ATTACHMENT P:

SHANNON-WILSON GEOTECH 2013

Geotechnical Site Assessment
King County Children and Family Justice Center
Redevelopment Project
1211 East Alder Street Site
Seattle, Washington

November 29, 2013

SHANNON & WILSON, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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REDEVELOPMENT PROJECT
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SEATTLE, WASHINGTON

1.0 INTRODUCTION

This report presents the results of a geotechnical site assessment for the proposed King County Children and Family Justice Center (CFJC) Redevelopment Project located at 1211 East Alder Street in Seattle, Washington. Our site assessment includes data review and a field reconnaissance. This report is based on the Scope of Work outlined in our Proposal for Geotechnical Input – Environmental Planning Services for Children and Family Justice Center Project, dated August 7, 2013. Authorization to proceed was received on September 24, 2013.

This report describes the site geology and identifies environmentally critical areas and seismic hazards. Preliminary geotechnical recommendations are given for foundation alternatives and applicable bearing pressures, shoring systems, and dewatering requirements. Information and recommendations contained herein is primarily from Shannon & Wilson, Inc., "Phase I Geotechnical Site Assessment, King County Youth Service Center, Courthouse Replacement Project, 1211 East Alder Street, Seattle, Washington," dated April 29, 2010, and Icicle Creek Engineers, Inc. (ICE), "Report Preliminary Geotechnical Engineering Services King County Children and Family Justice Center Redevelopment Project, 1211 East Alder Street, Seattle, Washington," dated November 26, 2013. ICE completed a series of nine soil borings (with monitoring wells) across the site. Shannon & Wilson, Inc.'s study was a data review only, without explorations.

2.0 PROJECT DESCRIPTION

We understand the approximately 9-acre CFJC site will be redeveloped by King County and a private developer. The site is bordered to the north by Remington Court, to the east by 14th Street, to the south by Spruce Street, and to the west by 12th Street, as shown in the Vicinity Map, Figure 1. The site currently includes the Alder Tower (built in 1972), the Alder Wing (built/remodeled in 1951/1972) and the Youth Detention Facility (built in 1991). Existing conditions are shown in Figure 2.

These existing buildings will be demolished and replaced with a new Courthouse, Juvenile Detention Facility, and Parking Garage at the locations shown in Figure 3. The new Courthouse may include one level below grade, the Juvenile Detention Facility may be constructed at or near existing grade, and the Parking Garage may be up to four levels below grade. The redevelopment layout generally clusters the new buildings toward the center of the site. Construction of these facilities will be procured by a design-build process.

The northwest, southwest, and southeast corners of the site may eventually be used for retail/residential development. The northeast corner of the site may be used as open community (public) space.

3.0 SITE DESCRIPTION

The CFJC site lies within the base of a wide valley bordered to the east and west by gently sloping hillsides. It is bordered by mixed commercial and residential properties to the west (12th Avenue) and to the north, east, and south (East Remington Court, 14th Avenue, and East Spruce Street, respectively) by residential properties.

Past site development has consisted of grading (cuts and fills) to form terraces for the buildings and parking areas. The buildings appear to be constructed with slab-on-grade floors and shallow, conventional spread footings with shallow embedment depths. The existing courthouse (Alder Tower), roughly centered within the site, is a multiple level building with a basement. The Alder Wing is situated at grade (no basement) to the northeast of the Alder Tower. The Youth Detention Facility is also built at grade in the south part of the site. Grass-covered slopes typically separate the different benched levels where parking/access or buildings are located.

The site slopes down to the southeast with elevations ranging from 260 feet at the northwest corner to 215 at the southeast for a total topographic relief of about 45 feet with intermediate terraces 4 to 12 feet high. A steep slope lies north of the existing detention center and south of the tower at the southern end of the site. A two-story building is adjacent to the tower's northeast corner with parking occupying the northwest quarter of the site.

The property is vegetated along the west boundary with deciduous trees, along the north boundary with a mixture of mature evergreen and deciduous trees, and along the east and south boundaries with a sparse mixture of evergreen and deciduous trees. Within the youth service campus area, landscaping consists of several wide, open lawn areas. The largest open lawn area in the northeast section of the site is called Remington Court Park and contains the King County Arts Commission, Spirit of Our Youth, 26-foot monumental cast bronze, glass, and rock sculpture with adjoining artistic earthwork. A smaller lawn area is located in the eastern portion in front of the detention center where the steep slope the detention center.

A very large parking lot is located in the northwest portion of the project site. It is bounded by 12th Avenue to the west, East Remington to the north, 13th Avenue to the east, and East Alder Court to the south. There is also additional parking next to this lot on the east side of 13th Avenue. A smaller parking area for up to six vehicles is located in the western portion of the site with an entrance on East Alder Street.

4.0 GEOLOGY

The U.S. Geological Survey (USGS) Geologic Map of Seattle – A Progress Report (Troost and others, 2005) shows the site is underlain with glacially derived sediment deposited during the Pleistocene (Vashon Stade) Fraser glacial advance and retreat that ended about 12,000 years ago. Surficial glacial deposits at or near the project consist of glacial till (Qvt) and recessional outwash (Qvro). The site lies within a north-south trending Qvro swath bordered on the east and west by Qvt deposits. Qvro is likely underlain with glacially overridden advanced outwash deposits (Qva). Qvt deposits are further west and east of the CFJC site.

5.0 SUBSURFACE EXPLORATIONS

Subsurface conditions at CFJC were explored by ICE in July 2013. Explorations included drilling nine test borings at the locations shown in Figure 4. Piezometers and groundwater monitoring wells were installed in six of the borings as shown. Details of the exploration program, along with the boring/monitor well logs are presented in ICE report. Details of the laboratory testing program and the results are also presented in ICE report. Boring logs and laboratory test results are also presented in Appendix A of this report.

The ICE test borings encountered relatively consistent soil conditions characterized by three primary soil (geologic) units: (a) Fill, (b) Recessional Outwash (Qvro) – Fine-Grained and Coarse-Grained, and (c) Advance Outwash (Qva).

The soil units encountered in the test borings are described in more detail below.

- **Fill** – Surficial fill consists of about 2 to 18 feet of loose to medium dense, silty sand and sand or soft to stiff, sandy silt with variable amounts of gravel and brick/wood/ plastic fragments (debris). A thin layer of buried topsoil was encountered beneath the fill in boring B-7. It is likely that the fill consists of on-site native soils (Recessional Outwash) that was graded (cut) and used for fill in other areas of the site.
- **Qvro Fine-grained** – Recessional Outwash – Fine-grained consists of medium stiff to very stiff, sandy silt, silt and clayey silt with variable amounts of gravel and medium/coarse sand with occasional thin layers of fine sand.

- **Qvro Coarse-grained** – Recessional Outwash – Coarse-grained consists of medium dense sand, sand with silt or silty sand with variable amounts of gravel.
- **Qva** – Advance Outwash – Consists of dense to very dense sand, sand with silt, and silty/clayey sand with variable amounts of gravel or very stiff to hard silt, sandy silt, and clayey silt with variable scattered amounts of gravel and occasional thin layers of fine sand or sand with silt.

The following is a tabular summary of soil and groundwater conditions encountered in the ICE borings/monitor wells.

ICE Boring Number	Fill Thickness (feet)	Recessional Outwash – Fine-grained thickness (feet)	Recessional Outwash – Coarse-Grained Thickness (feet)	Depth to Top of Advance Outwash (feet)	Depth to Groundwater (feet)	Boring Total Depth (feet)
B-1	9	–	9	18	16.2*	30.4
B-2	8	4	–	12	13.5/14.4**	30.9
B-3	2	8	4	15	5.0/4.6**	25.4
B-4	18	5	–	23	23.0*	31.0
B-5	2	-	–	2	7.6*	25.5
B-6/MW-6	4	13	5	22	12.4/12.6**	25.4
B-7/MW-7	7	9	6	22	13.1/13.4**	51.5
B-8/MW-8	13	13	7	34	21.0/20.2**	51.5
B-9	3	–	12	15	9.0/9.1**	51.5

Notes:
* At the time of drilling.
** Measured with electronic water level indicator on July 18, 2013/October 18, 2013.

Groundwater was observed in the test borings as shown in the preceding table from a depth of about 5 to 23 feet below the ground surface (bgs).

ICE reported that during drilling groundwater was not encountered until penetrating through Recessional Outwash – Fine-grained deposits. Once penetrated, groundwater apparently rose (slowly) several feet, which suggests that a confining layer overlies an aquifer. The confining layer would be a layer of low-permeability soil, likely the Recessional Outwash – Fine-grained deposit. The aquifer would be the more permeable deposits, likely Recessional Outwash – Coarse-grained or sandier layers within the Advance Outwash.

At the proposed Courthouse location, monitoring wells indicated saturated soil conditions generally between 12 and 14 feet deep. At the proposed Parking Garage location, monitoring wells indicated saturated soil conditions generally between 13 and 20 feet deep. At the proposed Detention Facility location, monitoring wells indicated saturated soil conditions generally between 6 and 14 feet deep.

It appears from the groundwater level elevation measurements in the borings and/or monitoring wells that the groundwater gradient (flow direction) is from the north-northwest to the south-southeast direction varying in elevation from about 245 to 210 feet.

6.0 CONCEPTUAL CONCLUSIONS AND RECOMMENDATIONS

6.1 General

As mentioned, Alder Tower, Alder Wing, and the Youth Detention Facility will be demolished and replaced with a new Courthouse, Juvenile Detention Facility and a Parking Garage. The new Courthouse may include one level below grade, the Juvenile Detention Facility would be constructed at or near existing grade, and the Parking Garage may be as many as four levels below grade.

The following sections provide conceptual geotechnical engineering recommendations for: foundation alternates, groundwater control, potential impacts during construction, excavation and shoring systems, seismic hazard evaluation, and environmentally critical areas.

6.2 Foundation Recommendations

Based on the ICE field exploration program and previous data reviews, the CFJC site is mantled with a varying thickness of fill ranging from 2 to 18 feet. The natural terrain suggests the original ground surface sloped gently down from north to south. Where grade changes were needed, short sections of fill were placed for these transitions. The courthouse building (Alder Tower) has a basement level which required an excavation (cut). It is likely that soil from that excavation was used as fill in other areas of the site, such as the northwest parking lot area. Fill has a random consistency varying from loose to dense silt and sand with scattered brick fragments and wood debris. Onsite fill soils would likely be acceptable to support slab-on-grade floors, but not for supporting conventional spread footing foundations due to risk of objectionable differential settlements.

Conventional spread footings should be adequate to support new buildings, provided that these foundations are supported by the native soils (Recessional Outwash and Advance Outwash) or on a pad of densely compacted structural fill that extends to competent native soils. To construct shallow foundations, excavations may be needed to remove unsuitable fill and soft silt or loose sand and expose suitable bearing soil. Some existing fill overexcavation may be required for the Courthouse in the vicinity of boring B-4. Approximately 13 feet of fill was encountered in B-4. Placement of compacted, structural fill to reach the desired foundation subgrade would follow excavation. Drilled shafts or piles could be used in areas of thicker fill. Typically, a deeper foundation is considered if existing fill is 10 or more feet thick and considerable grading would be required to remove unsuitable fill materials.

The allowable soil bearing pressure will be a function of soil type and footing embedment depth. In general, footings for the Courthouse and Detention Facility would be in recessional outwash deposits. A preliminary soil bearing value of 4,000 pounds per square foot (psf) could be used for design except in the vicinity of B-6 (Detention Facility) where a value of 2,500 psf is recommended. Footings should be embedded at least 18 inches below the lowest adjacent grade. At the Parking Garage, which we understand could be 3 to 4 levels below grade footings could be designed for 7,000 to 9,000 psf bearing within advanced outwash deposits.

Minimum footing widths should be 24 inches for individual square footings and 18 inches for continuous footings. The allowable bearing pressures could be increased by one-third for wind or earthquake loads.

