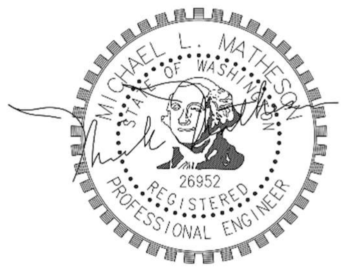
Preliminary
Storm Drainage Report

FOR

87 JV MARYSVILLE

MARYSVILLE, WA



Prepared for:	Reid Development Group, LLC Woodinville, WA 98072
Prepared by:	Sydney Stanton, E.I.T. Jake Broulette, E.I.T.
Approved by:	Mick Matheson, P.E.
Date:	August 2022
Core No:	21036

CORE DESIGN
12100 NE 195th Street, Suite 300
Bothell, Washington 98011
Ph 425.885.7877
www.coredesigninc.com

Table of Contents

1. Project Overview

Project: 87th JV Marysville

Project Parcel Information: Property information for the project site is shown in the table below. See Figure 1.1: Vicinity Map for the location of the project site.

Snohomish County Parcel #	Parcel Address	Total Area (AC) = 18.03
0059070002-1201	4218 87th Avenue NE Marysville 98270	.84
0059070002-1202	N/A	3.64
005907000-21300	4112 87th Ave NE, Marysville, WA 98270	4.47
0059070002-2000	4018 87th Ave NE, Marysville, WA 98270	4.47
0059070002-3600	3922 87th Ave NE, Marysville, WA 98270	4.614

Table 1-1 Parcel numbers

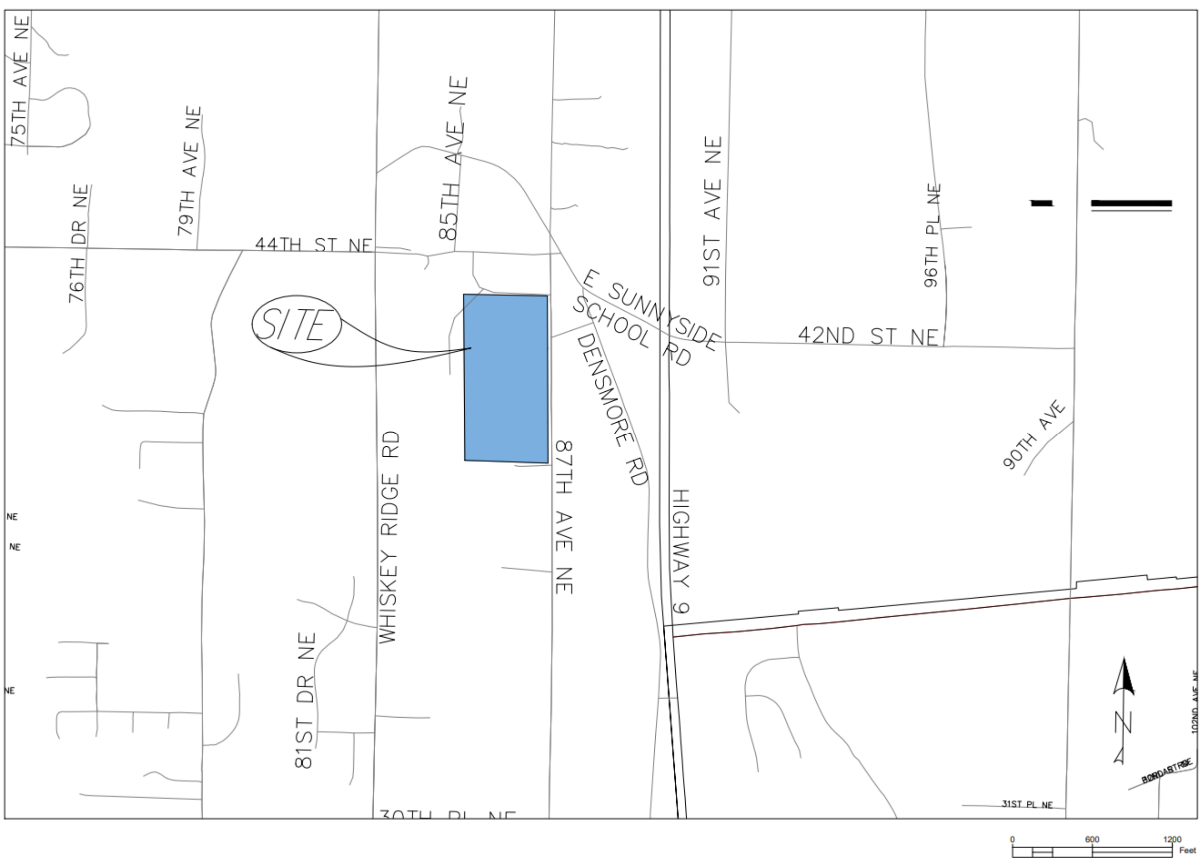


Figure 1-1 Vicinity Map

Existing Adjacent Development:

Existing development adjacent to the subject site includes the following:

North – Undeveloped lot & single family residence
East – 87th Avenue Northeast.
South –Single family residence.
West – Single family residence.

Pre-developed Site Conditions:

The project site's current use is single-family residences with associated driveways and accessory structures. The northwest corner of the project site is covered in trees, shrubs and long grass. The remainder of the site is covered by fields and lawn. The site slopes to the northeast at slopes ranging from approximately 1.5% to 16.5%.

Post-developed Site Conditions:

The project proposes to construct 188 single-family residences with associated parking, utilities and accessory parks. All existing structures on-site will be demolished and removed.

The site will be accessed from 87th Avenue NE at the east property line of the project site. The entire project site is located within the Lake Stevens Sub-Basin in Snohomish Watershed (see Appendix A for Snohomish County Sub-Basins Map).

The site consists of a single drainage basin which discharges to the northeast corner, into a roadside swale on the west side of 87th Avenue NE, as it does in the existing condition. Stormwater mitigation for the project includes two onsite combined detention/wet vaults to provide both flow control and water quality.

The performance standard for the detention vaults including water quality is based on the 2012 Stormwater Management Manual for Western Washington (SMMWW) as amended in December 2014. Based on the location of the site, the detention standard requires maintaining the durations of high flows at their predevelopment levels for all flows greater than one-half of the 2-year peak flow up to the full 50-year peak flow. The water quality system was sized based on the WWHM modeling program.

2. Conditions and Requirement Summary

The proposed project is classified as a new development which adds 5,000 square feet or more of new impervious surfaces. Therefore, all nine minimum requirements will be addressed per Section 2.4.1 of the DOE Manual. Section 2.5 in Volume I of the DOE Manual lists the nine minimum requirements for development. The applicable minimum requirements, and how the project proposal addresses each, are listed below.

Minimum Requirement #1: Preparation of Stormwater Site Plans: Preliminary Civil Plans under separate cover and a Preliminary Storm Drainage Report herein have been prepared for the subject project.

Minimum Requirement #2: Construction Stormwater Pollution Prevention: All 12 elements to be addressed. This minimum requirement will be addressed during final design.

Minimum Requirement #3: Source Control Pollution: This minimum requirement will be addressed during final design.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: The project will maintain the natural discharge location. The natural discharge pattern is to the northeast of the site towards 87th Ave NE where the existing stormwater drainage system is located. The project will connect the proposed stormwater drainage system onsite to the existing system on 87th Avenue NE.

Minimum Requirement #5: On-Site Stormwater Management: The project falls under minimum requirement #1 through #9 and is within UGA area, thus LID BMP's from List #2 have been chosen to comply with minimum requirement #5 (See section 4 for evaluation of List #2 BMP's). Per the NRCS Web Soil Survey, the soil onsite has a till underlying layer and may possess poor permeability, therefore infiltration facilities are considered possibly ineffective for the project site. Moreover, due to site constraints and the inability to provide the required flow paths, both full and basic dispersions are considered unfavorable. The project will implement BMP T5.13: Post-Construction Soil Quality and Depth for any disturbed land.

Minimum Requirement #6: Runoff Treatment: Preliminary design for the treatment facilities is included in Section 4 of this Report.

Minimum Requirement #7: Flow Control: Design of the flow control facilities is described in Section 4 of this Report. Detention vaults are designed to meet this requirement. See ***Developed Conditions Map*** at the end of Section 4 of this Report, for the proposed site and facility layout.

Minimum Requirement #8: Wetlands Protection: There are two wetlands on site identified and classified by the Soundview site investigation (see Appendix C).

Minimum Requirement #9: Operation and Maintenance: This minimum requirement will be addressed prior to approval.

3. Off-Site Analysis

Upstream

The site is located at addresses 4112 & 4018 87th Avenue NE Marysville.

Table 3-1
SNO tax Parcel numbers
0059070002-1201
0059070002-1202
0059070002-1300
0059070002-2000
0059070002-3600

The site is bounded by residential parcels to the North, south and west. 87th Ave NE runs along the east side. The site encompasses roughly 20 acres, the vast majority is farmland with some forested area near the northwestern corner. Slopes range from roughly 1% to roughly 10% on the northeastern corner.

Downstream Resource Review

Federal Emergency Management Agency Maps
The Site is within the boundary of FEMA Map 53061C0736F eff. 6/19/2020, and is located outside any flooding zones.

Web Soil Survey
The Web Soil Survey tool records the site soil makeup as Tokul Gravelly medial loam, with 0-8% slopes. This soil is comprised of 20-39 inches to densic material and an NRCS soil group B rating. The recorded depth to groundwater was 18-36 inches although this is a variable metric and depends heavily on seasonal weather conditions. This is rated as moderately well drained.

Soundview site summary report
Visited on August 4th 2021, Soundview reported on three of the five parcels, totaling 12.85 Acres. No sensitive areas were noted when reviewing U.S. Geological Survey (USGS) or Natural Resources Conservation Service (NRCS) data.

Downstream Analysis

Upstream:

The parcel and adjacent properties west of the project site generally slope to the northeast. Some runoff flows onto the site from western properties uphill of the site. However, these properties are a local highpoint in the drainage basin. Therefore, only a portion of the adjacent parcels contribute runoff onto the project site. Grass cover with scattered trees is found on both the project site and adjacent parcels.

Downstream:

Date of Field Inspection: Friday, December 23, 2021
Weather Conditions: Partly cloudy, approximately 37 degrees Fahrenheit

Figure 3-1: Downstream Map, included at the end of the section, will assist in this discussion.

The site currently consists of five parcels. The parcels consist of three single-family residences, a barn, multiple garages/sheds, and associated driveways. There are multiple types of pervious cover throughout the project site. Landscaped lawn, thick grassed pasture, and dense shrubbery are found at various locations. A variety of scattered trees are found throughout the site including a few large pines. The entire site is located within the Pilchuck River basin.

Stormwater from most of the site is drained into the drainage ditch running along the eastern boundary of the site, on the west side of 87th Avenue SE. The flow path runs north until being directed across the road via culvert at the driveway of the far northeastern parcel, address 4218. The flow path crosses underneath 87th Avenue SE east, and the remaining northern portion of the site drains to the 87th Avenue drainage ditch on the north side of the culvert (further detailed in the following paragraph). The runoff south of the 4218 driveway crosses 87th in a culvert and outlets into thick forested cover. The flow path continues southeast down the steep hill and collects along the western ditch on Densmore Road. This ditch directs runoff north to the intersection of Densmore Road and East Sunnyside School Road. Runoff is direct east underneath Densmore Road and is redirected south into another drainage ditch. This ditch flows south along the eastern side of Densmore Road until extending beyond the ¼ mile threshold of the analysis.

Runoff from the site section north of the 4218 driveway flows north along 87th Avenue SE in a drainage ditch on the west side of the road. This crosses 87th Avenue NE in a culvert near the corner of E Sunnyside School Road and 87thAvenue NE, feeding into another drainage ditch that runs along E Sunnyside school road. The flow path crosses over E Sunnyside School Road via a culvert to the east side of Densmore Road, combining with the Sheet flow runoff from the rest of the site, and reaches a ¼ mile, end of analysis.

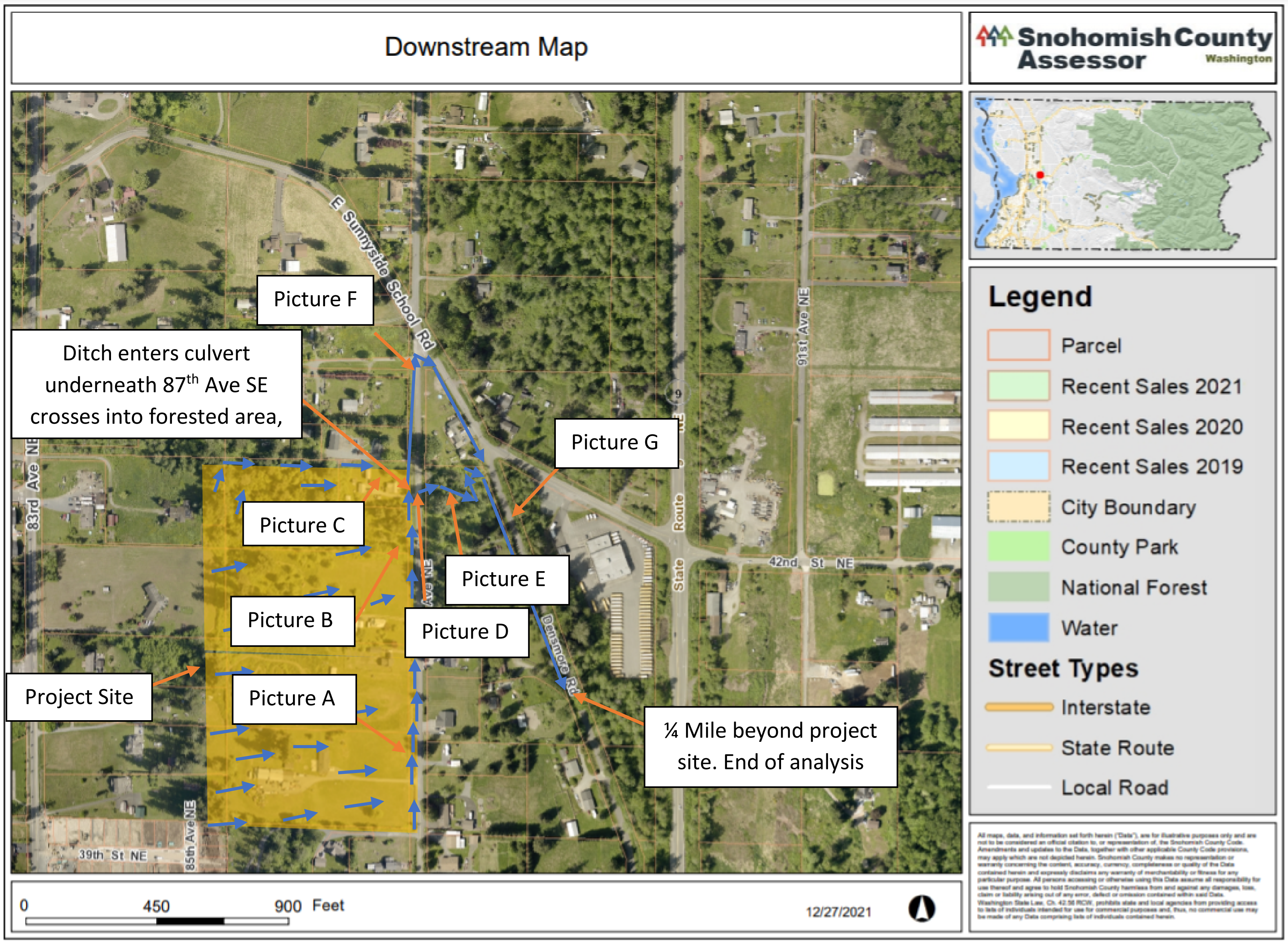
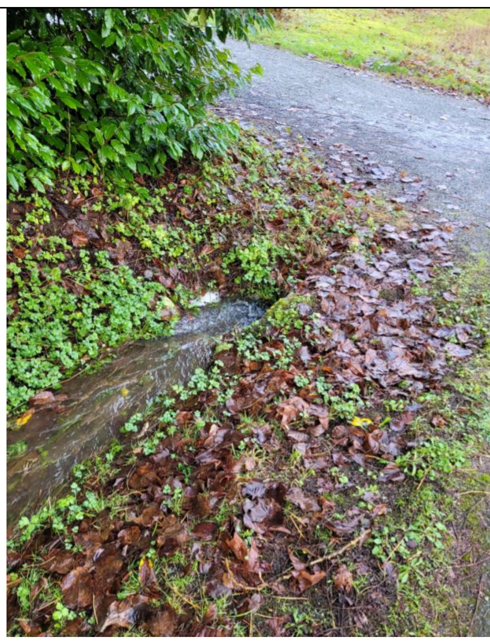


Figure 3-1 Downstream Map

Table 3-2 Drainage analysis site photos	
 A: Drainage ditch along property line facing North on 87^{th} Ave NE	 B: Drainage ditch along 87^{th} facing North on 87^{th} Ave NE
 C: runoff enters culvert before crossing 87^{th} Ave NE, facing north	 D: Culvert exit looking East over 87^{th} Ave NE

E: runoff over vegetated area

F: Corner of Densmore and East Sunnyside School Road Facing North

G: Densmore drainage ditch facing South

4. Flow Control and Water Quality Facility Analysis and Design

A. Project LID Feasibility

Per Minimum Requirement #5, the project shall implement on-site stormwater management BMPs in accordance with the 2014 SMMWW. The flow chart below is used to determine the BMP requirements for the project.

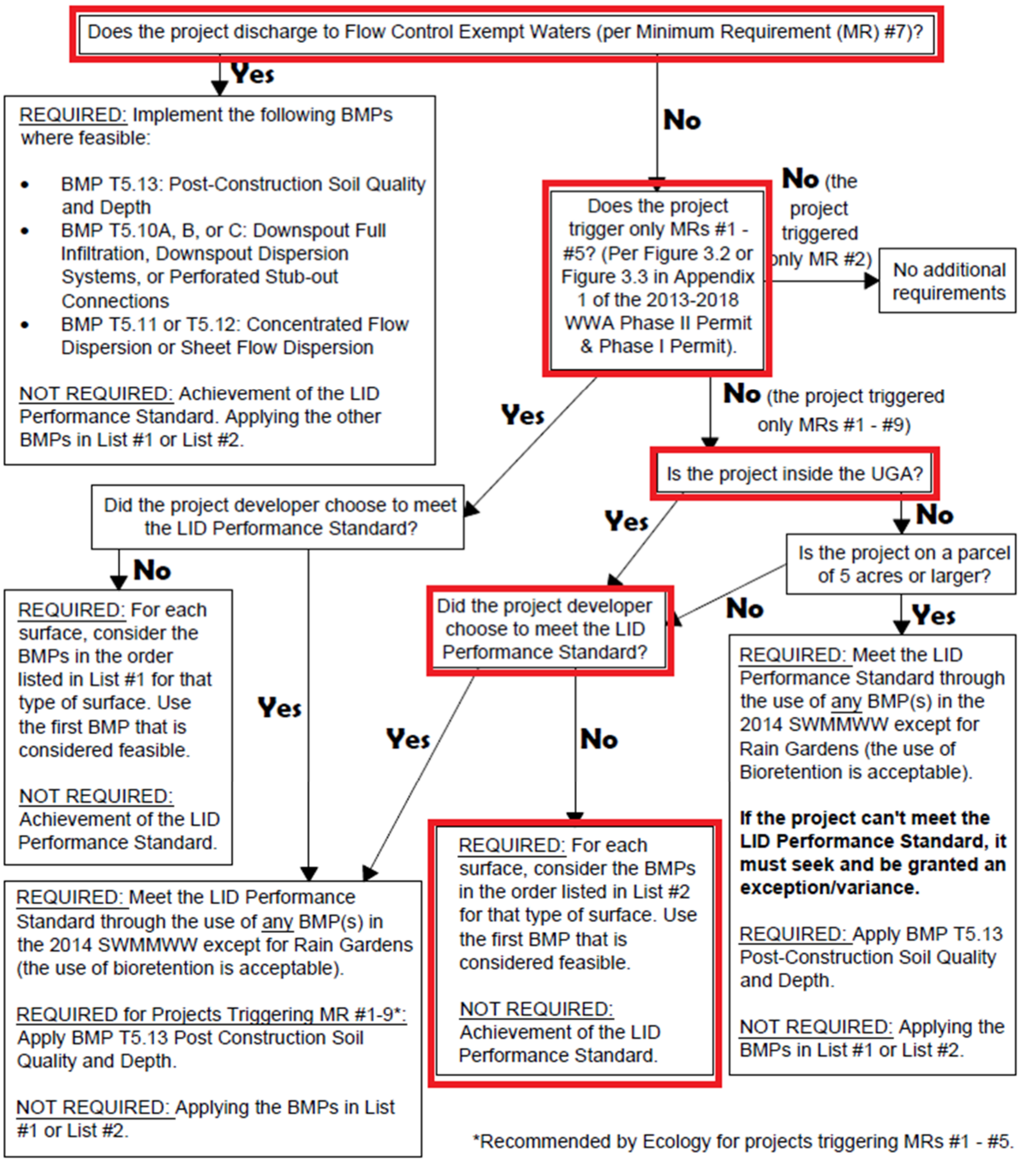


Figure 4-1: Flow Chart for Determining LID MR #5 Requirements

Site Soils

The NRCS web soil survey classifies the soils on site as Tokul gravelly medial loam. This is a moderately well drained soil but has an impermeable till layer after several feet. The Geotech report conducted for this project by Earth Solutions NW LLC (See Appendix C for full report) states that dense material was present from roughly three feet to the maximum test pit depth of nine and one-half feet. The geotechnical report advises against infiltration based on both site soil makeup and small-scale Pilot Infiltration Testing that observed no appreciable infiltration.

Hydrology

Following the flow chart in Figure 4-1 shown above, achievement of the LID performance standard is not required for this project. The BMPs in list #2 will be considered for each surface and applied where feasible. The following is a discussion evaluating the feasibility of each BMP from list #2.

List #2

For each surface, consider the BMPs in the order listed for that type of surface. Use the BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface. Feasibility shall be determined by the evaluation against:

1. Design criteria, limitations, and infeasibility criteria identified for each BMP in this manual; and
2. Competing Needs Criteria listed in Chapter V-5 – On-site Stormwater Management

Lawn and landscaped areas:

- Post-Construction Soil Quality and Depth in accordance with BMP T5.13.

Response: *BMP T5.13 will be implemented for all landscaped areas proposed by the project.*

Roofs:

1. Full dispersion in accordance with BMP T5.30 or Downspout Full Infiltration Systems in accordance with BMP T5.10A.

Response: *The project site cannot support the required 100-foot flow path; therefore, this BMP is not applicable.*

2. Bioretention facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.

Response: *Bioretention BMPs are considered infeasible due to their reliance on infiltration.*

3. Downspout Dispersion Systems in accordance with BMP T5.10B

Response: *The project site cannot support the required flowpath for full dispersion due to site constraints. This BMP is not applicable.*

4. Perforated Stub-out Connection in accordance with BMP T5.10C

Response: *Perforated stub-out connections are considered infeasible due to low infiltration potential of site soils.*

<u>Other Hard Surfaces:</u>

1. Full dispersion in accordance with BMP T5.30 or Downspout Full Infiltration Systems in accordance with BMP T5.10A.

Response: *The project site cannot support the required flowpath for full dispersion due to site constraints. This BMP is not applicable.*

2. Permeable pavement in accordance with BMP T5.15

Response: *The onsite soils are not conducive to infiltration applications; therefore, permeable pavement is considered infeasible.*

3. Bioretention BMP's that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.

Response: *Due to its reliance on infiltration and the poorly draining soils that exist on site, bioretention BMP's are considered infeasible.*

4. Sheet Flow Dispersion in accordance with BMP T5.12 or Concentrated Flow Dispersion in accordance with BMP T5.11.

Response: *The project site cannot support the required flow path for sheet flow dispersion due to site constraints. This BMP is not applicable.*

B. Hydraulic Analysis

All stormwater facilities will be designed in accordance with the 2014 Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW). The drainage analysis for detention and water quality sizing was modeled using the 2012 WWHM modeling program. The Geotech report for this project site (See Appendix D) showed no effective infiltration and confirmed that the site is underlaid by Glacial Till soils specifically Tokul gravelly medial loam, as stated by the NRCS Soil Survey for Snohomish County.
Infiltration is not recommended for Till soil, based on general soil properties and on-site testing.

Existing Conditions

The project consists of five parcels, four of them are made up of single-family residences and additional separated garages and shop spaces. There is a single undeveloped parcel on the far north of the site. Together the parcels make up a total of 18.04 Acres, with an additional 0.9 Acres in frontage improvements to 87th Avenue Northeast. The majority of land cover is pasture and grass, with a minor percentage taken up by housing and gravel roads. The site slopes generally at a medium slope (roughly 5-15%) to the north east, although there are several points in the north western side where the slope is minimal. The predeveloped (Historical) area will be modeled as moderate slope type C (Till) Forest for Tokul soil as specified by Snohomish county drainage manual volume 3, Table 3.1.

Table 4-2: Existing Condition Land Use Areas

EXISTING CONDITION (PREDEVELOPED LAND USE)	Net Project Area = 18.89 acres
Pasture/Fields	17.11 Acres
Houses/sheds	0.38 Acres
Gravel driveways	0.536 Acres
Frontage improvements	0.9 Acres
Overall Project Area	18.93 Acres

Table 4-3: Historical Conditions flow frequency (Till forest)

Flow Frequency		
Flow(cfs)		Predeveloped
2 Year	=	0.6998
5 Year	=	1.1190
10 Year	=	1.4527
25 Year	=	1.9418
50 Year	=	2.3579
100 Year	=	2.8205

Refer to the WWHM report attached in Appendix B for more detail regarding the modeling of existing conditions.

Developed Conditions

The project proposed to construct 188 single-family residences. The site will be accessed via a new public street within a 50' right-of-way that will be connected to 87th Avenue Northeast. Frontage improvements to 87th Avenue Northeast to the western side of the road include asphalt widening, installation of curb and gutter, and sidewalk.

The project is located within Sunnyside sub-basin which is part of in Snohomish Watershed. Refer to Appendix A for Snohomish County Sub-Basin Map. Stormwater mitigation for the project includes an on-site detention/water quality vault. The performance standard for the combination detention/water quality pond is based on the 2014 Stormwater Management Manual for Western Washington (SMMWW). Based on the location of the site, the detention standard requires maintaining the durations of the high flows at their predevelopment levels for all flows greater than one-half of the 2-year peak flow up to the full 50-year peak flow. The water quality system was sized based on the 2014 SMMWW using an approved continuous runoff model WWHM.

	Impervious	Pervious	Total
On-Site	**12.16**	**5.83**	**18**
Lots (Ac)	*6.43*	*2.75*	*9.18*
Open Space/Storm (Ac)	*0.475*	*3.08*	*3.56*
Roads (Ac)	*5.27*	*0*	*5.26*
Off-Site (Frontage improvements)	*0.83*	*0.1*	*0.93*
Total (SF)	**576,387**	**239,182**	**824,591**
Total (ac)	**13**	**5.93**	**18.93**

Table 4-4: Summary of developed areas

Tables 4-5 and 4-6 present the developed condition basin area routed to north (vault A) and central (vault B) onsite detention vaults. The impervious lot areas were calculated based on the maximum impervious coverage allowed by zoning, 70% of the lot areas. See Appendix B for detailed developed condition tables

Table 4-5 Developed Condition Vault A area

Land Cover	Area (SF)	Area (ac)
Impervious	162,525	3.73
Pervious	66,757	1.53
Total	229,282	5.26

Table 4-6 Developed Condition Vault B area

Land Cover	Area (SF)	Area (ac)
Impervious	400,122	9.21
Pervious	186,166	4.27
Total	594,028	13.48

C. Detention Calculations

The drainage analysis for detention pond sizing was modeled using the WWHM modeling software. Minimum Requirement #7, storm water discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. Both detention vaults meet or exceed this flow control requirement.

Figure 4-2: Summary of vault geometry

Mitigated Routing

Vault A

Width:	58 ft.	
Length:	121 ft.	
Depth:	13.7 ft.	
Discharge Structure		
Riser Height:	12.7 ft.	
Riser Diameter:	12 in.	
Orifice 1 Diameter:	1.2188 in	Elevation:0 ft.
Orifice 2 Diameter:	0.875 in.	Elevation:5.7 ft.
Orifice 3 Diameter:	2.2 in.	Elevation:7.9 ft.
Element Flows To:		
Outlet 1	Outlet 2	

Vault B

Width:	100 ft.	
Length:	197 ft.	
Depth:	12.7 ft.	
Discharge Structure		
Riser Height:	11.7 ft.	
Riser Diameter:	18 in.	
Orifice 1 Diameter:	2.0313 in	Elevation:0 ft.
Orifice 2 Diameter:	1.875 in.	Elevation:5.3 ft.
Orifice 3 Diameter:	3.125 in.	Elevation:7.5 ft.
Element Flows To:		
Outlet 1	Outlet 2	

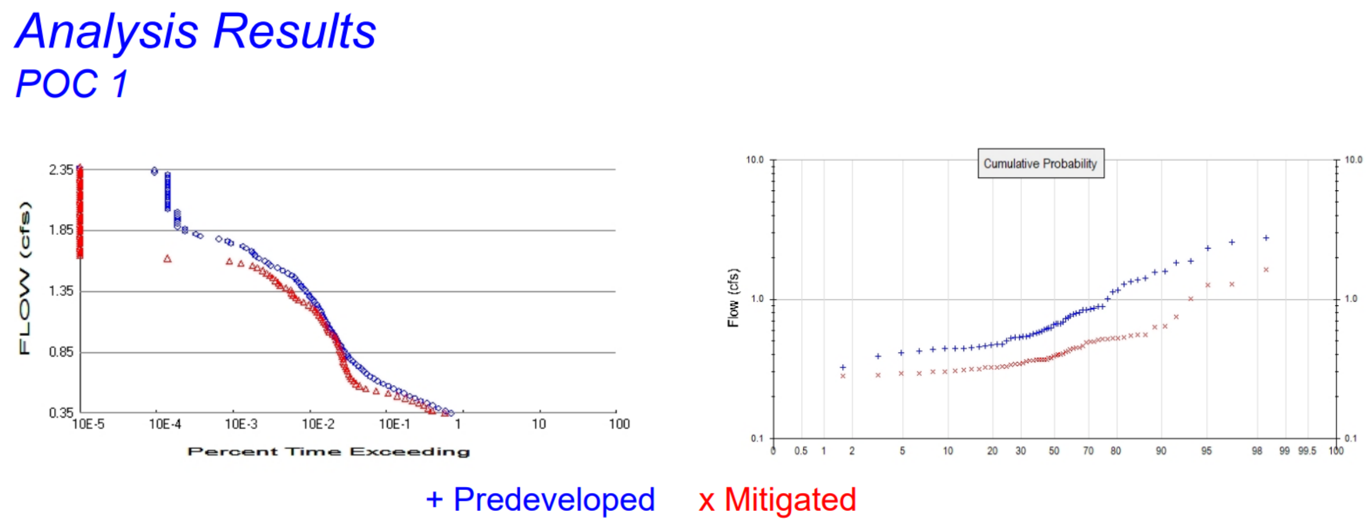


Figure 4-3 Full model results (Vaults A and B)

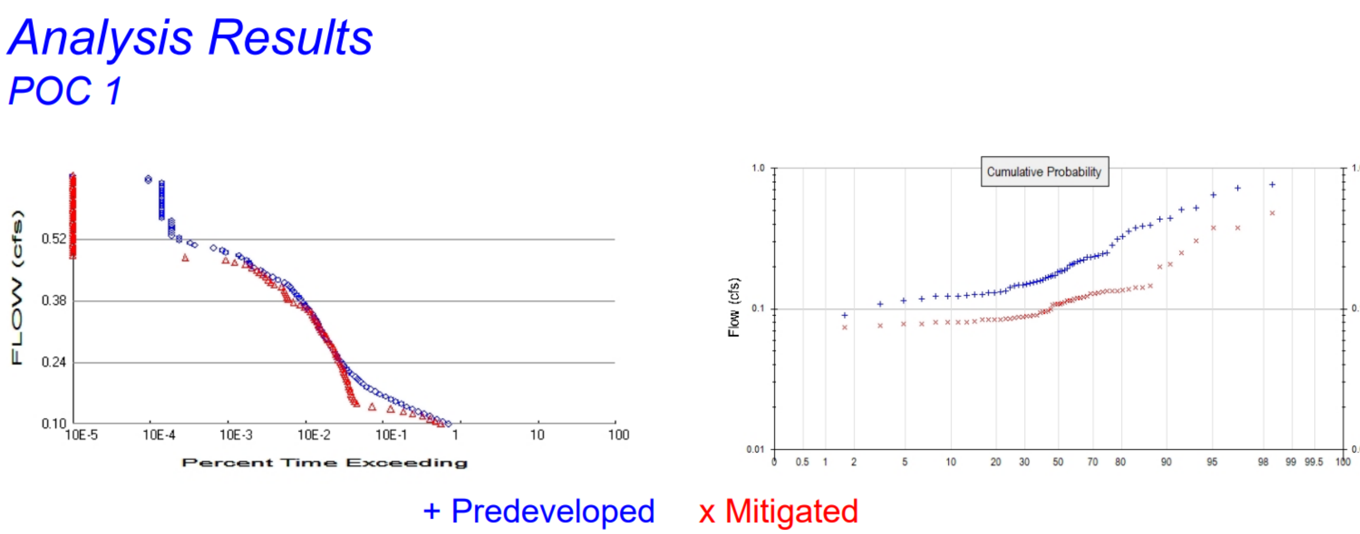
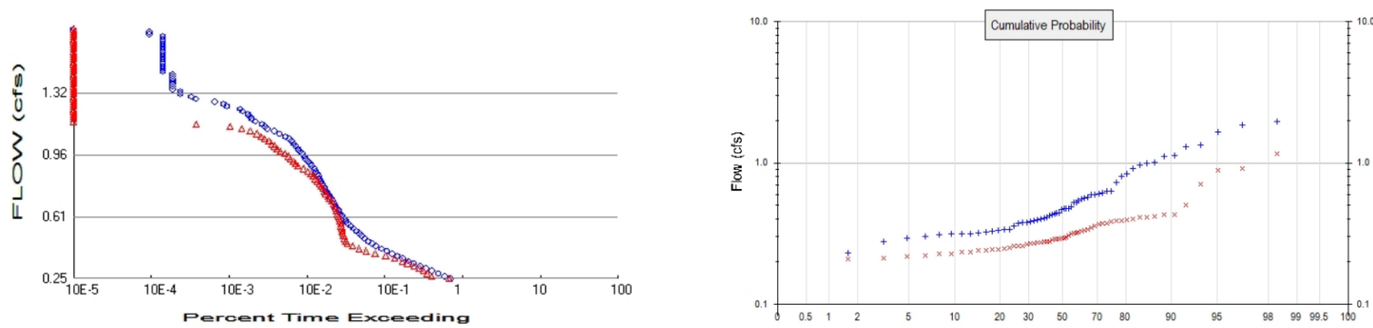


Figure 4-4 Vault A results

Analysis Results
POC 1



+ Predeveloped x Mitigated

Figure 4-5 Vault B results

Refer to the Full WWHM reports in Appendix B.

D. Wet Pond (Dead Storage)

Basic water quality treatment is proposed to be provided through dead storage in the vault. The required volume is the water quality design volume that is computed as the 91% non-exceedance, 24-hour runoff volume determined by approved continuous model (WWHM)4

Facility	Required volume	Provided volume
Detention Vault A	7,131 cf	14,036 cf
Detention Vault B	18,518 cf	31,520 cf
Total	25,710 cf	45,556 cf

Water Quality
Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.1637 acre-feet
On-line facility target flow: 0.0827 cfs.
Adjusted for 15 min: 0.0827 cfs.
Off-line facility target flow: 0.0547 cfs.
Adjusted for 15 min: 0.0547 cfs.

Figure 4-6 Vault A Water Quality volume

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.4251 acre-feet
On-line facility target flow:	0.2159 cfs.
Adjusted for 15 min:	0.2159 cfs.
Off-line facility target flow:	0.1421 cfs.
Adjusted for 15 min:	0.1421 cfs.

Figure 4-7 Vault B Water Quality volume

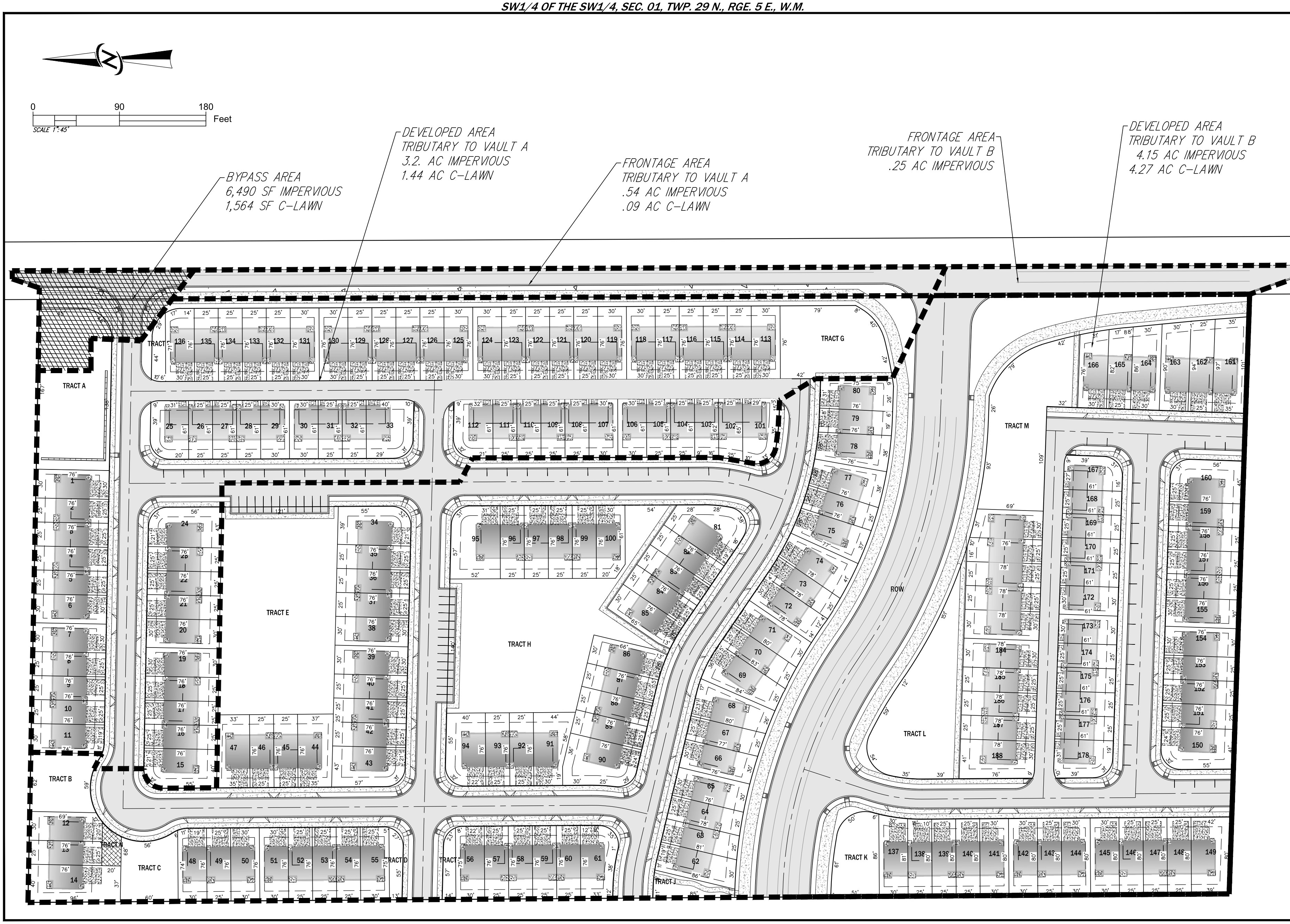
Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.5909 acre-feet
On-line facility target flow:	0.2996 cfs.
Adjusted for 15 min:	0.2996 cfs.
Off-line facility target flow:	0.1976 cfs.
Adjusted for 15 min:	0.1976 cfs.

Figure 4-8 Vault B Water Quality volume

SW1/4 OF THE SW1/4, SEC. 01, TWP. 29 N., RGE. 5 E., W.M.



8-31-22

CORE DESIGN

CIVIL ENGINEERING
LANDSCAPE ARCHITECTURE
PLANNING
SURVEYING

12100 NE 195th St, Suite 300 Bothell, Washington 98011 425.885.7877

FIGURE 4-9 DEVELOPED CONDITIONS EXHIBIT

87TH AND 40TH PRD

PNW INVESTORS, LLC

PO BOX 1930
WOODINVILLE, WA 98072

DATE	SEPTEMBER 2022
DESIGNED	JAKE BROUILETTE
DRAWN	CHUCK FEMLING
APPROVED	MICHAEL L. MATHESON
	BEN MADEO, AICP
	PROJECT MANAGER

SHEET	OF
1	1

PROJECT NUMBER
21036

5. Conveyance System and Analysis and Design

Will be provided with final engineering.

6. Special Reports and Studies

The following reports have been submitted under separate cover.

The following reports and assessments are provided for reference and informational purposes only. Core Design takes no responsibility or liability for these reports, assessments or designs as they were not completed under the direct supervision of Core Design.

- Soundview recon site summary
  Dated: September 3rd 2021
  Prepared for: 12.85-acre property, 4112 and 4018 87th Avenue Northeast
  Prepares by: Soundview Consultants, LLC
  2907 Harborview Drive, Suite D
  Gig Harbor, Washington 98335

- Geotechnical Engineering study
  Dated: September 2nd 2022
  Prepared for: 87th and 40th JV
  Prepares by: Earth Solutions NW, LLC
  15365 Northeast 90th Street Suite 100
  Redmond, Washington 98052

7. Erosion and Sedimentation Control Analysis and Design

The site will utilize Volume II of the 2019 SWMMWW for erosion and sedimentation control design to reduce the discharge of sediment carrying runoff offsite. Before earthwork starts, clearing limits and any fencing around trees, and silt fencing along the perimeter of the disturbed areas will be placed to limit downstream transport of sediment to neighboring stormwater systems.

Dust control, if needed will be supplied by a water truck. A certified Erosion and Sediment Control Lead inspector will be present on-site during earthwork activities. The ESC Lead inspector will determine the frequency of watering of the project site and direct and authorize any needed additional sediment control measure on site depending on conditions present. The erosion control plan will be comprised of both temporary measures (silt fence, interceptor swales stabilized construction entrance, etc.) and permanent measures (Hydroseeding, ect.)

Full temporary Erosion and Sedimentation control plans will be provided with final design.

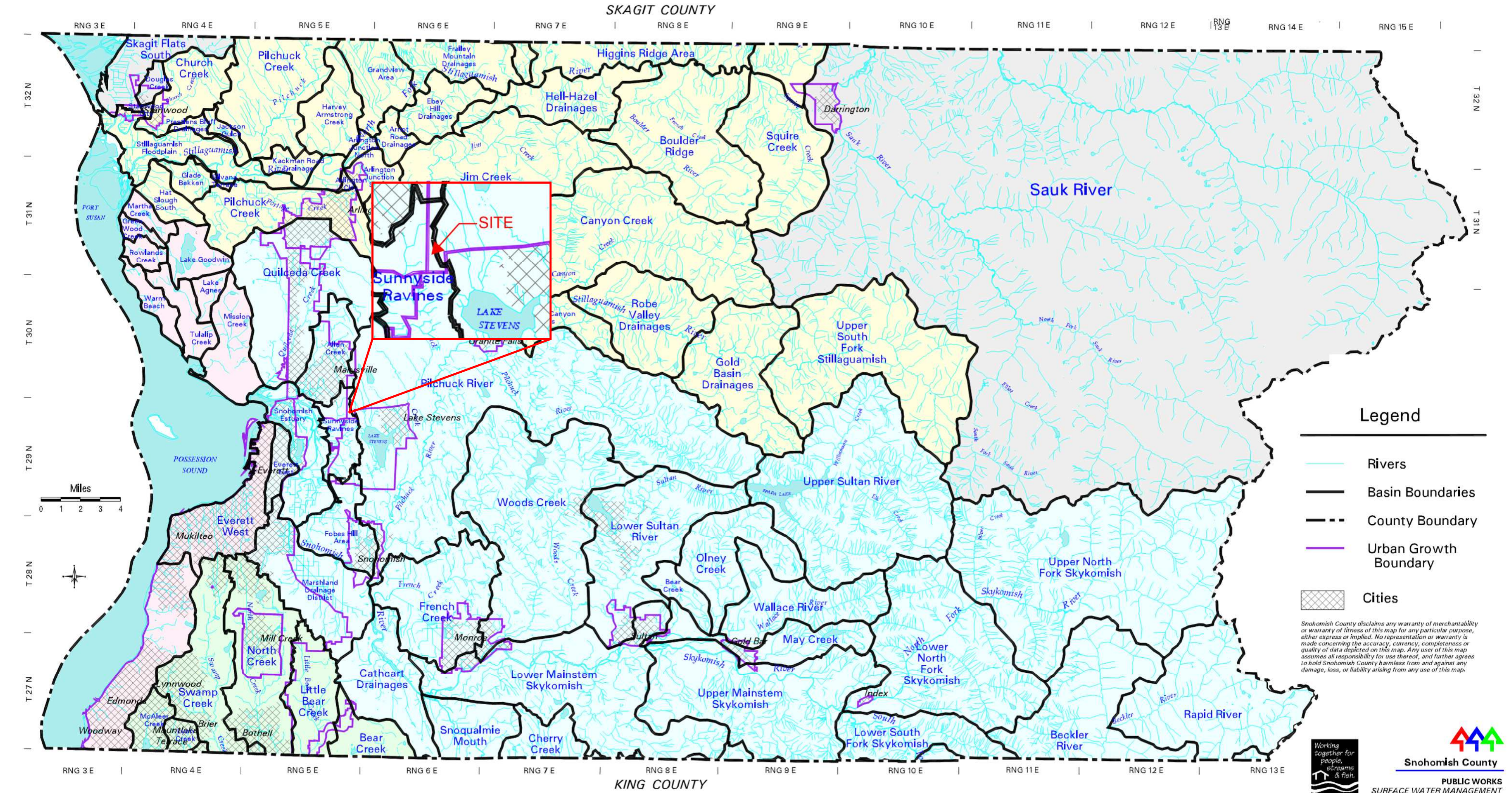
8. Operations and Maintenance Manual

Will be provided with final engineering.

Appendix A

Area maps

Snohomish County Sub-Basins



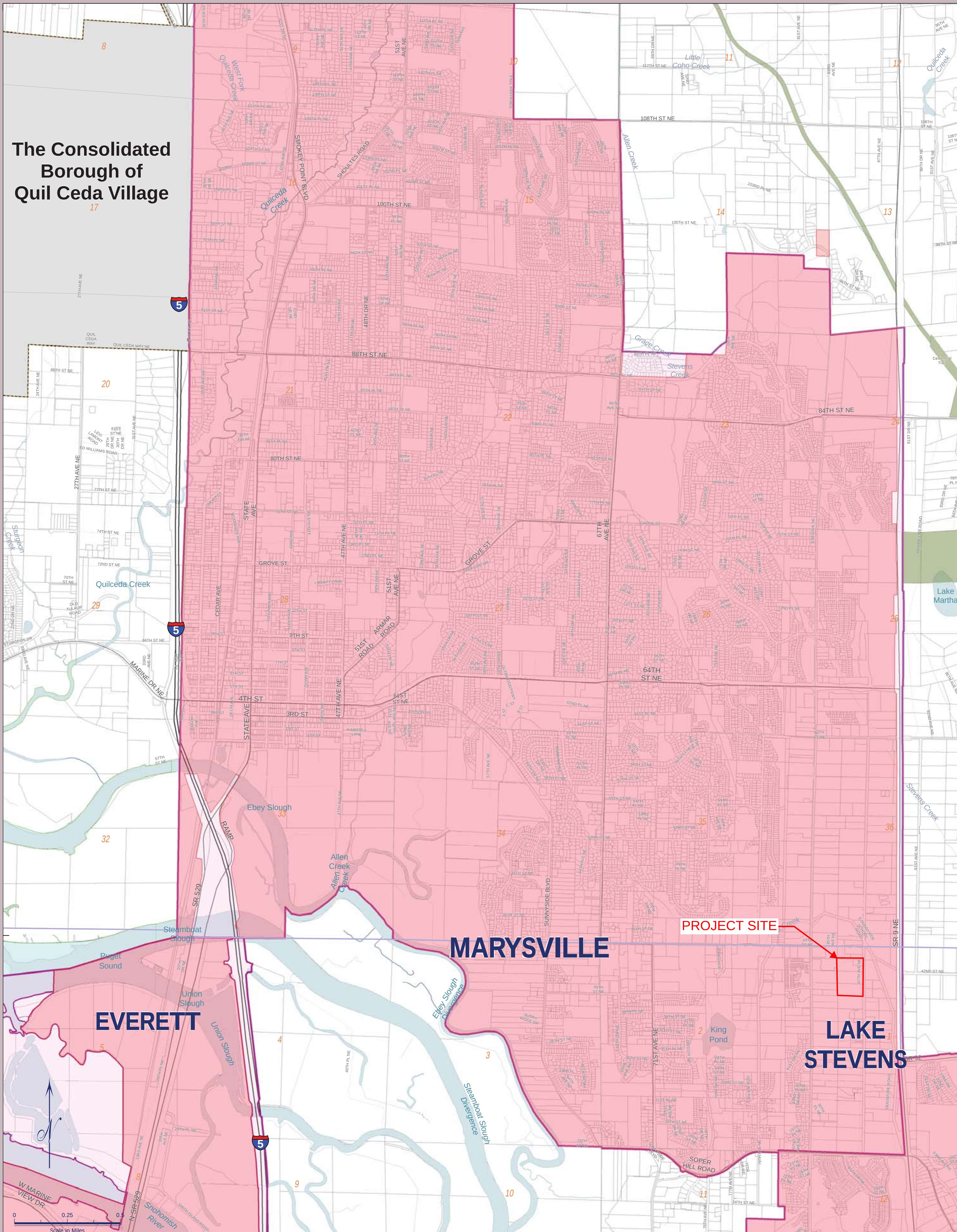
Sources: Snohomish County 1:24,000, hydro county, uga & city boundaries, basins. (gis/pw/swm/proj/cnty/amls/allbsn.aml) 10/00

State Plane Zone 5601, NAD 83, Units Feet

R. 5 E.

T. 30 N.

T. 29 N.

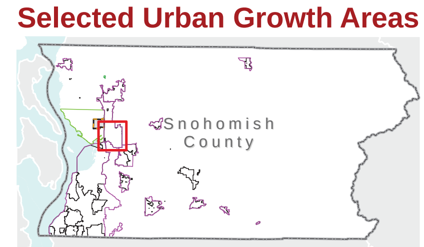


SNOHOMISH COUNTY

Marysville UGA (South Portion)

URBAN GROWTH AREAS AND INCORPORATED CITIES

Selected Urban Growth Areas



Legend

- County Boundary
- Incorporated City Boundary
- Municipal Urban Growth Boundary
- Urban Growth Boundary
- Tulalip Indian Reservation Boundary
- Stillaguamish Indian Reservation Boundary
- The Consolidated Borough of Quil Ceda Village
- U. S. National Forest Land
- County Park

Snohomish County

SNOHOMISH COUNTY DATA and MAP DISCLAIMER

All maps, data, and information set forth herein ("Data"), are for illustrative purposes only and are not to be considered an official citation to, or representation of, the Snohomish County Code. Amendments and updates to the Data, together with other applicable County Code provisions, may apply which are not depicted herein. Snohomish County makes no representation or warranty concerning the content, accuracy, currency, completeness or quality of the Data contained herein and expressly disclaims any warranty of merchantability or fitness for any particular purpose. All persons accessing or otherwise using this Data assume all responsibility for use thereof and agree to hold Snohomish County harmless from and against any damages, loss, claim or liability arising out of any error, defect or omission contained within said Data. Washington State Law, Ch. 42.56 RCW, prohibits state and local agencies from providing access to lists of individuals intended for use for commercial purposes and, thus, no commercial use may be made of any Data comprising lists of individuals contained herein.

Parcel lines and designation boundaries are adjusted to the Snohomish County Assessor Integrated Land Records Parcel Data Base as of March 2013.

This map is a graphic representation applied from the Snohomish County Geographic Information System. It does not represent survey accuracy. This map is based on the best available information as of the date shown on the map.

For the purposes of land use application review, final determination of future land use designations will be made by the County during the review process.

Appendix B

Developed Conditions Area Table

& WWHM2012 Reports

Developed Condition Vault A						
Lot/Tract	Total Area		Land Use Area			
			Total Impervious		Pervious	
Lot #	SF	Acre	SF	Acre	SF	Acre
Total	229739.2	5.274086	162524.6	3.731052	66757.09	1.532532
Tract A	10974.24	0.252	4441	0.102	6533.24	0.150
Tract G	8053.16	0.185	438	0.010	7615.16	0.175
Tract F	905.74	0.021	0	0.000	905.74	0.021
Road	66355.11	1.523	66355.11	1.523	0	0.000
Planter box	13035.95	0.299	0	0.000	13035.95	0.299
1	2280	0.052	1596	0.037	684	0.016
2	1900	0.044	1330	0.031	570	0.013
3	1900	0.044	1330	0.031	570	0.013
4	1900	0.044	1330	0.031	570	0.013
5	1900	0.044	1330	0.031	570	0.013
6	2280	0.052	1596	0.037	684	0.016
7	2280	0.052	1596	0.037	684	0.016
8	1900	0.044	1330	0.031	570	0.013
9	1900	0.044	1330	0.031	570	0.013
10	1900	0.044	1330	0.031	570	0.013
11	2273	0.052	1591.1	0.037	681.9	0.016
15	3015	0.069	2110.5	0.048	904.5	0.021
16	1900	0.044	1330	0.031	570	0.013
17	1900	0.044	1330	0.031	570	0.013
18	1900	0.044	1330	0.031	570	0.013
19	2280	0.052	1596	0.037	684	0.016
20	2280	0.052	1596	0.037	684	0.016
21	1900	0.044	1330	0.031	570	0.013
22	1900	0.044	1330	0.031	570	0.013
23	1900	0.044	1330	0.031	570	0.013
24	3092	0.071	2164.4	0.050	927.6	0.021
33	2895	0.066	2026.5	0.047	868.5	0.020
32	1525	0.035	1067.5	0.025	457.5	0.011
31	1525	0.035	1067.5	0.025	457.5	0.011
30	1930	0.044	1351	0.031	579	0.013
29	1830	0.042	1281	0.029	549	0.013
28	1525	0.035	1067.5	0.025	457.5	0.011
27	1525	0.035	1067.5	0.025	457.5	0.011
26	1525	0.035	1067.5	0.025	457.5	0.011
25	2331	0.054	1631.7	0.037	699.3	0.016
136	2256	0.052	1579.2	0.036	676.8	0.016
135	1900	0.044	1330	0.031	570	0.013
134	1900	0.044	1330	0.031	570	0.013
133	1900	0.044	1330	0.031	570	0.013
132	1900	0.044	1330	0.031	570	0.013
131	2280	0.052	1596	0.037	684	0.016

130	2280	0.052	1596	0.037	684	0.016
129	1900	0.044	1330	0.031	570	0.013
128	1900	0.044	1330	0.031	570	0.013
127	1900	0.044	1330	0.031	570	0.013
126	1900	0.044	1330	0.031	570	0.013
125	2280	0.052	1596	0.037	684	0.016
124	2280	0.052	1596	0.037	684	0.016
123	1900	0.044	1330	0.031	570	0.013
122	1900	0.044	1330	0.031	570	0.013
121	1900	0.044	1330	0.031	570	0.013
120	1900	0.044	1330	0.031	570	0.013
119	2280	0.052	1596	0.037	684	0.016
118	2280	0.052	1596	0.037	684	0.016
117	1900	0.044	1330	0.031	570	0.013
116	1900	0.044	1330	0.031	570	0.013
115	1900	0.044	1330	0.031	570	0.013
114	1900	0.044	1330	0.031	570	0.013
113	2280	0.052	1596	0.037	684	0.016
112	2401	0.055	1680.7	0.039	720.3	0.017
111	1525	0.035	1067.5	0.025	457.5	0.011
110	1525	0.035	1067.5	0.025	0	0.000
109	1525	0.035	1067.5	0.025	457.5	0.011
108	1525	0.035	1067.5	0.025	457.5	0.011
107	1830	0.042	1281	0.029	549	0.013
106	1830	0.042	1281	0.029	549	0.013
105	1525	0.035	1067.5	0.025	457.5	0.011
104	1525	0.035	1067.5	0.025	457.5	0.011
103	1528	0.035	1069.6	0.025	458.4	0.011
102	1581	0.036	1106.7	0.025	474.3	0.011
101	2388	0.055	1671.6	0.038	716.4	0.016

Developed Condition Vault B						
Lot/Tract	Total Area		Land Use Area			
			Total Impervious		Pervious	
Lot #	SF	Acre	SF	Acre	SF	Acre
Total	587472.6	13.48	401317.68	9.21	186154.96	4.27
Tract B	4043	0.093	371.17	0.009	3671.83	0.084
Tract C	3899.61	0.090	0	0.000	3899.61	0.090
Tract D	982.08	0.023	0	0.000	982.08	0.023
Tract H	21789.04	0.500	5584	0.128	16205.04	0.372
Tract I	913.11	0.021	0	0.000	913.11	0.021
Tract J	1609.54	0.037	0	0.000	1609.54	0.037
Tract K	3950.04	0.091	0	0.000	3950.04	0.091
Tract L	12477.32	0.286	3604.7	0.083	8872.62	0.204
Tract E	23424.65	0.538	2968	0.068	20456.65	0.470
Tract M	12036.66	0.276	2521	0.058	9515.66	0.218
Tract N	730	0.017	730	0.017	0	0.000
Road+sidev	191460	4.395	191460	4.395	0	0.000
Parking Lot	5665	0.130	5665	0.130	0	0.000
Planters	35330	0.811	0	0.000	35330	0.811
12	2243	0.051	1570.1	0.036	672.9	0.015
13	1900	0.044	1330	0.031	570	0.013
14	3703	0.085	2592.1	0.060	1110.9	0.026
48	2273	0.052	1591.1	0.037	681.9	0.016
49	1900	0.044	1330	0.031	570	0.013
50	2280	0.052	1596	0.037	684	0.016
51	2280	0.052	1596	0.037	684	0.016
52	1900	0.044	1330	0.031	570	0.013
53	1900	0.044	1330	0.031	570	0.013
54	1900	0.044	1330	0.031	570	0.013
55	2279	0.052	1595.3	0.037	683.7	0.016
47	2575	0.059	1802.5	0.041	772.5	0.018
46	1900	0.044	1330	0.031	570	0.013
45	1900	0.044	1330	0.031	570	0.013
44	2745	0.063	1921.5	0.044	823.5	0.019
43	3081	0.071	2156.7	0.050	924.3	0.021
42	1900	0.044	1330	0.031	570	0.013
41	1900	0.044	1330	0.031	570	0.013
40	1900	0.044	1330	0.031	570	0.013
39	2280	0.052	1596	0.037	684	0.016
38	2280	0.052	1596	0.037	684	0.016
37	1900	0.044	1330	0.031	570	0.013
36	1900	0.044	1330	0.031	570	0.013
35	1900	0.044	1330	0.031	570	0.013
34	2988	0.069	2091.6	0.048	896.4	0.021
100	2206	0.051	1544.2	0.035	661.8	0.015
99	1900	0.044	1330	0.031	570	0.013

98	1900	0.044	1330	0.031	570	0.013
97	1900	0.044	1330	0.031	570	0.013
96	1900	0.044	1330	0.031	570	0.013
95	3827	0.088	2678.9	0.061	1148.1	0.026
94	3050	0.070	2135	0.049	915	0.021
93	1900	0.044	1330	0.031	570	0.013
92	1900	0.044	1330	0.031	570	0.013
91	2673	0.061	1871.1	0.043	801.9	0.018
90	3507	0.081	2454.9	0.056	1052.1	0.024
89	1900	0.044	1330	0.031	570	0.013
88	1900	0.044	1330	0.031	570	0.013
87	1900	0.044	1330	0.031	570	0.013
86	2303	0.053	1612.1	0.037	690.9	0.016
85	2289	0.053	1602.3	0.037	686.7	0.016
84	1900	0.044	1330	0.031	570	0.013
83	1900	0.044	1330	0.031	570	0.013
82	1900	0.044	1330	0.031	570	0.013
81	3415	0.078	2390.5	0.055	1024.5	0.024
80	2484	0.057	1738.8	0.040	745.2	0.017
79	1900	0.044	1330	0.031	570	0.013
78	2512	0.058	1758.4	0.040	753.6	0.017
77	2530	0.058	1771	0.041	759	0.017
76	1908	0.044	1335.6	0.031	572.4	0.013
75	2500	0.057	1750	0.040	750	0.017
74	2629	0.060	1840.3	0.042	788.7	0.018
73	1945	0.045	1361.5	0.031	583.5	0.013
72	2341	0.054	1638.7	0.038	702.3	0.016
71	2367	0.054	1656.9	0.038	710.1	0.016
70	2031	0.047	1421.7	0.033	609.3	0.014
69	2784	0.064	1948.8	0.045	835.2	0.019
68	2686	0.062	1880.2	0.043	805.8	0.018
67	1960	0.045	1372	0.031	588	0.013
66	2291	0.053	1603.7	0.037	687.3	0.016
65	2275	0.052	1592.5	0.037	682.5	0.016
64	1923	0.044	1346.1	0.031	576.9	0.013
63	1981	0.045	1386.7	0.032	594.3	0.014
62	2496	0.057	1747.2	0.040	748.8	0.017
61	2686.31	0.062	1880.417	0.043	805.893	0.019
60	1899.99	0.044	1329.993	0.031	569.997	0.013
59	1899.99	0.044	1329.993	0.031	569.997	0.013
58	1899.99	0.044	1329.993	0.031	569.997	0.013
57	1899.99	0.044	1329.993	0.031	569.997	0.013
56	2276.32	0.052	1593.424	0.037	682.896	0.016
137	2480	0.057	1736	0.040	744	0.017
138	2003	0.046	1402.1	0.032	600.9	0.014
139	2000	0.046	1400	0.032	600	0.014

140	2000	0.046	1400	0.032	600	0.014
141	2400	0.055	1680	0.039	720	0.017
142	2400	0.055	1680	0.039	720	0.017
143	2000	0.046	1400	0.032	600	0.014
144	2400	0.055	1680	0.039	720	0.017
145	2400	0.055	1680	0.039	720	0.017
146	2000	0.046	1400	0.032	600	0.014
147	2000	0.046	1400	0.032	600	0.014
148	2000	0.046	1400	0.032	600	0.014
149	3267	0.075	2286.9	0.053	980.1	0.023
179	2164	0.050	1514.8	0.035	649.2	0.015
180	1939	0.045	1357.3	0.031	581.7	0.013
181	1950	0.045	1365	0.031	585	0.013
182	1950	0.045	1365	0.031	585	0.013
183	2340	0.054	1638	0.038	702	0.016
184	2340	0.054	1638	0.038	702	0.016
185	1950	0.045	1365	0.031	585	0.013
186	1950	0.045	1365	0.031	585	0.013
187	1950	0.045	1365	0.031	585	0.013
188	3103	0.071	2172.1	0.050	930.9	0.021
178	2325	0.053	1627.5	0.037	697.5	0.016
177	1525	0.035	1067.5	0.025	457.5	0.011
176	1525	0.035	1067.5	0.025	457.5	0.011
175	1525	0.035	1067.5	0.025	457.5	0.011
174	1525	0.035	1067.5	0.025	457.5	0.011
173	1830	0.042	1281	0.029	549	0.013
172	1830	0.042	1281	0.029	549	0.013
171	1525	0.035	1067.5	0.025	457.5	0.011
170	1525	0.035	1067.5	0.025	457.5	0.011
169	1525	0.035	1067.5	0.025	457.5	0.011
168	1525	0.035	1067.5	0.025	457.5	0.011
167	2088	0.048	1461.6	0.034	626.4	0.014
166	2375	0.055	1662.5	0.038	712.5	0.016
165	2102	0.048	1471.4	0.034	630.6	0.014
164	2635	0.060	1844.5	0.042	790.5	0.018
163	2754	0.063	1927.8	0.044	826.2	0.019
162	2382	0.055	1667.4	0.038	714.6	0.016
161	3454	0.079	2417.8	0.056	1036.2	0.024
160	3300	0.076	2310	0.053	990	0.023
159	1900	0.044	1330	0.031	570	0.013
158	1900	0.044	1330	0.031	570	0.013
157	1900	0.044	1330	0.031	570	0.013
156	1900	0.044	1330	0.031	570	0.013
155	2280	0.052	1596	0.037	684	0.016
154	2280	0.052	1596	0.037	684	0.016
153	1900	0.044	1330	0.031	570	0.013
152	1900	0.044	1330	0.031	570	0.013

151	1900	0.044	1330	0.031	570	0.013
150	3159	0.073	2211.3	0.051	947.7	0.022

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	21036 Prelim Vault Sizing Vault A
Site Name:	
Site Address:	
City:	
Report Date:	9/14/2022
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.20
Version:	2015/06/05

POC Thresholds

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

Landuse Basin Data
Predeveloped Land Use

Exsisting Basin A

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
C, Forest, Mod	5.274
Pervious Total	5.274
Impervious Land Use	Acres
Impervious Total	0
Basin Total	5.274

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Developed Basin A

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
C, Lawn, Flat	1.53
Pervious Total	1.53
Impervious Land Use	Acres
ROADS FLAT	3.73
Impervious Total	3.73
Basin Total	5.26

Element Flows To:

Surface	Interflow	Groundwater
Vault A	Vault A	

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault A

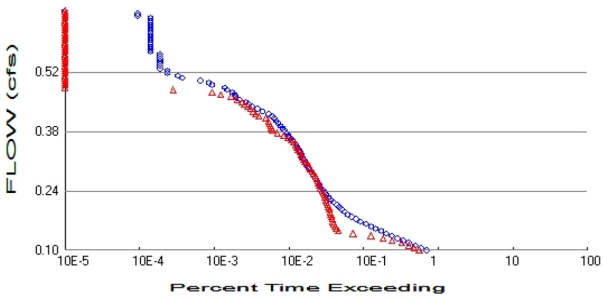
Width: 58 ft.
Length: 121 ft.
Depth: 13.7 ft.
Discharge Structure
Riser Height: 12.7 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 1.2188 in. Elevation:0 ft.
Orifice 2 Diameter: 0.875 in. Elevation:5.7 ft.
Orifice 3 Diameter: 2.2 in. Elevation:7.9 ft.
Element Flows To:
Outlet 1 Outlet 2

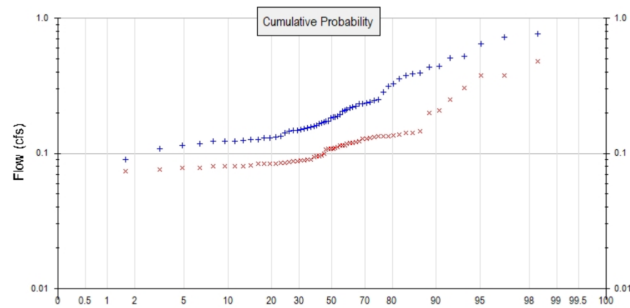
Vault Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.161	0.000	0.000	0.000
0.1522	0.161	0.024	0.015	0.000
0.3044	0.161	0.049	0.022	0.000
0.4567	0.161	0.073	0.027	0.000
0.6089	0.161	0.098	0.031	0.000
0.7611	0.161	0.122	0.035	0.000
0.9133	0.161	0.147	0.038	0.000
1.0656	0.161	0.171	0.041	0.000
1.2178	0.161	0.196	0.044	0.000
1.3700	0.161	0.220	0.047	0.000
1.5222	0.161	0.245	0.049	0.000
1.6744	0.161	0.269	0.052	0.000
1.8267	0.161	0.294	0.054	0.000
1.9789	0.161	0.318	0.056	0.000
2.1311	0.161	0.343	0.058	0.000
2.2833	0.161	0.367	0.060	0.000
2.4356	0.161	0.392	0.062	0.000
2.5878	0.161	0.416	0.064	0.000
2.7400	0.161	0.441	0.066	0.000
2.8922	0.161	0.466	0.068	0.000
3.0444	0.161	0.490	0.070	0.000
3.1967	0.161	0.515	0.072	0.000
3.3489	0.161	0.539	0.073	0.000
3.5011	0.161	0.564	0.075	0.000
3.6533	0.161	0.588	0.077	0.000
3.8056	0.161	0.613	0.078	0.000
3.9578	0.161	0.637	0.080	0.000
4.1100	0.161	0.662	0.081	0.000
4.2622	0.161	0.686	0.083	0.000
4.4144	0.161	0.711	0.084	0.000
4.5667	0.161	0.735	0.086	0.000
4.7189	0.161	0.760	0.087	0.000
4.8711	0.161	0.784	0.089	0.000
5.0233	0.161	0.809	0.090	0.000
5.1756	0.161	0.833	0.091	0.000
5.3278	0.161	0.858	0.093	0.000
5.4800	0.161	0.882	0.094	0.000
5.6322	0.161	0.907	0.095	0.000

5.7844	0.161	0.931	0.103	0.000
5.9367	0.161	0.956	0.108	0.000
6.0889	0.161	0.981	0.112	0.000
6.2411	0.161	1.005	0.116	0.000
6.3933	0.161	1.030	0.119	0.000
6.5456	0.161	1.054	0.122	0.000
6.6978	0.161	1.079	0.125	0.000
6.8500	0.161	1.103	0.127	0.000
7.0022	0.161	1.128	0.130	0.000
7.1544	0.161	1.152	0.132	0.000
7.3067	0.161	1.177	0.135	0.000
7.4589	0.161	1.201	0.137	0.000
7.6111	0.161	1.226	0.139	0.000
7.7633	0.161	1.250	0.142	0.000
7.9156	0.161	1.275	0.160	0.000
8.0678	0.161	1.299	0.200	0.000
8.2200	0.161	1.324	0.222	0.000
8.3722	0.161	1.348	0.240	0.000
8.5244	0.161	1.373	0.256	0.000
8.6767	0.161	1.397	0.270	0.000
8.8289	0.161	1.422	0.283	0.000
8.9811	0.161	1.447	0.295	0.000
9.1333	0.161	1.471	0.306	0.000
9.2856	0.161	1.496	0.316	0.000
9.4378	0.161	1.520	0.326	0.000
9.5900	0.161	1.545	0.336	0.000
9.7422	0.161	1.569	0.345	0.000
9.8944	0.161	1.594	0.354	0.000
10.047	0.161	1.618	0.363	0.000
10.199	0.161	1.643	0.371	0.000
10.351	0.161	1.667	0.380	0.000
10.503	0.161	1.692	0.388	0.000
10.656	0.161	1.716	0.395	0.000
10.808	0.161	1.741	0.403	0.000
10.960	0.161	1.765	0.410	0.000
11.112	0.161	1.790	0.418	0.000
11.264	0.161	1.814	0.425	0.000
11.417	0.161	1.839	0.432	0.000
11.569	0.161	1.863	0.439	0.000
11.721	0.161	1.888	0.445	0.000
11.873	0.161	1.912	0.452	0.000
12.026	0.161	1.937	0.458	0.000
12.178	0.161	1.962	0.465	0.000
12.330	0.161	1.986	0.471	0.000
12.482	0.161	2.011	0.477	0.000
12.634	0.161	2.035	0.483	0.000
12.787	0.161	2.060	0.759	0.000
12.939	0.161	2.084	1.645	0.000
13.091	0.161	2.109	2.430	0.000
13.243	0.161	2.133	2.829	0.000
13.396	0.161	2.158	3.139	0.000
13.548	0.161	2.182	3.418	0.000
13.700	0.161	2.207	3.673	0.000
13.852	0.161	2.117	3.910	0.000

Analysis Results
POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 5.274
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.53
Total Impervious Area: 3.73

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.194959
5 year	0.311769
10 year	0.404718
25 year	0.541003
50 year	0.65693
100 year	0.785819

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.108706
5 year	0.158469
10 year	0.199458
25 year	0.261662
50 year	0.316443
100 year	0.379252

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.217	0.089
1950	0.220	0.109
1951	0.186	0.084
1952	0.152	0.080
1953	0.123	0.080
1954	0.771	0.095
1955	0.234	0.134
1956	0.204	0.146
1957	0.283	0.128
1958	0.246	0.090

1959	0.192	0.099
1960	0.186	0.114
1961	0.387	0.133
1962	0.187	0.084
1963	0.316	0.087
1964	0.249	0.074
1965	0.154	0.111
1966	0.090	0.084
1967	0.183	0.085
1968	0.223	0.120
1969	0.722	0.090
1970	0.127	0.086
1971	0.240	0.207
1972	0.148	0.095
1973	0.146	0.108
1974	0.394	0.096
1975	0.151	0.080
1976	0.158	0.095
1977	0.114	0.088
1978	0.133	0.080
1979	0.442	0.089
1980	0.207	0.079
1981	0.130	0.082
1982	0.169	0.136
1983	0.358	0.085
1984	0.174	0.249
1985	0.232	0.133
1986	0.522	0.379
1987	0.236	0.306
1988	0.122	0.137
1989	0.157	0.078
1990	0.165	0.128
1991	0.170	0.110
1992	0.130	0.118
1993	0.124	0.076
1994	0.118	0.114
1995	0.173	0.141
1996	0.326	0.134
1997	0.647	0.478
1998	0.108	0.083
1999	0.141	0.119
2000	0.123	0.198
2001	0.042	0.067
2002	0.161	0.121
2003	0.126	0.109
2004	0.212	0.142
2005	0.148	0.106
2006	0.509	0.130
2007	0.376	0.123
2008	0.436	0.377
2009	0.133	0.114

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.7713	0.4776
2	0.7217	0.3785
3	0.6469	0.3767

4	0.5217	0.3055
5	0.5089	0.2494
6	0.4417	0.2071
7	0.4364	0.1985
8	0.3944	0.1465
9	0.3868	0.1417
10	0.3759	0.1415
11	0.3581	0.1368
12	0.3260	0.1356
13	0.3156	0.1339
14	0.2830	0.1338
15	0.2488	0.1331
16	0.2462	0.1328
17	0.2400	0.1296
18	0.2359	0.1283
19	0.2336	0.1277
20	0.2322	0.1232
21	0.2230	0.1211
22	0.2203	0.1199
23	0.2169	0.1193
24	0.2119	0.1183
25	0.2069	0.1144
26	0.2042	0.1142
27	0.1923	0.1141
28	0.1872	0.1108
29	0.1864	0.1101
30	0.1863	0.1088
31	0.1829	0.1086
32	0.1740	0.1076
33	0.1729	0.1060
34	0.1700	0.0994
35	0.1688	0.0960
36	0.1651	0.0949
37	0.1608	0.0947
38	0.1585	0.0945
39	0.1570	0.0897
40	0.1538	0.0896
41	0.1516	0.0892
42	0.1508	0.0892
43	0.1482	0.0879
44	0.1475	0.0872
45	0.1460	0.0865
46	0.1410	0.0852
47	0.1333	0.0847
48	0.1329	0.0841
49	0.1301	0.0837
50	0.1296	0.0835
51	0.1273	0.0833
52	0.1260	0.0820
53	0.1240	0.0804
54	0.1230	0.0800
55	0.1226	0.0800
56	0.1222	0.0798
57	0.1180	0.0785
58	0.1143	0.0782
59	0.1080	0.0761
60	0.0903	0.0740
61	0.0425	0.0665

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0975	15009	11890	79	Pass
0.1031	12410	10160	81	Pass
0.1088	10476	8652	82	Pass
0.1144	8650	6919	79	Pass
0.1201	7146	5135	71	Pass
0.1257	6087	3886	63	Pass
0.1314	5061	2697	53	Pass
0.1370	4261	1558	36	Pass
0.1427	3677	980	26	Pass
0.1483	3093	921	29	Pass
0.1540	2695	887	32	Pass
0.1596	2291	851	37	Pass
0.1653	1933	827	42	Pass
0.1709	1681	815	48	Pass
0.1766	1483	795	53	Pass
0.1822	1309	776	59	Pass
0.1879	1193	761	63	Pass
0.1935	1083	745	68	Pass
0.1992	1002	724	72	Pass
0.2048	937	706	75	Pass
0.2105	846	684	80	Pass
0.2162	782	668	85	Pass
0.2218	725	656	90	Pass
0.2275	675	639	94	Pass
0.2331	635	617	97	Pass
0.2388	614	595	96	Pass
0.2444	584	571	97	Pass
0.2501	551	549	99	Pass
0.2557	522	534	102	Pass
0.2614	499	521	104	Pass
0.2670	480	503	104	Pass
0.2727	457	482	105	Pass
0.2783	437	450	102	Pass
0.2840	420	435	103	Pass
0.2896	397	419	105	Pass
0.2953	382	400	104	Pass
0.3009	364	376	103	Pass
0.3066	349	348	99	Pass
0.3122	336	334	99	Pass
0.3179	325	326	100	Pass
0.3235	315	313	99	Pass
0.3292	299	299	100	Pass
0.3348	288	285	98	Pass
0.3405	277	271	97	Pass
0.3461	265	259	97	Pass
0.3518	246	248	100	Pass
0.3574	236	229	97	Pass
0.3631	222	206	92	Pass
0.3687	210	180	85	Pass
0.3744	198	149	75	Pass
0.3800	187	128	68	Pass
0.3857	175	125	71	Pass
0.3913	164	121	73	Pass

0.3970	154	117	75	Pass
0.4026	146	114	78	Pass
0.4083	135	105	77	Pass
0.4139	126	84	66	Pass
0.4196	113	76	67	Pass
0.4252	94	71	75	Pass
0.4309	81	65	80	Pass
0.4365	68	60	88	Pass
0.4422	61	54	88	Pass
0.4478	56	50	89	Pass
0.4535	46	43	93	Pass
0.4591	41	36	87	Pass
0.4648	40	26	65	Pass
0.4704	37	20	54	Pass
0.4761	32	6	18	Pass
0.4817	30	0	0	Pass
0.4874	20	0	0	Pass
0.4931	18	0	0	Pass
0.4987	14	0	0	Pass
0.5044	8	0	0	Pass
0.5100	7	0	0	Pass
0.5157	5	0	0	Pass
0.5213	5	0	0	Pass
0.5270	4	0	0	Pass
0.5326	4	0	0	Pass
0.5383	4	0	0	Pass
0.5439	4	0	0	Pass
0.5496	4	0	0	Pass
0.5552	4	0	0	Pass
0.5609	4	0	0	Pass
0.5665	3	0	0	Pass
0.5722	3	0	0	Pass
0.5778	3	0	0	Pass
0.5835	3	0	0	Pass
0.5891	3	0	0	Pass
0.5948	3	0	0	Pass
0.6004	3	0	0	Pass
0.6061	3	0	0	Pass
0.6117	3	0	0	Pass
0.6174	3	0	0	Pass
0.6230	3	0	0	Pass
0.6287	3	0	0	Pass
0.6343	3	0	0	Pass
0.6400	3	0	0	Pass
0.6456	3	0	0	Pass
0.6513	2	0	0	Pass
0.6569	2	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.1637 acre-feet
On-line facility target flow:	0.0827 cfs.
Adjusted for 15 min:	0.0827 cfs.
Off-line facility target flow:	0.0547 cfs.
Adjusted for 15 min:	0.0547 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
Vault A POC	☐	807.87			☐	0.00			
Total Volume Infiltrated		807.87	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

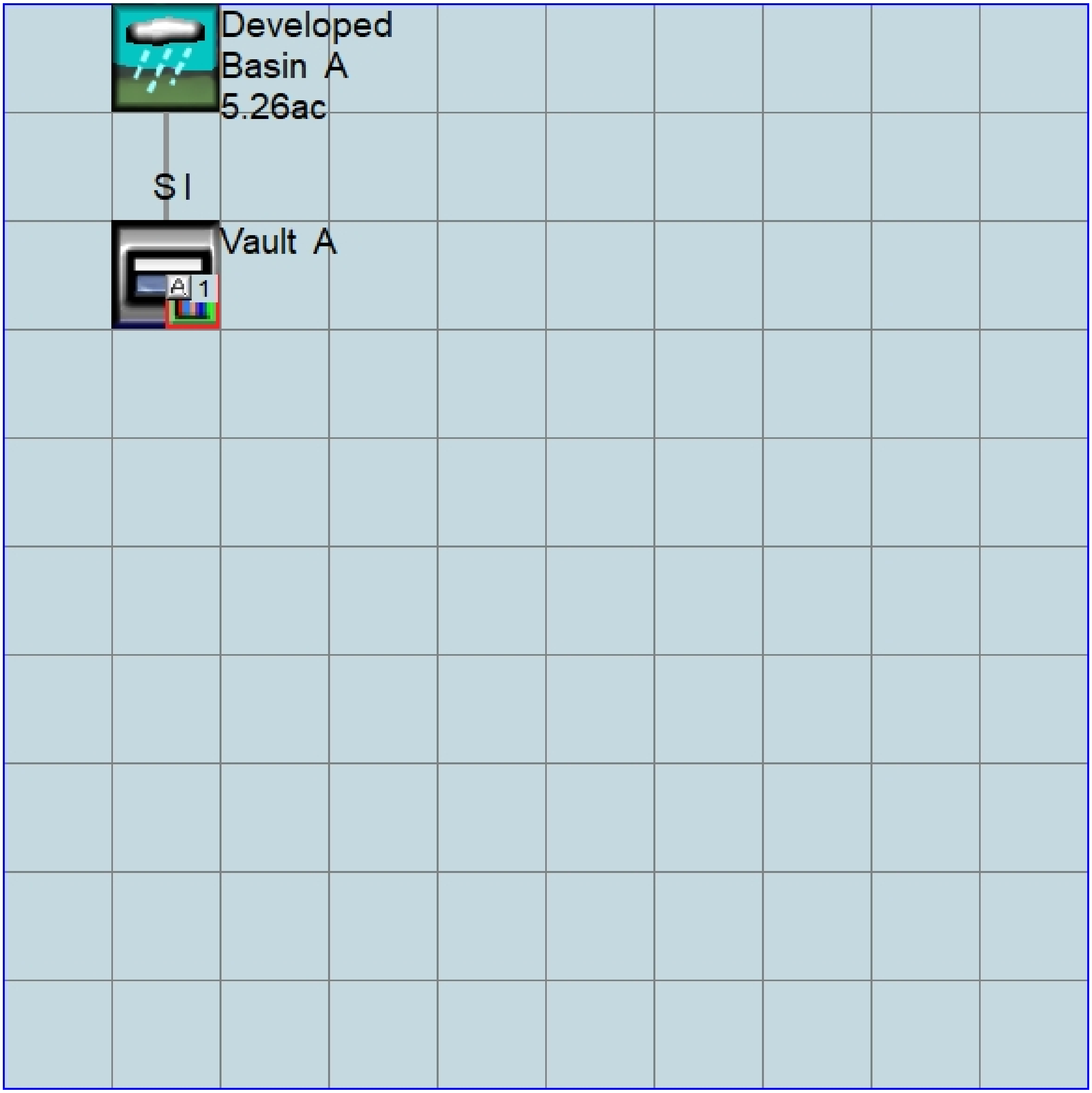
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   21036 Prelim Vault Sizing Vault A.wdm
MESSU      25   Pre21036 Prelim Vault Sizing Vault A.MES
           27   Pre21036 Prelim Vault Sizing Vault A.L61
           28   Pre21036 Prelim Vault Sizing Vault A.L62
           30   POC21036 Prelim Vault Sizing Vault A1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Exsisting Basin A           MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                             in  out          ***
   11     C, Forest, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   11         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   11             0       4.5      0.08       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11           0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

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

END PERLND

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

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Exsisting Basin A***
PERLND  11                       5.274     COPY   501     12
PERLND  11                       5.274     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

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

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   21036 Prelim Vault Sizing Vault A.wdm
MESSU      25   Mit21036 Prelim Vault Sizing Vault A.MES
           27   Mit21036 Prelim Vault Sizing Vault A.L61
           28   Mit21036 Prelim Vault Sizing Vault A.L62
           30   POC21036 Prelim Vault Sizing Vault A1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  A                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   16      C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

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

```
  16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
```

```
    # -  # ***PETMAX    PETMIN
    1            0         0
  END IWAT-PARM3

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Developed Basin  A***
PERLND  16                        1.53     RCHRES   1      2
PERLND  16                        1.53     RCHRES   1      3
IMPLND   1                        3.73     RCHRES   1      5

******Routing******
PERLND  16                        1.53     COPY     1     12
IMPLND   1                        3.73     COPY     1     15
PERLND  16                        1.53     COPY     1     13
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

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



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

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

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

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

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

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
```

```
    1              1      0.02       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                           ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE     1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.161111  0.000000  0.000000
  0.152222  0.161111  0.024525  0.015728
  0.304444  0.161111  0.049049  0.022242
  0.456667  0.161111  0.073574  0.027241
  0.608889  0.161111  0.098099  0.031455
  0.761111  0.161111  0.122623  0.035168
  0.913333  0.161111  0.147148  0.038525
  1.065556  0.161111  0.171673  0.041611
  1.217778  0.161111  0.196198  0.044484
  1.370000  0.161111  0.220722  0.047183
  1.522222  0.161111  0.245247  0.049735
  1.674444  0.161111  0.269772  0.052163
  1.826667  0.161111  0.294296  0.054482
  1.978889  0.161111  0.318821  0.056707
  2.131111  0.161111  0.343346  0.058847
  2.283333  0.161111  0.367870  0.060913
  2.435556  0.161111  0.392395  0.062910
  2.587778  0.161111  0.416920  0.064847
  2.740000  0.161111  0.441444  0.066727
  2.892222  0.161111  0.465969  0.068555
  3.044444  0.161111  0.490494  0.070336
  3.196667  0.161111  0.515019  0.072073
  3.348889  0.161111  0.539543  0.073769
  3.501111  0.161111  0.564068  0.075427
  3.653333  0.161111  0.588593  0.077049
  3.805556  0.161111  0.613117  0.078638
  3.957778  0.161111  0.637642  0.080195
  4.110000  0.161111  0.662167  0.081723
  4.262222  0.161111  0.686691  0.083223
  4.414444  0.161111  0.711216  0.084696
  4.566667  0.161111  0.735741  0.086144
  4.718889  0.161111  0.760265  0.087568
  4.871111  0.161111  0.784790  0.088969
  5.023333  0.161111  0.809315  0.090348
  5.175556  0.161111  0.833840  0.091707
  5.327778  0.161111  0.858364  0.093046
  5.480000  0.161111  0.882889  0.094366
  5.632222  0.161111  0.907414  0.095667
  5.784444  0.161111  0.931938  0.102989
  5.936667  0.161111  0.956463  0.108326
  6.088889  0.161111  0.980988  0.112427
  6.241111  0.161111  1.005512  0.115989
  6.393333  0.161111  1.030037  0.119227
  6.545556  0.161111  1.054562  0.122238
  6.697778  0.161111  1.079086  0.125079
  6.850000  0.161111  1.103611  0.127784
  7.002222  0.161111  1.128136  0.130379
  7.154444  0.161111  1.152660  0.132880
  7.306667  0.161111  1.177185  0.135299
  7.458889  0.161111  1.201710  0.137648
  7.611111  0.161111  1.226235  0.139933
  7.763333  0.161111  1.250759  0.142162
```

```
  7.915556  0.161111  1.275284  0.160720
  8.067778  0.161111  1.299809  0.200268
  8.220000  0.161111  1.324333  0.222854
  8.372222  0.161111  1.348858  0.240859
  8.524444  0.161111  1.373383  0.256401
  8.676667  0.161111  1.397907  0.270337
  8.828889  0.161111  1.422432  0.283115
  8.981111  0.161111  1.446957  0.295005
  9.133333  0.161111  1.471481  0.306186
  9.285556  0.161111  1.496006  0.316781
  9.437778  0.161111  1.520531  0.326881
  9.590000  0.161111  1.545056  0.336557
  9.742222  0.161111  1.569580  0.345862
  9.894444  0.161111  1.594105  0.354839
  10.04667  0.161111  1.618630  0.363524
  10.19889  0.161111  1.643154  0.371947
  10.35111  0.161111  1.667679  0.380131
  10.50333  0.161111  1.692204  0.388097
  10.65556  0.161111  1.716728  0.395864
  10.80778  0.161111  1.741253  0.403446
  10.96000  0.161111  1.765778  0.410859
  11.11222  0.161111  1.790302  0.418112
  11.26444  0.161111  1.814827  0.425217
  11.41667  0.161111  1.839352  0.432184
  11.56889  0.161111  1.863877  0.439020
  11.72111  0.161111  1.888401  0.445734
  11.87333  0.161111  1.912926  0.452332
  12.02556  0.161111  1.937451  0.458820
  12.17778  0.161111  1.961975  0.465204
  12.33000  0.161111  1.986500  0.471489
  12.48222  0.161111  2.011025  0.477680
  12.63444  0.161111  2.035549  0.483782
  12.78667  0.161111  2.060074  0.759394
  12.93889  0.161111  2.084599  1.645105
  13.09111  0.161111  2.109123  2.430709
  13.24333  0.161111  2.133648  2.828995
  13.39556  0.161111  2.158173  3.139865
  13.54778  0.161111  2.182698  3.418730
  13.70000  0.161111  2.207222  3.673914
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

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

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
```

```
  END MASS-LINK     3

  MASS-LINK         5
IMPLND     IWATER SURO       0.083333      RCHRES          INFLOW IVOL
  END MASS-LINK     5

  MASS-LINK        12
PERLND     PWATER SURO       0.083333      COPY            INPUT  MEAN
  END MASS-LINK    12

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

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

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

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	21036 Prelim Vault Sizing Vault B
Site Name:	
Site Address:	
City:	
Report Date:	9/14/2022
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.20
Version:	2015/06/05

POC Thresholds

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

Landuse Basin Data
Predeveloped Land Use

Pre-Target

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
C, Forest, Mod	13.48
Pervious Total	13.48
Impervious Land Use	Acres
Impervious Total	0
Basin Total	13.48

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Post-Target

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
C, Lawn, Flat	4.27
Pervious Total	4.27
Impervious Land Use	Acres
ROOF TOPS FLAT	9.21
Impervious Total	9.21
Basin Total	13.48

Element Flows To:

Surface	Interflow	Groundwater
Vault B	Vault B	

Overflow

Bypass:	Yes
GroundWater:	No
Pervious Land Use	Acres
C, Forest, Steep	0.036
Pervious Total	0.036
Impervious Land Use	Acres
ROADS MOD	0.15
Impervious Total	0.15
Basin Total	0.186

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault B

Width:	100 ft.	
Length:	197 ft.	
Depth:	12.7 ft.	
Discharge Structure		
Riser Height:	11.7 ft.	
Riser Diameter:	18 in.	
Orifice 1 Diameter:	2.0313 in	Elevation:0 ft.
Orifice 2 Diameter:	1.875 in.	Elevation:5.3 ft.
Orifice 3 Diameter:	3.125 in.	Elevation:7.5 ft.

Element Flows To:

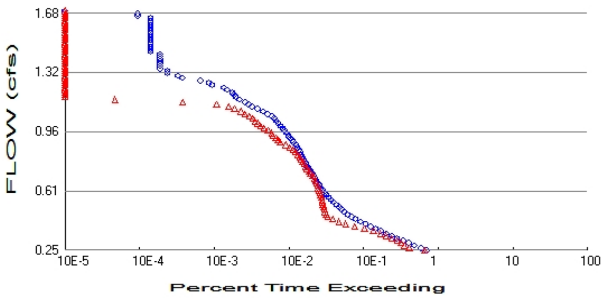
Outlet 1 Outlet 2

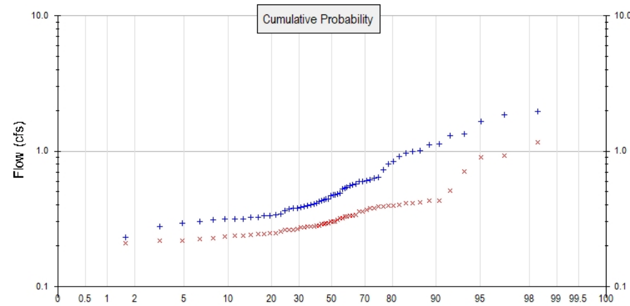
Vault Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.452	0.000	0.000	0.000
0.1411	0.452	0.063	0.042	0.000
0.2822	0.452	0.127	0.059	0.000
0.4233	0.452	0.191	0.072	0.000
0.5644	0.452	0.255	0.084	0.000
0.7056	0.452	0.319	0.094	0.000
0.8467	0.452	0.382	0.103	0.000
0.9878	0.452	0.446	0.111	0.000
1.1289	0.452	0.510	0.119	0.000
1.2700	0.452	0.574	0.126	0.000
1.4111	0.452	0.638	0.133	0.000
1.5522	0.452	0.702	0.139	0.000
1.6933	0.452	0.765	0.145	0.000
1.8344	0.452	0.829	0.151	0.000
1.9756	0.452	0.893	0.157	0.000
2.1167	0.452	0.957	0.162	0.000
2.2578	0.452	1.021	0.168	0.000
2.3989	0.452	1.084	0.173	0.000
2.5400	0.452	1.148	0.178	0.000
2.6811	0.452	1.212	0.183	0.000
2.8222	0.452	1.276	0.188	0.000
2.9633	0.452	1.340	0.192	0.000
3.1044	0.452	1.404	0.197	0.000
3.2456	0.452	1.467	0.201	0.000
3.3867	0.452	1.531	0.206	0.000
3.5278	0.452	1.595	0.210	0.000
3.6689	0.452	1.659	0.214	0.000
3.8100	0.452	1.723	0.218	0.000
3.9511	0.452	1.786	0.222	0.000
4.0922	0.452	1.850	0.226	0.000
4.2333	0.452	1.914	0.230	0.000
4.3744	0.452	1.978	0.234	0.000
4.5156	0.452	2.042	0.237	0.000
4.6567	0.452	2.106	0.241	0.000
4.7978	0.452	2.169	0.245	0.000
4.9389	0.452	2.233	0.248	0.000
5.0800	0.452	2.297	0.252	0.000
5.2211	0.452	2.361	0.255	0.000

5.3622	0.452	2.425	0.283	0.000
5.5033	0.452	2.488	0.305	0.000
5.6444	0.452	2.552	0.322	0.000
5.7856	0.452	2.616	0.335	0.000
5.9267	0.452	2.680	0.348	0.000
6.0678	0.452	2.744	0.359	0.000
6.2089	0.452	2.808	0.370	0.000
6.3500	0.452	2.871	0.379	0.000
6.4911	0.452	2.935	0.389	0.000
6.6322	0.452	2.999	0.398	0.000
6.7733	0.452	3.063	0.407	0.000
6.9144	0.452	3.127	0.415	0.000
7.0556	0.452	3.190	0.423	0.000
7.1967	0.452	3.254	0.431	0.000
7.3378	0.452	3.318	0.439	0.000
7.4789	0.452	3.382	0.447	0.000
7.6200	0.452	3.446	0.546	0.000
7.7611	0.452	3.510	0.597	0.000
7.9022	0.452	3.573	0.636	0.000
8.0433	0.452	3.637	0.670	0.000
8.1844	0.452	3.701	0.701	0.000
8.3256	0.452	3.765	0.729	0.000
8.4667	0.452	3.829	0.756	0.000
8.6078	0.452	3.892	0.780	0.000
8.7489	0.452	3.956	0.804	0.000
8.8900	0.452	4.020	0.827	0.000
9.0311	0.452	4.084	0.848	0.000
9.1722	0.452	4.148	0.869	0.000
9.3133	0.452	4.212	0.889	0.000
9.4544	0.452	4.275	0.909	0.000
9.5956	0.452	4.339	0.928	0.000
9.7367	0.452	4.403	0.946	0.000
9.8778	0.452	4.467	0.964	0.000
10.019	0.452	4.531	0.982	0.000
10.160	0.452	4.594	0.999	0.000
10.301	0.452	4.658	1.016	0.000
10.442	0.452	4.722	1.032	0.000
10.583	0.452	4.786	1.048	0.000
10.724	0.452	4.850	1.064	0.000
10.866	0.452	4.913	1.080	0.000
11.007	0.452	4.977	1.095	0.000
11.148	0.452	5.041	1.110	0.000
11.289	0.452	5.105	1.125	0.000
11.430	0.452	5.169	1.140	0.000
11.571	0.452	5.233	1.154	0.000
11.712	0.452	5.296	1.190	0.000
11.853	0.452	5.360	2.132	0.000
11.994	0.452	5.424	3.634	0.000
12.136	0.452	5.488	5.222	0.000
12.277	0.452	5.552	6.472	0.000
12.418	0.452	5.615	7.195	0.000
12.559	0.452	5.679	7.817	0.000
12.700	0.452	5.743	8.349	0.000
12.841	0.461	5.597	8.845	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 13.48
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 4.306
Total Impervious Area: 9.36

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.498302
5 year	0.796862
10 year	1.034434
25 year	1.38277
50 year	1.679072
100 year	2.008505

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.308838
5 year	0.425531
10 year	0.517477
25 year	0.651843
50 year	0.766206
100 year	0.893746

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.554	0.244
1950	0.563	0.275
1951	0.477	0.232
1952	0.388	0.254
1953	0.314	0.218
1954	1.971	0.295
1955	0.597	0.394
1956	0.522	0.413
1957	0.723	0.360
1958	0.629	0.332

1959	0.491	0.279
1960	0.476	0.309
1961	0.989	0.389
1962	0.478	0.248
1963	0.807	0.273
1964	0.636	0.216
1965	0.393	0.288
1966	0.231	0.236
1967	0.467	0.303
1968	0.570	0.333
1969	1.845	0.360
1970	0.325	0.240
1971	0.614	0.432
1972	0.379	0.319
1973	0.373	0.279
1974	1.008	0.292
1975	0.385	0.245
1976	0.405	0.272
1977	0.292	0.263
1978	0.341	0.249
1979	1.129	0.302
1980	0.529	0.263
1981	0.333	0.222
1982	0.431	0.400
1983	0.915	0.262
1984	0.445	0.512
1985	0.594	0.377
1986	1.333	0.922
1987	0.603	0.708
1988	0.312	0.394
1989	0.401	0.238
1990	0.422	0.367
1991	0.435	0.280
1992	0.331	0.329
1993	0.317	0.209
1994	0.302	0.302
1995	0.442	0.411
1996	0.833	0.390
1997	1.653	1.159
1998	0.276	0.228
1999	0.360	0.321
2000	0.313	0.433
2001	0.109	0.193
2002	0.411	0.329
2003	0.322	0.266
2004	0.542	0.420
2005	0.377	0.277
2006	1.301	0.377
2007	0.961	0.339
2008	1.115	0.896
2009	0.340	0.290

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.9713	1.1591
2	1.8446	0.9222
3	1.6534	0.8958

4	1.3333	0.7085
5	1.3007	0.5123
6	1.1289	0.4328
7	1.1154	0.4325
8	1.0081	0.4200
9	0.9886	0.4134
10	0.9608	0.4110
11	0.9153	0.4002
12	0.8334	0.3945
13	0.8067	0.3944
14	0.7235	0.3897
15	0.6359	0.3893
16	0.6293	0.3770
17	0.6135	0.3766
18	0.6030	0.3675
19	0.5971	0.3597
20	0.5936	0.3595
21	0.5700	0.3387
22	0.5630	0.3334
23	0.5544	0.3319
24	0.5415	0.3288
25	0.5287	0.3286
26	0.5220	0.3210
27	0.4914	0.3191
28	0.4784	0.3092
29	0.4765	0.3025
30	0.4762	0.3024
31	0.4674	0.3021
32	0.4447	0.2948
33	0.4420	0.2915
34	0.4346	0.2903
35	0.4314	0.2877
36	0.4221	0.2800
37	0.4110	0.2791
38	0.4050	0.2786
39	0.4013	0.2768
40	0.3931	0.2754
41	0.3876	0.2732
42	0.3854	0.2717
43	0.3787	0.2663
44	0.3770	0.2631
45	0.3730	0.2627
46	0.3605	0.2621
47	0.3406	0.2543
48	0.3397	0.2490
49	0.3326	0.2482
50	0.3313	0.2447
51	0.3254	0.2439
52	0.3220	0.2403
53	0.3170	0.2378
54	0.3144	0.2358
55	0.3135	0.2321
56	0.3122	0.2278
57	0.3016	0.2225
58	0.2921	0.2178
59	0.2761	0.2162
60	0.2307	0.2093
61	0.1086	0.1934

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2492	14786	13995	94	Pass
0.2636	12446	8677	69	Pass
0.2780	10220	7507	73	Pass
0.2925	8596	6774	78	Pass
0.3069	7208	6049	83	Pass
0.3214	5972	5099	85	Pass
0.3358	5050	4286	84	Pass
0.3503	4265	3602	84	Pass
0.3647	3621	2896	79	Pass
0.3791	3076	2199	71	Pass
0.3936	2648	1631	61	Pass
0.4080	2254	1231	54	Pass
0.4225	1927	1005	52	Pass
0.4369	1660	826	49	Pass
0.4514	1471	709	48	Pass
0.4658	1311	678	51	Pass
0.4802	1180	656	55	Pass
0.4947	1079	639	59	Pass
0.5091	1001	623	62	Pass
0.5236	921	611	66	Pass
0.5380	837	601	71	Pass
0.5525	782	594	75	Pass
0.5669	721	583	80	Pass
0.5814	673	571	84	Pass
0.5958	635	559	88	Pass
0.6102	610	545	89	Pass
0.6247	583	532	91	Pass
0.6391	551	518	94	Pass
0.6536	519	503	96	Pass
0.6680	498	486	97	Pass
0.6825	480	469	97	Pass
0.6969	456	446	97	Pass
0.7113	436	418	95	Pass
0.7258	416	400	96	Pass
0.7402	396	370	93	Pass
0.7547	382	357	93	Pass
0.7691	363	343	94	Pass
0.7836	348	329	94	Pass
0.7980	336	309	91	Pass
0.8125	323	297	91	Pass
0.8269	314	279	88	Pass
0.8413	299	260	86	Pass
0.8558	288	244	84	Pass
0.8702	276	220	79	Pass
0.8847	265	195	73	Pass
0.8991	245	163	66	Pass
0.9136	236	153	64	Pass
0.9280	221	143	64	Pass
0.9424	210	130	61	Pass
0.9569	198	126	63	Pass
0.9713	187	112	59	Pass
0.9858	175	99	56	Pass
1.0002	164	89	54	Pass

1.0147	153	82	53	Pass
1.0291	146	75	51	Pass
1.0436	135	70	51	Pass
1.0580	126	63	50	Pass
1.0724	111	55	49	Pass
1.0869	95	49	51	Pass
1.1013	80	40	50	Pass
1.1158	68	33	48	Pass
1.1302	61	23	37	Pass
1.1447	55	8	14	Pass
1.1591	46	1	2	Pass
1.1735	41	0	0	Pass
1.1880	39	0	0	Pass
1.2024	37	0	0	Pass
1.2169	32	0	0	Pass
1.2313	29	0	0	Pass
1.2458	20	0	0	Pass
1.2602	18	0	0	Pass
1.2746	14	0	0	Pass
1.2891	8	0	0	Pass
1.3035	7	0	0	Pass
1.3180	5	0	0	Pass
1.3324	5	0	0	Pass
1.3469	4	0	0	Pass
1.3613	4	0	0	Pass
1.3758	4	0	0	Pass
1.3902	4	0	0	Pass
1.4046	4	0	0	Pass
1.4191	4	0	0	Pass
1.4335	4	0	0	Pass
1.4480	3	0	0	Pass
1.4624	3	0	0	Pass
1.4769	3	0	0	Pass
1.4913	3	0	0	Pass
1.5057	3	0	0	Pass
1.5202	3	0	0	Pass
1.5346	3	0	0	Pass
1.5491	3	0	0	Pass
1.5635	3	0	0	Pass
1.5780	3	0	0	Pass
1.5924	3	0	0	Pass
1.6069	3	0	0	Pass
1.6213	3	0	0	Pass
1.6357	3	0	0	Pass
1.6502	3	0	0	Pass
1.6646	2	0	0	Pass
1.6791	2	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.4251 acre-feet
On-line facility target flow:	0.2159 cfs.
Adjusted for 15 min:	0.2159 cfs.
Off-line facility target flow:	0.1421 cfs.
Adjusted for 15 min:	0.1421 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
Vault B POC	☐	2042.93			☐	0.00			
Total Volume Infiltrated		2042.93	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   21036 Prelim Vault Sizing Vault B.wdm
MESSU      25   Pre21036 Prelim Vault Sizing Vault B.MES
           27   Pre21036 Prelim Vault Sizing Vault B.L61
           28   Pre21036 Prelim Vault Sizing Vault B.L62
           30   POC21036 Prelim Vault Sizing Vault B1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Pre-Target                  MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                            in  out           ***
   11     C, Forest, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   11         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   11             0       4.5      0.08       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11           0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

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

END PERLND

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

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Pre-Target***
PERLND  11                       13.48     COPY   501     12
PERLND  11                       13.48     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
```

```
WDM       1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM       1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

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

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   21036 Prelim Vault Sizing Vault B.wdm
MESSU      25   Mit21036 Prelim Vault Sizing Vault B.MES
           27   Mit21036 Prelim Vault Sizing Vault B.L61
           28   Mit21036 Prelim Vault Sizing Vault B.L62
           30   POC21036 Prelim Vault Sizing Vault B1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       4
      PERLND      12
      IMPLND       2
      RCHRES       1
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  B                    MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   16      C, Lawn, Flat           1    1    1    1   27    0
   12      C, Forest, Steep        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  12         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   12         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
   12         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16              0       4.5      0.03       400      0.05       0.5     0.996
   12              0       4.5      0.08       400      0.15       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
   12              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
   12            0.2       0.3      0.35         6       0.3       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16              0         0         0         0       2.5         1         0
   12              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    2         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    2            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4             0         0
    2             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4             0         0
    2             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Post-Target***
PERLND  16                        4.27     RCHRES   1      2
PERLND  16                        4.27     RCHRES   1      3
IMPLND   4                        9.21     RCHRES   1      5
Overflow***
PERLND  12                       0.036     COPY   501     12
PERLND  12                       0.036     COPY   601     12
PERLND  12                       0.036     COPY   501     13
PERLND  12                       0.036     COPY   601     13
IMPLND   2                        0.15     COPY   501     15
IMPLND   2                        0.15     COPY   601     15

******Routing******
PERLND  16                        4.27     COPY     1     12
IMPLND   4                        9.21     COPY     1     15
PERLND  16                        4.27     COPY     1     13
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

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



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

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

```
  END GEN-INFO
  *** Section RCHRES***

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

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

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

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.04       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                           ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.452250  0.000000  0.000000
  0.141111  0.452250  0.063817  0.042062
  0.282222  0.452250  0.127635  0.059484
  0.423333  0.452250  0.191452  0.072853
  0.564444  0.452250  0.255270  0.084124
  0.705556  0.452250  0.319087  0.094053
  0.846667  0.452250  0.382905  0.103030
  0.987778  0.452250  0.446722  0.111285
  1.128889  0.452250  0.510540  0.118969
  1.270000  0.452250  0.574357  0.126185
  1.411111  0.452250  0.638175  0.133011
  1.552222  0.452250  0.701992  0.139503
  1.693333  0.452250  0.765810  0.145706
  1.834444  0.452250  0.829627  0.151656
  1.975556  0.452250  0.893445  0.157381
  2.116667  0.452250  0.957262  0.162905
  2.257778  0.452250  1.021079  0.168247
  2.398889  0.452250  1.084897  0.173425
  2.540000  0.452250  1.148714  0.178453
  2.681111  0.452250  1.212532  0.183343
  2.822222  0.452250  1.276349  0.188106
  2.963333  0.452250  1.340167  0.192751
  3.104444  0.452250  1.403984  0.197287
  3.245556  0.452250  1.467802  0.201721
  3.386667  0.452250  1.531619  0.206060
  3.527778  0.452250  1.595437  0.210309
```

```
  3.668889  0.452250  1.659254  0.214474
  3.810000  0.452250  1.723072  0.218559
  3.951111  0.452250  1.786889  0.222570
  4.092222  0.452250  1.850707  0.226510
  4.233333  0.452250  1.914524  0.230382
  4.374444  0.452250  1.978341  0.234190
  4.515556  0.452250  2.042159  0.237937
  4.656667  0.452250  2.105976  0.241626
  4.797778  0.452250  2.169794  0.245260
  4.938889  0.452250  2.233611  0.248841
  5.080000  0.452250  2.297429  0.252371
  5.221111  0.452250  2.361246  0.255852
  5.362222  0.452250  2.425064  0.283084
  5.503333  0.452250  2.488881  0.305695
  5.644444  0.452250  2.552699  0.322013
  5.785556  0.452250  2.616516  0.335805
  5.926667  0.452250  2.680334  0.348114
  6.067778  0.452250  2.744151  0.359412
  6.208889  0.452250  2.807969  0.369959
  6.350000  0.452250  2.871786  0.379918
  6.491111  0.452250  2.935604  0.389398
  6.632222  0.452250  2.999421  0.398477
  6.773333  0.452250  3.063238  0.407213
  6.914444  0.452250  3.127056  0.415652
  7.055556  0.452250  3.190873  0.423828
  7.196667  0.452250  3.254691  0.431769
  7.337778  0.452250  3.318508  0.439500
  7.478889  0.452250  3.382326  0.447039
  7.620000  0.452250  3.446143  0.546204
  7.761111  0.452250  3.509961  0.597022
  7.902222  0.452250  3.573778  0.636730
  8.043333  0.452250  3.637596  0.670915
  8.184444  0.452250  3.701413  0.701606
  8.325556  0.452250  3.765231  0.729814
  8.466667  0.452250  3.829048  0.756133
  8.607778  0.452250  3.892866  0.780948
  8.748889  0.452250  3.956683  0.804525
  8.890000  0.452250  4.020500  0.827057
  9.031111  0.452250  4.084318  0.848691
  9.172222  0.452250  4.148135  0.869540
  9.313333  0.452250  4.211953  0.889695
  9.454444  0.452250  4.275770  0.909230
  9.595556  0.452250  4.339588  0.928206
  9.736667  0.452250  4.403405  0.946674
  9.877778  0.452250  4.467223  0.964679
  10.01889  0.452250  4.531040  0.982257
  10.16000  0.452250  4.594858  0.999440
  10.30111  0.452250  4.658675  1.016258
  10.44222  0.452250  4.722493  1.032734
  10.58333  0.452250  4.786310  1.048892
  10.72444  0.452250  4.850128  1.064751
  10.86556  0.452250  4.913945  1.080328
  11.00667  0.452250  4.977762  1.095640
  11.14778  0.452250  5.041580  1.110701
  11.28889  0.452250  5.105397  1.125523
  11.43000  0.452250  5.169215  1.140120
  11.57111  0.452250  5.233032  1.154501
  11.71222  0.452250  5.296850  1.190196
  11.85333  0.452250  5.360667  2.132189
  11.99444  0.452250  5.424485  3.634377
  12.13556  0.452250  5.488302  5.222032
  12.27667  0.452250  5.552120  6.472300
  12.41778  0.452250  5.615937  7.195560
  12.55889  0.452250  5.679755  7.817561
  12.70000  0.452250  5.743572  8.349535
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
```

```
<Name>   # <Name> # tem strg<-factor->strg <Name>   #  #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	21036 Prelim Vault Sizing (Vaults A+B combo)
Site Name:	87th JV marysville
Site Address:	4112 87th Ave NE
City:	Woodinville
Report Date:	9/14/2022
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.20
Version:	2015/06/05

POC Thresholds

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

Landuse Basin Data
Predeveloped Land Use

Pre Target

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
C, Forest, Mod	18.93
Pervious Total	18.93
Impervious Land Use	Acres
Impervious Total	0
Basin Total	18.93

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Vault A Post-Target Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
C, Lawn, Flat	1.53
Pervious Total	1.53
Impervious Land Use	Acres
ROADS FLAT	3.73
Impervious Total	3.73
Basin Total	5.26

Element Flows To:

Surface	Interflow	Groundwater
Vault A	Vault A	

Vault B post-target Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
C, Lawn, Flat	4.27
Pervious Total	4.27
Impervious Land Use	Acres
ROOF TOPS FLAT	9.21
Impervious Total	9.21
Basin Total	13.48

Element Flows To:

Surface	Interflow	Groundwater
Vault B	Vault B	

Overflow

Bypass:	Yes
GroundWater:	No
Pervious Land Use	Acres
C, Forest, Steep	0.036
Pervious Total	0.036
Impervious Land Use	Acres
ROADS MOD	0.15
Impervious Total	0.15
Basin Total	0.186

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault A

Width: 58 ft.
Length: 121 ft.
Depth: 13.7 ft.
Discharge Structure
Riser Height: 12.7 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 1.2188 in. Elevation:0 ft.
Orifice 2 Diameter: 0.875 in. Elevation:5.7 ft.
Orifice 3 Diameter: 2.2 in. Elevation:7.9 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.161	0.000	0.000	0.000
0.1522	0.161	0.024	0.015	0.000
0.3044	0.161	0.049	0.022	0.000
0.4567	0.161	0.073	0.027	0.000
0.6089	0.161	0.098	0.031	0.000
0.7611	0.161	0.122	0.035	0.000
0.9133	0.161	0.147	0.038	0.000
1.0656	0.161	0.171	0.041	0.000
1.2178	0.161	0.196	0.044	0.000
1.3700	0.161	0.220	0.047	0.000
1.5222	0.161	0.245	0.049	0.000
1.6744	0.161	0.269	0.052	0.000
1.8267	0.161	0.294	0.054	0.000
1.9789	0.161	0.318	0.056	0.000
2.1311	0.161	0.343	0.058	0.000
2.2833	0.161	0.367	0.060	0.000
2.4356	0.161	0.392	0.062	0.000
2.5878	0.161	0.416	0.064	0.000
2.7400	0.161	0.441	0.066	0.000
2.8922	0.161	0.466	0.068	0.000
3.0444	0.161	0.490	0.070	0.000
3.1967	0.161	0.515	0.072	0.000
3.3489	0.161	0.539	0.073	0.000
3.5011	0.161	0.564	0.075	0.000
3.6533	0.161	0.588	0.077	0.000
3.8056	0.161	0.613	0.078	0.000
3.9578	0.161	0.637	0.080	0.000
4.1100	0.161	0.662	0.081	0.000
4.2622	0.161	0.686	0.083	0.000
4.4144	0.161	0.711	0.084	0.000
4.5667	0.161	0.735	0.086	0.000
4.7189	0.161	0.760	0.087	0.000
4.8711	0.161	0.784	0.089	0.000
5.0233	0.161	0.809	0.090	0.000
5.1756	0.161	0.833	0.091	0.000
5.3278	0.161	0.858	0.093	0.000
5.4800	0.161	0.882	0.094	0.000
5.6322	0.161	0.907	0.095	0.000

5.7844	0.161	0.931	0.103	0.000
5.9367	0.161	0.956	0.108	0.000
6.0889	0.161	0.981	0.112	0.000
6.2411	0.161	1.005	0.116	0.000
6.3933	0.161	1.030	0.119	0.000
6.5456	0.161	1.054	0.122	0.000
6.6978	0.161	1.079	0.125	0.000
6.8500	0.161	1.103	0.127	0.000
7.0022	0.161	1.128	0.130	0.000
7.1544	0.161	1.152	0.132	0.000
7.3067	0.161	1.177	0.135	0.000
7.4589	0.161	1.201	0.137	0.000
7.6111	0.161	1.226	0.139	0.000
7.7633	0.161	1.250	0.142	0.000
7.9156	0.161	1.275	0.160	0.000
8.0678	0.161	1.299	0.200	0.000
8.2200	0.161	1.324	0.222	0.000
8.3722	0.161	1.348	0.240	0.000
8.5244	0.161	1.373	0.256	0.000
8.6767	0.161	1.397	0.270	0.000
8.8289	0.161	1.422	0.283	0.000
8.9811	0.161	1.447	0.295	0.000
9.1333	0.161	1.471	0.306	0.000
9.2856	0.161	1.496	0.316	0.000
9.4378	0.161	1.520	0.326	0.000
9.5900	0.161	1.545	0.336	0.000
9.7422	0.161	1.569	0.345	0.000
9.8944	0.161	1.594	0.354	0.000
10.047	0.161	1.618	0.363	0.000
10.199	0.161	1.643	0.371	0.000
10.351	0.161	1.667	0.380	0.000
10.503	0.161	1.692	0.388	0.000
10.656	0.161	1.716	0.395	0.000
10.808	0.161	1.741	0.403	0.000
10.960	0.161	1.765	0.410	0.000
11.112	0.161	1.790	0.418	0.000
11.264	0.161	1.814	0.425	0.000
11.417	0.161	1.839	0.432	0.000
11.569	0.161	1.863	0.439	0.000
11.721	0.161	1.888	0.445	0.000
11.873	0.161	1.912	0.452	0.000
12.026	0.161	1.937	0.458	0.000
12.178	0.161	1.962	0.465	0.000
12.330	0.161	1.986	0.471	0.000
12.482	0.161	2.011	0.477	0.000
12.634	0.161	2.035	0.483	0.000
12.787	0.161	2.060	0.759	0.000
12.939	0.161	2.084	1.645	0.000
13.091	0.161	2.109	2.430	0.000
13.243	0.161	2.133	2.829	0.000
13.396	0.161	2.158	3.139	0.000
13.548	0.161	2.182	3.418	0.000
13.700	0.161	2.207	3.673	0.000
13.852	0.161	2.117	3.910	0.000

Vault B

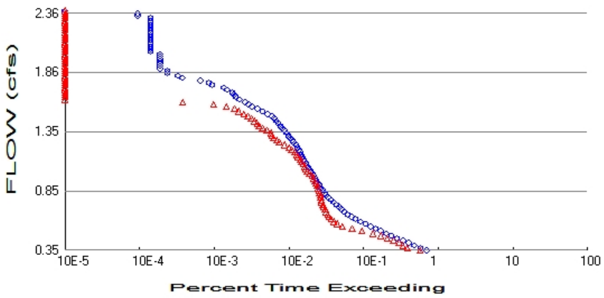
Width: 102 ft.
Length: 197 ft.
Depth: 12.7 ft.
Discharge Structure
Riser Height: 11.7 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 2.0313 in. Elevation:0 ft.
Orifice 2 Diameter: 1.875 in. Elevation:5.3 ft.
Orifice 3 Diameter: 3.125 in. Elevation:7.5 ft.
Element Flows To:
Outlet 1 Outlet 2

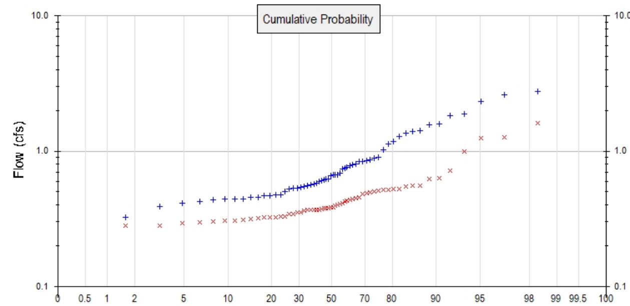
Vault Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.461	0.000	0.000	0.000
0.1411	0.461	0.065	0.042	0.000
0.2822	0.461	0.130	0.059	0.000
0.4233	0.461	0.195	0.072	0.000
0.5644	0.461	0.260	0.084	0.000
0.7056	0.461	0.325	0.094	0.000
0.8467	0.461	0.390	0.103	0.000
0.9878	0.461	0.455	0.111	0.000
1.1289	0.461	0.520	0.119	0.000
1.2700	0.461	0.585	0.126	0.000
1.4111	0.461	0.650	0.133	0.000
1.5522	0.461	0.716	0.139	0.000
1.6933	0.461	0.781	0.145	0.000
1.8344	0.461	0.846	0.151	0.000
1.9756	0.461	0.911	0.157	0.000
2.1167	0.461	0.976	0.162	0.000
2.2578	0.461	1.041	0.168	0.000
2.3989	0.461	1.106	0.173	0.000
2.5400	0.461	1.171	0.178	0.000
2.6811	0.461	1.236	0.183	0.000
2.8222	0.461	1.301	0.188	0.000
2.9633	0.461	1.367	0.192	0.000
3.1044	0.461	1.432	0.197	0.000
3.2456	0.461	1.497	0.201	0.000
3.3867	0.461	1.562	0.206	0.000
3.5278	0.461	1.627	0.210	0.000
3.6689	0.461	1.692	0.214	0.000
3.8100	0.461	1.757	0.218	0.000
3.9511	0.461	1.822	0.222	0.000
4.0922	0.461	1.887	0.226	0.000
4.2333	0.461	1.952	0.230	0.000
4.3744	0.461	2.017	0.234	0.000
4.5156	0.461	2.083	0.237	0.000
4.6567	0.461	2.148	0.241	0.000
4.7978	0.461	2.213	0.245	0.000
4.9389	0.461	2.278	0.248	0.000
5.0800	0.461	2.343	0.252	0.000
5.2211	0.461	2.408	0.255	0.000
5.3622	0.461	2.473	0.283	0.000
5.5033	0.461	2.538	0.305	0.000

5.6444	0.461	2.603	0.322	0.000
5.7856	0.461	2.668	0.335	0.000
5.9267	0.461	2.733	0.348	0.000
6.0678	0.461	2.799	0.359	0.000
6.2089	0.461	2.864	0.370	0.000
6.3500	0.461	2.929	0.379	0.000
6.4911	0.461	2.994	0.389	0.000
6.6322	0.461	3.059	0.398	0.000
6.7733	0.461	3.124	0.407	0.000
6.9144	0.461	3.189	0.415	0.000
7.0556	0.461	3.254	0.423	0.000
7.1967	0.461	3.319	0.431	0.000
7.3378	0.461	3.384	0.439	0.000
7.4789	0.461	3.450	0.447	0.000
7.6200	0.461	3.515	0.546	0.000
7.7611	0.461	3.580	0.597	0.000
7.9022	0.461	3.645	0.636	0.000
8.0433	0.461	3.710	0.670	0.000
8.1844	0.461	3.775	0.701	0.000
8.3256	0.461	3.840	0.729	0.000
8.4667	0.461	3.905	0.756	0.000
8.6078	0.461	3.970	0.780	0.000
8.7489	0.461	4.035	0.804	0.000
8.8900	0.461	4.100	0.827	0.000
9.0311	0.461	4.166	0.848	0.000
9.1722	0.461	4.231	0.869	0.000
9.3133	0.461	4.296	0.889	0.000
9.4544	0.461	4.361	0.909	0.000
9.5956	0.461	4.426	0.928	0.000
9.7367	0.461	4.491	0.946	0.000
9.8778	0.461	4.556	0.964	0.000
10.019	0.461	4.621	0.982	0.000
10.160	0.461	4.686	0.999	0.000
10.301	0.461	4.751	1.016	0.000
10.442	0.461	4.816	1.032	0.000
10.583	0.461	4.882	1.048	0.000
10.724	0.461	4.947	1.064	0.000
10.866	0.461	5.012	1.080	0.000
11.007	0.461	5.077	1.095	0.000
11.148	0.461	5.142	1.110	0.000
11.289	0.461	5.207	1.125	0.000
11.430	0.461	5.272	1.140	0.000
11.571	0.461	5.337	1.154	0.000
11.712	0.461	5.402	1.190	0.000
11.853	0.461	5.467	2.132	0.000
11.994	0.461	5.533	3.634	0.000
12.136	0.461	5.598	5.222	0.000
12.277	0.461	5.663	6.472	0.000
12.418	0.461	5.728	7.195	0.000
12.559	0.461	5.793	7.817	0.000
12.700	0.461	5.858	8.349	0.000
12.841	0.461	5.597	8.845	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	18.93
Total Impervious Area:	0

Mitigated Landuse Totals for POC #1

Total Pervious Area:	5.836
Total Impervious Area:	13.09

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.699767
5 year	1.119035
10 year	1.452657
25 year	1.941826
50 year	2.357923
100 year	2.820546

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.406868
5 year	0.569853
10 year	0.69994
25 year	0.892138
50 year	1.057352
100 year	1.24309

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.779	0.328
1950	0.791	0.376
1951	0.669	0.309
1952	0.544	0.321
1953	0.442	0.294
1954	2.768	0.370
1955	0.839	0.512
1956	0.733	0.553
1957	1.016	0.482
1958	0.884	0.377

1959	0.690	0.367
1960	0.669	0.415
1961	1.388	0.515
1962	0.672	0.323
1963	1.133	0.350
1964	0.893	0.282
1965	0.552	0.386
1966	0.324	0.314
1967	0.656	0.354
1968	0.800	0.446
1969	2.590	0.426
1970	0.457	0.324
1971	0.862	0.634
1972	0.532	0.403
1973	0.524	0.366
1974	1.416	0.382
1975	0.541	0.308
1976	0.569	0.361
1977	0.410	0.344
1978	0.478	0.324
1979	1.585	0.372
1980	0.742	0.331
1981	0.467	0.301
1982	0.606	0.527
1983	1.285	0.341
1984	0.625	0.718
1985	0.834	0.505
1986	1.872	1.270
1987	0.847	0.990
1988	0.438	0.523
1989	0.564	0.296
1990	0.593	0.489
1991	0.610	0.377
1992	0.465	0.437
1993	0.445	0.283
1994	0.424	0.405
1995	0.621	0.547
1996	1.170	0.517
1997	2.322	1.616
1998	0.388	0.307
1999	0.506	0.432
2000	0.440	0.624
2001	0.153	0.245
2002	0.577	0.442
2003	0.452	0.368
2004	0.760	0.553
2005	0.529	0.370
2006	1.827	0.492
2007	1.349	0.454
2008	1.566	1.251
2009	0.477	0.394

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	2.7683	1.6155
2	2.5903	1.2698
3	2.3218	1.2512

4	1.8724	0.9904
5	1.8266	0.7178
6	1.5853	0.6345
7	1.5664	0.6236
8	1.4157	0.5535
9	1.3882	0.5531
10	1.3492	0.5471
11	1.2854	0.5275
12	1.1703	0.5231
13	1.1329	0.5172
14	1.0160	0.5148
15	0.8930	0.5123
16	0.8837	0.5054
17	0.8616	0.4924
18	0.8468	0.4886
19	0.8386	0.4821
20	0.8336	0.4545
21	0.8004	0.4458
22	0.7906	0.4423
23	0.7786	0.4369
24	0.7605	0.4322
25	0.7425	0.4260
26	0.7330	0.4149
27	0.6901	0.4049
28	0.6718	0.4031
29	0.6692	0.3937
30	0.6688	0.3857
31	0.6564	0.3817
32	0.6246	0.3772
33	0.6206	0.3767
34	0.6104	0.3760
35	0.6058	0.3717
36	0.5927	0.3700
37	0.5771	0.3696
38	0.5687	0.3683
39	0.5635	0.3668
40	0.5521	0.3660
41	0.5442	0.3607
42	0.5413	0.3537
43	0.5318	0.3505
44	0.5295	0.3436
45	0.5239	0.3413
46	0.5062	0.3305
47	0.4783	0.3283
48	0.4770	0.3243
49	0.4670	0.3240
50	0.4652	0.3231
51	0.4570	0.3207
52	0.4522	0.3138
53	0.4452	0.3095
54	0.4416	0.3077
55	0.4402	0.3071
56	0.4385	0.3009
57	0.4235	0.2960
58	0.4102	0.2938
59	0.3877	0.2827
60	0.3239	0.2822
61	0.1525	0.2446

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3499	14872	12160	81	Pass
0.3702	12367	8241	66	Pass
0.3904	10254	7182	70	Pass
0.4107	8598	6387	74	Pass
0.4310	7129	5379	75	Pass
0.4513	5967	4427	74	Pass
0.4716	5037	3645	72	Pass
0.4919	4284	2866	66	Pass
0.5121	3595	2029	56	Pass
0.5324	3080	1498	48	Pass
0.5527	2646	1110	41	Pass
0.5730	2269	947	41	Pass
0.5933	1920	848	44	Pass
0.6136	1653	786	47	Pass
0.6338	1472	736	50	Pass
0.6541	1305	705	54	Pass
0.6744	1180	680	57	Pass
0.6947	1079	650	60	Pass
0.7150	1002	619	61	Pass
0.7353	921	603	65	Pass
0.7555	840	592	70	Pass
0.7758	783	584	74	Pass
0.7961	718	572	79	Pass
0.8164	672	560	83	Pass
0.8367	635	549	86	Pass
0.8570	610	536	87	Pass
0.8772	582	522	89	Pass
0.8975	552	509	92	Pass
0.9178	519	494	95	Pass
0.9381	498	475	95	Pass
0.9584	480	459	95	Pass
0.9787	456	438	96	Pass
0.9989	437	403	92	Pass
1.0192	416	373	89	Pass
1.0395	397	361	90	Pass
1.0598	382	349	91	Pass
1.0801	363	331	91	Pass
1.1004	348	317	91	Pass
1.1206	336	304	90	Pass
1.1409	323	285	88	Pass
1.1612	312	269	86	Pass
1.1815	299	255	85	Pass
1.2018	288	233	80	Pass
1.2221	276	213	77	Pass
1.2423	265	186	70	Pass
1.2626	245	158	64	Pass
1.2829	236	147	62	Pass
1.3032	221	132	59	Pass
1.3235	210	126	60	Pass
1.3438	197	123	62	Pass
1.3640	187	109	58	Pass
1.3843	174	94	54	Pass
1.4046	164	85	51	Pass

1.4249	153	80	52	Pass
1.4452	146	73	50	Pass
1.4655	135	67	49	Pass
1.4857	126	60	47	Pass
1.5060	111	53	47	Pass
1.5263	94	45	47	Pass
1.5466	80	40	50	Pass
1.5669	68	31	45	Pass
1.5872	61	21	34	Pass
1.6074	55	8	14	Pass
1.6277	46	0	0	Pass
1.6480	41	0	0	Pass
1.6683	39	0	0	Pass
1.6886	37	0	0	Pass
1.7089	32	0	0	Pass
1.7291	29	0	0	Pass
1.7494	20	0	0	Pass
1.7697	18	0	0	Pass
1.7900	14	0	0	Pass
1.8103	8	0	0	Pass
1.8306	7	0	0	Pass
1.8508	5	0	0	Pass
1.8711	5	0	0	Pass
1.8914	4	0	0	Pass
1.9117	4	0	0	Pass
1.9320	4	0	0	Pass
1.9523	4	0	0	Pass
1.9725	4	0	0	Pass
1.9928	4	0	0	Pass
2.0131	4	0	0	Pass
2.0334	3	0	0	Pass
2.0537	3	0	0	Pass
2.0740	3	0	0	Pass
2.0942	3	0	0	Pass
2.1145	3	0	0	Pass
2.1348	3	0	0	Pass
2.1551	3	0	0	Pass
2.1754	3	0	0	Pass
2.1957	3	0	0	Pass
2.2159	3	0	0	Pass
2.2362	3	0	0	Pass
2.2565	3	0	0	Pass
2.2768	3	0	0	Pass
2.2971	3	0	0	Pass
2.3174	3	0	0	Pass
2.3376	2	0	0	Pass
2.3579	2	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.7371 acre-feet
On-line facility target flow:	0.4056 cfs.
Adjusted for 15 min:	0.4056 cfs.
Off-line facility target flow:	0.2345 cfs.
Adjusted for 15 min:	0.2345 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
Vault A POC	☐	807.87			☐	0.00			
Vault B POC	☐	2042.97			☐	0.00			
Total Volume Infiltrated		2850.84	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

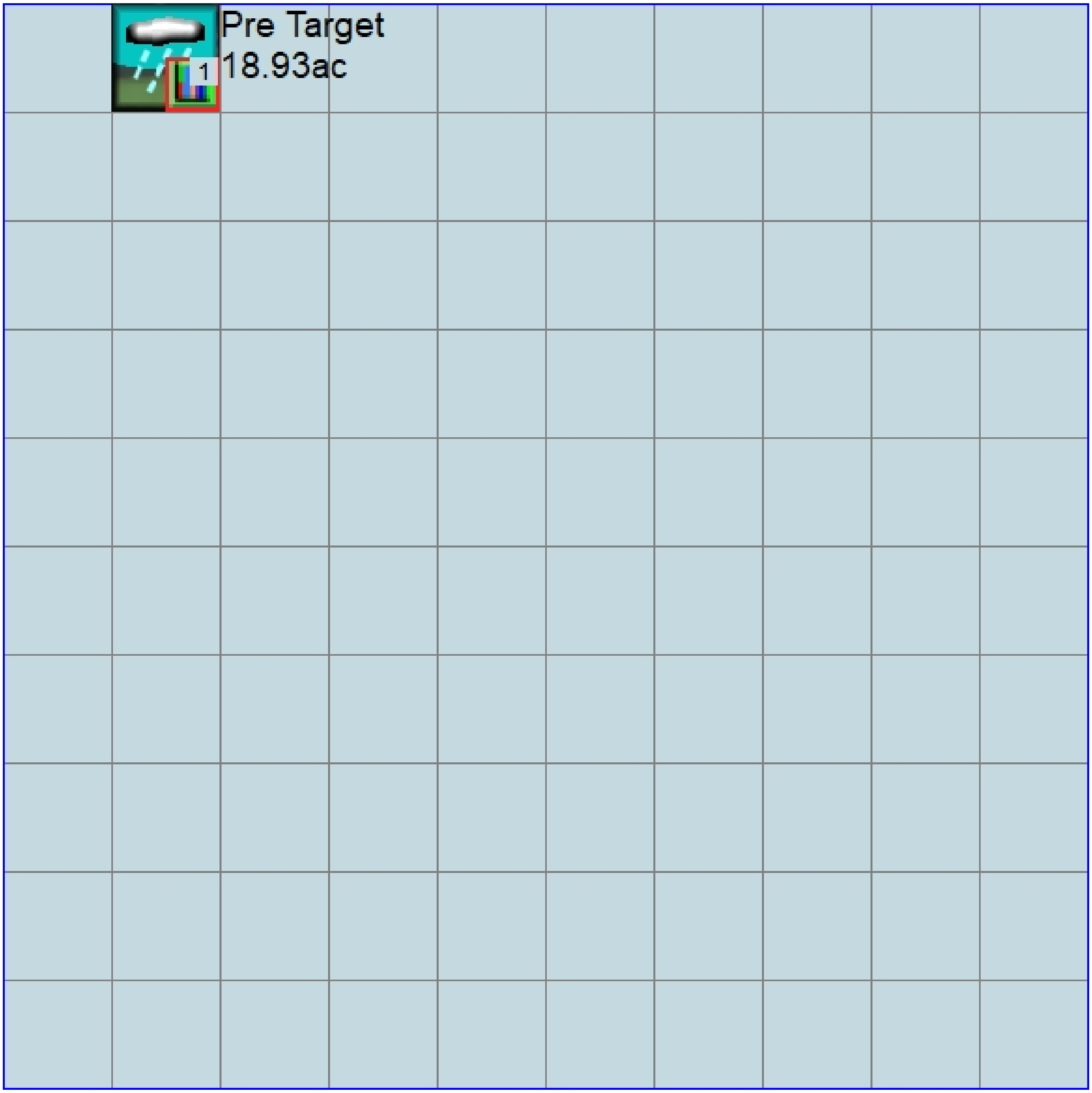
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   21036 Prelim Vault Sizing (Vaults A+B combo).wdm
MESSU      25   Pre21036 Prelim Vault Sizing (Vaults A+B combo).MES
           27   Pre21036 Prelim Vault Sizing (Vaults A+B combo).L61
           28   Pre21036 Prelim Vault Sizing (Vaults A+B combo).L62
           30   POC21036 Prelim Vault Sizing (Vaults A+B combo)1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Pre Target                  MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   11     C, Forest, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   11        0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   11             0       4.5      0.08       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11           0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

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

END PERLND

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

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Pre Target***
PERLND  11                       18.93     COPY   501     12
PERLND  11                       18.93     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
```

```
WDM       1 EVAP     ENGL    0.76            PERLND   1 999 EXTNL  PETINP
WDM       1 EVAP     ENGL    0.76            IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

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

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   21036 Prelim Vault Sizing (Vaults A+B combo).wdm
MESSU      25   Mit21036 Prelim Vault Sizing (Vaults A+B combo).MES
           27   Mit21036 Prelim Vault Sizing (Vaults A+B combo).L61
           28   Mit21036 Prelim Vault Sizing (Vaults A+B combo).L62
           30   POC21036 Prelim Vault Sizing (Vaults A+B combo)1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      IMPLND       4
      PERLND      12
      IMPLND       2
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  A                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  501        1    1
  601        1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
   12     C, Forest, Steep        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
   12         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   12         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
   12         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16              0       4.5      0.03       400      0.05       0.5     0.996
   12              0       4.5      0.08       400      0.15       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
   12              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
   12            0.2       0.3      0.35         6       0.3       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16              0         0         0         0       2.5         1         0
   12              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
```

```
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    4         0    0    4    0    0    0    1    9
    2         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
    2            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    2              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
    2              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Vault A Post-Target Basin***
PERLND  16                        1.53     RCHRES   1      2
PERLND  16                        1.53     RCHRES   1      3
IMPLND   1                        3.73     RCHRES   1      5
Vault B post-target Basin***
PERLND  16                        4.27     RCHRES   2      2
PERLND  16                        4.27     RCHRES   2      3
IMPLND   4                        9.21     RCHRES   2      5
Overflow***
PERLND  12                       0.036     COPY   501     12
PERLND  12                       0.036     COPY   601     12
PERLND  12                       0.036     COPY   501     13
PERLND  12                       0.036     COPY   601     13
IMPLND   2                        0.15     COPY   501     15
IMPLND   2                        0.15     COPY   601     15

******Routing******
PERLND  16                        1.53     COPY     1     12
IMPLND   1                        3.73     COPY     1     15
PERLND  16                        1.53     COPY     1     13
PERLND  16                        4.27     COPY     1     12
IMPLND   4                        9.21     COPY     1     15
PERLND  16                        4.27     COPY     1     13
RCHRES   1                           1     COPY   501     16
RCHRES   2                           1     COPY   501     16
END SCHEMATIC
```

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



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

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

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

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

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.02       0.0       0.0       0.5       0.0
    2             2      0.04       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                             ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.161111  0.000000  0.000000
  0.152222  0.161111  0.024525  0.015728
  0.304444  0.161111  0.049049  0.022242
```

0.456667	0.161111	0.073574	0.027241
0.608889	0.161111	0.098099	0.031455
0.761111	0.161111	0.122623	0.035168
0.913333	0.161111	0.147148	0.038525
1.065556	0.161111	0.171673	0.041611
1.217778	0.161111	0.196198	0.044484
1.370000	0.161111	0.220722	0.047183
1.522222	0.161111	0.245247	0.049735
1.674444	0.161111	0.269772	0.052163
1.826667	0.161111	0.294296	0.054482
1.978889	0.161111	0.318821	0.056707
2.131111	0.161111	0.343346	0.058847
2.283333	0.161111	0.367870	0.060913
2.435556	0.161111	0.392395	0.062910
2.587778	0.161111	0.416920	0.064847
2.740000	0.161111	0.441444	0.066727
2.892222	0.161111	0.465969	0.068555
3.044444	0.161111	0.490494	0.070336
3.196667	0.161111	0.515019	0.072073
3.348889	0.161111	0.539543	0.073769
3.501111	0.161111	0.564068	0.075427
3.653333	0.161111	0.588593	0.077049
3.805556	0.161111	0.613117	0.078638
3.957778	0.161111	0.637642	0.080195
4.110000	0.161111	0.662167	0.081723
4.262222	0.161111	0.686691	0.083223
4.414444	0.161111	0.711216	0.084696
4.566667	0.161111	0.735741	0.086144
4.718889	0.161111	0.760265	0.087568
4.871111	0.161111	0.784790	0.088969
5.023333	0.161111	0.809315	0.090348
5.175556	0.161111	0.833840	0.091707
5.327778	0.161111	0.858364	0.093046
5.480000	0.161111	0.882889	0.094366
5.632222	0.161111	0.907414	0.095667
5.784444	0.161111	0.931938	0.102989
5.936667	0.161111	0.956463	0.108326
6.088889	0.161111	0.980988	0.112427
6.241111	0.161111	1.005512	0.115989
6.393333	0.161111	1.030037	0.119227
6.545556	0.161111	1.054562	0.122238
6.697778	0.161111	1.079086	0.125079
6.850000	0.161111	1.103611	0.127784
7.002222	0.161111	1.128136	0.130379
7.154444	0.161111	1.152660	0.132880
7.306667	0.161111	1.177185	0.135299
7.458889	0.161111	1.201710	0.137648
7.611111	0.161111	1.226235	0.139933
7.763333	0.161111	1.250759	0.142162
7.915556	0.161111	1.275284	0.160720
8.067778	0.161111	1.299809	0.200268
8.220000	0.161111	1.324333	0.222854
8.372222	0.161111	1.348858	0.240859
8.524444	0.161111	1.373383	0.256401
8.676667	0.161111	1.397907	0.270337
8.828889	0.161111	1.422432	0.283115
8.981111	0.161111	1.446957	0.295005
9.133333	0.161111	1.471481	0.306186
9.285556	0.161111	1.496006	0.316781
9.437778	0.161111	1.520531	0.326881
9.590000	0.161111	1.545056	0.336557
9.742222	0.161111	1.569580	0.345862
9.894444	0.161111	1.594105	0.354839
10.04667	0.161111	1.618630	0.363524
10.19889	0.161111	1.643154	0.371947
10.35111	0.161111	1.667679	0.380131
10.50333	0.161111	1.692204	0.388097
10.65556	0.161111	1.716728	0.395864
10.80778	0.161111	1.741253	0.403446
10.96000	0.161111	1.765778	0.410859

11.11222	0.161111	1.790302	0.418112
11.26444	0.161111	1.814827	0.425217
11.41667	0.161111	1.839352	0.432184
11.56889	0.161111	1.863877	0.439020
11.72111	0.161111	1.888401	0.445734
11.87333	0.161111	1.912926	0.452332
12.02556	0.161111	1.937451	0.458820
12.17778	0.161111	1.961975	0.465204
12.33000	0.161111	1.986500	0.471489
12.48222	0.161111	2.011025	0.477680
12.63444	0.161111	2.035549	0.483782
12.78667	0.161111	2.060074	0.759394
12.93889	0.161111	2.084599	1.645105
13.09111	0.161111	2.109123	2.430709
13.24333	0.161111	2.133648	2.828995
13.39556	0.161111	2.158173	3.139865
13.54778	0.161111	2.182698	3.418730
13.70000	0.161111	2.207222	3.673914

END FTABLE 1
FTABLE 2
91 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.461295	0.000000	0.000000		
0.141111	0.461295	0.065094	0.042062		
0.282222	0.461295	0.130188	0.059484		
0.423333	0.461295	0.195281	0.072853		
0.564444	0.461295	0.260375	0.084124		
0.705556	0.461295	0.325469	0.094053		
0.846667	0.461295	0.390563	0.103030		
0.987778	0.461295	0.455657	0.111285		
1.128889	0.461295	0.520751	0.118969		
1.270000	0.461295	0.585844	0.126185		
1.411111	0.461295	0.650938	0.133011		
1.552222	0.461295	0.716032	0.139503		
1.693333	0.461295	0.781126	0.145706		
1.834444	0.461295	0.846220	0.151656		
1.975556	0.461295	0.911313	0.157381		
2.116667	0.461295	0.976407	0.162905		
2.257778	0.461295	1.041501	0.168247		
2.398889	0.461295	1.106595	0.173425		
2.540000	0.461295	1.171689	0.178453		
2.681111	0.461295	1.236783	0.183343		
2.822222	0.461295	1.301876	0.188106		
2.963333	0.461295	1.366970	0.192751		
3.104444	0.461295	1.432064	0.197287		
3.245556	0.461295	1.497158	0.201721		
3.386667	0.461295	1.562252	0.206060		
3.527778	0.461295	1.627345	0.210309		
3.668889	0.461295	1.692439	0.214474		
3.810000	0.461295	1.757533	0.218559		
3.951111	0.461295	1.822627	0.222570		
4.092222	0.461295	1.887721	0.226510		
4.233333	0.461295	1.952815	0.230382		
4.374444	0.461295	2.017908	0.234190		
4.515556	0.461295	2.083002	0.237937		
4.656667	0.461295	2.148096	0.241626		
4.797778	0.461295	2.213190	0.245260		
4.938889	0.461295	2.278284	0.248841		
5.080000	0.461295	2.343377	0.252371		
5.221111	0.461295	2.408471	0.255852		
5.362222	0.461295	2.473565	0.283084		
5.503333	0.461295	2.538659	0.305695		
5.644444	0.461295	2.603753	0.322013		
5.785556	0.461295	2.668846	0.335805		
5.926667	0.461295	2.733940	0.348114		
6.067778	0.461295	2.799034	0.359412		
6.208889	0.461295	2.864128	0.369959		
6.350000	0.461295	2.929222	0.379918		
6.491111	0.461295	2.994316	0.389398		

```
  6.632222  0.461295  3.059409  0.398477
  6.773333  0.461295  3.124503  0.407213
  6.914444  0.461295  3.189597  0.415652
  7.055556  0.461295  3.254691  0.423828
  7.196667  0.461295  3.319785  0.431769
  7.337778  0.461295  3.384878  0.439500
  7.478889  0.461295  3.449972  0.447039
  7.620000  0.461295  3.515066  0.546204
  7.761111  0.461295  3.580160  0.597022
  7.902222  0.461295  3.645254  0.636730
  8.043333  0.461295  3.710348  0.670915
  8.184444  0.461295  3.775441  0.701606
  8.325556  0.461295  3.840535  0.729814
  8.466667  0.461295  3.905629  0.756133
  8.607778  0.461295  3.970723  0.780948
  8.748889  0.461295  4.035817  0.804525
  8.890000  0.461295  4.100910  0.827057
  9.031111  0.461295  4.166004  0.848691
  9.172222  0.461295  4.231098  0.869540
  9.313333  0.461295  4.296192  0.889695
  9.454444  0.461295  4.361286  0.909230
  9.595556  0.461295  4.426380  0.928206
  9.736667  0.461295  4.491473  0.946674
  9.877778  0.461295  4.556567  0.964679
  10.01889  0.461295  4.621661  0.982257
  10.16000  0.461295  4.686755  0.999440
  10.30111  0.461295  4.751849  1.016258
  10.44222  0.461295  4.816942  1.032734
  10.58333  0.461295  4.882036  1.048892
  10.72444  0.461295  4.947130  1.064751
  10.86556  0.461295  5.012224  1.080328
  11.00667  0.461295  5.077318  1.095640
  11.14778  0.461295  5.142412  1.110701
  11.28889  0.461295  5.207505  1.125523
  11.43000  0.461295  5.272599  1.140120
  11.57111  0.461295  5.337693  1.154501
  11.71222  0.461295  5.402787  1.190196
  11.85333  0.461295  5.467881  2.132189
  11.99444  0.461295  5.532974  3.634377
  12.13556  0.461295  5.598068  5.222032
  12.27667  0.461295  5.663162  6.472300
  12.41778  0.461295  5.728256  7.195560
  12.55889  0.461295  5.793350  7.817561
  12.70000  0.461295  5.858444  8.349535
  END FTABLE  2
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1       1       WDM   1002 FLOW     ENGL      REPL
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COPY     1 OUTPUT MEAN   1 1    48.4       WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1    48.4       WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1    48.4       WDM    901 FLOW     ENGL      REPL
RCHRES   2 HYDR   RO     1 1       1       WDM   1004 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1       1       WDM   1005 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
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  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
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  END MASS-LINK   12

  MASS-LINK       13
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  END MASS-LINK   13

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

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

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

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

www.clearcreeksolutions.com

Appendix C

NRCS Soils Map

& Site Geotech Report

Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
87TH AND 40TH PRD
4218, 4112, 4018, AND 3922 – 87TH AVENUE NORTHEAST
MARYSVILLE, WASHINGTON

ES-7754

15365 N.E. 90th Street, Suite 100   Redmond, WA 98052
(425) 449-4704   Fax (425) 449-4711
www.earthsolutionsnw.com

PREPARED FOR

87TH & 40TH JV

September 2, 2022

Stephen H. Avril
Project Manager

09/08/2022

Kyle R. Campbell, P.E.
Principal Engineer

GEOTECHNICAL ENGINEERING STUDY
87TH AND 40TH PRD
4218, 4112, 4018, AND 3922 – 87TH AVENUE NORTHEAST
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Redmond, Washington 98052
Phone: 425-449-4704 | Fax: 425-449-4711
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Important Information about This

Geotechnical-Engineering Report

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

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

September 2, 2022
ES-7754

87th & 40th JV
P.O. Box 1930
Woodinville, Washington 98072

Attention: Mr. Mike Reid

Dear Mr. Reid:

Earth Solutions NW, LLC (ESNW) is pleased to present this report titled "Geotechnical Engineering Study, 87th and 40th PRD, 3922, 4018, 4112 & 4218 – 87th Avenue Northeast, Marysville, Washington".

In general, the native soil underlying the site consists of glacial till based on our observation of the subsurface conditions. In our opinion, the proposed residences can be supported on conventional continuous and spread footing foundations bearing on competent native soils, competent existing fill, or new structural fill. We anticipate suitable bearing soils will be encountered at depths below two feet at most locations on the site, except where fill was encountered to a depth of three feet. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material will be necessary.

Groundwater seepage was observed during our site investigation at depths between two to eight and one-half feet at several of the test sites. We interpret the groundwater as perched or present within a sand/gravel lens and not indicative of the static groundwater table. The client should anticipate perched groundwater seepage in excavations on the site, particularly at the contact between the weathered and unweathered glacial till. The maximum depth-of-exploration was nine and one-half feet below the existing surface elevations.

Recommendations for foundation design, site preparation, drainage, and other pertinent recommendations are provided in this study. We appreciate the opportunity to be of service to you on this project. If you have questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Stephen H. Avril
Project Manager

Table of Contents

ES-7754

Table of Contents

Cont'd

ES-7754

GEOTECHNICAL ENGINEERING STUDY
87TH AND 40TH PRD
4218, 4112, 4018, AND 3922 – 87TH AVENUE NORTHEAST
MARYSVILLE, WASHINGTON

ES-7754

INTRODUCTION

General

The project area consists of a site located on the west side of 87th Avenue Northeast, south of the intersection with East Sunnyside School Road in Marysville, Washington. The site is comprised of five separate properties totaling approximately 20 acres in size (parcel numbers 005907000-22000, 005907000-21201, 005907000-21202, 0059070002-3600, and 005907000-21300). The parcels are currently developed with a single-family residences and outbuildings. Site redevelopment plans include the demolition of the existing structures that occupy the site, and construction of a new residential development.

The purpose of this study was to explore subsurface conditions across the site and develop geotechnical recommendations for the proposed redevelopment. Our scope of services for completing this geotechnical engineering study included the following:

- Site exploration consisting of test pits advanced across the property;
- Laboratory testing of soil samples obtained during subsurface exploration;
- Engineering analyses of data gathered during site exploration, and;
- Preparation of this report.

The following documents/maps were reviewed as part of our report preparation:

- Geologic Map of Washington, Northwest Quadrant, Dragovich, Logan, et al, 2002;
- Washington State USDA Soil Conservation Survey (SCS), and;
- Client Provided Site Plan.

Project Description

We understand the property will be redeveloped with a residential development and associated improvements, following the demolition of the existing single-family residences and outbuildings that occupied the subject site at the time of this report production.

Given the topographic change across the site (about 40 feet in total relief), we anticipate grading activities may involve cuts, retaining walls, and fills of up to 15 feet to establish the final design grades.

Building construction is anticipated to consist of relatively lightly loaded wood framing and slab-on-grade floors. Perimeter foundation loading is expected to range from approximately one to two kips per foot. Slab-on-grade loading is expected to be on the order of 150 pounds per square foot (psf).

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

SITE CONDITIONS

Surface

The project area consists of a site located on the west side of 87th Avenue Northeast, south of the intersection with East Sunnyside School Road in Marysville, Washington. The site is comprised of five separate parcels. The site is comprised of pasture area, and is vegetated with field grass and sparsely treed.

The existing site topography is sloped in nature, with total elevation change on the order of 40 feet across the entirety of the site descending from southwest to northeast.

Subsurface

ESNW representatives observed, logged and sampled 11 test pits across accessible portions of the site. The test pits were advanced using an excavator and operator retained by ESNW, and advanced to a maximum depth of nine and one-half feet. The approximate location of the test pits is depicted on the Test Pit Location Plan (Plate 2). Please refer to the soil logs provided in Appendix A for a more detailed description of the subsurface conditions.

Topsoil

Topsoil was encountered at the test pit locations on the order of three to 16 inches in thickness. Where topsoil is encountered during site grading activities, it is not suitable for use as structural fill nor should it be mixed with material to be used as structural fill. Topsoil or otherwise unsuitable material can be used in landscaping areas if desired.

Fill

Fill soil was encountered at test locations TP-1, TP-7, TP-9 and TP-10. The fill extended to a maximum depth of three feet. The fill consisted of loose to medium dense silty sand and relic topsoil. Fill soil likely exists surrounding the existing buildings, roads, and utility alignments.

Native Soil

Underlying the topsoil and fill at the test pit locations, native soils consisting of silty sand (Unified Soil Classification, SM), poorly graded sand (SP), sandy silt (ML), and silty gravel with sand (GM) were encountered. The native soils were observed in a medium dense grading to very dense and cemented condition. These soil types were observed extending to the maximum exploration depth of nine and one-half feet below existing grades. The soil density was observed to increase with depth, and generally speaking became dense around three to four feet.

Geologic Setting

The referenced geologic map resource identifies glacial till deposits (Qvt) across the site and surrounding areas. The referenced SCS soil survey describes Tokul gravelly medial loam, 0 to 8 percent slopes (72) series soils for the majority of the site and surrounding area. Tokul gravelly medial loam series soils are typified by glacial till plains sometimes overlain by volcanic ash deposits. The native soil observed at the test locations are consistent with glacial till deposits, and are in-line with the geologic map descriptions for the area.

Groundwater

Groundwater seepage was observed at several of the test locations during the fieldwork (July 2022). The seepage was generally perched in nature, at the contact between the weathered and unweathered glacial till, and within sand and gravel lenses between two to eight feet in depth. Seepage should be expected in excavations at this site; particularly during the winter, spring, and early summer months. Groundwater seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the wetter, winter months. However, the groundwater table was not observed on the subject site.

GEOLOGIC CRITICAL AREA ASSESSMENT

As part of our report preparation, we assessed the site for potential critical areas utilizing the City of Marysville online geologic hazard map available on-line. The subject site is not described as possessing and geologic critical areas.

It is our opinion that there are no geologic hazards located on the subject site. We base this opinion on the subsurface data collected during our fieldwork, our review of the topographic survey for the subject site, and geologic hazard map. The glacial till soils appear to be uniform across the entirety of the subject site.

DISCUSSION AND RECOMMENDATIONS

General

In our opinion, construction of the proposed structures is feasible from a geotechnical standpoint. The proposed buildings can be supported on conventional continuous and spread footing foundations bearing on competent native soils, competent existing fill, or new structural fill. Slab-on-grade floors should be supported on competent native soil or structural fill. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material will be necessary. Recommendations for foundation design, site preparation, drainage, and other pertinent geotechnical recommendations are provided in the following sections of this study.

This study has been prepared for the exclusive use of 87th & 40th JV and their representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

Site preparation activities will involve demolition of the existing structures, site clearing and stripping, and implementation of temporary erosion control measures. The primary geotechnical considerations associated with site preparation activities include erosion control installation, building pad subgrade preparation, retaining wall construction, underground utility installations, and preparation of pavement subgrade areas.

Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls (potentially placed over geotextile) can be considered in order to minimize off-site soil tracking and to provide a stable access entrance surface. Erosion control measures should consist of silt fencing placed along the down gradient side of the site. Soil stockpiles should be covered or otherwise protected to reduce soil erosion. Temporary sedimentation ponds or other approaches for controlling surface water runoff should be in place prior to beginning earthwork activities.

Where encountered, topsoil and organic-rich soil is not suitable for foundation support, nor is it suitable for use as structural fill. Topsoil or organic-rich soil can be used in non-structural areas if desired. Over-stripping of the site, however, should be avoided. A representative of ESNW should observe the initial stripping operations, to provide recommendations for stripping depths based on the soil conditions exposed during stripping.

Structural fill soils placed throughout foundation, slab, and pavement areas should be placed over a firm base. Loose or otherwise unsuitable areas of native soil exposed at subgrade elevations should be compacted to structural fill requirements or overexcavated and replaced with a suitable structural fill material. Where structural fill soils are used to construct foundation subgrade areas, the soil should be compacted to the requirements of structural fill described in the following section. Foundation subgrade areas should be protected from disturbance, construction traffic, and excessive moisture. Where instability develops below structural fill areas, use of a woven geotextile below the structural fill areas may be required. A representative of ESNW should observe structural fill placement in foundation, slab, and pavement areas.

The process of removing existing structures may produce voids where foundations and basements were present. Complete restoration of voids caused by the removal of existing structure must be executed as part of overall subgrade and building pad preparation activities, unless the excavation for the new building will be lower than existing basements. The following guidelines for preparing building subgrade areas should be incorporated into the final design:

- Removal of the existing stem walls to an elevation where a four-foot vertical separation between the bottom of new foundations is maintained, and demolition of the slab present in the existing basement, or;

- Complete removal of all foundation elements, stem walls, footing drains, sewer and storm drainage pipes, etc. within the footprint of the existing structure.

- Where voids and related demolition disturbances extend below planned subgrade elevations, restoration of these areas should be completed. Structural fill should be used to restore voids or unstable areas resulting from the removal of existing structural improvements.

- Where pipes for stormwater and sanitary sewer are encountered, they should be plugged and abandoned.

- Recompact, or overexcavate and replace, areas of existing fill, if present, exposed at building subgrade elevations. ESNW should confirm subgrade conditions and the required level of recompaction, or overexcavation and replacement, during site preparation activities. Overexcavations should extend into competent native soils, and structural fill should be used to restore subgrades areas.

- ESNW should confirm the overall suitability of prepared subgrade areas following site preparation activities.

In-situ Soils

The soils encountered at the test sites have a moderate to high sensitivity to moisture and were generally in a moist condition at the time of the exploration (July 2022). In this respect, the in-situ soils are not suitable for use as structural fill unless the soil moisture content is within the range that will allow the soil to be compacted to the levels specified below. In general, soils encountered during the site excavations that are excessively over the optimum moisture content will require moisture conditioning prior to placement and compaction. Conversely, soils that are below the optimum moisture content will require moisture conditioning through the addition of water prior to use as structural fill. If the in-situ soils are determined to not be suitable for use as structural fill, then use of a suitable imported soil may be necessary. In our opinion, a contingency should be included in the project budget for exporting unsuitable soil and importing structural fill; or moisture conditioning recommendations can be provided upon request based on field observations during the construction phase of on-site work.

Imported Soils

Imported soil intended for use as structural fill should consist of a well graded granular soil with a moisture content that is at or near the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well graded granular soil with a fines content of 5 percent or less defined as the percent passing the #200 sieve, based on the minus three-quarter inch fraction.

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, and roadway areas. Fills placed to construct permanent slopes and throughout retaining wall and utility trench backfill areas are also considered structural fill. Soils placed in structural areas should be placed in loose lifts of 12 inches or less and compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D-1557). Additionally, more stringent compaction specifications may be required for utility trench backfill zones, depending on the responsible utility district or jurisdiction. Structural fill should be placed and compacted at moisture contents slightly above the optimum moisture content.

Foundations

Based on the results of our study, the proposed residential structures can be supported on conventional spread and continuous footings bearing on competent native soils, competent existing fill or new structural fill. Based on the soil conditions encountered at the test sites, competent native soils suitable for support of foundations should be encountered at depths of one to two feet below existing surface elevations in most areas. Loose to medium dense fill was observed at several locations to a maximum depth of three feet. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with structural fill, may be necessary.

Provided foundations will be supported as described above, the following parameters can be used for design of new foundations:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf (equivalent fluid)
- Coefficient of friction 0.40

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

Seismic Design Considerations

The 2018 International Building Code (2018 IBC) recognizes the most recent edition of the Minimum Design Loads for Buildings and Other Structures manual (ASCE 7-16) for seismic design, specifically with respect to earthquake loads. Based on the soil conditions encountered at the test pit locations, the parameters and values provided below are recommended for seismic design per the 2018 IBC.

Parameter	**Value**
Site Class	D*
Mapped short period spectral response acceleration, S_S (g)	1.098
Mapped 1-second period spectral response acceleration, S_1 (g)	0.390
Short period site coefficient, F_a	1.061
Long period site coefficient, F_v	1.991
Adjusted short period spectral response acceleration, S_{MS} (g)	1.165
Adjusted 1-second period spectral response acceleration, S_{M1} (g)	0.776
Design short period spectral response acceleration, S_{DS} (g)	0.777
Design 1-second period spectral response acceleration, S_{D1} (g)	0.518

* *Assumes very dense soil conditions, encountered to a maximum depth of 9.5 feet bgs during the July 2022 field exploration, remain very dense to at least 100 feet bgs. Based on our experience with the project geologic setting (glacial till) across the Puget Sound region, soil conditions are likely consistent with this assumption.*

Further discussion between the project structural engineer, the project owner (or their representative), and ESNW may be prudent to determine the possible impacts to the structural design due to increased earthquake load requirements under the 2018 IBC. ESNW can provide additional consulting services to aid with design efforts, including supplementary geotechnical and geophysical investigation, upon request.

Liquefaction is a phenomenon where saturated or loose soil suddenly loses internal strength and behaves as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or another intense ground shaking. In our opinion, site susceptibility to liquefaction may be considered negligible. The absence of a shallow groundwater table and the relative density of the native soil were the primary bases for this opinion.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed buildings constructed at this site should be supported on a firm and unyielding subgrade. Where feasible, the soil exposed at the slab-on-grade subgrade level can be compacted in place to the specifications of structural fill. Unstable or yielding areas of the subgrade should be recompacted or overexcavated and replaced with suitable structural fill prior to construction of the slab. A capillary break consisting of a minimum of four inches of free draining crushed rock or gravel should be placed below the slab. The free draining material should have a fines content of 5 percent or less (percent passing the #200 sieve, based on the minus three-quarter inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If a vapor barrier is to be utilized, it should be a material specifically designed for use as a vapor barrier and should be installed in accordance with the manufacturer's specifications.

Retaining Walls

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

- Active earth pressure (yielding condition) — 35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) — 55 pcf
- Traffic surcharge for passenger vehicles (where applicable) — 70 psf (rectangular distribution)
- Passive earth pressure — 300 pcf (equivalent fluid)
- Coefficient of friction — 0.40
- Seismic surcharge (active condition) — 8H (where H equals retained height)

Additional surcharge loading from adjacent foundations, sloped backfill, or other loads should be included in the retaining wall design. Drainage should be provided behind retaining walls such that hydrostatic pressures do not develop. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Retaining walls should be backfilled with free draining material that extends along the height of the wall, and a distance of at least 18 inches behind the wall. The upper one foot of the wall backfill can consist of a less permeable soil, if desired. A perforated drain pipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3.

Drainage

Seepage will likely be encountered in excavations on the site, particularly during winter, spring, and early summer months. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and to provide recommendations to reduce the potential for instability related to seepage effects.

Finish grades must slope away from the building at an inclination of at least 2 percent for a distance of at ten feet or as adjacent building setbacks allow. In addition, surface water should be controlled utilizing best management practices (BMP) during, and after, construction on the subject site.

Footing drains should be installed given the nature of the soils on the site. A typical foundation drain detail for footings not placed directly against shoring is provided as Plate 4.

Infiltration Evaluation

The subject site is underlain by glacial till deposits based on our observation of the subsurface conditions. The soil on the subject site consists primarily of cemented silty sand soils, which typically have a non-favorable infiltration capacity.

Infiltration testing was a part of our scope of services for this phase of the project. The infiltration testing consisted of small-scale Pilot Infiltration Testing at one of the test pit locations (TP-1 at a depth of five feet). The infiltration testing yielded no appreciable infiltration during the procedure. Full infiltration should be considered infeasible on the site due to the presence of a confining layer of soil within the upper three feet of the subsurface and our testing. However, based on our experience on similar sites it may be possible to utilize permeable pavements, provided a one-foot separation can be maintained from the unweathered till, and an underdrain with overflow provisions are part of the design.

Preliminary Stormwater Vault Design

Vault foundations should be supported on competent native, fill soil or clean crushed rock placed atop competent native soil. Final stormwater vault designs must incorporate adequate buffer space from property boundaries such that temporary excavations to construct the vault structure can be successfully completed. Perimeter drains should be installed around the vault and conveyed to an approved discharge point. The presence of perched groundwater seepage should be anticipated during excavation activities for the vault.

The following parameters can be used for preliminary stormwater vault design:

- Allowable soil bearing capacity (dense native soil) 5,000 psf
- Active earth pressure (unrestrained) 35 pcf
- Active earth pressure (unrestrained, hydrostatic) 80 pcf
- At-rest earth pressure (restrained) 55 pcf
- At-rest earth pressure (restrained, hydrostatic) 100 pcf
- Coefficient of friction 0.40
- Passive earth pressure (level grade) 300 pcf
- Seismic surcharge 8H*

* *Where H equals the retained height.*

Retaining walls should be backfilled with at least 18 inches of free-draining material or suitable sheet drainage that extends along the height of the walls. The upper one foot of the wall backfill can consist of a less permeable soil, if desired. A perforated drain pipe should be placed along the base of the vault wall and connected to an approved discharge location. If the elevation of the vault bottom is such that gravity flow to an outlet is not possible, the drain must be raised to a point at which it will gravity drain and the portion of the vault below the drain must be designed to include hydrostatic pressure. Design values accounting for hydrostatic pressure are included above.

ESNW should observe grading operations for the vault and the subgrade conditions prior to concrete forming and pouring to confirm conditions are as anticipated, and to provide supplemental recommendations as necessary. Additionally, ESNW should be contacted to review final vault designs to confirm that the above geotechnical design parameters and recommendations have been incorporated into the plans. Consideration should be given to vault placement and excavations. Where the allowable temporary slopes recommended below cannot be adhered to, shoring may be necessary to achieve safe excavations from a soil stability standpoint.

Excavations and Slopes

The Federal Occupation Safety and Health Administration (OSHA) and the Washington Industrial Safety and Health Act (WISHA) provide soil classification in terms of temporary slope inclinations. Based on the soil conditions encountered at the test locations, existing fill, loose native soil and any soil where groundwater seepage is exposed, are classified as Type C by OSHA/WISHA. Temporary slopes over four feet in height in Type C soils must be sloped no steeper than 1.5H:1V (Horizontal:Vertical). The presence of perched groundwater may cause caving of the temporary slopes due to hydrostatic pressure. The dense to very dense native silty sand soils observed are classified as Type A. Temporary slopes over four feet in height in Type A soils must be sloped no steeper than 0.75H:1V. Temporary excavations with inclinations steeper than those described may be acceptable from a geotechnical standpoint. ESNW should be consulted during the design phase to provide recommendations for steeper temporary excavations if necessary. ESNW should observe site excavations to confirm the soil type and allowable slope inclination. If the recommended temporary slope inclination cannot be achieved, temporary shoring may be necessary to support excavations.

Permanent slopes should maintain a gradient of 2H:1V, or flatter, and should be planted with vegetation to enhance stability and to minimize erosion. A representative of ESNW should observe temporary and permanent slopes to confirm the slope inclinations, and to provide additional excavation and slope recommendations, as necessary.

Preliminary Pavement Sections

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

For relatively lightly loaded pavements subjected to automobiles and occasional truck traffic, the following sections can be considered for preliminary design:

- Two inches of hot mix asphalt (HMA) placed over four inches of CRB, or;

- Two inches of HMA placed over three inches of asphalt treated base (ATB).

Heavier traffic areas generally require thicker pavement sections depending on site usage, pavement life expectancy, and site traffic. For preliminary design purposes, the following pavement sections can be considered for heavy traffic areas:

- Three inches of HMA placed over six inches of crushed rock base (CRB), or;

- Three inches of HMA placed over four-and-one-half inches of ATB.

Final pavement sections can be determined once traffic loads are defined. The HMA, CRB and ATB materials should conform to WSDOT specifications. The City of Marysville minimum pavement requirements may supersede our recommendations and may require thicker pavement sections.

Installation of pavement subgrade drainage should be considered in areas where inverted crown pavements are used and where unweathered glacial till is exposed at the pavement subgrade elevation. Such drainage measures can consist of finger drains at catch basin locations. A lack of subgrade drainage under the conditions described above will likely result in extremely accelerated distress to pavements in low areas.

Utility Support and Trench Backfill

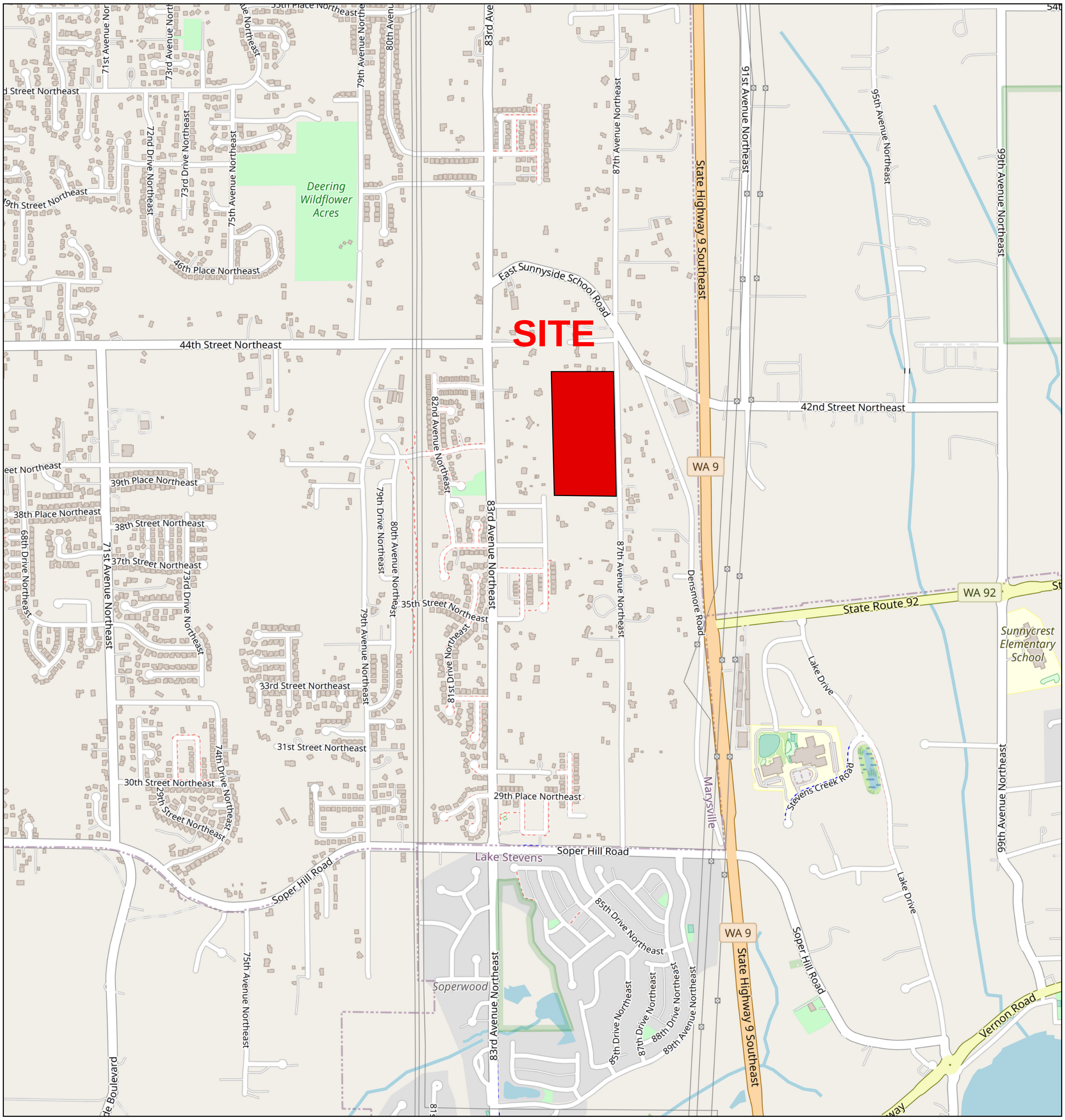
In our opinion, the soils anticipated to be exposed in utility excavations should generally be suitable for support of utilities. Organic or highly compressible soils encountered in the trench excavations should not be used for supporting utilities. The on-site soil may not be suitable for use as trench backfill if the soil moisture content is too high at the time of compaction. Utility trench backfill should be placed and compacted to the specifications of structural fill provided in this report, or to the applicable City of Marysville or Snohomish County specifications. Seepage should be anticipated within utility trench excavations. Caving of the trench sidewalls should also be anticipated where groundwater seepage is encountered.

LIMITATIONS

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

Additional Services

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



Reference:
Snohomish County, Washington
OpenStreetMap.org

NORTH

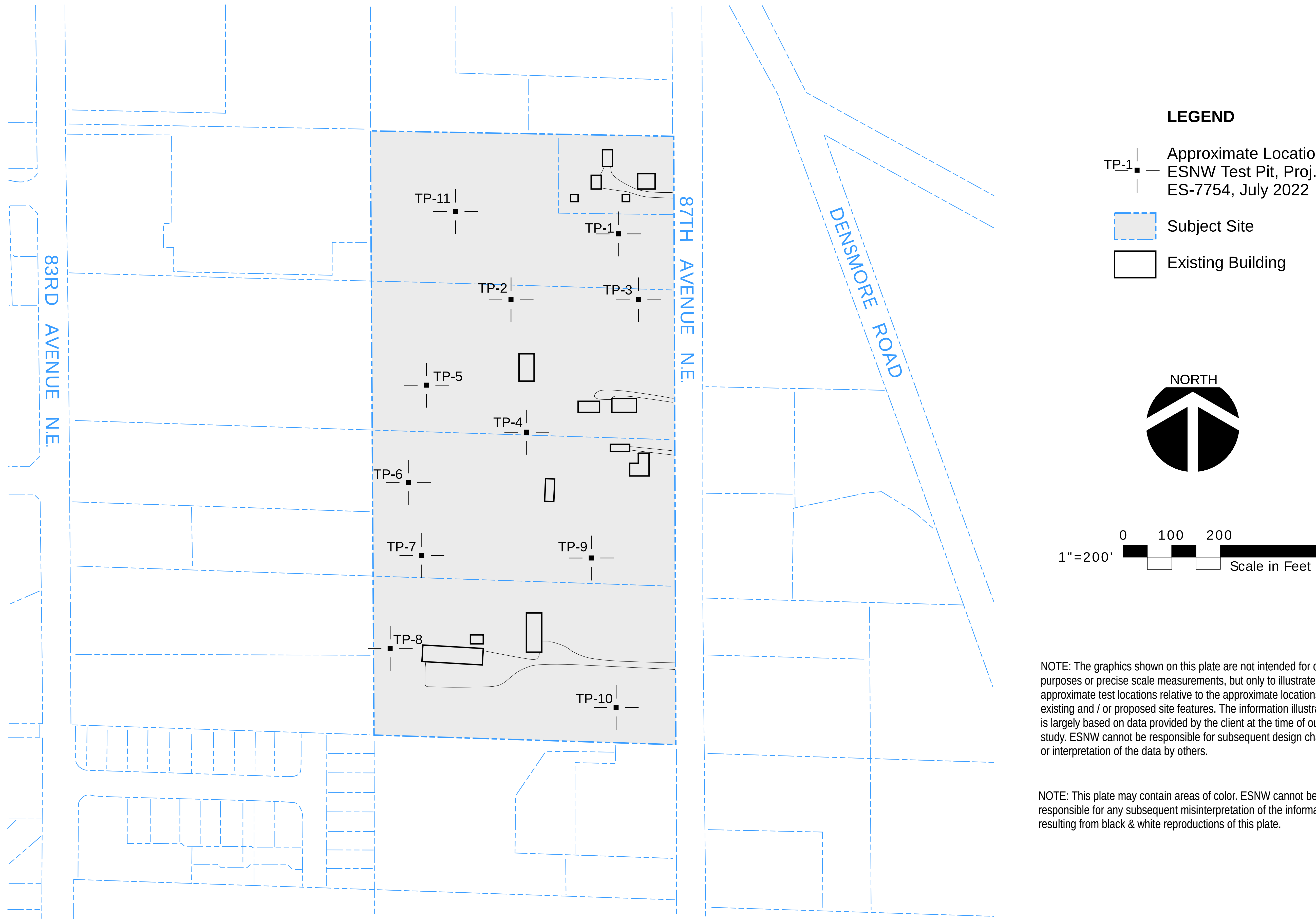
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
87th and 40th PRD
Marysville, Washington

Drwn. MRS	Date 09/08/2022	Proj. No. 7754
Checked BCS	Date Sept. 2022	Plate 1



LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-7754, July 2022

Subject Site

Existing Building

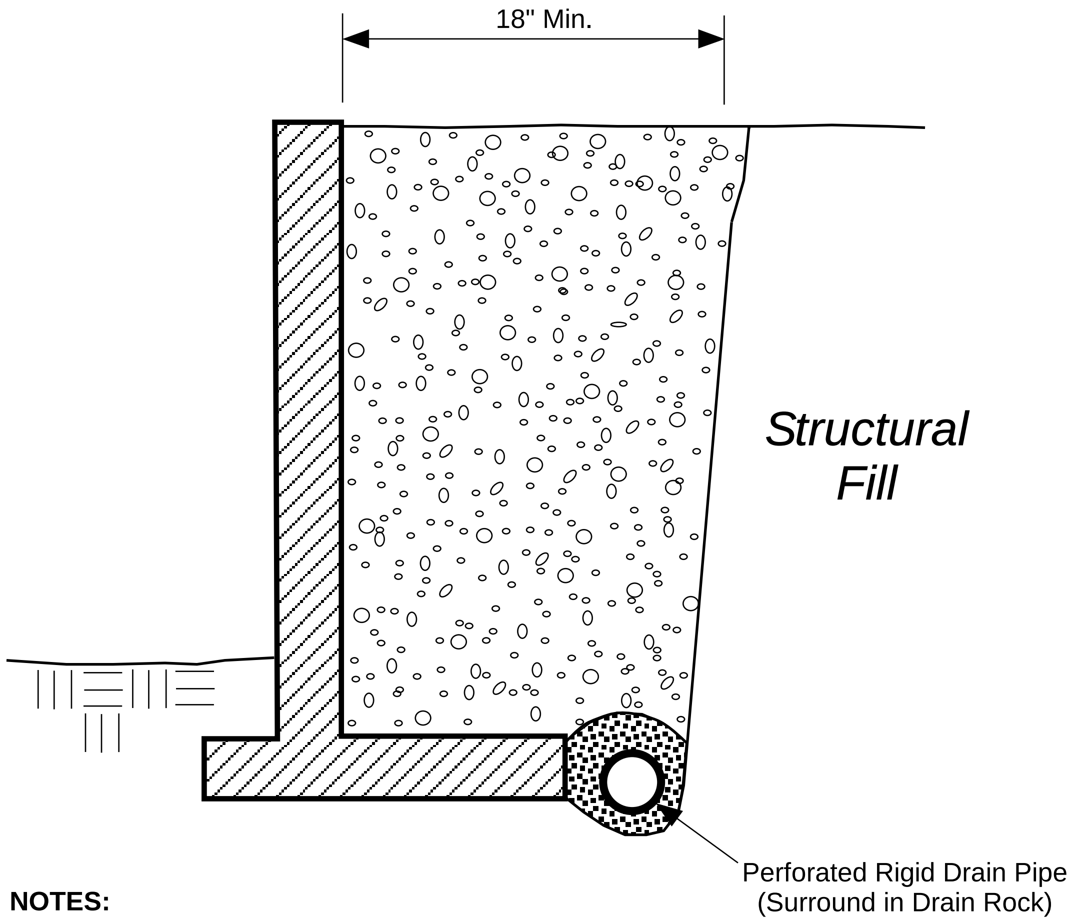
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided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

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

Test Pit Location Plan
87th and 40th PRD
Marysville, Washington

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

Drwn. By	MRS
Checked By	BCS
Date	09/08/2022
Proj. No.	7754
Plate	2



NOTES:

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

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

Free-draining Structural Backfill

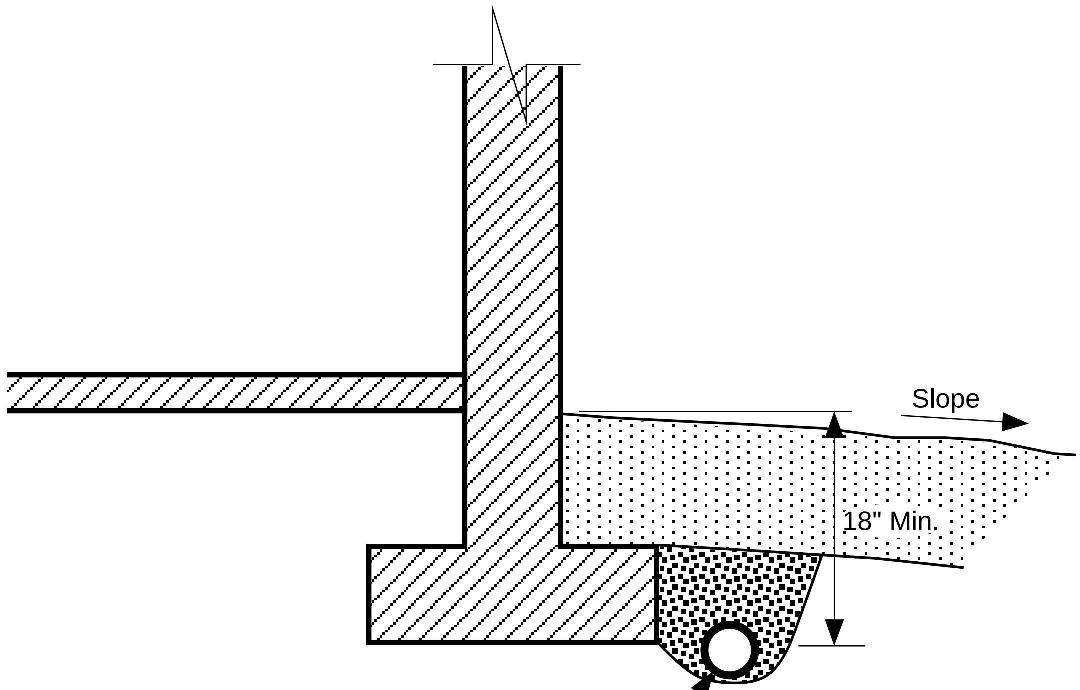
1-inch Drain Rock

Earth Solutions NW LLC

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

Retaining Wall Drainage Detail
87th and 40th PRD
Marysville, Washington

Drwn. MRS	Date 09/08/2022	Proj. No. 7754
Checked BCS	Date Sept. 2022	Plate 3



NOTES:

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

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

(dotted pattern)	Surface Seal: native soil or other low-permeability material.
(dense pattern)	1-inch Drain Rock

Earth Solutions NW LLC
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Footing Drain Detail
87th and 40th PRD
Marysville, Washington

Drwn. MRS	Date 09/08/2022	Proj. No. 7754
Checked BCS	Date Sept. 2022	Plate 4

Appendix A

Subsurface Exploration
Test Pit Logs

ES-7754

The subsurface conditions at the site were explored by excavating a total of 11 test pits across accessible portions of the property. The subsurface explorations were completed in July of 2022. The approximate test locations are illustrated on Plate 2 of this report. Logs of the test pits are provided in this Appendix. The test pits were excavated to a maximum depth of nine and one-half feet below existing grades.

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

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

DUAL SYMBOLS are used to indicate borderline soil classifications.

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

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03433 **LONGITUDE** -122.11473
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Blackberries
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			GP		Gray poorly graded GRAVEL, loose, dry (10" of 5/8" crushed rock) (Fill) -bricks, woven geotextile
				0.8	
			SM		Brown silty SAND, loose, moist (Fill)
				1.5	
			TPSL		Dark brown Relic TOPSOIL Horizon
				2.0	
2.5			SM		Brown silty SAND, medium dense, moist
		MC = 13.5%			-becomes gray, dense, weakly cemented (unweathered till) -light iron oxide staining
5.0		MC = 15.0% Fines = 44.4%			-infiltration test [USDA Classification: gravelly LOAM]
		MC = 15.8%			
7.5					
		MC = 11.3% Fines = 44.2%		9.0	[USDA Classification: slightly gravelly LOAM]

Test pit terminated at 9.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03396 **LONGITUDE** -122.11542
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass and Blackberries
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL		Dark brown TOPSOIL
1.0		MC = 15.7%	SM		Orange silty SAND, medium dense, moist -becomes gray -moderate iron oxide staining to 3' -becomes very dense, weakly cemented (unweathered till)
6.0		MC = 9.8%			Test pit terminated at 6.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Depth scale markings: 0.0, 2.5, 5.0

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
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Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-3

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03398 **LONGITUDE** -122.11453
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass and Blackberries
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL	1.2	Dark brown TOPSOIL and grass clippings
2.5		MC = 21.4%	SM		Tan silty SAND, medium dense, wet -moderate iron oxide staining
5.0		MC = 16.6% Fines = 49.8%			-becomes gray, dense, moist, weakly cemented [USDA Classification: slightly gravelly LOAM]
7.5		MC = 11.9% Fines = 47.3%		8.0	-becomes very dense (unweathered till) [USDA Classification: slightly gravelly LOAM]

Test pit terminated at 8.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
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Fax: 425-449-4711

TEST PIT NUMBER TP-4

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03323 **LONGITUDE** -122.11542
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL	0.6	Dark brown TOPSOIL
2.5		MC = 15.4%	SM	4.0	Brown silty SAND, medium dense, moist -becomes gray, dense -scattered gravel -moderate iron oxide staining to 4'
5.0 7.5		MC = 11.7% Fines = 53.0%	ML	8.5	Gray sandy SILT, very dense, moist -weakly cemented (unweathered till) [USDA Classification: slightly gravelly LOAM]

Test pit terminated at 8.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-5

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03354 **LONGITUDE** -122.11634
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Tall Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL		Dark brown TOPSOIL
1.0		MC = 16.7% MC = 16.7%	SM		Brown silty SAND, loose to medium dense, moist -light groundwater seepage -minor sand lensing -becomes gray, dense, weakly cemented -light to moderate groundwater seepage at 4'
2.5					
4.0		MC = 12.5%	GM		Gray silty GRAVEL with sand, dense, moist -moderately abundant large cobbles and small boulders -slight to moderate caving from 1' to 4'
5.0					
7.0					Test pit terminated at 7.0 feet below existing grade. Groundwater seepage encountered at 2.0 and 4.0 feet during excavation. Caving observed from 1.0 to 4.0 feet.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-6

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03289 **LONGITUDE** -122.11641
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL	0.6	Dark brown TOPSOIL
			SM		Brown silty SAND, medium dense, moist
		MC = 17.0%			
2.5					
					-becomes gray, dense to very dense, weakly cemented (unweathered till)
					-few large cobbles
					-variable cementation
5.0					-minor lensing of coarse sand
		MC = 16.7%			
					-light to moderate groundwater seepage 6' to 7'
		MC = 15.3%			-interbedded silt and coarse sand
7.5					
		MC = 8.4%		8.0	

Test pit terminated at 8.0 feet below existing grade due to refusal in very dense cemented "hardpan" glacial till. Groundwater seepage encountered at 6.0 to 7.0 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-7

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03251 **LONGITUDE** -122.11627
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			SM	1.5	Gray silty SAND with gravel, loose to medium dense, damp (Fill)
			TPSL	2.0	Dark brown Relic TOPSOIL Horizon
2.5 5.0 7.5		MC = 31.0%	SM	8.0	Gray silty fine SAND, dense, wet -heavy iron oxide staining -scattered gravel above 4'
		MC = 14.3%	SP	9.5	Gray poorly graded SAND, dense, wet to water bearing -moderate to heavy groundwater seepage -very dense, cemented glacial till exposed at BOH

Test pit terminated at 9.5 feet below existing grade. Groundwater seepage encountered at 8.5 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-8

PROJECT NUMBER ES-7754 **PROJECT NAME** 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22 **GROUND ELEVATION**
EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 48.03199 **LONGITUDE** -122.11657
LOGGED BY BCS **CHECKED BY** SHA **GROUND WATER LEVEL:**
NOTES ∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Manicured Grass **AFTER EXCAVATION**

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL	0.6	Dark brown TOPSOIL
			SM		Brown silty SAND, medium dense, moist
					-scattered gravel
2.5		MC = 13.1%			
					-becomes gray, dense
5.0					
		MC = 12.5%			-moderate abundant small to medium gravel
					-scattered zones of cohesion/weakly cemented
7.5				8.0	

Test pit terminated at 8.0 feet below existing grade due to refusal on boulder. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-9

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03248 **LONGITUDE** -122.1149
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL	1.0	Brown TOPSOIL with minor root intrusions (Fill)
2.5		MC = 9.0%	SM	3.0	Brownish gray silty SAND, medium dense, moist (Fill)
5.0		MC = 15.7%	SM		Gray silty SAND, dense, moist -scattered gravel -moderate iron oxide staining -weakly cemented, very dense (unweathered till)
7.5		MC = 11.6%		7.5	

Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-10

PROJECT NUMBER ES-7754 **PROJECT NAME** 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22 **GROUND ELEVATION**
EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 48.03167 **LONGITUDE** -122.11463
LOGGED BY BCS **CHECKED BY** SHA **GROUND WATER LEVEL:**
NOTES ∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Manicured Grass **AFTER EXCAVATION**

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION
0.0			TPSL		0.5	Dark brown TOPSOIL with minor root intrusions (Fill)
			SM		1.5	Brown silty SAND, loose, damp to moist (Fill)
2.5			TPSL		3.0	Dark brown to black TOPSOIL/organics (Fill)
5.0		MC = 18.9% MC = 14.2% MC = 13.7%	SM		7.5	Tan silty SAND, medium dense, moist to wet -light iron oxide staining to ~4' -becomes gray, dense -weakly cemented (unweathered till) -very light groundwater seepage
7.5						

Test pit terminated at 8.0 feet below existing grade. Groundwater seepage encountered at 7.0 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-11

PROJECT NUMBER ES-7754
PROJECT NAME 87th and 40th PRD
DATE STARTED 7/8/22 **COMPLETED** 7/8/22
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 48.03438 **LONGITUDE** -122.11617
LOGGED BY BCS **CHECKED BY** SHA
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Forest Floor
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL	1.4	Dark brown TOPSOIL
			SM		Gray silty SAND, dense, moist
					-weakly cemented (unweathered till)
2.5		MC = 13.2%			-scattered gravel
					-moderate iron oxide staining
5.0					-becomes very dense, moist
		MC = 10.1%			
7.5		MC = 10.9%		7.5	

Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Appendix B

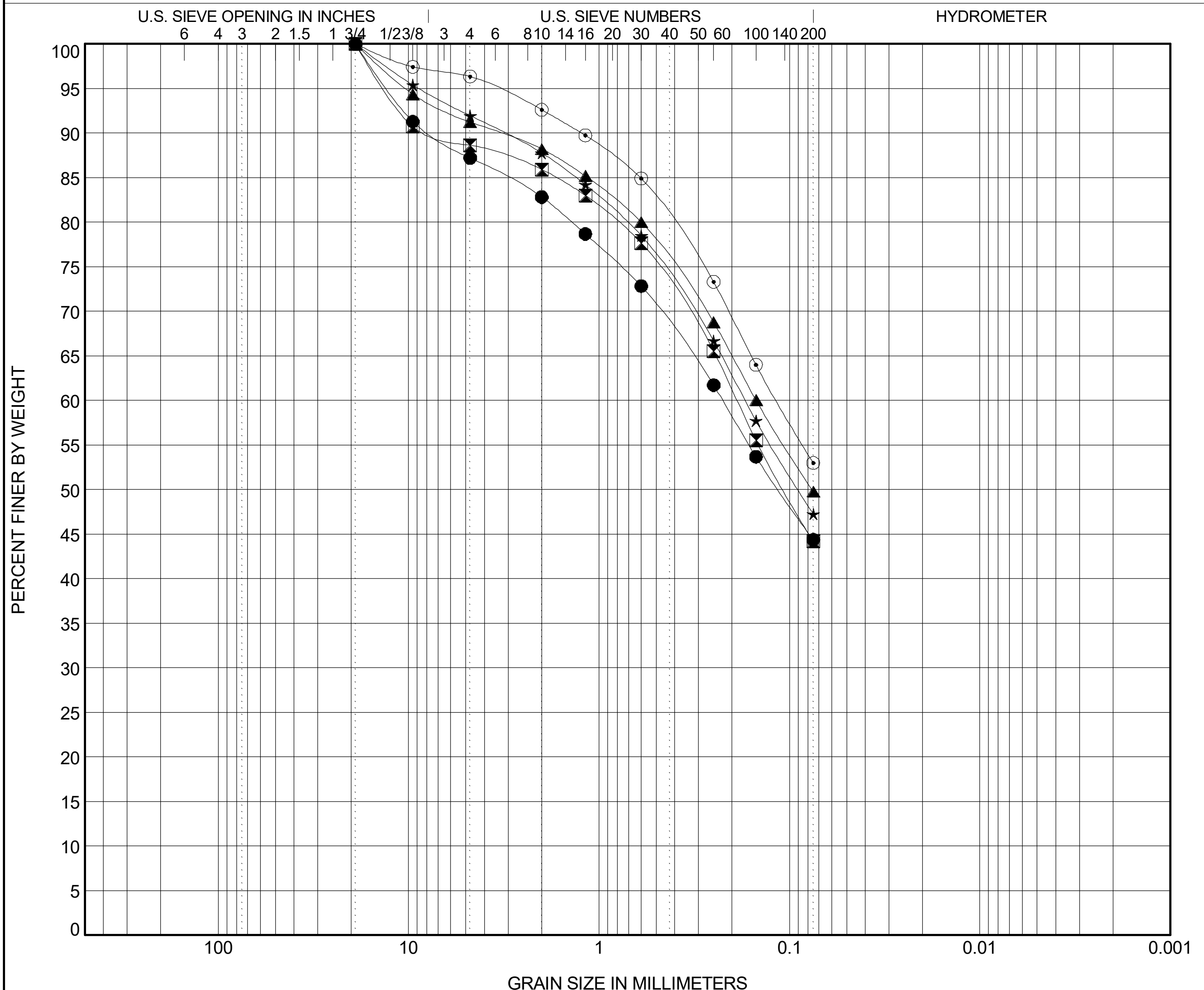
Laboratory Test Results

ES-7754

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-7754 **PROJECT NAME** 87th and 40th PRD



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● TP-01	5.00ft.	USDA: Gray Gravelly Loam. USCS: SM.		
⧗ TP-01	9.00ft.	USDA: Gray Slightly Gravelly Loam. USCS: SM.		
▲ TP-03	4.50ft.	USDA: Gray Slightly Gravelly Loam. USCS: SM.		
★ TP-03	8.00ft.	USDA: Gray Slightly Gravelly Loam. USCS: SM.		
⊙ TP-04	8.50ft.	USDA: Gray Slightly Gravelly Loam. USCS: Sandy ML.		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● TP-01	5.0ft.	19	0.224						44.4	
⧗ TP-01	9.0ft.	19	0.188						44.2	
▲ TP-03	4.5ft.	19	0.149						49.8	
★ TP-03	8.0ft.	19	0.171						47.3	
⊙ TP-04	8.5ft.	19	0.117						53.0	

Report Distribution

ES-7754

EMAIL ONLY

87th & 40th JV
P.O. Box 1930
Woodinville, Washington 98072

Attention: Mr. Mike Reid

Area of Interest (AOI) | **Soil Map** | Soil

Search

Map Unit Legend

Snohomish County Area, Washington (WA661)

Snohomish County Area, Washington (WA661)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
72	Tokul gravelly medial loam, 0 to 8 percent slopes	21.9	100.0%
Totals for Area of Interest		**21.9**	**100.0%**

Report — Map Unit Description

Snohomish County Area, Washington

72—Tokul gravelly medial loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t61k
Elevation: 160 to 1,150 feet
Mean annual precipitation: 45 to 70 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 140 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Tokul and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tokul

Setting

Landform: Hillslopes, till plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash mixed with loess over glacial till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oa - 1 to 2 inches: highly decomposed plant material
A - 2 to 6 inches: gravelly medial loam
Bs1 - 6 to 9 inches: gravelly medial loam
Bs2 - 9 to 17 inches: gravelly medial loam
Bs3 - 17 to 24 inches: gravelly medial loam
BC - 24 to 33 inches: gravelly medial fine sandy loam
2Bsm - 33 to 62 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 39 inches to densic material; 20 to 39 inches to cemented horizon
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: B
Ecological site: F002XA005WA - Puget Lowlands Moist Forest
Forage suitability group: Limited Depth Soils (G002XN302WA), Limited Depth Soils (G002XF303WA)
Other vegetative classification: Limited Depth Soils (G002XN302WA), Limited Depth Soils (G002XF303WA)
Hydric soil rating: No