CONTOUR
ENGINEERING • LLC

DRAINAGE REPORT

FOR

VALLEY AVE YARD

CITY OF PUYALLUP, WASHINGTON

AUGUST 2023
REVISED NOVEMBER 2023

Prepared For:
1124 Valley Ave LLC
550 S Michigan Street
Seattle, WA 98108

Prepared By:
Connor Jost, E.I.T., Design Engineer

Approved By:
Kyle Mauren, P.E., Project Engineer
PO Box 949
Gig Harbor, WA 98332
(253) 857-5454

KYLE M. MAUREN
56288

11/17/2023

Project # 21-247

*I hereby state that this **Drainage Report** for the **Valley Ave Contractor Yard** has been prepared by me or under my supervision and meets the standard of care and expertise that is usual and customary in this community of professional engineers. The analysis has been prepared utilizing procedures and practices specified by the City of Puyallup and within the standard accepted practices of the industry. I understand that the City of Poulsbo does not and will not assume liability for the sufficiency, suitability or performance of drainage facilities prepared by Contour Engineering, LLC.*

TABLE OF CONTENTS

1.0 PROJECT OVERVIEW

Purpose and Scope

This drainage report accompanies the development plans to construct a new contractor yard in Puyallup, Washington. The contractor yard will consist of a 62,768 SF paved area with associated stormwater infrastructure and landscaping. No structures are proposed as part of this development. The project site is located along Valley Ave on two tax parcels 0420163077 and 0420163042 within the Southwest ¼ of Section 16, Township 20 North, Range 4 East, W.M. See Appendix A for Vicinity Map.

The 2019 Department of Ecology Stormwater Management Manual for Western Washington (Ecology Manual) will establish the methodology and design criteria used for this project.

Project Description

As referenced above, the site is located along Valley Ave NW in the City of Puyallup, Washington. The site consists of three contiguous parcels. When combined, the parcels form an irregular shaped site that measures approximately 240 feet (north to south) by approximately 560 feet (east to west) and encompasses approximately 1.92 acres. The site is bounded by developed industrial sites parcels to the north, south and west, and Valley Ave NW to the east.

The following is a description of pertinent site information associated with the proposed project:

Parcel #:	0420163077 & 0420163042
Address:	1042 & 1036 Valley Ave NW, Puyallup, WA 98371
Zoning:	Limited Manufacturing (ML)
Lot Size:	1.70 acres (Parcel # 0420163077)
	0.14 acres (Parcel # 0420163042)

The project proposed paving the majority of the site for use as a contractor yard. Additional improvements to the site include stormwater infrastructure, new force main sewer line, public water connection, and landscaping.

Site Areas	Impervious Area	Pervious Area
Existing	14,647 SF (0.34 AC)	62,781 SF (1.44 AC)
Proposed	63,746 SF (1.46 AC)	13,682 SF (0.31 AC)

To mitigate the proposed project's stormwater runoff, three BioPod biofilter systems are proposed as the water quality device to treat the stormwater runoff from the site. The water quality devices flow to a singular detention system located north central of the site where it will release the runoff to the existing City storm system located along Valley Avenue Northwest. See Section 6.0 for a summary of the onsite stormwater management.

Minimum Requirements Summary
Since the project proposed over 5,000 square feet of new or replaced hard surface area, all applicable minimum requirements (Minimum Requirements #1 through #9) apply and are discussed below.

#1 - Preparation of Stormwater Site Plans
This drainage report and associated civil engineering plans fulfill this requirement.

#2 - Construction Stormwater Pollution Prevention Plan (SWPPP)
A Construction Stormwater Pollution Prevention Plan will be submitted with the drainage report.

#3 - Source Control of Pollution
Applicable Source Control BMPs that may be needed for this project are located within the Operation and Maintenance Manual.

#4 - Preservation of Natural Drainage Systems and Outfalls
The proposed project preserves the existing drainage pattern of the site.

#5 - On-site Stormwater Management
See Section 6.0 of this report for a discussion of the onsite storm system.

#6 – Runoff Treatment
Since the proposed improvements include more than 5,000 square feet of pollution generating impervious surface and discharge to fresh waters designated for aquatic life use, enhanced treatment is required for the site. Enhanced treatment will be provided by three Oldcastle BioPod Biofilter's prior to entering a detention vault. Sizing and detailed water quality calculations are provided below.

#7 – Flow Control
Since the project proposed more than 10,000 square feet of impervious surfaces, flow control is required. Flow control for site will be provided by detention chambers. Sizing and detailed flow control calculations are provided below.

#8 – Wetlands Protection
There are no known wetlands onsite or adjacent to the project site.

#9 – Operations and Maintenance

An operation and maintenance manual in included in this submittal.

2.0 EXISTING SITE CONDITIONS

Pre-Developed Site Conditions

The northwest lot, the larger of the two lots, is developed with two single-family residence and two private gravel driveways. The smaller lot located in the southeast corner of the project site is also developed with two structures and a concrete parking lot. Where there are no structures or driveways the area is primarily pasture.

Topography

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

Groundcover

Vegetation across the site generally consists of pasture grasses with ornamental trees, plants and shrubs.

Adjacent Land Uses

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

NORTH: Industrial Property (Zoned Limited Manufacturing)
SOUTH: Industrial Property (Zoned Limited Manufacturing)
EAST: Valley Avenue NW (Public ROW)
WEST: Industrial Property (Zoned Limited Manufacturing)

Native Soils

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) maps the site as being underlain by Brsicot loam (6A). Brsicot loam soil is classified within the Hydrologic Soil Group B/D.

See section 4.0 for more about the native soils in the project area. A copy of the Geotechnical report can also be found in Appendix B.

Critical and Sensitive Areas

SLOPES

The topography of the project area does not include slopes more than 30%.

LANDSLIDE HAZARD
No potential landslide hazards have been identified on site per from the Geotechnical report.

EROSION HAZARD
No erosion hazards have been identified on the project site.

SEISMIC HAZARD
No seismic hazards have been identified on the project site.

FLOODPLAIN
According to Pierce County GIS, the project site does not fall within the regulated floodplain.

AQUIFER RECHARGE
The project is located in an Aquifer Recharge Area per the Pierce County aquifer recharge map.

Other Existing Site Information
The entire site is located in a Lahar hazard area.

3.0 PROPOSED SITE CONDITIONS

The project proposes to demolish two buildings and construct a contractor yard by paving the site with asphalt. No structures are proposed. Additional improvements to the site include connecting the existing building that is remaining to City water and sewer system, constructing a new stormwater system, and other dry utilities.

Stormwater runoff from the proposed paved area will be collected in the BioPod Biofilter System Surface Vault with internal bypass along the south side of the paved area. It will then enter the detention chambers and be released to the existing stormwater system located within Valley Avenue NW.

4.0 INFILTRATION FEASIBILITY ASSESSMENT AND BMP DESIGN

The USDA Natural Resources Conservation (NRCS) Web Soil Survey maps most of the site as being underlain by Briscot Loam (Type 6A) soils.

On December 10, 2021, a field representative from GeoResources visited the site and monitored the drilling of two hollow-stem auger borings to depths of about 16½ feet below the existing ground surface, logged the subsurface conditions encountered in each boring, and obtained representative soil samples. At the locations of their explorations, they encountered relatively uniform subsurface conditions that, in their opinion, generally confirmed the mapped stratigraphy within the site vicinity. In boring B-1, they encountered approximately ½ foot of topsoil overlying grey-brown silty gravelly sand, which they interpreted to be consistent with undocumented fill soils. Underlying the fill, and at the surface of boring B-2, they encountered mottled grey-brown sand with silt interbeds. These soils were encountered to the full depth explored in B-1. Underlying these soils in boring B-2, their exploration encountered black silty sand to the full depth explored. They interpret these soils to be consistent with alluvium.

GeoResources determined that onsite infiltration into the native alluvium deposits is feasible dependent on the type of infiltration BMP. Based on their wet season monitoring, it appears the seasonal high groundwater occurs at about elevation 36.2 to 37.0 feet at the locations monitored, approximately 2.8 to 3.0 feet below the ground surface. Based on separation requirements for infiltration BMP's and the shallow depth to the water table, GeoResources does not recommend using a pond or gallery, but state that shallow infiltration facilities such as rain gardens, bioretention, and permeable pavement appear to be feasible. They calculated the preliminary design infiltration rate to be 1 inch per hour after the applied correction factors. A copy of the Geotechnical Engineering Report provided by GeoResources can be found in Appendix B.

A design was made to use an infiltration system, but due to the size of the infiltration system required for the site and the minimum clearance between the bottom of the infiltration system and the water table, a feasible design could not be implemented while also meeting grading requirements, minimum cover requirements and landscaping requirements.

5.0 LEVEL 1 DOWNSTREAM ANALYSIS

All available information provided at this time regarding the level 1 downstream analysis study area has been reviewed. Reviewed material includes the NRSC soil map, City of Puyallup GIS Maps, Pierce County GIS Maps and topographic survey data. See Appendix A for appropriate maps and information.

Onsite stormwater runoff in the developed conditions is discharged after water quality treatment and flow control to the stormwater conveyance system within Valley Avenue NW. Stormwater is conveyed northwesterly within an 18-inch pipe for roughly 1,200 feet where it turns westerly on 27th Avenue CT NW, runs for about 1,250 feet, and is discharged to Wapato Creek.

6.0 HYDROLOGIC & HYDRAULIC ANALYSIS

Onsite Stormwater Management

Since the project triggers minimum requirements #1-9, the project must employ stormwater management BMPs in order to infiltrate, disperse, or retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts. The project elects to follow the requirements of List #2.

Stormwater runoff from the proposed paved surface will be collected by three Oldcastle BioPod Biofilter surface vaults. These structures will provide enhanced water quality treatment before conveying the runoff the to detention chambers system. After passing through the flow control and water quality systems, stormwater runoff will be conveyed to the existing stormwater system located within Valley Ave NW.

Lawn and Landscape Areas

1. *Soil Preservation and amendment BMP (T5.13)*

   The project will employ Ecology BMP T5.13 to preserve undisturbed soils to the greatest extent possible and to restore soils where disturbed by construction activity.

Roofs

No structures are proposed in this project.

Other Hard Surfaces

1. *Full Dispersion BMP (T5.30)*

   This BMP is not feasible due to the lack of available space that can be provided to meet the required native vegetation protection area.

2. *Permeable Pavement (BMP T5.15)*

   Due to the expected truck volume on the site, it is expected that permeable pavements cannot provide sufficient strength to support the loads.

3. *Bioretention (BMP T7.30)*

   Per the geotechnical report, bioretention is not recommended due to insufficient separation between the bottom of bioretention and the seasonal high groundwater table.

4. *Sheet Flow Dispersion (BMP T5.11)*

   The necessary vegetated flowpath lengths cannot be provided for the proposed other hard surfaces The project proposes to centralize flow control and water quality treatment in order to ensure downstream properties are protected.

Flow Control

Because the proposed improvements for the contractor yard include more than 10,000 square feet of impervious surface, flow control is required on site. Flow control will be accomplished using Stormtech MC-3500 detention chambers. The detention system has been sized to match stormwater discharge of existing conditions from 50% of the 2-year peak flow up to the full 50-year peak flow. Below is a summary of the detention system. The proposed detention system was modeled using the 2012 Western Washington Hydrology Model (WWHM2012).

	Pre-Developed	Developed
Roads/ Flat	0	1.51
C, Pasture, Flat	1.51	0
Total Area	1.51	1.51

Detention Chambers Summary

Bottom of System Elevation= 34.64
Design water Surface = 39.14
Top of System Elevation = 40.14
Top of Gravel = 35.39

Design Storage Volume (@39.14) = 35,327 CF

Outlet Control Structure
Rim Elevation = 43.59
Riser Diameter = 18 inch
Restrictor Plate Diameter = 0.625 inch
Orifice #2 Diameter = 0.875 inch
Orifice #2 Height = 2.8 feet
Orifice #3 Diameter = 0.75 inch
Orifice #3 Height = 3.2 feet
Top of Riser = 4.5 ft

The WWHM outputs of this analysis can be found attached in Appendix C.

Water Quality

A stormwater treatment system is required for all projects which contribute more than 5,000 square feet of effective pollution generating hard surfaces. Since the proposed project exceeds this threshold, water quality treatment is required.

The project proposes to utilize three Biopod surface vaults prior to detention in order to meet enhanced water quality treatment requirements. Each Bipod vault (Model BPS-46IB) can treat up to 0.074 CFS.

The project can be divided into three basins. The following is a summary of the developed basins and their respective flow rates.

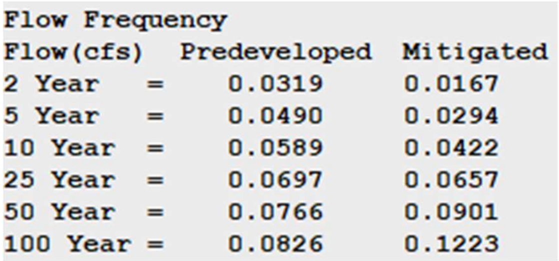
Developed			
	Basin 1	Basin 2	Basin 3
Concrete/Pavement	0.468 ac	0.691 ac	0.260 ac
Runoff (CFS)	0.018	0.0535	0.0520

Because each basin has a flow rate less than 0.074 CFS, the selected treatment vaults are feasible. WWHM printouts and a diagram of the treatment vault and specification document can be found in Appendix D.

Conveyance Capacity

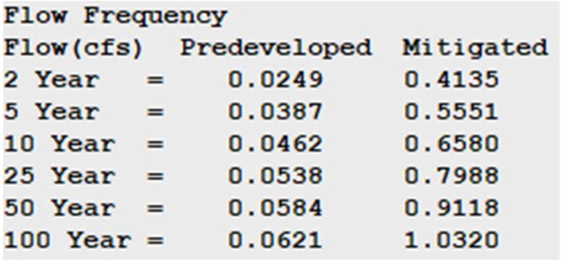
The onsite conveyance system is sized to meet the single segment capacity requirements. The two most constraining pipes – the pipe that connects Biopod 1 and Biopod 2 to the Stormtech system, 12” @ 1.14%, and the outlet pipe after the water quality structure, 12” @ 0.50%, were both analyzed. The blow WWHM results apply for the pipe respectively.

12” @ 0.50%



```
Flow Frequency
Flow(cfs)  Predeveloped  Mitigated
2 Year   =    0.0319     0.0167
5 Year   =    0.0490     0.0294
10 Year  =    0.0589     0.0422
25 Year  =    0.0697     0.0657
50 Year  =    0.0766     0.0901
100 Year =    0.0826     0.1223
```

12” @ 1.14%

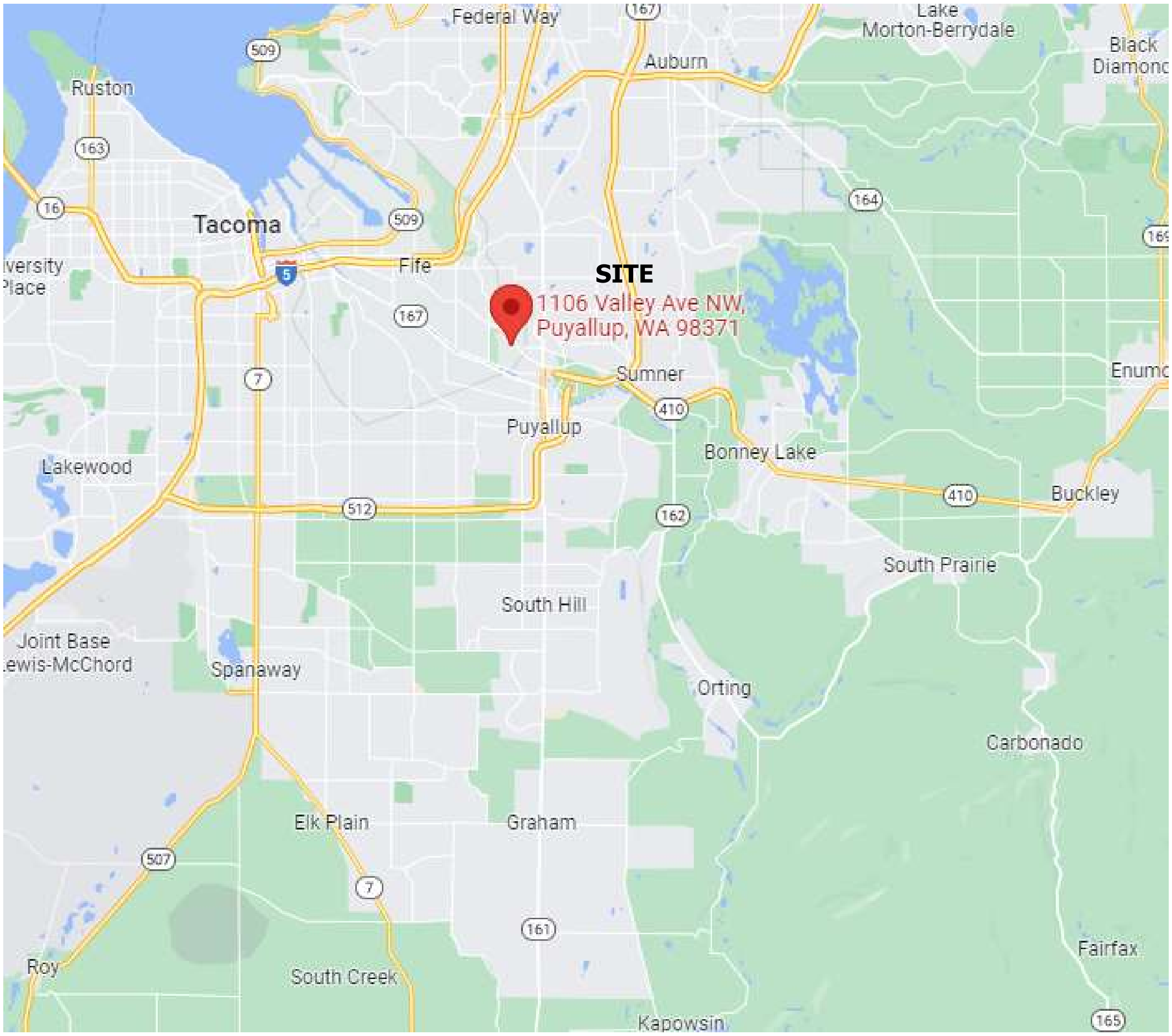


```
Flow Frequency
Flow(cfs)  Predeveloped  Mitigated
2 Year   =    0.0249     0.4135
5 Year   =    0.0387     0.5551
10 Year  =    0.0462     0.6580
25 Year  =    0.0538     0.7988
50 Year  =    0.0584     0.9118
100 Year =    0.0621     1.0320
```

The 12” pipe @0.50% has a full flow capacity of 2.73 CFS. The 12” @1.14% has a full flow capacity of 4.57 CFS. The conveyance calculations for these pipes are shown in Appendix E.

APPENDIX A

General Exhibits



Vicinity Map

Soil Map—Pierce County Area, Washington

Map Scale: 1:949 if printed on A landscape (11" x 8.5") sheet.

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

MAP LEGEND

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

Soils
- ☐ Soil Map Unit Polygons
- 〰 Soil Map Unit Lines
- ■ Soil Map Unit Points

Special Point Features
- Blowout
- ☒ Borrow Pit
- Clay Spot
- ◇ Closed Depression
- ✕ Gravel Pit
- ∴ Gravelly Spot
- Landfill
- Λ Lava Flow
- Marsh or swamp
- Mine or Quarry
- ◎ Miscellaneous Water
- ○ Perennial Water
- ∨ Rock Outcrop
- + Saline Spot
- ⁙ Sandy Spot
- Severely Eroded Spot
- ◇ Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- △ Other
- Special Line Features

Water Features
- 〰 Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 18, Sep 8, 2022

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

Date(s) aerial images were photographed: Jul 31, 2022—Aug 8, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Briscot loam	1.9	100.0%
Totals for Area of Interest		**1.9**	**100.0%**

Pierce County Area, Washington

6A—Briscot loam

Map Unit Setting

National map unit symbol: 2hrc
Elevation: 20 to 250 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 160 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Briscot, drained, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Briscot, Drained

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: loam
H2 - 11 to 38 inches: stratified fine sand to silt loam
H3 - 38 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 12 to 35 inches
Frequency of flooding: OccasionalNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Ecological site: F002XA007WA - Puget Lowlands Wet Forest
Forage suitability group: Seasonally Wet Soils (G002XN202WA)
Other vegetative classification: Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

Minor Components

Briscot, undrained

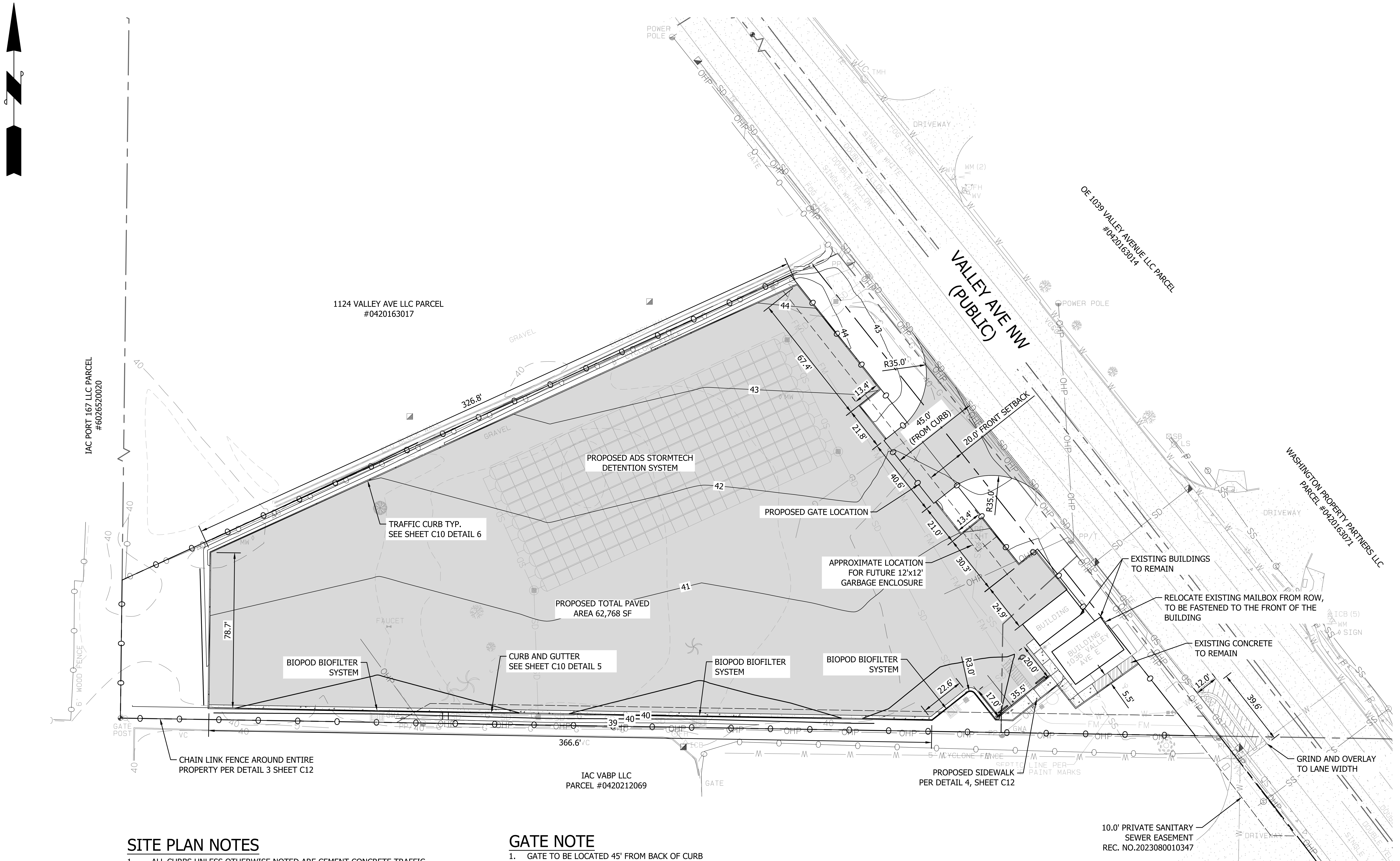
Percent of map unit: 5 percent
Landform: Flood plains
Other vegetative classification: Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 18, Sep 8, 2022

GRAPHIC SCALE
0 30 60
1 INCH = 30 FEET (22"x34")
1 INCH = 60 FEET (11"x17")

VALLEY AVE YARD
A PORTION OF SECTION 16, TOWNSHIP 20 NORTH, RANGE 04 EAST, W.M., CITY OF PUYALLUP, WASHINGTON
SITE PLAN



GENERAL NOTES

1. ALL WORK IN CITY RIGHT-OF-WAY REQUIRES A PERMIT FROM THE CITY OF PUYALLUP. PRIOR TO ANY WORK COMMENCING, THE GENERAL CONTRACTOR SHALL ARRANGE FOR A PRECONSTRUCTION MEETING AT THE DEVELOPMENT SERVICES CENTER TO BE ATTENDED BY ALL CONTRACTORS THAT WILL PERFORM WORK SHOWN ON THE APPROVED ENGINEERING PLANS, REPRESENTATIVES FROM ALL APPLICABLE UTILITY COMPANIES, THE PROJECT OWNER AND APPROPRIATE CITY STAFF. CONTACT ENGINEERING SERVICES AT (253-841-5568) TO SCHEDULE THE MEETING. THE CONTRACTOR IS RESPONSIBLE TO HAVE THEIR OWN SET OF APPROVED PLANS AT THE MEETING.
2. AFTER COMPLETION OF ALL ITEMS SHOWN ON THESE PLANS AND BEFORE ACCEPTANCE OF THE PROJECT THE CONTRACTOR SHALL OBTAIN A "PUNCH LIST" PREPARED BY THE CITY'S INSPECTOR DETAILING REMAINING ITEMS OF WORK TO BE COMPLETED. ALL ITEMS OF WORK SHOWN ON THESE PLANS SHALL BE COMPLETED TO THE SATISFACTION OF THE CITY PRIOR TO ACCEPTANCE OF THE WATER SYSTEM AND PROVISION OF SANITARY SEWER SERVICE.
3. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION (HEREINAFTER REFERRED TO AS THE "STANDARD SPECIFICATIONS"), WASHINGTON STATE DEPARTMENT OF TRANSPORTATION AND AMERICAN PUBLIC WORKS ASSOCIATION, WASHINGTON STATE CHAPTER, LATEST EDITION, UNLESS SUPERSEDED OR AMENDED BY THE CITY OF PUYALLUP CITY STANDARDS FOR PUBLIC WORKS ENGINEERING AND CONSTRUCTION (HEREINAFTER REFERRED TO AS THE "CITY STANDARDS").
4. A COPY OF THESE APPROVED PLANS AND APPLICABLE CITY DEVELOPER SPECIFICATIONS AND DETAILS SHALL BE ON SITE DURING CONSTRUCTION.
5. ANY REVISIONS MADE TO THESE PLANS MUST BE REVIEWED AND APPROVED BY THE DEVELOPER'S ENGINEER AND THE CITY PRIOR TO ANY IMPLEMENTATION IN THE FIELD. THE CITY SHALL NOT BE RESPONSIBLE FOR ANY ERRORS AND/OR OMISSIONS ON THESE PLANS.
6. THE CONTRACTOR SHALL HAVE ALL UTILITIES VERIFIED ON THE GROUND PRIOR TO ANY CONSTRUCTION. CALL AT LEAST TWO WORKING DAYS IN ADVANCE. THE OWNER AND HIS/HER ENGINEER SHALL BE CONTACTED IMMEDIATELY IF A CONFLICT EXISTS.
7. ANY STRUCTURE AND/OR OBSTRUCTION THAT REQUIRES REMOVAL OR RELOCATION RELATING TO THIS PROJECT SHALL BE DONE SO AT THE DEVELOPER'S EXPENSE.
8. LOCATIONS OF EXISTING UTILITIES ARE APPROXIMATE. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE TRUE ELEVATIONS AND LOCATIONS OF HIDDEN UTILITIES. ALL VISIBLE ITEMS SHALL BE THE ENGINEER'S RESPONSIBILITY.
9. THE CONTRACTOR SHALL INSTALL, REPLACE, OR RELOCATE ALL SIGNS, AS SHOWN ON THE PLANS OR AS AFFECTED BY CONSTRUCTION, PER CITY STANDARDS.
10. POWER, STREET LIGHT, CABLE, AND TELEPHONE LINES SHALL BE IN A TRENCH LOCATED WITHIN A 10-FOOT UTILITY EASEMENT ADJACENT TO PUBLIC RIGHT-OF-WAY. RIGHT-OF-WAY CROSSINGS SHALL HAVE A MINIMUM HORIZONTAL SEPARATION FROM OTHER UTILITIES (SEWER, WATER, AND STORM) OF 5 FEET.
11. ALL CONSTRUCTION SURVEYING FOR EXTENSIONS OF PUBLIC FACILITIES SHALL BE DONE UNDER THE DIRECTION OF A WASHINGTON STATE LICENSED LAND SURVEYOR OR A WASHINGTON STATE LICENSED PROFESSIONAL CIVIL ENGINEER.
12. DURING CONSTRUCTION, ALL PUBLIC STREETS ADJACENT TO THIS PROJECT SHALL BE KEPT CLEAN OF ALL MATERIAL DEPOSITS RESULTING FROM ON-SITE CONSTRUCTION, AND EXISTING STRUCTURES SHALL BE PROTECTED AS DIRECTED BY THE CITY.
13. CERTIFIED RECORD DRAWINGS ARE REQUIRED PRIOR TO PROJECT ACCEPTANCE.
14. A NPDES STORMWATER GENERAL PERMIT MAY BE REQUIRED BY THE DEPARTMENT OF ECOLOGY FOR THIS PROJECT. FOR INFORMATION CONTACT THE DEPARTMENT OF ECOLOGY, SOUTHWEST REGION OFFICE AT (360)407-6300.
15. ANY DISTURBANCE OR DAMAGE TO CRITICAL AREAS AND ASSOCIATED BUFFERS, OR SIGNIFICANT TREES DESIGNATED FOR PRESERVATION AND PROTECTION SHALL BE MITIGATED IN ACCORDANCE WITH A MITIGATION PLAN REVIEWED AND APPROVED BY THE CITY'S PLANNING DIVISION. PREPARATION AND IMPLEMENTATION OF THE MITIGATION PLAN SHALL BE AT THE DEVELOPER'S EXPENSE.

SITE PLAN NOTES

1. ALL CURBS UNLESS OTHERWISE NOTED ARE CEMENT CONCRETE TRAFFIC CURB PER DETAIL 6, SHEET C10. ALL CURBS THAT WILL CONVEY STORMWATER RUNOFF SHALL BE CEMENT CONCRETE TRAFFIC CURB AND GUTTER PER DETAIL 5, SHEET C10, UNLESS OTHERWISE NOTED.
2. ALL SIDEWALK SHALL BE CONSTRUCTED PER DETAIL 4, SHEET 12.
3. AN ASPHALT PAVEMENT SECTION IS DELINEATED AND SPECIFIED ON DETAIL 4, SHEET C6.
4. A 13.5' RIGHT OF WAY DEDICATION IS REQUIRED ON PARCEL A AND 9.5' RIGHT OF WAY DEDICATION IS REQUIRED ON PARCEL B ADJACENT TO VALLEY AVE NW.

GATE NOTE

1. GATE TO BE LOCATED 45' FROM BACK OF CURB
2. GATE TO STAY OPEN DURING NORMAL OPERATING HOURS
3. GATE PERMIT TO BE SUBMITTED BY OTHERS

APPROVED

BY ____________________
CITY OF PUYALLUP
DEVELOPMENT ENGINEERING

DATE ____________________

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

VERIFICATION NOTE

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

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

CALL 811 AT LEAST 48 HOURS BEFORE YOU DIG

REVISION	DESCRIPTION	DATE	BY

CONTOUR
E N G I N E E R I N G • L L C
CIVIL ENGINEERS ~ SURVEYORS ~ LAND PLANNERS
Phone: 253-857-5454 ~ Fax: 253-509-0044 ~ info@contourpllc.com
Mailing Address: P.O. Box 949, Gig Harbor, WA 98335
Physical Address: 4706 97th Street NW, Suite 100, Gig Harbor, WA 98332

BRETT M. ALLEN
37835
2023-11-17

SHEET TITLE: SITE PLAN
VALLEY AVE YARD

CLIENT: 1124 VALLEY AVE, LLC
550 S MICHIGAN STREET
SEATTLE, WA 98108
CONTACT: KERMIT JORGENSEN
PHONE: (206) 787-1475

DESIGNER: K. MAUREN
ENGINEER: B. ALLEN
DRAWN: K. MAUREN
S 16 T 20N R 04E WM
DATE: 2023-08-10
REVISED: --.--.----

PROJECT: 21-247
DWG NAME: 21-247-C

SHEET	REV.
C2 2 OF 17	0

APPENDIX B

Geotechnical Report

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, Washington 98424 | 253.896.1011 | www. georesources.rocks

July 13, 2022

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

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

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

INTRODUCTION

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

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

PURPOSE & SCOPE

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

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

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

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

SITE CONDITIONS

Surface Conditions

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

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

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

Site Soils

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

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

Site Geology

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

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

Subsurface Explorations

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

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

Boring Number	Functional Location	Surface Elevation (feet)	Termination Depth (feet)	Termination Elevation[1] (feet)
B-1/MW-1	End of driveway at 1106 Valley Ave NW	40.23	16.5	23.7
B-2/MW-2	Field in front of 1106 Valley Ave NW	38.77	16.5	22.3

Notes:
1 = Surface elevation estimated from the *Site Survey* prepared by Contour Engineering (NAVD 88)

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

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

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

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

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

Subsurface Conditions

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

TABLE 2:
APPROXIMATE THICKNESS, DEPTHS, AND ELEVATION OF ENCOUNTERESOIL TYPES

Boring Number	Thickness of Topsoil (Feet)	Thickness of Fill (feet)	Thickness of Loose Silt SAND (feet)	Depth to Loose SAND (feet)	Elevation^1 of Loose SAND (feet)
B-1/MW-1	0.5	1.5	8.0	10.0	30.2
B-2/MW-2	0.5	0.0	9.8	10.3	28.5

Notes:
1 = Surface elevation estimated from the *Site Survey* prepared by Contour Engineering (NAVD 88)

Laboratory Testing

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

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

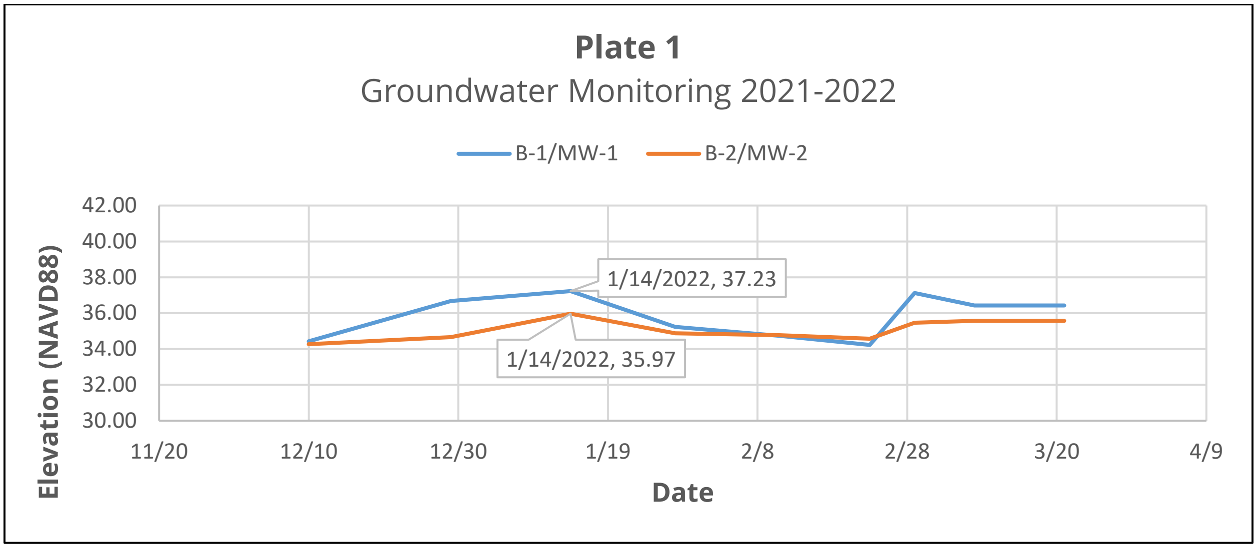
TABLE 3:
LABORATORY TEST RESULTS FOR ON-SITE SOILS

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

Groundwater Conditions

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

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



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

CONCLUSIONS

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

Infiltration Recommendations

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

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

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

Infiltration Rate

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

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

Feasibility of the Native Soils for Water Quality Treatment

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

Construction Considerations

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

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

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

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

LIMITATIONS

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

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

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

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

◆ ◆ ◆

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

Respectfully submitted,
GeoResources, LLC

Jordan L. Kovash, LG
Project Geologist

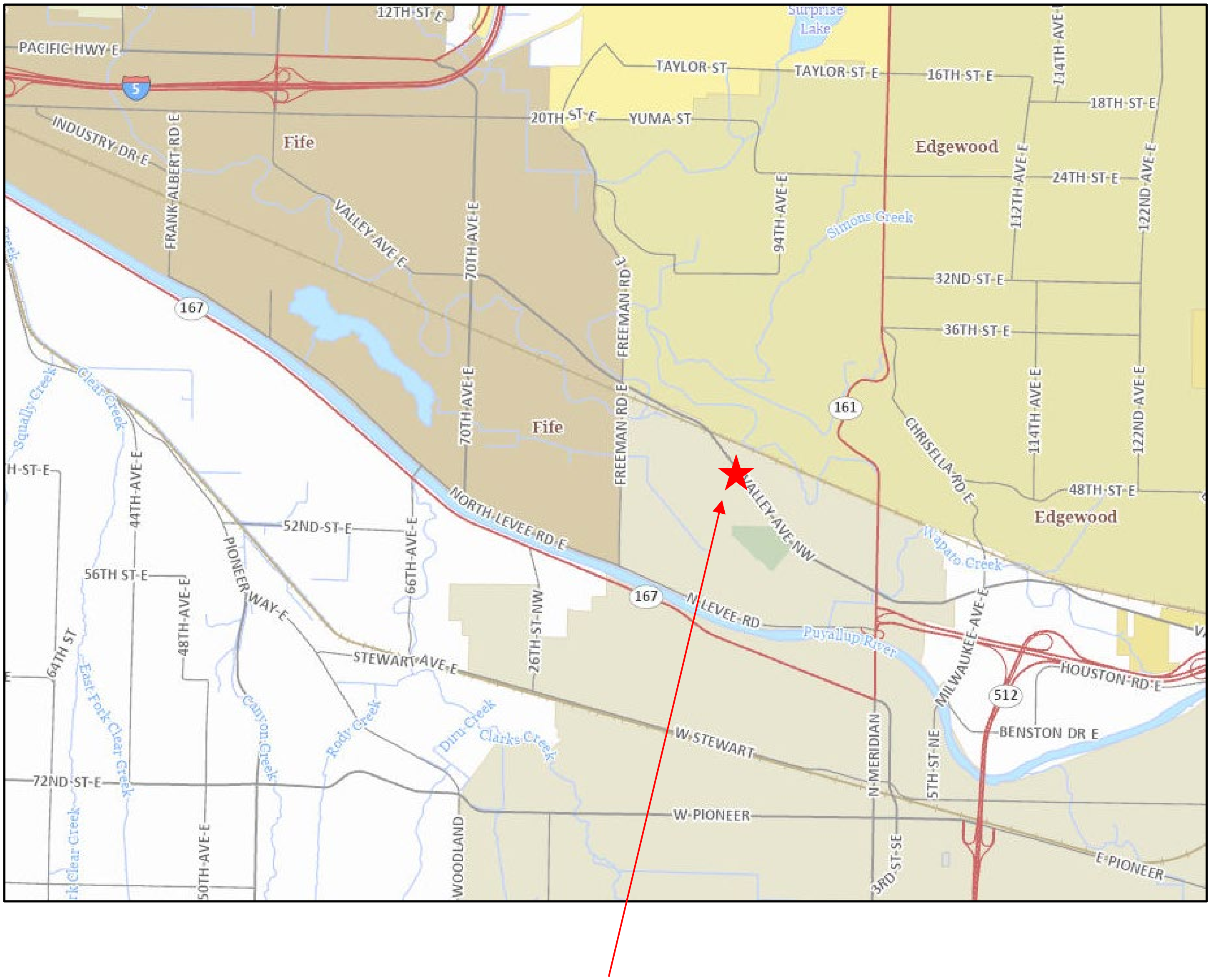
State of Washington
Engineering Geologist
925
Licensed Geologist
KEITH SCOTT SCHEMBS

ERIC WILLIAM HELLER
STATE OF WASHINGTON
43471
REGISTERED
PROFESSIONAL ENGINEER

Keith S. Schembs, LEG
Principal

Eric W. Heller, PE, LG
Senior Geotechnical Engineer

JLK:KSS:EWH/jlk
Doc ID: NWC.ValleyAveNW.SR
Attachments:
- Figure 1: Site Location Map
- Figure 2: Site Survey
- Figure 3: Site & Exploration Map
- Figure 4: NRCS Soils Map
- Figure 5: Geologic Map
- Appendix A – Subsurface Explorations
- Appendix B – Laboratory Test Results
- Appendix C – Massman Calculations



Approximate Site Location

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

N
W E
S

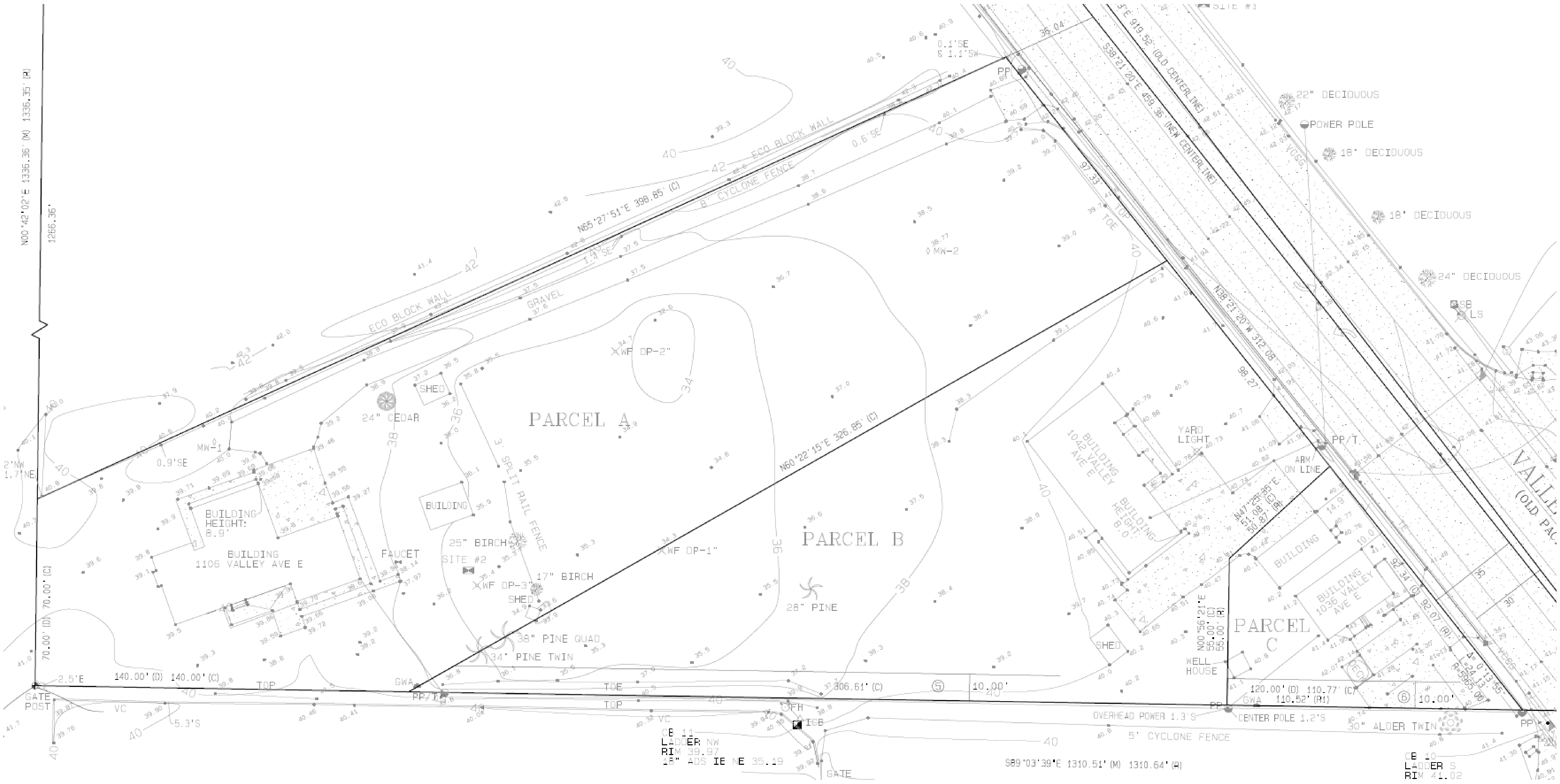
Not to Scale

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

Site Location Map

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

Doc ID: NWC.ValleyAve.Fu	July 2022	Figure 1



Notes:
Site Survey prepared by Contour Engineering
Not to Scale

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

Site Survey Map

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

Doc ID: NWC.ValleyAve.F2	July 2022	Figure 2

Approximate Site Location

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

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

N
W E
S

Not to Scale

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

Site & Exploration Map

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

Doc ID: NWC.ValleyAve.Fu	July 2022	Figure 3

Approximate Site Location

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

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

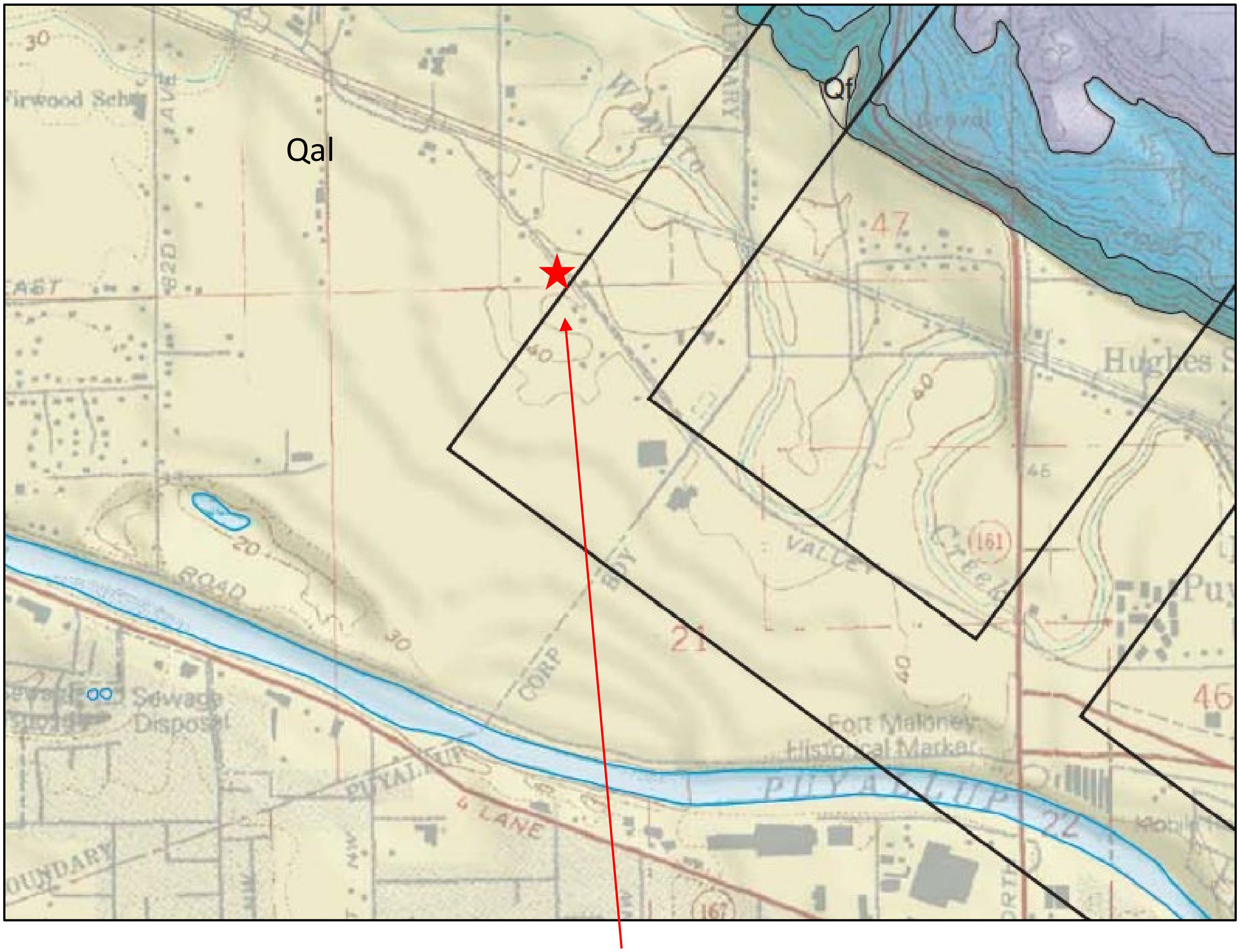
Not to Scale

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

NRCS Soils Map

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

Doc ID: NWC.ValleyAve.Fu	July 2022	Figure 4



Approximate Site Location

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

Qal	Alluvium

Not to Scale

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

Geologic Map

Proposed Industrial Development
25491 WA -3
Mason County, Washington
PN: 12321-1400040, 14-00041, 75-00030

Doc ID: NWC.ValleyAve.Fu	July 2022	Figure 5

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

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

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.

2. Soil classification using laboratory tests is based on ASTM D2487-90.

3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

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

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

Unified Soils Classification System

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

Doc ID: NWC.ValleyAve.Fu	July 2022	Figure A-1

LOG OF BORING B-1/MW-1

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

GEORESOURCES
earth science & geotechnical engineering

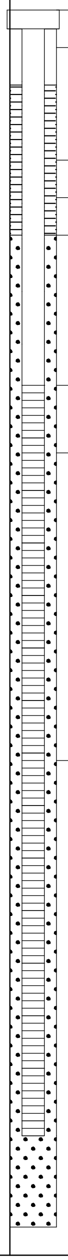
1. **Refer to log key for definition of symbols, abbreviations, and codes**
2. **USCS disination is based on visual manual classification and selected lab testing**
3. **Groundwater level, if indicated, is for the date shown and may vary**
4. **NE = Not Encountered**
5. **ATD = At Time of Drilling**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

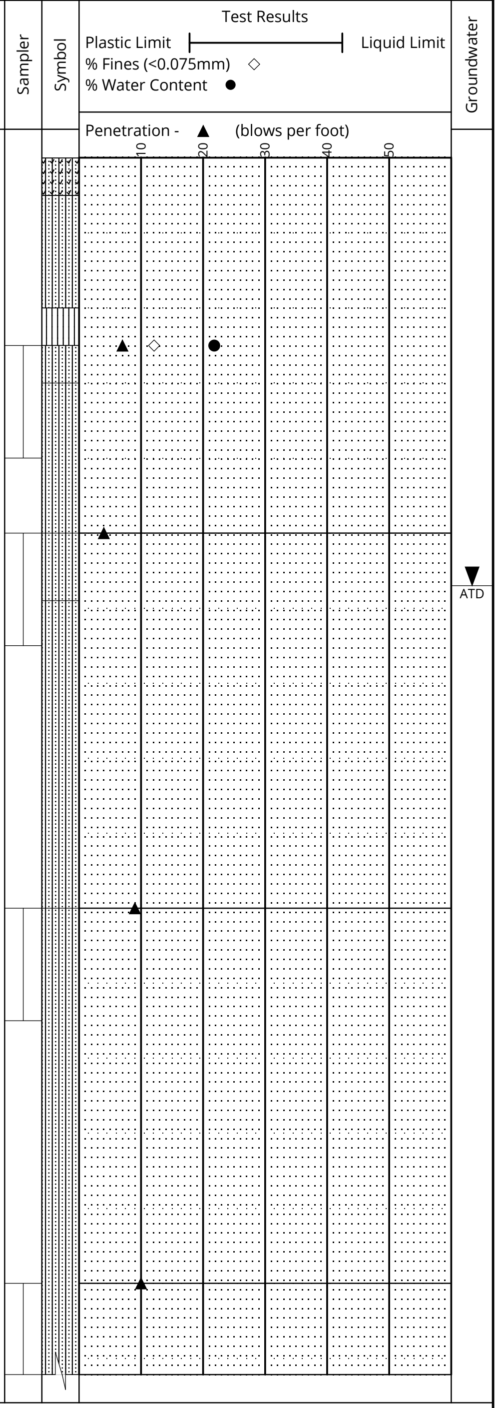
Drilling Company: Boretec 1, Inc.
Drilling Method: HSA
Drilling Rig: EC 95 Track Drill
Sampler Type: split spoon
Hammer Type: cat head
Hammer Weight: 140 lbs

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

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

Depth (feet)	Elevation (feet)	Soil description	STP Blowcounts
0	40	Dark brown silty SAND (loose to medium dense, moist) (Topsoil) (SM)	
		Grey-brown silty SAND with gravel (loose to medium dense, moist) (Fill) (SM)	
		Mottled grey-brown sandy SILT (medium stiff, moist) (Alluvium) (ML)	
2.5	37.5	Grey-brown silty SAND (loose, moist) (SM)	3 3 4
		Brown silty SAND (loose, moist) (SM)	
5	35	(very loose, wet)	1 2 2
		Mottled grey-brown silty SAND, small rootlets/organics (very loose, moist to wet) (SM)	
7.5	32.5		
10	30	Grey-brown silty SAND with silt interbeds (loose, wet) (Alluvium) (SM)	2 4 5
12.5	27.5		
15	25		2 4 6





▦ Description not given for: "0T"   ▥ Silty sand   ▥ Silt

GEORESOURCES
earth science & geotechnical engineering

LOG OF BORING B-1/MW-1

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

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

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

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

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

Depth (feet)	Elevation (feet)	Exploration notes	Soil description	STP Blowcounts	Sampler	Symbol	Test Results Plastic Limit ├──┤ Liquid Limit % Fines (<0.075mm) ◇ % Water Content ● Penetration - ▲ (blows per foot) 10 20 30 40 50	Groundwater
			(Termination Depth - 12/10/2021)					
17.5	22.5							
20	20							
22.5	17.5							
25	15							
27.5	12.5							
30	10							

▦ Description not given for: "0T" ▥ Silty sand ▥ Silt

GEORESOURCES
earth science & geotechnical engineering

LOG OF BORING B-2/MW-2

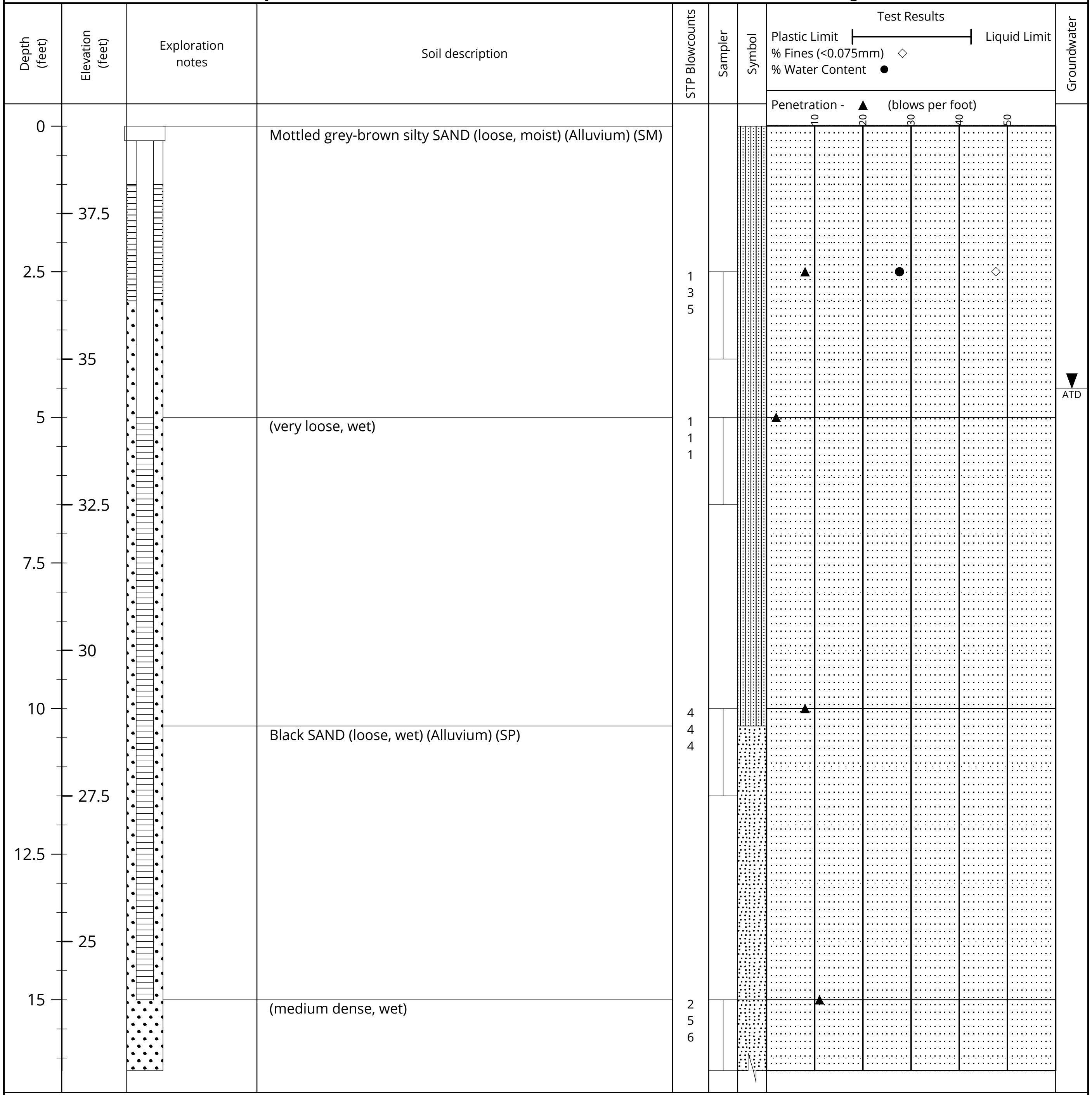
Proposed Contractor's Yard
1106 - 1036 Valley Ave NW
Puyallup, Washington

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

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

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

Notes: Field in front of 1106 Valley Ave NW



Depth (feet)	Soil description	STP Blowcounts
0	Mottled grey-brown silty SAND (loose, moist) (Alluvium) (SM)	
2.5		1 3 5
5	(very loose, wet)	1 1 1
10		4 4 4
10.6	Black SAND (loose, wet) (Alluvium) (SP)	
15	(medium dense, wet)	2 5 6

▦ Description not given for: "0T" ▥ Silty sand ▥ Silt ▨ Poorly graded sand

Sheet 1 of 2

JOB: NeilWalterCompany.ValleyAveNW

FIG. A-3

LOG OF BORING B-2/MW-2

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

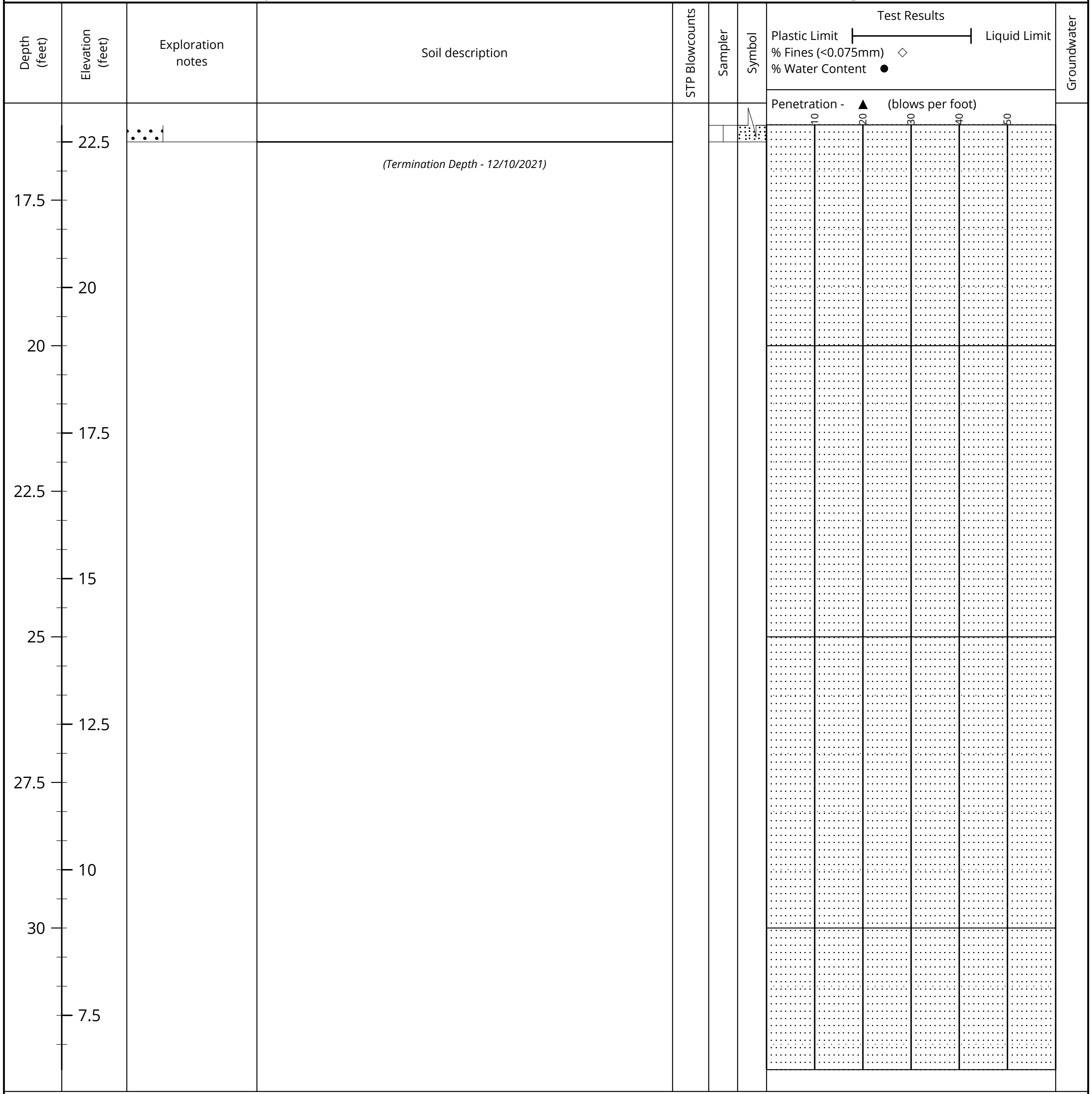
GEORESOURCES
earth science & geotechnical engineering

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

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

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

Notes: Field in front of 1106 Valley Ave NW



(Termination Depth - 12/10/2021)

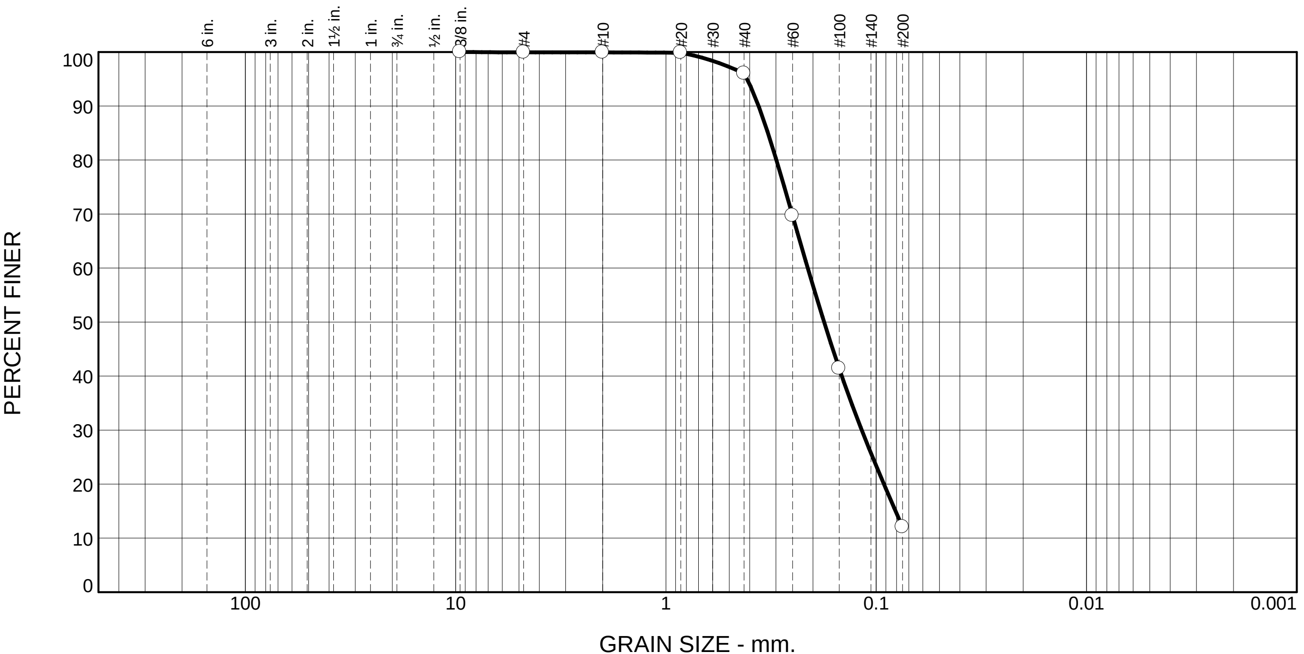
▦ Description not given for: "0T"
▥ Silty sand
▥ Silt
▨ Poorly graded sand

Sheet 2 of 2
JOB: NeilWalterCompany.ValleyAveNW
FIG. A-3

Appendix B

Laboratory Test Results

Particle Size Distribution Report



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

Test Results (ASTM D 6913 & ASTM D 1140)

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

* (no specification provided)

Material Description

Silty SAND (SM)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}=	0.3626	D_{85}=	0.3273	D_{60}=	0.2116
D_{50}=	0.1770	D_{30}=	0.1172	D_{15}=	0.0809
D_{10}=		C_u=		C_c=	

Remarks

Natural Moisture: 21.8%

Date Received: 12/10/21 **Date Tested:** 12/21/21

Tested By: MAW

Checked By: KSS

Title: PM

Source of Sample: B-1/MW-1 **Depth:** 2.5 **Date Sampled:** 12/10/21

Sample Number: 1a

GeoResources, LLC

Fife, WA

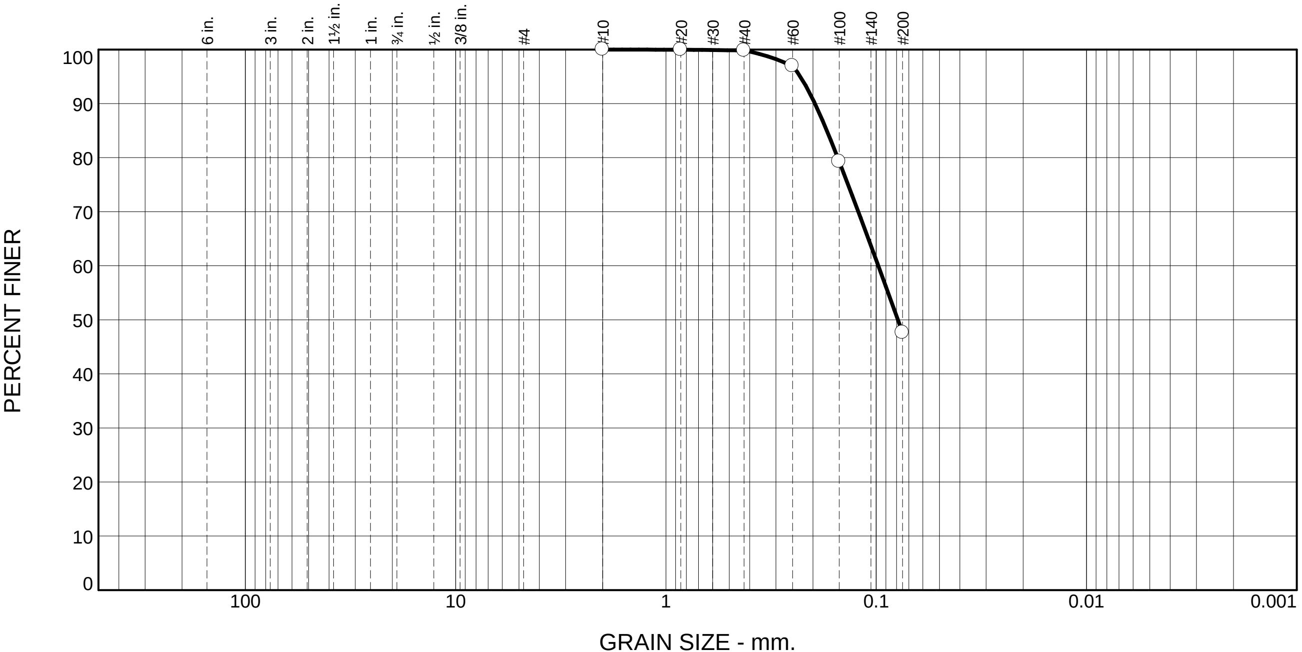
Client: Neil Walter Company

Project: Proposed Contractor's Yard

Project No: NeilWalterCompany.ValleyAveNW **Figure** B-1

Tested By: ____________________ **Checked By:** ____________________

Particle Size Distribution Report



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

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

* (no specification provided)

Material Description

Silty SAND (SM)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.1956 D_{85}= 0.1718 D_{60}= 0.0978
D_{50}= 0.0789 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 27.6%

Date Received: 12/10/21 **Date Tested:** 12/21/21
Tested By: MAW
Checked By: KSS
Title: PM

Source of Sample: B-2/MW-2 **Depth:** 2.5 **Date Sampled:** 12/10/21
Sample Number: 1

GeoResources, LLC

Fife, WA

Client: Neil Walter Company
Project: Proposed Contractor's Yard
Project No: NeilWalterCompany.ValleyAveNW **Figure** B-2

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

Tested By: __________ **Checked By:** __________

SPECTRA Laboratories ...Where experience matters
2221 Ross Way • Tacoma, WA 98421 • (253) 272-4850 • Fax (253) 572-9838 • www.spectra-lab.com

Analytical Report

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

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

Client ID: 103272 (HA-1, S-1) **Lab No: 302271-01** **Sample Date: 05/27/22 12:30**

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

Client ID: 103273 (HA-2, S-2) **Lab No: 302271-02** **Sample Date: 05/27/22 12:45**

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

Lab Qualifiers Comments:

Appendix C

Massman Calculations

City of Puyallup - 2014 SWMMWW

NeilWalterCompany.ValleyAveNW

Puyallup, Washington

Massman Calculation Sheet

Soil Grain Size Analysis Method

Procudure based on 2014 SWMMWW, Volume III

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

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

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

Effective Average Hydraulic Conductivity, K_{equiv}

Based on either:

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

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

Site Variability & number of location tested (CF_v)

	0.33 to 1.0

Factor to use for calculations: 0.75

Test Method (CF_t)

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

Factor to use for calculations: 0.4

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

	0.90

Factor to use for calculations: 0.9

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

Design Value **1.00** in/hr

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

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

DocID: NWC.ValleyAveNW | April 2022 | Figure C-1

APPENDIX C

Flow Control

WWHM2012

PROJECT REPORT

Flow Control

General Model Information

Project Name:	detention
Site Name:	
Site Address:	
City:	
Report Date:	7/27/2023
Gage:	40 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	1.51
Pervious Total	1.51
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.51

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.51
Impervious Total	1.51
Basin Total	1.51

Element Flows To:

Surface	Interflow	Groundwater
StormTech 1	StormTech 1	

Routing Elements

Predeveloped Routing

Mitigated Routing

StormTech 1

Chamber Model:	3500	
Dimensions		
Max Row Length:	150	
Number of Chambers:	220	
Number of Endcaps:	22	
Top Stone Depth:	12	
Bottom Stone Depth:	9	
Discharge Structure		
Riser Height:	4.5 ft.	
Riser Diameter:	18 in.	
Orifice 1 Diameter:	0.625 in.	Elevation:0 ft.
Orifice 2 Diameter:	0.875 in.	Elevation:2.8 ft.
Orifice 3 Diameter:	0.75 in.	Elevation:3.2 ft.
Element Flows To:		
Outlet 1	Outlet 2	

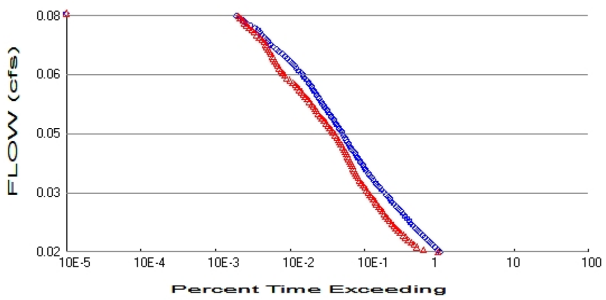
StormTech Hydraulic Table

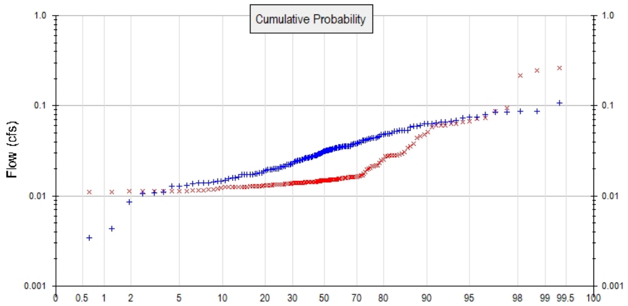
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.267	0.000	0.000	0.000
0.0833	0.267	0.008	0.003	0.000
0.1667	0.267	0.017	0.004	0.000
0.2500	0.267	0.026	0.005	0.000
0.3333	0.267	0.035	0.006	0.000
0.4167	0.267	0.044	0.006	0.000
0.5000	0.267	0.053	0.007	0.000
0.5833	0.267	0.062	0.008	0.000
0.6667	0.267	0.071	0.008	0.000
0.7500	0.267	0.080	0.009	0.000
0.8333	0.267	0.100	0.009	0.000
0.9167	0.267	0.119	0.010	0.000
1.0000	0.267	0.139	0.010	0.000
1.0833	0.267	0.158	0.011	0.000
1.1667	0.267	0.178	0.011	0.000
1.2500	0.267	0.197	0.011	0.000
1.3333	0.267	0.216	0.012	0.000
1.4167	0.267	0.236	0.012	0.000
1.5000	0.267	0.255	0.013	0.000
1.5833	0.267	0.274	0.013	0.000
1.6667	0.267	0.293	0.013	0.000
1.7500	0.267	0.312	0.014	0.000
1.8333	0.267	0.330	0.014	0.000
1.9167	0.267	0.349	0.014	0.000
2.0000	0.267	0.368	0.015	0.000
2.0833	0.267	0.386	0.015	0.000
2.1667	0.267	0.404	0.015	0.000
2.2500	0.267	0.423	0.015	0.000
2.3333	0.267	0.441	0.016	0.000
2.4167	0.267	0.459	0.016	0.000
2.5000	0.267	0.476	0.016	0.000
2.5833	0.267	0.494	0.017	0.000
2.6667	0.267	0.511	0.017	0.000
2.7500	0.267	0.529	0.017	0.000

2.8333	0.267	0.546	0.021	0.000
2.9167	0.267	0.563	0.025	0.000
3.0000	0.267	0.579	0.027	0.000
3.0833	0.267	0.596	0.029	0.000
3.1667	0.267	0.612	0.031	0.000
3.2500	0.267	0.628	0.036	0.000
3.3333	0.267	0.644	0.040	0.000
3.4167	0.267	0.659	0.043	0.000
3.5000	0.267	0.674	0.045	0.000
3.5833	0.267	0.689	0.047	0.000
3.6667	0.267	0.704	0.050	0.000
3.7500	0.267	0.718	0.052	0.000
3.8333	0.267	0.732	0.054	0.000
3.9167	0.267	0.745	0.055	0.000
4.0000	0.267	0.758	0.057	0.000
4.0833	0.267	0.770	0.059	0.000
4.1667	0.267	0.781	0.060	0.000
4.2500	0.267	0.791	0.062	0.000
4.3333	0.267	0.801	0.064	0.000
4.4167	0.267	0.810	0.065	0.000
4.5000	0.267	0.819	0.067	0.000
4.5833	0.267	0.829	0.450	0.000
4.6667	0.267	0.838	1.144	0.000
4.7500	0.267	0.847	2.009	0.000
4.8333	0.267	0.855	2.955	0.000
4.9167	0.267	0.864	3.886	0.000
5.0000	0.267	0.873	4.714	0.000
5.0833	0.267	0.882	5.370	0.000
5.1667	0.267	0.891	5.832	0.000
5.2500	0.267	0.900	6.150	0.000
5.3333	0.267	0.909	6.549	0.000
5.4167	0.267	0.918	6.866	0.000
5.5000	0.267	0.927	7.168	0.000

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	1.51
Total Impervious Area:	0

Mitigated Landuse Totals for POC #1

Total Pervious Area:	0
Total Impervious Area:	1.51

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.031858
5 year	0.049017
10 year	0.058936
25 year	0.069678
50 year	0.076589
100 year	0.082585

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.016705
5 year	0.029359
10 year	0.042209
25 year	0.065657
50 year	0.090094
100 year	0.122331

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.026	0.015
1903	0.020	0.012
1904	0.034	0.014
1905	0.016	0.018
1906	0.008	0.011
1907	0.049	0.014
1908	0.036	0.013
1909	0.035	0.015
1910	0.049	0.015
1911	0.032	0.014

1912	0.107	0.016
1913	0.050	0.029
1914	0.013	0.011
1915	0.021	0.022
1916	0.032	0.014
1917	0.011	0.013
1918	0.034	0.048
1919	0.026	0.014
1920	0.032	0.014
1921	0.035	0.016
1922	0.036	0.015
1923	0.028	0.017
1924	0.014	0.013
1925	0.017	0.013
1926	0.031	0.014
1927	0.023	0.014
1928	0.024	0.016
1929	0.049	0.021
1930	0.032	0.014
1931	0.030	0.015
1932	0.023	0.016
1933	0.025	0.015
1934	0.065	0.094
1935	0.030	0.034
1936	0.027	0.016
1937	0.043	0.014
1938	0.027	0.015
1939	0.002	0.011
1940	0.029	0.016
1941	0.018	0.011
1942	0.044	0.061
1943	0.022	0.015
1944	0.046	0.025
1945	0.035	0.015
1946	0.021	0.013
1947	0.015	0.013
1948	0.068	0.015
1949	0.059	0.031
1950	0.017	0.014
1951	0.022	0.013
1952	0.088	0.028
1953	0.080	0.065
1954	0.028	0.015
1955	0.025	0.012
1956	0.013	0.012
1957	0.042	0.020
1958	0.085	0.261
1959	0.053	0.072
1960	0.016	0.011
1961	0.053	0.060
1962	0.029	0.016
1963	0.014	0.011
1964	0.015	0.013
1965	0.060	0.067
1966	0.017	0.014
1967	0.027	0.012
1968	0.028	0.016
1969	0.026	0.015

1970	0.041	0.015
1971	0.063	0.038
1972	0.041	0.016
1973	0.053	0.028
1974	0.029	0.014
1975	0.067	0.247
1976	0.036	0.015
1977	0.016	0.011
1978	0.059	0.063
1979	0.017	0.013
1980	0.034	0.014
1981	0.031	0.015
1982	0.015	0.011
1983	0.053	0.018
1984	0.024	0.014
1985	0.038	0.014
1986	0.032	0.016
1987	0.061	0.044
1988	0.038	0.028
1989	0.035	0.014
1990	0.040	0.014
1991	0.032	0.016
1992	0.042	0.046
1993	0.043	0.015
1994	0.063	0.015
1995	0.014	0.014
1996	0.069	0.063
1997	0.028	0.013
1998	0.034	0.014
1999	0.003	0.013
2000	0.025	0.016
2001	0.014	0.011
2002	0.045	0.014
2003	0.039	0.015
2004	0.035	0.015
2005	0.063	0.016
2006	0.020	0.014
2007	0.021	0.015
2008	0.034	0.014
2009	0.022	0.014
2010	0.020	0.020
2011	0.018	0.013
2012	0.027	0.014
2013	0.020	0.011
2014	0.014	0.012
2015	0.027	0.013
2016	0.011	0.013
2017	0.048	0.028
2018	0.086	0.087
2019	0.085	0.074
2020	0.027	0.013
2021	0.044	0.036
2022	0.018	0.013
2023	0.037	0.016
2024	0.074	0.014
2025	0.033	0.015
2026	0.053	0.023
2027	0.020	0.013

2028	0.017	0.011
2029	0.036	0.028
2030	0.065	0.017
2031	0.022	0.012
2032	0.013	0.012
2033	0.020	0.012
2034	0.019	0.013
2035	0.074	0.216
2036	0.040	0.016
2037	0.011	0.013
2038	0.033	0.025
2039	0.004	0.010
2040	0.019	0.013
2041	0.025	0.012
2042	0.075	0.051
2043	0.036	0.028
2044	0.048	0.022
2045	0.032	0.017
2046	0.038	0.058
2047	0.028	0.017
2048	0.037	0.014
2049	0.033	0.015
2050	0.024	0.014
2051	0.034	0.015
2052	0.020	0.015
2053	0.035	0.061
2054	0.044	0.021
2055	0.018	0.012
2056	0.016	0.013
2057	0.025	0.016
2058	0.029	0.020
2059	0.052	0.029

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1071	0.2610
2	0.0878	0.2471
3	0.0865	0.2165
4	0.0854	0.0937
5	0.0848	0.0868
6	0.0797	0.0739
7	0.0752	0.0723
8	0.0744	0.0668
9	0.0740	0.0653
10	0.0687	0.0634
11	0.0678	0.0629
12	0.0666	0.0608
13	0.0653	0.0606
14	0.0649	0.0605
15	0.0631	0.0582
16	0.0629	0.0511
17	0.0628	0.0476
18	0.0607	0.0463
19	0.0596	0.0437
20	0.0589	0.0380
21	0.0585	0.0358
22	0.0534	0.0341

23	0.0531	0.0307
24	0.0531	0.0294
25	0.0530	0.0286
26	0.0526	0.0283
27	0.0519	0.0282
28	0.0499	0.0280
29	0.0494	0.0279
30	0.0493	0.0278
31	0.0493	0.0276
32	0.0483	0.0253
33	0.0479	0.0246
34	0.0458	0.0230
35	0.0454	0.0220
36	0.0440	0.0217
37	0.0439	0.0215
38	0.0438	0.0213
39	0.0431	0.0203
40	0.0428	0.0200
41	0.0422	0.0198
42	0.0415	0.0183
43	0.0412	0.0178
44	0.0410	0.0169
45	0.0398	0.0168
46	0.0396	0.0166
47	0.0391	0.0165
48	0.0380	0.0163
49	0.0379	0.0162
50	0.0376	0.0162
51	0.0369	0.0162
52	0.0368	0.0161
53	0.0360	0.0161
54	0.0357	0.0160
55	0.0357	0.0160
56	0.0356	0.0159
57	0.0356	0.0159
58	0.0353	0.0159
59	0.0353	0.0158
60	0.0352	0.0156
61	0.0349	0.0156
62	0.0348	0.0155
63	0.0345	0.0155
64	0.0341	0.0155
65	0.0340	0.0153
66	0.0339	0.0152
67	0.0339	0.0152
68	0.0336	0.0152
69	0.0336	0.0151
70	0.0330	0.0151
71	0.0329	0.0151
72	0.0327	0.0151
73	0.0324	0.0150
74	0.0323	0.0149
75	0.0320	0.0149
76	0.0319	0.0149
77	0.0318	0.0148
78	0.0317	0.0148
79	0.0316	0.0148
80	0.0312	0.0148

81	0.0309	0.0148
82	0.0300	0.0148
83	0.0299	0.0147
84	0.0294	0.0146
85	0.0294	0.0146
86	0.0292	0.0146
87	0.0288	0.0145
88	0.0283	0.0144
89	0.0283	0.0144
90	0.0281	0.0143
91	0.0280	0.0143
92	0.0278	0.0143
93	0.0271	0.0142
94	0.0270	0.0142
95	0.0270	0.0142
96	0.0267	0.0142
97	0.0267	0.0141
98	0.0265	0.0141
99	0.0265	0.0141
100	0.0264	0.0141
101	0.0258	0.0140
102	0.0254	0.0140
103	0.0253	0.0140
104	0.0249	0.0140
105	0.0247	0.0140
106	0.0247	0.0139
107	0.0243	0.0139
108	0.0241	0.0138
109	0.0235	0.0138
110	0.0229	0.0138
111	0.0226	0.0138
112	0.0225	0.0137
113	0.0222	0.0136
114	0.0222	0.0136
115	0.0216	0.0136
116	0.0212	0.0135
117	0.0208	0.0134
118	0.0208	0.0134
119	0.0201	0.0134
120	0.0200	0.0134
121	0.0200	0.0133
122	0.0199	0.0132
123	0.0197	0.0132
124	0.0197	0.0131
125	0.0196	0.0131
126	0.0192	0.0131
127	0.0187	0.0130
128	0.0182	0.0129
129	0.0181	0.0128
130	0.0178	0.0128
131	0.0177	0.0128
132	0.0174	0.0127
133	0.0174	0.0127
134	0.0173	0.0127
135	0.0172	0.0127
136	0.0171	0.0125
137	0.0163	0.0125
138	0.0159	0.0124

139	0.0158	0.0124
140	0.0156	0.0124
141	0.0149	0.0124
142	0.0147	0.0123
143	0.0145	0.0120
144	0.0143	0.0119
145	0.0140	0.0118
146	0.0139	0.0116
147	0.0138	0.0115
148	0.0138	0.0115
149	0.0130	0.0114
150	0.0128	0.0113
151	0.0127	0.0113
152	0.0111	0.0113
153	0.0108	0.0112
154	0.0106	0.0112
155	0.0085	0.0112
156	0.0044	0.0110
157	0.0034	0.0110
158	0.0022	0.0102

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0159	56896	52614	92	Pass
0.0165	52415	33584	64	Pass
0.0172	48381	27506	56	Pass
0.0178	44647	25241	56	Pass
0.0184	41273	23080	55	Pass
0.0190	38238	21174	55	Pass
0.0196	35495	19540	55	Pass
0.0202	32980	18038	54	Pass
0.0208	30520	16592	54	Pass
0.0214	28437	15385	54	Pass
0.0221	26509	14443	54	Pass
0.0227	24764	13595	54	Pass
0.0233	23130	12659	54	Pass
0.0239	21684	11822	54	Pass
0.0245	20332	11147	54	Pass
0.0251	19086	10565	55	Pass
0.0257	17856	9961	55	Pass
0.0263	16720	9485	56	Pass
0.0270	15617	8986	57	Pass
0.0276	14620	8465	57	Pass
0.0282	13723	8005	58	Pass
0.0288	12886	7623	59	Pass
0.0294	12105	7191	59	Pass
0.0300	11385	6814	59	Pass
0.0306	10659	6443	60	Pass
0.0312	9994	6116	61	Pass
0.0319	9363	5823	62	Pass
0.0325	8753	5520	63	Pass
0.0331	8199	5222	63	Pass
0.0337	7728	4924	63	Pass
0.0343	7241	4687	64	Pass
0.0349	6792	4482	65	Pass
0.0355	6421	4304	67	Pass
0.0361	6111	4154	67	Pass
0.0368	5828	3998	68	Pass
0.0374	5551	3861	69	Pass
0.0380	5270	3730	70	Pass
0.0386	5006	3603	71	Pass
0.0392	4782	3470	72	Pass
0.0398	4531	3364	74	Pass
0.0404	4339	3256	75	Pass
0.0411	4154	3139	75	Pass
0.0417	3937	3031	76	Pass
0.0423	3713	2902	78	Pass
0.0429	3537	2774	78	Pass
0.0435	3360	2658	79	Pass
0.0441	3227	2542	78	Pass
0.0447	3086	2436	78	Pass
0.0453	2966	2343	78	Pass
0.0460	2850	2221	77	Pass
0.0466	2738	2090	76	Pass
0.0472	2601	1981	76	Pass
0.0478	2477	1881	75	Pass

0.0484	2355	1780	75	Pass
0.0490	2266	1678	74	Pass
0.0496	2159	1584	73	Pass
0.0502	2056	1477	71	Pass
0.0509	1947	1386	71	Pass
0.0515	1837	1305	71	Pass
0.0521	1749	1238	70	Pass
0.0527	1659	1185	71	Pass
0.0533	1577	1130	71	Pass
0.0539	1510	1072	70	Pass
0.0545	1442	1013	70	Pass
0.0551	1367	938	68	Pass
0.0558	1296	878	67	Pass
0.0564	1241	832	67	Pass
0.0570	1182	784	66	Pass
0.0576	1129	737	65	Pass
0.0582	1079	687	63	Pass
0.0588	1026	650	63	Pass
0.0594	976	599	61	Pass
0.0600	922	547	59	Pass
0.0607	871	491	56	Pass
0.0613	819	465	56	Pass
0.0619	771	440	57	Pass
0.0625	717	417	58	Pass
0.0631	668	392	58	Pass
0.0637	629	374	59	Pass
0.0643	588	363	61	Pass
0.0649	549	346	63	Pass
0.0656	507	331	65	Pass
0.0662	471	321	68	Pass
0.0668	428	306	71	Pass
0.0674	392	295	75	Pass
0.0680	363	281	77	Pass
0.0686	329	270	82	Pass
0.0692	300	259	86	Pass
0.0698	281	248	88	Pass
0.0705	264	232	87	Pass
0.0711	248	214	86	Pass
0.0717	233	196	84	Pass
0.0723	218	182	83	Pass
0.0729	205	170	82	Pass
0.0735	186	155	83	Pass
0.0741	162	144	88	Pass
0.0748	142	136	95	Pass
0.0754	129	128	99	Pass
0.0760	117	119	101	Pass
0.0766	105	112	106	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.1542 acre-feet
On-line facility target flow:	0.2139 cfs.
Adjusted for 15 min:	0.2139 cfs.
Off-line facility target flow:	0.1242 cfs.
Adjusted for 15 min:	0.1242 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
StormTech 1 POC	☐	548.67			☐	0.00			
Total Volume Infiltrated		548.67	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

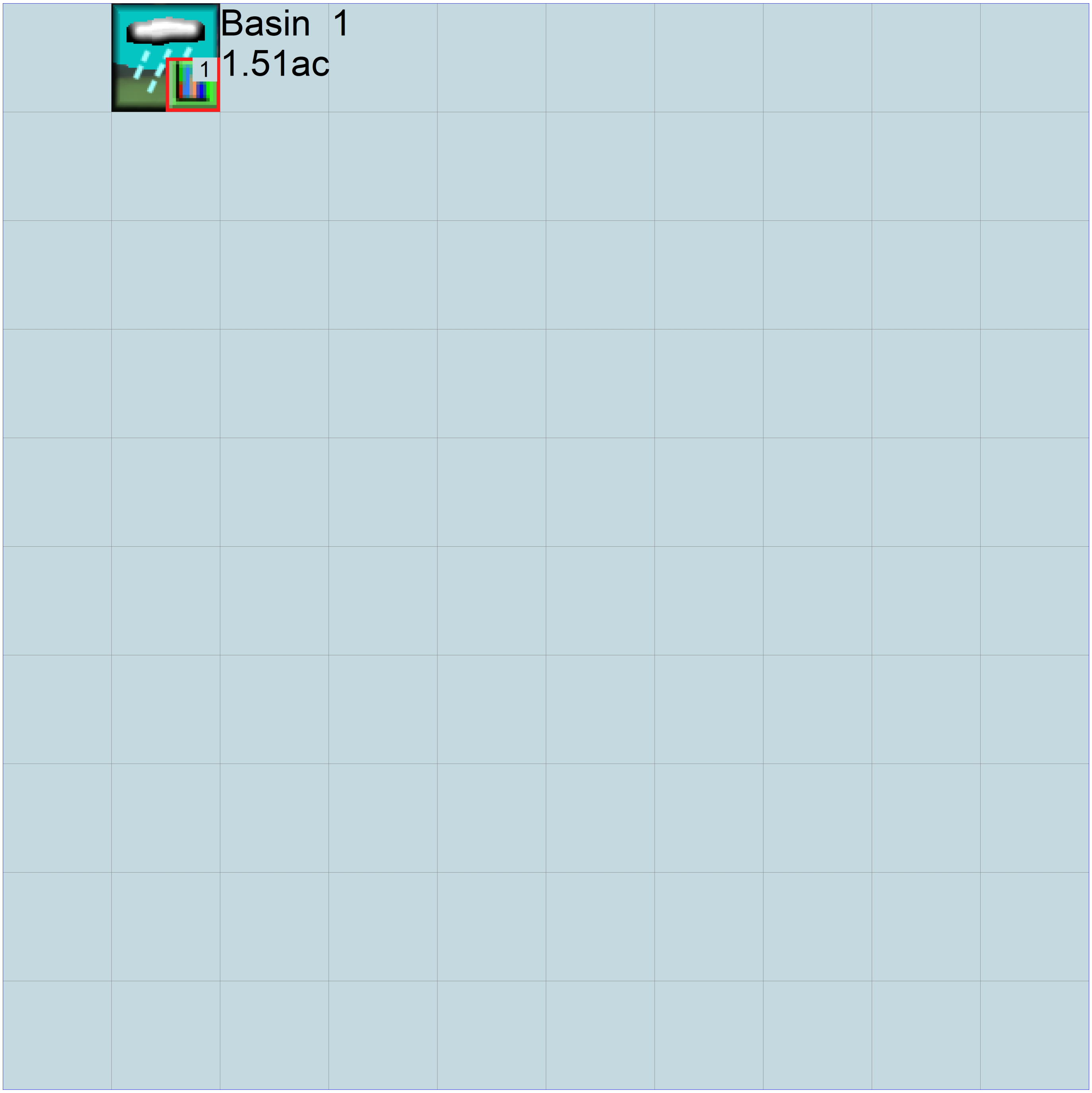
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   detention.wdm
MESSU      25   Predetention.MES
           27   Predetention.L61
           28   Predetention.L62
           30   POCdetention1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                             in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10             0       4.5      0.08       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10           0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                        1.41     COPY   501     12
PERLND  10                        1.41     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                    ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG               ***
                                           in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                         ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
              *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                            ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1               PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1               IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------->***
<-ID->                                                               ***
WDM        26   detention.wdm
MESSU      25   Mitdetention.MES
           27   Mitdetention.L61
           28   Mitdetention.L62
           30   POCdetention1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        StormTech  1                MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                             in  out             ***
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
  END PRINT-INFO

  PWAT-PARM1
```

```
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   1                        1.41     RCHRES   1      5

******Routing******
IMPLND   1                        1.41     COPY     1     15
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
    1     StormTech 1            1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.03       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
```

```
FTABLES
  FTABLE      1
   66    4
     Depth       Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.250220  0.000000  0.000000
  0.083333  0.250220  0.008339  0.002718
  0.166667  0.250220  0.016680  0.003843
  0.250000  0.250220  0.025021  0.004707
  0.333333  0.250220  0.033363  0.005435
  0.416667  0.250220  0.041702  0.006077
  0.500000  0.250220  0.050042  0.006657
  0.583333  0.250220  0.058383  0.007190
  0.666667  0.250220  0.066721  0.007687
  0.750000  0.250220  0.075064  0.008153
  0.833333  0.250220  0.093484  0.008594
  0.916667  0.250220  0.111814  0.009014
  1.000000  0.250220  0.130083  0.009414
  1.083333  0.250220  0.148294  0.009799
  1.166667  0.250220  0.166440  0.010169
  1.250000  0.250220  0.184510  0.010526
  1.333333  0.250220  0.202536  0.010871
  1.416667  0.250220  0.220469  0.011205
  1.500000  0.250220  0.238334  0.011530
  1.583333  0.250220  0.256115  0.011846
  1.666667  0.250220  0.273813  0.012154
  1.750000  0.250220  0.291424  0.012454
  1.833333  0.250220  0.308940  0.012747
  1.916667  0.250220  0.326361  0.013034
  2.000000  0.250220  0.343677  0.013314
  2.083333  0.250220  0.360889  0.013588
  2.166667  0.250220  0.377981  0.013858
  2.250000  0.250220  0.394953  0.014121
  2.333333  0.250220  0.411805  0.014381
  2.416667  0.250220  0.428522  0.014635
  2.500000  0.250220  0.445099  0.014885
  2.583333  0.250220  0.461528  0.015131
  2.666667  0.250220  0.477802  0.015374
  2.750000  0.250220  0.493916  0.015612
  2.833333  0.250220  0.509857  0.015847
  2.916667  0.250220  0.525620  0.016078
  3.000000  0.250220  0.541192  0.016306
  3.083333  0.250220  0.556555  0.016867
  3.166667  0.250220  0.571720  0.018598
  3.250000  0.250220  0.586661  0.020929
  3.333333  0.250220  0.601363  0.023668
  3.416667  0.250220  0.615787  0.026713
  3.500000  0.250220  0.629962  0.029994
  3.583333  0.250220  0.643840  0.033460
  3.666667  0.250220  0.657405  0.037068
  3.750000  0.250220  0.670599  0.040786
  3.833333  0.250220  0.683431  0.044583
  3.916667  0.250220  0.695832  0.048432
  4.000000  0.250220  0.707739  0.052311
  4.083333  0.250220  0.718993  0.056563
  4.166667  0.250220  0.729301  0.061363
  4.250000  0.250220  0.738802  0.066335
  4.333333  0.250220  0.747981  0.071474
  4.416667  0.250220  0.756877  0.076773
  4.500000  0.250220  0.765387  0.102166
  4.583333  0.250220  0.774011  0.484642
  4.666667  0.250220  0.782350  1.176802
  4.750000  0.250220  0.790693  2.041143
  4.833333  0.250220  0.799032  2.985412
  4.916667  0.250220  0.807372  3.915690
  5.000000  0.250220  0.815713  4.742338
  5.083333  0.250220  0.824052  5.397364
  5.166667  0.250220  0.832395  5.858089
  5.250000  0.250220  0.840733  6.175443
  5.333333  0.250220  0.849075  6.573149
```

```
  5.416667  0.250220  0.857414  6.889073
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1908/ 8/31 24: 0

RCHRES :    1

RELERR       STORS        STOR       MATIN      MATDIF
-0.00107     0.00000  0.0000E+00     0.00000  -7.122E-08

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1913/ 7/31 24: 0

RCHRES :    1

RELERR       STORS        STOR       MATIN      MATDIF
-2.684E-02     0.00000  0.0000E+00     0.00000  -2.757E-09

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
```

```
DATE/TIME: 1923/ 8/31 24: 0

RCHRES :    1

RELERR       STORS        STOR       MATIN      MATDIF
-1.706E-03     0.00000  0.0000E+00     0.00000  -4.524E-08

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1974/ 8/31 24: 0

RCHRES :    1

RELERR       STORS        STOR       MATIN      MATDIF
-2.362E-02     0.00000  0.0000E+00     0.00000  -3.145E-09

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1980/ 8/31 24: 0

RCHRES :    1

RELERR       STORS        STOR       MATIN      MATDIF
-1.173E-01     0.00000  0.0000E+00     0.00000  -5.874E-10

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
```

```
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
The count for the WARNING printed above has reached its maximum.

If the condition is encountered again the message will not be repeated.
```

Disclaimer

Legal Notice

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

www.clearcreeksolutions.com

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, Washington 98424 | 253.896.1011 | www. georesources.rocks

November 16, 2023

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

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

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

INTRODUCTION

This *Geotechnical Letter-Buoyancy* provides our recommendations for design and construction of the proposed stormwater vault with respect to hydrostatic and buoyant forces acting on the under-liner. We previously prepared an *Updated Soils Report* on July 13, 2022. In preparing this letter we reviewed the Details for the stormwater vault (dated July 6, 2023) prepared by Advanced Drainage Systems, Inc. We also discussed this with Brett Allen at Contour Engineering.

BUOYANCY CONSIDERATIONS

Buoyant Forces

Based on our wet season monitoring through the winter of 2021 and 2022, it appears that seasonal high groundwater occurs at about Elevation 35.97 to 37.23 feet (NAVD 88) at the locations monitored, approximately 2.80 to 3.00 feet below the ground surface. These levels were recorded on January 14, 2022.

We understand an impermeable liner will be placed below the base of the vault to prevent groundwater intrusion into the storage area. We further understand that the base of the vault will be placed at about Elevation 35.50 feet, which is 1.73 feet below the observed high groundwater elevation. In order to prevent flotation of the liner and buoyant forces acting on the vault, the plan set indicates 4 feet of structural fill should be placed over the liner. This is based on a unit weight of fill of 110 pounds per cubic foot (pcf). The depth of fill includes a factor of safety of 1.25. It is our opinion that the thickness of fill can be reduced to 1.5 feet while maintaining a factor of safety of at least 1.25 against buoyant uplift.

The fill should consist of material that meets the gradation requirements of AASHTO M43 which is approximately equivalent to permeable ballast as defined by WSDOT 9-03.9(2). Material should be placed in lifts not exceeding 1 foot in loose thickness and mechanically compacted to a firm condition.

LIMITATIONS

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

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

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

◆ ◆ ◆

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

Respectfully submitted,
GeoResources, LLC

ERIC WILLIAM HELLER
3471
11/16/23

KEITH SCOTT SCHEMBS
Engineering Geologist
925
11/16/2023

Eric W. Heller, PE, LG
Senior Geotechnical Engineer

Keith S. Schembs, LEG
Principal

KSS:EWH/ewh
Doc ID: NWC.ValleyAveNW.Buoyancy
Attachments: None

APPENDIX D

Water Quality

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	WQ_2023.06.28
Site Name:	
Site Address:	
City:	
Report Date:	8/1/2023
Gage:	40 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year
Low Flow Threshold for POC3:	50 Percent of the 2 Year
High Flow Threshold for POC3:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.205
Pervious Total	0.205
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.205

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.608
Pervious Total	0.608
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.608

Element Flows To:

Surface	Interflow	Groundwater

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.591
Pervious Total	0.591
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.591

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.468
Impervious Total	0.468
Basin Total	0.468

Element Flows To:

Surface	Interflow	Groundwater

Basin 2C

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.691
Impervious Total	0.691
Basin Total	0.691

Element Flows To:

Surface	Interflow	Groundwater

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.26
Impervious Total	0.26
Basin Total	0.26

Element Flows To:

Surface	Interflow	Groundwater

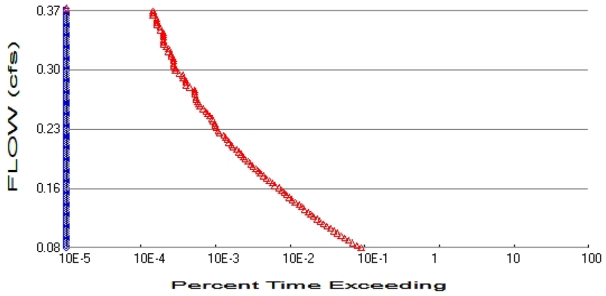
Routing Elements

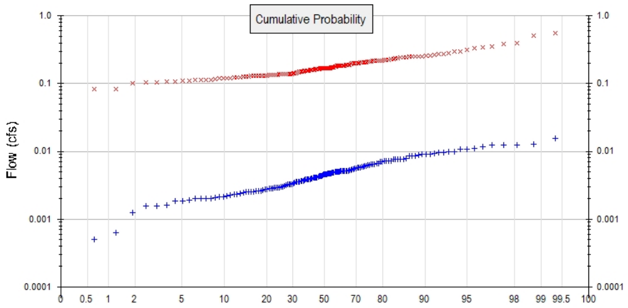
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	0.205
Total Impervious Area:	0

Mitigated Landuse Totals for POC #1

Total Pervious Area:	0
Total Impervious Area:	0.468

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.004632
5 year	0.007127
10 year	0.008569
25 year	0.010131
50 year	0.011135
100 year	0.012007

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.167829
5 year	0.225136
10 year	0.266767
25 year	0.323721
50 year	0.369415
100 year	0.417996

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.004	0.199
1903	0.003	0.220
1904	0.005	0.249
1905	0.002	0.112
1906	0.001	0.127
1907	0.007	0.167
1908	0.005	0.137
1909	0.005	0.169
1910	0.007	0.162
1911	0.005	0.182

1912	0.016	0.300
1913	0.007	0.130
1914	0.002	0.559
1915	0.003	0.113
1916	0.005	0.211
1917	0.002	0.084
1918	0.005	0.168
1919	0.004	0.105
1920	0.005	0.138
1921	0.005	0.118
1922	0.005	0.185
1923	0.004	0.129
1924	0.002	0.244
1925	0.003	0.103
1926	0.004	0.198
1927	0.003	0.170
1928	0.004	0.120
1929	0.007	0.240
1930	0.005	0.253
1931	0.004	0.122
1932	0.003	0.131
1933	0.004	0.130
1934	0.009	0.210
1935	0.004	0.114
1936	0.004	0.155
1937	0.006	0.204
1938	0.004	0.115
1939	0.000	0.141
1940	0.004	0.254
1941	0.003	0.277
1942	0.006	0.187
1943	0.003	0.185
1944	0.007	0.267
1945	0.005	0.201
1946	0.003	0.158
1947	0.002	0.122
1948	0.010	0.168
1949	0.009	0.259
1950	0.003	0.143
1951	0.003	0.221
1952	0.013	0.248
1953	0.012	0.230
1954	0.004	0.136
1955	0.004	0.128
1956	0.002	0.118
1957	0.006	0.135
1958	0.012	0.168
1959	0.008	0.168
1960	0.002	0.137
1961	0.008	0.380
1962	0.004	0.163
1963	0.002	0.121
1964	0.002	0.350
1965	0.009	0.163
1966	0.003	0.132
1967	0.004	0.186
1968	0.004	0.157
1969	0.004	0.141

1970	0.006	0.158
1971	0.009	0.155
1972	0.006	0.512
1973	0.008	0.296
1974	0.004	0.216
1975	0.010	0.222
1976	0.005	0.237
1977	0.002	0.102
1978	0.009	0.172
1979	0.002	0.187
1980	0.005	0.178
1981	0.005	0.170
1982	0.002	0.137
1983	0.008	0.185
1984	0.004	0.184
1985	0.006	0.209
1986	0.005	0.106
1987	0.009	0.190
1988	0.006	0.111
1989	0.005	0.111
1990	0.006	0.135
1991	0.005	0.204
1992	0.006	0.196
1993	0.006	0.217
1994	0.009	0.150
1995	0.002	0.116
1996	0.010	0.156
1997	0.004	0.139
1998	0.005	0.166
1999	0.001	0.190
2000	0.004	0.158
2001	0.002	0.129
2002	0.007	0.231
2003	0.006	0.134
2004	0.005	0.202
2005	0.009	0.393
2006	0.003	0.181
2007	0.003	0.203
2008	0.005	0.167
2009	0.003	0.127
2010	0.003	0.163
2011	0.003	0.170
2012	0.004	0.160
2013	0.003	0.151
2014	0.002	0.148
2015	0.004	0.241
2016	0.002	0.159
2017	0.007	0.245
2018	0.013	0.146
2019	0.012	0.218
2020	0.004	0.179
2021	0.006	0.150
2022	0.003	0.250
2023	0.005	0.314
2024	0.011	0.328
2025	0.005	0.165
2026	0.008	0.186
2027	0.003	0.202

2028	0.003	0.078
2029	0.005	0.129
2030	0.009	0.274
2031	0.003	0.082
2032	0.002	0.137
2033	0.003	0.173
2034	0.003	0.132
2035	0.011	0.167
2036	0.006	0.136
2037	0.002	0.182
2038	0.005	0.172
2039	0.001	0.346
2040	0.003	0.136
2041	0.004	0.172
2042	0.011	0.202
2043	0.005	0.221
2044	0.007	0.151
2045	0.005	0.123
2046	0.005	0.136
2047	0.004	0.168
2048	0.005	0.138
2049	0.005	0.204
2050	0.003	0.153
2051	0.005	0.215
2052	0.003	0.166
2053	0.005	0.140
2054	0.006	0.275
2055	0.003	0.157
2056	0.002	0.220
2057	0.004	0.105
2058	0.004	0.207
2059	0.008	0.261

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0156	0.5589
2	0.0128	0.5121
3	0.0126	0.3934
4	0.0124	0.3802
5	0.0123	0.3501
6	0.0116	0.3458
7	0.0109	0.3283
8	0.0108	0.3138
9	0.0108	0.3002
10	0.0100	0.2957
11	0.0099	0.2772
12	0.0097	0.2748
13	0.0095	0.2745
14	0.0094	0.2672
15	0.0092	0.2605
16	0.0091	0.2591
17	0.0091	0.2535
18	0.0088	0.2533
19	0.0087	0.2503
20	0.0086	0.2486
21	0.0085	0.2485
22	0.0078	0.2455

23	0.0077	0.2440
24	0.0077	0.2409
25	0.0077	0.2396
26	0.0076	0.2370
27	0.0075	0.2308
28	0.0073	0.2298
29	0.0072	0.2223
30	0.0072	0.2212
31	0.0072	0.2211
32	0.0070	0.2203
33	0.0070	0.2199
34	0.0067	0.2181
35	0.0066	0.2170
36	0.0064	0.2165
37	0.0064	0.2147
38	0.0064	0.2108
39	0.0063	0.2102
40	0.0062	0.2094
41	0.0061	0.2066
42	0.0060	0.2044
43	0.0060	0.2041
44	0.0060	0.2037
45	0.0058	0.2027
46	0.0058	0.2023
47	0.0057	0.2019
48	0.0055	0.2015
49	0.0055	0.2015
50	0.0055	0.1986
51	0.0054	0.1982
52	0.0054	0.1961
53	0.0052	0.1903
54	0.0052	0.1901
55	0.0052	0.1870
56	0.0052	0.1866
57	0.0052	0.1859
58	0.0051	0.1858
59	0.0051	0.1853
60	0.0051	0.1853
61	0.0051	0.1850
62	0.0051	0.1836
63	0.0050	0.1824
64	0.0050	0.1820
65	0.0049	0.1813
66	0.0049	0.1789
67	0.0049	0.1781
68	0.0049	0.1733
69	0.0049	0.1724
70	0.0048	0.1721
71	0.0048	0.1716
72	0.0048	0.1704
73	0.0047	0.1698
74	0.0047	0.1695
75	0.0047	0.1690
76	0.0046	0.1684
77	0.0046	0.1681
78	0.0046	0.1679
79	0.0046	0.1678
80	0.0045	0.1676

81	0.0045	0.1669
82	0.0044	0.1667
83	0.0044	0.1667
84	0.0043	0.1662
85	0.0043	0.1658
86	0.0042	0.1648
87	0.0042	0.1633
88	0.0041	0.1633
89	0.0041	0.1633
90	0.0041	0.1616
91	0.0041	0.1597
92	0.0040	0.1594
93	0.0039	0.1582
94	0.0039	0.1578
95	0.0039	0.1576
96	0.0039	0.1574
97	0.0039	0.1566
98	0.0039	0.1556
99	0.0039	0.1551
100	0.0038	0.1549
101	0.0038	0.1531
102	0.0037	0.1513
103	0.0037	0.1507
104	0.0036	0.1502
105	0.0036	0.1496
106	0.0036	0.1476
107	0.0035	0.1465
108	0.0035	0.1431
109	0.0034	0.1408
110	0.0033	0.1407
111	0.0033	0.1398
112	0.0033	0.1391
113	0.0032	0.1384
114	0.0032	0.1379
115	0.0031	0.1374
116	0.0031	0.1369
117	0.0030	0.1368
118	0.0030	0.1367
119	0.0029	0.1362
120	0.0029	0.1360
121	0.0029	0.1358
122	0.0029	0.1356
123	0.0029	0.1354
124	0.0029	0.1352
125	0.0028	0.1337
126	0.0028	0.1320
127	0.0027	0.1316
128	0.0026	0.1307
129	0.0026	0.1304
130	0.0026	0.1296
131	0.0026	0.1295
132	0.0025	0.1291
133	0.0025	0.1288
134	0.0025	0.1277
135	0.0025	0.1272
136	0.0025	0.1268
137	0.0024	0.1226
138	0.0023	0.1222

139	0.0023	0.1218
140	0.0023	0.1214
141	0.0022	0.1201
142	0.0021	0.1183
143	0.0021	0.1183
144	0.0021	0.1158
145	0.0020	0.1147
146	0.0020	0.1144
147	0.0020	0.1132
148	0.0020	0.1118
149	0.0019	0.1113
150	0.0019	0.1106
151	0.0018	0.1056
152	0.0016	0.1055
153	0.0016	0.1051
154	0.0015	0.1028
155	0.0012	0.1021
156	0.0006	0.0837
157	0.0005	0.0820
158	0.0003	0.0785

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0023	0	4926	n/a	Fail
0.0024	0	4343	n/a	Fail
0.0025	0	3797	n/a	Fail
0.0026	0	3357	n/a	Fail
0.0027	0	2979	n/a	Fail
0.0028	0	2652	n/a	Fail
0.0029	0	2371	n/a	Fail
0.0029	0	2120	n/a	Fail
0.0030	0	1932	n/a	Fail
0.0031	0	1721	n/a	Fail
0.0032	0	1538	n/a	Fail
0.0033	0	1394	n/a	Fail
0.0034	0	1263	n/a	Fail
0.0035	0	1137	n/a	Fail
0.0036	0	1047	n/a	Fail
0.0037	0	962	n/a	Fail
0.0037	0	862	n/a	Fail
0.0038	0	789	n/a	Fail
0.0039	0	727	n/a	Fail
0.0040	0	641	n/a	Fail
0.0041	0	590	n/a	Fail
0.0042	0	540	n/a	Fail
0.0043	0	494	n/a	Fail
0.0044	0	462	n/a	Fail
0.0045	0	424	n/a	Fail
0.0045	0	390	n/a	Fail
0.0046	0	347	n/a	Fail
0.0047	0	317	n/a	Fail
0.0048	0	291	n/a	Fail
0.0049	0	265	n/a	Fail
0.0050	0	241	n/a	Fail
0.0051	0	221	n/a	Fail
0.0052	0	208	n/a	Fail
0.0053	0	192	n/a	Fail
0.0053	0	175	n/a	Fail
0.0054	0	163	n/a	Fail
0.0055	0	150	n/a	Fail
0.0056	0	138	n/a	Fail
0.0057	0	130	n/a	Fail
0.0058	0	123	n/a	Fail
0.0059	0	115	n/a	Fail
0.0060	0	105	n/a	Fail
0.0061	0	94	n/a	Fail
0.0061	0	91	n/a	Fail
0.0062	0	83	n/a	Fail
0.0063	0	79	n/a	Fail
0.0064	0	75	n/a	Fail
0.0065	0	71	n/a	Fail
0.0066	0	62	n/a	Fail
0.0067	0	60	n/a	Fail
0.0068	0	56	n/a	Fail
0.0069	0	54	n/a	Fail
0.0069	0	54	n/a	Fail

0.0070	0	52	n/a	Fail
0.0071	0	50	n/a	Fail
0.0072	0	46	n/a	Fail
0.0073	0	43	n/a	Fail
0.0074	0	41	n/a	Fail
0.0075	0	38	n/a	Fail
0.0076	0	34	n/a	Fail
0.0077	0	33	n/a	Fail
0.0077	0	32	n/a	Fail
0.0078	0	30	n/a	Fail
0.0079	0	30	n/a	Fail
0.0080	0	29	n/a	Fail
0.0081	0	29	n/a	Fail
0.0082	0	29	n/a	Fail
0.0083	0	25	n/a	Fail
0.0084	0	22	n/a	Fail
0.0085	0	22	n/a	Fail
0.0086	0	22	n/a	Fail
0.0086	0	20	n/a	Fail
0.0087	0	20	n/a	Fail
0.0088	0	18	n/a	Fail
0.0089	0	16	n/a	Fail
0.0090	0	16	n/a	Fail
0.0091	0	15	n/a	Fail
0.0092	0	15	n/a	Fail
0.0093	0	15	n/a	Fail
0.0094	0	15	n/a	Fail
0.0094	0	14	n/a	Fail
0.0095	0	14	n/a	Fail
0.0096	0	13	n/a	Fail
0.0097	0	13	n/a	Fail
0.0098	0	12	n/a	Fail
0.0099	0	11	n/a	Fail
0.0100	0	11	n/a	Fail
0.0101	0	11	n/a	Fail
0.0102	0	11	n/a	Fail
0.0102	0	11	n/a	Fail
0.0103	0	11	n/a	Fail
0.0104	0	10	n/a	Fail
0.0105	0	10	n/a	Fail
0.0106	0	9	n/a	Fail
0.0107	0	9	n/a	Fail
0.0108	0	9	n/a	Fail
0.0109	0	9	n/a	Fail
0.0110	0	8	n/a	Fail
0.0110	0	8	n/a	Fail
0.0111	0	8	n/a	Fail

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

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

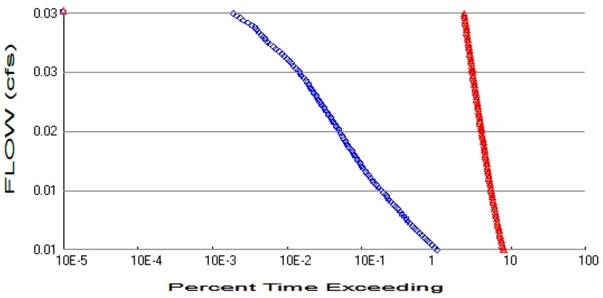
Water Quality BMP Flow and Volume for POC #1

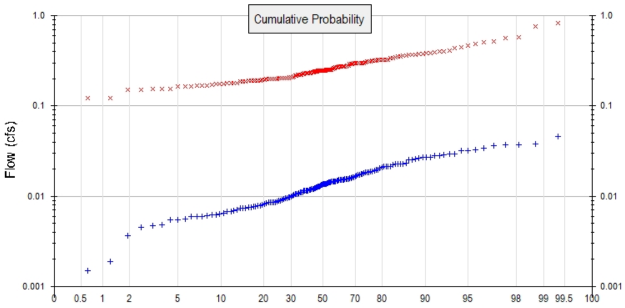
On-line facility volume:	0.0511 acre-feet
On-line facility target flow:	0.071 cfs.
Adjusted for 15 min:	0.071 cfs.
Off-line facility target flow:	0.0412 cfs.
Adjusted for 15 min:	0.0412 cfs.

LID Report

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

POC 2





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2	
Total Pervious Area:	0.608
Total Impervious Area:	0

Mitigated Landuse Totals for POC #2	
Total Pervious Area:	0
Total Impervious Area:	0.691

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.013737
5 year	0.021136
10 year	0.025413
25 year	0.030046
50 year	0.033026
100 year	0.035611

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.247799
5 year	0.332413
10 year	0.39388
25 year	0.477973
50 year	0.545439
100 year	0.61717

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1902	0.011	0.293
1903	0.008	0.325
1904	0.015	0.367
1905	0.007	0.165
1906	0.004	0.187
1907	0.021	0.246
1908	0.015	0.203
1909	0.015	0.249
1910	0.021	0.239
1911	0.014	0.269
1912	0.046	0.443

1913	0.022	0.193
1914	0.005	0.825
1915	0.009	0.167
1916	0.014	0.311
1917	0.005	0.124
1918	0.015	0.248
1919	0.011	0.156
1920	0.014	0.204
1921	0.015	0.175
1922	0.015	0.274
1923	0.012	0.190
1924	0.006	0.360
1925	0.007	0.152
1926	0.013	0.293
1927	0.010	0.250
1928	0.010	0.177
1929	0.021	0.354
1930	0.014	0.374
1931	0.013	0.180
1932	0.010	0.193
1933	0.011	0.191
1934	0.028	0.310
1935	0.013	0.169
1936	0.012	0.229
1937	0.019	0.301
1938	0.011	0.169
1939	0.001	0.208
1940	0.013	0.374
1941	0.008	0.409
1942	0.019	0.276
1943	0.010	0.274
1944	0.020	0.395
1945	0.015	0.297
1946	0.009	0.233
1947	0.006	0.180
1948	0.029	0.247
1949	0.025	0.383
1950	0.007	0.211
1951	0.010	0.327
1952	0.038	0.367
1953	0.034	0.339
1954	0.012	0.200
1955	0.011	0.189
1956	0.006	0.175
1957	0.018	0.200
1958	0.037	0.249
1959	0.023	0.248
1960	0.007	0.202
1961	0.023	0.561
1962	0.012	0.241
1963	0.006	0.179
1964	0.006	0.517
1965	0.026	0.241
1966	0.007	0.195
1967	0.012	0.274
1968	0.012	0.231
1969	0.011	0.208
1970	0.018	0.234

1971	0.027	0.229
1972	0.018	0.756
1973	0.023	0.437
1974	0.013	0.320
1975	0.029	0.328
1976	0.015	0.350
1977	0.007	0.151
1978	0.025	0.253
1979	0.007	0.276
1980	0.015	0.263
1981	0.013	0.252
1982	0.006	0.202
1983	0.023	0.273
1984	0.010	0.271
1985	0.016	0.309
1986	0.014	0.156
1987	0.026	0.281
1988	0.016	0.164
1989	0.015	0.163
1990	0.017	0.200
1991	0.014	0.301
1992	0.018	0.289
1993	0.018	0.320
1994	0.027	0.221
1995	0.006	0.171
1996	0.030	0.230
1997	0.012	0.205
1998	0.015	0.245
1999	0.001	0.281
2000	0.011	0.233
2001	0.006	0.191
2002	0.020	0.341
2003	0.017	0.197
2004	0.015	0.298
2005	0.027	0.581
2006	0.009	0.268
2007	0.009	0.299
2008	0.015	0.246
2009	0.010	0.188
2010	0.008	0.241
2011	0.008	0.251
2012	0.011	0.236
2013	0.009	0.223
2014	0.006	0.218
2015	0.012	0.356
2016	0.005	0.235
2017	0.021	0.362
2018	0.037	0.216
2019	0.037	0.322
2020	0.012	0.264
2021	0.019	0.222
2022	0.008	0.370
2023	0.016	0.463
2024	0.032	0.485
2025	0.014	0.243
2026	0.023	0.275
2027	0.009	0.299
2028	0.007	0.116

2029	0.015	0.191
2030	0.028	0.405
2031	0.009	0.121
2032	0.006	0.202
2033	0.008	0.256
2034	0.008	0.194
2035	0.032	0.246
2036	0.017	0.201
2037	0.005	0.269
2038	0.014	0.254
2039	0.002	0.511
2040	0.008	0.200
2041	0.011	0.255
2042	0.032	0.298
2043	0.016	0.326
2044	0.021	0.223
2045	0.014	0.181
2046	0.016	0.201
2047	0.012	0.248
2048	0.016	0.204
2049	0.014	0.302
2050	0.010	0.226
2051	0.015	0.317
2052	0.009	0.245
2053	0.015	0.206
2054	0.019	0.406
2055	0.008	0.232
2056	0.007	0.325
2057	0.011	0.155
2058	0.013	0.305
2059	0.022	0.385

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	**Predeveloped**	**Mitigated**
1	0.0462	0.8251
2	0.0378	0.7562
3	0.0373	0.5809
4	0.0368	0.5613
5	0.0365	0.5169
6	0.0344	0.5106
7	0.0324	0.4848
8	0.0321	0.4633
9	0.0319	0.4433
10	0.0296	0.4366
11	0.0292	0.4093
12	0.0287	0.4058
13	0.0282	0.4052
14	0.0280	0.3946
15	0.0272	0.3847
16	0.0271	0.3826
17	0.0271	0.3743
18	0.0262	0.3739
19	0.0257	0.3696
20	0.0254	0.3671
21	0.0252	0.3669
22	0.0230	0.3625
23	0.0229	0.3602

24	0.0229	0.3556
25	0.0229	0.3538
26	0.0227	0.3500
27	0.0224	0.3408
28	0.0215	0.3393
29	0.0213	0.3282
30	0.0213	0.3266
31	0.0212	0.3264
32	0.0208	0.3253
33	0.0207	0.3247
34	0.0197	0.3220
35	0.0196	0.3205
36	0.0190	0.3196
37	0.0189	0.3170
38	0.0189	0.3112
39	0.0186	0.3104
40	0.0185	0.3091
41	0.0182	0.3050
42	0.0179	0.3018
43	0.0178	0.3014
44	0.0177	0.3007
45	0.0172	0.2993
46	0.0171	0.2987
47	0.0169	0.2981
48	0.0164	0.2976
49	0.0164	0.2975
50	0.0162	0.2933
51	0.0159	0.2926
52	0.0159	0.2895
53	0.0155	0.2810
54	0.0154	0.2807
55	0.0154	0.2761
56	0.0154	0.2756
57	0.0153	0.2745
58	0.0152	0.2743
59	0.0152	0.2736
60	0.0152	0.2735
61	0.0150	0.2731
62	0.0150	0.2711
63	0.0149	0.2693
64	0.0147	0.2687
65	0.0146	0.2677
66	0.0146	0.2642
67	0.0146	0.2630
68	0.0145	0.2559
69	0.0145	0.2545
70	0.0142	0.2542
71	0.0142	0.2533
72	0.0141	0.2516
73	0.0140	0.2507
74	0.0139	0.2503
75	0.0138	0.2495
76	0.0138	0.2486
77	0.0137	0.2482
78	0.0136	0.2479
79	0.0136	0.2478
80	0.0134	0.2475
81	0.0133	0.2464

82	0.0129	0.2462
83	0.0129	0.2461
84	0.0127	0.2454
85	0.0127	0.2448
86	0.0126	0.2433
87	0.0124	0.2412
88	0.0122	0.2412
89	0.0122	0.2411
90	0.0121	0.2387
91	0.0121	0.2358
92	0.0120	0.2354
93	0.0117	0.2336
94	0.0116	0.2330
95	0.0116	0.2327
96	0.0115	0.2325
97	0.0115	0.2312
98	0.0114	0.2297
99	0.0114	0.2290
100	0.0114	0.2286
101	0.0111	0.2260
102	0.0110	0.2234
103	0.0109	0.2225
104	0.0108	0.2217
105	0.0107	0.2209
106	0.0106	0.2179
107	0.0105	0.2163
108	0.0104	0.2113
109	0.0101	0.2078
110	0.0099	0.2078
111	0.0098	0.2064
112	0.0097	0.2054
113	0.0096	0.2043
114	0.0096	0.2036
115	0.0093	0.2028
116	0.0092	0.2021
117	0.0090	0.2020
118	0.0090	0.2019
119	0.0087	0.2011
120	0.0086	0.2008
121	0.0086	0.2005
122	0.0086	0.2002
123	0.0085	0.1999
124	0.0085	0.1996
125	0.0084	0.1974
126	0.0083	0.1949
127	0.0081	0.1943
128	0.0078	0.1929
129	0.0078	0.1925
130	0.0077	0.1913
131	0.0076	0.1912
132	0.0075	0.1906
133	0.0075	0.1902
134	0.0074	0.1886
135	0.0074	0.1878
136	0.0074	0.1871
137	0.0070	0.1810
138	0.0068	0.1805
139	0.0068	0.1798

140	0.0067	0.1792
141	0.0064	0.1773
142	0.0063	0.1746
143	0.0063	0.1746
144	0.0062	0.1709
145	0.0060	0.1694
146	0.0060	0.1690
147	0.0060	0.1671
148	0.0059	0.1650
149	0.0056	0.1643
150	0.0055	0.1634
151	0.0055	0.1559
152	0.0048	0.1557
153	0.0047	0.1552
154	0.0046	0.1518
155	0.0037	0.1507
156	0.0019	0.1235
157	0.0015	0.1211
158	0.0010	0.1159

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0069	56841	438219	770	Fail
0.0071	52420	430352	820	Fail
0.0074	48370	422873	874	Fail
0.0077	44609	415671	931	Fail
0.0079	41213	408635	991	Fail
0.0082	38232	401765	1050	Fail
0.0085	35484	395228	1113	Fail
0.0087	32952	388912	1180	Fail
0.0090	30520	382874	1254	Fail
0.0092	28432	377112	1326	Fail
0.0095	26493	371184	1401	Fail
0.0098	24747	365589	1477	Fail
0.0100	23174	360270	1554	Fail
0.0103	21689	354786	1635	Fail
0.0106	20360	349578	1716	Fail
0.0108	19074	344537	1806	Fail
0.0111	17878	339772	1900	Fail
0.0114	16714	334897	2003	Fail
0.0116	15623	330409	2114	Fail
0.0119	14648	325867	2224	Fail
0.0122	13723	321268	2341	Fail
0.0124	12897	316892	2457	Fail
0.0127	12099	312460	2582	Fail
0.0129	11401	308360	2704	Fail
0.0132	10681	304316	2849	Fail
0.0135	9994	300327	3005	Fail
0.0137	9368	296449	3164	Fail
0.0140	8753	292515	3341	Fail
0.0143	8210	288859	3518	Fail
0.0145	7723	285147	3692	Fail
0.0148	7246	281657	3887	Fail
0.0151	6798	278277	4093	Fail
0.0153	6421	274843	4280	Fail
0.0156	6116	271463	4438	Fail
0.0159	5828	268084	4599	Fail
0.0161	5557	264870	4766	Fail
0.0164	5265	261657	4969	Fail
0.0166	5006	258555	5164	Fail
0.0169	4790	255619	5336	Fail
0.0172	4531	252516	5573	Fail
0.0174	4343	249580	5746	Fail
0.0177	4154	246533	5934	Fail
0.0180	3940	243652	6184	Fail
0.0182	3719	240993	6480	Fail
0.0185	3537	238001	6728	Fail
0.0188	3367	235176	6984	Fail
0.0190	3227	232350	7200	Fail
0.0193	3090	229746	7435	Fail
0.0196	2964	226866	7654	Fail
0.0198	2851	224317	7868	Fail
0.0201	2741	221880	8094	Fail
0.0203	2601	219387	8434	Fail
0.0206	2479	216838	8746	Fail
0.0209	2355	214290	9099	Fail

0.0211	2267	211963	9349	Fail
0.0214	2159	209581	9707	Fail
0.0217	2057	207254	10075	Fail
0.0219	1950	204982	10511	Fail
0.0222	1837	202656	11031	Fail
0.0225	1749	200384	11457	Fail
0.0227	1659	198113	11941	Fail
0.0230	1579	195952	12409	Fail
0.0232	1510	193847	12837	Fail
0.0235	1443	191686	13283	Fail
0.0238	1368	189636	13862	Fail
0.0240	1296	187476	14465	Fail
0.0243	1242	185481	14934	Fail
0.0246	1182	183432	15518	Fail
0.0248	1130	181382	16051	Fail
0.0251	1082	179443	16584	Fail
0.0254	1026	177448	17295	Fail
0.0256	980	175565	17914	Fail
0.0259	922	173626	18831	Fail
0.0262	872	171797	19701	Fail
0.0264	819	169969	20753	Fail
0.0267	771	168196	21815	Fail
0.0269	719	166424	23146	Fail
0.0272	668	164540	24631	Fail
0.0275	629	162822	25885	Fail
0.0277	587	160939	27417	Fail
0.0280	549	159332	29022	Fail
0.0283	507	157615	31087	Fail
0.0285	473	155953	32971	Fail
0.0288	428	154346	36062	Fail
0.0291	392	152629	38935	Fail
0.0293	363	150911	41573	Fail
0.0296	329	149305	45381	Fail
0.0299	300	147698	49232	Fail
0.0301	281	146147	52009	Fail
0.0304	264	144596	54771	Fail
0.0306	248	142989	57656	Fail
0.0309	233	141493	60726	Fail
0.0312	218	139997	64218	Fail
0.0314	205	138502	67561	Fail
0.0317	186	137117	73718	Fail
0.0320	163	135676	83236	Fail
0.0322	142	134236	94532	Fail
0.0325	130	132795	102150	Fail
0.0328	117	131410	112316	Fail
0.0330	105	130025	123833	Fail

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

Water Quality

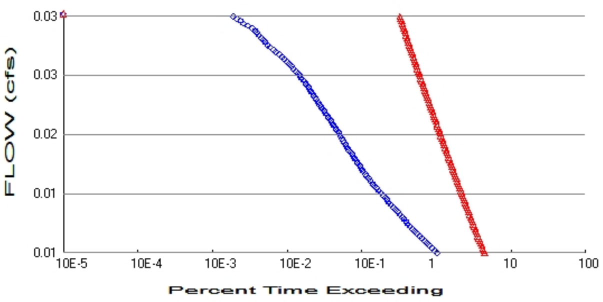
Water Quality BMP Flow and Volume for POC #2

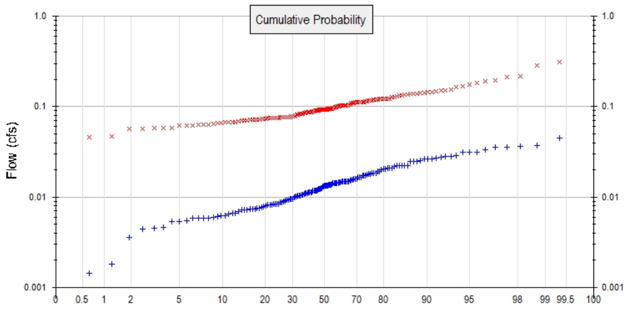
On-line facility volume:	0.0219 acre-feet
On-line facility target flow:	0.0122 cfs.
Adjusted for 15 min:	0.0122 cfs.
Off-line facility target flow:	0.0067 cfs.
Adjusted for 15 min:	0.0067 cfs.

LID Report

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

POC 3





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #3
Total Pervious Area: 0.591
Total Impervious Area: 0

Mitigated Landuse Totals for POC #3
Total Pervious Area: 0
Total Impervious Area: 0.26

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #3

Return Period	**Flow(cfs)**
2 year	0.013353
5 year	0.020546
10 year	0.024703
25 year	0.029206
50 year	0.032102
100 year	0.034615

Flow Frequency Return Periods for Mitigated. POC #3

Return Period	**Flow(cfs)**
2 year	0.093238
5 year	0.125076
10 year	0.148204
25 year	0.179845
50 year	0.20523
100 year	0.23222

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #3

Year	**Predeveloped**	**Mitigated**
1902	0.011	0.110
1903	0.008	0.122
1904	0.014	0.138
1905	0.007	0.062
1906	0.004	0.070
1907	0.021	0.093
1908	0.015	0.076
1909	0.015	0.094
1910	0.021	0.090
1911	0.013	0.101
1912	0.045	0.167

1913	0.021	0.072
1914	0.005	0.310
1915	0.009	0.063
1916	0.013	0.117
1917	0.005	0.046
1918	0.014	0.093
1919	0.011	0.059
1920	0.014	0.077
1921	0.015	0.066
1922	0.015	0.103
1923	0.012	0.072
1924	0.006	0.136
1925	0.007	0.057
1926	0.013	0.110
1927	0.009	0.094
1928	0.010	0.067
1929	0.021	0.133
1930	0.013	0.141
1931	0.013	0.068
1932	0.010	0.073
1933	0.011	0.072
1934	0.027	0.117
1935	0.013	0.064
1936	0.011	0.086
1937	0.018	0.113
1938	0.011	0.064
1939	0.001	0.078
1940	0.012	0.141
1941	0.007	0.154
1942	0.018	0.104
1943	0.009	0.103
1944	0.019	0.148
1945	0.015	0.112
1946	0.009	0.088
1947	0.006	0.068
1948	0.028	0.093
1949	0.025	0.144
1950	0.007	0.080
1951	0.009	0.123
1952	0.037	0.138
1953	0.033	0.128
1954	0.012	0.075
1955	0.010	0.071
1956	0.005	0.066
1957	0.018	0.075
1958	0.036	0.094
1959	0.022	0.093
1960	0.007	0.076
1961	0.022	0.211
1962	0.012	0.091
1963	0.006	0.067
1964	0.006	0.194
1965	0.025	0.091
1966	0.007	0.073
1967	0.011	0.103
1968	0.012	0.087
1969	0.011	0.078
1970	0.017	0.088

1971	0.026	0.086
1972	0.017	0.285
1973	0.022	0.164
1974	0.012	0.120
1975	0.028	0.123
1976	0.015	0.132
1977	0.007	0.057
1978	0.025	0.095
1979	0.007	0.104
1980	0.014	0.099
1981	0.013	0.095
1982	0.006	0.076
1983	0.022	0.103
1984	0.010	0.102
1985	0.016	0.116
1986	0.013	0.059
1987	0.025	0.106
1988	0.016	0.062
1989	0.015	0.061
1990	0.017	0.075
1991	0.013	0.113
1992	0.017	0.109
1993	0.018	0.121
1994	0.026	0.083
1995	0.006	0.064
1996	0.029	0.086
1997	0.012	0.077
1998	0.014	0.092
1999	0.001	0.106
2000	0.011	0.088
2001	0.006	0.072
2002	0.019	0.128
2003	0.016	0.074
2004	0.014	0.112
2005	0.026	0.219
2006	0.008	0.101
2007	0.009	0.113
2008	0.014	0.093
2009	0.009	0.071
2010	0.008	0.091
2011	0.007	0.094
2012	0.011	0.089
2013	0.008	0.084
2014	0.006	0.082
2015	0.011	0.134
2016	0.005	0.089
2017	0.020	0.136
2018	0.036	0.081
2019	0.036	0.121
2020	0.011	0.099
2021	0.018	0.083
2022	0.008	0.139
2023	0.015	0.174
2024	0.031	0.182
2025	0.014	0.092
2026	0.022	0.103
2027	0.008	0.112
2028	0.007	0.044

2029	0.015	0.072
2030	0.027	0.152
2031	0.009	0.046
2032	0.005	0.076
2033	0.008	0.096
2034	0.008	0.073
2035	0.031	0.093
2036	0.017	0.076
2037	0.004	0.101
2038	0.014	0.096
2039	0.002	0.192
2040	0.008	0.075
2041	0.010	0.096
2042	0.032	0.112
2043	0.015	0.123
2044	0.020	0.084
2045	0.014	0.068
2046	0.016	0.076
2047	0.012	0.093
2048	0.015	0.077
2049	0.014	0.114
2050	0.010	0.085
2051	0.014	0.119
2052	0.008	0.092
2053	0.015	0.078
2054	0.018	0.153
2055	0.008	0.087
2056	0.007	0.122
2057	0.010	0.058
2058	0.012	0.115
2059	0.022	0.145

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #3

Rank	Predeveloped	Mitigated
1	0.0449	0.3105
2	0.0368	0.2845
3	0.0362	0.2186
4	0.0358	0.2112
5	0.0355	0.1945
6	0.0334	0.1921
7	0.0315	0.1824
8	0.0312	0.1743
9	0.0310	0.1668
10	0.0288	0.1643
11	0.0284	0.1540
12	0.0279	0.1527
13	0.0274	0.1525
14	0.0272	0.1485
15	0.0264	0.1447
16	0.0264	0.1440
17	0.0263	0.1408
18	0.0254	0.1407
19	0.0250	0.1391
20	0.0247	0.1381
21	0.0245	0.1380
22	0.0224	0.1364
23	0.0223	0.1355

24	0.0222	0.1338
25	0.0222	0.1331
26	0.0220	0.1317
27	0.0217	0.1282
28	0.0209	0.1277
29	0.0207	0.1235
30	0.0207	0.1229
31	0.0207	0.1228
32	0.0203	0.1224
33	0.0201	0.1222
34	0.0192	0.1212
35	0.0190	0.1206
36	0.0185	0.1203
37	0.0184	0.1193
38	0.0184	0.1171
39	0.0181	0.1168
40	0.0179	0.1163
41	0.0177	0.1148
42	0.0174	0.1135
43	0.0173	0.1134
44	0.0172	0.1131
45	0.0167	0.1126
46	0.0166	0.1124
47	0.0164	0.1122
48	0.0159	0.1120
49	0.0159	0.1119
50	0.0157	0.1103
51	0.0155	0.1101
52	0.0154	0.1089
53	0.0151	0.1057
54	0.0150	0.1056
55	0.0149	0.1039
56	0.0149	0.1037
57	0.0149	0.1033
58	0.0148	0.1032
59	0.0148	0.1029
60	0.0148	0.1029
61	0.0146	0.1028
62	0.0146	0.1020
63	0.0145	0.1013
64	0.0143	0.1011
65	0.0142	0.1007
66	0.0142	0.0994
67	0.0142	0.0990
68	0.0141	0.0963
69	0.0141	0.0958
70	0.0138	0.0956
71	0.0138	0.0953
72	0.0137	0.0947
73	0.0136	0.0943
74	0.0135	0.0942
75	0.0134	0.0939
76	0.0134	0.0935
77	0.0133	0.0934
78	0.0133	0.0933
79	0.0132	0.0932
80	0.0131	0.0931
81	0.0130	0.0927

82	0.0126	0.0926
83	0.0125	0.0926
84	0.0123	0.0923
85	0.0123	0.0921
86	0.0122	0.0915
87	0.0121	0.0907
88	0.0119	0.0907
89	0.0118	0.0907
90	0.0118	0.0898
91	0.0117	0.0887
92	0.0117	0.0886
93	0.0114	0.0879
94	0.0113	0.0877
95	0.0113	0.0875
96	0.0112	0.0875
97	0.0112	0.0870
98	0.0111	0.0864
99	0.0111	0.0861
100	0.0111	0.0860
101	0.0108	0.0850
102	0.0107	0.0840
103	0.0106	0.0837
104	0.0105	0.0834
105	0.0104	0.0831
106	0.0103	0.0820
107	0.0102	0.0814
108	0.0101	0.0795
109	0.0099	0.0782
110	0.0096	0.0782
111	0.0095	0.0776
112	0.0094	0.0773
113	0.0093	0.0769
114	0.0093	0.0766
115	0.0090	0.0763
116	0.0089	0.0760
117	0.0087	0.0760
118	0.0087	0.0760
119	0.0084	0.0757
120	0.0084	0.0755
121	0.0084	0.0754
122	0.0084	0.0753
123	0.0082	0.0752
124	0.0082	0.0751
125	0.0082	0.0743
126	0.0080	0.0733
127	0.0078	0.0731
128	0.0076	0.0726
129	0.0076	0.0724
130	0.0075	0.0720
131	0.0074	0.0719
132	0.0073	0.0717
133	0.0073	0.0716
134	0.0072	0.0710
135	0.0072	0.0707
136	0.0072	0.0704
137	0.0068	0.0681
138	0.0067	0.0679
139	0.0066	0.0677

140	0.0065	0.0674
141	0.0063	0.0667
142	0.0062	0.0657
143	0.0061	0.0657
144	0.0060	0.0643
145	0.0059	0.0637
146	0.0058	0.0636
147	0.0058	0.0629
148	0.0058	0.0621
149	0.0055	0.0618
150	0.0054	0.0615
151	0.0053	0.0587
152	0.0046	0.0586
153	0.0045	0.0584
154	0.0044	0.0571
155	0.0036	0.0567
156	0.0018	0.0465
157	0.0014	0.0456
158	0.0009	0.0436

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0067	56841	246034	432	Fail
0.0069	52415	238721	455	Fail
0.0072	48359	231464	478	Fail
0.0074	44620	224539	503	Fail
0.0077	41224	218057	528	Fail
0.0080	38232	211741	553	Fail
0.0082	35479	205703	579	Fail
0.0085	32952	199775	606	Fail
0.0087	30515	194124	636	Fail
0.0090	28432	188695	663	Fail
0.0092	26493	183487	692	Fail
0.0095	24747	178279	720	Fail
0.0098	23130	173293	749	Fail
0.0100	21700	168695	777	Fail
0.0103	20332	163930	806	Fail
0.0105	19113	159609	835	Fail
0.0108	17872	155233	868	Fail
0.0110	16725	150801	901	Fail
0.0113	15645	146812	938	Fail
0.0116	14637	142712	975	Fail
0.0118	13728	138779	1010	Fail
0.0121	12903	135178	1047	Fail
0.0123	12111	131521	1085	Fail
0.0126	11396	127920	1122	Fail
0.0128	10654	124374	1167	Fail
0.0131	10011	121106	1209	Fail
0.0134	9363	117837	1258	Fail
0.0136	8753	114458	1307	Fail
0.0139	8210	111632	1359	Fail
0.0141	7734	108530	1403	Fail
0.0144	7241	105538	1457	Fail
0.0146	6798	102879	1513	Fail
0.0149	6426	100164	1558	Fail
0.0152	6111	97450	1594	Fail
0.0154	5834	94957	1627	Fail
0.0157	5557	92408	1662	Fail
0.0159	5267	90026	1709	Fail
0.0162	5011	87644	1749	Fail
0.0164	4790	85317	1781	Fail
0.0167	4531	82990	1831	Fail
0.0169	4345	80830	1860	Fail
0.0172	4160	78724	1892	Fail
0.0175	3937	76564	1944	Fail
0.0177	3719	74625	2006	Fail
0.0180	3537	72686	2055	Fail
0.0182	3365	70802	2104	Fail
0.0185	3227	68974	2137	Fail
0.0187	3091	67256	2175	Fail
0.0190	2966	65539	2209	Fail
0.0193	2850	63877	2241	Fail
0.0195	2741	62270	2271	Fail
0.0198	2603	60664	2330	Fail
0.0200	2477	59112	2386	Fail
0.0203	2360	57617	2441	Fail

0.0205	2267	56065	2473	Fail
0.0208	2159	54547	2526	Fail
0.0211	2059	53234	2585	Fail
0.0213	1949	51833	2659	Fail
0.0216	1835	50420	2747	Fail
0.0218	1749	49096	2807	Fail
0.0221	1659	47805	2881	Fail
0.0223	1578	46559	2950	Fail
0.0226	1510	45467	3011	Fail
0.0229	1445	44265	3063	Fail
0.0231	1367	43091	3152	Fail
0.0234	1296	42021	3242	Fail
0.0236	1242	41068	3306	Fail
0.0239	1182	40027	3386	Fail
0.0241	1128	38958	3453	Fail
0.0244	1082	37999	3511	Fail
0.0247	1026	37046	3610	Fail
0.0249	976	36055	3694	Fail
0.0252	925	35207	3806	Fail
0.0254	872	34260	3928	Fail
0.0257	819	33390	4076	Fail
0.0259	772	32570	4218	Fail
0.0262	718	31711	4416	Fail
0.0265	668	30941	4631	Fail
0.0267	629	30199	4801	Fail
0.0270	589	29434	4997	Fail
0.0272	549	28731	5233	Fail
0.0275	507	28033	5529	Fail
0.0277	473	27307	5773	Fail
0.0280	428	26565	6206	Fail
0.0282	393	25916	6594	Fail
0.0285	363	25257	6957	Fail
0.0288	329	24642	7489	Fail
0.0290	300	24033	8011	Fail
0.0293	281	23457	8347	Fail
0.0295	264	22869	8662	Fail
0.0298	248	22299	8991	Fail
0.0300	233	21811	9360	Fail
0.0303	218	21324	9781	Fail
0.0306	205	20820	10156	Fail
0.0308	187	20315	10863	Fail
0.0311	163	19839	12171	Fail
0.0313	142	19335	13616	Fail
0.0316	131	18886	14416	Fail
0.0318	117	18443	15763	Fail
0.0321	105	17989	17132	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #3

On-line facility volume:	0.0213 acre-feet
On-line facility target flow:	0.0118 cfs.
Adjusted for 15 min:	0.0118 cfs.
Off-line facility target flow:	0.0065 cfs.
Adjusted for 15 min:	0.0065 cfs.

LID Report

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

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

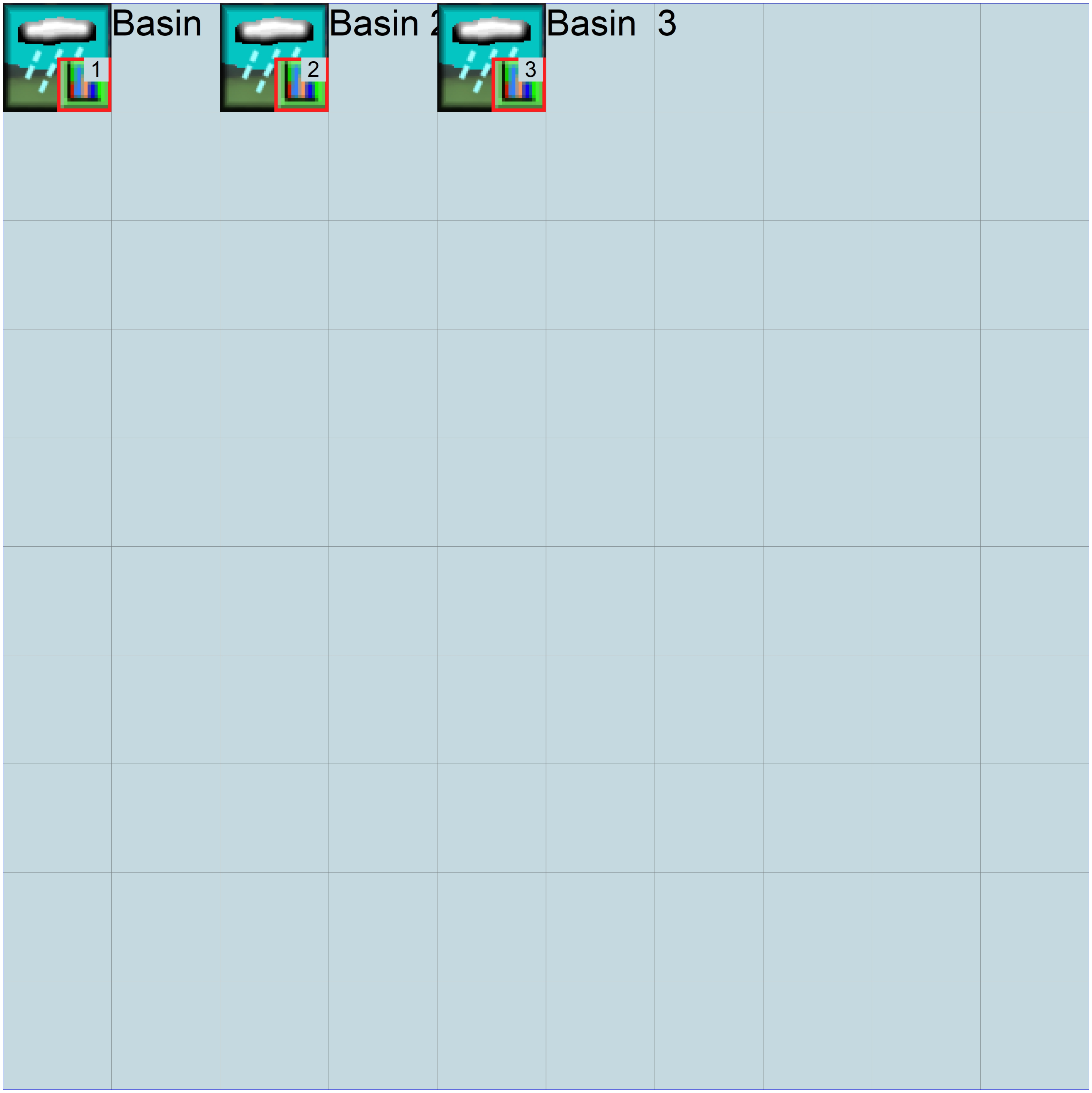
IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

Mitigated UCI File

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

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

www.clearcreeksolutions.com

APPENDIX E

Conveyance Analysis

Conveyance 12" @ 0.50%

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012
Channel Slope	0.005 ft/ft
Normal Depth	12.0 in
Diameter	12.0 in
Discharge	2.73 cfs

Results

Discharge	2.73 cfs
Normal Depth	12.0 in
Flow Area	0.8 ft²
Wetted Perimeter	3.1 ft
Hydraulic Radius	3.0 in
Top Width	0.00 ft
Critical Depth	8.5 in
Percent Full	100.0 %
Critical Slope	0.007 ft/ft
Velocity	3.47 ft/s
Velocity Head	0.19 ft
Specific Energy	1.19 ft
Froude Number	(N/A)
Maximum Discharge	2.94 cfs
Discharge Full	2.73 cfs
Slope Full	0.005 ft/ft
Flow Type	Critical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	8.5 in
Channel Slope	0.005 ft/ft
Critical Slope	0.007 ft/ft

Conveyance 12" Pipe @ 1.14%

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012
Channel Slope	0.014 ft/ft
Normal Depth	12.0 in
Diameter	12.0 in
Discharge	4.57 cfs

Results

Discharge	4.57 cfs
Normal Depth	12.0 in
Flow Area	0.8 ft²
Wetted Perimeter	3.1 ft
Hydraulic Radius	3.0 in
Top Width	0.00 ft
Critical Depth	10.7 in
Percent Full	100.0 %
Critical Slope	0.012 ft/ft
Velocity	5.81 ft/s
Velocity Head	0.53 ft
Specific Energy	1.53 ft
Froude Number	(N/A)
Maximum Discharge	4.91 cfs
Discharge Full	4.57 cfs
Slope Full	0.014 ft/ft
Flow Type	Critical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	10.7 in
Channel Slope	0.014 ft/ft
Critical Slope	0.012 ft/ft