INSIGHT ENGINEERING CO.

STORMWATER SITE PLAN
For
Haller

Prepared for
City of Arlington
238 N. Olympic Ave
Arlington, WA 98223
360.403.3500

Project Site Location:
106 Haller St
Arlington, WA 98223

Applicant:
Joshua & Stephanie Tremmel
16 Haller St
Arlington, WA 98223

Contact:
IECO
P.O. Box 1478
Everett, WA 98206
425-303-9363

Tax Id: 00461803001300
IECO Project: 24-1370

Certified Erosion and Sedimentation Control Lead:
To be named by contractor

Stormwater Site Plan Prepared By:

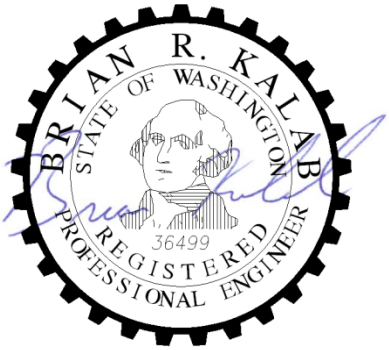
Shilpa Xavier, E. I. T.

Stormwater Site Plan Preparation Date:

December 17, 2024

Approximate Construction Date:

May 1, 2025



12/17/2024

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Acronyms and Abbreviations

BMP	Best Management Practices
DOE	Department of Ecology
ESC	Erosion and Sediment Control
IECO	Insight Engineering Company
MR	Minimum Requirement
SWPPP	Stormwater Pollution Prevention Plan
SWMMWW	Stormwater Management Manual for Western Washington
TESC	Temporary Erosion and Sediment Control
WWHM	Western Washington Hydrology Model

1.0 Project Overview

The proposed project ***Haller*** is located at 106 Haller St, Arlington, Washington. More generally, the site is located in Section 2, Township 31 North, and Range 5 East of the Willamette Meridian in Snohomish County, Washington. Please refer to the Vicinity Map attached later in the section. This report follows the requirements defined in the SWMMWW 2014 and the City of Arlington Requirements.

1.1 Existing Basin Summary

The project site contains approximately 0.25 Acres. The existing site is currently developed with an existing home. The site contains basin that slopes to the north. Based on the topographic survey of the site, there are upstream flows entering the site. Please refer to the upstream and downstream analysis for more details. Per NRCS survey of Snohomish County, the project site contains Alderwood soils that have a hydrologic classification of Type "C" and Everett type soils that have a hydrologic classification of Type "A". Please refer to the soils map and descriptions attached later in this report for more details.

1.2 Developed Basin Summary

The proposal is to construct 6 townhome units with access road and associated utilities. The access to the new units will be from E Haller Ave. The drive aisle entrances will be constructed per the city of Arlington standards.

To meet flow control requirements an aquacell system (98.25' X 5.95' X 4.02') with 100% infiltration at the bottom will be proposed which will be located underneath the drive aisle.

1.3 Drainage Information Summary

Project Name: **Haller** Project Engineer: **INSIGHT ENGINEERING COMPANY** Project Applicant: **Joshua & Stephanie Tremmel** Project Site Area**: 0.25 Ac** Project Development Area: **0.25 Ac**	Number of Units:**6**

Summary Table

Drainage Basin Information		*Individual Basin Designation*			
		A	*B*	*C*	*D*
On-site Sub-basin Area (Acres)		**0.22**			
Type of Storage Proposed		**Aquacell**			
Approximate Storage Volume (CF)		**2,000**			
Soil types(Natural Resource Conservation Service)		**Everett (Type A)**			
Pre-developed Runoff Rate					
Q (cfs)	2-year	**0.00**			
	10-year	**0.00**			
	50-year	**0.00**			
Post-developed Runoff Rate (without quantity controls)					
Q (cfs)	2-year	**0.12**			
	10 year	**0.19**			
	50 year	**0.26**			
Post-developed Runoff Rate (with quantity controls)					
Q (cfs)	2-year	**0**			
	10 year	**0**			
	50 year	**0**			
Offsite Upstream Area					
Number of acres		**0**			
Offsite Downstream Flow					
Q (cfs)	*50 yr*	**0**			

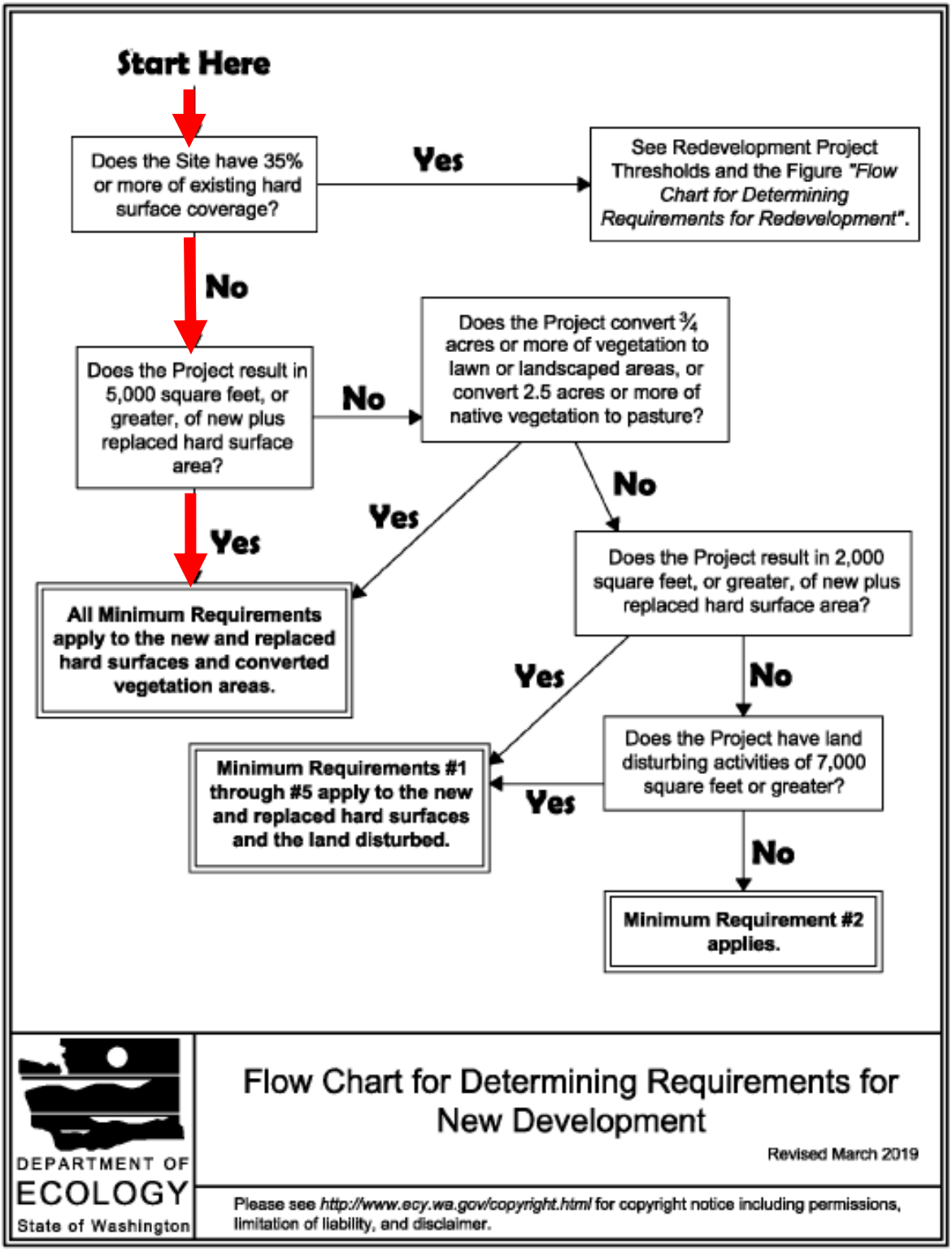

Figure 1- MR's for Determining Requirements for New Development

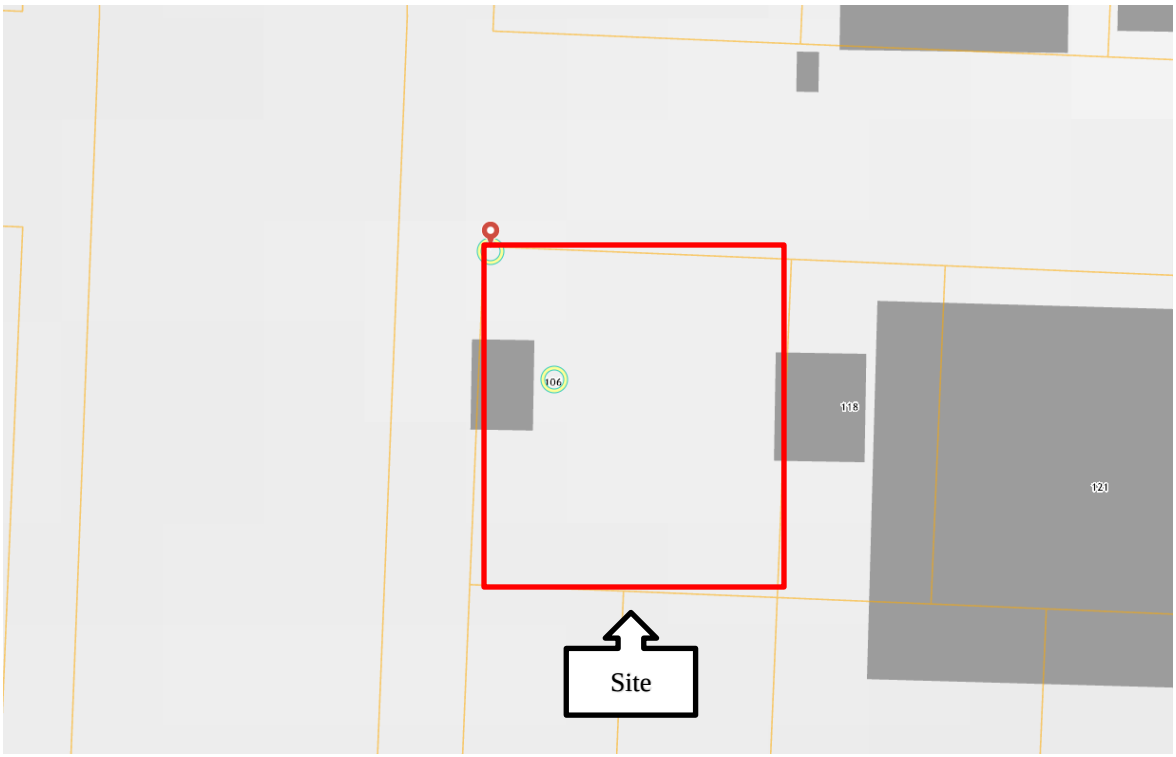

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Figure 2- Vicinity Map
Haller
Arlington, Washington

1.4 Minimum Requirements Summary

MR #1 Preparation of Stormwater Site Plan: This Stormwater Site Plan follows the Snohomish County requirements and is in accordance with the Snohomish County Drainage Manual.

MR #2 Stormwater Pollution Prevention Plans: Refer to section 5 of this report for the SWPPP.

MR #3 Source Control of Pollution: No source control pollutants pertain to the proposed project, therefore no BMPs are required for the proposed project.

MR #4 Preservation of Natural Drainage Systems and Outfalls: The proposed runoff will be infiltrated into the native soils.

MR #5 Onsite Stormwater Management: This project triggers Minimum Requirements 1-9 and is subject to on-site stormwater management BMPs per List #2.

BMP	Feasibility Criteria	Feasibility	Explanation
BMP T5.13: Post Construction Soil Quality and Depth	Infeasible on till soils with slopes greater than 33%.	Feasible	Slopes are less than 33% on-site.
Roof:			
BMP T5.30: Full Dispersion	At least 65% of the site must be preserved in native conditions and impervious surfaces must total less than 10% of the site. A minimum 100' flowpath must be provided.	Infeasible	Site preservation requirements could not be met.
BMPT5.10A: Downspout Full Infiltration	Feasible	Feasible	Feasible
BMP T7.30: Bioretention	NA	NA	NA
BMP T5.10B: Downspout Dispersion	NA	NA	NA
BMP T5.10C: Perforated Stub-out Connections	NA	NA	NA
Other Hard Surfaces:			
BMP T5.30: Full Dispersion	At least 65% of the site must be preserved in native conditions and	Infeasible	

	impervious surfaces must total less than 10% of the site. A minimum 100' flowpath must be provided.		
BMP T5.15: Permeable Pavement	Feasible	Feasible	Feasible
BMP T7.30: Bioretention	NA	NA	NA
BMP T5.12 or 5.11: Sheet Flow or Concentrated Flow Dispersion	NA	NA	NA

MR #6 Runoff Treatment: Water quality is exempt as the PGIS is only 2,849 SF which is less than the threshold limit of 5,000 SF.

MR #7 Flow Control: To meet flow control requirements an aquacell system (98.25' X 5.95' X 4.02') with 100% infiltration at the bottom will be proposed which will be located underneath the drive aisle.

MR #8 Wetlands protection: There is no wetland located on or near the site and runoff from the site will not be discharged either directly or indirectly to a wetland.

MR #9 Operations and Maintenance: Refer to Section 4 Appendix F for the operations and maintenance manual.

