Stormwater Site Plan

PREPARED FOR:

Integrus Architecture
Contact: Sarah Wilder
117 South Main Street, Suite 100
Seattle, WA 98104

PROJECT:

Pierce College Puyallup
New STEM Building
Puyallup, WA
2210810.10

PREPARED BY:

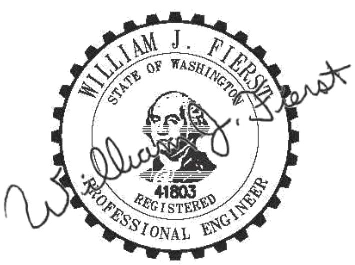
Claire Hovde
Project Engineer

REVIEWED BY:

William J. Fierst, PE
Principal

DATE:

May 2022
Revised August 2022
Revised October 2022



10/24/2022

I hereby state that this Stormwater Site Plan for the Pierce College Puyallup New STEM Building project has been prepared by me or under my supervision and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that City of Puyallup does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

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1.0 Project Overview

This Stormwater Site Plan (SSP) describes proposed stormwater mitigation for the proposed STEM classroom building project at Pierce College Puyallup (PCP). PCP is bounded by 39th Avenue SE to the south, Wildwood Park Drive to the north and east, and Bradley Lake and commercial properties to the west in Puyallup, Washington. The total campus area is approximately 122.3 acres and is situated on eight separate parcels.

The project proposes a new STEM classroom building and a new 108-stall parking lot. Refer to Section 1.2 for proposed basin areas. Improvements include asphalt paving, concrete paving, a new building, utilities services for the new building, and stormwater management. Refer to Appendices A-4.1 and A4.2 for Developed Conditions Maps for more information. A belowground detention facility using StormTech MC-7200 chambers is proposed for stormwater flow control. A bioretention facility will be used upstream of the proposed flow control facility to provide stormwater quality treatment for pollution generating impervious surfaces (PGIS).

This SSP describes the stormwater facilities designed for this project. The drainage plans and report have been prepared to satisfy all requirements of the Department of Ecology (DOE) 2019 *Stormwater Management Manual for Western Washington (SWMMWW)*. This report accompanies the final site plan submitted for the proposed new STEM building at PCP.

1.1 Existing Conditions

The 122.3-acre campus is partially developed and located on the north side of 39th Avenue SE. The campus consists of several buildings, parking lots, detention ponds, forested areas, wetlands, and an access drive loop that is routed around the perimeter of the developed portion of the campus.

PCP is bounded by 39th Avenue SE to the south, Wildwood Park Drive to the north and east, and Bradley Lake and commercial properties to the west in Puyallup, Washington. The main entrance driveway to the campus is located on the south side of the property along 39th Avenue SE. An additional driveway connection to the campus is located at the northwest of the site and connects to 7th Street SE. All adjacent properties are downgradient of the site and do not appear to discharge stormwater onto the campus.

The campus straddles two drainage basins, as outlined by the City of Puyallup Drainage Basin Map. The basin delineation line runs approximately north/south down the middle of the campus. The west side of the campus is within the State Highway Basin and the east side of the campus is within the Pothole Basin. Refer to Appendix A-10, City of Puyallup Drainage Basin Map for more information. The proposed improvements are located within the Pothole Basin. Refer to Appendices A-2.1 and A-2.2 for the Existing Condition Maps for more information.

The existing conditions at the project site include native vegetation and forested area that are undeveloped. Topography generally slopes from southwest to northeast. The project site drains to an existing conveyance system that is routed north and east before outfalling to an existing detention pond located at the far eastern edge of the campus. The existing detention pond outfalls to a biofiltration swale, where it eventually disperses into an existing unnamed wetland located approximately 320 feet southeast of the detention pond. Refer to Appendix A-3, Downstream Map for the location of the existing detention pond and existing wetland. Additionally, the parking lot portion of the project is adjacent to existing Wetland A. A small portion of the existing project basin drains to Wetland A in the existing condition. Refer to Appendix A-2.2, Existing Conditions Map for more information.

1.1.1 Critical Areas

The site contains five wetlands onsite, per the City of Puyallup GIS Critical Areas Map (see Appendix A-11 for more information). PCP maps indicate 11 wetlands are located onsite. An existing wetland, Wetland A, is located adjacent to the project limits located approximately 60 feet north of the proposed parking lot. A Wetland Analysis Report by Grette Associates dated April 25, 2022, has been completed for the wetlands near the proposed site improvements (see Appendix C-2). Refer to Section 2.8 for additional information.

1.1.2 Site Soils

Soils at the site are mapped by the Natural Resources Conservation Service (NRCS) as predominantly gravelly sandy loam underlain by glacial till. Refer to Appendix A-12 for the NRCS Soils Map.

The Geotechnical Engineering Services Report by GeoEngineers, Inc. dated January 21, 2021, confirms the site is underlain by glacial till. Pit testing showed perched groundwater and seepage into the pit. Therefore, infiltration is not possible. Refer to Appendix C-1 for the Geotechnical Engineering Services Report and Appendix C-3 for a memo dated May 4, 2022, from GeoEngineers detailing their pit testing results.

1.2 Proposed Conditions

The proposed STEM project is centrally located on the campus approximately 100 feet north of the Library Sciences Center (LSC) and approximately 250 feet east of the College Center (CTR). Refer to Appendix A-8, Campus Map for existing building and proposed project location.

The project proposes a new STEM building and a new 100-stall parking lot. Improvements include a new building, asphalt paving, concrete paving, utilities, and stormwater management facilities. Refer to Appendices A-4.1 and A-4.2 for Developed Conditions Maps for more information. A belowground detention facility using StormTech MC-7200 chambers is proposed for stormwater flow control. A bioretention facility will be used upstream of the proposed flow control facility to provide stormwater quality treatment for PGIS. Refer to Section 4.2 for more information. Proposed site areas are tabulated below:

	Acres	Percent of Project Area
Impervious Area	1.47	67%
PGIS Area	0.66	30%
Pervious Area	0.73	33%
Total Disturbed Area	2.20	130%

2.0 Minimum Requirements

The New STEM Building project is considered new development and is subject to Minimum Requirements (MRs) 1 through 9 because the project proposes more than 5,000 square feet of new and replaced hard surfaces. Therefore, all minimum requirements apply to new hard surfaces and the converted vegetation.

Based on discussions with the City of Puyallup, existing paving that is being replaced does not contribute to impervious surfaces thresholds for stormwater mitigation. To meet this requirement, the replaced impervious surfaces must maintain existing grades and therefore must follow the existing site characteristics for stormwater runoff. A small portion of existing paving located west of the STEM building will be replaced due to routing of utilities to serve the new STEM building. The replaced paving for utility routing will satisfy the above requirements and therefore will not be included in the stormwater calculations. However, the replaced paving will meet the requirements outlined below for MRs 1 through 4.

Below is a discussion of how the project meets each of the requirements.

2.1 MR 1: Preparation of Stormwater Site Plans

A complete stormwater site plan including civil plans and this report are provided with this site development permit package.

2.2 MR 2: Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan (CSWPPP) is included with this site development permit package.

2.3 MR 3: Source Control of Pollution

The project is required to provide source control of pollution. *SWMMWW* Volume 4, Chapter 4 was used as a reference because this is a commercial project. Maintenance, repair, and cleaning of vehicles will be conducted inside a building, which is consistent with the structural source controls of this chapter. Some additional practices include:

- Assign one or more individuals to be responsible for stormwater pollution control related to inspections, operation, maintenance, and emergencies.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).
- Maintenance and repair of equipment and vehicles that may result in discharge or spillage of pollutants to the ground or into surface water runoff must be conducted inside the detail shop.
- Spills and leaks of gasoline or other pollutants will be promptly contained and cleaned. Solid absorbents should be used for cleanup of liquid spills. Spill cleanup materials shall not be flushed to storm drains. Pollutants shall not be hosed down from any area to the ground or storm drains.
- All pollutants, including waste materials and demolition debris created onsite during construction, shall be handled and disposed of in a manner that does not cause contamination of surface water.

The CSWPPP, under separate cover, provides details on source control of pollution during construction.

2.4 MR 4: Preservation of Natural Drainage Systems and Outfalls

The campus is currently developed, with several sub-basins located throughout. The project site drains to an existing detention pond that ultimately disperses to an existing unnamed wetland. Refer to Appendix A-3, Downstream Map for more information on the project site's natural drainage systems and outfalls.

Stormwater from proposed improvements will outfall to the same waterbodies in the existing and proposed conditions within their respective sub-basins. Therefore, all proposed improvements will maintain onsite natural drainage courses.

2.5 MR 5: Onsite Stormwater Management

As outlined in *SWMMWW* Figure I-2.4.2*,* the project results in over 5,000 square feet of new plus replaced hard surfaces. Therefore, the project is subject to MRs 1 through 9 and List 2, as outlined in *SWMMWW* Section I-3.4.5.

Per *SWMMWW* Figure I-2.5.1, the project is subject to List 2 for considering feasibility of onsite stormwater management Best Management Practices (BMPs). List 2 feasibility follows:

Lawn and Landscaped Areas:

- <u>BMP T5.13: Post Construction Soil Quality and Depth</u> – The project will meet this requirement.

Roofs:

- <u>BMP T5.30: Full Dispersion</u> – Full dispersion is infeasible because the project does not have adequate native vegetation to provide full dispersion.

- <u>BMP T5.10A Full Downspout Infiltration</u> – Full downspout infiltration is infeasible because the project has underlying soils that are not suitable for infiltration.

- <u>BMP T7.30: Bioretention</u> – Bioretention facilities are infeasible because the project has underlying soils that are not suitable for infiltration.

- <u>BMP T5.10: Downspout Dispersion Systems</u> - Downspout dispersion systems are infeasible because the project does not have adequate native vegetation to provide full dispersion.

- <u>BMP T5.10C Perforated Stub-Out Connections</u> – Perforated stub-out connections are infeasible because the project has underlying soils that are not suitable for infiltration.

Other Hard Surfaces:

- <u>BMP T5.30: Full Dispersion</u> – Full dispersion is infeasible because the project does not have adequate native vegetation to provide full dispersion. However, Parking Lot 6 does have sufficient vegetated area down gradient of the proposed improvements; therefore, full dispersion is proposed.

- <u>BMP T5.15: Permeable Pavement</u> – Permeable pavement is infeasible because the project has underlying soils that are not suitable for infiltration.

- BMP T7.30: Bioretention – Bioretention facilities are infeasible because the project has underlying soils that are not suitable for infiltration. However, bioretention will be used for water quality for PGIS surfaces located at the parking lot. The bioretention will use an underdrain due to site soils not allowing for infiltration.

- BMP T5.12: Sheet Flow Dispersion – Sheet flow dispersion is infeasible because the project does not have adequate native vegetation to provide full dispersion.

- BMP T5.11: Concentrated Flow Dispersion - Concentrated flow dispersion is infeasible because the project does not have adequate native vegetation to provide full dispersion.

2.6 MR 6: Runoff Treatment

All proposed pollution generating surfaces will be treated for water quality via BMP T7.30 Bioretention. Refer to Section 4.4 for more information. Refer to Appendix A-5 for the location of the proposed bioretention facility. Refer to Appendix B-1 for water quality calculations.

Two raingardens are proposed to the east of the proposed building. However, these raingardens are provided for aesthetic and education purposes, not for water quality treatment. All water quality treatment is provided by the bioretention facility in the northeast corner of the new parking lot.

2.7 MR 7: Flow Control

A flow control system will be provided for the project via an underground detention facility. The system will use underground StormTech MC-7200 chambers. The flow control system has been calculated using the Western Washington Hydrology Model (WWHM) and meets all requirements of the 2019 *SWMMWW*. Refer to Section 4.2 for more information. Refer to Appendices A-4.1 and A-4.2 for the location of proposed flow control facilities. Refer to Appendix B-1 for flow control calculations.

2.8 MR 8: Wetlands Protection

The site contains five wetlands onsite, per the City of Puyallup GIS Critical Areas Map (see Appendix A-11 for more information). PCP maps indicate 11 wetlands are located onsite. A Wetland Analysis Report by Grette Associates, dated April 25, 2022, has been completed for the wetlands that are near the proposed site improvements. Refer to Appendix C-2 for more information.

The project site drains to an unnamed wetland located at the southeast corner of the campus. No work is planned in or near the wetland buffer; therefore, it is not included in the wetland study. The drainage basin tributary to the wetland is large and contains approximately 54.83 acres in total area. The basin is partially developed and includes approximately 14.67 acres of impervious surfaces. Refer to Appendix A-6, Existing Wetland Basin Map for more information. The entire basin has been modeled in WWHM to calculate the wetland hydroperiods in the existing and proposed conditions per the guidelines set forth in the *SWMMWW*, Appendix I-D. The proposed improvements are in compliance with the *SWMMWW* and will therefore not impact the wetlands hydrology. Refer to Appendix B-2, Wetland Hydroperiod Calculations for more information.

The parking lot improvements are located adjacent to a separate wetland, Wetland A, which the project outfalls to. Wetland A is located approximately 60 feet north of the project site. The project site and the wetland are separated by College Way. Wetland A is considered a Category III wetland, with a habitat score of 5 points and an 80-foot buffer. It is located approximately 110 feet from improvements at Parking Lot B. A small portion of the existing project basin drains to the adjacent wetland in the existing condition via a bypass catch basin. The bypass catch basin collects approximately 0.02 acre of pervious area in the existing condition. An area exchange is proposed to maintain the wetland's hydrology by providing an equal amount of area within the project limits. Therefore, Wetland A's hydrology will not be impacted by the proposed work. Refer to Appendix A-2.2, Existing Conditions Map for more information on Wetland A's existing basin. Refer to Appendix A-4.2 Developed Conditions Map for more information on the proposed basin exchange.

The existing hydrology for all onsite wetlands will not be impacted by the proposed work and therefore the project is in compliance with MR 8.

2.9 MR 9: Operations and Maintenance

An Operations and Maintenance Manual is provided with this submittal. Refer to Appendix D for more information.

3.0 Offsite Analysis

The project discharges at the northeast end of the campus along the College Way. Stormwater is then collected and conveyed via catch basins and 12-inch storm pipes. Stormwater is routed north for approximately 150 feet along College Way. Stormwater is then routed east through 18-inch storm pipes for approximately 100 feet, where it outfalls to a riprap ditch. Stormwater then flows south for approximately 500 feet before outfalling to the existing detention pond located at the eastern extent of the campus. The existing detention pond outfalls to a riprap pad, where it eventually disperses into an existing unnamed wetland located approximately 320 feet southeast of the detention pond. Refer to Appendix A-3, Downstream Map for the existing detention pond location.

Impacts to offsite drainage courses and conveyance systems are not anticipated.

4.0 Permanent Stormwater Control Plan

4.1 Existing Site Hydrology

The campus straddles two drainage basins, as outlined by the City of Puyallup Drainage Basin Map. The basin delineation line runs approximately north/south down the middle of the site. The west side of the site is in the State Highway Basin and the east side of the site is in the Pothole Basin. Refer to Appendix A-10, City of Puyallup Drainage Basin Map for more information. All adjacent properties are downgradient of the site and do not appear to discharge stormwater onto the proposed site.

The proposed STEM project is centrally located on the campus approximately 100 feet north of the Library Sciences Center (LSC) and approximately 250 feet east of the College Center (CTR). The project site is located within the City of Puyallup Pothole Basin. The existing conditions include native vegetation and forested area. Topography generally slopes from southwest to northeast. The project site drains to an existing conveyance system that is routed north and then east throughout the campus before ultimately outfalling to an existing detention pond located at the far eastern edge of the campus. The existing detention pond outfalls to a riprap pad, where it eventually disperses into an existing unnamed wetland located approximately 320 feet southeast of the detention pond. Refer to Appendix A-3, Downstream Map for the existing detention pond location.

A small portion of the existing basin drains to Wetland A located approximately 60 feet north of the project. A basin exchange is proposed to maintain the area tributary to the existing wetland.

Therefore, the existing hydrology of the north wetland will not be impacted by the proposed work. Refer to Appendix A-2.2, Existing Conditions Maps for more information on the project's existing basin. Refer to Appendix A-4.2, Developed Conditions Map for more information on the proposed basin exchange.

4.2 Developed Site Hydrology

All proposed improvements will maintain onsite natural drainage courses, as outlined in Section 4.1. Stormwater from proposed improvements will outfall to the same locations within their respective sub-basins. Stormwater flows from proposed developed areas will be properly managed and will meet all the requirements set forth in the *SWMMWW*. Proposed developed hydrology will not further impact downstream drainage courses.

4.3 Flow Control System

A flow control system will be provided for the project via an underground detention facility. The system will use underground StormTech MC-7200 chambers. The flow control system has been calculated using WWHM and meets all requirements of the 2019 *SWMMWW*. Refer to Section 4.2 for more information. Refer to Appendices A-4.1 and A-4.2 for the location of proposed flow control facilities. Refer to Appendix B-1 for flow control calculations.

The flow control system has been calculated using WWHM and meets all requirements of the 2019 *SWMMWW*. The project will use BMP T5.13: Post Construction Soil Quality and Depth for all pervious areas impacted by the project. Per the *SWMMWW*, Volume V, Section V11.1, project areas meeting the requirements set forth by BMP T5.13 may model pervious area as pasture rather than lawn. The project intends to use these criteria. Refer to Appendix B-1 for flow control calculations for more information.

4.4 Water Quality System

All proposed pollution generating surfaces will receive Basic Treatment for water quality via BMP T7.30 Bioretention. Refer to Appendix A-14 for the Runoff Treatment BMP Selection Flow Chart. The bioretention facility is located in the northeast corner of the new parking lot. Stormwater from the proposed parking will sheet flow over land and enter the bioretention facility. Refer to Appendix A-5 for the location of the proposed bioretention facility. The bioretention facility will use perforated pipe underdrains to treat a minimum of 91 percent of all stormwater that enters the facility. Stormwater that is treated by the bioretention facility will be conveyed to the downstream flow control facility.

All water quality systems have been calculated using WWHM and meet all requirements of the 2019 *SWMMWW,* as indicated in Section III-2.6. Refer to Appendix B-1 for water quality calculations.

Two raingardens are proposed to the east of the proposed building. However, these raingardens are provided for aesthetic and educational purposes, not for water quality treatment. All water quality treatment is provided by the bioretention facility in the northeast corner of the new parking lot.

4.5 Conveyance System Analysis and Design

The onsite conveyance system consists of catch basins and 12-inch storm pipes with a minimum slope of 0.005 ft/ft. A conveyance analysis was performed on the farthest downstream pipe prior to entering the detention system. The conveyance analysis was modeled conservatively by routing all runoff from the building sub-basin into SDCB 10. The parking sub-basin was routed into SDCB 19. The pipe slopes were changed from the actual slopes to 0.50 to be conservative as well. The conveyance system was analyzed for the 25-year, 24-hour design storm using the Santa Barbara Urban Hydrograph (SBUH) method, assuming a Type 1A rainfall distribution (3.5 inches). The model confirms the system has adequate capacity. Refer to Appendix B-3 for Conveyance Calculations.

5.0 Construction Stormwater Pollution Prevention Plan

A Construction Stormwater Pollution Prevention Plan (CSWPPP) will be included under a separate cover for this site development permit package.

6.0 Special Reports and Studies

This project includes a Geotechnical Engineering Services Report by GeoEngineers, Inc. dated January 21, 2021, and a Wetland Analysis Report by Grette Associates dated April 25, 2022. Refer to Appendix C for the special reports.

7.0 Conclusion

This analysis is based on data and records either supplied to or obtained by AHBL. These documents are referenced within the text of the analysis. The analysis has been prepared using procedures and practices within the standard accepted practices of the industry. We conclude that this project, as proposed, will not create any new problems within the existing downstream drainage system. This project will not noticeably aggravate any existing downstream problems due to either water quality or quantity.

AHBL, Inc.

Claire Hovde
Project Engineer

CFH/ACP/lsk

May 2022
Revised August 2022
Revised October 2022

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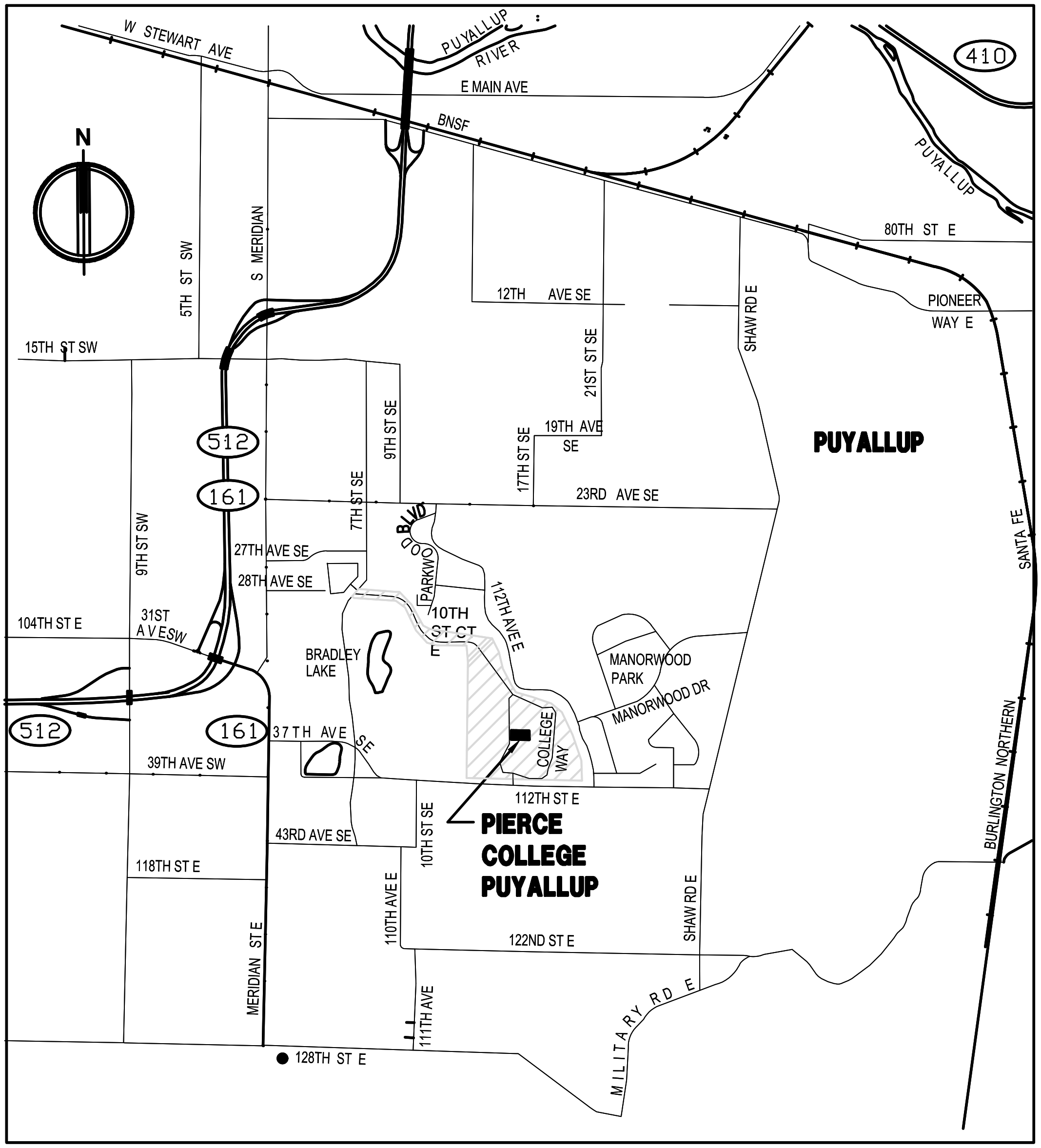
Appendix A

Exhibits



AHBL

2215 North 30th Street, Suite 300
Tacoma, WA 98403
253.383.2422 TEL 253.383.2572 FAX

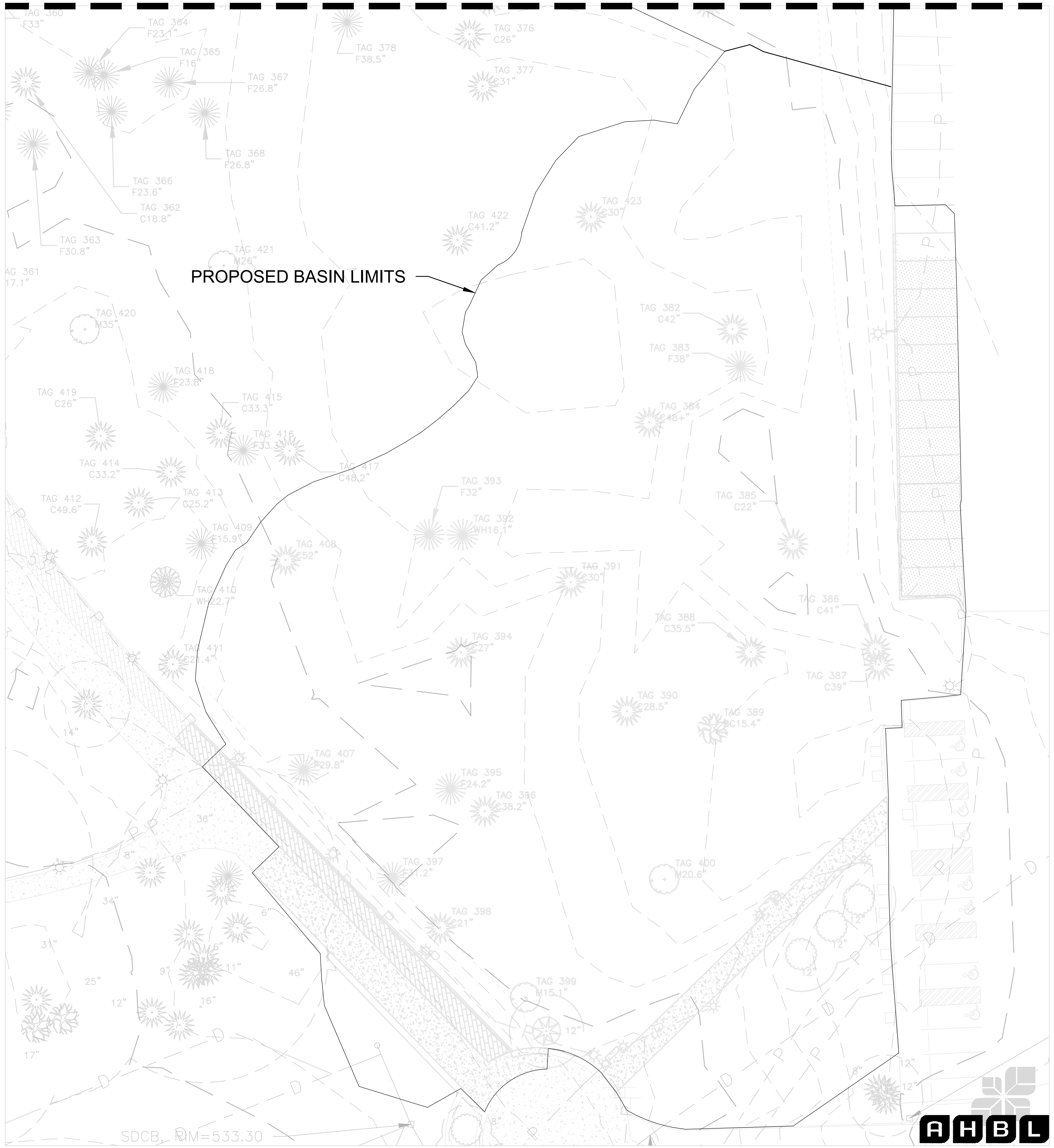
Pierce College Puyallup

Vicinity Map

DRAWN BY: ACP | DATE: 6/29/2021 | JOB NO.: 2190297.10

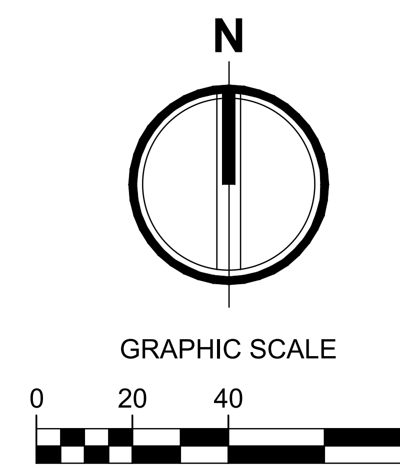
EX A-1

SEE EXHIBIT A2.2 FOR CONTINUATION



EXISTING BASIN AREAS

LANDSCAPE	IMPERVIOUS	TOTAL
1.24 AC	0.14 AC	1.38 AC



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Community Planners
Land Surveyors
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316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

PIERCE COLLEGE PUYALLUP
NEW STEM BUILDING

EXISTING BASIN MAP

EX-A2.1

SEE EXHIBIT A2.1 FOR CONTINUATION

EXISTING BASIN AREAS

LANDSCAPE	IMPERVIOUS	TOTAL
0.82 AC	0 AC	0.82 AC

N

GRAPHIC SCALE

0 20 40 80

1" = 40 FEET

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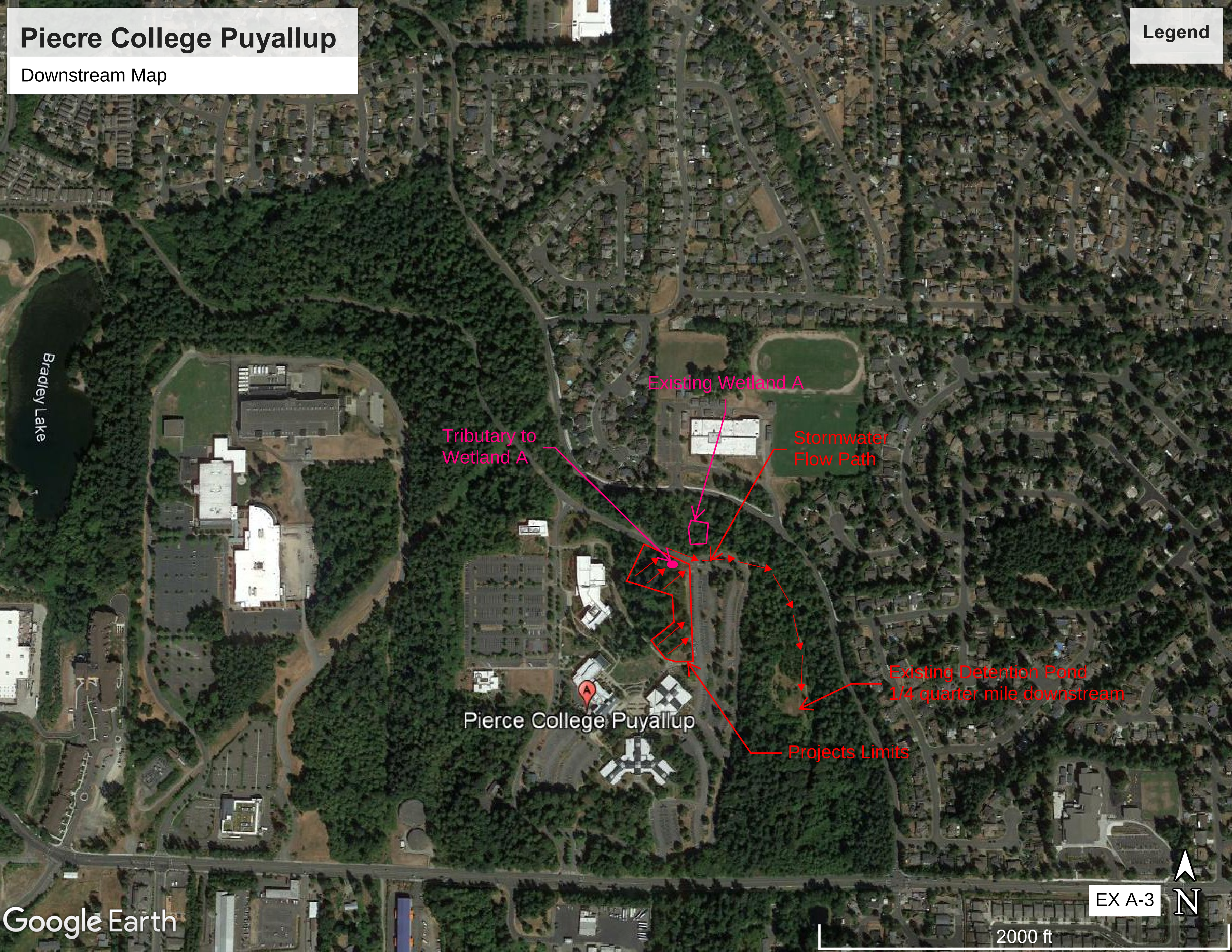
PIERCE COLLEGE PUYALLUP
NEW STEM BUILDING

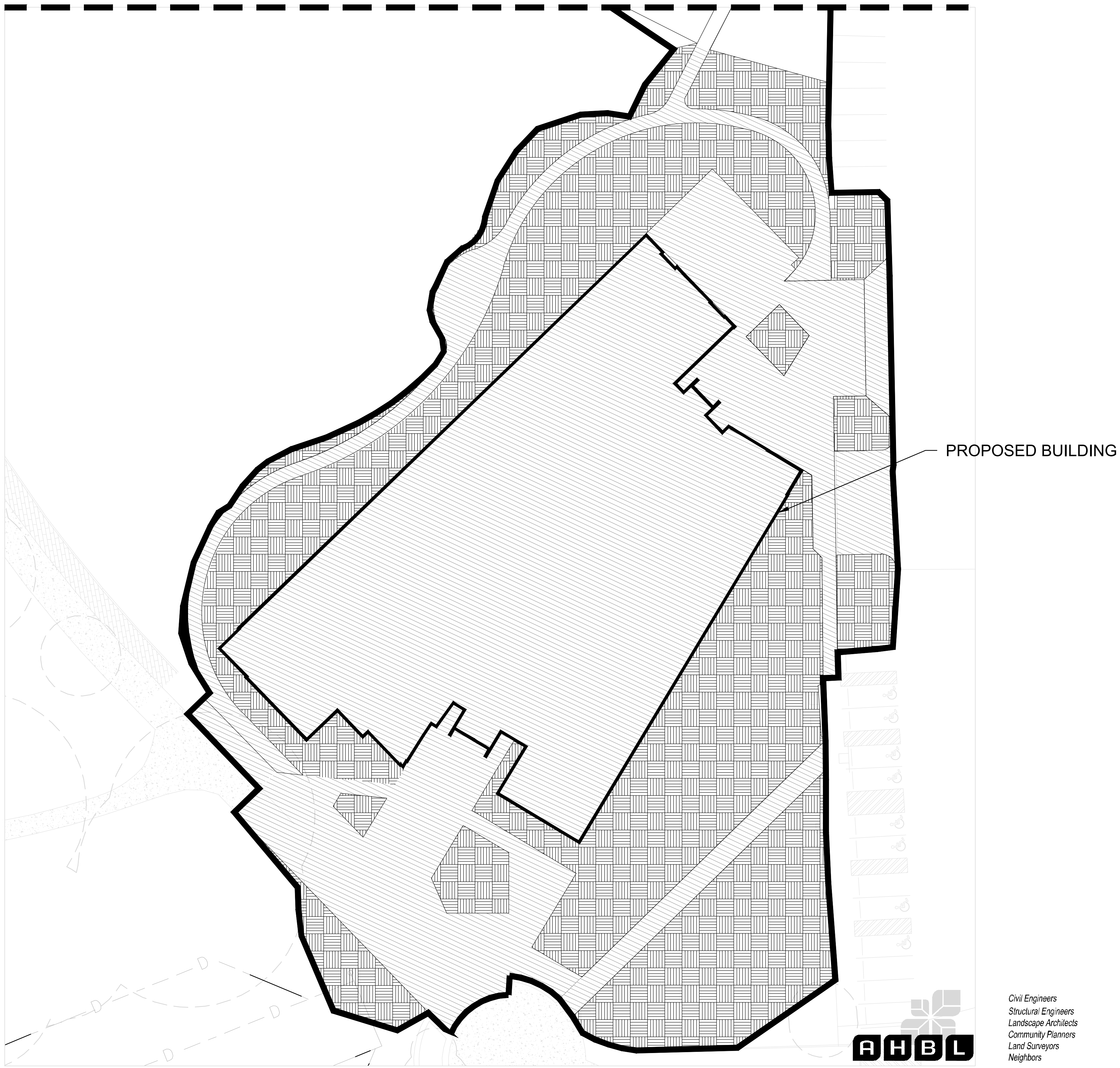
EXISTING BASIN MAP

EX-A2.2



Piecre College Puyallup
Downstream Map
Legend
Bradley Lake
Existing Wetland A
Tributary to Wetland A
Stormwater Flow Path
Existing Detention Pond 1/4 quarter mile downstream
Projects Limits
Pierce College Puyallup
Google Earth
EX A-3
N
2000 ft

SEE EXHIBIT A4.2 FOR CONTINUATION



BUILDING SUB-BASIN AREA

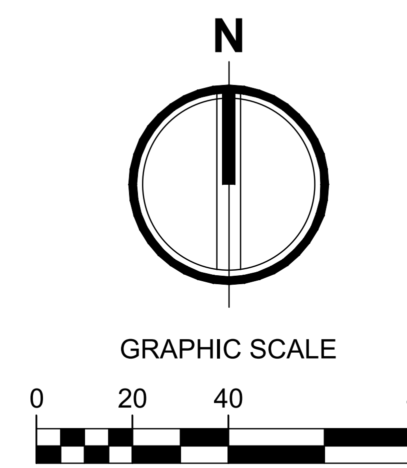
LANDSCAPE	IMPERVIOUS	TOTAL
0.57 AC	0.81 AC	1.38 AC

TOTAL BASIN AREAS

LANDSCAPE	IMPERVIOUS	TOTAL
0.73 AC	1.47 AC	2.20 AC

LAWN AND LANDSCAPING

IMPERVIOUS SURFACE



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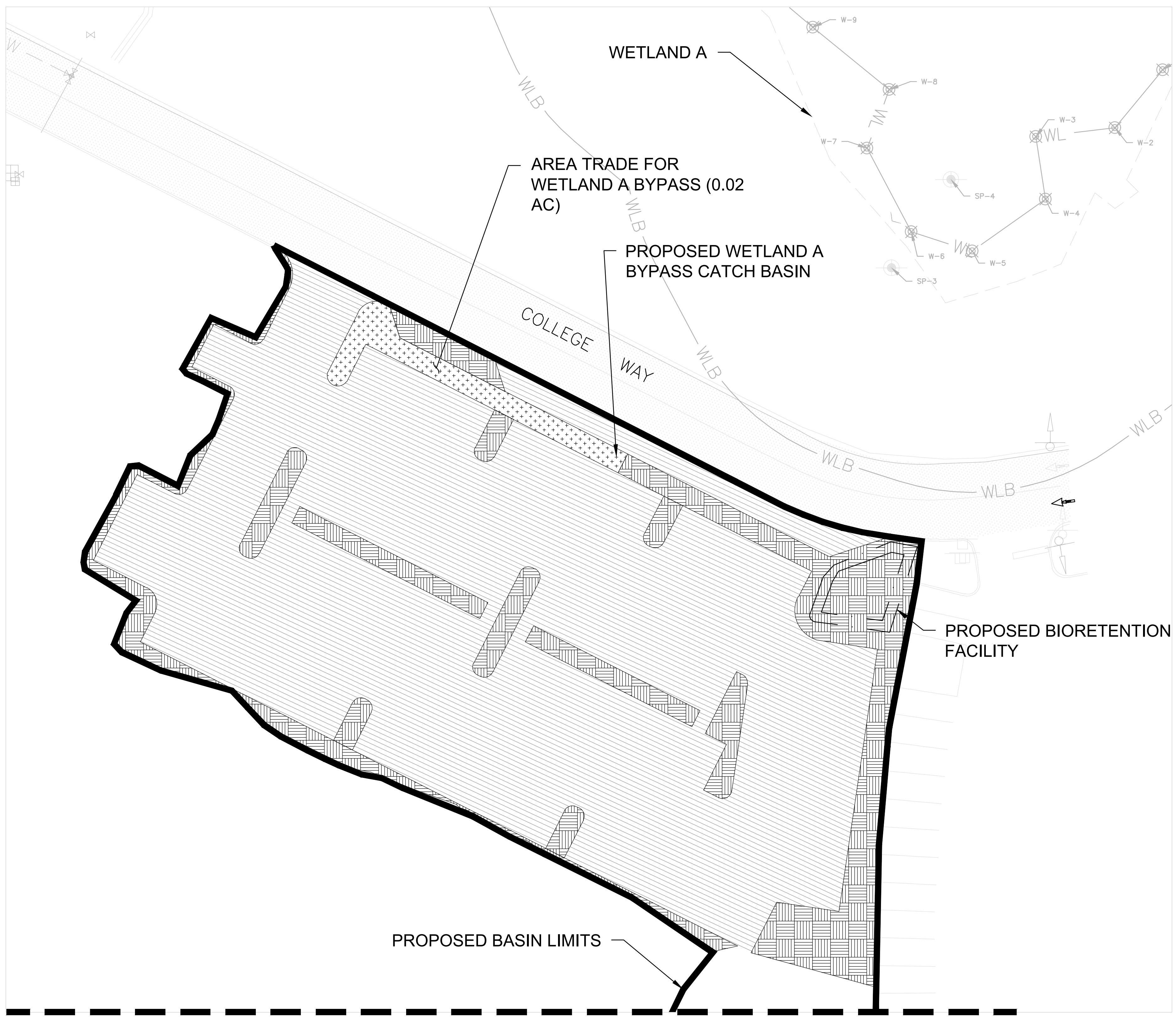
PIERCE COLLEGE PUYALLUP
NEW STEM BUILDING

DEVELOPED BASIN MAP

EX-A4.1



PARKING SUB-BASIN AREA

LANDSCAPE	IMPERVIOUS	TOTAL
0.16 AC	0.66 AC	0.82 AC

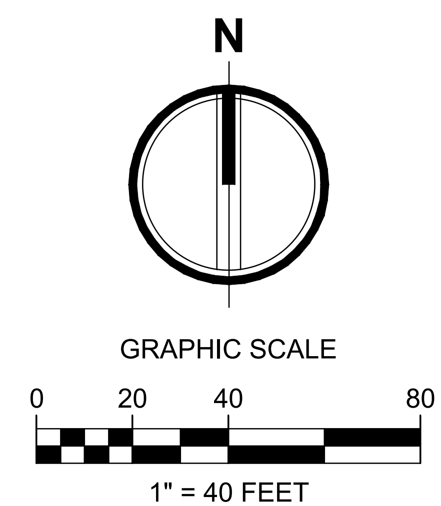
TOTAL BASIN AREAS

LANDSCAPE	IMPERVIOUS	TOTAL
0.73 AC	1.47 AC	2.20 AC

LAWN AND LANDSCAPING

IMPERVIOUS SURFACE

WETLAND BYPASS AREA (PERVIOUS)



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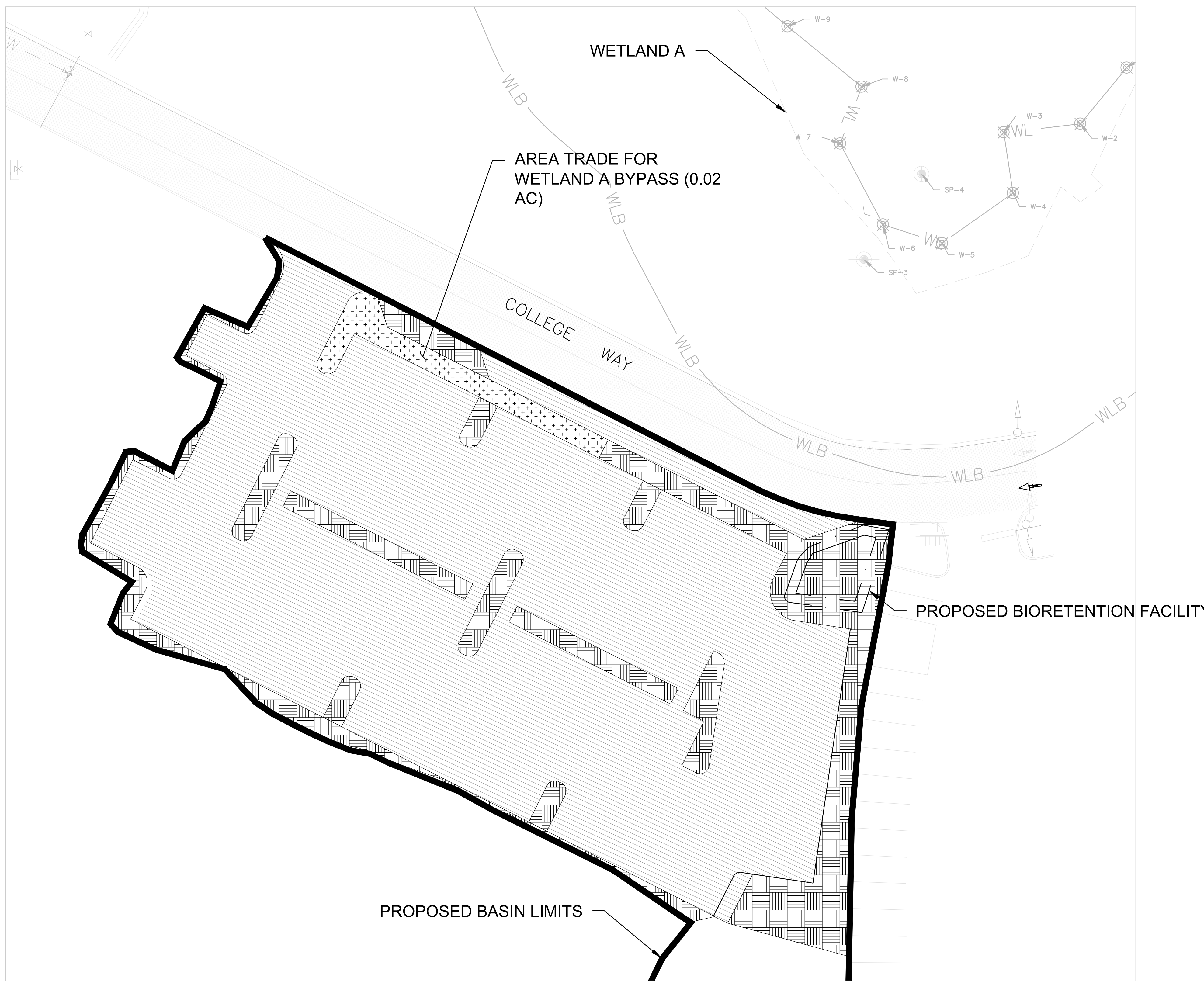
PIERCE COLLEGE PUYALLUP
NEW STEM BUILDING

DEVELOPED BASIN MAP

EX-A4.2



PROPOSED BASIN AREAS

PERVIOUS	IMPERVIOUS	TOTAL
0.16 AC	0.66 AC	0.82 AC

PERVIOUS

IMPERVIOUS SURFACE (PGIS)

WETLAND BYPASS AREA (PERVIOUS)

N

GRAPHIC SCALE

0 20 40 80

1" = 40 FEET

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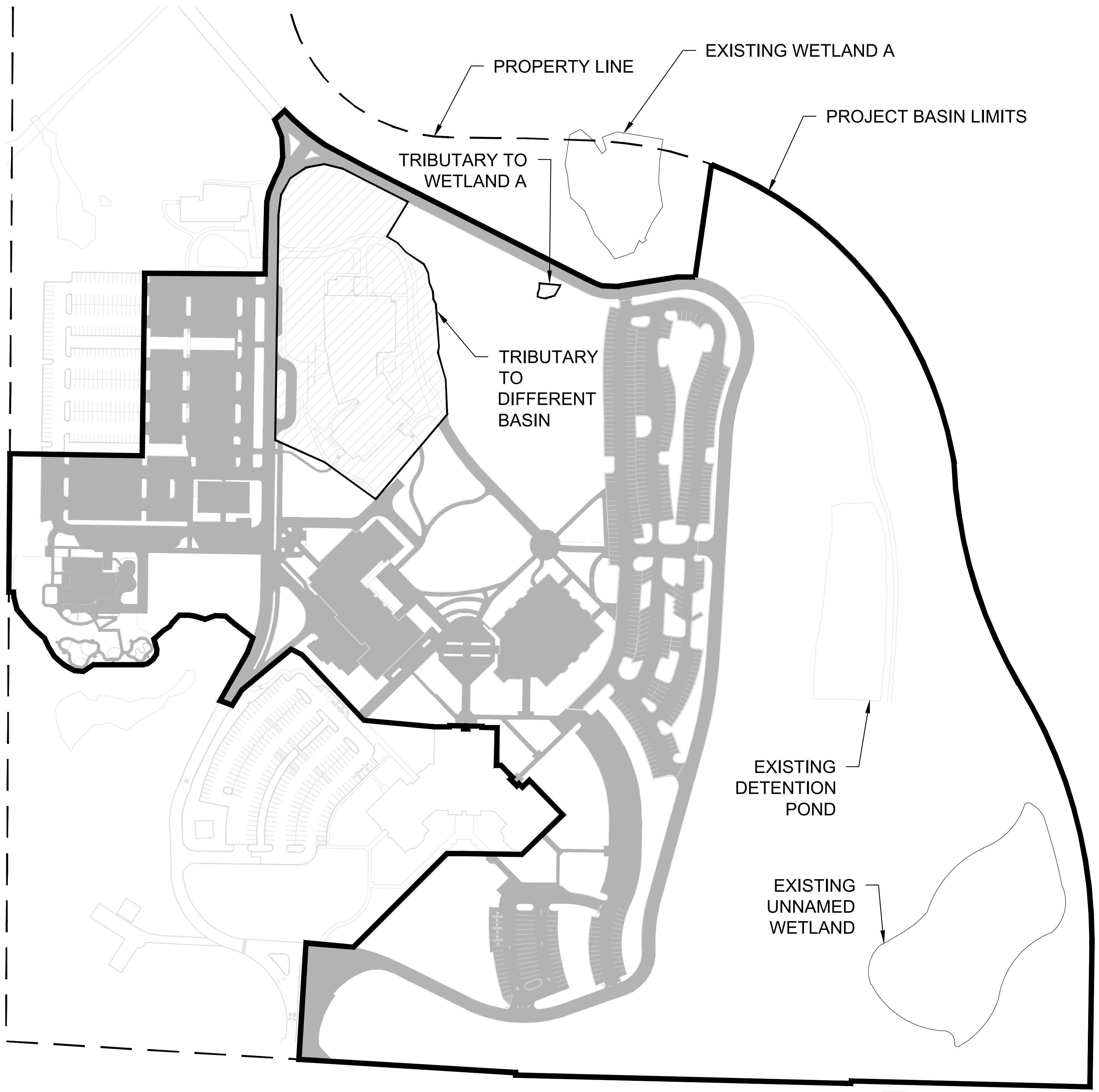
PIERCE COLLEGE PUYALLUP
NEW STEM BUILDING

WATER QUALITY BASIN MAP

EX-A5



IMPERVIOUS SURFACE

PERVIOUS SURFACE

BASIN AREAS			
BASIN	PERVIOUS	IMPERVIOUS	TOTAL
PROJECT BASIN	40.16 AC	14.67 AC	54.83 AC

N

GRAPHIC SCALE

0 125 250 500

1" = 250 FEET

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Community Planners
Land Surveyors
Neighbors
TACOMA · SEATTLE
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

PIERCE COLLEGE PUYALLUP
NEW STEM BUILDING

EXISTING WETLAND BASIN MAP

EX-A6

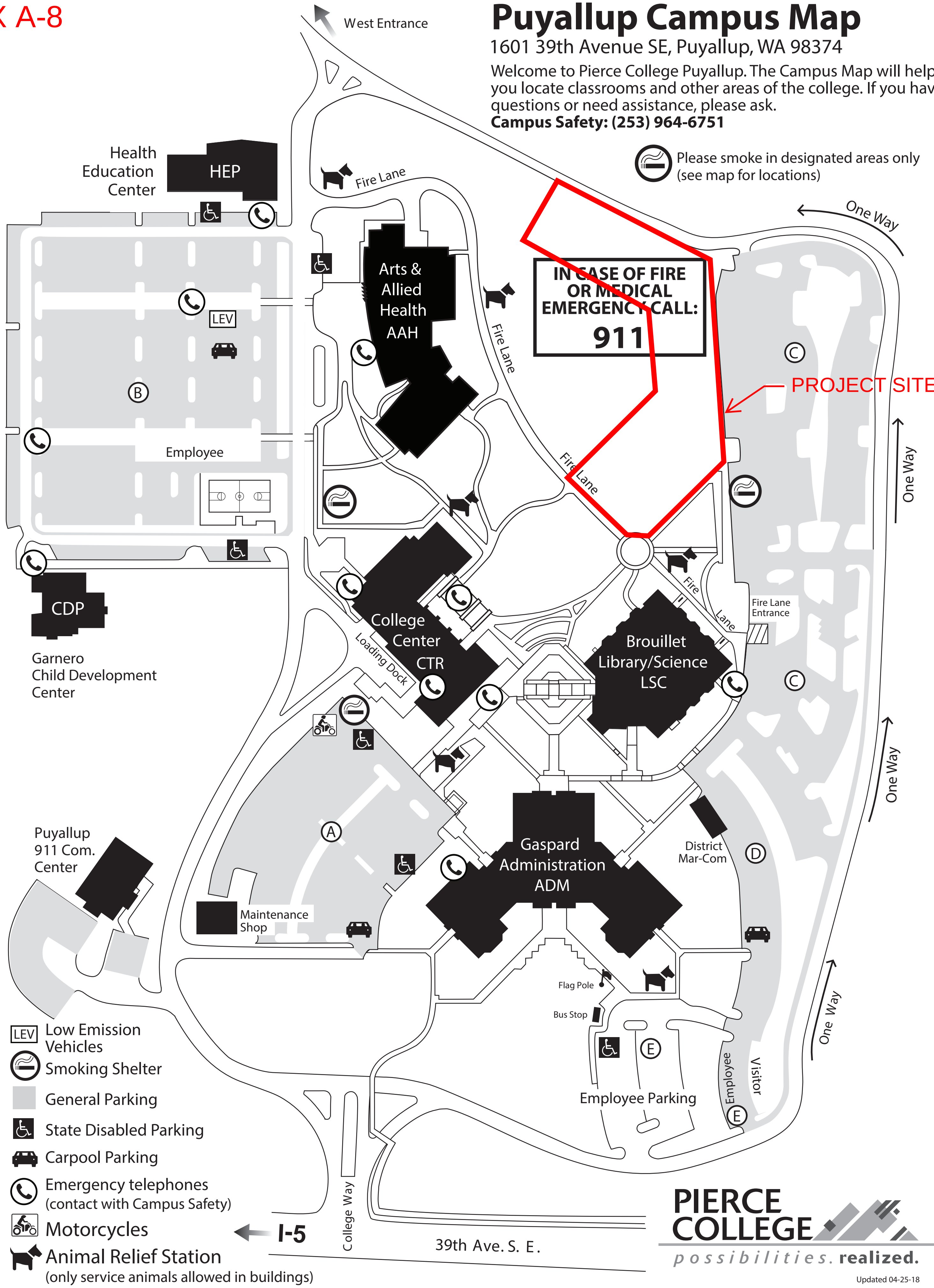
EX A-8

Puyallup Campus Map

1601 39th Avenue SE, Puyallup, WA 98374

Welcome to Pierce College Puyallup. The Campus Map will help you locate classrooms and other areas of the college. If you have questions or need assistance, please ask.

Campus Safety: (253) 964-6751



EX A-9

National Flood Hazard Layer FIRMette

FEMA

122°16'39"W 47°9'35"N

122°16'2"W 47°9'10"N

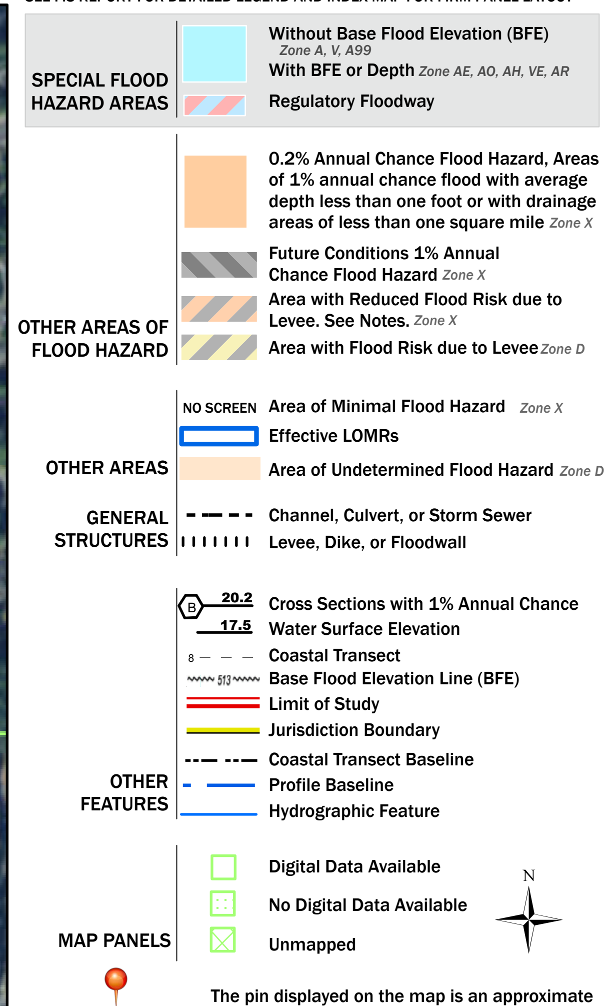
Feet
0 250 500 1,000 1,500 2,000

1:6,000

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

Legend

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



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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/29/2021 at 4:45 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

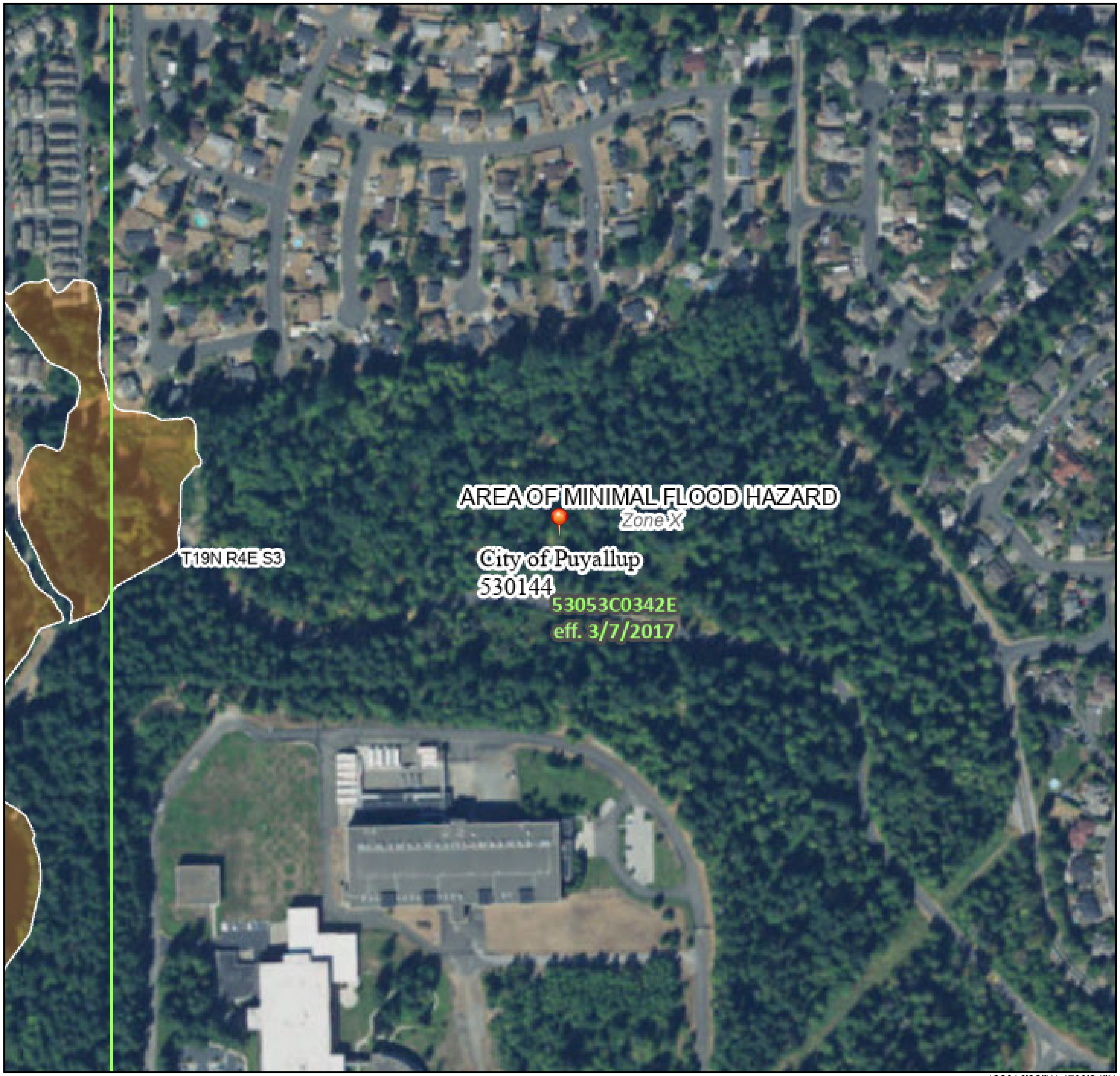
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory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

National Flood Hazard Layer FIRMette

EX A-9

FEMA

122°17'1"W 47°9'59"N



122°16'23"W 47°9'34"N

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

1:6,000

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

Legend

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

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

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

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

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

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

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

N

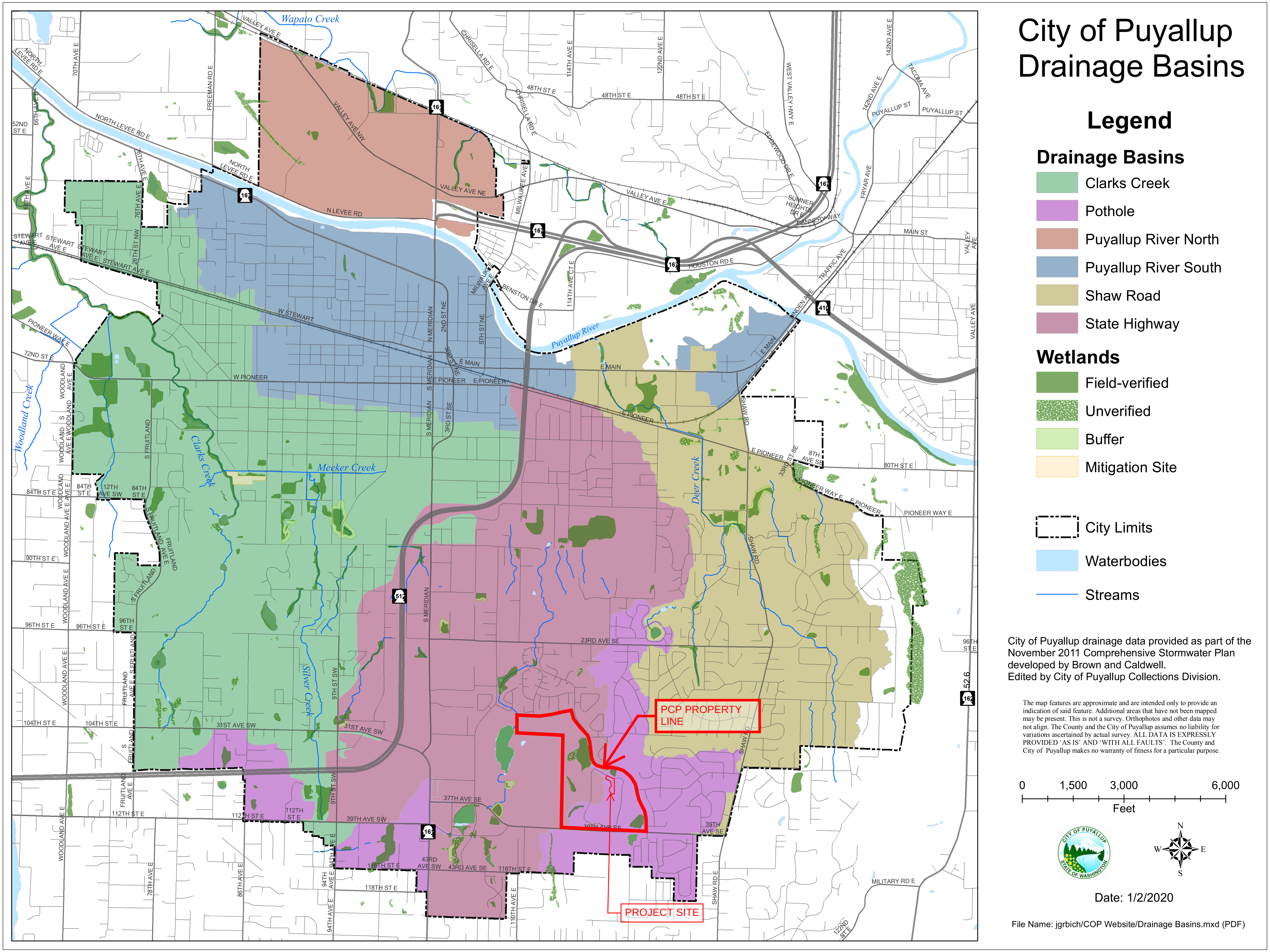
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/29/2021 at 4:51 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

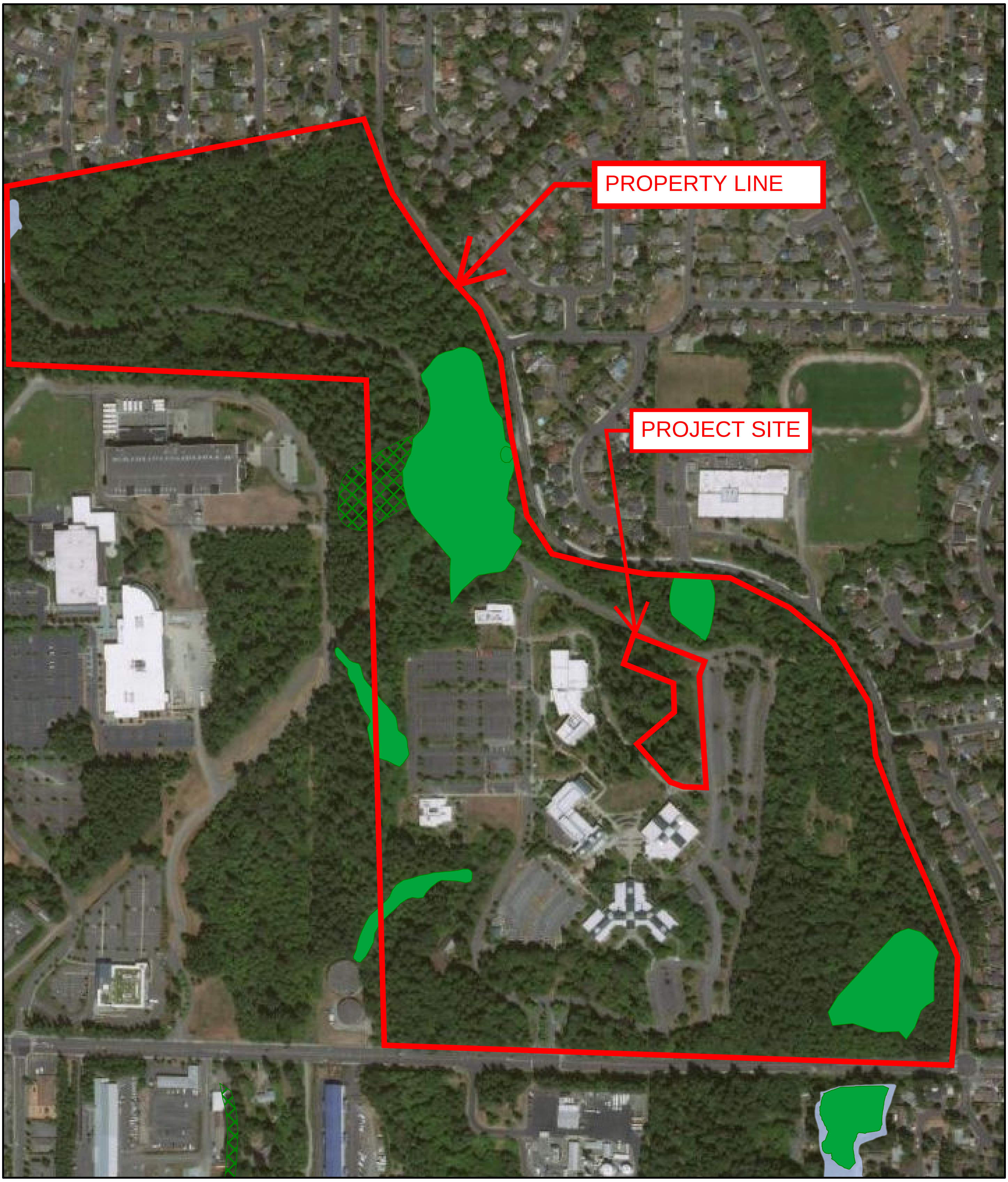
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory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

EX A-10


City of Puyallup Drainage Basins
Legend
Drainage Basins
Clarks Creek
Pothole
Puyallup River North
Puyallup River South
Shaw Road
State Highway
Wetlands
Field-verified
Unverified
Buffer
Mitigation Site
City Limits
Waterbodies
Streams
City of Puyallup drainage data provided as part of the November 2011 Comprehensive Stormwater Plan developed by Brown and Caldwell.
Edited by City of Puyallup Collections Division.
The map features are approximate and are intended only to provide an indication of said feature. Additional areas that have not been mapped may be present. This is not a survey. Orthophotos and other data may not align. The County and the City of Puyallup assumes no liability for variations ascertained by actual survey. ALL DATA IS EXPRESSLY PROVIDED 'AS IS' AND 'WITH ALL FAULTS'. The County and City of Puyallup makes no warranty of fitness for a particular purpose.
0
1,500
3,000
6,000
Feet
N
S
E
W
Date: 1/2/2020
File Name: jgrbich/COP Website/Drainage Basins.mxd (PDF)
PCP PROPERTY LINE
PROJECT SITE
Wapato Creek
Puyallup River
Clarks Creek
Meeker Creek
Silver Creek
Deer Creek
Woodland Creek

EX A-11

ArcGIS Web Map



6/29/2021, 11:26:01 AM

City Limits

Wetlands

Field-verified

Unverified

Unverified

Regulated Floodplain 2017

Zone X (SHADED)

1:9,028

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

Maxar

Web AppBuilder for ArcGIS

Maxar | Jennifer Recco, GIS Coordinator, City of Puyallup;

EX A-12

Map Scale: 1:7,010 if printed on B landscape (17" x 11") sheet.

Meters: 0, 100, 200, 400, 600

Feet: 0, 300, 600, 1200, 1800

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 16, Jun 4, 2020

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

Date(s) aerial images were photographed: Jul 29, 2018—Jul 22, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
4A	Bellingham silty clay loam	1.4	0.3%
13B	Everett very gravelly sandy loam, 0 to 8 percent slopes	157.9	34.8%
18B	Indianola loamy sand, 0 to 5 percent slopes	20.3	4.5%
18C	Indianola loamy sand, 5 to 15 percent slopes	41.7	9.2%
19B	Kapowsin gravelly ashy loam, 0 to 6 percent slopes	42.1	9.3%
19C	Kapowsin gravelly ashy loam, 6 to 15 percent slopes	141.4	31.2%
19E	Kapowsin gravelly ashy loam, 30 to 65 percent slopes	32.9	7.3%
20B	Kitsap silt loam, 2 to 8 percent slopes	2.8	0.6%
24D	Neilton gravelly loamy sand, 8 to 25 percent slopes	4.4	1.0%
W	Water	8.8	1.9%
Totals for Area of Interest		**453.7**	**100.0%**

Pierce County Area, Washington

13B—Everett very gravelly sandy loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t629
Elevation: 30 to 900 feet
Mean annual precipitation: 35 to 91 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everett

Setting

Landform: Eskers, moraines, kames
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: very gravelly sandy loam
Bw - 3 to 24 inches: very gravelly sandy loam
C1 - 24 to 35 inches: very gravelly loamy sand
C2 - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A

Forage suitability group: Droughty Soils (G002XS401WA), Droughty Soils (G002XN402WA), Droughty Soils (G002XF403WA)
Other vegetative classification: Droughty Soils (G002XS401WA), Droughty Soils (G002XN402WA), Droughty Soils (G002XF403WA)
Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 10 percent
Landform: Ridges, hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest, talf
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Indianola

Percent of map unit: 10 percent
Landform: Terraces, eskers, kames
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 16, Jun 4, 2020

Hydrologic Soil Group: B
Forage suitability group: Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)
Other vegetative classification: Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)
Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 5 percent
Landform: Ridges, hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest, talf
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Mckenna

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Dupont

Percent of map unit: 2 percent
Landform: Depressions, troughs
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Norma

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Harstine

Percent of map unit: 2 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Neilton

Percent of map unit: 2 percent
Landform: Outwash terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 16, Jun 4, 2020

Pierce County Area, Washington

19C—Kapowsin gravelly ashy loam, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t61x
Elevation: 50 to 900 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Kapowsin and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kapowsin

Setting

Landform: Moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash mixed with glacial drift over dense glaciomarine deposits

Typical profile

Ap - 0 to 7 inches: gravelly ashy loam
Bhs - 7 to 11 inches: gravelly ashy loam
Bs1 - 11 to 15 inches: gravelly ashy loam
2Bs2 - 15 to 25 inches: loam
3Bstm - 25 to 29 inches: loam
3Cd - 29 to 59 inches: gravelly loam

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches; More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: About 11 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: B
Forage suitability group: Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)
Other vegetative classification: Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)
Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 5 percent
Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope, talf
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Neilton

Percent of map unit: 2 percent
Landform: Outwash terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Norma

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Mckenna

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Dupont

Percent of map unit: 2 percent
Landform: Depressions, troughs
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Harstine

Percent of map unit: 2 percent
Landform: Ridges
Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Nose slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 16, Jun 4, 2020

Pierce County Area, Washington

19E—Kapowsin gravelly ashy loam, 30 to 65 percent slopes

Map Unit Setting

National map unit symbol: 2t620
Elevation: 50 to 900 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Kapowsin and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kapowsin

Setting

Landform: Moraines
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash mixed with glacial drift over dense glaciomarine deposits

Typical profile

Ap - 0 to 7 inches: gravelly ashy loam
Bhs - 7 to 11 inches: gravelly ashy loam
Bs1 - 11 to 15 inches: gravelly ashy loam
2Bs2 - 15 to 25 inches: loam
3Bstm - 25 to 29 inches: loam
3Cd - 29 to 59 inches: gravelly loam

Properties and qualities

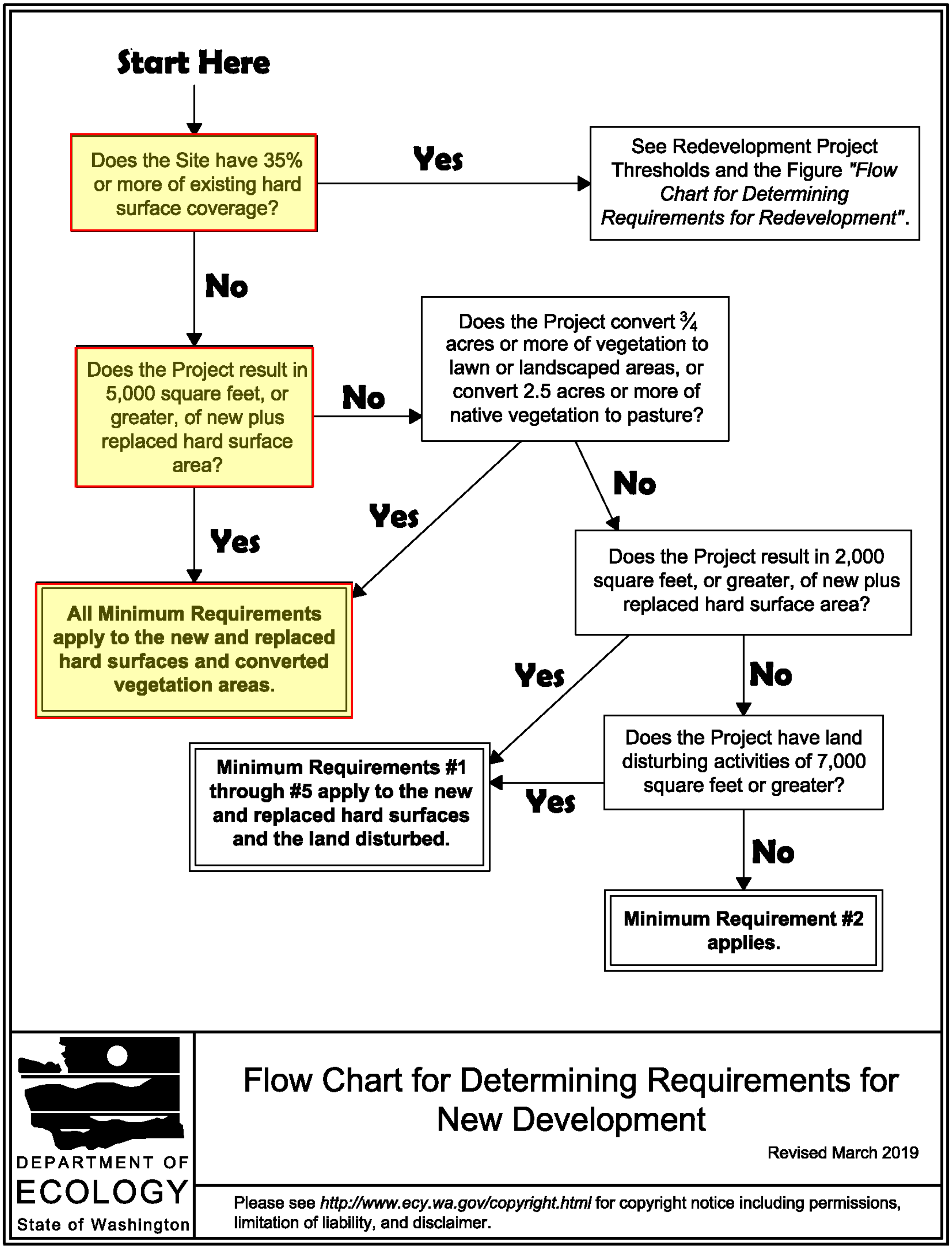
Slope: 30 to 65 percent
Depth to restrictive feature: More than 80 inches; More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: About 11 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.3 inches)

Interpretive groups

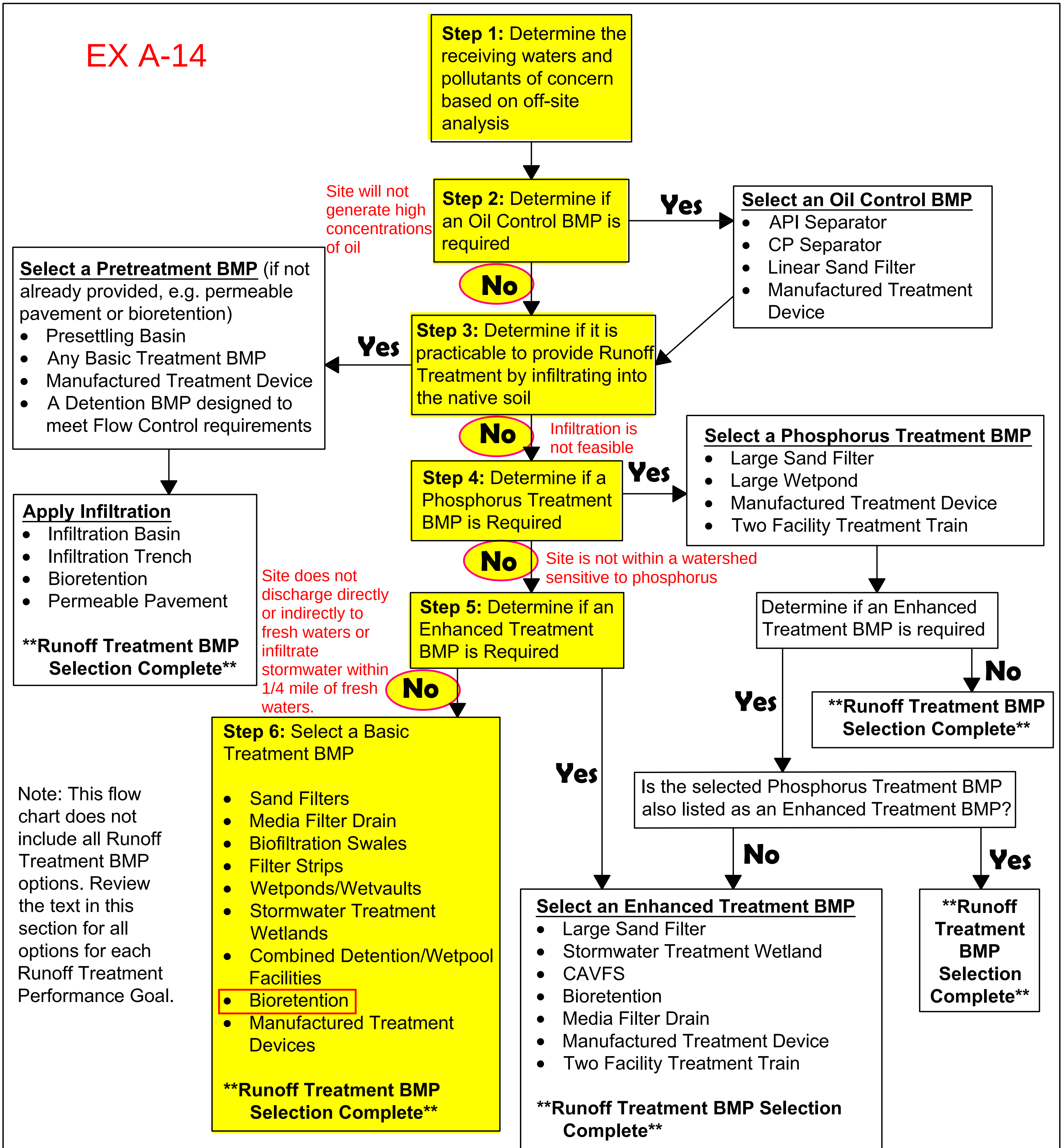
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e

EX A-13

Figure I-3.1: Flow Chart for Determining Requirements for New Development



EX A-14



DEPARTMENT OF ECOLOGY
State of Washington

Runoff Treatment BMP Selection Flow Chart

Revised January 2019

Appendix B

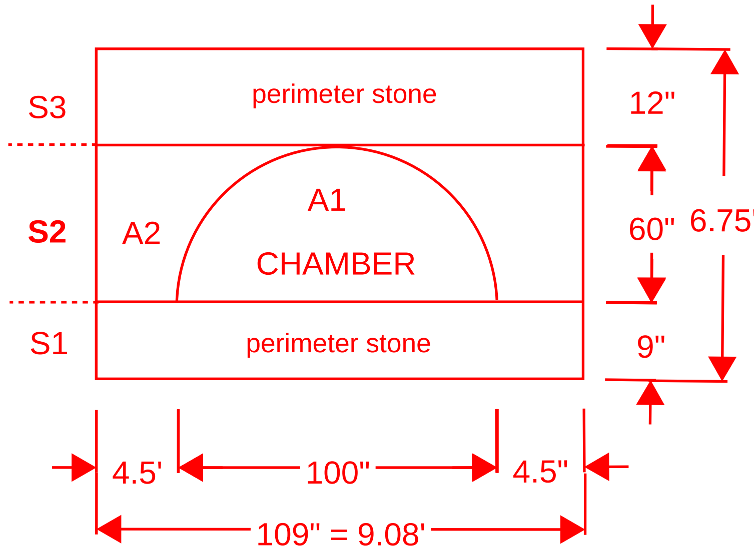
Flow Control, Water Quality, Wetland Hydroperiod, and Conveyance Calculations

Composite Porosity Calculation for Stormtech Chamber MC-7200

Chamber dimensions from detail:
L = 83.4" = 6.95'
W = 100" = 8.33'
H = 60" = 5.00'
Vol = 175.9 cf

S2 Areas:
A1 = 175.9 cf / 6.95'
A1 = 25.31 sf

A2 = (9.08' x 5.00') - 25.31 sf
A2 = 20.09 sf



perimeter stone porosity per manufacturer's specifications

S2 Composite Porosity:

$$\frac{(25.31 \times 1) + (20.09 \times 0.4)}{25.31 + 20.09} = 0.73$$

S2 Composite Porosity = 0.73

AHBL
2215 North 30th Street, Suite 300
Tacoma, WA 98403
253.383.2422 TEL 253.383.2572 FAX

Pierce College Puyallup STEM	
Composite Porosity Calculation for Stormtech Chamber MC-7200	
DRAWN BY: CFH	DATE: 10/13/2022	JOB NO.: 2210810.10

B1

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Pierce College Detention_Chambers
Site Name:	Pierce College STEM
Site Address:	1601 39th Ave SE
City:	Puyallup
Report Date:	10/13/2022
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

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

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	2.2
Pervious Total	2.2
Impervious Land Use	acre
Impervious Total	0
Basin Total	2.2

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.73
Pervious Total	0.73
Impervious Land Use	acre
ROADS FLAT	1.47
Impervious Total	1.47
Basin Total	2.2

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	1000.00 ft.
Bottom Width:	9.08 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	0.75
Pour Space of material for first layer:	0.4
Material thickness of second layer:	5
Pour Space of material for second layer:	0.73
Material thickness of third layer:	1
Pour Space of material for third layer:	0.4

Discharge Structure

Riser Height:	6.7 ft.	
Riser Diameter:	12 in.	
Orifice 1 Diameter:	0.6 in.	Elevation:0 ft.
Orifice 2 Diameter:	0.82 in.	Elevation:3.9 ft.
Orifice 3 Diameter:	1.1 in.	Elevation:4.5 ft.

Element Flows To:
Outlet 1 Outlet 2

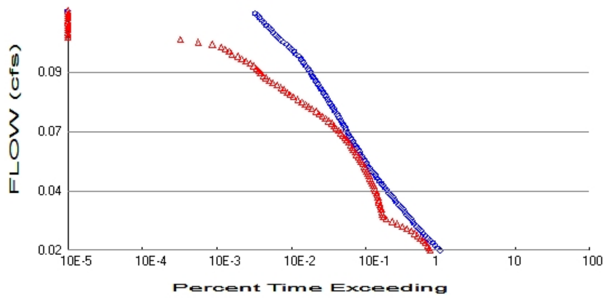
Gravel Trench Bed Hydraulic Table

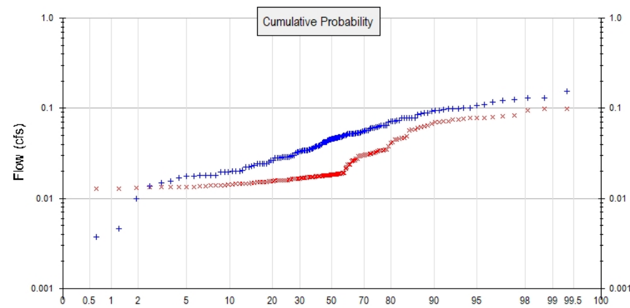
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.208	0.000	0.000	0.000
0.0750	0.208	0.006	0.002	0.000
0.1500	0.208	0.012	0.003	0.000
0.2250	0.208	0.018	0.004	0.000
0.3000	0.208	0.025	0.005	0.000
0.3750	0.208	0.031	0.006	0.000
0.4500	0.208	0.037	0.006	0.000
0.5250	0.208	0.043	0.007	0.000
0.6000	0.208	0.050	0.007	0.000
0.6750	0.208	0.056	0.008	0.000
0.7500	0.208	0.062	0.008	0.000
0.8250	0.208	0.073	0.008	0.000
0.9000	0.208	0.085	0.009	0.000
0.9750	0.208	0.096	0.009	0.000
1.0500	0.208	0.108	0.010	0.000
1.1250	0.208	0.119	0.010	0.000
1.2000	0.208	0.131	0.010	0.000
1.2750	0.208	0.142	0.011	0.000
1.3500	0.208	0.153	0.011	0.000
1.4250	0.208	0.165	0.011	0.000
1.5000	0.208	0.176	0.012	0.000
1.5750	0.208	0.188	0.012	0.000
1.6500	0.208	0.199	0.012	0.000
1.7250	0.208	0.210	0.012	0.000
1.8000	0.208	0.222	0.013	0.000
1.8750	0.208	0.233	0.013	0.000
1.9500	0.208	0.245	0.013	0.000
2.0250	0.208	0.256	0.013	0.000
2.1000	0.208	0.268	0.014	0.000
2.1750	0.208	0.279	0.014	0.000

2.2500	0.208	0.290	0.014	0.000
2.3250	0.208	0.302	0.014	0.000
2.4000	0.208	0.313	0.015	0.000
2.4750	0.208	0.325	0.015	0.000
2.5500	0.208	0.336	0.015	0.000
2.6250	0.208	0.347	0.015	0.000
2.7000	0.208	0.359	0.016	0.000
2.7750	0.208	0.370	0.016	0.000
2.8500	0.208	0.382	0.016	0.000
2.9250	0.208	0.393	0.016	0.000
3.0000	0.208	0.404	0.016	0.000
3.0750	0.208	0.416	0.017	0.000
3.1500	0.208	0.427	0.017	0.000
3.2250	0.208	0.439	0.017	0.000
3.3000	0.208	0.450	0.017	0.000
3.3750	0.208	0.462	0.017	0.000
3.4500	0.208	0.473	0.018	0.000
3.5250	0.208	0.484	0.018	0.000
3.6000	0.208	0.496	0.018	0.000
3.6750	0.208	0.507	0.018	0.000
3.7500	0.208	0.519	0.018	0.000
3.8250	0.208	0.530	0.019	0.000
3.9000	0.208	0.541	0.019	0.000
3.9750	0.208	0.553	0.024	0.000
4.0500	0.208	0.564	0.026	0.000
4.1250	0.208	0.576	0.028	0.000
4.2000	0.208	0.587	0.030	0.000
4.2750	0.208	0.598	0.031	0.000
4.3500	0.208	0.610	0.032	0.000
4.4250	0.208	0.621	0.033	0.000
4.5000	0.208	0.633	0.034	0.000
4.5750	0.208	0.644	0.044	0.000
4.6500	0.208	0.656	0.049	0.000
4.7250	0.208	0.667	0.053	0.000
4.8000	0.208	0.678	0.056	0.000
4.8750	0.208	0.690	0.059	0.000
4.9500	0.208	0.701	0.062	0.000
5.0250	0.208	0.713	0.065	0.000
5.1000	0.208	0.724	0.067	0.000
5.1750	0.208	0.735	0.069	0.000
5.2500	0.208	0.747	0.072	0.000
5.3250	0.208	0.758	0.074	0.000
5.4000	0.208	0.770	0.076	0.000
5.4750	0.208	0.781	0.078	0.000
5.5500	0.208	0.792	0.080	0.000
5.6250	0.208	0.804	0.082	0.000
5.7000	0.208	0.815	0.083	0.000
5.7750	0.208	0.822	0.085	0.000
5.8500	0.208	0.828	0.087	0.000
5.9250	0.208	0.834	0.088	0.000
6.0000	0.208	0.840	0.090	0.000
6.0750	0.208	0.847	0.092	0.000
6.1500	0.208	0.853	0.093	0.000
6.2250	0.208	0.859	0.095	0.000
6.3000	0.208	0.865	0.096	0.000
6.3750	0.208	0.872	0.098	0.000
6.4500	0.208	0.878	0.099	0.000
6.5250	0.208	0.884	0.101	0.000

6.6000	0.208	0.890	0.102	0.000
6.6750	0.208	0.897	0.104	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 2.2
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.73
Total Impervious Area: 1.47

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.04636
5 year	0.072123
10 year	0.086121
25 year	0.100369
50 year	0.108838
100 year	0.115801

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.022381
5 year	0.037679
10 year	0.051781
25 year	0.075351
50 year	0.097989
100 year	0.125848

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1902	0.034	0.018
1903	0.028	0.015
1904	0.046	0.017
1905	0.022	0.024
1906	0.010	0.013
1907	0.071	0.018
1908	0.053	0.016
1909	0.052	0.018
1910	0.072	0.018
1911	0.047	0.018

1912	0.154	0.034
1913	0.074	0.062
1914	0.018	0.013
1915	0.030	0.032
1916	0.046	0.017
1917	0.015	0.015
1918	0.050	0.064
1919	0.037	0.017
1920	0.047	0.017
1921	0.053	0.032
1922	0.053	0.018
1923	0.043	0.030
1924	0.019	0.016
1925	0.024	0.015
1926	0.045	0.016
1927	0.029	0.017
1928	0.036	0.022
1929	0.074	0.034
1930	0.047	0.018
1931	0.044	0.019
1932	0.034	0.031
1933	0.033	0.018
1934	0.097	0.081
1935	0.045	0.057
1936	0.039	0.027
1937	0.063	0.017
1938	0.038	0.018
1939	0.002	0.014
1940	0.042	0.031
1941	0.020	0.013
1942	0.064	0.078
1943	0.033	0.018
1944	0.060	0.032
1945	0.053	0.018
1946	0.029	0.014
1947	0.018	0.015
1948	0.100	0.019
1949	0.085	0.047
1950	0.024	0.016
1951	0.030	0.015
1952	0.130	0.058
1953	0.117	0.079
1954	0.042	0.026
1955	0.035	0.014
1956	0.017	0.015
1957	0.060	0.034
1958	0.125	0.098
1959	0.078	0.080
1960	0.021	0.013
1961	0.078	0.074
1962	0.042	0.028
1963	0.020	0.013
1964	0.022	0.015
1965	0.087	0.070
1966	0.024	0.016
1967	0.037	0.015
1968	0.038	0.019
1969	0.038	0.017

1970	0.060	0.019
1971	0.094	0.070
1972	0.061	0.021
1973	0.078	0.042
1974	0.042	0.018
1975	0.099	0.083
1976	0.052	0.019
1977	0.018	0.013
1978	0.088	0.072
1979	0.024	0.017
1980	0.050	0.018
1981	0.048	0.019
1982	0.019	0.014
1983	0.078	0.031
1984	0.032	0.016
1985	0.052	0.017
1986	0.046	0.026
1987	0.088	0.063
1988	0.056	0.046
1989	0.050	0.016
1990	0.057	0.018
1991	0.045	0.027
1992	0.064	0.060
1993	0.062	0.018
1994	0.093	0.024
1995	0.018	0.017
1996	0.102	0.079
1997	0.039	0.015
1998	0.046	0.018
1999	0.004	0.015
2000	0.035	0.027
2001	0.018	0.013
2002	0.065	0.018
2003	0.056	0.019
2004	0.052	0.018
2005	0.095	0.030
2006	0.029	0.016
2007	0.029	0.018
2008	0.049	0.018
2009	0.034	0.017
2010	0.029	0.029
2011	0.023	0.015
2012	0.034	0.017
2013	0.026	0.013
2014	0.020	0.014
2015	0.038	0.016
2016	0.015	0.015
2017	0.071	0.035
2018	0.130	0.100
2019	0.121	0.076
2020	0.040	0.016
2021	0.064	0.049
2022	0.027	0.016
2023	0.054	0.029
2024	0.102	0.018
2025	0.048	0.019
2026	0.078	0.034
2027	0.028	0.016

2028	0.024	0.014
2029	0.053	0.047
2030	0.098	0.045
2031	0.032	0.014
2032	0.018	0.014
2033	0.028	0.015
2034	0.028	0.016
2035	0.111	0.094
2036	0.057	0.022
2037	0.014	0.014
2038	0.046	0.031
2039	0.005	0.012
2040	0.025	0.017
2041	0.034	0.016
2042	0.108	0.075
2043	0.052	0.035
2044	0.070	0.045
2045	0.048	0.038
2046	0.056	0.067
2047	0.041	0.030
2048	0.053	0.017
2049	0.048	0.018
2050	0.034	0.017
2051	0.050	0.018
2052	0.029	0.018
2053	0.051	0.072
2054	0.065	0.058
2055	0.020	0.013
2056	0.023	0.014
2057	0.035	0.024
2058	0.044	0.033
2059	0.078	0.041

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1543	0.0999
2	0.1300	0.0979
3	0.1299	0.0939
4	0.1255	0.0833
5	0.1212	0.0811
6	0.1173	0.0800
7	0.1106	0.0788
8	0.1076	0.0786
9	0.1019	0.0775
10	0.1017	0.0764
11	0.0997	0.0747
12	0.0988	0.0745
13	0.0980	0.0720
14	0.0971	0.0718
15	0.0953	0.0705
16	0.0941	0.0701
17	0.0930	0.0669
18	0.0885	0.0643
19	0.0880	0.0627
20	0.0873	0.0620
21	0.0855	0.0601
22	0.0784	0.0582

23	0.0780	0.0579
24	0.0780	0.0569
25	0.0780	0.0491
26	0.0778	0.0473
27	0.0776	0.0471
28	0.0739	0.0462
29	0.0736	0.0455
30	0.0719	0.0454
31	0.0714	0.0424
32	0.0711	0.0415
33	0.0701	0.0379
34	0.0649	0.0347
35	0.0646	0.0346
36	0.0643	0.0344
37	0.0639	0.0338
38	0.0636	0.0338
39	0.0625	0.0336
40	0.0620	0.0329
41	0.0610	0.0321
42	0.0601	0.0317
43	0.0600	0.0317
44	0.0598	0.0314
45	0.0574	0.0310
46	0.0571	0.0309
47	0.0563	0.0306
48	0.0561	0.0303
49	0.0559	0.0301
50	0.0541	0.0300
51	0.0533	0.0295
52	0.0530	0.0295
53	0.0529	0.0275
54	0.0529	0.0274
55	0.0527	0.0266
56	0.0527	0.0265
57	0.0523	0.0263
58	0.0521	0.0259
59	0.0520	0.0239
60	0.0518	0.0238
61	0.0517	0.0236
62	0.0511	0.0221
63	0.0505	0.0218
64	0.0498	0.0212
65	0.0496	0.0192
66	0.0495	0.0192
67	0.0492	0.0190
68	0.0478	0.0189
69	0.0477	0.0189
70	0.0477	0.0188
71	0.0476	0.0187
72	0.0473	0.0187
73	0.0471	0.0185
74	0.0468	0.0185
75	0.0465	0.0184
76	0.0464	0.0183
77	0.0463	0.0183
78	0.0463	0.0183
79	0.0458	0.0182
80	0.0451	0.0182

81	0.0449	0.0182
82	0.0447	0.0181
83	0.0444	0.0181
84	0.0438	0.0181
85	0.0425	0.0181
86	0.0423	0.0180
87	0.0422	0.0180
88	0.0421	0.0179
89	0.0419	0.0178
90	0.0412	0.0178
91	0.0395	0.0177
92	0.0392	0.0176
93	0.0391	0.0176
94	0.0383	0.0176
95	0.0382	0.0175
96	0.0381	0.0175
97	0.0376	0.0174
98	0.0375	0.0174
99	0.0366	0.0174
100	0.0359	0.0172
101	0.0354	0.0172
102	0.0351	0.0172
103	0.0346	0.0171
104	0.0343	0.0171
105	0.0343	0.0170
106	0.0342	0.0170
107	0.0340	0.0169
108	0.0338	0.0168
109	0.0337	0.0168
110	0.0331	0.0167
111	0.0327	0.0166
112	0.0324	0.0165
113	0.0318	0.0164
114	0.0298	0.0164
115	0.0298	0.0164
116	0.0291	0.0163
117	0.0289	0.0161
118	0.0288	0.0160
119	0.0288	0.0159
120	0.0287	0.0159
121	0.0286	0.0159
122	0.0284	0.0158
123	0.0283	0.0158
124	0.0280	0.0157
125	0.0279	0.0157
126	0.0266	0.0155
127	0.0263	0.0154
128	0.0255	0.0153
129	0.0245	0.0153
130	0.0243	0.0152
131	0.0242	0.0151
132	0.0241	0.0150
133	0.0241	0.0150
134	0.0232	0.0148
135	0.0226	0.0148
136	0.0223	0.0147
137	0.0221	0.0146
138	0.0206	0.0145

139	0.0201	0.0144
140	0.0201	0.0144
141	0.0201	0.0143
142	0.0196	0.0142
143	0.0195	0.0140
144	0.0194	0.0140
145	0.0181	0.0140
146	0.0181	0.0139
147	0.0181	0.0137
148	0.0178	0.0136
149	0.0176	0.0135
150	0.0176	0.0134
151	0.0170	0.0134
152	0.0154	0.0134
153	0.0149	0.0133
154	0.0137	0.0133
155	0.0100	0.0130
156	0.0046	0.0129
157	0.0037	0.0129
158	0.0024	0.0120

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0232	54276	40243	74	Pass
0.0240	50176	38991	77	Pass
0.0249	46564	37118	79	Pass
0.0258	43329	34526	79	Pass
0.0266	40260	32132	79	Pass
0.0275	37462	29551	78	Pass
0.0284	34908	27224	77	Pass
0.0292	32576	24847	76	Pass
0.0301	30321	22227	73	Pass
0.0310	28276	19490	68	Pass
0.0318	26432	17008	64	Pass
0.0327	24797	14631	59	Pass
0.0336	23285	12354	53	Pass
0.0344	21933	10354	47	Pass
0.0353	20637	9385	45	Pass
0.0362	19423	9202	47	Pass
0.0370	18282	9030	49	Pass
0.0379	17224	8836	51	Pass
0.0388	16155	8670	53	Pass
0.0396	15152	8510	56	Pass
0.0405	14271	8332	58	Pass
0.0413	13451	8166	60	Pass
0.0422	12665	8005	63	Pass
0.0431	11933	7823	65	Pass
0.0439	11246	7679	68	Pass
0.0448	10559	7512	71	Pass
0.0457	9972	7241	72	Pass
0.0465	9374	6975	74	Pass
0.0474	8847	6731	76	Pass
0.0483	8332	6521	78	Pass
0.0491	7861	6294	80	Pass
0.0500	7457	6066	81	Pass
0.0509	7030	5861	83	Pass
0.0517	6609	5662	85	Pass
0.0526	6277	5460	86	Pass
0.0535	5978	5251	87	Pass
0.0543	5701	5017	88	Pass
0.0552	5437	4793	88	Pass
0.0561	5198	4595	88	Pass
0.0569	4942	4385	88	Pass
0.0578	4704	4161	88	Pass
0.0587	4511	3949	87	Pass
0.0595	4338	3754	86	Pass
0.0604	4156	3595	86	Pass
0.0613	3956	3408	86	Pass
0.0621	3764	3233	85	Pass
0.0630	3576	3032	84	Pass
0.0638	3412	2863	83	Pass
0.0647	3259	2687	82	Pass
0.0656	3134	2528	80	Pass
0.0664	3026	2367	78	Pass
0.0673	2927	2189	74	Pass
0.0682	2813	2054	73	Pass

0.0690	2682	1912	71	Pass
0.0699	2555	1743	68	Pass
0.0708	2451	1578	64	Pass
0.0716	2359	1440	61	Pass
0.0725	2256	1297	57	Pass
0.0734	2140	1193	55	Pass
0.0742	2038	1035	50	Pass
0.0751	1952	934	47	Pass
0.0760	1860	853	45	Pass
0.0768	1777	761	42	Pass
0.0777	1690	673	39	Pass
0.0786	1619	585	36	Pass
0.0794	1561	528	33	Pass
0.0803	1482	482	32	Pass
0.0812	1407	436	30	Pass
0.0820	1338	400	29	Pass
0.0829	1270	353	27	Pass
0.0837	1217	309	25	Pass
0.0846	1162	278	23	Pass
0.0855	1103	251	22	Pass
0.0863	1055	230	21	Pass
0.0872	1006	214	21	Pass
0.0881	963	202	20	Pass
0.0889	919	187	20	Pass
0.0898	872	173	19	Pass
0.0907	814	155	19	Pass
0.0915	772	135	17	Pass
0.0924	737	119	16	Pass
0.0933	694	105	15	Pass
0.0941	636	88	13	Pass
0.0950	601	81	13	Pass
0.0959	553	71	12	Pass
0.0967	517	63	12	Pass
0.0976	478	48	10	Pass
0.0985	433	31	7	Pass
0.0993	394	18	4	Pass
0.1002	364	0	0	Pass
0.1011	341	0	0	Pass
0.1019	310	0	0	Pass
0.1028	297	0	0	Pass
0.1036	273	0	0	Pass
0.1045	252	0	0	Pass
0.1054	237	0	0	Pass
0.1062	224	0	0	Pass
0.1071	206	0	0	Pass
0.1080	195	0	0	Pass
0.1088	180	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

Model Default Modifications

Total of 0 changes have been made.

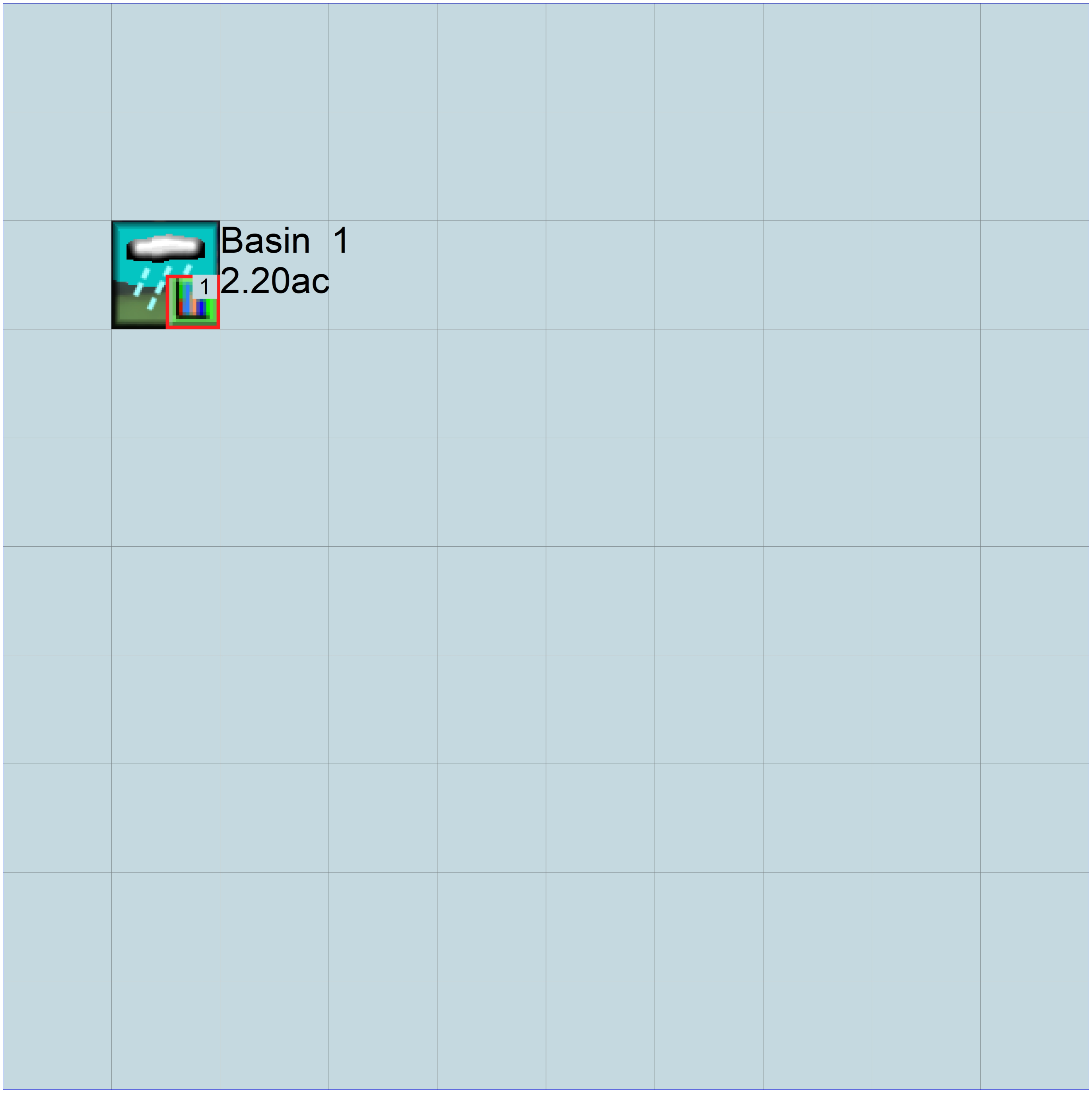
PERLND Changes

No PERLND changes have been made.

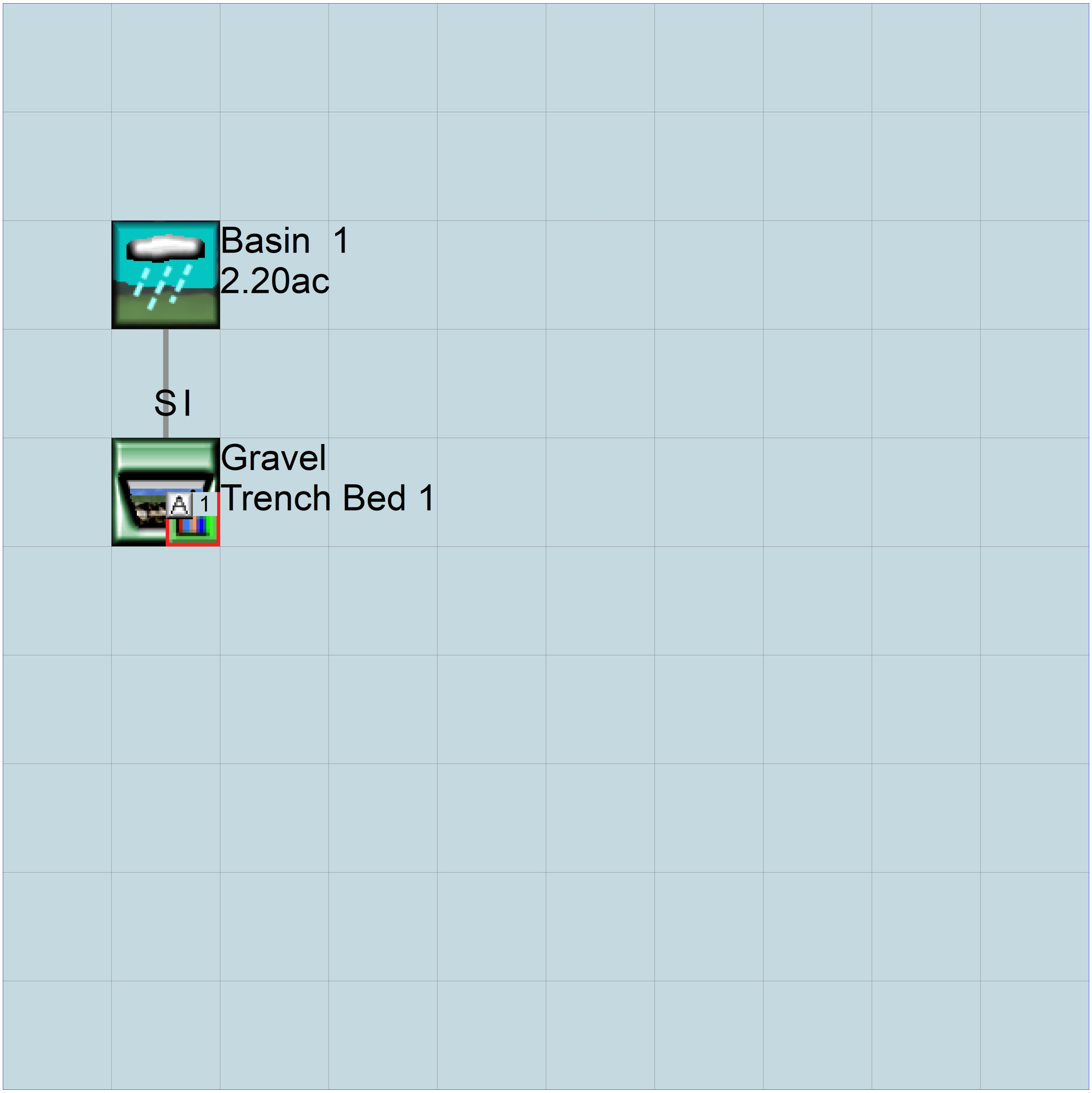
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



WWHM2012

PROJECT REPORT

General Model Information

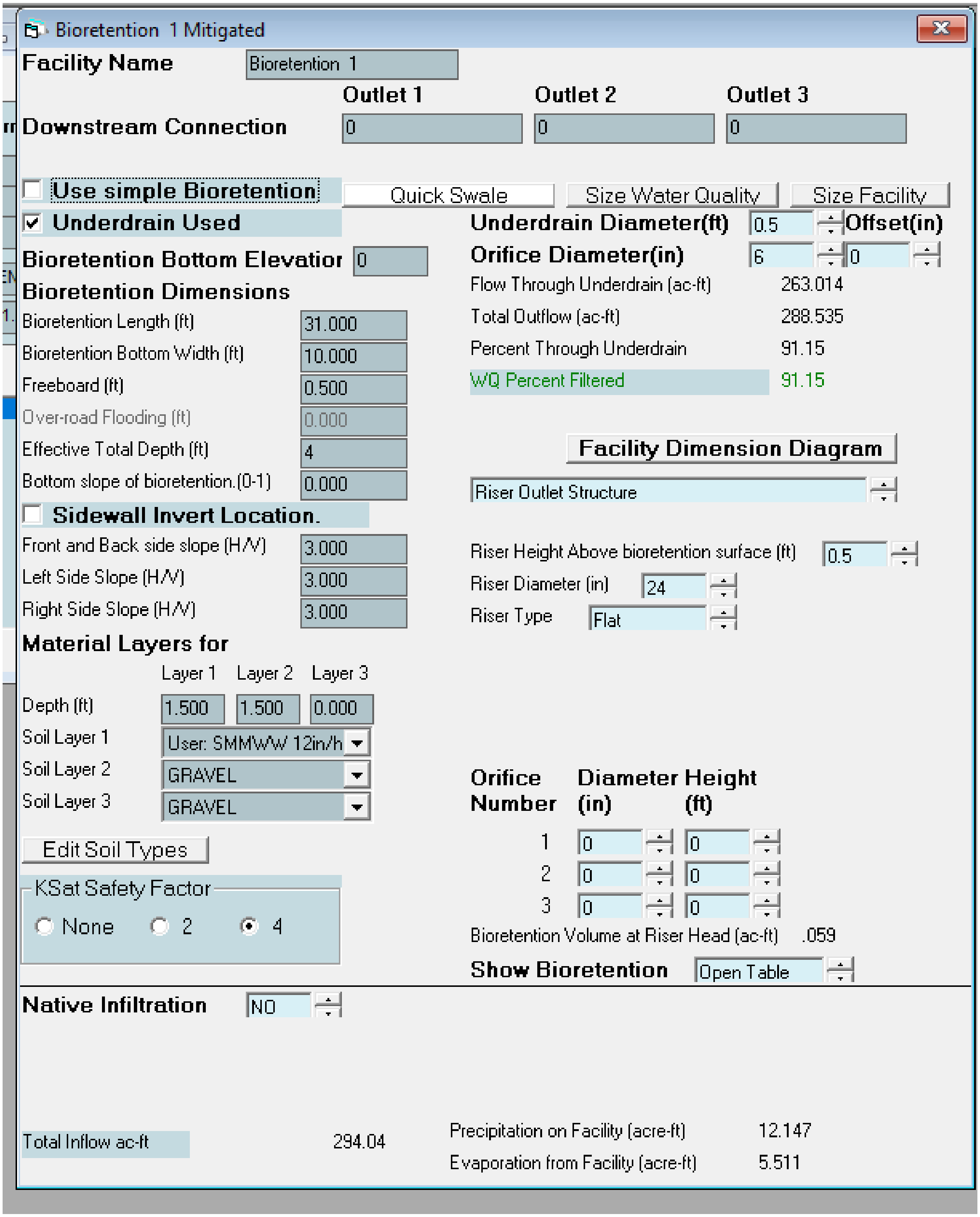
Project Name:	Parking Lot B
Site Name:	
Site Address:	
City:	
Report Date:	8/5/2022
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use



Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.16
Pervious Total	0.16
Impervious Land Use	acre
PARKING FLAT	0.66
Impervious Total	0.66
Basin Total	0.82

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	31.00 ft.
Bottom Width:	10.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	6
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	263.014
Total Outflow (ac-ft.):	288.535
Percent Through Underdrain:	91.15

Discharge Structure
Riser Height: 0.5 ft.
Riser Diameter: 24 in.
Element Flows To:
Outlet 1 Outlet 2

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.0315	0.0000	0.0000	0.0000
0.0440	0.0314	0.0001	0.0000	0.0000
0.0879	0.0309	0.0003	0.0000	0.0000
0.1319	0.0305	0.0005	0.0000	0.0000
0.1758	0.0300	0.0006	0.0000	0.0000
0.2198	0.0295	0.0008	0.0001	0.0000
0.2637	0.0291	0.0010	0.0002	0.0000
0.3077	0.0286	0.0011	0.0003	0.0000
0.3516	0.0282	0.0013	0.0004	0.0000
0.3956	0.0278	0.0015	0.0005	0.0000
0.4396	0.0273	0.0017	0.0007	0.0000
0.4835	0.0269	0.0019	0.0009	0.0000
0.5275	0.0265	0.0021	0.0011	0.0000
0.5714	0.0260	0.0023	0.0011	0.0000
0.6154	0.0256	0.0025	0.0014	0.0000
0.6593	0.0252	0.0027	0.0017	0.0000
0.7033	0.0248	0.0030	0.0021	0.0000
0.7473	0.0243	0.0032	0.0025	0.0000
0.7912	0.0239	0.0034	0.0027	0.0000
0.8352	0.0235	0.0037	0.0030	0.0000
0.8791	0.0231	0.0039	0.0034	0.0000
0.9231	0.0227	0.0042	0.0040	0.0000
0.9670	0.0223	0.0045	0.0046	0.0000
1.0110	0.0219	0.0047	0.0052	0.0000
1.0549	0.0215	0.0050	0.0052	0.0000
1.0989	0.0211	0.0053	0.0059	0.0000
1.1429	0.0207	0.0056	0.0066	0.0000
1.1868	0.0204	0.0059	0.0074	0.0000
1.2308	0.0200	0.0062	0.0083	0.0000

1.2747	0.0196	0.0065	0.0086	0.0000
1.3187	0.0192	0.0068	0.0092	0.0000
1.3626	0.0189	0.0072	0.0101	0.0000
1.4066	0.0185	0.0075	0.0112	0.0000
1.4505	0.0181	0.0078	0.0122	0.0000
1.4945	0.0178	0.0082	0.0132	0.0000
1.5385	0.0174	0.0085	0.0134	0.0000
1.5824	0.0170	0.0088	0.0146	0.0000
1.6264	0.0167	0.0092	0.0158	0.0000
1.6703	0.0163	0.0095	0.0171	0.0000
1.7143	0.0160	0.0098	0.0185	0.0000
1.7582	0.0157	0.0102	0.0191	0.0000
1.8022	0.0153	0.0106	0.0200	0.0000
1.8462	0.0150	0.0109	0.0214	0.0000
1.8901	0.0147	0.0113	0.0287	0.0000
1.9341	0.0143	0.0117	0.0287	0.0000
1.9780	0.0140	0.0121	0.0287	0.0000
2.0220	0.0137	0.0125	0.0287	0.0000
2.0659	0.0134	0.0129	0.0287	0.0000
2.1099	0.0130	0.0133	0.0287	0.0000
2.1538	0.0127	0.0137	0.0287	0.0000
2.1978	0.0124	0.0141	0.0287	0.0000
2.2418	0.0121	0.0146	0.0287	0.0000
2.2857	0.0118	0.0150	0.0287	0.0000
2.3297	0.0115	0.0154	0.0287	0.0000
2.3736	0.0112	0.0159	0.0287	0.0000
2.4176	0.0109	0.0164	0.0287	0.0000
2.4615	0.0106	0.0168	0.0287	0.0000
2.5055	0.0103	0.0173	0.0287	0.0000
2.5495	0.0100	0.0178	0.0287	0.0000
2.5934	0.0098	0.0183	0.0287	0.0000
2.6374	0.0095	0.0188	0.0287	0.0000
2.6813	0.0092	0.0193	0.0287	0.0000
2.7253	0.0089	0.0198	0.0287	0.0000
2.7692	0.0087	0.0203	0.0287	0.0000
2.8132	0.0084	0.0209	0.0287	0.0000
2.8571	0.0081	0.0214	0.0287	0.0000
2.9011	0.0079	0.0220	0.0287	0.0000
2.9451	0.0076	0.0225	0.0287	0.0000
2.9890	0.0074	0.0231	0.0287	0.0000
3.0000	0.0071	0.0232	0.0287	0.0000

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0315	0.0232	0.0000	0.0215	0.0000
3.0440	0.0320	0.0246	0.0000	0.0215	0.0000
3.0879	0.0324	0.0261	0.0000	0.0228	0.0000
3.1319	0.0329	0.0275	0.0000	0.0234	0.0000
3.1758	0.0334	0.0290	0.0000	0.0241	0.0000
3.2198	0.0339	0.0304	0.0000	0.0247	0.0000
3.2637	0.0344	0.0319	0.0000	0.0253	0.0000
3.3077	0.0348	0.0335	0.0000	0.0259	0.0000
3.3516	0.0353	0.0350	0.0000	0.0266	0.0000
3.3956	0.0358	0.0366	0.0000	0.0272	0.0000
3.4396	0.0363	0.0381	0.0000	0.0278	0.0000
3.4835	0.0368	0.0397	0.0000	0.0285	0.0000
3.5275	0.0373	0.0414	0.0967	0.0291	0.0000
3.5714	0.0378	0.0430	0.4049	0.0297	0.0000

3.6154	0.0383	0.0447	0.8304	0.0304	0.0000
3.6593	0.0388	0.0464	1.3452	0.0310	0.0000
3.7033	0.0394	0.0481	1.9330	0.0316	0.0000
3.7473	0.0399	0.0499	2.5809	0.0323	0.0000
3.7912	0.0404	0.0516	3.2771	0.0329	0.0000
3.8352	0.0409	0.0534	4.0103	0.0335	0.0000
3.8791	0.0415	0.0552	4.7689	0.0341	0.0000
3.9231	0.0420	0.0571	5.5408	0.0348	0.0000
3.9670	0.0425	0.0589	6.3140	0.0354	0.0000
4.0000	0.0429	0.0603	7.0765	0.0359	0.0000

Surface retention 1

Element Flows To:

Outlet 1	Outlet 2
	Bioretention 1

Analysis Results

POC 1

POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

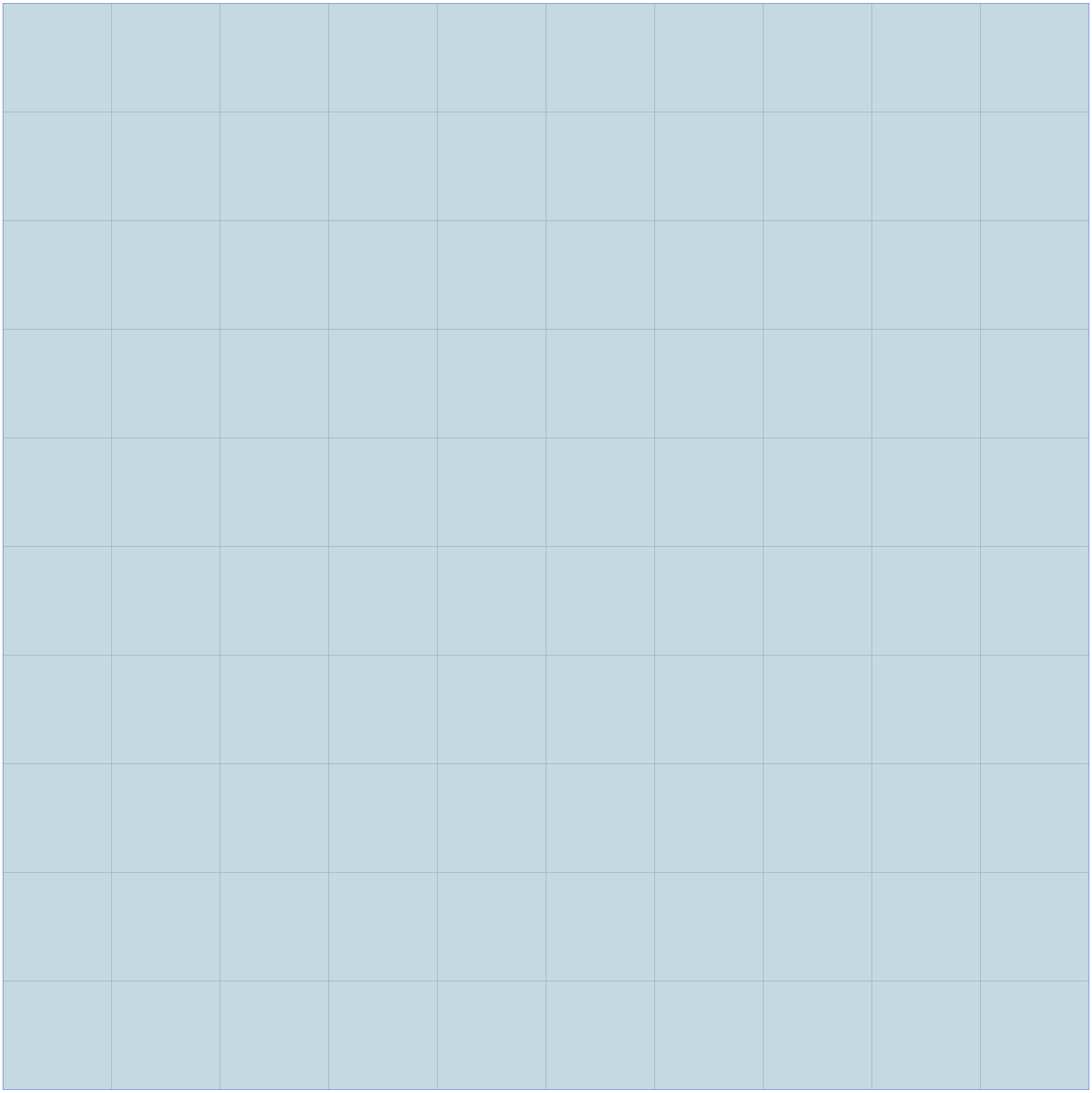
PERLND Changes

No PERLND changes have been made.

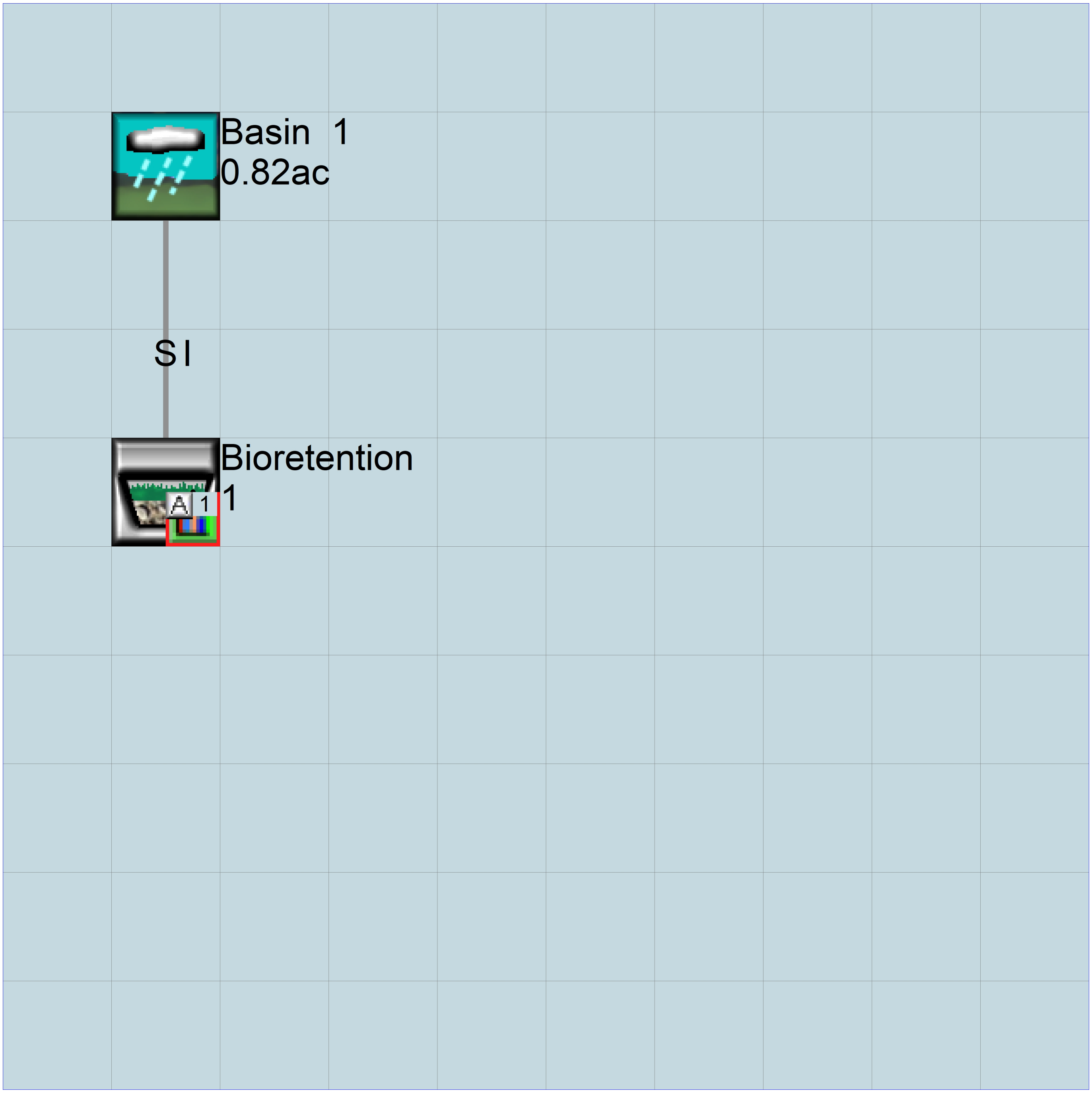
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



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Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Parking Lot B Wetland Calc
Site Name:	Pierce College Puyallup
Site Address:	1601 39th Ave SE
City:	Puyallup
Report Date:	2/4/2022
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

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

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	40.16
Pervious Total	40.16
Impervious Land Use	acre
ROADS FLAT	14.67
Impervious Total	14.67
Basin Total	54.83

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	39.41
C, Pasture, Flat	0.2 ← Parking Lot B Pervious Area
Pervious Total	39.61
Impervious Land Use	acre
ROADS FLAT	15.22 ← 14.67 ac (Existing Impervious) 00.55 ac (Parking Lot B Impervious)
Impervious Total	15.22
Basin Total	54.83

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.7463	6349	7014	110	Fail
2.8381	5601	6244	111	Fail
2.9299	4943	5546	112	Fail
3.0217	4417	4898	110	Fail
3.1135	3903	4390	112	Fail
3.2053	3510	3899	111	Fail
3.2971	3170	3502	110	Fail
3.3889	2862	3176	110	Fail
3.4807	2599	2895	111	Fail
3.5725	2367	2631	111	Fail
3.6643	2156	2399	111	Fail
3.7561	1966	2192	111	Fail
3.8479	1788	2011	112	Fail
3.9397	1635	1817	111	Fail
4.0315	1493	1677	112	Fail
4.1232	1368	1531	111	Fail
4.2150	1229	1402	114	Fail
4.3068	1104	1282	116	Fail
4.3986	1016	1151	113	Fail
4.4904	921	1044	113	Fail
4.5822	849	958	112	Fail
4.6740	760	884	116	Fail
4.7658	694	806	116	Fail
4.8576	623	735	117	Fail
4.9494	576	673	116	Fail
5.0412	528	601	113	Fail
5.1330	479	555	115	Fail
5.2248	437	514	117	Fail
5.3166	399	464	116	Fail
5.4084	358	432	120	Fail
5.5002	328	387	117	Fail
5.5919	301	353	117	Fail
5.6837	275	324	117	Fail
5.7755	252	300	119	Fail
5.8673	234	273	116	Fail
5.9591	215	255	118	Fail
6.0509	202	235	116	Fail
6.1427	186	214	115	Fail
6.2345	174	202	116	Fail
6.3263	154	191	124	Fail
6.4181	141	175	124	Fail
6.5099	130	159	122	Fail
6.6017	120	142	118	Fail
6.6935	114	129	113	Fail
6.7853	100	121	121	Fail
6.8771	96	114	118	Fail
6.9689	94	108	114	Fail
7.0606	89	97	108	Pass
7.1524	85	94	110	Pass
7.2442	77	92	119	Fail
7.3360	71	84	118	Fail
7.4278	66	80	121	Fail
7.5196	62	73	117	Fail
7.6114	59	70	118	Fail

7.7032	56	65	116	Fail
7.7950	53	61	115	Fail
7.8868	52	58	111	Fail
7.9786	44	56	127	Fail
8.0704	41	53	129	Fail
8.1622	40	51	127	Fail
8.2540	38	46	121	Fail
8.3458	37	40	108	Pass
8.4376	36	39	108	Pass
8.5293	33	37	112	Fail
8.6211	32	36	112	Fail
8.7129	30	35	116	Fail
8.8047	29	34	117	Fail
8.8965	28	31	110	Pass
8.9883	27	30	111	Fail
9.0801	26	29	111	Fail
9.1719	24	28	116	Fail
9.2637	24	27	112	Fail
9.3555	24	26	108	Pass
9.4473	23	25	108	Pass
9.5391	22	24	109	Pass
9.6309	22	24	109	Pass
9.7227	21	23	109	Pass
9.8145	21	22	104	Pass
9.9063	20	22	110	Pass
9.9981	19	22	115	Fail
10.0898	19	21	110	Pass
10.1816	19	20	105	Pass
10.2734	19	20	105	Pass
10.3652	18	19	105	Pass
10.4570	18	19	105	Pass
10.5488	16	19	118	Fail
10.6406	16	19	118	Fail
10.7324	15	18	120	Fail
10.8242	15	17	113	Fail
10.9160	14	16	114	Fail
11.0078	13	16	123	Fail
11.0996	13	15	115	Fail
11.1914	13	15	115	Fail
11.2832	12	13	108	Pass
11.3750	11	13	118	Fail
11.4668	11	13	118	Fail
11.5585	11	13	118	Fail
11.6503	11	12	109	Pass
11.7421	10	12	120	Fail
11.8339	9	11	122	Fail

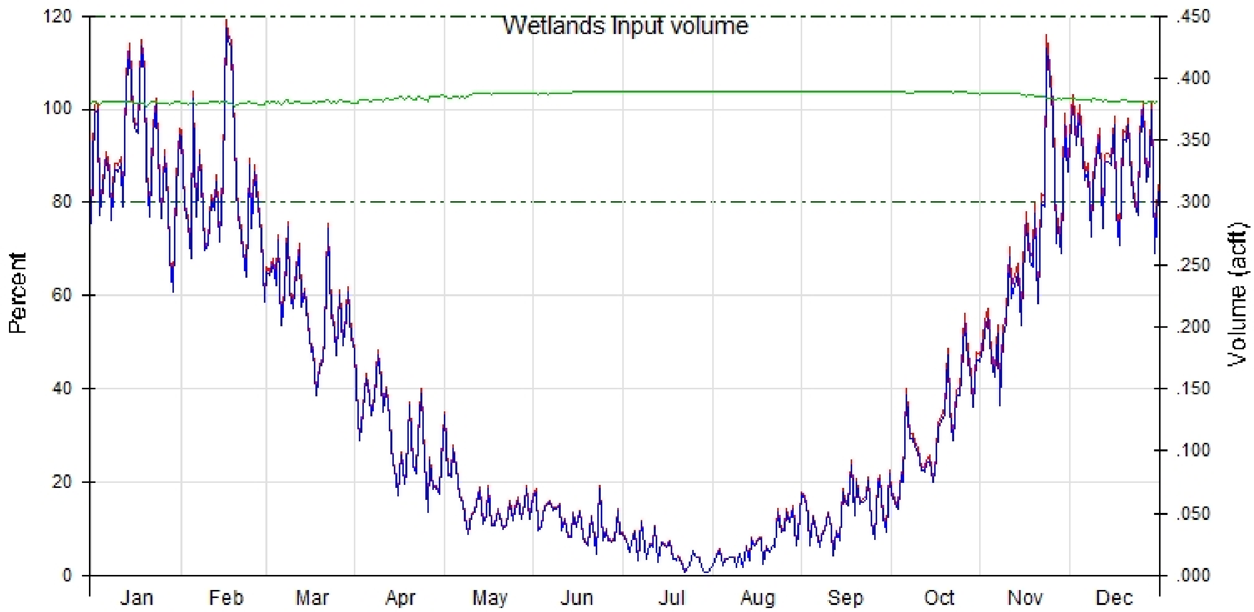
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

Wetland Input Volumes



Wetlands Input Volume for POC 1
Average Annual Volume (acft)
Series 1: 501 POC 1 Predeveloped flow
Series 2: 801 POC 1 Mitigated flow

Month	Series 1	Series 2	Percent	Pass/Fail
Jan	10.3006	10.4476	101.4	Pass
Feb	8.8841	9.0008	101.3	Pass
Mar	6.6987	6.7998	101.5	Pass
Apr	3.3524	3.4208	102.0	Pass
May	1.8381	1.8944	103.1	Pass
Jun	1.2639	1.3086	103.5	Pass
Jul	0.5960	0.6182	103.7	Pass
Aug	0.7066	0.7331	103.7	Pass
Sep	1.4904	1.5463	103.7	Pass
Oct	3.5792	3.7097	103.6	Pass
Nov	7.4693	7.6851	102.9	Pass
Dec	10.2018	10.3906	101.9	Pass

Day	Predevel	Mitigated	Percent	Pass/Fail
Jan1	0.2826	0.2865	101.4	Pass
2	0.3714	0.3780	101.8	Pass
3	0.3745	0.3800	101.4	Pass
4	0.2897	0.2929	101.1	Pass
5	0.3123	0.3170	101.5	Pass
6	0.3358	0.3411	101.6	Pass
7	0.3221	0.3270	101.5	Pass
8	0.2858	0.2902	101.6	Pass
9	0.3262	0.3317	101.7	Pass
10	0.3253	0.3306	101.6	Pass
11	0.3314	0.3364	101.5	Pass
12	0.2969	0.3013	101.5	Pass
13	0.3945	0.4013	101.7	Pass
14	0.4218	0.4282	101.5	Pass

15	0.3673	0.3719	101.2	Pass
16	0.3614	0.3663	101.4	Pass
17	0.3557	0.3607	101.4	Pass
18	0.4252	0.4311	101.4	Pass
19	0.4045	0.4093	101.2	Pass
20	0.3261	0.3284	100.7	Pass
21	0.2890	0.2924	101.2	Pass
22	0.3546	0.3606	101.7	Pass
23	0.3782	0.3842	101.6	Pass
24	0.3413	0.3456	101.2	Pass
25	0.2877	0.2912	101.2	Pass
26	0.3372	0.3419	101.4	Pass
27	0.3007	0.3043	101.2	Pass
28	0.2558	0.2586	101.1	Pass
29	0.2283	0.2312	101.3	Pass
30	0.3107	0.3163	101.8	Pass
31	0.3539	0.3594	101.6	Pass
Feb1	0.3530	0.3577	101.3	Pass
2	0.2961	0.2996	101.2	Pass
3	0.2837	0.2867	101.1	Pass
4	0.2544	0.2578	101.3	Pass
5	0.3833	0.3895	101.6	Pass
6	0.2880	0.2906	100.9	Pass
7	0.3375	0.3424	101.4	Pass
8	0.2930	0.2963	101.1	Pass
9	0.2615	0.2649	101.3	Pass
10	0.2654	0.2689	101.3	Pass
11	0.3014	0.3065	101.7	Pass
12	0.2945	0.2991	101.6	Pass
13	0.3169	0.3219	101.6	Pass
14	0.2686	0.2722	101.3	Pass
15	0.3200	0.3250	101.6	Pass
16	0.4404	0.4474	101.6	Pass
17	0.4292	0.4348	101.3	Pass
18	0.4252	0.4304	101.2	Pass
19	0.3506	0.3531	100.7	Pass
20	0.2853	0.2876	100.8	Pass
21	0.2849	0.2884	101.2	Pass
22	0.2602	0.2632	101.2	Pass
23	0.2396	0.2429	101.4	Pass
24	0.3300	0.3355	101.7	Pass
25	0.2792	0.2823	101.1	Pass
26	0.3252	0.3298	101.4	Pass
27	0.2982	0.3014	101.1	Pass
28	0.2734	0.2760	101.0	Pass
29	0.2201	0.2224	101.0	Pass
Mar1	0.2449	0.2485	101.5	Pass
2	0.2414	0.2449	101.4	Pass
3	0.2511	0.2549	101.5	Pass
4	0.2339	0.2370	101.3	Pass
5	0.2696	0.2737	101.5	Pass
6	0.2012	0.2034	101.1	Pass
7	0.2268	0.2308	101.8	Pass
8	0.2799	0.2851	101.8	Pass
9	0.2282	0.2313	101.4	Pass
10	0.2151	0.2181	101.4	Pass
11	0.2441	0.2478	101.5	Pass
12	0.2623	0.2664	101.6	Pass

13	0.2164	0.2192	101.3	Pass
14	0.2280	0.2312	101.4	Pass
15	0.2026	0.2053	101.3	Pass
16	0.1791	0.1815	101.3	Pass
17	0.1813	0.1841	101.5	Pass
18	0.1452	0.1471	101.3	Pass
19	0.1680	0.1706	101.5	Pass
20	0.1715	0.1743	101.6	Pass
21	0.1918	0.1952	101.7	Pass
22	0.2786	0.2838	101.9	Pass
23	0.2086	0.2116	101.5	Pass
24	0.1991	0.2022	101.6	Pass
25	0.1777	0.1802	101.4	Pass
26	0.2251	0.2295	102.0	Pass
27	0.1848	0.1876	101.5	Pass
28	0.2067	0.2104	101.8	Pass
29	0.2277	0.2315	101.7	Pass
30	0.1910	0.1934	101.3	Pass
31	0.1808	0.1831	101.3	Pass
Apr1	0.1264	0.1280	101.3	Pass
2	0.1085	0.1105	101.8	Pass
3	0.1310	0.1336	101.9	Pass
4	0.1586	0.1616	101.9	Pass
5	0.1430	0.1454	101.7	Pass
6	0.1286	0.1307	101.6	Pass
7	0.1418	0.1445	101.9	Pass
8	0.1774	0.1810	102.1	Pass
9	0.1568	0.1597	101.9	Pass
10	0.1316	0.1335	101.5	Pass
11	0.1486	0.1519	102.2	Pass
12	0.1256	0.1280	101.9	Pass
13	0.0883	0.0900	101.9	Pass
14	0.0864	0.0885	102.4	Pass
15	0.0643	0.0658	102.3	Pass
16	0.0970	0.0996	102.7	Pass
17	0.0734	0.0748	101.9	Pass
18	0.0824	0.0844	102.4	Pass
19	0.1361	0.1399	102.8	Pass
20	0.0883	0.0901	101.9	Pass
21	0.0820	0.0837	102.1	Pass
22	0.1090	0.1118	102.6	Pass
23	0.1460	0.1495	102.4	Pass
24	0.0930	0.0948	102.0	Pass
25	0.0509	0.0518	101.6	Pass
26	0.0928	0.0954	102.8	Pass
27	0.0695	0.0712	102.5	Pass
28	0.0707	0.0725	102.7	Pass
29	0.0650	0.0668	102.8	Pass
30	0.0896	0.0923	103.0	Pass
May1	0.1281	0.1315	102.7	Pass
2	0.0804	0.0823	102.3	Pass
3	0.0786	0.0805	102.4	Pass
4	0.1023	0.1052	102.8	Pass
5	0.0867	0.0891	102.7	Pass
6	0.0630	0.0646	102.5	Pass
7	0.0584	0.0600	102.6	Pass
8	0.0471	0.0483	102.5	Pass
9	0.0334	0.0343	102.6	Pass

10	0.0480	0.0496	103.2	Pass
11	0.0509	0.0526	103.3	Pass
12	0.0575	0.0594	103.4	Pass
13	0.0681	0.0704	103.4	Pass
14	0.0420	0.0434	103.3	Pass
15	0.0468	0.0484	103.5	Pass
16	0.0702	0.0726	103.4	Pass
17	0.0407	0.0419	103.1	Pass
18	0.0404	0.0418	103.3	Pass
19	0.0517	0.0536	103.5	Pass
20	0.0462	0.0478	103.4	Pass
21	0.0372	0.0385	103.4	Pass
22	0.0397	0.0410	103.4	Pass
23	0.0577	0.0597	103.4	Pass
24	0.0444	0.0459	103.3	Pass
25	0.0527	0.0545	103.3	Pass
26	0.0603	0.0623	103.3	Pass
27	0.0449	0.0464	103.3	Pass
28	0.0556	0.0575	103.5	Pass
29	0.0702	0.0726	103.4	Pass
30	0.0460	0.0475	103.4	Pass
31	0.0632	0.0654	103.6	Pass
Jun1	0.0669	0.0693	103.5	Pass
2	0.0364	0.0376	103.1	Pass
3	0.0392	0.0405	103.4	Pass
4	0.0543	0.0562	103.5	Pass
5	0.0572	0.0590	103.0	Pass
6	0.0586	0.0606	103.3	Pass
7	0.0525	0.0543	103.4	Pass
8	0.0535	0.0553	103.5	Pass
9	0.0556	0.0575	103.4	Pass
10	0.0366	0.0378	103.3	Pass
11	0.0437	0.0452	103.5	Pass
12	0.0308	0.0319	103.5	Pass
13	0.0312	0.0323	103.6	Pass
14	0.0494	0.0512	103.7	Pass
15	0.0391	0.0405	103.7	Pass
16	0.0504	0.0523	103.7	Pass
17	0.0316	0.0328	103.7	Pass
18	0.0269	0.0279	103.6	Pass
19	0.0245	0.0254	103.7	Pass
20	0.0463	0.0480	103.7	Pass
21	0.0306	0.0318	103.7	Pass
22	0.0169	0.0175	103.7	Pass
23	0.0700	0.0726	103.7	Pass
24	0.0282	0.0292	103.6	Pass
25	0.0356	0.0370	103.7	Pass
26	0.0285	0.0295	103.7	Pass
27	0.0264	0.0274	103.7	Pass
28	0.0284	0.0295	103.7	Pass
29	0.0518	0.0538	103.7	Pass
30	0.0327	0.0339	103.7	Pass
Jul1	0.0338	0.0351	103.7	Pass
2	0.0284	0.0295	103.7	Pass
3	0.0180	0.0187	103.7	Pass
4	0.0263	0.0272	103.7	Pass
5	0.0341	0.0354	103.7	Pass
6	0.0119	0.0124	103.7	Pass

7	0.0430	0.0446	103.7	Pass
8	0.0330	0.0342	103.7	Pass
9	0.0127	0.0132	103.7	Pass
10	0.0239	0.0248	103.7	Pass
11	0.0230	0.0239	103.7	Pass
12	0.0392	0.0406	103.7	Pass
13	0.0106	0.0110	103.7	Pass
14	0.0263	0.0272	103.6	Pass
15	0.0239	0.0248	103.7	Pass
16	0.0222	0.0230	103.7	Pass
17	0.0272	0.0282	103.7	Pass
18	0.0135	0.0140	103.7	Pass
19	0.0117	0.0121	103.7	Pass
20	0.0148	0.0154	103.7	Pass
21	0.0110	0.0114	103.7	Pass
22	0.0032	0.0033	103.7	Pass
23	0.0060	0.0062	103.7	Pass
24	0.0072	0.0075	103.7	Pass
25	0.0196	0.0203	103.7	Pass
26	0.0146	0.0152	103.7	Pass
27	0.0134	0.0139	103.7	Pass
28	0.0063	0.0066	103.7	Pass
29	0.0022	0.0023	103.7	Pass
30	0.0021	0.0022	103.7	Pass
31	0.0067	0.0069	103.7	Pass
Aug1	0.0073	0.0076	103.7	Pass
2	0.0158	0.0164	103.7	Pass
3	0.0204	0.0211	103.7	Pass
4	0.0074	0.0077	103.7	Pass
5	0.0123	0.0128	103.7	Pass
6	0.0133	0.0138	103.7	Pass
7	0.0144	0.0150	103.7	Pass
8	0.0135	0.0140	103.8	Pass
9	0.0061	0.0063	103.7	Pass
10	0.0166	0.0172	103.7	Pass
11	0.0066	0.0068	103.7	Pass
12	0.0228	0.0236	103.7	Pass
13	0.0114	0.0119	103.7	Pass
14	0.0297	0.0308	103.7	Pass
15	0.0238	0.0247	103.7	Pass
16	0.0283	0.0293	103.7	Pass
17	0.0290	0.0301	103.7	Pass
18	0.0091	0.0094	103.7	Pass
19	0.0225	0.0234	103.7	Pass
20	0.0180	0.0187	103.7	Pass
21	0.0233	0.0242	103.7	Pass
22	0.0223	0.0231	103.7	Pass
23	0.0515	0.0534	103.7	Pass
24	0.0352	0.0365	103.7	Pass
25	0.0356	0.0369	103.7	Pass
26	0.0510	0.0529	103.7	Pass
27	0.0431	0.0447	103.7	Pass
28	0.0539	0.0559	103.7	Pass
29	0.0240	0.0249	103.7	Pass
30	0.0318	0.0330	103.7	Pass
31	0.0650	0.0674	103.7	Pass
Sep1	0.0621	0.0644	103.8	Pass
2	0.0479	0.0497	103.7	Pass

3	0.0234	0.0243	103.7	Pass
4	0.0463	0.0480	103.7	Pass
5	0.0352	0.0365	103.7	Pass
6	0.0226	0.0234	103.7	Pass
7	0.0326	0.0338	103.7	Pass
8	0.0355	0.0368	103.7	Pass
9	0.0495	0.0514	103.7	Pass
10	0.0381	0.0395	103.7	Pass
11	0.0164	0.0170	103.7	Pass
12	0.0343	0.0355	103.7	Pass
13	0.0285	0.0295	103.7	Pass
14	0.0669	0.0695	103.7	Pass
15	0.0595	0.0618	103.7	Pass
16	0.0560	0.0581	103.7	Pass
17	0.0889	0.0923	103.7	Pass
18	0.0476	0.0494	103.7	Pass
19	0.0747	0.0775	103.7	Pass
20	0.0571	0.0592	103.7	Pass
21	0.0595	0.0617	103.7	Pass
22	0.0610	0.0633	103.8	Pass
23	0.0760	0.0788	103.7	Pass
24	0.0429	0.0445	103.7	Pass
25	0.0299	0.0311	103.7	Pass
26	0.0738	0.0766	103.7	Pass
27	0.0780	0.0810	103.7	Pass
28	0.0471	0.0488	103.7	Pass
29	0.0345	0.0358	103.7	Pass
30	0.0814	0.0844	103.7	Pass
Oct1	0.0660	0.0684	103.7	Pass
2	0.0594	0.0616	103.7	Pass
3	0.0536	0.0556	103.7	Pass
4	0.0798	0.0828	103.7	Pass
5	0.0746	0.0774	103.7	Pass
6	0.1448	0.1499	103.5	Pass
7	0.1096	0.1133	103.4	Pass
8	0.1105	0.1144	103.6	Pass
9	0.1051	0.1089	103.6	Pass
10	0.0990	0.1026	103.7	Pass
11	0.0842	0.0873	103.7	Pass
12	0.0835	0.0867	103.7	Pass
13	0.0896	0.0929	103.7	Pass
14	0.0928	0.0963	103.7	Pass
15	0.0747	0.0775	103.7	Pass
16	0.0935	0.0970	103.7	Pass
17	0.1191	0.1236	103.7	Pass
18	0.1227	0.1273	103.7	Pass
19	0.1304	0.1353	103.7	Pass
20	0.1765	0.1831	103.7	Pass
21	0.1321	0.1370	103.7	Pass
22	0.1083	0.1122	103.6	Pass
23	0.1430	0.1482	103.7	Pass
24	0.1450	0.1503	103.7	Pass
25	0.1602	0.1662	103.7	Pass
26	0.2032	0.2106	103.7	Pass
27	0.1730	0.1792	103.6	Pass
28	0.1569	0.1624	103.5	Pass
29	0.1353	0.1399	103.4	Pass
30	0.1731	0.1792	103.5	Pass

31	0.1713	0.1767	103.2	Pass
Nov1	0.1842	0.1904	103.4	Pass
2	0.1965	0.2034	103.5	Pass
3	0.2070	0.2144	103.6	Pass
4	0.1733	0.1794	103.5	Pass
5	0.1592	0.1648	103.5	Pass
6	0.1950	0.2018	103.5	Pass
7	0.1364	0.1410	103.3	Pass
8	0.1936	0.2003	103.5	Pass
9	0.2027	0.2095	103.3	Pass
10	0.2556	0.2644	103.4	Pass
11	0.2231	0.2305	103.3	Pass
12	0.2341	0.2418	103.3	Pass
13	0.2426	0.2507	103.3	Pass
14	0.2014	0.2078	103.2	Pass
15	0.2417	0.2490	103.0	Pass
16	0.2838	0.2919	102.9	Pass
17	0.2530	0.2606	103.0	Pass
18	0.2483	0.2558	103.0	Pass
19	0.2911	0.2994	102.8	Pass
20	0.2188	0.2245	102.6	Pass
21	0.2993	0.3079	102.9	Pass
22	0.2965	0.3042	102.6	Pass
23	0.4240	0.4348	102.5	Pass
24	0.4006	0.4100	102.3	Pass
25	0.3705	0.3784	102.1	Pass
26	0.2670	0.2722	102.0	Pass
27	0.2801	0.2866	102.3	Pass
28	0.2594	0.2650	102.1	Pass
29	0.3622	0.3712	102.5	Pass
30	0.3254	0.3326	102.2	Pass
Dec1	0.3475	0.3557	102.4	Pass
2	0.3772	0.3861	102.4	Pass
3	0.3468	0.3540	102.1	Pass
4	0.3706	0.3786	102.1	Pass
5	0.3545	0.3618	102.0	Pass
6	0.3175	0.3235	101.9	Pass
7	0.3251	0.3313	101.9	Pass
8	0.2726	0.2775	101.8	Pass
9	0.3123	0.3194	102.3	Pass
10	0.3335	0.3403	102.0	Pass
11	0.3526	0.3598	102.1	Pass
12	0.2794	0.2840	101.6	Pass
13	0.3319	0.3384	101.9	Pass
14	0.3331	0.3389	101.7	Pass
15	0.3301	0.3356	101.7	Pass
16	0.3630	0.3692	101.7	Pass
17	0.2930	0.2977	101.6	Pass
18	0.2655	0.2702	101.8	Pass
19	0.3509	0.3583	102.1	Pass
20	0.3487	0.3553	101.9	Pass
21	0.3618	0.3682	101.8	Pass
22	0.3177	0.3227	101.6	Pass
23	0.2979	0.3031	101.8	Pass
24	0.2893	0.2943	101.7	Pass
25	0.3489	0.3551	101.8	Pass
26	0.3760	0.3813	101.4	Pass
27	0.3167	0.3210	101.4	Pass

28	0.3321	0.3373	101.6	Pass
29	0.3749	0.3811	101.7	Pass
30	0.2589	0.2621	101.2	Pass
31	0.3103	0.3152	101.6	Pass

Model Default Modifications

Total of 0 changes have been made.

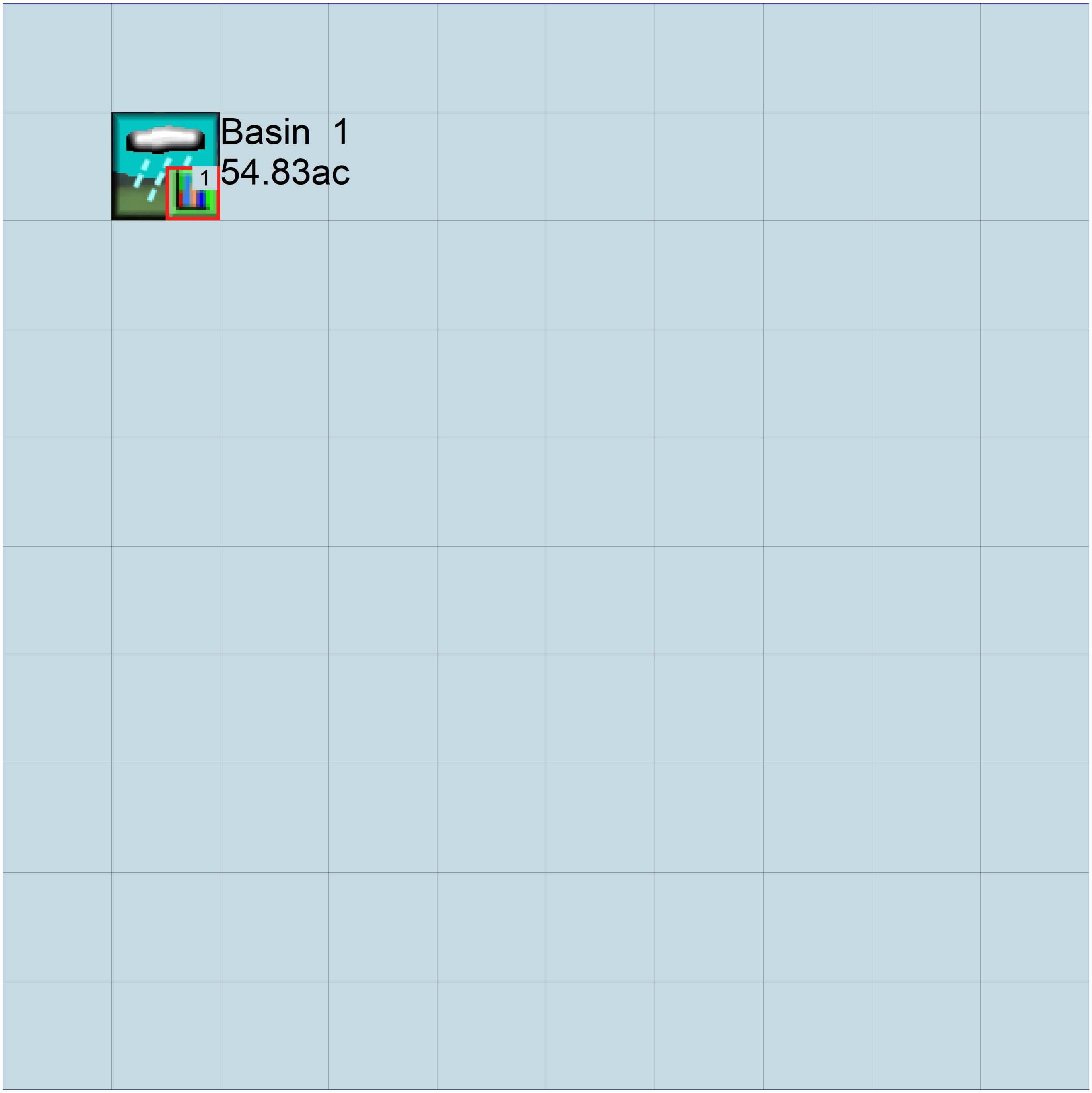
PERLND Changes

No PERLND changes have been made.

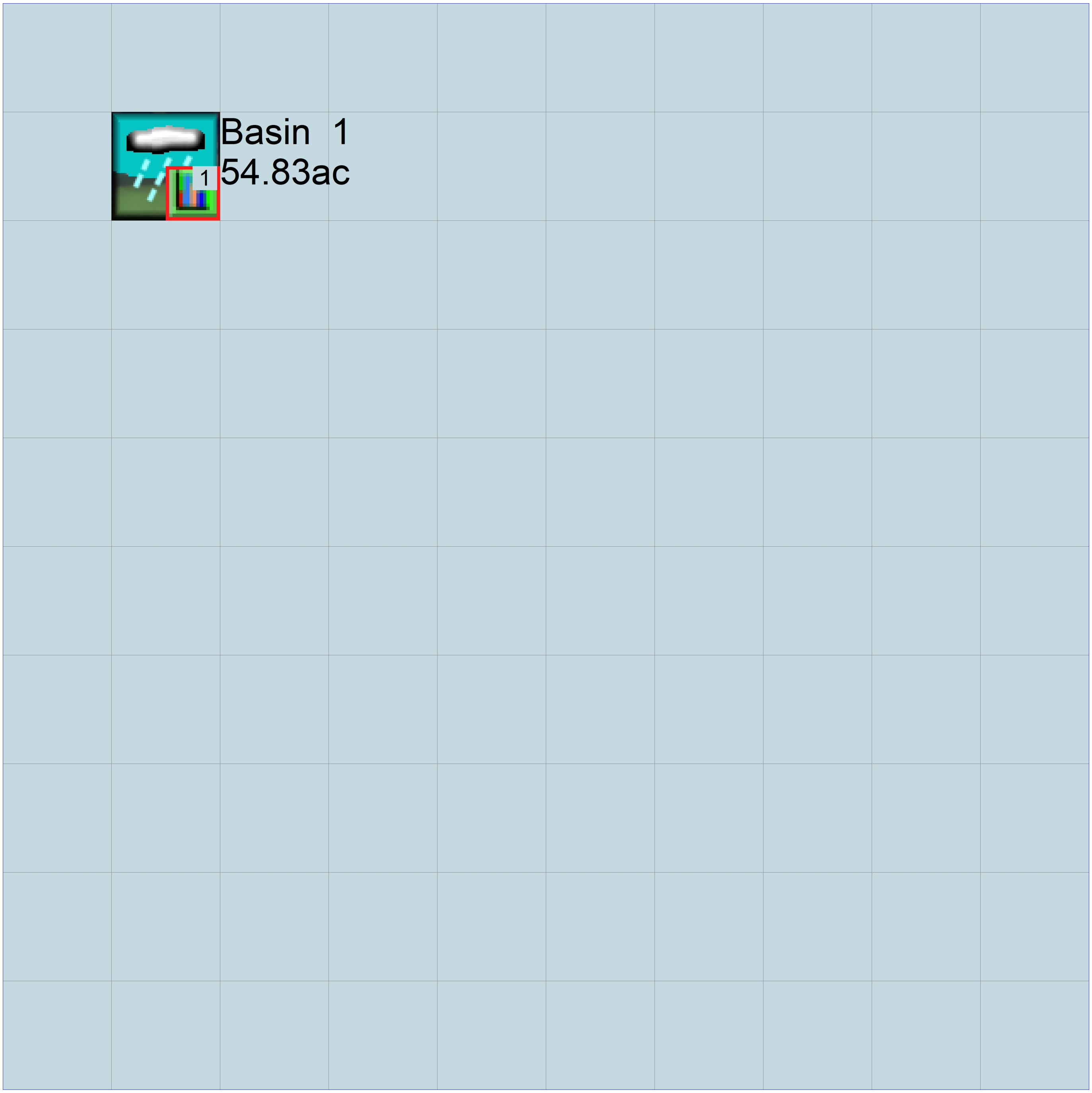
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



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Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
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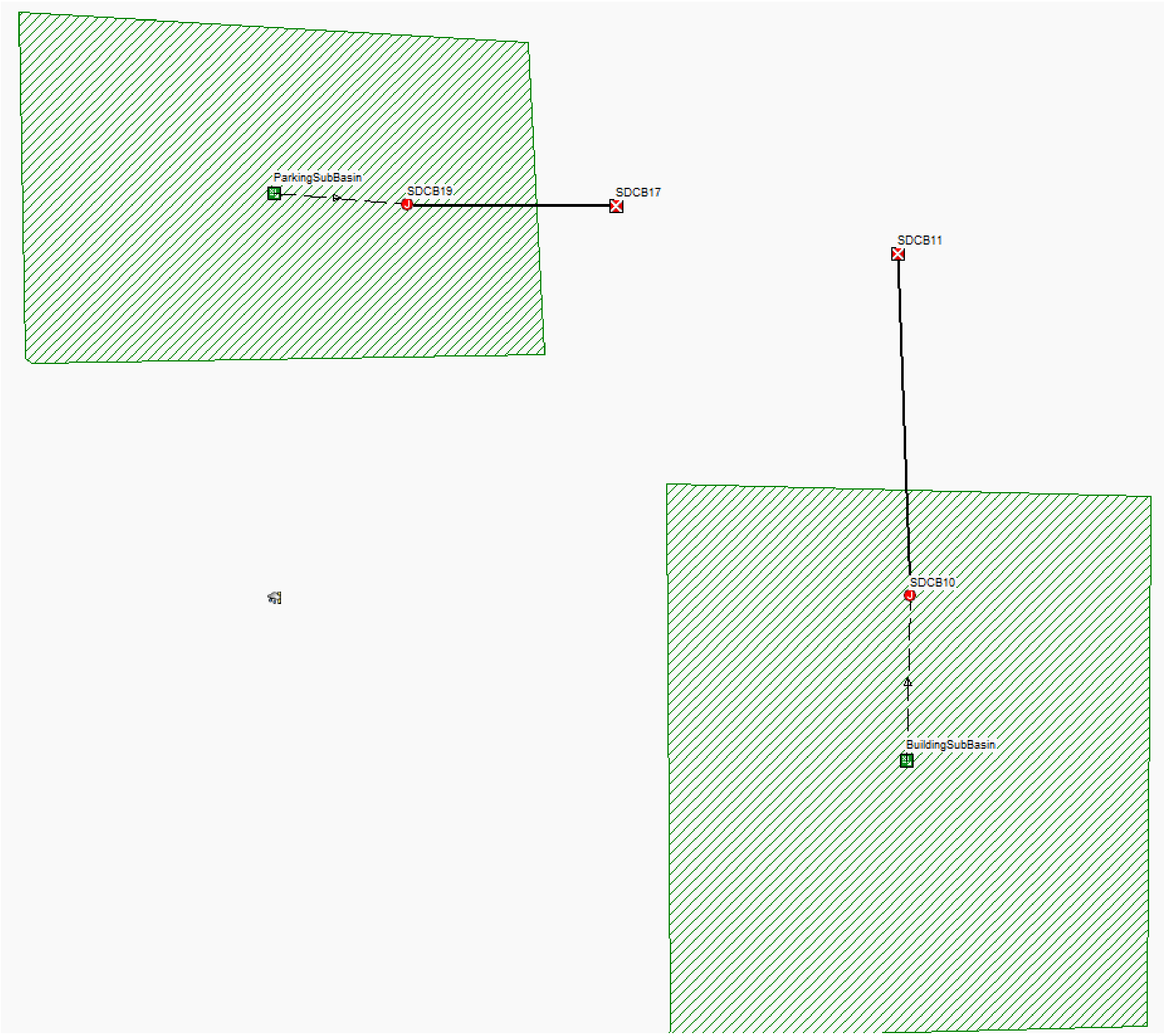
www.clearcreeksolutions.com

Appendix B-3 Conveyance Calculations

SN	Element ID	Description	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Pipe Shape	Pipe Diameter or Height	Pipe Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses
					(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(inches)	(inches)				
1	Link-01		SDCB10	SDCB11	77.00	514.08	0.00	513.69	0.00	0.38	0.5000	CIRCULAR	12.000	12.00	0.0110	0.5000	0.5000	0.0000
2	Link-02		SDCB19	SDCB17	19.00	512.73	0.00	512.63	0.00	0.10	0.5300	CIRCULAR	8.040	8.04	0.0150	0.5000	0.5000	0.0000



Initial Flow (cfs)	Flap Gate	Lengthening Factor	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Total Time Surcharged (min)	Max Flow Depth (ft)	Reported Condition
0.00	NO	1.00	0.79	0 08:00	3.21	0.40	2.98	0.27	0.35	0.00	0.35	Calculated
0.00	NO	1.00	0.57	0 07:54	2.39	0.13	0.76	0.75	0.65	0.00	0.43	Calculated

SN	Element ID	X Coordinate	Y Coordinate	Description	Invert Elevation	Boundary Type	Flap Gate	Fixed Water Elevation	Peak Inflow	Peak Lateral Inflow	Maximum HGL Depth Attained	Maximum HGL Elevation Attained
					(ft)			(ft)	(cfs)	(cfs)	(ft)	(ft)
1	SDCB11	1469.93	5857.46		513.69	NORMAL	NO		0.79	0.00	0.35	514.04
2	SDCB17	463.80	6027.14		512.63	NORMAL	NO		0.57	0.00	0.43	513.06

SN	Element ID	X Coordinate	Y Coordinate	Description	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (inches)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Elevation Attained (ft)
1	SDCB10	1514.48	4632.52		514.08	522.56	8.49	514.08	0.00	522.56	0.00	0.00	89.82	0.79	0.79	514.43
2	SDCB19	-283.29	6031.72		512.73	518.75	6.02	512.73	0.00	518.75	0.00	0.00	64.24	0.57	0.57	513.16

Maximum HGL Depth Attained (ft)	Maximum Surcharge Depth Attained (ft)	Minimum Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Maximum HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-inches)	Total Time Flooded (minutes)
0.35	0.00	8.13	514.21	0.13	0 08:00	0 00:00	0.00	0.00
0.43	0.00	5.59	512.88	0.15	0 07:54	0 00:00	0.00	0.00

SN	Element ID	Description	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01		Time Series	TS-03	Cumulative	inches	Washington	Pierce	25	3.5	SCS Type IA 24-hr

SN	Element ID	Description	Area	Drainage Node ID	Impervious Area Curve Number	Pervious Area Curve Number	Impervious Area	Rain Gage ID	Total Precipitation	Total Runoff	Peak Runoff	Time of Concentration
			(acres)				(%)		(inches)	(inches)	(cfs)	(days hh:mm:ss)
1	BuildingSubBasin		1.38	SDCB10	98.00	74.00	59.00	Rain Gage-01	3.49	2.43	0.79	0 00:05:00
2	ParkingSubBasin		0.82	SDCB19	98.00	74.00	80.00	Rain Gage-01	3.49	2.85	0.57	0 00:05:00

See Exhibit A-4 Developed Conditions Map for exhibit of sub-basins

Appendix C

Special Reports and Studies

Project 2020-148
Pierce College, Puyallup STEM Building

Attachment 6b:
Geotech Report

Geotechnical Engineering Services Report

Pierce College Puyallup – STEM Building Design Study
Puyallup, Washington

for
Washington State Department of Enterprise Services

January 21, 2021

GeoEngineers
Earth Science + Technology

Geotechnical Engineering Services Report

Pierce College Puyallup – STEM Building Design Study
Puyallup, Washington

for
Washington State Department of Enterprise Services

January 21, 2021

GeoEngineers

1101 South Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

Geotechnical Engineering Services Report

Pierce College Puyallup – STEM Building Design Study Puyallup, Washington

File No. 21342-002-00

January 21, 2021

Prepared for:

Washington State Department of Enterprise Services
Division of Engineering & Architectural Services
206 General Administration Building
Olympia, Washington 98504-1012

Attention: Christopher Gizzi

Prepared by:

GeoEngineers, Inc.
1101 South Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

Christopher R. Newton, PE 1/21/2021
Geotechnical Engineer

Dennis (D.J.) Thompson, PE 1/21/2021
Associate Geotechnical Engineer

CRN:DJT:tt

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APPENDICES

1.0 INTRODUCTION AND PROJECT UNDERSTANDING

This report presents the results of our geotechnical engineering services for the Pierce College Puyallup – Science, Technology, Engineering, Mathematics (STEM) Building project. The project site is located at 1601 39th Avenue SE in Puyallup, Washington as shown on the Vicinity Map, Figure 1. This report is proceeded by a draft report dated December 7, 2020.

Our project understanding is based on review of the "NEW STEM BUILDING, Pierce College Puyallup, Predesign Report" dated August 24, 2020 (Predesign Report). We were also provided with the "Geotechnical Report, Pierce College Puyallup, Communication Arts/Allied Health Building, Puyallup, Washington" dated May 9, 2006 and prepared by HWA Geosciences Inc. (HWA Report).

The Predesign Report indicates that the proposed STEM building will be constructed at the east site (Alternate B) in the north-central portion of campus in a currently forested area. The proposed building location is located to the east-southeast of the existing Communication Arts and Allied Health building and to the west of campus Parking Lot C. The building is to consist of a 54,400-square-foot, three-story structure containing classrooms, laboratories, faculty offices and study spaces. We understand that the project is in the beginning stages and that the project team seeks to establish baseline geotechnical data and recommendations to support future planning and design. Baseline data requested and recommendations provided include a description of soil and groundwater conditions, seismic hazards, building foundation options, stormwater infiltration feasibility, re-use of on-site soil as structural fill and backfill and other recommended design parameters.

It is our understanding that this project will ultimately be contracted as progressive design-build delivery method. As such, in the spirit of the progressive design-build format, innovation in project design and builder risk can be incorporated into the final planning, design, and construction process, within reason. We provide the geotechnical recommendations included in this report as baseline conditions, upon which the contractor may rely on within the context that they are presented. Any design-builder innovations or risks that alter the provided recommendations or the context within which they are provided, are done so at the design-builder's sole risk and would need to be fully supported by a separate set of geotechnical engineering recommendations.

2.0 SCOPE OF SERVICES

Our services have been provided in general accordance with our proposal for this project dated July 13, 2020 and Signed Agreement No. 2020-148 T(3) dated on September 4, 2020. A complete list of our scope or services is provided in our proposal.

3.0 SITE CONDITIONS

3.1. Surface Conditions

The site is bounded by undeveloped, forested land to the north, campus Parking Lot C to the east, and existing Pierce College buildings, landscaped and hardscaped common areas to the west and south. The site is currently forested with mature coniferous and deciduous trees and a dense understory layer, including brush, small trees, fallen trees, and forest duff. Site topography generally slopes upward toward the west-southwest of the site from approximate Elevation 526 feet to Elevation 532 feet (NAVD88).

3.2. Literature Review

3.2.1. Geologic Maps

Our understanding of the site geology is based on review of the *Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington* (Schuster, et al. 2015). The geologic map indicates the site is underlain by "Vashon Till" (Q_{gt}). "Recessional outwash" (Q_{go}) is also mapped in the near project vicinity. Vashon Till is glacially consolidated and is described as a low permeability, highly compact mixture of sand, gravel, silt and clay that can contain cobbles and boulders dispersed throughout.

Recessional outwash is generally described as variably sorted silt, clay, sand and gravel deposited by receding glacial ice. The outwash is typically underlain at some depth by glacial till. Recessional outwash deposits are not glacially consolidated and are generally loose to medium dense.

3.2.2. Soil Survey

We reviewed the Natural Resources Conservation Service (NRCS) Web Soil Survey (accessed October 29, 2020). According to the survey, the site is underlain by Kapowsin gravelly ashy loam, 6 to 15 percent slopes. Kapowsin gravelly ashy loam is described as moderately well drained with a very low capacity of the most limiting layer to transmit water and categorized as Hydrologic Soil Group B.

3.2.3. Geotechnical Report Reviewed

We reviewed the following geotechnical report for this project.

- "Geotechnical Report, Pierce College Puyallup, Communication Arts/Allied Health Building, Puyallup, Washington" dated May 9, 2006 prepared by HWA Geosciences, Inc.

HWA Geosciences, Inc. completed four test pits for the Communication Arts/Allied Health building to the northwest of the project site. In HWA's explorations, they noted typical soil conditions consisted of about 1 foot of forest duff overlying medium dense, weathered glacial deposits on the order of 1 to 5 feet thick. The weathered glacial deposits were noted to overlie dense to very dense granular glacial outwash deposits with interbedded lenses of glacial till. Cobbles and boulders were also encountered in their explorations. No groundwater seepage was observed in their explorations at the time of excavations, and they noted mottling of soils and increased moisture typically below 9 to 10 feet depth.

3.3. Subsurface Conditions

3.3.1. Subsurface Explorations and Laboratory Testing

We explored subsurface conditions at the site by excavating six test pits (TP-1 through TP-6) at the approximate locations shown on the attached Site Plan, Figure 2. A description of our subsurface exploration program and summary exploration logs are provided in Appendix A.

Selected samples collected from our test pits were tested in our laboratory to confirm field classifications and to evaluate pertinent engineering properties. Our laboratory testing program included grain-size distribution analyses and moisture content determinations. A summary of our laboratory testing program and the test results are provided in Appendix A.

3.3.2. Soil and Groundwater Conditions

In our explorations, after partially clearing the surface with the excavator, we typically observed about 4 to 8 inches of forest duff and/or organic-rich soil. Undisturbed forest duff thickness was typically on the order of about 9 to 12 inches. The depths of soil units described below are with respect to the partially cleared areas of forest duff thickness.

Beneath the forest duff, we generally observed silty sand with varying gravel content in a loose to dense condition to a depth of about 2 to 4½ feet below ground surface (bgs). Abundant roots were noted to a depth of about 2 feet bgs. We interpret the soil directly underlying the forest duff to be weathered glacial till. Underlying the weathered glacial till we observed silty sand with gravel to silty gravel with sand and occasional cobbles in a dense to very dense condition, which we interpret to be glacial till, extending to the full depths explored. We also encountered occasional boulders in exploration TP-1.

We did not observe the regional groundwater table nor indications of perched groundwater in our explorations. However, based on our experience, it is not uncommon for glacial soils to contain isolated zones of perched groundwater. Though not observed in our explorations, we anticipate that perched groundwater could be present in other areas at the site depending on soil conditions, rainfall amounts, irrigation activities and other factors. We anticipate that perched groundwater levels will generally be highest during the wet season, typically October through May.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1. Primary Geotechnical Considerations

Based on our understanding of the project, the explorations performed for this study, review of subsurface information near or within the project vicinity and our experience, it is our opinion that the proposed improvements can be designed and constructed generally as envisioned with regard to geotechnical considerations. A summary of the primary geotechnical considerations for the project is provided below and is followed by our detailed recommendations.

- Proposed structures at the site can be supported using shallow foundations and slabs-on-grade, provided that the foundation bearing surfaces are prepared as recommended. We do not anticipate that significant overexcavation will be required, unless isolated areas of loose, or otherwise unsuitable areas are encountered near foundation grade.
- We did not identify soils that we interpret to be prone to liquefaction in our explorations. In our opinion, the risk of liquefaction occurring at this site is low.
- Clearing and stripping depths for forest duff at the site will typically be on the order of 9 to 12 inches. Abundant roots were observed to a depth of about 2 feet bgs, which may require greater clearing and stripping efforts when establishing bearing surfaces for structures on site.
- Near-surface soils observed at the site contain a significant quantity of fines and, therefore, could be difficult or impossible to work with when wet or become easily disturbed if exposed to wet weather. Depending on the intended use of the material and the moisture/weather conditions, it may be difficult to re-use near-surface soils as structural fill.

- Based on our observations, the infiltration capacity of the observed site soils is low. Additional field testing will be necessary to further evaluate the suitability of site soils for stormwater infiltration and to establish a design infiltration rate if infiltration is included in design.

4.2. Seismic Design Considerations

4.2.1. Seismic Design Parameters

We understand seismic design of proposed structures will be performed using procedures outlined in the 2018 International Building Code (IBC). The 2018 IBC states structures shall be designed and constructed to resist the effects of earthquake motions in accordance with American Society of Civil Engineers (ASCE) 7-16.

We used map-based values as recommended by the United States Geological Survey (USGS) to determine the seismic design spectrum in accordance with ASCE 7-16. Based on subsurface conditions observed in our explorations, our review of site geology and our experience in the area, we anticipate soils below our explorations and extending to depth are glacially consolidated and dense to very dense. For seismic design and analysis, we recommend using a response spectrum for Site Class C. We recommend the parameters provided in Table 1 below be used for design.

TABLE 1. SEISMIC DESIGN CRITERIA

2018 IBC (ASCE 7-16) Seismic Design Parameters	
Spectral Response Acceleration at Short Periods (S_S)	1.253g
Spectral Response Acceleration at 1-Second Periods (S_1)	0.432g
Site Class	C
Design Peak Ground Acceleration (PGA_M)	0.6g
Design Spectral Response Acceleration at Short Periods (S_{DS})	1.003g
Design Spectral Response Acceleration at 1-Second Periods (S_{D1})	0.432g

4.2.2. Liquefaction

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in development of excess pore pressures in loose, saturated soils and subsequent loss of strength in the deposit of soil so affected. In general, soils that are susceptible to liquefaction include loose to medium dense sands to silty sands that are below the water table. The *Liquefaction Susceptibility Map of Pierce County, Washington* (Palmer, et al. 2004) indicates the site soils have a “very low” liquefaction potential. Based on the soil and groundwater conditions observed in our explorations and those documented in the report reviewed, we conclude that the potential for liquefaction at the site is low.

4.2.3. Lateral Spreading Potential

Lateral spreading related to seismic activity typically involves lateral displacement of large, surficial blocks of non-liquefied soil when a layer of underlying soil loses strength during seismic shaking. Lateral spreading usually develops in areas where sloping ground or large grade changes (including retaining walls) are present. Based on our understanding of the liquefaction risk at the site and the proposed improvements, it is our opinion that the risk of lateral spreading is low.

4.2.4. Surface Rupture Potential

According to the Washington State Department of Natural Resources Interactive Geologic Information Portal and the USGS Interactive Quaternary Faults Database (both accessed October 30, 2020), the nearest mapped fault is located about 6 miles north/northeast of the site. The fault is oriented in a northwest-southeast direction and is identified as part of the Tacoma fault zone system (USGS Fault ID No. 581; USGS Fault Class A). Based on the proximity of the site to this nearest mapped fault and fault information available at the time of this study, it is our opinion the risk for surface rupture at this site is low.

4.3. Site Development and Earthwork

4.3.1. General

We anticipate that site development and earthwork will include clearing and grubbing, site grading, excavating for shallow foundations, utilities and other improvements, establishing subgrades for foundations and roadways and placing and compacting fill and backfill materials. We expect that site grading and earthwork can be accomplished with conventional earthmoving equipment. The following sections provide specific recommendations for site development and earthwork.

4.3.2. Clearing and Stripping

We anticipate that clearing and stripping depths at the site will typically be on the order of 9 to 12 inches to remove forest duff. However, abundant roots were observed to about 2 feet bgs; therefore, it is likely that greater stripping depths will be required in areas of heavier vegetation or relatively lower lying areas.

During stripping operations excessive disturbance of surficial soils can occur, especially if left exposed to wet conditions. Glacial till soils expected to be exposed after clearing and stripping have a relatively high fines content and can be easily disturbed during wet weather. Clearing and stripping at the site should be performed during dry weather and/or exposed soils should be promptly covered and protected to avoid excessive disturbance. Disturbed soils may require additional compaction or remediation during construction and grading.

Cobbles were encountered in our explorations, and boulders were encountered in exploration TP-1. Cobbles and boulders are commonly present in glacial till soils in the project area. The contractor should be prepared to remove cobbles and boulders if encountered during grading or excavation. Boulders may be removed from the site or used in landscape areas. Voids caused by boulder removal should be backfilled with structural fill.

4.3.3. Erosion and Sedimentation Control

Erosion and sedimentation rates and quantities can be influenced by construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. Implementing an Erosion and Sedimentation Control Plan will reduce impacts to the project where erosion-prone areas are present. The plan should be designed in accordance with applicable city, county and/or state standards. The plan should incorporate basic planning principles, including:

- Scheduling grading and construction to reduce soil exposure;
- Re-vegetating or mulching denuded areas;
- Directing runoff away from exposed soils;

- Reducing the length and steepness of slopes with exposed soils;
- Decreasing runoff velocities;
- Preparing drainage ways and outlets to handle concentrated or increased runoff;
- Confining sediment to the project site; and
- Inspecting and maintaining control measures frequently.

Temporary erosion protection should be used and maintained in areas with exposed or disturbed soils to help reduce erosion and reduce transport of sediment to adjacent areas and receiving waters. Permanent erosion protection should be provided by paving, structure construction or landscape planting.

Until the permanent erosion protection is established, and the site is stabilized, site monitoring may be required by qualified personnel to evaluate the effectiveness of the erosion control measures and to repair and/or modify them as appropriate. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan. Where sloped areas are present, some sloughing and raveling of exposed or disturbed soil on slopes should be expected. We recommend that disturbed soil be restored promptly so that surface runoff does not become channeled.

4.3.4. Temporary Excavations and Cut Slopes

Based on observations made during excavation of our test pits and our experience with other projects in similar soil conditions, we anticipate that shallow or even moderately deep (about 10-foot) excavations could maintain vertical slopes for extended periods of time with only minor caving. However, excavations deeper than 4 feet should be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, “Excavation, Trenching and Shoring.” Regardless of the soil type encountered in the excavation shoring, trench boxes or sloped sidewalls will be required under Washington Industrial Safety and Health Act (WISHA). We recommend contract documents specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety and providing shoring, as required, to protect personnel and structures.

In general, we recommend that for planning purposes all temporary cut slopes be inclined no steeper than about 1½H to 1V (horizontal to vertical) if workers are required to enter the excavation. This guideline assumes all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope and that seepage is not present on the slope face. Flatter cut slopes will be necessary where seepage occurs or if surface surcharge loads are anticipated. Temporary covering with heavy plastic sheeting should be used to protect these slopes during periods of wet weather.

4.3.5. Permanent Cut and Fill Slopes

We recommend permanent slopes be constructed at a maximum inclination of 2H to 1V to manage erosion. Where 2H to 1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

To achieve uniform compaction, we recommend fill slopes be overbuilt and subsequently cut back to expose well-compacted fill. Fill placement on existing slopes steeper than 5H to 1V should be benched into the slope face. The configuration of benches depends on the equipment being used and the inclination of the existing slope. Bench excavations should be level and extend into the slope face at least half the width of the compaction equipment used.

Exposed areas should be re-vegetated as soon as practical to reduce surface erosion and sloughing. Temporary protection should be used until permanent protection is established.

4.3.6. Groundwater Handling Considerations

Based on our understanding of the proposed site improvements, we do not anticipate that the regional groundwater table will be encountered during excavations for this project.

Although not encountered in our explorations, areas of perched groundwater could be encountered at the site. The interface between more permeable and less permeable zones such as the contact between weathered glacial till and glacial till are likely locations for accumulation of perched groundwater. Groundwater handling needs will typically be lower during the summer and early fall months. We anticipate that shallow perched groundwater can be handled adequately with sumps, pumps, and/or diversion ditches, as necessary. Ultimately, we recommend that the contractor performing the work be made responsible for controlling and collecting groundwater encountered.

4.3.7. Surface Drainage

Surface water from roof downspouts, driveways and landscape areas should be collected and controlled. Curbs or other appropriate measures such as sloping pavements, sidewalks and landscape areas should be used to direct surface flow away from buildings, erosion sensitive areas and from behind retaining structures. Roof and catchment drains should not be connected to wall or foundation drains.

4.3.8. Subsurface Drainage

Based on our subsurface explorations, the site generally consists of low permeable, undisturbed glacial till soils at relatively shallow depths (on the order of 2 to 4½ feet bgs). Excavations that extend into undisturbed glacial till, such as foundation excavations, will likely create a perched groundwater condition. Utility trenches that extend into undisturbed glacial till and are backfilled with structural fill could also create perched groundwater due to difference in permeability between trench backfill and undisturbed glacial till.

Based on our explorations, we recommend that perimeter foundation drains be considered in the project design. It is our opinion that the building slab does not need to be drained unless excessive water is encountered during excavation and grade development for the building slab. To manage perched groundwater within site excavations and where groundwater or high moisture would be detrimental to other site improvements, other special drainage details could be required. For example, to clear groundwater accumulation in utility trenches and other excavations backfilled with permeable material and where also located near structures.

4.3.9. Subgrade Preparation

Subgrades that will support structures and roadways should be thoroughly compacted to a uniformly firm and unyielding condition on completion of stripping and before placing structural fill. We recommend that subgrades for structures and roadways be evaluated, as appropriate, to identify areas of yielding or soft soil. Probing with a steel probe rod or proof-rolling with a heavy piece of wheeled construction equipment are appropriate methods of evaluation.

If soft or otherwise unsuitable subgrade areas are revealed during evaluation that cannot be compacted to a stable and uniformly firm condition, we recommend that: (1) the unsuitable soils be scarified (e.g., with a ripper or farmer's disc), aerated and recompacted, if practical; or (2) the unsuitable soils be removed and replaced with compacted structural fill, as needed.

4.3.10. Subgrade Protection and Wet Weather Considerations

Near-surface soils observed at the site contain a significant quantity of fines and will be susceptible to disturbance during periods of wet weather. The wet weather season generally begins in October and continues through May in western Washington; however, periods of wet weather can occur during any month of the year. It may be possible to conduct earthwork at the site during wet weather months provided appropriate measures are implemented to protect exposed soil. If earthwork is scheduled during the wet weather months, we offer the following recommendations:

- Measures should be implemented to remove or eliminate the accumulation of surface water from work areas. The ground surface in and around the work area should be sloped so that surface water is directed away and graded so that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches.
- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting.
- The contractor should take necessary measures to prevent on-site soils and other soils to be used as fill from becoming wet or unstable. These measures may include the use of plastic sheeting, sumps with pumps and grading. The site soils should not be left uncompacted and exposed to moisture. Sealing exposed soils by rolling with a smooth-drum roller prior to periods of precipitation will help reduce the extent to which these soils become wet or unstable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with working pad materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practical.
- Protective surfacing such as placing asphalt-treated base (ATB) or haul roads made of quarry spalls or a layer of free-draining material such as well-graded pit-run sand and gravel may be considered to limit disturbance to completed areas. Minimum quarry spall thicknesses should be on the order of 12 to 18 inches. Typically, minimum gravel thicknesses on the order of 24 inches are necessary to provide adequate subgrade protection.

4.4. Fill Materials

4.4.1. Structural Fill

The workability of material for use as structural fill will depend on the gradation and moisture content of the soil. Material used for structural fill should be free of debris, organic contaminants and rock fragments larger than 6 inches. For most applications, structural fill consisting of material similar to "Select Borrow" or "Gravel Borrow" as described in Section 9-03.14 of the Washington State Department of Transportation (WSDOT) Standard Specifications will be appropriate.

Weather and site conditions should be considered when determining the type of import fill materials purchased and brought to the site for use as structural fill. If earthwork activities are scheduled during the wet weather months or during prolonged periods of wet weather, we recommend that washed crushed rock or select granular fill, as described below, be used for structural fill.

If prolonged dry weather prevails during the earthwork phase of construction, materials with a somewhat higher fines content may be acceptable.

4.4.2. Select Granular Fill

Select granular fill should consist of well-graded sand and gravel or crushed rock with a maximum particle size of 6 inches and less than 5 percent fines by weight based on the minus ¾-inch fraction. Organic matter, debris or other deleterious material should not be present. In our opinion, material with gradation characteristics similar to WSDOT Specification 9-03.9 (Aggregates for Ballast and Crushed Surfacing), or 9-03.14 (Borrow) is suitable for use as select granular fill, provided that the fines content is less than 5 percent (based on the minus ¾-inch fraction) and the maximum particle size is 6 inches.

4.4.3. Pipe Bedding

Trench backfill for the bedding and pipe zone should consist of well-graded granular material similar to "Gravel Backfill for Pipe Zone Bedding" described in Section 9-03.12(3) of the WSDOT Standard Specifications. The material must be free of roots, debris, organic matter and other deleterious material. Other materials may be appropriate depending on manufacturer specifications and/or local jurisdiction requirements.

4.4.4. Trench Backfill

Trench backfill must be free of debris, organic material and rock fragments larger than 6 inches. We recommend that trench backfill material consist of material similar to "Select Borrow" or "Gravel Borrow" as described in Section 9-03.14 of the WSDOT Standard Specifications.

4.4.5. On-Site Soil

Based on our subsurface explorations and experience, it is our opinion that existing site soils, excluding the forest duff, may be considered for use as structural fill and trench backfill, provided that it can be adequately moisture conditioned, placed and compacted as recommended and does not contain organic or other deleterious material. Based on our experience, the glacial till and weathered glacial till at the site are extremely moisture sensitive and will be very difficult or impossible to properly compact when wet.

In addition, it is likely that existing soils will be above optimum moisture content (OMC) when excavated, unless earthwork activities take place in the middle of summer. Even then, the soil could still be above OMC when excavated. Soils placed and compacted above OMC are typically difficult to work with and may have trouble achieving adequate compaction. If earthwork occurs during a typical wet season, or if the soils are persistently wet and cannot be dried back due to prevailing wet weather conditions or lack of drying space/time, we recommend the use of imported structural fill or select granular fill, as described above.

4.5. Fill Placement and Compaction

4.5.1. General

To obtain proper compaction, fill and backfill soil should be compacted near the OMC and in uniform horizontal lifts. Lift thickness and compaction procedures will depend on the moisture content and gradation characteristics of the soil and the type of equipment used. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Generally, 8- to 12-inch loose lifts are appropriate for steel-drum vibratory roller compaction equipment. Compaction should be achieved by mechanical means. During fill and backfill placement, sufficient testing of in-place density should be conducted to check that adequate compaction is being achieved.

4.5.2. Area Fills and Pavement Bases

Fill placed to raise site grades and materials under pavements and structural areas should be placed on subgrades prepared as previously recommended. Fill material placed below structures and footings should be compacted to at least 95 percent of the theoretical maximum dry density (MDD) per ASTM International (ASTM) D 1557. Fill material placed shallower than 2 feet below pavement sections should be compacted to at least 95 percent of the MDD. Fill placed deeper than 2 feet below pavement sections should be compacted to at least 90 percent of the MDD. Fill material placed in landscaping areas should be compacted to a firm condition that will support construction equipment, as necessary, typically around 85 to 90 percent of the MDD.

4.5.3. Backfill Behind Walls

Backfill behind retaining walls or below-grade structure walls should be compacted to between 90 and 92 percent of the MDD. Overcompaction of fill placed directly behind walls should be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 5 feet behind walls.

4.5.4. Trench Backfill

For utility excavations, we recommend that the initial lift of fill over the pipe be thick enough to reduce the potential for damage during compaction, but generally should not be greater than about 18 inches above the pipe. In addition, rock fragments greater than about 1 inch in maximum dimension should be excluded from this lift.

Trench backfill material placed below structures and footings should be compacted to at least 95 percent of the MDD. In paved areas, trench backfill should be uniformly compacted in horizontal lifts to at least 95 percent of the MDD in the upper 2 feet below subgrade. Fill placed below a depth of 2 feet from subgrade in paved areas must be compacted to at least 90 percent of the MDD. In non-structural areas, trench backfill should be compacted to a firm condition that will support construction equipment as necessary.

4.6. Foundation Support

4.6.1. General

In our opinion, the proposed structures at the site can be satisfactorily supported on continuous wall and isolated column footings. Exterior footings should be established at least 18 inches below the lowest adjacent grade. Interior footings can be founded a minimum of 12 inches below the bottom of the floor slab. Isolated column and continuous wall footings should have minimum widths of 24 and 18 inches, respectively.

Based on the groundwater conditions in our explorations and our understanding of the proposed footing elevations (bottom of footings established within a few feet of existing site grade), it is our opinion footing drains are not necessary to maintain bearing support as provided in this report. However, it is possible and even likely that perched groundwater zones will develop within fill placed over native glacial till soils at the site. Footing drains or perimeter drains are recommended to reduce the potential for perched groundwater accumulation in the fill around building foundations.

The sections below provide our recommendations for foundation bearing surface preparation and foundation design parameters.

4.6.2. Foundation Bearing Surface Preparation

Shallow footing excavations should be performed using a smooth-edged bucket to limit bearing disturbance. Foundations should bear on inert mineral native glacial till soils (weathered or unweathered) or on structural fill extending to these soils. The forest duff layer and any roots/organics should be completely removed from below proposed footing areas. It should be noted that abundant roots were observed to a depth of about 2 feet bgs in our explorations. Depending on bearing surface elevations, up to 2 feet of removal may be required below foundation areas. The bearing surface should be compacted as necessary to a firm, unyielding condition. Loose or disturbed materials present at the base of footing excavations should be removed or compacted.

If structural fill is placed below footings as either replacement of overexcavated soils or to establish a bearing pad, we recommend the structural fill extend laterally beyond the foundation perimeter a distance equal to the depth of fill (measured from the base of the footing where necessary), or 3 feet, whichever is less.

Foundation bearing surfaces should not be exposed to standing water. If water is present in the excavation, it must be removed before placing formwork and reinforcing steel. Protection of exposed soil, such as placing a 6-inch thick layer of crushed rock or a 3- to 4-inch layer of lean-mix concrete, could be used to limit disturbance to bearing surfaces.

We understand that areas containing soft, unsuitable site soils were encountered during site preparation for the nearby Communication Arts and Allied Health building, which resulted in overexcavation and replacement with import structural fill to depths up to about 3 to 4 feet. It should be noted that on-site material will become easily disturbed if stripped and left exposed to wet weather. Additional overexcavation depths may be required for this project depending on earthwork sequencing and how well exposed site soils are protected.

4.6.3. Allowable Soil Bearing Pressure

Shallow foundations bearing on subgrades prepared as recommended may be designed using an allowable soil bearing pressure of 3,500 pounds per square foot (psf). This bearing pressure applies to the total of dead and long-term live loads and may be increased by one-third when considering total loads, including earthquake or wind loads. These are net bearing pressures. The weight of the footing and overlying backfill can be ignored in calculating footing sizes.

It is possible that higher bearing pressures are attainable at the site, especially for structures well founded in the dense glacial till or on structural fill placed on this material. Additional considerations such as building load, foundation size, and settlement tolerances should also be considered to support higher bearing pressures.

4.6.4. Foundation Settlement

Disturbed soil must be removed from the base of footing excavations and the bearing surface should be prepared as recommended. Provided these measures are taken, we estimate the total static settlement of shallow foundations will be on the order of 1 inch or less for the bearing pressures presented above. Differential settlements could be on the order of ¼ to ½ inch between similarly loaded foundations or over a distance of 50 feet of continuous footings. The settlements should occur rapidly, essentially as loads are applied. Settlements could be greater than estimated if disturbed or saturated soil conditions are present below footings.

4.6.5. Lateral Resistance

The ability of the soil to resist lateral loads is a function of the base friction, which develops on the base of foundations and slabs, and the passive resistance, which develops on the face of below-grade elements of the structure as these elements move into the soil. For cast-in-place foundations supported in accordance with the recommendations presented above, the allowable frictional resistance on the base of the foundation may be computed using a coefficient of friction of 0.40 applied to the vertical dead-load forces. If precast foundations are included as part of project plans, we can provide specific recommendations for base friction resistance for precast foundations. The allowable passive resistance on the face of the foundation or other embedded foundation elements may be computed using an equivalent fluid density of 290 pounds per cubic foot (pcf).

These values include a factor of safety of about 1.5. The passive earth pressure and friction components may be combined provided that the passive component does not exceed two-thirds of the total. The top foot of soil should be neglected when calculating passive lateral earth pressure unless the area adjacent to the foundation is covered with pavement or a slab-on-grade.

4.7. Slab-on-Grade Floors

Slab-on-grade floors should bear on native glacial till soils or on structural fill extending to these soils and should be prepared as recommended in the "4.3.8 Subgrade Preparation" section of this report. Disturbed areas should be compacted, if possible, or removed and replaced with compacted structural fill. In all cases, the exposed soil should be compacted to a firm and unyielding condition.

We recommend the slab-on-grade floors be underlain by a minimum 6-inch-thick capillary break layer consisting of clean sand and gravel, crushed rock, or washed rock. The capillary break material should contain less than 3 percent fine material based on the percent passing the ¾-inch sieve size. Provided that loose soil is removed, and the subgrade is prepared as recommended, we recommend slabs-on-grade be designed using a modulus of subgrade reaction of 250 pounds per cubic inch (pci). We estimate that settlement for slabs-on-grade constructed as recommended will be less than ¾-inch for a floor load of up to 500 psf.

Based on our understanding of subsurface conditions at the site, it is our opinion that an underslab drain system is not necessary. If dry slabs are required (e.g., where adhesives are used to anchor carpet or tile to slab), a waterproof liner may be placed as a vapor barrier below the slab.

4.8. Retaining Walls and Below-Grade Structures

4.8.1. Design Parameters

We recommend the following lateral earth pressures be used for design of conventional retaining walls and below-grade structures. Our design pressures assume that the ground surface around the retaining structures will be level or near level. If drained design parameters are used, drainage systems must be included in the design in accordance with the recommendations presented in the "4.8.2 Drainage" section below.

- Active soil pressure may be estimated using an equivalent fluid density of 35 pcf for the drained condition.
- Active soil pressure may be estimated using an equivalent fluid density of 80 pcf for the undrained condition; this value includes hydrostatic pressures.
- At-rest soil pressure may be estimated using an equivalent fluid density of 55 pcf for the drained condition.
- At-rest soil pressure may be estimated using an equivalent fluid density of 90 pcf for the undrained condition; this value includes hydrostatic pressures.
- For seismic considerations, a uniform lateral pressure of 13*H psf (where H is the height of the retaining structure or the depth of a structure below ground surface) should be added to the lateral earth pressure.
- An additional 2 feet of fill representing a typical traffic surcharge of 250 psf should be included if vehicles are allowed to operate within ½ the height of the retaining walls. Other surcharge loads should be considered on a case-by-case basis.

The active soil pressure condition assumes the wall is free to move laterally 0.001 H, where H is the wall height. The at-rest condition is applicable where walls are restrained from movement. The above-recommended lateral soil pressures do not include surcharge loads other than described or the effects of sloping backfill surfaces. Overcompaction of fill placed directly behind retaining walls or below-grade structures must be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 5 feet of retaining walls and below-grade structures.

Retaining wall foundation bearing surfaces should be prepared following the "4.6 Foundation Support" section of this report. Provided bearing surfaces are prepared as recommended, retaining wall foundations may be designed using the allowable soil bearing values and lateral resistance values presented above for building foundation design. We estimate settlement of retaining structures will be similar to the values previously presented for building foundations.

4.8.2. Drainage

If retaining walls or below-grade structures are designed using drained parameters, a drainage system behind the structure must be constructed to collect water and prevent the buildup of hydrostatic pressure against the structure. We recommend the drainage system include a zone of free-draining backfill a minimum of 18 inches in width against the back of the wall. The drainage material should consist of coarse sand and gravel containing less than 5 percent fines by weight based on the fraction of material passing the ¾-inch sieve.

A perforated, rigid, smooth-walled drain pipe with a minimum diameter of 4 inches should be placed along the base of the structure within the free-draining backfill and extend for the entire wall length. The drain pipe should be metal or rigid PVC pipe and be sloped to drain by gravity. Discharge should be routed to appropriate discharge areas and to reduce erosion potential. Cleanouts should be provided to allow routine maintenance. We recommend roof downspouts or other types of drainage systems not be connected to retaining wall drain systems.

4.9. Infiltration Feasibility Assessment

We anticipate that stormwater facilities on site, if planned, will be designed in accordance with the 2014 Washington State Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW), as adopted by the City of Puyallup. According to the SWMMWW, measured infiltration rates in soils consolidated by glacial advance (i.e., glacial till) shall be determined using in-situ field tests such as a Pilot Infiltration Test (PIT). The manual does not allow the use of soil grain-size analysis to determine design infiltration rates for glacially consolidated soils. Additionally, detailed infiltration analyses including performance testing and groundwater mounding analysis are noted in the SWMMWW. Based on our explorations, we do not expect groundwater will be a factor in stormwater design for construction and excavations extending to the depths explored in this report.

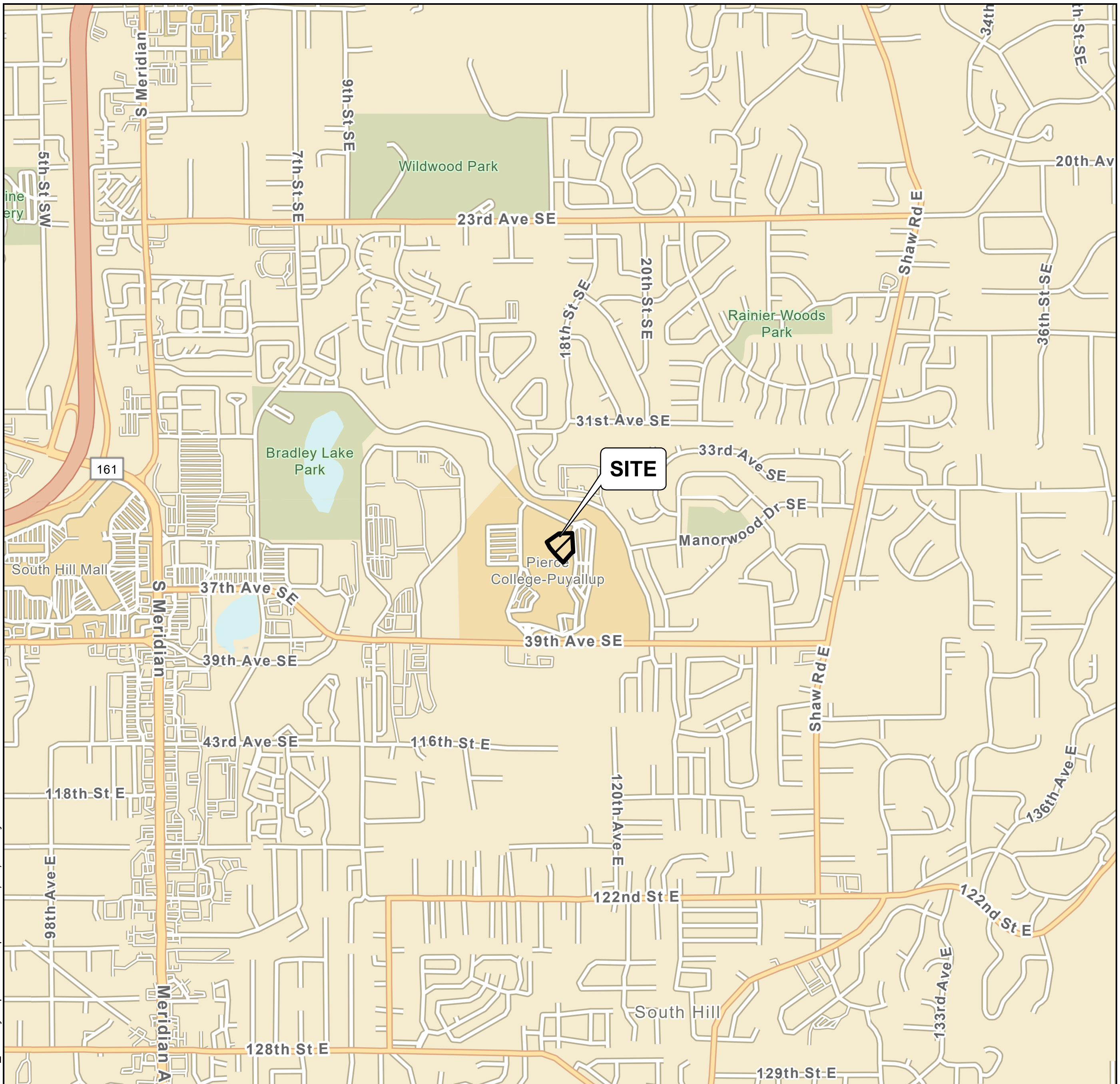
The site is generally underlain by undisturbed glacial till at relatively shallow depths (on the order of 2 to 4½ feet bgs). In our experience with similar soil and density conditions (undisturbed glacial till), PITs typically measure very slow infiltration rates, on the order of 0.05 to 0.25 inches per hour with correction factors and in some cases, no infiltration can be measured. We suggest this range be considered for preliminary design of facilities, then followed up with final rates determined by completing PITs.

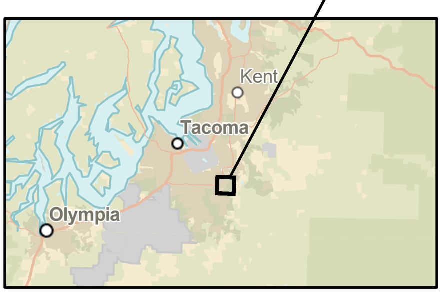
5.0 LIMITATIONS

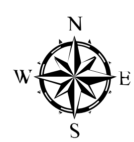
We have prepared this report for the Washington State Department of Enterprise Services (DES) for the Pierce College Puyallup – STEM Building Design Study project located in Puyallup, Washington. DES may distribute copies of this report to owner's authorized agents and regulatory agencies as may be required for the Project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to the services or this report.

Please refer to Appendix B titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.







2,000 0 2,000

Feet

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI

Projection:

Vicinity Map

Pierce College Puyallup –
STEM Building Design Study
Puyallup, Washington

GeoEngineers

Figure 1

P:\21\21342002\CAD\00\Geotech\2134200200_F02_Site Plan.dwg TAB:F02 - Site Plan Date Exported: 01/21/21 - 12:22 by kcook

Legend

TP-1 Test Pit, by GeoEngineers, Inc., 2020

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial from Bing Imagery, dated 07/2019.

Projection: NAD83 Washington State Planes, South Zone, US Foot

N W E S

100 0 100 Feet

Site Plan

Pierce College Puyallup -
STEM Building Design Study
Puyallup, Washington

GEOENGINEERS

Figure 2

APPENDIX A
Subsurface Explorations and Laboratory Testing

APPENDIX A
SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

Subsurface Explorations

Subsurface conditions for the proposed Pierce College Puyallup – STEM Building Design Study project were explored by excavating six test pits on October 5, 2020 at the approximate locations shown on the Site Plan, Figure 2. The test pits were excavated to depths between about 8 and 10¼ feet bgs using an excavator provided and operated by Kelly's Excavating, Inc. under subcontract to GeoEngineers. After each test pit was completed, the excavation was backfilled using the generated material and compacted using the bucket of the excavator.

During the exploration program, our field representative obtained soil samples, classified the soils encountered, and maintained a detailed log of each exploration. The relative densities noted on the test pit logs are based on the difficulty of excavation and our experience and judgment. The samples were collected and retained in sealed plastic bags and then transported back to our office. The soils were classified visually in general accordance with the system described in Figure A-1, which includes a key to the exploration logs. Summary logs of the explorations are included as Figures A-2 through A-7.

The locations of the test pits were determined using an electronic tablet equipped with global positioning system (GPS) software. The locations of the explorations should be considered approximate.

Laboratory Testing

Soil samples obtained from the borings were transported to GeoEngineers' laboratory. Representative soil samples were selected for laboratory tests to evaluate the pertinent geotechnical engineering characteristics of the site soils and to confirm our field classifications.

Our testing program consisted of the following:

- Four grain-size distribution analyses (sieve analyses [SA])
- Five moisture content determinations (MC)

Tests were performed in general accordance with test methods of ASTM International (ASTM) or other applicable procedures. The following sections provide a general description of the tests performed.

Sieve Analysis (SA)

Grain-size distribution analyses were completed on selected samples in general accordance with ASTM Test Method C 136. This test method covers the quantitative determination of the distribution of particle sizes in soils. Typically, the distribution of particle sizes larger than 75 micrometers (µm) is determined by sieving. The results of the tests were used to verify field soil classifications and determine pertinent engineering characteristics. Figure A-8 presents the results of our sieve analyses.

Moisture Content (MC)

The moisture content of selected samples was determined in general accordance with ASTM Test Method D 2216. The test results are used to aid in soil classification and correlation with other pertinent engineering soil properties. The results are presented on the test pit logs at the depth tested.

SOIL CLASSIFICATION CHART

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

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point load test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

Sampler Symbol Descriptions

- 2.4-inch I.D. split barrel
- Standard Penetration Test (SPT)
- Shelby tube
- Piston
- Direct-Push
- Bulk or grab
- Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Date Excavated: 10/5/2020	Total Depth (ft): 10.25	Logged By: CRN Checked By: DJT	Excavator: Kelly's Excavating Equipment: Komatsu PC120 Excavator	Groundwater not observed Caving not observed

Surface Elevation (ft): 526 Vertical Datum: NAVD88	Easting (X): 1199743 Northing (Y): 670480	Coordinate System: WA State Plane South Horizontal Datum: NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
526–525	0–1			SM	Brown silty fine to medium sand with organic matter (roots) and occasional gravel (loose, moist) (weathered glacial till)			Fine roots and roots up to approximately 1¼-inch diameter
525–522	1–4			SM	Gray-brown with occasional iron-oxide staining silty fine to medium sand with occasional gravel and organic matter (roots) (loose, moist)			Boulder observed in SE corner of test pit sidewall at approximately 1 foot bgs
524	2				Grades to without roots			
523	3	X	1 MC		Grades to dense	14		
522–516	4–10.25			SM	Gray with occasional iron-oxide staining silty fine to medium sand with gravel and occasional cobbles and includes pods of sandy silt with gravel (dense, moist) (glacial till)			
520	6	X	2 SA			15	41	
519	7				Grades to very dense			
518	8							Boulder encountered at approximately 8 to 9 feet bgs
516	9.5–10.25	X	3					

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-1

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Figure B-2
Sheet 1 of 1

Date Excavated	10/5/2020	Total Depth (ft)	8.75	Logged By	CRN	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	DJT	Equipment	Komatsu PC120 Excavator	Caving not observed

Surface Elevation (ft)	529	Easting (X)	1199604	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670477	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				DUFF	Approximately 4 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
528	1				SM	Gray-brown with occasional iron-oxide staining silty fine to medium sand with organic matter (roots) (loose, moist) (weathered glacial till)			Fine roots and roots up to approximately 1-inch diameter
527	2					Grades to with occasional organic matter (roots)			
526	3					Grades to dense			
525	4		1						
524	5		2 / SA		GM	Gray with occasional iron-oxide staining silty fine to coarse gravel with sand and occasional cobbles (dense, moist) (glacial till)	9	26	
523	6					Grades to very dense			
522	7								
521	8		3						

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-2

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Date Excavated	10/5/2020	Total Depth (ft)	8	Logged By	CRN	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	DJT	Equipment	Komatsu PC120 Excavator	Caving not observed

Surface Elevation (ft)	532	Easting (X)	1199570	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670341	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				DUFF	Approximately 4 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
					SM	Gray-brown silty fine to medium sand with organic matter (roots) and occasional gravel and cobbles (loose, moist) (weathered glacial till)			
531	1		1 MC				10		Fine roots and roots up to approximately ¾-inch diameter
530	2					Grades to with occasional organic matter (roots)			
					SM	Gray with occasional iron-oxide staining silty fine sand with gravel (very dense, moist) (glacial till)			
529	3								
			2 SA				8	47	
528	4					Grades to with occasional cobbles			
527	5								
526	6								
525	7								
524	8		3						

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-3

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Date Excavated	10/5/2020	Total Depth (ft)	8	Logged By	CRN	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	DJT	Equipment	Komatsu PC120 Excavator	Caving not observed

Surface Elevation (ft)	526	Easting (X)	1199738	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670377	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
526	0				DUFF	Approximately 8 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
525	1		1 MC		SM	Gray-brown silty fine to medium sand with organic matter (roots) and occasional gravel (loose, moist) (weathered glacial till)	15		Fine roots and roots up to approximately 1½-inch diameter
524	2					Grades to with occasional organic matter (roots)			
523	3		2		SM	Brown-gray with occasional iron-oxide staining silty fine to medium sand with gravel and occasional organic matter (fine roots) (dense, moist) (glacial till)			
522	4		3			Grades to gray with occasional cobbles and very dense			
521	5								
520	6								
519	7		4						
518	8								

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-4

GEOENGINEERS

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Date Excavated	10/5/2020	Total Depth (ft)	8.25	Logged By: CRN Checked By: DJT	Excavator: Kelly's Excavating Equipment: Komatsu PC120 Excavator
Groundwater not observed Caving not observed					

Surface Elevation (ft) Vertical Datum	531 NAVD88	Easting (X) Northing (Y)	1199668 670234
Coordinate System Horizontal Datum	WA State Plane South NAD83 (feet)		

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				DUFF	Approximately 8 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
530	1				SM	Gray-brown silty fine to medium sand with gravel and organic matter (roots) (loose to medium dense, moist) (weathered glacial till)			Fine roots and roots up to approximately 1¾-inch diameter
529	2		1 / MC			Grades to with occasional organic matter (roots)	11		
528	3				SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense, moist) (glacial till)			
527	4		2			Grades to very dense			
526	5								
525	6					Grades to fine to coarse sand grains			
524	7								
523	8		3						

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-5

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Date Excavated	10/5/2020	Total Depth (ft)	8.25	Logged By	OA	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	CRN	Equipment	Komatsu PC120 Excavator	Caving not observed

Surface Elevation (ft)	526	Easting (X)	1199777	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670327	Horizontal Datum	NAD83 (feet)

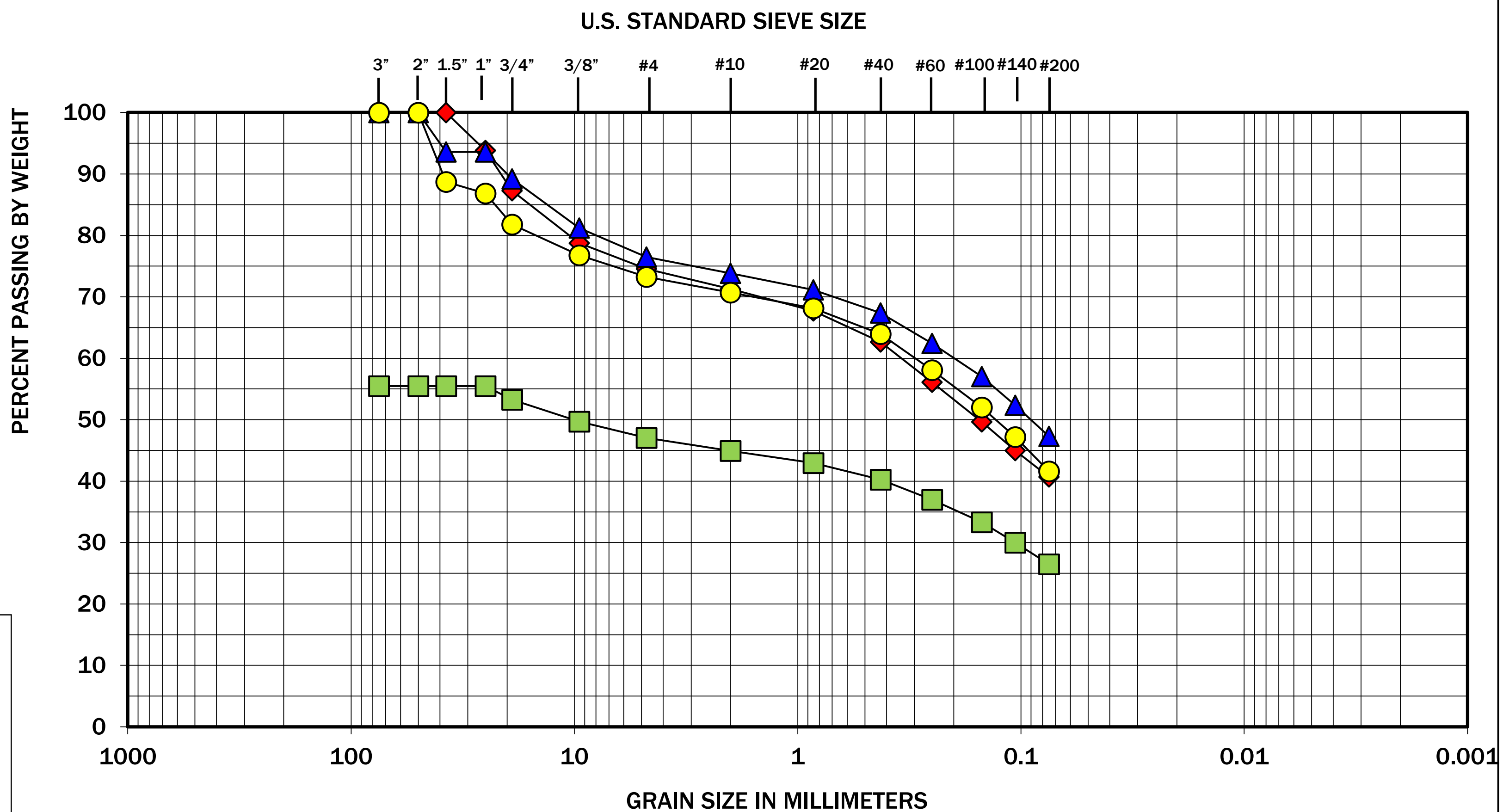
Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
526	0				DUFF	Approximately 8 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
525	1		1 / MC		SM	Gray-brown silty fine to medium sand with gravel and organic matter (roots) (loose to medium dense, moist) (weathered glacial till)	12		Fine roots and roots up to approximately 1-inch diameter
524	2				SM	Gray with occasional iron-oxide staining silty fine to coarse sand with gravel and occasional cobbles (dense, moist) (glacial till)			
523	3								
522	4		2 / SA			Grades to fine sand grains	10	42	
						Grades to very dense			
521	5								
520	6								
519	7								
518	8		3						

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-6

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Test Pit Number	Depth (feet)	Moisture (%)	Soil Description
◆ (red diamond)	TP-1	5.75	15	Silty sand with gravel (SM)
■ (green square)	TP-2	4.5	9	Silty gravel with sand (GM)
▲ (blue triangle)	TP-3	3.5	8	Silty sand with gravel (SM)
● (yellow circle)	TP-6	3.5	10	Silty sand with gravel (SM)

AASHTO ACCREDITED

Note: This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations, or generated by separate operations or processes.

The grain size analysis results were obtained in general accordance with ASTM C 136. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

GeoEngineers

Pierce College Puyallup-STEM Building Design Study
Puyallup, Washington

Sieve Analysis Results

Figure A-8

APPENDIX B
Report Limitations and Guidelines for Use

APPENDIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for Washington State Department of Enterprise Services (WSDES) and for the Project(s) specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with our Agreement with WSDES signed on September 4, 2020 and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is based on a Unique Set of Project-Specific Factors

This report has been prepared for the Pierce College Puyallup – STEM Building Design Study project in Puyallup, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Environmental Concerns are Not Covered

Unless environmental services were specifically included in our scope of services, this report does not provide any environmental findings, conclusions, or recommendations, including but not limited to, the likelihood of encountering underground storage tanks or regulated contaminants.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Geotechnical and Geologic Findings are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations are Not Final

We have developed the following recommendations based on data gathered from subsurface investigation(s). These investigations sample just a small percentage of a site to create a snapshot of the subsurface conditions elsewhere on the site. Such sampling on its own cannot provide a complete and accurate view of subsurface conditions for the entire site. Therefore, the recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and

- encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.

Geotechnical Engineering Services
Addendum Report No. 1

Pierce College Puyallup
STEM Building Design Services
Puyallup, Washington

for
Absher Construction Co.

June 29, 2022

GeoEngineers
Earth Science + Technology

Geotechnical Engineering Services
Addendum Report No. 1

Pierce College Puyallup
STEM Building Design Services
Puyallup, Washington

for
Absher Construction Co.

June 29, 2022

GeoEngineers

1101 South Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

Geotechnical Engineering Services
Addendum Report No. 1

Pierce College Puyallup
STEM Building Design Services
Puyallup, Washington

File No. 21342-002-01

June 29, 2022

Prepared for:

Absher Construction Co.
1001 Shaw Road
Puyallup, Washington 98372

Attention: Blaine Wolfe

Prepared by:

GeoEngineers, Inc.
1101 South Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

Christopher R. Newton, PE
Geotechnical Engineer

Dennis (D.J.) Thompson, PE
Associate Geotechnical Engineer

DENNIS JOHN THOMPSON
STATE OF WASHINGTON
38397
REGISTERED
PROFESSIONAL ENGINEER
6/29/22

CRN:DJT:kjb:leh

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APPENDICES

1.0 INTRODUCTION AND PROJECT UNDERSTANDING

This addendum report presents the results of our additional geotechnical engineering services for the proposed Science, Technology, Engineering, Mathematics (STEM) Building at Pierce College Puyallup, as shown on the Vicinity Map, Figure 1. Our previous work for this project includes preparation of a "Geotechnical Engineering Services Report, Pierce College Puyallup – STEM Building Design Study, Puyallup, Washington" dated January 21, 2021 (January 2021 Report). This addendum reflects additional subsurface explorations, information and recommendations not provided in our January 2021 report. This addendum addresses additional stormwater management and pavement design considerations for the parking lot to be located northeast of the STEM Building.

Our project understanding is based on discussions with you, AHBL, Inc. (AHBL; project civil engineer), and Integrus Architecture (Integrus; project structural engineer and architect). We also reviewed the Architectural, Civil, and Structural Plans from the GMP Plan Set dated March 11, 2022 and prepared by Integrus.

The proposed STEM Building is to consist of a 54,748-gross-square-foot, three-story steel frame structure containing classrooms, laboratories, faculty offices, and study spaces. Conventional shallow foundations, mat slabs, and slab-on-grade are planned for building support. The mat slabs will support buckling-restrained brace frames. Other site improvements include a proposed parking lot north of the STEM Building adjacent to Campus Way and Parking Lot C, trenching and utilities, and stormwater management facilities.

Stormwater management facilities currently being considered are Stormtech Chamber systems and bioretention facilities beneath or around the proposed parking lot. Rain gardens are also planned around the building. Stormwater management facilities on site will be designed in accordance with Washington State Department of Ecology's 2019 Stormwater Management Manual for Western Washington (SWMMWW).

Our services have been provided in general accordance with our signed agreement for this project authorized on March 1, 2022. A complete list of our scope of services is provided in our proposal dated February 10, 2022.

2.0 SITE CONDITIONS

2.1. Surface Conditions

The site is bounded by College Way to the north, campus Parking Lot C to the east, existing Pierce College buildings, landscaped and hardscaped common areas to the west and south. The site is currently forested with mature coniferous and deciduous trees and a dense understory layer, including brush, small trees, fallen trees, and forest duff. Site topography generally slopes downward toward the east-northeast from approximate Elevation 532 feet to Elevation 520 feet (The North American Vertical Datum of 1988; NAVD88). Elevations referenced in this report are with respect to NAVD88 unless noted otherwise.

2.2. Literature Review

2.2.1. Geologic and Soil Survey

Based on our additional review, we conclude that the geology description and soil survey descriptions provided in our January 2021 Report remain appropriate except as described below.

2.2.2. Soil Survey

We reviewed the Natural Resources Conservation Service (NRCS) Web Soil Survey (accessed April 18, 2022). According to the survey, the site is underlain by two subunits of Kapowsin gravelly ashy loam: 6 to 15 percent slopes and 30 to 65 percent slopes. Kapowsin gravelly ashy loam is described as moderately well drained with a very low capacity of the most limiting layer to transmit water and categorized as Hydrologic Soil Group B.

2.2.3. Water Well Information

We searched the Washington State Department of Natural Resources Interactive Geologic Information Portal on April 18, 2022 for water well log reports in the project vicinity. Based on our search, we found a water well log report dated May 28, 2002 (Ecology Well ID Tag No. AFR 833) near the southwest corner of the campus property. This well log reported the static groundwater level at about 411 feet below the top of the well (over 100 feet below project site grade). We interpret this static groundwater level to be more representative of the regional groundwater table in the project vicinity.

2.3. Subsurface Conditions

2.3.1. Subsurface Explorations and Laboratory Testing

We explored subsurface conditions at the project site by advancing one boring (MW-1) on March 9, 2022, and six test pit excavations (TP-1 (PIT-1) through TP-6) between April 5 and 6, 2022. The approximate locations of the boring and test pits are shown on the attached Site Plan, Figure 2. A groundwater monitoring well was constructed in the boring after drilling was complete. One small-scale pilot infiltration test (PIT) was completed in TP-1 (PIT-1) at approximately 12 feet below the ground surface (bgs). The test results and methodology for the PIT are discussed in further detail in the "Stormwater Infiltration" section of this report. A description of our subsurface exploration program and summary exploration logs for this study are provided in Appendix A.

Figure 2 also displays the locations of test pit explorations completed as part of our January 2021 Report. We provide this as additional reference when reviewing our January 2021 Report in concert with this report. The subsurface exploration procedures, interpreted conditions, and test pits logs are presented in our January 2021 Report.

Selected samples collected from our boring and test pits were tested in our laboratory to confirm field classifications and to evaluate pertinent engineering properties. Our laboratory testing program included grain-size distribution analyses and moisture content determinations. A summary of our laboratory testing program and the test results are provided in Appendix A.

2.3.2. Soil Conditions

2.3.2.1. General

We observed about 3- to 12-inches of forest duff and/or organic-rich soil at the surface in test pits TP-1 through TP-4. Approximately 6 inches of sod was observed at the surface in test pits TP-5 and TP-6 and boring MW-1. Descriptions of soils encountered below these surface materials are discussed in the following sections.

2.3.2.2. Monitoring Well MW-1

Below the sod at MW-1, we observed what we interpret to be glacial till. Glacial till was typically comprised of silty sand with gravel and silty gravel with sand. The upper approximately 8 feet of glacial till was observed to be in a weathered, loose condition. Below the weathered zone, the glacial till was generally observed to be very dense to the depth explored. MW-1 was terminated in glacial till soils.

2.3.2.3. Test Pits TP-1 (PIT-1) through TP-6

Below the sod, forest duff, and/or organic-rich soils in TP-1 (PIT-1) through TP-6, we observed what we interpret to be glacial till to the depths explored. The upper approximately 4 to 5 feet of glacial till were observed to be weathered and generally ranged between a loose to dense condition. Occasional roots generally extended to on the order of 3 feet depth. Underlying the weathered zone, glacial till generally consisted of dense to very dense silty sand with gravel and silty gravel with sand and variable cobbles and boulders content. In TP-1 (PIT-1) the glacial till gradually changed more course to a gravel with silt and sand at about 11 feet bgs to the full depth explored.

2.3.3. Groundwater Conditions

We did not observe what we interpret to be the regional groundwater table in our explorations. However, we observed groundwater seepage generally in the upper 6 feet and occasionally deeper for the explorations advanced for this report. We interpret the seepage observed to be perched groundwater and was generally within the weathered glacial till, perched near the interface with the intact glacial till and also at times, seeping through intermittent gravel seams.

We typically define slow seepage as less than 1 gallon per minute (gpm), moderate seepage 1 to 3 gpm, and rapid seepage is greater than 3 gpm. During drilling for monitoring well MW-1, we encountered shallow groundwater at about 5 feet depth, which is within the similar zone where groundwater seepage was encountered in nearby test pits TP-5 and TP-6.

Based on our experience, it is not uncommon for glacial soils to contain isolated zones of perched groundwater. We anticipate that perched groundwater could be present in other areas or depths at the project site depending on soil conditions, rainfall amounts and irrigation activities. We anticipate that perched groundwater levels will generally be highest during the wet season, typically October through May.

We tracked groundwater levels in monitoring well MW-1 using a pressure transducer data logger from March 10 through May 18, 2022. The pressure transducer was programmed to collect a groundwater level reading once a day. This data is presented in the Groundwater Hydrograph, Figure A-11 of Appendix A. Table 1 below presents our groundwater elevation summary for MW-1.

TABLE 1. GROUNDWATER LEVELS FROM MONITORING WELL MW-1

Approx. Ground Surface Elevation (feet)	Approx. Maximum Elevation (feet)	Date and Time of Maximum Elevation	Approx. Average Elevation (feet)[1]
522	504.6	3/27/22 12:00 PM	503.5

Notes: [1] Average groundwater elevation from March 10 through May 18, 2022.

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1. Primary Geotechnical Considerations

Based on our understanding of the project, the explorations performed for this study and our January 2021 Report, it is our opinion that the proposed improvements can be designed and constructed generally as envisioned with regard to geotechnical considerations. A summary of the primary geotechnical considerations for the project is provided below and is followed by our detailed recommendations. The conclusions and recommendations provided in our January 2021 Report remain valid except as modified herein. Our January 2021 Report should also be reviewed in its entirety and should be presented with this report when reviewed by others.

- Clearing and stripping depths for forest duff in the proposed parking lot area will typically be on the order of about 12 inches. Greater clearing and stripping depths may be required when establishing subgrades in areas of heavier vegetation or relatively lower lying areas. Adjacent to Parking Lot C, clearing and stripping depths will be on the order of 6 inches to remove sod.
- Most of the soils observed in our explorations for this study contain a significant quantity of fines and, therefore, could be difficult or impossible to work with when wet or become easily disturbed if exposed to wet weather.
- Isolated perched groundwater zones were commonly present in the explorations where wet conditions were typically encountered. Depending on the intended use of material generated in this area, and the moisture/weather conditions, it may be difficult to process and/or re-use on-site soils as structural fill and backfill.
- Based on our experience, subsurface conditions observed in our explorations, and results from our infiltration testing, it is our opinion that stormwater infiltration within proposed development areas related to this study is generally infeasible. We provide additional discussion in the “Stormwater Infiltration” section below.

3.2. Mat Foundations

We provide additional considerations below for mat foundation design. The shallow foundation bearing surface preparation recommendations outlined in our January 2021 Report should also be followed. We have assumed that mat foundation bearing surfaces will consist of thoroughly compacted, firm, and unyielding inert native soil or structural fill extending to such soil.

A modulus of subgrade reaction of 250 pounds per cubic inch (pci) may be used for structural design of mat foundations. This value is for a 1-foot by 1-foot square plate. The modulus of subgrade reaction for a mat foundation will vary based on its minimum width and is computed according to the following equation:

$$k_s = k_{s1}[(B+1)/2B]^2$$

Where k_s is the computed modulus of subgrade reaction, k_{s1} is the modulus of subgrade reaction for a 1- foot by 1-foot plate, and B is the minimum width or lateral dimension of the mat.

For bearing surfaces prepared as recommended, we estimate the total static settlement of mat foundations will be on the order of 1 inch or less for the modulus of subgrade reaction presented above. Differential settlements could be on the order of ¼ to ½ inch between similarly loaded foundations or over about 20 feet across a foundation dimension, such as along the width or length of the mat. The settlements should occur rapidly, essentially as loads are applied. Settlements could be greater than estimated if disturbed or saturated soil conditions are present below foundations.

The lateral resistance design parameters outlined in our January 2021 Report remain applicable to mat foundation design.

3.3. Luminaire Poles

3.3.1. Design Parameters

We understand that luminaire poles are planned for site improvements. It is our opinion that Washington State Department of Transportation (WSDOT) Standard Plans may be used, as applicable, for design of luminaire poles. Recommended soil properties and design parameters are provided in Table 2 below. Other jurisdictional design criteria or other methods of design may also be applicable and may take precedence. We can assist with other design methods, as requested.

Recommended values are based on our experience in the area, subsurface explorations, and review of the February 2022 WSDOT Geotechnical Design Manual (WSDOT GDM), Chapter 17, "Foundation Design for Signals, Signs, Noise Barriers, Culverts, and Buildings," and Table 17.2 of the same. We recommend that this document be referenced and reviewed during the design and selection process for luminaire pole foundations. The WSDOT GDM, Chapter 17 also provides design guidance if foundations other than indicated in the Standard Plans are required.

The allowable lateral bearing pressure listed below is for foundations constructed in relatively flat ground conditions, which is anticipated for this project. Special design considerations for foundations constructed on or near slopes are provided in WSDOT GDM, Chapter 17. We should be consulted further if sloping conditions are anticipated around luminaire poles.

TABLE 2. LUMINAIRE POLE DESIGN PARAMETERS

Soil Unit Weight (pcf)	Soil Friction Angle (deg)	Allowable Lateral Bearing Pressure (psf)
125	34	2,500

3.3.2. Construction and Additional Design Considerations

We present two conditions to consider when designing and constructing luminaire pole foundations (pole foundations).

- Condition #1, an excavation the same dimension as the designed pole foundation is developed, and the foundation is cast directly against undisturbed earth. Or,

- Condition #2, an excavation larger than the designed dimension of the pole foundation is developed, a corrugated metal pipe is placed into the excavation, and the foundation concrete is cast inside the metal pipe. The corrugated metal pipe is left in place after pouring the foundation concrete. Any overexcavated area outside of the corrugated metal pipe is backfilled with controlled density fill (CDF) or structural fill.

Construction of foundation Condition #1 requires the sidewalls of the excavation to stay stable and not cave into the excavation. In the case of drilling installation methods, temporary steel casing or drill slurry can also be used if caving soil conditions are encountered. Excavations made for foundation Condition #2 should be in accordance with the "Temporary Excavations and Cut Slopes" section of our January 2021 Report if workers are expected to enter the excavation. Recommendations regarding backfilling around pole foundations are included in the "Backfill Placement and Compaction Around Luminaire Pole Foundations" section of this report.

In general, we expect that the majority of the luminaire pole foundations will be constructed in fill and/or weathered soil overlying glacial till. We expect that the majority of the excavations for the foundations could remain open for a short period of time, but ultimately, we expect the potential for raveling, dislodged cobbles and oversized particles and seepage. At this time, we suggest Condition #2 be considered for budgeting and design purposes. Additional sumps/pumps and some dewatering or capture of decanted water, or other means of groundwater seepage management may be required. At a minimum, the contractor should be prepared to use casing, as necessary, to stabilize the hole, especially within the upper approximate 5 feet.

3.3.3. Backfill Placement and Compaction Around Luminaire Pole Foundations

Backfill in overexcavated areas and around pole foundations must be compacted in accordance with WSDOT Standard Specifications Section 2-09.3(1)E. If the overexcavated area is large enough for compaction equipment to access, import structural fill material should be used to backfill the excavations. Backfill material around pole foundations must be compacted to at least 95 percent of the theoretical maximum dry density (MDD) per ASTM International (ASTM) D 1557.

Alternatively, CDF may be used to backfill the excavation in accordance with WSDOT Standard Specification Section 2-09.3(1)E. CDF is a self-compacting, cementitious, flowable material requiring no subsequent vibration or tamping to achieve consolidation. CDF is included as an option for backfilling around pole foundations in the WSDOT Standard Signal Foundation Plans. If the area to backfill is too small for compaction equipment to access, CDF should also be used. Additionally, we recommend that CDF be used to backfill any large voids created during excavation if compaction equipment cannot access the void area.

3.4. Site Development and Earthwork

3.4.1. General

The recommendations provided herein are to supplement the "Site Development and Earthwork" section of our January 2021 Report, which remains applicable to this project.

3.4.2. Groundwater Handling Considerations

The isolated perched groundwater zones (shallow groundwater) observed in our explorations are common within glacial deposits encountered at this campus and in general, sites with similar soil conditions.

Groundwater seepage was generally observed between about Elevation 518 and 522 feet. The interface between more permeable and less permeable soil types such as the contact between weathered glacial till and glacial till are common conditions where perched groundwater can be present. As such, perched groundwater could be encountered in other excavations outside of our explorations, especially where more permeable sand and gravel seams may overlie less permeable materials.

Groundwater handling needs for excavations anticipated at this site will typically be lower during the summer and early fall months. Due to some of the variable soil layering and isolated, intermittent perched groundwater zones observed, it is our opinion that wells and well point systems will not be practical for dewatering of shallow excavations. It is our opinion that handling of shallow groundwater will be more practical with the use of larger sumps/pumps, diversion ditches, drain/collector systems, and/or combinations of methods.

We noted slow to rapid seepage rates in our explorations completed for this study. For preliminary dewatering considerations, we estimate seepage rates into shallow excavations could be on the order of 2 to 3 gpm. We recommend that additional test pits/explorations for critical excavation areas, primarily the location of the Stormtech Chambers be considered, especially in the wetter times of year, prior to primary earthwork activities. This will allow observation of seepage flow rates at current time, and the ability to consider any additional shallow groundwater management and handling criteria. Ultimately, we recommend that the contractor performing the work be responsible for controlling and collecting groundwater encountered. We are available to provide additional assistance on planning of shallow groundwater management, as requested.

3.5. Fill Materials

3.5.1. On-Site Soil

Most of the site soils observed in our explorations contain a significant quantity of fines and are difficult or impossible to work with when wet or become easily disturbed if exposed to wet weather. Isolated perched groundwater zones were commonly present in our explorations and the soil conditions encountered within these zones were typically wet.

Based on our subsurface explorations and experience, it is our opinion that existing site soils, excluding the forest duff and/or organic-rich soil and sod, could be considered for use as structural fill and trench backfill, provided that they can be adequately moisture conditioned, placed and compacted as recommended and do not contain organic or other deleterious material.

During excavation activities, seepage observed at the site could saturate drier soil located below or in between these seepage zones. In addition, some of the existing soils outside of the seepage zones will be generated at moisture contents above optimum (OMC) . The severity of this will depend on time of year of excavation and overall handling techniques. As such, we suggest earthwork activities take place in the middle of summer. In any event, segregation of dryer material from wetter material should be expected for use of on-site material at any time of year. Additionally, drying and staging of these materials may be required to spread material out and condition soil to a proper moisture content before use.

It should be expected and planned for that some on-site material will not be suitable for immediate use as a structural fill, especially during the wet season. Provisions for removal of on-site material and import structural and/or select granular fill should be expected on this project. Imported structural fill or select granular fill materials are described in the "Fill Materials" section of our January 2021 Report. Ultimately, we recommend that the use of on-site soils be evaluated on a case-by-case basis during construction. We are available to assist with additional consultation and considerations when planning to use on-site material.

3.6. Stormwater Infiltration

3.6.1. General

It is our understanding that stormwater management facilities will be designed in general accordance with the Washington State Department of Ecology's 2019 SWMMWW. According to the SWMMWW, design infiltration rates in glacially consolidated soils (i.e., glacial till) should be determined via in-situ infiltration testing such as a PIT. The sections below further describe our PIT methodology, infiltration suitability of site soils, and recommendations for stormwater management facility design.

We completed a small-scale PIT, PIT-1, during excavation of TP-1. PIT-1 was located approximately within the basal footprint of the larger grouping of planned Stormtech Chambers for the proposed parking lot.

A PIT was originally planned at each TP-2 and TP-5 (both are approximately within basal footprints of the planned Stormtech Chambers); however, due to moderate to rapid groundwater seepage observed in the excavations, we were not able to complete these PITs. We also observed moderate to rapid groundwater seepage at TP-4 and TP-6, so we were not able to perform a PIT at those test pits either.

3.6.2. Pilot Infiltration Tests

3.6.2.1. Methodology

We completed the PIT generally following GeoEngineers' standard methodology for PITs, which is a synthesis of best practices and, in our opinion, meets the intended procedures for small-scale PITs set forth in the SWMMWW. PIT-1 was completed at about 12 feet bgs or Elevation 512 feet (NAVD88), which is roughly the proposed bottom of Stormtech Chamber system elevation per the Civil GMP Plan Set. The approximate basal area of the PIT excavation was at least 16 square feet. Upon reaching the target depth, a piezoelectric pressure transducer was lowered to near the floor of the test pit to record water level readings during the PIT. A separate piezoelectric pressure transducer was secured to a tree branch near the test pit to record barometric pressure during the PIT. The piezoelectric pressure transducers were programmed to record water level/barometric pressure readings at 20-second intervals. Water was pumped into the PIT-1 excavation from a water tank trailer generally to depths of about 16 inches.

GeoEngineers' PIT procedure consists of a 6-hour (minimum) saturation period where the water depth in the PIT is raised and lowered, generally over intervals of 6 inches or less, in a series of falling-head stages. Water level measurements collected by the pressure transducer during each falling-head stage are used to calculate the apparent infiltration rate for each stage. Manual water level measurements are also recorded in the event a transducer malfunctions during the test. The falling-head stage methodology is intended to fully saturate the soils below the base of the PIT while allowing for a direct measurement of the infiltration rate to help determine when saturated or near-saturated conditions have been achieved. This is usually manifested by a progressive decline in the apparent infiltration rate until the rate approximately stabilizes. The stabilized rate corresponds to the saturated infiltration rate or the measured (initial) infiltration rate of the soil.

Generally, once a stabilized infiltration rate is observed and a minimum of 6 hours of saturation time has elapsed, the PIT is continued for one or more falling-head cycles or is left undisturbed until the water drains away completely. If left to drain away completely, the final drain-down period shows how infiltration changes over a continuous range of declining water depths. Sixteen falling-head stages were recorded for the PIT.

3.6.2.2. Test Results

The SWMMWW recommends that correction factors be applied to the measured (initial) infiltration rate determined in the PIT to establish a long-term design infiltration rate. The correction factors account for uncertainties in site variability, testing procedures, and long-term reduction in permeability due to plugging. Table 3 below provides a summary of the correction factors outlined in the SWMMWW that are, in our opinion, appropriate for use at this site. The total correction factor is equal to the product of the individual factors.

TABLE 3. CORRECTION FACTORS FOR FIELD INFILTRATION MEASUREMENTS

Correction Factor	Recommended Value
Site Variability and Number of Locations Tested	CF_v=0.33 Selected because of number of test locations
Test Method	Small-scale PIT, CF_t = 0.50
Degree of Influent Control to Prevent Siltation and Bio-buildup	CF_m= 0.9
Total Correction Factor (CF_v x CF_t x CF_m)	CF_T= 0.15

The long-term design infiltration rate (K_{sat_design}) is obtained by multiplying the measured (initial) infiltration rate ($K_{sat\_initial}$) by the total correction factor:

$$K_{sat\_design} = K_{sat\_initial} * CF_T$$

Table 4 summarizes the measured (initial) and long-term design infiltration rates for PIT-1.

TABLE 4. INFILTRATION RATE SUMMARY FOR PIT-1

Approximate Depth of PIT (feet bgs)	Approximate Elevation of PIT[1] (feet; NAVD88)	Measured (Initial) Infiltration Rate ($K_{sat\_initial}$; in/hr)	Long-Term Design Infiltration Rate[2] (K_{sat_design}; in/hr)
12	512	13.6	2.0

Notes:

[1] Elevation should be considered approximate.

[2] Long-term design infiltration rate with appropriate correction factors applied.

3.6.2.3. Conclusions of PIT Results and Stormwater Infiltration Feasibility

Based on the subsurface conditions observed in our explorations and our experience on campus, it is our opinion that stormwater infiltration is generally infeasible for this project. We do not recommend using the long-term design infiltration rate listed in Table 4 above. This PIT was completed in a more permeable gravel seam at depth. Glacial till soils in the project vicinity and at the site are undifferentiated and commonly include isolated and/or discontinuous seams of cleaner sand and gravel. During our studies, we did not observe this unit to be consistent across the area and at similar depths and did not observe conclusive evidence of suitable horizontal bedding layers in our explorations. As such, we recommend that infiltration not be considered as an option for stormwater management on this project. If a small amount of infiltration is necessary (i.e., small shallow bio-swales, yard drains, etc.), we recommend we be consulted first to review proposed location, design, and overall use before final determination.

3.7. Pavement Recommendations

3.7.1. General

Pavements for the proposed improvements will include new a new parking lot and driveways. Our recommended pavement sections provided below are based on our explorations and experience in the area. We understand asphalt concrete pavement (ACP) is planned for the proposed improvements.

The recommended pavement sections below may not be adequate for heavy construction traffic loads such as those imposed by concrete transit mixers, dump trucks or cranes. Additional pavement thickness may be necessary to prevent pavement damage during construction. An asphalt-treated base (ATB) section can also be used during construction to protect partially constructed pavement sections and pavement subgrades. The recommended sections assume final improvements surrounding the pavement areas will be designed and constructed such that stormwater or excess irrigation water from landscape areas does not accumulate below the pavement section or pond on pavement surfaces. If pavements in parking areas slope inward (toward the center of the parking area) full depth curbs or other measures should be used to prevent water from entering and ponding on the subgrade and within the base section.

3.7.2. Construction Considerations

Existing pavements, hardscaping or other structural elements should be removed prior to placement of new pavement sections. Pavement subgrade should be prepared to a uniformly firm, dense and unyielding condition as previously described. Crushed surfacing base course (CSBC) and subbase should be moisture conditioned to near optimum moisture content and compacted to at least 95 percent of the MDD (ASTM D 1557).

Crushed surfacing base course should conform to applicable sections of 4-04 and 9-03.9(3) of the WSDOT Standard Specifications. Hot mix asphalt should conform to applicable sections of 5-04, 9-02 and 9-03 of the WSDOT Standard Specifications.

Some areas of pavement may exhibit settlement and subsequent cracking over time. Cracks in the pavement will allow water to infiltrate to the underlying base course, which could increase the amount of pavement damage caused by traffic loads. To prolong the effective life of the pavement, cracks should be sealed as soon as possible.

3.7.3. Asphalt Concrete Pavement Design

3.7.3.1. Standard-Duty ACP – Automobile Driveways and Parking Areas

- 2 inches of hot mix asphalt, class ½ inch, PG 58-22
- 4 inches of CSBC
- 6 inches of subbase consisting of select granular fill, previously described, to provide a uniform grading surface, to provide pavement support, to maintain drainage, and to provide separation from subgrade soil.

- Subgrade consisting of proof-compacted firm and unyielding conditions, or structural fill prepared in accordance with the "Subgrade Preparation" and "Area Fills and Pavement Bases" sections of our January 2021 Report .

3.7.3.2. Areas Subject to Occasional Heavy Truck Traffic

- 3 inches of hot mix asphalt, class ½ inch, PG 58-22
- 6 inches of CSBC
- 6 inches of subbase consisting of select granular fill, previously described, to provide a uniform grading surface, to provide pavement support, to maintain drainage, and to provide separation from subgrade soil.
- Subgrade consisting of proof-compacted firm and unyielding conditions, or structural fill prepared in accordance with the "Subgrade Preparation" and "Area Fills and Pavement Bases" sections of our January 2021 Report.

3.7.3.3. Temporary Construction Surfacing

A temporary surfacing of ATB can be used to protect partially constructed pavement sections and pavement subgrades during construction. This can provide a relatively clean working surface, prevent construction traffic from damaging final paving surfaces and reduce subgrade repairs required for final paving. A 2-inch-thick section of ATB can be substituted for the upper 2 inches of CSBC in either the light-duty or heavy-duty pavement sections. Prior to placement of the final pavement surface sections, we recommend that any areas of ATB pavement failure be removed, and the subgrade repaired. If ATB is used and is serviceable when final pavements are constructed, the design asphalt concrete pavement thickness can be placed directly over the ATB.

Cement treatment of subgrades is sometimes used to create construction surfacing or to control soil moisture during wet weather construction. In our opinion cement treatment would not likely be cost effective for creating a wet weatherproof construction surface due to the high fines content in the soil. Cement treatment or cement stabilization would likely only be cost effective as an emergency or contingency action for reducing soil moisture in the on-site material if excavated and re-used as a structural fill. We estimate that it would take a significant amount of cement, likely on the order of 12 percent by weight, to create a firm and stable working surface that could handle wet weather construction. If used as a structural fill, likely on the order of 6 to 8 percent cement by weight would be required.

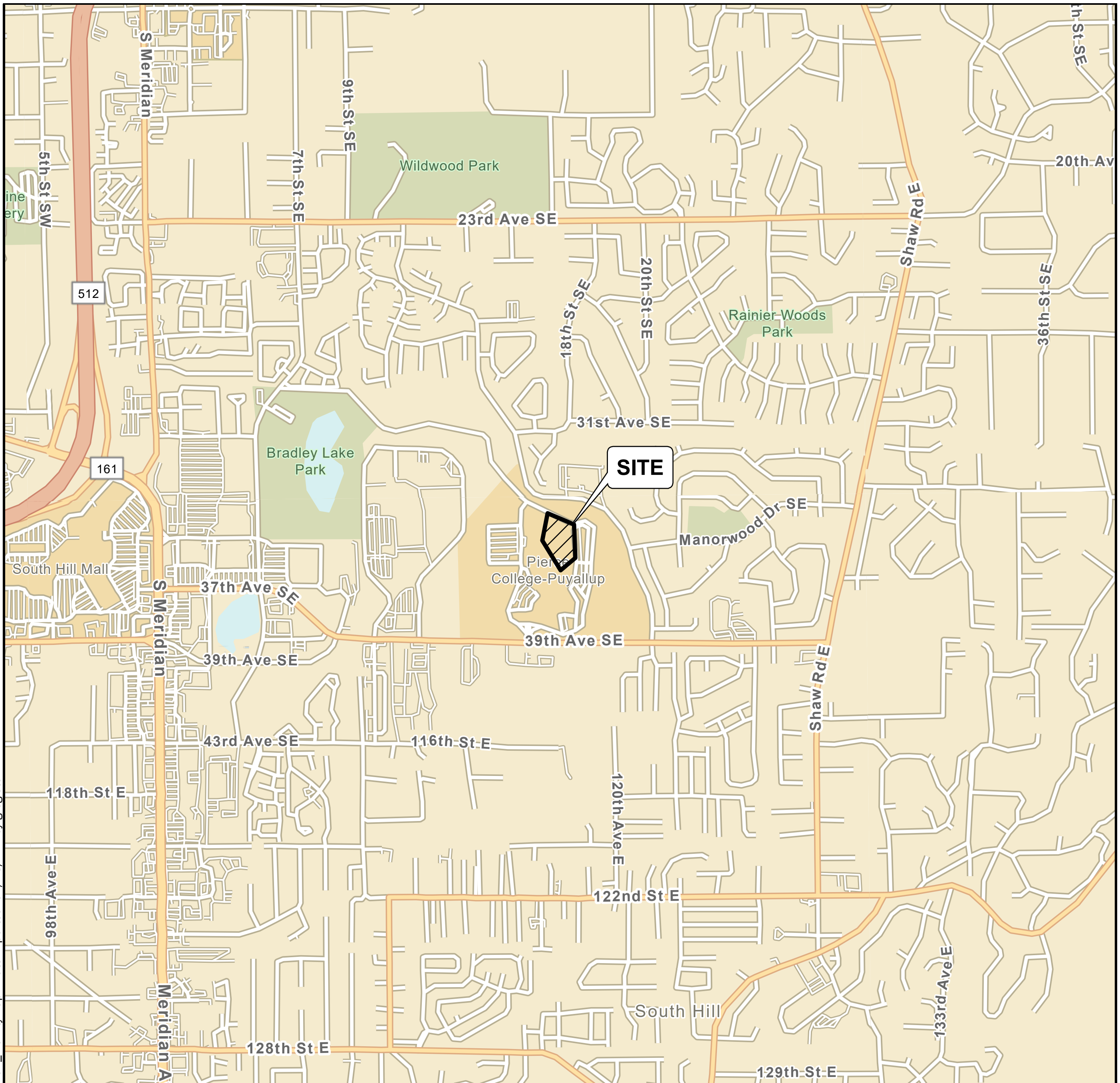
4.0 LIMITATIONS

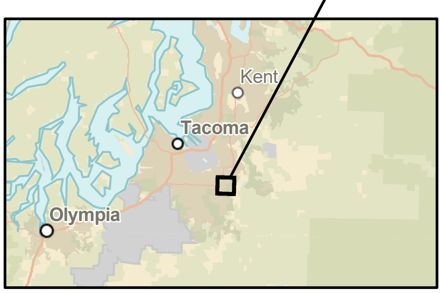
We have prepared this report for Absher Construction for the Pierce College Puyallup - STEM Building project located in Puyallup, Washington. Absher Construction may distribute copies of this report to owner's authorized agents and regulatory agencies as may be required for the Project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to the services or this report.

Please refer to Appendix B titled "Report Limitations and Guidelines for Use" of our January 2021 Report for additional information pertaining to use of this report.

FIGURES





N
W
E
S

2,000 0 2,000

Feet

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI

Projection:

Vicinity Map

Pierce College Puyallup - STEM Building Design Services
Puyallup, Washington

GEOENGINEERS

Figure 1

P:\21\21342002\GIS\21342002_Project\21342002_Project.aprx\2134200200_F01_VicinityMap Date Exported: 04/28/22 by gregister

Legend

- TP-1 (PIT-1) — Test Pit by GeoEngineers, Inc., 2022
- MW-1 — Monitoring Well by GeoEngineers, Inc., 2022
- TP-1 — Test Pit by GeoEngineers, Inc., January 2021 Report

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Background from AHBL, Inc., dated 04/19/2022.

Projection: Washington State Plane, South Zone, NAD83, US Foot

100 0 100
Feet

Site Plan

Pierce College Puyallup - STEM Building Design Services
Puyallup, Washington

GeoEngineers

Figure 2

P:\21\2134200201\CAD\01\Geotech Report\2134200201_F02_Site Plan.dwg TAB:F02 Date Exported: 04/28/22 - 7:35 by gregister

APPENDICES

APPENDIX A
Subsurface Explorations and Laboratory Testing

APPENDIX A
SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

Subsurface Explorations

Monitoring Well

Subsurface conditions were explored by advancing one hollow-stem auger boring on March 9, 2022. Subsurface exploratory services were provided by Holocene Drilling, Inc. under subcontract to GeoEngineers, Inc. The boring was advanced to 26½ feet below ground surface (bgs). A 2-inch diameter groundwater monitoring well was constructed after drilling and sampling within the borehole. The well was screened from approximately 10 to 25 feet bgs and a pressure transducer data logger was programmed and installed within the well to record water levels once a day. The groundwater elevations with respect to date are presented in the Groundwater Hydrograph, Figure A-11.

The approximate location of the boring was determined using a tablet equipped with global positioning system (GPS) software and/or pacing off from existing structural features. The exploration locations are included on the Site Plan, Figure 2. The location and elevation of the exploration should be considered approximate. The elevation was estimated based on an existing site topographic map provided by AHBL, Inc.

Our field representative collected samples, classified the soils, maintained a detailed log of the exploration and observed groundwater conditions. The samples were obtained with a standard split spoon sampler in general accordance with ASTM International (ASTM) D 1586. Field blow counts are presented on the log. The soils were classified visually in general accordance with the system described in Figure A-1, which includes a key to the exploration logs. A summary log of the exploration is included as Figure A-2.

The densities noted on the boring exploration log are based on the blow counts produced in the standard penetration test (SPT) and our experience and judgment. The log is based on our interpretation of the field and laboratory data and indicate the depth at which we interpret subsurface materials or their characteristics to change, although these changes might actually be gradual.

Observations of groundwater conditions were made during drilling and are presented on the boring log. Groundwater conditions observed during drilling represent a short-term condition and may or may not be representative of the long-term groundwater conditions at the site. Groundwater conditions observed during drilling should be considered approximate.

Test Pits and Pilot Infiltration Test (PIT)

We also explored subsurface conditions by excavating six test pits between April 5 and 6, 2022 at the approximate locations shown on the Site Plan, Figure 2. The test pits were excavated to depths between about 8¼ and 13¼ feet bgs using an excavator provided and operated by Green Earthworks Construction NW, Inc. under subcontract to GeoEngineers. After each test pit was completed, the excavation was backfilled using the generated material and compacted using the bucket of the excavator. A pilot infiltration test (PIT) was completed at about 12 feet bgs at TP-1 (PIT-1). After completing the PIT, the excavation was extended to observe soil conditions below the test elevation.

During the exploration program, our field representative obtained soil samples, classified the soils encountered, and maintained a detailed log of each exploration. The relative densities noted on the test pit logs are based on the difficulty of excavation and our experience and judgment. The soils were classified visually in general accordance with the system described in Figure A-1, which includes a key to the exploration logs. Summary logs of the explorations are included as Figures A-2 through A-8.

The locations of the test pits were determined using an electronic tablet equipped with GPS software. The locations of the explorations should be considered approximate. The elevations were estimated based on an existing site topographic map provided by AHBL, Inc.

Laboratory Testing

Soil samples obtained from the explorations were transported to GeoEngineers' laboratory. Representative soil samples were selected for laboratory tests to evaluate the pertinent geotechnical engineering characteristics of the site soils and to confirm our field classifications.

Our testing program consisted of the following:

- Six grain-size distribution analyses (sieve analyses [SA])
- Six moisture content determinations (MC)

Tests were performed in general accordance with test methods of ASTM International (ASTM) or other applicable procedures. The following sections provide a general description of the tests performed.

Sieve Analysis (SA)

Grain-size distribution analyses were completed on selected samples in general accordance with ASTM Test Method C 136. This test method covers the quantitative determination of the distribution of particle sizes in soils. Typically, the distribution of particle sizes larger than 75 micrometers (μm) is determined by sieving. The results of the tests were used to verify field soil classifications and determine pertinent engineering characteristics. Figures A-9 and A-10 present the results of our sieve analyses.

Moisture Content (MC)

The moisture content of selected samples was determined in general accordance with ASTM Test Method D 2216. The test results are used to aid in soil classification and correlation with other pertinent engineering soil properties. The results are presented on the test pit and boring logs at the depth tested.

SOIL CLASSIFICATION CHART

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

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

Sampler Symbol Descriptions

- 2.4-inch I.D. split barrel / Dames & Moore (D&M)
- Standard Penetration Test (SPT)
- Shelby tube
- Piston
- Direct-Push
- Bulk or grab
- Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point lead test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
UU	Unconsolidated undrained triaxial compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Drilled	Start	End	Total Depth (ft)	Logged By	Checked By	Driller	Drilling Method
	3/9/2022	3/9/2022	26.5	NJO	CRN	Holocene Drilling, Inc.	Hollow-stem Auger

Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Diedrich D-50 (track-mounted)
Surface Elevation (ft) / Vertical Datum	522 / NAVD88	Top of Casing Elevation (ft)	
Easting (X) / Northing (Y)	1199790 / 670600	Horizontal Datum	WA State Plane South NAD83 (feet)

DOE Well I.D.: BNZ 316
A 2-in well was installed on 3/9/2022 to a depth of 25 ft.

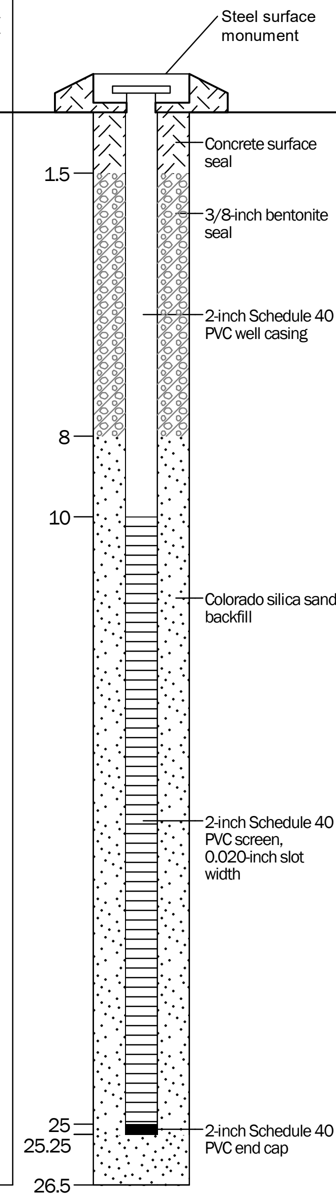
Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
3/9/2022	5.00	517.00

Notes: Samples 3 and 4 combined for one sieve analysis test

FIELD DATA

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot	Sample Name	Testing	Water Level	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)
	0						SOD	Approximately 6 inches sod		
520							SM	Gray-brown with occasional iron-oxide staining silty fine to medium sand with gravel (loose, moist) (weathered glacial till)		
	5	18	7	1		▼		Grades to wet		
515							SM	Gray silty fine to coarse sand with gravel (very dense, moist) (glacial till)		
	10	18	88	2						
510							GM	Gray silty fine gravel with sand (very dense, moist)		
	15	18	51	3	SA				8	19
505										
	20	11	74/11"	4	SA			Nearing wet		
500										
	25	18	87	5				Grades to wet		

WELL LOG



Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Topographic Survey.

Log of Boring MW-1

GEOENGINEERS

Project: Pierce College Puyallup - STEM Building Design Services
Project Location: Puyallup, Washington
Project Number: 21342-002-01

Figure A-2
Sheet 1 of 1

Date Excavated 4/6/2022	Total Depth (ft) 13.25	Logged By OA Checked By CRN	Excavator Equipment Volvo ECR 88D	See "Remarks" section for groundwater observed Caving not observed	

Surface Elevation (ft) 524 Vertical Datum NAVD88	Easting (X) 1199660 Northing (Y) 670700	Coordinate System WA State Plane South Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
524	0			Duff	Approximately 9 inches forest duff			
523	1			SM	Light brown with occasional iron oxide staining silty fine to coarse sand with gravel, occasional cobbles and organics (roots) (loose to medium dense, moist) (weathered glacial till)			
522	2	▯	1 / MC			14		
521	3							Roots extend to approximately 3 feet depth
520	4	▯	2	GP-GM	Gray-brown fine to coarse gravel with silt and sand (dense, moist)			
519	5	▯	3	SP	Approximately 4 inches gray-brown fine to medium sand with trace silt (dense, moist)			
				SM	Gray silty fine to medium sand with gravel and occasional cobbles (very dense, moist) (glacial till)			
518	6							Slow groundwater seepage observed at approximately 6 feet depth
517	7							
516	8	▯	4		Becomes nearly wet			
515	9							
514	10	▯	5		Grades to include fine to coarse grained sand			
513	11			GP-GM	Gray fine to coarse gravel with silt, sand and occasional boulders (very dense, moist)			
512	12							Pilot infiltration test conducted at approximately 12 feet depth on 4/6/2022
511	13	▯	6 / SA			9	10	

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1 (PIT-1)

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Project: Pierce College Puyallup - STEM Building Design Services
Project Location: Puyallup, Washington
Project Number: 21342-002-01

Date Excavated: 4/6/2022	Total Depth (ft): 12	Logged By: OA Checked By: CRN	Excavator Equipment: Volvo ECR 88D	See "Remarks" section for groundwater observed Caving not observed

Surface Elevation (ft): 523 Vertical Datum: NAVD88	Easting (X): 1199720 Northing (Y): 670650	Coordinate System: WA State Plane South Horizontal Datum: NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
523	0		Duff	Approximately 3 inches forest duff			
			SM	Dark brown silty fine to medium sand with gravel, occasional cobbles, boulders and organics (roots) (loose, moist) (weathered glacial till)			
522	1						
			GM	Brown silty fine to coarse gravel with sand, occasional cobbles and organics (roots) (loose to medium dense, wet)			Moderate to rapid groundwater seepage observed at approximately 1¼ feet depth Roots extend to approximately 1½ feet depth
521	2	1 / MC			9		Approximately 1-foot-diameter boulder encountered
520	3	2	SM	Gray-brown with laminations of oxidation staining silty fine to medium sand with gravel and occasional cobbles (dense, moist)			
519	4						
518	5		GM	Gray silty fine to coarse gravel with sand and occasional cobbles (very dense, moist) (glacial till)			
517	6	3 / SA			10	31	
516	7						
515	8						
514	9						
513	10						
512	11						
511	12						

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Services
Project Location: Puyallup, Washington
Project Number: 21342-002-01

Date Excavated	4/6/2022	Total Depth (ft)	13	Logged By	OA	Excavator		See "Remarks" section for groundwater observed
				Checked By	CRN	Equipment	Volvo ECR 88D	See "Remarks" section for caving observed

Surface Elevation (ft)	528	Easting (X)	1199600	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670640	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
528–527	0–1				Duff	Approximately 12 inches forest duff			
527–526	1–2	▯	1		SM	Brown-orange silty fine to coarse sand with gravel, occasional cobbles and organics (roots) (loose, moist) (weathered glacial till)			
526–523	2–5	▯ (3)	2 MC (3)		SM	Gray with oxidation laminations silty fine to coarse sand with gravel and occasional cobbles (medium dense, moist)	20 (3)		Roots extend to approximately 3 feet depth Two approximately 1-foot-diameter boulders encountered at 3 feet depth
	4					Grades to dense with occasional oxidation staining			
523–515.5	5–12.5	▯ (6), ▯ (12)	3 (6), 4 (12)		SM	Gray silty fine to coarse sand with gravel and occasional cobbles (very dense, moist) (glacial till)			Slow groundwater seepage observed at approximately 10 feet depth Minor caving observed from approximately 10 to 13 feet depth
515.5–515	12.5–13	▯	5 SA		GM	Gray silty fine to coarse gravel with occasional sand (very dense, moist)	27	22	

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-3

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Services
Project Location: Puyallup, Washington
Project Number: 21342-002-01

Date Excavated	4/5/2022	Total Depth (ft)	8.25	Logged By OA / Checked By CRN	Excavator Equipment Volvo ECR 88D	See "Remarks" section for groundwater observed / Caving not observed

Surface Elevation (ft)	525	Easting (X)	1199720	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670600	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				Duff	Approximately 6 inches forest duff			
524	1				SM	Brown silty fine to coarse sand with gravel and occasional organics (roots) (medium dense, moist) (weathered glacial till)			Roots up to approximately 4 inches in diameter
523	2								Roots extend to approximately 2 feet depth
522	3		1 MC		SM	Light brown-gray silty fine to coarse sand with gravel and occasional cobbles (medium dense, wet)	20		Moderate to rapid groundwater seepage observed from approximately 2½ to 3½ feet
521	4					Grades to with oxidation staining laminations at approximately 3½ feet			
520	5		2		SM	Gray with moderate oxidation staining silty fine to coarse sand with gravel and occasional cobbles (dense, moist) (glacial till)			
519	6								
518	7					Grades to very dense, nearly wet, without oxidation staining			
517	8		3						

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-4

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Project Location: Puyallup, Washington
Project Number: 21342-002-01

Figure A-6
Sheet 1 of 1

Date Excavated	4/5/2022	Total Depth (ft)	11	Logged By	OA	Excavator		See "Remarks" section for groundwater observed
				Checked By	CRN	Equipment	Volvo ECR 88D	Caving not observed

Surface Elevation (ft)	523	Easting (X)	1199780	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670590	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				SOD	Approximately 6 inches sod			
522	0.5–1				SM	Brown silty fine to coarse sand with gravel, occasional cobbles and organics (fine roots) (medium dense, moist) (weathered glacial till)			
520	2.5		1 MC				23		Roots extend to approximately 3 feet depth West sidewall includes an isolated 1- to 2-foot-thick zone of concentrated roots surrounded by black stained soil
519	3.5					Grades to wet			Slow to moderate groundwater seepage observed at approximately 4 feet depth on all four sides of excavation
518	4.5				SM	Gray with moderate oxidation staining silty fine to coarse sand with gravel and occasional cobbles (dense, moist) (glacial till)			
516	6.5					Grades to without oxidation staining			
515	8				GM	Gray silty fine to coarse gravel with sand and occasional cobbles (very dense, moist)			
514	8.5		2 SA				11	44	Approximately 1½-foot-diameter boulder removed from excavation
512	11								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-5

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Project: Pierce College Puyallup - STEM Building Design Services
Project Location: Puyallup, Washington
Project Number: 21342-002-01

Figure A-7
Sheet 1 of 1

Date Excavated	4/5/2022	Total Depth (ft)	12.5	Logged By: OA Checked By: CRN	Excavator Equipment: Volvo ECR 88D	See "Remarks" section for groundwater observed Caving not observed

Surface Elevation (ft)	524	Easting (X)	1199780	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670550	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
524	0				SOD	Approximately 6 inches sod			
523.5	0.5				SM	Brown silty fine to coarse sand with gravel, occasional cobbles and organics (roots) (loose, moist) (weathered glacial till)			
522	2		1						4-inch-diameter root at approximately 2 feet depth
521.5	2.5				SM	Gray-brown with moderate oxidation staining silty fine to medium sand with gravel, occasional cobbles and organics (roots) (medium dense, wet)			Slow groundwater seepage observed at approximately 2½ feet depth
520.5	3.5		2 MC				20		
520	4								Moderate groundwater seepage observed at approximately 4 feet depth Roots extend to approximately 4 feet depth and occasionally surrounded by black stained soil
519	5				SM	Gray silty fine to coarse sand with gravel and occasional cobbles (dense, moist) (glacial till)			
516	8					Grades to very dense			
515	9		3						
512	12		4 SA				9	36	

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-6

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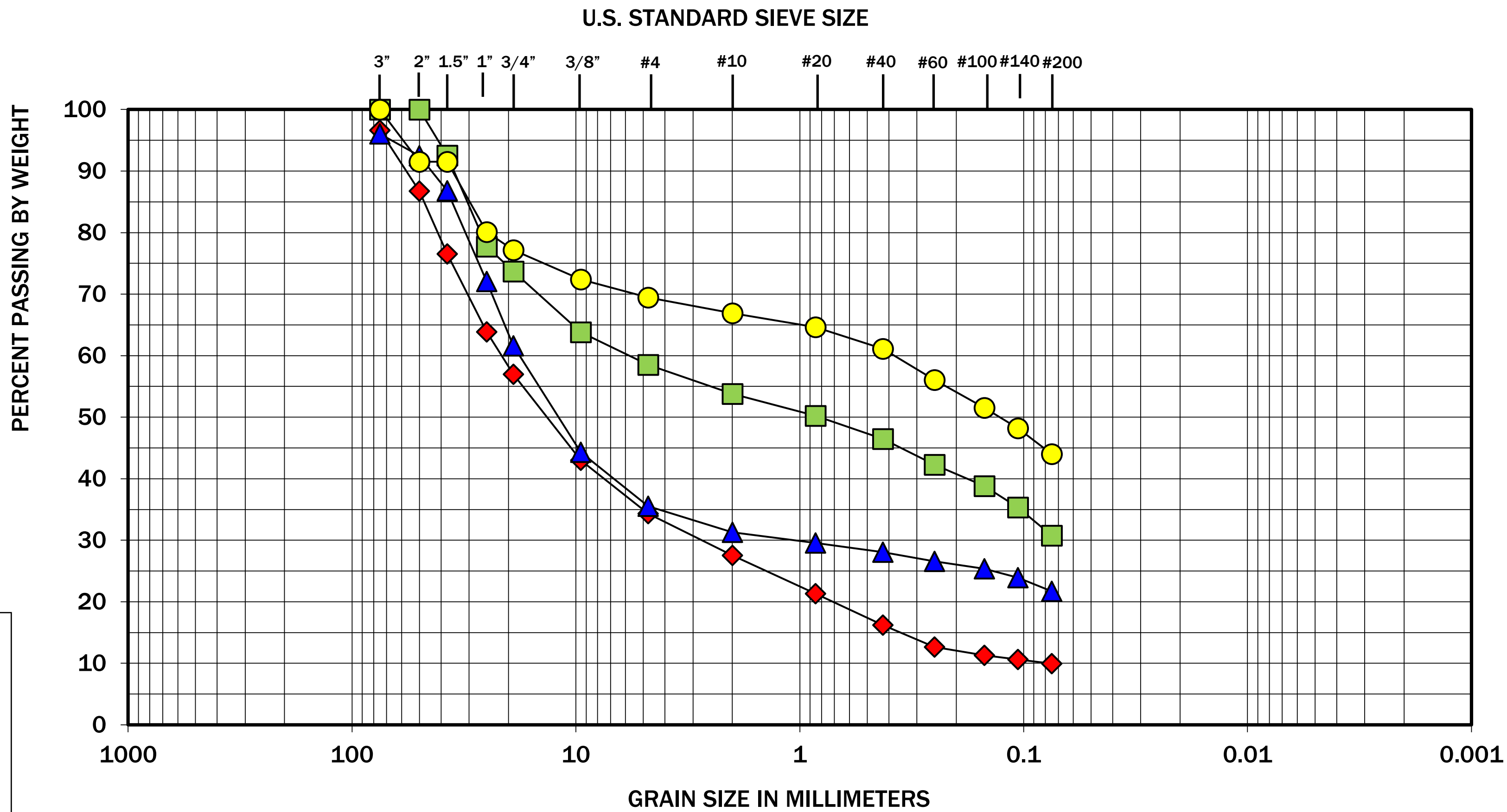
Project: Pierce College Puyallup - STEM Building Design Services
Project Location: Puyallup, Washington
Project Number: 21342-002-01

Figure A-8
Sheet 1 of 1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆ (red diamond)	TP-1	13	9	Poorly graded gravel with silt and sand (GP-GM)
■ (green square)	TP-2	6	10	Silty gravel with sand (GM)
▲ (blue triangle)	TP-3	12.5	27	Silty gravel (GM)
● (yellow circle)	TP-5	8.5	11	Silty gravel with sand (GM)

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The grain size analysis results were obtained in general accordance with ASTM C 136. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

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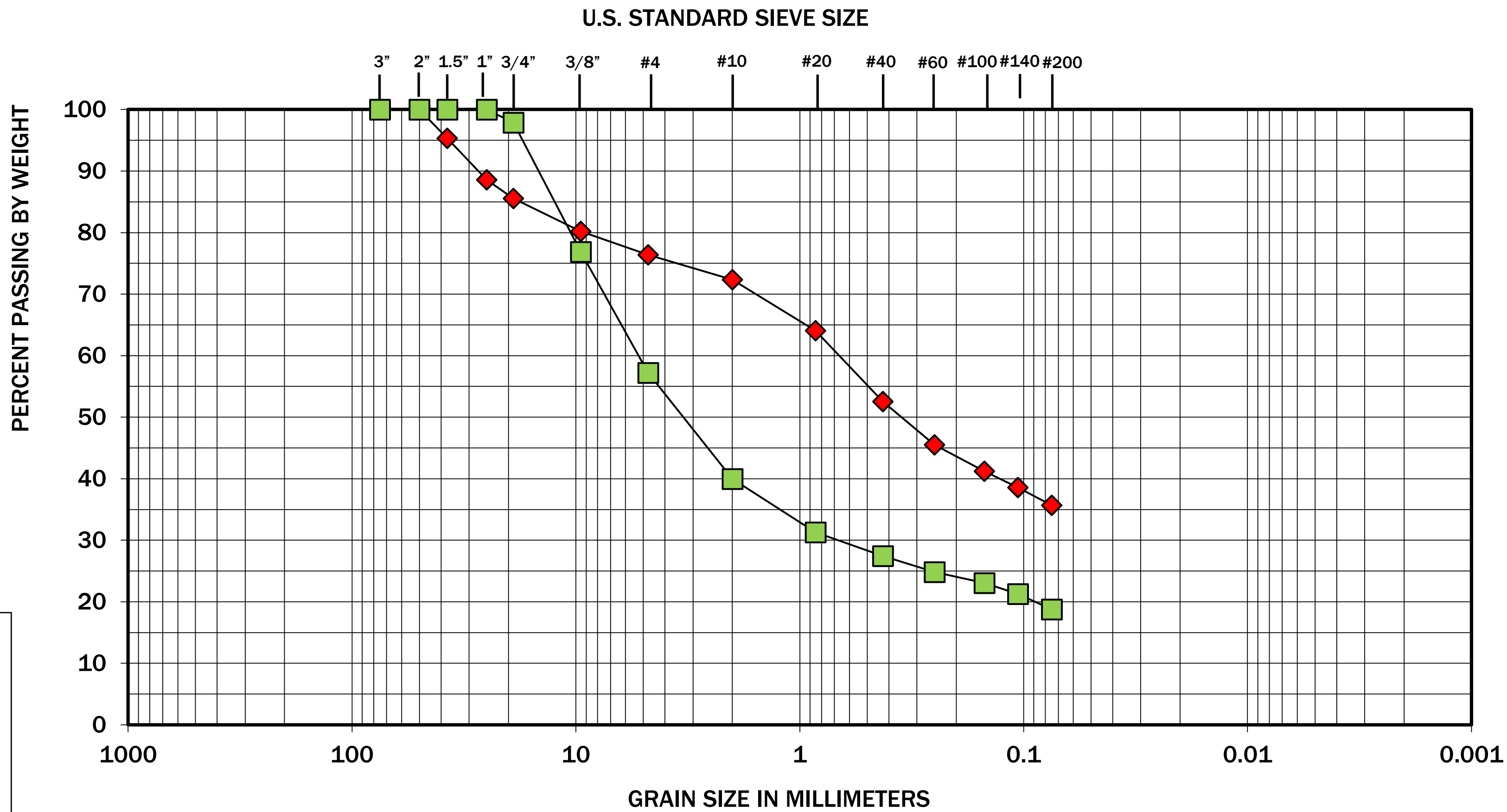
Pierce College – STEM Building Design
Puyallup, Washington

Sieve Analysis Results

Figure A–9

21342-002-01 Date Exported: 04/19/2022



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	TP-6	12	9	Silty sand with gravel (SM)
■	MW-1	15-20	8	Silty gravel with sand (GM)

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The grain size analysis results were obtained in general accordance with ASTM C 136. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

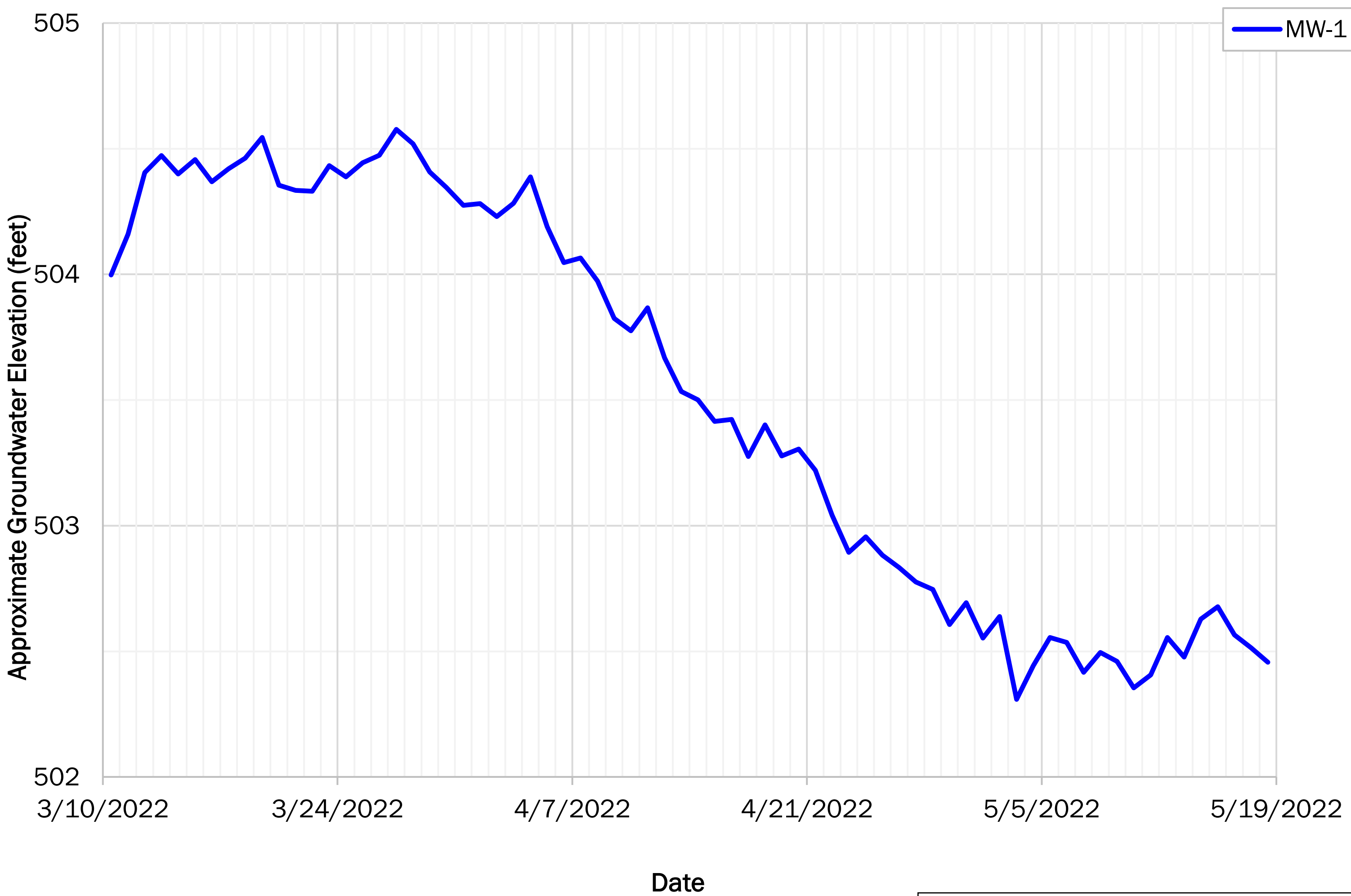
GeoEngineers

Sieve Analysis Results

Pierce College – STEM Building Design
Puyallup, Washington

Figure A-10

Groundwater Hydrograph



Note:
1. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Groundwater Hydrograph	
STEM Building Design Services Puyallup, Washington	
GeoEngineers	Figure A-11

GeoEngineers

PIERCE COLLEGE – PUYALLUP: STEM BUILDING PROJECT

WETLAND ANALYSIS REPORT

Grette Associates LLC
ENVIRONMENTAL CONSULTANTS

PIERCE COLLEGE – PUYALLUP: STEM BUILDING PROJECT

WETLAND ANALYSIS REPORT

PREPARED FOR:

SARA WILDER, AIA
117 SOUTH MAIN STREET, SUITE 100
SEATTLE, WA 98104

PREPARED BY:

GRETTE ASSOCIATES[LLC]
2102 NORTH 30TH STREET, SUITE A
TACOMA, WASHINGTON 98403
(253) 573-9300

APRIL 25, 2022

JANAE DINKINS
BIOLOGIST

DATE

CHAD WALLIN
BIOLOGIST
PIERCE COUNTY QUALIFIED WETLAND SPECIALIST

Grette Associates[LLC]
ENVIRONMENTAL CONSULTANTS

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1 INTRODUCTION

Grette Associates is under contract to prepare a wetland analysis report that summarizes the critical areas reconnaissance performed in the northeast portion of Pierce College's Puyallup Campus (Figure 1).

The purpose of this critical areas report is to provide a summary of the two areas where the proposed project will discharge stormwater as well as document all wetlands that are located within 300 feet of Pierce College's STEM project for conformance with Chapter 21.06 of the Puyallup Municipal Code (PMC).

Figure 1. Vicinity map

[1] Pierce College's Puyallup Campus is highlighted in yellow.

2 FEATURE SUMMARY

A Grette Associates qualified wetland professional and a Grette Associates biologist visited the campus on March 22, 2022 to identify any wetlands within 300 feet of the proposed project site (Appendix A).

Grette Associates collected wetland delineation data and delineated one wetland feature (Wetland A; Appendix A) that contained all three wetland criteria defined in the U.S. Army Corps of Engineers (USACE) *Federal Wetland Delineation Manual* (1987), and the USACE's *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)* (2010). Wetland A was rated according to PMC 21.06.910 and the Washington State Department of Ecology's (Ecology) *Washington State Wetland Rating System for Western WA – 2014 Update* (Hruby 2014). A wetland delineation summary, field datasheets and wetland rating form are presented in Appendices B, C and D, respectively. A summary of the delineated wetland is provided in Table 1.

Given the substantial development (i.e., College Way) which serves as a buffer interruption[1], the proposed project will not impact Wetland A or its associated buffer.

Table 1. Wetland delineation summary

Feature	Cowardin Class[2]	Hydrology Modifier	HGM Class	Wetland Category	Buffer Width[3]
A	PEM/SS	Seasonally Flooded and Saturated	Depressional	III	80 ft.

[1] Classification based on Cowardin et al. (1979).
[2] Buffers are based on PMC 21.06.930.

3 BACKGROUND

3.1 Local Critical Areas Inventory

The City of Puyallup's Public Data Viewer was queried to determine if there are any wetlands mapped in the vicinity of the proposed project site. According the City's database, there is a wetland feature mapped north of Pierce College's STEM project location (Appendix D).

3.2 National Wetlands Inventory

The U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) was queried to determine if previously-identified wetlands are present within 300 feet of the project site (USFWS 2022). According to the NWI Interactive Online Mapper, there were no wetlands identified within 300 feet of the project site.

3.3 Sensitive Wildlife and Plants

The Washington Department of Fish and Wildlife's (WDFW) Priority Habitats and Species (PHS) database on-line mapper was queried to determine if state or federally listed fish or wildlife species occur near the proposed project site (WDFW 2022). According to the PHS database, no priority species or habitats are mapped in the vicinity of the project site (Appendix D).

The Washington Department of Natural Resources' (WDNR) Wetlands of High Conservation Value mapper was queried to determine if the general campus area occurs in a location reported to contain high quality natural heritage wetland occurrences or occurrences of natural heritage features commonly associated with wetlands (WDNR 2022a). According to WDNR's mapper, there are no records of rare plants or high-quality native ecosystems occurring on or in the vicinity of the campus (Appendix D).

[1] While Chapter 21.06 of the PMC does not address buffer interruptions, Grette Associates was informed by the City's Planning Division (C. Beale, personal communication, December 13, 2021). According to the City's peer-review specialist, it is best available science that substantial development (e.g., paved roads) serve as a buffer interruption.

3.4 State Water Classification System

The Washington Department of Natural Resources' (WDNR) Mapping Tool on-line mapper was queried to identify the water typing of any streams mapped by WDNR (WDNR 2022b). According to WDNR, no stream features are mapped in the vicinity of the campus (Appendix D).

3.5 Soil Information

According to the Natural Resources Conservation Service's (NRCS) Web Soil Survey (NRCS 2022a), the soils within the general assessed area consist of Everett very gravelly sandy loam (0-8 percent slopes), Kapowsin gravelly ashy loam (0-6 percent slopes), Kapowsin gravelly ashy loam (6-15 percent slopes), and Kapowsin gravelly ashy loam (30-65 percent slopes). According to the NRCS, these mapped soils are not listed as hydric.

4 METHODS

The areas in the vicinity of the project site were traversed and data were collected to confirm wetland boundaries. The identified wetland was delineated according to the procedures described in the USACE's *Federal Wetland Delineation Manual* (1987), and the USACE's *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)* (2010). Paired data plots and soil test pits were excavated to evaluate wetland and upland conditions. Guidance from the USACE's *Regional Supplement* was used to evaluate the data at each data point.

The boundary of the wetland was established based on changes in vegetation, field indicators of hydric soils, water levels at or below 12 inches, topographic changes, and best professional judgment. Data plots were established in and adjacent to the wetland. The location of the wetland boundary was defined by placement of florescent orange flagging tape. The location of each data plot was defined by the placement of pink flagging tape. The wetland boundary flagging was labeled alpha-numerically (i.e., A-2), where the letter designates the wetland and the number designates the specific flag angle point. Please note that only the southern extent of the wetland that is near the project site was flagged.

Plants were determined to be more or less associated with wetlands based on their wetland indicator (FAC) status. The percent dominance for each plant strata was determined using the 50-20 Rule, which is the recommended method for selecting dominant species from a plant community in instances where quantitative data are available (USACE 2010). In utilizing this rule, dominants are the most abundant species that individually or collectively accounts for more than 50 percent of the total coverage of vegetation in the stratum plus any other species that, by itself accounts for at least 20 percent of the total.

4.1 Hydrophytic Vegetation

The U.S. Fish and Wildlife Service (USFWS) and the NWI have established a rating system that has been applied to commonly occurring plant species on the basis of their frequency of occurrence in wetlands (Table 2). Species indicator status expresses the range in which plants may occur in wetlands and non-wetlands (uplands). Under this system, vegetation is considered hydrophytic when there is an indicator status of facultative (FAC), facultative wetland (FACW) or obligate wetland (OBL) (Table 2). The hydrophytic vegetation criterion for wetland determination is met when ***more than*** 50 percent of the dominant species in the plant community are FAC or wetter. The USACE's *National Wetland Plant List* (USACE 2020) was used to determine vegetation indicator status.

Table 2. Definitions for USFWS plant indicator status

Plant Indicator Status Category	Indicator Status Abbreviation	Definition (Estimated Probability of Occurrence)
Obligate Upland	UPL	Occur rarely (<1 percent) in wetlands, and almost always (>99 percent) in uplands
Facultative Upland	FACU	Occur sometimes (1 percent to <33 percent) in wetlands, but occur more often (>67 percent to 99 percent) in uplands
Facultative	FAC	Similar likelihood (33 percent to 67 percent) of occurring in both wetlands and uplands
Facultative Wetland	FACW	Occur usually in wetlands (>67 percent to 99 percent), but also occur in uplands (1 percent to 33 percent)
Obligate Wetland	OBL	Occur almost always (>99 percent) in wetlands, but rarely occur in uplands (<1 percent)
Not Listed	NL	Not listed due to insufficient information to determine status

4.2 Wetland Hydrology

Evidence of permanent or periodic inundation (water marks, drift lines, drainage patterns), or soil saturation to the surface for 14 consecutive days or more during the growing season meets the hydrology criterion. Oxidized root channels in the top 12 inches and hydrogen sulfide are primary indicators and water-stained leaves and geomorphic position are secondary indicators of wetland hydrology.

4.3 Hydric Soils

Soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper soil horizons are considered hydric soils. Field indicators include histosols, the presence of a histic epipedon, a sulfidic odor, low soil chroma, and gleying. Soil conditions were compared to the Field Indicators of Hydric Soils detailed in the USACE's *Regional Supplement*.

5 PRECIPITATION ANALYSIS

The Puyallup 2.1 ESE, WA Weather Station (US1WAPR0020) recorded no rainfall during the day of the assessment (NOAA 2022). In the 14 days preceding the site assessment, 0.06 inches of rainfall was recorded at the station (NOAA 2022).

The total precipitation recorded at the Puyallup 2.1 ESE station from October 1, 2022 through March 22, 2022 (33.56 inches) was approximately 109 percent of the normal rainfall (30.78 inches) that occurs during the same time (NOAA 2022).

Table 3 below presents an analysis of the appropriate NRCS WETS table (NRCS 2022b) for the three months preceding the field investigation. Please note that the Puyallup 2.1 ESE weather station does not provide WETS data; therefore, the WETS data for McMillin Reservoir (NWS Station 455224) was used. These two stations are located approximately at the same distance from the project site and also situated at similar elevations. Precipitation data from the McMillin Reservoir station was not used in this analysis because the station did not have complete data for the month of February.

Table 3. WETS precipitation analysis Puyallup 2.1 ESE

Preceding Month	WETS Rainfall Percentile[1] (inches)		Measured Rainfall[2] (inches)	Conditions[3]	Condition Value[4]	Month Weight	Value
	30%	70%					
March	3.53	5.00	5.10	Wet	3	3	9
February	3.12	5.58	0.75	Dry	1	2	2
January	3.76	6.62	7.65	Wet	3	1	3
						Sum:	14

[1] WETS percentile was populated from the McMillin Reservoir
[2] Observed rainfall for the month (NOAA 2022)
[3] Dry conditions are below 30% WETS table value, Normal conditions are between 30% and 70% of the WETS table values, Wet conditions are above 70% of the WETS table value.
[4] Dry equals a value of 1, normal equals a value of 2, wet equals a value of 3
[5] Due to the timing of the site assessment, March precipitation results were included in this analysis.

Bins were established to determine the overall rainfall period during the field investigation; drier (sum is 6-9), normal (sum is 10-14), wet (sum is 15-18). A sum of 14 indicates that hydrologic conditions are normal.

6 WETLAND RESULTS

6.1 Wetland A

Wetland A is a palustrine emergent/scrub-shrub wetland the is situated in the northeast portion of the campus (Appendix A). Wetland A is hydrogeomorphically classified as a depressional wetland (Appendix D).

Vegetation within wetland A consist of red alder saplings (*Alnus rubra*, FAC), spiraea (*Spiraea douglasii*, FACW), water parsley (*Oenanthe sarmentosa*, OBL) and reed canary grass (*Phalaris arundinacea*, FACW). Also, skunk cabbage (*Lysichiton americanus*, OBL) was observed in the wetland as well. The wetland vegetation observed largely supports FACW and OBL species.

Soils observed within Wetland A were unconsolidated due to the high-water table and soil saturation. Based on these conditions, soils were not able to be accurately evaluated; however, it is Grette Associates' professional opinion that the soils evaluated meets the technical definition of hydric soils. Given the predominance of vegetation that generally has an association with prolonged inundation and/or soil saturation as well as hydrology indicators of prolonged inundation (e.g., algal mat) that were observed within the wetland, the soils within Wetland A are likely saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper soil horizons.

Wetland hydrology observed within the wetland consisted of shallow surface water, alga mat present, saturation, and water table.

6.2 Stormwater Pond

According to the information provided to Grette Associates, there is a potential wetland feature situated east of the project site and in one area where the project would discharge stormwater. Based on Grette Associates' assessment, the area mapped as potential wetland is a constructed stormwater pond that appears to collect stormwater from the eastern portion of campus (Figures 2 and 3).

Per PMC 21.06.210, wetlands do not include those artificial wetlands intentionally created from non-wetland sites which include, but not limited to, drainage ditches, grass-lined swales, and detention facilities. Therefore, it is Grette Associates' professional opinion, that the stormwater pond is not classified as wetland and subject to the requirements defined in Chapter 21.06 of the PMC.

Figure 2. Stormwater Pond Conveyance Features

[1]The photograph on the left captures the stormwater pond outlet pipe located in the southeastern portion of the stormwater pond and the photograph on the right captures a stormwater catch basin located on top of the earthen berm associated with the stormwater pond.

Figure 3. Stormwater Pond Conditions

6.3 Wetland Categorization

To determine the categorization of Wetland A based on function, the wetland classification guidelines in Ecology's wetland rating system (Hruby 2014) were used. Based on this guidance, each wetland was given a score for each of three functions: Water Quality, Hydrology, and Habitat (Table 4).

Table 4. Wetland rating and categorization summary

Feature	Cowardin Class	HGM Class	Water Quality	Hydrology	Habitat	Total	Category
Wetland A	PEM/SS	Depressional	8	6	5	19	III

Per Chapter 21.06 of the PMC, wetlands are subject to a buffer to protect the integrity and function of said feature. According to PMC 21.06.930, Category III wetlands providing less than moderate habitat function and with high land use are subject to an 80-foot buffer.

6.4 Project Impacts and Stormwater Management

Per PMC 21.06.530, a critical areas report shall include a description of the proposed stormwater management plan, an assessment of potential impacts to critical areas and their associated buffers, and an analysis of mitigation measures taken to avoid and minimize critical area impacts.

The proposed project will be constructed south of College Way which serves as a buffer interruption[2]. As such, the proposed project will not impact Wetland A (north of College Way) or its associated buffer and has therefore demonstrated that the proposed project has implemented all measures to avoid and minimize wetland impacts. Please refer to the stormwater analysis, or like document, that was submitted in support of the proposed project which addresses the proposed stormwater discharge into Wetland A.

6.5 Regulatory Considerations

Wetlands are regulated by agencies at the local, state, and federal levels. At the local level, wetlands and their associated buffers in the City of Puyallup are regulated under the City's critical areas ordinance (Chapter 21.06 of the PMC).

At the state level, wetlands are regulated by the Washington State Department of Ecology through the federal Clean Water Act (Section 401). The requirement for a Water Quality Certification from Ecology for wetland impacts is triggered by an applicant's applying for a federal Clean Water Act Section 404 permit from the USACE. Ecology may also issue an Administrative Order through RCW 90.48 (Water Pollution Control Act), allowing them wetland regulatory authority over Waters of the State without a federal nexus.

At the federal level, impacts (specifically dredging or filling) to wetlands are regulated by the Environmental Protection Agency through the US Army Corps of Engineers. The USACE administers the federal Clean Water Act (Section 404) for projects involving dredging or filling in Waters of the US (lakes, streams, marine waters, and most non-isolated wetlands).

While it is the regulatory agencies that make the final determination regarding jurisdictional status, project proponents can infer jurisdiction using the guidance provided by each agency or local government. This inference can be used to design a project based on the anticipated regulatory constraints within the project area. However, it is the project proponent's responsibility to contact each potential regulating agency and confirm their regulatory status and requirements.

[2] C. Beale, personal communication, December 13, 2021).

6.6 Disclaimer

The findings and conclusions documented in this report have been prepared for specific application to this proposed project site. They have been developed in a manner consistent with that level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area. Our work was also performed in accordance with the terms and conditions set forth in our proposal. The conclusions and recommendations presented in this report are professional opinions based on an interpretation of information currently available to us and are made within the operation scope, budget, and schedule of this project. No warranty, expressed or implied, is made. In addition, changes in government codes, regulations, or laws may occur. Because of such changes, our observations and conclusions applicable to this site may need to be revised wholly or in part.

Wetland boundaries are based on conditions present at the time of the site visit and considered preliminary until the flagged wetland and/or drainage boundaries are validated by the appropriate jurisdictional agencies. Validation of the boundaries by the regulating agencies provide a certification, typically in writing, that the wetland boundaries verified are the boundaries that will be regulated by the agencies until a specific date or until the regulations are modified. Only the regulating agencies can provide this certification.

Since wetlands are dynamic communities affected by both natural and human activities, changes in wetland boundaries may be expected. Because of such changes, our observations and conclusions applicable to this site may need to be revised wholly or in part.

7 BIOLOGIST QUALIFICATIONS

7.1 Janae Dinkins

Janae Dinkins is a Biologist with training in wetland delineation and ecologic restoration. Janae also has professional experience in stream and buffer restoration, marine aquatic sampling, mitigation monitoring, and fish and wildlife assessments.

Janae has earned Bachelors of Science degrees in Wildlife & Fisheries and Soil & Crop Sciences from Texas A&M University.

For a list of representative projects, please contact her at Grette Associates.

7.2 Chad Wallin

Chad Wallin is a Biologist with extensive training in wetland science and ecology restoration. Chad also has professional experience in stream and fish restoration, marine monitoring, mitigation monitoring, and fish and wildlife assessments.

Chad has earned a Bachelor's of Arts degree in Environmental Studies from the University of Washington along with certificates in ecology restoration and wetland science.

For a list of representative projects, please contact him at Grette Associates.

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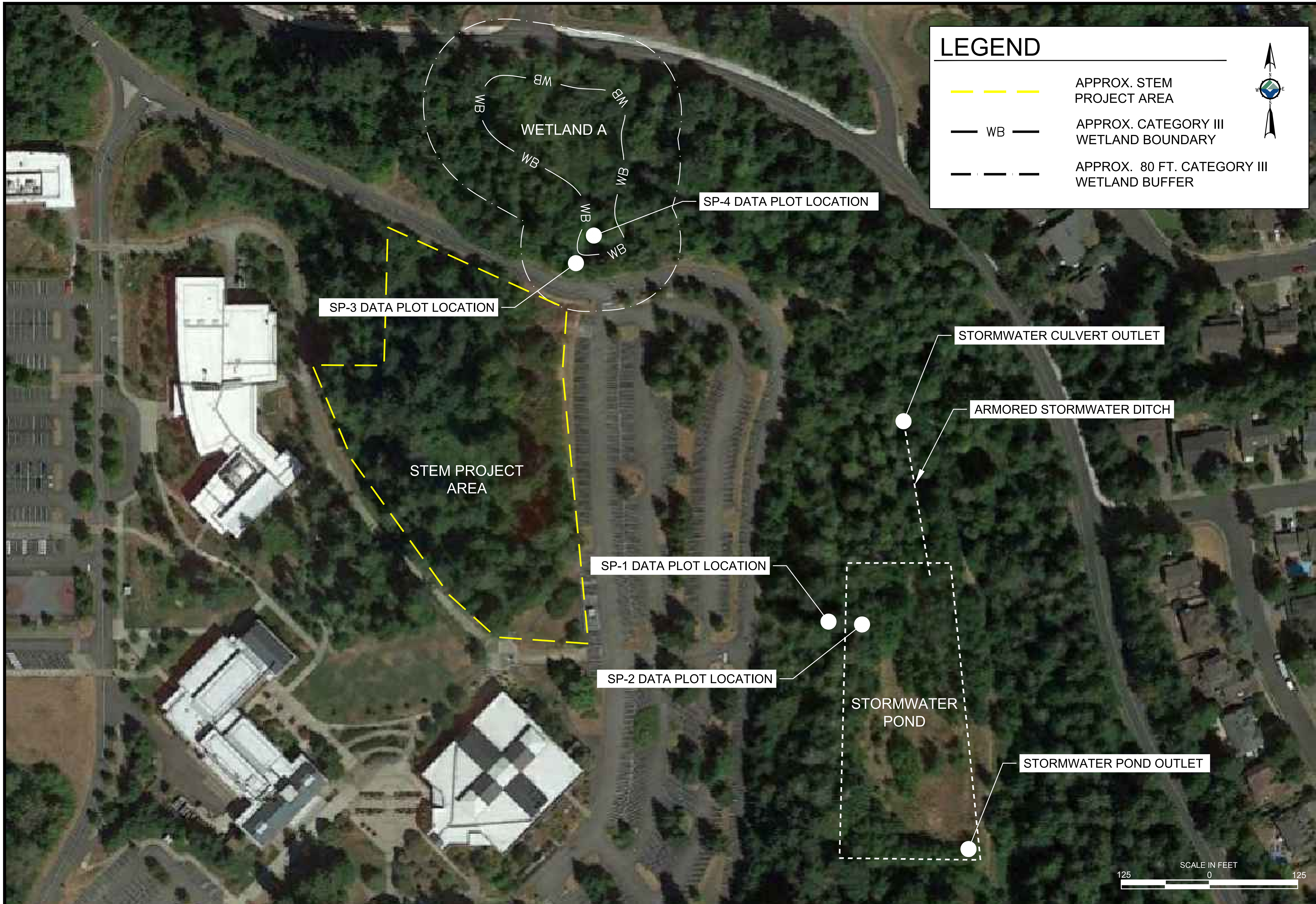
PIERCE COLLEGE-PUYALLUP CAMPUS: STEM PROJECT

WETLAND ANALYSIS REPORT

APPENDIX A: WETLAND DELINEATION MAP



Grette Associates LLC
ENVIRONMENTAL CONSULTANTS
2102 North 30th Street, Suite A
TACOMA, WA 98403
(253) 573-9300
gretteassociates.com

PROJECT #: 3062.001
DESIGNED BY: CW DATE: 04/28/22
CHECKED BY: SM DATE: 04/28/22
CLIENT: INTEGRUS ARCHITECTURE

PIERCE COLLEGE - PUYALLUP CAMPUS
STEM PROJECT
WETLAND ANALYSIS REPORT

DRAWING SCALE: SEE SCALE BAR
SITE ADDRESS: PUYALLUP, WA

DELINEATION MAP

SHEET 1 OF 1

PIERCE COLLEGE-PUYALLUP CAMPUS: STEM PROJECT

WETLAND ANALYSIS REPORT

APPENDIX B: WETLAND SUMMARY

WETLAND A SUMMARY

Approximate Size (sq. ft.):	-
Cowardin Classification[1]:	PEM/SS
HGM Classification[2]:	Depressional
Wetland Category[3]:	III
Wetland Buffer Width[4]:	80 ft.
Sample Plot Total[5]:	2
Hydrophytic Vegetation Present (Y/N)?	Yes
Hydric Soil Indicator?	Yes
Wetland Hydrology Present?	Yes

Summary of Findings

Dominant Vegetation:	The scrub-shrub area predominately consists of a spiraea (*Spiraea douglasii*) with an understory of native and non-native vegetation. The emergent area largely consists of reed canarygrass (*Phalaris arundinacea*) and skunk cabbage (*Lysichiton americanus*).
Soil Profile:	The soils observed in Wetland A were unconsolidated and were note able to be accurately evaluated.
Primary Hydrological Support:	Hydrologic support for Wetland A is primarily provided by high groundwater table and stormwater discharge.

Wetland Data Plot:

Upland Data Plot:

Notes:
[1] Classification based on Cowardin et al. (1979).
[2] HGM classification based on Brinson, M.M. (1993).
[3] Wetland rating was determined based on the guidelines defined in the local municipal code.
[4] Wetland buffer was determined based on the local municipal code.
[5] Sample plot total includes the collective amount of wetland and upland samples plots examined to define the wetland boundary.

PIERCE COLLEGE-PUYALLUP CAMPUS: STEM PROJECT

WETLAND ANALYSIS REPORT

APPENDIX C: WETLAND DATASHEETS

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project Site: PC - Puyallup Campus - STEM   City/County: Puyallup / Pierce   Sampling Date: 3/22/22

Applicant/Owner: ______   State: WA   Sampling Point: SP-1

Investigator(s): [illegible]   Section, Township, Range: ______

Landform (hillslope, terrace, etc.): Slope   Local relief (concave, convex, none): ____   Slope (%): ±35%

Subregion (LRR): ______   Lat: ______   Long: ______   Datum: ______

Soil Map Unit Name: ______   NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐, significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐, naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐	Is the Sampled Area within a Wetland?	Yes ☐ No ☒
Hydric Soil Present? Yes ☐ No ☒		
Wetland Hydrology Present? Yes ☐ No ☒		

Remarks: SP-1 near toe of slope at stormwater pond

VEGETATION – Use scientific names of plants

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. POBA	50%	Y	FAC
2. ALRU	20%	Y	FAC
3. THPL	5%	N	FAC
4.			
50% = ____, 20% = ____	75%	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. GASH	10%	Y	FACU
2.			
3.			
4.			
5.			
50% = ____, 20% = ____	10%	= Total Cover	
Herb Stratum (Plot size: 5')			
1. Misc. grass spp.	80%	Y	FAC®
2. moss	10%	N	–
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
50% = ____, 20% = ____	90%	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
50% = ____, 20% = ____		= Total Cover	

% Bare Ground in Herb Stratum ____

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	____	x1 =	____
FACW species	____	x2 =	____
FAC species	____	x3 =	____
FACU species	____	x4 =	____
UPL species	____	x5 =	____
Column Totals:	____ (A)		____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ☐ 1 – Rapid Test for Hydrophytic Vegetation
- ☒ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ☒ No ☐

Remarks:

Project Site: _____

SOIL

Sampling Point: SP-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-4"	10YR3/2	100%					Sandy loam	
4-18"+	10YR4/4	100%					loamy sand	w/small gravel

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ±18"

Depth (inches): gravelly hardpan

Hydric Soils Present? Yes ☐ No ☒

Remarks:

No redox observed.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stresses Plants (D1) **(LRR A)**
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) **(LRR A)**
- ☐ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Soils moist

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project Site: Pierce College - Puyallup STEM City/County: Puyallup/Pierce Sampling Date: 3/22/22
Applicant/Owner: ______ State: WA Sampling Point: SP-2
Investigator(s): Wall Section, Township, Range: ______
Landform (hillslope, terrace, etc.): Flat/depression Local relief (concave, convex, none): ____ Slope (%): ____
Subregion (LRR): ______ Lat: ______ Long: ______ Datum: ______
Soil Map Unit Name: ______ NWI classification: ______
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☐ (If no, explain in Remarks.)
Are Vegetation ☐, Soil ☐, or Hydrology ☐, significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐, naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐	Is the Sampled Area within a Wetland?	Yes ☒ No ☐
Hydric Soil Present? Yes ☒ No ☐		
Wetland Hydrology Present? Yes ☒ No ☐		

Remarks: SP-2 situated w/ NW corner of stormwater pond.

VEGETATION – Use scientific names of plants

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. POBA	20%	Y	FAC
2. ALRU	15%	Y	FAC
3.			
4.			
50% = ____, 20% = ____	35%	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
50% = ____, 20% = ____		= Total Cover	
Herb Stratum (Plot size: 5')			
1. JUEF	10%	N	FACW
2. Mix. grasses	80%	Y	FAC(R)
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
50% = ____, 20% = ____	90%	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
50% = ____, 20% = ____		= Total Cover	
% Bare Ground in Herb Stratum ____			

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)
Total Number of Dominant Species Across All Strata: 3 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	____	x1 =	____
FACW species	____	x2 =	____
FAC species	____	x3 =	____
FACU species	____	x4 =	____
UPL species	____	x5 =	____
Column Totals:	____ (A)		____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ☐ 1 – Rapid Test for Hydrophytic Vegetation
- ☒ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ☒ No ☐

Remarks:

Project Site: ____

SOIL

Sampling Point: SP-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-5"	10YR2/2	100%					Sandy Silt	
5-16"	7.5YR4/2	90%	7.5YR4/6	10%	C	M	Silty Sand	

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☒ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type: gravelly hardpan
Depth (inches): 16"

Hydric Soils Present? Yes ☒ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☒ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stresses Plants (D1) **(LRR A)**
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☒ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) **(LRR A)**
- ☒ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ☒	No ☐	Depth (inches):	surface ⊛
Water Table Present?	Yes ☐	No ☒	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ☒	No ☐	Depth (inches):	@ surface

Wetland Hydrology Present? Yes ☒ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Soils saturated w/ upper soil layer (0-5") but just moist below.
⊛ surface water (±2"-3" deep) w/ 24" of pit.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project Site: Pierce College – Puyallup STEM City/County: Puyallup/Pierce Sampling Date: 3/22/22
Applicant/Owner: ______ State: WA Sampling Point: SP-3
Investigator(s): Walker Section, Township, Range: ______
Landform (hillslope, terrace, etc.): Flat/Slope Local relief (concave, convex, none): ____ Slope (%): <2%
Subregion (LRR): ______ Lat: ______ Long: ______ Datum: ______
Soil Map Unit Name: ______ NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☐ (If no, explain in Remarks.)
Are Vegetation ☐, Soil ☐, or Hydrology ☐, significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐, naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☒ No ☐	Is the Sampled Area within a Wetland? Yes ☐ No ☒
Hydric Soil Present?	Yes ☐ No ☒	
Wetland Hydrology Present?	Yes ☐ No ☒	

Remarks: SP-3 situated near stormwater culvert that discharges to wetland. SP-3 south of flagged boundary

VEGETATION – Use scientific names of plants

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. ALRU	40%	Y	FAC
2. THPL	10%	Y	FAC
3.			
4.			
50% = ___, 20% = ___	50%	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. RUDI	75%	Y	FAC
2.			
3.			
4.			
5.			
50% = ___, 20% = ___	75%	= Total Cover	
Herb Stratum (Plot size: 5')			
1. Stinging Nettle	20%	FAC	Y
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
50% = ___, 20% = ___	20%	= Total Cover	
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
50% = ___, 20% = ___		= Total Cover	
% Bare Ground in Herb Stratum ___			

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)
Total Number of Dominant Species Across All Strata: 4 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	___	x1 =	___
FACW species	___	x2 =	___
FAC species	___	x3 =	___
FACU species	___	x4 =	___
UPL species	___	x5 =	___
Column Totals:	___ (A)		___ (B)

Prevalence Index = B/A = ___

Hydrophytic Vegetation Indicators:

- ☐ 1 – Rapid Test for Hydrophytic Vegetation
- ☒ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ☒ No ☐

Remarks:

Project Site: _____

SOIL

Sampling Point: SP-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR3/3	100%					loam	
8-18+	7.5YR4/3	75%	7.5YR4/6	5%	C	M	silty loam	

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type: _____
Depth (inches): _____

Hydric Soils Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stresses Plants (D1) **(LRR A)**
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) **(LRR A)**
- ☐ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches): _____
Water Table Present? Yes ☐ No ☑ Depth (inches): _____
Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Soils moist

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project Site: Pierce College - Puyallup STEM City/County: Puyallup/Pierce Sampling Date: 3/22/22

Applicant/Owner: ______ State: WA Sampling Point: SP-4

Investigator(s): Walk Section, Township, Range: ______

Landform (hillslope, terrace, etc.): Depressional Local relief (concave, convex, none): ____ Slope (%): ____

Subregion (LRR): ______ Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: ______ NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐, significantly disturbed? Are "Normal Circumstances" present? Yes ☐ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐, naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☒ No ☐	Is the Sampled Area within a Wetland? Yes ☒ No ☐
Hydric Soil Present?	Yes ☒ No ☐	
Wetland Hydrology Present?	Yes ☒ No ☐	

Remarks: SP-4 situated w/ southern portion of wetland

VEGETATION – Use scientific names of plants

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. ALRU	20%	Y	FAC
2.			
3.			
4.			
50% = ____, 20% = ____	20%	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
50% = ____, 20% = ____		= Total Cover	
Herb Stratum (Plot size: 5')			
1. PHAR	40%	Y	FACW
2. OESA	20%	Y	OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
50% = ____, 20% = ____	60%	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
50% = ____, 20% = ____		= Total Cover	
% Bare Ground in Herb Stratum 40%			

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	____	x1 = ____
FACW species	____	x2 = ____
FAC species	____	x3 = ____
FACU species	____	x4 = ____
UPL species	____	x5 = ____
Column Totals:	____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ☐ 1 – Rapid Test for Hydrophytic Vegetation
- ☒ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ☒ No ☐

Remarks: Evergreen huckleberry & elderberry are w/ plot, however, these species are growing on a mound and not reflective of wetland. As a result, not included in plot.

Project Site: ____

SOIL

Sampling Point: SP-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☒ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____

Depth (inches): ____

Hydric Soils Present? Yes ☒ No ☐

Remarks:

Soils unconsolidated due to water table and saturation.
Given FACW and OBL species observed and geo. position, soils likely meet hydric soil definition

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☒ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stresses Plants (D1) **(LRR A)**
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) **(LRR A)**
- ☐ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ☒	No ☐	Depth (inches): ±6" (*)
Water Table Present?	Yes ☒	No ☐	Depth (inches): surface
Saturation Present? (includes capillary fringe)	Yes ☒	No ☐	Depth (inches): Surface

Wetland Hydrology Present? Yes ☒ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

(*) surface water w/ 24" of plot

PIERCE COLLEGE-PUYALLUP CAMPUS: STEM PROJECT

WETLAND ANALYSIS REPORT

APPENDIX D: WETLAND RATING FORM

Wetland name or number A

RATING SUMMARY – Western Washington

Name of wetland (or ID #): PC-Pierce College- STEM Date of site visit: 03/22/22

Rated by J. Dinkins Trained by Ecology? ☑ Yes ☐ No Date of training 2021

HGM Class used for rating Depressional Wetland has multiple HGM classes? ☐ Y ☑ N

NOTE: **Form is not complete without the figures requested** *(figures can be combined)*.
Source of base aerial photo/map Google

OVERALL WETLAND CATEGORY III (based on functions ☑ or special characteristics ☐)

1. Category of wetland based on FUNCTIONS

- ☐ **Category I** – Total score = 23 - 27
- ☐ **Category II** – Total score = 20 - 22
- ☑ **Category III** – Total score = 16 - 19
- ☐ **Category IV** – Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
			Circle the appropriate ratings	
Site Potential	H ☑ M ☐ L ☐	H ☐ M ☑ L ☐	H ☐ M ☑ L ☐	
Landscape Potential	H ☐ M ☑ L ☐	H ☑ M ☐ L ☐	H ☐ M ☐ L ☑	
Value	H ☑ M ☐ L ☐	H ☐ M ☐ L ☑	H ☐ M ☑ L ☐	TOTAL
Score Based on Ratings	8	6	5	19

Score for each function based on three ratings
(order of ratings is not important)

9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	I ☐ II ☐
Wetland of High Conservation Value	I ☐
Bog	I ☐
Mature Forest	I ☐
Old Growth Forest	I ☐
Coastal Lagoon	I ☐ II ☐
Interdunal	I☐ II☐ III☐ IV☐
None of the above	☑

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Maps and figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	Fig. 1
Hydroperiods	D 1.4, H 1.2	Fig. 2
Location of outlet (*can be added to map of hydroperiods)*	D 1.1, D 4.1	Fig. 2
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	D 2.2, D 5.2	Fig. 1
Map of the contributing basin	D 4.3, D 5.3	Fig. 3
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	Fig. 4
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	Fig. 5
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	Fig. 6/7

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Ponded depressions	R 1.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	R 2.4	
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	
Width of unit vs. width of stream *(can be added to another figure)*	R 4.1	
Map of the contributing basin	R 2.2, R 2.3, R 5.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	R 3.1	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	

Lake Fringe Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	L 1.1, L 4.1, H 1.1, H 1.4	
Plant cover of trees, shrubs, and herbaceous plants	L 1.2	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	L 2.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	L 3.1, L 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	L 3.3	

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of **dense** trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of **dense, rigid** trees, shrubs, and herbaceous plants (*can be added to figure above)*	S 4.1	
Boundary of 150 ft buffer (can be added to another figure)	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

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HGM Classification of Wetlands in Western Washington

> For questions 1-7, the criteria described must apply to the entire unit being rated.
>
> If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

☑ NO – go to 2 ☐ **YES** – the wetland class is **Tidal Fringe** – go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

☐ **NO – Saltwater Tidal Fringe (Estuarine)** ☐ **YES – Freshwater Tidal Fringe**

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is an **Estuarine** wetland and is not scored. This method **cannot** be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

☑ NO – go to 3 ☐ **YES** – The wetland class is **Flats**

*If your wetland can be classified as a Flats wetland, use the form for **Depressional** wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?
   - ☐ The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;
   - ☐ At least 30% of the open water area is deeper than 6.6 ft (2 m).

☑ NO – go to 4 ☐ **YES –** The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?
   - ☐ The wetland is on a slope (*slope can be very gradual*),
   - ☐ The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks,
   - ☐ The water leaves the wetland **without being impounded**.

☑ NO – go to 5 ☐ **YES –** The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?
   - ☐ The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,
   - ☐ The overbank flooding occurs at least once every 2 years.

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☑ NO – go to 6 ☐ **YES** – The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

☐ NO – go to 7 ☑ **YES** – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

☑ NO – go to 8 ☐ **YES** – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

   NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

If you are still unable to determine which of the above criteria apply to your wetland, or if you have ***more than 2 HGM classes*** *within a wetland boundary, classify the wetland as Depressional for the rating.*

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DEPRESSIONAL AND FLATS WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

D 1.0. Does the site have the potential to improve water quality?	
D 1.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression (QUESTION 7 on key) with no surface water leaving it (no outlet). points = 3 ☑ Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2 ☐ Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 1 ☐ Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1 ☐	3
D 1.2. The soil 2 in below the surface (or duff layer) is true clay or true organic *(use NRCS definitions)*. Yes = 4 No = 0	0
D 1.3. Characteristics and distribution of persistent plants (Emergent, Scrub-shrub, and/or Forested Cowardin classes): Wetland has persistent, ungrazed, plants > 95% of area points = 5 ☑ Wetland has persistent, ungrazed, plants > ½ of area points = 3 ☐ Wetland has persistent, ungrazed plants > 1/10 of area points = 1 ☐ Wetland has persistent, ungrazed plants < 1/10 of area points = 0 ☐	5
D 1.4. Characteristics of seasonal ponding or inundation: *This is the area that is ponded for at least 2 months. See description in manual.* Area seasonally ponded is > ½ total area of wetland points = 4 ☑ Area seasonally ponded is > ¼ total area of wetland points = 2 ☐ Area seasonally ponded is < ¼ total area of wetland points = 0 ☐	4
Total for D 1 Add the points in the boxes above	12

Rating of Site Potential If score is: ☑ **12-16 = H** ☐ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*

D 2.0. Does the landscape have the potential to support the water quality function of the site?	
D 2.1. Does the wetland unit receive stormwater discharges? Yes = 1 No = 0	1
D 2.2. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants? Yes = 1 No = 0	1
D 2.3. Are there septic systems within 250 ft of the wetland? Yes = 1 No = 0	0
D 2.4. Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1-D 2.3? Source________________ Yes = 1 No = 0	0
Total for D 2 Add the points in the boxes above	2

Rating of Landscape Potential If score is: ☐ **3 or 4 = H** ☑ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

D 3.0. Is the water quality improvement provided by the site valuable to society?	
D 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list? Yes = 1 No = 0	0
D 3.2. Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list? Yes = 1 No = 0	1
D 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality (*answer YES if there is a TMDL for the basin in which the unit is found*)? Yes = 2 No = 0	2
Total for D 3 Add the points in the boxes above	3

Rating of Value If score is: ☑ **2-4 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

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DEPRESSIONAL AND FLATS WETLANDS **Hydrologic Functions** - Indicators that the site functions to reduce flooding and stream degradation	
D 4.0. Does the site have the potential to reduce flooding and erosion?	
D 4.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression with no surface water leaving it (no outlet) points = 4 ☑ Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet points = 2 ☐ Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch points = 1 ☐ Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 0 ☐	4
D 4.2. Depth of storage during wet periods: *Estimate the height of ponding above the bottom of the outlet. For wetlands with no outlet, measure from the surface of permanent water or if dry, the deepest part.* Marks of ponding are 3 ft or more above the surface or bottom of outlet points = 7 ☐ Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet points = 5 ☐ Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet points = 3 ☑ The wetland is a "headwater" wetland points = 3 ☐ Wetland is flat but has small depressions on the surface that trap water points = 1 ☐ Marks of ponding less than 0.5 ft (6 in) points = 0 ☐	3
D 4.3. Contribution of the wetland to storage in the watershed: *Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.* The area of the basin is less than 10 times the area of the unit points = 5 ☐ The area of the basin is 10 to 100 times the area of the unit points = 3 ☑ The area of the basin is more than 100 times the area of the unit points = 0 ☐ Entire wetland is in the Flats class points = 5 ☐	3
Total for D 4 Add the points in the boxes above	10

Rating of Site Potential If score is: ☐ **12-16 = H** ☑ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*

D 5.0. Does the landscape have the potential to support hydrologic functions of the site?	
D 5.1. Does the wetland receive stormwater discharges? Yes = 1 No = 0	1
D 5.2. Is >10% of the area within 150 ft of the wetland in land uses that generate excess runoff? Yes = 1 No = 0	1
D 5.3. Is more than 25% of the contributing basin of the wetland covered with intensive human land uses (residential at >1 residence/ac, urban, commercial, agriculture, etc.)? Yes = 1 No = 0	1
Total for D 5 Add the points in the boxes above	3

Rating of Landscape Potential If score is: ☑ **3 = H** ☐ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

D 6.0. Are the hydrologic functions provided by the site valuable to society?	
D 6.1. The unit is in a landscape that has flooding problems. *Choose the description that best matches conditions around the wetland unit being rated. Do not add points. Choose the highest score if more than one condition is met.* The wetland captures surface water that would otherwise flow down-gradient into areas where flooding has damaged human or natural resources (e.g., houses or salmon redds): • Flooding occurs in a sub-basin that is immediately down-gradient of unit. points = 2 ☐ • Surface flooding problems are in a sub-basin farther down-gradient. points = 1 ☐ Flooding from groundwater is an issue in the sub-basin. points = 1 ☐ The existing or potential outflow from the wetland is so constrained by human or natural conditions that the water stored by the wetland cannot reach areas that flood. *Explain why* Wetland contains no outlet. points = 0 ☑ There are no problems with flooding downstream of the wetland. points = 0 ☐	0
D 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for D 6 Add the points in the boxes above	0

Rating of Value If score is: ☐ **2-4 = H** ☐ **1 = M** ☑ **0 = L** *Record the rating on the first page*

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These questions apply to wetlands of all HGM classes.

HABITAT FUNCTIONS - Indicators that site functions to provide important habitat

H 1.0. Does the site have the potential to provide habitat?

H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class.* Check the Cowardin plant classes in the wetland. *Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.*

- ☐ Aquatic bed — 4 structures or more: points = 4
- ☑ Emergent — 3 structures: points = 2
- ☑ Scrub-shrub (areas where shrubs have > 30% cover) — 2 structures: points = 1
- ☐ Forested (areas where trees have > 30% cover) — 1 structure: points = 0

If the unit has a Forested class, check if:

- ☐ The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon

Points: 1

H 1.2. Hydroperiods

Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*).

- ☐ Permanently flooded or inundated — 4 or more types present: points = 3
- ☑ Seasonally flooded or inundated — 3 types present: points = 2
- ☐ Occasionally flooded or inundated — 2 types present: points = 1
- ☑ Saturated only — 1 type present: points = 0
- ☐ Permanently flowing stream or river in, or adjacent to, the wetland
- ☐ Seasonally flowing stream in, or adjacent to, the wetland
- ☐ **Lake Fringe wetland** — **2 points**
- ☐ **Freshwater tidal wetland** — **2 points**

Points: 1

H 1.3. Richness of plant species

Count the number of plant species in the wetland that cover at least 10 ft^2.

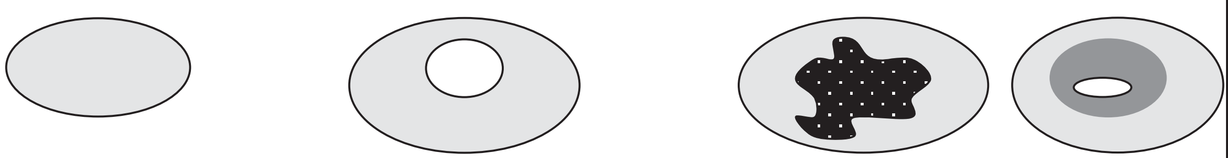
Different patches of the same species can be combined to meet the size threshold and you do not have to name the species. ***Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle***

If you counted:		
	> 19 species	points = 2
	5 - 19 species	points = 1
	< 5 species	points = 0

Points: 1

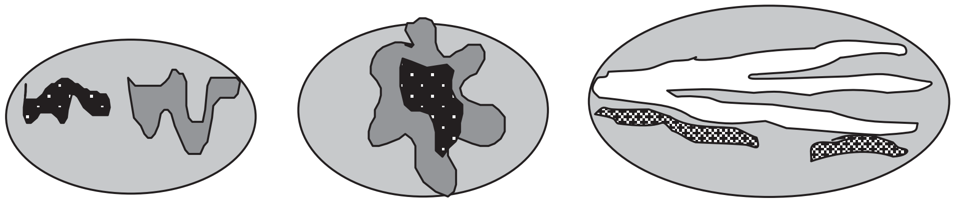
H 1.4. Interspersion of habitats

Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*



None = 0 points ☐ **Low** = 1 point ☑ **Moderate** = 2 points ☐

All three diagrams in this row are **HIGH** = 3points ☐



Points: 1

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H 1.5. Special habitat features:	
Check the habitat features that are present in the wetland. *The number of checks is the number of points.* ☑ Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long). ☑ Standing snags (dbh > 4 in) within the wetland ☐ Undercut banks are present for at least 6.6 ft (2 m) **and/or** overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m) ☐ Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present *(cut shrubs or trees that have not yet weathered where wood is exposed)* ☑ At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated *(structures for egg-laying by amphibians)* ☐ Invasive plants cover less than 25% of the wetland area in every stratum of plants (*see H 1.1 for list of strata*)	3
Total for H 1 — Add the points in the boxes above	7

Rating of Site Potential If score is: ☐ **15-18 = H** ☑ **7-14 = M** ☐ **0-6 = L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat functions of the site?

H 2.1. Accessible habitat (include *only habitat that directly abuts wetland unit*). *Calculate:* % undisturbed habitat 7.73 + [(% moderate and low intensity land uses)/2] 0.00 = 7.73 % If total accessible habitat is: > 1/3 (33.3%) of 1 km Polygon — points = 3 20-33% of 1 km Polygon — points = 2 10-19% of 1 km Polygon — points = 1 < 10% of 1 km Polygon — points = 0	1
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* % undisturbed habitat 25.67 + [(% moderate and low intensity land uses)/2] 7.21 = 32.88 % Undisturbed habitat > 50% of Polygon — points = 3 Undisturbed habitat 10-50% and in 1-3 patches — points = 2 Undisturbed habitat 10-50% and > 3 patches — points = 1 Undisturbed habitat < 10% of 1 km Polygon — points = 0	1
H 2.3. Land use intensity in 1 km Polygon: If > 50% of 1 km Polygon is high intensity land use — points = (- 2) ≤ 50% of 1 km Polygon is high intensity — points = 0	-2
Total for H 2 — Add the points in the boxes above	0

Rating of Landscape Potential If score is: ☐ **4-6 = H** ☐ **1-3 = M** ☑ **< 1 = L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?

H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose only the highest score that applies to the wetland being rated.* Site meets ANY of the following criteria: — points = 2 ☐ ☐ It has 3 or more priority habitats within 100 m (see next page) ☐ It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) ☐ It is mapped as a location for an individual WDFW priority species ☐ It is a Wetland of High Conservation Value as determined by the Department of Natural Resources ☐ It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats (listed on next page) within 100 m — points = 1 ☑ Site does not meet any of the criteria above — points = 0 ☐	1

Rating of Value If score is: ☐ **2 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here: http://wdfw.wa.gov/conservation/phs/list/)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: ***NOTE:*** *This question is independent of the land use between the wetland unit and the priority habitat.*

— **Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).

— **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).

— **Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock.

— **Old-growth/Mature forests:** Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.

— **Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).

— **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.

— **Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).

— **Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.

— **Nearshore**: Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page).*

— **Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.

— **Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.

— **Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.

— **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

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CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type *Check off any criteria that apply to the wetland. Circle the category when the appropriate criteria are met.*	Category
SC 1.0. Estuarine wetlands Does the wetland meet the following criteria for Estuarine wetlands? — The dominant water regime is tidal, — Vegetated, and — With a salinity greater than 0.5 ppt ☐Yes –Go to **SC 1.1** ☐No= **Not an estuarine wetland**	
SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? ☐Yes = **Category I** ☐No - Go to **SC 1.2**	**Cat. I**
SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? ☐ — The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are *Spartina*, see page 25) ☐ — At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ — The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. ☐Yes = **Category I** ☐No = **Category II**	**Cat. I** **Cat. II**
SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? ☐Yes **–** Go to **SC 2.2** ☐No **–** Go to **SC 2.3** SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? ☐Yes **= Category I** ☐No **= Not a WHCV** SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://www1.dnr.wa.gov/nhp/refdesk/datasearch/wnhpwetlands.pdf ☐Yes **– Contact WNHP/WDNR and go to SC 2.4** ☐No **= Not a WHCV** SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? ☐Yes **= Category I** ☐No **= Not a WHCV**	**Cat. I**
SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? *Use the key below.* ***If you answer YES you will still need to rate the wetland based on its functions.*** SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? ☐Yes – Go to **SC 3.3** ☐No – Go to **SC 3.2** SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? ☐Yes – Go to **SC 3.3** ☐No = **Is not a bog** SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? ☐Yes = **Is a Category I bog** ☐No – Go to **SC 3.4** **NOTE:** If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (> 30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? ☐Yes = **Is a Category I bog** ☐No **= Is not a bog**	**Cat. I**

Wetland name or number A

<table>
<tr><td>

SC 4.0. Forested Wetlands

Does the wetland have at least 1 contiguous acre of forest that meets one of these criteria for the WA Department of Fish and Wildlife's forests as priority habitats? ***If you answer YES you will still need to rate the wetland based on its functions.***

☐— **Old-growth forests** (west of Cascade crest): Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 in (81 cm) or more.

☐— **Mature forests** (west of the Cascade Crest): Stands where the largest trees are 80- 200 years old OR the species that make up the canopy have an average diameter (dbh) exceeding 21 in (53 cm).

☐Yes = **Category I** ☐No **= Not a forested wetland for this section**

</td><td>**Cat. I**</td></tr>
<tr><td>

SC 5.0. Wetlands in Coastal Lagoons

Does the wetland meet all of the following criteria of a wetland in a coastal lagoon?

— The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks

— The lagoon in which the wetland is located contains ponded water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon *(needs to be measured near the bottom)*

☐Yes – Go to **SC 5.1** ☐No = **Not a wetland in a coastal lagoon**

SC 5.1. Does the wetland meet all of the following three conditions?

— The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species on p. 100).

— At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland.

— The wetland is larger than $^{1}/_{10}$ ac (4350 ft^2)

☐Yes = **Category I** ☐No = **Category II**

</td><td>

Cat. I

Cat. II

</td></tr>
<tr><td>

SC 6.0. Interdunal Wetlands

Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? ***If you answer yes you will still need to rate the wetland based on its habitat functions.***

In practical terms that means the following geographic areas:

— Long Beach Peninsula: Lands west of SR 103

— Grayland-Westport: Lands west of SR 105

— Ocean Shores-Copalis: Lands west of SR 115 and SR 109

☐Yes – Go to **SC 6.1** ☐No = **not an interdunal wetland for rating**

SC 6.1. Is the wetland 1 ac or larger and scores an 8 or 9 for the habitat functions on the form (rates H,H,H or H,H,M for the three aspects of function)? ☐Yes = **Category I** ☐No – Go to **SC 6.2**

SC 6.2. Is the wetland 1 ac or larger, or is it in a mosaic of wetlands that is 1 ac or larger?

☐Yes = **Category II** ☐No – Go to **SC 6.3**

SC 6.3. Is the unit between 0.1 and 1 ac, or is it in a mosaic of wetlands that is between 0.1 and 1 ac?

☐Yes = **Category III** ☐No = **Category IV**

</td><td>

Cat I

Cat. II

Cat. III

Cat. IV

</td></tr>
<tr><td>

Category of wetland based on Special Characteristics

If you answered No for all types, enter "Not Applicable" on Summary Form

</td><td>N/A</td></tr>
</table>

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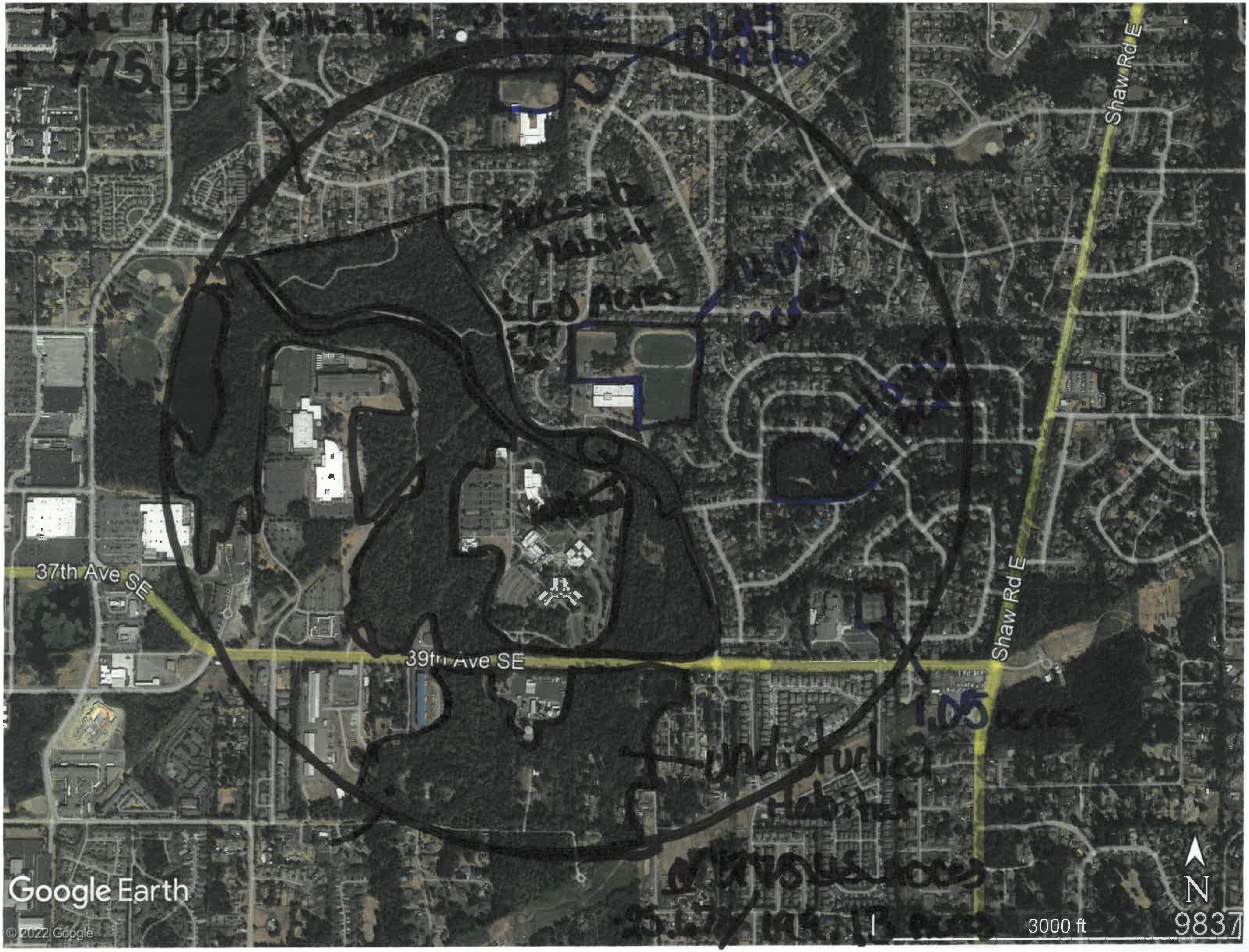
Wildwood Park Dr
Wildwood Park Dr
Wildwood Park Dr
College Way
College Way
150 ft buffer
E.M.
S.S.
Building (AAH)
SS = Scrub-Shrub
Em = Emergent
Google Earth
300 ft
N

Wetland contains No outlet
Wildwood Park Dr
Seasonally Flooded
Seasonally Saturated
Wildwood Park Dr
Way
College Way
Google Earth
N
200 ft


College Way
Wildwood Park Dr
Wetland A
College Way
21st St SE
22nd St SE
Manorwood Dr
College Way
21st St SE
Wildwood Park Dr
College Way
39th Ave SE
39th Ave SE
39th Ave SE
N
Google Earth
1000 ft

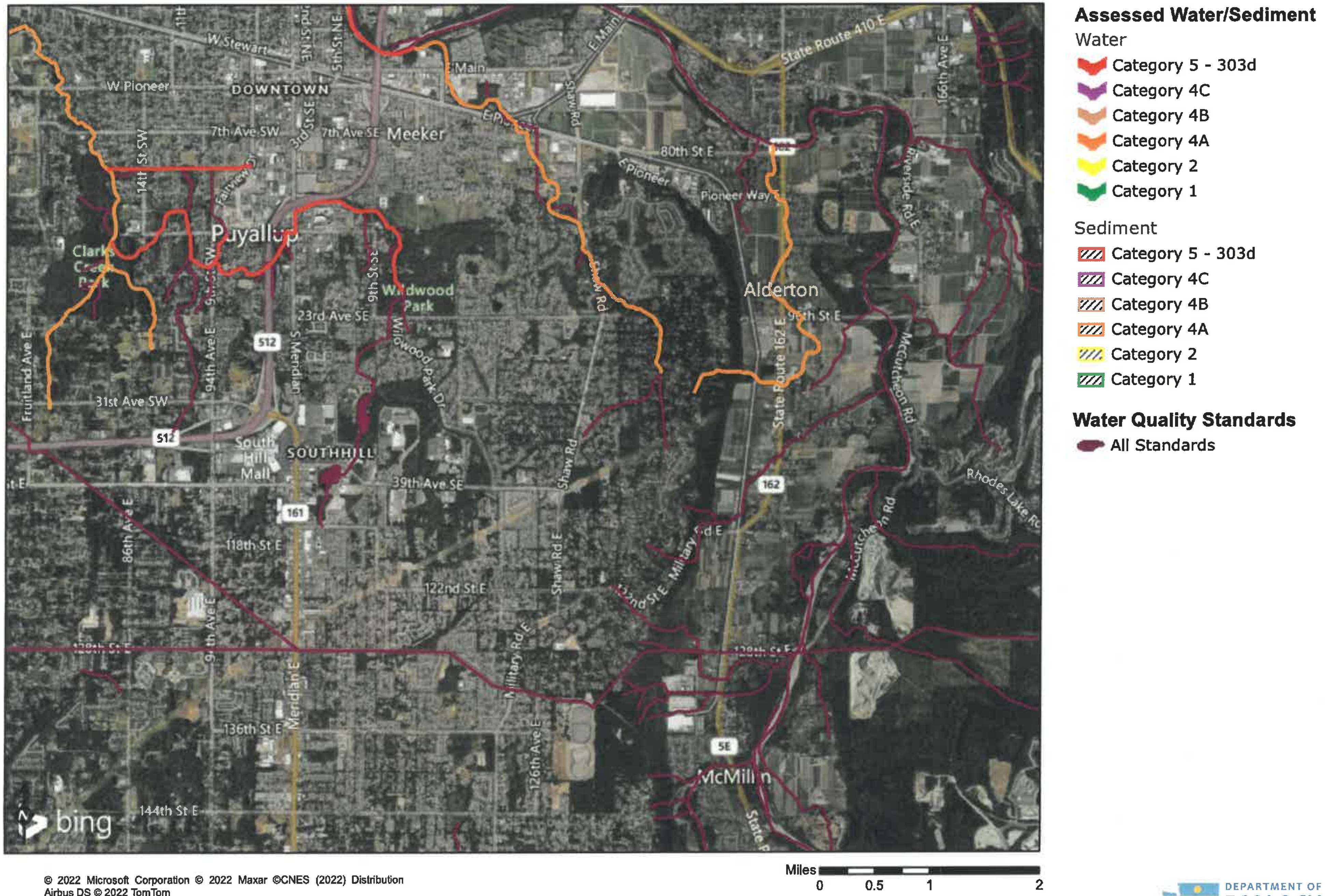


775.95
Access to Habitat
160 Acres
1.05 acres
Undisturbed Habitat
37th Ave SE
39th Ave SE
Shaw Rd E
Shaw Rd E
Google Earth
© 2022 Google
3000 ft
N

9837

March 25, 2022

303(d) Vicinity Map



DEPARTMENT OF ECOLOGY
State of Washington

Figure 6a

DEPARTMENT OF ECOLOGY State of Washington

Pierce County

Water quality improvement projects

Select the waterbody or pollutant name to find more information about the specific project.

Waterbody Name(s)	Pollutant(s)	Status	Project Lead(s)
Clarks and Meeker Creeks	Dissolved Oxygen Sediment Fecal Coliform	EPA approved and Has an implementation plan	Donovan Gray 360-407-6407
Clover Creek	Dissolved Oxygen Fecal Coliform Temperature	Under development	Donovan Gray 360-407-6407
Commencement Bay	Dioxin	EPA approved	Donovan Gray 360-407-6407
Nisqually Watershed Tributaries Tributaries: • McAllister Creek • Ohop Creek • Red Salmon Creek • Lynch Creek • Wash Creek • Unnamed Tributary to West Red Salmon Creek • Little McAllister Creek • Medicine Creek mouth	Fecal Coliform Dissolved Oxygen	EPA approved and Has an implementation plan	Donovan Gray 360-407-6407
Puyallup River	Fecal Coliform	EPA approved and	Donovan Gray

Figure 7

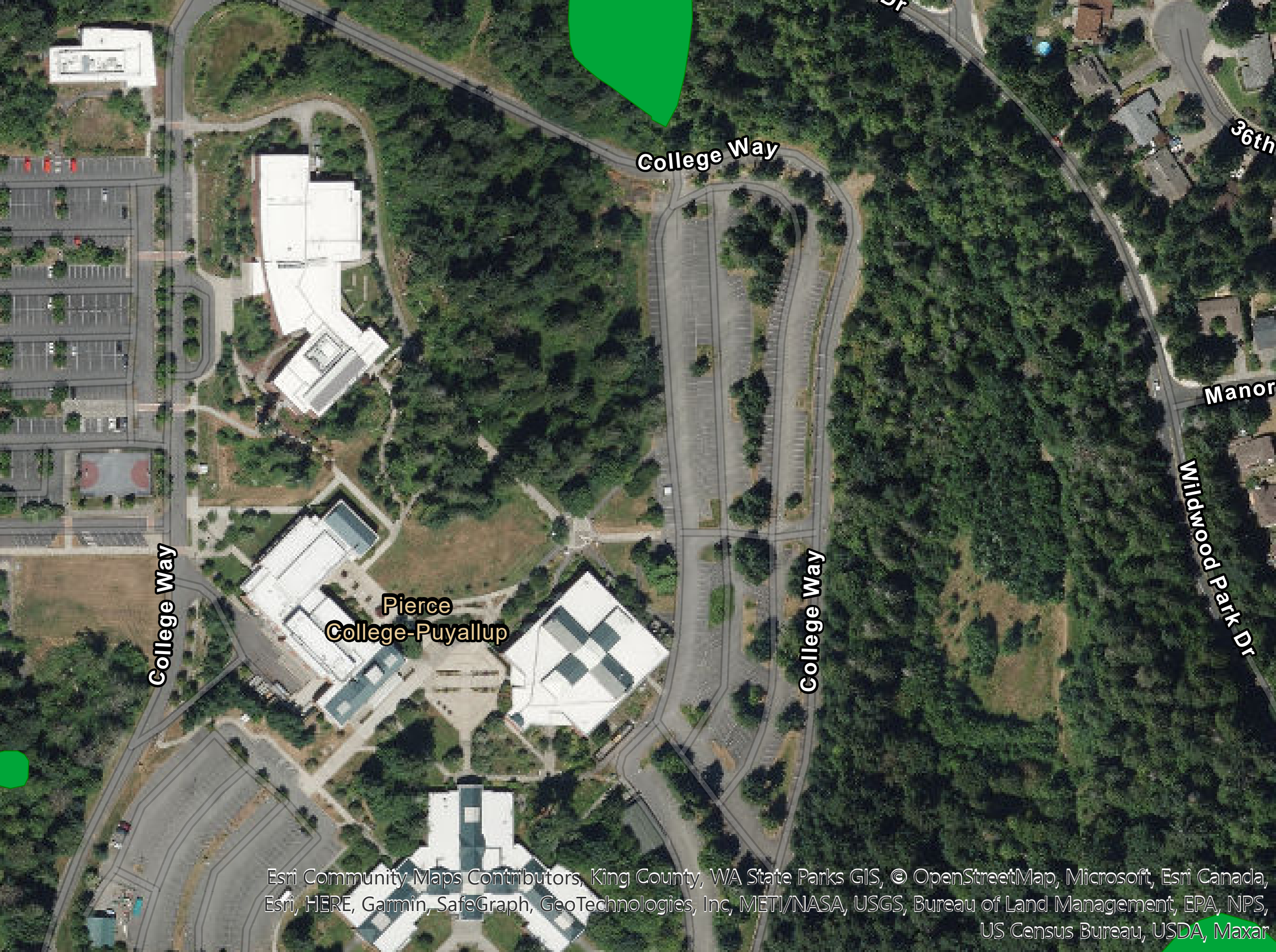
Watershed		Has implementation plan	360-407-6407
Puyallup River Watershed	Multi-parameter Ammonia-N BOD (5-day)	EPA approved	Donovan Gray 360-407-6407
Puyallup River: Upper White River	Sediment Temperature	EPA approved	Donovan Gray 360-407-6407
Puyallup River: Lower White River	pH	Under development	Donovan Gray 360-407-6407
South Prairie Creek	Fecal Coliform Temperature	EPA approved and Has an implementation plan	Donovan Gray 360-407-6407
Wapato Lake	Total Phosphorus	EPA approved	Donovan Gray 360-407-6407

To request ADA accommodation, call Ecology at 360-407-7668, 711 (relay service), or 877-833-6341 (TTY). More about our accessibility services.