For foundations designed as described above, we expect settlements to be less than ¾ inch, with differential settlements (between adjacent footings or over a 20-foot span of continuous footing) less than ½ inch.

As mentioned, drilled shafts could be used for foundation support of the buildings where the existing fill is too deep or cannot be removed for foundation support. The installation of drilled shafts can be impacted by caving soils, soil heave, and large obstructions, and may require a steel casing. The installation process does not generally create vibrations but can cause localized ground settlement in the drilled shaft area. Drilled shafts will generate spoils (soil cuttings) and may require dewatering or drilling with slurry with or without a casing. Drilled shafts do allow for relatively high vertical capacities that are dependent on the depth of the shaft in competent bearing soils.

6.3 Seismic Design Considerations

The Puget Sound lowland is located in the fore arc of the Cascadia Subduction Zone. Seismicity of this region is attributed primarily to the subduction zone interaction between the Juan de Fuca plate, the continental fore arc of the North American plate, and the landward continental arc. The Juan de Fuca plate is subducting beneath the North American plate. The majority of historical earthquakes occurred at depths of 20 miles or less. Most major earthquakes (magnitude greater the 8.5) occur within the deep, subcrustal zone (more than 20-mile depth).

Thick deposits of glacial and non-glacial sediments occur throughout most of the Puget Sound Basin. Due to the thick sediment cover, little is known regarding the nature of faults in the underlying bedrock. The Seattle Fault, the Southern Whidbey Island Fault, and the Tacoma Fault zones are the only known structural geology features that have indicated ground displacement in the Quaternary age glacial, interglacial, and post-glacial sediments in the Puget Sound region. The CFJC site is located north of the Seattle Fault Zone according to the USGS (Pacific Northwest Geologic Mapping and Urban Hazards, *Geomaps*). Recent geologic evidence indicates that Seattle Fault activity occurred as recently as 1,100 years ago.

6.3.1 Seismic Hazards

Seismic hazards can include fault-related ground rupture, liquefaction, settlement, and landsliding. Liquefaction is the phenomenon wherein soil strength is dramatically reduced when subjected to vibration or shaking. Liquefaction generally occurs in saturated, loose sand deposits, though recent studies have shown that silty sand or sandy silts are also susceptible to liquefaction. Because of the dense condition of the underlying soils (Advance Outwash) where groundwater is present liquefaction has a very low potential to occur at the CFJC site. At boring B-8, the Qvro may have some potential for liquefaction, but the base of the proposed Parking Garage would be at lower elevation, causing little impact to the buried structure.

The inferred soil type (Qvro) indicates the site is generally underlain with glacially overconsolidated soil at depth. As mentioned, due to the relatively dense nature of glacially overridden soils anticipated at the site, gentle topography, and estimated depth to groundwater, liquefaction, settlement, and landsliding at the site are low and therefore not considered a design issue for this project. As mentioned, the closest potentially active fault is the Seattle Fault located approximately 1 mile to the south. No evidence of surface rupture has been detected at the site.

6.3.2 Seismic Design Criteria

Based on our review of available geologic information and the subsurface soil conditions encountered in the test borings recently completed by ICE, we interpret the native soil conditions at the site to correspond to Seismic Site Class C, as defined by the 2012 IBC. This classification pertains to a very dense soil profile with an average Standard Penetration Test (SPT) of greater than 50 blows per foot for depth of 100 feet.

6.4 Floor Slabs

A conventional soil-supported slab-on-grade floor with a vapor retarder over capillary break can be used in the proposed buildings and parking garage if the subgrade is properly prepared. Capillary break material should consist of a 4-inch-thick layer of pea gravel or ¾-inch minus washed rock.

6.5 Subgrade Walls

Subgrade (belowgrade) walls should be designed to withstand external lateral soil pressures. Lateral earth pressures are dependent upon the degree of compaction and quality of backfill, backslope, drainage provisions, and whether or not the wall is allowed to yield laterally. A typical basement wall is braced at the top so wall does not yield. For this condition (rigid wall), at-rest fluid earth pressures are appropriate for design (56 pounds per cubic foot [pcf]). If the top of the wall is allowed to yield at least 0.001 times its height, the lateral soil fluid pressures would decrease to active earth pressure values (35 pcf). A seismic increment (uniform 9H psf) should be added to active (9H psf uniform) lateral earth pressure values. These values assume adequate drainage provisions are provided behind the walls. Deep belowgrade walls constructed next to shored excavations, e.g., soldier pile tieback anchors, could be designed for similar lateral earth pressures used to design temporary shoring wall. These lateral earth pressures also assume adequate drainage provisions are provided on face of the temporary shoring wall located behind the permanent wall.

All conventional backfilled basement and retaining walls should include a curtain drain of pea gravel or washed crushed gravel at least 12 inches wide at the back of the wall for full height. Also, a 4-inch-diameter rigid, perforated drainpipe should be installed within an envelope of pea gravel or washed crushed gravel at the bottom of the curtain drain (behind the heel of the wall). A filter fabric such as Mirafi 140N or equal should line the drain excavation.

6.6 Lateral Resistance

Lateral forces from soil, wind, or seismic loading may be resisted by friction along the base of the footings and by passive earth pressure against the buried portions of the structure. A coefficient of friction of 0.35 should be used between cast-in-place concrete competent bearing soils. An appropriate factor of safety (FS) (= 1.5) should be used when calculating the resistance to sliding at the base of a footing.

Passive earth pressures for footings placed against the silt soils may be estimated using an equivalent fluid density of 250 pcf. Passive earth pressures for granular and structural fill soils could be estimated using an equivalent fluid density of 350 pcf. These values are based on the assumption that footings extend at least 18 inches below the lowest adjacent grade, backfill around the structures is a well-compacted granular fill, and the ground surface is horizontal for a minimum distance of 10 feet from the edge of the footing. The above values include a FS of 1.5.

6.7 Site Preparation

The site soils including fill have high silt (fines) content. These soils are easily disturbed during wet weather conditions. If possible, earthwork should be performed during the drier summer months. It may be necessary to improve haul and access roads and the work area surface with crushed rock or quarry spalls in order to minimize disturbance during wet weather construction activities. Subgrade stabilization could also include layers of geogrid reinforcement and crushed rock (ballast) placed over soft, wet soils. As mentioned in Section 6.2, fill should be removed beneath proposed footing locations. Structural fill should extend beyond footings equal to the depth of structural fill.

6.8 Structural Fill

Structural fill refers to materials placed under building foundations, vaults, slab-on-grade floors, sidewalks, driveway slabs, asphaltic pavements, and other such load-bearing features that are settlement sensitive. We recommend that all new fill used in these applications at the project site meet the following structural fill criteria regarding composition, placement, and compaction.

Typical structural fill materials include well-graded mixtures of sand and gravel (commonly called Seattle Type 17 or gravel borrow or pit-run), crushed rock, controlled-density fill, lean-mix concrete, and miscellaneous mixtures of silt, sand, and gravel. Recycled asphalt, concrete, and glass, which are derived from pulverizing the parent materials, are also potentially useful as structural fill in certain applications. Structural fill should not contain any organic material or debris, nor should it contain particles greater than about 3 inches. The fines content (percent passing No. 200 sieve) should not exceed 20 percent for dry-weather construction.

The existing fill and native soils that underlie the site have a relatively high silt content, which renders them very sensitive to moisture conditions. This material should not be used for structural fill, but could be used in landscaping areas.

The suitability of a given soil for structural fill use depends primarily on its grain-size distribution and moisture content at the time it is placed. As the fines content increases, a soil becomes more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 3 percentage points above or below optimum. For fill placement during wet weather, we recommend using sand and gravel soils that have a fines content of 5 percent or less (by weight) based on the soil fraction passing a ¾-inch sieve.

Structural fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness. The actual lift thickness will depend on the quality of the fill and the type of compaction equipment used. Each lift should be thoroughly compacted with a mechanical compactor. We recommend using a minimum compaction standard of 95 percent of the maximum dry density (MDD) obtained in accordance with ASTM International (ASTM) Test Method D 1557.

Regardless of material or location, structural fill should be placed over firm, unyielding subgrades prepared as previously described in this report. Structural fill compaction should be evaluated by means of in-place density tests and/or proof rolling/probing observations (as deemed appropriate) performed during fill placement so that soil compaction can be evaluated, and compaction procedures modified as may be appropriate for the existing conditions. Compaction and proof rolling should be under continuous observation of an experienced geotechnical engineer.

6.9 Pavement Design Criteria

Proposed design pavement sections presented herein assume subgrade areas will be prepared as recommended in Sections 6.7 and 6.8, Site Preparation and Structural Fill. Paving should be completed during periods of generally dry weather. Based on the medium dense/stiff soils encountered in the borings and assuming densely compacted structural fill conditions in areas of raised elevation, a California Bearing Ratio value of 10 was assumed for the existing subgrade soils.

The pavement subgrade should be proof rolled prior to placing structural fill or base material and asphalt concrete. Areas that yield or deflect more than about 2 to 3 inches should be recompacted or otherwise repaired to achieve a firm and unyielding condition.

The design pavement section for areas subjected to personnel occupancy vehicle traffic with only occasional trucks (light-duty pavement section) should consist of at least 2½ inches of asphalt concrete over a base course of at least 6 inches of crushed rock. Portions of roadways and parking areas which will be subjected to frequent truck traffic (moderate-duty pavement section) should be paved with at least 3 inches of asphalt concrete underlain by at least 6 inches of crushed rock. We further recommend a subbase layer consisting of at least 12 inches of City of Seattle Type 17 sand and gravel. The subbase material should be compacted as structural fill to at least 95 percent of MDD obtained in accordance with ASTM Test Method D 1557.

6.10 Surface Drainage Considerations

The ground surface adjacent to structures should be sloped to drain surface water away from the structure. We recommend that all roof drains be connected to tight lines leading to the storm sewer system. Section 6.5 discusses wall drainage.

6.11 Excavations

6.11.1 Temporary Open Cut Slopes and Underground Utility Trenches

Temporary open cut slopes and underground utility trenches in advance outwash likely to encountered in the vicinity of boring B-5 could be completed at 0.75 horizontal to 1 vertical (.75H:1V), or flatter. Temporary cut slopes/underground utility trenches greater than 4 feet in depth in recessional outwash should be completed at 1H:1V, or flatter. Temporary cut slopes/underground utility trenches in fill should be no steeper than 1.5H:1V. Flatter slopes may be necessary if ground water seepage is encountered or if instability is observed.

Some sloughing and raveling of the cut slopes/trenches should be expected. Temporary covering, such as heavy plastic sheeting, should be used to protect slopes during periods of wet weather. Surface water runoff from above cut slopes/trenches should be prevented from flowing over the slope face by using berms, drainage ditches, swales, or other appropriate methods.

If temporary cut slopes or underground utility trenches experience excessive sloughing or raveling during construction, it may become necessary to modify the cut slopes to maintain stable working conditions and protect adjacent facilities or structures. Slopes experiencing problems can be flattened or regraded to add intermediate slope benches. Additional dewatering can be provided if slope instability is related to ground water seepage.

6.11.2 Shored Excavations

It is likely that shored excavations will be necessary for construction of deep belowgrade facilities, in particular, the Parking Garage which would have multiple belowgrade levels. Shored excavations are typically used where there are space limitations for open cuts, or the amount of excavated material required for an open cut is excessive. Often, temporary shoring can be incorporated into the permanent subgrade walls, i.e., top-down construction.

Temporary shoring appropriate for wide and deep excavations for this site would include conventional soldier pile and tieback wall systems. Alternatively, a soil nail wall shoring system could be used. A soil nail shoring system would require vertical elements to provide stability while excavating through near surface fill soils (boring B-8). Vertical elements include small wide-flanged beams or steel reinforcing bars. Both types of reinforcing would be set in grouted boreholes at 2- to 4-foot centers. Temporary dewatering including deep wells and wellpoints or combination of these during wall construction may be required to excavate in the dry or to control seepage. Extent and depth of dewatering systems will depend on the depth of the excavation. Temporary dewatering is not recommended for deep soil nail walls for the proposed Parking Garage excavation.

