Preliminary
Storm Drainage Report

FOR

COLVIN

3920 Densmore Road
Marysville, WA 98270

4/11/2022

Prepared for: Samuel Colvin
3920 Densmore Road
Marysville WA 98270

Approved by: **Preston Longoni, P.E.**
Prepared by: **Sydney Stanton, E.I.T., and Christian R. Vanderhoeven, E.I.T.**
Date: **April 2022**
Core No: **21387**

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

Table of Contents

Figures

Tables

Appendix

1. Project Overview

Project: Colvin

Project Parcel Information:

Property information for the project site is shown in the table below. See Figure 1-1: Vicinity Map for the exact location of the project site.

Table 1.1: Parcel Information		
Snohomish County Parcel #	**Parcel Address**	**Total Area (AC) = 4.29**
00590700023505	3920 Densmore Road Marysville, WA 98270	1.85
00590700024400	3920 Densmore Road Marysville, WA 98270	2.44

Existing Adjacent Development:

Existing development adjacent to the subject site includes the following:

North – Single-family residence.
East – Densmore Road
South –Single family residence.
West – Single family residence

Pre-developed Site Conditions:

The project site's current use is a single-family residence, two wood framed garages, a shed, and a gravel driveway used to access the site. The northern parcel contains a majority of the structures, only a small portion of the southernmost garage is located on the southern parcel. The site is mainly vegetated with grass and pasture with a few scattered trees.

Post-developed Site Conditions:

The project proposes to construct 28 lots with single-family residences. All existing structures on-site will be demolished and removed.

The site will be accessed from Densmore Road at the west property line of the project site. The project site is located in 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 east property boundary into a roadside swale on the west side of Densmore Road. Stormwater mitigation for the project includes an onsite combined detention/wet vault 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.

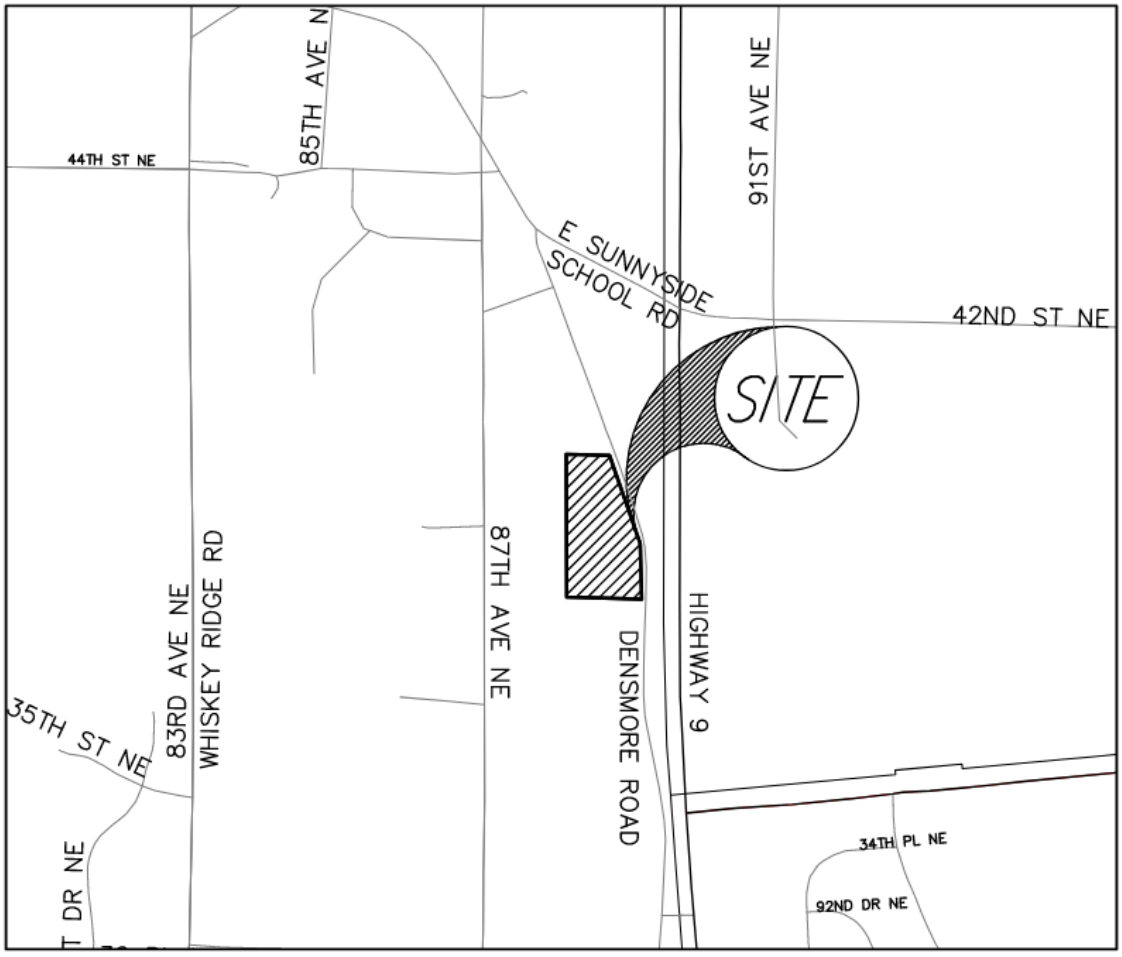


Figure 1.1 Vicinity Map

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. The project site is adding approximately 118,890 SF of new impervious surface. 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: This element will be addressed in Final Engineering.

Minimum Requirement #3: Source Control Pollution: This project is not classified as a commercial property, industrial property, multifamily property, boatyard, or sand and gravel mining operation, so the implementation of source control BMPs is not required.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: The project will maintain the natural discharge location. The natural discharge pattern to the east into a drainage ditch along Densmore Road.

Minimum Requirement #5: On-Site Stormwater Management: The project falls under minimum requirement #1 through #9 and is within UGA area, thus LID BMP from List #2 is chosen to comply with minimum requirement #5. An evaluation of the feasibility of each BMP from list #2 is provided in Section 4 of this report. The project will implement BMP T5.13: Post-Construction Soil Quality and Depth for any disturbed land.

Minimum Requirement #6: Runoff Treatment: Preliminary design of 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. A detention vault is proposed to meet this requirement.

Minimum Requirement #8: Wetlands Protection: There are no wetlands located onsite.

Minimum Requirement #9: Operation and Maintenance: This minimum requirement will be addressed in Final Design.

3. Off-Site Analysis

Upstream:

The parcel and adjacent properties west of the project site generally slope to the east. The entirety of the adjacent western properties are uphill of the site. Therefore, these parcels contribute runoff onto the project site via sheet flow. Grass cover with scattered trees are found on both the project site and adjacent parcels.

Downstream:

Date of Field Inspection: Friday, December 23, 2021
Weather Conditions: Partly cloudy, approximately 45 degrees Fahrenheit

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

The site currently consists of two parcels. The parcels consist of a single-family residence, a barn, 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 on site. 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.

Onsite stormwater is drained into the drainage ditch running along the eastern boundary of Densmore Road. Immediately after flowing north of the project site, the ditch outlets into a culvert which directs the flow path east underneath Densmore Road. The flow path crosses underneath Densmore Road east and outlets into thick forested cover. The flow path continues east down the hill for approximately 100 feet where it collects in a small southbound stream. The flow path continues along the stream southeast for approximately 250 feet until crossing underneath State Route 9 NE via culvert. After crossing underneath the highway, the flow path outlets directly into a creek which travels downhill east. This creek continues east until exceeding beyond the ¼ mile extent of the analysis.

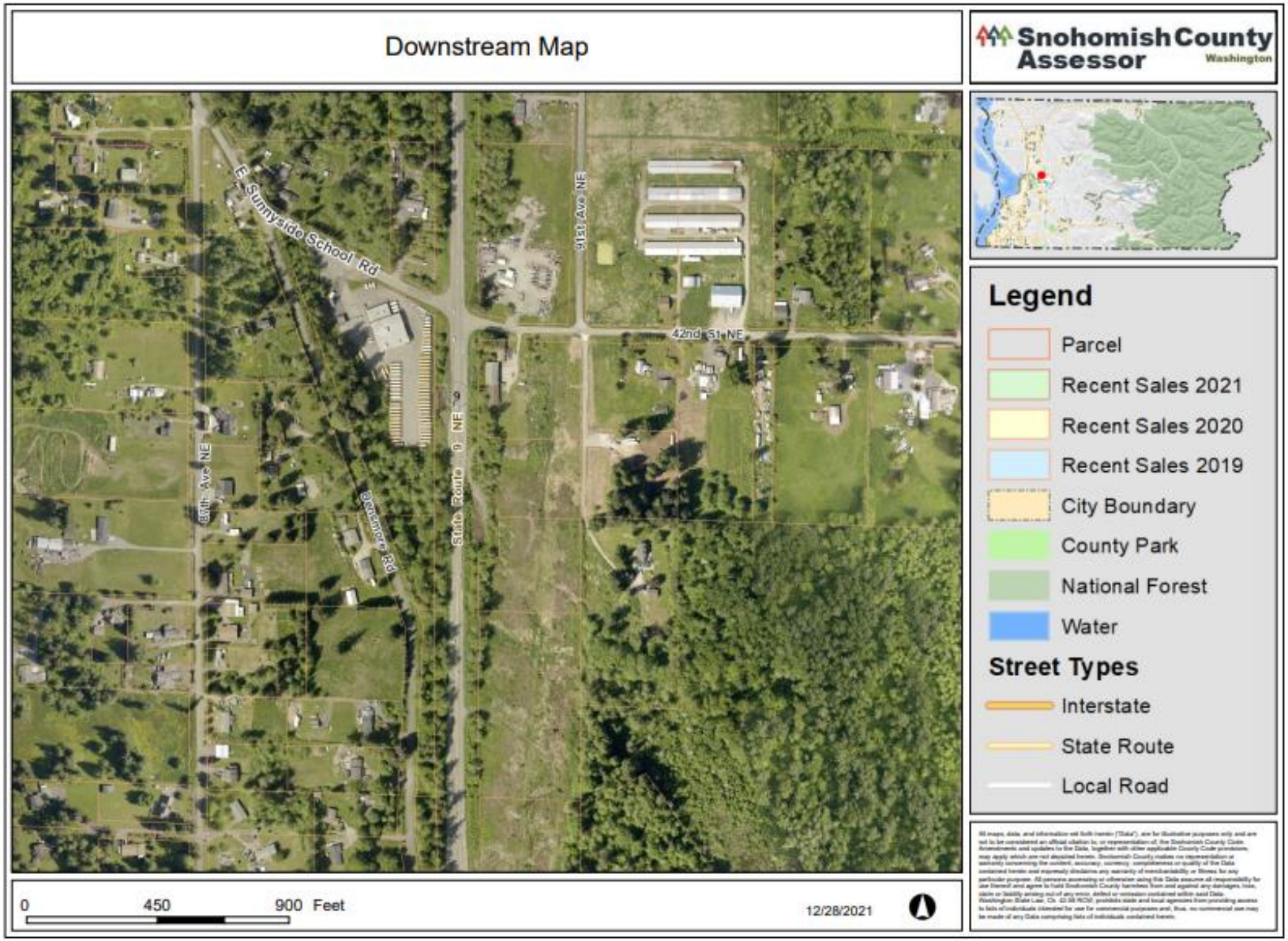


Figure 1 – Downstream Map

4. SECTION 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.

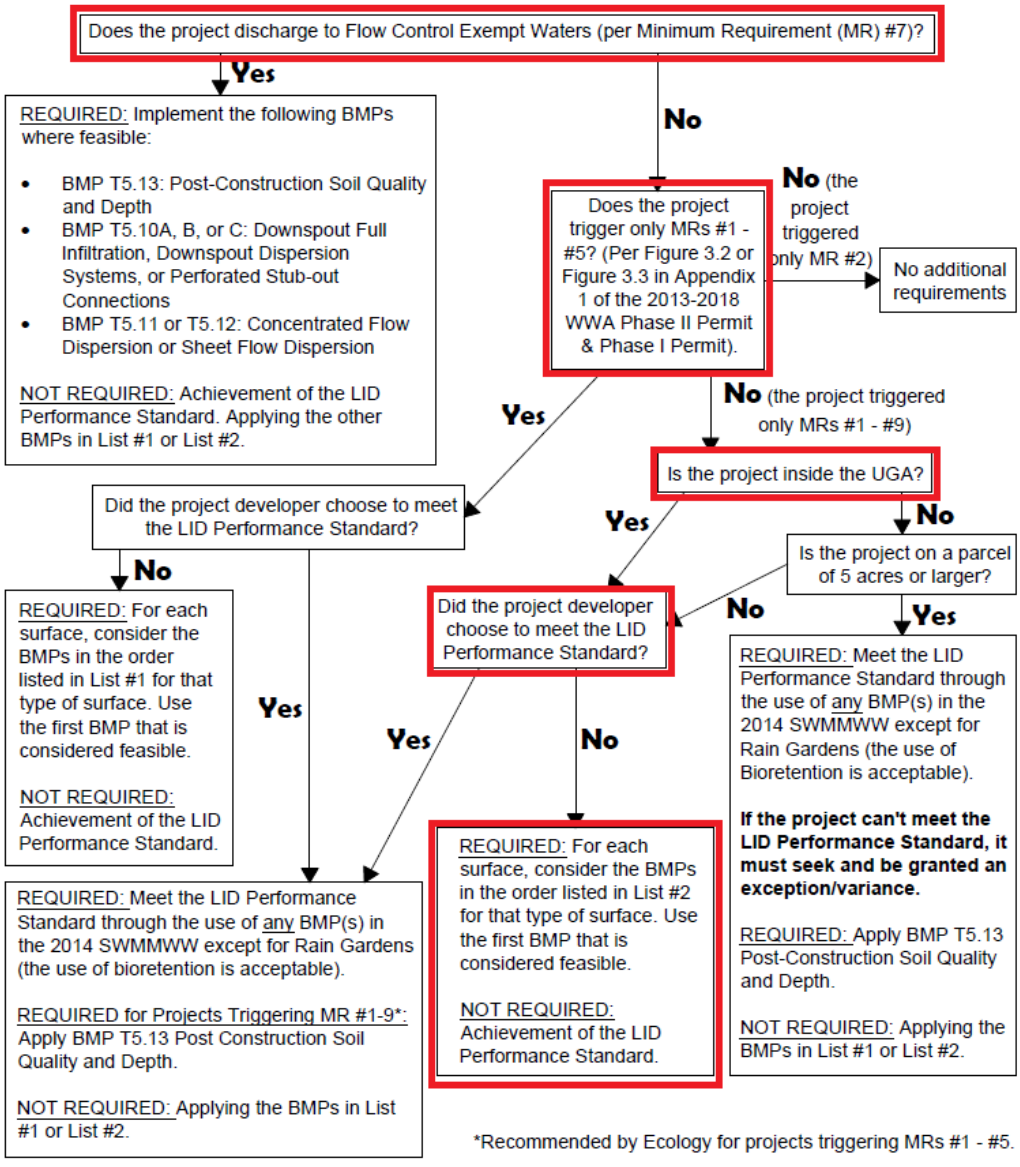


Figure 4.1: Flow Chart for Determining LID MR #5 Requirements

Site Soils

The NRCS classifies the soils on site as Tokul gravelly medial loam. This soil is associated with slow infiltration. The Geotechnical report performed by Earth Solutions NW, LLC dated February 14, 2022, states that the native soils consist of "silty sand with gravel (unifed Soil Classification, SM), sandy silt (ML), and silty gravel with sand (GM)." Groundwater seepage was observed at several of the test locations between three to six feet in depth. Per the infiltration evaluation, "infiltration testing yielded no appreciable infiltration during the procedure."

LID elements constructed on till soils do not typically perform well due to their reliance on 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 as per the geotechnical report infiltration is infeasible onsite.*

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 connection feasibility will be evaluated during final engineering.*

Other Hard Surfaces:

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: *Permeable Pavement is considered infeasible as per the geotechnical report infiltration is infeasible onsite.*

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: *Bioretention is considered infeasible as per the geotechnical report infiltration is infeasible onsite.*

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 flowpath 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 WWHM modeling program. Per the NRCS Soil Survey for Snohomish County, the site soils are Tokul gravelly medial loam. See USDA NRCS site soils map in Appendix C.

Existing Conditions

The project consists of 2 parcels that encompass a total area of 4.29 acres and connect to Densmore Road through a private gravel driveway. The parcel is currently occupied by a single-family residence, a wood-framed barn, a wood framed garage, and a small shed. The site is mainly vegetated with pasture, grass, and some shrubs. There are a few scattered trees located onsite. The site slopes consistently towards the east property line.

Table 4.1 Existing Condition Areas

Land Cover	**SF**	**AC**
Pervious	173,117	3.97
Impervious	13,591	0.31
Total	**186,708**	**4.29**

The areas will be modeled as the forested in the pre-developed condition per the SWMMWW. The pre-developed peak flow rates are included below. Refer to the WWHM report attached in Appendix B for more detail regarding the modeling of existing conditions.

EXISTING CONDITIONS
IMPERVIOUS: 0.31 ACRES
PERVIOUS: 3.97 ACRES
TOTAL: 4.29 ACRES

N19°55'42"W 441.72
447.71
N02°44'18"E 237.73
232.05
N87°53'39"W 327.46
N88°06'59"W 188.63
N00°14'53"W 646.86
N88°06'59"W 370.26
N87°53'39"W 340.29 REF.

SCALE: 1" = 50'
0 25 50 100

NO.	REVISIONS	DATE

CORE DESIGN
ENGINEERING • PLANNING • SURVEYING
12100 NE 195th St, Suite 300
Bothell, Washington 98011
425.885.7877 Fax 425.885.7963

EXISTING CONDITIONS
87th ASSEMBLAGE

DATE	JANUARY 2022
DESIGNED	SIDNEY M. STANTON
DRAWN	
APPROVED	
PROJECT MANAGER	

SHEET	OF
1	1

PROJECT NUMBER
21387

Developed Conditions

The project proposes the construction of 28 single-family residences with associated roads and utilities. The site will be accessed via a new street connected to Densmore Road. Concrete curb and gutter, landscape strip, and 5' sidewalk will be constructed along both sides of the road.

The project is located within the Lake Stevens subbasin. Refer to Appendix A for Snohomish County Sub-Basin Map. Stormwater mitigation for the project includes one on-site detention/water quality vault. The performance standard for the combination detention/water quality vault 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 detention and water quality system has been sized based on the 2014 SMMWW using WWHM, an approved continuous runoff model per the manual.

The tables below present the area breakdown for the onsite and offsite developed condition basins. The impervious areas for the lots were calculated based on the maximum impervious coverage allowed by zoning which is 70% of the lot areas.

Table 4.2 Developed Condition Areas		
Land Cover	**SF**	**AC**
Pervious	70,494	1.60
Impervious	116,431	2.69
Total	186,708	**4.29**

The areas from the above tables have been input into WWHM for modeling of the developed site to size the detention facility.

DEVELOPED CONDITIONS
IMPERVIOUS: 2.69 ACRES
PERVIOUS: 1.60 ACRES
TOTAL: 4.29 ACRES

PARCEL B
5,760

TRACT B
30,030

TRACT D
1,770

SCALE: 1" = 50'

0 25 50 100

12100 NE 195th St, Suite 300
Bothell, Washington 98011
425.885.7877 Fax 425.885.7963

CORE DESIGN
ENGINEERING • PLANNING • SURVEYING

NO. | REVISIONS | DATE

DEVELOPED CONDITIONS
87th ASSEMBLAGE

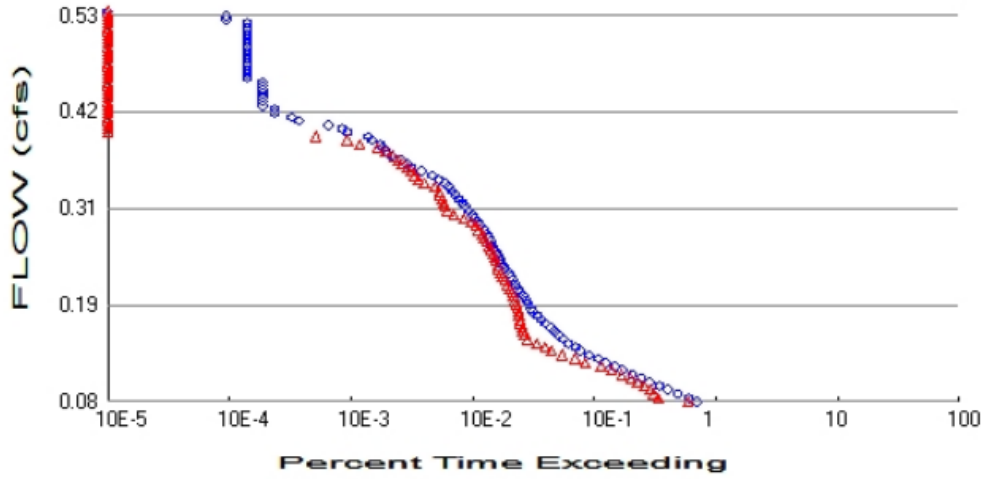
DATE APRIL 2022
DESIGNED SIDNEY M. STANTON
DRAWN
APPROVED
PROJECT MANAGER

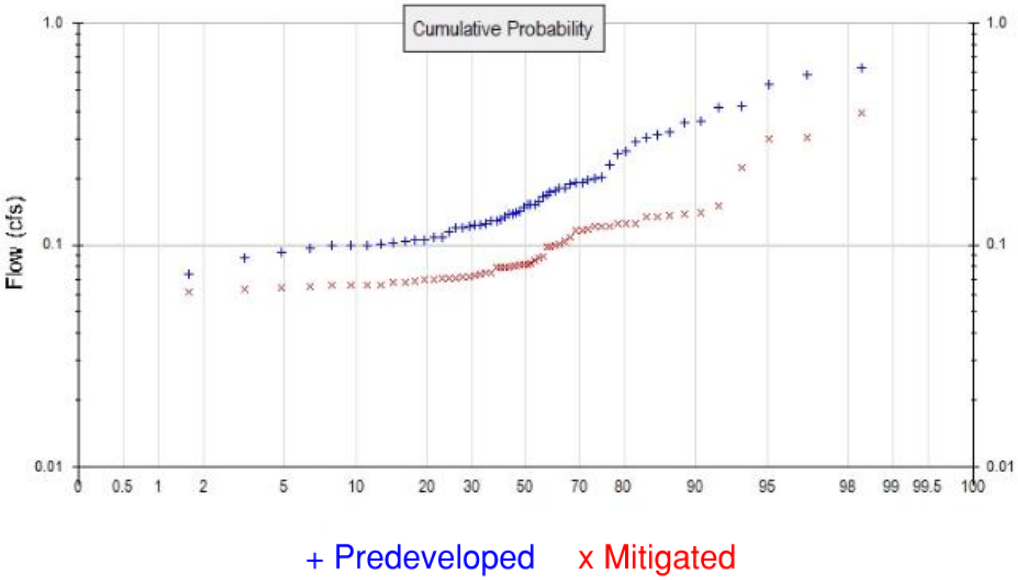
SHEET 1 OF 1

PROJECT NUMBER 21387

C. Detention Calculations

The drainage analysis for detention vault sizing was modeled using the WWHM modeling software, an approved continuous runoff model per the 2014 SMMWW. Per 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. In addition, the pre-developed 2- and 10-year peak flow rates must not be exceeded in developed condition. The output graphs from WWHM for each condition are included below and show that the detention vault meets these requirements.





The vault details are provided below.

Vault 1

Width:	64 ft.	
Length:	106 ft.	
Depth:	11 ft.	
Discharge Structure		
Riser Height:	10 ft.	
Riser Diameter:	18 in.	
Orifice 1 Diameter:	1.188 in.	Elevation:0 ft.
Orifice 2 Diameter:	1.188 in.	Elevation:4.7 ft.
Orifice 3 Diameter:	2 in.	Elevation:6.8 ft.
Element Flows To:		
Outlet 1	Outlet 2	

Refer to the full WWHM report in Appendix B.

D. Wet Vault (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. The proposed volume is based on a depth of 4' in the first cell of the detention/wet vault, a 22' cell width, and a cell length of 62'. The required volume was calculated using WWHM and is shown in the table below. Note that the provided volume is greater than the required volume, meeting the water quality requirement for this site. Refer to the full WWHM report located in the Appendix.

Table 4.3: DEAD STORAGE VOLUME

Facility	Required volume	Proposed Volume
Detention/Wet Vault	0.0682 acre-ft	0.094 acre-ft

5. Conveyance System Analysis and Design

Conveyance system analysis and design will be provided in 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.

- Phase 1 Environmental Site Assessment
  Preformed for: Colvin Property
  3920 Densmore Road
  Marysville, WA
  Performed by: Earth Solutions NW, LLC
  Dated: January 11, 2022
- Geotechnical Engineering Study
  Prepared for: Colvin Property
  3920 Densmore Road
  Marysville, WA
  Performed by: Earth Solutions NW, LLC
  Dated: February 14, 2022

7. Erosion and Sedimentation Control Analysis and Design

Erosion and Sedimentation Control Analysis and Design will be provided in Final Engineering.

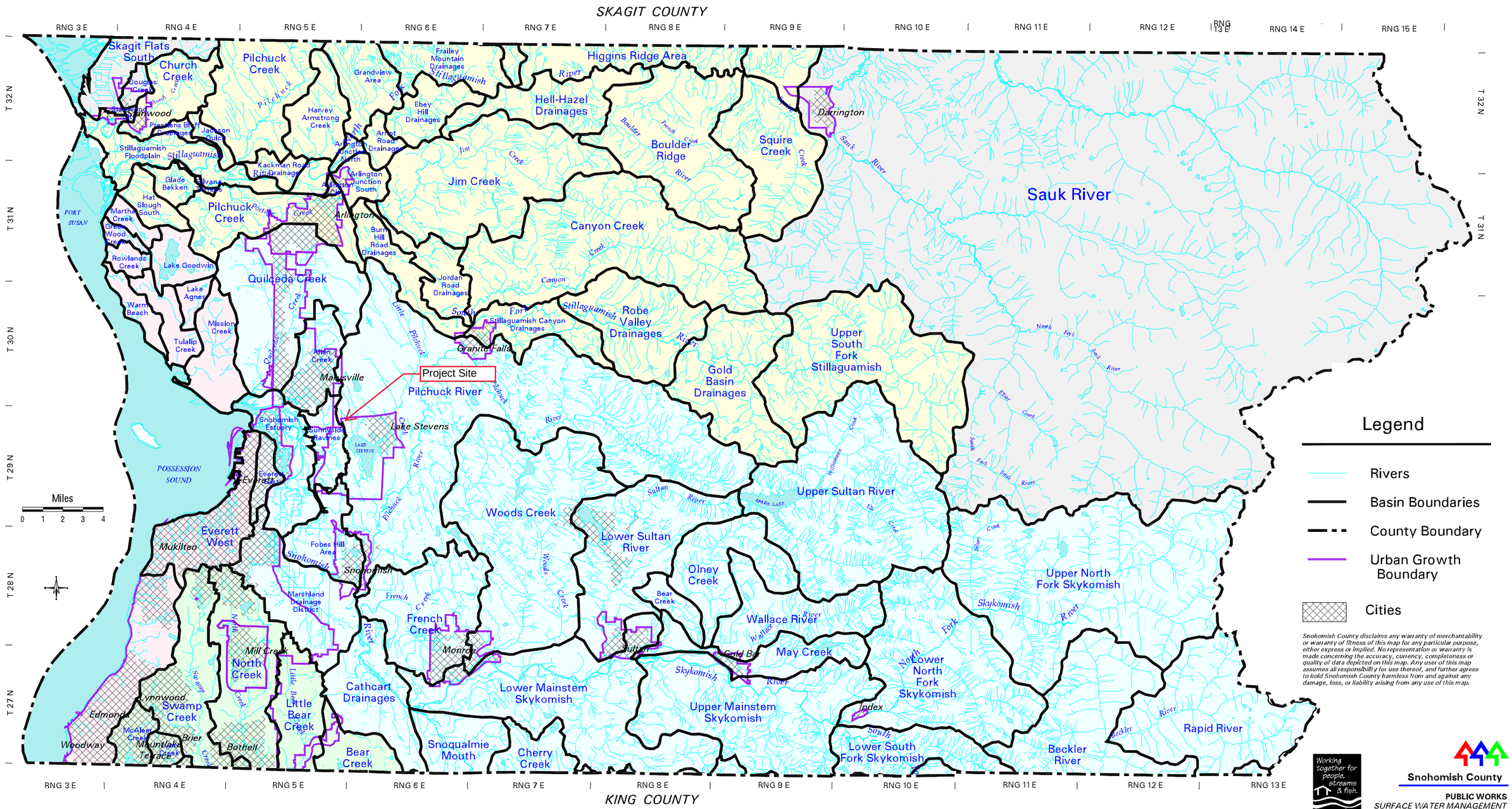
8. Operations and Maintenance Manual

Operations and Maintenance Manual will be provided in Final Engineering.

Appendix A

Drainage Basin Map

Snohomish County Sub-Basins



Legend

- Rivers
- Basin Boundaries
- County Boundary
- Urban Growth Boundary
- Cities

Working together for people, streams & fish.

Snohomish County
PUBLIC WORKS
SURFACE WATER MANAGEMENT
(425) 388-3464

State Plane Zone 5601, NAD 83, Units Feet

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

Appendix B

WWHM Results

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	21387 Preliminary Vault
Site Name:	Colvin
Site Address:	
City:	Marysville
Report Date:	4/4/2022
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

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C, Forest, Mod	4.29
Pervious Total	4.29

Impervious Land Use	Acres
Impervious Total	0
Basin Total	4.29

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C, Lawn, Mod	1.599
Pervious Total	1.599

Impervious Land Use	Acres
ROADS MOD	0.763
ROOF TOPS FLAT	1.929
Impervious Total	2.692
Basin Total	4.291

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 1

Width: 64 ft.
Length: 106 ft.
Depth: 11 ft.
Discharge Structure
Riser Height: 10 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.188 in. Elevation:0 ft.
Orifice 2 Diameter: 1.188 in. Elevation:4.7 ft.
Orifice 3 Diameter: 2 in. Elevation:6.8 ft.
Element Flows To:
Outlet 1 Outlet 2

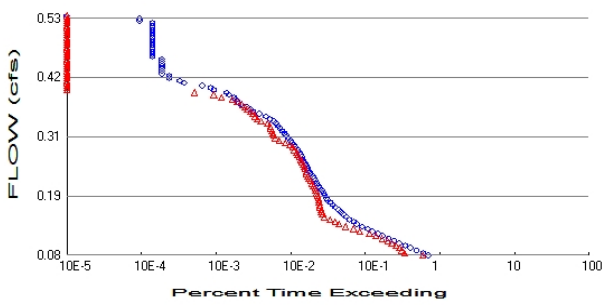
Vault Hydraulic Table

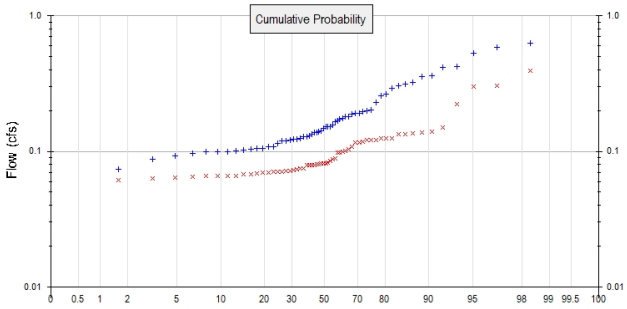
Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.155	0.000	0.000	0.000
0.1222	0.155	0.019	0.013	0.000
0.2444	0.155	0.038	0.018	0.000
0.3667	0.155	0.057	0.023	0.000
0.4889	0.155	0.076	0.026	0.000
0.6111	0.155	0.095	0.029	0.000
0.7333	0.155	0.114	0.032	0.000
0.8556	0.155	0.133	0.035	0.000
0.9778	0.155	0.152	0.037	0.000
1.1000	0.155	0.171	0.040	0.000
1.2222	0.155	0.190	0.042	0.000
1.3444	0.155	0.209	0.044	0.000
1.4667	0.155	0.228	0.046	0.000
1.5889	0.155	0.247	0.048	0.000
1.7111	0.155	0.266	0.050	0.000
1.8333	0.155	0.285	0.051	0.000
1.9556	0.155	0.304	0.053	0.000
2.0778	0.155	0.323	0.055	0.000
2.2000	0.155	0.342	0.056	0.000
2.3222	0.155	0.361	0.058	0.000
2.4444	0.155	0.380	0.059	0.000
2.5667	0.155	0.399	0.061	0.000
2.6889	0.155	0.418	0.062	0.000
2.8111	0.155	0.437	0.064	0.000
2.9333	0.155	0.456	0.065	0.000
3.0556	0.155	0.475	0.066	0.000
3.1778	0.155	0.494	0.068	0.000
3.3000	0.155	0.513	0.069	0.000
3.4222	0.155	0.533	0.070	0.000
3.5444	0.155	0.552	0.072	0.000
3.6667	0.155	0.571	0.073	0.000
3.7889	0.155	0.590	0.074	0.000
3.9111	0.155	0.609	0.075	0.000
4.0333	0.155	0.628	0.076	0.000
4.1556	0.155	0.647	0.078	0.000
4.2778	0.155	0.666	0.079	0.000
4.4000	0.155	0.685	0.080	0.000
4.5222	0.155	0.704	0.081	0.000

4.6444	0.155	0.723	0.082	0.000
4.7667	0.155	0.742	0.093	0.000
4.8889	0.155	0.761	0.101	0.000
5.0111	0.155	0.780	0.107	0.000
5.1333	0.155	0.799	0.112	0.000
5.2556	0.155	0.818	0.116	0.000
5.3778	0.155	0.837	0.120	0.000
5.5000	0.155	0.856	0.124	0.000
5.6222	0.155	0.875	0.127	0.000
5.7444	0.155	0.894	0.130	0.000
5.8667	0.155	0.913	0.134	0.000
5.9889	0.155	0.932	0.137	0.000
6.1111	0.155	0.951	0.140	0.000
6.2333	0.155	0.970	0.143	0.000
6.3556	0.155	0.989	0.145	0.000
6.4778	0.155	1.008	0.148	0.000
6.6000	0.155	1.027	0.151	0.000
6.7222	0.155	1.046	0.153	0.000
6.8444	0.155	1.065	0.179	0.000
6.9667	0.155	1.085	0.203	0.000
7.0889	0.155	1.104	0.219	0.000
7.2111	0.155	1.123	0.233	0.000
7.3333	0.155	1.142	0.245	0.000
7.4556	0.155	1.161	0.256	0.000
7.5778	0.155	1.180	0.266	0.000
7.7000	0.155	1.199	0.275	0.000
7.8222	0.155	1.218	0.284	0.000
7.9444	0.155	1.237	0.293	0.000
8.0667	0.155	1.256	0.301	0.000
8.1889	0.155	1.275	0.309	0.000
8.3111	0.155	1.294	0.316	0.000
8.4333	0.155	1.313	0.323	0.000
8.5556	0.155	1.332	0.331	0.000
8.6778	0.155	1.351	0.338	0.000
8.8000	0.155	1.370	0.344	0.000
8.9222	0.155	1.389	0.351	0.000
9.0444	0.155	1.408	0.357	0.000
9.1667	0.155	1.427	0.363	0.000
9.2889	0.155	1.446	0.370	0.000
9.4111	0.155	1.465	0.376	0.000
9.5333	0.155	1.484	0.381	0.000
9.6556	0.155	1.503	0.387	0.000
9.7778	0.155	1.522	0.393	0.000
9.9000	0.155	1.541	0.399	0.000
10.022	0.155	1.560	0.457	0.000
10.144	0.155	1.579	1.278	0.000
10.267	0.155	1.598	2.539	0.000
10.389	0.155	1.618	3.930	0.000
10.511	0.155	1.637	5.163	0.000
10.633	0.155	1.656	6.023	0.000
10.756	0.155	1.675	6.595	0.000
10.878	0.155	1.694	7.080	0.000
11.000	0.155	1.713	7.532	0.000
11.122	0.155	1.732	7.957	0.000
11.244	0.000	0.000	8.360	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 4.29
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.599
Total Impervious Area: 2.692

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.158584
5 year	0.253601
10 year	0.329208
25 year	0.440065
50 year	0.534363
100 year	0.639205

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.089687
5 year	0.129771
10 year	0.162593
25 year	0.212156
50 year	0.255606
100 year	0.305242

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.176	0.073
1950	0.179	0.082
1951	0.152	0.070
1952	0.123	0.066
1953	0.100	0.066
1954	0.627	0.079
1955	0.190	0.121
1956	0.166	0.133
1957	0.230	0.116
1958	0.200	0.074

1959	0.156	0.081
1960	0.152	0.098
1961	0.315	0.120
1962	0.152	0.070
1963	0.257	0.071
1964	0.202	0.061
1965	0.125	0.088
1966	0.073	0.069
1967	0.149	0.071
1968	0.181	0.108
1969	0.587	0.074
1970	0.104	0.071
1971	0.195	0.139
1972	0.121	0.079
1973	0.119	0.080
1974	0.321	0.079
1975	0.123	0.066
1976	0.129	0.079
1977	0.093	0.072
1978	0.108	0.066
1979	0.359	0.075
1980	0.168	0.065
1981	0.106	0.068
1982	0.137	0.126
1983	0.291	0.070
1984	0.142	0.150
1985	0.189	0.121
1986	0.424	0.306
1987	0.192	0.222
1988	0.099	0.125
1989	0.128	0.064
1990	0.134	0.117
1991	0.138	0.085
1992	0.105	0.101
1993	0.101	0.063
1994	0.096	0.087
1995	0.141	0.133
1996	0.265	0.125
1997	0.526	0.394
1998	0.088	0.068
1999	0.115	0.099
2000	0.100	0.140
2001	0.035	0.055
2002	0.131	0.100
2003	0.102	0.081
2004	0.172	0.135
2005	0.120	0.081
2006	0.414	0.118
2007	0.306	0.104
2008	0.355	0.300
2009	0.108	0.082

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.6274	0.3937
2	0.5870	0.3056
3	0.5262	0.3003

4	0.4243	0.2216
5	0.4139	0.1502
6	0.3593	0.1402
7	0.3550	0.1387
8	0.3208	0.1352
9	0.3146	0.1334
10	0.3058	0.1331
11	0.2913	0.1255
12	0.2652	0.1247
13	0.2567	0.1247
14	0.2302	0.1209
15	0.2024	0.1209
16	0.2003	0.1205
17	0.1953	0.1182
18	0.1919	0.1165
19	0.1900	0.1158
20	0.1889	0.1076
21	0.1814	0.1041
22	0.1792	0.1009
23	0.1764	0.0998
24	0.1723	0.0987
25	0.1683	0.0982
26	0.1661	0.0884
27	0.1564	0.0871
28	0.1522	0.0855
29	0.1517	0.0823
30	0.1516	0.0817
31	0.1488	0.0812
32	0.1415	0.0808
33	0.1407	0.0806
34	0.1383	0.0802
35	0.1373	0.0793
36	0.1343	0.0791
37	0.1308	0.0788
38	0.1289	0.0786
39	0.1277	0.0746
40	0.1251	0.0743
41	0.1233	0.0740
42	0.1227	0.0732
43	0.1205	0.0720
44	0.1200	0.0714
45	0.1187	0.0707
46	0.1147	0.0706
47	0.1084	0.0702
48	0.1081	0.0697
49	0.1058	0.0696
50	0.1054	0.0691
51	0.1036	0.0682
52	0.1025	0.0677
53	0.1009	0.0662
54	0.1001	0.0661
55	0.0998	0.0659
56	0.0994	0.0658
57	0.0960	0.0646
58	0.0930	0.0637
59	0.0879	0.0628
60	0.0734	0.0615
61	0.0346	0.0549

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0793	14938	12634	84	Pass
0.0839	12793	7193	56	Pass
0.0885	10404	6613	63	Pass
0.0931	8575	6102	71	Pass
0.0977	7321	5493	75	Pass
0.1023	6008	4849	80	Pass
0.1069	5174	4284	82	Pass
0.1115	4342	3606	83	Pass
0.1161	3600	2954	82	Pass
0.1207	3136	2438	77	Pass
0.1253	2652	1805	68	Pass
0.1299	2327	1499	64	Pass
0.1345	1948	1157	59	Pass
0.1390	1645	949	57	Pass
0.1436	1491	843	56	Pass
0.1482	1309	720	55	Pass
0.1528	1195	606	50	Pass
0.1574	1083	562	51	Pass
0.1620	1001	552	55	Pass
0.1666	935	543	58	Pass
0.1712	841	534	63	Pass
0.1758	789	526	66	Pass
0.1804	723	516	71	Pass
0.1850	672	508	75	Pass
0.1896	637	499	78	Pass
0.1942	610	488	80	Pass
0.1988	589	476	80	Pass
0.2034	553	464	83	Pass
0.2080	523	452	86	Pass
0.2126	500	429	85	Pass
0.2172	480	410	85	Pass
0.2218	457	392	85	Pass
0.2264	437	374	85	Pass
0.2310	420	364	86	Pass
0.2356	398	350	87	Pass
0.2402	382	341	89	Pass
0.2448	365	333	91	Pass
0.2494	349	322	92	Pass
0.2540	338	313	92	Pass
0.2586	324	304	93	Pass
0.2632	312	290	92	Pass
0.2678	300	278	92	Pass
0.2724	288	265	92	Pass
0.2769	279	256	91	Pass
0.2815	265	241	90	Pass
0.2861	245	226	92	Pass
0.2907	237	207	87	Pass
0.2953	222	179	80	Pass
0.2999	212	149	70	Pass
0.3045	198	134	67	Pass
0.3091	187	126	67	Pass
0.3137	175	123	70	Pass
0.3183	164	119	72	Pass

0.3229	154	116	75	Pass
0.3275	146	113	77	Pass
0.3321	135	103	76	Pass
0.3367	126	85	67	Pass
0.3413	112	76	67	Pass
0.3459	99	72	72	Pass
0.3505	80	67	83	Pass
0.3551	67	62	92	Pass
0.3597	62	56	90	Pass
0.3643	55	52	94	Pass
0.3689	46	48	104	Pass
0.3735	41	41	100	Pass
0.3781	39	35	89	Pass
0.3827	37	25	67	Pass
0.3873	32	20	62	Pass
0.3919	30	11	36	Pass
0.3965	20	0	0	Pass
0.4011	18	0	0	Pass
0.4057	14	0	0	Pass
0.4103	8	0	0	Pass
0.4148	7	0	0	Pass
0.4194	5	0	0	Pass
0.4240	5	0	0	Pass
0.4286	4	0	0	Pass
0.4332	4	0	0	Pass
0.4378	4	0	0	Pass
0.4424	4	0	0	Pass
0.4470	4	0	0	Pass
0.4516	4	0	0	Pass
0.4562	4	0	0	Pass
0.4608	3	0	0	Pass
0.4654	3	0	0	Pass
0.4700	3	0	0	Pass
0.4746	3	0	0	Pass
0.4792	3	0	0	Pass
0.4838	3	0	0	Pass
0.4884	3	0	0	Pass
0.4930	3	0	0	Pass
0.4976	3	0	0	Pass
0.5022	3	0	0	Pass
0.5068	3	0	0	Pass
0.5114	3	0	0	Pass
0.5160	3	0	0	Pass
0.5206	3	0	0	Pass
0.5252	3	0	0	Pass
0.5298	2	0	0	Pass
0.5344	2	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.1347 acre-feet
On-line facility target flow:	0.0682 cfs.
Adjusted for 15 min:	0.0682 cfs.
Off-line facility target flow:	0.0448 cfs.
Adjusted for 15 min:	0.0448 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 1 POC	☐	633.74			☐	0.00			
Total Volume Infiltrated		633.74	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.

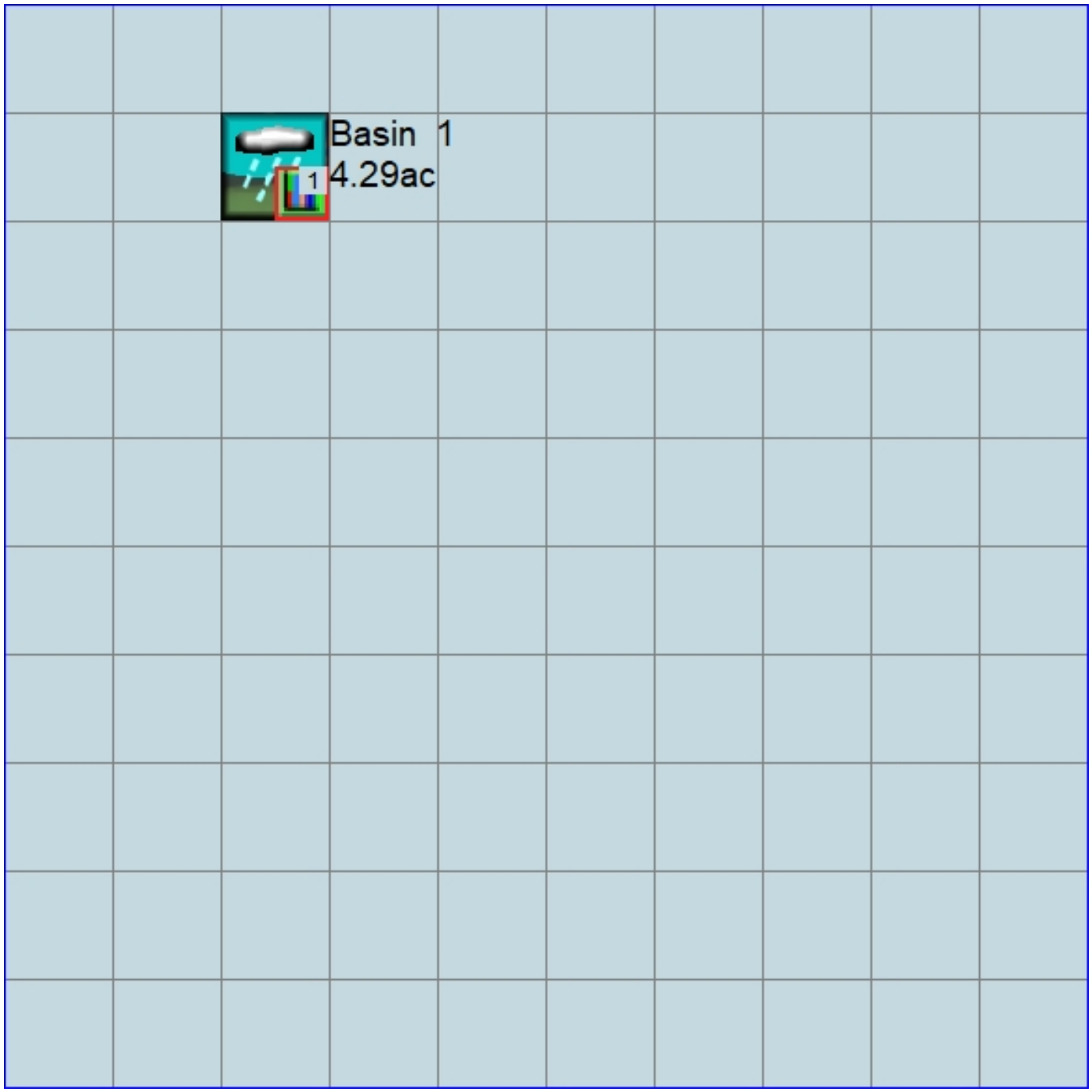
PERLND Changes

No PERLND changes have been made.

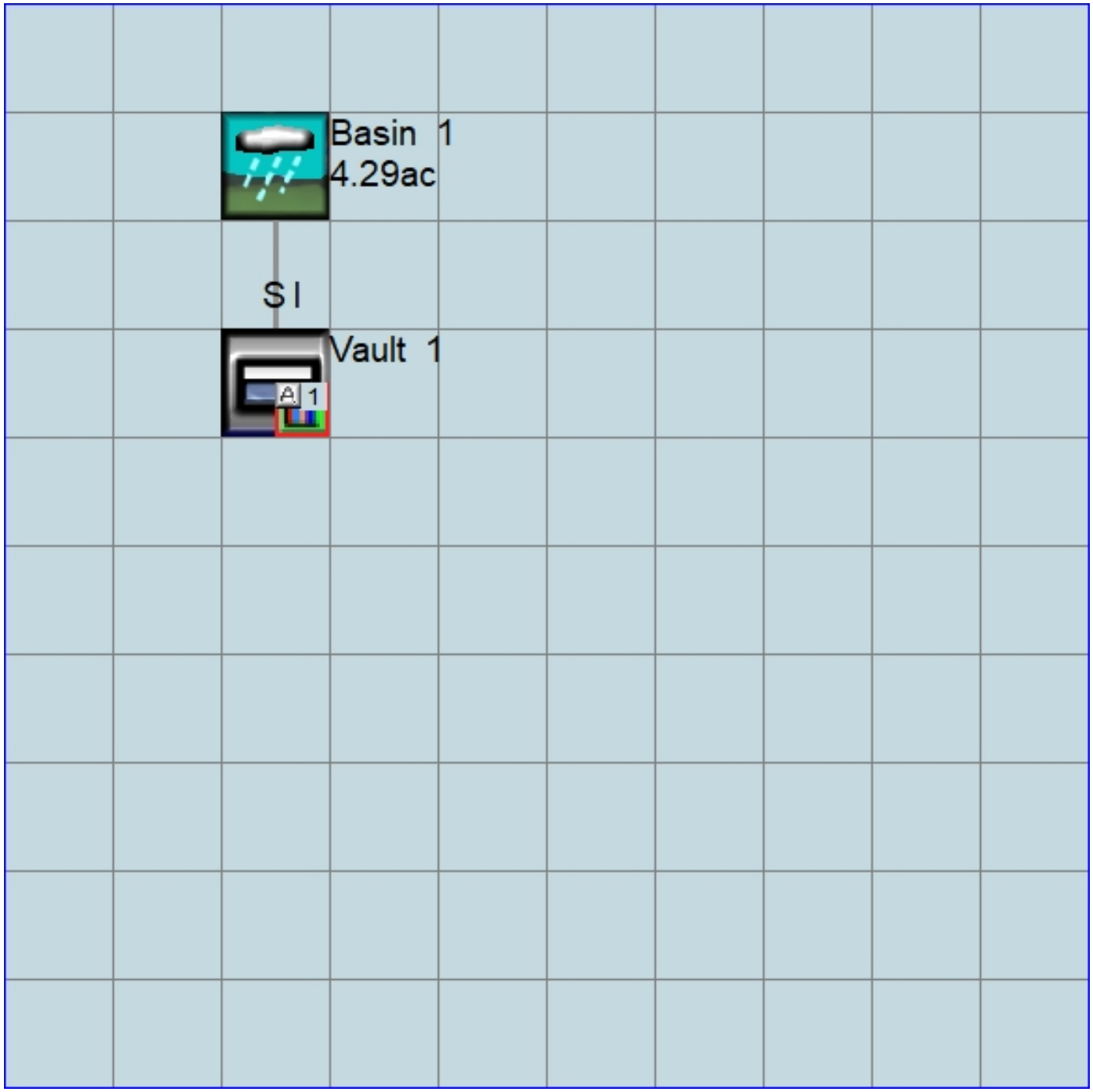
IMPLND Changes

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   21387 Preliminary Vault.wdm
MESSU      25   Pre21387 Preliminary Vault.MES
           27   Pre21387 Preliminary Vault.L61
           28   Pre21387 Preliminary Vault.L62
           30   POC21387 Preliminary Vault1.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        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
   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#   ***
Basin  1***
PERLND  11                        4.29     COPY   501     12
PERLND  11                        4.29     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   21387 Preliminary Vault.wdm
MESSU       25   Mit21387 Preliminary Vault.MES
            27   Mit21387 Preliminary Vault.L61
            28   Mit21387 Preliminary Vault.L62
            30   POC21387 Preliminary Vault1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      17
      IMPLND       2
      IMPLND       4
      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  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   17     C, Lawn, 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 ***
   17         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  *********
   17         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 ***
   17         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
   17             0       4.5      0.03       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
   17             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   17           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
   17             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           ***
    2      ROADS/MOD              1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
    4         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     ***
    2         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

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

```
    2            400      0.05       0.1      0.08
    4            400      0.01       0.1       0.1
  END IWAT-PARM2

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

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

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  17                      1.599     RCHRES   1      2
PERLND  17                      1.599     RCHRES   1      3
IMPLND   2                      0.763     RCHRES   1      5
IMPLND   4                      1.929     RCHRES   1      5

******Routing******
PERLND  17                      1.599     COPY     1     12
IMPLND   2                      0.763     COPY     1     15
IMPLND   4                      1.929     COPY     1     15
PERLND  17                      1.599     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  1                1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

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

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

  HYDR-PARM1
```

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

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.02       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
   92    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.155739  0.000000  0.000000
  0.122222  0.155739  0.019035  0.013390
  0.244444  0.155739  0.038070  0.018936
  0.366667  0.155739  0.057104  0.023191
  0.488889  0.155739  0.076139  0.026779
  0.611111  0.155739  0.095174  0.029940
  0.733333  0.155739  0.114209  0.032798
  0.855556  0.155739  0.133244  0.035425
  0.977778  0.155739  0.152278  0.037871
  1.100000  0.155739  0.171313  0.040169
  1.222222  0.155739  0.190348  0.042342
  1.344444  0.155739  0.209383  0.044408
  1.466667  0.155739  0.228418  0.046383
  1.588889  0.155739  0.247452  0.048277
  1.711111  0.155739  0.266487  0.050099
  1.833333  0.155739  0.285522  0.051858
  1.955556  0.155739  0.304557  0.053558
  2.077778  0.155739  0.323591  0.055207
  2.200000  0.155739  0.342626  0.056807
  2.322222  0.155739  0.361661  0.058364
  2.444444  0.155739  0.380696  0.059880
  2.566667  0.155739  0.399731  0.061359
  2.688889  0.155739  0.418765  0.062803
  2.811111  0.155739  0.437800  0.064214
  2.933333  0.155739  0.456835  0.065595
  3.055556  0.155739  0.475870  0.066948
  3.177778  0.155739  0.494905  0.068274
  3.300000  0.155739  0.513939  0.069574
  3.422222  0.155739  0.532974  0.070851
  3.544444  0.155739  0.552009  0.072105
  3.666667  0.155739  0.571044  0.073338
  3.788889  0.155739  0.590079  0.074550
  3.911111  0.155739  0.609113  0.075743
  4.033333  0.155739  0.628148  0.076917
  4.155556  0.155739  0.647183  0.078074
  4.277778  0.155739  0.666218  0.079214
  4.400000  0.155739  0.685253  0.080337
  4.522222  0.155739  0.704287  0.081446
  4.644444  0.155739  0.723322  0.082539
  4.766667  0.155739  0.742357  0.093507
  4.888889  0.155739  0.761392  0.101329
  5.011111  0.155739  0.780426  0.107097
```

