FULL STORMWATER DRAINAGE REPORT

for

14-Unit Mukilteo Plaza
823 2nd Street
Mukilteo, WA 98275

ISSUE DATE: February 5, 2021
REVISION DATE:

PREPARED BY:
Timothy Sarkela, P.E.

REVIEWED BY:
JESSE A. JARRELL, P.E.

02-05-21

CLIENT(s)
Robert Ford
40844 Sandpiper Court
Palm Desert, CA 92260

ENGINEER
Western Engineers & Surveyors, Inc.
Job # 20-1880-A

TABLE OF CONTENTS

Page

Minimum Requirement # 1: Stormwater Site Plan

Executive Summary

The project consists of clearing/grading and demolition of existing structures for the construction of a mixed use commercial and apartment building along with associated drive aisle access, internal covered parking, and utilities. The proposed building is to have an approximate roof area of 11,500 sf. along with proposed access and plaza areas totaling approximately 600 sf. A new 8' wide sidewalk will be located within the right-of-way and total approximately 1,000 sf. Total new and replaced impervious surface have been estimated at approximately 13,100 sf. Access to two stories of internal covered parking is proposed from two separate directions, one access from 2nd Street, as well as one access from an existing alley in the rear of the proposed building. Drainage management for the site improvements will primarily consist of rooftop bioretention planter boxes to mitigate stormwater runoff. Disturbed pervious areas will be amended per BMP T5.13. The project is to be designed according to the 2012 (with 2014 updates) DOE Stormwater Management Manual for Western Washington and the 2017 City of Mukilteo Development Standards.

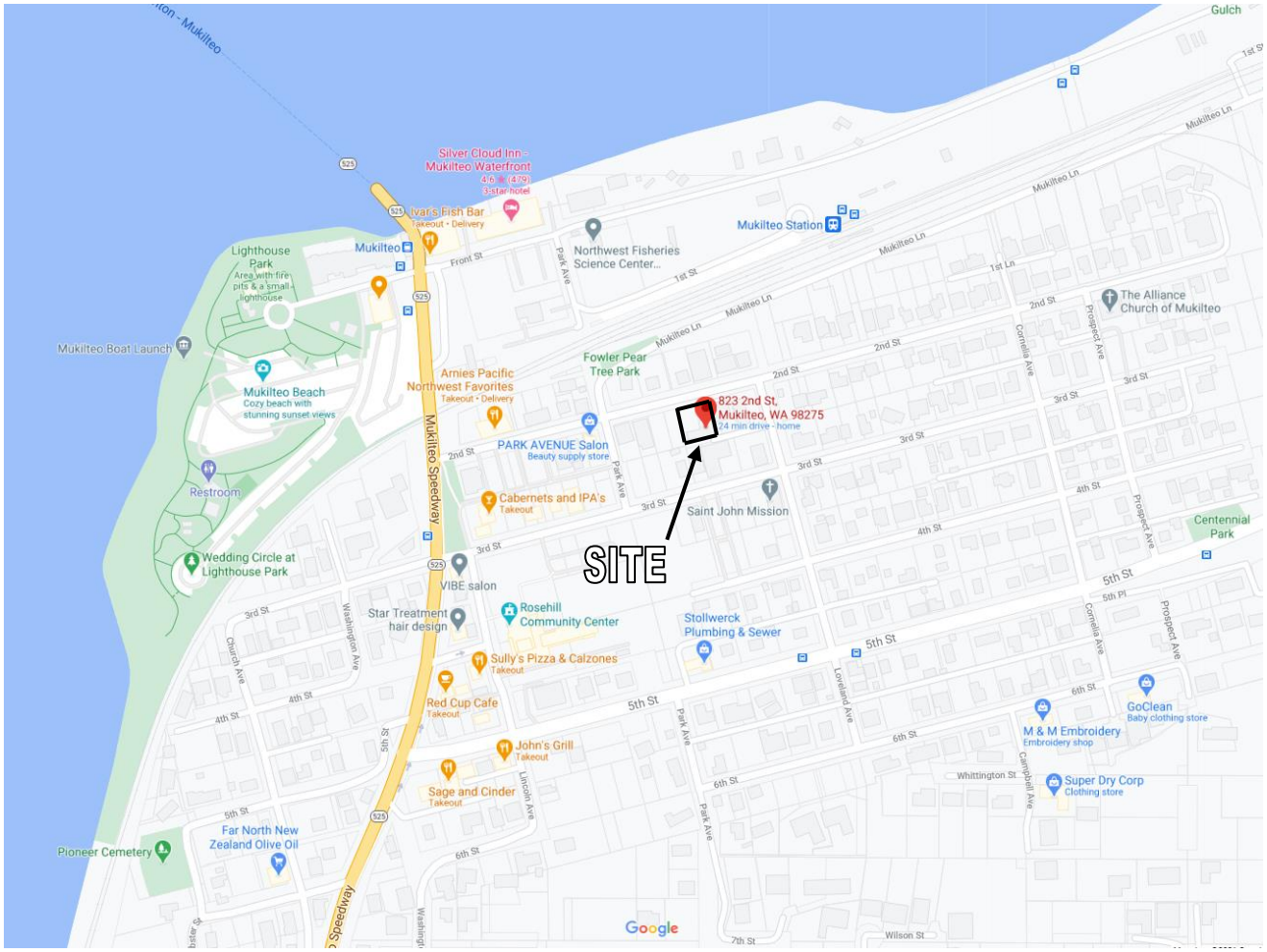
Existing Conditions Summary

The property is one tax parcel and contains a one story daycare building with walkways and play areas. Slopes on-site are flat to steep, ranging from 2% to 33%, and sloping northerly toward 2nd Street. Per NRCS/USDA soils mapping, the site contains Kitsap silt loam type soils. According to soil boring by Nelson Geotechnical Associates, Inc., site soils resemble loose, silty, fine sand with saturated sandy interbeds. Fine grained glacial soils were found at depth within the site. Refer to appendix II for soil information. Refer to the separate report by Nelson Geotechnical Associates for a full explanation of site soil conditions.

The adjacent parcels to the south, west, and east are developed commercial properties. The 2nd Street right-of-way lies immediately north of the site.

VICINITY MAP

MAP TAKEN FROM BING MAPS:



WESTERN ENGINEERS & SURVEYORS
SURVEYORS · ENGINEERS · LAND USE CONSULTANTS

9740 Evergreen Way, Everett WA 98204
(425) 356-2700 (425) 356-2708 (FAX)
westernengineers.com

MUKILTEO PLAZA
MUKILTEO, WA 98275

SCALE: 1" = ~550'	**DATE:** 01/22/21	**CHECKED:** JAJ
BY: JAJ	**JOB NUMBER:** 20-1880-A	**FILE NAME:** 201880A/VICINITYMAP

Upstream Analysis

The topography of the site and the surrounding area tends to slope northerly and northwesterly toward 2nd Street. Minor sheet flow runoff from pavement and roof areas on properties to the south may be encountered, but it appears each property contains stormwater conveyance systems and expected runoff is expected to be minimal. No evidence of erosion or concentrated flows was observed during site visit and no other upstream flows appear to enter the site.

Downstream Analysis

A downstream analysis was provided by Nathan Thompson of Western Engineers on January 25, 2021. Weather was partly sunny with a temperature around 40 degrees. Refer to the aerial map in the next section of this report for a depiction of runoff paths.

The entire property tends to slope northwesterly toward the northwest corner of the site (see photos 1, 4, 5, & 6). A small portion of the southwest corner of the site slopes toward the adjacent parking lot to the west and infiltrates along the edge of the parking lot and continues to flow subsurface in a northerly direction beneath 2nd Street for approximately 100 feet until it enters a catch basin within the public drainage system for Brewery Creek described later. A small portion of the southeast corner of the site slopes on a northly direction and enters one of two catch basins located along the east side of the existing building, of which the drainage system is unclear (see photos 2 & 3). The majority of the site runoff appears to sheet flow across the site in a northwest direction into a series of catch basins located along the southside of 2nd Street (see photos 7 & 8). According to field exploration, aerial maps, and City of Mukilteo stormwater system maps, the series of catch basins direct the runoff in a northwest direction beneath 2nd Street. The runoff is then directed in a westerly direction for approximately 150 feet into a storm drain manhole that directs the runoff into the conveyance system for Brewery Creek. The Runoff continues to flow in a northerly direction via an underground drainage pipe for approximately 700 feet until it empties into the Puget Sound. As this is the closest receiving water, further downstream analysis is not required.

Drainage Complaints

There are no known drainage complaints for the site.

DOWNSTREAM AND AERIAL MAP

DOWNSTREAM PHOTOGRAPHS

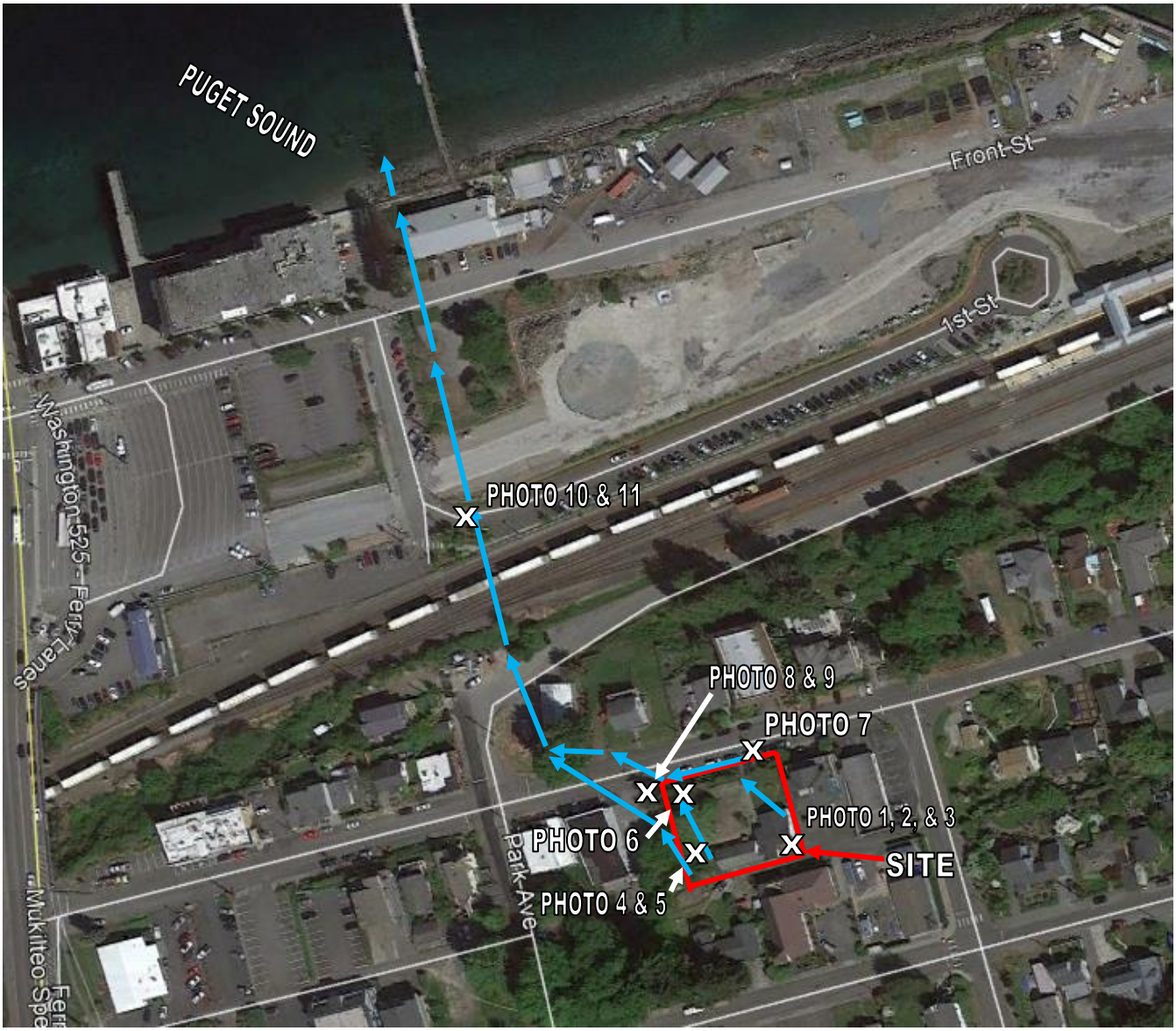


IMAGE TAKEN FROM GOOGLE EARTH

WESTERN ENGINEERS & SURVEYORS
SURVEYORS · ENGINEERS · LAND USE CONSULTANTS

9740 Evergreen Way, Everett WA 98204
(425) 356-2700 (425) 356-2708 (FAX)
westernengineers.com

MUKILTEO PLAZA
MUKILTEO, WA 98275

SCALE: 1"=380'	**DATE:** 01/26/21	**SHEET:** 1 OF 1	
BY: JAJ	**JOB NUMBER:** 20-1880-A	**FILE NAME:** Downstream 1.DOC	

DOWNSTREAM PHOTOGRAPHS

DOWNSTREAM PHOTOGRAPHS

PHOTO 1:
Figure to the Left:
Looking southwesterly from the southeast property corner.

