Geotechnical Engineering Services

Redmond Downtown Park
Redmond, Washington

for
City of Redmond and PFS Studio

April 12, 2016

GeoEngineers
Earth Science + Technology

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8410 154th Avenue NE
Redmond, Washington 98052
425.861.6000

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File No. 0500-205-00

April 12, 2016

Prepared for:

The City of Redmond
c/o PFS Studio
1777 West 3rd Avenue
Vancouver, BC V6JIK7

Attention: Kelty McKinnon

Prepared by:

GeoEngineers, Inc.
8410 154th Avenue NE
Redmond, Washington 98052
425.861.6000

FOR

Kyle M. Smith, PE
Staff Geotechnical Engineer

Lindsay C. Flangas, PE
Associate Geotechnical Engineer

LINDSAY C. FLANGAS
STATE OF WASHINGTON
45216
REGISTERED
PROFESSIONAL ENGINEER

4/12/16

KMS:LCF:tjh

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INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed Redmond Downtown Park project in Redmond, Washington. The location of the site and general configuration of the proposed park features are shown on the Vicinity Map and Site Plan, Figures 1 and 2, respectively.

The purpose of this study is to complete subsurface explorations at the project site and to provide geotechnical engineering conclusions and recommendations for the design and construction of the proposed improvements.

GeoEngineers' geotechnical engineering services were completed in general accordance with our services agreement dated May 15, 2015. Our scope of work includes:

- Reviewing previous geotechnical reports and boring logs prepared for projects in the site vicinity;
- Completing borings and geophysical testing to characterize the subsurface conditions at the project site;
- Completing laboratory testing on selected soil samples obtained from the explorations; and
- Preparing this geotechnical report.

Project Description

Our understanding of the project is based on discussions with and data provided by PFS Studio, the City of Redmond, the Redmond Downtown Park project team, and our experience with similar projects.

The park is planned for a site that was previously occupied by commercial buildings that were demolished prior to the construction of the 161st Street extension, which borders the west side of the park site. Park improvements will include an elevated lawn with bench retaining wall (the Great Lawn), a splash pad, a pavilion structure (the Pavilion), and a maintenance building. The project will also include removal of unsuitable peat deposits below the Great Lawn on the west side of the site.

FIELD EXPLORATIONS AND LABORATORY TESTING

Field Explorations

The subsurface soil and groundwater conditions at the site were evaluated by drilling fourteen new borings (B-1 through B-14). These borings were completed using track-mounted, continuous-flight, hollow-stem auger drilling equipment. Several other borings and a geophysical study have been completed at the site during previous explorations (see "Previous Studies" section of this report, below). Additionally, a new geophysical exploration program was conducted at this site to help delineate the deposit of peat that was anticipated based on previous studies.

The approximate locations of the explorations completed at this site are presented on Figure 2. Details of the field exploration program and logs of the explorations are presented in Appendix A. Details of the geophysical exploration completed for this study are presented in Appendix D.

Laboratory Testing

Soil samples were collected during drilling and taken to GeoEngineers' laboratory for further evaluation. Selected samples were tested for the determination of moisture content and gradation (sieve analysis). A description of the laboratory testing and the test results are presented in Appendix B.

Previous Studies

GeoEngineers previously conducted geotechnical and environmental services for projects at the site and in the site vicinity. The results of our relevant previous geotechnical services are summarized in the following documents:

- "Report, Phase II Environmental Site Assessment, Redmond Cycle Shop – Estrin Property, 16205 NE Redmond Way, Redmond, Washington," dated April 11, 2011.
- "Report, Geotechnical Engineering Services, 161st Avenue NE Extension, Bear Creek Parkway to Redmond Way, Redmond, Washington," dated June 15, 2010.
- "Report, Supplemental Site Assessment, Redmond Shopping Square, Future 161st Avenue NE Extension between Cleveland Street and Redmond Way, 16101-16149 NE Redmond Way, Redmond, Washington," dated August 17, 2009.

The approximate locations of relevant explorations completed for the studies listed above are shown on Figure 2. Logs of the relevant explorations are also included in Appendix C.

SITE CONDITIONS

Geology and Sensitive Area Designations

Geologic information for the project vicinity includes a Pacific Northwest Center for Geologic Mapping Studies map, "Geologic Map of King County, Washington" (Booth et al., 2007). The mapped geology in the project vicinity consists of alluvium. Alluvium consists of stream, river, and running water deposits. These deposits consist of sand, silt, gravel, and cobbles and locally can contain very soft peat lenses. Fill soils associated with previous site development and building demolition are also anticipated.

Sensitive areas maps produced by the City of Redmond indicate that the project area is within a Seismic Hazard Area and Aquifer Recharge Area with High Significance. The seismic hazard is due to the presence of moderately dense sandy alluvium below groundwater that could liquefy if these soils were subjected to strong, earthquake induced ground shaking. The aquifer recharge sensitive classification is because the upper sand and gravel formation (aquifer) is in direct continuity with the ground surface and is therefore at risk of degradation of water quality from surface spills of contaminants. The City of Redmond water wells are established in this upper sand and gravel aquifer.

Surface Conditions

The site is bounded by Cleveland Street to the south, 161st Avenue NE to the west, Redmond Way to the north, and commercial development to the east consisting of surface parking and single-story buildings. The site is divided into west and east segments by the abandoned Brown Street right-of-way, which is asphalt-paved. The eastern and western portions of the site are vegetated with grass. Concrete sidewalks border the site where adjacent to the right-of-way.

The site was previously occupied by the Redmond Shopping Square structure over the western portion of the site, which was demolished prior the 161st Avenue NE Extension project, and four smaller structures over the eastern portion of the site. The previous structure in the southeastern-most portion of the site had a single below-grade level. The below-grade level was removed, except for the east wall and east basement slab. The east wall was removed to a depth of 3 feet below grade and abandoned in place with the eastern portion of the basement slab.

Existing utilities within or near the project area include underground power, street signs, buried gas, fiber optic, storm sewer, sanitary sewer and water utilities.

Site grades are relatively flat, ranging between Elevation 40 and 40½ feet (North American Vertical Datum of 1988 [NAVD 88]) around the perimeter, with a slight depression in the western portion of the site to about Elevation 38 feet.

Subsurface Conditions

GeoEngineers' understanding of subsurface conditions is based on review of existing geotechnical information, previous explorations in the site vicinity, the results of 14 borings drilled at the site, and the results of the geophysical testing completed for this study. The approximate locations of previous and recent explorations are presented on the Figure 2.

The soils encountered at the site consist of fill overlying alluvial deposits and recessional outwash. Interpreted subsurface conditions underlying the site are presented in Cross Sections A-A' through C-C', Figures 3 through 5, respectively. The following is a summary of subsurface conditions encountered:

- **Fill.** In each of the borings, grass and topsoil or asphalt concrete pavement was encountered at the surface with a thickness of approximately 2 to 3 inches. The surficial grass or asphalt was underlain by 4 to 15 feet of fill typically consisting of loose to medium dense sand and gravel with variable silt content. Drilling resistance in the borings on the eastern portion of the site also indicated the presence of cobbles in the fill.
- **Alluvial deposits.** Alluvial deposits were encountered below the fill in the northwestern portion of the site, to the depths explored in borings B-2, B-3, B-4 and B-5, and to depths of 8 to 11½ feet in borings B-1, B-7, B-8, B-9 and B-10. The alluvial deposits typically consisted of up to 6 feet of peat overlying loose to medium dense silty sand with gravel and sand with silt and gravel to the depth of the borings. The peat is thickest in the northwest portion of the site and gradually thins to the south and east. Peat was not observed in borings B-1 or B-10. Geophysical testing consisting of ground penetrating radar (GPR) and electromagnetic survey was used in combination with the borings to estimate the approximate depths of the peat deposits in the northwestern portion of the site. The results of the GPR studies completed at this site are presented in Appendix D.
- **Recessional outwash.** Recessional outwash was encountered below the fill or alluvial deposits in borings B-1 and B-6 through B-14. The recessional outwash consisted of sand and gravel with variable silt content and cobbles.

Groundwater Conditions

The alluvial deposits and recessional outwash deposits form an extensive and prolific aquifer that extends beneath the City of Redmond. The aquifer is fed from the east by recharge and aquifer throughflow generated in Bear Creek and Evans Creek valleys. Groundwater typically flows from east to west through the downtown Redmond area and is in hydraulic continuity with the Sammamish River; the stage of which strongly controls groundwater levels in the aquifer.

Groundwater is relatively shallow and fluctuates seasonally and also in response to flood events with both direct infiltration as well as in response to the water level in the Sammamish River and in Bear Creek. Groundwater levels have been monitored at several sites throughout the project area, as well as at the Redmond water wells. As part of the City's wellhead protection program, a numerous array of wells distributed throughout the city have been read regularly over the past several years affording a database of groundwater levels throughout the city and subsequently around the project area.

On-going groundwater level readings obtained as part the City's wellhead protection program suggest that the seasonal groundwater levels in the project vicinity fluctuate between highs of about Elevation 29 to 27 feet (10 to 12 feet below existing site grades) and lows of Elevation 24 to 22 feet (15 to 17 feet below existing grades).

CONCLUSIONS AND RECOMMENDATIONS

Summary of Geotechnical Considerations

We conclude that the planned improvements can be successfully completed from a geotechnical perspective, provided the considerations presented in this report are incorporated into the project planning and design. A summary of the primary geotechnical considerations is provided below. The summary is presented for introductory purposes only and should be used in conjunction with the complete recommendations presented in this report.

- The maintenance building and Pavilion can be supported on shallow foundations with a design bearing pressure of 2,000 pounds per square foot (psf). Where existing fill is present at the foundation subgrade elevation, 2 feet of the existing fill should be overexcavated and replaced with 2 feet of properly compacted structural fill.
- Highly compressible peat deposits are present in the northwestern portion of the site, beneath the planned Great Lawn and extending toward the intersection of 161st Avenue NE and Redmond Way. The peat will settle under the weight of new fill as well as from organic decomposition. Settlement of the peat from organic decomposition alone where grades are increased by more than 12 inches is expected to be on the order of 1 foot over the design life of the project (typically 50 years). Recommendations for removal and replacement of the peat below the planned Great Lawn area and recommendations for an enhanced pavement section where peat will be left in place are presented in this report.
- The project is being designed to infiltrate a significant portion of the site surface run-off. Site run-off can be infiltrated below the Great Lawn area into the granular soil used as backfill for the peat removal excavation. A design infiltration rate of 2 inches per hour can be used for gravel borrow backfill meeting the requirements of Section 9-03.14(1) of the 2016 Washington State Department of Transportation (WSDOT) Standard Specifications.

These and other geotechnical considerations are discussed further, and recommendations pertaining to the geotechnical aspects of the project are presented in the following sections of this report.

Earthquake Engineering

2012 IBC Seismic Design Information

For the site, we recommend the International Building Code (IBC) 2012 parameters for Site Class, short period spectral response acceleration (S_S), 1-second period spectral response acceleration (S_1), and Seismic Coefficients F_A and F_V presented in Table 1.

TABLE 1. IBC SEISMIC PARAMETERS

2012 IBC Parameter	Recommended Value
Soil Profile Type	D
Short Period Spectral Response Acceleration, S_S (percent g)	126
1-Second Period Spectral Response Acceleration, S_1 (percent g)	48
Seismic Coefficient, F_A	1.0
Seismic Coefficient, F_V	1.52

Liquefaction Potential

Liquefaction refers to the condition in which vibration or shaking of the ground, usually from earthquake forces, results in the development of excess pore water pressures in saturated soils with subsequent loss of strength in the deposit of soil so affected. The evaluation of liquefaction potential is complex and dependent on numerous parameters, including soil type, grain-size distribution, soil density, depth to groundwater, in-situ static ground stresses, earthquake magnitude, peak ground acceleration (PGA), earthquake-induced ground stresses and excess pore water pressure generated during seismic shaking. In general, soils that are susceptible to liquefaction include very loose to medium dense, clean to silty sands that are below the groundwater table.

We evaluated liquefaction potential of the site soils using subsurface information obtained from the standard penetration tests (SPTs) completed during our exploration program and laboratory testing completed on the samples obtained from the borings. Our evaluation indicates that there is a low to moderate risk of liquefaction because of the presence of medium dense, relatively clean sand layers within the alluvial deposits and recessional outwash deposits below the groundwater table. Liquefaction induced settlement in the area of the maintenance building and Pavilion structure is estimated to be between 1 and 3 inches for the design earthquake. The liquefaction in the vicinity of the maintenance building and Pavilion structure is estimated to occur at depths greater than 20 feet below existing grades and the dense to medium dense soil between the foundation subgrade and liquefiable layers is anticipated to act as a “crust” and mitigate the potential for differential liquefaction-induced settlement. Earthquake input parameters used in our analyses were determined using the 2008 United States Geological Survey (USGS) seismic hazard model (http://geohazards.usgs.gov/deaggint/2008/) for a recurrence interval of 2,745 years. A mean earthquake of a magnitude 6.8 and a PGA of 0.52 g was used to evaluate liquefaction potential of the site soils.

Other Seismic Hazards

Due to the location of the site and the site's topography, the risk of adverse impacts resulting from seismically induced slope instability, surface displacement due to faulting, or lateral spreading is considered to be low.

Shallow Foundations

Based on the data observed from the borings completed at the site and the anticipated depth of excavation, the foundations for the Pavilion and maintenance building structures will bear on existing fill, alluvial or recessional outwash deposits. While thin lenses of organic soils were observed in previous excavations in the eastern portion of the site, peat is not present within the immediate vicinity of the planned structures, based on the borings and geophysical survey. The foundation for the retaining wall for the Great Lawn is currently planned to bear on imported structural fill for the peat removal excavation or on existing fill or medium dense to dense native soil where peat removal is not required. We recommend that these structures be supported on shallow foundations as described below.

Allowable Bearing Pressure

We recommend an allowable bearing pressure of 2,000 psf for shallow foundations where footings are founded on medium dense to dense native soils, on structural fill placed over dense native soils, or on a minimum 2-foot thickness of structural fill. Structural fill below footings can consist of existing fill provided it can be compacted to 95 percent of the maximum dry density (MDD) in accordance with ASTM D 1557. This allowable bearing pressure value may be increased by one-third for short-term live loads such as wind, seismic or impact forces.

The structural fill zone, if needed, should form a prism below each footing which extends a minimum distance of 2 feet beyond the edges of the footing. We recommend that GeoEngineers evaluate the soils exposed in the footing excavations before placement of structural fill to determine that the footing subgrade is acceptable and to evaluate if the work is completed in accordance with our recommendations.

Settlement

Provided that all loose soil is removed and that the subgrade is prepared as recommended under "Construction Considerations" below, we estimate that the total settlement of shallow foundations will be about ½ inch or less. The settlements will occur rapidly, essentially as loads are applied. Differential settlements between footings could be half of the total settlement. Note that smaller settlements will result from lower applied loads.

Size and Embedment

Foundations should bear at least 18 inches below final grade. Continuous wall footings and individual column footings should have minimum widths of 24 inches.

Lateral Resistance

Lateral loads may be resisted by friction on the base of footings and foundation elements and passive resistance on the sides. Frictional resistance may be determined using 0.4 for the coefficient of base friction. Passive resistance may be determined using an equivalent fluid density of 300 pounds per cubic foot (pcf), assuming that the soils against the footings for a distance of twice the footing depth consist of

compacted structural fill or consist of medium dense to dense native soils. The above coefficient of friction and passive equivalent fluid density values include a factor of safety of about 1.5. The allowable passive and friction values can be increased by one-third for seismic loads.

Construction Considerations

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

If foundation construction is completed during periods of wet weather, foundation subgrades should be protected with a rat slab consisting of 2 to 4 inches of lean or structural concrete. Alternatively, crushed surface base course (CSBC) may be used in place of lean or structural concrete to protect foundation subgrades. Protection of the subgrade prior to foundation installation is the responsibility of the contractor. If soft areas are present at the footing subgrade elevation, the soft areas should be removed and replaced with lean concrete or structural fill at the recommendation of GeoEngineers.

Slabs-on-Grade

Building or other slabs located at or near existing grades can be designed as slabs-on-grade. Slab subgrade areas should be evaluated as recommended in the "Site Preparation" section of the report. Loose, disturbed soils should be removed from below the slab footprint and the slab should be supported on medium dense to very dense native soils or on a minimum 12-inch thickness of structural fill. A subgrade modulus of 150 pounds per cubic inch (pci) may be used for design. We recommend the subgrade be evaluated by the GeoEngineers prior to placing the capillary break layer.

The capillary break layer placed over the subgrade (native soil or 12-inch structural fill layer) should consist of a 6-inch-thick layer of clean crushed gravel with a maximum particle size of 1½ inches and negligible sand or silt (similar to AASHTO Grading No. 57 in Section 9-03.1(4)C of the 2016 WSDOT Standard Specifications). A vapor retarder should be used below slab-on-grade floors located in occupied portions of the building or where moisture intrusion is not desirable. Specification of the vapor retarder requires consideration of the performance expectations of the occupied space, the type of flooring planned and other factors, and is typically completed by other members of the project team.

Below-Grade Structures and Retaining Walls

The following recommendations should be used for the design of below-grade walls that are intended to act as retaining walls, other retaining structures that are used to achieve grade changes, and buried vaults.

Drained Walls

We understand that the maintenance building will likely be installed with a sump to accommodate drainage of the retained soils. Lateral earth pressures for design of the maintenance building or other below-grade walls and retaining structures installed with adequate drainage should be evaluated using an equivalent fluid density of 35 pcf provided that the walls will not be restrained against rotation when backfill is placed. If the walls will be restrained from rotation, we recommend using an equivalent fluid density of 55 pcf. Walls are assumed to be restrained if top movement during backfilling is less than H/1000, where H is the wall height. These lateral soil pressures assume that the ground surface behind the wall is horizontal. For

seismic loading conditions, a rectangular earth pressure equal to 7H psf should be added to the active/at-rest pressures.

If vehicles can approach the tops of walls to within one-half the height of the wall, a traffic surcharge should be added to the wall pressure. For car parking areas, the traffic surcharge can be approximated by the equivalent weight of an additional 1 foot of soil backfill (125 psf) behind the wall. For utility truck parking areas, maintenance vehicle access areas, and access driveway areas, the traffic surcharge can be approximated by the equivalent weight of an additional 2 feet (250 psf) of soil backfill behind the wall.

These recommendations are based on the assumption that adequate drainage will be provided behind below-grade walls and retaining structures as discussed below. The values for soil bearing, frictional resistance, and passive resistance presented above for foundation design are applicable to retaining wall design. Walls located in level ground areas should be founded at least 18 inches below the adjacent grade.

Positive drainage should be provided behind below-grade and retaining walls that are designed for drained conditions by placing a minimum 2-foot-wide zone of free-draining backfill against the back of the wall, as presented in Earth Pressure Diagram, Figure 6. The free-draining backfill should consist of imported gravel backfill for walls as described in Section 9-03.12(2) of the 2016 WSDOT Standard Specifications. Where landscaping and irrigation is installed adjacent to the building wall, we recommend that full-face vertical geocomposite drainage board also be placed against the building wall between the backfill and the waterproofing layer.

A perforated drainpipe should be placed near the base of the retaining wall to provide drainage. The drainpipe should be surrounded by a minimum of 6 inches of clean crushed gravel with a maximum particle size of 1½ inches and negligible sand or silt (similar to AASHTO Grading No. 57 in Section 9-03.1(4)C of the 2016 WSDOT Standard Specifications), or an alternative approved by GeoEngineers. The clean crushed material should be wrapped with a geotextile filter fabric meeting the requirements of construction geotextile for underground drainage, WSDOT Standard Specification 9-33. The wall drainpipe should be connected to a header pipe and routed to a sump or gravity drain. Appropriate cleanouts for drainpipe maintenance should be installed. A larger-diameter pipe will allow for easier maintenance of drainage systems.

Undrained Walls and Vaults

We recommend that undrained vaults or the maintenance building basement walls (if not designed with a sump or gravity drain) be designed to resist hydrostatic pressure. Lateral earth pressures for design of the maintenance building or other below-grade walls and retaining structures installed without adequate drainage should be evaluated using an equivalent fluid density of 80 pcf provided that the walls will not be restrained against rotation when backfill is placed. If the walls will be restrained from rotation, we recommend using an equivalent fluid density of 90 pcf. Walls are assumed to be restrained if top movement during backfilling is less than H/1000, where H is the wall height. These lateral soil pressures assume that the ground surface behind the wall is horizontal. Seismic and traffic surcharge pressure should also be applied as described in the “Drained Walls” section.

Hydrostatic uplift pressures must also be considered for vault or basement slabs designed without a sump or gravity drain. For design purposes, we recommend that hydrostatic uplift force be considered for slabs extending below Elevation 31 feet. The uplift force acting on the proposed structure can be estimated by

multiplying the volume of structure extending deeper than Elevation 31 feet, in cubic feet, by the unit weight of water, 62.4 pcf.

Maintenance Building Waterproofing Considerations

Where moisture intrusion in below-grade space is not desirable, we recommend that waterproofing behind the basement wall, and a waterproofing membrane of vapor retarder below the basement slab be considered. Specification of the waterproofing requires consideration of the performance expectations of the basement space, the type of flooring and wall surfacing planned and other factors, and is typically completed by other members of the project team.

