



civil & structural
engineering & planning

PRELIMINARY STORMWATER SITE PLAN REPORT Alderwood Mall Blvd Apartments

4301 Alderwood Mall Blvd.
Lynnwood, WA 98036



03/02/22

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Section I – Project Overview

Section I Summary

Narrative

Existing Conditions

Developed Conditions

The proposed project consists of a multi-family redevelopment on a 1.1-acre lot located at 4301 Alderwood Mall Blvd in Lynnwood, WA. The existing site is a commercial building and parking lot which will be demoed. The site will be developed with a 5-level apartment building with two parking levels. The remaining site area will be paved with drive aisles and parking, and frontage improvements to conform with Lynnwood city center standards will be completed. This is a preliminary report for Design Review purposes and will be further completed in future stages of design.

The project will comply with the 2019 Department of Ecology (DOE) Stormwater Management Manual for Western Washington (SWMMWW) and will address Minimum Requirements #1-9 for new development and redevelopment. The project's total new plus replaced hard surfaces is 43,775 sf, and a detention vault will be used for flow control. Disturbance will affect the entire site.

Site Address: 4301 Alderwood Mall Blvd, Lynnwood, WA 98036.

Tax Parcel Number: 00372600701905

Existing Conditions

The existing site consisted of a restaurant with parking and landscape islands. The restaurant has since been demolished. Existing frontage improvements are on the south side of the site and consist of a 5' sidewalk and curb with a short rockery behind. There are existing stormwater improvements on site which consist of several conveyance pipes, catch basins and a small vault. The existing system discharges to a main on Alderwood Mall Blvd. One catch basin on the north end of the site conveys runoff to another catch basin located to the west of the site. Existing water, sewer and dry utilities are all drawn from mains along Alderwood Mall Blvd.

Site topography consists of slopes of about 5% from northeast to southwest. According to a USGS Web Soil Survey, site soils consist of Alderwood-Urban land complex at 2-8% slopes. See Section VI for the full report. Per the City of Lynnwood Environmentally Critical Areas Inventory, there are no critical areas on or near the site. The site is located in the Scriber Creek drainage basin in the Lake Washington Watershed.

Developed Conditions

In the development, all site structures, pavement, and underground utilities will be demolished. The apartments building and associated site improvements will be constructed. A detention vault will be constructed in the drive aisle for flow control with a connection to the existing main in the Right-of-Way (ROW).

The project must address Minimum Requirements #1-9 of the 2019 SWMMWW. Minimum Requirements are discussed in Section II, and Permanent Stormwater Control is discussed in Section V.

The proposed land coverage is as follows:

Roof:	21,835 sf (0.50 ac)
Asphalt Driveway:	16,251 sf (0.37 ac)
Concrete Walkways:	1,324 sf (0.03 ac)
ROW Roof:	157 sf (0.00 ac)
ROW Asphalt Driveway:	847 sf (0.02 ac)
ROW Concrete Walkways:	2,174 sf (0.05 ac)
<u>Landscaping:</u>	<u>6,221 sf (0.14 ac)</u>
Total:	49,996 sf (1.15 ac)

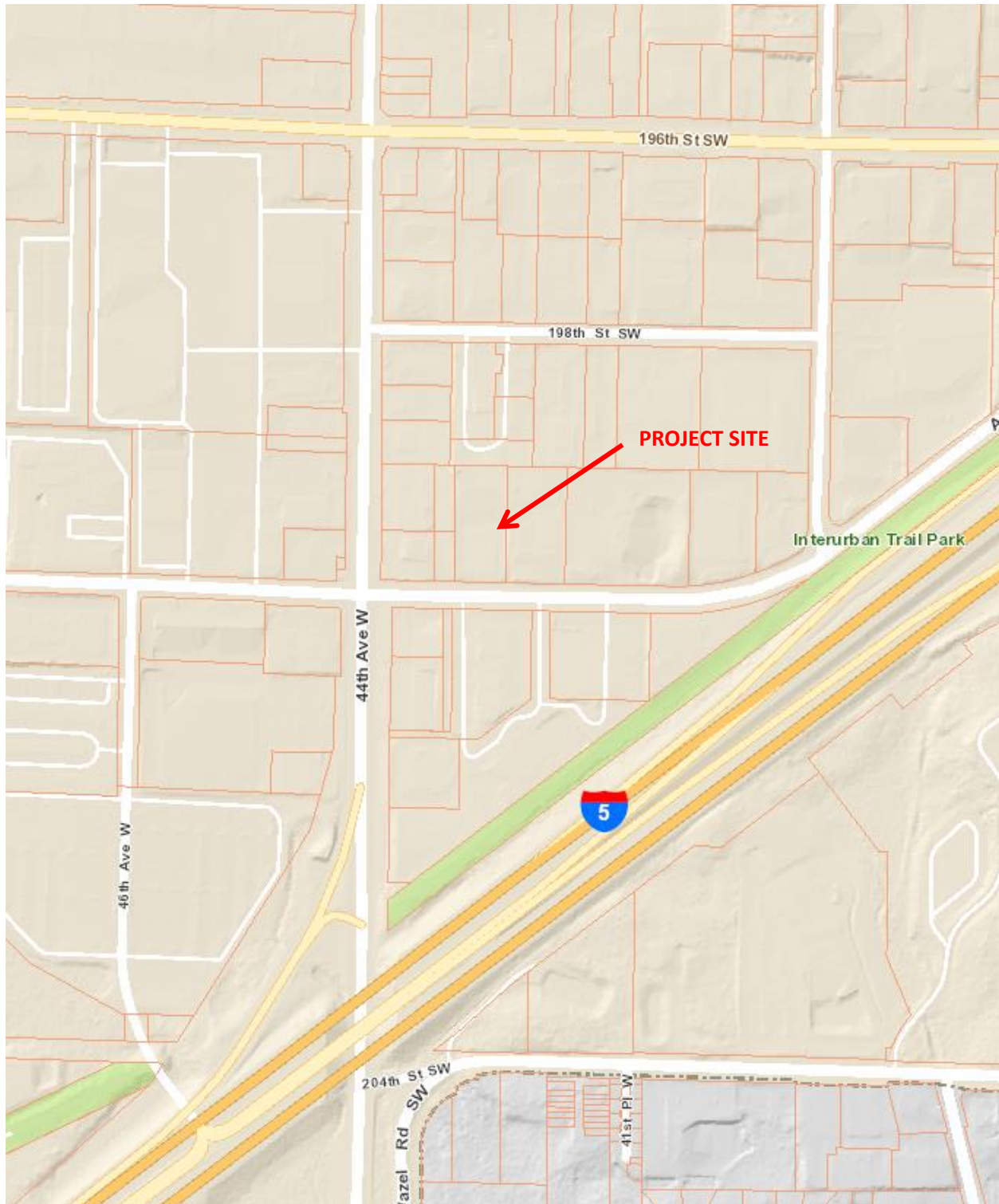


Figure I-1 Vicinity Map (Snohomish County SCOP)



Figure I-2 Aerial Photo (Snohomish County SCOP1)

Section II –Minimum Requirements

Section II Summary

Narrative

The project will result in total new hard surfaces of 5,000 sf or more. Therefore, Minimum Requirements #1-9 of the SWMMWW will be addressed.

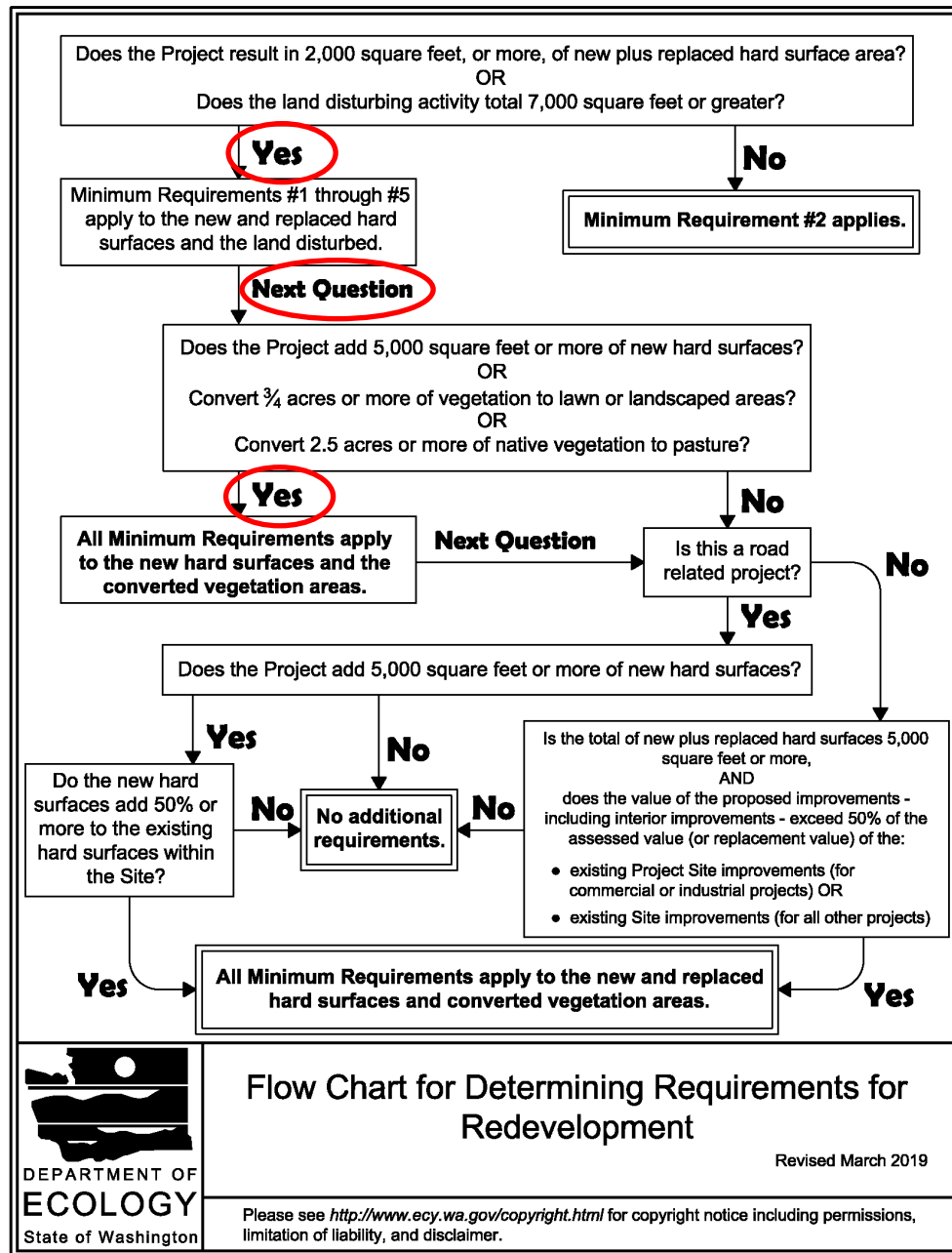


Figure II-1 Flow Chart for Determining Requirements for Redevelopment

Minimum Requirement 1: Preparation of Stormwater Site Plans

The stormwater site plan consists of this report and the civil drawings and is prepared in accordance with Chapter 3 of Volume I of the SWMMWW.

Minimum Requirement 2: Stormwater Pollution Prevention Plans (SWPPPs)

The SWPPP shall include a narrative and drawings. The SWPPP narrative shall include documentation that addresses the 13 elements of Construction Stormwater Pollution Prevention. Refer to Section IV – Stormwater Pollution Prevention Plan (SWPPP) Narrative and the civil drawings.

Minimum Requirement 3: Source Control of Pollution

Source control BMPs during construction are described in Section IV, which addresses Minimum Requirement 2. It is not anticipated that permanent source control BMPs will be required as the site does not contain any of the activities listed in Vol IV Ch. 3-5 of the SWMMWW.

Minimum Requirement 4: Preservation of Natural Drainage Systems and Outfalls

Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down-gradient properties. All projects shall submit an off-site qualitative analysis. A qualitative analysis of the upstream and downstream system entering the site is presented in Section III.

Minimum Requirement 5: On-site Stormwater Management

The project shall address the use of On-Site Stormwater Management BMPs from List No. 1 for all new plus replaced hard surfaces and land disturbed or demonstrate compliance with the LID Performance Standard. The project will address the use of On-Site Stormwater Management BMPs from List No. 1. See Section V for BMP feasibility review. Post-construction soil quality and depth in accordance with BMP T5.13 in Chapter 5 of Volume V of the SWMMWW will be used for all disturbed pervious areas.

Minimum Requirement #6: Runoff Treatment: This requirement applies to the new plus replaced hard surfaces and the converted vegetation areas. The following require construction of stormwater treatment facilities: i.) Projects in which the total of pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area of the project, or ii.) projects in which the total of pollution-generating pervious surfaces (PGPS) – not including permeable pavements is 0.75 acres or more in a threshold discharge area, and from which there will be a surface discharge in a natural or man-made conveyance system from the site. The project adds more than 5,000 sf of PGHS, and runoff treatment is required. See Section V.

Minimum Requirement #7: Flow Control: Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. The requirement below applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh waterbody. The following circumstances require achievement of the standard flow control requirement for western Washington: i.) Projects in which the total of effective impervious surfaces is 10,000 square feet or more in a threshold discharge area, or ii.) projects that convert 0.75 acres or more of vegetation to lawn or landscape, or iii.) projects that through a combination of hard surfaces and converted

vegetation areas cause a 0.15 cubic feet per second (cfs) increase or greater in the 100-year flow frequency from a threshold discharge area as estimated using the Western Washington Hydrology Model or other approved model and 15-minute time steps. The total target effective new/replaced hard surfaces in the threshold discharge area is greater than 10,000 sf, and flow control is required. See Section IV.

Minimum Requirement #8: Wetlands Protection: No wetlands are located near the site and wetlands protection is not required.

Minimum Requirement #9: Operation and Maintenance: An Operation and Maintenance Manual that is consistent with the provisions in Volume V of the Drainage Manual is required for proposed Stormwater Treatment and Flow Control BMPs/facilities. The party (or parties) responsible for maintenance and operation shall be identified in the operation and maintenance manual. For private facilities, a copy of the Operation and Maintenance Manual shall be retained on-site or within reasonable access to the site and shall be transferred with the property to the new owner. For public facilities, a copy of the operation and maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection. See Section VII.

Section III – Off Site Analysis

Section III Summary

Task 1 – Define and map the study area

Task 2 – Review all available information on the study area

Task 3 – Field inspect the study area

Task 4 – Describe the drainage system, and its existing and predicted problems

Task 1 – Define and map the study area

An initial qualitative analysis shall extend downstream for the entire flow path from the project site to the receiving water or up to one mile. The receiving water is Scriber Creek and is about 0.25 mi downstream.

For the purposes of the Design Review submittal this section should be treated as preliminary.

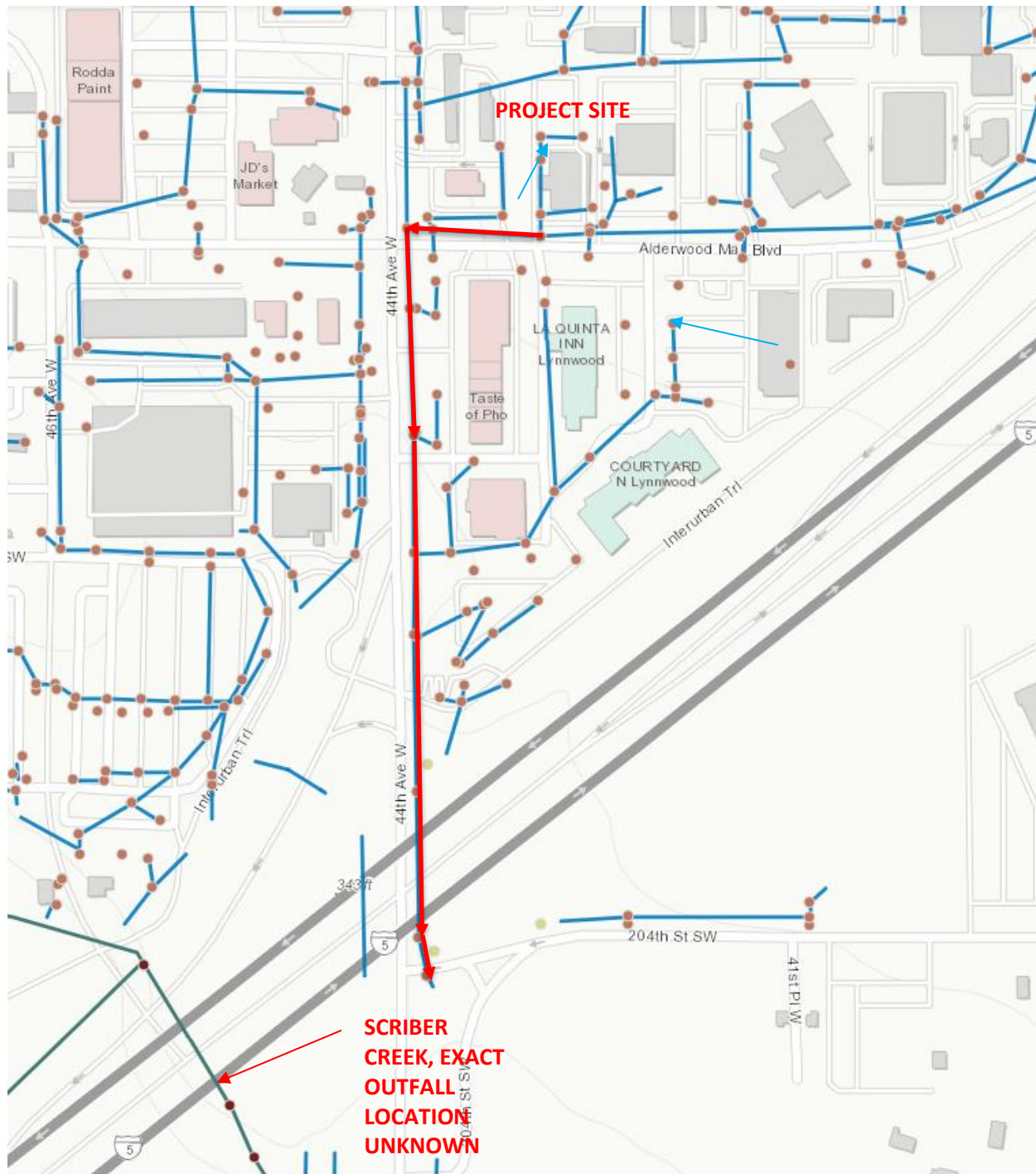


Figure III-1 Study Area (Lynnwood GIS Data).

Task 2 – Review all available information on the study area

Lynnwood GIS data and DOE's Water quality Atlas were reviewed for information on water quality issues and the downstream flow path. The Water Quality Atlas contained one 303D listing for Bioassessment at the approximate location of the outfall.

