CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN
FOR

2412 Inter Ave
Puyallup, Washington

Revised March 2025
September 2023

Prepared for:
Through Terra

Prepared by:
Matthew Seawright, E.I.T., Project Designer

Approved By:

Daniel Smith, P.E., Senior Project Manager

REPORT #20083

"I hereby state that this Drainage and Erosion/Sediment Control Plan for the 2412 Inter Ave project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community of professional engineers. I understand that City of Puyallup does not and will not assume liability for the sufficiency, suitability or performance of drainage facilities prepared by me."

This analysis is based on data and records either supplied to, or obtained by, C.E.S. NW, Inc. These documents are referenced within the text of the analysis. The analysis has been prepared utilizing procedures and practices within the standard accepted practices of the industry.

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EROSION/SEDIMENTATION CONTROL

1. Thirteen Elements

1.1 Mark Clearing Limits

The project proposes to clear areas onsite within the clearing limits shown on the approved plans. Clearing limits are to be staked by a professional land surveyor as shown on the approved plans prior to land disturbing activities, and all clearing shall remain within these limits.

1.2 Establish Construction Access

Construction vehicle access shall be limited to one route, that being from Inter Avenue. As necessary, the access point shall be stabilized with a pad of quarry spalls or crushed rock to minimize the tracking of sediment onto public and private roads (BMP C105). The stabilized construction entrance shall be installed prior to site grading and shall be maintained per the instructions included in *Appendix 'B'*.

If sediment is tracked off site, public roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather, if necessary, to prevent sediment from entering waters of the State. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner. Runoff from the street washing shall be directed towards a sump where sediment can be collected prior to discharging to downstream water bodies.

1.3 Control Flow Rates

The project will clear approximately 1.87-acres to construct the proposed improvements. Properties and waterways downstream from development sites shall be protected from erosion due to any increase in the volume, velocity, and peak flow rate of stormwater runoff from the project site. Stormwater runoff during construction will be mitigated through the use of cover measures (BMPs C120, C121, C122, C123), silt fencing (BMP C233), and temporary sediment pond (BMP C241). These BMPs shall be installed and maintained per the instructions included in *Appendix 'C'*.

1.4 Install Sediment Controls

Prior to discharge from the construction site, stormwater runoff shall pass through an appropriate sediment removal BMP. The project proposes silt fencing (BMP C233) around the downslope perimeter of the site to trap sediment onsite and prevent sediment-laden water from entering

adjacent properties and rights-of-way. These BMPs shall be installed prior to significant grading activity.

1.5 Stabilize Soils

All exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrop impact, flowing water, and wind. Construction is anticipated to be started and completed during the summer and fall of 2020. During the wet season, from October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. Site soils shall be stabilized, mulching (BMP C121), and plastic covering (BMP C123). Stockpiles shall be stabilized with plastic covering (BMP C123). During the dry season from May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. Site soils shall be stabilized with temporary or permanent seeding (BMP C120), mulching (BMP C121), and plastic covering (BMP C123). Stockpiles shall be stabilized with plastic covering (BMP C123).

This element applies to all soils on site, whether at final grade or not. Soils shall be stabilized at the end of the shift before a holiday or weekend, if needed, based on the weather forecast. Soil stabilization measures shall be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water. Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures and, when possible, be located away from storm drain inlets, waterways and drainage channels. The aforementioned BMPs shall be installed and maintained per the instructions included in *Appendix 'B'*.

1.6 Protect Slopes

There are no steep slopes onsite that require protection during the construction of the proposed improvements.

1.7 Protect Drain Inlets

All existing and newly constructed drainage collecting structures shall be protected from sediment deposition. Catch basin sediment protection (BMP C220) shall be provided on all existing drainage-collecting structures within 500 feet downstream of the project site. All approach roads shall be kept clean. Sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the State. Inlets shall be inspected weekly at a minimum and daily

during storm events. Inlet protection devices shall be cleaned or removed and replaced when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

1.8 Stabilize Channels and Outlets

The project does not propose any channels or outlets that require protection.

1.9 Control Pollutants

The project will require earth moving equipment. If vehicles are stored onsite care needs to be taken to make sure that any fluid leaks are contained with drip pans and the fluids are disposed of properly. All spills need to be cleaned up immediately as per the Department of Ecology (DOE) and City's standards. A construction staging area is shown on the approved plans. This area is for storing and maintaining vehicles. A wheel wash shall be included in this area per BMP C106 if the construction entrance does not prove adequate to prevent sediment leaving the site from vehicles.

Pollutants from woody debris, concrete and saw cutting shall also be controlled. Concrete shall be handled per BMP C151 while saw cutting shall have its slurry and cuttings cleaned per BMP C152. Woody debris may be chopped and spread cross the site to aid in site stabilization. Chemicals, liquid products, non-inert wastes and petroleum products shall be protected from vandalism stored in a manner to collect leaks and covered when not in use. The aforementioned BMPs shall be installed and maintained per the instructions included in `*Appendix 'B'*.

1.10 Control Dewatering

Dewatering is anticipated for construction of the utilities. If groundwater is encountered it should pumped to the temporary sediment pond prior to discharging offsite.

1.11 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 the approved plans and specifications included in *Appendix 'B'*. Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency will be reduced to once every month. In general, when sediment accumulation has reached 1/3 of the treatment

device or one foot of depth it shall be removed. Also, if there is a major storm event then the proposed BMPs shall be checked and cleaned appropriately.

If the sediment removed from these devices is approved by a geotechnical engineer, they can be stabilized onsite. If not, they must be removed per the Department of Ecology and City of Puyallup standards. All temporary erosion and sediment control BMPs shall be removed within 30 days after 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. Records shall be kept onsite.

1.12 Manage the Project

A construction sequence is provided on the plans. This construction sequence shall be followed to ensure that sediment is not deposited downstream. The City and the Project's Engineer shall inspect the erosion control BMPs after installation and during construction. The contractor is to employ a Certified Erosion and Sediment Control Lead (CESL, BMP C160) as described by the City to help manage and inspect the erosion control devices. The CESL shall provide sampling and record keeping for turbidity and pH. This SWPPP shall be retained on-site or within reasonable access to the site, and it shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state. The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. 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. Detailed descriptions of each BMP listed above can be found in Volume 2 of the Washington State Department of Ecology Stormwater Management Manual for Western Washington, 2019 Edition and in *Appendix 'B'*.

1.13 Protect Low Impact Development BMPs

The project proposes a detention pond to mitigate its runoff and soil amendments in landscaping areas. All heavy equipment shall be kept in the designated staging area when not in use to prevent over-compaction of amended soils.

2. Project Description

The 2412 Inter Ave project proposes the paving of an existing gravel parking lot and accompanying storm facilities on a 1.86-acre site comprised of four parcels (2105200320, 2105200350, 2105200340 and 2105200361) zoned Limited Manufacturing (ML). The site is accessed from Inter Ave with two commercial driveway approaches. The project is located in the Puyallup River Water Resources Inventory Area (WRIA 10). The Vicinity Map has been included in Appendix "A" of this report. A project summary is as follows:

Permit Applied for –Site Development
Address – 2412 Inter Ave Puyallup, WA 98372
Parcel Numbers – 2105200320, 2105200350, 2105200340 and 2105200361
Legal description – (Per Quit Claim Deed Filed Under Recording Number 200105070774)

Parcel A (2105200320):
East 100 Feet of Block 19, Ackerson's Second Addition to Puyallup, According to Plat Recorded in Book 8 of Plats, at Game 25, in Pierce County, Washington.

Parcel B (2105200350):
West 75 Feet if that Part of Block 20, Ackerson's Second Addition to Puyallup, Situated in the City of Puyallup, According to Plat Recorded in Book 8 of Plats, at Page 25, in Pierce County, Washington.
(Per Alta Commitment for Title Insurance Issued by Chicago Title Commitment Number 0012400-Tc Dated March 25, 2014)

Parcel #2105200361:
Block 20, Ackerson's Second Addition to Puyallup. According to Plat Recorded in Volume 8 of Plats, Page 25, Records of Pierce County Auditor.
Except the West 150 Feet Thereof.
(Per Real Estate Excise Tax Affidavit Filed Under Recording Number 4337181)

Parcel #2105200340:

The East 75 Feet of the West 150 Feet of Block 20, Ackerson's Second Addition to Puyallup, According to Plat Thereof Recorded in Volume 9 of Plats, at Page 25, Records of Pierce County Auditor.

All Situate in the City of Puyallup, County of Pierce, State of Washington.

The project site historically has been used as a gravel parking lot as depicted on the pre-developed basin map (Appendix "B"). The existing site is redeveloped with landscaping and repaving of the existing gravel with asphalt upon permit approval. The property has frontage with Inter Ave along its northern property line and access is provided with two commercial driveway approaches. The project proposes approximately 51,000 sq.ft. of asphalt paving across onsite and offsite improvements; therefore, according to Figure 1-3.1 and 1-3.2 of Volume I of the Manual, the project must evaluate all minimum requirements for the new and replaced surfaces. Section 5 of this report contains a detailed discussion of the minimum requirements. The project proposes a detention pond (BMP D.1) for flow control of the site improvements, and runoff treatment is provided by a combined wet pond (BMP T10.40) underneath the detention pond and two continuous inflow biofiltration swales (BMP T9.30) within the right-of-way. All disturbed areas which are not converted to impervious surface apply soil amendments in accordance with BMP T5.13.

3. Existing Site Conditions

The existing site is currently used as a gravel parking lot. The site is relatively flat between elevations 62-64 (NAVD 88) which gradually slopes towards Inter Avenue with a relative high spot south center of the parcels. Runoff sheet flows north across the gravel parking lot and is collected by the public closed conveyance system in Inter Ave. The public closed conveyance system is comprised of 12-inch concrete pipes and flows west for approximately 1,500-feet towards an offsite wetland complex and Upper Deer Creek. The site is accessed by existing gravel driveway approaches from Inter Avenue.

There is an existing gravity sewer main in Inter Avenue which currently serves the property. There are no known aquifer recharge or wellhead protection areas that affect this property. There are no known well or septic systems onsite. If a septic system or well is discovered onsite during construction, it will be decommissioned per Tacoma-Pierce County Health Department

standards. The parcel and all the proposed improvements are located within Zone X, which is considered outside of the 100-year floodplain, per FEMA Map # 53053C0334E. A copy of the FIRM Panel map can be found in Appendix 'A' of this report.

4. Adjacent Areas

The site is bound by Inter Avenue to the north and railroad tracks to the south and east. The parcels are bordered by commercial properties to the north, south, and west with a single family property to the southeast across the tracks. There is no significant runoff directed towards the site. Offsite areas should not experience problems with erosion if the BMPs described within this report and on the approved plans are implemented in accordance with the plans, specifications and Manufacturer recommendations.

5. Critical Areas

There are no known onsite or offsite critical areas within 200-feet of the property.

6. Soil

Onsite soils have been identified as Briscot loam (6A a Type D soil) determined by the USDA SCS maps of Pierce County, Washington. A description of the USDA soils and a copy of the soil map for this portion of Pierce County have been included in Appendix 'A' of this report. A draft geotechnical engineer's report has been prepared by Earth Solution NW LLC, dated February 12, 2019, with an addendum, dated April 27, 2021, where they documented groundwater table depths at a depth of 0.9 to 2.0-feet. A copy of the geotechnical report is included in Appendix 'C'.

7. Potential Erosion Problem Areas

The site does not contain slopes that exceeds 15%. The project should not experience problems with erosion if the BMPs described within this report and on the approved plans are implemented in accordance with the plans, specifications and Manufacturer recommendations.

8. Construction Phasing

The proposed improvements include an erosion/sedimentation control plan designed to prevent sediment-laden runoff from leaving the project site during construction. Construction is to occur in a single phase. The design specifies a combination of structural measures, cover measures and construction practices that are to be implemented to maintain erosion control. Prior to the start of any clearing and grading of the site, all erosion control measures shall be constructed.

A general outline of the proposed construction sequence has been included. The contractor will employ the best construction practices to properly clear and grade the site. The planned construction sequence is as follows:

1. The contractor is to request a pre-construction meeting with the City's inspector.
2. Clearly stake, flag or fence clearing limits/work area. No work shall be performed outside these limits without prior approval from the City of Puyallup.
3. Prior to starting site work, request an inspection for erosion and sediment, inspection code #1010, by calling the inspection request line at 1-877-232-6456.
4. Provide silt fencing as shown on the approved plans
5. Grade site as shown on the approved plans.
6. Construct the conveyance system and install inlet protection on the new catch basins.
7. Install filter fabric and permeable ballast.
8. Construct onsite planters and pave the storage area.
9. Construct frontage improvements and amend the landscape and lawn areas with soil amendments.
10. Amend soils per CS 01.02.08A on sheet C9.
11. Relocate erosion control measures or install new measures so that as site conditions change, the erosion and sediment control is always in accordance with City of Puyallup and department of ecology erosion and sediment control standards.
12. Cover all areas, including stockpiles, that will be unworked for more than seven days during the dry season or two days during the wet season with straw, wood fiber mulch, plastic sheeting or equivalent.
13. Stabilize all areas within seven days of reaching final grade.
14. Seed, sod, stabilize, or cover any areas to remain unworked for more than 30 days.

15. Call for final inspections. Upon completion of the project, stabilize all disturbed areas and remove BMPs if appropriate.

9. Construction Schedule

Construction is anticipated to begin in fall of 2023 and be completed by spring, 2024. Construction that exposes soils should be limited during the wet season (October 1 to April 30). During this time erosion control BMPs should be checked regularly (once a week) and after each runoff producing storm event. Grading, utility installation, and paving should be completed prior to the wet season.

10.Financial/Ownership Responsibilities

The owner and responsible party for the initiation of financial securities is Through Terra. Their contact information is as follows:
2412 Inter Ave
Puyallup, WA
98372-3425

11.Engineering Calculations

The surface area of the proposed sediment pond is determined by the following equation:

$$\text{Surface Area} = FS(Q_2/V_{sed})$$

Where;

Q_2 = Peak 2-year flow rate (cfs)

V_{sed} = Particle Settling Velocity-Type C Soils (ft/s)

FS = Factor of Safety

When;

$Q_2 = 0.454$ cfs

$V_{sed} = 0.00096$ ft/s

FS = 2

Therefore;

Required Surface Area = 945.83 sq.ft. at the top of the overflow weir. **10,725 sq.ft**. is provided.

The outlet length of the proposed sediment pond is determined by the following equation:

$$L = [Q_{100}/(3.21H^{3/2})]-2.4H$$

Where;

L = Length of weir outlet (ft)

Q_{100} = Peak 100-year flow rate (cfs)

H = Height of water over weir (ft)

When;

Q_{100} = 1.13 cfs

H = Calculated at <0.2 using Hydraflow Express; therefore, assume 0.2 as minimum

Therefore;

Length of weir outlet = 3.46 ft; therefore, **6 ft is provided**.

The dewatering diameter of the proposed sediment pond is determined by the following equations:

$$A_o = [A_s(2h)^{1/2}]/[0.6 \times 3600Tg^{1/2}]$$

$$D = 24(A_o/\pi)^{1/2}$$

Where;

A_o = Orifice Area (sq.ft.)

A_s = Pond Surface Area (required)

h = Head of water above orifice (height of riser)

T = Dewatering time (24 hours)

g = acceleration of gravity (32.2 feet/second^2)

D = Orifice Diameter

When;

A_s = 945.83 sq.ft.

h = 4.5 feet

Therefore;

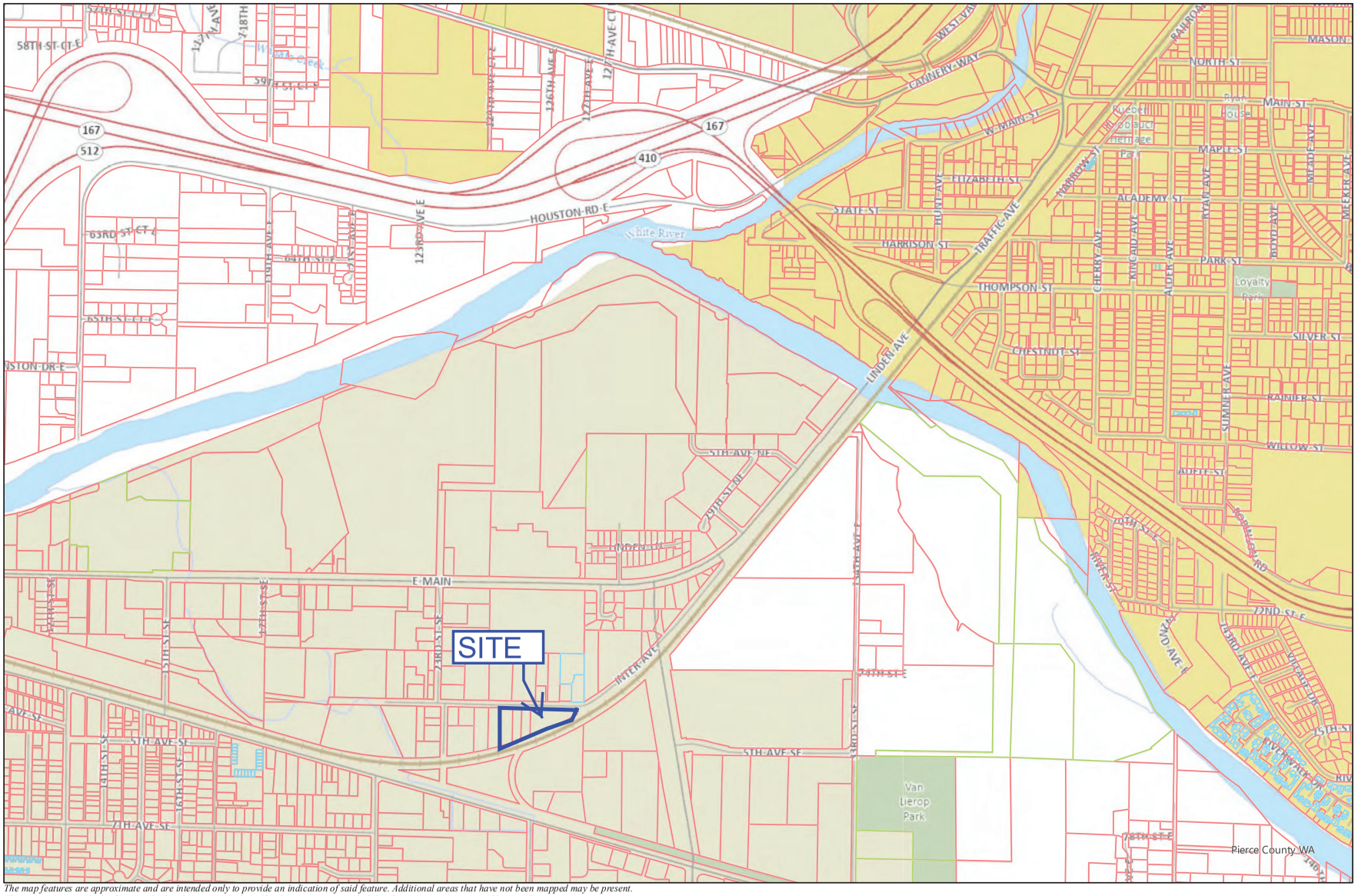
The dewatering orifice diameter required is 0.32 inches; therefore, **1 inch is provided** as the minimum allowed.

The calculations are performed according to Vol II Chapter 3 pages 389-391 of the Manual.

APPENDIX A

MAPS

VICINITY MAP



Legend

Tax Parcels

- Base Parcel
- Condominium
- Other

CES • NW
INCORPORATED
CIVIL ENGINEERING & SURVEYING
429 29th St NE, Suite D - Puyallup, WA 98372
PH: 253.848.4282
www.cesnwinc.com

Date: 8/31/2023 03:49 PM

Soil Map—Pierce County Area, Washington
(ProVac-South)

Map Scale: 1:985 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 45 90 180 270

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 18, Sep 8, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 31, 2022—Aug 8, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

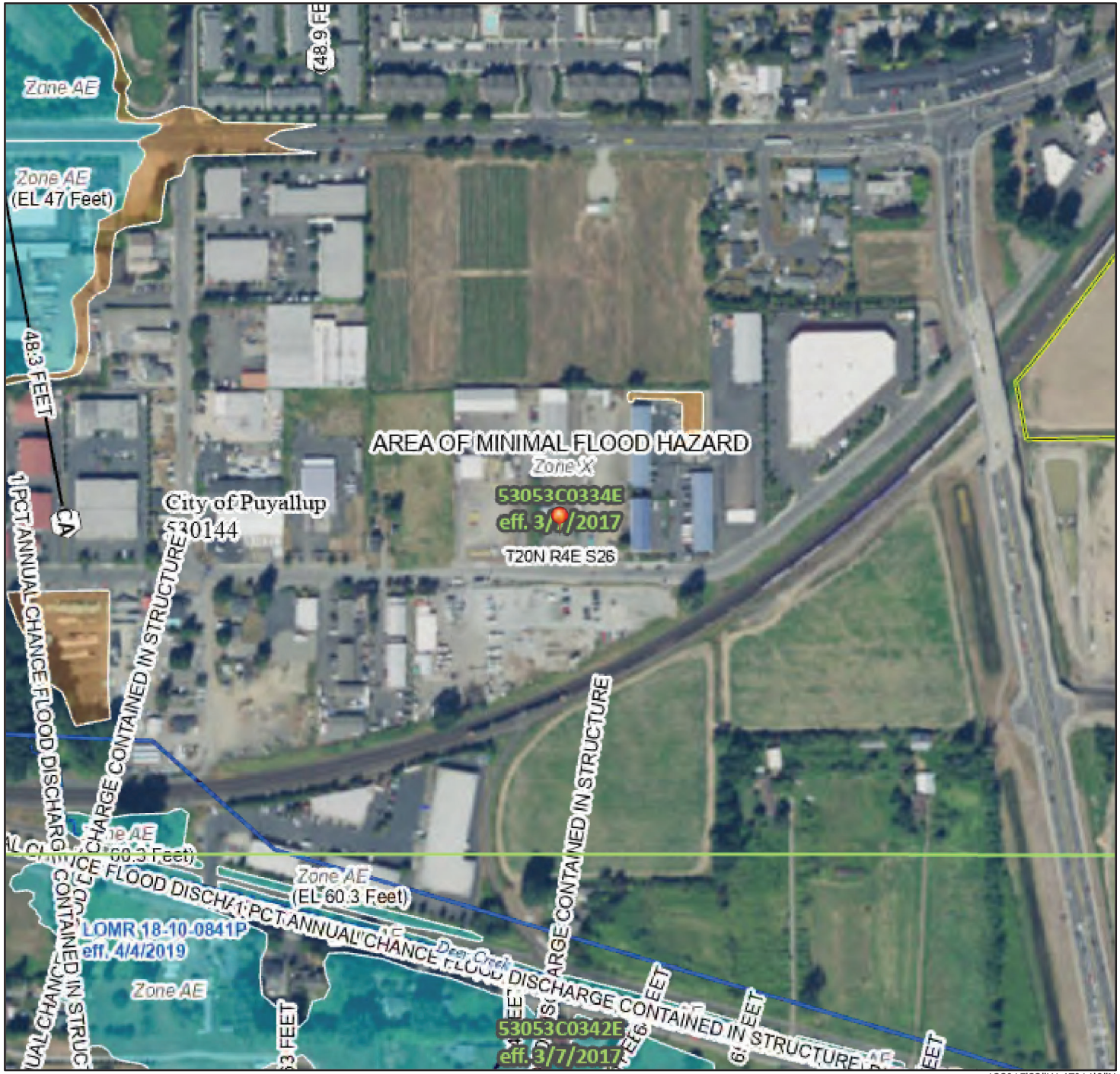
Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Briscot loam	2.9	100.0%
Totals for Area of Interest		**2.9**	**100.0%**

National Flood Hazard Layer FIRMette

FEMA

122°16'W 47°11'34"N



122°15'22"W 47°11'9"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/1/2021 at 1:21 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX B

Construction Best Management Practices (BMPs)

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Access

Purpose

Stabilized construction accesses are established to reduce the amount of sediment transported onto paved roads outside the project site by vehicles or equipment. This is done by constructing a stabilized pad of quarry spalls at entrances and exits for project sites.