Settlement Considerations

Due to the presence of the variable thickness of the peat deposit below the northwest portion of the project site, settlements can be expected as loads, such as fill, are applied. The peat deposit consists of highly organic, compressible material that decomposes over time. This decomposition and compressibility results in settlement that can continue indefinitely. Settlement of the peat from organic decomposition alone where new loads are applied is estimated to be on the order of 1 foot over the design life of the project (typically 50 years). Where site grades will be increased by 12 inches or less, settlement is estimated to be on the order of 1 to 3 inches over the design life of the project. The amount of settlement is highly variable due to the nature of the material.

There are several options to help partially mitigate the settlement issues of the peat deposits. These include preloading the project area where peat is present, or use of light weight fill to help minimize the amount of settlement of the peat. Full mitigation would require removal of the peat. Mitigation of the peat settlement can help reduce costs of future maintenance of the park. Based on meetings and discussions with the project team, we understand that removing the peat layer and replacing it with structural fill below the Great Lawn where site grades will be increased by 18 inches or more is the preferred option and that a preload will be used in future hardscape areas to the north and west of the Great Lawn where peat will remain in place. The peat removal alternative is discussed in more detail below.

Overexcavation and Replacement of the Peat below the Great Lawn

The only method to eliminate the long-term settlement potential of the peat is to overexcavate and remove the peat soils from below the site. The exploration data indicates that this will require excavations of as deep as 14 feet below existing grade. The explorations indicate that the uppermost 3 to 6 feet of soil at the site is not organic material and could be preserved for reuse as common borrow for the preloading berm. The lower peat is unsuitable for reuse as fill in structural areas; however, this material could be reused in non-structural areas, such as landscaping berms. Once the peat is removed, the excavations can be backfilled with properly placed structural fill in accordance with recommendation in this report.

The excavation side slopes should be sloped in accordance with the recommendations in the "Temporary Slopes" section, or the sides can be supported with temporary shoring.

The excavations may encroach on the groundwater level, especially during winter season high groundwater conditions. Therefore, we recommend performing this work during the late summer when seasonal low groundwater conditions exist.

Settlement Mitigation in Other Areas

We understand that it is not feasible to remove all of the peat within the project area for a number of reasons. The peat extends off site, and it is disruptive to perform excavations adjacent to existing sidewalks because of impacts on existing utilities and traffic impacts. The geophysical exploration completed for previous studies identified that the peat was in the range of 4 to 6 feet thick below Redmond Way, to the north. However, the full extent and thickness of the peat below Redmond Way has not been explored as part of the current study.

As discussed in the previous section, the project team is planning to remove the peat from below the planned Great Lawn area. The peat removal will be completed nine months to a year prior to the park development. Where peat is left in place to the north and west of the peat removal excavation for the Great Lawn, we recommend placing a 3-foot-high temporary pre-loading berm to remain in place following the peat removal project and prior to park development. For final park development, we recommend an enhanced pavement section in this area for mitigation of differential settlement, as described in the "Pavement Recommendations" section. The preloading and the enhanced pavement section will help to mitigate the potential for differential settlement of the park hardscape.

There may be some differential settlement of utilities over time across the interface between areas where there is no peat or the peat has been removed and areas where the peat remains. We recommend that the utilities be designed to accommodate this differential settlement. Where rigid pipe is used, the pipe joints should be able to accommodate minor rotation without separation. Alternatively, continuously-fused HDPE pipe materials can be used because it is highly flexible.

Construction Dewatering

On-going groundwater level readings obtained as part the City's wellhead protection program suggest that the seasonal groundwater levels in the project vicinity fluctuate between highs of about Elevation 29 to 27 feet (10 to 12 feet below existing site grades) and lows of Elevation 24 to 22 feet (15 to 17 feet below existing grades). Static groundwater was observed in some of the borings at the time of exploration (June 2015) at depths ranging between 12½ and 16 feet (Elevations 26½ and 23 feet). The groundwater level can be expected to fluctuate seasonally and is anticipated to be higher during the winter and spring months. Based on our understanding of the project, most of the utilities will be shallower than 6 feet and the excavation for the maintenance building will be about 10 to 11 feet. Excavation for peat removal, which may extend up to 14 feet below site grades (Elevation 26 or 27 feet), is planned for the late summer when groundwater levels are typically lower.

Dewatering during construction for excavations extending up to 1 to 2 feet below the groundwater table may be required depending on the timing and final depth of the maintenance building excavation. Based on the soil conditions and our experience in the area, we anticipate that groundwater in excavations less than about 1 to 2 feet below the static groundwater level may be controlled by open pumping using sump pumps. For excavations deeper than 1 to 2 feet below the water table dewatering using well points or deep wells might be necessary. We recommend that the contractor evaluate the groundwater level prior to commencing excavations in order to assess appropriate groundwater control methods. We recommend that the contractor be required to submit a proposed dewatering system design and plan layout to the project team for review and comment prior to beginning construction.

The level of effort required for dewatering will depend to a great extent on the time of year during which construction is accomplished. Less seepage into the work areas should be expected if construction is accomplished in the late summer or early fall months, and correspondingly, more seepage should be expected during the wetter periods of the year. We recommend that construction be completed in the late summer or early fall months when precipitation is typically at its lowest.

A general discussion of the open pumping dewatering method, which is anticipated for the project, is presented below. GeoEngineers should provide input related to well points or deep wells if planned excavation depths increase.

Open Pumping

This dewatering method involves removing water that has seeped into the excavation by pumping from a sump that has been excavated at one end of the excavation or trench. Drainage ditches that are connected to the sump are typically excavated along the sidewalls at the base of the excavation or trench. The excavation for the sump and the drainage ditches should be backfilled with gravel or crushed rock to reduce the amount of erosion and associated sediment in the water pumped from the sump. In our experience, a slotted casing or perforated 55-gallon drum that is installed in the sump backfill provides a suitable housing for a submersible pump.

The amount of water removed from the excavation by open pumping should be minimized because of high turbidity levels. Temporary storage of dewatering effluent from the sumps in a settlement tank or basin may be required to meet discharge permit requirements and reduce sediment content prior to discharging the water to surface water courses.

Earthwork

Site Preparation

Removal and demolition of existing site improvements and structures should include removal of foundation elements, existing pavement, or other improvements. Existing voids or new depressions created during demolition and site preparation should be cleaned of loose soil or debris and backfilled with compacted structural fill.

The near-surface on-site soils possess high fines (silt) content such that repeated construction traffic will result in considerable disturbance during wet weather construction. Structural fill placement using on-site soils should be accomplished during extended periods of dry weather, when the surficial soils will be less susceptible to disturbance and provide better support for construction equipment. Stripped subgrades should not be left exposed to inclement weather.

Following removal of existing structures, pavements, or other surficial materials, we recommend that the subgrade be thoroughly proofrolled with heavily loaded rubber-tired construction equipment, if site preparation is done during extended dry weather conditions. If soft or otherwise unsuitable areas revealed during proofrolling cannot be compacted to a stable and uniformly dense condition, the subgrade should be excavated to firm soil or to 2 feet below the original ground surface and replaced with structural fill, or as otherwise recommended by the Geotechnical Engineer.

If site preparation is performed during wet weather, the exposed surface should not be proofrolled because of the disturbance that would be caused. During wet weather, construction traffic should be kept off the

exposed surface. The subgrade should be evaluated by probing, by a representative from our firm to identify areas of soft soils which may need to be replaced. These soft areas should be excavated to the depth recommended by our representative.

Temporary Slopes

Since the contractor has control of the construction operations, the contractor should be made responsible for the dewatering of the site, shoring, stability of cut slopes, as well as the safety of the excavations. The contractor is present at the site continuously and is best able to observe changes in site and soil conditions and monitor the performance of excavations. Slope inclinations may have to be modified by the contractor if localized sloughing occurs or if seepage occurs.

We recommend temporary cut slopes in excess of 4 feet made in existing fill, alluvial deposits, or recessional outwash should be no steeper than 1.5H:1V, including temporary cut slopes for the peat removal excavation. Flatter slopes may be necessary if localized sloughing occurs and where groundwater seepage is present. In addition, we recommend the following procedures for open cuts at the site:

- No traffic, construction equipment, or supplies allowed at the top of cut slopes for a distance of at least 5 feet from the top of the cut.
- Surface water and groundwater seepage should be controlled and diverted away from excavations and finished slopes.
- Construction should be scheduled so that the length of time the temporary cut is left open is minimized.
- The general conditions of the temporary cut slopes should be observed periodically by the Geotechnical Engineer to identify potential problems.

Permanent Slopes

We recommend that permanent cut and fill slopes be constructed no steeper than 2H:1V. To achieve uniform compaction, we recommend that fill slopes be overbuilt slightly and subsequently cut back to expose properly compacted fill.

To reduce erosion, newly constructed slopes should be planted or hydroseeded shortly after completion of grading. Until the vegetation is established, some sloughing and raveling of the slopes should be expected. This may require localized repairs and reseeding. Temporary covering, such as jute fabric, loose straw or excelsior matting should be used to protect the slopes during periods of rainfall and aid in effective revegetation.

Structural Fill

Materials

Material used for the purposes summarized below is classified as structural fill for the purpose of this report. Structural fill material requirements vary depending upon its use as described below:

1. During dry weather, structural fill placed within new pavement areas or as utility trench backfill can contain an increased fines content provided it can be moisture conditioned and compacted to the minimum standard. For dry weather construction, imported fill may meet the criteria for common borrow as described in Section 9-03.14(3) of the 2016 WSDOT Standard Specifications. Common borrow will be suitable for use as structural fill during prolonged dry weather conditions only. Most of

the near-surface on-site soils are classified as common borrow and may be used as structural fill during prolonged dry weather conditions, as discussed below in "Use of On-Site Soils."

2. During wet weather, structural fill placed within new pavement areas or as utility trench backfill should consist of imported gravel borrow as described in Section 9-03.14(1) of the 2016 WSDOT Standard Specifications.

3. Structural fill placed below shallow foundations for the Pavilion and maintenance building should consist of crushed surfacing base course as described in Section 9-03.9(3) of the 2016 WSDOT Standard Specifications.

4. Structural fill placed in the Great Lawn area (to backfill the peat removal excavation) for use as stormwater infiltration should consist of imported gravel borrow as described in Section 9-03.14(1) of the 2016 WSDOT Standard Specifications.

5. Structural fill placed within the drain zone (minimum 2 feet wide) behind the back of retaining walls and below-grade walls designed for drained conditions should consist of imported gravel backfill for walls as described in Section 9-03.12(2) of the 2016 WSDOT Standard Specifications.

6. Drain rock placed for the gravel infiltration storage layer below the great lawn, as capillary break material below building slabs, or around wall drains should consist of clean crushed gravel with a maximum particle size of 1½ inches and negligible sand or silt meeting the gradation requirements of AASHTO Grading No. 57 in Section 9-03.1(4)C of the 2016 WSDOT Standard Specifications.

7. Structural fill placed as crushed surfacing top course and crushed surfacing base course below pavements should conform to Section 9-03.9(3) of the 2016 WSDOT Standard Specifications.

8. Fill placed to construct the preloading berm or other landscaping berms should conform to common borrow as described in Section 9-03.14(3) of the 2016 WSDOT Standard Specifications.

Reuse of On-site Native Soils

Most of the fill soils required for the project have specific gradation requirements, and most of the on-site soils do not meet these gradation requirements. Furthermore, the reuse of on-site soils is not recommended due to lack of stockpile areas and the time of year that construction will occur. Therefore, imported structural fill meeting the requirements described above should be used where structural fill is necessary.

Fill Placement and Compaction Criteria

Structural fill should be mechanically compacted to a firm, non-yielding condition. In general, structural fill should be placed in loose lifts not exceeding 12 inches in thickness when using heavy compaction equipment and 6 inches when using hand operated compaction equipment. Each lift should be conditioned to the proper moisture content and compacted to the specified density before placing subsequent lifts. Structural fill should be compacted to the following criteria:

1. Structural fill placed below foundations, on-grade slabs, within the top 2 feet of pavement or hardscape subgrade should be compacted to at least 95 percent of the MDD estimated in accordance with ASTM D 1557. Structural fill placed below the top 2 feet of pavement subgrade should be compacted to at least 90 percent of the MDD.

2. Structural fill placed within the top 2 feet of the Great Lawn soil section should be compacted to at least 95 percent of the MDD estimated in accordance with ASTM D 1557, unless otherwise specified

by the landscape architect. Structural fill placed below the top 2 feet of the Great Lawn section should be compacted to at least 90 percent of the MDD.

3. Structural fill placed behind retaining walls within a distance equal to the height of the wall should be compacted to between 90 to 92 percent of the MDD estimated in accordance with ASTM D 1557. Care should be taken such that backfill compaction does not overstress the wall.
4. Structural fill placed as crushed rock base course below pavements should be compacted to at least 95 percent of the MDD estimated in accordance with ASTM D 1557.
5. Fill placed to construct the preloading berm or other landscaping berms should be compacted to at least 85 percent of the MDD estimated in accordance with ASTM D 1557.

We recommend that a representative from our firm observe and evaluate (proof-rolling and/or probing) the exposed subgrade soils in structure and pavement areas prior to placement of structural fill and during the placement and compaction of structural fill. Our representative would evaluate the adequacy of the subgrade soils and identify areas needing further work, document placement of geotextile (where applicable), perform in-place moisture-density tests in the fill to evaluate if the work is being done in accordance with the compaction specifications, and advise on any modifications to procedures that may be appropriate for the prevailing conditions.

Weather Considerations

As discussed previously, the near-surface native soils contain a sufficient percentage of fines (silt) to be moisture sensitive. When the moisture content of these soils is appreciably above the optimum moisture content, these soils become muddy and unstable, operation of equipment on these soils will be difficult, and it will be difficult to meet the required compaction criteria. Additionally, disturbance of these near surface soils should be expected if earthwork is completed during periods of wet weather. During wet weather conditions we recommend that:

- The ground surface in and around the work area be sloped so that surface water is directed to a sump or discharge location. The ground surface should be graded such that areas of ponded water do not develop.
- Slopes with exposed soils should be covered with plastic sheeting or similar means, as practical.
- The site soils should not be left uncompacted and exposed to moisture. Sealing the surficial soils by rolling with a smooth-drum roller prior to periods of precipitation will reduce the extent to which these soils become wet or unstable.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practicable.
- Structural fill placed during the wet season should meet the requirements previously recommended in the “Materials” section of this report.

Erosion and Sedimentation Control

Potential sources or causes of erosion and sedimentation depend upon construction methods, slope length and gradient, amount of soil exposure or disturbance, soil type, construction sequencing and weather. The project impact on erosion-prone areas and adjacent areas can be reduced by implementing an erosion

and sedimentation control plan. The plan should be designed in accordance with applicable City standards. The plan should incorporate basic planning principles that include:

- Scheduling grading and construction to reduce soil exposure.
- Retaining existing vegetation whenever feasible.
- Preventing erosion from occurring by: minimizing the area of disturbance; providing blanket protection of disturbed areas; and grading to avoid concentration of surface runoff onto or off of cut or fill slopes, access roadways, or natural slopes.
- Intercepting surface runoff onto or off of disturbed areas to minimize sediment transport by use of brush barriers, straw wattles, swales, etc.
- Providing erosion control system redundancies. For example, combine the above preventive measures with installation of silt fences, straw bales, and rock check dams where appropriate to provide the desired redundancy.
- Inspecting and maintaining erosion control measures frequently.
- Hydroseeding or placing crushed rock surfacing on disturbed areas as soon as possible after completion.

Erosion protection of finished surfaces may be obtained by planting vegetation and covering the area with mulch or matting. Numerous products are available to cover the exposed area including jute matting, excelsior matting, woven straw matting, synthetic fiber matting, seed impregnated sheeting and sprayed fibers.

Until the permanent erosion protection is established and the site is stabilized, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures and repair and/or modify them as appropriate. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

Infiltration Evaluation

City of Redmond is adopting the 2012 Department of Ecology (DOE) *Stormwater Management Manual for Western Washington* (SMMWW). As such, we have determined design infiltration rates using the 2012 SMMWW methodology.

2012 Methodology

In the 2012 Manual, the design infiltration rates (saturated hydraulic conductivity) can be determined using one of the three methodologies outlined in Volume III, Chapter 3.3. These methods include large scale pilot infiltration test (PIT), small scale PIT, or soil grain size analysis method.

The soil grain size analysis method was used to evaluate design infiltration rates for the fill, alluvial deposits, and recessional outwash encountered at the site. The methods consist of correlations based on sieve analysis results, as discussed in Section 3.3.6.

The table below presents a summary of the estimated design saturated hydraulic conductivity for the on-site soils at various depths.

TABLE 2. INFILTRATION RECOMMENDATIONS BASED ON 2012 SMMWW MANUAL

Exploration	Depth (feet)	Soil Unit	USCS Symbol	K_{sat} (in/hr) initial	Total Correction Factor	K_{sat} (in/hr) design
B-1	10	Recessional Outwash	SP	178	0.12	21.1
B-3	12.5	Alluvial Deposits	SM	11.8	0.12	1.4
B-4	15	Alluvial Deposits	SM	14.5	0.12	1.7
B-5	12.5	Alluvial Deposits	SM	16.5	0.12	2.0
B-6	2.5	Fill	GM	16.5	0.12	2.0
B-7	7.5	Recessional Outwash	GP-GM	29.5	0.12	3.5
B-9	12.5	Recessional Outwash	GP-GM	17.2	0.12	2.0
B-10	5	Alluvial Deposits	GM	7.8	0.12	0.9
B-11	5	Fill	GP-GM	45.7	0.12	5.4
B-12	5	Fill	GP-GM	28.3	0.12	3.4
B-13	10	Recessional Outwash	GP-GM	84.6	0.12	10.1
B-14	5	Fill	GP-GM	71.0	0.12	8.4

Design Infiltration Rates

We understand that the project team's objective is to infiltrate 80 percent of the site stormwater run-off. The current strategy is to convey surface water to infiltrate into the backfill for the peat removal excavation below the Great Lawn. The following recommendations should be included in the design of the site infiltration system:

- Site drains conveying surface runoff to the backfill below the Great Lawn should lead to a perforated drainpipe within a clean crushed gravel storage layer below the Great Lawn. The perforated drainpipe should consist of perforated Schedule 40 polyvinyl chloride (PVC) pipes with a minimum diameter of 4 inches and should be installed with the perforations oriented downward.
- The gravel storage layer should consist of 18 inches of clean crushed gravel with a maximum particle size of 1½ inches and negligible sand or silt (similar to AASHTO Grading No. 57 in Section 9-03.1(4)C of the 2016 WSDOT Standard Specifications) should be installed between the upper soil section for the Great Lawn and the gravel borrow backfill for the peat removal excavation. Geotextile filter fabric meeting the requirements of construction geotextile for underground drainage, WSDOT Standard Specification 9-33 should be placed above and below the clean crushed gravel layer.
- We recommend a design infiltration rate of 2 inches per hour for gravel borrow meeting the requirements described in the "Earthwork" section that is used to backfill the peat removal excavation.
- Where conveying surface water toward the Great Lawn is not practical, a design infiltration rate of 1 inch per hour may be used for infiltration into existing soils below the park pavement section or landscaping berms.

It should be noted that the infiltration rates presented herein are based on design guidelines that are generally conservative. On-site PIT testing can be completed to establish more site-specific infiltration performance values, if needed. In our experience, site-specific testing often demonstrates higher infiltration performance than the design guideline values presented above. We also recommend that site soils be evaluated by the Geotechnical Engineer during construction to confirm that the recommended infiltration rates are appropriate.

Pavement and Hardscape Recommendations

Subgrade Preparation

We recommend the subgrade soils in new pavement areas be prepared and evaluated as described in the "Earthwork" section of this report. If the subgrade soils are loose or soft, it may be necessary to excavate localized areas and replace them with additional gravel borrow or gravel base material. Pavement subgrade conditions should be observed and proof-rolled during construction and prior to placing the subbase materials in order to evaluate the presence of unsuitable subgrade soils and the need for over-excavation and placement of a geotextile separator.

Portland Cement Concrete Pavement

Outside of park structures and landscaped areas, we understand that portland cement concrete (PCC) pavement will be used for park hardscape in both pedestrian and vehicular access areas and that unit pavers may be used locally for pavement transitions. Additionally, the existing sidewalk will be replaced locally in areas, where disturbed for park construction.

PCC pavements in pedestrian areas should consist of a minimum of 4 inches of PCC underlain by a minimum thickness of 4 inches of crushed surfacing base course conforming to Section 9-03.9(3) of the 2016 WSDOT Standard Specifications. PCC pavements in vehicular access areas or the pedestrian hardscape area to the north and west of the Great Lawn where peat will remain in place should consist of 6 inches of PCC underlain by a minimum thickness of 6 inches of crushed surfacing base course. If the concrete pavement will have doweled joints, we recommend that the concrete thickness be increased by an amount equal to the diameter of the dowels. The base course should be compacted to at least 95 percent MDD. In addition, biaxial geogrid meeting the requirements of Tensar BX1475, or similar, should be installed between the base course and the subgrade where peat will remain below the ground surface, to the north and west of the Great Lawn area.

Where sidewalks are replaced, they should be completed in accordance with the City of Redmond standard details. Where new sidewalks are adjacent to new park hardscape sections to the north and west of the Great Lawn where biaxial geogrid is required, the same biaxial geogrid should be extended below the subgrade and base course layer of the sidewalk pavement section.

We recommend PCC pavements incorporate construction joints and/or crack control joints spaced maximum distances of 8 feet apart, center-to-center, in both the longitudinal and transverse directions. In addition, we recommend that crack control joints be installed around structures, including manholes and vaults. Crack control joints should be in accordance with WSDOT Standard Specifications. We recommend the depth of the crack control joints be approximately one-fourth the thickness of the concrete; or about 1 to 2 inches deep for the recommended concrete thickness of 4 o 6 inches. The project team should consider sealing the crack control joints to help restrict water infiltration into the joints.