PHOTO 2:
Figure to the Right:
Looking northwesterly from the same location as the pervious photo.

WESTERN ENGINEERS & SURVEYORS
SURVEYORS · ENGINEERS · LAND USE CONSULTANTS
9740 Evergreen Way, Everett WA 98204
(425) 356-2700 (425) 356-2708 (FAX)
westernengineers.com

MUKILTEO PLAZA
MUKILTEO, WA 98275

SCALE:	None	**DATE:**	01/26/21	**SHEET:**	1 OF 6
BY:	JAJ	**JOB NUMBER:**	20-1880-A	**FILE NAME:**	Downstream 1.DOC

DOWNSTREAM PHOTOGRAPHS

PHOTO 3:
Figure to the Left:
Looking northerly from the same location as the previous photo.

PHOTO 4:
Figure to the Right:
Looking southerly from the west boundary line of the site.

WESTERN ENGINEERS & SURVEYORS
SURVEYORS · ENGINEERS · LAND USE CONSULTANTS
9740 Evergreen Way, Everett WA 98204
(425) 356-2700 (425) 356-2708 (FAX)
westernengineers.com

MUKILTEO PLAZA
MUKILTEO, WA 98275

SCALE:	None	**DATE:**	01/26/21	**SHEET:**	2 OF 6
BY:	JAJ	**JOB NUMBER:**	20-1880-A	**FILE NAME:**	Downstream 2.DOC

DOWNSTREAM PHOTOGRAPHS

PHOTO 5:
Figure to the Left:
Looking northwesterly from the same location as the previous photo.

PHOTO 6:
Figure to the Right:
Looking easterly from the background of photo 4.

WESTERN ENGINEERS & SURVEYORS
SURVEYORS · ENGINEERS · LAND USE CONSULTANTS
9740 Evergreen Way, Everett WA 98204
(425) 356-2700 (425) 356-2708 (FAX)
westernengineers.com

MUKILTEO PLAZA
MUKILTEO, WA 98275

SCALE:	None	**DATE:**	01/26/21	**SHEET:**	3 OF 6
BY:	JAJ	**JOB NUMBER:**	20-1880-A	**FILE NAME:**	Downstream 3.DOC

DOWNSTREAM PHOTOGRAPHS

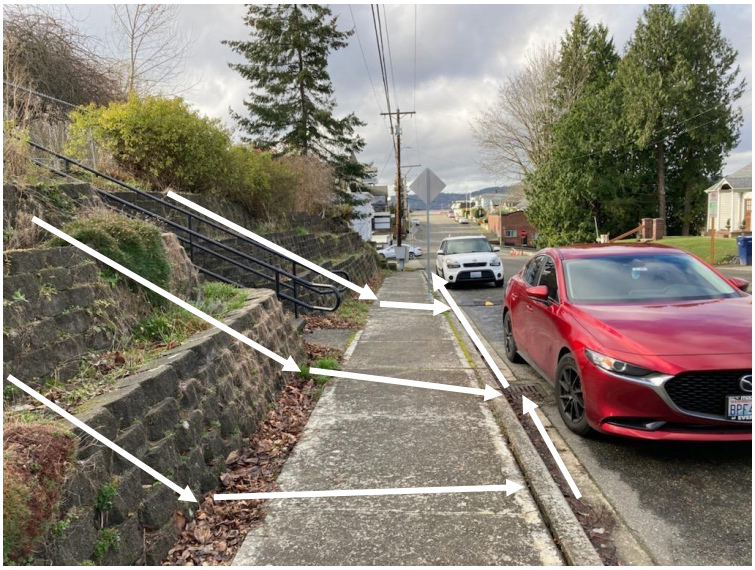


PHOTO 7:
Figure to the Left:
Looking southwesterly from the south side of 2nd Street.

PHOTO 8:
Figure to the Right:
Looking northeasterly from the background of the previous photo.

WESTERN ENGINEERS & SURVEYORS
SURVEYORS · ENGINEERS · LAND USE CONSULTANTS
9740 Evergreen Way, Everett WA 98204
(425) 356-2700 (425) 356-2708 (FAX)
westernengineers.com

MUKILTEO PLAZA
MUKILTEO, WA 98275

SCALE:	None	**DATE:**	01/26/21	**SHEET:**	4 OF 6
BY:	JAJ	**JOB NUMBER:**	20-1880-A	**FILE NAME:**	Downstream 4.DOC

DOWNSTREAM PHOTOGRAPHS

PHOTO 9:
Figure to the Left:
Looking northerly from the same location as the previous photo.

PHOTO 10:
Figure to the Right:
Looking southerly from the southside of Mukilteo Lane.

WESTERN ENGINEERS & SURVEYORS
SURVEYORS · ENGINEERS · LAND USE CONSULTANTS
9740 Evergreen Way, Everett WA 98204
(425) 356-2700 (425) 356-2708 (FAX)
westernengineers.com

MUKILTEO PLAZA
MUKILTEO, WA 98275

SCALE:	None	**DATE:**	01/26/21	**SHEET:**	5 OF 6
BY:	JAJ	**JOB NUMBER:**	20-1880-A	**FILE NAME:**	Downstream 5.DOC

DOWNSTREAM PHOTOGRAPHS

PHOTO 11:
Figure to the Left:
Looking northerly from the same location as the previous photo.

WESTERN ENGINEERS & SURVEYORS
SURVEYORS · ENGINEERS · LAND USE CONSULTANTS

9740 Evergreen Way, Everett WA 98204
(425) 356-2700 (425) 356-2708 (FAX)
westernengineers.com

MUKILTEO PLAZA
MUKILTEO, WA 98275

SCALE:	None	**DATE:**	01/26/21	**SHEET:**	6 OF 6
BY:	JAJ	**JOB NUMBER:**	20-1880-A	**FILE NAME:**	Downstream 6.DOC

Minimum Requirement # 2: SWPPP Narrative

Element #1: Mark Clearing Limits
Clearing limits have been shown on the SWPPP Plan.

Element #2: Establish Construction Entrance
A temporary construction entrance (BMP C105) has been shown on the SWPPP plan near the southeast corner of the site. All vehicles shall be free of debris prior to leaving the site.

Element # 3: Control Flow Rates
Flow rates during construction are to be contained through the installation silt fencing (BMP C233) on the northern clearing limits.

Element # 4: Install Sediment Controls
Sediment controls mainly consist of silt fencing (BMP C233) on the northern clearing limits.

Element # 5: Stabilize Soils
All soils disturbed during site grading will be stabilized by use of the most appropriate BMP method available. These consist of short-term and long-term solutions. Short-term methods consist of compaction of the soils by vibratory roller or bulldozer. Long-term methods consist of straw covering over the soils (this is in the case of the project becoming dormant for greater than 1 month). During summer construction periods longer than 1 working week (7 days) where the soils are exposed and un-worked will use the proscribed methods in the Storm Water Management Manual for Western Washington to reduce sedimentation transported offsite. If winter grading is conducted, all exposed soils shall be covered within 2 days.

Element # 6: Protect Slopes
Steep slopes within the project clearing limits will be protected with Mulching (BMP C121) and/or Nets and Blankets (BMP C122).

Element # 7: Protect Drain Inlets
Catch basin inlets along the site frontage will be protected from with catch basin sediment inserts or equivalent per BMP C220.

Element # 8: Stabilize Channels and Outlets
Channels and drainage outlets are not needed around the proposed development area on site. No stabilization is necessary. Existing channels or drainage outlets located within 500-feet of the property of the property should be routinely inspected for debris that may dam and/or aid erosion.

Element # 9: Control Pollutants
All pollutants from construction vehicles will be contained and disposed of in the approved manner consistent with state environmental policies. Any vehicle maintenance will be performed by authorized mechanics using drip pans and waste containment vessels. All pollutants will be disposed offsite at approved facilities. Concrete washout areas to be established on site. All excess concrete shall be contained to a designated area and disposed of at a city approved site.

Element # 10: Control De-Watering
De-watering of the site is not expected. If dewatering of the site is needed, all groundwater removed shall be retained and recharged into the ground after de-watering has been finalized.

Element # 11: Maintain BMP's
All Temporary Erosion and Sedimentation Control (TESC) devices and equipment will be inspected and maintained on a weekly basis if not sooner, based on storm events contributing to runoff. When construction is complete and the site is stabilized, any existing sediment will be removed and stabilized onsite.

Element # 12: Manage the Project
A general construction manager will manage the project for or by the owners. The construction manager shall maintain all of the above items in order to minimize sediment transport and turbid water leaving the site. His job will entail continual observation of the grading operations to ensure minimal effects to adjacent properties and offsite waterways.

Element # 13: Protect Low Impact Development BMPs
LID BMP's mainly consist of soil amendment per BMP T5.13 and roof bioretention planter boxes per BMP T7.30. The soil amendment and bioretention areas are to be protected from compaction and sedimentation when feasible.

Minimal Requirement # 3: Water Pollution Source Control

Due to the commercial nature of the proposed site improvements, some Source Control BMPs may apply. The proposed mixed commercial and residential use primarily deals with offices space and dwelling units. Source control BMPs that may apply to the project are listed below:

S411 – Landscaping and Lawn/Vegetation Management
S417 – Maintenance of Stormwater Drainage and Treatment Systems
S424 – Roof/Building Drains at Commercial Buildings

Minimum Requirement # 4: Preservation of Natural Drainage Systems and Outfalls, and provisions of off-site mitigation

No changes to the existing drainage systems and outfalls are proposed with this development. All proposed runoff from the project area is to be conveyed to the existing public drainage system within 2nd Street, which is the existing site outfall.

Minimum Requirement #5 On-Site Storm Water Management

Due to the project proposing more than 5,000 sf of new hard surfaces, Minimum Requirements 1 through 9 must be evaluated. The project is required to meet BMPs described in List #2 of Section 2.5.5 of the 2014 WADOE SWDM or design the site to the LID performance standard. The project will meet the requirements of List #2. Refer to analysis below for breakdown of feasible On-Site Stormwater BMPs based on List #2.

Lawn & Landscape Areas:

- Design in accordance with BMP T5.13
  - ⇨ Project is designed with disturbed pervious areas of the site being amended per BMP T5.13.

Roof Areas:

- Full Dispersion per BMP T5.30 or Full Infiltration per BMP T5.10A.
  - ⇨ The project area does not contain enough native forest to retain and is not considered a rural site. Full Dispersion infeasible.
  - ⇨ Due to the building footprint taking up almost all available lot area, there will be no on-site area available for infiltration BMPs.
- Bioretention Cells, Swales and Planter Boxes per BMP T7.30.
  - ⇨ Bioretention planter boxes with underdrain systems will be placed on the building roof to attenuate roof runoff.
- Downspout Dispersion Systems per BMP T5.10B
  - ⇨ Due to the building footprint taking up almost all available lot area, there will be no on-site area available for dispersion BMPs.
- Perforated Stub-Out Connections per BMP T5.10C
  - ⇨ Due to the building footprint taking up almost all available lot area, there will be no on-site area available for stub out trenches BMPs.

Other Hard Surface Areas:

- Full Dispersion per BMP T5.30
  - ⇨ The project area does not contain enough native forest to retain and is not considered a rural site. Full Dispersion infeasible.
- Permeable Pavements per BMP T5.15
  - ⇨ Due to almost the entire site being taken up by the building footprint, permeable pavement is not recommended.
- Rain Gardens per BMP T5.14A and Bioretention per BMP T7.30.
  - ⇨ Due to almost the entire site being taken up by the building footprint, there is not enough adjacent on-site area for rain garden or pavement bioretention areas.
- Sheet Flow Dispersion BMP T5.12 and Concentrated Flow Dispersion BMP T5.11
  - ⇨ The proposed site does not contain adequate vegetated flow paths for sheet flow or concentrated flow dispersion. Such dispersion is infeasible.

Minimum Requirement # 6: Runoff Treatment

Due to the site proposing less than 5,000 sf. of new/replaced pollution generating impervious surfaces, runoff treatment is not required.

Minimum Requirement # 7: Flow Control

The project site discharges directly to the Puget Sound through manmade conveyance and does not require flow control. Roof bioretention planter boxes will be utilized to attenuate site runoff and maintain a proposed 25-year runoff equivalent to pre-existing rates. Refer to WWHM runoff calculations in the following section for evaluation of flow rates.

Existing and Developed Site Summary

Total Property Area	= 12,465 sf. (0.286 Ac.)
Total Frontage Area	= 1,035 sf. (0.024 Ac.)
Total Project Area	= 13,500 sf. (0.310 Ac.)

Existing Site

On-site Hardscape Area:	
Ex. Building Roof	= 2,900 sf.
Ex. Asphalt Driveways	= 1,300 sf.
Ex. Concrete Walks/Stairs	= 500 sf.
Total	= 4,700 sf. (0.108 Ac.)
On-site Pervious Area:	
Ex. Commercial Lawn	= 7,765 sf. (0.178 Ac.)

Proposed Site

On-Site Hardscape Area:	
Mixed Use Building Roof	= 11,500 sf.
*Access and Uncovered Plaza	= 600 sf.
Total	= 12,100 sf. (0.278 Ac.)

*Note: Does not include areas covered by roof overhangs

On-Site Pervious Area:	
Commercial Landscaping	= 365 sf. (0.008 Ac.)
Off-Site Hardscape Area:	
New 8’ Sidewalk	= 1,000 sf. (0.023 Ac.)

Total New/Replaced Hardscape Surface = 13,100 sf. (0.301 Ac.)

WWHM2012 ROOF BIORETENTION

WWHM2012
PROJECT REPORT

Project Name: 20-1880-A Runoff
Site Name:
Site Address:
City :
Report Date: 1/22/2021
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Existing Site
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	.024
C, Lawn, Mod	.178
Pervious Total	0.202

Impervious Land Use	acre
ROOF TOPS FLAT	0.067
DRIVEWAYS FLAT	0.03
SIDEWALKS MOD	0.011
Impervious Total	0.108
Basin Total	0.31

MITIGATED LAND USE

Name : Proposed Site
Bypass: Yes

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	.008
Pervious Total	0.008

Impervious Land Use	acre
ROOF TOPS FLAT	0.099
DRIVEWAYS FLAT	0.015
SIDEWALKS FLAT	0.023
Impervious Total	0.137
Basin Total	0.145

Name : Roof Bioretention
Bottom Length: 100.00 ft.
Bottom Width: 72.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW 12 in/hr
Material thickness of second layer: 0
Material type for second layer: Sand
Material thickness of third layer: 0
Material type for third layer: GRAVEL
Underdrain used
Underdrain Diameter (feet): 0.5
Orifice Diameter (in.): 0.5
Offset (in.): 0
Flow Through Underdrain (ac-ft.): 15.791
Total Outflow (ac-ft.): 15.791
Percent Through Underdrain: 100
Discharge Structure
Riser Height: 0.5 ft.
Riser Diameter: 6 in.

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

Roof Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.1653	0.0000	0.0000	0.0000
0.0275	0.1653	0.0010	0.0000	0.0000
0.0549	0.1653	0.0021	0.0000	0.0000
0.0824	0.1653	0.0031	0.0000	0.0000
0.1099	0.1653	0.0042	0.0000	0.0000
0.1374	0.1653	0.0052	0.0004	0.0000
0.1648	0.1653	0.0062	0.0028	0.0000
0.1923	0.1653	0.0073	0.0030	0.0000
0.2198	0.1653	0.0083	0.0032	0.0000
0.2473	0.1653	0.0093	0.0034	0.0000
0.2747	0.1653	0.0104	0.0036	0.0000
0.3022	0.1653	0.0114	0.0037	0.0000
0.3297	0.1653	0.0125	0.0039	0.0000
0.3571	0.1653	0.0135	0.0041	0.0000
0.3846	0.1653	0.0145	0.0042	0.0000
0.4121	0.1653	0.0156	0.0044	0.0000
0.4396	0.1653	0.0166	0.0045	0.0000
0.4670	0.1653	0.0177	0.0046	0.0000
0.4945	0.1653	0.0187	0.0048	0.0000
0.5220	0.1653	0.0197	0.0049	0.0000
0.5495	0.1653	0.0208	0.0050	0.0000

0.5769	0.1653	0.0218	0.0052	0.0000
0.6044	0.1653	0.0228	0.0053	0.0000
0.6319	0.1653	0.0239	0.0054	0.0000
0.6593	0.1653	0.0249	0.0055	0.0000
0.6868	0.1653	0.0260	0.0056	0.0000
0.7143	0.1653	0.0270	0.0057	0.0000
0.7418	0.1653	0.0280	0.0058	0.0000
0.7692	0.1653	0.0291	0.0060	0.0000
0.7967	0.1653	0.0301	0.0061	0.0000
0.8242	0.1653	0.0311	0.0062	0.0000
0.8516	0.1653	0.0322	0.0063	0.0000
0.8791	0.1653	0.0332	0.0064	0.0000
0.9066	0.1653	0.0343	0.0065	0.0000
0.9341	0.1653	0.0353	0.0066	0.0000
0.9615	0.1653	0.0363	0.0067	0.0000
0.9890	0.1653	0.0374	0.0067	0.0000
1.0165	0.1653	0.0384	0.0068	0.0000
1.0440	0.1653	0.0395	0.0069	0.0000
1.0714	0.1653	0.0405	0.0070	0.0000
1.0989	0.1653	0.0415	0.0071	0.0000
1.1264	0.1653	0.0426	0.0072	0.0000
1.1538	0.1653	0.0436	0.0073	0.0000
1.1813	0.1653	0.0446	0.0074	0.0000
1.2088	0.1653	0.0457	0.0075	0.0000
1.2363	0.1653	0.0467	0.0075	0.0000
1.2637	0.1653	0.0478	0.0076	0.0000
1.2912	0.1653	0.0488	0.0077	0.0000
1.3187	0.1653	0.0498	0.0078	0.0000
1.3462	0.1653	0.0509	0.0079	0.0000
1.3736	0.1653	0.0519	0.0080	0.0000
1.4011	0.1653	0.0530	0.0080	0.0000
1.4286	0.1653	0.0540	0.0081	0.0000
1.4560	0.1653	0.0550	0.0082	0.0000
1.4835	0.1653	0.0561	0.0083	0.0000
1.5000	0.1653	0.0567	0.0096	0.0000

Surface Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
1.5000	0.1653	0.0567	0.0000	2.0000	0.0000
1.5275	0.1653	0.0612	0.0000	2.0000	0.0000
1.5549	0.1653	0.0658	0.0000	2.0733	0.0000
1.5824	0.1653	0.0703	0.0000	2.1099	0.0000
1.6099	0.1653	0.0749	0.0000	2.1465	0.0000
1.6374	0.1653	0.0794	0.0000	2.1832	0.0000
1.6648	0.1653	0.0839	0.0000	2.2198	0.0000
1.6923	0.1653	0.0885	0.0000	2.2564	0.0000
1.7198	0.1653	0.0930	0.0000	2.2930	0.0000
1.7473	0.1653	0.0976	0.0000	2.3297	0.0000
1.7747	0.1653	0.1021	0.0000	2.3663	0.0000
1.8022	0.1653	0.1066	0.0000	2.4029	0.0000
1.8297	0.1653	0.1112	0.0000	2.4396	0.0000
1.8571	0.1653	0.1157	0.0000	2.4762	0.0000
1.8846	0.1653	0.1203	0.0000	2.5128	0.0000
1.9121	0.1653	0.1248	0.0000	2.5495	0.0000
1.9396	0.1653	0.1293	0.0000	2.5861	0.0000
1.9670	0.1653	0.1339	0.0000	2.6227	0.0000
1.9945	0.1653	0.1384	0.0000	2.6593	0.0000

2.0220	0.1653	0.1430	0.0173	2.6667	0.0000
2.0495	0.1653	0.1475	0.0580	2.6667	0.0000
2.0769	0.1653	0.1520	0.1109	2.6667	0.0000
2.1044	0.1653	0.1566	0.1701	2.6667	0.0000
2.1319	0.1653	0.1611	0.2299	2.6667	0.0000
2.1593	0.1653	0.1657	0.2845	2.6667	0.0000
2.1868	0.1653	0.1702	0.3293	2.6667	0.0000
2.2143	0.1653	0.1748	0.3619	2.6667	0.0000
2.2418	0.1653	0.1793	0.3840	2.6667	0.0000
2.2692	0.1653	0.1838	0.4086	2.6667	0.0000
2.2967	0.1653	0.1884	0.4289	2.6667	0.0000
2.3242	0.1653	0.1929	0.4483	2.6667	0.0000
2.3516	0.1653	0.1975	0.4669	2.6667	0.0000
2.3791	0.1653	0.2020	0.4848	2.6667	0.0000
2.4066	0.1653	0.2065	0.5021	2.6667	0.0000
2.4341	0.1653	0.2111	0.5188	2.6667	0.0000
2.4615	0.1653	0.2156	0.5349	2.6667	0.0000
2.4890	0.1653	0.2202	0.5506	2.6667	0.0000
2.5000	0.1653	0.2220	0.5659	2.6667	0.0000

Name : Surface Bioretention

Element Flows To:

Outlet 1	**Outlet 2**
Roof Bioretention	

Name : PLANTER AREA
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Pasture, Flat	**.165**
Pervious Total	**0.165**

Impervious Land Use	**acre**
Impervious Total	**0**
Basin Total	**0.165**

Element Flows To:

Surface	**Interflow**	**Groundwater**
Surface Bioretention	Surface Bioretention	

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.202
Total Impervious Area:0.108

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.173
Total Impervious Area:0.137

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.029285
5 year	0.041431
10 year	0.050243
25 year	0.062263
50 year	0.071869
100 year	0.082043

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.033681
5 year	0.04443
10 year	0.05198
25 year	0.062035
50 year	0.069909
100 year	0.078122

Minimum Requirement # 8: Wetland Protection

There are no known wetlands on-site or within the vicinity of the site. Wetland protection is not required.

Minimum Requirement # 9: Operation and Maintenance

BMP T5.13 Post-Construction Soil Quality and Depth

Maintenance

- Soil quality and depth should be established toward the end of construction and once established, should be protected from compaction, such as from large machinery use, and from erosion.
- Soil should be planted and mulched after installation.
- Plant debris or its equivalent should be left on the soil surface to replenish organic matter.

No. 5 – Catch Basins

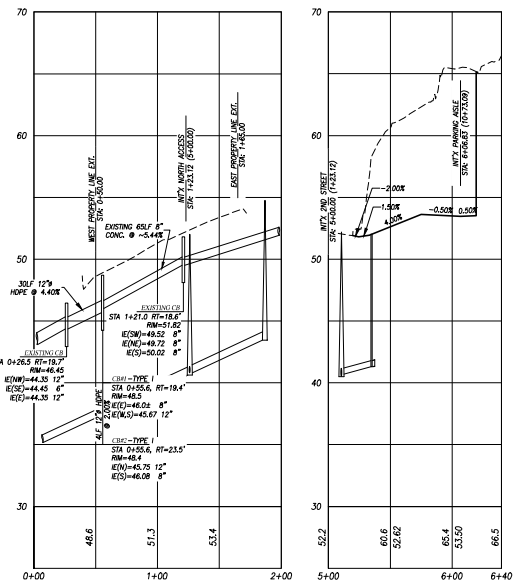
Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Sediment & Debris	Sediment, trash, and/or other debris material is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No sediment or debris is located immediately in front of catch basin or on grate opening.
		Sediment, trash, and/or other debris material (located in the catch basin) 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.	No sediment or debris is in the catch basin.
		Sediment, trash, and/or other debris material located in any inlet or outlet pipe is blocking more than 1/3 of its height.	Inlet and outlet pipes are free of sediment and debris.
		Dead animals or vegetation that impair catch basin function or that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation are present within 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 seeping into the catch basin).	Top slab is free of holes and cracks. No water and/or soil is seeping into the catch 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	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Catch basin is replaced or repaired to design standards.
		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.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	Settlement of misalignment of the catch basin causes a safety, function, or design problem.	Catch basin is replaced or repaired to design standards.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed.
Access Hole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is fully in place
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.

APPENDIX I

Drainage Plan

STORM DRAIN NOTES:

1. ALL PIPE SHALL BE PLACED ACCORDING DIVISION 7 OF THE WSDOT STANDARD SPECIFICATIONS.
2. BACKFILL SHALL BE PLACED EQUALLY ON BOTH SIDES OF THE PIPE OR PIPE-ARCH IN 6 AVERAGE DEPTH LOOSE LIFTS. MAXIMUM LIFT DEPTH SHALL NOT EXCEED 9'. EACH LIFT SHALL BE THOROUGHLY COMPACTED. COMPACTED LIFTS MUST EXTEND AT LEAST ONE PIPE DIAMETER ON EACH SIDE OF THE PIPE OR TO THE SIDE OF THE TRENCH. BACKFILL OVER THE PIPE SHALL BE PERFORMED IN ACCORDANCE WITH SECTIONS 7- 08.3(3) THE WSDOT STANDARD SPECIFICATIONS.
3. ALL GRATES LOCATED IN THE GUTTER FLOW LINE (INLET AND CATCH BASIN) SHALL BE DEPRESSED 0.1 FEET BELOW PAVEMENT LEVEL.
4. ALL CATCH BASINS ARE TO BE TYPE I UNLESS OTHERWISE APPROVED BY THE CITY OR DESIGNATED REPRESENTATIVE. THE USE AND INSTALLATION OF INLETS IS NOT ALLOWED.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ADJUSTING ALL MANHOLE, INLET AND CATCH BASIN FRAMES AND GRATES TO GRADE JUST PRIOR TO CURB INSTALLATION AND/OR PAVING.
6. ALL CATCH BASINS WITH A DEPTH OF 5 FEET OR GREATER TO THE FLOW LINE SHALL BE TYPE II CATCH BASINS.
7. VANED GRATES ARE REQUIRED ON ALL STORM STRUCTURES. ALL CATCH BASINS AND MANHOLES SHALL HAVE LOCKING LIDS. ROLLED GRATES ARE NOT APPROVED FOR USE.
8. POLYPROPYLENE SAFETY STEPS AND LADDER STEPS SHALL BE PROVIDED IN ALL MANHOLES AND SHALL BE POSITIONED CORRECTLY WITH THE BOLT AREAS ON THE RIM.
9. CATCH BASIN FRAMES AND GRATES SHALL BE OLYMPIC FOUNDRY MODEL SM60, SM52, OR SM44, LOCKING TYPE OR EQUIVALENT. MODEL SM52 SHALL BE REFERRED TO AS A "THROUGH CURB INLET ON THE PLANS.
10. DETENTION PONDS WITH SIDE SLOPES STEEPER THAN 3:1 OR WITH A MAXIMUM WATER DEPTH GREATER THAN 3 FEET SHALL REQUIRE A VINYL COATED CHAIN LINK PERIMETER FENCE. SIDE SLOPE AVERAGING SHALL NOT BE ALLOWED. ALL INLET AND OUTFALL PIPES SHALL HAVE A TRASH RACK INSTALLED AND A MORTARED RIPRAP HEADWALL.
11. PRIOR TO SIDEWALK CONSTRUCTION; LOT DRAINAGE SYSTEMS, STUB-OUTS AND ANY BEHIND SIDEWALK DRAINS MUST BE INSTALLED AS REQUIRED. PIPE SHALL BE PVC 3034, OR SDR-35. STUB-OUTS SHALL BE MARKED WITH A 2' X 4' WITH 3 FEET VISIBLE ABOVE GRADE AND MARKED "STORM". LOCATIONS OF THESE INSTALLATIONS SHALL BE SHOWN ON THE AS-BUILT CONSTRUCTION PLANS SUBMITTED TO THE CITY.
12. STORM WATER RETENTION/DETENTION FACILITIES, STORM DRAINAGE PIPE AND CATCH BASINS SHALL BE FLUSHED AND CLEANED BY THE DEVELOPER PRIOR TO:
    A. CITY OF MUKILTEO FINAL ACCEPTANCE OF THE PROJECT AND;
    B. UPON COMMENCEMENT AND COMPLETION OF THE 2 YEAR WARRANTY PERIOD FOR THE STORM DRAINAGE SYSTEM. AN INVOICE DETAILING THE FLUSHING AND CLEANING SHALL BE PROVIDED TO THE CITY.
13. ALL PIPES SHALL BE INSTALLED WITH RUBBER GASKETS AS PER MANUFACTURER'S RECOMMENDATIONS.
14. COVERAGE REQUIREMENTS FOR 12" DIAMETER PIPE:
    BACKFILL OVER PIPE LESS THAN 12' REQUIRES RCP CLASS IV. BACKFILL OVER PIPE LESS THAN 24' REQUIRES RCP MINIMUM. BACKFILL OVER PIPE GREATER THAN 24' REQUIRES 16 GAGE CMP MINIMUM.
15. CORRUGATED POLYETHYLENE PIPE (CPP):
    A. ALL PIPE SHALL BE SMOOTH INTERIOR. CPP SHALL BE DOUBLE-WALLED. ALL PIPE SHALL MEET AASHTO AND ASTM SPECIFICATIONS.
    B. UPON REQUEST BY THE CITY INSPECTOR, ALL PIPE RUNS SHALL PASS THE LOW PRESSURE AIR TEST REQUIREMENTS OF SECTION 7-04.3(1) E & F OF THE WSDOT STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION. PIPE RUNS SHALL BE TESTED WITH PIPE LOADED AND COMPACTED TO FINISH GRADE.
    C. UPON REQUEST BY THE CITY INSPECTOR, PIPE SHALL BE SUBJECT TO MANDREL TESTING (MANDREL SIZE = 90% OF NOMINAL PIPE DIAMETER).
    D. PIPE SHALL BE STORED ON SITE IN SHIPPING BUNKS ON A FLAT LEVEL SURFACE. THIS REQUIREMENT WILL BE STRICTLY ENFORCED; FAILURE TO COMPLY MAY RESULT IN REJECTION OF THE PIPE AND/OR FUTURE RESTRICTION ON USE OF MATERIAL.
    E. MINIMUM DEPTH OF COVER SHALL BE 2 FEET.
    F. COUPLINGS SHALL BE INTEGRAL BELL AND SPIGOT OR DOUBLE BELL SEPARATE COUPLINGS. SPLIT COUPLINGS WILL NOT BE ALLOWED.
    G. BACKFILL SHALL COMPLY WITH SECTION 7-08.3(3) OF THE WSDOT STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION WITH THE EXCEPTION THAT THE SECOND PARAGRAPH OF SECTION 7-08.3(3) IS DELETED AND REPLACED WITH: THE MATERIAL USED FOR BACKFILLING AROUND AND TO A POINT 1 FOOT ABOVE THE TOP OF THE PIPE SHALL BE CLEAN EARTH OR SAND, FREE FROM CLAY, ANY GRAVEL OR STONES INCLUDED IN THE BACKFILL SHALL PASS THROUGH A 1 INCH SIEVE.
16. ALL NON-PERFORATED METAL PIPE SHALL HAVE NEOPRENE GASKETS AT THE JOINTS. O-RING GASKETS MAY BE USED FOR TYPE-F COUPLING BAND.
17. CULVERT ENDS SHALL BE BEVELED TO MATCH SIDE SLOPES. FIELD CUTTING OF CULVERT ENDS IS PERMITTED WHEN APPROVED BY THE CITY.
18. ALL FIELD CUT CULVERT PIPE SHALL BE TREATED AS REQUIRED IN THE STANDARD SPECIFICATIONS OR GENERAL SPECIAL PROVISIONS.

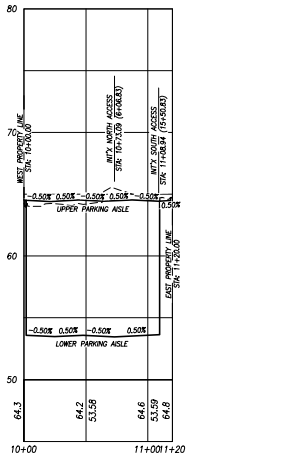


2ND STREET PROFILE:

SCALE:
VERT: 1"=5'
HORZ:1"=50'

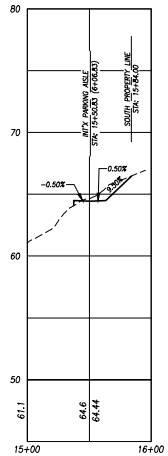
NORTH ACCESS PROFILE:

SCALE:
VERT: 1"=5'
HORZ:1"=50'



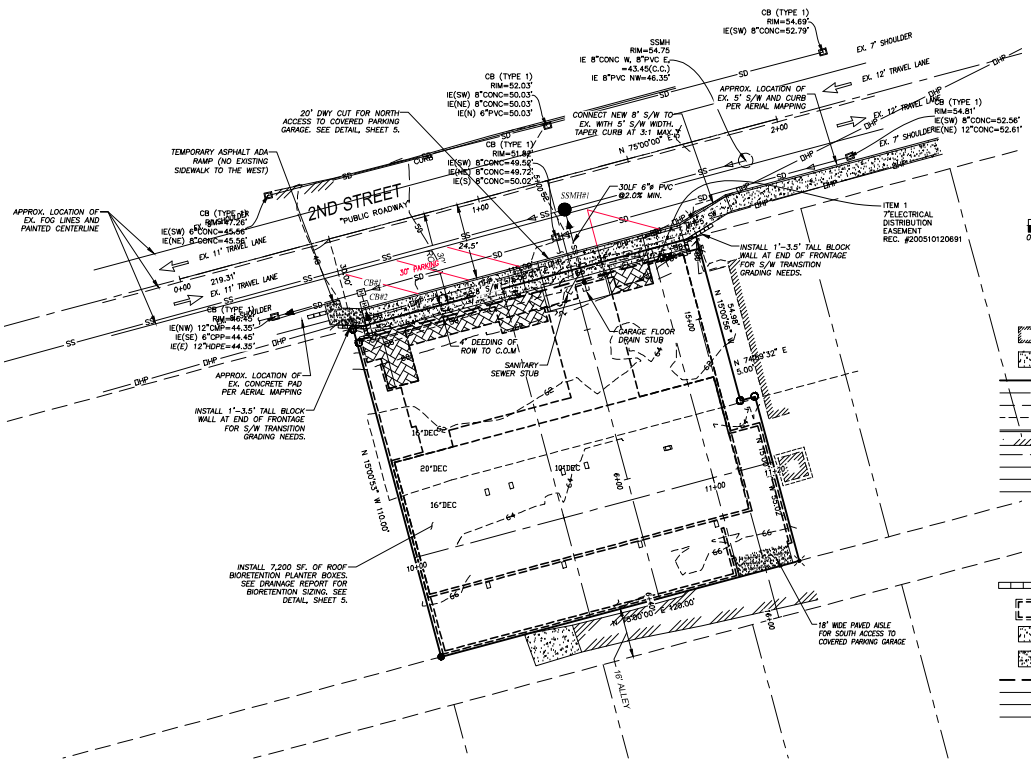
PARKING AISLE PROFILE:

SCALE:
VERT: 1"=5'
HORZ:1"=50'



SOUTH ACCESS PROFILE:

SCALE:
VERT: 1"=5'
HORZ:1"=50'



LEGEND

- EXISTING STORM DRAIN CATCH BASIN (CB)
- EXISTING SANITARY SEWER MANHOLE (SSMH)
- EXISTING WATER METER
- EXISTING BUILDING
- EXISTING CONCRETE
- EXISTING PROPERTY BOUNDARY
- EXISTING CENTERLINE
- XXX EXISTING CONTOUR (MAJOR)
- XXX EXISTING CONTOUR (MINOR)
- EXISTING CURB
- EXISTING EDGE OF ASPHALT
- EXISTING LOT LINE
- SD EXISTING STORM DRAIN LINE
- SS EXISTING SANITARY SEWER LINE
- W EXISTING WATER LINE
- CB#X PROPOSED STORM DRAIN CATCH BASIN (CB)
- PROPOSED STORM DRAIN STUB
- SSMH#X PROPOSED SANITARY SEWER MANHOLE (SSMH)
- SSCO PROPOSED SS CLEAN OUT (SSCO)
- PROPOSED WATER METER
- PROPOSED ECOLOGY BLOCK WALL
- PROPOSED BUILDING W/ ROOF OVERHANG
- PROPOSED CONCRETE
- PROPOSED ROADWAY
- PROPERTY BOUNDARY DEDICATION
- SD PROPOSED STORM DRAIN LINE
- SS PROPOSED SANITARY SEWER LINE
- W PROPOSED WATER LINE

HARDSCAPE AREA CALCULATION

TOTAL PROPERTY AREA: 12,465 (0.286 AC)

ON-SITE HARDSCAPE

MIXED USE BUILDING ROOF	11,500 SF.
*ACCESS AND PLAZA	600 SF.
TOTAL	12,100 SF.

OFF-SITE HARDSCAPE

NEW 8' SIDEWALK	1,000 SF.

TOTAL NEW/REPLACED HARDSCAPE: 13,100 SF.

CALL 811 TWO (2) BUSINESS DAYS BEFORE YOU DIG

TAX ACCOUNT NO.(S): 00465900300100

SITE ADDRESS: 823 2ND STREET MUKILTEO, WA 98275

#

CITY OF MUKILTEO
PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

BY: _____
NAME

R/W PERMIT NUMBER: _____

02-05-21

Western Engineers & Surveyors (425) 356-2700
SURVEYORS • PLANNERS • ENGINEERS
LAND USE CONSULTANTS
CIVIL ENGINEERS • LAND SURVEYORS
*** 9740 EVERGREEN WAY * EVERETT * WA * 98204 ***

DRAINAGE AND ACCESS PLAN FOR: 14-UNIT MUKILTEO PLAZA

NW 1/4 & SW 1/4, NE 1/4, SEC.04, T.28N, R.04E, W.M.
MUKILTEO, WASHINGTON

DRAWN BY	DATE	REV. BY	DATE	PROJECT MANAGER	SCALE
TAS	11/24/20			T. SARKELA	1"=20'
DRAWING FILE NAME		CHECKED BY	F.B. NO.	JOB NUMBER	SHEET NO.
20188DABASE.DWG		TAS	–	20-1880-A	4 OF 6

APPENDIX II

SOIL INFORMATION

Site Soil Logs

A field exploration was performed by Nelson Geotechnical Associates, Inc. and soil borings were taken on-site. Refer to the Geotechnical Engineering Report provided by Nelson Geotechnical Associates, Inc dated December 22, 2020 for geotechnical information.

