GEOTECHNICAL DATA REPORT
3rd Place SE Geotechnical Investigation
Prepared for:
King County Water and Land Resources Division

Project No. 160427-003-02 • November 17, 2017 FINAL

Aspect Consulting, LLC

Andrew J. Holmson, PE
Senior Geotechnical Engineer
aholmson@aspectconsulting.com

Jesse G. Favia, LG
Senior Staff Geologist
jfavia@aspectconsulting.com

Henry H. Haselton, PE
Principal Geotechnical Engineer
hhaselton@aspectconsulting.com

V:\160427 King County WLRD Work Order Geotechnical Services #E00453E16\ Deliverables\003_White River\Geotechnical Data Reports\02_3rd Place SE\Third Place - Geotechnical Data Report - Final.docx
Contents

1 Introduction .......................................................................................................................... 1
  1.1 Purpose and Scope of Work ......................................................................................... 1
  1.2 Background .................................................................................................................. 1

2 Site Conditions .................................................................................................................... 2
  2.1 Geography and Land Use ............................................................................................ 2
  2.2 Topography .................................................................................................................. 2
  2.3 Vegetation ..................................................................................................................... 2
  2.4 Geological Setting ......................................................................................................... 2
      2.4.1 Existing Subsurface Exploration Data Review .................................................. 4

3 Field Investigations ............................................................................................................. 5
  3.1 Subsurface Explorations .............................................................................................. 5
      3.1.1 Soil Borings ........................................................................................................... 5
      3.1.2 Test Pits ............................................................................................................... 5
      3.1.3 Well Development ............................................................................................... 6
      3.1.4 Laboratory Testing .............................................................................................. 6

4 Subsurface Conditions ....................................................................................................... 8
  4.1 Subsurface Stratigraphy ............................................................................................... 8
      4.1.1 Fill ....................................................................................................................... 8
      4.1.2 Holocene Alluvium - Floodplain Deposits ......................................................... 8
      4.1.3 Holocene Alluvium - Channel Deposits ............................................................. 9
  4.2 Groundwater ................................................................................................................ 9

5 Slug Testing for Hydraulic Conductivity .............................................................................. 11
  5.1 Field Methods .............................................................................................................. 11
  5.2 Data Acquisition .......................................................................................................... 11
  5.3 Test Procedures ........................................................................................................... 11
  5.4 Slug Test Results ......................................................................................................... 11

6 Limitations .......................................................................................................................... 13

7 References ........................................................................................................................... 14
List of Tables
1 Exploration Locations and Completion Information ................................6
2 Groundwater Levels Summary ..................................................................10
3 Slug Test Analysis Summary

List of Figures
1 Site Location Map
2 Site and Exploration Map

List of Appendices
A Subsurface Explorations
B Laboratory Testing Results
C Slug Test Analyses
1 Introduction

1.1 Purpose and Scope of Work

This Geotechnical Data Report (GDR) presents geotechnical data collected for the 3rd Place SE Geotechnical Investigation (Project). The Project area includes the area adjacent to the White River right bank on the waterside of 3rd Place SE and 3rd Avenue SE in Pacific, Washington (Site). This GDR includes a summary of Site explorations, data collection methods, geologic observations, laboratory testing, and aquifer testing (slug tests) results from three soil borings and six test pits completed between June 26 and July 13, 2017. We installed piezometers in two borings for slug testing and future groundwater monitoring use. Our work was completed in accordance with Work Order E00453-3 under contract number E00453E16 between King County (County) and Aspect Consulting, LLC (Aspect).

This GDR provides a basis for characterizing the subsurface conditions at the Site and piezometer installation information to inform future groundwater monitoring efforts being completed by the County.

The Site location is shown on Figure 1, Site Location Map. The locations of the completed subsurface explorations, existing topography, and existing features are shown on Figure 2, Site and Exploration Map. Subsurface exploration logs, laboratory results, and slug testing data are provided herein and in the attached appendices.

1.2 Background

The primary goal of the Project is to provide baseline information and establish piezometers to help understand geological and hydrogeological conditions at the Site. Data from the GDR will be used to inform the evaluation and design of the future Pacific Right Bank flood risk-reduction project that will include construction of a new setback flood protection system along the White River right bank. We anticipate that further geotechnical explorations and analyses will be performed to support the design of the future Pacific Right Bank flood risk-reduction project.

The Project vertical datum is North American Vertical Datum of 1988 (NAVD88) and is the basis for all elevations described herein.
2 Site Conditions

2.1 Geography and Land Use

The Site is on the right (west) bank of the White River in Pacific, Washington (Figure 1) and extends from the White River right bank to Third Place Southeast or Third Avenue Southeast in Pacific, Washington. The southern half of the Site is within the regulatory floodplain of the White River.

The Site is primarily a residential neighborhood and consists of single family residential parcels containing single-family mobile homes, or vacant parcels that recently contained mobile homes. Prior to construction of the mobile homes, the Site was historically part of the White River/Stuck River channel and portions of the Site have been filled in the past.

An existing levee is present along the White River right bank and was reportedly constructed in 1919. A row of temporary HESCO flood barriers were installed along the east side of White River Drive in 2013. The County acquired 13 residential properties and demolished 13 single-family residences at the Site between 2007 and 2016.

2.2 Topography

Site topography is generally flat between Elevation 85 in the west part of the Site and 90 feet in the east part of the Site. The White River surface water elevation varied between Elevation 88.35 and 86.15 between June 1 and August 17, 2017 at USGS gage No. 12100496, White River near Auburn, WA (USGS, 2017).

2.3 Vegetation

Site vegetation includes residential landscaping, and sparse mature trees along the White River. Residential landscaping is typically grass with short shrubs. The residential parcels acquired and owned by King County are predominantly grass covered. Mature trees along the White River were fir or maple trees up to 3 feet diameter at breast height (dbh).

2.4 Geological Setting

Geological mapping (Mullineaux, 1965) of the Project vicinity identifies a thick sequence of post-Fraser-glaciation alluvium deposited over Fraser glacial and pre-Fraser glacial and nonglacial sediments. Glacially-consolidated sediments from multiple Pleistocene glaciations and interglacial deposition during the Pleistocene (2.6 million to 11,600 years ago) compose the White River valley wall and valley floor. These older sediments were deeply eroded by subglacial meltwater flow during the latest regional glaciation (the Vashon stade of the Fraser glaciation). This subglacial meltwater erosion produced the deep network of channels and waterways of Puget Sound and lowland river valleys east of Puget Sound. At the end of the Fraser glaciation around 13,500 years ago, a deep and broad marine channel (formerly an arm of Puget Sound) extended from Elliott Bay in Seattle, through the Site area, and south to Commencement Bay at Tacoma.
Latest post glacial and Holocene (11,600 years ago to present) geologic processes included erosion and transport of sediment from uplands and drainage headwaters, and transport of sediment from lahars originating on Mount Rainier (Collins and Montgomery, 2010; Zehfuss et. al, 2003). The deep glacial meltwater channel below the Site has been subsequently infilled with Holocene (Recent) alluvium. This regional lowland now contains (from Seattle southward to Tacoma) the lower reaches of the Duwamish, Green, White, and Puyallup rivers. The Holocene alluvium deposited along these rivers merges into a continuous alluvial deposit.

Project area geologic history generally consists of the following processes:

- **Subglacial Erosion of the White-Green-Duwamish River Valley.** Erosion by ice from the Vashon ice sheet and subglacial meltwater flow created the broad north to south trending marine embayment now occupied by the White, Green, and Duwamish rivers. Glacially overridden soils and bedrock lie at considerable depth below younger and weaker late glacial and postglacial deposits.