Other Surfacing

Aggregate base course and subbase layers for unit pavers should meet manufacturers' minimum requirements and be reviewed by GeoEngineers. Biaxial geogrid should also be installed between the design pavement section and subgrade for unit pavers installed in areas where peat will remain below the ground surface.

We also understand that the project team is considering a finished aggregate surfacing for the bosque near the southeast corner of the site. The subbase material should meet the manufacturer's minimum requirements.

LIMITATIONS

We have prepared this report for the exclusive use of the City of Redmond, PFS Studio and other project team members for the Redmond Downtown Park project in Redmond, Washington. The data should be provided to prospective contractors for their bidding or estimating purposes, but our report and interpretations should not be construed as a warranty of the subsurface conditions.

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

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

Please refer to Appendix E titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

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FIGURES

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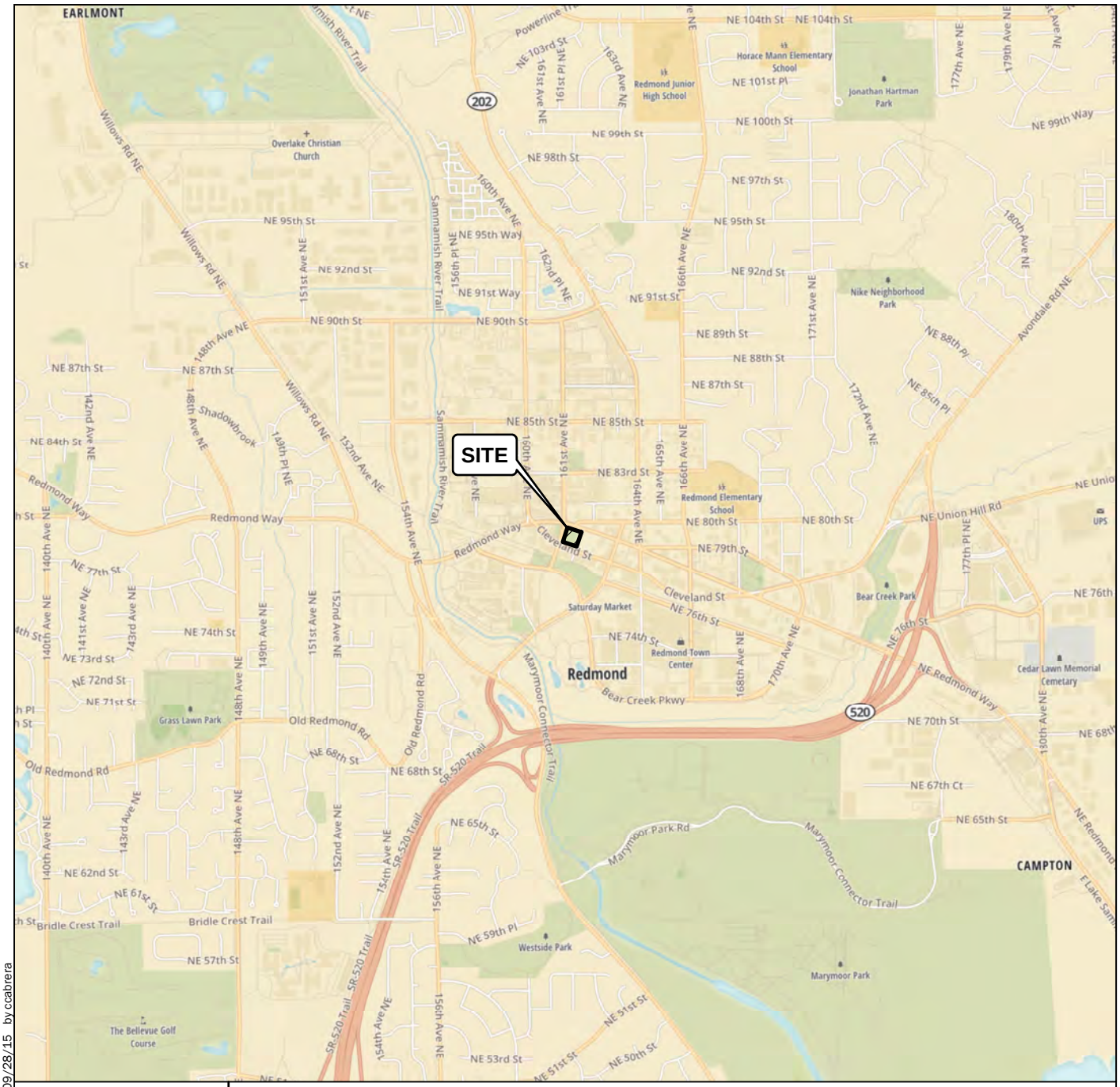

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Feet

Notes:

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

Data Source: Mapbox Open Street Map, 2015

Projection: NAD 1983 UTM Zone 10N

Vicinity Map

Redmond Downtown Park
Redmond, Washington

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Figure 1

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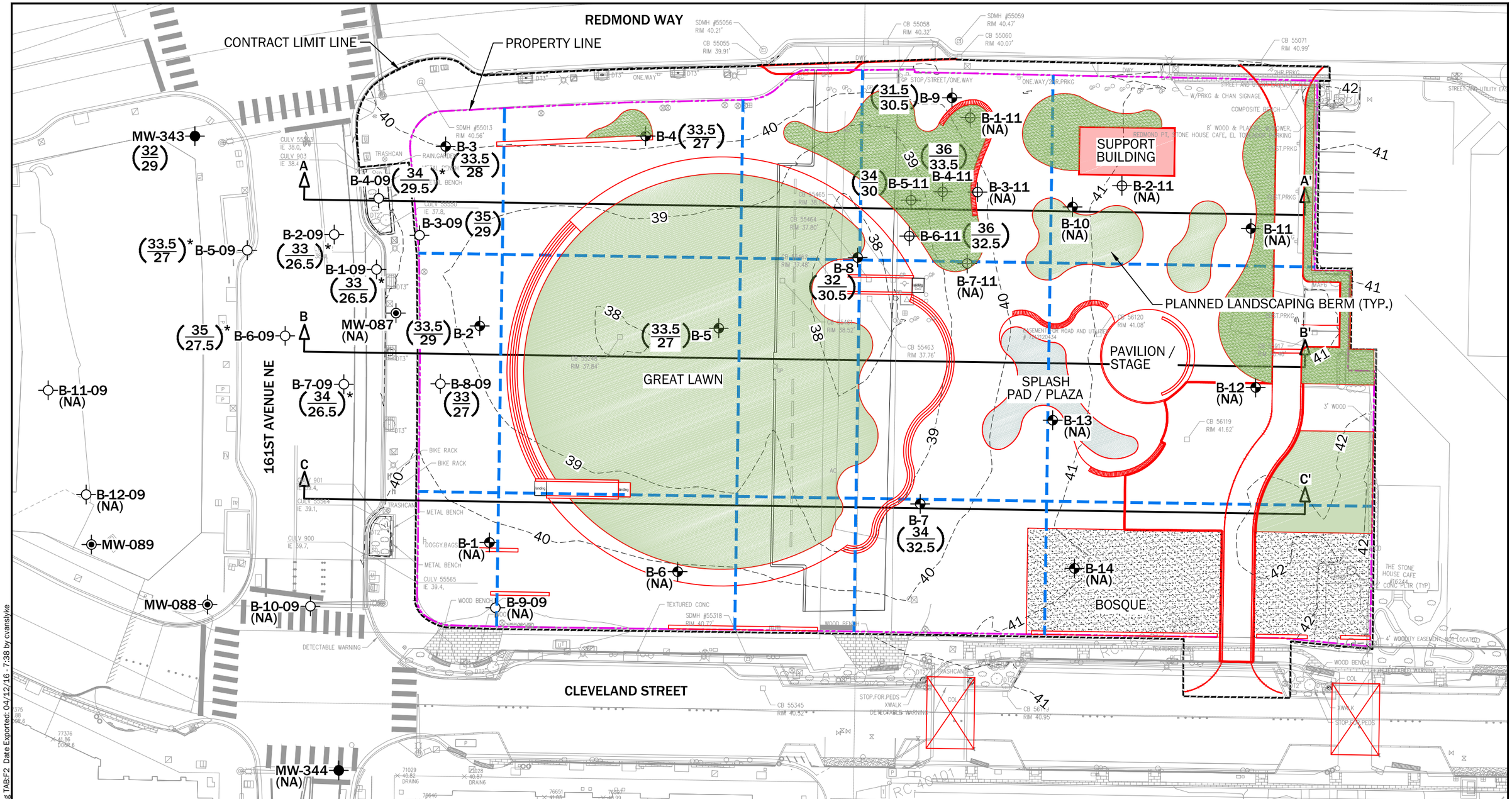

Notes:

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

Data Source: Field survey base drawing provided by KPG, Inc. and architect design by PFS Studio.

Vertical Datum: City of Redmond Vertical Control Datum (NAVD 88).

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

Legend

- B-1 — Boring by GeoEngineers, Inc., 2015
- B-1-11 — Boring by GeoEngineers, Inc., 2011
- MW-343 — Monitoring Well by GeoEngineers, Inc., 2010
- B-1-09 — Boring by GeoEngineers, Inc., 2009
- MW-087 — Monitoring Well by GeoEngineers, Inc., 2007

GPR Survey Line

A — A' Approximate cross section location

(33/27)*(Top Elev. of Peat / Bot. Elev. of Peat)

* Peat removed for 161st Ave NE extension

0 — 40

Site Plan

Redmond Downtown Park
Redmond, Washington

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Figure 2

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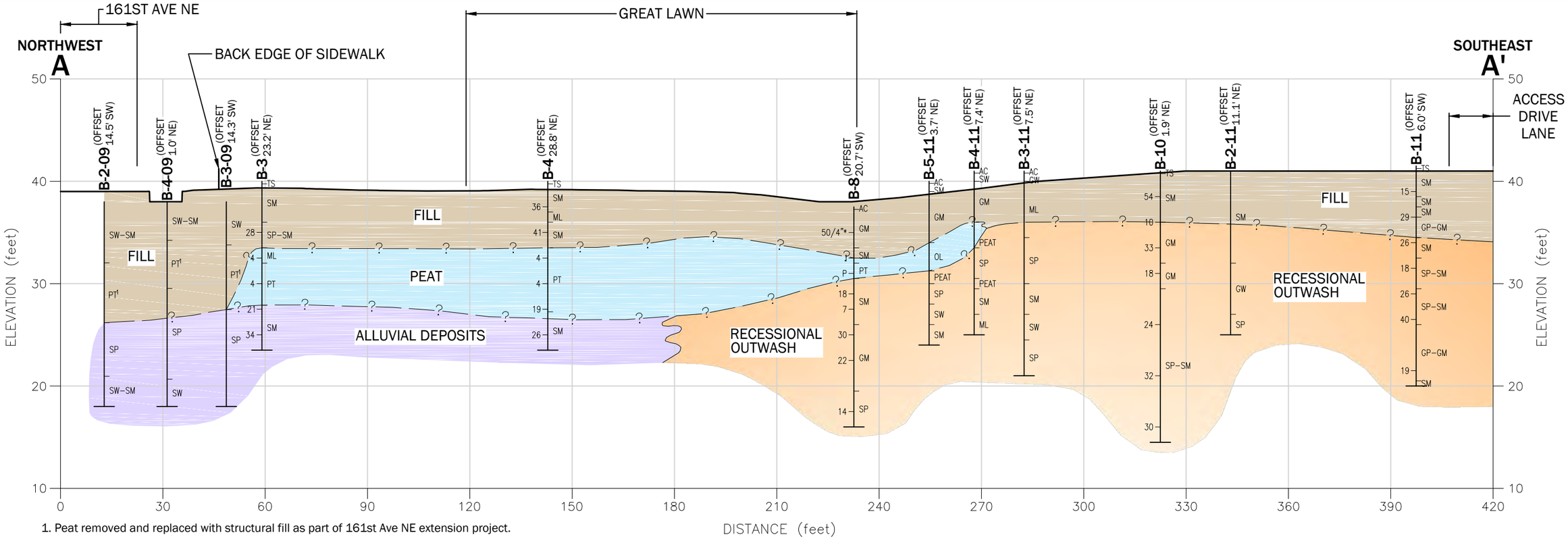
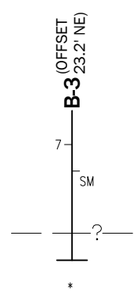


1. Peat removed and replaced with structural fill as part of 161st Ave NE extension project.



EXPLANATION:

- BORING NUMBER AND APPROXIMATE LOCATION
- BLOW COUNT
- SOIL TYPE AT SAMPLE LOCATION
- SOIL CONTACT
- BLOW COUNT OVERSTATED

30 0 30
Horizontal Scale in Feet

10 0 10
Vertical Scale in Feet
Vertical Exaggeration: 3X

Notes:

1. The subsurface conditions shown are based on interpolation between widely spaced explorations and review of geophysical data and should be considered approximate; actual subsurface conditions may vary from those shown.
2. Refer to Figure 2 for location of Cross Section.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

Cross Section A-A'

Redmond Downtown Park
Redmond, Washington

GEOENGINEERS

Figure 3

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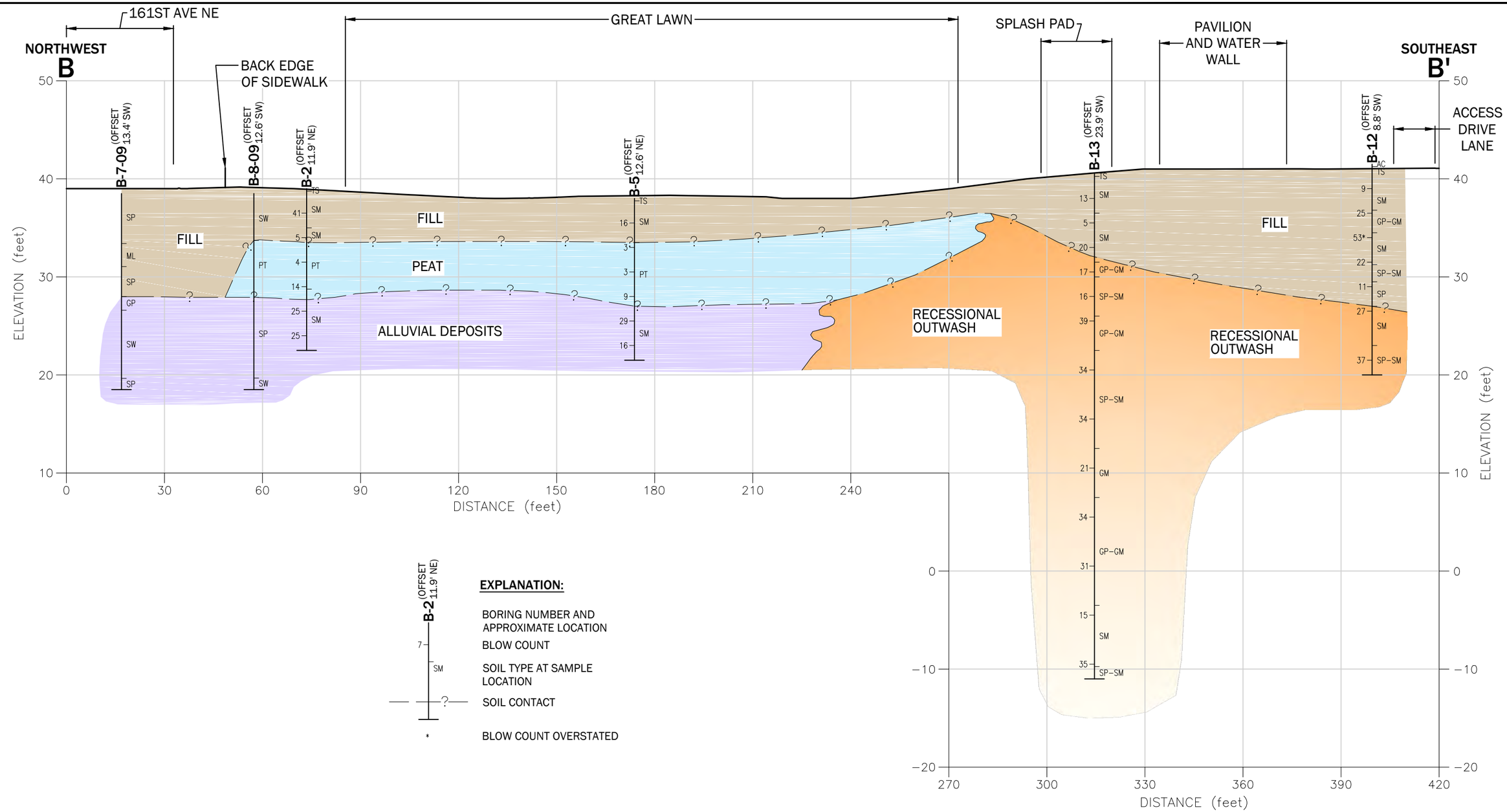

EXPLANATION:

BORING NUMBER AND APPROXIMATE LOCATION

BLOW COUNT

SOIL TYPE AT SAMPLE LOCATION

SOIL CONTACT

BLOW COUNT OVERSTATED

30 0 30
Horizontal Scale in Feet

10 0 10
Vertical Scale in Feet
Vertical Exaggeration: 3X

Cross Section B-B'

Redmond Downtown Park
Redmond, Washington

GEOENGINEERS

Figure 4

Notes:

1. The subsurface conditions shown are based on interpolation between widely spaced explorations and review of geophysical data and should be considered approximate; actual subsurface conditions may vary from those shown.
2. Refer to Figure 2 for location of Cross Section.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

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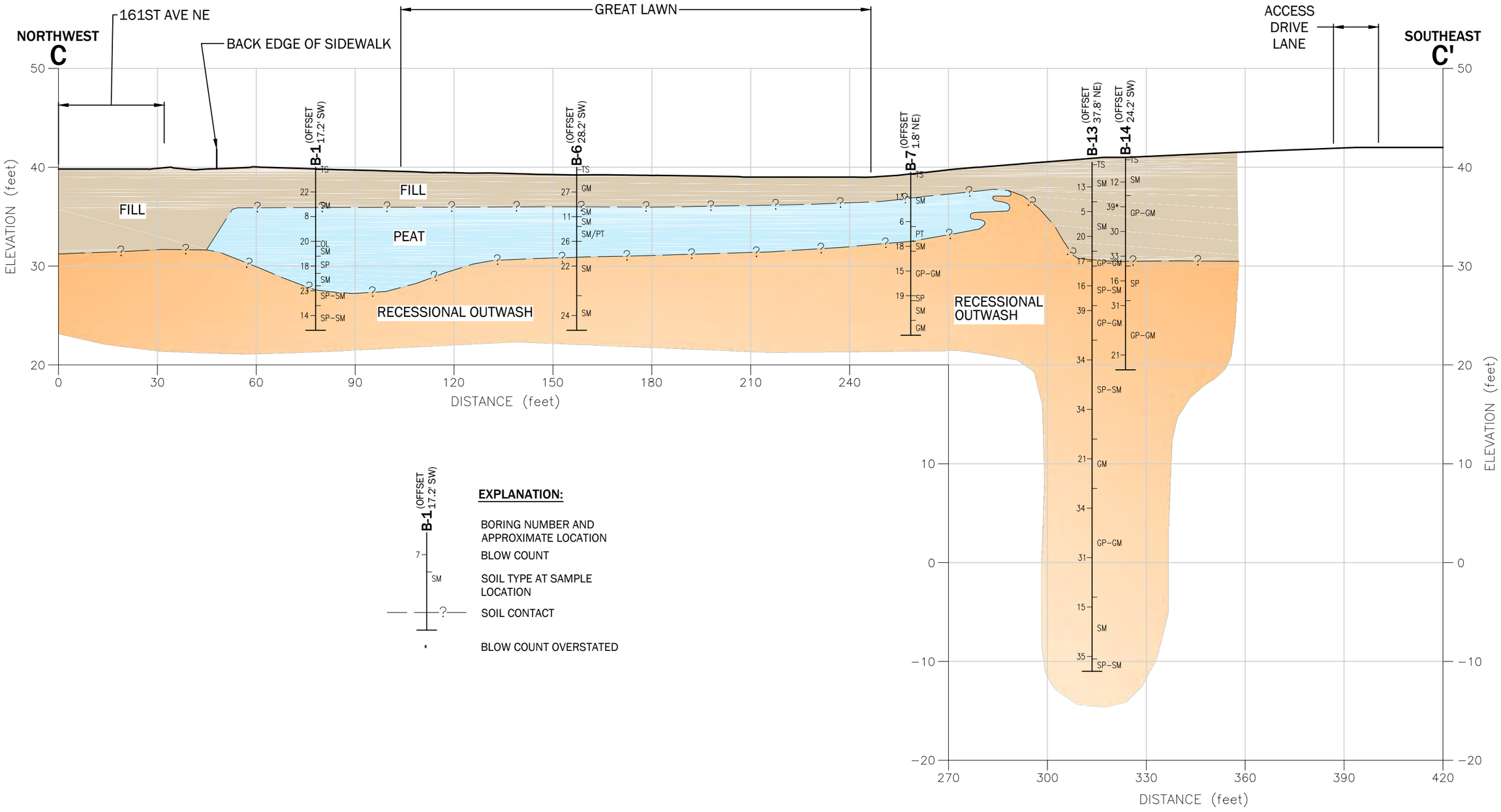

EXPLANATION:

