STORM DRAINAGE REPORT

Shao Short Plat

2137 Shaw Road

Puyallup, WA 98374

Prepared For:

Mitch Shao

12319 NE 68th Place

Kirkland, WA 98033

Date: January 17, 2025

TEBALDI ENGINEERING, LLC

P.O. Box 121, Sumner, WA 98390 (206) 450-5096

www.tebaldiengineering.com

ENGINEER'S CERTIFICATION

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

Chris M. Tebaldi, P.E.

1/17/25

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1.0 PROJECT OVERVIEW

The proposed project site is located within a portion of Section 2, Township 19 North, Range 4 East of the Willamette Meridian with a total project site area of 1,63 acres. More specifically, the site is located at 2317 Shaw Road, Puyallup, WA on tax parcel numbers 0419021061. See Figure 1.1-Vicinity Map in this section for the location of the proposed project site.

The proposed development includes a 4 lot short plat along with the associated frontage improvements, driveway and utilities. The project will involve the removal and disturbance of existing on-site soils and vegetation, and installation of site improvements required for development. The site is gently sloped, with approximately 40 feet of topographic relief from west to east. The existing site contains one storm drainage conveyance line along the western boundary.

The project site consists of a single Threshold Discharge Area and intends to match the existing drainage patterns on site. Under this proposal, the project contains 0.42 acres of new impervious surface, which is subject to all minimum requirements as specified in the flow chart (Figure 1.2) of this report. As part of the drainage requirements, the project intends to infiltrate all runoff from the improvements associated with the development. This Stormwater Site Plan will serve to address the drainage requirements contained within the 2019 Department of Ecology Stormwater Management Manual for Western Washington and City of Puyallup requirements. Please see the remainder of this plan for the project's design intent for mitigating any adverse impacts as a result of on-site improvements.

Area Summary		
	Pre-Developed	**Developed**
Parcel Area	70,999 SF	70,999 SF
Project Area (clearing limits)	43,000 SF	24,577 SF
Pervious	-	7,746 SF
Driveway (PGIS)*	-	8,200 SF
Buildings**	-	9,000 SF
Off-site Sidewalk	-	1,223 SF
Total Impervious	-	18,423 SF

***Assumes 2,700 SF for lot 2, 1,500 SF for lot 3, and 4,000 SF for lot 4.**
****Assumes 3,000 SF of roof area**

A. ANALYSIS OF THE MINIMUM REQUIREMENTS

Minimum Requirement No. 1: Preparation of Stormwater Site Plan:
Response: The Stormwater Site Plan has been prepared pursuant to the City of Puyallup Stormwater Requirements and the 2019 Department of Ecology Surface Water Management Manual for Western Washington.

Minimum Requirement No. 2: Construction Stormwater Pollution Prevention:
Response: A Stormwater Pollution Prevention Plan (SWPPP) has been prepared pursuant to the 2019 Department of Ecology Surface Water Management Manual for Western Washington.

Minimum Requirement No. 3: Source Control of Pollution:
Response: The project will implement source control BMPs associated in accordance with the 2019 Department of Ecology Surface Water Management Manual for Western Washington. An Operations and Maintenance manual has been prepared as a part of this project.

Minimum Requirement No. 4: Preservation of Natural Drainage System and Outfalls:
Response: In the existing condition, stormwater generally sheet flows two directions, west to Shaw Road and east to a natural conveyance in Upper Deer Creek. All runoff associated with the development is expected to be infiltrated and any bypass will be done such that the post-developed discharge off-site will be less than the pre-developed discharge.

Minimum Requirement No. 5: On-Site Stormwater Management:
Response: The proposed project is subject to City of Puyallup requirements which follow the 2019 Department of Ecology Surface Water Management Manual for Western Washington. The proposed project will meet the Low Impact Development Performance Standard.

Minimum Requirement No. 6: Runoff Treatment:
Response: The proposed project exceeds more than 5,000 square feet, therefore, water quality treatment will be required. Water quality requirements will be met in accordance with the stormwater manual.

Minimum Requirement No. 7: Flow Control:
Response: Flow control applies to the project. Flow control requirements will be met through the use of infiltration.

Minimum Requirement No. 8: Wetland Protection:
Response: The project does not discharge to any downstream wetlands.

Minimum Requirement No. 9: Operations and Maintenance:
Response: An Operations and Maintenance Manual has been prepared that provides guidance on the requirements to maintain stormwater BMPs.

Minimum Requirement No. 10: Financial Liability
Response: All required financial guarantees/bonds will be provided for the proposed project.

TEBALDI ENGINEERING, LLC PO BOX 121 SUMNER, WA 98390	FOR: SHAO SHORT PLAT	JOB #
	TITLE: VICINITY MAP	

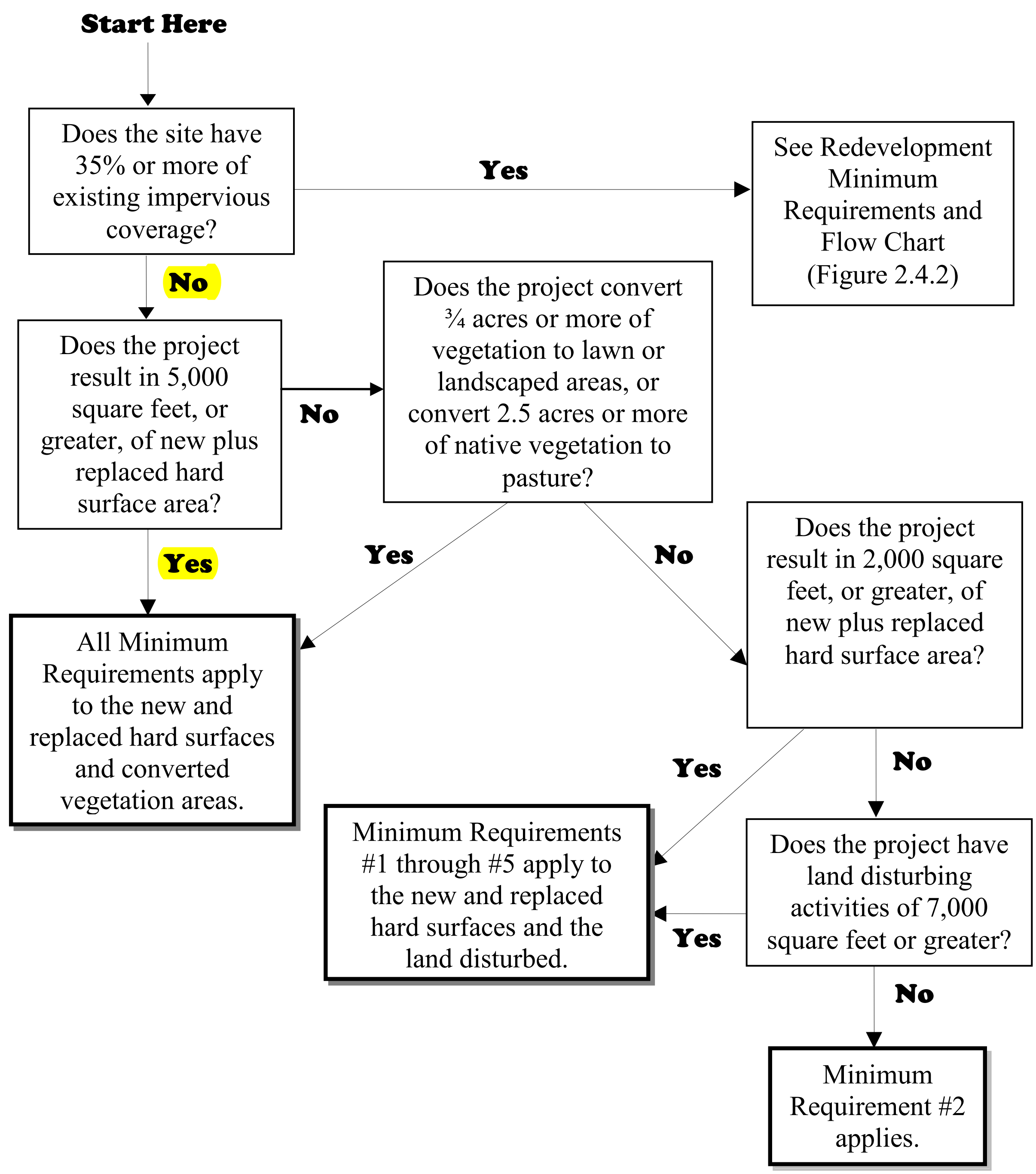


Figure 2.4.1 – Flow Chart for Determining Requirements for New Development

2.0 EXISTING CONDITIONS SUMMARY

The project site is located at 2317 Shaw Road, Puyallup, WA. The site is abutted by single family residences to the north and east, 24th Avenue Court SE to the south and Shaw Road E to the west. The site is currently occupied by a single-family residence and the associated driveway. The site generally slopes from west to east with slopes ranging from 0 to 30 percent.

Stormwater runoff for the west basin generally flows west to Shaw Road E. Runoff flows north in a series of pipes and catch basins where it discharges into Upper Deer Creek.

Stormwater runoff for the east basin generally flows east to a natural conveyance east of the subject property. Runoff continues down the natural conveyance where it discharges to Upper Deer Creek.

There is no upstream flow contributing to the property as the southern edge of the property discharges into the 24th Avenue Ct SE drainage system.

The site does not contain any on-site critical areas.

On-site native soils are classified as Indianola loamy sand and Kitsap silt loam. The soils report done for the subject property identified more sandy-gravelly soils during exploration that are suitable for infiltration. See section 3.0 of this report for additional information.

See Figure 2.1 - Soils Map.

Soil Map—Pierce County Area, Washington
(Soils Map)

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 20, Aug 27, 2024

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
18C	Indianola loamy sand, 5 to 15 percent slopes	0.3	20.1%
20C	Kitsap silt loam, 8 to 15 percent slopes	1.3	79.9%
Totals for Area of Interest		**1.6**	**100.0%**

3.0 INFILTRATION RATE / SOILS REPORT

An Infiltration Rate Report has been prepared by Ages Engineering dated December 24, 2024. On-site soils were identified to be tan sand. A long-term design infiltration rate was determined by the geotechnical engineer using the grain size analysis method to be 4.2 inches/hr.

See Infiltration Rate Report included in Appendix C of this report.

4.0 WELLS AND SEPTIC SYSTEM

There are no wells or septic systems within the vicinity of the project.

5.0 FUEL TANKS

No existing in-use or abandoned fuel tanks were identified on or adjacent to the project site.

6.0 SUBBASIN DESCRIPTION

There is no upstream flow contributing to the property as the southern edge of the property discharges into the 24th Avenue Ct SE drainage system.

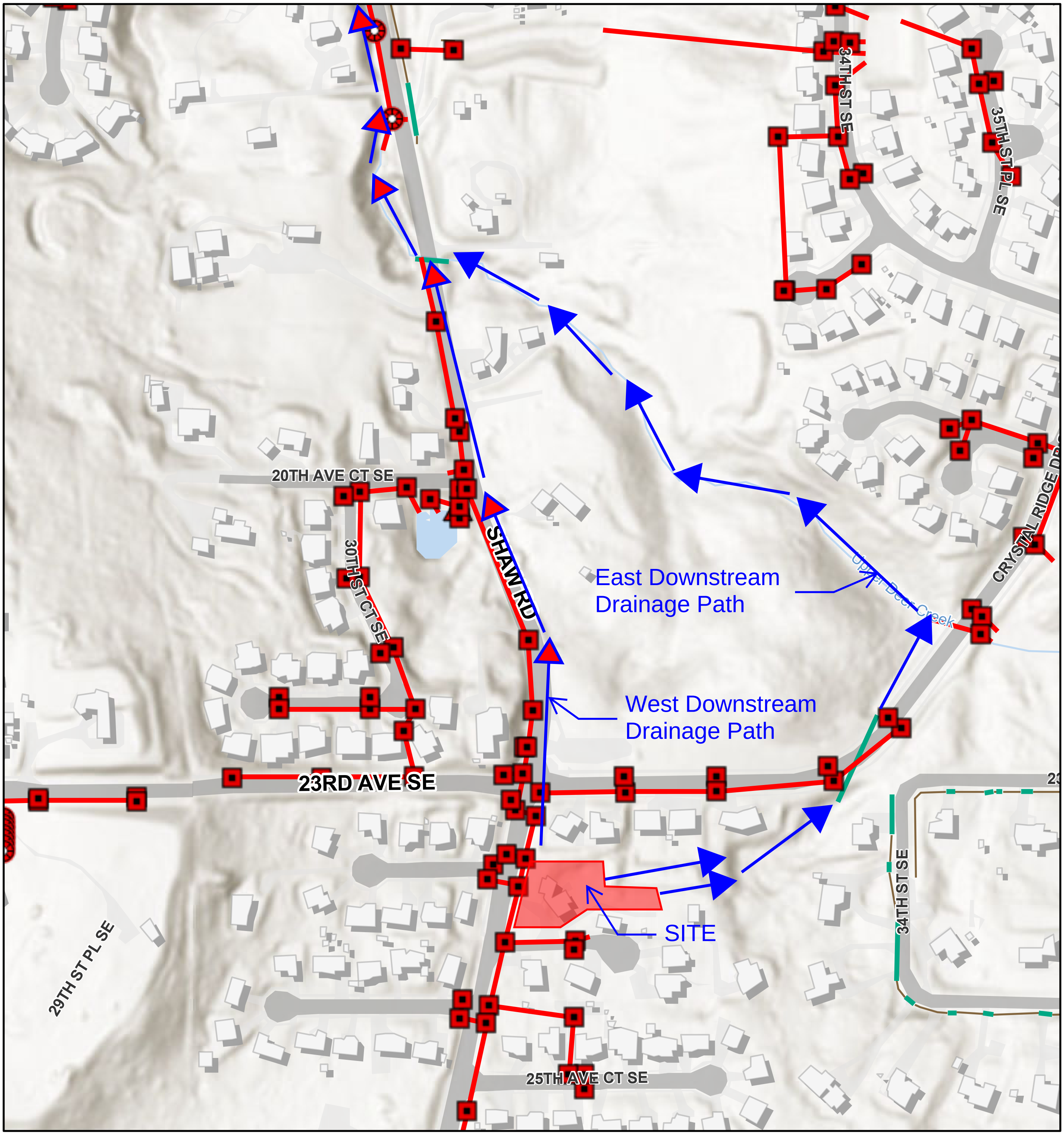
Stormwater runoff for the west basin generally flows west to Shaw Road E. The downstream drainage path consists of the sheetflow leaving the site and flowing west into Shaw Road E. Runoff flows north in Shaw Road E in a series of pipes and catch basins where it discharges into Upper Deer Creek. Runoff continues to flow north and west where it discharges into the Puyallup River.

Stormwater runoff for the east basin generally flows east to a natural conveyance east of the subject property. Runoff continues down the natural conveyance where it discharges to Upper Deer Creek. Runoff continues to flow north and west where it discharges into the Puyallup River.

A majority of the runoff created by the proposed development will be infiltrated on-site resulting in a reduction of downstream flows from the subject property.

See Figure 6.1 – Downstream Drainage Map.

Downstream Drainage Map



1/18/2025, 8:43:38 AM

Manholes		Pipes	
Inlets		Culverts	
Control Structures		Channels	

1:5,404

0 170 340 680 ft

0 50 100 200 m

Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

7.0 FLOODPLAIN ANALYSIS

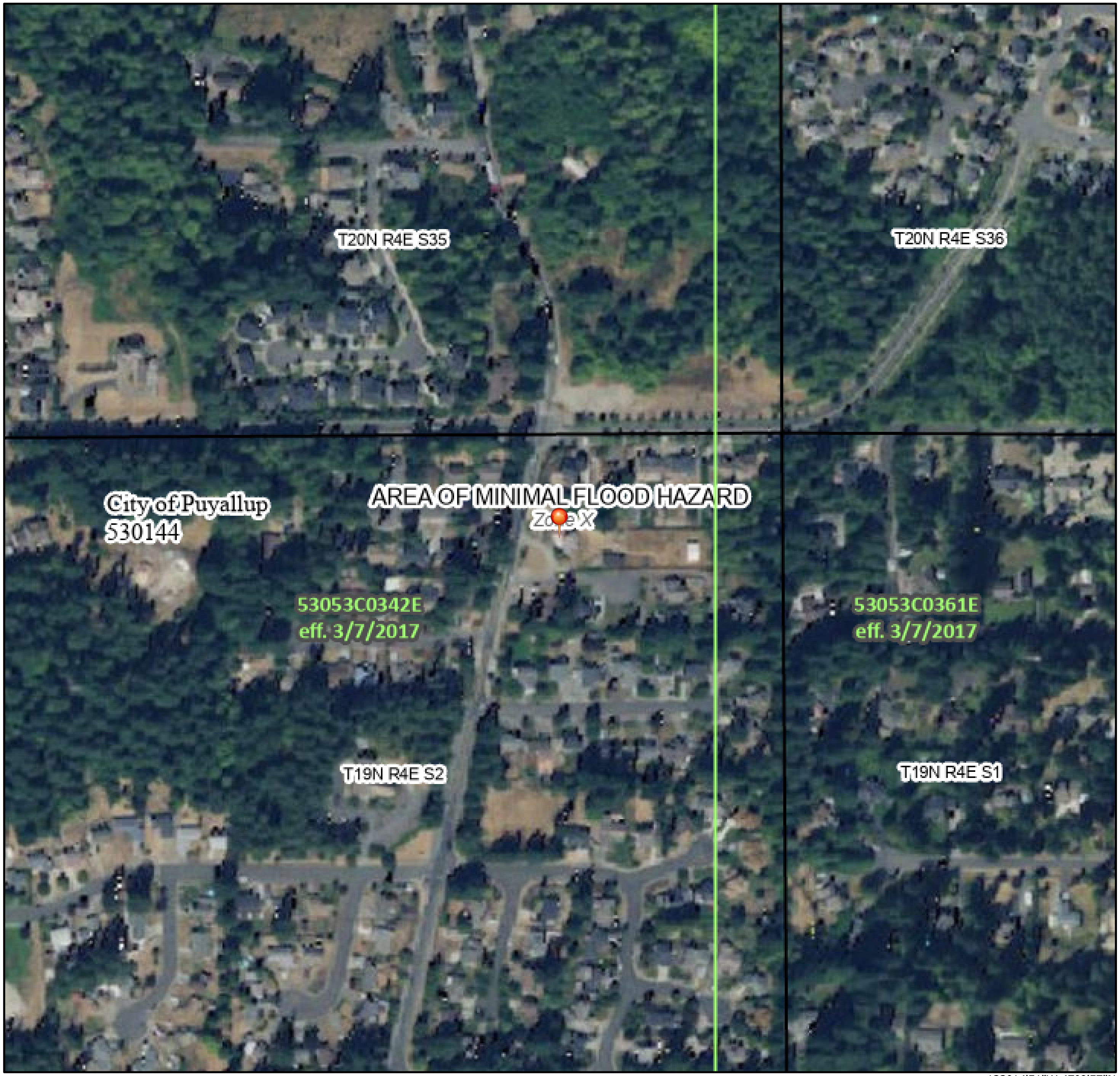
The project site resides in Panel 53053C0342E, effective March 6, 2017, of FEMA's National Flood Hazard Layer, and is designated Zone X at minimal risk for flood hazard. The site does not Reside in and is not near the 100-year flood plain.

See Figure 7.1 – FEMA floodplain map.

National Flood Hazard Layer FIRMette

FEMA

122°15'28"W 47°10'21"N



122°14'51"W 47°9'57"N

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

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/18/2025 at 5:17 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

8.0 AESTHETIC CONSIDERATIONS FOR FACILITIES

There are no proposed above-ground or surface drainage facilities associated with the project. The storm drainage facilities are proposed to be located below ground and installed in accordance with City of Puyallup requirements.

9.0 FACILITY SIZING AND DOWNSTREAM ANALYSIS

A. EXISTING SITE HYDROLOGY

The project site is located at 2317 Shaw Road, Puyallup, WA. The site is abutted by single family residences to the north and east, 24th Avenue Court SE to the south and Shaw Road E to the west. The site is currently occupied by a single-family residence and the associated driveway. The site generally slopes from west to east with slopes ranging from 0 to 30 percent.

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Stormwater runoff for the east basin generally flows east to a natural conveyance east of the subject property. Runoff continues down the natural conveyance where it discharges to Upper Deer Creek.

B. DEVELOPED SITE HYDROLOGY

The proposed development consists of a 4 lot short plat along with the associated frontage improvements, driveway and utilities. A majority of the runoff generated from the development will be collected and infiltrated on-site infiltration trenches. The trenches have been sized to meet the LID performance standard and flow control requirements. There will be some bypass of impervious sidewalk and some converted vegetation. See developed basin map in this section. The bypass of flows have been accounted for in the WWHM stormwater model. See stormwater runoff table below:

Area Summary		
	Pre-Developed	**Developed**
Parcel Area	70,999 SF	70,999 SF
Project Area (clearing limits)	43,000 SF	24,577 SF
Pervious	-	7,746 SF
Driveway (PGIS)*	-	8,200 SF
Buildings**	-	9,000 SF
Off-site Sidewalk	-	1,223 SF
Total Impervious	-	18,423 SF

***Assumes 2,700 SF for lot 2, 1,500 SF for lot 3, and 4,000 SF for lot 4.**

****Assumes 3,000 SF of roof area**

The general site topography and drainage patterns in the developed condition will maintain the natural drainage patterns present on site.

C. LOW IMPACT DEVELOPMENT FEATURES

Low impact development (LID) features are required for this project in accordance with the 2014 Ecology Stormwater Manual and Minimum Requirement No. 5. Compost amended topsoil is proposed for all disturbed soils that will be vegetated as a part of the project. The project proposed to meet the LID performance standard as the method of meeting minimum requirement No. 5.

D. PERFORMANCE STANDARDS AND GOALS

The project is subject to requirements pertaining to Low Impact Development and Flow Control. The infiltration trenches have been designed to infiltrate the full influent runoff file. The overall project has been designed to meet the LID performance standards which matches post-developed discharge durations to the pre-developed for the range of discharges between 8% of the 2-year storm and 50% of the 2-year storm. The project has also been designed to meet the flow control standard which matches post-developed discharge durations to the pre-developed for the range of discharges between 50% of the 2-year storm to the full 50-year storm. Water quality will be designed to comply with the requirements of the 2019 Department of Ecology Stormwater Management Manual for Western Washington.

E. FLOW CONTROL SYSTEM

Flow control facilities will be achieved through the use of infiltration trenches. Runoff from the tributary surfaces will be collected and routed to the proposed infiltration gallery.

F. WATER QUALITY SYSTEM

Water quality treatment will be provided for new pollution generating impervious surfaces. The underlying soils will be utilized to treat stormwater in accordance with the 2019 Department of Ecology Stormwater Management Manual for Western Washington.

G. CONVEYANCE SYSTEM ANALYSIS AND DESIGN

Conveyance sizing has been done to demonstrate that a 6-inch pipe can convey the 100-year design flow.

APPENDIX A

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: s

Site Name:	Shao
Site Address:	
City:	
Report Date:	1/17/2025
Gage:	40 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2023/03/31
Version:	4.2.19

POC Thresholds

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

Landuse Basin Data
Predeveloped Land Use

Predev

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	1
Pervious Total	1
Impervious Land Use	acre
Impervious Total	0
Basin Total	1

Mitigated Land Use

Bypass

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.59
Pervious Total	0.59
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.59

Lot Infiltration Trench

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.0689
DRIVEWAYS FLAT	0.0689
Impervious Total	0.1378
Basin Total	0.1378

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	80.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	3
Pour Space of material for first layer:	0.3
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	4.2
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	58.495
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	58.495
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0

Discharge Structure
Riser Height: 3 ft.
Riser Diameter: 10 in.
Element Flows To:
Outlet 1 Outlet 2

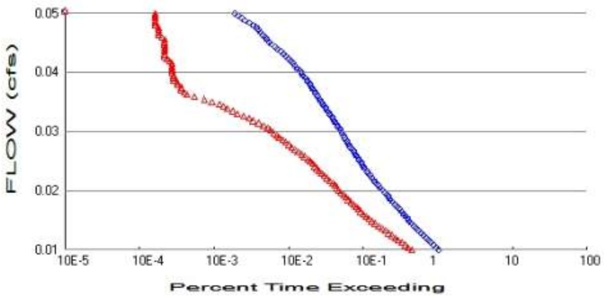
Gravel Trench Bed Hydraulic Table

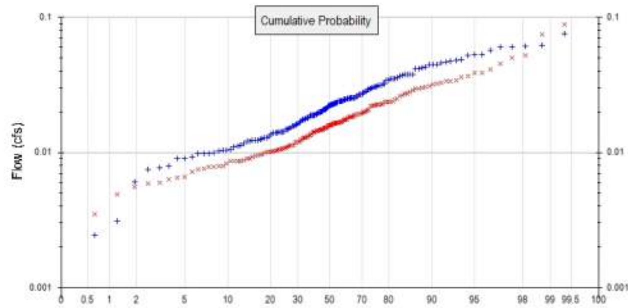
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.009	0.000	0.000	0.000
0.0444	0.009	0.000	0.000	0.038
0.0889	0.009	0.000	0.000	0.038
0.1333	0.009	0.000	0.000	0.038
0.1778	0.009	0.000	0.000	0.038
0.2222	0.009	0.000	0.000	0.038
0.2667	0.009	0.000	0.000	0.038
0.3111	0.009	0.000	0.000	0.038
0.3556	0.009	0.001	0.000	0.038
0.4000	0.009	0.001	0.000	0.038
0.4444	0.009	0.001	0.000	0.038
0.4889	0.009	0.001	0.000	0.038
0.5333	0.009	0.001	0.000	0.038
0.5778	0.009	0.001	0.000	0.038
0.6222	0.009	0.001	0.000	0.038
0.6667	0.009	0.001	0.000	0.038
0.7111	0.009	0.002	0.000	0.038
0.7556	0.009	0.002	0.000	0.038
0.8000	0.009	0.002	0.000	0.038
0.8444	0.009	0.002	0.000	0.038
0.8889	0.009	0.002	0.000	0.038
0.9333	0.009	0.002	0.000	0.038
0.9778	0.009	0.002	0.000	0.038
1.0222	0.009	0.002	0.000	0.038

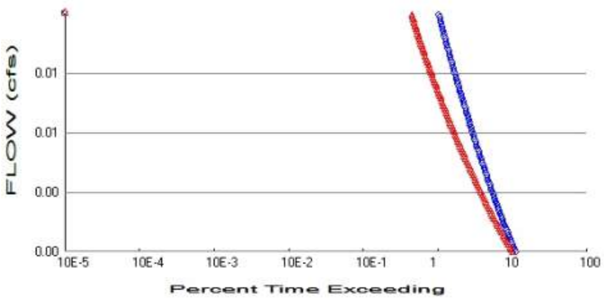
1.0667	0.009	0.002	0.000	0.038
1.1111	0.009	0.003	0.000	0.038
1.1556	0.009	0.003	0.000	0.038
1.2000	0.009	0.003	0.000	0.038
1.2444	0.009	0.003	0.000	0.038
1.2889	0.009	0.003	0.000	0.038
1.3333	0.009	0.003	0.000	0.038
1.3778	0.009	0.003	0.000	0.038
1.4222	0.009	0.003	0.000	0.038
1.4667	0.009	0.004	0.000	0.038
1.5111	0.009	0.004	0.000	0.038
1.5556	0.009	0.004	0.000	0.038
1.6000	0.009	0.004	0.000	0.038
1.6444	0.009	0.004	0.000	0.038
1.6889	0.009	0.004	0.000	0.038
1.7333	0.009	0.004	0.000	0.038
1.7778	0.009	0.004	0.000	0.038
1.8222	0.009	0.005	0.000	0.038
1.8667	0.009	0.005	0.000	0.038
1.9111	0.009	0.005	0.000	0.038
1.9556	0.009	0.005	0.000	0.038
2.0000	0.009	0.005	0.000	0.038
2.0444	0.009	0.005	0.000	0.038
2.0889	0.009	0.005	0.000	0.038
2.1333	0.009	0.005	0.000	0.038
2.1778	0.009	0.006	0.000	0.038
2.2222	0.009	0.006	0.000	0.038
2.2667	0.009	0.006	0.000	0.038
2.3111	0.009	0.006	0.000	0.038
2.3556	0.009	0.006	0.000	0.038
2.4000	0.009	0.006	0.000	0.038
2.4444	0.009	0.006	0.000	0.038
2.4889	0.009	0.006	0.000	0.038
2.5333	0.009	0.007	0.000	0.038
2.5778	0.009	0.007	0.000	0.038
2.6222	0.009	0.007	0.000	0.038
2.6667	0.009	0.007	0.000	0.038
2.7111	0.009	0.007	0.000	0.038
2.7556	0.009	0.007	0.000	0.038
2.8000	0.009	0.007	0.000	0.038
2.8444	0.009	0.007	0.000	0.038
2.8889	0.009	0.008	0.000	0.038
2.9333	0.009	0.008	0.000	0.038
2.9778	0.009	0.008	0.000	0.038
3.0222	0.009	0.008	0.029	0.038
3.0667	0.009	0.009	0.151	0.038
3.1111	0.009	0.009	0.323	0.038
3.1556	0.009	0.009	0.523	0.038
3.2000	0.009	0.010	0.733	0.038
3.2444	0.009	0.010	0.933	0.038
3.2889	0.009	0.011	1.107	0.038
3.3333	0.009	0.011	1.242	0.038
3.3778	0.009	0.011	1.337	0.038
3.4222	0.009	0.012	1.421	0.038
3.4667	0.009	0.012	1.494	0.038
3.5111	0.009	0.013	1.563	0.038
3.5556	0.009	0.013	1.630	0.038
3.6000	0.009	0.013	1.694	0.038

3.6444	0.009	0.014	1.755	0.038
3.6889	0.009	0.014	1.815	0.038
3.7333	0.009	0.015	1.873	0.038
3.7778	0.009	0.015	1.929	0.038
3.8222	0.009	0.016	1.983	0.038
3.8667	0.009	0.016	2.036	0.038
3.9111	0.009	0.016	2.087	0.038
3.9556	0.009	0.017	2.138	0.038
4.0000	0.009	0.017	2.187	0.038

Analysis Results
POC 1







+ Predeveloped x Mitigated

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

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.59
Total Impervious Area: 0.1378

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.022594
5 year	0.034764
10 year	0.041798
25 year	0.049417
50 year	0.054318
100 year	0.058571

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.015507
5 year	0.024655
10 year	0.03158
25 year	0.041282
50 year	0.049188
100 year	0.05767

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1902	0.018	0.012
1903	0.014	0.011
1904	0.024	0.031
1905	0.012	0.009
1906	0.006	0.005
1907	0.035	0.024
1908	0.025	0.017
1909	0.025	0.016
1910	0.035	0.023
1911	0.023	0.016
1912	0.076	0.088
1913	0.035	0.024
1914	0.009	0.006
1915	0.015	0.011
1916	0.022	0.016
1917	0.008	0.007
1918	0.024	0.016
1919	0.019	0.013
1920	0.023	0.016
1921	0.025	0.017
1922	0.025	0.019
1923	0.020	0.015
1924	0.010	0.009
1925	0.012	0.010
1926	0.022	0.015
1927	0.016	0.011
1928	0.017	0.012
1929	0.035	0.024
1930	0.022	0.015
1931	0.021	0.015
1932	0.016	0.012
1933	0.018	0.015
1934	0.046	0.033
1935	0.021	0.014
1936	0.019	0.013
1937	0.031	0.023
1938	0.019	0.014
1939	0.002	0.003
1940	0.021	0.014
1941	0.013	0.009
1942	0.031	0.022
1943	0.016	0.011
1944	0.032	0.030
1945	0.025	0.018
1946	0.015	0.013
1947	0.010	0.008
1948	0.048	0.032
1949	0.042	0.029
1950	0.012	0.009
1951	0.016	0.011
1952	0.062	0.046
1953	0.057	0.036
1954	0.020	0.014
1955	0.018	0.012
1956	0.009	0.007
1957	0.030	0.019

1958	0.060	0.039
1959	0.038	0.026
1960	0.011	0.008
1961	0.038	0.027
1962	0.020	0.015
1963	0.010	0.009
1964	0.010	0.010
1965	0.042	0.028
1966	0.012	0.009
1967	0.019	0.015
1968	0.020	0.017
1969	0.019	0.014
1970	0.029	0.020
1971	0.045	0.029
1972	0.029	0.019
1973	0.038	0.026
1974	0.021	0.017
1975	0.047	0.034
1976	0.025	0.022
1977	0.011	0.008
1978	0.042	0.027
1979	0.012	0.009
1980	0.024	0.016
1981	0.022	0.015
1982	0.011	0.008
1983	0.038	0.025
1984	0.017	0.015
1985	0.027	0.019
1986	0.023	0.016
1987	0.043	0.032
1988	0.027	0.017
1989	0.025	0.017
1990	0.028	0.019
1991	0.023	0.017
1992	0.029	0.018
1993	0.030	0.020
1994	0.045	0.030
1995	0.010	0.008
1996	0.049	0.033
1997	0.020	0.013
1998	0.024	0.018
1999	0.002	0.006
2000	0.018	0.013
2001	0.010	0.008
2002	0.032	0.033
2003	0.028	0.019
2004	0.024	0.016
2005	0.045	0.050
2006	0.014	0.010
2007	0.015	0.010
2008	0.024	0.016
2009	0.016	0.011
2010	0.014	0.010
2011	0.013	0.009
2012	0.019	0.019
2013	0.014	0.010
2014	0.010	0.008
2015	0.019	0.022

2016	0.008	0.006
2017	0.034	0.022
2018	0.061	0.041
2019	0.061	0.052
2020	0.019	0.014
2021	0.031	0.021
2022	0.013	0.009
2023	0.026	0.018
2024	0.052	0.074
2025	0.023	0.017
2026	0.037	0.025
2027	0.014	0.012
2028	0.012	0.010
2029	0.025	0.017
2030	0.046	0.030
2031	0.015	0.011
2032	0.009	0.007
2033	0.014	0.011
2034	0.014	0.011
2035	0.053	0.036
2036	0.028	0.018
2037	0.008	0.006
2038	0.023	0.020
2039	0.003	0.003
2040	0.013	0.011
2041	0.018	0.013
2042	0.053	0.039
2043	0.026	0.020
2044	0.034	0.022
2045	0.023	0.015
2046	0.027	0.018
2047	0.020	0.014
2048	0.026	0.018
2049	0.023	0.017
2050	0.017	0.012
2051	0.024	0.023
2052	0.014	0.010
2053	0.025	0.017
2054	0.031	0.024
2055	0.013	0.010
2056	0.011	0.009
2057	0.018	0.013
2058	0.021	0.014
2059	0.037	0.024

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0760	0.0881
2	0.0622	0.0740
3	0.0613	0.0520
4	0.0606	0.0500
5	0.0601	0.0456
6	0.0565	0.0409
7	0.0533	0.0388
8	0.0528	0.0385
9	0.0525	0.0364
10	0.0487	0.0360

11	0.0481	0.0343
12	0.0472	0.0335
13	0.0463	0.0334
14	0.0461	0.0329
15	0.0447	0.0325
16	0.0446	0.0318
17	0.0445	0.0308
18	0.0430	0.0304
19	0.0422	0.0299
20	0.0418	0.0296
21	0.0415	0.0295
22	0.0379	0.0289
23	0.0377	0.0281
24	0.0376	0.0272
25	0.0376	0.0271
26	0.0373	0.0264
27	0.0368	0.0259
28	0.0354	0.0250
29	0.0350	0.0248
30	0.0350	0.0239
31	0.0349	0.0237
32	0.0343	0.0236
33	0.0340	0.0235
34	0.0325	0.0235
35	0.0322	0.0228
36	0.0312	0.0228
37	0.0311	0.0225
38	0.0311	0.0225
39	0.0306	0.0223
40	0.0304	0.0222
41	0.0299	0.0221
42	0.0294	0.0219
43	0.0292	0.0208
44	0.0290	0.0204
45	0.0282	0.0203
46	0.0281	0.0200
47	0.0277	0.0198
48	0.0269	0.0194
49	0.0269	0.0193
50	0.0266	0.0192
51	0.0262	0.0192
52	0.0261	0.0190
53	0.0255	0.0188
54	0.0253	0.0187
55	0.0253	0.0183
56	0.0252	0.0183
57	0.0252	0.0182
58	0.0251	0.0182
59	0.0250	0.0179
60	0.0250	0.0176
61	0.0247	0.0176
62	0.0247	0.0174
63	0.0245	0.0173
64	0.0242	0.0173
65	0.0241	0.0170
66	0.0241	0.0169
67	0.0241	0.0168
68	0.0239	0.0167

69	0.0239	0.0166
70	0.0234	0.0166
71	0.0233	0.0166
72	0.0232	0.0165
73	0.0230	0.0164
74	0.0229	0.0164
75	0.0227	0.0163
76	0.0226	0.0161
77	0.0225	0.0160
78	0.0225	0.0160
79	0.0224	0.0159
80	0.0221	0.0158
81	0.0219	0.0156
82	0.0213	0.0155
83	0.0212	0.0153
84	0.0209	0.0152
85	0.0209	0.0152
86	0.0207	0.0150
87	0.0204	0.0147
88	0.0201	0.0147
89	0.0200	0.0147
90	0.0200	0.0146
91	0.0199	0.0146
92	0.0197	0.0145
93	0.0192	0.0143
94	0.0191	0.0143
95	0.0191	0.0143
96	0.0189	0.0142
97	0.0189	0.0141
98	0.0188	0.0141
99	0.0188	0.0137
100	0.0187	0.0135
101	0.0183	0.0133
102	0.0180	0.0133
103	0.0180	0.0131
104	0.0177	0.0129
105	0.0175	0.0129
106	0.0175	0.0129
107	0.0172	0.0124
108	0.0171	0.0123
109	0.0167	0.0120
110	0.0163	0.0120
111	0.0160	0.0119
112	0.0159	0.0118
113	0.0157	0.0113
114	0.0157	0.0112
115	0.0153	0.0112
116	0.0150	0.0112
117	0.0148	0.0110
118	0.0148	0.0109
119	0.0143	0.0107
120	0.0142	0.0106
121	0.0142	0.0105
122	0.0141	0.0105
123	0.0139	0.0104
124	0.0139	0.0103
125	0.0139	0.0102
126	0.0136	0.0101

127	0.0133	0.0101
128	0.0129	0.0100
129	0.0129	0.0100
130	0.0126	0.0097
131	0.0126	0.0096
132	0.0123	0.0095
133	0.0123	0.0094
134	0.0122	0.0093
135	0.0122	0.0090
136	0.0121	0.0089
137	0.0116	0.0088
138	0.0113	0.0087
139	0.0112	0.0086
140	0.0110	0.0086
141	0.0106	0.0086
142	0.0104	0.0083
143	0.0103	0.0079
144	0.0102	0.0079
145	0.0099	0.0078
146	0.0098	0.0078
147	0.0098	0.0076
148	0.0098	0.0075
149	0.0092	0.0072
150	0.0091	0.0066
151	0.0090	0.0065
152	0.0079	0.0063
153	0.0077	0.0059
154	0.0075	0.0059
155	0.0060	0.0056
156	0.0031	0.0049
157	0.0024	0.0035
158	0.0016	0.0030

LID Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0018	613285	554006	90	Pass
0.0019	592787	530627	89	Pass
0.0020	573397	508356	88	Pass
0.0021	555114	487138	87	Pass
0.0022	537774	467526	86	Pass
0.0023	521098	448579	86	Pass
0.0024	505198	430352	85	Pass
0.0025	489963	413123	84	Pass
0.0026	475448	396724	83	Pass
0.0027	461543	381046	82	Pass
0.0028	447970	366198	81	Pass
0.0029	435117	352126	80	Pass
0.0030	422485	338498	80	Pass
0.0031	410297	325534	79	Pass
0.0031	398552	313291	78	Pass
0.0032	387250	301490	77	Pass
0.0033	376503	290189	77	Pass
0.0034	366143	279441	76	Pass
0.0035	356392	269303	75	Pass
0.0036	346697	259497	74	Pass
0.0037	337445	250245	74	Pass
0.0038	328415	241325	73	Pass
0.0039	319772	232793	72	Pass
0.0040	311407	224650	72	Pass
0.0041	303208	216894	71	Pass
0.0042	295452	209414	70	Pass
0.0043	287806	202212	70	Pass
0.0044	280493	195287	69	Pass
0.0045	273458	188639	68	Pass
0.0046	266643	182324	68	Pass
0.0047	259940	176229	67	Pass
0.0048	253624	170412	67	Pass
0.0049	247308	164762	66	Pass
0.0050	241214	159332	66	Pass
0.0051	235342	154125	65	Pass
0.0052	229691	149028	64	Pass
0.0053	223985	144208	64	Pass
0.0054	218500	139499	63	Pass
0.0054	213237	135011	63	Pass
0.0055	208029	130469	62	Pass
0.0056	202988	126147	62	Pass
0.0057	198113	121992	61	Pass
0.0058	193404	118003	61	Pass
0.0059	188750	114236	60	Pass
0.0060	184263	110580	60	Pass
0.0061	180052	107145	59	Pass
0.0062	175952	103710	58	Pass
0.0063	171964	100552	58	Pass
0.0064	167975	97450	58	Pass
0.0065	164152	94458	57	Pass
0.0066	160496	91577	57	Pass
0.0067	156895	88807	56	Pass
0.0068	153404	86148	56	Pass

0.0069	149970	83544	55	Pass
0.0070	146645	81051	55	Pass
0.0071	143321	78669	54	Pass
0.0072	140164	76342	54	Pass
0.0073	137006	74071	54	Pass
0.0074	133903	71965	53	Pass
0.0075	130967	69971	53	Pass
0.0076	128031	67977	53	Pass
0.0077	125150	66038	52	Pass
0.0078	122380	64209	52	Pass
0.0078	119610	62437	52	Pass
0.0079	116951	60775	51	Pass
0.0080	114347	59168	51	Pass
0.0081	111854	57506	51	Pass
0.0082	109416	55955	51	Pass
0.0083	107034	54431	50	Pass
0.0084	104763	52963	50	Pass
0.0085	102491	51473	50	Pass
0.0086	100331	50021	49	Pass
0.0087	98225	48697	49	Pass
0.0088	96120	47384	49	Pass
0.0089	94015	46121	49	Pass
0.0090	92076	44841	48	Pass
0.0091	90137	43661	48	Pass
0.0092	88309	42487	48	Pass
0.0093	86425	41323	47	Pass
0.0094	84652	40215	47	Pass
0.0095	82824	39179	47	Pass
0.0096	81162	38193	47	Pass
0.0097	79500	37179	46	Pass
0.0098	77893	36226	46	Pass
0.0099	76287	35373	46	Pass
0.0100	74735	34515	46	Pass
0.0101	73240	33695	46	Pass
0.0101	71965	32925	45	Pass
0.0102	70470	32055	45	Pass
0.0103	69140	31324	45	Pass
0.0104	67700	30542	45	Pass
0.0105	66370	29756	44	Pass
0.0106	65151	29058	44	Pass
0.0107	63877	28349	44	Pass
0.0108	62714	27745	44	Pass
0.0109	61495	27047	43	Pass
0.0110	60387	26470	43	Pass
0.0111	59168	25839	43	Pass
0.0112	57949	25224	43	Pass
0.0113	56896	24692	43	Pass

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0113	56896	24692	43	Pass
0.0117	52426	22177	42	Pass
0.0122	48409	20005	41	Pass
0.0126	44614	18044	40	Pass
0.0130	41257	16249	39	Pass
0.0135	38298	14742	38	Pass
0.0139	35501	13368	37	Pass
0.0143	33002	12144	36	Pass
0.0148	30531	10947	35	Pass
0.0152	28459	9895	34	Pass
0.0156	26498	8903	33	Pass
0.0161	24770	7994	32	Pass
0.0165	23130	7219	31	Pass
0.0169	21695	6548	30	Pass
0.0174	20321	6000	29	Pass
0.0178	19080	5533	28	Pass
0.0182	17878	5123	28	Pass
0.0187	16725	4752	28	Pass
0.0191	15629	4438	28	Pass
0.0196	14626	4122	28	Pass
0.0200	13734	3800	27	Pass
0.0204	12881	3496	27	Pass
0.0209	12105	3227	26	Pass
0.0213	11385	2996	26	Pass
0.0217	10665	2781	26	Pass
0.0222	9983	2600	26	Pass
0.0226	9363	2458	26	Pass
0.0230	8753	2322	26	Pass
0.0235	8199	2150	26	Pass
0.0239	7734	1965	25	Pass
0.0243	7246	1787	24	Pass
0.0248	6792	1651	24	Pass
0.0252	6415	1524	23	Pass
0.0256	6111	1411	23	Pass
0.0261	5828	1317	22	Pass
0.0265	5557	1235	22	Pass
0.0269	5265	1166	22	Pass
0.0274	5006	1082	21	Pass
0.0278	4782	1005	21	Pass
0.0282	4531	909	20	Pass
0.0287	4341	825	19	Pass
0.0291	4155	742	17	Pass
0.0295	3938	666	16	Pass
0.0300	3713	609	16	Pass
0.0304	3537	557	15	Pass
0.0309	3361	500	14	Pass
0.0313	3228	460	14	Pass
0.0317	3083	410	13	Pass
0.0322	2966	385	12	Pass
0.0326	2850	350	12	Pass
0.0330	2738	314	11	Pass
0.0335	2605	291	11	Pass
0.0339	2477	252	10	Pass

0.0343	2359	220	9	Pass
0.0348	2266	185	8	Pass
0.0352	2159	163	7	Pass
0.0356	2056	138	6	Pass
0.0361	1949	113	5	Pass
0.0365	1835	99	5	Pass
0.0369	1749	83	4	Pass
0.0374	1659	74	4	Pass
0.0378	1579	65	4	Pass
0.0382	1510	52	3	Pass
0.0387	1442	41	2	Pass
0.0391	1367	30	2	Pass
0.0395	1296	24	1	Pass
0.0400	1241	22	1	Pass
0.0404	1182	20	1	Pass
0.0408	1129	20	1	Pass
0.0413	1079	18	1	Pass
0.0417	1026	18	1	Pass
0.0422	976	16	1	Pass
0.0426	922	16	1	Pass
0.0430	872	16	1	Pass
0.0435	819	15	1	Pass
0.0439	771	15	1	Pass
0.0443	717	15	2	Pass
0.0448	668	15	2	Pass
0.0452	629	15	2	Pass
0.0456	588	14	2	Pass
0.0461	549	13	2	Pass
0.0465	507	12	2	Pass
0.0469	471	12	2	Pass
0.0474	428	12	2	Pass
0.0478	392	12	3	Pass
0.0482	363	12	3	Pass
0.0487	329	12	3	Pass
0.0491	300	12	4	Pass
0.0495	281	12	4	Pass
0.0500	264	11	4	Pass
0.0504	248	10	4	Pass
0.0508	233	10	4	Pass
0.0513	218	10	4	Pass
0.0517	205	10	4	Pass
0.0521	186	9	4	Pass
0.0526	163	9	5	Pass
0.0530	142	9	6	Pass
0.0534	129	9	6	Pass
0.0539	117	9	7	Pass
0.0543	105	9	8	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Gravel Trench Bed 1 POC	☐	53.23			☐	100.00			
Total Volume Infiltrated		53.23	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

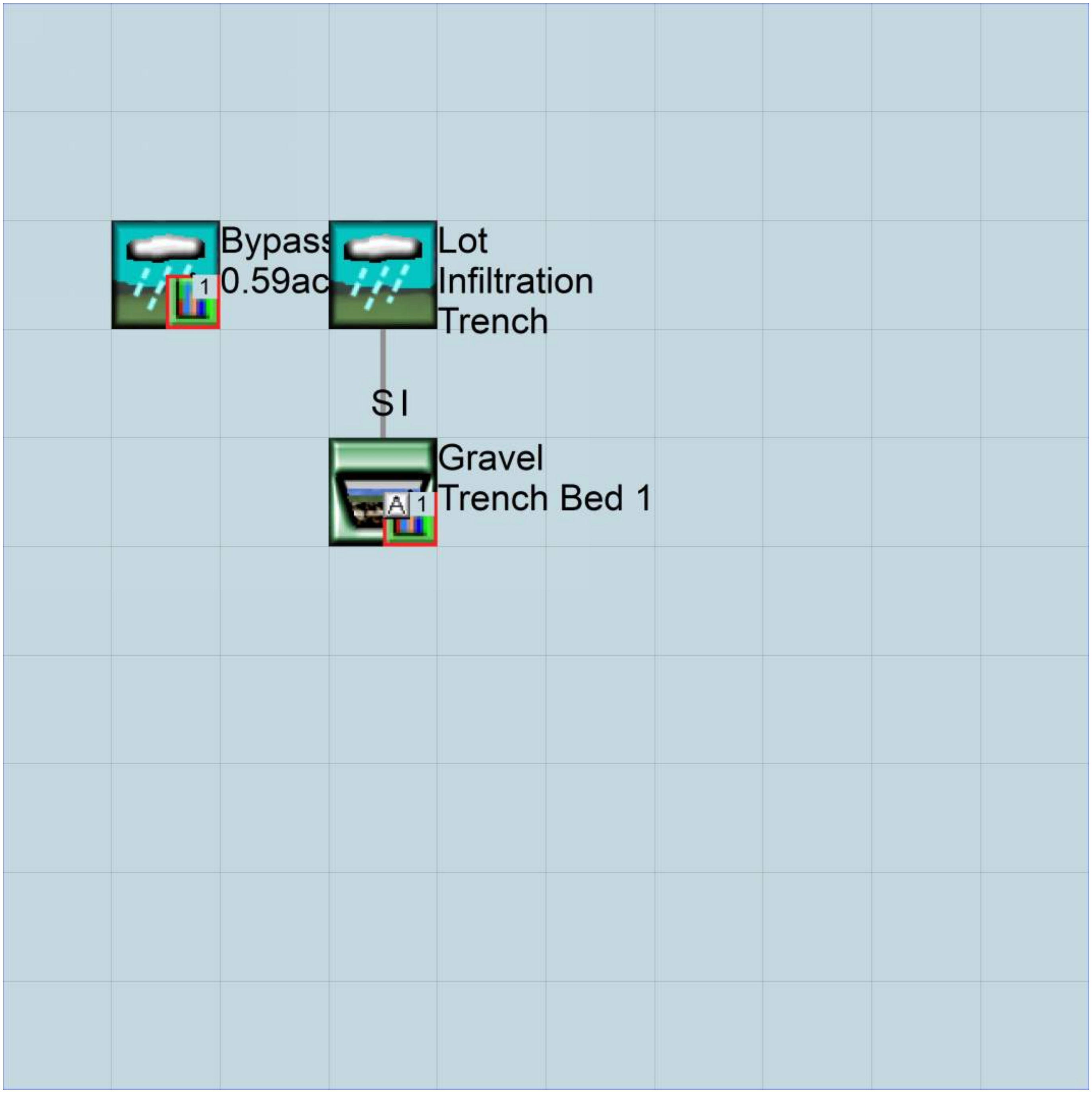
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



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   s.wdm
MESSU      25   Pres.MES
           27   Pres.L61
           28   Pres.L62
           30   POCs1.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        Predev                     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#   ***
Predev***
PERLND  10                          1     COPY   501     12
PERLND  10                          1     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   s.wdm
MESSU      25   Mits.MES
           27   Mits.L61
           28   Mits.L62
           30   POCs1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      13
      IMPLND       4
      IMPLND       5
      RCHRES       1
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Gravel Trench Bed 1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         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           ***
   13      C, Pasture, 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 ***
   13         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  *********
   13         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 ***
   13         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
   13              0       4.5      0.06       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
   13              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   13           0.15       0.4       0.3         6       0.5       0.4
  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
   13              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           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    4    1    9
    5         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     ***
    4         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
```

```
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Lot Infiltration Trench***
IMPLND   4                      0.0689     RCHRES   1      5
IMPLND   5                      0.0689     RCHRES   1      5
Bypass***
PERLND  13                        0.59     COPY   501     12
PERLND  13                        0.59     COPY   601     12
PERLND  13                        0.59     COPY   501     13
PERLND  13                        0.59     COPY   601     13

******Routing******
IMPLND   4                      0.0689     COPY     1     15
IMPLND   5                      0.0689     COPY     1     15
RCHRES   1                           1     COPY   501     17
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     Gravel Trench Be-006    2    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  5  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      0.02       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  5.0  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
   92    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.009183  0.000000  0.000000  0.000000
  0.044444  0.009183  0.000122  0.000000  0.038889
  0.088889  0.009183  0.000245  0.000000  0.038889
  0.133333  0.009183  0.000367  0.000000  0.038889
  0.177778  0.009183  0.000490  0.000000  0.038889
  0.222222  0.009183  0.000612  0.000000  0.038889
  0.266667  0.009183  0.000735  0.000000  0.038889
  0.311111  0.009183  0.000857  0.000000  0.038889
  0.355556  0.009183  0.000979  0.000000  0.038889
  0.400000  0.009183  0.001102  0.000000  0.038889
  0.444444  0.009183  0.001224  0.000000  0.038889
  0.488889  0.009183  0.001347  0.000000  0.038889
  0.533333  0.009183  0.001469  0.000000  0.038889
  0.577778  0.009183  0.001592  0.000000  0.038889
  0.622222  0.009183  0.001714  0.000000  0.038889
  0.666667  0.009183  0.001837  0.000000  0.038889
  0.711111  0.009183  0.001959  0.000000  0.038889
  0.755556  0.009183  0.002081  0.000000  0.038889
  0.800000  0.009183  0.002204  0.000000  0.038889
  0.844444  0.009183  0.002326  0.000000  0.038889
  0.888889  0.009183  0.002449  0.000000  0.038889
  0.933333  0.009183  0.002571  0.000000  0.038889
  0.977778  0.009183  0.002694  0.000000  0.038889
  1.022222  0.009183  0.002816  0.000000  0.038889
  1.066667  0.009183  0.002938  0.000000  0.038889
  1.111111  0.009183  0.003061  0.000000  0.038889
  1.155556  0.009183  0.003183  0.000000  0.038889
  1.200000  0.009183  0.003306  0.000000  0.038889
  1.244444  0.009183  0.003428  0.000000  0.038889
  1.288889  0.009183  0.003551  0.000000  0.038889
  1.333333  0.009183  0.003673  0.000000  0.038889
  1.377778  0.009183  0.003796  0.000000  0.038889
  1.422222  0.009183  0.003918  0.000000  0.038889
  1.466667  0.009183  0.004040  0.000000  0.038889
  1.511111  0.009183  0.004163  0.000000  0.038889
  1.555556  0.009183  0.004285  0.000000  0.038889
  1.600000  0.009183  0.004408  0.000000  0.038889
  1.644444  0.009183  0.004530  0.000000  0.038889
  1.688889  0.009183  0.004653  0.000000  0.038889
```

```
  1.733333  0.009183  0.004775  0.000000  0.038889
  1.777778  0.009183  0.004897  0.000000  0.038889
  1.822222  0.009183  0.005020  0.000000  0.038889
  1.866667  0.009183  0.005142  0.000000  0.038889
  1.911111  0.009183  0.005265  0.000000  0.038889
  1.955556  0.009183  0.005387  0.000000  0.038889
  2.000000  0.009183  0.005510  0.000000  0.038889
  2.044444  0.009183  0.005632  0.000000  0.038889
  2.088889  0.009183  0.005755  0.000000  0.038889
  2.133333  0.009183  0.005877  0.000000  0.038889
  2.177778  0.009183  0.005999  0.000000  0.038889
  2.222222  0.009183  0.006122  0.000000  0.038889
  2.266667  0.009183  0.006244  0.000000  0.038889
  2.311111  0.009183  0.006367  0.000000  0.038889
  2.355556  0.009183  0.006489  0.000000  0.038889
  2.400000  0.009183  0.006612  0.000000  0.038889
  2.444444  0.009183  0.006734  0.000000  0.038889
  2.488889  0.009183  0.006856  0.000000  0.038889
  2.533333  0.009183  0.006979  0.000000  0.038889
  2.577778  0.009183  0.007101  0.000000  0.038889
  2.622222  0.009183  0.007224  0.000000  0.038889
  2.666667  0.009183  0.007346  0.000000  0.038889
  2.711111  0.009183  0.007469  0.000000  0.038889
  2.755556  0.009183  0.007591  0.000000  0.038889
  2.800000  0.009183  0.007713  0.000000  0.038889
  2.844444  0.009183  0.007836  0.000000  0.038889
  2.888889  0.009183  0.007958  0.000000  0.038889
  2.933333  0.009183  0.008081  0.000000  0.038889
  2.977778  0.009183  0.008203  0.000000  0.038889
  3.022222  0.009183  0.008611  0.029284  0.038889
  3.066667  0.009183  0.009019  0.151685  0.038889
  3.111111  0.009183  0.009428  0.323094  0.038889
  3.155556  0.009183  0.009836  0.523118  0.038889
  3.200000  0.009183  0.010244  0.732975  0.038889
  3.244444  0.009183  0.010652  0.933531  0.038889
  3.288889  0.009183  0.011060  1.107385  0.038889
  3.333333  0.009183  0.011468  1.242541  0.038889
  3.377778  0.009183  0.011876  1.337097  0.038889
  3.422222  0.009183  0.012284  1.421241  0.038889
  3.466667  0.009183  0.012693  1.494171  0.038889
  3.511111  0.009183  0.013101  1.563705  0.038889
  3.555556  0.009183  0.013509  1.630275  0.038889
  3.600000  0.009183  0.013917  1.694231  0.038889
  3.644444  0.009183  0.014325  1.755860  0.038889
  3.688889  0.009183  0.014733  1.815397  0.038889
  3.733333  0.009183  0.015141  1.873043  0.038889
  3.777778  0.009183  0.015549  1.928967  0.038889
  3.822222  0.009183  0.015958  1.983315  0.038889
  3.866667  0.009183  0.016366  2.036212  0.038889
  3.911111  0.009183  0.016774  2.087770  0.038889
  3.955556  0.009183  0.017182  2.138085  0.038889
  4.000000  0.009183  0.017590  2.187243  0.038889
  4.044444  0.009183  0.017998  2.235320  0.038889
  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
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RCHRES    1 HYDR   O      1 1        1       WDM   1001 FLOW     ENGL       REPL
RCHRES    1 HYDR   O      2 1        1       WDM   1002 FLOW     ENGL       REPL
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  END MASS-LINK    5

  MASS-LINK       12
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  END MASS-LINK   12

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

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

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX B

APPENDIX C

Ages Engineering

A Geotechnical Engineering Services Company

P.O. Box 935
Puyallup, WA. 98371

Main (253) 845-7000

www.agesengineering.com

December 23, 2024
Project No. A-1692

Mingqi Shao
12319 NE 68th Place
Kirkland, WA 98033

Subject: Infiltration Testing
Shaw Road Residential
2317 Shaw Road
Puyallup, Washington

Reference: Geotechnical Report, Shaw Road Residential, prepared by Ages Engineering, dated August 6, 2024

Dear Mr. Shao,

As requested, we have completed the on-site infiltration testing on Lot 4 for the subject site located at 2317 Shaw Road in Puyallup, Washington. We discussed the project with you and were previously provided with a Site Plan showing the lot locations.

Based on the information provided to us, we understand the project will consist of dividing the site into 4 residential. The existing residence on the south end of the site will remain. The north end of the site will be divided into three additional residential lots. The development storm water for each lot will discharge to infiltration facilities on each lot. The driveways and sidewalks will be constructed using permeable pavement. We previously performed infiltration testing on the site and currently have been requested to perform an additional infiltration test on the north end of Lot 4 adjacent to our previous TH-8 location.

CONCLUSIONS AND RECOMMENDATIONS

We visited the site to perform one Small PIT in the approximate center of the north end of Lot 4 on the subject site. The infiltration test was performed in accordance with the City of Puyallup specifications.

To prepare the infiltration test area, we excavated the surface area around the test location to 5.0 feet by 4.0 feet. The test area was then excavated to a depth of 4.0 feet below surface grades and the size of the bottom of the test hole was 4.0 feet by 3.0 feet equating to a top surface area of 20 square feet. The side slopes were laid back at an approximate 0.75:1 inclination to avoid caving during the testing procedure. The bottom of the infiltration test pit measured approximately 4.0 feet by 3.0 feet equating to a surface area of 12.0 square feet. The test was performed in medium dense native sand with silt and gravel consistent with Advance Outwash.

A vertical measuring rod was placed in the infiltration test hole to allow accurate measuring of the infiltration rate during testing. We utilized a ¾ inch diameter flexible hose to convey water from a house spigot into a barrel adjacent the the test hole. The water was discharged from the barrel onto a splash block placed in the center of the infiltration test hole. The infiltration test hole was filled with 12 to 13 inches of water and allowed to soak for 6 hours. During the pre-soak period, the water flow through the hose was slightly altered to try and match the infiltration rate. After the 6-hour soak period, the Steady State period was performed. Water was added to the test hole at a rate that maintained a depth of 12 inches of water in the hole for 1 hour. Every 15 minutes during that hour, we estimated the cumulative volume and instantaneous flow rate (in gallons per minute) necessary to maintain 12 inches of water in the test hole. The hose did not have any devices that were able to accurately measure the cumulative volume and instantaneous flow rate. Therefor we had to calculate these values by periodically placing a one-gallon container between the hose and the pit. After the 1-hour Steady State period, the water was turned off and the infiltration rate was measured every 15 minutes for 1 hour. The measured rate in PIT 1 was 9.3 inches per hour, and the maximum falling head rate was 9.5 inches per hour. We utilized the measured rate of 9.3 for our design. The correction factors are 1.0 for Uniformity of Site Conditions, 0.5 for the small PIT, and 0.9 for Potential Siltation. After the correction factors have been applied, the long-term design infiltration rate for the site is 4.2 inches per hour.

We performed the infiltration testing on the site during a period of wet weather in the first month of the wet season. After the testing was complete, the test hole was excavated further but due to light rainfall and dark conditions due to heavy tree canopy coverage, it was nearly impossible to determine how deep the wet soils extended to. We obtained a soil sample during our site exploration and delivered it to an outside testing laboratory for determination of the cation exchange capacity (CEC) of the soil.

Based on our infiltration testing on the site, it is our opinion that the infiltration of the development storm water is feasible. Based on the results of our Small PIT, and the specifications provided by the City of Puyallup, we recommend the infiltration system be sized using a long-term design infiltration rate of 4.2 inches per hour.

◆ ◆ ◆

We trust this information is sufficient for your current needs. If you have any questions, or require additional information, please call.

Respectfully Submitted,
Ages Engineering

BERNARD P. KNOLL II
STATE OF WASHINGTON
38917
REGISTERED
PROFESSIONAL ENGINEER

12-23-2024

Bernard P. Knoll, II, P.E.
Principal

BPK:bpk
Project No.: A-1591

Small Pilot Infiltration Test (Small PIT)

Project Name: Shaw Road Residential
Date: December 18, 2024
Project Number: A-1692
Field Representative BK

Excavation:

Test Pit Surface Dimensions	3.0	5.0	feet
Test Pit Bottom Dimensions	3.0	4.0	feet
Test Pit Bottom Area	12.0		square feet
Test Pit Depth	4.0		feet

Pre-Soak Period:

Time (hh:mm)	Depth of Water (inches)
9:00	8.5
9:30	10.5
10:00	11.0
10:30	12.0
11:00	12.0
11:30	13.5
12:00	12.0
12:30	13.0
1:00	12.0
2:30	12.0

Steady-State Period:

On-Site Rate Test:	Container	1	Gallon Jug	
	Volume	0.13368	ft^3	
		0.00	in^3	
	Time	0:52:00	0.87	min
		0:52:00	0.87	min
		0:52:00	0.87	min

Time of Measurement (hh:mm)	Depth of Water (inches)	Cumulative Volume (gallons)	Flow Rate (gpm)	Infiltration Rate (inches/hour)
1:30	14.0	0		
1:45	14.0	17.31	1.15	9.3
2:00	14.0	17.31	1.15	9.3
2:15	14.0	17.31	1.15	9.3

Falling Head Period:

Time of Measurement 15-min intervals	Depth of Water (inches)	Infiltration Rate (inches/hour)
4:30	12.0	
4:45	6.5	9.5
5:00	1.0	9.5
5:15	0.0	5.0
5:30	0.0	4.0

Rate Determination:

Steady State		9.3	(inches/hour)
Falling Head		9.5	(inches/hour)
Selected Rate:		9.3	(inches/hour)
Correction Factor:	A	1	
	B	0.5	
	C	0.9	
Design Rate:		**4.2**	**(inches/hour)**

APPENDIX D

Ages Engineering

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P.O. Box 935
Puyallup, WA. 98371

(253) 845-7000

www.agesengineering.com

GEOTECHNICAL REPORT

Shaw Road Residential

2317 Shaw Road
Puyallup, Washington

Project No. A-1692

Prepared For:

Mingqi Shao
12319 NE 68th Place
Kirkland, WA 98033

February 24, 2024
Revised August 6, 2024

Ages Engineering

A Geotechnical Engineering Services Company

P.O. Box 935
Puyallup, WA. 98371

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February 24, 2024
Revised August 6, 2024
Project No. A-1692

Mingqi Shao
12319 NE 68th Place
Kirkland, WA 98033

Subject: Geotechnical Report
Shaw Road Residential
2317 Shaw Road
Puyallup, Washington
Parcel Number: 0419021061

Dear Mr. Shao,

As requested, we have conducted a geotechnical study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

Our field exploration indicates the site is generally underlain with either Old Fill soils or sand with silt consistent with Recessional Outwash overlying silty sand with gravel consistent with glacial till. We did not encounter groundwater seepage in any of our explorations.

In our opinion, the soil and groundwater conditions at the site are suitable for the planned development. The new structures can be supported on typical spread footing foundations bearing on the organic-free native soils observed at 0.0 to 5.5 feet below surface grades. Infiltration of the development storm water is feasible.

Detailed recommendations addressing these issues and other geotechnical design considerations are presented in the attached report. We trust the information presented is sufficient for your current needs. If you have any questions or require additional information, please call.

Respectfully Submitted,

Ages Engineering

8-6-24

Bernard P. Knoll, II
Principal

BPK:bpk

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Geotechnical Report
Shaw Road Residential
2317 Shaw Road
Puyallup, Washington

1.0 PROJECT DESCRIPTION

The project will consist of a residential development. We were provided with a preliminary site plan showing the planned development. Based on the plan provided to us, we understand the site will be divided into four single-family residential lots. The lots will extend east from Shaw Road. The existing residence on the western end of the site will remain and be remodeled. The development storm water on each lot will discharge to infiltration facilities constructed on each lot.

The conclusions and recommendations presented in this report are based on our understanding of the above-stated site and the planned project design features. If actual site conditions differ, the planned project design features are different than we expect, or if changes are made, we should review them in order to modify or supplement our conclusions and recommendations as necessary.

2.0 SCOPE

On February 1, 2024, we excavated one hand-augured test holes to a maximum depth of 3.0 feet below surface grades. We returned to the site on February 13, 2024, to excavate seven additional machine-excavated test pits to a maximum depth of 7.0 feet, install groundwater monitoring wells, and perform one Small Pilot Infiltration Test. Using the information obtained from our subsurface exploration, we developed geotechnical design and construction recommendations for the project. Specifically, this Geotechnical Report addresses the following:

- Reviewing the available geologic, hydrogeologic and geotechnical data for the site area, and conducting a geologic reconnaissance of the site area.
- Addressing the appropriate geotechnical regulatory requirements for the planned site development, including a Geologic Hazard evaluation.
- Advancing eight hand-augured test holes in the planned new development area to a maximum depth of approximately 7.0 feet below surface grades.
- Providing geotechnical recommendations for site grading including site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut and fill slopes, and drainage and erosion control measures.
- Providing geotechnical recommendations for design and construction of new foundations and floor slabs, including allowable bearing capacity and estimates of settlement.
- Providing geotechnical recommendations for lower-level building or retaining walls, including backfill and drainage requirements, lateral design loads, and lateral resistance values.
- Providing geotechnical recommendations for new site retaining walls.

- Performing one Small Pilot Infiltration Test (Small PIT) on the site.
- Providing preliminary recommendations for the discharge of the development storm water.
- Providing recommendations for site drainage.

After visiting the site on February 1, 2024, to explore the subsurface conditions on the site, it was determined that groundwater monitoring would be required. Therefor our scope was expanded to include the following:

- Performing periodic monitoring of the groundwater levels in the groundwater monitoring wells installed on the site.

3.0 SITE CONDITIONS

3.1 Surface

The subject site is a 1.63-acre irregularly shaped residential parcel located at 2317 Shaw Road in Puyallup, Washington. The site is currently occupied with a single-family residence located in the western end of the site, a detached structure to the SE of the residence, and a barn in the central eastern portion of the site. A short roadway with a cul-de-sac exists along the south property line. The cul-de-sac ends near the center of the site, and an easement driveway extends from the cul-de-sac to a single-family residence located along the south side of the eastern end of the site. The subject site is bordered by residential parcels to the north, east, and to the south of the eastern end of the site. The remaining portions to the south of the site consist of a roadway with cul-de-sac. The location of the site is shown on the Site Vicinity Map provided in Figure 1. The current site layout is shown on the Exploration Location Plan provided in Figure 2.

In general surface grades in the vicinity of the site slope down to the north and east. Surface grades on the west end of the subject site are flat in the front yard of the existing residence. Behind the residence, the site slopes down to the east at inclinations ranging from 10 to 13 percent. The center of the site is generally flat to sloping down to the north at an approximate 2 to 5 percent grade. Behind the barn along the east end of the site, the surface slopes down to the east at an inclination of 10 to 33 percent. Site vegetation around the residence that occupies the site consists of typical landscape bushes and trees. The center of the site is a grass field. The east end of the site consists of native medium sized evergreen and deciduous with moderately thin underbrush.

3.2 Mapped Soils

According to *The Geologic Map of Seattle- A Progress Report,* by Kathy Goetz Troost, Derek B. Booth, Aaron P. Wisher, and Scott A. Shimel, the surface soils in the vicinity of the site are mapped as Recessional Outwash (Qvr). Glacial Till (Qvt) is mapped as being under the Recessional Outwash. The Recessional Outwash and Glacial Till were deposited during the Vashon Stade of the Frasier Glaciation that occurred 12,000 to 15,000 years ago. The Glacial Till was deposited beneath the advancing glacial ice sheet and was consequently overridden by the glacial ice mass.

The Recessional Outwash deposited by meltwaters and streams that emanated from the receding glacial ice mass. The Glacial Till will typically be found in a very dense condition where undisturbed and the Recessional Outwash in a medium dense condition where undisturbed. The near surface soils at the site have been disturbed by natural weathering processes that have occurred since their deposition. No springs or groundwater seepage was observed on the surface of the site at the time of our site visit. A copy of the Geologic Map for the subject site is provided in Figure 3.

The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) maps the soils in the vicinity of the site as Kitsap Silt Loam (20C) soils that form on 8 to 15 percent slopes. According to the USDA NRCS, the site soil will have a moderate potential erosion when exposed.

3.3 Soils

The soils we observed at the site generally consist of Recessional Outwash at the east and west ends and Old Fill soils overlying glacial till along the majority of the center of the site.

The soils observed in Test Hole TH-1 consisted of 12 inches of topsoil overlying Old Fill soils consisting of reddish orange silty sand with gravel and cobbles.

In Test Hole TH-2, we encountered 2.0 feet of Old Fill soils consisting of tan, gray and brown silty sand with gravel and cobbles to 8 inches. Below 2.0 feet, we encountered topsoil to a depth of 3.0 feet below surface grades. Below 3.0 feet, the soil became native reddish-orange, medium dense to dense, slightly cemented silty sand with gravel consistent with glacial till.

In Test Hole TH-3, we encountered 6 inches of topsoil overlying Old Fill soils consisting of brown, reddish-orange and gray and silty sand with gravel and cobbles to 8 inches to a depth of 4.5 feet below surface grades. Below 4.5 feet we encountered 6 inches of topsoil. Below 5.0 feet, the soil became native tan and gray mottled reddish-orange, medium dense to dense, slightly cemented silty sand with gravel consistent with glacial till.

In Test Hole TH-4, we encountered 5.5 feet of Old Fill soils consisting of tan, gray and brown silty sand with gravel and cobbles to 8 inches. At a depth of 5.5 feet, we encountered a boulder that could be excavated past.

In Test Hole TH-5, we encountered 3.5 feet of Old Fill soils consisting of tan, gray and brown silty sand with gravel and cobbles to 8 inches. Below 3.5 feet, we encountered topsoil to a depth of 4.5 feet below surface grades. Below 4.5 feet, the soil became native gray, medium dense to dense, slightly cemented silty sand with gravel consistent with glacial till.

In Test Hole TH-6, we encountered 4.0 feet of Old Fill soils consisting of tan, gray and brown silty sand with gravel and cobbles to 8 inches. Below 4.0 feet, we encountered topsoil to a depth of 5.0 feet below surface grades. Below 5.0 feet, the soil became native gray, medium dense to dense, slightly cemented silty sand with gravel consistent with glacial till.

In Test Hole TH-7, we encountered 7.0 feet of sand with varying amounts of silt consistent with Recessional Outwash. The Outwash was predominantly medium grained, tan in the upper 3.0 feet and gray in the lower 4.0 feet. Below 7.0 feet, the soil became native gray, medium dense to dense, slightly cemented silty sand with gravel consistent with glacial till.

In Test Hole TH-8, we encountered 12 inches of topsoil overlying reddish orange silty sand and tan sand with silt consistent with Recessional Outwash.

Figures A-1 and A-2 present more detailed descriptions of the subsurface conditions encountered in the test holes. The approximate test hole and test boring locations are shown on the Exploration Location Plan provided in Figure 2.

3.4 Groundwater

We did not encounter groundwater during our site exploration on (February 13, 2024) to the depths explored. We installed groundwater monitoring wells in six of the eight test pits on the site. The wells were extended through the upper loose to medium dense soils and into the underlying dense glacial till. We returned to the site on February 17th and 23rd to check the water levels in the wells. At no time did we find groundwater had accumulated in the well. We did not find a seasonal perched water table beneath the site. The groundwater levels and flow rates will fluctuate seasonally and typically reach their highest levels during and shortly following the wet winter months (October through May).

4.0 GEOLOGIC HAZARDS

4.1 General

According to Chapter 21.06.1210 in the City of Puyallup Municipal Code (PMC) geologic hazard areas are defined as "...areas that, because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns."

4.2 Erosion

According to Chapter 21.06.1210 in the City of Puyallup Municipal Code (PMC) Erosion Hazard Areas are defined as "...those areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service or identified by a special study as having a "moderate to severe," "severe," or "very severe" erosion potential."

According to the USDA NRCS, the soils on the subject site are classified as having a "moderate" potential for erosion when exposed. According to the USDA NRCS classification of the site, the site is not classified as having erosion hazard areas.

Regardless of the erosion classification on the site, Temporary Erosion and Sediment Control (TESC) measures must be in place prior to and maintained during construction activity at the site. In our opinion, the potential for erosion is not a limiting factor in site development. Erosion hazards can be mitigated by applying Best Management Practices (BMPs) outlined in the Washington State Department of Ecology's (Ecology) *Stormwater Management Manual for Western Washington.*

Temporary Erosion and Sediment Control (TESC) measures, as required by the City of Puyallup, should be in place prior to the start of construction activities at the site.

4.3 Landslide

According to Chapter 21.06.1210 in the City of Puyallup Municipal Code (PMC) Landslide Hazard Areas are defined as "...areas include areas subject to landslides based on a combination of geologic, topographic, and hydrologic factors. They include any areas susceptible to landslide because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors, and include, at a minimum, the following:

(i) Areas of historic failures, such as:

(A) Those areas delineated by the United States Department of Agriculture Natural Resources Conservation Service as having a significant limitation for building site development;

(B) Those coastal areas mapped as class u (unstable), uos (unstable old slides), and urs (unstable recent slides) in the Department of Ecology Washington coastal atlas; or

(C) Areas designated as quaternary slumps, earthflows, mudflows, lahars, or landslides on maps published by the United States Geological Survey or Washington Department of Natural Resources.

(ii) Areas with all three of the following characteristics:

(A) Slopes steeper than 15 percent;

(B) Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and

(C) Springs or groundwater seepage.

(iii) Areas that have shown movement during the Holocene epoch (from 10,000 years ago to the present) or which are underlain or covered by mass wastage debris of this epoch;

(iv) Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials;

(v) Slopes having gradients steeper than eighty percent subject to rockfall during seismic shaking;

(vi) Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action, including stream channel migration zones;

(vii) Areas that show evidence of, or are at risk from snow avalanches;

(viii) Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and

(ix) Any area with a slope of 40 percent or steeper and with a vertical relief of 10 or more feet except areas composed of bedrock. A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least 10 feet of vertical relief.

The site does not contain areas of historic failures. The United States Department of Agriculture Natural Resources Conservation Service does not describe the site as having a significant limitation for building site development. The site is not located on a coastal shoreline and is therefore not mapped by the Department of Ecology Washington coastal atlas. We observed no areas having quaternary slumps, earthflows, mudflows, lahars, or landslides on maps published by the United States Geological Survey or Washington Department of Natural Resources. We observed no areas that have shown movement during the holocene epoch (from 10,000 years ago to the present) or which are underlain or covered by mass wastage debris of this epoch. We observed no slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials. We observed no slopes having gradients steeper than eighty percent subject to rockfall during seismic shaking. We observed no areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action, including stream channel migration zones. We observed no areas that show evidence of, or are at risk from, snow avalanches. We observed no areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding. The site does not have slopes with an inclination of 40 percent or more within a vertical elevation change of at least 10 feet. The site does have slopes steeper than 15 percent and hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock. We did not observe groundwater seepage on the site. Based on these factors, according to the City of Puyallup, the site is not classified as a landslide hazard area.

Regardless of the landslide hazard classification of the site, the site appears stable. Based on these soil and slope conditions, the potential for a landslide to occur at this site should be considered negligible.

<u>4.4 Seismic</u>

According to Chapter 21.06.1210 in the City of Puyallup Municipal Code (PMC) Landslide Hazard Areas are defined as "...areas that are subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, or soil liquefaction."

Liquefaction can be described as a phenomenon where there is a reduction or complete loss of soil strength due to an increase in pore water pressure. The increase in water pressure is typically induced by vibrations. Liquefaction mainly affects geologically recent deposits of loose, fine-grained sands that are below the groundwater table.

The site is located in an area underlain with medium dense, predominantly medium-grained Recessional Outwash soils and dense glacial till soils. Based on the medium dense to dense consistency and relatively well-graded nature of the native soils that underly the site, the risk for liquefaction to occur at the site should be considered negligible. According to the City of Puyallup Municipal Code, the site is located in a seismic hazard area.

The state of Washington has adopted the International Building Code (IBC). Based on the soil conditions encountered and the local geology, per the IBC, site class "D" can be used in structural design. This is based on the inferred range of SPT (Standard Penetration Test) blow counts for the upper 100 feet of the site relative to hand excavation progress and probing with a ½-inch diameter steel probe rod. The presence of glacially consolidated soil conditions were assumed to be representative for the site conditions beyond the depths explored.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 General

Based on our study, in our opinion, soil and groundwater conditions at the site are suitable for the proposed development. The new residences can be supported on conventional spread footing foundations bearing on the native soils underlying the site. We found no seasonal groundwater table underlying the site. Infiltration of the development storm water will not be feasible.

Based on our evaluation, it appears the subsurface soils along the center of the site previously consisted of Recessional outwash similar to the soils observed along the eastern and western ends of the site. This soil was likely excavated and removed from the site. The existing fill soils we observed in our explorations were brought to the site to restore grades. The fill is a relatively consistent depth across the center of the site but appears to become much deeper behind the barn along the crest of the sites' eastern slope area. We reviewed past aerial photos and according to the USDA NRCS, this slope should be inclined at a much shallower slope inclination. We believe the fill soils used to restore grades were extended eastward past the barn area and created the current 33 percent slope. Additionally, the native deciduous trees along the slope crest are typical for those that naturally grow quickly in cleared or filled areas.

The native soils encountered at the site contain a high enough percentage of fines (silt and clay-size particles) that will make them difficult to compact as structural fill when too wet. Accordingly, the ability to use the soils from site excavations as structural fill will depend on their moisture content and the prevailing weather conditions at the time of construction. If grading activities take place during the winter season, the owner should be prepared to import free-draining granular material for use as structural fill and backfill.

The following sections provide detailed recommendations regarding these issues and other geotechnical design considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and other deleterious materials including any existing structures, foundations or abandoned utility lines should be stripped and removed from the new development areas. Organic topsoil will not be suitable for use as structural fill but may be used for limited depths in non-structural areas. The Old Fill soil observed in the upper 3.0 to 5.5 feet of the site will not be suitable for supporting structural elements. Prior to construction these soils should be removed from under new foundation and slab areas.

Once clearing and stripping operations are complete, cut and fill operations can be initiated to establish desired grades. To achieve proper compaction of structural fill, and to provide adequate foundation and floor slab support, the existing subgrade must be in a stable condition. Due to the depth and consistency of the fill underlying the site, compaction of structural fill will be very difficult. If structural fill is necessary, it will likely have to be placed on a prepared subgrade surface consisting of either reinforcement fabric or quarry rock, or a combination of both. Once final design details become evident, we can provide specific recommendations for any structural fill on the site.

Our study indicates the native surface soils encountered at the site contain a sufficient percentage of fines (silt and clay-size particles) that will make them difficult to compact as structural fill when too wet. Accordingly, the ability to use the soil from site excavations as structural fill will depend on their moisture content and the prevailing weather conditions at the time of construction. If grading activities are planned during the wet winter months, or the on-site soil becomes too wet to achieve adequate compaction, the owner should be prepared to import a wet-weather structural fill. For wet weather structural fill, we recommend importing a granular soil that meets the following gradation requirements:

U. S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

* Based on the ¾ inch fraction

Prior to use, Ages Engineering should examine and test all materials to be imported to the site for use as structural fill.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soils' laboratory maximum dry density as determined by American Society for Testing and Materials (ASTM) Test Designation D-1557 (Modified Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this same ASTM standard. In non-structural areas, the degree of compaction can be reduced to 90 percent.

5.3 Excavations

General,

The inclination for a safe and stable excavation slope cut is determined based on two factors, the current Washington State Safety and Health Administration (WSHA) regulations for confined spaces and global stability of the slope cut. Most often, the WSHA regulations are more conservative than the global stability requirements.

According to WAC 296-809-099, a confined space is defined as: "A space that is all of the following:

(a) Large enough and arranged so an employee could fully enter the space and work.

(b) Has limited or restricted entry or exit. Examples of spaces with limited or restricted entry are tanks, vessels, silos, storage bins, hoppers, vaults, excavations, and pits.

(c) Not primarily designed for human occupancy."

In the context of site excavation and grading, the Washington State Department of Labor and Industries considers a confined space as a space in which a worker enters an excavation that is tall enough and/or narrow enough to inundate the worker and cause bodily harm if a cave-in occurs. This does not include excavations that are less than 4.0 feet in depth.

WSHA Approved Slope Cuts,

All excavations at the site associated with confined spaces, such as utility trenches and lower level building and retaining walls, must be completed in accordance with local, state, and/or federal requirements. Based on current Washington State Safety and Health Administration (WSHA) regulations, the existing Old Fill and Recessional Outwash soils are classified as Type C soils. The deeper unweathered till soils are classified as Type A soils.

According to WSHA, for temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be laid back at a slope inclination of 1.5:1 (Horizontal:Vertical) or flatter from the toe to the crest of the slope and the side slopes in Type A soils should be laid back at a slope inclination of 0.75:1 (Horizontal:Vertical) or flatter from the toe to the crest of the slope. All exposed slope faces should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume that all surface loads are kept at a minimum distance of at least one half the depth of the cut away from the top of the excavation slope and that significant seepage is not present on the slope face. Flatter cut slopes will be necessary where significant raveling or seepage occurs, or if construction materials will be stockpiled along the slope crest. If these safe temporary slope inclinations cannot be achieved due to property line constraints, shoring may be necessary.

This information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Ages Engineering assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

Global Stability Excavations,

Based on the composition and consistency of the site soils, stable slope cuts to provide adequate global stability can be steeper than WSHA standards in areas that are not considered confined spaces. Excavations into the native glacial till soils on the site that will not result in WSHA regulated confined spaces can be cut to an inclination of 0.5:1. Some raveling of the gravel and cobbles exposed on the slope surface may occur at an inclination of 0.5:1. Due to the potential for raveling to occur, and to prevent erosion, the slope face should be covered with durable plastic sheeting.

This information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Ages Engineering assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

5.4 Foundations

The new residential foundations may be supported on conventional spread footing foundations bearing on the existing organic-free native soils, or on new structural fill placed above the existing site soils. Foundation subgrades should be prepared as recommended in the "Site Preparation and Grading" section of this report. As discussed in the "Site Preparation and Grading" section of this report, the existing topsoil and fill observed in the upper 0.5 to 1.0 feet of the site will not be suitable for support of structural elements. Prior to construction, these old fill soils should be removed from under new foundation areas.

Perimeter foundations exposed to the weather should bear at a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab. We recommend designing new foundations for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. With the anticipated loads and this bearing stress applied, building settlements should be less than one-half inch total and one-quarter inch differential.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the sides of the footings can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pounds per cubic foot (pcf). We recommend not including the upper 12 inches of soil in this computation because it can be affected by weather or disturbed by future grading activity. This value assumes the foundations will be constructed neat against competent soil and backfilled with structural fill, as described in the "Site Preparation and Grading" section of this report. The values recommended include a safety factor of 1.5.

Foundation Parameter Summary	
Description	***Design Value**
Net Allowable Bearing Capacity	2,500 psf
Friction Coefficient	0.35
Lateral Resistance	300 pcf

*Details regarding the use of these parameters are provided in the section above.

5.5 Slab-On-Grade

Slab-on-grade floors should be supported on subgrades prepared as recommended in the "Site Preparation and Grading" section of this report. As discussed in the "Site Preparation and Grading" section of this report, the existing topsoil and fill observed in the upper 0.5 to 1.0 feet of the site will not be suitable for support of structural elements. Prior to construction, these old fill soils should be removed from under new slab areas.

Immediately below the floor slab, we recommend placing a four-inch-thick capillary break layer of clean, free-draining, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slabs. The drainage material should be placed in one lift and compacted to a firm and unyielding condition.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will not assist in uniform curing of the slab and may serve as a water supply for moisture transmission through the slab and affecting floor coverings. Additionally, if the sand is too dry, it can effectively drain the fresh concrete, thereby lowering its strength. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided.

5.6 Lower Level and Building Walls

The magnitude of earth pressure development on below-grade walls, such as basement or retaining walls, will greatly depend on the quality of the wall backfill and the wall drainage. We recommend placing and compacting wall backfill as structural fill. Wall backfill below structurally loaded areas, such as pavements or floor slabs, should be compacted to a minimum of 95 percent of its maximum dry density, as determined by ASTM Test Designation D-1557 (Modified Proctor). In unimproved areas, the relative compaction can be reduced to 90 percent.

To guard against hydrostatic pressure development, drainage must be installed behind the wall. We recommend that wall drainage consist of a minimum 12 inches of clean sand and/or gravel with less than three percent fines placed against the back of the wall. In addition, a drainage collector system consisting of 4-inch perforated PVC pipe should be placed behind the wall to provide an outlet for any accumulated water. The drains should be provided with cleanouts at easily accessible locations. These cleanouts should be serviced at least once every year. The wall drainage material should be capped at the ground surface with 1-foot of relatively impermeable soil to prevent surface intrusion into the drainage zone. Alternatively, the 12-inch wide drainage layer placed against the back of the wall can be replaced with a Mirafi G100N Drainage Board, or an approved equivalent. If drainage board is used, the 4-inch perforated PVC pipe should be covered with at least 12 inches of clean washed gravel and the drainage board should be hydraulically connected to drainpipe and surrounding gravel.

With wall backfill placed and compacted as recommended and the wall drainage properly installed, unrestrained walls can be designed for an active earth pressure equivalent to a fluid weighing 35 pcf. For restrained walls, an additional uniform lateral pressure of 100 psf should be included. These values assume a horizontal backfill condition and that no other surcharge loading, such as traffic, sloping embankments, or adjacent buildings, will act on the wall. If such conditions exist, then the imposed loading must be included in the wall design. Friction at the base of the wall foundation and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in the "Foundations" section of this report.

Lower Level Building and Retaining Wall Parameter Summary		
Description	**Condition**	***Design Value**
Earth Pressure	Unrestrained	35 pcf
Earth Pressure	Restrained	Additional 100 psf
Earth Pressure	Surcharge	Dependant upon magnitude

*Details regarding the use of these parameters are provided in the section above.

5.7 Storm Water

We visited the site to perform one Small PIT in the approximate center of the west end of the subject site. The infiltration test was performed in accordance with the City of Puyallup specifications during the wet season.

To prepare the infiltration test area, we utilized an excavator to excavate the area around the location. The test area was excavated to a depth of 6.0 feet below surface grades to get to the native soils. We then excavated an additional 2.0 feet into the native glacial till soils. The size was approximately 5.0 feet by 4.0 feet equating to a top surface area of 20.0 square feet. The side slopes were laid back at an approximate 0.5:1 inclination to avoid caving during the testing procedure. The bottom of the infiltration test pit measured approximately 4.0 feet by 3.0 feet equating to a surface area of 12.0 square feet. The test was performed in the medium dense till soils.

A vertical measuring rod was placed in the infiltration test hole to allow accurate measuring of the infiltration rate during testing. We utilized a ½ inch diameter garden hose to convey water from the house spigot into the test hole. The water was discharged onto a splash block placed in the center of the infiltration test hole. The infiltration test hole was filled with 12 to 18 inches of water and allowed to soak for 6 hours. During the pre-soak period, the water flow through the hose was slightly altered to try and match the infiltration rate. After the 6-hour soak period, the Steady State period was performed. Water was added to the test hole at a rate that maintained a depth of 12 inches of water in the hole for 1 hour. Every 15 minutes during that hour, we estimated the cumulative volume and instantaneous flow rate (in gallons per minute) necessary to maintain 12 inches of water in the test hole. The hose did not have any devices that were able to accurately measure the cumulative volume and instantaneous flow rate. Therefor we had to calculate these values by periodically placing a one-cup container between the hose and the pit. After the 1-hour Steady State period, the water was turned off and the infiltration rate was measured every 15 minutes for 1 hour. The measured steady state rate in PIT 1 was 0.4 inches per hour. The correction factors are 1.0 for Uniformity of Site Conditions, 0.5 for the small PIT, and 0.9 for Potential Siltation.

We performed the infiltration testing on the site during a period of wet weather near the middle of the wet season. We obtained a soil sample during our site exploration and delivered it to an outside testing laboratory for determination of the cation exchange capacity (CEC) of the soil.

Based on our infiltration testing on the site, it is our opinion the infiltration of the development storm water is feasible. The City of Puyallup requires a minimum measured infiltration rate of 0.30 inches per hour for feasibility. Based on the results of our Small PIT, the measured infiltration rate was 0.4 inches per hour. After correction factors, the rate would be 0.18 in/hr. The completed Pilot Infiltration Test (PIT) Checklist is provided in Appendix B.

5.8 Permanent Slopes and Embankments

All permanent cut and fill slopes should be graded with a finished inclination of no greater than 2:1 (Horizontal:Vertical). Upon completion of grading, the slope face should be appropriately vegetated or provided with other physical means to guard against erosion. Final grades at the top of the slope must promote surface drainage away from the slope crest. Water must not be allowed to flow in an uncontrolled fashion over the slope face. If it is necessary to direct surface runoff towards the slope, it should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe.

All fill used for slope and embankment construction should meet the structural fill requirements described in the Site Preparation and Grading section of this report. In addition, if new fills will be placed over existing slopes of 20 percent or greater, the structural fill should be keyed and benched into competent slope soils.

5.9 Site Drainage

Surface,

Final exterior grades should promote free and positive drainage away from the building area. All ground surfaces, pavements, and sidewalks should be sloped away from the structure. We recommend providing a gradient of at least three percent for a minimum distance of ten feet from the building perimeter, except in paved locations. In paved locations, a minimum gradient of one percent should be provided, unless provisions are included for collection and disposal of surface water adjacent to the structure.

Subsurface,

We recommend installing a continuous drain along the lower outside edge of the perimeter building foundation. The foundation drain should be tightlined to an approved point of controlled discharge. The roof drain should not be connected to the footing drains unless a backflow device will be installed, or an adequate gradient will prevent backflow into the footing drains.

Subsurface drains must be laid with a gradient sufficient to promote positive flow to the point of discharge. All drains should be provided with cleanouts at easily accessible locations. These cleanouts should be serviced at least once every year.

6.0 ADDITIONAL SERVICES

Ages Engineering should review the final project designs and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design. If changes are made in the loads, grades, locations, configurations or types 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 necessary.

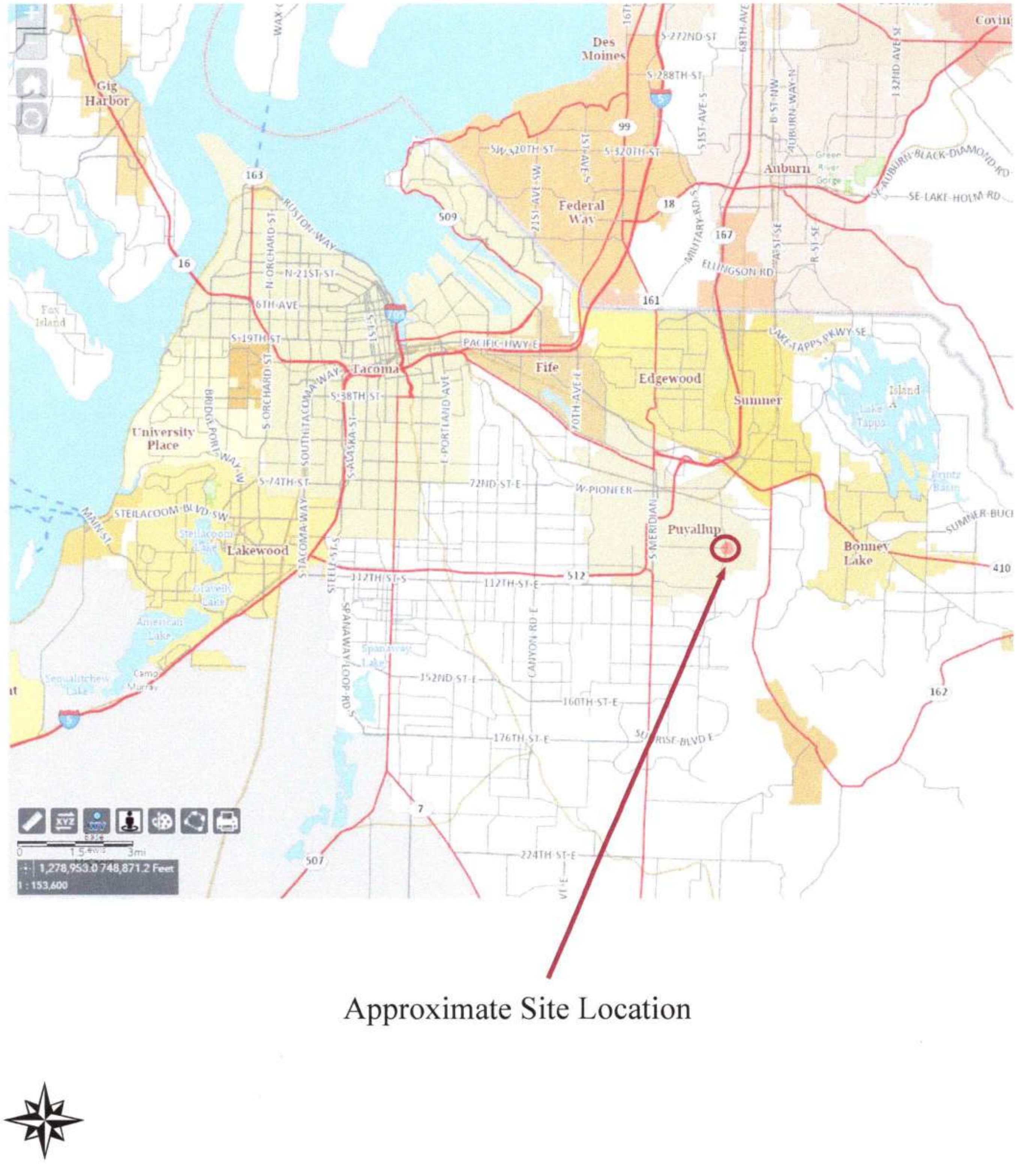
We should also provide geotechnical services during construction to observe compliance with our design concepts, specifications, and recommendations. This will allow for expedient design changes if subsurface conditions differ from those anticipated prior to the start of construction.

7.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. This report is the copyrighted property of Ages Engineering and is intended for the exclusive use of Mr. Mingqi Shao, and their authorized representatives for use in the design, permitting, and construction portions of this project.

The analysis and recommendations presented in this report are based on data obtained from others and our site explorations and should not be construed as a warranty of the subsurface conditions. Variations in subsurface conditions are possible. The nature and extent of which may not become evident until the time of construction. If variations appear evident, Ages Engineering should be requested to reevaluate the recommendations in this report prior to proceeding with construction. A contingency for unanticipated subsurface 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 during our exploration, 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.



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Site Vicinity Map
Shaw Road Residential
2317 Shaw Road
Puyallup, Washington

Project No.: A-1692	August 2024	**Figure 1**

KEY:

APPROXIMATE LOCATION OF TEST HOLE	TH-1 ◆
APPROXIMATE LOCATION OF INFILTRATION TEST	IT-1 ◆

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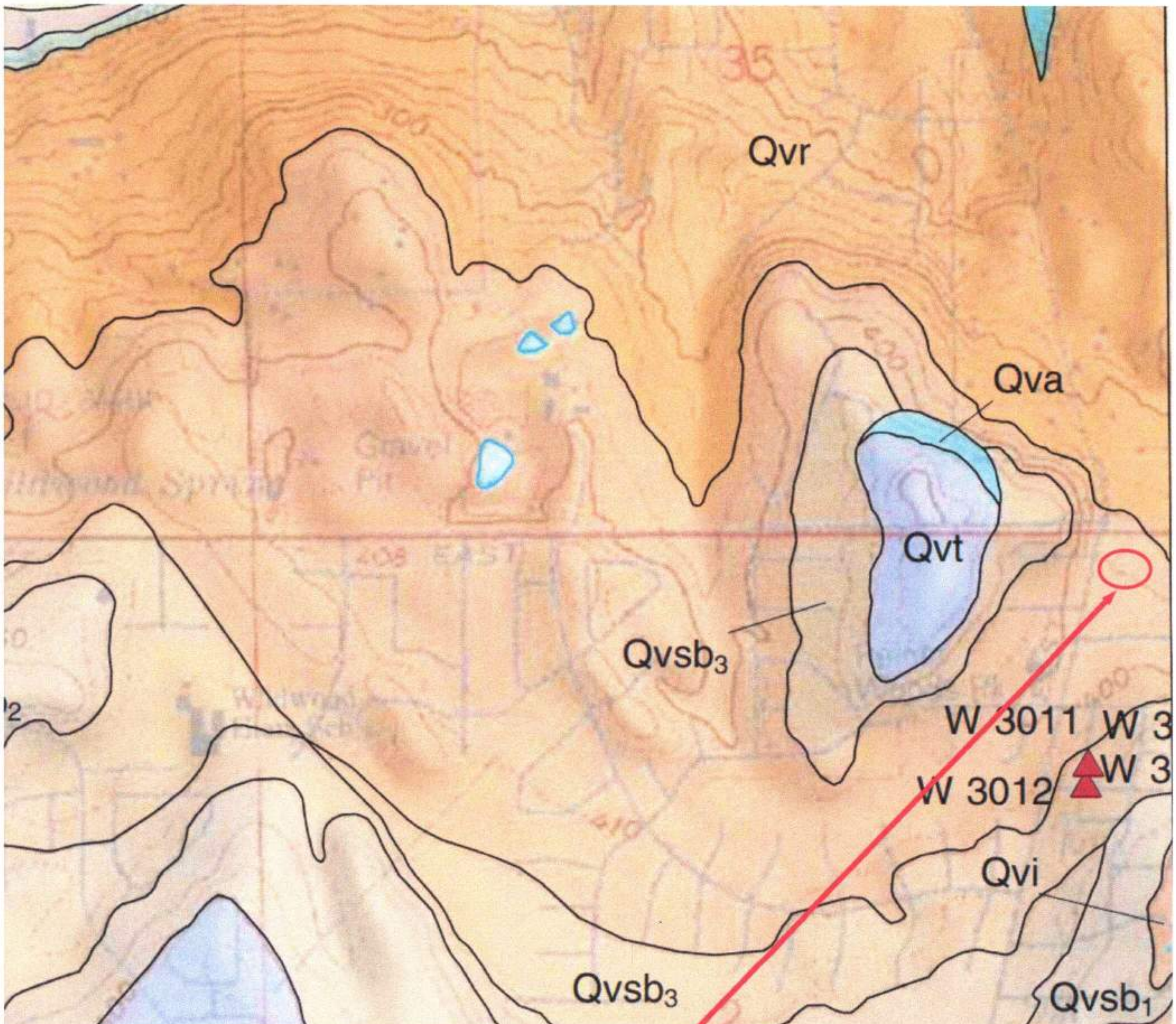
Exploration Location Plan
Shaw Road Residential
2317 Shaw Road
Puyallup, Washington

Project No.: A-1692	August 2024	**Figure 2**



Approximate Site Location

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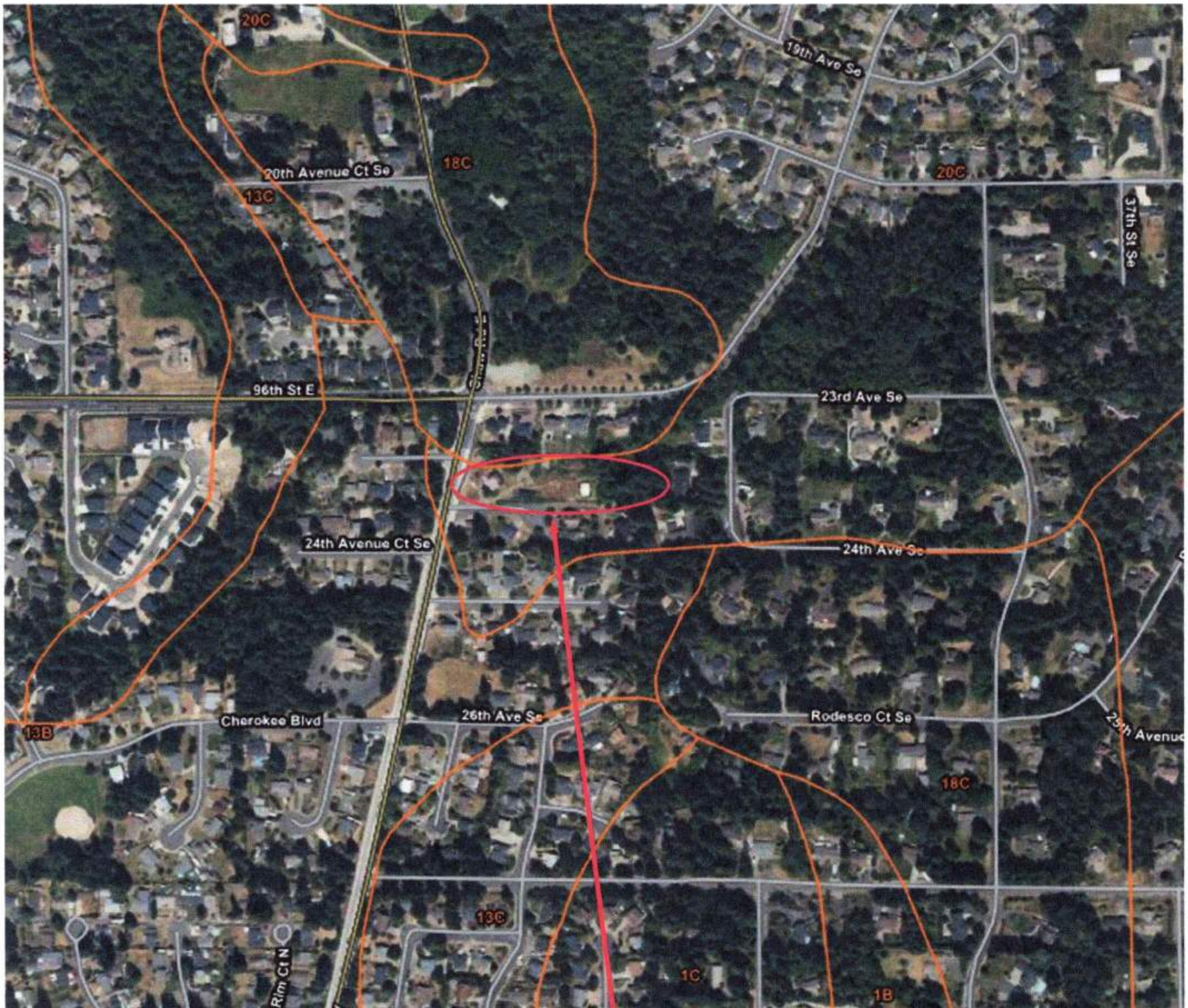
Geologic Map
Shaw Road Residential
2317 Shaw Road
Puyallup, Washington

Project No.: A-1692	August 2024	**Figure 3**



Approximate Site Location

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USDA NRCS Map
Shaw Road Residential
2317 Shaw Road
Puyallup, Washington

Project No.: A-1692	August 2024	**Figure 4**

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING

Shaw Road Residential
Puyallup, Washington

On February 1, 2024 we explored subsurface conditions at the site by excavating one hand-augured test holes to a maximum depth of 3.0 feet below surface grades. We returned to the site on February 13, 2024 we explored subsurface conditions at the site by excavating seven additional machine-excavated test pits to a maximum depth of 7.0 feet below surface grades. The approximate location of the site is shown on the Site Vicinity map provided in Figure 1. The approximate test hole locations are shown on the Exploration Location Plan provided in Figure 2.

A geotechnical engineering representative from our office conducted the field exploration, maintained a log of each test hole and classified the soils encountered, collected representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1. The test hole logs are presented on Figures A-2 through A-4.

Representative soil samples obtained from the test holes were placed in sealed containers and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the test hole logs.

UNIFIED 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	GRAVEL WITH < 5 % FINES	GW	Well-Graded GRAVEL
			GP	Poorly-Graded GRAVEL
		GRAVEL WITH BETWEEN 5 AND 15 % FINES	GW-GM	Well-Graded GRAVEL with silt
			GW-GC	Well-Graded GRAVEL with clay
			GP-GM	Poorly-Graded GRAVEL with silt
			GP-GC	Poorly-Graded GRAVEL with clay
		GRAVEL WITH > 15 % FINES	GM	Silty GRAVEL
			GC	Clayey GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	SAND WITH < 5 % FINES	SW	Well-Graded SAND
			SP	Poorly-Graded SAND
		SAND WITH BETWEEN 5 AND 15 % FINES	SW-SM	Well-Graded SAND with silt
			SW-SC	Well-Graded SAND with clay
			SP-SM	Poorly-Graded SAND with silt
			SP-SC	Poorly-Graded SAND with clay
		SAND WITH > 15 % 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	ML	Inorganic SILT with low plasticity
			CL	Lean inorganic CLAY with low plasticity
			OL	Organic SILT with low plasticity
		Liquid Limit 50 or more	MH	Elastic inorganic SILT with moderate to high plasticity
			CH	Fat inorganic CLAY with moderate to high plasticity
			OH	Organic SILT or CLAY with moderate to high plasticity
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

(1) Soil descriptions are based on visual field and laboratory observations using the classification methods described in ASTM D-2488. Where laboratory data are available, classifications are in accordance with ASTM D-2487.

(2) Solid lines between soil descriptions indicate a change in the interpreted geologic unit. Dashed lines indicate stratigraphic change within the unit.

(3) Fines are material passing the U.S. No. 200 Sieve.

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Unified Soil Classification System (USCS)
Shaw Road Residential
2317 Shaw Road
Puyallup, Washington

Project No.: A-1692 | August 2024 | **Figure A-1**

P.O. Box 935
Puyallup, WA. 98371
Office (253) 845-7000

Test Hole TH-1

DATE: February 1, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	6 inches **TOPSOIL**		
	FILL: Brown silty sand with gravel , cobbles to 8 inches.		
	FILL: Tan, reddish-brown and gray silty sand with gravel, moderate cementation, medium dense, moist. (SM) (Weathered Glacial Till)		
	Test Hole terminated at a depth of 3.0 feet below surface grades. No groundwater seepage encountered.		
5			

Test Hole TH-2

DATE: February 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	**FILL:** Tan, gray and brown silty sand with gravel, cobbles to 10 inches, loose, moist. (SM)		
	TOPSOIL		
	Reddish-orange silty **SAND** with gravel, slight cementation, medium dense, moist. (SM)		
5	Test Hole terminated at a depth of 5.0 feet below surface grades. No groundwater seepage encountered.		

Test Hole TH-3

DATE: February 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	6 inches **TOPSOIL**		
	FILL: Brown and reddish-orange silty sand with gravel , cobbles to 8 inches, medium dense, moist.		
	FILL: Gray and reddish-orange silty sand with gravel , cobbles to 8 inches, medium dense, moist.		
	6 inches **TOPSOIL**		
5	Tan and gray mottled reddish-orange silty SAND with gravel, medium dense, moist. (SM) (Glacial Till)		
	Test Hole terminated at a depth of 7.0 feet below surface grades. No groundwater seepage encountered.		

Figure A-2

P.O. Box 935
Puyallup, WA. 98371
Office (253) 845-7000

Test Hole TH-4

DATE: February 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	**FILL:** Tan, gray and brown silty sand with gravel, cobbles to 10 inches, loose, moist.		
	FILL: Brown silty sand with gravel and topsoil, cobbles to 8 inches, loose, moist.		
5	Large Boulder at 5.5 feet.		

Test Hole terminated at a depth of 6.5 feet below surface grades.

No groundwater seepage encountered.

Test Hole TH-5

DATE: February 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	**FILL:** Tan, gray and brown silty sand with gravel, cobbles to 10 inches, loose, moist. (SM)		
	TOPSOIL, with cobbles.		
5	Gray silty **SAND** with gravel, medium dense, moist. (SM) (Glacial Till)		

Test Hole terminated at a depth of 5.5 feet below surface grades.

No groundwater seepage encountered.

Test Hole TH-6

DATE: February 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	**FILL:** Tan, gray and brown silty sand with gravel, cobbles to 10 inches, loose, moist. (SM)		
	TOPSOIL, with cobbles.		
5	Gray silty **SAND** with gravel, medium dense, moist. (SM) (Glacial Till)		

Test Hole terminated at a depth of 6.0 feet below surface grades.

No groundwater seepage encountered.

Figure A-3

Test Hole TH-7

DATE: February 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	Tan SAND, trace silt, medium dense, moist. (SP) (Recessional Outwash)		
5	Gary SAND with silt, medium dense, moist. (SP/SM) (Recessional Outwash)		
	Gray silty **SAND** with gravel, medium dense, moist. (SM) (Glacial Till)		
	Test Hole terminated at a depth of 6.5 feet below surface grades.		
	No groundwater seepage encountered.		

Test Hole TH-8

DATE: February 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	Reddish-orange silty **SAND** with gravel, medium dense, moist. (SM)		
	Tan **SAND**, trace silt, medium dense, moist. (SP) (Recessional Outwash)		
	Test Hole terminated at a depth of 3.0 feet below surface grades.		
	No groundwater seepage encountered.		
5			

Figure A-4

APPENDIX B

SMALL PILOT INFILTRATION TEST

Shaw Road Residential
Puyallup, Washington

Small Pilot Infiltration Test (Small PIT)

Excavation:

Test Pit Surface Dimensions	4	5	feet
Test Pit Bottom Dimensions	3	4	feet
Test Pit Bottom Area	12		square feet
Test Pit Depth	8		feet

Pre-Soak Period:

Time (hh:mm)	Depth of Water (inches)
10:00	16
11:00	18
12:00	17
13:00	18
14:00	18
15:00	18
16:00	18

Steady-State Period:

Time of Measurement (hh:mm)	Depth of Water (inches)	Cumulative Volume (gallons)	Flow Rate (gpm)	Infiltration Rate (inches/hour)
16:00	18			0.3
16:15	18			0.4
16:30	18			0.4
16:45	18			0.4
17:00	18			0.4

Falling Head Period:

Time of Measurement 15-min intervals	Depth of Water (inches)	Infiltration Rate (inches/hour)
17:00	18	0
17:15	17.5	2
17:30	17	2
17:45	16.5	2
18:00	16	2

Rate Determination:

Steady State		0.4	(inches/hour)
Falling Head		2	(inches/hour)
Selected Rate:		0.4	(inches/hour)
Correction Factor:	A	1	
	B	0.5	
	C	0.9	

Design Rate: **0.18** **(inches/hour)**