

## **REPORT OF GEOTECHNICAL ENGINEERING SERVICES**

Zion Napier  
Seaborn Pile Driving  
1080 West Ewing Street  
Seattle, Washington 98119

For  
Bulkhead Recommendations  
Pisco Residence  
6000 Southeast 20<sup>th</sup> Street  
Mercer Island, Washington 98040

Project: SeabornP-1-01

January 31, 2025

Seaborn Pile Driving  
1080 West Ewing Street  
Seattle, Washington 98119

Attention: Zion Napier

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Bulkhead Recommendations

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6000 Southeast 20th Street

Mercer Island, Washington 98040

Project: SeabornP-1-01

NV5 is pleased to submit this report of geotechnical engineering services for the proposed cove and bulkhead repair project located at 6000 SE 20th Street in Mercer Island, Washington. This report has been prepared in accordance with our proposal dated January 06, 2025.

We appreciate the opportunity to be of service to you. Please contact us if you have questions regarding this report.

Sincerely,

NV5

Charlie Chou, L.G.  
Senior Geologist

Ricky Wang, PhD, PE, GE, LEG  
Senior Principal Geotechnical Engineer

Attachments

One copy submitted

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## ACRONYMS AND ABBREVIATIONS

ARC	Associated Rockery Contractors
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BGS	below ground surface
BMP	best management practices
GER	Geotechnical Engineering Report
H:V	horizontal to vertical
in/hr	inch(es) per hour
OHWM	Ordinary High Water Mark
pcf	pounds per cubic foot
pci	pounds per cubic inch
PGA	peak ground acceleration
psf	pounds per square foot
psi	pounds per square inch
USGS	U.S. Geological Survey

## 1.0 INTRODUCTION

This report provides NV5's geotechnical engineering recommendations for applying a permit for repairing a bulkhead and installing a cove at the above-referenced site. On January 21, 2025, NV5 observed the site conditions and performed subsurface exploration by advancing three borings using a hand auger behind the existing 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.

Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

## 2.0 PROJECT UNDERSTANDING

We understand that the owner plans to repair an existing rock bulkhead, about 156 feet long and about 5 feet tall, with 3-man rock and install a 911 square foot cove with beach gravel. A geotechnical engineering report (GER) will be needed for the project. Our understanding of the project is based on site plans prepared by the Client, Seaborn Pile Driving dated May 31, 2024.

An NV5 geologist visited the site on January 21, 2025 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 19.13.050(B), we recommend that the bulkhead be repaired to protect the property from being damaged by wave action from Lake Washington.

## 3.0 PURPOSE AND SCOPE

The purpose of this evaluation is to provide geotechnical engineering recommendations for use in design and construction of the proposed project. Specifically, we proposed the following scope of services:

- Review readily available, published geologic data and our in-house files for existing information on subsurface conditions in the site vicinity.
- Coordinate and manage the field exploration, including utility locating and coordination with existing property owners.
- Plan and conduct a geotechnical field exploration program that will include the following:
  - One day of hand auger exploration, hand augers will be excavated up to 5 feet, or until refusal, whichever is shallower. The hand auger borings will be located near the existing bulkhead and proposed cove area.
  - Maintain continuous logs of the explorations and collect samples at representative intervals.
  - Conduct laboratory testing on disturbed soil samples collected from the explorations; laboratory tests may include moisture content and sieve analysis.
- Prepare one final Geotechnical Engineering Report summarizing our findings, conclusions,

and recommendations, including information related to the following:

- Soil and groundwater conditions, evaluation of existing bulkhead, recommendation for design, repair, and construction of rock bulkhead and cove.
- Prepare a plan review letter to the City of Mercer Island based on the existing plan.

## **4.0 SITE CONDITIONS**

### **4.1 SURFACE CONDITIONS**

The approximately 0.5-acre site occupies developed residential land with a single-family residence. It is bound by 5904 SE 20<sup>th</sup> Street to the north, SE 20<sup>th</sup> Street to the east, 2005 SE 20<sup>th</sup> Street to the south, and Lake Washington to the west. The topography in the area grades very gently downward from east to west, and the site with an elevation change of 10 feet.

