FINAL TECHNICAL INFORMATION REPORT

Lewis River Subdivision
City of Woodland, Washington

Prepared by:
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Consulting Engineers and Planners
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Prepared for:
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Prepared: March 2024

TABLE OF CONTENTS

Technical Appendices:

CERTIFICATE OF ENGINEER

Lewis River Subdivision
Technical Information Report

The technical information and data contained in this report was prepared under the direction and supervision of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

TRAVIS G. JOHNSON
STATE OF WASHINGTON
43929
REGISTERED
PROFESSIONAL ENGINEER

4-25-24

This document was prepared by:

Travis G. Johnson, PE

Section A – Project Overview

The existing project site is currently vacant land located between Lewis River Road and the Lewis River. The site will be served by public sewer and water provided by the City of Woodland. This project phase proposes construction of an 85-lot subdivision with associated frontage improvements, roadways and utilities. Access to the site is from Lewis River Road.

There is not currently a physical address of the site, but it is located in Woodland, WA 98674. The parcel serial numbers for the site are 50650, 506520300, 506520400, and 506520500. The property is located in Section 18, T5N, R1E of the Willamette Meridian. The property is bordered by Lewis River Road to the North, Lewis River to the South, Single Family Residence to the West, and a Church to the East. The cumulative property area contains a total of 877,495 square feet (20 acres). This technical information report will address the stormwater runoff associated with the development which will take place.

The topography of the site is generally flat with elevations ranging from 24' to 31'. Slopes vary and are approximately 3:1 at the steepest. The site generally slopes towards the SE corner of the site, but there is no clear drainage path with several isolated low points. The site is located within the flood plain and the flood way. There is a wetland along the southern edge of the property line that abuts the Lewis River. Site drainage surface infiltrates into the sandy onsite soils.

After construction, the disturbed project area will contain approximately 518,888 square feet of landscaped area, and the site will contain approximately 263,701 square feet of impervious area. All stormwater will be routed towards the low lying cut area within the floodway where it will infiltrate into the ground. Treatment will be obtained through cartridge filter systems prior to being infiltrated.

Section B – Minimum Requirements

Section B.2 – Determination of Applicable Minimum Requirements

After site development, impervious surfaces will cover approximately 263,701 square feet, or 30% of the disturbed project area; projects resulting in more than 5,000 square foot of hard surface area must meet all nine Minimum Requirements of the stormwater manual. The entirety of the developed site will all discharge to the low area that was recently excavated, acting as one TDA, and will all be required to meet Minimum Requirements #6 and #7. The stormwater system is designed to comply with all City requirements for stormwater treatment and quantity control. The treatment regulations require treatment of 91% of the total runoff volume from pollution generating impervious surfaces while the quantity control regulations require that post-development discharges shall match 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.

Description	Area (acres)
Existing Hard Surface in Construction Area	0
New Hard Surface in Construction Area	3.52
Replaced Hard Surface in Construction Area	0
Total New and Replaced Hard Surface	3.52
Native Vegetation converted to Lawn or Pasture	0
Land Disturbing Activity	9.24
Pre-Development Pollution Generating Surfaces	0
Post-Development Pollution Generating Surfaces	3.52
Non-Pollution Generating Surfaces	14.45

Table 1: Land Disturbing Activity Synopsis

Minimum Requirement #1 Preparation of Stormwater Site Plans:

All projects meeting the thresholds in I-3.3 Applicability of the Minimum Requirements shall prepare a Stormwater Site Plan for local government review. Stormwater Site Plans shall use site appropriate development principles, as required, and encouraged by local development codes, to retain native vegetation and minimize impervious surfaces to the extent feasible. Stormwater Site Plans shall be prepared in accordance with III-3 Stormwater Site Plans.

The Civil plans contain a stormwater plan for the site. Additionally, this stormwater report describes the stormwater plan in further detail, satisfying minimum requirement #1. See Basin Maps in Appendix A.

Minimum Requirement #2 SWPPP:

All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters. Projects which result in 2,000 square feet or more of new plus replaced hard surface area, or which disturb 7,000 square feet or more of land must prepare a Construction Stormwater Pollution Prevention Plan (SWPPP) as part of the Stormwater Site Plan (see I-3.4.1 MR1: Preparation of Stormwater Site Plans).

The SWPPP is included in appendix C of this stormwater report.

Minimum Requirement #3 Source Control of Pollution

See Section D

Minimum Requirement #4 Preservation of Natural Drainage Systems and Outfalls

See Section D

Minimum Requirement #5 Onsite Stormwater Management

See Section E

Minimum Requirement #6 Runoff Treatment

See Section F

Minimum Requirement #7 Flow Control

See Section G

Minimum Requirement #8 Wetland Protection

See Section H

Minimum Requirement #9 Operations and Maintenance

See Appendix G

Section C – Soils Evaluation

Redmond Geotechnical Services completed a geotechnical review adjacent to the site, dated October 31, 2022. The soils are mapped by the NRCS as Clato silt loam, Newberg find sandy loam, and Pilchuck loamy fine sand. The soil profiles found during the geotechnical soil investigation are generally consistent with that soil mapping. The geotechnical report has been included in Appendix C and a soil map is included in Appendix A.

Section D – Source Control

Minimum Requirement #3:

All known, available and reasonable Source Control BMPs must be applied to all projects. Source Control BMPs must be selected, designed, and maintained in accordance with this manual.

The pollution risks involved with this project mainly include the sediment accumulation involved with construction. The Stormwater Pollution Prevention Plan is a document that notes our certain Best Management Practice's (BMP's) that will help prevent sediment laden water from leaving the site during construction. The Erosion Control Plan located in the final construction drawings will provide protection measures involved with minimizing the chance that sediment from the site could enter downstream waterways. After construction is complete, this project does not necessitate any special source control measures due to abnormal risks associated with the project. Source control responsibilities will fall primarily on property owner. The SWPPP is provided in Appendix F.

Minimum Requirement #3 is intended to address stormwater source control measures which are post-development BMP's that prevent pollutant generation, discharge and runoff by controlling it at its source or, at a minimum, limiting pollutant exposure to stormwater. These are ongoing, long-term pollution prevention strategies that address pollutant sources associated with the operations at the site (including both operational and structural controls).

The Stormwater Pollution Prevention Plan (see Appendix F) is a document that notes out certain Best Management Practice's (BMP's) that will help prevent sediment laden water from leaving the site during construction. Currently, the proposed construction improvements do not trigger any special source control requirements. BMP 411 should be used to manage vegetation. BMP S426 for spills of Oil and Hazardous Substances can be used to adequately control these pollutants if they are released on site and responsibility to select appropriate source control BMP's will fall on future owners. Direction on how to deal with cleaning of vehicles, equipment and structures can be found in BMP S431. Direction on how to deal with pesticides and pest management can be found in BMP S435. Directions on how to deal with pet waste are found in BMP S440. There aren't any BMP's directly for trash, solid waste and litter, but BMP S454 provides a general description of how these pollutants can be dealt with.

Other post construction long term source control BMP's applicable to this site include:

- BMP S411 - Landscaping and lawn/vegetation management.
- BMP S426 – Spills of oil and Hazardous Substances
- BMP S431 - Washing and steam cleaning vehicles/equipment/building structures.
- BMP S435 – Pesticides and Integrated Pest Management Program
- BMP S440 – Pet Waste
- BMP S454 – Preventive maintenance/good housekeeping.

Minimum Requirement #4:

Natural drainage patterns shall be maintained, and discharges from the Project Site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the Project Site must not cause a significant adverse impact to downstream receiving waters and downgradient properties. All outfalls require energy dissipation.

The runoff from the site surface infiltrates through the sandy soils, infiltration of the entire site is proposed therefore no adverse impacts to downstream receiving water will occur.

Section E – Onsite Stormwater Management BMP's (Min Requirement #5)

Projects shall employ Stormwater Management BMPs in accordance with the following thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on site to the extent feasible without causing flooding or erosion impacts.

Minimum Requirement 5 requires the applicant to employ On-site Stormwater Management BMPs in accordance with the following project thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts. Infiltration of all runoff is proposed meeting performance standards.

The applicant will meet LID performance standards by infiltration for all the runoff from the site. BMP T5.13 Post-Construction Soil Quality and Depth will be utilized for the landscape areas.

Section F – Runoff Treatment Analysis and Design (Min Requirement #6)

Stormwater runoff will be collected and directed to a stormfilter cartridge vault where the stormwater will be treated prior to infiltration.

Section G – Flow Control Analysis and Design (Min Requirement #7)

All runoff is proposed to be infiltrated, flow control analysis is not required.

Section H – Wetlands Protection (Min Requirement #8)

There is a category II wetland located south of the site. The 300' wetland buffer extends into the site. This wetland is supported by the Lewis river, so stormwater discharge from the site is not needed to maintain the wetland. The site improvements will not impact the wetland. See Critical Areas Report in Appendix D.

Section I – Other Permits

The project will be required to obtain preliminary subdivision approval, construction drawing approval, and building permit approval prior to construction. This project also requires an NPDES construction stormwater permit through DOE, which will be acquired prior to construction.

Section J – Conveyance Systems Analysis and Design

Conveyance calculations are provided in Appendix B.

Section K – Operations and Maintenance Manual (Min Requirement #9)

The stormwater facility located on-site will be maintained by the Lewis River Subdivision HOA. An Operations and Maintenance Manual is included as Appendix E of this report.

APPENDIX A

Maps

- **Vicinity Map**
- **Soils Map**
- **Floodplains – FEMA Map**
- **Basin Maps**

Page 142 Cowlitz County Road Atlas

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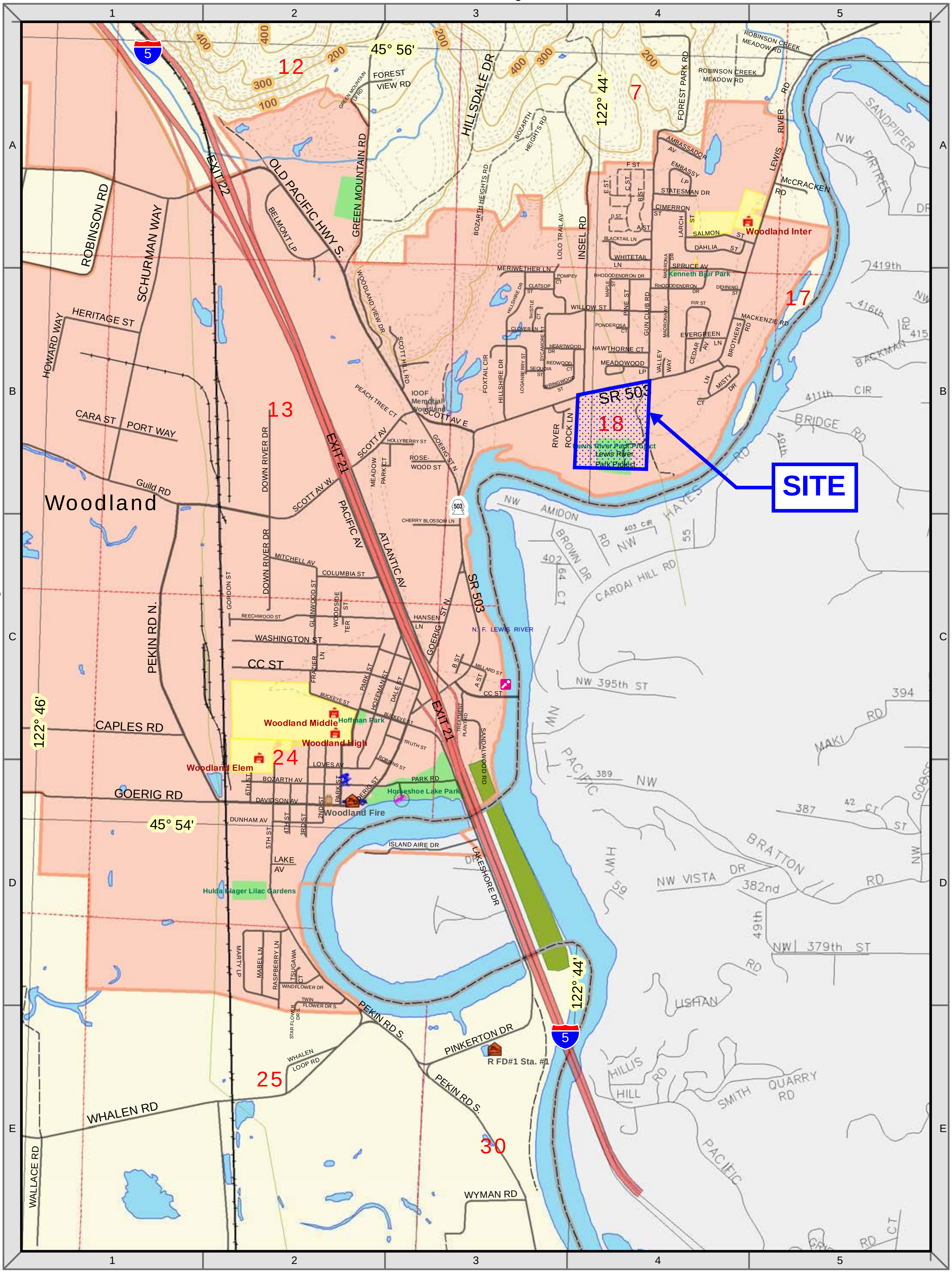


Continued on Page 143

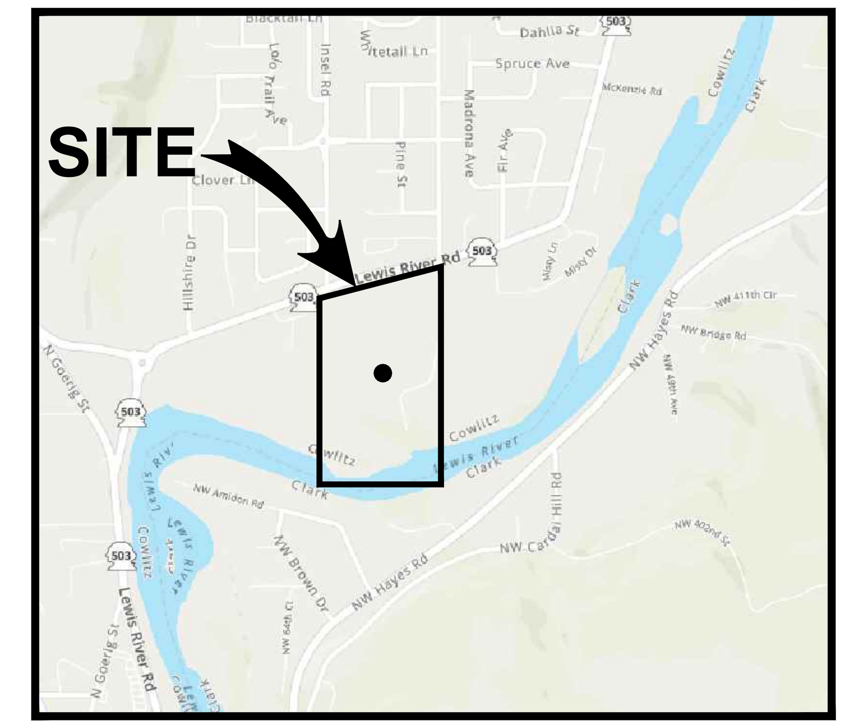
Continued on Page 145

Soil Map—Cowlitz County, Washington
(Lewis River Site Plan Soils Map)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
32	Clato silt loam, 0 to 3 percent slopes	0.0	0.0%
141	Newberg fine sandy loam, 0 to 3 percent slopes	21.8	64.1%
160	Pilchuck loamy fine sand, 0 to 8 percent slopes	10.3	30.4%
172	Riverwash	1.9	5.4%
Totals for Area of Interest		**34.0**	**100.0%**

Lewis River Subdivision

Located in the NE $\frac{1}{4}$ of Section 18, T5N, R1E W.M.
Woodland, Washington



VICINITY MAP
NOT TO SCALE

GENERAL NOTES

SITE LOCATION:
Near 1950 Lewis River Rd,
Woodland, WA 98674

Parcel #'s: 50650, 5065201, 506520100, 506520300, 506520400, 506520500

APPLICANT:
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CIVIL ENGINEER:
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Vancouver, WA 98660
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pm@plsengineering.com

Sheet Index
1. Pre-Development Basin Map
2. Post-Development Basin Map
3. Conveyance Basin Map

1 — 8.68 AC - THIS BASIN IS USED FOR ONLY TREATMENT CALCULATIONS

2 — 8.69 AC - THIS BASIN PLUS BASIN 1 IS USED FOR THE INFILTRATION CALCULATION

Drainage Basin Legend

Subbasin Divide

Subcatchment Area ID

Scale 1" = 80'

80 40 0 80

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Pre-Development Basin Map for:

Lewis River Subdivision

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Revisions

1		
2		
3		
4		
5		
6		

Project No. 3400	
SCALE:	H: 1" = 80' V: N/A
DESIGNED BY:	SWG
DRAFTED BY:	JSV
REVIEWED BY:	TGJ

1

3

Lewis River Subdivision

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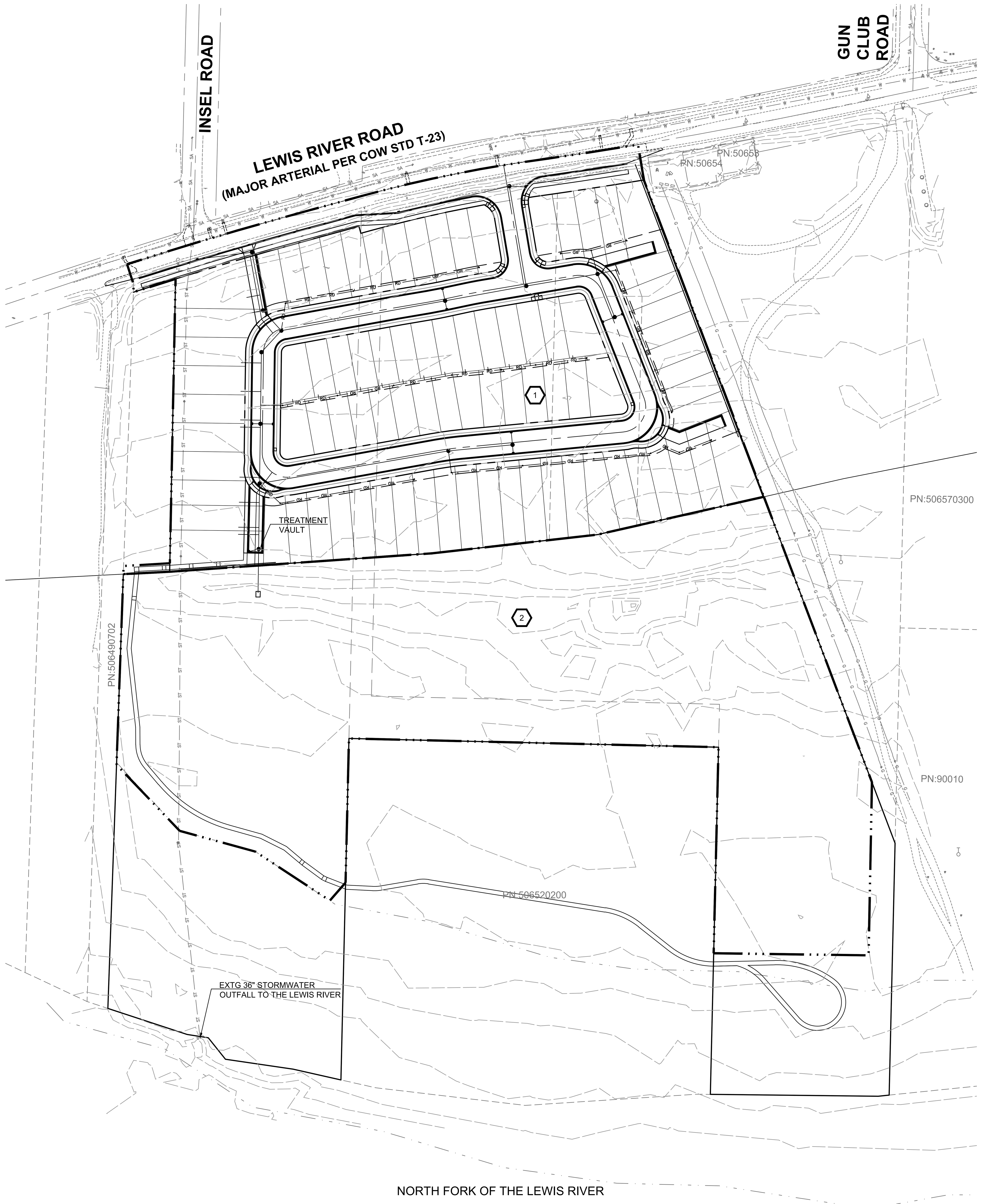
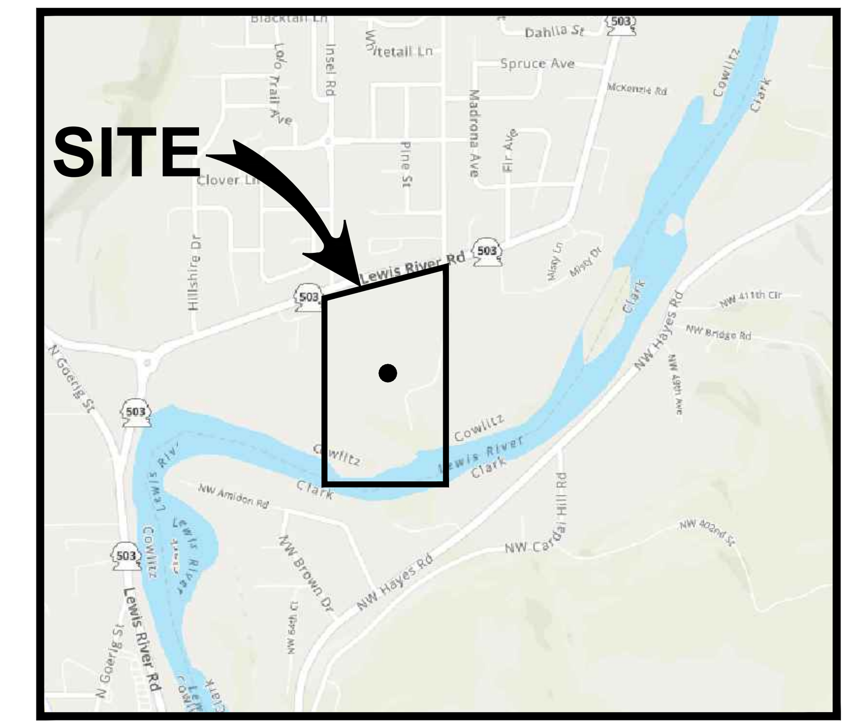
Woodland, Washington





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1 8.68 AC - THIS BASIN IS USED FOR ONLY TREATMENT CALCULATIONS

2 8.69 AC - THIS BASIN PLUS BASIN 1 IS USED FOR THE INFILTRATION CALCULATION

Drainage Basin Legend

Subbasin Divide

Subcatchment Area ID

Scale 1" = 80'
80 40 0 80

Post-Development Basin Map for:
Lewis River Subdivision

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Revisions

Revisions	
1	
2	
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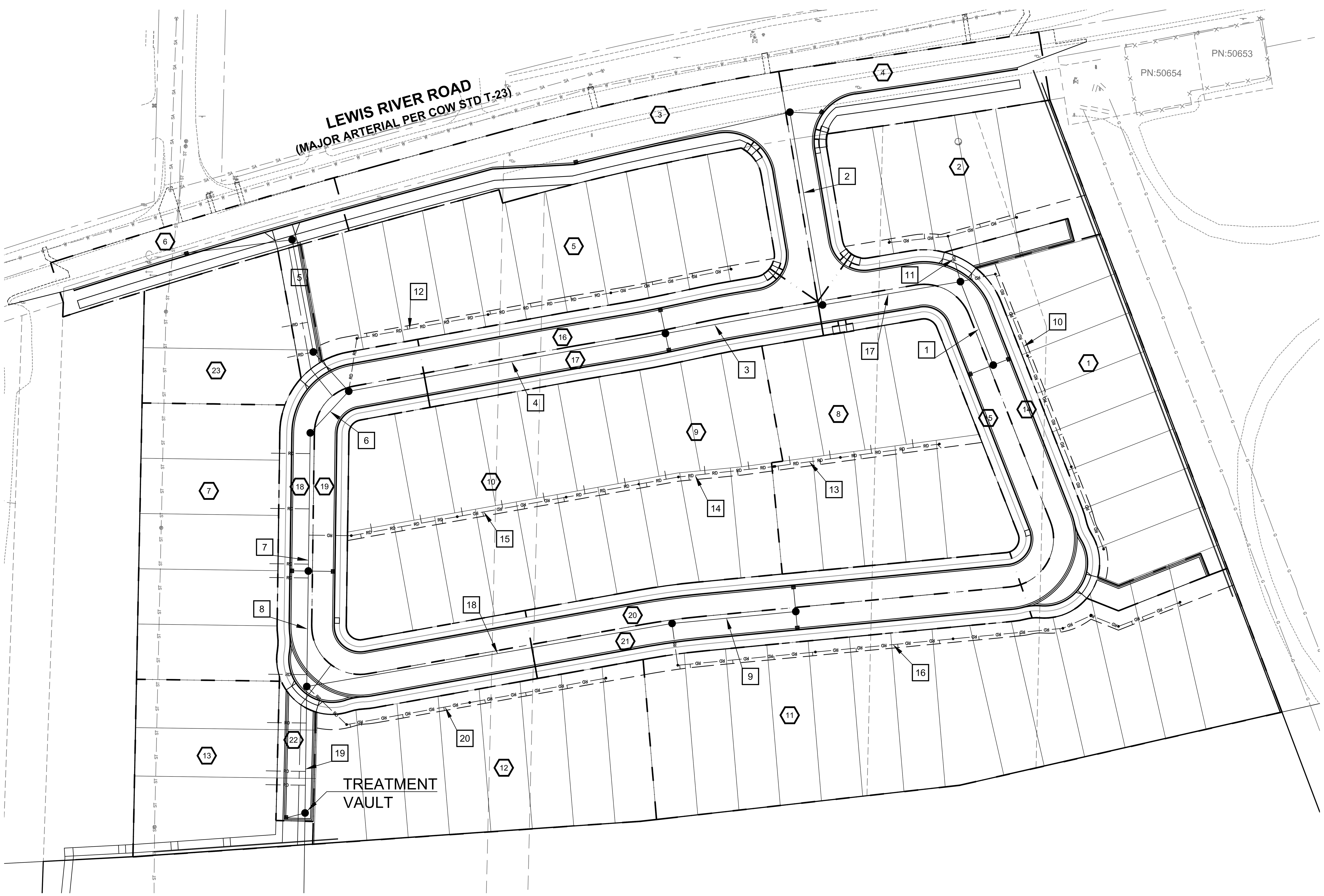

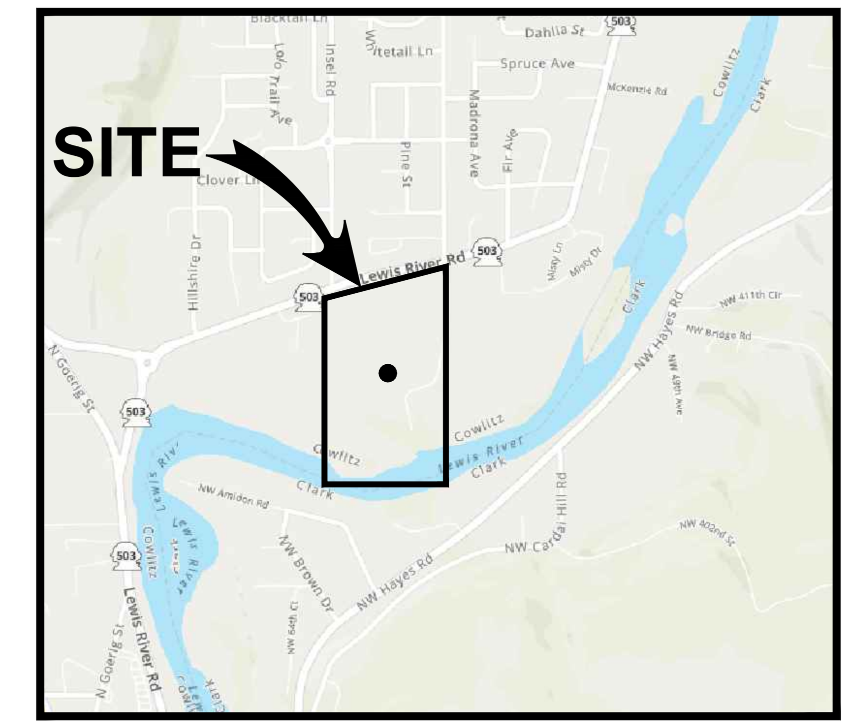

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pm@plsengineering.com

Drainage Basin Legend	
Subbasin Divide	
*Subcatchment Area ID	x
Reach	1

*See calcualtions for basin area sizes

Scale 1" = 40'

40 20 0 40

Post-Development Conveyance Basin Map for:
Lewis River Subdivision

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Revisions

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Project No. 3400	
SCALE:	H: 1" = 80' V: N/A
DESIGNED BY:	SWG
DRAFTED BY:	JSV
REVIEWED BY:	TGJ

3

3

APPENDIX B

Design Calculations and Modeling

Figure I-3.1: Flow Chart for Determining Requirements for New Development

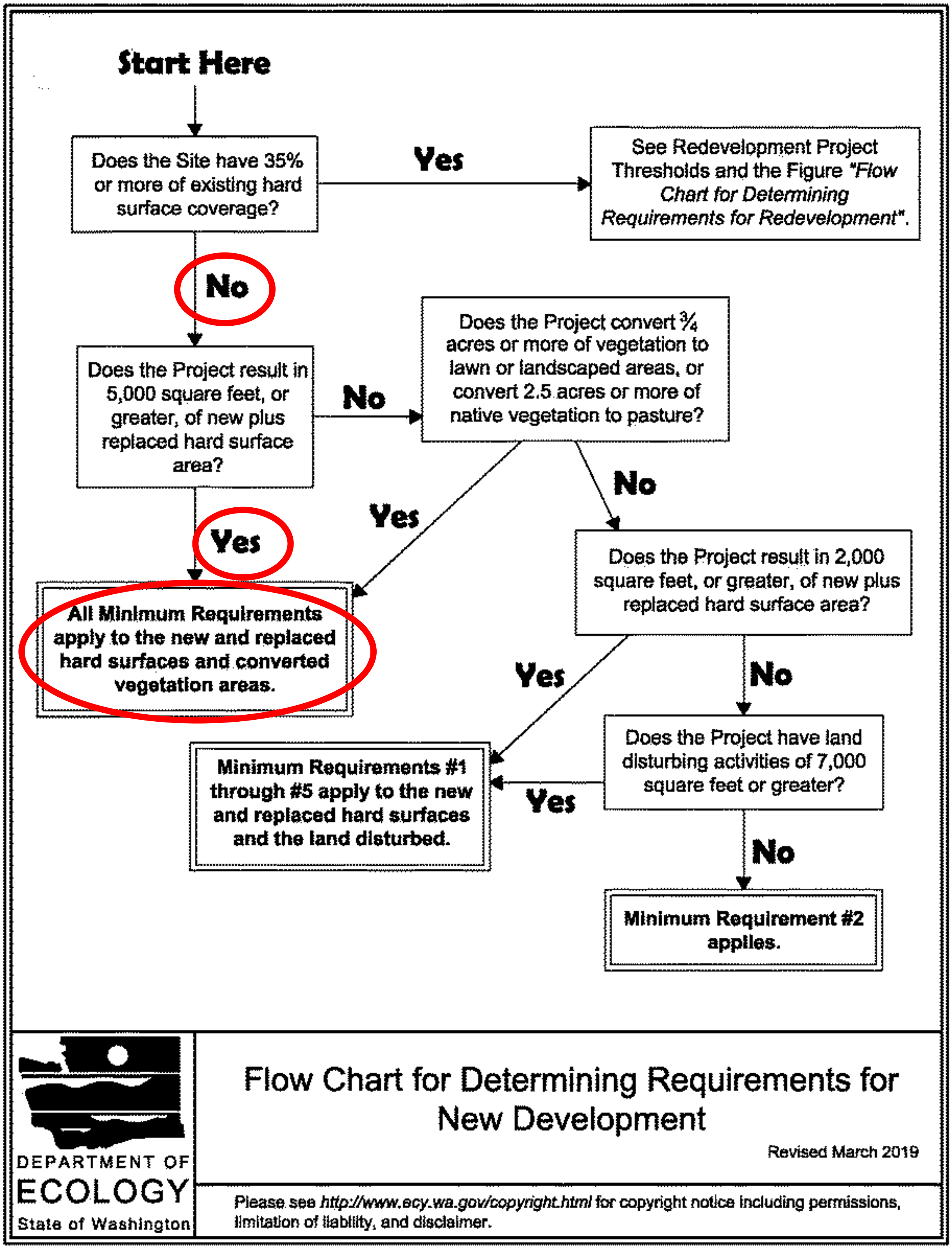


Figure I-3.3: Flow Chart for Determining MR #5 Requirements

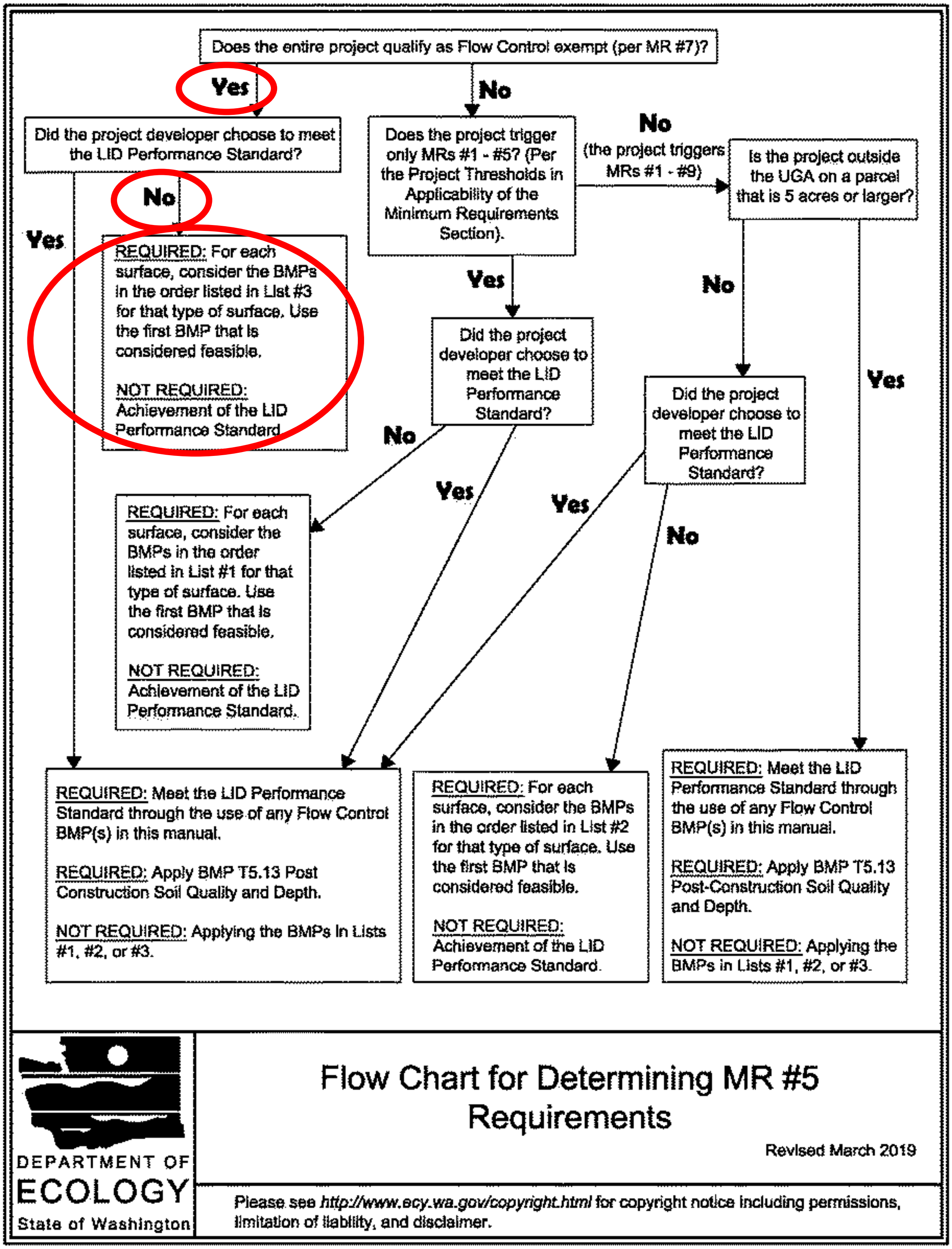
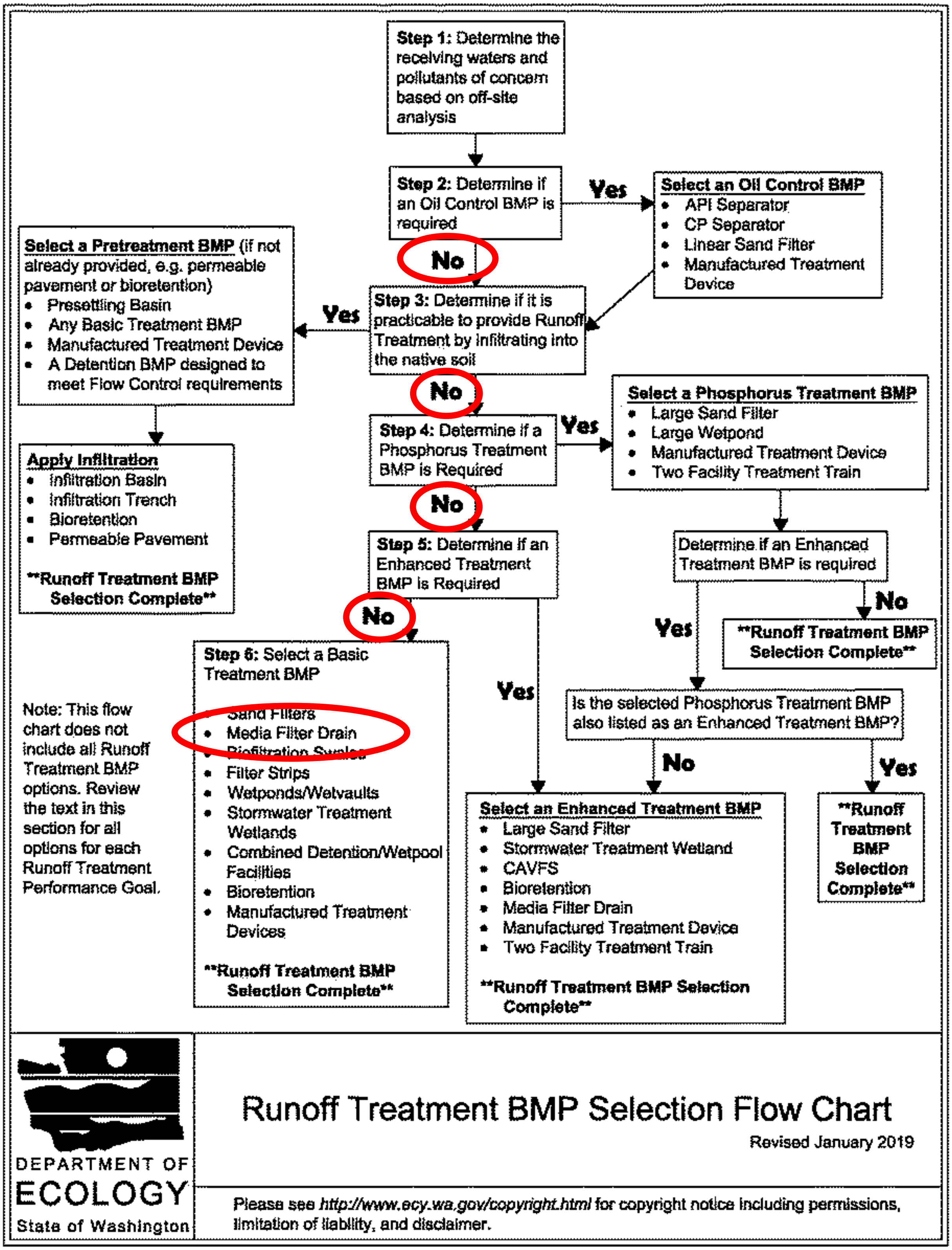


Figure III-1.1: Runoff Treatment BMP Selection Flow Chart



Precipitation Frequency Data Output

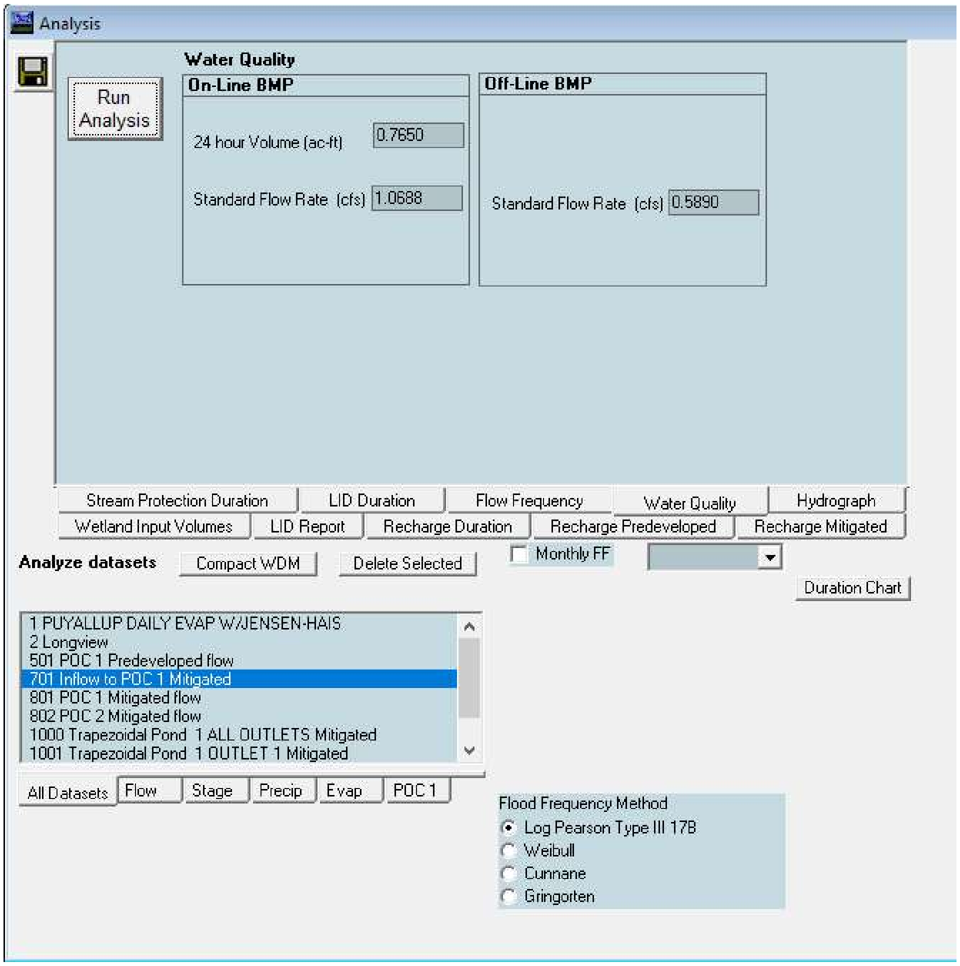
NOAA Atlas 2
Washington 45.917778°N 122.7319°W
Site-specific Estimates

Map	Precipitation (inches)	Precipitation Intensity (in/hr)
2-year 6-hour	1.23	0.21
2-year 24-hour	2.50	0.10
100-year 6-hour	2.37	0.40
100-year 24-hour	4.61	0.19

[Go to PFDS]
[Go to NA2]

Hydrometeorological Design Studies Center - NOAA/National Weather Service
1325 East-West Highway - Silver Spring, MD 20910 - (301) 713-1669
Mon Apr 22 18:21:08 2024

WATER QUALITY FLOWS



WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Infiltration Lewis River WWHM

Site Name:	
Site Address:	
City:	
Report Date:	4/25/2024
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

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

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	8.68
Pervious Total	8.68
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.68

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	2.6284
Pervious Total	2.6284
Impervious Land Use	acre
ROADS FLAT	2.6584
ROOF TOPS FLAT	2.5367
DRIVEWAYS FLAT	0.8586
Impervious Total	6.0537
Basin Total	8.6821

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	8.69
Pervious Total	8.69
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.69

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	200.00 ft.	
Bottom Width:	400.00 ft.	
Depth:	8 ft.	
Volume at riser head:	0.0000 acre-feet.	
Infiltration On		
Infiltration rate:	16	
Infiltration safety factor:	0.25	
Wetted surface area On		
Total Volume Infiltrated (ac-ft.):		962.262
Total Volume Through Riser (ac-ft.):		0
Total Volume Through Facility (ac-ft.):		962.262
Percent Infiltrated:		100
Total Precip Applied to Facility:		0
Total Evap From Facility:		0
Side slope 1:	0.33 To 1	
Side slope 2:	0.33 To 1	
Side slope 3:	0.33 To 1	
Side slope 4:	0.33 To 1	
Discharge Structure		
Riser Height:	0 ft.	
Riser Diameter:	0 in.	
Element Flows To:		
Outlet 1	Outlet 2	

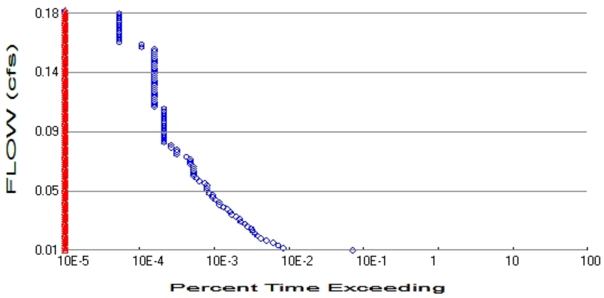
Pond Hydraulic Table

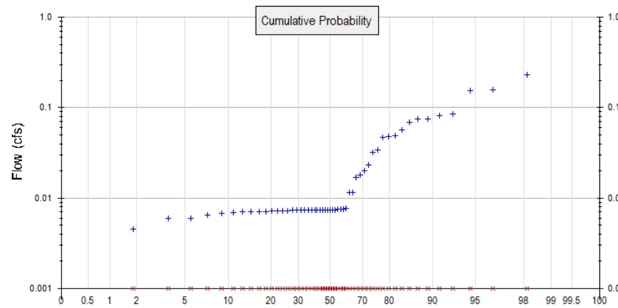
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.836	0.000	0.000	0.000
0.0889	1.837	0.163	0.000	7.410
0.1778	1.838	0.326	0.000	7.413
0.2667	1.839	0.490	0.000	7.417
0.3556	1.839	0.653	0.000	7.420
0.4444	1.840	0.817	0.000	7.423
0.5333	1.841	0.980	0.000	7.427
0.6222	1.842	1.144	0.000	7.430
0.7111	1.843	1.308	0.000	7.433
0.8000	1.843	1.472	0.000	7.436
0.8889	1.844	1.636	0.000	7.440
0.9778	1.845	1.800	0.000	7.443
1.0667	1.846	1.964	0.000	7.446
1.1556	1.847	2.128	0.000	7.449
1.2444	1.847	2.292	0.000	7.453
1.3333	1.848	2.456	0.000	7.456
1.4222	1.849	2.621	0.000	7.459
1.5111	1.850	2.785	0.000	7.462
1.6000	1.851	2.950	0.000	7.466
1.6889	1.851	3.114	0.000	7.469
1.7778	1.852	3.279	0.000	7.472
1.8667	1.853	3.444	0.000	7.476
1.9556	1.854	3.608	0.000	7.479
2.0444	1.855	3.773	0.000	7.482
2.1333	1.856	3.938	0.000	7.485
2.2222	1.856	4.103	0.000	7.489

2.3111	1.857	4.268	0.000	7.492
2.4000	1.858	4.433	0.000	7.495
2.4889	1.859	4.599	0.000	7.498
2.5778	1.860	4.764	0.000	7.502
2.6667	1.860	4.929	0.000	7.505
2.7556	1.861	5.095	0.000	7.508
2.8444	1.862	5.260	0.000	7.512
2.9333	1.863	5.426	0.000	7.515
3.0222	1.864	5.592	0.000	7.518
3.1111	1.864	5.757	0.000	7.521
3.2000	1.865	5.923	0.000	7.525
3.2889	1.866	6.089	0.000	7.528
3.3778	1.867	6.255	0.000	7.531
3.4667	1.868	6.421	0.000	7.535
3.5556	1.869	6.587	0.000	7.538
3.6444	1.869	6.753	0.000	7.541
3.7333	1.870	6.920	0.000	7.544
3.8222	1.871	7.086	0.000	7.548
3.9111	1.872	7.252	0.000	7.551
4.0000	1.873	7.419	0.000	7.554
4.0889	1.873	7.585	0.000	7.558
4.1778	1.874	7.752	0.000	7.561
4.2667	1.875	7.918	0.000	7.564
4.3556	1.876	8.085	0.000	7.567
4.4444	1.877	8.252	0.000	7.571
4.5333	1.878	8.419	0.000	7.574
4.6222	1.878	8.586	0.000	7.577
4.7111	1.879	8.753	0.000	7.581
4.8000	1.880	8.920	0.000	7.584
4.8889	1.881	9.087	0.000	7.587
4.9778	1.882	9.255	0.000	7.590
5.0667	1.882	9.422	0.000	7.594
5.1556	1.883	9.589	0.000	7.597
5.2444	1.884	9.757	0.000	7.600
5.3333	1.885	9.924	0.000	7.604
5.4222	1.886	10.09	0.000	7.607
5.5111	1.887	10.26	0.000	7.610
5.6000	1.887	10.42	0.000	7.614
5.6889	1.888	10.59	0.000	7.617
5.7778	1.889	10.76	0.000	7.620
5.8667	1.890	10.93	0.000	7.623
5.9556	1.891	11.10	0.000	7.627
6.0444	1.891	11.26	0.000	7.630
6.1333	1.892	11.43	0.000	7.633
6.2222	1.893	11.60	0.000	7.637
6.3111	1.894	11.77	0.000	7.640
6.4000	1.895	11.94	0.000	7.643
6.4889	1.896	12.10	0.000	7.647
6.5778	1.896	12.27	0.000	7.650
6.6667	1.897	12.44	0.000	7.653
6.7556	1.898	12.61	0.000	7.657
6.8444	1.899	12.78	0.000	7.660
6.9333	1.900	12.95	0.000	7.663
7.0222	1.900	13.12	0.000	7.666
7.1111	1.901	13.29	0.000	7.670
7.2000	1.902	13.46	0.000	7.673
7.2889	1.903	13.62	0.000	7.676
7.3778	1.904	13.79	0.000	7.680

7.4667	1.905	13.96	0.000	7.683
7.5556	1.905	14.13	0.000	7.686
7.6444	1.906	14.30	0.000	7.690
7.7333	1.907	14.47	0.000	7.693
7.8222	1.908	14.64	0.000	7.696
7.9111	1.909	14.81	0.000	7.700
8.0000	1.909	14.98	0.000	7.703
8.0889	1.910	15.15	0.000	7.706

Analysis Results
POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 8.68
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 11.3184
Total Impervious Area: 6.0537

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.012371
5 year	0.032419
10 year	0.057753
25 year	0.113308
50 year	0.180944
100 year	0.281906

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.159	0.000
1957	0.008	0.000
1958	0.075	0.000
1959	0.047	0.000
1960	0.075	0.000
1961	0.155	0.000
1962	0.081	0.000
1963	0.069	0.000
1964	0.017	0.000
1965	0.007	0.000

1966	0.007	0.000
1967	0.007	0.000
1968	0.007	0.000
1969	0.007	0.000
1970	0.007	0.000
1971	0.008	0.000
1972	0.049	0.000
1973	0.007	0.000
1974	0.047	0.000
1975	0.032	0.000
1976	0.007	0.000
1977	0.006	0.000
1978	0.011	0.000
1979	0.007	0.000
1980	0.007	0.000
1981	0.007	0.000
1982	0.057	0.000
1983	0.011	0.000
1984	0.018	0.000
1985	0.007	0.000
1986	0.084	0.000
1987	0.007	0.000
1988	0.007	0.000
1989	0.007	0.000
1990	0.023	0.000
1991	0.007	0.000
1992	0.007	0.000
1993	0.007	0.000
1994	0.007	0.000
1995	0.007	0.000
1996	0.230	0.000
1997	0.034	0.000
1998	0.007	0.000
1999	0.006	0.000
2000	0.007	0.000
2001	0.004	0.000
2002	0.007	0.000
2003	0.007	0.000
2004	0.006	0.000
2005	0.004	0.000
2006	0.007	0.000
2007	0.020	0.000
2008	0.007	0.000
2009	0.007	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2296	0.0000
2	0.1592	0.0000
3	0.1552	0.0000
4	0.0844	0.0000
5	0.0810	0.0000
6	0.0752	0.0000
7	0.0751	0.0000
8	0.0686	0.0000
9	0.0567	0.0000
10	0.0494	0.0000

11	0.0475	0.0000
12	0.0469	0.0000
13	0.0339	0.0000
14	0.0320	0.0000
15	0.0233	0.0000
16	0.0198	0.0000
17	0.0179	0.0000
18	0.0167	0.0000
19	0.0115	0.0000
20	0.0114	0.0000
21	0.0076	0.0000
22	0.0076	0.0000
23	0.0075	0.0000
24	0.0074	0.0000
25	0.0074	0.0000
26	0.0074	0.0000
27	0.0074	0.0000
28	0.0074	0.0000
29	0.0074	0.0000
30	0.0074	0.0000
31	0.0074	0.0000
32	0.0074	0.0000
33	0.0074	0.0000
34	0.0073	0.0000
35	0.0073	0.0000
36	0.0073	0.0000
37	0.0073	0.0000
38	0.0073	0.0000
39	0.0073	0.0000
40	0.0072	0.0000
41	0.0072	0.0000
42	0.0072	0.0000
43	0.0072	0.0000
44	0.0071	0.0000
45	0.0071	0.0000
46	0.0070	0.0000
47	0.0070	0.0000
48	0.0069	0.0000
49	0.0067	0.0000
50	0.0065	0.0000
51	0.0060	0.0000
52	0.0059	0.0000
53	0.0045	0.0000
54	0.0038	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0062	1356	0	0	Pass
0.0080	160	0	0	Pass
0.0097	136	0	0	Pass
0.0115	115	0	0	Pass
0.0132	95	0	0	Pass
0.0150	79	0	0	Pass
0.0168	72	0	0	Pass
0.0185	67	0	0	Pass
0.0203	61	0	0	Pass
0.0221	59	0	0	Pass
0.0238	52	0	0	Pass
0.0256	49	0	0	Pass
0.0274	43	0	0	Pass
0.0291	41	0	0	Pass
0.0309	37	0	0	Pass
0.0327	32	0	0	Pass
0.0344	31	0	0	Pass
0.0362	28	0	0	Pass
0.0380	25	0	0	Pass
0.0397	22	0	0	Pass
0.0415	22	0	0	Pass
0.0433	20	0	0	Pass
0.0450	18	0	0	Pass
0.0468	18	0	0	Pass
0.0486	16	0	0	Pass
0.0503	15	0	0	Pass
0.0521	15	0	0	Pass
0.0538	15	0	0	Pass
0.0556	14	0	0	Pass
0.0574	12	0	0	Pass
0.0591	11	0	0	Pass
0.0609	10	0	0	Pass
0.0627	10	0	0	Pass
0.0644	10	0	0	Pass
0.0662	10	0	0	Pass
0.0680	10	0	0	Pass
0.0697	9	0	0	Pass
0.0715	9	0	0	Pass
0.0733	9	0	0	Pass
0.0750	8	0	0	Pass
0.0768	6	0	0	Pass
0.0786	6	0	0	Pass
0.0803	6	0	0	Pass
0.0821	5	0	0	Pass
0.0839	5	0	0	Pass
0.0856	4	0	0	Pass
0.0874	4	0	0	Pass
0.0892	4	0	0	Pass
0.0909	4	0	0	Pass
0.0927	4	0	0	Pass
0.0944	4	0	0	Pass
0.0962	4	0	0	Pass
0.0980	4	0	0	Pass

0.0997	4	0	0	Pass
0.1015	4	0	0	Pass
0.1033	4	0	0	Pass
0.1050	4	0	0	Pass
0.1068	4	0	0	Pass
0.1086	4	0	0	Pass
0.1103	4	0	0	Pass
0.1121	3	0	0	Pass
0.1139	3	0	0	Pass
0.1156	3	0	0	Pass
0.1174	3	0	0	Pass
0.1192	3	0	0	Pass
0.1209	3	0	0	Pass
0.1227	3	0	0	Pass
0.1245	3	0	0	Pass
0.1262	3	0	0	Pass
0.1280	3	0	0	Pass
0.1298	3	0	0	Pass
0.1315	3	0	0	Pass
0.1333	3	0	0	Pass
0.1350	3	0	0	Pass
0.1368	3	0	0	Pass
0.1386	3	0	0	Pass
0.1403	3	0	0	Pass
0.1421	3	0	0	Pass
0.1439	3	0	0	Pass
0.1456	3	0	0	Pass
0.1474	3	0	0	Pass
0.1492	3	0	0	Pass
0.1509	3	0	0	Pass
0.1527	3	0	0	Pass
0.1545	3	0	0	Pass
0.1562	2	0	0	Pass
0.1580	2	0	0	Pass
0.1598	1	0	0	Pass
0.1615	1	0	0	Pass
0.1633	1	0	0	Pass
0.1651	1	0	0	Pass
0.1668	1	0	0	Pass
0.1686	1	0	0	Pass
0.1704	1	0	0	Pass
0.1721	1	0	0	Pass
0.1739	1	0	0	Pass
0.1756	1	0	0	Pass
0.1774	1	0	0	Pass
0.1792	1	0	0	Pass
0.1809	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.765 acre-feet
On-line facility target flow:	1.0688 cfs.
Adjusted for 15 min:	1.0688 cfs.
Off-line facility target flow:	0.589 cfs.
Adjusted for 15 min:	0.589 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
Trapezoidal Pond 1 POC	☐	875.66			☐	100.00			
Total Volume Infiltrated		875.66	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

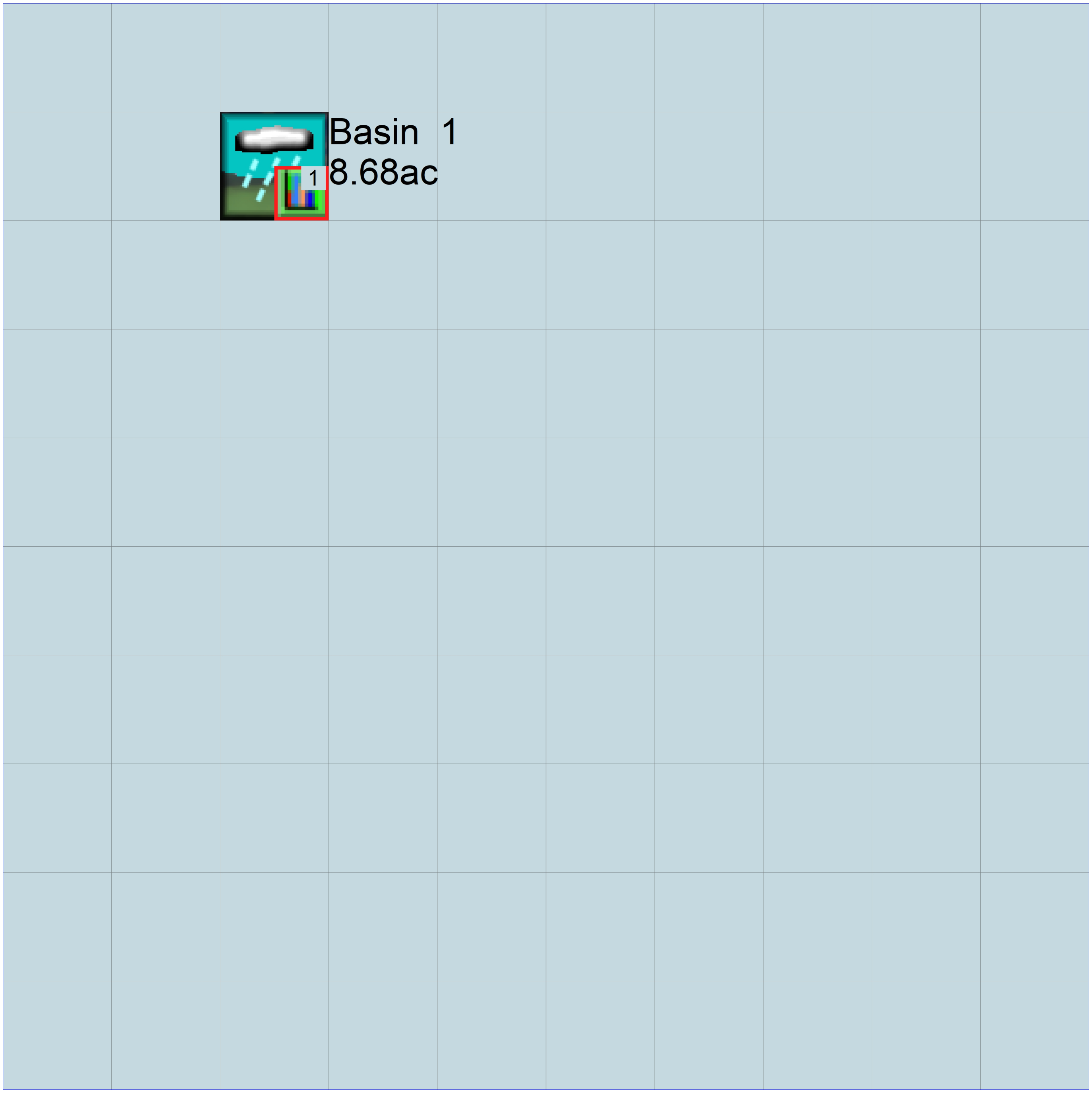
PERLND Changes

No PERLND changes have been made.

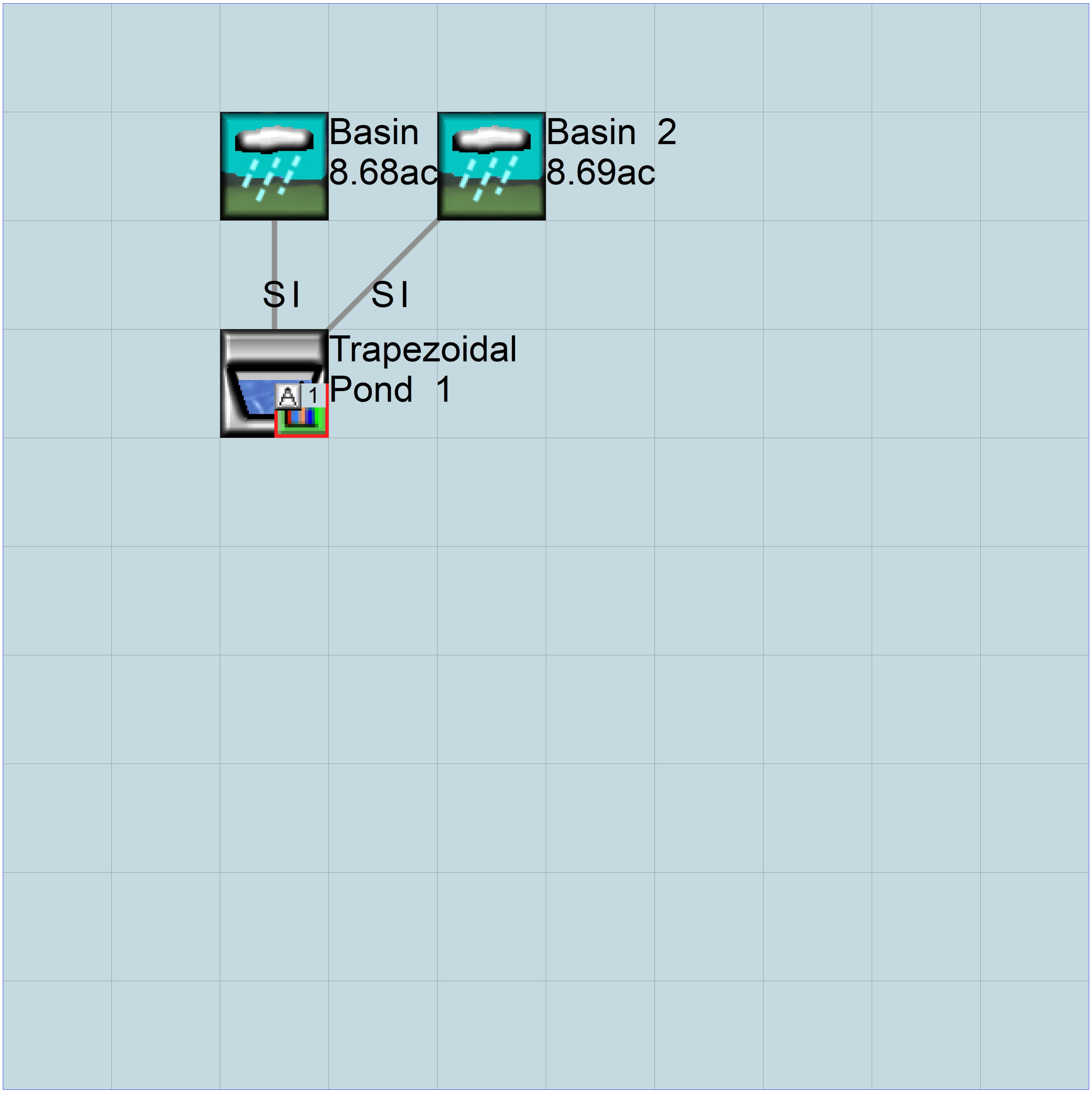
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 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   Infiltration Lewis River WWHM.wdm
MESSU      25   MitInfiltration Lewis River WWHM.MES
           27   MitInfiltration Lewis River WWHM.L61
           28   MitInfiltration Lewis River WWHM.L62
           30   POCInfiltration Lewis River WWHM1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       7
      IMPLND       1
      IMPLND       4
      IMPLND       5
      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        Trapezoidal Pond  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           ***
    7     A/B, 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 ***
    7         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  *********
    7         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 ***
    7         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
    7              0         5       0.8       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    7              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                   ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    7            0.1       0.5      0.25         0       0.7      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
    7              0         0         0         0         3         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
    5      DRIVEWAYS/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
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

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

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI    ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    5         0    0    0    0    0
```

```
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
    4             0         0
    5             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
    4             0         0
    5             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   7                      2.6284     RCHRES   1      2
PERLND   7                      2.6284     RCHRES   1      3
IMPLND   1                      2.6584     RCHRES   1      5
IMPLND   4                      2.5367     RCHRES   1      5
IMPLND   5                      0.8586     RCHRES   1      5
Basin  2***
PERLND   7                        8.69     RCHRES   1      2
PERLND   7                        8.69     RCHRES   1      3

******Routing******
PERLND   7                      2.6284     COPY     1     12
IMPLND   1                      2.6584     COPY     1     15
IMPLND   4                      2.5367     COPY     1     15
IMPLND   5                      0.8586     COPY     1     15
PERLND   7                      2.6284     COPY     1     13
PERLND   7                        8.69     COPY     1     12
PERLND   7                        8.69     COPY     1     13
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
    1     Trapezoidal Pond-007    2    1    1    1   28    0    1
  END GEN-INFO
```

```
  *** Section RCHRES***

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

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

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                        ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.04       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  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)      (cfs)  (ft/sec)    (Minutes)***
  0.000000  1.836547  0.000000  0.000000  0.000000
  0.088889  1.837355  0.163285  0.000000  7.410667
  0.177778  1.838164  0.326641  0.000000  7.413927
  0.266667  1.838972  0.490069  0.000000  7.417188
  0.355556  1.839781  0.653569  0.000000  7.420450
  0.444444  1.840590  0.817141  0.000000  7.423712
  0.533333  1.841399  0.980785  0.000000  7.426974
  0.622222  1.842208  1.144501  0.000000  7.430238
  0.711111  1.843017  1.308289  0.000000  7.433502
  0.800000  1.843826  1.472149  0.000000  7.436767
  0.888889  1.844636  1.636080  0.000000  7.440032
  0.977778  1.845446  1.800084  0.000000  7.443298
  1.066667  1.846256  1.964160  0.000000  7.446564
  1.155556  1.847066  2.128307  0.000000  7.449832
  1.244444  1.847876  2.292527  0.000000  7.453099
  1.333333  1.848686  2.456818  0.000000  7.456368
  1.422222  1.849497  2.621182  0.000000  7.459637
  1.511111  1.850307  2.785618  0.000000  7.462907
  1.600000  1.851118  2.950126  0.000000  7.466177
  1.688889  1.851929  3.114706  0.000000  7.469448
  1.777778  1.852741  3.279358  0.000000  7.472720
  1.866667  1.853552  3.444082  0.000000  7.475992
  1.955556  1.854363  3.608878  0.000000  7.479265
  2.044444  1.855175  3.773746  0.000000  7.482539
  2.133333  1.855987  3.938687  0.000000  7.485813
  2.222222  1.856799  4.103700  0.000000  7.489088
  2.311111  1.857611  4.268784  0.000000  7.492364
```

```
  2.400000  1.858423  4.433941  0.000000  7.495640
  2.488889  1.859235  4.599171  0.000000  7.498917
  2.577778  1.860048  4.764472  0.000000  7.502194
  2.666667  1.860861  4.929846  0.000000  7.505472
  2.755556  1.861674  5.095292  0.000000  7.508751
  2.844444  1.862487  5.260810  0.000000  7.512030
  2.933333  1.863300  5.426401  0.000000  7.515310
  3.022222  1.864113  5.592063  0.000000  7.518591
  3.111111  1.864927  5.757799  0.000000  7.521872
  3.200000  1.865741  5.923606  0.000000  7.525154
  3.288889  1.866554  6.089486  0.000000  7.528436
  3.377778  1.867368  6.255438  0.000000  7.531719
  3.466667  1.868183  6.421462  0.000000  7.535003
  3.555556  1.868997  6.587559  0.000000  7.538288
  3.644444  1.869811  6.753729  0.000000  7.541573
  3.733333  1.870626  6.919970  0.000000  7.544858
  3.822222  1.871441  7.086284  0.000000  7.548145
  3.911111  1.872256  7.252671  0.000000  7.551432
  4.000000  1.873071  7.419130  0.000000  7.554719
  4.088889  1.873886  7.585661  0.000000  7.558008
  4.177778  1.874702  7.752265  0.000000  7.561297
  4.266667  1.875517  7.918942  0.000000  7.564586
  4.355556  1.876333  8.085690  0.000000  7.567876
  4.444444  1.877149  8.252512  0.000000  7.571167
  4.533333  1.877965  8.419406  0.000000  7.574459
  4.622222  1.878781  8.586372  0.000000  7.577751
  4.711111  1.879598  8.753411  0.000000  7.581043
  4.800000  1.880414  8.920523  0.000000  7.584337
  4.888889  1.881231  9.087707  0.000000  7.587631
  4.977778  1.882048  9.254964  0.000000  7.590925
  5.066667  1.882865  9.422293  0.000000  7.594221
  5.155556  1.883682  9.589695  0.000000  7.597516
  5.244444  1.884499  9.757170  0.000000  7.600813
  5.333333  1.885317  9.924718  0.000000  7.604110
  5.422222  1.886134  10.09234  0.000000  7.607408
  5.511111  1.886952  10.26003  0.000000  7.610706
  5.600000  1.887770  10.42780  0.000000  7.614006
  5.688889  1.888588  10.59563  0.000000  7.617305
  5.777778  1.889406  10.76354  0.000000  7.620606
  5.866667  1.890225  10.93153  0.000000  7.623907
  5.955556  1.891043  11.09958  0.000000  7.627208
  6.044444  1.891862  11.26771  0.000000  7.630511
  6.133333  1.892681  11.43592  0.000000  7.633814
  6.222222  1.893500  11.60419  0.000000  7.637117
  6.311111  1.894319  11.77254  0.000000  7.640421
  6.400000  1.895139  11.94096  0.000000  7.643726
  6.488889  1.895958  12.10945  0.000000  7.647032
  6.577778  1.896778  12.27802  0.000000  7.650338
  6.666667  1.897598  12.44666  0.000000  7.653644
  6.755556  1.898418  12.61537  0.000000  7.656952
  6.844444  1.899238  12.78415  0.000000  7.660260
  6.933333  1.900058  12.95301  0.000000  7.663568
  7.022222  1.900879  13.12194  0.000000  7.666878
  7.111111  1.901699  13.29094  0.000000  7.670188
  7.200000  1.902520  13.46002  0.000000  7.673498
  7.288889  1.903341  13.62917  0.000000  7.676809
  7.377778  1.904162  13.79839  0.000000  7.680121
  7.466667  1.904984  13.96769  0.000000  7.683434
  7.555556  1.905805  14.13706  0.000000  7.686747
  7.644444  1.906627  14.30650  0.000000  7.690061
  7.733333  1.907448  14.47601  0.000000  7.693375
  7.822222  1.908270  14.64560  0.000000  7.696690
  7.911111  1.909092  14.81526  0.000000  7.700006
  8.000000  1.909915  14.98499  0.000000  7.703322
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
```

```
WDM       2 PREC      ENGL    1               PERLND   1 999 EXTNL  PREC
WDM       2 PREC      ENGL    1               IMPLND   1 999 EXTNL  PREC
WDM       1 EVAP      ENGL    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   O       1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O       2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE   1 1        1      WDM   1003 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       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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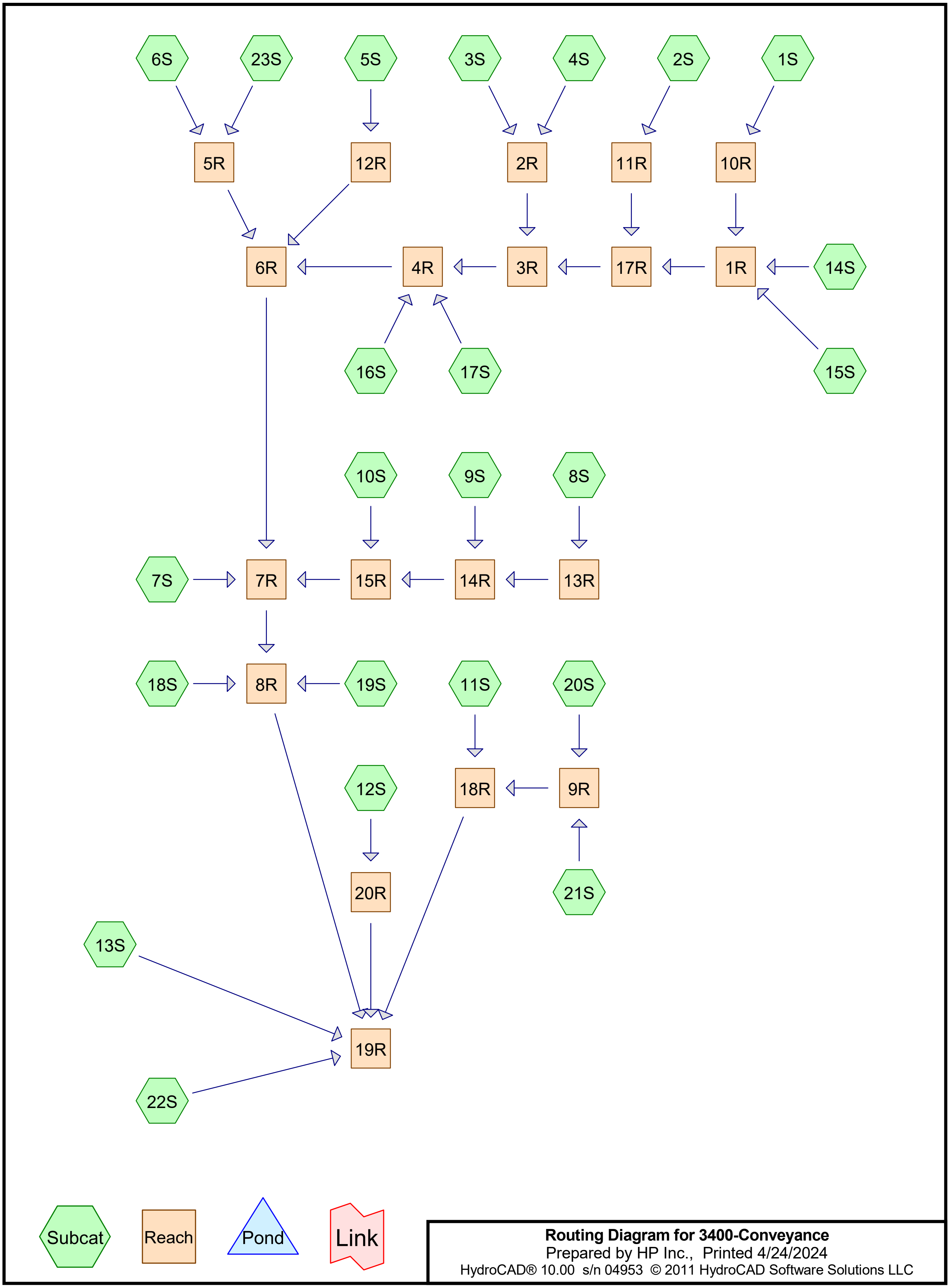

Routing Diagram for 3400-Conveyance
Prepared by HP Inc., Printed 4/24/2024
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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
107,915	78	Landscaping (1S, 2S, 5S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 23S)
42,500	98	Driveways (1S, 2S, 5S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 23S)
116,528	98	Roadway (3S, 4S, 6S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 22S)
110,500	98	Roofs (1S, 2S, 5S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 23S)
377,443	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
0	HSG D	
377,443	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 22S, 23S
377,443		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	0	0	42,500	42,500	Driveways	1S, 2S, 5S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 23S
0	0	0	0	107,915	107,915	Landscaping	1S, 2S, 5S,

Ground Covers (all nodes) (continued)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	0	0	116,528	116,528	Roadway	3S, 4S, 6S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 22S

Ground Covers (all nodes) (continued)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	0	0	110,500	110,500	Roofs	1S, 2S, 5S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 23S
0	**0**	**0**	**0**	**377,443**	**377,443**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1R	0.00	-0.14	65.0	0.0022	0.012	12.0	0.0	0.0
2	2R	0.00	-0.66	301.0	0.0022	0.012	12.0	0.0	0.0
3	3R	0.00	-0.25	115.0	0.0022	0.012	15.0	0.0	0.0
4	4R	0.00	-0.51	233.0	0.0022	0.012	18.0	0.0	0.0
5	5R	0.00	-0.26	120.0	0.0022	0.012	12.0	0.0	0.0
6	6R	0.00	-0.03	14.0	0.0021	0.012	18.0	0.0	0.0
7	7R	0.00	-0.22	100.0	0.0022	0.012	18.0	0.0	0.0
8	8R	0.00	-0.18	84.0	0.0021	0.012	24.0	0.0	0.0
9	9R	0.00	-0.20	90.0	0.0022	0.012	12.0	0.0	0.0
10	10R	0.00	-2.39	239.0	0.0100	0.012	6.0	0.0	0.0
11	11R	0.00	-0.33	33.0	0.0100	0.012	6.0	0.0	0.0
12	12R	0.00	-3.13	313.0	0.0100	0.012	6.0	0.0	0.0
13	13R	0.00	-1.20	120.0	0.0100	0.012	6.0	0.0	0.0
14	14R	0.00	-0.49	99.0	0.0049	0.012	8.0	0.0	0.0
15	15R	0.00	-0.79	262.0	0.0030	0.012	12.0	0.0	0.0
16	17R	0.00	-0.22	101.0	0.0022	0.012	12.0	0.0	0.0
17	18R	0.00	-0.59	268.0	0.0022	0.012	12.0	0.0	0.0
18	19R	0.00	-0.20	91.0	0.0022	0.012	24.0	0.0	0.0
19	20R	0.00	-2.20	220.0	0.0100	0.012	6.0	0.0	0.0

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=20,975 sf 68.65% Impervious Runoff Depth=3.71"
Tc=6.0 min CN=92 Runoff=0.47 cfs 6,483 cf

Subcatchment 2S: Runoff Area=16,210 sf 55.52% Impervious Runoff Depth=3.40"
Tc=6.0 min CN=89 Runoff=0.33 cfs 4,592 cf

Subcatchment 3S: Runoff Area=18,055 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.46 cfs 6,581 cf

Subcatchment 4S: Runoff Area=12,190 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.31 cfs 4,443 cf

Subcatchment 5S: Runoff Area=30,388 sf 65.16% Impervious Runoff Depth=3.60"
Tc=6.0 min CN=91 Runoff=0.66 cfs 9,127 cf

Subcatchment 6S: Runoff Area=8,550 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.22 cfs 3,116 cf

Subcatchment 7S: Runoff Area=20,149 sf 44.67% Impervious Runoff Depth=3.20"
Tc=6.0 min CN=87 Runoff=0.38 cfs 5,376 cf

Subcatchment 8S: Runoff Area=25,383 sf 63.82% Impervious Runoff Depth=3.60"
Tc=6.0 min CN=91 Runoff=0.55 cfs 7,624 cf

Subcatchment 9S: Runoff Area=14,820 sf 72.87% Impervious Runoff Depth=3.82"
Tc=6.0 min CN=93 Runoff=0.34 cfs 4,712 cf

Subcatchment 10S: Runoff Area=34,687 sf 72.65% Impervious Runoff Depth=3.82"
Tc=6.0 min CN=93 Runoff=0.80 cfs 11,029 cf

Subcatchment 11S: Runoff Area=49,376 sf 51.04% Impervious Runoff Depth=3.30"
Tc=6.0 min CN=88 Runoff=0.97 cfs 13,578 cf

Subcatchment 12S: Runoff Area=25,318 sf 56.88% Impervious Runoff Depth=3.40"
Tc=6.0 min CN=89 Runoff=0.52 cfs 7,173 cf

Subcatchment 13S: Runoff Area=13,280 sf 40.66% Impervious Runoff Depth=3.10"
Tc=6.0 min CN=86 Runoff=0.24 cfs 3,436 cf

Subcatchment 14S: Runoff Area=12,708 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.32 cfs 4,632 cf

Subcatchment 15S: Runoff Area=7,486 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.19 cfs 2,729 cf

Subcatchment 16S: Runoff Area=6,944 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.18 cfs 2,531 cf

Subcatchment 17S: Runoff Area=7,234 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.18 cfs 2,637 cf

Subcatchment 18S: Runoff Area=13,636 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.35 cfs 4,970 cf

Subcatchment 19S: Runoff Area=9,516 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.24 cfs 3,468 cf

Subcatchment 20S: Runoff Area=8,875 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.22 cfs 3,235 cf

Subcatchment 21S: Runoff Area=8,970 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.23 cfs 3,269 cf

Subcatchment 22S: Runoff Area=2,364 sf 100.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=98 Runoff=0.06 cfs 862 cf

Subcatchment 23S: Runoff Area=10,329 sf 34.85% Impervious Runoff Depth=3.01"
Tc=6.0 min CN=85 Runoff=0.18 cfs 2,590 cf

Reach 1R: Avg. Flow Depth=0.53' Max Vel=2.33 fps Inflow=0.98 cfs 13,844 cf
12.0" Round Pipe n=0.012 L=65.0' S=0.0022 '/' Capacity=1.79 cfs Outflow=0.98 cfs 13,844 cf

Reach 2R: Avg. Flow Depth=0.45' Max Vel=2.21 fps Inflow=0.77 cfs 11,024 cf
12.0" Round Pipe n=0.012 L=301.0' S=0.0022 '/' Capacity=1.81 cfs Outflow=0.76 cfs 11,024 cf

Reach 3R: Avg. Flow Depth=0.72' Max Vel=2.81 fps Inflow=2.07 cfs 29,460 cf
15.0" Round Pipe n=0.012 L=115.0' S=0.0022 '/' Capacity=3.26 cfs Outflow=2.07 cfs 29,460 cf

Reach 4R: Avg. Flow Depth=0.71' Max Vel=2.94 fps Inflow=2.42 cfs 34,627 cf
18.0" Round Pipe n=0.012 L=233.0' S=0.0022 '/' Capacity=5.32 cfs Outflow=2.42 cfs 34,627 cf

Reach 5R: Avg. Flow Depth=0.32' Max Vel=1.84 fps Inflow=0.40 cfs 5,707 cf
12.0" Round Pipe n=0.012 L=120.0' S=0.0022 '/' Capacity=1.80 cfs Outflow=0.40 cfs 5,707 cf

Reach 6R: Avg. Flow Depth=0.89' Max Vel=3.18 fps Inflow=3.47 cfs 49,462 cf
18.0" Round Pipe n=0.012 L=14.0' S=0.0021 '/' Capacity=5.27 cfs Outflow=3.47 cfs 49,462 cf

Reach 7R: Avg. Flow Depth=1.28' Max Vel=3.44 fps Inflow=5.53 cfs 78,202 cf
18.0" Round Pipe n=0.012 L=100.0' S=0.0022 '/' Capacity=5.34 cfs Outflow=5.52 cfs 78,202 cf

Reach 8R: Avg. Flow Depth=1.04' Max Vel=3.67 fps Inflow=6.09 cfs 86,641 cf
24.0" Round Pipe n=0.012 L=84.0' S=0.0021 '/' Capacity=11.34 cfs Outflow=6.09 cfs 86,641 cf

Reach 9R: Avg. Flow Depth=0.34' Max Vel=1.92 fps Inflow=0.45 cfs 6,504 cf
12.0" Round Pipe n=0.012 L=90.0' S=0.0022 '/' Capacity=1.82 cfs Outflow=0.45 cfs 6,504 cf

Reach 10R: Avg. Flow Depth=0.33' Max Vel=3.42 fps Inflow=0.47 cfs 6,483 cf
6.0" Round Pipe n=0.012 L=239.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.47 cfs 6,483 cf

Reach 11R: Avg. Flow Depth=0.26' Max Vel=3.16 fps Inflow=0.33 cfs 4,592 cf
6.0" Round Pipe n=0.012 L=33.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.33 cfs 4,592 cf

Reach 12R: Avg. Flow Depth=0.47' Max Vel=3.53 fps Inflow=0.66 cfs 9,127 cf
6.0" Round Pipe n=0.012 L=313.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.65 cfs 9,127 cf

Reach 13R: Avg. Flow Depth=0.37' Max Vel=3.51 fps Inflow=0.55 cfs 7,624 cf
6.0" Round Pipe n=0.012 L=120.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.55 cfs 7,624 cf

Reach 14R: Avg. Flow Depth=0.53' Max Vel=3.01 fps Inflow=0.89 cfs 12,336 cf
8.0" Round Pipe n=0.012 L=99.0' S=0.0049 '/' Capacity=0.92 cfs Outflow=0.89 cfs 12,336 cf

Reach 15R: Avg. Flow Depth=0.67' Max Vel=2.99 fps Inflow=1.68 cfs 23,365 cf
12.0" Round Pipe n=0.012 L=262.0' S=0.0030 '/' Capacity=2.12 cfs Outflow=1.68 cfs 23,365 cf

Reach 17R: Avg. Flow Depth=0.63' Max Vel=2.50 fps Inflow=1.31 cfs 18,436 cf
12.0" Round Pipe n=0.012 L=101.0' S=0.0022 '/' Capacity=1.80 cfs Outflow=1.31 cfs 18,436 cf

Reach 18R: Avg. Flow Depth=0.67' Max Vel=2.55 fps Inflow=1.42 cfs 20,082 cf
12.0" Round Pipe n=0.012 L=268.0' S=0.0022 '/' Capacity=1.81 cfs Outflow=1.42 cfs 20,082 cf

Reach 19R: Avg. Flow Depth=1.26' Max Vel=3.98 fps Inflow=8.33 cfs 118,193 cf
24.0" Round Pipe n=0.012 L=91.0' S=0.0022 '/' Capacity=11.49 cfs Outflow=8.32 cfs 118,193 cf

Reach 20R: Avg. Flow Depth=0.35' Max Vel=3.47 fps Inflow=0.52 cfs 7,173 cf
6.0" Round Pipe n=0.012 L=220.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.52 cfs 7,173 cf

Total Runoff Area = 377,443 sf Runoff Volume = 118,193 cf Average Runoff Depth = 3.76"
28.59% Pervious = 107,915 sf 71.41% Impervious = 269,528 sf

Summary for Subcatchment 1S:

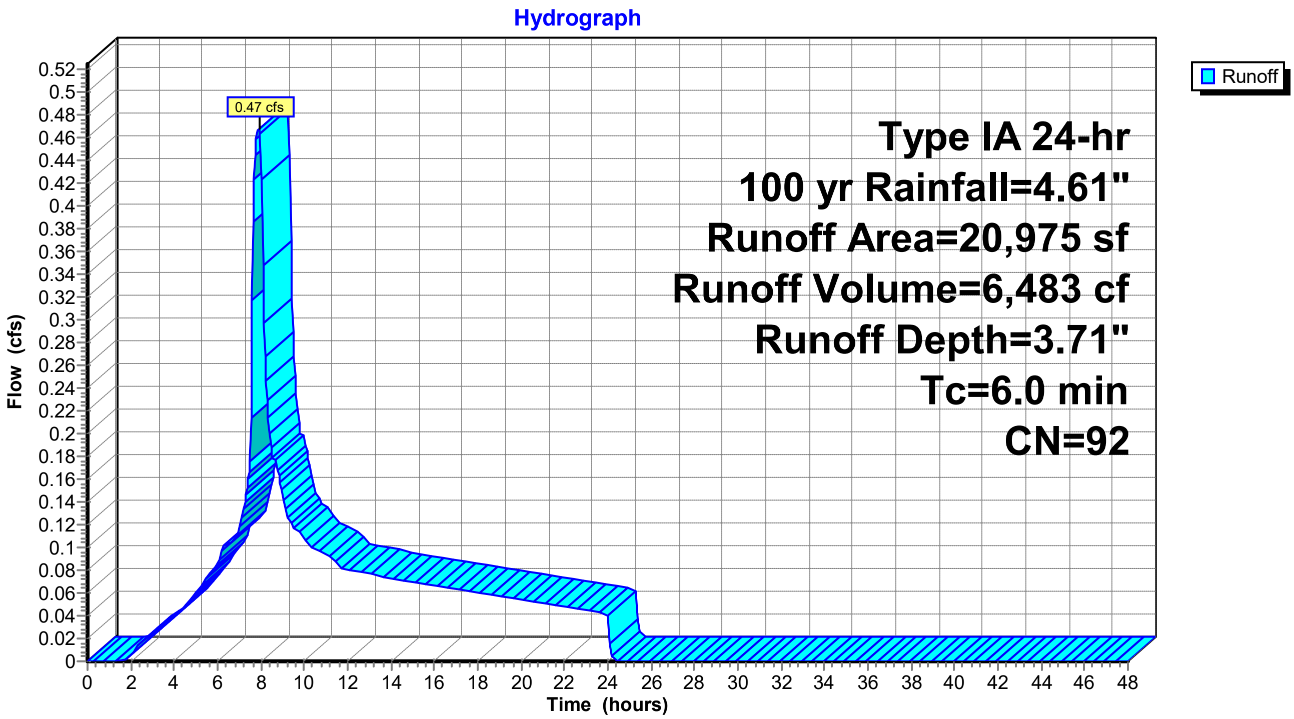
Runoff = 0.47 cfs @ 7.90 hrs, Volume= 6,483 cf, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	10,400	98	Roofs
*	4,000	98	Driveways
*	6,575	78	Landscaping
	20,975	92	Weighted Average
	6,575		31.35% Pervious Area
	14,400		68.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 1S:



Summary for Subcatchment 2S:

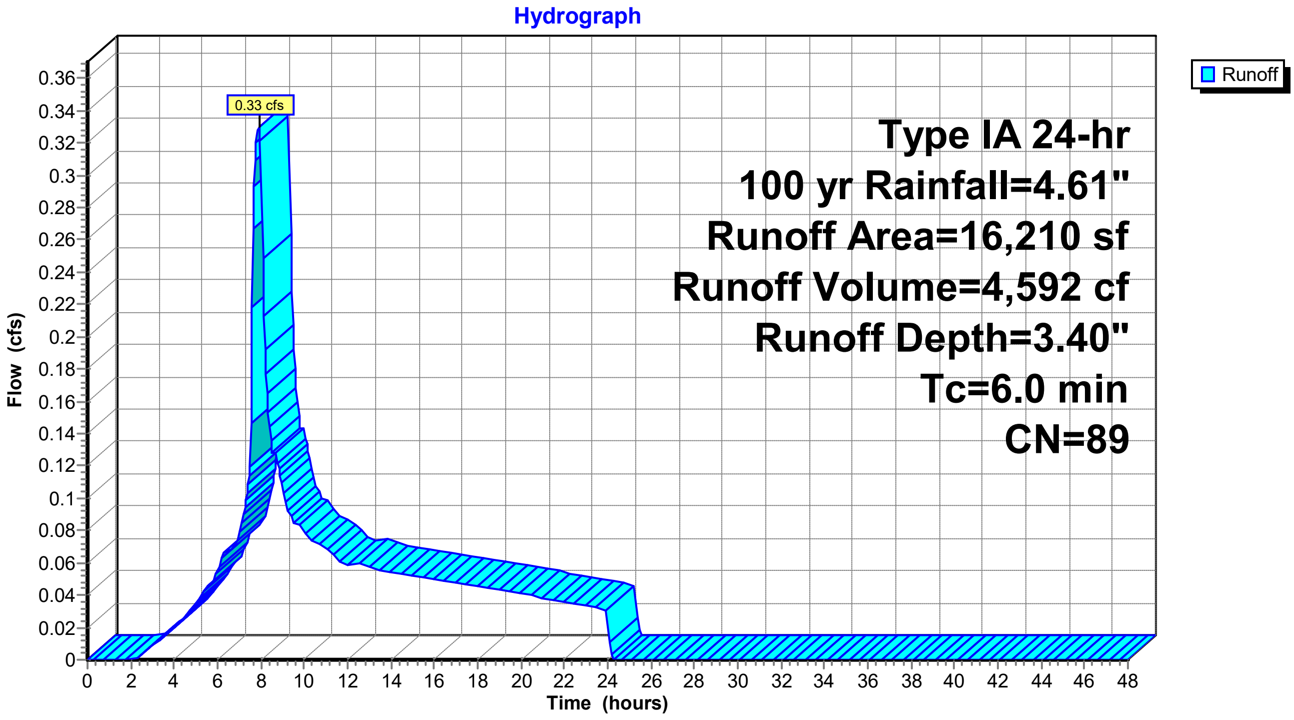
Runoff = 0.33 cfs @ 7.91 hrs, Volume= 4,592 cf, Depth= 3.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	6,500	98	Roofs
*	2,500	98	Driveways
*	7,210	78	Landscaping
	16,210	89	Weighted Average
	7,210		44.48% Pervious Area
	9,000		55.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 2S:



Summary for Subcatchment 3S:

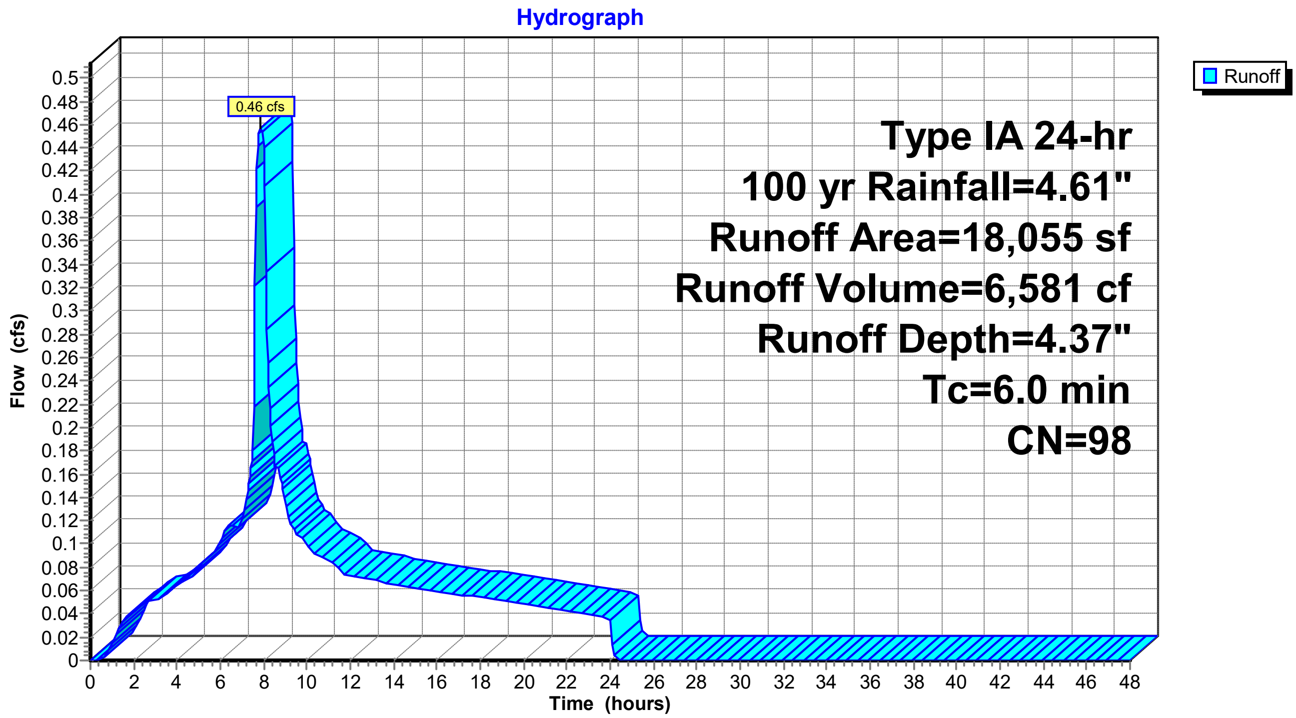
Runoff = 0.46 cfs @ 7.87 hrs, Volume= 6,581 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	18,055	98	Roadway
	18,055		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 3S:



Summary for Subcatchment 4S:

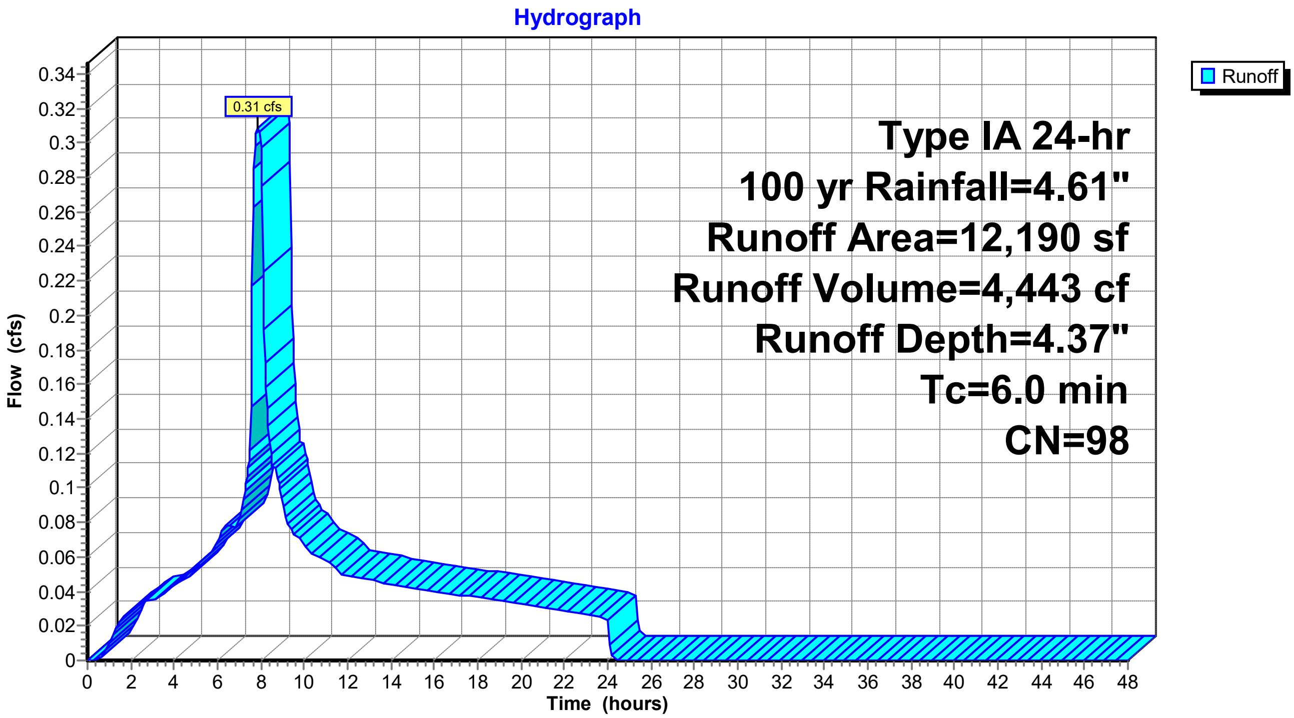
Runoff = 0.31 cfs @ 7.87 hrs, Volume= 4,443 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	12,190	98	Roadway
	12,190		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 4S:



Summary for Subcatchment 5S:

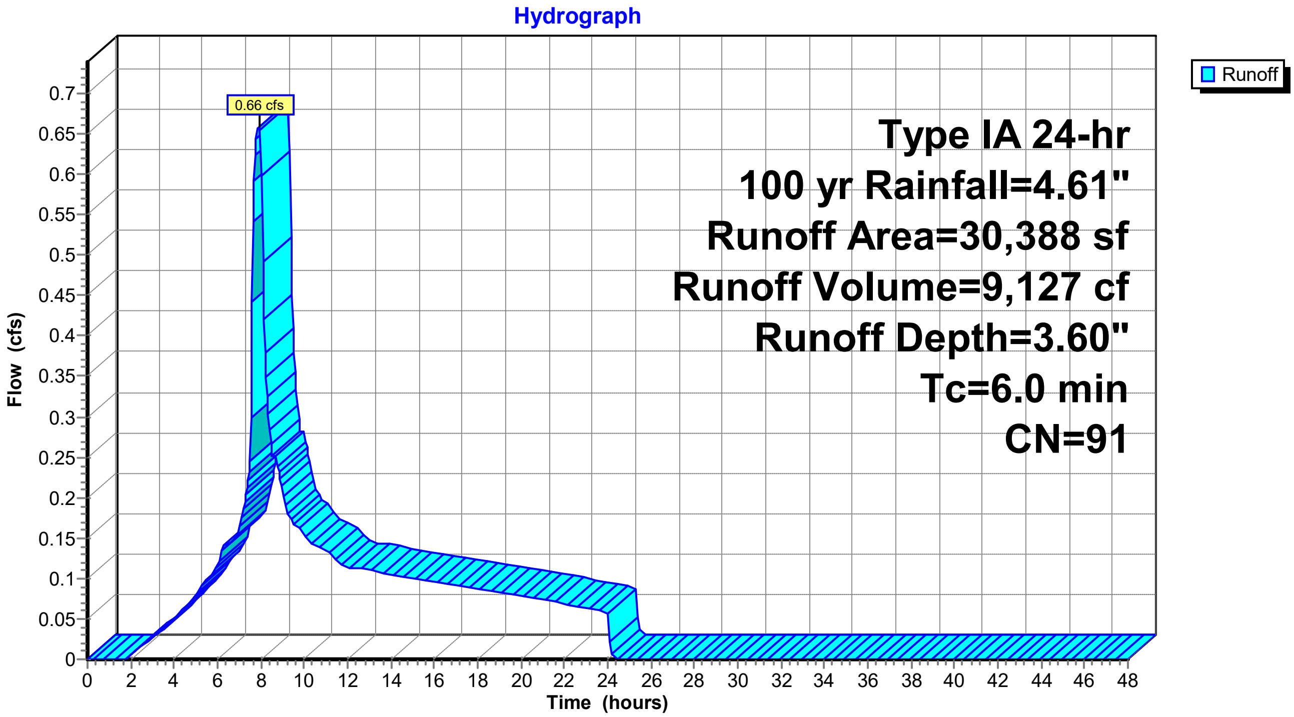
Runoff = 0.66 cfs @ 7.90 hrs, Volume= 9,127 cf, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	14,300	98	Roofs
*	5,500	98	Driveways
*	10,588	78	Landscaping
	30,388	91	Weighted Average
	10,588		34.84% Pervious Area
	19,800		65.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 5S:



Summary for Subcatchment 6S:

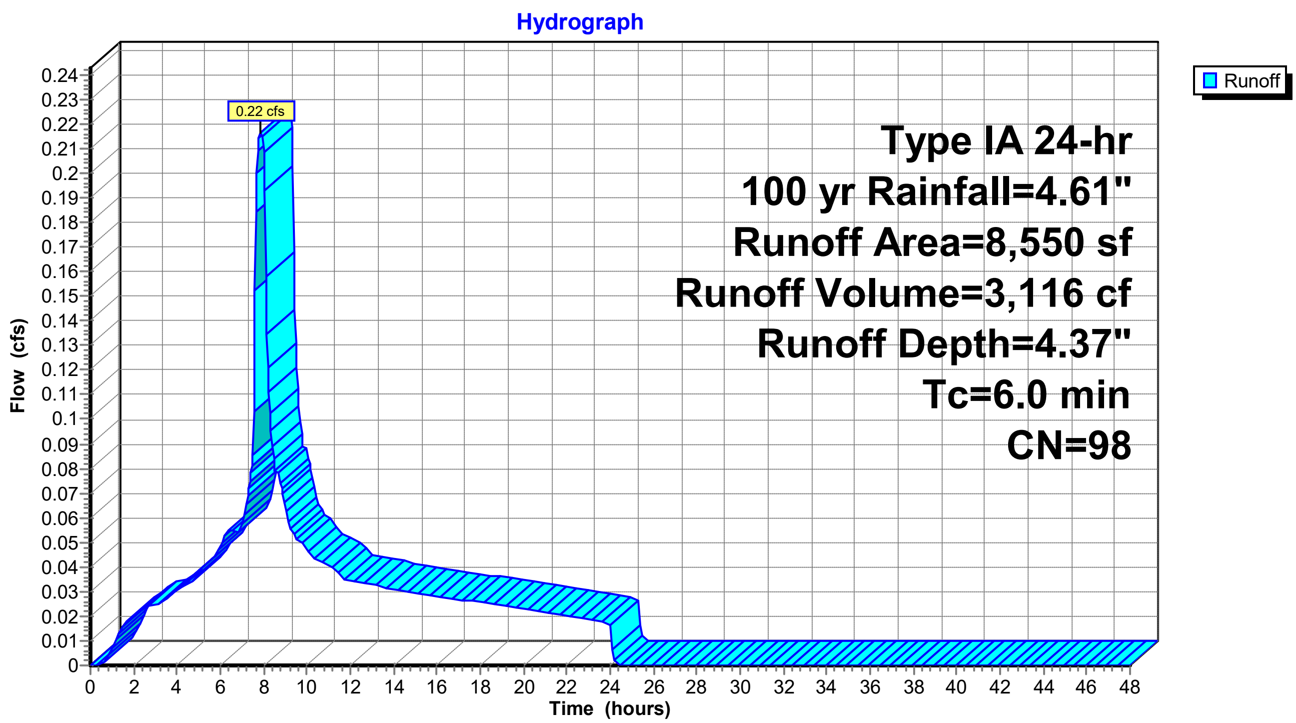
Runoff = 0.22 cfs @ 7.87 hrs, Volume= 3,116 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	8,550	98	Roadway
	8,550		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 6S:



Summary for Subcatchment 7S:

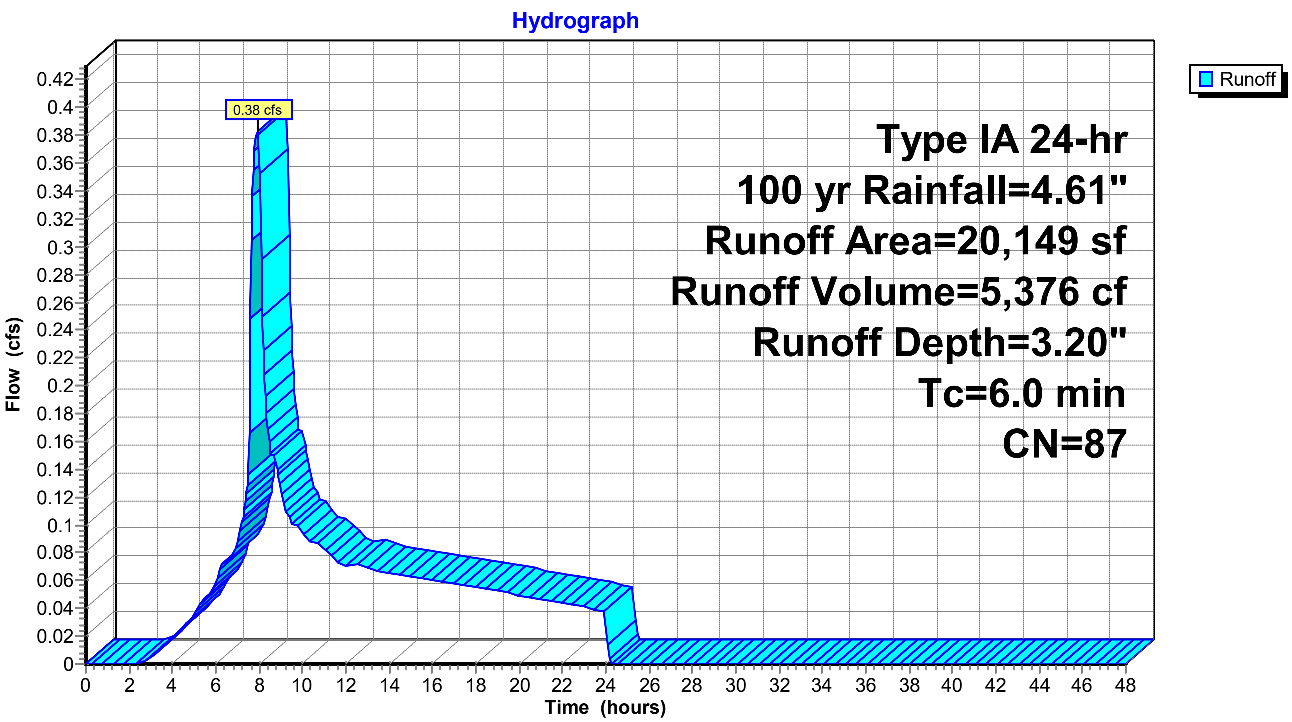
Runoff = 0.38 cfs @ 7.92 hrs, Volume= 5,376 cf, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	6,500	98	Roofs
*	2,500	98	Driveways
*	11,149	78	Landscaping
	20,149	87	Weighted Average
	11,149		55.33% Pervious Area
	9,000		44.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 7S:



Summary for Subcatchment 8S:

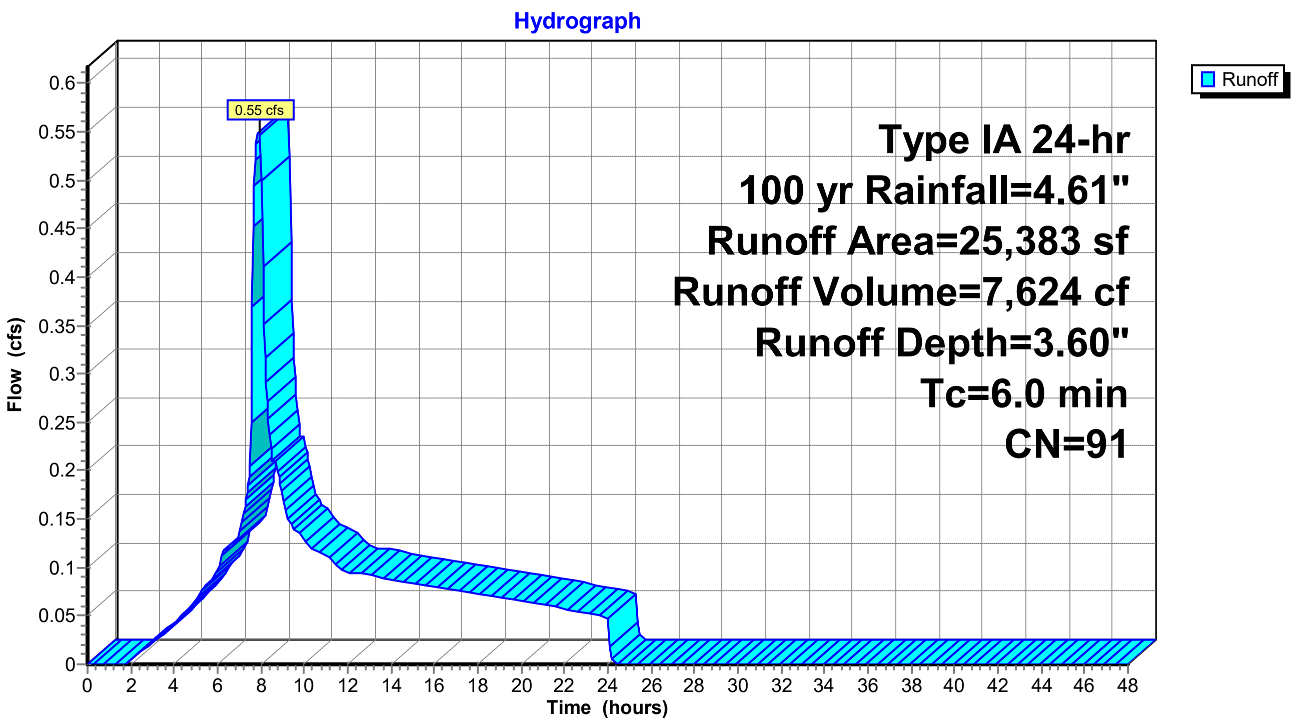
Runoff = 0.55 cfs @ 7.90 hrs, Volume= 7,624 cf, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	11,700	98	Roofs
*	4,500	98	Driveways
*	9,183	78	Landscaping
	25,383	91	Weighted Average
	9,183		36.18% Pervious Area
	16,200		63.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 8S:



Summary for Subcatchment 9S:

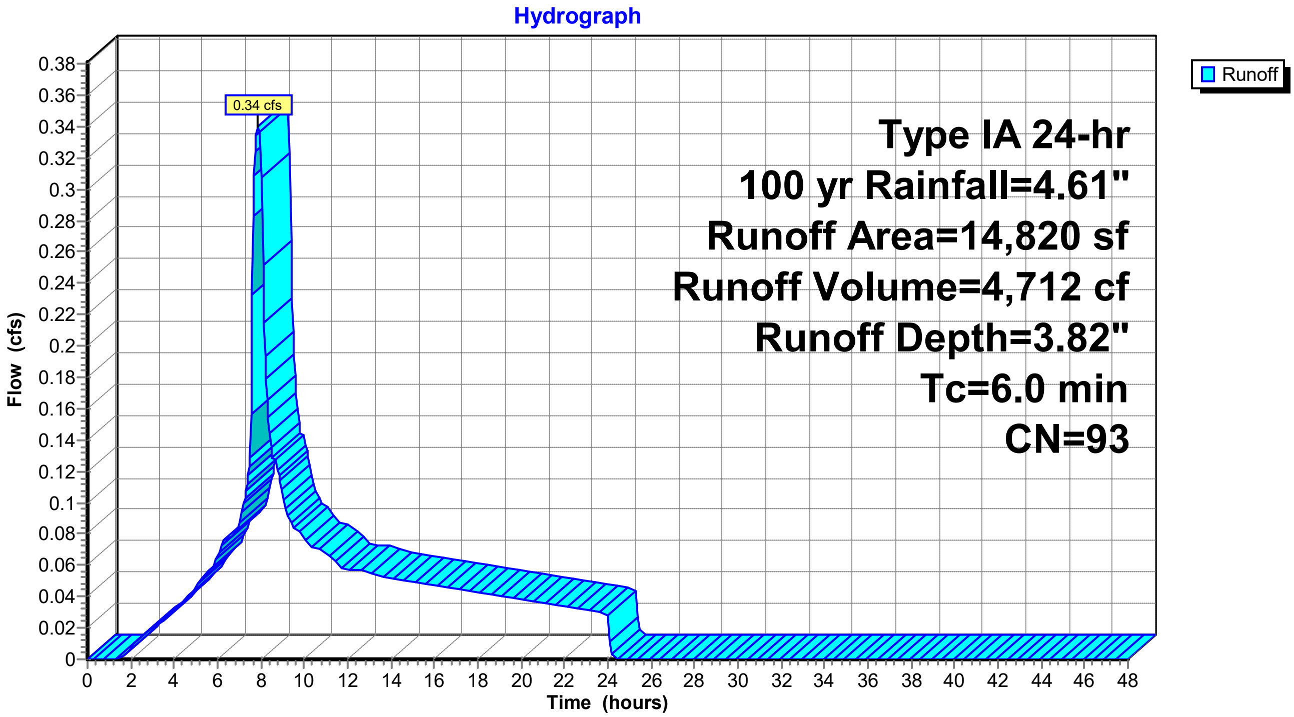
Runoff = 0.34 cfs @ 7.89 hrs, Volume= 4,712 cf, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	7,800	98	Roofs
*	3,000	98	Driveways
*	4,020	78	Landscaping
	14,820	93	Weighted Average
	4,020		27.13% Pervious Area
	10,800		72.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 9S:



Summary for Subcatchment 10S:

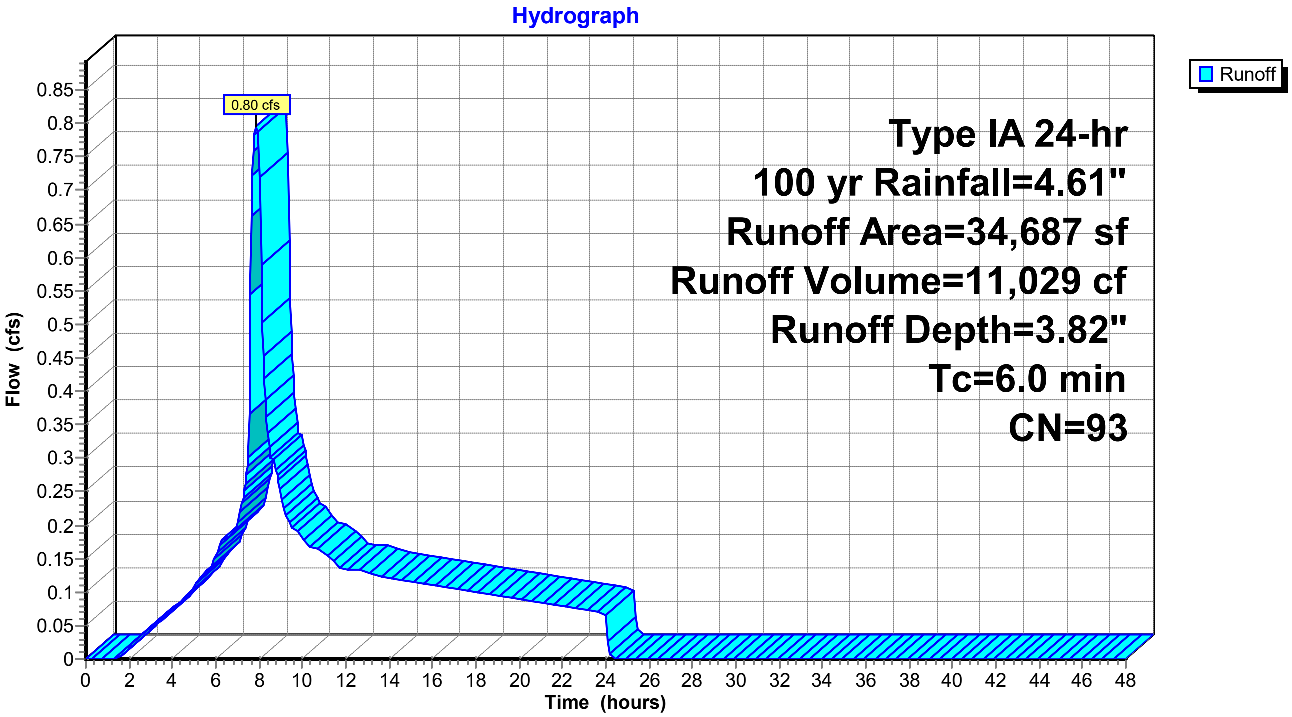
Runoff = 0.80 cfs @ 7.89 hrs, Volume= 11,029 cf, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	18,200	98	Roofs
*	7,000	98	Driveways
*	9,487	78	Landscaping
	34,687	93	Weighted Average
	9,487		27.35% Pervious Area
	25,200		72.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 10S:



Summary for Subcatchment 11S:

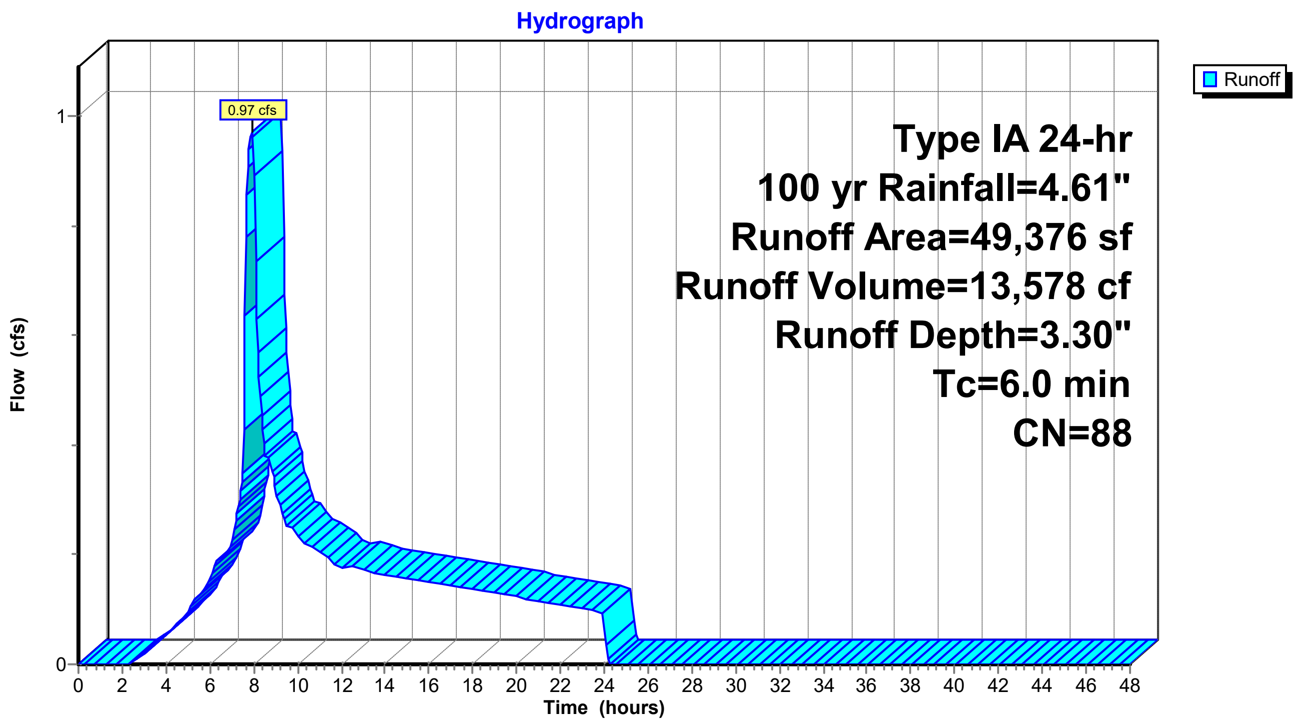
Runoff = 0.97 cfs @ 7.92 hrs, Volume= 13,578 cf, Depth= 3.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	18,200	98	Roofs
*	7,000	98	Driveways
*	24,176	78	Landscaping
	49,376	88	Weighted Average
	24,176		48.96% Pervious Area
	25,200		51.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 11S:



Summary for Subcatchment 12S:

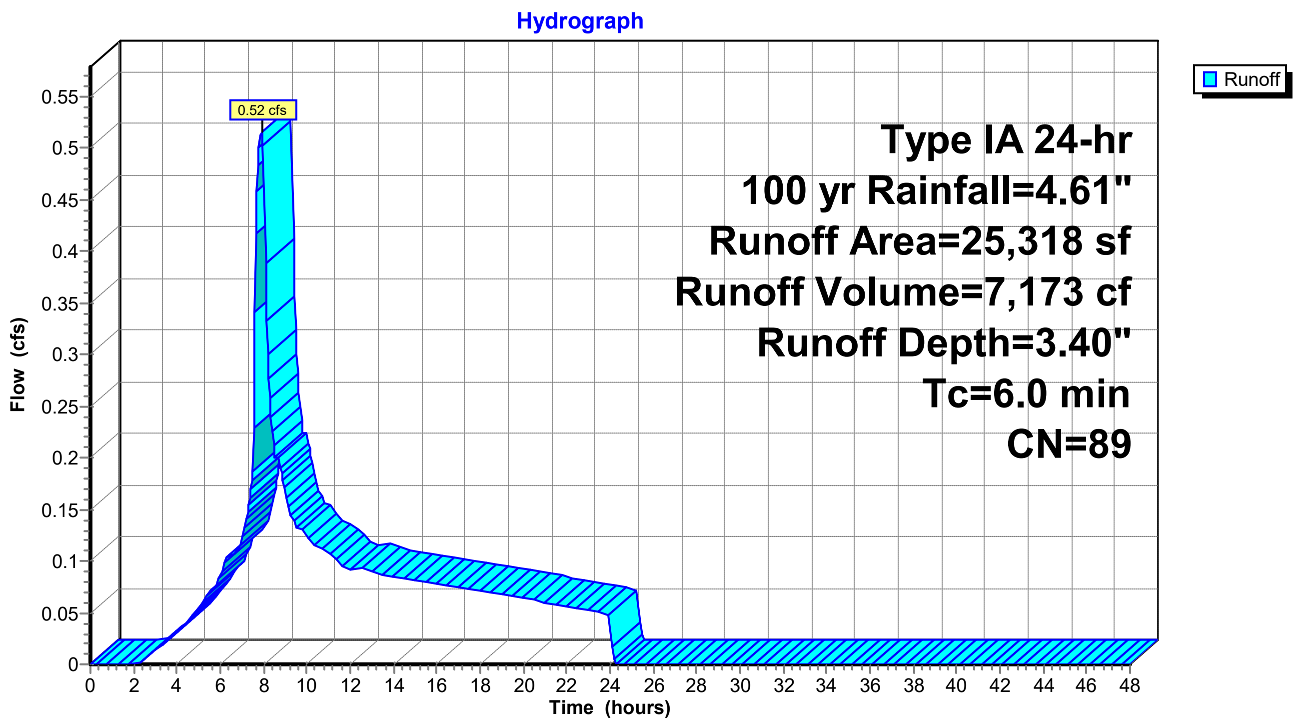
Runoff = 0.52 cfs @ 7.91 hrs, Volume= 7,173 cf, Depth= 3.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	10,400	98	Roofs
*	4,000	98	Driveways
*	10,918	78	Landscaping
	25,318	89	Weighted Average
	10,918		43.12% Pervious Area
	14,400		56.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 12S:



Summary for Subcatchment 13S:

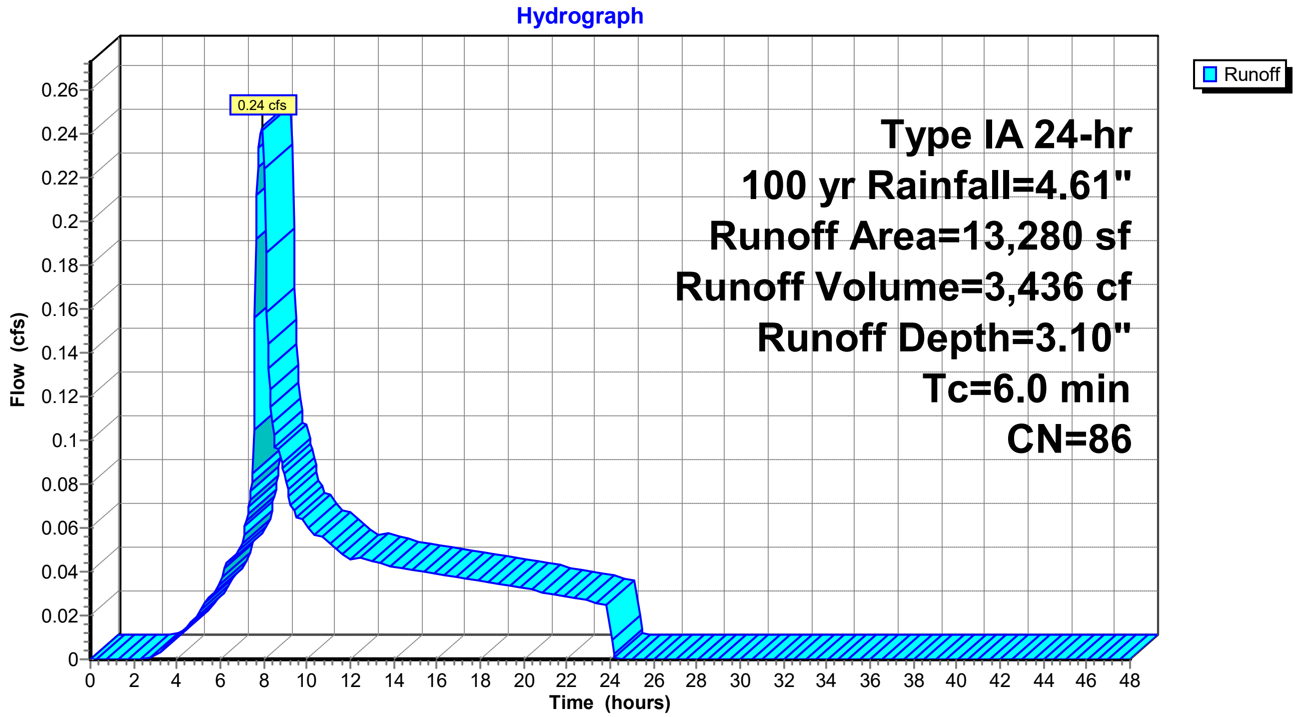
Runoff = 0.24 cfs @ 7.93 hrs, Volume= 3,436 cf, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	3,900	98	Roofs
*	1,500	98	Driveways
*	7,880	78	Landscaping
	13,280	86	Weighted Average
	7,880		59.34% Pervious Area
	5,400		40.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 13S:



Summary for Subcatchment 14S:

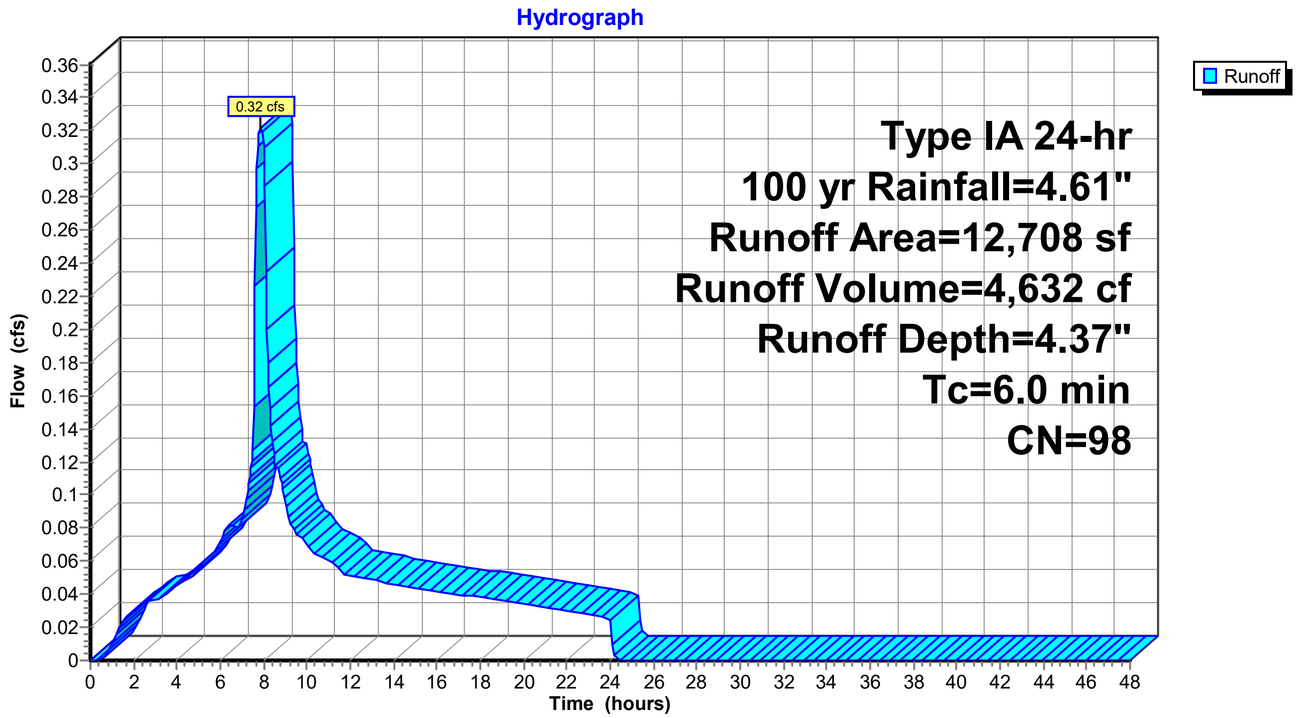
Runoff = 0.32 cfs @ 7.87 hrs, Volume= 4,632 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	12,708	98	Roadway
	12,708		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 14S:



Summary for Subcatchment 15S:

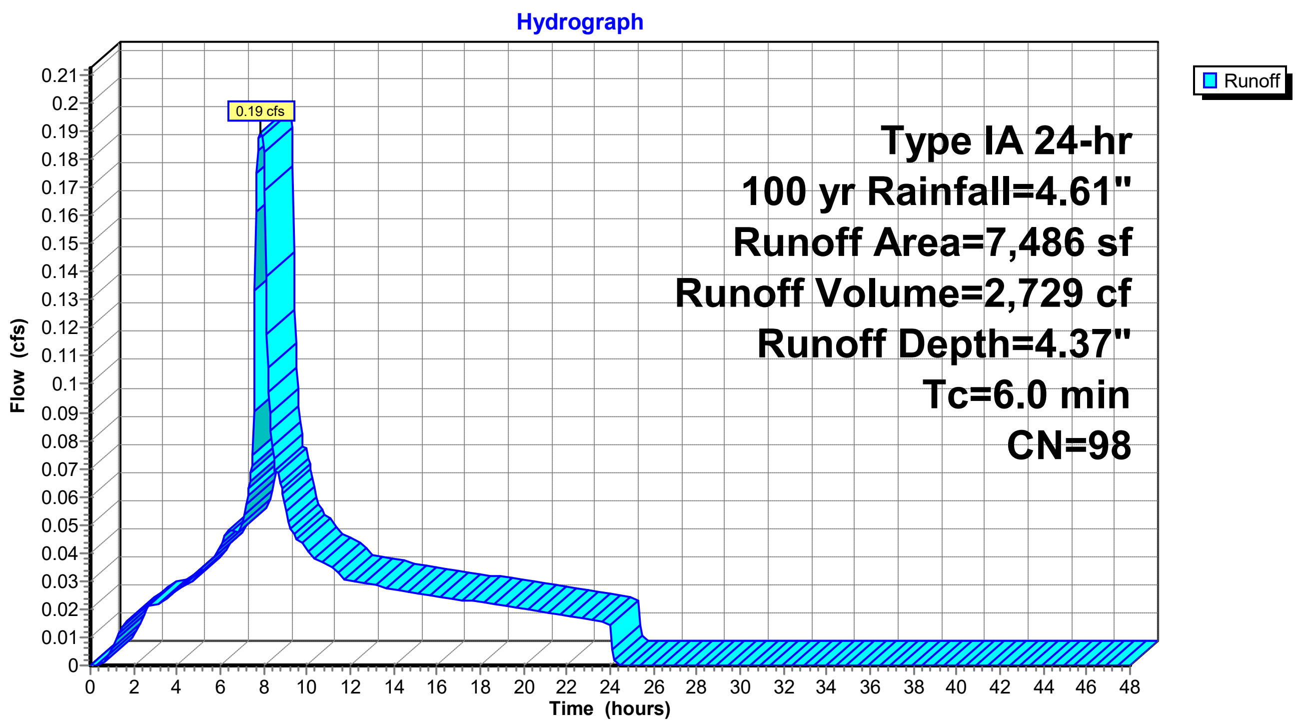
Runoff = 0.19 cfs @ 7.87 hrs, Volume= 2,729 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	7,486	98	Roadway
	7,486		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 15S:



