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November 24, 2025
Project No. 2GJ04221102

2018 ASCE Washington Honorable Mention Engineering Excellence

Buping Wang & Wanqiu Yang
thewbp@gmail.com

Re: Geotechnical Report Addendum
6450 E Mercer Way
Mercer Island, WA 98040

Dear Buping and Wanqiu:

This geotechnical report addendum provides recommendations for driven pin pile foundations. We understand the project is to demolish the existing detached garage and build a new DADU at approximately same location. We did the geotechnical study on slope at east of detached garage. We understand from the general contractor that foundation excavation has proceeded; however, bearing capacity verification and compaction testing/approval have not yet been approved by the City of Mercer Island inspection. Work should not proceed with placement of permanent footings/foundations until required tests and study are completed by geotechnical engineer. We visited site with your general contractor on October 7, 2025, and observed a test pit at DADU foundation area. Loose sand was encountered from existing ground surface to the depth of approximately 5 feet. The Pin Pile foundation was decided by you instead of strip footing by over-excavation.

Based on all the above information and understanding of the project and difficult access, we conducted a site investigation using Dynamic Cone Penetration Test (DCP[1]) with scope of work in compliance with our proposal No.P2GJ0127926 dated October 20, 2025, in particular includes:

- Conducting a visual site reconnaissance of the site and immediate vicinity;
- Performing two (2) DCP tests, to maximum depth of 15´, or drilling refusal, or till/
- bedrock, whichever occurs first.
- Logging soil and groundwater conditions
- Preparing a geotechnical engineering report with Pin Pile Design Recommendation.

CONCLUSION AND RECOMMENDATIONS:
The recommendations outlined in this addendum should be used in conjunction with our geotechnical report dated October 5, 2023.

[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

For relatively low loads, pin piles typically consist of 2-inch-diameter (nominal) Schedule-80 steel pile (2.375-inch outside diameter). For higher loads, diameters of 3, 4, or 6 inches area more commonly selected. Individual pipe segments typically range form about 5 to 10 feet long, and successive segments are joined with external threaded couplings, internal slip couplings, or butt welds as pile-driving progresses. It should be noted, however, that slip couplings are not appropriate for pin piles subjected to uplift loads.

By local practice, 2-inch-diameter pin piles are usually installed with a hand-portable pneumatic or hydraulic hammer, whereas larger diameters require the use of a pneumatic or hydraulic hammer mounted on the arm of a construction vehicle. Pin piles are more effective than many other deep foundation types for penetrating gravel or cobble layer. Nonetheless, it may be necessary to modify pile layouts if rocks or other obstructions are encountered during pile-driving. When refusal has been achieved, the butt of each pile can be cut off to a pre-determined height of elevation. Typically, a bearing plate is then affixed to the top of each pile to provide a good bond between the piles and the concrete grade beams or pile caps.

The following sections discuss various site-specific design considerations and our recommended design criteria for pin piles.

Pile Diameters: For the proposed addition, we specifically recommend that all pin piles consisted of Schedule-80 pipe. 2-inch diameter piles should consist of Schedule-80, ASTM A-53 Grade "A" pipe. 3-inch, 4-inch, and 6-inch diameter piles should consist of Schedule-40, ASTM A-53 Grade "A" pipe. Although smaller diameters may initially appear to provide adequate compressive capacities for the subject addition, we infer that they might be prone to buckling failure due to the low lateral resistance of offered by the near-surface soils.

Corrosion Considerations: Although no corrosion testing was performed on the site soils, the Puget Sound area's prolonged wet weather and elevated soil moisture content typically result in moderate corrosive conditions for buried steel. Therefore, we recommend that all pin piles be constructed with galvanized pipe.

Driving Conditions: We anticipate that all pin piles will readily penetrate the surficial loose to very dense silty sand with gravel. However, pile-driving will become progressively more difficult below depths of about 7 to 10 feet, near where our tests disclosed medium dense to very dense silty sand with gravel. If the piles encounter hard sand soil, advancement rates would decrease dramatically. We estimate that pin piles might achieve refusal at depths on the order of 7 to 10 feet below surface grades. When penetration begins to show progressively more resistance, the contractor should continue driving the piles for at least an additional 3 feet before declaring refusal. However, the foundation contractor should be prepared for an even wider range of actual pile lengths.

