Construction Stormwater Pollution Prevention Plan (SWPPP) Report

Tacoma Subaru MOD Facility

Prepared For
SDEV23-0202

Project Location
3812 S Tacoma Way

Tacoma, WA 98409

0220131004

SWPPP Prepared By

Name	Organization	Contact Telephone Number	Email Address
Daniel Hendrickson	Hendrickson Engineering PLLC	253.514.2413	dan@hendricksoncc.com

Erosion and Sediment Control Lead

Name	Organization	Contact Telephone Number	Email Address	CESCL/CPESC Number (if applicable)
Caleb Hilger	**Hilger Construction**	**253.584.4766**	**Caleb.hilger@hilgerconstruction.com**	**N/A**

Proposed Construction Schedule

Proposed Start Date	Proposed End Date	Described proposed phasing or sequencing (if any)
12/2023	12.2024	**None**

Date Prepared
10.3.2023

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Notes for Preparer:

When completing the Construction Stormwater Pollution Prevention Plan Report provide all required information in the textbox forms under each section and delete any sections from the report and appendices that are not applicable to the proposed project. Further information and guidance on the information required can be found in the comment bubbles to the right of each section. Once the report has been completed delete all comment bubbles and grey highlighted instructions, select the References tab and update the Table of Contents, and input the figure/table numbers and names in List of Figures and List of Tables under the contents page above.

1. Project Information

A. Project Contents

See Title Page for Construction Stormwater Pollution Prevention Plan Development Team and Erosion and Sediment Control Lead.

B. Property Owner

Name	Organization	Mailing Address	Contact Telephone Number	Email Address
(Insert Name)	Micky LLC	C/o Tacoma Subaru, PO Box 111270, Tacoma, WA 98411	253.468.2346	todd@toddwardllc.com

C. Applicant (if different than Property Owner)

Name	Organization	Mailing Address	Contact Telephone Number	Email Address
(Insert Name)	(Insert Name)	(Insert Address)	(Insert Phone Number)	(Insert Email Address)

D. Associated Permits

i) Associated City of Tacoma Permit Number(s)

SDEV23-0202

ii) Other Federal, State, or Local Associated Permit Types and Numbers

N/A

E. Vesting

i) City of Tacoma Stormwater Management Manual Edition Used

N/A

ii) If using a manual other than the most current version, provide vesting justification:

N/A

2. Project Overview

A. Provide a brief description of the proposed project.

Proposed improvements for the Bruce Titus Tacoma Subaru MOD Facility project include the demolition of three existing buildings and associated parking lot areas. A new building will be constructed, as well as reconstruction of the parking lot with new striping. The project site includes approximately 1.01 acre. The project site is located on parcel 0220131004. The parcel is located in Section 13, Township 20, Range 02, Quarter 14

3. Existing Project Site Conditions

A. Describe in words and/or provide a figure(s) or drawing(s) that describe the existing site conditions.

The project site consists of 0.98 acres located on the Tacoma Subaru property, just west of South Tacoma Way and south of South 38th Street. The site is developed and the area to be disturbed is approximately 100% hard surface in the existing condition.

Apex Engineering, PLLC performed a topographic survey of the site. The parking lot that will be replaced has moderate slopes up to 10 percent. To the east of the project site is a flatter parking area. The entire site generally slopes to the east.

Generally, the surrounding area slopes down from west to east across the site. Existing stormwater runoff sheet flows to the east and into a conveyance system that connects south to the city stormwater system.

There are no known historical problems such as flooding or erosion on the site. Power and irrigation are the only existing utilities in the project area; a gas line and some telecommunications lines are adjacent.

Adjacent Areas and Drainage

The site is located adjacent to the existing Tacoma Subaru Express Building and parking lot. To the north is the existing Fiat sales dealership. West of these parcels is the Burlington Northern Railway Parcel. To the east is South Tacoma Way.

Critical Areas

There are no known sensitive or critical areas on the project site other than being in the South Tacoma Groundwater Protection District (STGPD). There are no known groundwater wells or septic systems onsite or within 100 feet of the site. The site is not located in an aquifer recharge area or wellhead protection area, as defined by the Tacoma-Pierce County Health Department, the Environmental Protection Agency, or the City of Tacoma. There are no known Superfund areas in the vicinity of the project. There is no known basin plan for the area. There are moderate and steep slopes on the Tacoma Subaru property adjacent to the west of the project site.

Soils

Associated Earth Sciences, Inc. prepared a Subsurface Exploration and Geotechnical Engineering Evaluation for this project, dated November 2017. This report indicates soils generally consist of recessional and advanced outwash. One of the pits had some fill encountered at the top layers. The report states that soils are favorable for infiltration purposes.

Potential Erosion Problems

Associated Earth Sciences, Inc. prepared a Subsurface Exploration and Geotechnical Engineering Evaluation dated November 2017. This report indicates soils generally consist of recessional and advanced outwash. The report states that stripped areas should be revegetated quickly to prevent potential erosion.

4. 13 Elements of Construction Stormwater Pollution Prevention

Below the 13 Elements of Construction Stormwater Pollution Prevention are provided. For each element, place a checkmark next to the BMP that will be used to satisfy the element. If Other is checked describe how the element will be addressed in detail. If an element is not required, justification for why that element is not required must be included. Volume 3, Table 3-1: Construction Stormwater BMPs by SWPP Element is a guide that can be used to help determine appropriate BMPs to address each Element.

4.1 Element #1: Preserve Vegetation and Mark Clearing Limits

- Before beginning any land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area to prevent damage and offsite impacts. Mark clearing limits both in the field and on the plans.
- Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum degree practicable. If it is not practicable to retain the duff layer in place, stockpile it onsite, cover it to prevent erosion, and replace it immediately upon completion of the ground-disturbing activities.
- Plastic, metal, fabric fence, or other physical barriers may be used to mark the clearing limits.

The BMP(s) proposed to meet this element are:

☒ BMP C101: Preserving Natural Vegetation
☐ BMP C102: Buffer Zone
☒ BMP C103: High Visibility Fence
☐ Other: (Insert description of how element will be addressed)
☐ This Element is not required for this project because: (Insert Justification as to why Element is not required)

4.2 Element #2: Establish Construction Access

- Limit construction vehicle ingress and egress to one route, if possible.
- Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs to minimize tracking of sediment.
- Locate wheel wash or tire baths onsite if other measures fail to control sediment from leaving the site.
- No tracking of sediment offsite is allowed. If sediment is tracked offsite, offsite areas (including roadways) shall be thoroughly and immediately cleaned by shoveling or pickup sweeping. Transport sediment to a controlled sediment disposal area.
- Keep streets clean at ALL times. Clean tracked sediment immediately.
- Washing of sediment to the stormwater system is not allowed.

The BMP(s) proposed to meet this element are:

☒ BMP C105: Stabilized Construction Entrance

☐ BMP C106: Wheel Wash

☐ BMP C107: Construction Road/Parking Area Stabilization

☐ Other: (Insert description of how element will be addressed)

☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

4.3 Element #3: Control Flow Rates

- Protect downstream properties, receiving waters, and conveyance systems from erosion and other damage due to increases in the velocity and peak volumetric flowrate of stormwater from the project site. A quantitative downstream analysis may be required to ensure no damage to the downstream conveyance system during construction. See Additional Protective Measure - Infrastructure Protection.
- Where necessary, construct flow control facilities as one of the first steps in grading.
- Flow control facilities shall be functional prior to construction of site improvements (e.g. impervious surfaces). It may be necessary to install temporary flow control facilities to meet flow control requirements during construction.
- Control structures designed for permanent flow control BMPs are not appropriate for use during construction without modification. If used during construction, modify the control structure to allow for long-term storage of runoff and enable sediments to settle. Verify that the BMP is sized appropriately for this purpose. Restore BMPs to their original design dimensions, remove sediment, and install a final control structure at completion of the project.
- Velocity of water leaving the site shall not exceed 3 feet/second if the discharge is to a stream or ditch.
- Permanent infiltration facilities shall not be used for flow control during construction unless lined. The bottom of the facility shall be scarified to ensure any compaction that occurred during construction is mitigated.

<u>The BMP(s) proposed to meet this element are:</u>

☐ BMP C203: Water Bars

☐ BMP C207: Check Dams

☐ BMP C209: Outlet Protection

☐ BMP C235: Wattles

☒ BMP C240: Sediment Trap

☐ BMP C241: Temporary Sediment Pond

☐ Other: (Insert description of how element will be addressed)

☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

4.4 Element #4: Install Sediment Controls

- Design, install, and maintain effective erosion controls and sediment control to minimize the discharge of pollutants.
- Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater, and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- Prior to leaving a construction site or prior to discharge to an infiltration facility, stormwater from disturbed areas shall pass through a sediment removal BMP.
- Construct sediment control BMPs as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Locate BMPs in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or conveyance channels.
- Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize infiltration, where feasible.
- Seed and mulch earthen structures such as dams, dikes, and diversions according to the timing indicated in Element #5.
- Design outlet structures to withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column. If installing a floating pump structure, include a stopper to prevent the pump basket from hitting the bottom of the pond.
- Full stabilization includes concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion.

The BMP(s) proposed to meet this element are:

☐ BMP C231: Brush Barrier
☐ BMP C232: Gravel Filter
☒ BMP C233: Silt Fence
☐ BMP C234: Vegetated Filter Strip
☐ BMP C235: Wattles
☒ BMP C240: Sediment Trap
☐ BMP C241: Temporary Sediment Pond
☐ BMP C250: Construction Stormwater Chemical Treatment
☐ Other: (Insert description of how element will be addressed)
☐ This Element is not required for this project because: (Insert justification as to why Element is no required)

4.5 Element #5: Stabilize Soils

- Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion.

- From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This stabilization requirement applies to all soils onsite, whether at final grade or not.
- Stabilize soils at the end of the shift, before a holiday or weekend, if needed, based on the weather forecast.
- Select appropriate soil stabilization measures for the time of year, site conditions, estimated duration of use, and the potential water quality impacts that stabilization agents may have on downstream waters or groundwater.
- Stabilize soil stockpiles from erosion, protect stockpiles with sediment trapping measures, and where possible, locate piles away from stormwater system inlets, waterways, and conveyance channels.
- Control stormwater volume and velocity within the site to minimize soil erosion.
- Control stormwater discharges, including peak volumetric flowrates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.
- Ensure the gravel base used for stabilization is clean and does not contain fines or sediment.

<u>The BMP(s) proposed to meet this element are:</u>

☐ BMP C120: Temporary and Permanent Seeding
☐ BMP C121: Mulching
☐ BMP C122: Nets and Blankets
☒ BMP C123: Plastic Covering
☐ BMP C124: Sodding
☐ BMP C125: Compost
☐ BMP C126: Topsoiling
☐ BMP C127: Polyacrylamide for Soil Erosion Protection
☐ BMP C130: Surface Roughening
☐ BMP C131: Gradient Terraces
☒ BMP C140: Dust Control
☐ Other: (Insert description of how element will be addressed)
☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

4.6 Element #6: Protect Slopes

- Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).
- Divert offsite stormwater (sometimes called run-on) or groundwater away from slopes and disturbed areas with interceptor dikes and/or swales. Manage offsite stormwater separately from stormwater generated on the site.
- At the top of the slopes, collect stormwater in pipe slope drains or protected channels to prevent erosion. Size temporary pipe slope drains to convey either:
  - The peak volumetric flowrate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm using a single event model, or
  - The 10-year return period flowrate, indicated by an Ecology-approved continuous simulation model, using a 15-minute time step.
- Use the existing land cover condition for predicting flowrates from tributary areas outside the project limits. For tributary areas on the project site, use the temporary or permanent project land cover condition, whichever will produce the highest flowrate. If using, a continuous simulation model, model bare soils as landscaped areas.
- Provide temporary or permanent conveyance to remove groundwater seepage from the slope surface of exposed soil areas.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Place check dams at regular intervals within channels that are cut down a slope.
- Stabilize soils on slopes, as specified in Element #5.

<u>The BMP(s) proposed to meet this element are:</u>

☐ BMP C120: Temporary and Permanent Seeding
☐ BMP C121: Mulching
☐ BMP C122: Nets and Blankets
☒ BMP C123: Plastic Covering
☐ BMP C124: Sodding
☐ BMP C130: Surface Roughening
☐ BMP C131: Gradient Terraces
☐ BMP C200: Interceptor Dike and Swale
☐ BMP C201: Grass-Lined Channels
☐ BMP C203: Water Bars
☐ BMP C204: Pipe Slope Drains
☐ BMP C205: Subsurface Drains
☐ BMP C206: Level Spreader
☐ BMP C207: Check Dams
☐ BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)
☐ Other: (Insert description of how element will be addressed)

☐ BMP This Element is not required for this project because: (Insert justification as to why Element is not required)

4.7 Element #7: Protect Stormwater System Inlets

- Protect all stormwater system inlets that are operable during construction so that stormwater does not enter the conveyance system without first being filtered or treated to remove sediment.
- Clean or remove and replace inlet protection devices when sediment has filled 1/3 of the available storage (unless a different standard is specified by the product manufacturer).
- Keep all approach roads clean. Do not allow sediment to enter the stormwater system.
- Inspect inlets weekly at a minimum and daily during storm events.

The BMP(s) proposed to meet this element are:

☒ BMP C220: Stormwater System Inlet Protection

☐ Other: (Insert description of how element will be addressed)

☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

4.8 Element #8: Stabilize Channels and Outlets

- Design, construct, and stabilize all temporary onsite conveyance channels to prevent erosion from either:
  - The peak volumetric flowrate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm using a single event model, or
  - The 10-year return period flowrate, indicated by an Ecology-approved continuous simulation model, using a 15-minute time step.
- Use the existing land cover condition for predicting flowrates from tributary areas outside the project limits. For tributary areas on the project site, use the temporary or permanent project land cover condition, whichever will produce the highest flowrate. If using a continuous simulation model, model bare soils as landscaped areas.
- Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches at the outlets of all conveyance systems.

The BMP(s) proposed to meet this element are:

☐ BMP C122: Nets and Blankets

☒ BMP C202: Rip Rap Channel Lining

☐ BMP C207: Check Dams

☐ Other: (Insert description of how element will be addressed)

☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

4.9 Element #9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.
- All discharges to the City of Tacoma wastewater system require City approval. Some discharges to the City of Tacoma stormwater system require City approval. The approval may include a separate Special Approved Discharge (SAD) permit. Visit https://www.cityoftacoma.org/government/city_departments/environmentalservices/wastewater/wastewater_permits_and_manuals for additional information about SAD Permits.
- Handle and dispose of all pollutants, including waste materials and demolition debris that occur on site in a manner that does not cause contamination of stormwater.
- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health and the environment. Provide secondary containment for tanks holding pollutants including onsite fueling tanks. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest tank within the containment structure. Double-walled tanks do not require additional secondary containment.
- Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.
- Conduct oil changes, hydraulic system drain down, solvent and degreasing 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 stormwater using spill prevention measures, such as drip pans.
- Discharge wheel wash or tire bath wastewater to a separate onsite treatment system that prevents discharge to surface water. Alternatively, discharge wheel wash or tire bath wastewater to the wastewater system (only allowed with SAD Permit approval).
- Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemicals to stormwater. Follow manufacturers' recommendations for application rates and procedures.
- Use BMPs to prevent or treat contamination of stormwater by pH modifying sources. These sources include, but are not limited to, recycled concrete stockpiles, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, and concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of water quality standards.
- Manage concrete washout appropriately.
    - Washout concrete truck drums or concrete handling equipment in onsite or offsite designated concrete washout areas only.
        - Do not washout concrete truck drums or concrete handling equipment to streets, the stormwater system, receiving waterbodies, or the ground.
    - Washout of small concrete handling equipment may be disposed of in a formed areas awaiting concrete where it will not contaminate stormwater and surface water or groundwater.
    - Do not use upland land applications for discharging wastewater from concrete washout areas.
    - Do not dump excess concrete onsite, except in designated concrete washout areas.

    - Do not washout anything contaminated with concrete into formed areas awaiting infiltration BMPs.
    - Concrete spillage or concrete discharge directly to groundwater or surface waters of the State is prohibited.
- Written approval from the Department of Ecology is required prior to using chemical treatment other than CO2, dry ice, or food grade vinegar to adjust pH.
- Clean contaminated surfaces immediately following any discharge or spill incident.
- Uncontaminated water from water-only based shaft drilling for construction of building, road, and bridge foundations may be infiltrated provided the wastewater is managed in a way that prohibits discharge to surface waters. Prior to infiltration, water from water-only based shaft drilling that comes into contact with curing concrete must be neutralized until pH is in the range of 6.5 to 8.5.

The BMP(s) proposed to meet this element are:

☒ BMP C151: Concrete Handling
☒ BMP C152: Sawcutting and Surface Pollution Prevention
☒ BMP C153: Material Delivery, Storage and Containment
☒ BMP C154: Concrete Washout Area
☐ BMP C250: Construction Stormwater Chemical Treatment
☐ Other: (Insert description of how element will be addressed)
☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

4.10 Element #10: Dewatering

- Dewatering discharges to the City of Tacoma stormwater conveyance system or the City of Tacoma wastewater system may require City approval through a Special Approved Discharge (SAD) Permit. See https://www.cityoftacoma.org/government/city_departments/environmentalservices/wastewater/wastewater_permits_and_manuals for more information on the SAD Permit Process.
- Discharge foundation, vault, and trench dewatering water that has similar characteristics to site stormwater into a controlled conveyance system prior to discharge to a sediment trap or sediment pond. Stabilize channels as specified in Element #8.
- Clean, non-turbid dewatering water, such as well-point groundwater, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the dewatering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through TESC BMPs.
- Handle highly turbid or contaminated dewatering water separately from stormwater at the site.
- Other disposal options, depending on site constraints, may include:
    - Infiltration
    - Transport offsite in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters
    - Ecology approved onsite chemical treatment or other suitable treatment technologies

- Use of a sedimentation bag that discharges to a ditch or swale for small volumes of localized dewatering

The BMP(s) proposed to meet this element are:

☐ BMP C203: Water Bars
☐ BMP C206: Level Spreader
☐ BMP C236: Vegetative Filtration
☐ Other: (Insert description of how element will be addressed)
☒ This Element is not required for this project because: Based on the outwash soils found onsite, dewatering is not anticipated during construction.

4.11 Element #11: Maintain BMPs

- Maintain and repair as needed all temporary and permanent erosion and sediment control BMPs to assure continued performance of their intended function. Conduct maintenance and repairs in accordance with BMP specifications.
- 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. Trapped sediment shall be removed or stabilized onsite. Permanently stabilize disturbed soil resulting from removal of BMPs or vegetation.

The BMP(s) proposed to meet this element are:

☒ BMP C150: Materials on Hand
☒ BMP C160: Erosion and Sediment Control Lead
☐ BMP C236: Vegetative Filtration
☐ Other: (Insert description of how element will be addressed)
☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

4.12 Element #12: Manage the Project

- *Phasing of Construction* – Phase development projects in order to prevent soil erosion and the transport of sediment from the project site during construction, unless the Erosion and Sediment Control Lead can demonstrate that construction phasing is infeasible. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.
- *Seasonal Work Limitations* – From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the City that silt-laden stormwater will be prevented from leaving the site through a combination of the following:
    - Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters;
    - Limitations on activities and the extent of disturbed areas; and

- Proposed erosion and sediment control measures.

Based on the information provided and local weather conditions, the City may expand or restrict the seasonal limitation onsite disturbance. The following activities are exempt from the seasonal clearing and grading limitations:

- Routine maintenance and necessary repair of erosion and sediment control BMPs
- 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
- Activities where there is one hundred percent infiltration of stormwater within the site in approved and installed erosion and sediment control facilities

- *Inspection and Monitoring*
  a. Inspect, maintain, and repair all BMPs as needed to assure continued performance of their intended function. Projects regulated under the Construction Stormwater General Permit (CSWGP) must conduct site inspections and monitoring in accordance with Special Condition S4 of the CSWGP.
  b. Projects that disturb one or more acres must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL) or Certified Professional in Erosion and Sediment Control (CPESC).
  c. Projects disturbing less than one acre must have an Erosion Sediment Control Lead (ESC) conduct inspections. The ESC Lead does not have to have CESCL or CPESC certification.
  d. The CESCL, CPESC, or ESC Lead shall be identified in the SWPPP and shall be onsite or on-call at all times.
  e. The CESCL, CPESC, or ESC Lead must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen and evaluate the effectiveness of BMPs to determine if it is necessary to install, maintain, or repair BMPs.
  f. The CESCL, CPESC, or ESC Lead must inspect all areas disturbed by construction activities, all BMPs, and all locations where stormwater leaves the site at least once every calendar week and within 24 hours of any discharge from the site. (Individual discharge events that last more than one day do not require daily inspections). The CESCL, CPESC, or ESC Lead may reduce the inspection frequency for temporary stabilized, inactive sites to once every calendar month.
  g. Construction site operators must correct any problems identified by the CESCL, CPESC, or ESC Lead by:
     - Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within 7 days of the inspection.
     - Fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible but correcting the problem within 10 days.
     - Documenting BMP implementation and maintenance in the site log book. (Required for sites larger than 1 acre but recommended for all sites).

  Sampling and analysis of the stormwater discharges from a construction site may be necessary on a case-by-case basis to ensure compliance with standards. Ecology or the City will establish these monitoring and associated reporting requirements.
- *Responsible Party* – For all projects, a 24-hour responsible party shall be listed in the SWPPP, along with that person's telephone number and email address.
- *Maintenance of the Construction SWPPP* – Keep the Construction SWPPP onsite or within reasonable access to the site. Modify the SWPPP whenever there is a change in the design,

construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.
Modify the SWPPP if, during inspections or investigations conducted by the owner/operator, City staff, or by local or state officials, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. Modify the SWPPP as necessary to include additional or modified BMPs designed to correct problems identified. Complete revisions to the SWPPP within seven (7) days following the inspection. City of Tacoma Environment Services (review staff or inspector) may require that a modification to the SWPPP go through additional City review.

The BMP(s) proposed to meet this element are:

☒ BMP C150: Materials on Hand
☒ BMP C160: Erosion and Sediment Control Lead
☒ BMP C162: Scheduling
☐ Other: (Insert description of how element will be addressed)
☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

4.13 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 and full replacement of treatment media.
- Prevent compacting infiltration facilities by excluding construction equipment and foot traffic.
- Keep all heavy equipment off native soils under infiltration BMPs that have been excavated to final grade to retain the infiltration rate of the soils.
- Protect lawn and landscaped areas from compaction due to construction equipment and material stockpiles.
- Do not allow muddy construction equipment on the base material of permeable pavement or on the permeable pavement section.
- Do not allow sediment laden runoff onto permeable pavements or base materials of permeable pavements.
- Permeable pavements fouled with sediment or that can no longer pass an initial infiltration test must be cleaned prior to final acceptance.

