August 12, 2022

Madison Johnson
Seaborn Pile Driving
1080 West Ewing Street
Seattle, Washington 98119

RE: Retaining Wall and Bulkhead Recommendations
George Residence
9607 Southeast 72nd Street
Mercer Island, Washington 98040
RGI Project No. 2022-439-1

Dear Madison Johnson:

The Riley Group, Inc. (RGI) is pleased to present our recommendations for applying a permit for an existing retaining wall, repairing a bulkhead, and repairing existing dock at the above-referenced site. On July 26, 2022, RGI observed the site condition and performed subsurface exploration by advancing four borings using a hand auger in the existing retaining wall and proposed bulkhead area. The boring locations are shown on Figure 2. The following presents our findings of the soil conditions and recommendations for the proposed project based on referenced report and document.

PROJECT DESCRIPTION

RGI understands that the owner plans to repair 57 feet of rock bulkhead and existing deck. A block retaining wall was built between the residence and the bulkhead without a permit. The retaining wall was less than 25 feet from the shoreline and is located in a geological hazardous area. A geotechnical report will be needed for the project. Our understanding of the project is based on site plans prepared by Seaborn Pile Driving dated January 24, 2022.

An RGI geologist visited the site on July 26, 2022 and observed the existing shoreline condition. Based on our observations, the project is feasible from a geotechnical standpoint.

Currently, the bulkhead is the only structure to protect the site from being damaged by wave action. Per City of Mercer Island Municipal Codes 19.07110 (E)(2)(h), we recommend that the bulkhead be repaired to protect the property from being damaged by wave action from Lake Washington.

SOIL AND GROUNDWATER CONDITION

The soils encountered during field exploration include fill comprised of loose to medium dense, silty sand with trace to some gravel and dense angular gravel and quarry spalls over native deposits of medium dense gravelly sand with some silt. More detailed descriptions of the subsurface conditions encountered are presented in the attached logs. Sieve analysis was performed on one selected soil sample. The grain size distribution curve is included.

At the time of the field exploration was performed, the lake level is 2.5 to 3 feet below the top of the existing bulkhead. RGI understands that the lake level variates about 2 feet and will be lower in the winter.

GEOTECHNICAL RECOMMENDATIONS

Analysis

The existing bulkhead is supporting the slope above the shoreline. The existing bulkhead is in need of repair. If it is not repaired properly, the slope will be affected by erosion caused by wave action.

RGI reviewed a wave climate report in Lake Washington prepared by Mott McDonald dated September 2015, the report is for entire Lake Washington including wave information for Mercer Island. Based on the report, the largest significant waves occur at the shoreline facing south and southwest along Mercer Island in Lake Washington. The project area is facing east and the wave height at the bulkhead area is 2 to 3 feet with a peak period of 2 to 3 seconds and wave energy of 100 to 150 labs-foot per square foot. With the expected wave height, peak period, and energy, we expect that the shoreline, without protection from a bulkhead, will have an erosion rate from several inches to a foot per year. The toe of slope will be completely eroded within the next three years. The slope stability will be affected and a landslide will likely occur in the affected area.

The bulkhead is the only structure that protects the slope from being damaged by wave action. Per City of Mercer Island Municipal Codes 19.07110 (E)(2)(h), we recommend that the existing bulkhead be repaired as soon as possible to protect the property from being damaged by wave action from Lake Washington.

Based on the current scope of work, an existing rock bulkhead will be repaired to match the existing condition. Some of the rock blocks will be reused. We recommend that the height of the bulkhead be at least 2 feet higher than the maximum wave height which is 2 to 3 feet. The new bulkhead will be at least 4 feet above the Ordinary High Water Mark (OHWM). Our geotechnical comments and recommendations concerning the design and construction of the replacement bulkhead are provided below.