- **Postglacial Incision and Sedimentation.** Shortly after deglaciation, sea level was several hundred feet lower than at present, and the Puget Lowland was depressed by the weight of the glacial ice. Rapid isostatic rebound (causing uplift of land) combined with low post-glacial sea level allowed the east to west trending lowland rivers, including the White River, to incise to the lower base set by the low post-glacial sea level combined with the elevated land. Combined effects of worldwide sea level rise and local isostatic rebound following deglaciation resulted in several hundred feet of rising sea level that continued until about 5,000 years ago. This rise in sea level resulted in marine flooding of the Duwamish, White and Green river valleys. The oldest post-glacial deposits in the valleys includes marine clays and muds.

- **Embayment and Valley Filling.** The marine embayment filled rapidly from south to north with Holocene alluvium derived primarily from multiple lahars (volcanic mudflows) from Mount Rainier. The most recent large lahar that impacted the valley, known as the Osceola Mudflow, travelled down the White River valley from Mount Rainier approximately 5,600 years ago. White River deposition in the Puget Lowland has been fan-dominated and between Puyallup and Kent. Sedimentation of the White River fan was driven in part by large-scale erosion of lahar deposits in confined valleys upriver of the marine embayment and deposition within the marine embayment. Deposits associated with the fans can contain boulders and cobbles.

After the initial impulse of diamictic (unsorted) debris from the Osceola Mudflow, sedimentation around the Site occurred as hyperconcentrated flow deposits (sediment rich but water transported and reworked deposits), deltaic deposits, and alluvial deposits. Deposition occurred in several discrete phases and these deposits are described as tightly packed sand and gravel of volcanic origin with a distinct dark purple-gray color. Other post-Osceola mudflow deposits including hyperconcentrated sands have also been identified within younger Holocene alluvial strata (Zehfuss et al., 2003) in the Lowland.
• **Historic Filling and Hydraulic Engineering.** Historically, the White River flowed north across its alluvial fan through the present location of Auburn to join the Green River. The Stuck River, which is occupied by the present day White River, was a distributary of the White River that flowed into the Puyallup River and carried variable amounts of White River flow. Early twentieth century flooding and hydraulic engineering revised flow paths and outlet points of the White and Green Rivers, resulting in the system present today where the entire flow of the White River discharges south to the Puyallup River.

2.4.1 *Existing Subsurface Exploration Data Review*

We reviewed existing subsurface exploration data from the Pacific Park property immediately south of the Site (Shannon & Wilson, Inc., 2015 and 2016).

The data from the Pacific Park property was collected as part of Phase I and II environmental site assessments (ESA) and included a summary of existing subsurface exploration data and new data from 28 direct push explorations (geoprobes) and four test pit excavations.

The direct push explorations were advanced between 5 and 20 feet below the ground surface (bgs), with a typical exploration depth of 15 feet bgs. The test pit excavations were typically completed to 6 feet bgs.

The explorations typically encountered fill with refuse debris from the ground surface to between 4 and 10 feet bgs. Underlying the fill was alluvium deposits described as poorly graded sand with silt and gravel. Groundwater levels noted in the explorations were typically around 5 feet bgs.

Also described in the Phase I and II ESAs are the results of a geotechnical investigation for a mobile home north of Pacific Park and within the subject Site at 714 3rd Place, Pacific, Washington. The data from the geotechnical investigation included three test pit excavations advanced to a maximum depth of 10.5 feet bgs. The test pit logs of the subsurface indicate fill with refuse debris to an approximate depth of 5 feet bgs. Underlying the fill was alluvium deposits described as loose, moist to wet, gravelly sand with some silt. Rapid groundwater inflow was noted at 9 to 9.5 feet bgs in two of the three test pits.
3 Field Investigations

3.1 Subsurface Explorations

Aspect completed field explorations between June 26 and July 13, 2017. Field explorations included soil borings and test pits. Soils were classified using the Unified Soil Classification System (USCS) in general accordance with the American Society for Testing and Materials (ASTM) D2488, Standard Practice for Description and Identification of Soils (Visual and Manual Procedure). Exploration locations are shown on Figure 2. Logs of the subsurface explorations are provided in Appendix A.

3.1.1 Soil Borings

Aspect observed three soil borings (B-01 through B-03) advanced using hollow-stem auger or rotary wash drilling techniques by Holocene Drilling, Inc. (Holocene), under contract to Aspect, on June 26 and 27, 2017. Borings B-01 and B-03 were advanced to 31.5 feet bgs and boring B-02 was advanced to 61.5 feet bgs. The borings were advanced using a track-mounted Dietrich D-50 turbo drill rig equipped with a 140-pound automatic sampling hammer.

Soil samples were collected at five foot intervals from each boring using the Standard Penetration Test (SPT) method and in general accordance with American Society for Testing and Materials (ASTM) D1586. Soils samples were logged by Aspect staff in the field in general accordance with the Unified Soil Classification System (USCS), as defined in ASTM D2488, and standard geologic unit nomenclature.

Borings were backfilled and piezometers constructed in accordance with the Washington State Department of Ecology regulations. Piezometers were installed in borings B-01 and B-03. The piezometers consist of a 2-inch diameter polyvinyl chloride (PVC) well with a 10-foot-long screen embedded in sand. The piezometers have flush-mounted well covers. Details of the borings and piezometer installations are shown in Table 1 and Appendix A.

3.1.2 Test Pits

Aspect observed six test pits (TP-01 through TP-06), excavated with a rubber-tracked Takeuchi TB 138-FR mini-excavator operated by Kelly’s Excavating, under contract to Aspect. Soil samples were collected from representative units and returned to the Aspect office for further analysis, and selected samples were sent for laboratory testing. Soil density was evaluated using Dynamic Cone Penetrometer (DCP) test in general

1 The SPT test involves driving a 2-inch outside-diameter by 1¾ inch inside-diameter, split spoon sampler 18 inches into the soil with a 140-pound automatic hammer falling 30 inches. The number of blows of the hammer required to drive the sampler each 6 inches is recorded and used to determine soil density. A disturbed soil samples is collected in the split spoon sampler and returned to the surface for description.

2 The DCP test involves driving a 1.5-inch diameter steel-tipped cone 1.75-inches using a 15-pound anvil with a 20-inch drop. The number of blows for each 1.75-inch interval is recorded. The number of blows is correlated to resistance and provides a means of estimating soil density.
accordance with ASTM Special Technical Publication #399 Dynamic Cone for Shallow In-Situ Penetration Testing.

### 3.1.3 Well Development

Each of the piezometers was developed by Aspect field staff using a positive displacement 12-volt pump and plastic bailer. Wells were developed to a minimum criterion of either 10 well casings or a turbidity of less than 40 Nephelometric Turbidity Units (NTU).

**Table 1. Exploration Locations and Completion Information**

<table>
<thead>
<tr>
<th>Exploration</th>
<th>Northing (ft, SPN NAD83)</th>
<th>Latitude</th>
<th>Easting (ft, SPN NAD83)</th>
<th>Longitude</th>
<th>Elevation (ft, NAVD88)</th>
<th>Total Depth (ft, bgs)</th>
<th>Screened Interval (ft, bgs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-01</td>
<td>100087.589</td>
<td>47.265734</td>
<td>1293203.347</td>
<td>-122.231772</td>
<td>89.4^1</td>
<td>31.5</td>
<td>10-20</td>
</tr>
<tr>
<td>B-02</td>
<td>99992.079</td>
<td>47.265460</td>
<td>1292955.866</td>
<td>-122.232762</td>
<td>88.9^2</td>
<td>61.5</td>
<td>-</td>
</tr>
<tr>
<td>B-03</td>
<td>99818.199</td>
<td>47.264967</td>
<td>1292629.669</td>
<td>-122.234062</td>
<td>86.1^1</td>
<td>31.5</td>
<td>6-16</td>
</tr>
<tr>
<td>TP-01</td>
<td>100045.119</td>
<td>47.265616</td>
<td>1293172.267</td>
<td>-122.231894</td>
<td>90.0^2</td>
<td>6.0</td>
<td>-</td>
</tr>
<tr>
<td>TP-02</td>
<td>100118.195</td>
<td>47.265817</td>
<td>1293192.965</td>
<td>-122.231816</td>
<td>89.1^2</td>
<td>8.5</td>
<td>-</td>
</tr>
<tr>
<td>TP-03</td>
<td>100040.815</td>
<td>47.265595</td>
<td>1292989.758</td>
<td>-122.232629</td>
<td>88.1^2</td>
<td>8.5</td>
<td>-</td>
</tr>
<tr>
<td>TP-04</td>
<td>99944.758</td>
<td>47.265329</td>
<td>1292938.261</td>
<td>-122.232829</td>
<td>88.8^2</td>
<td>6.5</td>
<td>-</td>
</tr>
<tr>
<td>TP-05</td>
<td>99891.400</td>
<td>47.265168</td>
<td>1292650.031</td>
<td>-122.233986</td>
<td>85.6^2</td>
<td>5.5</td>
<td>-</td>
</tr>
<tr>
<td>TP-06</td>
<td>99762.539</td>
<td>47.264814</td>
<td>1292620.041</td>
<td>-122.234097</td>
<td>87.4^2</td>
<td>6.5</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**
1. Top of casing, per King County survey data.
2. Ground surface estimated from King County LiDAR (Quantum Spatial, 2016).