### **4.2 SUBSURFACE CONDITIONS**

The soils encountered during field exploration include less than 1 feet of fill comprised of soft red-brown silt with some concrete and brick material over native dense to medium dense silty sand with gravel. A water table was not encountered during exploration. More detailed descriptions of the subsurface conditions encountered are presented in the attached logs. Sieve analysis was performed on selected soil samples. 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. NV5 understands that the lake level variates about 2 feet and will be higher in the summer.

## **5.0 CONCLUSIONS AND RECOMMENDATIONS**

NV5 reviewed a wave climate report in Lake Washington prepared by Mott McDonald dated September 2015 as well as a King County Signature Report for Motion 15693 dated August 2020 which is for the entire Lake Washington including wave information for Mercer Island. Based on the report, the wave height at the bulkhead area is 4 to 5 feet with a peak period of 1 to 2 seconds and wave energy of up to 100 to 150 lbs-foot per square foot. With the expected wave height, peak period, and energy we expect that the shoreline, without protection from the bulkhead, will have an erosion rate from several inches to a foot per year. The slope stability will be affected in the area.

The bulkhead is the only structure that protects the slope from being damaged by wave action. Per City of Mercer Island Municipal Codes 19.13.050(B), 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 3 feet higher than the maximum wave height which is 4 to 5 feet. The new bulkhead will be at least 5 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.

### **5.1 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.

### **5.2 SITE PREPARATION**

Demolition should include the removal of structural elements, existing pavement, concrete curbs, abandoned utilities, and other buried elements. Demolition material should be transported off site for disposal or recycled and used on site if the material is acceptable for use as structural fill.

The sides and bottoms of excavations should be cut into firm material and sloped at an inclination no steeper than 1.5H:1V prior to installing structural fill. The resulting excavations should be backfilled with structural fill.

### **5.3 TEMPORARY SLOPES**

Excavation side slopes less than 10 feet high should be no steeper than 1.5H:1V, provided groundwater seepage does not occur. If slopes greater than 10 feet high are required, NV5 should be contacted to make additional recommendations. We recommend a minimum horizontal distance of 5 feet from the edge of the existing improvements to the top of the temporary slope. All cut slopes should be protected from erosion by covering them during wet weather. If sloughing or instability is observed, the slope should be flattened or supported by shoring. Excavations should not undermine adjacent utilities, foundations, walkways, streets, or other hardscapes, unless special shoring or underpinned support is provided.

### **5.4 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.

NV5 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.

### 5.5 STRUCTURAL FILL

The native soil encountered is suitable for re-use as structural fill if the moisture can be properly controlled. If the construction occurs in wet weather, NV5 recommends import structural fill be used for all grading and backfill. The import material must meet the grading requirements listed in Table 1 in order to be used as structural fill.

**Table 1 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 NV5 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 1. 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 2 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 NV5. 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.

## 6.0 LIMITATIONS

This letter is the property of NV5, 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 Pisco 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.

Explorations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

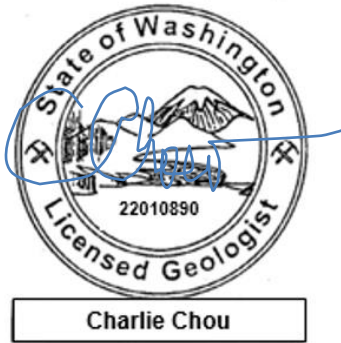
The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

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

We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

NV5



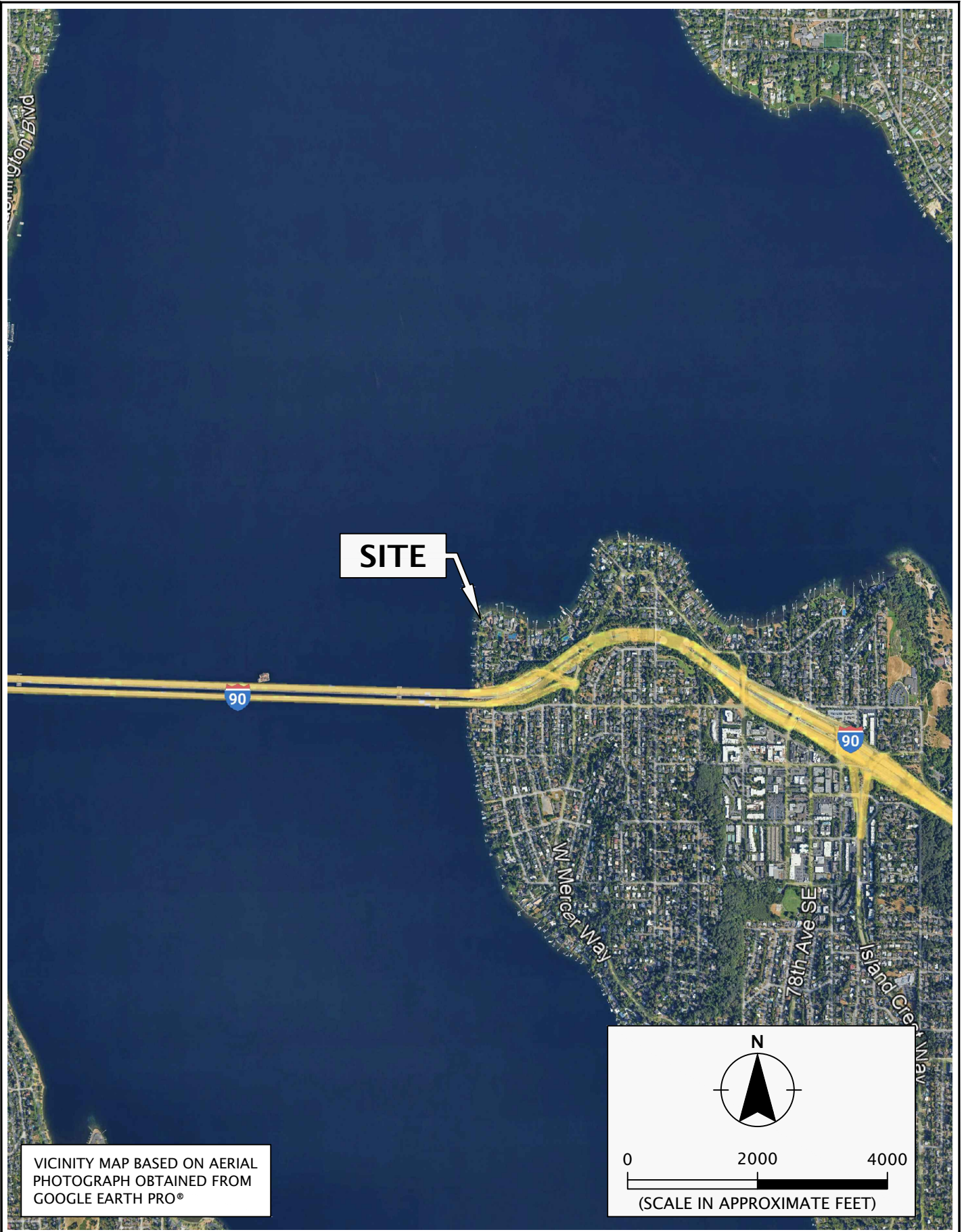
Charlie Chou, L.G.  
Senior Geologist



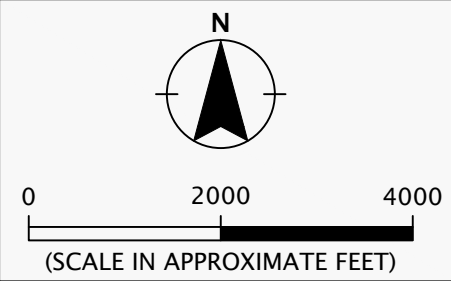
Ricky Wang, PhD, PE, GE, LEG  
Senior Principal Geotechnical Engineer