Retaining Wall

An existing Keystone retaining wall which is 2.5 to 4 feet in height (4 to 6 blocks each block is 8 inch thick) is located 15 to 20 feet west of the bulkhead. The retaining wall was built without a permit. RGI evaluated the retaining wall by advancing two hand auger borings in front of the retaining wall (HA-1 and HA-4). The auger borings encountered 1 to 2 feet of medium dense fill and native soil. The medium dense fill is suitable for foundation support of the retaining wall. Based on our observation, the retaining wall has batter of 1H: 8V and didn't show any sign of movement.

Therefore, RGI believes that the retaining wall is properly built and doesn't have any impact to the stability of the property. RGI recommends that the retaining wall be permitted.

Rock Bulkhead

Rock bulkhead is a rockery used to protect waterfront property, and it is not intended to function as an engineered structures to resist lateral earth pressures as a retaining wall. The primary function of a rock bulkhead is to provide stability and erosion control due to wave action. The amount of support obtained will depend on a large extent on the quality of the workmanship, size, shape of the rocks used, and drainage behind it. A critical factor in rockery construction is

the quality of the rock material used. Rock for use in rockery should be cubical, rectangular, or tubular in shape with the longest dimension not exceeding three times the width. The rocks recycled from existing bulkhead may not be used if not meeting the requirement. Additional rocks may need to be imported. The rock bulkhead should be constructed by an experienced rockery contractor in accordance with Associated Rockery Contractors (ARC) guidelines.

We recommended that limiting the rockery height to eight feet placed along the native dense soil. A general rock bulkhead section detail is included on Figure 3.

The following sections of the report provide general recommendations related to piles, erosion and sediment control, excavations, structural fill, and backfill compaction.

Piles

The existing steel piles can be repaired as proposed. New piles will not be needed.

Erosion and Sediment Control

Potential sources or causes of erosion and sedimentation depend on construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The impacts on erosion-prone areas can be reduced by implementing an erosion and sedimentation control plan. The plan should be designed in accordance with applicable city and/or county standards.

RGI recommends the following erosion control Best Management Practices (BMPs):

- Scheduling site preparation and grading for the drier summer and early fall months and undertaking activities that expose soil during periods of little or no rainfall
- Establishing a quarry spall construction entrance
- Installing siltation control fencing or anchored straw or coir wattles on the downhill side of work areas
- Covering soil stockpiles with anchored plastic sheeting
- Revegetating or mulching exposed soils with a minimum 3-inch thickness of straw if surfaces will be left undisturbed for more than one day during wet weather or one week in dry weather
- Directing runoff away from exposed soils and slopes
- Minimizing the length and steepness of slopes with exposed soils and cover excavation surfaces with anchored plastic sheeting (Graded and disturbed slopes should be tracked in place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion and channeling. Some sloughing and raveling of slopes with exposed or disturbed soil should be expected.)
- Decreasing runoff velocities with check dams, straw bales or coir wattles
- Confining sediment to the project site
- Inspecting and maintaining erosion and sediment control measures frequently (The contractor should be aware that inspection and maintenance of erosion control BMPs is critical toward their satisfactory performance. Repair and/or replacement of dysfunctional erosion control elements should be anticipated.)

Permanent erosion protection should be provided by reestablishing vegetation using hydroseeding and/or landscape planting. Until the permanent erosion protection is established, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

Excavations

All temporary cut slopes associated with the site and utility excavations should be adequately inclined to prevent sloughing and collapse. Based on OSHA regulations, the native soil classifies as a Group B soil. Accordingly, for excavations more than 4 feet but less than 20 feet in depth, the temporary side slopes should be laid back with a minimum slope inclination of 1-1/2H:1V (Horizontal:Vertical).

In all cases, however, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable OSHA or WISHA guidelines.

Structural Fill

The native soil encountered is suitable for re-use as structural fill if the moisture can be property controlled. If the construction occurs in wet weather, RGI recommends import structural fill be used for all grading and backfill. The import material must meet the grading requirements listed in Table 2 in order to be used as structural fill.