### 3.1.4 Laboratory Testing

Laboratory testing to characterize geotechnical properties was performed on selected soil samples obtained from the boreholes. Laboratory testing was conducted by Hayre McElroy & Associates, LLC. The results of the laboratory tests are presented in Appendix B. The following is a summary of geotechnical laboratory testing methods utilized for the project.

**Moisture Content Determination**

Selected soil samples were analyzed for water content by the ASTM D2216 test method. This test method allows for the laboratory determination of the moisture (water) content of a soil sample by measuring and recording the mass of a sample before and then after drying. Test results are illustrated graphically on the boring logs in Appendix A and tabulated in Appendix B.

**Grain Size Analysis**

Selected soil samples were analyzed for grain size by the ASTM D6913 and ASTM D1140 test methods. These test methods allow for the laboratory determination of the percent of the size fractions (by weight) of coarse-grained soil and the percent of fines in a soil sample, respectively. Grain size distribution plots are included in Appendix B and fines contents are indicated on the boring logs in Appendix A.
Plasticity Index (Atterberg Limits) Determination
Selected soil samples were analyzed for plasticity index by the ASTM D4318 test method. This test method allows for the laboratory determination of the liquid limit and the plastic limit of the fines in a soil sample. Test results are illustrated graphically on the boring logs in Appendix A and included in Appendix B.
4 Subsurface Conditions

4.1 Subsurface Stratigraphy

Our subsurface explorations correlate well with the existing geologic mapping and nearby existing subsurface exploration data reviewed for this work (Shannon & Wilson, Inc., 2015 and 2016). In all seven explorations (B-01 through B-03, and TP-01 through TP-06), we encountered fill or Holocene alluvium between the ground surface and the total depth of the explorations. Within the Holocene alluvium we distinguished floodplain deposits and channel deposits, as described below. The floodplain and channel deposits are not necessarily predictable using a continuous layered stratigraphy model due to past channel meandering through the area and infill processes associated with over-bank flooding events. Units are defined below.

4.1.1 Fill

We encountered fill at the surface in borings B-01, B-03 and TP-01 through TP-06. Fill extended from the ground surface to a maximum depth of 12.5 feet bgs in boring B-03; in all other explorations we observed between 0 and 7 feet of fill. Fill consisted of brown or gray silty SAND (SM) or sandy GRAVEL (GP, GW) with cobbles. In test pit TP-02 fill consisted of sand to boulder sized concrete fragments with steel wire. Gravel fill was inferred to be spoils from historic White River dredging.

Fill was typically loose as inferred from drill action. The fill can be assumed to possess moderate compressibility and low shear strength characteristics. The fill is typically coarse-grained and can be assumed to possess relatively high permeability characteristics. It can also be assumed to have low moisture sensitivity due to the low fines content.

4.1.2 Holocene Alluvium - Floodplain Deposits

During flood events, suspended-load sediment composed of sand, silt, and clay are deposited on floodplains peripheral to the active river channel. The deposits typically include relatively fine-grained soils ranging from silt and clay to silty fine to medium sand and are typically cross-bedded to laminated, although bedding may be indistinct. These deposits may also contain well-preserved and durable logs and in situ stumps, and other organics and woody debris.

We encountered floodplain deposits within the Holocene alluvium at the ground surface in boring B-02, below 39 feet bgs in boring B-02, from 20 to 23 feet bgs in boring B-03, and from 3 to 7.5 feet bgs in test pit TP-03. Floodplain deposits were distinguished based on grain size, fines content, interbedded texture, and density. Floodplain deposit soils consisted of wet, gray or gray-green, low plasticity SILT (ML), slightly silty to silty sand (SM, SP-SM), with organic fragments and scattered thin layers of PEAT (PT). Sand size fraction was typically fine to medium sand and rarely coarse, and soil types were commonly interbedded.

---

3 Soils classified in accordance with the Unified Soil Classification System (USCS), ASTM D2488.
The N-values ranged from 3 to 32 blows per foot (bpf), with an average N-value of 18 bpf, indicating the floodplain deposits are typically stiff/medium dense. The fine-grained portions of the floodplain deposits can be assumed to possess moderate to high compressibility, low shear strength, moderate permeability, and moderate to high moisture sensitivity characteristics. The coarse-grained portions of the floodplain deposits can be assumed to possess low to moderate compressibility, moderate shear strength, relatively high permeability, and low moisture sensitivity characteristics.

### 4.1.3 Holocene Alluvium - Channel Deposits

Channel deposits are the result of depositional sequences within the active or historic river channel(s). These deposits typically include relatively clean sand with gravel, cobbles, and boulders. Interbeds of silt, clay, and peat can be present within channel deposits, particularly in areas of historic oxbows or other low-energy channel features. Well-preserved and durable logs and wood debris may be present in the channel deposits.

We encountered channel deposits throughout the subsurface and typically underlying fill or floodplain deposits. We encountered channel deposits as deep as 39 feet bgs in boring B-02. Channel deposits were distinguished based on color, grainsize, and fines content; channel deposits were commonly a dark purple-gray indicative of their Mount Rainier source. Channel deposits consisted of gray or dark gray, clean to silty SAND (SP/SW, SP-SM/ SW-SM, SM) or clean to sandy GRAVEL (GP).

The SPT N-values ranged from 4 to greater than 50 bpf, with an average N-value of 35 bpf, indicating the channel deposits were variable and ranged from loose to very dense and were typically dense. Some N-values are overstated due to the presence of coarse gravel. Channel deposit density generally increased with depth. The channel deposits can be assumed to possess low compressibility and moderate shear strength characteristics. The channel deposits are typically coarse-grained and can be assumed to possess relatively high permeability characteristics. They can also be assumed to have low moisture sensitivity due to the low fines content.