Conditions of Use

Construction accesses shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential subdivision construction sites, provide a stabilized construction access for each residence, rather than only at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size and configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized accesses not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

See Figure II-3.1: Stabilized Construction Access for details. Note: the 100' minimum length of the access shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').

Construct stabilized construction accesses with a 12-inch thick pad of 4-inch to 8-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride for construction access stabilization because these products raise pH levels in stormwater and concrete discharge to waters of the State is prohibited.

A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the standards listed in Table II-3.2: Stabilized Construction Access Geotextile Standards.

Table II-3.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.

Table II-3.2: Stabilized Construction Access Geotextile Standards (continued)

Geotextile Property	Required Value
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized access. Also consider the installation of excess concrete as a stabilized access. During large concrete pours, excess concrete is often available for this purpose.
- Fencing (see BMP C103: High-Visibility Fence) shall be installed as necessary to restrict traffic to the construction access.
- Whenever possible, the access shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction accesses should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction access must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Alternative Material Specification

WSDOT has raised safety concerns about the Quarry Spall rock specified above. WSDOT observes that the 4-inch to 8-inch rock sizes can become trapped between Dually truck tires, and then released off-site at highway speeds. WSDOT has chosen to use a modified specification for the rock while continuously verifying that the Stabilized Construction Access remains effective. To remain effective, the BMP must prevent sediment from migrating off site. To date, there has been no performance testing to verify operation of this new specification. Jurisdictions may use the alternative specification, but must perform increased off-site inspection if they use, or allow others to use, it.

Stabilized Construction Accesses may use material that meets the requirements of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Section 9-03.9(1) (WSDOT, 2016) for ballast except for the following special requirements.

The grading and quality requirements are listed in Table II-3.3: Stabilized Construction Access Alternative Material Requirements.

Table II-3.3: Stabilized Construction Access Alternative Material Requirements

Sieve Size	Percent Passing
2½"	99-100

Table II-3.3: Stabilized Construction Access Alternative Material Requirements (continued)

Sieve Size	Percent Passing
2″	65-100
¾″	40-80
No. 4	5 max.
No. 100	0-2
% Fracture	75 min.

- All percentages are by weight.
- The sand equivalent value and dust ratio requirements do not apply.
- The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.

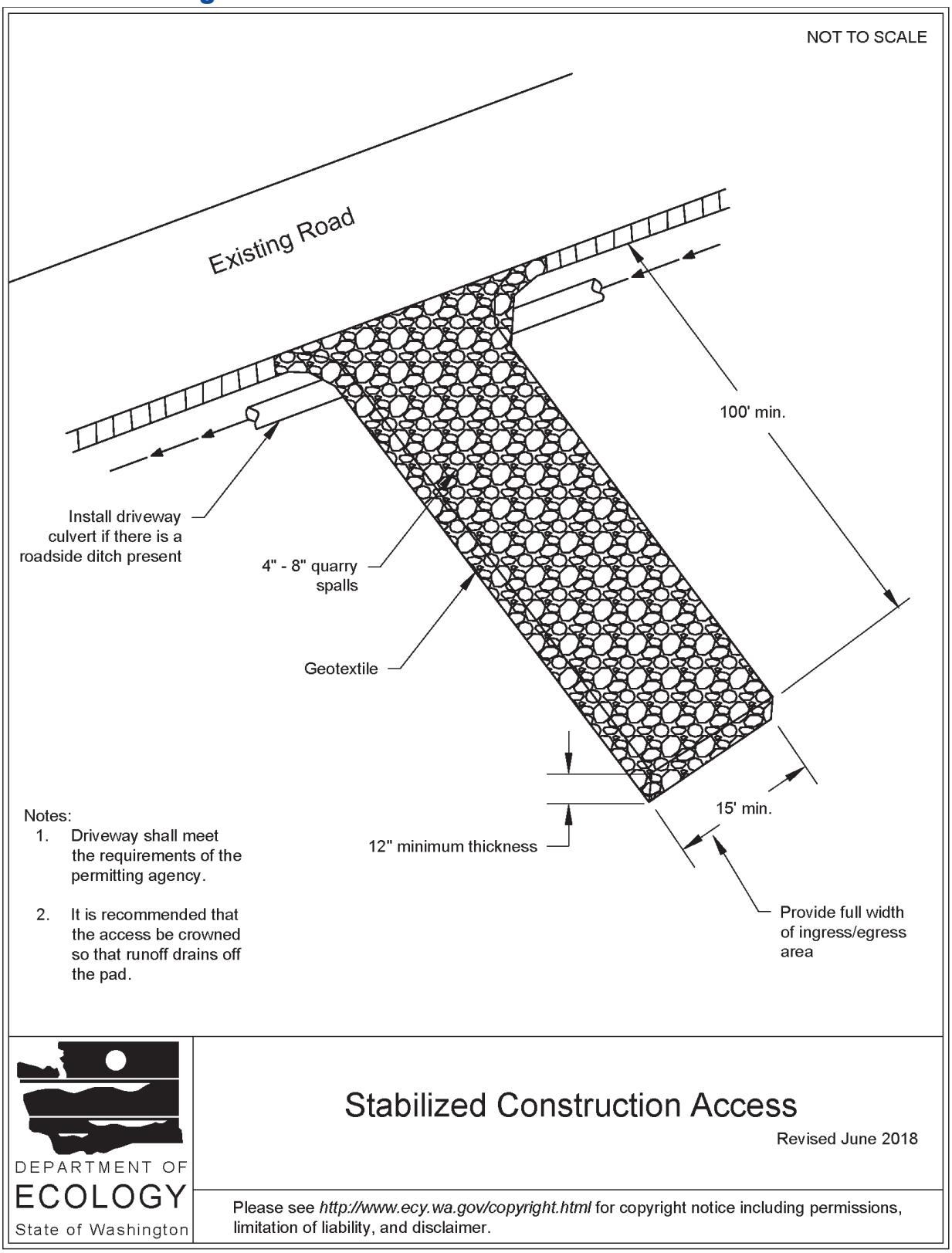
Maintenance Standards

Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the access is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions of the access, or the installation of BMP C106: Wheel Wash.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when high efficiency sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction access(es), BMP C103: High-Visibility Fence shall be installed to control traffic.

- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

Figure II-3.1: Stabilized Construction Access



Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C106: Wheel Wash

Purpose

Wheel washes reduce the amount of sediment transported onto paved roads by washing dirt from the wheels of motor vehicles prior to the motor vehicles leaving the construction site.

Conditions of Use

- Use a wheel wash when BMP C105: Stabilized Construction Access is not preventing sediment from being tracked off site.
- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.
- Wheel wash wastewater is not stormwater. It is commonly called process water, and must be discharged to a separate on-site treatment system that prevents discharge to waters of the State, or to the sanitary sewer with local sewer district approval.
- Wheel washes may use closed-loop recirculation systems to conserve water use.
- Wheel wash wastewater shall not include wastewater from concrete washout areas.
- When practical, the wheel wash should be placed in sequence with BMP C105: Stabilized Construction Access. Locate the wheel wash such that vehicles exiting the wheel wash will enter directly onto BMP C105: Stabilized Construction Access. In order to achieve this, BMP C105: Stabilized Construction Access may need to be extended beyond the standard installation to meet the exit of the wheel wash.

Design and Installation Specifications

Suggested details are shown in Figure II-3.2: Wheel Wash. The Local Permitting Authority may allow other designs. A minimum of 6 inches of asphalt treated base (ATB) over crushed base material or 8 inches over a good subgrade is recommended to pave the wheel wash.

Use a low clearance truck to test the wheel wash before paving. Either a belly dump or lowboy will work well to test clearance.

Keep the water level from 12 to 14 inches deep to avoid damage to truck hubs and filling the truck tongues with water.

Midpoint spray nozzles are only needed in extremely muddy conditions.

Wheel wash systems should be designed with a small grade change, 6- to 12-inches for a 10-foot-wide pond, to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment. A drainpipe with a 2- to 3-foot riser should be installed on the low side of the pond to allow for easy cleaning and refilling. Polymers may be used to promote coagulation and flocculation in a closed-loop system. Polyacrylamide (PAM) added to the wheel wash water at a rate of 0.25 - 0.5 pounds per 1,000 gallons of water increases effectiveness and reduces cleanup time. If PAM is already being used for dust or erosion control and is being applied by a water truck, the same truck can be used to change the wash water.

Maintenance Standards

The wheel wash should start out each day with fresh water.

The wheel wash water should be changed a minimum of once per day. On large earthwork jobs where more than 10-20 trucks per hour are expected, the wheel wash water will need to be changed more often.

Approved as Functionally Equivalent

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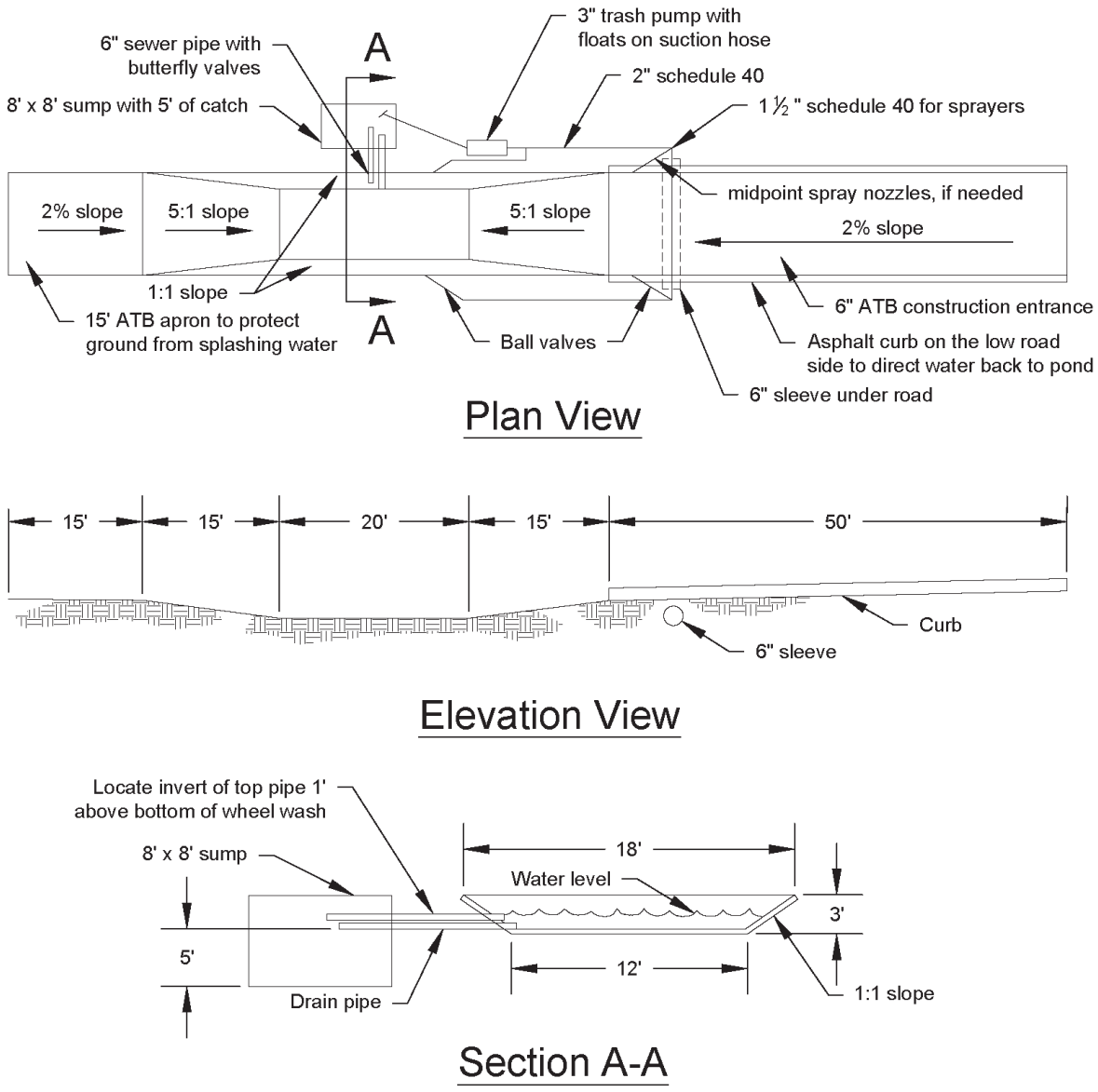
Figure II-3.2: Wheel Wash



Notes:

1. Build 8' x 8' sump to accomodate cleaning by trackhoe.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Wheel Wash

Revised June 2016

BMP C107: Construction Road / Parking Area Stabilization

Purpose

Stabilizing roads, parking areas, and other on-site vehicle transportation routes immediately after grading reduces erosion caused by construction traffic or stormwater runoff.

Conditions of Use

Roads and parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.

BMP C103: High-Visibility Fence shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

Design and Installation Specifications

- On areas that will receive asphalt as part of the project, install the first lift as soon as possible.
- A 6-inch depth of 2- to 4-inch crushed rock, gravel base, or crushed surfacing base course shall be applied immediately after grading or utility installation. A 4-inch course of asphalt treated base (ATB) may also be used, or the road/parking area may be paved. It may also be possible to use cement or calcium chloride for soil stabilization. If cement or cement kiln dust is used for roadbase stabilization, pH monitoring and BMP C252: Treating and Disposing of High pH Water is necessary to evaluate and minimize the effects on stormwater. If the area will not be used for permanent roads, parking areas, or structures, a 6-inch depth of hog fuel may also be used, but this is likely to require more maintenance. Whenever possible, construction roads and parking areas shall be placed on a firm, compacted subgrade.
- Temporary road gradients shall not exceed 15 percent. Roadways shall be carefully graded to drain. Drainage ditches shall be provided on each side of the roadway in the case of a crowned section, or on one side in the case of a super-elevated section. Drainage ditches shall be directed to a sediment control BMP.
- Rather than relying on ditches, it may also be possible to grade the road so that runoff sheetflows into a heavily vegetated area with a well-developed topsoil. Landscaped areas are not adequate. If this area has at least 50 feet of vegetation that water can flow through, then it is generally preferable to use the vegetation to treat runoff, rather than a sediment pond or trap. The 50 feet shall not include wetlands or their buffers. If runoff is allowed to sheetflow through adjacent vegetated areas, it is vital to design the roadways and parking areas so that no concentrated runoff is created.
- Storm drain inlets shall be protected to prevent sediment-laden water entering the drainage system (see BMP C220: Inlet Protection).

Maintenance Standards

Inspect stabilized areas regularly, especially after large storm events.

Crushed rock, gravel base, etc., shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.

Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.

Perform street cleaning at the end of each day or more often if necessary.

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

Use seeding throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.

The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1.

Between July 1 and August 30 seeding requires irrigation until 75 percent grass cover is established.

Between October 1 and March 30 seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established.

Review all disturbed areas in late August to early September and complete all seeding by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.

Mulch is required at all times for seeding because it protects seeds from heat, moisture loss, and transport due to runoff. Mulch can be applied on top of the seed or simultaneously by hydroseeding. See BMP C121: Mulching for specifications.

Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See BMP T5.13: Post-Construction Soil Quality and Depth.

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix. For vegetated channels that will have high flows, install erosion control blankets over the top of hydroseed. Before allowing water to flow in vegetated channels, establish 75 percent vegetation cover. If vegetated channels cannot be established by seed

before water flow; install sod in the channel bottom — over top of hydromulch and erosion control blankets.

- Confirm the installation of all required surface water control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. See BMP C121: Mulching for specifications.
- Areas that will have seeding only and not landscaping may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Re-install native topsoil on the disturbed soil surface before application. See BMP T5.13: Post-Construction Soil Quality and Depth.
- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. To overcome this, consider increasing seed quantities by up to 50 percent.
- Enhance vegetation establishment by dividing the hydromulch operation into two phases:
    - Phase 1- Install all seed and fertilizer with 25-30 percent mulch and tackifier onto soil in the first lift.
    - Phase 2- Install the rest of the mulch and tackifier over the first lift.

  Or, enhance vegetation by:
    - Installing the mulch, seed, fertilizer, and tackifier in one lift.
    - Spread or blow straw over the top of the hydromulch at a rate of 800-1000 pounds per acre.
    - Hold straw in place with a standard tackifier.

  Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:
    - Irrigation.
    - Reapplication of mulch.
    - Repair of failed slope surfaces.

  This technique works with standard hydromulch (1,500 pounds per acre minimum) and Bonded Fiber Matrix/ Mechanically Bonded Fiber Matrix (BFM/MBFMs) (3,000 pounds per acre minimum).
- Seed may be installed by hand if:
    - Temporary and covered by straw, mulch, or topsoil.
    - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- The seed mixes listed in Table II-3.4: Temporary and Permanent Seed Mixes include

recommended mixes for both temporary and permanent seeding.

- Apply these mixes, with the exception of the wet area seed mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Apply the wet area seed mix at a rate of 60 pounds per acre.
- Consult the local suppliers or the local conservation district for their recommendations. The appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the local authority may be used, depending on the soil type and hydrology of the area.

Table II-3.4: Temporary and Permanent Seed Mixes

Common Name	Latin Name	% Weight	% Purity	% Germination
Temporary Erosion Control Seed Mix A standard mix for areas requiring a temporary vegetative cover.				
Chewings or annual blue grass	*Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye	*Lolium perenne*	50	98	90
Redtop or colonial bentgrass	*Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover	*Trifolium repens*	5	98	90
Landscaping Seed Mix A recommended mix for landscaping seed.				
Perennial rye blend	*Lolium perenne*	70	98	90
Chewings and red fescue blend	*Festuca rubra var. commutata* or *Festuca rubra*	30	98	90
Low-Growing Turf Seed Mix A turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.				
Dwarf tall fescue (several varieties)	*Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay)	*Lolium perenne var. barclay*	30	98	90
Red fescue	*Festuca rubra*	20	98	90
Colonial bentgrass	*Agrostis tenuis*	5	98	90
Bioswale Seed Mix A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fes-	*Festuca arundin-*	75-80	98	90

Table II-3.4: Temporary and Permanent Seed Mixes (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
cue	*acea* or *Festuca elatior*			
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	92	85
Redtop bentgrass	*Agrostis alba* or *Agrostis gigantea*	5-10	90	80
Wet Area Seed Mix A low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.				
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	98	85
Meadow foxtail	*Alepocurus pratensis*	10-15	90	80
Alsike clover	*Trifolium hybridum*	1-6	98	90
Redtop bentgrass	*Agrostis alba*	1-6	92	85
Meadow Seed Mix A recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.				
Redtop or Oregon bentgrass	*Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue	*Festuca rubra*	70	98	90
White dutch clover	*Trifolium repens*	10	98	90

Roughening and Rototilling

- The seedbed should be firm and rough. Roughen all soil no matter what the slope. Track walk slopes before seeding if engineering purposes require compaction. Backblading or smoothing of slopes greater than 4H:1V is not allowed if they are to be seeded.
- Restoration-based landscape practices require deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum,

permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches complete the rototilling process in multiple lifts, or prepare the engineered soil system per specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer is recommended. This will prevent the over-application of fertilizer.
- Organic matter is the most appropriate form of fertilizer because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form.
- In general, use 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre. Always use slow-release fertilizers because they are more efficient and have fewer environmental impacts. Do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use. Too much agitation destroys the slow-release coating.
- There are numerous products available that take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100 percent cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal provides a good source of long-term, slow-release, available nitrogen.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

- On steep slopes use Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre with approximately 10 percent tackifier. Achieve a minimum of 95 percent soil coverage during application. Numerous products are available commercially. Most products require 24-36 hours to cure before rainfall and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs provide good alternatives to blankets in most areas requiring vegetation establishment. Advantages over blankets include:
    - BFM and MBFMs do not require surface preparation.
    - Helicopters can assist in installing BFM and MBFMs in remote areas.
    - On slopes steeper than 2.5H:1V, blanket installers may require ropes and harnesses for safety.
    - Installing BFM and MBFMs can save at least $1,000 per acre compared to blankets.

