PanGEO
INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

August 1, 2018
Revised on September 18, 2018
File No. 18-240

Janie & Mike Crowder
4884 Forest Avenue SE
Mercer Island, WA 98040

Subject: **Geotechnical Engineering Evaluation (Revised)**
Proposed Deck Expansion
4884 Forest Avenue SE, Mercer Island, Washington

Dear Janie & Mike,

As requested, PanGEO, Inc. has completed a geotechnical engineering evaluation to assist you and your project team with the design of the proposed Deck Expansion for the existing residence at the above address. Our service scope included reviewing readily-available geologic and geotechnical data in the project vicinity, reviewing preliminary design drawings, advancing two (2) hand borings, conducting a site reconnaissance, and developing the conclusions and recommendations presented in this report. Our work was authorized by Ms. Janie Crowder on July 19, 2018.

SITE AND PROJECT DESCRIPTION

The subject property is an approximately 17,458 square foot lot located at 4884 Forest Avenue SE in Mercer Island, Washington (see Vicinity Map, Figure 1). The irregularly shaped lot is situated on a westerly facing slope, and is bordered to the southeast by Forest Avenue SE, to the north by an open lot, and on all other sides by existing single-family residences (see Figure 2). The property is generally landscaped with a variety of trees, scrubs, lawn, and hardscarp elements. The existing house at the site is a one-story house with a partial daylight basement (see Plate 1 on page 2), which is situated roughly 15 feet above the lake shore at about elevation 20 feet. The portion of the property where the house is situated is gently sloped, but the northern half of the property slopes steeply down into a stream valley. The grade of this slope is roughly 65 to 70 percent based on review of GIS maps and field observations.

We understand that the proposed project includes expansion of the existing deck to the west of the existing house (Figure 2). As such, new foundations will be needed to support the deck. Because the site is located within a City mapped Potential Landslide Geologic Hazards area, a geotechnical report is required as part of the building permit application.

Plate 1. East (Lake side) view of the house, looking west from Forest Avenue SE.

The conclusions and recommendations in this report are based on our understanding of the proposed construction, which is in turn based on the project information provided. If the above project description is incorrect, or the project information changes, we should be consulted to review the recommendations contained in this study and make modifications, if needed.

SITE GEOLOGY

The Geologic Map of Mercer Island (Troost and Wisher, 2006) mapped the surficial geologic units at the subject site as Lawton Clay (Qlc), overlying Pre-Olympia Coarse-Grained (Qpogc) and Fine grained (Qpogf) glacial deposits. Troost, et al (2006) describe the Lawton Clay as very stiff to hard, laminated to massive silt, clayey silt and silty clay with occasional drop stones. Pre-Olympia coarse glacial deposits typically are described as very dense sand and gravel, clean to silty moderately to heavily weathered. Fine grained glacial deposits are described as hard silt and clay, laminated to massive, with occasional sand interbeds.

SUBSURFACE EXPLORATIONS AND SUBSURFACE CONDITIONS

SUBSURFACE EXPLORATIONS

Our subsurface exploration for the current study consisted of advancing two hand borings (HH-1 and HH-2) at the site on June 29, 2018, using hand augers and tools. The approximate hand boring locations were measured in the field from on-site features and are plotted on Figure 2. The hand borings were excavated to depths of about 1.2 feet in HH-1 to 4.3 feet below the existing grade in HH-2. The borings were conducted by an engineering geologist from PanGEO, Inc., who logged the soils encountered in the hand borings and periodically tested the density of the soils with a ½-inch soil probe.

SOIL AND GROUNDWATER CONDITIONS

The soils observed in our hand boring generally consisted of surficial fill or colluvium overlying native clayey silt to silty clay. The colluvium encountered generally consisted of loose, brown, silty, fine sand with some gravel to about 1 foot in HH-1 to 4.1 feet below the surface in HH-2. Below the colluvium, our hand borings generally encountered native, dense, brown, silty, fine sand with some gravel. Probing with the soil probe yielded penetrations of less than 1 inch at 1.2 feet in HH-1 and 4.1 feet in HH-2, indicating a dense condition. Please refer to the summary hand boring logs (Figures 4 and 5) for a detailed description of the subsurface conditions encountered.