### 4.2 Groundwater

Groundwater was encountered in all borings (B-01 through B-03) and in test pits TP-02 through TP-06; caving sidewalls in TP-01 suggest that groundwater was near the bottom of the exploration at 6-feet bgs. When water was encountered in borings during drilling, drilling was paused for 10 minutes to allow the groundwater to equilibrate and a water level measured using a water level indicator. Water levels were subsequently measured during well development and slug testing. Groundwater levels were generally measured between 4.5 and 6.5 feet bgs corresponding to between Elevation 80.6 and Elevation 85.2. Water level measurements are shown in Table 2.
Table 2. Groundwater Levels Summary

<table>
<thead>
<tr>
<th>Exploration</th>
<th>Exploration Type</th>
<th>Elevation (ft, NAVD 88)</th>
<th>Measure Date</th>
<th>Depth to Water (ft, bgs)</th>
<th>Water Level Elevation (ft, NAVD88)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-01</td>
<td>Well</td>
<td>89.4 (^1)</td>
<td>6/27/2017</td>
<td>5.2</td>
<td>85.2</td>
</tr>
<tr>
<td>B-02</td>
<td>Boring</td>
<td>88.9 (^2)</td>
<td>6/27/2017</td>
<td>4.5</td>
<td>84.4</td>
</tr>
<tr>
<td>B-03</td>
<td>Well</td>
<td>86.1 (^1)</td>
<td>6/26/2017</td>
<td>5.2</td>
<td>80.9</td>
</tr>
<tr>
<td>TP-01</td>
<td>Test Pit</td>
<td>90.0 (^2)</td>
<td>6/29/2017</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>TP-02</td>
<td>Test Pit</td>
<td>89.1 (^2)</td>
<td>7/14/2017</td>
<td>6.5</td>
<td>82.6</td>
</tr>
<tr>
<td>TP-03</td>
<td>Test Pit</td>
<td>88.1 (^2)</td>
<td>7/14/2017</td>
<td>6.0</td>
<td>82.1</td>
</tr>
<tr>
<td>TP-04</td>
<td>Test Pit</td>
<td>88.8 (^2)</td>
<td>7/14/2017</td>
<td>6.5</td>
<td>82.3</td>
</tr>
<tr>
<td>TP-05</td>
<td>Test Pit</td>
<td>85.6 (^2)</td>
<td>7/14/2017</td>
<td>4.5</td>
<td>81.1</td>
</tr>
<tr>
<td>TP-06</td>
<td>Test Pit</td>
<td>87.4 (^2)</td>
<td>7/14/2017</td>
<td>6.2</td>
<td>81.2</td>
</tr>
</tbody>
</table>

Notes:  
1. Top of casing, per King County survey data.  
2. Ground surface estimated from King County LiDAR (Quantum Spatial, 2016).
5 Slug Testing for Hydraulic Conductivity

Slug tests were used to estimate the hydraulic conductivity of water-bearing soils screened by wells B-01 and B-03. The test method involved displacing a volume of water within the well casing and monitoring the water-level recovery. The Bouwer and Rice (1976) method as presented by Butler (1998) was used to estimate hydraulic conductivity of the soil from the recorded water-level data.

5.1 Field Methods

Water displacement during slug tests was accomplished by either insertion or removal of a solid object (slug rod) into the well casing. Tests using slug rods measure water-level responses to both falling (as the rod is submerged) and rising (after the rod is removed) water levels. Slug rods consist of sand-filled PVC pipes of 1-inch outside diameter and in lengths of 2.5 or 5.0 feet. A marked braided polyester line was used to lower the slug and provide a close estimate of slug position, and to minimize slug rod bounce during the tests.

5.2 Data Acquisition

Water levels were measured during the slug tests using a 30-pounds per square inch (psi) pressure transducer with a data logger. The transducer was placed deep enough to avoid being struck by a falling slug. After transducer installation, the static water level (SWL) and the water depth over the transducer was measured both before and after the test series. A data logger was used to collect data during testing on a pseudo-logarithmic schedule with the recording interval starting at 0.1 second. Data was stored on a secondary storage device whenever the logger was reset.

5.3 Test Procedures

Documentation of well development was reviewed and approved by the Aspect field hydrogeologist prior to conducting the slug tests to ensure that development was complete and hydraulic connection was established between the well and the water bearing formation.

In all cases, the water level was allowed to stabilize between tests. The criterion for sufficient recovery was considered to be 95 percent of the previous change in head, or 0.1 foot.

5.4 Slug Test Results

Hydraulic conductivity estimates from the slug tests are summarized in Table 3. Slug test hydrographs and details of the analyses are presented in Appendix C.

Care must be taken in the interpretation and application of slug test results. A slug test only provides information from the immediate area around the piezometer casing, and does not account for changes in soil conditions further from the piezometer that may exhibit different hydraulic characteristics. Additionally, drilling activities disturb the soil
adjacent to the piezometer, including the potential formation of a “well skin” with lower hydraulic conductivity than the surrounding aquifer, that can affect slug test results. Given these limitations, the slug test results presented in this report should be considered approximations. The use of these results for further analysis or design should appropriately account for the soil conditions observed in the explorations at the Site, the piezometer construction techniques, and piezometer development methods.
6 Limitations

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of King County Department of Natural Resources and Parks, Water and Land Resources Division for specific application to the referenced project. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.
7 References


Quantum Spatial, 2016, King County LiDAR, delivered on May 27, 2016.

## Table 3 - Hydraulic Conductivity Estimates from Slug Tests

Project No. 160427-003-02, King County, WA

<table>
<thead>
<tr>
<th>Monitoring Well</th>
<th>B-01</th>
<th>B-03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Depth in Feet</td>
<td>16.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Drilling Method</td>
<td>Hollow-Stem Auger</td>
<td>Hollow-Stem Auger</td>
</tr>
<tr>
<td>Screen Length in Feet</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Depth to Screen in Feet</td>
<td>6.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Depth to Water in Feet</td>
<td>6.4</td>
<td>5.3</td>
</tr>
<tr>
<td>Depth to Sandpack in Feet</td>
<td>4.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Slug Displacement (Ho) in Feet</td>
<td>1.03</td>
<td>1.01</td>
</tr>
<tr>
<td>Porosity (n)</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Radius of Casing (rc) in Feet</td>
<td>0.083</td>
<td>0.083</td>
</tr>
<tr>
<td>Radius of Borehole (rw) in Feet</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Saturated Aquifer Thickness (H) in Feet</td>
<td>9.7</td>
<td>14.8</td>
</tr>
<tr>
<td>Saturated Well Thickness (Lw) in Feet</td>
<td>9.6</td>
<td>14.7</td>
</tr>
<tr>
<td>Effective Casing Radius (rceff) in Feet</td>
<td>0.083</td>
<td>0.083</td>
</tr>
<tr>
<td>Effective Screen Length (Le) in Feet</td>
<td>9.6</td>
<td>10.0</td>
</tr>
<tr>
<td>Slug Size</td>
<td>2.5' x1&quot;</td>
<td>5' x1&quot;</td>
</tr>
<tr>
<td>Rising/Falling Head Test</td>
<td>Rising</td>
<td>Rising</td>
</tr>
<tr>
<td>Fully Submerged Sandpack</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Transiently Exposed Sandpack</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Transiently Exposed Screen</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Partially Submerged Screen</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Bouwer and Rice Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normalized Head at t1 (y1) in Feet</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Time - t1 in Seconds</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Normalized Head at t2 (y2) in Feet</td>
<td>0.19</td>
<td>0.20</td>
</tr>
<tr>
<td>Time - t2 in Seconds</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Calculated K in cm/sec</td>
<td>5.5E-03</td>
<td>3.3E-03</td>
</tr>
<tr>
<td>Calculated K in ft/day</td>
<td>15.5</td>
<td>9.3</td>
</tr>
<tr>
<td>Geometric Mean K in ft/day</td>
<td>12.0</td>
<td>4.9</td>
</tr>
<tr>
<td>Screened Interval Soil Type</td>
<td>GP, SM, SW-SM</td>
<td>GP, SW</td>
</tr>
</tbody>
</table>

Notes:
- All depths are below ground surface
- Data processing by guidelines of Butler (1998).
- Data analysis by Bouwer and Rice (1976) method as presented by Butler (1998).
Properties acquired by King County and houses demolished in 2016.

Legend:
- Boring Location
- Monitoring Well Location
- Test Pit Location
- LiDAR Generated Contour

Source: Aerial image by King County Imagery, 2015. Contours from Mosaic of Pierce County 2010 and King County 2016 LiDAR DEMs.