Maintenance Standards

Reseed any seeded areas that fail to establish at least 75 percent cover (100 percent cover for areas that receive sheet or concentrated flows). If reseeding is ineffective, use an alternate method such as sodding, mulching, nets, or blankets.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. Reseed and protect by mulch any eroded area.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes run-off.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

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BMP C121: Mulching

Purpose

Mulching soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There are a variety of mulches that can be used. This section discusses only the most common types of mulch.

Conditions of Use

As a temporary cover measure, mulch should be used:

- For less than 30 days on disturbed areas that require cover.
- At all times for seeded areas, especially during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

For seeded areas, mulch may be made up of 100 percent:

- cottonseed meal;
- fibers made of wood, recycled cellulose, hemp, or kenaf;

- compost;
- or blends of these.

Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers.

Generally, mulches come in 40-50 pound bags. Seed and fertilizer are added at time of application.

Recycled cellulose may contain polychlorinated biphenyl (PCBs). Ecology recommends that products should be evaluated for PCBs prior to use.

Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.

Any mulch or tackifier product used shall be installed per the manufacturer's instructions.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see Table II-3.6: Mulch Standards and Guidelines. Consult with the local supplier or the local conservation district for their recommendations. Increase the application rate until the ground is 95% covered (i.e. not visible under the mulch layer). Note: Thickness may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.

Where the option of "Compost" is selected, it should be a coarse compost that meets the size gradations listed in Table II-3.5: Size Gradations of Compost as Mulch Material when tested in accordance with Test Method 02.02-B found in *Test Methods for the Examination of Composting and Compost* (Thompson, 2001).

Table II-3.5: Size Gradations of Compost as Mulch Material

Sieve Size	Percent Passing
3"	100%
1"	90% - 100%
3/4"	70% - 100%
1/4"	40% - 100%

Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material. Consult the Hydraulic Permit Authority (HPA) for mulch mixes if applicable.

Maintenance Standards

The thickness of the mulch cover must be maintained.

Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

Table II-3.6: Mulch Standards and Guidelines

Mulch Material	Guideline	Description
Straw	**Quality Standards**	Air-dried; free from undesirable seed and coarse material.
	Application Rates	2"-3" thick; 5 bales per 1,000 sf or 2-3 tons per acre
	Remarks	Cost-effective protection when applied with adequate thickness. Hand-application generally requires greater thickness than blown straw. The thickness of straw may be reduced by half when used in conjunction with seeding. In windy areas straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier as even light winds will blow it away. Straw, however, has several deficiencies that should be considered when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and it has no significant long-term benefits It should also not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	**Quality Standards**	No growth inhibiting factors.
	Application Rates	Approx. 35-45 lbs per 1,000 sf or 1,500 - 2,000 lbs per acre
	Remarks	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about 3/4 - 1 inch clog hydromulch equipment. Fibers should be kept to less than 3/4 inch.
Compost	**Quality Standards**	No visible water or dust during handling. Must be produced per WAC 173-350, Solid Waste Handling Standards, but may have up to 35% biosolids.
	Application Rates	2" thick min.; approx. 100 tons per acre (approx. 750 lbs per cubic yard)
	Remarks	More effective control can be obtained by increasing thickness to 3". Excellent mulch for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Compost used for mulch has a coarser size gradation than compost used for BMP C125: Topsoiling / Composting or BMP T5.13: Post-Construction Soil Quality and Depth. It is more stable and practical to use in wet areas and during rainy weather conditions. Do not use near wetlands or near phosphorous impaired water bodies.
Chipped Site Vegetation	**Quality Standards**	Gradations from fines to 6 inches in length for texture, variation, and interlocking properties. Include a mix of various sizes so that the average size is between 2- and 4- inches.
	Application Rates	2" thick min.;

Table II-3.6: Mulch Standards and Guidelines (continued)

Mulch Material	Guideline	Description
	Remarks	This is a cost-effective way to dispose of debris from clearing and grubbing, and it eliminates the problems associated with burning. Generally, it should not be used on slopes above approx. 10% because of its tendency to be transported by runoff. It is not recommended within 200 feet of surface waters. If permanent seeding or planting is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment. Note: thick application of this material over existing grass, herbaceous species, and some groundcovers could smother and kill vegetation.
Wood-Based Mulch	**Quality Standards**	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.
	Application Rates	2" thick min.; approx. 100 tons per acre (approx. 750 lbs. per cubic yard)
	Remarks	This material is often called "wood straw" or "hog fuel". The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).
Wood Strand Mulch	**Quality Standards**	A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.
	Application Rates	2" thick min.
	Remarks	Cost-effective protection when applied with adequate thickness. A minimum of 95-percent of the wood strand shall have lengths between 2 and 10-inches, with a width and thickness between 1/16 and 1/2-inches. The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life. Sawdust or wood shavings shall not be used as mulch. [Specification 9-14.4(4) from the *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT, 2016)

BMP C122: Nets and Blankets

Purpose

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows.

Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (for example, coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use

Erosion control netting and blankets shall be made of natural plant fibers unaltered by synthetic materials.

Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap.

Disadvantages of nets and blankets include:

- Surface preparation is required.
- On slopes steeper than 2.5H:1V, net and blanket installers may need to be roped and harnessed for safety.
- They cost at least $4,000-6,000 per acre installed.

Advantages of nets and blankets include:

- Installation without mobilizing special equipment.
- Installation by anyone with minimal training
- Installation in stages or phases as the project progresses.
- Installers can hand place seed and fertilizer as they progress down the slope.
- Installation in any weather.
- There are numerous types of nets and blankets that can be designed with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

An alternative to nets and blankets in some limited conditions is BMP C202: Riprap Channel Lining. Ensure that BMP C202: Riprap Channel Lining is appropriate before using it as a substitute for nets and blankets.

Design and Installation Specifications

- See Figure II-3.3: Channel Installation (Clackamas County et al., 2008) and Figure II-3.4: Slope Installation for typical orientation and installation of nets and blankets used in channels and as slope protection. Note: these are typical only; all nets and blankets must be installed per manufacturer's installation instructions.
- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Installation of nets and blankets on slopes:
    1. Complete final grade and track walk up and down the slope.
    2. Install hydromulch with seed and fertilizer.
    3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.
    4. Install the leading edge of the net/blanket into the small trench and staple approximately every 18 inches. NOTE: Staples are metal, "U"-shaped, and a minimum of 6 inches long. Longer staples are used in sandy soils. Biodegradable stakes are also available.
    5. Roll the net/blanket slowly down the slope as the installer walks backward. NOTE: The net/blanket rests against the installer's legs. Staples are installed as the net/blanket is unrolled. It is critical that the proper staple pattern is used for the net/blanket being installed. The net/blanket is not to be allowed to roll down the slope on its own as this stretches the net/blanket, making it impossible to maintain soil contact. In addition, no one is allowed to walk on the net/blanket after it is in place.
    6. If the net/blanket is not long enough to cover the entire slope length, the trailing edge of the upper net/blanket should overlap the leading edge of the lower net/blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.
- With the variety of products available, it is impossible to cover all the details of appropriate use and installation. Therefore, it is critical that the designer consult the manufacturer's information and that a site visit takes place in order to ensure that the product specified is appropriate. Information is also available in WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Division 8-01 and Division 9-14 (WSDOT, 2016).
- Use jute matting in conjunction with mulch (BMP C121: Mulching). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets (e.g., jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate candidates for use of synthetic blankets, as are riverbanks, beaches and other high-energy environments. If

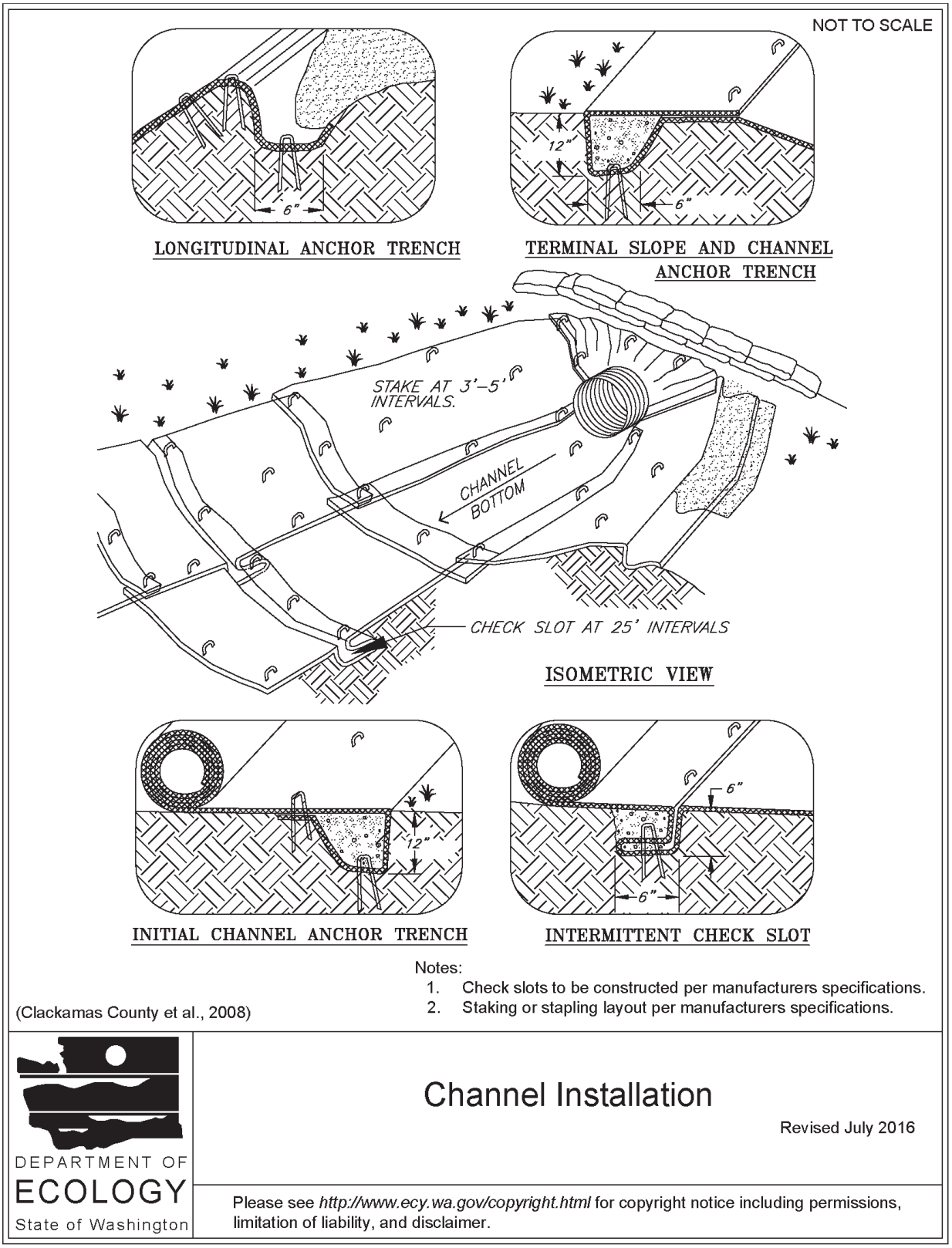
synthetic blankets are used, the soil should be hydromulched first.

- 100-percent biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which may last up to a year.
- Most netting used with blankets is photodegradable, meaning it breaks down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Maintenance Standards

- Maintain good contact with the ground. Erosion must not occur beneath the net or blanket.
- Repair and staple any areas of the net or blanket that are damaged or not in close contact with the ground.
- Fix and protect eroded areas if erosion occurs due to poorly controlled drainage.

Figure II-3.3: Channel Installation



Notes:

1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.

(Clackamas County et al., 2008)

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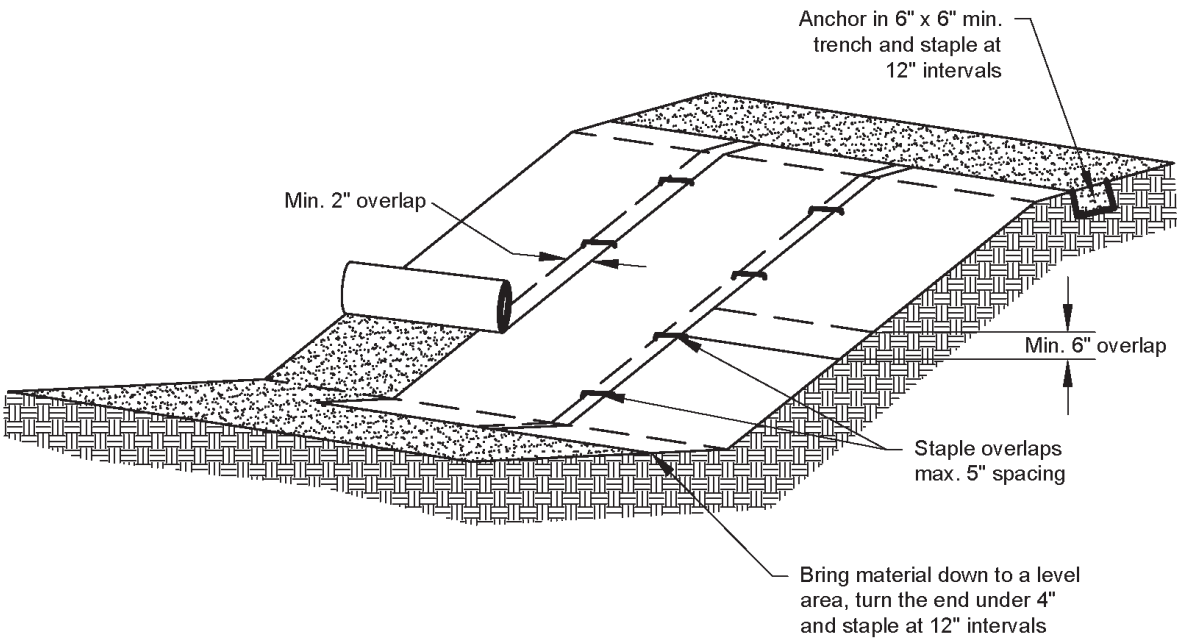
State of Washington

Channel Installation

Revised July 2016

Figure II-3.4: Slope Installation



Notes:

1. Slope surface shall be smooth before placement for proper soil contact.
2. Stapling pattern as per manufacturer's recommendations.
3. Do not stretch blankets/mattings tight - allow the rolls to mold to any irregularities.
4. For slopes less than 3H:1V, rolls may be placed in horizontal strips.
5. If there is a berm at the top of the slope, anchor upslope of the berm.
6. Lime, fertilize, and seed before installation. Planting of shrubs, trees, etc. should occur after installation.

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State of Washington

Slope Installation

Revised June 2016

BMP C123: Plastic Covering

Purpose

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Conditions of Use

Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.

- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. However, the relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for applications greater than six months.
- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on-site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- Although the plastic material is inexpensive to purchase, the cost of installation, maintenance, removal, and disposal add to the total costs of this BMP.
- Whenever plastic is used to protect slopes, install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to convey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.
- Other uses for plastic include:
    - Temporary ditch liner.
    - Pond liner in temporary sediment pond.
    - Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored.
    - Emergency slope protection during heavy rains.
    - Temporary drainpipe (“elephant trunk”) used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:
    1. Run plastic up and down the slope, not across the slope.
    2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.

3. Provide a minimum of 8-inch overlap at the seams.
4. On long or wide slopes, or slopes subject to wind, tape all seams.
5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil, which causes extreme erosion.
8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.

- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace the plastic if it begins to deteriorate due to ultraviolet radiation.
- Completely remove plastic when no longer needed.
- Dispose of old tires used to weight down plastic sheeting appropriately.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C124: Sodding

Purpose

The purpose of sodding is to establish turf for immediate erosion protection and to stabilize drainage paths where concentrated overland flow will occur.

pipe, sandbags, geotextile fabric and steel “T” posts.

- Materials should be stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or project proponent could keep a stockpile of materials that are available for use on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum list of items that will cover numerous situations includes:

- Clear Plastic, 6 mil
- Drainpipe, 6 or 8 inch diameter
- Sandbags, filled
- Straw Bales for mulching
- Quarry Spalls
- Washed Gravel
- Geotextile Fabric
- Catch Basin Inserts
- Steel "T" Posts
- Silt fence material
- Straw Wattles

Maintenance Standards

- All materials with the exception of the quarry spalls, steel “T” posts, and gravel should be kept covered and out of both sun and rain.
- Re-stock materials as needed.

BMP C151: Concrete Handling

Purpose

Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate concrete, concrete process water, and concrete slurry from entering waters of the State.

Conditions of Use

Any time concrete is used, utilize these management practices. Concrete construction project components include, but are not limited to:

- Curbs
- Sidewalks
- Roads
- Bridges
- Foundations
- Floors
- Runways

Disposal options for concrete, in order of preference are:

1. Off-site disposal
2. Concrete wash-out areas (see BMP C154: Concrete Washout Area)
3. De minimus washout to formed areas awaiting concrete

Design and Installation Specifications

- Wash concrete truck drums at an approved off-site location or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground (including formed areas awaiting concrete), or into storm drains, open ditches, streets, or streams. Refer to BMP C154: Concrete Washout Area for information on concrete washout areas.
    - Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete on site, except in designated concrete washout areas as allowed in BMP C154: Concrete Washout Area.
- Wash small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheelbarrows) into designated concrete washout areas or into formed areas awaiting concrete pour.
- At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow washwater from areas, such as concrete aggregate driveways, to drain directly (without detention or treatment) to natural or constructed stormwater conveyances.
- Contain washwater and leftover product in a lined container when no designated concrete washout areas (or formed areas, allowed as described above) are available. Dispose of contained concrete and concrete washwater (process water) properly.

- Always use forms or solid barriers for concrete pours, such as pilings, within 15-feet of surface waters.
- Refer to BMP C252: Treating and Disposing of High pH Water for pH adjustment requirements.
- Refer to the Construction Stormwater General Permit (CSWGP) for pH monitoring requirements if the project involves one of the following activities:
    - Significant concrete work (as defined in the CSWGP).
    - The use of soils amended with (but not limited to) Portland cement-treated base, cement kiln dust or fly ash.
    - Discharging stormwater to segments of water bodies on the 303(d) list (Category 5) for high pH.

Maintenance Standards

Check containers for holes in the liner daily during concrete pours and repair the same day.

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose

Sawcutting and surfacing operations generate slurry and process water that contains fine particles and high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate process water and slurry created through sawcutting or surfacing from entering waters of the State.

Conditions of Use

Utilize these management practices anytime sawcutting or surfacing operations take place. Sawcutting and surfacing operations include, but are not limited to:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing

Design and Installation Specifications

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance including stormwater systems. This may require temporarily blocking catch basins.
- Dispose of collected slurry and cuttings in a manner that does not violate ground water or surface water quality standards.
- Do not allow process water generated during hydro-demolition, surface roughening or similar operations to drain to any natural or constructed drainage conveyance including stormwater systems. Dispose of process water in a manner that does not violate ground water or surface water quality standards.
- Handle and dispose of cleaning waste material and demolition debris in a manner that does not cause contamination of water. Dispose of sweeping material from a pick-up sweeper at an appropriate disposal site.

Maintenance Standards

Continually monitor operations to determine whether slurry, cuttings, or process water could enter waters of the state. If inspections show that a violation of water quality standards could occur, stop operations and immediately implement preventive measures such as berms, barriers, secondary containment, and/or vacuum trucks.

BMP C153: Material Delivery, Storage, and Containment

Purpose

Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on-site, store materials in a designated area, and install secondary containment.

Conditions of Use

Use at construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g., Polyacrylamide)
- Fertilizers, pesticides and herbicides
- Detergents
- Asphalt and concrete compounds

BMP C160: Certified Erosion and Sediment Control Lead

Purpose

The project proponent designates at least one person as the responsible representative in charge of erosion and sediment control (ESC), and water quality protection. The designated person shall be responsible for ensuring compliance with all local, state, and federal erosion and sediment control and water quality requirements. Construction sites one acre or larger that discharge to waters of the State must designate a Certified Erosion and Sediment Control Lead (CESCL) as the responsible representative.

Conditions of Use

A CESCL shall be made available on projects one acre or larger that discharge stormwater to surface waters of the state. Sites less than one acre may have a person without CESCL certification conduct inspections.

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology.

  Ecology has provided the minimum requirements for CESCL course training, as well as a list of ESC training and certification providers at:

  https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Certified-erosion-sediment-control

  OR

- Be a Certified Professional in Erosion and Sediment Control (CPESC). For additional information go to:

  http://www.envirocertintl.org/cpesc/

Specifications

- CESCL certification shall remain valid for three years.
- The CESCL shall have authority to act on behalf of the contractor or project proponent and shall be available, or on-call, 24 hours per day throughout the period of construction.
- The Construction SWPPP shall include the name, telephone number, fax number, and address of the designated CESCL. See II-2 Construction Stormwater Pollution Prevention Plans (Construction SWPPPs).
- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region, but must be on site whenever earthwork activities are

occurring that could generate release of turbid water.

- Duties and responsibilities of the CESCL shall include, but are not limited to the following:
    - Maintaining a permit file on site at all times which includes the Construction SWPPP and any associated permits and plans.
    - Directing BMP installation, inspection, maintenance, modification, and removal.
    - Updating all project drawings and the Construction SWPPP with changes made.
    - Completing any sampling requirements including reporting results using electronic Discharge Monitoring Reports (WebDMR).
    - Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.
    - Keeping daily logs, and inspection reports. Inspection reports should include:
        - Inspection date/time.
        - Weather information; general conditions during inspection and approximate amount of precipitation since the last inspection.
        - Visual monitoring results, including a description of discharged stormwater. The presence of suspended sediment, turbid water, discoloration, and oil sheen shall be noted, as applicable.
        - Any water quality monitoring performed during inspection.
        - General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.
        - A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:
            1. Locations of BMPs inspected.
            2. Locations of BMPs that need maintenance.
            3. Locations of BMPs that failed to operate as designed or intended.
            4. Locations of where additional or different BMPs are required.

BMP C162: Scheduling

Purpose

Sequencing a construction project reduces the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

thickness is 2 feet.

- For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), use an engineered energy dissipator.
- Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion. See BMP C122: Nets and Blankets.

- Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. This work may require a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife. See I-2.11 Hydraulic Project Approvals.

Maintenance Standards

- Inspect and repair as needed.
- Add rock as needed to maintain the intended function.
- Clean energy dissipator if sediment builds up.

BMP C220: Inlet Protection

Purpose

Inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Conditions of Use

Use inlet protection at inlets that are operational before permanent stabilization of the disturbed areas that contribute runoff to the inlet. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless those inlets are preceded by a sediment trapping BMP.

Also consider inlet protection for lawn and yard drains on new home construction. These small and numerous drains coupled with lack of gutters can add significant amounts of sediment into the roof drain system. If possible, delay installing lawn and yard drains until just before landscaping, or cap these drains to prevent sediment from entering the system until completion of landscaping. Provide 18-inches of sod around each finished lawn and yard drain.

Table II-3.10: Storm Drain Inlet Protection lists several options for inlet protection. All of the methods for inlet protection tend to plug and require a high frequency of maintenance. Limit contributing drainage areas for an individual inlet to one acre or less. If possible, provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

Table II-3.10: Storm Drain Inlet Protection

Type of Inlet Protection	Emergency Overflow	Applicable for Paved/ Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding may occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area requirement: 30'x30'/acre
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No	Paved or Earthen	Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Block and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap	N/A	N/A	18 month expected life.

Design and Installation Specifications

Excavated Drop Inlet Protection

Excavated drop inlet protection consists of an excavated impoundment around the storm drain inlet. Sediment settles out of the stormwater prior to entering the storm drain. Design and installation specifications for excavated drop inlet protection include:

- Provide a depth of 1-2 ft as measured from the crest of the inlet structure.
- Slope sides of excavation should be no steeper than 2H:1V.
- Minimum volume of excavation is 35 cubic yards.
- Shape the excavation to fit the site, with the longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water.
- Clear the area of all debris.

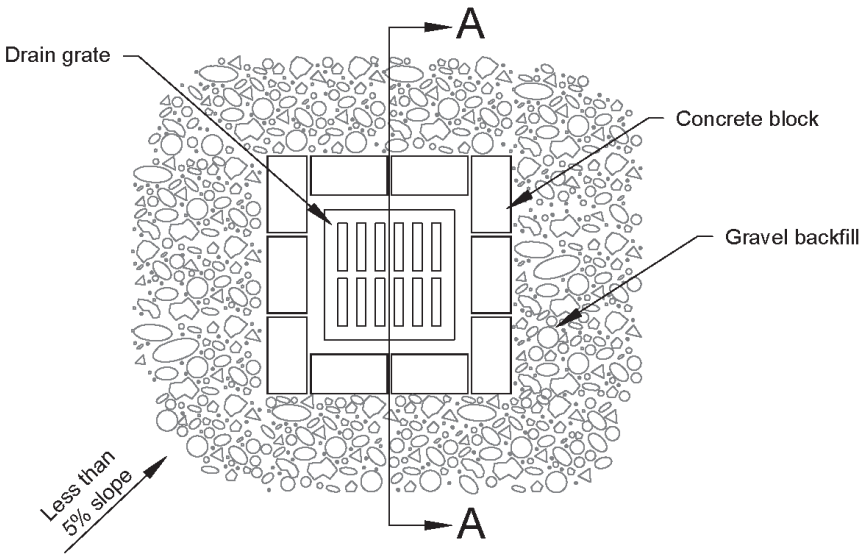
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope side of the structure to prevent bypass flow.

Block and Gravel Filter

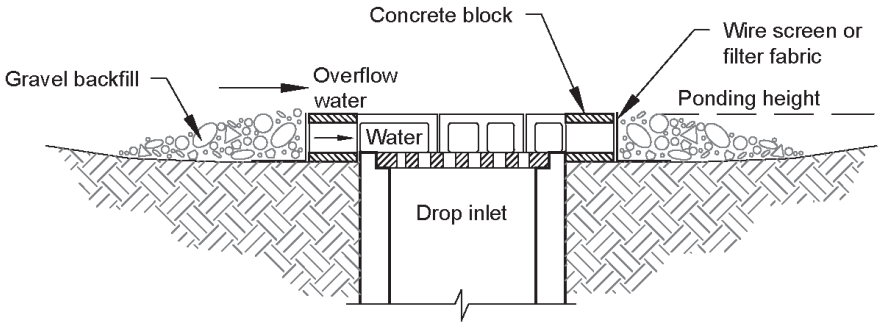
A block and gravel filter is a barrier formed around the inlet with standard concrete blocks and gravel. See Figure II-3.17: Block and Gravel Filter. Design and installation specifications for block gravel filters include:

- Provide a height of 1 to 2 feet above the inlet.
- Recess the first row of blocks 2-inches into the ground for stability.
- Support subsequent courses by placing a pressure treated wood 2x4 through the block opening.
- Do not use mortar.
- Lay some blocks in the bottom row on their side to allow for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel to just below the top of blocks on slopes of 2H:1V or flatter.
- An alternative design is a gravel berm surrounding the inlet, as follows:
    - Provide a slope of 3H:1V on the upstream side of the berm.
    - Provide a slope of 2H:1V on the downstream side of the berm.
    - Provide a 1-foot wide level stone area between the gravel berm and the inlet.
    - Use stones 3 inches in diameter or larger on the upstream slope of the berm.
    - Use gravel ½- to ¾-inch at a minimum thickness of 1-foot on the downstream slope of the berm.

Figure II-3.17: Block and Gravel Filter



Plan View



Section A-A

Notes:

1. Drop inlet sediment barriers are to be used for small, nearly level drainage areas. (less than 5%)
2. Excavate a basin of sufficient size adjacent to the drop inlet.
3. The top of the structure (ponding height) must be well below the ground elevation downslope to prevent runoff from bypassing the inlet. A temporary dike may be necessary on the downslope side of the structure.

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State of Washington

Block and Gravel Filter

Revised June 2016

Gravel and Wire Mesh Filter

Gravel and wire mesh filters are gravel barriers placed over the top of the inlet. This method does not provide an overflow. Design and installation specifications for gravel and wire mesh filters include:

- Use a hardware cloth or comparable wire mesh with ½-inch openings.
    - Place wire mesh over the drop inlet so that the wire extends a minimum of 1-foot beyond each side of the inlet structure.
    - Overlap the strips if more than one strip of mesh is necessary.
- Place coarse aggregate over the wire mesh.
    - Provide at least a 12-inch depth of aggregate over the entire inlet opening and extend at least 18-inches on all sides.

Catch Basin Filters

Catch basin filters are designed by manufacturers for construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. To reduce maintenance requirements, combine a catch basin filter with another type of inlet protection. This type of inlet protection provides flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way. Design and installation specifications for catch basin filters include:

- Provides 5 cubic feet of storage.
- Requires dewatering provisions.
- Provides a high-flow bypass that will not clog under normal use at a construction site.
- Insert the catch basin filter in the catch basin just below the grating.

Curb Inlet Protection with Wooden Weir

Curb inlet protection with wooden weir is an option that consists of a barrier formed around a curb inlet with a wooden frame and gravel. Design and installation specifications for curb inlet protection with wooden weirs include:

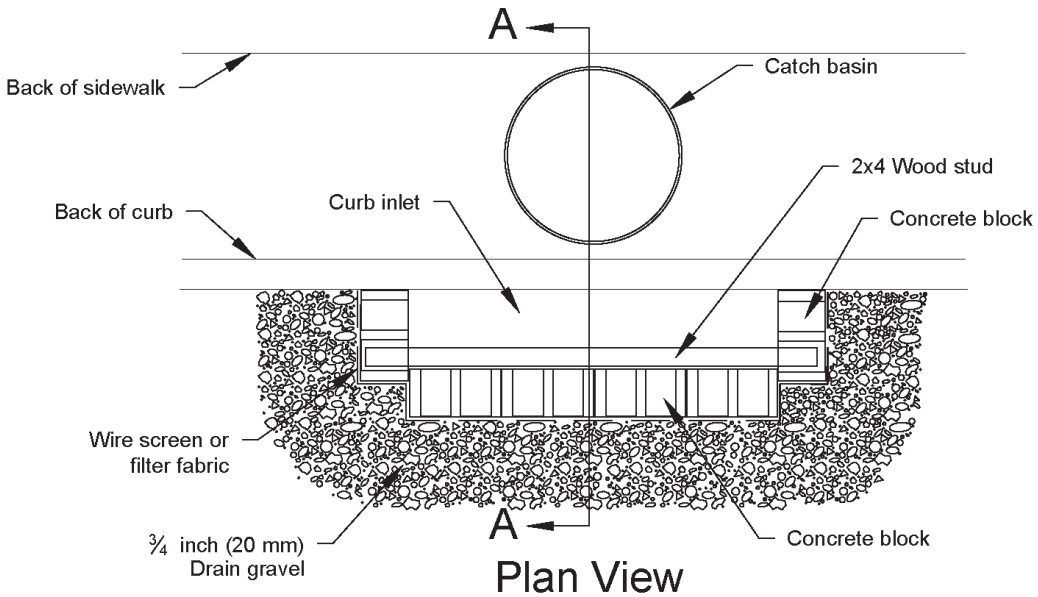
- Use wire mesh with ½-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against the wire and fabric.
- Place weight on the frame anchors.

Block and Gravel Curb Inlet Protection

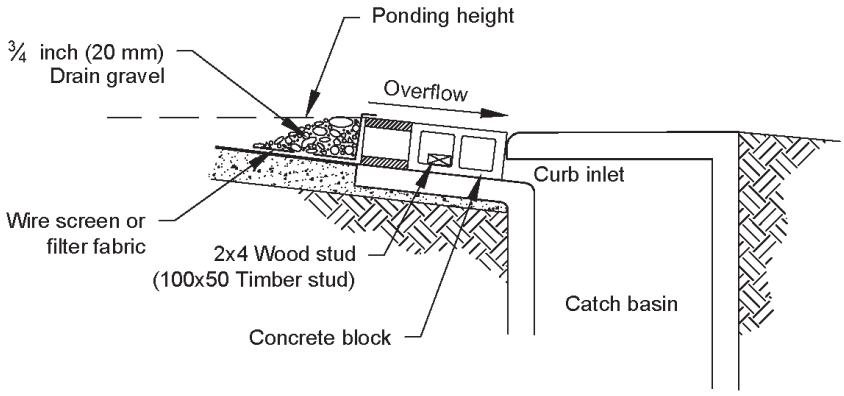
Block and gravel curb inlet protection is a barrier formed around a curb inlet with concrete blocks and gravel. See Figure II-3.18: Block and Gravel Curb Inlet Protection. Design and installation specifications for block and gravel curb inlet protection include:

- Use wire mesh with ½-inch openings.
- Place two concrete blocks on their sides abutting the curb at either side of the inlet opening. These are spacer blocks.
- Place a 2x4 stud through the outer holes of each spacer block to align the front blocks.
- Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
- Place wire mesh over the outside vertical face.
- Pile coarse aggregate against the wire to the top of the barrier.

Figure II-3.18: Block and Gravel Curb Inlet Protection



Plan View



Section A-A

Notes:

1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

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State of Washington

Block and Gravel Curb Inlet Protection

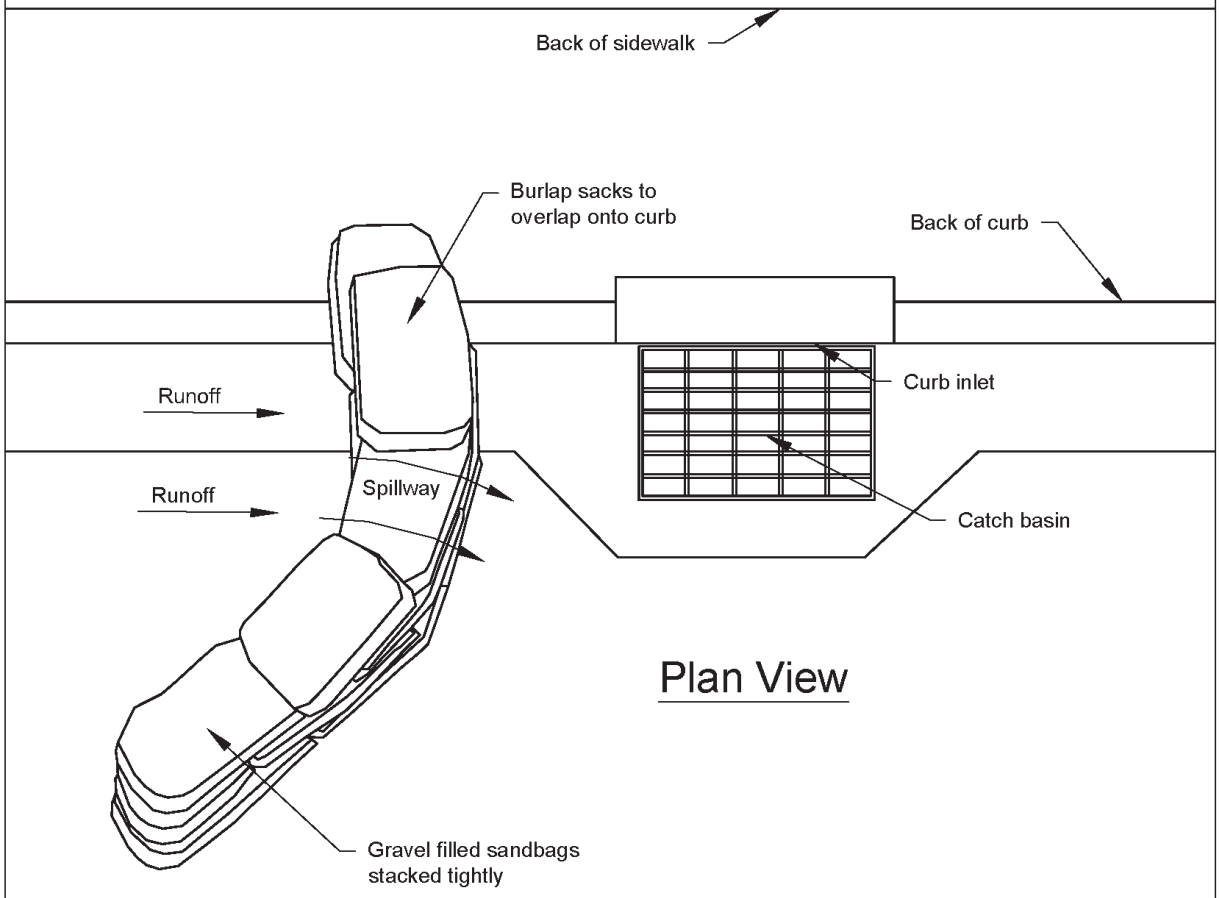
Revised June 2016

Curb and Gutter Sediment Barrier

Curb and gutter sediment barrier is a sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure II-3.19: Curb and Gutter Barrier. Design and installation specifications for curb and gutter sediment barrier include:

- Construct a horseshoe shaped berm, faced with coarse aggregate if using riprap, 3 feet high and 3 feet wide, at least 2 feet from the inlet.
- Construct a horseshoe shaped sedimentation trap on the upstream side of the berm. Size the trap to sediment trap standards for protecting a culvert inlet.

Figure II-3.19: Curb and Gutter Barrier



Notes:

1. Place curb type sediment barriers on gently sloping street segments, where water can pond and allow sediment to separate from runoff.
2. Sandbags of either burlap or woven 'geotextile' fabric, are filled with gravel, layered and packed tightly.
3. Leave a one sandbag gap in the top row to provide a spillway for overflow.
4. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

NOT TO SCALE

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State of Washington

Curb and Gutter Barrier

Revised June 2016

Maintenance Standards

- Inspect all forms of inlet protection frequently, especially after storm events. Clean and replace clogged catch basin filters. For rock and gravel filters, pull away the rocks from the inlet and clean or replace. An alternative approach would be to use the clogged rock as fill and put fresh rock around the inlet.
- Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C231: Brush Barrier

Purpose

The purpose of brush barriers is to reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Brush barriers may be used downslope of disturbed areas that are less than one-quarter acre.
- Brush barriers are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be directed to a sediment trapping BMP. The only circumstance in which overland flow can be treated solely by a brush barrier, rather than by a sediment trapping BMP, is when the area draining to the barrier is small.
- Brush barriers should only be installed on contours.

Design and Installation Specifications

- Height: 2 feet (minimum) to 5 feet (maximum).
- Width: 5 feet at base (minimum) to 15 feet (maximum).
- Filter fabric (geotextile) may be anchored over the brush berm to enhance the filtration ability of the barrier. Ten-ounce burlap is an adequate alternative to filter fabric.

BMP C233: Silt Fence

Purpose

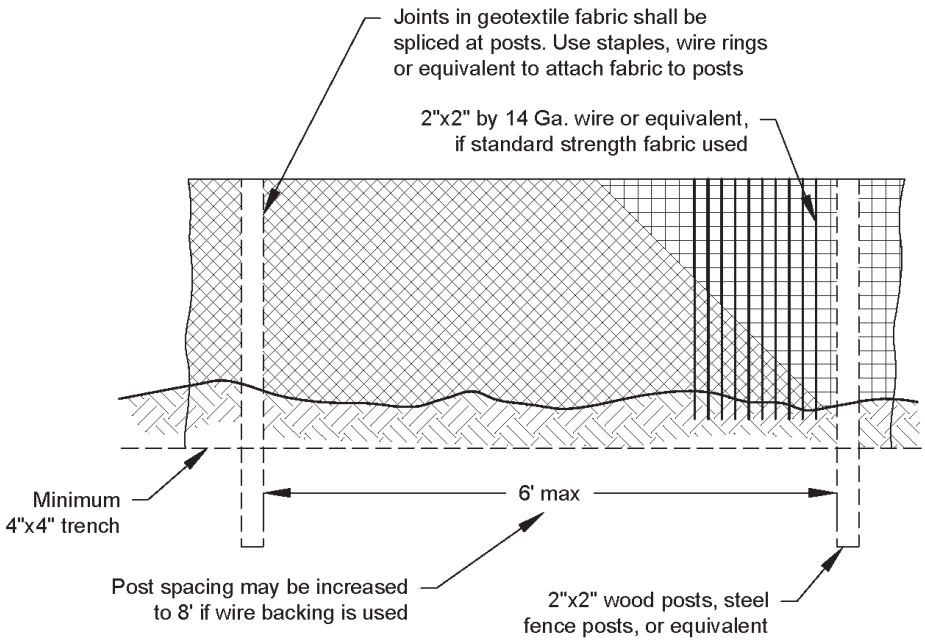
Silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

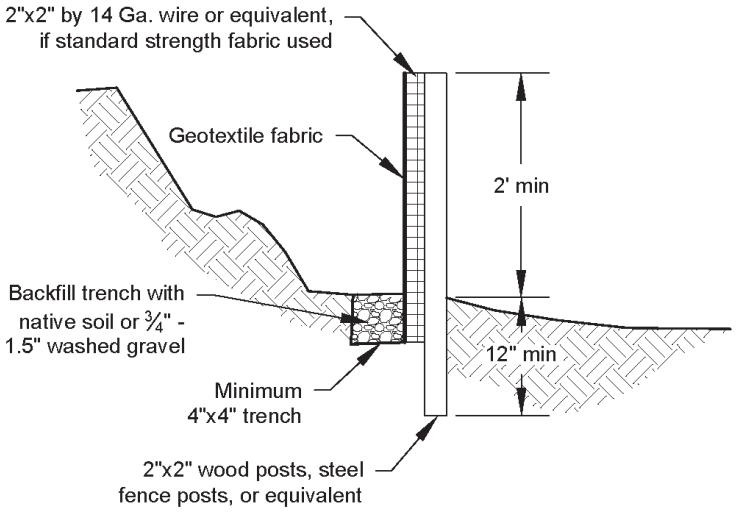
Conditions of Use

Silt fence may be used downslope of all disturbed areas.

- Silt fence shall prevent sediment carried by runoff from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Convey any concentrated flows through the drainage system to a sediment trapping BMP.
- Do not construct silt fences in streams or use in V-shaped ditches. Silt fences do not provide an adequate method of silt control for anything deeper than sheet or overland flow.

Figure II-3.22: Silt Fence





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State of Washington

Silt Fence

Revised July 2017

Design and Installation Specifications

- Use in combination with other construction stormwater BMPs.
- Maximum slope steepness (perpendicular to the silt fence line) 1H:1V.
- Maximum sheet or overland flow path length to the silt fence of 100 feet.
- Do not allow flows greater than 0.5 cfs.
- Use geotextile fabric that meets the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table II-3.11: Geotextile Fabric Standards for Silt Fence):

Table II-3.11: Geotextile Fabric Standards for Silt Fence

Geotextile Property	Minimum Average Roll Value
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film woven (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec^{-1} minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. Minimum for extra strength fabric. 100 lbs minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- Support standard strength geotextiles with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the geotextile. Silt fence materials are available that have synthetic mesh backing attached.
- Silt fence material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F to 120°F.
- One-hundred percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by the local jurisdiction.
- Refer to Figure II-3.22: Silt Fence for standard silt fence details. Include the following Standard Notes for silt fence on construction plans and specifications:

    1. The Contractor shall install and maintain temporary silt fences at the locations shown in the Plans.
    2. Construct silt fences in areas of clearing, grading, or drainage prior to starting those activities.