6.12 Dewatering

6.12.1 General

The subsurface information obtained from the ICE subsurface exploration program suggests that the site soils have a wide range of permeability. High rates of water seepage into excavations are expected where sands are present below the groundwater level such as the Parking Garage excavation. Silt soils are expected to have a generally lower permeability and may require deep wells or a wellpoint dewatering system.

The proposed Detention Facility would be constructed at grade. Borings indicate fill to a depth of 2 to 4 ft underlain with silt recessional outwash and dense sand in the northwest corner (boring B-5). Groundwater was measured 6 to 14 feet bgs. Likely sumps and ditches could be utilized at this location.

The proposed Courthouse would be constructed one level below grade. Borings indicate fill to a depth of 8 to 13 feet underlain with medium dense silt recessional outwash. Groundwater was measured 9 to 14 feet bgs. Groundwater would probably not be encountered during construction of the Courthouse, but sumps and ditches may be needed in local areas where seepage is encountered.

A combination of deep wells and wellpoints will likely be required for the Garage excavation.

6.12.1 Dewatering Methods

Because of the variability in soil permeability and depth to groundwater, several dewatering methods would be appropriate for this project. These include pumped wells, wellpoints and open (sump) pumping. A combination of these methods may also be required to achieve dry working conditions in some areas. Descriptions of these dewatering methods as they apply to this project are presented below.

6.12.2 Pumped Wells

Individually pumped deep wells may be considered for dewatering the Parking Garage excavation. Pumped wells that have been properly installed and developed are capable of producing high discharge rates. Pumped wells are generally the most effective dewatering method in areas where the groundwater level is more than 15 feet bgs.

6.12.3 Wellpoints

Wellpoints are effective for dewatering most types of soils, whether pumping small amounts of water from silt or large quantities of water from coarse sand and gravel. The volume of water generated by a wellpoint system is typically less than the volume generated by a corresponding system of pumped deep wells because the wellpoints are generally installed to a shallower depth. Because of the shallower completion depth, the volume of aquifer that contributes water to a wellpoint system is less than for a comparable deep pumped well system.

Wellpoint systems are suitable for dewatering shallow excavations where the water table needs to be lowered less than about 15 feet bgs. Multiple wellpoint stages are generally required beyond that depth because of the physical limitations of suction lift. Dewatering can be accomplished at depths greater than 15 feet where the excavation allows installation of the wellpoint system below the original grade. Multiple wellpoint stages or levels could be constructed in conjunction with soldier pile tieback lagging wall system.

6.12.4 Open Pumping

Open pumping involves removing water that has seeped into the excavation by pumping from a sump prepared in the base of the excavation. Drainage ditches that are connected to the sump are typically excavated along the sidewalls of the excavation. Sump excavation and drainage ditches should be backfilled with gravel or crushed rock to reduce the amount of sediment in the water pumped from the sump. A slotted casing or perforated 55-gallon drum installed in the sump backfill provides a suitable housing for a submersible pump.

Open pumping is useful for removing perched water that seeps into excavations. The amount of water removed from the excavation by open pumping would likely require pre-settling of dewatering effluent in a tank or basin prior to discharging the water.

6.12.5 Monitoring

We recommend installing piezometers in the area surrounding the Parking Garage excavation where significant dewatering is anticipated. The piezometers could be used to monitor the effectiveness of the dewatering system prior to the start of excavation. The discharge capacity of the dewatering system may need to be modified based on the water level measurements in the piezometers.

6.12.6 Water Disposal

Disposal of groundwater from within excavations or pumped wells or wellpoints may require special dewatering disposal plans and permits in the City of Seattle and for King County. Disposal water may need to be monitored in accordance with permit requirements, possibly for turbidity, pH, and other parameters.

6.13 Erosion and Sedimentation Control

The surface at the site is gently sloping, though "terracing" of the site may create localized steeper slope areas. The near-surface site soils consist of sand and silt which are highly erodible where sloped surfaces are exposed to runoff (such as benched terraces slopes and soil stockpiles).

Erosion and sediment controls (Best Management Practices [BMPs]) are recommended during construction to reduce the impacts to the surrounding area. Erosion controls should be designed to prevent sediment transport. This may be accomplished by constructing water bars or utilizing other methods to control surface water runoff and constructing silt fences and/or sediment ponds to control sedimentation. If construction is accomplished during the winter months, we further recommend that temporary erosion protection be provided, consisting of covering exposed soil areas with plastic sheeting.

Control of off-site transport of sediment will be an important consideration. In our opinion, conventional BMPs prescribed by the City of Seattle will be appropriate. A dry-season grading extension will be required if earthwork and grading occur past October 31. BMPs should be installed prior to site grading activities. Typically, stormwater runoff can be routed to the existing site storm drain system, but would likely require a permit from the appropriate agencies. It is probable that there is a threshold for turbidity for construction area stormwater runoff to the storm drain system. If highly turbid water is present, it may need to be detained in portable tanks (such as Baker tanks) to allow for sediment filtering or settling prior to discharge to the storm drain system.

The near-surface site soils will be very difficult to filter or precipitate once suspended in surface runoff. Therefore, it will be important to cover stockpiles and avoid vehicle traffic on exposed soil, especially during wet weather.

Dust control may be necessary during dry weather. Proper traffic surfaces such as crushed rock, quarry spalls or asphalt treated base will help significantly. Water on unpaved surfaces will provide adequate dust control.

Permanent erosion control measures should be established in exposed soil areas as soon as practical following construction.

6.14 Preliminary Infiltration Rates

Preliminary infiltration analysis of near-surface soils was completed in general accordance with Method 2 (U.S. Department of Agriculture Soil Textural Classification), and Method 3 (ASTM Gradation Testing D_{10} Method) as described in the Washington State Department of Ecology's (Ecology's) February 2005 Stormwater Management Manual for Western Washington. Near surface soils consist of fill and silty fine sand recessional outwash deposits. Underlying soils consisting of coarser sand recessional outwash and advanced outwash deposits have higher infiltration rates. Other than boring B-9 coarser grained recessional outwash is near elevation 218 feet or lower. Advanced outwash would only be encountered in the Parking Garage excavation below about elevation 205 ft or in the vicinity of boring B-5.

Gradation test and soil classification test results are presented in the ICE report and, based on the analysis, the near-surface site soils have a relatively low infiltration rate. The following short-term (field) and long-term (design) infiltration rates based on Ecology Methods 2 and 3 were proposed.

Preliminary Infiltration Rates		
Soil Type	Short-term (field) Infiltration Rate (inches per hour)	Long-term (design) Infiltration Rate (inches per hour)
Fill	0	0
Recessional Outwash Fine-grained	0	0
Recessional Outwash Coarse-Grained	2	0.5
Advance Outwash	0	0.8

Should on-site stormwater infiltration be considered, additional infiltration testing will be required by completing a field Pilot Infiltration Tests in accordance with Appendix E of the Seattle Stormwater Manual (November 2009).

6.15 Environmentally Critical Areas (ECAs)

The City of Seattle has regionally mapped and regulated ECAs including Steep Slopes, Potential Slide, Liquefaction Prone and Known Slide areas (as these ESAs pertain to geotechnical considerations) in accordance to Seattle Municipal Code 25.09. Based on our review of the regional mapping of ECAs (listed above) and our site observations, there is one Steep Slope ECA in the southeast part of the site which appears to be an engineered slope (not natural). This slope is less than 10 feet high and is, therefore, exempt from regulation. No other ECAs have been mapped at the site.

7.0 LIMITATIONS

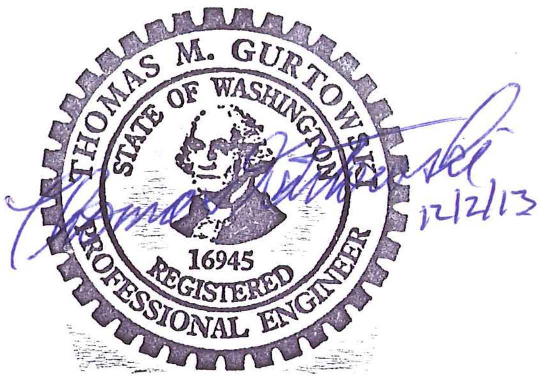
This report was prepared for the exclusive use of EA Engineering, Science, and Technology, Inc. for specific application to the geotechnical elements of this site. The report should be used for information of factual data only, and not as a warranty of subsurface conditions, such as those interpreted from the exploration logs and discussions of subsurface conditions included in this report.

The analyses, conclusions, and recommendations contained in this report are based on site conditions as they presently exist. Within the limitations of the scope, schedule, and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice in this area at the time this report was prepared. We make no other warranty, either express or implied.

The scope of our services for this report did not include soil borings, test pit excavations, or any evaluation regarding the presence or absence of wetlands. No assessments or evaluations regarding the presence or absence of hazardous or toxic substances in the soil or groundwater on or below this site were in our scope of work.

Shannon & Wilson, Inc. has prepared Appendix B, "Important Information About Your Geotechnical/Environmental Report," to assist you and others in understanding the use and limitations of our reports.

SHANNON & WILSON, INC.



Thomas M. Gurtowski, P.E., D.GE
Vice President

TMG/tmg

8.0 REFERENCES

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0 400 800

Approximate Scale in Feet

NOTE

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King County Children and Family Justice Redevelopment Center Project
Seattle, Washington

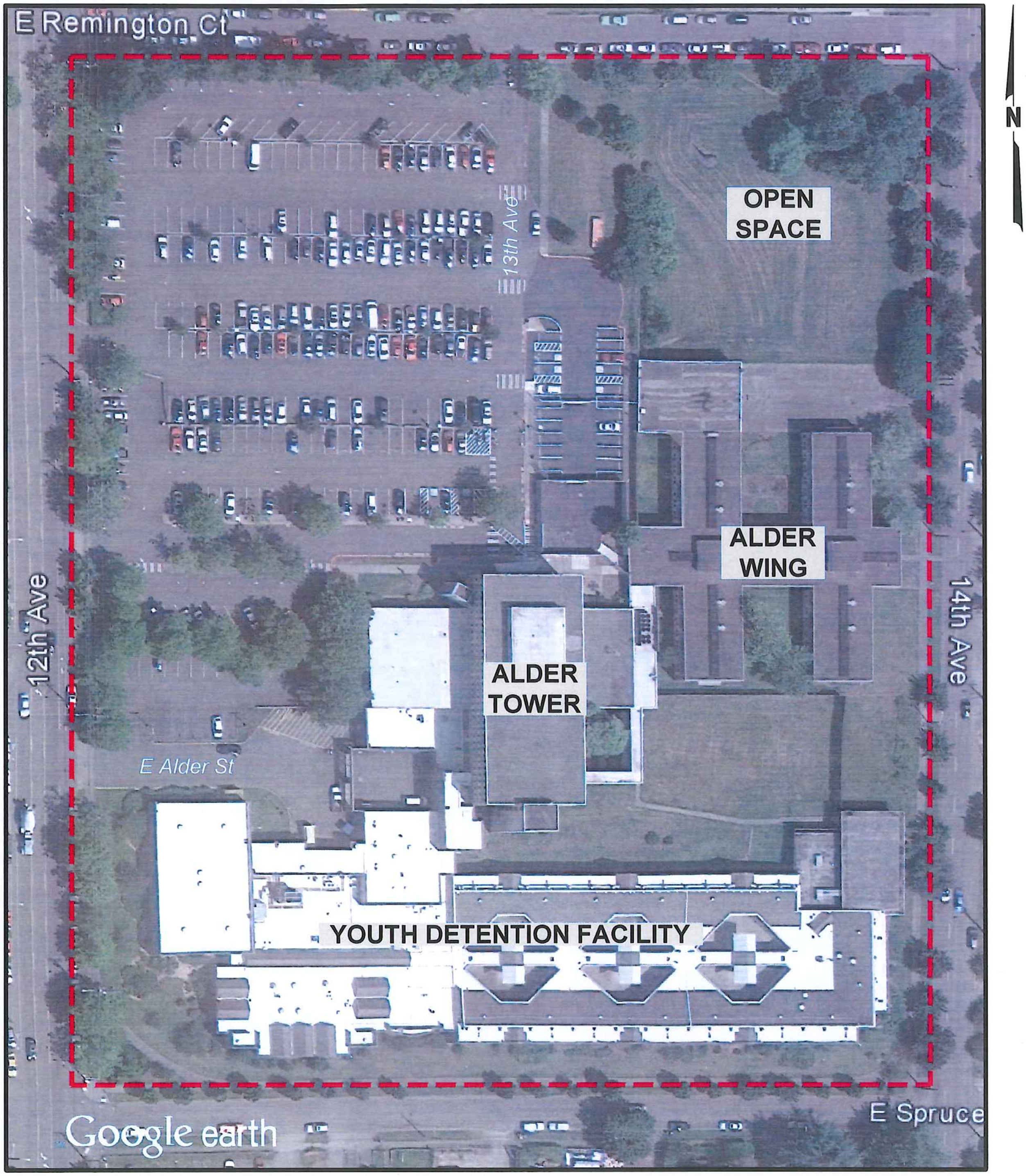
VICINITY MAP

November 2013 21-1-21911-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 1

Filename: J:\211\21911-001\21-1-21911-001 Fig 1.dwg Date: 11-01-2013 Login: SAC



0 100 200

Approximate Scale in Feet

LEGEND

- - - Site Boundary

NOTE

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth ™ Mapping Service.