Site and Exploration Map
3rd Place SE Geotechnical Investigation
Pacific, Washington

Scale: 1" = 120'
APPENDIX A

Subsurface Explorations
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Material Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>FILL</td>
<td>Loose, GRAVEL(GP); inferred from drill action and cuttings, no recovery.</td>
</tr>
<tr>
<td>2-6</td>
<td>HOLOCENE ALLUVIUM - Channel Deposits</td>
<td>Medium dense, wet, dark brown, silty SAND (SM) interbedded with very sandy, GRAVEL (GP); fine to coarse sand, fine to coarse rounded to subrounded gravel. Blows overstated due to gravel.</td>
</tr>
<tr>
<td>7-15</td>
<td>HOLOCENE ALLUVIUM - Channel Deposits</td>
<td>Medium dense, wet, dark brown, slightly gravelly, slightly silty SAND (SW-SM); fine to coarse sand, fine to coarse rounded to subrounded gravel. Blows overstated due to gravel.</td>
</tr>
<tr>
<td>16-20</td>
<td>Timed cap</td>
<td>Stiff, very moist, brown, SILT (ML); non-plastic.</td>
</tr>
<tr>
<td>21-40</td>
<td>Dense, wet, dark gray, slightly silty SAND (SW-SM); fine to coarse sand, trace fine subrounded gravel. Blows overstated due to sand heave in auger. 1 foot of sand heave noted at 17.5 feet.</td>
<td></td>
</tr>
<tr>
<td>41-60</td>
<td>Dense, wet, dark gray, GRAVEL (GP); fine to coarse sand, fine and coarse rounded to subrounded gravel.</td>
<td></td>
</tr>
<tr>
<td>61-80</td>
<td>Dense, wet, dark gray, slightly silty SAND (SW-SM); fine to coarse sand, trace fine subrounded gravel.</td>
<td></td>
</tr>
<tr>
<td>81-100</td>
<td>Rear 2-inch PVC riser 0.3-6 feet Bentonite chips 2-4 feet 10x20 sand 4-16 feet 2-inch Sch 40 PVC 0.010-inch-slot screen 6-16 feet Threaded cap Bentonite chips 20-30 feet</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- No Soil Sample Recovery
- Split Barrel 2" X 1.375" (SPT)
- Thin wall 3" (Shelby)
- Static Water Level
- Water Level ATD

See Exploration Log Key for explanation of symbols.
Logged by: JGF
Approved by: DHM - 8/25/2017

Exploration Log B-01
Sheet 1 of 1
6/27/2016 Boring backfilled with bentonite grout and capped with native soil.

6-inch OD Hollow-Stem Auger from 0 to 30 feet bgs. Water added to augers to balance pressure at 15 feet bgs, no apparent sand heave noted.

4-inch OD tricone bit from 30 feet to end of hole.

HOLOCENE ALLUVIUM - Floodplain Deposits
Very loose, wet, dark gray, SAND (SP); trace silt, fine to medium sand, rare organic fragments, red and white sand.

HOLOCENE ALLUVIUM - Channel Deposits
Very loose, wet, gray, sandy GRAVEL (GP); low recovery, inferred from drill action and cuttings.

Very loose, wet, dark brown, SAND (SW); trace silt, fine to coarse sand, fine rounded to subrounded gravel, rare organic fragments.

Dense, wet, gray, sandy GRAVEL (GP); trace silt, fine to coarse sand, fine and coarse rounded to subrounded gravel.

Dense, wet, gray, SAND (SP); trace silt and gravel, fine to medium sand, fine subrounded gravel.

Blows overstated due to gravel from 16 to 28 feet bgs.

Dense, wet, gray, sandy GRAVEL (GP); trace silt, fine to coarse sand, fine and coarse rounded to subrounded gravel.

Medium dense, wet, gray, SAND (SW); trace silt, fine to coarse sand.
Medium dense, wet, gray, SAND (SW); trace silt, fine to coarse sand. (continued)

Becomes dense at 35 feet bgs.

HOLOCENE ALLUVIUM - Floodplain Deposits

Medium dense, wet, dark gray, silty SAND (SM); fine to medium sand, trace organics.

Medium dense, wet, dark gray, SILT (ML); non-plastic, numerous organics.

Dense, wet, dark gray, slightly silty SAND (SM); fine to medium sand, numerous organics.

Dense, wet, dark gray, slightly silty SAND (SM); fine to medium sand.

Medium dense, wet, gray, very silty SAND (SM) interbedded with stiff, SILT (ML); non-plastic, fine to medium sand.

Stiff, wet, gray, SILT (ML); low plasticity.

Very stiff, wet, green and gray-green, SILT (ML) interbedded with medium dense, silty SAND (SM) and PEAT (PT); low plasticity, fine to medium sand.

Bottom of exploration at 61.5 ft. bgs.
**Geotechnical Exploration Log**

**Project Address & Site Specific Location**
3rd Place SE, Pacific, Washington.

**Contractor**
Holocene Drilling, Inc.

**Equipment**
Track Mounted Dietrich D50 Turbo

**Sampling Method**
Autohammer; 140 lb hammer; 30" drop

**Operator**
Alex

**Equipment**
Hollow Stem Auger

**Sampling Method**
8/26/2017

**Material**
- *FILL*
  - Medium dense, very moist, brown and dark brown, sandy GRAVEL (GP); fine to coarse sand, fine and coarse subrounded to angular gravel.
  - Becomes very dense at 10 feet. Blow counts overstated due to gravel.

**Material**
- **HOLOCENE ALLUVIUM - Channel Deposits**
  - Medium dense, wet, dark brown-gray, gravelly SAND (SW); fine to coarse sand, fine and coarse subrounded gravel, trace rootlets.
  - Minor sand heave noted at 17 feet bgs.

**Material**
- **HOLOCENE ALLUVIUM - Floodplain Deposits**
  - Medium dense, wet, gray, silty SAND (SM); fine to medium sand, frequent lamination of silt.

**Material**
- **HOLOCENE ALLUVIUM - Channel Deposits**
  - Dense, wet, gray, sandy GRAVEL (GP); fine to coarse sand, fine and coarse rounded to subrounded gravel.
  - Medium dense, wet, dark gray, SAND (SW); trace gravel, fine to coarse sand, fine and coarse rounded to subrounded gravel.
  - Bottom of exploration at 31.5 ft. bgs.
**FILL**
Medium dense, dry, brown, slightly gravelly, very silty SAND (SM); fine to coarse sand, fine and coarse rounded to subrounded gravel.

Loose, dry, gray, sandy GRAVEL (GW); fine to coarse sand, fine and coarse rounded to subrounded gravel, estimated 15 percent cobbles - from White River Dredge Spoils.

Becomes moist and dark gray at 2.5 feet bgs.

Bottom of exploration at 6 ft. bgs.

Note: Sidewalls caving from ground surface to 6 feet bgs. No seepage observed.
Test pit backfilled with excavated soil, placed in one-foot lifts and compacted with excavator bucket.

**Dense, dry, brown, slightly sandy slightly silty GRAVEL (GP-GM); fine to coarse sand, fine and coarse gravel, 25 percent cobbles, mainly concrete rubble with steel wire, very difficult excavating.**

**HOLOCENE ALLUVIUM - Channel Deposits**
Loose, wet, dark gray-brown, slightly silty SAND (SP-SM) interbedded with very silty SAND (SM); fine to medium sand, trace fine and coarse gravel, trace cobbles.

Bottom of exploration at 8.5 ft. bgs.

Note: Sidewalls caving from ground surface to 8.5 feet bgs. Seepage observed at 6.5 feet bgs. Refusal from collapsing excavation.
Test pit backfilled with excavated soil.

**HOLOCENE ALLUVIUM - Floodplain Deposits**
- Loose, moist, dark brown, organic SILT (OL); previous ground surface.
- Loose, moist, brown, silty SAND (SM) interbedded with sandy SILT (ML); non-plastic, fine to medium sand.

**HOLOCENE ALLUVIUM - Channel Deposits**
- Loose, wet, dark gray, slightly silty SAND (SP-SM) interbedded with silty SAND (SM); fine to medium sand.

Bottom of exploration at 8.5 ft. bgs.