Soil Designation

4- Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes

17- Everett very gravelly sandy loam, 0 to 8 percent slopes

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Figure 3- Soil Map

Haller

Arlington, Washington

2.0 Offsite Analysis

A site reconnaissance was performed by Brian R. Kalab of Insight engineering on November 20, 2024 to verify the downstream flow paths and observe any drainage problems downstream of the site. The sky was sunny with a temperature of 28 degrees.

2.1 Upstream Analysis

Based on the site reconnaissance and the topographic survey of the site, the upstream flows appear to be minimal.

2.2 Downstream Analysis

The site contains one drainage basin. The runoff from the site flows to the north to E Haller Way and enters the existing drainage along E Haller Way through a catch basin. It drains to west for 115-ft and to the north along West Ave. After 280-ft, the flow turns west along W Cox St for 400-ft. The flow continues west into Haller Park and finally discharges into Stillaguamish River. This is where the downstream analysis was concluded. No erosion or drainage issues were observed during the downstream analysis.

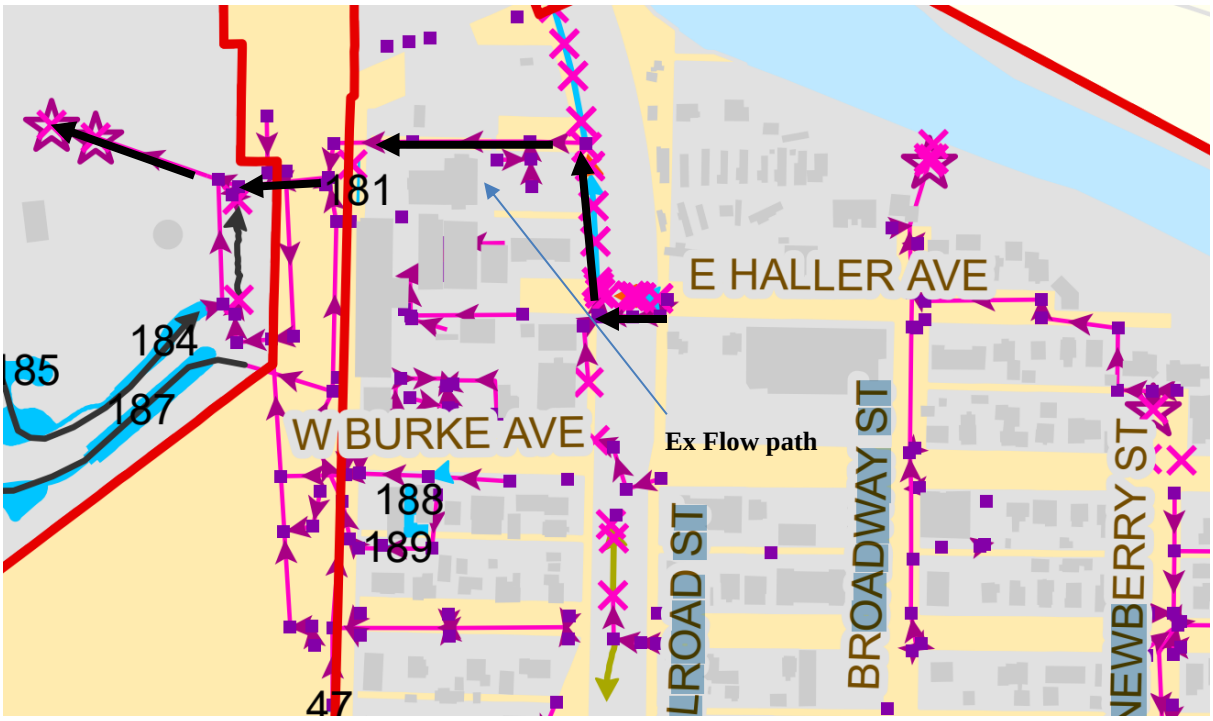

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Figure 4- Downstream Analysis Map
Haller
Arlington, Washington

3.0 Permanent Stormwater Control Plan

Total Site Area **= 11,000 SF (0.25 Acres)**
Clearing Area = 11,162 SF (0.26 Acres)
Total area included in the analysis* = 9,367 SF (0.22 Acres)

**The total area included in the analysis incorporates all the impervious area draining into the infiltration system. The remaining pervious area will be infiltrated directly into the soil.*

See existing and developed basin maps on the following pages for more details. Refer to Appendix D for WWHM modeling calculations.

3.1 Existing Basin Summary

Please see Section 1.1 of this report for a detailed description of the existing basin conditions. The soils are Everett type soils and have therefore been modeled as Type A soils in the WWHM model. For the purpose of MR #7 sizing calculations, the entire existing basin has been modeled as forested area in WWHM.

Total area included in the analysis = 0.22 Acres
Existing Basin = 0.22 Acres

3.2 Developed Basin Summary

Please see Section 1.2 of this report for a description of the proposed development. Please see Section 1.3 MR #7 for a description of the proposed flow control system for the site.

Total area included in the analysis = 0.22 Acres
Developed Basin = 0.22 Acres

Developed Onsite Basin	
Ground Cover	Area (acres)
Roof, flat	5,379 SF (0.12 acres)
Road, flat	2,533 SF (0.06 Acres)
Driveway, flat	316 SF (0.01 acres)
Sidewalk, flat	1,148 SF (0.03 acres)
Total	**9,376 SF (0.22 acres)**

3.3 Water Quality

Water quality is exempt as the PGIS is only 2,849 SF which is less than the threshold limit of 5,000 SF.

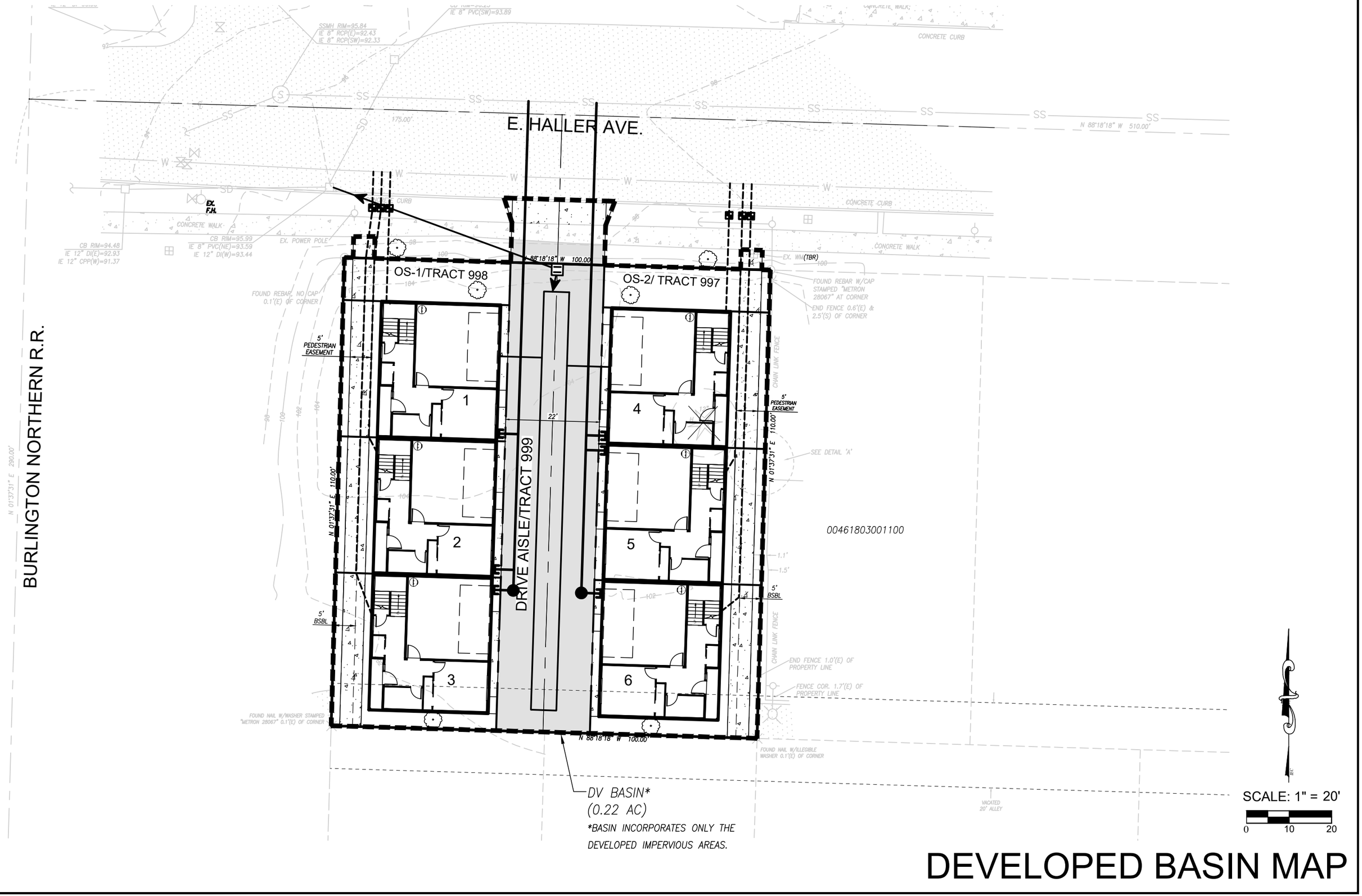
3.4 Conveyance Analysis

The 100yr peak flow for the project is only 0.30 cfs. A 12-inch pipe can convey 3 cfs at a minimum slope of 0.5-percent. The minimum size of the proposed system is 12-inch for the project can easily convey 0.30 cfs. Therefore, a detailed conveyance analysis was not performed.

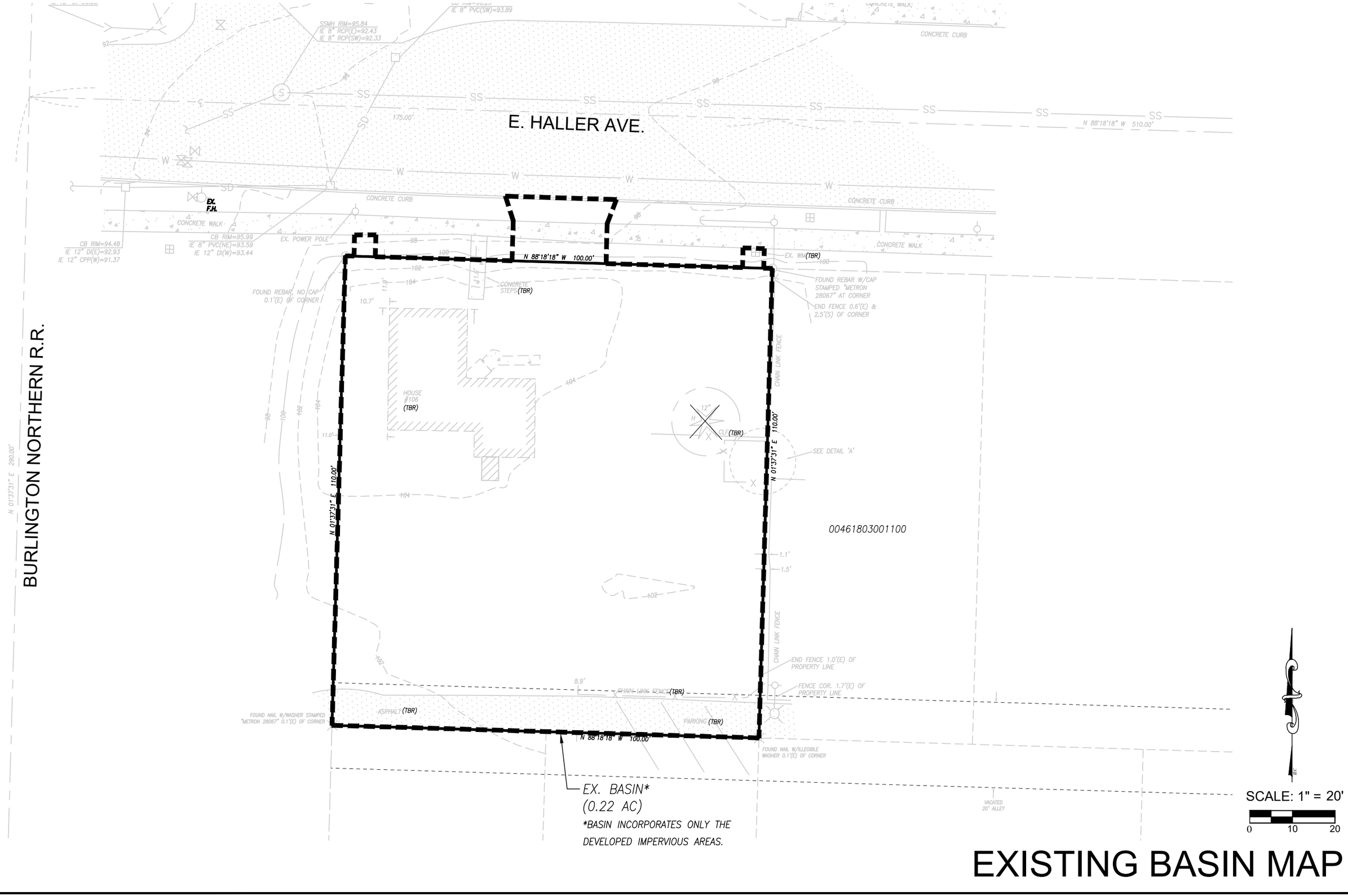
4.0 Appendix

A. Developed and Existing Basin Maps
B. WWHM Report
C. Geotechnical Report
D. Soil Amendment
E. Stormwater Pollution Prevention Plan
F. Operation and Maintenance Manual