King County Children and Family Justice Redevelopment Center Project
Seattle, Washington

EXISTING CONDITIONS

November 2013 21-1-21911-001

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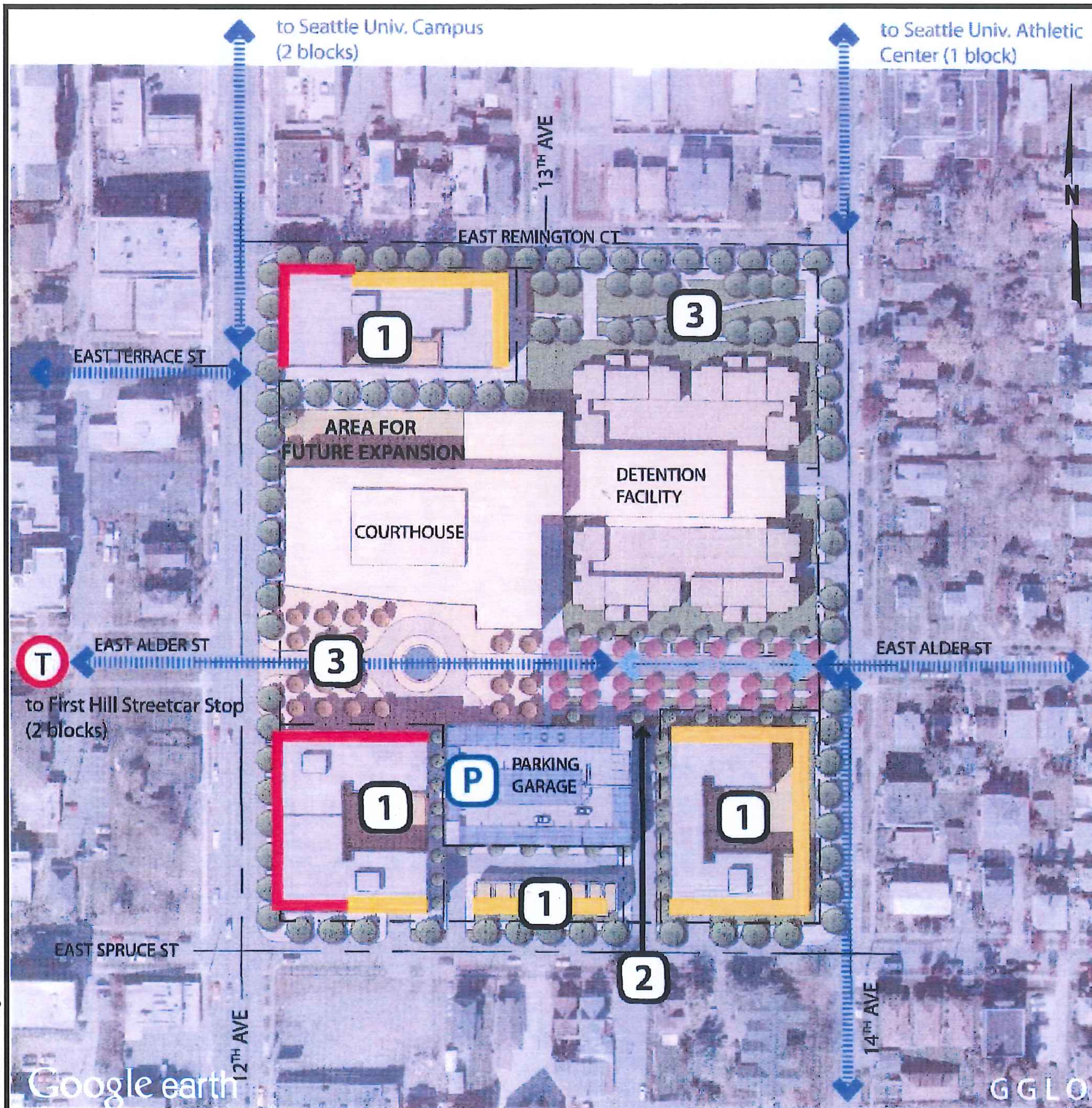
FIG. 2

Filename: J:\211\21911-001\21-1-21911-001 Fig 2.dwg Date: 11-01-2013 Login: SAC



0 150 300

Approximate Scale in Feet

LEGEND

(1) Private Development	Ground-Level Commercial Frontage
(2) Loading and Service	Ground-Level Residential Frontage
(3) Community Space	Important Connecting Routes
(P) Parking Structure	EVA / Pedestrian Only

NOTE

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth ™ Mapping Service.

King County Children and Family Justice Redevelopment Center Project
Seattle, Washington

PROPOSED DEVELOPMENT

November 2013 21-1-21911-001

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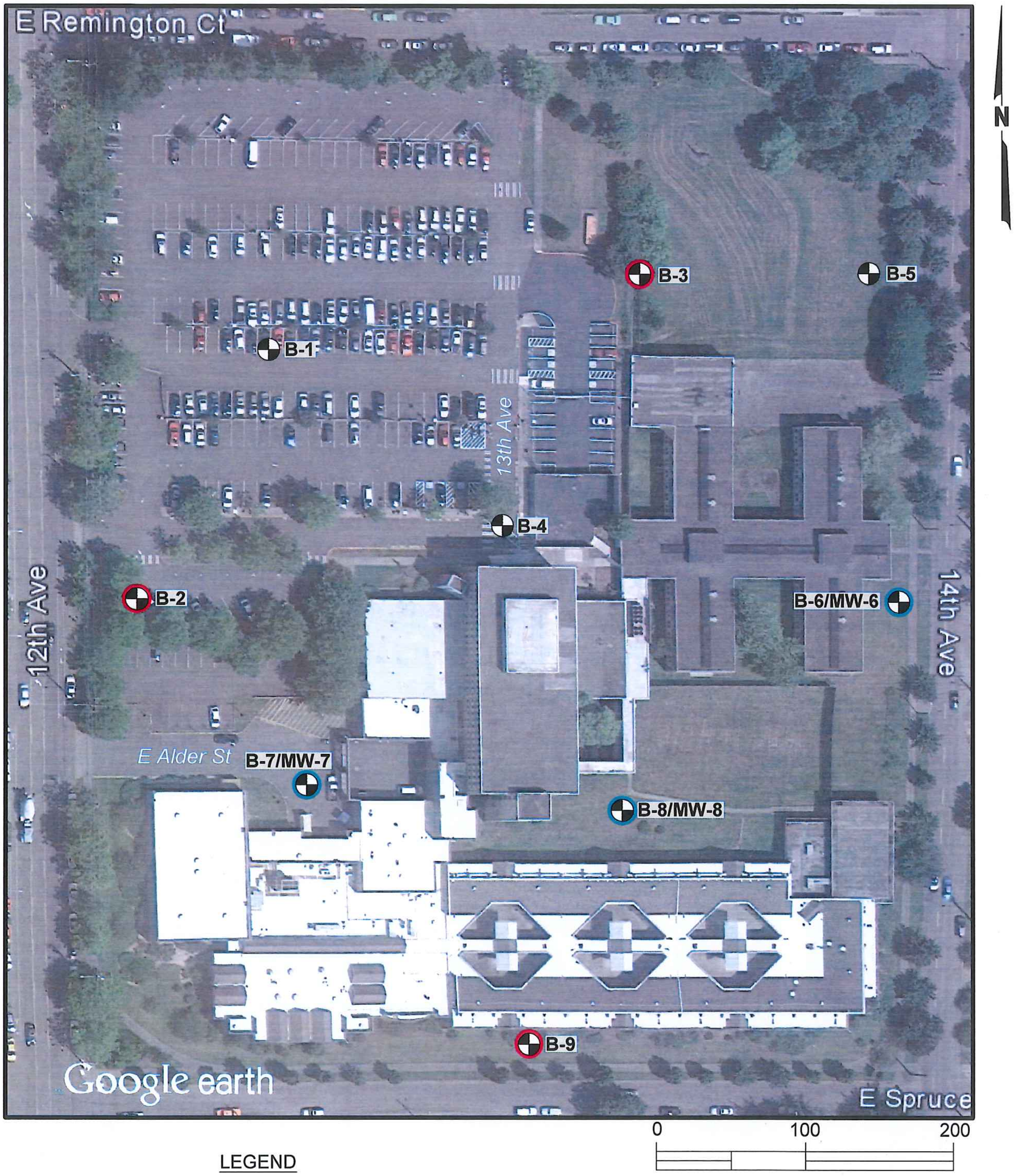
FIG. 3

Filename: J:\211\21911-001\21-1-21911-001 Fig 3.dwg Date: 11-01-2013 Login: SAC



LEGEND

B-1 Boring Designation and Approximate Location (Icicle Creek Engineers)

B-2 with Piezometer

B-6/MW-6 with Monitoring Well

NOTE

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King County Children and Family Justice Redevelopment Center Project
Seattle, Washington

SUBSURFACE EXPLORATION PLAN

November 2013 | 21-1-21911-001

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Geotechnical and Environmental Consultants

FIG. 4

Filename: J:\211\21911-001\21-1-21911-001 Fig 4.dwg Date: 11-01-2013 Login: SAC

APPENDIX A

ICICLE CREEK ENGINEERS, INC. SOIL BORING LOGS AND LABORATORY TEST RESULTS

APPENDIX A

ICICLE CREEK ENGINEERS, INC. SOIL BORING LOGS AND LABORATORY TEST RESULTS

TABLE OF CONTENTS

FIGURES

Unified Soil Classification System

MAJOR DIVISIONS			Soil Classification and Generalized Group Description	
Coarse-Grained Soils More than 50% retained on the No. 200 sieve	GRAVEL More than 50% of coarse fraction retained on the No. 4 sieve	CLEAN GRAVEL	GW	Well-graded gravels
			GP	Poorly-graded gravels
		GRAVEL WITH FINES	GM	Gravel and silt mixtures
			GC	Gravel and clay mixtures
	SAND More than 50% of coarse fraction passes the No. 4 sieve	CLEAN SAND	SW	Well-graded sand
			SP	Poorly-graded sand
		SAND WITH FINES	SM	Sand and silt mixtures
			SC	Sand and clay mixtures
Fine-Grained Soils More than 50% passing the No. 200 sieve	SILT AND CLAY Liquid Limit less than 50	INORGANIC	ML	Low-plasticity silts
			CL	Low-plasticity clays
		ORGANIC	OL	Low plasicity organic silts and organic clays
	SILT AND CLAY Liquid Limit greater than 50	INORGANIC	MH	High-plasticity silts
			CH	High-plasticity clays
		ORGANIC	OH	High-plasticity organic silts and organic clays
Highly Organic Soils	Primarily organic matter with organic odor		PT	Peat

Notes: 1) Soil classification based on visual classification of soil is based on ASTM D 2488.
2) Soil classification using laboratory tests is based on ASTM D 2487-00.
3) Description of soil density or consistency is based on interpretation of blow count data and/or test data.

