



CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

FOR

BASS PRO SHOPS WAREHOUSE ACCESS CONNECTION

CITY OF PUYALLUP, WASHINGTON

SEPTEMBER 2025



2025.09.10

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Project # 25-026

*I hereby state that this Construction Stormwater Pollution Prevention Plan for **Bass Pro Shops Warehouse Access Connection** has been prepared by me or under my supervision and meets the standard of care and expertise that is usual and customary in this community of professional engineers. I understand that the City of Puyallup does not and will not assume liability for the sufficiency, suitability or performance of drainage facilities prepared by Contour Engineering LLC. This analysis is based on data and records either supplied to, or obtained by, Contour Engineering, LLC. 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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1.0 PROJECT OVERVIEW

Purpose and Scope

This preliminary drainage report accompanies the preliminary site plan review application to construct a Bass Pro Shops access connection in Puyallup, Washington. The access connection will consist of a 2,128 SF paved area. No structures are proposed as part of this development. The project site is located along Valley Ave on three tax parcels 6026520020, 0420163077 and 0420163042 within the Southwest ¼ of Section 16, Township 20 North, Range 4 East, W.M. See Appendix A for Vicinity Map.

The 2024 Department of Ecology Stormwater Management Manual for Western Washington (Ecology Manual) will establish the methodology and design criteria used for this project.

Project Description

As referenced above, the site is located along Valley Ave NW in the City of Puyallup, Washington. The site consists of three contiguous parcels. When combined, the parcels encompass approximately 14.87 acres. The site is bounded by developed industrial sites parcels to the north, south and west, and Valley Ave NW to the east.

The project proposes paving an access area that will replace approximately 2,128 sq. ft. of hard surfaces.

Parcel #:	6026520020, 0420163077 and 0420163042
Address:	1212 ,1042, 1036 Valley Ave NW, Puyallup, WA 98371
Owner:	Andy Sprague
Zoning:	Limited Manufacturing (ML)
Lot Size:	13.12 acres (Parcel # 6026520020)
	1.636 acres (Parcel # 0420163077)
	0.114 acres (Parcel # 0420163042)

2.0 EXISTING CONDITIONS

Pre-Developed Site Conditions

The western lot is developed with a Warehouse and parking lot, three smaller structures, and a private gravel driveway. The middle lot is developed with a paved lot. The third smaller lot to the southeast is also developed with two structures and a concrete parking lot.

Topography and Ground Cover

According to the soils report prepared by Georesources LLC, "the site slopes down from Valley Avenue to the southwest at about 0 to 3 percent to a wide shallow depression located in the central portion of the site. The western portion of the site then slopes back up to the southwest at about 0 to 3 percent. The total topographic relief across the site is on the order of 6 feet." See Appendix B for a copy of the complete soils report.

Adjacent Land Uses

The project area is surrounded by the following uses and entities:

North:	Industrial Property (Zoned Limited Manufacturing)
West:	Industrial Property (Zoned Limited Manufacturing)
East:	Valley Avenue NW (Public ROW)
South:	Industrial Property (Zoned Limited Manufacturing)

Drainage Patterns

By examining the topography of the site and the area surrounding the site and the City GIS, it can be concluded that there is no off-site drainage contributory to the property.

Critical and Sensitive Areas

The site is located in an aquifer recharge area per the Pierce County aquifer recharge map. The site is also located in a Lahar hazard area.

Other Existing Site Information

N/A

CONSTRUCTION STORMWATER POLLUTION PREVENTION ELEMENTS

The Elements have been addressed and the appropriate BMPs have been incorporated into the Temporary Erosion and Sedimentation Control (TESC) Plan (See Appendix B). BMPs used in the sites TESC Plan can be found in Appendix C, along with some others that may be needed if site conditions change as construction progresses. The list of BMPs was taken from the 2019 Department of Ecology Stormwater Management Manual for Western Washington (Ecology Manual) and includes:

TESC Plan BMPs (included in Appendix C)

- BMP C101: Preserving Natural Vegetation
- BMP C103: High Visibility Plastic or Metal Fence
- BMP C105: Stabilized Construction Entrance
- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C123: Plastic Covering
- BMP C140: Dust Control
- BMP C150: Materials on Hand
- BMP C151: Concrete Handling
- BMP C153: Material Delivery, Storage and Containment
- BMP C160: Certified Erosion and Sediment Control Lead
- BMP C162: Scheduling
- BMP C209: Outlet Protection
- BMP C220: Storm Drain Inlet Protection
- BMP C233: Silt Fence
- BMP C235: Wattles

If necessary, contractor shall review all available BMPs to provide proper erosion, sediment, and pollutant control onsite.

Element #1: Mark Clearing Limits

Prior to beginning construction activities, all clearing and construction limits shall be delineated. The remaining portions of the clearing limits will be delineated with High Visibility Plastic Fencing (BMP C103) as necessary. The TESC Plan shows the clearing limits for the project, see Appendix B.

Element #2: Establish Construction Access

The construction site is accessible from Valley Ave NW. No sediment tracking on the roadway is allowed. If sediment is inadvertently tracked onto the road, the road shall be cleaned immediately. Sediment shall be removed from roads by shoveling, sweeping or by another approved means and transported to a controlled sediment disposal area. No street washing of sediments to the storm drain system will be allowed. If needed, a Wheel Wash (BMP C106) shall be utilized either constructed on-site or an approved portable unit can be brought onto the site.

Element #3: Control Flow Rates

Flows will be controlled by silt fence (BMP 233) down slope of the project site, placed as needed. All stormwater from the project site will be dispersed on site.

Element #4: Install Sediment Controls

Silt Fence (BMP C233) will be utilized along disturbed or newly constructed slopes as needed to reduce erosion and minimize sediment runoff.

Element #5: Stabilize Soils

Exposed and un-worked soils, such as soil stockpiles, shall be stabilized by application of effective erosion control measures that protect the soil from the erosive forces of raindrops, flowing water, and wind. Such measures include Plastic Covering (BMP C123) along with Temporary and Permanent Seeding (BMP C120). This project does not appear to have steep slopes.

Selected soil stabilization measures shall be appropriate for the time of year, site conditions, estimated duration of use, and the water quality impacts that stabilization agents may have on downstream waters or ground water.

The "Wet Season" is from October 1 to April 30. Within this period, no soils shall remain exposed and un-worked for more than 2 days. The "Dry Season" is from May 1 to September 30. Within this period, no soils shall remain exposed and un-worked for more than 7 days. This stabilization requirement applies to all soils on-site, whether at final grade or not. Soils shall be stabilized at the end of each shift before a holiday or weekend (if needed) based on the weather forecast.

Linear construction activities such as right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirements. Contractors shall install the bedding materials, roadbeds, structures, pipelines, or utilities and re-stabilize the disturbed soils so to adhere to the season timelines outlined above.

Element #6: Protect Slopes

Slopes along the road shall be maintained as vegetated as much as feasible. Cut-and-fill slopes shall be constructed in a manner to minimize erosion. All stormwater shall be conveyed in such a manner that avoids steep slopes. Wattles (BMP C235) and Plastic Covering (BMP C123) shall be utilized as field conditions warrant. While the existing slopes are currently maintained and seeded, implement temporary and permanent seeding (BMP C120) and mulching (BMP C121) as needed to minimize exposed soils.

Element #7: Protect Drain Inlets

It is important to protect storm conveyance and mitigation systems from any sediment-laden runoff. Both existing and constructed catch basins and other inlets shall be protected per the Storm Drainage Inlet Protection BMP (BMP C220). See the TESC Plan in Appendix B for locations of required inlet protection.

Element #8: Stabilize Channels and Outlets

No channels or outlets are proposed as part of this proposed development. The existing outlet will be maintained and utilized for this proposed development. No additional outlets are proposed at this time.

Element #9: Control Pollutants

All pollutants, including waste materials and demolition debris, that occur on-site during construction shall be handled and disposed of in a manner that does not cause contamination of surface water. Woody debris may be chopped and spread on site.

Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).

Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into surface water runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

Application of agricultural chemicals including fertilizers and pesticides shall be conducted in a manner and at application rates that will not result in chemicals entering surface water. Manufacturers' recommendations for application rates and procedures shall be followed.

All applicable BMPs shall be used to prevent or treat contamination of surface water runoff by pH modifying sources. These sources include bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters. Some applicable BMPs include Concrete Handling (BMP C151), and those within Chapter 5 of *Volume IV – Source Control BMPs* of the *2021 SWMM*.

Element #10: Control Dewatering

It is anticipated that dewatering will not be needed. However, if needed the following guidance is provided.

Discharge from foundation, vault, and trench dewatering water that has similar characteristics to site stormwater runoff into a controlled conveyance system prior to discharge to a stabilized outfall location. If conveyance system is used, it must be designed by an engineer and approved by the city prior to use.

Clean, non-turbid dewatering water, such as well-point groundwater, can be discharged to systems tributary to state surface waters, provided the dewatering flow does not cause

erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds/tanks.

Handle highly turbid or contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam separately from stormwater at the site.

Other disposal options, depending on site constraints, may include:

- Transport off-site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters
- Ecology approved on-site chemical treatment or other suitable treatment technologies

Element #11: Maintain BMPs

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 BMPs.

Sediment control BMPs shall be inspected weekly or after a runoff-producing storm events during the "Dry Season" and daily during the "Wet Season". The inspection frequency for stabilized inactive sites shall be determined by the City based on the level of soil stability and potential for adverse environmental impacts.

Remove temporary erosion and sediment control BMPs within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed with approval of the inspector. Trapped sediment shall be removed or stabilized on site. Permanently stabilize disturbed soil resulting from removal of BMPs or vegetation.

Element #12: Manage the Project

Development projects shall be phased in order to prevent the transport of sediment from the development site during construction, unless the project engineer can demonstrate that construction phasing is infeasible. Re-vegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance and compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by the City, shall be delineated on the site plans and the development site.

Seasonal Work Limitations are from October 1 to April 30 where clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the City that the transport of sediment from the construction site will be prevented. Based on the information provided and local weather conditions, the City may expand or restrict the seasonal limitation on site disturbance. The City may take enforcement action (such as a notice of violation, administrative order, penalty, or stop-work order) if violations are noticed, required BMPs are not being maintained, or the approved plans are not being followed. The following activities are exempt from the seasonal clearing and grading limitations:

1. Routine maintenance and necessary repair of erosion and sediment control BMPs;
2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
3. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Additional BMPs and erosion control measures shall be installed as deemed necessary to protect adjacent properties and County right-of-ways.

Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of, or potential to discharge, a significant amount of any pollutant, the SWPPP shall be modified, as appropriate, in a timely manner.

Spillage and/or discharge of pollutants shall be reported within 24-hours. Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing/cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground, or into surface water runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

Report spillage or discharge of pollutants within 24-hours to the local jurisdiction.

The Construction SWPPP shall be retained on-site or within reasonable access to the site. The Construction SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP. The inspector shall be notified of any changes to the Construction SWPPP. The inspector may require a plan modification to go through the City review process.

Element #13: Protect Permanent Stormwater BMPs

Protect all permanent stormwater BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the BMPs. Restore all BMPs to their fully functioning condition if they accumulate sediment during construction. Sediment impacting Best Management Practices shall be removed before system start-up. Restoring the BMP shall include removal of all sediment.

- Protect lawn and landscaped areas from compaction due to construction equipment and material stockpiles.

Construction Sequence

1. Obtain required permits
2. Hold a pre-construction meeting with the City.
3. Pothole any existing utilities for verification of depth and location as needed, See verification note.
4. Establish clearing and grading limits and install construction entrance.
5. Construct erosion control BMPs as shown.
6. Schedule an erosion control inspection with the city.
7. Construct improvements per plan.
9. Stabilize all exposed soils.
10. Onsite TESC measures to remain until construction has been completed and the site is stabilized to the approval of the city inspector.
11. Arrange final inspection with city.
12. Remove TESC measures when allowed by the city.

CONSTRUCTION SCHEDULE

Construction is anticipated to begin once all necessary permits have been issued. The project will be constructed in a single phase and be completed as soon as possible.

FINANCIAL/OWNERSHIP RESPONSIBILITIES

Andy Sprague
5615 48th Ave E,
Tacoma, WA 98443

EROSION CONTROL SPECIALIST

Someone shall be placed in charge of ensuring proper sediment and erosion control. This person does not need to be a Certified Erosion Control Specialist, but they must be available at all times. This person and his contact info are as follows:

