Drainage Report
Hsiao SP

PFN:

for

OWNER:
Jennifer Hsiao
8503 63rd St NE
Marysville, WA 98270

SITE LOCATION:
UNADDRESSED
TPNs: 00550600001200, 00550600001300, 30052100314700

Prepared by:
Elias J. Troutman, E.I.T

Checked by:
Joseph M. Smeby, P.E.

Job No: 22-0711
August 2022 (Prelim.)
Revised: December 2022/February 2023

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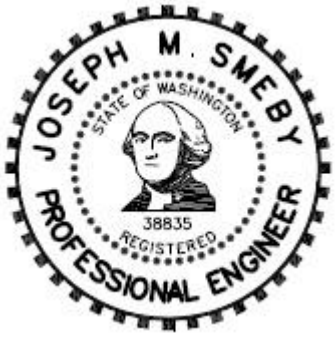

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1. INTRODUCTION

This document is intended to provide the preliminary engineering information necessary to support the 5-lot preliminary short plat for this project which includes the development of 1.14 acres across three separate properties with frontage improvements to 81st Pl NE. This project will include 5 new lots, private and public roads.

The proposed improvements for this project will require the construction of a private road, frontage improvements, stormwater facilities and other utilities. Roof runoff from the new buildings will be connected to individual infiltration systems. Road runoff from the new roads and driveways on site will be collected, treated, and infiltrated on-site.

The Geotechnical Engineer for this project (Nelson Geotechnical Associates, Inc.) has prepared a report summarizing their findings in the field. They found approximately 1.8 to 4 feet undocumented fill/topsoil underlain by fine to coarse sand with gravel (Marysville Sand) to 10 to 11 feet below grade. Groundwater was observed within several test pits at depths of 9 to 10 feet below grade. In addition, they have provided a recommended long-term infiltration rate of 5.45 inches per hour for stormwater infiltration.

The site is located at XXX 81st Pl NE in the City of Marysville, and in Section 21, Township 30N, Range 5E, Willamette Meridian. See Figure 1 - Vicinity Map.

A. DRAINAGE INFORMATION SUMMARY FORM

Project: **Hsiao SP**
PFN:

Engineer: **Omega Engineering, Inc.**
2707 Wetmore Ave — On-site Project area: **1.14 acres**
Everett, WA 98201 — Offsite area: **0.06 acres**
Attention: Joseph Smeby, P.E. — Project area: **1.20 acres**

Applicant: **Jennifer Hsiao**
8503 63rd St NE
Marysville, WA 98270 — New Lots: 5

Drainage Basin Information	**Basin A**
On-site Developed Area	1.14 acres
Off-site Improved Area	0.06 acres
Types of storage proposed on site	Infiltration
Approximate total storage volume	N/A
Soil Types	Type A/B Soils
Basin Data	
Multiple On-site Systems	
See Section 5	

2. EXISTING SITE CONDITIONS

The site is unaddressed in the City of Marysville, and in Section 21, Township 30N, Range 5E, Willamette Meridian. See Figure 1 - Vicinity Map.

Land use around the site is primarily single-family homes, with multiple vacant lots to the west. The parcel associated with this project is currently undeveloped with pasture ground cover. The City has called for frontage improvements along 81st Pl NE. In addition, a private road will be constructed to serve lots 3, 4 and 5. The new road sections conform to the City of Marysville Street Standards.

The existing developable site is irregular in shape made up of three parcels. The grades on the site are very flat. The vegetation found on the existing property consists of pasture.

A site visit was conducted on July 21, 2021. The weather was sunny with temperatures in the 80's. No standing water was observed throughout the site.

Based on the geotechnical findings for this project, the site soils will be analyzed as Type A/B based on the sandy material found. Refer to the Geotech report in Appendix B.

This project proposes to create five buildable lots. Approximately 50% of this project will be impervious surface with the remaining area to be landscaped.

3. DEVELOPED SITE CONDITIONS

This development proposes to cover the site with nearly 50% impervious surfaces. The runoff from these surfaces will be collected and infiltrated in different ways. First the runoff from the future SFR and duplex roofs will be collected and infiltrated via infiltration trenches on each lot. The runoff from the frontage improvements, private road and driveway runoff from lots 1 through 4 will also be collected and infiltrated via infiltration trenches. Finally, the lot 5 driveway will be constructed partially of concrete that will drain to road infiltration trench #2 and partially of permeable pavers/concrete for infiltration. This approach will allow for the infiltration of runoff throughout the site to mimic the existing conditions.

By fully infiltrating the runoff from the new impervious surfaces, the new drainage system will not increase the peak flow rates or durations to the downstream system. Refer to section 5 of this report along with the attached calculations contained in Appendix A.

Based on the recommendations of the project Geotechnical Engineer in the soils report, the proposed infiltration systems will be designed with a 5”/hr infiltration rate and the bottom of the trenches will extend past the surficial topsoil into the native sandy soils beneath the site. The geotechnical engineer found evidence of groundwater at approximately 9 to 10 feet below grade. Refer to the included document in Appendix B.

4. OFFSITE ANALYSIS

DEFINE STUDY AREA:

From observations made during the field visit, and the topographic survey, no significant off-site area drains toward the project site.

Due to the permeable soils found on and around this site, limited amounts of surface flow are expected in the existing condition.

REVIEW AVAILABLE INFORMATION:

This project is not located within a FEMA floodplain and no other basin plans or drainage resource information has been located as this time.

FIELD INSPECTION:

The site slopes in no particular direction and is very flat.

DESCRIPTION OF DRAINAGE SYSTEM AND ANY EXISTING OR PREDICTED PROBLEMS:

There is no formal downstream drainage system for this project. The design concept for this short plat is to fully infiltrate all runoff generated from the project on-site.

5. STORMWATER CONTROL PLAN

A. Site Hydrology Analysis

Pre-Developed Site Hydrology

The existing site is very flat and drains in no particular direction. Due to the permeable soils underlying the site, it is anticipated that runoff generated will not leave the site.

Developed Site Hydrology

For the developed site hydrology, all the new impervious surfaces will be collected and infiltrated on-site.

By fully infiltrating the site runoff generated by the impervious surfaces this drainage design will only slight increase the peak flows in the downstream system and will protect those areas from additional risk of flooding or erosion.

B. PERFORMANCE STANDARDS

The proposed infiltration systems designed for the new roadways, along with all of the other infiltration facilities proposed for this project have been sized using the WWMH2012 software as required in the DOE 2012 manual.

C. FLOW CONTROL SYSTEM

As noted above, the site drainage will utilize full infiltration of all developed surfaces up to the 100-year storm event. The following provides the input information for WWHM12 along with the required trench sizes for each system. The following table summarizes the impervious surfaces accounted for in each system.

DEVELOPED INFILTRATION BASINS		
	Impervious area (sf)	Impervious area (ac)
Lot 1 Roof	2,600	0.06
Lot 2 Roof	2,600	0.06
Lot 3 Roof	3,450	0.08
Lot 4 Roof	3,450	0.08
Lot 5 Roof	4,300	0.10
Frontage, ½ Priv. Rd & D/Ws	9,500	0.22
½ Priv. Rd, Lot 3 & 4 D/Ws	9,000	0.21
Lot 5 Driveway	2,349	0.054

The road infiltration trenches will collect runoff from the entire private access road, sidewalk and planter strip within the access tract along with the frontage improvements and driveways from lots 1 through 5. The results of sizing were a 80'x6' trench (Trench #1) and 60'x8' trench (Trench #2)

A roof area has been assumed on each new lot based on the building footprints that the applicant plans to build on each lot, and individual 'roof' infiltration trenches are proposed on each new lot to infiltrate all new roof runoff.

To check if this project triggers flow Control (MR #7), the WWMH2012 software was used to model the site runoff in the predeveloped conditions against the developed conditions. The predeveloped conditions were modeled as forest, and all pervious areas in the developed conditions were modeled as lawn. All impervious surfaces to be infiltrated were modeled as such using an infiltration rate of 5 inches per hour, resulting in 100 percent infiltration of new and replaced impervious surfaces.

Analysis Results:

Predeveloped Conditions:	100-year Flow Rate = 0.074 cfs
Developed Conditions:	100-year Flow Rate = 0.035 cfs
Total Runoff Increase:	= **-0.039 cfs**

In conclusion, this project will result in a runoff *decrease* from the site of 0.039 cfs, less than the 0.15 cfs *increase* threshold for Flow Control. See Appendix A for WWHM model results.

D. WATER QUALITY SYSTEM

The project Geotech has determined that the on-site soils are highly permeable, but per the DOE Manual, infiltration of PGIS requires pretreatment. To provide pretreatment for the runoff from the pollution-generating hard surfaces, two single-cartridge Contech filters are proposed to provide pretreatment and treatment for the runoff from the new PGHS. These was sized using the Western Washington Hydrology Model which found required water quality flow rates of 0.035 cfs (16 gpm) to CB #4, and 0.033 cfs (15 gpm) to CB #6. Each individual 27" PSORB cartridge can treat up to 18.79 gpm, so a 1-cartridge catch basin will be used for each stormfilter. The individual driveway runoff on lot 5 will partially drain to road trench #2 and partially be infiltrated via permeable pavers/concrete underlain with an amended soil layer that will meet the DOE standards for treatment.

E. CONVEYANCE SYSTEM ANALYSIS

This project does not intend to collect large areas and/or convey those flows. So, the proposed 8-inch and 12-inch pipes with minimum slopes of 0.5% will be more than adequate to handle the expected flows from the new impervious surfaces. An official flow capacity analysis will be performed at the time of construction level review.

6. SWPPP NARRATIVE

The intent of this section is to provide the information necessary to support the engineering plans to implement a design that will; reduce, eliminate or prevent the discharge of stormwater pollutants, meet or exceed the water quality and sediment management standards for the City and State, and prevent adverse impacts to the receiving waters for this project. Note; this narrative is intended to support the SWPPP that is included with the Drainage Plans also a part of this submittal package to the City.

A. SITE GRADING/EROSION CONTROL RISK ASSESSMENT

Area proposed to be cleared/worked:	1.20 acres
Average slope for the site:	<3% (Area of Disturbance Only)
Erosion Hazard of Soil	Low
Critical Areas downslope	No
Site is upstream of an ESA Stream	No

Based on the above information and the fact that significant areas of vegetation can be retained along the perimeter of the area of disturbance along with the permeable on-site soils, and that if site conditions warrant, additional BMP's can be implemented as corrective measures the Risk Category for this site is **Low Risk.**

B. SWPPP Minimum Elements

1: Preserve Vegetation and Mark Clearing Limits
The first step in the construction process is for the contractor to flag or fence the limits of clearing/disturbance prior to any other construction activity. The engineering plans locate and provide the square footages for the areas of grading, clearing, impervious surfaces and un-disturbed areas on the proposed site. Existing vegetation can be preserved around the perimeter of the site during the initial construction phases on this project. Approximately 100% of the entire site will be cleared or disturbed for this project.

2: Establish Construction Access
The SWPPP calls for the existing gravel on-site to be used as the construction entrance. At this time winter work is expected during the wet season.

3: Control Flow Rates
The site will be graded, and the permeable on-site soils will be available to infiltrate runoff from the construction site. The contractor will be able to construct small low areas as needed around the project to aid in collecting and infiltrating runoff. However, these low areas shall not be in the location of the future infiltration areas.

4: Install Sediment Controls
This site SWPPP proposes to construct/maintain gravel entrances, silt fencing or a brush barrier if necessary. The construction of these features should be completed before the clearing and grading of the site. Mulch will also be used on the exposed soil as necessary to limit erosion.

5: Stabilize Soils
The “Construction Sequence” calls for the stabilization of soils that remain unworked for certain lengths of time based on the time of year. Stabilization techniques may include but not limited to mulching, plastic sheeting or hydroseeding, notes have been added to the plan regarding protection for the stock pile area if necessary. Stockpile areas have been identified on the SWPPP and are setback a minimum of 25-feet from any down slope property line.

6: Protect Slopes
All disturbed slopes on site during construction are required to be protected with mulch or other means as specified in the construction sequence. No concentrated runoff or significant amounts of sheet flow will be directed to new cut or fill slopes during construction.

7: Protect Drain Inlets
All existing catch basins adjacent to this project and immediately downstream will be protected with inlet protection. All new catch basins will also be installed with plugs to prevent runoff from entering the infiltration system until the site has been fully stabilized.

8: Stabilize Channels and Outlets
No new or existing channels/outlets are proposed or will be impacted by this project.

9: Control Pollutants
No outside chemicals are expected to be necessary for the construction of this project. All vehicles working on and around the site would need to meet the State requirements for emissions. Vehicle fueling locations will be used to limit the potential impacts from any spills and concrete washout areas will also be provided well away from the critical areas.

10: Control DeWatering
DeWatering is not anticipated for this project, as the water table was not encountered to a depth of at least 9 to 10 feet below grade.

11: Maintain BMPs
The construction supervisor will be responsible for maintaining all BMPs during construction and working with the City to relocate or add BMPs as necessary as site conditions change.

12: Manage the Project
It will be the responsibility of the Contractor and Developer to manage this project and coordinate with the City Inspector and Engineer.

Inspection and Monitoring:
Site inspections shall be done by a person who is knowledgeable in the principles and practices of erosion and sediment control. The person must have skills to first assess the site conditions and construction activities that could impact the quality of stormwater, and second assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

Maintaining an Updated Construction SWPPP:
The construction SWPPP shall be retained on-site or within reasonable access to the site. The SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.

The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven days following inspection.

13: Protect On-Site Stormwater Management BMPs for Runoff from Hard Surfaces
The use of on-site management BMPs for this project will allow for the installation of the infiltration systems for both the road and future lot runoff at the end of the project.

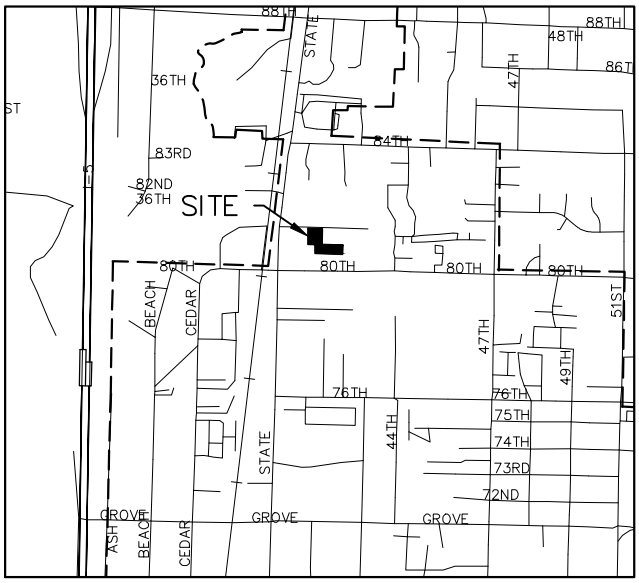
The areas for long-term infiltration have been shown on the plans and shall be noted on the construction plans to be protected from compaction/disturbance during construction.

The future road infiltration systems will be constructed as part of the plat improvements. So those areas must be protected at the time of lot building construction to ensure no sediment from those future phases of construction are allowed to enter the infiltration trenches. Lot infiltration trenches for roof and landscaping runoff will be installed at the time of building permit and shall also be protected at that time.

7. PROJECT OVERVIEW

This project proposes to 5 new buildable lots across three parcels. In addition, public road frontage improvements and a private road will be required along with utilities to serve/mitigate the proposed improvements. Approximately 1.14 acres of the site and 0.06 acres off-site will be developed/disturbed under this project. All the new impervious surfaces will be infiltrated in trenches spread around the site and permeable pavement. The existing ground cover is pasture and several trees.

The site grades for this project do not exceed 5 percent. Some site grading will be necessary to achieve the necessary road slopes for drainage. The new road runoff will also be infiltrated on-site with no offsite flows expected from the on-site improvements. Sewer and water main extensions will be extended under the new private road to serve the new lots. No existing drainfields were found on this site.



VICINITY MAP

SCALE 1" = 2000'

FIG. 1

OMEGA
ENGINEERING, INC.
2707 WETMORE AVE.
Everett, WA 98201
(o)425.387.3820 (f) 425.259.1958

VICINITY MAP
HSIAO SP

DATE	JOB NO.	SCALE	SHEET
8/5/22	22-0711	1" = 2000'	1 OF 1

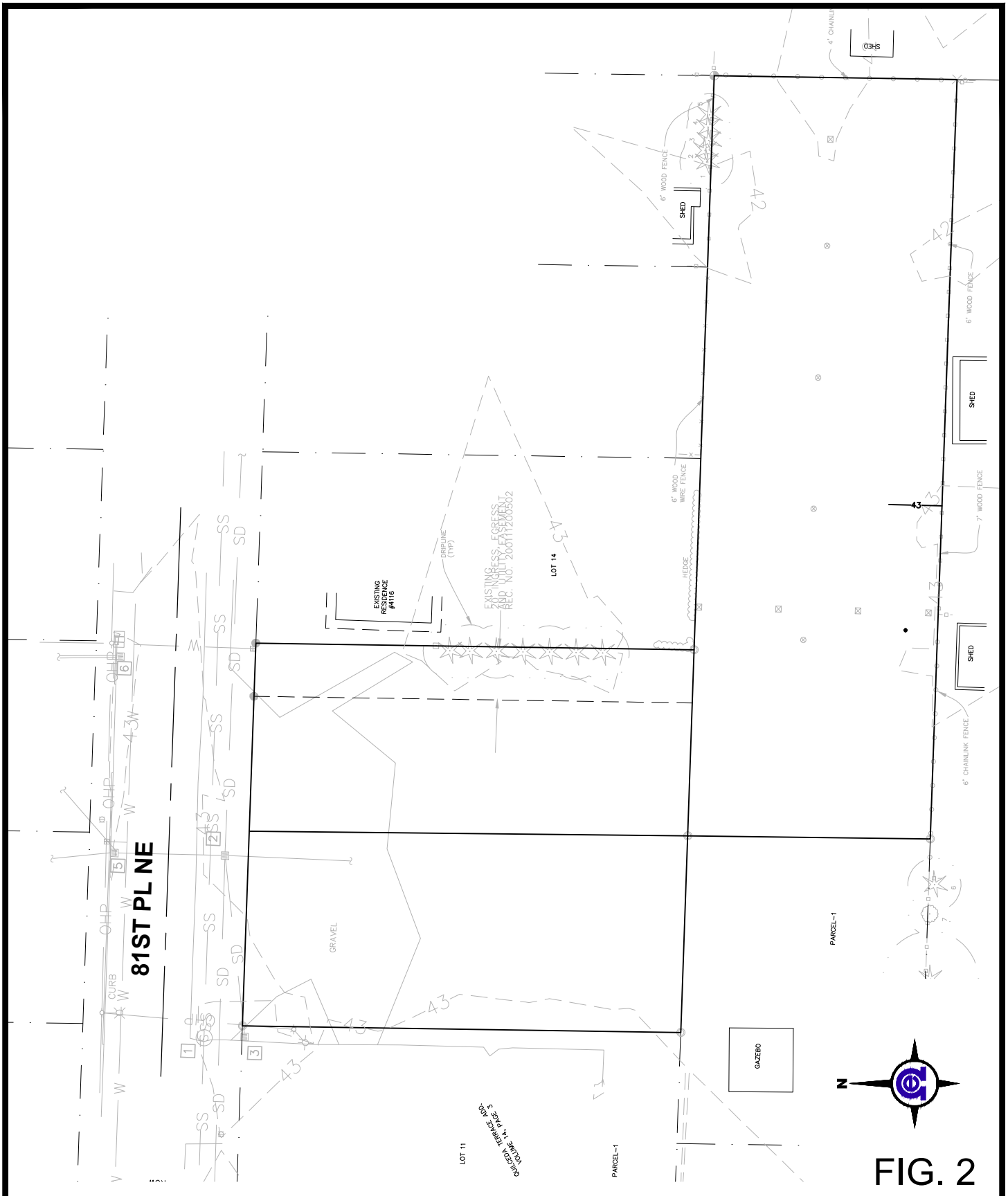


FIG. 2

OMEGA
ENGINEERING, INC.
2707 WETMORE AVE.
Everett, WA 98201
(o)425.387.3820 (f) 425.259.1958

EXISTING BASIN MAP
HSIAO SP

DATE	JOB NO.	SCALE	SHEET
8/5/22	22-0711	1" = 50'	1 OF 1

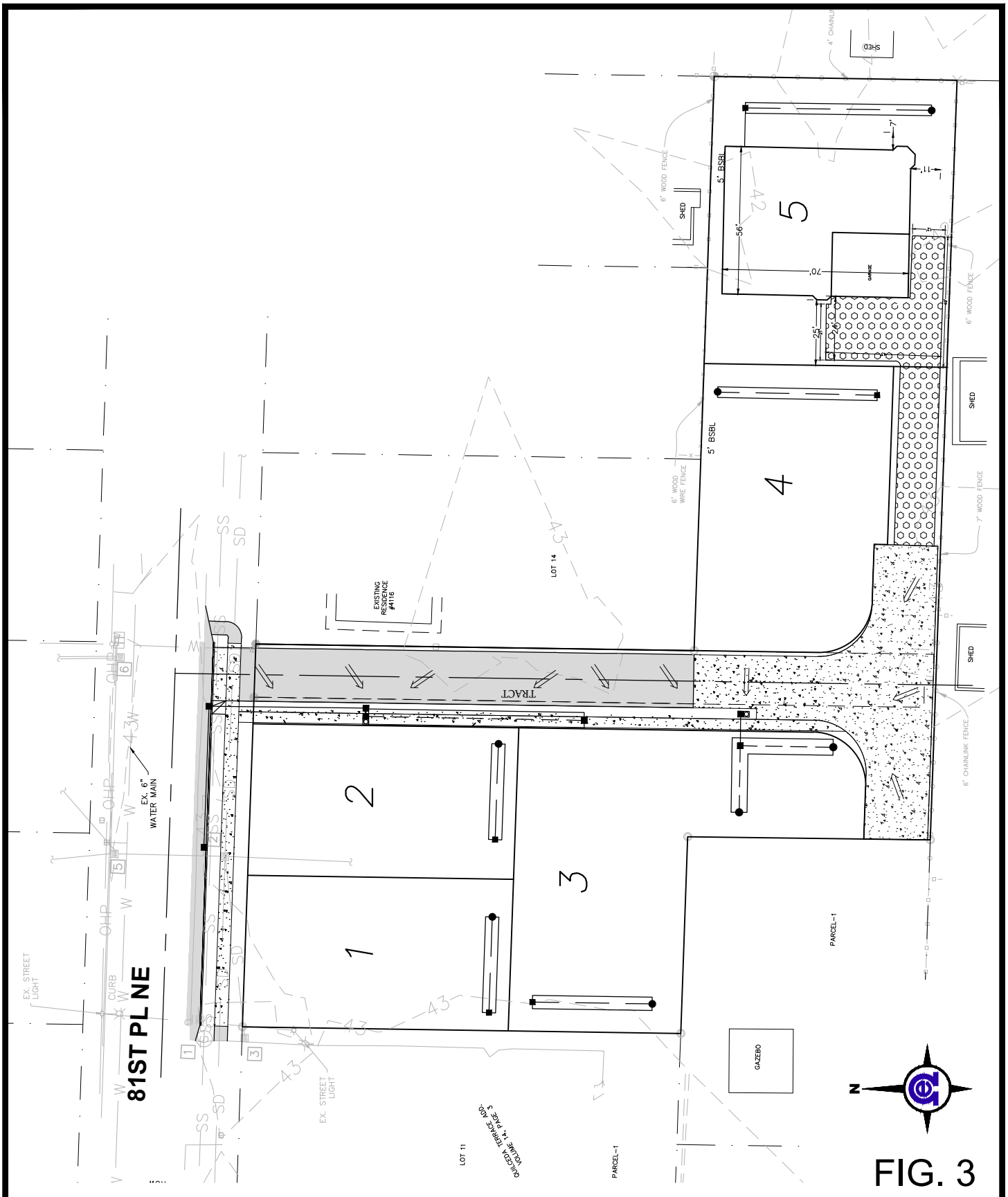


FIG. 3

OMEGA
ENGINEERING, INC.
2707 WETMORE AVE.
Everett, WA 98201
(o)425.387.3820 (f) 425.259.1958

DEVELOPED BASIN MAP
HSIAO SP

DATE	JOB NO.	SCALE	SHEET
2/10/23	22-0711	1" = 50'	1 OF 1

APPENDIX A

STORMWATER CALCULATIONS

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	INFILTRATION
Site Name:	
Site Address:	
City:	
Report Date:	12/19/2022
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.000 (adjusted)
Version Date:	2019/09/13
Version:	4.2.17

THIS IS A GLITCH. PRECIPITATION FACTOR IN THIS AREA OF MARYSVILLE IS 1.000 SEE SCREENSHOT ON NEXT PAGE FOR THE PRECIPATION SCALE THAT THE MODEL IS ACTUALLY USING IN THE ANALYSIS.

POC Thresholds

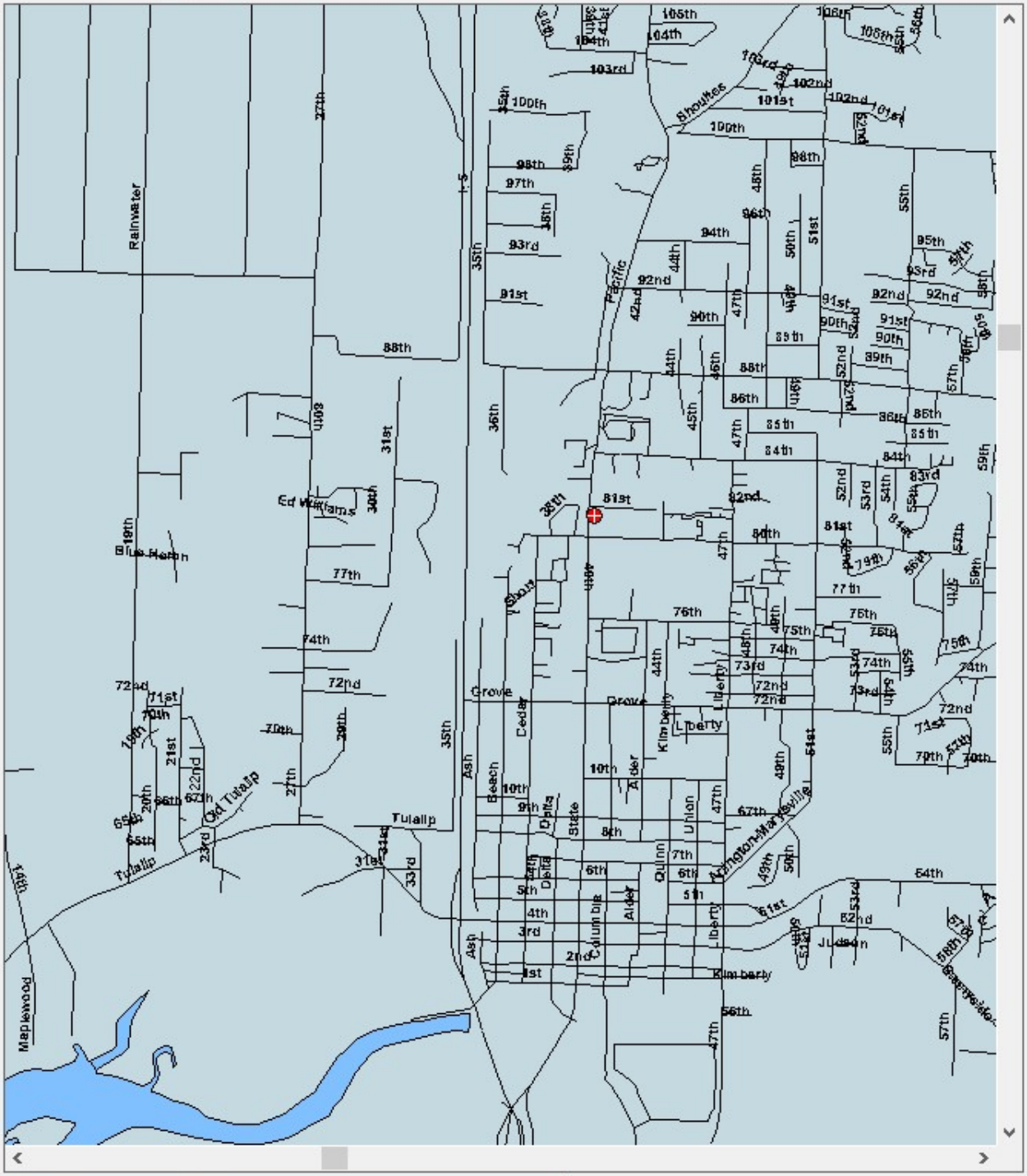
Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Western Washington Hydrology Model 2012

File Edit View Help Summary Report

Snohomish2012

Snohomish2012



Site Information

Site Name

Address

City

Gage Everett

Precip Factor 1.000

☐ Use WS-DOT data

Map Controls

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	1.2
Pervious Total	1.2
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.2

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Roof Lot 5

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.1
Impervious Total	0.1
Basin Total	0.1

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 3	Gravel Trench Bed 3	

Roof Lots 3 & 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.16
Impervious Total	0.16
Basin Total	0.16

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 3	Gravel Trench Bed 3	

Roof Lots 1 & 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.12
Impervious Total	0.12
Basin Total	0.12

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 3	Gravel Trench Bed 3	

FRONTAGE, 1/2 PRIV. ROAD & D/Ws

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.15
Pervious Total	0.15

Impervious Land Use	acre
ROADS FLAT	0.12
DRIVEWAYS FLAT	0.05
SIDEWALKS FLAT	0.05
Impervious Total	0.22
Basin Total	0.37

Element Flows To:

Surface	Interflow	Groundwater
ROAD TRENCH #1	ROAD TRENCH #1	

Basin 5

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.12
Pervious Total	0.12

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.12

Element Flows To:

Surface	Interflow	Groundwater
Channel 1	Channel 1	

1/2 PRIV. RD, LOT 3 & 4 D/W

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.1
Pervious Total	0.1

Impervious Land Use	acre
ROADS FLAT	0.15
DRIVEWAYS FLAT	0.05
SIDEWALKS FLAT	0.01
Impervious Total	0.21
Basin Total	0.31

Element Flows To:

Surface	Interflow	Groundwater
ROAD TRENCH #2	ROAD TRENCH #2	

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 3 **(LOTS 1 & 2 COMBINED)**

Bottom Length:	90.00 ft.
Bottom Width:	4.00 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:	2
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	18.449
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	18.449
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	2 ft.
Riser Diameter:	8 in.
Element Flows To:	
Outlet 1	Outlet 2
Channel 1	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.008	0.000	0.000	0.000
0.0333	0.008	0.000	0.000	0.041
0.0667	0.008	0.000	0.000	0.041
0.1000	0.008	0.000	0.000	0.041
0.1333	0.008	0.000	0.000	0.041
0.1667	0.008	0.000	0.000	0.041
0.2000	0.008	0.000	0.000	0.041
0.2333	0.008	0.000	0.000	0.041
0.2667	0.008	0.000	0.000	0.041
0.3000	0.008	0.000	0.000	0.041
0.3333	0.008	0.001	0.000	0.041
0.3667	0.008	0.001	0.000	0.041
0.4000	0.008	0.001	0.000	0.041
0.4333	0.008	0.001	0.000	0.041
0.4667	0.008	0.001	0.000	0.041
0.5000	0.008	0.001	0.000	0.041
0.5333	0.008	0.001	0.000	0.041
0.5667	0.008	0.001	0.000	0.041
0.6000	0.008	0.001	0.000	0.041
0.6333	0.008	0.001	0.000	0.041
0.6667	0.008	0.001	0.000	0.041
0.7000	0.008	0.002	0.000	0.041
0.7333	0.008	0.002	0.000	0.041
0.7667	0.008	0.002	0.000	0.041

0.8000	0.008	0.002	0.000	0.041
0.8333	0.008	0.002	0.000	0.041
0.8667	0.008	0.002	0.000	0.041
0.9000	0.008	0.002	0.000	0.041
0.9333	0.008	0.002	0.000	0.041
0.9667	0.008	0.002	0.000	0.041
1.0000	0.008	0.002	0.000	0.041
1.0333	0.008	0.003	0.000	0.041
1.0667	0.008	0.003	0.000	0.041
1.1000	0.008	0.003	0.000	0.041
1.1333	0.008	0.003	0.000	0.041
1.1667	0.008	0.003	0.000	0.041
1.2000	0.008	0.003	0.000	0.041
1.2333	0.008	0.003	0.000	0.041
1.2667	0.008	0.003	0.000	0.041
1.3000	0.008	0.003	0.000	0.041
1.3333	0.008	0.003	0.000	0.041
1.3667	0.008	0.004	0.000	0.041
1.4000	0.008	0.004	0.000	0.041
1.4333	0.008	0.004	0.000	0.041
1.4667	0.008	0.004	0.000	0.041
1.5000	0.008	0.004	0.000	0.041
1.5333	0.008	0.004	0.000	0.041
1.5667	0.008	0.004	0.000	0.041
1.6000	0.008	0.004	0.000	0.041
1.6333	0.008	0.004	0.000	0.041
1.6667	0.008	0.004	0.000	0.041
1.7000	0.008	0.004	0.000	0.041
1.7333	0.008	0.005	0.000	0.041
1.7667	0.008	0.005	0.000	0.041
1.8000	0.008	0.005	0.000	0.041
1.8333	0.008	0.005	0.000	0.041
1.8667	0.008	0.005	0.000	0.041
1.9000	0.008	0.005	0.000	0.041
1.9333	0.008	0.005	0.000	0.041
1.9667	0.008	0.005	0.000	0.041
2.0000	0.008	0.006	0.000	0.041
2.0333	0.008	0.006	0.043	0.041
2.0667	0.008	0.006	0.121	0.041
2.1000	0.008	0.006	0.219	0.041
2.1333	0.008	0.007	0.329	0.041
2.1667	0.008	0.007	0.441	0.041
2.2000	0.008	0.007	0.547	0.041
2.2333	0.008	0.007	0.639	0.041
2.2667	0.008	0.008	0.711	0.041
2.3000	0.008	0.008	0.762	0.041
2.3333	0.008	0.008	0.808	0.041
2.3667	0.008	0.009	0.847	0.041
2.4000	0.008	0.009	0.885	0.041
2.4333	0.008	0.009	0.921	0.041
2.4667	0.008	0.009	0.956	0.041
2.5000	0.008	0.010	0.989	0.041
2.5333	0.008	0.010	1.022	0.041
2.5667	0.008	0.010	1.053	0.041
2.6000	0.008	0.010	1.084	0.041
2.6333	0.008	0.011	1.114	0.041
2.6667	0.008	0.011	1.143	0.041
2.7000	0.008	0.011	1.171	0.041

2.7333	0.008	0.012	1.198	0.041
2.7667	0.008	0.012	1.225	0.041
2.8000	0.008	0.012	1.252	0.041
2.8333	0.008	0.012	1.277	0.041
2.8667	0.008	0.013	1.303	0.041
2.9000	0.008	0.013	1.328	0.041
2.9333	0.008	0.013	1.352	0.041
2.9667	0.008	0.014	1.376	0.041
3.0000	0.008	0.014	1.399	0.041

Gravel Trench Bed 3 **(LOTS 3 & 4 COMBINED)**

Bottom Length:	90.00 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:	2
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	24.669
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	24.669
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	2 ft.
Riser Diameter:	8 in.

Element Flows To:
Outlet 1 Outlet 2
Channel 1

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.010	0.000	0.000	0.000
0.0333	0.010	0.000	0.000	0.052
0.0667	0.010	0.000	0.000	0.052
0.1000	0.010	0.000	0.000	0.052
0.1333	0.010	0.000	0.000	0.052
0.1667	0.010	0.000	0.000	0.052
0.2000	0.010	0.000	0.000	0.052
0.2333	0.010	0.000	0.000	0.052
0.2667	0.010	0.001	0.000	0.052
0.3000	0.010	0.001	0.000	0.052
0.3333	0.010	0.001	0.000	0.052
0.3667	0.010	0.001	0.000	0.052
0.4000	0.010	0.001	0.000	0.052
0.4333	0.010	0.001	0.000	0.052
0.4667	0.010	0.001	0.000	0.052
0.5000	0.010	0.001	0.000	0.052
0.5333	0.010	0.001	0.000	0.052
0.5667	0.010	0.002	0.000	0.052
0.6000	0.010	0.002	0.000	0.052
0.6333	0.010	0.002	0.000	0.052
0.6667	0.010	0.002	0.000	0.052
0.7000	0.010	0.002	0.000	0.052
0.7333	0.010	0.002	0.000	0.052
0.7667	0.010	0.002	0.000	0.052
0.8000	0.010	0.002	0.000	0.052
0.8333	0.010	0.003	0.000	0.052

0.8667	0.010	0.003	0.000	0.052
0.9000	0.010	0.003	0.000	0.052
0.9333	0.010	0.003	0.000	0.052
0.9667	0.010	0.003	0.000	0.052
1.0000	0.010	0.003	0.000	0.052
1.0333	0.010	0.003	0.000	0.052
1.0667	0.010	0.003	0.000	0.052
1.1000	0.010	0.004	0.000	0.052
1.1333	0.010	0.004	0.000	0.052
1.1667	0.010	0.004	0.000	0.052
1.2000	0.010	0.004	0.000	0.052
1.2333	0.010	0.004	0.000	0.052
1.2667	0.010	0.004	0.000	0.052
1.3000	0.010	0.004	0.000	0.052
1.3333	0.010	0.004	0.000	0.052
1.3667	0.010	0.004	0.000	0.052
1.4000	0.010	0.005	0.000	0.052
1.4333	0.010	0.005	0.000	0.052
1.4667	0.010	0.005	0.000	0.052
1.5000	0.010	0.005	0.000	0.052
1.5333	0.010	0.005	0.000	0.052
1.5667	0.010	0.005	0.000	0.052
1.6000	0.010	0.005	0.000	0.052
1.6333	0.010	0.005	0.000	0.052
1.6667	0.010	0.006	0.000	0.052
1.7000	0.010	0.006	0.000	0.052
1.7333	0.010	0.006	0.000	0.052
1.7667	0.010	0.006	0.000	0.052
1.8000	0.010	0.006	0.000	0.052
1.8333	0.010	0.006	0.000	0.052
1.8667	0.010	0.006	0.000	0.052
1.9000	0.010	0.006	0.000	0.052
1.9333	0.010	0.007	0.000	0.052
1.9667	0.010	0.007	0.000	0.052
2.0000	0.010	0.007	0.000	0.052
2.0333	0.010	0.007	0.043	0.052
2.0667	0.010	0.008	0.121	0.052
2.1000	0.010	0.008	0.219	0.052
2.1333	0.010	0.008	0.329	0.052
2.1667	0.010	0.009	0.441	0.052
2.2000	0.010	0.009	0.547	0.052
2.2333	0.010	0.009	0.639	0.052
2.2667	0.010	0.010	0.711	0.052
2.3000	0.010	0.010	0.762	0.052
2.3333	0.010	0.010	0.808	0.052
2.3667	0.010	0.011	0.847	0.052
2.4000	0.010	0.011	0.885	0.052
2.4333	0.010	0.011	0.921	0.052
2.4667	0.010	0.012	0.956	0.052
2.5000	0.010	0.012	0.989	0.052
2.5333	0.010	0.013	1.022	0.052
2.5667	0.010	0.013	1.053	0.052
2.6000	0.010	0.013	1.084	0.052
2.6333	0.010	0.014	1.114	0.052
2.6667	0.010	0.014	1.143	0.052
2.7000	0.010	0.014	1.171	0.052
2.7333	0.010	0.015	1.198	0.052
2.7667	0.010	0.015	1.225	0.052

2.8000	0.010	0.015	1.252	0.052
2.8333	0.010	0.016	1.277	0.052
2.8667	0.010	0.016	1.303	0.052
2.9000	0.010	0.016	1.328	0.052
2.9333	0.010	0.017	1.352	0.052
2.9667	0.010	0.017	1.376	0.052
3.0000	0.010	0.017	1.399	0.052

Gravel Trench Bed 3 **(LOT 5)**

Bottom Length:	70.00 ft.
Bottom Width:	4.00 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:	2
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	15.342
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	15.342
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	2 ft.
Riser Diameter:	8 in.
Element Flows To:	
Outlet 1	Outlet 2
Channel 1	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.006	0.000	0.000	0.000
0.0333	0.006	0.000	0.000	0.032
0.0667	0.006	0.000	0.000	0.032
0.1000	0.006	0.000	0.000	0.032
0.1333	0.006	0.000	0.000	0.032
0.1667	0.006	0.000	0.000	0.032
0.2000	0.006	0.000	0.000	0.032
0.2333	0.006	0.000	0.000	0.032
0.2667	0.006	0.000	0.000	0.032
0.3000	0.006	0.000	0.000	0.032
0.3333	0.006	0.000	0.000	0.032
0.3667	0.006	0.000	0.000	0.032
0.4000	0.006	0.000	0.000	0.032
0.4333	0.006	0.001	0.000	0.032
0.4667	0.006	0.001	0.000	0.032
0.5000	0.006	0.001	0.000	0.032
0.5333	0.006	0.001	0.000	0.032
0.5667	0.006	0.001	0.000	0.032
0.6000	0.006	0.001	0.000	0.032
0.6333	0.006	0.001	0.000	0.032
0.6667	0.006	0.001	0.000	0.032
0.7000	0.006	0.001	0.000	0.032
0.7333	0.006	0.001	0.000	0.032
0.7667	0.006	0.001	0.000	0.032
0.8000	0.006	0.001	0.000	0.032
0.8333	0.006	0.001	0.000	0.032

0.8667	0.006	0.001	0.000	0.032
0.9000	0.006	0.002	0.000	0.032
0.9333	0.006	0.002	0.000	0.032
0.9667	0.006	0.002	0.000	0.032
1.0000	0.006	0.002	0.000	0.032
1.0333	0.006	0.002	0.000	0.032
1.0667	0.006	0.002	0.000	0.032
1.1000	0.006	0.002	0.000	0.032
1.1333	0.006	0.002	0.000	0.032
1.1667	0.006	0.002	0.000	0.032
1.2000	0.006	0.002	0.000	0.032
1.2333	0.006	0.002	0.000	0.032
1.2667	0.006	0.002	0.000	0.032
1.3000	0.006	0.002	0.000	0.032
1.3333	0.006	0.003	0.000	0.032
1.3667	0.006	0.003	0.000	0.032
1.4000	0.006	0.003	0.000	0.032
1.4333	0.006	0.003	0.000	0.032
1.4667	0.006	0.003	0.000	0.032
1.5000	0.006	0.003	0.000	0.032
1.5333	0.006	0.003	0.000	0.032
1.5667	0.006	0.003	0.000	0.032
1.6000	0.006	0.003	0.000	0.032
1.6333	0.006	0.003	0.000	0.032
1.6667	0.006	0.003	0.000	0.032
1.7000	0.006	0.003	0.000	0.032
1.7333	0.006	0.003	0.000	0.032
1.7667	0.006	0.004	0.000	0.032
1.8000	0.006	0.004	0.000	0.032
1.8333	0.006	0.004	0.000	0.032
1.8667	0.006	0.004	0.000	0.032
1.9000	0.006	0.004	0.000	0.032
1.9333	0.006	0.004	0.000	0.032
1.9667	0.006	0.004	0.000	0.032
2.0000	0.006	0.004	0.000	0.032
2.0333	0.006	0.004	0.043	0.032
2.0667	0.006	0.005	0.121	0.032
2.1000	0.006	0.005	0.219	0.032
2.1333	0.006	0.005	0.329	0.032
2.1667	0.006	0.005	0.441	0.032
2.2000	0.006	0.005	0.547	0.032
2.2333	0.006	0.006	0.639	0.032
2.2667	0.006	0.006	0.711	0.032
2.3000	0.006	0.006	0.762	0.032
2.3333	0.006	0.006	0.808	0.032
2.3667	0.006	0.007	0.847	0.032
2.4000	0.006	0.007	0.885	0.032
2.4333	0.006	0.007	0.921	0.032
2.4667	0.006	0.007	0.956	0.032
2.5000	0.006	0.007	0.989	0.032
2.5333	0.006	0.008	1.022	0.032
2.5667	0.006	0.008	1.053	0.032
2.6000	0.006	0.008	1.084	0.032
2.6333	0.006	0.008	1.114	0.032
2.6667	0.006	0.008	1.143	0.032
2.7000	0.006	0.009	1.171	0.032
2.7333	0.006	0.009	1.198	0.032
2.7667	0.006	0.009	1.225	0.032

2.8000	0.006	0.009	1.252	0.032
2.8333	0.006	0.010	1.277	0.032
2.8667	0.006	0.010	1.303	0.032
2.9000	0.006	0.010	1.328	0.032
2.9333	0.006	0.010	1.352	0.032
2.9667	0.006	0.010	1.376	0.032
3.0000	0.006	0.011	1.399	0.032

ROAD TRENCH #1

Bottom Length:	80.00 ft.
Bottom Width:	6.00 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:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	34.118
Total Volume Through Riser (ac-ft.):	0.001
Total Volume Through Facility (ac-ft.):	34.119
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	8 in.
Element Flows To:	
Outlet 1	Outlet 2
Channel 1	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.011	0.000	0.000	0.000
0.0444	0.011	0.000	0.000	0.055
0.0889	0.011	0.000	0.000	0.055
0.1333	0.011	0.000	0.000	0.055
0.1778	0.011	0.000	0.000	0.055
0.2222	0.011	0.000	0.000	0.055
0.2667	0.011	0.001	0.000	0.055
0.3111	0.011	0.001	0.000	0.055
0.3556	0.011	0.001	0.000	0.055
0.4000	0.011	0.001	0.000	0.055
0.4444	0.011	0.001	0.000	0.055
0.4889	0.011	0.001	0.000	0.055
0.5333	0.011	0.002	0.000	0.055
0.5778	0.011	0.002	0.000	0.055
0.6222	0.011	0.002	0.000	0.055
0.6667	0.011	0.002	0.000	0.055
0.7111	0.011	0.002	0.000	0.055
0.7556	0.011	0.002	0.000	0.055
0.8000	0.011	0.003	0.000	0.055
0.8444	0.011	0.003	0.000	0.055
0.8889	0.011	0.003	0.000	0.055
0.9333	0.011	0.003	0.000	0.055
0.9778	0.011	0.003	0.000	0.055
1.0222	0.011	0.003	0.000	0.055
1.0667	0.011	0.004	0.000	0.055
1.1111	0.011	0.004	0.000	0.055

1.1556	0.011	0.004	0.000	0.055
1.2000	0.011	0.004	0.000	0.055
1.2444	0.011	0.004	0.000	0.055
1.2889	0.011	0.005	0.000	0.055
1.3333	0.011	0.005	0.000	0.055
1.3778	0.011	0.005	0.000	0.055
1.4222	0.011	0.005	0.000	0.055
1.4667	0.011	0.005	0.000	0.055
1.5111	0.011	0.005	0.000	0.055
1.5556	0.011	0.006	0.000	0.055
1.6000	0.011	0.006	0.000	0.055
1.6444	0.011	0.006	0.000	0.055
1.6889	0.011	0.006	0.000	0.055
1.7333	0.011	0.006	0.000	0.055
1.7778	0.011	0.006	0.000	0.055
1.8222	0.011	0.007	0.000	0.055
1.8667	0.011	0.007	0.000	0.055
1.9111	0.011	0.007	0.000	0.055
1.9556	0.011	0.007	0.000	0.055
2.0000	0.011	0.007	0.000	0.055
2.0444	0.011	0.007	0.000	0.055
2.0889	0.011	0.008	0.000	0.055
2.1333	0.011	0.008	0.000	0.055
2.1778	0.011	0.008	0.000	0.055
2.2222	0.011	0.008	0.000	0.055
2.2667	0.011	0.008	0.000	0.055
2.3111	0.011	0.008	0.000	0.055
2.3556	0.011	0.009	0.000	0.055
2.4000	0.011	0.009	0.000	0.055
2.4444	0.011	0.009	0.000	0.055
2.4889	0.011	0.009	0.000	0.055
2.5333	0.011	0.009	0.000	0.055
2.5778	0.011	0.009	0.000	0.055
2.6222	0.011	0.010	0.000	0.055
2.6667	0.011	0.010	0.000	0.055
2.7111	0.011	0.010	0.000	0.055
2.7556	0.011	0.010	0.000	0.055
2.8000	0.011	0.010	0.000	0.055
2.8444	0.011	0.011	0.000	0.055
2.8889	0.011	0.011	0.000	0.055
2.9333	0.011	0.011	0.000	0.055
2.9778	0.011	0.011	0.000	0.055
3.0222	0.011	0.012	0.023	0.055
3.0667	0.011	0.012	0.121	0.055
3.1111	0.011	0.013	0.255	0.055
3.1556	0.011	0.013	0.404	0.055
3.2000	0.011	0.013	0.547	0.055
3.2444	0.011	0.014	0.665	0.055
3.2889	0.011	0.014	0.747	0.055
3.3333	0.011	0.015	0.799	0.055
3.3778	0.011	0.015	0.860	0.055
3.4222	0.011	0.016	0.909	0.055
3.4667	0.011	0.016	0.956	0.055
3.5111	0.011	0.017	1.000	0.055
3.5556	0.011	0.017	1.043	0.055
3.6000	0.011	0.018	1.084	0.055
3.6444	0.011	0.018	1.123	0.055
3.6889	0.011	0.019	1.161	0.055

3.7333	0.011	0.019	1.198	0.055
3.7778	0.011	0.020	1.234	0.055
3.8222	0.011	0.020	1.269	0.055
3.8667	0.011	0.021	1.303	0.055
3.9111	0.011	0.021	1.336	0.055
3.9556	0.011	0.022	1.368	0.055
4.0000	0.011	0.022	1.399	0.055

Lot 5 D/W

Pavement Area:0.0184 acre.Pavement Length:40.00 ft.
Pavement Width: 20.00 ft.
Pavement slope 1:0 To 1
Pavement thickness: 0.5
Pour Space of Pavement: 0.25
Material thickness of second layer: 0.5
Pour Space of material for second layer: 0.35
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 5
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 2.456
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 2.456
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0.2
Element Flows To:
Outlet 1 Outlet 2
Channel 1

Permeable Pavement Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.018	0.000	0.000	0.000
0.0222	0.018	0.000	0.000	0.092
0.0444	0.018	0.000	0.000	0.092
0.0667	0.018	0.000	0.000	0.092
0.0889	0.018	0.000	0.000	0.092
0.1111	0.018	0.000	0.000	0.092
0.1333	0.018	0.000	0.000	0.092
0.1556	0.018	0.001	0.000	0.092
0.1778	0.018	0.001	0.000	0.092
0.2000	0.018	0.001	0.000	0.092
0.2222	0.018	0.001	0.000	0.092
0.2444	0.018	0.001	0.000	0.092
0.2667	0.018	0.001	0.000	0.092
0.2889	0.018	0.001	0.000	0.092
0.3111	0.018	0.002	0.000	0.092
0.3333	0.018	0.002	0.000	0.092
0.3556	0.018	0.002	0.000	0.092
0.3778	0.018	0.002	0.000	0.092
0.4000	0.018	0.002	0.000	0.092
0.4222	0.018	0.002	0.000	0.092
0.4444	0.018	0.002	0.000	0.092
0.4667	0.018	0.003	0.000	0.092
0.4889	0.018	0.003	0.000	0.092
0.5111	0.018	0.003	0.000	0.092
0.5333	0.018	0.003	0.000	0.092
0.5556	0.018	0.003	0.000	0.092
0.5778	0.018	0.003	0.000	0.092
0.6000	0.018	0.003	0.000	0.092
0.6222	0.018	0.003	0.000	0.092
0.6444	0.018	0.003	0.000	0.092
0.6667	0.018	0.004	0.000	0.092

0.6889	0.018	0.004	0.000	0.092
0.7111	0.018	0.004	0.000	0.092
0.7333	0.018	0.004	0.000	0.092
0.7556	0.018	0.004	0.000	0.092
0.7778	0.018	0.004	0.000	0.092
0.8000	0.018	0.004	0.000	0.092
0.8222	0.018	0.004	0.000	0.092
0.8444	0.018	0.004	0.000	0.092
0.8667	0.018	0.004	0.000	0.092
0.8889	0.018	0.005	0.000	0.092
0.9111	0.018	0.005	0.000	0.092
0.9333	0.018	0.005	0.000	0.092
0.9556	0.018	0.005	0.000	0.092
0.9778	0.018	0.005	0.000	0.092
1.0000	0.018	0.005	0.000	0.092
1.0222	0.018	0.006	0.055	0.092
1.0444	0.018	0.006	0.156	0.092
1.0667	0.018	0.007	0.286	0.092
1.0889	0.018	0.007	0.441	0.092
1.1111	0.018	0.007	0.616	0.092
1.1333	0.018	0.008	0.810	0.092
1.1556	0.018	0.008	1.021	0.092
1.1778	0.018	0.009	1.248	0.092
1.2000	0.018	0.009	1.489	0.092
1.2222	0.018	0.009	1.744	0.092
1.2444	0.018	0.010	2.012	0.092
1.2667	0.018	0.010	2.292	0.092
1.2889	0.018	0.011	2.585	0.092
1.3111	0.018	0.011	2.889	0.092
1.3333	0.018	0.011	3.204	0.092
1.3556	0.018	0.012	3.530	0.092
1.3778	0.018	0.012	3.866	0.092
1.4000	0.018	0.013	4.212	0.092
1.4222	0.018	0.013	4.568	0.092
1.4444	0.018	0.014	4.933	0.092
1.4667	0.018	0.014	5.307	0.092
1.4889	0.018	0.014	5.691	0.092
1.5111	0.018	0.015	6.084	0.092
1.5333	0.018	0.015	6.485	0.092
1.5556	0.018	0.016	6.894	0.092
1.5778	0.018	0.016	7.312	0.092
1.6000	0.018	0.016	7.738	0.092
1.6222	0.018	0.017	8.172	0.092
1.6444	0.018	0.017	8.613	0.092
1.6667	0.018	0.018	9.063	0.092
1.6889	0.018	0.018	9.520	0.092
1.7111	0.018	0.018	9.984	0.092
1.7333	0.018	0.019	10.45	0.092
1.7556	0.018	0.019	10.93	0.092
1.7778	0.018	0.020	11.42	0.092
1.8000	0.018	0.020	11.91	0.092
1.8222	0.018	0.020	12.41	0.092
1.8444	0.018	0.021	12.92	0.092
1.8667	0.018	0.021	13.43	0.092
1.8889	0.018	0.022	13.95	0.092
1.9111	0.018	0.022	14.48	0.092
1.9333	0.018	0.022	15.01	0.092
1.9556	0.018	0.023	15.55	0.092

1.9778	0.018	0.023	16.09	0.092
2.0000	0.018	0.024	16.65	0.092

Channel 1

Bottom Length: 20.00 ft.
Bottom Width: 2.00 ft.
Manning's n: 0.03
Channel bottom slope 1: 0.02 To 1
Channel Left side slope 0: 0 To 1
Channel right side slope 2: 0 To 1
Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Flows To:
Outlet 1 Outlet 2

Channel Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000918	0.000000	0.000	0.000
0.0333	0.000918	0.000031	0.047	0.000
0.0667	0.000918	0.000061	0.147	0.000
0.1000	0.000918	0.000092	0.284	0.000
0.1333	0.000919	0.000122	0.449	0.000
0.1667	0.000919	0.000153	0.639	0.000
0.2000	0.000919	0.000184	0.850	0.000
0.2333	0.000919	0.000214	1.080	0.000
0.2667	0.000919	0.000245	1.325	0.000
0.3000	0.000919	0.000276	1.585	0.000
0.3333	0.000919	0.000306	1.858	0.000
0.3667	0.000919	0.000337	2.142	0.000
0.4000	0.000919	0.000367	2.437	0.000
0.4333	0.000919	0.000398	2.742	0.000
0.4667	0.000919	0.000429	3.055	0.000
0.5000	0.000919	0.000459	3.376	0.000
0.5333	0.000919	0.000490	3.705	0.000
0.5667	0.000919	0.000521	4.041	0.000
0.6000	0.000919	0.000551	4.383	0.000
0.6333	0.000919	0.000582	4.730	0.000
0.6667	0.000919	0.000613	5.084	0.000
0.7000	0.000920	0.000643	5.442	0.000
0.7333	0.000920	0.000674	5.805	0.000
0.7667	0.000920	0.000705	6.173	0.000
0.8000	0.000920	0.000735	6.545	0.000
0.8333	0.000920	0.000766	6.920	0.000
0.8667	0.000920	0.000797	7.299	0.000
0.9000	0.000920	0.000827	7.682	0.000
0.9333	0.000920	0.000858	8.068	0.000
0.9667	0.000920	0.000889	8.457	0.000
1.0000	0.000920	0.000919	8.849	0.000
1.0333	0.000920	0.000950	9.244	0.000
1.0667	0.000920	0.000981	9.641	0.000
1.1000	0.000920	0.001011	10.04	0.000
1.1333	0.000920	0.001042	10.44	0.000
1.1667	0.000920	0.001073	10.84	0.000
1.2000	0.000920	0.001103	11.25	0.000
1.2333	0.000921	0.001134	11.66	0.000
1.2667	0.000921	0.001165	12.07	0.000
1.3000	0.000921	0.001195	12.48	0.000

1.3333	0.000921	0.001226	12.89	0.000
1.3667	0.000921	0.001257	13.31	0.000
1.4000	0.000921	0.001287	13.73	0.000
1.4333	0.000921	0.001318	14.14	0.000
1.4667	0.000921	0.001349	14.56	0.000
1.5000	0.000921	0.001379	14.99	0.000
1.5333	0.000921	0.001410	15.41	0.000
1.5667	0.000921	0.001441	15.83	0.000
1.6000	0.000921	0.001472	16.26	0.000
1.6333	0.000921	0.001502	16.68	0.000
1.6667	0.000921	0.001533	17.11	0.000
1.7000	0.000921	0.001564	17.54	0.000
1.7333	0.000921	0.001594	17.97	0.000
1.7667	0.000922	0.001625	18.40	0.000
1.8000	0.000922	0.001656	18.83	0.000
1.8333	0.000922	0.001687	19.26	0.000
1.8667	0.000922	0.001717	19.70	0.000
1.9000	0.000922	0.001748	20.13	0.000
1.9333	0.000922	0.001779	20.56	0.000
1.9667	0.000922	0.001809	21.00	0.000
2.0000	0.000922	0.001840	21.44	0.000
2.0333	0.000922	0.001871	21.87	0.000
2.0667	0.000922	0.001902	22.31	0.000
2.1000	0.000922	0.001932	22.75	0.000
2.1333	0.000922	0.001963	23.19	0.000
2.1667	0.000922	0.001994	23.63	0.000
2.2000	0.000922	0.002025	24.07	0.000
2.2333	0.000922	0.002055	24.51	0.000
2.2667	0.000922	0.002086	24.95	0.000
2.3000	0.000922	0.002117	25.39	0.000
2.3333	0.000923	0.002148	25.84	0.000
2.3667	0.000923	0.002178	26.28	0.000
2.4000	0.000923	0.002209	26.72	0.000
2.4333	0.000923	0.002240	27.17	0.000
2.4667	0.000923	0.002271	27.61	0.000
2.5000	0.000923	0.002301	28.06	0.000
2.5333	0.000923	0.002332	28.50	0.000
2.5667	0.000923	0.002363	28.95	0.000
2.6000	0.000923	0.002394	29.40	0.000
2.6333	0.000923	0.002424	29.84	0.000
2.6667	0.000923	0.002455	30.29	0.000
2.7000	0.000923	0.002486	30.74	0.000
2.7333	0.000923	0.002517	31.19	0.000
2.7667	0.000923	0.002548	31.64	0.000
2.8000	0.000923	0.002578	32.08	0.000
2.8333	0.000923	0.002609	32.53	0.000
2.8667	0.000924	0.002640	32.98	0.000
2.9000	0.000924	0.002671	33.43	0.000
2.9333	0.000924	0.002702	33.88	0.000
2.9667	0.000924	0.002732	34.33	0.000
3.0000	0.000924	0.002763	34.78	0.000
3.0333	0.000924	0.002794	35.24	0.000

ROAD TRENCH #2

DESIGN IS FOR A 60'x8' WHICH HAS AN EVEN LARGER BOTTOM AREA THAN 75'x6'

Bottom Length:	75.00 ft.
Bottom Width:	6.00 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:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	32.539
Total Volume Through Riser (ac-ft.):	0.001
Total Volume Through Facility (ac-ft.):	32.54
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0

Discharge Structure

Riser Height:	3 ft.
Riser Diameter:	8 in.

Element Flows To:

Outlet 1 Outlet 2

Channel 1

Gravel Trench Bed Hydraulic Table

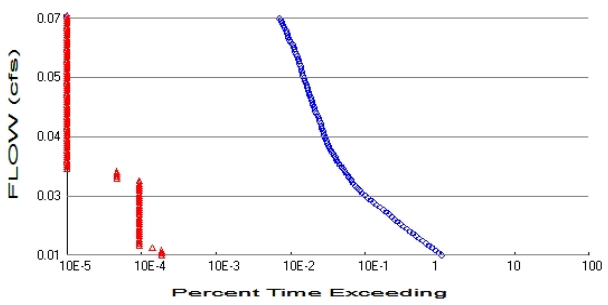
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.010	0.000	0.000	0.000
0.0444	0.010	0.000	0.000	0.052
0.0889	0.010	0.000	0.000	0.052
0.1333	0.010	0.000	0.000	0.052
0.1778	0.010	0.000	0.000	0.052
0.2222	0.010	0.000	0.000	0.052
0.2667	0.010	0.001	0.000	0.052
0.3111	0.010	0.001	0.000	0.052
0.3556	0.010	0.001	0.000	0.052
0.4000	0.010	0.001	0.000	0.052
0.4444	0.010	0.001	0.000	0.052
0.4889	0.010	0.001	0.000	0.052
0.5333	0.010	0.001	0.000	0.052
0.5778	0.010	0.002	0.000	0.052
0.6222	0.010	0.002	0.000	0.052
0.6667	0.010	0.002	0.000	0.052
0.7111	0.010	0.002	0.000	0.052
0.7556	0.010	0.002	0.000	0.052
0.8000	0.010	0.002	0.000	0.052
0.8444	0.010	0.003	0.000	0.052
0.8889	0.010	0.003	0.000	0.052
0.9333	0.010	0.003	0.000	0.052
0.9778	0.010	0.003	0.000	0.052
1.0222	0.010	0.003	0.000	0.052
1.0667	0.010	0.003	0.000	0.052
1.1111	0.010	0.004	0.000	0.052

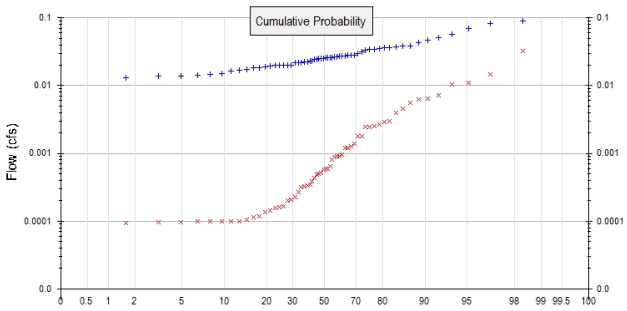
1.1556	0.010	0.004	0.000	0.052
1.2000	0.010	0.004	0.000	0.052
1.2444	0.010	0.004	0.000	0.052
1.2889	0.010	0.004	0.000	0.052
1.3333	0.010	0.004	0.000	0.052
1.3778	0.010	0.005	0.000	0.052
1.4222	0.010	0.005	0.000	0.052
1.4667	0.010	0.005	0.000	0.052
1.5111	0.010	0.005	0.000	0.052
1.5556	0.010	0.005	0.000	0.052
1.6000	0.010	0.005	0.000	0.052
1.6444	0.010	0.005	0.000	0.052
1.6889	0.010	0.006	0.000	0.052
1.7333	0.010	0.006	0.000	0.052
1.7778	0.010	0.006	0.000	0.052
1.8222	0.010	0.006	0.000	0.052
1.8667	0.010	0.006	0.000	0.052
1.9111	0.010	0.006	0.000	0.052
1.9556	0.010	0.007	0.000	0.052
2.0000	0.010	0.007	0.000	0.052
2.0444	0.010	0.007	0.000	0.052
2.0889	0.010	0.007	0.000	0.052
2.1333	0.010	0.007	0.000	0.052
2.1778	0.010	0.007	0.000	0.052
2.2222	0.010	0.008	0.000	0.052
2.2667	0.010	0.008	0.000	0.052
2.3111	0.010	0.008	0.000	0.052
2.3556	0.010	0.008	0.000	0.052
2.4000	0.010	0.008	0.000	0.052
2.4444	0.010	0.008	0.000	0.052
2.4889	0.010	0.009	0.000	0.052
2.5333	0.010	0.009	0.000	0.052
2.5778	0.010	0.009	0.000	0.052
2.6222	0.010	0.009	0.000	0.052
2.6667	0.010	0.009	0.000	0.052
2.7111	0.010	0.009	0.000	0.052
2.7556	0.010	0.010	0.000	0.052
2.8000	0.010	0.010	0.000	0.052
2.8444	0.010	0.010	0.000	0.052
2.8889	0.010	0.010	0.000	0.052
2.9333	0.010	0.010	0.000	0.052
2.9778	0.010	0.010	0.000	0.052
3.0222	0.010	0.011	0.023	0.052
3.0667	0.010	0.011	0.121	0.052
3.1111	0.010	0.012	0.255	0.052
3.1556	0.010	0.012	0.404	0.052
3.2000	0.010	0.013	0.547	0.052
3.2444	0.010	0.013	0.665	0.052
3.2889	0.010	0.014	0.747	0.052
3.3333	0.010	0.014	0.799	0.052
3.3778	0.010	0.014	0.860	0.052
3.4222	0.010	0.015	0.909	0.052
3.4667	0.010	0.015	0.956	0.052
3.5111	0.010	0.016	1.000	0.052
3.5556	0.010	0.016	1.043	0.052
3.6000	0.010	0.017	1.084	0.052
3.6444	0.010	0.017	1.123	0.052
3.6889	0.010	0.018	1.161	0.052

3.7333	0.010	0.018	1.198	0.052
3.7778	0.010	0.019	1.234	0.052
3.8222	0.010	0.019	1.269	0.052
3.8667	0.010	0.019	1.303	0.052
3.9111	0.010	0.020	1.336	0.052
3.9556	0.010	0.020	1.368	0.052
4.0000	0.010	0.021	1.399	0.052

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.2
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.37
Total Impervious Area: 0.828365

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.025723
5 year	0.038074
10 year	0.04653
25 year	0.057436
50 year	0.065687
100 year	0.074027

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.000616
5 year	0.002391
10 year	0.005079
25 year	0.011742
50 year	0.020568
100 year	0.034502

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.015	0.000
1950	0.028	0.001
1951	0.023	0.001
1952	0.018	0.000
1953	0.015	0.000
1954	0.057	0.010
1955	0.039	0.006
1956	0.034	0.001
1957	0.038	0.001
1958	0.026	0.003

1959	0.028	0.001
1960	0.024	0.002
1961	0.025	0.032
1962	0.022	0.000
1963	0.027	0.001
1964	0.023	0.003
1965	0.026	0.000
1966	0.014	0.000
1967	0.031	0.001
1968	0.037	0.000
1969	0.028	0.002
1970	0.020	0.000
1971	0.028	0.005
1972	0.025	0.001
1973	0.020	0.000
1974	0.035	0.003
1975	0.020	0.001
1976	0.019	0.001
1977	0.016	0.000
1978	0.020	0.000
1979	0.036	0.002
1980	0.023	0.001
1981	0.019	0.000
1982	0.024	0.001
1983	0.034	0.001
1984	0.025	0.000
1985	0.033	0.004
1986	0.082	0.007
1987	0.037	0.003
1988	0.020	0.000
1989	0.017	0.001
1990	0.027	0.001
1991	0.028	0.000
1992	0.022	0.000
1993	0.014	0.000
1994	0.013	0.000
1995	0.027	0.000
1996	0.047	0.006
1997	0.090	0.015
1998	0.017	0.000
1999	0.025	0.000
2000	0.014	0.002
2001	0.004	0.000
2002	0.026	0.000
2003	0.019	0.000
2004	0.030	0.000
2005	0.022	0.000
2006	0.051	0.011
2007	0.043	0.006
2008	0.069	0.000
2009	0.022	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0899	0.0320
2	0.0823	0.0146
3	0.0688	0.0109

4	0.0569	0.0103
5	0.0508	0.0073
6	0.0471	0.0064
7	0.0433	0.0063
8	0.0386	0.0056
9	0.0379	0.0045
10	0.0368	0.0040
11	0.0366	0.0030
12	0.0362	0.0029
13	0.0352	0.0027
14	0.0344	0.0025
15	0.0341	0.0025
16	0.0334	0.0024
17	0.0314	0.0018
18	0.0298	0.0018
19	0.0284	0.0014
20	0.0283	0.0013
21	0.0282	0.0012
22	0.0276	0.0012
23	0.0275	0.0010
24	0.0271	0.0009
25	0.0268	0.0009
26	0.0266	0.0009
27	0.0260	0.0008
28	0.0256	0.0006
29	0.0256	0.0006
30	0.0255	0.0006
31	0.0253	0.0006
32	0.0251	0.0005
33	0.0247	0.0005
34	0.0245	0.0005
35	0.0243	0.0004
36	0.0230	0.0004
37	0.0227	0.0003
38	0.0227	0.0003
39	0.0222	0.0003
40	0.0219	0.0003
41	0.0216	0.0003
42	0.0216	0.0002
43	0.0202	0.0002
44	0.0202	0.0002
45	0.0201	0.0002
46	0.0201	0.0002
47	0.0201	0.0002
48	0.0193	0.0001
49	0.0189	0.0001
50	0.0185	0.0001
51	0.0183	0.0001
52	0.0171	0.0001
53	0.0170	0.0001
54	0.0162	0.0001
55	0.0151	0.0001
56	0.0145	0.0001
57	0.0141	0.0001
58	0.0139	0.0001
59	0.0136	0.0001
60	0.0132	0.0001
61	0.0045	0.0001

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0129	22651	4	0	Pass
0.0134	20555	4	0	Pass
0.0139	18617	4	0	Pass
0.0145	16805	3	0	Pass
0.0150	15163	2	0	Pass
0.0155	13732	2	0	Pass
0.0161	12459	2	0	Pass
0.0166	11306	2	0	Pass
0.0171	10235	2	0	Pass
0.0177	9308	2	0	Pass
0.0182	8461	2	0	Pass
0.0187	7681	2	0	Pass
0.0193	6943	2	0	Pass
0.0198	6316	2	0	Pass
0.0203	5773	2	0	Pass
0.0209	5285	2	0	Pass
0.0214	4857	2	0	Pass
0.0219	4438	2	0	Pass
0.0225	4094	2	0	Pass
0.0230	3707	2	0	Pass
0.0235	3375	2	0	Pass
0.0241	3054	2	0	Pass
0.0246	2748	2	0	Pass
0.0251	2505	2	0	Pass
0.0257	2304	2	0	Pass
0.0262	2107	2	0	Pass
0.0267	1949	2	0	Pass
0.0273	1823	2	0	Pass
0.0278	1698	2	0	Pass
0.0283	1581	2	0	Pass
0.0289	1483	2	0	Pass
0.0294	1398	2	0	Pass
0.0299	1329	1	0	Pass
0.0305	1260	1	0	Pass
0.0310	1197	1	0	Pass
0.0315	1138	1	0	Pass
0.0321	1081	0	0	Pass
0.0326	1025	0	0	Pass
0.0331	956	0	0	Pass
0.0337	915	0	0	Pass
0.0342	879	0	0	Pass
0.0347	846	0	0	Pass
0.0353	808	0	0	Pass
0.0358	767	0	0	Pass
0.0363	733	0	0	Pass
0.0369	700	0	0	Pass
0.0374	676	0	0	Pass
0.0379	655	0	0	Pass
0.0385	639	0	0	Pass
0.0390	620	0	0	Pass
0.0395	604	0	0	Pass
0.0401	588	0	0	Pass
0.0406	573	0	0	Pass

0.0411	560	0	0	Pass
0.0417	551	0	0	Pass
0.0422	539	0	0	Pass
0.0427	523	0	0	Pass
0.0433	511	0	0	Pass
0.0438	496	0	0	Pass
0.0443	473	0	0	Pass
0.0449	458	0	0	Pass
0.0454	448	0	0	Pass
0.0459	438	0	0	Pass
0.0465	426	0	0	Pass
0.0470	417	0	0	Pass
0.0475	402	0	0	Pass
0.0481	396	0	0	Pass
0.0486	385	0	0	Pass
0.0491	374	0	0	Pass
0.0497	362	0	0	Pass
0.0502	355	0	0	Pass
0.0507	349	0	0	Pass
0.0513	338	0	0	Pass
0.0518	329	0	0	Pass
0.0523	320	0	0	Pass
0.0529	310	0	0	Pass
0.0534	306	0	0	Pass
0.0539	300	0	0	Pass
0.0545	296	0	0	Pass
0.0550	288	0	0	Pass
0.0555	283	0	0	Pass
0.0561	276	0	0	Pass
0.0566	270	0	0	Pass
0.0571	260	0	0	Pass
0.0577	252	0	0	Pass
0.0582	245	0	0	Pass
0.0588	239	0	0	Pass
0.0593	234	0	0	Pass
0.0598	227	0	0	Pass
0.0604	214	0	0	Pass
0.0609	205	0	0	Pass
0.0614	200	0	0	Pass
0.0620	194	0	0	Pass
0.0625	188	0	0	Pass
0.0630	184	0	0	Pass
0.0636	176	0	0	Pass
0.0641	170	0	0	Pass
0.0646	165	0	0	Pass
0.0652	158	0	0	Pass
0.0657	152	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

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
Channel 1 POC	☐	0.05			☐	0.00			
Gravel Trench Bed 3	☐	16.79			☐	100.00			
Gravel Trench Bed 3	☐	22.45			☐	100.00			
Gravel Trench Bed 3	☐	13.96			☐	100.00			
ROAD TRENCH #1	☐	31.05			☐	100.00			
Lot 5 D/W	☐	2.24			☐	100.00			
ROAD TRENCH #2	☐	29.61			☐	100.00			
Total Volume Infiltrated		116.14	0.00	0.00		99.96	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.

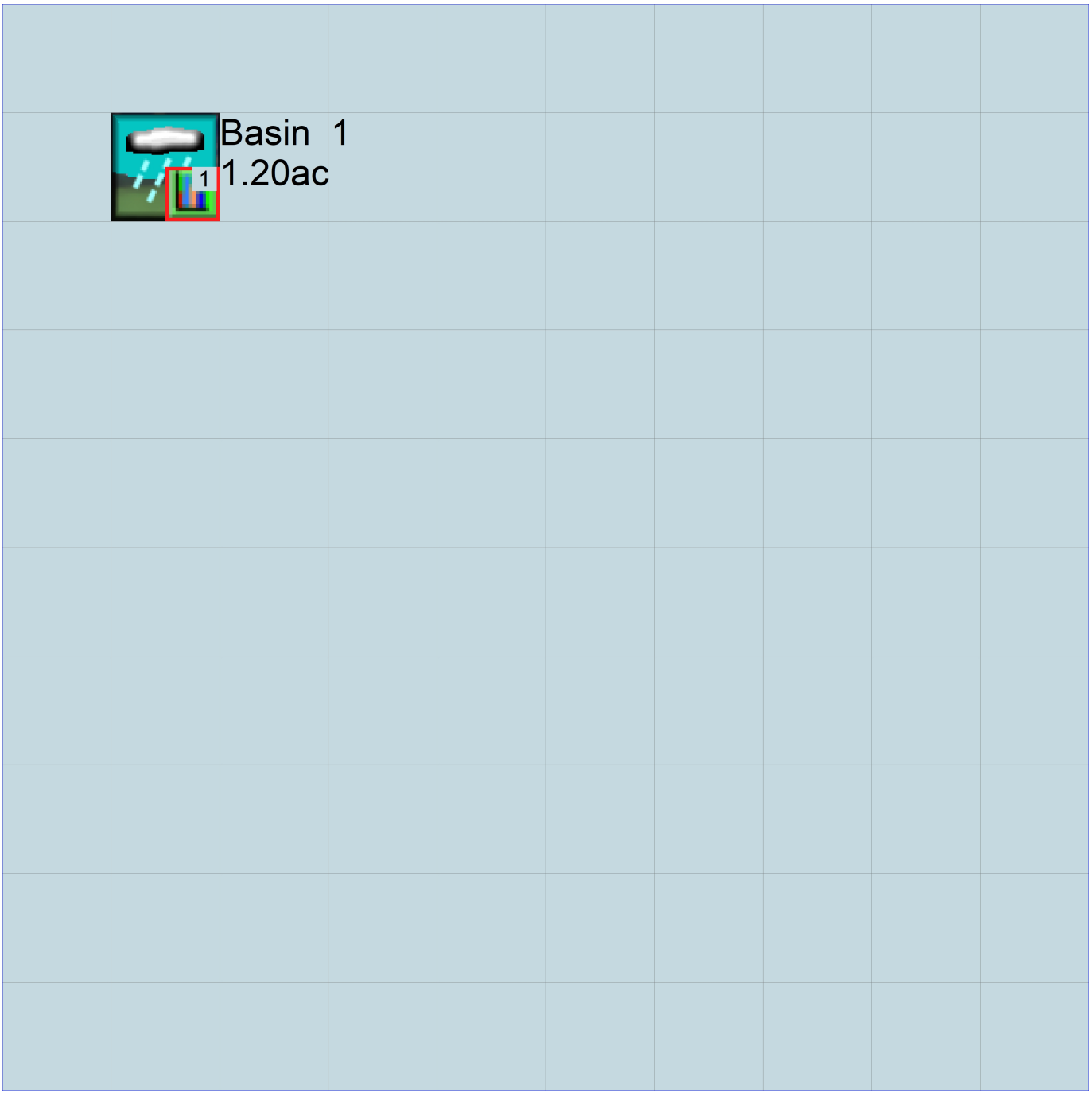
PERLND Changes

No PERLND changes have been made.

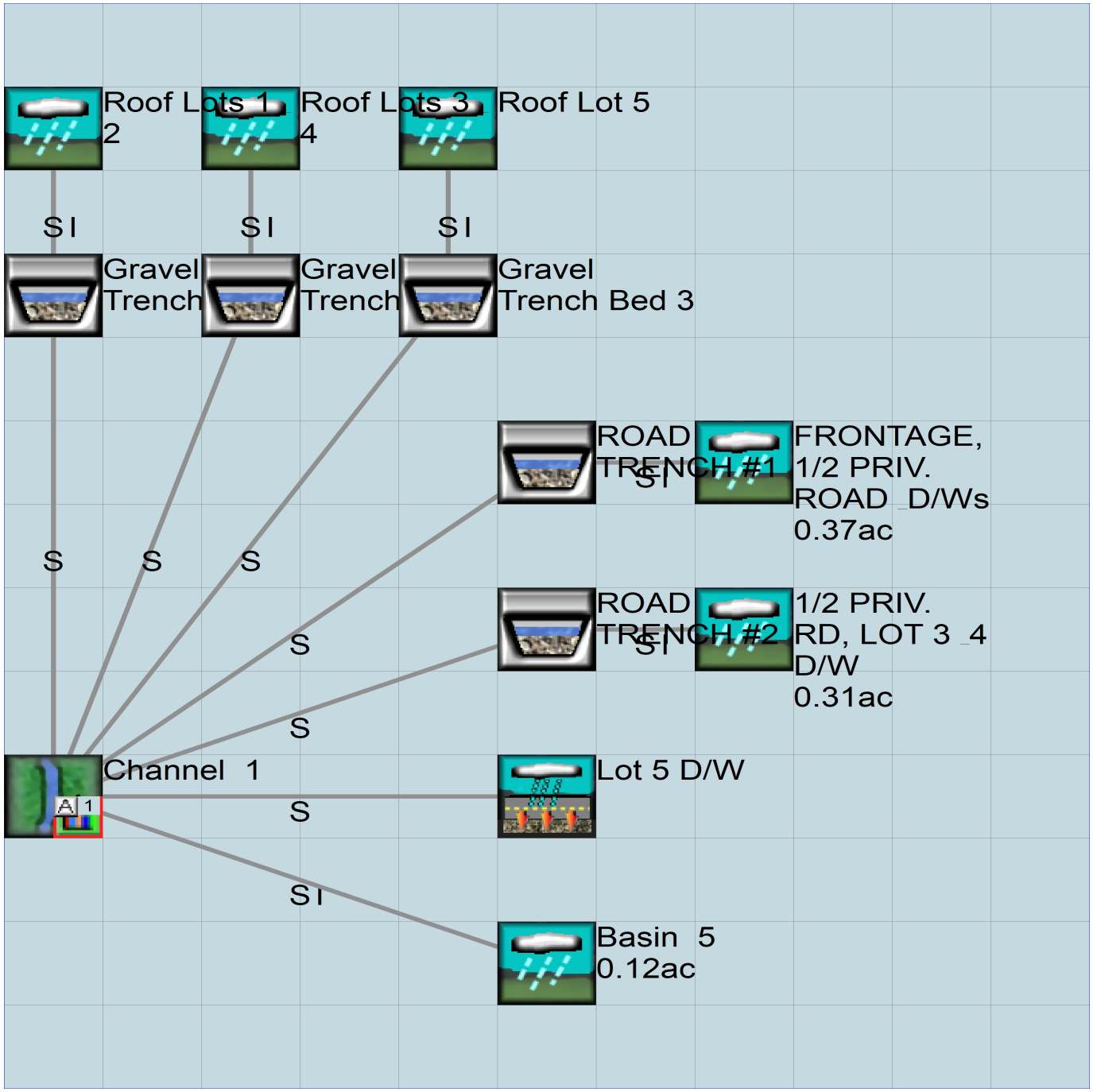
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



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APPENDIX B

GEOTECHNICAL REPORT

NELSON GEOTECHNICAL
ASSOCIATES, INC.

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(425) 486-1669
www.nelsongeotech.com

June 27, 2022

Jennifer Hsiao
VIA Email: jhsiao168@msn.com

Geotechnical Engineering Evaluation
Hsiao Short Plat Development
4100 – 81st Place NE
Marysville, Washington 98270
NGA File No. 1368322

Dear Jennifer:

We are pleased to submit the attached report titled **"Geotechnical Engineering Evaluation – Hsiao Short Plat Development – 4100 - 81st Place NE – Marysville, Washington."** This report summarizes our observations of the existing surface and subsurface conditions within the site and provides general recommendations for the proposed site development. Our services were completed in general accordance with the proposal signed by you on May 10, 2022.

Two combined rectangular parcels form an irregularly-shaped site that covers approximately 1.14 acres in area. It is currently vacant and undeveloped land that is located east of Damascus Road Church. The property is bordered by 81st Place NE to the north, by Damascus Road Church to the west, and by existing residential development on all other sides. Topographically, the site is relatively level. We understand the plans for development include short-platting the site to form five new lots, including the construction of new residences on each lot. We have been requested to provide this report for determination of geological hazards that may be affecting the site, as well as development considerations for the proposed site development. We also understand that stormwater generated within the property may be directed to onsite infiltrations systems, if feasible.

We monitored the excavation of five trackhoe excavated test pits at the site on May 20, 2022. Our explorations indicated that the site was underlain by surficial undocumented fill with competent, native outwash sand soils at depth.

We have concluded that the site is generally compatible with the planned development. We have recommended that the new residences be founded on the medium dense native outwash soils for bearing capacity and settlement considerations. These soils should generally be encountered approximately two to four feet below the existing ground surface, based on our explorations. However, deeper areas of loose soil and/or undocumented fill could also exist within unexplored areas of the site.

Infiltration analysis in accordance with the Washington State Department of Ecology 2019 Stormwater Management Manual for Western Washington was also performed. The subsurface soils generally consisted of light brown to gray, fine to medium sand with generally low silt content. Due to the granular nature of the site soils and the soils being classified as recessional outwash, infiltration rates were determined by performing grain size analyses on samples obtained at various depths throughout the site.

Based on our laboratory analyses and the granular nature of the native outwash soils encountered throughout the site, it is our opinion that stormwater infiltration is feasible within this site.

In the attached report, we have also provided general recommendations for site grading, foundation support, slabs-on-grade, structural fill placement, erosion control, and drainage. We should be retained to review and comment on final development plans and observe the earthwork phase of construction. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications.

It has been a pleasure to provide service to you on this project. Please contact us if you have any questions regarding this report or require further information.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

Khaled M. Shawish, PE
Principal

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Geotechnical Engineering Evaluation
Hsiao Short Plat Development
4100 – 81st Place NE
Marysville, Washington

INTRODUCTION

This report presents the results of our geotechnical engineering investigation and evaluation of the planned Hsiao Short Plat Development project. The project site is located at **4100 – 81st Place NE in Marysville, Washington,** as shown on the Vicinity Map in Figure 1. The purpose of this study is to explore and characterize the site's surface and subsurface conditions and to provide geotechnical recommendations for the planned site development. The parcel number for the affected properties are 00550600001200, -013-00, and -003-147-00.

The two combined rectangular parcel forms an irregularly-shaped site that covers approximately 1.14 acres in area. It is currently vacant and undeveloped land that is located east of Damascus Road Church. The property is bordered by 81st Place NE to the north, by Damascus Road Church to the west, and by existing residential development on all other sides. Topographically, the site is relatively level. We understand the plans for development include short-platting the site to form five new lots, including the construction of new residences on each lot.

Specific grading and stormwater plans have not been developed, but we understand that stormwater may be directed to on-site infiltration systems, if feasible. We have been requested to evaluate the infiltration capacity of the site soils. We will collect samples and determine the infiltration rate based on the Department of Ecology's 2019 Stormwater Management Manual for Western Washington (2019 SWMMWW), utilized by the City of Marysville. According to this manual, we understand that long-term design infiltration rates for this site can be determined by performing grain size analyses.

For our use in preparing this report, we were provided with a survey site plan titled "Boundary and Topographic Survey for Jennifer Hsiao," dated April 29, 2022 and prepared by James Watkins. We were also provided with a Draft Revision 3 of the proposed 5-lot short plat layout dated June 3, 2022.

SCOPE

The purpose of this study is to explore and characterize the site surface and subsurface conditions and provide general recommendations for site development.

Specifically, our scope of services included the following:

1. Reviewing available soil and geologic maps of the area.
2. Exploring the subsurface soil and groundwater conditions within the site using trackhoe-excavated test pits. Excavation services to be subcontracted by NGA.
3. Installing piezometers in at least two test pits to monitor seasonal groundwater levels, as needed.
4. Providing long-term design infiltration rates based on laboratory grain size sieve analyses per the 2019 SWMMWW, if feasible.
5. Providing recommendations for earthwork and foundation support.
6. Providing recommendations for retaining walls.
7. Providing recommendations for temporary and permanent slopes.
8. Providing recommendations for subsurface utilities and pavement subgrade preparation.
9. Providing general recommendations for site drainage and erosion control.
10. Documenting the results of our findings, conclusions, and recommendations in a written geotechnical report.

SITE CONDITIONS

Surface Conditions

The combined rectangular parcel forms an irregularly-shaped site that covers approximately 1.14 acres in area. It is currently vacant and undeveloped land that is located east of Damascus Road Church. The property is bordered by 81st Place NE to the north, by Damascus Road Church to the west, and by existing residential development on all other sides. Topographically, the site is relatively level. We observed some gravel surfacing near the road, and irrigation control boxes within the site; however, no other signs of disturbance were noted. We did not observe surface water within the site during our site visit on May 20, 2022.

Subsurface Conditions

Geology: The geologic units for this area are shown on the Geologic Map of the Marysville Quadrangle, Snohomish County, Washington, by James P. Minard, et al. (USGS, 1985). The site is mapped as Marysville Sand (Qvrm). The Marysville Sand is described as well-drained, stratified to massive outwash sand with fine gravel, silt and clay. Our explorations generally encountered undocumented fill underlain by fine to medium grained sand with varying amounts of silt consistent with the description of Marysville sand mapped in this area.

Explorations: The subsurface conditions within the site were explored on May 20, 2022 by excavating five test pits to approximate depths of 10 to 11 feet below the existing ground surface using a trackhoe. The approximate locations of our explorations are shown on the Site Plan in Figure 2. A geologist from NGA was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the test pits. The soils were visually classified in general accordance with the Unified Soil Classification System, presented in Figure 3. The logs of our test pits are attached to this report and are presented as Figure 4. We present a brief summary of the subsurface conditions in the following paragraph. For a detailed description of the subsurface conditions, the logs of the test pits should be reviewed. We installed two monitoring wells MW-1 and MW-2 within Test Pit One and Test Pit Three, respectively.

Undocumented Fill/Topsoil: Stratigraphy encountered was generally the same across the site. We encountered 1.8 to 4.0-feet of grass underlain by dark brown silty fine to medium sand with gravel, roots, various debris and iron oxide staining.

Marysville Sand: Underlying the topsoil, we encountered orange-brown to gray fine to coarse sand with gravel with occasional silty beds. This sand was encountered in a medium dense or better condition, and we interpreted it to be Marysville Sand mapped to the depths explored.

Hydrogeologic Conditions

We observed groundwater within TP-3, TP-4, and TP-5 below depths of 9 to 10.0 feet. While some groundwater encountered could be attributed to perched conditions on top of siltier layers, we interpret most of the water encountered to be associated with the regional groundwater table within the area. We would expect the groundwater elevation to be slightly lower during drier times of the year and slightly higher during wetter periods.

SENSITIVE AREA EVALUATION

Seismic Hazard

We reviewed the 2018 International Building Code (IBC) for seismic site classification for this project. Since competent glacial outwash soils are inferred to underlie the site at depth, the site conditions best fit the IBC description for Site Class D.

Table 1 below provides seismic design parameters for the site that are in conformance with the 2018 IBC, which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps.

Table 1 – 2018 IBC Seismic Design Parameters

Site Class	Spectral Acceleration at 0.2 sec. (g) S_s	Spectral Acceleration at 1.0 sec. (g) S_1	Site Coefficients		Design Spectral Response Parameters	
			F_a	F_v	S_{DS}	S_{D1}
D	1.111	0.396	1.2	null	0.889	null

The spectral response accelerations were obtained from the USGS Earthquake Hazards Program Interpolated Probabilistic Ground Motion website (2008 data) for the project latitude and longitude.

Hazards associated with seismic activity include liquefaction potential and amplification of ground motion. Liquefaction is caused by a rise in pore pressures in a loose, fine sand deposit beneath the groundwater table. It is our opinion that the medium dense or better native glacial outwash deposits interpreted to underlie the site have a low to moderate potential for liquefaction or amplification of ground motion.

Erosion Hazard

The criteria used for determination of the erosion hazard for affected areas include soil type, slope gradient, vegetation cover, and groundwater conditions. The erosion sensitivity is related to vegetative cover and the specific surface soil types, which are related to the underlying geologic soil units. The Soil Survey of Snohomish County Area, Washington by the Natural Resources Conservation Service (NRCS), classifies the site as Ragnar fine sandy loam, 0 to 8 percent slopes. This soil is listed as having moderate erosion hazard. Based on our experience in the area and our observations in the field, it is our opinion that the site would have a slight to moderate erosion hazard for areas where the soils are exposed. It is our opinion that the erosion hazard for site soils should be low in areas where vegetation is not disturbed.

LABORATORY ANALYSIS

We performed three grain-size analyses on a selected soil samples obtained from the site. Laboratory tests were performed on samples taken from Test Pit 1 at 7.5 feet, Test Pit 3 at 2.0 feet, and Test Pit 5 at 10.0 feet. In general, the soils tested were classified as fine to medium sand with trace to minor amounts of silt. The results of the sieve analysis are presented as Figures 5 through 7.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion from a geotechnical standpoint that the site planned development is feasible. Our explorations indicated that the site was underlain by surficial undocumented fill soils with competent glacial outwash soils at relatively shallow depths throughout the site. The native glacial outwash soils should provide adequate support for foundation, slab, and pavement loads. We recommend that the new structures be designed utilizing shallow foundations. Footings should extend through any loose soil and be founded on the underlying medium dense native bearing soil, or structural fill extending to these soils. The competent soil should typically be encountered approximately 2.0- to 4.0-feet below the existing surface. We should note that deeper areas of unsuitable soils and/or undocumented fill could be encountered in the unexplored areas of the site. This condition, if encountered, would require deeper excavations in foundation, slab, and pavement areas to remove the unsuitable soils.

It is our opinion that the native granular outwash soils encountered at depth within our explorations are suitable for stormwater infiltration. The City of Marysville utilizes the 2019 Washington State Department of Ecology Stormwater Management Manual for Western Washington to determine long-term design infiltration rates for the site. In accordance with the manual, laboratory analysis of soil samples collected in the field can be used to determine the infiltration system design along with long-term design infiltration rates due to the site being located within outwash type soils that have not been glacially overridden. We performed three grain-size analyses in accordance with the manual to determine the infiltration capabilities of the site soils. Based on our observations and testing, we recommend that a long-term design infiltration rate of 5.45 inches/hour be used in the design of the stormwater handling systems within this site. We have included details of our on-site infiltration evaluation in the **Infiltration Evaluation** subsection of this report.

The surficial soils encountered on this site are considered moisture-sensitive and may disturb easily when wet. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during wet weather, the soils may disturb and additional expenses and delays should be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls to protect exposed subgrades and construction traffic areas. Some of the native granular on-site soils may be suitable for use as structural fill depending on the moisture content of the soil during construction. NGA should be retained to determine if the on-site soils can be used as structural fill material during construction.

Erosion Control

The erosion hazard for the on-site soils is interpreted to be slight to moderate for exposed soils, but actual erosion potential will be dependent on how the site is graded and how water is allowed to concentrate. Best Management Practices (BMPs) should be used to control erosion. Areas disturbed during construction should be protected from erosion. Erosion control measures may include diverting surface water away from the stripped or disturbed areas. Silt fences and/or straw bales should be erected to prevent muddy water from leaving the site. Disturbed areas should be planted as soon as practical, and the vegetation should be maintained until it is established. The erosion potential of areas not stripped of vegetation should be low.

Site Preparation and Grading

After erosion control measures are implemented, site preparation should consist of removing loose soils, topsoil, and any undocumented fill from foundations, slab, and pavement areas, to expose medium dense or better native glacial bearing soils at depth. The stripped soil should be removed from the site or stockpiled for later use as a landscaping fill. Based on our observations, we anticipate native, medium dense or better soil to be encountered at approximately two to four feet across the site. We recommend that if loose soils are encountered at the foundation subgrades exposing native granular outwash soils, that the subgrade be compacted to a non-yielding condition using a vibratory roller or a heavy plate compactor. We should note that deeper areas of unsuitable soils and/or undocumented fill could be encountered in the unexplored areas of the site. This condition, if encountered, would require deeper excavations in foundation, slab, and pavement areas to remove the unsuitable soils. After site preparation, if the exposed subgrade is deemed loose, it should be compacted to a non-yielding condition and then proof-rolled with a heavy rubber-tired piece of equipment. Areas observed to pump or weave during the proof-roll test should be reworked to structural fill specifications or over-excavated and replaced with properly compacted structural fill or rock spalls. If loose soils are encountered in the foundation areas, the loose soils should be removed and replaced with rock spalls. If significant surface water flow is encountered during construction, this flow should be diverted around areas to be developed, and the exposed subgrades should be maintained in a semi-dry condition. If wet conditions are encountered, alternative site grading techniques might be necessary. These techniques could include using large excavators equipped with wide tracks and a smooth bucket to complete site grading and covering exposed subgrade with a layer of crushed rock for protection. If wet conditions are encountered or construction is attempted in wet weather, the subgrade should not be compacted, as this could cause further subgrade disturbance. In wet conditions, it may be necessary to cover the exposed subgrade with a layer of crushed rock as soon as it is exposed to protect the moisture sensitive soils from disturbance by

machine or foot traffic during construction. The prepared subgrade should be protected from construction traffic and surface water should be diverted around areas of prepared subgrade.

Temporary and Permanent Slopes

Temporary cut slope stability is a function of many factors, including the type and consistency of soils, depth of the cut, surcharge loads adjacent to the excavation, length of time a cut remains open, and the presence of surface or groundwater. It is exceedingly difficult under these variable conditions to estimate a stable, temporary, cut slope angle. Therefore, it should be the responsibility of the contractor to maintain safe slope configurations at all times as indicated in OSHA guidelines for cut slopes.

The following information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Nelson Geotechnical Associates, Inc. assumes responsibility for job site safety. Job site safety is the sole responsibility of the project contractor.

For planning purposes, we recommend that temporary cuts in the on-site soils be no steeper than 2 Horizontal to 1 Vertical (2H:1V). If significant groundwater seepage or surface water flow were encountered, we would expect that flatter inclinations would be necessary. We recommend that cut slopes be protected from erosion. The slope protection measures may include covering cut slopes with plastic sheeting and diverting surface runoff away from the top of cut slopes. We do not recommend vertical slopes for cuts deeper than four feet, if worker access is necessary. We recommend that cut slope heights and inclinations conform to appropriate OSHA/WISHA regulations. Permanent cut and fill slopes should be no steeper than 3H:1V. However, flatter inclinations may be required in areas where loose soils are encountered. Permanent slopes should be vegetated, and the vegetative cover maintained until established.

Foundations

Conventional shallow spread foundations should be placed on medium dense or denser native bearing soils or be supported on structural fill or rock spalls extending to those soils. Medium dense soils should be encountered approximately two to four feet below ground surface based on our explorations. Where undocumented fill or less dense soils are encountered at footing bearing elevation, the subgrade should be over-excavated to expose suitable bearing soil. The over-excavation may be filled with structural fill, or the footing may be extended down to the competent native soils. If footings are supported on structural fill, the fill zone should extend outside the edges of the footing a distance equal to one half of the depth of the over-excavation below the bottom of the footing.

Footings should extend at least 18-inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Foundations should be designed in accordance with the 2018 IBC. Footing widths should be based on the anticipated loads and allowable soil bearing pressure. Water should not be allowed to accumulate in footing trenches. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For foundations constructed as outlined above, we recommend an allowable bearing pressure of not more than 2,000 pounds per square foot (psf) be used for the design of footings founded on the medium dense or denser native bearing soils or structural fill extending to the competent native bearing material. The foundation bearing soil should be evaluated by a representative of NGA. We should be consulted if higher bearing pressures are needed. Current IBC guidelines should be used when considering increased allowable bearing pressure for short-term transitory wind or seismic loads. Potential foundation settlement using the recommended allowable bearing pressure is estimated to be less than 1-inch total and ½-inch differential between adjacent footings or across a distance of about 20 feet, based on our experience with similar projects. Lateral loads may be resisted by friction on the base of the footing and passive resistance against the subsurface portions of the foundation. A coefficient of friction of 0.35 may be used to calculate the base friction and should be applied to the vertical dead load only. Passive resistance may be calculated as a triangular equivalent fluid pressure distribution. An equivalent fluid density of 200 pounds per cubic foot (pcf) should be used for passive resistance design for a level ground surface adjacent to the footing. This level surface should extend a distance equal to at least three times the footing depth. These recommended values incorporate safety factors of 1.5 and 2.0 applied to the estimated ultimate values for frictional and passive resistance, respectively. To achieve this value of passive resistance, the foundations should be poured “neat” against the native medium dense soils or compacted fill should be used as backfill against the front of the footing. We recommend that the upper one foot of soil be neglected when calculating the passive resistance.

Structural Fill

General: Fill placed beneath foundations, pavement, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional or soils technician. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the **Site Preparation and Grading** subsection prior to beginning fill placement. Sloping areas to receive fill should be benched using a minimum 8-foot-wide horizontal benches into competent soils.

Materials: Structural fill should consist of a good quality, granular soil, free of organics and other deleterious material, and be well graded to a maximum size of about three inches. All-weather fill should contain no more than five-percent fines (soil finer than U.S. No. 200 sieve, based on that fraction passing the U.S. 3/4-inch sieve). Some of the more granular on-site soils may be suitable for use as structural fill depending on the moisture content of the soil during construction. We should be retained to evaluate all proposed structural fill material prior to placement.

Fill Placement: Following subgrade preparation, placement of structural fill may proceed. All filling should be accomplished in uniform lifts up to eight inches thick. Each lift should be spread evenly and be thoroughly compacted prior to placement of subsequent lifts. All structural fill underlying building areas and pavement subgrade should be compacted to a minimum of 95 percent of its maximum dry density. Maximum dry density, in this report, refers to that density as determined by the ASTM D-1557 Compaction Test procedure. The moisture content of the soils to be compacted should be within about two percent of optimum so that a readily compactable condition exists. It may be necessary to over-excavate and remove wet soils in cases where drying to a compactable condition is not feasible. All compaction should be accomplished by equipment of a type and size sufficient to attain the desired degree of compaction and should be tested.

Slab-on-Grade

Slabs-on-grade should be supported on subgrade soils prepared as described in the **Site Preparation and Grading** subsection of this report. We recommend that all floor slabs be underlain by at least six inches of free-draining gravel with less than three percent by weight of the material passing Sieve #200 for use as a capillary break. A suitable vapor barrier, such as heavy plastic sheeting (6-mil minimum), should be placed over the capillary break material. An additional 2-inch-thick moist sand layer may be used to cover the vapor barrier. This sand layer is optional and is intended to be used to protect the vapor barrier membrane and to aid in curing the concrete.

Pavements

Pavement subgrade preparation and structural filling where required, should be completed as recommended in the **Site Preparation and Grading** and **Structural Fill** subsections of this report. The pavement subgrade should be proof-rolled with a heavy, rubber-tired piece of equipment, to identify soft or yielding areas that require repair. The pavement section should be underlain by a minimum of six inches of clean granular pit run or crushed rock. We should be retained to observe the proof-rolling and recommend subgrade repairs prior to placement of the asphalt or hard surfaces.

Utilities

We recommend that underground utilities be bedded with a minimum six inches of pea gravel prior to backfilling the trench with on-site or imported material. Trenches within settlement sensitive areas should be compacted to 95% of the modified proctor as described in the **Structural Fill** subsection of this report. Trenches located in non-structural areas should be compacted to a minimum 90% of the maximum dry density. Trench backfill compaction should be tested.

Infiltration Evaluation

We performed three grain-size analyses on selected soil samples obtained within the site in accordance with the 2019 Washington State Department of Ecology (WSDOE) Stormwater Management Manual for Western Washington. Laboratory tests were performed on samples taken from Test Pit 1 at 7.5 feet, Test Pit 3 at 2.0 feet, and Test Pit 5 at 10.0 feet. In general, the soils tested were classified as fine to medium sand with trace to minor amounts of silt. The results of the sieve analysis are presented as Figures 5 through 7. Based on the laboratory analysis, the soils encountered in our explorations within the proposed infiltration area meet the classification of sand and loamy sand in the USDA Textural Triangle.

An equation provided in Section V-5.4 of the 2019 WSDOE Stormwater Management Manual for Western Washington was used to determine the infiltration capabilities of the site soil utilizing data from the grain-size analyses. Based on this equation and information obtained from the grain-size analyses, initial short-term infiltration rates in the range of 21.3 to 44.3 inches/hour were calculated. We also referenced Table V-5.1 of the manual to provide an adequate correction factor to infiltration rates obtained from the above equation to calculate a long-term design rate. Correction factors of 0.80, 0.40, and 0.80 were utilized in this equation for CF_v, CF_t, CF_m, respectively. We applied the correction factors to the rate obtained from the grain-size analysis calculations which is 21.3 inches/hour and concluded that a long-term design infiltration rate of 5.45 inches per hour could be utilized to design on-site infiltration systems founded within the native granular outwash soils encountered at shallow depths throughout the property. We recommend that any infiltration system be extended down through the unsuitable undocumented fill soils and founded within the clean native granular outwash soils. Based on our explorations, the native granular outwash soils should be encountered at depths in the range of 2.0 to 4.0 feet below the existing ground surface. We should be retained during construction to evaluate the soils exposed in the infiltration systems to verify that the soils are appropriate for infiltration.

The stormwater manual recommends a five-foot separation between the base of an infiltration system and any underlying bedrock, impermeable horizon, or groundwater. We did encounter groundwater within three of our explorations down to depths of 9.0 to 10.0 feet below the existing ground surface. It is our opinion that any observed groundwater within the site would likely be associated with the regional groundwater table. We do not anticipate that the groundwater levels would fluctuate significantly throughout the year based on our understating of the nearby vicinity; however, we have installed two monitoring wells MW-1 and MW-2 within Test Pit One and Test Pit Three, respectively, to monitor groundwater fluctuations if needed based on infiltration system design.

Site Drainage

Surface Drainage: The finished ground surface should be graded such that stormwater is directed to an appropriate stormwater collection system. Water should not be allowed to stand in any areas where footings, slabs, or pavements are to be constructed. Final site grades should allow for drainage away from the proposed structures. We suggest that the finished ground be sloped at a minimum downward gradient of three percent, for a distance of at least 10 feet away from the proposed structures. Surface water should be collected by permanent catch basins and drain lines and be discharged into an approved discharge system.

Subsurface Drainage: If groundwater is encountered during construction, we recommend that the contractor slope the bottom of the excavation and collect the water into ditches and small sump pits where the water can be pumped out and routed into a permanent storm drain. We recommend the use of footing drains around the structures. Footing drains should be installed at least one foot below planned finished floor elevation. The drains should consist of a minimum 4-inch-diameter, rigid, slotted or perforated, PVC pipe surrounded by free-draining material wrapped in a filter fabric. We recommend that the free-draining material consist of an 18-inch-wide zone of clean (less than three-percent fines), granular material placed along the back of walls. Pea gravel is an acceptable drain material. The free-draining material should extend up the wall to one foot below the finished surface. The top foot of backfill should consist of impermeable soil placed over plastic sheeting or building paper to minimize surface water or fines migration into the footing drain. Footing drains should discharge into tightlines leading to an approved collection and discharge point with convenient cleanouts to prolong the useful life of the drains. Roof drains should not be connected to wall or footing drains.

CONSTRUCTION MONITORING

We should be retained to provide construction monitoring services during the earthwork phase of the project to evaluate subgrade conditions, temporary cut conditions, fill compaction, and drainage system installation.

USE OF THIS REPORT

NGA has prepared this report for **Jennifer Hsiao and Kechien Yang**, and their agents, for use in the planning and design of the development on this site only. The scope of our work does not include services related to construction safety precautions and our recommendations are not intended to direct the contractors' methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. There are possible variations in subsurface conditions between the explorations and also with time. Our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions. A contingency for unanticipated conditions should be included in the budget and schedule.

We recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications. We should be contacted a minimum of one week prior to construction activities and could attend pre-construction meetings if requested.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this report was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

o-o-o

It has been a pleasure to provide service to you on this project. If you have any questions or require further information, please call.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

Katelyn S. Brower, GIT
Project Geologist

6.27.2022

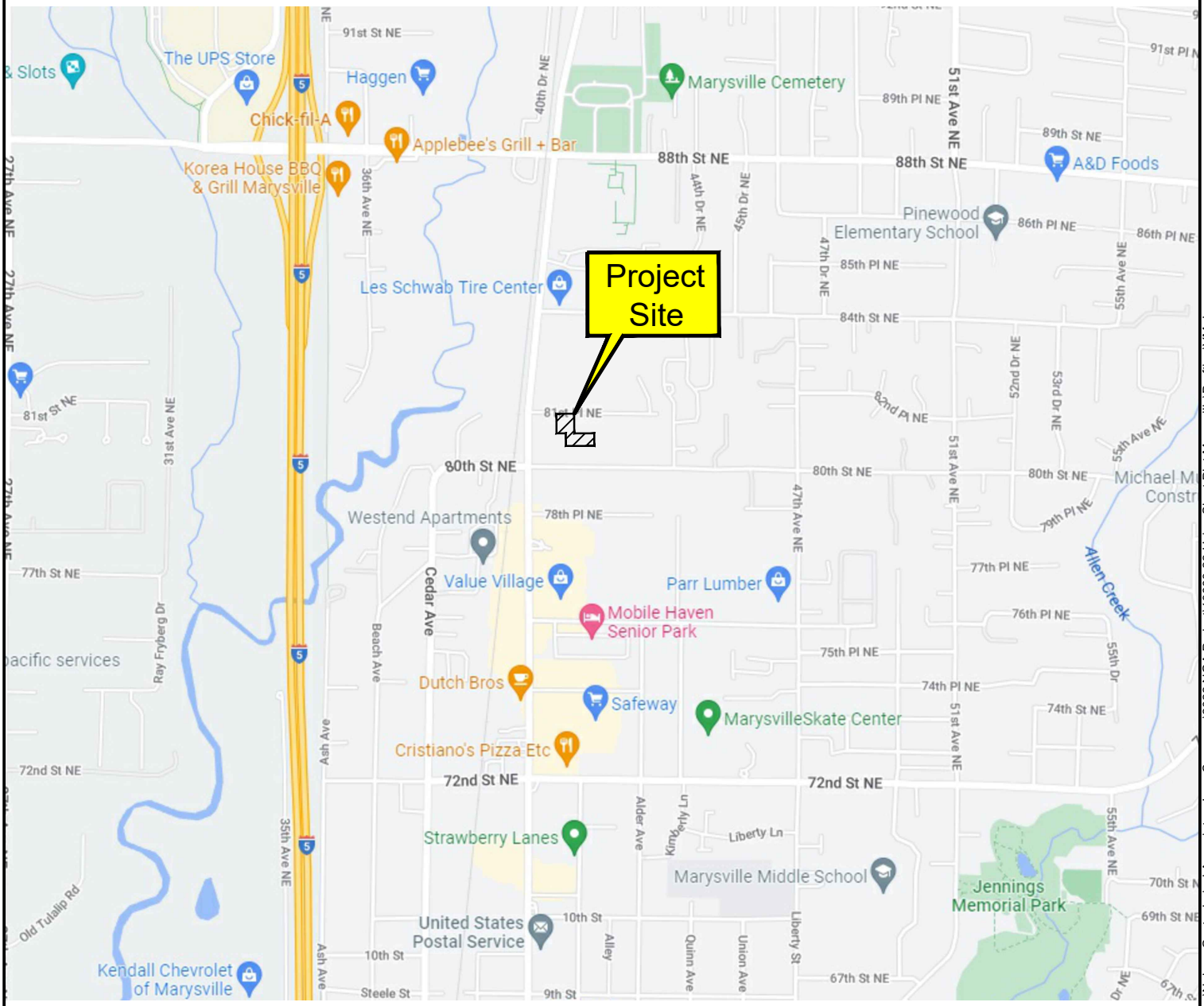
Khaled M. Shawish, PE
Principal Engineer

KSB:KMS:dy

Seven Figures Attached

VICINITY MAP

Not to Scale



Marysville, WA

Project Number	Hsiao Short Plat Vicinity Map	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
1368322			1	5/31/22	Original	DPN	KSB
Figure 1		

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Project Number
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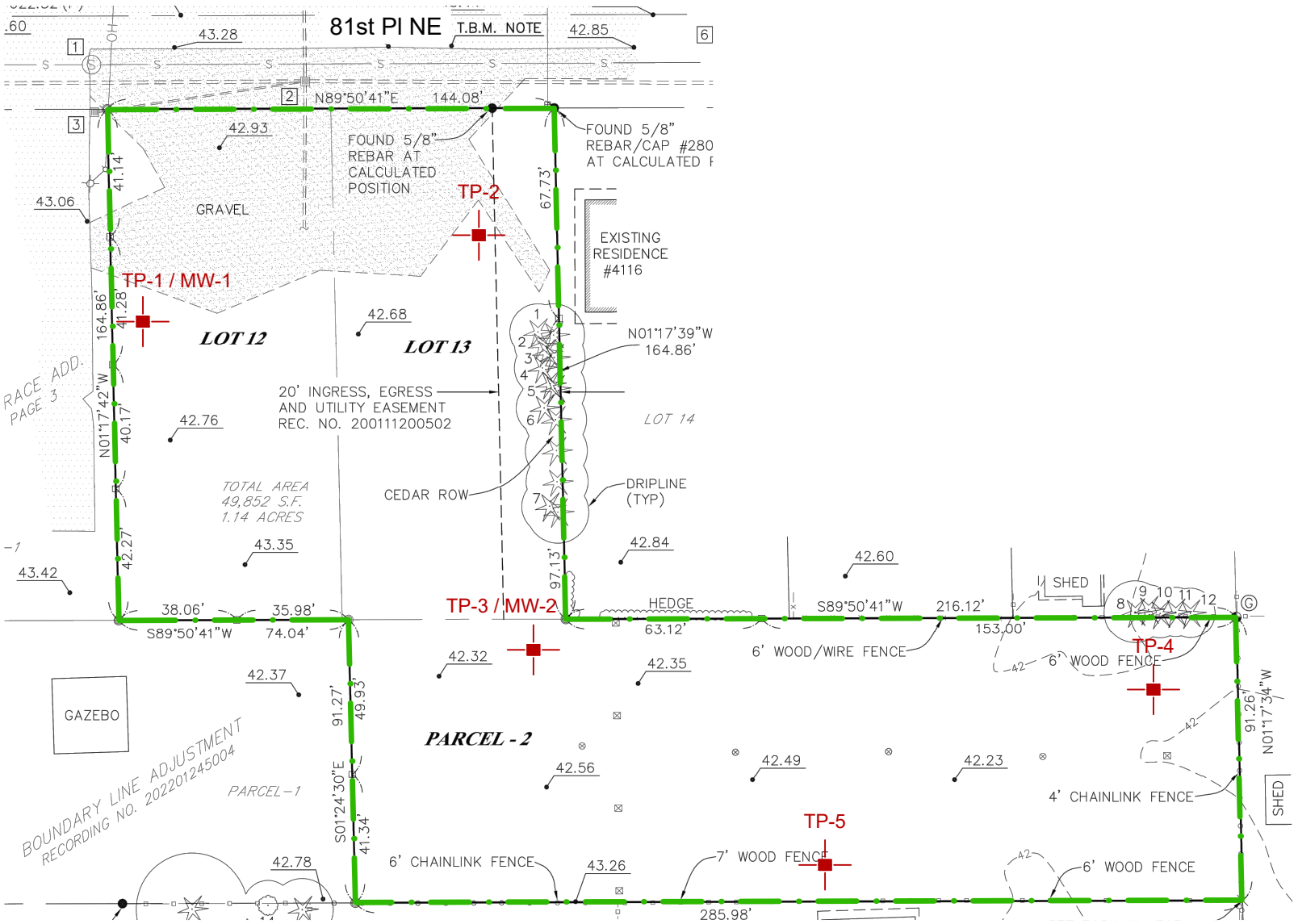
Figure 2

Hsiao Short Plat
Site Plan



LEGEND

Property line

TP-1
Number and approximate location of test pit

MW-1
Number and approximate location of monitoring well

0 50 100

Scale: 1 inch = 50 feet

Reference: Site plan based on a plan dated April 29, 2022 titled "Boundary and Topographic Survey for Jennifer Hsiao," prepared by Allied Land Surveying, Inc.

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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	CLEAN GRAVEL	GW	WELL-GRADED, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50 % OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE - GRAINED SOILS MORE THAN 50 % PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50 %	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 % OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-93.

2) Soil classification using laboratory tests is based on ASTM D 2488-93.

3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry - Absence of moisture, dusty, dry to the touch

Moist - Damp, but no visible water.

Wet - Visible free water or saturated, usually soil is obtained from below water table

Project Number	Hsiao Short Plat Soil Classification Chart
1368322	
Figure 3	

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LOG OF EXPLORATION

DEPTH (FEET)	USCS	SOIL DESCRIPTION
TEST PIT ONE		
0.0 – 4.0		GRASS UNDERLAIN BY DARK BROWN, SILTY FINE TO MEDIUM SAND WITH ORGANICS, ROOTS, AND GRAVEL (LOOSE, MOIST) (**FILL**)
4.0 – 10.5	SP	GRAY, MEDIUM TO COARSE SAND (MEDIUM DENSE, MOIST)
		SAMPLES WERE COLLECTED AT 4.0, 7.5, AND 10.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED MINOR TEST PIT CAVING WAS ENCOUNTERED FROM 4.0 TO 10.5 FEET TEST PIT WAS COMPLETED AT 10.5 FEET ON 05/20/2022
TEST PIT TWO		
0.0 – 2.0		GRASS UNDERLAIN BY DARK BROWN TO ORANGE, SILTY FINE TO MEDIUM SAND WITH GRAVEL AND DEBRIS (LOOSE, MOIST) (**FILL**)
2.0 – 9.0	SP	GRAY, MEDIUM TO COARSE SAND WITH GRAVEL (MEDIUM DENSE, MOIST)
9.0 – 10.5	SW-SM	GRAY SAND WITH SILT LENSES AND IRON-OXIDE STAINING (MEDIUM DENSE, MOIST)
		SAMPLES WERE COLLECTED AT 4.0, 9.0, AND 10.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 10.5 FEET ON 05/20/2022
TEST PIT THREE		
0.0 – 2.0		GRASS UNDERLAIN BY DARK BROWN TO BROWN, SILTY FINE TO MEDIUM SAND WITH ORGANICS AND GRAVEL (LOOSE, MOIST) (**FILL**)
2.0 – 11.0	SP	GRAY, MEDIUM TO COARSE SAND WITH GRAVEL AND TRACE IRON-OXIDE STAINING (MEDIUM DENSE, MOIST TO WET)
		SAMPLE WAS COLLECTED AT 3.5 FEET RAPID GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 10.0 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 11.0 FEET ON 05/20/2022
TEST PIT FOUR		
0.0 – 3.0		GRASS UNDERLAIN BY DARK BROWN TO BROWN, SILTY FINE TO MEDIUM SAND WITH GRAVEL, ROOTS, ORGANICS, TREE ROOTS, AND IRON-OXIDE STAINING (LOOSE, MOIST) (**FILL**)
3.0 – 9.0	SW	GRAY, FINE TO COARSE SAND WITH GRAVEL AND TRACE SILT (MEDIUM DENSE, MOIST TO WET)
9.0 – 10.0	SW-SM	GRAY SAND WITH SILT LENSES AND IRON-OXIDE STAINING (MEDIUM DENSE, WET)
		SAMPLES WERE COLLECTED AT 7.5 AND 10.0 FEET MODERATE GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 9.0 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 10.0 FEET ON 05/20/2022
TEST PIT FIVE		
0.0 – 1.8		GRASS UNDERLAIN BY DARK BROWN TO BROWN, SILTY FINE TO MEDIUM SAND WITH ROOTS, ORGANICS, AND GRAVEL (LOOSE, MOIST) (**FILL**)
1.8 – 10.0	SW	ORANGE-BROWN TO BROWN, FINE TO COARSE SAND WITH GRAVEL AND TRACE IRON-OXIDE STAINING (MEDIUM DENSE, MOIST)
		SAMPLES WERE COLLECTED AT 4.0 AND 10.0 FEET MODERATE GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 9.0 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 10.0 FEET ON 05/20/2022

Project Number
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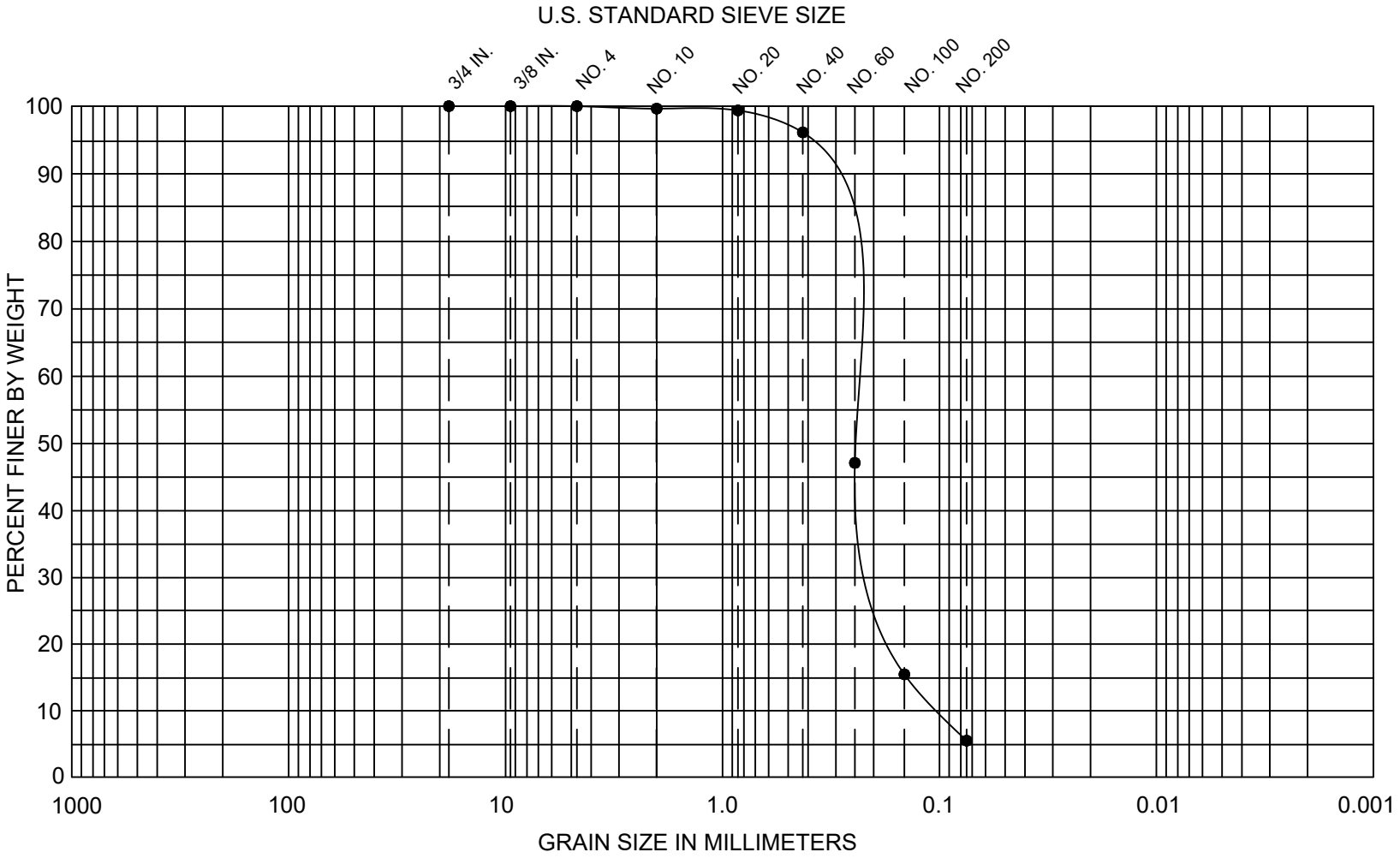
Figure 5

Hsiao Short Plat
Sieve Analysis



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

U.S.C. SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	SOIL DESCRIPTION	SOIL DISTRIBUTION
●SP-SM	TP-1	7.5 feet	Fine sand with silt	Gravel = 0% Sand = 94% Silt/Clay = 6%

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Figure 6

Hsiao Short Plat
Sieve Analysis

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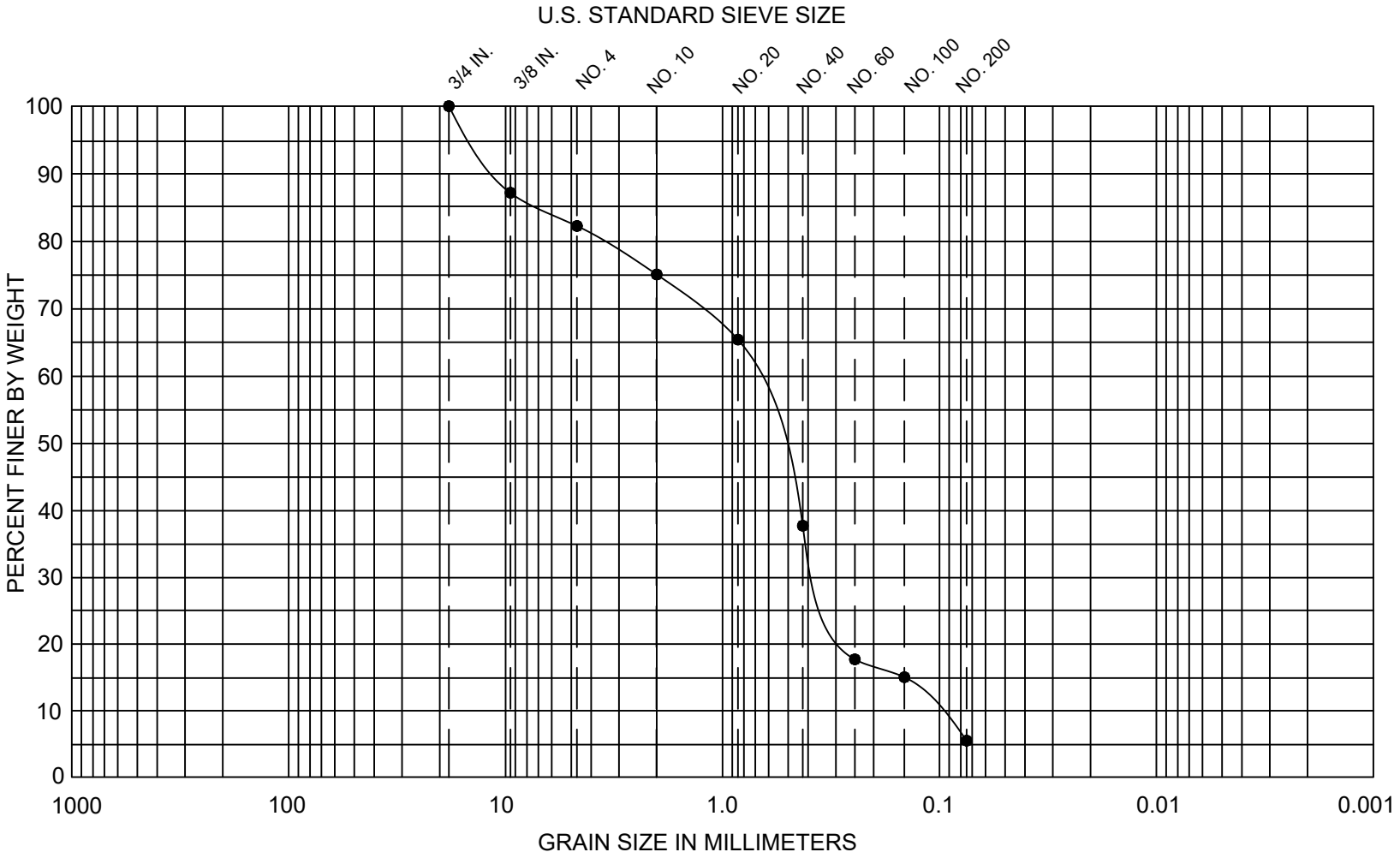

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

U.S.C. SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	SOIL DESCRIPTION	SOIL DISTRIBUTION
●SP-SM	TP-3	2.0 feet	Fine medium sand with gravel and silt	Gravel = 17% Sand = 77% Silt/Clay = 6%

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Figure 7

Hsiao Short Plat
Sieve Analysis

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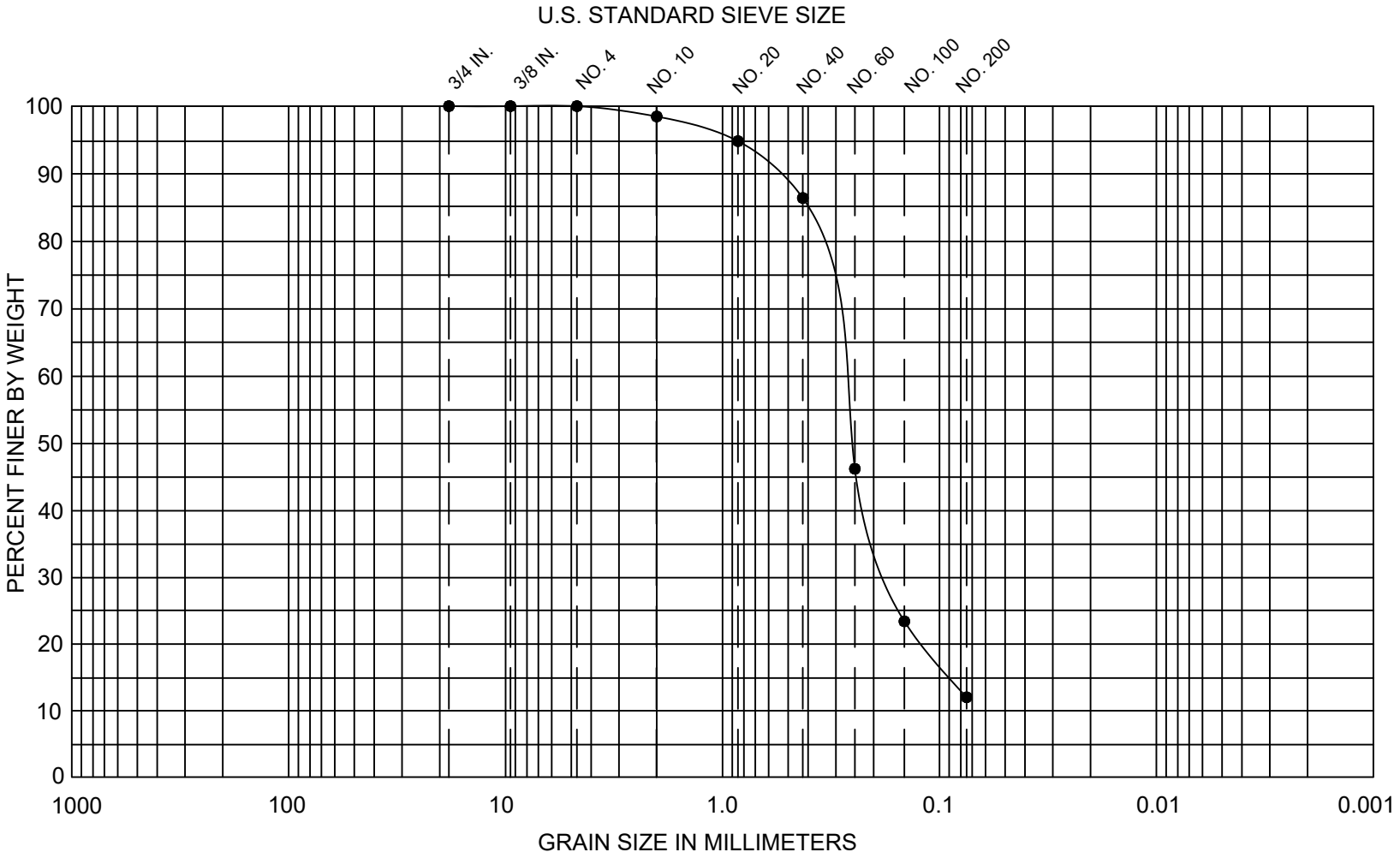

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

U.S.C. SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	SOIL DESCRIPTION	SOIL DISTRIBUTION
●SP-SM	TP-5	10.0 feet	Fine sand with silt	Gravel = 0% Sand = 88% Silt/Clay = 12%

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