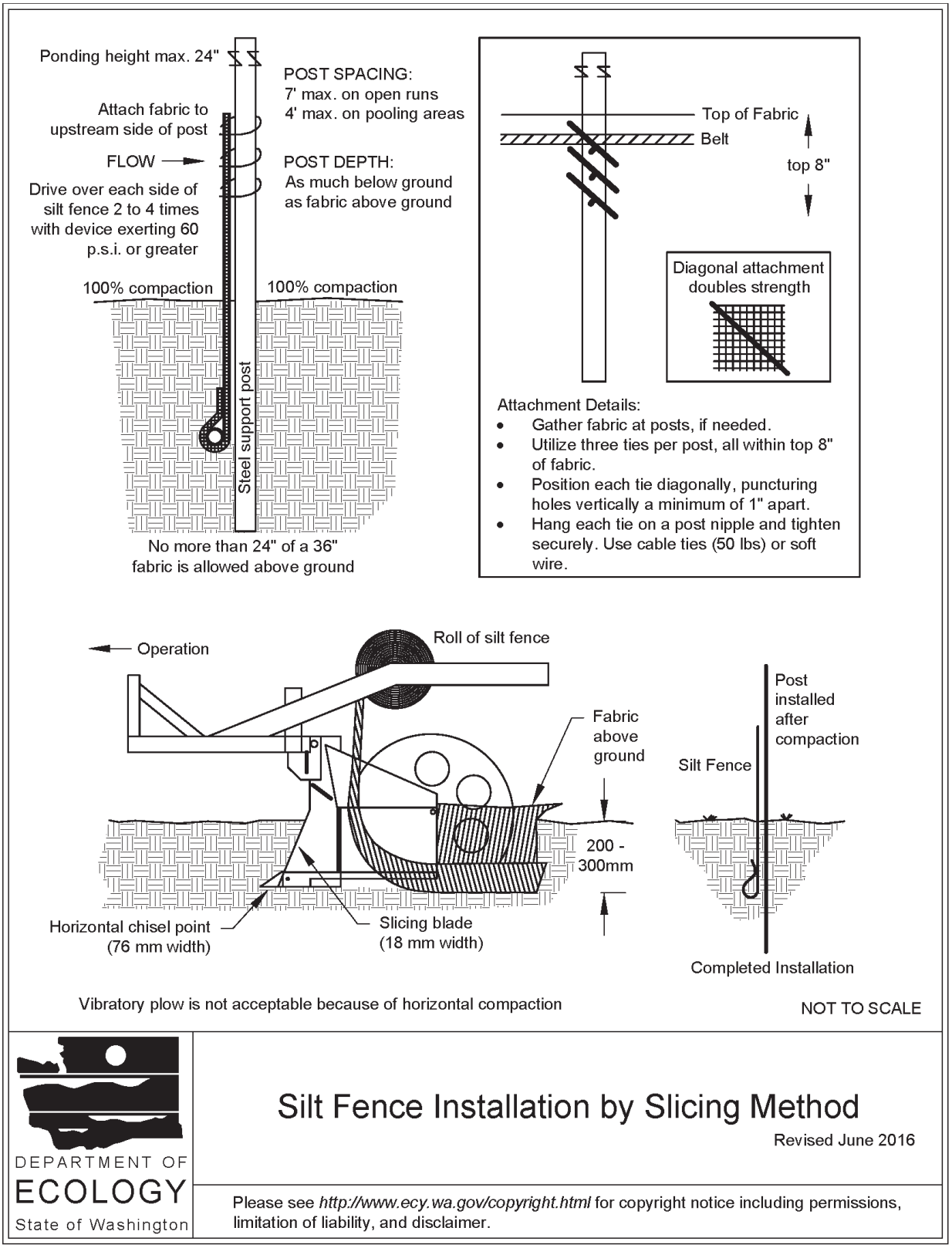
3. The silt fence shall have a 2-feet min. and a 2½-feet max. height above the original ground surface.
4. The geotextile fabric shall be sewn together at the point of manufacture to form fabric lengths as required. Locate all sewn seams at support posts. Alternatively, two sections of silt fence can be overlapped, provided that the overlap is long enough and that the adjacent silt fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.
5. Attach the geotextile fabric on the up-slope side of the posts and secure with staples, wire, or in accordance with the manufacturer's recommendations. Attach the geotextile fabric to the posts in a manner that reduces the potential for tearing.
6. Support the geotextile fabric with wire or plastic mesh, dependent on the properties of the geotextile selected for use. If wire or plastic mesh is used, fasten the mesh securely to the up-slope side of the posts with the geotextile fabric up-slope of the mesh.
7. Mesh support, if used, shall consist of steel wire with a maximum mesh spacing of 2-inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to the same level of ultraviolet radiation as the geotextile fabric it supports.
8. Bury the bottom of the geotextile fabric 4-inches min. below the ground surface. Backfill and tamp soil in place over the buried portion of the geotextile fabric, so that no flow can pass beneath the silt fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the ground 3-inches min.
9. Drive or place the silt fence posts into the ground 18-inches min. A 12–inch min. depth is allowed if topsoil or other soft subgrade soil is not present and 18-inches cannot be reached. Increase fence post min. depths by 6 inches if the fence is located on slopes of 3H:1V or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.
10. Use wood, steel or equivalent posts. The spacing of the support posts shall be a maximum of 6-feet. Posts shall consist of either:
    - Wood with minimum dimensions of 2 inches by 2 inches by 3 feet. Wood shall be free of defects such as knots, splits, or gouges.
    - No. 6 steel rebar or larger.
    - ASTM A 120 steel pipe with a minimum diameter of 1-inch.
    - U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft.
    - Other steel posts having equivalent strength and bending resistance to the post sizes listed above.
11. Locate silt fences on contour as much as possible, except at the ends of the fence,

where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.

12. If the fence must cross contours, with the exception of the ends of the fence, place check dams perpendicular to the back of the fence to minimize concentrated flow and erosion. The slope of the fence line where contours must be crossed shall not be steeper than 3H:1V.
    - Check dams shall be approximately 1-foot deep at the back of the fence. Check dams shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence.
    - Check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. Check dams shall be located every 10 feet along the fence where the fence must cross contours.

- Refer to Figure II-3.23: Silt Fence Installation by Slicing Method for slicing method details. The following are specifications for silt fence installation using the slicing method:
    1. The base of both end posts must be at least 2- to 4-inches above the top of the geotextile fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.
    2. Install posts 3- to 4-feet apart in critical retention areas and 6- to 7-feet apart in standard applications.
    3. Install posts 24-inches deep on the downstream side of the silt fence, and as close as possible to the geotextile fabric, enabling posts to support the geotextile fabric from upstream water pressure.
    4. Install posts with the nipples facing away from the geotextile fabric.
    5. Attach the geotextile fabric to each post with three ties, all spaced within the top 8-inches of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1-inch vertically apart. Each tie should be positioned to hang on a post nipple when tightening to prevent sagging.
    6. Wrap approximately 6-inches of the geotextile fabric around the end posts and secure with 3 ties.
    7. No more than 24-inches of a 36-inch geotextile fabric is allowed above ground level.
    8. Compact the soil immediately next to the geotextile fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips. Check and correct the silt fence installation for any deviation before compaction. Use a flat-bladed shovel to tuck the fabric deeper into the ground if necessary.

Figure II-3.23: Silt Fence Installation by Slicing Method



Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment trapping BMP.
- Check the uphill side of the silt fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence and remove the trapped sediment.
- Remove sediment deposits when the deposit reaches approximately one-third the height of the silt fence, or install a second silt fence.
- Replace geotextile fabric that has deteriorated due to ultraviolet breakdown.

BMP C234: Vegetated Strip

Purpose

Vegetated strips reduce the transport of coarse sediment from a construction site by providing a physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Vegetated strips may be used downslope of all disturbed areas.
- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to BMP C241: Sediment Pond (Temporary) or other sediment trapping BMP. The only circumstance in which overland flow can be treated solely by a vegetated strip, rather than by a sediment trapping BMP, is when the following criteria are met (see Table II-3.12: Contributing Drainage Area for Vegetated Strips):

Table II-3.12: Contributing Drainage Area for Vegetated Strips

Average Contributing Area Slope	Average Contributing Area Percent Slope	Max Contributing area Flowpath Length
1.5H : 1V or flatter	67% or flatter	100 feet
2H : 1V or flatter	50% or flatter	115 feet
4H : 1V or flatter	25% or flatter	150 feet
6H : 1V or flatter	16.7% or flatter	200 feet
10H : 1V or flatter	10% or flatter	250 feet

BMP C241: Sediment Pond (Temporary)

Purpose

Sediment ponds are temporary ponds used during construction to remove sediment from runoff originating from disturbed areas of the project site. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Consequently, they usually reduce turbidity only slightly.

Conditions of Use

- Use a sediment pond where the contributing drainage area to the pond is 3 acres or more. Ponds must be used in conjunction with other Construction Stormwater BMPs to reduce the amount of sediment flowing into the pond.
- Do not install sediment ponds on sites where failure of the BMP would result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. Also, sediment ponds are attractive to children and can be dangerous. Compliance with local ordinances regarding health and safety must be addressed. If fencing of the pond is required, show the type of fence and its location on the drawings in the Construction SWPPP.
- Sediment ponds that can impound 10 acre-ft (435,600 cu-ft, or 3.26 million gallons) or more, or have an embankment of more than 6 feet, are subject to the Washington Dam Safety Regulations (Chapter 173-175 WAC). See BMP D.1: Detention Ponds for more information regarding dam safety considerations for detention ponds.
- Projects that are constructing permanent Flow Control BMPs or Runoff Treatment BMPs that use ponding for treatment may use the rough-graded or final-graded permanent BMP footprint for the temporary sediment pond. When permanent BMP footprints are used as temporary sediment ponds, the surface area requirement of the temporary sediment pond must be met. If the surface area requirement of the sediment pond is larger than the surface area of the permanent BMP, then the sediment pond shall be enlarged beyond the permanent BMP footprint to comply with the surface area requirement.

  The permanent control structure must be temporarily replaced with a control structure that only allows water to leave the temporary sediment pond from the surface or by pumping. Alternatively, the permanent control structure may used if it is temporarily modified by plugging any outlet holes below the riser. The permanent control structure must be installed as part of the permanent BMP after the site is fully stabilized.

Design and Installation Specifications

General

- See Figure II-3.28: Sediment Pond Plan View, Figure II-3.29: Sediment Pond Cross Section, and Figure II-3.30: Sediment Pond Riser Detail for details.
- Use of permanent infiltration BMP footprints for temporary sediment ponds during

construction tends to clog the soils and reduce their capacity to infiltrate. If permanent infiltration BMP footprints are used, the sides and bottom of the temporary sediment pond must only be rough excavated to a minimum of 2 feet above final grade of the permanent infiltration BMP. Final grading of the permanent infiltration BMP shall occur only when all contributing drainage areas are fully stabilized. Any proposed permanent pretreatment BMP prior to the infiltration BMP should be fully constructed and used with the temporary sediment pond to help prevent clogging of the soils. See Element 13: Protect Low Impact Development BMPs for more information about protecting permanent infiltration BMPs.

- The pond shall be divided into two roughly equal volume cells by a permeable divider that will reduce turbulence while allowing movement of water between the cells. The divider shall be at least one-half the height of the riser, and at least one foot below the top of the riser. Wire-backed, 2- to 3-foot high, high strength geotextile fabric supported by treated 4"x4"s can be used as a divider. Alternatively, staked straw bales wrapped with geotextile fabric may be used. If the pond is more than 6 feet deep, a different divider design must be proposed. A riprap embankment is one acceptable method of separation for deeper ponds. Other designs that satisfy the intent of this provision are allowed as long as the divider is permeable, structurally sound, and designed to prevent erosion under and around the divider.
- The most common structural failure of sediment ponds is caused by piping. Piping refers to two phenomena: (1) water seeping through fine-grained soil, eroding the soil grain by grain and forming pipes or tunnels; and, (2) water under pressure flowing upward through a granular soil with a head of sufficient magnitude to cause soil grains to lose contact and capability for support.

  The most critical construction practices to prevent piping are:

  - Tight connections between the riser and outlet pipe, and other pipe connections.
  - Adequate anchoring of the riser.
  - Proper soil compaction of the embankment and riser footing.
  - Proper construction of anti-seep devices.

Sediment Pond Geometry

To determine the sediment pond geometry, first calculate the design surface area (SA) of the pond, measured at the top of the riser pipe. Use the following equation:

$$SA = 2 \times Q_2 / 0.00096$$

or

2080 square feet per cfs of inflow

See BMP C240: Sediment Trap for more information on the above equation.

The basic geometry of the pond can now be determined using the following design criteria:

- Required surface area SA (from the equation above) at the top of the riser.
- Minimum 3.5-foot depth from the top of the riser to the bottom of the pond.

- Maximum 3H:1V interior side slopes and maximum 2H:1V exterior slopes. The interior slopes can be increased to a maximum of 2H:1V if fencing is provided at or above the maximum water surface.
- One foot of freeboard between the top of the riser and the crest of the emergency spillway.
- Flat bottom.
- Minimum 1-foot deep spillway.
- Length-to-width ratio between 3:1 and 6:1.

Sediment Pond Discharge

The outlet for the pond consists of a combination of principal and emergency spillways. These outlets must pass the peak runoff expected from the contributing drainage area for a 100-year storm. If, due to site conditions and basin geometry, a separate emergency spillway is not feasible, the principal spillway must pass the entire peak runoff expected from the 100-year storm. However, an attempt to provide a separate emergency spillway should always be made. Base the runoff calculations on the site conditions during construction. The flow through the dewatering orifice cannot be utilized when calculating the 100-year storm elevation because of its potential to become clogged; therefore, available spillway storage must begin at the principal spillway riser crest.

The principal spillway designed by the procedures described below will result in some reduction in the peak rate of runoff. However, the design will not control the discharge flow rates to the extent required to comply with I-3.4.7 MR7: Flow Control. The size of the contributing basin, the expected life of the construction project, the anticipated downstream effects, and the anticipated weather conditions during construction should be considered to determine the need for additional discharge control.

Principal Spillway: Determine the required diameter for the principal spillway (riser pipe). The diameter shall be the minimum necessary to pass the peak volumetric flow rate using a 15-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Use Figure II-3.31: Riser Inflow Curves to determine the riser diameter.

To aid in determining sediment depth, one-foot intervals shall be prominently marked on the riser.

Emergency Overflow Spillway: Size the emergency overflow spillway for the peak volumetric flow rate using a 10-minute time step from a Type 1A, 100-year, 24-hour frequency storm for the developed condition. See BMP D.1: Detention Ponds for additional guidance for Emergency Overflow Spillway design

Dewatering Orifice: Size of the dewatering orifice(s) (minimum 1-inch diameter) using a modified version of the discharge equation for a vertical orifice and a basic equation for the area of a circular orifice. Determine the required area of the orifice with the following equation:

$$A_o = \frac{A_S(2h)^{0.5}}{0.6 \times 3600 T g^{0.5}}$$

where

A_o = orifice area (square feet)

A_S = pond surface area (square feet)

h = head of water above orifice (height of riser in feet)

T = dewatering time (24 hours)

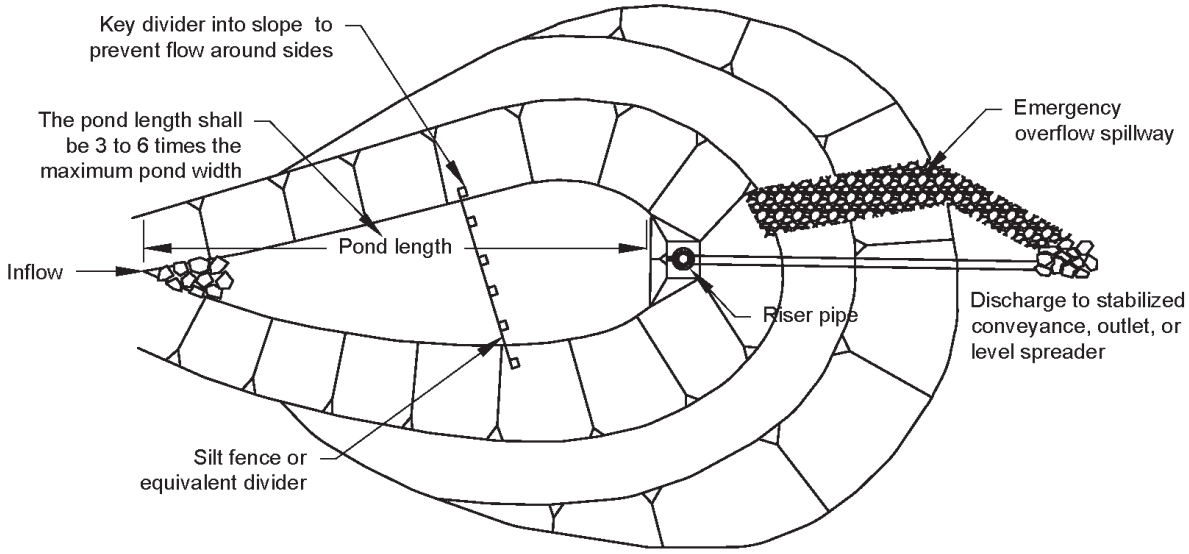
g = acceleration of gravity (32.2 feet/second^2)

Convert the orifice area (in square feet) to the orifice diameter D (in inches):

$$D = 24 \times \sqrt{\frac{A_o}{\pi}} = 13.54 \times \sqrt{A_o}$$

The vertical, perforated tubing connected to the dewatering orifice must be at least 2 inches larger in diameter than the orifice to improve flow characteristics. The size and number of perforations in the tubing should be large enough so that the tubing does not restrict flow. The orifice should control the flow rate.

Figure II-3.28: Sediment Pond Plan View



Note: Pond may be formed by berm or by partial or complete excavation

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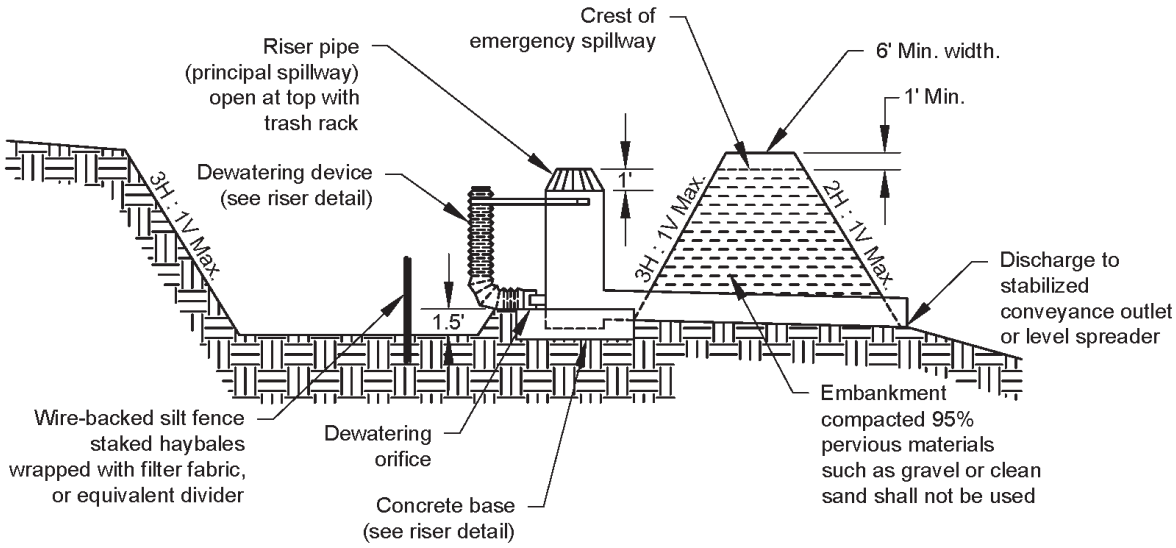
Sediment Pond Plan View

Revised June 2016

Figure II-3.29: Sediment Pond Cross Section



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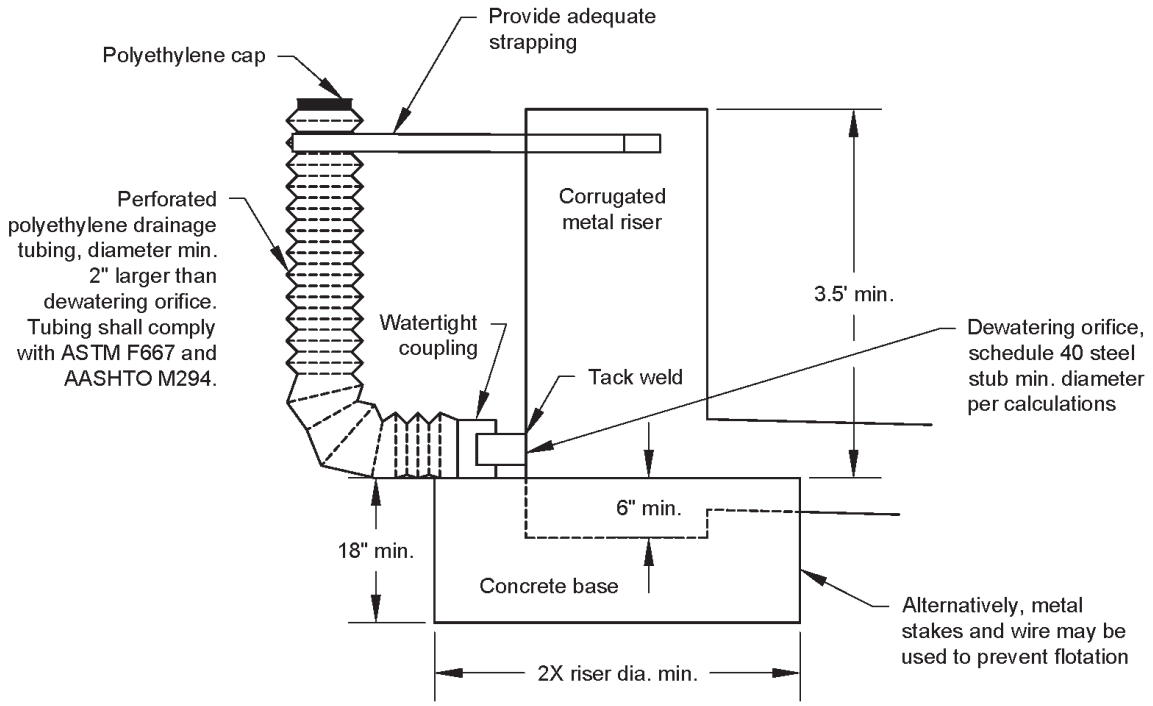
Sediment Pond Cross Section

Revised June 2016

Figure II-3.30: Sediment Pond Riser Detail



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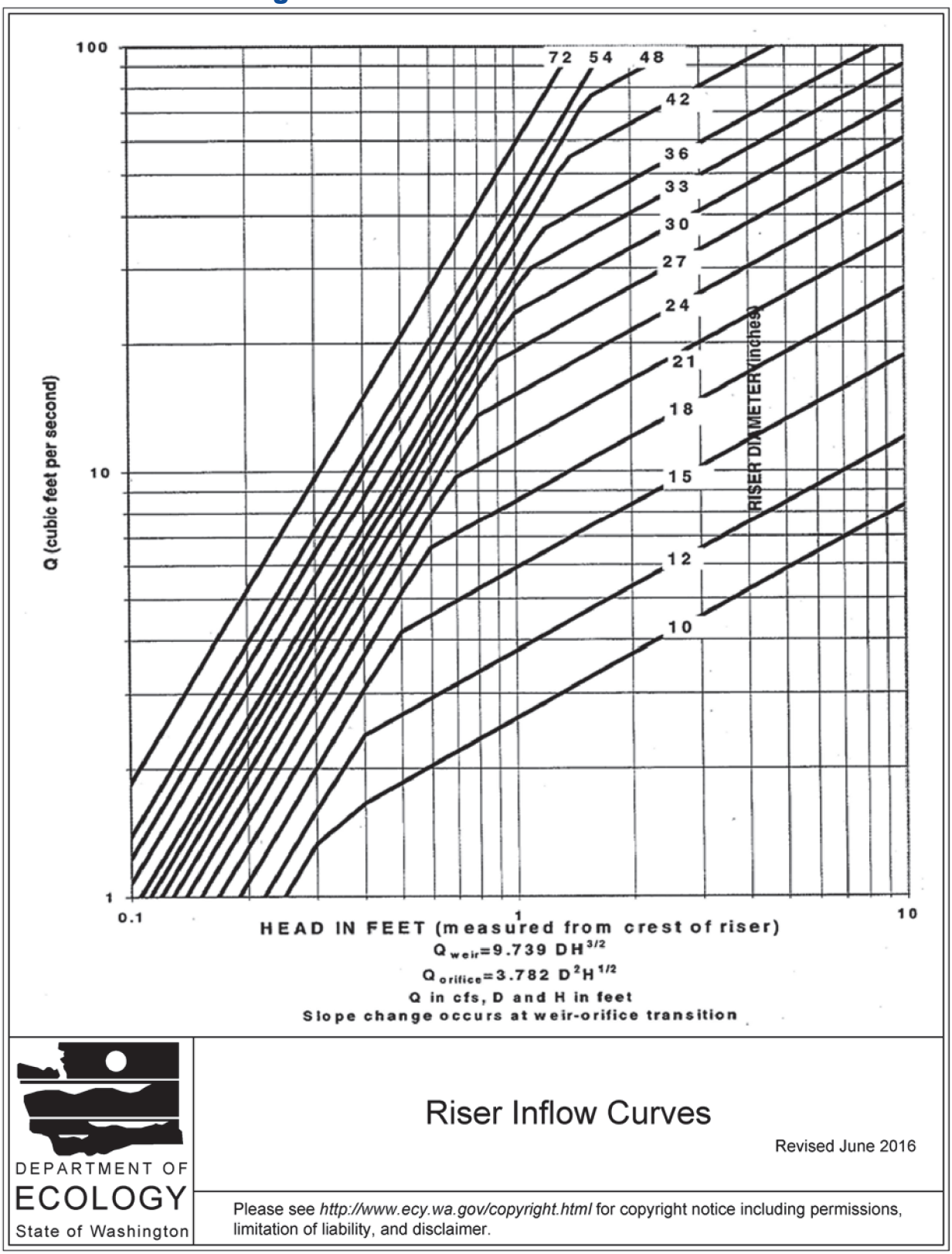
Sediment Pond Riser Detail

Revised June 2016

Figure II-3.31: Riser Inflow Curves



Maintenance Standards

- Remove sediment from the pond when it reaches 1 foot in depth.
- Repair any damage to the pond embankments or slopes.

BMP C250: Construction Stormwater Chemical Treatment

Purpose

This BMP applies when using chemicals to treat turbidity in stormwater by either batch or flow-through chemical treatment.

Turbidity is difficult to control once fine particles are suspended in stormwater runoff from a construction site. BMP C241: Sediment Pond (Temporary) is effective at removing larger particulate matter by gravity settling, but is ineffective at removing smaller particulates such as clay and fine silt. Traditional Construction Stormwater BMPs may not be adequate to ensure compliance with the water quality standards for turbidity in the receiving water.

Chemical treatment can reliably provide exceptional reductions of turbidity and associated pollutants. Chemical treatment may be required to meet turbidity stormwater discharge requirements, especially when construction proceeds through the wet season.

Conditions of Use

Formal written approval from Ecology is required for the use of chemical treatment, regardless of site size. See https://fortress.wa.gov/ecy/publications/SummaryPages/ecy070258.html for a copy of the Request for Chemical Treatment form. The Local Permitting Authority may also require review and approval. When authorized, the chemical treatment systems must be included in the Construction Stormwater Pollution Prevention Plan (SWPPP).

Chemically treated stormwater discharged from construction sites must be nontoxic to aquatic organisms. The Chemical Technology Assessment Protocol - Ecology (CTAPE) must be used to evaluate chemicals proposed for stormwater treatment. Only chemicals approved by Ecology under the CTAPE may be used for stormwater treatment. The approved chemicals, their allowable application techniques (batch treatment or flow-through treatment), allowable application rates, and conditions of use can be found at the Department of Ecology Emerging Technologies website:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

Background on Chemical Treatment Systems

Coagulation and flocculation have been used for over a century to treat water. The use of coagulation and flocculation to treat stormwater is a very recent application. Experience with the treatment of water and wastewater has resulted in a basic understanding of the process, in particular factors

APPENDIX C

Geotechnical Engineer's Report

Earth Solutions NW LLC
Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

February 12, 2019
ES-6481

Best Parking Lot Cleaning, Inc.
2412 Inter Avenue
Puyallup, Washington 98372

Attention: Mr. Rich Hamilton

Subject: Geotechnical Evaluation
Proposed Parking Lot Redevelopment
2512 Inter Avenue
Puyallup, Washington

Reference: Timothy J. Walsh
Geologic Map of the South Half of the Tacoma Quadrangle, Washington, 1987

CES NW, Inc.
Topographic Survey, dated May 30, 2018

United States Department of Agriculture
Natural Resources Conservation Service
Online Web Soil Survey (WSS) Resource

Dear Mr. Hamilton:

As requested, Earth Solutions NW, LLC (ESNW) has prepared this geotechnical evaluation for the subject site. We performed our work in general accordance with the scope of services outlined in our proposal dated December 18, 2018 and authorized by you on January 2, 2019. A summary of our subsurface exploration and pertinent geotechnical considerations are provided in this letter.

Project Description

We understand the existing gravel parking lot, in the eastern portion of the site, will be improved. The feasibility of using shallow infiltration facilities to accommodate stormwater runoff from new impervious surfaces was the primary focus of our investigation. Infiltration facilities would likely be installed in the northeastern portion of the site, where feasible.

This letter has been prepared for the exclusive use of Best Parking Lot Cleaning, Inc. and their representatives. A warranty is neither expressed nor implied. The recommendations and conclusions provided in this letter are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. Variations in the soil and groundwater conditions encountered at the test pit locations may exist and may not become evident until construction. ESNW should reevaluate the contents of this letter if variations are encountered.

Surface Conditions

The subject site is located on the south side of Inter Avenue, about 450 feet east of the intersection with 23rd Street Southeast, in Puyallup, Washington. The approximate location of the property is illustrated on Plate 1 (Vicinity Map). The property is comprised of four tax parcels (Pierce County Parcel Nos. 210520-0320, -0350, -0340, and -0361) totaling approximately 2.79 acres. Two commercial buildings, asphalt parking, gravel parking, and related infrastructure improvements currently occupy the site. The site is surrounded to the north by Inter Avenue, to the south and east by BNSF railroad tracks, and to the west by a commercial development. Site topography is relateively level, with little discernible elevation change across the property. Vegetation primarily consists of scattered trees and grass.

Subsurface Conditions

An ESNW representative observed, logged, and sampled three test pits, excavated within accessible areas of the site, on January 30, 2019 using a trackhoe and operator provided by the client. The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the attached test pit logs for a more detailed description of subsurface conditions. Representative soil samples collected at the test pit locations were analyzed in accordance with both Unified Soil Classification System (USCS) and United States Department of Agriculture (USDA) methods and procedures.

Topsoil and Fill

Topsoil was not encountered at the test pit locations. Given the existing level of site development, we do no anticipate topsoil will be consequential during the proposed construction.

Fill was encountered at the test pit locations to depths of approximately one to two and one-half feet below the existing ground surface (bgs). The fill was characterized as crushed rock or silty gravel with sand (USCS: GM) and was encountered in a medium dense and moist condition. Where encountered during construction, ESNW can evaluate fill deposits, as necessary.

Native Soil

Underlying fill, native soils at depth were characterized primarily as loose to medium dense silty sand (USCS: SM). The upper two feet was predominately silt (USCS:ML) with various amounts of sand and gravel. The native soils were observed primarily in a moist to wet condition. The maximum exploration depth was approximately 10 feet bgs.

Geologic Setting

The referenced geologic map resource identifies alluvium (Qal) as the primary geologic unit underlying the subject site and surrounding areas. Alluvial deposits are dominant in the Puyallup Valley and typically consist of loose, stratified to massively bedded fluvial silt, sand, and gravel, and locally includes sandy to silty estuarine deposits.

The referenced WSS resource identifies Briscot loam (Map Unit Symbol: 6A) as the primary soil unit underlying the subject site. The Briscot series was formed in flood plains. Based on our field observations, native soils on the subject site are consistent with alluvium, as outlined in this section.

Groundwater

During our subsurface exploration completed on January 30, 2019, groundwater was encountered at the test pit locations between depths of roughly three to eight feet bgs. Our interpretation of field conditions is that groundwater seepage is present in the upper three to four feet bgs, and the groundwater table occurs at about seven to eight feet bgs. Even though our fieldwork occurred during the wet season, our observed groundwater elevations should not be considered representative of the seasonal high without confirmation by a seasonal groundwater monitoring program.

It is our opinion that the contractor should be prepared to manage groundwater during construction, especially within deeper site excavations. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches, sumps, and dewatering pumps. It should be noted seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the winter, spring, and early summer months.

Stormwater Facility Considerations

We understand shallow infiltration facilities are proposed to accommodate stormwater runoff from new impervious surfaces. As indicated in the *Subsurface* section of this letter, native soils encountered during our fieldwork were characterized primarily as loose to medium dense alluvial deposits. Given the relatively high fines content and presence of a shallow groundwater table, it is our opinion infiltration is not feasible from a geotechnical standpoint.

Alternatively, we understand detention may be utilized for stormwater management. At the time of this letter, specific detention plans were not available for review; however, based on our field observations, in general, it is our opinion construction of a detention facility is feasible from a geotechnical standpoint. Design and installation of a detention facility must consider seasonal groundwater elevations, which were estimated at about seven feet bgs (in the northern site area) at the time of our January 2019 fieldwork. Perched groundwater seepage should be anticipated within detention facility excavations. Final detention facility designs must incorporate adequate buffer space from property boundaries such that temporary construction excavations may be successfully completed. ESNW can provide additional recommendations and design parameters to aid with detention facility design, if needed, as project plans develop.

ESNW should have an opportunity to review final project plans with respect to the geotechnical recommendations provided in this letter. ESNW should also be retained to observe the construction of detention facilities on site to provide supplementary testing and recommendations, where necessary.

We trust this letter meets your current needs. If you have questions regarding the content herein, or require additional information, please call.

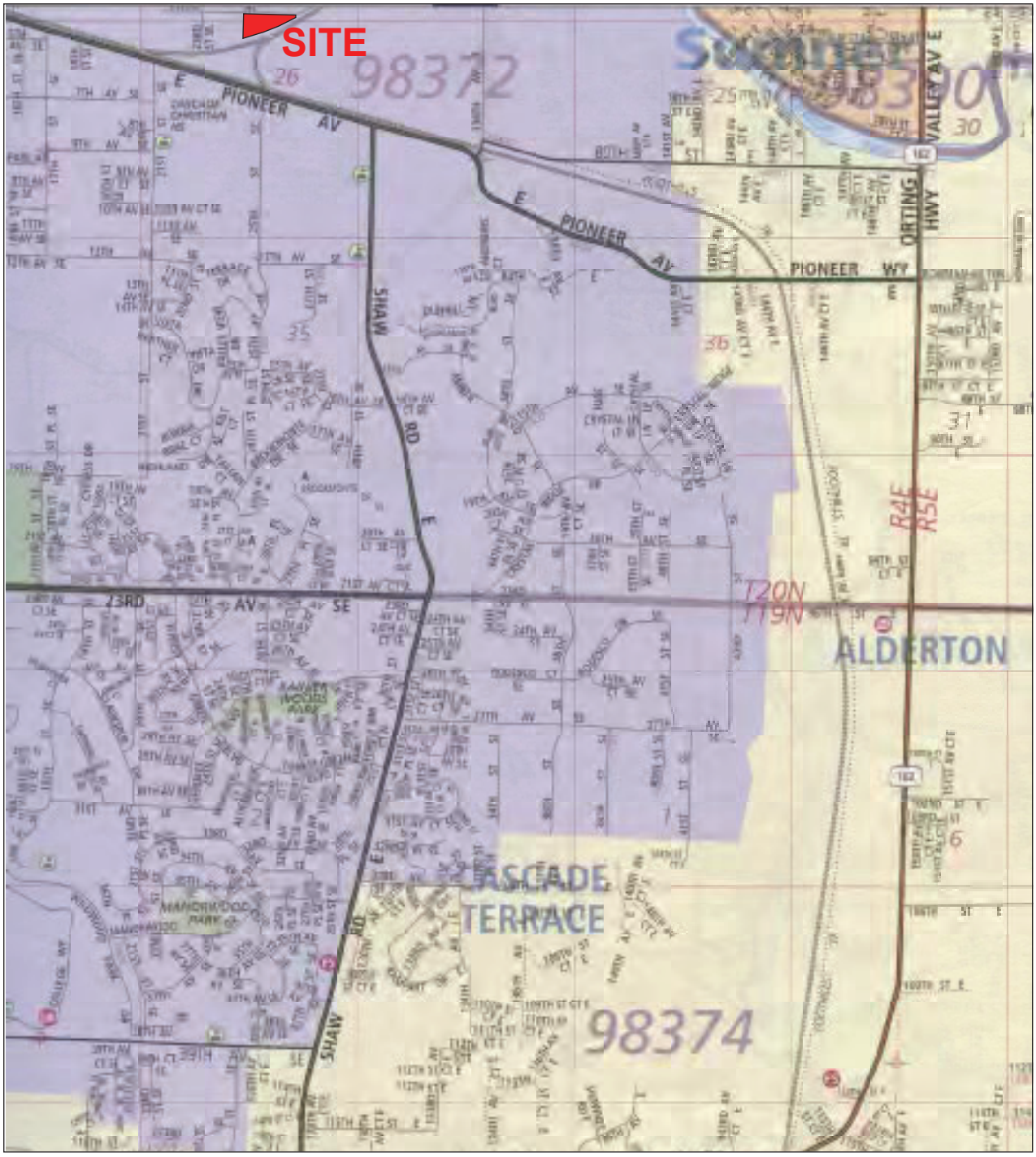
Sincerely,

EARTH SOLUTIONS NW, LLC

Terry J. Dunn
Staff Geologist

Keven D. Hoffmann, P.E.
Senior Project Manager

Attachments: Plate 1 – Vicinity Map
Plate 2 – Test Pit Location Plan
Test Pit Logs
Grain Size Distribution



Reference:
Pierce County, Washington
Map 835
By The Thomas Guide
Rand McNally
32nd Edition

NORTH

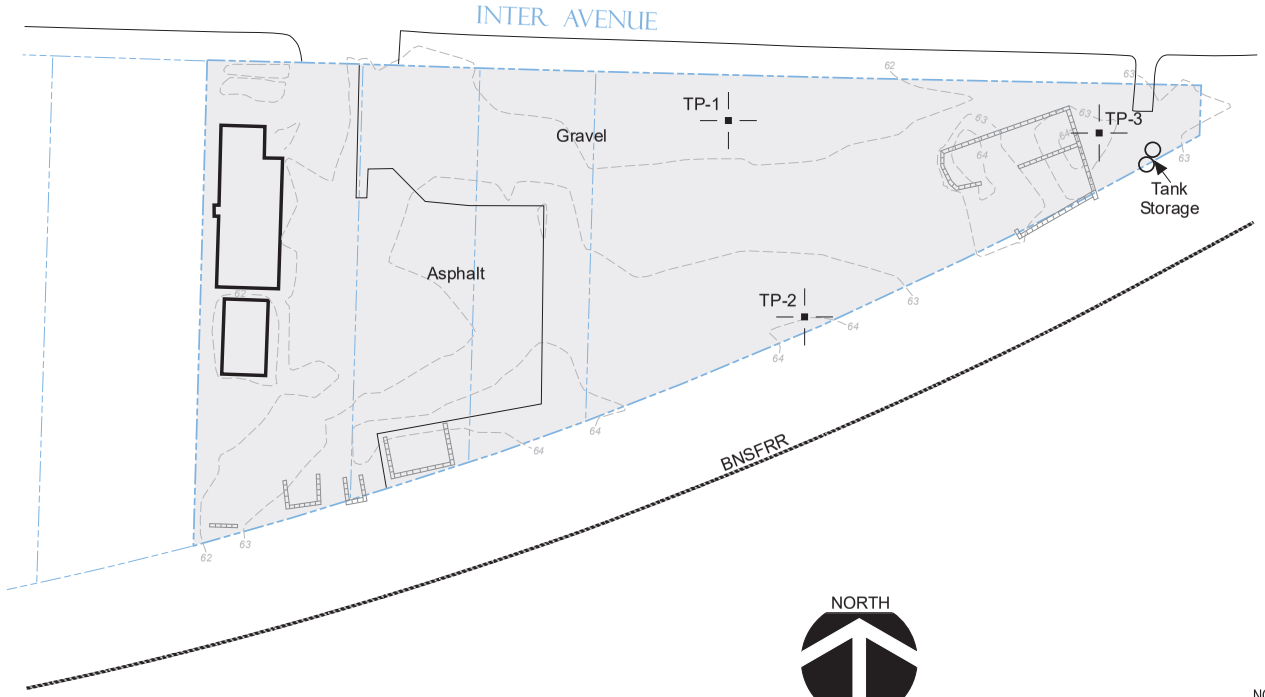
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
Best Parking
Puyallup, Washington

Drwn. CAM	Date 02/06/2019	Proj. No. 6481
Checked TJD	Date Feb. 2019	Plate 1



LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-6481, Jan. 2019

Subject Site

Existing Building

Existing Concrete Block Wall

NORTH

1"=80'

0 40 80 160

Scale in Feet

NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

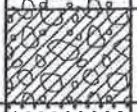
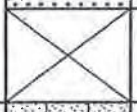
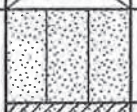
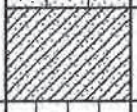
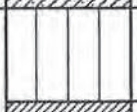
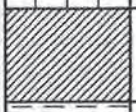
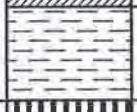
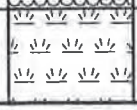
Test Pit Location Plan
Best Parking
Puyallup, Washington

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Drwn. By	CAM
Checked By	TJD
Date	02/06/2019
Proj. No.	6481
Plate	2

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-6481 **PROJECT NAME** Best Parking

DATE STARTED 1/30/19 **COMPLETED** 1/30/19 **GROUND ELEVATION** 61 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR Client Provided **GROUND WATER LEVELS:**

EXCAVATION METHOD ▽ **AT TIME OF EXCAVATION** 8.0 ft / Elev 53.0 ft

LOGGED BY TJD **CHECKED BY** KDH **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 6": crushed rock minus **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			FILL		Crushed rock minus	60.5
				0.5	Gray silty GRAVEL with sand, medium dense, moist (Fill)	
			GM		-increased gravel content	59.0
		MC = 22.20% Fines = 66.70%	ML	2.0	Gray gravelly SILT, loose to medium dense, moist [USDA Classification: gravelly LOAM] -caving to 8' -light groundwater seepage at 4'	57.0
5		MC = 28.80%		4.0	Gray silty fine SAND, loose to medium dense, moist to wet -iron oxide staining -moderate to heavy groundwater seepage -increased sand content	
		MC = 25.90%	SM		-becomes black, wet ▽ -groundwater table	
10		MC = 26.80% Fines = 12.60%		10.0	[USDA Classification: slightly gravelly SAND]	51.0
					Test pit terminated at 10.0 feet below existing grade. Groundwater table encountered at 8.0 feet and groundwater seepage encountered at 4.0 and 6.0 feet during excavation. Caving observed from 3.0 to 8.0 feet. Bottom of test pit at 10.0 feet.	

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-6481 **PROJECT NAME** Best Parking

DATE STARTED 1/30/19 **COMPLETED** 1/30/19 **GROUND ELEVATION** 63 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR Client Provided **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY TJD **CHECKED BY** KDH **AT END OF EXCAVATION** —

NOTES Depth of Topsoil & Sod 4"-6": crushed rock minus **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			FILL		0.5 Crushed rock minus	62.5
			GM		Gray silty GRAVEL with sand, medium dense, damp to moist (Fill)	
					2.5	60.5
		MC = 31.70%	ML		Gray SILT with sand, loose to medium dense, moist to wet -iron oxide staining	
		MC = 29.40%			4.5 -light groundwater seepage	58.5
5			SM		Gray silty fine SAND, loose to medium dense, moist to wet -caving from 4.5' to 8'	
		MC = 28.80% Fines = 37.30%			-iron oxide staining [USDA Classification: very fine sandy LOAM] -moderate groundwater seepage -becomes black, wet	
10		MC = 32.50%			10.0	53.0
					Test pit terminated at 10.0 feet below existing grade. Groundwater seepage encountered at 4.0 and 8.0 feet during excavation. Caving observed from 4.5 to 8.0 feet. Bottom of test pit at 10.0 feet.	