1. Name: _____
2. Phone: _____
3. Email: _____

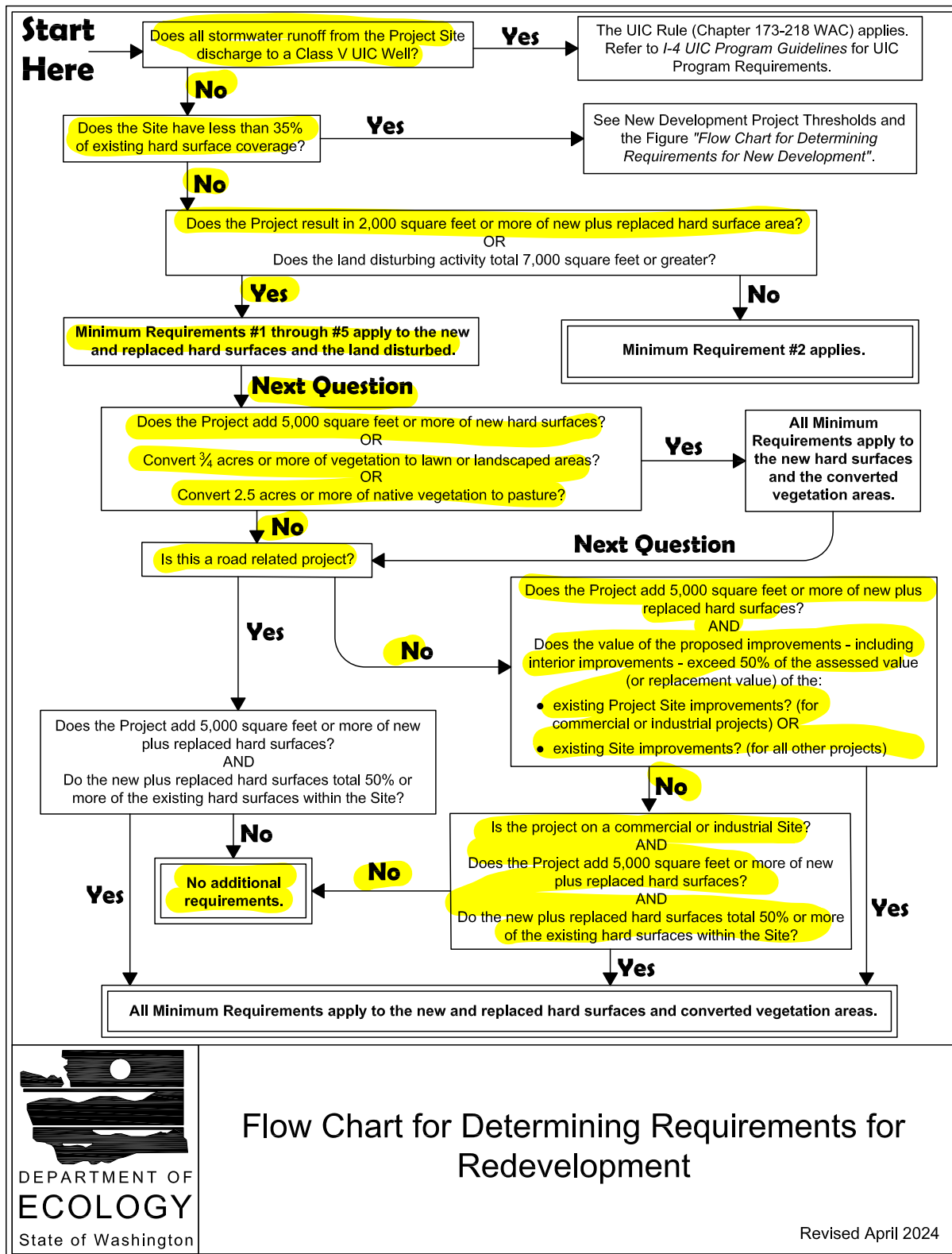
APPENDIX A

General Exhibits



Vicinity Map

Figure I-3.2: Flow Chart for Determining Requirements for Redevelopment














APPENDIX B

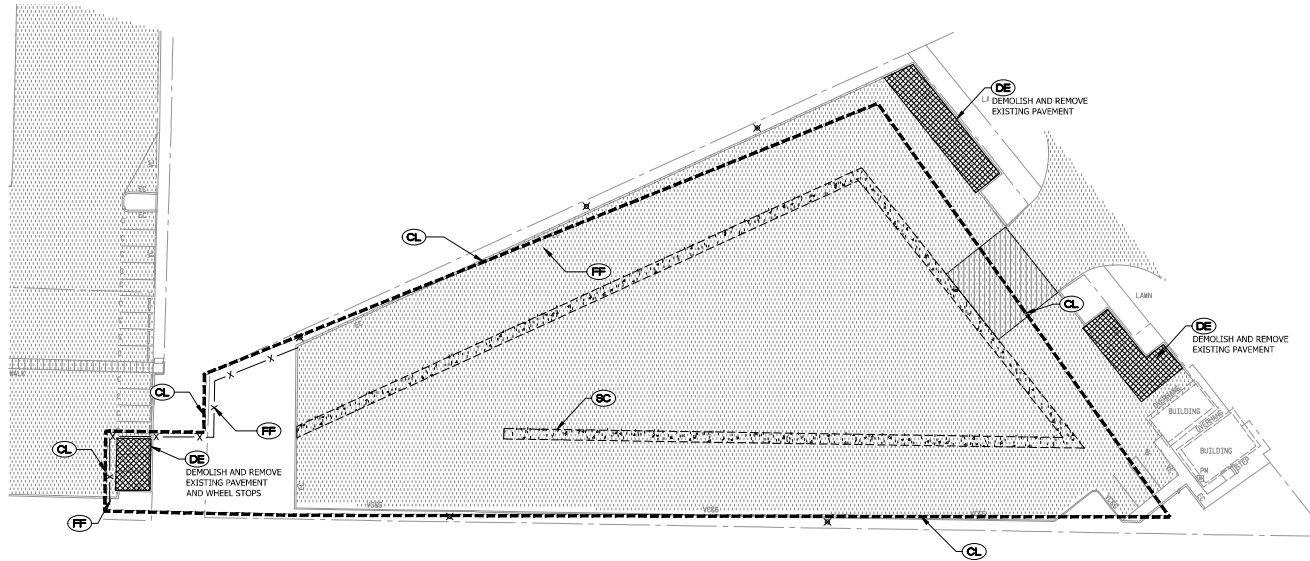
TESC Plan Exhibits

1 INCH = 30 FEET (22"x34")
1 INCH = 60 FEET (11"x17")



TESC LEGEND

- | | | |
|---|---|--|
|  |  | CLEARING/GRADING/DISTURBED LIMITS |
|  |  | DEMOLISH AND REMOVE
PER PLANS |
| |  | PRESERVE AND PROTECT AS NOTED |
|  |  | STORM DRAIN INLET PROTECTION
SEE DETAIL 1, SHEET C4 |
|  |  | SILTATION FENCE SEE DETAIL 3,
SHEET C4 |
|  |  | SAWCUT LINE |



NOTE: THIS APPROVAL IS VOID AFTER 180 DAYS FROM APPROVAL DATE. THE CITY WILL NOT BE RESPONSIBLE FOR ERRORS AND/OR OMISSIONS ON THESE PLANS. FIELD CONDITIONS MAY Dictate CHANGES TO THESE PLANS AS DETERMINED BY THE DEVELOPMENT ENGINEERING MANAGER.

ALL EXISTING UTILITIES IN THE CONSTRUCTION AREA SHALL BE IDENTIFIED AND VERIFIED FOR DEPTH AND LOCATION PRIOR TO ANY CONSTRUCTION ACTIVITIES SO TO IDENTIFY ANY POTENTIAL CONFLICTS WITH PROPOSED CONSTRUCTION. CONTACT PROJECT ENGINEER IMMEDIATELY IF ANY CONFLICTS ARE IDENTIFIED.

PRIOR TO ANY CONSTRUCTION ACTIVITIES, VERIFY EXISTING TOPOGRAPHY IS CONSISTENT WITH WHAT IS SHOWN ON PLANS AND IF THERE ARE ANY POTENTIAL CONFLICTS WITH PROPOSED CONSTRUCTION ACTIVITIES. CONTACT PROJECT ENGINEER IMMEDIATELY IF ANY CONFLICTS ARE IDENTIFIED.

CALL 811 AT LEAST 48 HOURS BEFORE YOU DIG

[illegible]

APPENDIX C

Applicable BMPs

**Table II-4.1: Construction Stormwater BMPs by SWPPP Element
(continued)**

Con- struction Stormwater BMP	Construction SWPPP Element #												
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13
II-2.2 Element 2: Establish Construction Access II-2.3 Element 3: Control Flow Rates II-2.4 Element 4: Install Sediment Controls II-2.5 Element 5: Stabilize Soils II-2.6 Element 6: Protect Slopes II-2.7 Element 7: Protect Storm Drain Inlets II-2.8 Element 8: Stabilize Channels and Outlets II-2.9 Element 9: Control Pollutants II-2.10 Element 10: Control Dewatering II-2.11 Element 11: Maintain BMPs II-2.12 Element 12: Manage the Project II-2.13 Element 13: Protect Infiltration BMPs													

II-4.2 Construction Source Control BMPs

BMP C101: Preserving Natural Vegetation

Purpose

The purpose of preserving natural (or existing) vegetation is to reduce erosion wherever practicable. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers can hold up to about 50% of all rain that falls during a storm. Up to 20% to 30% of this rain may never reach the ground but is taken up by the tree or evaporates. Another benefit is that the rain held in the tree can be released slowly to the ground after the storm.

Conditions of Use

Natural vegetation should be preserved on steep slopes, near perennial and intermittent water-courses or swales, and on building sites in wooded areas.

- As required by the local jurisdiction.
- Phase construction to preserve natural vegetation on the project site for as long as possible during the construction period.

Design and Installation Specifications

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved. Local jurisdictions may also have ordinances to save natural vegetation and trees.
- Fence or clearly mark areas around trees that are to be saved. It is preferable to keep ground disturbance away from the trees at least as far out as the dripline.

Plants need protection from three kinds of injuries:

- *Construction Equipment* - This injury can be above or below the ground level. Damage results from scarring, cutting of roots, and compaction of the soil. Placing a fenced buffer zone around plants to be saved prior to construction can prevent construction equipment injuries.
- *Grade Changes* - Changing the natural ground level will alter grades, which affects the plant's ability to obtain the necessary air, water, and minerals. Minor fills usually do not cause problems although sensitivity between species does vary and should be checked. Trees can typically tolerate fill of 6 inches or less. For shrubs and other plants, the fill should be less.

When there are major changes in grade, it may become necessary to supply air to the roots of plants. This can be done by placing a layer of gravel and a tile system over the roots before the fill is made. The tile system should be laid out on the original grade leading from a drywell around the tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

Lowering the natural ground level can seriously damage trees and shrubs. The highest percentage of the plant roots are in the upper 12 inches of the soil and cuts of only 2 to 3 inches can cause serious injury. To protect the roots it may be necessary to terrace the immediate area around the plants to be saved. If roots are exposed, construction of retaining walls may be needed to keep the soil in place. Plants can also be preserved by leaving them on an undisturbed, gently sloping mound. To increase the chances for survival, it is best to limit grade changes and other soil disturbances to areas outside the dripline of the plant.

- *Excavations* - Protect trees and other plants when excavating for drainfields and power, water, and/or sewer lines. Where possible, the trenches should be routed around trees and large shrubs. When this is not possible, it is best to tunnel under them. This can be done with hand tools or with power augers. If it is not possible to route the trench around plants to be saved, then the following should be observed:
 - Cut as few roots as possible. When you have to cut, cut clean. Paint cut root ends with a wood dressing like asphalt base paint if roots will be exposed for more than 24 hours.
 - Backfill the trench as soon as possible.
 - Tunnel beneath root systems as close to the center of the main trunk to preserve most of the important feeder roots.

Some problems that can be encountered are:

- Maple, Dogwood, Red alder, Western hemlock, Western red cedar, and Douglas fir do not readily adjust to changes in environment and special care should be taken to protect these trees.
- The windthrow hazard of Pacific silver fir and madrona is high, while that of Western hemlock is moderate. The danger of windthrow increases where dense stands have been thinned. Other species (unless they are on shallow, wet soils less than 20 inches deep) have a low windthrow hazard.
- Cottonwoods, maples, and willows have water-seeking roots. These can cause trouble in sewer lines and infiltration fields. On the other hand, they thrive in high moisture conditions that other trees would not.
- Thinning operations in pure or mixed stands of grand fir, Pacific silver fir, noble fir, Sitka spruce, western red cedar, western hemlock, Pacific dogwood, and red alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

Maintenance Standards

Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

If tree roots have been exposed or injured, “prune” cleanly with an appropriate pruning saw or loppers directly above the damaged roots and recover with native soils. Treatment of sap flowing trees (e.g. fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.

BMP C102: Buffer Zones

Purpose

Creation of an undisturbed area or strip of natural vegetation or an established suitable planting that will provide a living filter to reduce soil erosion and stormwater runoff velocities.

Conditions of Use

Buffer zones are used along streams, wetlands and other bodies of water that need protection from erosion and sedimentation. Contractors can use vegetative buffer zone BMPs to protect natural swales and they can incorporate them into the natural landscaping of an area.

Do not use critical area buffer zones as sediment treatment areas. These areas shall remain completely undisturbed. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

The types of buffer zones can change the level of protection required as shown below:

- Designated Critical Area Buffers - buffers that protect Critical Areas, as defined by the Washington State Growth Management Act, and are established and managed by the local

permitting authority. These should not be disturbed and must be protected with sediment control BMPs to prevent impacts. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

- Vegetative Buffer Zones - areas that may be identified in undisturbed vegetation areas or managed vegetation areas that are outside any Designated Critical Area Buffer. They may be utilized to provide an additional sediment control area and/or reduce runoff velocities. If being used for preservation of natural vegetation, they should be arranged in clumps or strips. They can be used to protect natural swales and incorporated into the natural landscaping area.

Design and Installation Specifications

- Preserving natural vegetation or plantings in clumps, blocks, or strips is generally the easiest and most successful method.
- Leave all unstable steep slopes in natural vegetation.
- Mark clearing limits and keep all equipment and construction debris out of the natural areas and buffer zones. Steel construction fencing is the most effective method to protect sensitive areas and buffers. Alternatively, wire-backed silt fence on steel posts is marginally effective. Flagging alone is typically not effective.
- Keep all excavations outside the dripline of trees and shrubs.
- Do not push debris or extra soil into the buffer zone area because it will cause damage by burying and smothering vegetation.
- Vegetative buffer zones for streams, lakes or other waterways shall be established by the local permitting authority or other state or federal permits or approvals.

Maintenance Standards

Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed. Replace all damaged flagging immediately. Remove all materials located in the buffer area that may impede the ability of the vegetation to act as a filter.

BMP C103: High-Visibility Fence

Purpose

High-visibility fencing is intended to:

- Restrict clearing to approved limits.
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed.
- Limit construction traffic to designated construction entrances, exits, or internal roads.
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits, plastic, fabric, or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

High-visibility plastic fence shall be composed of a high-density polyethylene (HDPE) material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method.

If appropriate, install fabric silt fence in accordance with [BMP C233: Silt Fence](#) to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.

Metal fences shall be designed and installed according to the manufacturer's specifications.

Metal fences shall be at least 3 feet high and must be highly visible.

Fences shall not be wired or stapled to trees.

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-4.1: 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-4.2: Stabilized Construction Access Geotextile Standards](#).

Table II-4.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	No. 20 to No. 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. Local 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-4.3: Stabilized Construction Access Alternative Material Requirements](#).

**Table II-4.3: Stabilized Construction
Access Alternative Material
Requirements**

Sieve Size	Percent Passing
2½"	99 to 100
2"	65 to 100
¾"	40 to 80
No. 4	5 max.
No. 100	0 to 2
% Fracture	75 min.
Notes: 1. All percentages are by weight. 2. The sand equivalent value and dust ratio requirements do not apply. 3. 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

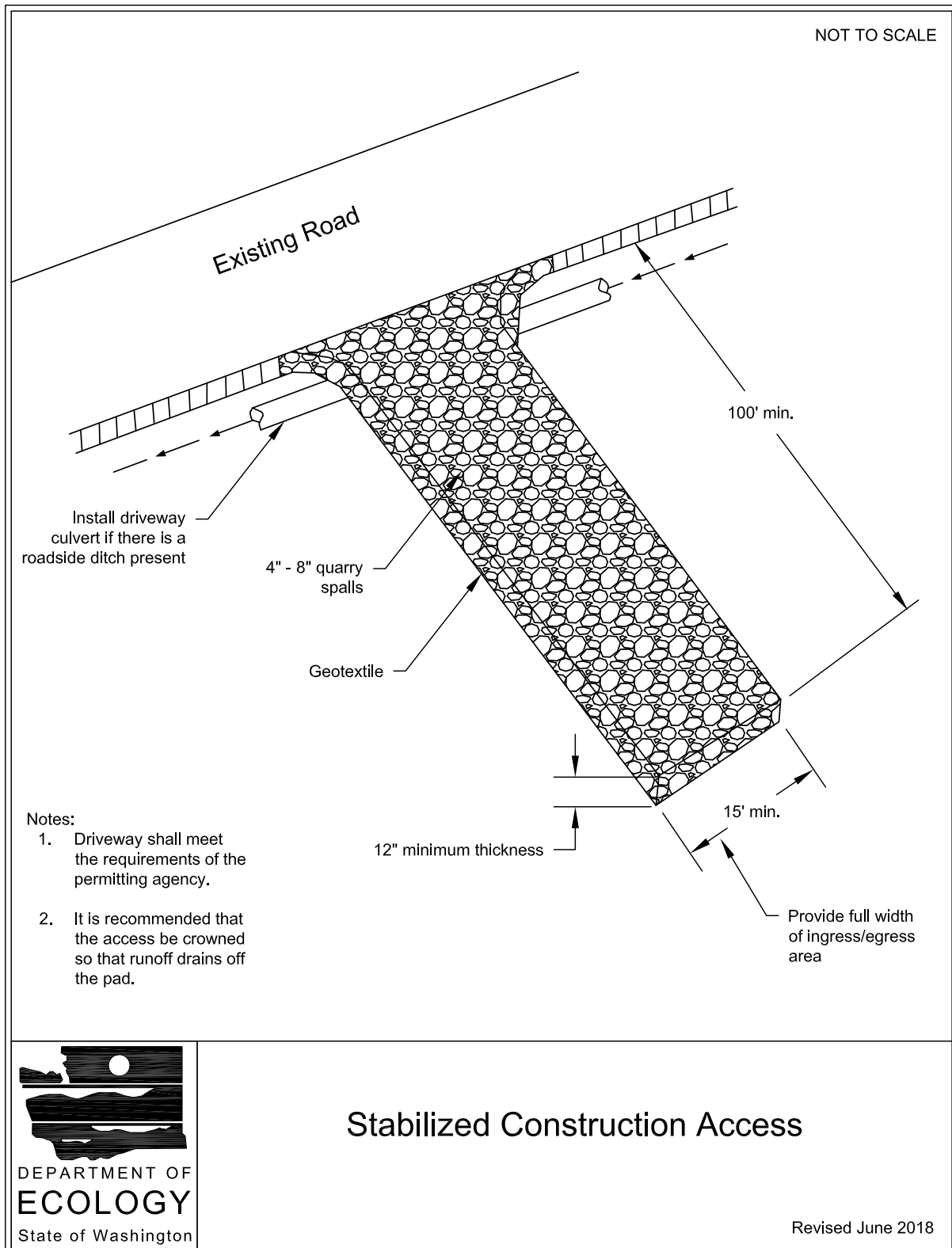
Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- 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 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-4.1: 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-4.2: Wheel Wash](#). The local permitting authority may allow other designs. A minimum of 6 inches of asphalt treated base (ATB) over crushed base

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. See [II-2.5 Element 5: Stabilize Soils](#) for specific timelines for stabilizing exposed soils.
- See [Table II-4.4: Seeding Windows in Western Washington \(continued\)](#) for appropriate seeding windows.
- 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](#).

Table II-4.4: Seeding Windows in Western Washington

Month	Seeding Recommendations
January	Seeding requires a cover of mulch or an erosion control blanket until 75% grass cover is established
February	
March	

Table II-4.4: Seeding Windows in Western Washington (continued)

Month	Seeding Recommendations
April	Optimum seeding window
May	
June	
July	Seeding requires irrigation until 75% grass cover is established
August	
September	Optimum seeding window
October	Seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established
November	
December	

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix (BFM). 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 a 75% vegetation cover. If vegetated channels cannot be established by seed before water flow, install sod or prevegetated mats in the channel bottom over top of hydromulch and erosion control blankets.
- Confirm the installation of all required stormwater control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre (lb/acre) of mulch with 3% 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.
- Vegetation establishment can be enhanced by one of the following two approaches:
 - Approach 1: Enhance vegetation establishment by dividing the hydromulch operation into two phases:

- Phase 1 – Install all seed and fertilizer with 25% to 30% mulch and tackifier onto the soil in the first lift.
- Phase 2 – Install the remaining mulch and tackifier over the first lift.
- Approach 2: Vegetation can also be enhanced by:
 - Installing the mulch, seed, fertilizer, and tackifier in one lift;
 - Spreading or blowing straw over the top of the hydromulch at a rate of about 800 to 1,000 lb/acre; or
 - Holding straw in place with a standard tackifier.

Both of these approaches (Approach 1 and Approach 2) 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, and
- Repair of failed slope surfaces.

Either of these approaches can use standard hydromulch (1,500 lb/acre minimum) and BFM/mechanically bonded fiber matrix (MBFM) (3,000 lb/acre minimum).

- Seed may be installed by hand if it is:
 - Temporary and covered by straw, mulch, or topsoil; or
 - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- Consult the local suppliers and/or the local conservation district for their recommendations for appropriate seed mixes and application rates. The appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic.
- In addition to meeting erosion control functions and not hindering maintenance operations, selection of long-lived, successional growth native vegetation that can compete against or exclude weeds and grow with minimal maintenance after plant establishment is preferred. Provide diversity to the greatest extent possible and plan for a succession of flowering times to improve pollinator habitat.
- The seed mixes listed in [Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington \(continued\)](#) include recommended mixes for both temporary and permanent seeding. Alternative seed mixes approved by the local jurisdiction may also be used.
- Apply the mixes in [Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington \(continued\)](#), 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.

Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington

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	<i>Festuca rubra</i> var. <i>commutata</i> or <i>Poa annua</i>	40	98	90
Perennial rye	<i>Lolium perenne</i>	50	98	90
Redtop or colonial bentgrass	<i>Agrostis alba</i> or <i>Agrostis tenuis</i>	5	92	85
White dutch clover	<i>Trifolium repens</i>	5	98	90
Landscaping Seed Mix A recommended mix for landscaping seed.				
Perennial rye blend	<i>Lolium perenne</i>	70	98	90
Chewings and red fescue blend	<i>Festuca rubra</i> var. <i>commutata</i> or <i>Festuca rubra</i>	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)	<i>Festuca arundinacea</i> var.	45	98	90
Dwarf perennial rye (Barclay)	<i>Lolium perenne</i> var. <i>barclay</i>	30	98	90
Red fescue	<i>Festuca rubra</i>	20	98	90
Colonial bentgrass	<i>Agrostis tenuis</i>	5	98	90
Bioswale Seed Mix A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fescue	<i>Festuca arundinacea</i> or <i>Festuca elatior</i>	75-80	98	90
Seaside/Creeping bentgrass	<i>Agrostis palustris</i>	10-15	92	85
Redtop bentgrass	<i>Agrostis alba</i> or <i>Agrostis gigantea</i>	5-10	90	80
Wet Area Seed Mix				

Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
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	<i>Festuca arundinacea</i> or <i>Festuca elatior</i>	60-70	98	90
Seaside/Creeping bentgrass	<i>Agrostis palustris</i>	10-15	98	85
Meadow foxtail	<i>Alepocurus pratensis</i>	10-15	90	80
Alsike clover	<i>Trifolium hybridum</i>	1-6	98	90
Redtop bentgrass	<i>Agrostis alba</i>	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	<i>Agrostis alba</i> or <i>Agrostis oregonensis</i>	20	92	85
Red fescue	<i>Festuca rubra</i>	70	98	90
White dutch clover	<i>Trifolium repens</i>	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 receive 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 soil amendments per the specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer needed is recommended. This will prevent the overapplication 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 to take the place of chemical fertilizers, including several with seaweed extracts that are beneficial to soil microbes and organisms. If 100% 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% tackifier. Achieve a minimum of 95% 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 the following:
 - 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% cover (100% cover for areas that receive sheet or concentrated flows) of all seeded areas after 3 months of active growth following germination during the growing season. If reseeding is ineffective, use an alternate method, such as sodding, mulching, or nets/blankets. If winter weather prevents

adequate grass growth, this time limit may be relaxed at the discretion of the local authority when sensitive areas would otherwise be protected.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. If the erosion problem is drainage related, the problem shall be fixed and the eroded area reseeded and protected by mulch.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes runoff.

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 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-4.7: Mulch Standards and Guidelines \(continued\)](#). 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-4.6: 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).

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.

Table II-4.6: Size Gradations of Compost as Mulch Material

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

Table II-4.7: Mulch Standards and Guidelines

Mulch Material	Guideline	Description
Straw	Quality Stand-	Air-dried; free from undesirable seed and coarse material.

Table II-4.7: Mulch Standards and Guidelines (continued)

Mulch Material	Guideline	Description
	Standards	
	Application Rates	2" to 3" thick; 5 bales per 1,000 sf or 2 to 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 because 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. Straw should only be used if mulches with long-term benefits are unavailable locally. 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 minimum; approximately 100 tons per acre (approximately 750 lbs per cubic yard)
	Remarks	More effective control can be obtained by increasing thickness to 3". Compost makes an 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 compost near wetlands if biosolids are included. Do not use compost 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

Table II-4.7: Mulch Standards and Guidelines (continued)

Mulch Material	Guideline	Description
		average size is between 2 and 4 inches.
	Application Rates	2" thick minimum.
	Remarks	<p>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 approximately 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.</p> <p>Note: Thick application of this material over existing grass, herbaceous species, and some groundcovers could smother and kill vegetation.</p>
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 minimum; approximately 100 tons per acre (approximately 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 minimum.
	Remarks	Cost-effective protection when applied with adequate thickness. A minimum of 95% of the wood strand shall have lengths between 2 and 10 inches, with a width and thickness between 1/16 and 0.5 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. See specification 9-14.4(4) from the <i>Standard Specifications for Road, Bridge, and Municipal Construction</i> (WSDOT, 2016)

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.

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 systems during high flows.

Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (e.g. 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

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 6 mil.
- 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 C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, into drainage systems, and into surface waters.

Conditions of Use

Use dust control in areas (including roadways) subject to surface and air movement of dust where on-site or off-site impacts to roadways, drainage systems, or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until the surface is wet. Repeat as needed. To prevent carryout of mud onto the street, refer to [BMP C105: Stabilized Construction Access](#) and [BMP C106: Wheel Wash](#).
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local jurisdictions may approve other dust palliatives such as calcium chloride or PAM.
- PAM ([BMP C126: Polyacrylamide \(PAM\) for Soil Erosion Protection](#)) added to water at a rate of 0.5 pounds per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to the increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may reduce the quantity of water needed for dust control.

Note that the application rate specified here applies to this BMP, and is not the same application rate that is specified in [BMP C126: Polyacrylamide \(PAM\) for Soil Erosion Protection](#), but the downstream protections still apply.

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. PAM use shall

be reviewed and approved by the local permitting authority and discharge of PAM may be a basis for penalties per [RCW 90.48.080](#).

- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP. See the following website for more information:

<https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Clean-air-agencies>

- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Techniques that can be used for unpaved roads and lots include:
 - Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
 - Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
 - Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
 - Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
 - Encourage the use of alternate, paved routes, if available.
 - Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
 - Limit dust-generating work on windy days.
 - Pave unpaved permanent roads and other trafficked areas.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C150: Materials on Hand

Purpose

Keep quantities of erosion prevention and sediment control materials on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy rains. Having these materials on-site reduces the time needed to replace existing or implement new BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements. In addition, contractors can save money by buying some materials in bulk and storing them at their office or yard.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible 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 contain fine particles and have a 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 by 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 groundwater 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 groundwater 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
- Hazardous chemicals such as acids, lime, adhesives, paints, solvents, and curing compounds
- Any other material that may be detrimental if released to the environment

Design and Installation Specifications

- The temporary storage area should be located away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Safety Data Sheets (SDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers.
- Hazardous material storage on-site should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the wet weather season (October 1 – April 30), consider storing materials in a covered area.
- Materials should be stored in secondary containments, such as an earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, within secondary containment.
- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rain-water on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.
- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain 10% of the total enclosed container volume of all containers, or 110% of the capacity of the largest container within its boundary, whichever is greater.

- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (Oct 1 – April 30), each secondary containment facility shall be covered during non-working days.
- Secondary containment facilities shall be covered at all times, except when in active use.
- Keep material storage areas clean, organized, and equipped with an ample supply of appropriate spill clean-up material (spill kit).
- The spill kit should include, at a minimum:
 - 1 - Water resistant nylon bag
 - 3 - Oil absorbent socks 3"x 4'
 - 2 - Oil absorbent socks 3"x 10'
 - 12 - Oil absorbent pads 17"x19"
 - 1 - Pair splash resistant goggles
 - 3 - Pairs nitrile gloves
 - 10 - Disposable bags with ties
 - Instructions

Maintenance Standards

- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Re-stock spill kit materials as needed.

BMP C154: Concrete Washout Area

Purpose

Prevent or reduce the discharge of pollutants from concrete waste to stormwater by conducting washout off-site, or performing on-site washout in a designated area.

Conditions of Use

Concrete washout areas are implemented on construction projects where:

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 ESC 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-3 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).
 - Facilitating, participating in, and taking 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 ESC 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 can reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

Conditions of Use

The construction sequence schedule is an orderly listing of all major land-disturbing activities together with the necessary erosion and sediment control (ESC) measures planned for the

project. This type of schedule guides the contractor on work to be done before other work is started so that serious erosion and sedimentation problems can be avoided.

Following a specified work schedule that coordinates the timing of land-disturbing activities and the installation of control measures is perhaps the most cost-effective way of controlling erosion during construction. The removal of ground cover leaves a site vulnerable to erosion. Construction sequencing that limits land clearing, provides timely installation of ESC BMPs, and restores protective cover quickly can significantly reduce the erosion potential of a site.

Design Considerations

- Minimize construction during rainy periods.
- Schedule projects to disturb only small portions of the site at any one time. Complete grading as soon as possible. Immediately stabilize the disturbed portion before grading the next portion. Practice staged seeding in order to revegetate cut and fill slopes as the work progresses.

II-4.3 Construction Runoff BMPs

BMP C200: Interceptor Dike and Swale

Purpose

Provide a dike of compacted soil or a swale at the top or base of a disturbed slope or along the perimeter of a disturbed construction area to convey stormwater. Use the dike and/or swale to intercept the runoff from unprotected areas and direct it to areas where erosion can be controlled. This can prevent storm runoff from entering the work area or sediment-laden runoff from leaving the construction site.

Conditions of Use

Use an interceptor dike or swale where runoff from an exposed site or disturbed slope must be conveyed to an erosion control BMP that can safely convey the stormwater.

- Locate upslope of a construction site to prevent runoff from entering the disturbed area.
- When placed horizontally across a disturbed slope, it reduces the amount and velocity of runoff flowing down the slope.
- Locate downslope to collect runoff from a disturbed area and direct it to a sediment trapping BMP (e.g. [BMP C240: Sediment Trap](#) or [BMP C241: Sediment Pond \(Temporary\)](#)).

Design and Installation Specifications

- Dike and/or swale and channel must be stabilized with temporary or permanent vegetation or other channel protection during construction.
- Steep grades require channel protection and check dams.

- The leading edge of the TSD must be secured with rocks, sandbags, or a small key slot and staples.
- In the case of grass-lined ditches and swales, check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4%. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

Maintenance Standards

- Inspect TSDs for performance and sediment accumulation during and after each rainfall that produces runoff. Remove sediment when it reaches one half the height of the TSD.
- Anticipate submergence and deposition above the TSD and erosion from high flows around the edges of the TSD. Immediately repair any damage or any undercutting of the TSD.

BMP C209: Outlet Protection

Purpose

Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Conditions of Use

Use outlet protection at the outlets of all ponds, pipes, ditches, or other conveyances that discharge to a natural or constructed drainage feature such as a stream, wetland, lake, or ditch.

Design and Installation Specifications

- The receiving channel at the outlet of a pipe shall be protected from erosion by lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1 foot above the maximum tailwater elevation, or 1 foot above the crown, whichever is higher. For pipes larger than 18 inches in diameter, the outlet protection lining of the channel shall be four times the diameter of the outlet pipe.
- Standard wingwalls, tapered outlets, and paved channels should also be considered when appropriate for permanent culvert outlet protection ([WSDOT, 2015](#)).
- [BMP C122: Nets and Blankets](#) or [BMP C202: Riprap Channel Lining](#) provide suitable options for lining materials.
- With low flows, [BMP C201: Grass-Lined Channels](#) can be an effective alternative for lining material.
- The following guidelines shall be used for outlet protection with riprap:
 - If the discharge velocity at the outlet is less than 5 fps, use 2-inch to 8-inch riprap. Minimum thickness is 1 foot.

- For a 5 to 10 fps discharge velocity at the outlet, use 24-inch to 48-inch riprap. Minimum 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-2.14 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-4.11: 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-4.11: 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 to 2 feet as measured from the crest of the inlet structure.
- Side slopes 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.

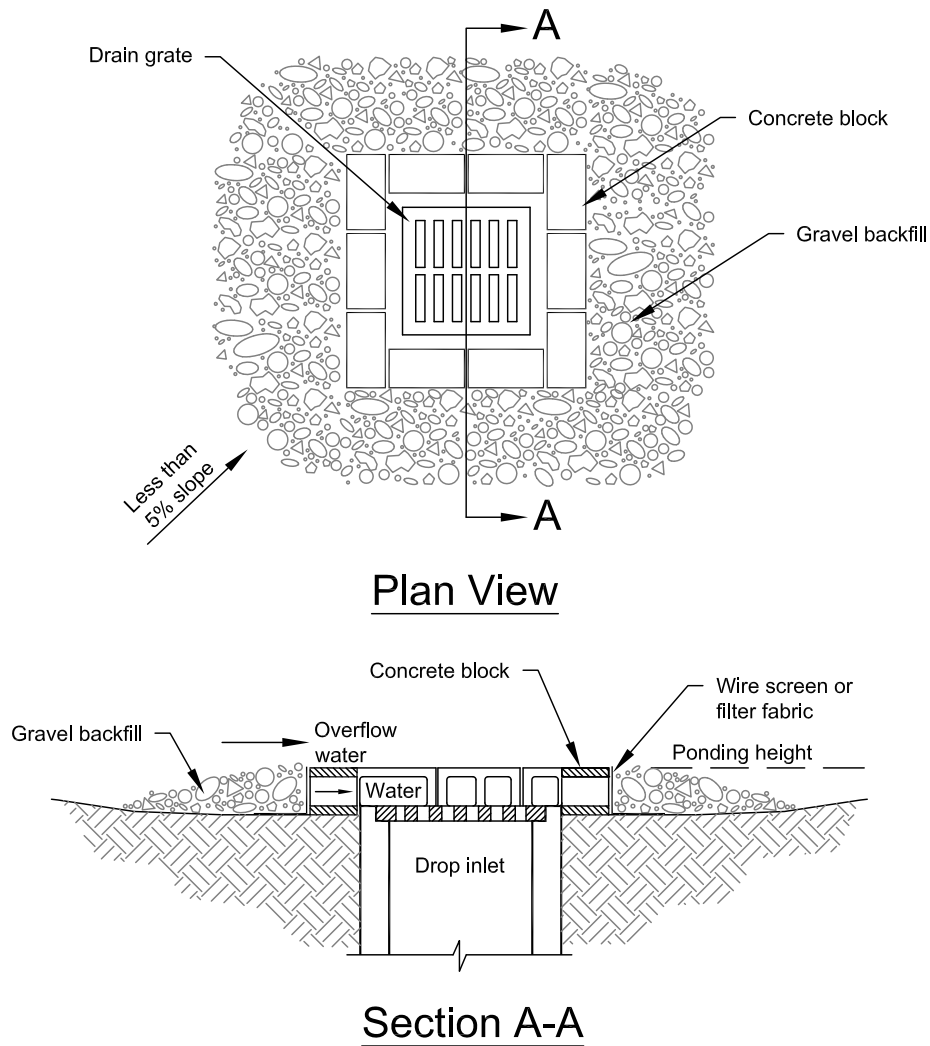
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope side of the structure to prevent 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-4.17: Block and Gravel Filter](#). Design and installation specifications for block and 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 0.5-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 rock area between the gravel berm and the inlet.
 - Use rocks 3 inches in diameter or larger on the upstream slope of the berm.
 - Use gravel 0.5 to 0.75 inch at a minimum thickness of 1-foot on the downstream slope of the berm.

Figure II-4.17: Block and Gravel Filter



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.

NOT TO SCALE



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 0.5 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:

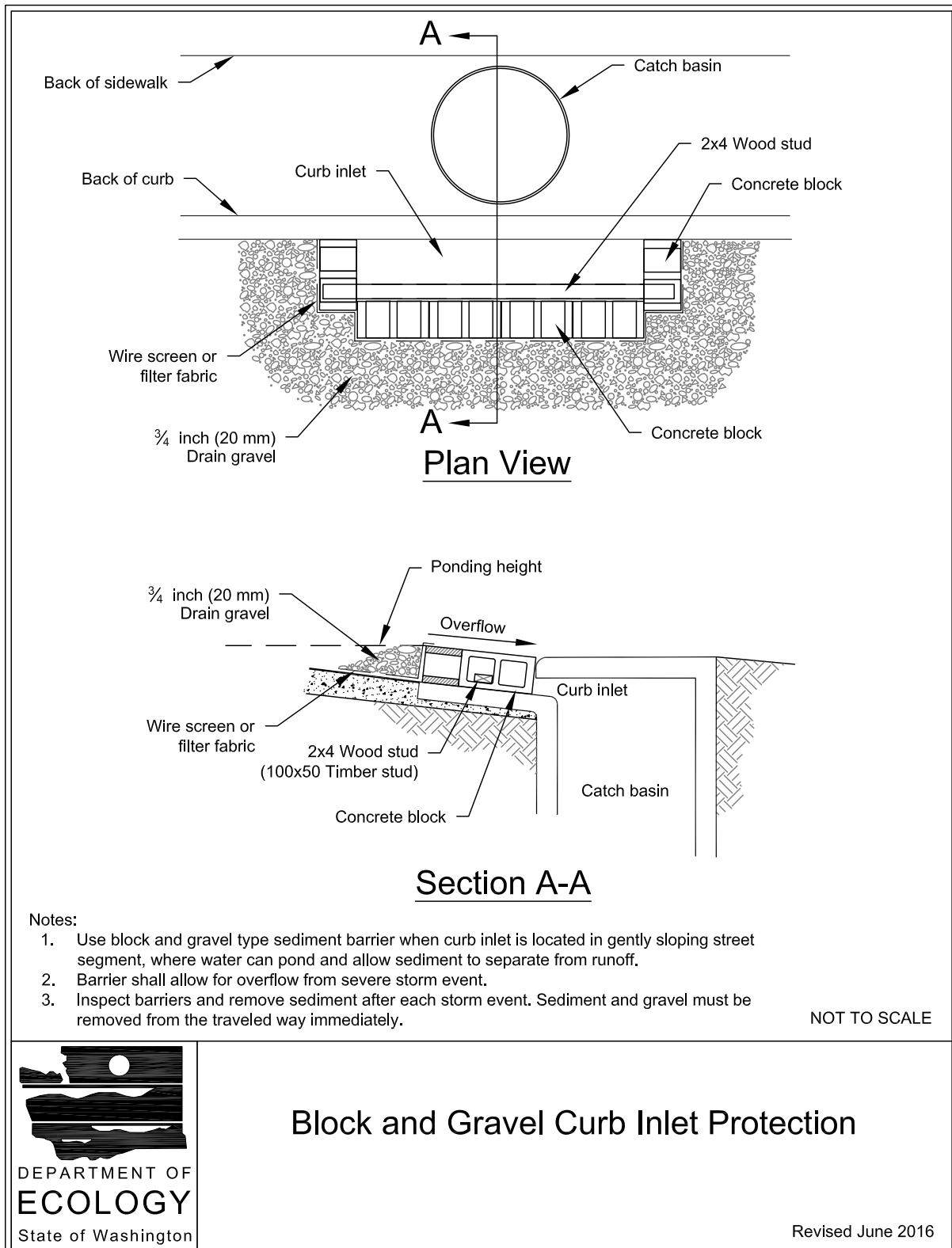
- Use wire mesh with 0.5 inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against the wire and fabric.
- Place weight on the frame anchors.

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-4.18: Block and Gravel Curb Inlet Protection](#). Design and installation specifications for block and gravel curb inlet protection include:

- Use wire mesh with 0.5 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-4.18: Block and Gravel Curb Inlet Protection

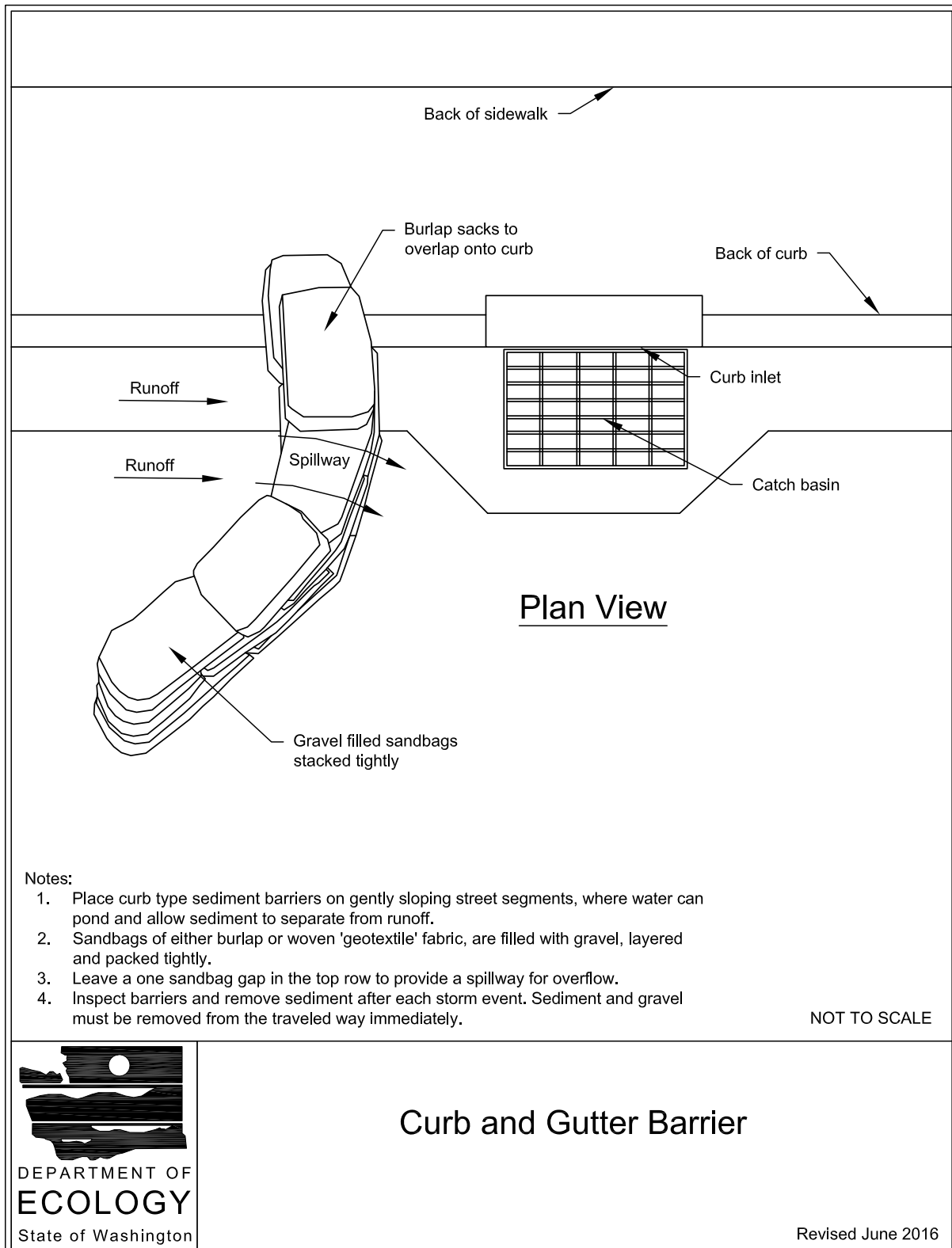


Curb and Gutter Sediment Barrier

A 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-4.19: Curb and Gutter Barrier](#). Design and installation specifications for curb and gutter sediment barriers 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-4.19: Curb and Gutter Barrier



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).

BMP C233: Silt Fence

Purpose

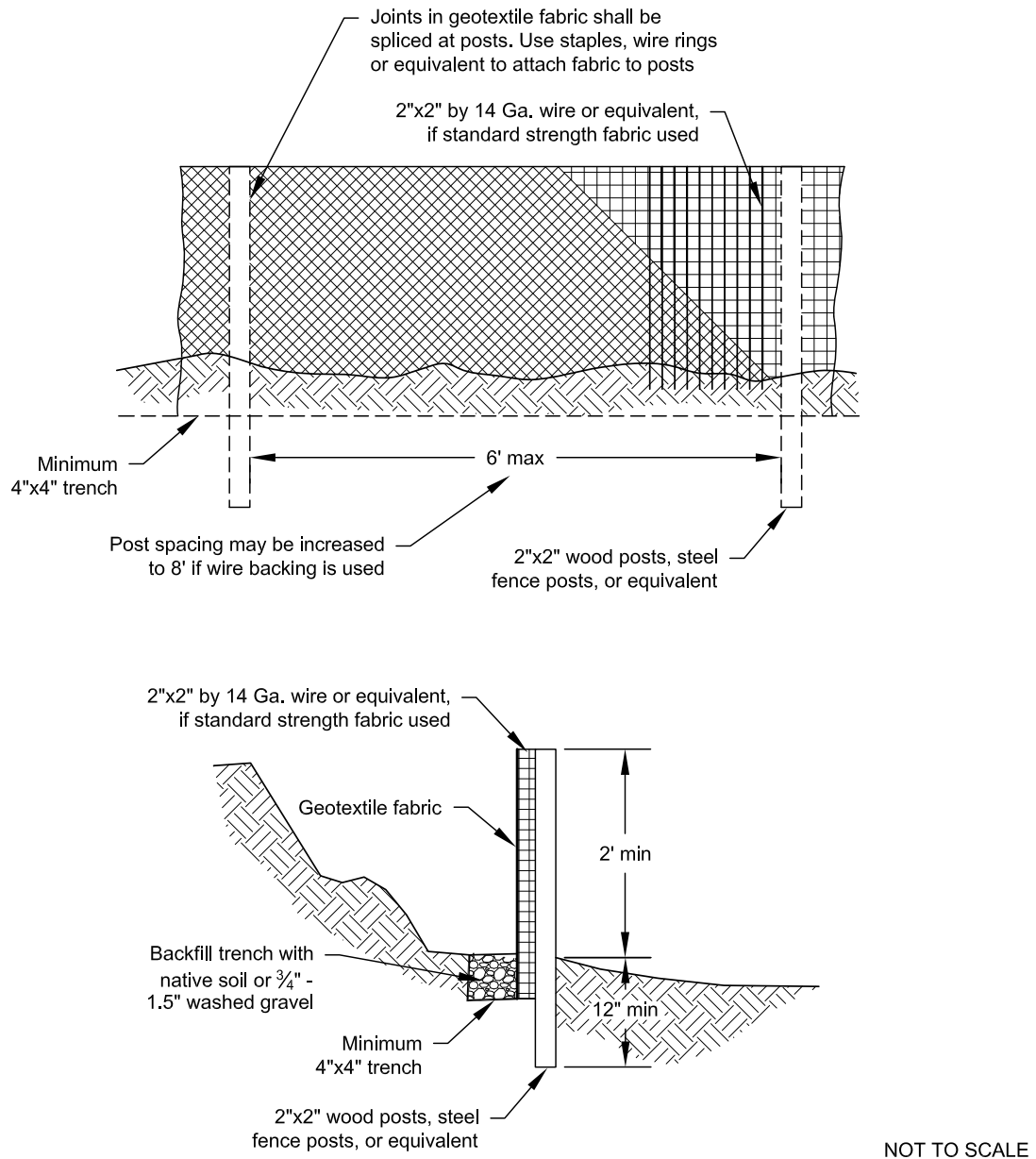
Silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

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-4.22: Silt Fence



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-4.12: Geotextile Fabric Standards for Silt Fence](#)):

Table II-4.12: Geotextile Fabric Standards for Silt Fence

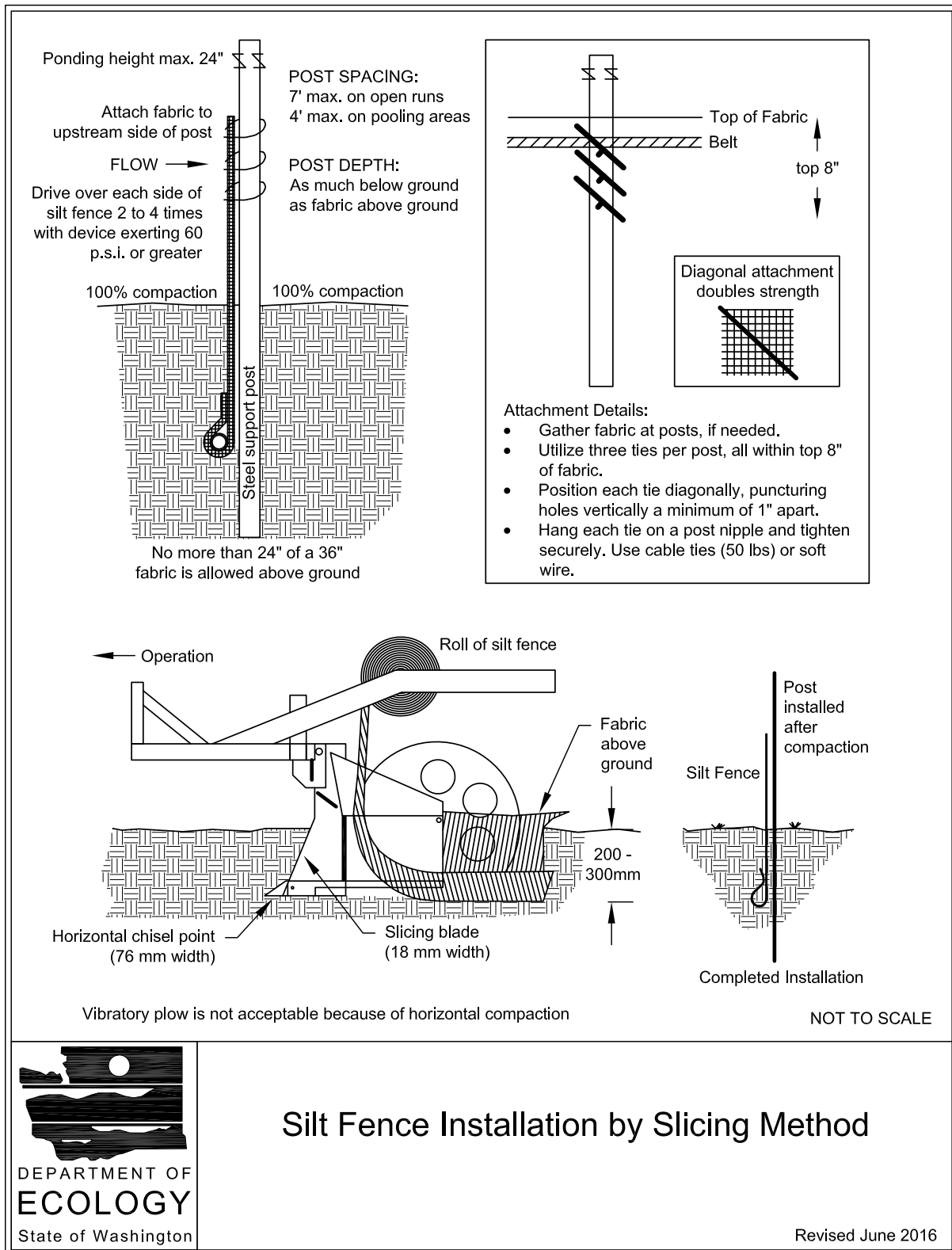
Geotextile Property	Minimum Average Roll Value
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film woven (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec ⁻¹ minimum
Grab Tensile 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 6 months of expected usable construction life at a temperature range of 0°F to 120°F.
- 100% 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-4.22: 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-foot min. and a 2.5-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. Back-fill 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 one of the following:
 - 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-4.23: 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-4.23: 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-4.13: Contributing Drainage Area for Vegetated Strips](#)):

Table II-4.13: Contributing Drainage Area for Vegetated Strips

Average Contributing Area Slope	Average Contributing Area Percent Slope	Maximum 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

Design and Installation Specifications

- The vegetated strip shall consist of a continuous strip of dense vegetation with topsoil for a minimum length of 25 feet along the flow path. Grass-covered, landscaped areas are generally not adequate because the volume of sediment overwhelms the grass. Ideally, vegetated strips shall consist of undisturbed native growth with a well-developed soil that allows for infiltration of runoff.
- The slope within the vegetated strip shall not exceed 4H:1V.
- The uphill boundary of the vegetated strip shall be delineated with clearing limits.

Maintenance Standards

- Any areas damaged by erosion or construction activity shall be seeded immediately and protected by mulch.
- If more than 5 feet of the original vegetated strip width has had vegetation removed or is being eroded, sod must be installed.
- If there are indications that concentrated flows are traveling across the vegetated strip, stormwater runoff controls must be installed to reduce the flows entering the vegetated strip, or additional perimeter protection must be installed.

BMP C235: Wattles

Purpose

Wattles are temporary erosion and sediment control barriers consisting of straw, compost, or other material that is wrapped in netting made of natural plant fiber or similar encasing material. They reduce the velocity and can spread the flow of rill and sheet runoff, and can capture and retain sediment.

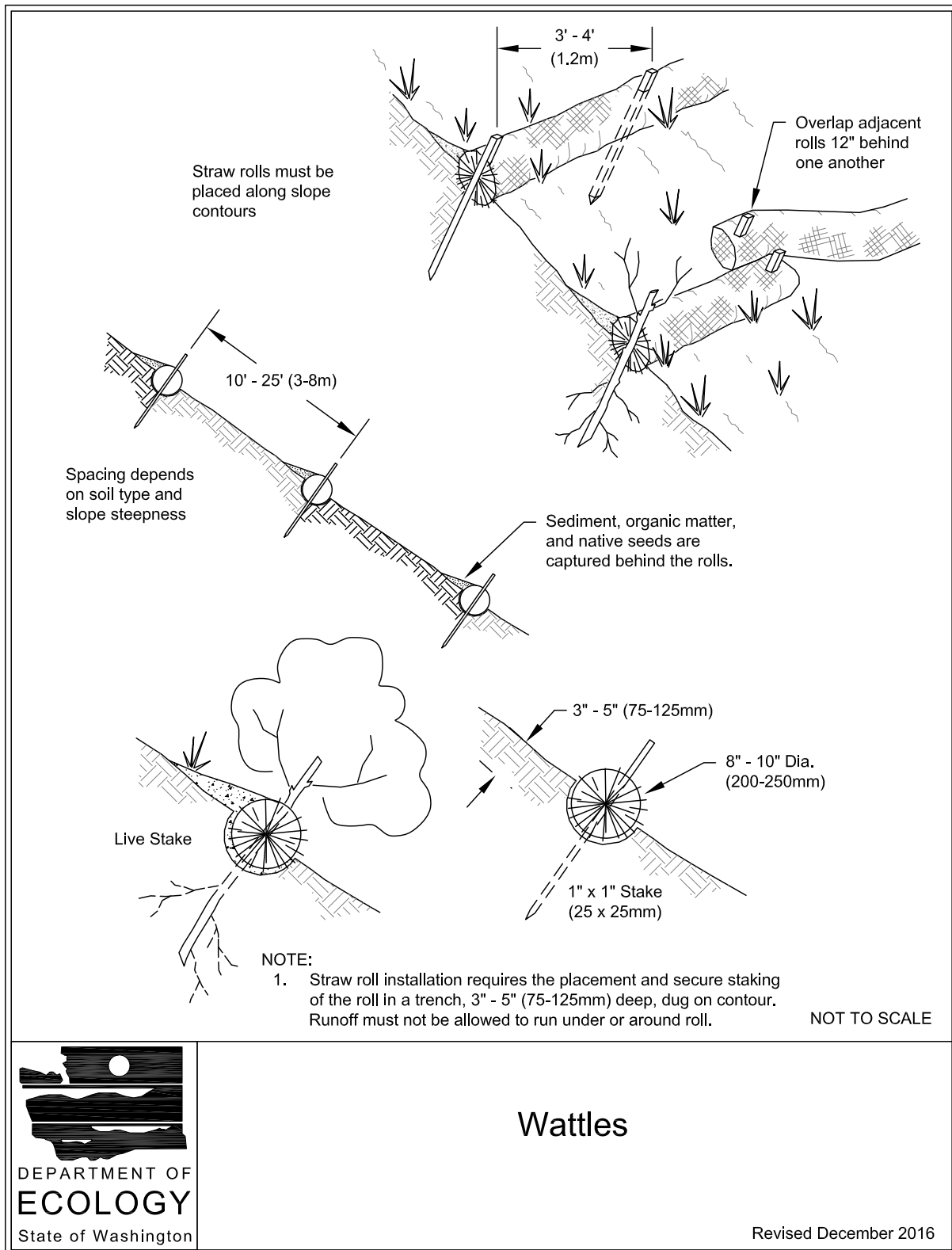
Conditions of Use

- Use wattles:
 - In disturbed areas that require immediate erosion protection.
 - On exposed soils during the period of short construction delays, or over winter months.
 - On slopes requiring stabilization until permanent vegetation can be established.
- The material used dictates the effectiveness period of the wattle. Generally, wattles are effective for one to two seasons.
- Prevent rilling beneath wattles by entrenching and overlapping wattles to prevent water from passing between them.

Design Criteria

- Wattles shall consist of cylinders of plant material such as weed-free straw, coir, wood chips, excelsior, or wood fiber or shavings encased within netting made of natural plant fibers unaltered by synthetic materials.
- See [Figure II-4.24: Wattles](#) for typical construction details.
- Wattles are typically 8 to 10 inches in diameter and 25 to 30 feet in length.
- Install wattles perpendicular to the flow direction and parallel to the slope contour.
- Place wattles in shallow trenches, staked along the contour of disturbed or newly constructed slopes. Dig narrow trenches across the slope (on contour) to a depth of 3 to 5 inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, the trenches should be dug to a depth of 5 to 7 inches, or 1/2 to 2/3 of the thickness of the wattle.
- Start building trenches and installing wattles from the base of the slope and work up. Spread excavated material evenly along the uphill slope and compact it using hand tamping or other methods.
- Construct trenches at intervals of 10 to 25 feet depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the trenches.
- Install the wattles snugly into the trenches and overlap the ends of adjacent wattles 12 inches behind one another.
- Install stakes at each end of the wattle, and at 4 foot centers along entire length of wattle.
- If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.
- Wooden stakes should be approximately 0.75 x 0.75 x 24 inches minimum. Willow cuttings or 3/8 inch rebar can also be used for stakes.
- Stakes should be driven through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle.

Figure II-4.24: Wattles



Maintenance Standards

- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall on steep sandy soils.
- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted or water has scoured beneath the wattles.

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 C236: Vegetative Filtration

Purpose

Vegetative filtration as a BMP is used in conjunction with detention storage in the form of portable tanks or [BMP C241: Sediment Pond \(Temporary\)](#), [BMP C206: Level Spreader](#), and a pumping system with surface intake. Vegetative filtration improves turbidity levels of stormwater discharges by filtering runoff through existing vegetation where undisturbed forest floor duff layer or established lawn with thatch layer are present. Vegetative filtration can also be used to infiltrate dewatering waste from foundations, vaults, and trenches as long as runoff does not occur.

Conditions of Use

- For every 5 acres of disturbed soil, use 1 acre of grass field, farm pasture, or wooded area. Reduce or increase this area depending on project size, groundwater table height, and other site conditions.
- Wetlands shall not be used for vegetative filtration.
- Do not use this BMP in areas with a high groundwater table, or in areas that will have a high seasonal groundwater table during the use of this BMP.
- This BMP may be less effective on soils that prevent the infiltration of the water, such as hard till.
- Using other effective source control measures throughout a construction site will prevent the generation of additional highly turbid water and may reduce the time period or area need for this BMP.
- Stop distributing water into the vegetated filtration area if standing water or erosion results.

APPENDIX D

Geotechnical Engineering Report prepared by
GeoResources, LLC dated July 13, 2022

July 13, 2022

Neil Walter Company
1940 East D Street, Suite 100
Tacoma, Washington 98421

Attn: Kermit Jorgensen
(253) 779-8400
kjorgensen@neilwalter.com

Updated Stormwater Feasibility Soils
Report
Proposed Contractor's Yard
1036 – 1106 Valley Avenue NW
Puyallup, Washington
PN: 042016-3042, -3041, & -3040
Doc ID: NWC.ValleyAveNW.SRu

INTRODUCTION

This *Updated Soils Report* addresses the feasibility of the site soils to support the infiltration of stormwater runoff generated by the proposed contractor's yard to be constructed at 1036 – 1106 Valley Ave NW in Puyallup, Washington. The location of the project site is shown on the attached Site Location Map, Figure 1.

Our understanding of the project is based on our conversations with you; our review of the provided *Site Survey* prepared by Contour Engineering; our December 10, 2021 site visit and subsurface explorations; our understanding of the City of Puyallup (the City) development requirements; and our experience in the site area. The site consists of three adjacent tax parcels, each of which is currently developed with an existing single-family residence, driveway, and associated utilities. We understand that you propose to demolish the existing structures and develop the site as a contractor's yard. We were not provided with a site plan prior to the preparation of this document, but a copy of the recent survey prepared by Contour Engineering is attached as Figure 2.

PURPOSE & SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions at the site as a basis for providing our opinion on the feasibility of infiltration of stormwater and monitoring the groundwater levels during the wet season to observe if infiltration is feasible at the site for the proposed development in order to satisfy the City of Puyallup requirements. Specifically, our scope of services for the project included the following:

1. Reviewing the available geologic, hydrogeologic, and geotechnical data for the site area;
2. Exploring the surface and subsurface conditions by reconnoitering the site and monitoring the drilling of two hollow-stem auger borings to depths of 16.5 feet each, completed as groundwater observation wells;
3. Describing surface and subsurface conditions, including soil type, depth to groundwater, if encountered, and an estimate of seasonal high groundwater levels;

4. Providing our opinion about the feasibility of onsite stormwater infiltration in accordance with the 2014 SWMMWW, including a preliminary design infiltration rate based on grain size analysis; and,
5. Preparing this *Soils Report* that satisfies the 2014 SWMMWW requirements and summarizes our site observations and conclusions, our geotechnical recommendations and design criteria, along with the supporting data.

The above scope of work was completed in accordance with our *Proposal for Services* dated November 28, 2021. We received written notice to proceed on December 3, 2021.

SITE CONDITIONS

Surface Conditions

The site consists of three adjacent tax parcels located at 1036 – 1106 Valley Avenue NW in Puyallup, Washington, within an area of existing commercial development. The parcels, when combined, form an irregular shaped site that generally measures about 80 to 315 feet wide (northwest to southeast), by about 80 to 450 feet long (northeast to southwest), and encompass approximately 1.93 acres. The site is bounded by existing warehouse and light industrial development to the north, west, and south, and by Valley Avenue NW to the east.

The site is located in the Puyallup River valley and is generally flat. According to topographic information obtained from the Pierce County Public GIS website and as generally confirmed in the field, the site slopes down from Valley Avenue to the southwest at about 0 to 3 percent to a wide shallow depression located in the central portion of the site. The western portion of the site then slopes back up to the southwest at about 0 to 3 percent. The total topographic relief across the site is on the order of 6 feet. The existing site configuration and topography is shown on the attached Site & Exploration Map, Figure 3.

Vegetation across the site generally consists of pasture grasses with ornamental trees, plants, and shrubs surrounding the residence. No evidence of seeps, springs, or soil erosion was observed at the time of our site visit. However, standing water was observed in the stormwater pond located on the adjacent property near the southwest corner of the site.

Site Soils

The Natural Resources Conservation Survey (NRCS) Web Soil Survey maps the site as Briscot loam (6A) soils. An NRCS soils map for the site area is included as Figure 4.

- *Briscot Loam (6A)*: These soils are derived from alluvium and form on slopes of 0 to 2 percent. The Briscot Loam soils have a “slight” erosion hazard when exposed and are included in hydrologic soils group B/D.

Site Geology

The draft *Geologic Map of the Puyallup 7.5-minute Quadrangle, Pierce County, Washington* (Troost et al, in review) maps the site as being underlain by alluvium (Qal). No geologic formations or deposits that could potentially adversely affect the development of the site such as landslides, areas of mass wasting, or alluvial fans are mapped within 300 feet of the site. An excerpt of the above referenced map is included as Figure 5.

- Alluvium (Qal): Alluvium generally consists of fluvial sediments deposited during the late Pleistocene to Holocene epochs, and typically consists of loose and stratified, fluvial silt, sand, and gravel, and is typically well rounded and well sorted and locally includes sandy to silty estuarine deposits. Because the alluvium was not overridden by the continental ice mass, it is considered normally consolidated. The infiltration potential of alluvium is highly variable, depending on the grain size distribution of the soil.

Subsurface Explorations

On December 10, 2021, we visited the site and monitored the drilling of two hollow-stem auger borings to depths of about 16½ feet below the existing ground surface, logged the subsurface conditions encountered in each boring, and obtained representative soil samples. The borings were drilled using a small track-mounted drill rig operated by a licensed drilling contractor working for GeoResources. Table 1, below, summarizes the approximate functional locations, surface elevations, and termination depths of our test pits explorations.

TABLE 1:
APPROXIMATE LOCATIONS, ELEVATIONS, AND DEPTHS OF EXPLORATIONS

Boring Number	Functional Location	Surface Elevation (feet)	Termination Depth (feet)	Termination Elevation ¹ (feet)
B-1/MW-1	End of driveway at 1106 Valley Ave NW	40.23	16.5	23.7
B-2/MW-2	Field in front of 1106 Valley Ave NW	38.77	16.5	22.3
Notes: 1 = Surface elevation estimated from the <i>Site Survey</i> prepared by Contour Engineering (NAVD 88)				

The specific locations, and depths of our borings were selected based on the configuration of the proposed development and were adjusted in the field based on considerations for underground utilities, existing site conditions, site access limitations, and encountered stratigraphy. Representative soil samples obtained from the borings were placed in sealed plastic bags and then taken to our laboratory for further examination and testing as deemed necessary. The borings were completed as groundwater monitoring wells per WA State regulations.

During drilling, soil samples were obtained at 2½ and 5 foot depth intervals in accordance with Standard Penetration Test (SPT) as per the test method outlined by ASTM D1586. The SPT method consists of driving a standard 2 inch-diameter split-spoon sampler 18 inches into the soil with a 140-pound hammer. The number of blows required to drive the sampler through each 6-inch interval is counted, and the total number of blows struck during the final 12 inches is recorded as the Standard Penetration Resistance, or "SPT blow count". If a total of 50 blows for any 6-inch interval is reached, refusal is called and the blow counts are recorded as 50 for the actual depth driven. The resulting Standard Penetration Resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The subsurface explorations completed as part of this evaluation indicates the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site.

Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun.

The approximate locations and numbers of our borings/wells are shown on the attached Site Survey, Figure 2 and the Site & Exploration Map, Figure 3. The indicated locations were determined by taping or pacing from existing site features and reference points; as such, the locations should only be considered as accurate as implied by the measurement method. The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D2488. The USCS is included in Appendix A as Figure A-1, while the descriptive logs of our borings are included as Figures A-2 and A-3.

Subsurface Conditions

At the locations of our explorations we encountered relatively uniform subsurface conditions that, in our opinion, generally confirmed the mapped stratigraphy within the site vicinity. Boring B-1 encountered about ½ foot of dark brown topsoil in a loose, moist to wet condition overlying grey-brown silty gravelly sand in a loose to medium dense, moist condition. We interpret these soils to be consistent with undocumented fill soils. Underlying the fill in boring B-1 and at the surface of boring B-2, our explorations encountered mottled grey-brown sand with silt interbeds in a very loose to loose, moist to wet condition. These soils were encountered to the full depth explored in boring B-1. Underlying these soils in boring B-2, our exploration encountered black silty sand in a loose to medium dense, wet condition to the full depth explored. We interpret these soils encountered in our borings to be consistent with alluvium. Table 2 below summarizes the soils encountered in our borings.

TABLE 2:
APPROXIMATE THICKNESS, DEPTHS, AND ELEVATION OF ENCOUNTERED SOIL TYPES

Boring Number	Thickness of Topsoil (Feet)	Thickness of Fill (feet)	Thickness of Loose Silt SAND (feet)	Depth to Loose SAND (feet)	Elevation ¹ of Loose SAND (feet)
B-1/MW-1	0.5	1.5	8.0	10.0	30.2
B-2/MW-2	0.5	0.0	9.8	10.3	28.5
Notes: 1 = Surface elevation estimated from the <i>Site Survey</i> prepared by Contour Engineering (NAVD 88)					

Laboratory Testing

Geotechnical laboratory tests were performed on select samples retrieved from the test pits to estimate index engineering properties of the soils encountered. Laboratory testing included visual soil classification per ASTM D2488 and ASTM D2487, moisture content determinations per ASTM D2216, and grain size analyses per ASTM D6913 standard procedures.

We returned to the site on May 27, 2022 to collect shallow subsurface samples adjacent to each boring exploration. Cat-ion exchange capacity (CEC) and organic content testing were performed by an independent laboratory to evaluate the treatment capacity of the shallow onsite soils for LID methods. The results of the laboratory tests are summarized below in Table 3 and graphical outputs are included in Appendix B.

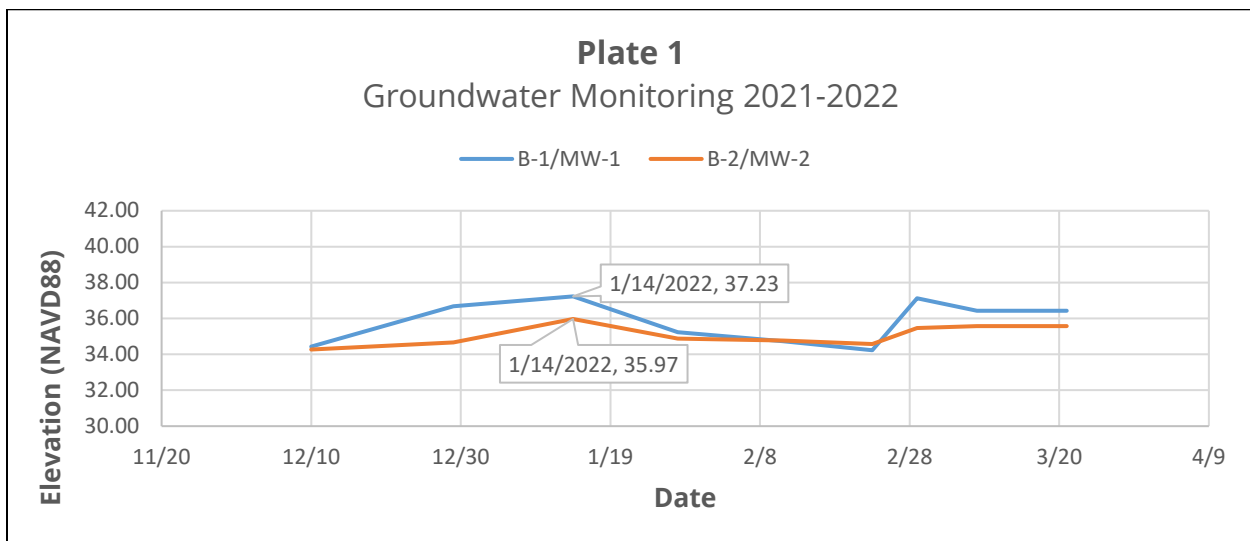
TABLE 3:
LABORATORY TEST RESULTS FOR ON-SITE SOILS

Sample	Soil Type	Lab ID	Gravel Content (percent)	Sand Content (percent)	Silt/Clay Content (percent)	D10 Ratio (mm)
B-1, S-1a, 2½'	SM	102783	0.1	87.8	12.1	>0.075
B-2, S-1, 2'	SM	102784	0.0	52.4	47.6	>0.075

Groundwater Conditions

Groundwater monitoring wells were installed at the site on December 10, 2021. The locations of the observation wells are shown on the Site & Exploration Map, Figure 2. At the time of drilling, groundwater was encountered at about 4.5 to 5.8 feet below the ground surface (Elevation 34.3 to 34.4 feet). Groundwater readings for the observation wells were manually measured on a bi-monthly basis from December 10, 2021 to March 21, 2022.

Based on our wet season monitoring, it appears that seasonal high groundwater occurs at about Elevation 35.97 to 37.23 feet (NAVD 88) at the locations monitored, approximately 2.80 to 3.00 feet below the ground surface. These levels were recorded on January 14, 2022. Plate 1, below, summarizes the groundwater levels recorded as part of our groundwater monitoring program during our monitoring period.



We anticipate fluctuations in the local groundwater levels will occur in response to precipitation patterns, off site construction activities, and site utilization and will in general be similar to the water surface elevation of the adjacent river. As such, water level observations made at the time of our field investigation may vary from those encountered during the construction phase. Analysis or modeling of anticipated groundwater levels during construction is beyond the scope of this report.

CONCLUSIONS

Based on the results of our site reconnaissance and subsurface explorations, it is our opinion that conventional infiltration using a pond or gallery is likely not feasible given the shallow depth to groundwater, but the use of low-impact development (LID) Best Management Practices (BMPs) per the Puyallup stormwater manual does appear feasible.

Infiltration Recommendations

Based on our subsurface explorations and groundwater monitoring, it is our opinion that stormwater infiltration via a shallow trench or basin type system, and permeable pavement is feasible at the site, provided the bottom of the facility is located above elevation 37 feet (NAVD88). This elevation is based on the results of our winter season groundwater monitoring and topographic information obtained from the Pierce County Public GIS and should be surveyed in the field.

Per Volume III Section 3.1.1 of the 2014 SWMMWW, downspout infiltration is considered feasible if there is at least 1 foot of clearance from the expected bottom elevation of the infiltration facility to the seasonal high ground water table. Infiltration facilities for flow control and treatment, Volume III Section 3.3.7 *Site Suitability Criteria (SSC) 5 Depth to Bedrock, Water Table, or Impermeable Layer*, requires that the base of all infiltration basins or trench system be greater than or equal to 5 feet above the seasonal high water mark, bedrock (or hardpan), or other low permeability layer. The vertical separation may be reduced to 3 feet as recommended by the site professional. For the purposes of this infiltration feasibility evaluation, we have assumed that, at a minimum, the standard infiltration trench section (6 inches of topsoil over a 2 foot deep trench) would be used. Based on the above, there is not sufficient separation from seasonal high groundwater to the bottom of an infiltration trench.

Volume III Section 3.4.2 of the 2014 SWMMWW requires at least 1 foot of separation from the bottoms of rain gardens and permeable pavement to seasonal high groundwater. A 1 foot or 3 foot minimum separation from the bottom of bioretention is required depending upon the drainage area. For the purposes of this evaluation, a standard permeable pavement section (6 inches of pavement over 6 inches of storage course) would be used. Based on the above, shallow infiltration facilities such as rain gardens, bioretention, and permeable pavement appear to be feasible. Deeper trenches and thicker storage courses may be designed by a civil engineer where the vertical separation requirements can be met.

Infiltration Rate

We completed soil gradation analyses on two representative soil samples from the site per the 2014 SWMMWW, Volume III, Section 3.3.6, Method 3 (Massman, 2003) and in accordance with ASTM D6913. Based on our gradation analyses, we recommend a preliminary design infiltration rate of 1 inch per hour be used for the alluvium soils encountered at the site. Appropriate correction factors have been applied to these values in accordance with the 2014 SWMMWW, Volume III, Section 3.3.6, Table 3.3.1, including correction factors for site variability ($F_{variability}$), testing method ($F_{testing}$) and maintenance for situation biofouling ($F_{maintenance}$). Our calculations are included in Appendix C.

All proposed infiltration facilities should be designed and constructed in accordance with the 2014 SWMMWW. All minimum separations, setback requirements, and infeasibility criteria per 2014 SWMMWW should be considered prior to the selection, design and location of any stormwater facility for the proposed development.

Feasibility of the Native Soils for Water Quality Treatment

Volume III, Section 3.3.7 SSC-6 *Soil Physical and Chemical Suitability for Treatment* of the 2014 SWMMWW requires treatment soils to have at least 5mEq/100g of cation exchange capacity (CEC) and 1 percent by weight organic content. Cation exchange capacity and organic content testing was performed by a third party independent laboratory. The organic content of the site soils were determined to be about 1.12 to 11.1 percent per ASTM D2974-13, with a cation exchange capacity of 15.4 to 16.7 milliequivalents per 100 grams as determined by SW-846 Test Method 9081. Based on the results of the soil testing, the soils meet the minimum requirements for water quality treatment via infiltration; therefore, the subgrade soils should provide adequate treatment of stormwater runoff generated by the proposed pollution generating impervious surface.

Construction Considerations

Appropriate design, construction and maintenance measures will be required to ensure the infiltration rate can be effectively maintained over time. Stormwater Best Management Practices (BMPs) in accordance with the 2014 SWMMWW should be included in the project plans and specifications to minimize the potential for fines contamination of Low Impact Development BMPs utilized at the site.

We recommend that a representative from our firm be onsite at the time of excavation of the proposed infiltration facilities to verify that the soils encountered during construction are consistent with the soils observed in our subsurface explorations. In-situ infiltration testing should be performed at the time of construction to verify the recommended infiltration rate and to determine if a different site specific infiltration rate would be more appropriate for the site.

Suspended solids could clog the underlying soil and reduce the infiltration rate of the facilities. To reduce potential clogging of the infiltration systems, the infiltration system should not be connected to the stormwater runoff system until after construction is complete and the site area is landscaped, paved or otherwise protected. Temporary systems may be utilized throughout construction. Periodic sweeping of the paved areas will help extend the life of the infiltration system.

Additional measures may also be taken during construction to minimize the potential of fines contamination of the proposed infiltration system, such as utilizing an alternative storm water management location during construction or leaving the bottom of the permanent systems 1 to 2 feet high, and subsequently excavating to the finished grade once the site soils have been stabilized. All contractors working on the site (builders and subcontractors) should divert sediment laden stormwater away from proposed infiltration facilities during construction and landscaping activities. No concrete trucks should be washed or cleaned, and washout areas should not be within the vicinity of the proposed infiltration facilities. After construction activities have been completed, periodic sweeping of the paved areas will help extend the life of the infiltration system.

LIMITATIONS

We have prepared this report for use by Neil Walter Company and members of the design team, for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, published geologic information, and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.



We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

Jordan L. Kovash, LG
Project Geologist



Keith S. Schembs, LEG
Principal



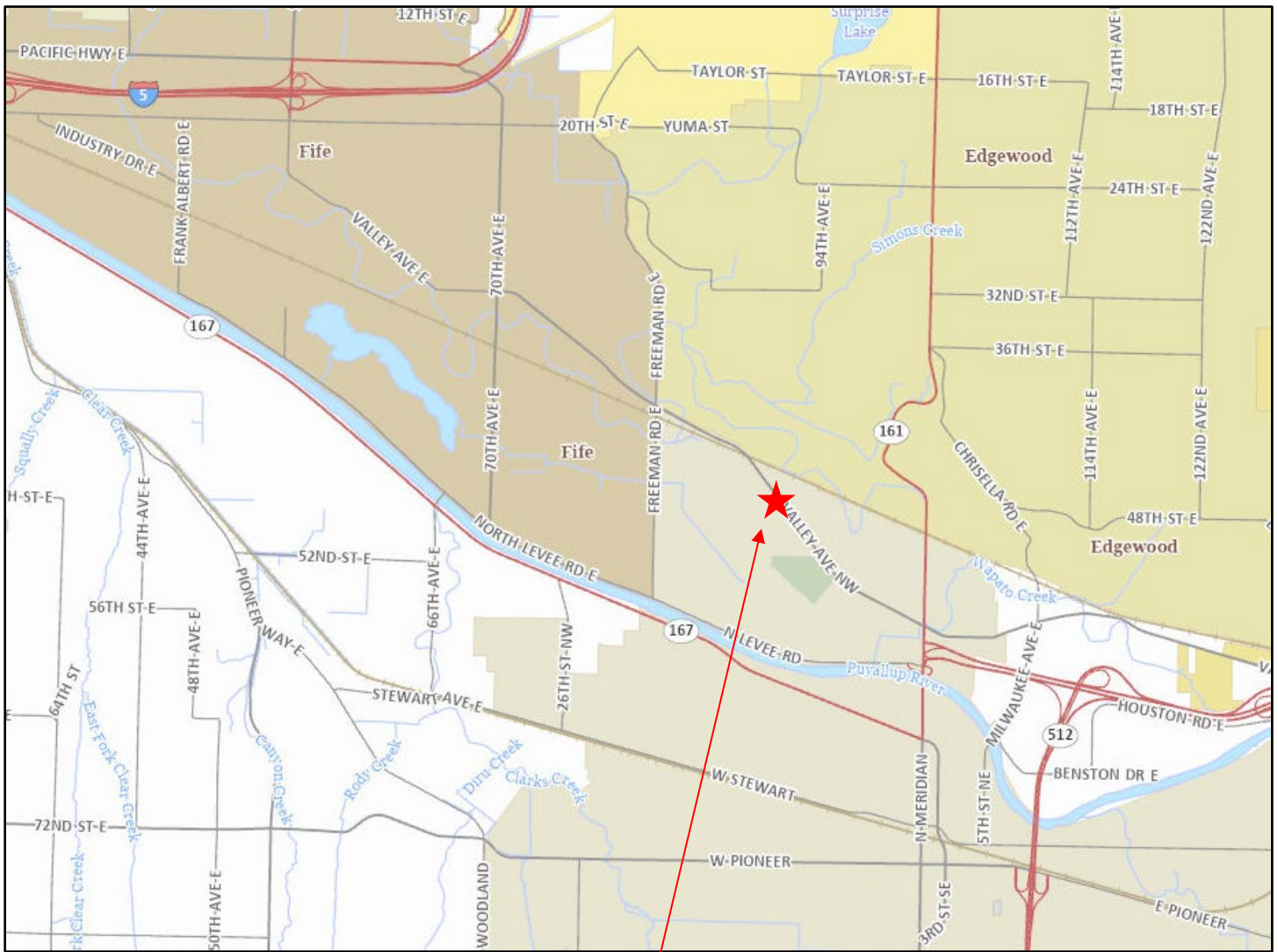
Eric W. Heller, PE, LG
Senior Geotechnical Engineer

JLK:KSS:EWH/jlk

Doc ID: NWC.ValleyAveNW.SR

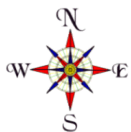
Attachments:

- Figure 1: Site Location Map
- Figure 2: Site Survey
- Figure 3: Site & Exploration Map
- Figure 4: NRCS Soils Map
- Figure 5: Geologic Map
- Appendix A – Subsurface Explorations
- Appendix B – Laboratory Test Results
- Appendix C – Massman Calculations



Approximate Site Location

Map created from Pierce County WA GIS (<https://matterhornwab.co.pierce.wa.us/publicgis/>)



Not to Scale



4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www.georesources.rocks

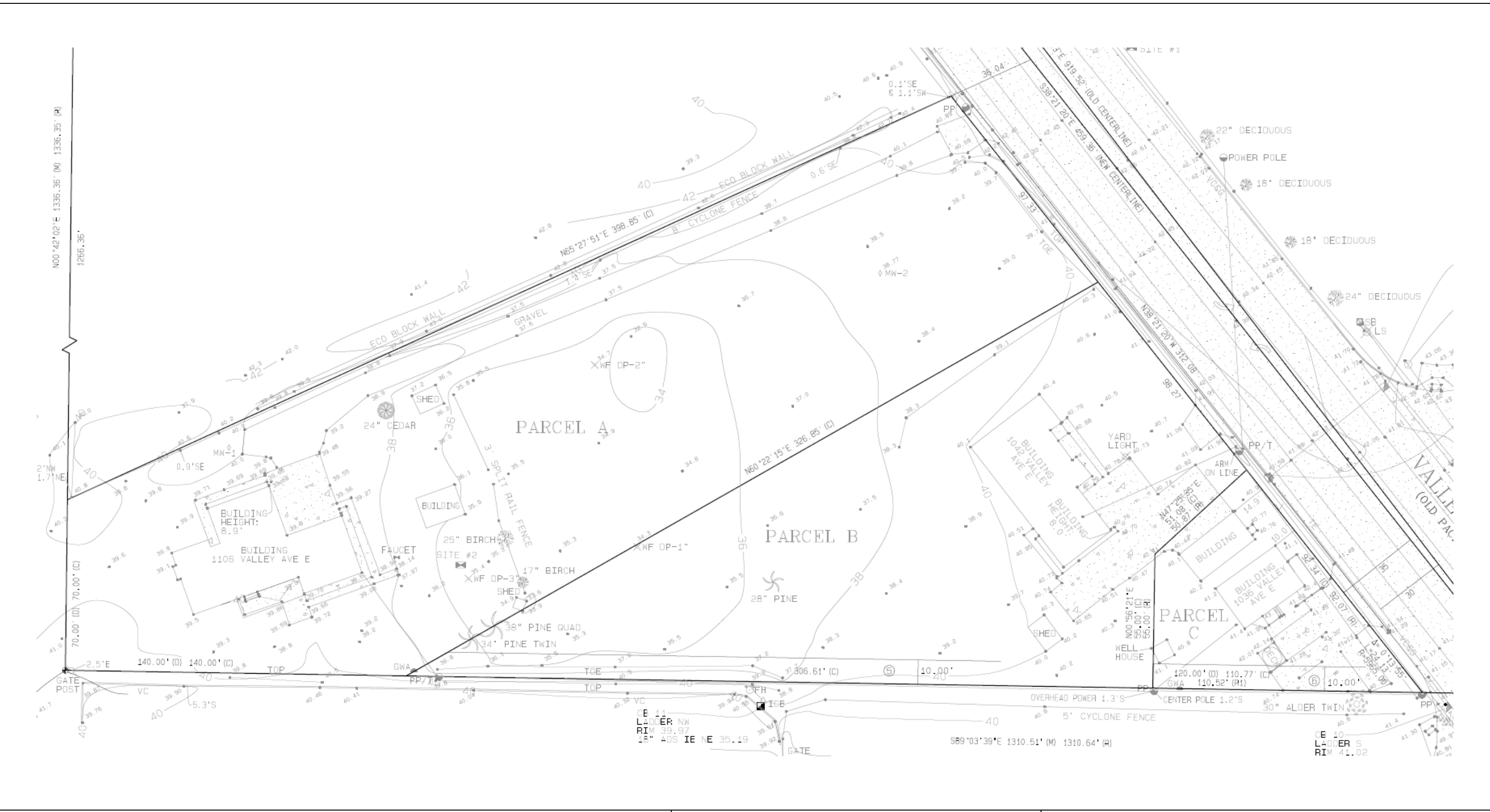
Site Location Map

Proposed Contractor's Yard
1036 – 1106 Valley Avenue NW
Puyallup, Washington
PN: 042016-3040, 3041, 3042

Doc ID: NWC.ValleyAve.Fu

July 2022

Figure 1



Notes:
Site Survey prepared by Contour Engineering
Not to Scale





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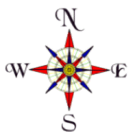
Site Survey Map
Proposed Contractor's Yard
1036 – 1106 Valley Avenue NW
Puyallup, Washington
PN: 042016-3040, 3041, 3042



Approximate Site Location

Map created from Pierce County WA GIS (<https://matterhornwab.co.pierce.wa.us/publicgis/>)

B/MW  Exploration number and approximate location (GeoResources 2021)



Not to Scale



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Site & Exploration Map

Proposed Contractor's Yard
1036 – 1106 Valley Avenue NW
Puyallup, Washington
PN: 042016-3040, 3041, 3042

Doc ID: NWC.ValleyAve.Fu

July 2022

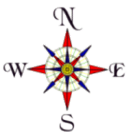
Figure 3



Approximate Site Location

Map created from Web Soil Survey (<http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
6A	Briscot Loam	Alluvium	0 to 2	Slight	B/D
30A	Puget silty clay loam	Alluvium	0 to 2	None	C/D
31A	Puyallup fine sandy loam	Alluvium	0 to 3	Slight	A
42A	Sultan silt loam	Alluvium	0 to 2	Slight	C/D



Not to Scale



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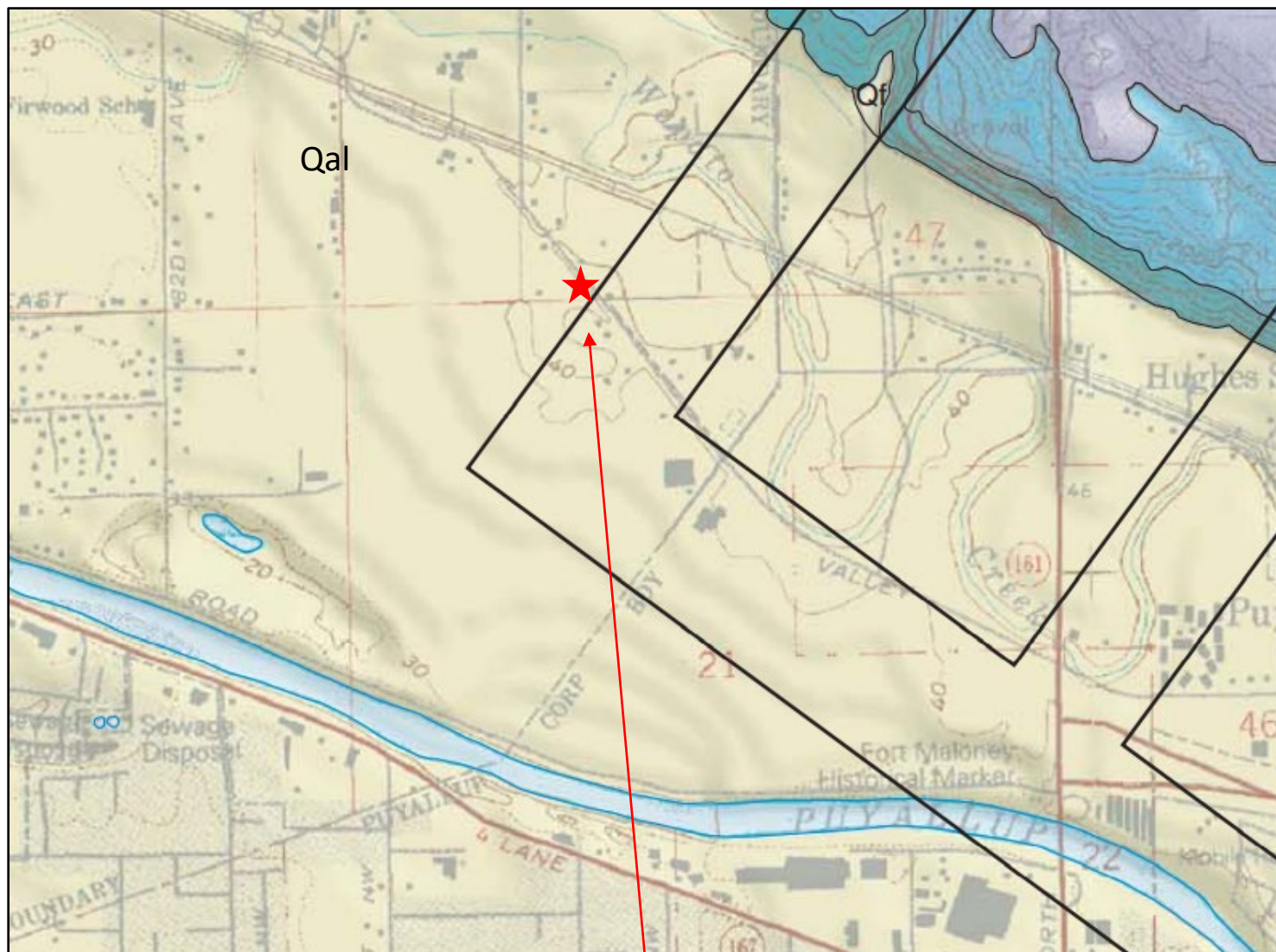
NRCS Soils Map

Proposed Contractor's Yard
1036 – 1106 Valley Avenue NW
Puyallup, Washington
PN: 042016-3040, 3041, 3042

Doc ID: NWC.ValleyAve.Fu

July 2022

Figure 4



Approximate Site Location

An excerpt from the draft *Geologic Map of the Puyallup 7.5-minute Quadrangle, Pierce County, Washington* by Troost et. al.

Qal	Alluvium
-----	----------



Not to Scale



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Geologic Map

Proposed Industrial Development
25491 WA -3

Mason County, Washington

PN: 12321-1400040, 14-00041, 75-00030

Doc ID: NWC.ValleyAve.Fu

July 2022

Figure 5

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

- Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
- Soil classification using laboratory tests is based on ASTM D2487-90.
- Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

- Dry- Absence of moisture, dry to the touch
- Moist- Damp, but no visible water
- Wet- Visible free water or saturated, usually soil is obtained from below water table

Unified Soils Classification System

Proposed Contractor's Yard
1036 – 1106 Valley Avenue NW
Puyallup, Washington
PN: 042016-3040, 3041, 3042

LOG OF BORING

B-1/MW-1

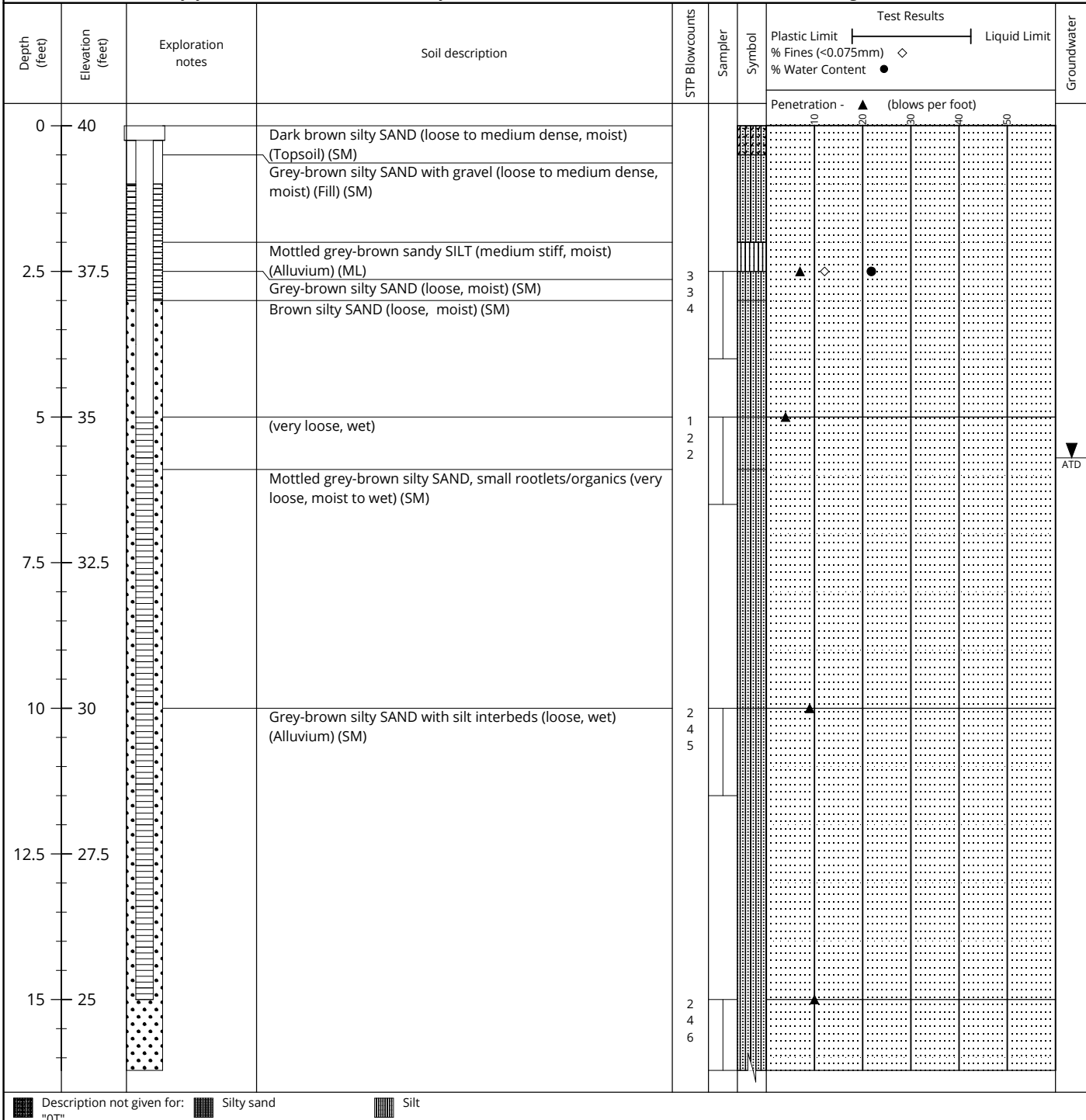
Proposed Contractor's Yard
1106 - 1036 Valley Ave NW
Puyallup, Washington

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company: Borettec 1, Inc.
Drilling Method: HSA
Drilling Rig: EC 95 Track Drill
Sampler Type: split spoon
Hammer Type: cat head
Hammer Weight: 140 lbs

Logged By: JLK
Drilling Date: 12/10/2021
Datum: NAVD88
Elevation: 40
Termination Depth: 16.5
Latitude:
Longitude:

Notes: End of driveway, just north of house at 1106 Valley Ave NW





LOG OF BORING

B-1/MW-1

Proposed Contractor's Yard
1106 - 1036 Valley Ave NW
Puyallup, Washington

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company: Borettec 1, Inc.
Drilling Method: HSA
Drilling Rig: EC 95 Track Drill
Sampler Type: split spoon
Hammer Type: cat head
Hammer Weight: 140 lbs

Logged By: JLK
Drilling Date: 12/10/2021
Datum: NAVD88
Elevation: 40
Termination Depth: 16.5
Latitude:
Longitude:

Notes: End of driveway, just north of house at 1106 Valley Ave NW

Depth (feet)	Elevation (feet)	Exploration notes	Soil description	STP Blowcounts	Sampler	Symbol	Test Results			Groundwater
							Plastic Limit % Fines (<0.075mm) ◇	% Water Content ●	Liquid Limit	
							Penetration - ▲ (blows per foot)			
17.5	22.5		(Termination Depth - 12/10/2021)							
20	20									
22.5	17.5									
25	15									
27.5	12.5									
30	10									

Description not given for:
 "OT"

Silty sand

Silt

Sheet 2 of 2

JOB: NeilWalterCompany.ValleyAveNW

FIG. A-2

LOG OF BORING

B-2/MW-2

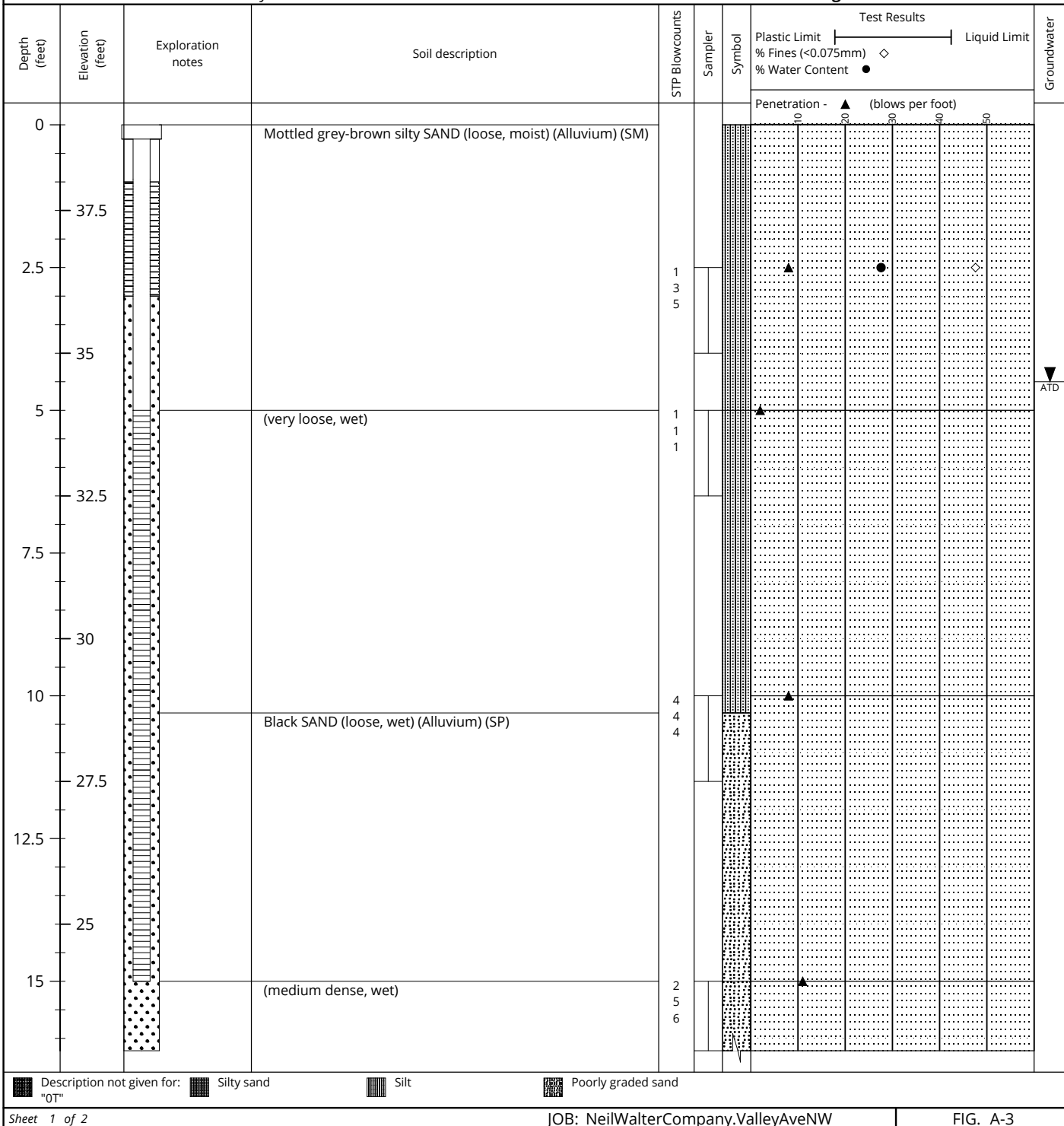
Proposed Contractor's Yard
1106 - 1036 Valley Ave NW
Puyallup, Washington

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company: Boretac 1, Inc.
Drilling Method: HSA
Drilling Rig: EC 95 Track Drill
Sampler Type: split spoon
Hammer Type: cat head
Hammer Weight: 140 lbs

Logged By: JLK
Drilling Date: 12/10/2021
Datum: NAVD88
Elevation: 39
Termination Depth: 16.5
Latitude:
Longitude:

Notes: Field in front of 1106 Valley Ave NW





LOG OF BORING

B-2/MW-2

Proposed Contractor's Yard
1106 - 1036 Valley Ave NW
Puyallup, Washington

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company: Boretac 1, Inc.
Drilling Method: HSA
Drilling Rig: EC 95 Track Drill
Sampler Type: split spoon
Hammer Type: cat head
Hammer Weight: 140 lbs
Logged By: JLK
Drilling Date: 12/10/2021
Datum: NAVD88
Elevation: 39
Termination Depth: 16.5
Latitude:
Longitude:

Notes: Field in front of 1106 Valley Ave NW

Depth (feet)	Elevation (feet)	Exploration notes	Soil description	STP Blowcounts	Sampler	Symbol	Test Results			Groundwater
							Plastic Limit	% Fines (<0.075mm)	Liquid Limit	
							Penetration - ▲ (blows per foot)			
22.5										
17.5			(Termination Depth - 12/10/2021)							
20										
20										
17.5										
22.5										
15										
25										
12.5										
27.5										
10										
30										
7.5										

■ Description not given for: "OT"

■ Silty sand

■ Silt

■ Poorly graded sand

Sheet 2 of 2

JOB: NeilWalterCompany.ValleyAveNW

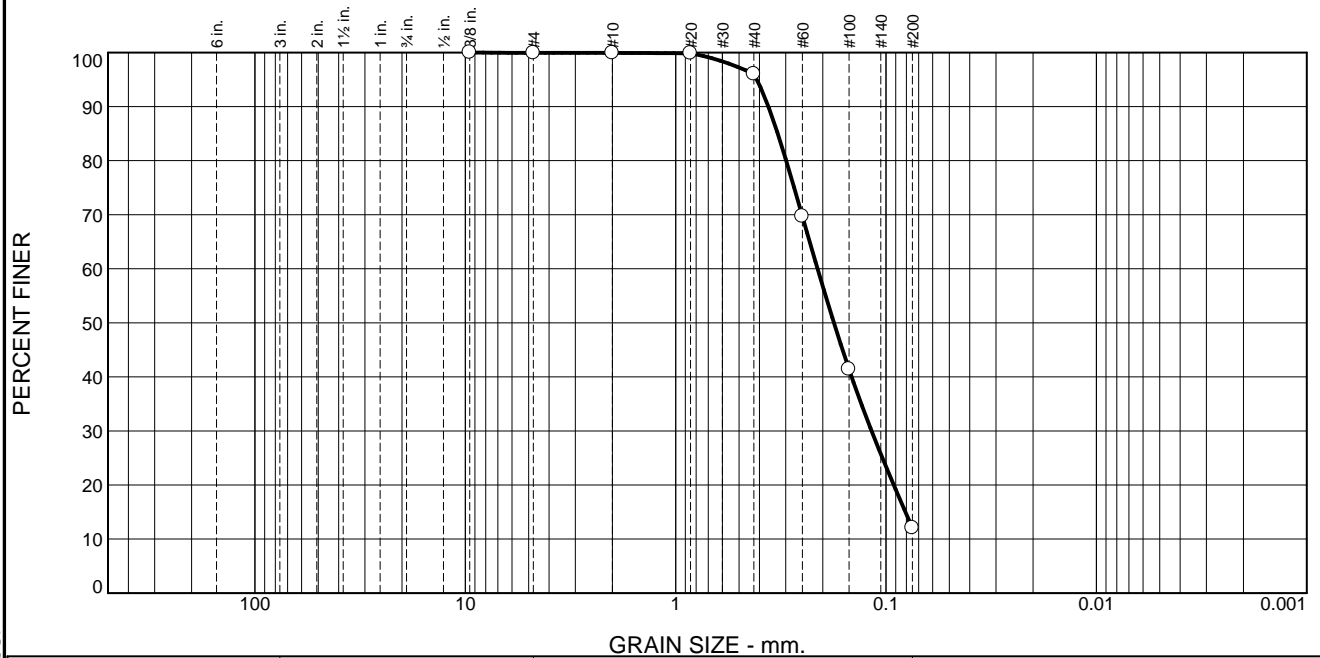
FIG. A-3

Appendix B

Laboratory Test Results

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.0	3.9	83.9	12.1	

Test Results (ASTM D 6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375	100.0		
#4	99.9		
#10	99.9		
#20	99.9		
#40	96.0		
#60	69.7		
#100	41.4		
#200	12.1		

* (no specification provided)

Material Description		
Silty SAND (SM)		
Atterberg Limits (ASTM D 4318)		
PL= NP	LL= NV	PI= NP
Classification		
USCS (D 2487)= SM	AASHTO (M 145)=	A-2-4(0)
Coefficients		
D ₉₀ = 0.3626	D ₈₅ = 0.3273	D ₆₀ = 0.2116
D ₅₀ = 0.1770	D ₃₀ = 0.1172	D ₁₅ = 0.0809
D ₁₀ =	C _u =	C _c =
Remarks		
Natural Moisture: 21.8%		
Date Received: 12/10/21 Date Tested: 12/21/21		
Tested By: MAW		
Checked By: KSS		
Title: PM		

Source of Sample: B-1/MW-1
Sample Number: 1a

Depth: 2.5

Date Sampled: 12/10/21

GeoResources, LLC

Fife, WA

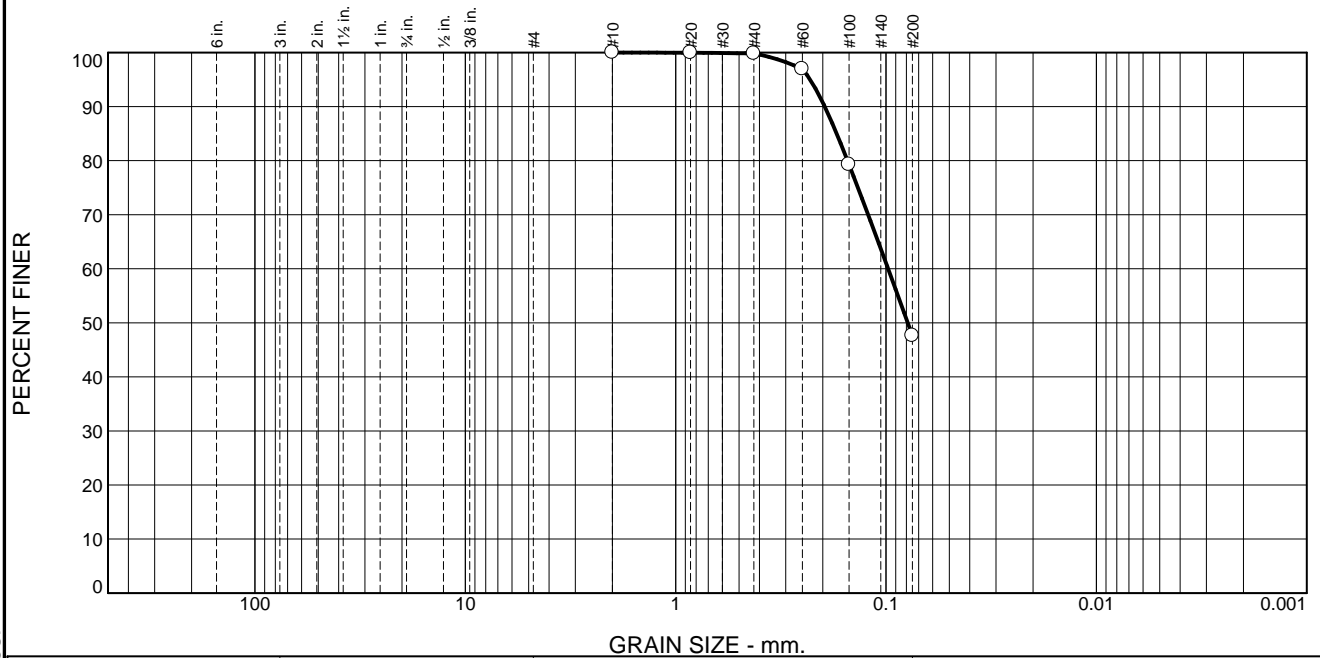
Client: Neil Walter Company
Project: Proposed Contractor's Yard

Project No: NeilWalterCompany.ValleyAveNW Figure B-1

Tested By: _____ Checked By: _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	52.2	47.6	

Test Results (ASTM D 6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	100.0		
#40	99.8		
#60	97.0		
#100	79.3		
#200	47.6		

* (no specification provided)

Material Description		
Silty SAND (SM)		
Atterberg Limits (ASTM D 4318)		
PL= NP	LL= NV	PI= NP
Classification		
USCS (D 2487)= SM	AASHTO (M 145)=	A-4(0)
Coefficients		
D ₉₀ = 0.1956	D ₈₅ = 0.1718	D ₆₀ = 0.0978
D ₅₀ = 0.0789	D ₃₀ =	D ₁₅ =
D ₁₀ =	C _u =	C _c =
Remarks		
Natural Moisture: 27.6%		
Date Received: 12/10/21 Date Tested: 12/21/21		
Tested By: MAW		
Checked By: KSS		
Title: PM		

Source of Sample: B-2/MW-2
Sample Number: 1

Depth: 2.5

Date Sampled: 12/10/21

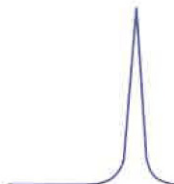
GeoResources, LLC

Fife, WA

Client: Neil Walter Company
Project: Proposed Contractor's Yard

Project No: NeilWalterCompany.ValleyAveNW Figure B-2

Tested By: _____ Checked By: _____



Analytical Report

Geo Resources, LLC
4809 Pacific Hwy E
Fife, WA 98424

Project NWC.Valley Ave
PO Number
Date Received 05/27/2022

Client ID: 103272 (HA-1, S-1)

Lab No: 302271-01

Sample Date: 05/27/22 12:30

Analyte	Method	Result	Units	PQL	Qualifiers	Analysis Date	Analyst
Cation Exchange Capacity	SW 9081	16.7	Na, mEq/100g	---	---	6/29/2022	KLH
Organic Matter	ASTM D-2974-13	1.12	wt. % Dry	0.005	---	6/23/2022	KLH

Client ID: 103273 (HA-2, S-2)

Lab No: 302271-02

Sample Date: 05/27/22 12:45

Analyte	Method	Result	Units	PQL	Qualifiers	Analysis Date	Analyst
Organic Matter	ASTM D-2974-13	11.1	wt. % Dry	0.005	---	6/23/2022	KLH
Cation Exchange Capacity	SW 9081	15.4	Na, mEq/100g	---	---	6/29/2022	KLH

Lab Qualifiers Comments:

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These results relate only to the items tested and the sample(s) as received by the laboratory. This report shall not be reproduced except in full, without prior express written approval by Spectra Laboratories.

Appendix C

Massman Calculations

City of Puyallup - 2014 SWMMWW

NeilWalterCompany.ValleyAveNW

Puyallup, Washington

Massman Calculation Sheet

Soil Grain Size Analysis Method

Procedure based on 2014 SWMMWW, Volume III

$$K_{sat} = 10^{(-1.57 + 1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08F_{fines})} \quad (\text{provides } K_{sat} \text{ in cm/s})$$

$$K_{sat} = [10^{(-1.57 + 1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08F_{fines})}] * 1417 \quad (\text{provides } K_{sat} \text{ in in/hr})$$

Sample Information				Sieve Data				Unfactored Rate	
I.D.	Test Pit	Depth (ft)	Layer Thickness (ft)	D ₁₀	D ₆₀	D ₉₀	F _{fines}	Individual K _{sat} (cm/s)	Equivalent K _{sat} (in/hr)
102783	B-1	2.5'	15'+	0.07	0.2116	0.3626	0.121	0.020	28.917
102784	B-2	2.5'	15'+	0.030	0.0978	0.1956	0.476	0.003	4.438

Effective Average Hydraulic Conductivity, K_{equiv}

Based on either:

- 1) Average K_{sat} determined using harmonic mean
- 2) Lowest conductive layer, if within 5ft of bottom of pond

$k_{equiv} =$	16.678	Average
	4.438	Lowest
	4.438	To Use

Site Variability & number of location tested (CF_v)

	0.33 to 1.0
--	-------------

Factor to use for calculations **0.75**

Test Method (CF_t)

	0.4 to 0.75
--	-------------

Large-scale PIT	0.75
Small-scale PIT	0.5
Other small-scale (e.g. Double ring, falling head)	0.4
Grain Size Method	0.4

Factor to use for calculations **0.4**

Degree of influent control to prevent siltation and bio-buildup (CF_m)

	0.90
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Factor to use for calculations **0.9**

$$I_{design} = I_{measured} * F_{testing} * F_{geometry} * F_{plugging} \quad \mathbf{1.20} \quad \text{in/hr}$$

Design Value **1.00** in/hr

Infiltration Analysis

Proposed Contractor's Yard

1036-1106 Valley Avenue NW

Puyallup, Washington

PN: 042016-3042, -3041, & -3040

DocID: NWC.ValleyAveNW

April 2022

Figure C-1



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