FACET

Formerly DCG/Watershed

Drainage Report

ADDRESS: 6423 E Mercer Way Mercer Island, WA 98040
PARCEL: 302405-9001
DATE: September 2025

OWNER:
Citizen Design
c/o Isaac Greenetz
10 Dravus St
Seattle, WA 98109

FOR SUBMITTAL TO:
CITY OF MERCER ISLAND

CERTIFICATE OF ENGINEER

The technical material and data contained within this report has been prepared by or under the direction of the following registered professional engineer(s), licensed in accordance with the laws of the State of Washington to practice in the State of Washington.

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Quick Reference Project Information

GENERAL PROJECT INFORMATION

Project Description	The project proposes to construct a new single-family residence. Site improvements include drainage, grading, paving, utilities, and landscaping to support the construction of the proposed development.
Project Address	6423 E Mercer Way Mercer Island, WA 98109
Project Size	Developed Site = 13,915 SF (0.319 Acres)
Owner/Developer	Citizen Design c/o Isaac Greenetz 10 Dravus St Seattle, WA 98109
Consulting Engineer	Ben, Iddins, PE Facet 9706 4th Ave NE, Suite 300 Seattle, WA 98115 Phone: (206) 523-0024 ext. 115

DRAINAGE SUMMARY

Drainage Requirements	2019 Washington State Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW) & the City of Mercer Island site specific amendments. • Minimum Requirements #1-9	
Tributary Drainage Area & Land Cover Summary	Predeveloped Conditions: Impervious Surface = 407 SF PGIS = 407 SF Pervious Surface = 13,508 SF Total = 13,915 SF (0.319 Acres)	Developed Conditions: Total Impervious = 8,683 SF Total PGIS = 3,235 SF Pervious Surface = 5,232 SF Total = 13,915 SF (0.319 Acres)
Soils	A Geotechnical Engineering Report was performed by PanGEO, Inc. and summarized in a report dated August 27, 2025. See Section 1.6 and Appendix A for additional information.	
Stormwater BMPs	Detention Facility, Soil Amendment	
ESC Measures	TESC plan required per the Stormwater Manual. TESC measures include (but are not limited to) storm drain inlet protection, perimeter protection, construction entrance, construction fencing, straw wattles, and street cleaning.	

1. Project Overview

The project proposes to construct a new single-family residence. The project is located at 6423 E Mercer Way, Mercer Island, WA 98040 (Parcel #302405-9001). Improvements include site grading, drainage, water services, sewer utilities, and power and gas utilities. The project site is bound by single-family residences to the west and east, a private access roadway to the north, and by E Mercer Way to the south.

The project location is shown in Figure 1. The City of Mercer Island has site specific amendments which adopt the 2019 Washington State Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW), the combination of which is hereafter referred to as “the Manual”.

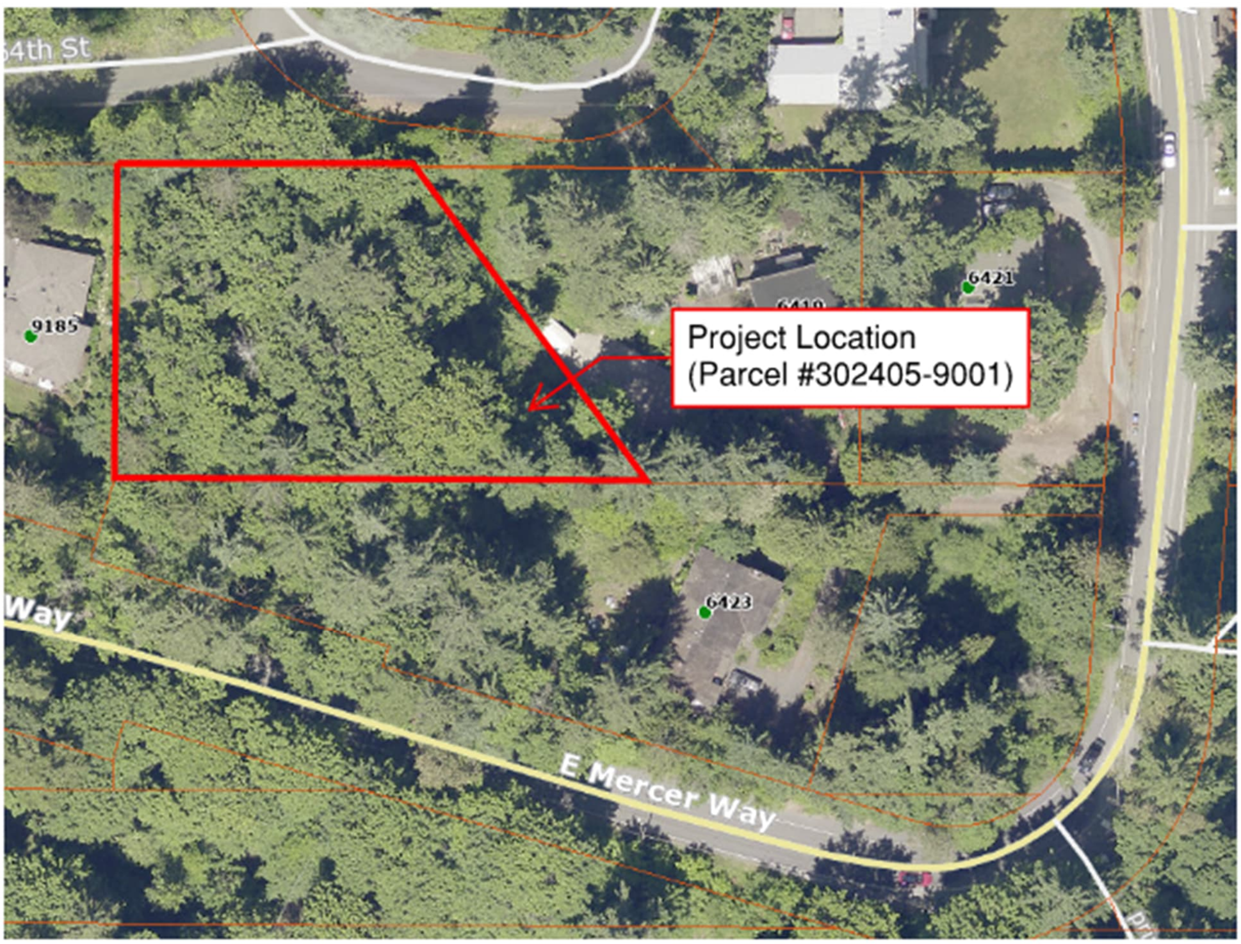


Figure 1. Site Location (via King County iMap)

1.1 Predeveloped Site Conditions

The existing parcel currently has a single-family residence with a driveway to access E Mercer Way. The site slopes from northwest to southeast with an average gradient of approximately 13-14% and a total elevation change of approximately 40 feet. There are steep slopes and seismic hazard environmentally critical areas on the site according to the City of Mercer Island online mapping tool. Table 1 summarizes the existing site conditions and land cover characteristics of the project site's on-site areas.

1.2 Developed Site Conditions

The developed parcel conditions, shown in the Civil Plans (under separate cover), include a new single-family residence with a driveway, walkways, utilities, and landscaping necessary to support the development. The project proposes a detention facility to serve impervious surfaces onsite (roof and at-grade areas), meeting on-site stormwater management requirements per the City of Mercer Island drainage requirements. The outlet from the detention facility will connect to the proposed storm system in the private access roadway fronting the site and then into the existing system in E Mercer Way. Table 1 summarizes the developed site conditions and land cover characteristics of the project site's on-site areas.

1.3 Site Area and Size of Improvements

The total project site contains 13,915 SF (0.319 acres) of improvements, located on E Mercer Way. The drainage basin for this site is the project parcel, the ROW improvements, and the downstream drainage system. The site area and size of improvements are shown in the project plans and summarized in Table 1. See Section 8 of this report for the Drainage Plan for the project.

Table 1. On-Site Project Areas and Size of Improvements

Description of On-site Areas	Ex Areas		Dev Areas	
	SF	Acres	SF	Acres
EX Buildings				
EX Driveway				
EX Walkway/Walls				
New Buildings			4,089	0.094
New Driveway			1,691	0.039
New Walkways/Walls			1,359	0.031
Total EX Impervious Surface:				
Total New/Replaced Impervious Surface:			7,139	0.164
Total EX Pollution Generating Impervious Surface:				
Total New/Replaced Pollution Generating Impervious Surface:			1,691	0.039
Total Impervious Surface:			7,139	0.164
EX Onsite Pervious Surface:	12,028	0.276		
New/Replaced Onsite Pervious Surface:			4,889	0.112
Total Pervious Surface:	12,028	0.276	4,889	0.112
Total Onsite Project Site Area	12,028	0.276	12,028	0.276

Table 2. Private Access Roadway Project Areas and Size of Improvements

Description of Private Access Roadway Areas	Ex Areas		Dev Areas	
	SF	Acres	SF	Acres
Roadway, Curb & Gutter	407	0.009	1,544	0.035
Sidewalk				
Driveway Approach				
Total EX Impervious Surface	407	0.009		
Total New/Replaced Impervious Surface			1,544	0.035
Total EX Pollution Generating Impervious Surface	407	0.009		
Total New/Replaced Pollution Generating Impervious Surface			1,544	0.035
Total Impervious Surface	407	0.009	1,544	0.035
EX Pervious Surface	1480	0.034		
New/Replaced Pervious Surface			343	0.008
Total Pervious Surface	1480	0.034	343	0.008
Total Private Access Roadway Project Site Area	1887	0.043	1,887	0.043

Table 3. Total Project Areas (On-site & Private Access Roadway)

Combined On-site & Private Access Roadway Areas	Ex Areas		Dev Areas	
	SF	Acres	SF	Acres
Total EX Impervious Surface	407	0.009		
Total New/Replaced Impervious Surface:			8,683	0.199
Total EX Pollution Generating Impervious Surface:	407	0.009		
Total New/Replaced Pollution Generating Impervious Surface:			3,235	0.074
Total Pervious Surface:	13,508	0.310	5,232	0.120
Total Project Site Area:	13,915	0.319	13,915	0.319

1.4 Pre-developed Stormwater Runoff Conditions

Runoff from the existing vacant parcel is dispersed onto the surrounding pervious areas and flows northeast across the site. No additional onsite stormwater facilities are known to exist.

1.5 Post-developed Stormwater Runoff Conditions

Roof runoff for the SFR and the at-grade surfaces will be collected via downspouts and routed to a catch basin which conveys stormwater runoff to the proposed detention facility. The outlet from the detention facility will connect to the proposed storm system in the private access roadway fronting the site and then into the existing system in E Mercer Way.

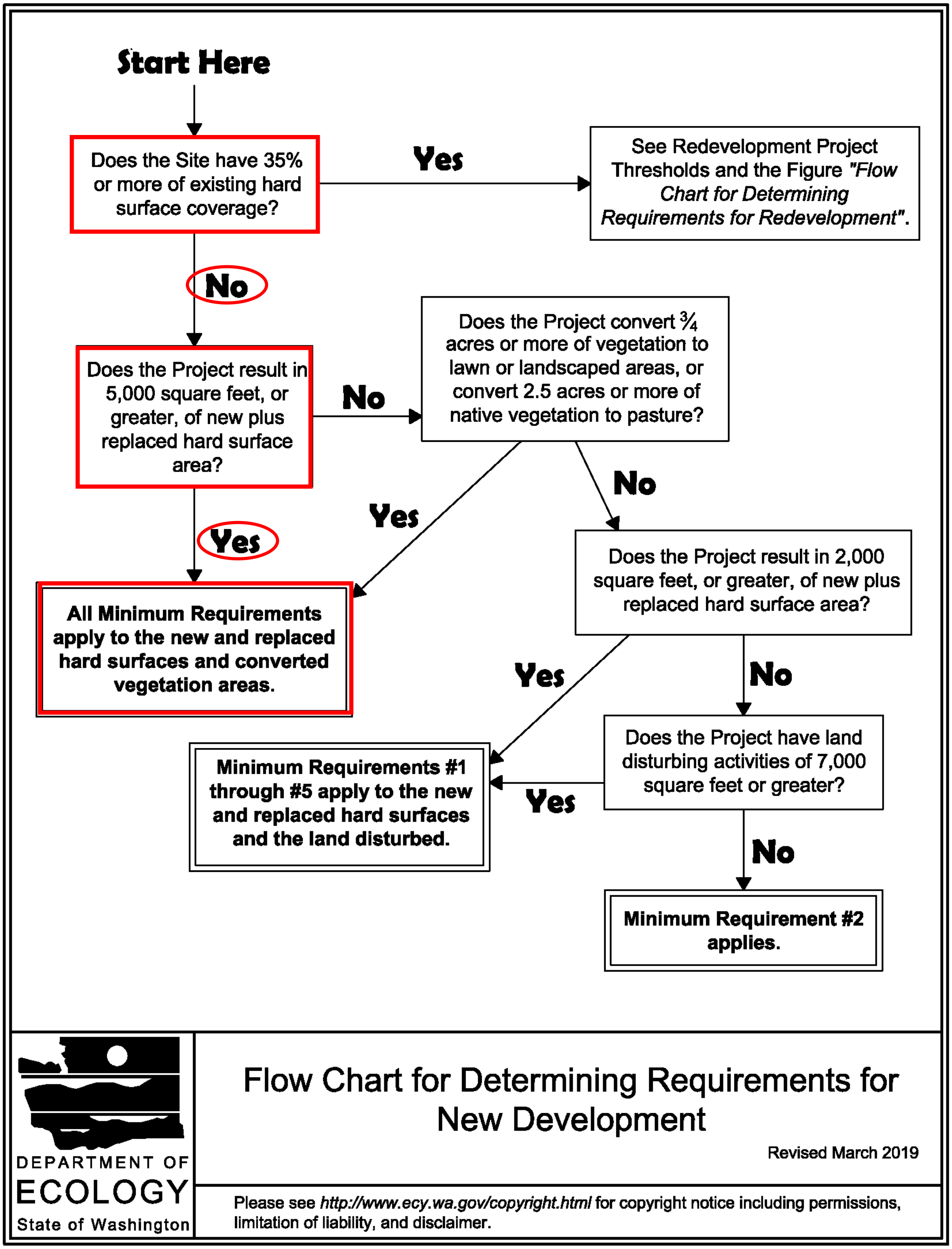
1.6 Soils

A Geotechnical Engineering Report was performed by PanGEO, Inc. and summarized in a report dated August 27, 2025. Test borings were excavated, and the site is underlain by Lawton Clay (Qvlc) material with pre-Olympia non-glacial deposits (Qpon) located at the base of the site. Based on the existing conditions, it was determined that infiltration is infeasible onsite. Please see Appendix A which includes the above-mentioned Geotechnical Engineering Report.

2. Minimum Requirements

The Minimum Requirements applicable to this project were determined using *Figure I-3.1: Flow Chart for Determining Requirements for New Development* from the Stormwater Manual, as shown on the next page.

Figure I-3.1: Flow Chart for Determining Requirements for New Development



As shown in Figure I-3.1, all Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas. The project meets the Stormwater Manual's minimum requirements as summarized in the following sections.

2.1 Minimum Requirement #1: Preparation of Stormwater Site Plans

The Stormwater Site Plan was prepared in accordance with Volume 1 Section I-3.4.1 of the Stormwater Manual and includes the minimum requirements applicable to the subject site based on thresholds of new and replaced site impervious coverage.

2.2 Minimum Requirement #2: Construction Stormwater Pollution Prevention Plan

The Construction Stormwater Pollution Prevention Plan (SWPPP) was prepared in accordance with Volume 1 Section I-3.4.2 of the Stormwater Manual, utilizing the Department of Ecology's (DOE) Construction Stormwater General Permit SWPPP template, and is described further in Section 4. The Temporary Erosion and Sediment Control Plan (TESC Plan) can be seen in Section 8 of this report and serves as a guide for the contractor to implement a final TESC Plan. As the site disturbance is less than one acre, a Construction Stormwater General Permit through the DOE is not required.

2.3 Minimum Requirement #3: Source Control of Pollution

The proposed detention facility, storm drains, area drains, and cleanouts serve as source control of pollution for the project site prior to being detained and released from the project site. To control pollutants, proper maintenance and cleaning of debris, sediments, and oil from stormwater collection and conveyance systems is required per the operation and maintenance recommendations found in Volume 5 Appendix A of the Stormwater Manual in addition to the BMPs in Volume IV Section IV-1. See Appendix C for Operation and Maintenance requirements pertaining to the project.

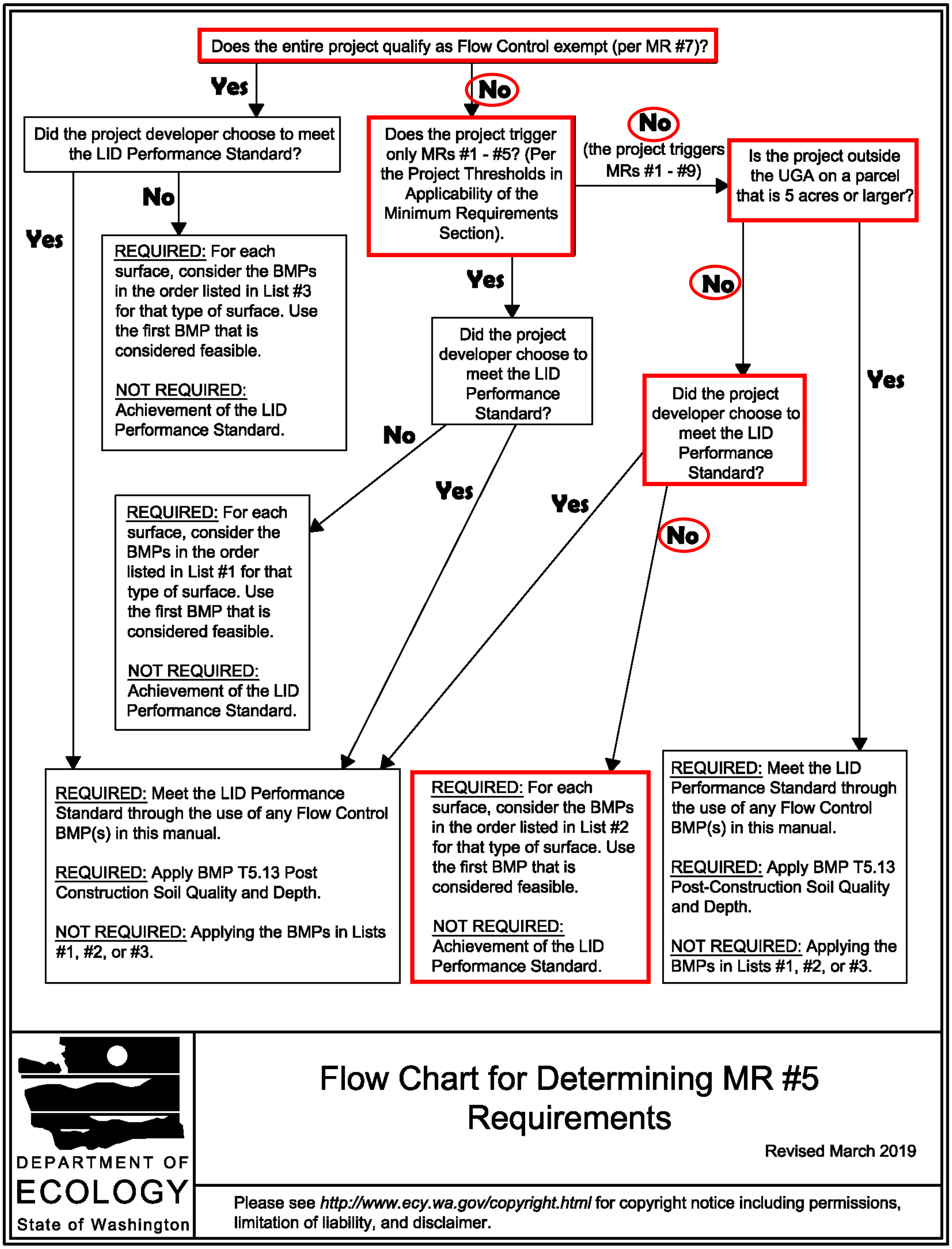
2.4 Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

The proposed drainage system will emulate the natural pre-developed conditions of the site as much as possible as runoff from all new and replaced impervious surfaces will be collected and discharged to the existing public drainage system in E Mercer Way which eventually discharges to Lake Washington, thus maintaining the natural drainage course from the site.

2.5 Minimum Requirement #5: On-Site Stormwater Management

The On-Site Stormwater Management requirements applicable to this project were determined using *Figure I-3.3 – Flow Chart for Determining LID MR #5 Requirements* from the Stormwater Manual, as shown on the next sheet.

Figure I-3.3: Flow Chart for Determining MR #5 Requirements



As shown in Figure I-3.3, List #2 applies to this project. This project complies with List #2 as described below:

<u>Lawn and landscaped areas:</u>
All disturbed pervious surfaces not covered by an impervious surface in the developed condition will be amended in accordance with the Post-Construction Soil Quality and Depth requirements as listed under BMP T5.13 in Chapter 5 of Volume V.

<u>Roof:</u>

- Full Dispersion/Downspout Dispersion Systems are infeasible because the required vegetated flow path is not available onsite.
- Downspout Full Infiltration is infeasible because the geotechnical report indicates that infiltration is not feasible at this project site. See Appendix A of this report for the full geotechnical report.
- Bioretention is infeasible because the geotechnical report indicates that infiltration is not feasible at this project site. See Appendix A of this report for the full geotechnical report.
- Perforated Stub-out Connections are infeasible because the geotechnical report indicates that infiltration is not feasible at this project site, and because the area available for siting a perforated stub-out connection is at the east (low) end of the site, which would then requiring pumping up to the detention facility or significantly lowering the detention facility. See Appendix A of this report for the full geotechnical report.
- On-Site Detention is feasible and will be utilized for all new roof areas onsite.

<u>Other Hard Surfaces:</u>

- Full, Sheet and Concentrated Flow Dispersion are infeasible because the required vegetated flow path is not available onsite.
- Bioretention is infeasible because the geotechnical report indicates that infiltration is not feasible at this project site. See Appendix A of this report for the full geotechnical report.
- Permeable Pavement is infeasible because the geotechnical report indicates that infiltration is not feasible at this project site. See Appendix A of this report for the full geotechnical report.

See Section 1.5 and 5.1 of this report for additional information on the proposed storm system.

2.6 Minimum Requirement #6: Runoff Treatment

This project does not trigger Minimum Requirement #6 since the entire project development will add and replace less than 5,000 SF of PGIS (total of 3,235 SF).

2.7 Minimum Requirement #7: Flow Control

The project does not trigger Minimum Requirement #7 because less than 10,000 SF of effective impervious surfaces are proposed, the project will not convert ¾ acres or more of vegetation to lawn or landscape, and the project will not cause a 0.15 cubic foot per second increase in the 100-year flow frequency as estimated using WWHM2012 utilizing 15-minute timesteps. Using 15-minute time steps the predeveloped 100-year flow frequency is 0.025-cfs and the developed site 100-year flow frequency is 0.161-cfs, resulting in a 0.136-cfs increase. The predeveloped site was modeled utilizing a forested land cover. The developed site was modeled using the proposed areas with all roof areas, driveway, and walkways. Please see Appendix B for the full WWHM2012 modeling report.

2.8 Minimum Requirement #8: Wetlands Protection

There are no wetlands on the project site or within the following mile of the downstream drainage path. Therefore, the project does not trigger Minimum Requirement #8: Wetlands Protection.

2.9 Minimum Requirement #9: Operation and Maintenance

An Operations and Maintenance Manual consistent with Volume V of the Stormwater Manual has been provided in Appendix C.

3. Off-Site Analysis Report

The project proposes to discharge stormwater offsite to the City's public stormwater network. Therefore, an offsite analysis is required for this project in accordance with Section I-3.5.3 AMP2 of the Stormwater Manual. The downstream drainage system was followed utilizing the City of Mercer Island's online GIS mapping, Google Maps, and a site visit. Please see the Downstream Drainage Exhibit and the Downstream Analysis Photos included in Appendix E of this report. The general path of flow for the downstream drainage system is as follows:

The offsite analysis performed begins at the project site. Stormwater discharged from the site flows east into the stormwater main/system in E Mercer Way which flows north and eventually drains into Lake Washington.

There was no visual indication of conveyance system capacity problems, localized flooding, erosion impacts, or violations of surface water quality standards. Additionally, there was no evidence of any damage to the drainage system. See Appendix E of this report for the Downstream Drainage Exhibit and Downstream Analysis Photos.

4. Construction Stormwater Pollution Prevention Plan (SWPPP)

This section summarizes the construction stormwater pollution prevention plan (CSWPPP) analysis and design. The two components of the CSWPPP are the erosion and sediment control (ESC) and the stormwater pollution prevention and spill (SWPPS) plans. Both the ESC Plan and SWPPS serve as guides as the contractor is required to design a working CSWPPP for the site. The analysis and design of these plans are discussed in the following sections.

4.1 ESC Plan Analysis and Design

The ESC design follows the guidelines provided in Appendix D of The Manual and is intended to satisfy Core Requirement #5 Erosion and Sediment Control.

A stabilized construction entrance will be maintained throughout the construction of the site improvements. Perimeter protection such as silt fence, straw wattles, or compost socks will be installed downslope of the improvements. Street cleaning on E Mercer Way will occur daily or as needed to remove any sediment tracked from the site. Site surface drainage will be maintained to prevent any ponding and inlet protection will be provided at all existing and proposed inlets that may receive runoff during construction. All disturbed areas that will not be paved will be stabilized by planting and mulching in accordance with BMP T5.13 of the 2019 Washington State DOE Stormwater Management Manual for Western Washington immediately after construction. The proposed ESC measures are shown on the Temporary Erosion and Sediment Control Plan in Section 8 and summarized in Table 4.

An ESC supervisor will be designated for the project and must be a Certified Professional in Erosion and Sediment Control or a Certified Erosion and Sediment Control Lead, as recognized by King County. The ESC supervisor will be responsible for the performance, maintenance, and review of all ESC measures, as well as the compliance with all permit conditions relating to ESC as described in The Manual.

4.2 SWPPS Plan Design

The SWPPS plan is intended to prevent pollutants from coming into contact with stormwater runoff, surface waters, or groundwater, during construction. Vehicles, construction equipment, materials, chemical storage, and sediment from clearing and grading all have the potential to pollute stormwater during construction. The following BMPs are required during the construction of this project:

- Maintain good housekeeping.
- Designate vehicle, equipment, and chemical storage areas.

- Inspect vehicle, equipment, and petroleum product storage and dispensing areas regularly to detect any leaks or spills.
- Store and contain liquid materials in such a manner that if the tank leaks, the contents will not discharge into the storm drainage system, surface waters, or groundwater.
- Provide maintenance and cleaning of the storm drainage system regularly by removing sediment and debris.
- All spills will be cleaned up immediately and disposed of correctly. Do not hose down spill areas to a storm drainage system.
- All toxic materials will be stored under cover when not in use or during a rain event.
- Use storm drain covers or other similarly effective runoff control measures to prevent sediment and other pollutants from entering catch basins.

All ESC and SWPPS BMPs will be inspected routinely by the ESC supervisor. All ESC measures will be removed, the site stabilized, and the drainage system cleaned once construction is completed.

4.3 Rainy Season Requirements

The construction of this project will be managed to minimize the amount of time that exposed soil is receptive to rainfall. This will help minimize stormwater runoff and erosion. Compost socks, silt fencing, and/or straw wattles will be placed around the site where needed to control the flow rate and disperse stormwater leaving the site. Mulching will be used to help stabilize the soil, especially when rain is anticipated.

4.4 Seasonal Suspension Plan

N/A. Construction is not expected to come to a halt at any time during the year unless specifically directed by the City of Mercer Island construction inspector.

Table 4. Proposed ESC Measures

(All ESC Measures Shall Comply with the Stormwater Manual)

	ESC Measure	Comment
1	Identify Project Limits	Mark by fencing or other means to contain the grubbing and grading activities.
2	Catch Basin Inlet Protection	Install catch basin inlet protection in any drainage structures that may collect any stormwater flowing from the construction site.
3	Phase Grubbing and Grading	Phase clearing so that only those areas that are actively being worked are uncovered. From October 1 through April 30, no soils shall remain exposed for more than 2 days. From May 1 through September 30, no soils shall remain exposed for more than 7 days.
4	Install Straw Wattles	Install straw wattles around disturbed areas where sediment could be transported off-site. Adjust straw wattles as required by site conditions and construction sequencing.
5	Sod/Seed Exposed Areas	Cleared areas will be sod/seeded as soon as possible after grading completed (few weeks).
6	Soil Removal	Remove excess soil from the site as soon as possible after backfilling.
7	Protect Adjacent Properties	Adjacent properties shall be protected from sediment deposition by appropriate use of vegetative buffer strips, sediment barriers or filters, dikes or mulching, or by a combination of these measures and other appropriate BMPs.
8	Street Cleaning	Provide for periodic street cleaning to remove any sediment that may have been tracked out. Sediment should be removed by shoveling or sweeping and carefully removed to a suitable disposal area where it will not be re-eroded.
9	Inspect ESC BMPs	Inspect all erosion and sediment control BMPs installed regularly, especially after any large storm. Maintenance, including removal and proper disposal of sediment should be done as necessary.

5. Permanent Stormwater Control

Total areas and land-cover characteristics for all proposed surfaces are shown in Table 1 for the developed site. Please see the Site Assessment and Summary Exhibit Included in Section 8 of this report for tributary areas to the proposed stormwater network elements. The stormwater requirement thresholds are as follows:

- On-site stormwater management BMPs per Table I-3.2 of the Stormwater Manual. See Section 5.1 of this report for more information.
- Flow Control is not required for the project site (<10,000 SF of effective impervious surface is proposed, & less than 0.15-cfs increase in the 100-year flow frequency).
- Water quality treatment is not required for the site (<5,000 SF of new plus replaced PGIS).

Table 5. Stormwater Facilities Summary

Facilities Summary
(1) Detention Facility
(3) Catch Basins
(3) Area Drains

5.1 On-Site Stormwater Management (LID BMPs)

The project proposes to utilize a detention facility to meet On-Site Stormwater Management requirements (Minimum Requirement #5). The detention facility was sized using the City of Mercer Island's detention system sizing Chart for projects with less than 9,500 SF of impervious surface. The system was sized with a total of 6,627 SF of impervious surface conveying into the detention system and applies the sizing parameters for sites with Type C soils.

Due to the sloping of the proposed driveway, 512 SF of onsite impervious surface will be conveyed and collected into the detention system proposed for the neighboring site (6427 E Mercer Way) under separate permit, which has also been adequately sized using the sizing parameters for sites with Type C soils. Please see Appendix G for more detention system sizing information.

5.2 Flow Control

Flow control is not triggered (see Section 2.7).

5.3 Water Quality

Water quality is not triggered (see Section 2.6).

5.4 Conveyance System Analysis and Design

The onsite conveyance system is comprised of 4-to-8-inch storm drainpipes, area drains, catch basins, and a detention facility. Stormwater exiting the detention facility will be routed to the existing storm drain main within E Mercer Way. All proposed storm drains onsite have been sized to handle anticipated site runoff from a storm event greater than a 100-year storm event. See conveyance calculations located in Appendix F for sizing results.

6. Special Reports and Studies

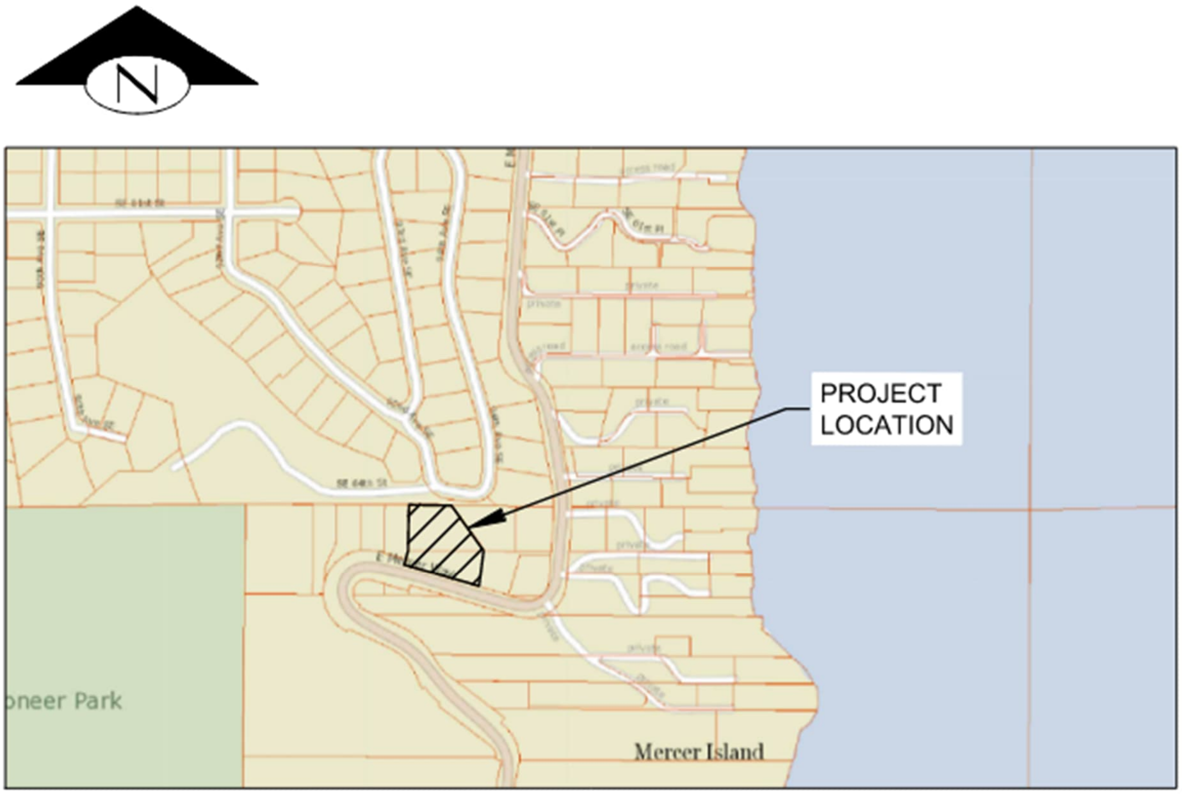
A Geotechnical Engineering Report was performed by PanGEO, Inc. and summarized in a report dated March 3, 2025 (see Section 1.6 and Appendix A for additional information). No other special reports or studies were required or conducted for this project.

7. Other Permits

No other permits or approvals are expected to be required for this project.

8. Additional Figures

Figure 2. Vicinity Map



VICINITY MAP

Figure 3. Site Assessment and Summary

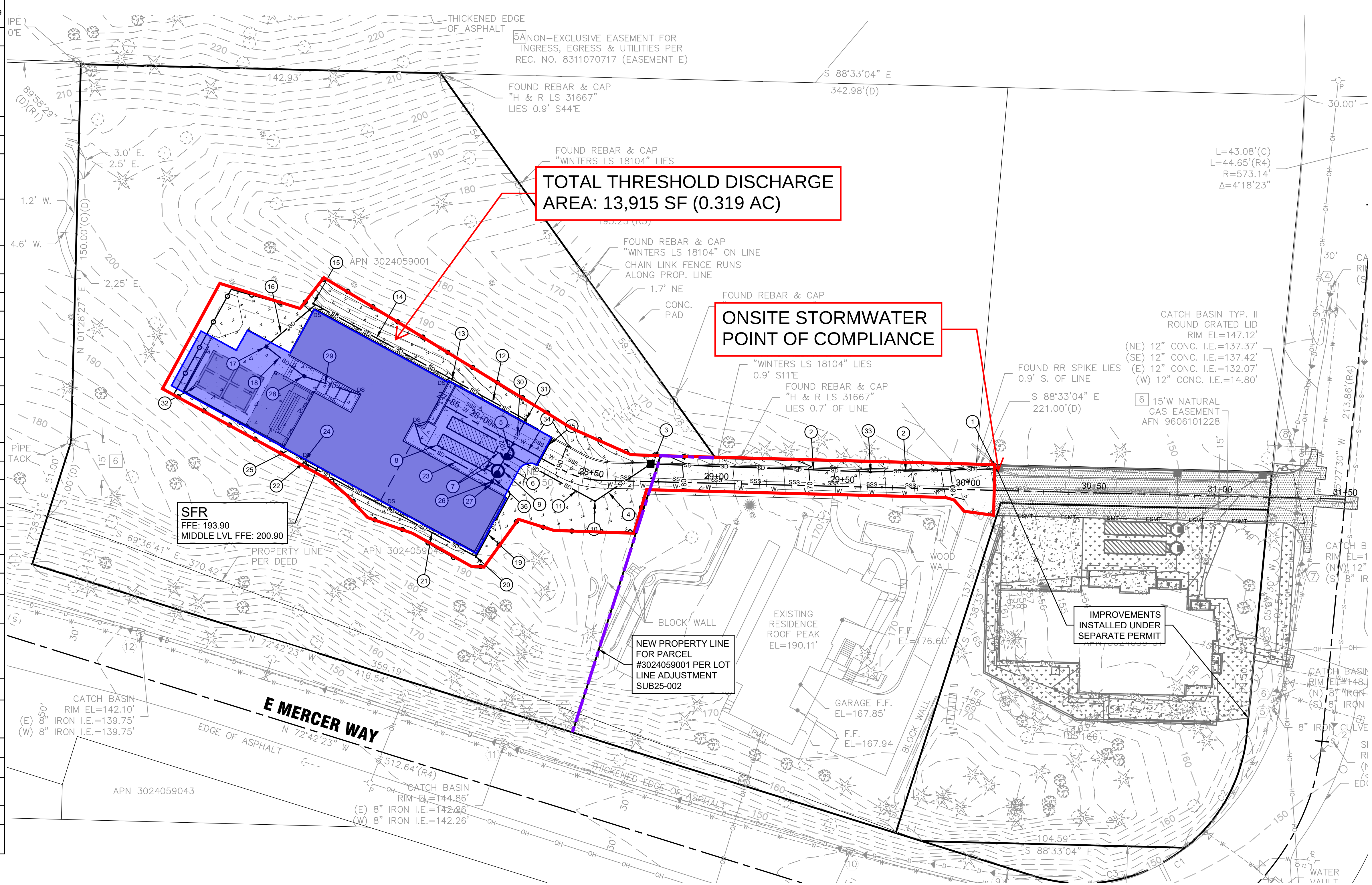
SCALE: 1" = 20'

KEY NOTES:

KEY	NOTE	DETAIL/ SHEET
1	NEW CONNECTION INTO TYPE 1 CB (SEE GRADING PROFILE - PRIVATE ROAD, SHEET C05)	C05
2	8" SD @ 2.00% MIN (SEE GRADING PROFILE - PRIVATE ROAD, SHEET C05)	C05
3	CB #1 - TYPE 1 (48"Ø) (SEE GRADING PROFILE - PRIVATE ROAD, SHEET C05)	C05 & D/C09
4	27 LF 8" SD @ 2.00% MIN	G/C09
5	CB #2 - TYPE 2 (54"Ø) W/ FLOW CONTROL STRUCTURE RIM 191.92 8" IE (SE) 184.50 (OUTLET) 36" IE (NW) 184.50 8" IE (SW) 184.50 6" IE (NE) 188.00 OVERFLOW ELEV 189.00	F/C09
6	8" SD @ ELEV 184.50	G/C09
7	36" SD @ ELEV 184.50	G/C09
8	DETENTION FACILITY DIMENSION: (2) 21.5'L x 5'Ø TOP OF FACILITY/LIVE STORAGE 189.00 DEAD STORAGE ELEV 184.50 BOTTOM OF FACILITY 184.00	L/C11
9	CB #3 - TYPE 2 (54"Ø) RIM 192.82 8" IE (NE) 184.50 36" IE (NW) 184.50 6" IE (SW) 189.00	E/C09
10	6" SDCO RIM 186.88 6" IE 183.70	H/C10
11	40 LF 6" SD @ 2.00% MIN	G/C09
12	34 LF 6" SD @ 2.00% MIN	G/C09
13	6" SDCO RIM 198.58 6" IE 194.00	H/C10
14	63 LF 6" SD @ 2.00% MIN	G/C09
15	6" SDCO RIM 199.19 6" IE 196.50	-
16	26 LF 6" SD @ 2.00% MIN	G/C09
17	AREA DRAIN RIM 201.88 6" IE (E) 197.10 6" IE (N) 197.10	-
18	19 LF 6" SD @ 2.00% MIN	G/C09
19	37 LF 6" SD @ 2.00% MIN	G/C09
20	6" SDCO RIM 193.67 6" IE 190.50	H/C10
21	78 LF 6" SD @ 2.00% MIN	G/C09
22	6" SDCO RIM 199.49 6" IE 196.90	H/C10
23	40 LF 6" SD @ 2.00% MIN	G/C09
24	ROOF DOWNSPOUT TIGHTLINE W/ 2.0' MIN COVER @ 2.00% MIN SLOPE (TYP)	-
25	PERIMETER FOOTING DRAIN: 4" PERFORATED PVC PIPE IN 3/4" WASHED ROCK WRAPPED IN FILTER FABRIC (TYP)	-
26	AREA DRAIN RIM 193.51 6" IE (NE) 189.50 6" IE (SE) 189.50 6" IE (NW) 189.50 4" IE (SW) 190.00 (FTG DRN)	-
27	4" SOLID WALL PVC FOOTING DRAIN TIGHTLINE @ 2.00% MIN	-
28	AREA DRAIN RIM 200.80 6" IE (E) 197.50 6" IE (W) 197.50	-
29	22 LF 6" SD @ 2.00% MIN	G/C09
30	15 LF 6" SD @ 2.00% MIN	G/C09
31	6" SDCO RIM 192.08 6" IE 189.50	H/C10
32	PERGOLA PER ARCH PLANS	-
33	8" SDCO (SEE GRADING PROFILE - PRIVATE ROAD, SHEET C05)	H/C10
34	13 LF 6" SD @ 2.00% MIN	G/C09
35	TRENCH DRAIN RIM ±191.00 6" IE 188.50	-
36	2 LF 6" SD @ 2.00% MIN	G/C09

LEGEND:

Hatch denotes proposed roof and at-grade areas to proposed detention facility (6,627 SF)



DRAINAGE PLAN

SCALE: 1" = 20'

NO.	DATE	BY	REVISION

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. FACET CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, AND ALL OTHER EXISTING FEATURES AND CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN AND/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT FACET PRIOR TO CONSTRUCTION.

FACET
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FEDERAL WAY | KIRKLAND | MOUNT VERNON | SEATTLE | SPOKANE | WHIDBEY ISLAND

BENJAMIN J. IDDINS, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER
Digitally signed by Ben Iddins
Date: 2025.09.11 11:06:40 -07'00'

CALL 811
2 BUSINESS DAYS BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

6423 E MERCER WAY
6423 E MERCER WAY
MERCER ISLAND, WA 98040
2501.0551.00

PERMIT PLAN

DRAINAGE PLAN

DATE: 9/11/2025

PLAN NUMBER: C06

SHEET 6 OF 11

PRINCIPAL: BI PROJECT MANAGER: JR DESIGNED BY: ZP DRAWN BY: GS CHECKED BY: BI

FILE LOCATION: \\EGNYTEDRIVE\FACET\SHARED\PROJECTS\ACTIVE\2025\01\2501.0551_CITIZEN DESIGN_6423 E MERCER WAY MERCER ISLAND\DRAWINGS\CAD-REVIT\ACTIVEFILE\6423 E MERCER WAY_MERCER ISLAND.DWG - ORIGINAL SHEET SIZE: ARCH FULL BLEED D (36.00 X 24.00 INCHES) - LAST MODIFIED BY: ZOE POPOVICH

Figure 4. Drainage Plan

SCALE: 1" = 20'

KEY NOTES:

KEY	NOTE	DETAIL/ SHEET
1	NEW CONNECTION INTO TYPE 1 CB (SEE GRADING PROFILE - PRIVATE ROAD, SHEET C05)	C05
2	8" SD @ 2.00% MIN (SEE GRADING PROFILE - PRIVATE ROAD, SHEET C05)	C05
3	CB #1 - TYPE 1 (48"Ø) (SEE GRADING PROFILE - PRIVATE ROAD, SHEET C05)	C05 & D/C09
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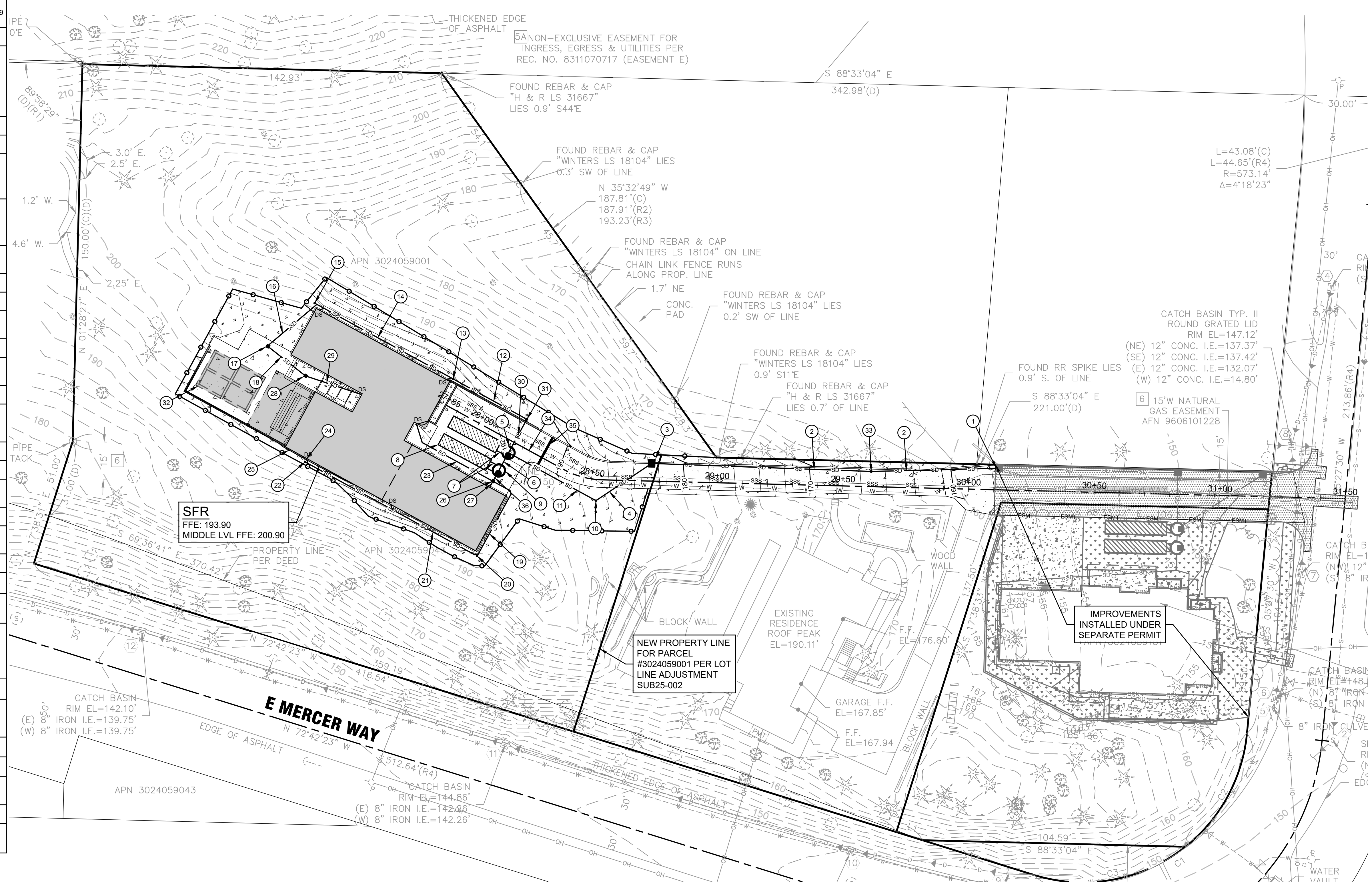
6	8" SD @ ELEV 184.50	G/C09
7	36" SD @ ELEV 184.50	G/C09
8	DETENTION FACILITY DIMENSION: (2) 21.5'L x 5'Ø TOP OF FACILITY/LIVE STORAGE 189.00 DEAD STORAGE ELEV 184.50 BOTTOM OF FACILITY 184.00	L/C11
9	CB #3 - TYPE 2 (54"Ø) RIM 192.82 8" IE (NE) 184.50 36" IE (NW) 184.50 6" IE (SW) 189.00	E/C09
10	6" SDCO RIM 186.88 6" IE 183.70	H/C10
11	40 LF 6" SD @ 2.00% MIN	G/C09
12	34 LF 6" SD @ 2.00% MIN	G/C09
13	6" SDCO RIM 198.58 6" IE 194.00	H/C10
14	63 LF 6" SD @ 2.00% MIN	G/C09
15	6" SDCO RIM 199.19 6" IE 196.50	-
16	26 LF 6" SD @ 2.00% MIN	G/C09
17	AREA DRAIN RIM 201.88 6" IE (E) 197.10 6" IE (N) 197.10	-
18	19 LF 6" SD @ 2.00% MIN	G/C09
19	37 LF 6" SD @ 2.00% MIN	G/C09
20	6" SDCO RIM 193.67 6" IE 190.50	H/C10
21	78 LF 6" SD @ 2.00% MIN	G/C09
22	6" SDCO RIM 199.49 6" IE 196.90	H/C10
23	40 LF 6" SD @ 2.00% MIN	G/C09
24	ROOF DOWNSPOUT TIGHTLINE W/ 2.0' MIN COVER @ 2.00% MIN SLOPE (TYP)	-
25	PERIMETER FOOTING DRAIN: 4" PERFORATED PVC PIPE IN 3/4" WASHED ROCK WRAPPED IN FILTER FABRIC (TYP)	-
26	AREA DRAIN RIM 193.51 6" IE (NE) 189.50 6" IE (SE) 189.50 6" IE (NW) 189.50 4" IE (SW) 190.00 (FTG DRN)	-
27	4" SOLID WALL PVC FOOTING DRAIN TIGHTLINE @ 2.00% MIN	-
28	AREA DRAIN RIM 200.80 6" IE (E) 197.50 6" IE (W) 197.50	-
29	22 LF 6" SD @ 2.00% MIN	G/C09
30	15 LF 6" SD @ 2.00% MIN	G/C09
31	6" SDCO RIM 192.08 6" IE 189.50	H/C10
32	PERGOLA PER ARCH PLANS	-
33	8" SDCO (SEE GRADING PROFILE - PRIVATE ROAD, SHEET C05)	H/C10

34	13 LF 6" SD @ 2.00% MIN	G/C09
35	TRENCH DRAIN RIM ±191.00 6" IE 188.50	-
36	2 LF 6" SD @ 2.00% MIN	G/C09



DRAINAGE PLAN

SCALE: 1" = 20'

FILE LOCATION: \\EGNYTEDRIVE\FACET\SHARED\PROJECTS\ACTIVE\2025\01\2501.0551_CITIZEN DESIGN_6423 E MERCER WAY MERCER ISLAND\DRAWINGS\CAD-REVIT\ACTIVEFILE\6423 E MERCER WAY_MERCER ISLAND.DWG - ORIGINAL SHEET SIZE: ARCH FULL BLEED D (36.00 X 24.00 INCHES) - LAST MODIFIED BY: ZOE POPOVICH

PRINCIPAL: BI PROJECT MANAGER: JR DESIGNED BY: ZP DRAWN BY: GS CHECKED BY: BI

NO.	DATE	BY	REVISION

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. FACET CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, AND ALL OTHER EXISTING FEATURES AND CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN AND/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT FACET PRIOR TO CONSTRUCTION.

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BENJAMIN J. IDDINS, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER
Digitally signed by Ben Iddins
Date: 2025.09.11 06:48

CALL 811
2 BUSINESS DAYS BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

6423 E MERCER WAY

6423 E MERCER WAY
MERCER ISLAND, WA 98040
2501.0551.00

PERMIT PLAN

DRAINAGE PLAN

DATE: 9/11/2025

PLAN NUMBER:

C06

SHEET 6 OF 11

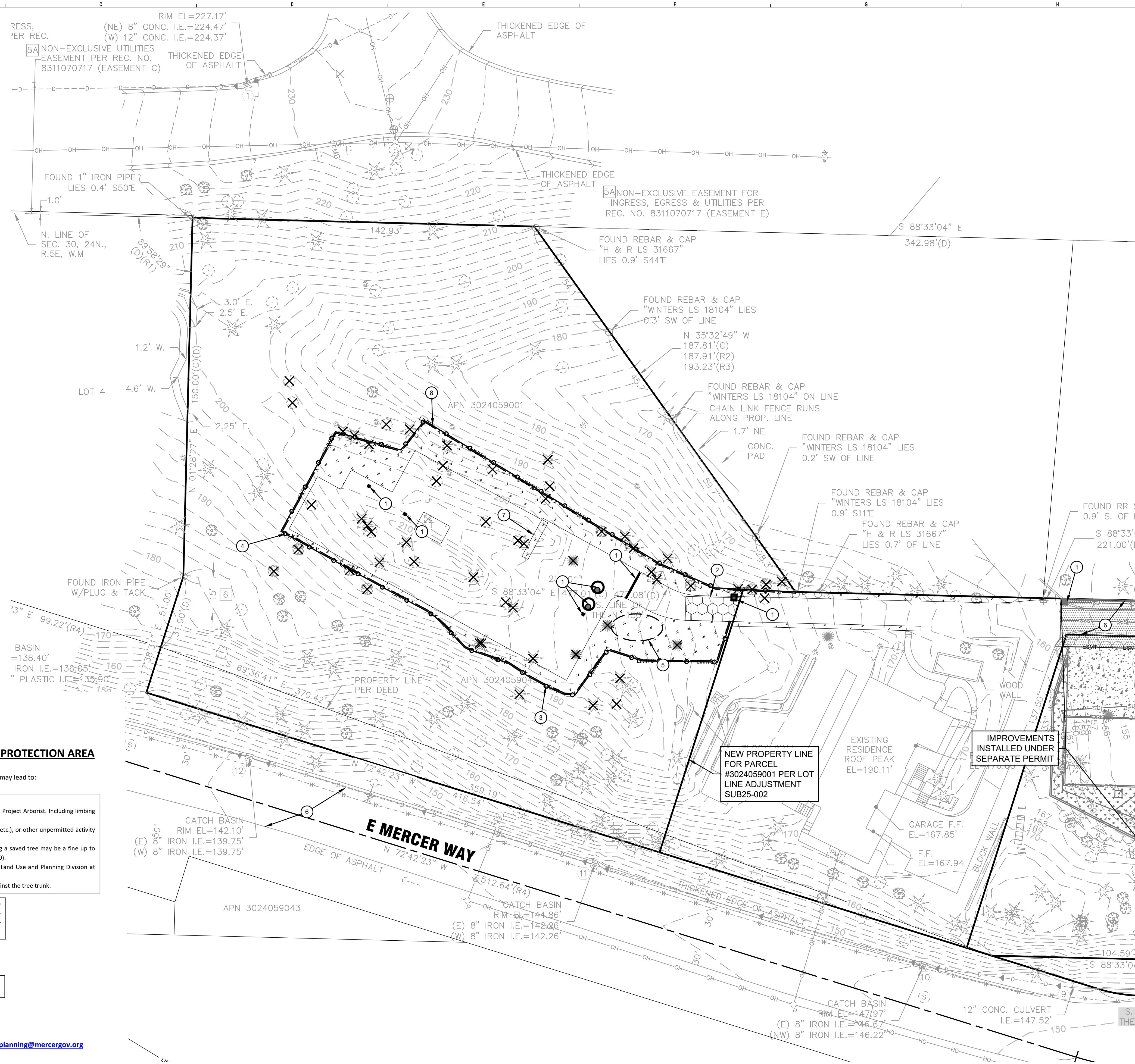
Figure 5. TESC Plan

SCALE: 1" = 20'

KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	INSTALL TEMPORARY STORM DRAIN INLET PROTECTION IN ALL STRUCTURES WITHIN 500' OF THE PROJECT SITE (INCLUDING THOSE THAT BECOME OPERABLE DURING CONSTRUCTION) AND REMOVE AFTER PERMANENT SITE STABILIZATION	A/C08
2	INSTALL TEMPORARY STABILIZED CONSTRUCTION AT PROPOSED DRIVEWAY LOCATION. FINAL LOCATION IN FIELD BASED ON ACCESS AVAILABILITY	B/C08
3	INSTALL APPROX 505 LF PERIMETER PROTECTION*	C/C08
4	TREE PROTECTION FENCING (TYP)	TP/C04
5	PROPOSED STOCKPILE LOCATION. CONTRACTOR TO DETERMINE FINAL LOCATION IN FIELD	-
6	CONTRACTOR TO SWEEP STREET IF NECESSARY TO REMOVE TRACKED SEDIMENT. FREQUENCY OF STREET SWEEPING TO BE COORDINATED BETWEEN THE CONTRACTOR AND THE ON-SITE INSPECTOR	-
7	AMEND ALL DISTURBED PERVIOUS AREAS IN ACCORDANCE W/ BMP T5.13 IN VOLUME V OF THE DOE 2019 STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON	-
8	APPROXIMATE ON-SITE CLEARING LIMITS	-

* INSTALL PERIMETER PROTECTION, SUCH AS SILT FENCING, COMPOST SOCKS, OR STRAW WATTLES IN ACCORDANCE WITH VOL II OF THE 2019 DOE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON



TEMPORARY EROSION AND SEDIMENT CONTROL PLAN

SCALE: 1" = 20'

TREE PROTECTION AREA (TPZ)

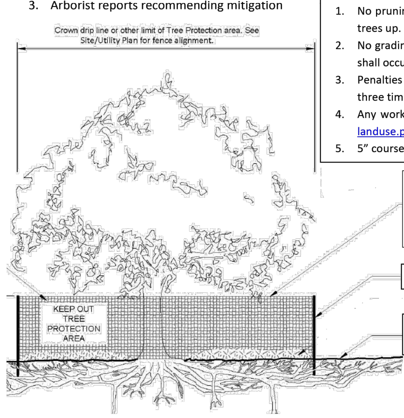
KEEP OUT!

DO NOT REMOVE OR ADJUST THE APPROVED LOCATION OF THIS TREE PROTECTION AREA

Trees enclosed by this fence are protected and are subject to the conditions of the tree permit. Violation of tree conditions may lead to:

1. Correction Notices or Stop Work Orders until compliance is achieved
2. RE Inspection Fees/financial penalties
3. Arborist reports recommending mitigation

Notes
1. No pruning shall be performed unless under the direction of the Project Arborist. Including limbing trees up.
2. No grading, excavation, storage (materials, equipment, vehicles, etc.), or other unpermitted activity shall occur inside the protective fencing.
3. Penalties for damaging by root damage/compaction or removing a saved tree may be a fine up to three times the value of the tree plus restoration (MICC 19.10.160).
4. Any work in approved TPZ must be with the permission of the Land Use and Planning Division at landuse.planning@mercergov.org
5. 5" course woodchips within the tree protection zone, but not against the tree trunk.



Tree protection fence: 4-6" **chain link** fence, solidly anchored into the ground, or if authorized High-density polyethylene fencing with 3.5" x 1.5" openings; color orange. Steel posts installed at 8' o.c.

2" x 6" steel posts or approved equal

Maintain existing grade with the tree protection fence unless otherwise indication on the plans

Any Work in the protected area must be with the permission of the Land Use and Planning Division at landuse.planning@mercergov.org

TREE PROTECTION FENCING (TP / C04)
NOT TO SCALE

FILE LOCATION: \\EGNYTEDRIVE\FACET\SHARED\PROJECTS\ACTIVE\2025\01\2501.0551_CITIZEN DESIGN_6423 E MERCER WAY MERCER ISLAND\DRAWINGS\CAD-REVIT\ACTIVEFILE\6423 E MERCER WAY_MERCER ISLAND.DWG - ORIGINAL SHEET SIZE: ARCH FULL BLEED D (36.00 X 24.00 INCHES) - LAST MODIFIED BY: ZOE POPOVICH

PRINCIPAL: BI PROJECT MANAGER: JR DESIGNED BY: ZP DRAWN BY: GS CHECKED BY: BI

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BENJAMIN J. IDDINS, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER — Digitally signed by Ben Iddins, Date: 2025.09.11 06:15 -07'00'

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6423 E MERCER WAY

6423 E MERCER WAY
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2501.0551.00

PERMIT PLAN

TEMPORARY EROSION AND SEDIMENT CONTROL PLAN

DATE: 9/11/2025

PLAN NUMBER:

C04

APPENDIX A. Geotechnical Report

GEOTECHNICAL ENGINEERING REPORT
PROPOSED SINGLE-FAMILY RESIDENCE
9191 SE 64th Street
Mercer Island, Washington

PROJECT NO. 25-036.200
AUGUST 27, 2025

Image Credit: Citizen Design

Prepared for: CITIZEN DESIGN

PanGEO INCORPORATED

Geotechnical & Earthquake
Engineering Consultants

PanGEO
INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

August 27, 2025
File No. 25-036.200

Citizen Design
Attn: Mr. Isaac Greenetz
3800 Woodland Park Avenue #300
Seattle, WA 98103

Subject: **Geotechnical Engineering Report**
Proposed Single-Family Residence
9191 SE 64th Street, Mercer Island, Washington

Dear Isaac,

Please find attached our geotechnical engineering report for the proposed single-family residence at the above address in Mercer Island, Washington. This report documents the subsurface conditions at the site and presents our geotechnical engineering recommendations for the proposed project.

PanGEO previously prepared a geotechnical report for three lots, including the subject lot, dated April 16, 2019. We subsequently prepared supplemental addendums to address the previously proposed developments on each specific lot. The attached report is intended to supersede our original report for the three lots, and all previous addendums, and should be used for the design of the currently proposed project.

Surface and Subsurface Conditions - Topographically, the site is comprised of a nominally west to east running ridgeline with steep slopes on the south, and moderate to steep slopes on the north. The crest of the ridge descends from roughly 210 feet in elevation on the west to about 185 feet near the east property line. The currently proposed house footprint straddles the ridgeline near the center of the property. Soil conditions at the site were evaluated based on a total of five test borings. In summary, the footprint of the house is generally underlain by competent soils consisting of very stiff to hard clayey silt over medium dense to dense silty sand. Groundwater was not encountered within the depths of our explorations.

Foundation Recommendations - Based on the currently proposed design, the proposed house foundations are expected to bear on competent soils. As such, conventional footings will be appropriate to support the structure. However, steep slopes are located in close proximity to the foundations on both the north and especially on the south side of the house. To maintain adequate stability of the house foundations, particular during the design seismic event, we recommend that a row of stabilizing soldier piles be incorporated into the design along the south foundation wall, and the northern footings bear on a 4-foot-deep block of lean-mix concrete, to effectively increase the embedment depth of the footing.

Critical Area Considerations – Provided that the recommendations presented in this report are incorporated into the project plans and construction of the project, in our opinion the proposed project is feasible from the geotechnical standpoint, and will not adversely affect the mapped critical areas at the site.

We appreciate the opportunity to work on this project. Please call if there are any questions.

Sincerely,

Stephen H. Evans, L.E.G.
Senior Engineering Geologist
sevans@pangeoinc.com

Jon C. Rehkopf, P.E.
Principal Geotechnical Engineer
jrehkopf@pangeoinc.com

Encl.: Geotechnical Engineering Report

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LIST OF ATTACHMENTS

LIST OF APPENDICES

LIST OF APPENDICES (CONT.)

GEOTECHNICAL ENGINEERING REPORT
PROPOSED SINGLE-FAMILY RESIDENCE
9191 SE 64TH STREET
MERCER ISLAND, WASHINGTON

1.0 INTRODUCTION

This report presents the results of a geotechnical engineering study that was undertaken to support the design of the proposed single-family residence (SFR) at 9191 SE 64th Street (Parcel 302405-9151) on Mercer Island, Washington. This study was performed in general accordance with our mutually agreed scope of services outlined in our proposal for the current study dated January 24, 2025, which was subsequently authorized on January 29, 2025. Our scope of services included reviewing readily available geologic and geotechnical data, including our previous studies on this site, compiling our previous engineering analyses and recommendations, performing additional engineering analyses, and preparing this geotechnical engineering report for the currently proposed project. All previous reports and memos provided for this property are superseded by this report.

2.0 SITE AND PROJECT DESCRIPTION

The project site consists of an irregularly shaped, undeveloped parcel located at 9191 SE 64th Street, on the east side of Mercer Island, Washington (see Figure 1, *Vicinity Map*). The current property includes an original parcel identified by the parcel number 302405-9001 (address 9191 SE 64th Street, per City of Mercer Island), a 25,125 square-foot parcel. As the original property line ran down the center of the ridgeline (topography discussed below), the portion of the property at 6423 East Mercer Way south of the original lot, down to East Mercer Way, was added to the present site (see Figure 2, *Site and Exploration Plan*) to yield the current 47,398 square-foot property.

The western property line contains a topographic saddle or upper bench area, near the top of the property, around elevation 201 feet (see Figure 2). From here a ridgeline with moderately steep slopes reaches down to the southeast toward the existing house at 6423 East Mercer Way. From a relatively sharp crest below the upper bench, the ridge crest broadens out, especially below elevation 198 feet (see Plate 1, following page). An access driveway or dirt road has been graded up the spine of the ridge to the upper bench area, and the upper part of the ridge appears to have been undercut by past grading work. This has created areas of vertical and near vertical slopes and road cuts where the access road has been excavated through the crest of the ridge (see Plate 2, following page). The ridge area is covered with scattered conifer and deciduous trees, while the lower, broad ridge area was mainly grassy.

North of the ridgeline, between the house site and the steep slope rising the SE 64th Street, there is an open, incised drainage swale. Moderate to steep slopes descending into this swale form the north flank of the ridgeline (see Figure 2).

Plate 1 – General conditions of the property, looking downslope to the east from the approximate location of the currently proposed house, where the ridge crest broadens. (6/18/2025)

The property is mapped by the City of Mercer Island within several geological hazard areas, including an erosion hazard area, a potential landslide hazard area, and seismic hazard area. As such, the development will need to consider these hazards, which are addressed in *Section 5.0* of this report.

Plate 2 – "Road" cut, looking uphill to the west along the ridge crest. Note vertical slope in shadow on left. (6/18/2025)

Plate 3 –Schematic View from the East, dated 5/23/25, by Citizen Design.

Current plans call for developing the house footprint on the central portion of the ridgeline discussed above (see Figure 2). We understand that the house will be multi-level, with the garage level at approximately elevation 194 feet, the main level on the north portion of the house at elevation 199 feet, and the main living area on the south section of the house at elevation 201 feet. All elevations are assumed to be NAVD88. The preliminary plans call for a complex, multilevel excavation, with cuts up to 20 feet in some locations. However, since the cuts are removing the ridge crest, resulting open cuts are generally less than 8 to 10 feet.

The conclusions and recommendations in this report are based on our understanding of the proposed development, 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.

3.0 SUBSURFACE EXPLORATIONS

PanGEO completed five test borings at the subject site. Three of the borings (PG-4-19, PG-5-19 and PG-8-19) were completed during our previous exploration program on March 7, 2019 and March 21, 2019. Two additional borings (PG-1-25 and PG-2-25) were drilled on the revised house footprint on July 1, 2025. The 2019 borings were advanced to between 14 and 41½ feet below the existing ground surface using an EC-95 track mounted drill owned and operated by Boretec, Inc. The 2025 borings were advanced to depths of 41½ and 36½ feet below ground surface, respectively. They were drilled using a track-mounted Acker Recon drill rig owned and operated by Geologic Drill Partners of Fall City, Washington. The approximate boring locations are shown on the attached Figure 2.

Soil samples were obtained from the borings at 2½-foot and 5-foot depth intervals in general accordance with Standard Penetration Test (SPT) sampling methods (ASTM test method D-1586) in which the samples were obtained using a 2-inch outside diameter split-spoon sampler. The sampler was driven 18-inches into the soil using a 140-pound weight freely falling a distance of 30 inches. The 2019 samples were obtained with aa hammer that was advanced using a rope and cathead method, while the 2025 samples were obtained using a higher efficiency auto-trip hammer. The number of blows required for each 6-inch increment of sampler penetration was recorded. The number of blows required to achieve the last 12 inches of sample penetration is defined as the SPT N-value. The N-value provides an empirical measure of the relative density of cohesionless soil, or the relative consistency of fine-grained soils.

A geologist from PanGEO was present on a full-time basis to observe the drilling, assist in sampling, and to describe and document the soil samples obtained from the borings. The soils were logged in general accordance with the system summarized on *Figure A-1, Terms and Symbols for Boring and Test Pit Logs*. Summary boring logs are included as Figures A-2 to A-6 in Appendix A. The stratigraphic contacts indicated on the boring logs represent the approximate depth to the boundaries between soils units. Actual transitions between soil units may be more gradual or occur at different elevations. The descriptions of groundwater conditions and depth are likewise approximate.

4.0 SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

According to *The Geologic Map of Mercer Island (Troost and Wisher,2006)*, the subject parcel is underlain almost entirely by Lawton Clay (Qvlc) material, with possibly some pre-Olympia non-glacial deposits (Qpon) toward the base of the site. The mapping suggests the site surface is mantled with mass-wasting deposits. Our borings along the ridgeline indicates that the house site is underlain predominantly by sand deposits, with relatively minor interbeds of silt and clayey silt above the house site, which is inconsistent with the mapped geology. Moreover, the clayey silt and sandy silt beds occur at a topographic level above where they would be expected to be found. In our opinion, the project area is underlain by pre-Olympia strata, both fine grained (Qponf) and coarse-grained (Qponc).

- **Mass-wastage Deposits (Qmw) –** Mass-wastage deposits consist of surficial deposits transported downslope in mass by gravity (landslides, colluvial soil movement, and other gravitational processes). Mass-wastage deposits typically consist of intermixed, very loose to medium dense, coarse-grained deposits and soft to stiff fine-grained deposits with voiding. This geologic unit typically exhibits moderate to high compressibility and low to moderate strength characteristics due to the highly variable composition and the nature in which this unit was deposited. We did not observe significant amounts of this material along the ridgeline at the proposed house location, and only logged about four feet of this unit in PG-8-19.

- **Pre-Olympia Non-Glacial Deposits (Qponf & Qponc)** – This geologic unit (non-differentiated) is described by Troost and Wisher as generally consisting of very dense and hard, sand, gravel, silt, clay and organics of non-glacial origin. The unit may contain tephra beds, paleosols, and iron oxidized layers. These pre-Olympia deposits typically exhibit low compressibility and high strength characteristics in an undisturbed state. As stated above, on this site, in our opinion we have beds of fine-grained Pre-Olympia non-glacial material (Qponf), which is described as laminated to massive silt and clay, as well as coarse-grained deposits (Qponc), described as sand and gravel, clean to silty.

4.2 Soil Conditions

The test borings advanced at the project site generally encountered soils inconsistent with the mapped geologic stratigraphy, as described above, and we did not encounter significant mass-wasting deposits. The thin disturbed surficial materials we found at the site of the proposed house were interpreted to be fill, as clear grading activities had occurred on the site.

The interpreted subsurface conditions are depicted in Figures 3, 4 and 5 – *Generalized Subsurface Profiles A-A', B-B' and C-C',* respectively, and brief descriptions of the generalized soil conditions encountered at the locations of the test borings advanced at the site are presented below. Please refer to the summary boring logs in *Appendix A* for more details. A layer of colluvium (mass wasting deposit) was encountered in PG-8-19, but as this boring was not located near the proposed house footprint, the soil unit is not included in the descriptions below.

Fill – Fill was encountered as thin layers of medium dense, yellow brown, silty sand in both 2025 borings. The unit was not found in the 2019 borings PG-4-19 or PG-5-19, likely because both were located in a road cut area. The unit was roughly less than 2 feet thick, and was characterized by mixed texture and organics.

Pre-Olympia Non-Glacial Fine-Grained Deposits (Qponf) – This unit consisted of sandy silt to silty lean clay, very stiff to hard, varying in color from yellow brown to brown gray. The unit was encountered near the top of the ridge, where it levels off into a shoulder. The unit was found in PG-1-25, PG-4-19 and PG-5-19, and becomes thicker up the slope. The contact zone between the fine-grained strata and the lower sand zone tends to be a zone of interbedded material. Though the material is sticky to the hand, Atterberg Testing shows the bed in PG-1-25 to be non-plastic. The bed is 6½ feet thick in PG-1-25, and up to 12 feet thick in PG-4-19.

Pre-Olympia Non-Glacial Coarse-Grained Deposits (Qponc) – This soil unit was encountered at depth in all borings along the ridgeline. The unit consisted of silty sand to sand with silt, fine to medium, and medium dense to very dense. Number 200 mesh separation tests indicated the fines varied from a low of 9.6% to a high of 16.4%. There was scattered gravel in some beds, and the unit varied from laminated to massive and homogeneous.

Our subsurface descriptions are based on the conditions encountered and observed at the time of our exploration. Soil conditions between exploration locations may vary from those encountered. The nature and extent of variations between our exploratory locations may not become evident until construction. If variations do appear, PanGEO should be requested to reevaluate the recommendations in this report and to modify or verify them in writing prior to proceeding with earthwork and construction.

Selected Sample Photos: Plates 4 through 6 below depict select soil samples obtained from our recent test borings. For reference purposes, the split-soon samplers pictured below have an outside diameter of 2 inches.

Plate 4 – Pre-Olympia, Non-glacial Fine Grained: Hard, sandy SILT (Qponf) | PG-1-25, S-4 @ 7½ – 9 feet.

Plate 5 –Pre-Olympia, Non-glacial Coarse Grained: Very dense fine SAND with silt (Qponc)| PG-1-25, S-9 @ 25-26½ feet.

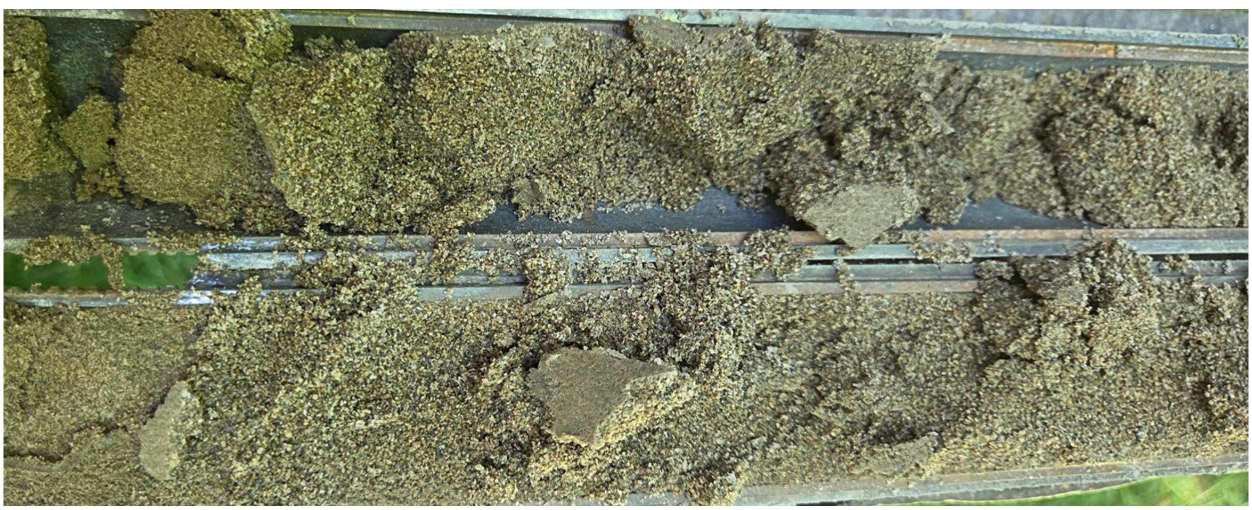


Plate 6 – Pre-Olympia, Non-glacial Coarse Grained: Medium Dense to Very dense, SAND, with silt | PG-2-25, S-4 @ 7½-9 feet.

4.3 GROUNDWATER CONDITIONS

Groundwater was not encountered in any of our test borings. Please note that there will be fluctuations in seepage and groundwater levels, depending on the season, amount of rainfall, surface water runoff, local subsurface conditions and other factors. Generally, the groundwater levels are higher and seepage rates are greater in the wetter winter months (typically October through May).

5.0 GEOLOGIC HAZARDS EVALUATION

As part of our study, we conducted an assessment of potential geologic hazards within the subject site as defined in Mercer Island City Code Chapter 19.07.160, Geologically Hazardous Areas. Mercer Island City Code identifies three different types of Geologic Hazards: Erosion Hazards, Potential Landslide Hazards, and Seismic Hazards. The City's criteria for the various hazard areas and our assessment of the hazard areas with respect to the planned improvements are provided in the following sections of this report.

5.1 EROSION HAZARDS

The site is mapped as a potential erosion hazard area in accordance with the City of Mercer Island's Geologic Hazards Map. Based on the Web Soil Survey data, the mapped site soils (Kitsap Silt Loam KpD) have an Erosion Factor K of 0.37 to sheet and rill erosion. Factor K values range between 0.02 and 0.69, with the higher number indicating higher vulnerability. As such, we interpret the site soils to have a moderate susceptibility to erosion.

Conclusions: In our opinion, the erosion hazards at the site can be effectively mitigated with best management practices 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 a silt fence at the construction perimeter, placing quarry spalls or hay bales at the disturbed and high traffic areas, covering stockpiled soil or cut slopes with plastic sheets, constructing a temporary drainage pond, if needed, to control surface runoff and trap sediment, and by maintaining a stabilized construction entrance.

Permanent erosion control measures should be applied to the disturbed areas of the site as soon as feasible. These measures may include, but not limited to, planting and mulching. The use of permanent erosion control mats may also be considered in conjunction with planting/mulching to protect the soils from erosion.

5.2 POTENTIAL LANDSLIDE HAZARDS

The subject site is mapped within a potential landslide hazard area according to the City of Mercer Island's Geologic Hazards Map.

The City of Mercer Island GIS mapping identifies a few landslide indicators within 500 feet of the subject site. Most are below the subject site. Two landslides are indicated on properties west of the subject site, but no information is available as to the nature of these slides. Several small slides are also mapped on the church property north of the project site, also with no further information The map also shows a landslide scarp along the north side of a drainage swale north of the house site. This scarp is not associated with any mapped slide.

Site Reconnaissance and Observations: We conducted a reconnaissance visit to review the condition of the sloping areas of the site, and areas adjacent to the site, and identify indications of potential historical slope instability.

As described above, the site morphology consists of a descending ridge running southeast from a saddle or bench area along the west property line as shown in Figure 2. The upper portion of the ridge is relatively narrow, but widens below elevation 198 feet (see Plate 1). During our site visits, we did not observe evidence of recent slope instability such as slide scarps or tension cracks within the subject property. In addition, no recent or historical slides have been mapped on or directly adjacent to the subject property. Review of the recent Lidar image of the area shows the site grading work fairly readily, and the road cut to the bench, but shows no features that may suggest slope instability in the subject area.

Conclusions: Based on our reconnaissance and our understanding of subsurface conditions at the site, in our opinion a large, deep-seated type of slope failure is unlikely on the subject property. In our opinion, relatively shallow landslides at the site have the potential to occur due to the steep topography. As such, as described below, we performed a detailed slope stability analysis of the site to determine the risk of landsliding, and to provide recommendations to adqeuatly stabilize the site.

It is our opinion that the proposed improvements are 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 improvements are properly designed and constructed. Our recommendations include the use of permanent stabilizing piles along the south side of the developed area to provide adequate support for the proposed residence in the static and seismic condition, per the current standard of practice. In addition, we recommend effectively deepening the northern house footings adjacent to the moderately steep slopes along the north side of the proposed house footprint by constructing the footings on a 4-foot-deep concrete bearing pad, to achieve adequate stability.

5.3 Seismic Hazards

Based on our review of the City of Mercer Island's Geologic Hazards Maps, the project site is mapped in 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, soil liquefaction or surface faulting.

Based on our subsurface explorations, the site is underlain by primarily dense silty sand, and a static groundwater level was not encountered in the test borings. Based on these conditions, in our opinion the liquefaction potential of the soils underlying the site is low, and design considerations related to soil liquefaction are not necessary for this project.

It is also our opinion that the potential for significant deep-seated seismic-induced land sliding is low at the site due to the underlying dense sand. However, relatively shallow slides that could adversely affect the proposed development are possible during the design earthquake. As such, we have recommended measures to mitigate the risk of seismic slope instability impacting the proposed house. Provided the proposed project is designed and constructed in accordance with the recommendations in the report, the developed portion of the site should not be adversely affected during the code-level seismic event.

According to our review of the WA DNR Geologic Information portal, the closest mapped fault is described as a strand of the Seattle Fault, and is located about 1000 meters to the north of the project site. Based on the distance to the fault, in our opinion ground rupture is low at the project site.

6.0 SLOPE STABILITY

Due to the mapped geologic hazards at the site, as well as the steep slopes adjacent to the proposed residence, we performed a slope stability analysis to evaluate the stability of the proposed development. Our analysis was intended to evaluate if stabilizing measures would be needed to meet the current building code requirements.

6.1 Slope Stability Analysis

Our evaluation was based on our understanding of the subsurface conditions as described above, the topographic data derived from the topographic survey by Informed Land Survey, the results of our site reconnaissance, and our understanding of the planned improvements.

The stability of a slope depends on a variety of factors, including the geometry of the slope, the subsurface stratigraphy, material properties of the soils, the location of groundwater, and the effects of surface loads. Based on our understanding of the subsurface conditions at the site, the topography shown on Figure 2, and site features observed during our site reconnaissance, we developed generalized subsurface profiles through the site as shown on Figure 2, and presented in Figures 3, 4 and 5. We selected subsurface profile B-B' as the most critical section for our analyses.

Soil & Groundwater Parameters - Soil parameters utilized in the stability analyses are shown on the attached Figures 6 and 7. Soil parameters were selected based on observed soil types, the results of standard penetration tests performed in the test borings, the results of laboratory testing, published correlations for soil units in the Puget Sound Area, and our experience.

Groundwater was not included in our stability model, as none of the test borings encountered water.

Surcharge Loads – Estimated foundation surcharge loads were included in the model, as noted on Figures 6 and 7. The added mass of the recommended 4-foot-thick concrete bearing pad below the northern footings were also included as a surcharge load.

Analysis Method - We performed our slope stability analysis using the program SLIDE2 (Slide) published by Rocscience Inc. Slide is a two-dimensional limit equilibrium slope stability analysis program. Search routines were used to identify the potential circular and non-circular failure surface having the lowest static factor of safety using the Spencer method of analysis.

The seismic stability was analyzed using a pseudo-static approach, where the effect of earthquake ground shaking is added to the static analysis in the form of an additional horizontal force. The seismic coefficient used in the pseudo-static stability analysis shall correspond to some fraction of the anticipated peak ground acceleration associated with a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years). Based on the current IBC, a seismic coefficient of 0.373g was used for this project, which corresponds to one-half of the expected peak PGA_M of 0.745g.

6.2 STABILITY ANALYSIS RESULTS

The City of Mercer Island Building Code states that, *Alteration of landslide hazard areas and seismic hazard areas and associated buffers may occur if the critical area study documents find that the proposed alteration (a) Will not adversely impact other critical areas; (b) Will not* *adversely impact the subject property or adjacent properties; (c) Will mitigate impacts to the geologically hazardous area consistent with best available science to the maximum extent reasonably possible such that the site is determined to be safe; and (d) Includes the landscaping of all disturbed areas outside of building footprints and installation of hardscape prior to final inspection.* In our opinion, to meet criteria (c) above, the static and seismic factors of safety against global instability of 1.5 and 1.1, respectively, should be achieved, to be consistent with the local standard of practice.

As such, to determine if the proposed development on the slope will have an acceptable factor of safety in accordance with the criteria stated above, we evaluated the stability of the proposed condition and found that the factor of safety against global instability did not meet the requirements of 1.1 for the seismic condition. As such, we recommend that mitigating measures be incorporated into the proposed project to adequately stabilize and protect the developed area of the site in accordance with the current building code.

6.3 Recommended Stabilizing Measures

South Wall Foundation of House: To improve the stability of the site and provide adequate factors of safety against future instability of the developed portion of the site, we recommend that a stabilizing wall be constructed along the south side of the proposed house. In our opinion, a feasible wall type consists of drilled soldier piles (steel beams inserted into concrete shafts) with a minimum diameter of 24-inches, and a minimum spacing of 6 feet on-center. As shown in the attached Figures 6A and 6B, if the stabilizing piles have a minimum embedment of 20 feet below the house foundation, or approximately a tip elevation of 172.5 feet (NAVD88), the developed area will exceed the required factor of safety of 1.5 and 1.1 for the static and seismic condition, respectively. Our analysis assumed that each pile, spaced 6-foot on-center, has an allowable shear capacity of 120 kips. See *Section 7.5 Stabilization Piles* for additional discussion and details. As described below, we recommend that the stabilizing soldier piles be designed for an exposed face of 6 feet below the foundation subgrade elevation to account for erosion and/or future slope movements downslope of the wall, particularly during the code-level seismic event. The piles may be extended up to the existing ground surface to serve as temporary shoring to reduce the amount of earthwork associated with open cut excavations.

North Wall Foundation & North and South Site Walls: Along the north side of the house, our analysis indicated that the house footings need to be embedded four feet below the currently designed bottom of footing elevation. In our opinion, a feasible alternative to deepening the footings is to construct the house footings on a 4-foot block of lean-mix concrete to effectively deepen the footing. Figures 7A and 7B depict the proposed deepened footing along the north side of the house, and the associated adequate factors of safety for the static and seismic condition. We recommend the same 4-foot-deep lean-mix bearing pad be installed below all site retaining walls along the north and south sides of the developed area that are adjacent to the steep slopes.

6.4 Stability Risks and Qualifications

Based on the results of our study, it is our opinion that the proposed building and site improvements as planned will have adequate factors of safety against potential future slope instability and will not have adverse impacts on the subject and surrounding properties, provided the project is properly designed and constructed. However, it should be noted that any development on or near a steep slope or a potential landslide area always involves some level of risk. In addition, future activities on and off the site could also affect the stability of the subject site. This may include but is not limited to the proper maintenance of surface drainage, and adequate protection of the side slopes from erosion.

7.0 GEOTECHNICAL RECOMMENDATIONS

7.1 Seismic Design Considerations

7.1.1 Site Class

We understand that the project will be designed in accordance with the 2021 edition of the International Building Code (IBC), and ASCE 7-16, which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years). For design purposes, Site Class C (very dense soil and soft rock) is considered appropriate for the seismic design of the project.

7.1.2 Liquefaction

Liquefaction is a process that can occur when soil loses its shear strength for short periods of time during a seismic event. Ground shaking of sufficient strength and duration results in the loss of grain-to-grain contact and an increase in pore water pressure, causing the soil to behave as a fluid. Soils with a potential for liquefaction are typically cohesionless, predominately silt and sand sized, must be loose to medium dense, and be below the groundwater table.

Based on our subsurface explorations, the site is underlain by primarily dense silty sand, and a static groundwater level was not encountered in the test borings. Based on these conditions, in our opinion the liquefaction potential of the soils underlying the site is low, and design considerations related to soil liquefaction are not necessary for this project.

7.2 FOUNDATION RECOMMENDATIONS

Based on the results of our test borings and our understanding of the project design, we anticipate that the building footings will bear on competent native soils. The following sections present our design recommendations for conventional footings.

7.2.1 Conventional Footings

Footings should bear on the undisturbed native medium dense to dense or hard soils, or on properly compacted structural fill placed on the undisturbed competent native soils. Footing locations that encounter unanticipated areas of fills or disturbed, loose soils, should be over-excavated to expose undisturbed medium dense to dense native soil, and backfilled with properly compacted structural fill, or lean-mix concrete, as described below.

7.2.2 Over-excavation & Replacement

Any over-excavation should be backfilled with lean-mix concrete (1½ sack of cement per cubic yard, minimum) or properly compacted structural fill, such as 1¼-inch minus crushed rock, or approved equivalent. If lean-mix is used, the over-excavation should extend horizontally at least one-half foot beyond the edges of the footings. If structural fill is utilized, the fill should extend horizontally out from the edges of the footing a distance equal to one-half of the over-excavation depth. As such, to limit the amount of earthwork, if over-excavations more than about 3 feet are required, we recommend lean-mix be used as backfill.

Required 4-foot Over-Excavation for Stability – As described above in *Section 6.3*, we recommend that the northern house footings, and all other site walls that run along the north and south sides of the house, adjacent to steep slopes, be constructed on a 4-foot-deep block of lean-mix concrete (1½-sack of cement per cubic yard, minimum). The lean-mix should extend a minimum of 6 inches wider than the footing on all sides.

7.2.3 Allowable Bearing Pressure

A maximum allowable soil bearing pressure of 3,000 pounds per square foot may be used to size footings bearing on the undisturbed medium dense to dense native soils, or structural fill or lean mix placed over the native soils. For allowable stress design, the recommended allowable bearing pressure may be increased by one-third for transient loading conditions such as those due to wind and/or seismic forces. For frost protection considerations, footings should be placed at least 18 inches below adjacent finished grade.

7.2.4 Lateral Resistance

Lateral loads acting on footings may be resisted by passive earth pressure developed against the embedded portion of the footings and by frictional resistance developed at the base of the footings.

- An allowable frictional coefficient of 0.4 may be used to evaluate sliding resistance.
- An allowable passive soil resistance may be calculated using an equivalent fluid pressure of 300 pcf, assuming the footings are backfilled with compacted structural fill and level ground surface. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

The above values include a geotechnical factor of safety of 1.5.

7.2.5 Footing Drains

Footing drains should be installed around the perimeter of the building, at or just below the bottom of the footings. Under no circumstances should roof downspout drain lines be connected to the footing drain systems. Roof downspouts must be separately tightlined to appropriate discharge locations, and away from steep slope areas. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

7.2.6 Footing Subgrade Preparation

Footing subgrades should be carefully prepared and should not contain loose, soft, or disturbed soils. The adequacy of footing subgrades should be verified by a representative of PanGEO prior to placing forms or rebar. The footing subgrades should be in a dense and unyielding condition prior to pouring concrete.

Please note that the site soils are moderately to highly moisture sensitive and can become disturbed and softened when exposed to moisture and construction traffic. Sandy soils with low fines content are also vulnerable to disturbance by general foot traffic. Protection of the foundation bearing soils should be the responsibility of the contractor.

7.2.7 Foundation Performance

Total and differential settlements are anticipated to be within tolerable limits for footings designed and constructed as discussed above. Footing settlement under static loading conditions is estimated to be about ½-inch, and differential settlement across the structure should be about ½-inch or less. Most settlement will be realized during construction as the dead loads are applied.

7.3 FLOOR SLABS

7.3.1 Concrete Slab-on-grade

A slab-on-grade may be used for the lowest level floors of the proposed building. In general, we anticipate that medium dense or very stiff to hard native soil will be encountered at excavation level. Care should be taken to avoid disturbing the sandy silt or silty sand subgrade. Any areas that become disturbed, or areas that are found to be disturbed by previous grading activities or other circumstance, should be over-excavated and replaced with properly compacted structural fill.

We recommend that construction joints be incorporated into the floor slab to control cracking.

7.3.2 Capillary Break

Floor slabs should be placed over a layer of capillary break material to reduce the potential of moisture passing through the slab. The capillary break material should consist of at least 4 inches of free-draining, clean (less than 3 percent fines) crushed rock compacted to a firm and unyielding condition. The capillary break material should have no more than 10 percent and 5 percent by weight of material passing the U.S. Standard No. 4 and No. 100 sieves, respectively. We also recommend that a 10-mil polyethylene vapor barrier be placed below the slab.

7.4 RETAINING AND BELOW-GRADE WALLS

Free standing retaining walls and below-grade foundation walls should be properly designed to resist the lateral earth pressures exerted by the soils behind the walls. The current design includes basement walls and concrete cantilever walls along the north and south side of the developed area that appear to be up to about 8 feet tall.

Proper drainage provisions should be provided behind the walls to intercept and remove groundwater that may be present behind the wall. Our geotechnical recommendations for the design and construction of the retaining and below-grade walls are presented in the sections below.

7.4.1 Concrete Wall Foundation Support

The footing recommendations outlined in *Section 7.2* of this report are also applicable for the walls. For walls along the north and south sides of the developed area, in close proximity to the steep slopes, see *Section 7.2.1.1* for over-excavation and placement of a lean-mix bearing pad below the wall footings.

7.4.2 Lateral Earth Pressures

Cantilever walls should be designed for an equivalent fluid pressure of 35 pcf for level backfills behind the walls, assuming the walls are free to rotate. If walls are to be restrained at the top from free movement, such as basement walls, equivalent fluid pressures of 50 pcf should be used for level backfills behind the walls. Walls with a maximum 2H:1V backslope should be designed for an active and at rest earth pressure of 50 and 65 pcf, respectively. The recommended lateral pressures assume that the backfill behind the wall consists of free draining and properly compacted fill with adequate drainage provisions to prevent the development of hydrostatic pressure.

Permanent walls should be designed for an additional uniform lateral pressure of 9H psf for seismic loading, where H corresponds to the buried depth of the wall in feet. The recommended lateral pressures assume that the backfill behind the wall consists of a free draining and properly compacted fill with adequate drainage provisions.

7.4.3 Wall Surcharge

The retaining and basement walls should be designed to resist surcharge pressures, if present, within the height dimension of the wall. As a minimum, for anticipated cars and delivery vans, the traffic surcharge may be considered as 90 psf of horizontal uniform pressure. Similarly, surcharge loads from construction equipment or soil/material stockpiles should be considered in the retaining and basement wall design during construction. We recommend that Figure 8 be used to calculate the lateral pressure on the face of the wall face resulting from surcharge loading.

7.4.4 Lateral Resistance

Lateral forces from wind or seismic loading and unbalanced lateral earth pressures may be resisted by a combination of passive earth pressures acting against the embedded portions of the foundation, and by friction acting on the base of the footings. Passive resistance values may be determined using an equivalent fluid weight of 300 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 the footings and level ground surface. If there is a slope descending below the wall, the passive pressure will be significantly reduced, and PanGEO can provide an acceptable value based on the specific geometry and soil conditions at the wall location. An allowable frictional coefficient of 0.4 may be used to evaluate sliding resistance at the base of a footing. This value includes a geotechnical factor of safety of 1.5.

7.4.5 Wall Drainage

Provisions for permanent control of subsurface water should be incorporated into the design and construction of the below-grade walls. As a minimum, 4-inch diameter perforated drainpipes should be installed behind and at the base of the wall footings, embedded in 12 to 18 inches of crushed rock or washed gravel. The gravel should be wrapped in a geotextile filter fabric to prevent the migration of fines into the drain system. The drainpipe should be graded to direct water to a suitable outlet, and away from any steep slopes.

Under no circumstances should roof downspout drain lines be connected to the perforated footing/wall drain systems for basement walls. Roof downspouts must be separately tightlined to appropriate discharge locations. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

7.4.6 Wall Backfill

In our opinion, the on-site excavated soils are not suitable for use as wall backfill. We recommend that wall backfill should consist of free draining granular structural fill as defined in *Section 8.3* of this report.

Wall backfill 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 (Modified Proctor). Within 5 feet of the wall, the backfill should be compacted with hand-operated equipment to at least 90 percent of the maximum dry density.

7.4.7 Damp-proofing/Waterproofing

We recommend the designers consider utilizing a waterproofing material, such as prefabricated clay mats, or other measures, on the exterior of all below grade foundation walls to reduce the potential for moisture intrusion into the below-grade portion of the homes. We recommend that a waterproofing or building envelope specialty consultant be retained to provide details regarding waterproofing measures, as waterproofing is beyond the scope of our work.

7.5 SOLDIER PILE STABILIZING WALL

To adequately stabilize the developed portion of the site, as described above, we recommend the installation of soldier pile stabilizing piles along the south, downslope side of the house.

Minimum Pile Size and Spacing - To evaluate the minimum depth of embedment needed to provide adequate stabilization of the developed area, we performed slope stability analyses using limit-equilibrium methods for both static and seismic loading conditions. Based on the results of our analyses, the soldier piles along the south (downslope) side of the developed area should have a minimum hole diameter of 24 inches, a center-to-center spacing of 6 feet or less, and a minimum embedment below the bottom of the house foundation of 20 feet, which is equivalent to a minimum tip elevation of +172.2 feet, or deeper as determined by structural analysis. The piles should have a minimum shear capacity of 120 kips.

As described above, we recommend that the stabilizing soldier piles be designed for an exposed face of 6 feet to account for erosion and/or future slope movements downslope of the wall, particularly during the code-level seismic event.

Design Earth Pressures - The recommended earth pressures depicted on Figure 9 should be used for design of the stabilizing piles, which will function as a cantilevered wall after a potential slide.

Above the bottom of excavation, the recommended active earth pressure should be applied over the full width of the pile spacing. Below the bottom of excavation, the passive resistance should be applied over two times the pile diameter, and the active pressure applied over one single pile diameter.

Because the soldier pile wall is permanent, we recommended a seismic pressure of 9H (psf) be included in the pile design, where H is the exposed design height of the wall in feet.

The footing surcharge pressure behind the piles should be included in the analysis of the piles in the cantilevered condition. Figure 8 may be used to calculate the footing surcharge pressure.

***Vertical Capacity* –** Soldier piles may be designed using an allowable skin friction value of 1.0 ksf for the portion of the pile below the bottom of the potential exposed height of the pile, and an allowable end bearing value of 40 ksf.

***Corrosion Protection* –** Since the soldier pile wall will be utilized as a permanent stabilizing wall, all potentially exposed portions of the steel beams should be galvanized or coated with corrosion protection. The corrosion protection should extend at least 2 feet below the potentially exposed portion of the wall, which is equal to 2 feet more than the 6-foot design height of the wall. Alternatively, the steel section should be over-sized to account for corrosion.

Lagging – In our opinion lagging the wall below the elevation of the house foundation is not required. If a slide were to occur in the future, we anticipate soil arching between the piles spaced at 6 feet on-center will prevent significant soil loss between the piles. If this occurred, lagging would be added and backfilled to repair the wall. However, if the wall is utilized for temporary shoring, lagging will be needed above the bottom of the excavation.

Lagging design recommendations for the anticipated conditions are presented on Figure 9. Lagging, if included in the design, may consist of materials such as timber boards, cast-in-place concrete, precast concrete panels, or steel sheets. For the permanent condition, if timber lagging is utilized, treated timber should be specified, and the saw cut ends of the lagging should be treated on-site prior to lagging installation. It should be noted that even treated timber lagging will eventually deteriorate, and would need to be replaced. The lifespan on treated timber lagging may range from 15 to 25 years. The advantage of concrete or steel lagging is that they would be permanent.

7.6 Permanent Cut and Fill Slopes

Based on the anticipated soil that will be exposed at the site, we recommend permanent cut and fill slopes, if any, be constructed no steeper than 2H:1V (Horizontal:Vertical). Any proposed permanent slopes with a relief of more than 8 feet should be evaluated by PanGEO on a case-by-case basis.

Cut slopes should be observed by PanGEO during excavation to verify that conditions are as anticipated. Supplementary recommendations can then be developed, if needed, to improve stability. Fill slopes must consist of properly placed and compacted structural fill, with careful compaction out to the slope face. Proper compaction may require the need to over-build the slope and then cut it back to the desired final condition. All fill must be placed on horizontal benches, and adequately keyed into the native soil. If fill slopes are proposed, PanGEO will need to assist the design team by providing specific recommendations for the fill slope proposed.

Permanently exposed slopes should be treated with permanent erosion control measures as soon as possible to improve stability of the surficial layer of soil.

7.7 Permanent Drainage

Permanent control of surface water and roof runoff should be incorporated in the final grading design. In addition to these sources, irrigation and rainwater infiltrating into landscape and planter areas adjacent to paved areas or building walls should also be controlled. All collected runoff should be directed into conduits that carry the water away from the pavement, structure, and steep slopes, and into appropriate outlets. Adequate surface gradients should be incorporated into the grading design such that surface runoff is directed away from structures and steep slope.

Under no circumstances should collected surface water or downspout drains be allowed to discharge onto open slopes or behind walls. Furthermore, it is important to note that roof downspouts should be tightlined to a suitable outlet, and not discharged into the wall or perimeter footing drain system.

7.8 Permanent Erosion Control Considerations

Permanent erosion control measures such as covering exposed ground surfaces with topsoil or mulch, and installing landscaping, should be performed as soon as possible after construction to limit the time the exposed surfaces are susceptible to erosion.

8.0 CONSTRUCTION CONSIDERATIONS

8.1 Site Preparation

Site preparation for the proposed project includes clearing, grubbing, and excavations to the design subgrade. All stripped surface materials should be properly disposed of off-site.

Following site excavations, the adequacy of the subgrade where structural fill, foundations, slabs, or pavements are to be placed should be verified by a representative of PanGEO. The subgrade soil in the improvement areas, if recompacted and still yielding, should be over-excavated and replaced with compacted structural fill.

8.2 Material Reuse

The soils at the site are moisture sensitive and will become disturbed / soft when exposed to inclement weather conditions. In our opinion, the on-site soils are not suitable to be reused as structural fill. In the context of this report, structural fill is defined as compacted fill placed under footings, pavements, concrete stairs, landings, and slabs, or other load-bearing areas. Material for use as structural fill is described in the following section.

The on-site soil may potentially be used as general fill in the non-structural and landscaping areas. If use 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.

8.3 Structural Fill Placement and Compaction

For planning purposes, structural fill should consist of imported, well-graded, granular material such as Seattle Type 17 Mineral Aggregate (*COS Standards and Specifications, 2023, Section 9-03.14*), WSDOT Gravel Borrow (*WSDOT Standards and Specifications, 2025, Section 9-03.14(1)*), or an approved equivalent.

Structural fill should be moisture conditioned near its optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and systematically compacted to a dense and relatively unyielding condition. The adequacy of the compaction should be verified by PanGEO. If density tests are performed, the test results should indicate at least 95 percent of the maximum dry density, as determined using test method ASTM D1557 (modified proctor). For utility backfill or backfill within 5 feet of retaining walls, the backfill should be compacted to at least 90 percent of the maximum dry density.

The procedure to achieve proper density of a compacted fill depends on the size and type of compacting equipment, the number of passes, thickness of the lifts being compacted, and certain soil properties. We recommend that structural fill supporting foundations be compacted with jumping jack compactors at a minimum. If the excavation to be backfilled is constricted and limits the use of heavy equipment, smaller equipment can be used, but the lift thickness will need to be reduced to achieve the required relative compaction. PanGEO can provide additional recommendations regarding structural fill and compaction during construction.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with high fines contents are particularly susceptible to becoming too wet and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods.

8.4 Temporary Excavations

8.4.1 Temporary Open Cuts

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. All temporary excavations deeper than a total of 4 feet should be sloped or shored. Temporary excavations less than 4 feet along the property lines should also be sloped or shored.

For planning purposes, we recommend that temporary excavations be sloped no steeper than 1H:1V (Horizontal:Vertical). If temporary excavations are not in the fill, but in the dense native soil, steeper excavations may be feasible, based on PanGEO's field observations and the configuration of the excavations.

The temporary excavations and cut slopes should be re-evaluated in the field during construction based on actual observed soil conditions. If groundwater seepage is encountered, the temporary slope will likely need to be cut to shallower angles to maintain stability, or require shoring. During wet weather, runoff water should be prevented from entering excavations and the exposed slopes should be covered with plastic sheets.

8.4.2 Temporary Shoring

Based on currently available plans, temporary shoring is not presently planned for. However, the stabilizing soldier pile wall may be extended up to the existing ground surface to serve as a temporary shoring wall. Future plans, especially for facilities such as stormwater retention facilities, may require temporary shoring in the form of trench boxes or similar systems.

8.4.3 Groundwater Impacts

Groundwater was not encountered in the borings, and we do not anticipate groundwater to impact construction on this site. However, thin water-bearing lenses could be encountered, especially if construction proceeds during wet winter months. We anticipate such impacts should be relatively minimal, but contractors should be prepared to control any groundwater as needed with sumps and pumps.

8.4.4 Surcharge Avoidance

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.

8.5 TEMPORARY EROSION AND DRAINAGE CONSIDERATIONS

We recommend that the exposed temporary slopes be covered with plastic sheeting.

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 prevent water from entering excavations or to prevent turbid runoff from leaving the work site.

Temporary erosion control may require the use of hay bales on the downhill side of the project to prevent water from leaving the site, especially on steep slope sides, and potential storm water detention to trap sand and silt before the water is discharged to a suitable outlet. All collected water should be directed under control to an appropriate / approve discharge point or outlet.

While we do not anticipate groundwater impacts, we recommend that the contractor should be prepared to provide temporary groundwater control methods, especially if excavation is conducted in the wet season. If present, we anticipate that the groundwater can likely be controlled with sumps and pumps.

8.6 Soldier Pile Installation Considerations

The drilling of soldier piles is anticipated to encounter several feet of fill over hard silt and clay, which is underlain by medium dense to dense fine to medium sand with some silt. It is important to note that caving of the surficial soils is possible, especially if zones of seepage are encountered. The contractor should be prepared to temporarily case the holes to maintain stability during drilling. Caving in the underlying clean sand is also possible.

We recommend that the following should be incorporated into the project plans and specifications:

- The geotechnical engineer shall verify the suitability of all soldier pile holes before concrete placement;
- Tremie methods shall be used for concrete placement in all holes having 6 or more inches of accumulated water if perched ground water or heavy precipitation is encountered during construction.
- All soldier pile holes drilled shall be filled with lean concrete mix or structural concrete on the same day.
- If soldier piles are designed as a permanent foundation system, any soft/disturbed soils encountered at the bottom of the hole during drilling will need to be removed using a cleanout bucket prior to placing the steel beam and concrete.
- Caving in fill, or wet sand/silty sand layers could occur during drilling. As a result, the drilling contractor should be prepared to stabilize the holes by using temporary casings, hydrostatic pressures (i.e., flooding the hole), or drilling fluids.

8.7 Wet Earthwork Recommendations

General recommendations relating to earthwork performed in wet weather or in wet conditions are presented below:

- All surfaces of the foundation subgrade should be protected against inclement weather. It is the contractor’s responsibility to protect the footing subgrade from disturbance. One option is to place a 2- to 3-inch-thick layer of lean-mix concrete or 3 to 4 inches of clean crushed rock on the footing subgrade as soon as the subgrade is exposed.

- Earthwork should be performed in small areas to minimize subgrade exposure to wet weather. Excavation or the removal of unsuitable soil should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance.

- During wet weather, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight based on the portion passing ¾-inch sieve. The fines should be non-plastic.

- 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. Erosion control measures should be installed along all the property boundaries.

- Excavation slopes and soils stockpiled on site should also be covered with plastic sheets.

9.0 ADDITIONAL SERVICES

We anticipate the City of Mercer Island will require a plan review and geotechnical special inspections to confirm that our recommendations are properly incorporated into the design and construction of the proposed project. Specifically, we anticipate that the following construction support services may be needed:

- Review final project plans and specifications;
- Verify implementation of erosion control measures;
- Observe the stability of open cut slopes;
- Monitor soldier pile installations;
- Verify footing subgrades;
- Confirm the adequacy of the compaction of structural backfill;
- Observe installation of subsurface drainage provisions, and;
- Other consultation as may be required during construction.

Modifications to our recommendations presented in this report may be necessary, based on the actual conditions encountered during construction.

10.0 LIMITATIONS

We have prepared this report for use by Citizen Design and the project design team. Recommendations contained in this report are based on a site reconnaissance, 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 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 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.

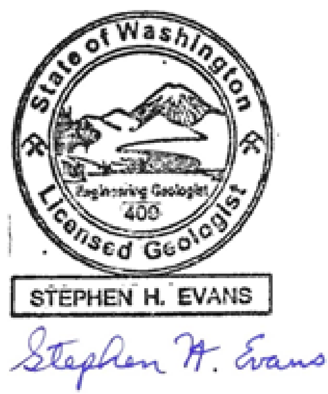
It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. 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.

Within the limitation of scope, schedule and budget, PanGEO engages in the practice of geotechnical engineering and endeavors to perform its services in accordance with generally accepted professional principles and practices at the time the Report or its contents were prepared. No warranty, express or implied, is made.

We appreciate the opportunity to be of service to you on this project. Please feel free to contact our office with any questions you have regarding our study, this report, or any geotechnical engineering related project issues.

Sincerely,

PanGEO, Inc.



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11.0 REFERENCES

ASCE 2016, Minimum Design Loads for Buildings and Other Structures, ASCE/SEI Standard 7-16.

ASTM D1557-12e1, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb./ft3 (2,700 kN-m/m3)),* ASTM International, West Conshohocken, PA, 2012, www.astm.org

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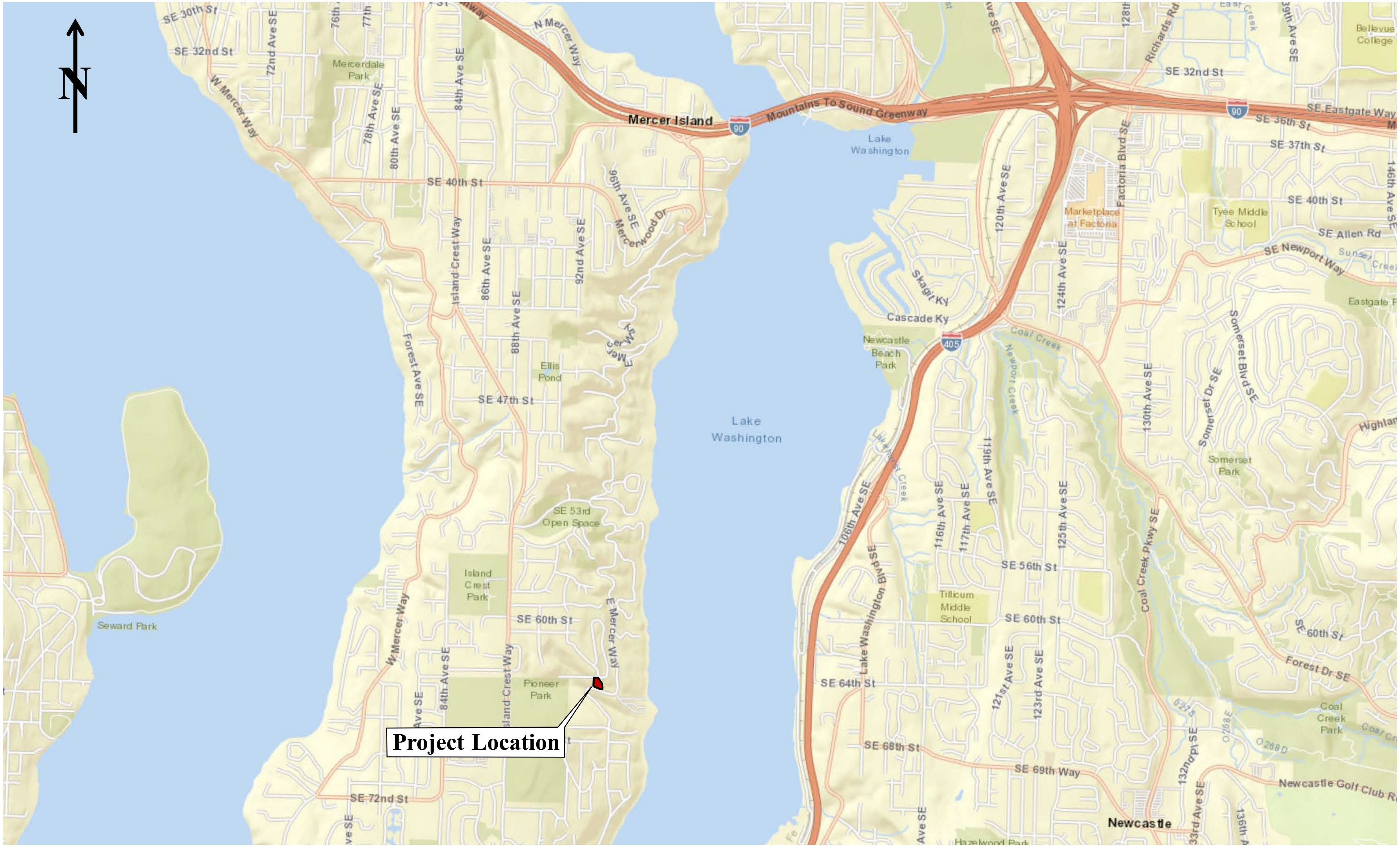


Map not to Scale
Base Map from
Dept of Natural
Resources Geological
Information Portal

PanGEO INCORPORATED

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

VICINITY MAP

Project No.	Figure No.
25-036.200	1

Notes:

1. Topographic Survey by Informed Land Survey.
2. Assumed Vertical Datum NAVD 88.

Approximate Scale
1" = 30'

PanGEO INCORPORATED

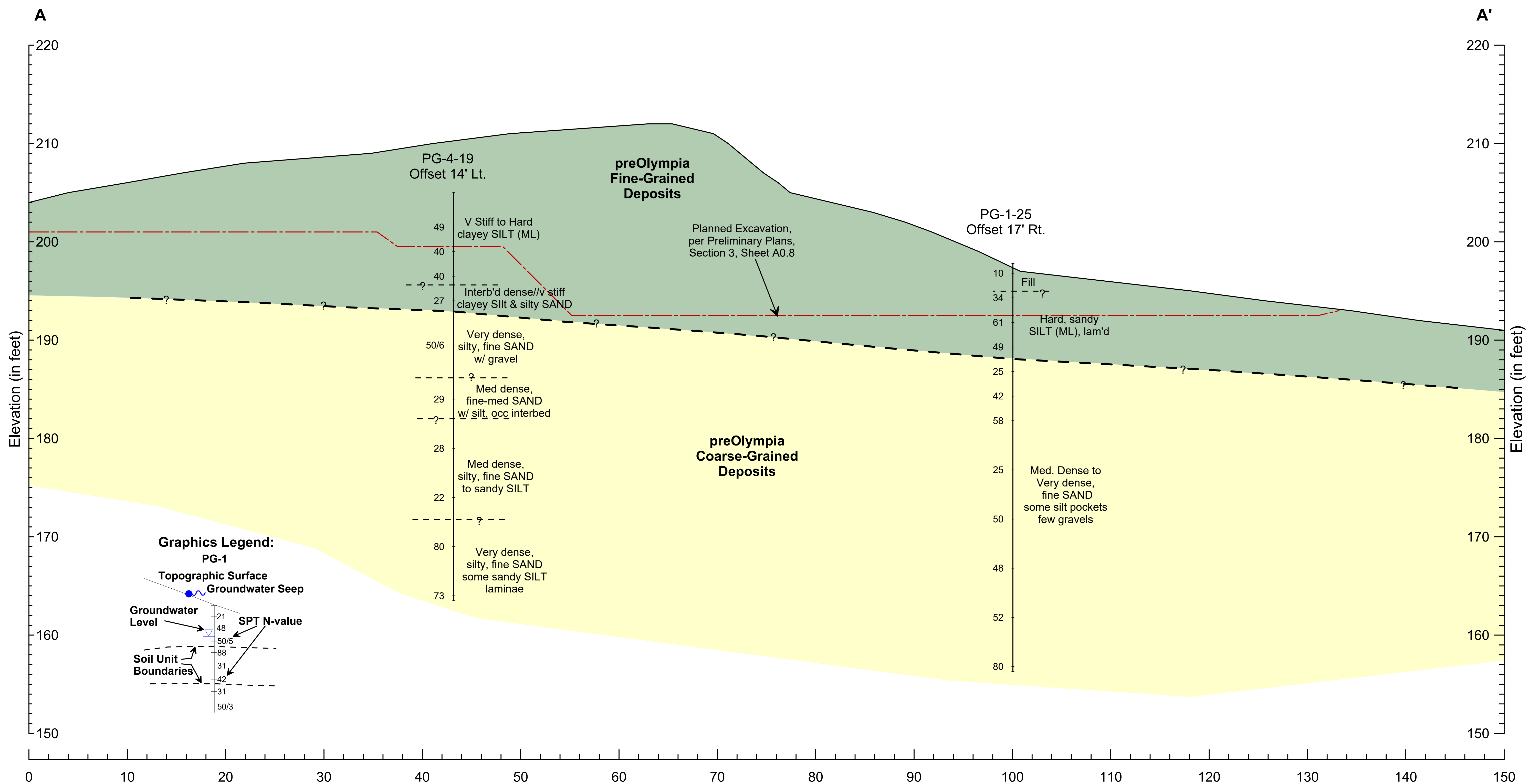
Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

SITE AND EXPLORATION PLAN

Project No. 25-036.200

Figure No. 2

25-036 Site Plan.ppt 8/27/2025(10:12 AM) SHE

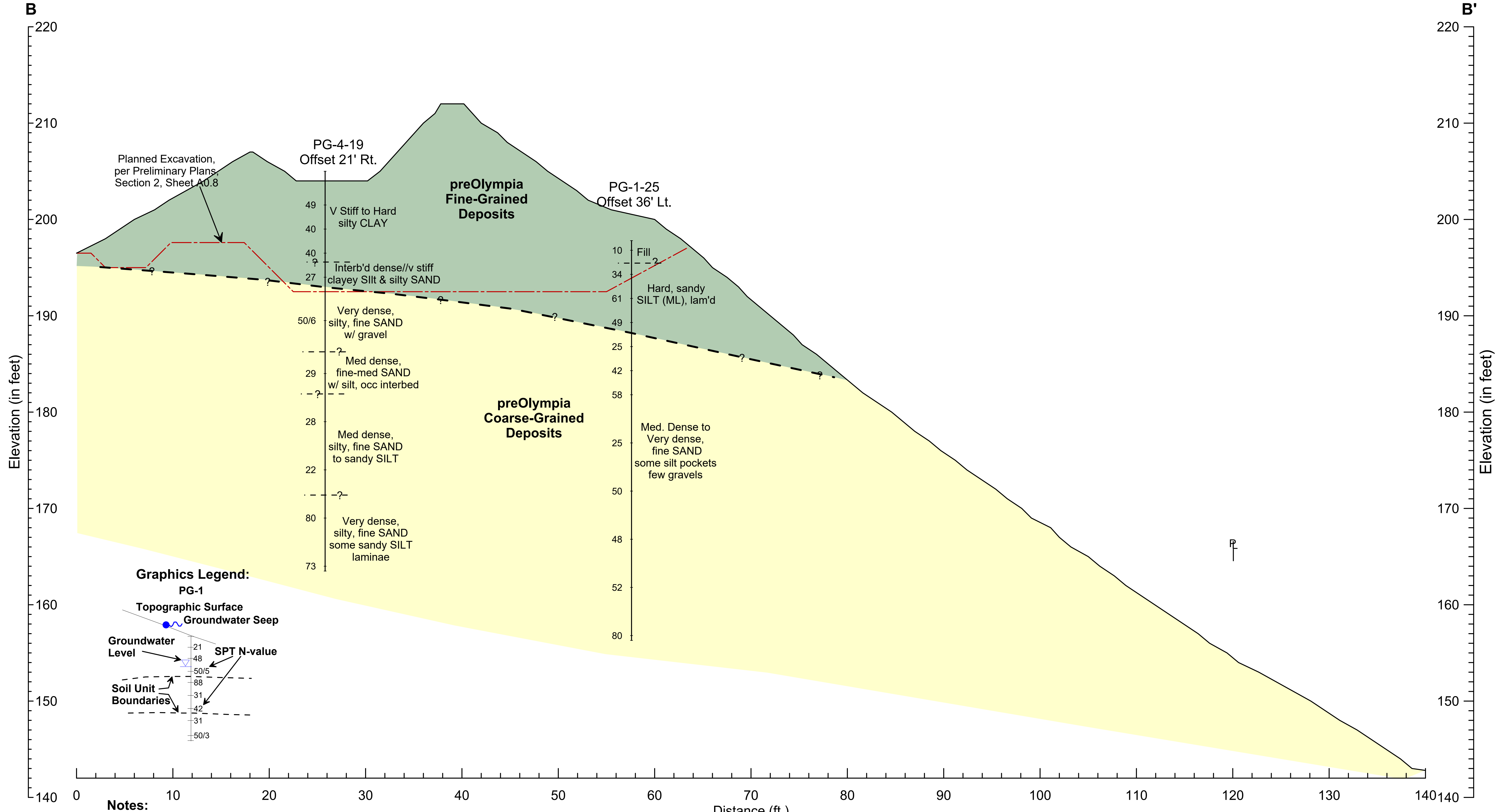


Notes:

1. Existing ground profile based on topographic survey by Informed Land Survey.
2. Transitions between soil units and in between explorations are best estimates and may vary from the actual soil conditions.
3. See report text for detailed descriptions of subsurface conditions across site.
4. See Appendix A for detailed exploration logs.
5. See Figure 2 for Site Plan with approximate profile location.
6. Planned Cut Elevations from Sheets A0.7 and A0.8, MI 6429 Lot A Schematic 25.0523.pdf design drawing.
7. Vertical Datum assumed to be NAVD88.

PanGEO INCORPORATED	Proposed Single Family Residence 9191 SE 64th Street Mercer Island, Washington	GENERALIZED SUBSURFACE PROFILE - SECTION A-A'
		Project No. 25-036.200 / Figure No. 3

25-036 Stick Log and Profile Data.xls 8/28/25 (8:15:47) SHE

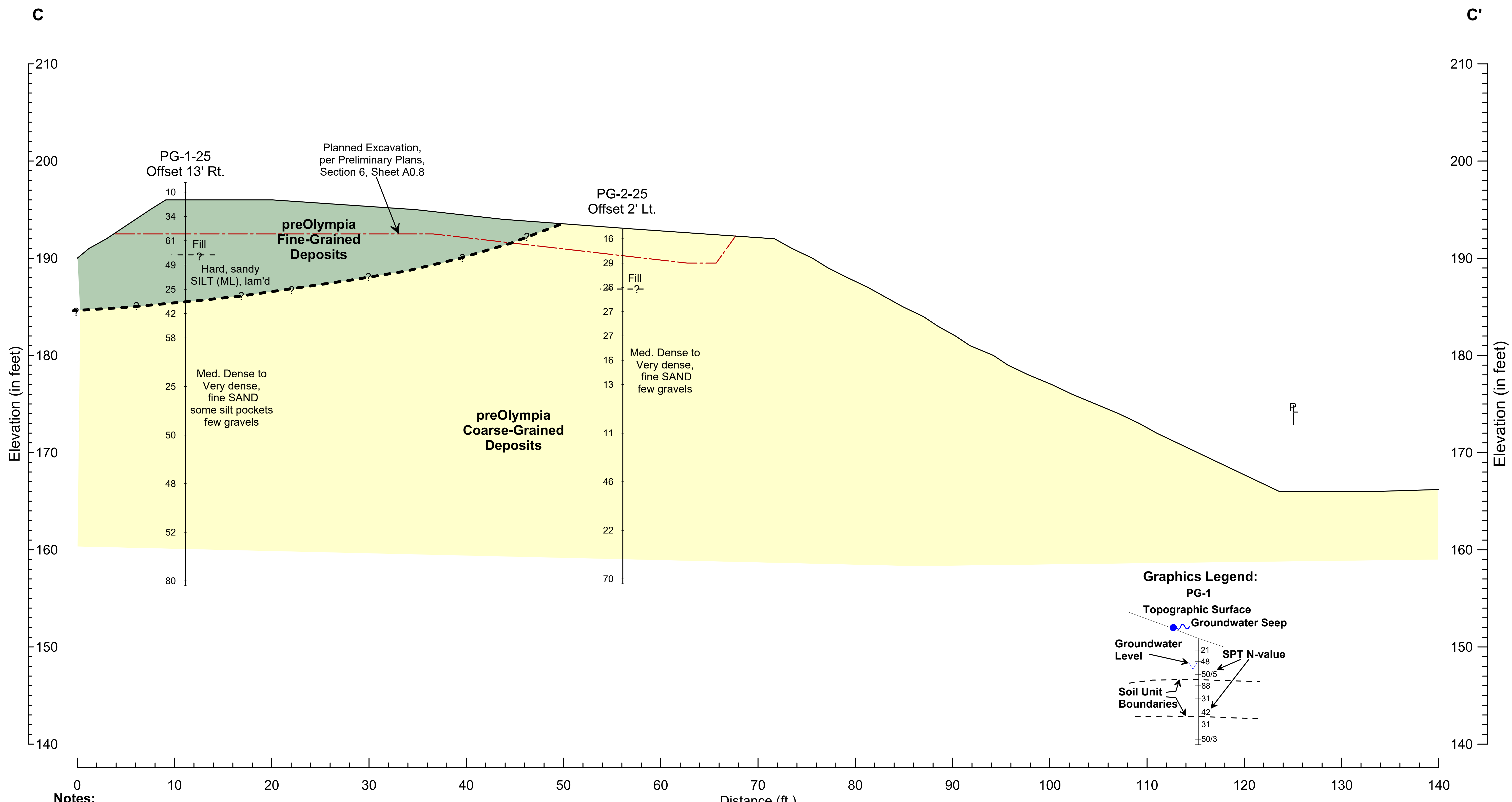


Notes:

1. Existing ground profile based on topographic survey by Informed Land Survey.
2. Transitions between soil units and in between explorations are best estimates and may vary from the actual soil conditions.
3. See report text for detailed descriptions of subsurface conditions across site.
4. See Appendix A for detailed exploration logs.
5. See Figure 2 for Site Plan with approximate profile location.
6. Planned Cut Elevations from Sheets A0.7 and A0.8, MI 6429 Lot A Schematic 25.0523.pdf design drawing.
7. Vertical Datum assumed to be NAVD88.

PanGEO INCORPORATED	Proposed Single Family Residence 9191 SE 64th Street Mercer Island, Washington	GENERALIZED SUBSURFACE PROFILE SECTION B-B'
		Project No. 25-036.200 / Figure No. 4

25-036 Stick Log and Profile Data.xls 8/28/25 (8:15:16) SHE

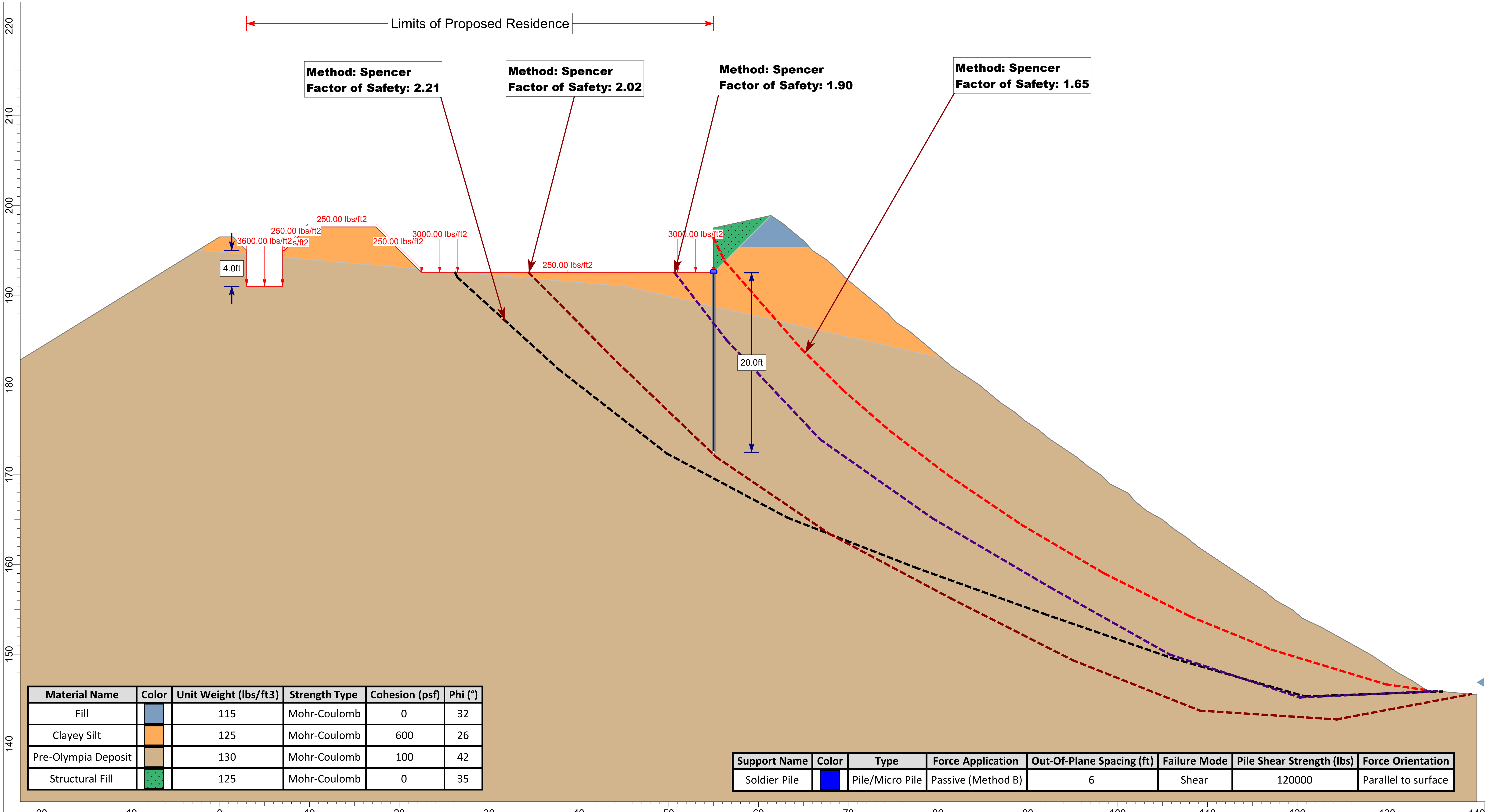


Notes:

1. Existing ground profile based on topographic survey by Informed Land Survey.
2. Transitions between soil units and in between explorations are best estimates and may vary from the actual soil conditions.
3. See report text for detailed descriptions of subsurface conditions across site.
4. See Appendix A for detailed exploration logs.
5. See Figure 2 for Site Plan with approximate profile location.
6. Planned Cut Elevations from Sheets A0.7 and A0.8, MI 6429 Lot A Schematic 25.0523.pdf design drawing.
7. Vertical Datum assumed to be NAVD88.

PanGEO INCORPORATED	Proposed Single Family Residence 9191 SE 64th Street Mercer Island, Washington	GENERALIZED SUBSURFACE PROFILE SECTION C-C'	
		Project No. 25-036.200	Figure No. 5

25-036 Stick Log and Profile Data.xls 8/28/25 (8:16:36) SHE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill		115	Mohr-Coulomb	0	32
Clayey Silt		125	Mohr-Coulomb	600	26
Pre-Olympia Deposit		130	Mohr-Coulomb	100	42
Structural Fill		125	Mohr-Coulomb	0	35

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
Soldier Pile		Pile/Micro Pile	Passive (Method B)	6	Shear	120000	Parallel to surface

PanGEO INCORPORATED

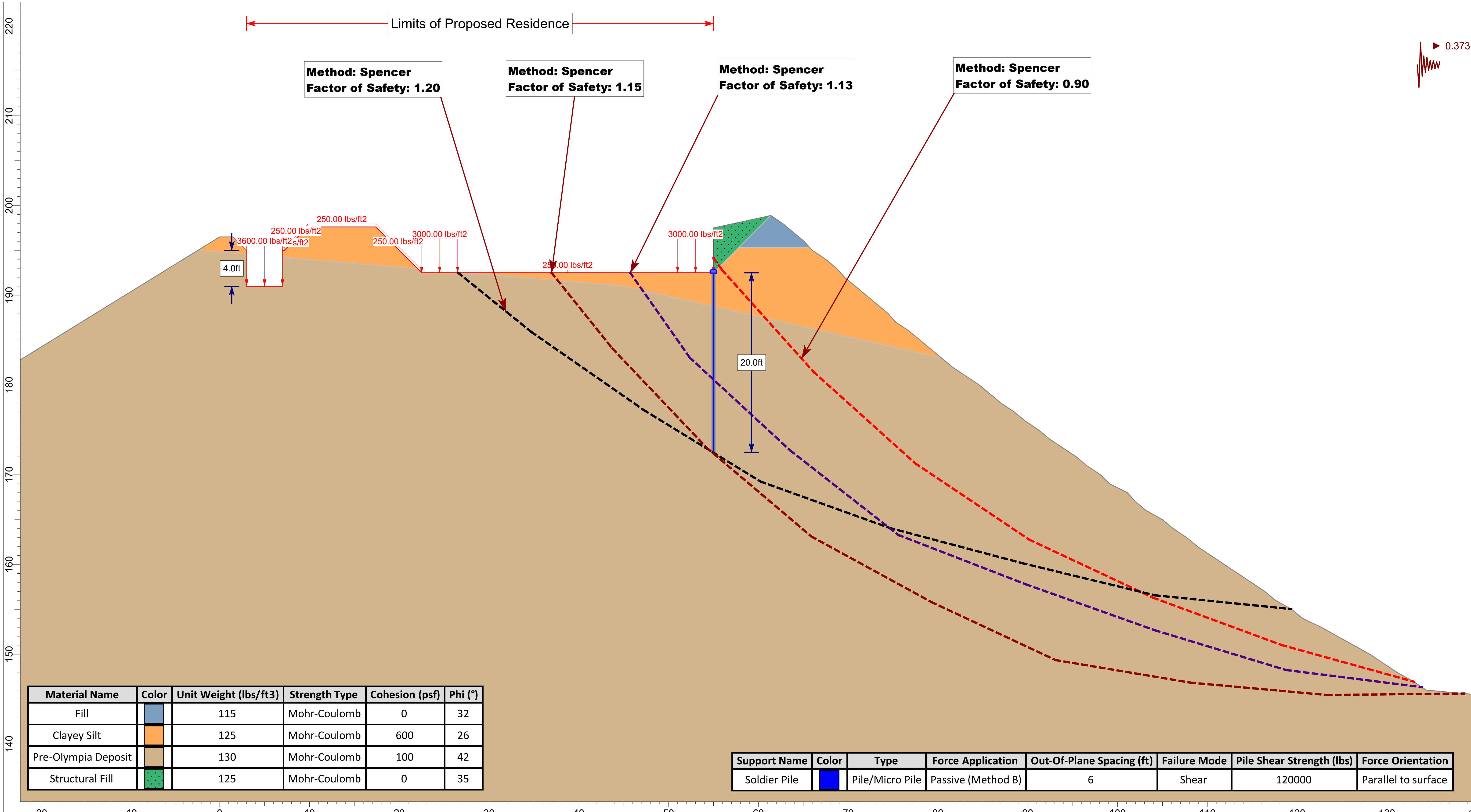
SLIDEINTERPRET 9.036

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

Static Slope Stability Analysis (right)

Section B-B'

Scale:	Project No.	Figure No.
1:120	25-036.200	6A



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill		115	Mohr-Coulomb	0	32
Clayey Silt		125	Mohr-Coulomb	600	26
Pre-Olympia Deposit		130	Mohr-Coulomb	100	42
Structural Fill		125	Mohr-Coulomb	0	35

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
Soldier Pile		Pile/Micro Pile	Passive (Method B)	6	Shear	120000	Parallel to surface

PanGEO INCORPORATED

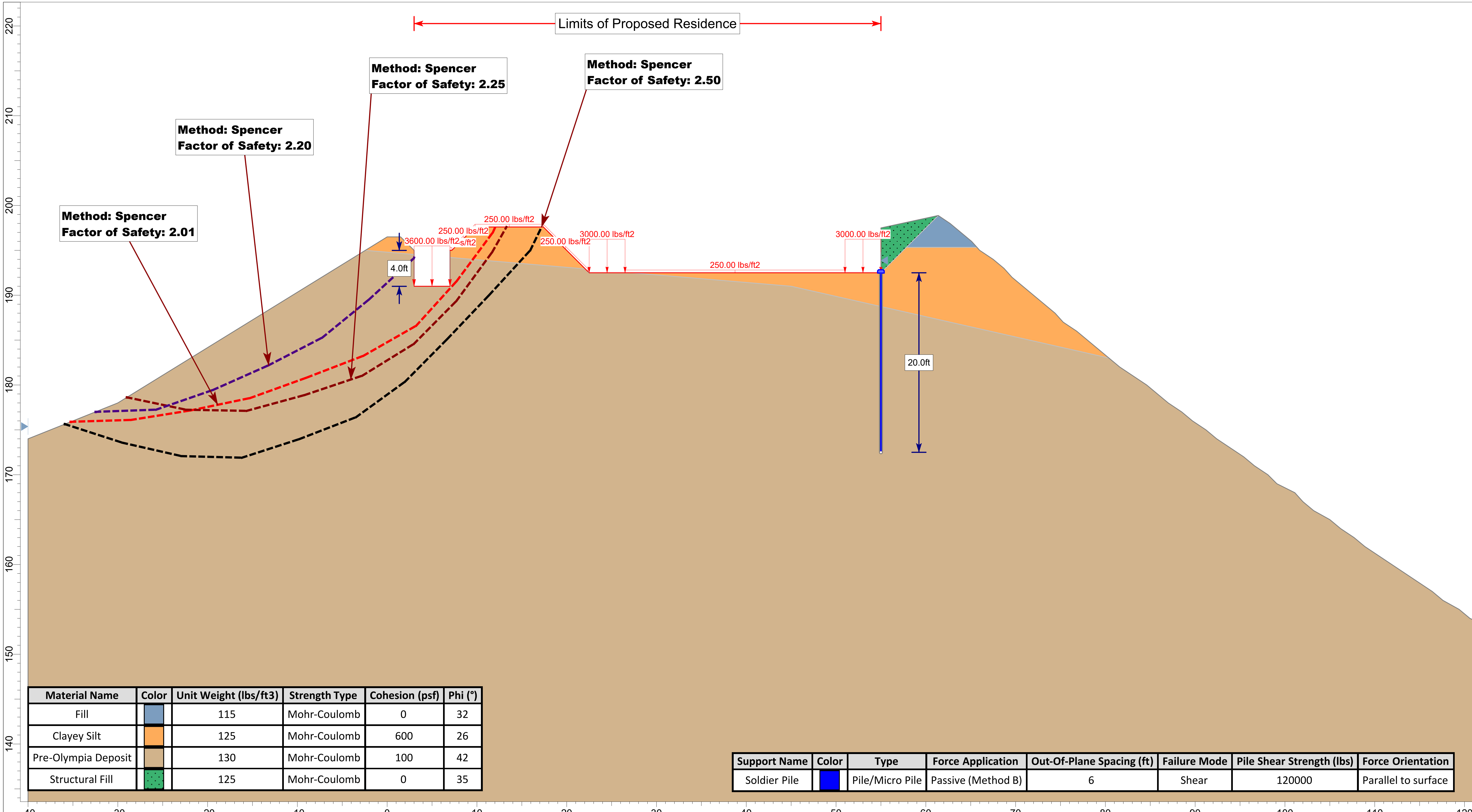
SLIDEINTERPRET 9.036

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

Pseudo Static Slope Stability Analysis (right)

Section B-B'

Scale:	Project No.	Figure No.
1:120	25-036.200	6B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill		115	Mohr-Coulomb	0	32
Clayey Silt		125	Mohr-Coulomb	600	26
Pre-Olympia Deposit		130	Mohr-Coulomb	100	42
Structural Fill		125	Mohr-Coulomb	0	35

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
Soldier Pile		Pile/Micro Pile	Passive (Method B)	6	Shear	120000	Parallel to surface

PanGEO INCORPORATED

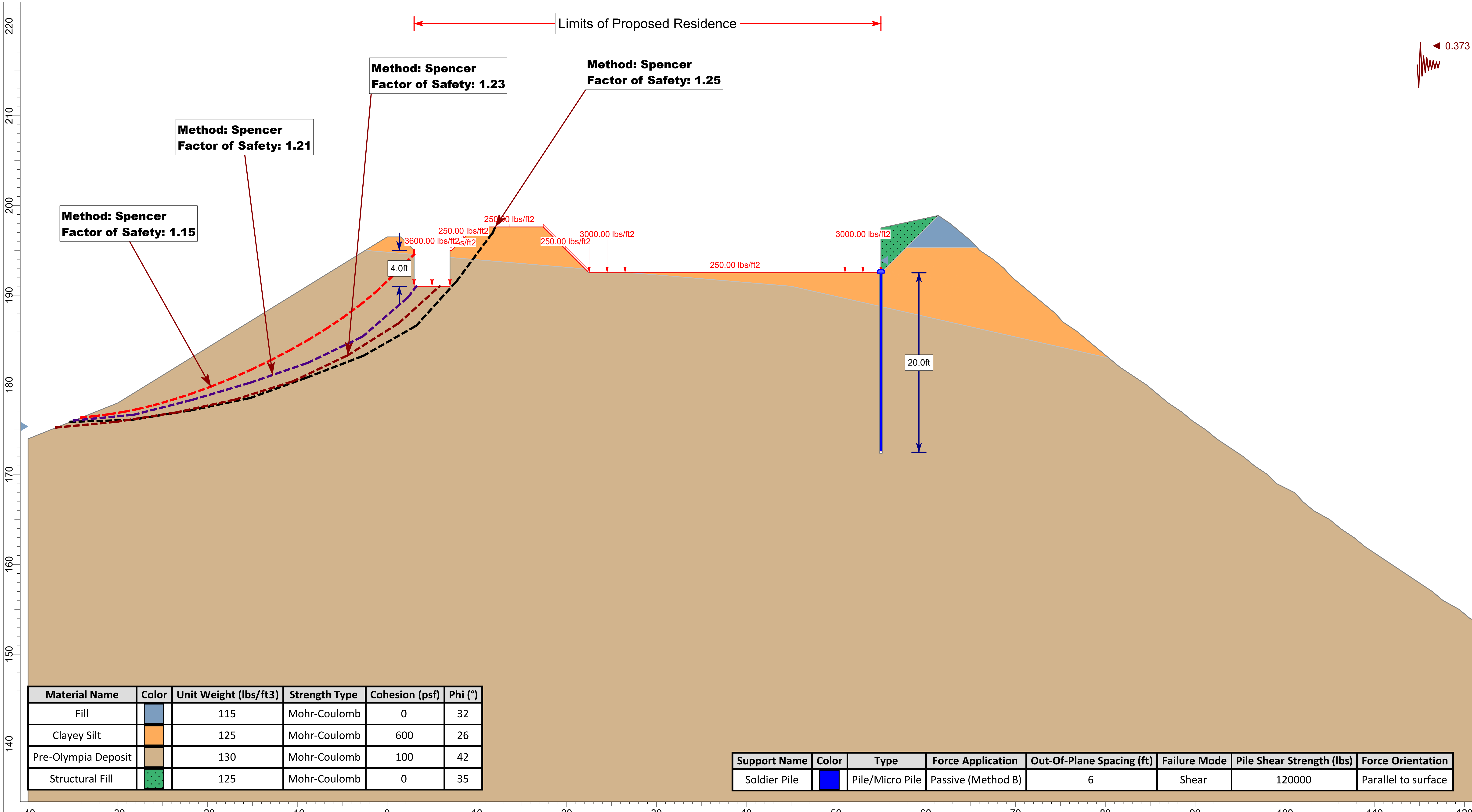
SLIDEINTERPRET 9.036

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

Static Slope Stability Analysis (left)

Section B-B'

Scale:	Project No.	Figure No.
1:120	25-036.200	7A



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill		115	Mohr-Coulomb	0	32
Clayey Silt		125	Mohr-Coulomb	600	26
Pre-Olympia Deposit		130	Mohr-Coulomb	100	42
Structural Fill		125	Mohr-Coulomb	0	35

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
Soldier Pile		Pile/Micro Pile	Passive (Method B)	6	Shear	120000	Parallel to surface

PanGEO INCORPORATED

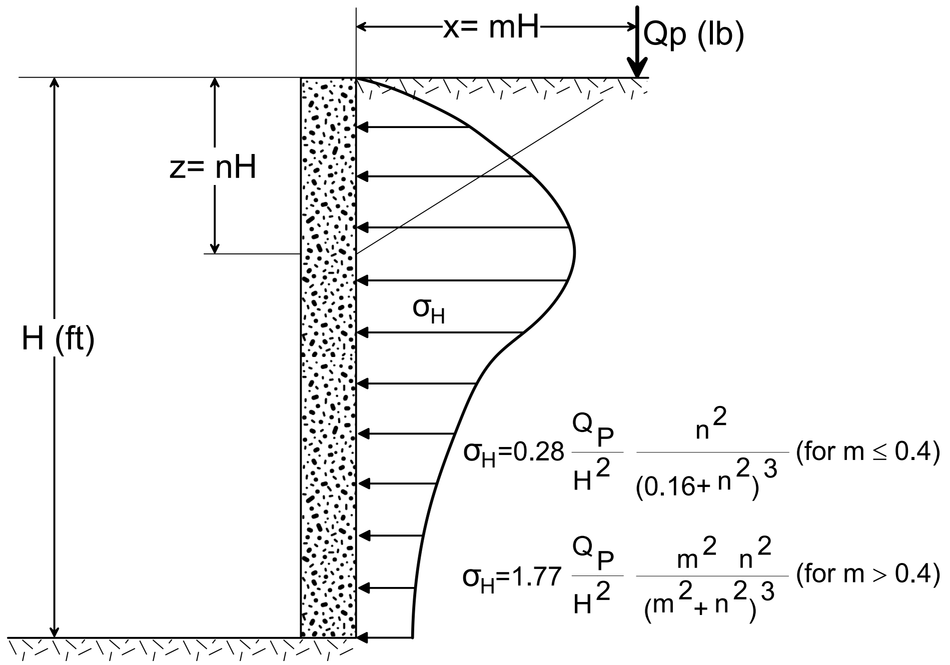
SLIDEINTERPRET 9.036

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

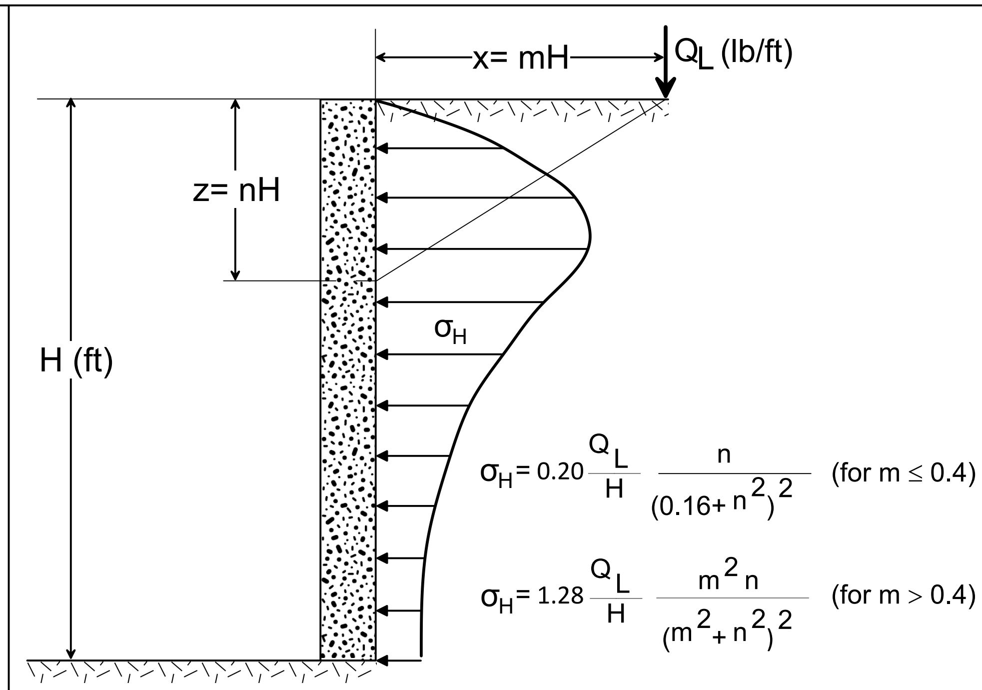
Pseudo Static Slope Stability Analysis (left)

Section B-B'

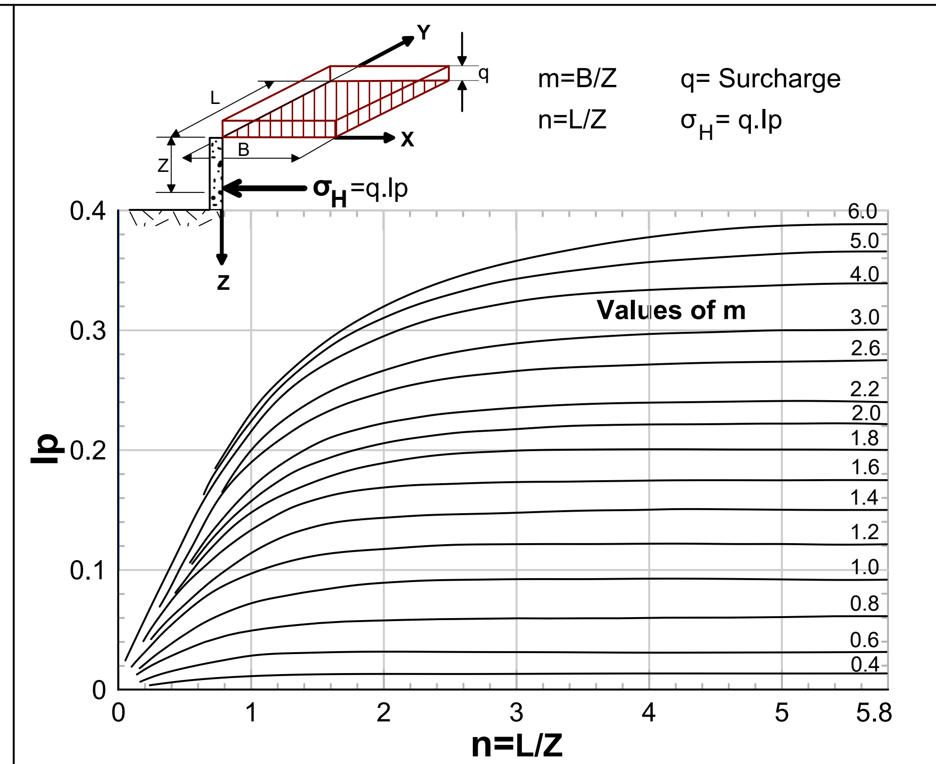
Scale:	Project No.	Figure No.
1:120	25-036.200	7B



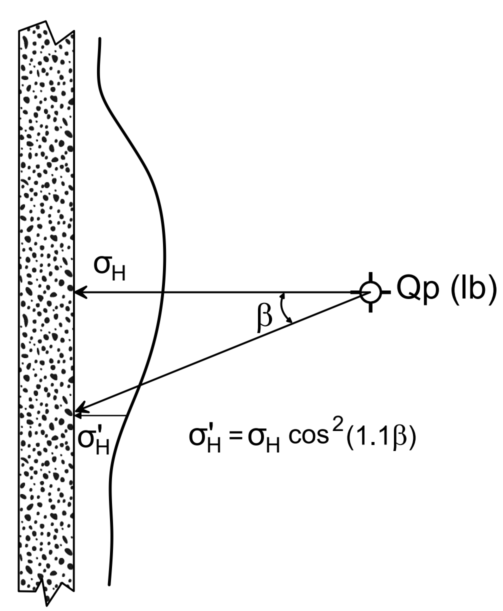
A-1) Lateral Pressure Due to Point Load- Elevation View



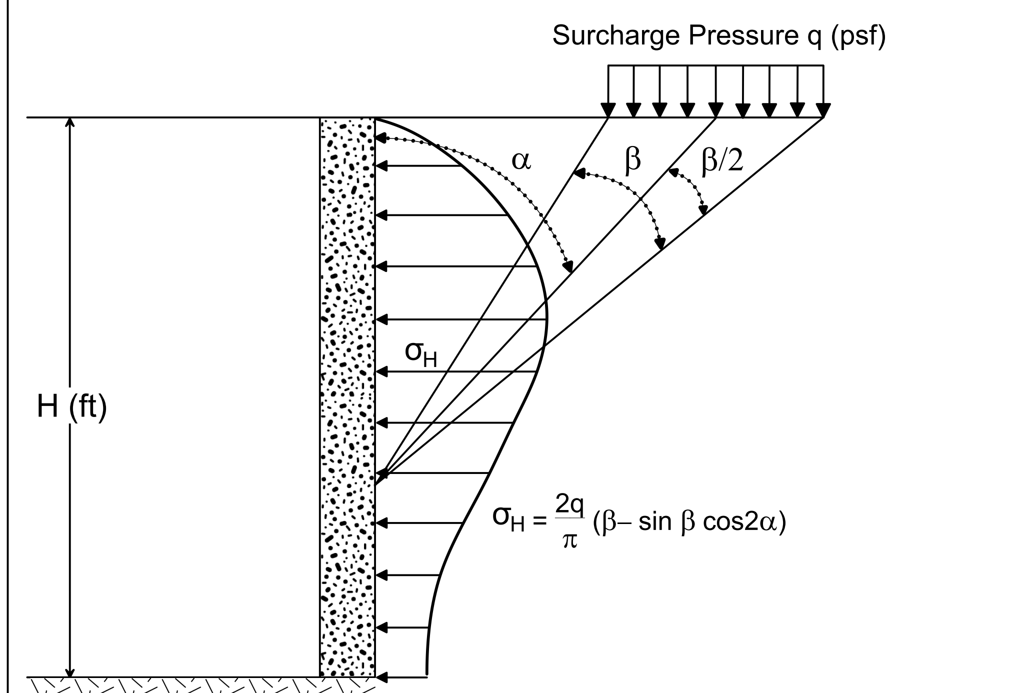
B) Lateral Pressure Due to Line Load-Parallel to the Wall



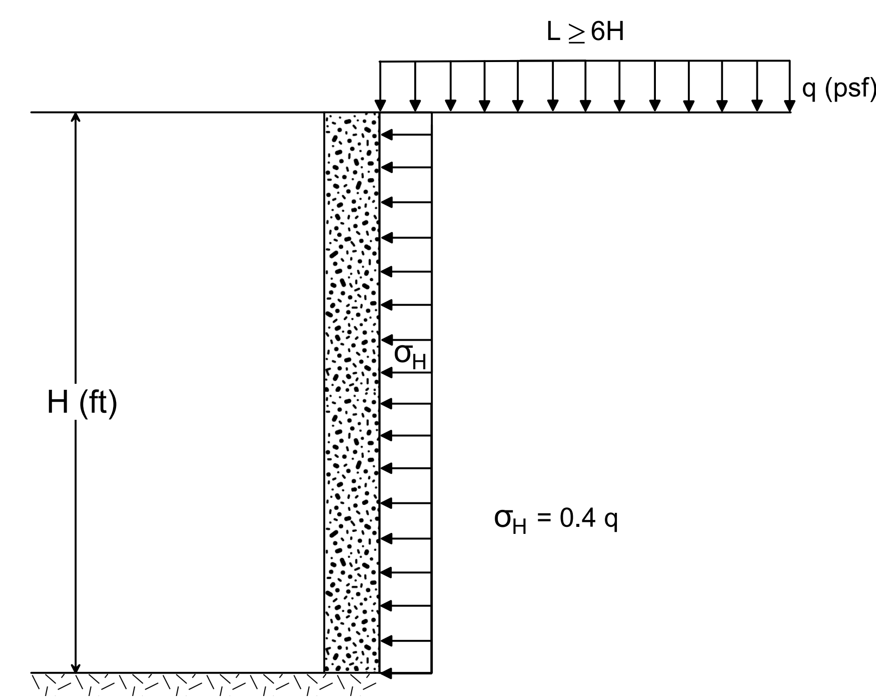
D) Lateral Pressure Due to Adjacent Footing



A-2) Lateral Pressure Due to Point Load- Plan View



C) Lateral Pressure Due to Strip Load-Perpendicular to the Wall



E) Lateral Pressure Due to Uniform Surcharge.
(For L ≤ 6H Use Chart D Above)

* σ_H in psf.

PanGEO INCORPORATED

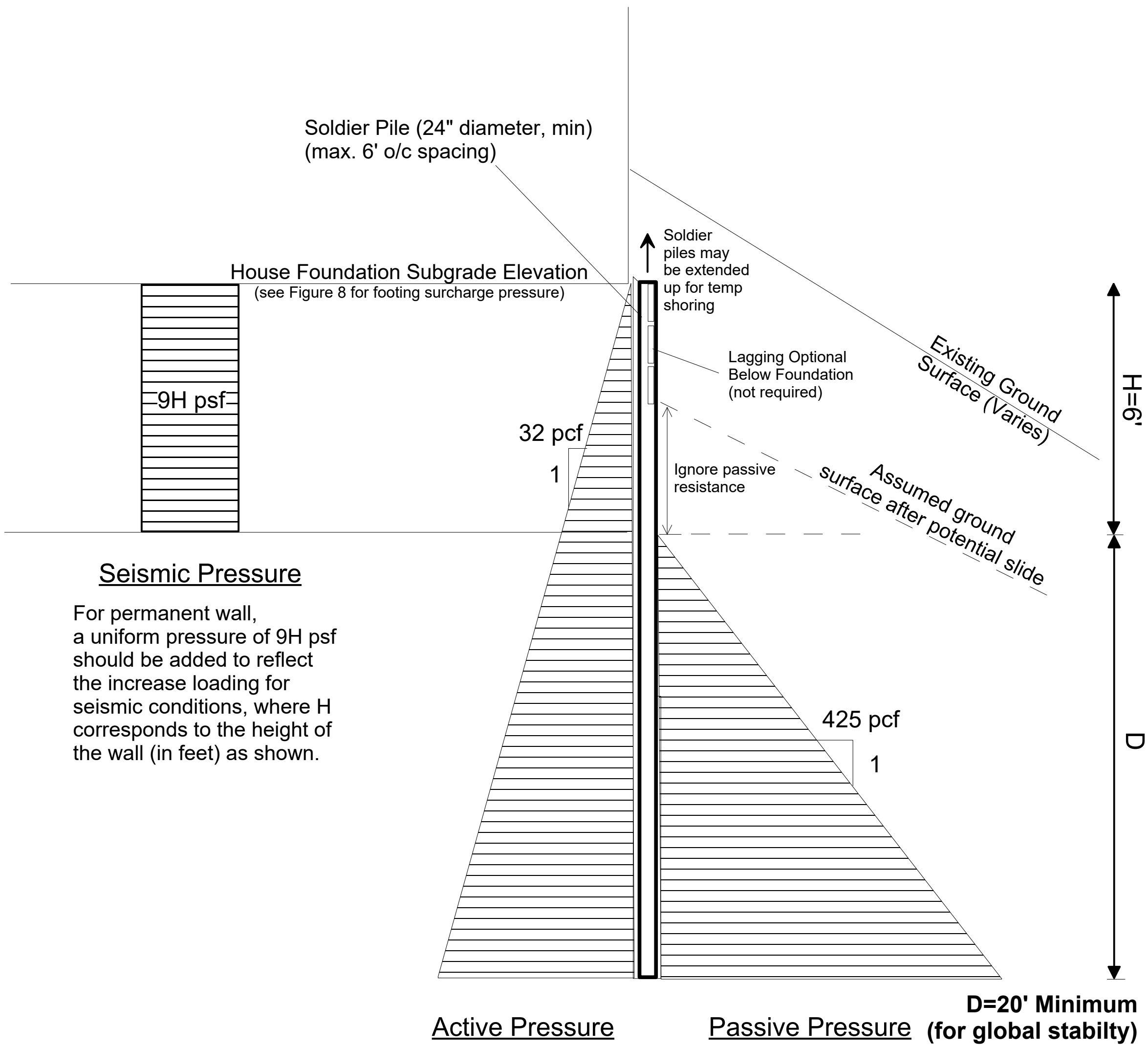
Proposed Single-Family Residence
9191 SE 64th Street
Mercer Island, Washington

SURCHARGE LOADING ON WALLS

Project No. **25-036.200**

Figure No. **8**

19-062.300 Surcharge Loading for Walls 8/27/25 (3:33:46)



Notes:
1. Embedment (D) should be determined by summation of moments at the bottom of the soldier piles, or minimum tip elevation, as shown.
2. A factor of safety of 1.5 has been applied to the recommended passive earth pressure values. No factor of safety has been applied to the recommended active earth pressure values.
3. Active and seismic pressures should be applied over the full width of the pile spacing above the the bottom of excavation. The active pressure should be applied over one pile diameter below the bottom of excavation.
4. Passive pressure should be applied to two times the diameter of the soldier piles.
5. Use 50% of the lateral earth pressure for lagging design if used for temporary shoring.
6. For permanent wall, piles should be treated for corosion protection, or oversized accordingly.
7. Refer to report text for additional discussions.

Fig 8 EP diagram.grf 8/27/25 (7:46:21) JCR

PanGEO INCORPORATED

Proposed Single-Family Residence
9191 SE 64th Street
Mercer Island, Washington

DESIGN LATERAL PRESSURES
SOUTH STABILIZING SOLDIER PILE WALL

Project No. **25-036.200**

Figure No. **9**

APPENDIX A

SUMMARY BORING LOGS

9191 SE 64th Street, Mercer Island, WA | PanGEO, Inc.

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

Laminated: Layers of soil typically 0.05 to 1mm thick, max. 1 cm

Lens: Layer of soil that pinches out laterally

Interlayered: Alternating layers of differing soil material

Pocket: Erratic, discontinuous deposit of limited extent

Homogeneous: Soil with uniform color and composition throughout

Fissured: Breaks along defined planes

Slickensided: Fracture planes that are polished or glossy

Blocky: Angular soil lumps that resist breakdown

Disrupted: Soil that is broken and mixed

Scattered: Less than one per foot

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

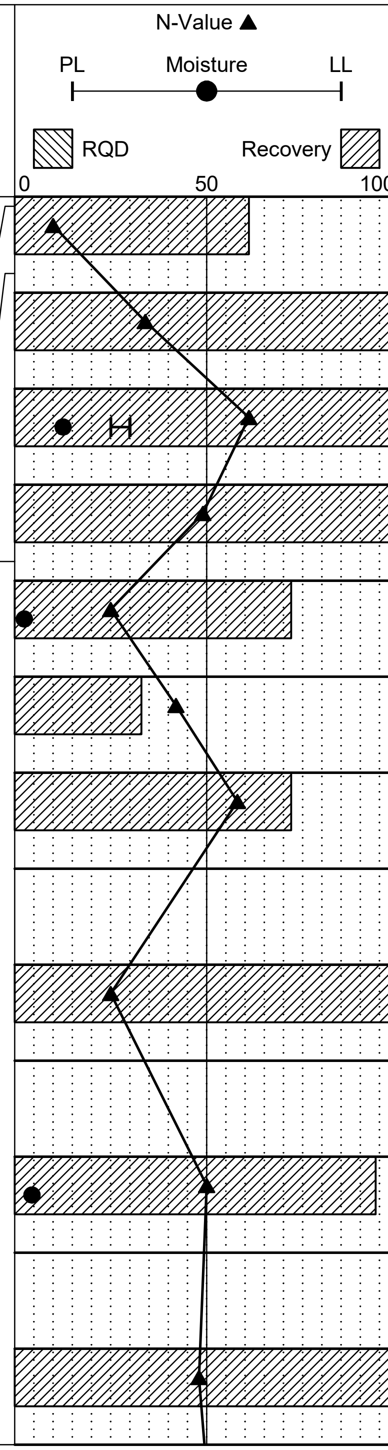
PanGEO INCORPORATED
Phone: 206.262.0370

Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	Proposed Single-Family Residence	Surface Elevation:	197.8ft
Job Number:	25-036.200	Top of Casing Elev.:	N/A
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54521, Easting: -122.2134	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0	S-1	X	4 6 4			**[Topsoil]** Approximately 3 inches of topsoil overlain by forest litter. **[Fill]**
2.5	S-2	X	7 15 19			Medium dense, yellow-brown, silty SAND, organics (rootlets and wood fragments); moist. **[Pre-Olympia Nonglacial Fine-grained Deposit - Qponf]**
5.0	S-3	X	9 25 36			Hard, yellow-brown, sandy SILT (ML), laminated to thinly bedded, non-plastic fines, weathered appearance; moist.
7.5	S-4	X	8 21 28			
10.0	S-5	X	6 13 12	GS		**[Pre-Olympia Nonglacial Coarse-grained Deposits - Qponc]** Medium dense to very dense, brown, SAND silty to with silt, some silt pockets, few subangular to subrounded fine gravel, scattered iron oxide staining; moist.
12.5	S-6	X	23 23 19			#200 mesh passing - 16.4%.
15.0	S-7	X	20 40 18			-- gravel no longer present in samples.
17.5						
20.0	S-8	X	8 11 14			Homogeneous below 20 feet, massive, faint Fe staining.
22.5						
25.0	S-9	X	14 24 26	GS		#200 mesh passing - 9.6%.
27.5						
30.0	S-10	X	10 20 28			
32.5						



Completion Depth:	41.5ft
Date Borehole Started:	7/1/25
Date Borehole Completed:	7/1/25
Logged By:	T. Howitz
Drilling Company:	Geologic Drill Partners, Inc.

Remarks: Borings drilled using tracked drill rig. Standard Penetration Test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated by hydraulic mechanism. Samples were collected using a 2-inch OD split-spoon. Coordinates and elevation are approximate and based on their relative location to known site features. This surface elevation is estimated from the topographic survey provided by Informed Land Survey dated May 23, 2025.

PanGEO INCORPORATED

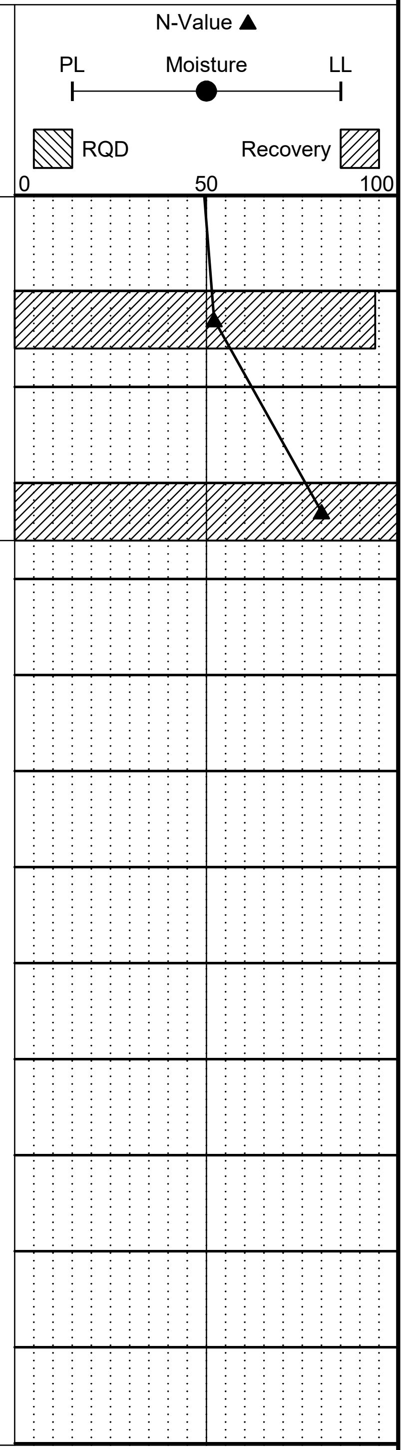
LOG OF TEST BORING PG-1-25

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Single-Family Residence	Surface Elevation:	197.8ft
Job Number:	25-036.200	Top of Casing Elev.:	N/A
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54521, Easting: -122.2134	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
32.5						**[Pre-Olympia Nonglacial Coarse-grained Deposits - Qponc]** Medium dense to very dense, brown, SAND silty to with silt, some silt pockets, few subangular to subrounded fine gravel, scattered iron oxide staining; moist. *(Continued)*
35.0	S-11		15 22 30			-- silt content increases, silty laminae.
37.5						
40.0	S-12		28 40 40			-- becomes yellow-brown and slight increase in grain size.
						Boring terminated approximately 41.5 feet below ground surface. No obvious signs of groundwater were observed at the time of drilling.
42.5						
45.0						
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						



Completion Depth:	41.5ft
Date Borehole Started:	7/1/25
Date Borehole Completed:	7/1/25
Logged By:	T. Howitz
Drilling Company:	Geologic Drill Partners, Inc.

Remarks: Borings drilled using tracked drill rig. Standard Penetration Test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated by hydraulic mechanism. Samples were collected using a 2-inch OD split-spoon. Coordinates and elevation are approximate and based on their relative location to known site features. This surface elevation is estimated from the topographic survey provided by Informed Land Survey dated May 23, 2025.

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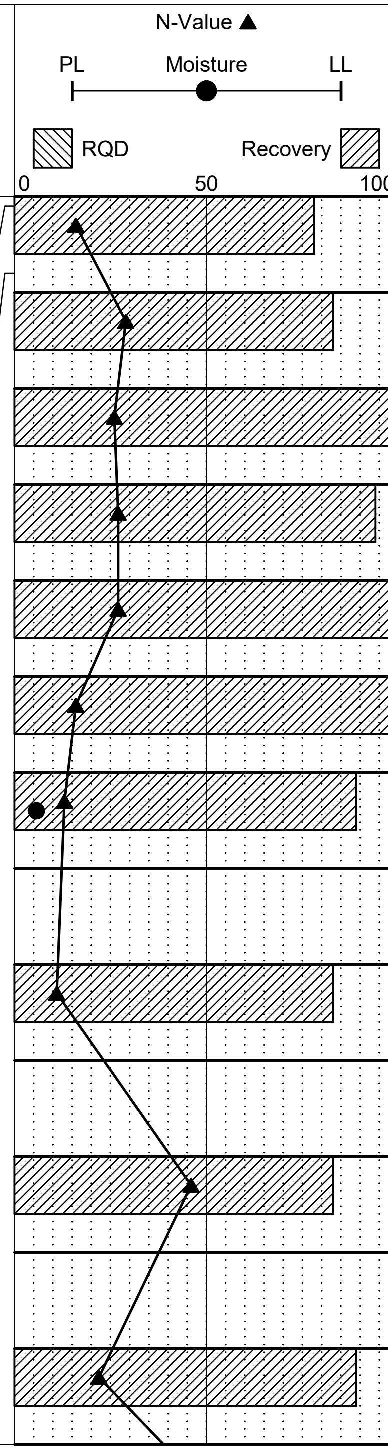
LOG OF TEST BORING PG-1-25

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Single-Family Residence	Surface Elevation:	192.8ft
Job Number:	25-036.200	Top of Casing Elev.:	N/A
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54527, Easting: -122.21325	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0	S-1	SPT	2, 5, 11			**[Topsoil]** Approximately 3 inches of topsoil overlain by forest litter.
2.5	S-2	SPT	8, 13, 16			**[Fill]** Medium dense, yellow-brown, silty SAND, organics (rootlets and wood fragments); moist.
5.0	S-3	SPT	11, 14, 12			**[Pre-Olympia Nonglacial Coarse-grained Deposits - Qponc]** Medium dense to very dense, brown, fine silty SAND, few subangular to subrounded fine gravel, homogeneous, scattered iron oxide staining; moist.
7.5	S-4	SPT	8, 13, 14			-- gravel no longer present in samples.
10.0	S-5	SPT	9, 13, 14			
12.5	S-6	SPT	8, 8, 8			
15.0	S-7	SPT	7, 6, 7	GS		#200 mesh passing - 11.4%.
17.5						
20.0	S-8	SPT	5, 6, 5			
22.5						
25.0	S-9	SPT	11, 22, 24			
27.5						
30.0	S-10	SPT	9, 11, 11			Laminated with silty laminae.
32.5						



Completion Depth:	36.5ft
Date Borehole Started:	7/1/25
Date Borehole Completed:	7/1/25
Logged By:	T. Howitz
Drilling Company:	Geologic Drill Partners, Inc.

Remarks: Borings drilled using tracked drill rig. Standard Penetration Test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated by hydraulic mechanism. Samples were collected using a 2-inch OD split-spoon. Coordinates and elevation are approximate and based on their relative location to known site features. This surface elevation is estimated from the topographic survey provided by Informed Land Survey dated May 23, 2025.

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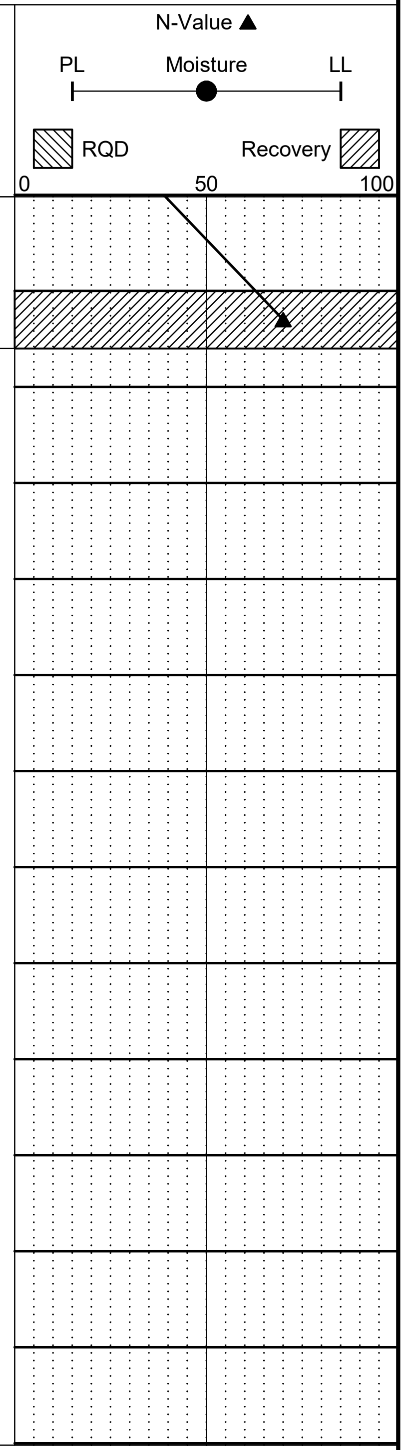
LOG OF TEST BORING PG-2-25

Figure A-3

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Single-Family Residence	Surface Elevation:	192.8ft
Job Number:	25-036.200	Top of Casing Elev.:	N/A
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54527, Easting: -122.21325	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
32.5						**[Pre-Olympia Nonglacial Coarse-grained Deposits - Qponc]** Medium dense to very dense, brown, fine silty SAND, few subangular to subrounded fine gravel, homogeneous, scattered iron oxide staining; moist. *(Continued)*
35.0	S-11		25 30 40			-- slight increase in grain size, fine to medium silty sand, massive.
37.5						Boring terminated approximately 36.5 feet below ground surface. No obvious signs of groundwater were observed at the time of drilling.
40.0						
42.5						
45.0						
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						



Completion Depth:	36.5ft
Date Borehole Started:	7/1/25
Date Borehole Completed:	7/1/25
Logged By:	T. Howitz
Drilling Company:	Geologic Drill Partners, Inc.

Remarks: Borings drilled using tracked drill rig. Standard Penetration Test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated by hydraulic mechanism. Samples were collected using a 2-inch OD split-spoon. Coordinates and elevation are approximate and based on their relative location to known site features. This surface elevation is estimated from the topographic survey provided by Informed Land Survey dated May 23, 2025.

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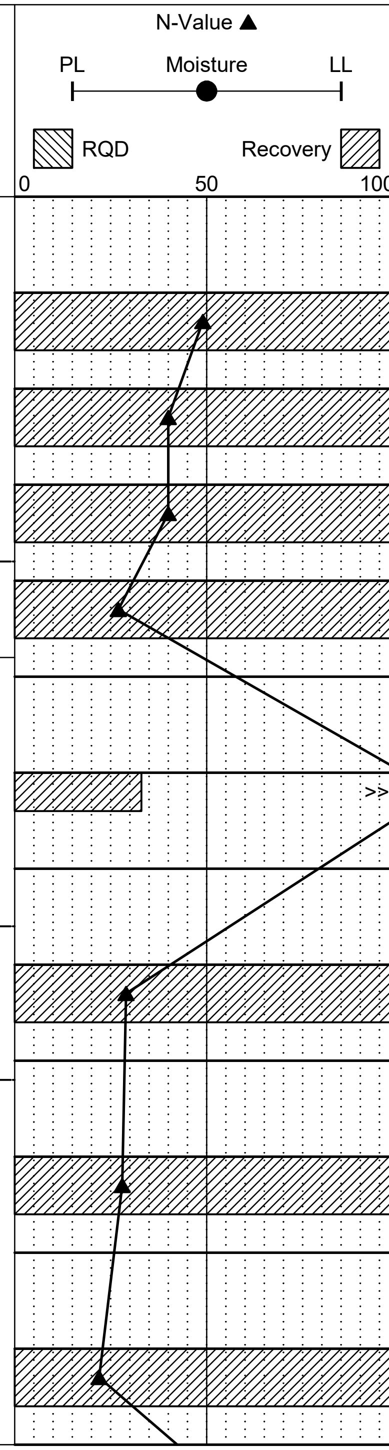
LOG OF TEST BORING PG-2-25

Figure A-3

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Lot Development	Surface Elevation:	205.2ft
Job Number:	25-036.200	Top of Casing Elev.:	
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Hard, brown gray, silty, lean CLAY: slightly moist, low plastic, homogeneous, laminated, occasional slightly rusty laminae, dip ~ 10°. **(Pre-Olympia Non-glacial Fine-grained Deposit - Qponf)**.
2.5	S-1	X	10 21 28			
5.0	S-2	X	10 19 21			Low plastic, slow dilatancy, light brown laminae and partings, splits easily on bedded, dips to ~ 20°.
7.5	S-3	X	14 17 23			Laminated, dips to 25°, planar fracture cutting across bedding at 60°, occasional fine organic grains and non-plastic silt laminae.
10.0	S-4	X	6 13 14			Medium dense or very stiff, brown gray, interbedded clayey SILT and silty, fine SAND:slightly moist, slightly to low plastic and non-plastic, moderately sharp contacts, dips to 20°.
12.5						Dense, brown gray, silty, fine SAND with gravel: slightly moist, gravel subrounded, blocky and tabular, non-plastic fines, homogeneous, gravelly beds especially, massive. **(Pre-Olympia Non-glacial Coarse-grained Deposit - Qponc)**.
15.0	S-5	X	16 50/6			
17.5						
20.0	S-6	X	10 13 16			Medium dense, brown, fine to medium SAND with silt: slightly moist, non-plastic fines, homogeneous, laminated with occasional clayey silt interbed, dips to 10°.
22.5						Medium dense, brown gray, silty, fine SAND: slightly moist, non-plastic fines, grading to sandy silt in some layers, homogeneous, indistinctly laminated with dips to 5°.
25.0	S-7	X	12 14 14			
27.5						
30.0	S-8	X	9 10 12			Sub-horizontal laminae, slightly rusty laminae.
32.5						



Completion Depth:	41.5ft
Date Borehole Started:	3/7/19
Date Borehole Completed:	3/7/19
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: No groundwater encountered during drilling.

PanGEO INCORPORATED

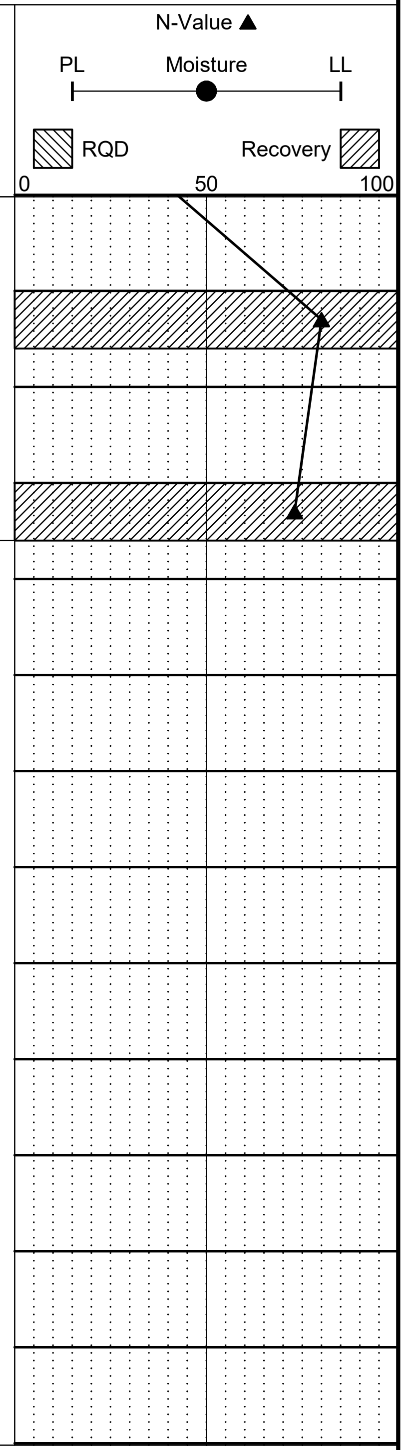
LOG OF TEST BORING PG-4-19

Figure A-4

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Lot Development	Surface Elevation:	205.2ft
Job Number:	25-036.200	Top of Casing Elev.:	
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
32.5						Medium dense, brown gray, silty, fine SAND: slightly moist, non-plastic fines, grading to sandy silt in some layers, homogeneous, indistinctly laminated with dips to 5°. *(Continued)*
35.0	S-9		19 37 43			Becoming very dense, rare rusty pocket.
37.5						
40.0	S-10		19 34 39			Indistinctly laminated to massive.
						Bottom of Boring.
42.5						
45.0						
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						



Completion Depth: 41.5ft
Date Borehole Started: 3/7/19
Date Borehole Completed: 3/7/19
Logged By: S. Evans
Drilling Company: Boretec, Inc

Remarks: No groundwater encountered during drilling.

PanGEO INCORPORATED

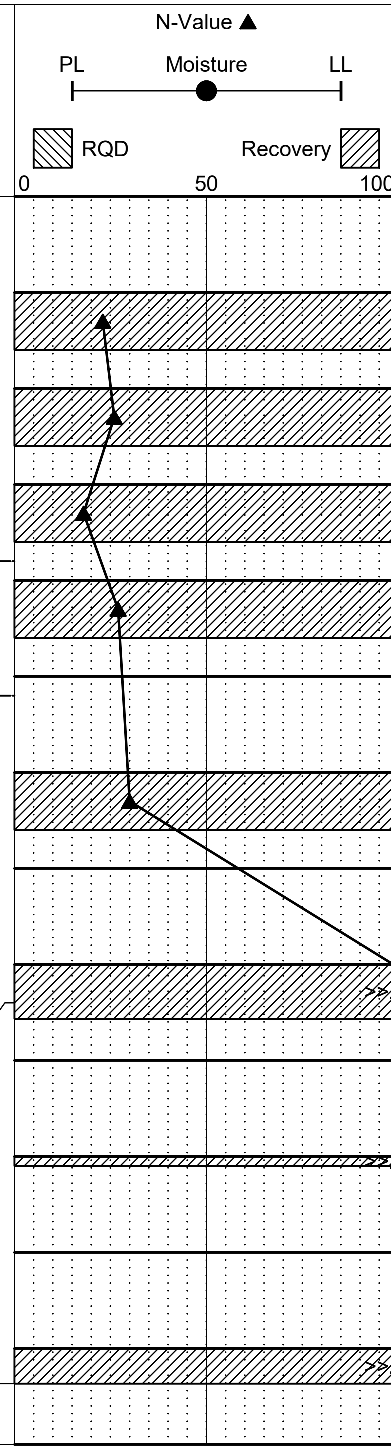
LOG OF TEST BORING PG-4-19

Figure A-4

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Lot Development	Surface Elevation:	201.5ft
Job Number:	25-036.200	Top of Casing Elev.:	
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Very stiff, brown gray, silty, lean CLAY: moist, low plastic, homogenous, laminated with occasional rusty laminae, dips to 5°. **(Pre-Olympia Non-glacial Fine-grained Deposit - Qponf)**.
2.5	S-1	X	5 10 13			
5.0	S-2	X	7 12 14			Occasional organic bits, rusty laminae, dips 5 to 7°.
7.5	S-3	X	7 8 10			Occasional non-plastic silt bed, one hard, waxy gray clay bed, occasional rip-up clast, rusty veins.
10.0	S-4	X	10 13 14			Medium dense, brown gray, clayey SILT: slightly moist, slightly plastic, homogeneous, laminated with rusty partings and pockets, occasional organic bits, dips to 5°.
12.5						Dense or hard, brown gray, interbedded, silty, fine SAND and silty, lean CLAY: slightly moist, non-plastic and low plastic beds, occasional rusty zones, fine bedded (4 to 6 inches), indistinctly laminated.
15.0	S-5	X	8 14 16			
17.5						
20.0	S-6	X	14 43 50/5			Grading to clayey Silt, slightly to low plastic, massive, occasional rusty vein.
22.5						Very dense, brown gray, fine to coarse SAND; slightly moist, trace to some silt, massive, weathered gravel at upper contact. **(pre-Olympia Non-glacial Coarse-grained Deposit - Qponc)**.
25.0	S-7	X	50/3			Grading to fine to medium SAND.
27.5						
30.0	S-8	X	35 50/5			Homogeneous, indistinctly laminated to massive.
						Bottom of Boring.
32.5						



Completion Depth:	30.9ft
Date Borehole Started:	3/7/19
Date Borehole Completed:	3/7/19
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: No groundwater encountered during drilling.

PanGEO INCORPORATED

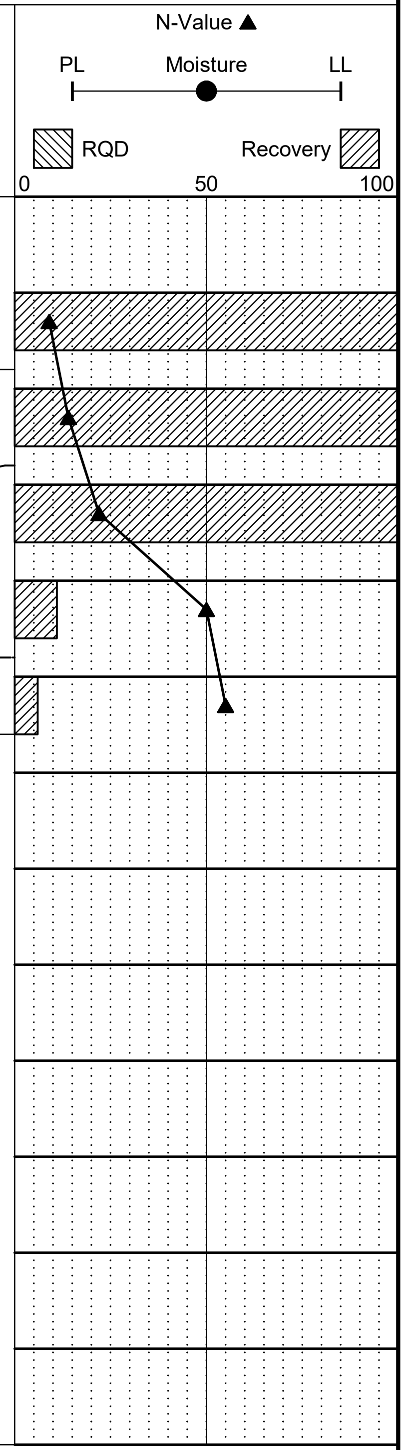
LOG OF TEST BORING PG-5-19

Figure A-5

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Lot Development	Surface Elevation:	194.8ft
Job Number:	25-036.200	Top of Casing Elev.:	
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Loose / Stiff, brown, clayey SILT to silty CLAY: wet, slightly to low plastic layers, some layers with rapid dilatancy, faint rusty mottles, occasional gravel, massive. **(Colluvium / Mass Wasting Deposit)**.
2.5	S-1		2 3 6			
5.0	S-2		4 6 8			Stiff, brown, silty, lean CLAY: very moist to wet, low plastic, homogeneous, faint reddish stains, laminated, occasional fine gravel, possible organic clast. **(pre-Olympia Non-glacial Fine-grained Deposit)**.
7.5	S-3		7 8 14			Medium dense to very dense, brown gray, clayey SILT with fine sand: very moist, slightly plastic, homogeneous, occasional rusty bands, massive to indistinctly laminated.
10.0	S-4		12 20 30			Becoming moist, very dense.
12.5	S-5		31 28 27			Hard / Very dense, brown gray, clayey SIL to silty, lean CLAY: moist, some fine sand, low to slightly plastic, homogeneous, occasional fine gravel, massive.
15.0						Bottom of Boring.
17.5						
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						



Completion Depth:	14.0ft
Date Borehole Started:	3/21/19
Date Borehole Completed:	3/21/19
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: Groundwater level estimated based on wetness of soil sample and water on the sampling rods.

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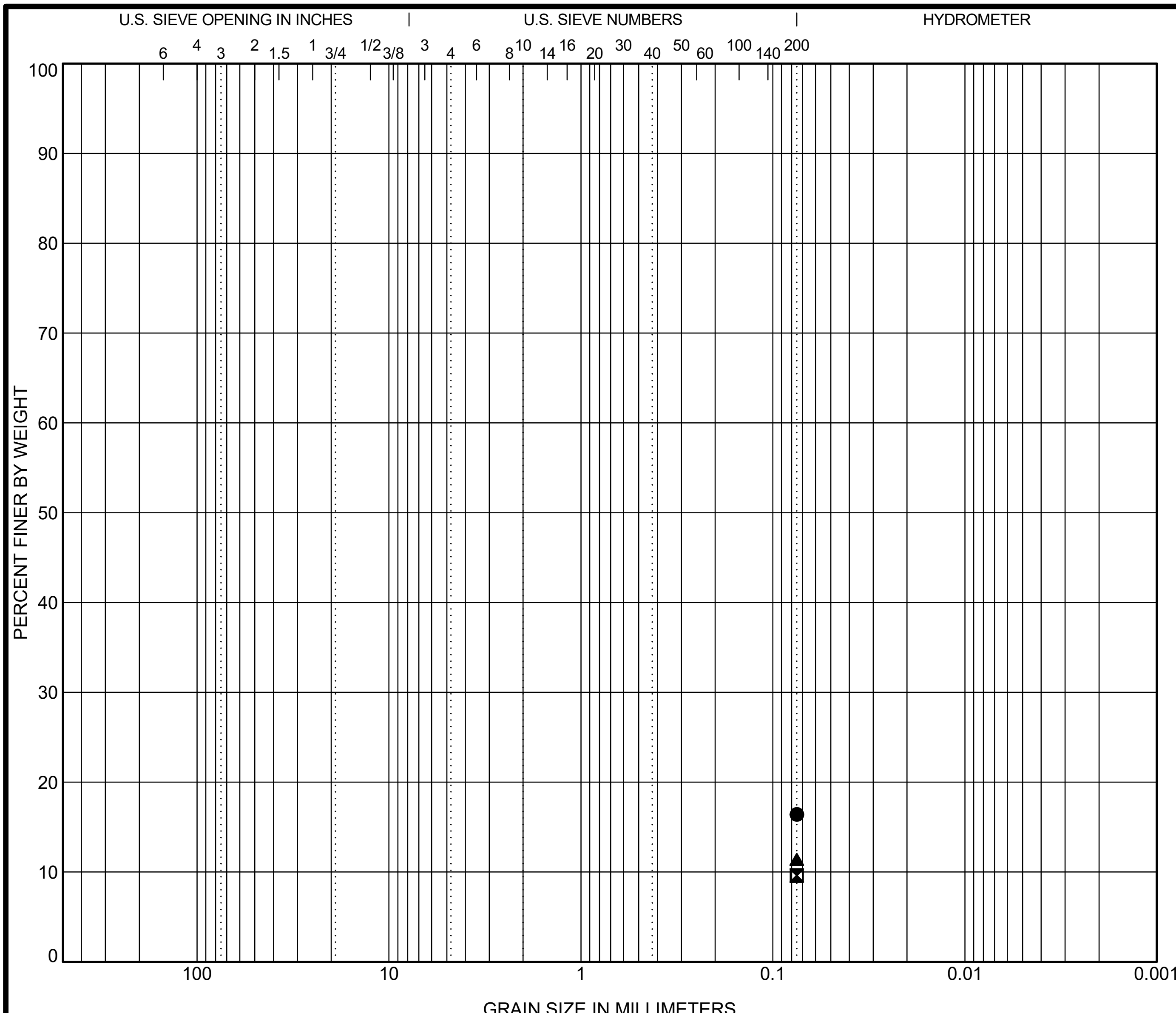
LOG OF TEST BORING PG-8-19

Figure A-6

The stratification lines represent approximate boundaries. The transition may be gradual.

APPENDIX B

LABORATORY TEST RESULTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**PG-1-25**	**@ 11.0 ft.**	**SILTY SAND**					
⊠	**PG-1-25**	**@ 26.0 ft.**	**SAND, SOME SILT**					
▲	**PG-2-25**	**@ 16.0 ft.**	**SAND, SOME SILT**					

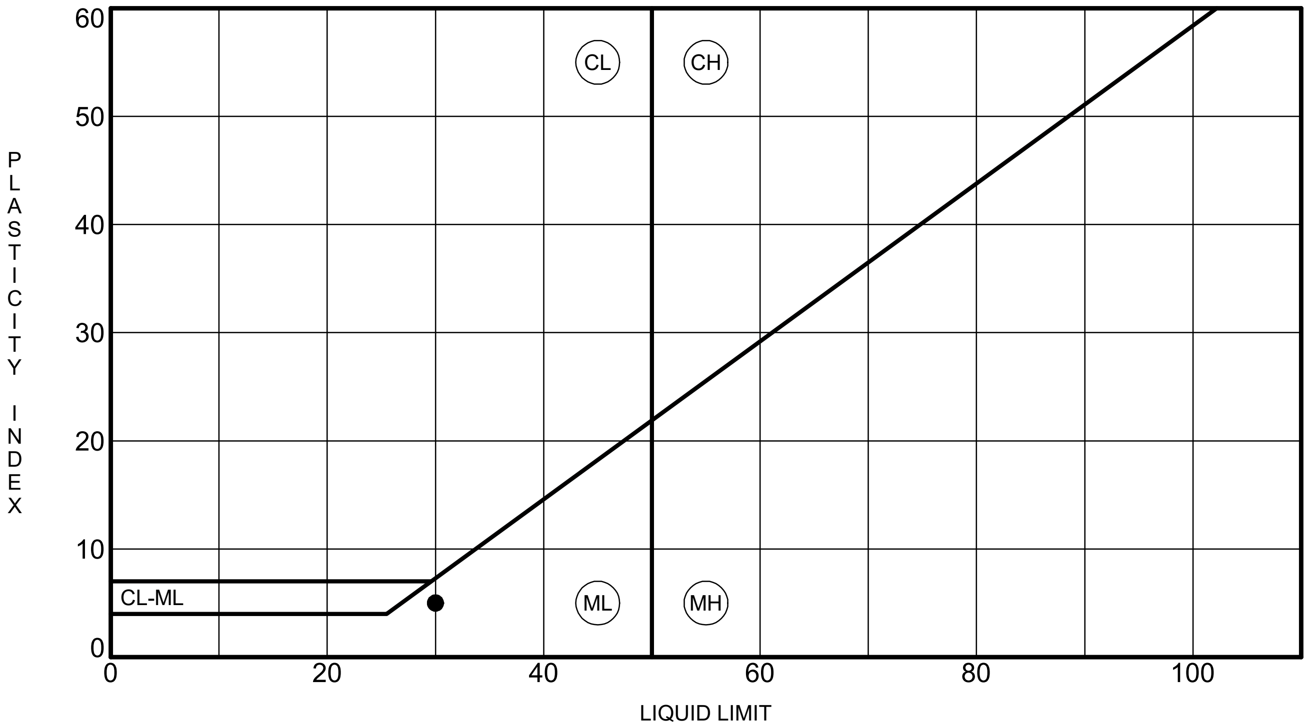
	Specimen Identification		D90	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**PG-1-25**	**11.0**					**0.0**	**0.0**	**16.4**	
⊠	**PG-1-25**	**26.0**					**0.0**	**0.0**	**9.6**	
▲	**PG-2-25**	**16.0**					**0.0**	**0.0**	**11.4**	

GRAIN SIZE DISTRIBUTION

PanGEO INCORPORATED
Phone: 206.262.0370

Project: Proposed Single-Family Residence
Job Number: 25-036.200
Location: 9191 SE 64th Street, Mercer Island, WA

Figure B-1



	Specimen Identification		M	LL	PL	PI	Fines	Classification
●	**PG-1-25**	**6.0**	**13**	**30**	**25**	**5**		**SANDY SILT (ML)**

PanGEO INCORPORATED
Phone: 206.262.0370

ATTERBERG LIMITS

Project: Proposed Single-Family Residence
Job Number: 25-036.200
Location: 9191 SE 64th Street, Mercer Island, WA

Figure B-2

APPENDIX B. WWHM Documentation

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 6423 E Mercer Way

Site Name:	6423 E Mercer Way
Site Address:	6423 E Mercer Way
City:	Mercer Island
Report Date:	8/15/2025
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

PREDEVELOPED AREAS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.319
Pervious Total	0.319
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.319

Mitigated Land Use

ONSITE AREAS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.112
Pervious Total	0.112
Impervious Land Use	acre
ROOF TOPS FLAT	0.094
DRIVEWAYS FLAT	0.039
SIDEWALKS FLAT	0.031
Impervious Total	0.164
Basin Total	0.276

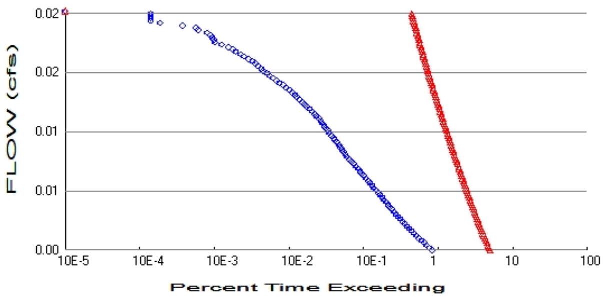
PRIVATE ROW AREAS

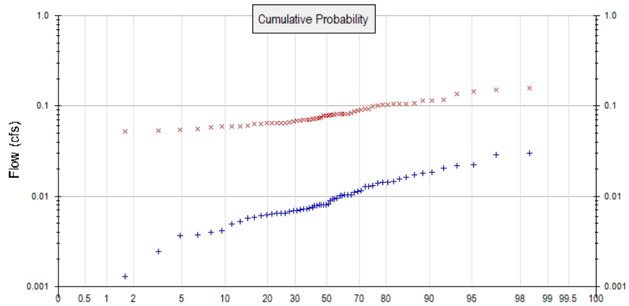
Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.008
Pervious Total	0.008
Impervious Land Use	acre
ROADS FLAT	0.035
Impervious Total	0.035
Basin Total	0.043

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.319
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.12
Total Impervious Area: 0.199

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.009379
5 year	0.01473
10 year	0.017762
25 year	0.020975
50 year	0.022963
100 year	0.024654

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.078201
5 year	0.099181
10 year	0.113481
25 year	0.132075
50 year	0.146338
100 year	0.160972

Annual Peaks
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.009	0.104
1950	0.011	0.106
1951	0.021	0.067
1952	0.007	0.055
1953	0.005	0.059
1954	0.008	0.064
1955	0.013	0.072
1956	0.010	0.070
1957	0.008	0.082
1958	0.009	0.065

1959	0.008	0.064
1960	0.014	0.070
1961	0.008	0.070
1962	0.005	0.059
1963	0.007	0.067
1964	0.009	0.063
1965	0.006	0.083
1966	0.006	0.056
1967	0.013	0.094
1968	0.008	0.106
1969	0.008	0.075
1970	0.006	0.074
1971	0.007	0.087
1972	0.015	0.092
1973	0.007	0.053
1974	0.008	0.079
1975	0.010	0.089
1976	0.007	0.063
1977	0.001	0.065
1978	0.007	0.079
1979	0.004	0.108
1980	0.015	0.104
1981	0.006	0.082
1982	0.011	0.115
1983	0.010	0.091
1984	0.006	0.059
1985	0.004	0.079
1986	0.016	0.069
1987	0.014	0.106
1988	0.006	0.064
1989	0.004	0.080
1990	0.030	0.156
1991	0.018	0.116
1992	0.007	0.059
1993	0.007	0.050
1994	0.002	0.054
1995	0.010	0.072
1996	0.022	0.081
1997	0.018	0.078
1998	0.004	0.074
1999	0.017	0.151
2000	0.007	0.078
2001	0.001	0.082
2002	0.008	0.100
2003	0.010	0.081
2004	0.013	0.144
2005	0.009	0.069
2006	0.011	0.061
2007	0.022	0.137
2008	0.029	0.115
2009	0.014	0.098

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0301	0.1562
2	0.0288	0.1510
3	0.0223	0.1440

4	0.0220	0.1365
5	0.0207	0.1165
6	0.0184	0.1147
7	0.0181	0.1147
8	0.0172	0.1081
9	0.0163	0.1062
10	0.0154	0.1058
11	0.0146	0.1056
12	0.0144	0.1040
13	0.0141	0.1035
14	0.0140	0.1003
15	0.0131	0.0981
16	0.0129	0.0935
17	0.0128	0.0919
18	0.0115	0.0911
19	0.0112	0.0886
20	0.0111	0.0865
21	0.0104	0.0835
22	0.0103	0.0824
23	0.0103	0.0821
24	0.0101	0.0816
25	0.0100	0.0813
26	0.0094	0.0812
27	0.0093	0.0803
28	0.0092	0.0794
29	0.0089	0.0792
30	0.0083	0.0789
31	0.0081	0.0777
32	0.0080	0.0775
33	0.0080	0.0751
34	0.0079	0.0740
35	0.0079	0.0736
36	0.0078	0.0719
37	0.0076	0.0716
38	0.0074	0.0704
39	0.0073	0.0698
40	0.0073	0.0698
41	0.0070	0.0690
42	0.0070	0.0688
43	0.0069	0.0673
44	0.0067	0.0665
45	0.0065	0.0645
46	0.0065	0.0645
47	0.0064	0.0643
48	0.0063	0.0642
49	0.0062	0.0642
50	0.0061	0.0634
51	0.0058	0.0632
52	0.0057	0.0612
53	0.0053	0.0590
54	0.0049	0.0590
55	0.0042	0.0588
56	0.0039	0.0586
57	0.0037	0.0561
58	0.0037	0.0547
59	0.0024	0.0536
60	0.0013	0.0527
61	0.0009	0.0498

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0047	17554	105618	601	Fail
0.0049	16159	102303	633	Fail
0.0051	14966	99180	662	Fail
0.0052	13851	96100	693	Fail
0.0054	12814	93298	728	Fail
0.0056	11809	90496	766	Fail
0.0058	10900	87780	805	Fail
0.0060	10119	85127	841	Fail
0.0062	9383	82604	880	Fail
0.0064	8731	80208	918	Fail
0.0065	8143	77941	957	Fail
0.0067	7593	75695	996	Fail
0.0069	7060	73642	1043	Fail
0.0071	6588	71588	1086	Fail
0.0073	6147	69642	1132	Fail
0.0075	5777	67738	1172	Fail
0.0076	5431	65942	1214	Fail
0.0078	5097	64102	1257	Fail
0.0080	4808	62434	1298	Fail
0.0082	4524	60744	1342	Fail
0.0084	4252	59140	1390	Fail
0.0086	4017	57621	1434	Fail
0.0088	3782	56081	1482	Fail
0.0089	3546	54584	1539	Fail
0.0091	3337	53151	1592	Fail
0.0093	3136	51740	1649	Fail
0.0095	2950	50456	1710	Fail
0.0097	2785	49151	1764	Fail
0.0099	2599	47868	1841	Fail
0.0100	2449	46670	1905	Fail
0.0102	2310	45537	1971	Fail
0.0104	2162	44360	2051	Fail
0.0106	2029	43312	2134	Fail
0.0108	1898	42157	2221	Fail
0.0110	1790	41088	2295	Fail
0.0111	1695	40083	2364	Fail
0.0113	1590	39013	2453	Fail
0.0115	1486	38051	2560	Fail
0.0117	1381	37110	2687	Fail
0.0119	1293	36190	2798	Fail
0.0121	1221	35270	2888	Fail
0.0123	1156	34415	2977	Fail
0.0124	1098	33538	3054	Fail
0.0126	1049	32768	3123	Fail
0.0128	997	31955	3205	Fail
0.0130	930	31228	3357	Fail
0.0132	883	30458	3449	Fail
0.0134	838	29773	3552	Fail
0.0135	790	29110	3684	Fail
0.0137	743	28383	3820	Fail
0.0139	716	27720	3871	Fail
0.0141	669	27078	4047	Fail
0.0143	633	26479	4183	Fail
0.0145	596	25838	4335	Fail

0.0147	567	25217	4447	Fail
0.0148	539	24597	4563	Fail
0.0150	497	24020	4832	Fail
0.0152	473	23442	4956	Fail
0.0154	435	22886	5261	Fail
0.0156	401	22373	5579	Fail
0.0158	368	21817	5928	Fail
0.0159	348	21327	6128	Fail
0.0161	323	20837	6451	Fail
0.0163	296	20392	6889	Fail
0.0165	272	19924	7325	Fail
0.0167	256	19489	7612	Fail
0.0169	235	19051	8106	Fail
0.0171	217	18651	8594	Fail
0.0172	195	18208	9337	Fail
0.0174	180	17851	9917	Fail
0.0176	158	17396	11010	Fail
0.0178	145	17023	11740	Fail
0.0180	130	16683	12833	Fail
0.0182	119	16281	13681	Fail
0.0183	109	15928	14612	Fail
0.0185	97	15571	16052	Fail
0.0187	91	15231	16737	Fail
0.0189	82	14908	18180	Fail
0.0191	76	14591	19198	Fail
0.0193	69	14286	20704	Fail
0.0195	61	14001	22952	Fail
0.0196	54	13702	25374	Fail
0.0198	48	13441	28002	Fail
0.0200	41	13186	32160	Fail
0.0202	38	12897	33939	Fail
0.0204	33	12641	38306	Fail
0.0206	27	12363	45788	Fail
0.0207	22	12093	54968	Fail
0.0209	21	11839	56376	Fail
0.0211	20	11584	57920	Fail
0.0213	19	11336	59663	Fail
0.0215	17	11082	65188	Fail
0.0217	13	10861	83546	Fail
0.0219	12	10664	88866	Fail
0.0220	8	10416	130200	Fail
0.0222	4	10196	254900	Fail
0.0224	3	10012	333733	Fail
0.0226	3	9820	327333	Fail
0.0228	3	9648	321600	Fail
0.0230	3	9430	314333	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

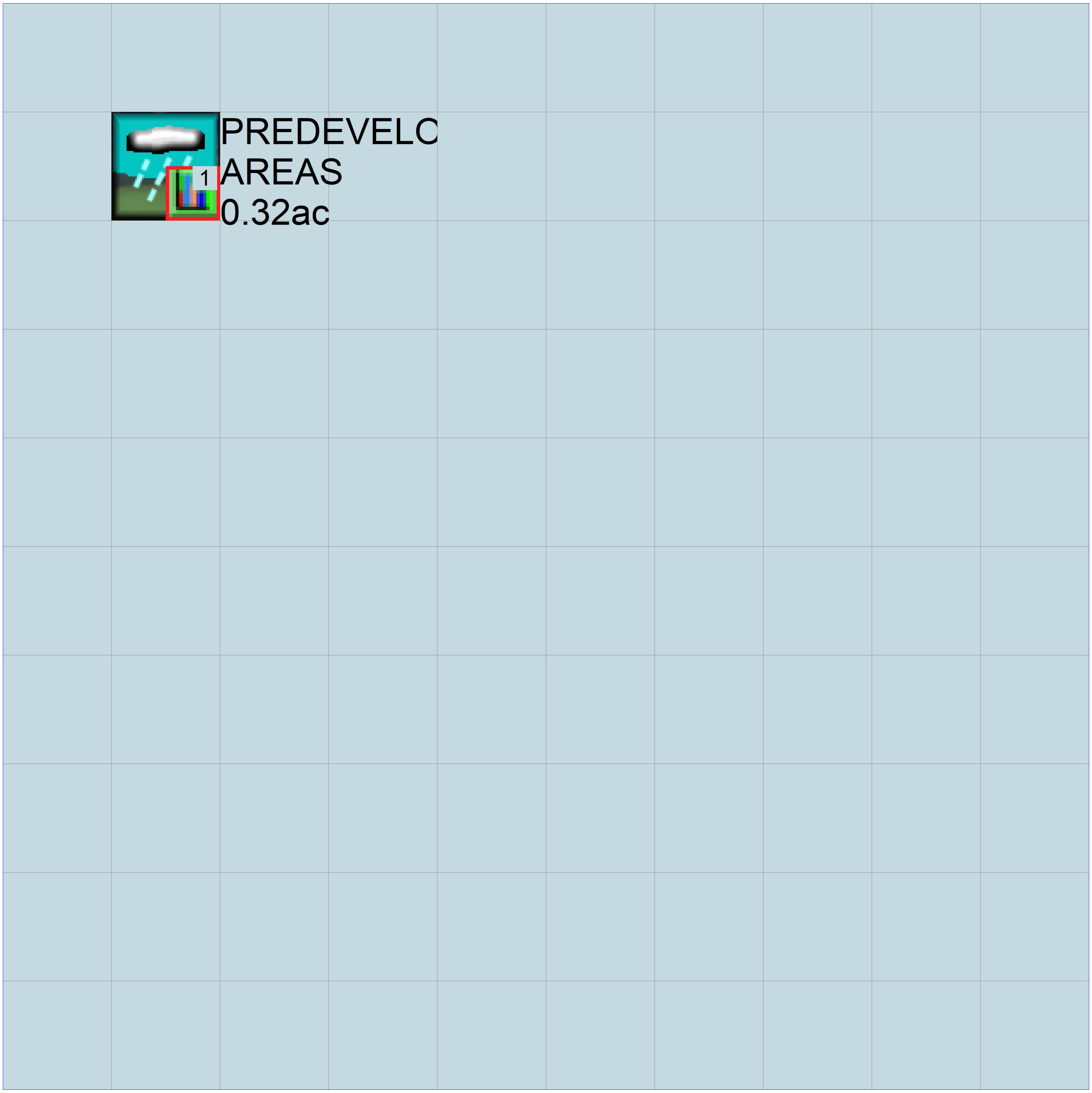
PERLND Changes

No PERLND changes have been made.

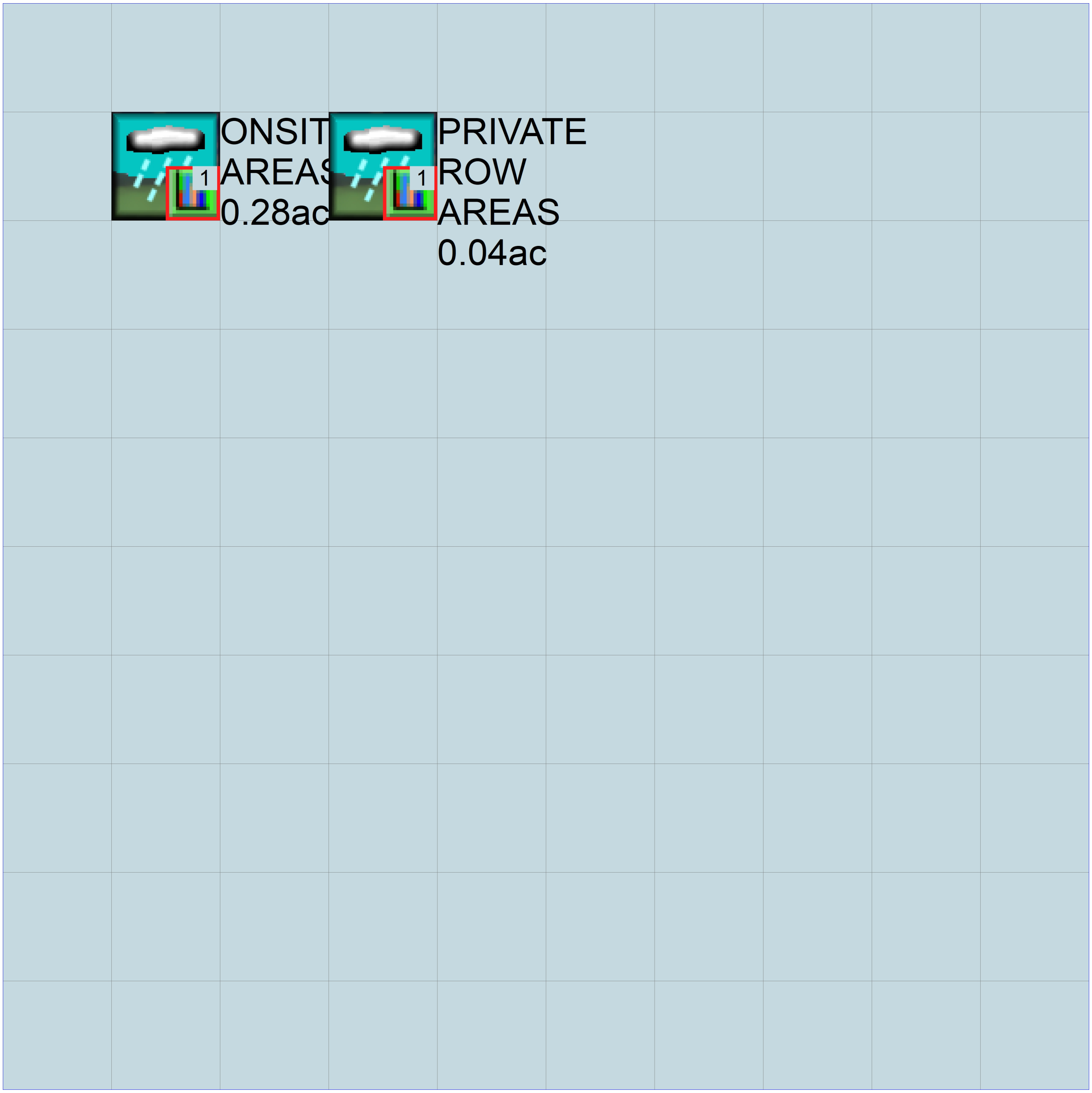
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   6423 E Mercer Way.wdm
MESSU      25   Pre6423 E Mercer Way.MES
           27   Pre6423 E Mercer Way.L61
           28   Pre6423 E Mercer Way.L62
           30   POC6423 E Mercer Way1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        PREDEVELOPED AREAS          MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10             0       4.5      0.08       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10           0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
PREDEVELOPED AREAS***
PERLND  10                       0.319     COPY   501     12
PERLND  10                       0.319     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76            IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   6423 E Mercer Way.wdm
MESSU      25   Mit6423 E Mercer Way.MES
           27   Mit6423 E Mercer Way.L61
           28   Mit6423 E Mercer Way.L62
           30   POC6423 E Mercer Way1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      13
      IMPLND       4
      IMPLND       5
      IMPLND       8
      IMPLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        ONSITE AREAS                MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   13      C, Pasture, Flat        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   13         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   13         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   13              0       4.5      0.06       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   13              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                   ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   13           0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   13              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   *********
    4         0    0    4    0    0    4    1    9
    5         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI    ***
    4         0    0    0    0    0
```

```
    5         0    0    0    0    0
    8         0    0    0    0    0
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
    8              0         0
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
    8              0         0
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
ONSITE AREAS***
PERLND  13                       0.112     COPY   501     12
PERLND  13                       0.112     COPY   501     13
IMPLND   4                       0.094     COPY   501     15
IMPLND   5                       0.039     COPY   501     15
IMPLND   8                       0.031     COPY   501     15
PRIVATE ROW AREAS***
PERLND  13                       0.008     COPY   501     12
PERLND  13                       0.008     COPY   501     13
IMPLND   1                       0.035     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***
```

```
  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                       ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->        ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Local (360)943-0304

www.clearcreeksolutions.com

APPENDIX C. Maintenance Plan

6423 E Mercer Way
Operation and Maintenance Manual

Person or Organization Responsible for Maintenance of the On-Site Storm System:

Citizen Design c/o Isaac Greenetz
10 Dravus St
Seattle, WA 98109

The Location Where the Operation and Maintenance Manual is to be Kept:

6423 E Mercer Way
Mercer Island, WA 98040

*Note: The manual and maintenance activity log must be made available to the City of Mercer Island for inspection purposes.

Description of On-Site Storm System

The on-site storm system for the 6423 E Mercer Way project consists of 4” to 8” conveyance pipes, cleanouts, catch basins, area drains, and a detention facility.

Stormwater runoff from onsite will be captured in a detention facility and then routed to the existing storm drain conveyance system in E Mercer Way.

Property owner(s) shall be responsible for any and all claims, injuries, and damage due to operation and/or failure of the pump system.

The proposed detention facility, storm drains, area drains, and cleanouts serve as source control of pollution for the project site prior to being detained and released from the project site. To control pollutants, proper maintenance and cleaning of debris, sediments and oil from stormwater collection and conveyance system is required per the operations and maintenance recommendations found in Volume 5 Appendix V-A of the Stormwater Manual in addition to the BMPs in Volume IV Section 2.2. See the attached sheets for operation and maintenance requirements pertaining to the project.

Contact Information for Stormwater Facility Manufacturers and Installers:
Contractor (Installer of On-Site Stormwater Facilities)
TBD

Civil Engineer (Designer of On-Site Stormwater Facilities)
Ben Iddins, P.E.
Facet
9706 4th Ave NE, Suite 300
Seattle, WA 98115
Phone – 206.523.0024 Ext. 115
biddins@facetnw.com

Attachments

- Operation and Maintenance Manual for Closed Detention Systems (Tanks/Vaults) (2019 DOE Manual)
- Operation and Maintenance Manual for Control Structure/Flow Restrictor (2019 DOE Manual)
- Operation and Maintenance Manual for Catch Basins (2019 DOE Manual) Catch Basins

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.4: Maintenance Standards - Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall. Structure is not in upright position (allow up to 10% from plumb). Connections to outlet pipe are not watertight and show signs of rust. Any holes - other than designed holes - in the structure.	Structure securely attached to wall and outlet pipe. Structure in correct position. Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)
Catch Basin	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

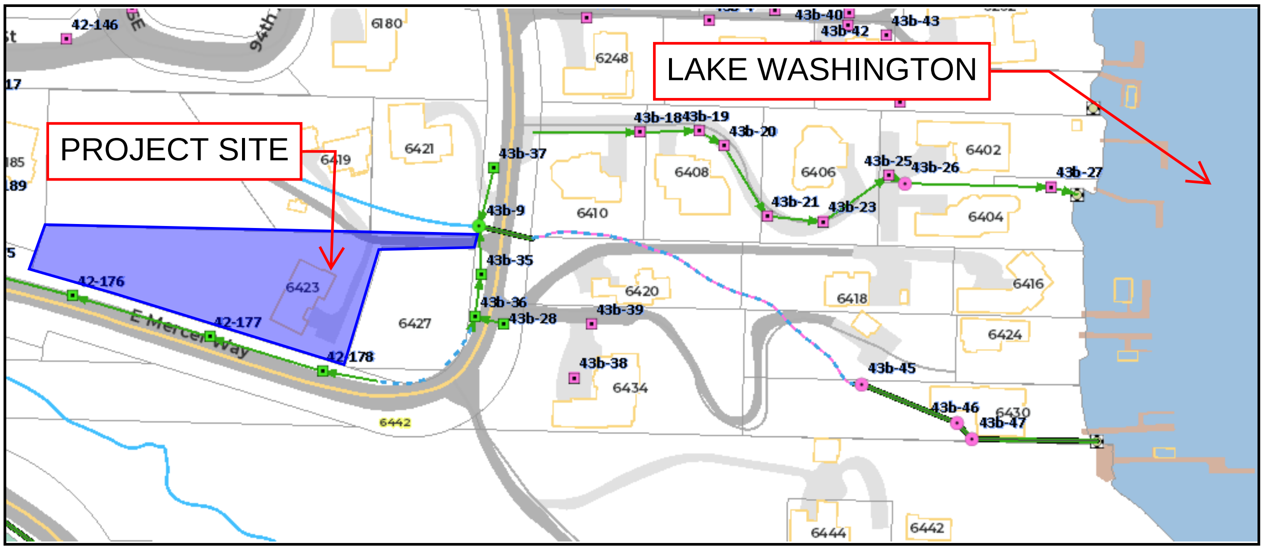
Table V-A.5: Maintenance Standards - Catch Basins

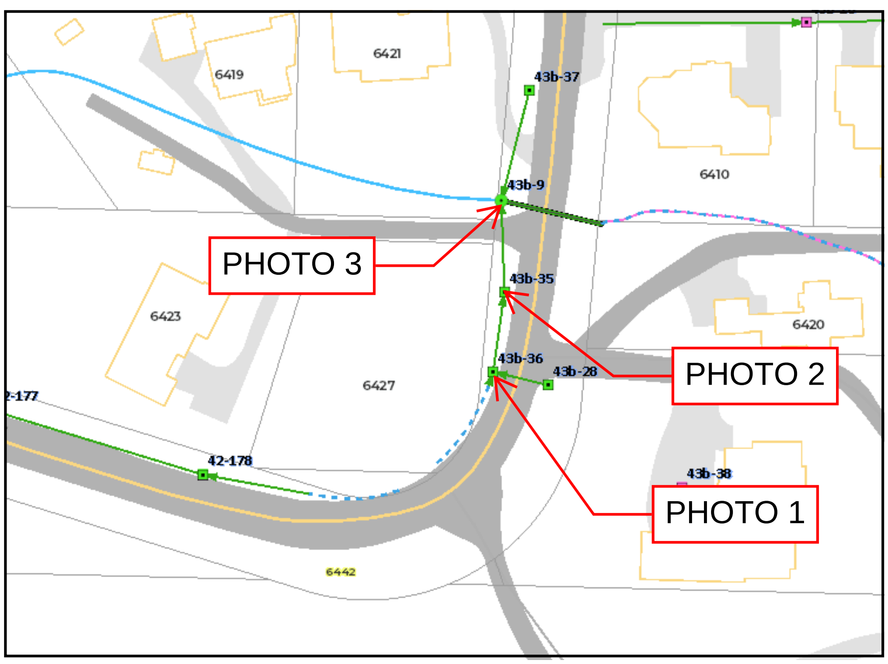
Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

APPENDIX D. Covenants, Dedications, Easements (To be Provided at Final Engineering)

APPENDIX E. Downstream Analysis Exhibit & Photos

DOWNSTREAM DRAINAGE ANALYSIS





DOWNSTREAM ANAYLSIS PHOTOS

Photo 1 (looking north): culvert flowing north into type 1 catch basin. 8” corrugated polyethylene pipe flowing north.

Photo 2 (looking west): type 1 catch basin. 12” concrete pipe flowing north.

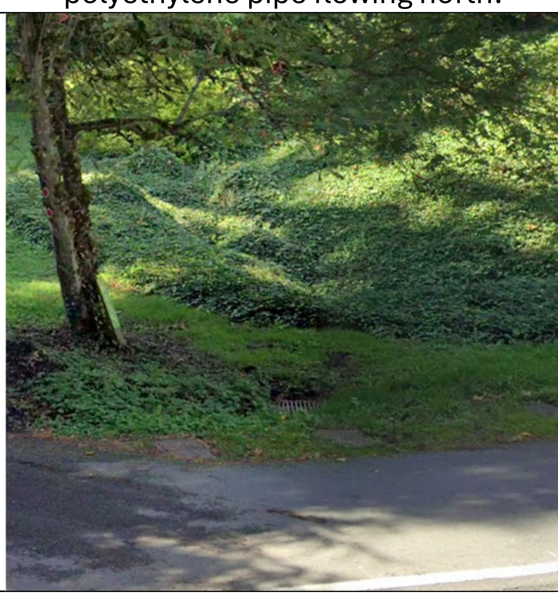


Photo 3 (looking northwest): type 2 catch basin. 12” concrete pipe flowing east.

APPENDIX F. Conveyance Calculations

RATIONAL METHOD
for Conveyance Facility Sizing

Project: 6423 E Mercer Way Mercer Island
Description: Rational Method for pipe upstream of the proposed detention facility.

Design Storm: 100 yr

Q=CIA
Where: Q = peak flow (cfs) | I = peak rainfall intensity (inches/hour)
C = estimated composite runoff coefficient | A = drainage subbasin area (acres)

Composite Runoff Coefficient

Cc = (C1*A1+C2*A2…)/At
Where: Cc = composite runoff coefficient | A# = area of land cover (acres)
C# = runoff coefficient for Area # | At = total area (acres)

C #		Description	Area (sf)	Area (acres)	C	A*C
1	Onsite/New	Impervious Surface	6,627	0.152	0.90	0.137
			Totals:	**0.152**		**0.137**

Cc = 0.90 (total C#*A#)/(total area)

Time of Concentration

Seg. #	Description of Flow Path Segment	Length (ft)	kr	Upper Elev	Lower Elev	Slope (ft/ft)	Travel Time (minutes)
1	Paved Area (sheet flow) and shallow gutter flow	85	20	451	448.5	0.029	0.41
	Totals:	**85**					**0.4**

Unity Peak Intensity Factor
ir = ar*Tc^-br
where: Tc = time of concentration (minutes)
ar and br = coefficients from Table 3.2.1.B

Tc = 6.30 minutes (from table above or 6.3 minimum or 100 max)
ar = 2.61 (from Table 3.2.1.B)
br = 0.63 (from Table 3.2.1.B)

ir = 0.82

Peak Rainfall Intensity

Ir = Pr*ir
where: Ir = peak rainfall intensity (inches/hour)
Pr = total 24-hour precipitation for design return period (inches/24 hours)
ir = unit peak rainfall intensity factor

Pr = 3.15 precipitation (inches)
ir = 0.82 unit peak intensity factor (from above)

Ir = 2.58 inches/hour

Peak Runoff Rate
Q = C*Ir*A

C = 0.90 Cc (unitless) from above
Ir = 2.58 Ir (inches/hour) from above
A = 0.15 total area (acres) from above

Q = 0.353 cfs

Pipe Capacity Calculations (Manning's Equation)
Full Flow (d/D = 0.90)

Description	ID (inches)	Area (sf)	Wetted Per. (ft)	Hyd. Radius (ft)	Manning's n	Slope (ft/ft)	Velocity (ft/s)	Pipe Capacity (cfs)	Req'd Flow (cfs)	
6" for all areas onsite	6	0.1963495	1.570796327	0.125	0.012	0.02	4.39	0.862	**0.353**	**Capacity OK**

APPENDIX G. Detention Facility Sizing

Table 1

ON-SITE DETENTION DESIGN FOR PROJECTS BETWEEN 500 SF AND 9,500 SF NEW PLUS REPLACED IMPERVIOUS SURFACE AREA

New and Replaced Impervious Surface Area (sf)	Detention Pipe Diameter (in)	Detention Pipe Length (ft)		Lowest Orifice Diameter (in)[3]		Distance from Outlet Invert to Second Orifice (ft)		Second Orifice Diameter (in)	
		B soils	C soils	B soils	C soils	B soils	C soils	B soils	C soils
500 to 1,000 sf	36"	30	22	0.5	0.5	2.2	2.0	0.5	0.8
	48"	18	11	0.5	0.5	3.3	3.2	0.9	0.8
	60"	11	7	0.5	0.5	4.2	3.4	0.5	0.6
1,001 to 2,000 sf	36"	66	43	0.5	0.5	2.2	2.3	0.9	1.4
	48"	34	23	0.5	0.5	3.2	3.3	0.9	1.2
	60"	22	14	0.5	0.5	4.3	3.6	0.9	0.9
2,001 to 3,000 sf	36"	90	66	0.5	0.5	2.2	2.4	0.9	1.9
	48"	48	36	0.5	0.5	3.1	2.8	0.9	1.5
	60"	30	20	0.5	0.5	4.2	3.7	0.9	1.1
3,001 to 4,000 sf	36"	120	78	0.5	0.5	2.4	2.2	1.4	1.6
	48"	62	42	0.5	0.5	2.8	2.9	0.8	1.3
	60"	42	26	0.5	0.5	3.8	3.9	0.9	1.3
4,001 to 5,000 sf	36"	134	91	0.5	0.5	2.8	2.2	1.7	1.5
	48"	73	49	0.5	0.5	3.6	2.9	1.6	1.5
	60"	46	31	0.5	0.5	4.6	3.5	1.6	1.3
5,001 to 6,000 sf	36"	162	109	0.5	0.5	2.7	2.2	1.8	1.6
	48"	90	59	0.5	0.5	3.5	2.9	1.7	1.5
	60"	54	37	0.5	0.5	4.6	3.6	1.6	1.4
6,001 to 7,000 sf	36"	192	128	0.5	0.5	2.7	2.2	1.9	1.8
	48"	102	68	0.5	0.5	3.7	2.9	1.9	1.6
	60"	64	43	0.5	0.5	4.6	3.6	1.8	1.5
7,001 to 8,000 sf	36"	216	146	0.5	0.5	2.8	2.2	2.0	1.9
	48"	119	79	0.5	0.5	3.8	2.9	2.2	1.7
	60"	73	49	0.5	0.5	4.5	3.6	2.0	1.6
8,001 to 8,500 sf[1]	36"	228	155	0.5	0.5	2.8	2.2	2.1	1.9
	48"	124	84	0.5	0.5	3.7	2.9	1.9	1.8
	60"	77	53	0.5	0.5	4.6	3.6	2.0	1.6
8,501 to 9,000 sf	36"	NA [1]	164	0.5	0.5	NA [1]	2.2	NA [1]	1.9
	48"	NA [1]	89	0.5	0.5	NA [1]	2.9	NA [1]	1.9
	60"	NA [1]	55	0.5	0.5	NA [1]	3.6	NA [1]	1.7
9,001 to 9,500 sf[2]	36"	NA [1]	174	0.5	0.5	NA [1]	2.2	NA [1]	2.1
	48"	NA [1]	94	0.5	0.5	NA [1]	2.9	NA [1]	2.0
	60"	NA [1]	58	0.5	0.5	NA [1]	3.7	NA [1]	1.7

Notes:

▪ Minimum Requirement #7 (Flow Control) is required when the 100-year flow frequency causes a 0.15 cubic feet per second increase (when modeled in WWHM with a 15-minute timestep). Breakpoints shown in this table are based on a flat slope (0-5%). The 100-year flow frequency will need to be evaluated on a site-specific basis for projects on moderate (5-15%) or steep (> 15%) slopes.

▪ Soil type to be determined by geotechnical analysis or soil map.

▪ Sizing includes a Volume Correction Factor of 120%.

▪ Upper bound contributing area used for sizing.

[1] On Type B soils, new plus replaced impervious surface areas exceeding 8,500 sf trigger Minimum Requirement #7 (Flow Control)

[2] On Type C soils, new plus replaced impervious surface areas exceeding 9,500 sf trigger Minimum Requirement #7 (Flow Control)

[3] Minimum orifice diameter = 0.5 inches

in = inch

ft = feet

sf = square feet

Basis of Sizing Assumptions:

Sized per MR#5 in the Stormwater Management Manual for Puget Sound Basin (1992 Ecology Manual)

SBUH, Type 1A, 24-hour hydrograph

2-year, 24-hour storm = 2 in; 10-year, 24-hour storm = 3 in; 100-year, 24-hour storm = 4 in

Predeveloped = second growth forest (CN = 72 for Type B soils, CN = 81 for Type C soils)

Developed = impervious (CN = 98)

0.5 foot of sediment storage in detention pipe

Overland slope = 5%