MERIT ENGINEERING INC.

GEOTECHNICAL ENGINEERING INVESTIGATION

Proposed Single Family House Addition
4815 E Mercer Way
Mercer Island, Washington
Parcel#: 2162000050

Prepared For:
Jerry Zhang
4815 E Mercer Way
Mercer Island, Washington

November 14, 2022
Project No. 2DF0119981

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Jerry Zhang
jerry@hooyou.com

Re: Geotechnical Engineering Investigation
4815 E Mercer Way
Mercer Island, WA

Dear Jerry:

At your request, we have conducted a geotechnical engineering investigation at the above referenced project site. The following geotechnical engineering report represents the results of our visual site reconnaissance, DCP test observations, engineering analysis, and derived conclusions on the foundation support of proposed house additions.

Thank you for this opportunity to work with you on this project. Please contact us if you have any questions about this report.

Sincerely,

Austin X. Huang, Ph.D., P.E., L.G., D.GE., F.ASCE
Principal

F.ASCE: Fellow - American Society of Civil Engineering
D.GE - Diplomate - Academy of GeoProfessionals

D.GEs provide successful projects that benefit their clients.
The D.GE certification recognizes geotechnical engineers who possess specialty education, extensive experience, integrity, and good judgment.

GEOTECHNICAL ENGINEERING REPORT

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4815 E Mercer Way
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Prepared for:

Jerry Zhang
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Mercer Island, Washington

by

November 14, 2022

Austin X. Huang, Ph.D., P.E., L.G., G.DE, F.ASCE
Principal

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TABLE OF CONTENTS

1. INTRODUCTION

Jerry Zhang requested that Merit Engineering, Inc. conduct a geotechnical engineering investigation for the residential development at 4815 E Mercer Way, in Mercer Island, Washington (Parcel# 2162000050). The project area and vicinity is shown in Figure 1 and the site plan with test locations in Figure 2 in the Appendix.

We understand, from the information Jerry Zhang provided to us, that the subject parcel is currently occupied by a single family house. The project is proposed to construct a stairwell on southwest corner of house and expend a bedroom on the second floor to west and north sides of house.

The objective of this study was to investigate subsurface soil and groundwater conditions at the proposed project site, derive conclusions, and provide preliminary geotechnical engineering recommendations for site preparation and the design of foundations to support the proposed structure.

2. SCOPE

Based on all the above information and understanding of the project and difficult access, we conducted a site exploration using Dynamic Cone Penetration Test (DCP[1]) with scope of work in compliance with our proposal No. P2DD0314767 dated April 14, 2022, in particular includes:

- Conduct a visual site reconnaissance of the site and immediate vicinity;
- Conducting four (4) DCP to maximum depth of 4.6 feet, where penetration very stiff/ hard soil was encountered.
- Logging soil and groundwater features;

[1] DCP test consists of driving a 10 cm^2 (1.4″ diameter) cone into the ground. The cone is attached to steel rods and driven by a 35 pound hammer with 15″ free fall. Number of blows for each 10 cm (4″) penetration was recorded

- Preparing a geotechnical engineering report with geotechnical engineering recommendations:
    (1) surface conditions,
    (2) subsurface soil conditions,
    (3) groundwater conditions

Recommendations for:

(4) foundation design parameters,
(5) structural fill and compaction criteria,
(6) foundation retaining wall design parameters,
(7) drainage, and
(8) site grading.

3. SITE INVESTIGATION

3.1 Surface Conditions

The project site is a triangle-shaped parcel of land with an area of approximately 0.42 acres shown on the King County Assessor. The project site has the parcel number of 2162000050 on the King County iMap. The site is bordered by single-family residences to the west, east and south, north by E Mercer Way.

The site is currently occupied by a single family house close to the south property boundary. Topography at the project site shows a steep slope at northwest and southeast of house according to the topographic survey from CHADWICK & WINTERS LAND SURVEYING AND MAPPING. The concrete stair way was along the west side of house. The rest of the property is primarily vegetated with ground cover; and mature trees.