Groundwater or seepage was not encountered within the hand boring depths during our field exploration. It should be noted that groundwater elevations and seepage rates are likely to vary depending on the season, local subsurface conditions, and other factors. Groundwater levels and seepage rates are normally highest during the winter and early spring.

GEOLOGY HAZARDS ASSESSMENT

LANDSLIDE HAZARDS AND STEEP SLOPES

The steep slope portion of the subject site is mapped within a known landslide hazard area according to the City of Mercer Island's Geologic Hazards Map. A site reconnaissance of the subject property was conducted on June 29, 2018. During our site reconnaissance, we did not observe obvious evidence of slope instability or ground movement at the site. Based on our field observations, in our opinion, the subject site appears to be globally stable in its current configuration. Furthermore, it is our opinion that the proposed deck addition project as currently planned is feasible from a geotechnical engineering standpoint, and in our opinion, will not adversely affect the overall stability of the site or adjacent properties, provided the recommendations outlined herein are followed and the proposed development is properly design and constructed.

EROSION HAZARDS

The site is mapped within a potential erosion hazard area in accordance with the City of Mercer Island's Geologic Hazards Map. Based on the results of our hand borings, the site soils are anticipated to exhibit slight to moderate erosion potential. In our opinion, the erosion hazards at the site can be effectively mitigated with the best management practice during construction and with properly designed and implemented landscaping for permanent erosion control. During construction, the temporary erosion hazard can be effectively managed with an appropriate erosion and sediment control plan, including but not limited to installing silt fence at the construction perimeter, limiting removal of vegetation to the construction area, placing rocks or hay bales at the disturbed/traffic areas and on the downhill side of the project, covering stockpile soil or cut slopes with plastic sheets, constructing a temporary drainage pond to control surface runoff and sediment trap if needed, placing rocks at the construction entrance, etc. Permanent erosion control measures should include establishing vegetation, landscape plants, and hardscape established at the end of project.

SEISMIC HAZARDS

Based on our review of the City of Mercer Island's Geologic Hazards Maps, the subject site does not appear to be mapped as a seismic hazard area. The City of Mercer Island Code defines seismic hazard areas as those areas subject to risk of damage as a result of earthquake-induced ground shaking, slope failure, and soil liquefaction or surface faulting. Based on the soil conditions encountered in the hand borings and previous test borings in the site vicinity, in our opinion, the potential for soil liquefaction during an IBC-code level earthquake is considered negligible. As such, it is our opinion that special design considerations associated with soil liquefaction are not necessary for this project.

GEOTECHNICAL DESIGN RECOMMENDATIONS

SEISMIC DESIGN PARAMETERS

The following table provides seismic design parameters for the site that are in conformance with the 2015 edition of the International Building Code (IBC), which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps:

Site Class	Spectral Acceleration at 0.2 sec. (g)	Spectral Acceleration at 1.0 sec. (g)	Site Coefficients		Design Spectral Response Parameters		Design PGA ($S_{DS}/2.5$)
	S_S	S_1	F_a	F_v	S_{DS}	S_{D1}	
D	1.438	0.552	1.0	1.50	0.958	0.552	0.38

NEW DECK FOUNDATIONS

Based on the results of our hand borings boring, the near surface soils generally consist of loose to dense silty, fine sand to silt. In our opinion, the new deck may be supported by conventional footings. The new footings should be bearing on undisturbed native soil or on compacted structural fill placed on undisturbed, dense native soil. It should be noted that excavations for the new deck footing near the hand boring HH-2 may need to extend to about 4 to 4½ feet to reach the dense native soils. We also recommend the new deck foundations in the steep slope areas be tied back to the existing house foundation to prevent movement due to potential future soil/slope creep. Alternatively, to reduce the excavation and ground disturbance, small diameter steel pipes (pin pile) may be used to support the new deck foundation. The following sections present our design recommendations for the footings and pin piles.

Shallow Footings

We recommend an allowable soil bearing pressure of 1,500 pounds per square feet (psf) be used to sizing the new footings. The recommended allowable bearing pressure is for dead plus live loads. For allowable stress design, the recommended bearing pressure may be increased by one-third for transient loading, such as wind or seismic forces. New deck foundations should have a minimum width of 12 inches. Foundation elements should be placed at a minimum depth of 18 inches below final exterior grade. In the steep slope areas, new footings may likely be as much as 4½ feet deep to reach dense native soil.