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-3

PROJECT NUMBER ES-6481 **PROJECT NAME** Best Parking

DATE STARTED 1/30/19 **COMPLETED** 1/30/19 **GROUND ELEVATION** 63 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR Client Provided **GROUND WATER LEVELS:**

EXCAVATION METHOD ▽ **AT TIME OF EXCAVATION** 7.0 ft / Elev 56.0 ft

LOGGED BY TJD **CHECKED BY** KDH **AT END OF EXCAVATION** ---

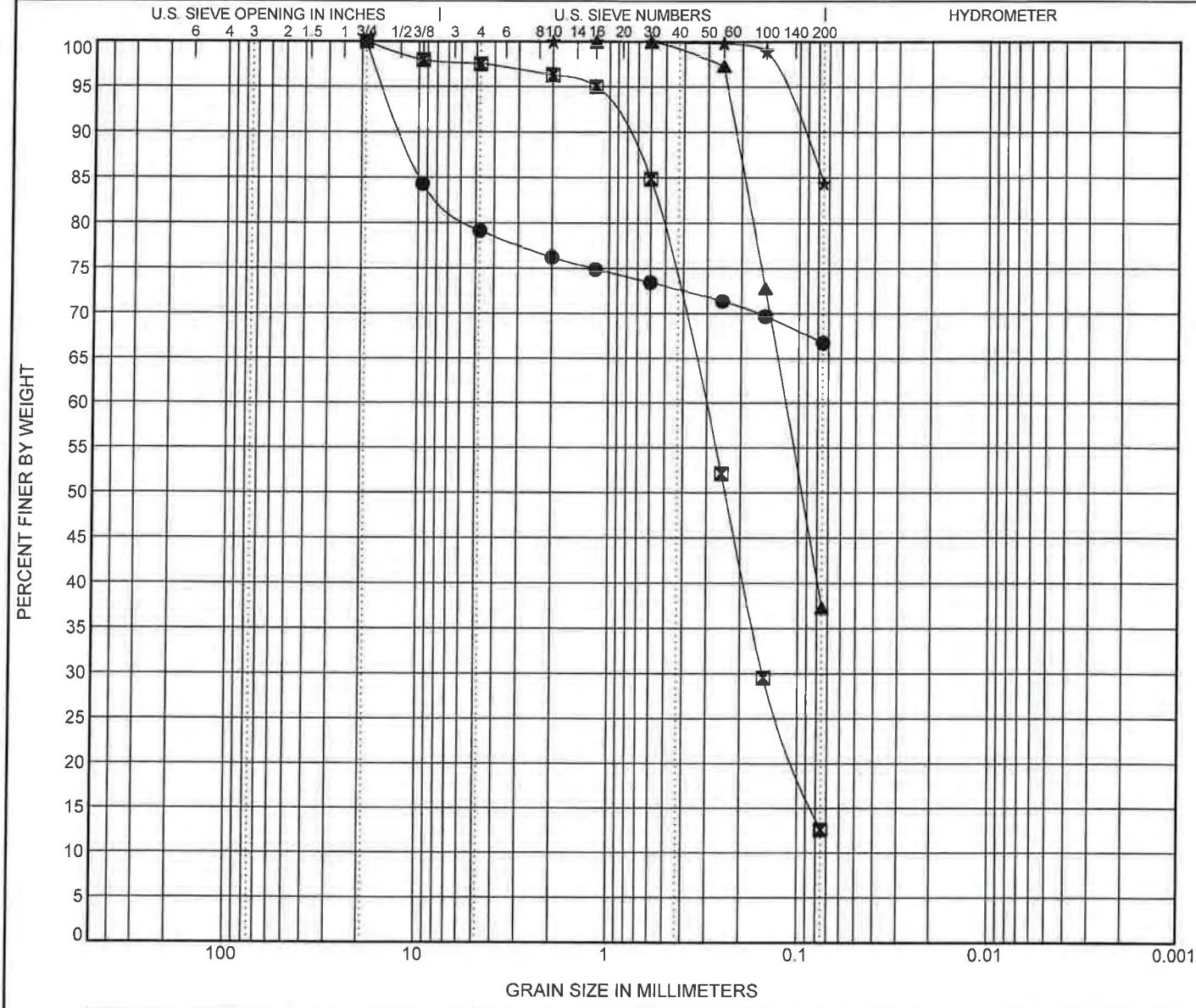
NOTES Depth of Topsoil & Sod 6"-10": 2"-4" quarry spalls **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			FILL		Quarry spalls Crushed rock minus	
					0.9	62.1
		MC = 25.30%	ML		Gray SILT with sand, loose to medium dense, moist to wet	
		MC = 33.00% Fines = 84.40%			-light groundwater seepage at 3', caving from 3' to 7'	
					3.0	60.0
			SM		Gray fine silty SAND, loose to medium dense, wet [USDA Classification: LOAM]	
5					-light groundwater seepage -iron oxide staining to 8'	
		MC = 32.10%			-silt lens ▽ -groundwater table	
		MC = 31.60%				
					9.5	53.5
					Test pit terminated at 9.5 feet below existing grade. Groundwater table encountered at 7.0 feet and groundwater seepage encountered at 3.0 and 5.0 feet during excavation. Caving observed from 3.0 to 7.0 feet. Bottom of test pit at 9.5 feet.	

Earth Solutions NW, LLC
1805 - 136th PL N.E., Suite 201
Bellevue, WA 98005
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-6481 **PROJECT NAME** Best Parking



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● TP-01	2.50ft.	USDA: Gray Gravelly Loam. USCS: Gravelly ML.		
⊠ TP-01	10.00ft.	USDA: Black Slightly Gravelly Sand. USCS: SM.		
▲ TP-02	7.50ft.	USDA: Gray Very Fine Sandy Loam. USCS: SM.		
★ TP-03	3.00ft.	USDA: Gray Loam. USCS: ML with Sand.		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● TP-01	2.5ft.	19							66.7	
⊠ TP-01	10.0ft.	19	0.309	0.152					12.6	
▲ TP-02	7.5ft.	1.18	0.117						37.3	
★ TP-03	3.0ft.	2							84.4	

GRAIN SIZE USDA ES-6481 BEST PARKING.GPJ GINT US LAB.GDT 1/31/19

Earth Solutions NW LLC
Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

April 27, 2021
ES-6481.01

BPLC Properties, LLC
10615 – 438th Street Court East
Eatonville, Washington 98328

Attention: Mr. Rich Hamilton

Subject: Groundwater Monitoring Program Summary
Best Parking Lot Cleaning Site Improvements
2412 Inter Avenue
Puyallup, Washington

Reference: Earth Solutions NW, LLC
Geotechnical Evaluation
Project No. ES-6481, dated February 19, 2019

City of Puyallup, Washington
E-20-0067 Civil Comments 1 Letter, dated March 16, 2020

Dear Mr. Hamilton:

As requested, Earth Solutions NW, LLC (ESNW) has prepared this letter summarizing the results of our seasonal groundwater monitoring program on site.

The monitoring program consisted of installing three groundwater monitoring wells at the approximate locations depicted on Plate 2 (Subsurface Exploration Plan). Since the installation of the groundwater wells on June 8, 2020, daily groundwater levels have been recorded using dataloggers. ESNW personnel visited the site biweekly to download the collected data and perform manual measurements at each borehole using a depth-to-water meter. The table on page 2 summarizes the groundwater data collected during our monitoring program.

Borehole	Depth of Borehole (ft)	Ground Elevation* (ft)	Peak GWT Depth† (ft bgs)	Peak GWT Elevation* (ft)	Peak Date
B-1	21.5	56	0.9	55.1	01/13/2021
B-2	21.5	56	1.6	54.4	01/13/2021
B-3	21.5	54	2.0	52.0	01/13/2021

** Elevations are approximate, based on readily available topographic survey data; monitoring well locations have not been surveyed.*
† Depth measured from existing ground surface.

Monitoring charts are attached to letter, along with boring logs and laboratory analyses from the June 2020 fieldwork. The monitoring period extended before and after the minimum period requested by the City of Puyallup (December 21 to April 1), as outlined in the referenced comments letter. As anticipated, high groundwater readings corresponded with relatively high rainfall events. Based on the data collected during the monitoring period, it is our opinion the peak groundwater table depths listed in the table above are indicative of the seasonal high groundwater elevations.

We trust this letter meets your current needs. Should you have any questions regarding the content herein, or require additional information, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

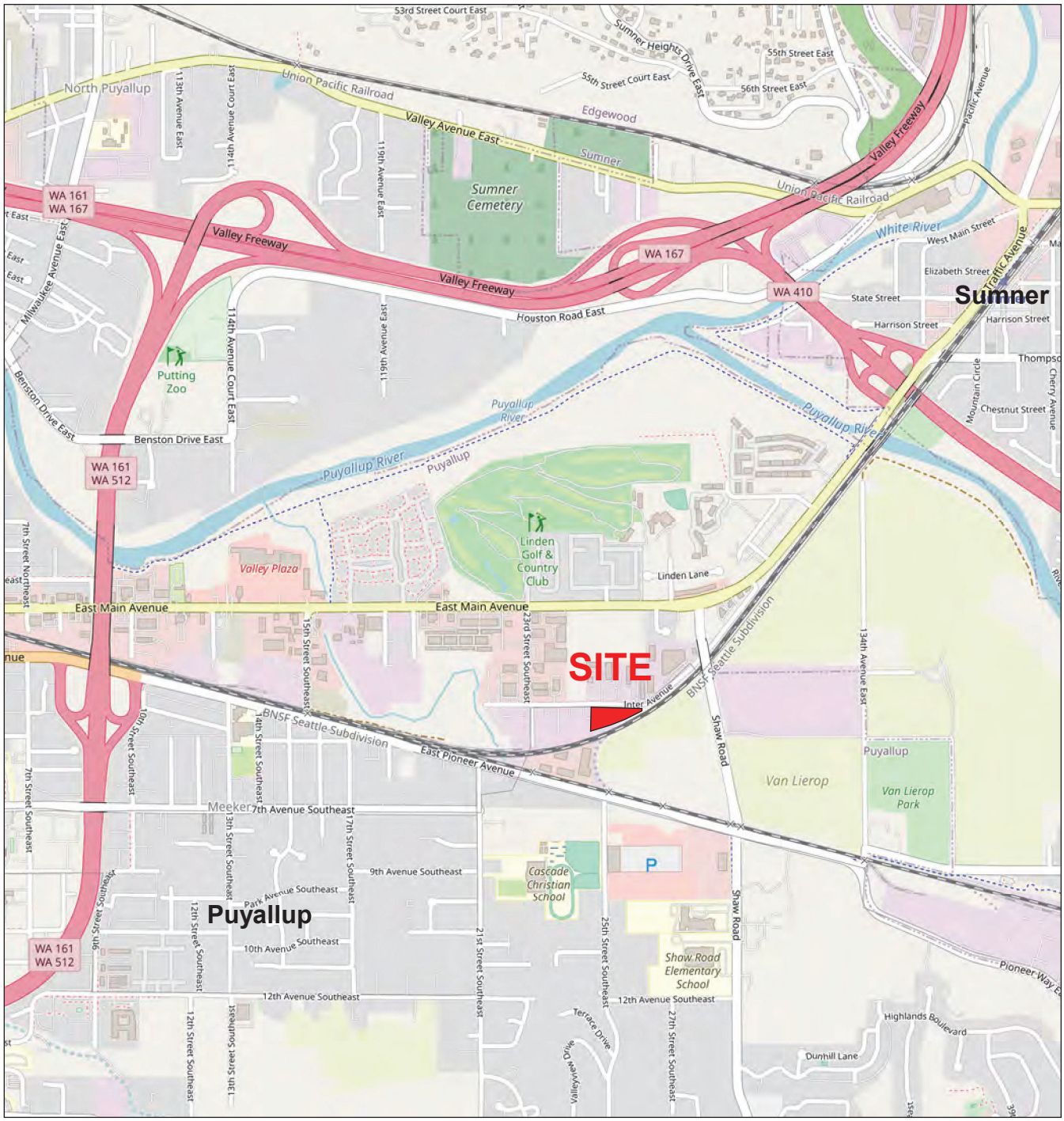
04/27/2021

Adam Z. Shier, L.G.
Project Geologist

Keven D. Hoffmann, P.E.
Geotechnical Engineering Services Manager

Attachments: Plate 1 – Vicinity Map
Plate 2 – Subsurface Exploration Plan
Boring Logs
Grain Size Distribution
Seasonal Groundwater Monitoring Charts

cc: Barghausen Consulting Engineers, Inc.
Attention: Mr. Jason Hubbell, P.E. (Email only)



Reference:
Pierce County, Washington
OpenStreetMap.org

NORTH

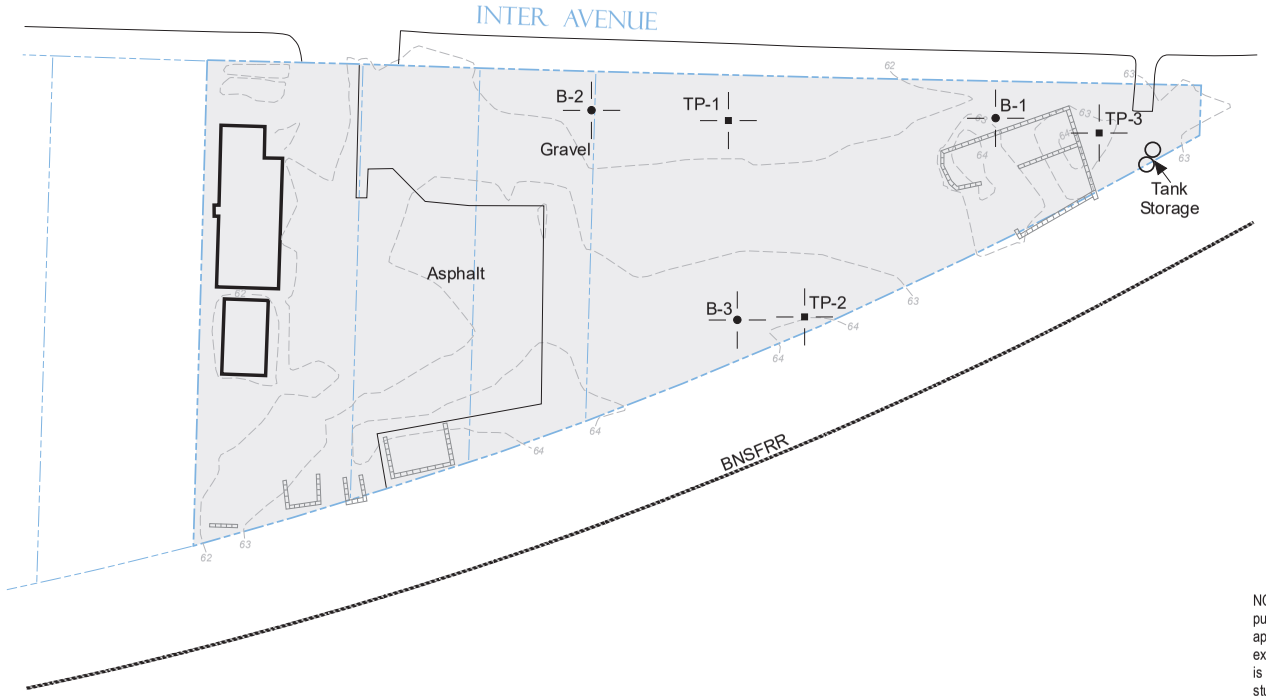
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
Best Parking Lot Cleaning Site Improvements
Puyallup, Washington

Drwn. MRS	Date 06/30/2020	Proj. No. 6481.01
Checked KDH	Date June 2020	Plate 1



LEGEND

B-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-6481.01, June 2020

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-6481, Jan. 2019

Subject Site

Existing Building

Existing Concrete Block Wall

NORTH

1"=80' 0 40 80 160 Scale in Feet

NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

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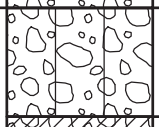
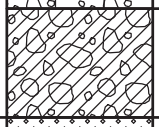
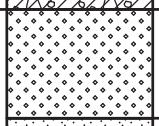
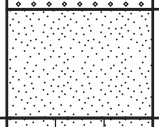
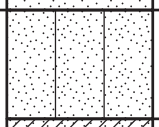
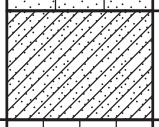
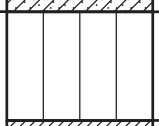
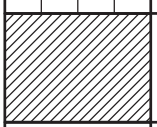
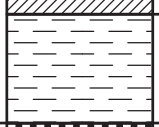
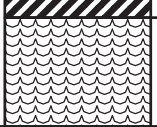
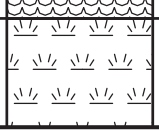
Subsurface Exploration Plan
Best Parking Lot Cleaning Site Improvements
Puyallup, Washington

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Drwn. By	MRS
Checked By	KDH
Date	06/30/2020
Proj. No.	6481.01
Plate	2

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER B-1

PROJECT NUMBER ES-6481.01 **PROJECT NAME** Best Parking Lot Cleaning Site Improvements

DATE STARTED 6/8/20 **COMPLETED** 6/8/20 **GROUND ELEVATION** 63 ft **HOLE SIZE**

DRILLING CONTRACTOR Holocene Drilling **GROUND WATER LEVELS:**

DRILLING METHOD HSA ▽ **AT TIME OF DRILLING** 7.0 ft

LOGGED BY AZS **CHECKED BY** KDH **AT END OF DRILLING** ---

NOTES Surface Conditions: exposed soil **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					SW-SM		Gray well-graded SAND with silt, medium dense, moist
	SS	11	7-8-7 (15)	MC = 10.6%			
5							
	SS	17	1-4-4 (8)	MC = 8.1% Fines = 11.1%			[USDA Classification: gravelly coarse SAND] -becomes loose
							▽ -groundwater table, becomes water bearing
	SS	50	4-2-5 (7)	MC = 40.5%			8.0
10					ML		Gray SILT, medium dense, water bearing
	SS	100	7-8-10 (18)	MC = 29.8%			
15							
	SS	67	3-5-6 (11)	MC = 34.5%			
20							20.0 43.0

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Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER B-1

PROJECT NUMBER ES-6481.01 **PROJECT NAME** Best Parking Lot Cleaning Site Improvements

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20							
	SS	67	2-3-5 (8)	MC = 31.1%	ML		Gray SILT, loose, water bearing
21.5							41.5

Boring terminated at 21.5 feet below existing grade. Groundwater table encountered at 7.0 feet during drilling. 2" PVC standpipe installed to bottom of boring. Lower 10.0 feet slotted. Well ID: BNF287. Boring backfilled with bentonite/sand.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER B-2

PROJECT NUMBER ES-6481.01 **PROJECT NAME** Best Parking Lot Cleaning Site Improvements

DATE STARTED 6/8/20 **COMPLETED** 6/8/20 **GROUND ELEVATION** 62 ft **HOLE SIZE**

DRILLING CONTRACTOR Holocene Drilling **GROUND WATER LEVELS:**

DRILLING METHOD HSA ▽ **AT TIME OF DRILLING** 6.0 ft

LOGGED BY AZS **CHECKED BY** KDH **AT END OF DRILLING** ---

NOTES Surface Conditions: gravel driveway **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					GM		Gray silty GRAVEL with sand, loose, moist (Fill)
	SS	6	1-2-5 (7)	MC = 22.3%			3.0 59.0
					SP		Gray poorly graded SAND, loose, moist
							4.0 58.0
5					ML		Brown SILT with sand, loose, wet
	SS	67	1-1-2 (3)	MC = 43.5% Fines = 77.1%			[USDA Classification: slightly gravelly LOAM]
							▽ -iron oxide staining
							-groundwater table, becomes water bearing
	SS	100	2-6-7 (13)	MC = 42.8%			8.5 53.5
10					SM		Gray silty fine SAND, medium dense, water bearing
	SS	100	3-11-16 (27)	MC = 31.3%			-4" wood debris
15							
	SS	67	6-6-6 (12)	MC = 29.5%			
20							20.0 42.0

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Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER B-2

PROJECT NUMBER ES-6481.01 **PROJECT NAME** Best Parking Lot Cleaning Site Improvements

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20							
	SS	100	2-4-8 (12)	MC = 33.5%	SP		Gray poorly graded SAND, medium dense, water bearing 21.0 41.0
					ML		21.5 Gray SILT, medium dense, water bearing -wood debris 40.5

Boring terminated at 21.5 feet below existing grade. Groundwater table encountered at 6.0 feet during drilling. 2" PVC standpipe installed to bottom of boring. Lower 10.0 feet slotted. Well ID: BNF288. Boring backfilled with bentonite/sand.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER B-3

PROJECT NUMBER ES-6481.01 **PROJECT NAME** Best Parking Lot Cleaning Site Improvements

DATE STARTED 6/8/20 **COMPLETED** 6/8/20 **GROUND ELEVATION** 64 ft **HOLE SIZE**

DRILLING CONTRACTOR Holocene Drilling **GROUND WATER LEVELS:**

DRILLING METHOD HSA ▽ **AT TIME OF DRILLING** 10.0 ft

LOGGED BY AZS **CHECKED BY** KDH **AT END OF DRILLING** ---

NOTES Surface Conditions: gravel driveway **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0								
					GM		Gray silty GRAVEL with sand, loose, moist (Fill)	
								2.5 61.5
	SS	67	4-3-4 (7)	MC = 34.5% Fines = 98.3%	ML		Gray SILT, loose, moist [USDA Classification: slightly gravelly LOAM] -iron oxide staining	
5							-becomes sandy silt	
	SS	11	4-4-5 (9)	MC = 25.2% Fines = 60.4%			[USDA Classification: slightly gravelly LOAM]	
								7.5 56.5
	SS	33	3-4-6 (10)	MC = 21.8%	SM		Gray silty fine SAND with gravel, medium dense, moist to wet	
10							▽ -groundwater table, becomes water bearing, no recovery	
	SS		4-4-6 (10)					
15								15.5 48.5
	SS	67	2-4-7 (11)	MC = 28.6%	SP		Gray poorly graded SAND, medium dense, water bearing	
20								20.0 44.0

(Continued Next Page)

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER B-3

PROJECT NUMBER ES-6481.01 **PROJECT NAME** Best Parking Lot Cleaning Site Improvements