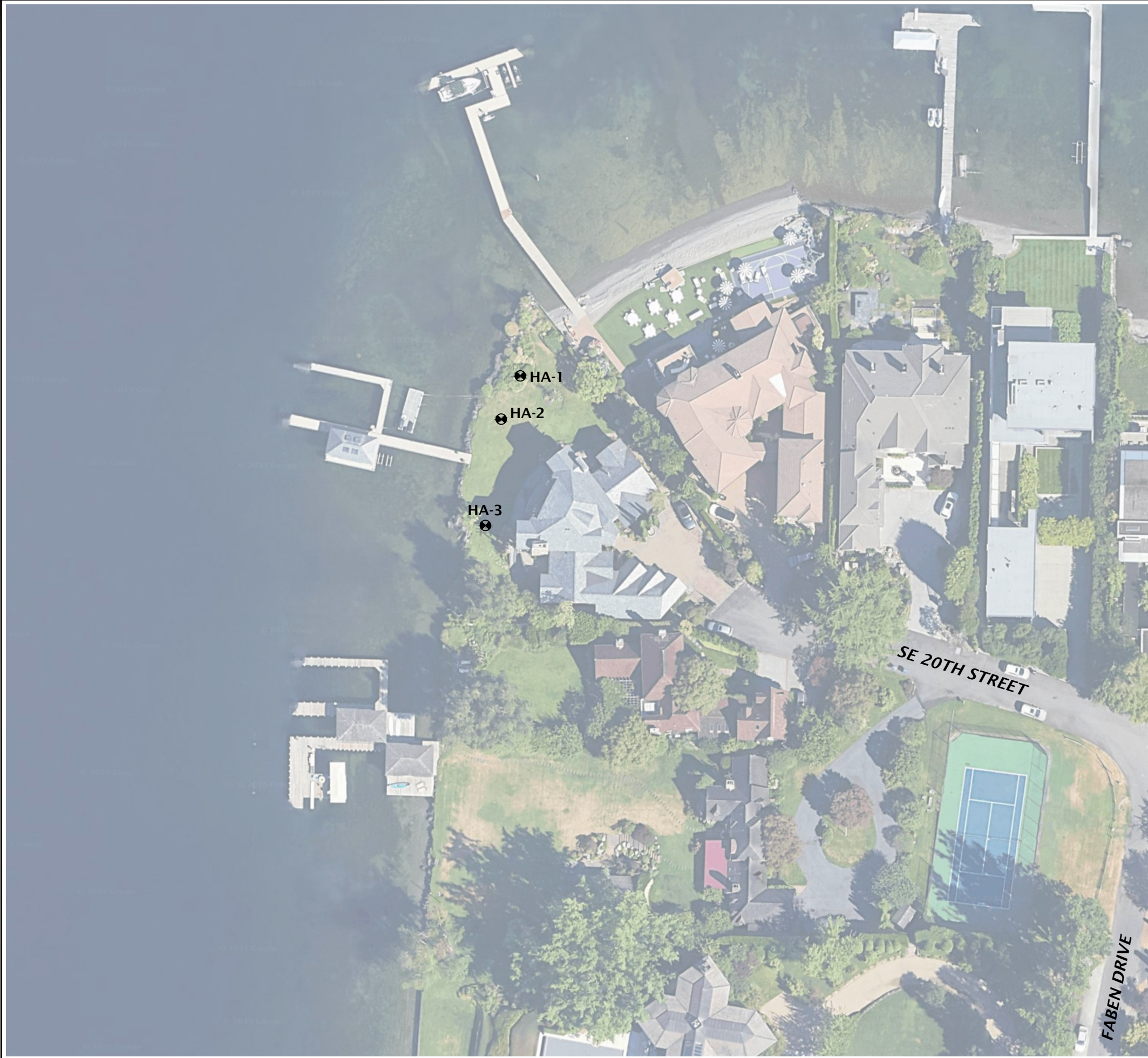
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File Name: J:\S-Z\SeabornP-1-01\Figures\CAD\SeabornP-1-01-VM01.dwg | Layout: FIGURE 1



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

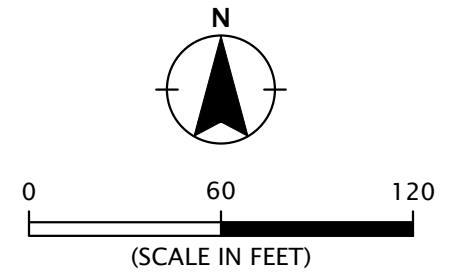


	SEABORNP-1-01	VICINITY MAP	
	JANUARY 2025	PISCO RESIDENCE MERCER ISLAND, WA	FIGURE 1



**LEGEND:**

HA-1 ● HAND AUGER BORING



SITE PLAN BASED ON AERIAL PHOTOGRAPH DATED  
AUGUST 21, 2022, OBTAINED FROM GOOGLE EARTH PRO.



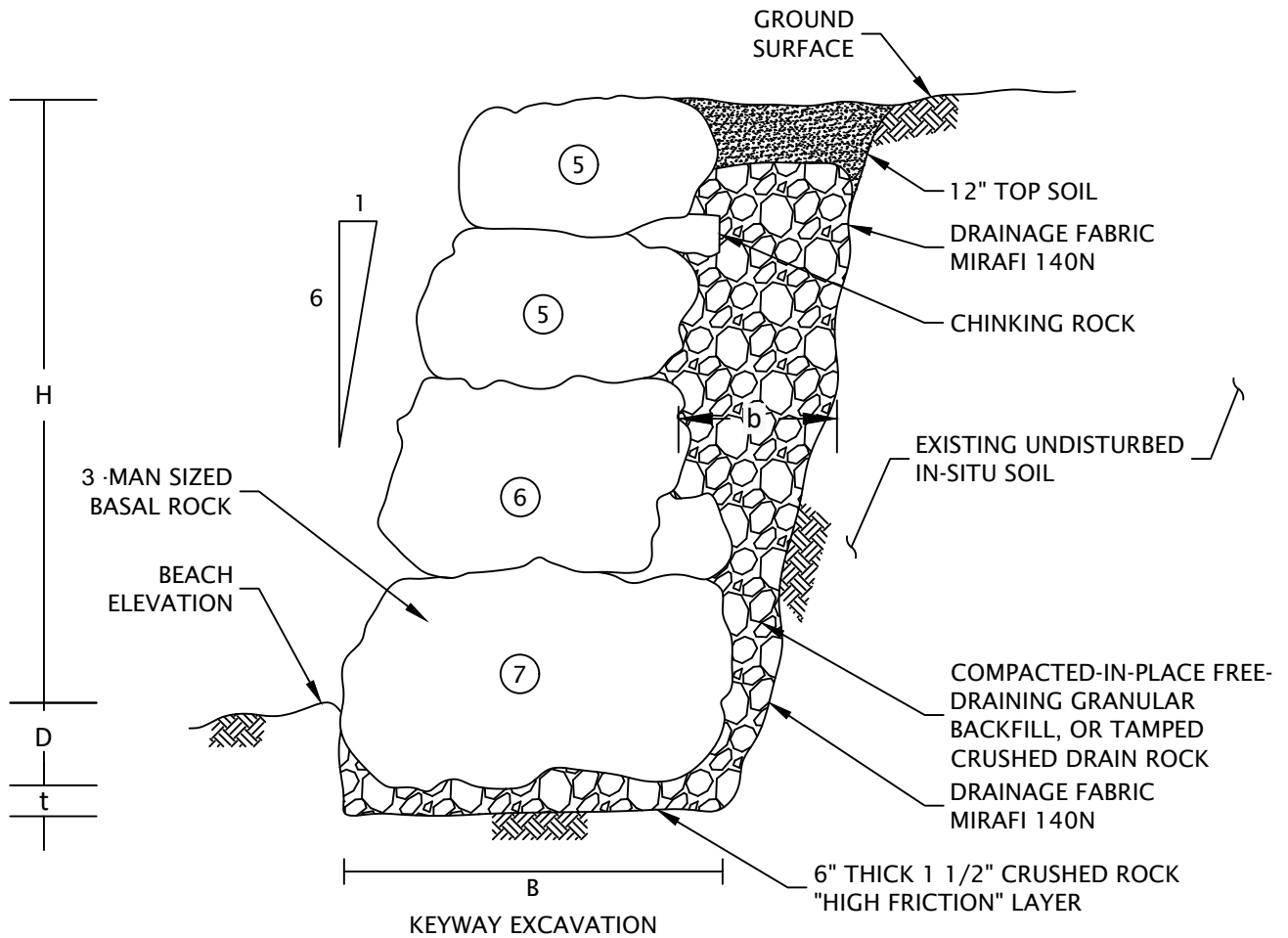
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JANUARY 2025

SITE PLAN

PISCO RESIDENCE  
MERCER ISLAND, WA

FIGURE 2



**LEGEND**

- MAXIMUM ESTIMATED FREE-STANDING ROCK WALL HEIGHT, H = 7 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 = 9-1/2 FEET
- MINIMUM RECOMMENDED WIDTH OF KEYWAY EXCAVATION, B = 7 FEET
- 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 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	4.5	3
6	5.5	4
8	7	5.5
10	8.5	6
12	9.5	7

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DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	COMMENTS
<b>HA-1</b>							
0.0		Loose, red-brown SILT (ML); moist (topsoil to 3 inches) - FILL.					Surface elevation was not measured at the time of exploration.
1.5		Dense, gray, silty SAND (SM); moist, sand is fine to coarse.	1.5	SIEV	☒	●	
2.5		Exploration terminated at a depth of 2.5 feet due to refusal on rock.	2.5				
<b>HA-2</b>							
0.0		Loose, red-brown SILT with debris (ML); moist, debris is bricks and concrete pieces (topsoil to 3 inches) - FILL.					Surface elevation was not measured at the time of exploration.
2.0		Dense, gray, silty SAND (SM); moist, sand is fine to coarse.	2.0				
2.5		Exploration terminated at a depth of 2.5 feet due to refusal on dense sand.	2.5				
DRILLED BY: NV5 staff		LOGGED BY: C. Chou		COMPLETED: 01/21/25			
BORING METHOD: hand auger (see document text)				BORING BIT DIAMETER: 3 inches			
		SEABORNP-1-01		<b>BORING</b>			
		JANUARY 2025					

BORING LOG - NV5 - 2 PER PAGE SEABORNP-1-01-HA1\_3.GPJ GDL NV5.GDT PRINT DATE: 31/1/25.SP

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	COMMENTS
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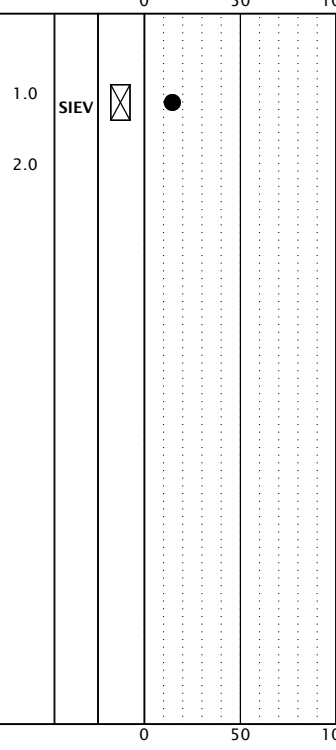
**HA-3**

0.0  
2.5  
5.0  
7.5

Loose, red-brown SILT (ML); moist (topsoil to 4 inches) - FILL.

Dense, gray, silty SAND (SM); moist, sand is fine to coarse.

Exploration terminated at a depth of 2.0 feet due to refusal on dense sand.



Surface elevation was not measured at the time of exploration.

BORING LOG - NV5 - 2 PER PAGE SEABORNP-1-01-HA1\_3.GPJ GDL NV5.GDT PRINT DATE: 31/1/25.SP

DRILLED BY: NV5 staff LOGGED BY: C. Chou COMPLETED: 01/21/25

BORING METHOD: hand auger (see document text) BORING BIT DIAMETER: 3 inches

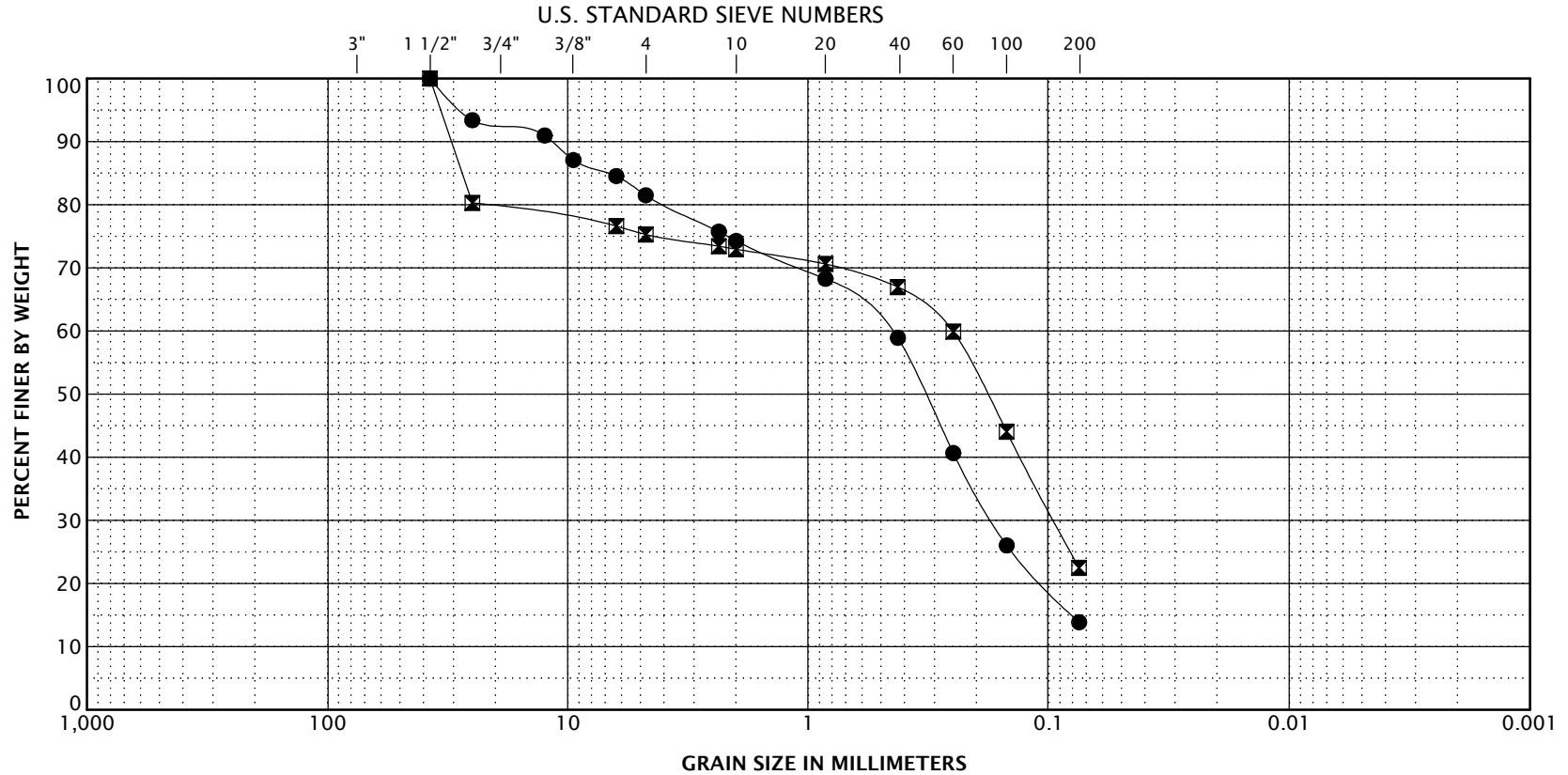


SEABORNP-1-01  
JANUARY 2025

**BORING**  
(continued)

PISCO RESIDENCE  
6000 SE 20TH STREET, MERCER ISLAND, WA

**FIGURE A-2**



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

KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	D60	D50	D30	D10	D5	GRAVEL (PERCENT)	SAND (PERCENT)	SILT (PERCENT)	CLAY (PERCENT)
●	HA-1	1.5	17	0.46	0.33	0.17			18	68	14	
☒	HA-3	1.0	15	0.25	0.18	0.10			25	53	22	



SEABORNP-1-01

**GRAIN-SIZE TEST RESULTS**


JANUARY 2025

PISCO RESIDENCE  
6000 SE 20TH STREET, MERCER ISLAND, WA

**FIGURE A-3**

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
HA-1	1.5		17		18	68	14			
HA-3	1.0		15		25	53	22			

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	SEABORNP-1-01	<b>SUMMARY OF LABORATORY DATA</b>								
	JANUARY 2025	PISCO RESIDENCE 6000 SE 20TH STREET, MERCER ISLAND, WA							<b>FIGURE A-4</b>	