Foundation Performance: Footings designed and constructed in accordance with the above recommendations should experience total settlement of less than one inch and differential settlement of less than ½ inch. Most of the anticipated settlement should occur during construction as dead loads are applied.

Lateral Resistance: Lateral loads on the structures may be resisted by passive earth pressure developed against the embedded faces of the foundations and by frictional resistance between the bottom of the foundation and the supporting subgrade soils. For footings bearing on the dense native soil or compacted sand/structural fill, a frictional coefficient of 0.35 may be used to evaluate sliding resistance. Passive soil resistance may be calculated using an equivalent fluid weight of 200 pcf, assuming properly compacted structural fill will be placed against the footings. The above values include a factor of safety of 1.5. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

Footings in the steep slope area may experience lateral displacement due to soil creep. We recommend that footing elements in the steep slope areas be structurally tied to the main house foundations to resist displacement.

Footing Excavation and Subgrade Preparation: All footing excavations should be trimmed neat and footing subgrades should be carefully prepared. The adequacy of footing subgrade should be verified by a representative of PanGEO, prior to placing forms or rebar. Any loose or softened soil should be removed from the footing subgrade prior to concrete placement. Any footing subgrade over-excavations should be backfilled with compacted structural fill or lean-mix concrete/Control Density Fill (CDF). Footing excavations should be observed by PanGEO to confirm that the exposed footing subgrade is consistent with the expected conditions and adequate to support the design bearing pressure.

Driven Small Diameter Steel Pipe Piles (Pin Piles)

As previously indicated, small diameter steel pipes (pin pile) may also be considered to support the new deck foundation to reduce the excavation and ground disturbance. The following are our pin pile design recommendations:

Pin Pile Sizes - In our opinion, due to limited access for construction equipment, 2-inch diameter, Schedule 80, galvanized, pin piles may be used to support the new deck foundation. Two-inch diameter pin piles are typically installed using a 90 pound jack hammer or a 140 pound Rhino hammer, both operated by hand.

Pin Pile Capacity - The number of piles required depends on the magnitude of the design load and should be determined by the project structural engineer. An allowable axial compression capacity of 2 tons may be used for 2-inch diameter piles with an approximate factor of safety of

2. Penetration resistance required to achieve the allowable capacity is normally 60 seconds per inch of penetration for either of the two hammers listed above. Tensile capacity of pin piles should be ignored in design calculations.

It is our experience that the driven pipe pile foundations should provide adequate support with total settlements on the order of ½-inch or less.

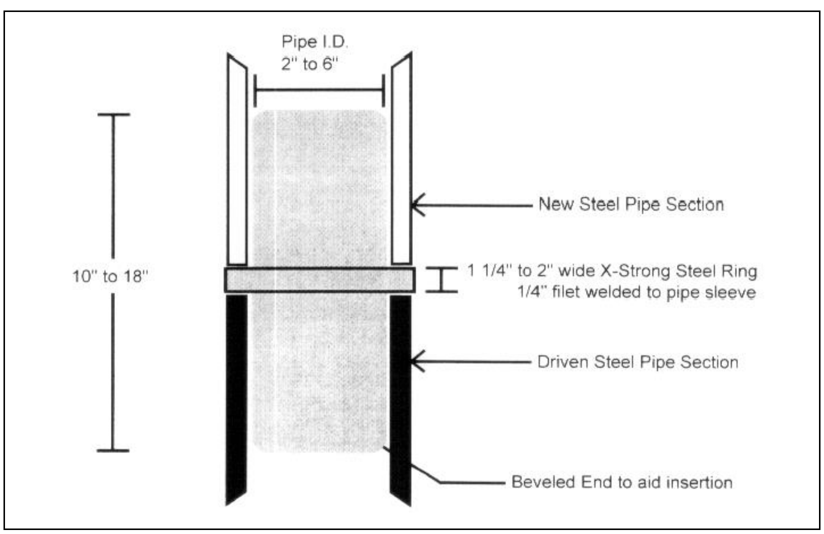
Pin Pile Specifications - We recommend that the following specifications be included on the foundation plan:

1. 2-inch diameter piles should consist of galvanized Schedule-80, ASTM A-53 Grade "A" pipe.

2. 2-inch piles shall be driven to refusal with a minimum 90-lb pneumatic jack hammer or 140-lb pneumatic Rhino hammer. The driving criteria will be 60 second per inch of penetration.