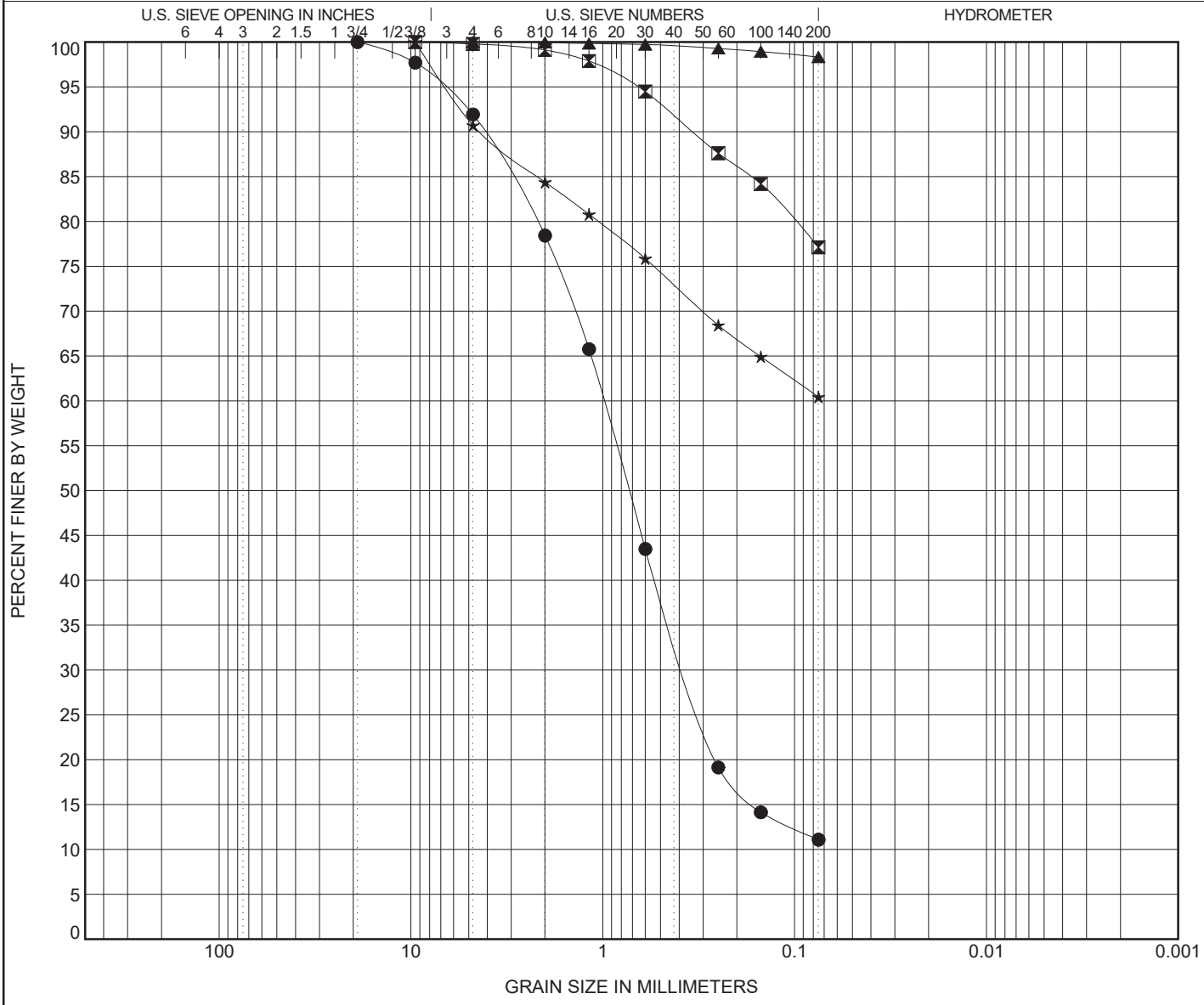
DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20							
	SS	67	4-4-3 (7)	MC = 22.6%	SP		Gray poorly graded SAND, loose, water bearing
21.5							42.5

Boring terminated at 21.5 feet below existing grade. Groundwater table encountered at 10.0 feet during drilling. 2" PVC standpipe installed to bottom of boring. Lower 10.0 feet slotted. Well ID: BNF289. Boring backfilled with bentonite/sand.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

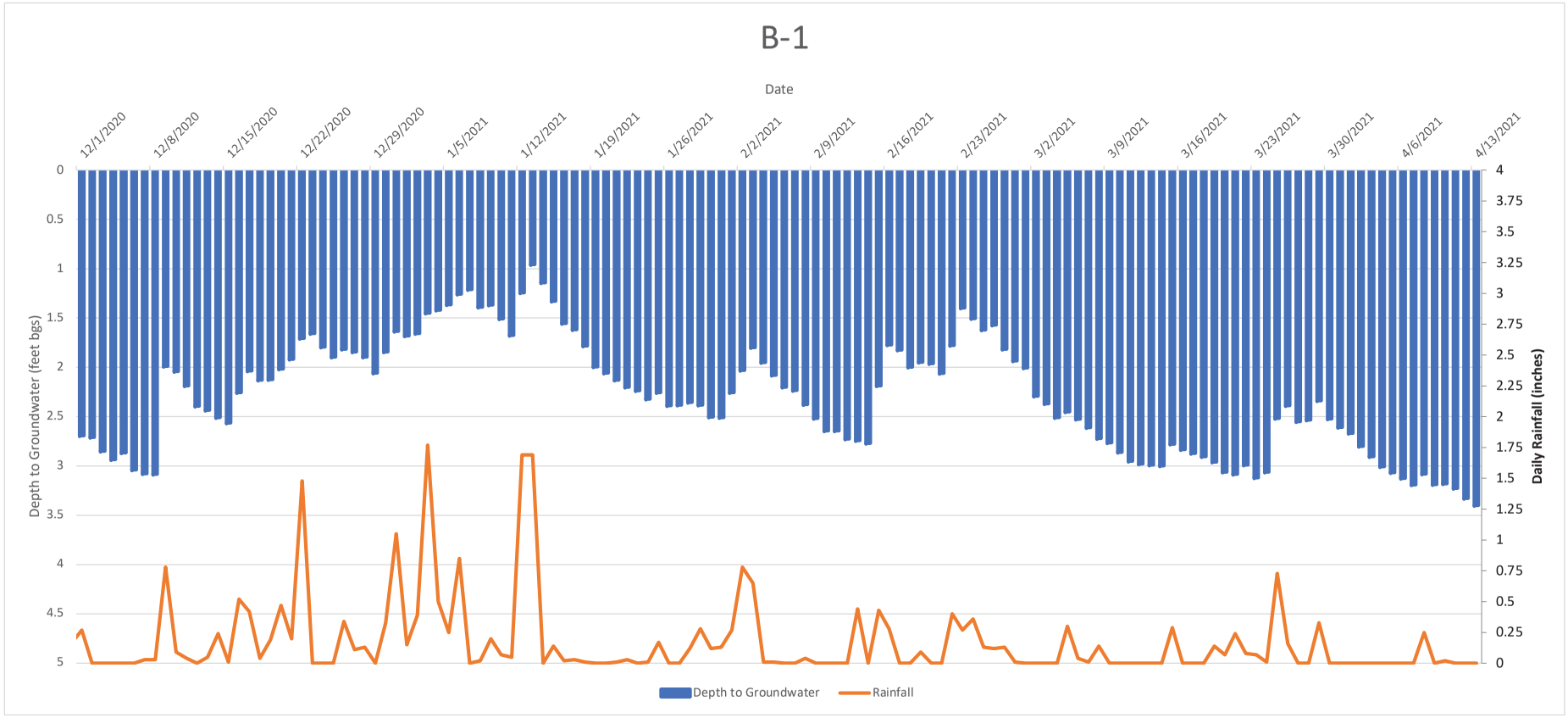
PROJECT NUMBER ES-6481.01 **PROJECT NAME** Best Parking Lot Cleaning Site Improvements



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	Cc	Cu
●	**B-01**	**5.00ft.**	**USDA: Gray Gravelly Coarse Sand. USCS: SW-SM.**	**2.35**	**16.92**
⊠	**B-02**	**5.00ft.**	**USDA: Brown Slightly Gravelly Loam. USCS: ML with Sand.**		
▲	**B-03**	**2.50ft.**	**USDA: Gray Slightly Gravelly Loam. USCS: ML.**		
★	**B-03**	**5.00ft.**	**USDA: Gray Slightly Gravelly Loam. USCS: Sandy ML.**		

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	**B-01**	**5.0ft.**	**19**	**0.991**	**0.369**					**11.1**	
⊠	**B-02**	**5.0ft.**	**9.5**							**77.1**	
▲	**B-03**	**2.5ft.**	**4.75**							**98.3**	
★	**B-03**	**5.0ft.**	**9.5**							**60.4**	


B-1
Date
12/1/2020
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12/22/2020
12/29/2020
1/5/2021
1/12/2021
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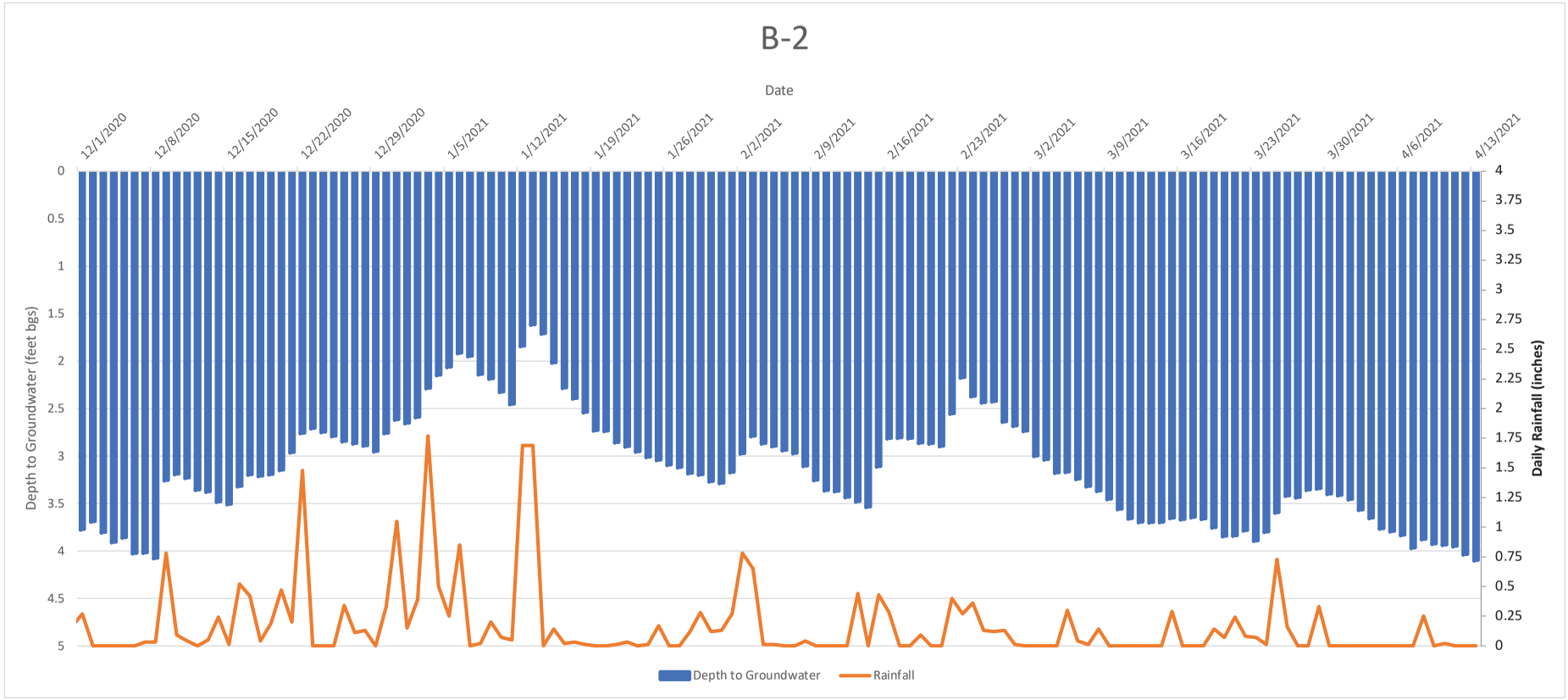
1/26/2021
2/2/2021
2/9/2021
2/16/2021
2/23/2021
3/2/2021
3/9/2021
3/16/2021
3/23/2021
3/30/2021
4/6/2021
4/13/2021
Depth to Groundwater (feet bgs)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Daily Rainfall (inches)
4
3.75
3.5
3.25
3
2.75
2.5
2.25
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
Depth to Groundwater
Rainfall


B-2
Date
12/1/2020
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12/22/2020
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1/26/2021
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2/9/2021
2/16/2021
2/23/2021
3/2/2021
3/9/2021
3/16/2021
3/23/2021
3/30/2021
4/6/2021
4/13/2021
Depth to Groundwater (feet bgs)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Daily Rainfall (inches)
4
3.75
3.5
3.25
3
2.75
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2.25
2
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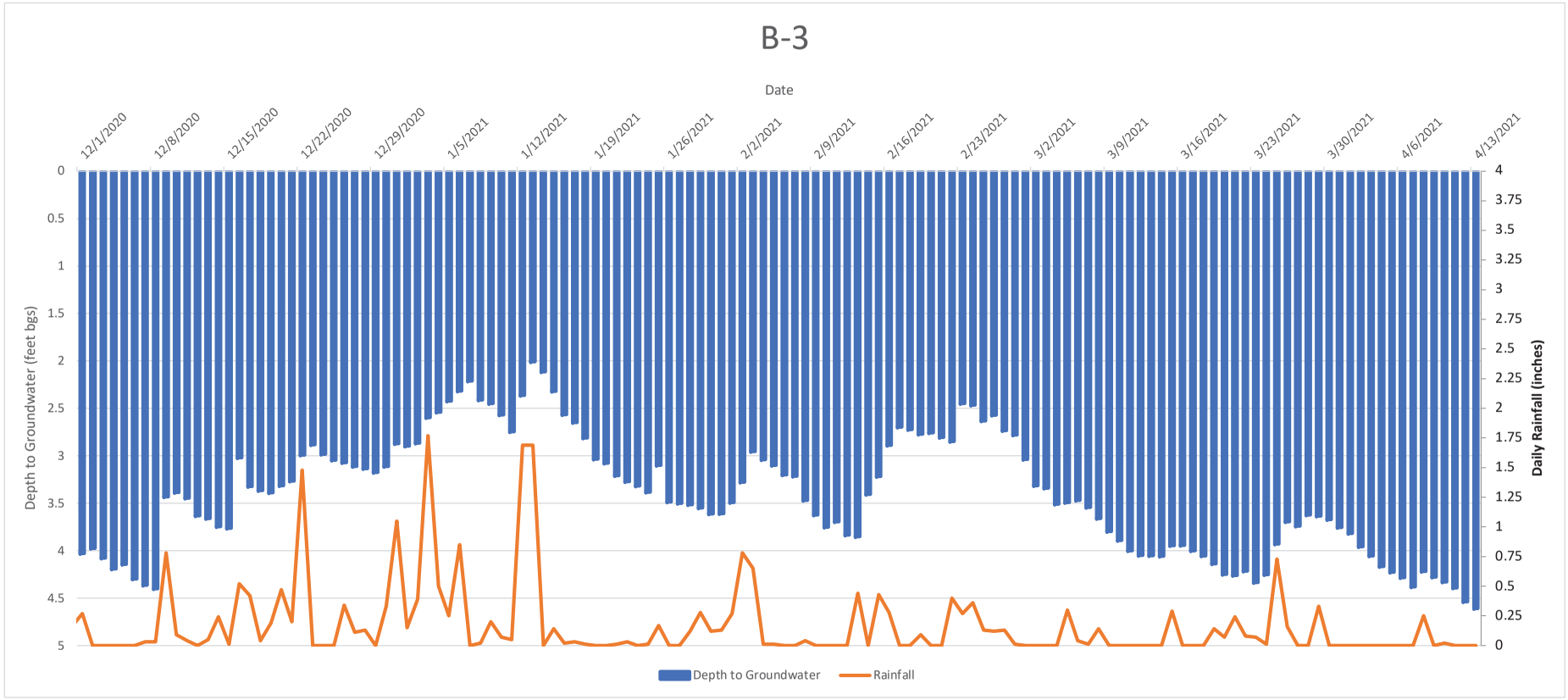
1
0.75
0.5
0.25
0
Depth to Groundwater
Rainfall


B-3
Date
12/1/2020
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1/5/2021
1/12/2021
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1/26/2021
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2/16/2021
2/23/2021
3/2/2021
3/9/2021
3/16/2021
3/23/2021
3/30/2021
4/6/2021
4/13/2021
Depth to Groundwater (feet bgs)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Daily Rainfall (inches)
4
3.75
3.5
3.25
3
2.75
2.5
2.25
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
Depth to Groundwater
Rainfall

Earth Solutions NW LLC
Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

August 3, 2021
ES-6481.01

BPLC Properties, LLC
10615 – 438th Street Court East
Eatonville, Washington 98328

Attention: Mr. Rich Hamilton

Subject: Detention Pond Liner & Pavement Section Recommendations
Best Parking Lot Cleaning Site Improvements
2512 Inter Avenue
Puyallup, Washington

Reference: Earth Solutions NW, LLC
Geotechnical Evaluation
Project No. ES-6481, dated February 19, 2019

Earth Solutions NW, LLC
Groundwater Monitoring Program Summary
Project No. ES-6481.01, dated April 27, 2021

Barghausen Consulting Engineers, Inc.
Civil Plans, dated February 2020

Greetings, Mr. Hamilton:

As requested by Barghausen Consulting Engineers, Inc., Earth Solutions NW, LLC (ESNW) has prepared this letter for the subject project. Recommendations provided herein concern lining the proposed detention pond and a pavement section for the heavier (truck) traffic anticipated on the new asphalt.

Detention Pond Liner

Per the referenced civil plans, a detention pond is proposed within the northeast site area. Because the detention pond will be constructed below the seasonal high groundwater table (GWT), a liner will be installed to resist hydrostatic uplift. Based on the pond sections depicted in the referenced plans as well as the results of our groundwater monitoring program through the 2020–2021 wet season (as summarized in the referenced letter), the following is a summary of the design parameters for the detention pond

- Top of pond elevation 64.5 feet
- Maximum water surface elevation 63.5 feet
- Static water surface elevation 57.5 feet
- Bottom of pond elevation 57.0 feet
- Seasonal high GWT elevation 62.2 feet

The seasonal high GWT elevation was based on the monitoring completed at boring B-1, which was installed within the detention pond area. It is noted that the seasonal high GWT elevation obtained at B-1 was the shallowest groundwater level obtained across the site; readings at B-2 and B-3 were 0.7 feet and 1.1 feet deeper, respectively.

The design parameters outlined in this section were incorporated into an equation to determine the required liner thickness to resist hydrostatic uplift. A calculation sheet is attached to this letter. Based on the computation results, the following recommendations are offered for the detention pond liner:

- A 40-mil PVC or HDPE liner should be placed continuously over the pond bottom.
- Atop the liner, at least four-and-one-half feet of ballast should be placed. If desired and/or required, the upper 12 inches of the ballast may be substituted as amended soil.
- An ESNW representative should be contacted to observe and document installation of the pond liner. Supplementary recommendations may be provided at the time of construction, where necessary.

The above recommendations incorporate a safety factor of about 1.1 with respect to hydrostatic uplift resistance. In our opinion, this safety factor is appropriate for the pond liner design from a geotechnical standpoint.

Pavement Section Recommendations

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proofrolling with a loaded dump truck. Soft, wet, or otherwise unsuitable subgrade areas may still exist after base grading activities. Areas of unsuitable or yielding subgrade conditions may require remedial measures, such as overexcavation and replacement with structural fill or thicker crushed rock sections, prior to pavement.

In our opinion, the following pavement sections for heavier traffic (occasional truck traffic) areas may be considered:

- Three inches of hot-mix asphalt (HMA) placed over six inches of crushed rock base (CRB).
- Three inches of HMA placed over four-and-one-half inches of asphalt-treated base (ATB).

The HMA, ATB, and CRB materials should conform to WSDOT and/or City of Puyallup specifications, where applicable. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557. Road standards utilized by the City of Puyallup may supersede the recommendations provided in this section.

We trust this letter meets your current needs. Please call if you have any questions about this letter or if we can be of further assistance.

Sincerely,

EARTH SOLUTIONS NW, LLC

08/03/2021
Keven D. Hoffmann, P.E.
Geotechnical Engineering Services Manager

Attachment: Calculation Sheet

cc: Barghausen Consulting Engineers, Inc.
Attention: Mr. Jason Hubbell, P.E. (Email only)

Earth Solutions NW LLC
CALCULATION SHEET

Name: KDH
Date: 07/27/2021
Project Number: 6481.01
Project Name: BPLC Improvements (Puyallup)

Detention Pond Liner Evaluation:
Req'd Amended Soil Thickness to resist Uplift

Assumptions / Design Parameters

(ref. Barghausen Consulting Engr., Storm Drainage Plan/Sections, Feb. 2020)

Top of pond = El. 64.5

Max. W.S. = El. 63.5

Static W.S. = El. 57.5

Bottom of pond = El. 57.0

Seasonal high GWE = El. 62.2

*NEED: Liner thickness/elevation req'd to resist uplift * ("x")

NOTE: Pond liner assumed as ballast + amended soil, $\gamma = 135$ pcf

Solve the imbalance equation, need to resist uplift

Imbalance = [(Seasonal high GWE) − (Liner elevation)] (Unit wt. H_2O)

Resistance to uplift = Dead Storage

= [(Static W.S.) − (Bottom of pond)] (Unit wt. H_2O) +

(Liner thickness) (Unit wt. liner)

Where Imbalance = Resistance to uplift, FOS = 1.0. Solve equation...

$(62.2 - 57.0 + x)(62.4) = (57.5 - 57.0)(62.4) + (x)(135)$

$\Rightarrow x = 4.04'$, so 4.04' liner req'd for resistance.

Use min. FOS = 1.1 for design and round up: $4.04(1.1) = 4.44 \triangleq$ **4.5'**

→ **Use 4.5' Liner thickness** ←