3.2 Subsurface Conditions

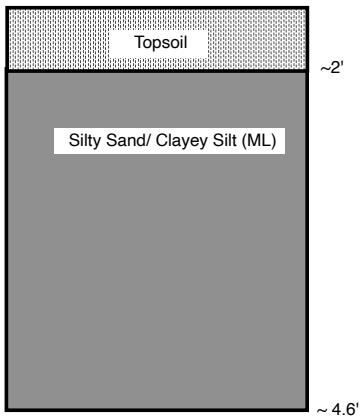
Subsurface soil and ground water conditions were investigated by four (4) DCP tests to maximum 4.6' depth on November 11, 2022. Test locations are shown on the site plan

(Figure 2). Test logs are presented in the Appendix of this report as Figures 4 through 7. Descriptions of soil symbols and classifications used in this report are also presented in the Appendix (Figure 3).

It is typical to incorporate soil conditions from other sources such as test pits, test borings, or published soil/geological information. In this case, we have referenced preliminary subsurface investigation report dated January 28, 2002 form Zipper Zeman Associates, Inc. The soil report indicates that the on-site soils and nearby up to 5.5′ depth are interpreted as shown:

a. Topsoil

b. Silty Sand/Clayey Fine Sands (ML)



a. Topsoil

A layer of topsoil which varies in thickness from 0" - 2' generally blankets the entire property. Black, fine grained silty sand with organics, and vegetation roots were found. The topsoil was damp, crumbly when disturbed, and loose in situ.

b. Silty Sand/Clayey silt (ML)

A layer of silts underlying the topsoil extends to the maximum depth of test hole at ~4.6'. The soil is brown/gray, very stiff to hard and damp.

3.3 Geologic Background

The 1:250,000 geologic map from Washington State Department of Natural Resources indicates the area of the project site is mapped as Pleistocene continental glacial drift (Qgo) -

which is Recessional and proglacial stratified sand, gravel, and cobbles with minor silt and clay interbeds deposited in delta, ice-contact, beach, and meltwater stream environments; may include advance outwash, the soils as also indicated in the NCRS soil report for this property is Kitsap silt loam, 15 to 30 percent slopes (AgC). This is consistent with our exploration.

3.4 Surface and Ground Water Conditions

No surface water and groundwater was observed during our visit on November 11, 2022. It should be noted that runoff or seeps of stormwater, and possibly pockets of temporary shallow groundwater, may occur locally during periods of heavy rainfall.

4. CONCLUSIONS AND RECOMMENDATIONS

We conclude, based on this investigation, that the site may be suitable for proposed construction if the recommendations in this report are followed.

It should be emphasized that our exploration revealed subsurface conditions only at discrete locations on the project site and that actual conditions could vary at other locations. Furthermore, the nature and extent of any such variations will not become evident until construction activities have begun. If significant variations are observed at that time. We may need to modify our conclusions and recommendations to reflect actual conditions.

4.1 Site Preparation and Grading

We recommend removing top organic soil and unsuitable loose or soft soils, if would be encountered, from the area of proposed addition and stairwell down to firm subgrade.

We recommend grading the exposed subgrade away from footing and slab-on-grade locations to minimize the potential for accumulation of surface water. We anticipate soil excavation can be accomplished with conventional equipment.

Due to the fine-grained nature of some on-site subsoil, we recommend that care be taken to the maximum extent possible for erosion and ground control if work is done in the wet season. It should be understood that significant additional costs and construction difficulty could be incurred if work proceeds in wet weather comparing with dry weather construction.

Exposed subgrade soils in areas of proposed addition and stairwell should be proof-rolled with a loaded dump truck to reveal soft or yielding surficial soils. Any soft subgrade soils encountered during site excavation or exposed during proof-rolling should be removed and replaced with structural fill as recommended in the Structural Fill section of this report.

A temporary cut slope at the site should be no steeper than 2:1 (Horizontal to Vertical). Temporary shoring is required for excavation below the water table. We recommend we evaluate site conditions for suitable cut slope during site excavation.

We recommend that we observe and verify site excavation to suitable soil stratum, observe proof-roll, test to verify import fill, observe and test compaction of structural fill materials.

4.2 Foundation Design Parameters

We recommend placing foundation on native firm silt soil or on import structural fill installed on the native silt soil. Sand sub grade soils should be compacted to 95% modified proctor. If site soils are not found to be firm at a footing location and grade, we recommend excavating down to appropriately firm soils and replacing the soft/loose soil section with structural fill.

We recommend that all perimeter footings be at least 18 inches below final outside grade for frost protection. The base width of footings shall be at least 18 and 24 inches for continuous and isolated column spread footings, respectively..