Note: Sidewalls caving from 4 feet bgs to 8.5 feet bgs. Seepage observed at 6 feet bgs.
Test pit backfilled with excavated soil, placed in one-foot lifts and compacted with excavator bucket.

FILL
Medium dense, dry, brown, slightly gravelly, silty SAND (SM); fine to coarse sand, fine gravel.

Loose, dry, gray, sandy GRAVEL (GW); trace silt, fine to coarse sand, fine and coarse rounded to subrounded gravel, estimated 20 percent cobbles - from White River Dredge Spoils.

Becomes wet at 6.5 feet bgs. Bottom of exploration at 6.5 ft. bgs.

Note: Sidewalls caving from ground surface to 6.5 feet bgs. Bucket teeth wet at 6.5 feet bgs. Refusal from collapsing excavation.
**Test pit backfilled with excavated soil.**

**Loose, dry, gray, sandy GRAVEL (GW); trace silt, fine to coarse sand, fine and coarse rounded to subrounded gravel, estimated 10 percent cobbles - from White River Dredge Spoils. Becomes wet at 4.5 feet bgs. Bottom of exploration at 5.5 feet bgs. Note: Sidewalls caving from ground surface to 5.5 feet bgs. Seepage observed at 4.5 feet bgs. Refusal from collapsing excavation.**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Material Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FILL</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

**Depth to Water (Below GS): 4.5' (ATD)**

**Ground Surface (GS) Elev. (NAVD88): 95.6' (est)**

**Exploration Number:** TP-05

**Operator:** Kelly's Excavating

**Equipment:** Takeuchi TB 138-FR

**Sampling Method:** Grab

**Work Start/Completion Dates:** 7/14/2017

**Project Address & Site Specific Location:** 3rd Place SE, Pacific, Washington.

**ASPECT STANDARD EXPLORATION LOG TEMPLATE**

---

**Plastic Limit**

**Water Level ATD**

See Exploration Log Key for explanation of symbols.

Logged by: JGF

Approved by: DHM - 8/25/2017

Exploration Log

**TP-05**

Sheet 1 of 1
7/14/2017

Test pit backfilled with excavated soil, placed in one-foot lifts and compacted with excavator bucket.

FILL
Medium dense, dry, brown, slightly gravelly, very silty SAND (SM); fine sand, fine and coarse rounded to angular gravel.

Loose, moist, dark gray, sandy GRAVEL (GW); fine to coarse sand, fine and coarse rounded to subrounded gravel - from White River Dredge Spoils.

Becomes wet at 6.2 feet bgs.

Bottom of exploration at 6.5 feet bgs.

Note: Sidewalls caving from 1 foot bgs to 6.5 feet bgs. Seepage observed at 6.2 feet bgs. Refusal from collapsing excavation.

---

Test Pit Completion and Notes

Pat Test Pits

7/14/2017
APPENDIX B

Laboratory Testing Results
<table>
<thead>
<tr>
<th>HMA Sample #</th>
<th>Sample #</th>
<th>Location</th>
<th>Date Received</th>
<th>Date of Test</th>
<th>Tare #</th>
<th>Wt of Tare</th>
<th>Tare+ Wet</th>
<th>Tare+ Dry</th>
<th>Moisture %</th>
</tr>
</thead>
<tbody>
<tr>
<td>7964-1</td>
<td>B-01 S-3</td>
<td>15'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>B192-2</td>
<td>15.8</td>
<td>401.3</td>
<td>354.9</td>
<td>13.7</td>
</tr>
<tr>
<td>7964-2</td>
<td>B-01 S-5</td>
<td>20'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>A-8</td>
<td>16.1</td>
<td>322.3</td>
<td>273.8</td>
<td>18.8</td>
</tr>
<tr>
<td>7964-3</td>
<td>B-01 S-7</td>
<td>30'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>B-1</td>
<td>16.0</td>
<td>330.9</td>
<td>270.5</td>
<td>23.7</td>
</tr>
<tr>
<td>7964-4</td>
<td>B-02 S-1</td>
<td>5'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>A-17</td>
<td>15.9</td>
<td>312.0</td>
<td>249.4</td>
<td>26.8</td>
</tr>
<tr>
<td>7964-5</td>
<td>B-02 S-3a</td>
<td>15'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>B-2</td>
<td>16.0</td>
<td>314.1</td>
<td>255.5</td>
<td>24.5</td>
</tr>
<tr>
<td>7964-6</td>
<td>B-02 S-4</td>
<td>20'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>B-26</td>
<td>15.9</td>
<td>319.8</td>
<td>266.9</td>
<td>26.1</td>
</tr>
<tr>
<td>7964-7</td>
<td>B-02 S-5a</td>
<td>25'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>A191-1</td>
<td>15.9</td>
<td>311.9</td>
<td>247.8</td>
<td>27.6</td>
</tr>
<tr>
<td>7964-8</td>
<td>B-02 S-8a</td>
<td>40'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>B-4</td>
<td>15.70</td>
<td>281.30</td>
<td>211.20</td>
<td>35.9</td>
</tr>
<tr>
<td>7964-9</td>
<td>B-02 S-9</td>
<td>45'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>B-15</td>
<td>15.80</td>
<td>317.70</td>
<td>247.5</td>
<td>30.3</td>
</tr>
<tr>
<td>7964-10</td>
<td>B-02 S-10</td>
<td>50'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>A-26</td>
<td>15.9</td>
<td>324.00</td>
<td>257.40</td>
<td>27.6</td>
</tr>
<tr>
<td>7964-11</td>
<td>B-02 S-11</td>
<td>55'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>B-11</td>
<td>16.1</td>
<td>328.1</td>
<td>238.3</td>
<td>40.4</td>
</tr>
<tr>
<td>7964-12</td>
<td>B-02 S-12</td>
<td>60'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>A-2</td>
<td>16.1</td>
<td>327.1</td>
<td>239.30</td>
<td>39.3</td>
</tr>
<tr>
<td>7964-13</td>
<td>B-03 S-3</td>
<td>15'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>A822</td>
<td>15.9</td>
<td>673.2</td>
<td>559.5</td>
<td>20.9</td>
</tr>
<tr>
<td>7964-14</td>
<td>B-03 S-4</td>
<td>20'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>A-20</td>
<td>16.0</td>
<td>339.3</td>
<td>276.8</td>
<td>24.0</td>
</tr>
<tr>
<td>7964-15</td>
<td>B-03 S-6</td>
<td>30'</td>
<td>7/11/2017</td>
<td>7/12/2017</td>
<td>B</td>
<td>15.9</td>
<td>606.1</td>
<td>495.9</td>
<td>23.0</td>
</tr>
</tbody>
</table>
## Moisture Contents

Moisture Content Test Results (ASTM D2216) - King County-White River Drive  Project:160427-003-02 /08-175

<table>
<thead>
<tr>
<th>HMA Sample #</th>
<th>Sample #</th>
<th>Location</th>
<th>Date Received</th>
<th>Date of Test</th>
<th>Tare #</th>
<th>Wt of Tare</th>
<th>Tare+ Wet</th>
<th>Tare+ Dry</th>
<th>Moisture %</th>
</tr>
</thead>
<tbody>
<tr>
<td>7961-1</td>
<td>TP-03</td>
<td>S-1</td>
<td>3.5’</td>
<td>7/21/2017</td>
<td>7/22/2017</td>
<td>B-6</td>
<td>15.9</td>
<td>354.0</td>
<td>258.3</td>
</tr>
<tr>
<td>7969-2</td>
<td>TP-03</td>
<td>S-2</td>
<td>6.5’</td>
<td>7/21/2017</td>
<td>7/22/2017</td>
<td>B-20</td>
<td>15.7</td>
<td>384.8</td>
<td>292.4</td>
</tr>
</tbody>
</table>
### Particle Size Distribution Report

**GRAIN SIZE - mm.**

<table>
<thead>
<tr>
<th>PERCENT FINER</th>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Finer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>#200</td>
<td>6.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Soil Description