BORING NUMBER AND APPROXIMATE LOCATION

BLOW COUNT

SOIL TYPE AT SAMPLE LOCATION

SOIL CONTACT

BLOW COUNT OVERSTATED

30 0 30
Horizontal Scale in Feet

10 0 10
Vertical Scale in Feet
Vertical Exaggeration: 3X

Cross Section C-C'

Redmond Downtown Park
Redmond, Washington

GEOENGINEERS

Figure 5

Notes:

1. The subsurface conditions shown are based on interpolation between widely spaced explorations and review of geophysical data and should be considered approximate; actual subsurface conditions may vary from those shown.
2. Refer to Figure 2 for location of Cross Section.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

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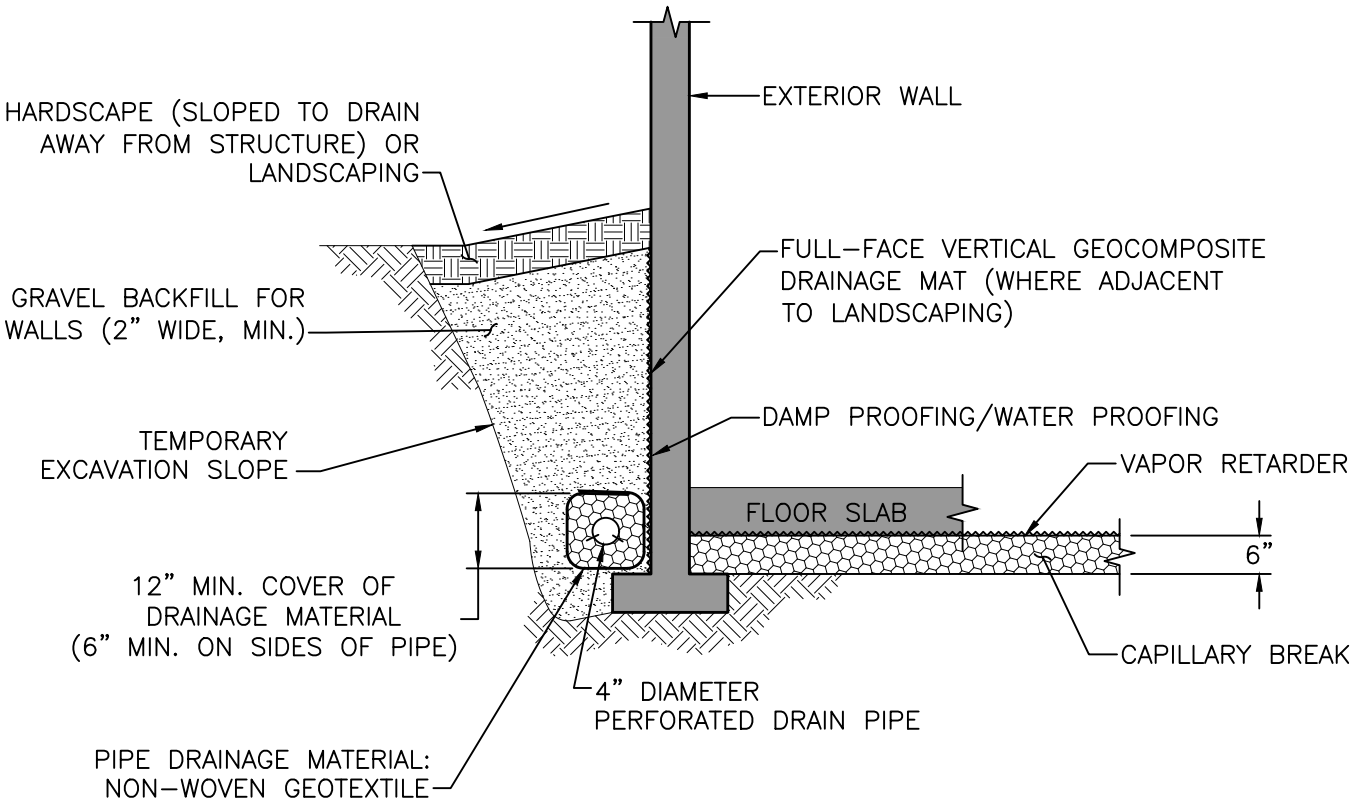

NOT TO SCALE

Materials:

A. GRAVEL BACKFILL FOR WALLS: Shall meet requirements of Section 9-03.12(2) of the 2016 WSDOT Standard Specifications.

B. PIPE DRAINAGE MATERIAL AND CAPILLARY BREAK: Should consist of clean crushed gravel with a maximum size of 1-1/2 inches and negligible sand or fines, meeting the gradation requirements of AASHTO Grading No. 57 of Section 9-03.1(4)c of the 2016 WSDOT Standard Specifications.

C. PERFORATED DRAIN PIPE: Should consist of a 4-inch diameter perforated heavy-wall solid pipe (SDR-35 PVC) or rigid corrugated polyethylene pipe (ADS N-12) or equivalent. Drain pipes should be placed with 0.5 percent minimum slopes and discharge to the storm water collection system (sump or gravity drain).

D. NON-WOVEN GEOTEXTILE: Shall meet the requirements of construction geotextile for underground drainage, 2016 WSDOT Standard Specification 9-33.

Wall Drainage and Backfill	
Redmond Downtown Park Redmond, Washington	
GEOENGINEERS	**Figure 6**

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APPENDICES

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APPENDIX A
Field Explorations

APPENDIX A
FIELD EXPLORATIONS

Subsurface soil and groundwater conditions were evaluated by drilling fourteen borings (B-1 through B-14) at the approximate locations shown on Figure 2. Locations of the explorations were determined in the field by pacing and tape measuring distances from the exploration locations to existing site features such as sidewalks, fences, parking lot curbs, and buildings. Ground surface elevations were interpolated from a site topographic map prepared by KPG and are shown on the exploration logs.

Borings

Fourteen borings (B-1 through B-14) were drilled on June 3 through 5, 2015, to depths ranging from 16½ to 51½ feet below the existing ground surface. The borings were drilled by Geologic Drill, Inc. of Spokane, Washington, using a track-mounted limited access drill rig equipped with a rope and cathead hammer and a track-mounted drill rig equipped with an automatic hammer. The borings were advanced using hollow-stem augers. Drilling services were subcontracted to GeoEngineers, and the borings were advanced under the full-time observation of a representative from our firm.

The soils encountered in the borings were typically sampled at 2½- to 5-foot vertical intervals with a 2.0-inch-outside-diameter split-barrel standard penetration test (SPT) sampler. The samples were obtained by driving the sampler 18 inches into the soil with a 140-pound rope and cat head-driven hammer or 140-pound automatic hammer free-falling 30 inches. The number of blows required for each 6 inches of penetration is recorded. The blow count ("N-value") of the soil is calculated as the number of blows required for the final 12 inches of penetration. This resistance, or N-value, provides a measure of the relative density of granular soils and the relative consistency of cohesive soils. Where very dense soil conditions preclude driving the full 18 inches, the penetration resistance for the partial penetration is entered on the logs. The blow counts are shown on the boring logs at the respective sample depths.

The borings were logged by a geologist from our firm who identified the boring locations, classified the soils encountered, obtained representative soil samples and maintained a detailed log of each boring. The soils encountered during boring operations were visually classified in the field in general accordance with the Unified Soil Classification System (USCS), ASTM D 2488, and the system described on Figure A-1. Representative soil samples were obtained from the borings, logged, placed in plastic bags, and transported to our laboratory in Redmond, Washington. The field classifications were checked in our laboratory.

In addition, pertinent information including soil sample depth, stratigraphy, and groundwater were recorded. Groundwater levels were estimated by observing soil samples and the drill rods. The drilling operation was also monitored for indication of various drilling conditions, such as hard and soft drilling. At completion of drilling, the borings were backfilled in accordance with the procedures of the Washington State Department of Ecology.

Summary boring logs are presented on Figures A-2 through A-15. A key to the symbols and terms used on the logs are included on Figure A-1. These logs are based on our interpretation of the field and laboratory data and indicate the various types of soils encountered. They also indicate the approximate depths at which the soils or their characteristics change, although the change may be gradual. If a change occurred between samples in the borings, it was interpreted.

SOIL CLASSIFICATION CHART

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

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

ADDITIONAL MATERIAL SYMBOLS

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

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Material Description Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

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

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

Laboratory / Field Tests

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

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

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

KEY TO EXPLORATION LOGS

GEOENGINEERS

FIGURE A-1

Drilled	Start 6/3/2015	End 6/3/2015	Total Depth (ft) 16.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	40 NAVD88		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Bobcat MT55 Mini Drill Rig
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass and root mass			
									SM	Dark brown silty fine to coarse sand with occasional gravel and organics (loose to medium dense, moist) (fill)			
			4	22		1				Becomes fine to medium sand with increased gravel content			
35	5		2	8		2				Becomes brown and gray mottled with decreased gravel content and loose			
			10	20		3A MC 3B			OL	Dark brown organic sandy silt (old topsoil layer)	21		
									SM	Brown silty fine to coarse sand with gravel (medium dense, moist) (alluvial deposits)			
									SP	Dark orange-brown fine to medium sand (medium dense, moist) (recessional outwash)			
30	10		13	18		4 SA					6	4	
									SM	Brown silty fine to coarse sand with gravel (medium dense, moist)			
			10	23		5			SP-SM	Gray fine to coarse sand with silt and occasional gravel (medium dense, moist)			
									SP-SM	Brown fine to coarse sand with silt (medium dense, wet)			
25	15		14	14		6							Groundwater encountered at 15 feet at time of drilling

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-1

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-2
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/3/2015	End 6/3/2015	Total Depth (ft) 16.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	39 NAVD88		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Bobcat MT55 Mini Drill Rig
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass and root mass			
									SM	Brown silty fine to coarse sand with gravel, organic matter and trace roots (dense, moist) (fill)			
35			12	41		1							
									SM	Dark brown silty fine to medium sand with occasional gravel, trace organics, bark fragments (loose, moist)			
	5		9	5		2 MC					32		
									PT	Dark brown to black peat (soft, moist) (alluvial deposits)			
			18	4		3 MC					193		
30													
	10		18	14		4A %F			SM	Gray silty fine sand (medium dense, moist to wet)	29	49	
						4B							
			14	25		5							
25										Becomes silty fine to medium sand and wet			
	15			25		6							Groundwater encountered at 15 feet at time of drilling

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-2

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-3
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/3/2015	End 6/3/2015	Total Depth (ft) 16.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	40 NAVD88		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Bobcat MT55 Mini Drill Rig
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass and root mass			
									SM	Brown silty fine to coarse sand with gravel and asphalt fragments (dense, moist) (fill)			
									SP-SM	Light brown fine to medium sand with silt and gravel (medium dense, moist)			
35	5		6	28		2							
									ML	White diatomaceous earth with peat lenses (soft, moist) (alluvial deposits)			
			18	4		3A							
						3B / MC			PT	Dark brown fibrous peat with occasional gray silt lenses (soft, moist)	275		
30	10		18	4		4 / MC					424		
			18	21		5 / SA			SM	Gray silty fine sand (medium dense to dense, moist to wet)	23	25	
25	15		18	34		6							

Groundwater encountered at 16.5 feet at time of drilling

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-3

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-4
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/3/2015	End 6/3/2015	Total Depth (ft) 16.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	40 NAVD88		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Bobcat MT55 Mini Drill Rig
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass			
									SM	Brown silty fine to coarse sand with gravel (dense, moist) (fill)			
			12	36		1A 1B							
									ML	Brown silt with sand (hard, moist)			
									SM	Brown silty fine to coarse sand with occasional gravel (dense, moist)			
35	5		11	41		2							
									PT	Dark brown fibrous peat with occasional silt lenses (soft, moist) (alluvial deposits)			
			18	4		3 MC					160		
30	10		18	4		4 MC					391		
			18	19		5			SM	Gray silty fine sand (medium dense, moist to wet)			
25	15		18	26		6 SA					20	21	Groundwater encountered at 16 feet at time of drilling

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-4

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-5
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/3/2015	End 6/3/2015	Total Depth (ft) 16.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	38 NAVD88		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Bobcat MT55 Mini Drill Rig
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass and root mass			
									SM	Reddish brown silty fine to coarse sand with gravel (medium dense, moist) (fill)			
35			12	16		1							
	5		18	3		2 MC			PT	Dark brown fibrous peat (soft, moist) (alluvial deposits)	156		
30			18	3		3 MC					397		
	10		18	9		4			SM	Gray silty fine sand (medium dense, moist to wet)			
25			18	29		5 SA					20	18	
	15		12	16		6							Groundwater encountered at 15 feet at time of drilling

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-5

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-6
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/4/2015	End 6/4/2015	Total Depth (ft) 16.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	40 / NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval / Recovered (in)	Blows/foot	Collected Sample / Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						TS	3 inches grass and root mass			
							GM	Brown silty fine to coarse gravel with sand, trace roots and bark (medium dense, moist) (fill)			
		14	27	1 SA					6	14	
							SM	Brown silty fine to medium sand with occasional gravel (medium dense, moist)			Drilling less gravelly
35	5	14	11	2			SM	Brown silty fine sand with occasional gravel (medium dense, moist)			
							SM	Dark brown silty fine to medium sand with organic matter (medium dense, moist)			
		12	26	3			SM	Brown silty fine to medium sand with gravel, brick fragments (medium dense, moist)			
30	10	10	22	4							
							SM	Brown silty fine to coarse sand with gravel (medium dense, wet) (recessional outwash)			
25	15		24	5							Groundwater encountered at 15 feet at time of drilling

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-6

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-7
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/4/2015	End 6/4/2015	Total Depth (ft) 16.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	39.5 NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass and root mass			
									SM	Brown silty fine to medium sand with gravel and organics (medium dense, moist) (fill)			Grinding on gravel
			12	13		1							
35													
	5		3	6		2							No recovery with SPT sampler; reattempted in adjacent hole with Shelby sampler
									PT	Brown peat (soft, moist) (alluvial deposits)			
									SM	Brown silty fine to medium sand with gravel (medium dense, moist)	5	8	
			3	18		3 SA			GP-GM	Gray-brown fine to coarse gravel with silt and sand (medium dense, moist) (recessional outwash)			
30													
	10		14	15		4							
			10	15		5			SP	Brown fine to coarse sand (medium dense, moist)			
									SM	Brown silty fine to coarse sand with gravel (medium dense, moist)			
25													
	15			19					GM	Brown silty fine to coarse gravel with sand (medium dense, wet)			Groundwater encountered at 15 feet at time of drilling

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-7

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-8
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/4/2015	End 6/4/2015	Total Depth (ft) 21.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	37.5 NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								AC	Asphalt concrete			
									GM	Brown silty fine to coarse gravel with sand and asphalt debris (medium dense, moist) (fill)			
35			1	50/4"*		1							*Blow count overstated due to gravel
									SM	Brown silty fine to medium sand with occasional gravel and trace organics (loose, moist)			
	5		10	1		2A							
						2B MC			PT	Dark brown fibrous peat (soft, moist) (alluvial deposits)	192		
				P		3							
30									SM	Gray silty fine sand with organic matter (loose to medium dense, moist)			
			2	18		4							
	10		2	7		5							
									GM	Brown silty fine to coarse gravel with sand (medium dense, wet) (recessional outwash)			
25			1	30		6							Poor recovery due to gravel and groundwater Groundwater observed at 12.5 feet at time of drilling
	15		2	22		7				With oxidation staining			
20									SP	Brown fine to medium sand with occasional gravel (medium dense, wet)			6 inches of heave
	20		18	14		8 %F					19	2	

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-8

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-9
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/4/2015	End 6/4/2015	Total Depth (ft) 21.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	40 / NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass and root mass			
									SM	Dark brown silty fine to medium sand with occasional gravel, organic matter (wood) (medium dense, moist) (fill)			
			18	17		1A, 1B							Drill rig grinding
									SM	Dark gray silty fine to medium sand with occasional gravel (medium dense, moist)			
									OL	Dark brown organic silt (medium stiff, moist) (alluvial deposits)			
35	5		12	5		2A MC, 2B					62		Smoother drilling
									ML/OL	Gray silt with organic silt lenses (medium stiff, soft)			
			16	7		3A, 3B, 3C MC			SM/SP-SM	Gray silty fine sand with occasional silt lenses (loose, moist)			
									PT	Dark brown peat (medium stiff, moist)	100		
30	10		6	22		4			SM	Brown silty fine to coarse sand with occasional gravel (medium dense, moist) (recessional outwash)			
			6	47*		5 SA			GP-GM	Brown fine to coarse gravel with silt and sand, orange mottling (medium dense, moist)	7	10	*Blowcount overstated due to gravel
									SP-SM	Brown fine to medium sand with silt and occasional gravel (medium dense, wet)			
25	15		10	26		6							Groundwater encountered at 16 feet at time of drilling 1 foot of heave
20	20			17		7							

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-9

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-10
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/4/2015	End 6/4/2015	Total Depth (ft) 26.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	41 NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass and root mass			
40									SM	Brown silty fine to medium sand with gravel, trace organics (very dense, moist) (fill)			Drill rig grinding
			12	54		1							
	5		7	10		2 SA			GM	Brown silty fine to coarse gravel with sand and organic silt lenses (old topsoil layer?) (medium dense, moist) (alluvial deposits)	11	22	Smoother drilling
35			8	33		3							
									GM	Brown silty fine to coarse gravel with sand (medium dense, moist) (recessional outwash)			Drill rig grinding
	10		5	18		4							
30													Smoother drilling
									SP-SM	Brown fine to coarse sand with silt and gravel (medium dense, moist)			
	15		13	24		5				Becomes wet			Groundwater encountered at 15.5 feet at time of drilling
25													
	20		0	32		6							No recovery
20													
	25		6	30		7							
15													

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-10

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-11
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/4/2015	End 6/4/2015	Total Depth (ft) 21.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	41.5 NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches grass			
40									SM	Dark brown silty fine to medium sand with occasional gravel, organic matter (medium dense, moist) (fill)			Insulation in cuttings
			18	15		1A 1B 1C			SM	Brown silty fine to medium sand with occasional gravel (medium dense, moist)			
									SM	Dark brown silty fine to medium sand with occasional gravel, asphalt fragments (medium dense, moist)			
	5		4	29		2 SA			GP-GM	Brown fine to coarse gravel with silt and sand (medium dense, moist)	5	7	
35													Drill rig grinding on gravel
			8	26		3			SM	Brown silty fine to medium sand with gravel (medium dense, moist) (recessional outwash)			
									SP-SM	Brown fine to coarse sand with silt and gravel (medium dense, moist)			
	10		12	18		4							
30													
			14	26		5			SP-SM	Brown fine to coarse sand with silt and occasional gravel (medium dense, moist)			
	15		10	40		6A 6B			GP-GM	Brown fine to coarse gravel with sand and silt (dense, wet)			Groundwater encountered at 15.5 feet at time of drilling
25													
	20		18	19		7A 7B 7C			SM	Brown silty fine to medium sand with gravel (medium dense, moist)			
20													

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-11

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-12
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/4/2015	End 6/4/2015	Total Depth (ft) 21.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	41.5 NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches soil and hydroseed			
									AC	2 inches asphalt concrete			
40									SM	Dark brown silty fine to medium sand with occasional gravel, organics and glass shards (loose, moist) (fill)			
			14	9		1							
									GP-GM	Brown fine to coarse gravel with silt, sand and trace organics (medium dense, moist)			Rough drilling
	5		3	25		2 SA					6	7	Gravel lodged in sampler shoe
35													
			8	53*		3							*Blow count overstated due to gravel
	10		8	22		4A 4B			SP-SM	Orange-brown fine to coarse sand with silt and gravel (medium dense, moist)			
30													Drilling becomes smoother
			14	11		5			SP	Brown fine to medium sand with occasional gravel (medium dense, moist)			Gravel with some trash debris observed in cuttings between 12 and 15 feet
	15		12	27		6			SM	Brown silty fine to coarse sand with occasional gravel (medium dense, wet) (recessional outwash)			Groundwater encountered at 15.5 feet at time of drilling
25													
									SP-SM	Brown fine to coarse sand with silt and gravel (dense, wet)			
	20		12	37		7							
20													

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-12

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-13
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/4/2015	End 6/4/2015	Total Depth (ft) 51.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	40.5 NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
40	0								TS	3 inches soil and hydroseed			
									SM	Dark brown silty fine to medium sand with occasional gravel and organic matter (medium dense, moist) (fill)			Smoother drilling
			10	13		1							
									SM	Gray silty fine to medium sand with occasional gravel, concrete debris (loose, moist)			
35	5		10	5		2							
			12	20		3				Becomes dark brown with organic content			
									GW-GM	Brown fine to coarse gravel with silt and sand (medium dense, moist) (recessional outwash)			
30	10		12	17		4 SA					3	6	
									SP-SM	Brown fine to medium sand with silt and occasional gravel (medium dense, moist)			
			12	16		5							
									GP-GM	Brown fine to coarse gravel with silt and sand (dense, wet)			Groundwater encountered at 15 feet at time of drilling Gravel in sampler shoe
25	15			39		6							
									SP-SM	Gray-brown fine to coarse sand with silt and gravel (dense, wet)			
20	20		18	34		7							
15	25		18	34		8							

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-13

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-14
Sheet 1 of 2

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample: Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
							GM	Brown silty fine to coarse gravel with sand (medium dense, wet)			
10	30	8	21	9							
							GP-GM	Brown fine to coarse gravel with silt and sand (medium dense, wet)			
5	35	10	34	10							
0	40	8	31	11							
							SM	Brown silty fine sand (medium dense, wet)			
-5	45	14	15	12							
-10	50	18	35	13			SP-SM	Gray fine to medium sand with silt (dense, wet)			

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-13 (continued)

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-14
Sheet 2 of 2

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

Drilled	Start 6/3/2015	End 6/3/2015	Total Depth (ft) 21.5	Logged By IRH / Checked By LCF	Driller Geologic Drill, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	41 NAVD88		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Bobcat MT55 Mini Drill Rig
Latitude / Longitude			System Datum	N/A	Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft)	See remarks
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0								TS	3 inches hydroseed and soil			
40									SM	Brown silty fine to medium sand with gravel (medium dense, moist) (fill)			Grinding during drilling
			0	12		1							No recovery
													Drill rig chatter
	5		8	39*		2 SA			GP-GM	Brown fine to coarse gravel with silt and sand (dense, moist)	3	8	*Blow count may be overstated
35													
			9	30		3							
	10		5	33		4							
30									SP	Brown fine to medium sand with occasional gravel (medium dense, moist) (recessional outwash)			
			14	16		5							
	15		8	31		6			GP-GM	Brown fine to coarse gravel with silt and layers of fine to medium sand with silt (medium dense, wet)			Groundwater encountered at 15.5 feet at time of drilling
25													
	20		10	21		7							
20													

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-14

GEOENGINEERS

Project: Redmond Downtown Park
Project Location: Redmond, Washington
Project Number: 0500-205-00

Figure A-15
Sheet 1 of 1

Redmond: Date:9/29/15 Path:C:\USERS\KJANCI\DESKTOP\050020500.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_STANDARD

APPENDIX B
Laboratory Testing

APPENDIX B
LABORATORY TESTING

Soil samples obtained from the explorations were transported to our laboratory and examined to confirm or modify field classifications, as well as to evaluate engineering properties of the soils. Representative samples were selected for laboratory testing consisting of moisture content determinations, percent fines content, and sieve analyses. The tests were performed in general accordance with test methods of ASTM or other applicable procedures.