USDA Soil Map

Map Unit Legend

Snohomish County Area, Washington (WA661)

Snohomish County Area, Washington (WA661)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
27	Kitsap silt loam, 0 to 8 percent slopes	0.3	100.0%
Totals for Area of Interest		0.3	100.0%

USDA Soil Map Legend

27—Kitsap silt loam, 0 to 8 percent slopes

Map Unit Setting

- *National map unit symbol:* 2hyh
- *Elevation:* 0 to 490 feet
- *Mean annual precipitation:* 37 inches
- *Mean annual air temperature:* 50 degrees F
- *Frost-free period:* 160 to 200 days
- *Farmland classification:* All areas are prime farmland

Map Unit Composition

- *Kitsap and similar soils:* 85 percent
- *Minor components:* 5 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Kitsap

Setting

- *Landform:* Terraces
- *Parent material:* Lacustrine deposits

Typical profile

- *H1 - 0 to 6 inches:* ashy silt loam
- *H2 - 6 to 33 inches:* silt loam
- *H3 - 33 to 60 inches:* stratified silt to silty clay loam

Properties and qualities

- *Slope:* 0 to 8 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
- *Depth to water table:* About 18 to 30 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water capacity:* High (about 11.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 3w
- *Hydrologic Soil Group:* C
- *Forage suitability group:* Soils with Few Limitations (G002XF503WA)
- *Other vegetative classification:* Soils with Few Limitations (G002XF503WA)
- *Hydric soil rating:* No

Minor Components

Bellingham, undrained

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

APPENDIX III

SOIL AMENDMENT

Building Soil

Guidelines and Resources For Implementing Soil Quality and Depth BMP T5.13

in WDOE Stormwater Management Manual for Western Washington

2016 Edition

Summary

Soil quality is directly related to stormwater detention capacity, and so to the health of streams and aquatic resources in the Pacific Northwest. Soil quality also determines landscape success: plant survival, growth, disease resistance, and maintenance needs.

This publication provides guidance for landscape designers, builders, planners, and inspectors to implement soil quality "Best Management Practices" (or BMPs), in order to protect and restore soil functions. The guide describes techniques for construction site soil handling, reducing soil compaction, and amending site soils with compost to meet BMP T5.13 "Post Construction Soil Quality and Depth" in the WA Dept. of Ecology's *Stormwater Management Manual for Western Washington*. This guide also includes field inspection techniques, WA suppliers of compost and soil testing laboratories, and specification language in APWA and CSI formats.

Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington

1st edition 2003
2nd edition 2005
2nd edition, 2007 printing (web links updated – no other changes)
2nd edition, 2009 printing (web links, and compost suppliers and laboratories lists updated – no other changes)
2nd edition, 2010 printing (web links updated – no other changes)
3rd edition, 2012 (Ecology's 2012 revised BMP text, compost suppliers, and web links updated)
4th edition, 2016 (Ecology's 2014 revised BMP text, and web links updated)

This publication is provided to help professionals in the land development and landscape industries understand and implement the new Washington State Department of Ecology "Best Management Practice" (BMP) for soil quality, designed to improve stormwater retention and water quality.

The specifications, procedures and forms contained in this publication were developed by a team of landscape professionals, municipal inspectors, soil scientists and public agency staff. They are provided as examples of the tools needed to implement the State's soil quality BMP.

This manual, specifications, and resources are available online at

www.SoilsforSalmon.org

and along with factsheets for builders at

www.BuildingSoil.org

CONTENTS

CREDITS

DEVELOPMENT AND FIRST EDITION FUNDING: Snohomish County Public Works Department

PROJECT MANAGER: Sego Jackson, Snohomish County Public Works Department

MANUAL LEAD AUTHOR: Howard Stenn, Stenn Design, Vashon, WA

TECHNICAL ASSISTANCE – AMENDMENT CALCULATIONS: Dr. Craig Cogger, Washington State University-Puyallup

TECHNICAL ASSISTANCE – SPECIFICATIONS: Jeff Girven, The Berger Partnership, Seattle, WA

TECHNICAL ASSISTANCE & EDITING – SECOND EDITION: David McDonald, Seattle Public Utilities

FIRST EDITION GRAPHIC DESIGN: Partners in Design, Seattle, WA

ILLUSTRATIONS/PHOTOS: Courtesy of King County Department of Natural Resources and Parks, and Seattle Public Utilities

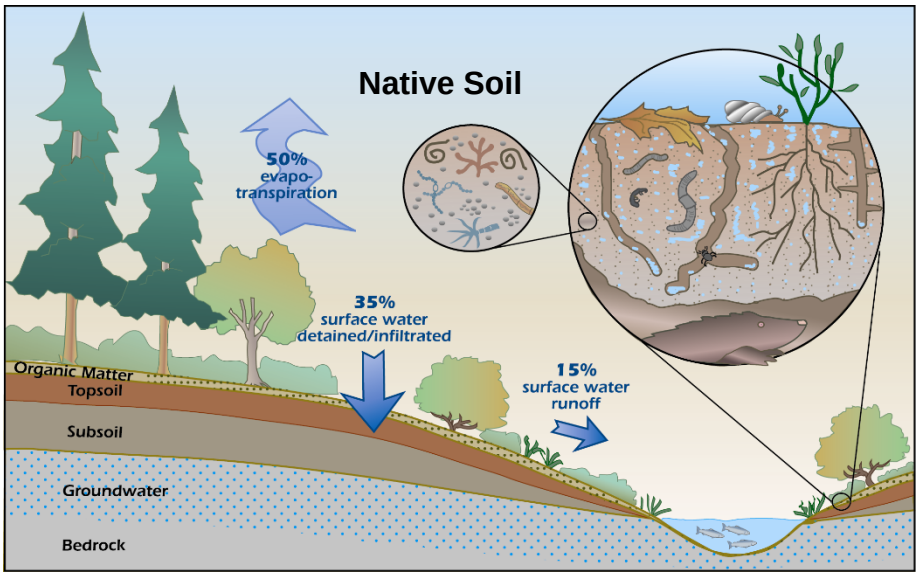
SECOND EDITION GRAPHIC DESIGN AND FUNDING: Seattle Public Utilities

THE ROLE OF SOIL QUALITY IN STORMWATER MANAGEMENT

The Benefits of Healthy Soil

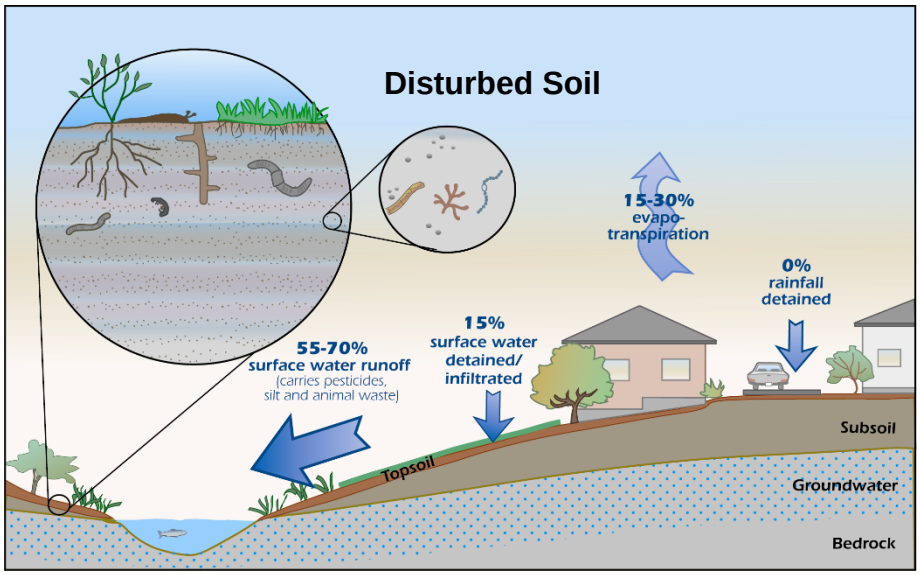
Healthy soil provides important stormwater management functions including efficient water infiltration and storage, adsorption of excess nutrients, filtration of sediments, biological decomposition of pollutants, and moderation of peak stream flows and temperatures. In addition, healthy soils support vigorous plant growth that intercepts rainfall, returning much of it to the sky through evaporation and transpiration.

Rapid urbanization of forest and farmland in the Puget Sound basin has severely degraded soil capacity to absorb, filter and store rainwater; and support vigorous plant growth. Common development practices include removal of topsoil during grading and clearing, compaction of remaining soil, and planting into unimproved soil or shallow depths of poor quality imported topsoil. These conditions typically produce unhealthy plants that require excessive fertilizers and pesticides, further contaminating runoff.



Stormwater management functions of healthy soils:

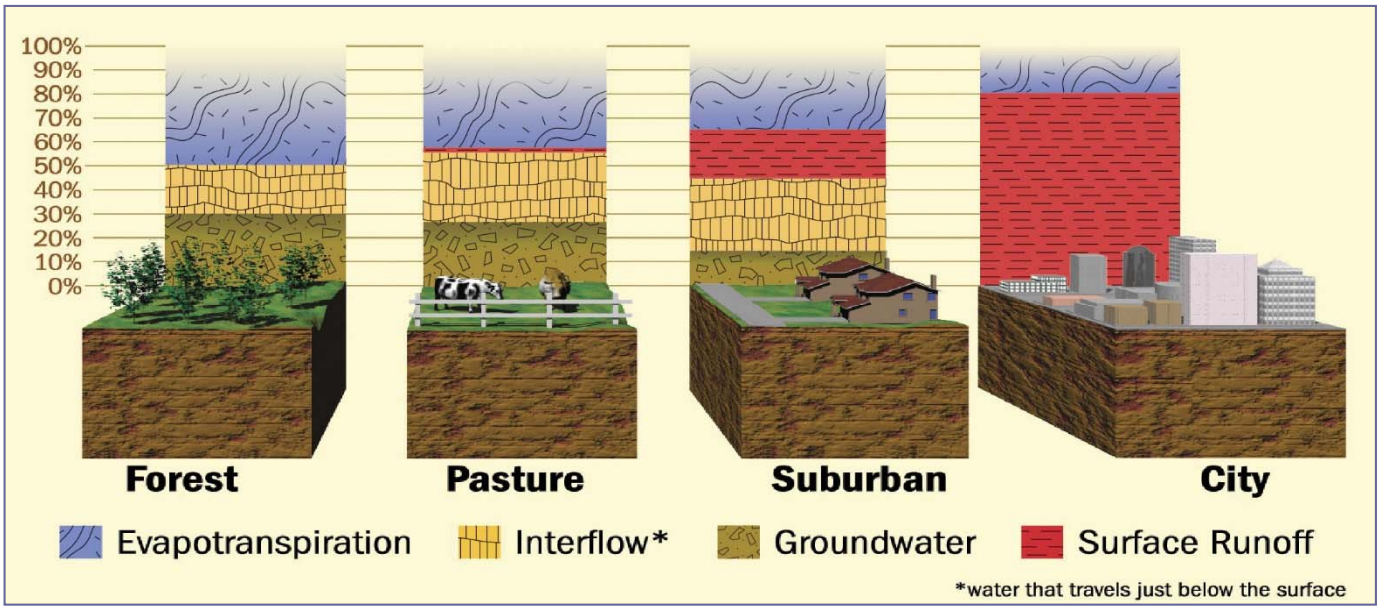
- Provides high rates of water infiltration and retention
- Minimizes surface water runoff and erosion
- Traps sediments, heavy metals and excess nutrients; and biodegrades chemical contaminants
- Encourages vigorous protective vegetative cover
- Supports beneficial soil life that fight pests and disease, and supply plant nutrients — reducing need for fertilizers and pesticides that may contaminate waterways.



During development, soil functions are often impaired by topsoil loss and compaction:

- Decreases surface water infiltration and storage
- Increases surface water runoff, including contamination from roadways and yards.
- Increases erosion and flooding.
- Reduces beneficial soil life
- Impairs plant growth, pest and disease resistance
- Increases landscape needs for irrigation, fertilizers, and pesticides, which further increases surface water pollution.

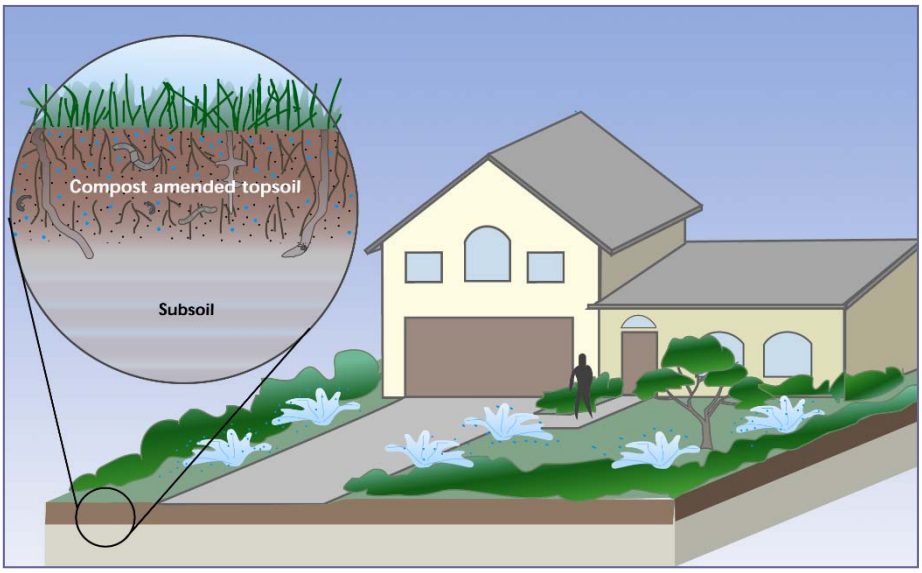
Where the Rain Goes – The Regional Impact of Urbanization on Stormwater Flows



These changes, plus the listing of some Puget Sound salmon runs as "threatened" under the Endangered Species Act, has stimulated examination of alternative practices to preserve and restore the soil's stormwater and water quality functions.