3. Piles shall be driven in nominal sections and connected with compression fitted sleeve couplers (see detail below – Courtesy of McDowell Pile King, Kent, WA). We discourage welding of pipe joints, particularly when galvanized pipe is used, as we have frequently observed welds broken during driving.

The quality of a pin pile foundation is dependent, in part, on the experience and professionalism of the installation company. We recommend that a company with experienced personnel be selected to install the piles.



Lateral Forces - Lateral capacity of vertical pin piles should be ignored in design calculations. Some resistance to lateral loads may be accomplished by battering the piles to a slope of 3(H):12(V), or steeper. ***Friction at the base of pile-supported concrete grade beam should be ignored in the design calculations.*** Passive resistance values may be determined using an equivalent fluid weight of 200 pounds per cubic foot (pcf). This value includes a safety factor of about 1.5 assuming that properly compacted granular fill will be placed adjacent to and surrounding the pile caps and grade beams.

Estimated Pile Length – For planning and cost estimating purposes, an average pile length of about 10 feet may be used.

TEMPORARY EXCAVATIONS

Based on the currently available information, we anticipate that the proposed construction will only require temporary excavations on the order of 4 feet or less for the new deck foundations. We anticipate that the proposed excavations will encounter fill/colluvium over native dense silty sand. All temporary excavations deeper than a total of 2 feet should be sloped or shored. All temporary excavations should be performed in accordance with Part N of WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring.

Based on the anticipated soil conditions, it is our opinion that temporary excavations for the proposed construction may be sloped 1H:1V. Based on our current understanding of the remodeling layout, it appears that sufficient space is available for unsupported open cut excavations.

The temporary excavations and cut slopes should be re-evaluated in the field during construction based on actual observed soil conditions. Cut slope may need to be flattened in the wet season. Cut slopes should be covered with plastic sheets in wet weather. We also recommend that heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a distance equal to 1/3 the slope height from the top of any excavation.

MATERIAL REUSE

In the context of this report, structural fill is defined as compacted fill placed under footings, concrete stairs and landings, and slabs, or other load-bearing areas. In our opinion, the on-site soils may not be re-used as a resource for structural fill, as they are predominantly fine grained.

Structural fill should consist of imported, well-grade granular material, such as WSDOT Gravel Borrow (WSDOT 9-03.14(1)), should be used as structural fill. The on-site soil can also be used as general fill in the non-structural and landscaping areas. If reuse of the on-site soil is planned, the excavated soil should be stockpiled and protected with plastic sheeting to prevent softening from rainfall in the wet season.

STRUCTURAL FILL PLACEMENT AND COMPACTION

While we do not anticipate the use of structural fill for this project, any structural fill used should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and systematically compacted to a dense and relatively unyielding condition and to at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557.

Depending on the type of compaction equipment used and depending on the type of fill material, it may be necessary to decrease the thickness of each lift to achieve adequate compaction. PanGEO can provide additional recommendations regarding structural fill and compaction during construction.

WET WEATHER EARTHWORK

In our opinion, the proposed site construction may be accomplished during wet weather (such as in winter) without adversely affecting the site stability. However, the on-site soils will be vulnerable to softening and erosion during rain events, and earthwork performed during the drier summer months likely will be more economical. Winter construction will require the implementation of best management erosion and sedimentation control practices to reduce the chance of off-site sediment transport. The site soils contain a high percentage of fines and are moisture sensitive. Any footing subgrade soils that become softened either by disturbance or rainfall should be removed and replaced with structural fill, Controlled Density Fill (CDF), or lean-mix concrete. General recommendations relative to earthwork performed in wet conditions are presented below:

- Site stripping, excavation and subgrade preparation should be followed promptly by the placement and compaction of clean structural fill or CDF;

- The size and type of construction equipment used may have to be limited to prevent soil disturbance;
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water;
- Geotextile silt fences should be strategically located to control erosion and the movement of soil;
- Structural fill should consist of less than 5% fines; and
- Excavation slopes should be covered with plastic sheets.

SURFACE DRAINAGE CONSIDERATIONS

Surface runoff can be controlled during construction by careful grading practices. Typically, this includes the construction of shallow, upgrade perimeter ditches or low earthen berms in conjunction with silt fences to collect runoff and prevent water from entering excavations or to prevent runoff from the construction area from leaving the immediate work site.

Permanent control of surface water should be incorporated in the final grading design. Adequate surface gradients and drainage systems should be incorporated into the design such that surface runoff is directed away from slopes and structures. Water from roof drains and other impervious areas should be properly collected and discharged into a storm drain system and should not be discharged on to the slope areas.

ADDITIONAL SERVICES

To confirm that our recommendations are properly incorporated into the design and construction of the proposed residence, PanGEO should be retained to conduct a review of the final project plans and specifications, and to monitor the construction of geotechnical elements. The City of Mercer Island, as part of the permitting process, will also require geotechnical construction inspection services. PanGEO can provide you a cost estimate for construction monitoring services at a later date.

CLOSURE

We have prepared this report for Janie & Mike Crowder and the project design team. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the locations of the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be notified to review the applicability of our recommendations if there are any changes in the project scope.

The scope of our work does not include services related to construction safety precautions. Our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use this report.

We appreciate the opportunity to be of service.

Sincerely,

9/18/2018

Stephen H. Evans, L.E.G.
Senior Engineering Geologist

H. Michael Xue, P.E.
Senior Geotechnical Engineer

Attachments:

Figure 1	Vicinity Map
Figure 2	Site and Exploration Map
Figure 3	Terms and Symbols for Boring and Test Pit Logs
Figure 4	Summary Logs of Hand Borings HH-1 and HH-2

REFERENCES

International Code Council, 2015, *International Building Code (IBC).*

Troost, K.G., and Wisher, A. P, 2006. *Geologic Map of Mercer Island, Washington, scale 1:12,000*.

WSDOT, 2018, *Standard Specifications for Road, Bridge and Municipal Construction, M 41-10.*

18-240 Fig 1 - Vicinity Map.grf 8/1/18 (17:35) SHE

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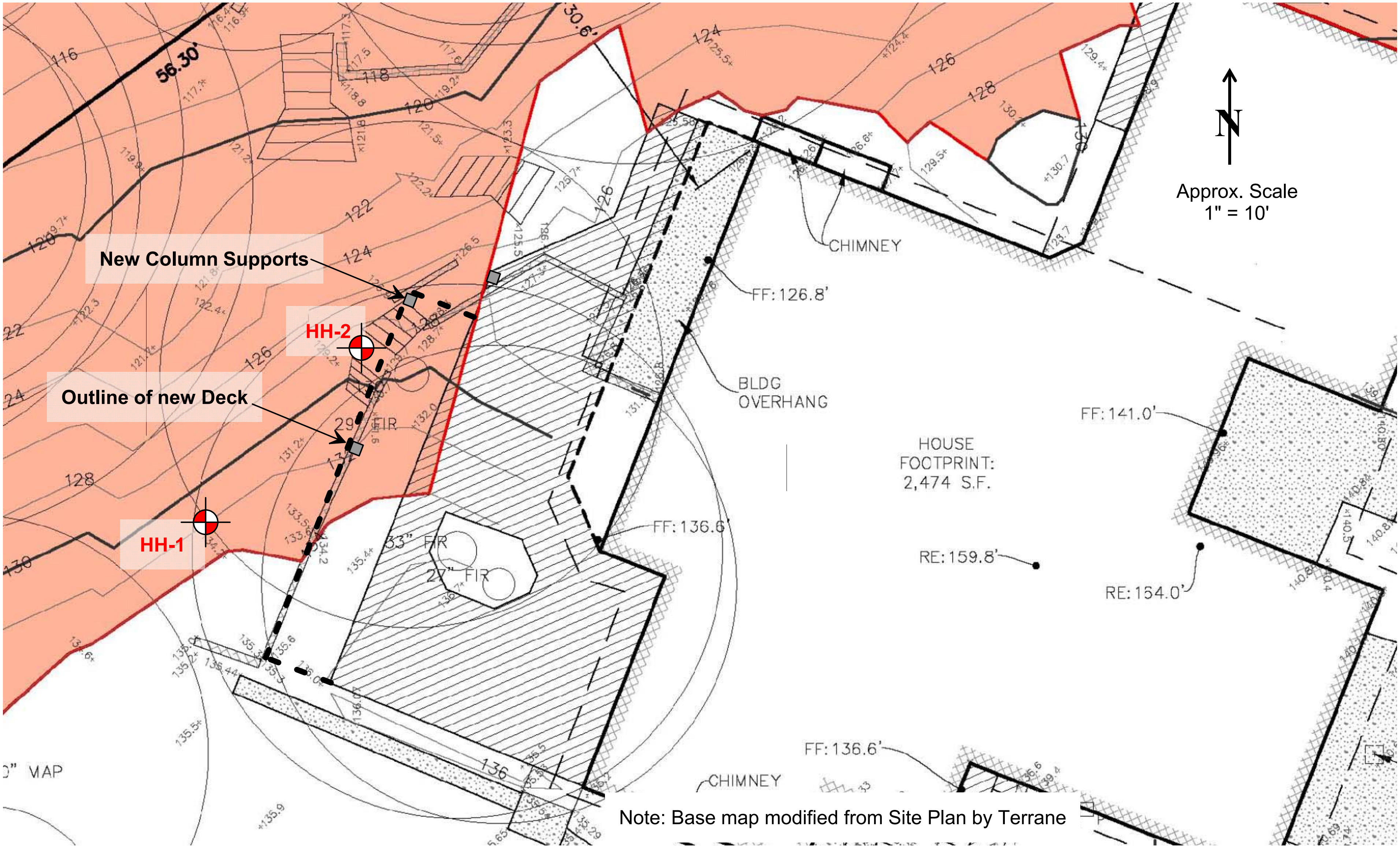
Proposed Deck
4884 Forest Avenue SE
Mercer Island, Washington