- **Atterberg Limits**
  - PL =
  - LL =
  - PI =

- **Coefficients**
  - D₉₀ =
  - D₅₀ =
  - D₃₀ =
  - D₄₅ =
  - Cₜ =
  - Cₓ =

- **Classification**
  - USCS =
  - AASHTO =

### Remarks

**Location:** B-01 S-5  
**Sample Number:** 7964-2  
**Depth:** 20'  
**Date:** 07/17/2017

**Hayre McElroy & Associates, LLC**

**Redmond, WA**

**Client:** Aspect Consulting  
**Project:** King County-3rd Place SE

**Project No:** 160427-003-02/08-175  
**Figure**

**Tested By:** BH  
**Checked By:** JAM
# Grain Size Distribution Test Data

**Client:** Aspect Consulting  
**Project:** King County-3rd Place SE  
**Project Number:** 160427-003-02/08-175  
**Location:** B-01 S-5  
**Depth:** 20'  
**Date:** 07/17/2017  
**Sample Number:** 7964-2  
**Tested by:** BH  
**Checked by:** JAM

## Sieve Test Data

Post #200 Wash Test Weights (grams):  
- Dry Sample and Tare = 256.20  
- Tare Wt. = 16.10  
- Minus #200 from wash = 6.8%

<table>
<thead>
<tr>
<th>Dry Sample and Tare (grams)</th>
<th>Tare (grams)</th>
<th>Sieve Opening Size</th>
<th>Weight Retained (grams)</th>
<th>Percent Finer</th>
</tr>
</thead>
<tbody>
<tr>
<td>273.80</td>
<td>16.10</td>
<td>#200</td>
<td></td>
<td>6.8</td>
</tr>
</tbody>
</table>

## Fractional Components

<table>
<thead>
<tr>
<th>Cobbles</th>
<th>Gravel</th>
<th>Sand</th>
<th>Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Coarse</td>
<td>Medium</td>
<td>Fine</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D_{10}</th>
<th>D_{15}</th>
<th>D_{20}</th>
<th>D_{30}</th>
<th>D_{50}</th>
<th>D_{60}</th>
<th>D_{80}</th>
<th>D_{85}</th>
<th>D_{90}</th>
<th>D_{95}</th>
</tr>
</thead>
</table>

---

Hayre McElroy & Associates, LLC
GRAIN SIZE DISTRIBUTION TEST DATA

Client: Aspect Consulting
Project: King County-3rd Place SE
Project Number: 160427-003-02/08-175
Location: B-01 S-7

Depth: 30'
Date: 07/17/2017

Sample Number: 7964-3

Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 247.10
Tare Wt. = 16.00
Minus #200 from wash = 9.2%

<table>
<thead>
<tr>
<th>Dry Sample and Tare (grams)</th>
<th>Tare (grams)</th>
<th>Sieve Opening Size</th>
<th>Weight Retained (grams)</th>
<th>Sieve Weight (grams)</th>
<th>Percent Finer</th>
</tr>
</thead>
<tbody>
<tr>
<td>270.50</td>
<td>16.00</td>
<td>#200</td>
<td></td>
<td></td>
<td>9.2</td>
</tr>
</tbody>
</table>

Fractional Components

<table>
<thead>
<tr>
<th>Cobbles</th>
<th>Gravel</th>
<th>Sand</th>
<th>Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Coarse</td>
<td>Medium</td>
<td>Fine</td>
</tr>
<tr>
<td></td>
<td>Silt</td>
<td>Clay</td>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D_{10}</th>
<th>D_{15}</th>
<th>D_{20}</th>
<th>D_{30}</th>
<th>D_{50}</th>
<th>D_{60}</th>
<th>D_{80}</th>
<th>D_{85}</th>
<th>D_{90}</th>
<th>D_{95}</th>
</tr>
</thead>
</table>

Hayre McElroy & Associates, LLC
Particle Size Distribution Report

<table>
<thead>
<tr>
<th>GRAIN SIZE - mm</th>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
<td>Medium</td>
</tr>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>4.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>PERCENT FINER</th>
<th>SPEC.* PERCENT</th>
<th>PASS? (X=NO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#30</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#40</td>
<td>95.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#100</td>
<td>18.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>4.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Soil Description
- Sand

Atterberg Limits
- PL =
- LL =
- PI =

Coefficients
- D_90 = 0.3786
- D_85 = 0.3484
- D_60 = 0.2542
- D_50 = 0.2270
- D_30 = 0.1786
- D_16 = 0.1396
- C_u = 2.09
- C_c = 1.03

Classification
- USCS = SP
- AASHTO =

Remarks

Location: B-02 S-1
Sample Number: 7964-4
Depth: 5'
Date: 07/17/2017

Hayre McElroy & Associates, LLC
Redmond, WA

Client: Aspect Consulting
Project: King County-3rd Place SE
Project No: 160427-003-02/08-175

Tested By: BH
Checked By: JAM
Client: Aspect Consulting
Project: King County-3rd Place SE
Project Number: 160427-003-02/08-175
Location: B-02 S-1
Depth: 5'  Sample Number: 7964-4
Material Description: Sand
Date: 07/17/2017
USCS Classification: SP
Tested by: BH  Checked by: JAM

Sieve Test Data
Post #200 Wash Test Weights (grams):  Dry Sample and Tare = 242.20
Tare Wt. = 15.90
Minus #200 from wash = 3.1%

<table>
<thead>
<tr>
<th>Dry Sample and Tare (grams)</th>
<th>Tare (grams)</th>
<th>Sieve Opening Size</th>
<th>Weight Retained (grams)</th>
<th>Sieve Weight (grams)</th>
<th>Percent Finer</th>
</tr>
</thead>
<tbody>
<tr>
<td>249.40</td>
<td>15.90</td>
<td>#30</td>
<td>0.00</td>
<td>0.00</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#40</td>
<td>11.20</td>
<td>0.00</td>
<td>95.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#100</td>
<td>179.00</td>
<td>0.00</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#200</td>
<td>33.20</td>
<td>0.00</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Fractional Components

<table>
<thead>
<tr>
<th>Cobble</th>
<th>Gravel</th>
<th>Sand</th>
<th>Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Total</td>
</tr>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D10</th>
<th>D15</th>
<th>D20</th>
<th>D30</th>
<th>D50</th>
<th>D60</th>
<th>D80</th>
<th>D85</th>
<th>D90</th>
<th>D95</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1215</td>
<td>0.1396</td>
<td>0.1539</td>
<td>0.1786</td>
<td>0.2270</td>
<td>0.2542</td>
<td>0.3242</td>
<td>0.3484</td>
<td>0.3786</td>
<td>0.4226</td>
</tr>
</tbody>
</table>

Fineness Modulus

<table>
<thead>
<tr>
<th>Cu</th>
<th>Cc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.07</td>
<td>2.09</td>
</tr>
</tbody>
</table>
Particle Size Distribution Report

GRAIN SIZE - mm.

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>PERCENT FINER</th>
<th>SPEC. PERCENT</th>
<th>PASS? (X=NO)</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#200</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (no specification provided)

PL=
LL=
PL=

Coefficients

$D_{90} =$
$D_{60} =$
$D_{30} =$
$D_{15} =$
$C_u =$
$C_c =$

Classification

USCS=
AASHTO=

Remarks

Location: B-02 S-4
Sample Number: 7964-6
Depth: 20'

Date: 07/17/2017

Hayre McElroy & Associates, LLC
Redmond, WA

Client: Aspect Consulting
Project: King County-3rd Place SE
Project No: 160427-003-02/08-175

Tested By: BH
Checked By: JAM
GRAIN SIZE DISTRIBUTION TEST DATA

Client: Aspect Consulting
Project: King County-3rd Place SE
Project Number: 160427-003-02/08-175
Location: B-02 S-4
Depth: 20'
Date: 07/17/2017
Sample Number: 7964-6
Tested by: BH
Checked by: JAM

Sieve Test Data
Post #200 Wash Test Weights (grams): Dry Sample and Tare = 251.60
Tare Wt. = 15.90
Minus #200 from wash = 2.2%

<table>
<thead>
<tr>
<th>Dry Sample and Tare (grams)</th>
<th>Tare (grams)</th>
<th>Sieve Opening Size</th>
<th>Weight Retained (grams)</th>
<th>Percent Finer</th>
</tr>
</thead>
<tbody>
<tr>
<td>256.90</td>
<td>15.90</td>
<td>#200</td>
<td>2.2</td>
<td></td>
</tr>
</tbody>
</table>

Fractional Components

<table>
<thead>
<tr>
<th>Cobbles</th>
<th>Gravel</th>
<th>Sand</th>
<th>Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D_{10}</th>
<th>D_{15}</th>
<th>D_{20}</th>
<th>D_{30}</th>
<th>D_{50}</th>
<th>D_{60}</th>
<th>D_{80}</th>
<th>D_{95}</th>
<th>D_{95}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils.