Soil Particle Size Definitions

Component	Size Range
Boulders	Coarser than 12 inch
Cobbles	3 inch to 12 inch
Gravel	3 inch to No. 4 (4.78 mm)
Coarse	3 inch to 3/4 inch
Fine	3/4 inch to No. 4 (4.78 mm)
Sand	No. 4 (4.78 mm) to No. 200 (0.074mm)
Coarse	No. 4 (4.78 mm) to No. 10 (2.0 mm)
Medium	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Finer than No. 200 (0.074 mm)

Soil Moisture Modifiers

Soil Moisture	Description
Dry	Absence of moisture
Moist	Damp, but no visible water
Wet	Visible water

Key to Boring Log Symbols

Sampling Method	Boring Log Symbol	Description
Blows required to drive a 2.4 inch I.D. split-barrel sampler 12-inches or other indicated distance using a 300-pound hammer falling 30 inches.	34	Location of relatively undisturbed sample
	12	Location of disturbed sample
	21	Location of sample attempt with no recovery
Blows required to drive a 1.5-inch I.D. split barrel sampler (SPT - Standard Penetration Test) 12-inches or other indicated distance using a 140-pound hammer falling 30 inches.	14	Location of sample obtained in general accordance with Standard Penetration Test (ASTM D-1586) test procedures.
	30	Location of SPT sampling attempt with no recovery.
Pushed Sampler	P	Sampler pushed with the weight of the hammer or against weight of the drilling rig.
Grab Sample	G	Sample obtained from drill cuttings.

Note: The lines separating soil types on the logs represents approximate boundaries only. The actual boundaries may vary or be gradual.

Laboratory Tests

Test	Symbol
Moisture Content	MC
Density	DN
Grain Size	GS
Percent Fines	PF
Atterberg Limits	AL
Hydrometer Analysis	HA
Consolidation	CN
Compaction	CP
Permeability	PM
Unconfined Compression	UC
Unconsolidated Undrained TX	UU
Consolidated Undrained TX	CU
Consolidated Drained TX	CD
Chemical Analysis	CA

Boring B-1

Latitude 47.60496; Longitude -122.31611

Approximate Elevation: 252.9 feet

JMS/BRB:11/26/13

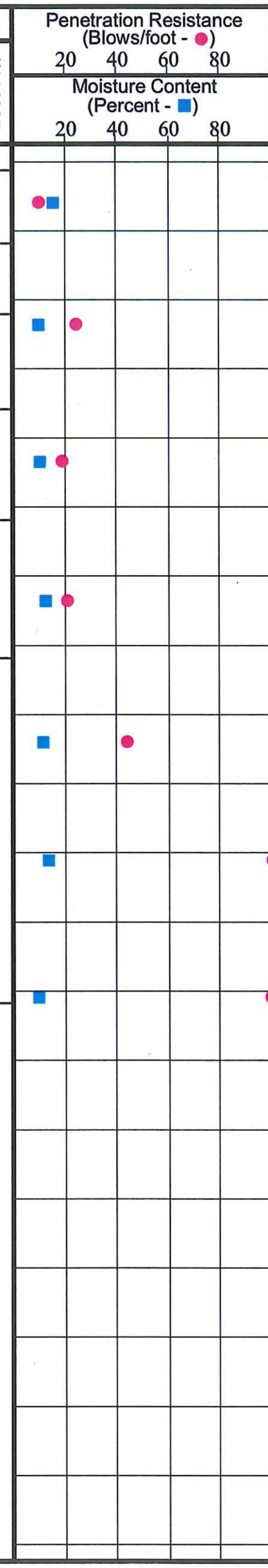
Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

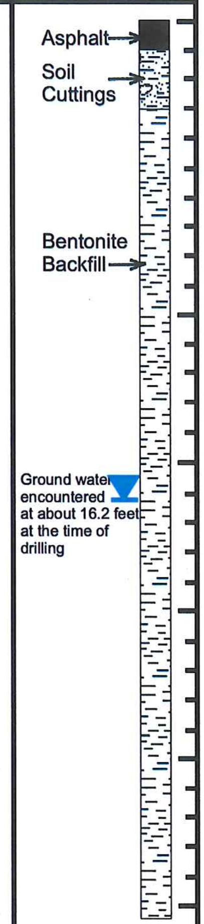
ICE File No. 0105-011

Depth in Feet	Soil Profile: Description	Group Symbol	Blow Count	Laboratory Testing
0	Asphalt Pavement (3 inches)			
	Brown and greenish-gray sandy SILT with a trace of fine gravel and charcoal and brick fragments (stiff, moist) (Fill)	ML	11	MC
	Light grayish-brown, dark brown and reddish-yellow silty fine to medium SAND with occasional gravel and brick fragments (medium dense, moist) (Fill)	SM		
5	Grayish-brown fine to medium SAND with a trace of silt (medium dense, moist) (Fill)	SP	24	MC
10	Brown, light grayish-brown and reddish-yellow silty fine to medium SAND with gravel (medium dense, moist) (Recessional Outwash - Coarse-Grained)	SM	19	MC GS
15	Light grayish-brown silty fine to medium SAND with a trace of gravel and fine to medium SAND with silt and a trace of gravel (medium dense, wet) (Recessional Outwash - Coarse-Grained)	SM/ SP-SM	21	MC
20	Gray silty fine to medium SAND with occasional gravel and thin layers of medium sand (dense to very dense) (Advance Outwash - Transitional Beds)	SM	43	MC
25	grades to with gravel at about 25 feet	SM	50/4"	MC
30		SM	50/5"	MC
	Boring completed at approximately 30.4 feet on July 12, 2013			

Penetration Resistance (Blows/foot - ●) / Moisture Content (Percent - ■)



Comments/ Ground Water Observations



See Figures A-1 and A-2 for explanation of symbols

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Boring B-2

Latitude 47.60451; Longitude -122.31653

Approximate Elevation: 246.5 feet

Depth in Feet	Soil Profile: Description	Group Symbol	Blow Count	Laboratory Testing
0	Sod and Topsoil (2 inches)			
	Light brown fine to medium SAND with silt and fine roots (medium dense, moist) (Fill)	SP-SM	15	MC
	Dark brown and dark gray sandy SILT with a trace of gravel, wood debris (stiff, moist) (Fill)	ML	11	MC
	Brownish-gray and reddish-yellow sandy SILT with a trace of gravel (very stiff, moist) (Recessional Outwash - Fine-Grained)	ML	19	MC GS
	Brown and reddish-yellow silty fine to medium SAND with gravel (very dense, moist) (Advance Outwash - Transitional Beds)	SM	50/5"	MC
20	Gray silty fine to medium SAND with occasional gravel (dense, moist) (Advance Outwash - Transitional Beds)	SM	41	MC
	becomes wet at about 21 feet			
25	grades to very dense	SM	50/5"	MC
30		SM	50/5"	MC
	Boring completed at approximately 30.9 feet on July 14, 2013			

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80

Ground Water Monitor Well Construction Details and Measurements:

- Flush Grade Steel Monument
- Concrete Plug
- Bentonite Backfill
- 1¼-inch PVC Solid Pipe
- Ground water measured at 13.5 feet (7/18/13) and 14.4 feet (10/18/13)
- Sand Backfill
- 1¼-inch PVC Slotted Pipe
- Bentonite Backfill

See Figure A-1 for explanation of symbols

JMS/BRB:11/26/13

Boring B-3

Latitude 47.60511; Longitude -122.31502

Approximate Elevation: 240.4 feet

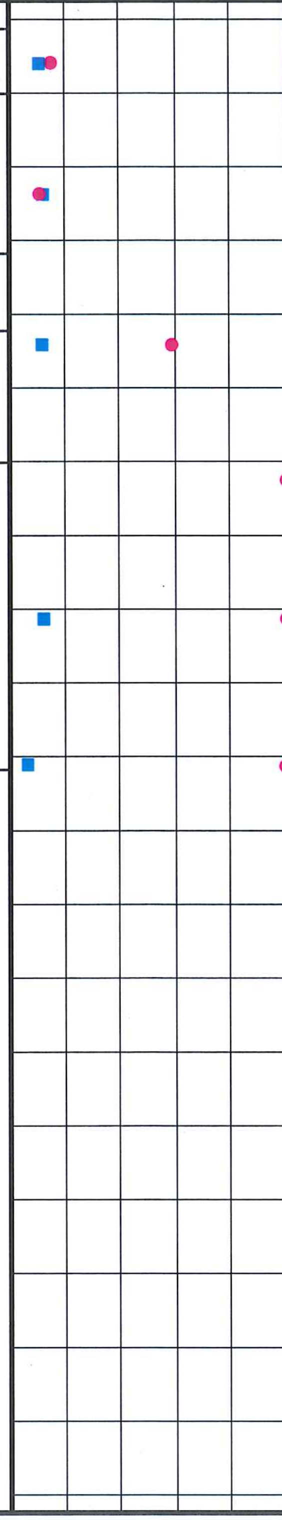
Depth in Feet	Soil Profile: Description	Group Symbol	Blow Count	Laboratory Testing
0	Sod and Topsoil (4 inches)			
	Brown, reddish-yellow and greenish-gray sandy SILT with a trace of gravel (very stiff, moist) (Fill)	ML	17	MC
5	Gray sandy SILT with a trace of gravel and occasional thin layers of fine sand with silt (stiff, moist) (Recessional Outwash - Fine-Grained)	ML	12	MC
	Gray clayey SILT with sand and a trace of fine gravel (stiff, moist) (Recessional Outwash - Fine-Grained)	ML		
10	Brown fine to medium SAND with occasional gravel and a trace of silt (very dense*, wet) (Recessional Outwash - Coarse-Grained)	SP	59*	MC
15	Gray silty fine to medium SAND with occasional gravel (very dense, moist) (Advance Outwash - Transitional Beds)	SM	50/4"	MC
20		SM	50/5"	MC
25		SM	50/5"	MC

Boring completed at approximately 25.4 feet on July 12, 2013

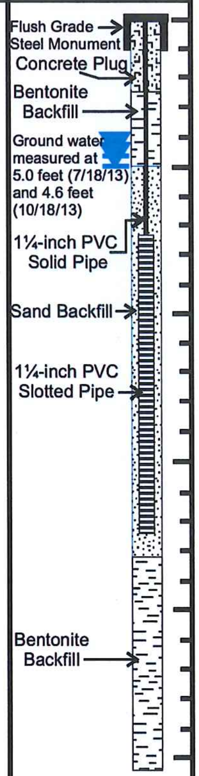
* density and blow count may not be representative because of the presence of gravel

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80



Ground Water Monitor Well Construction Details and Measurements



Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

See Figure A-1 for explanation of symbols

JMS:11/26/13

Logged by: JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Boring B-4

Latitude 47.60496; Longitude -122.31611

Approximate Elevation: 252.9 feet

Depth in Feet	Description	Group Symbol	Blow Count	Laboratory Testing
0	Asphalt Pavement (8 inches)			
	Crushed Rock (4 inches)			
	Brown, dark grayish-brown silty fine to coarse SAND with gravel and occasional brick fragments (medium dense, moist) (Fill)	SM	17	MC
5	grades to dark brown, dark greenish-gray and white	SM	28	MC
	Dark brown silty fine to coarse GRAVEL with sand, brick fragments, trace organics and wood fragments (loose, moist) (Fill)	GM	7	MC
15	becomes brown, greenish-gray and reddish-yellow with plastic fragments, dense*	GM	34*	MC
	Gray sandy SILT with a trace of gravel (very stiff, moist to wet) (Recessional Outwash - Fine-Grained)	ML	28	MC
	Grayish-brown fine to medium SAND with silt and gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SP-SM	72	MC
	Gray silty SAND with a trace of gravel (very dense, moist to wet) (Advance Outwash - Transitional Beds)	SM	50/6"	MC