VICINITY MAP

Project No.	18-240	Figure No.	1



Legend:

HH-1 Approx. Hand Boring Location

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Proposed Deck
4884 Forest Avenue SE
Mercer Island, Washington

SITE AND EXPLORATION PLAN

Project No. **18-240**

Figure No. **2**

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean CLAY
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes: 1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered:	Units of material distinguished by color and/or composition from material units above and below	Fissured:	Breaks along defined planes
Laminated:	Layers of soil typically 0.05 to 1mm thick, max. 1 cm	Slickensided:	Fracture planes that are polished or glossy
Lens:	Layer of soil that pinches out laterally	Blocky:	Angular soil lumps that resist breakdown
Interlayered:	Alternating layers of differing soil material	Disrupted:	Soil that is broken and mixed
Pocket:	Erratic, discontinuous deposit of limited extent	Scattered:	Less than one per foot
Homogeneous:	Soil with uniform color and composition throughout	Numerous:	More than one per foot
		BCN:	Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

ATT	Atterberg Limit Test
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

MONITORING WELL

- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

LOG KEY 13-104_LOGS.GPJ PANGEO.GDT 6/18/13

PanGEO INCORPORATED
Phone: 206.262.0370

Terms and Symbols for Boring and Test Pit Logs

Figure 3

Figure 4

Summary Log of Hand Boring HH-1 Approximate ground surface elevation: 132 feet. Excavated 6/29/18	
Depth (ft)	Material Description
0 – 1"	Loose, brown, silty, fine SAND: slightly moist, non-plastic, some fine gravel. (Colluvium?)
1" – 1.2'	Dense, brown, silty, fine SAND: moist, some gravel, non-plastic fines (Lawton Clay) - 1" penetration with ½" steel soil probe at 1'
Notes: 1. HH-1 was terminated at 1.2 feet below ground surface due to soil density.	

Summary Log of Hand Boring HH-2 Approximate ground surface elevation: 129 feet. Drilled 6/29/18	
Depth (ft)	Material Description
0 – 4"	Crushed ROCK and silty SAND (Fill)
4" – 4.0'	- Loose to medium dense, brown, silty, fine SAND: dry to moist, some gravel, non-plastic fines (Colluvium) 12" penetration with ½" steel soil probe at 1.2' - 2.2 feet penetration with ½" steel soil probe at 1.8' - 1.4 feet penetration with ½" steel soil probe at 2.7' - Probe consistently stopped at 4 feet
4.0 – 4.2'	Dense, brown, very silty, fine SAND to sandy SILT: dry, non-plastic, some gravel (Lawton Clay) - 1" penetration with ½" steel soil probe at 4.1'
Notes: 2. Water added to soil to allow augering, otherwise, sand simply runs out of auger when extracting barrel. 3. HH-2 was terminated at 4.2 feet below ground surface due to inability of auger to penetrate.	