SOIL DATA

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SOURCE</th>
<th>SAMPLE NO.</th>
<th>DEPTH</th>
<th>NATURAL WATER CONTENT (%)</th>
<th>PLASTIC LIMIT (%)</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX (%)</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>B-02 S-11 55'</td>
<td>7964-11</td>
<td>55'</td>
<td>40.4</td>
<td>27</td>
<td>33</td>
<td>6</td>
<td>ML</td>
</tr>
</tbody>
</table>

Hayre McElroy & Associates, LLC  
Redmond, WA

Client: Aspect Consulting  
Project: King County-3rd Place SE  
Project No.: 160427-003-02/08-175  
Figure

Tested By: BH  
Checked By: JAM
LIQUID AND PLASTIC LIMIT TEST DATA

Client: Aspect Consulting
Project: King County-3rd Place SE
Project Number: 160427-003-02/08-175
Location: B-02 S-11
Depth: 55'
USCS: ML
Tested by: BH
Sample Number: 7964-11
Checked by: JAM

Liquid Limit Data

<table>
<thead>
<tr>
<th>Run No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet+Tare</td>
<td>34.85</td>
<td>33.16</td>
<td>32.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry+Tare</td>
<td>29.72</td>
<td>28.39</td>
<td>27.77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tare</td>
<td>13.60</td>
<td>13.71</td>
<td>13.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Blows</td>
<td>30</td>
<td>25</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td>31.8</td>
<td>32.5</td>
<td>34.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Plastic Limit Data

<table>
<thead>
<tr>
<th>Run No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet+Tare</td>
<td>22.45</td>
<td>22.45</td>
<td>22.45</td>
<td></td>
</tr>
<tr>
<td>Dry+Tare</td>
<td>20.56</td>
<td>20.56</td>
<td>20.56</td>
<td></td>
</tr>
<tr>
<td>Tare</td>
<td>13.56</td>
<td>13.56</td>
<td>13.56</td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td>27.0</td>
<td>27.0</td>
<td>27.0</td>
<td></td>
</tr>
</tbody>
</table>

Natural Moisture Data

<table>
<thead>
<tr>
<th>Wet+Tare</th>
<th>Dry+Tare</th>
<th>Tare</th>
<th>Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>328.1</td>
<td>238.3</td>
<td>16.1</td>
<td>40.4</td>
</tr>
</tbody>
</table>

Liquid Limit = 33
Plastic Limit = 27
Plasticity Index = 6
Natural Moisture = 40.4
Liquidity Index = 2.2

Hayre McElroy & Associates, LLC
### Particle Size Distribution Report

**GRAIN SIZE - mm.**

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Medium</td>
</tr>
<tr>
<td>0.0</td>
<td>11.3</td>
<td>6.3</td>
<td>3.5</td>
</tr>
</tbody>
</table>

**SIEVE SIZE**  
- 1 1/4"
- 1"
- 3/4"
- 1/2"
- #4
- #10
- #40
- #100
- #200

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>PERCENT FINER</th>
<th>SPEC.* PERCENT</th>
<th>PASS? (X=NO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4&quot;</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>96.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>88.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>87.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>82.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td>78.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#40</td>
<td>33.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#100</td>
<td>5.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (no specification provided)

**Soil Description**  
Sand with Gravel

**Atterberg Limits**
- PL =
- LL =
- CL =

**Coefficients**
- D90 = 20.1859
- D85 = 7.8929
- D60 = 3.855
- D10 = 0.1984

**Classification**
- USCS = SP
- AASHTO =

**Remarks**

---

**Location:** B-03 S-3  
**Sample Number:** 7964-13  
**Depth:** 15"  
**Date:** 07/18/2017

**Client:** Aspect Consulting  
**Project:** King County-3rd Place SE  
**Project No:** 160427-003-02/08-175  
**Figure**

**Tested By:** BH  
**Checked By:** JAM
### Grain Size Distribution Test Data

**Client:** Aspect Consulting  
**Project:** King County-3rd Place SE  
**Project Number:** 160427-003-02/08-175  
**Location:** B-03 S-3  
**Depth:** 15'  
**Material Description:** Sand with Gravel  
**Date:** 07/18/2017  
**USCS Classification:** SP  
**Checked by:** JAM

#### Sieve Test Data

<table>
<thead>
<tr>
<th>Dry Sample and Tare (grams)</th>
<th>Tare (grams)</th>
<th>Sieve Opening Size</th>
<th>Weight Retained (grams)</th>
<th>Sieve Weight (grams)</th>
<th>Percent Finer</th>
</tr>
</thead>
<tbody>
<tr>
<td>559.50</td>
<td>15.90</td>
<td>1 1/4&quot;</td>
<td>0.00</td>
<td>0.00</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1&quot;</td>
<td>18.70</td>
<td>0.00</td>
<td>96.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3/4&quot;</td>
<td>42.80</td>
<td>0.00</td>
<td>88.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/2&quot;</td>
<td>5.00</td>
<td>0.00</td>
<td>87.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#4</td>
<td>29.10</td>
<td>0.00</td>
<td>82.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#10</td>
<td>19.20</td>
<td>0.00</td>
<td>78.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#40</td>
<td>246.70</td>
<td>0.00</td>
<td>33.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#100</td>
<td>154.00</td>
<td>0.00</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#200</td>
<td>8.90</td>
<td>0.00</td>
<td>3.5</td>
</tr>
</tbody>
</table>

#### Fractional Components

<table>
<thead>
<tr>
<th>Cobble Size</th>
<th>Gravel</th>
<th>Sand</th>
<th>Fines</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Medium</td>
<td>Fine</td>
<td>Total</td>
</tr>
<tr>
<td>0.0</td>
<td>11.3</td>
<td>45.4</td>
<td>30.0</td>
<td>78.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C_d</th>
<th>0.1984</th>
<th>0.2421</th>
<th>0.2865</th>
<th>0.3855</th>
<th>0.6691</th>
<th>0.8961</th>
<th>2.2419</th>
<th>7.8929</th>
<th>20.1859</th>
<th>23.9399</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fineness Modulus</td>
<td>C_u</td>
<td>C_c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.22</td>
<td>4.52</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Shelby Tube Extrusion Description

Project Name: King County - 3rd Place SE
Sample ID: 7964-16
Depth: 3.01 5-4.17'

Project Number: 160427-003-02/08-175
Total Sample Length: 2' 3" (27"
Date Extruded: 07/18/2017 By: B.H

Diagram:

Lab Tests:
- Unit Weight
- Moisture
- Hydrometer
- Consol
- CU
- Specific Gravity
- Atterberg
- Grain Size
- Organic Content
- UU
- Perm
- Other

Modified 5/4/2011 JH
APPENDIX C

Slug Test Analyses
Figure C-1

B-01 Slug Test Responses
160427-003-02 3rd Place SE
King County, WA
Figure C-2
B-03 Slug Test Responses
160427-003-02 3rd Place SE
King County, WA