A. Developed and Existing Basin Maps



DEVELOPED BASIN MAP



EXISTING BASIN MAP

B. WWHM Report

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Haller

Site Name:	Haller
Site Address:	106 Haller St Arlington
City:	Arlington
Report Date:	12/13/2024
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.200
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Existing Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	0.22
Pervious Total	0.22
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.22

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Mitigated Land Use

Devloped Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.06
ROOF TOPS FLAT	0.12
DRIVEWAYS FLAT	0.01
SIDEWALKS FLAT	0.03
Impervious Total	0.22
Basin Total	0.22

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Gravel Trench Bed 1	Gravel Trench Bed 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	98.25 ft.
Bottom Width:	5.95 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	4.02
Pour Space of material for first layer:	0.85
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	42.589
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	42.589
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	0 ft.
Riser Diameter:	0 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

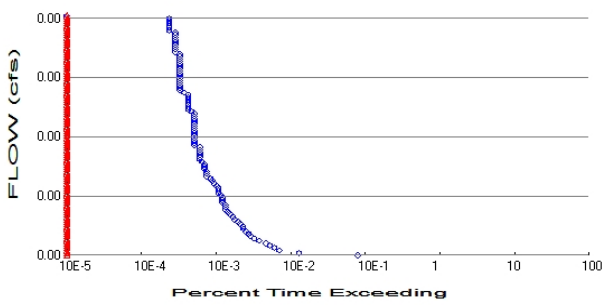
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.013	0.000	0.000	0.000
0.0448	0.013	0.000	0.000	0.027
0.0896	0.013	0.001	0.000	0.027
0.1343	0.013	0.001	0.000	0.027
0.1791	0.013	0.002	0.000	0.027
0.2239	0.013	0.002	0.000	0.027
0.2687	0.013	0.003	0.000	0.027
0.3134	0.013	0.003	0.000	0.027
0.3582	0.013	0.004	0.000	0.027
0.4030	0.013	0.004	0.000	0.027
0.4478	0.013	0.005	0.000	0.027
0.4926	0.013	0.005	0.000	0.027
0.5373	0.013	0.006	0.000	0.027
0.5821	0.013	0.006	0.000	0.027
0.6269	0.013	0.007	0.000	0.027
0.6717	0.013	0.007	0.000	0.027
0.7164	0.013	0.008	0.000	0.027
0.7612	0.013	0.008	0.000	0.027
0.8060	0.013	0.009	0.000	0.027
0.8508	0.013	0.009	0.000	0.027
0.8956	0.013	0.010	0.000	0.027
0.9403	0.013	0.010	0.000	0.027
0.9851	0.013	0.011	0.000	0.027

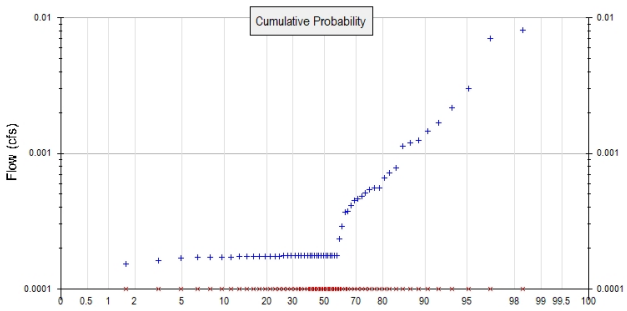
1.0299	0.013	0.011	0.000	0.027
1.0747	0.013	0.012	0.000	0.027
1.1194	0.013	0.012	0.000	0.027
1.1642	0.013	0.013	0.000	0.027
1.2090	0.013	0.013	0.000	0.027
1.2538	0.013	0.014	0.000	0.027
1.2986	0.013	0.014	0.000	0.027
1.3433	0.013	0.015	0.000	0.027
1.3881	0.013	0.015	0.000	0.027
1.4329	0.013	0.016	0.000	0.027
1.4777	0.013	0.016	0.000	0.027
1.5224	0.013	0.017	0.000	0.027
1.5672	0.013	0.017	0.000	0.027
1.6120	0.013	0.018	0.000	0.027
1.6568	0.013	0.018	0.000	0.027
1.7016	0.013	0.019	0.000	0.027
1.7463	0.013	0.019	0.000	0.027
1.7911	0.013	0.020	0.000	0.027
1.8359	0.013	0.020	0.000	0.027
1.8807	0.013	0.021	0.000	0.027
1.9254	0.013	0.022	0.000	0.027
1.9702	0.013	0.022	0.000	0.027
2.0150	0.013	0.023	0.000	0.027
2.0598	0.013	0.023	0.000	0.027
2.1046	0.013	0.024	0.000	0.027
2.1493	0.013	0.024	0.000	0.027
2.1941	0.013	0.025	0.000	0.027
2.2389	0.013	0.025	0.000	0.027
2.2837	0.013	0.026	0.000	0.027
2.3284	0.013	0.026	0.000	0.027
2.3732	0.013	0.027	0.000	0.027
2.4180	0.013	0.027	0.000	0.027
2.4628	0.013	0.028	0.000	0.027
2.5076	0.013	0.028	0.000	0.027
2.5523	0.013	0.029	0.000	0.027
2.5971	0.013	0.029	0.000	0.027
2.6419	0.013	0.030	0.000	0.027
2.6867	0.013	0.030	0.000	0.027
2.7314	0.013	0.031	0.000	0.027
2.7762	0.013	0.031	0.000	0.027
2.8210	0.013	0.032	0.000	0.027
2.8658	0.013	0.032	0.000	0.027
2.9106	0.013	0.033	0.000	0.027
2.9553	0.013	0.033	0.000	0.027
3.0001	0.013	0.034	0.000	0.027
3.0449	0.013	0.034	0.000	0.027
3.0897	0.013	0.035	0.000	0.027
3.1344	0.013	0.035	0.000	0.027
3.1792	0.013	0.036	0.000	0.027
3.2240	0.013	0.036	0.000	0.027
3.2688	0.013	0.037	0.000	0.027
3.3136	0.013	0.037	0.000	0.027
3.3583	0.013	0.038	0.000	0.027
3.4031	0.013	0.038	0.000	0.027
3.4479	0.013	0.039	0.000	0.027
3.4927	0.013	0.039	0.000	0.027
3.5374	0.013	0.040	0.000	0.027
3.5822	0.013	0.040	0.000	0.027

3.6270	0.013	0.041	0.000	0.027
3.6718	0.013	0.041	0.000	0.027
3.7166	0.013	0.042	0.000	0.027
3.7613	0.013	0.042	0.000	0.027
3.8061	0.013	0.043	0.000	0.027
3.8509	0.013	0.043	0.000	0.027
3.8957	0.013	0.044	0.000	0.027
3.9404	0.013	0.044	0.000	0.027
3.9852	0.013	0.045	0.000	0.027
4.0300	0.013	0.046	0.000	0.027

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.22
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.22

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.000283
5 year	0.000689
10 year	0.001185
25 year	0.002246
50 year	0.003516
100 year	0.005387

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.000	0.000
1950	0.001	0.000
1951	0.001	0.000
1952	0.000	0.000
1953	0.000	0.000
1954	0.002	0.000
1955	0.001	0.000
1956	0.000	0.000
1957	0.000	0.000
1958	0.000	0.000

1959	0.001	0.000
1960	0.000	0.000
1961	0.001	0.000
1962	0.000	0.000
1963	0.000	0.000
1964	0.001	0.000
1965	0.000	0.000
1966	0.000	0.000
1967	0.000	0.000
1968	0.000	0.000
1969	0.000	0.000
1970	0.000	0.000
1971	0.001	0.000
1972	0.000	0.000
1973	0.000	0.000
1974	0.001	0.000
1975	0.000	0.000
1976	0.001	0.000
1977	0.000	0.000
1978	0.000	0.000
1979	0.001	0.000
1980	0.000	0.000
1981	0.000	0.000
1982	0.000	0.000
1983	0.000	0.000
1984	0.000	0.000
1985	0.000	0.000
1986	0.002	0.000
1987	0.001	0.000
1988	0.000	0.000
1989	0.000	0.000
1990	0.000	0.000
1991	0.000	0.000
1992	0.000	0.000
1993	0.000	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.003	0.000
1997	0.007	0.000
1998	0.000	0.000
1999	0.000	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.000	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.008	0.000
2007	0.000	0.000
2008	0.000	0.000
2009	0.000	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0081	0.0000
2	0.0071	0.0000
3	0.0030	0.0000

4	0.0022	0.0000
5	0.0017	0.0000
6	0.0015	0.0000
7	0.0012	0.0000
8	0.0012	0.0000
9	0.0011	0.0000
10	0.0008	0.0000
11	0.0007	0.0000
12	0.0007	0.0000
13	0.0006	0.0000
14	0.0006	0.0000
15	0.0005	0.0000
16	0.0005	0.0000
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22	0.0004	0.0000
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51	0.0002	0.0000
52	0.0002	0.0000
53	0.0002	0.0000
54	0.0002	0.0000
55	0.0002	0.0000
56	0.0002	0.0000
57	0.0002	0.0000
58	0.0002	0.0000
59	0.0002	0.0000
60	0.0002	0.0000
61	0.0001	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0001	1685	0	0	Pass
0.0002	274	0	0	Pass
0.0002	152	0	0	Pass
0.0002	129	0	0	Pass
0.0003	112	0	0	Pass
0.0003	100	0	0	Pass
0.0003	81	0	0	Pass
0.0004	69	0	0	Pass
0.0004	61	0	0	Pass
0.0004	58	0	0	Pass
0.0005	53	0	0	Pass
0.0005	50	0	0	Pass
0.0006	49	0	0	Pass
0.0006	45	0	0	Pass
0.0006	42	0	0	Pass
0.0007	38	0	0	Pass
0.0007	36	0	0	Pass
0.0007	33	0	0	Pass
0.0008	31	0	0	Pass
0.0008	29	0	0	Pass
0.0008	29	0	0	Pass
0.0009	29	0	0	Pass
0.0009	26	0	0	Pass
0.0009	26	0	0	Pass
0.0010	26	0	0	Pass
0.0010	25	0	0	Pass
0.0010	23	0	0	Pass
0.0011	23	0	0	Pass
0.0011	23	0	0	Pass
0.0011	22	0	0	Pass
0.0012	20	0	0	Pass
0.0012	19	0	0	Pass
0.0012	18	0	0	Pass
0.0013	16	0	0	Pass
0.0013	16	0	0	Pass
0.0013	16	0	0	Pass
0.0014	15	0	0	Pass
0.0014	15	0	0	Pass
0.0014	15	0	0	Pass
0.0015	14	0	0	Pass
0.0015	13	0	0	Pass
0.0015	13	0	0	Pass
0.0016	13	0	0	Pass
0.0016	13	0	0	Pass
0.0016	13	0	0	Pass
0.0017	13	0	0	Pass
0.0017	11	0	0	Pass
0.0017	11	0	0	Pass
0.0018	11	0	0	Pass
0.0018	11	0	0	Pass
0.0018	11	0	0	Pass
0.0019	11	0	0	Pass
0.0019	11	0	0	Pass

0.0019	11	0	0	Pass
0.0020	11	0	0	Pass
0.0020	11	0	0	Pass
0.0021	11	0	0	Pass
0.0021	11	0	0	Pass
0.0021	11	0	0	Pass
0.0022	11	0	0	Pass
0.0022	10	0	0	Pass
0.0022	9	0	0	Pass
0.0023	9	0	0	Pass
0.0023	9	0	0	Pass
0.0023	9	0	0	Pass
0.0024	9	0	0	Pass
0.0024	9	0	0	Pass
0.0024	9	0	0	Pass
0.0025	8	0	0	Pass
0.0025	7	0	0	Pass
0.0025	7	0	0	Pass
0.0026	7	0	0	Pass
0.0026	7	0	0	Pass
0.0026	7	0	0	Pass
0.0027	7	0	0	Pass
0.0027	7	0	0	Pass
0.0027	7	0	0	Pass
0.0028	7	0	0	Pass
0.0028	7	0	0	Pass
0.0028	7	0	0	Pass
0.0029	7	0	0	Pass
0.0029	7	0	0	Pass
0.0029	7	0	0	Pass
0.0030	7	0	0	Pass
0.0030	7	0	0	Pass
0.0030	6	0	0	Pass
0.0031	6	0	0	Pass
0.0031	6	0	0	Pass
0.0031	6	0	0	Pass
0.0032	6	0	0	Pass
0.0032	6	0	0	Pass
0.0032	6	0	0	Pass
0.0033	6	0	0	Pass
0.0033	6	0	0	Pass
0.0033	5	0	0	Pass
0.0034	5	0	0	Pass
0.0034	5	0	0	Pass
0.0034	5	0	0	Pass
0.0035	5	0	0	Pass
0.0035	5	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