Soil Classifications

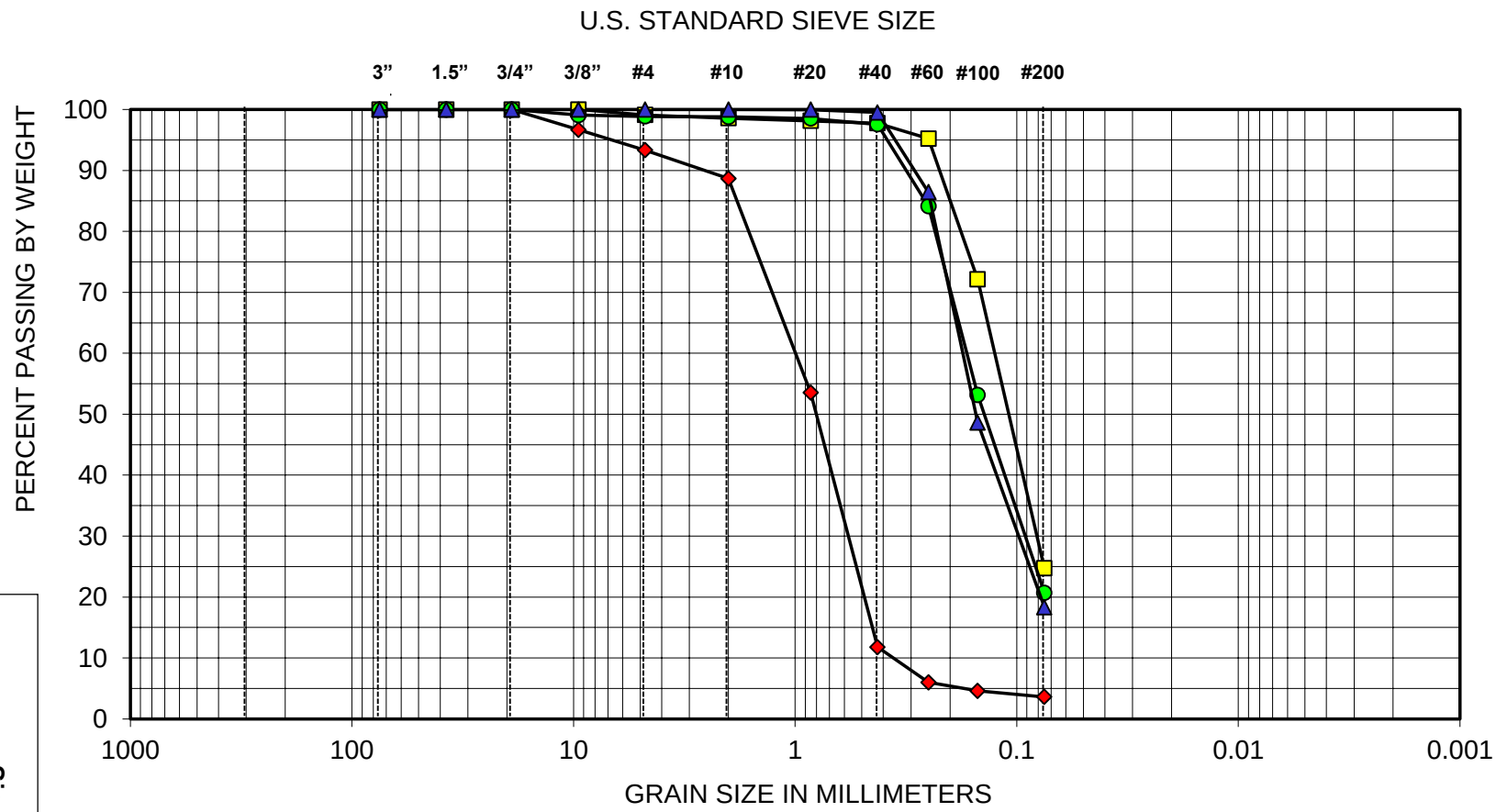
Soil samples obtained from the explorations were visually classified in the field and/or in our laboratory using a system based on the USCS and ASTM classification methods. ASTM test method D 2488 was used to visually classify the soil samples, while ASTM D 2487 was used to classify the soils based on laboratory tests results. These classification procedures are incorporated in the exploration logs shown in Figures A-2 through A-15 in Appendix A.

Moisture Content Determinations

Moisture contents tests were completed in general accordance with ASTM D 2216 for representative samples obtained from the explorations. The test results are presented on the exploration logs in Appendix A at the respective sample depth.

Sieve Analysis

Sieve analyses were performed on selected samples in general accordance with ASTM D 422. The wet sieve analysis method was used to estimate the percentage of soil greater than the U.S. No. 200 mesh sieve. The results of the sieve analyses were plotted, classified in general accordance with the USCS, and presented on Figures B-1 through B-3.



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆	B-1	10	Fine to coarse sand (SP)
□	B-3	12.5	Silty fine sand (SM)
○	B-4	15	Silty fine sand (SM)
▲	B-5	12.5	Silty fine sand (SM)

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The grain size analysis results were obtained in general accordance with ASTM D 6913.

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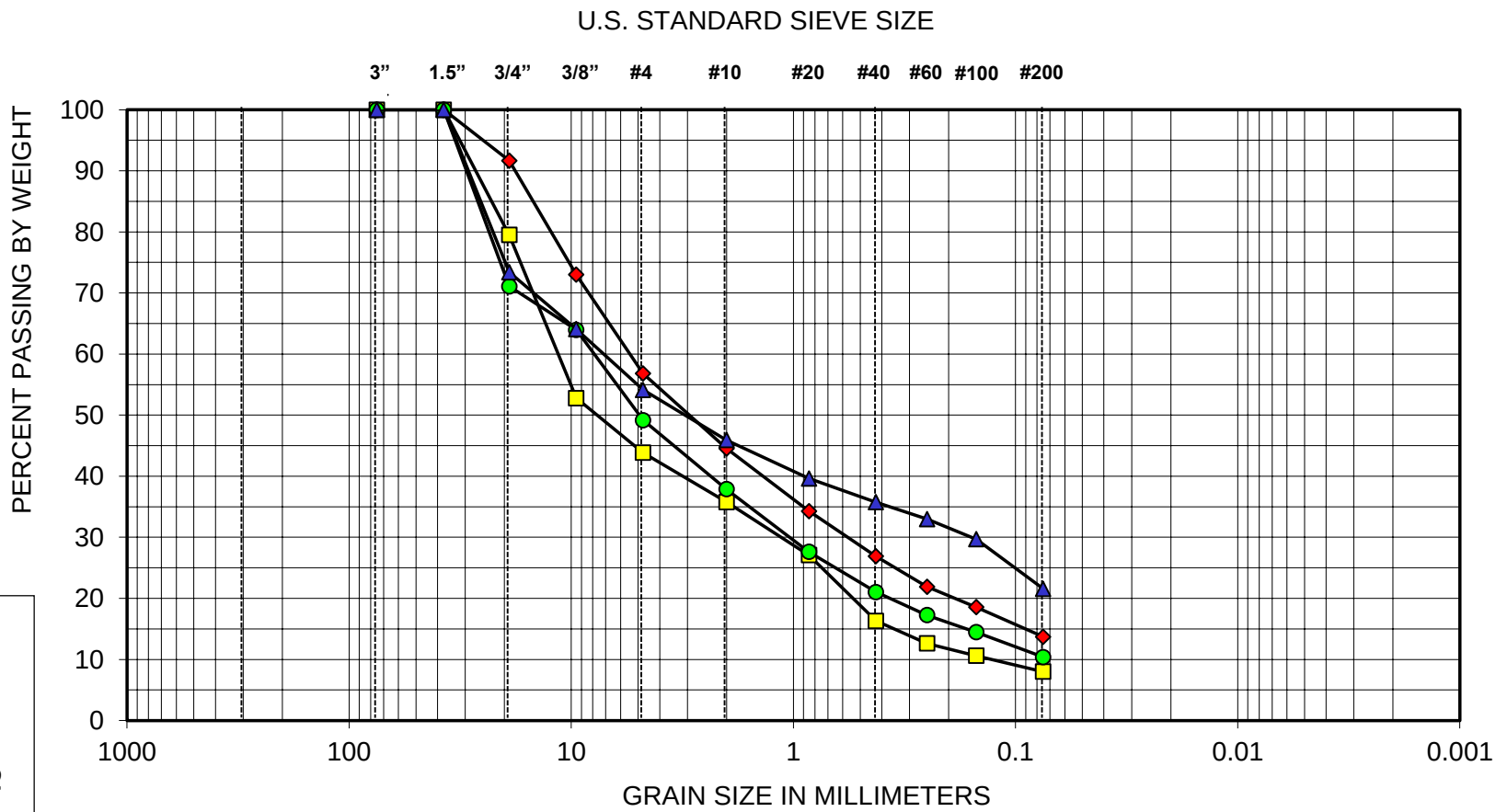
Redmond Downtown Park
Redmond, Washington

Sieve Analysis Results

Figure B-1



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆	B-6	2.5	Silty fine to coarse gravel with sand (GM)
□	B-7	7.5	Fine to coarse gravel with silt and sand (GP-GM)
●	B-9	12.5	Fine to coarse gravel with silt and sand (GP-GM)
▲	B-10	5	Silty fine to coarse gravel with sand (GM)

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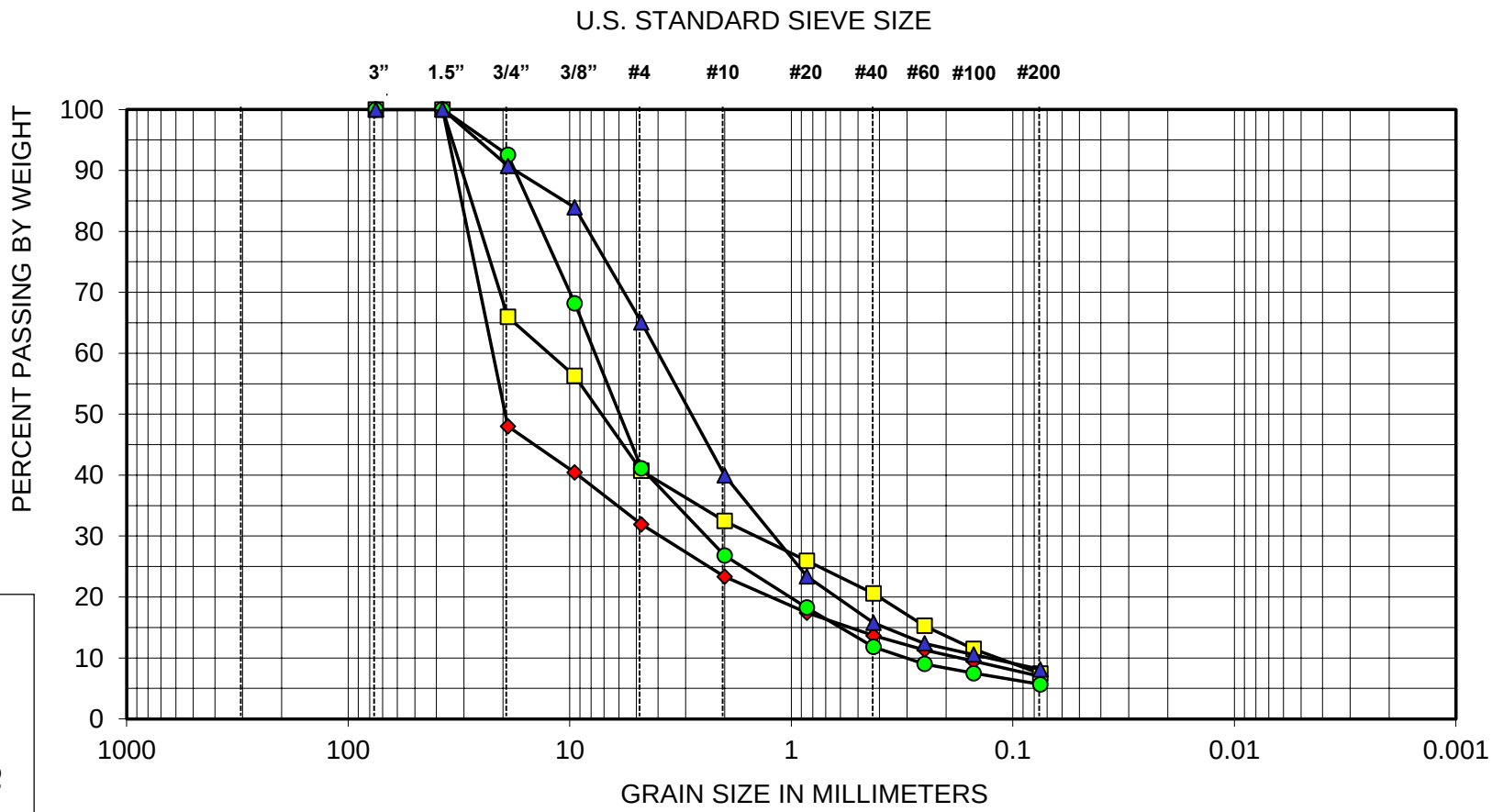
The grain size analysis results were obtained in general accordance with ASTM D 6913.

GEOENGINEERS

Figure B-2

Redmond Downtown Park
Redmond, Washington

Sieve Analysis Results



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆	B-11	5	Fine to coarse gravel with silt and sand (GP-GM)
□	B-12	5	Fine to coarse gravel with silt and sand (GW-GM)
○	B-13	10	Fine to coarse gravel with silt and sand (GW-GM)
▲	B-14	5	Fine to coarse gravel with silt and sand (GW-GM)

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The grain size analysis results were obtained in general accordance with ASTM D 6913.

GEOENGINEERS

Figure B-3

Redmond Downtown Park
Redmond, Washington

Sieve Analysis Results

APPENDIX C
Previous Studies

APPENDIX C
PREVIOUS STUDIES

Included in this section are relevant logs and geophysical evaluations from the following reports completed for previous work in the site vicinity:

- "Report, Phase II Environmental Site Assessment, Redmond Cycle Shop – Estrin Property, 16205 NE Redmond Way, Redmond, Washington," dated April 11, 2011.
- "Report, Geotechnical Engineering Services, 161st Avenue NE Extension, Bear Creek Parkway to Redmond Way, Redmond, Washington," dated June 15, 2010.
- "Report, Supplemental Site Assessment, Redmond Shopping Square, Future 161st Avenue NE Extension Between Cleveland Street and Redmond Way, 16101-16149 NE Redmond Way, Redmond, Washington," dated August 17, 2009.

Drilled Start 2/25/2011 End 2/25/2011	Total Depth (ft) 20	Logged By ARJ Checked By	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum Not Researched		Hammer Data	Drilling Equipment W134 Direct Push	
Easting (X) Northing (Y)		System Datum	Groundwater Date Measured 2/25/2011	Depth to Water (ft) 15.0 / Elevation (ft)
Notes:				

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		18						AC	2 inches asphalt			
									SM	Brown silty fine to medium sand and gravel (fill)			
						1			ML	Dark brown silt (stiff, moist)	NS	<10	
			24			4.5					NS	<10	
	5								SP	Gray-brown mottled fine to medium sand (medium dense, moist)			
						7					NS	<10	
			24										
						9.5 CA					SS	<10	
	10								GW	Gravel with fine to coarse sand (medium dense, moist)			
									SW	Tan fine to coarse sand with gravel and silt (medium dense, moist)			
						11.5					NS	<10	
			24										
									SP	Tan fine to coarse sand with gravel (medium dense, moist)			
	15					14.5 CA	▽				NS	<10	
			36						SP	Tan medium sand (medium dense, wet)			
						17					NS	<10	
	20												

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-1

GEOENGINEERS

Project: Redmond Cycle Shop, 16205 Redmond Way NE
Project Location: Redmond, Washington
Project Number: 0500-178-00

Figure B-2
Sheet 1 of 1

Drilled Start 2/25/2011 End 2/25/2011	Total Depth (ft) 16	Logged By ARJ Checked By	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum Not Researched		Hammer Data	Drilling Equipment W134 Direct Push	
Easting (X) Northing (Y)		System Datum	Groundwater Date Measured 2/25/2011	Depth to Water (ft) 14.0 / Elevation (ft)
Notes:				

Elevation (feet)	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0	24						SM	Brown silty fine to coarse sand with gravel (medium dense, moist)			
					1.5					NS	<10	
		6								NS	<10	
	5											
					6.5					NS	<10	
										NS	<10	
		12										
					9.5			GW	Brown fine to coarse gravel with sand (dense, moist)	NS	<10	
	10											
		30			12 CA					NS	<10	
								SP	Brown medium sand (medium dense, wet)			
					14.5 CA					NS	<10	
	15											

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-2

GEOENGINEERS

Project: Redmond Cycle Shop, 16205 Redmond Way NE
Project Location: Redmond, Washington
Project Number: 0500-178-00

Figure B-3
Sheet 1 of 1

Drilled Start 2/25/2011 End 2/25/2011	Total Depth (ft) 20	Logged By ARJ Checked By	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum Not Researched		Hammer Data	Drilling Equipment W134 Direct Push	
Easting (X) Northing (Y)		System Datum	Groundwater Date Measured 2/25/2011	Depth to Water (ft) 15.0 / Elevation (ft)
Notes:				

FIELD DATA

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name: Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		18						AC	2 inches asphalt			
									GW	Brown gravel with fine to coarse sand (fill)			
						1			ML	Brown silt with trace organics (medium stiff, moist)	NS	<10	
			24			4.5					NS	<10	
	5												
						7			SP	Gray-brown mottled fine to medium sand (dense, moist)	NS	<10	
			24										
	10					9.5					NS	<10	
						11.5			SM	Brown silty fine to coarse sand with gravel (medium dense, moist)	NS	<10	
			18										
						14.5			SW	Brown fine to coarse sand with gravel (dense, moist)	NS	<10	
	15												
						17			SP	Brown medium sand (dense, wet)	NS	<10	
	20												

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-3

GEOENGINEERS

Project: Redmond Cycle Shop, 16205 Redmond Way NE
Project Location: Redmond, Washington
Project Number: 0500-178-00

Figure B-4
Sheet 1 of 1

Drilled Start 2/25/2011 End 2/25/2011	Total Depth (ft) 16	Logged By ARJ Checked By	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum Not Researched		Hammer Data	Drilling Equipment W134 Direct Push	
Easting (X) Northing (Y)		System Datum	Groundwater Date Measured 2/25/2011	Depth to Water (ft) 14.0 / Elevation (ft)
Notes:				

FIELD DATA

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		24						AC	2 inches asphalt			
									SW	Brown fine to coarse sand and gravel with silt (medium dense, moist)	NS	<10	
						1			GM	Gray silty gravel and sand (dense, moist)	NS	<10	
			30									<10	
						4.5					NS	<10	
	5								PEAT	Peat (soft, moist)			
						7					NS	<10	
			24						SP	Gray fine sand (medium dense, moist)			
						9.5					NS	<10	
	10								PEAT	Peat (soft, moist)	NS	<10	
			24			11.5 CA			SM	Brown silty fine to coarse sand with gravel (medium dense, moist)	NS	<10	
									ML	Brown silt (medium stiff, wet)			
	15					14.5 CA					NS	<10	

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-4

GEOENGINEERS

Project: Redmond Cycle Shop, 16205 Redmond Way NE
Project Location: Redmond, Washington
Project Number: 0500-178-00

Figure B-5
Sheet 1 of 1

Drilled Start 2/25/2011	End 2/25/2011	Total Depth (ft) 16	Logged By ARJ / Checked By	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) / Vertical Datum	Not Researched	Hammer Data		Drilling Equipment	W134 Direct Push
Easting (X) / Northing (Y)		System Datum		Groundwater: Date Measured 2/25/2011	Depth to Water (ft) 12.0 / Elevation (ft)
Notes:					