Task 3 – Field inspect the study area

A site visit and field inspection will be prepared for future project submittals. Lynnwood GIS maps and Google Maps was used to inspect the study area for the purposes of this design review.

Task 4 – Describe the drainage system, and its existing and predicted problems

The drainage system consists of a detention vault with a flow control structure. Outflow from the detention system will tie into the public storm system on Alderwood Mall Blvd. No existing problems were observed on the site, and the proposed system is not anticipated to cause any issues upstream or downstream of the site.

Section IV – Stormwater Pollution Prevention Plan (SWPPP)

Narrative

Section IV Summary

Narrative

SWPPP

A construction SWPPP will be provided for future submittals.

Section V – Permanent Stormwater Control Plan Narrative

Section V Summary

Narrative

On-site Stormwater Management

Runoff Treatment

Flow Control

WWHM2012 Report

The project triggers Minimum Requirements #1-9 of the SWMMWW. This section addresses MR #5: On-site Stormwater Management, MR #6: Runoff Treatment and MR #7: Flow Control.

On-site Stormwater Management

To meet MR #5, the project must either use On-site Stormwater Management BMPs from List #1 or demonstrate compliance with the LID performance standard per Section 2.5.5 of Volume I of the 2019 SWMMWW. The project will comply with List #1 as follows:

Lawn and landscaped areas:

1. Post-construction soil quality and depth in accordance with BMP T5.13 in Chapter 5 of Volume V of the SWMMWW will be used for all disturbed pervious areas.

Roofs:

1. Full Dispersion in accordance with BMP T5.30 is **infeasible** because there is no room on-site or enough forested area for a dispersion system.
2. Downspout Infiltration in accordance with BMP T5.10A is **infeasible** per recommendation from the Geotech engineer.
3. Rain garden BMPs in accordance with Chapter 5 of Volume V is **infeasible** due to site constraints and setbacks.
4. Downspout Dispersion in accordance with BMP T5.10B is **infeasible** as site constraints do not allow for the 25-foot flowpath required.
5. Perforated Stub-out Connections in accordance with BMP T5.10C are **infeasible** per recommendation from the Geotech engineer.

Other Hard Surfaces:

1. Full Dispersion in accordance with BMP T5.30 is **infeasible** because there is no room on-site or enough forested area for a dispersion system.
2. Permeable Pavement in accordance with BMP T5.15 is **infeasible** per recommendation from the Geotech engineer.
3. Rain garden BMPs in accordance with Chapter 5 of Volume V is **infeasible** due to site constraints and setbacks.
4. Sheet Flow Dispersion in accordance with BMP T5.12 is **infeasible** since there is no room on-site to allow for a vegetated buffer and transition zone to disperse the runoff.

Due to the infeasibility of BMPs from List #1 for the project, stormwater runoff from the site will be conveyed directly to the runoff treatment and flow control systems as described below.

Runoff Treatment

Runoff Treatment per Minimum Requirement #6 of the SWMMWW is required since the project adds over 5,000 sf of PGHS. Enhanced Treatment is required since the project is a multi-family development. The project will use a Manufactured Treatment Device for runoff treatment. The water quality treatment volume and flow rate calculations are included in the Flow Control WWHM Report at the end of this section.

Flow Control

Flow Control per Minimum Requirement #7 of the SWMMWW is required since the project has a total effective impervious surface of 10,000 square feet or more in a threshold discharge area. The project will implement a 144'x20'x7' detention vault and flow control structure under the proposed underground parking to meet 50% of the 2-year to 100% of the 50-year peak developed flows. Vault calculations from WWHM are included below.

**WWHM2012
PROJECT REPORT**

Project Name: Alderwood Apts Detention Vault 02.23.22
Site Name:
Site Address:
City :
Report Date: 2/23/2022
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Mod	1.15
Pervious Total	1.15
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	1.15

Element Flows To:
Surface **Interflow** **Groundwater**

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Lawn, Flat	.14

Pervious Total	0.14
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<u>Impervious Land Use</u>	<u>acre</u>
ROOF TOPS FLAT	0.5
DRIVEWAYS FLAT	0.02
DRIVEWAYS MOD	0.36
SIDEWALKS FLAT	0.08
SIDEWALKS MOD	0.03

Impervious Total	0.99
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Basin Total	1.13
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Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1

Width : 20 ft.

Length : 144 ft.

Depth: 7 ft.

Discharge Structure

Riser Height: 6.5 ft.

Riser Diameter: 8 in.

Notch Type: Rectangular

Notch Width: 0.010 ft.

Notch Height: 1.200 ft.

Orifice 1 Diameter: 0.47 in. **Elevation:** 0.5 ft.

Element Flows To:

Outlet 1	Outlet 2
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Vault Hydraulic Table

<u>Stage(feet)</u>	<u>Area(ac.)</u>	<u>Volume(ac-ft.)</u>	<u>Discharge(cfs)</u>	<u>Infilt(cfs)</u>
0.0000	0.066	0.000	0.000	0.000
0.0778	0.066	0.005	0.000	0.000
0.1556	0.066	0.010	0.000	0.000
0.2333	0.066	0.015	0.000	0.000
0.3111	0.066	0.020	0.000	0.000
0.3889	0.066	0.025	0.000	0.000
0.4667	0.066	0.030	0.000	0.000
0.5444	0.066	0.036	0.001	0.000
0.6222	0.066	0.041	0.002	0.000
0.7000	0.066	0.046	0.002	0.000
0.7778	0.066	0.051	0.003	0.000

0.8556	0.066	0.056	0.003	0.000
0.9333	0.066	0.061	0.003	0.000
1.0111	0.066	0.066	0.004	0.000
1.0889	0.066	0.072	0.004	0.000
1.1667	0.066	0.077	0.004	0.000
1.2444	0.066	0.082	0.005	0.000
1.3222	0.066	0.087	0.005	0.000
1.4000	0.066	0.092	0.005	0.000
1.4778	0.066	0.097	0.005	0.000
1.5556	0.066	0.102	0.006	0.000
1.6333	0.066	0.108	0.006	0.000
1.7111	0.066	0.113	0.006	0.000
1.7889	0.066	0.118	0.006	0.000
1.8667	0.066	0.123	0.007	0.000
1.9444	0.066	0.128	0.007	0.000
2.0222	0.066	0.133	0.007	0.000
2.1000	0.066	0.138	0.007	0.000
2.1778	0.066	0.144	0.007	0.000
2.2556	0.066	0.149	0.007	0.000
2.3333	0.066	0.154	0.008	0.000
2.4111	0.066	0.159	0.008	0.000
2.4889	0.066	0.164	0.008	0.000
2.5667	0.066	0.169	0.008	0.000
2.6444	0.066	0.174	0.008	0.000
2.7222	0.066	0.180	0.008	0.000
2.8000	0.066	0.185	0.009	0.000
2.8778	0.066	0.190	0.009	0.000
2.9556	0.066	0.195	0.009	0.000
3.0333	0.066	0.200	0.009	0.000
3.1111	0.066	0.205	0.009	0.000
3.1889	0.066	0.210	0.009	0.000
3.2667	0.066	0.216	0.010	0.000
3.3444	0.066	0.221	0.010	0.000
3.4222	0.066	0.226	0.010	0.000
3.5000	0.066	0.231	0.010	0.000
3.5778	0.066	0.236	0.010	0.000
3.6556	0.066	0.241	0.010	0.000
3.7333	0.066	0.246	0.010	0.000
3.8111	0.066	0.252	0.010	0.000
3.8889	0.066	0.257	0.011	0.000
3.9667	0.066	0.262	0.011	0.000
4.0444	0.066	0.267	0.011	0.000
4.1222	0.066	0.272	0.011	0.000
4.2000	0.066	0.277	0.011	0.000
4.2778	0.066	0.282	0.011	0.000
4.3556	0.066	0.288	0.011	0.000
4.4333	0.066	0.293	0.011	0.000
4.5111	0.066	0.298	0.012	0.000
4.5889	0.066	0.303	0.012	0.000
4.6667	0.066	0.308	0.012	0.000
4.7444	0.066	0.313	0.012	0.000
4.8222	0.066	0.318	0.012	0.000
4.9000	0.066	0.324	0.012	0.000
4.9778	0.066	0.329	0.012	0.000
5.0556	0.066	0.334	0.012	0.000
5.1333	0.066	0.339	0.012	0.000
5.2111	0.066	0.344	0.013	0.000

5.2889	0.066	0.349	0.013	0.000
5.3667	0.066	0.354	0.013	0.000
5.4444	0.066	0.360	0.015	0.000
5.5222	0.066	0.365	0.016	0.000
5.6000	0.066	0.370	0.018	0.000
5.6778	0.066	0.375	0.020	0.000
5.7556	0.066	0.380	0.023	0.000
5.8333	0.066	0.385	0.025	0.000
5.9111	0.066	0.390	0.027	0.000
5.9889	0.066	0.396	0.030	0.000
6.0667	0.066	0.401	0.033	0.000
6.1444	0.066	0.406	0.035	0.000
6.2222	0.066	0.411	0.038	0.000
6.3000	0.066	0.416	0.041	0.000
6.3778	0.066	0.421	0.044	0.000
6.4556	0.066	0.426	0.047	0.000
6.5333	0.066	0.432	0.092	0.000
6.6111	0.066	0.437	0.305	0.000
6.6889	0.066	0.442	0.563	0.000
6.7667	0.066	0.447	0.761	0.000
6.8444	0.066	0.452	0.871	0.000
6.9222	0.066	0.457	0.959	0.000
7.0000	0.066	0.462	1.040	0.000
7.0778	0.066	0.468	1.114	0.000
7.1556	0.000	0.000	1.183	0.000

Name : Basin 2

Bypass: Yes

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
Pervious Total	0
<u>Impervious Land Use</u>	<u>acre</u>
DRIVEWAYS MOD	0.02
Impervious Total	0.02
Basin Total	0.02

Element Flows To:		
Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.15
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.14
Total Impervious Area:1.01

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.02562
5 year	0.039219
10 year	0.048995
25 year	0.06212
50 year	0.072413
100 year	0.083121

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.020828
5 year	0.036558
10 year	0.051538
25 year	0.077286
50 year	0.102644
100 year	0.134497

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.014	0.017
1950	0.027	0.019
1951	0.025	0.016
1952	0.019	0.017
1953	0.014	0.018
1954	0.073	0.024
1955	0.038	0.040
1956	0.033	0.046
1957	0.037	0.018
1958	0.026	0.028
1959	0.028	0.016
1960	0.023	0.017
1961	0.024	0.033
1962	0.021	0.016
1963	0.031	0.018
1964	0.022	0.015
1965	0.024	0.016
1966	0.013	0.014
1967	0.030	0.024
1968	0.035	0.018
1969	0.035	0.028
1970	0.019	0.018

1971	0.031	0.046
1972	0.024	0.022
1973	0.020	0.017
1974	0.043	0.023
1975	0.019	0.018
1976	0.019	0.017
1977	0.015	0.015
1978	0.019	0.015
1979	0.043	0.020
1980	0.022	0.018
1981	0.018	0.013
1982	0.023	0.019
1983	0.040	0.019
1984	0.024	0.047
1985	0.034	0.041
1986	0.082	0.227
1987	0.035	0.047
1988	0.019	0.016
1989	0.019	0.017
1990	0.026	0.016
1991	0.027	0.017
1992	0.021	0.016
1993	0.013	0.014
1994	0.013	0.018
1995	0.026	0.017
1996	0.048	0.018
1997	0.092	0.460
1998	0.016	0.018
1999	0.024	0.016
2000	0.014	0.027
2001	0.004	0.012
2002	0.025	0.038
2003	0.018	0.014
2004	0.029	0.025
2005	0.021	0.015
2006	0.062	0.037
2007	0.049	0.027
2008	0.066	0.048
2009	0.021	0.019

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0921	0.4601
2	0.0818	0.2266
3	0.0731	0.0480
4	0.0659	0.0471
5	0.0620	0.0467
6	0.0487	0.0462
7	0.0484	0.0457
8	0.0429	0.0408
9	0.0427	0.0397
10	0.0399	0.0378
11	0.0376	0.0371
12	0.0374	0.0334
13	0.0352	0.0278

14	0.0351	0.0276
15	0.0347	0.0272
16	0.0345	0.0265
17	0.0326	0.0248
18	0.0311	0.0240
19	0.0308	0.0240
20	0.0301	0.0230
21	0.0285	0.0220
22	0.0279	0.0202
23	0.0272	0.0192
24	0.0271	0.0187
25	0.0264	0.0185
26	0.0260	0.0185
27	0.0255	0.0185
28	0.0249	0.0184
29	0.0246	0.0180
30	0.0245	0.0179
31	0.0244	0.0179
32	0.0242	0.0178
33	0.0240	0.0178
34	0.0237	0.0176
35	0.0234	0.0176
36	0.0233	0.0175
37	0.0224	0.0174
38	0.0217	0.0174
39	0.0213	0.0170
40	0.0210	0.0170
41	0.0207	0.0168
42	0.0207	0.0166
43	0.0196	0.0166
44	0.0194	0.0166
45	0.0194	0.0162
46	0.0194	0.0161
47	0.0192	0.0161
48	0.0192	0.0161
49	0.0187	0.0158
50	0.0185	0.0158
51	0.0181	0.0156
52	0.0181	0.0156
53	0.0164	0.0154
54	0.0155	0.0153
55	0.0144	0.0152
56	0.0141	0.0147
57	0.0139	0.0145
58	0.0135	0.0142
59	0.0133	0.0136
60	0.0126	0.0134
61	0.0043	0.0122

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs) Predev Mit Percentage Pass/Fail

0.0128	20668	16525	79	Pass
0.0134	18360	10380	56	Pass
0.0140	16311	8209	50	Pass
0.0146	14431	6915	47	Pass
0.0152	12893	6115	47	Pass
0.0158	11477	5527	48	Pass
0.0164	10243	5050	49	Pass
0.0170	9137	4614	50	Pass
0.0176	8188	4218	51	Pass
0.0182	7279	3884	53	Pass
0.0188	6489	3566	54	Pass
0.0194	5833	3309	56	Pass
0.0200	5251	3080	58	Pass
0.0206	4757	2892	60	Pass
0.0212	4301	2742	63	Pass
0.0218	3861	2594	67	Pass
0.0224	3461	2438	70	Pass
0.0230	3071	2291	74	Pass
0.0236	2716	2154	79	Pass
0.0242	2449	2025	82	Pass
0.0249	2207	1849	83	Pass
0.0255	2008	1748	87	Pass
0.0261	1844	1642	89	Pass
0.0267	1708	1566	91	Pass
0.0273	1572	1484	94	Pass
0.0279	1455	1404	96	Pass
0.0285	1362	1332	97	Pass
0.0291	1291	1281	99	Pass
0.0297	1213	1229	101	Pass
0.0303	1145	1188	103	Pass
0.0309	1074	1144	106	Pass
0.0315	996	1063	106	Pass
0.0321	934	994	106	Pass
0.0327	893	945	105	Pass
0.0333	849	897	105	Pass
0.0339	809	850	105	Pass
0.0345	761	800	105	Pass
0.0351	720	755	104	Pass
0.0357	689	719	104	Pass
0.0363	664	679	102	Pass
0.0369	641	623	97	Pass
0.0375	623	577	92	Pass
0.0381	603	526	87	Pass
0.0387	586	485	82	Pass
0.0393	570	453	79	Pass
0.0399	554	416	75	Pass
0.0405	540	384	71	Pass
0.0411	523	360	68	Pass
0.0417	508	328	64	Pass
0.0423	484	307	63	Pass
0.0429	463	288	62	Pass
0.0435	448	270	60	Pass
0.0441	439	242	55	Pass
0.0447	424	218	51	Pass
0.0453	412	189	45	Pass
0.0459	403	167	41	Pass
0.0465	390	137	35	Pass

0.0471	376	113	30	Pass
0.0477	365	98	26	Pass
0.0483	357	93	26	Pass
0.0489	343	92	26	Pass
0.0495	335	90	26	Pass
0.0501	322	89	27	Pass
0.0507	311	89	28	Pass
0.0513	304	87	28	Pass
0.0519	300	87	29	Pass
0.0525	293	87	29	Pass
0.0531	285	86	30	Pass
0.0537	275	83	30	Pass
0.0544	268	82	30	Pass
0.0550	259	82	31	Pass
0.0556	251	82	32	Pass
0.0562	242	81	33	Pass
0.0568	235	80	34	Pass
0.0574	228	80	35	Pass
0.0580	213	80	37	Pass
0.0586	205	80	39	Pass
0.0592	198	80	40	Pass
0.0598	191	78	40	Pass
0.0604	185	77	41	Pass
0.0610	177	77	43	Pass
0.0616	168	77	45	Pass
0.0622	163	76	46	Pass
0.0628	154	74	48	Pass
0.0634	148	74	50	Pass
0.0640	141	73	51	Pass
0.0646	132	73	55	Pass
0.0652	126	72	57	Pass
0.0658	119	71	59	Pass
0.0664	115	70	60	Pass
0.0670	110	70	63	Pass
0.0676	108	70	64	Pass
0.0682	104	67	64	Pass
0.0688	101	67	66	Pass
0.0694	98	66	67	Pass
0.0700	91	66	72	Pass
0.0706	86	66	76	Pass
0.0712	76	66	86	Pass
0.0718	70	64	91	Pass
0.0724	67	64	95	Pass

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	Through	Volume	Volume	Volume
		Treatment?	Needs				
Water Quality			Treatment	Facility	(ac-ft.)	Infiltration	Infiltrated
Treated			(ac-ft)	(ac-ft)		Credit	
Vault 1 POC		N	150.91			N	0.00
Total Volume Infiltrated			150.91	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.

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**WWHM2012
PROJECT REPORT**

Project Name: Alderwood Apts Water Quality 02.23.22
Site Name:
Site Address:
City :
Report Date: 2/23/2022
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Mod	.42
Pervious Total	0.42
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	0.42

Element Flows To:

Surface	Interflow	Groundwater
----------------	------------------	--------------------

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
Pervious Total	0
<u>Impervious Land Use</u>	<u>acre</u>
DRIVEWAYS FLAT	0.02
DRIVEWAYS MOD	0.37
SIDEWALKS MOD	0.03
Impervious Total	0.42
Basin Total	0.42

Element Flows To:		
Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.42
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.42

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.009357
5 year	0.014323
10 year	0.017894
25 year	0.022687
50 year	0.026446
100 year	0.030357

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.215697
5 year	0.290047
10 year	0.34416
25 year	0.418301
50 year	0.477862
100 year	0.541255

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

Year	Predeveloped	Mitigated
1949	0.005	0.219
1950	0.010	0.218
1951	0.009	0.286
1952	0.007	0.209
1953	0.005	0.240
1954	0.027	0.334
1955	0.014	0.273
1956	0.012	0.118
1957	0.014	0.181
1958	0.010	0.470
1959	0.010	0.200
1960	0.009	0.202
1961	0.009	0.630
1962	0.008	0.243
1963	0.011	0.233
1964	0.008	0.145
1965	0.009	0.194
1966	0.005	0.192
1967	0.011	0.388
1968	0.013	0.196
1969	0.013	0.409
1970	0.007	0.171
1971	0.011	0.212
1972	0.009	0.283
1973	0.007	0.228
1974	0.016	0.285
1975	0.007	0.225
1976	0.007	0.166
1977	0.006	0.166
1978	0.007	0.132
1979	0.016	0.258
1980	0.008	0.244
1981	0.007	0.167
1982	0.009	0.188
1983	0.015	0.224
1984	0.009	0.210
1985	0.013	0.284
1986	0.030	0.273
1987	0.013	0.247
1988	0.007	0.220
1989	0.007	0.192
1990	0.009	0.170
1991	0.010	0.238
1992	0.008	0.207
1993	0.005	0.170
1994	0.005	0.189
1995	0.009	0.166
1996	0.018	0.283
1997	0.034	0.237
1998	0.006	0.275
1999	0.009	0.110
2000	0.005	0.490

2001	0.002	0.133
2002	0.009	0.151
2003	0.007	0.204
2004	0.010	0.379
2005	0.008	0.166
2006	0.023	0.240
2007	0.018	0.221
2008	0.024	0.200
2009	0.008	0.164

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0336	0.6303
2	0.0299	0.4899
3	0.0267	0.4699
4	0.0241	0.4090
5	0.0226	0.3879
6	0.0178	0.3787
7	0.0177	0.3341
8	0.0157	0.2857
9	0.0156	0.2855
10	0.0146	0.2835
11	0.0137	0.2833
12	0.0137	0.2825
13	0.0129	0.2747
14	0.0128	0.2733
15	0.0127	0.2729
16	0.0126	0.2584
17	0.0119	0.2472
18	0.0114	0.2442
19	0.0113	0.2428
20	0.0110	0.2399
21	0.0104	0.2399
22	0.0102	0.2381
23	0.0100	0.2374
24	0.0099	0.2333
25	0.0097	0.2284
26	0.0095	0.2250
27	0.0093	0.2242
28	0.0091	0.2207
29	0.0090	0.2201
30	0.0089	0.2194
31	0.0089	0.2177
32	0.0088	0.2116
33	0.0088	0.2099
34	0.0086	0.2090
35	0.0086	0.2071
36	0.0085	0.2041
37	0.0082	0.2022
38	0.0079	0.1998
39	0.0078	0.1997
40	0.0077	0.1956
41	0.0076	0.1941
42	0.0075	0.1921
43	0.0072	0.1920

44	0.0071	0.1888
45	0.0071	0.1881
46	0.0071	0.1811
47	0.0070	0.1712
48	0.0070	0.1701
49	0.0068	0.1701
50	0.0068	0.1671
51	0.0066	0.1665
52	0.0066	0.1663
53	0.0060	0.1658
54	0.0057	0.1657
55	0.0053	0.1636
56	0.0052	0.1509
57	0.0051	0.1455
58	0.0049	0.1331
59	0.0049	0.1319
60	0.0046	0.1176
61	0.0016	0.1103

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0.0424 acre-feet

On-line facility target flow: 0.0753 cfs.

Adjusted for 15 min: 0.0753 cfs.

Off-line facility target flow: 0.0426 cfs.

Adjusted for 15 min: 0.0426 cfs.

LID Report

LID Technique	Used for	Total Volume	Volume	Infiltration	Cumulative	Percent
Water Quality	Percent	Comment	Needs	Through	Volume	Volume
Water Quality		Treatment?	Facility	(ac-ft.)	Infiltration	Infiltrated
Treated			(ac-ft)	(ac-ft)	Credit	
Total Volume Infiltrated		0.00	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.

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Section VI – Special Reports and Forms

Section VI Summary

Narrative

The following reports are provided in this section:

1. USDA NRCS Custom Soil Resource Report dated November 23, 2021.
2. Geotechnical Engineering Investigation by Krazan & Associates, Inc., dated November 1, 2021.



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Snohomish County Area, Washington



November 23, 2021

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
5	Alderwood-Urban land complex, 2 to 8 percent slopes	1.2	100.0%
Totals for Area of Interest		1.2	100.0%

Snohomish County Area, Washington

5—Alderwood-Urban land complex, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2hz9
Elevation: 50 to 800 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Alderwood and similar soils: 60 percent
Urban land: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alderwood

Setting

Landform: Till plains
Parent material: Basal till

Typical profile

H1 - 0 to 7 inches: gravelly ashy sandy loam
H2 - 7 to 35 inches: very gravelly ashy sandy loam
H3 - 35 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Limited Depth Soils (G002XN302WA)
Other vegetative classification: Limited Depth Soils (G002XN302WA)
Hydric soil rating: No

Minor Components

Norma, undrained

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Custom Soil Resource Report

Mckenna

Percent of map unit: 5 percent

Landform: Depressions

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

Terric medisaprists, undrained

Percent of map unit: 5 percent

Landform: Depressions

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

**GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED MULTI-STORY BUILDING
4301 ALDERWOOD MALL BOULEVARD
LYNNWOOD, WASHINGTON 98005**

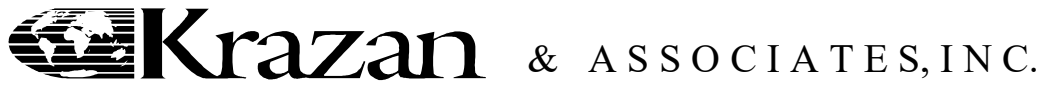
Project No. 092-21009
NOVEMBER 1, 2021

Prepared for:

KOZ DEVELOPMENT
ATTN: JOSHUA SCOTT
1830 BICKFORD AVENUE, #201
SNOHOMISH, WA 98290

Prepared by:

KRAZAN & ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING DIVISION
4303 – 198th St SW
Lynnwood, Washington 98036
(425) 485-5519



GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

November 1, 2021

Krazan File Number 092-21009

koz Development LLC
1830 Bickford Avenue, #201
Snohomish, WA 98290

Attn: Joshua Scott
VP, Design and Construction

Email: Josh@kozdevelopment.com
Phone: 206-755-1290

Reference: Geotechnical Engineering Investigation
Proposed Multi-Use Building
4301 Alderwood Mall Boulevard
Lynnwood, WA

Dear Mr. Scott,

In accordance with your request, we have completed a Geotechnical Engineering Investigation for the referenced site. The results of our investigation are presented in the attached report.

If you have any questions, or if we can be of further assistance, please do not hesitate to contact our office.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Michael D. Rundquist, P.E.
Senior Project Manager

MDR

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November 1, 2021

KA Project No. 092-21009

**GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED MULTI-STORY BUILDING
4301 ALDERWOOD MALL BOULEVARD
LYNNWOOD, WASHINGTON**

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed building project located at 4301 Alderwood Mall Boulevard in Lynnwood, Washington as shown on the Vicinity Map in Figure 1. Discussions regarding site conditions are presented in this report, together with conclusions and recommendations pertaining to site preparation, excavations, foundations, structural fill, utility trench backfill, pavement design, drainage, and erosion control.

We have been provided with undated scaled conceptual drawings by the client for the project. We were also provided with the “ALTA/NSPS Land Title Survey” for the site, prepared by Terrane, dated July 29, 2021.

The approximate locations of the exploratory soil borings are presented in the Site Plan in Figure 2 following the text of this report. A description of the field investigation as well as the exploratory soil boring logs and laboratory test results are presented in Appendix A. Appendix B contains a guide to aid in the development of earthwork specifications for the project. Pavement design guidelines are presented in Appendix C. The recommendations in the main text of the report have precedence over the more general specifications in the appendices.

PURPOSE AND SCOPE

This geotechnical investigation was conducted to evaluate the subsurface soil and groundwater conditions at the site, to develop geotechnical engineering recommendations for use in project design and to provide criteria for site preparation and earthwork construction.

Our geotechnical engineering services were performed in general accordance with our proposal for this project, dated August 5, 2021 (Krazan proposal number G21654WAL). The geotechnical services performed for this project generally include the following:

- Exploration of the subsurface soil and groundwater conditions by conducting five (5) geotechnical borings using a subcontracted drill rig;

- Provide a site plan showing the geotechnical boring locations;
- Provide comprehensive boring logs including soil stratification and classification, and groundwater levels where applicable;
- Provide laboratory test results;
- Provide foundation recommendations for the proposed structures including foundation type, allowable bearing pressure, anticipated settlements (both total and differential), coefficient of horizontal friction, and frost penetration depth;
- Provide recommendations for seismic design considerations including site coefficient and ground acceleration based on the 2018 IBC;
- Provide recommendations for temporary excavations;
- Provide recommendations for construction and excavation considerations, topsoil/unsuitable soil stripping depth, identification of potentially problematic soils or groundwater conditions, and depth of over-excavation if required;
- Provide recommendations for structural fill materials, placement, and compaction;
- Provide recommendations regarding the suitability of on-site soils as structural fill;
- Provide recommendations for site drainage and erosion control;
- Provide our opinion regarding the feasibility/infeasibility of stormwater infiltration at this site;
- Provide recommendations for retaining wall design;
- Provide recommendations for temporary shoring design;
- Provide recommendations for pavement design;

Environmental services, such as chemical analysis of soil and groundwater for possible environmental contaminants, are not included in our scope of services for this project. In-situ infiltration testing was also not included in our scope of services for this project.

PROPOSED DEVELOPMENT

The conceptual plans indicate that the proposed development will include design and construction of a five-story wood frame structure over a ground level concrete podium building, with a portion of the site also being developed as a single-story below grade parking structure. The site development will also include design and construction of pavement, utilities, and landscape areas.

SITE CONDITIONS

The site consists of a single assessor parcel (00372600701905) and covers an area of about 1.1 acres. The site has previously been developed as a commercial property and is situated in a neighborhood of other commercial developments. The concrete foundations and slab of a demolished commercial building are located on the southern portion of the property, and the remainder of the site consists of paved parking and landscaped areas. The property is bordered by Alderwood Mall Boulevard to the south, and commercial properties to the north, east and west.

The property slopes gently down to the southwest toward Alderwood Mall Boulevard. Based on the ALTA/NSPS survey of the site, surface elevations range from about 396 feet in the northeast portion of the site, to about 378 feet near the southwest corner of the property, along the sidewalk and the driveway entrance from Alderwood Mall Boulevard. There are rockeries, up to about five feet in height, along the eastern and southern property lines. It appears that some grading, including some fill placement, may have occurred during previous development of this area.

GEOLOGIC SETTING

The site lies within the central Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances/retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and nonglacial sediments.

We referred to the “Geologic Map of the Edmonds East and part of the Edmonds West Quadrangles, Washington”, prepared by James P. Minard (USGS 1983), during our project research. The geologic map indicates that the site vicinity is underlain by Quaternary Vashon glacial till (Qvt). Glacial till consists of compact clay, silt, sand, gravel, cobbles and boulders deposited at the base of the continental glacier. Our explorations generally encountered surficial layers of pavement and undocumented fill overlying the competent native glacial soils.

FIELD INVESTIGATION

Four (4) exploratory soil borings were completed to evaluate the subsurface soil and groundwater conditions in the asphalt parking lot areas of the property. The soil explorations were completed on August 19, 2021 with a subcontracted drill rig. The soil borings extended to depths of approximately 11.5 to 28.5 feet below the existing ground surface (bgs). Krazan geotechnical representatives were present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the subsurface soils using the Standard Penetration Test (SPT), and maintained logs of the explorations. The approximate locations of the soil borings are shown on the Site Plan in Figure 2.

Representative samples of the subsurface soils encountered in the geotechnical explorations were collected and sealed in plastic bags. The soils encountered in the borings were visually classified in general accordance with the Unified Soil Classification System (USCS). A more detailed description of the field investigation is presented in Appendix A.

SOIL PROFILE AND SUBSURFACE CONDITIONS

The information provided below includes a brief summary of the materials encountered in the soil explorations. Detailed soil logs are presented in Appendix A.

Soil boring B-1 was located in the parking lot north of the demolished building foundation, in the central portion of the property. Asphalt pavement was encountered to a depth of about 0.2 feet. Underlying the asphalt, the soil boring encountered moist, loose to medium dense, silty sand with a trace of gravel to a depth of approximately 3.0 feet bgs. We interpreted the silty sand with a trace of gravel to be undocumented fill. Below the fill material, the soil boring encountered moist, dense to very dense silty sand with gravel to the depth explored of approximately 28.5 feet bgs. We interpreted the dense to very dense silty sand with gravel to be native glacial till soil.

Soil boring B-2 was located in the parking lot west of the demolished building foundation, in the southwest portion of the property. Asphalt pavement was encountered to a depth of about 0.2 feet. Underlying the asphalt, the soil boring encountered moist to wet, medium dense, silty sand with gravel to a depth of approximately 5.5 feet bgs. We interpreted the silty sand with gravel to be undocumented fill. Below the fill material, the soil boring encountered moist to wet, medium dense silty sand with gravel to a depth of about 7.0 feet bgs. We interpreted the medium dense silty sand with gravel to be weathered native granular soils. Underlying the weathered horizon, the soil boring encountered moist, dense to very dense silty sand with gravel to the depth explored of approximately 11.5 feet bgs. We interpreted the dense to very dense silty sand with gravel to be native glacial till soil.

Soil boring B-3 was located in the parking lot east of the demolished building foundation, in the southeast portion of the property. Asphalt pavement was encountered to a depth of about 0.2 feet. Underlying the asphalt, the soil boring encountered moist to wet, medium dense, silty sand with gravel to a depth of approximately 5.5 feet bgs. We interpreted the silty sand with gravel to be undocumented fill. Below the fill material, the soil boring encountered moist to wet, medium dense silty sand with gravel to a depth of about 7.0 feet bgs. We interpreted the medium dense silty sand with gravel to be weathered native granular soils. Underlying the weathered horizon, the soil boring encountered moist, dense to very dense silty sand with gravel to the depth explored of approximately 11.5 feet bgs. We interpreted the dense to very dense silty sand with gravel to be native glacial till soil.

Soil boring B-4 was located in the parking lot in the northeast portion of the site. Asphalt pavement was encountered to a depth of about 0.2 feet. Underlying the asphalt, the soil boring encountered moist, loose to medium dense, silty sand with a trace of gravel to a depth of approximately 8.0 feet bgs. We interpreted

the silty sand with a trace of gravel to be undocumented fill. Underlying the fill, the soil boring encountered moist, dense to very dense, silty sand with a trace of gravel to a depth of approximately 10.5 feet bgs, which was interpreted as native weathered soil. Below the silty sand, the boring encountered moist, hard, bedded gray sandy silt to a depth of 14.0 feet bgs, which was interpreted as glacially consolidated cohesive soil. Underling the sandy silt, the boring encountered moist, dense to very dense silty sand with gravel to the depth explored of approximately 11.5 feet bgs. We interpreted the dense to very dense silty sand with gravel to be native glacial till soil.

There is potential for cobbles and boulders to be encountered in the native glacial soils and there may be debris in the fill material. There is also potential for thicker layers of loose/soft soils, and/or undocumented fill in unexplored areas of the site.

GROUNDWATER

The soil borings were checked for the presence of groundwater during drilling operations. Groundwater seepage was only encountered in the B-3 at a depth of about 10.5 feet bgs. The groundwater seepage was interpreted as perched groundwater. It is our opinion that perched groundwater could occur in some areas of this property, especially during and after prolonged periods of wet weather.

Perched water occurs when surface water infiltrates through less dense, more permeable soils and accumulates on top of a relatively low permeability soil layer. Perched water does not represent a regional groundwater "table" within the upper soil horizons. Perched water tends to vary spatially and is dependent upon the amount of rainfall. We would expect the amount of perched water to decrease during drier times of the year and increase during wetter periods.

It should be recognized that groundwater elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Therefore, groundwater levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

GEOLOGIC HAZARDS

Erosion Hazard

The Natural Resources Conservation Service (NRCS) map for Snohomish County Area, Washington indicates that the soils in the site vicinity consist of Alderwood Urban land (2 to 8 percent slopes) (Hydrologic Soil Group B). The NRCS indicates that the Alderwood Urban land complex soils with 2 to 8 percent slopes have a slight to moderate risk of soil erosion when exposed.

It has been our experience that soil erosion potential can be minimized through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall

and may be controlled by the use of normal temporary erosion control measures, such as silt fences, hay bales, mulching, control ditches or diversion trenching, and contour furrowing. Erosion control measures should be in place before the onset of wet weather.

Seismic Hazard

The 2018 International Building Code (IBC), Section 1613.2.2, refers to Chapter 20 of ASCE 7-16 for Site Class Definitions. It is our opinion that the overall soil profile corresponds to Site Class C as defined by Table 20.3-1 “Site Class Definitions,” according to the ASCE 7-16 Standard. Site Class C applies to a “very dense soil and soft rock” profile. The seismic site class is based on a soil profile extending to a depth of 100 feet. The soil explorations on this site extended to a maximum depth of approximately 28.5 feet and this seismic site class designation is based on the assumption that dense to very dense conditions continue below the depth explored.

We referred to the Applied Technology Council (ATC) website and 2018 IBC to obtain values for S_S , S_{MS} , S_{DS} , S_I , S_{MI} , S_{DI} , F_a , F_v and T_s . The ATC website utilizes the most updated published data on seismic conditions from the United States Geological Survey. The seismic design parameters for this site are presented in the following table:

Seismic Design Parameters
(Reference: 2018 IBC Section 1613.2.2, ASCE7-16, and ATC)

Seismic Item	Value
Site Class	C
Site Coefficient F_a	1.200
S_s	1.303
S_{MS}	1.563
S_{DS}	1.042
Site Coefficient F_v	1.500
S_1	0.461
S_{M1}	0.6.91
S_{D1}	0.461
PGA*	0.558

**For an earthquake magnitude with a 2 percent probability of being exceeded in 50 years.*

Additional seismic considerations include liquefaction potential and amplification of ground motions by loose/soft soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. The medium dense to very dense native soils interpreted to underlie the site are considered to have a low potential for liquefaction and amplifications of ground motion.

The Liquefaction Susceptibility Map of Snohomish County, Washington, by Stephen Palmer, et al. (WADNR, September 2004) indicates that the property is located in an area of very low liquefaction susceptibility. Therefore, a site-specific liquefaction analysis was not performed.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion from a geotechnical standpoint that the site is compatible with the proposed multi-story building with underground parking, provided that our geotechnical recommendations are incorporated into project plans and are implemented during construction.

Our geotechnical explorations generally encountered loose to medium dense undocumented fill, underlain by medium dense to very dense native granular soils. Based on our explorations, the competent native soils were encountered at depths of about 2.0 to 8.0 feet bgs. The thickness of the fill materials may vary in unexplored areas of the site.

The medium dense to very dense native soils are interpreted to be glacially compacted deposits, and are considered suitable for foundation support. The undocumented fill is not considered suitable for foundation support in its current condition.

The dense to very dense glacial till soils interpreted to underlie this site have very low permeability and are not considered suitable for infiltration management of stormwater runoff.

Groundwater seepage was encountered in soil boring B-3 at approximately 10.5 feet in depth at the time of our explorations. Moist to wet soils were encountered in soil borings B-2, and B-3 directly below the asphalt pavement. In our opinion, there is the potential for perched groundwater seepage to develop on this site, particularly after periods of heavy precipitation.

Recommendations for foundation support and temporary shoring design, including over-excavation of existing fill materials, are provided in this report. Specific geotechnical recommendations for foundation design are presented in the Shallow **Foundations** section of this report.

The soils encountered in our explorations are considered to be moisture sensitive and will be difficult or impossible to compact in wet conditions. The moisture content of the silty soils is important in determining if the soils can be used as structural fill at the time of construction. Krazan and Associates is available on request to evaluate the suitability of the on-site soils for use as structural fill material during earthwork construction. The moisture sensitive subgrade soils can degrade rapidly in wet weather. The exposed subgrade should be protected from construction traffic with a layer of crushed rock or lean concrete during wet weather construction.

Site Preparation

Site preparation for this project is anticipated to include demolition of the existing slab and foundations and some removal of asphalt pavement. If loose undocumented fill is encountered, caving of may occur during excavation or if the excavations are left open. Caving could cause undermining of adjacent portions of the existing pavement. The contractor should be prepared to shore the trench walls if caving conditions are encountered.

If over-excavation below the planned bottom of footing elevation is necessary to expose the suitable native subgrade soil, it may be feasible to place structural fill to the planned footing elevation. However, if caving conditions are encountered, it may be prudent to consider using clean rock ballast, clean rock chips, or Controlled Density Fill (CDF) as structural fill materials to eliminate the need for vibratory compaction methods. Vibratory compaction may cause caving of the excavation walls. Alternatively, the over-excavation could be filled with extra concrete. The structural engineer should be consulted regarding rebar placement if extra concrete is to be used.

During wet weather conditions, which typically occur from October through May, subgrade stability problems and grading difficulties may develop due to excess moisture, disturbance of moisture sensitive

soils and/or the presence of perched groundwater. Earthwork construction during extended periods of wet weather could create the need to remove wet disturbed soils if they cannot be suitably compacted due to elevated moisture contents. The on-site soils encountered in our borings have significant silt content, and are considered to be moisture sensitive. Silty soils typically disturb easily and are difficult to compact when wet. If over-excavation is necessary, it should be confirmed through continuous monitoring and testing by a qualified geotechnical engineer or geologist. Soils that have become unstable may require drying to near their optimal moisture content before compaction is feasible. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry, warm weather (typically during the summer months). If the soils cannot be dried back to a workable moisture condition, remedial measures may be required. Preparation of the site for wet weather conditions may consist of the placement of a layer of aggregate base for the protection of exposed soils during construction.

It should be understood that even if Best Management Practices (BMPs) for soil protection are implemented for the wet season, there is a significant chance that additional soil mitigation work will be needed.

Any buried structures encountered during construction should be properly removed and backfilled. Excavations, depressions, or soft and pliant areas extending below the planned finish subgrade levels should be excavated to expose firm undisturbed native soil, and backfilled with structural fill. In general, any septic tanks, underground storage tanks, debris pits, cesspools, or similar structures should be completely removed. Concrete footings should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as recommended by the geotechnical engineer. The resulting excavations should be backfilled with structural fill.

A geotechnical representative of our firm should be present to observe and evaluate foundation excavations, native subgrade soil, and structural fill placement. This observation and evaluation are integral parts of our service, as acceptance of foundation construction is dependent upon the excavation and subgrade conditions and the stability of the material. The geotechnical engineer may reject any material that does not meet compaction and stability requirements. Further recommendations, contained in this report, are predicated upon the assumption that earthwork construction will conform to the recommendations set forth in this section and in the Structural Fill Section of this report.

Temporary Excavations

The on-site soils have variable cohesion strengths, therefore the safe angles to which these materials may be cut for temporary excavations is variable, as the soils may be prone to caving and slope failures in temporary excavations deeper than 4 feet. Very loose to medium dense undocumented fill was encountered in our borings. Temporary excavations in the undocumented fill soils should be sloped no steeper than 2H:1V (horizontal to vertical) where room permits. However, if medium dense to dense native soils area exposed during excavations, then the excavations maybe sloped to 1H:1V. Steeper inclinations may be feasible for temporary excavations in very dense glacial till.

It may be desirable to use near-vertical excavation walls to reduce disturbance to the existing pavement. If so, the contractor should be prepared to shore the excavation walls for soil stability and worker safety.

All temporary cuts should be in accordance with Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. The temporary slope cuts should be visually inspected daily by a qualified person during construction work activities and the results of the inspections should be included in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and minimizing slope erosion during construction. The temporary cut slopes should be closely monitored until the foundations or utility installations are completed and backfilled. Materials should not be stored and equipment operated within 10 feet of the top of any temporary cut slope.

A Krazan & Associates geologist or geotechnical engineer should observe, at least periodically, the temporary cut slopes during the excavation work. The reason for this excavation observation is that all soil conditions may not be fully delineated by the limited sampling of the site from the geotechnical explorations. In the case of temporary slope cuts, the existing soil conditions may not be fully revealed until the excavation work exposes the soil. Typically, as excavation work progresses, the maximum inclination of the temporary slope will need to be evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed smoothly and required deadlines can be met. If any variations or undesirable conditions are encountered during construction, Krazan & Associates should be notified so that supplemental recommendations can be made.

Structural Fill

Fill placed beneath foundations or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the structural fill should be suitably prepared as described in the **Site Preparation** section of this report, and the prepared subgrade should be evaluated by a Krazan representative, prior to beginning fill placement.

Best Management Practices (BMP's) should be followed when considering the suitability of the on-site soils for use as structural fill. The on-site soils may be suitable for reuse as structural fill, provided the soil is free of organic material and debris, and it is within ± 2 percent of the optimum moisture content. The on-site soils encountered in our borings have significant silt content, and are considered to be moisture sensitive and will be difficult to compact during the wet weather. *Any cobbles and boulders and organic debris* should be removed prior to use as structural fill. If the on-site soils are stockpiled for later use as structural fill, the stockpiles should be covered to protect the soil from wet weather conditions. We

recommend that a representative of Krazan & Associates be on site during the excavation work to determine which soils are suitable for placement as structural fill.

Imported, all weather granular structural fill material should consist of well-graded gravel or a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). Structural fill can also consist crushed rock, rock spalls and controlled density fill (CDF). All structural fill material should be submitted for approval to the geotechnical engineer at least 48 hours prior to delivery to the site.

Granular fill soils should be placed in horizontal lifts not exceeding 8 inches in thickness prior to compaction, moisture-conditioned as necessary, (moisture content of soil shall not vary by more than ± 2 percent of optimum moisture) and the material should be compacted to at least 95 percent of the maximum dry density based on ASTM D1557 Test Method. In-place density tests should be performed on all structural fill to document proper moisture content and adequate compaction. Additional lifts should not be placed if the previous lift did not meet the compaction requirements or if soil conditions are not considered stable.

Foundations

General: The proposed structure may be supported on a conventional spread foundation system bearing on the medium dense or firmer native soils or on structural fill including granular soils, rock spalls or CDF extending to the medium dense or firmer native soils. Based on our soil borings, we interpreted the medium dense or firmer native load bearing soils at this site to range from about 2.0 to 8.0 feet bgs. The depth to bearing soils may vary in unexplored portions of the site. A representative of Krazan and Associates should evaluate the foundation bearing soil and evaluate all structural fill subgrade and monitor all structural fill placement, where utilized.

We have assumed column loads of 50,000 to 60,000 pounds and wall loads of 4,000 plf for the soil bearing capacity and settlement analyses. *We should be contacted to re-evaluate the potential settlement and the allowable bearing pressure, if the design loads vary significantly from these assumed values*

Soil Bearing: Conventional shallow spread footings supported on medium dense or firmer native soils, or on structural fill extending to the dense or firmer native soils, may be designed using an allowable soil bearing pressure of **4,000 pounds per square foot (psf)** for dead plus live loads. This value may be increased by 1/3 for short duration loads such as wind or seismic loading. A representative of Krazan and Associates should evaluate the foundation bearing soil and observe structural fill placement.

Footings should have a minimum embedment depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Footing widths should be based on the anticipated loads and allowable soil bearing pressure. Footings should have a minimum width of at least 12 inches regardless of load. Water should not be allowed to accumulate in footing trenches. All undocumented fill and loose or

disturbed soils should be removed from the foundation excavations prior to placing concrete. The exposed subgrade soil should be protected from construction traffic with a layer of crushed rock or lean concrete during wet weather construction.

Structural Fill in Footing Areas: If structural fill consisting of granular soils and rock spalls are used, then the foundation excavations would need to be widened on both sides of the footing a distance equal to one-half of the depth of the over-excavation below the bottom of the footing. Structural fill consisting granular soils should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. To reduce the volume of extra excavation needed for the footing trenches and to simplify structural fill placement, it may be practical to place CDF to fill the deeper footing trenches to the planned footing subgrade elevations. If CDF is used, the trench may be excavated only slightly wider (6 inches wider on each side) than the footing.

Potential Foundation Settlement: For foundations constructed as recommended, the total settlement is not expected to exceed one-inch. Differential settlement should be less than ½-inch. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated. It should be noted that the risk of liquefaction and seismically induced settlement is considered low, given the composition and density of the native, on-site soils.

Design Parameters – Lateral Resistance: Resistance to lateral displacement can be computed using an allowable friction factor of 0.4 acting between the bases of foundations and the supporting subgrade soil. Lateral resistance for footings can also be developed using an allowable equivalent fluid passive pressure of 350 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglecting the upper 12 inches). The allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. These values are based on footings founded on competent native soils or on structural fill extending to the competent native soils, and structural fill placement in all foundation excavations

Foundation Drainage: Seasonal rainfall, water run-off, and the normal practice of watering trees and landscaping areas around the proposed structures, should not be permitted to flood and/or saturate foundation subgrade soils. To prevent the buildup of water within the footing areas, continuous footing drains (with cleanouts) should be provided at the bases of the footings. The footing drains should consist of a minimum 4-inch diameter rigid perforated PVC pipe, sloped to drain, with perforations placed near the bottom and enveloped in all directions by washed rock and wrapped with filter fabric to limit the migration of silt and clay into the drain. Footing drains should be directed to a suitable outlet, and should be separated from roof and shoring drainage systems.

Temporary Shoring Walls

General: We understand that the excavations for the building foundations may be on the order of 5 to 32 feet below the existing grade. In our opinion, a soil nail wall or soldier pile wall may be the most practical types of shoring systems for this project.

A shoring wall can be installed to provide top down support for the excavation. The shoring wall can be designed as a temporary system and the building designed and constructed independent of the wall, or the shoring wall could be integrated in the building design. In the latter case, the shoring wall would likely be designed to resist vertical loads as well as lateral loads.

The shoring system, adjacent ground, and nearby structures, should be monitored for movement during construction. A system of survey points should be established prior to commencing with the excavation activities. Survey readings should be taken periodically and be compared to the original baseline measurements. The survey monitoring should continue until the permanent walls and floors are in place at least to level of the surrounding grade, and survey cessation has been recommended by the geotechnical engineer, and cessation is approved by the jurisdiction.

It should be understood that the risk of movement and settlement in adjacent structures can be reduced with proper construction procedures and with a well-designed, sufficiently stiff shoring system, however a certain level of risk of movement in the nearby features will always be present.

Soldier Pile Walls

A soldier pile wall typically consists of a series of steel H-beams installed prior to the building excavation. The soldier piles are installed vertically at a certain distance from one another (typically six to ten feet). The beams are usually placed in drilled shafts that are filled with concrete or Control Density Fill (CDF). The concrete shafts are typically embedded below the bottom of the planned excavation by a depth of one to two times the height of the cut to be shored, if tiebacks are not used. The steel beams are extended above the finished ground surface to provide shoring capabilities for the cut. The beams are typically spanned by pressure treated timber lagging installed from the top down as the excavation is being made. The H-beam type, shaft diameter, shaft embedment, and pile spacing are dependent on the nature of the soils anticipated in the cut and at depth, wall height, drainage conditions, the need for tiebacks, and the final geometry.

Tiebacks extending into the native soils behind the shoring wall may be used to provide additional resistance for the shoring wall. The feasibility of the tiebacks, however, will depend on boundary line issues and overall cost. It might be possible to brace the shoring wall internally to avoid installing the tiebacks, or the building configuration may be modified to allow more room between the building and property boundaries. These options should be evaluated during the design phase of the project.

Solider Pile Wall Design: The shoring wall should be designed by an experienced structural engineer licensed in the State of Washington. In many cases, shoring contractors have qualified structural engineers

on board, or have a working relationship with qualified wall designers. The wall designer should be provided a copy of our report, and we should be retained to review the geotechnical aspects of the shoring wall design prior to construction.

If the shoring wall is allowed to yield at the top at least one thousandth of the height of the above ground portion of the wall, the wall should be designed for an active loading condition. If the wall is restrained from yielding by external bracing, tiebacks, or wall stiffness, the wall should be designed for an at-rest loading condition. For an active loading condition, the design of the soldier piles and lagging should be calculated based on a triangular pressure distribution equivalent to that exerted by a fluid with a density of 35 pounds per cubic foot (pcf). If at-rest conditions prevail, the wall should be designed to resist loads resulting from a triangular pressure distribution equivalent to that exerted by a fluid with a density of 55 pcf. These values are based on the assumption of well-drained retained soil and a level backfill behind the wall.

The above loads should be applied on the full center-to-center pile spacing above the base of the cut. These loads could be resisted by passive resistance acting on the below-grade portion of the piles, and/or by tiebacks extending into the native soils behind the shoring wall. The passive resistance for soldier piles embedded in the dense to very dense glacial till could be calculated based on a 350 pcf equivalent fluid density acting on two effective pile diameters below the base of the cut. This passive resistance value incorporates a factor of safety of 1.5. The below-grade portion of the wall should not be shorter than wall stick-up height, if tiebacks are not used.

Soldier Pile Wall Installation: The shoring wall should be installed by a shoring contractor experienced with this type of system. Although we anticipate that an open-hole drilling method will be adequate for installing the soldier piles, the shoring contractor should be capable of casing the holes if sloughing and/or water seepage is encountered. It might be prudent to perform a few “test” holes to confirm installation conditions prior to finalizing work plans. Any sloughing or water that may collect in the drilled holes should be removed prior to pouring grout. Grout should be readily available on site at the time the holes are drilled. The holes should not be left open for any length of time, as that may increase the potential for caving and water seepage to impact wall installation.

There may be obstructions in unexplored areas of the site. The contractor should be prepared to penetrate or remove obstructions if they are encountered.

If groundwater seepage is encountered, we recommend that the concrete be tremied from the bottom of the soldier pile borings to displace the groundwater to the surface. The shoring contractor might elect to introduce polymers into the soldier pile borings to reduce the effects of seepage. We should be retained to observe shoring wall installation.

Tiebacks

General: Tieback soil anchors may be used to provide additional resistance for the shoring wall, if needed. The tiebacks can be permanent and form a part of the structure, or temporary until the excavation is braced by the building. If the tiebacks are made permanent, they will have to meet double corrosion standards, and soil creep needs to be considered, when determining their capacity. The contractor or the wall designer should submit working drawings for review showing their proposed method of tieback support. The drawings shall include lists of materials to be used, sequence of operations and sufficient number details and notes to clearly illustrate the scope of work. Double corrosion protection for the tieback strands/bars shall be detailed on the drawings. We recommend that five percent of the tiebacks, but not less than two, be treated as verification tiebacks and be tested to a minimum of 200 percent of the design loads. The soil creep characteristics would be evaluated in these tests.

No-Load Zone: The portion of all tiebacks where anchorage is achieved by soil/grout adhesion must be located a sufficient distance behind the retained excavation face, to develop resistance within a stable soil mass. We recommend the anchorage be obtained behind an assumed no-load zone. The no-load zone shall be defined by a line extending horizontally from the base of the excavation into the soil a distance of one-third the height of the shoring wall ($H/3$). The line should extend up from the base elevation at an angle of 60 degrees above the horizontal. We expect that medium dense sand and gravel will exist beyond the no-load zone. However, we do not have subsurface data at the tieback locations. We recommend that we monitor soil conditions during tieback installation in order to evaluate adequate penetration into these soils.

The portion of the tieback within the no-load zone should be immediately backfilled. The sole purpose of the backfill is to prevent possible collapse of the holes, loss of ground, and surface subsidence. We recommend that the backfill consist of sand, gravel or a non-cohesive mixture. A sand cement grout should be utilized only if an acceptable form of bond breaker (such as plastic sheathing) is applied to the tieback rod within the length of the no-load zone.

Soil Design Values: We have limited explorations in the areas where the tiebacks might be planned. Therefore, the design strengths for tieback adhesion are difficult to estimate. For use in design of the verification tiebacks installed in the dense to very dense glacial till soils, we estimate an allowable grout to soil bond strength of 22 pounds per square inch (pci). We expect that this value is high if silts are encountered. If silts are encountered, creep will become an important factor in the design loads. This value is presented for planning purposes only and should be confirmed or modified using the data obtained from the verification testing prior to production tieback installation.

Tieback Installation and Testing: The contractor should be responsible for using equipment suited for the site conditions. We do not recommend the use of open hole methods for the purpose of installing the tiebacks. Secondary grouting to increase soil adhesion may be used; however, if secondary grouting is used, the tiebacks should be tested using the methods outlined for the verification testing.

Five percent of the tiebacks, but a minimum of two, should be verification tested to 200 percent of the tieback design capacity. The verification tests should consist of cyclic loading in increments of 25 percent of the design load, as outlined in the Federal Highways Administration (FHA) report No. FHWA/RD-82/047. Final soil adhesion design values will be based on these tests. The test location should be determined in the field, based on soil conditions observed during excavation. All production tiebacks should be proof tested to at least 130 percent of design capacity. The tieback testing program should be reviewed and monitored by a geotechnical representative.