Boring completed at approximately 31.0 feet on July 13, 2013

* density and blow count may not be representative because of the presence of gravel

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80

Comments/ Ground Water Observations:

Asphalt

Soil Cuttings

Bentonite Backfill

Ground water encountered at about 23 feet at the time of drilling

See Figure A-1 for explanation of symbols

Icicle Creek Engineers

Boring Log - Figure A-5

Boring B-5

Latitude 47.60512; Longitude -122.31445

Approximate Elevation: 240.5 feet

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet	Soil Profile: Description	Group Symbol	Blow Count	Laboratory Testing	Comments/ Ground Water Observations
0	Sod and Topsoil (3 inches)				
	Brown and reddish-yellow silty fine to medium SAND with occasional gravel (medium dense, dry to moist) (Fill)	SM	29	MC	
	Brown silty fine to medium SAND with gravel (very dense*, moist) (Advance Outwash - Transitional Beds)				
5	becomes wet at about 6 feet	SM	50/4"*	MC	Ground water encountered at about 7.6 feet at the time of drilling
	Gray fine to medium SAND (very dense, wet) (Advance Outwash - Transitional Beds)	SP			
10	Gray silty fine to medium SAND with gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SM	57	MC GS	Bentonite Backfill
15		SM	50/5"	MC GS	
20	Gray silty fine to medium SAND with a trace of gravel and thin layers of sand with silt (very dense, moist to wet) (Advance Outwash - Transitional Beds)	SM/ SP-SM	50/6"	MC	
25	Gray sandy SILT with occasional gravel and thin layers of medium sand (hard, moist) (Advance Outwash - Transitional Beds)	ML	50/6"	MC	
	Boring completed at approximately 25.5 feet on July 12, 2013				

* density and blow count may not be representative because of the presence of gravel

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80

See Figure A-1 for explanation of symbols

Boring B-6/Monitor Well MW-6

Latitude 47.60448; Longitude -122.31437

Approximate Elevation: 236.3 feet

Logged by: JMS

Project Name: Parametrix GT, King County Youth Services Center

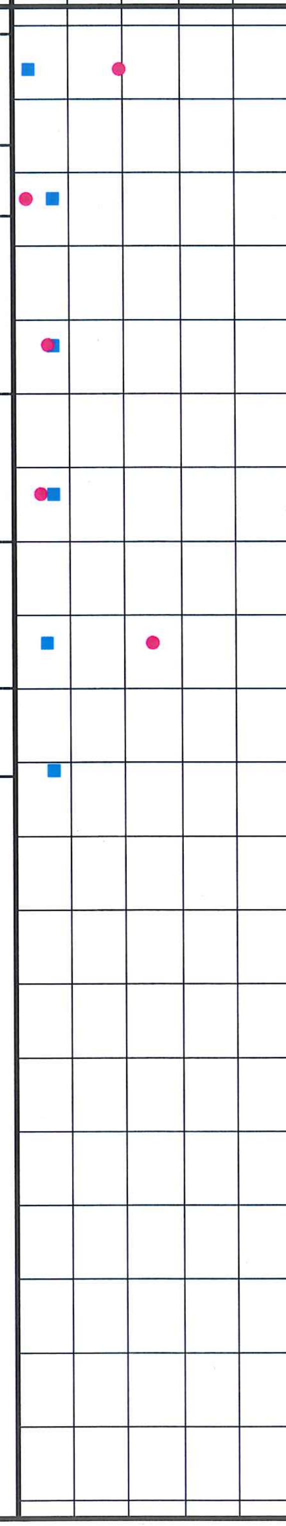
ICE File No. 0105-011

Depth in Feet	Soil Profile – Description	Group Symbol	Blow Count	Laboratory Testing
0	Sod and Topsoil (3 inches)			
0–4	Light brown silty fine to medium SAND with occasional gravel (dense*, dry to moist) (Fill)	SM	39*	MC
4–6.5	Brown and reddish-yellow sandy SILT (medium stiff, moist) (Recessional Outwash - Fine-Grained)	ML	5	MC
6.5–13	Grayish-brown sandy SILT with a trace of gravel (stiff, moist) (Recessional Outwash - Fine-Grained)	ML	13	MC, GS
13–18	Gray clayey SILT with sand and a trace of gravel (stiff, moist to wet) (Recessional Outwash - Fine-Grained)	ML	10	MC
18–23	Gray fine to coarse GRAVEL with sand and a trace of silt (dense to very dense*, wet) (Recessional Outwash - Coarse-Grained)	GP	50*	MC
23–25.4	Gray SILT with variable fine sand and a trace of gravel (hard, moist) (Advance Outwash - Transitional Beds)	ML	50/5"	MC

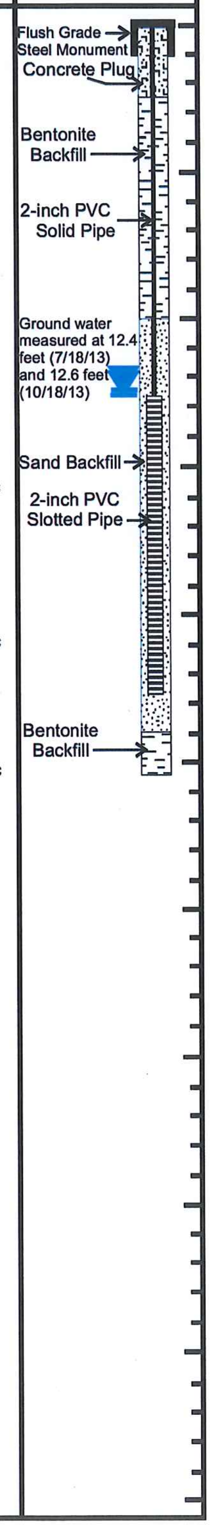
Boring completed at approximately 25.4 feet on July 14, 2013

* density and blow count may not be representative because of the presence of gravel

Penetration Resistance (Blows/foot - ●) / Moisture Content (Percent - ■)



Comments/ Ground Water Observations



See Figure A-1 for explanation of symbols

Boring B-7/Monitor Well MW-7

Latitude 47.60414; Longitude -122.31605

Approximate Elevation: 235.8 feet

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80

Depth in Feet	Soil Profile – Description	Group Symbol	Blow Count	Laboratory Testing	Comments/ Ground Water Observations
0	Asphalt Pavement (3.5 inches)				Flush Grade Steel Monument
	Brown fine to coarse GRAVEL with silt and sand (dense, moist) (Fill)	GP-GM	44*	MC	Concrete Plug
	Brown silty GRAVEL with sand and occasional brick and wood fragments (dense*, moist) (Fill)	GM			Bentonite Backfill
5	Reddish-yellow and greenish-gray sandy SILT (soft to medium stiff) (moist to wet) (Fill)	ML	4	MC	2-inch PVC Solid Pipe
	Dark brown organic SILT with wood fragments (soft to medium stiff) (moist to wet) (Buried Topsoil)	OL			
	Grayish-brown and reddish-yellow sandy SILT/silty fine to medium SAND (very stiff/medium dense, moist) (Recessional Outwash - Fine-Grained)				
10		ML/ SM	17	MC	Ground water measured at 13.1 feet (7/18/13) and 13.4 feet (10/18/13)
	Gray to grayish-brown clayey SILT (very stiff, moist to wet) (Recessional Outwash - Fine-Grained)				
15		ML	21	MC	2-inch PVC Slotted Pipe
	Grayish brown medium to fine SAND with silt and gravel (medium dense, wet) (Recessional Outwash - Coarse-Grained)	SP-SM			
20	Interlayered gray fine to medium SAND with silt and occasional gravel and gray silty fine to medium SAND with occasional gravel (medium dense, wet) (Recessional Outwash - Coarse-Grained)	SP-SM/ SM	26	MC	Sand Backfill
	Gray silty fine to medium SAND with occasional gravel (very dense, moist to wet) (Advance Outwash - Transitional Beds)				
25		SM	50/4"	MC	
30		SM	50/5"	MC	
	Gray sandy SILT with thin layers of fine sand (hard, moist) (Advance Outwash - Transitional Beds)				Bentonite Backfill
35		ML	75		
40	becomes moist to wet	ML	30		
45		ML	50		
50					

See Figure A-1 for explanation of symbols

Boring B-7/Monitor Well MW-7

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet	Soil Profile: Description	Graphic Log	Sample Data: Group Symbol	Blow Count	Sample Location	Penetration Resistance (Blows/foot - ●) / Moisture Content (Percent - ■) 20 40 60 80	Laboratory Testing	Comments/ Ground Water Observations
50	Gray sandy SILT with variable amounts of fine sand and thin layers of fine sand (hard, moist to wet) (Advance Outwash - Transitional Beds)		ML	57			MC	Bentonite Backfill
	Boring completed at approximately 51.5 feet on July 14, 2013							
55	* density and blow count may not be representative because of the presence of gravel							
60								
65								
70								
75								
80								
85								
90								
95								
100								

See Figures A-1 and A-2 for explanation of symbols

Boring B-8/Monitor Well MW-8

Latitude 47.60413; Longitude -122.31514

Approximate Elevation: 235.9 feet

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Soil Profile – Description	Group Symbol	Blow Count	Laboratory Testing
Sod and Topsoil (4 inches)			
Light brown silty fine to medium SAND with occasional gravel (dense, dry to moist) (Fill)	SM	32	MC
Brown sandy SILT (hard, moist) (Fill)	ML	31	MC
	ML SM	18	
Greenish-gray and grayish-brown fine to medium silty SAND with occasional gravel (medium dense, moist) (Fill)	SM	23	MC
Grayish-brown clayey SILT (very stiff, moist) (Recessional Outwash - Fine-Grained)	ML		
becomes gray, sandy, medium stiff, with fine sand partings at about 15 feet	ML	7	MC
grades to with a trace gravel, stiff at about 20 feet	ML	10	MC
grades to with occasional gravel, moist to wet at about 25 feet grades to brown at about 26 feet	ML	13	MC
Grayish brown fine to medium SAND with silt and gravel (dense*, wet) (Recessional Outwash - Coarse-Grained)	SP-SM	39*	
Grayish brown fine to medium SAND with silt and gravel (dense*, wet) (Advance Outwash - Transitional Beds)	SP-SM	50/6"	
Gray silty fine to medium SAND with gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SM	50/6"	
Gray SILT (hard, wet) (Advance Outwash - Transitional Beds)	ML	64	
Grayish-brown fine to medium SAND with silt and gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SP-SM		
Gray silty fine SAND (very dense, wet) (Advance Outwash - Transitional Beds)	SM		

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80

Comments/Ground Water Observations:

- Flush Grade Steel Monument
- Concrete Plug
- Bentonite Backfill
- 2-inch PVC Solid Pipe
- Ground water measured at 21.0 feet (7/18/13) and 20.2 feet (10/18/13)
- 2-inch PVC Slotted Pipe
- Sand Backfill
- Bentonite Backfill

See Figure A-1 for explanation of symbols

JMS/BRB:11/26/13

Boring B-8/Monitor Well MW-8

Depth in Feet	Soil Profile: Description	Graphic Log	Sample Data: Group Symbol	Blow Count	Sample Location	Penetration Resistance (Blows/foot - ●) / Moisture Content (Percent - ■)	Laboratory Testing	Comments/ Ground Water Observations
50	Gray clayey SILT and SILT (hard, moist) (Advance Outwash - Transitional Beds)		ML	57			MC	Bentonite Backfill
	Boring completed at approximately 51.5 feet on July 13, 2013							
	* density and blow count may not be representative because of the presence of gravel							
55								
60								
65								
70								
75								
80								
85								
90								
95								
100								

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

See Figure A-1 for explanation of symbols

Boring B-9

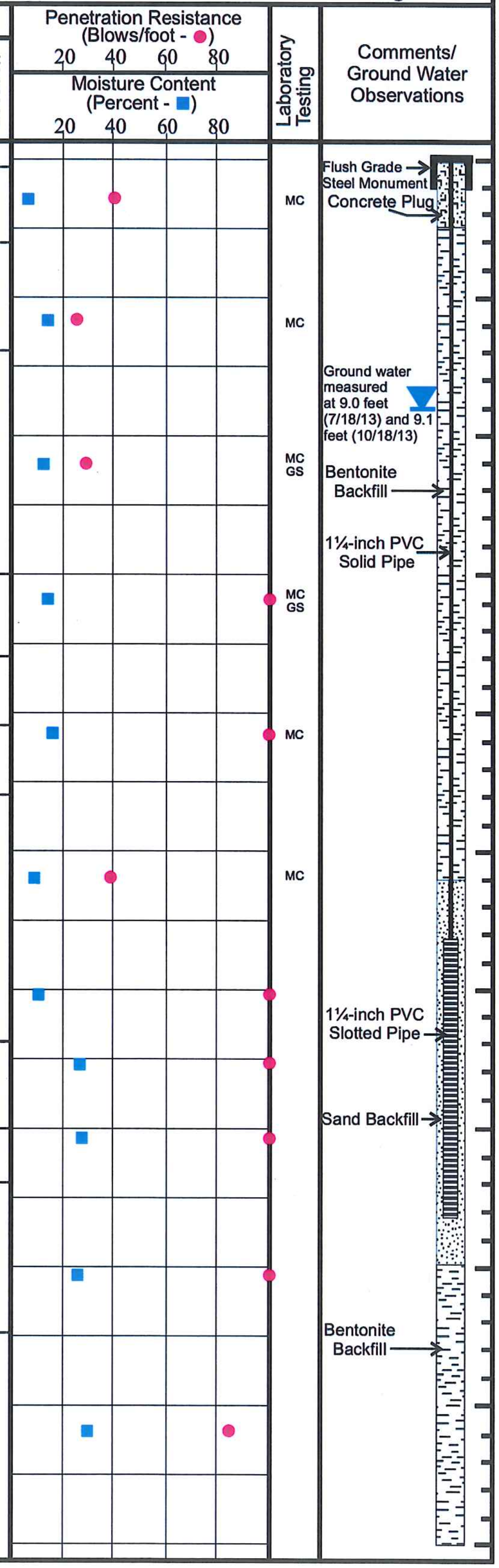
Latitude 47.60361; Longitude -122.31545

Approximate Elevation: 217.0 feet

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

Depth in Feet	Soil Profile – Description	Group Symbol	Blow Count	Laboratory Testing
0	Sod and Topsoil (4 inches)			
	Light brown silty fine SAND with gravel and occasional concrete fragments (dense*, dry to moist) (Fill)	SM	41*	MC
5	Brown, reddish-yellow and gray silty fine to coarse SAND with occasional fine gravel (medium dense, moist) (Recessional Outwash - Coarse-Grained)	SM	26	MC
10	Brown fine to medium SAND with silt and gravel (medium dense, wet) (Recessional Outwash - Coarse-Grained)	SP-SM	29	MC GS
15	Brown fine to medium SAND with gravel and thin layers sandy silt (very dense, wet) (Advance Outwash - Transitional Beds)	SP	50/5"*	MC GS
	Gray sandy SILT and silty fine SAND (hard/very dense, moist) (Advance Outwash - Transitional Beds)	ML/SM		
20	Reddish-yellow fine to medium SAND with silt (very dense, wet) (Advance Outwash - Transitional Beds)	SP-SM	50/4"	MC
25	Gray silty fine to medium SAND with occasional gravel (dense, moist) (Advance Outwash - Transitional Beds)	SM	39	MC
30		SM	50/2"	
	Gray sandy SILT and silty fine SAND (hard/very dense, moist to wet) (Advance Outwash - Transitional Beds)	ML/SM	50/4"	
35	Gray SILT (hard, moist) (Advance Outwash - Transitional Beds)	ML	50/4"	
40	Gray silty fine to medium SAND with gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SM	50/4"	
45	Gray silty CLAY (hard, moist) (Advance Outwash - Transitional Beds)	CL	85	
50				



ICE File No. 0105-011

See Figure A-1 for explanation of symbols

Boring B-9

Depth in Feet	Description	Graphic Log	Group Symbol	Blow Count	Sample Location	Penetration Resistance (Blows/foot - ●) 20 40 60 80 / Moisture Content (Percent - ■) 20 40 60 80	Laboratory Testing	Comments/ Ground Water Observations
50	Gray silty CLAY (hard, moist) (Advance Outwash - Transitional Beds)		CL	34			MC	Bentonite Backfill
	Boring completed at approximately 51.5 feet on July 12, 2013							
55	* density and blow count may not be representative because of the presence of gravel							
60								
65								
70								
75								
80								
85								
90								
95								
100								

JMS/BRB:11/26/13

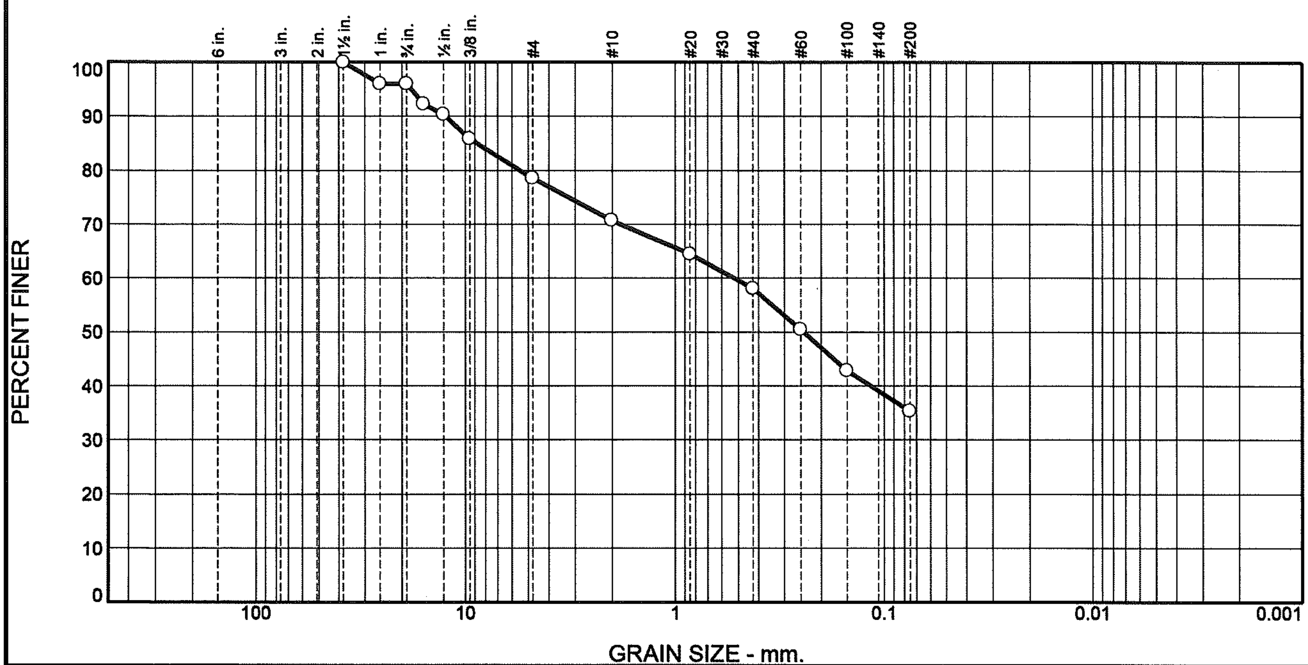
Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

See Figure A-1 for explanation of symbols

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.0	17.5	7.8	12.6	22.8	35.3	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1.0	96.0		
3/4	96.0		
5/8	92.3		
1/2	90.3		
3/8	85.8		
#4	78.5		
#10	70.7		
#20	64.5		
#40	58.1		
#60	50.4		
#100	42.8		
#200	35.3		

* (no specification provided)

Material Description

Brown silty fine to medium SAND with gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= 12.4289 D_{85}= 8.8011 D_{60}= 0.5244

D_{50}= 0.2428 D_{30}= D_{15}=

D_{10}= C_u= C_c=

Remarks

Date Received: 07/15/13 **Date Tested:** 7/25-7/26/13

Tested By: HAL/SAW

Checked By: KSK

Title: Principal Eng Geologist

Source of Sample: Soil Samples from Borings **Depth:** 10 - 11.5 Feet **Date Sampled:** 07/12/13

Sample Number: Boring B-1, S-3

ICICLE CREEK ENGINEERS, INC.

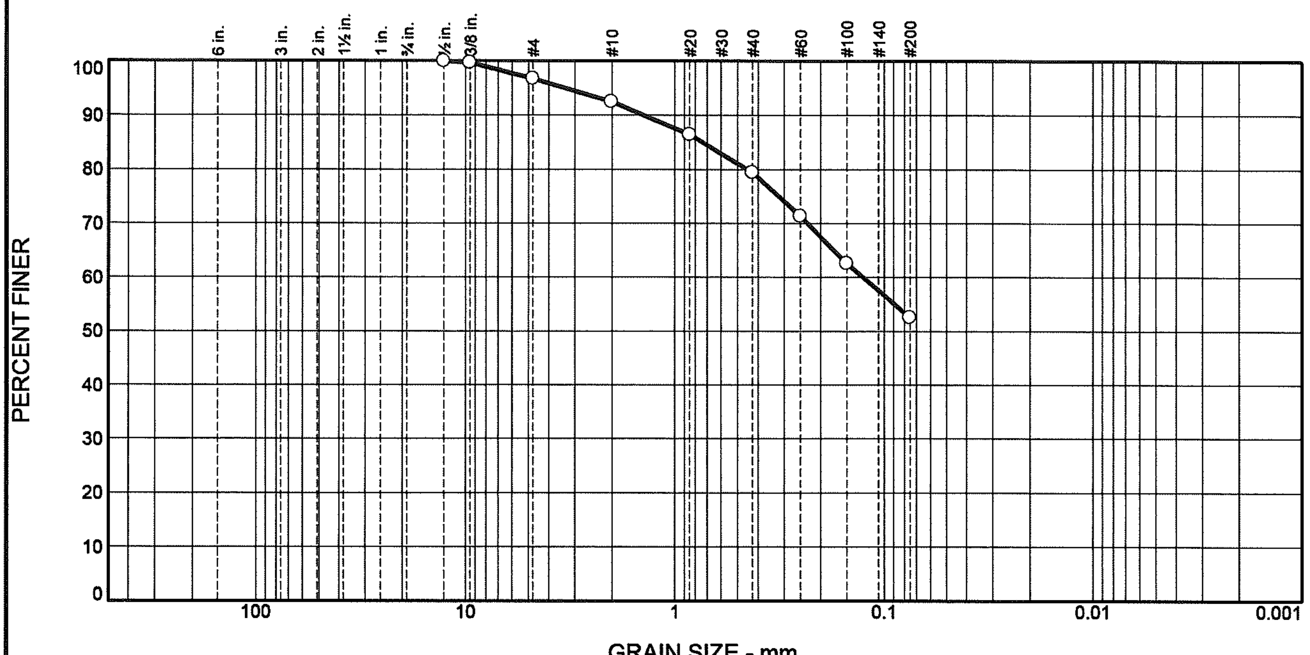
Carnation, WA

Client: King County / Parametrix

Project: King County Children and Family Justice Center

Project No: 0105-011 **Figure** B-1

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.2	4.3	13.1	26.9	52.5	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1/2	100.0		
3/8	99.7		
#4	96.8		
#10	92.5		
#20	86.4		
#40	79.4		
#60	71.3		
#100	62.6		
#200	52.5		

* (no specification provided)

Material Description

Brownish-gray and reddish-yellow sandy SILT with a trace of gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= ML AASHTO (M 145)=

Coefficients

D_{90}= 1.4035 D_{85}= 0.7379 D_{60}= 0.1256
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

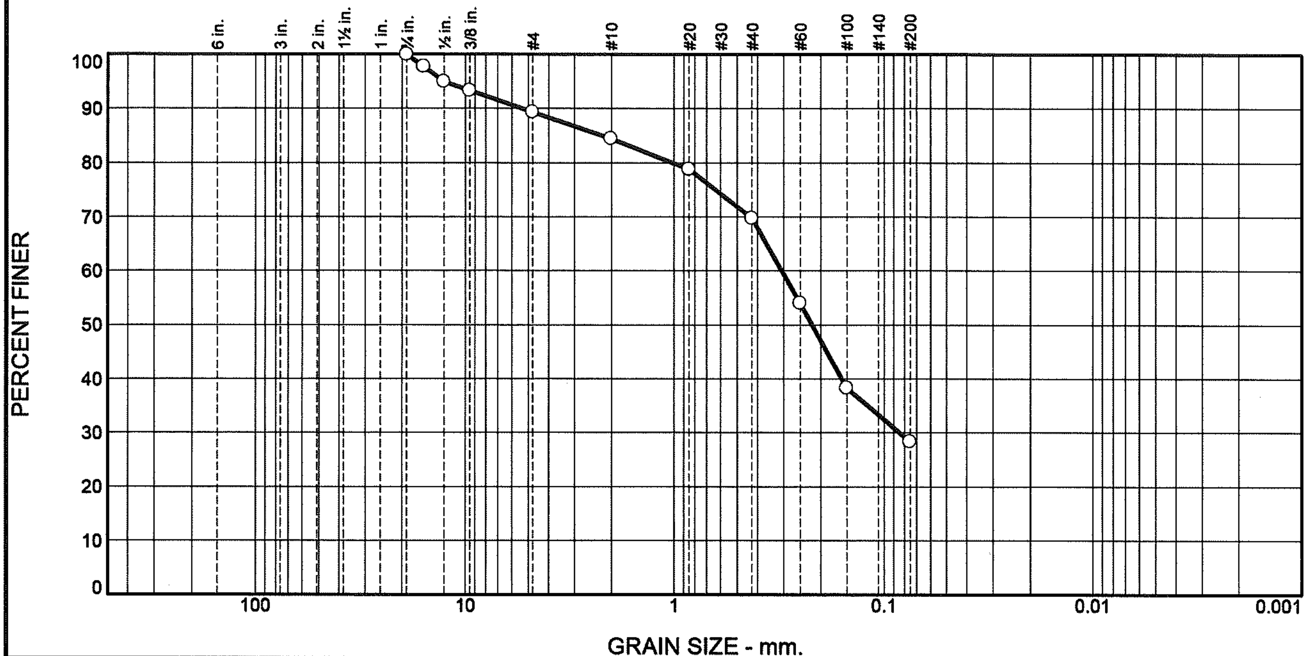
Date Received: 07/15/13 **Date Tested:** 7/24/-7/25/13
Tested By: HAL/SAW
Checked By: KSK
Title: Principal Eng Geologist

Source of Sample: Soil Samples from Borings **Depth:** 10 - 11.5 Feet **Date Sampled:** 07/14/13
Sample Number: Boring B-2, S-3

ICICLE CREEK ENGINEERS, INC.
Carnation, WA

Client: King County / Parametrix
Project: King County Children and Family Justice Center
Project No: 0105-011 **Figure** B-2

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.7	4.9	14.7	41.4	28.3	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4	100.0		
5/8	97.8		
1/2	95.0		
3/8	93.3		
#4	89.3		
#10	84.4		
#20	78.8		
#40	69.7		
#60	54.0		
#100	38.3		
#200	28.3		

* (no specification provided)

Material Description

Gray silty fine to medium SAND with gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 5.3478 D_{85}= 2.2153 D_{60}= 0.3060
D_{50}= 0.2195 D_{30}= 0.0842 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 07/15/13 **Date Tested:** 7/24-7/25/13

Tested By: HAL/SAW

Checked By: KSK

Title: Principal Eng Geologist

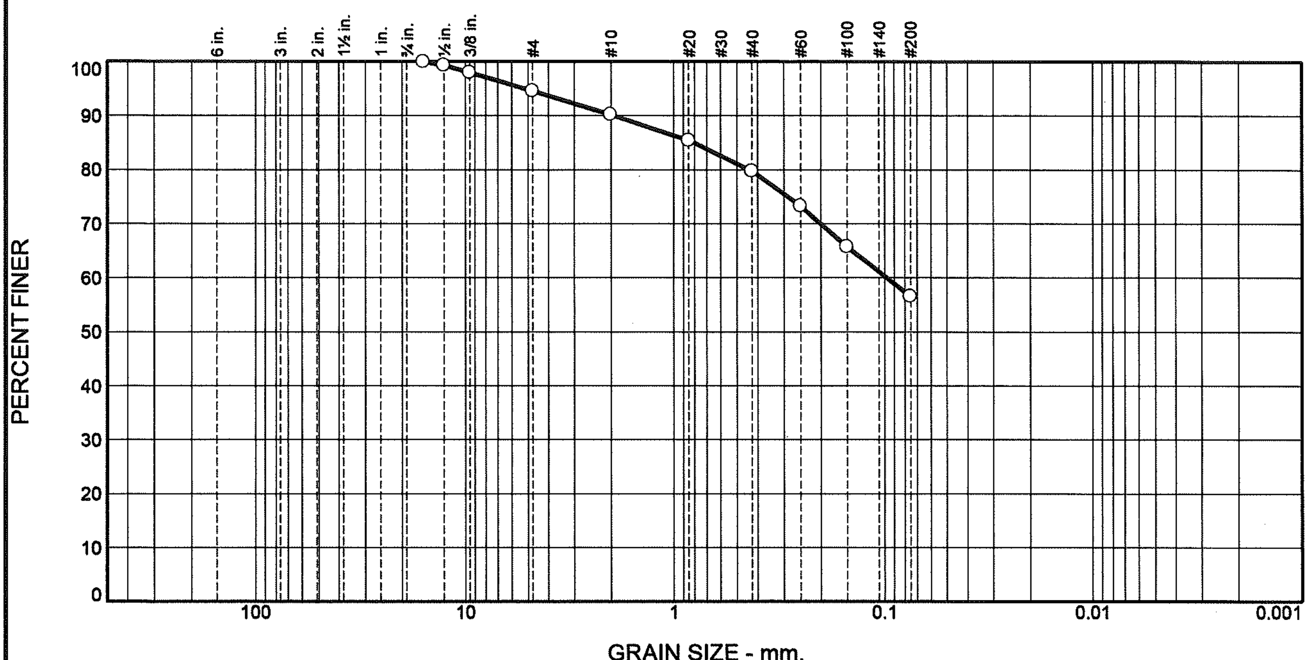
Source of Sample: Soil Samples from Borings **Depth:** 10.5 - 15.9 Feet **Date Sampled:** 7/12/13
Sample Number: Boring B-5, S-3b/4 an4

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: King County / Parametrix
Project: King County Children and Family Justice Center
Project No: 0105-011 **Figure** B-3

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.4	4.4	10.5	23.1	56.6	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
5/8	100.0		
1/2	99.3		
3/8	98.0		
#4	94.6		
#10	90.2		
#20	85.4		
#40	79.7		
#60	73.3		
#100	65.7		
#200	56.6		

* (no specification provided)

Material Description

Grayish-brown sandy SILT with a trace of gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= ML AASHTO (M 145)=

Coefficients

D_{90}= 1.9277 D_{85}= 0.8056 D_{60}= 0.0972
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

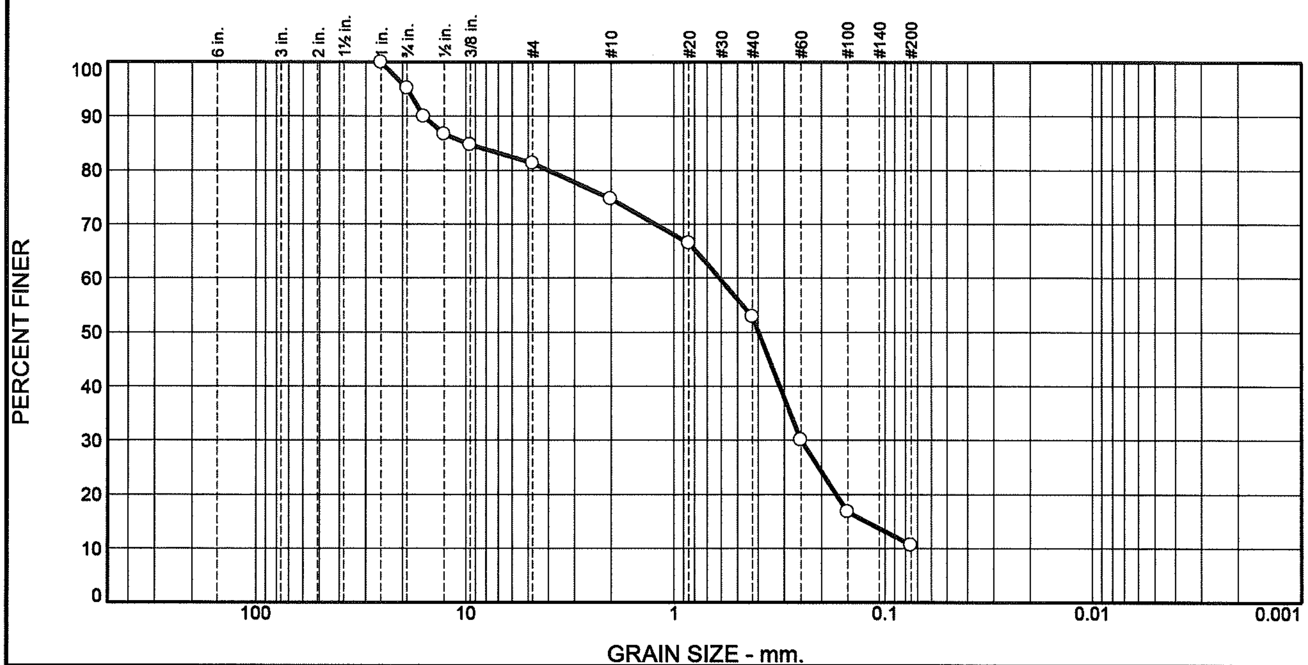
Date Received: 07/15/13 **Date Tested:** 7/24-7/25/13
Tested By: HAL/SAW
Checked By: KSK
Title: Principal Eng Geologist

Source of Sample: Soil Samples from Borings **Depth:** 10 - 11.5 Feet **Date Sampled:** 7/14/13
Sample Number: Boring B-6, S-3

ICICLE CREEK ENGINEERS, INC.
Carnation, WA

Client: King County / Parametrix
Project: King County Children and Family Justice Center
Project No: 0105-011 **Figure** B-4

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.8	13.9	6.6	21.9	42.2	10.6	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
3/4	95.2		
5/8	90.0		
1/2	86.7		
3/8	84.7		
#4	81.3		
#10	74.7		
#20	66.5		
#40	52.8		
#60	30.1		
#100	16.8		
#200	10.6		

* (no specification provided)

Material Description

Brown fine to medium SAND with silt and gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=**

Coefficients

D_{90}= 15.8915 D_{85}= 9.9121 D_{60}= 0.6117
D_{50}= 0.3977 D_{30}= 0.2491 D_{15}= 0.1229
D_{10}= C_u= C_c=

Remarks

Date Received: 07/15/13 **Date Tested:** 7/24-7/25/13
Tested By: HAL/SAW
Checked By: KSK
Title: Principal Eng Geologist

Source of Sample: Soil Samples from Borings **Depth:** 10 - 16.4 Feet **Date Sampled:** 7/12/13
Sample Number: Boring B-9, S-3/S-4

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: King County / Parametrix
Project: King County Children and Family Justice Center
Project No: 0105-011 **Figure** B-5

APPENDIX B

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland