Snohomish County Public Works

Stormwater Drainage Report

for

Arlington Operations Center
19620 67th Ave NE
Arlington, WA 98223

Snohomish County Public Works
3000 Rockefeller Avenue
Everett, WA 98201
(206) 533-6500

Prepared for
Dykeman Architects

January 31, 2025

Prepared by
Mark Davis, P.E., Lic. #51549
Reid Middleton
728 134th Street SW, Suite 200
Everett, WA 98204
425-741-3800; Fax 425-741-3900

Snohomish County Public Works

Stormwater Drainage Report

Arlington Operations Center

Prepared for
Dykeman Architects

January 2025

I hereby state that this drainage report for Arlington Operations Center has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Arlington does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Prepared by

Mark Davis, P.E.

ReidMiddleton
728 134th Street SW, Suite 200
Everett, WA 98204
425-741-3800; Fax 425-741-3900
www.reidmiddleton.com
File No. 212024.009

Intentionally Left Blank

Table of Contents

SECTION 1. PROJECT OVERVIEW 1

INTRODUCTION 1
PROJECT LOCATION 1
EXISTING CONDITIONS 1
DEVELOPED CONDITIONS 1

SECTION 2. CONDITIONS AND REQUIREMENTS SUMMARY 3

MINIMUM REQUIREMENT #1: PREPARATION OF STORMWATER SITE PLANS 3
MINIMUM REQUIREMENT #2: CONSTRUCTION STORMWATER POLLUTION PREVENTION (SWPP) 3
MINIMUM REQUIREMENT #3: SOURCE CONTROL OF POLLUTION 3
MINIMUM REQUIREMENT #4: PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS 3
MINIMUM REQUIREMENT #5: ON-SITE STORMWATER MANAGEMENT 3
MINIMUM REQUIREMENT #6: RUNOFF TREATMENT 4
MINIMUM REQUIREMENT #7: FLOW CONTROL 4
MINIMUM REQUIREMENT #8: WETLAND PROTECTION 4
MINIMUM REQUIREMENT #9: OPERATION AND MAINTENANCE 4

SECTION 3. SITE AND BASIN ASSESSMENT 7

3.1 PHASED OFF-SITE ANALYSIS 7
3.2 UPSTREAM DESCRIPTION 8
3.3 SOILS/INFILTRATION RATES 8
3.4 CRITICAL AREAS AND FLOOD PLAIN 8
3.5 ASSESSMENT SUMMARY 8

SECTION 4. CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN 9

RAINY SEASON REQUIREMENTS 10

SECTION 5. PERMANENT STORMWATER CONTROL 11

5.1 FLOW CONTROL 11
5.2 WATER QUALITY 12
5.3 SOURCE CONTROL 12
CONVEYANCE SYSTEM ANALYSIS AND DESIGN 13

SECTION 6. SPECIAL REPORTS AND STUDIES 14

SECTION 7. OTHER PERMITS 15

SECTION 8. FIGURES 16

Appendices

APPENDIX A – GEOTECHNICAL REPORT
APPENDIX B – DOCUMENTATION
APPENDIX C – MAINTENANCE PLAN

Intentionally Left Blank

SECTION 1. PROJECT OVERVIEW

Introduction

This report details the stormwater management for the Arlington Operations Center (AOC) Building project on the existing AOC property. The proposed site development will reconfigure the existing site to accommodate new buildings, vehicle access routes, and utility infrastructure improvements in several phases. The Phase 1 development project will install a new administration and crew support building and convert an existing infiltration pond into a large underground infiltration gallery. The site improvements include paved parking lots and driveways, fire department access, pedestrian hardscapes, and site grading. Utility improvements include sanitary sewer, storm drainage, and domestic and fire protection systems for the administration building and future buildouts in the subsequent development phases.

Project Location

The project site is located within the AOC property in Arlington, Washington. The parcel number is 31051500101500. The AOC property is approximately 17.56 acres.

Existing Conditions

The Phase 1 project site is occupied by the existing Road Crew building, paved parking lots, access driveways, and the large existing infiltration pond system. The Phase 1 site occupies the eastern third of the property. The remaining property is occupied by the existing Bridge and Road Crew's Shop building, several storage buildings and storage bunkers, and large areas of pavement.

The property is separated into two subbasins, with the western quarter of the property draining to a smaller existing infiltration pond and the remaining area discharging to the large infiltration pond to the east. The existing infiltration pond occupies approximately 2.6 acres of the property and is approximately 20 feet deep.

Stormwater from the pavement areas drains as sheet flow to catch basins that convey stormwater through underground storm pipes to either infiltration pond. Stormwater from building roofs either tightlines directly into the surrounding conveyance pipe system or discharges to the adjacent pavement surfaces.

Both infiltration ponds have a pre-settling basin to provide basic water quality treatment prior to releasing into the main infiltration basin. The main infiltration pond contains two catch basin structures at the east edge of the pond that act as a pre-setting basin to collect debris prior to release into the main infiltration basin.

Developed Conditions

The Phase 1 site development will consist of demolishing the existing Road Crew building and pavement surfaces to accommodate the redevelopment project. A new two-story building with a footprint of 11,390 square feet will be constructed just east of the existing admin/crew building. The main existing infiltration pond will be filled in to create an underground gallery to provide additional pavement area. Additional improvements include pedestrian hardscapes, walkways,

paved parking, and landscaping. Building roof and pavement stormwater will be collected and conveyed to the converted infiltration facility through a series of existing and proposed storm pipes and catch basins. Water quality facilities that include bioretention BMPs and filter vaults will be constructed to provide water quality for the Phase 1 project site improvements.

The project is subject to Minimum Requirements 1 through 9 as outlined in the 2019 *Stormwater Management Manual for Western Washington* (SWMMWW). The project is not subject to restrictions from other agencies.

SECTION 2. CONDITIONS AND REQUIREMENTS SUMMARY

This section summarizes the Minimum and Special Requirements from the SWMMWW.

Minimum Requirement #1: Preparation of Stormwater Site Plans

The project exceeds the 2,000-square-foot threshold for hard surfaces. A set of construction drawings and this drainage report have been prepared to meet Minimum Requirement #1.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPP)

A Construction Stormwater Pollution Prevention Plan (SWPPP) that meets the Washington State Department of Ecology's construction stormwater general discharge permit coverage requirements has been prepared. The SWPPP is summarized in Section 4 of this report and a separate SWPPP report is included in the submittal.

Minimum Requirement #3: Source Control of Pollution

Source control is required for this project. Section 5.3, Source Control, provides more information.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Stormwater runoff from the project site is collected and conveyed to two existing infiltration ponds. Stormwater from the property does not exit the site. There are no existing outfalls.

Minimum Requirement #5: On-site Stormwater Management

Feasibility analysis for each Best Management Practice (BMP) included in List #2, On-site Stormwater Management BMPs for Projects Triggering Minimum Requirements 1 through 9, is as follows.

<u>Lawn and Landscape Area</u>
Pervious areas disturbed or created shall adhere to BMP T5.13, Post Construction Soil Quality and Depth.

<u>Roofs</u>

1. BMP T5.30 – Full dispersion: This BMP is infeasible on this project site based on the following criteria:
   - There is no location on this project site that can provide a dispersion flow path with native vegetation approaching 100 feet. The project site is fully developed.

2. BMP T5.10A – Downspout Full Infiltration: This BMP is feasible, and the building roof area will be tightlined directly to the main infiltration gallery that will provide flow control for the project site.

<u>Other Hard Surfaces</u>

1. BMP T5.30 – Full dispersion: This BMP is infeasible on this project site based on the following criteria:

- There is no location on this project site that can provide a dispersion flow path with native vegetation approaching 100 feet. The project site is fully developed.

2. BMP T5.15 – Permeable Pavements: This BMP is infeasible on this project based on the following criteria:
    - Pavement areas in the upper parking area could threaten the basement level of the new building.
    - Pavement areas will be in areas likely to have long-term excessive sediment deposition due the industrial operations of the site.

3. BMP T7.30 – Bioretention: Bioretention is feasible on this project based on the following criteria:
    - There is adequate space to install a bioretention adjacent to paved parking.
    - A bioretention cell will have an underdrain system to collect and convey treated stormwater to the main infiltration gallery.

Minimum Requirement #6: Runoff Treatment

The project will generate more than 5,000 square feet of pollution-generating impervious surface. Industrial developments require enhanced treatment as the minimum.

Minimum Requirement #7: Flow Control

The project exceeds the 5,000-square-foot threshold for new hard surfaces. A converted infiltration pond to an underground gravel gallery will be constructed near the center of the property.

Minimum Requirement #8: Wetland Protection

This project does not discharge either directly or indirectly to any wetlands. No additional requirements are necessary.

Minimum Requirement #9: Operation and Maintenance

The stormwater drainage facilities of this project will be owned and operated by the property owner, which is Snohomish County Public Works. The operation and maintenance manual is discussed in detail in Appendix C.

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

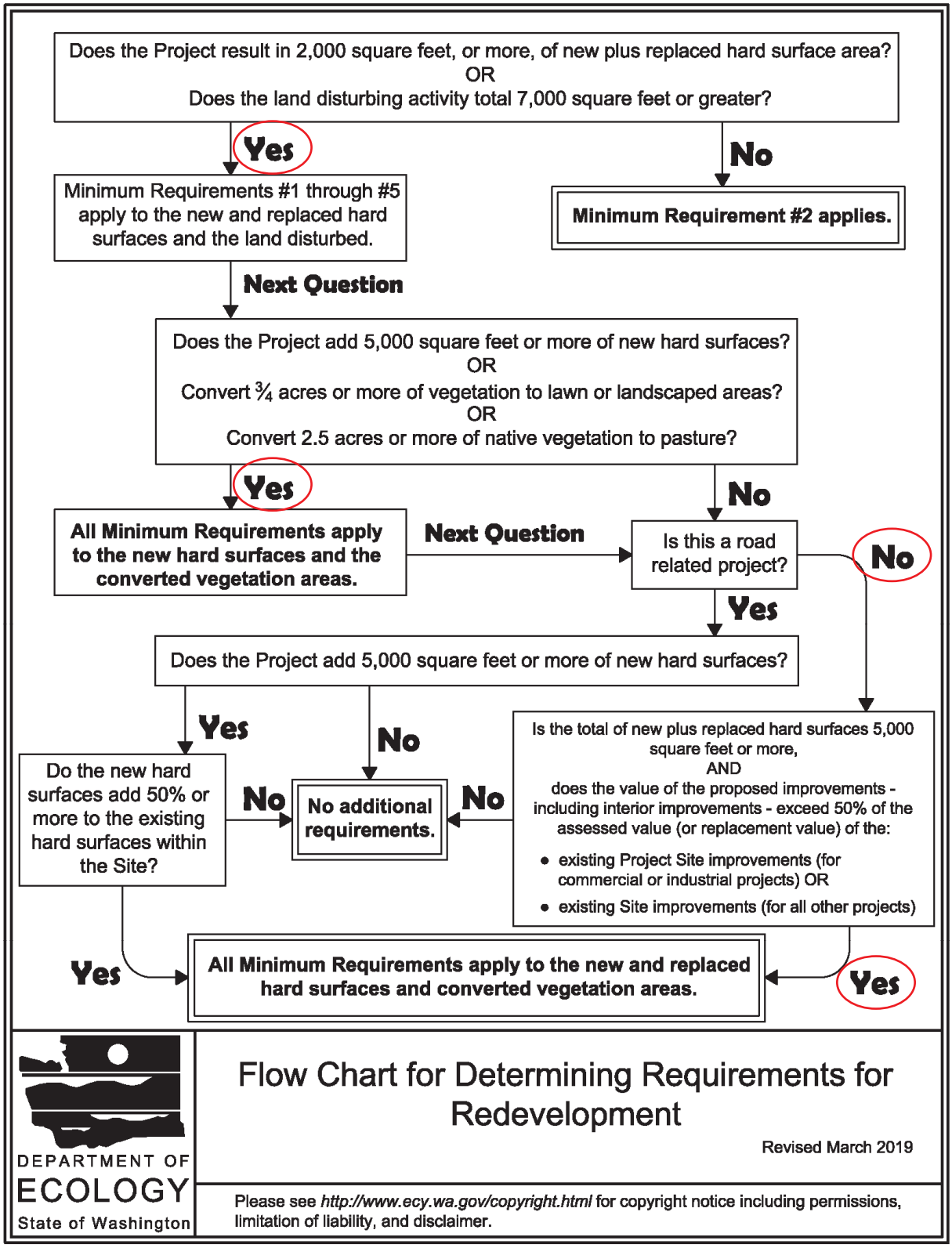


Table I-3.1: Minimum Requirement #5 Compliance Options for Projects Triggering Minimum Requirements #1 - #9

Project Location and Parcel Size	Minimum Requirement #5 Compliance Options
Projects inside the UGA, on any size parcel	• Use the LID BMPs from List #2 for all surfaces within each type of surface in List #2; or
Projects outside the UGA, on a parcel smaller than 5 acres	• Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.
Projects outside the UGA, on a parcel 5 acres or larger	Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.
Note: This text refers to the Urban Growth Area (UGA) as designated under the Growth Management Act (GMA) (Chapter 36.70A RCW) of the State of Washington. If the project is located in a county that is not subject to planning under the GMA, the city limits shall be used instead.	

Flow Control Exempt Projects

Projects qualifying as Flow Control exempt in accordance with the TDA Exemption in I-3.4.7 MR7: Flow Control shall either:

- Use the LID BMPs from List #3 for all surfaces within each type of surface in List #3;

  or

- Use any Flow Control BMP(s) desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.

If the project has multiple TDAs, all TDAs must be Flow Control exempt per the TDA Exemption in I-3.4.7 MR7: Flow Control for the project to use the options listed here.

The text in this box originates from one or more of the following Permits:
Appendix 1 of the Phase I / Phase II Municipal Stormwater Permits
Construction Stormwater General Permit

SECTION 3. SITE AND BASIN ASSESSMENT

The AOC site is fully developed and is bounded to the north by 197th Street NE, to the west by 63rd Avenue NE, to the east by 67th Avenue NE, and to the south by the commercial Cuz Concrete Products property. Vehicle access to the project site will be from the existing site entrances along 67th Avenue and 197th Street. Frontage improvements that include landscape strips and sidewalk are provided along both site entrance roadways. The property is separated into two subbasins, with the western quarter of the property draining to a smaller existing infiltration pond and the remaining area discharging to the large infiltration pond to the east.

The west subbasin (approximately 5.7 acres) is composed of mostly asphalt pavement, several metal sheds, and open and covered bunkers for material storage. The area slopes primarily to the west at a relatively flat grade toward the existing infiltration pond near the southwest corner of the property. The area along the south property line is a gently sloped grass lawn area that slopes to the north. Stormwater from the paved areas is collected and conveyed by catch basins and storm pipe to the infiltration pond, which contains a pre-settling basin. There are existing drywells along the northern property that collect and infiltrate a portion of the surrounding pavement area.

The east subbasin (approximately 11.9 acres), which includes the Phase 1 redevelopment area, is composed of three building structures (Road Crew office, Fleet Maintenance Building, and Bridge Crew office), the surrounding paved parking lots and drive aisles, a covered parking area, open storage bunkers, and the large open infiltration pond. The area generally slopes toward the interior of the site and the infiltration pond. Stormwater from the pavement areas and buildings is collected and conveyed by catch basins and storm pipe to the infiltration pond, which contains pre-settling ponds at both ends of the basin.

There are no other water quality facilities within the project site. There are no environmentally sensitive areas within the property. There are no documented flooding events on the project site. The table below summarizes the existing and proposed improvements for the site.

Target Surface Condition	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
Existing (East Basin)	3.44*	8.46	11.9
Developed (East Basin)	0.86	11.04	11.9
Existing (West Basin)	1.37	4.33	5.7
Future Buildout (West Basin)	0.29	5.41	5.7

* Includes 2.6 acres of existing infiltration pond

3.1 Phased Off-site Analysis

A Level 1 downstream analysis was not performed for the project, since stormwater infiltrates the underlying soil layer within the property.

The project site is in a General Industrial zone and adjacent to General Industrial zoning.

3.2 Upstream Description

The east half of 63rd Avenue drains onto the property. It appears most of the runoff infiltrates the existing vegetation along the west property line.

3.3 Soils/Infiltration Rates

According to the geotechnical report by Associated Earth Sciences (see Appendix A), the subsurface soils at the proposed building location area include a layer of fill material consisting of brown silty fine to medium sand with gravel, and organics. Marysville Recessional Outwash soils are present more than 18 feet below the ground surface. Groundwater level is approximately 60 feet below the ground surface. Subsurface soils within and adjacent to the infiltration pond include a 5-foot-thick layer of fill material underlain with Marysville Recessional Outwash. Groundwater level is approximately 75 feet below the ground surface. The Recessional Outwash sands are conducive to infiltration and have an estimated long-term design infiltration rate of 5 inches per hour.

According to the Phase II Environmental Assessment Report by TRC Environmental Corp, soil sampling did not find any metal and non-metal constituents in the soil that exceeded soil cleanup levels.

3.4 Critical Areas and Flood Plain

There are no critical areas within or near the project site. The project site is not within a designated flood hazard zone.

3.5 Assessment Summary

Figures 2 and 3 show site assessment plan drawings. To meet water quality and stream bank erosion goals, the project is constructing an infiltration pond facility that meets current regulations and water quality facilities that meet the enhanced treatment requirement. The project will slope paved areas toward the stormwater management facilities and amend disturbed soils on site. No other mitigation measures are required for this project.

SECTION 4. CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

The proposed project disturbs more than one acre of land. A standard construction Stormwater Pollution Prevention Plan (SWPPP) has been prepared for this project. The SWPPP is prepared in accordance with the Washington State Department of Ecology (DOE) requirements and uses the DOE template. A Notice of Intent will be filed with the DOE, and a Public Notice will be published in local newspapers prior to construction.

A Temporary Erosion Control Plan is included in the drawing set. The drawings show some basic erosion control BMPs, including the elements described below.

Element 1: Preserve Vegetation/Mark Clearing Limits

Prior to any site clearing or grading, clearing limits shall be delineated with silt fencing and temporary chain link fence.

Element 2: Establish Construction Access

The existing paved parking and drive aisles will be used. If a portion of the existing pavement is removed, a stabilized construction entrance will be installed. A wheel wash or vacuum sweepers shall be used to prevent tracking of sediment onto the adjacent public roads.

Element 3: Control Flow Rates

Construction stormwater will be collected in a temporary storage tank to collect and hold stormwater.

Element 4: Install Sediment Controls

A storage tank as part of a treatment train system will be constructed to capture any construction runoff. Wattles will be installed to prevent runoff from exiting the site.

Element 5: Stabilize Soils

All disturbed areas shall be protected by an application of mulch for short periods of time. Permanent and temporary seeding will also be used on disturbed areas. Soil stockpiles will be covered with mulch and plastic sheeting.

Element 6: Protect Slopes

Temporary and permanent seeding or mulch will be used on disturbed slopes.

Element 7: Protect Drain Inlets

Catch basin filter inserts will be installed in existing catch basin structures within the site.

Element 8: Stabilize Channels and Outlets

Not applicable. There are no existing channels or outfalls within the project site.

Element 9: Control Pollutants

Use dust control measures to reduce wind transport of dust during demolition operations. Maintain good housekeeping and preventative measures for vehicle and construction equipment storage.

Element 10: Control Dewatering

Exposed groundwater or seepage will be collected and dispersed onto the site to be filtrated through the underlying soil.

Element 11: Maintain BMPs

All temporary or permanent erosion control BMPs shall be maintained and repaired as needed during construction operations.

Element 12: Manage the Project

The attached SWPPP provides detailed guidance for managing the project.

Element 13: Protect Low Impact Development BMPs

Prevent compacting the infiltration gallery by excluding construction equipment and foot traffic.

Rainy Season Requirements

The rainy season is defined as the months between October 1 and April 30. The following construction activities are prohibited during the rainy season unless the City has given approval to begin or continue:

1. Clearing and grading of 11,000 square feet or more.
2. Disturbing more than 700 square feet of soil and:
    a. Having areas that drain to a tributary water.
    b. Having slopes steeper than 15 percent adjacent to or on the site.
    c. Having highly-erodible soils.
    d. Having a high groundwater table.

SECTION 5. PERMANENT STORMWATER CONTROL

The proposed stormwater pattern will continue to maintain the two drainage subbasins. Stormwater from the east subbasin will be collected by a series of catch basins and storm pipe and conveyed to the new underground infiltration gallery. During the Phase 1 construction, the existing infiltration pond will be filled in with a combination of clean crushed rock and structural fill material to create usable space for pavement and building construction. The voids in the crushed rock will be used as live storage volume for the infiltration system. The size of the infiltration facility will meet design standards from the upcoming 2024 Stormwater Manual and accommodate future buildout within the east subbasin area. The Phase 1 and future buildout within the east subbasin is approximately 92% impervious coverage.

Proprietary water quality units (e.g. BioPod) will be installed at several locations within the filled-in pond area to provide enhanced water quality treatment of site stormwater prior to discharging to the newly constructed underground infiltration facility. Conveyance piping and catch basins are intended to be installed along the main vehicle corridors of the future phases to collect and convey pavement and surrounding building runoff to the infiltration system. Trench drains are intended to collect existing surface runoff at the west end of the site, which is the lowest point of the redevelopment project. The trench drains accommodate a shallow collection and conveyance profile to discharge to the infiltration gallery at an appropriate elevation.

Stormwater from the parking areas in Phase 1 will drain as sheet flow to either a bioretention cell or media filter drain facility. Both systems will use an underdrain system to convey the treated stormwater to the constructed infiltration gallery.

Several treatment train systems will be constructed to accommodate stormwater flows in the lower main portion of the site. The system consists of a flow splitter structure to divert water quality flow to the treatment portion and larger flows to the infiltration facility. The treatment system includes a pre-settling basin structure, an oil/water separator, and an enhanced water quality unit (described above) that will discharge to the infiltration facility via a bottomless catch basin or pipe outfall.

During subsequent development phases in the western subbasin, the existing infiltration pond can be converted to an underground infiltration facility. The infiltration facility should be sized to accommodate future buildout within the west subbasin area. Site stormwater collection, conveyance, and treatment will match the same regime provided in the east subbasin described above. The future buildout within the west subbasin is approximately 92% impervious coverage.

5.1 Flow Control

The infiltration gallery for the east subbasin will have 10 feet of live storage capacity within the voids of the crushed rock and 1 foot of freeboard. The bottom of the gallery will match the bottom elevations of the existing infiltration pond. The table below identifies the infiltration facility design stages for the different recurrence interval flows.

Storm Interval (year)	Design Stage Elevation (feet)
2	3.09
5	4.69
10	5.89
25	7.56
50	8.91
100	10.36

Approximately 42,800 cubic feet of live storage is required to meet the flow control requirement for future buildout in the west subbasin. The proposed infiltration system will be an underground system using a crushed rock gallery or vault system. The depth and location will depend on the future layout within the basin. WWHM calculations are provided in Appendix B.

5.2 Water Quality

Pollution-generating pavement surfaces from the Phase 1 development will require water quality treatment. The pedestrian walkways and building roof area are non-pollution-generating and do not require treatment.

To meet the enhanced (Metals) treatment requirement for commercial and industrial sites, a combination of bioretention and proprietary units that meet the General Use Level Designation (GULD) for Enhanced Treatment will be used. Bioretention cells (BMP T7.30) and media filter drains (BMP T8.40) will be installed adjacent to the new parking lots in Phase 1. The BioPod Biofilter vault by Old Castle will be installed at several locations throughout the Phase 1 development within the east subbasin. The BioPod facility was sized based on the water quality release rate prior to infiltration.

To meet the pretreatment requirement for the proposed infiltration facility, a pretreatment facility that has GULD approval, such as the Contech Stormceptor system (STC 2400), will be used (see Appendix C).

5.3 Source Control

According to the SWMMWW, Volume IV, Source Control BMPs, Chapter IV-2, "Selection of Operational and Structural Source Control BMPs," the following Source Control BMPs are identified as appropriate for this project:

BMP S411 Landscaping and Lawn/Vegetation Management:

Amended soil/landscape systems, such as BMP T5-13, will be implemented in the landscape design.

BMP S412 Loading and Unloading Areas for Liquid or Solid Material:

The asphalt pavement in the main industrial area drains toward a series of catch basins that collects accumulated stormwater and conveys to the series of water quality facilities.

BMP S417 Maintenance of Stormwater Drainage and Treatment Systems:

Maintenance and operations guidelines detailed in Appendix C of this report shall be implemented by the project owner.

BMP S424 Roof/Building Drains at Manufacturing and Commercial Buildings:

Not Applicable. The roof is composed of non-leaching materials.

Conveyance System Analysis and Design

The conveyance system for the project is sized to convey the 25-year recurrence interval peak flow from the site. The Rational Method was used to develop runoff flows from the site. Manning's equation was used for preliminary pipe sizing. Analysis of the 100-year peak flow was completed to assess the capability to accommodate the 100-year runoff for developed conditions without creating a flooding problem.

SECTION 6. SPECIAL REPORTS AND STUDIES

Relevant reports and studies for this project include:

1. Geotechnical Engineering Report, Cornerstone General Contractors – Arlington Operations Center Redevelopment, Arlington, Washington. By Associated Earth Sciences, dated May 30, 2024. (See Appendix A).

SECTION 7. OTHER PERMITS

The following permits are required for this project:

1. Clearing and Grading Permit
2. Building Permit
3. Demolition Permit
4. NPDES Stormwater Permit

SECTION 8. FIGURES

Figure 1. Vicinity Map

Figure 2. Site Assessment Maps

Figure 3. Site Development: The construction plans accompanying this report will substitute for this figure.

sah\21\24\009\reports\drainage report\arlington\aoc drainage report.docx\mad

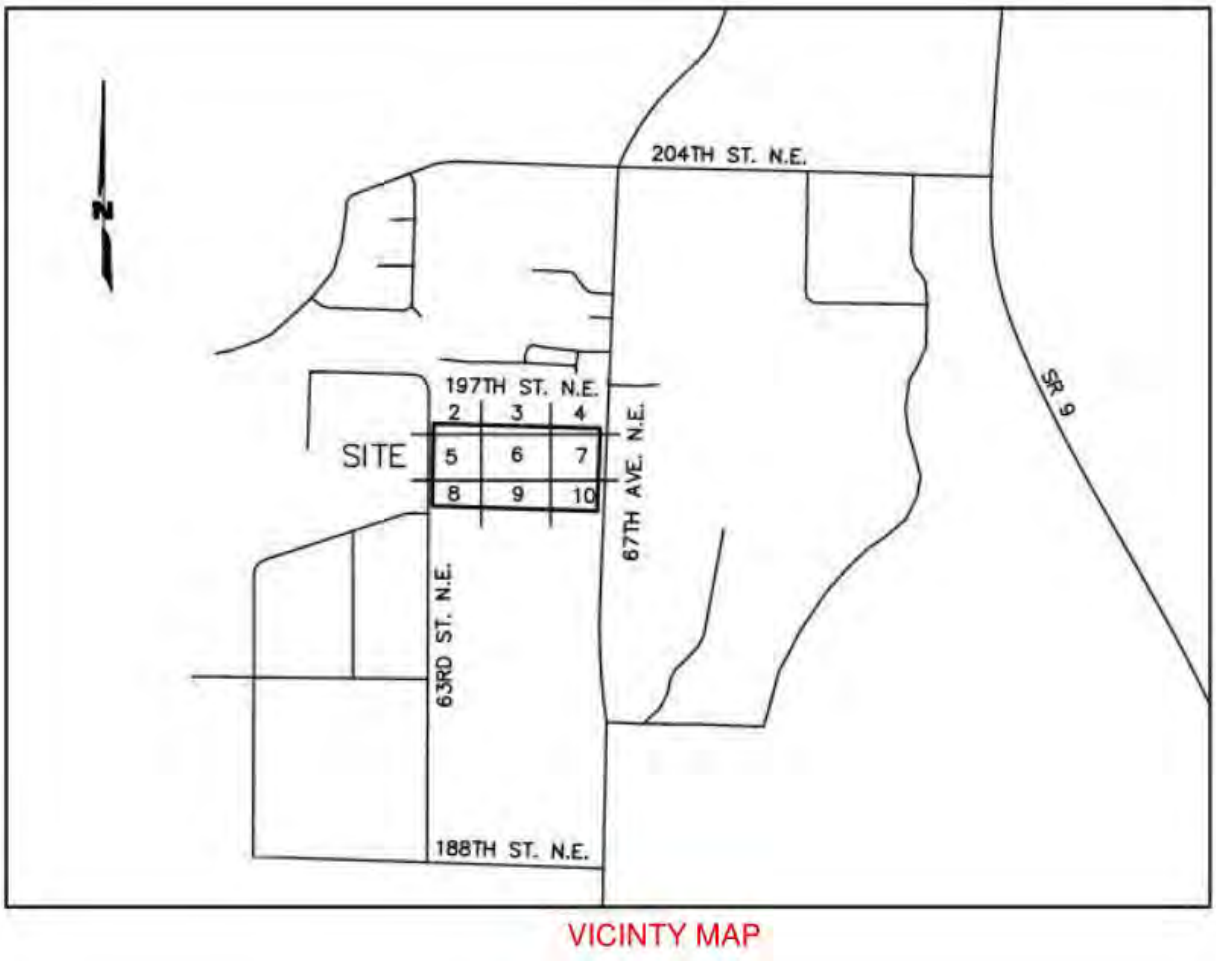
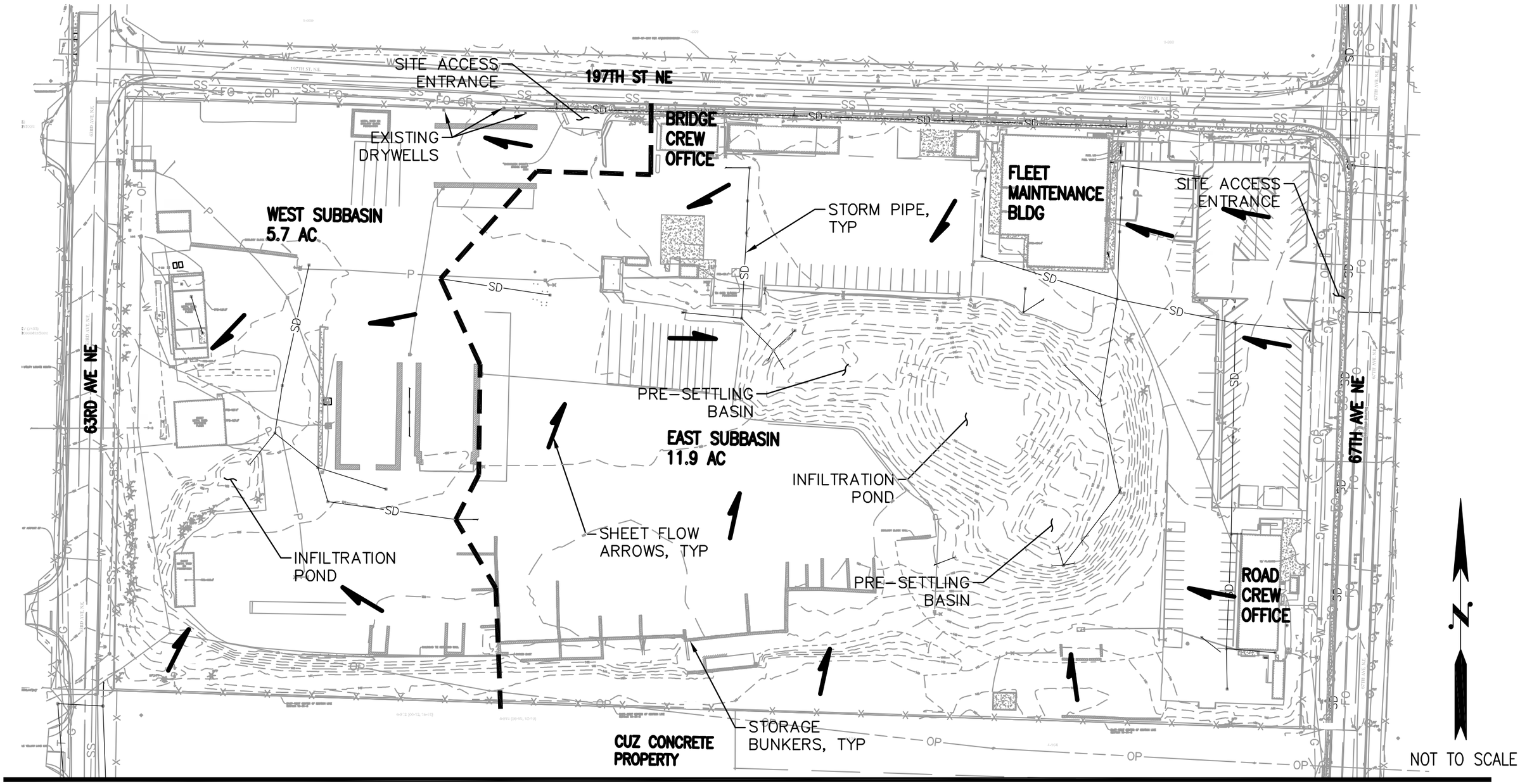


Figure 1. Vicinity Map.



ReidMiddleton

EXISTING DRAINAGE BASIN

SNOHOMISH COUNTY - ARLINGTON OPERATIONS CENTER

Fig No.2A

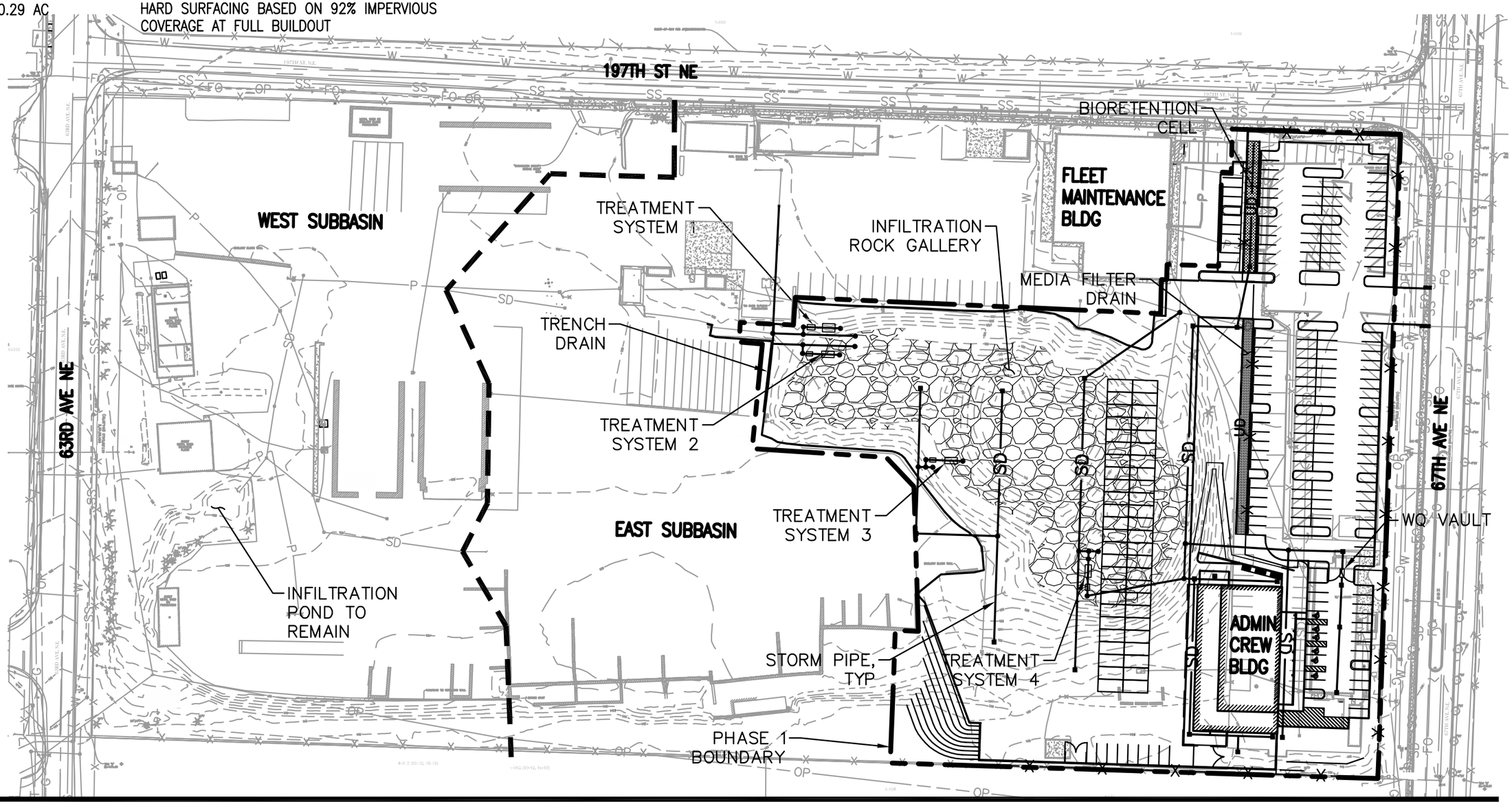
01/22/2025 2:09pm H:\21Cp\24\009 Dykeman_Arlington Ops Center\Drafting\Design\Work-MAD\Drainage Basins.dwg

EAST SUBBASIN – 12 AC TOTAL
HARD SURFACE = 11.04 AC
PERVIOUS = 0.96

WEST SUBBASIN – 5.7 AC
HARD SURFACE = 5.41 AC
PERVIOUS = 0.29 AC

EAST SUBBASIN
HARD SURFACING BASED ON 92% IMPERVIOUS COVERAGE AT FULL BUILDOUT. PHASE 1
PERVIOUS = 0.92 AC

WEST SUBBASIN
HARD SURFACING BASED ON 92% IMPERVIOUS COVERAGE AT FULL BUILDOUT

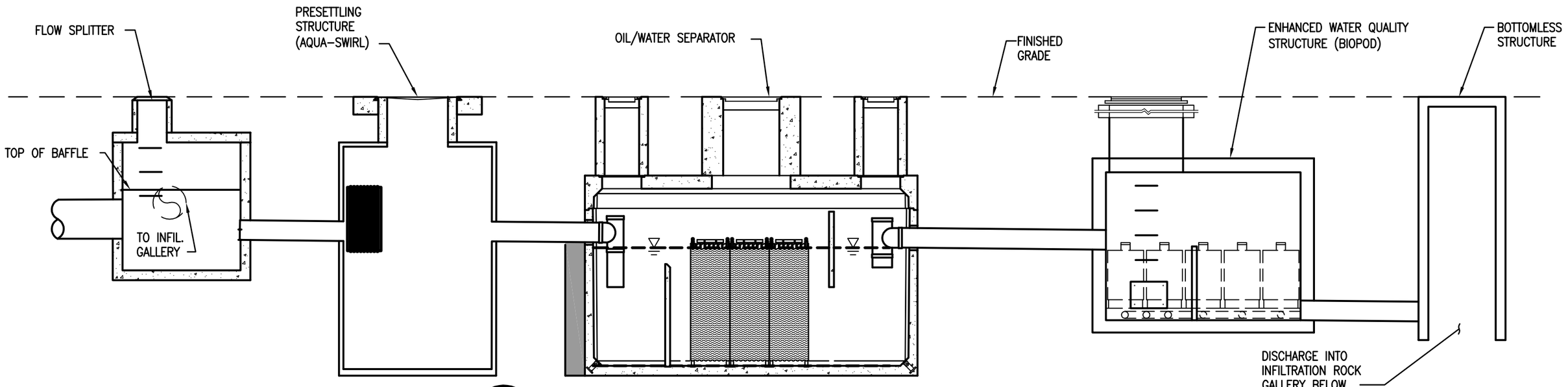


Reid Middleton

DEVELOPED DRAINAGE BASIN

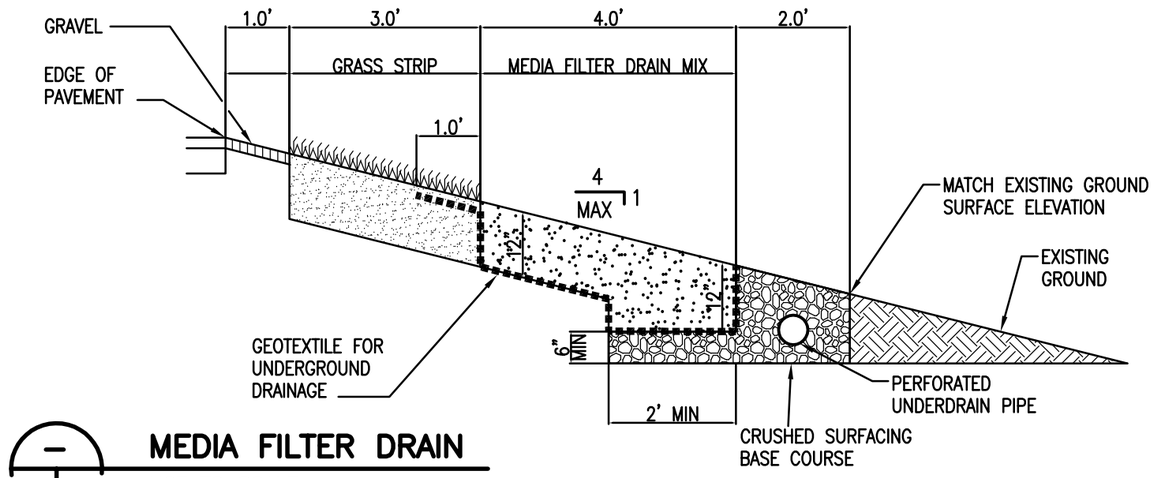
SNOHOMISH COUNTY - ARLINGTON OPERATIONS CENTER

Fig No.2B



TYPICAL STORM WATER TREATMENT SYSTEM

NOT TO SCALE



MEDIA FILTER DRAIN

NOT TO SCALE

Reid Middleton

TREATMENT DETAILS

SNOHOMISH COUNTY - ARLINGTON OPERATIONS CENTER

Fig No.2C

APPENDIX A

GEOTECHNICAL REPORT

Intentionally Left Blank

associated
earth sciences
incorporated

Subsurface Exploration, Geologic Hazards,
Preliminary Geotechnical Engineering, and Infiltration Feasibility Report

ARLINGTON OPERATIONS CENTER REDEVELOPMENT

Arlington, Washington

Prepared For:

CORNERSTONE GENERAL CONTRACTORS, INC.

Project No. 20240001E001
May 30, 2024

Associated Earth Sciences, Inc.

www.aesgeo.com

Kirkland | Mount Vernon | Tacoma

associated earth sciences incorporated

May 30, 2024
Project No. 20240001E001

Cornerstone General Contractors, Inc.
11805 North Creek Parkway South, #115
Bothell, Washington 98011

Attention: Sam Comer

Subject: Subsurface Exploration, Geologic Hazards, Preliminary Geotechnical Engineering, and Infiltration Feasibility Report
Arlington Operations Center Redevelopment
19620 67th Avenue SE
Arlington, Washington

Dear Sam Comer:

We are pleased to present the enclosed copy of our preliminary geotechnical report. This report presents subsurface exploration and laboratory data and presents preliminary recommendations for the design of the project. We recommend that we be allowed to review project plans as they near completion and verify or update the recommendations in this report as needed to reflect the final design.

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. Please contact me if you have any questions or if we can be of additional help to you.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Kurt D. Merriman, P.E.
Senior Principal Engineer

KDM/ld – 20240001E001-002

SUBSURFACE EXPLORATION, GEOLOGIC HAZARDS, PRELIMINARY GEOTECHNICAL ENGINEERING, AND INFILTRATION FEASIBILITY REPORT

ARLINGTON OPERATIONS CENTER REDEVELOPMENT

Arlington, Washington

Prepared for:
Cornerstone General Contractors, Inc.
11805 North Creek Parkway South, #115
Bothell, Washington 98011

Prepared by:
Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, Washington 98033
425-827-7701

May 30, 2024
Project No. 20240001E001

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of Associated Earth Sciences, Inc.'s (AESI's) subsurface exploration, geologic hazard, preliminary geotechnical engineering, and stormwater infiltration feasibility study for the proposed site improvements for the Arlington Operations Center Redevelopment in Arlington, Washington. The site location is shown on the "Vicinity Map," Figure 1. The approximate locations of explorations completed for this study are shown on the "Existing Site and Exploration Plan," Figure 2 and "Proposed Site Improvements," Figure 3. Copies of the exploration logs are included in Appendix A, previous exploration logs completed by AESI, and historical exploration logs completed by others are included in Appendix B, and laboratory testing results are included in Appendix C. Groundwater data provided by others is presented in Appendix D. AESI is familiar with the project site through the completion of our previous report, titled "Stormwater Infiltration Facility Arlington Road Maintenance Yard," dated January 12, 2000. For the preparation of this report, we were provided with the following documents:

- "Phase 1 Environmental Site Assessment" prepared by CDM Smith, dated August 31, 2015.

- "Revised Preliminary Geotechnical Report Arlington Operations Center," prepared by Shannon & Wilson, dated May 7, 2020.

This report is considered preliminary, as the project design was still in the conceptual phase and no project plans were available for our review. We recommend that we be allowed to review the recommendations contained in this report and modify them, if necessary, once project plans have been finalized.

1.1 Purpose and Scope

The purpose of this study is to provide subsurface soil and groundwater data to be utilized in the design of the project. Our study included reviewing selected available geologic literature, review of previous studies completed by AESI and others, advancing three exploration borings, and performing a geologic study to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow groundwater. Geotechnical engineering studies were completed to determine the type of suitable foundations, allowable foundation soil bearing pressures, anticipated foundation settlements, geologic hazard mitigation considerations, erosion control recommendations, structural fill placement and compaction, drainage considerations, and the feasibility of stormwater infiltration. This report summarizes our current fieldwork and offers preliminary geotechnical recommendations based on our present understanding of the project. We recommend that we be allowed to review the

recommendations presented in this report and revise them, if needed, when a project design has been finalized.

1.2 Authorization

Written authorization to proceed with this study was granted by means of signed scope of work and cost proposals dated January 16, 2024. This report has been prepared for the exclusive use of Cornerstone General Contractors, Inc., and their agents, for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The subject site is the Snohomish County's Arlington Operations Center located at 19620 67th Avenue NE in Arlington, Washington (Snohomish County Parcel No. 31051500101500). The site is rectangular in plan view and is approximately 17.5 acres in area. The site is bordered by 63rd Avenue NE to the west, 197th Street NE to the north, 67th Avenue NE to the east, and existing commercial properties to the south.

The Arlington site was formerly a sand and gravel pit that was filled in by the County as part of their mine reclamation process as indicated in the "Phase 1 Environmental Site Assessment, Snohomish County Maintenance Shop" prepared by CDM Smith, dated 2015. As a result, portions of the site are underlain by existing fill soils up to 20 feet thick. These areas are generally located near the central and eastern-central portions of the site, where the former pit was located and the final grades were raised the highest. The Arlington Operations Center generally consists of gravel and paved surfaces used by the County for storage of road cleaning and maintenance equipment, stockpiled materials, and vehicles. Several buildings and covered storage areas are present across the property. This phase of the project is focused on the southeastern corner of the site where the existing single-story administrative and crew building and large, vegetated infiltration pond are located. The infiltration pond has steep slopes with maximum slope heights of about 24 feet at inclinations near 2H:1V (Horizontal:Vertical) on the east side and 3H:1V along the north, west, and south sides of the pond. Site topography slopes from a topographical high of approximately 148 feet along the southern property boundary down to the low point at the infiltration pond bottom with a total vertical relief of approximately 30 feet. Outside of the infiltration pond, site topography is comparatively flatter and generally slopes gently downward towards the north.

The first phase of the Arlington Operations Center site development will consist of a new two-story operations building with an approximate footprint of 15,000 square feet, new

underground stormwater facilities, utilities, paved parking and driveways, and landscaping as shown on Figure 3, "Proposed Site Improvements." Future project phases may include covered gathering areas, a fabrication shop, equipment storage, waste material storage, a heated vehicle storage building, and various storage sheds. We understand the project will pursue stormwater infiltration with a new infiltration vault proposed near the bottom of the existing large stormwater infiltration pond.

2.1 Previous Studies

Previous studies were completed at the site by AESI in 2000, CDM Smith in 2015, and by Shannon & Wilson in 2020. The AESI study completed in 2000, "Stormwater Infiltration Facility, Arlington Road Maintenance Yard," included five exploration pits on the northern edge of the site north of the currently proposed site improvements. The 2000 study was focused on the hydrogeologic conditions for a proposed infiltration pond.

CDM Smith completed the "Phase 1 Environmental Site Assessment, Snohomish County Maintenance Shop," in 2015 at the site. The study includes a site history that details the site's historical use. The site was previously the location of a railroad from the early 1900's until it was used as a gravel mine in the 1940's. The site was then redeveloped in 1973 to support its current operations. Historical information indicates that the mined areas were slowly being restored to reclamation grade by the late 1990's by the placement of unspecified "excavated materials." AESI reviewed figures showing elevation data prior to the grading of the pond to determine potential depths of existing fill soils in the vicinity of the proposed site improvements.

The Shannon & Wilson study completed in 2020, "Revised Preliminary Geotechnical Report, Arlington Operations Center," was focused on the redevelopment of the operations center. Exploration borings were completed across the site with SW-2-19 and SW-3-19 completed in the area of the currently proposed Phase 1 site improvements. One of the explorations, SW-3-19, was completed as a vibrating wire piezometer (VWP) in which groundwater readings were taken from December 2019 through March 2020. The hydrograph created from those groundwater readings is included in Appendix D of this report for reference. The Shannon & Wilson report also provides groundwater data from a VWP (SB-01) which had been previously installed by Snohomish County, and the logs of two borings completed by Terracon in 2016. The additional groundwater data and 2016 borings logs are also included in this report for reference.

The approximate locations of the borings and exploration pits are shown on Figures 2 and 3, and copies of the exploration logs are included in Appendix B. The subsurface conditions encountered in the previous explorations are summarized in Section 3.2 of this report. The previous subsurface exploration information was used to supplement the subsurface information obtained for this current study and aided in our assessment of the depth to groundwater, fill depths, and the characteristics of the native sediments.

3.0 SUBSURFACE EXPLORATION

Our field study, completed in April 2024, included advancing three explorations to define the general soil and shallow groundwater conditions in the vicinity of the proposed Phase 1 improvements. The exploration locations are shown on Figure 2 and Figure 3. 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. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types in the field. The locations of our field explorations were determined by approximate measurements from known site features.

The conclusions and recommendations presented in this report are based, in part, on the exploration borings completed for this study. The number, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions might sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

3.1 Exploration Borings

The exploration borings were completed by Advance Drill Technology Inc., an independent driller working under subcontract to AESI, by advancing a 6-inch outside-diameter, hollow-stem auger with a track-mounted drill rig. The approximate locations of the borings completed for this study are shown on Figure 2. During the drilling process, samples were generally obtained at 2½- to 5-foot-depth intervals. After drilling, each borehole was backfilled with bentonite grout in combination with bentonite chips, and the surface was patched with on-site material.

Disturbed, but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *ASTM International* (ASTM) D-1586. This test and sampling method 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 is known as the Standard Penetration Resistance (“N”) or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The borings were continuously observed and logged by a geologist from our firm. The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing. The exploration logs presented in Appendix A are based on the N-values, field observations, and drilling action.

3.2 Historical Explorations and Explorations by Others

Summaries of the subsurface conditions encountered in the previously completed explorations at the site are provided below.

AESI 2000

Our previous study included the excavation of five exploration pits in October of 1999, along the northern side of the infiltration pond. These pits were completed to depths between 12 and 13.5 feet below the ground surface. The exploration pits typically encountered fill, overlying Vashon recessional outwash. Fill was observed extending beyond the total depth explored in EP-1 and EP-2 near the northwestern end of the infiltration pond. EP-3, EP-4, and EP-5 encountered recessional outwash underlying the fill at depths of 2, 6, and 8 feet below the ground surface. No groundwater was encountered at the time of the explorations. The sediments observed within the 2000 exploration pits are generally consistent with the borings completed as part of this study. The approximate boring locations are shown on Figures 2 and 3, and copies of the exploration logs from previous studies are included in Appendix B.

Shannon & Wilson 2020

Subsurface explorations for this study included the completion of five exploration borings spread across the parcel, with one of the explorations, SW-3-19, completed as a VWP. These borings typically encountered 7 to 16 feet of fill overlying Vashon recessional outwash (Marysville Sand Member). Vashon advance outwash was reported below the recessional outwash in SW-3-19 and SW-4-19 at depths of 93 feet and 88 feet, respectively. The Shannon & Wilson borings were completed in May 2020, and the depth to groundwater in all five borings, observed at the time of drilling, ranged from 40 feet to 56 feet below the surface. These depths correlate to an elevation range of 72 to 94 feet (NAVD 88). The highest observed groundwater at the time of drilling was observed in the boring completed as the VWP. Groundwater measurements taken from the VWP between December 2019 through March 2020 indicate the estimated groundwater elevation (not surveyed) reportedly fluctuated between depths of 53 feet to 45 feet. Groundwater is discussed in more detail in Section 4.3.

The 2020 Shannon & Wilson report also contained summaries and boring logs for studies completed by Terracon and for the previously mentioned Snohomish County VWP. The Terracon explorations, which were completed along the southeastern margin of the site, encountered

10 to 15 feet of existing fill overlying a 2.5-foot-thick layer of peat with medium dense sand and gravel present below. These borings were completed to a depth of 21.5 feet below the surface. The Snohomish County boring SB-01 northwest of the infiltration pond encountered 3 feet of fill over medium dense to dense sand and interbedded silty sand and was completed to a maximum depth of 145.5 feet. The sediments encountered below the fill are consistent with recessional outwash sediments.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, previous work by others, visual reconnaissance of the site, and review of applicable geologic literature. As shown on the attached logs in Appendix A, the exploration borings generally encountered existing fill overlying Vashon recessional outwash. Two explorations completed in 2020 by Shannon & Wilson encountered Vashon advance outwash at depth below the recessional outwash. Two explorations completed by Terracon in the southeastern corner of the site encountered a layer of peat below the existing fill and above the recessional outwash. The following section presents more detailed subsurface information organized from shallowest (youngest) to deepest (oldest).

4.1 Stratigraphy

Sod/Topsoil

Sod and organic-rich, dark brown topsoil was encountered in all three of the current exploration borings and extended to approximately 4 to 6 inches below ground surface. The organic topsoil is not suitable for infiltration, foundation support, or for use in structural fill.

Fill

Directly below the sod/topsoil in EB-1, EB-2, and EB-3 we encountered a variety of existing fill material. The fill generally consisted of slightly moist to moist brown to dark brown silty, fine sand, some gravel and scattered to abundant organic debris (rootlets, wood debris, fine black organics). The texture of the existing fill ranged from silty sand to sand some silt with varying amounts of gravel but was typically granular in nature, and also varied in color. During the drilling process, areas of gravel and abundant organics were observed at varying depths. Fill observed by others was typically between 7 and 16 feet thick depending on location with the thickest fills observed to the east of the site. In our recent explorations the existing fill was observed between 5.5 and 19 feet thick. The thicker fill was observed in EB-1 and EB-2 at higher topographic site elevations near the top of the southeast infiltration pond slope. Due to the granular nature of this fill, it may be suitable for reuse in structural fill applications, provided it is free of excessive organic/construction debris and a proper moisture conditioning can be attained.

Peat

A 2.5-foot-thick layer of peat consisting of soft, brown fibrous organic silt was encountered by Terracon in exploration boring B-1 and B-2; see Figures 2 and 3. The peat was encountered 10.5 feet and 15 feet below the existing ground surface in B-1 and B-2, respectively. Peat is typically deposited in areas that were formerly occupied by streams or swamps. Peat is highly compressible and not suitable for structural support. Peat sediments were not encountered in any of the explorations completed by AESI, Shannon & Wilson, or Snohomish County.

Vashon Recessional Outwash- Marysville Sand Member

Sediments encountered directly below the existing fill at a depth of 19 feet in EB-1 and EB-2 and at 5.5 feet in EB-3 generally consisted of medium dense to dense, partially stratified, brownish gray, sand, some gravel with trace to some silt and ranged to gravelly sand with some silt. Occasional layers of very stiff silt, sandy silt, and/or medium dense to dense gravel were observed within the unit with cobbles encountered during drilling. We interpret these sediments to be representative of Vashon recessional outwash (Marysville Sand Member). The Vashon recessional outwash was deposited by meltwater streams flowing off of the retreating glacial ice during the latter portion of the Vashon Stade of the Fraser Glaciation approximately 12,500 to 15,000 years ago. Where encountered in our explorations the recessional outwash extended beyond the depths explored. Laboratory sieve analyses were conducted on three samples of the recessional outwash to assess the suitability of the outwash for infiltration. Copies of the sieve analyses results are included in Appendix C.

Properly prepared recessional outwash is suitable for support of foundation loads. Excavated recessional outwash that is free of organic debris, oversized cobbles and boulders, and other deleterious materials, and which exhibits a moisture content compatible with achieving the specified level of compaction is suitable for reuse as structural fill. Although the majority of the outwash consisted predominantly of granular material (sand and gravel), the outwash has the potential to contain lenses or interbeds of silt. Excavated portions of the outwash that consist predominantly of silt are not recommended for use as structural fill.

Vashon Advance Outwash

Sediments encountered below the Vashon recessional outwash in two borings completed by Shannon & Wilson, SW-3-19 and SW-4-19, consisted of wet, dense, gray silty fine to medium sand with occasional fine gravel layers, lenses of silt, and occasional seams of iron-oxide staining. This material was encountered at depths of 88 feet and 93 feet below ground surface and was interpreted as Vashon advance outwash. Vashon advance outwash was deposited by meltwater streams that emanated from the advancing glacial ice during the Vashon Stade of the Fraser Glaciation, approximately 12,500 to 15,000 years ago. These sediments typically have high

relative density characteristics due to their consolidation by the massive weight of the glacial ice that overrode these sediments subsequent to their deposition.

4.2 Regional Geologic and Soils Mapping

Review of the published geologic map, titled *Geologic Map of the Arlington West 7.5 Minute Quadrangle*, *Snohomish County, Washington* by J.P. Minard, 1985, indicates that the site is expected to be underlain by Vashon recessional outwash Marysville Sand Member with Vashon advance outwash mapped in the vicinity to the east.

Review of regional soils mapping (*Web Soil Survey*, U.S. Department of Agriculture [USDA], Natural Resources Conservation Service [NRCS]) indicates that the subject site is underlain by Everett very gravelly sandy loam, 0 to 8 percent slopes on the eastern half of the parcel and Lynnwood loamy sand, 0 to 3 percent slopes on the western half of the parcel. The Everett and Lynnwood series soils mapped onsite generally formed from the granular glacial outwash. Our interpretation of the shallow site geology and soils is in general agreement with the regional mapping in that we encountered recessional outwash underlying the existing fill soils.

4.3 Hydrology

Groundwater is present at the site as part of the local water table within the Vashon recessional outwash and as perched groundwater seams within the fill and peat, and above silt/silty interbeds within the Vashon recessional outwash. Information on the Vashon recessional outwash aquifer, perched groundwater, and the existing infiltration pond are described below. Our explorations were conducted in April when groundwater levels are typically elevated. It should be noted that groundwater conditions, including depth and duration and quantity of seepage, should be expected to vary seasonally, and in response to changes in precipitation, soil grain-size distribution, topography, on- and off-site land usage, and other factors. Groundwater measurement data provided by others is included in Appendix D.

Perched Groundwater

Though not encountered in our recent borings, zones of perched groundwater may be present above the groundwater table. Perched groundwater occurs when surface water infiltrates down through relatively permeable shallow soils and becomes trapped or “perched” atop lower-permeable layers such as silty zones within the existing fill, peat, and Vashon recessional outwash sediments. Perched water may travel laterally in flow directions unrelated to the ground surface topography or may be discontinuous and isolated. Wet conditions were noted in the peat sediments encountered in the 2016 Terracon borings.

Vashon Recessional Outwash Aquifer

Groundwater was encountered in EB-2 and EB-3 at the time of drilling within the Vashon recessional outwash deposits and described by others (Shannon & Wilson, 2000). Depth to groundwater and estimated groundwater elevations are summarized in Table 1 below. The depth to groundwater in EB-2 and EB-3 ranged from 33 feet in EB-3 to 54.5 feet in EB-2. These groundwater depths correlate to estimated elevations of 87 feet and 91.5 feet. We interpret this groundwater as the local unconfined groundwater table present within the Vashon recessional outwash sediments.

In addition to the groundwater levels observed in our explorations, the referenced Shannon & Wilson report completed in 2020 indicated that groundwater elevations in the area of the proposed improvements were measured between 91 and 94 feet from the VWP installed in boring SW-3-19. Groundwater measurements were collected between December 2019 and March 2020. These groundwater elevations are similar to the depths observed in our explorations completed for this current study.

This report also summarizes groundwater data reviewed by Shannon & Wilson for a VWP installed by Snohomish County, labeled SB-01. Groundwater data was collected from this VWP over the course of a one-year period during 2016. A plot of the water level measurements is provided in Appendix D. This plot has an irregularity where a rise in groundwater of 11 feet was measured on a single day. No source or explanation for the irregularity was determined in the Shannon & Wilson report. The report does provide water levels measured from SB-01 in January and March of 2020 at depths of 40 feet and 38 feet, respectively. Based on the more recent water level measurements, the report estimates groundwater between elevations 84 feet and 86 feet, from January to March.

Table 1
Estimated Groundwater Depths and Elevations

Exploration Boring No.	EB-1	EB-2	EB-3	SW-1-19	SW-2-19	SW-3-19	SW-4-19	SW-5-19	SB-01
Groundwater Depth (feet)	N/A	54.5	33	52	40	53 to 60	50	46	38 to 40
Approximate Groundwater Elevation* (feet)	N/A	91.5	87	79	80	91 to 94	72	79	84 to 86

*Note: Groundwater elevations for the AESI borings are estimated. The elevations will be defined once the boring locations are surveyed.

It is important to note that the anomalous groundwater data from VWP SB-01 reported by Shannon & Wilson brings an additional level of uncertainty to the data. The uncertainty from the

irregularity in the data is also in addition to some level of uncertainty that comes when reviewing work from others. AESI considered this uncertainty when relying on the information in these reports to formulate our recommendations.

Existing Infiltration Pond Observations

At the time of our exploration the infiltration pond was not holding any water and anecdotally, does not hold water throughout the year. Minor evidence of erosion due to surface flow was observed on slope faces near catch basins and in swales surrounding the infiltration pond.

4.4 Laboratory Testing

AESI performed three grain-size analyses (sieves) on samples of Vashon recessional outwash. The testing was completed generally in accordance with ASTM procedures on samples collected from EB-3 at varying depths. Due to the size of the gravels present at the 7.5-foot-depth sample, it is likely that the sample size obtained from the split-spoon sampler did not meet the ASTM requirement and may not accurately represent the amount of gravel or the maximum size of the gravel present. This sampling method limits gravel size obtained in the sample to less than 2 inches. The grain-size analyses test results are included in Appendix C and summarized below.

Table 2
Summary of Sieve Analysis Test Results

Exploration Boring No.	Sample Depth (feet)	Geologic Unit	USCS Soil Description	Fines Content (%)
EB-3	7.5	Vashon Recessional Outwash	Very gravelly SAND, trace silt	4.8
EB-3	15	Vashon Recessional Outwash	SAND, trace gravel, trace silt	4.5
EB-3	20	Vashon Recessional Outwash	SAND, some gravel, some silt	5.5

USCS = Unified Soil Classification System

We sent out three samples to a subcontracted laboratory for organic content and cation exchange capacity tests. The tests were completed on representative samples of Vashon recessional outwash. The organic content testing was completed in accordance with ASTM procedure D-2974 on samples collected from EB-3 at varying depths. The cation exchange capacity testing was completed in accordance with the Environmental Protection Agency (EPA) EPA-9081 test procedure. The results of these tests are included in Appendix C and summarized below in Table 3 and Table 4.

Table 3
Summary of Organic Burn Test Results

Exploration Boring No.	Sample Depth (feet)	Geologic Unit	Organic Content (%wt)
EB-3	7.5	Vashon Recessional Outwash	1.81
EB-3	15	Vashon Recessional Outwash	0.48
EB-3	20	Vashon Recessional Outwash	0.53

%wt = percent by weight

Table 4
Summary of Cation Exchange Capacity Test Results

Exploration Boring No.	Sample Depth (feet)	Geologic Unit	Cation Exchange Capacity (meq/100g)
EB-3	7.5	Vashon Recessional Outwash	5.1
EB-3	15	Vashon Recessional Outwash	2.7
EB-3	20	Vashon Recessional Outwash	2.7

meq/100g = milliequivalents per 100 grams

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic conditions as observed and discussed herein.

5.0 LANDSLIDE HAZARDS AND MITIGATIONS

The *City of Arlington Municipal Code* (AMC) classifies landslide hazards in subsection 20.93.600b(2) as the following:

(A) Areas characterized by slopes greater than fifteen percent and impermeable soils (typically silt and clay) frequently interbedded with permeable granular soils (predominantly sand and gravel) or impermeable soils overlain with permeable soils or springs or groundwater seepage;

(B) Any area that has exhibited movement during the Holocene epoch (from ten thousand years ago to present) or which is underlain by mass wastage debris of that epoch;

(C) Any area potentially unstable due to rapid stream incision, stream bank erosion or undercutting by wave action;

(D) Any area located on an alluvial fan presently subject to or potentially subject to inundation by debris flows or deposition of steam-transported sediments;

(E) Any area with a slope of thirty-three percent or greater and with a vertical relief of ten or more feet except areas composed of consolidated rock;

(F) Any area with slope defined by the United States Department of Agriculture Soil Conservation Service as having a severe limitation for building site development; and

(G) Any shoreline designated or mapped as class U, UOS, or URS by the Department of Ecology Coastal Zone Atlas.

Portions of the infiltration pond slope meet criteria E above, for treatment of a landslide hazard. No exceptions were provided in the AMC, for slopes created by past grading activities to be exempt from the landslide hazard classification. As previously mentioned, these slopes were constructed during the mine reclamation process and construction of the infiltration pond. Currently, these slopes are vegetated with grass and other low-lying vegetation. During the completion of our site work, we observed no signs of slope instability of the pond slopes and no signs of groundwater seepage. At its steepest, the pond slopes are generally inclined at a 2H:1V

slope, which is a suitable permanent slope inclination for unsaturated existing fill or Vashon recessional outwash. We understand the project proposes to construct an infiltration vault in the vicinity of the infiltration pond and then backfill the remaining pond area up to adjacent grades. This process will eliminate the slope and any associated hazard. As long as the recommendations in this report are followed, the project will not increase the risk of the hazard on the subject property or neighboring properties.

Slopes less than 8 feet in height were observed in the Light Detection and Ranging (LiDAR)-based contours on Figure 2 near the south property line. These slopes appear to have been created during previous grading activities and are generally retained by ecology blocks and/or existing stockpiles of road repair and maintenance materials. We anticipate that the site improvements associated with this phase of the project will not alter the southern slope.

6.0 SEISMIC HAZARDS AND MITIGATIONS

The following discussion is a general assessment of seismic hazards that is intended to be useful to the project design team in terms of understanding seismic issues, and to the structural engineer for design.

All of Western Washington is at risk of strong seismic events resulting from movement of the tectonic plates associated with the Cascadia Subduction Zone (CSZ), where the offshore Juan de Fuca plate subducts beneath the continental North American plate. The site lies within a zone of strong potential shaking from subduction zone earthquakes associated with the CSZ. The CSZ can produce earthquakes up to magnitude 9.0, and the recurrence interval is estimated to be on the order of 500 years. Geologists infer the most recent subduction zone earthquake occurred in 1700 (Goldfinger et al., 2012[1]). Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound region document a distinct zone of shallow crustal seismicity (e.g., the Seattle Fault Zone). These shallow fault zones may include surficial expressions of previous seismic events, such as fault scarps, displaced shorelines, and shallow bedrock exposures. The shallow fault zones typically extend from the surface to depths ranging from 16 to 19 miles. A deeper zone of seismicity is associated with the subducting Juan de Fuca plate. Subduction zone seismic events produce intraplate earthquakes at depths ranging from 25 to 45 miles beneath the Puget Lowland including the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event) and interplate earthquakes at shallow depths near the Washington coast including the 1700 earthquake, which had a magnitude of approximately 9.0. The 1949 earthquake appears to have been the largest in this region during recorded history and was

[1] Goldfinger, C., Nelson, C.H., Morey, A.E., Johnson, J.E., Patton, J.R., Karabanov, E., Gutierrez-Pastor, J., Eriksson, A.T., Gracia, E., Dunhill, G., Enkin, R.J., Dallimore, A., and Vallier, T., 2012: *Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone*: U.S. Geological Survey Professional Paper 1661–F, 170.

centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides or lateral spreading, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

Generally, the largest earthquakes that have occurred in the Puget Sound area are sub-crustal events with epicenters ranging from 25 to 45 miles in depth. Earthquakes that are generated at such depths usually do not result in fault rupture at the ground surface. Based on current knowledge, the subject property is located several miles from known surface faults. Therefore, based on current information, the risk of damage to planned improvements as a result of surface rupture due to faulting is low, in our opinion.

6.2 Seismically Induced Landslides

Current project plans indicate that an infiltration vault will be constructed in the location of the existing steep-sided stormwater infiltration pond. The vault and pond will be backfilled during construction effectively eliminating the existing on-site slopes. Based on the proposed final site configuration and the lack of steep slopes at the site, it is our opinion that the risk of damage to the subject project by landsliding is low under either static or seismic conditions. No quantitative assessment of seismic slope stability was completed for the current study and none is warranted for the project as currently proposed, in our opinion.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by very soft to stiff, non-cohesive silt and very loose to medium dense, non-silty to silty sands with low relative densities, accompanied by a shallow water table.

We reviewed liquefaction hazards for the new building. The exploration borings generally encountered medium dense native soils below the existing fills at depths between 5.5 and 19 feet

below the ground surface. Groundwater was encountered within the recessional outwash at a depth of 54.5 feet below the ground surface in EB-2 and a depth of 33 feet below the ground surface in EB-5. While saturated Vashon recessional outwash can be prone to liquefaction, groundwater was encountered approximately 54 feet below the surface near the proposed location of the new building. Current local practice assumes that liquefaction that occurs below a depth of about 50 feet will not propagate to the ground surface and result in significant settlement. Therefore, provided the new building is constructed at or above existing grade, the risk of significant liquefaction settlement affecting the new building will be low, in our opinion.

We also reviewed liquefaction hazards for the proposed infiltration vault. The vault base will be situated at a lower elevation, and closer to the water table. Therefore, the risk of liquefaction-induced settlement affecting the proposed infiltration vault may be somewhat greater. Based on the type of structure, the increased risk of liquefaction settlement affecting the vault does not warrant further study of mitigation measures, in our opinion.

No quantitative liquefaction hazard analysis was completed as part of this study and none is warranted based on observed subsurface conditions, in our opinion.

6.4 Ground Motion/Seismic Site Class (2021 *International Building Code*)

Structural design should follow 2021 *International Building Code* (IBC) standards using seismic Site Class "D" as defined in Table 20.3-1 of American Society of Civil Engineers (ASCE) 7-16 *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. AESI is available on request to complete an analysis of seismic site class in accordance with ASCE 7-22 if the structural engineer predicts such an analysis would benefit the project.

7.0 EROSION HAZARDS AND MITIGATION

Section 20.93.600 (b) of the AMC defines Erosion Hazard Areas as the following:

> *(1) Erosion hazard areas are as defined by the USDA Soil Conservation Service, United States Geological Survey, or by the Department of Ecology Coastal Zone Atlas. The following classes are high erosion hazard areas.*
>
> *a. Class 3, class U (unstable) includes severe erosion hazards and rapid surface runoff areas;*
>
> *b. Class 4, class UOS (unstable old slides) includes areas having severe limitations due to slope; and,*
>
> *c. Class 5, class URS (unstable recent slides).*

The on-site soils do not meet the requirements of AMC 20.93.600 (b) and is therefore not considered an erosion hazard under the AMC. Furthermore, the property is not within a stream channel migration zone and is not situated along a shoreline.

Although the site is not classified as an Erosion Hazard Area, the fill and natural sediments underlying the site contain quantities of silt and fine sand that are sensitive to disturbance when wet. In order to mitigate erosion hazards and the potential for off-site sediment transport, we recommend the following best management practices (BMPs):

1. Construction activity should be scheduled or phased as much as possible to avoid earthwork activity during the wet season.

2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The site plan should include ground-cover measures and staging areas. The contractor should be prepared to implement and maintain the required measures to reduce the amount of exposed ground.

3. Temporary erosion and sedimentation control (TESC) elements and perimeter flow control should be established prior to the start of grading.

4. During the wetter months of the year, or when significant storm events are predicted during the summer months, the work area should be stabilized so that if showers occur, it can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be "buttoned-up" will depend on the time of year and the duration that the area will be left unworked. During the winter months, areas that are to be left unworked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor's ability to get back into a work area after a storm event. The stabilization process also includes establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment/discharge facilities.

5. All disturbed areas should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.

6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport.

7. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering stockpiles with plastic sheeting or the use of silt fences around pile perimeters.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate erosion mitigation (BMPs) throughout construction, the potential adverse impacts from erosion hazards on the project should be mitigated.

III. PRELIMINARY DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

Our exploration indicates that, from a geotechnical engineering standpoint, the proposed Phase 1 site improvements at the subject site are feasible. At the time this report was written, the project was still in the conceptual design phase and final project plans were not available.

Our explorations encountered Vashon recessional outwash beneath a thin layer of topsoil and varying thickness of fill. Fill soils were observed to be the thickest near the edges of the existing stormwater infiltration pond where previous grading and filling occurred during previous site reclamation. Existing fill soils are not suitable for foundation support. Groundwater is present in the recessional outwash sediments, at estimated depths of 52 feet to 59 feet below the surface in the vicinity of the proposed new building. At this depth we do not anticipate that groundwater will be a factor during construction of the proposed improvements. Due to the thickness of the existing fill, we have provided recommendations for a ground improvement system to support the proposed building. Due to the location and anticipated depth of the proposed infiltration vault, we expect the vault can be supported by conventional shallow foundations.

Stormwater infiltration is considered feasible within the recessional outwash sediments. Recessional outwash was encountered near the proposed infiltration vault location at an elevation of approximately 114.5 feet. Where observed as permeable and unsaturated, these sediments are a suitable stormwater infiltration receptor. We have included a discussion on shallow stormwater infiltration later in this report.

9.0 SITE PREPARATION

Prior to site work, erosion and surface water control should be established around the perimeter of the site to satisfy the City of Arlington requirements.

9.1 Clearing and Stripping

Existing pavements, buried utilities, vegetation, topsoil, and any other deleterious materials should be removed where they are located below planned Phase 1 construction areas. Any disturbed soils or depressions, such as those that may be caused by demolition activities, below planned final grades should be compacted with a smooth-drum, vibratory roller to at least 90 percent of the modified Proctor maximum dry density, as determined by the ASTM D-1557 test procedure, and to a firm and unyielding surface, then structural fill should be placed to reach planned grades as discussed under the “Structural Fill” section of this report.

Where excavated existing fill and natural sediments are free of organics and near their optimum moisture content for compaction they can be segregated and considered for reuse as structural fill, if allowed by project specifications. Some of the existing fills and outwash sediments encountered in our explorations contained a moderate silt fraction and are moisture sensitive. These siltier soils may be difficult to reuse as structural fill accept during the drier summer months.

9.2 Temporary Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction based on the conditions encountered at that time. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in unsaturated existing fill or unsaturated medium dense recessional outwash can be made at a maximum slope of 1.5H:1V or flatter. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times. If steeper or deeper cuts are required, then temporary shoring may be necessary.

9.3 Site Disturbance

Most of the near-surface site soils are fills which have a variable grain size and can contain a moderate percentage of fine-grained material, which makes them moisture-sensitive and subject to disturbance when wet. Some of the fill soils may be above their optimum moisture content for compaction when exposed during construction. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened, particularly during wet weather conditions. If disturbance occurs in areas of conventional footings such as the area for the infiltration vault, the softened soils should be removed and the area brought to grade with clean crushed rock fill. Because of the moisture-sensitive nature of the soils, we anticipate that wet weather construction would significantly increase the earthwork costs over dry weather construction.

9.4 Winter Construction

The near-surface fill soils can contain moderate quantities of silt and fine sand and are considered moisture-sensitive. Soils excavated onsite may require drying during favorable dry weather conditions to allow their reuse in structural fill applications. Care should be taken to seal all earthwork areas during mass grading at the end of each workday by grading all surfaces to drain and sealing them with a smooth-drum roller. Stockpiled soils that will be reused in structural fill applications should be covered whenever rain is possible.

If winter construction is expected, crushed rock fill should be used to provide construction staging areas where exposed soil is present. The stripped subgrade should be observed by

the geotechnical engineer, and should then be covered with a geotextile fabric, such as Mirafi 500X or equivalent. Once the fabric is placed, we recommend using a crushed rock fill layer at least 10 inches thick in areas where construction equipment will be used. Soil-cement treatment is another approach to providing a workable site during the winter. We are available to provide more detailed cement-treatment recommendations on request.

9.5 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw, and then be recompacted prior to placing subsequent lifts of structural fill. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

10.0 STRUCTURAL FILL

We anticipate that structural fill will be required to establish design elevations and fill around the proposed infiltration vault, below pavements and for the backfill of utilities. Structural fill should be placed and compacted according to the recommendations presented in this section and requirements included in project specifications. All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials, as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

10.1 Compaction

Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to at least 95 percent of the modified Proctor maximum dry density using ASTM D-1557 as the standard. For backfill of buried utilities in the right-of-way, the backfill should be placed and compacted in accordance with applicable codes and standards.

10.2 Reuse of Site Soils

Soils in which the amount of fine-grained material (smaller than No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions.

Those portions of the existing fills that are free of organic debris and other deleterious materials and that have moisture contents suitable for achieving the recommended level of compaction

may be used as structural fill. At the time of our field study, the moisture contents of the existing fill and recessional outwash sediments encountered in our explorations appeared to be near, or slightly over optimum for achieving suitable compaction. If, at the time of construction, the moisture content of the on-site soil is outside the optimum level to achieve suitable compaction, it should be moisture-conditioned prior to its use as structural fill. This could be achieved by either adding water if the soil is too dry, or aerating the soil during periods of warm, dry weather (typically July through September) if the soil is too wet.

10.3 Wet Weather Fill

Use of moisture-sensitive soil in structural fills is not recommended during the winter or spring months or under wet site and weather conditions. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance. If import soil is required, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction and at least 30 percent retained on the No. 4 sieve.

10.4 Compaction Testing

A representative from our firm should observe the subgrades and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing frequency.

11.0 FOUNDATIONS

Based on the conceptual plans for this phase of the project we understand that the new administrative and crew building will be constructed at or near the existing grade near the southeast corner of the site. Our explorations near this location encountered up to 19 feet of existing loose fill soils, not suitable for foundation support. Underlying the loose fill we encountered native sediments generally consisting of medium dense Vashon recessional outwash sediments. Due to the depth to the suitable bearing material we recommend a ground improvement strategy to transfer the building loads to the Vashon recessional sediments present below the existing loose fill. We have provided recommendations for ground improvement through stone columns or aggregate piers below.

As alternative foundation options AESI also assessed deep foundation systems including pipe pile foundations and augercast piles. We determined that both of these options had challenges that rendered them not as favorable as the aggregate pier option provided below. For a pipe pile foundation system, we found that it is unlikely the driven, small-diameter, piles would achieve the required refusal criteria in the Vashon recessional outwash sediments, resulting in pile lengths that could approach 100 feet. Augercast piles were also assessed as a potential option and were considered not as favorable as ground improvement for foundation support. Because of the code requirement for full-depth reinforcement, augercast piles have a maximum practical installation depth of about 50 feet, which is not deep enough to fully penetrate the liquefiable soils and achieve the desired capacities within the deeper, non-liquefiable sediments.

11.1 Stone Columns or Aggregate Piers (Administrative Building)

A ground improvement program consisting of vibratory stone columns or rammed aggregate piers (RAPs) may be used to provide building foundation and slab-on-grade support. The ground improvement system would be designed by the ground improvement contractor to mitigate and limit post-construction differential settlements to structural design requirements. Subsequent to completion of the ground improvement program, the building could be supported using conventional spread footing foundations.

The ground improvement contractor in conjunction with the project structural engineer should provide the final spacing, depths, and diameters of the stone columns/aggregate piers. For project planning purposes, shallow foundations bearing on properly completed stone columns/aggregate piers can typically be designed for an allowable soil bearing pressure ranging from 4,000 to 6,000 pounds per square foot (psf).

Since the geologic conditions are expected to be variable between exploration locations, provisions should be included in the plans and contract documents to allow for adjustments in the extent of the ground improvement area within the building footprint based on the soil conditions encountered at the time of construction. No building loading information was available at the time of this report.

11.2 Conventional Spread Footings (Stormwater Infiltration Vault)

Based on the elevation and limited thickness of fill in the area of the proposed infiltration vault we anticipate that conventional shallow spread footings can be utilized without the use of ground improvement. Conventional spread footings can be founded directly on medium dense to dense Vashon recessional outwash or on structural fill placed over these sediments. For foundations bearing on sediments as described above, we recommend that foundations be designed using an allowable foundation soil bearing pressure of 3,000 psf, including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading.

11.3 Additional Foundation Recommendations for Building and Vault

Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all footings must penetrate to the prescribed bearing stratum, and no footing should be founded in or above organic or loose soils. All footings should have a minimum width of 18 inches.

It should be noted that the area bound by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM D-1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded as described above should be on the order of 1 inch or less. Disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms to the recommendations contained in this report. Such inspections may be required by the City of Arlington. Perimeter footing drains for the building should be provided as discussed under the "Drainage Considerations" section of this report. A perimeter foundation drain for the vault can be omitted because any groundwater seepage adjacent to the vault walls is expected to infiltrate into the recessional outwash sediments.

11.4 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the existing fill, exposed outwash soils or supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with structural fill and compacted to at least 95 percent of the maximum dry density to achieve the passive resistance design values recommended below. We recommend the following allowable design parameters which include a factor of safety of 1.5:

- Passive equivalent fluid = 300 pounds per cubic foot (pcf)
- Coefficient of friction = 0.30

12.0 FLOOR SUPPORT

Building slab-on-grade floors may be constructed on a subgrade improved by stone columns or aggregate piers. Areas of the slab subgrade that are disturbed (loosened) during construction should be recompacted to an unyielding condition prior to placing the pea gravel, as described below.

In order to control moisture vapor transfer through the slab, slab-on-grade floors should be constructed atop a capillary break consisting of a minimum thickness of 4 inches of washed pea gravel or washed crushed rock. The pea gravel or clean crushed rock should be overlain by a 10-mil (minimum thickness) plastic vapor retarder.

13.0 CAST-IN-PLACE RETAINING WALLS AND BELOW-GRADE WALLS

All backfill placed behind site walls and foundation walls should be placed in accordance with the recommendations contained in the "Structural Fill" section of this report. Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed to resist lateral earth pressure represented by an equivalent fluid pressure equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid pressure of 55 pcf. Walls with sloping backfill up to a maximum gradient of 2H:1V should be designed using an equivalent fluid pressure of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions. It should be noted that the lateral earth pressures presented above are applicable for medium dense native soils or properly compacted structural fill.

If vehicle parking areas are adjacent to walls, we recommend a vertical surcharge equal to 250 psf be added to the wall height in determining the lateral design forces. The lateral pressure resulting from each vertical surcharge can be calculated by multiplying the surcharge load by 0.4 and applying the load as a rectangular distribution along the height of the wall.

As required by the 2021 IBC, retaining wall design should include a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. Considering the site soils and the recommended wall backfill materials, we recommend a seismic surcharge pressure of 10H and 14H psf, where H is the wall height in feet for the "active" and "at-rest" loading conditions, respectively. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the walls.

14.0 DRAINAGE CONSIDERATIONS

Traffic across the on-site fill soils when they are damp or wet will result in disturbance of the otherwise firm stratum. Therefore, during site work and construction, the contractor should provide surface drainage and subgrade protection, as necessary.

All perimeter footings, slabs, and retaining walls should be provided with a drain at the footing or subgrade elevation, with the exception of the infiltration vault. Drains should consist of rigid, perforated, PVC pipe surrounded by washed gravel. The level of the perforations in the pipe should be set at the bottom of the footing, and the perforations should be located on the lower

portion of the pipe. The drains should be constructed with sufficient gradient to allow gravity discharge away from the structures. In addition, any retaining or subgrade walls should be lined with a minimum, 12-inch-thick, washed gravel blanket. The drainage aggregate or composite should tie into and freely communicate with the footing drains. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain.

To minimize erosion, stormwater discharge or concentrated runoff should not be allowed to flow down any steep slopes. In planning, exterior grades adjacent to walls should be sloped downward away from the structures at an inclination of at least 3 percent to achieve surface drainage. Runoff water from impervious surfaces should be collected by a storm drain system that discharges into the site stormwater system.

15.0 INFILTRATION FEASIBILITY

Stormwater infiltration feasibility depends upon the presence of a suitable native receptor soil of sufficient thickness, extent, permeability, and vertical separation from the groundwater table. Overall, infiltration appears feasible into the Vashon recessional outwash encountered in our explorations. At the time this report was prepared, project plans were in the conceptual phase and the elevation of the infiltration facility subgrade was not established.

Permeable Vashon advance outwash sediments were encountered in EB-3 near the proposed infiltration vault at an estimated elevation of about 114.5 feet. These sediments generally consisted of fine or fine to medium sand with varying amounts of gravel and trace silt.

We encountered the groundwater table in this boring at about elevation 87 feet at the time of drilling. Groundwater levels in the Vashon recessional outwash fluctuate and current project information as described in Section 4.3 measured groundwater at estimated elevation 94 feet.

Design of the infiltration facility will need to follow the 2019 Washington State Department of Ecology (Ecology) *Stormwater Management Manual for Western Washington* (Ecology Manual). The Ecology Manual requires the infiltration facility to have at least 5 feet of vertical separation from the groundwater table, which can be reduced to 3 feet with a mounding analysis.

For preliminary planning and conceptual sizing purposes only, we recommend use of an estimated long-term design infiltration rate of 5 inches per hour for the proposed infiltration facility.

Additional studies will be required to provide final design infiltration rates for site- and project-specific design described in the Ecology Manual. For a facility sized to receive runoff from more than 10 acres, these studies will include:

- Site-specific explorations (minimum of two) in the footprint of the proposed facility.
- Infiltration testing (minimum of two). The infiltration tests should take place at the bottom elevation of the proposed infiltration system.
- Groundwater level monitoring and groundwater flow direction. The existing water level data may satisfy this requirement.
- Groundwater mounding.
- Review of the infiltration facility design relative to Site Suitability Criteria.

16.0 PAVEMENT RECOMMENDATIONS

The pavement sections included in this report section are for driveway and parking areas onsite and are not applicable to right-of-way improvements. At this time, we are not aware of any planned right-of-way improvements; however, if any new paving of public streets is required, we should be allowed to offer situation-specific recommendations.

Pavement areas should be prepared in accordance with the "Site Preparation" section of this report. If the stripped existing fill soils exposed at pavement subgrade can be compacted to 95 percent of ASTM D-1557 and is firm and unyielding, no additional overexcavation is required. Soft or yielding areas should be overexcavated to provide a suitable subgrade and backfilled with structural fill. The upper 2 feet of pavement subgrade should be recompacted to 95 percent of ASTM D-1557. If required, structural fill may then be placed to achieve desired subbase grades.

Based on the conceptual plans the project will include an expansion of the east parking lot area. We anticipate this parking lot will be subject to light-duty pavements for passenger vehicles and heavy-duty pavements for fire trucks and garbage trucks. In light-duty traffic areas, we recommend a pavement section consisting of 3 inches of hot-mix asphalt (HMA) underlain by 4 inches of crushed surfacing base course (CSBC) as the recommended minimum in areas of planned passenger car lanes and parking. In heavy-duty traffic areas, a minimum pavement section consisting of 4 inches of HMA underlain by 6 inches of CSBC is recommended. The CSBC must be compacted to 95 percent of the maximum density, as determined by ASTM D-1557. All paving materials should meet gradation criteria contained in the current Washington State Department of Transportation (WSDOT) Standard Specifications. If the parking lot expansion will be subjected to continued heavy equipment traffic, we should be allowed to reassess our heavy pavement section recommendations.

Depending on construction staging and desired performance, the crushed base course material may be substituted with asphalt treated base (ATB) beneath the final asphalt surfacing. The substitution of ATB should be as follows: 4 inches of crushed rock can be substituted with 3 inches of ATB, and 6 inches of crushed rock may be substituted with 4 inches of ATB. ATB should be placed over a firm and unyielding subgrade as determined by proof-rolling and a 1½- to 2-inch thickness of crushed rock to act as a working surface. If ATB is used for construction access and staging areas, some rutting and disturbance of the ATB surface should be expected.

The general contractor should remove affected areas and replace them with properly compacted ATB prior to final surfacing.

17.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our recommendations may be properly interpreted and implemented in the design. We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundation system depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of our currently approved scope of work.

We have enjoyed working with you on this study and are confident these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

DRAFT

Brendan C. Young, L.G.
Senior Staff Geologist

DRAFT

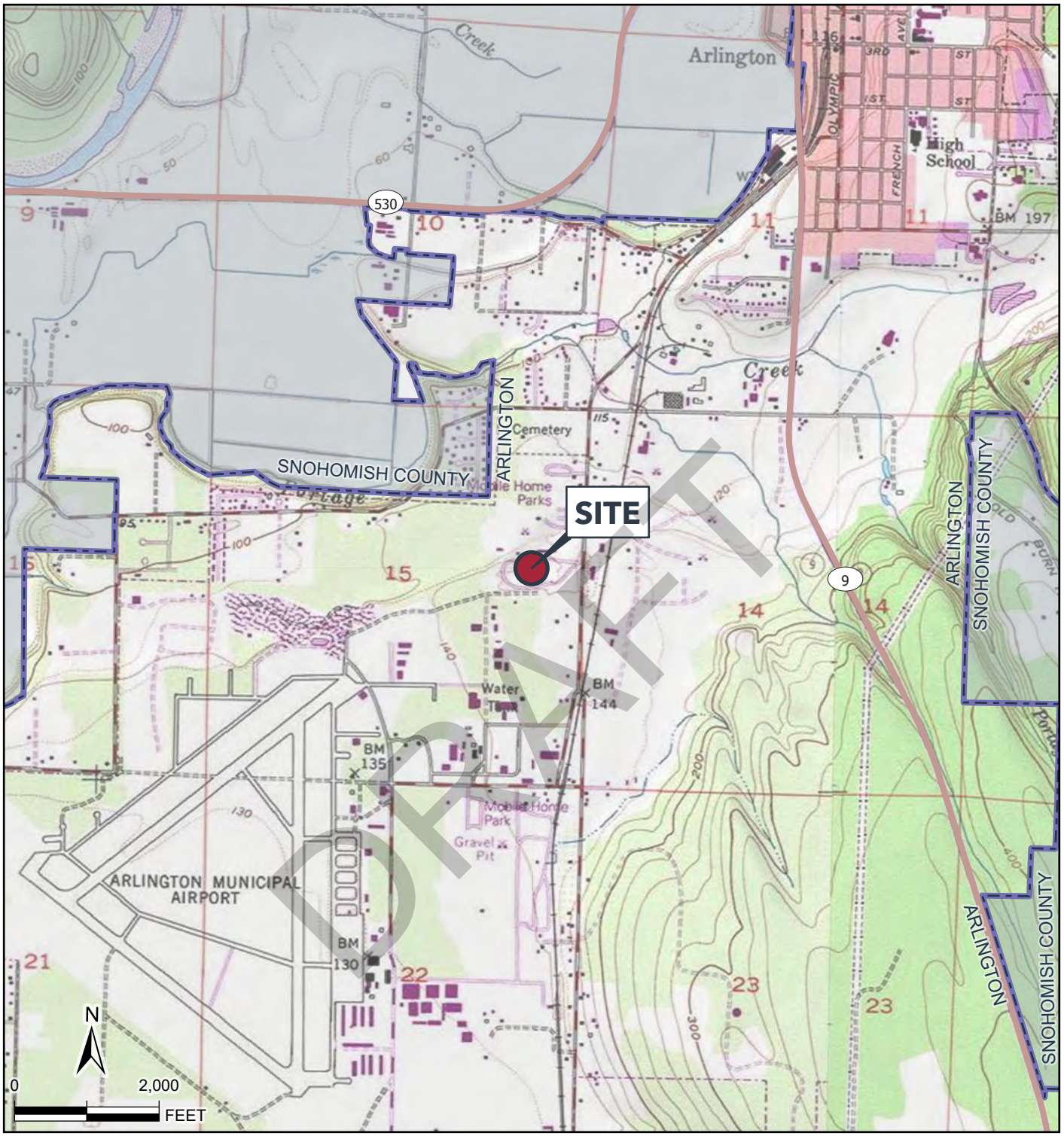
Anthony W. Romanick, P.E.
Senior Engineer

DRAFT

Kurt D. Merriman, P.E.
Senior Principal Engineer

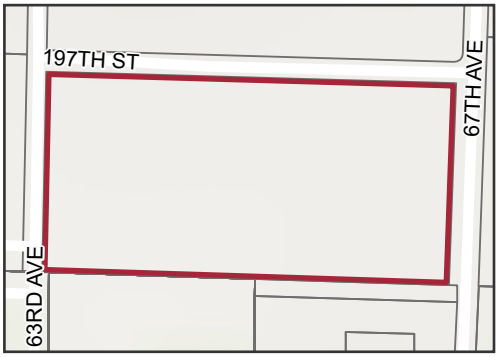
Attachments

Figure 1: Vicinity Map
Figure 2: Existing Site and Exploration Plan
Figure 3: Proposed Site Improvements
Appendix A: Exploration Logs
Appendix B: Historical Exploration Logs
Appendix C: Laboratory Testing
Appendix D: Hydrographs



COUNTY LOCALE

LOCATION



ESRI, USGS, NATIONAL GEOGRAPHIC, DELORME, NATURALVUE, I-CUBED, GEBCO: ARCGIS ONLINE BASEMAP. WADOT STATE ROUTES 24K (12/20). SNOHOMISH CO: PARCELS, ROADS (3/24).

