DRAFT

City of Redmond 12/28/2009
Draft Document Released for
Public Records Request

This document is a working draft, not intended for public release. City staff are working with the consultant to produce a final document that will be posted to the City website in the near future. There may be inaccurate information or mistakes within this draft document that has not had the benefit of a complete City review and approval.

Users of this draft are encouraged to review the final document when it is available.

October 9, 2009

City of Redmond
c/o Otak
10230 NE Points Drive, Suite 400
Kirkland, Washington 98033

Attention: Russ Gaston

Subject: Preliminary Geotechnical Design Services
Overlake Village Stormwater and Park Facilities
Redmond, Washington
File No. 0500-161-00

INTRODUCTION

~~This report summarizes the results of our geotechnical services for the proposed Overlake Village Stormwater and Park Facilities to be located in Redmond, Washington. Our understanding of this project is based on information provided by Otak and the City. We understand that new stormwater and park facilities are being considered at two sites in the Overlake neighborhood in Redmond, Washington. One site is the PS Business Park Property located at 2801 152nd Avenue NE and the other site is the Sears Parking Area Property located at 2200 148th Avenue NE. The locations of the proposed stormwater management sites are shown on the attached Vicinity Map, Figure 1. Conceptual designs are being explored to meet the area's stormwater needs and incorporate new parks into a single integrated design.~~

~~GeoEngineers is concurrently completing Phase I Environmental Site Assessments (ESA) of the two project parcels, the results of which will be presented under separate cover.~~

See new introduction at end of document to be inserted here.

SCOPE

Our services were completed in general accordance with the Subconsultant Agreement between Otak and GeoEngineers. Our specific scope of geotechnical services included the following tasks:

1. Review geologic maps and available geotechnical reports in our database and make these reports available to the City of Redmond.
2. Prepare an exploration plan for proposed borings. This information was submitted to the City of Redmond in order to obtain necessary rights-of-access and street use permits.
3. Locate and clear existing utilities at proposed boring locations. We contacted the One Call Utility Locate Service before beginning our explorations. We also hired a private utility locate company to check our boring locations for utilities.
4. Explore subsurface soil and groundwater conditions by completing a boring at each of the two proposed pond areas. The borings both extended to a depth of about 50 feet and were completed using trailer-mounted equipment. Monitoring wells were constructed in both borings to measure groundwater.
5. Perform laboratory tests on samples obtained from the borings. The laboratory tests included moisture content and sieve analyses.
6. Install piezometers with automatic dataloggers. We will download groundwater data on a quarterly basis for one year.

7. Evaluate pertinent physical and engineering characteristics of the soils based on the results of the field exploration, laboratory testing and our experience.
8. Prepare a report presenting our preliminary design conclusions and recommendations together with detailed boring logs, site plans and other supporting information.
9. Provide consultation and attend meetings, as requested.

SUBSURFACE CONDITIONS

SITE EXPLORATION

Subsurface soil and groundwater conditions were evaluated by drilling two borings, one at each of the sites, on September 15, 2009. Both borings were drilled to approximately 50 feet below the ground surface (bgs) and completed with standpipe piezometers. Boring B-1 was completed adjacent to the west curb of 152nd Ave NE, adjacent to the PS Business Park site at the approximate location shown on the attached Site Plan, Figure 2A. Boring B-2 was completed along the east margin of the Sears Parking Area at the approximate location shown on the attached Site Plan, Figure 2B. Details of the exploration program, logs of the explorations including details of the piezometer installations, and results of the laboratory testing are presented in Attachment A.

SOIL AND GROUNDWATER CONDITIONS

The soils encountered in the explorations include fill and till overlying advance outwash, and deeper glacial deposits. The soils encountered in the borings are generally consistent with the recently developed information from the City's on-going surficial soil mapping project which indicates that the shallow surficial soil in the stormwater planning areas consists mostly of glacial till (also referred to as hardpan) and recessional outwash deposits. The subsequent sections describe the subsurface conditions encountered in the borings completed at each of the project areas.

~~*PS Business Park Site*~~ North Site

The road surface at boring B-1 consists of an 8½-inch thick asphalt concrete pavement. Fill associated with existing utility trench backfill in the area was encountered beneath the pavement to approximately 12 feet below ground surface (bgs) in boring B-1. The fill generally consists of medium dense to dense silty sand with occasional gravel and cobbles. An approximately 5 foot layer of till consisting of very dense silty sand with gravel was observed beneath the fill. Advance outwash consisting of very dense sand and gravel with variable silt was encountered below the till at approximately 17 feet bgs and extended to below 52 feet bgs, the full depth explored in boring B-1.

Groundwater was encountered at a depth of approximately 43 feet bgs at the time of drilling and measured in the piezometer the following day to a depth of 38.7 feet bgs.

~~*Sears Parking Area Site*~~ South Site

The parking lot surface at boring B-2 consists of a 3-inch thick asphalt concrete pavement. Fill was encountered beneath the pavement to approximately 4½ feet bgs in boring B-2. The fill generally consists of medium dense to dense silty sand with gravel and occasional cobbles. An approximately 10 foot layer of stratified organic silt, silt, and silty sand was encountered below the fill. The stratified silt is underlain by an 8½ foot layer of till consisting of dense silty sand with occasional gravel. Advance outwash consisting of dense to very dense sand and gravel with variable silt was encountered below the till at approximately 23 feet bgs and extends to 39 feet bgs. Below the advance outwash, boring B-2 encountered glacial deposits of very dense silty sand with occasional silt lenses grading to sand with silt. This lowest layer extends to below 51 feet bgs, the maximum depth explored in boring B-2.

Groundwater was encountered at a depth of approximately 27 feet bgs at the time of drilling and measured in the piezometer the following day at a depth of 18.2 feet bgs.