Low Impact Development (LID) practices that improve on-site management of storm water runoff include:

- Minimizing impervious surfaces,
- Preserving native soil and vegetation, and
- Establishing minimum soil quality and depth standards in landscaped areas.



Amending soils with compost or other organic materials can restore soil functions:

- Restores soil water infiltration and storage capacities
- Decreases surface water runoff and erosion
- Traps sediments, heavy metals and excess nutrients; and biodegrades chemical contaminants
- Rebuilds the beneficial soil life that fights pests and disease, and supplies plants with nutrients and water
- Improves plant health, with reduced need for additional water, fertilizers and pesticides
- Aids deep plant root growth and vigorous vegetative cover.

Illustrations for this section were created by the King County Department of Natural Resources and Parks

BMP T5.13 "POST CONSTRUCTION SOIL QUALITY AND DEPTH"
IN THE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON

Excerpted from the Washington State Department of Ecology's Stormwater Management Manual for Western Washington, Vol. V: Runoff Treatment BMPs, Chapter 5, pages 5-8 to 5-11 (or pages 105 to 108 in the online PDF file) as revised December 2014. "BMP" means "Best Management Practice", a term used for techniques that are recommended or (in this case) required. The Manual can be found online at www.ecy.wa.gov/programs/wq/stormwater/manual.html

Purpose and Definition

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. These functions are largely lost when development strips away native soil and vegetation and replaces it with minimal topsoil and sod. Not only are these important stormwater functions lost, but such landscapes themselves become pollution generating pervious surfaces due to increased use of pesticides, fertilizers and other landscaping and household/industrial chemicals, the concentration of pet wastes, and pollutants that accompany roadside litter.

Establishing soil quality and depth regains greater stormwater functions in the post development landscape, provides increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals, thus reducing pollution through prevention.

Applications and Limitations

Establishing a minimum soil quality and depth is not the same as preservation of naturally occurring soil and vegetation. However, establishing a minimum soil quality and depth will provide improved on-site management of stormwater flow and water quality.

Soil organic matter can be attained through numerous materials such as compost, composted woody material, biosolids, and forest product residuals. It is important that the materials used to meet the soil quality and depth BMP be appropriate and beneficial to the plant cover to be established. Likewise, it is important that imported topsoils improve soil conditions and do not have an excessive percent of clay fines.

This BMP can be considered infeasible on till soil slopes greater than 33 percent.

Design Guidelines

Soil retention. Retain, in an undisturbed state, the duff layer and native topsoil to the maximum extent practicable. In any areas requiring grading remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas, to be reapplied to other portions of the site where feasible.

Soil quality. All areas subject to clearing and grading that have not been covered by impervious surface, incorporated into a drainage facility or engineered as structural fill or slope shall, at project completion, demonstrate the following:

1) A topsoil layer with a minimum organic matter content of 10% dry weight in planting beds, and 5% organic matter content in turf areas, and a pH from 6.0 to 8.0 or matching the pH of the undisturbed soil. The topsoil layer shall have a minimum depth of eight inches except where tree roots limit the depth of incorporation of amendments needed to meet the criteria. Subsoils below the topsoil layer should be scarified at least 4 inches with some incorporation of the upper material to avoid stratified layers, where feasible.
2) Mulch planting beds with 2 inches of organic material.
3) Use compost and other materials that meet these organic content requirements:
    a) The organic content for "pre-approved" amendment rates can be met only using compost meeting the compost specification for Bioretention (BMP T7.30), with the exception that the compost may have up to 35% biosolids or manure.
    The compost must also have an organic matter content of 40% to 65%, and a carbon to nitrogen ratio below 25:1.
    The carbon to nitrogen ratio may be as high as 35:1 for plantings composed entirely of plants native to the Puget Sound Lowlands region.
    b) Calculated amendment rates may be met through use of composted material meeting (a.) above; or other organic materials amended to meet the carbon to nitrogen ratio requirements, and not exceeding the contaminant limits identified in Table 220-B, Testing Parameters, in WAC 173-350-220.

The resulting soil should be conducive to the type of vegetation to be established.

Editor's note: "other organic materials" includes other composts not meeting the stringent specification in BMP T5.30, which is designed for bioretention swales. Any mature, stable compost is appropriate for general soil amendment.

Implementation Options. The soil quality design guidelines listed above can be met by using one of the methods listed below:

1) Leave undisturbed native vegetation and soil, and protect from compaction during construction.
2) Amend existing site topsoil or subsoil either at default "pre-approved" rates, or at custom calculated rates based on tests of the soil and amendment.
3) Stockpile existing topsoil during grading, and replace it prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a default "pre-approved" rate or at a custom calculated rate.
4) Import topsoil mix of sufficient organic content and depth to meet the requirements.

More than one method may be used on different portions of the same site. Soil that already meets the depth and organic matter quality standards, and is not compacted, does not need to be amended.

Planning/Permitting/Inspection/Verification Guidelines & Procedures

Local governments are encouraged to adopt guidelines and procedures similar to those recommended in *Guidelines and Resources For Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington*. This document is available at: http://www.soilsforsalmon.org/pdf/Soil_BMP_Manual.pdf

Maintenance

- Establish soil quality and depth toward the end of construction and once established, protect from compaction, such as from large machinery use, and from erosion.
- Plant vegetation and mulch the amended soil area after installation.
- Leave plant debris or its equivalent on the soil surface to replenish organic matter.
- Reduce and adjust, where possible, the use of irrigation, fertilizers, herbicides and pesticides, rather than continuing to implement formerly established practices.

Runoff Model Representation

Areas meeting the design guidelines may be entered into approved runoff models as "Pasture" rather than "Lawn."

Flow reduction credits can be taken in runoff modeling when BMP T5.13 is used as part of a dispersion design under the conditions described in:

BMP T5.10B Downspout Dispersion

BMP T5.11 Concentrated Flow Dispersion

BMP T5.12 Sheet Flow Dispersion

BMP T5.18 Reverse Slope Sidewalks

BMP T5.30 Full Dispersion (for public road projects)

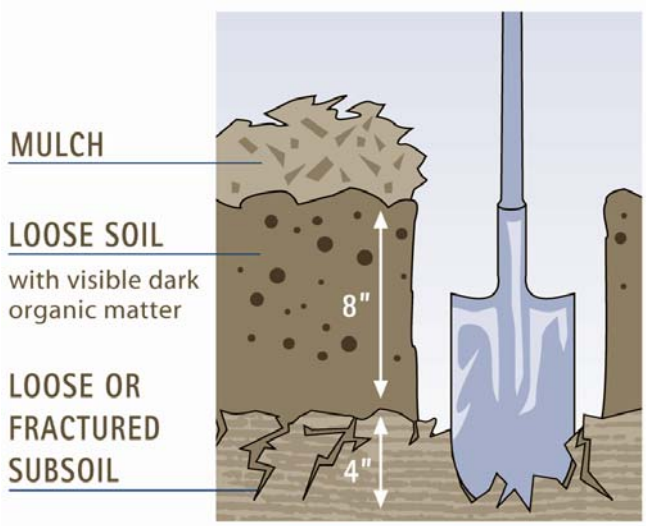


Figure 5.3.3 – Planting bed Cross-Section
(Reprinted from *Guidelines and Resources For Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington*, 2010, Washington Organic Recycling Council)

Related BMP's in the same volume (Vol. V, Ch. 5) of the Stormwater Management Manual for Western Washington
available online at
www.ecy.wa.gov/programs/wq/stormwater/manual.html

- **BMP T5.40 Preserving Natural Vegetation**
- **BMP T5.41 Better Site Design**

See also Chapters 7 and 9 in Volume V on Infiltration and Biofiltration/Bioretention BMPs
and see Volume III, Appendix C "Low Impact Development Flow Modeling Guidance"

SUMMARY OF STEPS FOR IMPLEMENTING BMP T5.13

PROPOSED SPECIFICATION FOR PERMITTING AND INSPECTION
TO IMPLEMENT BMP T5.13 "POST-CONSTRUCTION SOIL QUALITY AND DEPTH"

The following approach to implementation of BMP T5.13 *(BMP = Best Management Practice)* in the Department of Ecology's Stormwater Manual has been developed with expert input and review. It is proposed as a practical methodology to implement the State's BMP guidelines.

Proposed Soil Specifications

These specifications are designed to achieve an 8 inch depth of soil with 10% "Soil Organic Matter" (SOM) content in planting beds, and 5% organic content in turf areas.

Detailed amendment rates and procedures are described in Section 4 "Amendment Options," and in the specifications included in Section 7 "Resources".

Developers may select from the following four options to meet the requirements:

Option 1.
Leave undisturbed native vegetation and soil, and protect from compaction during construction.

Option 2.
Amend existing site topsoil or subsoil either at "pre-approved" default rates, or at custom calculated rates based on tests of the soil and amendment.

Option 3.
Stockpile existing topsoil during grading, and replace it prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a "pre-approved" default rate or at a custom calculated rate.

Option 4.
Import topsoil mix of sufficient organic content and depth to meet the requirements.

Methods and Amendment Quality
More than one treatment may be used on different areas of the same site. Soil that already meets the depth and organic matter quality standards, and is not compacted, does not need to be amended.

- Compacted subsoils must be scarified at least 4 inches below the 8 inch deep amended layer (for a finished uncompacted depth of 12 inches).
- Planting beds must be mulched with 2 inches of organic material.
- Compost and other materials used to meet organic content must meet these standards:
  - The organic content for "pre-approved" amendment rates can be met only using compost that meets the definition for "composted materials" in WAC 173-350, section 220, available online at www.ecy.wa.gov/programs/swfa/organics/soil.html
    - The compost must also have an organic matter content of 35% to 65%, and a carbon to nitrogen ratio below 25:1.
    - The carbon to nitrogen ratio may be as high as 35:1 for plantings composed entirely of plants native to the Puget Sound Lowlands region.
  - Calculated amendment rates may be met through use of composted materials as defined above; or other organic materials amended to meet the carbon to nitrogen ratio requirements, and meeting the contaminant standards for "composted materials" in WAC 173-350-section 220.

See Section 4 "Amendment Options," and Section 7 "Resources" for more on calculated amendment rates.

Note: In Ecology's 2014 update (see page 4) they changed this to require a more tightly specified compost for "pre-approved" amendment rates.

Planning and Permitting

A site specific Soil Management Plan (SMP – see Section Five "Guide to Developing a Soil Management Plan") must be approved as part of the clearing and grading or construction permit application.

The Soil Management Plan (SMP) includes:

- A scale-drawing (11" X 17" or larger) identifying area where native soil and vegetation will be retained undisturbed, and which soil treatments will applied in landscape areas.
- A completed SMP form identifying treatments and products to be used to meet the soil depth and organic content requirements for each area.
- Computations of compost or topsoil volumes to be imported (and/or site soil to be stockpiled) to meet "pre-approved" amendment rates; or calculations by a qualified professional to meet organic content requirements if using custom calculated rates. Qualified professionals include certified Agronomists, Soil Scientists or Crop Advisors; and licenced Landscape Architects, Civil Engineers or Geologists.
- Copies of laboratory analyses for compost and topsoil products to be used, documenting organic matter contents and carbon to nitrogen ratios.

Inspection and Verification Procedures

(See also Section Six "Field Guide to Verifying Soil Quality and Depth in New Landscapes.")

Inspection and verification should be performed by appropriate jurisdiction inspectors.

Some verification may be made by supervising Landscape Architects or Civil Engineers, who submit signed certification that the approved SMP had been implemented.

The following is an outline of a preferred inspection schedule and tasks:
Depending on local resources and procedures, the inspection tasks may be consolidated into fewer visits.

1) Pre-Grading Inspection

- Verify delineation and fencing off of native soils and vegetation to be left undisturbed, per the SMP.
- Review the SMP with the general contractor to ensure that topsoil stockpiling and other specified measures are incorporated into the work plan.

2) Grading Progress Inspection

- Verify that proper erosion control methods are being implemented.
- Verify that excavation and stockpiling of native soils follows the SMP.
- Verify that subgrades are consistent with the SMP.

3) Post-Construction Inspection

Preferably prior to planting, so that omissions can easily be corrected:

- Verify that compost, mulch, topsoil and amendment delivery tickets match volumes, types and sources approved in the SMP. If materials other than those approved in the SMP were delivered, submissions by the supplier should verify that they are equivalent to approved products.
- Check soil for compaction, scarification and amendment incorporation by digging at least one 12 inch deep test hole per acre for turf and at least one per acre for planting beds. Test holes must be excavated using only a garden spade driven solely by inspector's weight.
- Test 10 locations per landscaped acre (10 locations minimum) for compaction, using a simple "rod penetrometer" (a 4 foot long 3/8th inch diameter stainless steel rod, with and a 30 degree bevel cut into the side at that goes in 1/8 inch at the tip). Rod must penetrate to 12" depth driven solely by inspector's weight (see illustration in Section 6).
- Verify placement of two inches of organic mulch material on all planting beds.

Secondary Verification For Failing Sites

If inspector believes the installation does not meet the approved permit conditions, additional testing may be ordered to determine whether remediation steps are required prior to final occupancy and payment. An independent consultant (Certified Soil Scientist, Crop Advisor or Agronomist; or Licensed Landscape Architect, Civil Engineer or Geologist) should conduct the following additional sampling and analysis:

- Organic matter content should be verified by an independent soil testing service, using the Loss On Ignition method.
- If necessary, the percentage of fine particles (less than #200 mesh) should be confirmed by a certified Soil Laboratory using a wet sieve test.
- At present, an analytical method for verifying scarification has not been identified. Verification may be a matter of professional opinion.

AMENDMENT OPTIONS

Select the soil preparation options that best suit each area of the project site.
Either choose a pre-approved default amendment rate, or have a qualified professional calculate a custom rate based on soil and amendment tests described in Section 5, using the calculation method described in Section 7 “Resources”).

OPTION 1: Leave native vegetation and soil undisturbed, and protect from compaction during construction.

Identify areas of the site that will not be stripped, logged, graded or driven on, and fence off those areas to prevent impacts during construction. If neither soils nor vegetation are disturbed, these areas do not require amendment.

OPTION 2: Amend existing site topsoil or subsoil

either at default “pre-approved” rates, or at custom calculated rates based on specifier's tests of the soil and amendment.

Scarification. Scarify or till subgrade to 8 inches depth (or to depth needed to achieve a total depth of 12 inches of uncompacted soil after calculated amount of amendment is added). Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained. Amend soil to meet required organic content.

A. Planting Beds

1. PRE-APPROVED RATE: Place 3 inches of composted material and rototill into 5 inches of soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
2. CALCULATED RATE: Place calculated amount of composted material or approved organic material and rototill into depth of soil needed to achieve 8 inches of settled soil at 10% organic content.

Rake beds to smooth and remove surface rocks larger than 2 inches diameter.

Mulch planting beds with 2 inches of organic mulch.

B. Turf Areas

1. PRE-APPROVED RATE: Place 1.75 inches of composted material and rototill into 6.25 inches of soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
2. CALCULATED RATE: Place calculated amount of composted material or approved organic material and rototill into depth of soil needed to achieve 8 inches of settled soil at 5% organic content.

Water or roll to compact to 85% of maximum dry density.

Rake to level, and remove surface woody debris and rocks larger than 1 inch diameter.

OPTION 3: Stockpile existing topsoil during grading. Replace it before planting.

Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a pre-approved default rate or at a custom calculated rate.

Scarification. If placed topsoil plus compost or other organic material will amount to less than 12 inches:
Scarify or till subgrade to depth needed to achieve 12 inches of loosened soil after topsoil and amendment are placed. Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

Stockpile and cover soil with weed barrier material that sheds moisture yet allows air transmission, in approved location, prior to grading.

Replace stockpiled topsoil prior to planting. Amend if needed to meet required organic content.

A. Planting Beds

1. PRE-APPROVED RATE: Place 3 inches of composted material and rototill into 5 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
2. CALCULATED RATE: Place calculated amount of composted material or approved organic material and rototill into depth of replaced soil needed to achieve 8 inches of settled soil at 10% organic content.

Rake beds to smooth and remove surface rocks larger than 2 inches diameter.

Mulch planting beds with 2 inches of organic mulch or stockpiled duff.

B. Turf Areas

1. PRE-APPROVED RATE: Place 1.75 inches of composted material and rototill into 6.25 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
2. CALCULATED RATE: Place calculated amount of composted material or approved organic material and rototill into depth of replaced soil needed to achieve 8 inches of settled soil at 5% organic content.

Water or roll to compact soil to 85% of maximum dry density.

Rake to level, and remove surface rocks larger than 1 inch diameter.

OPTION 4: Import topsoil mix of sufficient organic content and depth to meet the requirements.

Scarification. Scarify or till subgrade in two directions to 6 inches depth.
Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

A. Planting Beds

Use imported topsoil mix containing 10% organic matter (typically around 40% compost). Soil portion must be sand or sandy loam as defined by the USDA.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place second lift of 3 inches topsoil mix on surface.

Rake beds to smooth, and remove surface rocks over 2 inches diameter.

Mulch planting beds with 2 inches of organic mulch.

B. Turf Areas

Use imported topsoil mix containing 5% organic matter (typically around 25% compost). Soil portion must be sand or sandy loam as defined by the USDA.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place second lift of 3 inches topsoil mix on surface.

Water or roll to compact soil to 85% of maximum.

Rake to level, and remove surface rocks larger than 1 inch diameter.

GUIDE TO DEVELOPING A SOIL MANAGEMENT PLAN

This section outlines steps for professional specifiers to prepare a Soil Management Plan (SMP) to meet the provisions of BMP T5.13 in the Department of Ecology's Stormwater Manual for Western Washington. The main steps to creating the SMP are:

Step 1: Review Site Landscape Plans and Grading Plans.

Examine all areas that will not be covered by structures, impervious surfaces, or stormwater detention / infiltration structures, to assess how grading will impact soil conditions and determine areas where different soil treatments may be applied.

Those allowed soil treatment options are:

Option 1: Areas where native soil and/or vegetation will be retained in place;
Option 2: Areas where topsoil or subsoil will be amended in place;
Option 3: Areas where topsoil will be stripped and stockpiled prior to grading for reapplication, and;
Option 4: Areas where imported topsoil will be applied.

Step 2: Visit Site to Determine Soil Conditions

Working with plans, check the soil in each area to identify information outlined in the chart below.
Identify compaction of subgrade in each area by digging down to a level that will be 12" below finished grade.
Use a shovel or "rod penetrometer" driven solely by the your weight, as described in Section 3, and illustrated in Section 6 "Field Guide to Verifying Soil Quality and Depth."

Areas	Assess Conditions	Include Information on SMP
Native vegetation / undisturbed soil to be preserved	✓ Established native plants. ✓ Undisturbed topsoil and duff layer.	✓ Identify those areas to be left undisturbed and fenced during construction.
Topsoil not requiring grading, but cleared of native vegetation	✓ Depth of compacted layers less than 12 inches deep. ✓ Presence of organic matter that may make amendment unnecessary, or allow calculation of reduced amendment rate. ✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.	✓ Will scarification be needed? What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth? ✓ Will area be amended with compost or topsoil at "pre-approved" rate, or custom calculated rate? ✓ Can areas be protected from compaction during construction?
Areas to be cut during grading	✓ Quantity of topsoil that can pbe stockpiled and reapplied. ✓ Depth of any compacted layer less than 12 inches below ultimate finished grade. ✓ Presence of organic matter in subgrade or topsoil that may make amendment unnecessary, or allow calculation of reduced amendment rate. ✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.	✓ Will scarification be needed? What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth? ✓ Will topsoil be stockpiled during grading and reapplied? Will it require supplemental topsoil or compost to achieve 8 inches depth at specified organic content? ✓ Will area be amended with compost or topsoil at "pre-approved" rate, or at custom calculated rate?
Areas to be filled during grading	✓ Estimate what subgrade conditions will be when fill is in place. ✓ Depth of any compacted layer less than 12 inches below ultimate finished grade. ✓ Presence of organic matter in fill soil that may make amendment unnecessary, or allow calculation of reduced amendment rate. ✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.	✓ What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth? ✓ Will area be amended with compost or topsoil at "pre-approved" rate, or custom calculated rate?

Step 3: Select Amendment Options.

The most convenient and economic method for achieving the Soil Quality and Depth guidelines depends on: site soil conditions, grading, and resulting subgrade compaction; the practicality of stockpiling topsoil during grading; and site access issues.

"Pre-Approved" or custom calculated rates?
Use of "Pre-Approved" amendment rates may simplify planning, however custom calculated rates can save substantial effort and expense—easily repaying the expense of testing and calculations. (See testing required for custom rates at right and on next page, and calculation method in Section 7 "Resources".)

Often pasture or woodland soils have adequate organic matter if existing organic layers are preserved. Also, compost products will frequently provide the desired soil organic matter content at lower applications than the Pre-Approved rates (which are based on "average" conditions).

Identifying Options on the Site Plan and SMP form

- Identify the areas where each amendment option will be applied by outlining each area on the site plan with a dark, thick-line pen.
- Assign each area an identifying number or letter (A, B, C…) on the plan, and on the Soil Management Plan form.

Step 4: Identify Compost, Topsoils and Other Organic Materials for Amendment and Mulch.

Amendments for Pre-Approved rates must be compost meeting the definition for "Composted Materials" in WAC 173-350, section 220, (available online at www.ecy.wa.gov/programs/swfa/organics/soil.html) or topsoil manufactured from these composts plus clean sand or sandy loam soil. Products must be identified on the Soil Management Plan form, and recent product test results must be provided showing that they meet the additional requirements in this Guide for organic matter content and carbon to nitrogen ratio (see specification in Section 3).

For Custom Calculated amendment rates (see right, next page, and formula in Section 7 "Resources"), organic matter may be provided by:

- Compost (as defined above), or
- Other by organic materials with a carbon to nitrogen ratio under 25:1 (35:1 for native plantings), meeting the same contaminant standards as "Composted Materials" in WAC 173-350, section 220.

These products must be identified on the Soil Management Plan form, and recent test results provided showing that they meet these requirements.

Step 5: Calculate Amendment, Topsoil and Mulch Volumes on SMP form

- For Pre-Approved amendment rates, figure the square footage of each area and complete the simple calculation to convert inches of amendment into cubic yards.
- To compute custom calculated amendment rates, use soil and amendment test results and the *Model Amendment Rate Calculator Spreadsheet* and/or the *Equation for Calculating Compost Application Rates* (both are in Section 7 "Resources") to achieve the target Soil Organic Matter content (10% SOM for landscape beds, or 5% SOM for turf areas).

Site Assessment Supplies

- Copy of site grading plan
- Sturdy shovel
- Tape measure

If using custom calculated amendment rates requiring soil tests:

- Clean bucket or stainless steel bowl for mixing soil samples
- Sealable bags for soil samples, and indelible ink pen to label

Sampling and Testing for Custom Calculated Amendment Rates

Soil and amendments submitted for testing should be a composite of samples taken from several spots on a site or in a pile of amendment.

Soil:

Gather samples from soil that will be the subgrade after all grading operations are completed, before placement of imported topsoil or amendments.

- Take samples from 10-12 spots in each area. Imagine a line dividing the area in half lengthwise, then divide each half into five near equal sized widths. Take samples near the middle of each subsection.
- At each sampling spot dig a spades-width hole at least 8 inches deep, then shave a 1 inch slice from the side of the hole to use in the composite sample.
- Thoroughly mix the 10-12 samples from each turf or planting area together in a clean plastic bucket or bowl. Place 2 cups of the mix into a sealable plastic bag for testing (some tests may require more soil, ask laboratories).
- Label the bag with the site information, area of sample; plus your name, address and phone number.

Amendment:

Producers of composts and manufactured topsoils can usually provide test results for their products. If tests are

nonexistent or incomplete, conduct necessary tests on each proposed amendment.

- Take samples from 10-12 spots in pile of material. Imagine a line dividing the pile in half lengthwise, then gather samples from five spots equally spaced along the length of each side of the pile.
- At each sampling spot, dig a spades-width hole at least 8 inches deep. Use a clean cup or trowel to collect a cup of amendment from the bottom of each hole.
- Thoroughly mix the 10-12 samples from each pile together in a clean plastic bucket or bowl. Place 2 cups of the mix into a sealable plastic bag for testing (some tests may require more compost, ask laboratories).
- Label the bag with the product and supplier information; plus your name, address and phone number.

Tests to Conduct for Custom Calculated Amendment Rates:

Soil	**Compost Amendment**
- Bulk Density	- Bulk Density
- Percent Organic Matter (by "loss on ignition" method)	- Percent Organic Matter (by "loss on ignition" method)
	- Moisture Content as is
	- Carbon to Nitrogen Ratio (C:N)
	- Heavy Metals Analysis (per WAC 173-350, section 220)

Model SOIL MANAGEMENT PLAN for BMP T5.13

(available as MS Word file at www.SoilsforSalmon.org)

PROJECT INFORMATION **Page # ____ of ____ pages**

Complete all information on page 1; only site address and permit number on additional pages.

Site Address / Lot No.: 823 2nd Street, Mukilteo, WA 98275	
Permit Type: Commercial	**Permit Number:**
Permit Holder: Robert Ford	**Phone:**
Mailing Address: 40844 Sandpiper Court, Palm Desert, CA 92260	
Contact Person: Jesse Jarrell, P.E.	**Phone:** 425-356-2700
Plan Prepared By: Timothy Sarkela, P.E.	

ATTACHMENTS REQUIRED (*Check off required items that are attached to this plan*)

___ **Site Plan showing, to scale:**	___ Areas of undisturbed native vegetation (no amendment required) ___ New planting beds and turf areas (amendment required) ___ Type of soil improvement proposed for each area
___ **Soil test results (required if proposing custom amendment rates)**	
___ **Product test results for proposed amendments**	

AREA #_____ (*should match Area # on Site Plan*)

PLANTING TYPE ___ Turf ___ Planting Beds	___ Undisturbed native vegetation ___ Other: _____	
SQUARE FOOTAGE OF THIS AREA: _____ square feet		
SCARIFICATION ___ Subsoil will be scarified	___ inches (depth) of scarification needed to achieve finished total 12" loosened depth.	
PRE-APPROVED AMENDMENT METHOD: ___ Topsoil import X Amend with compost ___ Stockpile and amend (____ cu. yds. stockpiled)	1.75 inches of compost or imported topsoil applied X 3.1 (*conversion factor, inches to cubic yards*) 5.43 = cu. yards per 1,000 sq. ft. X .37 ,000s sq.ft. in this area 2.0 = cubic yards of amendment → → → → → (*needed to cover this area to designated depth*)	PRODUCT: Compost QUANTITY: 2.0 CU. YDS.
CUSTOM AMENDMENT ___ Topsoil import ___ Topsoil & compost lift ___ Amend ___ Stockpile and amend (____ cu. yds. stockpiled)	**Attach test results and calculations.** ____ inches organic matter or topsoil import X 3.1 _____= cu. yards / 1,000 sq. ft. X ___ ,000s sq.ft. in this area ____ = cubic yards of amendment → → → → →	PRODUCT: _____ QUANTITY: _____ CU. YDS.
MULCH	___ ,000 sq.ft. X 6.2 (*conversion, to give 2 inch mulch depth*) ____ = cubic yards of mulch → → → → → →	PRODUCT: _____ QUANTITY: _____ CU. YDS.

TOTAL AMENDMENT/TOPSOIL/MULCH FOR ALL AREAS (*complete on page 1 only, totaling all areas/pages in this Plan*)

❑ **Product #1:** _____	❑ **Quantity:** _____ **cu. yds.**
❑ **Test Results:** ___ **% organic matter** ____ **C:N ratio <25:1** (except mulch, or <35:1 for native plants)	____ **"stable"** (yes/no)
❑ **Product #2:** _____	❑ **Quantity:** _____ **cu. yds.**
❑ **Test Results:** ___ **% organic matter** ____ **C:N ratio <25:1** (except mulch, or <35:1 for native plants)	____ **"stable"** (yes/no)
❑ **Product #3:** _____	❑ **Quantity:** _____ **cu. yds.**
❑ **Test Results:** ___ **% organic matter** ____ **C:N ratio <25:1** (except mulch, or <35:1 for native plants)	____ **"stable"** (yes/no)

Date:	**Inspector:**	**Approved:**	**Revisions Required:**
Date:	**Inspector:**	**Approved:**	**Revisions Required:**

COMMENTS: _____

FIELD GUIDE TO VERIFYING SOIL QUALITY AND DEPTH IN NEW LANDSCAPES

This guide is provided to help professional inspectors verify implementation of soil improvements to fulfill BMP T5.13 "Post Construction Soil Quality and Depth" in the Washington Department of Ecology's Stormwater Management Manual Western Washington.

The main conditions to be confirmed are:

1. Provision of eight inches of topsoil containing 10% organic matter in planting beds, or 5% in turf areas.
2. Scarification of compacted subsoil four inches below the topsoil layer (for a total uncompacted depth of 12 inches).
3. Placement of two inches of mulch on all planting beds.

Site Inspection Supplies

- A copy of the approved Soil Management Plan (SMP) for the site, with site drawing.
- A sturdy shovel
- Tape measure or 12" ruler
- 3/8 inch diameter 3-4 foot stainless steel "rod penetrometer" with a 1/8" bevel cut into the tip at 30 degrees from the side, and a 90 degree bend at top to form a handle (*see illustration, next page*).
- Field Verification Form to record results

The following steps may be completed at multiple visits as a project progresses or in one final project approval inspection, depending on local practices:

STEP 1: Compare site conditions with approved Soil Management Plan (SMP).

The SMP approved with the site permit describes soil treatments approved for each area. Make sure site conditions match these details in the SMP:

- Site location and permit holder.
- Turf and planting areas match approved drawings.
- Areas to remain as undisturbed native soil and vegetation have been fenced off during construction to prevent soil compaction or damage to plants.

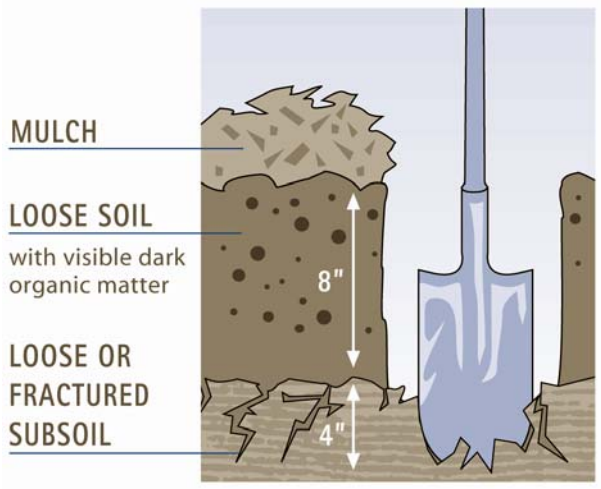
STEP 2: Inspect delivery tickets for compost, topsoil and mulches.

Permitee must provide original delivery tickets for all soil and mulch products. Compare delivery tickets with the SMP to match the following information:

- Delivery location.
- Total quantities for each soil product and mulch.
- Product descriptions and sources.
  If materials other than those listed in the SMP were delivered, laboratory test results must be provided to confirm that they are equivalent to approved products.

STEP 3: Verify depth of amended soil and scarification.

Use a shovel to dig at least one test hole per acre for turf and one per acre for planting beds to verify eight inch topsoil depth (below mulch layer), incorporation of amendments, and four inches of uncompacted subsoil.



Test holes should be about one foot deep (after first scraping away any mulch) and about one foot square.

Eight Inch Depth of Amended Soil. The top eight inches of soil should be easy to dig using a garden spade driven solely by your weight. The soil should be darker than the unamended soil below, and particles of added organic

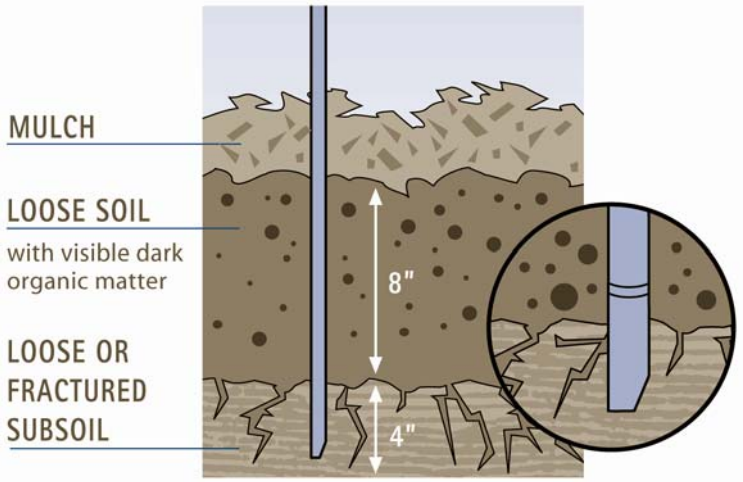
matter are likely to be visible. Clay soil that been saturated and then dried may require jumping on the shovel step to penetrate, but the soil should yield easily when moist. Soil that requires vigorous chipping with the shovel to penetrate probably does not meet the specification.

Four Inch Depth of Scarified Subsoil. The next four-inch depth of soil should be loose enough to penetrate with the shovel. It may be rocky, and the loosened depth may vary due to the pattern of scarifying equipment – but some sections of subsoil in a one foot square hole should be loose four inches deep into the subsoil (that is, to a total 12 inch depth from the soil surface).

STEP 4: Check soil depth in several spots.

Use a simple "rod penetrometer" (illustration below) to confirm that the soil is uncompacted twelve inches deep at ten locations per acre – with a minimum of ten on smaller sites. To locate test spots, imagine a line dividing the site (or each acre) in half lengthwise, then divide each half into five nearly equal sections. Conduct tests near the middle of each section. Additional test locations are encouraged.

The rod penetrometer should enter the soil twelve inches deep, driven solely by the inspector's weight. Irregular scarification or rocks in the lower layer may require probing a few spots at each location to reach the full depth.



A rod penetrometer is a 4 foot long, 3/8 inch or 10 mm diameter stainless steel rod with a 90 degree bend 5 inches form the top to make a handle, and a 30 degree bevel cut 1/8 inch or 3 mm into the side of the tip.

STEP 5: Check mulch depth.

Use a shovel to scrape away and reveal surface mulch thickness. A two inch layer of organic material (mulch) such as composted sawdust, wood chips, or ground bark should be distinguished from the underlying soil on all planting beds.

FINAL STEP: Record results on "Field Verification Form" or similar document *(see sample form on next page)*.

What should be attached to the Soil Management Plan?

- Scale drawings showing layout of turf and planting beds, and identifying where soil treatments described in the SMP will be applied.
- Copies of compost and topsoil test results demonstrating that products contain adequate organic matter, and meet carbon to nitrogen ratio and stability standards.
- Where custom calculated amendment rates are used, include laboratory analyses of the soil and organic matter sources plus calculations by a qualified professional showing that the organic matter requirement will be achieved.

What If A Site Does Not Meet the Soil Management Plan Requirements?

If inspection indicates that an installation does not fulfill the approved SMP, the permit holder or their agent should be notified of what steps are needed to comply. When results are unclear or disputed, an independent consultant should conduct sampling for analytical testing of organic matter as described in the project specifications.
Qualified consultants include: Certified Soil Scientists, Crop Advisors or Agronomists; or Licensed Landscape Architects, Civil Engineers or Geologists.

Model FIELD VERIFICATION FORM for BMP T5.13

(available as MS Word file at www.SoilsforSalmon.org)

PROJECT INFORMATION **Page # ____ of ____ pages**

Complete all information on page 1, only site address and permit number on additional pages.

Site Address: _____	
Permit Type:	**Permit Number:**
Permit Holder:	**Phone:**
Mailing Address: _____	
Customer Representative At Inspection:	**Phone:**
Plan Prepared By:	

VISIT RECORD

Date:	**Inspector:**	**Items Approved: __ Fencing off undisturbed areas __ Soil preparation __ Mulch __ Other:**
Date:	**Inspector:**	**Items Approved: __ Fencing off undisturbed areas __ Soil preparation __ Mulch __ Other:**
Date:	**Inspector:**	**Items Approved: __ Fencing off undisturbed areas __ Soil preparation __ Mulch __ Other:**

DELIVERY TICKETS FOR AMENDMENT, TOPSOIL & MULCH.

(*Check if tickets match Soil Management Plan (SMP). Total volumes for all areas should be on page 1 of the SMP*).

❑ **Product #1:** _____ ❑ **Test Results: ___ % organic matter ____C:N ratio <25:1 ____ "stable"** (Y/N) ❑ **Quantity: _____cu. yds.** (except mulch, or <35:1 for native plants)	**Comments:**
❑ **Product #2:** _____ ❑ **Test Results: ___ % organic matter ____C:N ratio <25:1 ____ "stable"** (Y/N) ❑ **Quantity: _____cu. yds.** (except mulch, or <35:1 for native plants)	
❑ **Product #3:** _____ ❑ **Test Results: ___ % organic matter ____C:N ratio <25:1 ____ "stable"** (Y/N) ❑ **Quantity: _____cu. yds.** (except mulch, or <35:1 for native plants)	

AREA #___ (*refer to Areas mapped on Site Plan and described on Soil Management Plan*)

PLANTING TYPE ___ Undisturbed vegetation ___ Turf ___ Planting Beds ___ Other: _____ **Square footage:_____**	**Test Holes** **Number Test Holes Required:____** (minimum 1 hole/acre) **Soil Amended 8 Inches Deep? Y / N** **Amendment Matches Soil Mgmt. Plan? Y / N** ❑ Topsoil Product ? ❑ Amendment Visible ? **Subsoil Loose/Scarified 12 Inches Deep? Y / N**	**Rod Test** **Number Rod Tests Required:____** (minimum 10 tests/acre) **Rod penetrates 12 inches deep in all areas? Y / N**
(*If Planting Bed, Mulch is Required After Planting*) **Mulch Product:** _____ **Mulch two inches deep? Y / N**	**Comments:**	

AREA #___

PLANTING TYPE ___ Undisturbed vegetation ___ Turf ___ Planting Beds ___ Other: _____ **Square footage:_____**	**Test Holes** **Number Test Holes Required:____** (minimum 1 hole/acre) **Soil Amended 8 Inches Deep? Y / N** **Amendment Matches Soil Mgmt. Plan? Y / N** ❑ Topsoil Product ? ❑ Amendment Visible ? **Subsoil Loose/Scarified 12 Inches Deep? Y / N**	**Rod Test** **Number Rod Tests Required:____** (minimum 10 tests/acre) **Rod penetrates 12 inches deep in all areas? Y / N**
(*If Planting Bed, Mulch is Required After Planting*) **Mulch Product:** _____ **Mulch two inches deep? Y / N**	**Comments:**	

Add additional sheets for additional Areas