Under condition of satisfying the above recommended footing dimensions, a soil bearing pressure of 2,000 psf (*pounds per square foot*) is recommended. Bearing pressure may be increased by $^1/_3$ for transient wind or seismic loads.

Assuming construction of the proposed structure is accomplished as recommended above, we estimate the total and differential settlements of foundations should be less than about 1 inch. Most settlement will occur immediately during construction when loads are applied.

We recommend proof-rolling building pads before placement of footings with a loaded dump truck to reveal soft or yielding surficial soils. Any soft subgrade soils encountered during site excavation or exposed during proof-rolling should be re-compacted.

We recommend that we review portions of plans and specifications pertaining to earthwork and foundations to ensure they are consistent with recommendations in this report. We recommend that we verify site excavation to suitable soil stratum, and observe and test compaction of fills.

4.3 Seismic Design Parameters

Based on these results from our subsurface exploration the soil profile at the site may be defined as Site Class D according to IBC (International Building Code) 2018, representing a stiff soil. Seismic design parameters for this site class and location, from ATC Hazard by location Seismic Design Maps Tool with NEHRP-2015 (National Earthquake Hazards Reduction Program) reference document, are summarized in the following table:

Table 1: Spectral Response Acceleration (SRA)

SRA and Site Conditions	Short Period (0.2 sec)	1- Second Period
Mapped SRA	$S_S = 1.435$	$S_1 = 0.498$
Site Coefficients	$F_a = 1.0$	$F_v = 1.802$
Max. Considered Earthquake SRA	$S_{MS} = 1.435$	$S_{M1} = 0.898$
Design SRA	$S_{DS} = 0.956$	$S_{D1} = 0.598$

4.4 Slab-On-Grade Floor

The slab-on-grade-floor may be supported on the building pad prepared as recommended above. At least 4-inches of drain rock of ¾" maximum size should be placed between the slab and slab subgrade.

A vapor barrier visquine should be placed between the slab and capillary break material. An additional 1 to 2 inches of sand may be placed on top of the vapor barrier if desired to aid in concrete curing. In addition, use of a commercial concrete slab sealant for moisture protection may prove to be very helpful.

Floor slabs reinforced with 6 x 6 wire mesh may help reduce potential crack separation and vertical offsets at cracks. Reinforcement should be set at or above the mid-depth of the slabs. To reduce cracking potential we suggest exterior patios and other flatworks contain reinforcement as recommended above for floor slabs. Any flatwork subgrades should be watered thoroughly prior to concrete placement to close soil shrinkage cracks. Flatworks should have frequent joint controls.

Additional measures to reduce potential cracking are considered warranted at critical areas where slab movement could impair use; such critical areas include any exterior patio slabs

that meet the interior floor level at doorways. For such areas we recommend that a layer of 12″ import structural fill materials as specified in the Structural Fill section of this report.

4.5 Foundation Drainage

A perimeter drainage system should consist of at least 6-inch diameter, perforated, rigid pipe. Pipes should be placed along the exterior base of the foundation perimeter and tightlined to a storm drain system or natural drain course. Pipe should be bedded on 2 inches, and backfilled with a minimum of 12-inches, of pea gravel. Under-slab cross-drains may be helpful to maintain a dry slab floor to facilitate drainage. A cross-drain system should be overlain by drain rock beneath the slab.

Roof downspouts should be tightlined to a storm drain system separately from footing drains. In addition, the site should be graded so that surface water runoff is directed to catch basins attached to a storm sewer drain.

In addition, an adequate drainage system should be installed around the proposed development to help reduce runoff potential and surface ponding.

4.6 Structural Fill

Structural fill should be placed on firm, horizontal subgrade in about 10-inch thick loose lifts and compacted to at least 95% of the ASTM D-1557 maximum dry density.

We recommend import structural fill be sandy gravel or gravelly sand meeting specification - 9-03.12 (1) B, APWA/DOT 2006, that is typical in this area as base granular materials with exception that percent passing U.S. No. 200 Sieve shall not exceed 5% and all materials smaller than 4″. The specification is summarized below:

Table 2: Specification of Imported Fill Materials

Sieve Size	Percent Passing by Weight
4″ Square	100
2″ Square	75-100
U.S. No. 4	22-66
U.S. No. 200	5.0 max.
Dust Ratio $\frac{\%\ Passing\ U.S.\ No.\ 200}{\%\ Passing\ U.S.\ No.\ 40}$	⅔ max.
Sand Equivalent	30 min.

5. GENERAL CONDITIONS

The recommendations provided herein are based on our understanding of the project at this time. We expect the on-site soil conditions to reflect our findings, however, some variations may occur. Should soil conditions be encountered that cause concern and/or are not discussed herein, Merit Engineering, Inc. should be contacted immediately to determine if additional or alternate recommendations are required.

We recommend that we review those portions of the plans and specifications that pertain to earthwork and foundations to ensure consistency with the recommendations in this report.

We recommend that we verify site excavation to suitable soil stratum, observe proof-roll, verify imported fill materials, and observe and test compaction of structural fill.

This report is prepared for Jerry Zhang for specific application to a residential site at 4815 E Mercer Way, Mercer Island, Washington. This report is completed in accordance with generally accepted geotechnical engineering practices in this area. No other warranty, expressed or implied, is made.

This report is an instrument of our professional service, and we (Merit Engineering) shall retain an ownership and property interest therein. We grant Jerry Zhang a license to use the instrument of our professional service for the purpose of constructing the above mentioned addition structures on site. We do not permit reuse or modification of this document for application to a different structure other than the proposed at the site or to another property because soil and subsurface conditions are unique and site specific for different locations.

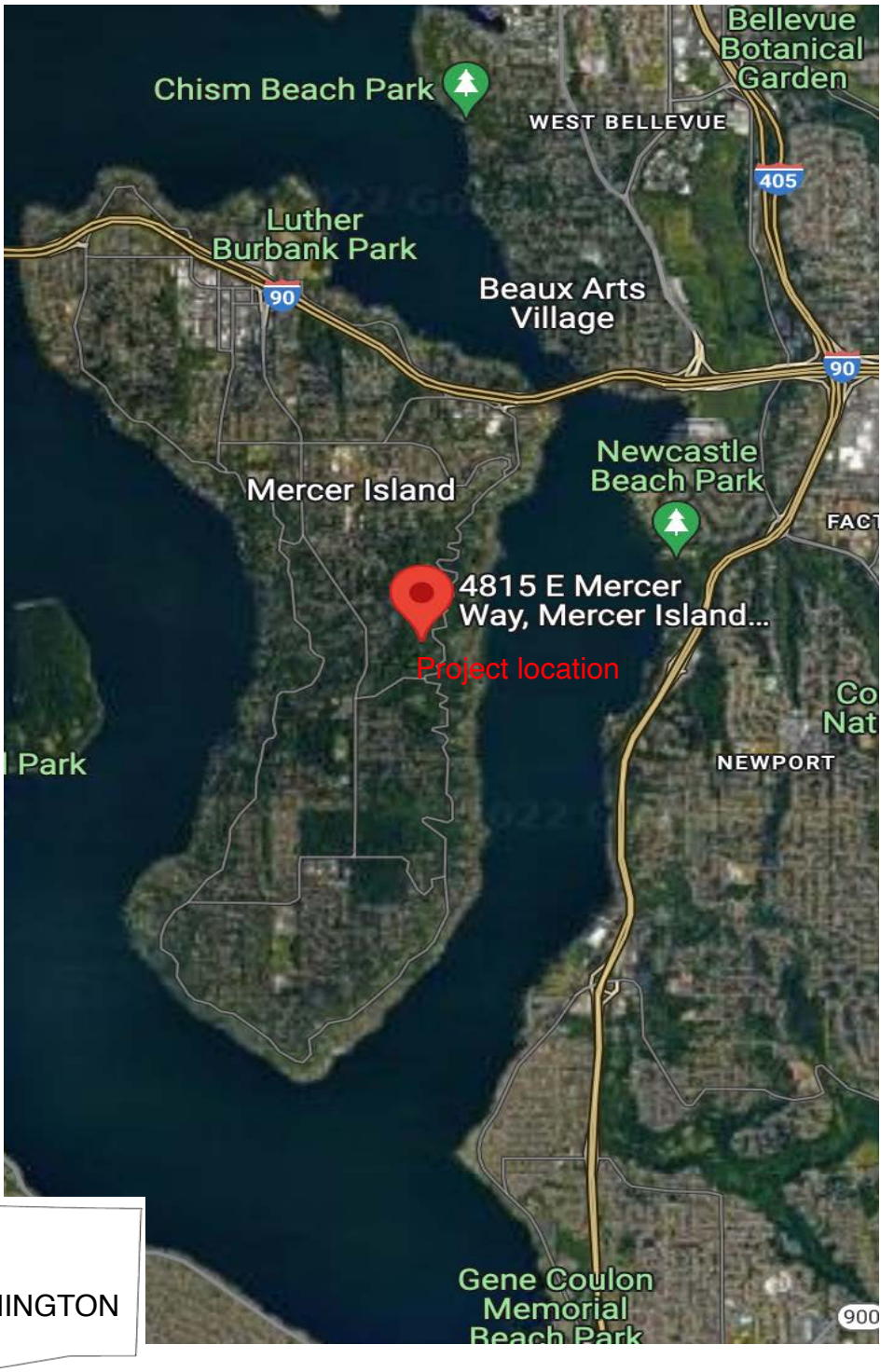
APPENDIX

Subsurface conditions at the site were investigated by conducting four (4) DCP tests to maximum depth 4.6' on November 11, 2022.

The proposed addition footprint and related site development plan are provided by Jerry Zhang. DCP tests were determined by a representative of Merit Engineering Inc. as shown approximately on the Site Plan (Figure 2) presented in the Appendix of this report. Tests were conducted near the adjacent to the building footprint to generalize subsurface soil conditions. Depths referred to in this report are relative to the existing ground surface at the time of this field investigation.

The description of subsurface conditions is based on observations made on site at the time of the field investigation. Soil logs are presented in Figures 4 to 7. Soils observed at the site were classified using the USCS (*Unified Soils Classification System*) in accordance with ASTM D-2488-69 and ASTM D 2487. This classification system is also presented in the Appendix (Figure 3).

MERCER ISLAND, WASHINGTON



Project No.2DF0119981	**PROJECT LOCATION & VICINITY MAP**	11/14/2022	*Figure 1*

Proposed Single Family House Addition
4815 E Mercer Way
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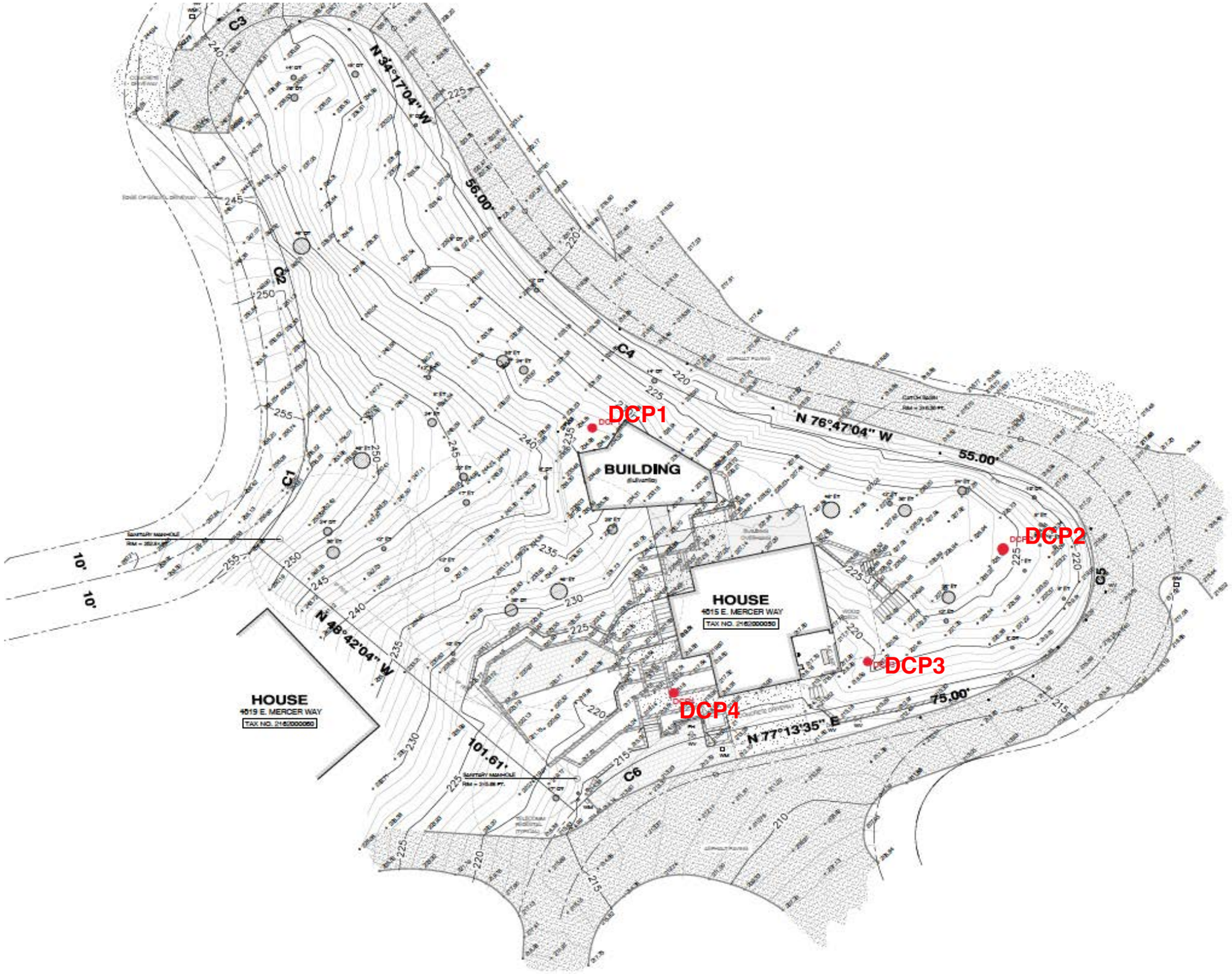

MERCER ISLAND, WASHINGTON

EXISTING SITE CONDITIONS

Note:

The site plan was based on the map from CHADWICK&WINTERS LAND SURVEYING AND MAPPING.

Proposed Single Family House Addition 4815 East Mercer Way Mercer Island, Washington	**SITE PLAN**			
	Figure 2	PROJECT NO.	DATE	APPROVED BY
Prepared For: Jerry Zhang	Scale: Not to Scale	2DF0119981	11/14/2022	AXH

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS				DESCRIPTION
COARSE GRAINED SOILS more than 50% retained on #200 sieve	GRAVELS more than 50% coarse fraction is larger than No. 4 sieve size	Gravels with less than 5% fines	GW	Well graded gravels, gravel-sand mixtures
			GP	Poorly graded gravels, gravel-sand mixtures
		Gravels with more than 12% fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS more than 50% coarse fraction is smaller than No. 4 sieve size	Sands with less than 5% fines	SW	Well graded sands, gravelly sands
			SP	Poorly graded sands, gravelly sands
		Sands with more than 12% fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS more than 50% passing #200 sieve	SILTS AND CLAYS Liquid Limit less than 50		ML	Inorganic silts & very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, or lean clays
			OL	Organic clays and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limits greater than 50		MH	Inorganic silts, micaceous or diatomacious fine, sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils
UNCONTROLLED FILL				Uncontrolled, with highly variable constituents

LEGEND

SAMPLE	SYMBOL
SPLIT SPOON SAMPLER	GROUNDWATER TABLE
SHELBY TUBE SAMPLER	q_u PENETROMETER READING TSF (*tons per square foot*)

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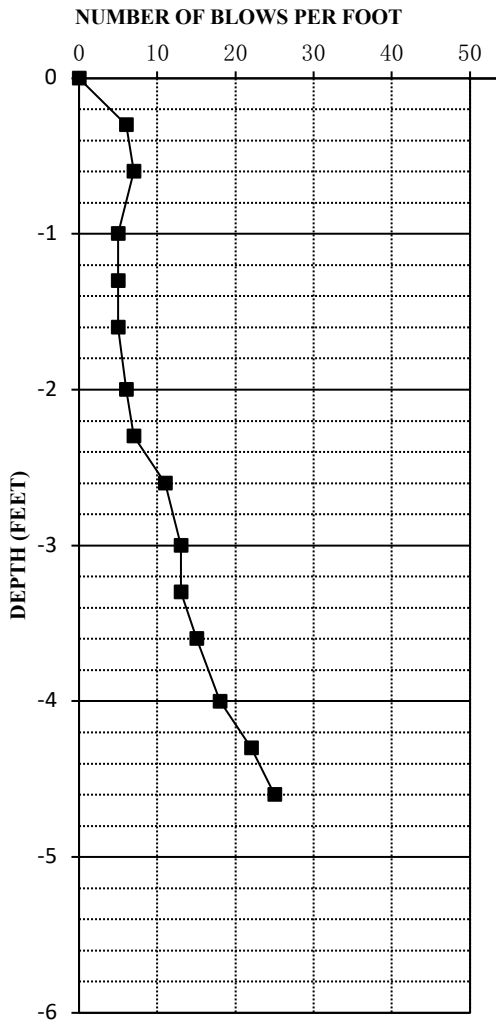
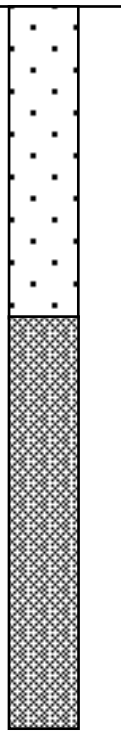
SOIL CLASSIFICATION & LEGEND

Figure 3

DCP-1 DYNAMIC CONE PENETRATION TEST	SOIL DESCRIPTION AND CLASSIFICATION

X,Y =
Surface Elevation = 234'
Surface Conditions = Ground Cover





LOOSE SILTY SANDS

SILTY AND CLAYEY SILT (ML)

End at 4.6'

Note: Soil profile is inferred from CPT results. Subsrface conditions were not observed directly during DCP testing.

Project No: 2DF0119981	Date: 11/14/2022	**LOG OF DCP TEST**	Approved by AXH	Figure 4

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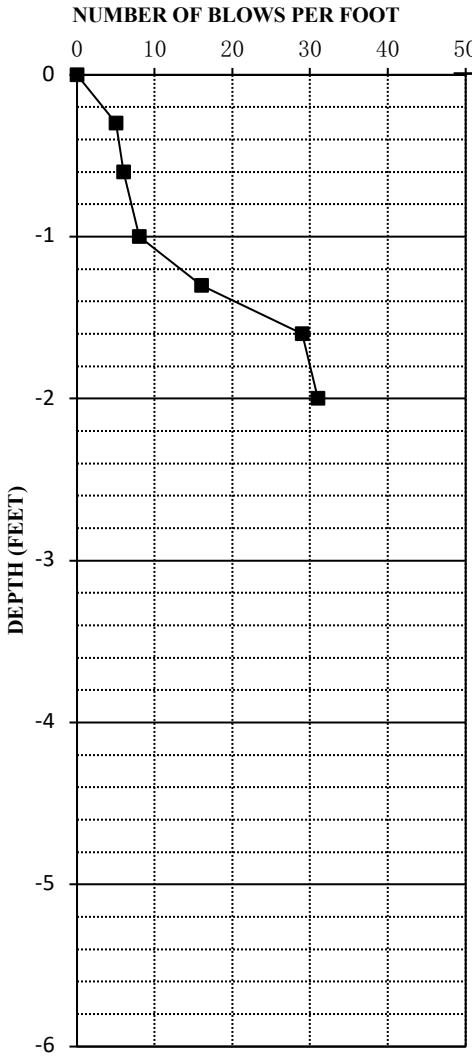
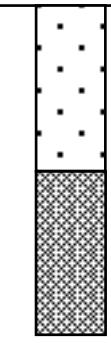
DCP-2 DYNAMIC CONE PENETRATION TEST	SOIL DESCRIPTION AND CLASSIFICATION



X,Y =
Surface Elevation = 226'
Surface Conditions = Ground Cover



LOOSE SILTY SANDS

SILTY AND CLAYEY SILTS (ML)

End at 2'

Note: Soil profile is inferred from CPT results. Subsrface conditions were not observed directly during DCP testing.

Project No: 2DF0119981	Date: 11/14/2022	**LOG OF DCP TEST**	Approved by AXH	Figure 5