Penetration resistance required to achieve the capacities will be determined based on the hammer used to install the pile. The tensile capacity of pin piles should be ignored in design calculations. The following are driving-refusal conditions in each pile sizes:

- 2-inch piles shall be driven to refusal with a minimum 90-lb jackhammer. Refusal is defined as no more than 1 inch of penetration for 1 minute of continuous driving.
- 3-inch piles shall be driven to refusal with a minimum 600-lb hydraulic hammer. We recommend the following refusal criteria based on the size of hammer utilized:

Hammer Size	Blow per Minute	Refusal Criteria (3-inch pile)
600 lbs	1000	12 seconds per inch
850 lbs	900	10 seconds per inch
1100 lbs	900	6 seconds per inch

The driving criteria recommended in the table above will be verified by a static load test program (see discussion in static load test).

- 4-inch piles shall be driven to refusal with a minimum 850-lb hydraulic hammer. We recommend the following refusal criteria based on the size of hammer utilized:

Hammer Size	Blow per Minute	Refusal Criteria (4-inch pile)
850 lbs	900	16 seconds per inch
1100 lbs	900	10 seconds per inch
2000 lbs	600	4 seconds per inch

The driving criteria recommended in the table above will be verified by a static load test program (see discussion in static load test).

- 6-inch piles shall be driven to refusal with a minimum 2000-lb hydraulic hammer. We recommend the following refusal criteria based on the size of hammer utilized:

Hammer Size	Blow per Minute	Refusal Criteria (6-inch pile)
2000 lbs	600	10 seconds per inch
3000 lbs	500	6 seconds per inch
4700 lbs	500	4 seconds per inch

The driving criteria recommended in the table above will be verified by a static load test program (see discussion in static load test).

Static Load Test:

At least 3% (but no more than 5 piles maximum) of the 3-inch, 4-inch, and 6-inch pin piles should be load tested. All load tests shall be performed in accordance with the procedure outlined in ASTM D1143. The maximum test load shall be 2 times the design load. The objective of the testing program is to verify the adequacy of the driving criteria, and the efficiency of the hammer used for the project.

Axial Load Capacities: In our opinions, properly designed and installed pin pile driven to refusal (as defined above) will provide the following allowable axial compressive capacities to resist static. These capacities assume a minimum pile spacing (center to center) of three diameters to avoid group-effect reductions.

Pile Diameter (Inches)	Allowable Compressive Capacity (kips)
2	6
3	12
4	20
6	30

Note: Table values referenced from DPD Director's Rule 10-2009 (Seattle).

If all elements are properly installed, we estimate that total post-construction settlements of pin pile foundation system should not exceed 1/2 inch.

Regardless of which pile size is selected, we recommend that merit engineering be retained to monitor pin pile installations. Our field representative would observe the installation procedures, document the foundation contractor's activities, and provide geotechnical consultation to assist the contractor in handling unanticipated soil conditions.

We recommend pin pile supported grade beams as pile cap with structural slab on grade for additions. Exterior on-grade slabs, such as driveways, patios, and walkways, would also prone to long-term settlements due to consolidation of the underlying loose sand layer. Because pile support is typically not practical for such slabs, they should be designed to accommodate settlements on the order of several inches. This might include provisions such as exaggerated drainage gradient, to compensate for adverse tilting; shear reinforcement within the slabs and between adjacent slabs, to resist cracking and faulting; and shear reinforcement at transitions between on-grade slabs and pile-supported building elements, to create a structural hinge.

Lateral Resistance:

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 1(H):4(V), or steeper.

In addition, lateral forces may be resisted by tying the grade beams and pile caps to the soldier pile shoring wall, if it is designed as a permanent wall. Passive soil resistance values for embedded pile caps and grade beams may be determined using an equivalent fluid weight of 300 pounds per cubic foot (pcf). This value includes a factor of safety of at least

1.5 assuming that a properly compacted structural fill will be placed adjacent to the sides of the pile caps and grade beams.