The BMP(s) proposed to meet this element are:

☐ BMP C102: Buffer Zone
☒ BMP C103: High Visibility Fence
☐ BMP C200: Interceptor Dike and Swale

☐ BMP C201: Grass-Lined Channels
☐ BMP C207: Check Dams
☐ BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)
☐ BMP C231: Brush Barrier
☒ BMP C233: Silt Fence
☐ BMP C234: Vegetated Filter Strip
☐ Other: (Insert description of how element will be addressed)
☐ This Element is not required for this project because: (Insert justification as to why Element is not required)

Appendices

A. Modeling Report

- WWHM Model
- Sediment Trap Calculation

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 20230926TESC
Site Name:
Site Address:
City:

Report Date:	10/4/2023
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2023/03/31
Version:	4.2.19

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.26
Pervious Total	0.26

Impervious Land Use	acre
ROOF TOPS FLAT	0.03
PARKING FLAT	0.69
Impervious Total	0.72
Basin Total	0.98

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.13
PARKING FLAT	0.38
Impervious Total	0.51
Basin Total	0.51

Basin 2

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.27
Pervious Total	0.27

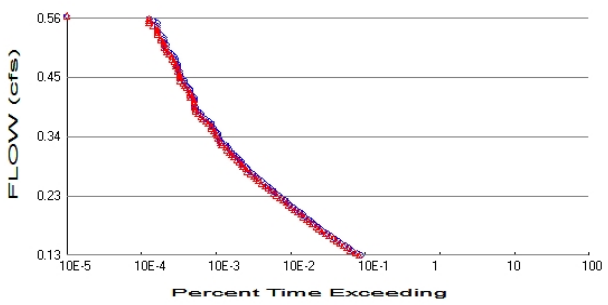
Impervious Land Use	acre
SIDEWALKS FLAT	0.01
PARKING FLAT	0.19
Impervious Total	0.2
Basin Total	0.47

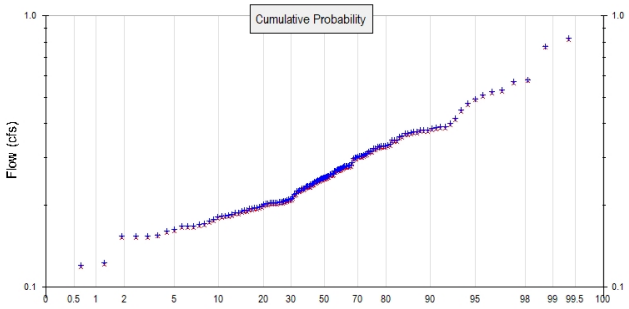
Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.26
Total Impervious Area: 0.72

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.27
Total Impervious Area: 0.71

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.25272
5 year	0.339512
10 year	0.402633
25 year	0.489066
50 year	0.558467
100 year	0.632301

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.249232
5 year	0.334844
10 year	0.397109
25 year	0.482374
50 year	0.550838
100 year	0.623678

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.298	0.294
1903	0.331	0.326
1904	0.374	0.369
1905	0.168	0.166
1906	0.188	0.185
1907	0.251	0.248
1908	0.206	0.204
1909	0.255	0.251
1910	0.243	0.240
1911	0.273	0.269

1912	0.494	0.489
1913	0.197	0.195
1914	0.828	0.817
1915	0.170	0.167
1916	0.318	0.313
1917	0.120	0.118
1918	0.255	0.251
1919	0.156	0.153
1920	0.207	0.204
1921	0.178	0.175
1922	0.279	0.275
1923	0.195	0.192
1924	0.367	0.362
1925	0.154	0.151
1926	0.299	0.295
1927	0.244	0.240
1928	0.181	0.178
1929	0.361	0.356
1930	0.378	0.373
1931	0.182	0.180
1932	0.197	0.194
1933	0.195	0.192
1934	0.317	0.312
1935	0.168	0.166
1936	0.235	0.232
1937	0.349	0.344
1938	0.171	0.168
1939	0.215	0.212
1940	0.379	0.374
1941	0.374	0.369
1942	0.282	0.278
1943	0.279	0.275
1944	0.401	0.395
1945	0.304	0.300
1946	0.236	0.232
1947	0.184	0.181
1948	0.253	0.249
1949	0.391	0.385
1950	0.221	0.218
1951	0.334	0.330
1952	0.378	0.373
1953	0.348	0.343
1954	0.205	0.203
1955	0.191	0.188
1956	0.188	0.186
1957	0.204	0.201
1958	0.256	0.253
1959	0.260	0.256
1960	0.201	0.198
1961	0.573	0.565
1962	0.246	0.243
1963	0.183	0.181
1964	0.531	0.524
1965	0.239	0.236
1966	0.199	0.196
1967	0.279	0.275
1968	0.235	0.232
1969	0.212	0.209

1970	0.241	0.238
1971	0.234	0.231
1972	0.773	0.762
1973	0.449	0.443
1974	0.325	0.320
1975	0.336	0.331
1976	0.358	0.353
1977	0.154	0.151
1978	0.267	0.264
1979	0.272	0.268
1980	0.268	0.265
1981	0.253	0.249
1982	0.206	0.203
1983	0.279	0.275
1984	0.277	0.274
1985	0.316	0.311
1986	0.160	0.158
1987	0.282	0.278
1988	0.168	0.166
1989	0.154	0.151
1990	0.203	0.200
1991	0.303	0.299
1992	0.288	0.284
1993	0.329	0.325
1994	0.225	0.222
1995	0.175	0.173
1996	0.236	0.232
1997	0.210	0.208
1998	0.250	0.247
1999	0.272	0.268
2000	0.239	0.236
2001	0.192	0.189
2002	0.348	0.343
2003	0.203	0.200
2004	0.305	0.300
2005	0.582	0.574
2006	0.273	0.269
2007	0.305	0.301
2008	0.252	0.248
2009	0.192	0.189
2010	0.247	0.243
2011	0.260	0.256
2012	0.241	0.237
2013	0.227	0.224
2014	0.220	0.217
2015	0.369	0.364
2016	0.231	0.227
2017	0.370	0.365
2018	0.231	0.229
2019	0.328	0.324
2020	0.269	0.265
2021	0.227	0.223
2022	0.385	0.380
2023	0.476	0.469
2024	0.511	0.504
2025	0.248	0.244
2026	0.272	0.268
2027	0.304	0.299

2028	0.119	0.117
2029	0.195	0.193
2030	0.391	0.386
2031	0.123	0.121
2032	0.208	0.205
2033	0.261	0.258
2034	0.205	0.202
2035	0.252	0.248
2036	0.204	0.202
2037	0.275	0.271
2038	0.261	0.257
2039	0.524	0.517
2040	0.205	0.202
2041	0.260	0.257
2042	0.300	0.296
2043	0.332	0.328
2044	0.228	0.225
2045	0.185	0.182
2046	0.205	0.202
2047	0.253	0.249
2048	0.209	0.206
2049	0.309	0.305
2050	0.230	0.227
2051	0.325	0.320
2052	0.248	0.245
2053	0.211	0.208
2054	0.418	0.412
2055	0.256	0.253
2056	0.330	0.326
2057	0.163	0.160
2058	0.311	0.307
2059	0.388	0.382

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.8280	0.8165
2	0.7730	0.7623
3	0.5820	0.5740
4	0.5733	0.5653
5	0.5310	0.5236
6	0.5241	0.5169
7	0.5114	0.5045
8	0.4938	0.4894
9	0.4759	0.4693
10	0.4489	0.4427
11	0.4183	0.4125
12	0.4008	0.3952
13	0.3909	0.3855
14	0.3906	0.3852
15	0.3879	0.3825
16	0.3852	0.3799
17	0.3788	0.3736
18	0.3782	0.3732
19	0.3778	0.3725
20	0.3744	0.3692
21	0.3743	0.3691
22	0.3702	0.3650

23	0.3692	0.3640
24	0.3674	0.3623
25	0.3609	0.3559
26	0.3576	0.3526
27	0.3493	0.3444
28	0.3481	0.3433
29	0.3480	0.3432
30	0.3360	0.3314
31	0.3343	0.3297
32	0.3322	0.3276
33	0.3307	0.3261
34	0.3304	0.3258
35	0.3294	0.3249
36	0.3284	0.3239
37	0.3249	0.3204
38	0.3246	0.3201
39	0.3177	0.3132
40	0.3166	0.3122
41	0.3157	0.3113
42	0.3110	0.3067
43	0.3093	0.3050
44	0.3054	0.3012
45	0.3045	0.3003
46	0.3038	0.2995
47	0.3035	0.2993
48	0.3032	0.2990
49	0.3003	0.2962
50	0.2993	0.2951
51	0.2984	0.2942
52	0.2883	0.2843
53	0.2815	0.2776
54	0.2815	0.2776
55	0.2793	0.2755
56	0.2792	0.2753
57	0.2791	0.2752
58	0.2788	0.2749
59	0.2775	0.2736
60	0.2749	0.2711
61	0.2731	0.2693
62	0.2730	0.2692
63	0.2722	0.2684
64	0.2721	0.2683
65	0.2720	0.2682
66	0.2688	0.2651
67	0.2684	0.2647
68	0.2668	0.2635
69	0.2615	0.2579
70	0.2608	0.2572
71	0.2603	0.2567
72	0.2597	0.2564
73	0.2595	0.2559
74	0.2561	0.2526
75	0.2559	0.2526
76	0.2548	0.2513
77	0.2545	0.2510
78	0.2529	0.2494
79	0.2529	0.2494
80	0.2526	0.2491

81	0.2519	0.2484
82	0.2517	0.2482
83	0.2511	0.2476
84	0.2501	0.2466
85	0.2481	0.2447
86	0.2479	0.2444
87	0.2467	0.2433
88	0.2465	0.2431
89	0.2438	0.2404
90	0.2434	0.2400
91	0.2413	0.2379
92	0.2408	0.2374
93	0.2391	0.2360
94	0.2389	0.2356
95	0.2357	0.2325
96	0.2355	0.2323
97	0.2353	0.2320
98	0.2349	0.2316
99	0.2340	0.2308
100	0.2313	0.2286
101	0.2307	0.2275
102	0.2304	0.2272
103	0.2282	0.2250
104	0.2271	0.2239
105	0.2266	0.2234
106	0.2254	0.2223
107	0.2210	0.2179
108	0.2196	0.2166
109	0.2149	0.2119
110	0.2122	0.2092
111	0.2107	0.2078
112	0.2105	0.2075
113	0.2085	0.2056
114	0.2081	0.2052
115	0.2071	0.2042
116	0.2064	0.2036
117	0.2058	0.2030
118	0.2054	0.2025
119	0.2051	0.2023
120	0.2048	0.2020
121	0.2047	0.2019
122	0.2044	0.2016
123	0.2038	0.2009
124	0.2030	0.2002
125	0.2029	0.2001
126	0.2009	0.1981
127	0.1992	0.1965
128	0.1973	0.1946
129	0.1965	0.1938
130	0.1955	0.1928
131	0.1949	0.1922
132	0.1946	0.1919
133	0.1921	0.1895
134	0.1916	0.1890
135	0.1911	0.1884
136	0.1883	0.1857
137	0.1879	0.1853
138	0.1847	0.1822

139	0.1840	0.1814
140	0.1832	0.1806
141	0.1822	0.1797
142	0.1808	0.1783
143	0.1776	0.1752
144	0.1752	0.1727
145	0.1707	0.1684
146	0.1698	0.1674
147	0.1680	0.1656
148	0.1679	0.1656
149	0.1679	0.1656
150	0.1625	0.1603
151	0.1603	0.1581
152	0.1556	0.1534
153	0.1536	0.1515
154	0.1536	0.1515
155	0.1535	0.1514
156	0.1230	0.1213
157	0.1200	0.1183
158	0.1189	0.1172

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1264	4808	4581	95	Pass
0.1307	4305	4071	94	Pass
0.1351	3715	3506	94	Pass
0.1395	3312	3134	94	Pass
0.1438	2971	2825	95	Pass
0.1482	2624	2492	94	Pass
0.1525	2388	2255	94	Pass
0.1569	2149	2048	95	Pass
0.1613	1921	1822	94	Pass
0.1656	1733	1637	94	Pass
0.1700	1523	1448	95	Pass
0.1744	1400	1324	94	Pass
0.1787	1283	1209	94	Pass
0.1831	1137	1076	94	Pass
0.1875	1050	989	94	Pass
0.1918	970	913	94	Pass
0.1962	866	816	94	Pass
0.2006	800	755	94	Pass
0.2049	740	686	92	Pass
0.2093	654	614	93	Pass
0.2137	602	569	94	Pass
0.2180	543	509	93	Pass
0.2224	501	480	95	Pass
0.2267	473	439	92	Pass
0.2311	419	399	95	Pass
0.2355	391	357	91	Pass
0.2398	354	330	93	Pass
0.2442	322	301	93	Pass
0.2486	296	275	92	Pass
0.2529	270	253	93	Pass
0.2573	247	224	90	Pass
0.2617	222	207	93	Pass
0.2660	204	189	92	Pass
0.2704	189	177	93	Pass
0.2748	177	161	90	Pass
0.2791	158	145	91	Pass
0.2835	145	137	94	Pass
0.2879	137	127	92	Pass
0.2922	125	122	97	Pass
0.2966	122	115	94	Pass
0.3009	115	106	92	Pass
0.3053	104	95	91	Pass
0.3097	96	90	93	Pass
0.3140	90	84	93	Pass
0.3184	84	78	92	Pass
0.3228	80	76	95	Pass
0.3271	76	66	86	Pass
0.3315	66	63	95	Pass
0.3359	63	62	98	Pass
0.3402	61	59	96	Pass
0.3446	59	57	96	Pass
0.3490	58	55	94	Pass
0.3533	55	51	92	Pass

0.3577	52	48	92	Pass
0.3621	48	48	100	Pass
0.3664	48	43	89	Pass
0.3708	44	40	90	Pass
0.3751	40	36	90	Pass
0.3795	36	35	97	Pass
0.3839	35	32	91	Pass
0.3882	32	29	90	Pass
0.3926	29	29	100	Pass
0.3970	29	28	96	Pass
0.4013	28	28	100	Pass
0.4057	28	28	100	Pass
0.4101	28	28	100	Pass
0.4144	28	25	89	Pass
0.4188	26	25	96	Pass
0.4232	25	25	100	Pass
0.4275	25	24	96	Pass
0.4319	24	22	91	Pass
0.4363	22	21	95	Pass
0.4406	21	20	95	Pass
0.4450	21	18	85	Pass
0.4493	19	18	94	Pass
0.4537	18	18	100	Pass
0.4581	18	18	100	Pass
0.4624	18	17	94	Pass
0.4668	17	17	100	Pass
0.4712	17	16	94	Pass
0.4755	17	16	94	Pass
0.4799	16	15	93	Pass
0.4843	16	14	87	Pass
0.4886	15	14	93	Pass
0.4930	14	13	92	Pass
0.4974	13	12	92	Pass
0.5017	12	12	100	Pass
0.5061	12	11	91	Pass
0.5105	12	11	91	Pass
0.5148	11	11	100	Pass
0.5192	11	10	90	Pass
0.5235	11	10	90	Pass
0.5279	10	9	90	Pass
0.5323	9	9	100	Pass
0.5366	9	9	100	Pass
0.5410	9	9	100	Pass
0.5454	9	8	88	Pass
0.5497	9	7	77	Pass
0.5541	8	7	87	Pass
0.5585	7	7	100	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

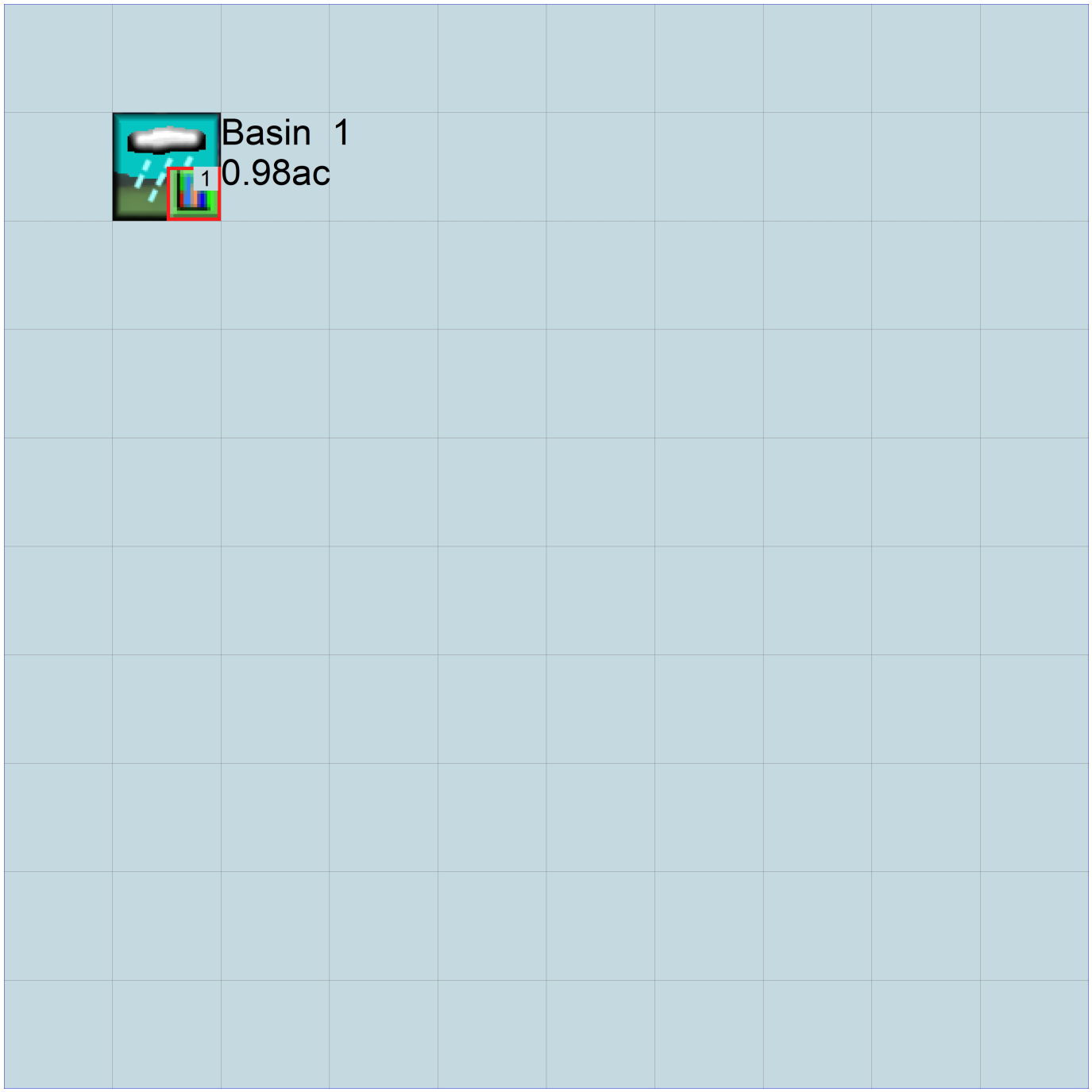
PERLND Changes

No PERLND changes have been made.

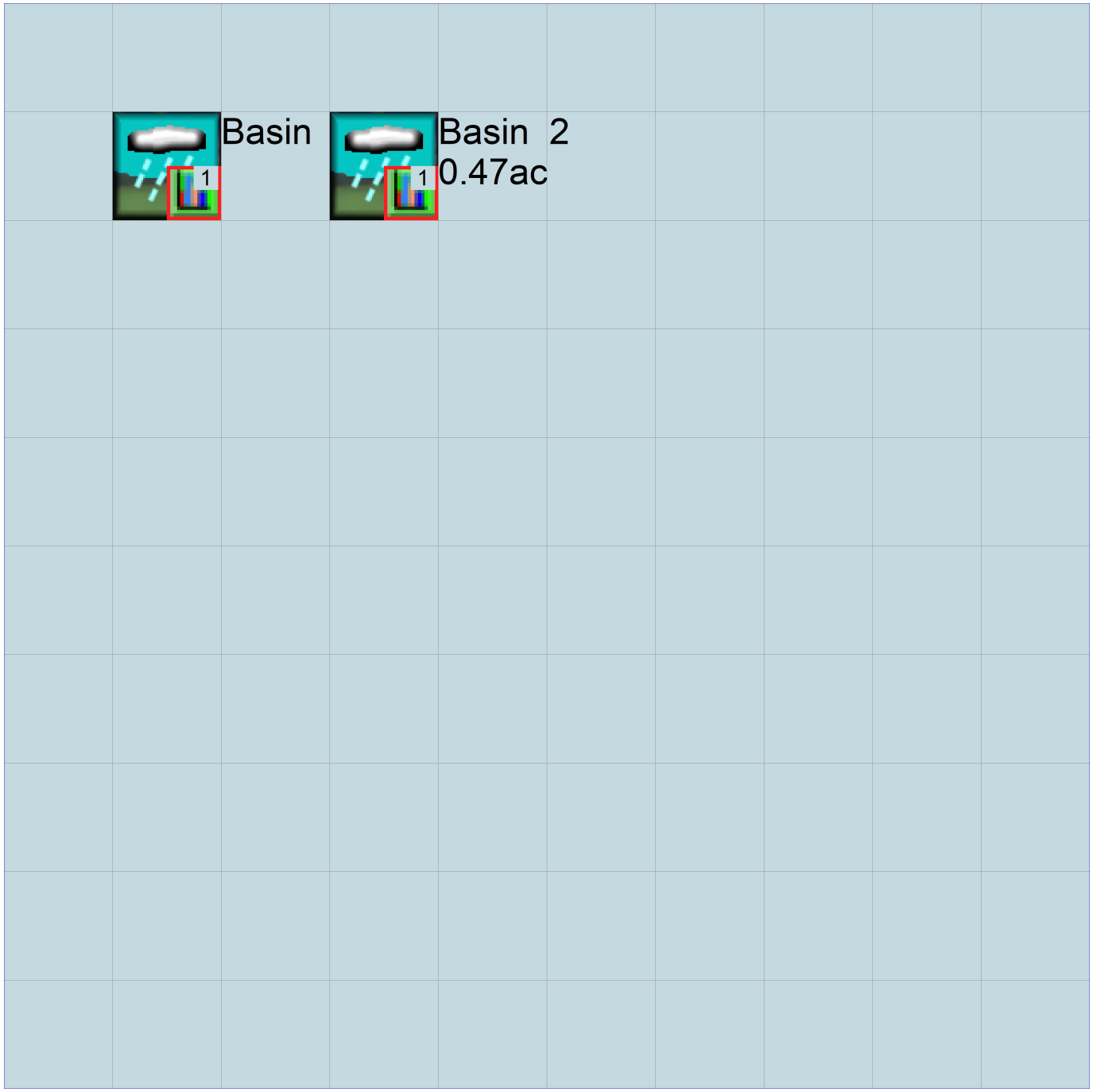
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



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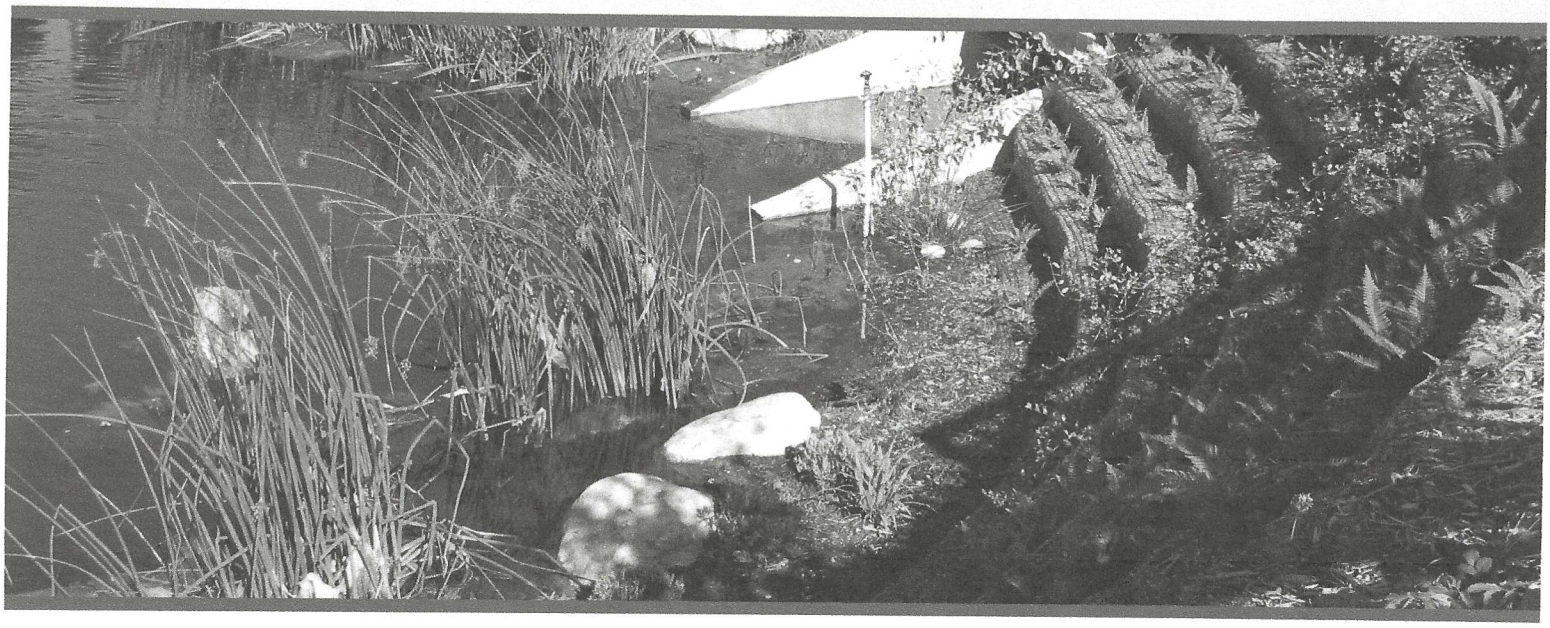
Sediment Trap Calculation Per 2021 DEO SWMMWW					
	Per BMP C240				
	Section 1.42.3				
	SA=FS(Q2/Vs)		SA=	Design Surface Area	
			Q2=	2ys 24hr flow rate (cfs)	0.263
			Vs=	Settling Velocity (ft/s)	0.00096
			FS=	Factor of Safety	2
	SA=	547.916667	SF		
	Dimensions =	15'x37'			

B. Soils Report

The Soils Report is available as a stand-alone document as part of the Permit submittal. It is titled: *Associated Earth Sciences Incorporated-Subsurface Exploration and Geotechnical Engineering Evaluation- March 2018*

associated
earth sciences
incorporated



Subsurface Exploration and
Geotechnical Engineering Evaluation

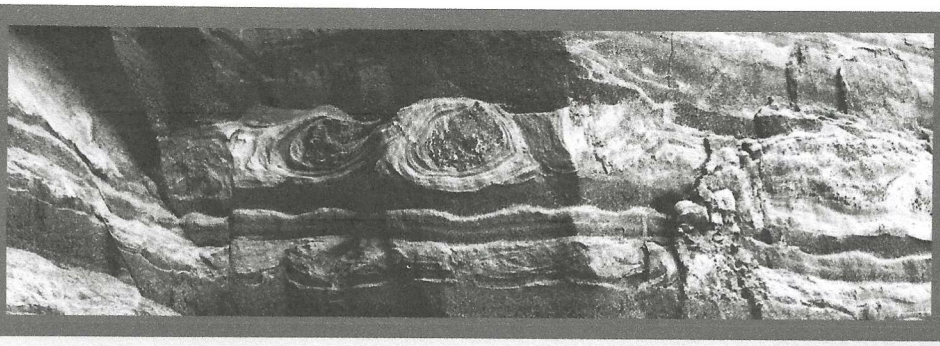
TACOMA SUBARU ADDITION

Tacoma, Washington

Prepared For:

BRUCE TITUS AUTOMOTIVE GROUP

Project No. 170536E001
March 12, 2018



Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, WA 98033
P (425) 827 7701
F (425) 827 5424

associated
earth sciences
incorporated

March 12, 2018
Project No. 170536E001

Bruce Titus Automotive Group
6221 Tacoma Mall Boulevard
Tacoma, Washington 98409

Attention: Todd Ward, Owner's Representative

Subject: Subsurface Exploration and Geotechnical Engineering Evaluation
Tacoma Subaru Addition
3838 South Tacoma Way
Tacoma, Washington

Dear Mr. Ward:

Associated Earth Sciences, Inc. (AESI) is pleased to submit this report describing our subsurface exploration and geotechnical engineering evaluation concerning the planned Tacoma Subaru building addition in Tacoma, Washington. Our services were completed in general accordance with our proposal dated September 26, 2017, and were authorized by the owner's signature on September 29, 2017.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions, or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Tacoma, Washington

James M. Brisbine, P.E., L.G., L.E.G.
Senior Associate Geotechnical Engineer

JMB/ld
170536E001-3
Projects\20170536\TE\WP

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING EVALUATION

TACOMA SUBARU ADDITION

Tacoma, Washington

Prepared for:
Bruce Titus Automotive Group
6221 Tacoma Mall Boulevard
Tacoma, Washington 98409

Prepared by:
Associated Earth Sciences, Inc.
1552 Commerce Street, Suite 102
Tacoma, Washington 98402
253-722-2992
Fax: 253-722-2993

March 12, 2018
Project No. 170536E001

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LIST OF FIGURES

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1.0 PROJECT AND SITE DESCRIPTION

The project site consists of an existing automobile dealership located in South Tacoma, as shown on the attached "Vicinity Map" (Figure 1). This facility occupies three contiguous parcels that are visually delineated by a Sound Transit railroad on the west, by South Tacoma Way on the east, and by commercial properties on the north and south. The combined parcels form a roughly rectangular shape that measures approximately 450 feet by 600 feet overall and encompasses about 3.7 acres. Presently, the site is occupied by a main sales and service building, along with several ancillary structures. The remainder of the site is mostly covered with asphaltic pavement. Our attached "Site and Exploration Plan" (Figure 2) illustrates certain site boundaries and existing features.

Development plans call for constructing a new automotive parts and service building addition on the site. According to a conceptual layout plan prepared by Feltus Hawkins Design, this new addition will be located immediately north of the main building. It will be a single-story, at-grade or split-level structure, likely imposing relatively low foundation and floor loads. Most of the existing asphaltic pavement will remain in place. Figure 2 shows the proposed building addition in context with existing features. We understand that stormwater runoff will be infiltrated onsite if soil conditions are found to be suitable; if not, then runoff will be conveyed to the municipal drainage system.

2.0 PURPOSE AND SCOPE

Associated Earth Sciences, Inc. (AESI) performed this study to characterize subsurface conditions below the site, such that we can derive geotechnical conclusions and recommendations concerning the proposed improvements. Our scope of work included the following tasks.

- Reviewed topographic maps, geologic maps, site layout drawings, aerial photos, survey plans, and other available information pertaining to the site vicinity.
- Performed a visual surface reconnaissance of the site and immediate surroundings.
- Advanced four exploration borings (designated EB-1 through EB-4) to a maximum depth of about 26½ feet, at strategic locations across the site.
- Installed one groundwater monitoring well (designated EB-2w) to a depth of about 20 feet in a selected borehole.
- Visually classified all soil samples obtained from our explorations.
- Conducted one laboratory grain-size (sieve) test on a representative sample of the on-site soils.

- Analyzed all research, field, and laboratory data in context with the proposed site improvements.
- Prepared this report summarizing our geotechnical findings, conclusions, and recommendations.

Figure 2 shows the locations of all subsurface explorations with respect to existing and proposed site features. Appendix A contains our exploration logs, and Appendix B contains our laboratory testing data.

3.0 FIELD EXPLORATION PROCEDURES

We explored subsurface conditions at the site on October 27, 2017. The number, locations, and depths of our explorations were completed within the constraints of surface access, utility conflicts, and project budgets. Our exploration procedures are described below. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A. Soil contact depths shown on the logs should be regarded as only an approximation; the actual changes between sediment types are often gradational and/or undulating.

The conclusions and recommendations presented in this report are based, in part, on conditions encountered by our explorations completed for this study. Due to the nature of subsurface exploratory work, it is necessary to interpolate and extrapolate soil conditions between and beyond the field explorations. Differing subsurface conditions could be present outside the area of the explorations due to the random nature of deposition and the alteration of topography by past grading activities. The nature and extent of any variations between the field explorations might not become fully evident until construction begins. If variations are observed at that time, it could be necessary to modify specific conclusions or recommendations in this report.

3.1 Exploration Borings

All exploration borings were performed by Holocene Drilling, Inc., working under subcontract to AESI. Each boring was completed by advancing an 8-inch outside-diameter, hollow-stem auger with a truck-mounted drill rig. During the drilling process, disturbed but representative soil samples were obtained at 2½- or 5-foot-depth intervals using the Standard Penetration Test (SPT) procedure in accordance with the *American Society for Testing and Materials* (ASTM) specification D-1586. After completion of drilling, each borehole was backfilled with bentonite chips, and the surface was patched with concrete.

The SPT testing and sampling procedure consists of driving a standard, 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the

number of blows required to drive the sampler the final 12 inches represents the Standard Penetration Resistance (also known as the "N-value"). If a total of 50 blows is reached within one 6-inch interval, the N-value is recorded as 50 blows for the corresponding number of inches of penetration. The N-value provides a measure of the relative density of granular soils or the relative consistency of cohesive soils. Higher N-values correspond to a denser or stiffer soil. Our measured N-values are plotted on the exploration boring logs presented in Appendix A.

All exploration borings were continuously observed and logged by an AESI geologist. The materials obtained from the split-barrel sampler were classified in the field, and representative portions were placed in watertight containers. These soil samples were then transported to our office for further visual classification and/or laboratory testing. The soil descriptions shown on our exploration logs are generally based on a combination of factors, such as N-values, drilling action, field observations, and laboratory test results.

3.2 Monitoring Wells

Our groundwater monitoring well was installed by Holocene Drilling, Inc. in conjunction with our exploration borings. This well consists of a 2-inch-diameter plastic casing with a finely slotted screen near the bottom to allow water inflow. The annular space around the well screen was backfilled with clean sand, and the upper portion of annulus was sealed with bentonite chips and concrete. A flush-mounted steel monument was placed over the top of the wellhead for protection. The as-built well configuration is illustrated on the boring logs in Appendix A. Following installation, an AESI representative developed the well by adding several well-volumes of water. We also installed an electronic data-logger in the well casing to allow for continuous monitoring of future groundwater levels.

4.0 SITE CONDITIONS

The following text sections describe current site conditions, including development features, regional and local topography, regional geology, local soils, and local groundwater. Our sources of information include topographic and geologic maps published by the U.S. Geological Survey (USGS), a site survey map prepared by Apex Engineers, and aerial photographs published by Google Earth.

4.1 Development Features

Presently, the eastern part of the site is occupied by a single-story, high-bay, concrete-walled, main building, as well as several small, single-story, ancillary buildings. Asphalt-paved driveways and parking lots cover the remainder of the site. The proposed building addition footprint overlies an existing ancillary building and part of an existing parking lot. The foundation of the main building appears to be adequately supported; we did not observe any obvious indications of settlement, such as cracking, tilting, or warping in the exterior walls.

The existing asphaltic pavements appear to be in fair to good condition. We observed several large cracks directly north of the existing main building (in the vicinity of borings EB-2 and EB-3), but other areas of pavement were generally free of cracks. Our exploration borings revealed about 2 to 2½ inches of asphalt concrete pavement covering the parking lots, underlain by a crushed gravel base course of 3 to 4 inches.

4.2 Regional and Local Topography

The project site is located on the western edge of a broad glacial terrace, and immediately east of the "Nalley Valley" topographic trough. Regional surface grades across this terrace are flat to slightly undulating, with a gradual slope downward from east to west. Surface elevations range from about 235 feet within the trough, to 260 feet or more on the terrace. Existing grades across the proposed building footprint reflect this regional gradient; surface elevations rise approximately from 257 to 261 feet in a west-to-east direction.

4.3 Regional Geology

The draft USGS *Geologic Map of the Tacoma South Quadrangle, Pierce County, Washington* (1:24,000 scale) indicates that the project site and adjacent areas are underlain by Vashon-age recessional outwash sediments. These sediments normally comprise a loose to medium dense, well-sorted mixture of sands, gravels, and/or cobbles, with a total thickness ranging from several feet to several tens of feet. Recessional outwash is typically underlain by dense to very dense, glacial lodgement till, and the geologic map shows Vashon-age lodgement till exposed on the hill located east of the site. The recessional outwash at this site is believed to have scoured into older glacial deposits during ice recession and, as such, directly overlies Vashon-age advance outwash (Esperance Sand). These sand deposits are slightly older than the Vashon lodgement till and were deposited as deltaic deposits into a proglacial (ice-dammed) lake occupying the Puget Lowland during glacial advances.

4.4 Local Soils

Our subsurface explorations confirmed the presence of glacially deposited recessional outwash below the site, as shown on the regional geology map. We also encountered surficial fill soils in one borehole. These various soils are discussed below, and the exploration logs contained in Appendix A provide additional information concerning observed soil conditions.

Surficial Fill: Boring EB-2 disclosed approximately 7 feet of fill soils underlying the southwestern corner of the proposed building footprint. These fill soils consisted of brown, medium to coarse sandy gravel to gravelly medium to coarse sand with a trace of silt. They were likely reworked or placed here during past site grading activities.

Recessional Outwash: Below the pavement and/or surficial fill, all four of our borings revealed native recessional outwash comprising a mixture of loose to dense sands, gravelly sands, and

sandy gravels. A few soil samples also included small quantities of silt. This outwash deposit ranged from about 5 to 11 feet thick at our boring locations.

Advance Outwash: Underlying the recessional outwash, at a depth of about 7½ to 12½ feet below existing grades, all four of our exploration borings encountered dense, subtly to distinctly stratified sands with varying amounts of silt and scattered gravel dropstones. We interpret this deposit to be Vashon-age advance outwash deltaic deposits (locally known as Esperance Sand). The advance outwash extended beyond our maximum exploration depth of 26½ feet, and it has been observed to have a total thickness ranging from several tens of feet to a few hundred feet in the Puget Sound region.

4.5 Local Groundwater

At the time of drilling (October 27, 2017), none of our exploration borings encountered groundwater within their maximum termination depth (26½ feet). Subsequent checks of our on-site monitoring well EB-2w in November, December, and January also found dry conditions to a depth of 20 feet or more. Groundwater levels typically rise during the wet season and fluctuate over long periods of time due to changes in precipitation patterns, on-site and off-site development, and other factors. However, it is difficult to predict whether the seasonal high water level will rise to the elevation of our monitoring well. For this reason, AESI will be monitoring on-site groundwater levels throughout the 2017-18 wet season by means of an electronic data-logger.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our surface reconnaissance, subsurface explorations, and document research, we conclude that the proposed site improvements are feasible from a geotechnical standpoint, contingent on proper design implementation and construction practices. Our geotechnical conclusions and recommendations concerning general considerations, site preparation, foundations, slab-on-grade floors, retaining walls, pavements, and structural fill are presented herein.

Specification Codes: The following reference documents are cited for specification purposes within subsequent report sections.

- ASTM: Refers to the latest manual published by the *American Society for Testing and Materials* (ASTM).
- WSDOT: Refers to the 2016 edition of *Standard Specifications for Road, Bridge, and Municipal Construction* published by the Washington State Department of Transportation (WSDOT).

5.1 General Considerations

We offer the following comments, conclusions, and recommendations concerning general geotechnical design issues affecting the overall project.

Geological Hazards: Our evaluation did not reveal any geological hazards associated with steep slopes, erosion zones, landslide zones, or abandoned landfills in the site vicinity. In addition, we infer that the dense advance outwash sediments and other glacially overridden soil deposits underlying the site represent a negligible hazard with respect to seismically induced liquefaction. Earthquake activity is obviously a widespread hazard throughout Western Washington, but the risk of associated shaking and ground rupture does not appear to be any higher at this site than elsewhere in the region. Consequently, the proposed site improvements are not constrained by any prevailing geological hazards, in our opinion.

Foundation Support: Our subsurface explorations encountered loose to medium dense recessional outwash (gravelly sands and sandy gravels) underlying the proposed building addition footprint at fairly shallow depths. In our opinion, these native outwash soils are suitable for supporting the new addition on conventional spread footings, although some degree of subgrade improvement will be needed below all footings, and localized remedial measures will be needed in areas of uncontrolled fill soils.

Closure Pours: Because some gradual settlement of the new addition is inevitable, differential settlements will occur relative to the existing main building. This differential settlement will be most apparent at the contact line between the existing and new structures. To minimize the adverse effects of such differential settlement, we recommend that any closure pours connecting the existing and new structures be delayed as long as practical in the construction process.

Drainage Considerations: Due to the coarse-grained soil conditions and absence of observed shallow groundwater levels at the site, surface and near-surface seepage water will tend to percolate downward rather than collecting near or below on-site structures. Therefore, we infer that conventional perimeter foundation drains will not be needed around the new building addition. The use of such drains can be considered optional at the discretion of the project civil engineer and/or architect. Nonetheless, final site grades should be sloped so that surface water flows away from the building rather than ponding near the foundation walls.

Earthwork Scheduling: Our explorations indicate that the on-site soils generally have a high sand and gravel content and a low silt content. These native soils tend to be relatively insensitive to changes in moisture content and can be used during a variety of weather conditions. As such, earthwork does not necessarily need to be scheduled for the dry season. It should be noted, however, that the native outwash might contain localized silty zones that become difficult to use during wet weather.

Seismic Site Class: The 2015 *International Building Code* (IBC) assigns a seismic Site Class on the basis of geological conditions prevailing within a depth of 100 feet below the local ground surface. Although our subsurface explorations did not extend to such a depth, we infer from shallower soil observations and from available geologic maps that the subsurface conditions correspond to Site Class "D" as defined by the IBC.

Infiltration Potential: The native recessional outwash and advance outwash deposits underlying the site appear to be favorable receptor soils for stormwater infiltration, due to their relatively high permeability. Also, on-site groundwater levels were observed to be fairly low (more than 27½ feet below existing grades) at the time of this study. We therefore conclude that the use of an infiltration trench or other shallow system would be feasible for on-site stormwater disposal, as long as the wintertime groundwater table remains sufficiently low to provide an adequate thickness of unsaturated soil below the infiltration subgrade. AESI will be monitoring on-site groundwater levels throughout the 2017-18 wet-season in order to further assess this feasibility.

Infiltration Rates: Although our scope of work did not include field infiltration testing as needed to establish a design value for an on-site infiltration system, we are able to derive tentatively estimated values on the basis of our soil texture observations, laboratory sieve test, and local experience. For preliminary system sizing purposes, a design rate in the range of 2 to 10 inches per hour can be assumed, with the faster rates generally corresponding to a shallow system and the slower rates generally corresponding to a deeper system. Prior to final design, one or more field infiltration tests should be performed at the planned system location and depth.

5.2 Site Preparation

Preparation of the project site will involve tasks such as temporary drainage, stripping, cutting, erosion control, and subgrade compaction. The paragraphs below present our geotechnical comments and recommendations concerning these various site issues.

Site Demolition: We anticipate that initial site preparation will involve demolition or removal of all existing features located within the new building footprint. We recommend that any underground foundation elements or abandoned utilities be removed as part of this work. Removal of any underground storage tanks, if present, would require special environmental oversight; AESI is available to assist with such a task upon request.

Well Decommissioning: Our field exploration program for this project included the installation of a ground water monitoring well. This well can be used by the future construction contractor to measure on-site ground water levels before and during earthwork, if desired. Once the well is no longer needed, it should be decommissioned by a licensed well driller in accordance with *Washington Administrative Code* (WAC) 173-160. We recommend that all decommissioning activities be included in the contractor's scope of work.

Temporary Drainage: Any sources of surface or near-surface water that could potentially enter the construction zones should be intercepted and diverted before stripping and excavating activities begin. We tentatively anticipate that a system of temporary swales, berms, or curbs placed around the construction zone will adequately intercept most off-site surface water runoff. Because the selection of an appropriate drainage system will depend on the actual water quantity, season, weather conditions, construction sequence, and contractor's methods, final decisions regarding temporary drainage details are best made in the field at the time of construction.

Clearing and Stripping: After surface and near-surface water sources have been controlled, the construction zone should be cleared and stripped of all existing sod, topsoil, pavements, and other surface features. Our exploration borings disclosed about 2 to 2½ inches of asphaltic pavement in the new building footprint. However, the actual thicknesses could vary considerably from one location to another.

Weather Considerations: The native outwash soils do not appear to be especially sensitive to moisture changes and wet weather. However, they can become saturated and difficult to use during periods of heavy precipitation. During the summer months, sprinkling will likely be needed to moisture-condition soils for compaction purposes and dust control.

Erosion Control Measures: Because stripped surfaces and soil stockpiles are typically a source of runoff sediments, they should be given particular attention. If earthwork occurs during wet weather, we recommend that all stripped surfaces be covered with straw to reduce runoff erosion. Similarly, soil stockpiles and cut slopes should be covered with plastic sheeting for erosion protection. We also recommend that silt fences, berms, and/or swales be maintained around stripped areas and stockpiles in order to capture runoff water and thereby reduce the downslope sediment transport. Stripped areas should be revegetated as soon as possible, also reducing the potential for erosion.

5.3 Spread Footings

In our opinion, conventional spread footings could be used for supporting the new building addition if general subgrade improvements and localized remediation are performed where needed. We offer the following comments and recommendations concerning design and construction of spread footings.

Footing Depths and Widths: For frost and erosion protection, the bottoms of all exterior footings should bear at least 18 inches below adjacent outside grades, whereas the bottoms of interior footings need bear only 12 inches below the surrounding slab or crawl-space level. To reduce post-construction settlements, continuous (wall) and isolated (column) footings should be at least 18 and 24 inches wide, respectively. It should be noted, however, that greater depths or widths might be needed for other reasons, as determined by the project structural engineer.

Bearing Provisions: We recommend that all footings gain support from the native, loose to medium dense, recessional outwash soils underlying the site. Suitable bearing soils were observed at a shallow depth in most explored locations. After the footing excavations have been completed, we recommend that the exposed subgrade soils be compacted to a uniformly firm and unyielding condition using a vibratory roller or hydraulic oscillator ("hoe-packer"). Where localized zones of uncontrolled fill soils are observed in the subgrade (such as at the location of EB-2), these materials should be overexcavated and then be recompacted or replaced with granular fill. Regardless of type, all fill should be compacted to a density of at least 95 percent of the maximum dry density (per ASTM D-1557).

Bearing Capacities: Based on the bearing provisions described above, we recommend that all footings be designed for the following maximum allowable bearing capacities. These values are stated in pounds per square foot (psf), and they incorporate static and transient (wind or seismic) safety factors of at least 2.0 and 1.5, respectively. Due to the thickness of the recessional outwash deposit, it does not appear economically practical to achieve higher bearing capacities for this project.

Static Allowable Bearing Capacity:	3,000 psf
Transient Allowable Bearing Capacity:	4,000 psf

Footing Setbacks: For stability purposes, footings should not be placed near steep slopes or steps in the bearing soils. We specifically recommend keeping all footings at least 3 feet behind any slopes, and also behind a 0.75H:1V (Horizontal:Vertical) line extending upward from the toe of any retaining walls. Furthermore, utility trenches, footing trenches, and other excavations should not encroach on a 1.0H:1V influence line extending downward from any existing footing. If the new building location requires localized excavations very close to any existing footings, proper underpinning or shoring should be provided. Upon request, we can supply specific underpinning or shoring recommendations for specific situations at the site.

Footing Settlements: We estimate that total post-construction settlements of properly designed footings bearing on a properly prepared subgrade will not exceed 1 inch. Differential settlements between new foundation elements over horizontal spans on the order of 50 feet could approach ¾ inch. In all cases, these settlements would be reduced if the actual design bearing pressures are lower than our recommended maximum allowable pressures.

Footing and Stemwall Backfill: To provide erosion protection and lateral load resistance, we recommend that backfill be placed on both sides of the footings and stemwalls after the concrete has cured. Either on-site or imported granular soils can be used for this purpose. All footing and stemwall backfill soil should be compacted to a uniform density of at least 90 percent (based on ASTM D-1557).

Lateral Resistance: Footings and stemwalls that have been properly backfilled as described above will resist lateral loads by means of both passive earth pressure and base friction. We

recommend using the following allowable values. These earth pressures are stated in pounds per cubic foot (pcf), and they incorporate static and transient (wind or seismic) safety factors of at least 1.5 and 1.1, respectively. Allowable base friction, which includes a safety factor of 1.5, can be combined with the respective passive pressure to resist static and transient loads.

Allowable Static Passive Pressure:	300 pcf
Allowable Transient Passive Pressure:	400 pcf
Base Friction Coefficient:	0.35

Subgrade Verification and Construction Monitoring: Footings should never be cast atop loose, soft, organic, or frozen soil, slough, debris, uncontrolled fill, or surfaces covered by standing water. We recommend that the condition of all subgrades be verified by an AESI representative before any concrete is placed. Furthermore, all subgrade remediation work should be continuously monitored and/or tested by an AESI representative.

5.4 Slab-On-Grade Floors

Because floor slabs typically carry a light load in comparison to building foundations, they allow more latitude concerning support options. We offer the following comments and recommendations for slab-on-grade floors.

Floor Sections: A conventional slab-on-grade floor section typically comprises a reinforced concrete slab over a vapor retarder over an aggregate base course over a granular subbase course. Assuming that the slab has a conventional thickness on the order of 4 inches and is subjected to typical loads, we recommend the following underslab layers (top to bottom) and minimum thicknesses for floors in the new building addition.

Vapor Retarder:	10 mils
Base Course:	4 inches

Subgrade Preparation: After the floor footprint has been excavated as needed to accommodate the above-recommended floor section, the exposed subgrade should be compacted to a firm and unyielding condition using a heavy vibratory roller. Any localized zones of soft, organic-rich, or saturated soils revealed during compaction should be overexcavated and replaced with granular structural fill.

Base Course: The base course serves as both a capillary break layer and a leveling layer for the floor slab. Ideally, the base course would consist of clean, uniform, well-rounded gravel, such as pea gravel, $^5/_8$-inch washed rock, or $^7/_8$-inch washed rock. It would also be acceptable to use a washed, angular gravel or crushed rock for this purpose. In all cases, the base course should be lightly compacted with a static roller or vibratory sled to create a firm, smooth surface.

Vapor Retarder: A vapor retarder consists of heavy-duty plastic sheeting that is placed between the base course and floor slab. In our opinion, a vapor retarder provides a significant benefit by reducing the amount of ground moisture that penetrates the floor slab. We recommend that a vapor retarder be installed beneath all floor areas that will be covered by carpet, wood, tile, or any other moisture-sensitive materials. The vapor retarder should be selected on the basis of allowable vapor transmission rates for the planned floor finish materials, and should be installed in strict accordance with the manufacturer's guidelines.

Floor Settlements: If the subgrade and underslab layers are properly constructed, we estimate that total post-construction static settlements of the slab-on-grade floor will not exceed ¾ inch under conventional loading conditions. Differential settlements across the length or width of the floor could approach one-half of the actual total settlement.

Subgrade Verification and Construction Monitoring: Floor slab sections should never be placed atop loose, soft, organic-rich, or frozen soil, slough, debris, or surfaces covered by standing water. We recommend that an AESI representative be allowed to monitor all floor slab construction to verify suitable conditions. Our monitoring services would include probings of subgrade soils, observation and testing of underslab fill layers, and a check of layer thicknesses.

5.5 Backfilled Retaining Walls

We anticipate that backfilled concrete retaining walls might be used to accommodate grade changes in certain interior and/or exterior site locations. Furthermore, any subsurface vault walls should also be designed as backfilled retaining walls. Our design and construction recommendations for new backfilled retaining walls are presented below.

Wall Foundations: To avoid excessive differential settlement of any new retaining walls, they should be supported on firm, non-organic native soils in accordance with our recommendations presented in the "Spread Footings" section of this report. The allowable static and transient bearing capacities presented in that text section would apply to the wall footings.

Static Lateral Earth Pressures: Yielding (cantilever) walls that are allowed to deflect more than 0.005 times the wall height should be designed to withstand an appropriate static *active* lateral earth pressure. Non-yielding (restrained) walls that are allowed to deflect less than 0.005 times the wall height should be designed to withstand an appropriate static *at-rest* lateral earth pressure. These pressures act over the entire back of the wall and vary with the backslope inclination. For retaining walls with a level or 2H:1V backslope and well-drained conditions, we recommend using the following values, which are given in pcf of equivalent fluid pressure.

Static Active Earth Pressure with Level Backslope:	35 pcf
Static Active Earth Pressure with 2H:1V Backslope:	50 pcf
Static At-Rest Earth Pressure with Level Backslope:	55 pcf
Static At-Rest Earth Pressure with 2H:1V Backslope:	80 pcf

Static Lateral Surcharge Pressures: Any backslope load located within a 0.75H:1V line projected upward from the wall base will apply a lateral surcharge on the wall. Possible sources of surcharge loading include parking lots, traffic lanes, and structure footings. These surcharge pressures act over the portion of wall adjacent to the load source. For distributed vertical loads, active and at-rest static lateral surcharge pressures can be approximated by multiplying the vertical pressure "Q" (in psf) by the appropriate coefficient shown below. We recommend using a vertical pressure of 250 psf to model traffic and parking loads behind the wall.

Static Active Surcharge Pressure:	0.30(Q) psf
Static At-Rest Surcharge Pressure:	0.45(Q) psf

Seismic Lateral Surcharge Pressures: The total static pressures acting on a wall should be increased to account for seismic surcharge loadings resulting from lateral earthquake motions. These surcharge pressures act over the entire back of the wall and vary with the backslope inclination, the seismic acceleration, and the wall height. For retaining walls with a level backslope, active and at-rest seismic lateral surcharge pressures can be approximated by multiplying the wall height "H" (in feet) by the appropriate coefficient shown below.

Seismic Active Surcharge Pressure:	8(H) psf
Seismic At-Rest Surcharge Pressure:	12(H) psf

Curtain Drains: A curtain drain is a vertical layer of drainage material placed against the back of a wall to dissipate hydrostatic pressures. We recommend that a curtain of washed gravel be used behind all walls. This curtain drain should extend outward at least 12 inches from the wall and should extend upward nearly to the ground surface. The backslope directly above this drain should be capped with asphalt or concrete or a layer of low-permeability soil.

Heel Drains: A heel drain is a horizontal drainage element placed behind the rearward projection (heel) of a wall foundation to collect water from the curtain drain. We recommend that a heel drain be included behind the subject wall. The heel drain should comprise a 4-inch-diameter perforated pipe surrounded by at least 6 inches of washed gravel, all wrapped with filter fabric (such as Mirafi 140N). The drainpipe should then be connected to a tightline discharge pipe that routes water to an appropriate location.

Backfill Soil: We recommend that all backfill placed behind the curtain drain consist of granular structural fill. Non-organic, sandy and gravelly portions of the on-site soils would be suitable for this purpose. Other suitable materials include imported, well-graded sand and gravel mixtures, such as "Ballast" per WSDOT 9-03.9(1) or "Gravel Borrow" per WSDOT 9-03.14. It would also be acceptable to reuse on-site soils having a maximum particle size of 4 inches and a low fines content. If the backfill soil contains more than 10 percent fines, a layer of filter fabric (such as Mirafi 140N) should be placed between the curtain drain and backfill.

Backfill Compaction: Because soil compactors place significant lateral pressures on walls, we recommend that only small, hand-operated compaction equipment be used within 3 feet of a wall. Also, the soil within 3 feet should be compacted to a density as close as possible to 90 percent of the maximum dry density (based on ASTM D-1557). A greater degree of compaction closely behind the wall would increase the lateral earth pressure, whereas a lesser degree of compaction might lead to excessive post-construction settlements. Structural backfill placed more than 3 feet behind the wall should be compacted to a density of at least 95 percent.

Construction Monitoring: We recommend that an AESI representative be allowed to monitor all retaining wall construction. Our monitoring services would include verification of foundation systems, observation of drainage components, and testing of backfill compaction.

5.6 Conventional Pavement Sections

We understand that conventional flexible (asphalt concrete) pavements might be used in the new car parking areas and driveways, whereas rigid (cement concrete) pavement might be used for certain other locations. The following comments and recommendations are given for pavement design and construction purposes.

Soil Design Values: Soil conditions can be defined by a California Bearing Ratio (CBR), which quantitatively predicts the effects of wheel loads imposed on a saturated subgrade. Although our scope of work did not include a CBR test on the surficial site soils, we infer from our observations and limited textural testing that a CBR value on the order of 4 to 8 would likely be appropriate for pavement design purposes.

Traffic Design Values: Traffic conditions can be defined by a Traffic Index (TI), which quantifies the combined effects of projected car and truck traffic. Although no specific traffic data was available at the time of our analysis, we estimate that a TI of 3.0 to 4.0 would likely be appropriate for the car parking areas. A higher TI of about 5.0 to 6.0 appears appropriate for driveways and other areas that are occasionally or periodically subjected to delivery trucks and other heavy vehicles.

Flexible Pavement Sections: A flexible pavement section typically comprises an asphalt concrete pavement (ACP) over a crushed aggregate base (CAB) over a granular subbase (GSB). Our recommended minimum thicknesses for flexible pavement sections, which are based on the aforementioned design values and a 20-year lifespan, are shown below.

Car Parking Lots

Asphalt Concrete Pavement (ACP):	3 inches
Crushed Aggregate Base Course (CAB):	4 inches

Access Driveways

Asphalt Concrete Pavement (ACP):	4 inches
Crushed Aggregate Base Course (CAB):	4 inches
Granular Subbase Course (GSB):	6 inches

Rigid Pavement Sections: A rigid pavement section typically comprises a cement concrete pavement (CCP) over a CAB over a GSB. We recommend the following minimum thicknesses for a rigid pavement section that is subjected to occasional delivery trucks. Pavements and slabs that are subjected to frequent truck traffic or to other heavy structural loads would require a special design.

Access Driveways

Cement Concrete Pavement (CCP):	7 inches
Crushed Aggregate Base Course (CAB):	4 inches

Subgrade Preparation: All pavement subgrades should be compacted to a firm and unyielding condition before any pavement layers are placed. We recommend using a heavy vibratory-drum roller for granular (sand and gravel) subgrades, and a heavy static-drum roller for cohesive (silt and clay) subgrades. The resulting subgrade condition should then be verified by proof-rolling with a loaded dump truck or other heavy construction vehicle, in the presence of an AESI representative. Any localized zones of soft, organic-rich, or debris-laden soils disclosed during the proof-rolling test should be overexcavated and replaced with compacted structural fill.

Granular Subbase: A subbase course helps to provide more-uniform structural support for a pavement section bearing on a variable subgrade. For the subbase course, we recommend using an imported, well-graded sand and gravel, such as "Ballast" per WSDOT 9-03.9(1) or "Gravel Borrow" per WSDOT 9-03.14. Other acceptable options include 1¼-inch crushed rock and crushed recycled concrete. It would also be acceptable to reuse on-site soils having a maximum particle size of 3 inches. In all cases, the subbase should be vibratory-compacted to achieve a uniform density of at least 95 percent (based on ASTM D-1557).

Crushed Aggregate Base: We recommend that all CAB material conform to the criteria for "Crushed Surfacing Base Course" per WSDOT 9-03.9(3). In the interest of using recycled materials from on-site or off-site sources, it would be acceptable to substitute up to 20 percent of the CAB with crushed recycled concrete, provided that the final mixture meets the same grain-size criteria as the aforementioned WSDOT material. Regardless of composition, all CAB material should be compacted to a minimum density of 95 percent based on the modified Proctor maximum dry density (per ASTM D-1557).

Asphalt Concrete Pavement: We recommend that the ACP aggregate gradation conform to the control points for a ½-inch mix (per WSDOT 9-03.8(6)) and that the binder conform to Performance Grade 58-22 criteria (per WSDOT 9-02.1(4)). We also recommend that the ACP be compacted to a target average density of 92 percent, with no individual locations compacted to

less than 90 percent nor more than 96 percent, based on the Rice theoretical maximum density for that material (per ASTM D-2041).

Cement Concrete Pavement: We recommend that the CCP consist of Portland cement concrete with a minimum compressive strength of 4,000 pounds per square inch (psi) and a minimum rupture modulus of 500. We also recommend that the concrete be reinforced with a welded wire mesh, such as W2-6x6, positioned at a one-third depth within the CCP layer.

Pavement Life and Maintenance: It should be realized that conventional asphaltic pavements are not maintenance-free. The foregoing pavement sections represent our minimum recommendations for an average level of performance during a 20-year design life; therefore, an average level of maintenance will likely be required. Furthermore, a 20-year pavement life typically assumes that an overlay will be placed after about 10 years. Thicker asphalt, base, and subbase courses would offer better long-term performance, but would cost more initially; thinner courses would be more susceptible to "alligator" cracking and other failure modes. As such, pavement design can be considered a compromise between a high initial cost and low maintenance costs versus a low initial cost and higher maintenance costs.

5.7 Structural Fill

The term *structural fill* refers to any materials placed under foundations, retaining walls, slab-on-grade floors, sidewalks, pavements, and other such features. Our comments, conclusions, and recommendations concerning structural fill are presented in the following paragraphs.

Soil Moisture Considerations: The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the fines content (that soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum.

Structural Fill Materials: For general use, a well-graded mixture of sand and gravel with a low fines content (commonly called "gravel borrow" or "pit-run") provides an economical structural fill material. For specialized applications, it may be necessary to use a highly processed material such as crushed rock, quarry spalls, clean sand, granulithic gravel, pea gravel, drain rock, controlled-density fill (CDF), or lean-mix concrete (LMC). Recycled asphalt or concrete, which are derived from pulverizing the parent materials, are also potentially useful as structural fill in certain applications. Soils used for structural fill should not contain any organic matter, debris, environmental contaminants, or individual particles greater than about 6 inches in diameter.

On-Site Soils: We expect that moderate quantities of on-site soils will be generated by the building and utility excavations and other grading activities. Most of the on-site soils will likely consist of native sandy gravels and gravelly sands, with variable amounts of cobbles. In our

opinion, these native soils can likely be reused as structural fill if segregated from any cobbles larger than about 4 inches. Localized zones of silty soils might be present and would be difficult to reuse during the wet season or during isolated periods of rainy weather.

Fill Placement and Compaction: Structural fill materials should be placed in horizontal lifts not exceeding about 12 inches in loose thickness. Unless stated otherwise in this report, we recommend that each lift then be thoroughly compacted with a mechanical compactor to a uniform density of at least 95 percent, based on the modified Proctor maximum dry density (per ASTM D-1557). Compaction is not necessary for certain structural fill materials, such as pea gravel, drain rock, quarry spalls, CDF, and LMC.

Subgrade Verification and Compaction Testing: Regardless of material or location, all structural fill should be placed over firm, unyielding subgrades prepared in accordance with our various recommendations for site preparation. The condition of all subgrades should be verified by an AESI representative before soil or concrete placement begins. Also, fill soil compaction should be verified by means of in-place density testing, hand-probing, proof-rolling, or other appropriate methods performed during fill placement so that the adequacy of soil compaction efforts may be evaluated as earthwork progresses.

6.0 CLOSURE

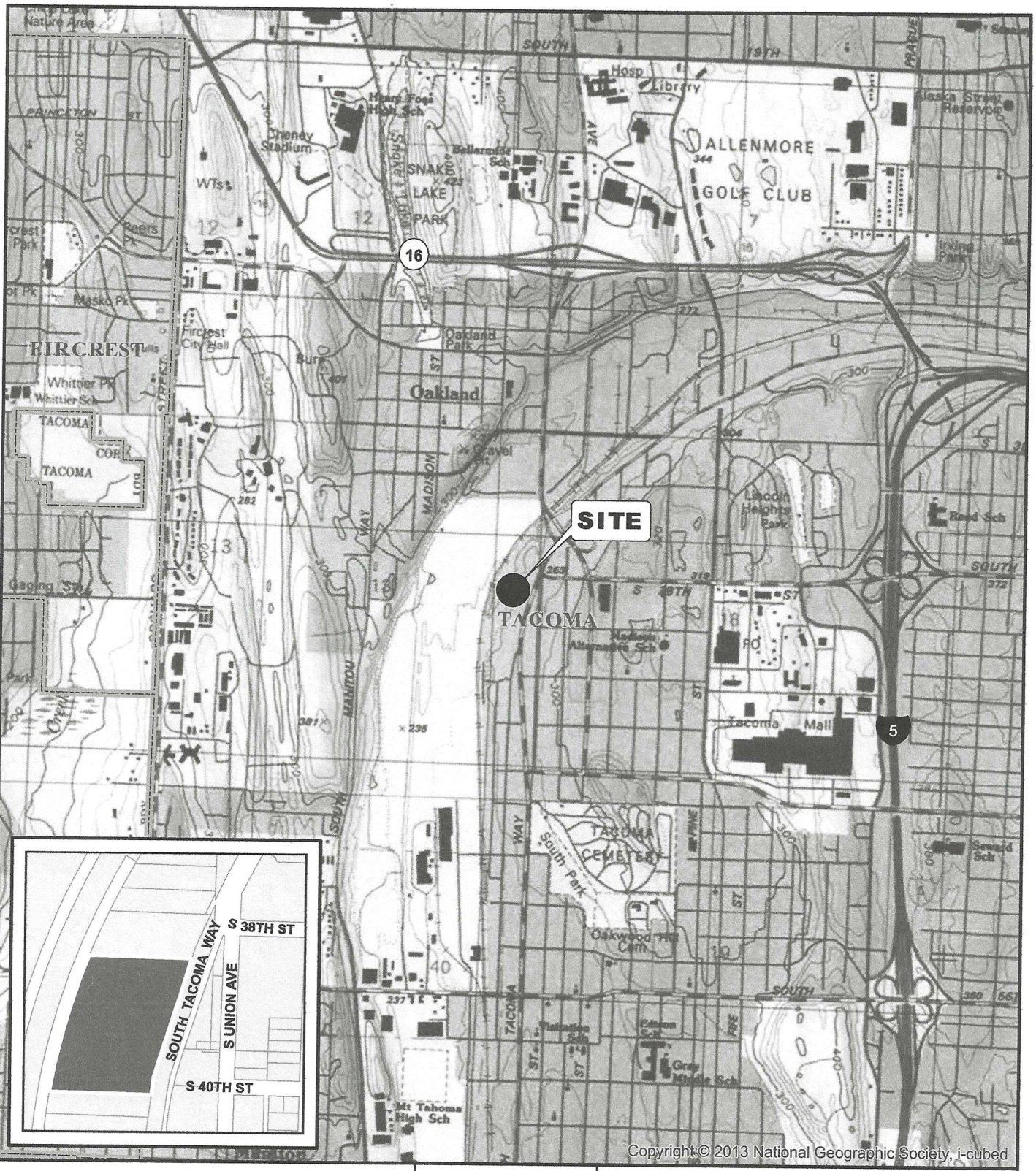
AESI has prepared this report for the exclusive use of our client and their agents, for specific application to this project. Within the limitations of scope and schedule, our services have been performed in accordance with generally accepted local geotechnical engineering practices in effect at the time our report was prepared. No other warranty, express or implied, is made.

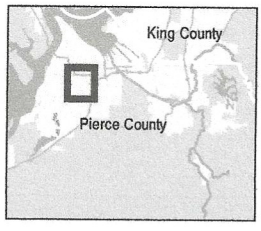
We appreciate the opportunity to be of continued service to you on this project. Should you have any questions regarding this report or other geotechnical aspects of the project, please call us at your earliest convenience.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Tacoma, Washington

Matthew A. Miller, P.E.
Principal Geotechnical Engineer

James M. Brisbine, P.E., L.G., L.E.G.
Senior Associate Geotechnical Engineer





DATA SOURCES / REFERENCES:
USGS: 24K SERIES TOPOGRAPHIC MAPS
PIERCE CO: STREETS, CITY LIMITS, PARCELS 02/17

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 1000 2000
FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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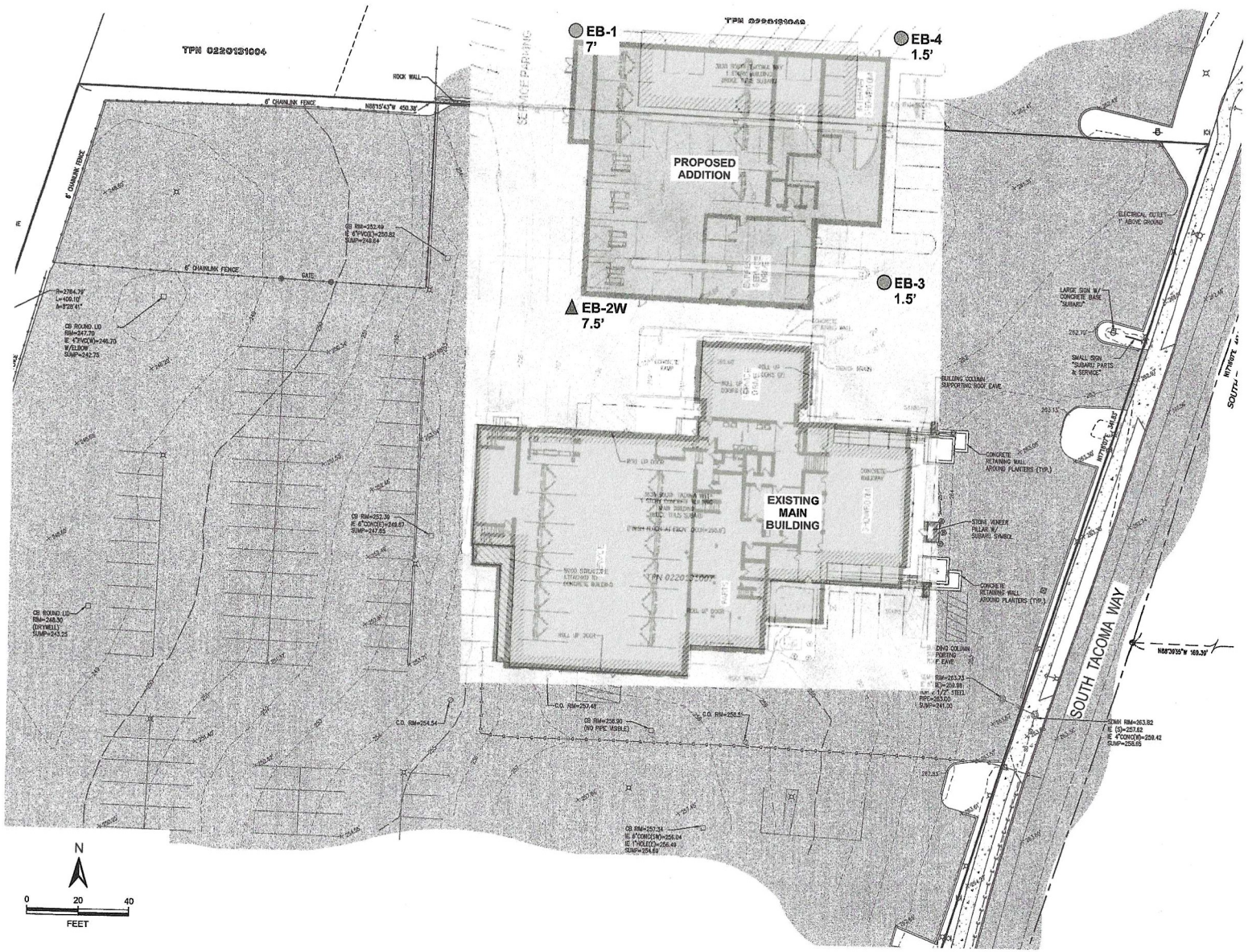
VICINITY MAP

TACOMA SUBARU ADDITION
TACOMA, WASHINGTON

PROJ NO.	DATE:	FIGURE:
170536E001	11/17	1

Document Path: G:\GIS_Projects\aTemplates\aVM_Template\VM_MXD\170536E001 F1 VM_TSubaru.mxd



LEGEND:

- ● EB — EXPLORATION BORING WITH DEPTH (FT) OF NATIVE BEARING HORIZON BELOW EXISTING GROUND SURFACE
- ▲ EB — MONITORING WELL WITH DEPTH (FT) OF NATIVE BEARING HORIZON BELOW EXISTING GROUND SURFACE

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

NOTES:

1. BASE MAP REFERENCE: APEX ENGINEERING, TACOMA SUBARU TOPOGRAPHIC SURVEY, SHEET 1 OF 1, DATED 7/3/2017 FELTUS HAWKINS DESIGN, TACOMA SUBARU PROPOSED SITE PLAN, SHEET 4 OF 7, DATED 5/18/2017

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SITE AND EXPLORATION PLAN

TACOMA SUBARU ADDITION
TACOMA, WASHINGTON

PROJ NO.	DATE:	FIGURE:
170536E001	11/17	2

170536 Tacoma Subaru Addition \ 170536E001 F2 S-E.cdr

APPENDIX A

Field Exploration Logs

Coarse-Grained Soils - More than 50% [1] Retained on No. 200 Sieve	Gravels - More than 50% [1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines [5]	GW	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines [5]	GM	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50% [1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines [5]	SW	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines [5]	SM	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50% [1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

Coarse-Grained Soils	Density	SPT [2] blows/foot
	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

Fine-Grained Soils	Consistency	SPT [2] blows/foot
	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

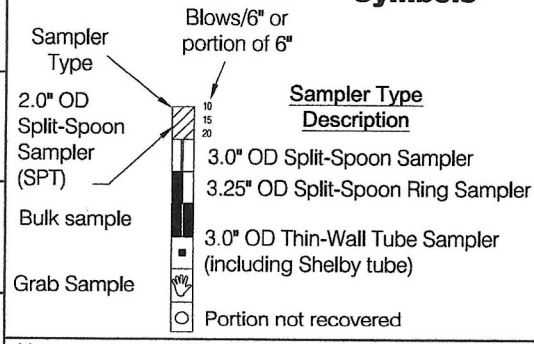
[3] Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

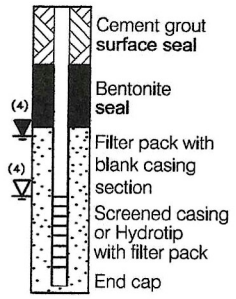
Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols



Sampler Type Description

3.0" OD Split-Spoon Sampler
3.25" OD Split-Spoon Ring Sampler
3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
Portion not recovered



(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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EXPLORATION LOG KEY

FIGURE A1

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Exploration Log

Project Number	Exploration Number	Sheet
170536E001	EB-1	1 of 1

Project Name: Tacoma Subaru Addition
Location: Tacoma
Driller/Equipment: Holocene Drilling, Inc. / HSA / Truck
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 258
Datum: NGVD 29
Date Start/Finish: 10/27/17,10/27/17
Hole Diameter (in): 8 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Asphalt - 2 inches					
				Crushed Rock Base Course - 3 inches					
				Vashon Recessional Outwash					
		S-1		Dry, brown, fine to medium sandy, GRAVEL, trace silt (GP).			2 3 2	▲5	
5		S-2		Dry, brown, fine to medium SAND, trace to some gravel (SP).			3 3 2	▲5	
				Driller notes gravel.					
10				No recovery. Driller notes cobble obstruction; blowcounts overstated.			50/6"		▲50/6"
				Vashon Advance Outwash					
				No recovery due to cobble obstruction. Driller notes gravelly sand in auger; blowcount overstated (SP).			50/3"		▲50/3"
15				First pass: No recovery due to obstruction. Repeated: No recovery due to obstruction. Blowcount overstated.			50/1"		▲50/1"
		S-3		Moved auger hole 2 feet north to redrill. No recovery due to obstruction. Sample S-3 auger represents 10 to 20 feet interval; blowcount overstated.			50/2"		▲50/2"
20				Dry; Refusal using Modified California Sampler.					
				Bottom of exploration boring at 20 feet No groundwater encountered.					
25									

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

Logged by: JDD
Approved by: JHS

AESIBOR 170536.GPJ November 29, 2017

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Exploration Log

Project Number	Exploration Number	Sheet
170536E001	EB-3	1 of 1

Project Name	Tacoma Subaru Addition	Ground Surface Elevation (ft)	260.5
Location	Tacoma	Datum	NGVD 29
Driller/Equipment	Holocene Drilling, Inc. / HSA / Truck	Date Start/Finish	10/27/17,10/27/17
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Asphalt - 2.5 inches					
				Crushed Rock Base Course - 4 inches					
				Vashon Recessional Outwash Visually noted: Dry, gray, sandy, fine GRAVEL, trace silt in auger (GP).					
		S-1		Moist, brown to gray, fine sandy, GRAVEL, some coarse sand, trace silt; few fractured clasts (GP).			9 12 13	▲25	
5		S-2		Moist, brown to gray, medium to coarse sandy, GRAVEL, trace fine sand; slightly stratified; fractured clasts (GP). Grades upwards to gravelly, medium to coarse SAND, trace fine sand; mid to upper delta facies (SP).			8 21 18	▲39	
				Vashon Advance Outwash					
10		S-3		Moist to very moist, brownish gray, silty, fine SAND to fine sandy, SILT, some medium sand, with beds (2 to 4 inches thick) of trace silt; middle to lower delta facies (SP-SM).			13 16 20	▲36	
15		S-4		Moist, light gray, fine to medium SAND; stratified and subtly graded; with beds of fine SAND, trace silt or silty, fine SAND, contains a few dropstones (SP/SM).			13 16 20	▲36	
20		S-5		Moist to very moist, brownish gray, fine SAND, some coarse sand grades to fine SAND, trace silt; subtly reverse graded beds (SP).			9 20 26	▲46	
25		S-6		Moist, gray, fine to medium SAND; subtly bedded, grades to fine SAND, some silt; thin to thick beds (SP).			13 20 21	▲41	
				Bottom of exploration boring at 26.5 feet No groundwater encountered.					

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

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Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
170536E001	EB-4	1 of 1

Project Name	Tacoma Subaru Addition	Ground Surface Elevation (ft)	261
Location	Tacoma	Datum	NGVD 29
Driller/Equipment	Holocene Drilling, Inc. / HSA / Truck	Date Start/Finish	10/27/17,10/27/17
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Asphalt - 2 inches					
				Crushed Rock Base Course - 3 inches					
				Vashon Recessional Outwash					
		S-1		Dry brown, fine gravelly, SAND, some silt (SP/SM).					
		S-2		Moist, brown, medium sandy, GRAVEL (GP).			4 6 15	▲21	
5		S-3		Moist, brown, gravelly, medium to coarse SAND, trace fine sand; subtly graded; some fractured gravel (SP).			7 9 10	▲19	
				Vashon Advance Outwash					
10		S-4		Moist, gray to slightly mottled, fine to medium SAND, trace gravel; few thin beds of coarse sand (SP).			9 18 16	▲34	
15		S-5		Moist, gray, fine SAND, some medium sand; some beds have trace silt; a thin bed (~2 inches thick) of gravelly, medium to coarse SAND in bottom of sample; subtly graded; gravel fractured (SP).			13 17 21	▲28	
20		S-6		Moist, gray, fine SAND, beds of medium SAND and beds of fine SAND, some silt; subtly bedded/graded (SP).			12 17 21	▲38	
25		S-7					10 15 20	▲35	
				Bottom of exploration boring at 26.5 feet No groundwater encountered.					

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

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Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
170536E001	EB-2W	1 of 1

Project Name: Tacoma Subaru Addition
Location: Tacoma
Driller/Equipment: Holocene Drilling, Inc. / HSA / Truck
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 257
Datum: NGVD 29
Date Start/Finish: 10/27/17,10/27/17
Hole Diameter (in): 8 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Asphalt - 2 inches — *Flush mount monument*					
				Crushed Rock Base Course - 3 inches					
				Fill					
		S-1		Moist, brown, medium to coarse sandy, GRAVEL; slightly stratified; fractured clasts (GP).			7 15 8	▲23	
5		S-2		Moist, brown, gravelly, medium to coarse SAND, trace silt; few fractured clasts (SP).			4 4 3	▲7	
				Vashon Recessional Outwash					
10		S-3		Moist, gray, gravelly, medium SAND, some coarse sand grades to gravelly, medium to coarse SAND; few fractured clasts (SP). Grades to gravelly in auger.			9 8 7	▲15	
				Vashon Advance Outwash					
				Refusal at 15 feet due to gravel obstruction; cobble caught in auger. Moved 4 feet north. Sample S-4 and blowcounts from new drill hole.					
15		S-4		Moist, gray, fine SAND, trace coarse sand, trace gravel (dropstones) (SP).			14 20 24	▲44	
20		S-5		Moist, gray, fine to medium SAND, trace coarse sand, trace silt (SP).	*Slip cap*		10 13 17	▲30	
25		S-6		Moist, brownish gray, fine SAND, trace coarse sand (SP).			13 16 17	▲33	
				Bottom of exploration boring at 26.5 feet No groundwater encountered.					

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

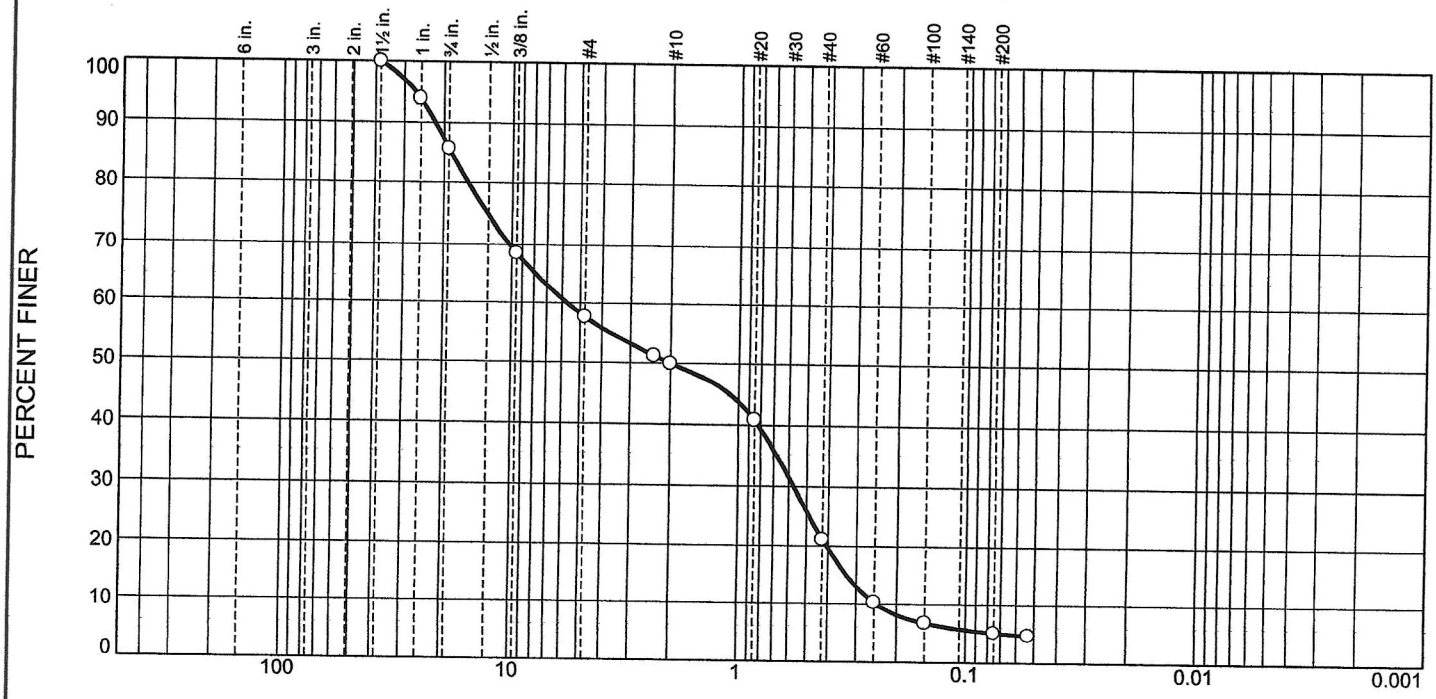
Logged by: JDD
Approved by: JHS

AESIBOR 170536.GPJ November 29, 2017

APPENDIX B

Laboratory Testing Data

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.3	28.1	7.7	28.8	16.0	5.1	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	93.9		
.75	85.7		
.375	68.5		
#4	57.6		
#8	51.2		
#10	49.9		
#20	40.8		
#40	21.1		
#60	10.3		
#100	6.8		
#200	5.1		
#270	4.7		

* (no specification provided)

Material Description

very gravelly, SAND, some silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI=

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-a

Coefficients

D_{90}= 21.9472 D_{85}= 18.6090 D_{60}= 5.7284
D_{50}= 2.0152 D_{30}= 0.5721 D_{15}= 0.3309
D_{10}= 0.2446 C_u= 23.42 C_c= 0.23

Remarks

Collected by: JDD

Date Received: 11-2-2017 **Date Tested:** 11-3-2017

Tested By: BN

Checked By: JB

Title:

Location: Onsite

Sample Number: EB-4 **Depth:** 1.0'-2.5' **Date Sampled:** 10-27-2017

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Client:

Project: Tacoma Subaru

Project No: 170536 E001 **Figure**

C. Temporary Erosion and Sediment Control BMPs

- Preservation of Vegetation (BMP C101)
- High Visibility Fencing (BMP C103)
- Construction Entrance (BMP C105)
- Plastic Covering (BMP C123)
- Dust Control (BMP C140)
- Materials on Hand (BMP C150)
- Concrete Handling (BMP C151)
- Sawcutting and Surface Pollution Prevention (BMP C152)
- Material Delivery, Storage, and Containment (BMP C153)
- Concrete Wash out Area (BMP C154)
- Erosion and Sediment Control Lead (BMP C160)
- Scheduling (BMP C162)
- Rip Rap Channel Lining (BMP C202)
- Inlet Protection (BMP C220)
- Silt Fence (BMP C233)
- Sediment Trap (BMP C240)

1.1 BMP C101: Preserving Natural Vegetation

1.1.1 Purpose

The purpose of preserving natural 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 percent of all rain that falls during a storm. Up to 20-30 percent 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.

1.1.2 Conditions of Use

Natural vegetation should be preserved on steep slopes, near perennial and intermittent watercourses or swales, in wooded areas, and any other location practicable.

Phase construction to preserve natural vegetation on the project site for as long as possible during construction.

1.1.3 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. The City of Tacoma encourages the preservation of native vegetation and trees, where practicable.
- Existing trees to be preserved shall be fenced and protected during construction activities per Tacoma Municipal Code 9.18.030, according to industry standards (ANSI A300 Part 5) and the International Society of Arboriculture's Best Management Practices – Managing Trees During Construction.

Described below are the most common types of injury that occur to trees. The language is adapted from the International Society of Arboriculture's Best Management Practices – Managing Trees from Construction.

- Root cutting or damage which can be caused by excavation equipment, trenching equipment, burial of debris, fill over roots, and alterations made to the water table by grade changes.
- Soil compaction resulting from vehicle, equipment and foot traffic. Compacted soils permit less root growth and biological activity as a result of aeration, higher mechanical resistance to root penetration and slowed water movement.
- Mechanical injury to the tree. Trunks, roots, and tree crowns can be damaged by construction equipment. Injury can affect the ability of the tree or plant to transport water and nutrients, and removes the ability for the plant to protect against pathogens.
- Fill placed near the root collar can facilitate infection and encourage stem-girdling which will affect the long-term longevity of the tree or plant

1.1.4 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.

1.3 BMP C103: High Visibility Fence

1.3.1 Purpose

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 or roads.
- Protect areas where marking with survey tape or flagging may not provide adequate protection.

1.3.2 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.

1.3.3 Design and Installation Specifications

- High visibility plastic fence shall be composed of a high-density polyethylene 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 requirement of this BMP.
- Design and install metal fences according to the manufacturer's specifications.
- Metal fences shall be at least 3 feet high and must be highly visible.
- Do not wire or staple fences to trees.

1.3.4 Maintenance Standards

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

1.4 BMP C105: Stabilized Construction Entrance/Exit

1.4.1 Purpose

Construction entrances are stabilized to reduce the amount of sediment transported onto paved roads by vehicles or equipment by constructing a stabilized pad of quarry spalls at entrances and exits to construction sites.

1.4.2 Conditions of Use

Construction entrances shall be stabilized wherever traffic will be leaving a construction site and traveling on paved roads or other paved areas within 1,000 feet of the site.

Construction vehicle ingress and egress shall be limited to one route. Additional routes may be allowed for very large projects or linear projects.

For residential construction provide stabilized construction entrances/exits for each residence. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking based upon lot size and configuration. See Figure 3 - 1: Stabilized Construction Entrance.

1.4.3 Design and Installation Specifications

- The stabilized construction entrance shall be:
  - A minimum of 15' wide; and a minimum of 100' feet long.

  The length of the entrance may be reduced to the maximum practicable size when the size or configuration of the site does not allow the full lengths.

- Construct stabilized construction entrance with a pad that is:
  - A minimum 12" thick pad of 4" to 8" quarry spalls, or
  - A minimum 4" course of asphalt treated base, or
  - Existing pavement, or
  - A minimum 12" thick pad of permeable ballast meeting the requirements of WSDOT's Standard Specifications for Road, Bridge, and Municipal Construction Section 9-03.9(2).
  - For single-family residence construction, the concrete pad may be clean 1 ½" minimum aggregate placed at least 8" thick.
  - Manufactured alternatives to construction entrance may be used provided they ensure no track-out.
- Do not use crushed concrete, cement or asphalt rubble for the stabilized construction entrance.
- Place a separation geotextile under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet WSDOT Standard Specification 9-33.2(1) Table 3 - Geotextile for Separation or Soil Stabilization or the following standards:
  - 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) – 20 to 45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt or extra concrete in areas that will be paved; this can be used as a stabilized entrance.
- Install fencing (see BMP C103: High Visibility Fence) as necessary to restrict traffic to the construction entrance.
- Whenever possible, construct the entrance on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance
- If possible, install the stabilized construction entrance on the uphill side of the site so that stormwater will not pond near the stabilized construction entrance.
- Construction entrance should avoid crossing existing sidewalks if possible. If a construction entrance must cross a sidewalk, the sidewalk must be covered and protected from sediment leaving the site.

1.4.4 Maintenance Standards

- Add quarry spalls or additional permeable ballast if the pad is no longer in accordance with the specifications.
- If the entrance is not preventing sediment from being tracked onto pavement, alternative measures to keep the streets free of sediment shall be used. This may include replacement of the stabilized construction entrance, street sweeping, an increase in the dimensions of the entrance, or the installation of a wheel wash.
- No tracking of sediment onto the roadway is allowed. If sediment is tracked onto the road, immediately clean the road thoroughly by shoveling or pickup sweeping. Transport sediment to a controlled sediment disposal area.
- 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.
- Keep streets clean at ALL times. Clean tracked sediment immediately.
- Street washing of sediment to the stormwater system is not allowed.
- If sediment is discharged to the stormwater system it is the responsibility of the applicant to clean the downstream system.
- Immediately remove any materials that are loosened from the pad and end up on the roadway.
- Install fencing if vehicles are entering or exiting the site at points other than the construction entrance(s).
- Upon project completion and site stabilization, permanently stabilize all construction accesses intended as permanent access for maintenance.

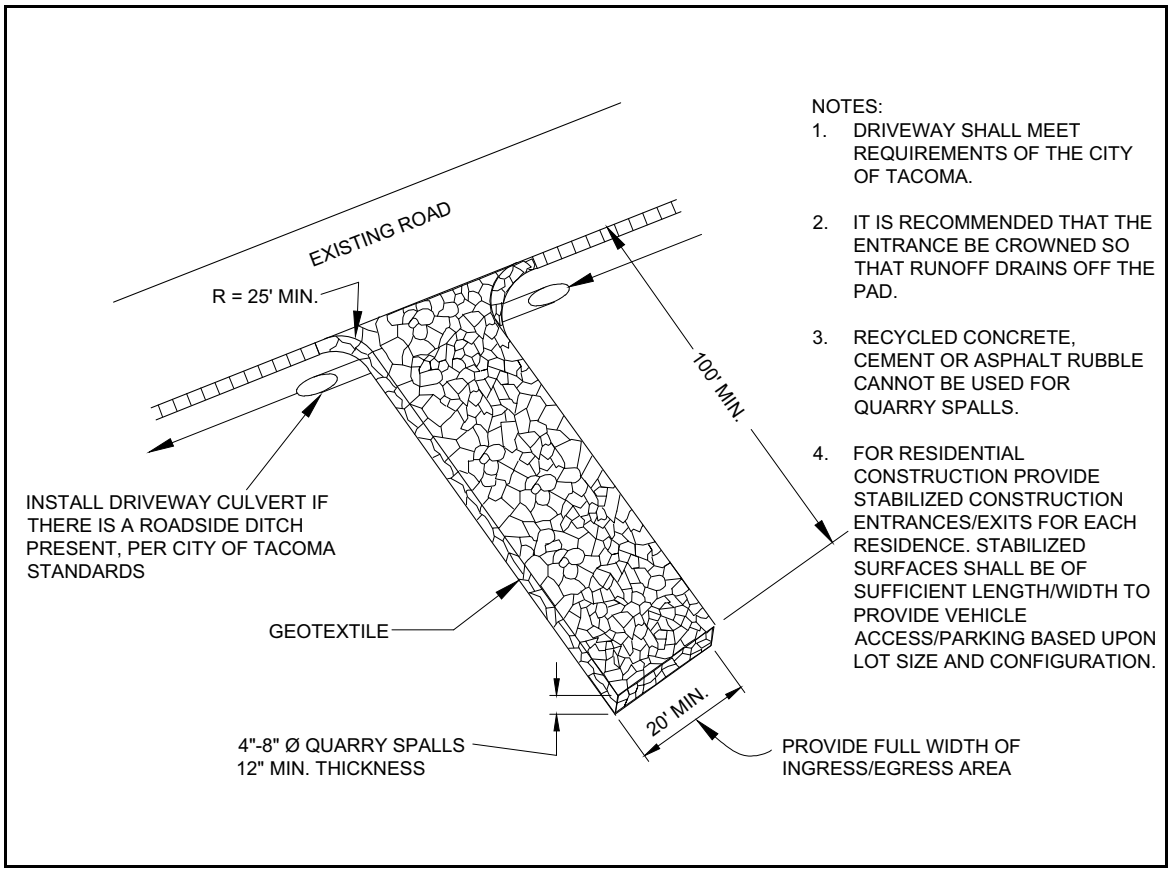


Figure 3 - 1: Stabilized Construction Entrance

1.10 BMP C123: Plastic Covering

1.10.1 Purpose

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

1.10.2 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.
- The relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than six months) applications.
- Due to rapid runoff caused by plastic covering, this method shall not be used upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Whenever plastic is used to protect slopes, water collection measures must be installed 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. At no time is clean runoff from a plastic covered slope to be mixed 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; and
  - Temporary conveyance used to direct stormwater and surface water.

1.10.3 Design and Installation Specifications

Plastic slope cover must be installed as follows:

- Run plastic up and down slope, not across slope.
- Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.
- Minimum of 8-inch overlap at seams.
- On long or wide slopes, or slopes subject to wind, all seams should be taped.
- 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.
- Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and pound a wooden stake through each to hold them in place. Alternative options for holding plastic in place exist and may be considered with COT approval.
- 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;
- 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.

1.10.4 Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- If the plastic begins to deteriorate due to ultraviolet radiation, it must be completely removed and replaced.
- When the plastic is no longer needed, it shall be completely removed.
- Properly dispose of products used to weigh down covering.

1.17 BMP C140: Dust Control

1.17.1 Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces.

1.17.2 Conditions of Use

Use dust control practices in areas (including roadways) subject to surface and air movement of dust where onsite and offsite impacts to streets, the stormwater system, or receiving waterbodies are likely.

1.17.3 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 to those areas where immediate activity will take place, leaving the remaining area(s) in the original condition, if stable. 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 surface is wet. Repeat as needed. To prevent carryout of mud onto street, refer to Stabilized Construction Entrance (BMP C105: Stabilized Construction Entrance/Exit).
- Irrigation water can be used for dust control. Install irrigation systems 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.
- PAM (BMP C127: Polyacrylamide for Soil Erosion Protection) added to water at a rate of 2/3 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 actually reduce the quantity of water needed for dust control. There are concerns with the proper use of PAM, refer to BMP C127: Polyacrylamide for Soil Erosion Protection for more information on PAM application. PAM use requires COT approval.
- 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 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.
- Restrict use of paved roadways by tracked vehicles and heavy trucks to prevent damage to road surfaces and bases.

- 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.
- Pave unpaved permanent roads and other trafficked areas.
- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Limit dust-causing work on windy days.
- Contact the Puget Sound Clean Air Agency for guidance and training on other dust control measures. Compliance with the Puget Sound Clean Air Agency's recommendations/requirements constitutes compliance with this BMP.

1.17.4 Maintenance Standards

Evaluate the potential for dust generation frequently during dry periods. Complete the actions outlined above as needed to limit the dust.

Any dust which leaves the site must be cleaned immediately.

1.18 BMP C150: Materials On Hand

1.18.1 Purpose

Quantities of erosion prevention and sediment control materials should be kept on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy summer rains. Having these materials onsite reduces the time needed to implement BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements.

1.18.2 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 are stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or developer could keep a stockpile of materials that are available to be used on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at a location less than one hour from the project site.

1.18.3 Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. Table 3 - 10: Materials on Hand, provides a good minimum that will cover numerous situations.

Table 3 - 10: Materials on Hand

Material	Measure	Quantity
Clear Plastic, 6 mil	100 foot roll	1-2
Drain Pipe, 6 or 8 inch diameter	25 foot section	4-6
Sandbags, filled	each	25-50
Quarry Spalls	ton	2-4
Washed Gravel	cubic yard	2-4
Geotextile Fabric	100 foot roll	1-2
Catch Basin Inserts	each	2-4
Steel “T” Posts	each	12-24

1.18.4 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 used as needed.

1.19 BMP C151: Concrete Handling

1.19.1 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.

1.19.2 Conditions of Use

Utilize these management practices any time concrete is used.

Concrete construction projects include, but are not limited to, the following:

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

Disposal options for concrete, in order of preference are:

1. Offsite disposal
2. Concrete washout areas
3. De minimus washout to formed areas awaiting concrete

1.19.3 Design and Installation Specifications

- Wash concrete truck drums at an approved offsite location or in designated concrete washout areas only.
    - Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete onsite, except in designated concrete washout areas as allowed in BMP C154: Concrete Washout Area.
- Do not wash out concrete trucks onto the ground (including formed areas awaiting concrete), or into the stormwater conveyance system, open ditches, streets, or streams.
- 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 discharge 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 within 15-feet of surface waters.
- Refer to BMP C252: Treating and Disposing of High pH Water and BMP C253: Portable Sediment Tank for pH adjustment requirements.
- Refer to the Construction Stormwater General Permit for pH monitoring requirements if the project involves one of the following activities:
  - Significant concrete work (as defined in the Construction Stormwatwer General Permit).
  - The use of engineered 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.

1.19.4 Maintenance Standards

Containers shall be checked for holes in the liner daily during concrete pours and repaired the same day.

1.20 BMP C152: Sawcutting and Surfacing Pollution Prevention

1.20.1 Purpose

Sawcutting and surfacing operations generate slurry and process water that contains fine particles and high pH (concrete cutting), both of which can violate water quality standards in the receiving water. This BMP is intended to minimize and eliminate process water and slurry from entering waters of the State

1.20.2 Conditions of Use

Anytime sawcutting or surfacing operations take place, use these management practices. Sawcutting and surfacing operations include, but are not limited to, the following:

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

1.20.3 Design and Installation Specifications

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Do not leave slurry and cuttings on permanent concrete or asphalt pavement overnight.
- Do not allow slurry and cuttings to enter any natural or constructed conveyance system.
- Dispose of collected slurry and cuttings in a manner that does not violate groundwater or surface water quality standards.
- Do not allow process water that is generated during hydro-demolition, surface roughening, or similar operations to enter any natural or constructed conveyance system. 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. If the area is swept with a pick-up sweeper, haul the material out of the area to an appropriate disposal site.

1.20.4 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 vacuum trucks.

1.21 BMP C153: Material Delivery, Storage and Containment

1.21.1 Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in a designated area, and installing secondary containment.

1.21.2 Conditions of Use

These procedures are suitable for use at all 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

1.21.3 Design and Installation Specifications

The following steps should be taken to minimize risk:

- Locate temporary storage area away from vehicular traffic, near the construction entrance(s), and away from conveyance systems and receiving waterbodies.
- Supply Material Safety Data Sheets (MSDS) for all materials stored. Keep chemicals in their original labeled containers.
- Surrounding materials with earth berms is an option for temporary secondary containment.
- Minimize hazardous material storage onsite.
- Handle hazardous materials as infrequently as possible.
- During the wet weather season (October 1 through April 30), consider storing materials in a covered area.
- Store materials in secondary containment, such as an earthen dike, a horse trough, or a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. "Bus boy" trays or concrete mixing trays may be used as secondary containment for small amounts of material.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, in secondary containment.
- If drums cannot be stored under a roof, domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.

1.21.4 Material Storage Areas and Secondary Containment Practices:

- Store liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 in approved containers and drums and do not overfill the containers or drums. Store containers and drums in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain precipitation from a 25 year, 24 hour storm event plus 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.
- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, collect accumulated rainwater and spills and place into drums. Handle these liquids as hazardous waste unless testing determines them to be non-hazardous. Dispose of all wastes properly.
- Provide sufficient separation between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (October 1 through April 30), cover each secondary containment facility during non-working days, prior to and during rain events.
- Keep material storage areas clean, organized, and equipped with an ample supply of appropriate spill clean-up material.
- The spill kit should include, at a minimum:
    - 1 water resistant nylon bag
    - 3 oil absorbent socks (3-inches by 4-feet)
    - 2 oil absorbent socks (3-inches by 10-feet)
    - 12 oil absorbent pads (17-inches by 19-inches)
    - 1 pair splash resistant goggles
    - 3 pairs nitrile gloves
    - 10 disposable bags with ties
    - Instructions

1.21.5 Maintenance Standards

Any stormwater within the material storage area shall be pumped or otherwise discharged after each rain event. Before pumping, the stormwater must be evaluated to determine if it must go to treatment or can be discharged without treatment. If stormwater is contaminated, direct the discharge to appropriate treatment.

Restock spill kit materials as needed.

1.22 BMP C154: Concrete Washout Area

1.22.1 Purpose

Prevent or reduce the discharge of pollutants to stormwater from concrete waste by conducting washout offsite, or performing onsite washout in a designated area to prevent pollutants from entering surface waters or groundwater.

1.22.2 Conditions of Use

Use concrete washout best management practices on construction projects where:

- It is not possible to dispose of all concrete wastewater and washout offsite (ready mix plant, etc.)
- Concrete truck drums are washed onsite.
- Concrete is used as a construction material.

At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.

Note: Auxiliary concrete truck components (e.g. chutes and hoses) and small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheelbarrows) may be washed into formed areas awaiting concrete pour.

1.22.3 Design and Installation Specifications

Implementation

- Perform washout of concrete truck drums at an approved offsite location or in designated concrete washout areas only.
- Do not wash out concrete trucks onto the ground, or into the stormwater conveyance system, open ditches, streets, or streams.
- Do not allow excess concrete to be dumped onsite, except in designated concrete washout areas.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly discharge to natural or constructed stormwater conveyance or potential infiltration areas.
- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures (above-grade or below-grade).
- Prefabricated containers are most resistant to damage and protect against spills and leaks. Companies may offer delivery service and provide regular maintenance and disposal of solid and liquid waste.
- If self-installed concrete washout areas are used, below-grade structures are preferred over above-grade structures because they are less prone to spills and leaks.
- Self-installed above-grade structures should only be used if excavation is not practical.
- Identify concrete washout area on the TESC plan.

- Concrete washout areas shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

Education

- Discuss the concrete management techniques described in this BMP with the ready-mix concrete supplier before any deliveries are made.
- Educate employees and subcontractors on the concrete waste management techniques described in this BMP.
- Arrange for the contractor's superintendent or Erosion and Sediment Control Lead (BMP C160: Erosion and Sediment Control Lead) to oversee and enforce concrete waste management procedures.
- Install a sign adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.

Contracts

Incorporate requirements for concrete waste management into concrete supplier and subcontractor agreements.

Location and Placement Considerations:

- Locate washout area or temporary concrete washout facilities at least 50 feet from sensitive areas such as stormwater system inlets, open conveyance ditches, or waterbodies, including wetlands.
- Allow convenient access for concrete trucks, preferably near the area where the concrete is being poured.
- If trucks need to leave a paved area to access washout, prevent track-out with a pad of rock or quarry spalls (BMP C105: Stabilized Construction Entrance/Exit). These areas should be far enough away from other construction traffic to reduce the likelihood of accidental damage and spills.
- The washout area volume installed should depend on the expected demand for storage capacity.
- On large sites with extensive concrete work, washouts may be placed in multiple locations for ease of use by concrete truck drivers.

Concrete Truck Washout Procedures

- Washout concrete truck drums in designated concrete washout areas only.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated concrete washout areas or properly disposed of offsite.

Concrete Washout Area Installation

- Install concrete washout areas prior to starting concrete work.
- Construct concrete washout areas of sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations. It is recommended that the minimum length and width be 10 feet.

- Plastic lining should be a minimum of 10-mil polyethylene sheeting and free of holes, tears, or other defects that compromise impermeability.
- Lath and flagging should be commercial grade.
- Install liner seams per manufacturer's recommendations.
- Prepare soil base free of rocks or other debris that may cause tears of holes in plastic lining.

1.22.4 Inspection and Maintenance

- Inspect and verify that concrete washout BMPs are in place prior to the commencement of concrete work.
- Once concrete wastes are washed into designated washout areas and allowed to harden, the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.
- During periods of concrete work, inspect daily to verify continued performance.
  - Check overall condition and performance.
  - Check remaining capacity (% full).
  - If using self-installed washout facilities, verify plastic liners are intact and sidewalls are not damaged.
  - If using prefabricated containers, check for leaks.
- Maintain washout facilities to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.
- If the washout is nearing capacity, vacuum and dispose of the waste material in an approved manner.
  - Do not discharge liquid or slurry to streets, the stormwater system, receiving waterbodies, or the ground..
  - Do not use wastewater system without obtaining a City of Tacoma Special Approved Discharge permit. Call Source Control at 253.591.5588 for more information.
  - Place a secure, non-collapsing, non-water collecting cover over the concrete washout facility prior to predicted wet weather to prevent accumulation and overflow of precipitation.
  - Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused onsite or hauled away for disposal or recycling.
- When you remove materials from the self-installed concrete washout, build a new structure; or, if the previous structure is still intact, inspect for signs of weakening or damage, and make any necessary repairs. Re-line the structure with new plastic after each cleaning.

1.22.5 Removal of Temporary Concrete Washout Facilities

- When temporary concrete washout facilities are no longer required for the work, remove and properly dispose of the hardened concrete, slurries and liquids.

- Remove materials used to construct temporary concrete washout facilities from the site of the work and dispose of or recycle it.
- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities shall be backfilled, repaired, and stabilized to prevent erosion.

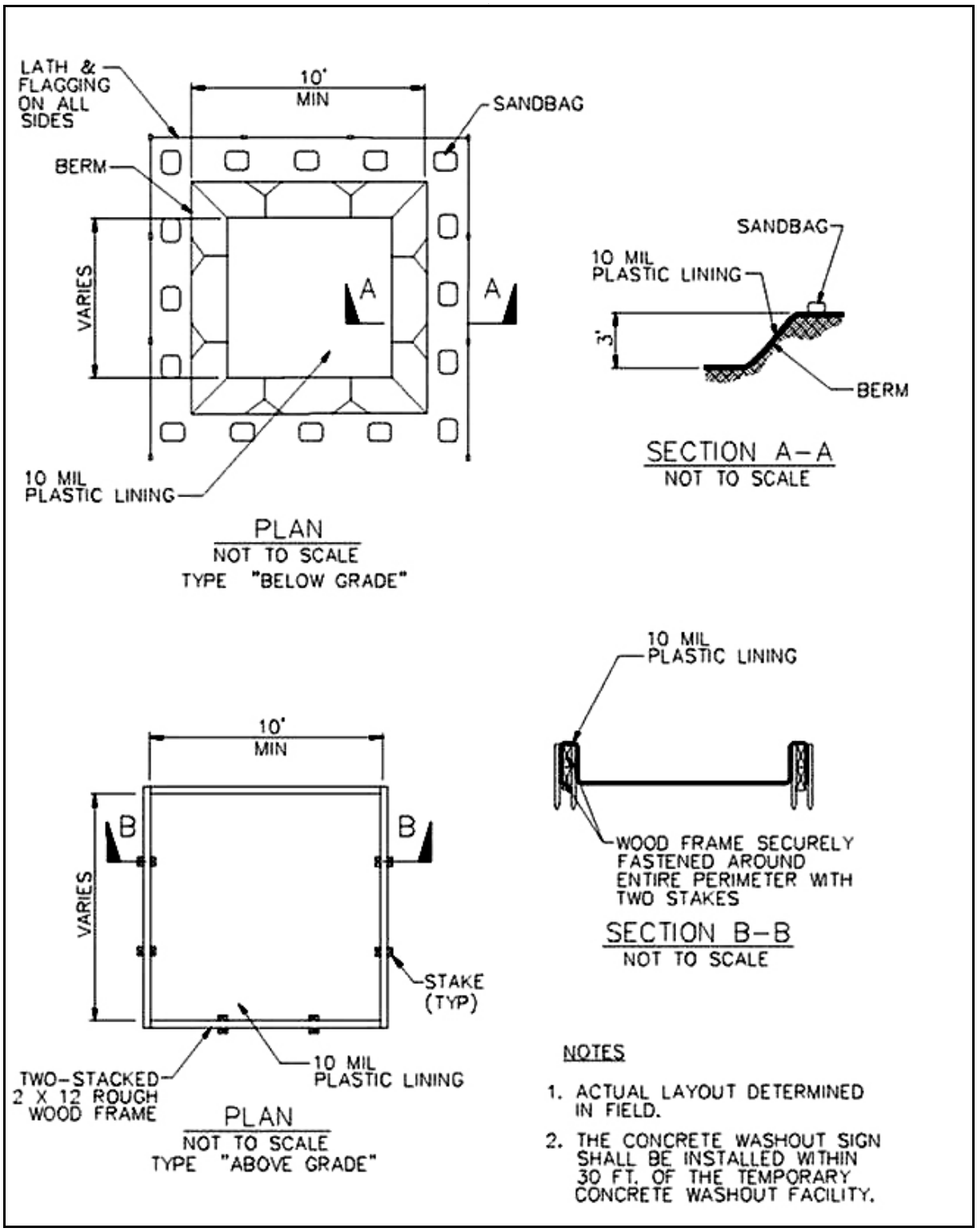


Figure 3 - 7: Temporary Concrete Washout Facility

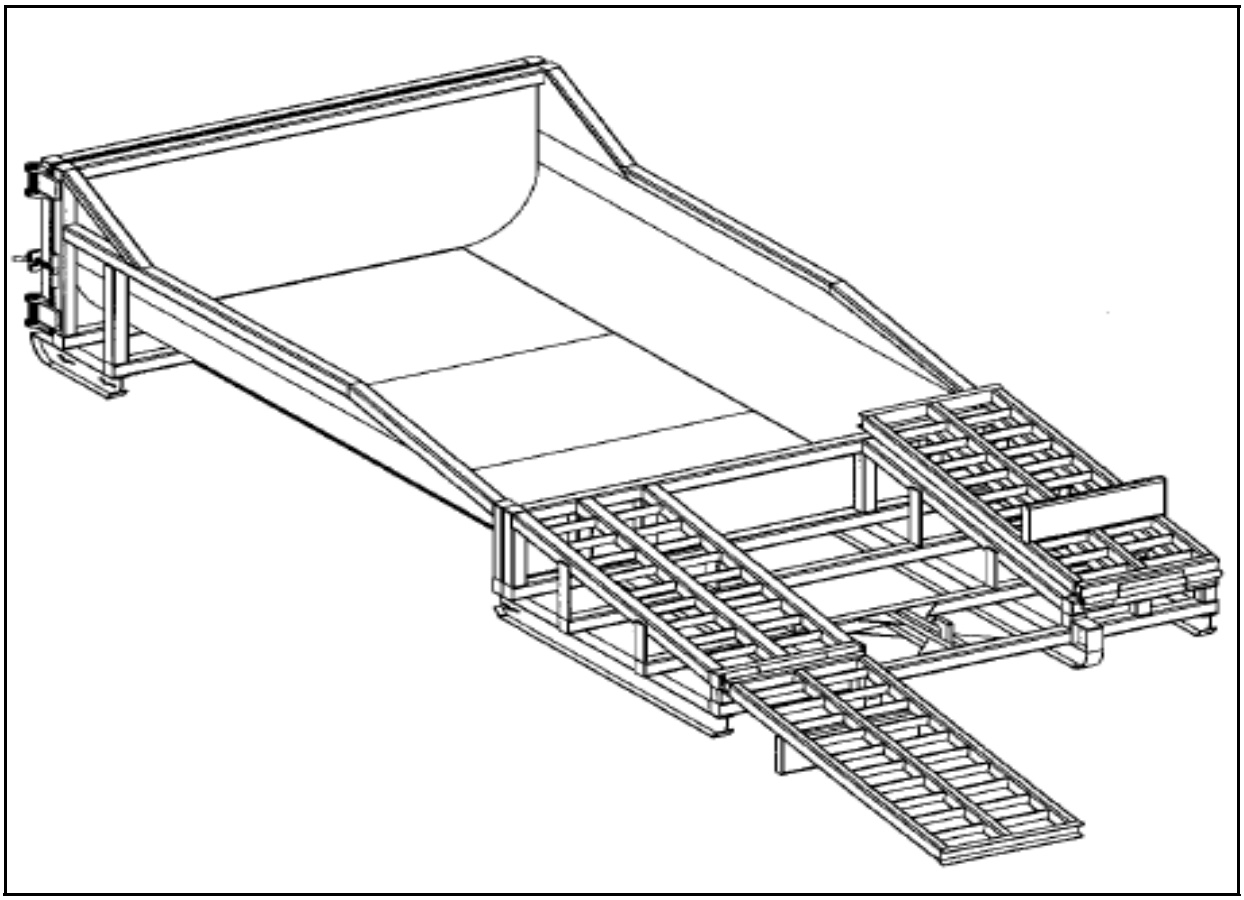


Figure 3 - 8: Prefabricated Concrete Washout Container with Ramp

1.23 BMP C160: Erosion and Sediment Control Lead

1.23.1 Purpose

The project proponent must designate 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 the erosion and sediment control (ESC) lead, who is responsible for ensuring compliance with all local, state, and federal erosion and sediment control and water quality requirements.

1.23.2 Conditions of Use

- An erosion and sediment control contact is required for all project sites.
- A certified erosion and sediment control lead (CESCL) or certified professional in erosion and sediment control (CPESC) is required on projects that include, but are not limited to:
  - Construction activity that disturbs one acre of land or more.
- Projects disturbing less than one acre must have an Erosion Sediment Control Lead (ESC) conduct inspections. The ESC Lead does not have to have CESCL or CPESC certification.
- The CESCL, CPESC, or ESC Lead shall be identified in the SWPPP and shall be onsite or on-call at all times.
- The CESCL, CPESC, or ESC Lead must be knowledgeable in the principles and practices of erosion and sediment control and have the skills to assess:
  - Site conditions and construction activities that could impact the quality of stormwater.
  - Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

1.23.3 Specifications

- The CESCL lead shall:
  - Have a current certified erosion and sediment control lead (CESCL) certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology.
- For additional information concerning the Certified Professional in Erosion and Sediment Control program please go to https://envirocertintl.org/cpesc/.
- The ESC lead shall have authority to act on behalf of the contractor or developer and shall be available, on call, 24 hours per day throughout the period of construction.
- The Construction SWPPP shall include the name, telephone number, email, and address of the designated ESC lead.
- An ESC lead may provide inspection and compliance services for multiple construction projects in the same geographic region.
- Duties and responsibilities of the ESC lead shall include, but are not limited to, the following:
  - Inspecting all areas disturbed by construction activities, all BMPs and all locations where runoff leaves the site at least once every calendar week and within 24 hours of

any discharge from the site. The ESC lead may reduce the inspection frequency for temporary stabilized, inactive sites to monthly.

- Examining stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen.
- Evaluating the effectiveness of BMPs.
- Maintaining a permit file onsite at all times which includes the 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.
- 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.
  - A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:
    - Locations of BMPs inspected,
    - Locations of BMPs that need maintenance,
    - Locations of BMPs that failed to operate as designed or intended, and
    - Locations where additional or different BMPs are required.
  - 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.
- Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.
- Keep an inventory of equipment onsite.

1.24 BMP C162: Scheduling

1.24.1 Purpose

Sequencing a construction project reduces the amount and duration of soil exposed to erosion.

1.24.2 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 measures planned for the project. This type of schedule guides the contractor on work to be done before other work is started so 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 surface ground cover leaves a site vulnerable to accelerated erosion. Construction procedures that limit land clearing, provide timely installation of erosion and sedimentation controls, and restore protective cover quickly can significantly reduce the erosion potential of a site.

1.24.3 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.

1.27 BMP C202: Rip Rap Channel Lining

1.27.1 Purpose

To protect erodible channels by providing a channel liner using either blankets or riprap.

1.27.2 Conditions of Use

- Use this BMP when natural soils or vegetated stabilized soils in a channel are not adequate to prevent channel erosion.
- Use this BMP when a permanent ditch or pipe system is to be installed and a temporary measure is needed.
- The Federal Highway Administration recommends not using flexible liners whenever the slope exceeds 10 percent or the shear stress exceeds 8 pounds per square foot.

1.27.3 Design and Installation Specifications

- See BMP C122: Nets and Blankets for information on blankets.
- Since riprap is used where erosion potential is high, construction must be sequenced so the riprap is put in place with the minimum possible delay (see Figure 3 - 11: Soil Erosion Protection – Rip Rap Protection).
- Only disturb areas where riprap is to be placed if final preparation and placement of the riprap can immediately follow the initial disturbance. Where riprap is used for outlet protection, place the riprap before or in conjunction with the construction of the pipe or channel so it is in place when the pipe or channel begins to operate.
- The designer, after determining the appropriate riprap size for stabilization, shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size. Consider the possibility of damage when selecting a riprap size, especially if there is nearby water or a gully in which to toss the stones. See Volume 5, Section 4.3: Open Channel Specifications for additional channel protection guidance.
- Use field stone or quarry stone of approximately rectangular shape for the riprap. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and shall be suitable in all respects for the purpose intended.
- Place a lining of engineering filter fabric (geotextile) between the riprap and the underlying soil surface to prevent soil movement into or through the riprap. The geotextile should be keyed in at the top of the bank.
- Do not use filter fabric on slopes steeper than 1-1/2H:1V as slippage may occur. It should be used in conjunction with a layer of coarse aggregate (granular filter blanket) when the riprap to be placed is 12 inches and larger.

1.27.4 Maintenance Standards

- Replace riprap as needed.

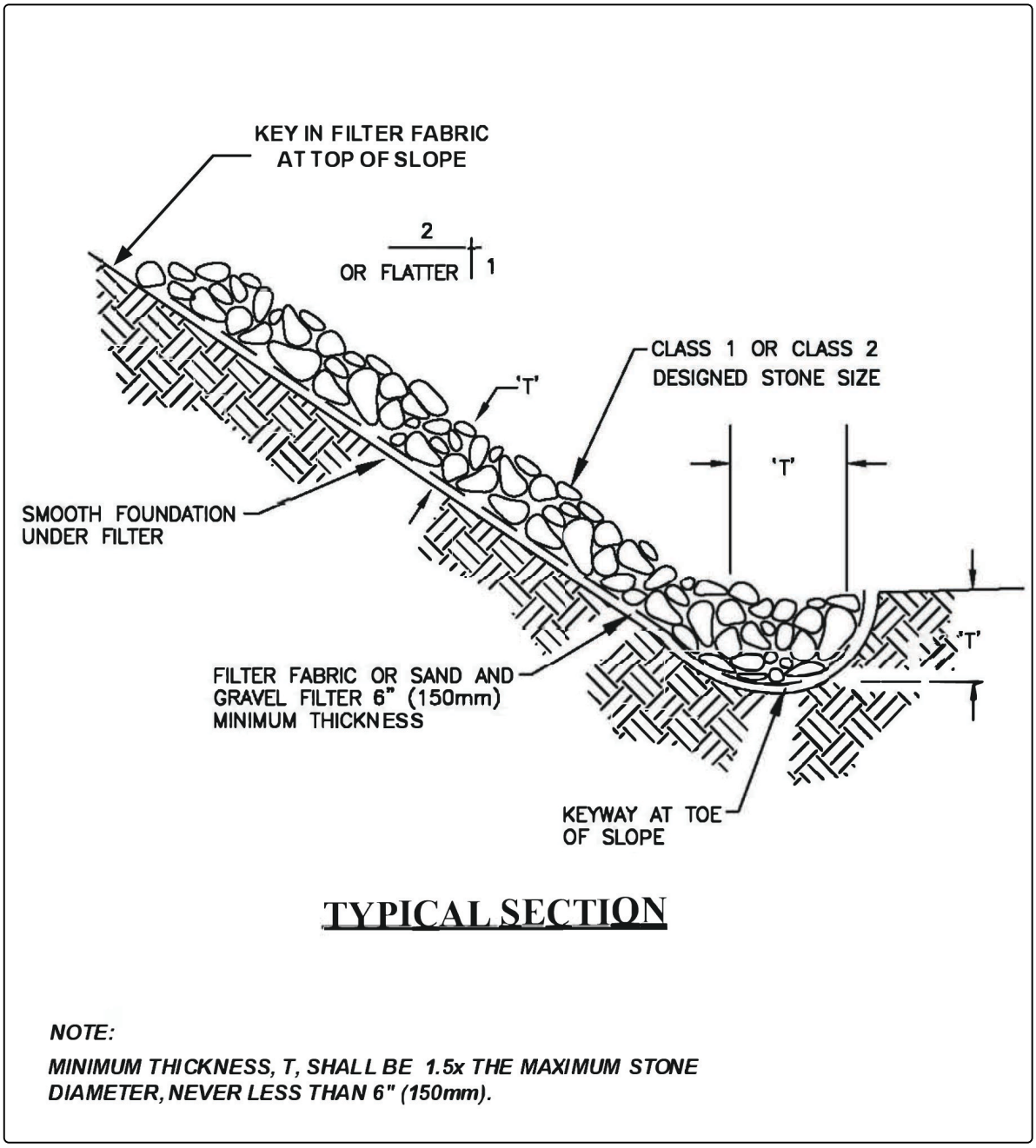


Figure 3 - 11: Soil Erosion Protection – Rip Rap Protection

1.35 BMP C220: Stormwater System Inlet Protection

1.35.1 Purpose

To prevent coarse sediment from entering stormwater systems prior to permanent stabilization of the disturbed area.

1.35.2 Conditions of Use

- Use where inlets are to be made operational before permanent stabilization of the disturbed area.
- Provide protection for all stormwater system inlets downslope and within 500 feet of a disturbed or construction area, unless those inlets are preceded by another sediment trapping device.
- Table 3 - 11: Stormwater System Inlet Protection lists several options for inlet protection. All of the methods for stormwater system inlet protection are prone to plugging and require a high frequency of maintenance. Contributing areas should be limited to 1 acre or less. Emergency overflows may be required where stormwater ponding would cause a hazard. If an emergency overflow is provided, additional end-of-pipe treatment may be required.

Table 3 - 11: Stormwater System Inlet Protection

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

1.35.3 Design and Installation Specifications

Excavated Drop Inlet Protection

- An excavated impoundment around the inlet. Sediment settles out of the stormwater prior to entering the stormwater conveyance system..

- Provide depth of 1 to 2 feet, as measured from the crest of the inlet structure.
- Slope sides of excavation no steeper than 2H:1V.
- Minimum volume of excavation 35 cubic yards.
- Shape excavation to fit site with longest dimension oriented toward the longest inflow area.
- Install provisions for collection and conveyance to prevent standing water problems.
- 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.
- It may be necessary to build a temporary dike 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 stormwater system inlet with standard concrete blocks and gravel. See Figure 3 - 17: Drop Inlet with Block and Gravel Filter.
- Provide a height 1 to 2 feet above inlet.
- Recess the first row 2 inches into the ground for stability.
- Support subsequent courses by placing a piece of 2x4 lumber through the block opening.
- Do not use mortar.
- Lay some blocks in the bottom row on their side for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel just below the top of blocks on slopes of 2H:1V or flatter.
- An alternative design is a gravel berm surrounding the inlet with the following characteristics:
  - Provide an inlet slope of 3H:1V.
  - Provide an outlet slope of 2H:1V.
  - Provide a 1-foot wide level stone area between the structure and the inlet.
  - Use inlet slope stones 3 inches in diameter or larger.
  - For outlet slope use gravel ½- to ¾-inch at a minimum thickness of 1-foot.

Gravel and Wire Mesh Filter

- A gravel and wire mesh filter is a gravel barrier placed over the top of the inlet (see). This structure does not provide an overflow.
- Use a hardware cloth or comparable wire mesh with 1/2-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

- Inserts (Figure 3 - 19: Catch Basin Filter) shall be designed by the manufacturer for use at construction sites. The limited sediment storage capacity increases the frequency of inspection and maintenance required, which may be daily for heavy sediment loads. The maintenance requirements can be reduced by combining 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.
- Provide a minimum of 5 cubic feet of storage.
- Requires dewatering provisions.
- Provide a high-flow bypass that will not clog under normal use at a construction site.
- The catch basin filter is inserted in the catch basin just below the grating.

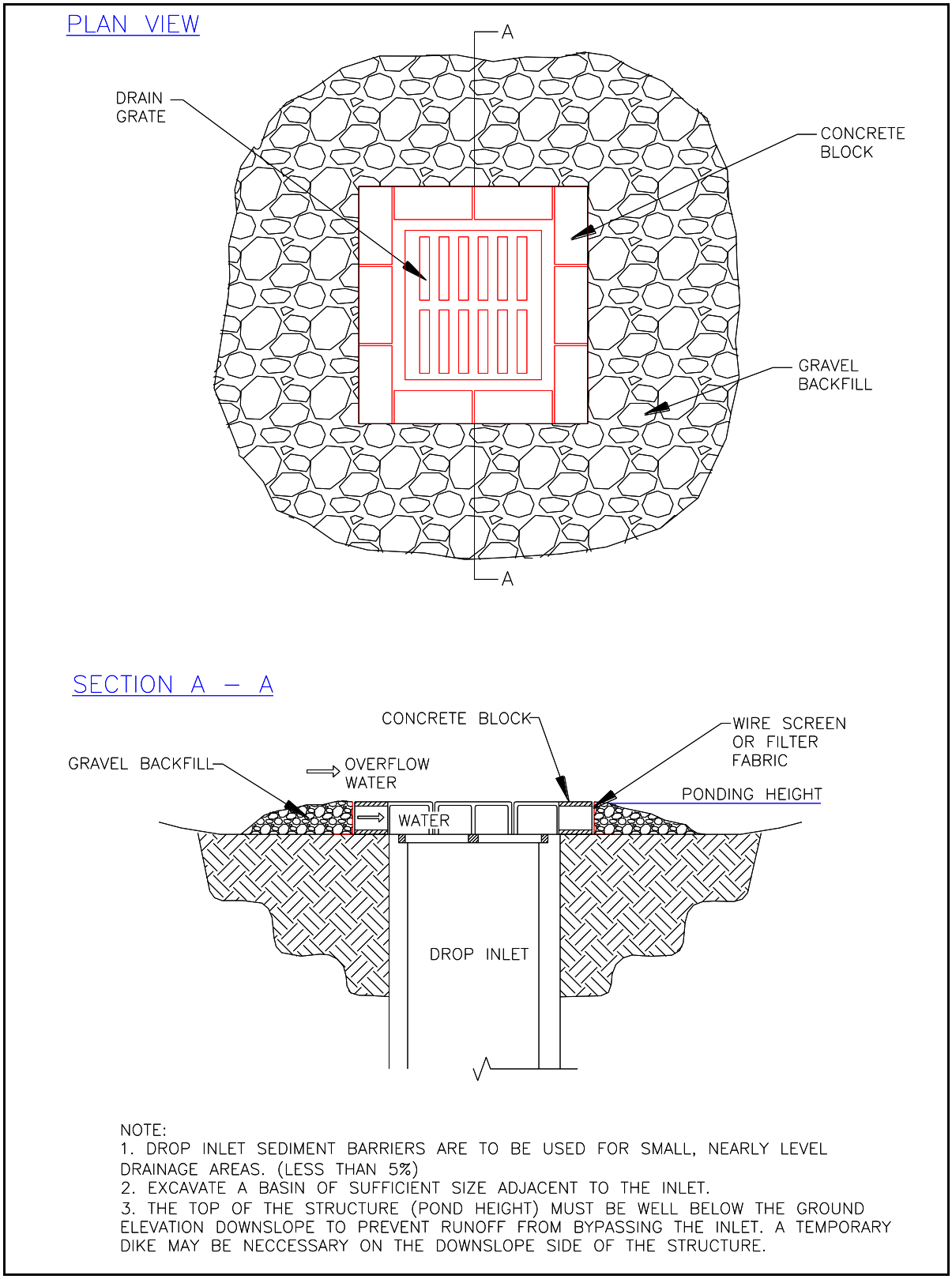


Figure 3 - 17: Drop Inlet with Block and Gravel Filter

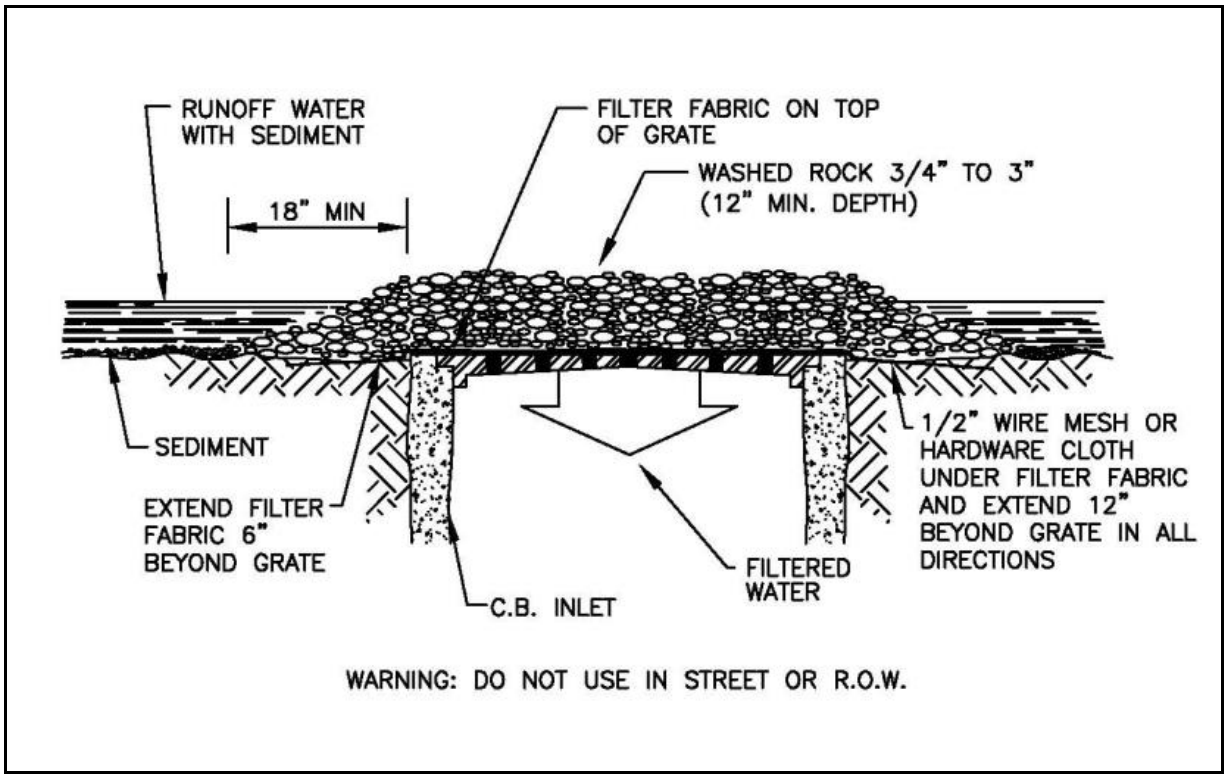
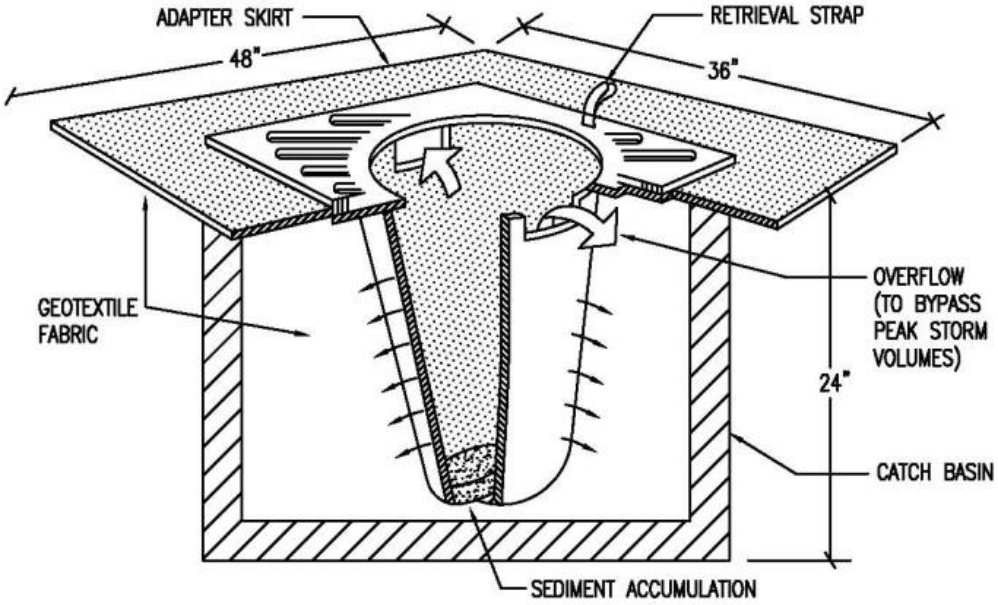


Figure 3 - 18: Gravel and Wire Mesh Filter



INLET PROTECTION NOTES:

1. FILTERS SHALL BE INSPECTED AFTER EACH STORM EVENT AND CLEANED OR REPLACED WHEN 1/3 FULL.

Figure 3 - 19: Catch Basin Filter

Curb Inlet Protection with Wooden Weir

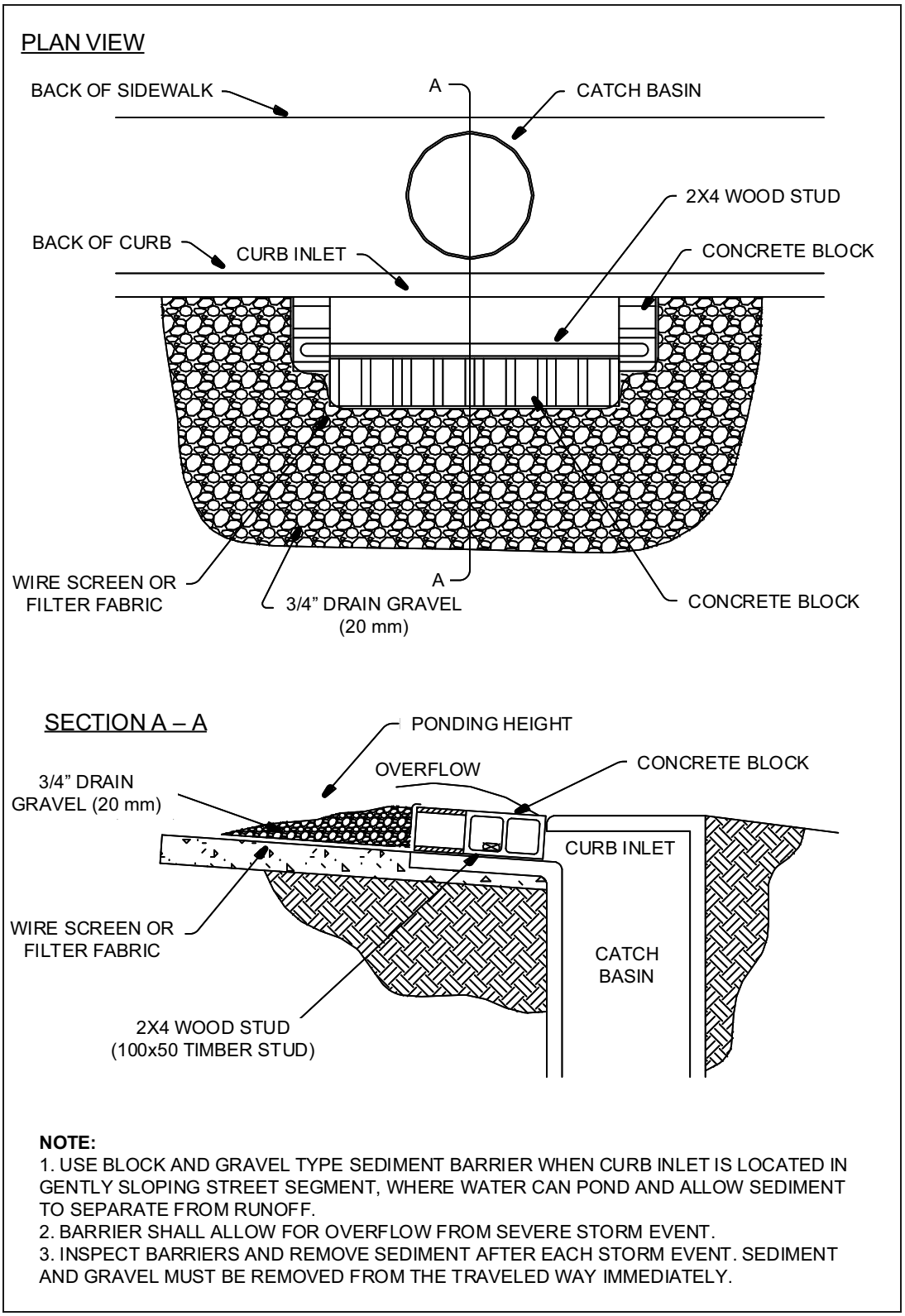
Barrier formed around a curb inlet with a wooden frame and gravel.

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

Block and Gravel Curb Inlet Protection

Barrier formed around an inlet with concrete blocks and gravel. See Figure 3 - 20: Block and Gravel Curb Inlet Protection.

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



NOTE:
1. USE BLOCK AND GRAVEL TYPE SEDIMENT BARRIER WHEN CURB INLET IS LOCATED IN GENTLY SLOPING STREET SEGMENT, WHERE WATER CAN POND AND ALLOW SEDIMENT TO SEPARATE FROM RUNOFF.
2. BARRIER SHALL ALLOW FOR OVERFLOW FROM SEVERE STORM EVENT.
3. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.

Figure 3 - 20: Block and Gravel Curb Inlet Protection

Curb and Gutter Sediment Barrier

Sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure 3 - 21: Curb and Gutter Sediment Barrier.

- 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 outside of the berm sized to sediment trap standards for protecting a culvert inlet.

1.35.4 Maintenance Standards

- Inspect inlet protection frequently, especially after storm events. If the insert becomes clogged, clean or replace it.
- For systems using stone filters: If the stone filter becomes clogged with sediment, the stones must be pulled away from the inlet and cleaned or replaced. Since cleaning of gravel at a construction site may be difficult, an alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.
- Do not wash sediment into the stormwater system while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.
- Do not allow accumulated sediment to enter the stormwater system.
- Inlet protection shall be removed when area is fully stabilized and erosion and sediment controls are no longer needed.

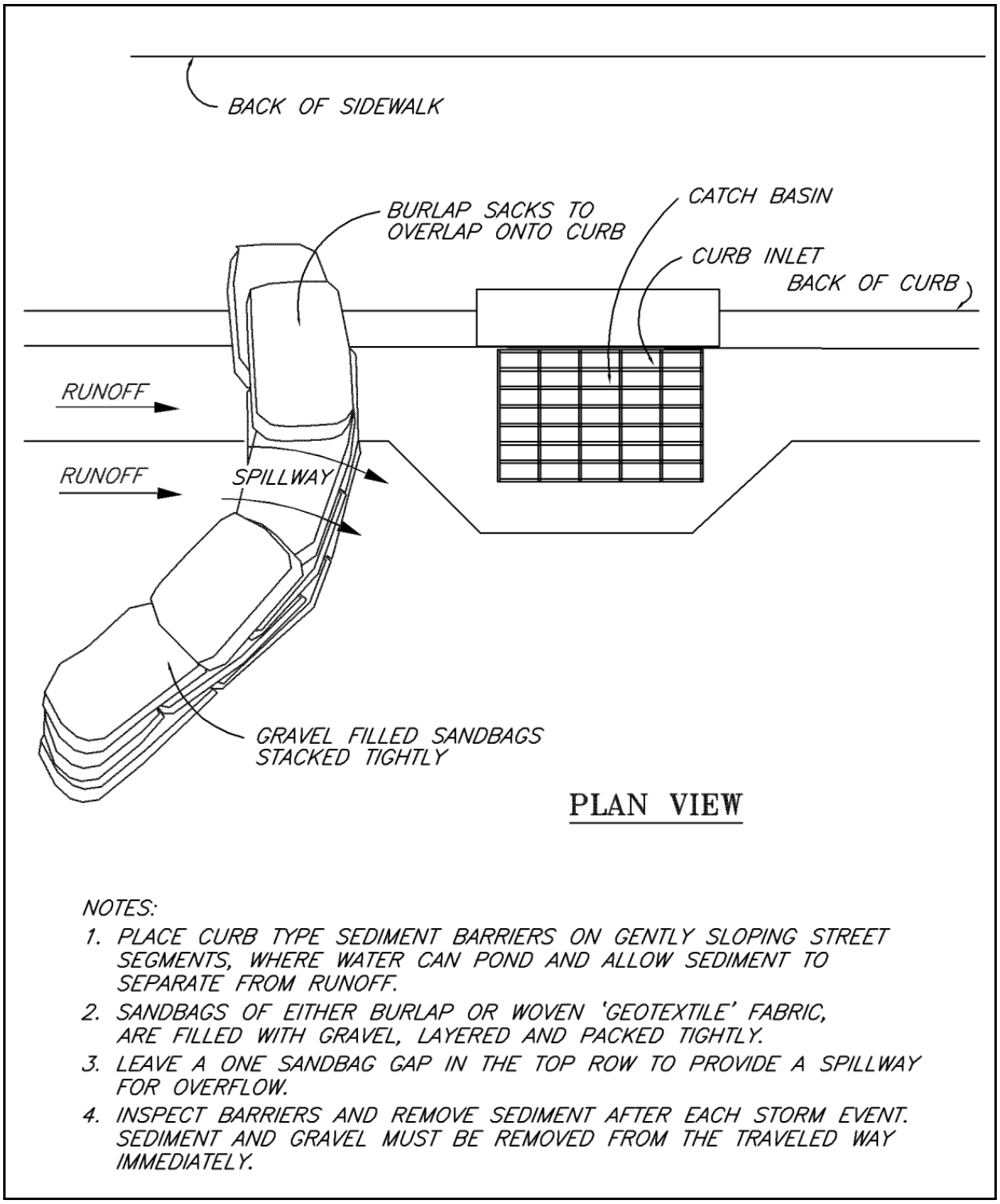


Figure 3 - 21: Curb and Gutter Sediment Barrier

1.38 BMP C233: Silt Fence

1.38.1 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.

1.38.2 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 concentrated flows to a sediment trapping BMP.
- Do not construct silt fences in streams or use them in V-shaped ditches. Silt fences do not provide an adequate method of silt control for anything deeper than sheet or overland flow.

1.38.3 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 or WSDOT Standard Specification 9-33.2(1) Table 6 - Geotextile for Temporary Silt Fence. 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 3 - 12: Geotextile Fabric Standards for Silt Fence):

Table 3 - 12: Geotextile Fabric Standards for Silt Fence

Standard	Description
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for silt film wovens (#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 fabrics with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the geotextile. Silt fence materials are available that have synthetic mesh backing attached.
- Silt fence material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0° F to 120° F.

- 100 percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by the local jurisdiction.
- Refer to Figure 3 - 23: Silt Fence for standard silt fence details. Include the following Standard Notes for silt fence on construction plans and specifications:
  - The Contractor shall install and maintain temporary silt fences at the locations shown in the Plans.
  - Construct silt fences in areas of clearing, grading, or where runoff will drain prior to starting those activities.
  - The silt fence shall have a 2-feet min. and a 2½-feet max. height above the original ground surface.
  - 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.
  - 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.
  - 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.
  - 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.
  - Bury the bottom of the geotextile fabric 4-inches min. below the ground surface. Backfill and tamp soil in place over the buried portion of the geotextile fabric, so that no flow can pass beneath the silt fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the ground 3-inches min.
  - 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.
  - Use wood, steel or equivalent posts. The spacing of the support posts shall be a maximum of 6-feet. Posts shall consist of either:
    - Wood with minimum dimensions of 2 inches by 2 inches by 3 feet. Wood shall be free of defects such as knots, splits, or gouges.
    - No. 6 steel rebar or larger.

        - ASTM A 120 steel pipe with a minimum diameter of 1-inch.
        - U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft.
        - Other steel posts having equivalent strength and bending resistance to the post sizes listed above.
    - Locate the 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.
    - 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 3 - 24: Silt Fence Installation by Slicing for slicing method details. The following are specifications for silt fence installation using the slicing method:
    - 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.
    - Install posts 3 to 4 feet apart in critical retention areas and a maximum of 6 feet apart in standard applications.
    - 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.
    - Install posts with the nipples facing away from the geotextile fabric.
    - 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.
    - Wrap approximately 6 inches of geotextile fabric around the end posts and secure with 3 ties.
    - No more than 24 inches of a 36-inch geotextile fabric is allowed above ground level.
    - Compact the soil immediately next to the geotextile fabric with the front wheel of a 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.

1.38.4 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 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.

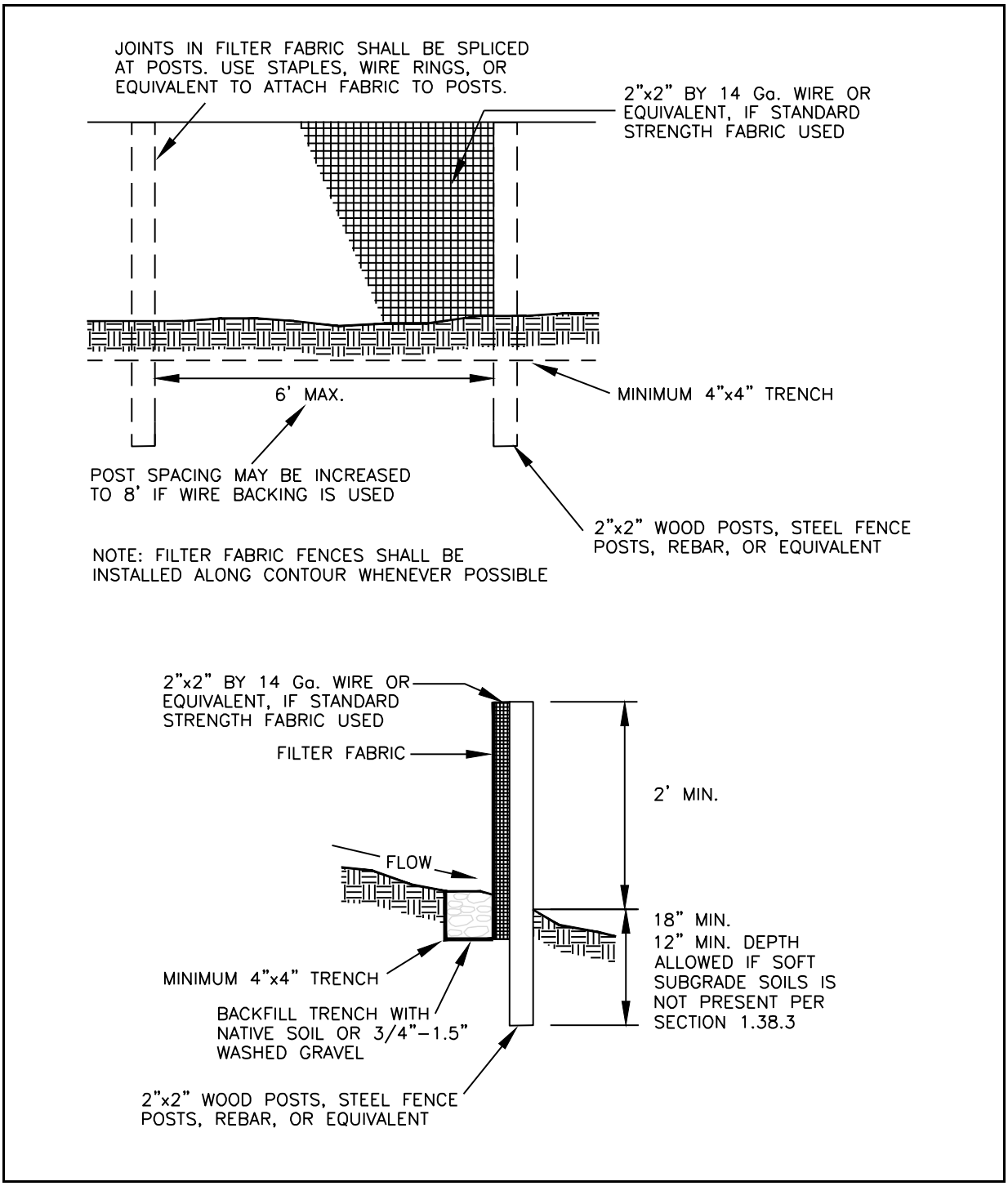


Figure 3 - 23: Silt Fence

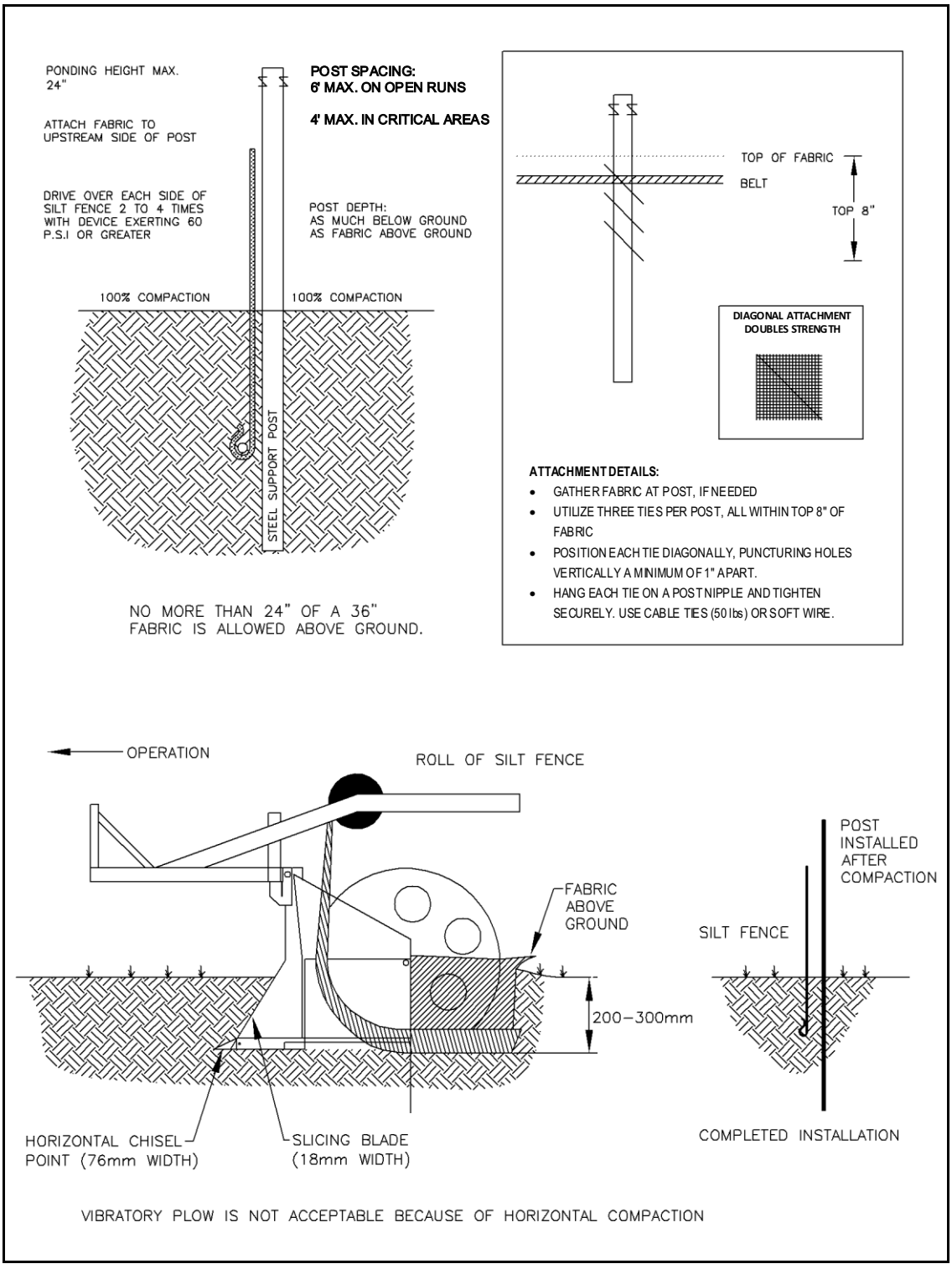


Figure 3 - 24: Silt Fence Installation by Slicing

1.42 BMP C240: Sediment Trap

1.42.1 Purpose

A sediment trap is a small temporary ponding area with a gravel outlet used to collect and store sediment from sites cleared and/or graded during construction. Install sediment traps, along with other perimeter controls, before any land disturbance takes place.

1.42.2 Conditions of Use

- Sediment traps are intended for use on sites where the contributing area is less than 3 acres, with no unusual stormwater and surface water features, and a projected build-out time of six months or less. The sediment trap is a temporary measure (with a design life of approximately 6 months) and shall be maintained until the site area is permanently protected against erosion by the installation of vegetation and/or structures.
- Sediment traps are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, emphasizing the need to control erosion to the maximum extent first.
- When permanent facilities are used as temporary sedimentation facilities, the surface area requirement of a sediment trap must be met. If the surface area requirements are larger than the surface area of the permanent facility, then the trap or pond shall be enlarged to comply with the surface area requirement.
- A skimmer may be used for the sediment trap outlet.

1.42.3 Design and Installation Specifications

See Figure 3 - 27: Cross-Section of a Sediment Trap and Figure 3 - 28: Sediment Trap Outlet for details.

If permanent runoff control facilities are part of the project, they should be used for sediment retention.

- To determine the sediment trap geometry, first calculate the design surface area (*SA*) of the trap, measured at the invert of the weir. Use the following equation:

  (Equation 3 - 2)

$$SA = FS\left(\frac{Q_2}{V_s}\right)$$

  Where:

  SA = Design surface area, in square feet, of the sediment trap measured at the invert of the weir.

  Q_2= Design inflow, in cubic feet per second, is the peak volumetric flowrate from the contributing area calculated using a 10-minute timestep from a Type 1A, 2-year, 24-hour frequency storm using a single event model. A type 1A, 10-year, 24-hour frequency storm (Q10) shall be used in the calculation if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection. If no hydrologic analysis is required, the Rational Method may be used.

Alternatively, Q_2 = Design inflow (cfs) is the 2-year return period flowrate, indicated by an Ecology-approved continuous simulation model, using an 15-minute timestep. Use the 10-year return period flowrate (Q10) in the calculation if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection.

Vs= The settling velocity of the soil particle of interest. The 0.02 millimeter (medium silt) particle with an assumed density of 2.65 grams per cubic centimeter has been selected as the particle of interest and has a settling velocity (*Vs*) of 0.00096 feet per second.

FS= A safety factor of 2 to account for non-ideal settling.

Therefore, the equation for computing surface area becomes:

(Equation 3 - 3)

$$SA = \frac{2 \times Q_2}{0.00096} \text{ OR}$$

SA = 2080 (Q_2)

Note: Even if permanent facilities are used, they must still have a surface area that is at least as large as that derived from the above formula. If they do not, the pond must be enlarged.

- Smaller sites may use the minimum pond sizes in Table 3 - 15: Sediment Trap Sizing instead of providing calculations.

Table 3 - 15: Sediment Trap Sizing

Contributing Area (acres)	Required Surface Area of Pond (sq. ft.)
⅛ acre or less	130
¼ acre or less	260
½ acre or less	520
¾ acre or less	780
1 acre or less	1040

- To aid in determining sediment depth, all sediment traps shall have a staff gauge with a prominent mark 1-foot above the bottom of the trap.
- Sediment traps may not be feasible on utility projects due to the limited work space or short-term nature of the work. Portable tanks may be used in place of sediment traps for utility projects.
- The basic geometry of the pond can now be determined using the following design criteria:
  - Required surface area SA (from the equation above) at top of riser.

- Minimum 3.5-foot depth from top of riser to bottom of pond.
- Maximum 3H:1V interior side slopes and maximum 2H:1V exterior slopes. The interior slopes can be increased to a maximum of 2H:1V if fencing is provided at or above the maximum water surface.
- One foot of freeboard between the top of the riser and the crest of the emergency spillway.
- Flat bottom.
- Minimum 1-foot deep spillway.
- Length-to-width ratio between 3:1 and 6:1.

1.42.4 Maintenance Standards

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

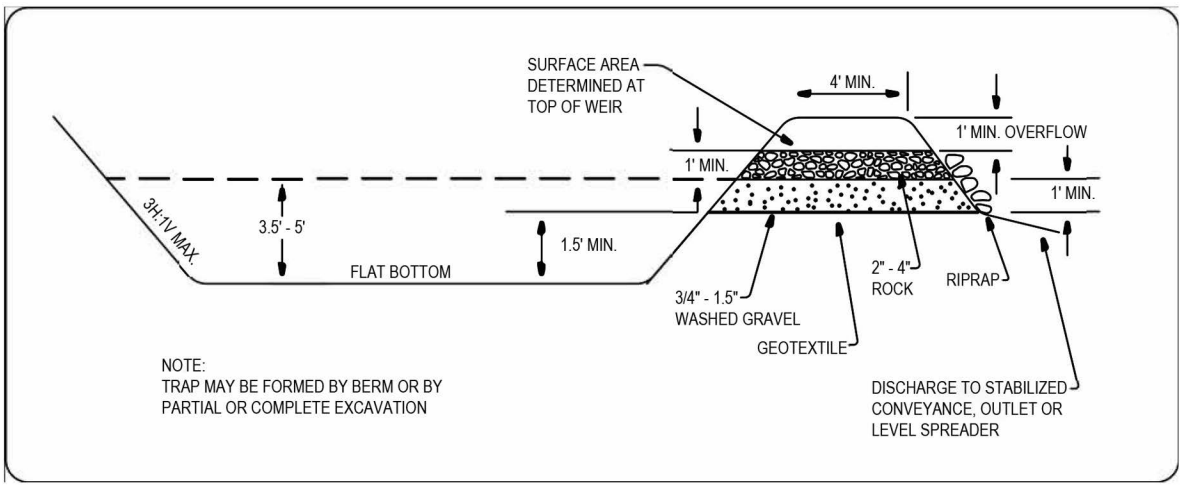


Figure 3 - 27: Cross-Section of a Sediment Trap

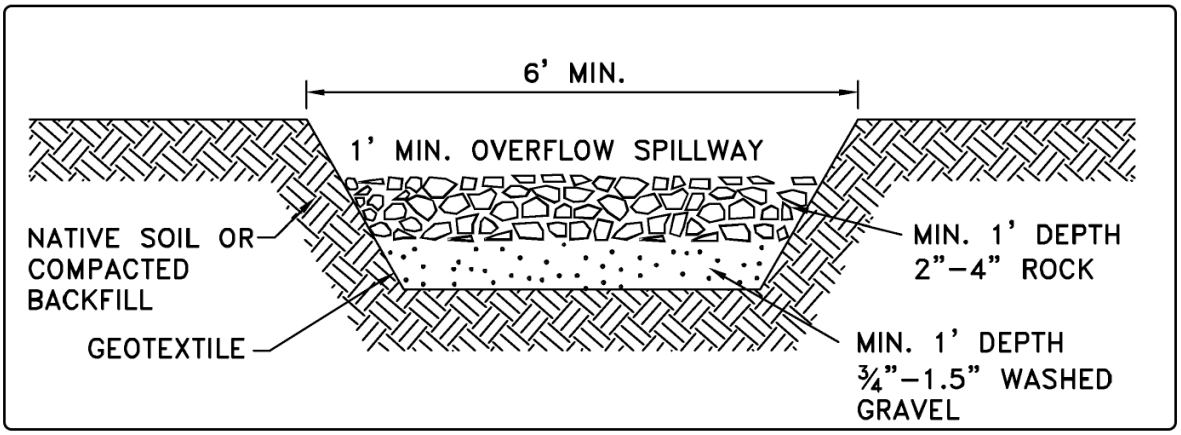


Figure 3 - 28: Sediment Trap Outlet