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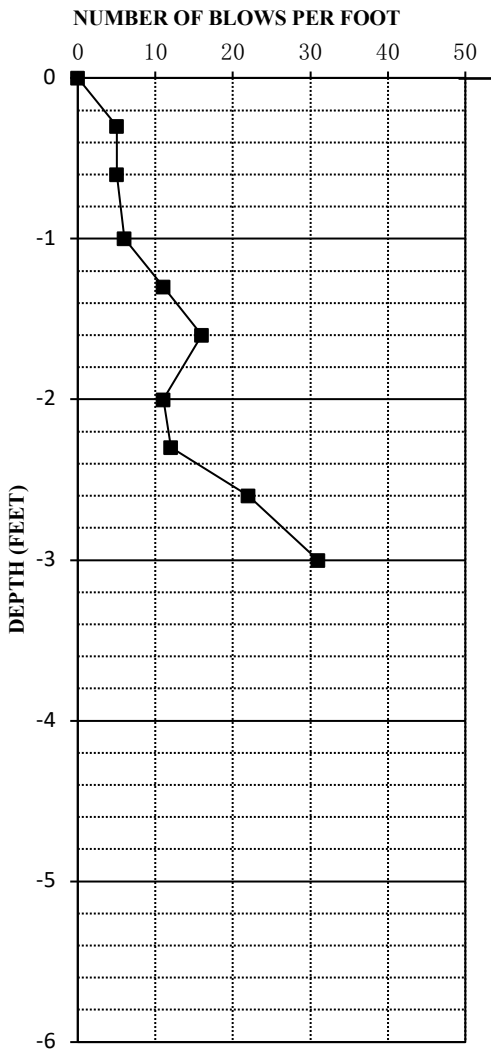
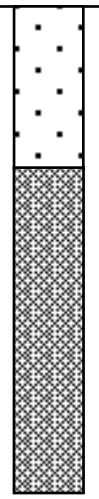
DCP-3 DYNAMIC CONE PENETRATION TEST	SOIL DESCRIPTION AND CLASSIFICATION



X,Y =
Surface Elevation = 220'
Surface Conditions = Ground Cover



LOOSE SILTY SANDS

SILTY AND CLAYEY SILTS (ML)

End at 3'

Note: Soil profile is inferred from CPT results. Subsrface conditions were not observed directly during DCP testing.

Project No: 2DF0119981	Date: 11/14/2022	**LOG OF DCP TEST**	Approved by AXH	Figure 6

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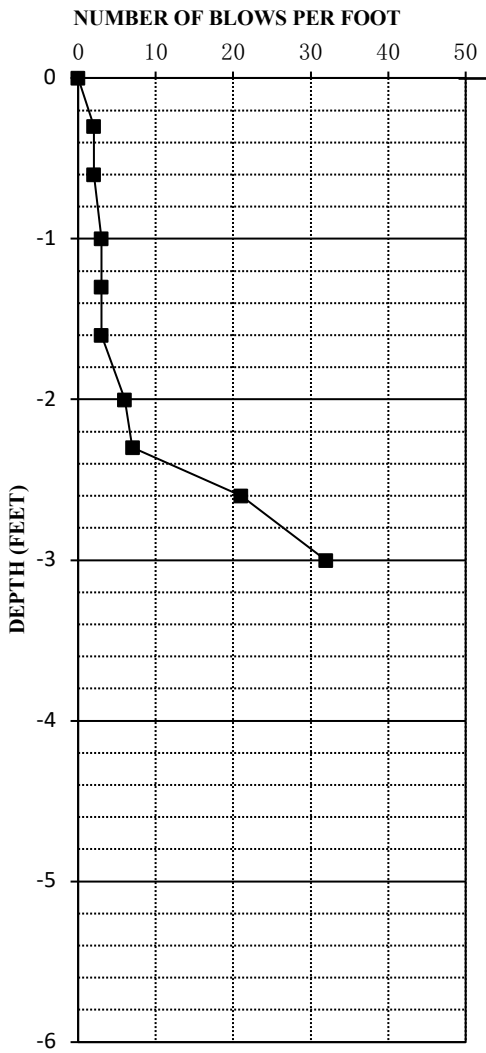
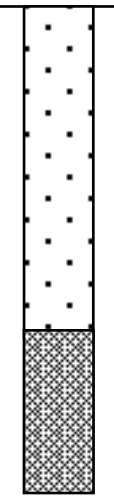
DCP-4 DYNAMIC CONE PENETRATION TEST	SOIL DESCRIPTION AND CLASSIFICATION

X,Y =
Surface Elevation = 216'
Surface Conditions = Ground Cover





LOOSE SILTY SANDS

SILTY AND CLAYEY SILTS (ML)

End at 3'

Note: Soil profile is inferred from CPT results. Subsrface conditions were not observed directly during DCP testing.

Project No: 2DF0119981	Date: 11/14/2022	**LOG OF DCP TEST**	Approved by AXH	Figure 7

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