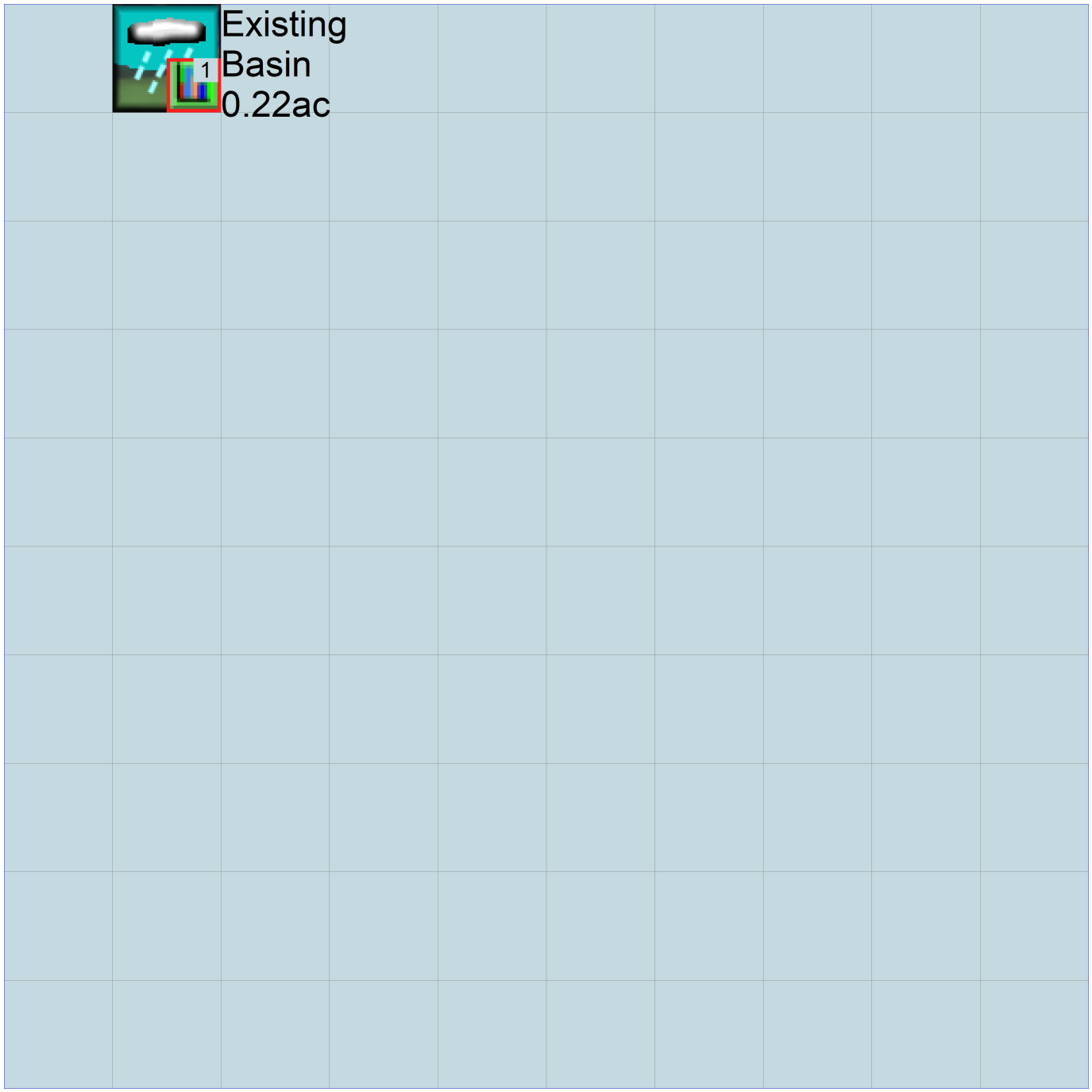
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

C. Geotechnical Report

GeoTest

741 Marine Drive
Bellingham, WA 98225

20611-67th Avenue NE
Arlington, WA 98223

PHONE
360 733_7318

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April 21, 2015
Job No. 15-0191

Monterra Partners
1729 145th Place SE
Mill Creek, Washington, 98082

Attention: Mr. David Martin

Re: Geotechnical Engineering Evaluation
Haller Avenue Apartments
Near E. Haller Avenue and Railroad Avenue
Arlington, Washington

Dear Mr. Martin:

As requested, GeoTest Services, Inc. is pleased to submit this report summarizing the results of our geotechnical engineering evaluation for the above-referenced project. The purpose of this evaluation was to establish general subsurface conditions beneath the site from which conclusions and recommendations for project design could be formulated. Specifically, our scope of services included the following tasks:

- Exploration of soil and groundwater conditions underlying the site by observing a total of 2 exploration test pits to evaluate subsurface conditions.

- Laboratory testing on representative samples in order to classify and evaluate the engineering characteristics and infiltration potential of the soils encountered.

- Provide this written report containing a description of subsurface conditions, test pit logs, and findings and recommendations pertaining to seismic design, site preparation and earthwork, fill and compaction, wet weather earthwork, foundation recommendations, concrete slab-on-grade construction, foundation and site drainage, stormwater design recommendations, geotechnical consultation and construction monitoring.

PROJECT DESCRIPTION

The project site is an approximately 0.25 acre previously graded and developed property that contains an existing residential structure and detached shed/garage structure. GTS understands that the existing structures will be torn down and removed from the site and that a new 3-story apartment building will be constructed on the property. The new construction will include a partially buried garage structure that daylights onto E. Haller Avenue. GTS also understands that a rock trench is planned on site for the purposes of infiltrating stormwater. GTS anticipates that the structures will utilize wood-frame construction with shallow conventional foundations. Structural loads are expected to be relatively light.

SITE CONDITIONS

This section discusses the general surface and subsurface conditions observed at the project site at the time of our field investigation. Interpretations of the site conditions are based on the results of our review of available information, site reconnaissance, subsurface explorations, laboratory testing, and our experience in the project vicinity.

Surface Conditions

The site is bordered to the north by E. Haller Avenue, to the south by a parking lot from the adjacent grocery store, to the east by a similar residential structure, and to the west by Centennial Trail and Railroad Avenue. The project site is within an established residential neighborhood and retail area, with typical grass lawns and irrigated landscaping. The site is largely flat, but contains an approximately 6-foot high, steep slope on the north side of the property.

Subsurface Soil Conditions

Subsurface conditions were explored by advancing 2 exploration test pits (TP-1 and TP-2) on April 9, 2015. The explorations were advanced to depths of 13 and 12.5 feet below ground surface (BGS), respectively, using a backhoe provided by the client.

The on-site subsurface soils generally consisted of 1 to 1.5 feet of topsoil over Glacial Outwash, with the upper 1 to 1.5 feet of Glacial Outwash being less dense and weathered to red brown. Glacial Outwash generally consisted of medium dense silty sand to sandy gravel. Additionally, a several foot thick, very sandy, silt layer was encountered in both locations at a depth of approximately 9 feet BGS in TP-1 and 7 feet BGS in TP-2.

Please refer to the attached Site and Exploration Map (Figure 2) and Logs of Test Pits (Figure 5) for more information regarding the subsurface soil conditions that were encountered.

General Geologic Conditions

Geologic information for the project site was obtained from the interactive *Geologic Map of the Arlington East Quadrangle (Minard, 1985)*, published by the U.S. Geological Survey. According to the referenced map, near surface soils in the vicinity of the project site consist of Marysville Sand Member Recessional Glacial Outwash (Qvrm). According to Minard, Marysville Sand Recessional Glacial Outwash generally consists of well-drained, stratified to massive, outwash sand with some pebble gravel with localized areas of silt and clay. Native soils encountered during our subsurface exploration were generally consistent with the mapped Glacial Outwash deposits.

Groundwater

A free groundwater condition was not encountered at the time of our subsurface investigation in April of 2015. Our subsurface explorations indicated the presence of a silt layer at a depth of about 7 and 9 feet below existing site elevations. Surface water will likely have reduced infiltration rates as it passes through this silt layer, however, GTS

did not observe indications of a perched or seasonal groundwater condition as indicated by mottled soil conditions.

The groundwater conditions reported on the exploration logs are for the specific locations and date indicated, and therefore may not necessarily be indicative of other locations and/or times. Groundwater levels are not static and groundwater conditions will vary depending on local subsurface conditions, precipitation, changes in site use, both on and off site, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

Based upon evaluation of the data collected during this investigation, it is our opinion that subsurface conditions at the site are suitable for the proposed construction of the development, provided the recommendations contained herein are incorporated into the project design.

Site Preparation and Earthwork

The portions of the site to be occupied by the proposed building foundations and pavements should be prepared by removing any existing topsoil, fill, relic topsoil and loose/soft, upper portions of the native soil.

Prior to placement of any structural fill, the exposed subgrade under all areas should be recompacted to a firm and unyielding condition and proof rolled with a loaded dump truck, large self-propelled vibrating roller, or equivalent piece of equipment applicable to the size of the excavation. The purpose of this effort is to identify possible loose or soft soil deposits and recompact the soil exposed during site excavation activities.

Proof rolling should be carefully observed by qualified geotechnical personnel. Areas exhibiting significant deflection, pumping, or over-saturation that cannot be readily compacted should be overexcavated to firm soil. Overexcavated areas should be backfilled with compacted granular material placed in accordance with subsequent recommendations for structural fill. During periods of wet weather, proof rolling could damage the exposed subgrade. Under these conditions, qualified geotechnical personnel should observe subgrade conditions to determine if proof rolling is feasible.

Fill and Compaction

Structural fill used to obtain final elevations for footings and soil-supported floor slabs must be properly placed and compacted. In general, any suitable, non-organic, predominantly granular soil may be used for fill material provided the material is properly moisture conditioned prior to placement and compaction, and the specified degree of compaction is obtained. Excavated site material containing topsoil, wood, trash, organic material, or construction debris will not be suitable for reuse as structural fill and should be properly disposed offsite or placed in nonstructural areas.

Reuse of Onsite Soil

It is our opinion that non-silty portions of the Glacial Outwash, observed below 2 feet BGS and above 7 feet BGS, can be used in structural fill applications provided it is

moisture conditioned, compacted, and if allowed for use in the project plans and specifications.

We do not recommend that silty portions of the Glacial Outwash, observed generally below 7 feet BGS, be used as structural fill due to its elevated fines and moisture content. Re-use of this soil would likely require a moisture conditioning program. The space and time requirements of such a program, however, is not anticipated to be feasible within the current project scope. We can provide additional guidance and recommendations pertaining to moisture conditioning programs upon request.

Soils containing more than approximately 5 percent fines are considered moisture sensitive, and are very difficult to compact to a firm and unyielding condition when over the optimum moisture content by more than approximately 2 percent. The optimum moisture content is that which allows the greatest dry density to be achieved at a given level of compactive effort.

Imported Structural Fill

We recommend that imported structural fill consist of clean, well-graded sandy gravel, gravelly sand, or other approved naturally occurring granular material (pit run) with at least 30 percent retained on the No. 4 sieve, or a well-graded crushed rock. Structural fill for dry weather construction may contain on the order of 10 percent fines (that portion passing the U.S. No. 200 sieve) based on the portion passing the U.S. No. 4 sieve. Soil containing more than about 5 percent fines cannot consistently be compacted to a dense, non-yielding condition when the water content is greater than optimum. Accordingly, we recommend that imported structural fill with less than 5 percent fines be used during wet weather conditions. Due to wet weather or wet site conditions, soil moisture contents could be high enough that it may be very difficult to compact even "clean" imported select granular fill to a firm and unyielding condition. Soils with over-optimum moisture contents should be either scarified and dried back to more suitable moisture contents during periods of dry weather or removed and replaced with fill soils at a more suitable range of moisture contents.

Backfill and Compaction

Structural fill should be placed in horizontal lifts 8 to 10 inches in loose thickness and thoroughly compacted. All structural fill placed under load bearing areas should be compacted to at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557. Structural fill should be placed in horizontal lifts 8 to 10 inches in loose thickness and thoroughly compacted. The top of the compacted structural fill should extend outside all foundations and other structural improvements a minimum distance equal to the thickness of the fill. We recommend that compaction be tested periodically throughout the fill placement.

Temporary and Permanent Slopes

Actual construction slope configurations and maintenance of safe working conditions, including temporary excavation stability, should be the responsibility of the contractor, who is able to monitor the construction activities and has direct control over the means and methods of construction. All applicable local, state, and federal safety codes should be followed. All open cuts should be monitored during and after excavation for any

evidence of instability. If instability is detected, the contractor should flatten the side slopes or install temporary shoring.

Temporary excavations in excess of 4 ft should be shored or sloped in accordance with Safety Standards for Construction Work Part N, WAC 296-155-657.

Temporary unsupported excavations in Glacial Outwash should be classified as a Type C soil according to WAC 296-155-657 and may be sloped as steep as 1.5H:1V (Horizontal: Vertical). All soils encountered are classified as Type C soil in the presence of groundwater seepage. Flatter slopes or temporary shoring may be required in areas where groundwater flow is present and unstable conditions develop.

Temporary slopes and excavations should be protected as soon as possible using appropriate methods to prevent erosion from occurring during periods of wet weather.

We recommend that permanent cut or fill slopes be designed for inclinations of 2H:1V or flatter and all open ponds or water holding features sloped to 3H:1V or flatter. All permanent slopes should be vegetated or otherwise protected to limit the potential for erosion as soon as practical after construction.

Seismic Design Considerations

The Pacific Northwest is seismically active and the site could be subject to ground shaking from a moderate to major earthquake. Consequently, moderate levels of earthquake shaking should be anticipated during the design life of the project, and the proposed structure should be designed to resist earthquake loading using appropriate design methodology.

Site Class Definition

For structures designed using the seismic design provisions of the 2012 International Building Code, the underlying alluvial soils interpreted to underlie the site within the upper 100 feet classifies as Site Class D according to 2010 ASCE -7 Standard – Table 20.3-1, Site Class Definitions. The corresponding values for calculating a design response spectrum for the assumed soil profile type is considered appropriate for the site.

Please use the following values for seismic structural design purposes:

Conterminous 48 States – 2012 International Building Code
Zip Code 98223
Central Latitude = 48.20083, Central Longitude = -122.12584

<u>Short Period (0.2 sec) Spectral Acceleration</u>

Maximum Considered Earthquake (MCE) Value of S_s = 1.051 (g)
Site Response Coefficient, F_a = 1.080 (Site Class D)
Adjusted spectral response acceleration for Site Class D, $S_{MS} = S_s \times F_a = 1.134$ (g)
Design spectral response acceleration for Site Class D, $S_{DS} = 2/3 \times SM_s = 0.756$ (g)

One Second Period (1 sec) Spectral Acceleration

Maximum Considered Earthquake (MCE) Value of S_1 = 0.408 (g)
Site Response Coefficient, F_v = 1.592 (Site Class D)
Adjusted spectral response acceleration for Site Class D, $S_{M1} = S_1 \times F_v = 0.650$ (g)
Design spectral response acceleration for Site Class D, $S_{D1} = 2/3 \times SM_1 = 0.433$ (g)

Building Foundation Support and Settlement

We recommend that all topsoil, relic topsoil, and organic portions of the native site soil be removed below footing and slab areas down to native soil. Foundation support for the proposed building may be provided by continuous or isolated spread footings founded on the proof-rolled or recompacted, undisturbed, firm and unyielding Glacial Outwash (Marysville Sand) or on properly compacted structural fill placed directly over prepared subgrades. In areas requiring overexcavation to competent native soil, the limits of the overexcavation should extend laterally beyond the edge of each side of the footing a distance equal to the depth of the fill. If CDF is used to backfill the overexcavation, the limits of the overexcavation need only extend a nominal distance beyond the width of the footing.

All continuous and isolated spread footings should be founded a minimum of 18 inches below the lowest adjacent final grade for freeze/thaw protection.

Allowable Bearing Capacity

Assuming the above foundation support criteria are satisfied, continuous or isolated spread footings founded directly on firm and unyielding Glacial Outwash, compacted structural fill, or CDF placed directly over undisturbed Glacial Outwash, may be proportioned using a maximum net allowable soil bearing pressure of 2,500 pounds per square ft (psf). The term "net allowable bearing pressure" refers to the pressure that can be imposed on the soil at foundation level resulting from the total of all dead plus live loads, exclusive of the weight of the footing or any backfill placed above the footing. The net allowable bearing pressure may be increased by one-third for transient wind or seismic loads.

Foundation Settlement

Settlement of shallow foundations depends on foundation size and bearing pressure, as well as the strength and compressibility characteristics of the underlying soil. Assuming construction is accomplished as previously recommended and for the maximum allowable soil bearing pressure recommended above, we estimate the total settlement of building foundations should be less than about 1 inch and differential settlement between two adjacent load-bearing components supported on competent soil should be less than about one half the total settlement. The soil response to applied stresses caused by building and other loads is expected to be predominantly elastic in nature, with most of the settlement occurring during construction as loads are applied.

Concrete Slabs-on-Grade

Floor slabs may be supported on properly prepared native subgrade or on structural fill placed over properly prepared native soil. New floor slabs should not be founded on

topsoil, existing fill, or loose native soils. Prior to placement of structural fill, the native soil should be proof-rolled as recommended in the *Site Preparation and Earthwork* section of this report.

We recommend that interior concrete slab-on-grade floors be underlain by a minimum of 6 inches of compacted, clean, free-draining gravel with less than 3 percent passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The purpose of this layer is to provide uniform support for the slab, provide a capillary break, and act as a drainage layer. To help reduce the potential for water vapor migration through floor slabs, a continuous 10-mil minimum thickness polyethylene sheet with tape-sealed joints should be installed below the slab to serve as an impermeable vapor barrier. The vapor barrier should be installed and sealed in accordance with the manufactures instructions.

The American Concrete Institute (ACI) guidelines suggest that the slab may either be poured directly on the vapor barrier or on a granular curing layer placed over the vapor barrier depending on conditions anticipated during construction. We recommend that the architect or structural engineer specify if a curing layer should be used. If moisture control within the building is critical, we recommend that the vapor barrier be observed by a representative of GTS to confirm that openings have been properly sealed. Use of a curing layer is generally only recommended during drier months of the year and/or when limited rain is expected during the slab-on-grade construction process. If the slab will be constructed during the wet season, exposed to rain after construction or the site may be potentially wet, we do not recommend the use of curing layer as excessive moisture emissions through the slab may occur.

Exterior concrete slabs-on-grade, such as sidewalks, may be supported directly on undisturbed native or on properly placed and compacted structural fill; however, long-term performance will be enhanced if exterior slabs are placed on a layer of clean, durable, well-draining granular material.

Foundation and Site Drainage

To reduce the potential for groundwater and surface water to seep into interior spaces we recommend that an exterior footing drain system be constructed around the perimeter of new building foundations as shown in the Typical Footing and Wall Drain Section, Figure 3. The drain should consist of a minimum 4-inch diameter perforated PVC pipe, surrounded by a minimum 12 inches of filtering media with the discharge sloped to carry water to a suitable collection system. The filtering media may consist of open-graded drain rock wrapped by a nonwoven geotextile fabric (such as Mirafi 140N or equivalent) or a graded sand and gravel filter. The drainage backfill should be carried up the back of the wall and contain less than 3 percent by weight passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The invert of the footing drain pipe should be placed at approximately the same elevation as the bottom of the footing or 12 inches below the adjacent floor slab grade, whichever is deeper, so that water will not seep through walls or floor slabs. The footing drain should discharge to an approved drain system and include cleanouts to allow periodic maintenance and inspection.

Positive surface gradients should be provided adjacent to the proposed structures to direct surface water away from foundation areas and toward suitable drainage facilities. Roof drainage should not be introduced into the perimeter footing drains, but should be separately discharged directly to the stormwater collection system or other appropriate outlet. Pavement and sidewalk areas should be sloped and drainage gradients should be maintained to carry all surface water away from above-ground structures towards the local stormwater collection system. Surface water should not be allowed to pond and soak into the ground surface near buildings or paved areas during or after construction. Construction excavations should be sloped to drain to sumps where water from seepage, rainfall, and runoff can be collected and pumped to a suitable discharge facility.

Resistance to Lateral Loads

Current apartment designs include a partially buried parking garage that daylights to E Haller Avenue to the north. The south, east and west walls of this garage are anticipated to consist of cast in place retaining walls. The lateral earth pressures that develop against retaining walls will depend on the method of backfill placement, degree of compaction, slope of backfill, type of backfill material, provisions for drainage, magnitude and location of any adjacent surcharge loads, and the degree to which the wall can yield laterally during or after placement of backfill. If the wall is allowed to rotate or yield so the top of the wall moves an amount equal to or greater than about 0.001 to 0.002 times its height (a yielding wall), the soil pressure exerted will be the active soil pressure. When a wall is restrained against lateral movement or tilting (a nonyielding wall), the soil pressure exerted is the at-rest soil pressure. Wall restraint may develop if a rigid structural network is constructed prior to backfilling or if the wall is inherently stiff.

We recommend that yielding walls under drained conditions be designed for an equivalent fluid density of 35 pounds per cubic ft (pcf) for structural fill in active soil conditions. Nonyielding walls under drained conditions should be designed for an equivalent fluid density of 50 pcf for structural fill in at-rest conditions. Design of walls should include appropriate lateral pressures caused by surcharge loads located within a horizontal distance equal to or less than the height of the wall. For uniform surcharge pressures, a uniformly distributed lateral pressure equal to 35 percent and 50 percent of the vertical surcharge pressure should be added to the lateral soil pressures for yielding and nonyielding walls, respectively. GTS assumes that retaining walls or below-grade structures will not extend below the groundwater table. If walls or structures extend below the water table, GTS should be contacted so that we may provide lateral earth pressures for submerged conditions.

Passive earth pressures developed against the sides of building foundations, in conjunction with friction developed between the base of the footings and the supporting subgrade, will resist lateral loads transmitted from the structure to its foundation. For design purposes, the passive resistance of well-compacted fill placed against the sides of foundations may be considered equivalent to a fluid with a density of 300 pounds per cubic ft. The recommended value includes a safety factor of about 1.5 and is based on the assumption that the ground surface adjacent to the structure is level in the direction of movement for a distance equal to or greater than twice the embedment depth. The recommended value also assumes drained conditions that will prevent the buildup of hydrostatic pressure in the compacted fill. Retaining walls should include a drain system constructed in general accordance with the recommendations presented in the

Foundation and Site Drainage section of this report. In design computations, the upper 12 inches of passive resistance should be neglected if the soil is not covered by floor slabs or pavement. If future plans call for the removal of the soil providing resistance, the passive resistance should not be considered.

An allowable coefficient of base friction of 0.35, applied to vertical dead loads only, may be used between the underlying native soils or imported granular structural fill and the base of the footing. If passive and frictional resistance are considered together, one half the recommended passive soil resistance value should be used since larger strains are required to mobilize the passive soil resistance as compared to frictional resistance. We do not recommend increasing the coefficient of friction to resist seismic or wind loads.

Pavement Subgrade Preparation

Selection of a pavement section is typically a compromise between higher initial cost and lower maintenance versus lower initial cost, with more frequent maintenance (such as reduced time before overlay, crack sealing and/or pothole repair may become necessary). For this reason, we recommend that the owner participate in the selection of a pavement section for the site. Site grading plans should include provisions for sloping of the subgrade soils in proposed pavement areas, so that passive drainage of the pavement section(s) can proceed uninterrupted during the life of the project.

GTS does not recommend placing new pavements on existing pavements, topsoil, existing fill, or loose native soils. New pavement sections should be installed over stripped, compacted, and/or otherwise firm and unyielding subgrades. Near surface native soils can be susceptible to degradation during wet weather due to their elevated fines contents. To protect against degradation that would otherwise require over-excavation of loose or yielding soils, we recommend “working mats” of structural fill be placed over prepared native grades in areas of anticipated construction traffic. We recommend other areas be left un-stripped and unprepared as long as feasible.

Utilities

It is important that utility trenches be properly backfilled and compacted to reduce cracking or localized loss of foundation, slab, or pavement support. It is anticipated that excavations for new shallow underground utilities will be in silty sand to very sandy, gravel (Glacial Outwash). Deeper utilities may encounter silt below 7 feet BGS.

Trench backfill in improved areas (beneath structures, pavements, sidewalks, etc.) should consist of structural fill as defined earlier in this report. Outside of improved areas, trench backfill may consist of re-used native fill provided it can be compacted to the project specifications. Trench backfill should be placed and compacted in general accordance with the recommendations presented in the *Fill and Compaction* section of this report.

Surcharge loads on trench support systems due to construction equipment, stockpiled material, and vehicle traffic should be included in the design of any anticipated shoring system. The contractor should implement measures to prevent surface water runoff from entering trenches and excavations. In addition, vibration as a result of construction activities and traffic may cause caving of the trench walls.

Actual trench configurations are the responsibility of the contractor. All applicable local, state, and federal safety codes should be followed. All open cuts should be monitored by the contractor during excavation for any evidence of instability. If instability is detected, the contractor should flatten the side slopes or install temporary shoring. If groundwater or groundwater seepage is present, and the trench is not properly dewatered, the soil within the trench zone may be prone to caving, channeling, and running. Trench widths may be substantially wider than under dewatered conditions.

Stormwater Design Recommendations

From the explorations excavated at the site, five representative soil samples were selected and mechanically tested for grain size distribution and interpretation according to the United States Department of Agriculture (USDA) soil textural classification. Subsurface infiltration rates corresponding to the United States Department of Agriculture (USDA) soil textural classification were obtained from the 2005 Washington State Department of Ecology *Stormwater Management Manual for Western Washington*, Table 3.7 and are reproduced in Table 1 below.

TABLE 1
Test Pit Soil Sample Infiltration Rates
Based On The 2005 DOE Stormwater Management Manual Table 3.7

Exploration	Sample Depth (ft)	Unit	Classification (USDA)	Infiltration Rate (Inches/Hour)
TP-1	6.0	Glacial Outwash	Sand	2.0
TP-1	9.5	Glacial Outwash	Loam	0.13
TP-2	2.0	Weathered Glacial Outwash	Sand	2.0
TP-2	8.0	Glacial Outwash	Loam	0.13
TP-2	11.0	Glacial Outwash	Sand	2.0
Note: Listed infiltration rates are long term (design) rates as stated in Table 3.7.				

Based on the grain size distribution of the collected samples, the silt layer encountered at depth throughout the site classifies as Loam per USDA classification and a long term design infiltration rate of 0.13 in/hr per the 2005 DOE Stormwater Management Manual. The Glacial Outwash above and below this silt lens classifies as Sand per USDA classification and a long term design infiltration rate of 2.0 in/hr.

