BLUELINE

Landmark Apartments

Federal Way, Washington

Date: February 24, 2020

Technical Information Report

Prepared for
Landmark, LLC
10900 NE 8th Street, Suite 1200
Bellevue, WA 98004

Blueline Job No. 19-019
Prepared by: James Reynes, EIT
Reviewed by: Garrett Wine, PE

2/26/2020

TABLE OF CONTENTS

- Review of Wetland Z Adjacent to Parcel 1721049036 prepared by Habitat Technologies dated July 16, 2018
- Geotechnical Engineering Study prepared by Earth Solutions NW, LLC dated June 19, 2019

Section 1 Project Overview

The project is located at 33005 15th Ave S, Federal Way, WA 98003. More generally, the site is located in the SE ¼ of Section 17, Township 21N, Range 4E of the Williamette Principal Meridian in King County. Please see vicinity map below.

Vicinity Map
Not to Scale

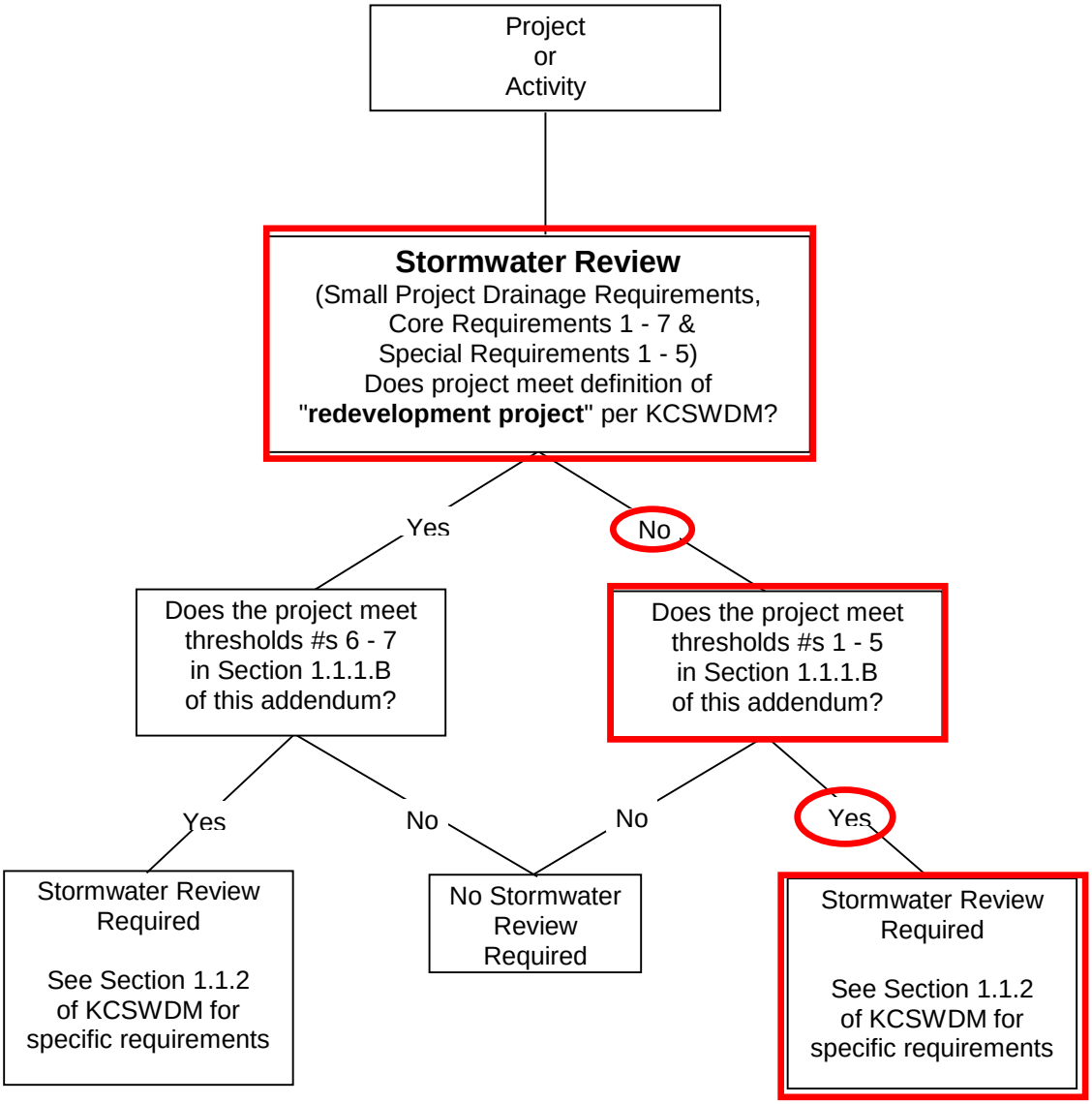
The site contains eleven (11) parcels (Parcel Numbers 1721049034, 1721049074, 1721049051, 1721049019, 1721049046, 1721049057, 1721049028, 1721049030, 1721049035, 1721049059, 1721049060). The project proposes to develop most of the total parcel area of 7.45-ac along with frontage improvements associated with providing adequate site access from 13th Pl S and 15th Ave S. See Section 4 for detailed site areas. The site currently contains dirt roads, broken asphalt and concrete surfacing, a house, a garage, access roads, heavy brush, and trees. All hardscapes will be removed prior to construction. Refer to the *Existing Conditions Exhibit* included in the Appendix. In the developed condition, the project proposes to construct new multi-story apartment buildings and a daycare with parking areas, pedestrian plazas, planters, landscaping and associated utility infrastructure for the new development. Refer to the *Developed Conditions Exhibit* in the Appendix. Runoff from the targeted portion of the site is generated from three separate drainage basins that do not combine within 1/4-mile downstream. The project site is located within the Hylebos Creek Basin and is ultimately tributary to Brook Lake. Refer to the Level 1 Downstream Analysis included in Section 3.

Per the Geotechnical Engineering Study by Earth Solutions NW, LLC, included in Section 6, "the soil conditions encountered during our fieldwork consisted primarily of loamy sand (USDA Classification), with areas of coarse sand and coarse sandy loam and are generally not favorable for infiltration." Additionally, most test pits indicated a hard, cementitious layer below the topsoil layer, making on-site infiltration difficult. The presence of these non-infiltrative soils on-site renders several Flow Control BMP options, outlined in Section 1.2.9.2 of the King County Surface Water Design Manual (2016 KCSWDM), infeasible. See Section 4 for more information regarding Flow Control BMPs. Downstream soils are mapped as outwash soils per the USDA Web Soil Survey.

Stormwater elements will be designed in accordance with the 2016 King County Surface Water Design Manual (KCSWDM) and the "Addendum to the King County Surface Water Design Manual" by the City of Federal Way. The proposed developments will create more than a 0.15 cfs increase in site runoff in two of the three existing on-site drainage basins over the historic, predeveloped condition for the 100-year storm event when modelled using a 15-minute timestep in WWHM2012. The project is therefore required to provide flow control facilities per Section 1.2.3 of the KCSWDM for Drainage Basins B & C due to the increase in runoff compared to the historic condition. The project is required to provide water quality for a new development per Section 1.1.1.A of the "Addendum to the King County Surface Water Design Manual" to meet the standards of Section 1.2.8 of the KCSWDM. Stormwater Low Impact Development (LID) features will be provided to the maximum extent feasible per Section 1.2.9.2.1 of the KCSWDM. Please see Section 4 for the LID BMP, Flow Control, and Water Quality design consideration and subsequent discussion. The project is subject to Full Drainage Review per the City of

Federal Way's Stormwater Review Flow Chart, included on the following pages. The requirements for the Full Drainage Review are listed in Section 2.

FIGURE 1.1.1.B
Stormwater Review Flow Chart *



* The requirement to complete a stormwater review is separate from the requirements to conform to the Water Quality Review (1.1.1.A). If water quality is triggered, but a stormwater review is not, the applicant is still required to conform to the Water Quality requirements.

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner: Landmark, LLC
Phone: 425.233.6444
Address: 10900 NE 8th Street, Suite 1200
Bellevue, WA 98004
Project Engineer: Garrett Wine, PE
Company: The Blueline Group
Phone: 425-250-7246

Part 2 PROJECT LOCATION AND DESCRIPTION

Project Name: Landmark Apartments
DPER Permit #:
Location Township: 21N
Range: 4E
Section: 17
Site Address: 33005 15th Ave S,
Federal Way, WA 98003

Part 3 TYPE OF PERMIT APPLICATION

- ☐ Landuse (e.g.,Subdivision / Short Subd. / UPD)
- ☐ Building (e.g.,M/F / Commercial / SFR)
- ☑ Clearing and Grading
- ☐ Right-of-Way Use
- ☐ Other

Part 4 OTHER REVIEWS AND PERMITS

- ☐ DFW HPA
- ☐ COE 404
- ☐ DOE Dam Safety
- ☐ FEMA Floodplain
- ☐ COE Wetlands
- ☐ Other
- ☐ Shoreline Management
- ☑ Structural Rockery/Vault/
- ☐ ESA Section 7

Part 5 PLAN AND REPORT INFORMATION

Technical Information Report

Type of Drainage Review (check one):
- ☑ Full
- ☐ Targeted
- ☐ Simplified
- ☐ Large Project
- ☐ Directed

Date (include revision dates): 2/24/2020
Date of Final:

Site Improvement Plan (Engr. Plans)

Plan Type (check one):
- ☑ Full
- ☐ Modified
- ☐ Simplified

Date (include revision dates): 2/24/2020
Date of Final:

Part 6 SWDM ADJUSTMENT APPROVALS

Type (circle one): Standard / Experimental / Blanket

Description: (include conditions in TIR Section 2)

CORE REQUIREMENTS 1 - 9 AND SPECIAL REQUIREMENTS 1 - 5

Approved Adjustment No. _____ Date of Approval: _____

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 7 MONITORING REQUIREMENTS

Monitoring Required: Yes / (No)

Start Date: _____

Completion Date: _____

Describe: _____

_____

_____

Re: KCSWDM Adjustment No. _____

Part 8 SITE COMMUNITY AND DRAINAGE BASIN

Community Plan : CITY OF FEDERAL WAY

Special District Overlays: N/A

Drainage Basin: HYLEBOS CREEK BASIN

Stormwater Requirements: LEVEL II FLOW CONTROL / ENHANCED WATER QUALITY

Part 9 ONSITE AND ADJACENT SENSITIVE AREAS

- ☐ River/Stream _____
- ☐ Lake _____
- ☑ Wetlands _____
- ☐ Closed Depression _____
- ☐ Floodplain _____
- ☐ Other _____

_____

- ☐ Steep Slope _____
- ☐ Erosion Hazard _____
- ☐ Landslide Hazard _____
- ☐ Coal Mine Hazard _____
- ☐ Seismic Hazard _____
- ☐ Habitat Protection _____
- ☐ _____

Part 10 SOILS

Soil Type	Slopes	Erosion Potential
NEAR SURFACE - SILTY SAND	8-15%	SLIGHT TO MODERATE
VARYING DEPTHS - SILTY SAND	8-15%	SLIGHT TO MODERATE

- ☐ High Groundwater Table (within 5 feet)
- ☐ Other _____
- ☐ Sole Source Aquifer
- ☐ Seeps/Springs

☑ Additional Sheets Attached SEE APPENDIX OF TIR FOR ADDITIONAL REPORTS

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS

REFERENCE	LIMITATION / SITE CONSTRAINT
☐ Core 2 – Offsite Analysis	
☑ Sensitive/Critical Areas	NEIGHBORING WETLAND
☑ SEPA	
☑ LID Infeasibility	INFILTRATION NOT RECOMMENDED
☐ Other	
☐	

☐ Additional Sheets Attached

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Threshold Discharge Area: (name or description) Basin A - Basin runoff does not trigger detention and water quality requirements. Stormwater will be conveyed to the natural discharge location

Core Requirements (all 8 apply):

Discharge at Natural Location	Number of Natural Discharge Locations: 1
Offsite Analysis	Level: (1) / 2 / 3 dated: 09/20/2019
Flow Control (include facility summary sheet)	Level: 1 / 2 / 3 or Exemption Number #2 Flow Control BMPs
Conveyance System	Spill containment located at: N/A
Erosion and Sediment Control / Construction Stormwater Pollution Prevention	(CSWPP)/CESCL/ESC Site Supervisor: TBD Contact Phone: TBD After Hours Phone: TBD
Maintenance and Operation	Responsibility (circle one): Private / (Public) If Private, Maintenance Log Required: Yes / No
Financial Guarantees and Liability	Provided: (Yes) / No
Water Quality (include facility summary sheet)	Type (circle one): Basic / Sens. Lake / Enhanced Basic / Bog or Exemption No. 1. Surface Area Exemption Landscape Management Plan: Yes / No

Special Requirements (as applicable):

Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / (None) Name:
Floodplain/Floodway Delineation	Type (circle one): Major / Minor / Exemption / (None) 100-year Base Flood Elevation (or range): Datum:
Flood Protection Facilities	Describe: N/A

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)	
Source Control (commercial / industrial land use)	Describe land use: COMMERCIAL/RESIDENTIAL MIXED USE Describe any structural controls: TBD
Oil Control	High-use Site: Yes / (No) Treatment BMP: _____ Maintenance Agreement: Yes / (No) with whom? _____
Other Drainage Structures	
Describe:	

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION	MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
☑ Clearing Limits	☑ Stabilize exposed surfaces
☑ Cover Measures	☑ Remove and restore Temporary ESC Facilities
☑ Perimeter Protection	☑ Clean and remove all silt and debris, ensure operation of Permanent Facilities, restore operation of Flow Control BMP Facilities as necessary
☑ Traffic Area Stabilization	☑ Flag limits of SAO and open space preservation areas
☑ Sediment Retention	☐ Other _____
☑ Surface Water Collection	
☑ Dewatering Control	
☑ Dust Control	
☑ Flow Control	
☑ Protection of Flow Control BMP Facilities (existing and proposed)	
☑ Maintain BMPs / Manage Project	

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

Flow Control	Type/Description	Water Quality	Type/Description
☐ Detention	_____	☐ Vegetated Flowpath	_____
☐ Infiltration	_____	☐ Wetpool	_____
☐ Regional Facility	_____	☐ Filtration	_____
☐ Shared Facility	_____	☐ Oil Control	_____
☐ Flow Control BMPs	_____	☐ Spill Control	_____
☐ Other	_____	☐ Flow Control BMPs	_____
		☐ Other	_____

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 15 EASEMENTS/TRACTS	Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement	☐ Cast in Place Vault
☐ Covenant	☐ Retaining Wall
☐ Native Growth Protection Covenant	☐ Rockery > 4' High
☐ Tract	☐ Structural on Steep Slope
☐ Other _____	☐ Other _____

Part 17 SIGNATURE OF PROFESSIONAL ENGINEER

I, or a civil engineer under my supervision, have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attached Technical Information Report. To the best of my knowledge the information provided here is accurate.

2/26/2020

Signed/Date

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS

REFERENCE	LIMITATION / SITE CONSTRAINT
☐ Core 2 – Offsite Analysis	
☐ Sensitive/Critical Areas	
☐ SEPA	
☑ LID Infeasibility	INFILTRATION NOT RECOMMENDED
☐ Other	
☐	

☐ Additional Sheets Attached

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Threshold Discharge Area: (name or description) Basin B - All basin runoff will be routed to the detention vault and then the water quality facility prior to being conveyed to a natural discharge location.

Core Requirements (all 8 apply):

Discharge at Natural Location	Number of Natural Discharge Locations: 1
Offsite Analysis	Level: (1) / 2 / 3 dated: 09/20/2019
Flow Control (include facility summary sheet)	Level: 1 / (2) / 3 or Exemption Number _____ Flow Control BMPs Vault
Conveyance System	Spill containment located at: N/A
Erosion and Sediment Control / Construction Stormwater Pollution Prevention	(CSWPP)/CESCL/ESC Site Supervisor: TBD Contact Phone: TBD After Hours Phone: TBD
Maintenance and Operation	Responsibility (circle one): Private / (Public) If Private, Maintenance Log Required: Yes / No
Financial Guarantees and Liability	Provided: (Yes) / No
Water Quality (include facility summary sheet)	Type (circle one): Basic / Sens. Lake / (Enhanced Basic) / Bog or Exemption No. _____ Landscape Management Plan: Yes / No

Special Requirements (as applicable):

Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / (None) Name: _____
Floodplain/Floodway Delineation	Type (circle one): Major / Minor / Exemption / (None) 100-year Base Flood Elevation (or range): _____ Datum:
Flood Protection Facilities	Describe: N/A

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 12 TIR SUMMARY SHEET	(provide one TIR Summary Sheet per Threshold Discharge Area)
Source Control (commercial / industrial land use)	Describe land use: COMMERCIAL/RESIDENTIAL MIXED USE Describe any structural controls: WATER QUALITY FACILITIES FOR PGIS PARKING LOTS
Oil Control	High-use Site: Yes / (No) Treatment BMP: _____ Maintenance Agreement: Yes / (No) with whom? _____
Other Drainage Structures	
Describe:	

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION		MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
☑ Clearing Limits		☑ Stabilize exposed surfaces
☑ Cover Measures		☑ Remove and restore Temporary ESC Facilities
☑ Perimeter Protection		☑ Clean and remove all silt and debris, ensure operation of Permanent Facilities, restore operation of Flow Control BMP Facilities as necessary
☑ Traffic Area Stabilization		☑ Flag limits of SAO and open space preservation areas
☑ Sediment Retention		☐ Other _____
☑ Surface Water Collection		
☑ Dewatering Control		
☑ Dust Control		
☑ Flow Control		
☑ Protection of Flow Control BMP Facilities (existing and proposed)		
☑ Maintain BMPs / Manage Project		

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

Flow Control	Type/Description		Water Quality	Type/Description
☑ Detention	VAULT		☐ Vegetated Flowpath	_____
☐ Infiltration	_____		☐ Wetpool	_____
☐ Regional Facility	_____		☐ Filtration	_____
☐ Shared Facility	_____		☐ Oil Control	_____
☐ Flow Control BMPs	_____		☐ Spill Control	_____
☐ Other	_____		☐ Flow Control BMPs	_____
			☑ Other	BioPod System

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 15 EASEMENTS/TRACTS		Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement		☑ Cast in Place Vault
☐ Covenant		☑ Retaining Wall
☐ Native Growth Protection Covenant		☐ Rockery > 4' High
☐ Tract		☐ Structural on Steep Slope
☐ Other _____		☐ Other _____

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Signed/Date

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS

REFERENCE	LIMITATION / SITE CONSTRAINT
☐ Core 2 – Offsite Analysis	
☐ Sensitive/Critical Areas	
☐ SEPA	
☑ LID Infeasibility	INFILTRATION NOT RECOMMENDED
☐ Other	
☐	

☐ Additional Sheets Attached

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Threshold Discharge Area: (name or description) Basin C - All basin runoff will be routed to the detention vault and then the water quality facility prior to being conveyed to a natural discharge location.

Core Requirements (all 8 apply):

Discharge at Natural Location	Number of Natural Discharge Locations: 1
Offsite Analysis	Level: (1) / 2 / 3 dated: 09/20/2019
Flow Control (include facility summary sheet)	Level: 1 / (2) / 3 or Exemption Number _____ Flow Control BMPs Vault
Conveyance System	Spill containment located at: N/A
Erosion and Sediment Control / Construction Stormwater Pollution Prevention	(CSWPP)/CESCL/ESC Site Supervisor: TBD Contact Phone: TBD After Hours Phone: TBD
Maintenance and Operation	Responsibility (circle one): Private / (Public) If Private, Maintenance Log Required: Yes / No
Financial Guarantees and Liability	Provided: (Yes) / No
Water Quality (include facility summary sheet)	Type (circle one): Basic / Sens. Lake / (Enhanced Basic) / Bog or Exemption No. _____ Landscape Management Plan: Yes / No

Special Requirements (as applicable):

Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / (None) Name: _____
Floodplain/Floodway Delineation	Type (circle one): Major / Minor / Exemption / (None) 100-year Base Flood Elevation (or range): _____ Datum:
Flood Protection Facilities	Describe: N/A

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 12 TIR SUMMARY SHEET	(provide one TIR Summary Sheet per Threshold Discharge Area)
Source Control (commercial / industrial land use)	Describe land use: COMMERCIAL/RESIDENTIAL MIXED USE Describe any structural controls: Water quality facilities for PGIS parking lots.
Oil Control	High-use Site: Yes / (No) Treatment BMP: _____ Maintenance Agreement: Yes / (No) with whom? _____
Other Drainage Structures	
Describe:	

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION		MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
☑ Clearing Limits		☑ Stabilize exposed surfaces
☑ Cover Measures		☑ Remove and restore Temporary ESC Facilities
☑ Perimeter Protection		☑ Clean and remove all silt and debris, ensure operation of Permanent Facilities, restore operation of Flow Control BMP Facilities as necessary
☑ Traffic Area Stabilization		☑ Flag limits of SAO and open space preservation areas
☑ Sediment Retention		☐ Other _____
☑ Surface Water Collection		
☑ Dewatering Control		
☑ Dust Control		
☑ Flow Control		
☑ Protection of Flow Control BMP Facilities (existing and proposed)		
☑ Maintain BMPs / Manage Project		

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

Flow Control	Type/Description		Water Quality	Type/Description
☑ Detention	VAULT		☐ Vegetated Flowpath	_____
☐ Infiltration	_____		☐ Wetpool	_____
☐ Regional Facility	_____		☐ Filtration	_____
☐ Shared Facility	_____		☐ Oil Control	_____
☐ Flow Control BMPs	_____		☐ Spill Control	_____
☐ Other	_____		☐ Flow Control BMPs	_____
			☑ Other	BioPod System

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 15 EASEMENTS/TRACTS	Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement	☑ Cast in Place Vault
☐ Covenant	☑ Retaining Wall
☐ Native Growth Protection Covenant	☐ Rockery > 4' High
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☐ Other _____	☐ Other _____

Part 17 SIGNATURE OF PROFESSIONAL ENGINEER

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2/26/2020

Signed/Date

Section 2 Conditions and Requirements Summary

2.1 CORE REQUIREMENTS

Core Requirement #1: Discharge at the Natural Location
The proposed development will provide drainage infrastructure to manage onsite storm water and convey runoff to the existing natural discharge locations. The natural discharge locations are described further in Section 3 and Section 4 of this report.

Core Requirement #2: Offsite Analysis
See Section 3 of this report for a Level I Downstream Analysis completed for the project.

Core Requirement #3: Flow Control Facilities
See Section 4. The proposed development will capture runoff on-site prior to discharging stormwater to its natural drainage location. A detention system will be provided meeting the requirements of Section 1.2.3 of the KCSWDM, matching the historic site conditions from 50% of the 2-year peak flow up to the full 50-year peak flow and the peak discharge rates for the 2-year and 10-year return periods.

Core Requirement #4: Conveyance System
See Section 5. The conveyance system will be designed to convey the 100-year, 24-hour storm event without overtopping during final engineering.

Core Requirement #5: Construction Stormwater Pollution Prevention
See Section 8. The temporary erosion and sedimentation control (TESC) plan will consist of temporary measures (stabilized construction entrance, inlet protection, silt fence, concrete washout basin, etc.) as well as permanent measures (permanent landscaping and stabilization of the disturbed areas). The TESC plan and Stormwater Pollution Prevention Plan (SWPPP) will be provided at final engineering.

Core Requirement #6: Maintenance and Operations
See Section 10. A Maintenance and Operations manual will be provided at final engineering.

Core Requirement #7: Financial Guarantees and Liability
See Section 9. A Federal Way Bond Quantity Worksheet for the project will be provided at final engineering.

Core Requirement #8: Water Quality Facilities
See Section 4. The proposed improvements include construction of a mixed-use development with associated parking and road improvements. The on-site and frontage improvement basins will result in greater than 5,000 sq. ft. of new plus replaced Pollution Generating Impervious Surface (PGIS) triggering Enhanced Water Quality. Enhanced Water Quality will be achieved utilizing Oldcastle's BioPod water quality system. The BioPod meets the General Use Level Designation for Enhanced Water Quality through the Department of Ecology's TAPE program.

Core Requirement #9: Flow Control BMPs
The proposed improvements encompass greater than 22,000 sq. ft. of area but is not a Large Rural Lot. Compost amended soils will be implemented. See Section 4 for further discussion.

Special Requirement #1: Other Adopted Area-Specific Requirements
There are no known additional requirements for the subject project.

Special Requirement #2: Flood Hazard Area Delineation
The Offsite Analysis (Section 3) identifies all sensitive areas associated with the project. The project is not located within or nearby a Flood Hazard Area. This Special Requirement, therefore, is not applicable.

Special Requirement #3: Flood Protection Facilities
The site does not rely on nor will the site modify an existing flood protection facility or construct a new flood protection facility. This Special Requirement, therefore, is not applicable.

Special Requirement #4: Source Controls
The subject project is a commercial development. Per the 2016 KCSWDM, source control measures are required per the King County Stormwater Pollution Prevention Manual for commercial sites. On-site stormwater source controls do not apply to the project post site stabilization. Source Control Pollution created from construction of the subject project will be addressed within the SWPPP (to be provided under separate cover at final engineering).

Special Requirement #5: Oil Control
The proposed project is neither an industrial development nor a high-use site. This Special Requirement, therefore, is not applicable.

2.2 SEPA MITIGATIONS

Mitigations are not anticipated to be required to receive SEPA approval.

2.3 ENVIRONMENTALLY SENSITIE AREA REQUIREMENTS

No work shall be performed in the wetland buffer boundary. The buffer boundary is shown in the Developed Conditions Exhibit in the Appendix and the civil plans under separate cover.

2.4 VARIANCES AND ADJUSTMENTS

No variances or adjustments are proposed for the site.

2.5 CONDITIONS OF PLAT APPROVAL

Conditions of Plat Approval will be completed prior to final engineering.

Section 3 Offsite Analysis

A Level 1 offsite analysis was conducted for the project site located at 33005 15th Ave S, Federal Way, WA 98003, on September 20, 2019. Weather conditions were partly cloudy with temperatures about 60 degrees Fahrenheit.

There are three existing drainage basins on-site: Basin A, Basin B, and Basin C. Each of these drainage basins provide separate downstream drainage paths that do not combine within ¼-mile. Detailed downstream drainage path descriptions are provided later in this section.

3.1 STUDY AREA DEFINITION AND MAPS

See Section 1 of this Report for a description of the site. Additionally, see the *Existing Conditions Exhibit* and the *Downstream Drainage Exhibit* in the Appendix.

3.2 RESOURCE REVIEW

The best available resource information, including King County iMap, NRCS Web Soil Survey, the Geotechnical Engineering Study prepared by Earth Solutions NW, LLC (included in Section 6), and the City of Federal Way (CFW) resource maps, were reviewed for existing or potential problems. The following is a summary of the findings from the information used in preparing this report.

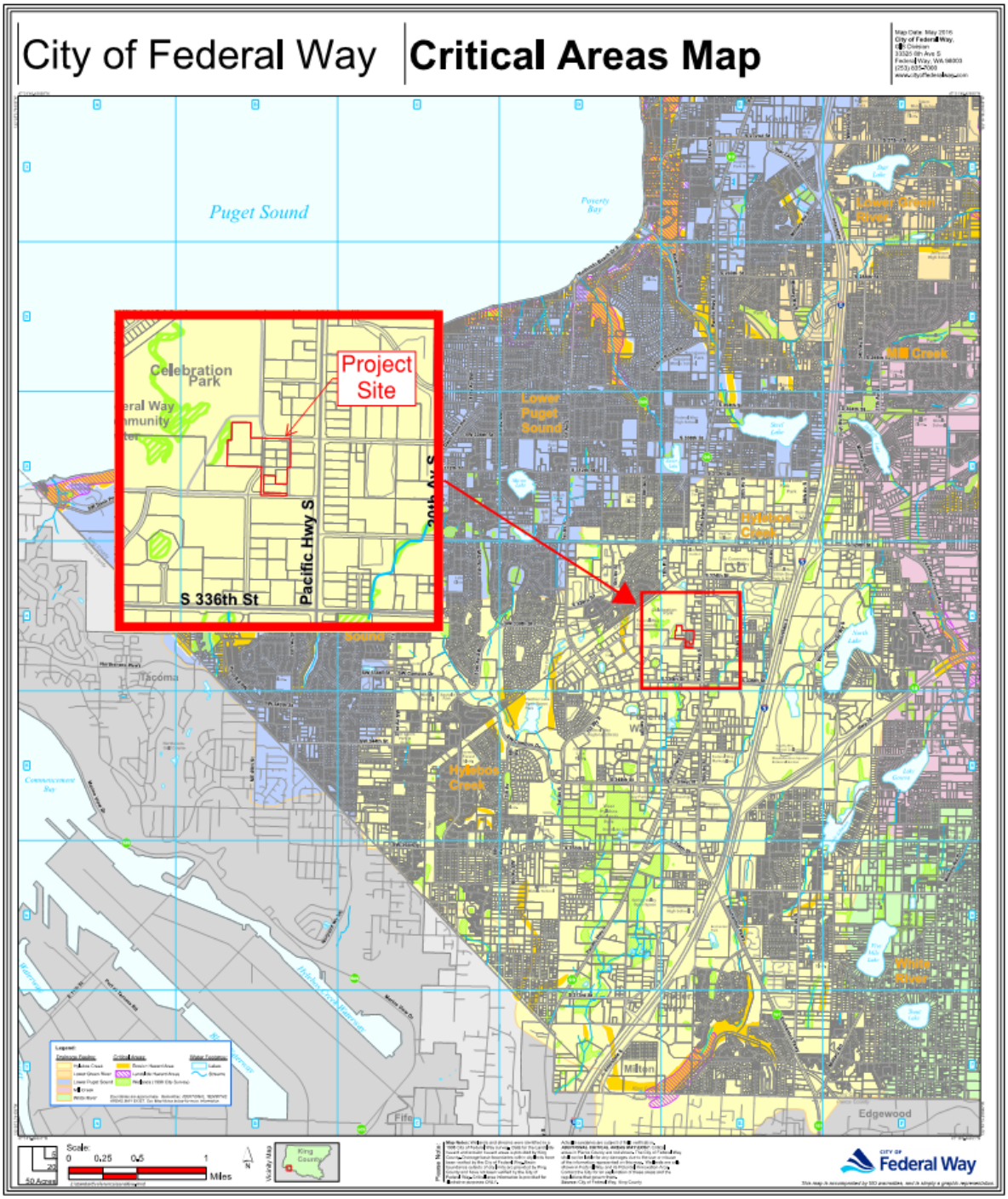
- The Natural Resource Conservation Service Web Soil Survey Identifies soils as, Everett-Alderwood gravelly sandy loams, 6-15% slopes. Everett-Alderwood soils are classified as outwash soils by KCSWDM 2016; however, according to the Geotechnical Report created by Earth Solutions NW, LLC, “the soil conditions encountered during our fieldwork consisted primarily of loamy sand (USDA Classification), with areas of coarse sand and coarse sandy loam and are generally not favorable for infiltration.”

- The site is not located within a Flood Plain (King County iMap).

- The site is not located within an Erosion Hazard Area (King County iMap and CFW Critical Areas Map).

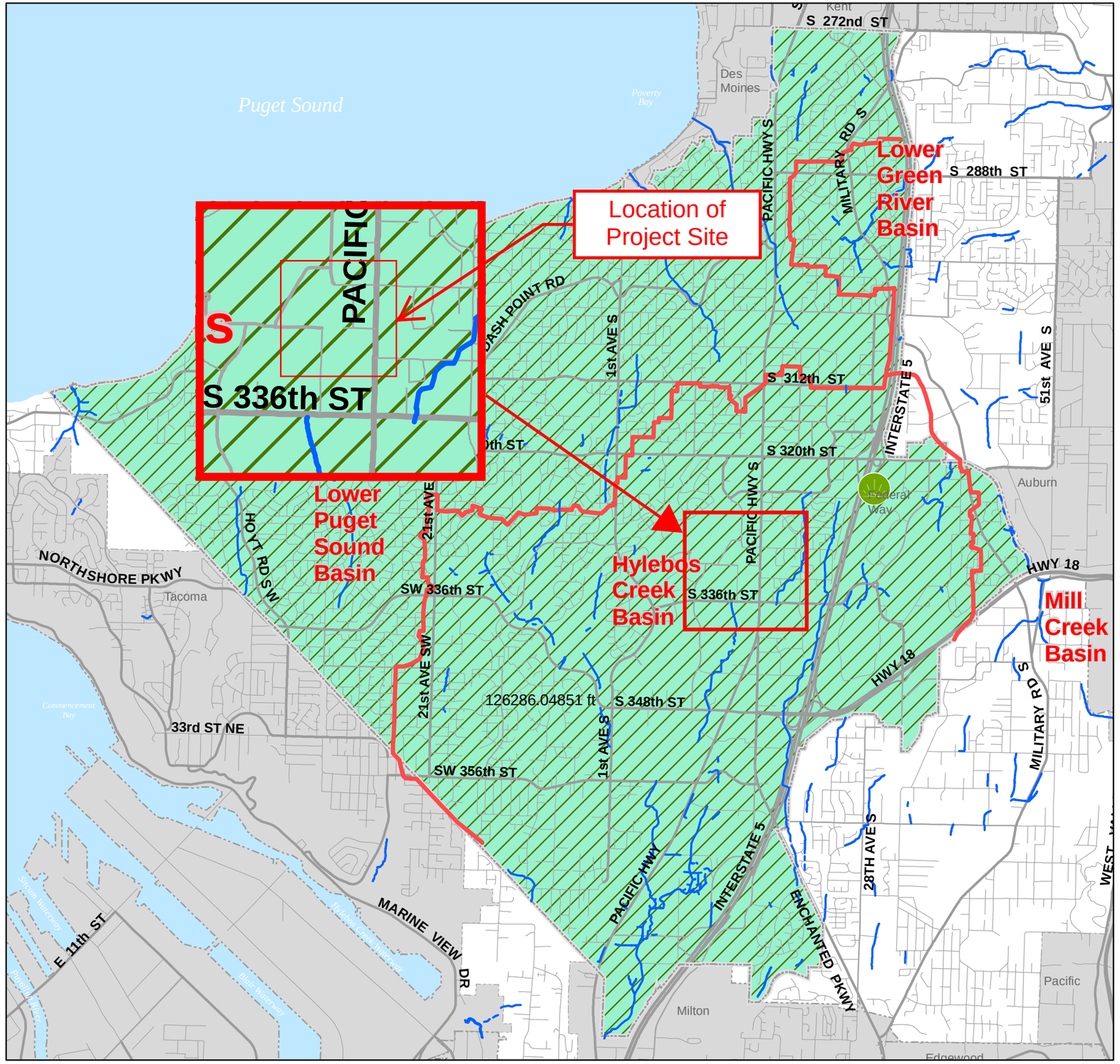
- The site is not located in a Landslide Hazard Area (King County iMap and CFW Critical Areas Map).

- The site is partially located in a Seismic Hazard Area (King County iMap).


City of Federal Way
Critical Areas Map
Puget Sound
Project Site
Celebration Park
S 336th St
Pacific Hwy S
Lower Puget Sound
Hylebos Creek
Tacoma
Milton
Edgewood
Federal Way

City of Federal Way

Water Quality Applications Map



Legend

- Drainage Basin Boundary
- Streams
- City Limits

Water Quality Treatment Area Types

- Enhanced Basic Water Quality Treatment Menu Required*
- Sensitive Lake
- Identified Sphagnum Bog Wetlands

* High density single family, multi-family, commercial, and industrial uses, as well as most roads, are subject to Enhanced Basic Water Quality Treatment Requirements.

Map Date: November 2013
SWM Division
City of Federal Way
33325 8th Ave S.
Federal Way, WA. 98003
(253) 835 - 2700
www.cityoffederalway.com

Scale:

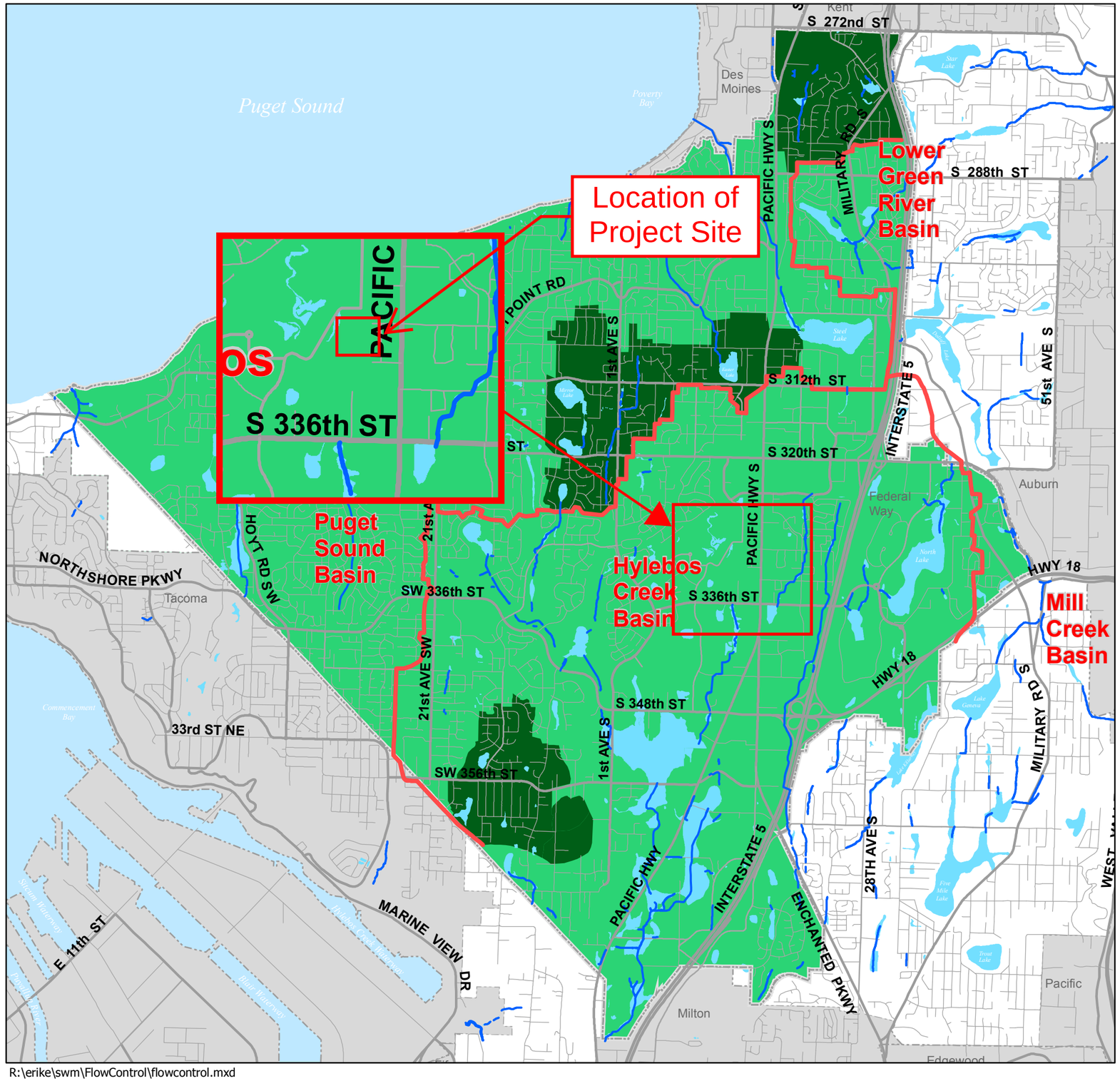
0 0.25 0.5 1 Mile

CITY OF Federal Way

\\users\erike\swm\watqual.mxd

City of Federal Way

Flow Control Applications Map



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Legend

- Drainage Basin Boundary
- Streams
- City Limits
- Lakes and Wetlands

Flow Control

- Basic Flow Control Areas
- Conservation Flow Control Areas
- Flood Problem Flow Control Areas

Major Receiving Waters

1. Puget Sound

Map Date: February, 2010

SWM Division
City of Federal Way
33325 8th Ave S
PO Box 9718
Federal Way, WA 98063
(253) 835-2700
www.cityoffederalway.com

Scale:

0 0.25 0.5 1 Mile

CITY OF Federal Way

3.3 FIELD INSPECTION AND DRAINAGE SYSTEM DESCRIPTION

A Level 1 Downstream Analysis was conducted on September 20, 2019, an overcast day with temperatures around 60˚F. Drainage path descriptions for the onsite basins are provided in Task 4 of this Section. Please see the *Existing Conditions Exhibit*, along with the *Downstream Drainage Exhibit* for basin delineation and downstream drainage paths included in the Appendix of this report.

ON-SITE BASINS

The site currently contains a single-family residence with associated access and utilities. Additionally, the site has small portions of asphalt and concrete accesses that are overgrown and in disrepair. Most of the site is currently vegetation and trees. The site has three separate drainage basins that do not combine within 1/4-mile downstream. Please see the *Existing Conditions Exhibit.* Stormwater from Basin A flows east prior to being collected in the public storm system located on the east side of 15th Ave S, flowing south and then east towards Pacific Hwy S. Runoff from Basin B flows south, where stormwater is then conveyed into a public storm system in 13th Place S. Stormwater from Basin C flows west into the neighboring Celebration Park parcel prior to being conveyed south towards the public drainage system located in S 332nd Street.

UPSTREAM BASIN

The east and southern borders of the site are bounded by roads that either slope away from the site or collect stormwater in a public conveyance system. On the west portion of the site, the existing topography is sloped away from the site towards the neighboring Celebration Park parcel. There is an upstream area to the north that slopes towards the property. In the developed condition, portions of this upstream area will be routed to the stormwater facility in Basin C, however, most of the upstream area will maintain the existing drainage patterns that are not tributary to the proposed on-site improvements. See Section 4, the *Existing Conditions Exhibit*, and the *Developed Conditions Exhibit* for itemized areas describing what upstream areas will be collected and what upstream areas will remain untouched in the developed condition.

EXISTING DOWNSTREAM DRAINAGE PATHS

There are three existing on-site drainage basins that do not converge within ¼-mile. All tightline systems consist of catch basins and 12-inch minimum pipes. See the below discussion describing each drainage basin.

On-site Basin A sheet flows west towards 15th Avenue S. Stormwater is then collected in the public storm drainage system (Photos 1A-3A) located on the eastern side of the road flowing south. The runoff is then conveyed southeast and then east into a series of catch basins located on the north side of S 332nd Street (Photos 4A-6A). Runoff continues east until it reaches Pacific Highway S in a storm drainage manhole (Photo 7A). Stormwater is conveyed south in the southbound lanes of Pacific Highway S through a series of manholes (Photos 8A-9A) until the runoff reaches the ¼-mile downstream drainage location (Photo 10A).

On-site Basin B sheet flows south and south west into the existing catch basins located in 13th Place S (Photo 1B-2B). Stormwater then crosses S 332nd Street continuing south along the western side of 13th Place S (Photo 3B). Runoff is tightlined through a series of catch basins and pipes along the western side of 13th Place south to S

336th Street (Photos 4B-11B). Stormwater crosses S 336th Street and daylights into a drainage swale at approximately the ¼-mile downstream drainage location.

On-site Basin C sheet flows west onto the neighboring Celebration Park parcel where stormwater is then conveyed south through the Federal Way Public Schools Nutrition Services property into a manhole located in the driveway of that property on the north side of S 332nd Street (Photo 1C), beginning the tightline conveyance. Stormwater is then conveyed southeast towards the Federal Way Public Schools Support Services Center's upper parking lot (Photo 2C). The runoff is conveyed into the lower school bus parking lot, where it is conveyed south into a manhole (Photo 3C) before being conveyed southwest into a manhole located on the northeast side of parcel 9265010030 (Photo 4C), bypassing the detention facility on the south side of the bus yard. Stormwater continues south towards the driveway of parcel 9265030055 (Photo 5C) before being conveyed east into a manhole located in the planter area (Photo 6C). Stormwater is then conveyed south across S 336th Street into another manhole at the approximate ¼-mile downstream drainage location (Photo 7C).

3.4 MITIGATION OF EXISTING OR POTENTIAL PROBLEMS

At the time of the site investigation, no problems were found with the existing systems beyond standard maintenance and cleaning. Existing catch basins and pipes require no immediate corrective maintenance. No significant drainage complaints within the downstream path were noted to have occurred within the preceding ten-year period per King County iMaps. There are five drainage complaints provided by Leah Myhre from the City of Federal Way. Four of the five complaints do not fall within the direct ¼-mile downstream drainage path. The fifth complaint describes gravel, debris, or automotive materials affecting the surrounding storm system along S 332nd Street due to the neighboring tow yards. The project proposes to collect, detain, and treat stormwater within the targeted basins prior to the stormwater being conveyed in a tightline system towards S 332nd Street. The proposed development will not create additional adverse impacts to this area because it is outside of the targeted on-site basin areas. The drainage complaints provided by the City are located in the Appendix.

A temporary erosion and sedimentation control (TESC) plan will be designed to minimize the discharge of sediment-laden runoff from the site. The plan will be comprised of temporary measures (rock entrance, silt fence, inlet protection, etc.) as well as permanent measures (final stabilization of disturbed areas). All TESC facilities shall be periodically inspected and maintained as necessary during construction to minimize impacts to the downstream system.

3.5 EXISTING DOWNSTREAM DRAINAGE PATHS

Basin A:

Photo 1A – Looking South – On-site flows from Basin A are captured in the catch basin and are conveyed south along the eastern side of 15th Avenue S.

Photo 2A – Looking South – Flows continue south through a series of catch basins along the eastern side of 15th Avenue S.

Photo 3A – Looking Southeast – Flows continue to the catch basin at the corner of 15th Avenue S and S 332nd Street. Runoff is then conveyed southeast to a series of catch basins located on the north side of S 332nd Street.

Photo 4A – Looking East – Flows are conveyed east along the north side of S 332nd Street in a series of catch basins towards Pacific Highway S.

Photo 5A – Looking East – Flows are conveyed east along the north side of S 332nd Street in a series of catch basins towards Pacific Highway S.

Photo 6A – Looking East – Flows are conveyed east from the catch basin to a manhole located in the southbound lanes of Pacific Highway South.

Photo 7A – Looking South – Flows enter the manhole from the east and are then conveyed south through a series of manholes in the southbound lanes of Pacific Highway South.

Photo 8A – Looking South – Runoff continues south through a series of manholes in the southbound lane of Pacific Highway South.

Photo 9A – Looking South – Runoff continues south through a series of manholes in the southbound lane of Pacific Highway South.

Photo 10A – Looking South – Runoff continues into the manhole located in Pacific Highway S at the approximate ¼-mile downstream drainage location.

Basin B:

Photo 1B – Looking West – On-site flows flow south along 13th Place South and enter the public storm system through a catch basin. Runoff is then conveyed west across 13th Place South.

Photo 2B – Looking South – Flows enter the catch basin on the west side of 13th Place South and is conveyed south across S 332nd Street along the west side of 13th Place South.

Photo 3B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 4B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 5B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 6B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 7B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 8B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 9B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 10B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 11B – Looking South – Flows continue south along the west side for 13th Place South in a series of pipes and catch basins.

Photo 12B – Looking Southwest – Flows are conveyed southwest to a manhole located in the eastbound lanes of S 336th Street.

Photo 13B – Looking South – Flows enter a drainage course at roughly the ¼-mile downstream drainage location.

Basin C:

Photo 1C – Looking South – Runoff from the existing wetland west of the site enters the manhole above and continues south and southeast towards the parking lot of the Federal Way Public Schools Transportation Department.

Photo 2C – Looking South – Flows enter this manhole and are conveyed south into the bus parking lot.

Photo 3C – Looking Southwest – Stormwater enters the manhole and is conveyed southwest towards the southern boundary of the Federal Way Public Schools Transportation Department.

Photo 4C – Looking Southeast – Flows enter the stormwater manhole located on the northeast corner of parcel 9265010030 and is then conveyed southeast.

Photo 5C – Looking West – Flows enter the catch basin and is conveyed west into a manhole located in the planter area of parcel 9265030055.

Photo 6C – Looking South – Flows enter the manhole and are conveyed south across S 336th Street.

Photo 7C – Looking South – Flows enter the manhole located in the eastbound lanes of S 336th Street at the approximate ¼-mile downstream drainage location.

Section 4 Flow Control and Water Quality Analysis and Design

In the existing conditions there are three existing on-site drainage basins. All on-site hardscapes will be removed prior to construction. Natural discharge locations for each on-site basin will be maintained in the developed condition. See the Existing Conditions Exhibit located in the Appendix for the locations and areas of each drainage basin that will be evaluated.

In the developed condition, stormwater evaluation will occur at the discharge point for each of the three on-site drainage basins (see the *Developed Conditions Exhibit*). For Basins B & C, stormwater will be collected, detained, and treated in two separate on-site stormwater systems to match predeveloped flow rates while discharging to their natural locations. Basin A is flow control and water quality exempt because the flows will not create more than a 0.15-cfs increase and less than 5,000 SF of pollution generating hard surface will be created. Please see the *Developed Conditions Exhibit* in the Appendix of this report delineating areas tributary to the on-site stormwater systems and the areas being bypassed.

The drainage analysis was modeled using the Western Washington Hydrology Model software with 15-minute time steps in accordance with the 2016 KCSWDM. According to the Geotechnical Report by Earth Solutions NW, LLC, onsite soils are predominantly till and will be modeled as such.

The project was modeled with the following parameters:
Rainfall Region: Seatac
Scale Factor: 1.0

4.1 HYDRAULIC ANALYSIS

EXISTING CONDITIONS

The site generally slopes from north to south. Per the Geotechnical Report, soils are primarily till throughout the site. Ground cover in the existing condition is typically forested with small sections of impervious surfaces scattered throughout. All on-site areas were modeled as the historic forested conditions.

The project study area has three (3) separate drainage basins that do not combine within ¼-mile downstream. The total targeted area of the project is approximately 7.60-acres which is mostly vegetation and trees with a total upstream area of 0.38-acre. On-site stormwater flows are not currently collected in a stormwater system on-site. Please refer to the Downstream Drainage Exhibit for information regarding each downstream drainage path for the three on-site drainage basins.

In the existing condition, Basin A encompasses approximately 1.37-acres of on-site area with 0.07-acre of frontage along 15th Avenue S in the existing condition. Currently a house, garage, broken asphalt pads, trees and vegetation are located within this basin boundary. Stormwater is collected in the public storm systems located in S 330th Street and 15th Avenue S and is conveyed east towards Pacific Highway S.

Basin B contains approximately 2.73-acres of on-site area and 0.25-acre of frontage along S 330th Street and 13th Place S in the existing condition. Additionally, 0.15-acre of upstream area flows through Basin B. This drainage basin is mostly trees and vegetation. Water typically sheet flows west or southwest until it is conveyed into the

existing drainage system at the corner of S 332nd Street and 13th Place S. Stormwater continues south along 13th Place S until it reaches the ¼-mile downstream drainage location.

Basin C is approximately 3.17-acres of on-site area with approximately 0.01-acre of future frontage improvements near 13th Place S. The on-site basin currently contains an overgrown dirt/gravel road with a broken concrete slab surrounded by trees and vegetation. All existing hardscapes will be removed. Additionally, there is approximately 0.23-acre of upstream area which flows through this basin and into the neighboring parcel. Stormwater from Basin C flows west onto the neighboring parcel prior to being conveyed south through private parcels until it reaches the ¼-mile downstream drainage location.

The site is within a Level 2 Flow Control Area which dictates that the existing condition shall be modeled in the historic (forested) condition. The areas used to compute the drainage calculations associated with the existing basin conditions, as well as the corresponding WWHM output, are summarized below. The WWHM Model Outputs are located in the Appendix.

Existing Basin A

On-Site	**1.37-ac**
Frontage	**0.07-ac**
Total (Till-Forest)	**1.44-ac**

Flow Frequency Return Periods for Predeveloped. Basin POC #1	
Return Period	**Flow(cfs)**
2 year	0.0429
5 year	0.0703
10 year	0.0879
25 year	0.1088
50 year	0.1233
100 year	0.1369

Existing Basin B

On-Site	**2.73-ac**
Frontage	**0.25-ac**
Upstream	**0.15-ac**
Total (Till-Forest)	**3.13-ac**

Existing Basin C

On-Site	**3.17-ac**
Frontage	**0.01-ac**
Upstream	**0.23-ac**
Total (Till-Forest)	**3.41-ac**

DEVELOPED CONDITIONS

The proposed development will include the construction of a multi-story, mixed-use development with associated utilities and infrastructure to support the site. Site stormwater discharge locations will be maintained in the developed conditions using the proposed on-site stormwater drainage conveyance system. Infiltration and dispersion BMPs are determined to be infeasible due to the presence of till soils onsite and the lack of space for dispersion. Compost amended soils will be implemented in landscaped areas.

The developed conditions will include three (3) separate drainage basins as shown on the Developed Conditions Exhibit at the end of this section. The basins have been separated by their natural drainage discharge locations, matching the discharge durations of each basin's existing condition flow rate. Land uses in the developed conditions will consist primarily of impervious surfaces, including but not limited to roof areas, parking lots, and sidewalks. Landscaped areas are also proposed, scattered throughout the site. Pollution Generating Impervious Surfaces (PGIS) collected in each basin, will be conveyed to a water quality facility prior to being detained and then will outfall to the basin's respective natural drainage discharge location.

Basin A, the easternmost basin, encompasses a total of 0.14-acre. In the developed condition, road regrading, sidewalk and curb installation, driveway installation, and frontage landscaping will be constructed. Stormwater will not be treated for water quality because the basin produces less than 5,000 SF of PGIS. The proposed improvements do not impose more than a 0.15-cfs increase in 100-year storm event compared to the historic forested condition and is therefore exempt from flow control requirements.

Basin B, the middle basin, encompasses a total of 3.77-acres. In the developed condition, a new road, apartment buildings, parking lots, pedestrian walkways, and other supporting impervious infrastructure will be constructed along with site landscaping. In the developed condition, there is a 0.15-cfs increase in 100-year peak flows when compared to the existing conditions, triggering a flow control facility. A detention vault is proposed underneath the proposed parking lot. Additionally, more than 5,000 SF of PGIS will be constructed within this basin requiring Enhanced Water Quality. All on-site runoff will be collected and conveyed into the detention facility prior to being treated in a BioPod system which provides Enhanced Water Quality treatment. After the stormwater has been treated to the enhanced water quality standard, the stormwater will be discharged to its natural discharge location in 13th Place South. All stormwater within Basin B cannot be collected for water quality treatment. For the project, there is a proposed PGIS mitigation swap to collect more PGIS area than the area that is bypassing the onsite stormwater facilities. There will be a portion of 15th Ave S that will be conveyed into the on-site stormwater system as seen on the *Developed Conditions Exhibit* located in the Appendix.

Basin C, the westernmost basin, encompasses approximately 4.05-acres. In the developed condition parking lots, an apartment building, a daycare facility, sidewalks, and other impervious infrastructure will be constructed along with site landscaping. The proposed basin creates more than a 0.15-cfs increase in the 100-year peak flows compared to the existing conditions, triggering a detention vault that will be located on the southwestern on-site parking lot. Additionally, more than 5,000 SF of PGIS will be constructed within this basin requiring Enhanced Water Quality. On-site runoff will be collected and conveyed into the detention facility prior to being treated in a BioPod system which provides Enhanced Water Quality treatment. After the stormwater has been treated to the enhanced water quality standard, the stormwater will be discharged to its natural discharge location to the west.

Developed Basin A (Analysis Point # 1)

Site	Area [AC]
Pervious – Lawn Till	0.02
PGIS	0.10
Impervious	0.02
Total	**0.14 ac**

Flow Frequency Return Periods for Developed.	Basin POC #1
Return Period	Flow(cfs)
2 year	0.0546
5 year	0.0699
10 year	0.0806
25 year	0.0948
50 year	0.1060
100 year	0.1176

This basin is detention exempt because less than a 0.15-cfs increase in 100-year peak flows result when comparing the existing conditions of Basin A to the developed conditions of Basin A.

Change in 100-year Peak flows = Developed – Existing = 0.1176 – 0.1369 cfs = **-0.0193 cfs**

Please see the WWHM reports in the Appendix for Basin A hydrology information.

Developed Basin B (Analysis Point #2)

Site	Area [AC]
Pervious – Till Lawn	0.48
Impervious	3.08
PGIS Mitigation Swap	0.05
By-Pass Pervious – Till Lawn	0.15
*Bypass Impervious	0.01
Total	**3.77 ac**

*Total impervious by-pass is 0.04-ac PGIS and 0.02-ac impervious prior to subtracting out the 0.05 PGIS Mitigation Trade. Net impervious bypass is 0.01-acres.

Please see the WWHM reports in the Appendix for Basin B hydrology information.

Developed Basin C (Analysis Point #3)

Site	Area [AC]
Pervious – Lawn	0.33
Pervious Upstream – Forest	0.08
PGIS	1.26
Impervious	1.05
Pervious Upstream Bypass - Forest	0.30
Pervious Bypass – Forest	0.68
Pervious Bypass – Lawn	0.35
Total	**4.05 ac**

Please see the WWHM report in the Appendix for Basin C hydrology information.

4.2 FLOW CONTROL ANALYSIS AND DESIGN

The flow control systems were designed in compliance with the 2016 KCSWDM. A detention vault and control structure will be located on the southwestern portion of the site, and a detention tank system with a control structure is proposed on the southeastern portion of the site. The outlet control structures on each of these detention systems will release runoff at rates that match the Level 2 flow control criteria of 50% of the 2-year peak flow to the 50-year peak flow. All on-site stormwater from Basins B and C (the only basins triggering flow control requirements) will be collected and conveyed to their respective detention facilities prior to offsite discharge to each basin's respective natural discharge location.

BASIN B DETENTION SYSTEM

Per the WWHM printout provided in the Appendix, the live storage volume required at the maximum stage of 7.25' is 102,080 cubic feet. The proposed detention vault will be 4 - 21' x 176' x 7.25' detention cells providing 107,184 cubic feet. Therefore, the vault is adequately sized per the flow control requirements.

Live Storage Volume
Required = 102,080 cubic feet
Provided = 107,184 cubic feet

Please see the WWHM printout for Basin B in the Appendix.

BASIN C DETENTION SYSTEM

Per the WWHM printout provided below, the live storage volume required at the maximum stage of 8' is 62,272 cubic feet. The proposed vault will provide 2 – 14' x 288' x 8' live storage cells, totaling to 64,512 cubic feet. The proposed vault is therefore adequately sized for the required flow control.

Live Storage Volume
Required = 62,272 cubic feet
Provided = 64,512 cubic feet

Please see the WWHM printout for Basin C in the Appendix.

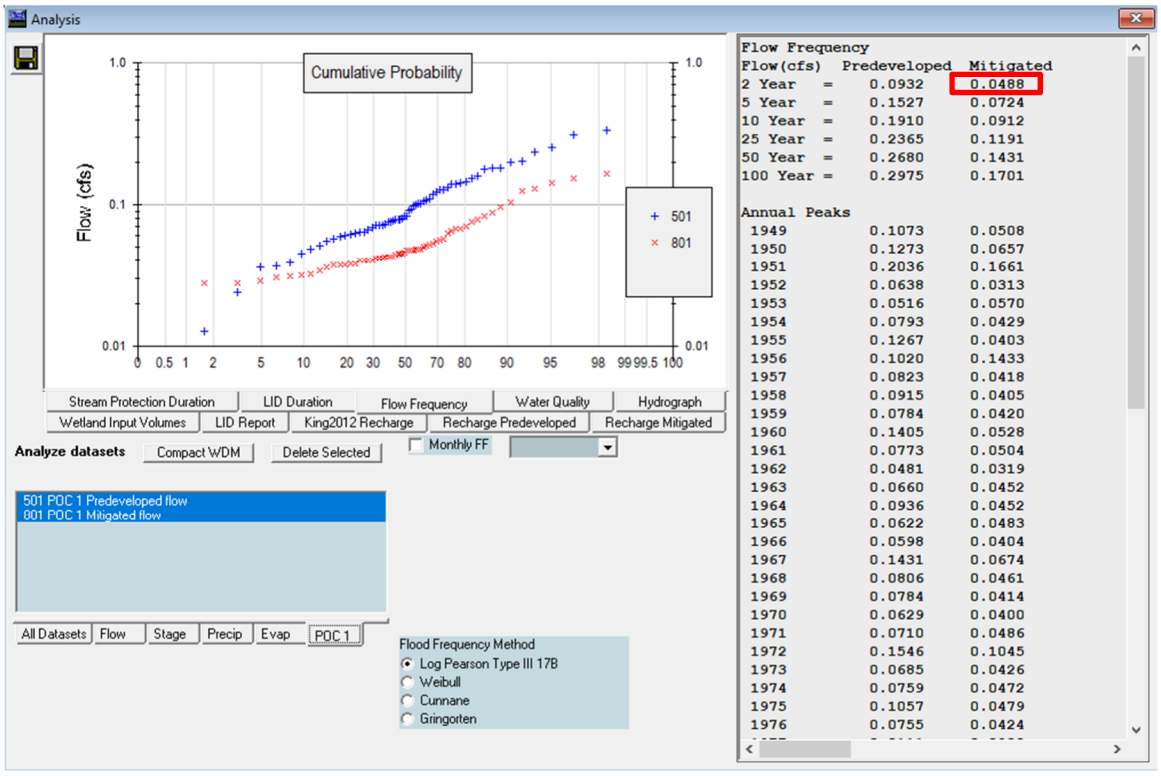
4.3 WATER QUALITY SYSTEM

For Basins B and C, water quality is required because each basin will create more than 5,000 SF of PGIS. The Enhanced Water Quality standard will be met utilizing an Oldcastle BioPod system downstream of detention. The BioPod system is a GULD approved product through the DOE's TAPE program for Enhanced Water Quality. Basin A, in the developed condition, contains under 5,000 SF of PGIS and is therefore exempt from water quality requirements.

For Basin B and C, water quality will be provided post detention. According to the letter provided for GULD, a BioPod downstream of detention will be sized using the full 2-year release rate of the detention facility. Both the GULD Letter of Approval and the BioPod Detail are located in the Appendix of this report.

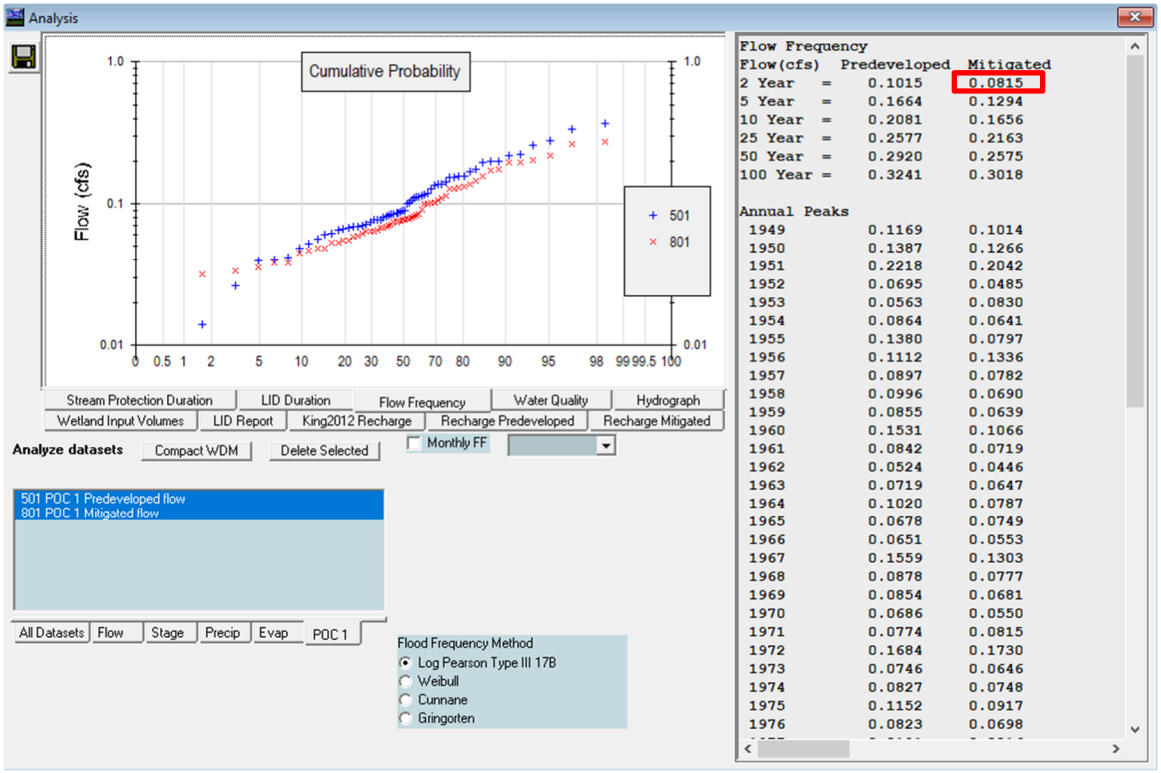
BASIN B: DETENTION VAULT TO BIOPOD 2-YEAR RELEASE RATE

Per the Basin B WWHM printout below, the 2-year release rate from the detention vault is 0.0488 cfs. The BioPod model that meets this 2-year flowrate is the BPU-44 (See the BioPod detail located in the Appendix).



BASIN C: DETENTION VAULT TO BIOPOD 2-YEAR RELEASE RATE:

Per the Basin C WWHM printout below, the 2-year release rate from the detention vault is 0.0815 cfs. The BioPod model that meets this 2-year flowrate is the BPU-46 (See the BioPod detail located in the Appendix).



4.4 FLOW CONTROL BMPS

Core Requirement #9 in Section 1.2.9 of the 2016 KCWDM requires the project to implement Flow Control BMPs for the roofs and other impervious surfaces to the maximum extent feasible. Full infiltration and Basic Dispersion were considered as preferred designs but upon analysis were found to be infeasible. Full Infiltration is infeasible due to the incompatible infiltration performance of the site, and limited infiltration is not feasible either as delineated below. Basic Dispersion is infeasible due to the lack of a viable vegetated flow path. The project will satisfy BMP requirements using post amended soils. LID BMP feasibility is summarized below.

1. **Full Dispersion** – The site is bounded to the north and east by S 330th Street and 15th Ave S, respectively. The south currently has a government building and 13th Place South. To the west, there is not enough of an on-site vegetated flow path to allow for full dispersion. For the above reasons, full dispersion is not feasible.

2. **Full Infiltration of Roof Runoff** – The Geotechnical Analysis (included in the Appendix) says that full infiltration is not feasible due to non-infiltrative soils on the site.

3. **Full Infiltration, Limited Infiltration, Bioretention, or Permeable Pavement –** The Geotechnical Analysis (included in the Appendix) indicates that there is a presence of till soils underlaying the site. Till soils are not conducive to infiltration making full infiltration, limited infiltration, bioretention and permeable pavement infeasible.

4. **Basic Dispersion** – The site's impervious surfaces cannot be treated using basic dispersion due to a lack of vegetated flow path for the proposed project.

5. **Native Growth Retention** – There is no feasible native growth area onsite suitable for native growth retention.

6. **Post-Amended Soils** – Amended soils will be applied to landscaped areas on the site.

7. **Perforated Pipe Connection** – Perforated pipe connections are not recommended due to the lack of infiltrative soils onsite.

Section 5 Conveyance System Analysis and Design

The conveyance system will be designed at final engineering to convey the 100-year, 24-hour storm event without overtopping.

Section 6 Special Reports and Studies

The following reports are relevant to the project and are included in the Appendix at the end of this Report.

- Geotechnical Engineering Study prepared by Earth Solutions NW, LLC dated June 19, 2019.
- Review of Wetland Z Adjacent to Parcel 1721049036 prepared by Habitat Technologies dated July 16, 2018

Section 7 Other Permits

At this time, there are no additional permits associated with this project.

Section 8 SWPPP and TESC Analysis and Design

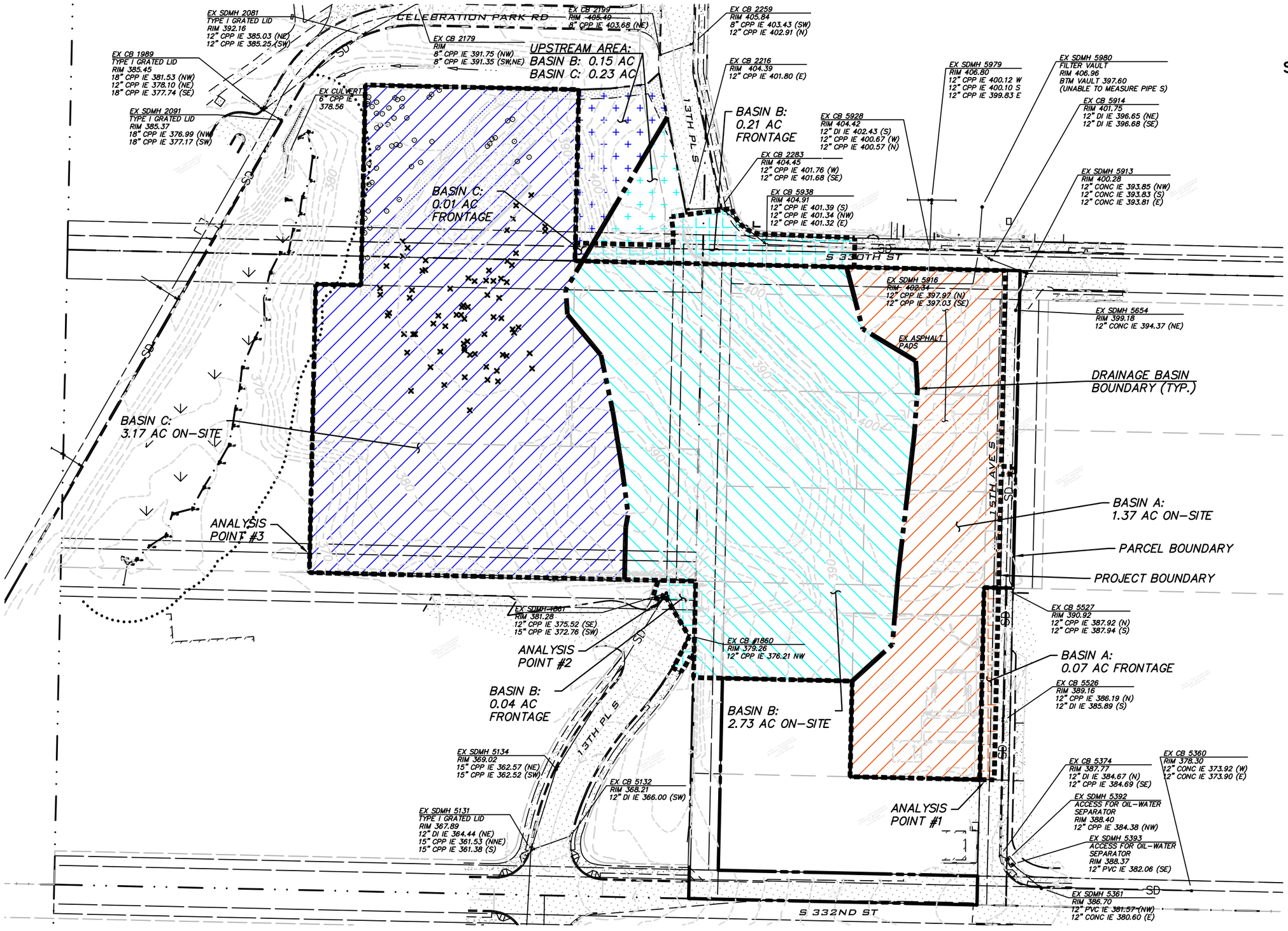
A SWPPP will be submitted at final engineering. A TESC Plan has been provided in the planset submitted under separate cover.

Section 9 Bond Quantities and Facilities Summary

A bond quantity worksheet will be included at final engineering.

Appendix

EXISTING CONDITIONS EXHIBIT



N

SCALE: 1" = 100'
0 25 50 100

BLUELINE
25 CENTRAL WAY, SUITE 400
KIRKLAND, WA 98033
P: 425.216.4051 F: 425.216.4052
WWW.THEBLUELINEGROUP.COM

EXISTING CONDITIONS EXHIBIT
LANDMARK APARTMENTS
TECHNICAL INFORMATION REPORT

SCALE	AS NOTED
PROJECT MANAGER	GARRETT WINE, PE
DESIGNED BY	SHAWN COOPER
DRAWN BY	JAMES REYNES, EIT
PLOT DATE	February 25, 2020

JOB NUMBER: 19-019

FIGURE: EC

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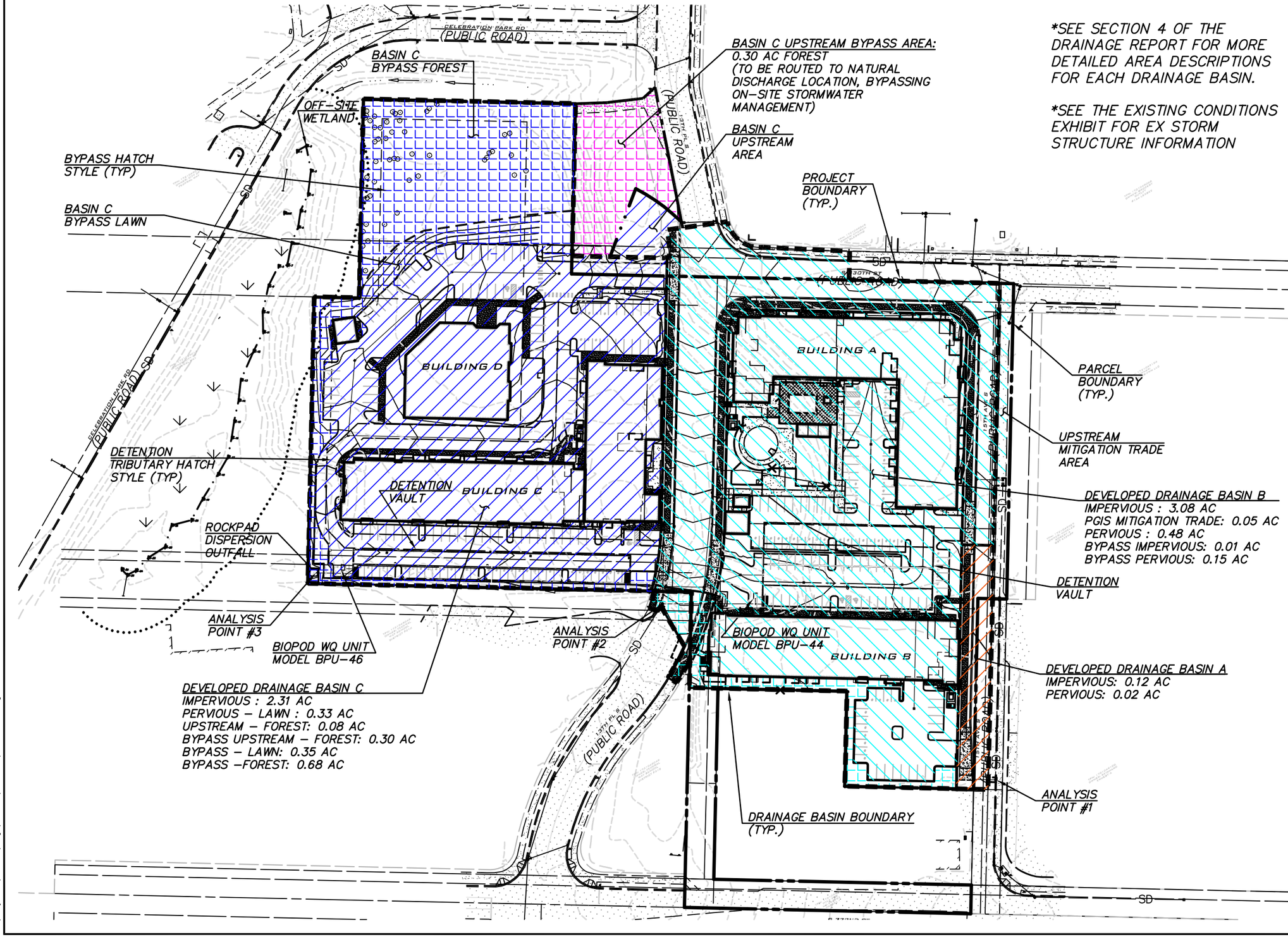
DEVELOPED CONDITIONS EXHIBIT



*SEE SECTION 4 OF THE DRAINAGE REPORT FOR MORE DETAILED AREA DESCRIPTIONS FOR EACH DRAINAGE BASIN.

*SEE THE EXISTING CONDITIONS EXHIBIT FOR EX STORM STRUCTURE INFORMATION

N

SCALE: 1" = 80'

0 20 40 80

BLUELINE

25 CENTRAL WAY, SUITE 400
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WWW.THEBLUELINEGROUP.COM

DEVELOPED CONDITIONS EXHIBIT
LANDMARK APARTMENTS
TECHNICAL INFORMATION REPORT

SCALE	AS NOTED
PROJECT MANAGER	GARRETT WINE, PE
DESIGNED BY	SHAWN COOPER
DRAWN BY	JAMES REYNES, EIT
PLOT DATE	February 25, 2020

JOB NUMBER: 19-019

FIGURE: DC

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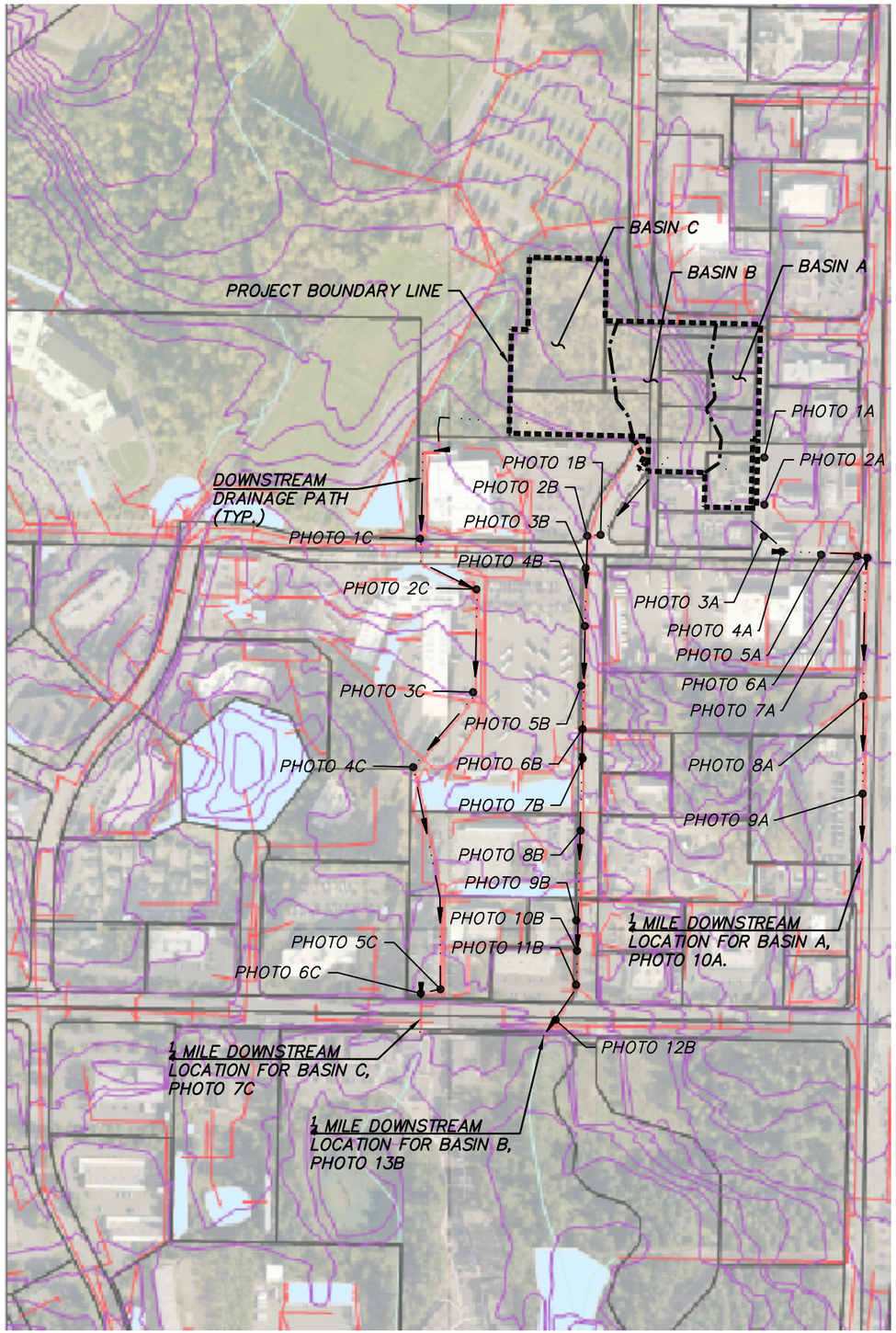
DOWNSTREAM DRAINAGE EXHIBIT



N

SCALE: 1" = 400'

0 100 200 400

BLUELINE

25 CENTRAL WAY, SUITE 400
KIRKLAND, WA 98033
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WWW.THEBLUELINEGROUP.COM

DOWNSTREAM DRAINAGE EXHIBIT
LANDMARK APARTMENTS
TECHNICAL INFORMATION REPORT

SCALE	AS NOTED
PROJECT MANAGER	GARRETT WINE, PE
DESIGNED BY	SHAWN COOPER
DRAWN BY	JAMES REYNES, EIT
PLOT DATE	FEBRUARY 24, 2020

JOB NUMBER: 19–019

FIGURE: DS

WWHM2012
PROJECT REPORT

Project Name: Basin A : Analysis Point #1
Site Name: Landmark Apartments
Site Address:
City : Federal Way
Report Date: 2/21/2020
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	1.44
Pervious Total	1.44

Impervious Land Use	acre
Impervious Total	0
Basin Total	1.44

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Mod	.02
Pervious Total	0.02

Impervious Land Use	acre
ROADS MOD	0.12
Impervious Total	0.12
Basin Total	0.14

Element Flows To:

Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.44
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.02
Total Impervious Area:0.12

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.042876
5 year	0.070257
10 year	0.087862
25 year	0.108803
50 year	0.123309
100 year	0.136858

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.054551
5 year	0.06985
10 year	0.080571
25 year	0.09482
50 year	0.105964
100 year	0.117576

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.049	0.071
1950	0.059	0.071
1951	0.094	0.042
1952	0.029	0.035
1953	0.024	0.042
1954	0.036	0.044
1955	0.058	0.052
1956	0.047	0.048
1957	0.038	0.052
1958	0.042	0.044
1959	0.036	0.048
1960	0.065	0.048
1961	0.036	0.046
1962	0.022	0.039
1963	0.030	0.048
1964	0.043	0.046
1965	0.029	0.054
1966	0.028	0.039
1967	0.066	0.064
1968	0.037	0.084
1969	0.036	0.050
1970	0.029	0.050
1971	0.033	0.061
1972	0.071	0.062
1973	0.032	0.039
1974	0.035	0.057
1975	0.049	0.059
1976	0.035	0.046
1977	0.005	0.045
1978	0.029	0.066
1979	0.018	0.079
1980	0.084	0.086
1981	0.026	0.052
1982	0.054	0.076
1983	0.046	0.061
1984	0.028	0.040
1985	0.017	0.051
1986	0.073	0.044
1987	0.065	0.070
1988	0.026	0.046
1989	0.017	0.072
1990	0.155	0.093
1991	0.082	0.080
1992	0.034	0.041
1993	0.033	0.050
1994	0.011	0.043
1995	0.047	0.047
1996	0.109	0.062
1997	0.084	0.049
1998	0.021	0.051
1999	0.092	0.112
2000	0.033	0.051
2001	0.006	0.062

2002	0.038	0.065
2003	0.057	0.066
2004	0.060	0.108
2005	0.045	0.041
2006	0.050	0.040
2007	0.117	0.102
2008	0.143	0.074
2009	0.067	0.076

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1553	0.1116
2	0.1430	0.1078
3	0.1174	0.1018
4	0.1087	0.0926
5	0.0937	0.0864
6	0.0920	0.0842
7	0.0839	0.0802
8	0.0837	0.0792
9	0.0824	0.0761
10	0.0735	0.0757
11	0.0711	0.0741
12	0.0667	0.0720
13	0.0658	0.0711
14	0.0649	0.0709
15	0.0646	0.0695
16	0.0605	0.0663
17	0.0586	0.0656
18	0.0583	0.0655
19	0.0566	0.0640
20	0.0543	0.0625
21	0.0505	0.0620
22	0.0493	0.0618
23	0.0486	0.0615
24	0.0470	0.0610
25	0.0469	0.0586
26	0.0464	0.0574
27	0.0449	0.0542
28	0.0431	0.0524
29	0.0421	0.0522
30	0.0379	0.0522
31	0.0379	0.0513
32	0.0371	0.0510
33	0.0365	0.0506
34	0.0361	0.0501
35	0.0361	0.0499
36	0.0355	0.0499
37	0.0349	0.0489
38	0.0348	0.0483
39	0.0336	0.0480
40	0.0328	0.0479
41	0.0327	0.0476
42	0.0327	0.0474
43	0.0315	0.0464
44	0.0304	0.0460

45	0.0294	0.0459
46	0.0294	0.0458
47	0.0290	0.0453
48	0.0286	0.0445
49	0.0280	0.0443
50	0.0275	0.0440
51	0.0263	0.0434
52	0.0256	0.0421
53	0.0238	0.0419
54	0.0221	0.0415
55	0.0205	0.0407
56	0.0178	0.0400
57	0.0169	0.0395
58	0.0166	0.0388
59	0.0110	0.0388
60	0.0059	0.0386
61	0.0051	0.0353

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0214	0	0	0	Pass
0.0225	0	0	0	Pass
0.0235	0	0	0	Pass
0.0245	0	0	0	Pass
0.0256	0	0	0	Pass
0.0266	0	0	0	Pass
0.0276	0	0	0	Pass
0.0286	0	0	0	Pass
0.0297	0	0	0	Pass
0.0307	0	0	0	Pass
0.0317	0	0	0	Pass
0.0328	0	0	0	Pass
0.0338	0	0	0	Pass
0.0348	0	0	0	Pass
0.0358	0	0	0	Pass
0.0369	0	0	0	Pass
0.0379	0	0	0	Pass
0.0389	0	0	0	Pass
0.0400	0	0	0	Pass
0.0410	0	0	0	Pass
0.0420	0	0	0	Pass
0.0430	0	0	0	Pass
0.0441	0	0	0	Pass
0.0451	0	0	0	Pass
0.0461	0	0	0	Pass
0.0472	0	0	0	Pass
0.0482	0	0	0	Pass
0.0492	0	0	0	Pass
0.0503	0	0	0	Pass
0.0513	0	0	0	Pass
0.0523	0	0	0	Pass

0.0533	0	0	0	Pass
0.0544	0	0	0	Pass
0.0554	0	0	0	Pass
0.0564	0	0	0	Pass
0.0575	0	0	0	Pass
0.0585	0	0	0	Pass
0.0595	0	0	0	Pass
0.0605	0	0	0	Pass
0.0616	0	0	0	Pass
0.0626	0	0	0	Pass
0.0636	0	0	0	Pass
0.0647	0	0	0	Pass
0.0657	0	0	0	Pass
0.0667	0	0	0	Pass
0.0677	0	0	0	Pass
0.0688	0	0	0	Pass
0.0698	0	0	0	Pass
0.0708	0	0	0	Pass
0.0719	0	0	0	Pass
0.0729	0	0	0	Pass
0.0739	0	0	0	Pass
0.0749	0	0	0	Pass
0.0760	0	0	0	Pass
0.0770	0	0	0	Pass
0.0780	0	0	0	Pass
0.0791	0	0	0	Pass
0.0801	0	0	0	Pass
0.0811	0	0	0	Pass
0.0821	0	0	0	Pass
0.0832	0	0	0	Pass
0.0842	0	0	0	Pass
0.0852	0	0	0	Pass
0.0863	0	0	0	Pass
0.0873	0	0	0	Pass
0.0883	0	0	0	Pass
0.0894	0	0	0	Pass
0.0904	0	0	0	Pass
0.0914	0	0	0	Pass
0.0924	0	0	0	Pass
0.0935	0	0	0	Pass
0.0945	0	0	0	Pass
0.0955	0	0	0	Pass
0.0966	0	0	0	Pass
0.0976	0	0	0	Pass
0.0986	0	0	0	Pass
0.0996	0	0	0	Pass
0.1007	0	0	0	Pass
0.1017	0	0	0	Pass
0.1027	0	0	0	Pass
0.1038	0	0	0	Pass
0.1048	0	0	0	Pass
0.1058	0	0	0	Pass
0.1068	0	0	0	Pass
0.1079	0	0	0	Pass
0.1089	0	0	0	Pass
0.1099	0	0	0	Pass
0.1110	0	0	0	Pass

0.1120	0	0	0	Pass
0.1130	0	0	0	Pass
0.1140	0	0	0	Pass
0.1151	0	0	0	Pass
0.1161	0	0	0	Pass
0.1171	0	0	0	Pass
0.1182	0	0	0	Pass
0.1192	0	0	0	Pass
0.1202	0	0	0	Pass
0.1213	0	0	0	Pass
0.1223	0	0	0	Pass
0.1233	0	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

LID Technique	Used for Water Quality	Total Volume Percent Treatment?	Volume Needs Treatment (ac-ft)	Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Volume Infiltration Credit	Comment
Total Volume Infiltrated			0.00	0.00	0.00	0.00	
0.00	0%	No Treat. Credit					

Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: BASIN B VAULT: Analysis Point #2
Site Name: Landmark Apartments
Site Address:
City : Federal Way
Report Date: 2/21/2020
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	3.13
Pervious Total	3.13

Impervious Land Use	acre
Impervious Total	0
Basin Total	3.13

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	.48
Pervious Total	**0.48**

Impervious Land Use	acre
ROADS FLAT	3.13
Impervious Total	**3.13**
Basin Total	**3.61**

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault
Width : 176 ft.
Length : 80 ft.
Depth: 10 ft.
Discharge Structure
Riser Height: 7.25 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.8125 in. **Elevation:** 0 ft.
Orifice 2 Diameter: 1.625 in. **Elevation:** 5.75 ft.
Orifice 3 Diameter: 1.5 in. **Elevation:** 6.25 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.323	0.000	0.000	0.000
0.1111	0.323	0.035	0.006	0.000
0.2222	0.323	0.071	0.008	0.000
0.3333	0.323	0.107	0.010	0.000
0.4444	0.323	0.143	0.011	0.000
0.5556	0.323	0.179	0.013	0.000
0.6667	0.323	0.215	0.014	0.000
0.7778	0.323	0.251	0.015	0.000
0.8889	0.323	0.287	0.016	0.000
1.0000	0.323	0.323	0.017	0.000
1.1111	0.323	0.359	0.018	0.000
1.2222	0.323	0.395	0.019	0.000
1.3333	0.323	0.431	0.020	0.000
1.4444	0.323	0.466	0.021	0.000
1.5556	0.323	0.502	0.022	0.000
1.6667	0.323	0.538	0.023	0.000

1.7778	0.323	0.574	0.023	0.000
1.8889	0.323	0.610	0.024	0.000
2.0000	0.323	0.646	0.025	0.000
2.1111	0.323	0.682	0.026	0.000
2.2222	0.323	0.718	0.026	0.000
2.3333	0.323	0.754	0.027	0.000
2.4444	0.323	0.790	0.028	0.000
2.5556	0.323	0.826	0.028	0.000
2.6667	0.323	0.862	0.029	0.000
2.7778	0.323	0.897	0.029	0.000
2.8889	0.323	0.933	0.030	0.000
3.0000	0.323	0.969	0.031	0.000
3.1111	0.323	1.005	0.031	0.000
3.2222	0.323	1.041	0.032	0.000
3.3333	0.323	1.077	0.032	0.000
3.4444	0.323	1.113	0.033	0.000
3.5556	0.323	1.149	0.033	0.000
3.6667	0.323	1.185	0.034	0.000
3.7778	0.323	1.221	0.034	0.000
3.8889	0.323	1.257	0.035	0.000
4.0000	0.323	1.292	0.035	0.000
4.1111	0.323	1.328	0.036	0.000
4.2222	0.323	1.364	0.036	0.000
4.3333	0.323	1.400	0.037	0.000
4.4444	0.323	1.436	0.037	0.000
4.5556	0.323	1.472	0.038	0.000
4.6667	0.323	1.508	0.038	0.000
4.7778	0.323	1.544	0.039	0.000
4.8889	0.323	1.580	0.039	0.000
5.0000	0.323	1.616	0.040	0.000
5.1111	0.323	1.652	0.040	0.000
5.2222	0.323	1.688	0.040	0.000
5.3333	0.323	1.723	0.041	0.000
5.4444	0.323	1.759	0.041	0.000
5.5556	0.323	1.795	0.042	0.000
5.6667	0.323	1.831	0.042	0.000
5.7778	0.323	1.867	0.055	0.000
5.8889	0.323	1.903	0.070	0.000
6.0000	0.323	1.939	0.079	0.000
6.1111	0.323	1.975	0.087	0.000
6.2222	0.323	2.011	0.093	0.000
6.3333	0.323	2.047	0.117	0.000
6.4444	0.323	2.083	0.132	0.000
6.5556	0.323	2.119	0.143	0.000
6.6667	0.323	2.154	0.154	0.000
6.7778	0.323	2.190	0.163	0.000
6.8889	0.323	2.226	0.172	0.000
7.0000	0.323	2.262	0.180	0.000
7.1111	0.323	2.298	0.188	0.000
7.2222	0.323	2.334	0.195	0.000
7.3333	0.323	2.370	0.456	0.000
7.4444	0.323	2.406	1.082	0.000
7.5556	0.323	2.442	1.755	0.000
7.6667	0.323	2.478	2.234	0.000
7.7778	0.323	2.514	2.515	0.000
7.8889	0.323	2.549	2.750	0.000
8.0000	0.323	2.585	2.966	0.000

8.1111	0.323	2.621	3.167	0.000
8.2222	0.323	2.657	3.355	0.000
8.3333	0.323	2.693	3.533	0.000
8.4444	0.323	2.729	3.702	0.000
8.5556	0.323	2.765	3.863	0.000
8.6667	0.323	2.801	4.018	0.000
8.7778	0.323	2.837	4.167	0.000
8.8889	0.323	2.873	4.311	0.000
9.0000	0.323	2.909	4.450	0.000
9.1111	0.323	2.945	4.585	0.000
9.2222	0.323	2.980	4.716	0.000
9.3333	0.323	3.016	4.843	0.000
9.4444	0.323	3.052	4.967	0.000
9.5556	0.323	3.088	5.088	0.000
9.6667	0.323	3.124	5.206	0.000
9.7778	0.323	3.160	5.322	0.000
9.8889	0.323	3.196	5.435	0.000
10.000	0.323	3.232	5.545	0.000
10.111	0.323	3.268	5.654	0.000
10.222	0.000	0.000	5.760	0.000

Name : Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	**acre**
C, Lawn, Flat	**.15**
Pervious Total	**0.15**

Impervious Land Use	**acre**
ROADS FLAT	**0.01**
Impervious Total	**0.01**
Basin Total	**0.16**

Element Flows To:

Surface	**Interflow**	**Groundwater**

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1

Total Pervious Area:3.13
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.63
Total Impervious Area:3.14

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.093196
5 year	0.152711
10 year	0.190977
25 year	0.236497
50 year	0.268026
100 year	0.297477

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.048847
5 year	0.07236
10 year	0.091186
25 year	0.119076
50 year	0.143096
100 year	0.170128

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.107	0.051
1950	0.127	0.066
1951	0.204	0.166
1952	0.064	0.031
1953	0.052	0.057
1954	0.079	0.043
1955	0.127	0.040
1956	0.102	0.143
1957	0.082	0.042
1958	0.091	0.041
1959	0.078	0.042
1960	0.140	0.053
1961	0.077	0.050
1962	0.048	0.032
1963	0.066	0.045
1964	0.094	0.045
1965	0.062	0.048
1966	0.060	0.040
1967	0.143	0.067
1968	0.081	0.046
1969	0.078	0.041
1970	0.063	0.040
1971	0.071	0.049
1972	0.155	0.104
1973	0.069	0.043
1974	0.076	0.047

1975	0.106	0.048
1976	0.076	0.042
1977	0.011	0.029
1978	0.064	0.042
1979	0.039	0.028
1980	0.182	0.084
1981	0.057	0.038
1982	0.118	0.068
1983	0.101	0.044
1984	0.061	0.037
1985	0.036	0.032
1986	0.160	0.045
1987	0.141	0.052
1988	0.056	0.036
1989	0.037	0.034
1990	0.337	0.097
1991	0.179	0.079
1992	0.073	0.038
1993	0.071	0.030
1994	0.024	0.028
1995	0.102	0.047
1996	0.236	0.153
1997	0.182	0.131
1998	0.045	0.037
1999	0.200	0.088
2000	0.071	0.048
2001	0.013	0.025
2002	0.082	0.055
2003	0.123	0.048
2004	0.131	0.063
2005	0.098	0.037
2006	0.110	0.076
2007	0.255	0.126
2008	0.311	0.071
2009	0.145	0.056

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3375	0.1661
2	0.3109	0.1532
3	0.2551	0.1433
4	0.2363	0.1310
5	0.2036	0.1256
6	0.2000	0.1045
7	0.1824	0.0965
8	0.1820	0.0880
9	0.1790	0.0838
10	0.1597	0.0792
11	0.1546	0.0755
12	0.1450	0.0706
13	0.1431	0.0682
14	0.1410	0.0674
15	0.1405	0.0657
16	0.1314	0.0628
17	0.1273	0.0570

18	0.1267	0.0561
19	0.1230	0.0553
20	0.1180	0.0528
21	0.1097	0.0524
22	0.1073	0.0508
23	0.1057	0.0504
24	0.1022	0.0486
25	0.1020	0.0483
26	0.1010	0.0482
27	0.0975	0.0479
28	0.0936	0.0479
29	0.0915	0.0475
30	0.0824	0.0472
31	0.0823	0.0461
32	0.0806	0.0452
33	0.0793	0.0452
34	0.0784	0.0450
35	0.0784	0.0438
36	0.0773	0.0429
37	0.0759	0.0426
38	0.0755	0.0424
39	0.0731	0.0422
40	0.0713	0.0420
41	0.0710	0.0418
42	0.0710	0.0414
43	0.0685	0.0405
44	0.0660	0.0404
45	0.0639	0.0403
46	0.0638	0.0400
47	0.0629	0.0383
48	0.0622	0.0378
49	0.0608	0.0374
50	0.0598	0.0374
51	0.0571	0.0373
52	0.0557	0.0363
53	0.0516	0.0342
54	0.0481	0.0319
55	0.0446	0.0316
56	0.0386	0.0313
57	0.0368	0.0302
58	0.0361	0.0288
59	0.0240	0.0276
60	0.0128	0.0276
61	0.0111	0.0249

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0466	17079	5854	34	Pass
0.0488	15483	4800	31	Pass
0.0511	14067	4241	30	Pass
0.0533	12799	3835	29	Pass

0.0555	11567	3559	30	Pass
0.0578	10515	3332	31	Pass
0.0600	9563	3123	32	Pass
0.0623	8750	2883	32	Pass
0.0645	8031	2693	33	Pass
0.0667	7347	2492	33	Pass
0.0690	6733	2291	34	Pass
0.0712	6188	2137	34	Pass
0.0734	5728	1968	34	Pass
0.0757	5309	1766	33	Pass
0.0779	4924	1608	32	Pass
0.0801	4569	1443	31	Pass
0.0824	4235	1282	30	Pass
0.0846	3951	1106	27	Pass
0.0869	3643	971	26	Pass
0.0891	3388	872	25	Pass
0.0913	3133	788	25	Pass
0.0936	2915	704	24	Pass
0.0958	2706	638	23	Pass
0.0980	2488	551	22	Pass
0.1003	2325	502	21	Pass
0.1025	2136	456	21	Pass
0.1048	1974	419	21	Pass
0.1070	1830	396	21	Pass
0.1092	1702	377	22	Pass
0.1115	1579	356	22	Pass
0.1137	1445	339	23	Pass
0.1159	1326	302	22	Pass
0.1182	1235	282	22	Pass
0.1204	1147	265	23	Pass
0.1226	1086	245	22	Pass
0.1249	1022	231	22	Pass
0.1271	947	212	22	Pass
0.1294	887	198	22	Pass
0.1316	827	176	21	Pass
0.1338	760	161	21	Pass
0.1361	725	148	20	Pass
0.1383	674	134	19	Pass
0.1405	623	114	18	Pass
0.1428	590	88	14	Pass
0.1450	549	69	12	Pass
0.1472	506	61	12	Pass
0.1495	470	53	11	Pass
0.1517	427	42	9	Pass
0.1540	388	30	7	Pass
0.1562	356	27	7	Pass
0.1584	328	23	7	Pass
0.1607	298	19	6	Pass
0.1629	270	13	4	Pass
0.1651	241	7	2	Pass
0.1674	219	0	0	Pass
0.1696	198	0	0	Pass
0.1719	174	0	0	Pass
0.1741	152	0	0	Pass
0.1763	130	0	0	Pass
0.1786	119	0	0	Pass
0.1808	105	0	0	Pass

0.1830	95	0	0	Pass
0.1853	84	0	0	Pass
0.1875	74	0	0	Pass
0.1897	69	0	0	Pass
0.1920	61	0	0	Pass
0.1942	53	0	0	Pass
0.1965	46	0	0	Pass
0.1987	39	0	0	Pass
0.2009	29	0	0	Pass
0.2032	25	0	0	Pass
0.2054	22	0	0	Pass
0.2076	20	0	0	Pass
0.2099	17	0	0	Pass
0.2121	14	0	0	Pass
0.2143	12	0	0	Pass
0.2166	8	0	0	Pass
0.2188	7	0	0	Pass
0.2211	7	0	0	Pass
0.2233	7	0	0	Pass
0.2255	6	0	0	Pass
0.2278	6	0	0	Pass
0.2300	6	0	0	Pass
0.2322	6	0	0	Pass
0.2345	6	0	0	Pass
0.2367	5	0	0	Pass
0.2389	5	0	0	Pass
0.2412	5	0	0	Pass
0.2434	5	0	0	Pass
0.2457	5	0	0	Pass
0.2479	5	0	0	Pass
0.2501	5	0	0	Pass
0.2524	4	0	0	Pass
0.2546	4	0	0	Pass
0.2568	3	0	0	Pass
0.2591	3	0	0	Pass
0.2613	3	0	0	Pass
0.2636	3	0	0	Pass
0.2658	3	0	0	Pass
0.2680	3	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

LID Technique	Used for Water Quality	Total Volume Percent	Volume Needs Treatment?	Infiltration Through Facility	Cumulative Volume Infiltration (ac-ft.)	Percent Volume Infiltrated	Comment Water Quality Treated

		(ac-ft)	(ac-ft)		Credit	
Vault 1 POC	N	482.26			N	0.00
Total Volume Infiltrated		482.26	0.00	0.00		0.00

0.00 0% No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: Basin C : Analysis Point #3
Site Name: Landmark Apartments
Site Address:
City : Federal Way
Report Date: 2/21/2020
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	3.41
Pervious Total	3.41

Impervious Land Use	acre
Impervious Total	0
Basin Total	3.41

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	.33
C, Forest, Mod	.08
Pervious Total	0.41

Impervious Land Use	acre
ROADS FLAT	2.31
Impervious Total	2.31
Basin Total	2.72

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	.35
C, Forest, Mod	.98
Pervious Total	1.33

Impervious Land Use	acre
Impervious Total	0
Basin Total	1.33

Element Flows To:

Surface	Interflow	Groundwater

Name : Vault
Width : 28 ft.
Length : 278 ft.
Depth: 10 ft.
Discharge Structure
Riser Height: 8 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.6875 in. **Elevation:** 0 ft.
Orifice 2 Diameter: 1.4375 in. **Elevation:** 5.9 ft.

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

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.178	0.000	0.000	0.000
0.1111	0.178	0.019	0.004	0.000
0.2222	0.178	0.039	0.006	0.000
0.3333	0.178	0.059	0.007	0.000
0.4444	0.178	0.079	0.008	0.000
0.5556	0.178	0.099	0.009	0.000
0.6667	0.178	0.119	0.010	0.000
0.7778	0.178	0.139	0.011	0.000
0.8889	0.178	0.158	0.012	0.000
1.0000	0.178	0.178	0.012	0.000
1.1111	0.178	0.198	0.013	0.000
1.2222	0.178	0.218	0.014	0.000
1.3333	0.178	0.238	0.014	0.000
1.4444	0.178	0.258	0.015	0.000
1.5556	0.178	0.278	0.016	0.000
1.6667	0.178	0.297	0.016	0.000
1.7778	0.178	0.317	0.017	0.000
1.8889	0.178	0.337	0.017	0.000
2.0000	0.178	0.357	0.018	0.000
2.1111	0.178	0.377	0.018	0.000
2.2222	0.178	0.397	0.019	0.000
2.3333	0.178	0.417	0.019	0.000
2.4444	0.178	0.436	0.020	0.000
2.5556	0.178	0.456	0.020	0.000
2.6667	0.178	0.476	0.020	0.000
2.7778	0.178	0.496	0.021	0.000
2.8889	0.178	0.516	0.021	0.000
3.0000	0.178	0.536	0.022	0.000
3.1111	0.178	0.555	0.022	0.000
3.2222	0.178	0.575	0.023	0.000
3.3333	0.178	0.595	0.023	0.000
3.4444	0.178	0.615	0.023	0.000
3.5556	0.178	0.635	0.024	0.000
3.6667	0.178	0.655	0.024	0.000
3.7778	0.178	0.675	0.024	0.000
3.8889	0.178	0.694	0.025	0.000
4.0000	0.178	0.714	0.025	0.000
4.1111	0.178	0.734	0.026	0.000
4.2222	0.178	0.754	0.026	0.000
4.3333	0.178	0.774	0.026	0.000
4.4444	0.178	0.794	0.027	0.000
4.5556	0.178	0.814	0.027	0.000
4.6667	0.178	0.833	0.027	0.000
4.7778	0.178	0.853	0.028	0.000
4.8889	0.178	0.873	0.028	0.000
5.0000	0.178	0.893	0.028	0.000
5.1111	0.178	0.913	0.029	0.000

5.2222	0.178	0.933	0.029	0.000
5.3333	0.178	0.953	0.029	0.000
5.4444	0.178	0.972	0.029	0.000
5.5556	0.178	0.992	0.030	0.000
5.6667	0.178	1.012	0.030	0.000
5.7778	0.178	1.032	0.030	0.000
5.8889	0.178	1.052	0.031	0.000
6.0000	0.178	1.072	0.049	0.000
6.1111	0.178	1.092	0.057	0.000
6.2222	0.178	1.111	0.063	0.000
6.3333	0.178	1.131	0.069	0.000
6.4444	0.178	1.151	0.073	0.000
6.5556	0.178	1.171	0.078	0.000
6.6667	0.178	1.191	0.082	0.000
6.7778	0.178	1.211	0.085	0.000
6.8889	0.178	1.231	0.089	0.000
7.0000	0.178	1.250	0.092	0.000
7.1111	0.178	1.270	0.095	0.000
7.2222	0.178	1.290	0.099	0.000
7.3333	0.178	1.310	0.101	0.000
7.4444	0.178	1.330	0.104	0.000
7.5556	0.178	1.350	0.107	0.000
7.6667	0.178	1.370	0.110	0.000
7.7778	0.178	1.389	0.112	0.000
7.8889	0.178	1.409	0.115	0.000
8.0000	0.178	1.429	0.117	0.000
8.1111	0.178	1.449	0.509	0.000
8.2222	0.178	1.469	1.168	0.000
8.3333	0.178	1.489	1.808	0.000
8.4444	0.178	1.509	2.215	0.000
8.5556	0.178	1.528	2.476	0.000
8.6667	0.178	1.548	2.702	0.000
8.7778	0.178	1.568	2.910	0.000
8.8889	0.178	1.588	3.104	0.000
9.0000	0.178	1.608	3.286	0.000
9.1111	0.178	1.628	3.459	0.000
9.2222	0.178	1.648	3.623	0.000
9.3333	0.178	1.667	3.780	0.000
9.4444	0.178	1.687	3.930	0.000
9.5556	0.178	1.707	4.075	0.000
9.6667	0.178	1.727	4.214	0.000
9.7778	0.178	1.747	4.350	0.000
9.8889	0.178	1.767	4.481	0.000
10.000	0.178	1.787	4.608	0.000
10.111	0.178	1.806	4.732	0.000
10.222	0.000	0.000	4.852	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1

Total Pervious Area:3.41
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:1.74
Total Impervious Area:2.31

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.101533
5 year	0.166371
10 year	0.208061
25 year	0.257653
50 year	0.292003
100 year	0.324088

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.081534
5 year	0.129413
10 year	0.165612
25 year	0.216279
50 year	0.257535
100 year	0.301766

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.117	0.101
1950	0.139	0.127
1951	0.222	0.204
1952	0.070	0.049
1953	0.056	0.083
1954	0.086	0.064
1955	0.138	0.080
1956	0.111	0.134
1957	0.090	0.078
1958	0.100	0.069
1959	0.085	0.064
1960	0.153	0.107
1961	0.084	0.072
1962	0.052	0.045
1963	0.072	0.065
1964	0.102	0.079
1965	0.068	0.075
1966	0.065	0.055
1967	0.156	0.130
1968	0.088	0.078
1969	0.085	0.068
1970	0.069	0.055
1971	0.077	0.081
1972	0.168	0.173
1973	0.075	0.065
1974	0.083	0.075

1975	0.115	0.092
1976	0.082	0.070
1977	0.012	0.032
1978	0.070	0.059
1979	0.042	0.038
1980	0.198	0.147
1981	0.062	0.054
1982	0.129	0.128
1983	0.110	0.077
1984	0.066	0.049
1985	0.039	0.036
1986	0.174	0.100
1987	0.154	0.102
1988	0.061	0.046
1989	0.040	0.038
1990	0.368	0.264
1991	0.195	0.174
1992	0.080	0.062
1993	0.078	0.053
1994	0.026	0.033
1995	0.111	0.076
1996	0.257	0.219
1997	0.199	0.158
1998	0.049	0.058
1999	0.218	0.195
2000	0.077	0.067
2001	0.014	0.022
2002	0.090	0.084
2003	0.134	0.100
2004	0.143	0.137
2005	0.106	0.076
2006	0.119	0.111
2007	0.278	0.275
2008	0.339	0.196
2009	0.158	0.114

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3677	0.2752
2	0.3387	0.2638
3	0.2779	0.2195
4	0.2575	0.2042
5	0.2218	0.1962
6	0.2179	0.1951
7	0.1987	0.1743
8	0.1983	0.1730
9	0.1950	0.1580
10	0.1740	0.1465
11	0.1684	0.1371
12	0.1579	0.1336
13	0.1559	0.1303
14	0.1536	0.1283
15	0.1531	0.1266
16	0.1432	0.1144
17	0.1387	0.1107

18	0.1380	0.1066
19	0.1340	0.1023
20	0.1286	0.1014
21	0.1195	0.1002
22	0.1169	0.1001
23	0.1152	0.0917
24	0.1114	0.0845
25	0.1112	0.0830
26	0.1100	0.0815
27	0.1062	0.0797
28	0.1020	0.0787
29	0.0996	0.0782
30	0.0897	0.0777
31	0.0897	0.0769
32	0.0878	0.0759
33	0.0864	0.0758
34	0.0855	0.0749
35	0.0854	0.0748
36	0.0842	0.0719
37	0.0827	0.0698
38	0.0823	0.0690
39	0.0796	0.0681
40	0.0777	0.0674
41	0.0774	0.0647
42	0.0774	0.0646
43	0.0746	0.0641
44	0.0719	0.0639
45	0.0696	0.0621
46	0.0695	0.0594
47	0.0686	0.0578
48	0.0678	0.0553
49	0.0662	0.0550
50	0.0651	0.0536
51	0.0622	0.0535
52	0.0606	0.0487
53	0.0563	0.0485
54	0.0524	0.0463
55	0.0486	0.0446
56	0.0421	0.0378
57	0.0401	0.0377
58	0.0393	0.0356
59	0.0261	0.0332
60	0.0139	0.0316
61	0.0121	0.0221

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0508	17079	16993	99	Pass
0.0532	15481	14604	94	Pass
0.0556	14070	12769	90	Pass
0.0581	12799	11355	88	Pass

0.0605	11567	10031	86	Pass
0.0630	10515	8953	85	Pass
0.0654	9563	8083	84	Pass
0.0678	8750	7373	84	Pass
0.0703	8031	6690	83	Pass
0.0727	7347	6166	83	Pass
0.0751	6733	5640	83	Pass
0.0776	6188	5183	83	Pass
0.0800	5726	4840	84	Pass
0.0824	5309	4496	84	Pass
0.0849	4924	4196	85	Pass
0.0873	4569	3933	86	Pass
0.0898	4235	3670	86	Pass
0.0922	3951	3373	85	Pass
0.0946	3643	3110	85	Pass
0.0971	3388	2883	85	Pass
0.0995	3133	2676	85	Pass
0.1019	2917	2475	84	Pass
0.1044	2712	2280	84	Pass
0.1068	2490	2090	83	Pass
0.1092	2319	1955	84	Pass
0.1117	2141	1818	84	Pass
0.1141	1973	1716	86	Pass
0.1166	1828	1598	87	Pass
0.1190	1706	1507	88	Pass
0.1214	1578	1406	89	Pass
0.1239	1443	1305	90	Pass
0.1263	1325	1192	89	Pass
0.1287	1233	1107	89	Pass
0.1312	1150	999	86	Pass
0.1336	1085	881	81	Pass
0.1361	1021	798	78	Pass
0.1385	950	709	74	Pass
0.1409	886	635	71	Pass
0.1434	826	572	69	Pass
0.1458	764	512	67	Pass
0.1482	725	462	63	Pass
0.1507	675	425	62	Pass
0.1531	623	388	62	Pass
0.1555	589	347	58	Pass
0.1580	552	306	55	Pass
0.1604	506	257	50	Pass
0.1629	469	222	47	Pass
0.1653	428	194	45	Pass
0.1677	388	158	40	Pass
0.1702	356	144	40	Pass
0.1726	328	127	38	Pass
0.1750	298	112	37	Pass
0.1775	270	103	38	Pass
0.1799	241	95	39	Pass
0.1824	218	88	40	Pass
0.1848	198	75	37	Pass
0.1872	173	62	35	Pass
0.1897	152	56	36	Pass
0.1921	130	39	30	Pass
0.1945	119	32	26	Pass
0.1970	104	24	23	Pass

0.1994	95	17	17	Pass
0.2018	83	12	14	Pass
0.2043	74	4	5	Pass
0.2067	69	4	5	Pass
0.2092	61	4	6	Pass
0.2116	54	4	7	Pass
0.2140	46	4	8	Pass
0.2165	39	4	10	Pass
0.2189	29	4	13	Pass
0.2213	25	3	12	Pass
0.2238	22	3	13	Pass
0.2262	20	3	15	Pass
0.2286	17	3	17	Pass
0.2311	14	3	21	Pass
0.2335	12	3	25	Pass
0.2360	8	3	37	Pass
0.2384	7	2	28	Pass
0.2408	7	2	28	Pass
0.2433	7	2	28	Pass
0.2457	6	2	33	Pass
0.2481	6	2	33	Pass
0.2506	6	2	33	Pass
0.2530	6	2	33	Pass
0.2555	6	2	33	Pass
0.2579	5	2	40	Pass
0.2603	5	2	40	Pass
0.2628	5	2	40	Pass
0.2652	5	1	20	Pass
0.2676	5	1	20	Pass
0.2701	5	1	20	Pass
0.2725	5	1	20	Pass
0.2749	4	1	25	Pass
0.2774	4	0	0	Pass
0.2798	3	0	0	Pass
0.2823	3	0	0	Pass
0.2847	3	0	0	Pass
0.2871	3	0	0	Pass
0.2896	3	0	0	Pass
0.2920	3	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

LID Technique	Used for Water Quality	Total Volume Percent	Volume Needs Treatment?	Infiltration Through Facility	Cumulative Volume (ac-ft.)	Percent Infiltration	Comment	Volume Infiltrated	Volume Treated

		(ac-ft)	(ac-ft)		Credit	
Vault 1 POC	N	357.10			N	0.00
Total Volume Infiltrated		357.10	0.00	0.00		0.00

0.00 0% No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

August 2019

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

For

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

Ecology's Decision:

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

1. **General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus Treatment:**
   - **Sized at a hydraulic loading rate of 1.6 gallons per minute (gpm) per square foot (sq ft) of media surface area.**
   - **Constructed with a minimum media thickness of 18-inches (1.5-feet).**

2. **Ecology approves the BioPod at the hydraulic loading rate listed above, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:**

   - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**
   - **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
   - **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

3. **The GULD has no expiration date, but may be amended or revoked by Ecology.**

Ecology's Conditions of Use:

The BioPod shall comply with these conditions:

1) **Applicants shall design, assemble, install, operate, and maintain the BioPod installations in accordance with Oldcastle Infrastructure, Inc.'s applicable manuals and the Ecology Decision.**

2) **The minimum size filter surface-area for use in Washington is determined by using the design water quality flow rate (as determined in Ecology Decision, Item 3, above) and the Infiltration Rate (as identified in Ecology Decision, Item 1, above). Calculate the required area by dividing the water quality design flow rate (cu-ft/sec) by the Infiltration Rate (converted to ft/sec) to obtain required surface area (sq ft) of the BioPod unit**

3) **BioPod media shall conform to the specifications submitted to and approved by Ecology**

4) **Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent on the efficiency of the device and the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**

- **The BioPod is designed for a target maintenance interval of 1 year. Maintenance includes replacing the mulch, assessing plant health, removal of trash, and raking the top few inches of engineered media.**
- **A BioPod system tested at the Lake Union Ship Canal Test Facility in Seattle, WA required maintenance after 1.5 months, or 6.3% of a water year. Monitoring personnel observed similar maintenance issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may be unusual and maintenance requirements of systems installed at the Test Facility may not be indicative of maintenance requirements for all sites.**
- **Test results provided to Ecology from a BioPod System evaluated in a lab following New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs have indicated the BioPod System is capable of longer maintenance intervals.**
- **Owners/operators must inspect BioPod systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to the SWMMEW, the wet season in eastern Washington is October 1 to June 30.) After the first year of operation,**

owners/operators must conduct inspections based on the findings during the first year of inspections.

- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.**

5) **Install the BioPod in such a manner that you bypass flows exceeding the maximum operating rate and you will not resuspend captured sediment.**

6) **Discharges from the BioPod shall not cause or contribute to water quality standards violations in receiving waters.**

Applicant: Oldcastle Infrastructure, Inc.

Applicant's Address: 7100 Longe St, Suite 100
Stockton, CA 95206

Application Documents:

Technical Evaluation Report TreePod™ BioFilter System Performance Certification Project, Prepared for Oldcastle, Inc., Prepared by Herrera Environmental Consultants, Inc. February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., January 2018

Application for Pilot Use Level Designation, TreePod™ Biofilter – Stormwater Treatment System, Oldcastle Stormwater Solutions, May 2016

Emerging Stormwater Treatment Technologies Application for Certification: The TreePod™ Biofilter, Oldcastle Stormwater Solutions, April 2016

Applicant's Use Level Request:

- General Use Level Designation as a Basic, Enhanced, and Phosphorus Treatment device in accordance with Ecology's *Stormwater Management Manual for Western Washington*

Applicant's Performance Claims:

Based on results from laboratory and field-testing, the applicant claims the BioPod™ Biofilter operating at a hydraulic loading rate of 153 inches per hour is able to remove:

- 80% of Total Suspended Solids (TSS) for influent concentrations greater than 100 mg/L and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L.
- 60% dissolved zinc for influent concentrations 0.02 to 0.3 mg/L.
- 30% dissolved copper for influent concentrations 0.005 to 0.02 mg/L.
- 50% or greater total phosphorus for influent concentrations 0.1 to 0.5 mg/L.

Ecology's Recommendations:

Ecology finds that:

- Oldcastle Infrastructure, Inc. has shown Ecology, through laboratory and field testing, that the BioPod™ Biofilter is capable of attaining Ecology's Basic, Total Phosphorus, and Enhanced treatment goals.

Findings of Fact:

Field Testing

1. Herrera Environmental Consultants, Inc. conducted monitoring of the BioPod™ Biofilter at the Lake Union Ship Canal Test Facility in Seattle Washington between November 2016 and April 2018. Herrera collected flow-weight composite samples during 14 separate storm events and peak flow grab samples during 3 separate storm events. The system was sized at an infiltration rate of 153 inches per hour or a hydraulic loading rate of 1.6 gpm/ft^2.
2. The D_{50} of the influent PSD ranged from 3 to 292 microns, with an average D_{50} of 28 microns.
3. Influent TSS concentrations ranged from 17 mg/L to 666 mg/L, with a mean concentration of 98 mg/L. For all samples (influent concentrations above and below 100 mg/L) the bootstrap estimate of the lower 95 percent confidence limit (LCL 95) of the mean TSS reduction was 84% and the bootstrap estimate of the upper 95 percent confidence limit (UCL95) of the mean TSS effluent concentration was 8.2 mg/L.
4. Dissolved copper influent concentrations from the 17 events ranged from 9.0 µg/L to 21.1 µg/L. The 21.1 µg/L data point was reduced to 20.0 µg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean dissolved copper reduction was 35%.
5. Dissolved zinc influent concentrations from the 17 events ranged from 26.1 µg/L to 43.3 µg/L. A bootstrap estimate of the LCL95 of the mean dissolved zinc reduction was 71%.
6. Total phosphorus influent concentrations from the 17 events ranged from 0.064 mg/L to 1.56 mg/L. All influent data greater than 0.5 mg/L were reduced to 0.5 mg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean total phosphorus reduction was 64%.
7. The system experienced rapid sediment loading and needed to be maintained after 1.5 months. Monitoring personnel observed similar sediment loading issues with other systems

evaluated at the Test Facility. The runoff from the Test Facility may not be indicative of maintenance requirements for all sites.

Laboratory Testing

1. Good Harbour Laboratories (GHL) conducted laboratory testing at their site in Mississauga, Ontario in October 2017 following the New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs. The testing evaluated a 4-foot by 6-foot standard biofiltration chamber and inlet contour rack with bypass weir. The test sediment used during the testing was custom blended by GHL using various commercially available silica sands, which had an average d_{50} of 69 µm. Based on the lab test results:
   a. GHL evaluated removal efficiency over 15 events at a Maximum Treatment Flow Rate (MTFR) of 37.6 gpm, which corresponds to a MTFR to effective filtration treatment area ratio of 1.80 gpm/ft^2. The system, operating at 100% of the MTFR with an average influent concentration of 201.3 mg/L, had an average removal efficiency of 99 percent.
   b. GHL evaluated sediment mass loading capacity over an additional 16 events using an influent SSC concentration of 400 mg/L. The first 11 runs were evaluated at 100% of the MTFR. The BioPod began to bypass, so the remaining 5 runs were evaluated at 90% of the MTFR. The total mass of the sediment captured was 245.0 lbs and the cumulative mass removal efficiency was 96.3%.
2. Herrera Environmental Consultants Inc. conducted laboratory testing in September 2014 at the Seattle University Engineering Laboratory. The testing evaluated the flushing characteristics, hydraulic conductivity, and pollutant removal ability of twelve different media blends. Based on this testing, Oldcastle Infrastructure, Inc. selected one media blend, Mix 8, for inclusion in their TAPE evaluation of the BioPod™ Biofilter.
   a. Herrera evaluated Mix 8 in an 8-inch diameter by 36-inch tall polyvinyl chloride (PVC) column. The column contained 18-inches of Mix 8 on top of 6-inches of pea gravel. The BioPod will normally include a 3-inch mulch layer on top of the media layer; however, this was not included in the laboratory testing.
   b. Mix 8 has a hydraulic conductivity of 218 inches per hour; however, evaluation of the pollutant removal ability of the media was based on an infiltration rate of 115 inches per hour. The media was tested at 75%, 100%, and 125% of the infiltration rate. Based on the lab test results:
      - The system was evaluated using natural stormwater. The dissolved copper and dissolved zinc concentrations in the natural stormwater were lower than the TAPE influent standards; therefore, the stormwater was spiked with 66.4 mL of 100 mg/L Cu solution and 113.6 mL of 1,000 mg/L Zn solution.
      - The BioPod removed an average of 81% of TSS, with a mean influent concentration of 48.4 mg/L and a mean effluent concentration of 9.8 mg/L.
      - The BioPod removed an average of 94% of dissolved copper, with a mean influent concentration of 10.6 µg/L and a mean effluent concentration of 0.6 µg/L.
      - The BioPod removed an average of 97% of dissolved zinc, with a mean influent concentration of 117 µg/L and a mean effluent concentration of 4 µg/L.
      - The BioPod removed an average of 97% of total phosphorus, with a mean influent concentration of 2.52 mg/L and a mean effluent concentration of 0.066 mg/L. When total phosphorus influent concentrations were capped at the TAPE upper limit of 0.5 mg/L, calculations showed an average removal of 87%.

Other BioPod Related Issues to be Addressed By the Company:

1. Conduct hydraulic testing to obtain information about maintenance requirements on a site with runoff that is more typical of the Pacific Northwest.

Technology Description: Download at https://oldcastleprecast.com/stormwater/bioretention-biofiltration-applications/bioretention-biofiltration-solutions/

Contact Information:

Applicant: Chris Demarest
Oldcastle Infrastructure, Inc.
(925) 667-7100
Chris.demarest@oldcastle.com

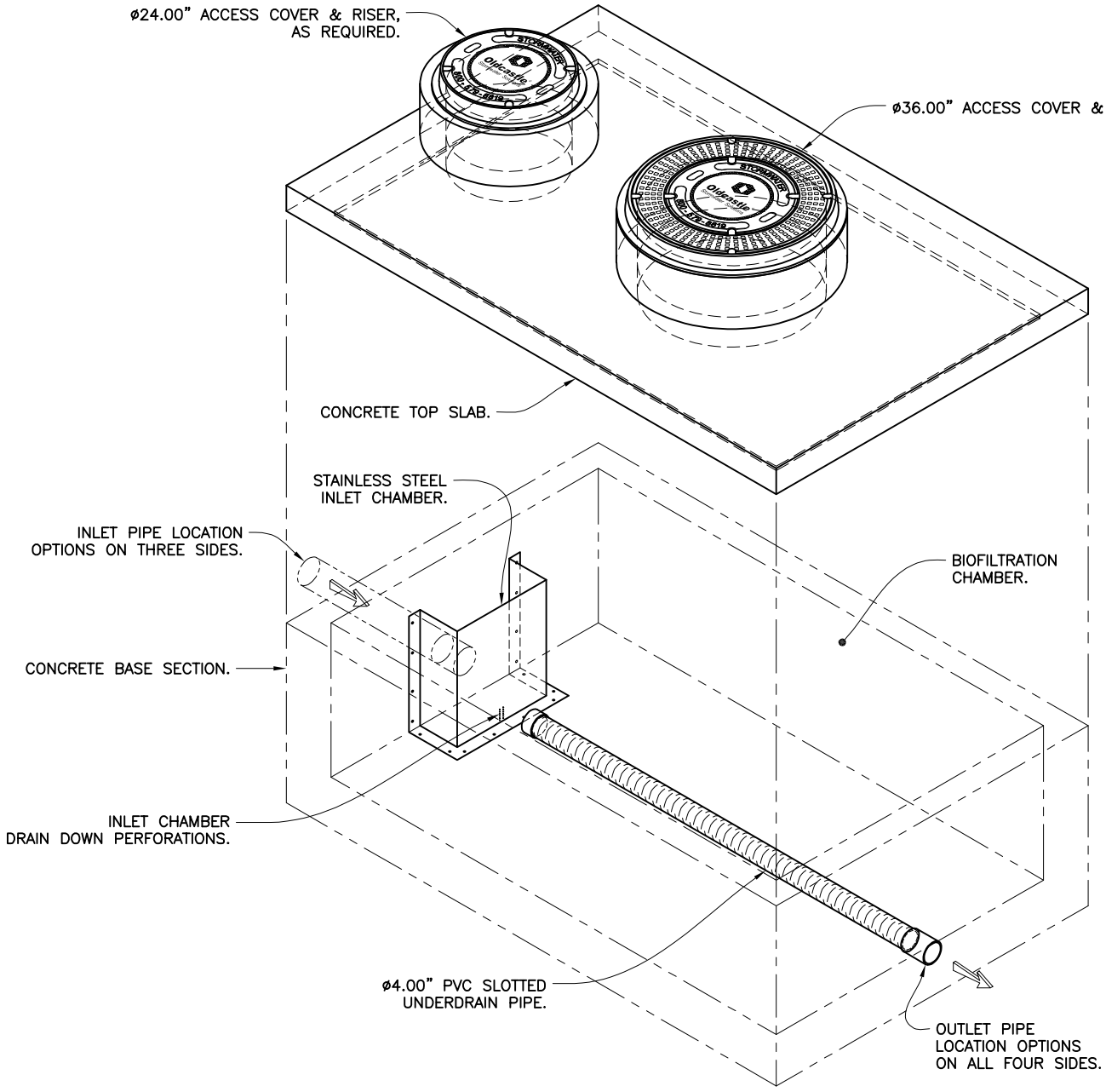
Applicant website: https://oldcastleprecast.com/stormwater/

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

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
March 2018	GULD granted for Basic Treatment
March 2018	Provisional GULD granted for Enhanced and Phosphorus Treatment
June 2016	PULD Granted
April 2018	GULD for Basic and Provisional GULD for Enhanced and Phosphorus granted, changed name to BioPod from TreePod
July 2018	GULD for Enhanced and Phosphorus granted
September 2018	Changed Address for Oldcastle
December 2018	Added minimum media thickness requirement
May 2019	Changed language on who must Install and maintain the device from Oldcastle to Applicants
August 2019	Added text on sizing using infiltration rate and water quality design flow rate



ISOMETRIC VIEW

FILTER MEDIA & DRAIN ROCK NOT SHOWN FOR CLARITY.
SCALE: 1X

NOTES:

1. SEPARATE BYPASS STRUCTURE IS REQUIRED IF PEAK FLOW RATE EXCEEDS TREATMENT CAPACITY.
2. CONTACT OLDCASTLE STORMWATER FOR ENGINEERING ASSISTANCE AND DETAIL DRAWINGS.
3. CONCRETE COMPONENTS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C890 & C913.

US Patents Pending

Bioretention/ Biofiltration

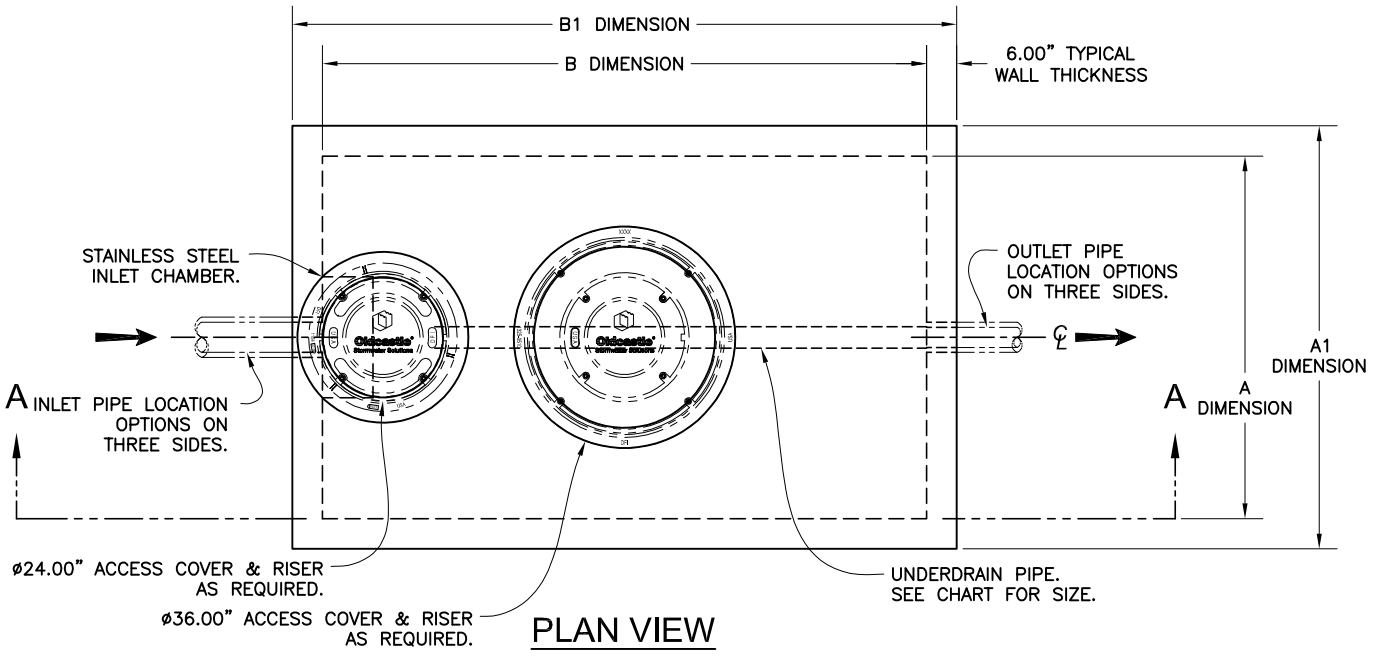
BioPod™ Biofilter Underground

Vault with External Bypass

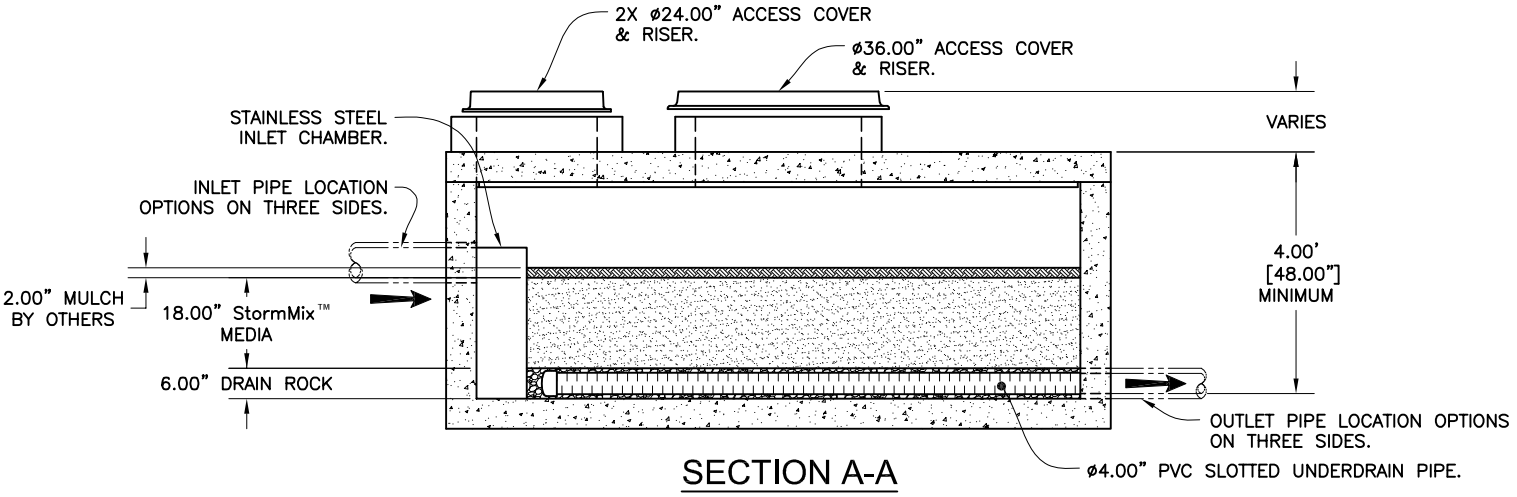
Oldcastle® INFRASTRUCTURE

Ph: 800.579.8819 | oldcastlestormwater.com

DRAWING NO.	REV	ECO	DATE	
BPU	A	ECO-0155 JPR 10/4/18	JPR 6/12/18	SHEET 1 OF 2



PLAN VIEW



SECTION A-A

MODEL	VAULT SIZE [1] (ID)		VAULT FOOTPRINT [1] (OD)		TREATMENT FLOW CAPACITY [2] (GPM/CFS)	TREATMENT FLOW CAPACITY [3] (GPM/CFS)
	A DIM	B DIM	A1 DIM	B1 DIM		
BASIN B MODEL → BPU-44	4'	4'	5'	5'	25.6 / 0.057	28.8 / 0.064
BASIN C MODEL → BPU-46	4'	6'	5'	7'	38.4 / 0.086	43.2 / 0.096
BPU-48	4'	8'	5'	9'	51.2 / 0.114	57.6 / 0.128
BPU-412	4'	12'	5'	13'	76.8 / 0.171	86.4 / 0.193
BPU-66	6'	6'	7'	7'	57.6 / 0.128	64.8 / 0.144
BPU-68	6'	8'	7'	9'	76.8 / 0.171	86.4 / 0.193
BPU-612	6'	12'	7'	13'	115.2 / 0.257	129.6 / 0.289
BPU-816	8'	16'	9'	17'	204.8 / 0.456	230.4 / 0.513

[1] All Dimensions Are Nominal
[2] Based on an WA Ecology GULD Approval for Basic, Enhanced & Phosphorus. At 1.60 gpm/sf Media Surface Area.
[3] Based on an NJCAT Verification & NJ DEP Certification. At 1.80 gpm/sf Media Surface Area.

US Patents Pending

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DRAWING NO.	REV	ECO	DATE	
BPU	A	ECO-0155 JPR 10/4/18	JPR 6/12/18	SHEET 1 OF 2

HABITAT TECHNOLOGIES

July 16, 2018

Mr. Robert Hansen, Planning Manager
@ City of Federal Way
33325 – 8th Avenue South
Federal Way, Washington 98003

Ms. Becky Chapin, Associated Planner
@ City of Federal Way
33325 – 8th Avenue South
Federal Way, Washington 98003
e-mail Becky.Chapin@cityoffederalway.com

RE: Review of Wetland Z Adjacent to Parcel 1721049034

I would first like to thank you both for meeting with me to discuss the potential implementation of Wetland Z and its associated buffer (as depicted in the prior delineation for the Celebration Park Area) in relation to the future planning for Parcel 1721049034. As noted for the prior Celebration Park Area, Wetland Z was confined within a narrow ravine and dominated by a forest plant community. As such, Wetland Z was defined in 1997 as a City of Federal Way Category II Wetland with a standard buffer of 100 feet in width. Wetland Z was also defined as not exhibiting any high value ratings for any functions.

As we discussed, and as depicted within the mapping prepared for the Celebration Park Area, the prior standard 100-foot buffer for Wetland Z extended approximately 30 to 40 feet onto the very western boundary of Parcel 1721049034. In addition, the compensatory mitigation completed along Wetland Z also pushed the standard buffer even further onto the western boundary of Parcel 1721049034.

Following our discussion Habitat Technologies completed an onsite assessment and subsequent categorization of Wetland Z pursuant to the Washington State *Wetland Rating System for Western Washington* (Hruby, 2014). Wetland Z was identified as confined within an existing ravine that appeared to have not changed significantly since the 1997 assessment completed for the Celebration Park Area, was dominated by a deciduous forest plant community, as not exhibiting an intermittent defined channel, and as entering a stormwater system at the southern end of the wetland. In addition, the prior mitigation work completed along Wetland Z as a part of the development of the Celebration Park has added a variety of young coniferous trees and a mixture of native shrubs to the buffer area.

As defined, Wetland Z was identified as meeting the present criteria for designation as a City of Federal Way Category III Wetland. This wetland received a total of 17 points for total functions which included a total of 4 points for habitat functions (Appendix A). As such, the present City of Federal Way buffer for this wetland would be 60 feet in width.

With a Category III Wetland rating and a standard buffer of 60 feet it appears that the standard buffer for this wetland would generally follow the existing chain link fence along the western boundary of Parcel 1721049034. In addition, as discussed it would appear beneficial that any required landscaping associated with the future development of Parcel 1721049034 be composed on native species located along the western boundary of the parcel.

Thank you for your attention to this site planning.

Sincerely,

Thomas D. Deming

Thomas D. Deming, PWS
Habitat Technologies

cc. Mr. Paul Rasmussen, @ Cascadia Senior Living
e-mail paulr@cascadiaseniorliving.com

Appendix A – 2014 Wetland Rating Worksheet

Wetland name or number Z

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland Z Date of site visit: 13 JUL 2018

Rated by Habitat Technologies Trained by Ecology? X Yes ___No Date of training 2014

HGM Class used for rating Depressional Wetland has multiple HGM classes? X 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 3 (based on functions X or special characteristics___)

1. Category of wetland based on FUNCTIONS

_____**Category I** – Total score = 23 - 27

_____**Category II** – Total score = 20 - 22

X **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	7	6	4	17

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	X

Wetland name or number Z

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	W1
Hydroperiods	D 1.4, H 1.2	W2
Location of outlet *(can be added to map of hydroperiods)*	D 1.1, D 4.1	W2
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	D 2.2, D 5.2	W2
Map of the contributing basin	D 4.3, D 5.3	W3
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	W4
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	W5
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	W6

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	N/A
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	N/A
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	N/A
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	

Wetland name or number Z

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.

Wetland name or number Z

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.*

Wetland name or number Z

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	2
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	2
Total for D 1 Add the points in the boxes above	9

Rating of Site Potential If score is: ___ **12-16 = H** X **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** X **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	1
Total for D 3 Add the points in the boxes above	2

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

Wetland name or number Z

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	2
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	5
Total for D 4 — Add the points in the boxes above	10

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

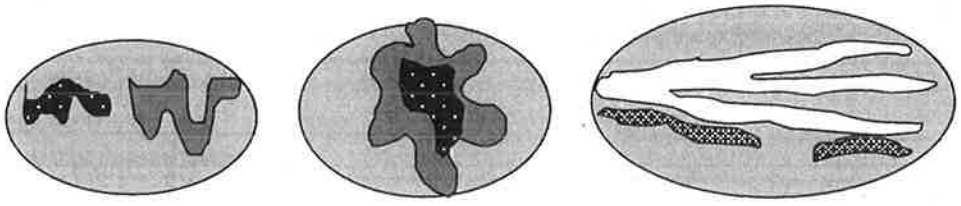
D 5.0. Does the landscape have the potential to support hydrologic functions of the site?	
D 5.1. Does the wetland receive stormwater discharges? Yes = 1 No = 0	1
D 5.2. Is >10% of the area within 150 ft of the wetland in land uses that generate excess runoff? Yes = 1 No = 0	0
D 5.3. Is more than 25% 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	2

Rating of Landscape Potential If score is: ___ **3 = H** _X_ **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* _____ points = 0 There are no problems with flooding downstream of the wetland. points = 0	1
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	1

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

Wetland name or number Z

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 __X__Forested (areas where trees have > 30% cover) — 1 structure: points = 0 *If the unit has a Forested class, check if:* __X__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	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 __X__Seasonally flooded or inundated — 3 types present: points = 2 ____Occasionally flooded or inundated — 2 types present: points = 1 __X__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**	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	2
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 	0

Wetland name or number Z

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.* X 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)* X 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)* X 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** X **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 0 + [(% moderate and low intensity land uses)/2] 5 = 5 % 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	0
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* % undisturbed habitat 10 + [(% moderate and low intensity land uses)/2] 0 = 0 % 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** X **< 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	0

Rating of Value If score is: ___ **2 = H** ___ **1 = M** X **0 = L** *Record the rating on the first page*

Wetland name or number Z

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.

Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
CELEBRATION PARK ASSEMBLAGE
33040-33090 - 14TH AVENUE SOUTH &
33002, 33061 & 33101 - 15TH AVENUE SOUTH
FEDERAL WAY, WASHINGTON

ES-1026.04

1805 - 136th Place N.E., Suite 201 Bellevue, WA 98005
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www.earthsolutionsnw.com

PREPARED FOR

DEVCO, INC.

June 19, 2019

FOR: **Adam Z. Shier, L.G.**
Senior Staff Geologist

6/19/19

Raymond A. Coglas, P.E.
Principal Engineer

GEOTECHNICAL ENGINEERING STUDY
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Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that 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.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

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Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

June 19, 2019
ES-1026.04

DevCo, Inc.
10900 Northeast 8th Street, Suite 1200
Bellevue, Washington 98004

Attention: Mr. David Ratliff

Dear Mr. Ratliff:

Earth Solutions NW, LLC (ESNW) is pleased to present this report titled "Geotechnical Engineering Study, Celebration Park Assemblage, 33040–33090 – 14th Avenue South & 33002, 33061 & 33101 – 15th Avenue South, Federal Way, Washington". Based on the results of our investigation, construction of the proposed apartment building and related infrastructure improvements is feasible from a geotechnical standpoint. Our subsurface exploration indicates the site is underlain by dense to very dense ice-contact deposits. During our recent subsurface exploration completed on May 7 and 8, 2019, groundwater was encountered at B-2 through B-4 at depths of about 14 to 21.5 feet below existing grades. As such, the contractor should be prepared to manage discrete zones of groundwater seepage during construction.

Based on our findings, it is our consideration that the proposed development may be constructed on conventional continuous and spread footing foundations bearing upon the dense native soils identified at our test sites. In general, dense native soil suitable for support of foundations will likely be encountered beginning at depths of about two-and-one-half to five feet below the ground surface. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, overexcavation to a depth that exposes dense native soils and replacement with crushed rock or lean-mix concrete will be necessary. It should be noted that due to the expected relatively high foundation loads, common earth structural fill should not be used for support of foundations.

Pertinent geotechnical recommendations are provided in this study. We appreciate the opportunity to be of service to you on this project. If you have questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

For: Adam Z. Shier, L.G.
Senior Staff Geologist

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FEDERAL WAY, WASHINGTON

ES-1026.04

INTRODUCTION

General

This geotechnical engineering study (study) was prepared for the proposed Celebration Park Assemblage project to be constructed immediately southwest of the intersection between 15th Avenue South and South 330th Street, in Federal Way, Washington. The purpose of this study was to provide geotechnical recommendations for currently proposed development plans. We performed the following services during this project phase:

- Borings for purposes of characterizing soil and groundwater conditions;
- Laboratory testing of soil samples collected at the boring locations;
- Engineering analyses, and;
- Preparation of this report.

The following documents and maps were reviewed as part of our study preparation:

- Geologic Map of the Poverty Bay 7.5' Quadrangle, King and Pierce Counties, Washington, by D.B. Booth, H.H. Waldron, and K.G. Troost, 2004;
- Online Web Soil Survey (WSS) resource maintained by the United States Department of Agriculture (USDA), Natural Resources Conservation Service;
- iMap, King County online GIS database;
- Chapter 19.145 of the Federal Way Revised Code (FWRC), and;
- Liquefaction Susceptibility (Map 11-5) for King County, May 2010.

Project Description

Although the project is still in the preliminary stages of design, we understand the site will be redeveloped with a six-story apartment building and related infrastructure improvements. Site ingress and egress will likely be provided by 15th Avenue South. Although unspecified at the time of this report, stormwater management plans will likely utilize infiltration to the extent practicable. We presume a stormwater detention system will be used to manage the majority of the site stormwater.

At the time of report submission, specific building load plans were not available for review; however, based on our experience with similar developments, the structure will likely incorporate podium-style construction utilizing a post-tensioned slab, with relatively lightly loaded wood framing above. Column loads are estimated to be about 300 to 400 kips, with perimeter footing loads of about 5 to 7 kips per lineal foot (klf). Slab-on-grade loading is anticipated to be approximately 150 pounds per square foot (psf).

Grade cuts and/or fills of about five feet are anticipated to achieve finish grades, and grade cuts of 10 or more feet will likely be necessary to construct a detention vault. Retaining walls and/or rockeries may be incorporated into final designs to accommodate grade transitions, where necessary.

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations provided in this report. ESNW should review final designs to confirm that appropriate geotechnical recommendations have been incorporated into the plans.

SITE CONDITIONS

Surface

The subject site is located immediately southwest of the intersection between South 330th Street and 15th Avenue South, in Federal Way, Washington. The approximate location of the property is illustrated on Plate 1 (Vicinity Map). The subject site consists of 11 adjoining tax parcels (King County Parcel Nos. 172104-9019, -9028, -9030, -9034, -9035, -9046, -9051, -9057, -9059, -9064, and -9090), totaling approximately 7.16 acres.

The site is bordered to the north by South 330th Street and Celebration Park Road, to the east by 15th Avenue South, to the south by a commercial development, and to the west by Celebration Park. Existing topography descends toward the west, with approximately 50 feet of elevation change across the site.

Subsurface

An ESNW representative observed, logged, and sampled five borings, advanced at accessible locations within the property boundaries, on May 7 and 8, 2019, using a drill rig and operators retained by our firm. The borings were completed to assess and classify soil and groundwater conditions. The approximate locations of the borings are depicted on Plate 2 (Boring Location Plan). Please refer to the boring logs provided in Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at the boring locations were evaluated in accordance with both Unified Soil Classification System (USCS) and United States Department of Agriculture (USDA) methods and procedures.

Existing Fill

Fill was not encountered at the boring locations during our fieldwork. Due to the forested condition across the majority of the site, we do not anticipate significant fill will be encountered during site grading and earthwork activities.

Native Soil

Native soils consisted primarily of dense to very dense silty sand with gravel, and silt (USCS: SM, and ML, respectively). The native soils were encountered in a damp to moist condition and extended to the maximum exploration depth of about 35.5 feet below the ground surface (bgs).

Geologic Setting

The referenced geologic map resource identifies ice-contact deposits (Qvi) across the site and immediately surrounding area. Ice-contact deposits typically consists of stratified sand and gravel that is poorly sorted with a silt-rich matrix. Ice-contact deposits can contain lenses and pods of till.

The referenced WSS resource identifies Everett-Alderwood gravelly sandy loam (Map Unit Symbol: EwC) across the site and surrounding areas. The Everett-Alderwood series was formed in moraines and till plains. Based on our field observations, native soils underlying the site are generally consistent with the composition of ice-contact deposits, as described in this section.

Groundwater

During our subsurface exploration completed on May 7 and 8, 2019, groundwater was encountered at B-2 through B-4 at depths of about 14 to 21.5 feet bgs; however, perched groundwater may be encountered within shallower excavations on the subject site. Seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the winter, spring, and early summer months.

Geologically Hazardous Areas Assessment

Readily available maps and resources were reviewed to identify potential geologically hazardous areas on, or adjacent to, the site. Based on review of the referenced FWRC and the critical areas map, there are no geologically hazardous areas (landslide, erosion, or seismic) within, or immediately adjacent to, the subject site. Based on our field observations and site exploration, it is our opinion geologically hazardous areas are not present on site.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our investigation, construction of an apartment building as currently proposed is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed development include foundation support, slab-on-grade subgrade support, the suitability of using on-site soils as structural fill, and stormwater management.

Based on our findings, it is our consideration that the proposed development may be constructed on conventional continuous and spread footing foundations bearing upon the dense native till soils identified at our test sites. In general, dense native soil suitable for support of foundations will likely be encountered beginning at depths of about two-and-one-half to five feet bgs. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, overexcavation to a depth that exposes dense native soils and replacement with crushed rock or lean-mix concrete will be necessary. It should be noted that common earth structural fill should not be used for support of the relatively heavy foundation loads.

Given the presence of dense to very dense native glacial till at relatively shallow depths, it is our opinion full-scale infiltration is not feasible from a geotechnical standpoint. The appreciable fines contents and high in-situ density of the deposit will likely inhibit the function of any large-scale infiltration system. From a geotechnical standpoint, the native glacial till should be considered impervious for purposes of large-scale infiltration design.

This study has been prepared for the exclusive use of DevCo, Inc. and their representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

Initial site preparation activities will consist of installing temporary erosion control measures, establishing grading limits, performing clearing and site stripping, and removing existing structural improvements. Subsequent earthwork activities will involve mass site grading, foundation subgrade preparation, and related infrastructure improvements.

Temporary Erosion Control

The following temporary erosion control measures should be considered:

- Temporary construction entrances and drive lanes should consist of at least six inches of quarry spalls to both minimize off-site soil tracking and provide a stable access entrance surface. Placing geotextile fabric underneath the quarry spalls will provide greater stability, if needed.
- Silt fencing should be placed around downgradient areas of the site perimeter.
- When not in use, soil stockpiles should be covered or otherwise protected.
- Temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or interceptor swales, should be installed prior to beginning earthwork activities.
- Dry soils disturbed during construction should be wetted to minimize dust.
- When appropriate, permanent planting or hydroseeding will help to stabilize site soils.

Additional Best Management Practices (BMPs), as specified by the project design team and indicated on the plans, should be incorporated into construction activities. Temporary erosion control measures may be modified during construction as site conditions require, as approved by the site erosion control lead.

Excavations and Slopes

Excavation activities are likely to expose dense to very dense glacial deposits. Based on the soil conditions observed at the boring locations, the following allowable temporary slope inclinations, as a function of horizontal to vertical (H:V) inclination, may be used. The applicable Federal Occupation Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) soil classifications are also provided:

- Areas exposing existing fill — 1.5H:1V (Type C)
- Areas containing groundwater seepage — 1.5H:1V (Type C)
- Dense to very dense glacial soils — 0.75H:1V (Type A)

Steeper temporary slope inclinations within undisturbed, very dense native deposits may be feasible based on the soil and groundwater conditions exposed within the excavations. If pursued, ESNW can assist in evaluating the feasibility of utilizing oversteepened slopes at the time of construction. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations.

The presence of perched groundwater may cause localized sloughing of temporary slopes due to excess seepage forces. An ESNW representative should observe temporary and permanent slopes to confirm slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations, as necessary. Permanent slopes should be planted with vegetation to enhance stability and to minimize erosion, and should maintain a gradient of 2H:1V or flatter.

In-situ and Imported Soils

On-site soils are moisture sensitive, and successful use of on-site soils as structural fill will largely be dictated by the moisture content at the time of placement and compaction. Remedial measures, such as soil aeration, may be necessary as part of site grading and earthwork activities. If the on-site soils cannot be successfully compacted, the use of an imported soil may be necessary. In our opinion, a contingency should be provided in the project budget for export of soil that cannot be successfully compacted as structural fill if grading activities take place during periods of extended rainfall activity. Soils with fines contents greater than 5 percent typically degrade rapidly when exposed to periods of rainfall.

Imported soil intended for use as structural fill should consist of a well-graded, granular soil with a moisture content that is at (or slightly above) the optimum level. The fines content of the imported granular soil should be 5 percent or less during wet-weather conditions (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Subgrade Preparation

Competent, uniform subgrade areas consisting of dense native till soils should be established below the foundation and slab elements to both minimize the potential for differential settlement and provide competent bearing conditions along structural subgrades. Where dense till subgrade conditions are exposed at proposed subgrade elevations, minimal preparations will likely be necessary. ESNW should confirm acceptability of subgrade areas prior to placing formwork. Supplementary recommendations for subgrade improvement may be provided at the time of construction; such recommendations would likely include overexcavation of unsuitable soils to expose competent native soils and replacement with clean crushed rock or lean-mix concrete (foundation subgrade). It should be noted that common earth structural fill soils should not be used for support of building foundation elements.

The process of removing existing structures may produce voids where old foundations and/or crawl space areas may have been present. Complete restoration of voids resulting from demolition activities must be executed as part of overall subgrade and building pad preparation activities. ESNW should confirm subgrade conditions, as well as the required level of recompaction and/or overexcavation and replacement, during site preparation activities. ESNW should also evaluate the overall suitability of prepared subgrade areas following site preparation activities.

Structural Fill

Structural fill is defined as compacted soil placed in slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. Soils placed in structural areas should be placed in loose lifts of 12 inches or less and compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D1557). For soil placed in utility trenches underlying structural areas, compaction requirements are dictated by the local city, county, or utility district, and are typically specified to a relative compaction of at least 95 percent. As previously noted, structural fill placed below foundation elements must consist of two-inch diameter, clean crushed rock or lean-mix concrete placed directly atop dense native soils.

Foundations

Based on our findings, it is our opinion the proposed structure may be constructed on conventional continuous and spread footing foundations bearing upon the dense native till soils identified at our test sites. In general, dense native soil suitable for support of foundations will likely be encountered beginning at depths of about two-and-one-half to five feet bgs. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, overexcavation to a depth that exposes dense native soil and subsequent replacement with crushed rock or lean-mix concrete will be necessary.

Provided the foundations will be supported as prescribed, the following parameters may be used for design:

• Allowable soil bearing capacity	5,000 psf* (preliminary)
• Passive earth pressure	350 pcf (equivalent fluid)
• Coefficient of friction	0.40

* *Applicable if foundations are supported on either dense, unweathered glacial deposits or two-inch-diameter, clean crushed rock or lean-mix concrete atop dense native soils, as verified by ESNW during construction. It should be noted that an improved bearing value in excess of 5,000 psf may be possible based on ESNW review of final grades and foundation plans.*

A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. The above passive pressure and friction values include a factor-of-safety of 1.5. With structural loading as expected, total settlement in the range of one inch and differential settlement of about one-half inch is anticipated. The majority of the settlements should occur during construction, as dead loads are applied.

Seismic Design

The 2015 International Building Code recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. In accordance with Table 20.3-1 of the ASCE Minimum Design Loads for Buildings and Other Structures manual, Site Class D should be used for design.

The referenced liquefaction susceptibility map indicates the majority of the subject site maintains very low liquefaction susceptibility. Liquefaction is a phenomenon where saturated and loose sands suddenly lose internal strength and behave as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or other intense ground shaking. Due to the presence of consolidated glacial deposits and the absence of a uniformly established groundwater table, it is our opinion site susceptibility may be characterized as low.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed multi-family structure should be supported on well-compacted, firm and unyielding subgrades. Where feasible, native soils exposed at the slab-on-grade subgrade levels can likely be compacted in situ to the specifications of structural fill. Unstable or yielding subgrade areas should be recompacted, or overexcavated and replaced with suitable structural fill, prior to slab construction.

A capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below each slab. The free-draining material should have a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. The vapor barrier material should be specifically designed for that use and installed in accordance with the specifications of the manufacturer.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters may be used for design:

• Active earth pressure (unrestrained condition)	35 pcf (equivalent fluid)
• At-rest earth pressure (restrained condition)	55 pcf
• Traffic surcharge (passenger vehicles)	70 psf (rectangular distribution)*
• Passive earth pressure	350 pcf (equivalent fluid)
• Coefficient of friction	0.40
• Seismic surcharge	6H psf**

* *Where applicable*
** *Where H equals the retained height (in feet)*

The above design parameters are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill may consist of a less permeable soil, if desired. A sheet drain may also be considered in lieu of free-draining material. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Drainage

Groundwater should be anticipated in site excavations depending on the time of year grading operations take place. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches and sumps. ESNW should be consulted during preliminary grading to identify areas of groundwater and to provide recommendations to reduce the potential for instability related to groundwater effects. Based on our May 2019 field observations, at this time, we do not anticipate a sub-slab drainage system will be necessary for this project.

Finish grades must be designed to direct surface water away from the new structure and/or slopes for a distance of at least 10 feet or as setbacks allow. Water must not be allowed to pond adjacent to the new structure\ and/or slopes. In our opinion, foundation drains should be installed along the building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Infiltration Feasibility

As indicated in the *Subsurface* section of this report, native soils encountered during our fieldwork were characterized primarily as dense to very dense ice-contact deposits. Based upon the results of USDA textural analyses performed on representative soil samples, native soils are also classified as gravelly loam, very gravelly sandy loam, and gravelly fine sandy loam. Disregarding gravel content, fines within the native soils were about 18 to 54 percent at the tested locations. Given the appreciable fines contents and dense to very dense in-situ condition of the glacial soils, it is our opinion full-scale infiltration is not feasible from a geotechnical standpoint. Small-scale infiltration devices incorporating overflow may be feasible and can be further evaluated by ESNW, if requested.

Preliminary Detention Vault Design

Although unspecified at this time, we presume a detention vault will be used as the primary means of stormwater management. Based on our experience with similar projects, we assume grade cuts of 10 or more feet will be necessary to achieve the subgrade elevation of the vault foundation. Based on our field observations, grade cuts for the vault are likely to expose dense to very dense, undisturbed glacial till.

The vault foundation should be supported directly on competent native soils. Should overexcavation(s) be necessary at the vault foundation subgrade, quarry spalls should be used to restore grades. The final vault design must incorporate adequate buffer space from property boundaries such that temporary excavations to construct the vault structure may be successfully completed. Perimeter drains should be installed around the vault and conveyed to an approved discharge point. Perched groundwater seepage should be anticipated within the vault excavation; however, buoyancy is not expected to influence the vault structure.

The following preliminary design parameters may be used for the vault:

- Allowable soil bearing capacity — 5,000 psf (dense native soil)
- Active earth pressure (unrestrained) — 35 pcf
- Active earth pressure (unrestrained, hydrostatic) — 80 pcf
- At-rest earth pressure (restrained) — 55 pcf
- At-rest earth pressure (restrained, hydrostatic) — 100 pcf
- Coefficient of friction — 0.40
- Passive earth pressure — 350 pcf
- Seismic surcharge — 6H psf*

* *Where H equals the retained height (in feet)*

Vault retaining walls should be backfilled with free-draining material or suitable sheet drainage that extends along the height of the walls. The upper one foot of the wall backfill may consist of a less permeable soil, if desired. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. If the elevation of the vault bottom is such that gravity flow to an outlet is not possible, the portions of the vault below the drain should be designed to include hydrostatic pressure.

ESNW should observe grading operations for the vault and subgrade conditions prior to concrete forming and pouring. If the soil conditions encountered during construction differ from those anticipated, supplementary recommendations may be provided. ESNW should be contacted to review the final vault design to confirm appropriate geotechnical parameters have been incorporated.

Preliminary Pavement Sections

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

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections may be considered:

- A minimum of two inches of hot-mix asphalt (HMA) placed over four inches of crushed rock base (CRB), or;
- A minimum of two inches of HMA placed over three inches of asphalt-treated base (ATB).

Heavier traffic areas generally require thicker pavement sections depending on site usage, pavement life expectancy, and site traffic. For preliminary design purposes, the following pavement sections for occasional truck traffic and access roadways areas may be considered:

- Three inches of HMA placed over six inches of CRB, or;
- Three inches of HMA placed over four-and-one-half inches of ATB.

An ESNW representative should be requested to observe subgrade conditions prior to placement of CRB or ATB. As necessary, supplemental recommendations for achieving subgrade stability and drainage can be provided. If on-site roads will be constructed with an inverted crown, additional drainage measures may be recommended to assist in maintaining road subgrade and pavement stability.

Final pavement design recommendations, including recommendations for heavy traffic areas, access roads, and frontage improvement areas, can be provided once final traffic loading has been determined. Road standards utilized by the governing jurisdiction may supersede the recommendations provided in this report. The HMA, ATB, and CRB materials should conform to WSDOT specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557.

Utility Support and Trench Backfill

In our opinion, on-site soils will generally be suitable for support of utilities. Remedial measures may be necessary in some areas to provide support for utilities, such as overexcavation and replacement with structural fill and/or placement of geotextile fabric. Groundwater seepage may be encountered within utility excavations, and caving of trench walls may occur where groundwater is encountered. Depending on the time of year and conditions encountered, dewatering, as well as temporary trench shoring, may be necessary during utility excavation and installation.

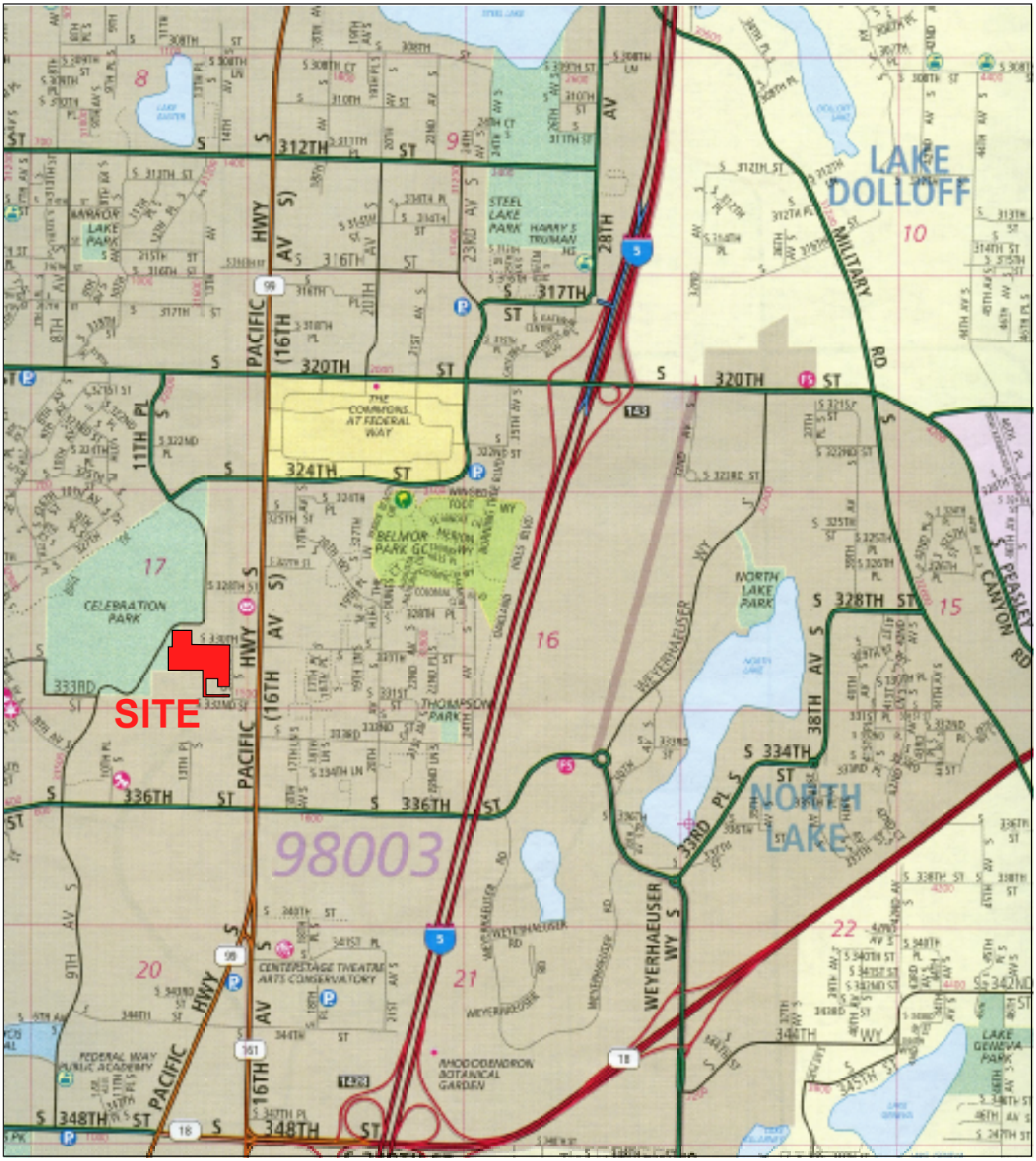
Using on-site soils successfully as structural backfill throughout utility trench excavations will depend on the moisture content at the time of placement and compaction. Moisture conditioning of the soils may be necessary at some locations prior to use as structural fill. Each section of the utility lines must be adequately supported in the bedding material. Utility trench backfill should be placed and compacted to the specifications of structural fill as previously detailed in this report, or to the applicable specifications of the responsible jurisdiction or agency.

LIMITATIONS

The recommendations and conclusions provided in this geotechnical engineering study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is not expressed or implied. Variations in the soil and groundwater conditions observed at the boring locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this geotechnical engineering study if variations are encountered.

Additional Services

ESNW should have an opportunity to review final project plans with respect to the geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services during construction.



Reference:
King County, Washington
Map 745
By The Thomas Guide
Rand McNally
32nd Edition

NORTH

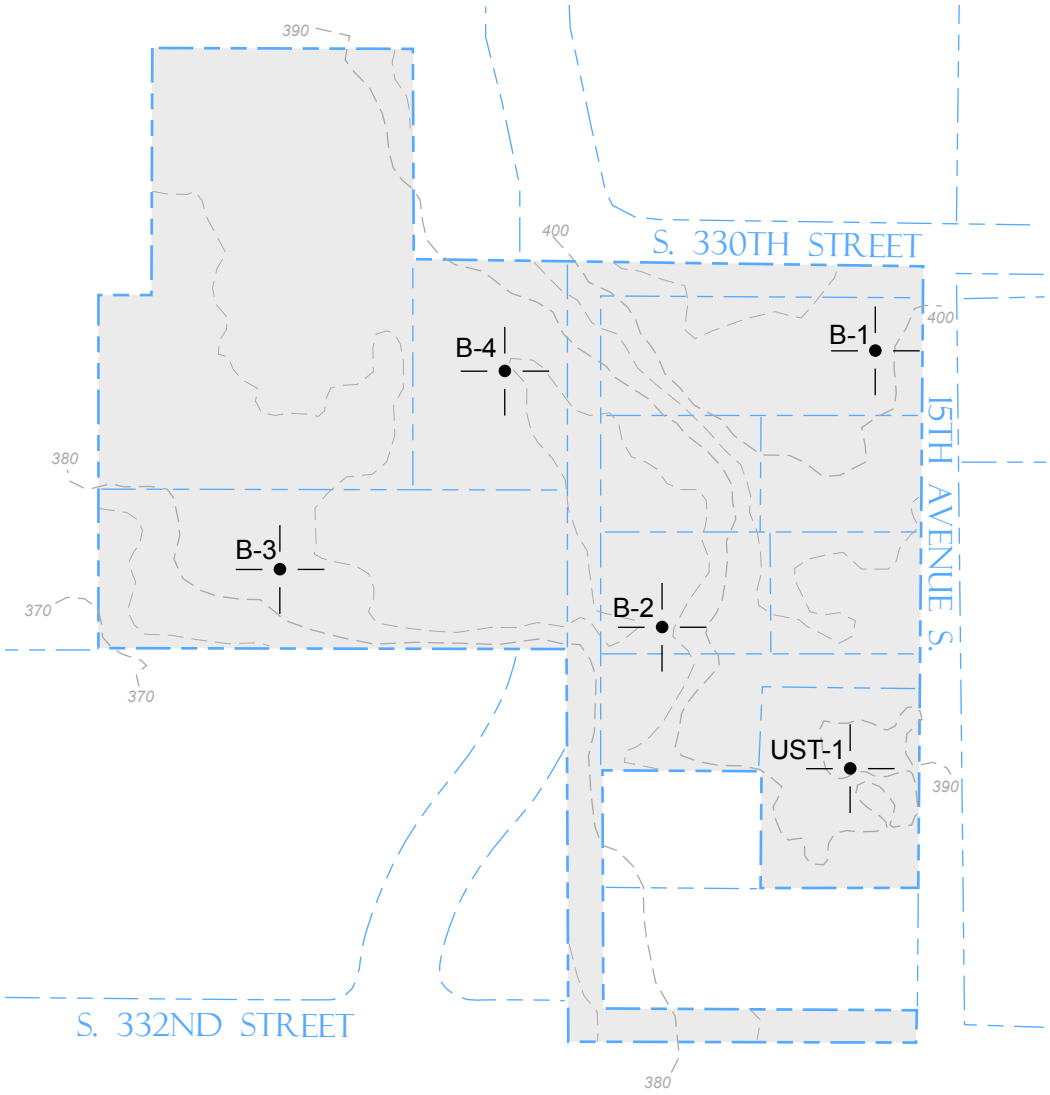
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
Celebration Park Assemblage
Federal Way, Washington

Drwn. MRS	Date 05/22/2019	Proj. No. 1026.04
Checked AZS	Date May 2019	Plate 1



LEGEND

B-1 — Approximate Location of ESNW Boring, Proj. No. ES-1026.04, May 2019

Subject Site

NORTH

NOT - TO - SCALE

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

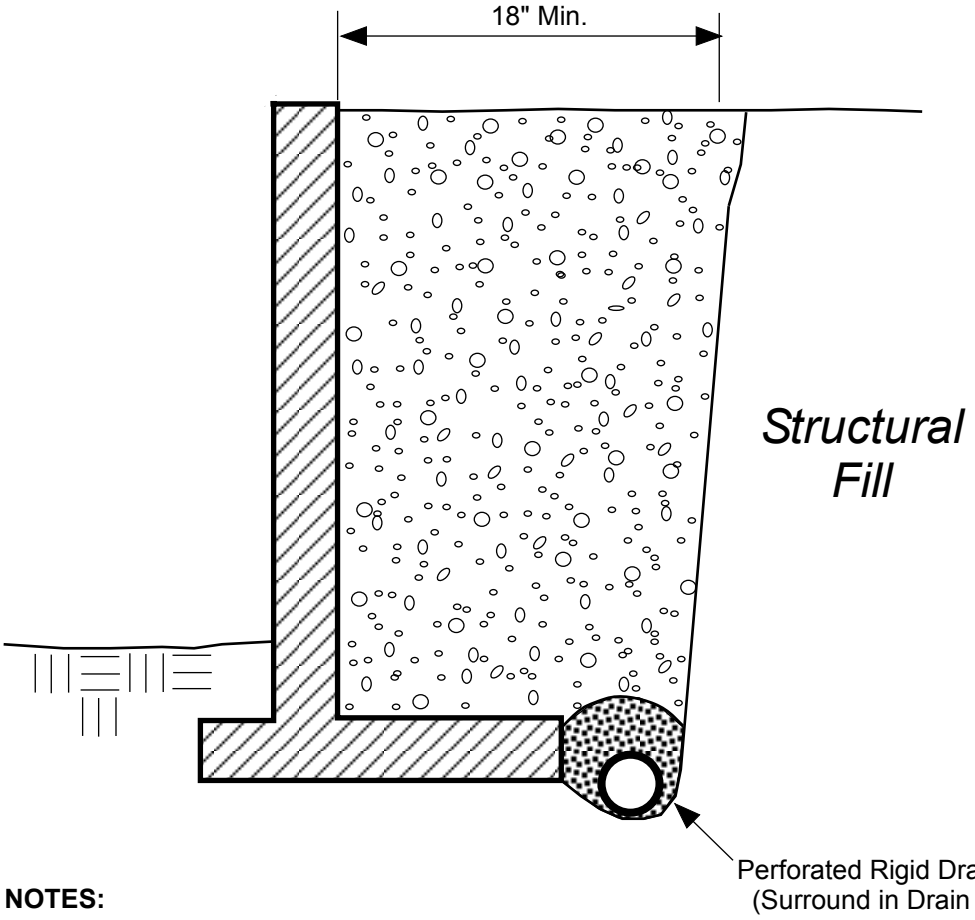
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Boring Location Plan
Celebration Park Assemblage
Federal Way, Washington

Drwn.	MRS	Date	05/22/2019	Proj. No.	1026.04
Checked	AZS	Date	May 2019	Plate	2



NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

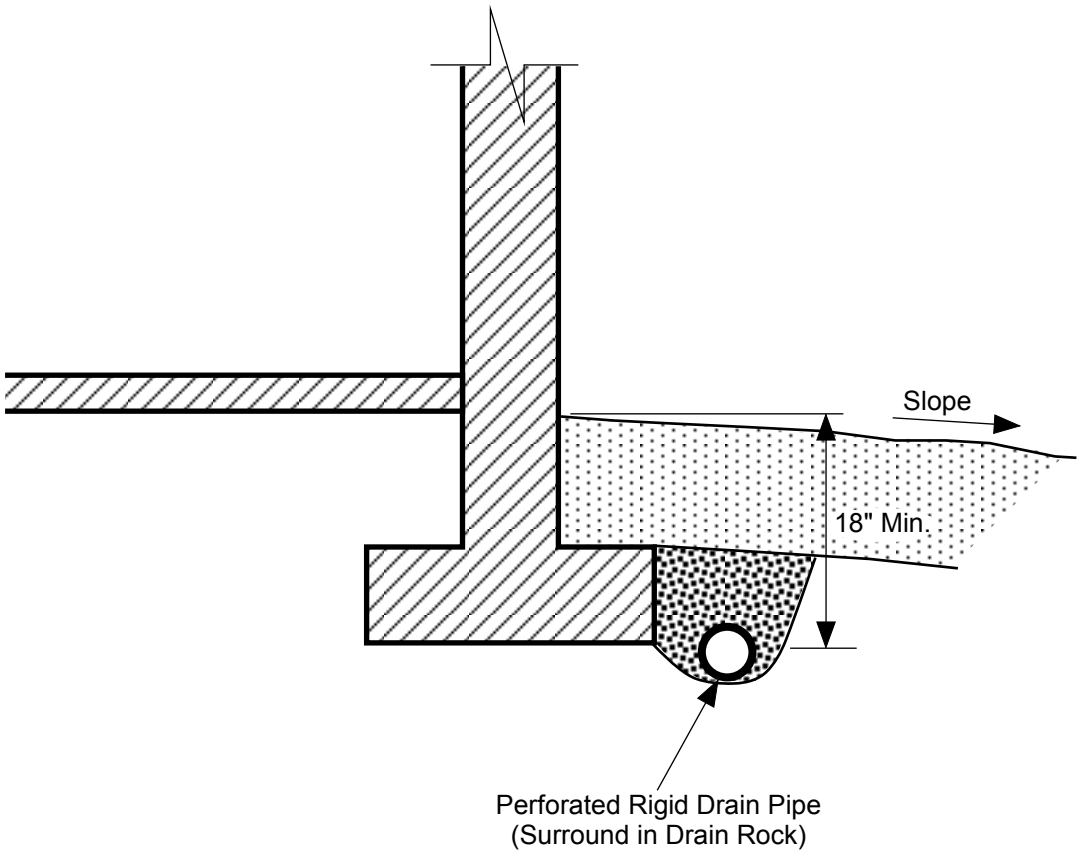
Free-draining Structural Backfill

1-inch Drain Rock

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

Retaining Wall Drainage Detail
Celebration Park Assemblage
Federal Way, Washington

Drwn. MRS	Date 05/22/2019	Proj. No. 1026.04
Checked AZS	Date May 2019	Plate 3



NOTES:

- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

Surface Seal: native soil or other low-permeability material.

1-inch Drain Rock

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

Footing Drain Detail
Celebration Park Assemblage
Federal Way, Washington

Drwn. MRS	Date 05/22/2019	Proj. No. 1026.04
Checked AZS	Date May 2019	Plate 4

Appendix A

Subsurface Exploration
Boring Logs

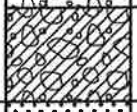
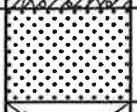
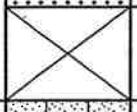
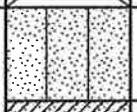
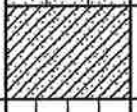
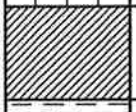
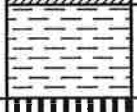
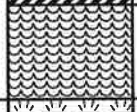
ES-1026.04

Subsurface conditions at the subject site were explored on May 7 and 8, 2019, by advancing five borings using a tracked drill rig and operators retained by our firm. The approximate locations of the borings are illustrated on Plate 2 of this study. The borings are provided in this Appendix. The maximum exploration depth was approximately 35.5 feet bgs.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

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

DUAL SYMBOLS are used to indicate borderline soil classifications.

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

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Fax: 425-449-4711

BORING NUMBER B-1

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DATE STARTED 5/7/19 **COMPLETED** 5/7/19 **GROUND ELEVATION** 402 ft **HOLE SIZE**

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

DRILLING METHOD HSA **AT TIME OF DRILLING** ---

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

NOTES Surface Conditions: field grass **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Gray silty SAND with gravel, very dense, moist
5	SS	100	27-50/6"	MC = 5.90%	SM		
10	SS	100	31-50/3"	MC = 6.40%			
15	SS	0	50/1"				-bounce on rock
20							

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BORING NUMBER B-1

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	100	50/6"	MC = 6.60%	SM		Gray silty SAND with gravel, very dense, moist *(continued)*
25	SS	100	50/6"	MC = 6.50% Fines = 33.60%			25.5 [USDA Classification: very gravelly LOAM] 376.5 Boring terminated at 25.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with bentonite chips. Bottom of hole at 25.5 feet.

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BORING NUMBER B-2

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DATE STARTED 5/7/19 **COMPLETED** 5/7/19 **GROUND ELEVATION** 383 ft **HOLE SIZE**

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

DRILLING METHOD HSA ▽ **AT TIME OF DRILLING** 19.0 ft / Elev 364.0 ft

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

NOTES Surface Conditions: dirt road **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Gray silty SAND with gravel, very dense, moist
5	SS	0	6-16-50/3"		SM		-no recovery
10	SS	78	17-26-38 (64)	MC = 12.20%			
14.0							369.0
15	SS	100	16-31-33 (64)	MC = 11.90% Fines = 53.60%	ML		Gray sandy SILT, very dense, moist [USDA Classification: gravelly LOAM]
20							▽ -groundwater table, becomes wet

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BORING NUMBER B-2

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	100	19-50/4"	MC = 7.40%	ML		Gray sandy SILT, very dense, moist *(continued)*
							-increasing gravel content
25	SS	100	44-50/4"	MC = 10.50%			
							26.0 357.0 Boring terminated at 26.0 feet below existing grade. Groundwater table encountered at 19.0 feet during drilling. Boring backfilled with bentonite chips.
							Bottom of hole at 26.0 feet.

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BORING NUMBER B-3

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DATE STARTED 5/7/19 **COMPLETED** 5/7/19 **GROUND ELEVATION** 383 ft **HOLE SIZE**

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

DRILLING METHOD HSA **AT TIME OF DRILLING** ---

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

NOTES Surface Conditions: native groundcover **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Gray silty SAND with gravel, very dense, moist to wet
5	SS	100	19-31-42 (73)	MC = 7.70%	SM		
10	SS	67	9-16-21 (37)	MC = 3.00% Fines = 17.90%			[USDA Classification: gravelly sandy LOAM] -becomes medium dense
15	SS	100	19-36-50/6"	MC = 6.90%			-becomes very dense
20							

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BORING NUMBER B-3

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	100	38-50/6"	MC = 9.50%	SM		Gray silty SAND with gravel, very dense, moist to wet *(continued)*
							-light groundwater seepage
25	SS	100	18-29-37 (66)	MC = 20.50%			-decreasing gravels
							26.5 356.5 Boring terminated at 26.5 feet below existing grade. Groundwater seepage encountered at 21.5 feet during drilling. Boring backfilled with bentonite chips. Bottom of hole at 26.5 feet.

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BORING NUMBER B-4

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DATE STARTED 5/8/19 **COMPLETED** 5/8/19 **GROUND ELEVATION** 385 ft **HOLE SIZE**

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

DRILLING METHOD HSA ▽ **AT TIME OF DRILLING** 14.0 ft / Elev 371.0 ft

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

NOTES Surface Conditions: native groundcover **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Gray silty SAND with gravel, medium dense, moist
5	SS	6	5-7-10 (17)	MC = 11.60% Fines = 42.70%	SM		[USDA Classification: gravelly LOAM]
10	SS	67	9-18-50/6"	MC = 9.20%			-light groundwater seepage -becomes very dense
15	SS	100	5-50/2"	MC = 10.70%			▽ -groundwater table
20							

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BORING NUMBER B-4

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	75	5-33-50/4"	MC = 11.80%			Gray silty SAND with gravel, medium dense, moist *(continued)*
25	SS	100	5-12-16 (28)	MC = 24.80%	SM		-silt lense -becomes medium dense
30	SS		50/0"				-becomes very dense
35	SS	100	50/2"	MC = 11.90%			35.5 349.5 Boring terminated at 35.5 feet below existing grade. Groundwater table encountered at 14.0 feet, and groundwater seepage encountered at 11.0 feet during drilling. Boring backfilled with bentonite chips. Bottom of hole at 35.5 feet.

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BORING NUMBER UST-1

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DATE STARTED 5/7/19 **COMPLETED** 5/7/19 **GROUND ELEVATION** 295 ft **HOLE SIZE**

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

DRILLING METHOD HSA **AT TIME OF DRILLING** ---

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

NOTES Surface Conditions: grass **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Gray silty SAND with gravel, very dense, moist
5	SS	100	18-26-24 (50)	MC = 10.20% Fines = 35.80%			[USDA Classification: gravelly fine sandy LOAM]
10	SS	100	23-50/6"		SM		-no sample
15	SS	100	50/6"				-no sample
20							

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BORING NUMBER UST-1

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	100	24-50/5"	MC = 6.30%	SM		Gray silty SAND with gravel, very dense, moist *(continued)*
25	SS	100	30-45-50/6"	MC = 6.70%			
							26.5 268.5 Boring terminated at 26.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with bentonite chips. Bottom of hole at 26.5 feet.

Appendix B

Laboratory Test Results

ES-1026.04

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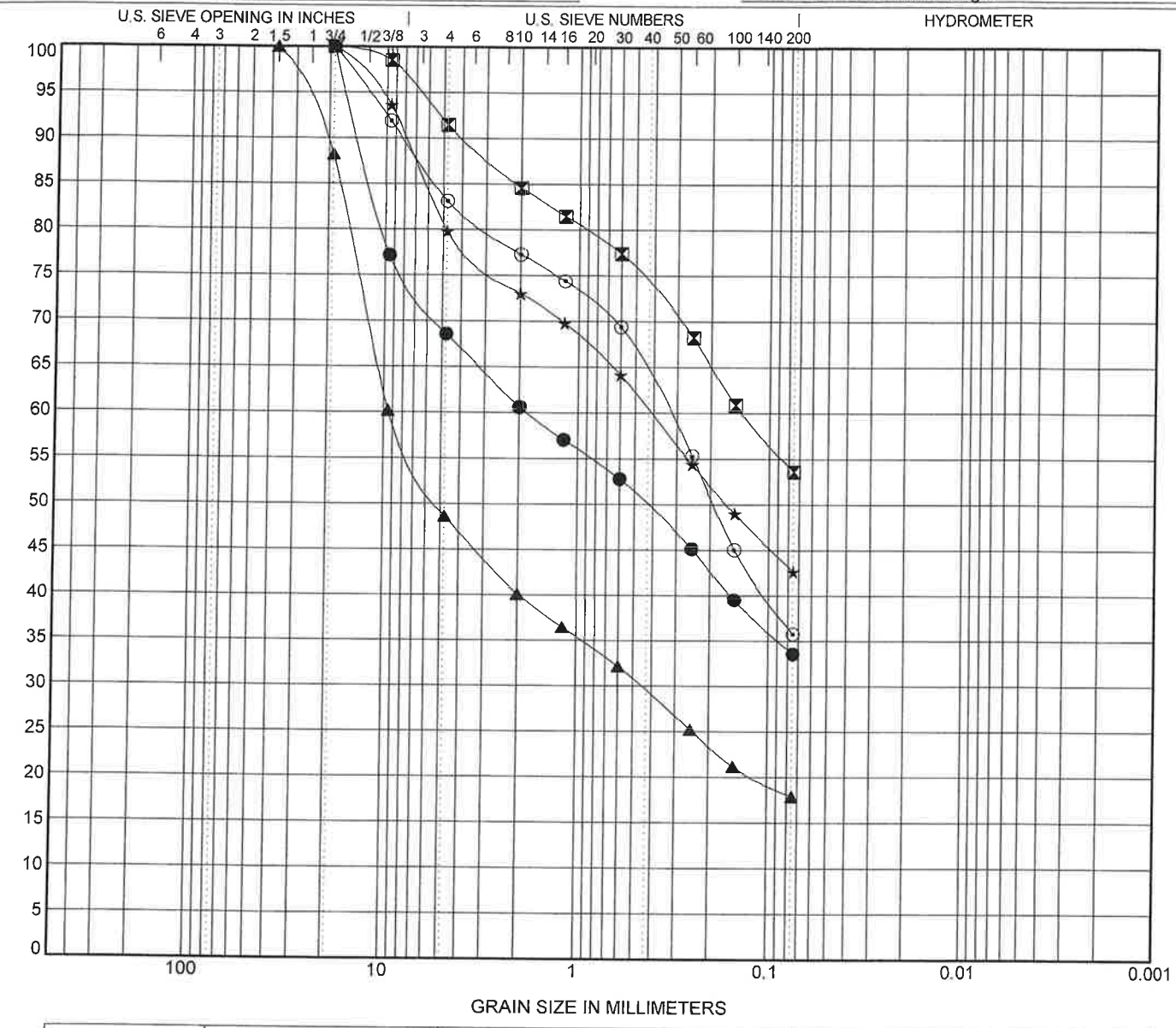
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-1026.04 **PROJECT NAME** Celebration Park Assemblage



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● B-01	25.0ft.	USDA: Gray Very Gravelly Loam. USCS: SM with Gravel.		
⊠ B-02	15.0ft.	USDA: Gray Gravelly Loam. USCS: Sandy ML.		
▲ B-03	10.0ft.	USDA: Gray Very Gravelly Sandy Loam. USCS: SM with Gravel.		
★ B-04	5.0ft.	USDA: Gray Gravelly Loam. USCS: SM with Gravel.		
⊙ UST-01	5.0ft.	USDA: Gray Gravelly Fine Sandy Loam. USCS: SM with Gravel.		

Specimen Identification		D100	D90	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● B-01	25.0ft.	19	14.026	1.835						33.6	
⊠ B-02	15.0ft.	19	3.965	0.139						53.6	
▲ B-03	10.0ft.	37.5	21.081	9.399	0.459					17.9	
★ B-04	5.0ft.	19	7.943	0.414						42.7	
⊙ UST-01	5.0ft.	19	8.223	0.335						35.8	

Report Distribution

ES-1026.04

EMAIL ONLY

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