```
  5.133333  0.155739  0.799461  0.111986
  5.255556  0.155739  0.818496  0.116348
  5.377778  0.155739  0.837531  0.120347
  5.500000  0.155739  0.856566  0.124076
  5.622222  0.155739  0.875600  0.127592
  5.744444  0.155739  0.894635  0.130935
  5.866667  0.155739  0.913670  0.134134
  5.988889  0.155739  0.932705  0.137208
  6.111111  0.155739  0.951740  0.140174
  6.233333  0.155739  0.970774  0.143046
  6.355556  0.155739  0.989809  0.145833
  6.477778  0.155739  1.008844  0.148543
  6.600000  0.155739  1.027879  0.151185
  6.722222  0.155739  1.046914  0.153763
  6.844444  0.155739  1.065948  0.179167
  6.966667  0.155739  1.084983  0.203065
  7.088889  0.155739  1.104018  0.219510
  7.211111  0.155739  1.123053  0.233137
  7.333333  0.155739  1.142088  0.245137
  7.455556  0.155739  1.161122  0.256039
  7.577778  0.155739  1.180157  0.266130
  7.700000  0.155739  1.199192  0.275590
  7.822222  0.155739  1.218227  0.284538
  7.944444  0.155739  1.237262  0.293059
  8.066667  0.155739  1.256296  0.301217
  8.188889  0.155739  1.275331  0.309060
  8.311111  0.155739  1.294366  0.316627
  8.433333  0.155739  1.313401  0.323949
  8.555556  0.155739  1.332435  0.331050
  8.677778  0.155739  1.351470  0.337953
  8.800000  0.155739  1.370505  0.344674
  8.922222  0.155739  1.389540  0.351228
  9.044444  0.155739  1.408575  0.357630
  9.166667  0.155739  1.427609  0.363890
  9.288889  0.155739  1.446644  0.370018
  9.411111  0.155739  1.465679  0.376023
  9.533333  0.155739  1.484714  0.381913
  9.655556  0.155739  1.503749  0.387695
  9.777778  0.155739  1.522783  0.393375
  9.900000  0.155739  1.541818  0.398959
  10.02222  0.155739  1.560853  0.457189
  10.14444  0.155739  1.579888  1.278850
  10.26667  0.155739  1.598923  2.539008
  10.38889  0.155739  1.617957  3.930351
  10.51111  0.155739  1.636992  5.162995
  10.63333  0.155739  1.656027  6.023041
  10.75556  0.155739  1.675062  6.595660
  10.87778  0.155739  1.694097  7.080190
  11.00000  0.155739  1.713131  7.532278
  11.12222  0.155739  1.732166  7.957717
  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

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages.

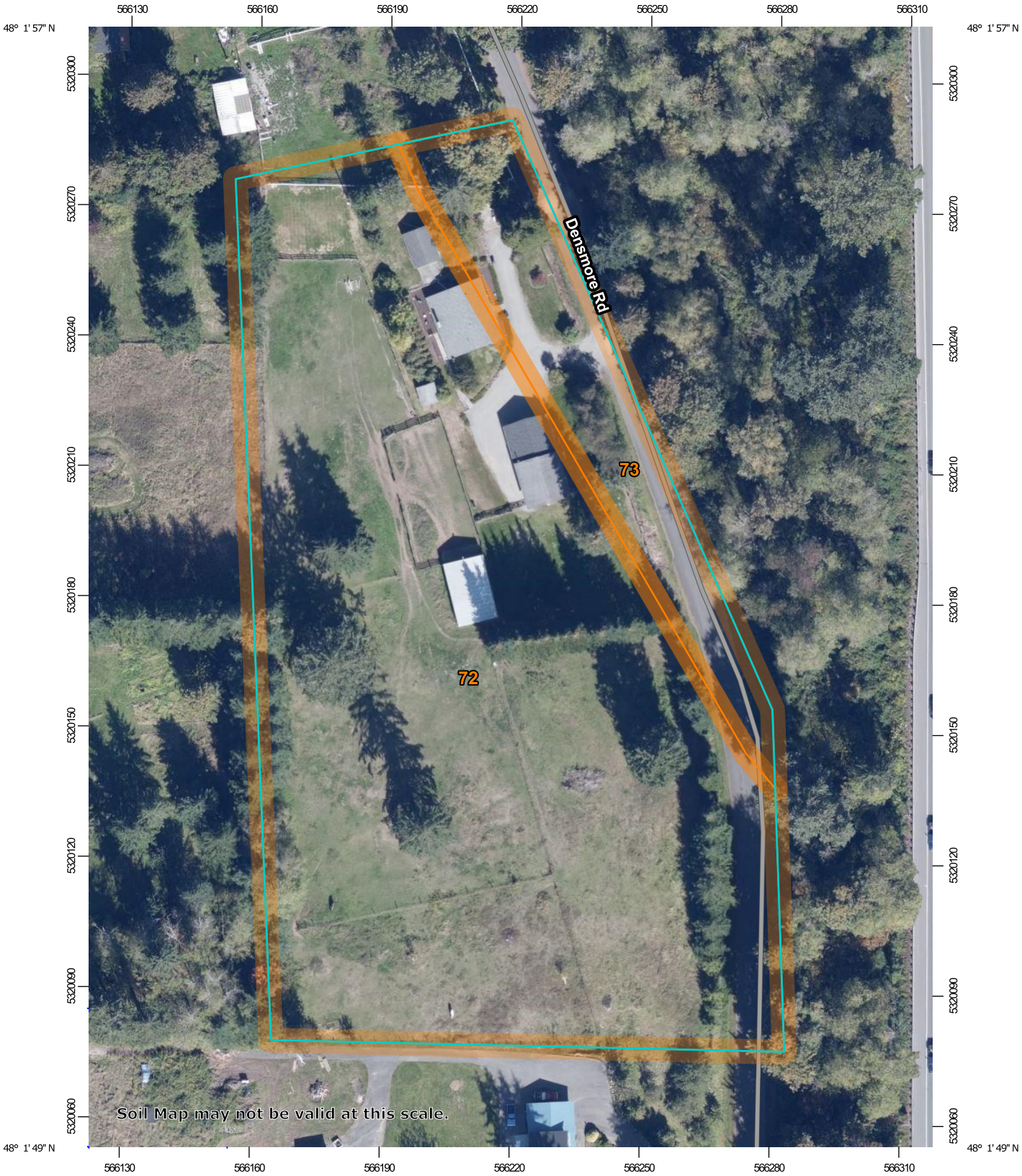
Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Appendix C

NRCS Soil Map

Soil Map—Snohomish County Area, Washington
(COLVIN)



Map Scale: 1:1,260 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 23, Aug 31, 2021

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

Date(s) aerial images were photographed: Sep 26, 2018—Oct 16, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
72	Tokul gravelly medial loam, 0 to 8 percent slopes	4.5	86.1%
73	Tokul gravelly medial loam, 8 to 15 percent slopes	0.7	13.9%
Totals for Area of Interest		**5.3**	**100.0%**