PIERCE COLLEGE-PUYALLUP CAMPUS: STEM PROJECT

WETLAND ANALYSIS REPORT

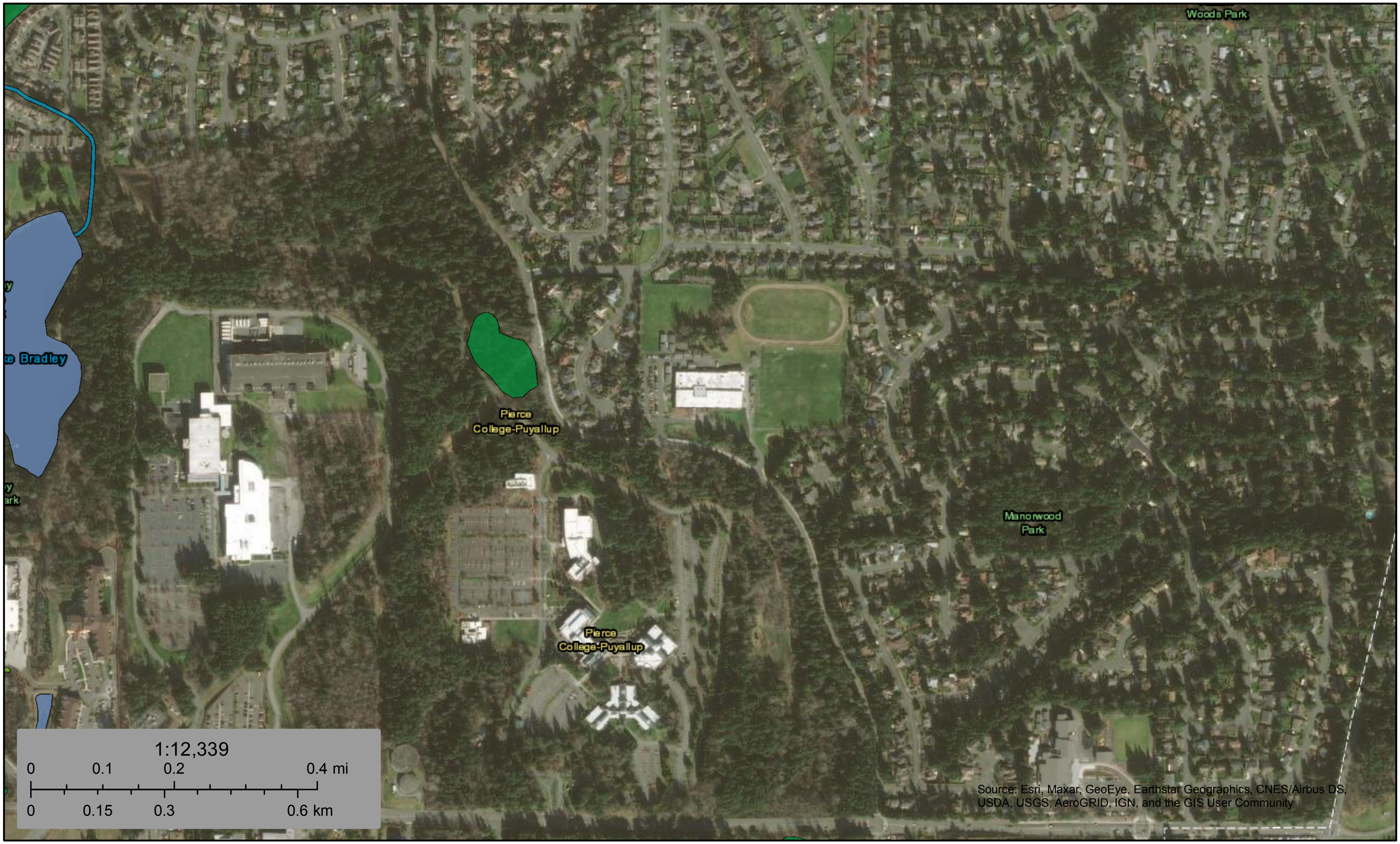
APPENDIX E: QUERIED DATABASE FIGURES


College Way
36th
Manor
Wildwood Park Dr
College Way
College Way
Pierce
College-Puyallup
Esri Community Maps Contributors, King County, WA State Parks GIS, © OpenStreetMap, Microsoft, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, Maxar

U.S. Fish and Wildlife Service

National Wetlands Inventory

Puyallup College-STEM



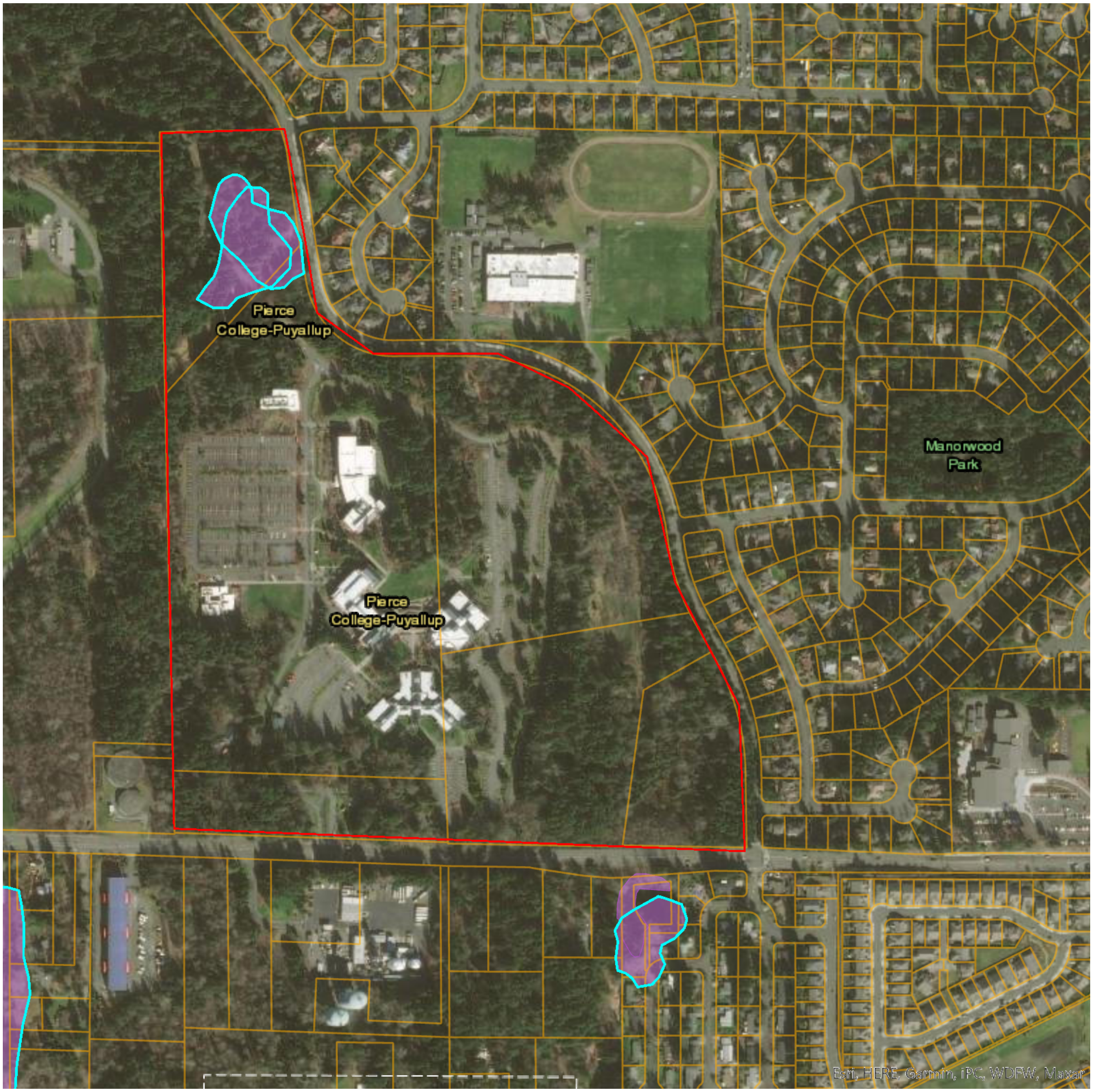
March 23, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

Priority Habitats and Species on the Web



Report Date: 01/26/2022

PHS Species/Habitats Overview:

Occurence Name	Federal Status	State Status	Sensitive Location
Wetlands	N/A	N/A	No
Waterfowl Concentrations	N/A	N/A	No
Freshwater Forested/Shrub Wetland	N/A	N/A	No

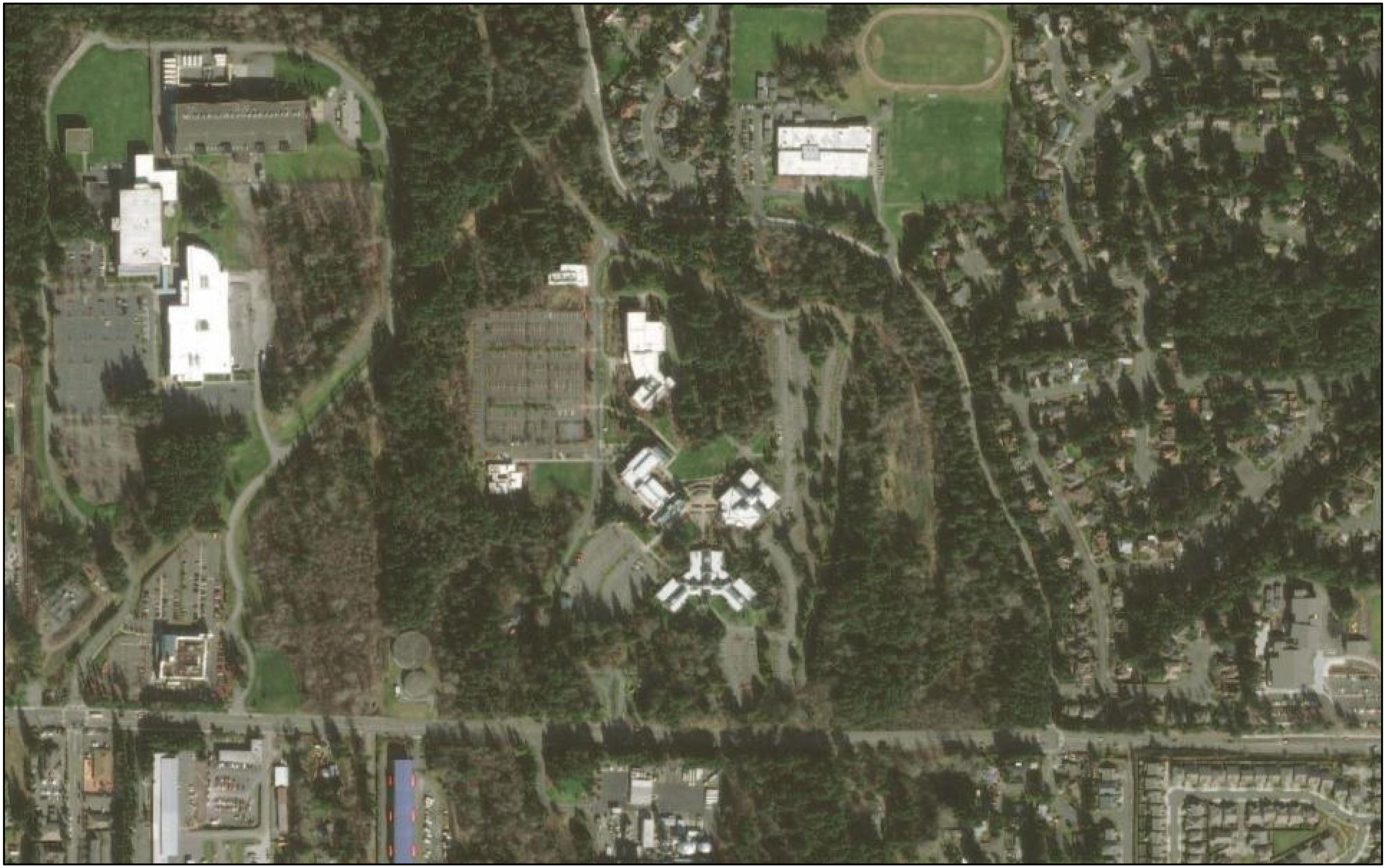
PHS Species/Habitats Details:

Wetlands	
Priority Area	Aquatic Habitat
Site Name	SOUTH PUYALLUP WETLANDS
Accuracy	1/4 mile (Quarter Section)
Notes	POTHOLE WETLANDS IN SOUTH PUYALLUP AREA
Source Record	902560
Source Dataset	PHSREGION
Source Name	NAUER, DON WDW
Source Entity	WA Dept. of Fish and Wildlife
Federal Status	N/A
State Status	N/A
PHS Listing Status	PHS Listed Occurrence
Sensitive	N
SGCN	N
Display Resolution	AS MAPPED
ManagementRecommendations	http://www.ecy.wa.gov/programs/sea/wetlands/bas/index.html
Geometry Type	Polygons

Waterfowl Concentrations	
Priority Area	Regular Concentration
Site Name	PIERCE COUNTY - NON FARM
Accuracy	1/4 mile (Quarter Section)
Notes	SMALL WATERFOWL CONCENTRATION AREAS, NON AGRICULTURAL.
Source Record	902564
Source Dataset	PHSREGION
Source Name	NAUER, DON WDW
Source Entity	WA Dept. of Fish and Wildlife
Federal Status	N/A
State Status	N/A
PHS Listing Status	PHS LISTED OCCURRENCE
Sensitive	N
SGCN	N
Display Resolution	AS MAPPED
ManagementRecommendations	http://wdfw.wa.gov/publications/pub.php?id=00026
Geometry Type	Polygons

Freshwater Forested/Shrub Wetland	
Priority Area	Aquatic Habitat
Site Name	N/A
Accuracy	NA
Notes	Wetland System: Freshwater Forested/Shrub Wetland - NWI Code: PFO1C
Source Dataset	NWIWetlands
Source Name	Not Given
Source Entity	US Fish and Wildlife Service
Federal Status	N/A
State Status	N/A
PHS Listing Status	PHS Listed Occurrence
Sensitive	N
SGCN	N
Display Resolution	AS MAPPED
ManagementRecommendations	http://www.ecy.wa.gov/programs/sea/wetlands/bas/index.html
Geometry Type	Polygons

WA Wetlands of High Conservation Value



1/26/2022, 3:14:04 PM

Counties

1:9,028

0 0.05 0.1 0.2 mi

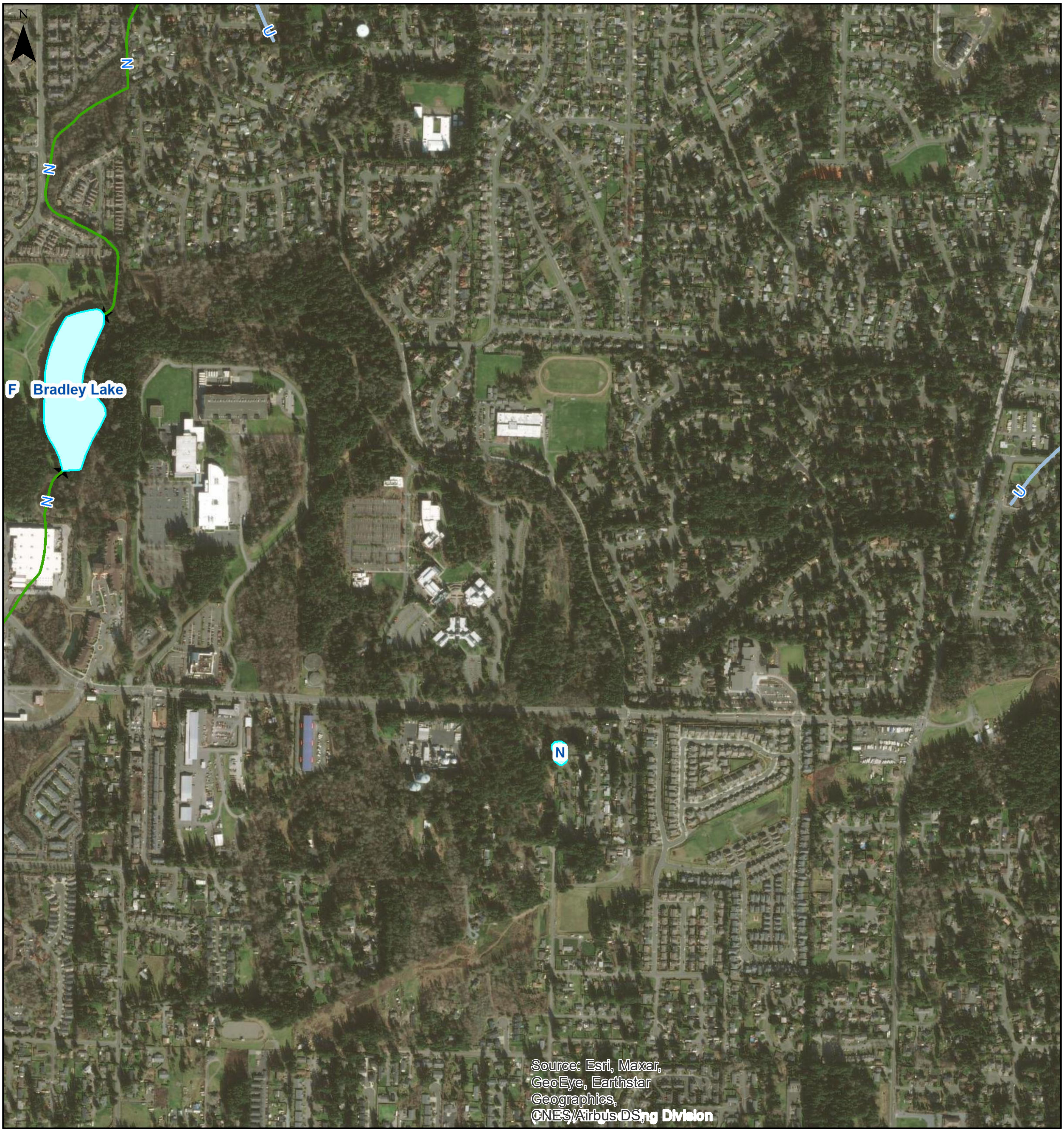
0 0.07 0.15 0.3 km

Maxar

Washington Natural Heritage Program

Washington State Department of Natural Resources | Washington Natural Heritage Program http://www.dnr.wa.gov/natural-heritage-program | Maxar |

Forest Practices Activity Map - Application #____________



Map Symbols		Additional Information	Legal Description
Harvest Boundary	Landing		S10 T19.0N R04.0E, S03 T19.0N R04.0E
Road Construction	Waste Area		S02 T19.0N R04.0E, S11 T19.0N R04.0E
Stream	Clumped WRTS/GRTS		
RMZ / WMZ Buffers	Existing Structure		
Rock Pit			

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Extreme care was used during the compilation of this map to ensure its accuracy. However, due to changes in data and the need to rely on outside information, the Department of Natural Resources cannot accept responsibility for errors or omissions, and therefore, there are no warranties that accompany this material.

0 0.25 Miles

Date: 1/26/2022 Time: 3:16:27 PM

Appendix D

Operation and Maintenance Manual

Private Stormwater Facilities Operation & Maintenance Manual

PREPARED FOR:

Integrus Architecture
Contact: Sarah Wilder
117 South Main Street, Ste 100
Seattle, WA 98104

PROJECT:

Pierce College Puyallup
New STEM Building
Puyallup, WA
2210810.10

PREPARED BY:

Andrew Coito-Poile
Project Engineer

REVIEWED BY:

William J. Fierst, PE
Principal

DATE

April 2022
Revised August 2022

Table of Contents

Section **Page**

Appendices

Maintenance Checklists

Annual Inspection Report

1.0 Introduction

The Pierce College Puyallup Campus maintenance staff shall be responsible for maintaining properly functioning stormwater control facilities. This report presents a maintenance program that meets City of Puyallup maintenance requirements. The private stormwater facilities for this project include a system of catch basins and pipes to collect surface runoff and route it through bioretention facilities for stormwater treatment prior to routing to a detention facility through a level spreader.

It is vitally important that the proponent/owner maintain these facilities in a timely and conscientious manner to ensure the facilities function as designed. Siltation, debris, or lack of maintenance can reduce the capabilities of the conveyance system which can lead to localized flooding. If bioretention facilities are not maintained in accordance with the attached maintenance checklist, onsite stormwater can contribute to negative water quality to downstream waterbodies of the state.

2.0 Responsibility

The private stormwater facilities will be owned and maintained by Pierce College Puyallup Campus maintenance personnel.

Property Owner:

Pierce College Puyallup Campus
1601 39th Avenue SE
Puyallup, WA 98374
(253) 840-8400

3.0 Schedule

Maintenance of the stormwater facilities shall follow the schedule as specified in the attached maintenance checklists and as recommended by the media filter manufacturer guidelines. Additional maintenance may be required to respond to unusual storm events or reduced performance of the treatment system. A copy of the Pierce County-recommended maintenance schedule is attached and may be photocopied and used as inspection records. An annual inspection report must be submitted to City of Puyallup in accordance with the Maintenance Agreement.

4.0 Cost

The following is an estimate of the average annual cost of maintenance for the stormwater control facilities within the scope of this project.

Vactor truck @ $200/hour x 6 hours	$1,200
Personnel @ $25/hour x 6 hours	$150
Dumping Fees @ $50/ton x 6 tons	$300
Sweep Parking Lot Once Yearly	$500
Total Estimated Annual Cost	**$2,150**

5.0 Vegetation Management Plan

The attached maintenance schedule provides guidance on vegetation control and management. Irrigation and other maintenance, as necessary, shall be provided to ensure that vegetation remains viable and that a hardy root structure forms in the first year. Vegetation planting shall be provided, as described in the construction documents

6.0 Instructions for Person Maintaining Stormwater System

The attached Maintenance Checklists specify maintenance schedules for stormwater facilities onsite. Plan to complete a checklist for all system components per the following schedule:

1. Monthly from November through April.

2. Once in late summer (preferably September).

3. After any major storm event (items marked “S” only).

Using photocopies of the attached pages, check off the problems that are noted each time the item is inspected. Document comments on problems found and the corrective action taken. The Inspection Checklist sheets should be kept on file and used to prepare the annual report required by Pierce County, due on or before May 15 of each year. Use the Pierce County suggested inspection frequency at the left of each item as an inspection guide.

7.0 Conclusion

This Private Stormwater Facilities Operation and Maintenance Manual is developed for the operation of the Pierce College Puyallup Campus STEM classroom building private stormwater systems. This maintenance document has been prepared within the guidelines of City of Puyallup Construction Standards. If this plan is implemented, the owner can expect the stormwater system to function as designed.

AHBL, Inc.

William J. Fierst

William J. Fierst, PE
Principal

ACP/CFH/lsk

February 2022
Revised August 2022

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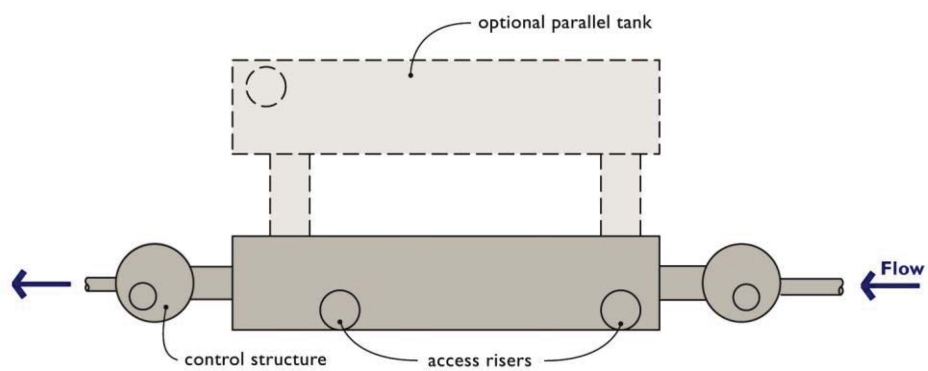
Maintenance Checklists

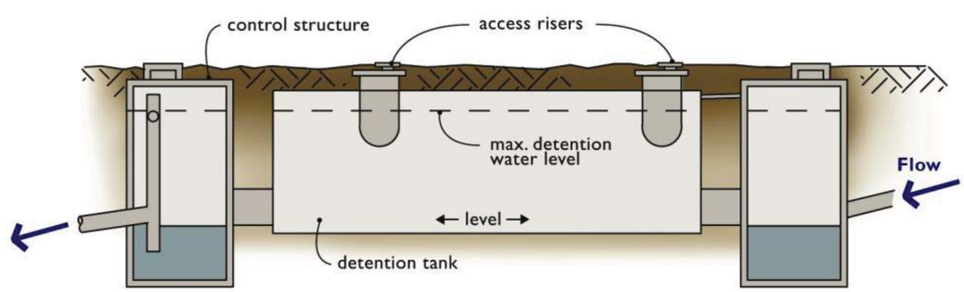
3.3 Closed Detention Systems (Tanks/Vaults)

Closed detention systems function similar to detention ponds with the temporary storage volume provided by an underground structure to regulate the storm discharge rate from the site. The structure is typically constructed of large diameter pipe (48” diameter or greater) or a concrete box (Vault). These systems are typically utilized for sites that do not have space available for an above-ground system and are more commonly associated with commercial sites.

Underground detention systems are an enclosed space where harmful chemicals and vapors can accumulate. Therefore, the inspection and maintenance of these facilities should be conducted by an individual with training and certification in working in hazardous confined spaces.



BIRD'S-EYE VIEW



Note:
Closed detention systems will contain water during rainfall events, bus should be empty during dry periods.

SIDE PROFILE

Closed Detention Systems (Tanks/Vaults) Checklist

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	Storage Area					Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
M	Storage Area					Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for ½ length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
A	Storage Area					Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
A	Storage Area					Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
A	Storage Area					Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications and is structurally sound.
A	Storage Area						Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls	No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.
A	Manhole					Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
A	Manhole					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 (may not apply to self-locking lids).	Mechanism opens with proper tools.

Closed Detention Systems (Tanks/Vaults) Checklist (Continued)

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
A	Manhole					Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
A	Manhole					Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:
(M) Monthly from November through April.
(A) Once in late summer (preferable September)
(S) After any major storm (use 1-inch in 24 hours as a guideline).

9.0 Inspection and Maintenance

9.1 ISOLATOR ROW INSPECTION

Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3" (76 mm), cleanout is required.

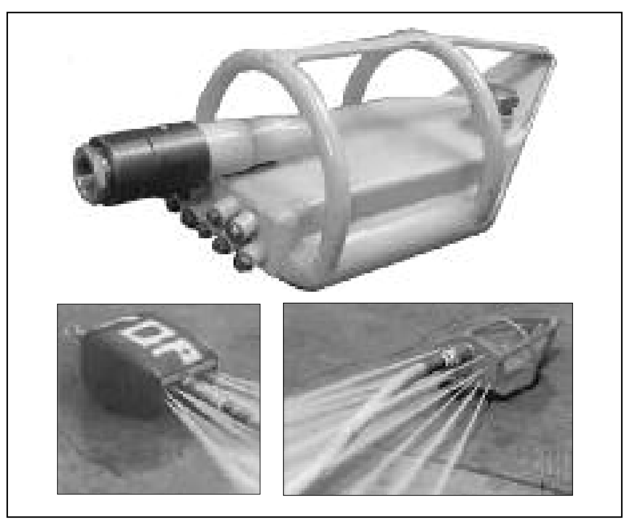
A StormTech Isolator Row should initially be inspected immediately after completion of the site's construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site's owner. Once in normal service, a StormTech Isolator Row should be inspected bi-annually until an understanding of the sites characteristics is developed. The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

9.2 ISOLATOR ROW MAINTENANCE

JetVac maintenance is recommended if sediment has been collected to an average depth of 3" (76 mm) inside the Isolator Row. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" (1143 mm) are best. The JetVac process shall only be performed on StormTech Rows that have AASHTO class 1 woven geotextile over their foundation stone (ADS 315WTM or equal).

Looking down the Isolator Row.

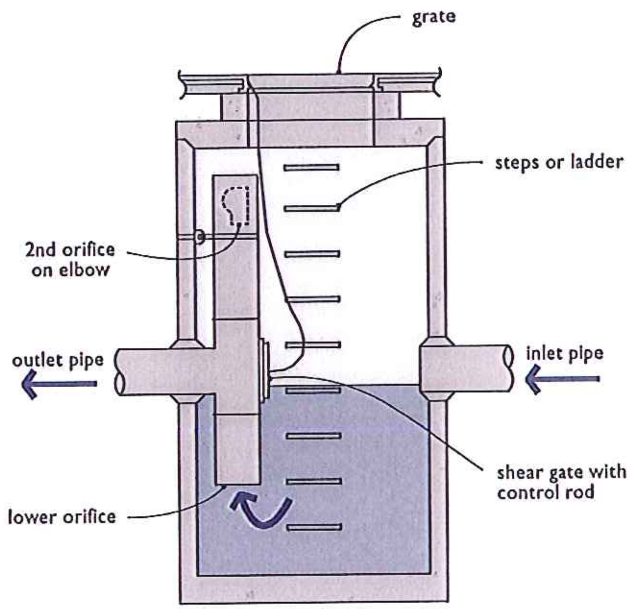
A typical JetVac truck. (This is not a StormTech product.)



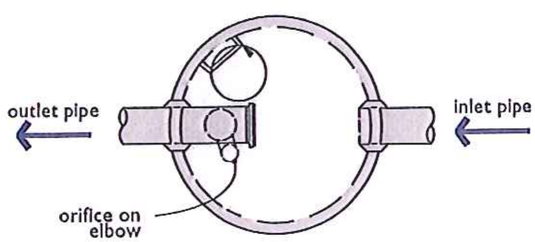
Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

3.4 Control Structure/Flow Restrictor

Control structures/flow restrictors are located on the outlet pipe of a detention system. The control structure is typically a Type 2 concrete catch basin (see Section 3.5 for catch basin description) with a riser (vertical pipe). The control structure reduces the discharge rate of stormwater from a detention facility. The flow is regulated by a combination of orifices (holes with specifically sized diameters) and weirs (plates with rectangular or vee shaped notch). Lack of maintenance of the control structure can result in the plugging of an orifice. This can result in flooding of the stormwater system and/or an increase in the rate of discharge from the site potentially damaging downstream property.



BIRD'S-EYE VIEW



SECTION PROFILE

Control Structure/Flow Restrictor Checklist

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	General					Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
A	General					Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
A	General					Structural Damage	Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
A	General					Structural Damage	Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
A	General					Structural Damage	Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
A	Cleanout Gate					Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
A	Cleanout Gate					Damaged or Missing	Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
A	Cleanout Gate					Damaged or Missing	Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
A	Cleanout Gate					Damaged or Missing	Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
A	Orifice Plate					Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
M,S	Orifice Plate					Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
	Overflow Pipe					Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
A	Manhole					Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.

Control Structure/Flow Restrictor Checklist (Continued)

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
A	Manhole					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 (may not apply to self-locking lids).	Mechanism opens with proper tools.
A	Manhole					Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
A	Manhole					Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

(M) Monthly from November through April.
(A) Once in late summer (preferable September)
(S) After any major storm (use 1-inch in 24 hours as a guideline).

3.5 Catch Basins

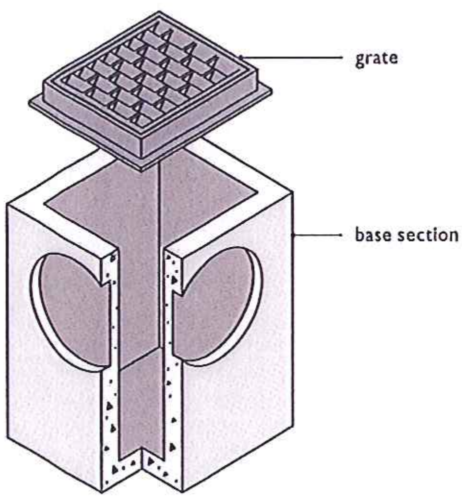
Catch basins are underground concrete structures typically provided with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two catch basin types.

A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

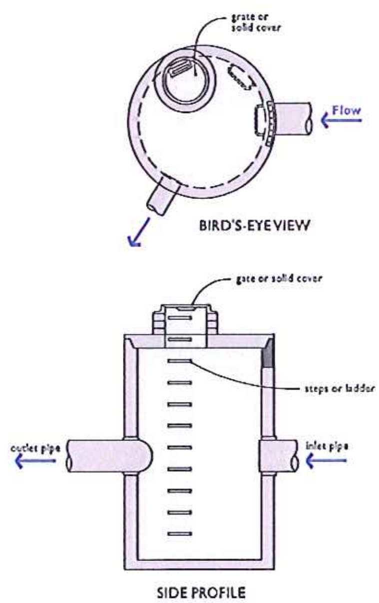
Type 2 catch basins, also commonly referred to as storm manholes, are round concrete structures ranging in diameter of 4 feet to 8 feet. Type 2 catch basins are used when the connecting conveyance pipe is 18 inches or greater or the depth from grate to pipe bottom exceeds 5 feet. Type 2 catch basins typically have manhole steps mounted on the side of the structure to allow for access.

Both catch basin types typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also provided with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils.

The most common cleaning method for catch basins is to utilize a truck with a tank and vacuum hose (vactor truck) to remove sediment and debris from the sump. Catch basins may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual with training and certification in working in hazardous confined spaces.



Type I



Type 2

Catch Basins Checklist

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
A	General					"Dump no pollutants " Stencil or stamp not visible	Stencil or stamp should be visible and easily read	Warning signs (e.g., "Dump No Waste-Drains to Stream") shall be painted or embossed on or adjacent to all storm drain inlets.
M,S	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%.	No trash or debris located immediately in front of catch basin or on grate opening.
M	General					Trash & Debris	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.	No trash or debris in the catch basin.
M	General					Trash & Debris	Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
M	General					Trash & Debris	Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
M	General					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
A	General					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).	Top slab is free of holes and cracks.

Catch Basins Checklist (Continued)

Frequency	Drainage System Feature	Date ✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
A	General					Structure Damage to Frame and/or Top Slab	Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
A	General					Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
A	General					Fractures or Cracks in Basin Walls/ Bottom	Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is re-grouted and secure at basin wall.
A	General					Settlement / Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
M	General					Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
M	General					Vegetation	Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
M	General					Contamination and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.
A	Catch Basin Cover					Cover Not in Place	Cover is missing or only partially in place.	Any open catch basin requires maintenance. Catch basin cover is closed
A	Catch Basin Cover					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.
A	Catch Basin Cover					Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is to keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.

Catch Basins Checklist (Continued)

Frequency	Drainage System Feature	Date ✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
A	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.
	Grates					Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
M,S	Grates					Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
A	Grates					Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

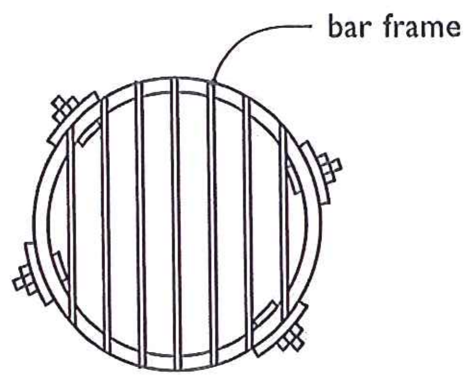
<u>Key</u>:

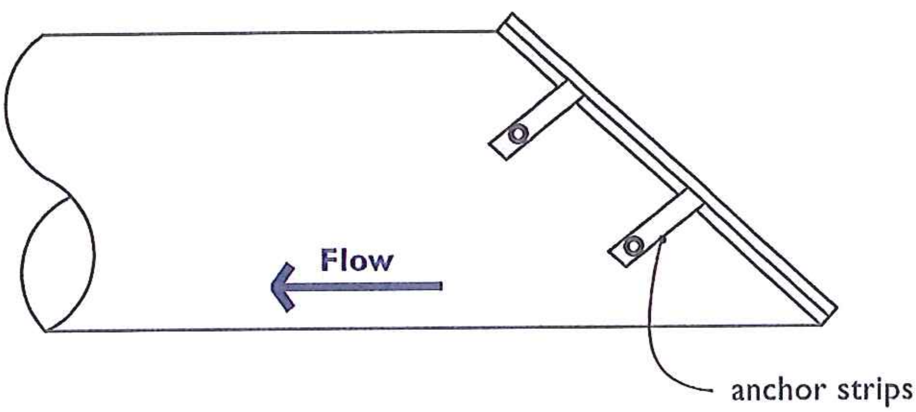
(M) Monthly from November through April.
(A) Once in late summer (preferable September)
(S) After any major storm (use 1-inch in 24 hours as a guideline).

3.6 Debris Barriers (e.g. Trash Racks)

Debris barriers consist of bar grates over the open end of a culvert or conveyance pipe. The intent of a debris barrier is to prevent large materials from entering a closed pipe system. Debris barriers are typically located on the outlet pipe from a detention pond to the control structure. If a debris barrier is not located on the outlet pipe, one should be provided to prevent plugging of the control structure and possible flooding.

Access barriers are similar to debris barriers but are included on all pipe ends that exceed 18 inches in diameter. Their function is to prevent debris and unauthorized access into the storm conveyance pipe. Removing debris and maintenance to the debris barrier when there is flow through the conveyance pipe should be performed by qualified personnel only.





Debris Barriers (e.g. Trash Racks) Checklist

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
M,S	General					Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
A	General					Damaged/Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
A	General					Damaged/Missing Bars.	Bars are missing or entire barrier missing.	Bars in place according to design.
A	General					Damaged/Missing Bars.	Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
A	General					Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe.	Barrier firmly attached to pipe.

If you are unsure whether a problem exists, please contact a Professional Engineer.

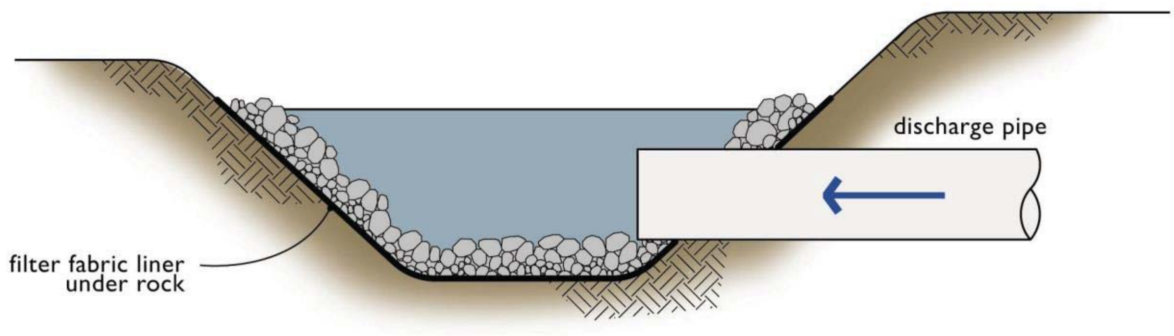
Comments:

Key:

(M) Monthly from November through April.
(A) Once in late summer (preferable September)
(S) After any major storm (use 1-inch in 24 hours as a guideline).

3.7 Energy Dissipaters

Energy dissipaters are provided on the inlet and outlet to a closed pipe system to prevent erosion at these locations. Design of an energy dissipater can vary significantly from highly engineered systems (concrete or rock gabion structures) to the more commonly used rock pad. The rock pad is typically constructed of 4- to 12-inch diameter rocks a minimum of 12 inches thick and is often lined with filter fabric. The rock pad should extend above the top of the pipe a minimum of 1 foot.



Energy Dissipaters Checklist

		Date						
Frequency	**Drainage System Feature**	✓	✓	✓	✓	**Problem**	**Conditions to Check For**	**Conditions That Should Exist**
External:								
M	Rock Pad					Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
M	Rock Pad					Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
M	Dispersion Trench					Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
M	Dispersion Trench					Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
M	Dispersion Trench					Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
M	Dispersion Trench					Water Flows Out Top of “Distributor” Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
M	Dispersion Trench					Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:								
M	Manhole/ Chamber					Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
M	Manhole/ Chamber					Trash& Debris	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.	No trash or debris in the catch basin.
M	Manhole/ Chamber					Trash& Debris	Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
M	Manhole/ Chamber					Trash& Debris	Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.

Energy Dissipaters Checklist (Continued)

		Date						
Frequency	**Drainage System Feature**	✓	✓	✓	✓	**Problem**	**Conditions to Check For**	**Conditions That Should Exist**
Internal (Continued):								
M	Manhole/ Chamber					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. There shall be a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
A	Manhole/ Chamber					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).	Top slab is free of holes and cracks.
A	Manhole/ Chamber					Structure Damage to Frame and/or Top Slab	Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
A	Manhole/ Chamber					Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
A	Manhole/ Chamber					Fractures or Cracks in Basin Walls/ Bottom	Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is re-grouted and secure at basin wall.
A	Manhole/ Chamber					Settlement / Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
M	Manhole/ Chamber					Contamination and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.
A	Catch Basin Cover					Cover Not in Place	Cover is missing or only partially in place.	Any open catch basin requires maintenance. Catch basin cover is closed

Energy Dissipaters Checklist (Continued)

		Date						
Frequency	**Drainage System Feature**	✓	✓	✓	✓	**Problem**	**Conditions to Check For**	**Conditions That Should Exist**
Internal (Continued):								
A	Catch Basin Cover					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.
A	Catch Basin Cover					Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is to keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

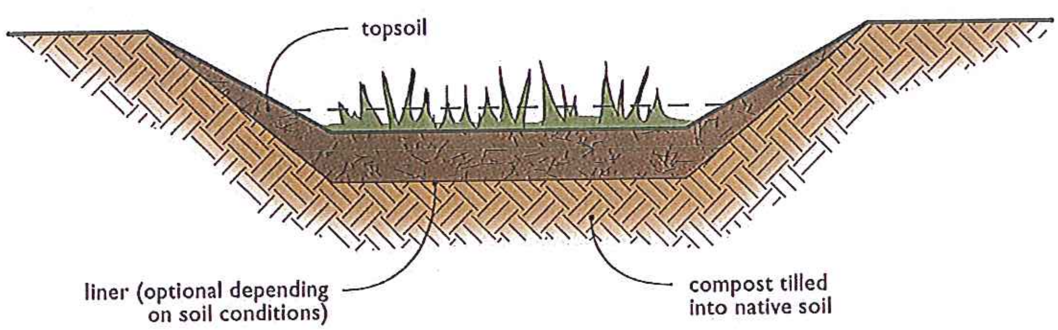
Key:
(M) Monthly from November through April.
(A) Once in late summer (preferable September)
(S) After any major storm (use 1-inch in 24 hours as a guideline).

3.8 Typical Biofiltration Swale

Biofiltration swales are engineered grass-lined open channels with moderate centerline slope similar in appearance to typical ditches.

Biofiltration uses vegetation in conjunction with slow and shallow-depth flow for runoff treatment. As runoff passes through the vegetation, pollutants are removed through the combined effects of filtration, infiltration, and settling. These effects are aided by the reduction of the velocity of stormwater as it passes through the biofilter.

Biofiltration swales provide stormwater quality control (treatment), but do not provide stormwater quantity control (detention/retention).



Typical Biofiltration Swale Checklist

Frequency	Drainage System Feature	Date ✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	General					Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the bio-swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
M	General					Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.
M	General					Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.
M	General					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.
M	General					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.
M	General					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 is not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.

Typical Biofiltration Swale Checklist (Continued)

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	General					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.
M	General					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.
M	General					Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from bioswale.
M	General					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.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

(M) Monthly from November through April.
(A) Once in late summer (preferable September)
(S) After any major storm (use 1-inch in 24 hours as a guideline).

3.21 Grounds (Landscaping)

Landscaping is an essential component of stormwater management. Bare soil areas generate higher levels of stormwater runoff and sedimentation in stormwater facilities. The following check list gives some general guidance for landscape management.

Grounds (Landscaping) Checklist

		Date						
Frequency	**Drainage System Feature**	✓	✓	✓	✓	**Problem**	**Conditions to Check For**	**Conditions That Should Exist**
M	General					Weeds (nonpoisonous)	Weeds growing in more than 20% of the landscaped area (trees and shrubs only).	Weeds present in less than 5% of the landscaped area.
M	General					Insect hazard	Any presence of poison ivy or other poisonous vegetation or insect nests.	No poisonous vegetation or insect nests present in landscaped area.
M,S	General					Trash or litter	See Ponds Checklist.	See Ponds Checklist.
M,S	General					Erosion of Ground Surface	Noticeable rills are seen in landscaped areas.	Causes of erosion are identified and steps taken to slow down/spread out the water. Eroded areas are filled, contoured, and seeded.
A	Trees and shrubs					Damage	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trim trees/shrubs to restore shape. Replace trees/shrubs with severe damage.
M	Trees and shrubs					Damage	Trees or shrubs that have been blown down or knocked over.	Replant tree, inspecting for injury to stem or roots. Replace if severely damaged.
A	Trees and shrubs					Damage	Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Place stakes and rubber-coated ties around young trees/shrubs for support.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:
(M) Monthly from November through April.
(A) Once in late summer (preferable September)
(S) After any major storm (use 1-inch in 24 hours as a guideline).

3.26 Inlet/Outlet Stormwater Pipe

The inlet and outlet stormwater pipes convey stormwater in, through, and out of stormwater facilities.

Storm sewer pipes convey stormwater. Pipes are built from many materials and are sometimes perforated to allow stormwater to infiltrate into the ground. Stormwater pipes are cleaned to remove sediment or blockages when problems are identified. Stormwater pipes must be clear of obstructions and breaks to prevent localized flooding. All stormwater pipes should be in proper working order and free of the possible defects listed below.

In addition, outlet stormwater pipes should be inspected to make sure stormwater exits the facility without causing any negative impacts to the drainage area, if applicable.

Inlet/Outlet Storm Pipe Checklist

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	General					Obstructions including roots	Storm pipe- root enters or deforms pipe, reducing flow.	Use mechanical methods to remove root. Do not put root-dissolving chemicals in storm sewer pipes. If necessary, remove the vegetation over the line.
M	General					Pipe dented or broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
M	General					Pipe rusted or deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced.
M	Erosion					Erosion	Eroded or scoured areas due to flow channelization, high flows, or vehicular damage.	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 damaged area should be re-graded and re-seeded. For smaller bare areas, overseed.
M	Pipe outfall					Missing or removed rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
M	Pipe outfall					Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.

Inlet/Outlet Storm Pipe Checklist (Continued)

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	Pipe outfall					Erosion/Scouring	Eroded or scoured ditch or stream banks 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, damaged area should be re-graded and re-seeded. For smaller bare areas, overseed.
M	Pipe Outfall					Missing or Moved Rock	Only one layer of rock exists above native soil area in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
M	Pipe Outfall					Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:
(A) Annual (March or April preferred)
(M) Monthly (see schedule)
(S) After major storms (use 1-inch in 24 hours as a guideline)

Annual Inspection Report

Annual Inspection Report

City of Puyallup – Stormwater BMP Facilities Inspection and Maintenance Log

Return Form to:
Stormwater Engineer/ City of Puyallup
333 South Meridian
Puyallup, WA 98371

Facility Name: ____

Address: ____

Begin Date: ___________________________ End Date: _____________________________

Date	BMP ID#	BMP facility Description	Inspected By	Cause for Inspection	Exceptions Noted	Notes / Actions Taken

Instructions:

Record all inspections and maintenance for all treatment BMP's on this form. Use additional log sheets and/or attach extended comments or documentation as necessary. Submit a copy of the completed log with the Annual Independent Inspector Report to the City, and start a new log at that time. Checklists provided should be used prior to filling out this form. If you have any questions on how to complete your inspection, please contact City staff.

BMP ID #- always use ID# from the Operation and Maintenance Manual.
Inspected by- Note all Inspections and maintenance on this form, including the required independent annual inspection.
Cause for Inspection- Note if the inspection is routine, pre-rainy season, post storm, annual, or in response to a noted problem or complaint.
Exceptions Noted- Note any condition that requires correction or indicates a need for maintenance.
Notes / Actions Taken- Describe any maintenance done and need for follow up.