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE. BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

associated earth sciences incorporated

VICINITY MAP

ARLINGTON OPERATIONS CENTER REDEVELOPMENT
ARLINGTON, WASHINGTON

PROJECT NO.	DATE	FIGURE
20240001E001	4/24	1

G:\GIS_Projects\20241240001 Arlington Operations Center_aprx\20240001E001 F1 VM_Arlington Operations Center.aprx | 20240001E001 F1 VM_Arlington Operations Center | 2024-04-26 | mtrop

LEGEND

- SITE
- EXPLORATION BORING (AESI, 2024)
- EXPLORATION PIT (AESI, 1999)
- EXPLORATION BORING (SNOHOMISH COUNTY, 2015)
- EXPLORATION BORING (TERRACON, 2016)
- EXPLORATION BORING (SHANNON & WILSON, 2019)
- ADMIN/CREW 2-STORY
- VAULT
- CONTOUR 10 FT
- CONTOUR 2 FT
- PARCEL

N

0 120

FEET

DATA SOURCES/REFERENCES:
SNOHOMISH COUNTY: TAX PARCELS (3/24), STREETS (3/24).
AERIAL IMAGERY (2022, PICTOMETRY).
WA DNR LIDAR: NORTH_PUGET_2017 ACQUIRED MARCH TO SEPT 2016, 3' CELL SIZE. CONTOURS DERIVED FROM LIDAR.

associated earth sciences incorporated

EXISTING SITE AND EXPLORATION PLAN

ARLINGTON OPERATIONS CENTER REDEVELOPMENT
ARLINGTON, WASHINGTON

PROJECT NO.	DATE	FIGURE
20240001E001	5/24	2

LEGEND

- SITE
- EXPLORATION BORING (AESI, 2024)
- EXPLORATION PIT (AESI, 1999)
- EXPLORATION BORING (SNOHOMISH COUNTY, 2015)
- EXPLORATION BORING (TERRACON, 2016)
- EXPLORATION BORING (SHANNON & WILSON, 2019)
- CONTOUR 10 FT
- CONTOUR 2 FT
- PARCEL

N

0 120

FEET

DATA SOURCES/REFERENCES:
SNOHOMISH COUNTY: TAX PARCELS (3/24), STREETS (3/24).
AERIAL IMAGERY (2022, PICTOMETRY).
WA DNR LIDAR: NORTH_PUGET_2017 ACQUIRED MARCH TO SEPT 2016, 3' CELL SIZE. CONTOURS DERIVED FROM LIDAR.
PHASE 1 SITE PLAN.

associated earth sciences incorporated

PROPOSED SITE IMPROVEMENTS

ARLINGTON OPERATIONS CENTER REDEVELOPMENT
ARLINGTON, WASHINGTON

PROJECT NO.	DATE	FIGURE
20240001E001	5/24	3

G:\GIS_Projects\20240001 Arlington Operations Center_aprx\20240001E001 F3 SP_Arlington Operations Center.aprx | 20240001E001 F3 SP_Arlington Operations Center | 2024-05-20 | mtrop

APPENDIX A

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[2]	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[2]	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[2]	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[2]	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[3] 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[3] 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)

[4] 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 and Description

- Blows/6" or portion of 6"
- Split-Spoon Sampler (SPT)
- California Sampler
- Ring Sampler
- Continuous Sampling
- Grab Sample
- Portion not recovered

Groundwater depth

- ATD At time of drilling
- Static water level (date)

- Cement grout surface seal
- Bentonite seal
- Filter pack with blank casing section
- Screened casing or Hydrotip with filter pack
- End cap

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.

(1) Percentage by dry weight
(2) Combined USCS symbols used for fines between 5% and 12%
(3) (SPT) Standard Penetration Test (ASTM D-1586)
(4) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

associated earth sciences incorporated

EXPLORATION LOG KEY FIGURE: A1

associated earth sciences incorporated

Exploration Boring EB-1

Arlington Operations Center Redevelopment — Sheet: 1 of 3

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 51.5
Ground Surface Elevation (ft): ≈140
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0					**Sod / Topsoil - 4 inches**				
					Fill				
					Some gravel chatter.				
2.5		1			Slightly moist, dark brown, silty, fine SAND, some gravel; scattered to abundant organics (rootlets and wood debris) (SM).		4 4 4	8	
5		2			As above; scattered organics (rootlets); poor recovery.		2 3 5	8	
		3			Cal Mod at 5.5: Moist, dark brown mixed with gray, very silty, fine SAND, trace to some gravel; abundant organics (rootlets and wood); scattered construction debris; distorted texture (SM).		1 5 5	10	
7.5		4			Becomes dark gray; occasional organics (wood and rootlets); poor recovery (SM).		4 5 5	10	
					Grades to some gravel; scattered organics (rootlets); layer (at 9 feet, 6 inches thick) of heavily oxidized to orange, fine sand, some gravel.				
10		5			Becomes very moist; rare to scattered organics (rootlets).		3 2 3	5	
12.5		6			Moist, dark gray transitioning to gray in lower 6 inches, silty, fine SAND, some gravel; rare organics (rootlets); less silty with depth; becomes gray, silty, fine to coarse sand, some fine gravel (SM).		3 4 8	12	
15		7			Moist, gray, silty, SAND, some gravel (angular); scattered organics (rootlets and fine organics); poor recovery (SM).		4 7 24	31	
					Cal Mod: Gray, brown, silty, fine to coarse SAND; cobbles (broken); pockets at bottom of sample of brown, silty, sand, organic laden (SM).				
17.5									

associated earth sciences incorporated

Exploration Boring EB-1

Arlington Operations Center Redevelopment — Sheet: 2 of 3

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 51.5
Ground Surface Elevation (ft): ≈140
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
20		8			**Marysville Recessional Outwash** Slightly moist, grayish brown with orange oxidation, gravelly, fine to coarse SAND, trace silt; etching around gravel; some brown sand in top of sample; broken gravel in split spoon; blow count overstated (SP).		7 15 24	39	
22.5									
25		9			Slightly moist, brown and grayish brown, gravelly, medium to coarse SAND; interbed of brown, fine SAND; blow counts overstated; broken gravel in spoon (SP).		14 24 22	46	
27.5									
30		10			Moist, grayish brown, fine sandy, SILT; interbeds (1/4 inch thick) of fine sand; layers becoming gray, fine to medium sand, trace fine gravel (ML).		4 18 20	38	
32.5									
35		11			Slightly moist, grayish brown, fine to medium SAND, some gravel; cross beds (<1 inch thick) of orangish brown, fine sand (SP).		12 14 15	29	
37.5									

associated earth sciences incorporated

Exploration Boring EB-1

Arlington Operations Center Redevelopment — Sheet: 3 of 3

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 51.5
Ground Surface Elevation (ft): ≈140
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
40		12			Slightly moist, grayish brown, fine to medium SAND; rare gravel; massive (SP).		12 13 13	26	
42.5									
45		13			Slightly moist, grayish brown, fine to medium SAND; massive (SP).		7 9 10	19	
47.5									
50		14			Very moist, grayish brown, medium SAND, some fine sand, trace gravel; layers (6 inches thick) of brownish gray, fine sand at tip of sampler (SP).		10 10 11	21	
					No groundwater observed.				
52.5									
55									

5/23/2024

20240001E001

associated earth sciences incorporated

Exploration Boring EB-2

Arlington Operations Center Redevelopment — Sheet: 1 of 4

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 54.5

Total Depth (ft): 61.5
Ground Surface Elevation (ft): 146
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0					**Sod and Topsoil - 4 inches**				
					Fill				
					Gravel chatter.				
2.5		1			Slightly moist, brown mixed with gray to dark gray, silty, fine SAND, some gravel; abundant organics (roots and wood); layers of crushed angular gravel, some light brown silt (SM).		10 5 3	8	
5		2			Slightly moist, dark gray, silty, SAND, some gravel; occasional fine organics; layer (6 inches thick) of moist, brown and tan, fine to coarse sand, some gravel, trace silt (SM).		3 3 2	5	
					Driller notes gravel still loose drilling.				
10		3			Moist, brown to orange brown, fine to medium SAND, some silt, some gravel; abundant fine black organics (SP-SM).		3 3 3	6	
15		4			Moist, dark brown with some orange brown, fine SAND, some gravel, some silt; abundant fine organics; occasional construction debris (plastic) (SP-SM).		2 2 2	4	
17.5									

5/23/2024

20240001E001

associated earth sciences incorporated

Exploration Boring EB-2

Arlington Operations Center Redevelopment — Sheet: 2 of 4

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 54.5
Total Depth (ft): 61.5
Ground Surface Elevation (ft): 146
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
					Marysville Recessional Outwash				
20		5			Slightly moist, grayish brown, gravelly, fine to medium SAND, trace silt; pockets of orange oxidized, silt; broken gravel in sampler; blow counts overstated; cobbles present in cuttings (SP).		40 45 25	70	
22.5									
25		6			Slightly moist, grayish brown, fine to medium SAND; interbeds of fine sand; occasional layer of silty, fine to medium sand; angular crushed rock; blow counts overstated; broken gravel in sampler; layer (2 inches thick) of fine sand at tip of sample (SP).		15 17 19	36	
27.5					Driller notes fine gravel and cobbles while drilling.				
30		7			Slightly moist, grayish brown, gravelly, fine SAND; trace oxidized gravel in horizontal bedding; broken gravel in sampler; blow counts overstated (SP).		22 26 30	56	
32.5					Cuttings predominantly brown, fine sand.				
35		8			Slightly moist, grayish brown, fine to medium SAND, some gravel; transitions to gray, fine sand; occasional mica; broken gravel in sampler; blow counts overstated (SP).		20 16 18	34	
37.5									

associated earth sciences incorporated

Exploration Boring EB-2

Arlington Operations Center Redevelopment — Sheet: 3 of 4

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 54.5

Total Depth (ft): 61.5
Ground Surface Elevation (ft): 146
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
40		9			Slightly moist, grayish brown, fine to medium SAND, some gravel, trace silt; occasional laminated silt; broken gravel in sampler; blow counts overstated (SP).		15 23 16	39	
42.5									
45		10			Very moist, grayish brown, fine SAND, some silt; occasional interbed of silty, fine sand (SP-SM). Lower 8 inches: Transitions to gray with brown oxidation staining, fine to medium SAND, trace fine gravel (SP).		17 21 22	43	
47.5					Driller notes material becomes tighter.				
50		11			Very moist, gray to grayish brown, fine to medium SAND; occasional lamination of sandy, silt; rare fine gravel; some observable cross-bedding of fine to medium sand (SP).		13 13 13	26	
52.5									
55		12			Wet, gray, fine to medium SAND; rare fine gravel; massive (SP).	▼	7 10 12	22	

associated earth sciences incorporated

Exploration Boring EB-2

Arlington Operations Center Redevelopment — Sheet: 4 of 4

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 54.5

Total Depth (ft): 61.5
Ground Surface Elevation (ft): 146
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 / 20 / 30 / 40 / 50+)	Other Tests
57.5									
60		13			Wet, gray, fine to medium SAND transitioning to brownish gray, fine to medium SAND; interbed of sandy, gravel between (SP).		14 17 20	37	
					Groundwater encountered at 54.5 feet ATD.				
62.5									
65									
67.5									
70									
72.5									
75									

5/23/2024
20240001E001

associated earth sciences incorporated

Exploration Boring EB-3

Arlington Operations Center Redevelopment — Sheet: 1 of 5

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 33
Total Depth (ft): 76.5
Ground Surface Elevation (ft): 120
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0					**Sod / Topsoil - 6 inches**				
					Fill				
2.5		1			Slightly moist, brown, fine SAND, some gravel, some silt; scattered organics (rootlets) (SP-SM). Lower 6 inches: Slightly moist, gray, fine SAND; interbed (≈2 inches thick) of brown, fine to medium sand (SP).		7 9 11	20	
5		2			Upper 4 inches: Slightly moist, brown, silty, fine SAND, some gravel; scattered organics (SM).		7 11 17	28	
					Marysville Recessional Outwash Lower 4 inches: Transitions to grayish brown, fine SAND, some gravel; broken gravel in spoon; blow counts overstated (SP).				
7.5		3			Slightly moist, grayish brown, very gravelly, SAND, trace silt; occasional interbed of fine to medium sand; broken gravel in sampler (SP).		10 17 17	34	
10		4			Slightly moist, grayish brown with rare oxidation staining to orange around gravel, gravelly, fine to coarse SAND, trace silt; faintly stratified; blow counts overstated; broken gravel in spoon (SP).		5 16 16	32	
12.5		5			Moist, grayish brown, gravelly, fine to medium SAND, some fine sand (≈2 inches) observed at tip of sampler (SP).		7 11 12	23	
15		6			Grades to trace gravel, trace silt; occasional interbed of brown, fine to medium sand (SP).		7 9 11	20	
17.5		7			As above; some gravel; occasional interbed (≈1/2 inch thick) of gray, fine sand, some silt (SP).		10 10 14	24	

associated earth sciences incorporated

Exploration Boring EB-3

Arlington Operations Center Redevelopment — Sheet: 2 of 5

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 33
Total Depth (ft): 76.5
Ground Surface Elevation (ft): 120
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
20		8			Grades to some silt; massive (SP-SM).		10 11 10	21	
22.5		9			Moist, grayish brown, fine to medium SAND, trace fine gravel; massive (SP).		9 13 11	24	
25		10			Moist, grayish brown, fine to coarse SAND, some gravel; broken gravel in sampler; blow counts may be overstated (SP).		8 13 14	27	
27.5		11			Moist, grayish brown with some oxidation staining, fine to medium SAND; rare fine gravel; massive; sampler overfilled (SP).		7 10 15	25	
30		12			Very moist, grayish brown with some oxidation staining, fine to coarse SAND, some gravel; oxidation staining around gravel; moisture appears to increase with depth; trace silt at tip of sampler; massive (SP).		12 13 16	29	
32.5		13			Wet, grayish brown, sandy, GRAVEL, trace silt; broken gravel in sampler; blow counts overstated (GP).	▼	10 26 16	42	
35		14			Wet, grayish brown, fine SAND; stratified; layers of gray, medium to coarse sand, some fine gravel; occasional interbed (≈1/4 inch thick) of brownish gray, fine sand, some silt (SP).		8 10 16	26	
37.5									

associated earth sciences incorporated

Exploration Boring EB-3

Arlington Operations Center Redevelopment — Sheet: 3 of 5

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 33

Total Depth (ft): 76.5
Ground Surface Elevation (ft): 120
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
40		15			As above, some gravel; broken gravel in sampler; blow counts overstated.		9 13 13	26	
42.5									
45		16			Wet, grayish brown to slightly brownish gray, fine SAND, trace silt; occasional medium sand; finely stratified (SP).		5 10 14	24	
47.5									
50		17			Wet, grayish brown, fine SAND, trace silt; rare gravel; massive (SP).		11 11 16	27	
52.5									
55		18			Wet, grayish brown, fine to medium SAND, some gravel, trace silt; interbeds of fine sand; occasional interbed of orange oxidized, medium sand (SP). Lower 3 inches: Becomes fine sand, some silt (SP SM).		10 14 14	28	

associated earth sciences incorporated

Exploration Boring EB-3

Arlington Operations Center Redevelopment — Sheet: 4 of 5

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 33
Total Depth (ft): 76.5
Ground Surface Elevation (ft): 120
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
57.5									
60		19			Wet, gray to brownish gray, fine SAND, some silt, trace fine gravel; occasional lamination of light gray, silt (SP-SM).		6 11 12	23	
62.5									
65		20			Wet, gray to brownish gray, fine SAND, trace silt; occasional stratification of brown, fine sand, trace silt (SP).		11 15 16	31	
67.5									
70		21			Wet, grayish brown with occasional orange brown horizontal oxidation staining, fine SAND, some silt; rare gravel; layer (4 inches thick) of fine to medium sand in center of sample; stratified(SP-SM).		11 12 16	28	
72.5									
75		22			Wet, grayish brown with some orange horizontal oxidation staining, fine		4 12	31	

associated earth sciences incorporated

Exploration Boring EB-3

Arlington Operations Center Redevelopment — Sheet: 5 of 5

Arlington, WA	Start Date: 4/23/24	Logged By: BCY
20240001E001	Ending Date: 4/23/24	Approved By: JHS

Driller/Equipment: Advance Drill Technology / D-50
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 6
Groundwater Depth ATD (ft): 33

Total Depth (ft): 76.5
Ground Surface Elevation (ft): 120
Datum: NAVD 88
Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot 10 20 30 40 50+	Other Tests
					SAND, trace silt; layers (≈1/2 inch thick) of fine to medium sand (SP).		19		
					Groundwater encountered at 33 feet ATD.				
77.5									
80									
82.5									
85									
87.5									
90									
92.5									

APPENDIX B

Historical Exploration Logs

LOG OF EXPLORATION PIT NO. EP-1

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.

Depth, ft	DESCRIPTION
	Fill
1	Medium stiff, moist, brown SILT with occasional fine to coarse sand with coarse sand and gravel and organics. (ML)
2	Medium dense to dense, moist, brown to black, SILTY fine to medium SAND with coarse SAND, GRAVEL, and ORGANICS. (SM)
3	
4	
5	
6	
7	
8	
9	Stiff, moist, brown/blue SILT with fine to medium SAND and occasional coarse sand, gravel, and organics. (ML)
10	
11	
12	
13	Dense, moist, brown/black, SILTY fine to medium SAND with coarse SAND and GRAVEL. (ML)
14	Bottom of exploration pit at depth 13.5 feet No ground water encountered; no caving
15	
16	
17	
18	
19	
20	

Arlington Road Maintenance Yard
Arlington, Washington

Logged by: GS
Approved by:

ASSOCIATED EARTH SCIENCES, INC

Project No. KG99556A
October 1999

KCTP3 99556.GPJ December 6, 1999

LOG OF EXPLORATION PIT NO. EP-2

Depth, ft	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION**
	Fill
1	Stiff, moist, brown SILT with fine to coarse SAND and GRAVEL. (ML)
2	Medium dense to dense, moist, brown/black, SILTY fine to medium SAND with coarse SAND and GRAVEL. (SM)
3	
4	Medium dense to dense, moist, gray GRAVEL with occasional fine to coarse sand and trace silt. (GP)
5	
6	
7	Medium dense to dense, moist, brown/black, SILTY fine to medium SAND with coarse SAND and GRAVEL. (SM)
8	
9	
10	
11	Medium dense to dense, moist, gray GRAVEL with occasional fine to coarse sand and trace silt. (GP)
12	
13	Medium dense to dense, moist, brown/black GRAVEL with occasional fine to coarse sand and trace silt. (GP)
14	Medium stiff, moist, brown SILT with fine to medium SAND and GRAVEL. (ML) Bottom of exploration pit at depth 13.5 feet No ground water encountered; severe caving @ 4-7' and 11-13'
15	
16	
17	
18	
19	
20	

Arlington Road Maintenance Yard
Arlington, Washington

Logged by: GS
Approved by:

ASSOCIATED EARTH SCIENCES, INC

Project No. KG99556A
October 1999

LOG OF EXPLORATION PIT NO. EP-3

Depth, ft	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
1	**Fill** Very dense, moist to wet, brown, SILTY fine to medium SAND with coarse SAND and GRAVEL. (SM)
2	
3	**Recessional Outwash** Medium dense, moist, brown, fine to medium SAND with coarse SAND and GRAVEL and trace silt. (SP)
4	
5	
6	Medium dense, moist, brown, fine to medium SAND with occasional coarse sand and gravel and trace silt. (SP)
7	
8	
9	
10	
11	
12	
13	
14	Bottom of exploration pit at depth 13.5 feet No ground water encountered; moderate caving 10-13.5'
15	
16	
17	
18	
19	
20	

Arlington Road Maintenance Yard
Arlington, Washington

Logged by: GS
Approved by:

ASSOCIATED EARTH SCIENCES, INC

Project No. KG99556A
October 1999

LOG OF EXPLORATION PIT NO. EP-4

Depth, ft	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
1	**Fill** Very dense, moist to wet, brown SILTY fine to medium SAND with coarse SAND and GRAVEL. (SM)
2	
3	Medium dense to dense, moist, gray, SILTY fine SAND with occasional medium to coarse sand and gravel. (SM)
4	
5	
6	**Recessional Outwash**
7	Medium dense, moist, brown, fine GRAVEL with fine to coarse SAND and trace silt. (GP)
8	
9	
10	
11	
12	
13	Bottom of exploration pit at depth 12 feet No ground water encountered; moderate caving 10-12'
14	
15	
16	
17	
18	
19	
20	

Arlington Road Maintenance Yard
Arlington, Washington

Logged by: GS
Approved by:

ASSOCIATED EARTH SCIENCES, INC

Project No. KG99556A
October 1999

KCTP3 99556.GPJ December 6, 1999

LOG OF EXPLORATION PIT NO. EP-5

Depth, ft	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION**
	Fill
1	Medium stiff, moist to wet, brown SILT with fine to coarse SAND and GRAVEL. (ML)
2	
3	Medium dense, moist, to wet, brown, fine to medium SAND with SILT and coarse SAND and GRAVEL. (SP)
4	Medium stiff, moist, brown SILT with occasional fine to medium sand and occasional gravel. (ML)
5	
6	Medium dense to dense, moist, gray, SILTY fine SAND with occasional fine to medium sand and gravel. (SM)
7	
8	**Recessional Outwash**
9	Medium dense, moist, brown, medium to coarse SAND with GRAVEL and trace silt. (SP)
10	
11	
12	
13	Bottom of exploration pit at depth 12.5 feet No ground water encountered; moderate caving 1-5'
14	
15	
16	
17	
18	
19	
20	

Arlington Road Maintenance Yard
Arlington, Washington

Logged by: GS
Approved by:

ASSOCIATED EARTH SCIENCES, INC

Project No. KG99556A
October 1999

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 131 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

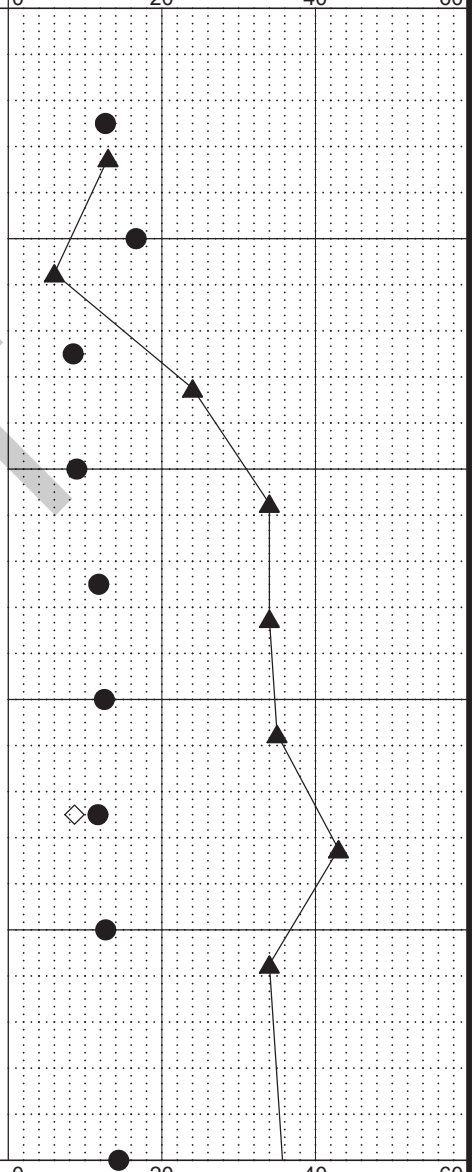
Depth, ft.	Soil Description
0.2	Asphalt.
2.0	*Poorly Graded Gravel with Sand (GP)*. (Hf)
4.5	Medium dense, brown, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; wet; fine to coarse, subrounded to angular gravel; fine to coarse sand; nonplastic. (Hf)
7.0	Loose, brown to orange-brown, *Poorly Graded Gravel with Sand (GP)*; moist; fine to coarse, subrounded to angular gravel; fine to coarse sand; iron oxide staining. (Hf)
12.0	Medium dense to dense, brown, *Poorly Graded Gravel with Sand (GP)* to *Poorly Graded Sand with Gravel (SP)*; moist; fine to coarse, subrounded gravel; fine to coarse sand; nonplastic. (Qvrm)
19.5	Dense, brown, *Well Graded Sand with Silt and Gravel (SW-SM)*; wet; fine to coarse, subrounded gravel; fine to coarse sand; trace iron oxide staining. (Qvrm)
23.0	Dense, brown, *Poorly Graded Sand (SP)*; moist; fine to coarse sand; trace iron oxide staining. (Qvrm)
	Dense, gray-brown, *Poorly Graded Sand with Gravel (SP)*; moist; fine to coarse, subrounded gravel; fine to medium sand; nonplastic.

CONTINUED NEXT SHEET

Symbol | Samples | Ground Water Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-1-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-2
Sheet 1 of 4

Log: SAW Rev: EAS Typ: LKN

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20

REV 3 - Approved for Submittal

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 131 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

(Qvrm)

9

28.0

Medium dense to very dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; wet; trace fine, subrounded to subangular gravel; fine to coarse sand; nonplastic. (Qvrm)

10

11

12

- Gravelly layer at 41 feet.

- Gravelly layer at 43 feet inferred from drill action.

13

79/11"

0 20 40 60

30

35

40

45

0 20 40 60

◇ % Fines (<0.075mm)

● % Water Content

CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-1-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-2
Sheet 2 of 4

Log: SAW Rev: EAS Typ: LKN

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20

REV 3 - Approved for Submittal

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 131 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

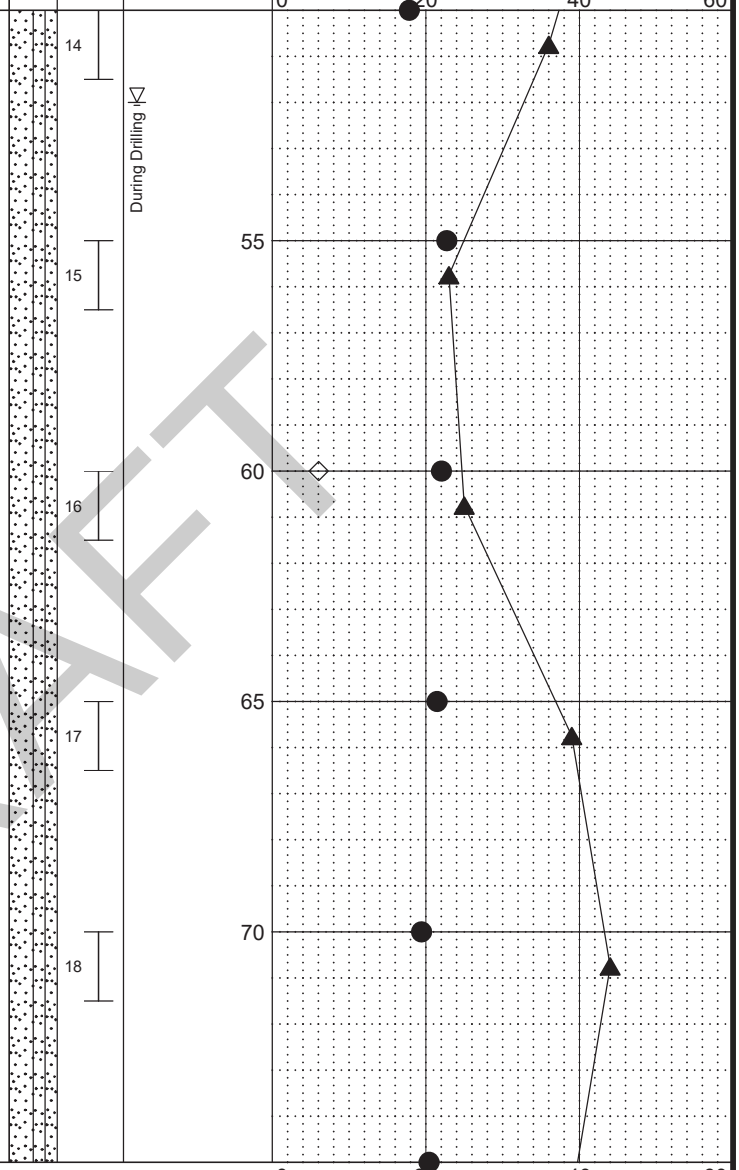
Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

- Few silty sand seams with iron oxide staining at 55 feet.

- Trace silty sand seams below 70 feet.



CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-1-19

May 2020 | 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-2
Sheet 3 of 4

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 131 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 20 40 60

19

20 *

81.5

BOTTOM OF BORING
COMPLETED 11/7/2019

80 85 90 95

0 20 40 60

◇ % Fines (<0.075mm)

● % Water Content

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-1-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-2
Sheet 4 of 4

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

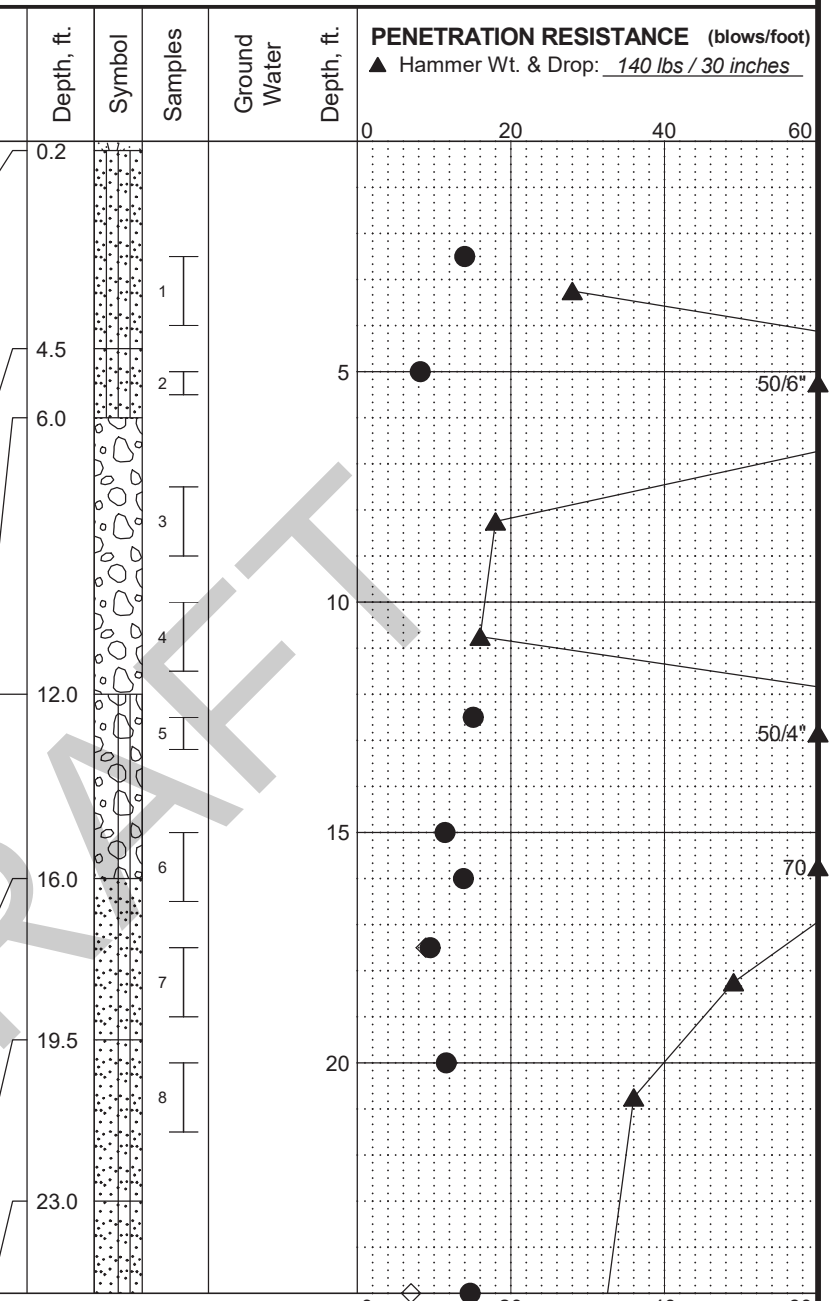
Total Depth:	81.5 ft.	Northing:		Drilling Method:	Mud Rotary	Hole Diam.:	6 in.
Top Elevation:	~ 120 ft.	Easting:		Drilling Company:	Holocene Drilling	Rod Diam.:	2-inch ID
Vert. Datum:		Station:		Drill Rig Equipment:	Diedrich D120 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft.	Soil Description
0.2	Topsoil and grass.
	Medium dense, brown, *Silty Sand with Gravel (SM)* to *Silty Gravel with Sand (GM)*; moist; fine to coarse, angular to subrounded gravel; fine to coarse sand; nonplastic to low plasticity; trace iron oxide staining at 4.5 feet. (Hf)
4.5	- Dark brown organic pockets around 3.5 feet.
6.0	Very dense, brown, *Silty Sand with Gravel (SM)*; moist; fine, subrounded gravel; fine to coarse sand; nonplastic. (Hf)
	- Mud loss from 5 to 7 feet.
	Medium dense, gray, *Poorly Graded Gravel (GP)*; moist; subangular, fine to coarse sand. (Hf)
12.0	Very dense, mottled gray to brown, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; wet; fine to coarse, subangular gravel; fine to coarse sand; nonplastic; strong iron oxide staining at 12.8 and 13.2 feet; dark brown, organic pocket at 15.8 feet. (Hf)
16.0	Dense to very dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)* to *Poorly Graded Gravel with Silt and Sand (GP-GM)*; moist to wet; fine to coarse, subangular gravel; fine to coarse sand; nonplastic. (Qvrm)
19.5	Dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist to wet; fine to coarse, subangular gravel; fine to coarse sand; nonplastic. (Qvrm)
23.0	

CONTINUED NEXT SHEET



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-2-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-3
Sheet 1 of 4

Log: SAW Rev: EAS Typ: LKN

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20

REV 3 - Approved for Submittal

Total Depth:	81.5 ft.	Northing:		Drilling Method:	Mud Rotary	Hole Diam.:	6 in.
Top Elevation:	~ 120 ft.	Easting:		Drilling Company:	Holocene Drilling	Rod Diam.:	2-inch ID
Vert. Datum:		Station:		Drill Rig Equipment:	Diedrich D120 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 20 40 60

Medium dense to dense, gray-brown to brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; wet; fine, subrounded to subangular gravel; fine to coarse sand; nonplastic. (Qvrm)

- Iron oxide staining at 31 feet.

9
10
11
12
13

During Drilling ▽

30
35
40
45

43.0

Medium dense, brown, *Poorly Graded Sand (SP)*; wet; fine to medium sand; nonplastic; few silty, fine sand seams. (Qvrm)

48.0

Very dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; wet; fine to coarse, subrounded to subangular gravel; fine to

CONTINUED NEXT SHEET

0 20 40 60

◇ % Fines (<0.075mm)

● % Water Content

LEGEND

* Sample Not Recovered

▽ Ground Water Level ATD

⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-2-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-3
Sheet 2 of 4

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

REV 3 - Approved for Submittal

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 120 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

coarse sand; nonplastic; trace iron oxide staining.
(Qvrm)

52.0

Medium dense to dense, brown, *Poorly Graded Sand with Silt (SP-SM)*; wet; trace fine, subangular gravel; fine to medium sand; nonplastic; few silty sand seams with iron oxide staining.
(Qvrm)

14 | 15 | 16 | 17 | 18

0 20 40 60

55 | 60 | 65 | 70

CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-2-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-3
Sheet 3 of 4

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

REV 3 - Approved for Submittal

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 120 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

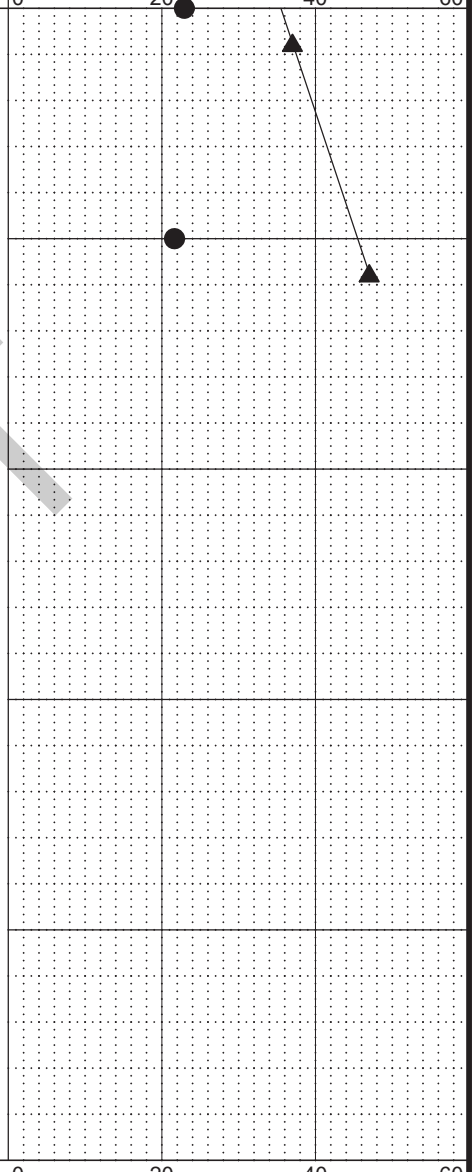
- Few seams with iron oxide staining at 80 feet.

81.5

BOTTOM OF BORING
COMPLETED 11/5/2019

19

20



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-2-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-3
Sheet 4 of 4

REV 3 - Approved for Submittal

Log: SAW Rev: EAS Typ: LKN

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 147 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

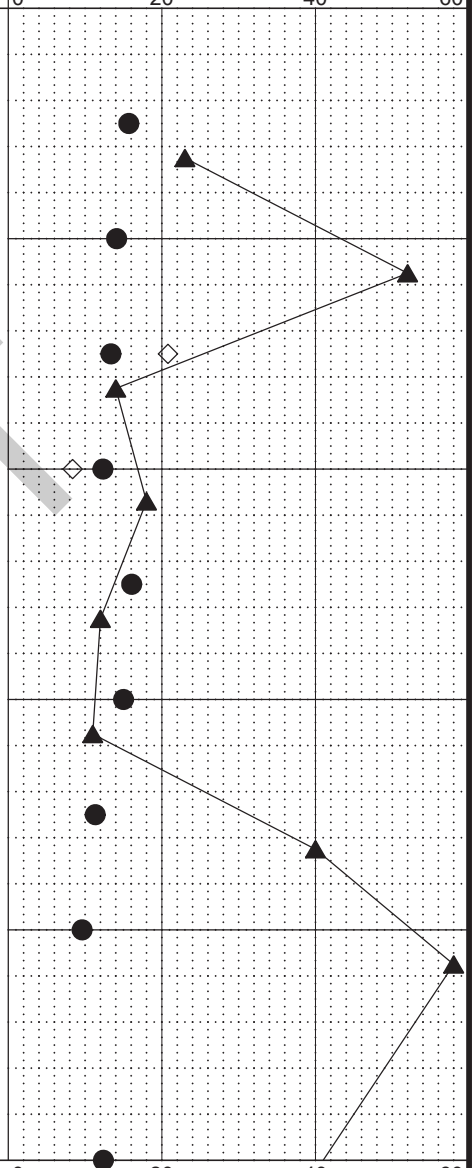
Depth, ft.	Soil Description
0.4	Asphalt.
0.5	*Poorly Graded Gravel and Sand (GP).* (Hf)
	Medium dense, brown to red-brown, *Silty Sand with Gravel (SM)*; moist; fine to coarse, subangular gravel; fine to coarse sand; nonplastic to low plasticity (Hf)
7.0	Medium dense, brown, *Silty Sand with Gravel (SM)*; moist; fine to coarse, subrounded gravel; fine to coarse sand; nonplastic. (Qvrm)
9.5	Medium dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)* to *Silty Sand with Gravel (SM)*; moist to wet; fine to coarse, subrounded gravel; fine to coarse sand; nonplastic. (Qvrm)
17.0	Dense to very dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; wet; fine to coarse, subrounded gravel; fine to coarse sand; nonplastic. (Qvrm)
23.0	Dense to very dense, gray-brown, *Silty Sand (SM)* and *Poorly Graded Sand with Silt (SP-SM)*; few fine to coarse, subangular

CONTINUED NEXT SHEET

Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

- * Sample Not Recovered
- 2.0" O.D. Split Spoon Sample
- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-3-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 1 of 7

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

REV 3 - Approved for Submittal

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 147 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

gravel; fine to coarse sand; nonplastic.
(Qvrm)

9
10
11

38.0

Very dense, gray-brown, *Poorly Graded Sand with Gravel (SP)*; wet; fine, subrounded gravel; fine to coarse sand; nonplastic.
(Qvrm)

12

43.0

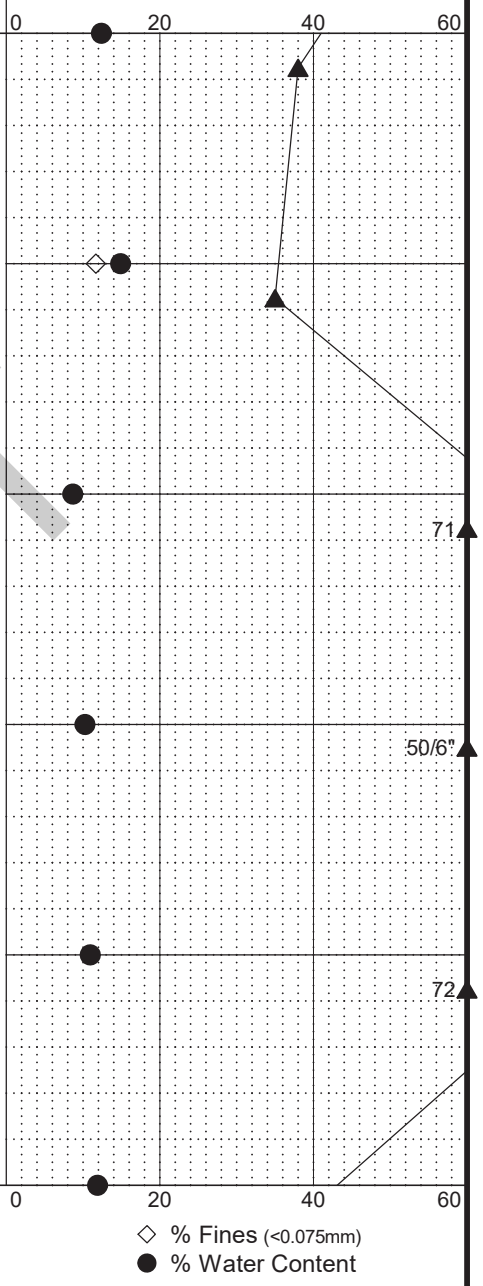
Very dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)* to *Silty Sand (SM)*; moist to wet; fine, subrounded gravel; fine to coarse sand; nonplastic.
(Qvrm)

13

48.0

Dense, gray-brown, *Poorly Graded Sand (SP)*; wet; trace fine, subrounded gravel; fine to medium sand; nonplastic.

CONTINUED NEXT SHEET



LEGEND

* Sample Not Recovered
2.0" O.D. Split Spoon Sample
Well Screen and Sand Filter
Bentonite-Cement Grout
Bentonite Chips/Pellets
Bentonite Grout
Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-3-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 2 of 7

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

REV 3 - Approved for Submittal

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 147 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

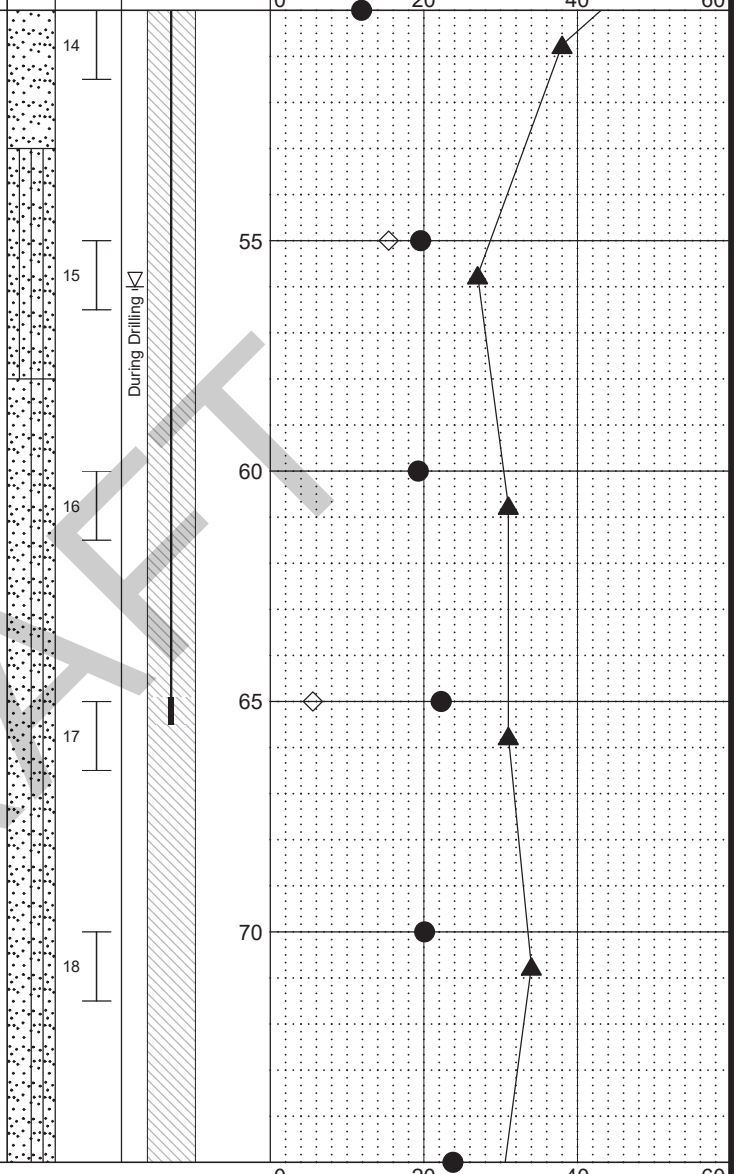
(Qvrm)

53.0

Medium dense, gray-brown, *Silty Sand (SM)*; moist to wet; fine to medium sand; nonplastic; few silty, fine sand seams.
(Qvrm)

58.0

Dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)* to *Poorly Graded Sand (SP)*; wet; fine to medium sand; nonplastic.
(Qvrm)



CONTINUED NEXT SHEET

LEGEND

- * Sample Not Recovered
- 2.0" O.D. Split Spoon Sample
- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-3-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 3 of 7

REV 3 - Approved for Submittal

Log: SAW Rev: EAS Typ: LKN

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 147 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

- Few silty sand seams with iron oxide staining at 90 feet.

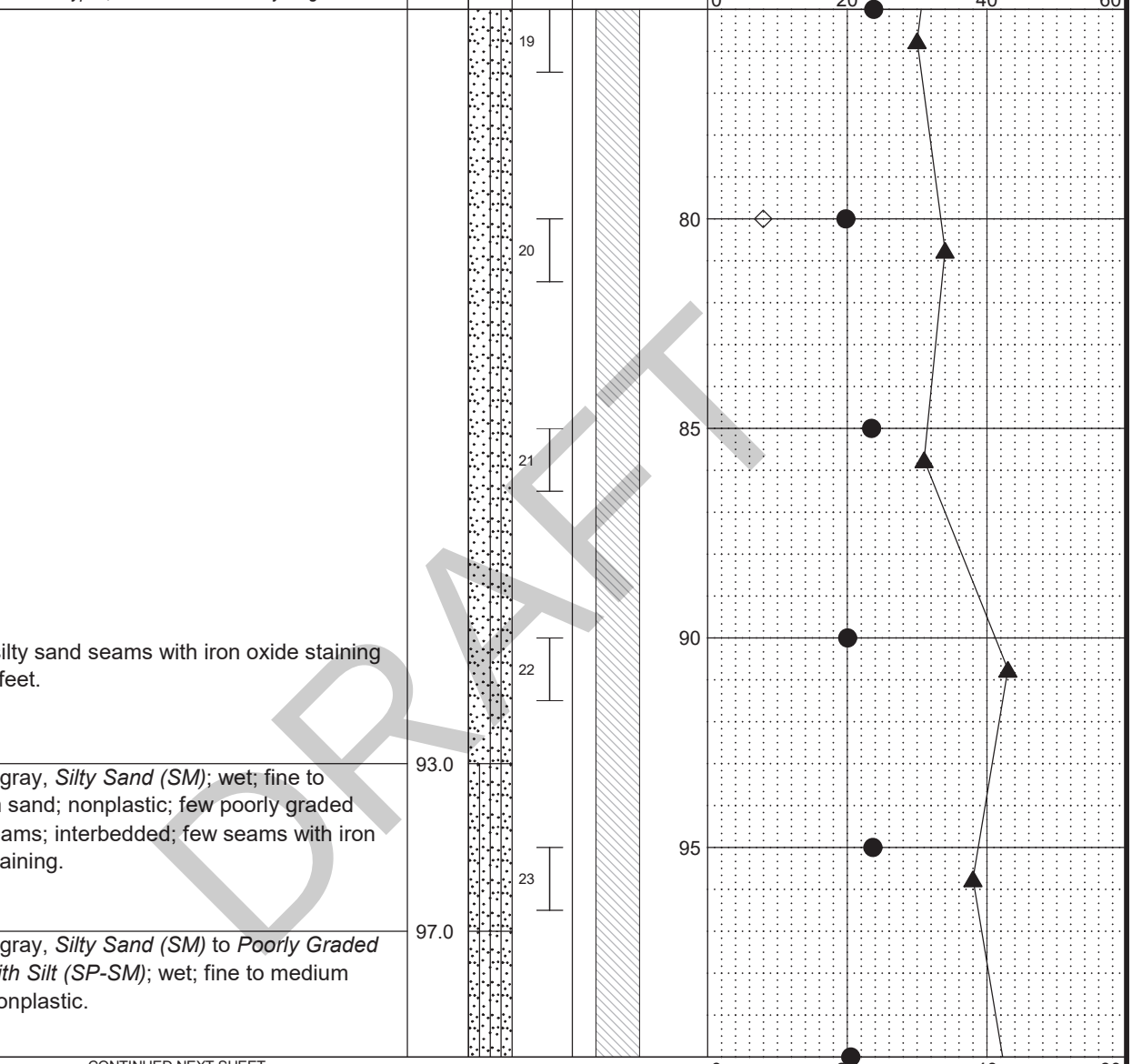
93.0

Dense, gray, *Silty Sand (SM)*; wet; fine to medium sand; nonplastic; few poorly graded sand seams; interbedded; few seams with iron oxide staining.
(Qva)

97.0

Dense, gray, *Silty Sand (SM)* to *Poorly Graded Sand with Silt (SP-SM)*; wet; fine to medium sand; nonplastic.
(Qva)

CONTINUED NEXT SHEET



LEGEND

- * Sample Not Recovered
- 2.0" O.D. Split Spoon Sample
- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-3-19

May 2020 | 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 4 of 7

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 147 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

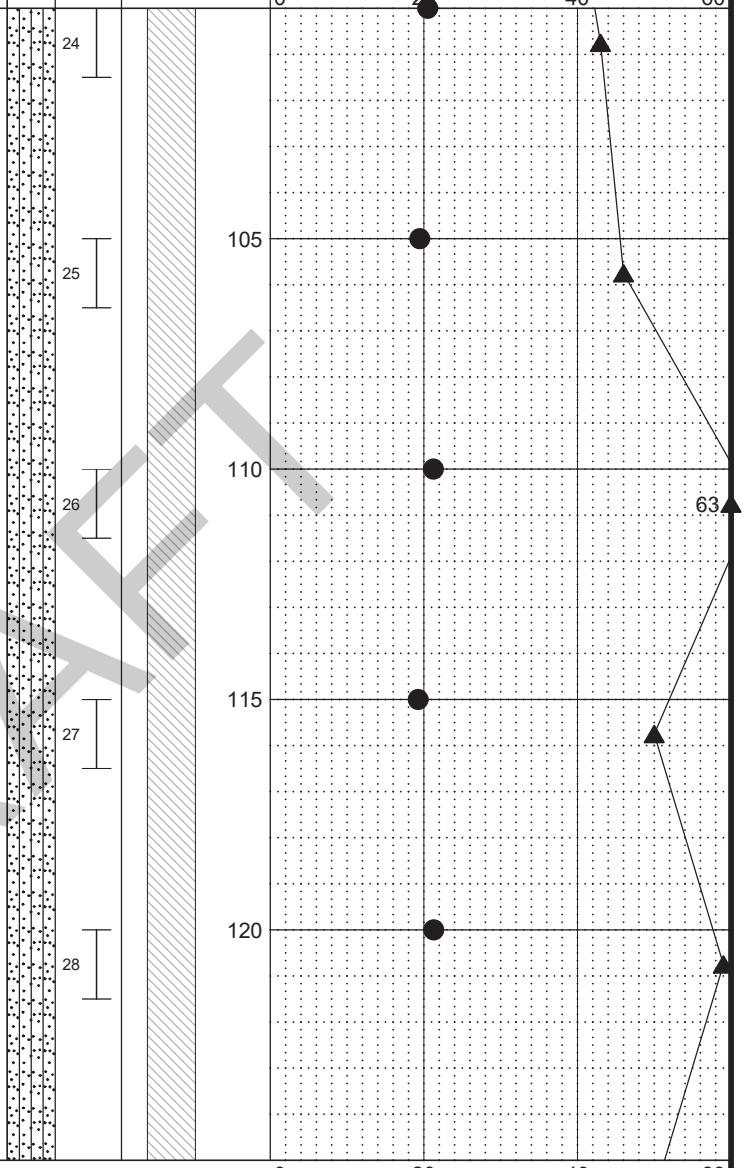
Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

- Few seams with iron oxide staining at 105 feet.
- Fine gravelly layer at about 105.2 feet.
- 1/4-inch silt pockets around 105.5 feet.

- Few seams with iron oxide staining at 120 feet.



CONTINUED NEXT SHEET

LEGEND

- * Sample Not Recovered
- 2.0" O.D. Split Spoon Sample
- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-3-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 5 of 7

REV 3 - Approved for Submittal

Log: SAW Rev: EAS Typ: LKN

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 147 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 20 40 60

29
30
31
32
33

130 135 140 145

62
64

- Few silty sand seams with strong iron oxide staining at 141.3 feet.

- Few silt seams below 145 feet.

CONTINUED NEXT SHEET

0 20 40 60

◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
2.0" O.D. Split Spoon Sample
Well Screen and Sand Filter
Bentonite-Cement Grout
Bentonite Chips/Pellets
Bentonite Grout
Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-3-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 6 of 7

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 147 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 20 40 60

151.5 — 34

BOTTOM OF BORING
COMPLETED 11/11/2019

155 160 165 170

0 20 40 60

◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
2.0" O.D. Split Spoon Sample
Well Screen and Sand Filter
Bentonite-Cement Grout
Bentonite Chips/Pellets
Bentonite Grout
Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-3-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 7 of 7

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

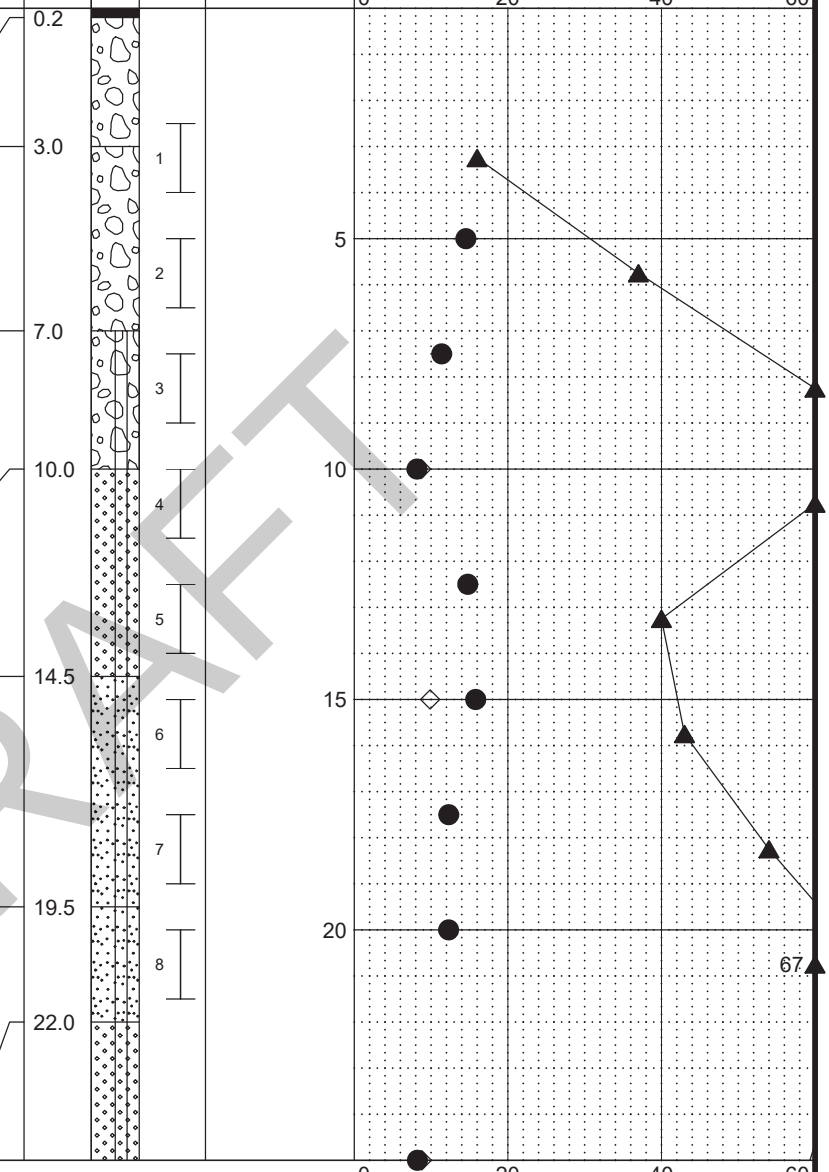
Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 122 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft.	Soil Description
0.2	Asphalt.
	Poorly Graded Gravel with Sand (GP). (Hf)
3.0	Medium dense to dense, brown, *Poorly Graded Gravel with Sand (GP)*; moist; fine to coarse, subrounded to angular gravel; fine to coarse sand. (Hf)
7.0	Very dense, brown, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; wet; fine to coarse, subrounded to subangular gravel; fine to coarse sand; nonplastic to low plasticity. (Qvrm)
10.0	Dense to very dense, brown, *Well Graded Sand with Silt and Gravel (SW-SM)*; wet; fine to coarse, subrounded to subangular gravel; fine to coarse sand; nonplastic. (Qvrm)
14.5	Dense to very dense, brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; few fine to coarse, subrounded gravel; fine to coarse sand; iron oxide staining on few gravels. (Qvrm)
19.5	Very dense, gray-brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; wet; fine, subrounded to subangular gravel; fine to coarse sand; nonplastic. (Qvrm)
22.0	Very dense, brown to gray, *Well Graded Sand with SIlt and Gravel (SW-SM)*; moist; fine to coarse, subangular gravel; fine to coarse

CONTINUED NEXT SHEET



PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

◇ % Fines (<0.075mm)

● % Water Content

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-4-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 1 of 7

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

REV 3 - Approved for Submittal

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 122 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

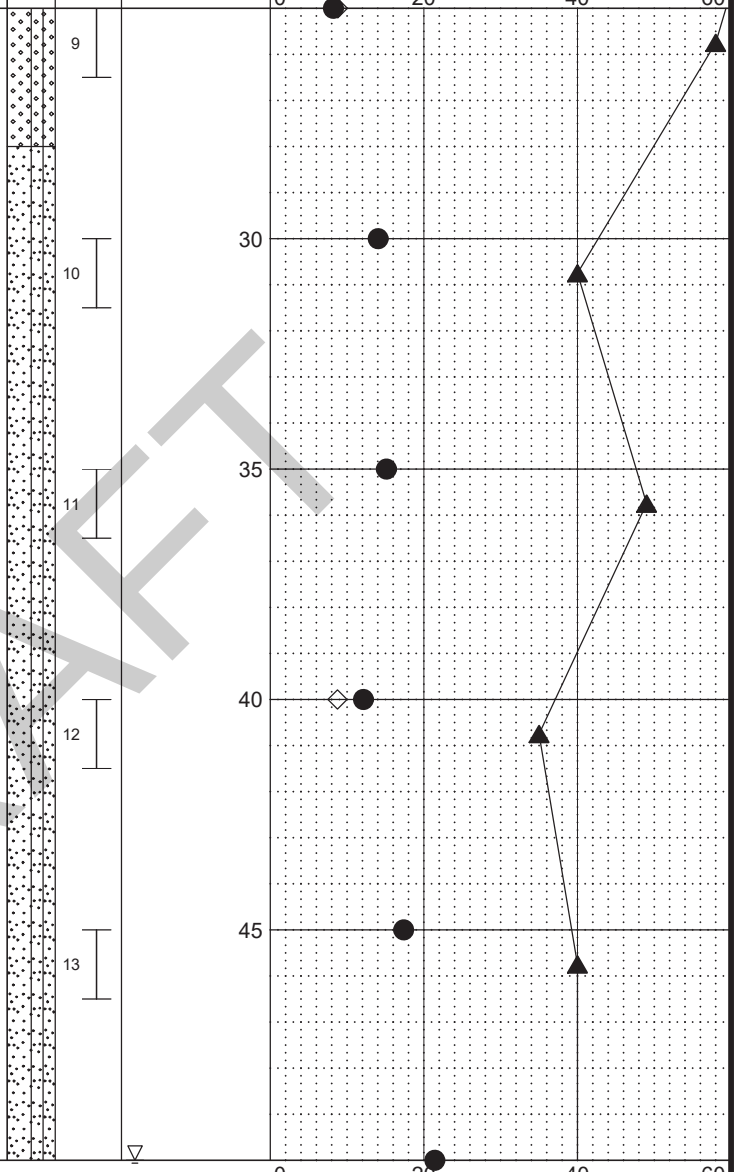
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

sand; nonplastic; few dark brown pockets with organics.
(Qvrm)

28.0

Dense to very dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist to wet; trace to few fine to coarse, subrounded gravel; fine to medium sand; nonplastic; few poorly graded sand with silt seams.
(Qvrm)



CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample
▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-4-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 2 of 7

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

REV 3 - Approved for Submittal

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 122 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

- Few silty sand seams at 55 feet.

14
15
16
17
18

During Drilling

0 20 40 60

55
60
65
70

0 20 40 60

CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-4-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 3 of 7

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

REV 3 - Approved for Submittal

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 122 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

- Few silty sand seams with iron oxide staining at 85 feet.

88.0

Dense to very dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)* to *Silty Sand (SM)*; wet; fine to coarse sand; nonplastic; few seams with iron oxide staining.
(Qva)

19 | 20 | 21 | 22 | 23

0 20 40 60

80 | 85 | 90 | 95

0 20 40 60

CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-4-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 4 of 7

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 122 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

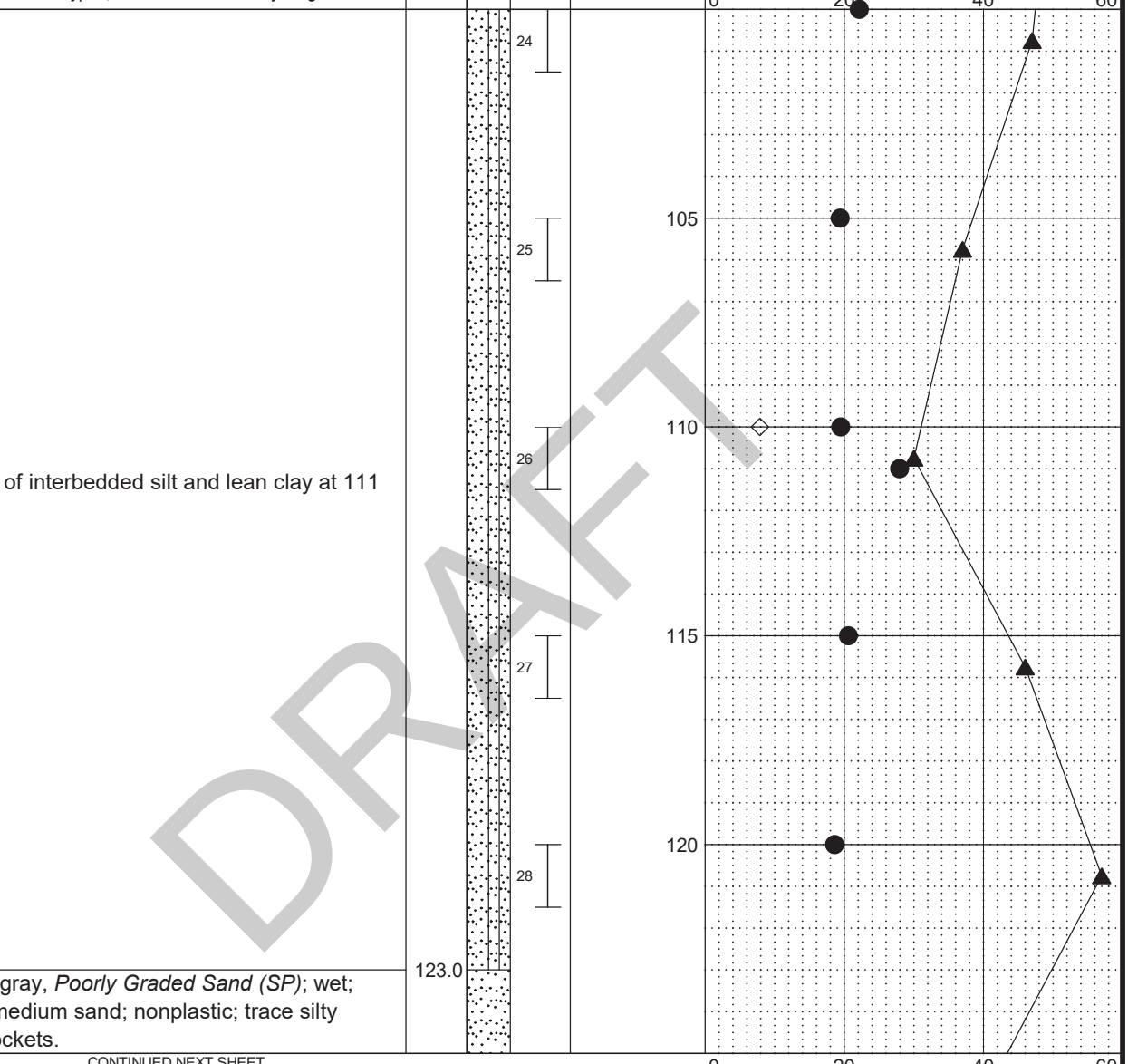
PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

- Layer of interbedded silt and lean clay at 111 feet.

123.0 Dense, gray, *Poorly Graded Sand (SP)*; wet; fine to medium sand; nonplastic; trace silty sand pockets.

CONTINUED NEXT SHEET



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-4-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 5 of 7

REV 3 - Approved for Submittal

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 122 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

(Qva)

128.0

Dense to very dense, dark gray, *Silty Sand (SM)* to *Poorly Graded Sand with Silt (SP-SM)*; wet; fine to medium sand.
(Qva)

- Few silty, fine sand seams below 140 feet.

- Few sandy silt seams at 145 feet.

29 | 30 | 31 | 32 | 33

130 | 135 | 140 | 145

61

0 20 40 60

CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-4-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 6 of 7

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*151.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 122 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

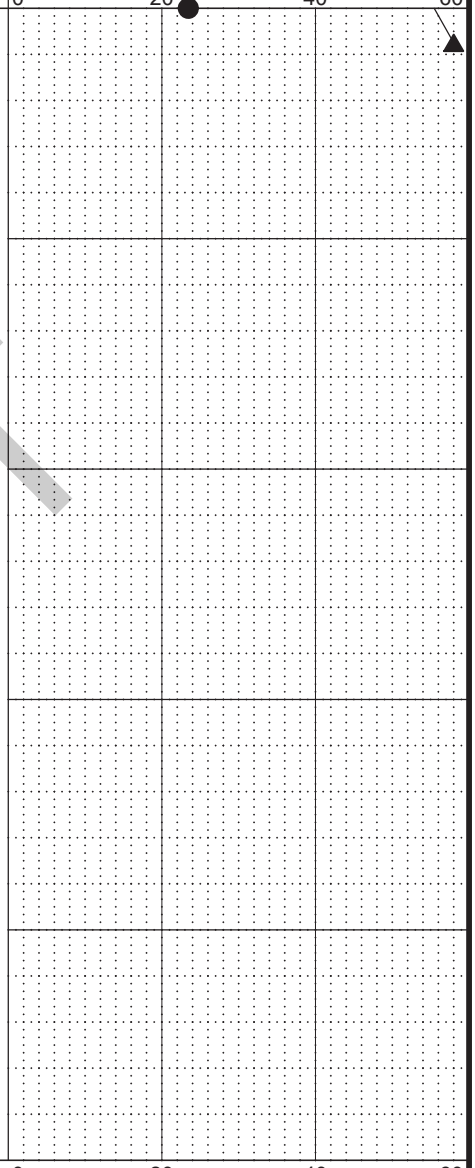
PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

- Few sandy silt seams at 150 feet.

151.5 — 34

BOTTOM OF BORING
COMPLETED 11/6/2019



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
2.0" O.D. Split Spoon Sample
Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-4-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 7 of 7

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 125 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Asphalt. — 0.2

Medium dense, gray to brown, *Poorly Graded Gravel with Sand (GP)*; moist; fine, angular gravel; fine to coarse sand; nonplastic. (Hf) — 3.0

Loose, brown, *Silty Sand with Gravel (SM)* to *Silty Gravel with Sand (GM)*; wet; fine, angular gravel; fine to coarse sand; nonplastic; trace organics. (Hf)

- Coarse gravel layer around 4 feet. — 7.0

Loose to medium dense, *Silty Sand (SM)*; moist; no sample recovery; description inferred from samples above and below 7 to 12 feet and drill action. (Hf)

Stiff, brown, *Lean Clay (CL)*; moist; trace gray silt seams; low to medium plasticity. (Qvrl) — 12.0

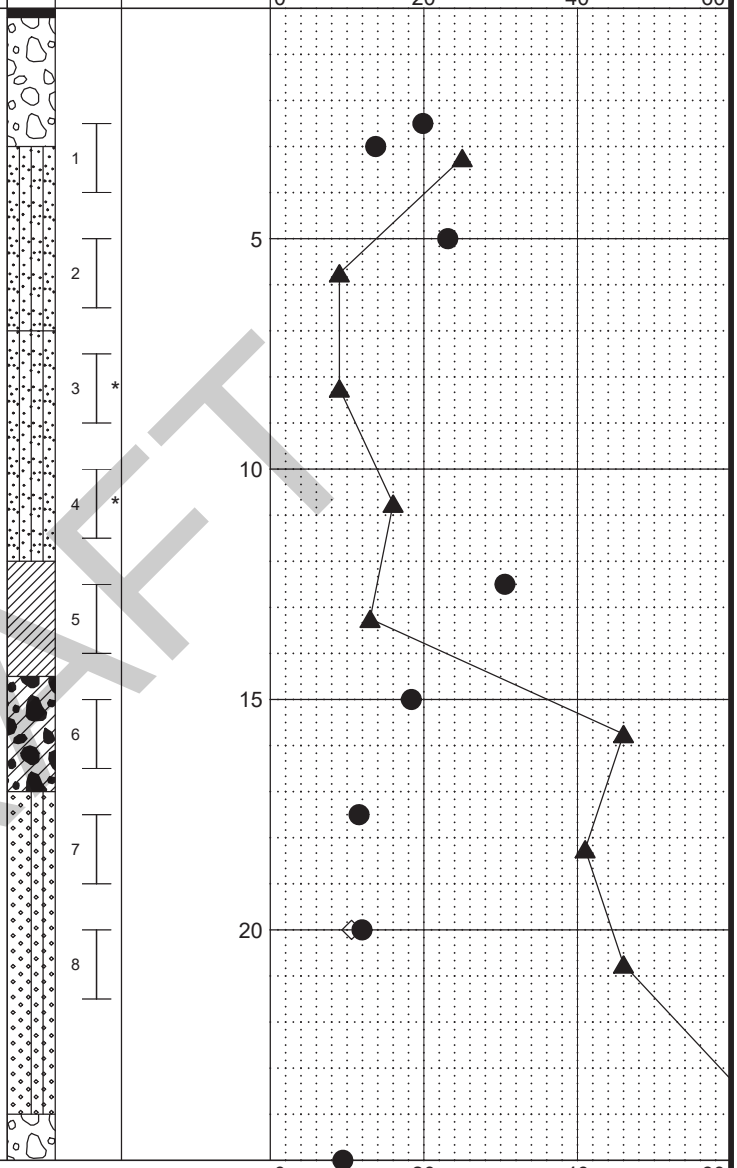
Dense, brown, *Clayey Gravel with Sand (GC)*; wet; fine to coarse, subangular gravel; fine to coarse sand; low to medium plasticity. (Qvrm) — 14.5

Dense, gray-brown, *Well Graded Sand with Silt and Gravel (SW-SM)*; wet; fine to coarse, subangular gravel; fine to coarse sand. (Qvrm) — 17.0

24.0

CONTINUED NEXT SHEET

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-5-19

May 2020 — 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-6
Sheet 1 of 4

Log: SAW Rev: EAS Typ: LKN

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20

REV 3 - Approved for Submittal

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 125 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Very dense, gray and brown, *Poorly Graded Gravel with Sand (GP)* to *Poorly Graded Gravel with Silt and Sand (GP-GM)*; wet; fine to coarse, subangular gravel; fine to coarse sand; nonplastic.
(Qvrm)

33.0

Medium dense to very dense, brown to gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; trace coarse sand; fine to medium sand; nonplastic.
(Qvrm)

CONTINUED NEXT SHEET

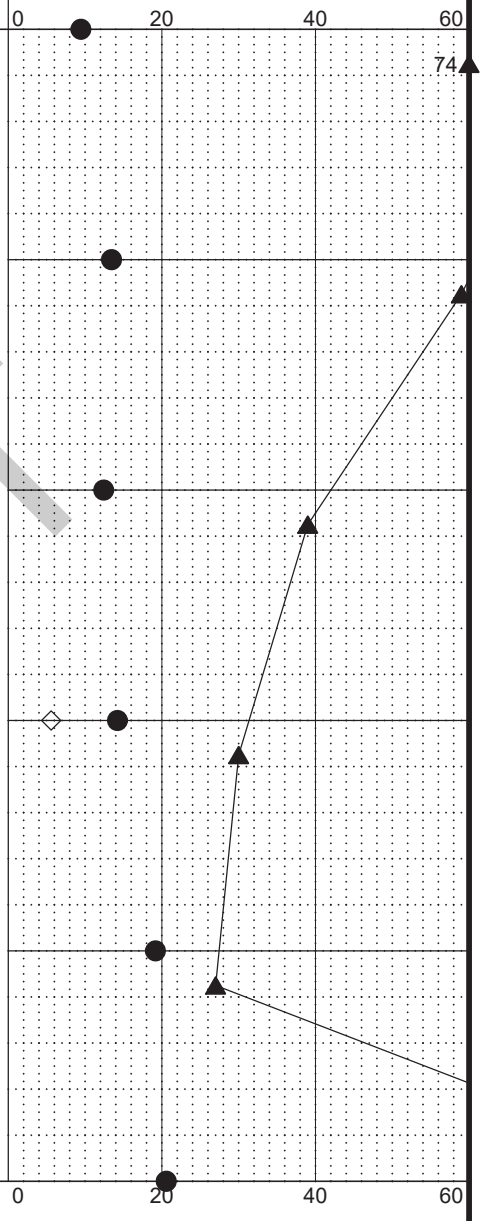
Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

Samples: 9, 10, 11, 12, 13

During Drilling ▽

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

▽ Ground Water Level ATD

⊥ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-5-19

May 2020 | 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-6
Sheet 2 of 4

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 125 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

52.0

Medium dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; wet; fine to coarse, subangular gravel; fine to coarse sand; nonplastic.
(Qvrm)

58.0

Medium dense, gray-brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)* to *Silty Sand with Gravel (SM)*; wet; fine, subrounded to subangular gravel; fine to coarse sand; nonplastic; few silty sand seams.
(Qvrm)

- Increased gravel lenses around 65 feet.
- Iron oxide staining at 66.2 feet.

68.0

Dense, brown, *Poorly Graded Sand with Silt (SP-SM)* to *Silty Sand (SM)*; wet; fine to medium sand; nonplastic; few silty sand lenses around 70 feet.
(Qvrm)

74.0

14 15 16 17 18

50/6"

0 20 40 60

55 60 65 70

CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-5-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-6
Sheet 3 of 4

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 125 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Dense, gray-brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; wet; fine, subrounded to subangular gravel; fine to coarse sand; nonplastic.
(Qvrm)

78.0

Dense, gray-brown, *Poorly Graded Sand (SP)*; wet; few fine, subrounded gravel; fine to medium sand; nonplastic.
(Qvrm)

81.5

BOTTOM OF BORING
COMPLETED 11/4/2019

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

19

20

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 20 40 60

80 85 90 95

0 20 40 60

◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
2.0" O.D. Split Spoon Sample
Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-5-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-6
Sheet 4 of 4

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 125 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

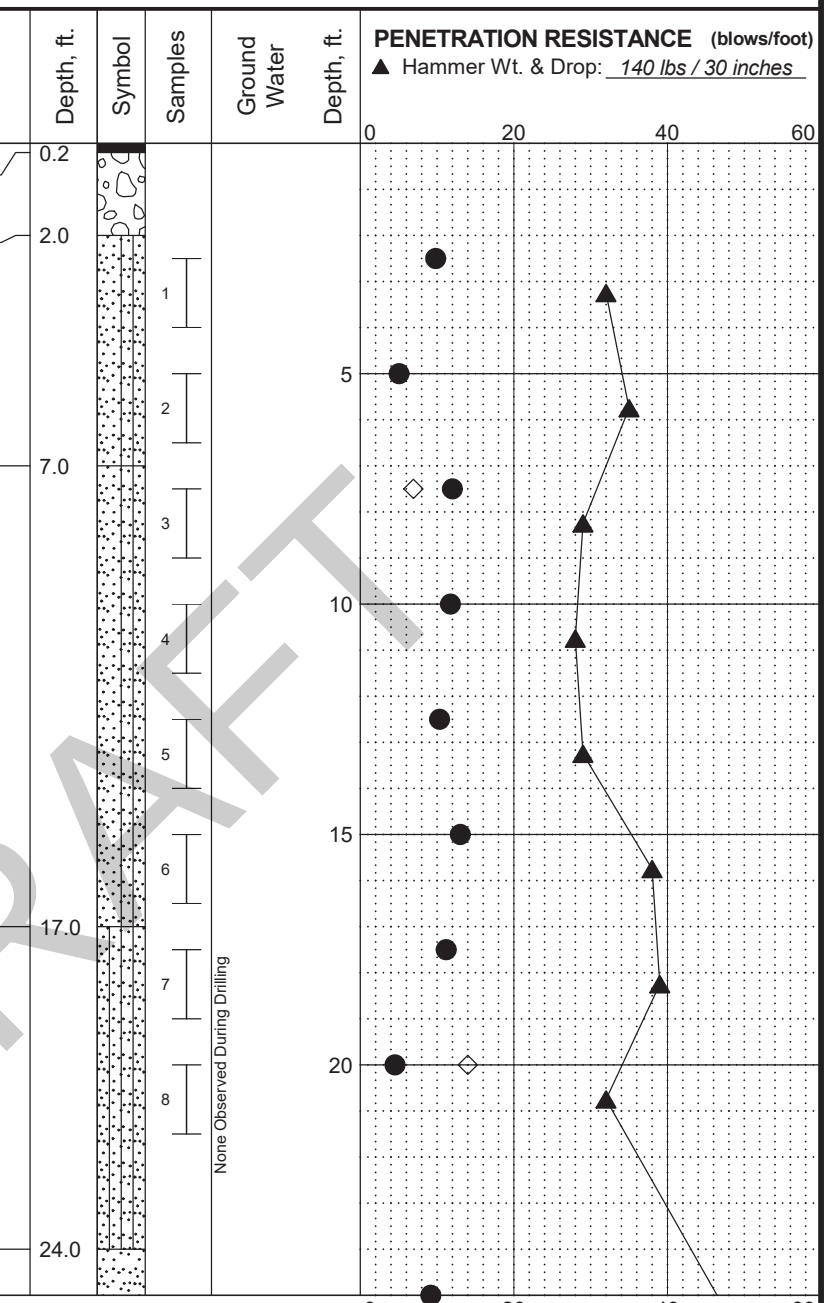
Asphalt.

Poorly Graded Gravel with Sand (GP).
(Hf)

Dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist; fine to coarse, subrounded gravel; fine to coarse sand; nonplastic.
(Hf)
- Gravelly layer from 5.5 to 6 feet.
- Strong iron oxide staining at 6.3 feet.

Medium dense to dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; trace fine, subangular gravel; fine to coarse sand; nonplastic.
(Qvrm)

Dense, gray-brown, *Silty Sand (SM)*; moist; few fine, subangular gravel; fine to coarse sand; nonplastic.
(Qvrm)



CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-6-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-7
Sheet 1 of 4

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

REV 3 - Approved for Submittal

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 125 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

Dense, gray-brown, *Poorly Graded Sand with Gravel (SP)*; moist; fine, subangular gravel; fine to coarse sand; nonplastic; few silty sand seams.
(Qvrm)

28.0

- Strong iron oxide staining at 25 feet.

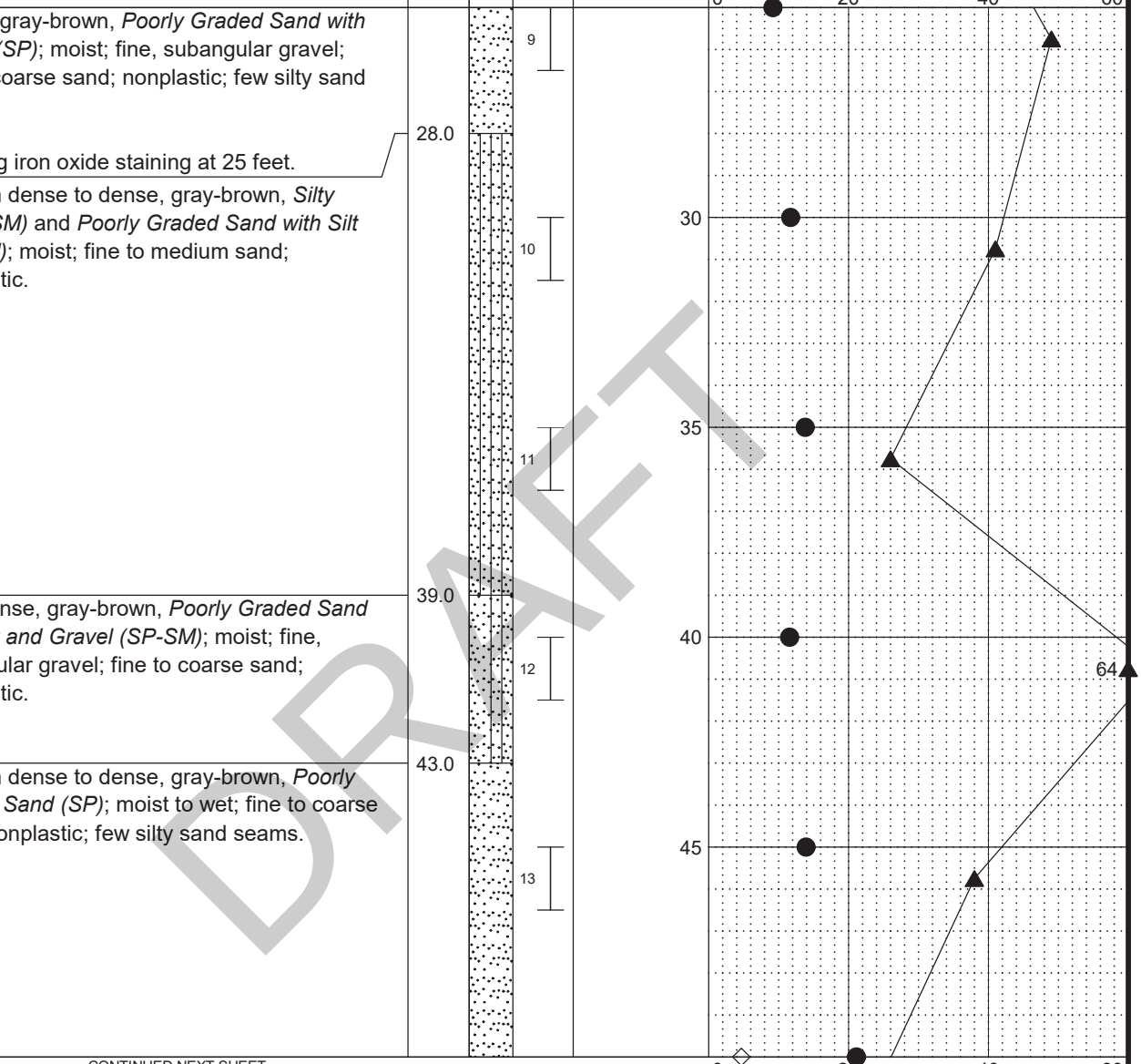
Medium dense to dense, gray-brown, *Silty Sand (SM)* and *Poorly Graded Sand with Silt (SP-SM)*; moist; fine to medium sand; nonplastic.
(Qvrm)

39.0

Very dense, gray-brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist; fine, subangular gravel; fine to coarse sand; nonplastic.
(Qvrm)

43.0

Medium dense to dense, gray-brown, *Poorly Graded Sand (SP)*; moist to wet; fine to coarse sand; nonplastic; few silty sand seams.
(Qvrm)



CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-6-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-7
Sheet 2 of 4

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 125 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 20 40 60

14 15 16 17 18

55 60 65 70

71/10"

Very dense, gray-brown, *Poorly Graded Sand with Gravel (SP)*; wet; fine, subangular gravel; fine to coarse sand; nonplastic. (Qvrm)

67.0

Dense, gray-brown, *Silty Sand (SM)* and *Poorly Graded Sand (SP)*; moist to wet; fine to medium sand; nonplastic; iron oxide staining at 76.2 feet.

72.0

CONTINUED NEXT SHEET

0 20 40 60

◇ % Fines (<0.075mm)

● % Water Content

LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-6-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-7
Sheet 3 of 4

REV 3 - Approved for Submittal

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20 Log: SAW Rev: EAS Typ: LKN

Total Depth:	*81.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 125 ft.*	Easting:		Drilling Company:	*Holocene Drilling*	Rod Diam.:	*2-inch ID*
Vert. Datum:		Station:		Drill Rig Equipment:	*Diedrich D120 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

(Qvrm)

- Layer of interbedded, sandy silt and low plasticity silt at 80 feet.
- Layer of silty sand with gravel at 80.7 feet.

81.5

BOTTOM OF BORING
COMPLETED 11/6/2019

19

20

0 20 40 60

80

85

90

95

0 20 40 60

◇ % Fines (<0.075mm)

● % Water Content

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Snohomish County Public Works
Arlington Operations Center
Arlington, Washington

LOG OF BORING SW-6-19

May 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-7
Sheet 4 of 4

REV 3 - Approved for Submittal

Log: SAW Rev: EAS Typ: LKN

MASTER LOG E 104098.GPJ SHAN_WIL.GDT 5/7/20

PROJECT:	**Arlington Shop Redevelopment** **19620 67th Ave NE** **Arlington, Wa. 98223**	BORING NO.:	**SB-01**
		DRILLER:	**WSDOT**
		DRILL TYPE:	**CME 850 (PC2-4)**
C.R.P.#:	**ROFAC-52-37** DATE: **12/21/15**	AUGER TYPE:	**HC Wireline Core**
STATION:	**Center Yard Power Pole** OFFSET:	FLUID:	**Super Gel X Bentonite Polymer**
GEO./ENGR.:	**Kirk R. Bailey** ELEV.:	TOTAL DEPTH:	**145.50**

SAMPLE INTERVAL	SAMPLE #	SPT BLOWS/FT	STRATA	DEPTH	SOIL DESCRIPTION	NOTES
					0.0 - 3.0' **Sand**; Red brown to brown, fine- to medium-grained, loose, damp (*fill*).	12/17/2015 0.0 - 45.5' Hole advanced using HC wire line and recirculating Super Gel-X Bentonite Polymer mud with good circulation. Surface casing set and advanced as necessary to maintain circulation.
X	1	9/9/11		5	3.0 - 19.0' **Sand**; Gray brown to brown, fine- to coarse-grained, medium dense, damp (*sp*).	
X	2	8/12/14		10	14.0' trace silt, trace gravel	
X	3	10/14/14		15		SPT soil samples taken on 5 ft. intervals as indicated on log. Representative soil samples were collected and placed in clear glass jars for later correlation and testing. Samples will be stored at the testing lab until project is complete.
X	4	19/21/26		20	19.0 - 42.0' **Sand**; Gray brown, fine- to coarse-grained, trace to little gravel, trace silt, local iron staining of gravels, dense, increasing moisture with depth (*sp*).	
X	5	16/24/23		25		
X	6	15/16/19		30	34.0' little gravel	
X	7	14/19/26				Boring log continued on next page.

NOTES: **Soil samples were taken in accordance with ASTM D1586-84 standards and specifications. Soil classifications were developed in the field in accordance with ASTM D2488 and following the Unified Soil Classification system format.**

PROJECT:	**Arlington Shop Redevelopment** **19620 67th Ave NE** **Arlington, Wa. 98223**	BORING NO.:	**SB-01**
C.R.P.#:	**ROFAC-52-37** DATE: **12/21/15**	DRILLER:	**WSDOT**
STATION:	**Center Yard Power Pole** OFFSET:	DRILL TYPE:	**CME 850 (PC2-4)**
GEO./ENGR.:	**Kirk R. Bailey** ELEV.:	AUGER TYPE:	**HC Wireline Core**
		FLUID:	**Super Gel X Bentonite Polymer**
		TOTAL DEPTH:	**145.50**

SAMPLE INTERVAL	SAMPLE #	SPT BLOWS/FT	STRATA	DEPTH	SOIL DESCRIPTION	NOTES
					19.0 - 42.0' **Sand**; Continued from previous page.	
X	8	14/14/13		40	42.0' ground water table (2/10/2016)	
					42.0 - 48.0' **Sand**; Gray brown to gray, fine- to medium-grained, little silt, trace coarse-grained sand, trace gravel, medium dense, wet to saturated (*sp*).	
X	9	13/9/12		45		
					48.0 - 53.0' **Sand**; Gray brown, fine- to coarse-grained, some gravel, dense, wet (*sp*).	12/18/2015 Continued drilling hole from 45.5' to 100.5 ft bgs. Drill mud down hole measured at 20 ft bgs.
X	10	16/20/24		50		
					53.0 - 62.0' **Sand**; Gray brown, fine- to coarse-grained, trace silt, medium dense, wet (*sp*).	
X	11	13/10/14		55		
X	12	10/8/12		60		
					62.0 - 67.0' **Silty Sand**; Gray brown to tan, very fine- to fine-grained, thin laminations of silt, local iron staining, loose to medium dense, wet (*sm*).	
X	13	6/7/10		65		
					67.0 - 82.0' **Silty Sand**; Gray brown to gray, fine-grained, trace medium-grained sand, local red brown staining, medium dense, wet (*sm*).	Boring log continued on next page
X	14	10/12/13				

NOTES: **Soil samples were taken in accordance with ASTM D1586-84 standards and specifications. Soil classifications were developed in the field in accordance with ASTM D2488 and following the Unified Soil Classification system format.**

PROJECT:	**Arlington Shop Redevelopment** **19620 67th Ave NE** **Arlington, Wa. 98223**	BORING NO.:	**SB-01**
		DRILLER:	**WSDOT**
		DRILL TYPE:	**CME 850 (PC2-4)**
C.R.P.#:	**ROFAC-52-37** DATE: **12/21/15**	AUGER TYPE:	**HC Wireline Core**
STATION:	**Center Yard Power Pole** OFFSET:	FLUID:	**Super Gel X Bentonite Polymer**
GEO./ENGR.:	**Kirk R. Bailey** ELEV.:	TOTAL DEPTH:	**145.50**

SAMPLE INTERVAL	SAMPLE #	SPT BLOWS/FT	STRATA	DEPTH	SOIL DESCRIPTION	NOTES
					67.0 - 82.0' **Silty Sand**; Continued from previous page.	
X	15	13/13/12		75		
X	16	10/10/11		80		
					82.0 - 87.0' **Sand**; Gray brown, fine- to coarse-grained, dense, moist to wet (*sp*).	
X	17	14/15/22		85		
					87.0 - 145.5 **Sand to Silty Sand**; Gray brown, very fine-grained to medium-grained, occasional silt laminations, locally iron stained, medium dense to dense, wet (*sm-sp*).	
X	18	10/13/19		90	89.0' fine- to very fine-grained sand, trace medium-grained sand, trace to little silt.	
X	19	12/12/14		95		12/21/2015 continued drilling from 100.5 to 145.5 ft bgs. Drill mud down hole measured at 27.9 ft bgs.
X	20	16/16/17		100		
					104.0' trace to little medium-grained sand, trace to little silt	Boring log continued on next page
X	21	13/13/17				

NOTES: **Soil samples were taken in accordance with ASTM D1586-84 standards and specifications. Soil classifications were developed in the field in accordance with ASTM D2488 and following the Unified Soil Classification system format.**

PROJECT:	**Arlington Shop Redevelopment** **19620 67th Ave NE** **Arlington, Wa. 98223**	BORING NO.:	**SB-01**
C.R.P.#:	**ROFAC-52-37** DATE: **12/21/15**	DRILLER:	**WSDOT**
STATION:	**Center Yard Power Pole** OFFSET:	DRILL TYPE:	**CME 850 (PC2-4)**
GEO./ENGR.:	**Kirk R. Bailey** ELEV.:	AUGER TYPE:	**HC Wireline Core**
		FLUID:	**Super Gel X Bentonite Polymer**
		TOTAL DEPTH:	**145.50**

SAMPLE INTERVAL	SAMPLE #	SPT BLOWS/FT	STRATA	DEPTH	SOIL DESCRIPTION	NOTES
					87.0 - 145.5' **Sand to Silty Sand**; Continued from previous page.	
X	22	15/14/14		110		
X	23	24/19/18		115		
					119.0' trace to little medium-grained sand, trace to little silt	
X	24	12/15/15		120		
X	25	12/14/19		125		
X	26	12/14/16		130		
X	27	15/10/13		135	134.0' Silty Sand, very fine-grained	
X	28	13/18/22				Boring log continued on next page

NOTES: **Soil samples were taken in accordance with ASTM D1586-84 standards and specifications. Soil classifications were developed in the field in accordance with ASTM D2488 and following the Unified Soil Classification system format.**

PROJECT:	**Arlington Shop Redevelopment** **19620 67th Ave NE** **Arlington, Wa. 98223**	BORING NO.:	**SB-01**
C.R.P.#:	**ROFAC-52-37** DATE: **12/21/15**	DRILLER:	**WSDOT**
STATION:	**Center Yard Power Pole** OFFSET:	DRILL TYPE:	**CME 850 (PC2-4)**
GEO./ENGR.:	**Kirk R. Bailey** ELEV.:	AUGER TYPE:	**HC Wireline Core**
		FLUID:	**Super Gel X Bentonite Polymer**
		TOTAL DEPTH:	**145.50**

SAMPLE INTERVAL	SAMPLE #	SPT BLOWS/FT	STRATA	DEPTH	SOIL DESCRIPTION	NOTES
					87.0 - 145.5' **Sand to Silty Sand**; Continued from previous page.	
	29	17/21/30		145		
					Total Depth = 145.5 ft. bgs. Driller: Danny Henderson #2742 VWP Serial #1503092	Boring backfilled to 100 ft. bgs with bentonite pellets. Vibrating wire piezometer installed at 100 ft. bgs. Boring backfilled from 100 ft. bgs to surface with mixture of quickset concrete and bentonite chips. VWP installed with standpipe monument and 4 surrounding bollards.

NOTES: **Soil samples were taken in accordance with ASTM D1586-84 standards and specifications. Soil classifications were developed in the field in accordance with ASTM D2488 and following the Unified Soil Classification system format.**

BORING LOG NO. B-1

PROJECT: Sno County Maintenance Triple Wide

CLIENT: Burton Construction
1000 Industry Drive Tukwila, WA 98188

SITE: 19700 67th Ave NE
Arlington, WA

will@burtonconstruction.net

	FILL - GRASS AND TOPSOIL (SM)							
	FILL - POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)					)		!!
	FILL - CRUSHED ROCK (5/8" minus) mixed with SILTY SAND (GW-GM)	)						
	FILL - SANDY GRAVEL (GW)	!*				"F		
	SANDY ORGANIC SILT (PEAT) (OL)							
	MIX SILTY SAND and GRAVEL (SM)	!)						
	POORLY GRADED SAND (SP)	"*						
	Boring Terminated at 21.5 Feet							

WATER LEVEL OBSERVATIONS

Terracon

FIG. A-9

BORING LOG NO. B-2

PROJECT: Sno County Maintenance Triple Wide

CLIENT: Burton Construction
1000 Industry Drive Tukwila, WA 98188

SITE: 19700 67th Ave NE
Arlington, WA

will@burtonconstruction.net

*+&	**FILL - ASPHALT CONCRETE**				!* ! !' $%&!						
!+)	**FILL - POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**										
"+)	**FILL - SILTY SAND (SM)**										
	FILL - SANDY GRAVEL (GW)				!! ! ! !" $%"&			(			!"
)+*											
	FILL - GRAVELLY SAND (SW)	)			!* F ($%!Ä						
!* +*											
	FILL - SANDY GRAVEL (GW)				) ' ($%!&			F			
!" +*		!*			&)) $%!*						
	FILL - CRUSHED ROCK (5/8" minus) mixed with SANDY SILT (GW-GM)										
!) +*											
	SANDY ORGANIC SILT (PEAT) (OL)	!)			" " " $%Ä			'''			
!' +)											
	GRAVELLY SAND (SW)										
"! +)		"*			&) ' $%!"						
	Boring Terminated at 21.5 Feet										

K9<71;: 2 :1 5Ã[:5U9 R M/ =0 Ã5:2 ÃK6: .	S: :ÃZTU335ÃK ÃBÃ94 ;.3Q53 Ã\BÃB3:= Q/; :9 A: 4+	$/ 5:4R
K- 719/ 12 :1 5Ã[:5U9 R V/ .3164Ã-7;> B=9 Ã05UÃ4/3Ã;A5316 4ÃAQ/1Ã;/2Q=53/1+	S: :ÃKQQ:1937ÃBÃ94 ;. 3Q53/Ã\BÃ=/. 75. 8 Q/; :9 A: 4Ã719Ã99353 7=Ã975Ã3BÃ78@ S: :ÃKQQ:1937ÃDÃBÃ:TQ=7753/Ã\BÃ82 -/ =4Ã719 7- -. :< 3753/1+	

WATER LEVEL OBSERVATIONS

Terracon

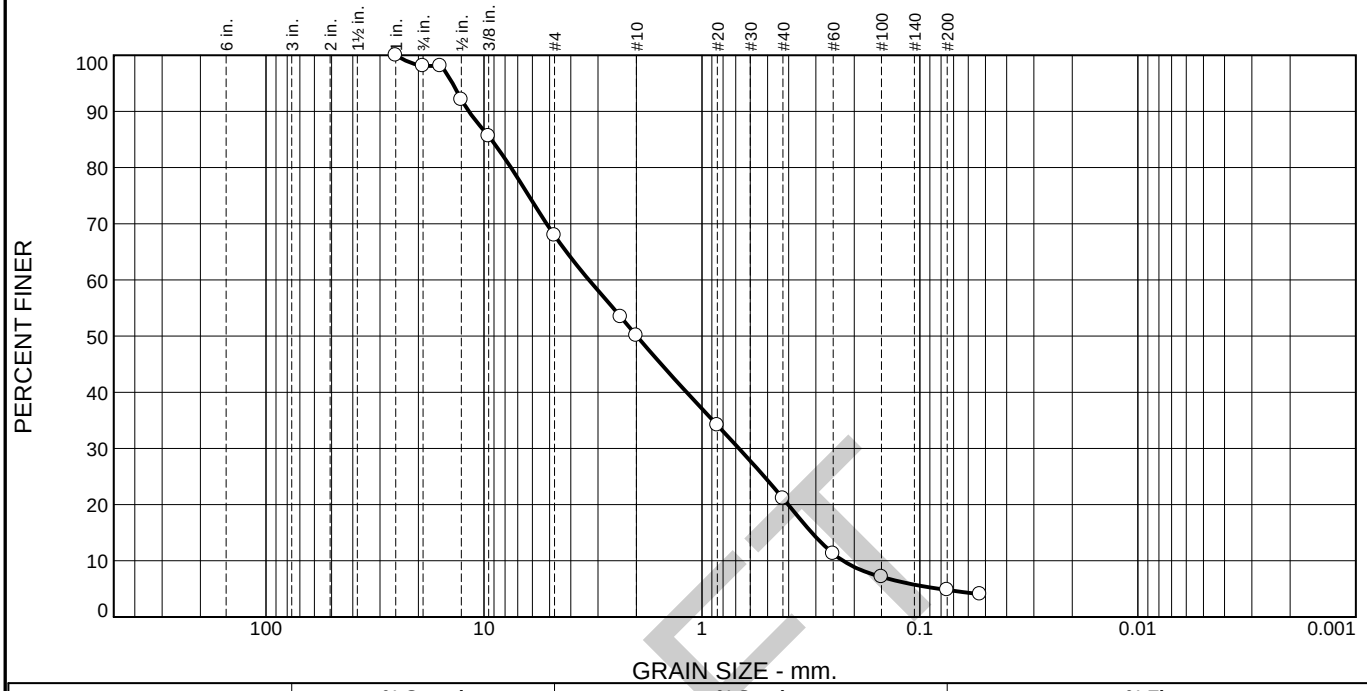
V/ .316ÃS57.5:9RÃ H"H* !(	V/ .316Ã5/ 2Q=5: 9RÃ H"H* !(
X.3=+ÃSRÃ7.7; >	X.3==Ã : / =/63;
L./ a ; 5Ã / =RÃ !( )!)F	ZTU335R K)

FIG. A-10

APPENDIX C

Laboratory Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.9	30.2	17.8	29.0	16.3	4.8	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
3/4"	98.1		
5/8"	98.1		
1/2"	92.1		
3/8"	85.6		
#4	67.9		
#8	53.4		
#10	50.1		
#20	34.1		
#40	21.1		
#60	11.3		
#100	7.1		
#200	4.8		
#270	4.1		

* (no specification provided)

Material Description

very gravelly SAND trace silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

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

Coefficients

D_{90}= 11.7370 D_{85}= 9.2633 D_{60}= 3.2986
D_{50}= 1.9897 D_{30}= 0.6767 D_{15}= 0.3131
D_{10}= 0.2251 C_u= 14.66 C_c= 0.62

Remarks

Date Received: 5-13-2024 **Date Tested:** 5-15-2024

Tested By: FEW

Checked By: BCY/TR

Title:

Location: Onsite
Sample Number: EB-3 **Depth:** 7.5'

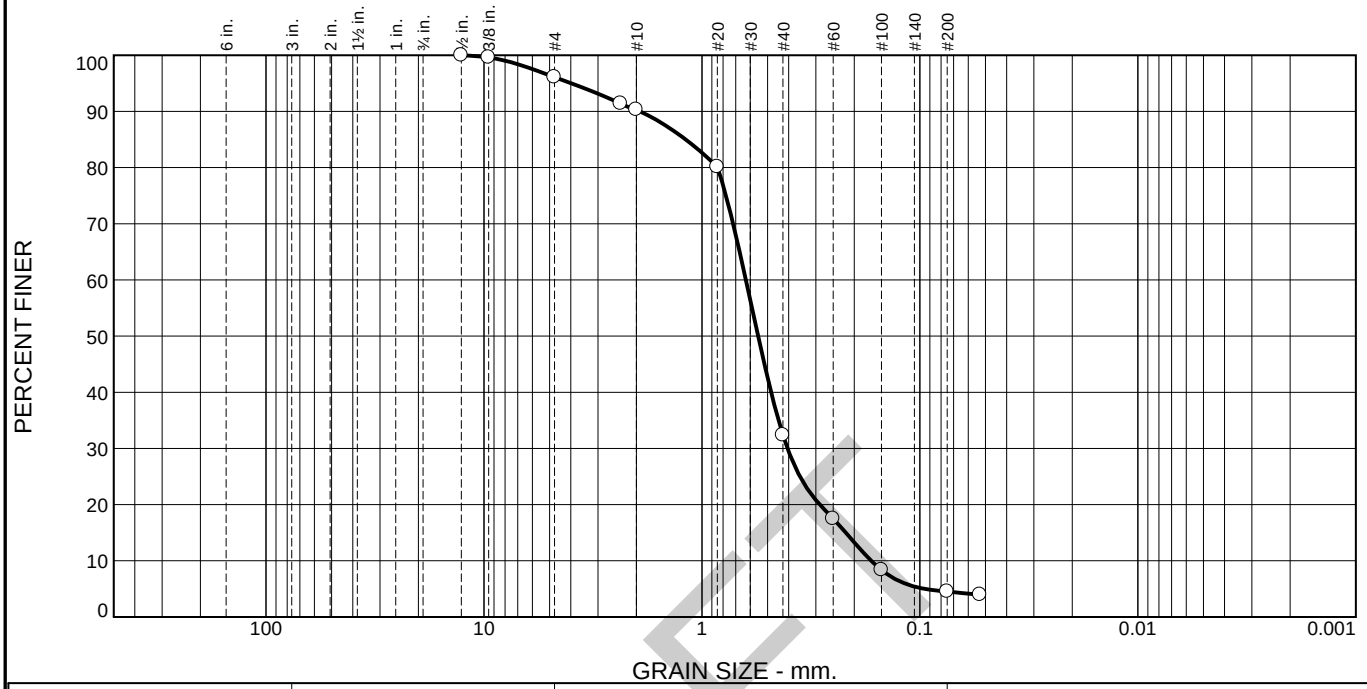
Date Sampled: 4/24/2024

associated earth sciences incorporated

Client: Cornerstone General Contractors, Inc.
Project: Arlington Operations Center Redevelopment

Project No: 20240001E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.9	5.8	57.9	27.9	4.5	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1/2"	100.0		
3/8"	99.6		
#4	96.1		
#8	91.4		
#10	90.3		
#20	80.1		
#40	32.4		
#60	17.5		
#100	8.4		
#200	4.5		
#270	3.9		

* (no specification provided)

Material Description

SAND trace gravel trace silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 1.9226 D_{85}= 1.1874 D_{60}= 0.6286
D_{50}= 0.5524 D_{30}= 0.4051 D_{15}= 0.2188
D_{10}= 0.1672 C_u= 3.76 C_c= 1.56

Remarks

Date Received: 5-13-2024 **Date Tested:** 5-15-2024

Tested By: FEW

Checked By: BCY/TR

Title:

Location: Onsite
Sample Number: EB-3 **Depth:** 15'

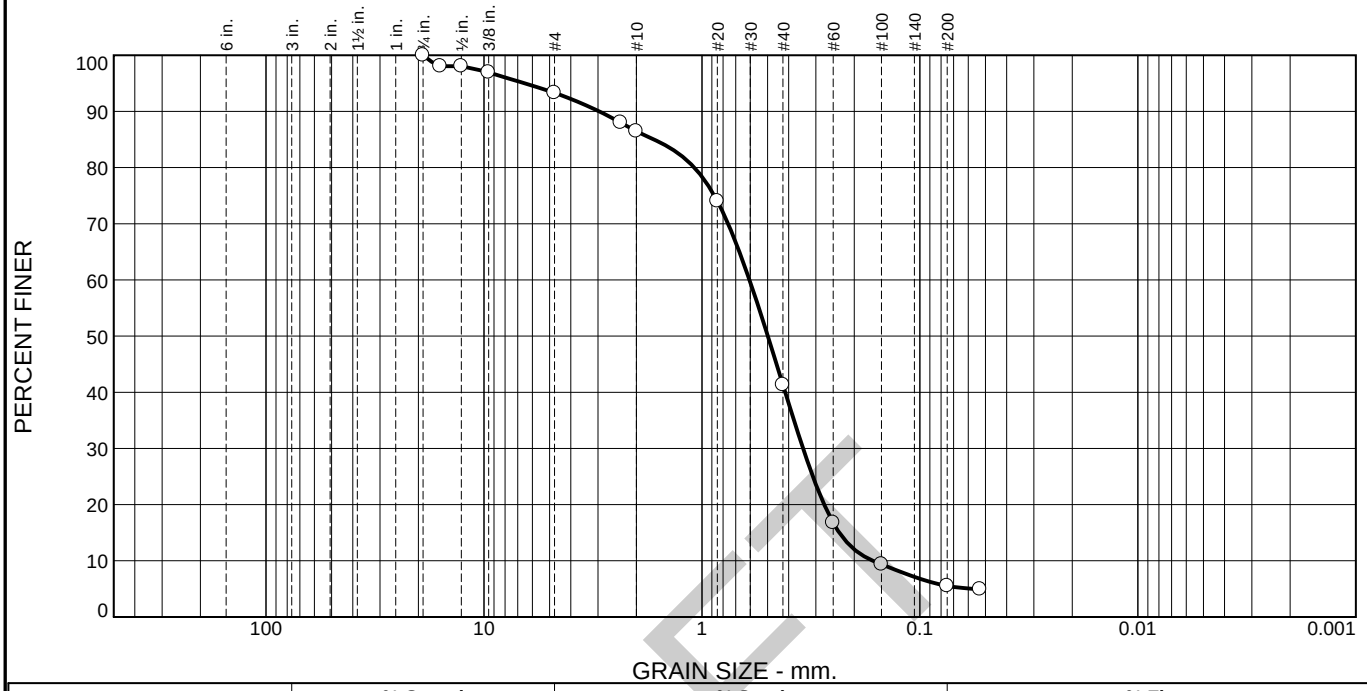
Date Sampled: 4-24-2024

associated earth sciences incorporated

Client: Cornerstone General Contractors, Inc.
Project: Arlington Operations Center Redevelopment

Project No: 20240001E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.7	6.8	45.2	35.8	5.5	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
5/8"	98.0		
1/2"	98.0		
3/8"	97.0		
#4	93.3		
#8	88.0		
#10	86.5		
#20	74.0		
#40	41.3		
#60	16.8		
#100	9.4		
#200	5.5		
#270	4.9		

* (no specification provided)

Material Description

SAND some gravel some silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

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

Coefficients

D_{90}= 2.9624 D_{85}= 1.6638 D_{60}= 0.6054
D_{50}= 0.4987 D_{30}= 0.3435 D_{15}= 0.2343
D_{10}= 0.1641 C_u= 3.69 C_c= 1.19

Remarks

Date Received: 5-13-2024 **Date Tested:** 5-15-2024

Tested By: FEW

Checked By: BCY/TR

Title:

Location: Onsite
Sample Number: EB-3 **Depth:** 20'

Date Sampled: 4-24-2024

associated earth sciences incorporated

Client: Cornerstone General Contractors, Inc.
Project: Arlington Operations Center Redevelopment

Project No: 20240001E001 **Figure**

Northwest Agricultural Consultants

2545 W Falls Avenue
Kennewick, WA 99336
509.783.7450
www.nwag.com
lab@nwag.com

PAP-Accredited
NAPT

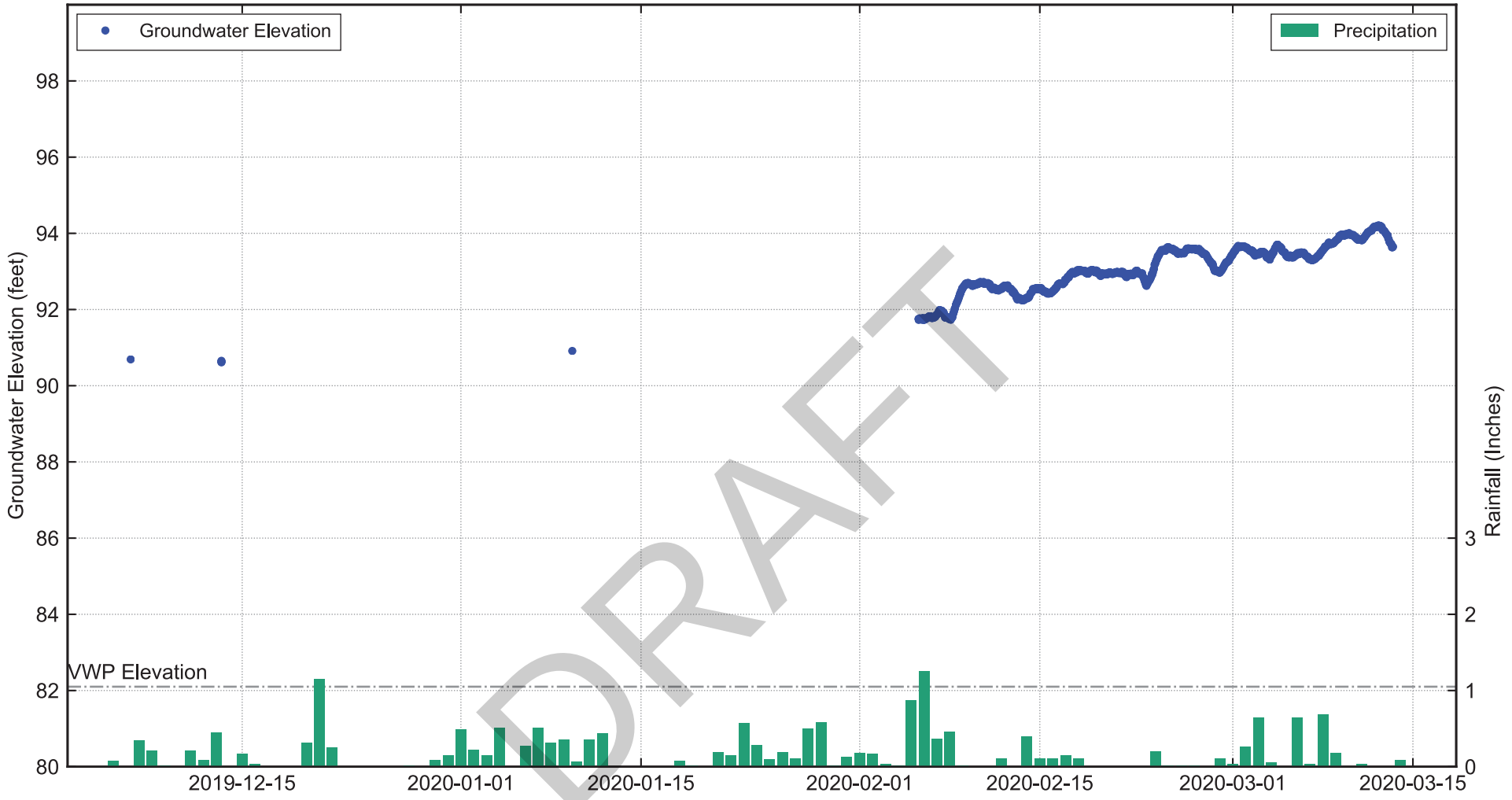
Associated Earth Sciences Inc.
911 5th Ave
Kirkland, WA 98033

Report: 68315-1-1
Date: May 15, 2024
Project No: 20240001E001
Project Name: Arlington Operations Center Redevelopment

Sample ID	Organic Matter	Cation Exchange Capacity
EB-3 @ 5.0’	1.81 %	5.1 meq/100g
EB-3 @ 12.5’	0.48 %	2.7 meq/100g
EB-3 @ 22.5’	0.53 %	2.7 meq/100g
Method	**ASTM D2974**	**EPA 9081**

APPENDIX D

Hydrographs



Notes:
1. Ground surface elevation at SW-3-19 is approximately 147 feet.The VWP is installed at a depth of 65 feet, corresponding to approximate elevation +82 feet.
2. Rainfall data sourced from NOAA station US1WASN0043 located in North Marysville about 5 miles south of Arlington

Arlington Operations Center
Arlington, Washington

VIBRATING WIRE PIEZOMETER GROUNDWATER ELEVATIONS SW-3-19

March 2020 104098-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-11

FIG. A-11

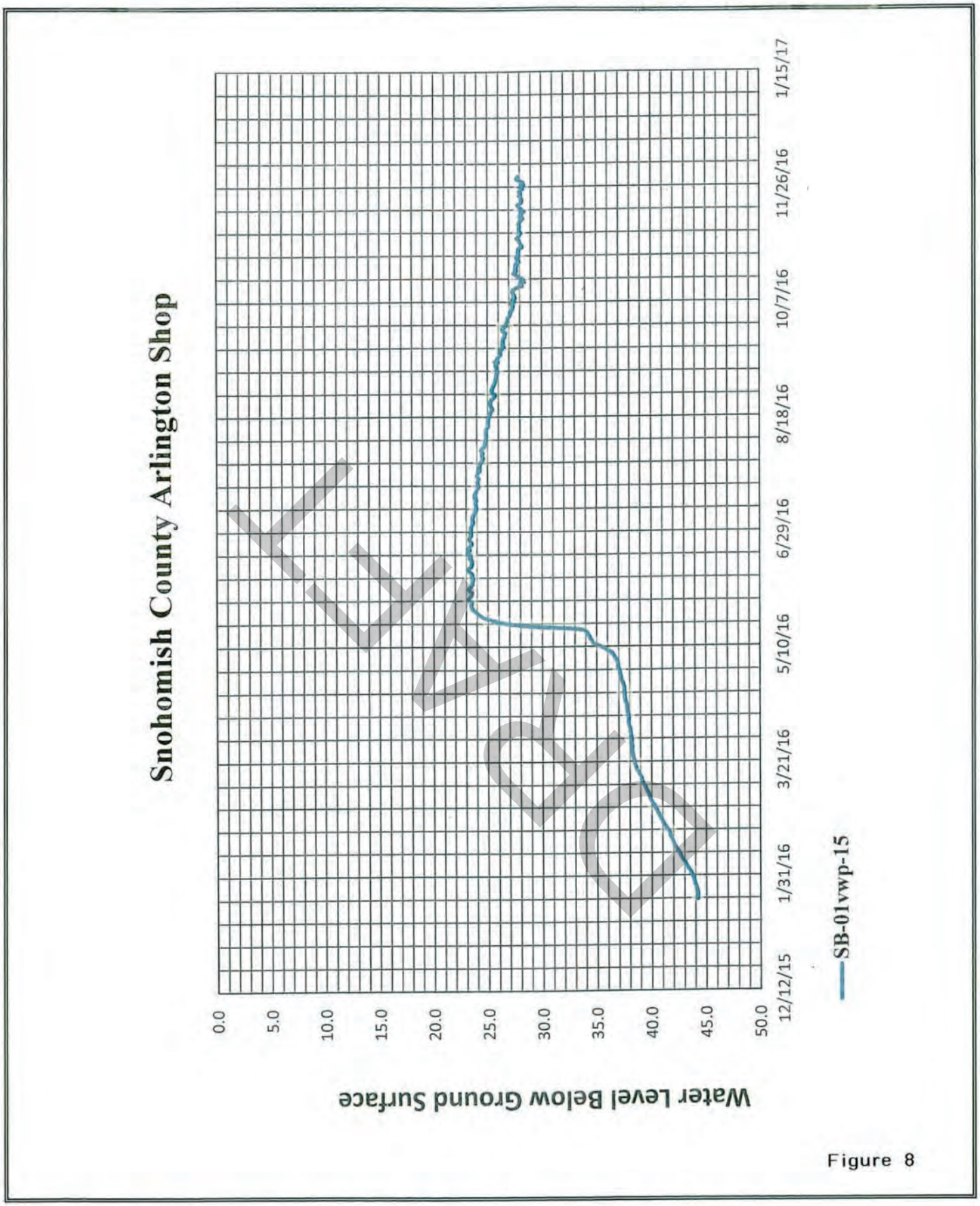


Figure 8

VIBRATING WIRE PIEZOMETER DATA

Arlington Shop Redevelopment Project – Geologic and Seismic Profile

ROFAC-52-37

APPENDIX B

DOCUMENTATION

Intentionally Left Blank

WWHM2012
PROJECT REPORT

Project Name: Arlington Ops
Site Name: Arlington Operations Center
Site Address: 19620 67th Ave NE
City : Arlington
Report Date: 1/21/2025
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2024/06/28
Version : 4.3.1

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

High Flow Threshold for POC 1: 50 year

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

High Flow Threshold for POC 2: 50 year

PREDEVELOPED LAND USE

Name : West Subbasin
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	5.7
Pervious Total	5.7

Impervious Land Use	acre
Impervious Total	0
Basin Total	5.7

Element Flows To:

Surface	Interflow	Groundwater

Name : East Subbasin

Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	12
Pervious Total	12

Impervious Land Use	acre
Impervious Total	0
Basin Total	12

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : West Basin - Developed
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.29
Pervious Total	0.29

Impervious Land Use	acre
ROADS FLAT	5.41
Impervious Total	5.41
Basin Total	5.7

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Name : East Basin - Developed
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.96
Pervious Total	**0.96**

Impervious Land Use	acre
ROADS FLAT	11.04
Impervious Total	**11.04**
Basin Total	**12**

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 2	Gravel Trench Bed 2	

Name : West Infiltration Gallery
Bottom Length: 110.00 ft.
Bottom Width: 60.00 ft.
Trench bottom slope 1: 3 To 1
Trench Left side slope 0: 3 To 1
Trench right side slope 2: 3 To 1
Material thickness of first layer: 11
Pour Space of material for first layer: 0.33
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 5
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 1048.48
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 1048.48
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 10 ft.
Riser Diameter: 18 in.

Element Flows To:

Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.151	0.000	0.000	0.000
0.1222	0.154	0.006	0.000	0.763

0.2444	0.157	0.012	0.000	0.763
0.3667	0.160	0.018	0.000	0.763
0.4889	0.163	0.025	0.000	0.763
0.6111	0.166	0.032	0.000	0.763
0.7333	0.169	0.038	0.000	0.763
0.8556	0.172	0.045	0.000	0.763
0.9778	0.175	0.052	0.000	0.763
1.1000	0.178	0.059	0.000	0.763
1.2222	0.181	0.067	0.000	0.763
1.3444	0.184	0.074	0.000	0.763
1.4667	0.187	0.081	0.000	0.763
1.5889	0.190	0.089	0.000	0.763
1.7111	0.194	0.097	0.000	0.763
1.8333	0.197	0.105	0.000	0.763
1.9556	0.200	0.113	0.000	0.763
2.0778	0.203	0.121	0.000	0.763
2.2000	0.207	0.129	0.000	0.763
2.3222	0.210	0.138	0.000	0.763
2.4444	0.213	0.146	0.000	0.763
2.5667	0.217	0.155	0.000	0.763
2.6889	0.220	0.164	0.000	0.763
2.8111	0.223	0.173	0.000	0.763
2.9333	0.227	0.182	0.000	0.763
3.0556	0.230	0.191	0.000	0.763
3.1778	0.234	0.200	0.000	0.763
3.3000	0.237	0.210	0.000	0.763
3.4222	0.241	0.220	0.000	0.763
3.5444	0.244	0.229	0.000	0.763
3.6667	0.248	0.239	0.000	0.763
3.7889	0.252	0.249	0.000	0.763
3.9111	0.255	0.260	0.000	0.763
4.0333	0.259	0.270	0.000	0.763
4.1556	0.263	0.281	0.000	0.763
4.2778	0.266	0.291	0.000	0.763
4.4000	0.270	0.302	0.000	0.763
4.5222	0.274	0.313	0.000	0.763
4.6444	0.278	0.324	0.000	0.763
4.7667	0.281	0.336	0.000	0.763
4.8889	0.285	0.347	0.000	0.763
5.0111	0.289	0.359	0.000	0.763
5.1333	0.293	0.370	0.000	0.763
5.2556	0.297	0.382	0.000	0.763
5.3778	0.301	0.394	0.000	0.763
5.5000	0.305	0.407	0.000	0.763
5.6222	0.309	0.419	0.000	0.763
5.7444	0.313	0.432	0.000	0.763
5.8667	0.317	0.444	0.000	0.763
5.9889	0.321	0.457	0.000	0.763
6.1111	0.325	0.470	0.000	0.763
6.2333	0.329	0.483	0.000	0.763
6.3556	0.333	0.497	0.000	0.763
6.4778	0.337	0.510	0.000	0.763
6.6000	0.342	0.524	0.000	0.763
6.7222	0.346	0.538	0.000	0.763
6.8444	0.350	0.552	0.000	0.763
6.9667	0.354	0.566	0.000	0.763
7.0889	0.359	0.581	0.000	0.763

7.2111	0.363	0.595	0.000	0.763
7.3333	0.367	0.610	0.000	0.763
7.4556	0.372	0.625	0.000	0.763
7.5778	0.376	0.640	0.000	0.763
7.7000	0.380	0.655	0.000	0.763
7.8222	0.385	0.671	0.000	0.763
7.9444	0.389	0.686	0.000	0.763
8.0667	0.394	0.702	0.000	0.763
8.1889	0.398	0.718	0.000	0.763
8.3111	0.403	0.734	0.000	0.763
8.4333	0.407	0.751	0.000	0.763
8.5556	0.412	0.767	0.000	0.763
8.6778	0.416	0.784	0.000	0.763
8.8000	0.421	0.801	0.000	0.763
8.9222	0.426	0.818	0.000	0.763
9.0444	0.430	0.835	0.000	0.763
9.1667	0.435	0.853	0.000	0.763
9.2889	0.440	0.870	0.000	0.763
9.4111	0.445	0.888	0.000	0.763
9.5333	0.449	0.906	0.000	0.763
9.6556	0.454	0.924	0.000	0.763
9.7778	0.459	0.943	0.000	0.763
9.9000	0.464	0.961	0.000	0.763
10.022	0.469	0.980	0.052	0.763
10.144	0.474	0.999	0.869	0.763
10.267	0.479	1.019	2.123	0.763
10.389	0.484	1.038	3.509	0.763
10.511	0.489	1.058	4.737	0.763
10.633	0.493	1.077	5.592	0.763
10.756	0.499	1.097	6.159	0.763
10.878	0.504	1.118	6.639	0.763
11.000	0.509	1.138	7.086	0.763

Name : East Infiltration Gallery
Bottom Length: 135.00 ft.
Bottom Width: 100.00 ft.
Trench bottom slope 1: 3 To 1
Trench Left side slope 0: 3 To 1
Trench right side slope 2: 3 To 1
Material thickness of first layer: 11
Pour Space of material for first layer: 0.33
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 5
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 2140.055
Total Volume Through Riser (ac-ft.): 0.002
Total Volume Through Facility (ac-ft.): 2140.057
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 10 ft.

Riser Diameter: 12 in.

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

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.309	0.000	0.000	0.000
0.1222	0.313	0.012	0.000	1.562
0.2444	0.317	0.025	0.000	1.562
0.3667	0.321	0.038	0.000	1.562
0.4889	0.325	0.051	0.000	1.562
0.6111	0.330	0.064	0.000	1.562
0.7333	0.334	0.077	0.000	1.562
0.8556	0.338	0.091	0.000	1.562
0.9778	0.342	0.105	0.000	1.562
1.1000	0.346	0.119	0.000	1.562
1.2222	0.350	0.133	0.000	1.562
1.3444	0.354	0.147	0.000	1.562
1.4667	0.359	0.161	0.000	1.562
1.5889	0.363	0.176	0.000	1.562
1.7111	0.367	0.191	0.000	1.562
1.8333	0.372	0.206	0.000	1.562
1.9556	0.376	0.221	0.000	1.562
2.0778	0.380	0.236	0.000	1.562
2.2000	0.385	0.251	0.000	1.562
2.3222	0.389	0.267	0.000	1.562
2.4444	0.394	0.283	0.000	1.562
2.5667	0.398	0.299	0.000	1.562
2.6889	0.402	0.315	0.000	1.562
2.8111	0.407	0.331	0.000	1.562
2.9333	0.412	0.348	0.000	1.562
3.0556	0.416	0.365	0.000	1.562
3.1778	0.421	0.381	0.000	1.562
3.3000	0.425	0.398	0.000	1.562
3.4222	0.430	0.416	0.000	1.562
3.5444	0.435	0.433	0.000	1.562
3.6667	0.439	0.451	0.000	1.562
3.7889	0.444	0.469	0.000	1.562
3.9111	0.449	0.487	0.000	1.562
4.0333	0.453	0.505	0.000	1.562
4.1556	0.458	0.523	0.000	1.562
4.2778	0.463	0.542	0.000	1.562
4.4000	0.468	0.561	0.000	1.562
4.5222	0.473	0.580	0.000	1.562
4.6444	0.478	0.599	0.000	1.562
4.7667	0.483	0.618	0.000	1.562
4.8889	0.487	0.638	0.000	1.562
5.0111	0.492	0.658	0.000	1.562
5.1333	0.497	0.678	0.000	1.562
5.2556	0.502	0.698	0.000	1.562
5.3778	0.507	0.718	0.000	1.562
5.5000	0.512	0.739	0.000	1.562

5.6222	0.518	0.760	0.000	1.562
5.7444	0.523	0.781	0.000	1.562
5.8667	0.528	0.802	0.000	1.562
5.9889	0.533	0.823	0.000	1.562
6.1111	0.538	0.845	0.000	1.562
6.2333	0.543	0.867	0.000	1.562
6.3556	0.549	0.889	0.000	1.562
6.4778	0.554	0.911	0.000	1.562
6.6000	0.559	0.933	0.000	1.562
6.7222	0.564	0.956	0.000	1.562
6.8444	0.570	0.979	0.000	1.562
6.9667	0.575	1.002	0.000	1.562
7.0889	0.580	1.025	0.000	1.562
7.2111	0.586	1.049	0.000	1.562
7.3333	0.591	1.073	0.000	1.562
7.4556	0.597	1.097	0.000	1.562
7.5778	0.602	1.121	0.000	1.562
7.7000	0.608	1.145	0.000	1.562
7.8222	0.613	1.170	0.000	1.562
7.9444	0.619	1.195	0.000	1.562
8.0667	0.624	1.220	0.000	1.562
8.1889	0.630	1.245	0.000	1.562
8.3111	0.636	1.271	0.000	1.562
8.4333	0.641	1.296	0.000	1.562
8.5556	0.647	1.322	0.000	1.562
8.6778	0.653	1.349	0.000	1.562
8.8000	0.658	1.375	0.000	1.562
8.9222	0.664	1.402	0.000	1.562
9.0444	0.670	1.429	0.000	1.562
9.1667	0.676	1.456	0.000	1.562
9.2889	0.681	1.483	0.000	1.562
9.4111	0.687	1.511	0.000	1.562
9.5333	0.693	1.539	0.000	1.562
9.6556	0.699	1.567	0.000	1.562
9.7778	0.705	1.595	0.000	1.562
9.9000	0.711	1.624	0.000	1.562
10.022	0.717	1.653	0.035	1.562
10.144	0.723	1.682	0.572	1.562
10.267	0.729	1.711	1.318	1.562
10.389	0.735	1.740	1.921	1.562
10.511	0.741	1.770	2.251	1.562
10.633	0.747	1.800	2.506	1.562
10.756	0.753	1.831	2.737	1.562
10.878	0.759	1.861	2.950	1.562
11.000	0.766	1.892	3.149	1.562

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:5.7

Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.29
Total Impervious Area:5.41

Stream Protection Duration
POC #1 (West Subbasin)
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0033	2357	0	0	Pass
0.0038	1323	0	0	Pass
0.0044	433	0	0	Pass
0.0050	112	0	0	Pass
0.0055	102	0	0	Pass
0.0061	89	0	0	Pass
0.0066	77	0	0	Pass
0.0072	66	0	0	Pass
0.0078	61	0	0	Pass
0.0083	58	0	0	Pass
0.0089	54	0	0	Pass
0.0094	50	0	0	Pass
0.0100	49	0	0	Pass
0.0106	47	0	0	Pass
0.0111	43	0	0	Pass
0.0117	40	0	0	Pass
0.0122	36	0	0	Pass
0.0128	36	0	0	Pass
0.0134	32	0	0	Pass
0.0139	31	0	0	Pass
0.0145	31	0	0	Pass
0.0150	29	0	0	Pass
0.0156	29	0	0	Pass
0.0162	27	0	0	Pass
0.0167	26	0	0	Pass
0.0173	26	0	0	Pass
0.0178	26	0	0	Pass
0.0184	25	0	0	Pass
0.0190	23	0	0	Pass
0.0195	23	0	0	Pass
0.0201	23	0	0	Pass
0.0206	23	0	0	Pass
0.0212	23	0	0	Pass
0.0218	21	0	0	Pass
0.0223	19	0	0	Pass
0.0229	18	0	0	Pass
0.0234	17	0	0	Pass
0.0240	16	0	0	Pass
0.0246	16	0	0	Pass
0.0251	15	0	0	Pass
0.0257	15	0	0	Pass

0.0262	14	0	0	Pass
0.0268	13	0	0	Pass
0.0274	13	0	0	Pass
0.0279	13	0	0	Pass
0.0285	13	0	0	Pass
0.0290	13	0	0	Pass
0.0296	13	0	0	Pass
0.0302	13	0	0	Pass
0.0307	13	0	0	Pass
0.0313	13	0	0	Pass
0.0318	11	0	0	Pass
0.0324	11	0	0	Pass
0.0330	11	0	0	Pass
0.0335	11	0	0	Pass
0.0341	11	0	0	Pass
0.0346	11	0	0	Pass
0.0352	11	0	0	Pass
0.0358	11	0	0	Pass
0.0363	11	0	0	Pass
0.0369	11	0	0	Pass
0.0375	11	0	0	Pass
0.0380	11	0	0	Pass
0.0386	11	0	0	Pass
0.0391	10	0	0	Pass
0.0397	10	0	0	Pass
0.0403	9	0	0	Pass
0.0408	9	0	0	Pass
0.0414	8	0	0	Pass
0.0419	8	0	0	Pass
0.0425	8	0	0	Pass
0.0431	8	0	0	Pass
0.0436	8	0	0	Pass
0.0442	8	0	0	Pass
0.0447	8	0	0	Pass
0.0453	8	0	0	Pass
0.0459	8	0	0	Pass
0.0464	8	0	0	Pass
0.0470	8	0	0	Pass
0.0475	8	0	0	Pass
0.0481	8	0	0	Pass
0.0487	8	0	0	Pass
0.0492	8	0	0	Pass
0.0498	7	0	0	Pass
0.0503	7	0	0	Pass
0.0509	7	0	0	Pass
0.0515	7	0	0	Pass
0.0520	6	0	0	Pass
0.0526	6	0	0	Pass
0.0531	6	0	0	Pass
0.0537	6	0	0	Pass
0.0543	6	0	0	Pass
0.0548	6	0	0	Pass
0.0554	6	0	0	Pass
0.0559	6	0	0	Pass
0.0565	6	0	0	Pass
0.0571	6	0	0	Pass
0.0576	6	0	0	Pass

0.0582	5	0	0	Pass
0.0587	5	0	0	Pass

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 Water Quality	Total Volume Percent Treatment?	Volume Needs Treatment (ac-ft)	Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Volume Infiltration Credit	Comment
Gravel Trench Bed 1 POC	N	954.12				N	100.00
Total Volume Infiltrated		954.12	0.00	0.00			
100.00	0.00	0%	No Treat. Credit				

Compliance with LID Standard 8
Duration Analysis Result = Passed

Stream Protection Duration

Predeveloped Landuse Totals for POC #2
Total Pervious Area:12
Total Impervious Area:0

Mitigated Landuse Totals for POC #2
Total Pervious Area:0.96
Total Impervious Area:11.04

Stream Protection Duration
POC #2 (East Subbasin)
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0069	2357	4	0	Pass
0.0081	1322	4	0	Pass
0.0092	433	4	0	Pass
0.0104	112	3	2	Pass
0.0116	103	3	2	Pass
0.0128	89	3	3	Pass

0.0140	77	3	3	Pass
0.0151	66	3	4	Pass
0.0163	61	3	4	Pass
0.0175	58	2	3	Pass
0.0187	54	2	3	Pass
0.0199	50	2	4	Pass
0.0210	49	2	4	Pass
0.0222	47	2	4	Pass
0.0234	43	1	2	Pass
0.0246	40	1	2	Pass
0.0258	36	0	0	Pass
0.0269	36	0	0	Pass
0.0281	32	0	0	Pass
0.0293	31	0	0	Pass
0.0305	31	0	0	Pass
0.0317	29	0	0	Pass
0.0328	29	0	0	Pass
0.0340	27	0	0	Pass
0.0352	26	0	0	Pass
0.0364	26	0	0	Pass
0.0376	26	0	0	Pass
0.0387	25	0	0	Pass
0.0399	23	0	0	Pass
0.0411	23	0	0	Pass
0.0423	23	0	0	Pass
0.0435	23	0	0	Pass
0.0446	23	0	0	Pass
0.0458	21	0	0	Pass
0.0470	19	0	0	Pass
0.0482	18	0	0	Pass
0.0494	17	0	0	Pass
0.0505	16	0	0	Pass
0.0517	16	0	0	Pass
0.0529	15	0	0	Pass
0.0541	15	0	0	Pass
0.0553	14	0	0	Pass
0.0564	13	0	0	Pass
0.0576	13	0	0	Pass
0.0588	13	0	0	Pass
0.0600	13	0	0	Pass
0.0612	13	0	0	Pass
0.0623	13	0	0	Pass
0.0635	13	0	0	Pass
0.0647	13	0	0	Pass
0.0659	13	0	0	Pass
0.0670	11	0	0	Pass
0.0682	11	0	0	Pass
0.0694	11	0	0	Pass
0.0706	11	0	0	Pass
0.0718	11	0	0	Pass
0.0729	11	0	0	Pass
0.0741	11	0	0	Pass
0.0753	11	0	0	Pass
0.0765	11	0	0	Pass
0.0777	11	0	0	Pass
0.0788	11	0	0	Pass
0.0800	11	0	0	Pass

0.0812	11	0	0	Pass
0.0824	10	0	0	Pass
0.0836	10	0	0	Pass
0.0847	9	0	0	Pass
0.0859	9	0	0	Pass
0.0871	8	0	0	Pass
0.0883	8	0	0	Pass
0.0895	8	0	0	Pass
0.0906	8	0	0	Pass
0.0918	8	0	0	Pass
0.0930	8	0	0	Pass
0.0942	8	0	0	Pass
0.0954	8	0	0	Pass
0.0965	8	0	0	Pass
0.0977	8	0	0	Pass
0.0989	8	0	0	Pass
0.1001	8	0	0	Pass
0.1013	8	0	0	Pass
0.1024	8	0	0	Pass
0.1036	8	0	0	Pass
0.1048	7	0	0	Pass
0.1060	7	0	0	Pass
0.1072	7	0	0	Pass
0.1083	7	0	0	Pass
0.1095	6	0	0	Pass
0.1107	6	0	0	Pass
0.1119	6	0	0	Pass
0.1131	6	0	0	Pass
0.1142	6	0	0	Pass
0.1154	6	0	0	Pass
0.1166	6	0	0	Pass
0.1178	6	0	0	Pass
0.1190	6	0	0	Pass
0.1201	6	0	0	Pass
0.1213	6	0	0	Pass
0.1225	5	0	0	Pass
0.1237	5	0	0	Pass

Water Quality BMP Flow and Volume for POC #2
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 Water Quality	Total Volume Percent Treatment? Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Comment Water Quality Treated
Gravel Trench Bed 2 POC	N	1947.45			N	100.00	

Total Volume Infiltrated 1947.45 0.00 0.00
100.00 0.00 0% No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed

WWHM2012
PROJECT REPORT

Project Name: Arlington Ops
Site Name: Arlington Operations Center
Site Address: 19620 67th Ave NE
City : Arlington
Report Date: 1/22/2025
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2024/06/28
Version : 4.3.1

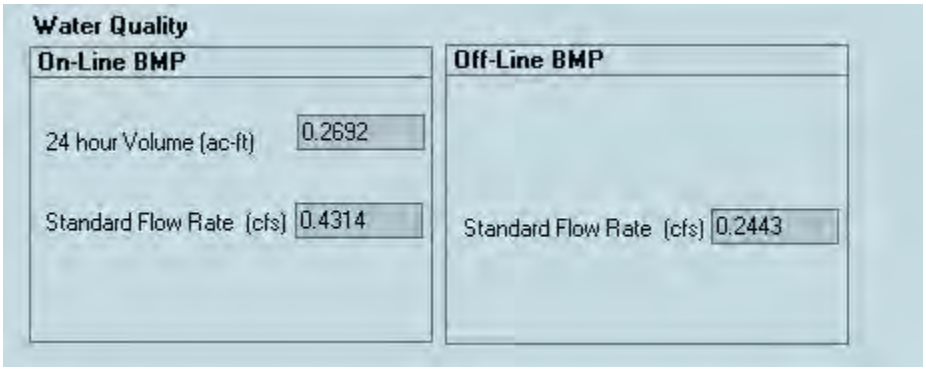
MITIGATED LAND USE

Name : Treatment Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	0

Impervious Land Use	acre
ROADS FLAT	2.23
Impervious Total	2.23
Basin Total	2.23



Biopod Sizing for 8’x12’ Vault using Off-line flow rate

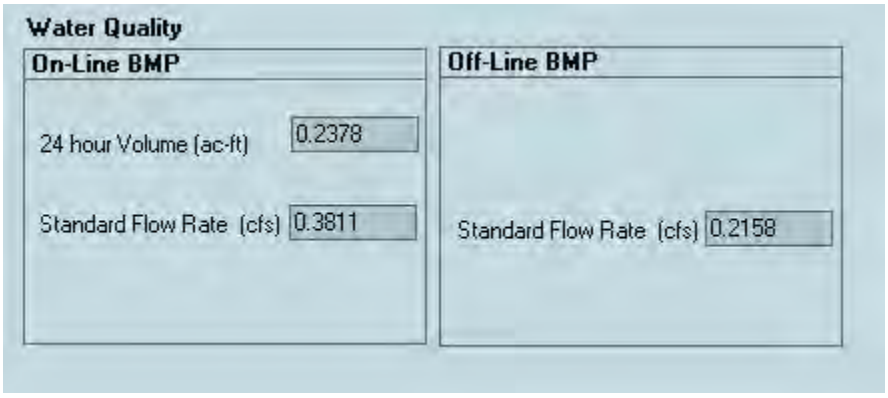
PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.304 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.270 cfs
Bypass Capacity	6.5 cfs
*Contact Oldcastle for alternative treatment flow capacities.	

Name : Basin 2
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
Pervious Total	**0**

Impervious Land Use	**acre**
ROADS FLAT	**1.97**
Impervious Total	**1.97**
Basin Total	**1.97**



Biopod Sizing for 6’x12’ Vault using off-line flow rate

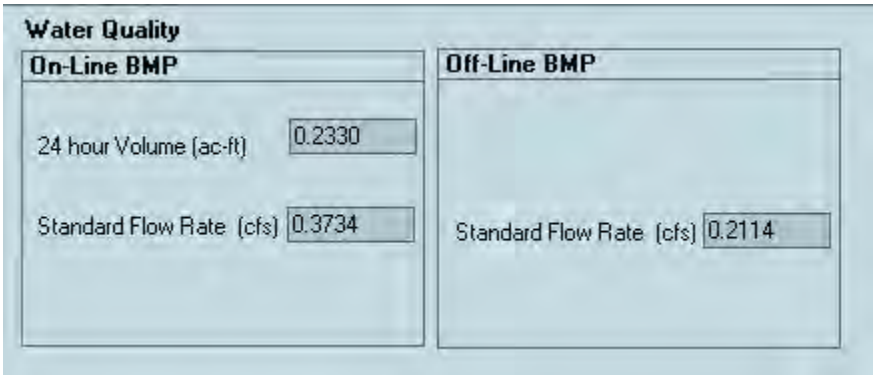
PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.240 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.213 cfs
Bypass Capacity	5.0 cfs
*Contact Oldcastle for alternative treatment flow capacities.	

Name : Basin 3
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	**0**

Impervious Land Use	acre
ROADS FLAT	**1.93**
Impervious Total	**1.93**
Basin Total	**1.93**



Biopod Sizing for 6’x12’ Vault using off-line flow rate

PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.240 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.213 cfs
Bypass Capacity	5.0 cfs
*Contact Oldcastle for alternative treatment flow capacities.	

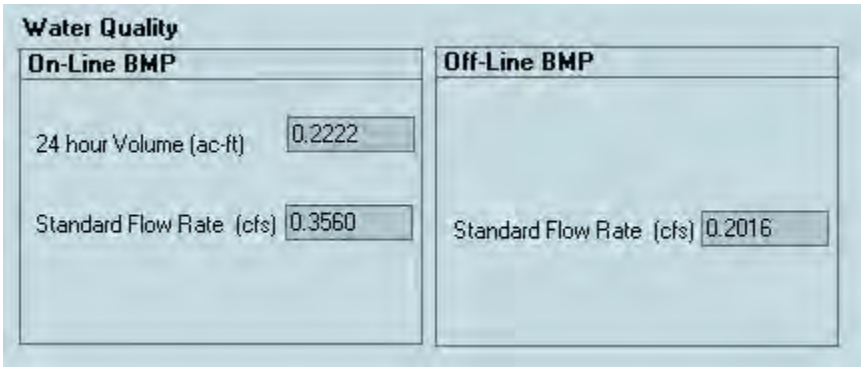
Name : Basin 4
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	**0**

Impervious Land Use	acre
ROADS FLAT	**1.84**
Impervious Total	**1.84**

Basin Total **1.84**



Biopod Sizing for 6’x12’ Vault using off-line flow rate

PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.240 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.213 cfs
Bypass Capacity	5.0 cfs
*Contact Oldcastle for alternative treatment flow capacities.	

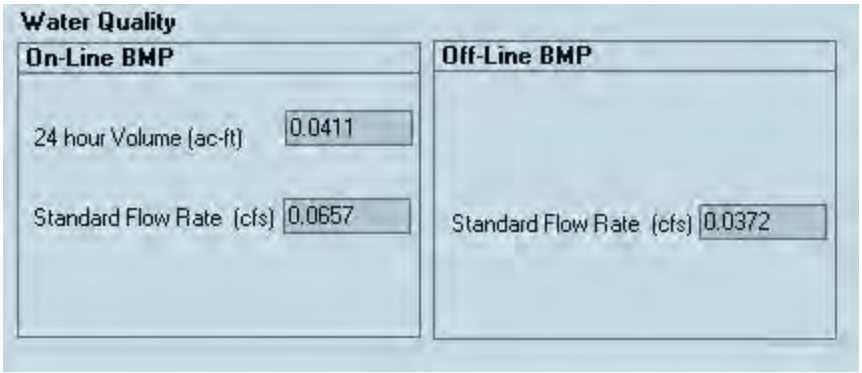
Name : Basin 5 (WQ Vault Basin)
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
Pervious Total	**0**

Impervious Land Use	**acre**
ROADS FLAT	**0.34**
Impervious Total	**0.34**

Basin Total **0.34**



Biopod Sizing for 4’x 8’ Vault using on-line flow rate

PERFORMANCE SPECIFICATIONS	
Treatment Flow Capacities:*	
NJDEP 80% Removal, 75 micron	0.096 cfs
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.085 cfs
Bypass Capacity	5.0 cfs
*Contact Oldcastle for alternative treatment flow capacities.	

February 2024

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), METALS, AND PHOSPHORUS TREATMENT

For

Oldcastle Infrastructure, Inc.'s
The BioPod™ Biofilter
(Formerly the TreePod Biofilter)

Ecology's Decision

Based on Oldcastle Infrastructure, Inc. application submissions for The BioPod™ Biofilter (BioPod), Ecology hereby issues the following use level designation:

1) General Use Level Designation (GULD) for Basic, Metals, and Phosphorus Treatment:
   - Sized at a hydraulic loading rate of 1.6 gallons per minute (gpm) per square foot (sq ft) of media surface area.
   - Constructed with a minimum media thickness of 18-inches (1.5-feet)
2) Ecology approves the BioPod at the hydraulic loading rate listed above, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:
   - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology- approved continuous runoff model.
   - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.7.6 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
   - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.
3) For systems that have a drain down outlet, designers must increase the water quality design flow rate calculated in Item 2, above, to account for the water that will enter the initial bay but won't be treated by the engineered soil. Multiply the flow rate determined above by 1.05 to determine the required flowrate for the BioPod unit.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

September 2018

GENERAL USE LEVEL DESIGNATION FOR PRETREATMENT (TSS)
For
Stormceptor System®

Ecology's Decision:

Based on Imbrium Systems Corporation's application submissions, Ecology hereby issues the following Use Level Designation for the Imbrium Systems Corporation Stormceptor System:

1. **General Use Level Designation (GULD) for pretreatment, as defined in Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE)* Table 2, (a) ahead of infiltration treatment, or (b) to protect and extend the maintenance cycle of a basic or enhanced treatment device (e.g., sand or media filter). This GULD applies to Stormceptor System® units sized in accordance with Table 1 (below) at the water quality design flowrate.**

Table 1

Unit	Treatment Flowrate (gpm)
STC 450i	143
STC 900	285
STC 1200	285
STC 1800	285
STC 2400	476
STC 3600	476
STC 4800	793
STC 6000	793
STC 7200	1110
STC 11000	1585
STC 13000	1585
STC 16000	2220

2. **Ecology approves Stormceptor systems for treatment at the hydraulic loading rates shown in Table 1, and sized based on the water quality design flow rate. Calculate the water quality design flow rate using the following procedures:**

APPENDIX C

MAINTENANCE PLAN

Intentionally Left Blank

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

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

Table V-A.8: Maintenance Standards - Typical Biofiltration Swale (continued)

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
	Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea-gravel drain the length of the swale or by-pass the baseflow around the swale.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or re-seed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back over-hanging limbs and remove brushy vegetation on adjacent slopes.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from bioswale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

Table V-A.9: Maintenance Standards - Wet Biofiltration Swale

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation	Sediment depth exceeds 2-inches in 10% of the swale treatment area.	Remove sediment deposits in treatment area.
	Water Depth	Water not retained to a depth of about 4 inches during the wet season.	Build up or repair outlet berm so that water is retained in the wet swale.
	Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail, which do not allow water to flow through the clumps.	Determine cause of lack of vigor of vegetation and correct. Replant as needed. For excessive cattail growth, cut cattail shoots back and compost off-site. Note: normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters.
	Inlet/Outlet	Inlet/outlet area clogged with sediment and/or debris.	Remove clogging or blockage in the inlet and outlet areas.
	Trash and Debris Accumulation	See Table V-A.1: Maintenance Standards - Detention Ponds	Remove trash and debris from wet swale.
	Erosion/Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.	Check design flows to assure swale is large enough to handle flows. By-pass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as Juncus effusus (soft rush) in wet areas or snowberry (Symphoricarpos albus) in dryer areas.

Table V-A.13: Maintenance Standards - Sand Filters (Above Ground/Open) (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

Table V-A.14: Maintenance Standards - Sand Filters (Below Ground/Enclosed)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault.	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 1/2-inch.	No sediment deposits on sand filter section that which would impede permeability of the filter section.
	Sediment Accumulation in Pre-Settling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	No sediment deposits in first chamber of vault.
	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault and inlet/outlet piping.
	Sediment in Drain Pipes/Cleanouts	When drain pipes, cleanouts become full with sediment and/or debris.	Sediment and debris removed.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover. Maintenance person cannot remove cover using normal lifting pressure.	Cover repaired to proper working specifications or replaced.
	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.

Table V-A.15: Maintenance Standards - Manufactured Media Filters

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground	Sediment Accumulation on Media.	Sediment depth exceeds 0.25-inches.	No sediment deposits which would impede permeability of the

Table V-A.15: Maintenance Standards - Manufactured Media Filters (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Vault			compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6-inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

Table V-A.17: Maintenance Standards - Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1-inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-A.18: Maintenance Standards - Catch Basin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with sheet flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There should be no areas of standing water once inflow has ceased.
	No-vegetation	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean to spread flows evenly over entire embankment width.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
	zone/flow spreader		
	Poor vegetation coverage	Grass is sparse or bare, or eroded patches are observed in more than 10% of the grass strip surface area.	Determine why grass growth is poor and correct the offending condition. Reseed into loosened, fertile soil or compost; or, replant with plugs of grass from the upper slope.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow vegetation or remove nuisance vegetation to not impede flow. Mow grass to a height of 6 inches.
	Media filter drain mix replacement	Water is seen on the surface of the media filter drain mix long after the storms have ceased. Typically, the 6-month, 24-hour precipitation event should drain within 48 hours. More common storms should drain within 24 hours. Maintenance also needed on a 10-year cycle and during a preservation project.	Excavate and replace all of the media filter drain mix contained within the media filter drain.
	Excessive shading	Grass growth is poor because sunlight does not reach embankment.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes.
	Trash and debris	Trash and debris have accumulated on embankment.	Remove trash and debris from embankment.
	Flooding of Media filter drain	When media filter drain is inundated by flood water	Evaluate media filter drain material for acceptable infiltration rate and replace if media filter drain does not meet long-term infiltration rate standards.

Table V-A.20: Maintenance Standards - Compost Amended Vegetated Filter Strip (CAVFS)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass	Sediment depth exceeds 2 inches.	Remove sediment deposits. Relevel so slope is even and flows pass evenly through strip.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow grass and control nuisance vegetation so that flow is not impeded. Grass should be mowed to a height of 6 inches.
	Trash and debris	Trash and debris have accumulated on the vegetated filter strip.	Remove trash and debris from filter.
	Erosion/scouring	Areas have eroded or scoured due to flow channelization or high flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with a 50/50 mixture of crushed gravel and compost. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the vegetated filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width

Table V-A.21: Maintenance Standards - Bioretention Facilities

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility Footprint				
Earthen side slopes and berms	B, S		Erosion (gullies/ rills) greater than 2 inches deep around inlets, outlet, and alongside slopes	• Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made. • Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention facility sizing; (2) flow velocities and gradients within the facility; and (3) flow dissipation and erosion protection strategies at the facility inlet.
	A		Erosion of sides causes slope to become a hazard	Take actions to eliminate the hazard and stabilize slopes
	A, S		Settlement greater than 3 inches (relative to undisturbed sections of berm)	Restore to design height
	A, S		Downstream face of berm wet, seeps or leaks evident	Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)
	A		Any evidence of rodent holes or water piping in berm	• Eradicate rodents (see "Pest control") • Fill holes and compact (may require consultation with engineer, particularly for larger berms)
Concrete sidewalls	A		Cracks or failure of concrete sidewalls	• Repair/ seal cracks • Replace if repair is insufficient
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)
Facility area		All maintenance visits (at least biannually)	Trash and debris present	Clean out trash and debris
Facility bottom area	A, S		Accumulated sediment to extent that infiltration rate is reduced (see "Ponded water") or surface storage capacity significantly impacted	• Remove excess sediment • Replace any vegetation damaged or destroyed by sediment accumulation and removal • Mulch newly planted vegetation • Identify and control the sediment source (if feasible) • If accumulated sediment is recurrent, consider adding presettlement or installing berms to create a forebay at the inlet
		During/after fall leaf drop	Accumulated leaves in facility	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded
Low permeability check dams and weirs	A, S		Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice	Clear the blockage
	A, S		Erosion and/or undercutting present	Repair and take preventative measures to prevent future erosion and/or undercutting
	A		Grade board or top of weir damaged or not level	Restore to level position

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Ponded water	B, S		Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.	Determine cause and resolve in the following order: 1. Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris. 2. Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain. 3. Check for other water inputs (e.g., groundwater, illicit connections). 4. Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem, the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with an engineer is recommended.
Bioretention soil mix	As needed		Bioretention soil mix protection is needed when performing maintenance requiring entrance into the facility footprint	• Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils. • Never drive equipment or apply heavy loads in facility footprint. • Because the risk of compaction is higher during saturated soil conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions. • Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction. • If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the facility and away from the inlet structure	Reconfigure/ repair blocks to direct water to facility and away from structure
Curb cut inlet/outlet	M during the wet season and before severe storm is forecasted	Weekly during fall leaf drop	Accumulated leaves at curb cuts	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
Pipe inlet/outlet	A		Pipe is damaged	Repair/ replace
	W		Pipe is clogged	Remove roots or debris
	A, S		Sediment, debris, trash, or mulch reducing capacity of inlet/outlet	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
		Weekly during fall leaf drop	Accumulated leaves at inlets/outlets	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
		A	Maintain access for inspections	• Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Erosion control at inlet	A		Concentrated flows are causing erosion	Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb cut or swale)
Trash rack	S		Trash or other debris present on trash rack	Remove/dispose
	A		Bar screen damaged or missing	Repair/replace
Overflow	A, S		Capacity reduced by sediment or debris	Remove sediment or debris/dispose
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	• Plant roots, sediment or debris reducing capacity of underdrain • Prolonged surface ponding (see "Ponded water"	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.
Vegetation				
Facility bottom area and upland slope vegetation	Fall and Spring		Vegetation survival rate falls below 75% within first two years of establishment (unless project O&M manual or record drawing stipulates more or less than 75% survival rate).	• Determine cause of poor vegetation growth and correct condition • Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jurisdictional species list for appropriate plant replacements (See Appendix 3 - Bioretention Plant List, in the *LID Technical Guidance Manual for Puget Sound*, (Hinman and Wulkan, 2012)). • Confirm that plant selection is appropriate for site growing conditions • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Vegetation (general)	As needed		Presence of diseased plants and plant material	• Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • See the *Pacific Northwest Plant Disease Management Handbook* (Pscheidt and Ocamb, 2016) for information on disease recognition and for additional resources • Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".
Trees and shrubs		All pruning seasons (timing varies by species)	Pruning as needed	• Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques • All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist
	A		Large trees and shrubs interfere with operation of the facility or access for maintenance	• Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. • Remove trees and shrubs, if necessary.
	Fall and Spring		Standing dead vegetation is present	• Remove standing dead vegetation • Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season) • If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately. • Determine cause of dead vegetation and address issue, if possible

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				• If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.
	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.
	Fall and Spring		Presence of or need for stakes and guys (tree growth, maturation, and support needs)	• Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage • Monitor tree support systems: Repair and adjust as needed to provide support and prevent damage to tree. • Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year. • Backfill stake holes after removal.
Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	A		Vegetation causes some visibility (line of sight) or driver safety issues	• Maintain appropriate height for sight clearance • When continued, regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location. • Remove or transplant if continual safety hazard • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Flowering plants		A	Dead or spent flowers present	Remove spent flowers (deadhead)
Perennials		Fall	Spent plants	Cut back dying or dead and fallen foliage and stems
Emergent vegetation		Spring	Vegetation compromises conveyance	Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning)
Ornamental grasses (perennial)		Winter and Spring	Dead material from previous year's growing cycle or dead collapsed foliage	• Leave dry foliage for winter interest • Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow
Ornamental grasses (evergreen)		Fall and Spring	Dead growth present in spring	• Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring • Clean, rake, and comb grasses when they become too tall • Cut back to ground or thin every 2-3 years as needed
Noxious weeds		M (March - October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions • Apply mulch after weed removal (see "Mulch")
Weeds		M (March - October,	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
		preceding seed dispersal)		appropriate • Follow IPM protocols for weed management (see "Additional Maintenance Resources" section for more information on IPM protocols)
Excessive vegetation		Once in early to mid- May and once in early- to mid-September	Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil	• Edge or trim groundcovers and shrubs at facility edge • Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks • While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging
	As needed		Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety	• Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics • Determine if planting type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow) • Remove plants that are weak, broken or not true to form; replace in-kind • Thin grass or plants impacting facility function without leaving visual holes or bare soil areas • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
	As needed		Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass	Remove vegetation and sediment buildup
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Replenish mulch per O&M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels) • Keep all mulch away from woody stems
Watering				
Irrigation system (if any)		Based on manufacturer's instructions	Irrigation system present	Follow manufacturer's instructions for O&M
	A		Sprinklers or drip irrigation not directed/located to properly water plants	Redirect sprinklers or move drip irrigation to desired areas
Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present ◦ Pulse water to enhance soil absorption, when feasible

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				◦ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff • Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present
Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present ◦ Pulse water to enhance soil absorption, when feasible ◦ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff
Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear • Water during drought conditions or more often if necessary to maintain plant cover
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • To facilitate maintenance, manually remove standing water and direct to the storm drainage system (if runoff is from non pollution-generating surfaces) or sanitary sewer system (if runoff is from pollution-generating surfaces) after getting approval from sanitary sewer authority. • Use of pesticides or *Bacillus thuringiensis israelensis* (Bti) may be considered only as a temporary measure while addressing the standing water cause. If overflow to a surface water will occur within 2 weeks after pesticide use, apply for coverage under the Aquatic Mosquito Control NPDES General Permit.
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	• Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.) • Place predator decoys • Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" section for more information on IPM protocols) • Remove pet waste regularly • For public and right-of-way sites consider adding garbage cans with dog bags for picking up pet waste.
Insect pests	Every site visit associated with		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	• Reduce hiding places for pests by removing diseased and dead plants • For infestations, follow IPM protocols (see "Additional Maintenance Resources" section for more information on IPM

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	vegetation management			protocols)

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

IPM - Integrated Pest Management

ISA - International Society of Arboriculture

Table V-A.22: Maintenance Standards - Permeable Pavement

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				
Permeable Pavements, all	A, S		Runoff from adjacent pervious areas deposits soil, mulch or sediment on paving	• Clean deposited soil or other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface
Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ◦ Walk-behind vacuum (sidewalks) ◦ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ◦ ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.
	A_b		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods: