EASTSIDE CONSULTANTS, INC.
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ENGINEERS-SURVEYORS

TECHNICAL INFORMATION REPORT

FOR

RAND-MILESTONE 3 LOT PRELIMINARY SHORT PLAT

7621 SE 22^ND^ STREET

Eastside Consultants, Inc. File No. 20025

June 16, 2021

RONALD S. FREDERIKSEN
STATE OF WASHINGTON
39053
REGISTERED PROFESSIONAL ENGINEER
6/16/2021

Prepared by:
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Prepared for:
Milestone-WCMI LLC
7621 SE 22nd Street
Mercer Island, WA 98040

1320 N.W. MALL STREET, SUITE B, ISSAQUAH, WASHINGTON 98027 PHONE: (425) 392-5351 FAX: (425) 392-4676

PROJECT SITE DESCRIPTION

The proposed Prelimianry Short Plat consists of Short Platting an existing lot into 3 Lots. The project is located at 7621 SE 22nd Street in Mercer, Island, WA.

The project parcel is located on the north side of Mercer Island and will be discharging detained stormwater runoff through the existing bulkhead into Lake Washington.

The physical location of the site is 7621 SE 22nd Street in Mercer Island, WA. There is single family residences to the west, and south and an access road to the east.. SE 22nd borders the site to the north

The runoff will primarily sheetflow off the roof into gutters and be transported via downspouts to a detention system. The proposed driveway will be conveyed catch basins and conveyed to the detention system.

HYDROLOGIC CONDITIONS

A. Existing Runoff Conditions

The project consists of removing an existing 2,619 sf home, 1,312 sf of patio, 3,517 sf of gravel area, 1,784 sf of concrete driveway, 149 sf of concrete area, and 133 sf of concrete planter for a total of 9,514 sf to be removed.

Based on the City of Mercer Island Code, the existing runoff conditions were analyzed per the 2014 DOE Manual.

B. Proposed Runoff Conditions

The runoff will primarily sheetflow off the roof into gutters and be transported via downspouts to a detention system. The proposed driveway will be conveyed catch basins and conveyed to the detention system. The Lots were analyzed using 50 percent Lot Coverage. See (5. Minimum Requirement Number 5: On-Site Stormwater Management) for Calculations and Sizing

OFF-SITE ANALYSIS

See attached

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LEVEL 1 DRAINAGE ANALYSIS

FOR

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Mercer Island, WA 98040

Task 1 – Define Map and Study Area

The downstream drainage path consists of one flow path where the runoff on the site sheet flows to the northeast where it enters a ditch system that runs under driveways through culverts. The runoff then enters a large box culvert that crosses north across SE 22nd St eventually out falling to Lake Washington. The site is located within the Mercer Island drainage basin.

Task 2 – Resource Review

A review of the IMAP Sensitive Area Map Folio's revealed that there are no sensitive areas on or around the site.

A review of the IMAP Drainage Complaint Reports showed there were no drainage complaints relevant to the site.

Task 3 – Field Inspection

Upstream basin

The upstream basin extends southwest of the site. See the Upstream Drainage Map Section for a map defining the area.

Downstream Basin

The downstream flowpath and basin is described in the following section. During the field inspection, no problems seemed to exist in the basin. See the Downstream Drainage Map Section for a map defining the area.

Task 4 – Drainage System Description

Downstream Basin

The stormwater runoff for the flow path leaves the site (Point A) at the northeast corner of the property of the property and sheet flows approximately 14 feet before it enters a ditch and immediately enters a culvert (Point B). Runoff flows east approximately 24 feet within a 12” green plastic pipe beneath the driveway for 7627 SE 22nd St and outlets to the ditch (Point C). Runoff flows east in ditch for approximately 27 feet until it reaches a culvert made of 12” plastic corrugated pipe (point D) that flows east for approximately 35 feet under the driveway to King County-Waste Water facility where it then enters an 8” concrete pipe (point E). Runoff flows in this concrete pipe east southeast for approximately 34 feet where it outfalls to a stream that immediately enters a 5-foot wide concrete box culvert (Point F). The runoff flows north in this concrete culvert beneath SE 22nd St and continues going between the houses to the north. We were unable to follow the rest of the downstream due to it entering private property, but it is assumed that the box culvert continues north for approximately 464 feet where it then outlets into Lake Washington thus ending the downstream analysis.

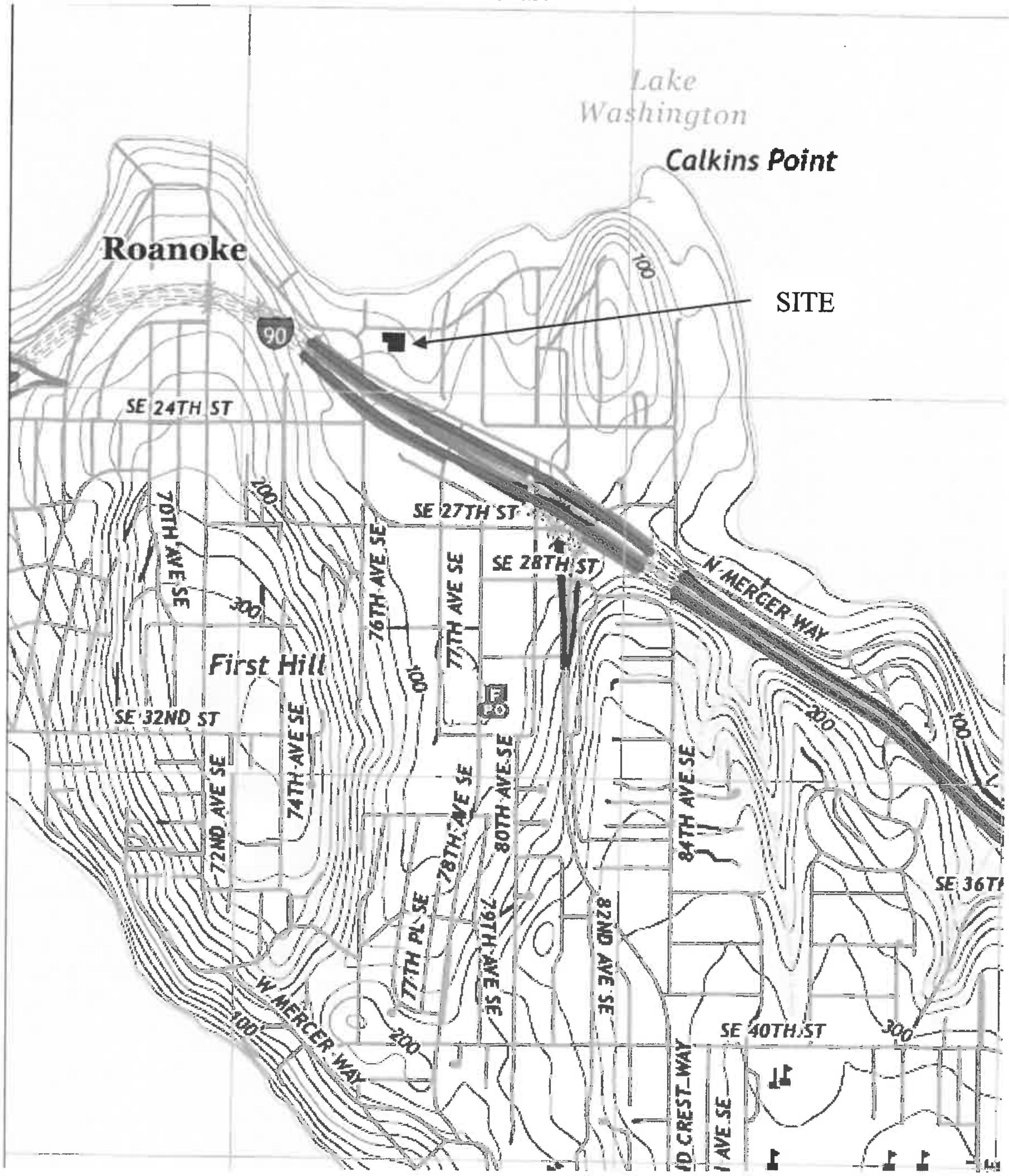
Task 5 – Mitigation of Existing or Potential Problems

The project’s current downstream flowpath was overgrown and pipes going under driveways could be obstructed needing to be cleared out.

QUAD, SOILS, AND VICINITY MAPS

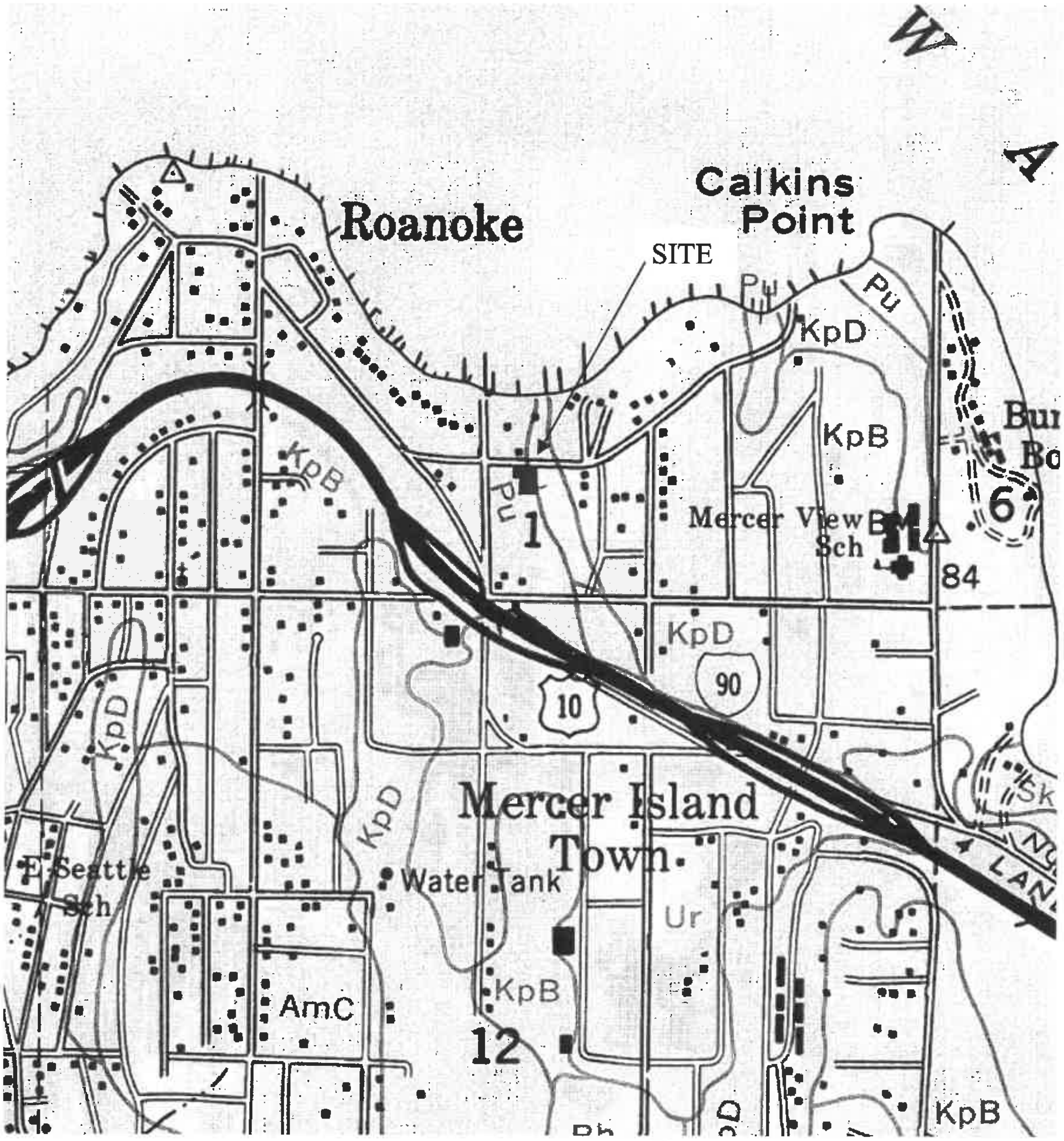
QUAD MAP

N.T.S.

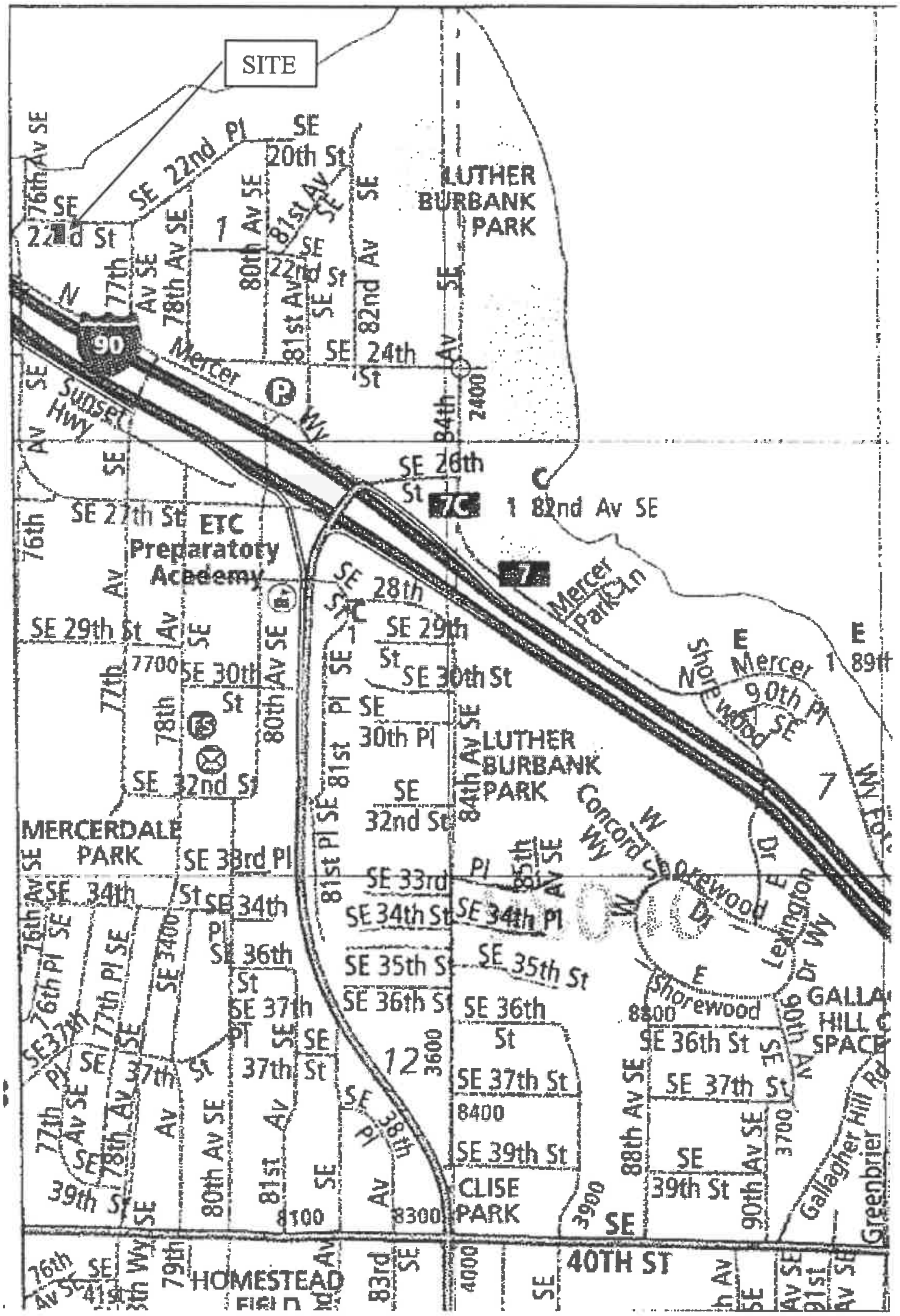

Lake Washington
Calkins Point
Roanoke
SITE
90
SE 24TH ST
SE 27TH ST
SE 28TH ST
N MERCER WAY
70TH AVE SE
76TH AVE SE
77TH AVE SE
First Hill
SE 32ND ST
72ND AVE SE
74TH AVE SE
78TH AVE SE
80TH AVE SE
84TH AVE SE
77TH PL SE
79TH AVE SE
82ND AVE SE
W MERCER WAY
SE 40TH ST
SE 36TH
100
200
300

SOILS MAP

N.T.S.

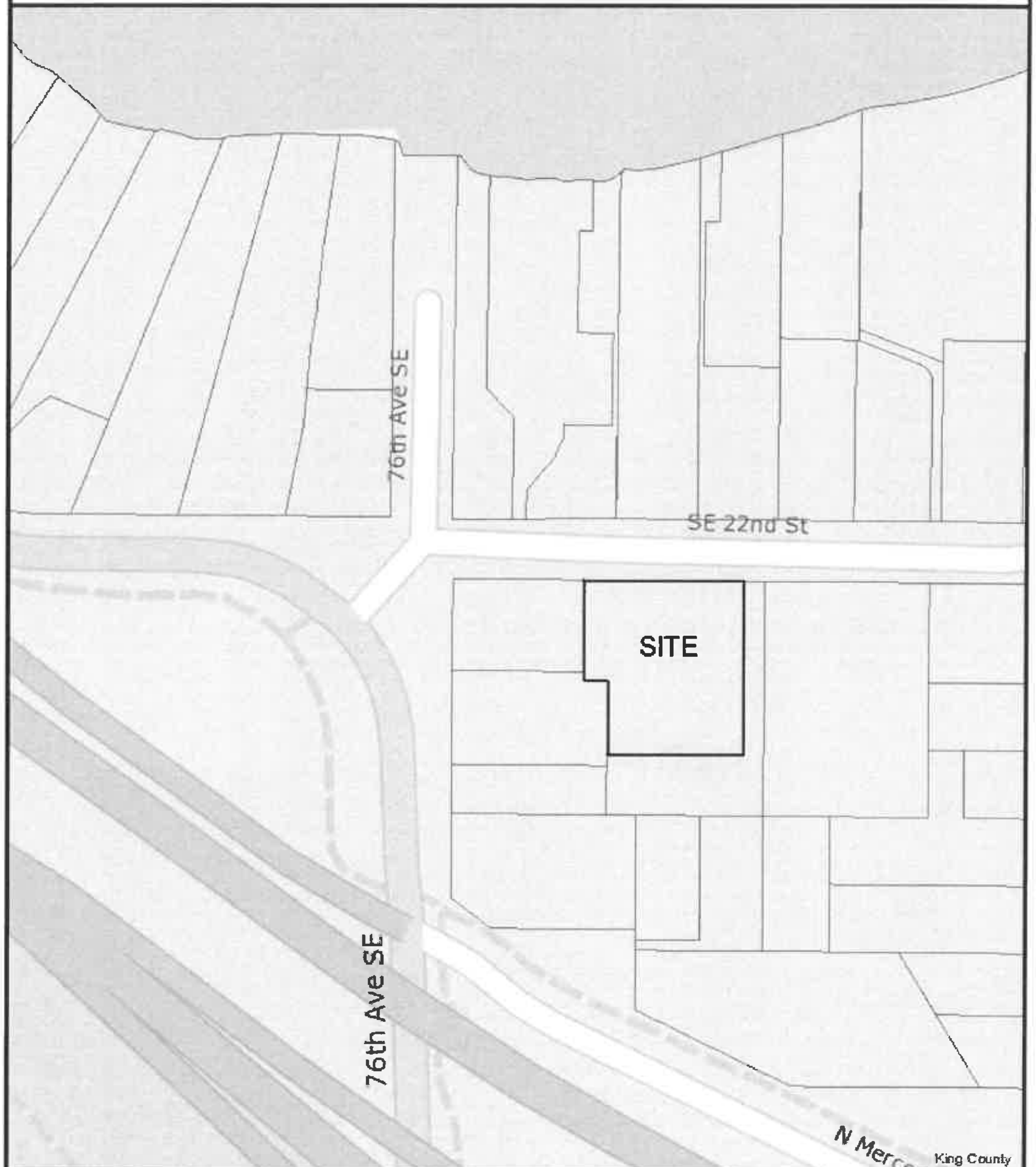


VICINITY MAP



SENSITIVE AREA FOLIO MAPS

SAO EROSION

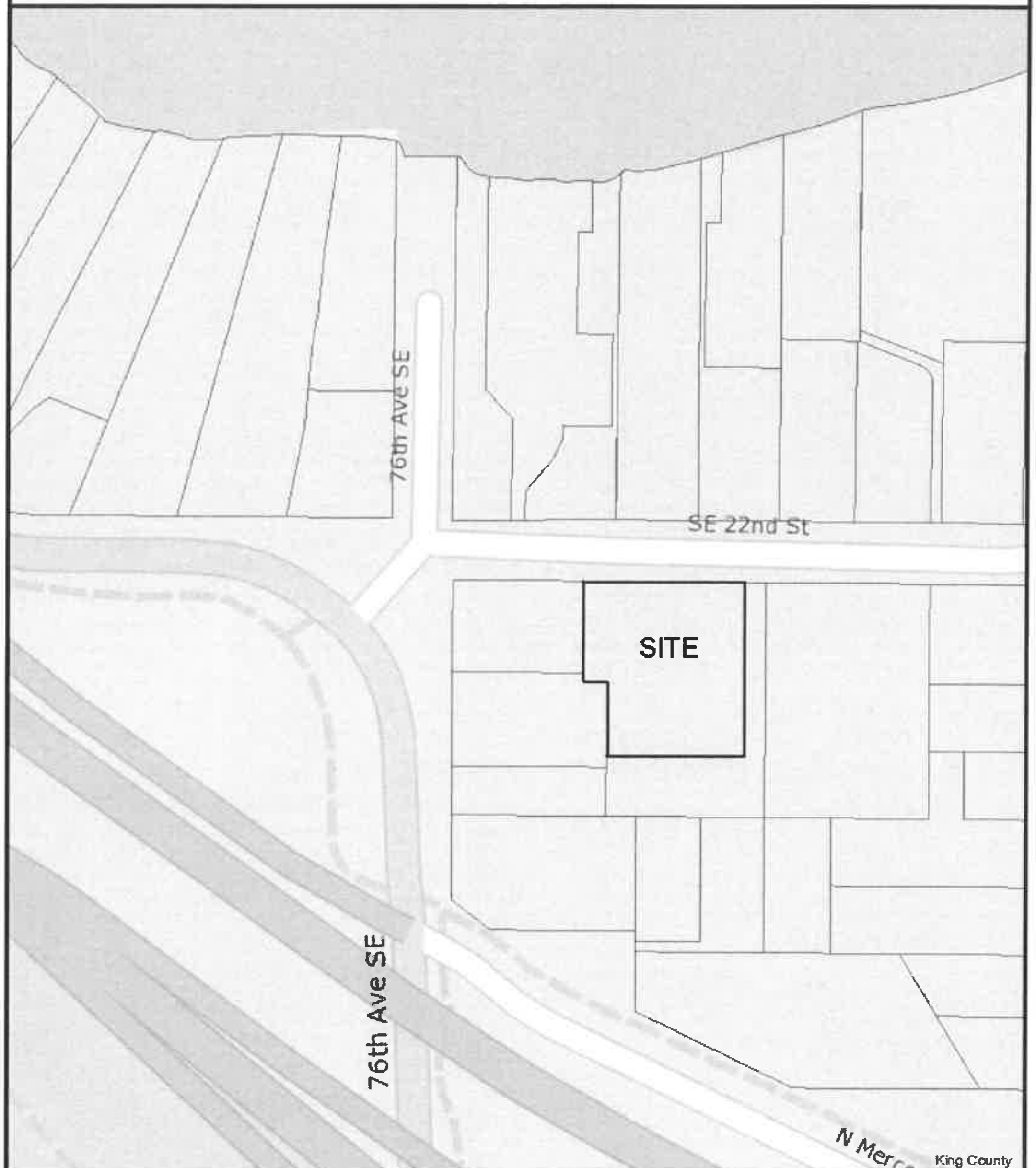


N

King County

Date: 6/17/2021 Notes:

SAO SEISMIC



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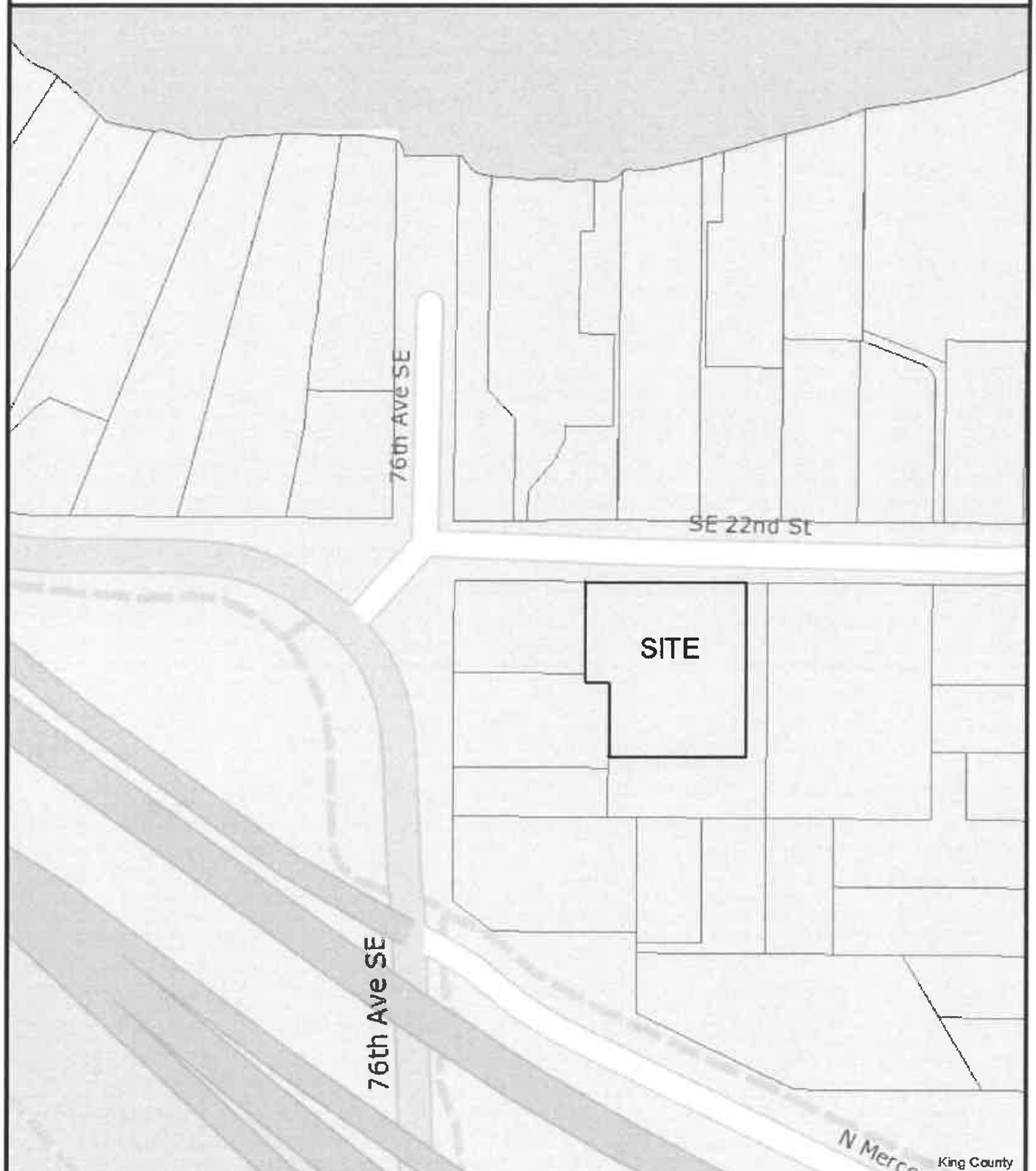
King County

Date: 6/17/2021 Notes:

SAO STREAM



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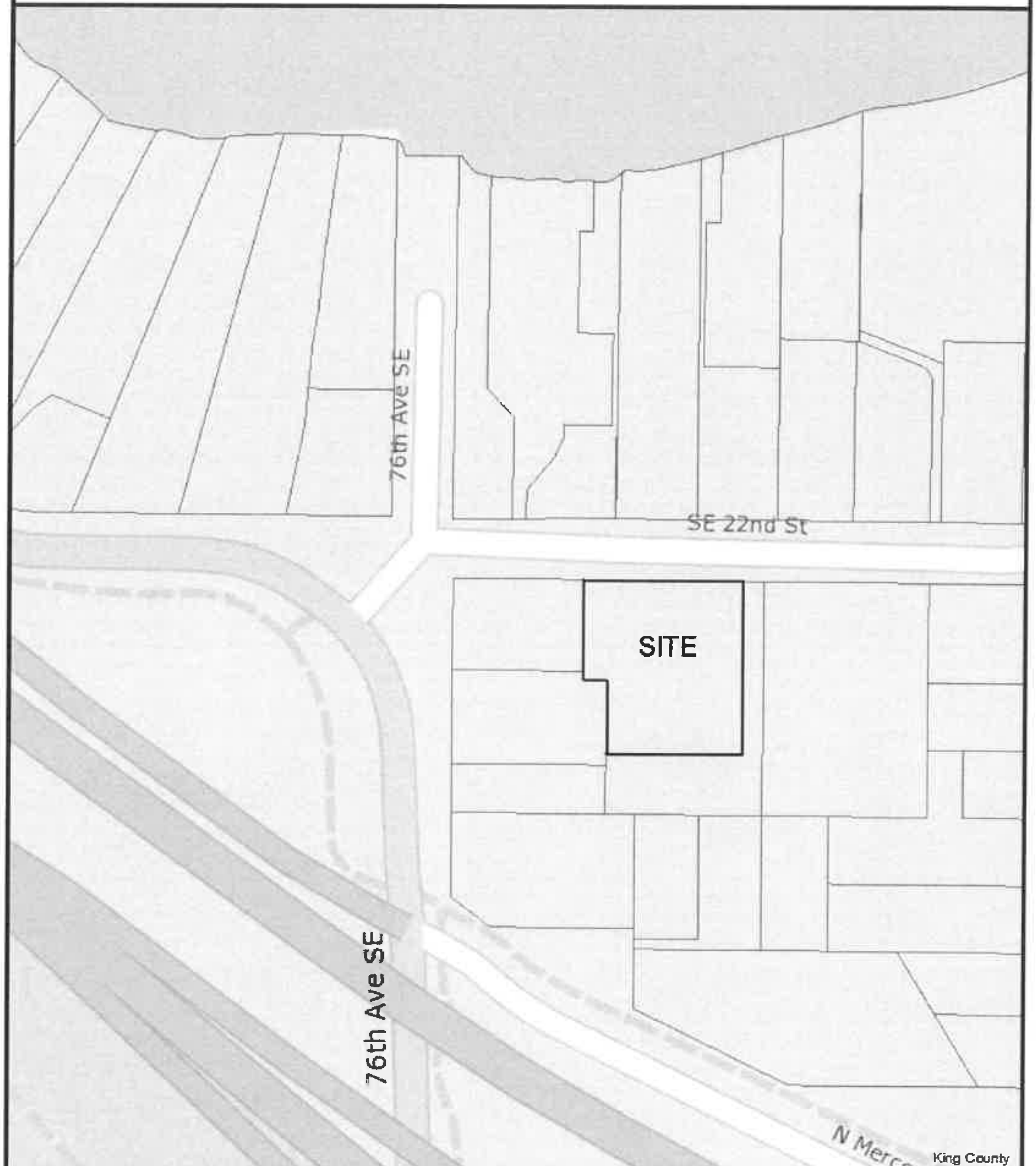
King County

Date: 6/17/2021 Notes:

SAO LANDSLIDE



Date: 6/17/2021 Notes:

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King County

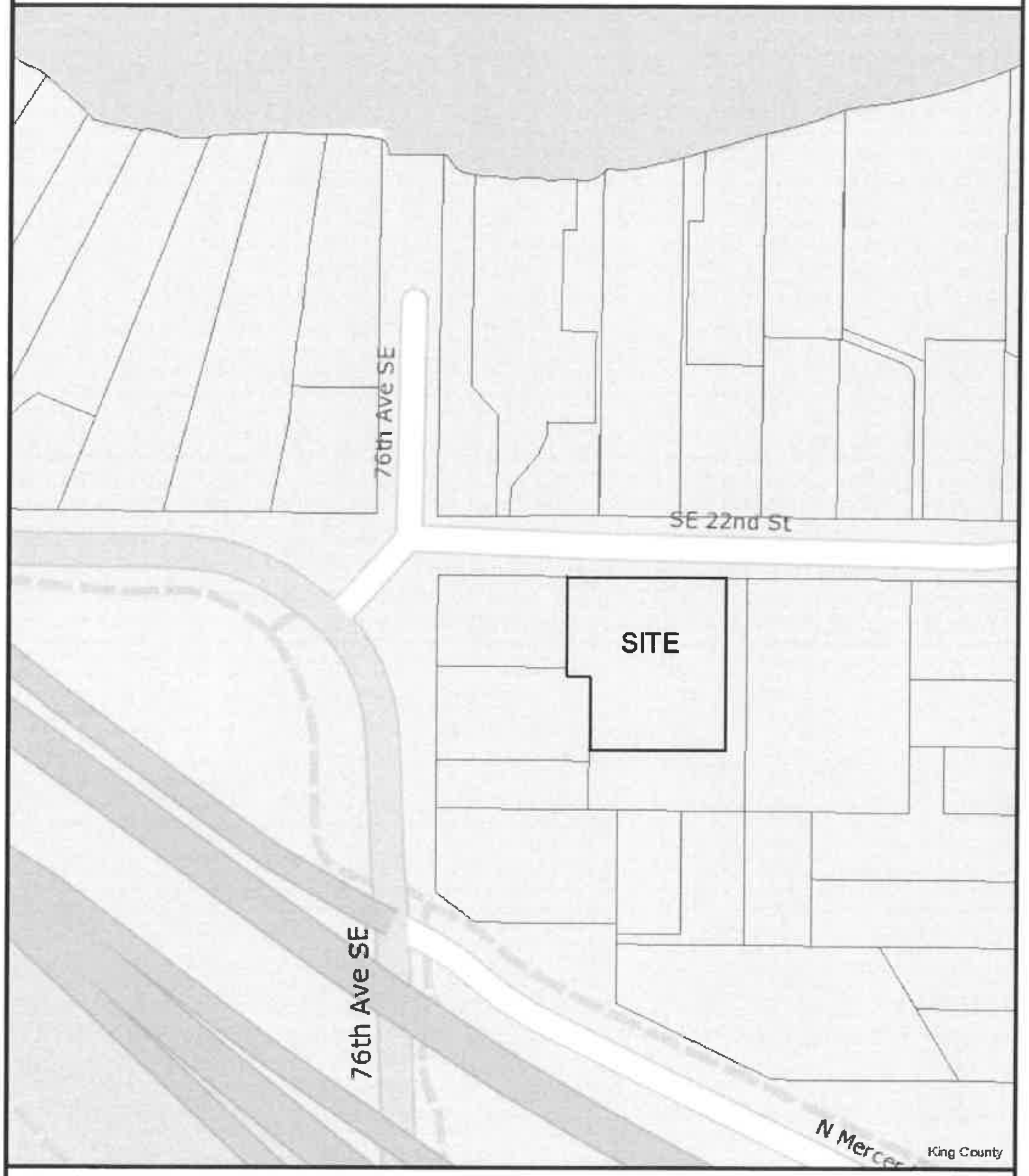
SAO COALMINE

N

Date: 6/17/2021 Notes:

King County

SAO WETLAND



Date: 6/17/2021 Notes:

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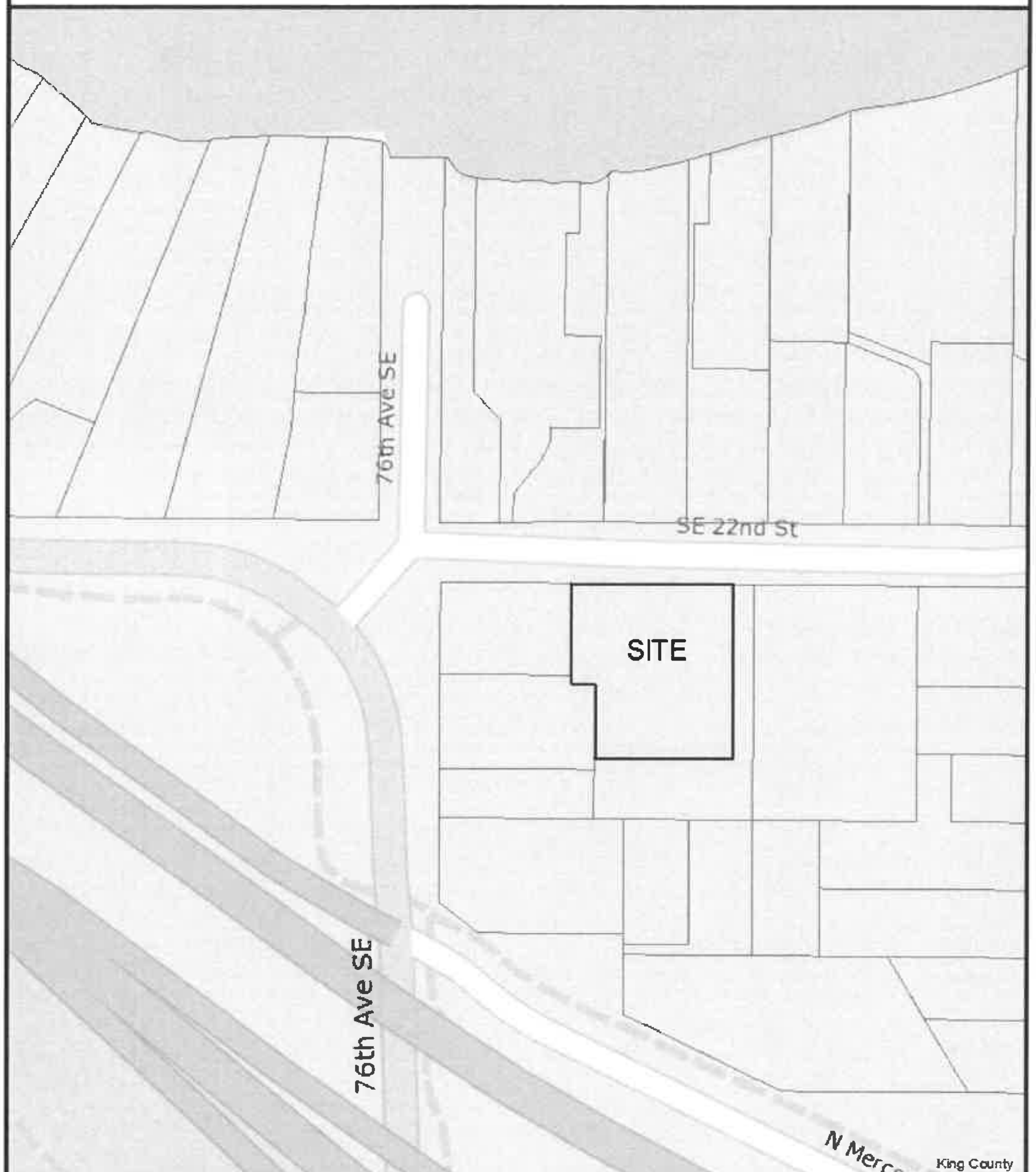
King County

DRAINAGE COMPLAINTS

DRAINAGE COMPLAINTS

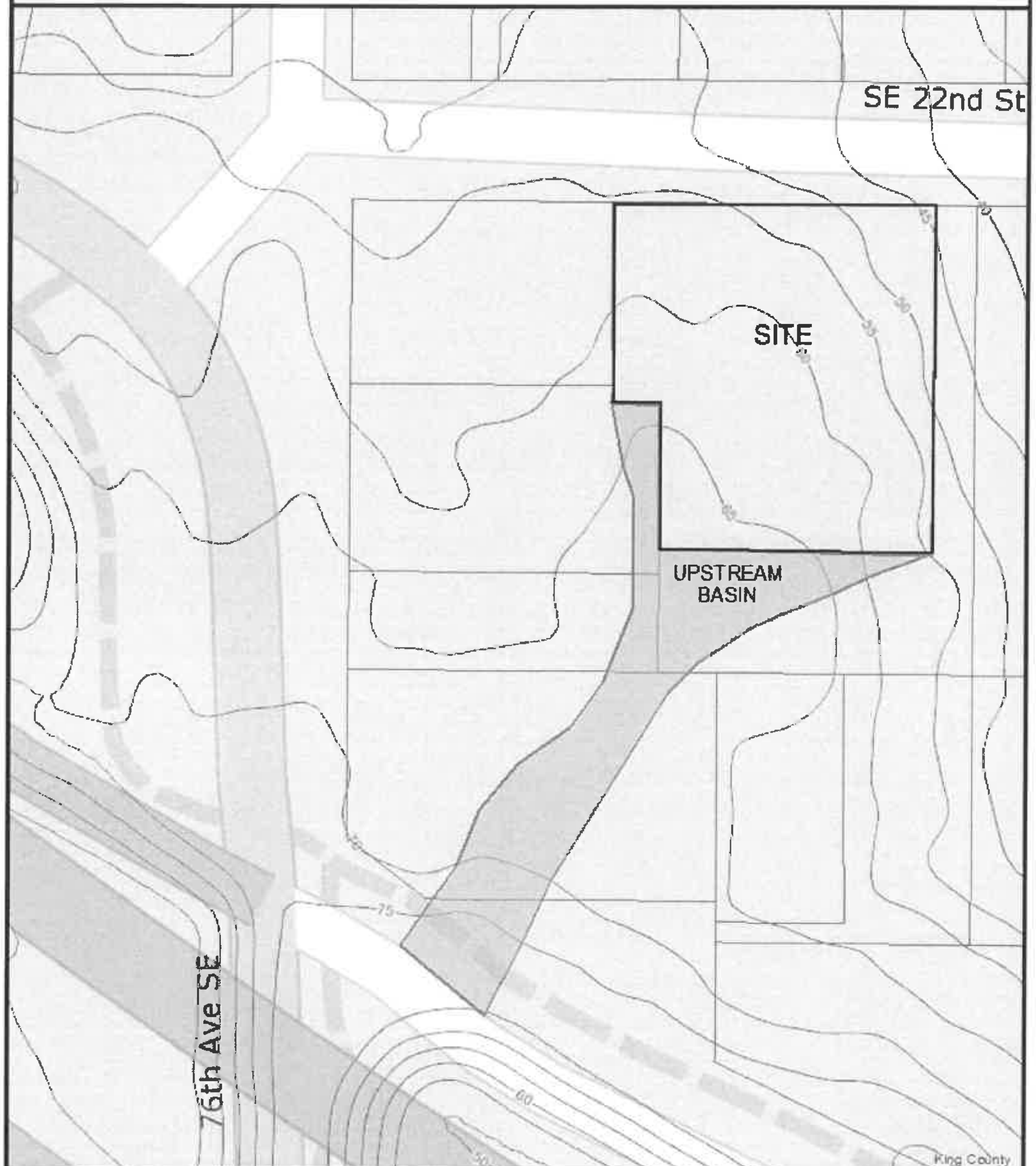


Date: 6/17/2021 Notes:

King County

UPSTREAM DRAINAGE MAPS

UPSTREAM DRAINAGE BASIN



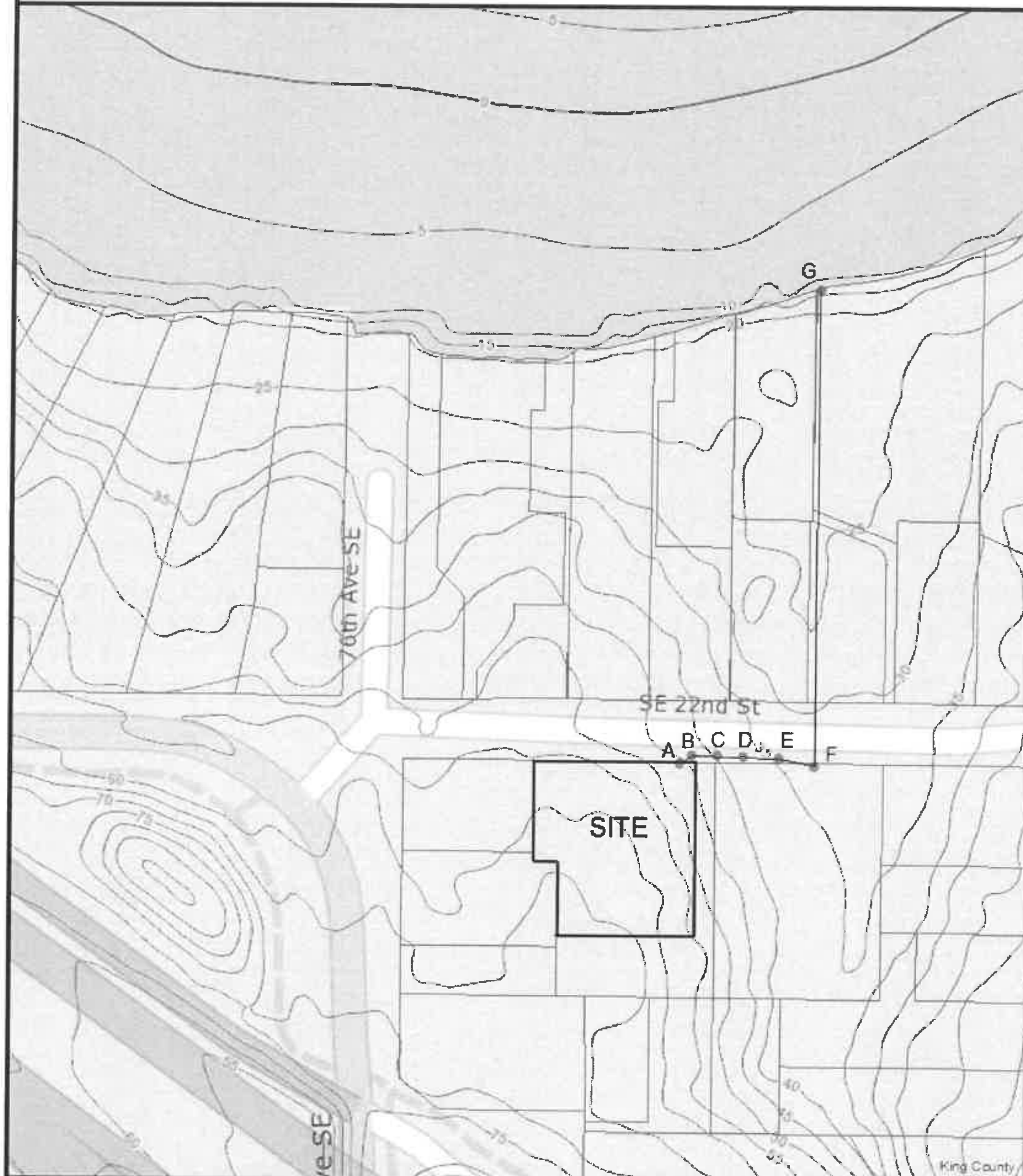
Date: 6/17/2021 Notes:

N

King County

DOWNSTREAM DRAINAGE MAPS

DOWNSTREAM FLOW PATH



Date: 6/17/2021 Notes:

King County

OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE

OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
SURFACE WATER DESIGN MANUAL, CORE REQUIREMENT #2

Basin: Mercer Island **Subbasin Name:** **Subbasin Number:**

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector, resource reviewer, or resident
see map	Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	¼ ml = 1,320 ft.	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
A	Site Discharge			0	None observed	None	Looked in good condition
A-B	Sheet Flow	From northeast corner of the property until it reaches ditch south of SE 22nd St where it immediately enters a culvert		0-14’	None observed	None	Looked in good condition
B-C	12” Green Plastic Pipe	Flows beneath driveway for 7627 SE 22nd St		14’-38’	None observed	None	Entrance and exit overgrown and could potentially be problematic
C-D	Ditch	Flows east until it reaches next culvert		38’-65’	None observed	None	Vegetation overgrown.
D-E	12” Plastic Corrugated Pipe	Flows east under driveway to King County-Waste Water facility.		65’-100’	None observed	None	Entrance and exit overgrown and could cause constriction

E-F	8" Concrete Pipe	Transports runoff to the east south east where it outfalls to a stream that immediately enters a box culvert		100'-134'	None observed	None	Looked in good condition
F-G	5' Wide Concrete Box Culvert	Culvert crosses north across SE 22nd St and continues going between the houses to the north.		134'-598'	None observed	None	The box culvert looked to be in good condition and the grate leading to it was in working condition preventing debris from entering.
G	Lake Washington	The runoff enters Lake Washington thus ending the downstream analysis.		598'	Unable to be observed.	None	Unable to be observed due to the outfall occurring on private property, but no problems anticipated

ADHERENCE TO 2014 STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON MINIMUM TECHNICAL REQUIREMENTS 1-9

1. Minimum Requirement #1: Preparation of Stormwater Site Plans

A set of preliminary civil plans have been prepared and included with this submittal.

2. Minimum Requirement #2: Construction Stormwater Pollution Prevention

All exposed soils shall be either hydroseeded, sodded, mulched, covered with a plastic coating, or application of ground base on areas to be paved within the following time periods listed below. 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.

Bmp's shall be siutable for the appropriate time of year construction takes place. These shall include but not limited to silt fence, catchbasin inserts, strawbale and rock checkdams, nad interceptor trenches.

Permanent catch basins used during the construction phase of the project will be protected using filter fabric barriers under the grate. These will be routinely replaced to prevent plugging.

All underground utility construction guidelines will be complied with according to erosion and sediment control requirement # 9.

A construction entrance will be established using quarry spalls. All temporary BMPs will be removed within 30 days after final site stabilization is complete.

All dewatering onsite will be detained in a temporary detention pond before entering any pipe.

All temporary and permanent control measures will be properly maintained and repaired as needed to assure proper performance measures. The contractor shall be bonded to assure compliance with the sediment and control plan.

3. Minimum Requirement #3: Source Control of Pollution

The main source of pollution in this project will be automobile oils and grease. Since the impact of this will be insignificant, no measures will be taken.

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

Drainage from the proposed site will dischrge directly into Lake Washington. The proposed driveway will be directly discharged to Lake Washington since it is less than 5,000 sf. The stormwater is discharged in the natural downstream direction which enters Lake Washington.

5. Minimum Requirement Number 5: On-Site Stormwater Management

Lawn and Landscape Areas:

1) We will be applying Post-Construction Soil Quality and Depth per BMP T5.13

Roofs:

Using List #2

1) Full Dispersion is infeasible due to an inadequate flow path.

   Full Infiltration is infeasible due to poor soils per the Geotechnical Report

2) Bioretention is infeasible due to the poor soils.

3) Downspout Dispersion is infeasible due to inadequate flowpath

   Using a Perforated Stub-out connection per BMP T5.10C is deemed infeasible due poor soils.

   We recommend going to detention before discharging

Other Hard Surfaces

For all other impervious areas, Using List #2

1) Full Dispersion is infeasible due to an inadequate flow path.

   Full Infiltration is infeasible due to poor soils per City of Bellevue Infiltration Infeasibility map

2) Permeable Pavement is infeasible due to the poor soils

3) Bioretention is infeasible due to the poor soils.

4) Sheet Flow Dispersion is infeasible due to inadequate flowpath.

6. Minimum Requirement Number 6: Runoff Treatment

Since it is expected that less than 5,000 sf of new Pollution Generating Impervious Surface will be added, no water quality measures are deemed necessary.

7. Minimum Requirement Number 7: Flow Control

7. Minimum Requirement Number 7: Flow Control

Flow control is required since are over 5,000 sf on new plus replaced impervious surface Flow Control is required. (Detention/Water Quality Sizing Calculations).

Detention System and Water Quality Analysis and Design

1. Overview

Total Disturbed Area Being Analyzed = 25,221 sf or 0.579 acres

Soils: Vashon Glacial Till
TILL SOILS

Design Standards:

1. City of Mercer Island Storm and Surface Water Engineering Standards
   2014 Department of Ecology Manual
2. Used Western Washington Hydrologic Runoff Model and DOE flow duration standard

2. Existing Site Conditions

Modeled as forest/moderate
Disturbed Area = 25,221 sf or 0.579 acres
Total = 0.579 acres

3. Developed Site Conditions

Impervious Area:
Assuming 50% Lot coverage:
Lot 1 = 8402 sf X 0.50 = 4,201 sf
Lot 2 = 8419 sf X 0.50 = 4,209.50 sf
Lot 3 = 8,400 sf X 0.50 = 4,200 sf
Total = 12,610.50 sf

Pervious Area:

Modeled as Lawn
Planter area = (25,221 – 12,610.50) = 12,610.50 sf or 0.289 acres

Required Tank Volume = 7,643 cf
Tank Size = 9' x 126' (live storage) = 7,948.44 cf

WWHM2012
PROJECT REPORT

Project Name: 20025 Tank
Site Name:
Site Address:
City :
Report Date: 6/17/2021
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2018/10/10
Version : 4.2.16

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	.69
Pervious Total	0.69

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.69

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Lawn, Mod	**.289**

Pervious Total 0.289

Impervious Land Use	**acre**
ROOF TOPS FLAT	**0.289**

Impervious Total 0.289

Basin Total 0.578

Element Flows To:

Surface	**Interflow**	**Groundwater**
Tank 1	Tank 1	

Name : Tank 1
Tank Name: Tank 1

Dimensions
Depth: 9 ft.
Tank Type : Circular
Diameter : 9 ft.
Length : 125.617902794098 ft.
Discharge Structure
Riser Height: 8 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.001 ft.
Notch Height: 1.273 ft.
Orifice 1 Diameter: 0.382 in. **Elevation:** 0 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Tank Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000	0.000	0.000	0.000
0.1000	0.005	0.000	0.001	0.000
0.2000	0.007	0.001	0.001	0.000
0.3000	0.009	0.001	0.002	0.000
0.4000	0.010	0.002	0.002	0.000
0.5000	0.011	0.004	0.002	0.000
0.6000	0.012	0.005	0.003	0.000
0.7000	0.013	0.006	0.003	0.000
0.8000	0.014	0.008	0.003	0.000
0.9000	0.015	0.009	0.003	0.000
1.0000	0.016	0.011	0.004	0.000

1.1000	0.017	0.012	0.004	0.000
1.2000	0.017	0.014	0.004	0.000
1.3000	0.018	0.016	0.004	0.000
1.4000	0.018	0.018	0.004	0.000
1.5000	0.019	0.020	0.004	0.000
1.6000	0.019	0.022	0.005	0.000
1.7000	0.020	0.024	0.005	0.000
1.8000	0.020	0.026	0.005	0.000
1.9000	0.021	0.028	0.005	0.000
2.0000	0.021	0.030	0.005	0.000
2.1000	0.022	0.032	0.005	0.000
2.2000	0.022	0.034	0.005	0.000
2.3000	0.022	0.037	0.006	0.000
2.4000	0.023	0.039	0.006	0.000
2.5000	0.023	0.041	0.006	0.000
2.6000	0.023	0.043	0.006	0.000
2.7000	0.023	0.046	0.006	0.000
2.8000	0.024	0.048	0.006	0.000
2.9000	0.024	0.051	0.006	0.000
3.0000	0.024	0.053	0.006	0.000
3.1000	0.024	0.056	0.007	0.000
3.2000	0.024	0.058	0.007	0.000
3.3000	0.025	0.061	0.007	0.000
3.4000	0.025	0.063	0.007	0.000
3.5000	0.025	0.066	0.007	0.000
3.6000	0.025	0.068	0.007	0.000
3.7000	0.025	0.071	0.007	0.000
3.8000	0.025	0.073	0.007	0.000
3.9000	0.025	0.076	0.007	0.000
4.0000	0.025	0.078	0.007	0.000
4.1000	0.025	0.081	0.008	0.000
4.2000	0.025	0.083	0.008	0.000
4.3000	0.025	0.086	0.008	0.000
4.4000	0.025	0.089	0.008	0.000
4.5000	0.026	0.091	0.008	0.000
4.6000	0.025	0.094	0.008	0.000
4.7000	0.025	0.096	0.008	0.000
4.8000	0.025	0.099	0.008	0.000
4.9000	0.025	0.102	0.008	0.000
5.0000	0.025	0.104	0.008	0.000
5.1000	0.025	0.107	0.008	0.000
5.2000	0.025	0.109	0.009	0.000
5.3000	0.025	0.112	0.009	0.000
5.4000	0.025	0.114	0.009	0.000
5.5000	0.025	0.117	0.009	0.000
5.6000	0.025	0.120	0.009	0.000
5.7000	0.025	0.122	0.009	0.000
5.8000	0.024	0.125	0.009	0.000
5.9000	0.024	0.127	0.009	0.000
6.0000	0.024	0.129	0.009	0.000
6.1000	0.024	0.132	0.009	0.000
6.2000	0.024	0.134	0.009	0.000
6.3000	0.023	0.137	0.009	0.000
6.4000	0.023	0.139	0.010	0.000
6.5000	0.023	0.141	0.010	0.000
6.6000	0.023	0.144	0.010	0.000
6.7000	0.022	0.146	0.010	0.000

6.8000	0.022	0.148	0.010	0.000
6.9000	0.022	0.150	0.010	0.000
7.0000	0.021	0.153	0.010	0.000
7.1000	0.021	0.155	0.011	0.000
7.2000	0.020	0.157	0.011	0.000
7.3000	0.020	0.159	0.012	0.000
7.4000	0.019	0.161	0.012	0.000
7.5000	0.019	0.163	0.012	0.000
7.6000	0.018	0.165	0.013	0.000
7.7000	0.018	0.167	0.013	0.000
7.8000	0.017	0.168	0.014	0.000
7.9000	0.017	0.170	0.014	0.000
8.0000	0.016	0.172	0.015	0.000
8.1000	0.015	0.173	0.517	0.000
8.2000	0.014	0.175	1.419	0.000
8.3000	0.013	0.176	2.516	0.000
8.4000	0.012	0.178	3.647	0.000
8.5000	0.011	0.179	4.654	0.000
8.6000	0.010	0.180	5.416	0.000
8.7000	0.009	0.181	5.908	0.000
8.8000	0.007	0.182	6.354	0.000
8.9000	0.005	0.183	6.738	0.000
9.0000	0.000	0.183	7.102	0.000
9.1000	0.000	0.000	7.448	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.69
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.289
Total Impervious Area:0.289

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.018593
5 year	0.03017
10 year	0.036641
25 year	0.04333
50 year	0.04735
100 year	0.050679

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.009686
5 year	0.016733

10 year	0.023361
25 year	0.034633
50 year	0.045628
100 year	0.059333

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.020	0.008
1950	0.040	0.009
1951	0.044	0.055
1952	0.013	0.007
1953	0.010	0.009
1954	0.015	0.008
1955	0.027	0.008
1956	0.023	0.010
1957	0.017	0.008
1958	0.019	0.009
1959	0.016	0.008
1960	0.027	0.014
1961	0.016	0.009
1962	0.009	0.007
1963	0.012	0.008
1964	0.016	0.009
1965	0.012	0.010
1966	0.012	0.008
1967	0.027	0.009
1968	0.016	0.008
1969	0.016	0.008
1970	0.012	0.009
1971	0.011	0.008
1972	0.032	0.028
1973	0.014	0.010
1974	0.015	0.009
1975	0.023	0.008
1976	0.014	0.008
1977	0.001	0.006
1978	0.012	0.009
1979	0.007	0.006
1980	0.021	0.046
1981	0.011	0.008
1982	0.021	0.010
1983	0.019	0.009
1984	0.012	0.007
1985	0.007	0.007
1986	0.034	0.009
1987	0.028	0.011
1988	0.010	0.007
1989	0.006	0.007
1990	0.046	0.013
1991	0.040	0.011
1992	0.013	0.009
1993	0.015	0.007
1994	0.004	0.006
1995	0.021	0.009
1996	0.041	0.036

1997	0.038	0.106
1998	0.008	0.007
1999	0.024	0.013
2000	0.015	0.008
2001	0.002	0.006
2002	0.018	0.010
2003	0.014	0.008
2004	0.034	0.015
2005	0.018	0.008
2006	0.024	0.010
2007	0.064	0.057
2008	0.051	0.040
2009	0.028	0.010

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.0642	0.1058
2	0.0506	0.0567
3	0.0459	0.0547
4	0.0436	0.0464
5	0.0411	0.0400
6	0.0401	0.0357
7	0.0396	0.0275
8	0.0378	0.0146
9	0.0342	0.0141
10	0.0335	0.0132
11	0.0323	0.0129
12	0.0284	0.0114
13	0.0283	0.0111
14	0.0272	0.0104
15	0.0268	0.0102
16	0.0267	0.0100
17	0.0243	0.0099
18	0.0237	0.0098
19	0.0232	0.0097
20	0.0229	0.0095
21	0.0212	0.0094
22	0.0210	0.0093
23	0.0210	0.0092
24	0.0205	0.0092
25	0.0193	0.0092
26	0.0188	0.0089
27	0.0184	0.0089
28	0.0184	0.0088
29	0.0173	0.0088
30	0.0158	0.0087
31	0.0157	0.0087
32	0.0156	0.0087
33	0.0155	0.0085
34	0.0155	0.0085
35	0.0152	0.0085
36	0.0152	0.0084
37	0.0148	0.0084
38	0.0148	0.0084
39	0.0143	0.0084

40	0.0141	0.0083
41	0.0135	0.0083
42	0.0135	0.0082
43	0.0132	0.0082
44	0.0125	0.0081
45	0.0124	0.0081
46	0.0124	0.0079
47	0.0123	0.0078
48	0.0119	0.0076
49	0.0116	0.0076
50	0.0113	0.0072
51	0.0111	0.0071
52	0.0103	0.0070
53	0.0103	0.0070
54	0.0092	0.0070
55	0.0077	0.0070
56	0.0072	0.0069
57	0.0066	0.0067
58	0.0065	0.0064
59	0.0037	0.0063
60	0.0018	0.0062
61	0.0014	0.0056

Stream Protection Duration
POC #1
The Facility FAILED

Facility FAILED duration standard for 1+ flows.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0093	4211	3499	83	Pass
0.0097	3877	2562	66	Pass
0.0101	3592	1728	48	Pass
0.0104	3309	1215	36	Pass
0.0108	3057	1043	34	Pass
0.0112	2820	938	33	Pass
0.0116	2616	845	32	Pass
0.0120	2441	758	31	Pass
0.0124	2268	690	30	Pass
0.0128	2133	612	28	Pass
0.0131	1996	528	26	Pass
0.0135	1862	470	25	Pass
0.0139	1736	404	23	Pass
0.0143	1618	334	20	Pass
0.0147	1517	287	18	Pass
0.0151	1422	198	13	Pass
0.0154	1340	192	14	Pass
0.0158	1260	186	14	Pass
0.0162	1194	177	14	Pass
0.0166	1132	174	15	Pass
0.0170	1053	169	16	Pass
0.0174	989	161	16	Pass
0.0178	931	151	16	Pass
0.0181	887	147	16	Pass
0.0185	830	144	17	Pass
0.0189	785	137	17	Pass

0.0193	744	127	17	Pass
0.0197	705	123	17	Pass
0.0201	665	120	18	Pass
0.0204	628	115	18	Pass
0.0208	583	109	18	Pass
0.0212	550	103	18	Pass
0.0216	525	99	18	Pass
0.0220	491	96	19	Pass
0.0224	466	95	20	Pass
0.0227	436	94	21	Pass
0.0231	407	90	22	Pass
0.0235	385	87	22	Pass
0.0239	351	83	23	Pass
0.0243	334	81	24	Pass
0.0247	315	77	24	Pass
0.0251	296	75	25	Pass
0.0254	280	72	25	Pass
0.0258	266	72	27	Pass
0.0262	252	71	28	Pass
0.0266	243	68	27	Pass
0.0270	230	68	29	Pass
0.0274	219	66	30	Pass
0.0277	208	62	29	Pass
0.0281	200	60	30	Pass
0.0285	187	58	31	Pass
0.0289	183	58	31	Pass
0.0293	175	54	30	Pass
0.0297	173	50	28	Pass
0.0301	163	47	28	Pass
0.0304	153	45	29	Pass
0.0308	145	43	29	Pass
0.0312	136	43	31	Pass
0.0316	132	41	31	Pass
0.0320	122	38	31	Pass
0.0324	114	38	33	Pass
0.0327	107	36	33	Pass
0.0331	97	36	37	Pass
0.0335	89	34	38	Pass
0.0339	82	33	40	Pass
0.0343	77	30	38	Pass
0.0347	70	29	41	Pass
0.0350	64	28	43	Pass
0.0354	62	28	45	Pass
0.0358	55	26	47	Pass
0.0362	51	26	50	Pass
0.0366	47	26	55	Pass
0.0370	43	26	60	Pass
0.0374	40	26	65	Pass
0.0377	38	25	65	Pass
0.0381	35	24	68	Pass
0.0385	33	24	72	Pass
0.0389	31	24	77	Pass
0.0393	29	24	82	Pass
0.0397	28	24	85	Pass
0.0400	23	23	100	Pass
0.0404	22	22	100	Pass
0.0408	19	20	105	Pass

0.0412	14	20	142	Fail
0.0416	14	19	135	Fail
0.0420	13	19	146	Fail
0.0424	10	18	180	Fail
0.0427	10	17	170	Fail
0.0431	9	17	188	Fail
0.0435	8	16	200	Fail
0.0439	7	15	214	Fail
0.0443	5	15	300	Fail
0.0447	5	15	300	Fail
0.0450	5	14	280	Fail
0.0454	3	14	466	Fail
0.0458	3	14	466	Fail
0.0462	2	14	700	Fail
0.0466	2	12	600	Fail
0.0470	2	12	600	Fail
0.0474	2	12	600	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.

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   Total Volume   Volume   Infiltration   Cumulative
Percent   Water Quality   Percent   Comment
                                 Treatment? Needs   Through   Volume   Volume
Volume   Water Quality
                                             Treatment   Facility (ac-ft.)   Infiltration
Infiltrated   Treated
                                             (ac-ft)   (ac-ft)   Credit

Tank 1 POC   N   67.51   N
0.00
Total Volume Infiltrated   67.51   0.00   0.00   0.00
0.00   0%   No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Failed

Perlnd and Implnd Changes

No changes have been made.

8. Minimum Requirement Number 8: Wetlands Protection

The subject site does not discharge to a wetland, therefore this requirement is not applicable

9. Minimum Requirement Number 9: Operation and Maintenance

An Operation and Maintenance Manual will be prepared during the next submittal phase.

Appendix A

Geotechnical Report

RILEYGROUP

GEOTECHNICAL ENGINEERING REPORT

PREPARED BY:

THE RILEY GROUP, INC.
17522 BOTHELL WAY NORTHEAST
BOTHELL, WASHINGTON 98011

PREPARED FOR:

MILESTONE NORTHWEST
227 BELLEVUE WAY NORTHEAST, SUITE 183
MERCER ISLAND, WASHINGTON 98004

RGI PROJECT NO. 2020-404-1

MERCER ISLAND 3-LOT
7621 SOUTHWEST 22ND STREET
MERCER ISLAND, WASHINGTON

SEPTEMBER 15, 2020

Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone 425.415.0551 ♦ Fax 425.415.0311

www.riley-group.com

RILEYGROUP

September 15, 2020

Mr. Greg Arms
Milestone Northwest
227 Bellevue Way Northeast, Suite 183
Mercer Island, Washington 98004

Subject: **Geotechnical Engineering Report**
Mercer Island 3-Lot
7621 Southwest 22nd Street
Mercer Island, Washington
RGI Project No. 2020-404-1

Dear Mr. Arms:

As requested, The Riley Group, Inc. (RGI) has prepared this Geotechnical Engineering Report (GER) for the above-referenced site. Our services were completed in accordance with our proposal 2020-404-PRP1 dated August 13, 2020 and authorized by you on August 19, 2020. The information in this GER is based on our understanding of the proposed construction, and the soil and groundwater conditions encountered in the test pits and completed by RGI at the site on August 28, 2020.

RGI recommends the project plans and specifications be submitted for a general review so that RGI may confirm that the recommendations in this GER are interpreted and implemented properly in the construction documents. RGI also recommends that a representative of our firm be present on site during portions of the project construction to confirm that the soil and groundwater conditions are consistent with those that form the basis for the engineering recommendations in this GER.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

State of Washington Licensed Geologist 2698
ERIC L. WOODS
9/15/2020

RICKY RUNQI WANG, STATE OF WASHINGTON, 35013 REGISTERED PROFESSIONAL ENGINEER
9/15/2020

Eric L. Woods, LG
Project Geologist

Ricky R. Wang, PhD, PE
Principal Engineer

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LIST OF APPENDICES

Executive Summary

This Executive Summary should be used in conjunction with the entire GER for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and this GER must be read in its entirety for a comprehensive understanding of the items contained herein. Section 7.0 should be read for an understanding of limitations.

RGI's geotechnical scope of work included the advancement of three test pits to depths up to 9 feet below ground surface (bgs).

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified.

Soil Conditions: The soils encountered include stiff to very stiff silt, silt with some sand, and sandy silt.

Groundwater: Groundwater was not encountered during our field exploration.

Foundations: Foundations for the proposed buildings can be supported on conventional continuous and spread footings bearing on medium dense native soil or new structural fill.

Slab-on-grade: Slab-on-grade floors for the proposed building can be supported on medium dense native soil or new structural fill.

Pavements: The following pavement sections are recommended for driveways:

- **Flexible** : 3 inches of hot mix asphalt (HMA) over 6 inches of crushed rock base(CRB) over compacted subgrade
- **Concrete:** 5 inches of concrete over 4 inches of CRB over compacted subgrade

1.0 Introduction

This Geotechnical Engineering Report (GER) presents the results of the geotechnical engineering services provided for the proposed Mercer Island 3-Lot in Mercer Island, Washington. The purpose of this GER is to assess subsurface conditions and provide geotechnical recommendations for the construction of 3 single-family residences with associated facilities and driveways. Our scope of services included field explorations, laboratory testing, engineering analyses, and preparation of this GER.

The recommendations in the following sections of this GER are based upon our current understanding of the proposed site development as outlined below. If actual features vary or changes are made, RGI should review them in order to modify our recommendations as required. In addition, RGI requests to review the site grading plan, final design drawings and specifications when available to verify that our project understanding is correct and that our recommendations have been properly interpreted and incorporated into the project design and construction.

2.0 Project Description

The site is located at 7621 Southwest 22nd Street in Mercer Island, Washington. The approximate location of the site is shown on Figure 1. The site is currently occupied by a single-family residence in the middle portion of the site.

RGI understands that the client plans to demolish the existing structure and develop the site into 3 residential lots. Our understanding of the project is based on site plan prepared by Architecture Innovations dated April 23, 2020.

Based on our experience with similar construction, RGI anticipates that the proposed buildings will be supported on perimeter walls with bearing loads of 2 to 3 kips per linear foot, and a series of columns with a maximum load up to 100 kips. Slab-on-grade floor loading of 250 pounds per square foot (psf) are expected.

3.0 Field Exploration and Laboratory Testing

3.1 Field Exploration

On August 28, 2020, RGI observed the excavation of three test pits across the site. The approximate exploration locations are shown on Figure 2.

Field logs of each exploration were prepared by the geologist who continuously observed the excavation. These logs included visual classifications of the materials encountered during excavation as well as our interpretation of the subsurface conditions between samples. The test pit logs included in Appendix A represent an interpretation of the field logs and include modifications based on laboratory observation and analysis of the samples.

3.2 Laboratory Testing

During the field investigation, a representative portion of each recovered sample was sealed in containers and transported to our laboratory for further visual and laboratory examination. Samples retrieved from the test pits were tested for moisture content and grain size to aid in soil classification and provide input for the recommendations provided in this GER. The results and descriptions of the laboratory tests are enclosed in Appendix A.

4.0 Site Conditions

4.1 Surface

The site is an irregular-shaped land including a tax parcel with a total area of approximately 25,218 square feet in size. The site is bound to the north by Southeast 22nd Street, and to the east, south, and west by residential properties.

The site is occupied by a residential building in the middle portion of the site. The site slopes from southwest to the northeast with a slope gradient of about 10 to 15 percent, with the southern portion of the property containing an approximately 10-foot-high southeast facing slope that descends at gradients of about 26 to 33 percent. The total elevation change across the site is approximately 20 feet. The site is vegetated with grass, mixed brush and ferns, decorative plants and shrubs, and small- to large-diameter trees.

4.2 Geology

Review of the *Geologic Map of Mercer Island, Washington* by Kathy G. Troost, etc, (2006) indicates that the soil through most of the site is mapped as Vashon till (Map Unit Qvt) that consists of a dense to very dense mixture of silt, sand, and gravel deposited at the base of the Vashon ice sheet. The eastern edge of the site is mapped as Recessional outwash deposits (Qvr) which is stratified sand and gravel with localized silty sand and silt, deposited by meltwater streams issuing from the retreating Vashon ice sheet. Much of the site is secondarily mapped as mass wastage deposits. The native soils encountered below the site appears to be different from what was described in the geology map, possibly Lawton Clay (Qvlc) which is laminated to massive silt and clay with scattered dropstones deposited in proglacial lakes. Evidence of mass wastage was observed at the site.

4.3 Soils

The soils encountered include stiff to very stiff silt, silt with some sand, and sandy silt.

More detailed descriptions of the subsurface conditions encountered are presented in the test pit logs included in Appendix A. Sieve analysis was performed on four selected soil samples. The grain-size distribution curve is included in Appendix A.

4.4 GROUNDWATER

Groundwater was not encountered during our field exploration.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the explorations were performed. In addition, perched water can develop within seams and layers contained in fill soils or higher permeability soils overlying less permeable soils following periods of heavy or prolonged precipitation.

4.5 SEISMIC CONSIDERATIONS

Based on the 2015 International Building Code (IBC), RGI recommends the follow seismic parameters in Table 1 be used for design.

Table 1 IBC Seismic Parameters

2012/2015 IBC Parameter	Value
Site Soil Class[1]	D[2]
Site Latitude	47.590989 N
Site Longitude	122.236687 W
Maximum considered earthquake spectral response acceleration parameters (g)	S_s =1.365, S_1 =0.526
Spectral response acceleration parameters adjusted for site class (g)	S_{ms} =1.365, S_{m1} =0.789
Design spectral response acceleration parameters (g)	S_{ds} =0.91, S_{d1} =0.526

1 Note: In general accordance with the USGS *2015 International Building Code*. IBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

2 Note: The *2015 International Building Code* requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope of our services does not include the required 100 foot soil profile determination. Explorations extended to a maximum depth of 9 feet, and this seismic site class definition considers that very dense soil continues below the maximum depth of the subsurface exploration.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations from a seismic event. Liquefaction mainly affects geologically recent deposits of fine-grained sands that are below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction, thus reducing or eliminating the soil's strength.

RGI reviewed the results of the field and laboratory testing and assessed the potential for liquefaction of the site's soil during an earthquake. Based on the soil and groundwater conditions encountered, RGI considers that the possibility of liquefaction during an earthquake is minimal.

4.6 GEOLOGIC HAZARD AREAS

RGI reviewed the City of Bellevue Municipal Codes. The review indicates that the eastern portion of the site is mapped as erosion hazard. Erosion and Sediment control recommendations are provide below.

5.0 Discussion and Recommendations

5.1 GEOTECHNICAL CONSIDERATIONS

Based on our observations, explorations and analysis, the site is suitable for the proposed construction from a geotechnical standpoint. RGI recommends that foundations for the proposed buildings be supported on conventional spread footings bearing on medium dense native soil or new structural fill if needed. Slab-on-grade floors and pavement sections can be similarly supported on competent native soil or structural fill.

Detailed recommendations regarding the above issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 EARTHWORK

The earthwork for the project is expected to including mass grading of the site to provide lot and access roadway grades, excavation and backfilling of the detention vault, installing underground utilities, and excavating and backfilling the residence foundations. The earthwork should take place in the dry season (June through September).

5.2.1 EROSION AND SEDIMENT CONTROL

Potential sources or causes of erosion and sedimentation depend on construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The impacts on erosion-prone areas can be reduced by implementing an erosion and sedimentation control plan. The plan should be designed in accordance with applicable city and/or county standards.

RGI recommends the following erosion control Best Management Practices (BMPs):

- Scheduling site preparation and grading for the drier summer and early fall months and undertaking activities that expose soil during periods of little or no rainfall
- Establishing a quarry spall construction entrance

- Installing siltation control fencing or anchored straw or coir wattles on the downhill side of work areas
- Covering soil stockpiles with anchored plastic sheeting
- Revegetating or mulching exposed soils with a minimum 3-inch thickness of straw if surfaces will be left undisturbed for more than one day during wet weather or one week in dry weather
- Directing runoff away from exposed soils and slopes
- Minimizing the length and steepness of slopes with exposed soils and cover excavation surfaces with anchored plastic sheeting (Graded and disturbed slopes should be tracked in place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion and channeling. Some sloughing and raveling of slopes with exposed or disturbed soil should be expected.)
- Decreasing runoff velocities with check dams, straw bales or coir wattles
- Confining sediment to the project site
- Inspecting and maintaining erosion and sediment control measures frequently (The contractor should be aware that inspection and maintenance of erosion control BMPs is critical toward their satisfactory performance. Repair and/or replacement of dysfunctional erosion control elements should be anticipated.)

Permanent erosion protection should be provided by reestablishing vegetation using hydroseeding and/or landscape planting. Until the permanent erosion protection is established, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

5.2.2 STRIPPING

Stripping efforts should include removal of pavements, vegetation, organic materials, and deleterious debris from areas slated for building, pavement, and utility construction. The test pits encountered 6 to 10 inches of topsoil. Deeper areas of stripping and excavation may be required.

5.2.3 EXCAVATIONS

All temporary cut slopes associated with the site and utility excavations should be adequately inclined to prevent sloughing and collapse. The site soils consist of medium dense to very dense silty sand soils which are classified as Group B soil.

Accordingly, for excavations more than 4 feet but less than 20 feet in depth, the temporary side slopes should be laid back with a slope inclination no steeper than 1H:1V (Horizontal:Vertical) in the native soil. If there is insufficient room to complete the excavations in this manner, or excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations should be considered.

For open cuts at the site, RGI recommends:

- No traffic, construction equipment, stockpiles or building supplies are allowed at the top of cut slopes within a distance of at least 5 feet from the top of the cut
- Exposed soil along the slope is protected from surface erosion using waterproof tarps and/or plastic sheeting
- Construction activities are scheduled so that the length of time the temporary cut is left open is minimized
- Surface water is diverted away from the excavation
- The general condition of slopes should be observed periodically by a geotechnical engineer to confirm adequate stability and erosion control measures

In all cases, however, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable OSHA or WISHA guidelines.

5.2.4 SITE PREPARATION

Subgrade soils that become disturbed due to elevated moisture conditions should be overexcavated to reveal firm, non-yielding, non-organic soils and backfilled with compacted structural fill. If earthwork is completed during the wet season (typically November through May) it will be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork will require additional mitigative measures beyond that which would be expected during the drier summer and fall months.

5.2.5 STRUCTURAL FILL

RGI anticipates that some areas of loose or soft soil will be exposed upon completion of stripping and grubbing. Proofrolling and subgrade verification should be considered an essential step in site preparation. After stripping, grubbing, and prior to placement of structural fill, RGI recommends proofrolling building and pavement subgrades and areas to receive structural fill. These areas should moisture condition and compacted to a firm and unyielding condition in order to achieve a minimum compaction level of 95 percent of the modified proctor maximum dry density as determined by the American Society of Testing and Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

RGI recommends fill below the foundations and floor slabs, behind retaining walls, and below pavement and hardscape surfaces be placed in accordance with the following recommendations for structural fill.

The suitability of excavated site soils and import soils for compacted structural fill use will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion passing the U.S. No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve. Soils containing more than about 5 percent fines cannot be consistently compacted to a dense, non-yielding condition when the moisture content is more than 2 percent above or below optimum. Optimum moisture content is that moisture that results in the greatest compacted dry density with a specified compactive effort.

Non-organic site soils are only considered suitable for structural fill provided that their moisture content is within about 2 percent of the optimum moisture level as determined by ASTM D1557. Excavated site soils may not be suitable for re-use as structural fill depending on the moisture content and weather conditions at the time of construction. If soils are stockpiled for future reuse and wet weather is anticipated, the stockpile should be protected with plastic sheeting that is securely anchored.

Even during dry weather, moisture conditioning (such as, windrowing and drying) of site soils to be reused as structural fill may be required. Even during the summer, delays in grading can occur due to excessively high moisture conditions of the soils or due to precipitation. If wet weather occurs, the upper wetted portion of the site soils may need to be scarified and allowed to dry prior to further earthwork, or may need to be wasted from the site.

Most of the site soils are moisture sensitive and moisture conditioning of the site soils may be necessary depending on the time of year the construction is completed. If on-site soils are or become unusable, it may become necessary to import clean, granular soils to complete site work that meet the grading requirements listed in Table 2 to be used as structural fill.

Table 2 Structural Fill Gradation

U.S. Sieve Size	Percent Passing
4 inches	100
No. 4 sieve	75 percent
No. 200 sieve	5 percent *

*Based on minus 3/4 inch fraction.

Prior to use, an RGI representative should observe and test all materials imported to the site for use as structural fill. Structural fill materials should be placed in uniform loose layers not exceeding 12 inches and compacted as specified in Table 3. The soil's maximum density and optimum moisture should be determined by ASTM D1557.

Table 3 Structural Fill Compaction ASTM D1557

Location	Material Type	Minimum Compaction Percentage	Moisture Content Range	
Foundations	On-site granular or approved imported fill soils:	95	+2	-2
Retaining Wall Backfill	On-site granular or approved imported fill soils:	92	+2	-2
Slab-on-grade	On-site granular or approved imported fill soils:	95	+2	-2
General Fill (non-structural areas)	On-site soils or approved imported fill soils:	90	+3	-2
Pavement – Subgrade and Base Course	On-site granular or approved imported fill soils:	95	+2	-2

Placement and compaction of structural fill should be observed by RGI. A representative number of in-place density tests should be performed as the fill is being placed to confirm that the recommended level of compaction is achieved.

5.2.6 Cut and Fill Slopes

All permanent cut and fill slopes should be graded with a finished inclination no greater than 2H:1V. Upon completion of construction, the slope face should be trackwalked, compacted and vegetated, or provided with other physical means to guard against erosion. All fill placed for slope construction should meet the structural fill requirements as described in Section 5.2.5.

Final grades at the top of the slopes must promote surface drainage away from the slope crest. Water must not be allowed to flow in an uncontrolled fashion over the slope face. If it is necessary to direct surface runoff towards the slope, it should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe of the slope.

5.2.7 Wet Weather Construction Considerations

RGI recommends that preparation for site grading and construction include procedures intended to drain ponded water, control surface water runoff, and to collect shallow subsurface seepage zones in excavations where encountered. It will not be possible to successfully compact the subgrade or utilize on-site soils as structural fill if accumulated water is not drained prior to grading or if drainage is not controlled during construction. Attempting to grade the site without adequate drainage control measures will reduce the amount of on-site soil effectively available for use, increase the amount of select import fill materials required, and ultimately increase the cost of the earthwork phases of the project. Free water should not be allowed to pond on the subgrade soils. RGI anticipates that the use of berms and shallow drainage ditches, with sumps and pumps in utility trenches, will be required for surface water control during wet weather and/or wet site conditions.

5.3 FOUNDATIONS

Following site preparation and grading, the proposed building foundations can be supported on conventional spread footings bearing on medium dense native soil or new structural fill. Loose, organic, or other unsuitable soils may be encountered in the proposed building footprint. If unsuitable soils are encountered, they should be overexcavated and backfilled with structural fill.

Perimeter foundations exposed to weather should be at a minimum depth of 18 inches below final exterior grades. Interior foundations can be constructed at any convenient depth below the floor slab. Finished grade is defined as the lowest adjacent grade within 5 feet of the foundation for perimeter (or exterior) footings and finished floor level for interior footings.

Table 4 Foundation Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf[1]
Friction Coefficient	0.30
Passive pressure (equivalent fluid pressure)	250 pcf[2]
Minimum foundation dimensions	Columns: 24 inches Walls: 16 inches

1. psf = pounds per square foot
2. pcf = pounds per cubic foot

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. For short-term loads, such as wind and seismic, a 1/3 increase in this allowable capacity may be used. At perimeter locations, RGI recommends not including the upper 12 inches of soil in the computation of passive pressures because it can be affected by weather or disturbed by future grading activity. The passive pressure value assumes the foundation will be constructed neat against competent soil or backfilled with structural fill as described in Section 5.3.2. The recommended base friction and passive resistance value includes a safety factor of about 1.5.

With spread-footing foundations designed in accordance with the recommendations in this section, maximum total and differential post-construction settlements of 1 inch and 1/2 inch, respectively, should be expected.

5.4 RETAINING WALL

If retaining walls are needed, RGI recommends cast-in-place concrete walls be used. The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. RGI recommends placing and compacting wall backfill as structural fill. Wall drainage will be needed behind the wall face. A typical retaining wall drainage detail is shown on Figure 3 for backfilled walls.

With wall backfill placed and compacted as recommended, and drainage properly installed, RGI recommends using the values in the following table for design. Without proper drainage, fully saturated earth pressure should be used for wall design.

Table 5 Retaining Wall Design

Design Parameter	Value
Allowable Bearing Capacity – Dense native soils	2,500 psf
Active Earth Pressure (unrestrained walls)	35 pcf
At-rest Earth Pressure (restrained walls)	50 pcf
Fully Saturated Earth Pressure (no drainage)	85 pcf

For seismic design, an additional uniform load of 7 times the wall height (H) for unrestrained walls and 14H for restrained walls should be applied to the wall surface. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 5.3.

5.5 SLAB-ON-GRADE CONSTRUCTION

Once site preparation has been completed as described in Section 5.2, suitable support for slab-on-grade construction should be provided. Immediately below the floor slab, RGI recommends placing a 4-inch-thick capillary break layer of clean, free-draining pea gravel, washed rock, or crushed rock that has less than 5 percent passing the U.S. No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab. Where moisture by vapor transmission is undesirable, an 8- to 10-millimeter-thick plastic membrane should be placed on a 4-inch-thick layer of clean gravel or rock. For the anticipated floor slab loading, we estimate post-construction floor settlements of ¼- to ½-inch.

5.6 DRAINAGE

5.6.1 SURFACE

Final exterior grades should promote free and positive drainage away from the building area. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. For non-pavement locations, RGI recommends providing a minimum drainage gradient of 3 percent for a minimum distance of 10 feet from the building perimeter. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structure.

5.6.2 SUBSURFACE

RGI recommends installing perimeter foundation shown on Figures 4. The foundation and roof downspouts should be tightlined separately to an approved discharge facility. Subsurface drains must be laid with a gradient sufficient to promote positive flow to a controlled point of approved discharge.

5.6.3 INFILTRATION

The site soils are comprised of silt, silt with some sand, and sandy silt, and are generally not considered suitable for infiltration.

5.7 UTILITIES

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) specifications. For site utilities located within the right-of-ways, bedding and backfill should be completed in accordance with City of Mercer Island specifications. At a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 5.2.5. Where utilities occur below unimproved areas, the degree of compaction can be reduced to a minimum of 90 percent of the soil's maximum density as determined by ASTM D1557. The onsite excavated soil may be suitable for re-use as structural fill depending on time of the construction. If the construction occurs in winter, imported structural fill may be required for trench backfill as recommended Table 2.

5.8 PAVEMENTS

Pavement subgrades should be prepared as described in Section 5.3 of this GER and as discussed below. Regardless of the relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. This condition should be verified by proofrolling with heavy construction equipment.

With the pavement subgrade prepared as described above, RGI recommends the following pavement sections for parking and drive areas paved with flexible asphalt concrete surfacing.

- **For drive areas**: 3 inches of hot mix asphalt (HMA) over 6 inches of crushed rock base (CRB) over compacted subgrade

The asphalt paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for Hot Mix Asphalt Class 1/2 inch and CRB surfacing.

If concrete driveways are preferred, the following section can be used.

- **For driveway area**: 5 inches of concrete over 4 inches of CRB over compacted subgrade

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability.

For optimum pavement performance, surface drainage gradients of no less than two percent are recommended. Also, some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

6.0 Additional Services

RGI is available to provide further geotechnical consultation throughout the design phase of the project. RGI should review the final design and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design and construction.

RGI is also available to provide geotechnical engineering and construction monitoring services during construction. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this scope of work. If these services are desired, please let us know and we will prepare a proposal.

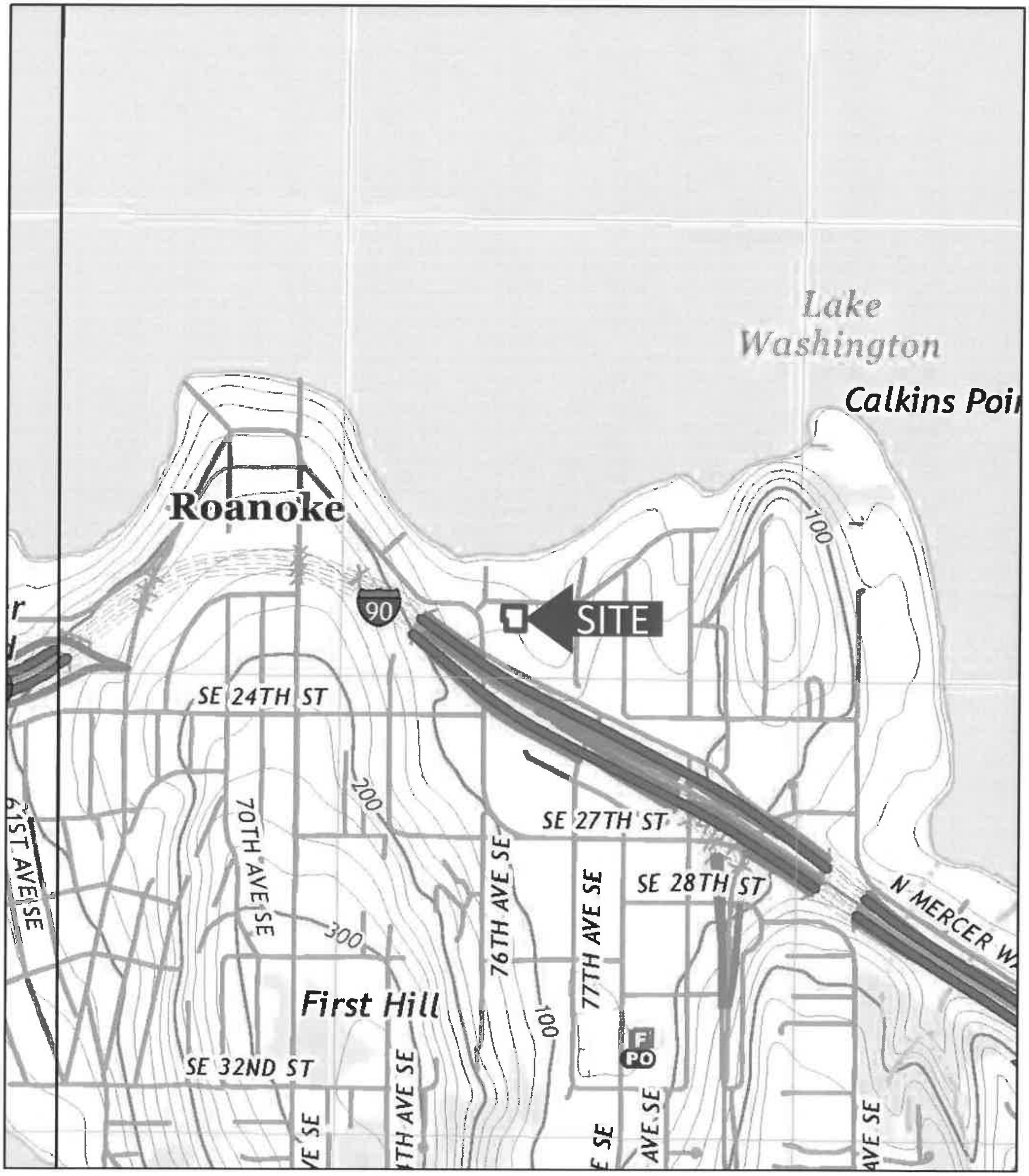
7.0 Limitations

This GER is the property of RGI, Milestone Northwest, and their designated agents. Within the limits of the scope and budget, this GER was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this report was issued. This GER is intended for specific application to Mercer Island 3-Lot project at 7621 Southwest 22nd Street in Mercer Island, Washington, and for the exclusive use of Milestone Northwest and their authorized representatives. No other warranty, expressed or implied, is made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

The scope of services for this project does not include either specifically or by implication any environmental or biological (for example, mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, we can provide a proposal for these services.

The analyses and recommendations presented in this GER are based upon data obtained from the test exploration performed on site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, RGI should be requested to reevaluate the recommendations in this GER prior to proceeding with construction.

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



USGS, 2020, Mercer Island, Washington
USGS, 2020, Seattle South, Washington
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000

N

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Mercer Island 3-Lot		Figure 1
RGI Project Number: 2020-404-1	Site Vicinity Map	Date Drawn: 09/2020
Address: 7621 Southeast 22nd Street, Mercer Island, Washington 98040		

= Test pit by RGI, 08/28/20

= Site boundary

Approximate Scale: 1"=30'

0 15 30 60

N

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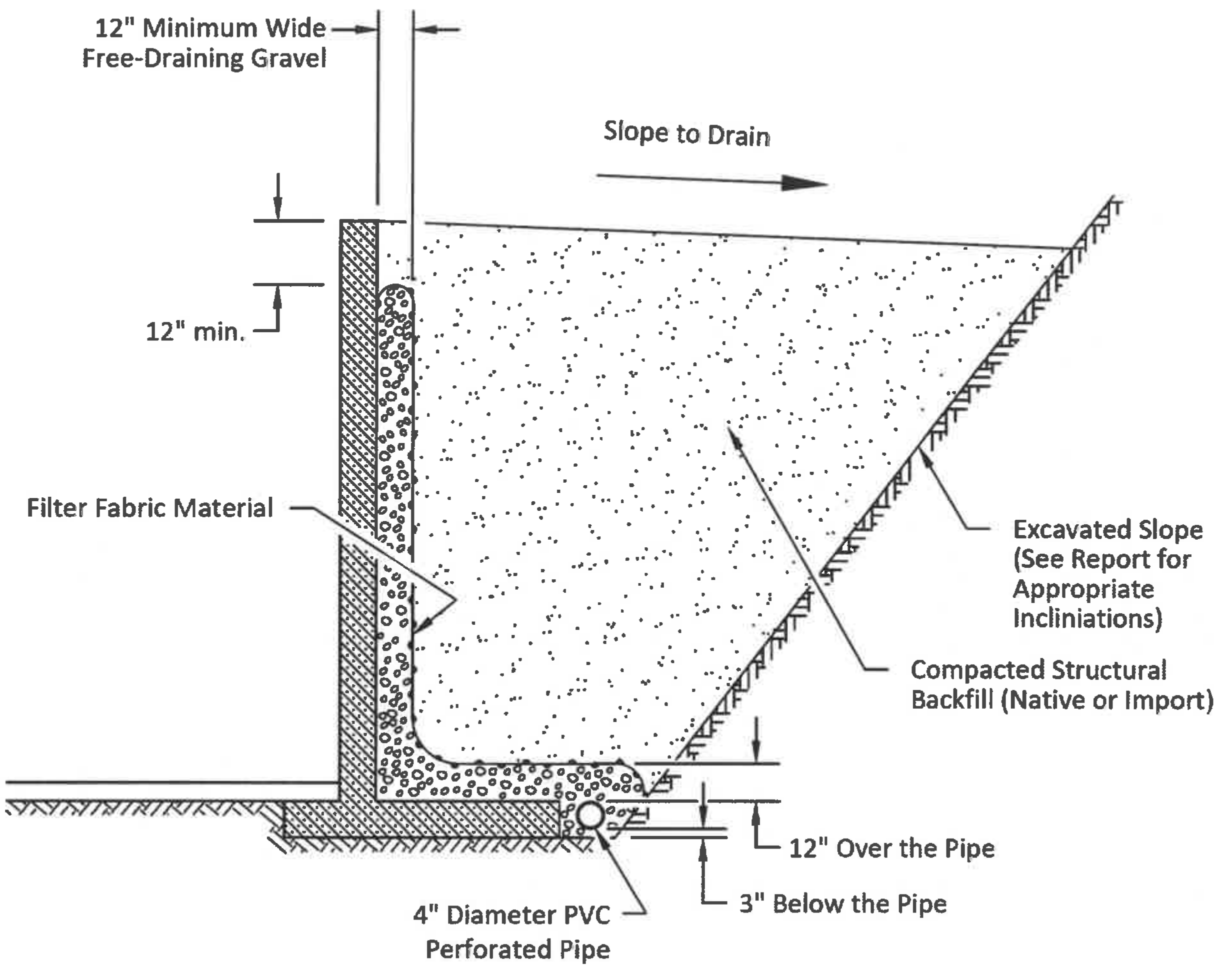
Mercer Island 3-Lot		Figure 2
RGI Project Number: 2020-404-1	Geotechnical Exploration Plan	Date Drawn: 09/2020
Address: 7621 Southeast 22nd Street, Mercer Island, Washington 98040		



Not to Scale

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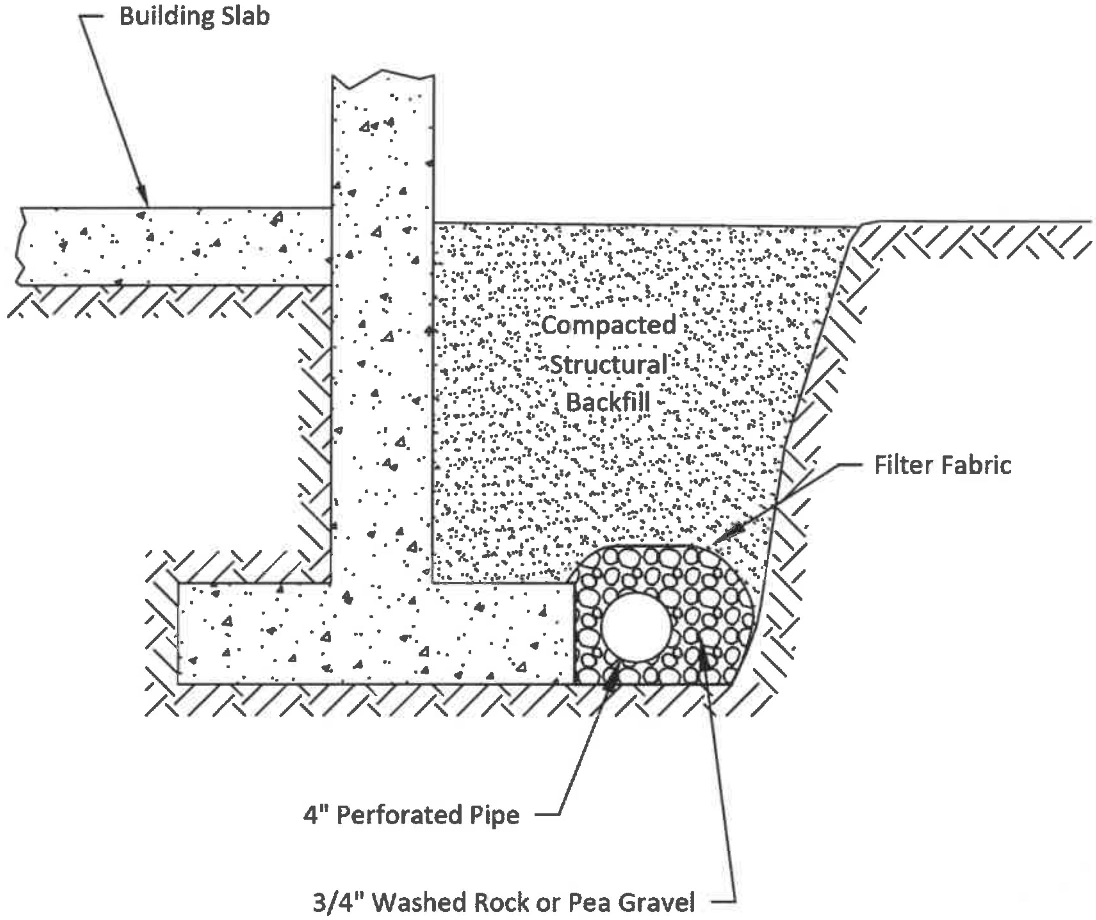
Mercer Island 3-Lot		Figure 3
RGI Project Number: 2020-404-1	Retaining Wall Drainage Detail	Date Drawn: 09/2020
Address: 7621 Southeast 22nd Street, Mercer Island, Washington 98040		



Not to Scale

RILEYGROUP Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	Mercer Island 3-Lot		Figure 4
	RGI Project Number: 2020-404-1	Typical Footing Drain Detail	Date Drawn: 09/2020
	Address: 7621 Southeast 22nd Street, Mercer Island, Washington 98040		

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

On August 28, 2020, RGI explored the subsurface soil conditions at the site by observing the excavation of three test pits to depths up to 9 feet bgs. The test pit locations are shown on Figure 2. The test pit locations were approximately determined by measurements from existing property lines and paved roads.

A geologist from our office conducted the field exploration and classified the soil conditions encountered, maintained a log of each test exploration, obtained representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS).

Representative soil samples obtained from the explorations were placed in closed containers and taken to our laboratory for further examination and testing. As a part of the laboratory testing program, the soil samples were classified in our in house laboratory based on visual observation, texture, and the limited laboratory testing described below.

Moisture Content Determinations

Moisture content determinations were performed in accordance with the American Society of Testing and Materials D2216-10 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216) on representative samples obtained from the exploration in order to aid in identification and correlation of soil types. The moisture content of typical sample was measured and is reported on the test pit logs.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses for the greater than 75 micrometer portion of the samples were performed in accordance with American Society of Testing and Materials D422 Standard Test Method for Particle-Size Analysis of Soils (ASTM D422) on four of the samples, the results of which are attached in Appendix A.

Project Name: **Mercer Island 3-Lot** Project Number: **2020-404-1** Client: **Milestone Northwest**	RILEYGROUP **Test Pit No.: TP-1** **Sheet 1 of 1**

Date(s) Excavated: **8/28/2020**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6 feet bgs**
Excavator Type: **Mini Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **58**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **7621 Southwest 22nd Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
58	0			TPSL		8" topsoil and roots	
				ML		Tan sandy SILT, stiff, dry to moist	15% moisture
				ML		Dark gray SILT with some sand, very stiff, moist	18% moisture, 71% fines
				ML		Gray sandy SILT, hard, moist Well cemented	16% moisture
53	5						15% moisture
						Test Pit terminated at 6'	
48	10						

Project Name: **Mercer Island 3-Lot** Project Number: **2020-404-1** Client: **Milestone Northwest**	RILEYGROUP **Test Pit No.: TP-2** **Sheet 1 of 1**

Date(s) Excavated: **8/28/2020**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **9 feet bgs**
Excavator Type: **Mini Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **47**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **7621 Southwest 22nd Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
47	0			TPSL		8" topsoil and roots	
				ML		Tan SILT, very stiff, dry to moist	25% moisture
						Becomes mottled, moist	23% moisture
							22% moisture
42	5					Occasional slickensides	
							29% moisture
				ML		Tan SILT with some sand, very stiff, moist to wet	22% moisture, 78% fines
				ML		Tan SILT, very stiff, moist	29% moisture
						Slickensides	30% moisture, 100% fines
						Test Pit terminated at 9'	
37	10						

Project Name: **Mercer Island 3-Lot**	**Test Pit No.: TP-3**
Project Number: **2020-404-1**	**Sheet 1 of 1**
Client: **Milestone Northwest**	RILEYGROUP

Date(s) Excavated: **8/28/2020**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **4.5 feet bgs**
Excavator Type: **Mini Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **52**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **7621 Southwest 22nd Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
52	0			TPSL		8" topsoil and roots	
				ML		Tan SILT, very stiff, dry	
						Becomes moist	
							20% moisture
				ML		Tan sandy SILT, very stiff, moist	18% moisture, 60% fines, infiltration test at 4'
						Test Pit terminated at 4.5'	
47	5						
42	10						

Project Name: **Mercer Island 3-Lot**	**Key to Logs**
Project Number: **2020-404-1**	RILEYGROUP **Sheet 1 of 1**
Client: **Milestone Northwest**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet).
2 Depth (feet): Depth in feet below the ground surface.
3 Sample Type: Type of soil sample collected at the depth interval shown.
4 Sample Number: Sample identification number.
5 USCS Symbol: USCS symbol of the subsurface material.
6 Graphic Log: Graphic depiction of the subsurface material encountered.
7 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
8 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

SILT, SILT w/SAND, SANDY SILT (ML)

Topsoil

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mercer Island 3-Lot	SAMPLE ID/TYPE	TP-1
PROJECT NO.	2020-404-1	SAMPLE DEPTH	2'
TECH/TEST DATE	EW 8/28/2020	DATE RECEIVED	8/28/2020

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	308.5
Wt Dry Soil & Tare (gm)	(w2)	263.6
Weight of Tare (gm)	(w3)	16.3
Weight of Water (gm)	(w4=w1-w2)	44.9
Weight of Dry Soil (gm)	(w5=w2-w3)	247.3
Moisture Content (%)	(w4/w5)*100	18

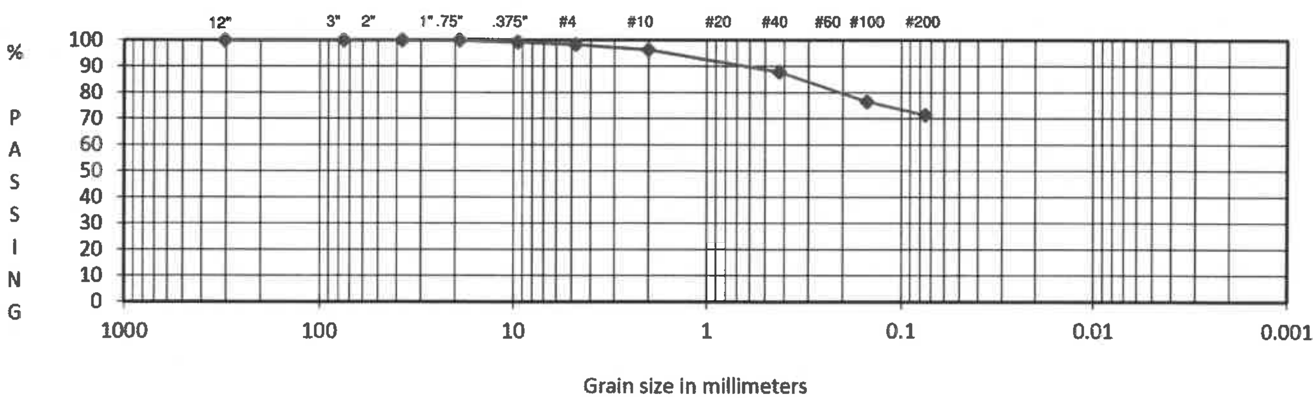
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)	263.6
Tare Weight (gm)	16.3
(W6) Total Dry Weight (gm)	247.3

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	1.7
% C SAND	2.0
% M SAND	8.4
% F SAND	16.5
% FINES	71.4
% TOTAL	100.0
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.3	0.00	0.00	100.00	cobbles
3.0"	16.3	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	16.3	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	16.3	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	18.0	1.70	0.69	99.31	fine gravel
#4	20.4	4.10	1.66	98.34	coarse sand
#10	25.4	9.10	3.68	96.32	medium sand
#20					medium sand
#40	46.2	29.90	12.09	87.91	fine sand
#60					fine sand
#100	74.1	57.80	23.37	76.63	fine sand
#200	87.0	70.70	28.59	71.41	fines
PAN	263.6	247.30	100.00	0.00	silt/clay



DESCRIPTION	SILT with some sand
USCS	ML

Prepared For:
Milestone Northwest

Reviewed By:
RW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mercer Island 3-Lot	SAMPLE ID/TYPE	TP-2
PROJECT NO.	2020-404-1	SAMPLE DEPTH	7.5'
TECH/TEST DATE	EW 8/28/2020	DATE RECEIVED	8/28/2020

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	382.5
Wt Dry Soil & Tare (gm)	(w2)	315.3
Weight of Tare (gm)	(w3)	16.3
Weight of Water (gm)	(w4=w1-w2)	67.2
Weight of Dry Soil (gm)	(w5=w2-w3)	299.0
Moisture Content (%)	(w4/w5)*100	22

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

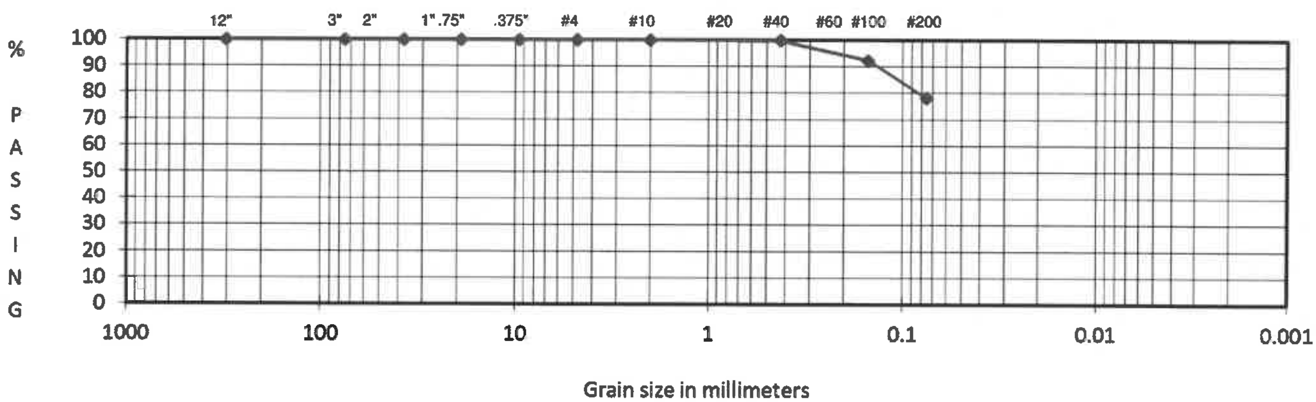
	Weight Of Sample (gm)	315.3
	Tare Weight (gm)	16.3
(W6)	Total Dry Weight (gm)	299.0

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	0.0
% C SAND	0.0
% M SAND	0.2
% F SAND	21.8
% FINES	78.0
% TOTAL	100.0

D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.3	0.00	0.00	100.00	cobbles
3.0"	16.3	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	16.3	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	16.3	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	16.3	0.00	0.00	100.00	fine gravel
#4	16.3	0.00	0.00	100.00	coarse sand
#10	16.3	0.00	0.00	100.00	medium sand
#20					medium sand
#40	16.8	0.50	0.17	99.83	fine sand
#60					fine sand
#100	39.2	22.90	7.66	92.34	fine sand
#200	82.0	65.70	21.97	78.03	fines
PAN	315.3	299.00	100.00	0.00	silt/clay



DESCRIPTION	SILT with some sand
USCS	ML

Prepared For:
Milestone Northwest

Reviewed By:
RW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mercer Island 3-Lot	SAMPLE ID/TYPE	TP-2
PROJECT NO.	2020-404-1	SAMPLE DEPTH	8.5'
TECH/TEST DATE	EW 8/28/2020	DATE RECEIVED	8/28/2020

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	357.8
Wt Dry Soil & Tare (gm)	(w2)	305.3
Weight of Tare (gm)	(w3)	133.1
Weight of Water (gm)	(w4=w1-w2)	52.5
Weight of Dry Soil (gm)	(w5=w2-w3)	172.2
Moisture Content (%)	(w4/w5)*100	30

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

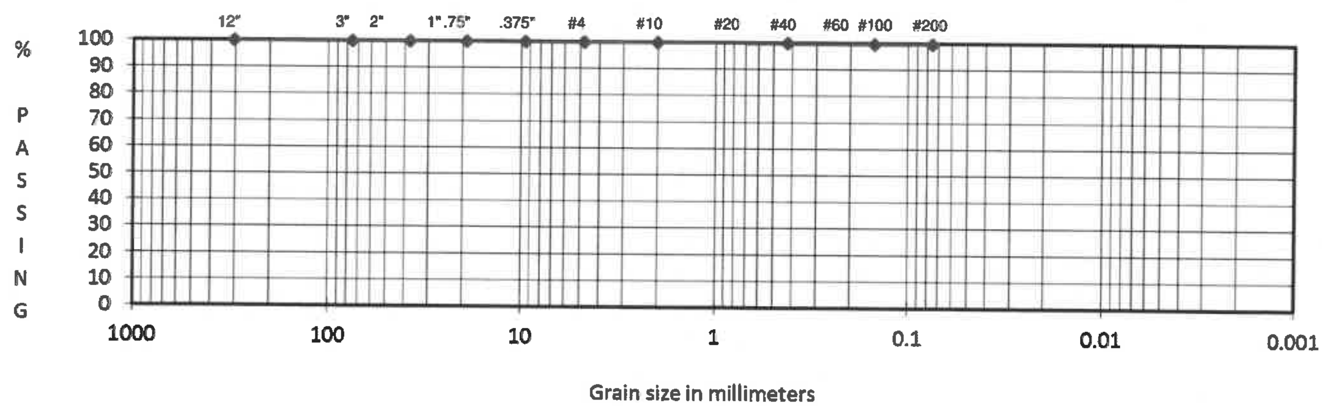
	Weight Of Sample (gm)	305.3
	Tare Weight (gm)	133.1
(W6)	Total Dry Weight (gm)	172.2

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	0.0
% C SAND	0.1
% M SAND	0.1
% F SAND	0.2
% FINES	99.7
% TOTAL	100.0

D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	133.1	0.00	0.00	100.00	cobbles
3.0"	133.1	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	133.1	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	133.1	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	133.1	0.00	0.00	100.00	fine gravel
#4	133.1	0.00	0.00	100.00	coarse sand
#10	133.2	0.10	0.06	99.94	medium sand
#20					medium sand
#40	133.4	0.30	0.17	99.83	fine sand
#60					fine sand
#100	133.5	0.40	0.23	99.77	fine sand
#200	133.7	0.60	0.35	99.65	fines
PAN	305.3	172.20	100.00	0.00	silt/clay



DESCRIPTION	SILT
USCS	ML

Prepared For:
Milestone Northwest

Reviewed By:
RW

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