GTS did not encounter a regional groundwater table within our explorations that would directly impact planned stormwater infiltration systems. Based on the site plan provided to us by the client, stormwater is to be managed by a seven foot deep rock trench infiltration facility along the south side of the property. The current design places the infiltration facility just above a restrictive silt layer (encountered between 7 and 9 feet BGS in exploration TP-2). We recommend this silt layer be removed from below the

proposed infiltration facility so that the higher long term design infiltration rate of 2.0 in/hr can be utilized. If the silt layer is not removed from below the proposed facility, we recommend a long term design infiltration rate of 0.13 in/hr can be utilized in design.

CATION EXCHANGE CAPACITY AND OTHER TESTING

GTS submitted a total of 3 samples for determination of Cation Exchange Capacity (CEC), pH, and Organic Content in accordance SSC-6, "Soil Physical and Chemical Suitability for Treatment" within the 2005 DOE Stormwater Management Manual. GTS has provided a copy of the laboratory test results attached at the end of this letter. Table 2, listed below, presents a summary of the laboratory results:

Table 2
Testing of Treatment Capacity Parameters

Test Pit Number	Sample Depth (Feet)	Unit	pH (unitless)	CEC (meq/100g)	Organic Content (percent)
TP-2	2.0	Weathered Glacial Outwash	6.5	13.6	5.15
TP-2	8.0	Glacial Outwash	6.6	5.8	1.41
TP-2	11.0	Glacial Outwash	6.8	2.4	1.01

Recommendations for the Treatment of Stormwater

The Department of Ecology *Stormwater Management Manual for Western Washington* (Ecology) states that the cation exchange capacity (CEC) of the treatment soil must be greater than or equal to 5 milliequivalents CEC/100g dry soil. The manual also recommends a minimum organic content of 1 percent of the dry weight. As indicated in the above-referenced laboratory data, the samples of the Weathered Outwash met the Ecology-recommended cation exchange capacity and organic content. The Glacial Outwash below the silt layer (sample at 11 feet BGS in TP-2) did not achieve the Ecology-recommended cation exchange capacity of at least 5 milliequivelents.

Based on the laboratory results, it is our opinion that the unweathered, non-silty native Glacial Outwash, encountered both above and below the silt layer, is not suitable for the treatment of stormwater without being amended or replaced with soils that have the soil properties recommended by Ecology. Though the silt layer does achieve the Ecology-recommended cation exchange capacity of at least 5 milliequivelents, we do not anticipate it will be utilized for infiltration due to its very low design infiltration rate.

GTS anticipates that amendment may include placement of the near surface red brown Weathered Glacial Outwash soils, cut from other areas of the site, at the base of infiltration facilities.

Amendment may also include the addition of mulch or other admixtures to elevate the cation exchange capacity and/or organic content of the native soil. It should be noted

that it has been historically difficult to obtain a uniformly blended amended soil by using conventional construction equipment to mix on-site soils and imported materials. On-site amended soil would also require additional testing of the amended soil to confirm compliance with Ecology-recommended soil properties. GTS is available to perform additional laboratory testing as part of an expanded scope of services if the soil is to be amended. Alternatively, the Owner may elect to import amended soils with the desired properties for the planned infiltration facility.

Geotechnical Consultation and Construction Monitoring

We recommend that geotechnical construction monitoring services be provided. These services should include observation by geotechnical personnel during fill placement/compaction activities and subgrade preparation operations to verify that design subgrade conditions are obtained beneath the proposed building. We also recommend that periodic field density testing be performed to verify that the appropriate degree of compaction is obtained. The purpose of these services would be to observe compliance with the design concepts, specifications, and recommendations of this report, and in the event subsurface conditions differ from those anticipated before the start of construction, provide revised recommendations appropriate to the conditions revealed during construction. GeoTest Services would be pleased to provide these services for you.

GeoTest Services is also available to provide a full range of materials testing and special inspection during construction as required by the local building department and the International Building Code. This may include specific construction inspections on materials such as reinforced concrete, reinforced masonry, and structural steel. These services are supported by our fully accredited materials testing laboratory.

USE OF THIS REPORT

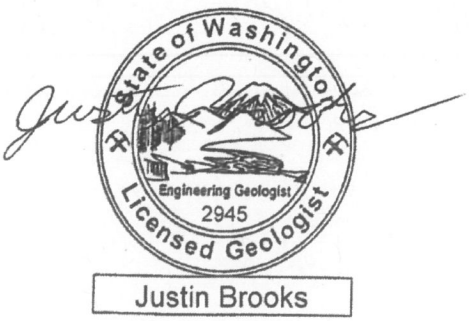
GeoTest Services has prepared this report for the exclusive use of Monterra Partners and their design consultants for specific application to the design of the proposed Haller Street Apartments to be located in Arlington, Washington. Use of this report by others or for another project is at the user's sole risk. Within the limitations of scope, schedule, and budget, our services have been conducted in accordance with generally accepted practices of the geotechnical engineering profession; no other warranty, either express or implied, is made as to the professional advice included in this report.

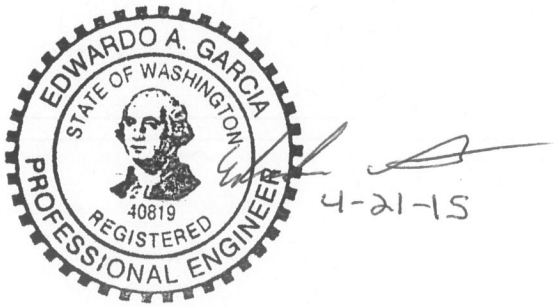
Our site explorations indicate subsurface conditions at the dates and locations indicated. It is not warranted that they are representative of subsurface conditions at other locations and times. The analyses, conclusions, and recommendations contained in this report are based on site conditions to the limited depth of our explorations at the time of our exploration program, a brief geological reconnaissance of the area, and review of published geological information for the site. We assume that the explorations are representative of the subsurface conditions throughout the site during the preparation of our recommendations. If variations in subsurface conditions are encountered during construction, we should be notified for review of the recommendations of this report, and revision of such if necessary. If there is a substantial lapse of time between submission of this report and the start of construction, or if conditions change due to construction operations at or adjacent to the project site, we recommend that we review this report to determine the applicability of the conclusions and recommendations contained herein.

The earthwork contractor is responsible to perform all work in conformance with all applicable WISHA/OSHA regulations. GeoTest Services, Inc. should not be assumed to be responsible for job site safety on this project, and this responsibility is specifically disclaimed.

We appreciate the opportunity to provide geotechnical services on this project and look forward to assisting you during the construction phase. If you have any questions or comments regarding the information contained in this report, or if we may be of further service, please call.

Respectfully Submitted,
GeoTest Services, Inc.





Justin Brooks, L.E.G.
Engineering Geologist

Edwardo Garcia, P.E.
Project Geotechnical Engineer

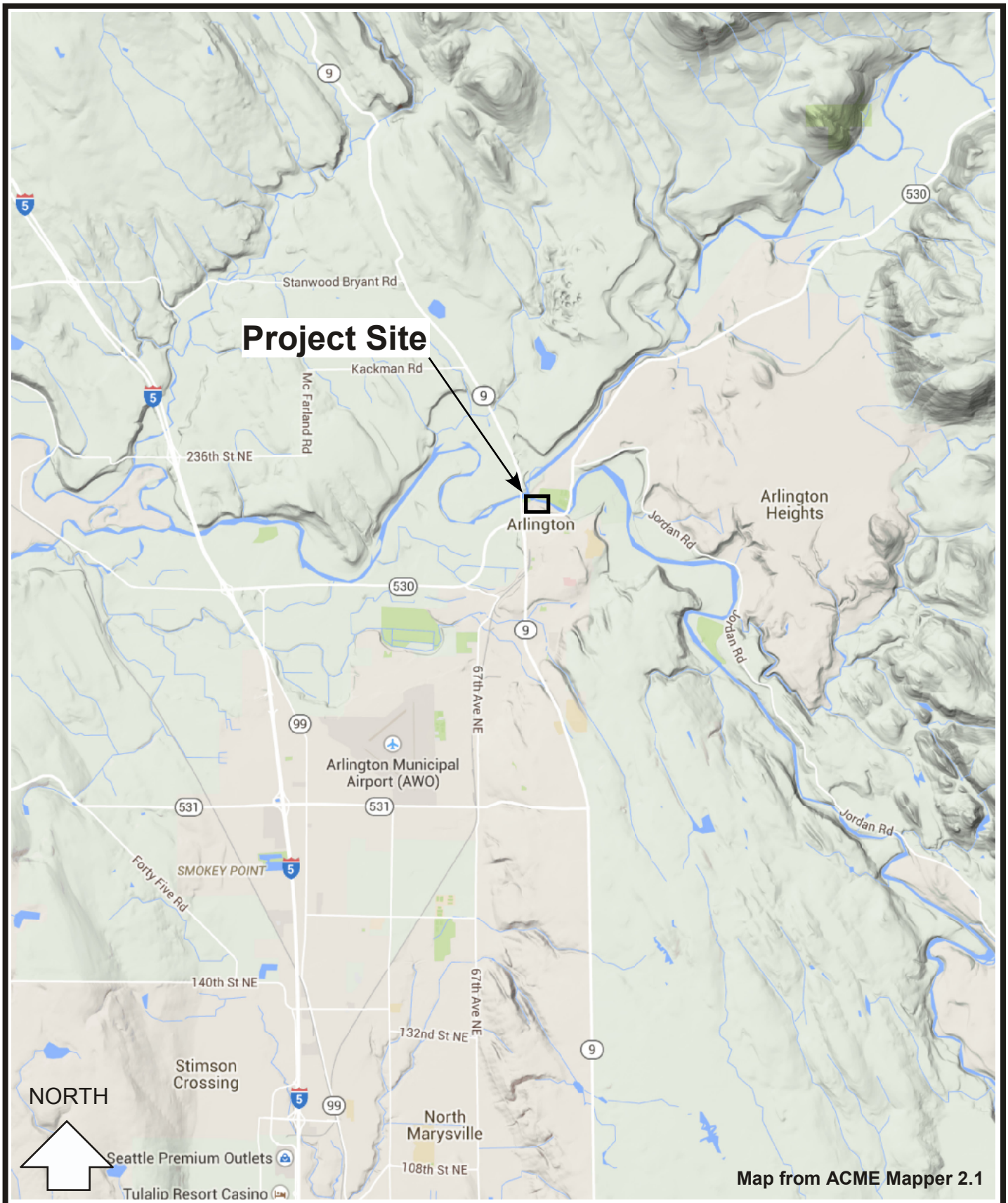
Attachments:

	Figure 1	Vicinity Map
	Figure 2	Site and Exploration Plan
	Figure 3	Typical Footing and Wall Drain Section
	Figure 4	Soil Classification System and Key
	Figure 5	Exploration Logs
	Figure 6	Grain Size Test Data
	Attached	Northwest Agricultural Consultants Test Results (1 page)
	Attached	Report Limitations and Guidelines for Its Use (3 pages)

REFERENCES

Minard, J.P., 1985, Geologic map of the Marysville quadrangle, Snohomish County, Washington: U.S. Geological Survey Miscellaneous Field Studies Map MF-1743

Washington State Department of Ecology Water Quality Program. February 2005. *Stormwater Management Manual for Western Washington.*



GEOTEST SERVICES, INC.
741 Marine Drive
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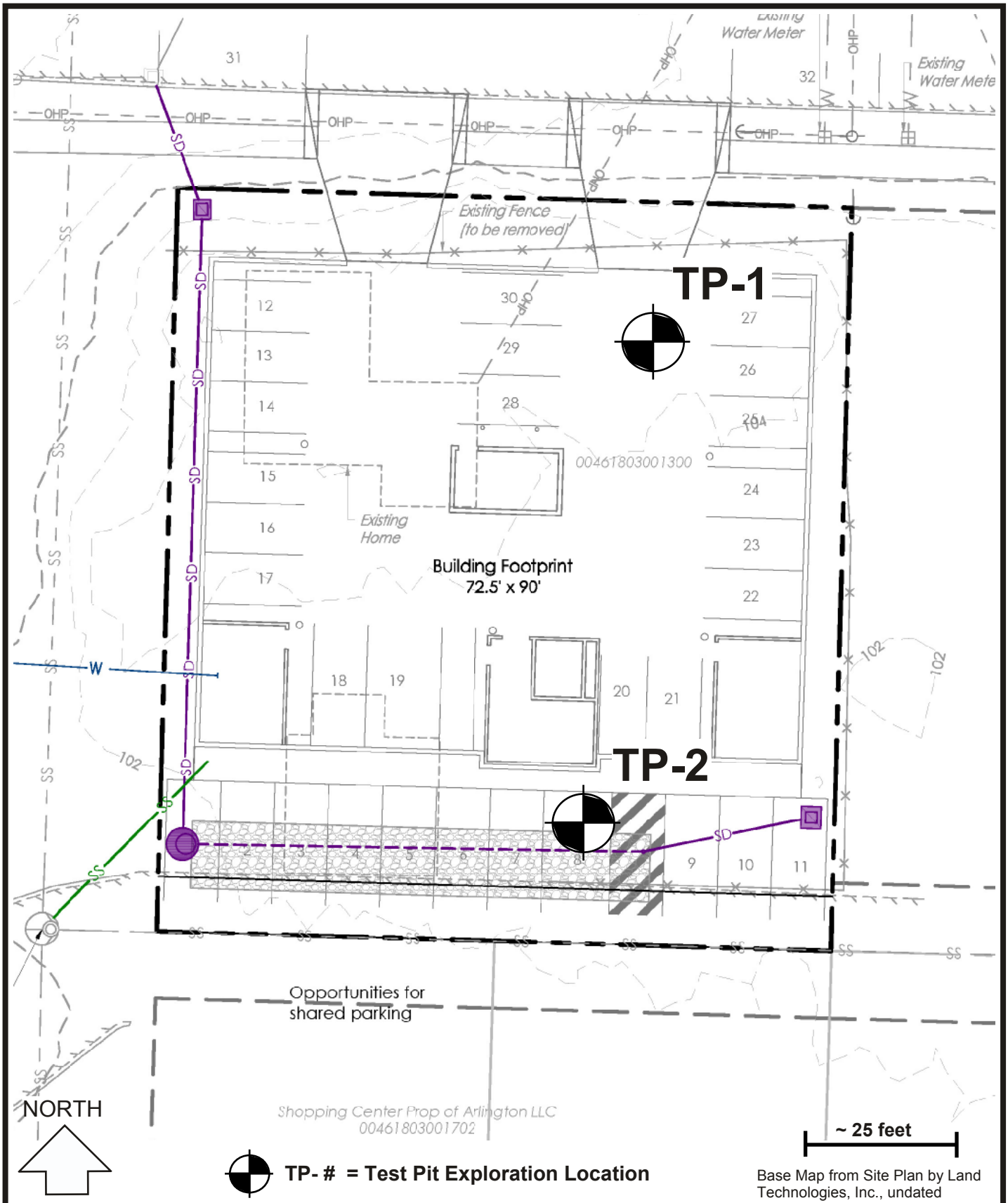
fax: (360) 733-7418

Date: 4-9-15	By: JB	Scale: none	Project 15-0191

VICINITY MAP
HALLER AVENUE APARTMENTS
EAST HALLER AVENUE
ARLINGTON, WASHINGTON

Figure 1



Base Map from Site Plan by Land Technologies, Inc., undated

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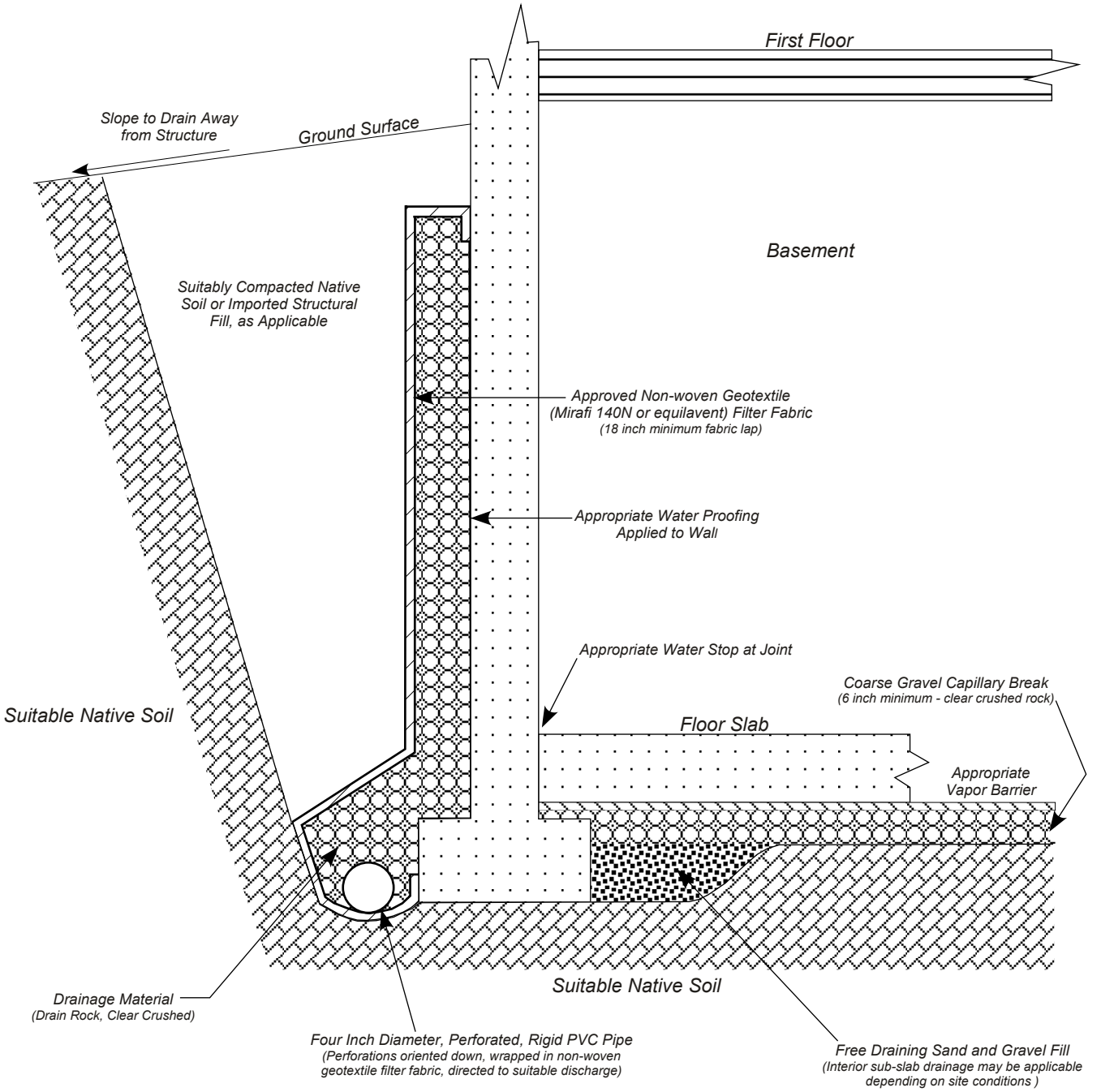
SITE AND EXPLORATION PLAN
HALLER AVENUE APARTMENTS
EAST HALLER AVENUE
ARLINGTON, WASHINGTON

Figure 2

BASEMENT WITH INTERIOR SLAB-ON-GRADE



Notes:
Footings should be properly buried for frost protection in accordance with International Building Code or local building codes (Typically 18 inches below exterior finished grades)

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TYPICAL FOOTING & WALL DRAIN SECTION HALLER AVENUE APARTMENTS EAST HALLER AVENUE ARLINGTON, WASHINGTON			15-0191
			Figure 3

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL	TYPICAL DESCRIPTIONS[1][2]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			PT	Peat; humus; swamp soil with high organic content

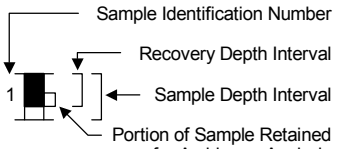
OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

Notes:
1. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test Method for Classification of Soils for Engineering Purposes*, as outlined in ASTM D 2487.
2. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent: > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents: > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
> 12% and ≤ 30% - "gravelly," "sandy," "silty," etc.
Additional Constituents: > 5% and ≤ 12% - "slightly gravelly," "slightly sandy," "slightly silty," etc.
≤ 5% - "trace gravel," "trace sand," "trace silt," etc., or not noted.

Drilling and Sampling Key

SAMPLE NUMBER & INTERVAL



SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Other - See text if applicable

Groundwater

▽ ATD — Approximate water elevation at time of drilling (ATD) or on date noted. Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

GEOTEST

Haller Avenue Appartments
East Haller Avenue
Arlington, Washington

Soil Classification System and Key

Figure 4

TP-1

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): ~105	
0	1	d			SM/ OL	Loose, dark brown, moist, organic, very silty, SAND (Topsoil)	Groundwater not encountered.
	2	d			SM	Loose, red brown, moist, slightly gravelly, silty, SAND (Weathered Glacial Outwash)	
	3	d			SP-SM	Medium dense, tan to grey, damp, slightly silty, gravelly, SAND (Glacial Outwash) with scattered cobbles	
5	4	d	W = 5 GS		GP/ SP	Medium dense, tan, damp, very sandy, GRAVEL to very gravelly, fine to coarse SAND (Glacial Outwash) with slight to moderate caving and scattered cobbles	
10	5	d	W = 20 GS pp=3.5		ML	Very stiff to hard, grey, moist, very sandy, SILT (Glacial Outwash)	
	6	d					
	7	d			SP-SM	Medium dense, grey, damp, slightly silty, fine to medium SAND (Glacial Outwash)	
15							

Test Pit Completed 04/09/15
Total Depth of Test Pit = 13.0 ft.

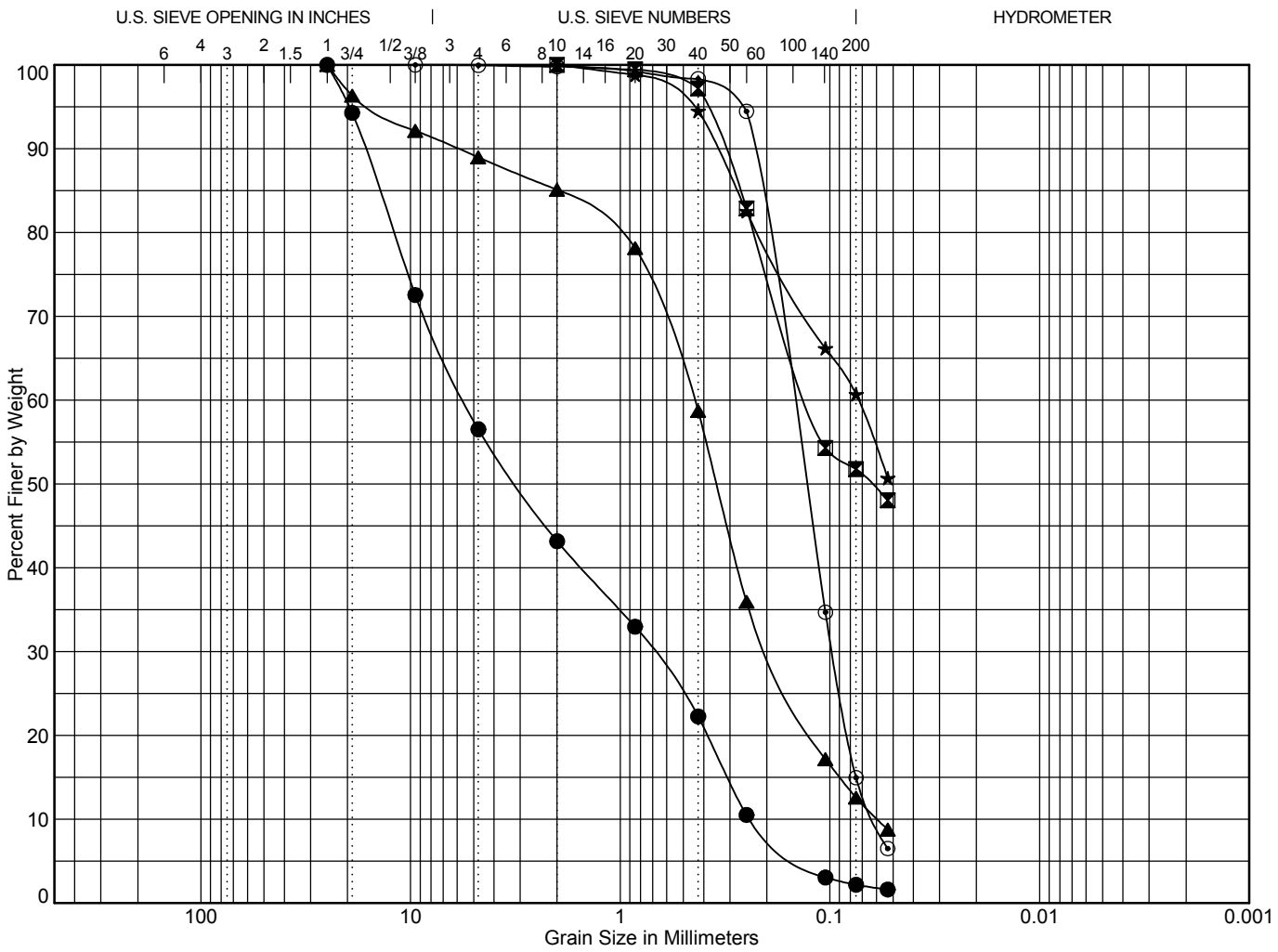
TP-2

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): ~102	
0					SM/ OL	Loose, dark brown, moist, organic, very silty, SAND (Topsoil)	Groundwater not encountered.
	8	d	W = 21 GS		SM	Loose, red brown, moist, slightly gravelly, silty, fine to medium SAND (Weathered Glacial Outwash)	
	9	d			GP/ SP	Medium dense, grey, damp, very sandy, GRAVEL to very gravelly, SAND (Glacial Outwash) with slight to moderate caving and scattered cobbles	
5	10	d	pp=4 W = 23 GS		ML	Very stiff to hard, tan grey, moist, very sandy, SILT (Glacial Outwash)	
	11	d					
	12	d			SM	Medium dense, grey, damp, silty, fine SAND (Glacial Outwash)	
10	13	d	W = 12 GS				
15							

Test Pit Completed 04/09/15
Total Depth of Test Pit = 12.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST	Haller Avenue Appartments East Haller Avenue Arlington, Washington	Log of Test Pits	Figure 5



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point		Depth	Classification	LL	PL	PI	C_c	C_u
●	TP-1	6.0	Very gravely, fine to coarse SAND (USDA Sand) (SP)				0.38	23.41
⊠	TP-1	9.5	Very sandy, SILT (USDA Loam) (ML)					
▲	TP-2	2.0	Slightly gravelly, silty, fine to medium SAND (USDA Sand) (SM)				1.37	7.50
★	TP-2	8.0	Very sandy, SILT (USDA Loam) (ML)					
⊙	TP-2	11.0	Silty, fine SAND (USDA Sand) (SM)				1.01	2.48

Point		Depth	D_{100}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-1	6.0	25	5.521	3.113	0.701	0.236	5.7	37.8	13.4	20.9	20.1	2.2
⊠	TP-1	9.5	2	0.125	0.064			0.0	0.0	0.0	2.8	45.4	51.8
▲	TP-2	2.0	25	0.445	0.347	0.19	0.059	3.7	7.3	3.9	26.4	46.1	12.6
★	TP-2	8.0	2	0.073				0.0	0.0	0.0	5.5	33.8	60.7
⊙	TP-2	11.0	9.5	0.152	0.131	0.097	0.061	0.0	0.0	0.2	1.4	83.4	14.9

$C_c = D_{30}^2/(D_{60} * D_{10})$
$C_u = D_{60}/D_{10}$

To be well graded: $1 < C_c < 3$ and $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

Haller Avenue Appartments
East Haller Avenue
Arlington, Washington

Grain Size Test Data

Figure 6

15-0191 4/13/15 C:\USERS\JUSTIN\DESKTOP\JOB FILES\15-0191 - HALLER ST APTS\15-0191 - HALLER ST APTS.GPJ GRAIN SIZE W/STATS

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NAPT
2015

GEOTEST SERVICES INC
741 MARINE DR
BELLINGHAM, WA 98225

SOIL
Client No.: 9678 Date Received: 04-10-2015
Report No.: 34937 Page: 1 of 1
a6be5b-83814

Grower	Sampler	Field No.	Field Name	Crop Year	Crop	Yield Goal
			Job #: 15-0191			

Depth (ft.)	Available Inches	NO3-N lbs/acre	NH4-N lbs/acre	Sulfur ppm	pH	Soluble Salts (mmhos /cm)	Organic Matter Percent	P(bic) ppm	K(bic) ppm	P(ace) ppm	K(ace) ppm	Calcium (meq. per 100 grams)	Magne-sium (meq. per 100 grams)	Sodium (meq. per 100 grams)	Eff.	Boron ppm	Zinc ppm	Manga-nese ppm	Iron ppm	Copper ppm	CEC (meq. per 100 grams)	% Base Sat.	Chloride lbs. per. acre	Bray 1P ppm	Total Bases (meq. per 100 grams)	SampleI D
1					6.5		5.15														13.6					
2					6.6		1.41														5.8					
3					6.8		1.01														2.4					
Total	0.00																									

Estimated Nitrogen Release from Organic Matter

Estimated Total Nitrogen Available to Crop

Last Year's Crop

Fertilizer

Comments

Sample ID	pH	LOI Organic Matter	Cation Exchange Capacity
TP2-2	6.5	5.15%	13.6 meq/100g
TP2-8	6.6	1.41%	5.8 meq/100g
TP2-11	6.8	1.01%	2.4 meq/100g

CEC Method: EPA 9081
Organic Matter Method: Loss on Ignition

REPORT LIMITATIONS AND GUIDELINES FOR ITS USE[1]

Subsurface issues may cause construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help:

Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

At GeoTest our geotechnical engineers and geologists structure their services to meet specific needs of our clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of an owner, a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineer who prepared it. And no one – not even you – should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report is Based on a Unique Set of Project-Specific Factors

GeoTest's geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the clients goals, objectives, and risk management preferences; the general nature of the structure involved its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless GeoTest, who conducted the study specifically states otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed, for example, from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed construction,
- alterations in drainage designs; or
- composition of the design team; the passage of time; man-made alterations and construction whether on or adjacent to the site; or by natural alterations and events, such as floods, earthquakes or groundwater fluctuations; or project ownership.

Always inform GeoTest's geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

[1]Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. Do not rely on the findings and conclusions of this report, whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact GeoTest before applying the report to determine if it is still relevant. A minor amount of additional testing or analysis will help determine if the report remains applicable.

Most Geotechnical and Geologic Findings are Professional Opinions

Our site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoTest's engineers and geologists review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ – sometimes significantly – from those indicated in your report. Retaining GeoTest who developed this report to provide construction observation is the most effective method of managing the risks associated with anticipated or unanticipated conditions.

A Report's Recommendations are *Not* Final

Do not over-rely on the construction recommendations included in this report. Those recommendations are not final, because geotechnical engineers or geologists develop them principally from judgment and opinion. GeoTest's geotechnical engineers or geologists can finalize their recommendations only by observing actual subsurface conditions revealed during construction. GeoTest cannot assume responsibility or liability for the report's recommendations if our firm does not perform the construction observation.

A Geotechnical Engineering or Geologic Report may be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. Lower that risk by having GeoTest confer with appropriate members of the design team after submitting the report. Also, we suggest retaining GeoTest to review pertinent elements of the design teams plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having GeoTest participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do not Redraw the Exploration Logs

Our geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors of omissions, the logs included in this report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable; but recognizes that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, consider advising the contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the GeoTest and/or to conduct

[1]Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. In addition, it is recommended that a contingency for unanticipated conditions be included in your project budget and schedule.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering or geology is far less exact than other engineering disciplines. This lack of understanding can create unrealistic expectations that can lead to disappointments, claims, and disputes. To help reduce risk, GeoTest includes an explanatory limitations section in our reports. Read these provisions closely. Ask questions and we encourage our clients or their representative to contact our office if you are unclear as to how these provisions apply to your project.

Environmental Concerns Are Not Covered in this Geotechnical or Geologic Report

The equipment, techniques, and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated containments, etc. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. Do not rely on environmental report prepared for some one else.

Obtain Professional Assistance to Deal with Biological Pollutants

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts biological pollutants from growing on indoor surfaces. Biological pollutants includes but is not limited to molds, fungi, spores, bacteria and viruses. To be effective, all such strategies should be devised for the express purpose of prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional biological pollutant prevention consultant. Because just a small amount of water or moisture can lead to the development of severe biological infestations, a number of prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of this study, the geotechnical engineer or geologist in charge of this project is not a biological pollutant prevention consultant; none of the services preformed in connection with this geotechnical engineering or geological study were designed or conducted for the purpose of preventing biological infestations.

[1]Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

D. Soil Amendment Calculation

Compost and Topsoil Calculation Worksheet for the Pre-approved Amendment Rate

NOTE: For Options 2 and 3, use this worksheet if you plan to use the pre-approved compost amendment rate of 2 inches. This worksheet should not be used if a custom compost amendment rate is selected for Options 2 and/or 3.

Option 1

Leave native soil undisturbed, and protect from compaction during construction.

- Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

No calculations for compost or topsoil are necessary for this option.

Option 2

Amend existing soil in-place (2-inch layer of compost).

- Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

- Enter combined square footage of lettered areas in thousands _____ — (example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)

- Multiply combined square footage by **6.2** and enter product in box A :

A	=Cubic Yards

AMOUNT OF COMPOST NEEDED FOR THESE AREAS

Note: MR 5 is triggered on sites with more than 2,000 sq. ft. of new, replaced, or new plus replaced impervious surface, or 7,000 sq. ft. or greater of land disturbing activity.

Option 3

Native Soil – stockpile site duff and topsoil and reapply after grading and construction.

- Enter lettered areas from site plan where this option will be used:

_____ 1,786 SF _____ _____ _____

- Enter combined square footage of lettered areas in thousands 1.79
  (example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)

- Multiply **combined square footage** by **25** and enter product in box B :

B	44.75 =Cubic Yards

AMOUNT OF TOPSOIL TO BE STOCKPILED AND REAPPLIED IN THESE AREAS

Option 4

Import topsoil.

- Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

- Enter combined square footage of lettered areas in thousands _____
  (example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)

- Multiply **combined square footage** by **25** and enter product in box C:

C	=Cubic Yards

AMOUNT OF IMPORTED TOPSOITHESE NEEDED FOR THESE AREAS

Order

Order These Amounts:

- Enter amount in Box **A:** _____**Cubic Yards of Compost**

- Enter amount in Box **C :** _____**Cubic Yards of Topsoil**

Note: MR 5 is triggered on sites with more than 2,000 sq. ft. of new, replaced, or new plus replaced impervious surface, or 7,000 sq. ft. or greater of land disturbing activity.

E. Construction Stormwater Pollution Prevention Plan

This Stormwater Pollution Prevention Plan (SWPPP) has been prepared as part of the Construction stormwater permit requirements for the ***Haller*** project in Arlington, Washington. It is located at 106 Haller St, Arlington, Washington. More generally, the site is located in Section 2, Township 31 North, and Range 5 East of the Willamette Meridian in Snohomish County, Washington. The site contains 11.32 acres. The existing site is developed with a gravel driveway, a home and garage with various outbuildings. The remainder of the site exists as lawn and native vegetation. The proposal is to construct 6 townhome units with access road and associated utilities. The access to the new units will be from E Haller Ave. The drive aisle entrances will be constructed per the city of Arlington standards.

To meet flow control requirements an aquacell system (98.25' X 5.21' X 4.02') with 100% infiltration at the bottom will be proposed which will be located underneath the drive aisle.

The purpose of this SWPPP is to describe the proposed construction activities and all temporary and permanent erosion and sediment control (TESC) measures, pollution prevention measures, inspection/monitoring activities, and recordkeeping that will be implemented during the proposed construction project. The objectives of the SWPPP are to:

1. Implement Best Management Practices (BMPs) to prevent erosion and sedimentation, and to identify, reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.

2. Prevent violations of surface water quality, ground water quality, or sediment management standards.

3. Prevent, during the construction phase, adverse water quality impacts including impacts on beneficial uses of the receiving water by controlling peak flow rates and volumes of stormwater runoff at the Permittee's outfalls and downstream of the outfalls.

This SWPPP was prepared using the Ecology SWPPP Template. This SWPPP was prepared based on the requirements set forth in the Construction Stormwater General Permit and in the Stormwater Management Manual for Western Washington (SWMMWW 2012).

The 13 BMP Elements

Element #1 – Mark Clearing Limits

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin.

Element #2 – Establish Construction Access

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, and wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters.

Element #3 – Control Flow Rates

In order to protect the properties and waterways downstream of the project site, stormwater discharges from the site will be controlled. In general, discharge rates of stormwater from the site will be controlled where increases in impervious area or soil compaction during construction could lead to downstream erosion, or where necessary to meet local agency stormwater discharge requirements.

The existing landscape pond will function as sediment trap.

Element #4 – Install Sediment Controls

Install silt fencing, inlet protection, and mulch according to the approved plans, prior to any clearing or grading activities. Maintain until all construction activities are completed.

Element #5 – Stabilize Soils

Exposed and un-worked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project.

Apply temporary hydro-seed to exposed and un-worked soils, according to the approved construction plans, as needed to prevent erosion during site grading. Apply permanent hydro-seed to areas at final grade as site grading is completed.

Apply mulching to exposed and un-worked soils, according to the approved construction plans, as needed to prevent erosion during site grading. Maintain until site grading is completed and permanent hydro-seed is applied.

Cover stockpiles with plastic sheeting, according to the approved construction plans, as needed to prevent erosion during site grading. Maintain until stockpiles are removed from site.

Element #6 – Protect Slopes

All cut and fill slopes will be designed, constructed, and protected in a manner that minimizes erosion. The following specific BMPs will be used to protect slopes for this project.

Slopes are protected by plastic covering, mulching, and seeds.

Element #7 – Protect Drain Inlets

All storm drain inlets and culverts made operable during construction shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. However, the first

priority is to keep all access roads clean of sediment and keep street wash water separate from entering storm drains until treatment can be provided.

Element #8 – Stabilize Channels and Outlets
N/A

Element #9 – Control Pollutants
All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well-organized, and free of debris.

Element #10 – Control Dewatering
There will be no dewatering expected as part of this proposal. If it occurs, Baker tanks will be used for dewatering.

Element #11 – Maintain BMPs
All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMP's specifications. Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any rainfall event that causes a discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency will be reduced to once every month. All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element #12 – Manage the Project
Erosion and sediment control BMPs for this project have been designed based on the following principles:
Design the project to fit the existing topography, soils, and drainage patterns; Emphasize erosion control rather than sediment control; Minimize the extent and duration of the area exposed; Keep runoff velocities low; Retain sediment on site; Thoroughly monitor site and maintain all ESC measures and Schedule major earthwork during the dry season. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

Element #13 – Protect On-site Stormwater Management BMPs for Runoff from Roofs and Other Hard Surfaces
N/A

F. Operation and Maintenance Manual

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

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

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.