Friction at the base of pile-supported grade beams should be ignored.

Obstructions:

Obstructions, if encountered, should be removed to facilitate the pile driving. If obstructions cannot be removed, the structural engineer of record should be notified to revise the pile layout to accommodate moving the piles.

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.

We appreciate the opportunity to work on this project. If you have any questions, please contact us at 425-454-2133.

Sincerely,

November 24, 2025

Austin Huang, Ph.D., P.E., LG., F.ASCE, D.GE
President
Diplomate - Academy of Geo-Professionals
Fellow - American Society of Civil Engineering

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.

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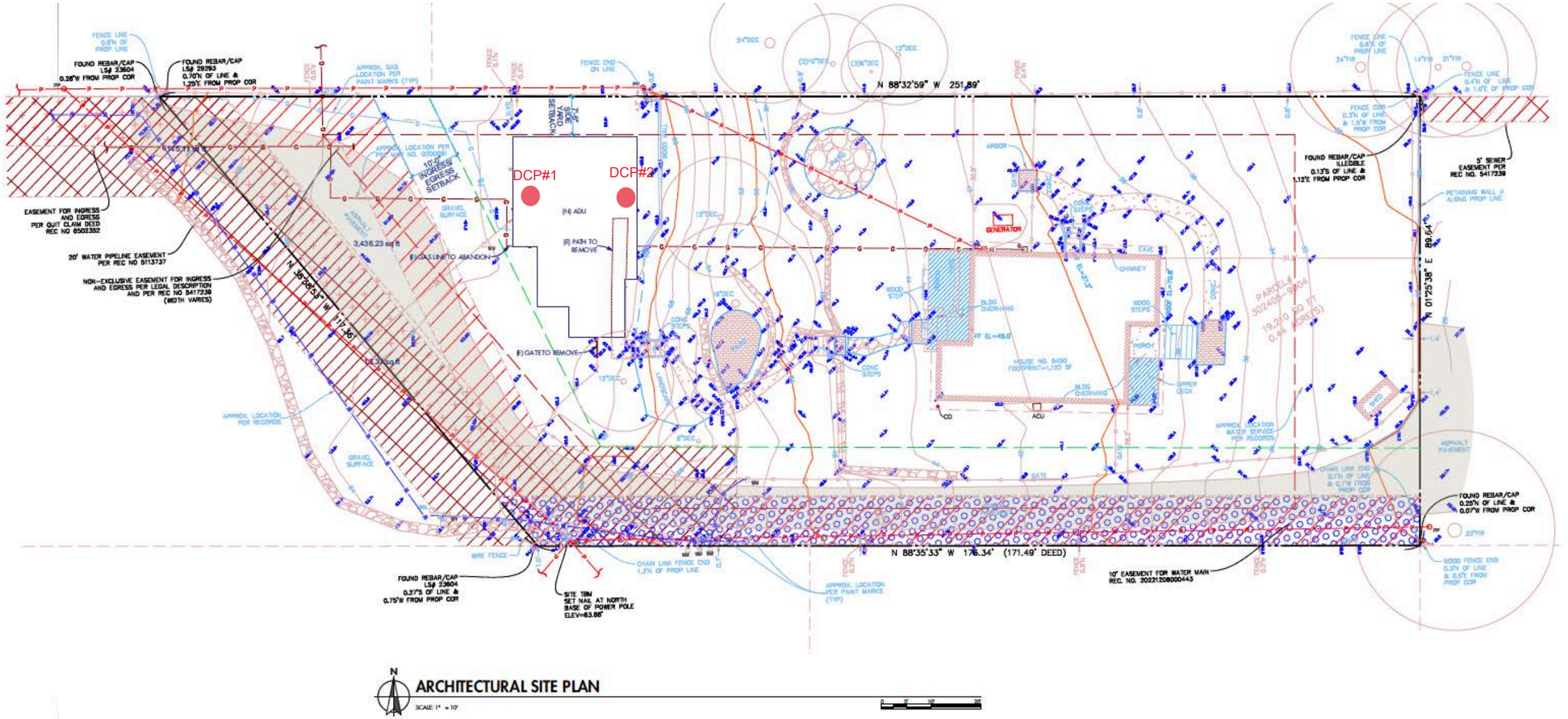