Soil Nail Wall Design Recommendations

General: Soil nailing is a technique for reinforcing, stabilizing, and retaining steep slopes through the introduction of relatively small, closely spaced anchors (usually steel bars) grouted into a soil mass, the face of which is then locally stabilized. A zone of reinforced ground is the result, which functions as a temporary soil retention system. Soil nail walls are retaining walls that are built from the top downwards in situations where the soil has enough apparent cohesion that it can stand up on its own during construction. The walls consist of soil nails, typically spaced three to six feet on center with a reinforced shotcrete facing.

The soil nail wall proposed for protection of the excavation should consist of a grid of soil nail anchors drilled and grouted into the slope, and attached to a reinforced shotcrete facing. This wall system is suitable for the intended purpose of supporting and protecting the excavation from erosion and sloughing, but should not be considered a permanent slope stabilization method. The final extent and heights of the soil nail wall should be determined after an accurate site survey is completed.

The process begins by making a 4-foot vertical cut along the top of the shoring area, followed immediately by the drilling, placement and grouting of the soil nails. A geotextile drainage composite is placed over the face of the excavation between the soil nails to avoid buildup of hydrostatic pressure behind the shotcrete facing. The cut is then covered with reinforcing steel and wire mesh. Shotcrete is placed over the face of the excavation, incorporating the reinforcing steel and wire mesh into the soil nail wall. As the excavation progresses downward, the drainage composite is extended until reaching the base of the excavation where weep holes are placed through the shotcrete to allow seepage to be collected in the drainage system for the building retaining walls.

The soil nail spacing, lengths, diameters, angle of declination, and bar type should be determined by the shoring designer. The grouted soil nails should be sized to provide resistance for an active pressure resulting from a fluid with an equivalent density of 35 pounds per cubic foot (pcf) acting along the back of the wall. This design pressure does not include surcharge loading due to the slope or other factors. We are available to consult with the design team as grading plans are developed to discuss surcharge loads that may be necessary for the wall design.

Soil nails are not pre-stressed like tiebacks since they are designed as passive elements. Accordingly, soil nail walls will typically deflect more than a soldier pile wall. The shoring designer should provide an

estimate of the lateral deflection that is anticipated for the soil nail wall. Caving of loose or granular soil, or from zones of seepage, can require that the shoring contractor modify their installation techniques. This can increase the cost and time necessary to install the wall.

Recommended Soil Design Values: Our explorations generally encountered competent native glacial soils consisting of silty sand with gravel and cobbles. Compressible soils were not encountered in our explorations. For use in design of the soil nails, we present estimated soil parameters in the following table.

These values are presented for planning purposes only and should be confirmed or modified using the data obtained from the verification testing of sacrificial nails prior to the installation of the production soil nails.

Soil Nail Installation and Testing Recommendations: The contractor should be responsible for using equipment suited for the site conditions. A minimum of two nails in each soil type should be verification tested to 200 percent of the design capacity. The verification tests should consist of cyclic loading in

Design Parameters for Soil Nail					
Depth below ground surface (feet)	Soil Description	Estimated <i>effective</i> angle of internal friction (degrees)	Estimated <i>effective</i> cohesion (psf)	Allowable Bond Strength (psi)	Estimated soil unit weight (moist) (pcf)
0.5-8.0	Medium dense sand with gravel (undocumented fill)	28	0	6	120
8.5-28.0+	Very dense silty sand with gravel (native glacial soils)	38	100	22	135

increments of 25 percent of the design load. Final soil adhesion design values will be based on the verification test results. The test locations should be determined in the field based on soil conditions observed during construction. At least five percent of the production soil nails should be proof tested to at least 130 percent of design capacity. The shoring designer should provide the soil nail testing program. The soil nail testing program should be reviewed and monitored by Krazan. We can discuss the soil nail test procedures with the contractor at the time of construction.

Waterproofing

If a damp-proof wall is desired, a building envelope consultant should be retained to provide recommendations. Generally, waterproof barriers, such as bentonite panels, should be used between buried walls and the earth or between walls cast directly against the shoring. We recommend that at a minimum, waterproofing is considered for any below grade storage areas and any other areas that are desired to be moisture proof. For areas that are shored, the waterproofing can be placed over a geo-composite drain prior to pouring or shooting the concrete wall.

Lateral Earth Pressures and Retaining Walls

We have developed criteria for the design of retaining or below grade walls. Our design parameters are based on retention of the granular native soils or structural fill. The wall design criteria are based on the total unit weight of backfill of 135 pounds per cubic foot (pcf) and friction angle of 36 degrees. The parameters are also based on level, well-drained wall backfill conditions. Walls may be designed as “restrained” retaining walls based on “at-rest” earth pressures, plus any surcharge on top of the walls as described below, if the walls are braced to restrain movement and/or movement is not acceptable. Unrestrained walls may be designed based on “active” earth pressure, if the walls are not part of the buildings and some movement of the retaining walls is acceptable. Acceptable lateral movement equal to at least 0.2 percent of the wall height would warrant the use of “active” earth pressure values for design. We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 35 pcf for yielding (active condition) walls, and 55 pcf for non-yielding (at-rest condition) walls.

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls with well-drained level backfill.

Wall Design Criteria	
“At-rest” Conditions (Lateral Earth Pressure)	55 pcf Equivalent Fluid Density (EFD) (Triangular Distribution)
“Active” Conditions (Lateral Earth Pressure)	35 pcf (EFD) (Triangular Distribution)
Seismic Increase for “Active” Conditions (Lateral Earth Pressure)	7 psf *H (Uniform Distribution) Where H is the height of the wall in feet
Passive Earth Pressure on Low Side of Wall (includes factor of safety of 1.5)	Neglect upper 1-foot, then 350 pcf (EFD) in glacial till or structural fill
Soil-Footing Coefficient of Sliding Friction (includes factor of safety of 1.5)	0.4 in glacial till or structural fill

If vehicular loads are expected to act on the surface of the wall backfill within a horizontal distance of less than or equal to one-half of the wall height behind the back face of the wall, a live load surcharge should be applied for the design. In this case, we recommend the addition of vehicle surcharges of 70 psf and 100 psf to the active and at-rest earth pressures, respectively.

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls or loads imposed by construction equipment, foundations or roadways adjacent to the wall (surcharge loads). To minimize the lateral earth pressure and prevent the buildup of water pressure against the walls, continuous footing drains (with cleanouts) should be provided at the bases of the walls. The footing drains should consist of a minimum 4-inch diameter rigid PVC perforated pipe, sloped to drain, with perforations placed near the bottom. The drainpipe should be enveloped by 6 inches of washed gravel in all directions wrapped in filter fabric to prevent the migration of silt and clay into the drain. Wall drains should be directed to a suitable outlet.

The wall fill material adjacent to and extending a lateral distance of at least 2 feet behind the walls should consist of free-draining granular material. All free-draining backfill should contain less than 3 percent fines (passing the U.S. Standard No. 200 Sieve) based upon the fraction passing the U.S. Standard No. 4 Sieve with at least 30 percent of the material being retained on the U.S. Standard No. 4 Sieve. Alternatively, a drainage composite may be used. This drainage layer should be connected to a tightline. It should be realized that the primary purpose of the free-draining material is the reduction of hydrostatic pressure. Some potential for the moisture to contact the back face of the wall may exist, even with treatment, which may require that more extensive waterproofing be specified for walls, which require interior moisture sensitive finishes.

We recommend that the wall fill be compacted to at least 95 percent of the maximum dry density based on ASTM D1557 Test Method. In-place density tests should be performed to verify adequate compaction. Soil compactors place transient surcharges on the backfill. Consequently, only light hand operated equipment is recommended for fill compaction within 3 feet of walls so that excessive stress is not imposed on the walls.

Floor Slabs and Exterior Flatwork

Before the placement of concrete floors or sidewalks on the site, or before any floor supporting fill is placed, the organic topsoil should be removed. Our soil explorations generally exposed up to 8 feet of undocumented fill overlying competent native soil. If undocumented fill is encountered at the planned slab subgrade elevations, then we recommended that the undocumented fill soils should be excavated to *at least 1 foot* below the planned slab subgrade and then backfilled with structural fill. Deeper excavation may be required, if soft/loose and yielding soil conditions are exposed during over-excavation. We should evaluate the subgrade soil conditions, and observe the over-excavation and structural fill placement during construction.

Floor slabs may be designed using a modulus of subgrade reaction value of $k = 150$ pounds per cubic inch (pci) for slabs supported on medium dense or firmer native soils or on at least one-foot of structural fill as recommended.

In areas where it is desired to reduce floor dampness, such as areas covered with moisture sensitive floor coverings, we recommend that concrete slab-on-grade floors be underlain by a water vapor retarder system. The water vapor retarder should consist of a vapor retarder sheeting underlain by a minimum of 4-inches of compacted clean (less than 5 percent passing the U.S. Standard No. 200 Sieve), open-graded coarse rock chips of $\frac{3}{4}$ -inch maximum size. The vapor retarder sheeting should be protected from puncture damage. In addition, ventilation of the structure may be prudent to reduce the accumulation of interior moisture.

Erosion and Sediment Control

Erosion and sediment control (ESC) is used to minimize the transportation of sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented and these measures should be in general accordance with local regulations. As a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features of the site:

- 1) Phase the soil, foundation, utility and other work, requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be undertaken during the wet season (generally October through April), but it should also be known that this may increase the overall cost of the project.

- 2) All site work should be completed and stabilized as quickly as possible.
- 3) Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.
- 4) Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited, other filtration methods will need to be incorporated.

Groundwater Influence on Construction

Groundwater seepage was encountered in soil boring B-3 at approximately 13.5 feet below the surface at the time of our explorations, which was interpreted as perched groundwater. Additionally, moist to wet soils were encountered in soil borings B-1, B-2, and B-4 directly below the asphalt pavement. In our opinion, there is the potential for perched groundwater seepage to develop on this site, particularly after periods of heavy precipitation.

It should be recognized that groundwater elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Therefore, groundwater levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

If groundwater is encountered during construction, we should observe the conditions to determine if dewatering will be needed. Design of temporary dewatering systems to remove groundwater should be the responsibility of the contractor. If earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated. These soils may “pump,” and the materials may not respond to densification techniques. Typical remedial measures include: disk and aerating the soil during dry weather; mixing the soil with drier materials; removing and replacing the soil with an approved fill material. A qualified geotechnical engineering firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

Drainage and Landscaping

Special attention to the drainage and irrigation adjacent to the buildings is recommended. Grading should establish drainage away from the structures and this drainage pattern should be maintained. Water should not be allowed to collect adjacent to the structures. Excessive irrigation within landscaped areas adjacent to the structure should not be allowed to occur.

The ground surface should slope away from building pads and pavement areas, toward appropriate drop inlets or other surface drainage devices. It is recommended that adjacent exterior grades be sloped a minimum of 2 percent for a minimum distance of 5 feet away from structures. Roof drains should be tightlined away from foundations to a suitable outlet. Roof drains should not be connected to the footing drains.

Subgrade soils in pavement areas should be inclined at a minimum of 1 percent and drainage gradients should be maintained to carry all surface water to collection facilities, and suitable outlets. These grades should be maintained for the life of the development.

Specific recommendations for and design of storm water disposal systems or septic disposal systems are beyond the scope of our services and should be prepared by other consultants that are familiar with design and discharge requirements.

Utility Trench Backfill

Utility trenches should be excavated according to accepted engineering practices following Occupational Safety and Health Administration (OSHA) standards, by a contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be minimized; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation.

All utility trench backfill should consist of structural fill. Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. The upper 5 feet of utility trench backfill placed in pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Below 5 feet, utility trench backfill in pavement areas should be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

It is recommended that the utility trenches within the building pads be compacted, as specified in this report, to minimize the transmission of moisture through the utility trench backfill.

The contractor is responsible for removing all water-sensitive soils from the trenches regardless of the backfill location and compaction requirements. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction.

Pavement Design

Our soil explorations generally exposed up to 4.5 feet of undocumented fill overlying competent native soil. If soft/loose undocumented fill soils are encountered in the pavement subgrade, we recommend that

subgrade modification techniques be considered. Subgrade modification typically includes the overexcavation of unsuitable materials, the placement of a high-strength geotextile fabric at the bottom of the over-excavated area, and then the placement of structural fill. Subgrade modification such as this is intended to disperse surcharge loads and therefore aid in pavement performance.

Where loose soils are encountered in the pavement subgrade, we recommend overexcavation of the soft/loose or undocumented fill soils to at least 12 inches below the planned pavement subgrade elevation. We recommend that a high-strength geotextile separation fabric, such as Mirafi 600X or equivalent then be placed over the compacted soil. After the fabric is placed, the area should be filled to the planned pavement subgrade elevation with structural fill. It should be noted that subgrade soils that have relatively high silt contents may be highly sensitive to moisture conditions. The subgrade strength and performance characteristics of a silty subgrade material may be dramatically reduced if it becomes wet. Therefore, we recommend that the pavement subgrade not be exposed for long periods, especially during wet weather.

Deeper excavation may be required, if soft/loose and yielding soil conditions are exposed during over-excavation. We should evaluate the subgrade soil conditions, and observe the over-excavation and structural fill placement during construction.

Traffic loads were not provided, however, based on our knowledge of the proposed project, we expect the traffic to range from light duty (passenger automobiles) to heavy duty (firetrucks). The following tables show the minimum recommended pavement sections for both light duty and heavy-duty traffic loads.

**ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT
LIGHT DUTY**

Asphaltic Concrete	Aggregate Base*
3.0 in.	6.0 in.

**ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT
HEAVY-DUTY**

Asphaltic Concrete	Aggregate Base*
4.0 in.	6.0 in.

PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT

Min. PCC Depth	Aggregate Base*
6.0 in.	6.0 in.

** 95% compaction based on ASTM Test Method D1557*

The pavement specification in Appendix C provides additional recommendations. The asphaltic concrete depth in the flexible pavement tables should be a surface course type asphalt, such as Washington Department of Transportation (WSDOT) ½-inch HMA. The rigid pavement design is based on a Portland Cement Concrete (PCC) mix that has a 28-day compressive strength of 4,000 pounds per square inch (psi) with a fiber mesh. The design is also based on a concrete flexural strength or modulus of rupture of 575 psi.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our services as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. We should also be present during the construction of stormwater management system to evaluate the soils. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor. Furthermore, Krazan & Associates is not responsible for the contractor's procedures, methods, scheduling or management of the work site.

LIMITATIONS

Geotechnical engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences improves. Although your site was analyzed using the most appropriate current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to improvements in the field of geotechnical engineering, physical changes in the site either due to excavation or fill placement, new agency regulations or possible changes in the proposed structure after the time of completion of the soils report may require the soils report to be professionally reviewed. In light of this, the owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that two years be considered a reasonable time for the usefulness of this report.

This report has been prepared for the exclusive use of koz Development LLC and their assigns. Foundation and earthwork construction are characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. Our report, design conclusions and interpretations should not be construed as a warranty of the subsurface conditions. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. The findings and conclusions of this report can be affected by the passage of time, such as seasonal weather conditions, manmade influences,

such as construction on or adjacent to the site, natural events such as earthquakes, slope instability, flooding, or groundwater fluctuations. If any variations or undesirable conditions are encountered during construction, the geotechnical engineer should be notified so that supplemental recommendations can be made.

The conclusions of this report are based on the information provided regarding the proposed construction. If the proposed construction is relocated or redesigned, the conclusions in this report may not be valid. The geotechnical engineer should be notified of any changes so that the recommendations can be reviewed and reevaluated.

Misinterpretations of this report by other design team members can result in project delays and cost overruns. These risks can be reduced by having Krazan & Associates, Inc. involved with the design teams' meetings and discussions after submitting the report. Krazan & Associates, Inc. should also be retained for reviewing pertinent elements of the design team's plans and specifications. Contractors can also misinterpret this report. To reduce this, risk Krazan & Associates, Inc. should participate in pre-bid and preconstruction meetings, and provide construction observations during the site work.

This report is a geotechnical engineering investigation with the purpose of evaluating the soil conditions in terms of foundation design. The scope of our services did not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands. Any statements or absence of statements, in this report or on any soils log regarding odors, unusual or suspicious items, or conditions observed are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous and/or toxic assessments.

The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments. We emphasize that this report is valid for this project as outlined above, and should not be used for any other site. Our report is prepared for the exclusive use of our client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing.

o-O-o

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (425) 485-5519.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

11/01/2021

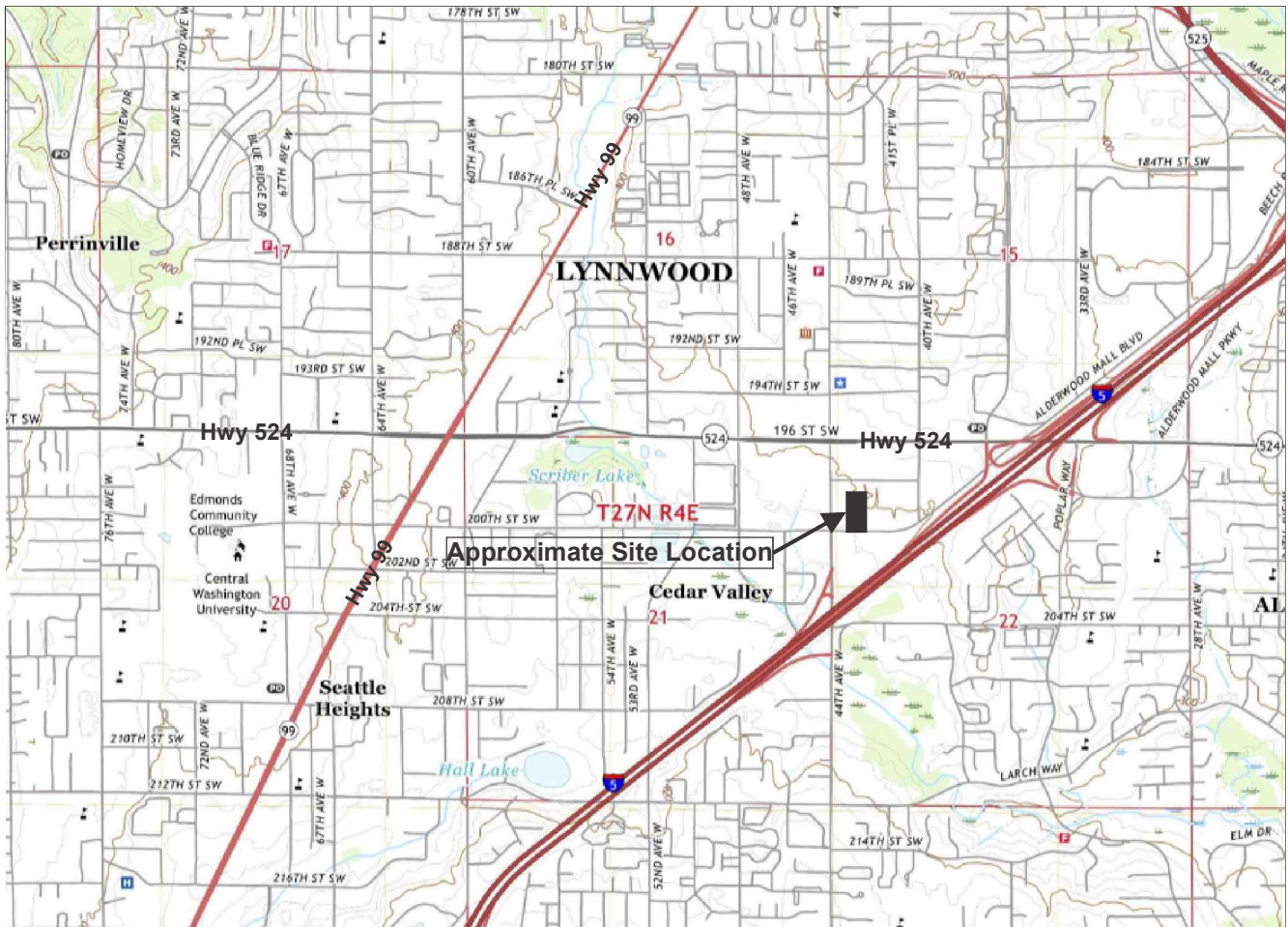


Michael D. Rundquist, P.E.
Senior Project Manager

MDR:VC

Vicinity Map

(Not to Scale)



4301 Alderwood Mall Blvd, Lynnwood, WA

Reference: The Vicinity Map is based on the USGS Topographic Map titled, "East Edmonds, WA, US Topo Map" dated 2020



Krazan & ASSOCIATES, INC.

Proposed Multi-Story Building - Lynnwood, WA

Date: Aug 2021

Project Number: 092-21009

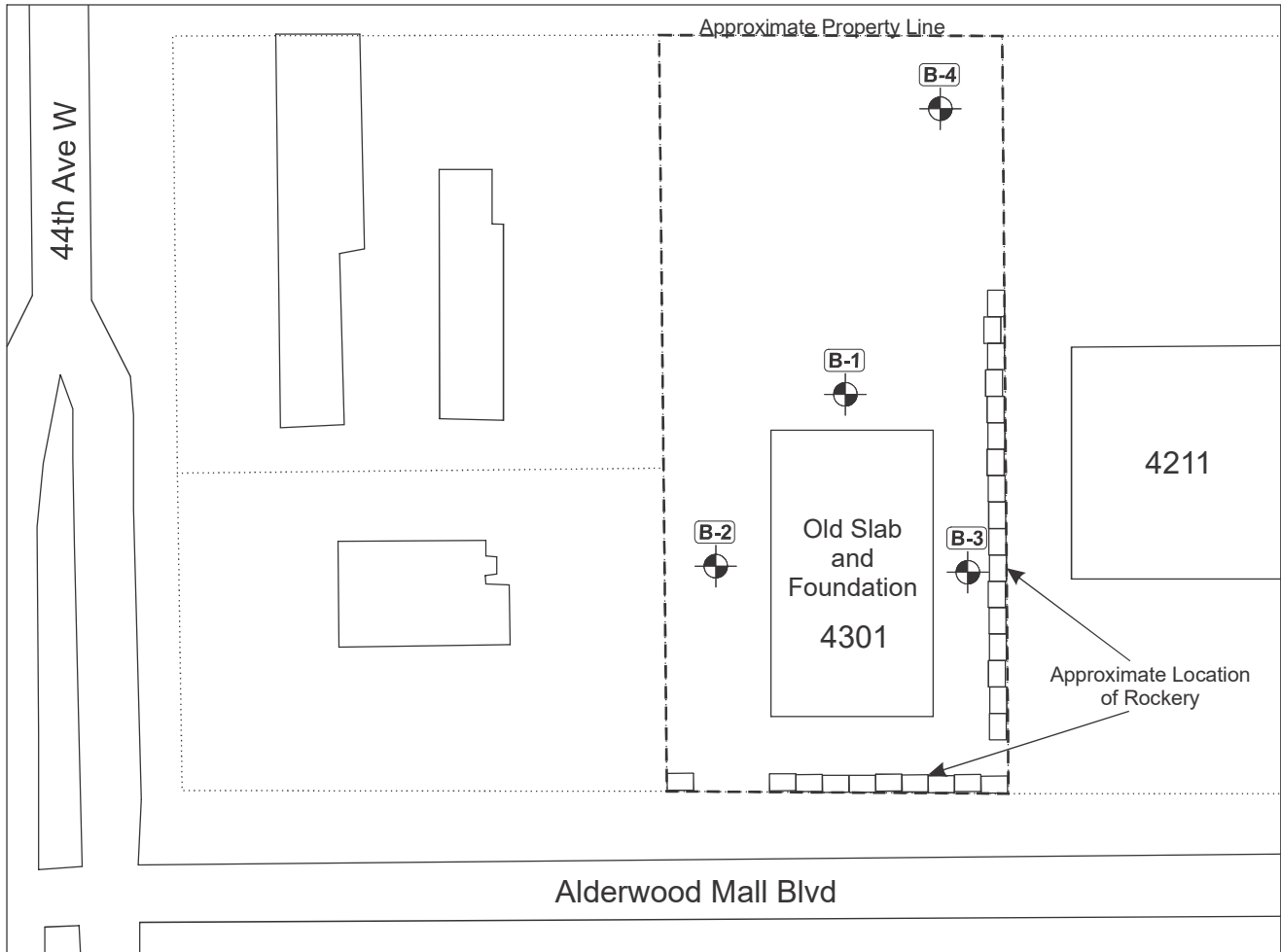
Drawn By: EC

Figure 1


Not to scale

Site Plan

(Not to Scale)



LEGEND

B-1
 Number and Approximate Location of Soil Boring

Reference: The site plan is based on the USGS Topographic Map titled, "East Edmonds, WA, US Topo Map" dated 2020



Krazan & ASSOCIATES, INC.

Proposed Multi-Story Building - Lynnwood, WA

Date: August 2021

Project Number: 092-21009

Drawn By: EC

Figure 2

Not to scale

APPENDIX A

FIELD INVESTIGATION AND LABORATORY TESTING

Field Investigation

The field investigation consisted of a surface reconnaissance and a subsurface exploration program. Four (4) geotechnical borings were completed for sampling the subsurface soils at this site. The soil borings were completed on August 17, 2021 by a Krazan subcontractor utilizing a mobile drill rig. The soil borings were advanced to depths of about 11.5 to 28.5 feet below the existing ground surface. The approximate exploration locations are shown on the Site Plan in Figure 2. The depths shown on the attached soil logs are below the existing ground surface at the time of our exploration.

Soil samples were obtained by using the Standard Penetration Test (SPT) as described in ASTM Test Method D1586. The Standard Penetration Test and sampling method consists of driving a standard 2-inch outside-diameter, split barrel sampler into the subsoil with a 140-pound hammer free falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the Standard Penetration Resistance, or N-value. The blow count is presented graphically on the boring logs in this appendix. The resistance, or “N” value, provides a measure of the relative density of granular soils or of the relative consistency of cohesive soils.

The soils encountered were logged in the field during the subsurface exploration and, with supplementary laboratory test data, are described in accordance with the Unified Soil Classification System (USCS). All samples from the explorations were returned to our laboratory for evaluation. The logs of the soil explorations are presented in this appendix.

Laboratory Testing

The laboratory testing program was developed primarily to determine the index properties of the soils. Test results were used for soil classification and as criteria for determining the engineering suitability of the surface and subsurface materials encountered. The laboratory test results are included in this appendix.

Soil Classification

USCS Soil Classification					
Major Division			Group Description		
Coarse-Grained Soils < 50% passes #200 sieve	Gravel and Gravelly Soils < 50% coarse fraction passes #4 sieve	Gravel (with little or no fines)	GW	Well-Graded Gravel	
			GP	Poorly Graded Gravel	
		Gravel (with > 12% fines)	GM	Silty Gravel	
			GC	Clayey Gravel	
	Sand and Sandy Soils > 50% coarse fraction passes #4 sieve	Sand (with little or no fines)	SW	Well-Graded Sand	
			SP	Poorly Graded Sand	
		Sand (with > 12% fines)	SM	Silty Sand	
			SC	Clayey Sand	
Fine-Grained Soils > 50% passes #200 sieve	Silt and Clay Liquid Limit < 50		ML	Silt	
			CL	Lean Clay	
			OL	Organic Silt and Clay (Low Plasticity)	
	Silt and Clay Liquid Limit > 50		MH	Inorganic Silt	
			CH	Inorganic Clay	
			OH	Organic Clay and Silt (Med. to High Plasticity)	
Highly Organic Soils			PT	Peat	

Relative Density with Respect to SPT N-Value			
Coarse-Grained Soils		Fine-Grained Soils	
Density	N-Value (Blows/Ft)	Density	N-Value (Blows/Ft)
Very Loose	0 - 4	Very Soft	0 - 1
Loose	5 - 10	Soft	2 - 4
Medium Dense	11 - 30	Medium Stiff	5 - 8
Dense	31 - 50	Stiff	9 - 15
Very Dense	> 50	Very Stiff	16 - 30
		Hard	> 30



Krazan & ASSOCIATES, INC.

Proposed Multi-Story Building - Lynnwood, WA

Date: August 2021

References: USCS

Drawn By: EC

Project Number: 092-21009

KRAZAN AND ASSOCIATES, INC.

LOG OF EXPLORATORY BORING B-1

PROJECT: Proposed Multi-Story Building DATE: 8/19/21

PROJECT NO.: 092-21009

PAGE: 1 of 2

LOGGED BY: Eddie Canfield

SURFACE ELEVATION: --

CONTRACTOR: EDI

BORING TYPE: Hollow Stem Auger

SAMPLE METHOD: Split Spoon, SPT

LOCATION: Lynnwood, WA

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH)				Natural Moisture Content			
							10	20	30	40	(Percent)			
			2" Thick Asphalt											
			Brown Silty Sand with Gravel (Moist)(Medium Dense)(Fill?)											
				9										
			Light Brown to Tan Sand with Trace Gravel (SM) (Moist)(Very Dense)(Glacial Till)	38	50+								7.6	
				50(6)										
5			Gray Silty Sand with Gravel (SM) (Moist)(Very Dense)(Glacial Till)										6.8	
				41	50+									
				50(2)										
				50(6)	50+									
10				50(6)	50+									
15				50(0)										

Water Level Initial: ∇ Final: ▼

Water Observations: Groundwater seepage was not observed.

Notes: --

KRAZAN AND ASSOCIATES, INC.

LOG OF EXPLORATORY BORING B-1

PROJECT: Proposed Multi-Story Building DATE: 8/19/21
PROJECT NO.: 092-21009 PAGE: 2 of 2
LOGGED BY: Eddie Canfield SURFACE ELEVATION: --
CONTRACTOR: EDI BORING TYPE: Hollow Stem Auger
SAMPLE METHOD: Split Spoon, SPT LOCATION: Lynnwood, WA

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH)				Natural Moisture Content				
							10	20	30	40	(Percent) 10 20 30 40				
20			Gray Silty Sand with Gravel (SM) (Moist)(Very Dense)(Glacial Till)	50(0)	50+	II									
25			Gray Silty Sand with Gravel (SM) (Moist)(Very Dense)(Glacial Till)	50(6)	50+	II									
30			Gray Silty Sand with Gravel (SM) (Moist)(Very Dense)(Glacial Till)	50(0)	50+	II									
End of Exploratory Boring															

Water Level Initial: Final:

Water Observations: Groundwater seepage was not observed.

Notes: --

KRAZAN AND ASSOCIATES, INC.

LOG OF EXPLORATORY BORING B-2

PROJECT: Proposed Multi-Story Building DATE: 8/19/2021

PROJECT NO.: 092-21009

PAGE: 1 of 1

LOGGED BY: Eddie Canfield

SURFACE ELEVATION: --

CONTRACTOR: EDI

BORING TYPE: Hollow Stem Auger

SAMPLE METHOD: Split Spoon, SPT

LOCATION: Lynnwood, WA

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH)				Natural Moisture Content			
							10	20	30	40	(Percent)			
			3" Thick Asphalt											
			Brown Silty Sand with Gravel (Moist to Wet)(Medium Dense)(Fill?)											
				7										
				7	12									
				5										
5														
				9										
			Brown Silty Sand with Gravel (SM) (Moist to Wet)(Medium Dense)(Weathered Soils)	11	26									
				15										
			Gray Silty Sand with Gravel (SM) (Moist)(Very Dense)(Glacial Till)											
				33										
				50(4)	50+									
10														
				50(4)	50+									
			End of Exploratory Boring											
15														

Water Level Initial: ∇ Final: ▼

Water Observations: Groundwater seepage was not observed.

Notes: --

KRAZAN AND ASSOCIATES, INC.

LOG OF EXPLORATORY BORING B-3

PROJECT: Proposed Multi-Story Building DATE: 8/19/2021

PROJECT NO.: 092-21009

PAGE: 1 of 1

LOGGED BY: Eddie Canfield

SURFACE ELEVATION: --

CONTRACTOR: EDI

BORING TYPE: Hollow Stem Auger

SAMPLE METHOD: Split Spoon, SPT

LOCATION: Lynnwood, WA

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH)				Natural Moisture Content			
							10	20	30	40	10	20	30	40
			3" Thick Asphalt											
			Brown Silty Sand with Gravel (Moist to Wet)(Medium Dense)(Fill?)											
				9										
				9	18									
				9										
5														
			Brown Silty Sand with Gravel (SM) (Moist to Wet)(Medium Dense)(Weathered Soils)	8										
				10	27									
				17										
			Gray Silty Sand with Gravel (SM) (Moist)(Very Dense)(Glacial Till)											
				31										
				50(6)	50+									
10														
				50(6)	50+									
			End of Exploratory Boring											
15														

Water Level Initial:  Final: 

Water Observations: Groundwater seepage was observed at a depth of about 10.5 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.

LOG OF EXPLORATORY BORING B-4

PROJECT: Proposed Multi-Story Building DATE: 8/19/2021

PROJECT NO.: 092-21009

PAGE: 1 of 1

LOGGED BY: Eddie Canfield

SURFACE ELEVATION: --

CONTRACTOR: EDI

BORING TYPE: Hollow Stem Auger

SAMPLE METHOD: Split Spoon, SPT

LOCATION: Lynnwood, WA

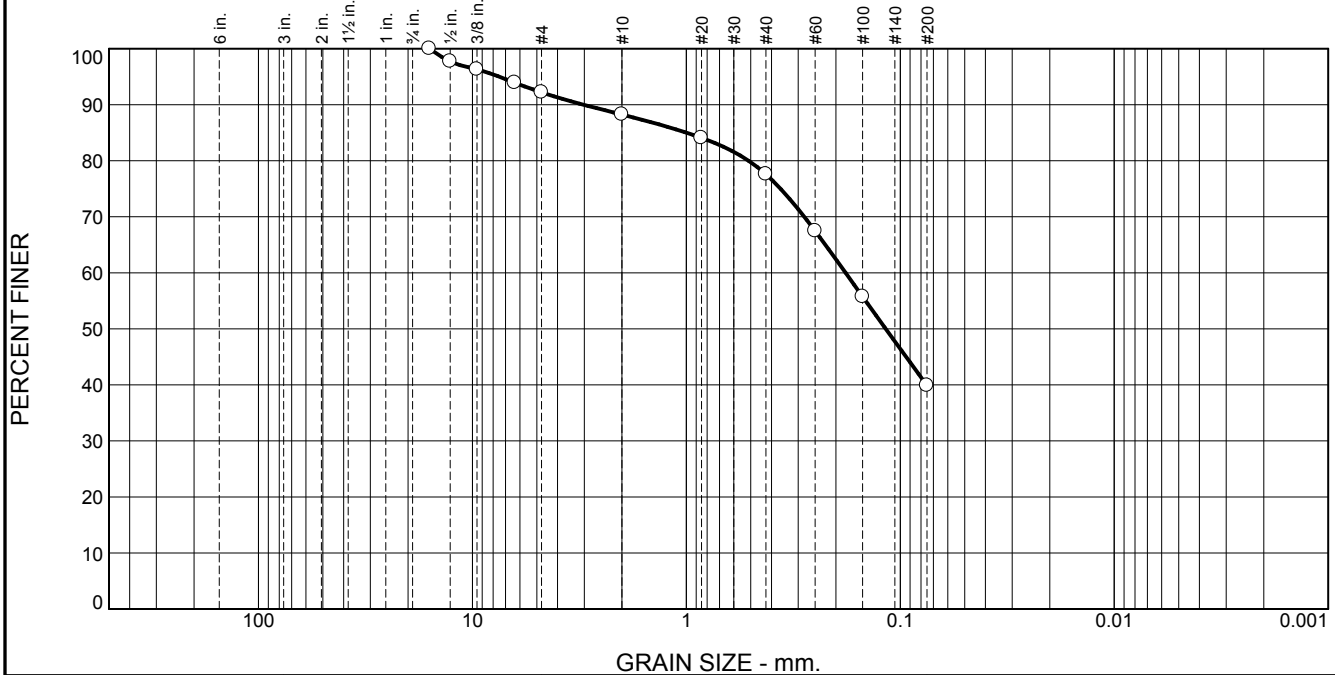
DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH)				Natural Moisture Content			
							10	20	30	40	(Percent)			
			2" Thick Asphalt											
			Brown Silty Sand with Gravel (Moist)(Very Loose to Medium Dense)(Fill?)											
				5										
				2	4									
				2										
5				5										
				12	22									
				10										
				5										
			Gray to Brown Silty Sand with Trace Gravel (SM) (Moist)(Medium Dense)(Weathered Soils?)	5	15								13.3	
				10										
10				18									10.5	
			Gray Silty Sand with Gravel (SM) (Moist)(Very Dense)(Glacial Till)	32	50+									
				50(5)										
			End of Exploratory Boring											
15														

Water Level Initial: ▼ Final: ▼

Water Observations: Groundwater seepage was not observed.

Notes:

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.8	4.0	10.6	37.7	39.9	

Test Results (ASTM C-136 & ASTM C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.625	100.0		
.5	97.7		
.375	96.3		
.25	93.9		
#4	92.2		
#10	88.2		
#20	84.1		
#40	77.6		
#60	67.4		
#100	55.7		
#200	39.9		

* (no specification provided)

Material Description

Light brown to tan silty sand with trace of gravel.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 3.0229 D₈₅= 0.9994 D₆₀= 0.1803
D₅₀= 0.1169 D₃₀= C_u=
D₁₀= C_c=

Remarks

Natural Moisture Content (ASTM D-2216): 7.6%

Date Received: 9/30/2021 Date Tested: 10/4/2021

Tested By: Cole Demas

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 1

Sample Number: 76424-A

Depth: 2.5'

Date Sampled: 9/30/2021



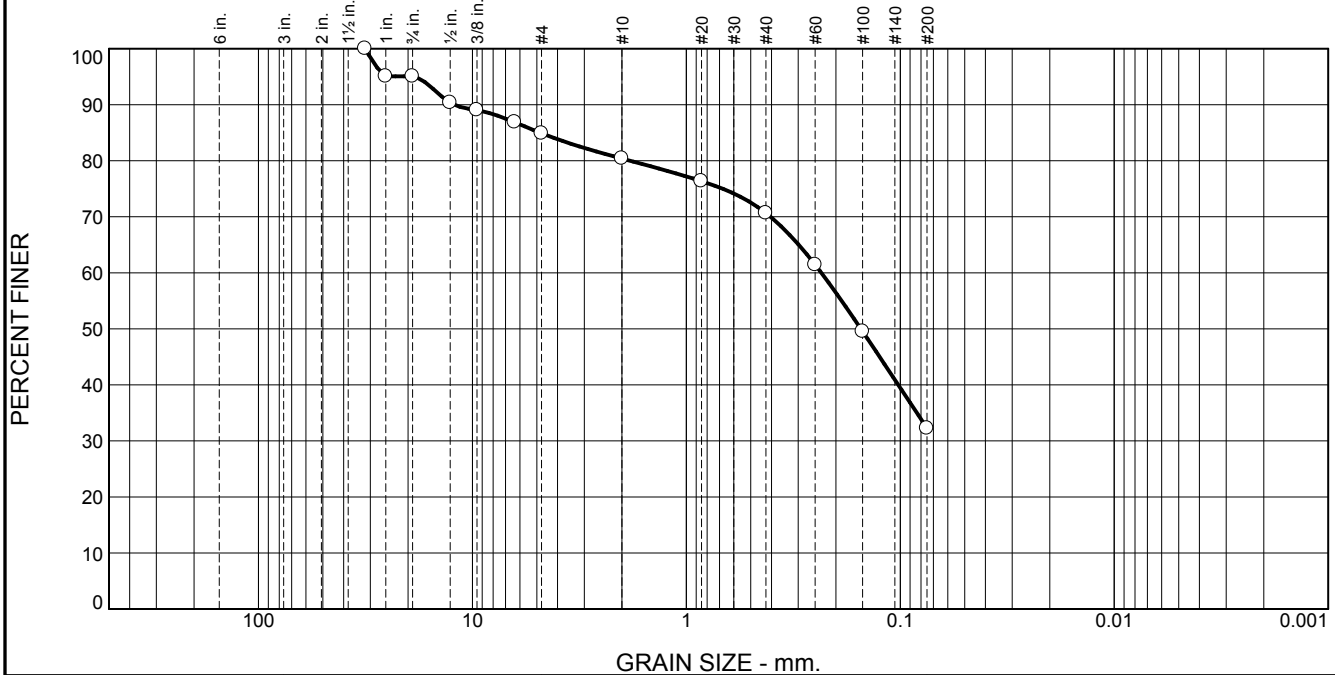
Client: KOZ Development LLC

Project: Proposed Apartment Building

Project No: 09221009

Figure

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.9	10.2	4.5	9.7	38.4	32.3	

Test Results (ASTM C-136 & ASTM C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.25	100.0		
1	95.1		
.75	95.1		
.5	90.4		
.375	89.0		
.25	86.9		
#4	84.9		
#10	80.4		
#20	76.4		
#40	70.7		
#60	61.4		
#100	49.5		
#200	32.3		

* (no specification provided)

Material Description

Gray silty sand with gravel.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D₉₀= 12.1963 D₈₅= 4.8252 D₆₀= 0.2339
D₅₀= 0.1530 D₃₀= C_u=
D₁₀= C_c=

Remarks

Natural Moisture Content (ASTM D-2216): 6.8%

Date Received: 9/30/2021 Date Tested: 10/4/2021

Tested By: Cole Demas

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 1
Sample Number: 76424-B

Depth: 5'

Date Sampled: 9/30/2021

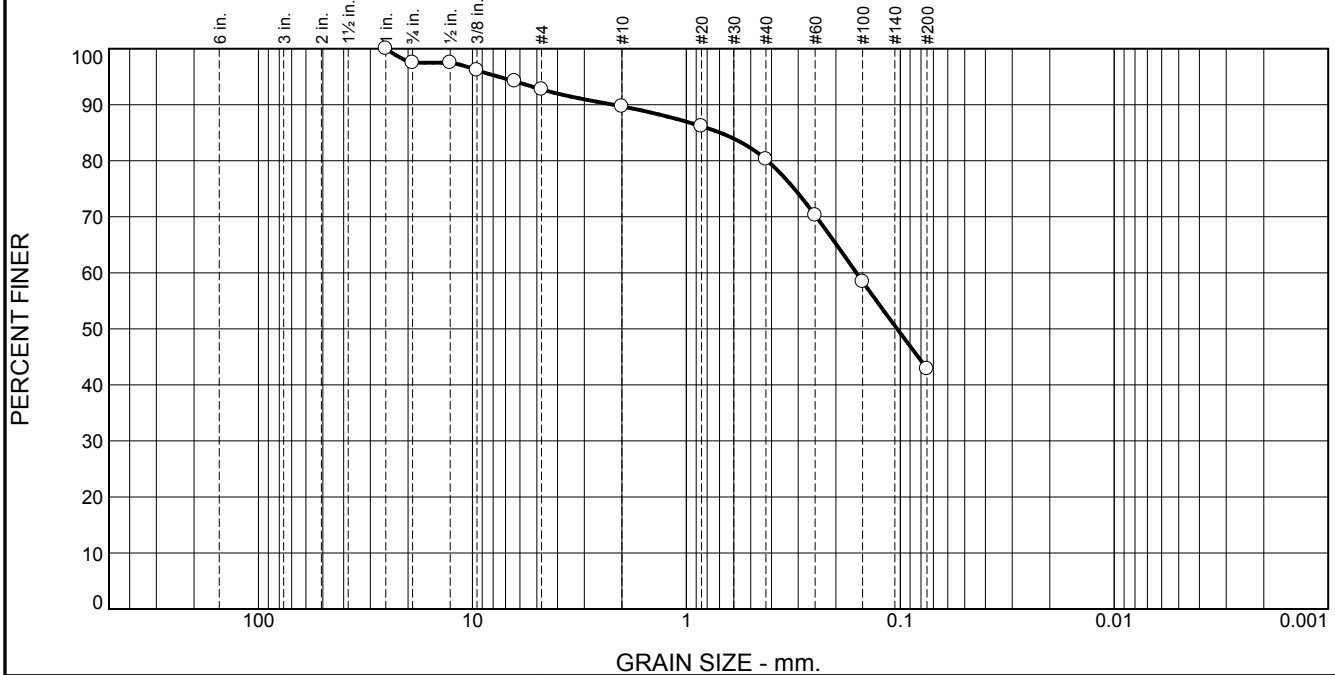


Client: KOZ Development LLC
Project: Proposed Apartment Building

Project No: 09221009

Figure

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.5	4.8	3.0	9.5	37.3	42.9	

Test Results (ASTM C-136 & ASTM C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	97.5		
.5	97.5		
.375	96.1		
.25	94.2		
#4	92.7		
#10	89.7		
#20	86.2		
#40	80.2		
#60	70.3		
#100	58.4		
#200	42.9		

* (no specification provided)

Material Description

Gray to brown silty sand with trace of gravel.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 2.1972 D₈₅= 0.6936 D₆₀= 0.1604
D₅₀= 0.1035 D₃₀= C_u=
D₁₀= C_c=

Remarks

Natural Moisture Content (ASTM D-2216): 13.3%

Date Received: 9/30/2021 Date Tested: 10/4/2021

Tested By: Cole Demas

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 4
Sample Number: 76424-C

Depth: 7.5'

Date Sampled: 9/30/2021

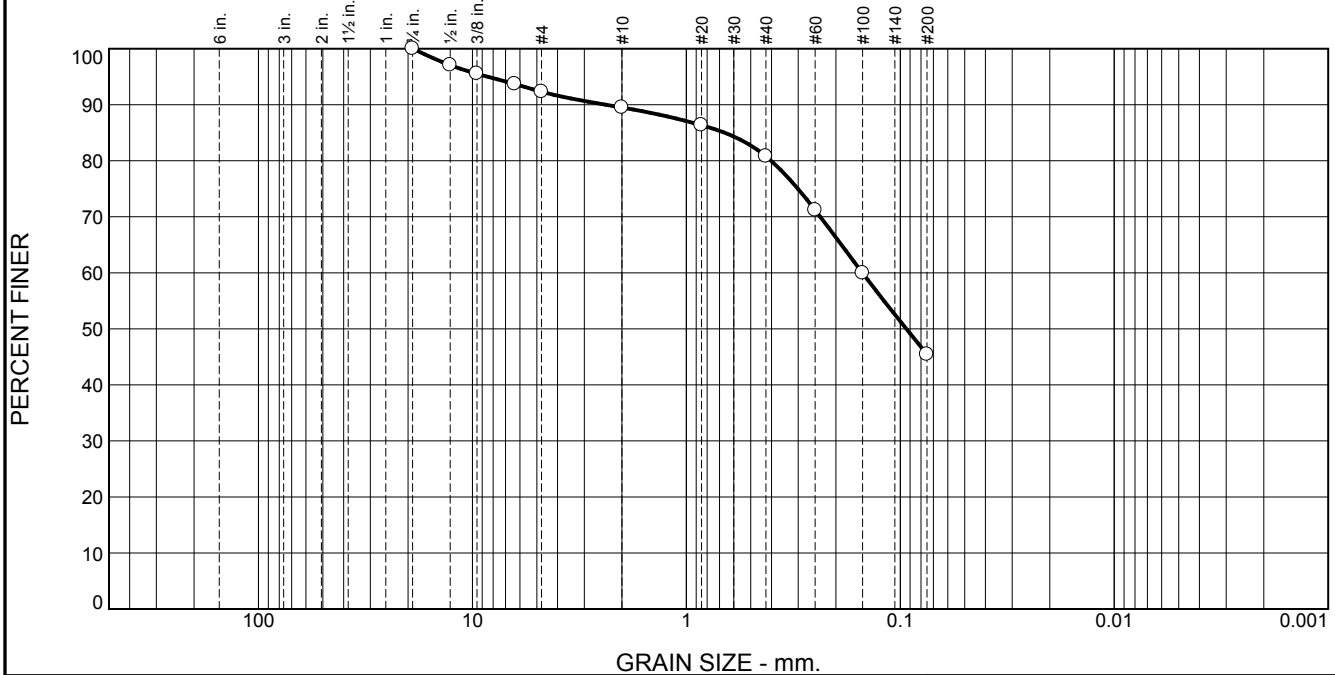


Client: KOZ Development LLC
Project: Proposed Apartment Building

Project No: 09221009

Figure

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.7	2.8	8.7	35.4	45.4	

Test Results (ASTM C-136 & ASTM C-117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.5	97.1		
.375	95.5		
.25	93.7		
#4	92.3		
#10	89.5		
#20	86.4		
#40	80.8		
#60	71.2		
#100	59.9		
#200	45.4		

* (no specification provided)

Material Description

Brown silty sand with trace of gravel.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 2.3765 D₈₅= 0.6613 D₆₀= 0.1505
D₅₀= 0.0937 D₃₀= C_u=
D₁₀= C_c=

Remarks

Natural Moisture Content (ASTM D-2216): 10.5%

Date Received: 9/30/2021 Date Tested: 10/4/2021

Tested By: Cole Demas

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 4
Sample Number: 76424-D

Depth: 10'

Date Sampled: 9/30/2021



Client: KOZ Development LLC
Project: Proposed Apartment Building

Project No: 09221009

Figure

APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, the recommendations in the report have precedence.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including but not limited to the furnishing of all labor, tools, and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans, and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Inc., hereinafter known as the Geotechnical Engineer and/or Testing Agency. Attainment of design grades when achieved shall be certified to by the project Civil Engineer. Both the Geotechnical Engineer and Civil Engineer are the Owner's representatives. If the contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory as determined by both the Geotechnical Engineer and Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Geotechnical Engineer, Civil Engineer or project Architect.

No earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner of the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to a density not less than 95 percent of maximum dry density as determined by ASTM Test Method D1557 as specified in the technical portion of the Geotechnical Engineering Report. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work will be judged by the Geotechnical Engineer.

SOIL AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the soil report.

The Contractor shall make his own interpretation of the data contained in said report, and the Contractor shall not be relieved of liability under the contract for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including Court costs of codefendants, for all claims related to dust or windblown materials attributable to his work.

SITE PREPARATION

Site preparation shall consist of site clearing and grubbing and preparations of foundation materials for receiving fill.

CLEARING AND GRUBBING: The Contractor shall accept the site in this present condition and shall demolish and/or remove from the area of designated project, earthwork all structures, both surface and subsurface, trees, brush, roots, debris, organic matter, and all other matter determined by the Geotechnical Engineer to be deleterious. Such materials shall become the property of the Contractor and shall be removed from the site.

Tree root systems in proposed building areas should be removed to a minimum depth of 3 feet and to such an extent which would permit removal of all roots larger than 1 inch. Tree root removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill or tree root excavation should not be permitted until all exposed surfaces have been inspected and the Geotechnical Engineer is present for the proper control of backfill placement and compaction. Burning in areas, which are to receive fill materials, shall not be permitted.

SUBGRADE PREPARATION: Surfaces to receive Structural fill shall be prepared as outlined above, excavated/scarified to a depth of 12 inches, moisture-conditioned as necessary, and compacted to 95 percent compaction.

Loose and/or areas of disturbed soils shall be moisture conditioned and compacted to 95 percent compaction. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill material. All areas which are to receive fill materials shall be approved by the Geotechnical Engineer prior to the placement of any of the fill material.

EXCAVATION: All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable technical requirements.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Geotechnical Engineer. Material from the required site excavation may be utilized for construction site fills provided prior approval is given by the Geotechnical Engineer. All materials utilized for constructing site fills shall be free from vegetable or other deleterious matter as determined by the Geotechnical Engineer.

PLACEMENT, SPREADING AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. However, compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Geotechnical Engineer.

Both cut and fill shall be surface compacted to the satisfaction of the Geotechnical Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture content and density of previously placed fill are as specified.

APPENDIX C

PAVEMENT SPECIFICATIONS

1. DEFINITIONS – The term “pavement” shall include asphalt concrete surfacing, untreated aggregate base, and aggregate subbase. The term “subgrade” is that portion of the area on which surfacing, base, or subbase is to be placed.

2. SCOPE OF WORK – This portion of the work shall include all labor, materials, tools and equipment necessary for and reasonable incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically noted as “Work Not Included.”

3. PREPARATION OF THE SUBGRADE – The Contractor shall prepare the surface of the various subgrades receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans and as per the pavement design section of this report. The upper 12 inches of the soil subgrade beneath the pavement section shall be compacted to a minimum compaction of 95% of maximum dry density as determined by test method ASTM D1557. The finished subgrades shall be tested and approved by the Geotechnical Engineer prior to the placement of additional pavement of additional pavement courses.

4. AGGREGATE BASE – The aggregate base shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base should conform to WSDOT Standard Specification for Crushed Surfacing Base Course or Top Course (Item 9-03.9(3)). The base material shall be compacted to a minimum compaction of 95% as determined by ASTM D1557. Each layer of subbase shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

5. ASPHALTIC CONCRETE SURFACING – Asphaltic concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The drying, proportioning, and mixing of the materials shall conform to WSDOT Specifications.

The prime coat, spreading and compacting equipment, and spreading and compacting the mixture shall conform to WSDOT Specifications, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with combination steel-wheel and pneumatic rollers, as described in WSDOT Specifications. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

6. TACK COAT – The tack (mixing type asphaltic emulsion) shall conform to and be applied in accordance with the requirements of WSDOT Specifications.

Section VII – Operation and Maintenance

Section VII Summary:

Narrative

The Operation and Maintenance Manual is a standalone document that should be given to the homeowner following the construction of the project.

**Alderwood Mall Blvd Apartments
4301 Alderwood Mall Blvd,
Lynnwood, WA 98036**

OPERATION AND MAINTENANCE MANUAL

Date: March 2022

Operation and Maintenance Manual

This Operation and Maintenance Manual has been created for the Alderwood Mall Blvd Apartments. The permanent stormwater control plan consists of a detention vault and flow control structure under the proposed underground parking along with catch basins on-site and in the ROW. Included in this Operation and Maintenance Manual is an 11" x 17" grading and drainage plan sheet showing the location of the facilities. Please note that this map is generated during the design phase and may not reflect all changes made in permitting and construction. CG Engineering may be contacted for an updated copy of this map once the as-built drawings are completed for the site.

Included in this manual are facility specific sheets indicating the various maintenance components of the following facilities:

Catch Basins: Concrete structures with steel grates that collect stormwater runoff from the site and act as junctions for storm conveyance pipes.

Catch Basin Inserts: Filter socks/traps to be placed in catch basins to prevent sediment-laden waters from entering the public storm system.

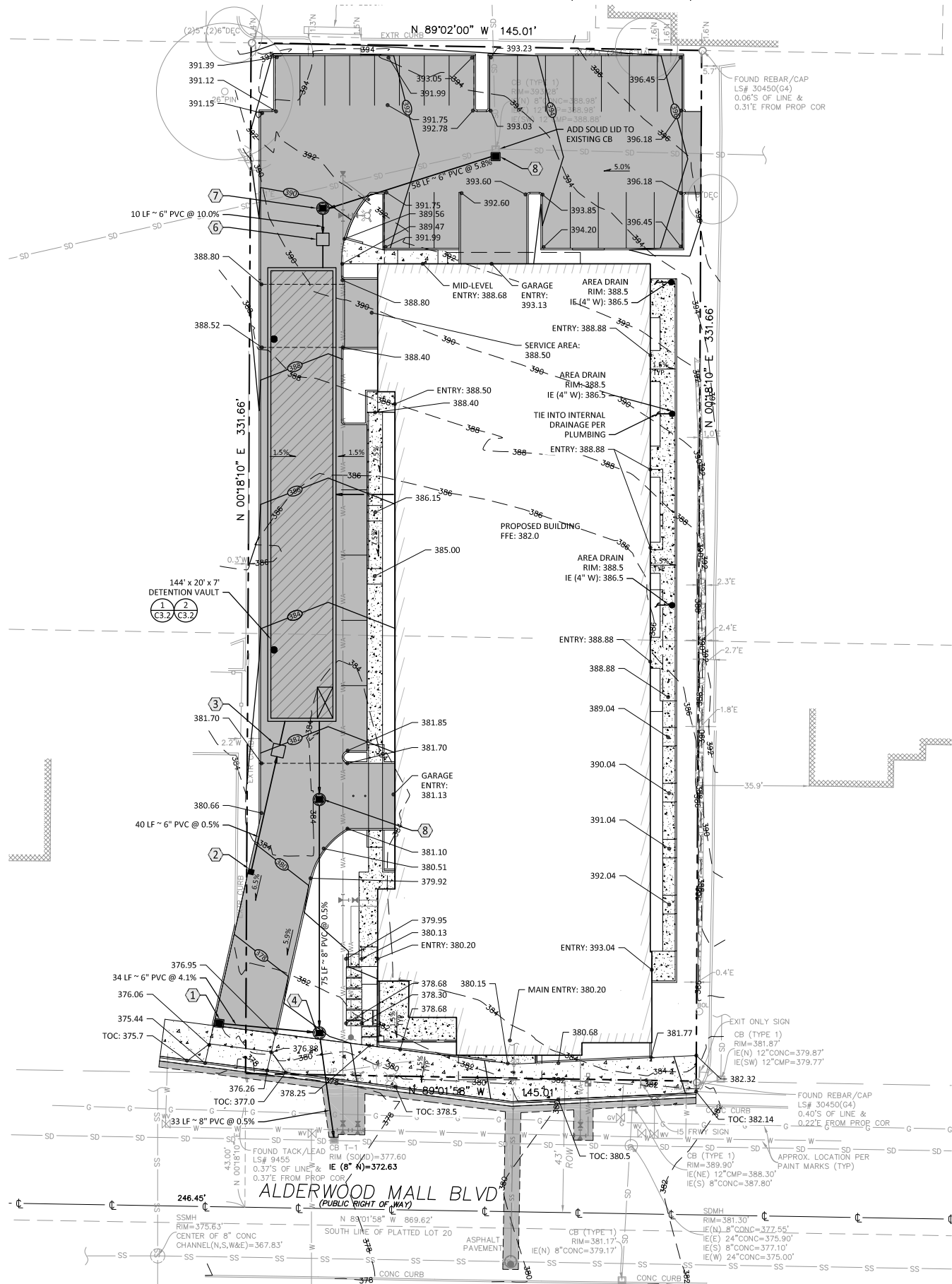
Stormwater Detention Pipe w/ Flow Restrictor: A underground structure to detain stormwater so it can be released at required rates.

Vegetation Management: Landscaping can include grading, soil transfer, vegetation removal, pesticide and fertilizer applications, and watering. Stormwater contaminants include toxic organic compounds, heavy metals, oils, total suspended solids, coliform bacteria, fertilizers, and pesticides.

Facilities shall be inspected for defects listed in the following facility sheets.

Most maintenance tasks are generally reactionary to a defect being found, rather than a matter of constant upkeep. It is generally expected that few to none of these defects will be present upon the yearly inspection of each facility. The facility sheets list the potential conditions warranting maintenance and the expected result following any maintenance. Several engineer's notes for specific tasks are provided within the facility sheets. **Unless otherwise noted on the facility sheets the maintenance tasks should be performed on an "as needed" basis: (a) when the described defect is visible to whomever performs the yearly inspection, or (b) should any defect become apparent between inspections.**

NW 1/4, NW 1/4, SECTION 22, TOWNSHIP 27 NORTH, RANGE 4 EAST, W.M.



GRADING QUANTITIES	
TOTAL EXCAVATION (CUT) -	11,250 CU YDS TOTAL
EMBANKMENT (FILL) -	110 CU YDS
TOTAL	11,360 CU YDS

THE QUANTITIES SHOWN ABOVE ARE FOR THE PERMIT PROCESS ONLY. THESE VALUES ARE APPROXIMATE. DO NOT USE FOR BIDDING, PAYMENT, OR ESTIMATING PURPOSES.

CATCH BASIN SCHEDULE				
MARK	TYPE	RIM ELEV	INV ELEV	NOTES
①	TYPE I	376.65	(6" N): 374.15	
②	TYPE I	379.35	(6" N): 376.85	
③	MWS-L-4-4-V	381.80	(6" S): 376.70 (6" N): 375.70	ENHANCED RUNOFF TREATMENT (S) C3.2
④	TYPE II	378.15	(8" N): 372.80 (6" W): 372.80 (4" E): 372.80 (8" S): 372.80	SOLID COVER (S) C3.3
⑤	54"Ø TYPE II	381.20	(8" N): 373.18 (8" S): 373.18	FLOW CONTROL STRUCTURE, SOLID COVER (S) C3.2 (S) C3.2 (S) C3.3
⑥	MWS-L-4-4-V	389.40	(6" N): 378.0 (6" S): 377.0	ENHANCED RUNOFF TREATMENT (S) C3.2
⑦	TYPE II	389.95	(6" E): 387.0 (6" S): 379.0	
⑧	TYPE I	392.85	(6" W): 390.35	

GRADING AND DRAINAGE NOTES:

- ALL DISTURBED AREAS ON AND OFF-SITE SHALL BE COMPOST-AMENDED PER THE REQUIREMENTS OF BMP T5.13 IN THE STORMWATER MANUAL VOLUME V, CHAPTER 5.
- TOP AND TOE REFER TO FINISHED GRADE AT THE TOP AND BOTTOM OF THE WALLS, RESPECTIVELY.
- A MINIMUM OF 3' HORIZONTAL SEPARATION AND 1' VERTICAL SEPARATION IS REQUIRED BETWEEN DRY UTILITIES (POWER, GAS, PHONE, CABLE, ETC) AND SEWER, WATER AND STORM, AND A MINIMUM OF 5' HORIZONTAL SEPARATION AND 1' VERTICAL SEPARATION FROM ANY CITY -OWNED LINES.
- A TYPE II CATCH BASIN IS REQUIRED WHENEVER RIM TO INVERT EXCEEDS 5'.
- A MINIMUM OF 2' OF COVER IS REQUIRED FOR ALL PIPES LOCATION UNDER DRIVABLE SURFACES AND 1' OF COVER UNDER LANDSCAPE SURFACES.
- PRIOR TO PLACING ANY SURFACING MATERIAL ON THE ROADWAY, IT WILL BE THE RESPONSIBILITY OF THE DEVELOPER/CONTRACTOR TO PROVIDE DENSITY TEST REPORTS CERTIFIED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF WASHINGTON.
- NEW/REPLACED IMPERVIOUS SURFACE (INCLUDING ROW): 43,775 SF
 - NEW BUILDING: 20,944 SF ROOF AREA (INCLUDING OVERHANGS). RUNOFF ROUTED TO DETENTION PIPE THROUGH ROOF DRAINS.
 - NEW DRIVEWAY: 16,251 SF. RUNOFF ROUTED TO DETENTION PIPE THROUGH CATCH BASINS AND CONVEYANCE PIPES.
 - NEW SIDEWALK: 1,324 SF. RUNOFF ROUTED TO DETENTION PIPE THROUGH CATCH BASINS AND CONVEYANCE PIPES.
 - BYPASS DRIVEWAY: 1,048 SF. RUNOFF ROUTED TO PUBLIC STORM MAIN THROUGH CATCH BASINS AND CONVEYANCE PIPES. MODELED AS SEPARATE BASIN IN WWHM.
 - ROW SIDEWALK: 2,174 SF. RUNOFF FLOWS INTO ROW OF ALDERWOOD MALL BLVD. DETENTION VAULT SIZED TO INCLUDE THIS AREA.
 - ROW SAWCUTS: 847 SF. RUNOFF FLOWS INTO ROW OF ALDERWOOD MALL BLVD. DETENTION VAULT SIZED TO INCLUDE THIS AREA.

THIS PLAN IS FOR DESIGN REVIEW PURPOSES AND SHOULD NOT BE USED FOR CONSTRUCTION, BIDDING, OR ESTIMATES. PLAN SET WILL BE UPDATED FOR FUTURE SUBMITTALS.

PR-XXXXXX-2021

CITY OF LYNNWOOD PUBLICWORKS DEPARTMENT APPROVED FOR CONSTRUCTION	
Subject to all Revisions, Field Conditions, and Inspections	
Reviewer	Date
Reviewer	Date
William Franz, PE - Public Works Director	Date

C.G. ENGINEERING
250 4TH AVE. S., SUITE 200
EDMONDS, WASHINGTON 98020
PHONE (425) 778-8500
FAX (425) 778-5536



03/02/22

MARK	DATE	DESCRIPTION
	03/02/22	PROJECT DESIGN REVIEW

DESIGN:	BJL
DRAWN:	ATD
CHECK:	JPU
JOB NO:	21350.20
DATE:	03/02/22

ALDERWOOD MALL BLVD APARTMENTS
4301 ALDERWOOD MALL BOULEVARD
LYNNWOOD, WA 98036
GRADING AND DRAINAGE
PLAN

SHEET:

C3.1

can cause air pollution include grain dust, sawdust, coal, gravel, crushed rock, cement, and boiler fly ash. Air emissions can contaminate stormwater. The objective of this BMP is to reduce the stormwater pollutants caused by dust generation and control.

Pollutant Control Approach: Prevent dust generation and emissions where feasible, regularly clean-up dust that can contaminate stormwater, and convey dust contaminated stormwater to proper treatment.

Applicable BMPs:

- Clean, as needed, powder material handling equipment and vehicles.
- Regularly sweep dust accumulation areas that can contaminate stormwater. Conduct sweeping using vacuum filter equipment to minimize dust generation and to ensure optimal dust removal.
- Use dust filtration/collection systems such as baghouse filters, cyclone separators, etc. to control vented dust emissions that could contaminate stormwater. Control of zinc dusts in rubber production is one example.
- Maintain on-site controls to prevent vehicle track-out.
- Maintain dust collection devices on a regular basis.

Recommended BMPs:

- In manufacturing operations, train employees to handle powders carefully to prevent generation of dust.
- Use water spray to flush dust accumulations to sanitary sewers where allowed by the local sewer authority or to other appropriate treatment system.
- Use approved dust suppressants such as those listed in *Methods for Dust Control* (Ecology, 2016b). Application of some products may not be appropriate in close proximity to receiving waters or conveyances close to receiving waters. For more information check with Ecology or the local jurisdiction.

Recommended Treatment BMPs

Install sedimentation basins, wet ponds, wet vaults, catch basin filters, vegetated filter strips, or equivalent sediment removal BMPs.

S411 BMPs for Landscaping and Lawn / Vegetation Management

Description of Pollutant Sources: Landscaping can include grading, soil transfer, vegetation planting, and vegetation removal. Examples include weed control on golf course lawns, access roads, and utility corridors and during landscaping; and residential lawn/plant care. Proper management of vegetation can minimize excess nutrients and pesticides.

Pollutant Control Approach: Maintain appropriate vegetation to control erosion and the discharge of stormwater pollutants. Prevent debris contamination of stormwater. Where practicable, grow plant species appropriate for the site, or adjust the soil properties of the site to grow desired plant species.

Applicable BMPs:

- Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
- Select the right plants for the planting location based on proposed use, available maintenance, soil conditions, sun exposure, water availability, height, sight factors, and space available.
- Ensure that plants selected for planting are not on the noxious weed list. For example, butterfly bush often gets planted as an ornamental but is actually on the noxious weed list.

The Washington State Noxious Weed List can be found at the following webpage:

<https://www.nwcb.wa.gov/printable-noxious-weed-list>

- Do not dispose of collected vegetation into waterways or storm sewer systems.
- Do not blow vegetation or other debris into the drainage system.
- Dispose of collected vegetation such as grass clippings, leaves, sticks by composting or recycling.
- Remove, bag, and dispose of class A & B noxious weeds in the garbage immediately.
- Do not compost noxious weeds as it may lead to spreading through seed or fragment if the composting process is not hot enough.
- Use manual and/or mechanical methods of vegetation removal (pincer-type weeding tools, flame weeders, or hot water weeders as appropriate) rather than applying herbicides, where practical.
- Use at least an eight-inch "topsoil" layer with at least 8 percent organic matter to provide a sufficient vegetation-growing medium.
 - Organic matter is the least water-soluble form of nutrients that can be added to the soil. Composted organic matter generally releases only between 2 and 10 percent of its total nitrogen annually, and this release corresponds closely to the plant growth cycle. Return natural plant debris and mulch to the soil, to continue recycling nutrients indefinitely.
- Select the appropriate turfgrass mixture for the climate and soil type.
 - Certain tall fescues and rye grasses resist insect attack because the symbiotic endophytic fungi found naturally in their tissues repel or kill common leaf and stem-eating lawn insects.

- The fungus causes no known adverse effects to the host plant or to humans.
 - Tall fescues and rye grasses do not repel root-feeding lawn pests such as Crane Fly larvae.
 - Tall fescues and rye grasses are toxic to ruminants such as cattle and sheep
- Endophytic grasses are commercially available; use them in areas such as parks or golf courses where grazing does not occur.
- Local agricultural or gardening resources such as Washington State University Extension office can offer advice on which types of grass are best suited to the area and soil type.
- Use the following seeding and planting BMPs, or equivalent BMPs, to obtain information on grass mixtures, temporary and permanent seeding procedures, maintenance of a recently planted area, and fertilizer application rates: BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, BMP C123: Plastic Covering, and BMP C124: Sodding.
- Adjusting the soil properties of the subject site can assist in selection of desired plant species. Consult a soil restoration specialist for site-specific conditions.

Recommended Additional BMPs:

- Conduct mulch-mowing whenever practicable.
- Use native plants in landscaping. Native plants do not require extensive fertilizer or pesticide applications. Native plants may also require less watering.
- Use mulch or other erosion control measures on soils exposed for more than one week during the dry season (May 1 to September 30) or two days during the rainy season (October 1 to April 30).
- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Apply an annual topdressing application of 3/8" compost. Amending existing landscapes and turf systems by increasing the percent organic matter and depth of topsoil can:
 - Substantially improve the permeability of the soil.
 - Increase the disease and drought resistance of the vegetation.
 - Reduces the demand for fertilizers and pesticides.
- Disinfect gardening tools after pruning diseased plants to prevent the spread of disease.
- Prune trees and shrubs in a manner appropriate for each species.
- If specific plants have a high mortality rate, assess the cause and replace with another more appropriate species.
- When working around and below mature trees, follow the most current American National Standards Institute (ANSI) ANSI A300 standards (see

http://www.tcia.org/TCIA/BUSINESS/ANSI_A300_Standards_/TCIA/BUSINESS/A300_Standards/A300_Standards.aspx?hkey=202ff566-4364-4686-b7c1-2a365af59669) and International Society of Arboriculture BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil).

- Monitor tree support systems (stakes, guys, etc.).
 - Repair and adjust as needed to provide support and prevent tree damage.
 - Remove tree supports after one growing season or maximum of 1 year.
 - Backfill stake holes after removal.
- When continued, regular pruning (more than one time during the growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location.
- Make reasonable attempts to remove and dispose of class C noxious weeds.
- Re-seed bare turf areas until the vegetation fully covers the ground surface.
- Watch for and respond to new occurrences of especially aggressive weeds such as Himalayan blackberry, Japanese knotweed, morning glory, English ivy, and reed canary grass to avoid invasions.
- Plant and protect trees per BMP T5.16: Tree Retention and Tree Planting.
- Aerate lawns regularly in areas of heavy use where the soil tends to become compacted. Conduct aeration while the grasses in the lawn are growing most vigorously. Remove layers of thatch greater than ¾-inch deep.
- Set the mowing height at the highest acceptable level and mow at times and intervals designed to minimize stress on the turf. Generally mowing only 1/3 of the grass blade height will prevent stressing the turf.
 - Mowing is a stress-creating activity for turfgrass.
 - Grass decreases its productivity when mowed too short and there is less growth of roots and rhizomes. The turf becomes less tolerant of environmental stresses, more disease prone and more reliant on outside means such as pesticides, fertilizers, and irrigation to remain healthy.

Additional BMP Information:

- King County's *Best Management Practices for Golf Course Development and Operation* (King County, 1993) has additional BMPs for Turfgrass Maintenance and Operation.
- King County, Seattle Public Utilities, and the Saving Water Partnership have created the following natural lawn and garden care resources that include guidance on building healthy soil with compost and mulch, selecting appropriate plants, watering, using alternatives to pesticides, and implementing natural lawn care techniques.

- *Natural Yard Care - Five steps to make your piece of the planet a healthier place to live* (King County and SPU, 2008)
- *The Natural Lawn & Garden Series: Smart Watering* (Saving Water Partnership, 2006)
- *Natural Lawn Care for Western Washington* (Saving Water Partnership, 2007)
- *The Natural Lawn & Garden Series: Growing Healthy Soil; Choosing the Right Plants; and Natural Pest, Weed and Disease Control* (Saving Water Partnership, 2012)
- The International Society of Arboriculture (ISA) is a group that promotes the professional practice of arboriculture and fosters a greater worldwide awareness of the benefits of trees through research, technology, and education. ISA standards used for managing trees, shrubs, and other woody plants are the American National Standards Institute (ANSI) A300 standards. The ANSI A300 standards are voluntary industry consensus standards developed by the Tree Care Industry Association (TCIA) and written by the Accredited Standards Committee (ASC). The ANSI standards can be found on the ISA website: www.isa-arbor.com/education/publications/index.aspx
- Washington State University's *Gardening in Washington State* website at <http://gardening.wsu.edu> contains Washington State specific information about vegetation management based on the type of landscape.
- See the *Pacific Northwest Plant Disease Management Handbook* (Pscheidt and Ocamb, 2016) for information on disease recognition and for additional resources.

S425 BMPs for Soil Erosion and Sediment Control at Industrial Sites

Description of Pollutant Sources: Industrial activities on soil areas; exposed and disturbed soils; steep grading; etc. can be sources of sediments that can contaminate stormwater runoff.

Pollutant Control Approach: Limit the exposure of erodible soil, stabilize, or cover erodible soil where necessary to prevent erosion, and/or provide treatment for stormwater contaminated with TSS caused by eroded soil.

Applicable BMPs:

- Limit the exposure of erodible soil.
- Stabilize entrances/exits to prevent track-out. See [BMP C105: Stabilized Construction Access](#).
- Stabilize or cover erodible soil to prevent erosion. Cover practice options include:
 - Use vegetative cover such as grass, trees, shrubs, on erodible soil areas.
 - Cover exposed areas with mats such as clear plastic, jute, synthetic fiber. See [BMP C122: Nets and Blankets](#) and [BMP C123: Plastic Covering](#).

Table V-A.2: Maintenance Standards - Infiltration (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

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 regouted and secure at basin wall.
	Settlement/ Mis-alignment	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.

Table V-A.17: Maintenance Standards - Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1-inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-A.18: Maintenance Standards - Catch Basin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with sheet flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There should be no areas of standing water once inflow has ceased.
	No vegetation	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean to spread flows evenly over entire embankment width

[illegible]