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name: Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		24						AC	2 inches asphalt			
									SM	Brown silty fine to medium sand (fill)			
									GM	Dark brown silty gravel with sand (dense, moist)			
						1.5					NS	<10	
			6										
						4.5					–	–	
	5												
									OL	Dark brown organic rich silt (soft, moist)			
						7					NS	<10	
			24								NS	<10	
									PEAT	Peat (soft, moist)			
						9.5 CA					NS	<10	
	10								SP	Gray fine to medium sand (medium dense, wet)			
			24			12 CA	▽		SW	Brown medium to coarse sand with gravel and trace silt (dense, wet)	NS	<10	
									SM	Brown silty medium sand with gravel (medium dense, wet)	NS	<10	
	15												

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-5

GEOENGINEERS

Project: Redmond Cycle Shop, 16205 Redmond Way NE
Project Location: Redmond, Washington
Project Number: 0500-178-00

Figure B-6
Sheet 1 of 1

Drilled Start 2/25/2011 End 2/25/2011	Total Depth (ft) 16	Logged By ARJ Checked By	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum Not Researched		Hammer Data	Drilling Equipment W134 Direct Push	
Easting (X) Northing (Y)		System Datum	Groundwater Date Measured 2/25/2011	Depth to Water (ft) 12.0 / Elevation (ft)
Notes:				

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		24						AC	2 inches asphalt			
									SM	Brown silty sand with gravel (medium dense, moist)			
						1.5					NS	<10	
											NS	<10	
			24						PEAT	Peat (soft, moist)			
	5					5					NS	<10	
						7					NS	<10	
									SP	Gray brown mottled fine sand (medium dense, moist)			
			24										
						9.5					NS	<10	
	10								PEAT	Peat (soft, moist)	NS	<10	
									SM	Brown silty fine to coarse sand with gravel (dense, wet)			
						11.5 CA					NS	<10	
						14.5 CA					NS	<10	
	15												

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-6

GEOENGINEERS

Project: Redmond Cycle Shop, 16205 Redmond Way NE
Project Location: Redmond, Washington
Project Number: 0500-178-00

Figure B-7
Sheet 1 of 1

Drilled Start 2/25/2011 End 2/25/2011	Total Depth (ft) 20	Logged By ARJ Checked By	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum: Not Researched		Hammer Data	Drilling Equipment	W134 Direct Push
Easting (X) Northing (Y)		System Datum	Groundwater Date Measured: 2/25/2011	Depth to Water (ft): 16.0 / Elevation (ft)
Notes:				

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		10						AC	2 inches asphalt			
						1			SP	Brown fine to medium sand (medium dense, moist))	NS	<10	
			30										
						4.5			ML	Dark brown silt (stiff, moist)	NS	<10	
	5												
						7			SP	Gray-brown mottled fine sand (medium dense, moist)	NS	<10	
			18										
	10										SS	<10	Organic sheen and odor
						10.5 CA					NS	<10	
									GP	Pea gravel (loose, moist) (fill)			
			18						SW	Brown fine to coarse sand and gravel (medium dense, moist)			
	15					14.5 CA					NS	<10	
			24										
						17					NS	<10	
											NS	<10	
									SP	Brown medium sand (dense, wet)			
	20												

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-7

GEOENGINEERS

Project: Redmond Cycle Shop, 16205 Redmond Way NE
Project Location: Redmond, Washington
Project Number: 0500-178-00

Figure B-8
Sheet 1 of 1

Drilled	Start 2/1/2010	End 2/1/2010	Total Depth (ft) 26.5	Logged By BHC / Checked By DPC	Driller Boretec	Drilling Method Hollow Stem Auger

Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Volvo EC 55
Surface Elevation (ft) / Vertical Datum	38.5 NAVD88	Top of Casing Elevation (ft)	38.0
Easting (X) / Northing (Y)	1322037.4 / 248797.9	Horizontal Datum	NAD83

A 2 (in) well was installed on 2/1/2010 to a depth of 25 (ft).

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
2/1/2010	12.0	26.50

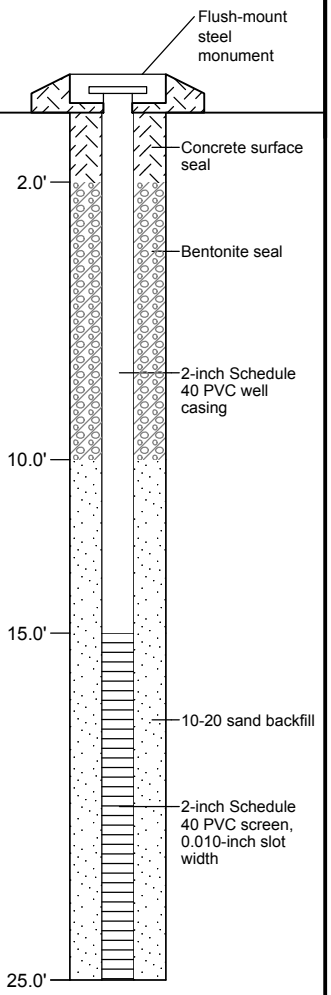
Notes:

FIELD DATA

Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name	Water Level	Group Classification	MATERIAL DESCRIPTION	Sheen	Moisture Content %
0							AC	7 inches of asphalt concrete pavement		
							SM	Dark brown silty fine to coarse sand with gravel (loose to medium dense, moist) (fill)		
		6	10		1				NS	17
5		6	6		2		SM	Gray silty fine to medium sand with gravel and trace organics (loose, moist)	NS	22
							OL/ML	Dark brown organic silt (medium stiff, moist)		
10		2	23		3	▼	SM	Dark brown silty fine to coarse sand with gravel and occasional cobbles (medium dense, moist to wet)	NS	
15		6	11		4		SP	Gray fine to coarse sand with gravel, trace silt and occasional cobbles (medium dense, wet)		20
20		5	16		5			Moderate heaving at 20 feet bgs		
25		6	15		6					

Elevation (feet): 35, 30, 25, 20, 15

WELL LOG



Note: Please see Figure A-1 for explanation of symbols

Log of Monitoring Well MW-343

GEOENGINEERS

Project: 161st Ave NE Ext - Bear Crk Pkwy to Redmond Way
Project Location: Redmond, Washington
Project Number: 0500-164-00

Figure A-2
Sheet 1 of 1

Redmond: Date:4/6/10 Path:W:\REDMOND\PROJECTS\0\0500164\GINT\0500164GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_WELL

Drilled	Start 2/1/2010	End 2/1/2010	Total Depth (ft) 26.5	Logged By BHC / Checked By DPC	Driller Boretec	Drilling Method Hollow Stem Auger

Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Volvo EC 55
Surface Elevation (ft) Vertical Datum	40.5 NAVD88	Top of Casing Elevation (ft)	40.3
Easting (X) Northing (Y)	1321993.5 248523.2	Horizontal Datum	NAD83

A 2 (in) well was installed on 2/1/2010 to a depth of 20 (ft).

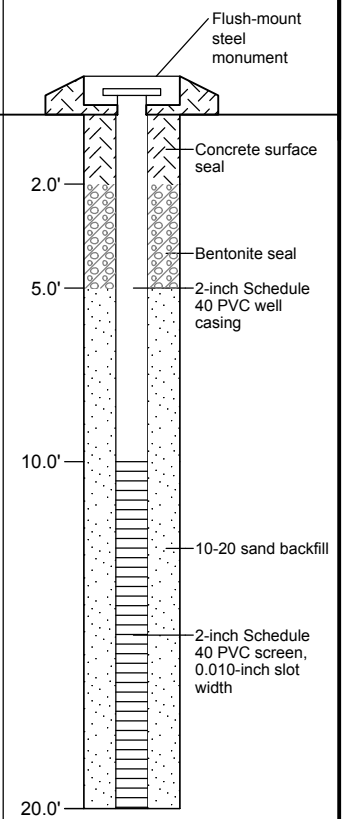
Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
2/1/2010	13.5	27.00

Notes:

FIELD DATA

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Moisture Content %
40	0								AC	7.5 inches asphalt concrete pavement		
									SP-SM	Dark brown fine to coarse sand with gravel, silt and occasional cobbles (medium dense, moist)		
			16	19		1					NS	7
35	5		4	19		2					NS	
									SP-SM	Brown fine to coarse sand with silt and gravel and occasional cobbles (loose to medium dense, moist to wet)		
30	10		4	6		3	▼				SS	6
25	15		18	11		4			SP	Brown fine to coarse sand with gravel, trace silt and occasional cobbles (medium dense, wet)	NS	13
20	20		18	23		5				Heaving sands		
15	25		18	21		6						

WELL LOG



Note: Please see Figure A-1 for explanation of symbols

Log of Monitoring Well MW-344

GEOENGINEERS

Project: 161st Ave NE Ext - Bear Crk Pkwy to Redmond Way
Project Location: Redmond, Washington
Project Number: 0500-164-00

Figure A-3
Sheet 1 of 1

Redmond: Date:4/6/10 Path:W:\REDMOND\PROJECTS\0\0500164\GINT\050016400.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_WELL

Drilled Start 6/29/2009 End 6/29/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push, Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/29/2009	Depth to Water (ft) 11.5 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Depth (feet)	Interval / Recovered (in)	Blows/foot	Collected Sample / Sample Name / Testing	Water Level	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
0					AC	3 inches asphalt			
					SM	Brown silty fine to medium sand with gravel			
	☒		1				NS	<10	
	☒		2 CA			Brown medium to coarse sand with occasional gravel (moist)	SS	<10	
5					PT	Brown peat with 1-inch interbedded gray fine to medium sand lenses (soft, moist)			
			3				NS	<10	
			4			Brown peat (soft, moist)	NS	<10	
10			5				NS	<10	
			6	▽	SP	Gray fine sand (wet)	NS	<10	
			7				NS	<10	
15			8				NS	<10	
			9				NS	<10	
			10				NS	<10	
20									

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-1

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-2
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate\LibTemplate\GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/29/2009 End 6/29/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push, Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/29/2009	Depth to Water (ft) 12.0 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0								AC	3 inches asphalt			
									SW-SM	Brown silty medium to coarse sand with occasional gravel (moist)			
						1					NS	<10	
						2				Gray silty fine to medium sand with occasional gravel (moist)	NS	<10	
	5								PT	Brown peat with interbedded gray sand (moist, soft)			
						3					NS	<10	
						4				Brown peat (moist, soft)	NS	<10	
	10					5 CA					NS	<10	
						6	▽		SP	Gray fine sand (wet)	NS	<10	
						7				Gray medium sand	NS	<10	
	15												
						8			SW-SM	Gray fine to coarse sand with silt and gravel (wet)	NS	<10	
						9					NS	<10	
						10					NS	<10	
	20												

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-2

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-3
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/29/2009 End 6/29/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/29/2009	Depth to Water (ft) 11.0 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0								AC	3 inches asphalt			
									SW	Brown fine to coarse sand with occasional gravel and silt (medium dense, moist)			
						1					NS	<10	
									PT	Brown peat (soft, moist)			
						2					NS	<10	
	5									Brown peat (soft, wet)			
						3					NS	<10	
						4				Brown peat (soft, moist)	NS	<10	
	10					5					NS	<10	
							▽		SP	Gray fine sand (wet)			
						6 CA					NS	<10	
						7					NS	<10	
	15												
						8					NS	<10	
						9					NS	<10	
						10					NS	<10	
	20												

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-3

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-4
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate\LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/29/2009 End 6/29/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Truck-Mounted Direct Push/Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/29/2009	Depth to Water (ft) 10.5 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0								AC	3 inches asphalt			
									SW-SM	Brown silty medium to coarse sand with gravel (moist)			
		☒				1					NS	<10	
		☒				2				Brown medium to coarse sand with gravel (moist)	NS	<10	
									PT	Brown peat (soft, moist)			
	5					3					NS	<10	
						4					NS	<10	
										Brown peat with fine gray sand interbedded (soft, moist)			
	10					5	▽				NS	<10	
									SP	Gray fine sand (medium dense to dense, wet)			
						6					NS	<10	
						7					NS	<10	
	15												
						8					NS	<10	
									SW	Gray fine to medium sand with gravel (angular) (wet)			
						9					NS	<10	
						10				No recovery	NS	<10	Rock in shoe.
	20												

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-4

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-5
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate\LibTemplate\GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/29/2009 End 6/29/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push Truck Mount	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/29/2009	Depth to Water (ft) 13.0 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0								AC	3 inches asphalt			
									SM	Brown silty fine to medium sand with gravel (medium dense, moist)			
		☒				1					NS	<10	
		☒				2					NS	<10	
	5								PT	Brown peat with 3-inch gray fine sand lense (soft, moist)			
						3					NS	<10	
						4				Brown peat with 1/2-inch interbedded gray fine sand lenses (soft, moist)	NS	<10	
	10					5				Brown peat (soft, moist)	NS	<10	
									SP	Fine gray sand (medium dense, very moist)			
						6	▽				NS	<10	
						7				Gray medium sand (wet)	NS	<10	
	15					8				Gray medium sand with angular gravel (wet)	NS	<10	
						9					NS	<10	
						10				No recovery	NS	<10	
	20												

Note: See Figure B-1 for explanation of symbols.

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate:LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Log of Boring B-5

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-6
Sheet 1 of 1

Drilled Start 6/29/2009 End 6/29/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push, Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/29/2009	Depth to Water (ft) 10.5 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0								AC	3 inches asphalt			
									SW	Brown fine to coarse sand with gravel and trace silt (medium dense, moist)			
						1					NS	<10	
									PT	Brown peat with occasional fine gravel (soft, moist)			
						2					NS	<10	
	5									Brown peat (soft, moist)			
						3					NS	<10	
						4					NS	<10	
	10					5 CA	▽				NS	<10	
									SM	Gray silty fine sand (medium dense, wet)			
						6					NS	<10	
						7				Gray fine sand	NS	<10	
	15												
						8					NS	<10	
									SW	Gray fine to medium sand with gravel (wet)			
						9					NS	<10	
						10					NS	<10	
	20												

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-6

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-7
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/29/2009 End 6/29/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push, Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/29/2009	Depth to Water (ft) 11.0 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0								AC	3 inches asphalt			
									SW	Brown fine to medium sand with occasional gravel			
						1					NS	<10	
						2					NS	<10	
									PT	Brown peat (soft, moist)			
	5					3					NS	<10	
						4					NS	<10	
	10					5	▽				NS	<10	
									WD	Log at base of peat			
						6 CA			SP	Gray fine sand (medium dense, wet)	NS	<10	
						7					NS	<10	
	15					8					NS	<10	
						9					NS	<10	
						10			SW	Gray fine to coarse sand with angular gravel	NS	<10	
	20												

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-7

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-8
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/29/2009 End 6/30/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push, Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/29/2009	Depth to Water (ft) 11.5 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval / Recovered (in)	Blows/foot	Collected Sample / Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0						CC	3 inches concrete			
							SW	Brown fine to coarse sand with gravel and silt (medium dense, moist)			
				1					NS	<10	
				2					NS	<10	
	5						PT	Brown peat with occasional gray fine sand lenses (soft, moist)			
				3					NS	<10	
								Brown peat (soft, moist)			
				4					NS	<10	
	10			5					NS	<10	
					▽		SP	Gray fine sand (medium dense, wet)			
				6					NS	<10	
				7					NS	<10	
	15										
				8					NS	<10	
				9					NS	<10	
				10			SW	Gray fine to medium sand with angular gravel (wet)	NS	<10	
	20										

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-8

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-9
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate\LibTemplate\GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/30/2009 End 6/30/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push, Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/30/2009	Depth to Water (ft) 15.0 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0								AC	3 inches asphalt			
									SP	Brown fine sand (medium dense, dry)			
		☒				1					NS	<10	
		☒				2					NS	<10	
										Brown fine to medium sand with silt and gravel (medium dense, dry)			
	5												
						3				Brown medium sand (medium dense, dry)	NS	<10	
						4					NS	<10	
	10					5					NS	<10	
						6			SW	Brown fine to coarse sand with gravel and trace silt (medium dense, moist)	NS	<10	
						7			SP	Brown medium sand (dense, moist)	NS	<10	
	15						▽						
						8			SW	Brown fine to coarse sand with gravel (dense, wet)	NS	<10	
						9					NS	<10	
						10					NS	<10	
	20												

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-9

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-10
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate\LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/30/2009 End 6/30/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined		Hammer Data		Drilling Equipment Direct Push, Air Knife
Easting (X) Northing (Y)		System Datum		Groundwater: Date Measured 6/30/2009; Depth to Water (ft) Not Encountered; Elevation (ft)

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0							SM	Brown silty fine sand with gravel and cobbles			
		☒			1					NS	<10	
									No recovery to base of boring			No recovery between 4 and 20 feet bgs due to gravel. Decision made to obtain groundwater sample only.
	5											
	10					▽						
	15											
	20											

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-10

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-11
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate\LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/30/2009 End 6/30/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push, Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/30/2009	Depth to Water (ft) 14.5 / Elevation (ft) Undetermined

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0							AC	3 inches asphalt			
								GP	Coarse gravel and cobbles			
								SM	Brown silty fine to medium sand with gravel and cobbles (moist)			No sample obtained due to rocks.
					1					NS	<10	
	5											
					2			SP	Brown medium sand (medium dense, moist)	NS	<10	
					3					NS	<10	
	10				4					NS	<10	
					5					NS	<10	
					6	▽			Gray medium sand with occasional gravel (medium dense, moist)	NS	<10	
	15								Gray medium sand with occasional gravel (medium dense, wet)			
					7					NS	<10	
	20											

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-11

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-12
Sheet 1 of 1

Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate\LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Drilled Start 6/30/2009 End 6/30/2009	Total Depth (ft) 20	Logged By ARJ Checked By JAS	Driller Cascade	Drilling Method Direct Push, Air Knife
Surface Elevation (ft) Vertical Datum Undetermined	Hammer Data		Drilling Equipment Direct Push, Air Knife	
Easting (X) Northing (Y)	System Datum		Groundwater Date Measured 6/30/2009	Depth to Water (ft) Not Encountered / Elevation (ft)

Notes: Air-knife used from approximately 0 to 5 feet bgs. Grab soil samples were obtained using a hand auger.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval / Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0							SP	Brown fine to medium sand with gravel (medium dense, moist)			
					1					NS	<10	
												No sample obtained due to cobbles.
	5								Brown medium sand (moist)			
					2					NS	<10	
					3					NS	<10	
									No Recovery to base of boring			No recovery between 9 and 20 feet bgs due to coarse gravel. Obtained groundwater sample only.
	10											
	15											
	20											

Note: See Figure B-1 for explanation of symbols.

Log of Boring B-12

GEOENGINEERS

Project: Redmond Shopping Square, Redmond, Washington
Project Location: 16101-16149 NE Redmond Way
Project Number: 0500-158-00

Figure B-13
Sheet 1 of 1

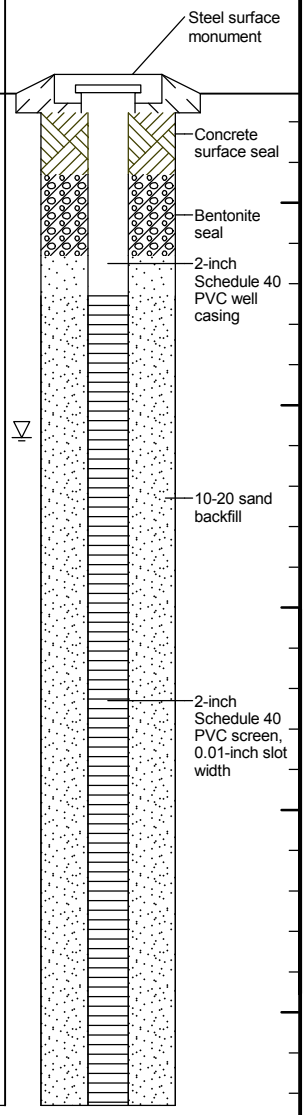
Redmond: Date:8/13/09 Path:W:\REDMOND\PROJECTS\0\0500158\GINT\0500158.GPJ DBTemplate\LibTemplate:GEOENGINEERS8.GDT/GEI8_ENVIRONMENTAL_STANDARD

Date(s) Drilled	07/21/07	Logged By	SHL	Checked By	GJA
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4-inch ID Hollow-stem Auger	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	Truck-mounted Drill Rig
Total Well Depth (ft)	25	Ground Surface Elevation (ft)	37.7	Groundwater Elevation (ft)	29.2
Vertical Datum	NAVD88	Datum/ System	NAD83	Easting(x): Northing(y):	1322088.6 248703.5

Elevation feet	Depth feet	Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Testing	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV (ppm)
	0						AC	3 inches asphalt		
							SP	Brown fine to coarse sand with gravel (medium dense, moist)		
		16	11	1	CA				SS	<1
	5	16	4	2					NS	<1
		16	15	3				Decreasing gravel, becomes wet	NS	<1
	10	16	15	4					NS	<1
		16	15	5					NS	<1
	15	16	9	6				Becomes loose	NS	<1
		16	9	7					NS	<1
	20	16	8	8			SM	Brown and gray silty fine sand (medium dense, wet)	NS	<1
		12	10	9			SP	Gray fine to coarse sand (loose, wet)	NS	<1
	25									
	30									

Note: See Figure C-1 for explanation of symbols.

WELL CONSTRUCTION



LOG OF MONITORING WELL MW-087

GEOENGINEERS

Project: Redmond Shopping Square
Project Location: Redmond, Washington
Project Number: 0500-164-00

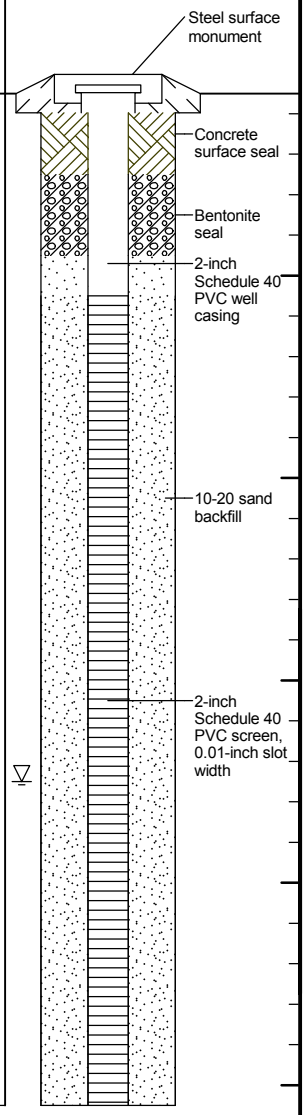
Figure C-2
Sheet 1 of 1

V6_ENVWELL W:\REDMOND\PROJECTS\0\0500164\GINT\050013302-BEAR CREEK.GPJ GEIV6_1.GDT 4/6/10

Date(s) Drilled	07/21/07	Logged By	SHL	Checked By	GJA
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4-inch ID Hollow-stem Auger	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	Truck-mounted Drill Rig
Total Well Depth (ft)	25	Ground Surface Elevation (ft)	39.5	Groundwater Elevation (ft)	22.5
Vertical Datum	NAVD88	Datum/ System	NAD83	Easting(x): Northing(y):	1321971 248615.2

Elevation feet	Depth feet	SAMPLES Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Testing	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV (ppm)
	0						AC	1 foot asphalt (continuous layer)		
							SW	Brown fine to coarse sand with gravel (medium dense/moist) (almost dry)		
		16	18	1					NS	<1
	5	16	13	2					NS	<1
		16	10	3					NS	<1
							SP	Brown medium to coarse sand with gravel (medium dense, moist)		
	10	16	9	4					NS	<1
		16	10	5					NS	<1
	15	16	14	6					NS	<1
		16	16	7	CA			Becomes wet	NS	<1
	20	14	13	8					NS	<1
		16	12	9					NS	<1
									NS	<1
	25									
	30									

WELL CONSTRUCTION



Note: See Figure C-1 for explanation of symbols.

LOG OF MONITORING WELL MW-088

GEOENGINEERS

Project: Redmond Shopping Square
Project Location: Redmond, Washington
Project Number: 0500-164-00

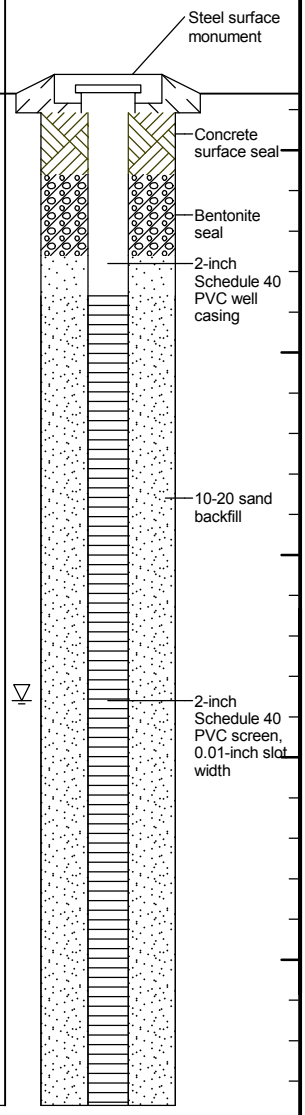
Figure C-3
Sheet 1 of 1

V6_ENVWELL W:\REDMOND\PROJECTS\0\0500164\GINT\050013302-BEAR CREEK.GPJ GEIV6_1.GDT 4/6/10

Date(s) Drilled	07/21/07	Logged By	SHL	Checked By	GJA
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4-inch ID Hollow-stem Auger	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	Truck-mounted Drill Rig
Total Well Depth (ft)	25	Ground Surface Elevation (ft)	41.4	Groundwater Elevation (ft)	26.4
Vertical Datum	NAVD88	Datum/ System	NAD83	Easting(x): Northing(y):	1321936.6 248648.1

Elevation feet	Depth feet	SAMPLES Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Testing	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV (ppm)
	0						AC	1 foot asphalt		
							SP	Brown medium to coarse sand with gravel (medium dense, moist) Cobbles at 2 feet		
		16		1					SS	<1
	5	16	13	2					NS	<1
		16	11	3					NS	<1
	10	16	10	4					NS	<1
		16	11	5	CA				NS	<1
	15	16	26	6					NS	<1
							GP	Fine to coarse gravel with sand (medium dense, wet)		
		16	18	7					NS	<1
							SP	Brown coarse sand (medium dense, wet)		
	20	16	24	8					NS	<1
		12	19	9					NS	<1
	25									
	30									

WELL CONSTRUCTION



Note: See Figure C-1 for explanation of symbols.

LOG OF MONITORING WELL MW-089

GEOENGINEERS

Project: Redmond Shopping Square
Project Location: Redmond, Washington
Project Number: 0500-164-00

Figure C-4
Sheet 1 of 1

V6_ENVWELL W:\REDMOND\PROJECTS\0\0500164\GINT\050013302-BEAR CREEK.GPJ GEIV6_1.GDT 4/6/10

Global Geophysics
16651 White Mountain Road SE
Monroe, WA 98272
Tel: 425-890-4321
Fax: 360-805-0259

January 18, 2010 Our ref: 093-0623-001.000

GeoEngineers
8410 154th Avenue NE
Redmond, Washington 98052

ATTENTION: Mr. Daniel Ciani

RE: REPORT FOR PEAT LAYER DELINEATING AT 16149 NE REDMOND WAY, REDMOND, WA

This letter report presents the results of the geophysical survey performed by Global Geophysics in June (Phase 1: septic tank locate) and December (Phase 2: peat layer delineating), 2009 at 16149 NE Redmond Way, Redmond, Washington. The objective of the Phase 2 study was to delineate the peat layer encountered in boreholes B1 through B8. Ground penetrating radar (GPR) was used for the survey. The followings describe the methods and results.

METHODOLOGY, INSTRUMENTATION AND FIELD PROCEDURES

The GPR method uses electromagnetic pulses, emitted at regular intervals by an antenna to map subsurface features. The electromagnetic pulses are reflected where changes in electrical properties of materials occur such as changes in lithology or where voids are present. The reflected electromagnetic energy is received by an antenna, converted into an electrical signal, and recorded on the GPR unit. The data is recorded and viewed in real time on a graphical display that depicts a continuous profile or cross-section image of the subsurface directly beneath the path of the antenna.

The depth of penetration of the GPR signal varies according to antenna frequency and the conductivity of the subsurface material. The depth of subsurface penetration decreases with an increase in the frequency of the antenna and an increase in soil conductivity.

The data at this site were collected using Geophysical Survey Systems, Inc. (GSSI) SIR 2000 GPR system. An antenna having a center frequency of 200MHz was used for the investigation.

RESULTS

The GPR data were collected in an area of 230 ft by 200 ft along transects 5-10 feet apart in orthogonal directions. The survey area is shown in Figure 1. The interpreted depth to the top and bottom of the peat layer and isopach are shown in the Figure 2. The thickness of the peat layer varies from 0 to 7.5 ft.

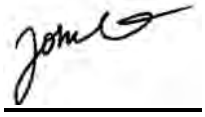
LIMITATIONS

Global Geophysics's services are conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services. Ground penetrating radar (GPR) is remote sensing geophysical method that may not detect all subsurface features. The diffractions from the underground utilities frequently disrupt the reflectors from the top and bottom of the peat layer and make the reflector tracing difficult. The errors in the calculated depths and thickness of the peat layer may be in the range of ± 1.0-1.5 ft

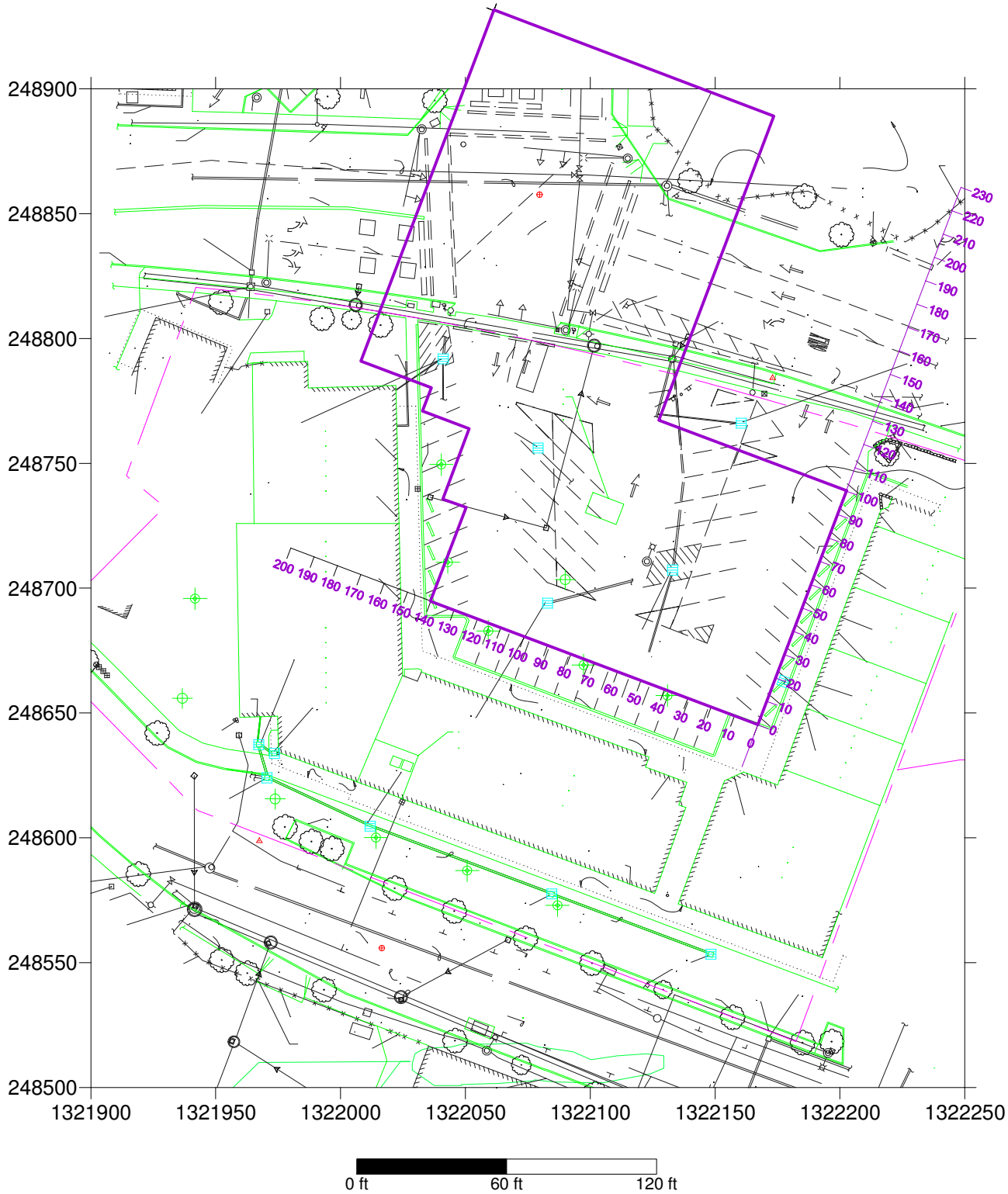
If you have any questions or require additional information, please contact us at 425-890-4321.

Sincerely,

Global Geophysics



John Liu, Ph.D.
Principal Geophysicist



Legend

Surveyed Area With GPR

PROJECT

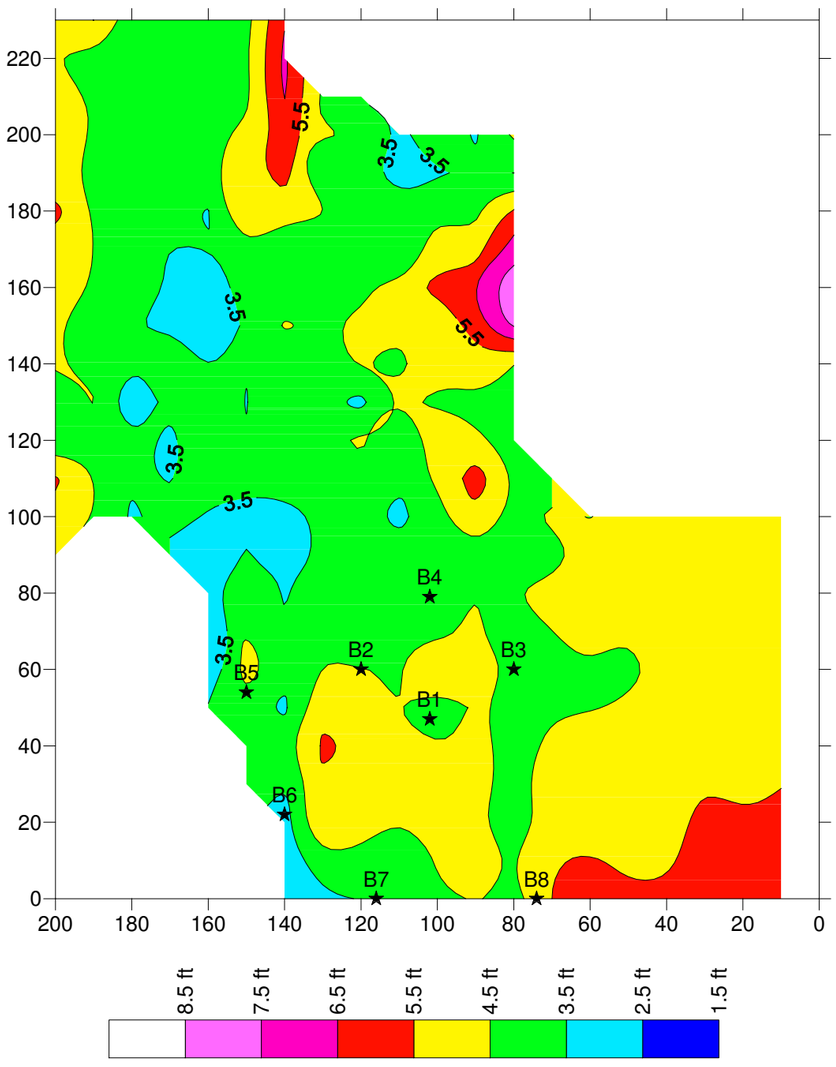
Ground Penetrating Survey
At 16101-16149 NE Redmond Way
Redmond, WA

TITLE

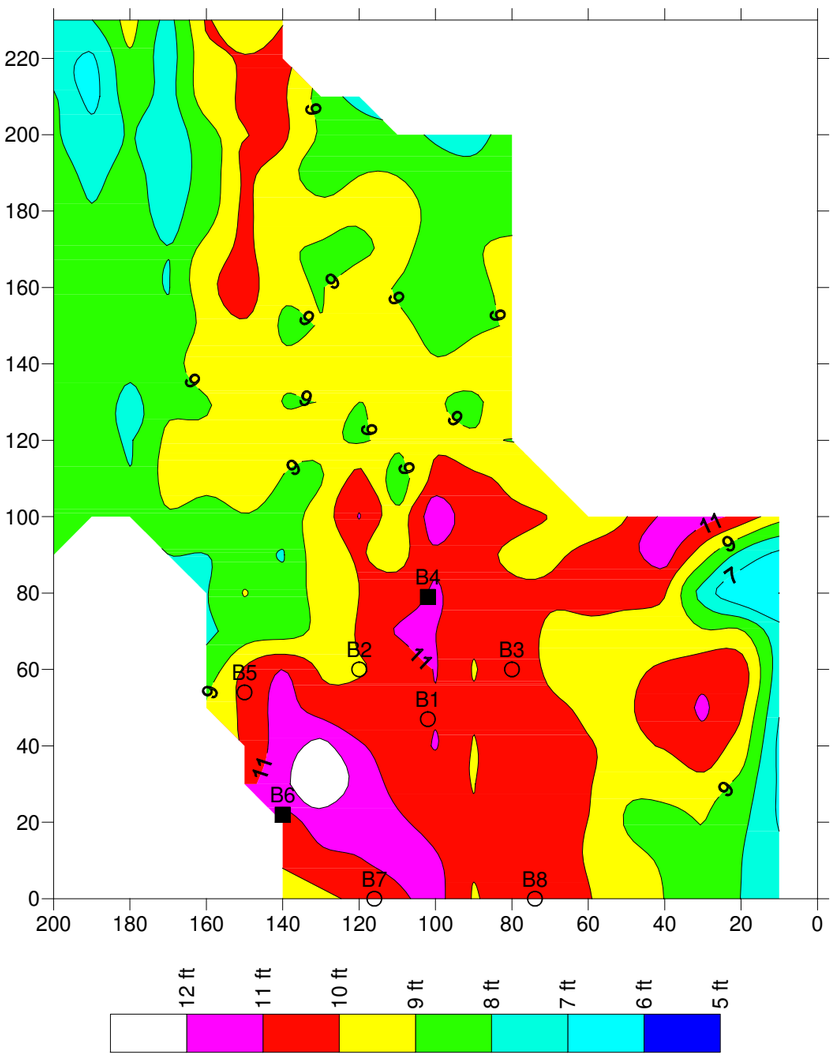
Site Plan Showing the Survey Area

Global Geophysics
16651 White Mountain Road SE
Monroe, WA, 98272
Tel: 425-890-4321

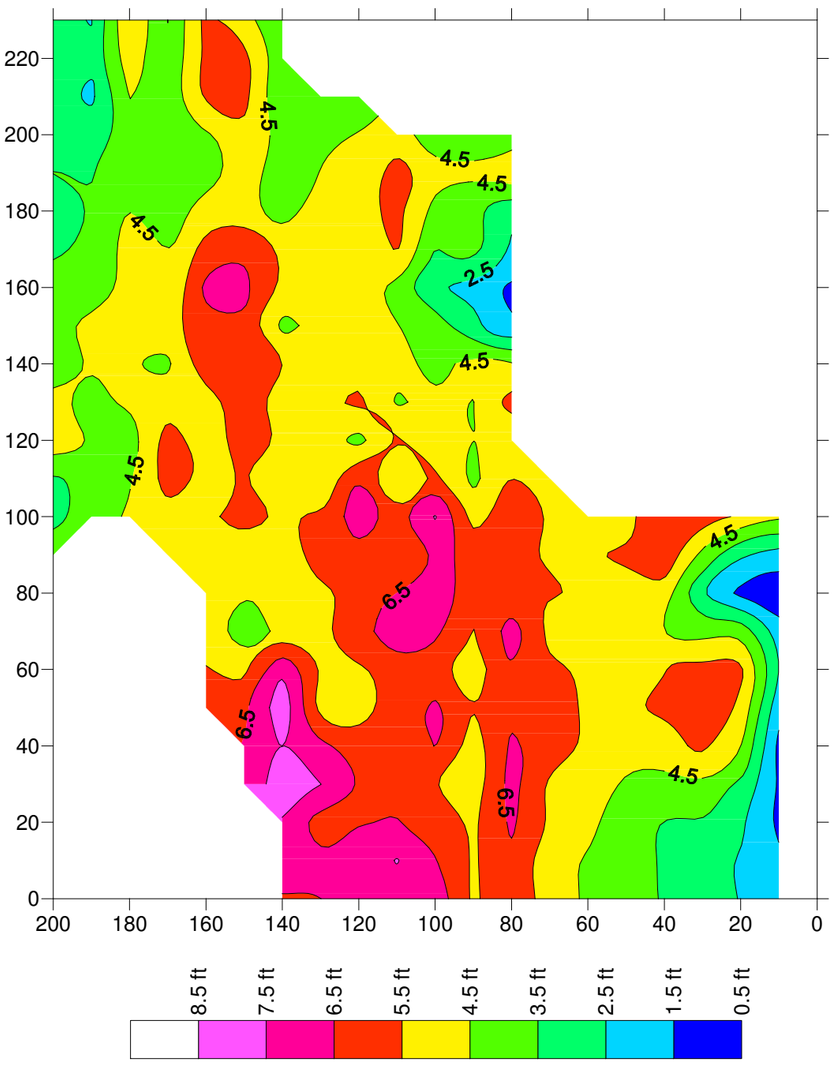
PROJECT No.	093-0623.000	FILE No.
DESIGN	--	SCALE AS SHOWN / REV.
CADD	JL	**FIGURE 1**
CHECK	--	
REVIEW	--	



Depth to the top of the peat layer



Depth to the bottom of the peat layer



Isopach of interpreted peat layer

0 ft 40 ft 80 ft

PROJECT
Ground Penetrating Survey
At 16101-16149 NE Redmond Way
Redmond, WA

TITLE
Contour Plans Showing The Depths to The Top And Bottom Of The Peat Layer, And The Thickness Of The Peat Layer

Global Geophysics
16651 White Mountain Road SE
Monroe, WA, 98272
Tel: 425-890-4321

PROJECT No.	093-0623.000	FILE No.
DESIGN	--	SCALE AS SHOWN REV.
CADD	JL	**FIGURE 2**
CHECK	--	
REVIEW	--	

APPENDIX D
Geophysical Evaluation

GEOPHYSICAL INVESTIGATION

PEAT INVESTIGATION
REDMOND DOWNTOWN PARK
REDMOND, WASHINGTON

FOR

GEOENGINEERS, INC.
REDMOND, WASHINGTON

JUNE 24, 2015

PHILIP H. DUOOS
GEOPHYSICAL CONSULTANT

Philip H. Duoos **Geophysical Consultant**

June 24, 2015 Our Ref: 1169-15

Ms. Lindsay Flangas
GeoEngineers
8410 154th Avenue NE
Redmond, WA 98052

REPORT: Geophysical Investigation
Redmond Downtown Park
Redmond Way, Redmond, WA

Dear Ms. Flangas:

This report provides the results of the geophysical survey that I performed on Wednesday, May 6, 2015 at the site. Preliminary results were provided to you on May 20th to assist you in locating additional borings. The data were reviewed and some changes to the interpretation were made based on the new boring results. The purpose of the investigation was to locate areas with peat, and to determine the depth to the top and bottom of the peat layer.