KING COUNTY, WASHINGTON

Note:

The site plan was based on the map from Architectural Site Plan

DCP TEST LOCATION

Proposed Accessory Dwelling Unit 6450 E Mercer Way Mercer Island, WA	**SITE PLAN**			
	Figure 2	PROJECT NO.	DATE	APPROVED BY
Prepare For: Buping Wang	Scale: Not to Scale	2GJ04221102	11/24/2025	AXH

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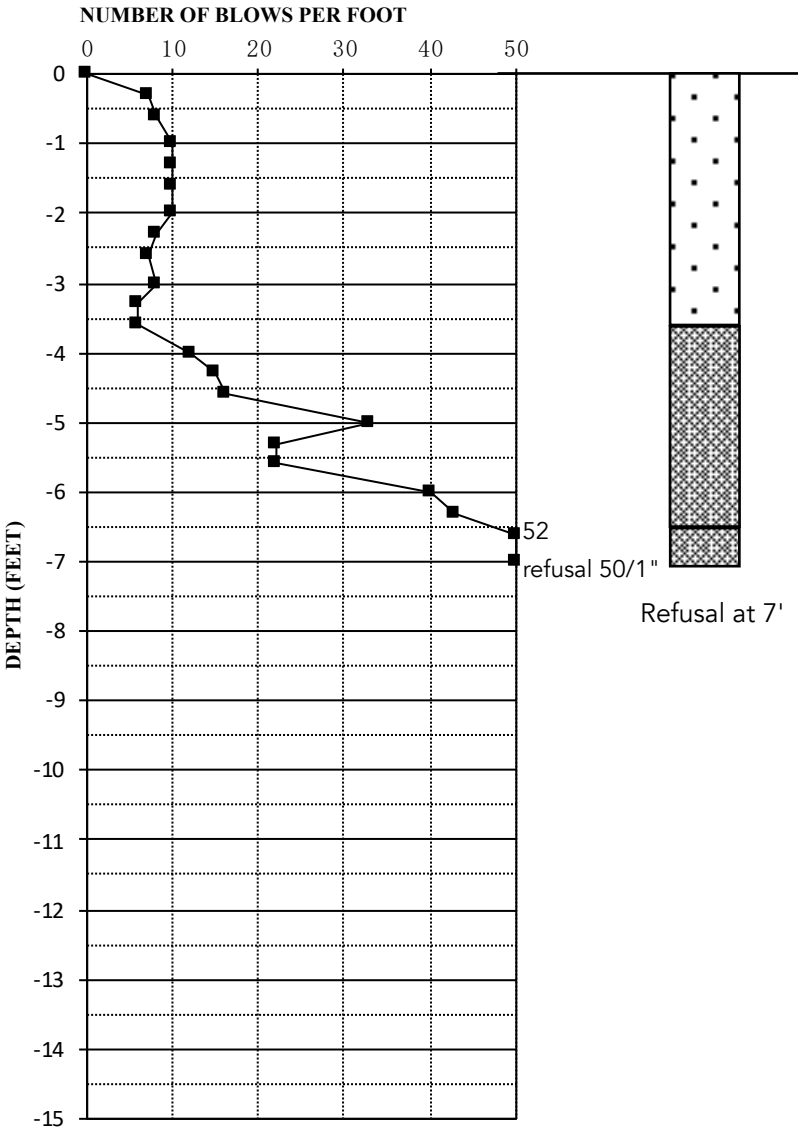
DCP-1 DYNAMIC CONE PENETRATION TEST	SOIL DESCRIPTION AND CLASSIFICATION

X,Y =
Surface Elevation = ~60'
Surface Conditions = Cleared Excavation Area



LOOSE SILTY SANDS

SILTY SANDS WITH GRAVEL (SM)

SILTY SANDS WITH GRAVEL (OUTWASH/TILL)

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

Project No: 2GJ04221102	Date: 11/24/2025	**LOG OF DCP TEST**	Approved by AXH	Figure 2

Proposed Accessory Dwelling Unit
6450 E Mercer Way
Mercer Island, WA

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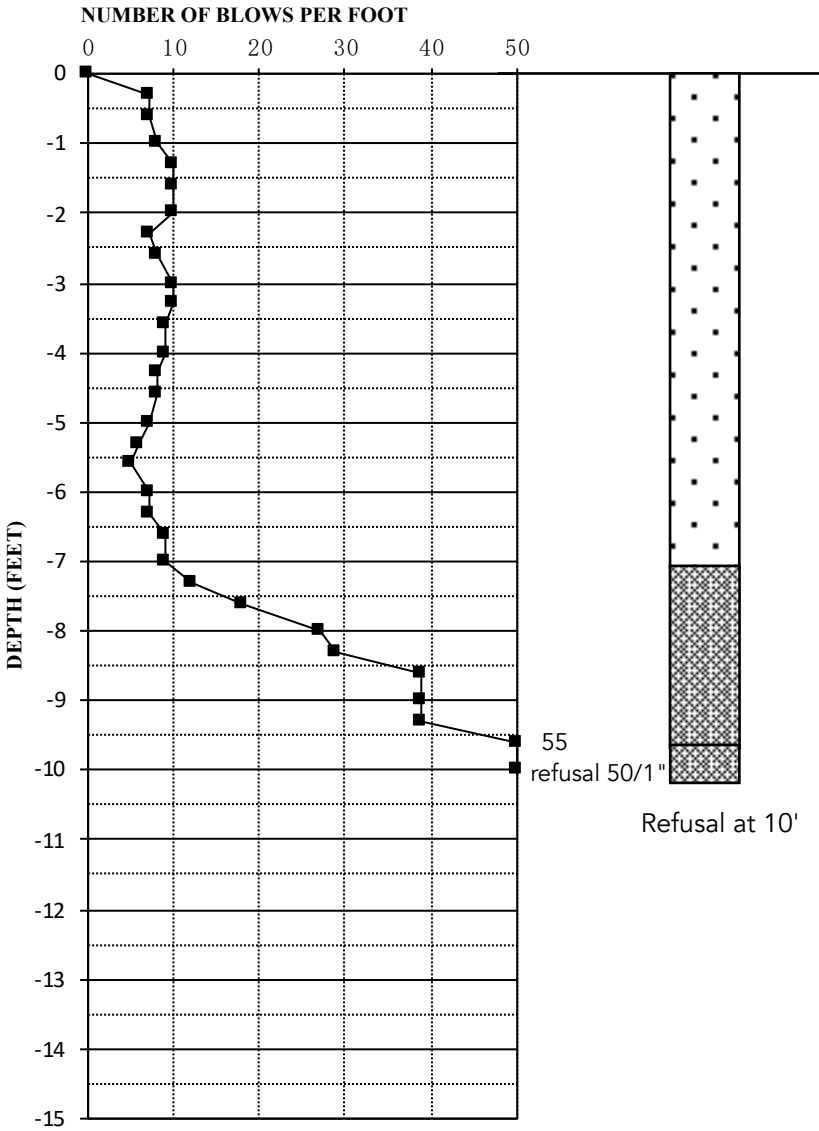
DCP-2 DYNAMIC CONE PENETRATION TEST	SOIL DESCRIPTION AND CLASSIFICATION

X,Y =
Surface Elevation = ~60'
Surface Conditions = Cleared Excavation Area



LOOSE SILTY SANDS

SILTY SANDS WITH GRAVEL (SM)

SILTY SANDS WITH GRAVEL (OUTWASH/TILL)

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

Project No: 2GJ04221102	Date: 11/24/2025	**LOG OF DCP TEST**	Approved by AXH	Figure 3

Proposed Accessory Dwelling Unit
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