Table 2 Structural Fill Gradation

U.S. Sieve Size	Percent Passing
3 inches	100
No. 4 sieve	75 percent
No. 200 sieve	5 percent *

*Based on minus 3/4 inch fraction.

Prior to use, an RGI representative should observe and test all materials imported to the site for use as structural fill. Structural fill materials should be placed in uniform loose layers not exceeding 12 inches and compacted as specified in Table 3. The soil's maximum density and optimum moisture should be determined by American Society of Testing and Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

Table 3 Structural Fill Compaction ASTM D1557

Location	Material Type	Minimum Compaction Percentage	Moisture Content Range	
Foundations	On-site granular or approved imported fill soils:	95	+2	-2
Retaining Wall Backfill	On-site granular or approved imported fill soils:	92	+2	-2

Placement and compaction of structural fill should be observed by RGI. A representative number of in-place density tests should be performed as the fill is being placed to confirm that the recommended level of compaction is achieved.

ADDITIONAL SERVICES

RGI is available to provide further geotechnical consultation throughout the design phase of the project. RGI should review the final design and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design and construction.

RGI is also available to provide geotechnical engineering and construction monitoring services during construction. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this scope of work. If these services are desired, please let us know and we will prepare a cost proposal.

LIMITATIONS

This letter is the property of RGI, Seaborn Pile Driving, and its designated agents. Within the limits of the scope and budget, this letter was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this letter was issued. This letter is intended for specific application to the Shi Residence project in Mercer Island, Washington, and for the exclusive use of Seaborn Pile Driving and its authorized representatives. No other warranty, expressed or implied, is made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

The scope of services for this project does not include either specifically or by implication any environmental or biological (for example, mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, we can provide a proposal for these services.

The analyses and recommendations presented in this letter are based upon data obtained from reviewing the explorations completed by others on the site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, RGI should be requested to reevaluate the recommendations in this letter prior to proceeding with construction.

We trust the information presented is sufficient for your current needs. If you have any questions regarding this letter report or require additional information, please call us at (425) 415-0551.

Sincerely yours,

THE RILEY GROUP, INC.

State of Washington
2698
Licensed Geologist
8/12/2022
ERIC L. WOODS

RICKY RUNQI WANG
STATE OF WASHINGTON
35013
REGISTERED
PROFESSIONAL ENGINEER
8/12/2022

Eric L. Woods, LG
Project Geologist

Ricky R. Wang, PhD, PE
Principal Engineer

Attachments: Figure 1 Site Vicinity Map
Figure 2 Geotechnical Exploration Plan
Figure 3 Typical Rock Bulkhead Section
Hand Auger Boring Logs and Grainsize Analysis

USGS, 2020, Mercer Island, Washington
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000

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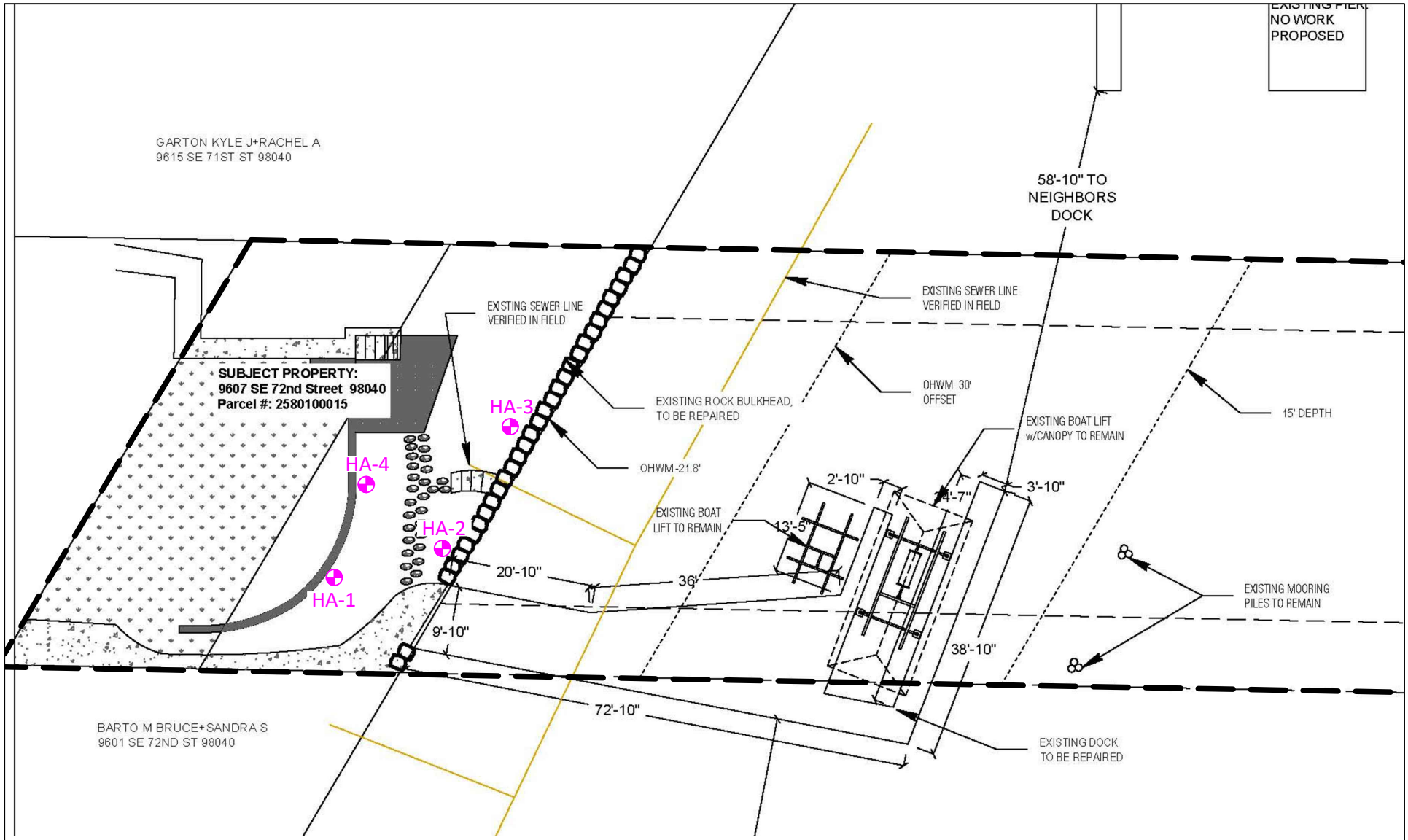
George Residence		Figure 1
RGI Project Number: 2022-439-1	Site Vicinity Map	Date Drawn: 08/2022
Address: 9607 Southeast 72nd Street, Mercer Island, Washington 98040		