The investigation was performed using ground penetrating radar (GPR) and electromagnetic conductivity instruments. The GPR data was obtained with a GSSI SIR 3000 Digital Radar System and a 200 MHz antenna. The GPR depth of investigation is estimated at about 12 feet in areas with peat, and greater than about 16 feet in areas without peat. A Geonics EM-31 electromagnetic instrument was used to measure electrical properties of the soils to a depth of about 18 feet. A brief description of the methods is attached.

The EM-31 instrument responds to the electrical properties of the subsurface. Higher EM-31 conductivity values correlate to the thicker layer of peat in the western portion of the site. The GPR data shows a strong reflective layer at the interpreted base of the peat layer. The top of the peat is also present in the GPR data, but is more difficult to resolve. The GPR data also indicates that the thicker layer of peat is generally below the western portion of the site.

GEOPHYSICAL METHODOLOGY

GPR and EM-31 data were gathered along numerous lines oriented both east-west and north-south across the site. Figure 1 shows the locations of the EM-31 and GPR survey lines. Additional GPR lines were run 5 to 10 feet away from these lines to provide additional information. Several reference lines were marked at 20-foot intervals across the site using temporary PVC pin flags. The reference point for the reference baselines was at the northwest corner of the job in the asphalt parking lot, which was located at grid point 165E, 220N (shown on Figure 1).

GPR data were recorded continuously along the survey lines. EM-31 electrical conductivity data were recorded at 5-foot intervals along each line, using both the deep (18-foot) and shallow (9-foot) effective depth modes of the instrument.

Philip H. Duoos **13503 NE 78th Place, Redmond, Washington, 98052**
PH/FAX: (425) 882-2634, CELL: (425) 765-6316 **Email: geopyg@aol.com**

GEOPHYSICAL INTERPRETATION RESULTS

Interpretation of the EM-31 data indicates that the western portion of the site has higher conductivity values, which seems to correlate with the peat observed in the borings. A questionable zone of elevated conductivity values was observed along Line 280E, but may be related to interference from buried metal related to the former building (old foundation or pipe) or other feature. The higher conductivity zones in the western portion of the site may be related to shallower depths to the top of the peat and/or a thicker layer of peat. Elevated conductivity values may also be related to increased amounts of finer-grained materials such as silt, and increased moisture.

The GPR data indicates a relatively strong reflector below the western portion of the site that is interpreted as the bottom of the peat layer. The top of the peat layer provides a noticeable reflection in some portions of the site, but is not as evident in other areas. The interpreted depths to the top and bottom of the peat are shown on Figure 2. Both reflectors are difficult to delineate towards the eastern portion of the site. This is probably a combination of the interference from the buried utilities below the asphalt, the peat layer thinning to the east, and the disturbed soils and possible excavations related to the numerous former buildings in the eastern portion of the site.

The depths to the top and bottom of the peat layer are estimated based on the travel time of the GPR signal. The shallow soil materials (fill, sand, etc.) have a two-way travel time of about 4.7 ns/foot for the GPR signal based on reflections from two of the shallow pipes at the site. The peat has an estimated two-way travel time of about 3.2 ns/foot. This value is based on the borehole information in order to make the reflector of the peat fit the borehole data, and was revised slightly based on the newer borehole information within our main area of interest. Both of these two-wave travel times are within the range that are typical for these materials. However, the velocity of the GPR wave in peat can be highly variable depending on whether the peat is an organic peat or a mineral peat, moisture content, etc.

The two-wave travel time may vary across the site due to the variability in soil conditions, and probably accounts for most of the discrepancy in the interpreted depths compared to the borehole depths. In the eastern portion of the site the interpretation may be affected by reflections from silt layers or other soil changes. However, the GPR data in general correlates fairly well with the borehole data, and provides a general representation of the peat depth and thickness. The southern edge of the peat layer is interpreted from the GPR data, and correlates well with the boring information and the EM-31 data.

An example GPR profile of the western portion of Line 175N is provided on Figure 3. The travel time (in nanoseconds) is along the side and stationing (in feet) along the top. The interpreted peat layer is shown (top and bottom) and two strong targets indicating probable utilities. A deeper reflector is highlighted in blue and slopes down to the west. Similar, parallel reflectors are observed in the eastern portion of the site, and may indicate the edges of a depositional layer such as the edge of a river or lake. Similar sloping layers are observed along the south edge of the site that slope down to the north. The entire Line 175N profile is also attached as a jpeg file with this report.

CONCLUSIONS

The GPR and EM-31 data were interpreted for features that may be related to the peat deposit located beneath the site. Other features such as utilities and possible disturbed soils may be present in the data but were not interpreted. The use of these methods provided a rapid and non-intrusive means of investigating the area of interest to help assist in determining subsurface

conditions in the area. These results are interpretive in nature, and may change based on additional information. While the GPR and EM-31 methods can help evaluate areas of concern, only intrusive methods such as test pits, borings or other means can ultimately characterize the subsurface conditions.

Please contact me if you have any questions or comments regarding this information, or if you require further assistance. I appreciated the opportunity to work with you on this project and look forward to providing you with geophysical services in the future.

Sincerely,

Philip H. Duoos
Geophysical Consultant (Lic. Geol. # 561)

State of Washington
561
Licensed Geologist
Philip H. Duoos

Attachments:

Description of Methods
Figure 1: EM-31 Interpretation Results Map
Figure 2: GPR Interpretation Results Map
Figure 3: Example GPR Profile, Line 175N, Sta. 40E to 200E

DESCRIPTION OF METHODS

GROUND PENETRATING RADAR

Some of the uses of GPR include locating buried tanks and drums, delineating boundaries of landfills and trenches, and defining voids and geologic stratigraphy. Although other techniques can also provide this information, GPR is less affected by cultural interferences such as overhead powerlines, buildings, and fences. GPR can also provide higher resolution of the target in many cases. A variety of antennas can be used depending on subsurface conditions and the objective of the survey. Resolution of shallow objects requires higher frequencies, while lower frequencies work better for deeper investigations.

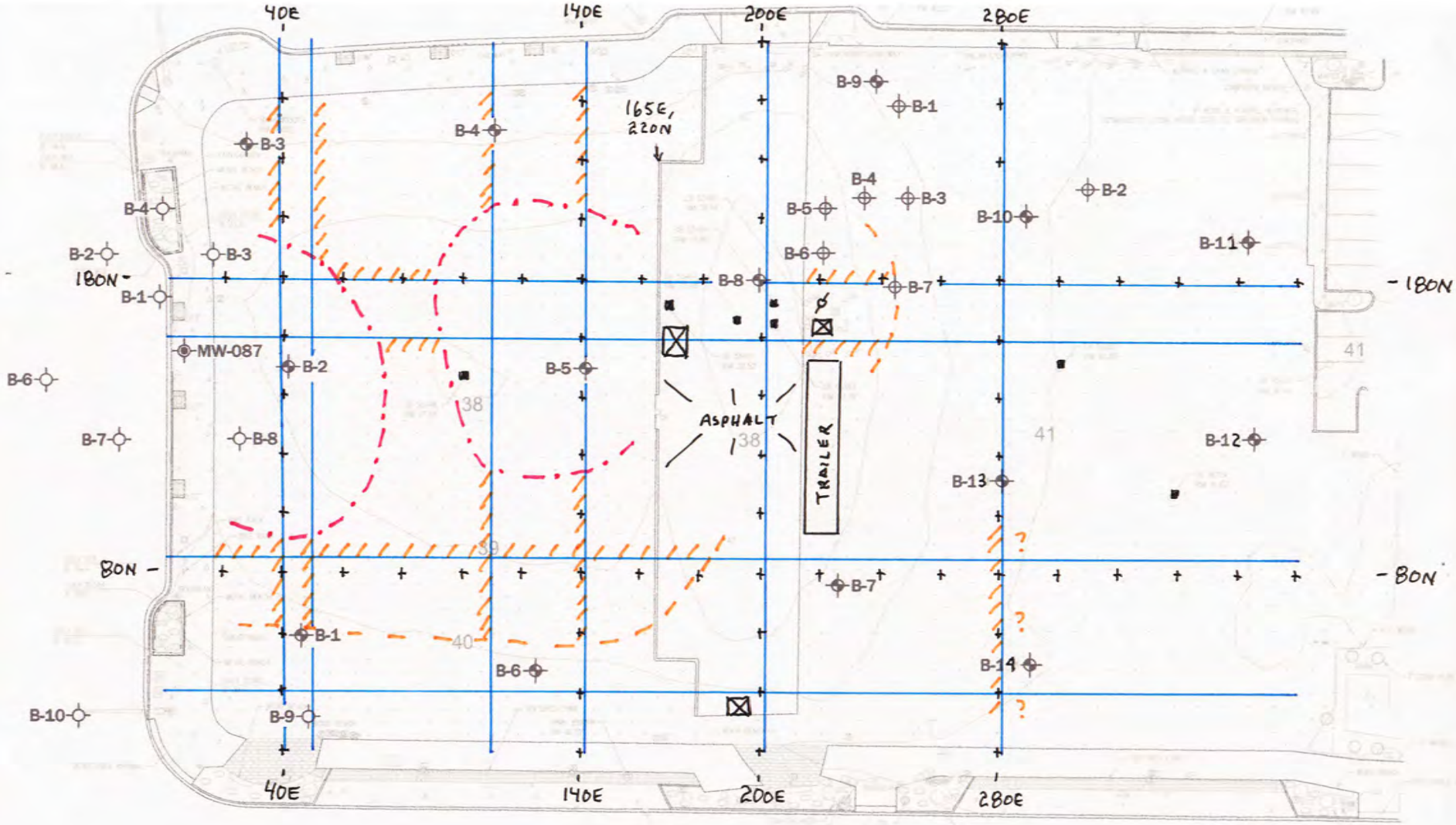
Several factors can affect the effectiveness of the GPR method including reinforced concrete at the surface, the presence of highly conductive materials (such as clays and water), the size, depth, and physical property of the target and; in stratigraphic investigations, the conductivity contrast between stratigraphic units. The presence of numerous buried objects may mask objects and/or stratigraphy below.

ELECTROMAGNETICS (EM-31)

The EM-31 measures subsurface conductance using the principles of electromagnetic induction to depths of about 18 feet, and can detect large amounts of metal at greater depths. The EM-31 is portable, rapid and non-destructive. It has a fixed boom containing the transmitter and receiver coils so that handling and data gathering is easily achieved by one operator.

Factors which may increase subsurface conductivities include higher moisture content, greater amounts of finer materials, increased clay and/or silt content, soil contamination and/or ground water contamination. The presence of buried metal can also affect the conductivity data. The detectability of metal objects (buried pipes, drums, etc.) can be enhanced by measuring the change in the magnitude of the primary field (inphase component) of the induced magnetic field.

Several factors can limit the effectiveness of the EM method including the proximity of cultural interferences (such as buildings, fences and reinforced concrete) the presence of highly conductive materials (such as clays and water), and the size, depth and conductivity contrast of the target.



EXPLANATION

- Reference Flag Locations
- Catch Basin
- Surface Metal Feature
- EM-31 and GPR Survey Lines
- High Electrical Conductivity Zone
- Moderate Electrical Conductivity Zone

Legend

B-1	Boring by GeoEngineers, Inc., 2015
B-1	Boring by GeoEngineers, Inc., 2011
MW-343	Monitoring Well by GeoEngineers, Inc., 2010
B-1	Boring by GeoEngineers, Inc., 2009
MW-087	Monitoring Well by GeoEngineers, Inc., 2007

N E S W

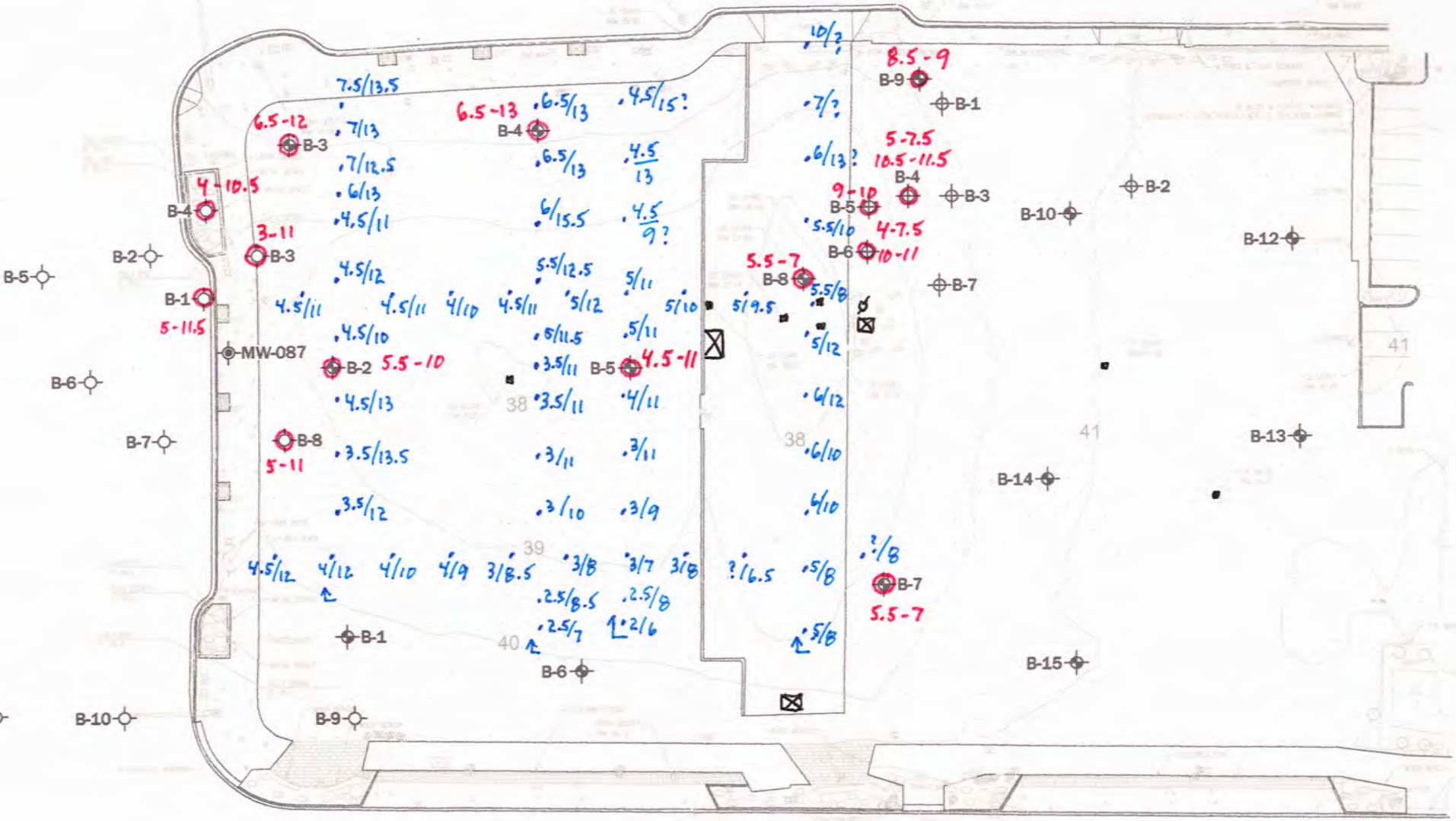
40 0 40
Feet

EM-31 ELECTRICAL CONDUCTIVITY RESULTS

Peat Layer Evaluation
Redmond Downtown Park
Redmond Way, Redmond, WA

Philip H. Duoos, Geophysical Consultant
June 24, 2015 **Job No. 1175-15**

FIGURE 1



EXPLANATION

↑ Interpreted Southern Edge of Peat

4/9 Interpreted Depth (feet) to Top and Bottom of Peat

4.5/11 Depth (feet) to Top and Bottom Of Peat Observed in Borings.

Legend

B-1 Boring by GeoEngineers, Inc., 2015

B-1 Boring by GeoEngineers, Inc., 2011

MW-343 Monitoring Well by GeoEngineers, Inc., 2010

B-1 Boring by GeoEngineers, Inc., 2009

MW-087 Monitoring Well by GeoEngineers, Inc., 2007

N E S W

40 0 40

Feet

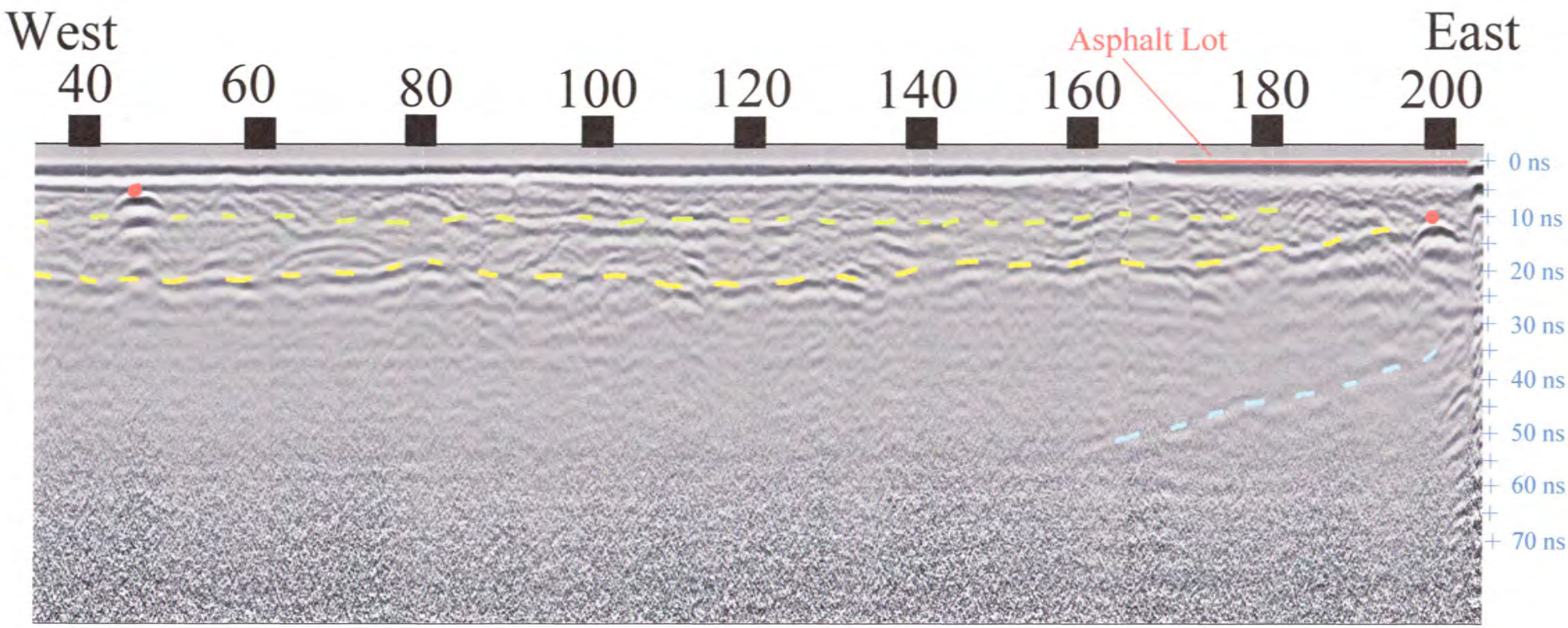
1" = 50'

GROUND PENETRATING RADAR RESULTS

Peat Layer Evaluation
Redmond Downtown Park
Redmond Way, Redmond, WA

Philip H. Duoos, Geophysical Consultant
June 24, 2015 Job No. 1175-15

Rev. 1, Aug. 12, 2015 **FIGURE 2**



Top of Peat

Bottom of Peat

Unknown Deeper Layer

Probable Utility

Philip H. Duoos, Geophysical Consultant
June 24, 2015 Job No. 1169-15

EXAMPLE GPR DATA PROFILE
Line 175N (Partial)
Redmond Downtown Park

200 MHz Data

FIGURE 3

APPENDIX E
Report Limitations and Guidelines for Use

APPENDIX E
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

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

Geotechnical Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for the exclusive use of the City of Redmond and other project team members for the Redmond Downtown Park project. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

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

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

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

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical and Geologic Findings Are Professional Opinions

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

Geotechnical Engineering Report Recommendations Are Not Final

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

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

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

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

Do Not Redraw the Exploration Logs

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

Give Contractors a Complete Report and Guidance

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

Contractors Are Responsible for Site Safety on Their Own Construction Projects

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

Read These Provisions Closely

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

Geotechnical, Geologic and Environmental Reports Should Not Be Interchanged

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

Biological Pollutants

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

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

Have we delivered World Class Client Service?

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

GeoEngineers