Laboratory Testing

Sieve analyses were completed on six samples, three samples obtained from each of the two borings. Results of the sieve analyses are summarized on Figures A-4 and A-5 for borings B-1 and B-2, respectively.

Table 1 summarizes the values for the following parameters: D10 (particle size where 10% of the dry sample passes through the sieves), percent retained on the #10 sieve (percent of dry sample that is larger than 2 millimeters [mm] in diameter), and percent fines (percent of dry sample that passes the #200 sieve [0.075 mm opening]).

Table 1. Summary of Sieve Analyses Results

Boring	Sample Depth	D_{10}	#10 retained	Fines
B-1	12½ – 14 feet	--	17%	36.2%
B-1	25 – 26½ feet	0.075 mm	57%	10.2%
B-1	35 – 36½ feet	0.15 mm	47%	7.7%
B-2	15 – 16½ feet	--	26%	27.0%
B-2	25 – 26½ feet	--	13%	16.6%
B-2	45 – 46½ feet	0.07 mm	1%	10.9%

CONCLUSIONS AND PRELIMINARY DESIGN RECOMMENDATIONS

PRELIMINARY DESIGN INFILTRATION RATES

Two methods were used to evaluate approximate design (long-term) infiltration rates for the various soils encountered at the proposed stormwater management sites. The methods consist of correlations based on United States Department of Agriculture (USDA) soil textural classification and ASTM gradation testing, as discussed in Section 3.3.6 of the Stormwater Management Manual for Western Washington (Ecology, 2005).

Table 2 presents a summary of the soil conditions pertaining to infiltration as encountered in the borings including the estimated infiltration rates based on the two methods; (1) USDA textural class, (2) ASTM laboratory gradation testing.

Table 2. Infiltration Data

Boring	Sample Depth (feet)	GeoEngineers Classification	USDA Textural Class	ASTM D_{10} (mm)	Estimate of Infiltration Rate (inches/hour) [1]	
					USDA	ASTM
B-1	12½–14	SM	Sandy Loam	<0.05	0.25	<0.15
B-1	25–26½	GP-GM	Loamy Sand	0.075	0.5	1.5
B-1	35–36½	SW-SM	Sand	0.15	2	2.75
B-2	15–16½	SM	Sandy Loam	<0.05	0.25	<0.15
B-2	25–26½	SM	Loamy Sand	<0.05	0.5	<0.15
B-2	45–46½	SP-SM	Sand	0.07	2	1.4

Notes:
[1]Infiltration rates shown for three different methodologies

Based on the USDA textural and the ASTM gradation methods of evaluating approximate design (long-term) infiltration rates, the near-surface on-site soils at the two stormwater management facility sites are generally suitable for only limited stormwater infiltration. Boring B-1 completed adjacent to the PS Business Park site encountered sand and gravel soils at depths deeper than about 17 feet bgs which corresponds to approximately 21 feet higher than the measured groundwater at about 38 feet bgs. Accordingly, these soils appear to provide the greatest infiltration potential (infiltration rates ranging from 0.5 to 2.75 inches/hour). Boring B-2 encountered groundwater at a depth of about 18 feet bgs and the soils above that level were very silty such that only limited stormwater infiltration may be expected at this location.

It should be noted that these discussions of likely infiltration performance are based on design guidelines that are intentionally conservative; not on actual on-site infiltration performance testing. We recommend completing on-site infiltration testing to establish more site-specific infiltration performance values. In our experience, site-specific testing often demonstrates higher infiltration performance than the values discussed above.

PRELIMINARY BURIED STRUCTURE DESIGN PARAMETERS

General

Information regarding the stormwater management facilities design is only very conceptual at this time; however, some types of buried structures or vaults are anticipated. The buried structures may consist of retaining walls, open bottom infiltration vaults and/or closed bottom vaults with or without covers. The following paragraphs present preliminary geotechnical design recommendations for foundation bearing capacity, expected settlement performance and lateral earth pressures that are generally applicable to any type of buried structure or vault.

Allowable Bearing Pressure

Buried structures that extend to depths on the order of 20 feet bgs are being considered at both stormwater management facility sites. At this depth, the soils at both locations explored for this study consisted of glacially consolidated materials that will have relatively high allowable bearing capacities in the undisturbed condition. On this basis, preliminary foundations designs for the buried structures can be evaluated using an allowable soil bearing capacity of 4 kips per square foot (ksf) for properly compacted structural fill or undisturbed native soils. Retaining wall foundations that are subject to overturning loads can be evaluated using an allowable maximum toe bearing pressure of 4.5 ksf. These allowable soil bearing values apply to the total of dead and long-term live loads and may be increased by up to one-third for seismic loads.

Buried structures that do not extend down to bottom out in glacially consolidated soils should be designed for lesser bearing capacities. Foundation capacities for these shallower structures should be evaluated independently.

Settlement Performance

Provided all loose soil is removed and the subgrade is prepared as recommended under "Construction Considerations" below, we estimate the total settlement of buried structure foundations will be on the order of 1 inch or less. The settlements will occur rapidly, essentially as loads are applied. Differential settlements measured along 25 feet of the structure are expected to be less than ½ inch.

Construction Considerations

Subgrade disturbance may occur if foundation excavations are completed during wet weather. A working mat of lean concrete or compacted crushed rock should be placed over the buried structure foundation subgrade immediately following excavation to reduce softening and disturbance of the subgrade if construction occurs during wet weather.

If soft areas are present at the subgrade elevation, the soft areas should be removed and replaced with structural fill at the direction of a Geotechnical Engineer. In such instances, the zone of structural fill should extend laterally beyond the buried structure foundation edges a horizontal distance at least equal to the thickness of the fill.

The condition of the foundation subgrades should be observed by a Geotechnical Engineer to evaluate if the work is completed in accordance with these recommendations and that the subsurface conditions are as anticipated.

Lateral Pressures

If the buried structure walls are rigid (restrained against rotation), we recommend that the walls be designed for an at-rest earth pressure taken as an equivalent fluid density of 55 pounds per cubic foot (pcf) (triangular distribution). Rigid walls are walls that deflect less than about 0.001H under the at-rest pressure loading, where H is the height of the wall measured from the bottom of the structure to the ground surface. Once the wall moves approximately 0.001H, the active pressure state is achieved. Walls that are allowed to deflect more than about 0.001H under loading may be designed for the active earth pressure taken as an equivalent fluid density of 35 pcf (triangular distribution). Both the at-rest and active pressures presented above require that the soils surrounding the vault are well drained. If drainage of the backfill surrounding the vault is not provided, the vault should be designed using an equivalent fluid density of 80 pcf (triangular distribution).

To account for traffic surcharge loading, we recommend that the buried structure walls be designed for a uniform surcharge pressure determined by increasing the height of the fill behind the walls by 2 feet. Other surcharge loads such as heavy construction equipment or soil stockpiles should be included as appropriate.

If drainage is not provided around the buried structures, uplift forces on the structures will need to be considered. Uplift forces may be resisted by widening the structure's footings such that the weight of the backfill over the footing exceeds the uplift force. If drainage around the buried structure is feasible and desired, we can provide additional recommendations for drainage.

Seismic earth pressure should be used as a check in the buried structure wall design. We recommend that a rectangular seismic earth pressure distribution equal to 7H in pounds per square foot (where H is the wall height in feet) be added to the static lateral earth pressures presented above for the rigid wall or active earth pressure condition, whichever is appropriate.

Lateral wall loads on buried structures can be resisted by a combination of friction between the footing and the supporting soil and by the passive lateral resistance of the soil surrounding the embedded portion of the footing. A coefficient of friction between concrete and soil of 0.4 and a passive lateral resistance corresponding to an equivalent fluid density of 150 pcf may be used in the design. We recommend that the upper 2 feet of passive resistance be ignored. The friction coefficient and passive lateral resistance are allowable values and include a suitable factor of safety. The passive resistance value assumes undrained conditions.

LIMITATIONS

We have prepared this report for the exclusive use of the City of Redmond, Otak, and their authorized agents for ~~The Parkside development~~ in Redmond, Washington.

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

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

Please refer to the Attachment B titled Report Limitations and Guidelines for Use for additional information pertaining to use of this report.

We appreciate the opportunity to provide geotechnical services on this project. Should you have any questions or comments, or if we may be of further service, please do not hesitate to call.

Sincerely,
GeoEngineers, Inc.

Christopher M. Kokesh
Geotechnical Engineer

Overlake Stormwater and Park Facilities Plan

Thomas A. Tobin, PE
Principal

CMK:TAT:nlu
RED:P:\0\0500161\00\Finals\050016100 DR.doc

Attachments: Figure 1. Vicinity Map
Figures 2A…2B. Site Plan
Attachment A – Field Exploration and Laboratory Testing
Attachment B – Report Limitations and Guidelines for Use

Three copies submitted

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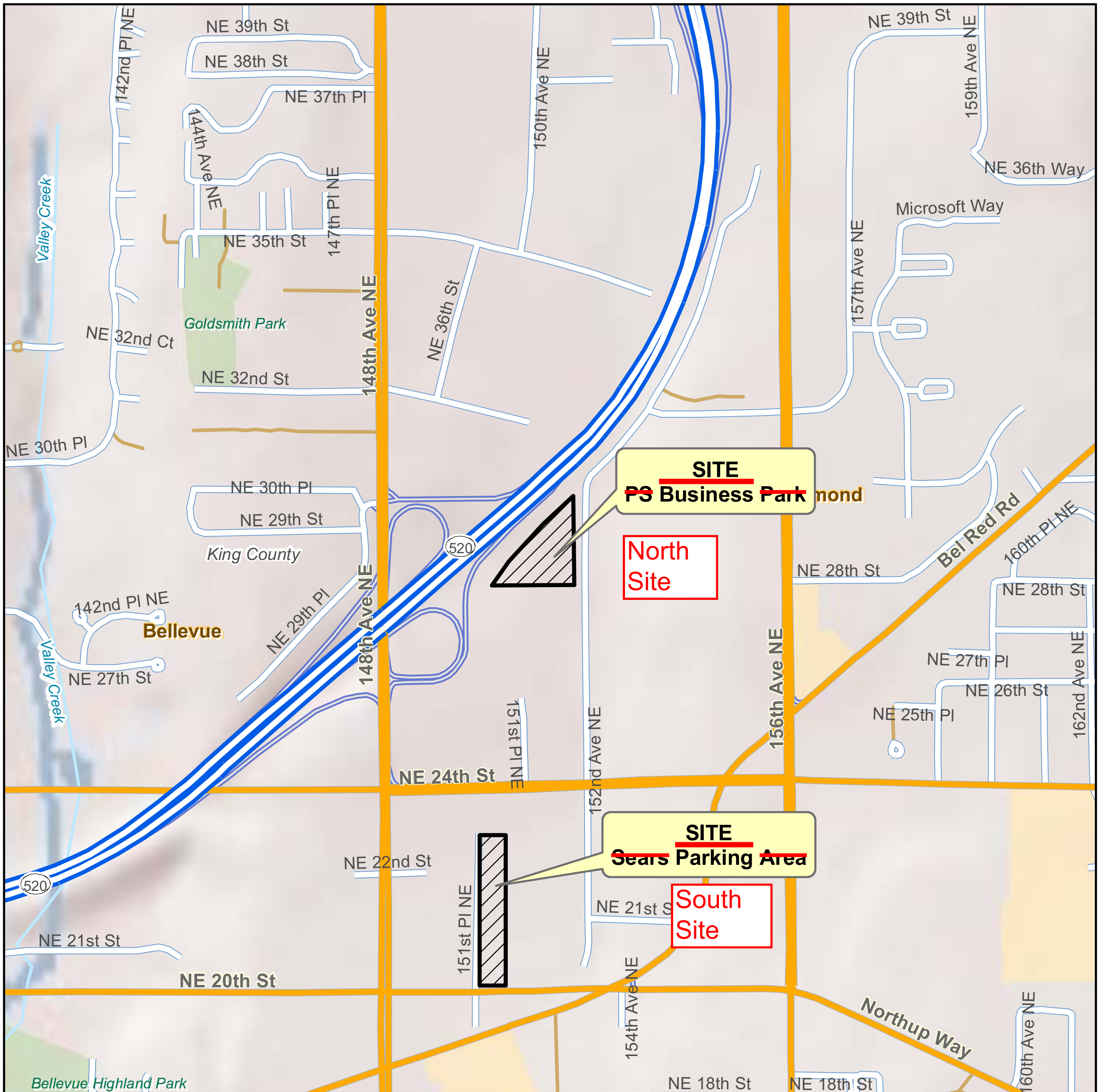

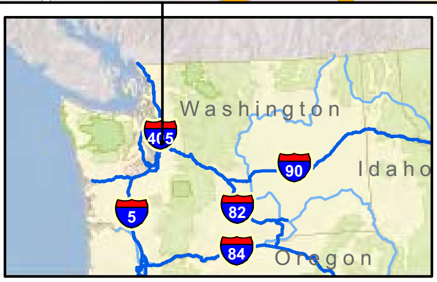

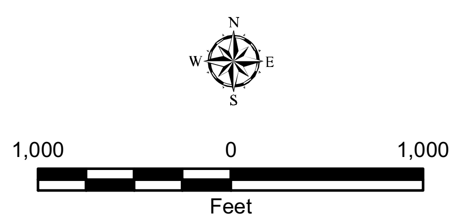

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
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Data Sources: ESRI Data & Maps, Street Maps 2008
Projection: NAD_1983_UTM_Zone_10N
Datum: D_North_American_1983
North arrow oriented to grid north

Vicinity Map

Overlake Village Stormwater and Park Facilities
Redmond, Washington

GeoEngineers

Figure 1

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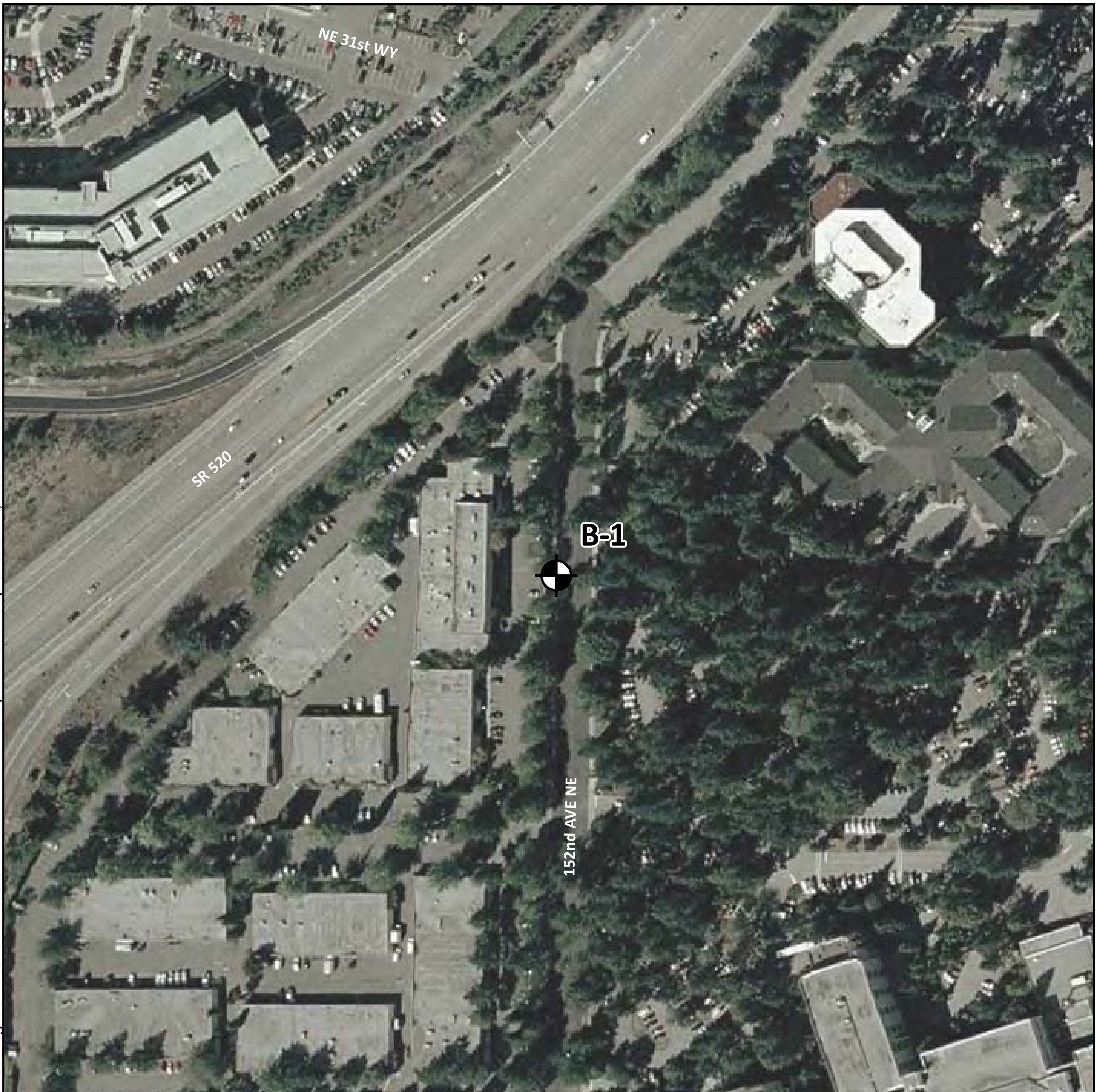

Legend

Boring (Piezometer)

B-1

N
W E
S

200 0 200

Feet

Site Plan

Overlake Village Stormwater and Park Facilities
Redmond, Washington

GeoEngineers

Figure 2A

Notes:
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Data Sources: Aerial from ESRI, I3 Imagery.

Office: Redmond Path: P:\0\0500161\GIS\050016100 Figure2A SitePlan.mxd Map Revised: September 22, 2009 EL

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Map Revised: September 22, 2009 EL

Path: P:\0\0500161\GIS\050016100_Figure2B_SitePlan.mxd

Office: Redmond

Legend

Boring (Piezometer)

B-2

N W E S

200 0 200

Feet

Notes:
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Data Sources: Aerial from ESRI, I3 Imagery.

Site Plan

Overlake Village Stormwater and Park Facilities
Redmond, Washington

GEOENGINEERS

Figure 2B

ATTACHMENT A
FIELD EXPLORATION AND LABORATORY TESTING

ATTACHMENT A
FIELD EXPLORATION AND LABORATORY TESTING

EXPLORATION PROGRAM

Subsurface conditions at the site were explored by drilling two borings (B-1 and B-2). The borings were completed to depths ranging from about 51 to 52 feet below the existing ground surface. The drilling was performed by Geologic Drill under subcontract to GeoEngineers on September 15, 2009.

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

The borings were completed using trailer-mounted, continuous-flight, hollow-stem auger drilling equipment. The borings were continuously monitored by an engineer from our firm who examined and classified the soils encountered, obtained representative soil samples, observed groundwater conditions and prepared a detailed log of each exploration. In addition, piezometers were installed in borings B-1 and B-2. Installation details of the piezometers are included in Figures A-2 and A-3 for borings B-1 and B-2, respectively.

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

Soils encountered in the borings were visually classified in general accordance with the classification system described in Figure A-1. A key to the boring log symbols is also presented in Figure A-1. The logs of the borings are presented in Figures A-2 through A-5. The boring logs are based on our interpretation of the field and laboratory data and indicate the various types of soils and groundwater conditions encountered. The logs also indicate the depths at which these soils or their characteristics change, although the change may actually be gradual. If the change occurred between samples, it was interpreted. The densities noted on the boring logs are based on the blow count data obtained in the borings and judgment based on the conditions encountered.

Observations of groundwater conditions were made during drilling, and these observations represent a short-term condition and may or may not be representative of the long-term groundwater conditions at the site. Groundwater conditions observed during drilling should be considered approximate.

LABORATORY TESTING

All soil samples were brought to our laboratory for further examination. Selected samples were tested to determine their moisture contents and gradation. The results of the moisture content tests are presented on the exploration logs, Figures A-2 and A-3. The sieve analysis testing is summarized in Figures A-4 and A-5.

SOIL CLASSIFICATION CHART

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

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

ADDITIONAL MATERIAL SYMBOLS

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

Measured groundwater level in exploration, well, or piezometer

Groundwater observed at time of exploration

Perched water observed at time of exploration

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

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
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

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

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Drilled	Start 9/15/2009	End 9/15/2009	Total Depth (ft)	52	Logged By RBM / Checked By CMK	Driller	Geologic Drill, Inc.	Drilling Method	Hollow-Stem Auger

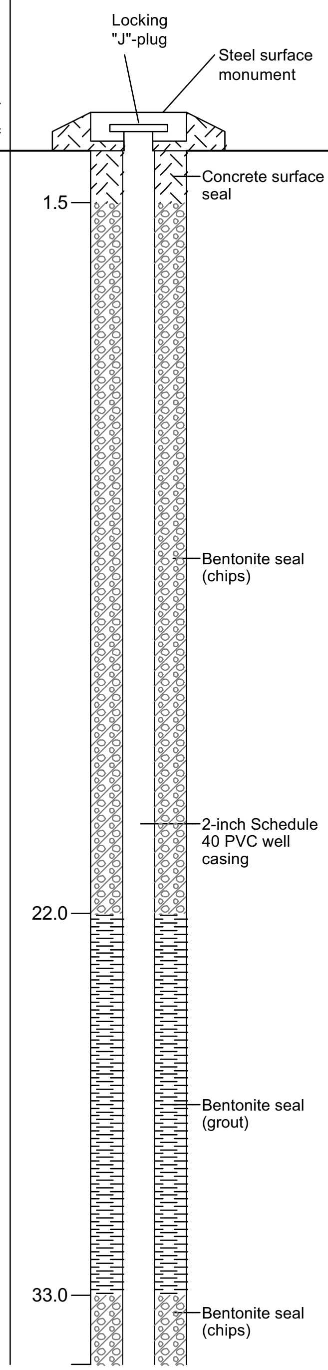
Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Trailer-mounted Deep Rock XL	A 2 (in) well was installed on 9/15/2009 to a depth of 48.8 (ft).	
Surface Elevation (ft) Vertical Datum	Undetermined	Top of Casing Elevation (ft)		Groundwater	
Easting (X) Northing (Y)		System Datum		Date Measured: 9/16/2009	Depth to Water (ft): 38.7; Elevation (ft): Undetermined

Notes: Auger Data: 4 ¼" I.D. 8 ½" O.D.

FIELD DATA

Depth (feet)	Recovered (in)	Blows/foot	Sample Name	Group Classification	Material Description	Water Content, %
0				AC	8.5 inches asphalt concrete	
				GM	4 inches gray silty gravel with sand and trace organic matter (medium dense, moist) (base course)	
				SM	Grayish brown silty fine sand with occasional gravel and occasional cobbles (medium dense, moist) (fill)	
	16	26	1			
5	18	15	2			
	18	30	3			
10	13	29	4			
				SM	Grayish brown silty fine to medium sand with occasional fine gravel (very dense, moist) (till)	
	12	65/9"	5 SA			9
15	5	50/5"	6			
				SP-SM	Brown and gray medium to coarse sand with silt and fine gravel (very dense, moist) (advance outwash)	
20	12	50/6"	7			
				GP-GM	Brown and gray fine gravel with silt and medium to coarse sand (very dense, moist)	
25	4	50/4"	8 SA			7
				SW-SM	Brown and gray medium to coarse sand with silt and fine gravel (very dense, moist)	
30	5	50/5"	9			
35						

WELL LOG



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

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Log of Boring B-1

GEOENGINEERS

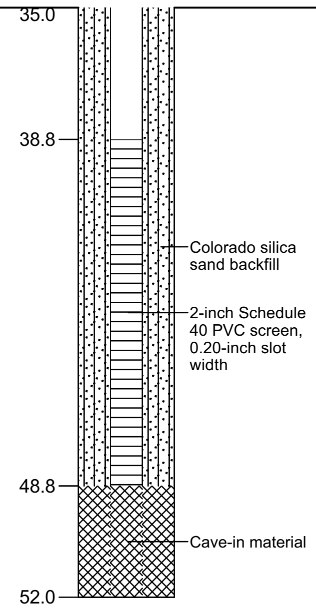
Project: Overlake Village Stormwater and Park Facilities
Project Location: Redmond, Washington
Project Number: 0500-161-00

Figure A-2
Sheet 1 of 2

DRAFT

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Water Content, %	Dry Density, (pcf)
	35		9	50/5"		10 / SA					9	
	40		5	50/5"		11				(Rock fragments in sampler shoe)		
									SP	Grayish brown medium to coarse sand with trace silt and occasional gravel (very dense, wet)		
	45		18	90		12				(6 inches of heave)		
										(12 inches of heave)		
	50		10	92/10"		13				(Sample 14 from 2.4-inch I.D. split barrel sampler used to remove heave prior to well installation)		
						14						

WELL LOG



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

Log of Boring B-1 (continued)

GeoEngineers

Project: Overlake Village Stormwater and Park Facilities
Project Location: Redmond, Washington
Project Number: 0500-161-00

Drilled	Start	End	Total Depth (ft)	Logged By	Checked By	Driller	Drilling Method
	9/15/2009	9/15/2009	51	RBM	CMK	Geologic Drill, Inc.	Hollow-Stem Auger

Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Trailer-mounted Deep Rock XL
Surface Elevation (ft) Vertical Datum	Undetermined	Top of Casing Elevation (ft)	
Easting (X) Northing (Y)		System Datum	

A 2 (in) well was installed on 9/15/2009 to a depth of 49.8 (ft).

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
9/16/2009	18.2	Undetermined

Notes: Auger Data: 4 ¼" I.D. 8 ½" O.D.

FIELD DATA

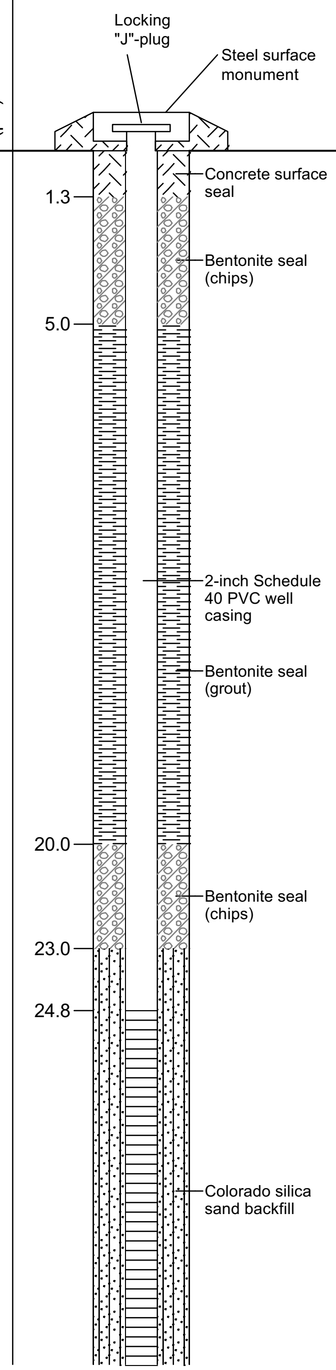
Recovered (in)	Blows/foot	Sample Name	Water Content, %
18	34	1	
18	8	2	
18	11	3	
18	27	4	
18	14	5	
18	43	6 SA	7
18	42	7	
18	34	8	
18	34	9 SA	16
11	50/5"	10	

Depth (feet): 0, 5, 10, 15, 20, 25, 30, 35

MATERIAL DESCRIPTION

Group Classification	Material Description
AC	3 inches asphalt concrete
SM	Brown with orange staining silty fine to coarse sand with gravel and occasional cobble (medium dense to dense, moist) (fill) (Refusal on boulder/cobble at 5 feet, boring redrilled 3 feet west)
OL	Dark brown organic silt with organic matter (medium stiff to stiff, moist)
ML	Gray silt with sand and organic matter (medium stiff, moist)
SM	Gray silty fine sand with occasional gravel (dense, moist)
ML	Brownish gray silt with occasional fine sand (stiff, moist)
SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense, moist to wet) (till) (Rock fragments in sampler shoe)
SM	Brown and gray silty fine to medium sand with occasional gravel (dense, moist) (advance outwash)
SP/SP-SM	Brown and gray medium to coarse sand with trace silt and occasional fine gravel (very dense, wet)

WELL LOG



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

Log of Boring B-2

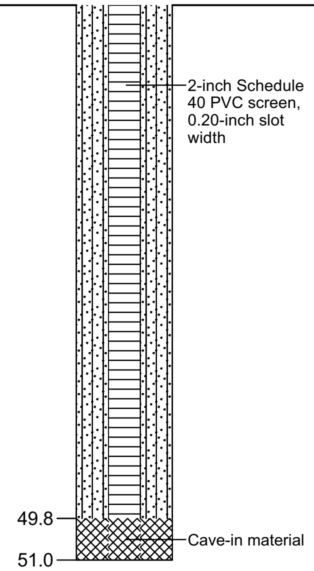
GEOENGINEERS

Project: Overlake Village Stormwater and Park Facilities
Project Location: Redmond, Washington
Project Number: 0500-161-00

DRAFT

WELL LOG

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot	Collected Sample	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Water Content, %	Dry Density, (pcf)
	35	18	88		11						
									(Drilling under water head)		
								SM	Brown silty fine sand with occasional gray silt lenses (1/2-inch) (very dense, wet)		
	40	11	50/5"		12						
								SP-SM	Brown and gray fine to medium sand with silt (very dense, wet)		
	45	10	50/4"		13 SA					17	
	50	12	50/6"		14						



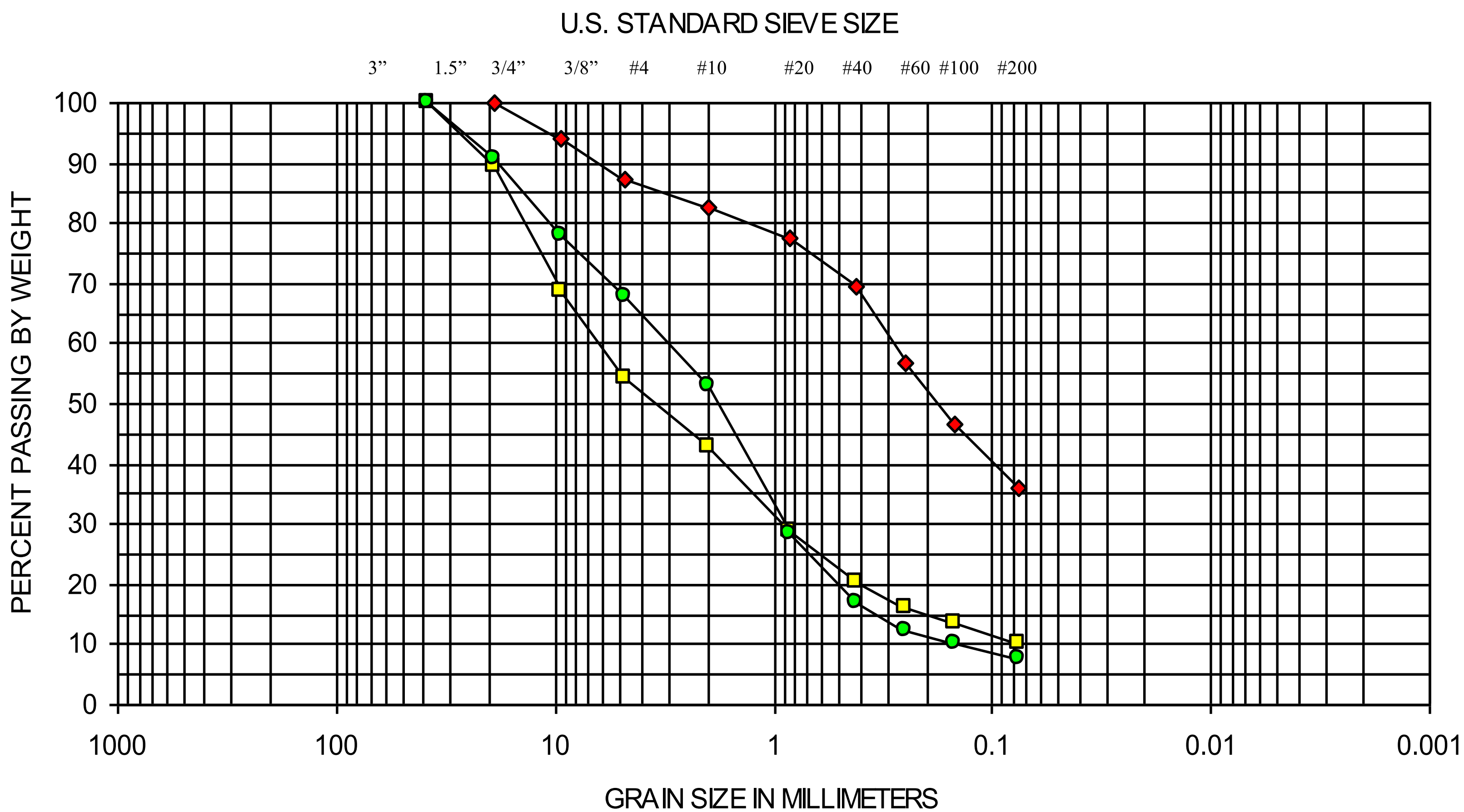
Note: See Figure A-1 for explanation of symbols.

Log of Boring B-2 (continued)

GEOENGINEERS

Project: Overlake Village Stormwater and Park Facilities
Project Location: Redmond, Washington
Project Number: 0500-161-00

Figure A-3
Sheet 2 of 2



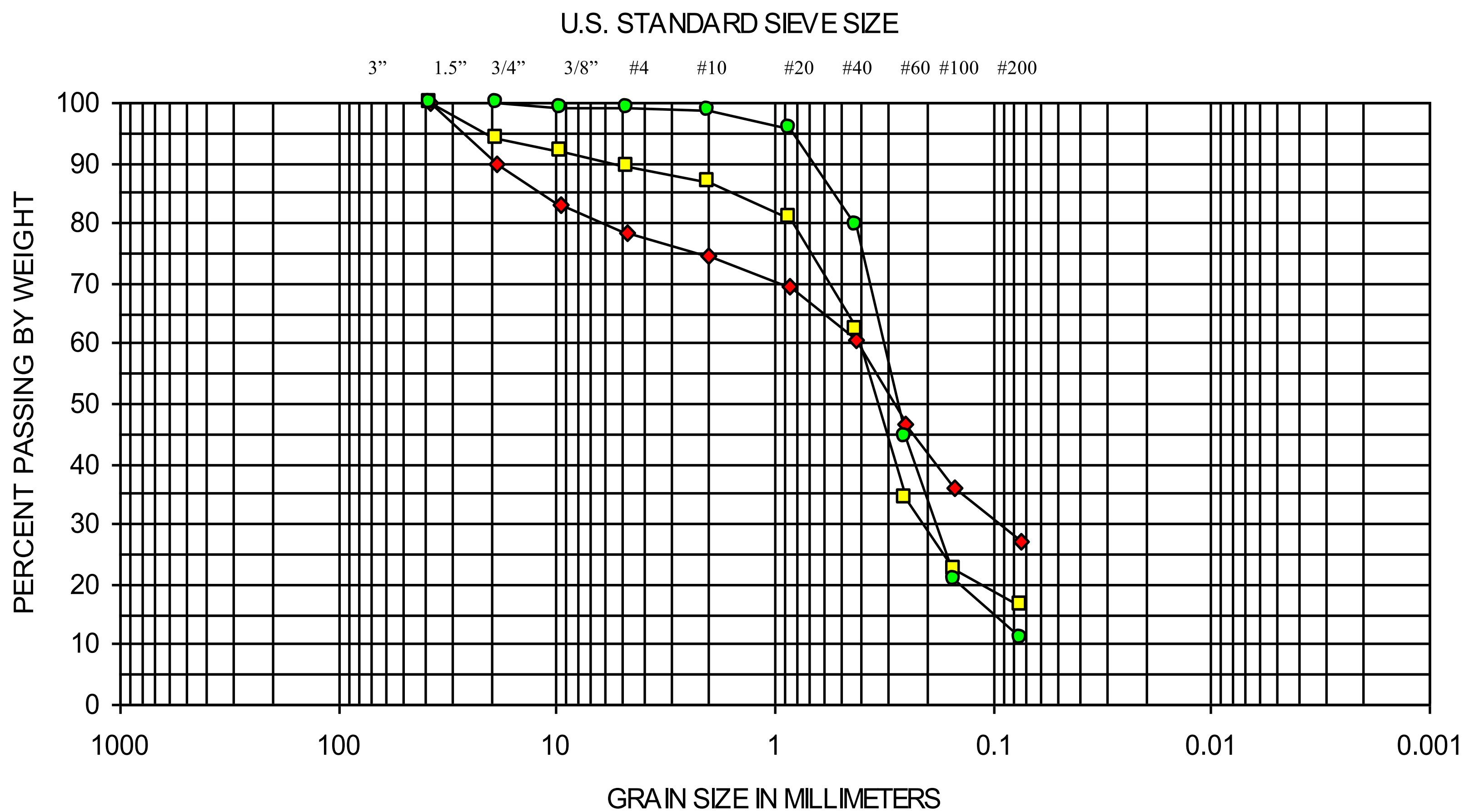
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆ (red diamond)	B-1	12½ – 14	Grayish brown silty fine to medium sand with occasional fine gravel (SM)
■ (yellow square)	B-1	25 – 26½	Brown and gray fine gravel with silt and medium to coarse sand (GP-GM)
● (green circle)	B-1	35 – 36½	Brown and gray medium to coarse sand with silt and fine gravel (SW-SM)

GEOENGINEERS

SIEVE ANALYSIS RESULTS

FIGURE A-4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆	B-2	15 – 16½	Gray silty fine to medium sand with gravel and occasional cobbles (SM)
■	B-2	25 – 26½	Brown and gray silty fine to medium sand with occasional gravel (SM)
●	B-2	45 – 46½	Brown and gray fine to medium sand with silt (SP-SM)

GEOENGINEERS

SIEVE ANALYSIS RESULTS

FIGURE A-5

ATTACHMENT B

REPORT LIMITATIONS AND GUIDELINES FOR USE

ATTACHMENT B
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, Otak and their authorized agents. 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 Overlake Village Stormwater and Park Facilities 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.

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.

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

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.

NEW INTRODUCTION

This report summarizes the results of our geotechnical services for the proposed Overlake Village Stormwater and Park Facilities Plan. Our understanding of this project is based on information provided by Otak and the City. We understand that Otak, Inc. is under contract to the City of Redmond to evaluate alternative sites and configurations for multiple large regional stormwater and collocated park facilities. GeoMapNW and NHC are under contract to the City to develop improved surficial geology information and develop sizing parameters for the regional stormwater facilities to be located at a few sites within the study area. That information is being used by Otak to develop concepts for low impact development throughout the neighborhood, develop conceptual designs for large ponds or vaults, and improve the understanding of groundwater conditions. GeoEngineers has been tasked by Otak to provide more detailed soils and groundwater information specific to two locations, and provide information about suitability of those locations for construction of large regional stormwater vaults or ponds, and infiltration at those sites. The North Site is located near 2801 – 152nd Avenue NE, within the right-of-way of 152nd Avenue, just south of SR520. The South site is located in southeast portion of the Sears parking area, just north of NE 20th Street and east of 148th Avenue NE. The locations of the North and South sites are shown on the attached Vicinity Map, Figure 1.