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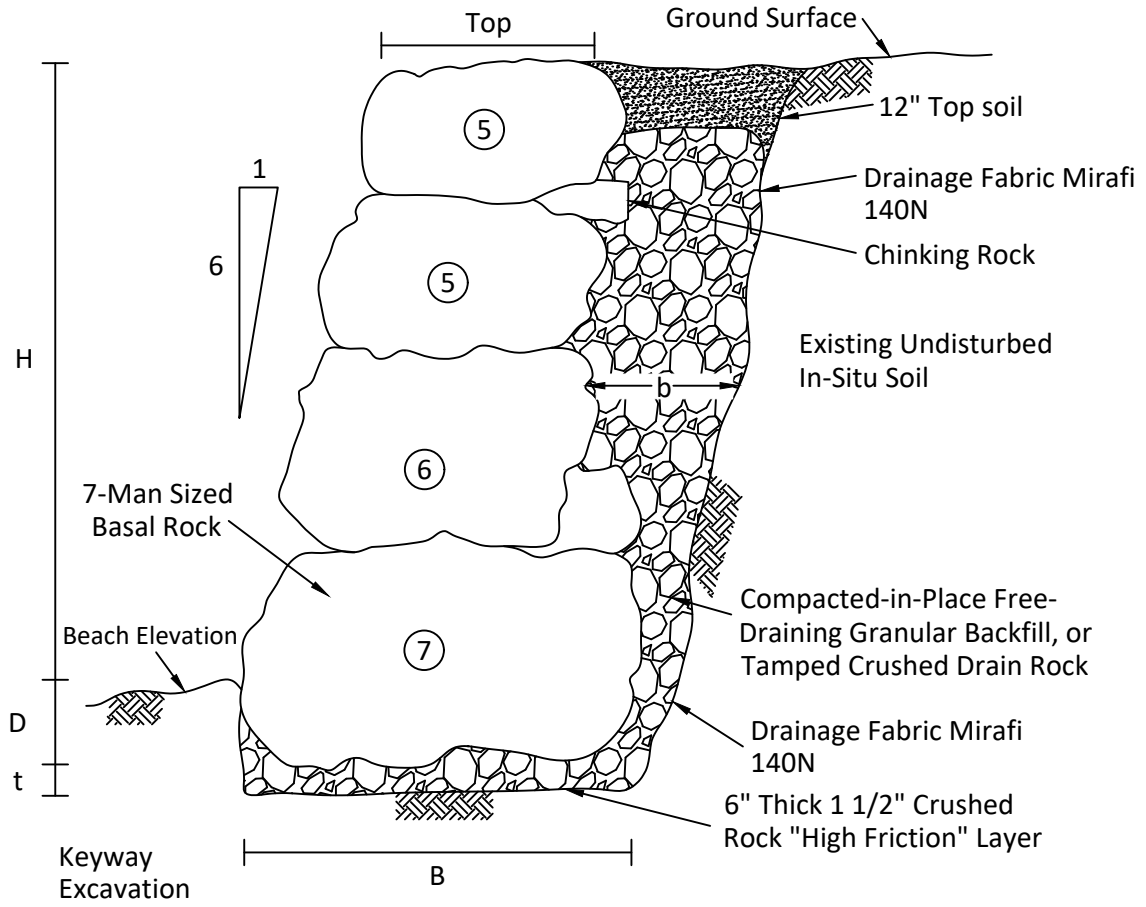
George Residence		Figure 2
RGI Project Number: 2022-439-1	Geotechnical Exploration Plan	Date Drawn: 08/2022
Address: 9607 Southeast 72nd Street, Mercer Island, Washington 98040		



LEGEND

- Maximum estimated free-standing rock wall height, H = 12 feet
- Minimum estimated keyway excavation depth, D = 2-1/2 feet
- Minimum recommended thickness of 1-1/2" crushed rock "high friction" - layer t = 6 inches
- Minimum estimated total rock wall length, H+D-I = 13-1/2 feet
- Minimum recommended width of keyway excavation, B = See Table
- Minimum recommended thickness of drain rock layer, b = 1 foot
- Allowable soil bearing capacity of base of rock wall = 2,100 psf
- Minimum recommended basal rock size = 7-man
- Minimum recommended size of chinking rock = 2-man
- Neglect upper 1 foot of passive resistance in design
- Rock bulkhead wall construction to be in general accordance with the geotechnical engineering report and the ARC Rockery Construction Guidelines

Rock Man-Size	Rock Dimensions (Inches)	Rock Weight (Pounds)
3-man	28-36	700-2,000
4-man	36-48	2,000-4,000
5-man	48-54	4,000-6,000
6-man	54-60	6,000-8,000
7-man	>60	>8,000

H (Feet)	B (Feet)	Top (Feet)
4	4	3
6	5.5	4
8	7	5.5
10	8.5	6
12	9.5	7

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George Residence | Figure 3

RGI Project Number: 2022-439-1 | Typical Rock Bulkhead Section | Date Drawn: 08/2022

Address: 9607 Southeast 72nd Street, Mercer Island, Washington 98040

Project Name: **George Residence** Project Number: **2022-439-1** Client: **Seaborn Pile Driving**	Hand Auger No.: **HA-1** **Sheet 1 of 1**

Date(s) Drilled: **7/26/2022**	Logged By: **ELW**	Surface Conditions: **Soil**
Drilling Method(s): **Hand Auger**	Drill Bit Size/Type: **4" auger**	Total Depth of Borehole: **2 feet bgs**
Drill Rig Type: **N/A**	Drilling Contractor: **N/A**	Approximate Surface Elevation: **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s): **Grab**	Hammer Data : **N/A**
Borehole Backfill: **Cuttings**	Location: **9607 Southeast 77th Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					Fill		Brown silty SAND with some gravel, loose to medium dense, moist (Fill)	
	1					SP-SM		Brown gravelly SAND with some silt, medium dense, moist, 7% fines	11
	2							Hand Auger terminated at 2'	
	3								

The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **George Residence**
Project Number: **2022-439-1**
Client: **Seaborn Pile Driving**

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Hand Auger No.: **HA-2**
Sheet 1 of 1

Date(s) Drilled: **7/26/2022**	Logged By: **ELW**	Surface Conditions: **Soil**
Drilling Method(s): **Hand Auger**	Drill Bit Size/Type: **4" auger**	Total Depth of Borehole: **1.5 feet bgs**
Drill Rig Type: **N/A**	Drilling Contractor: **N/A**	Approximate Surface Elevation: **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Cuttings**	Location: **9607 Southeast 77th Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					Fill		Brown silty SAND with trace gravel, loose, moist (Fill)	
						Fill		Gray quarry spalls, dense, moist	
	1								
								Hand Auger terminated at 1.5'	
	2								
	3								

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17522 Bothell Way NE, Bothell, WA 98011

Project Name: **George Residence**
Project Number: **2022-439-1**
Client: **Seaborn Pile Driving**

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Hand Auger No.: **HA-3**
Sheet 1 of 1

Date(s) Drilled: **7/26/2022**	Logged By: **ELW**	Surface Conditions: **Soil**
Drilling Method(s): **Hand Auger**	Drill Bit Size/Type: **4" auger**	Total Depth of Borehole: **2 feet bgs**
Drill Rig Type: **N/A**	Drilling Contractor: **N/A**	Approximate Surface Elevation: **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Cuttings**	Location: **9607 Southeast 77th Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					Fill		Brown silty SAND with some gravel, loose to medium dense, moist (Fill)	
	1					Fill		Gray angular gravel, dense, moist (Fill)	
	2							Hand Auger terminated at 2'	
	3								

The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **George Residence** Project Number: **2022-439-1** Client: **Seaborn Pile Driving**	Hand Auger No.: **HA-4** **Sheet 1 of 1**

Date(s) Drilled: **7/26/2022**	Logged By: **ELW**	Surface Conditions: **Soil**
Drilling Method(s): **Hand Auger**	Drill Bit Size/Type: **4" auger**	Total Depth of Borehole: **2.5 feet bgs**
Drill Rig Type: **N/A**	Drilling Contractor: **N/A**	Approximate Surface Elevation: **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Cuttings**	Location: **9607 Southeast 77th Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					Fill		Brown silty SAND with some gravel, loose to medium dense, moist (Fill)	
	1								
	2					SP-SM		Gray gravelly SAND with some silt, medium dense, moist	
								Hand Auger terminated at 2.5'	
	3								

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17522 Bothell Way NE, Bothell, WA 98011

Project Name: **George Residence**

Project Number: **2022-439-1**

Client: **Seaborn Pile Driving**

Key to Log of Boring

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample ID: Sample identification number.
5. Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6. Recovery (%): Core Recovery Percentage is determined based on a ratio of the length of core sample recovered compared to the cored interval length.
7. USCS Symbol: USCS symbol of the subsurface material.
8. Graphic Log: Graphic depiction of the subsurface material encountered.
9. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
10. Moisture (%): Moisture, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

AF

Poorly graded SAND with Silt (SP-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

THE RILEY GROUP, INC.
17522 Bothell Way NE
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PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	George Residence		**SAMPLE ID/TYPE**	HA-1	
PROJECT NO.	2022-439-1		**SAMPLE DEPTH**	1.5 feet	
TECH/TEST DATE	CM	8/2/2022	**DATE RECEIVED**	7/26/2022	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	469.0
Wt Dry Soil & Tare (gm)	(w2)	422.8
Weight of Tare (gm)	(w3)	15.8
Weight of Water (gm)	(w4=w1-w2)	46.2
Weight of Dry Soil (gm)	(w5=w2-w3)	407.0
Moisture Content (%)	(w4/w5)*100	11

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

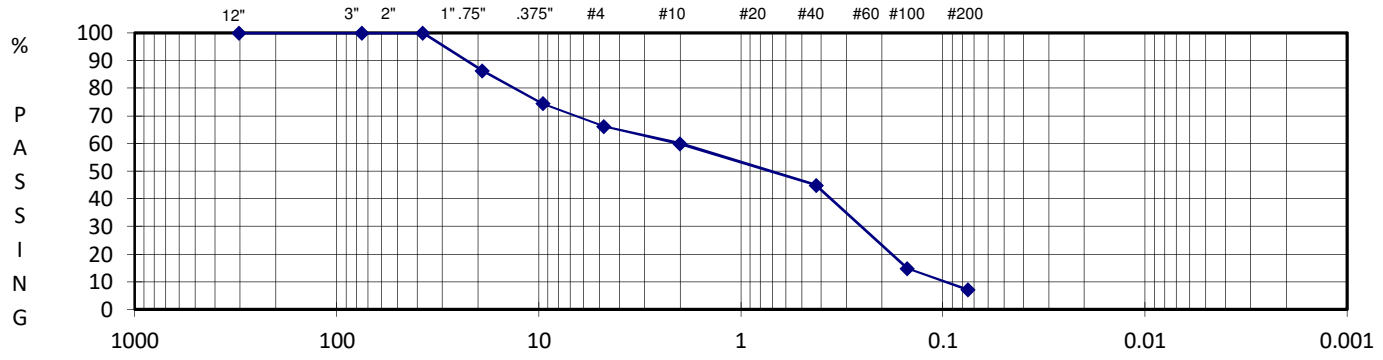
Weight Of Sample (gm)		422.8
Tare Weight (gm)		15.8
(W6) Total Dry Weight (gm)		407.0

% COBBLES	**0.0**
% C GRAVEL	**13.7**
% F GRAVEL	**20.2**
% C SAND	**6.3**
% M SAND	**15.0**
% F SAND	**37.9**
% FINES	**7.0**
% TOTAL	**100.0**

D10 (mm)	0.095
D30 (mm)	0.26
D60 (mm)	2
Cu	21.1
Cc	0.4

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.8	0.00	0.00	100.00	cobbles
3.0"	15.8	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.8	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	71.6	55.80	13.71	86.29	fine gravel
0.50"					fine gravel
0.375"	120.3	104.50	25.68	74.32	fine gravel
#4	153.7	137.90	33.88	66.12	coarse sand
#10	179.2	163.40	40.15	59.85	medium sand
#20					medium sand
#40	240.1	224.30	55.11	44.89	fine sand
#60					fine sand
#100	362.7	346.90	85.23	14.77	fine sand
#200	394.5	378.70	93.05	6.95	fines
PAN	422.8	407.00	100.00	0.00	silt/clay



DESCRIPTION	Gravelly SAND with some silt
USCS	SP-SM

Prepared For:
Seaborn Pile Driving

Reviewed By:
ELW

RILEYGROUP