Summary for Subcatchment 16S:

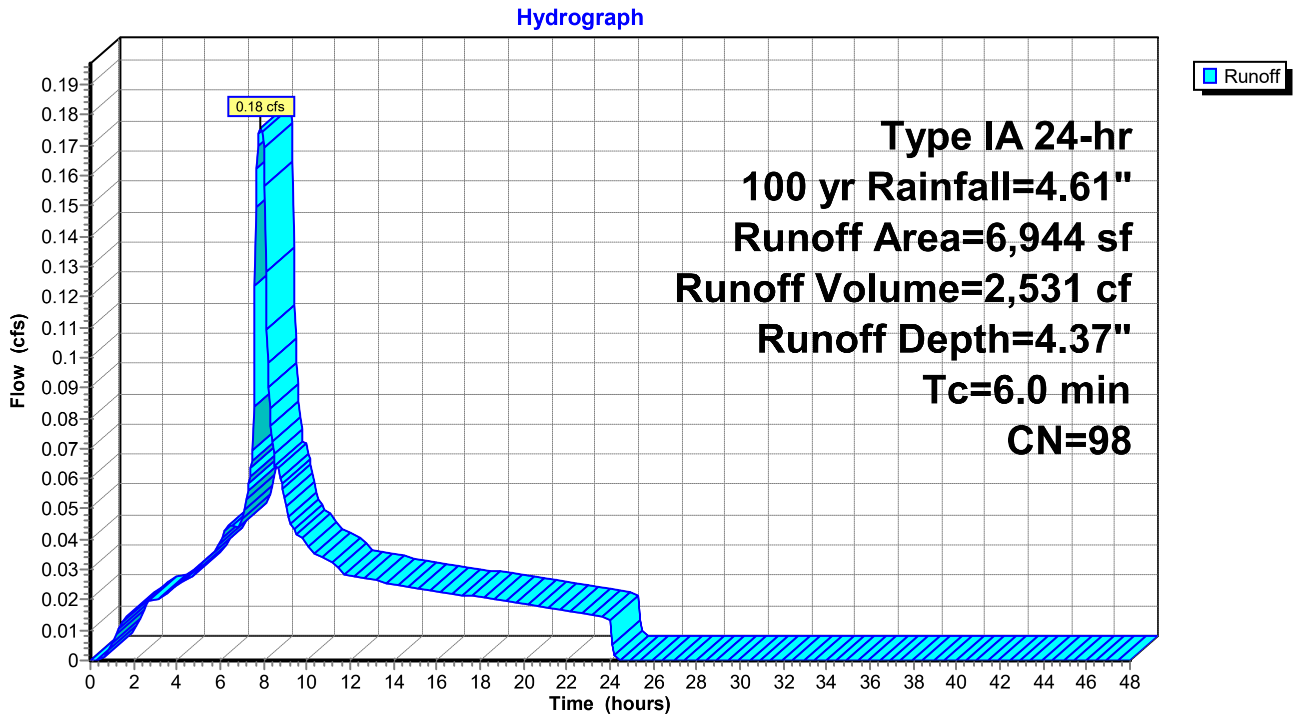
Runoff = 0.18 cfs @ 7.87 hrs, Volume= 2,531 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	6,944	98	Roadway
	6,944		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 16S:



Summary for Subcatchment 17S:

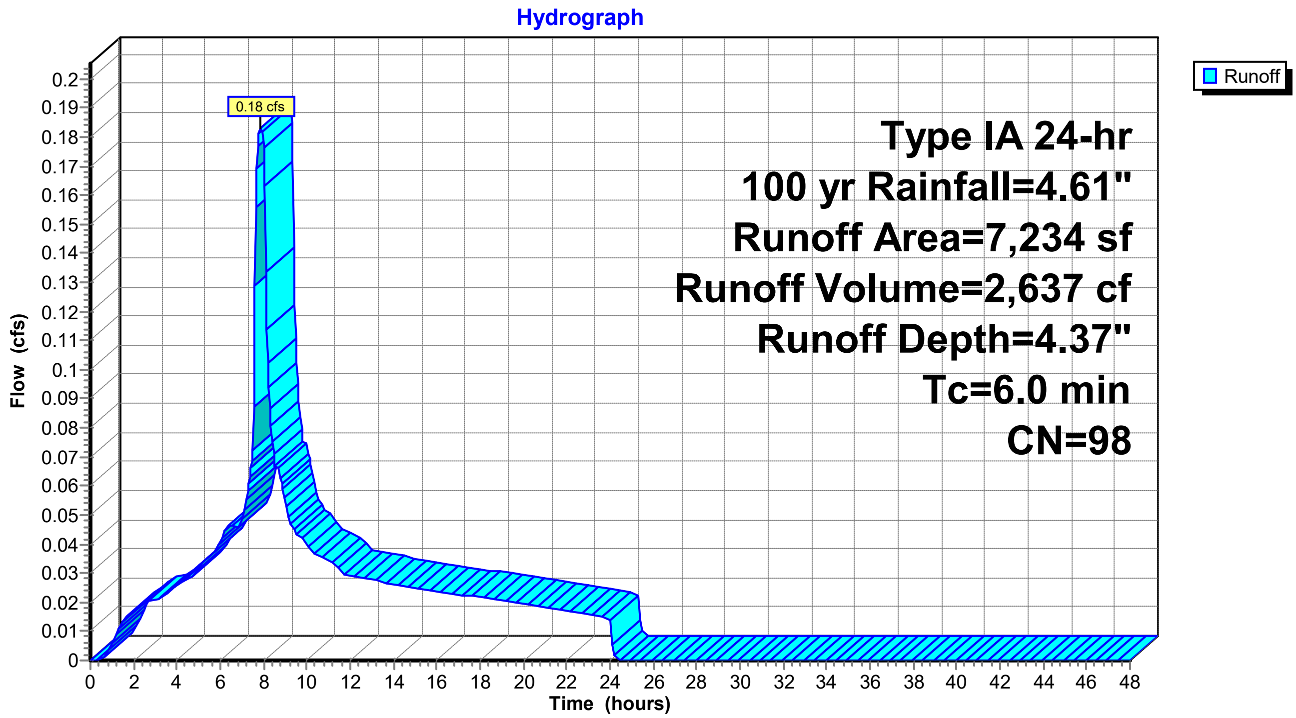
Runoff = 0.18 cfs @ 7.87 hrs, Volume= 2,637 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	7,234	98	Roadway
	7,234		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 17S:



Summary for Subcatchment 18S:

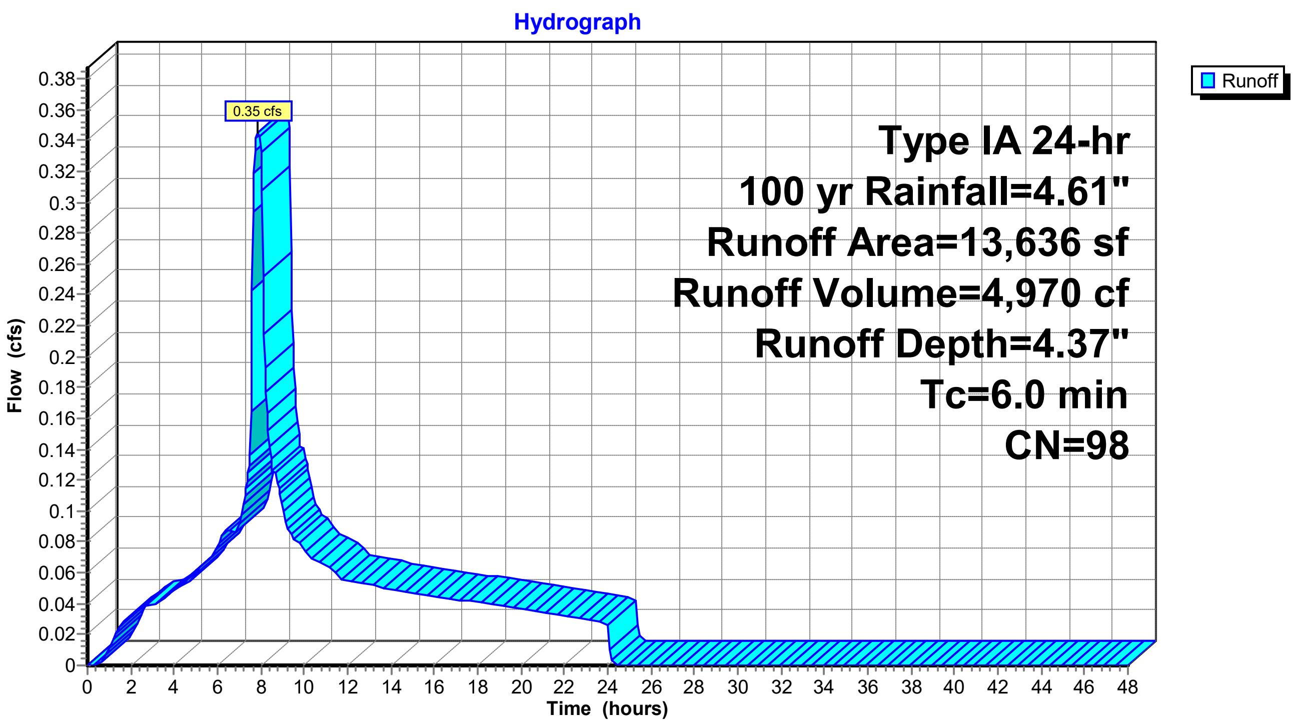
Runoff = 0.35 cfs @ 7.87 hrs, Volume= 4,970 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	13,636	98	Roadway
	13,636		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 18S:



Summary for Subcatchment 19S:

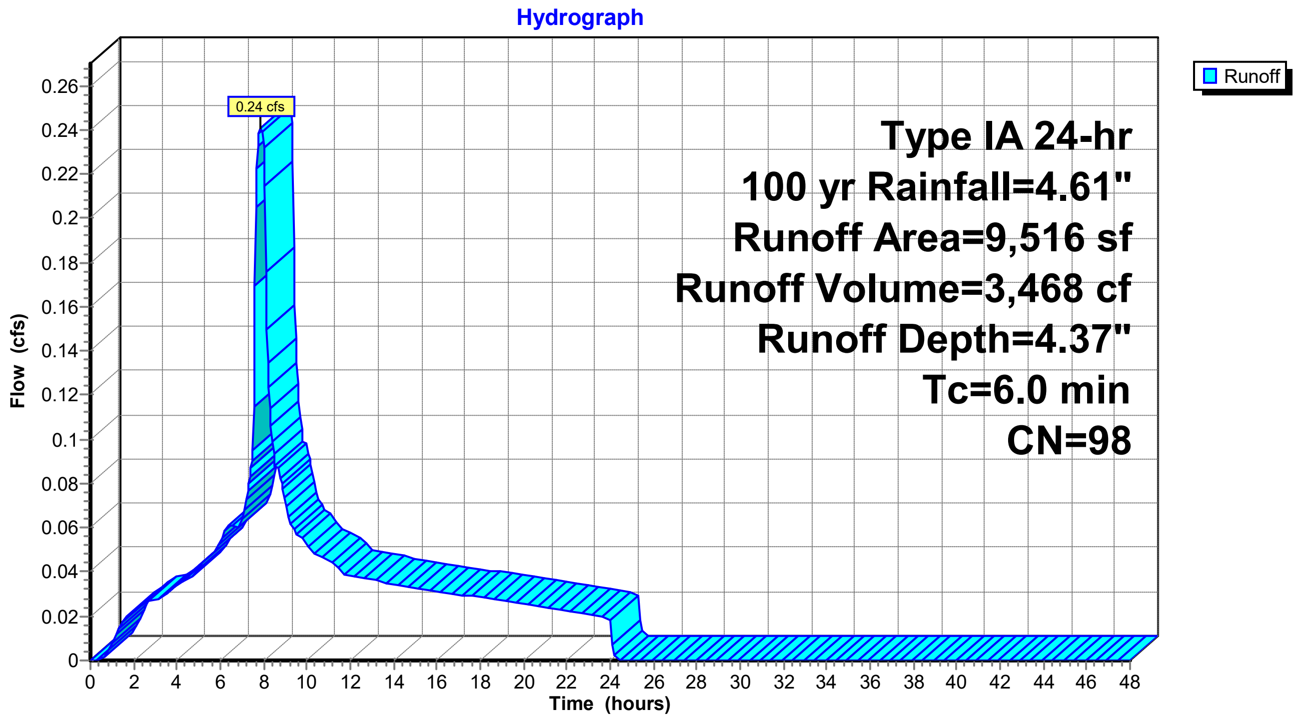
Runoff = 0.24 cfs @ 7.87 hrs, Volume= 3,468 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	9,516	98	Roadway
	9,516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 19S:



Summary for Subcatchment 20S:

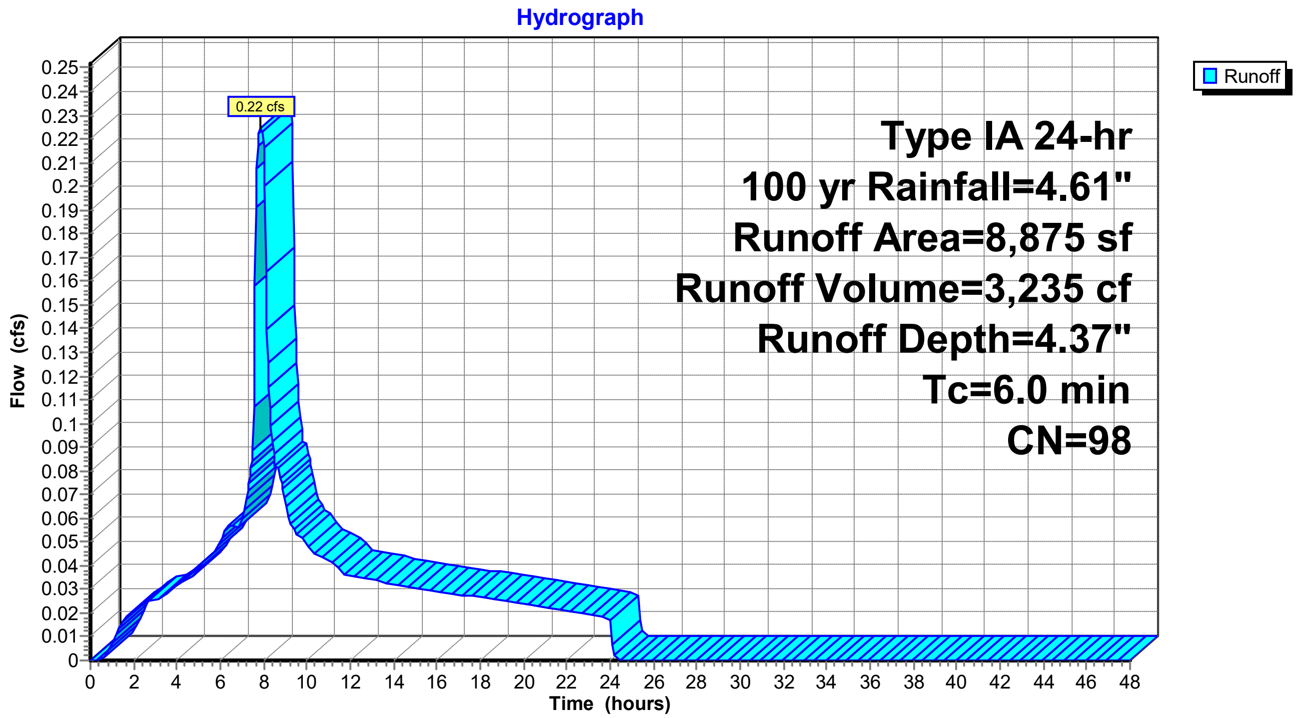
Runoff = 0.22 cfs @ 7.87 hrs, Volume= 3,235 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	8,875	98	Roadway
	8,875		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 20S:



Summary for Subcatchment 21S:

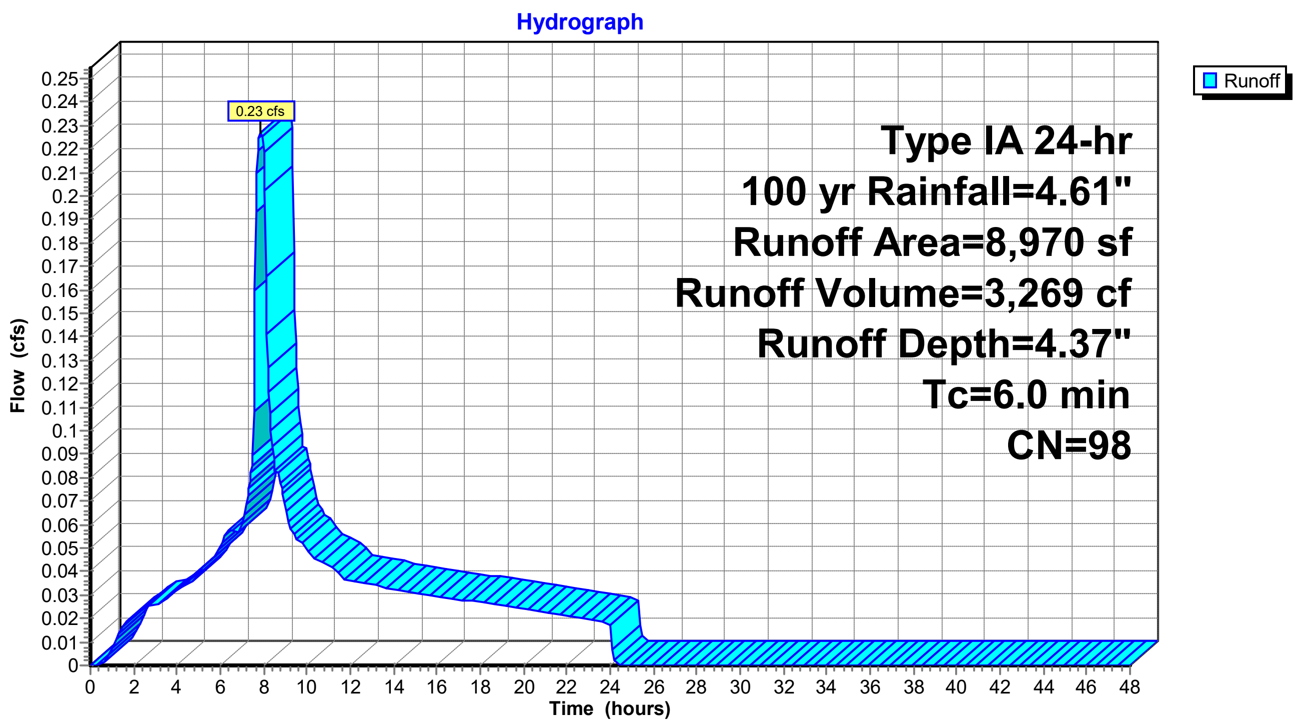
Runoff = 0.23 cfs @ 7.87 hrs, Volume= 3,269 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	8,970	98	Roadway
	8,970		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 21S:



Summary for Subcatchment 22S:

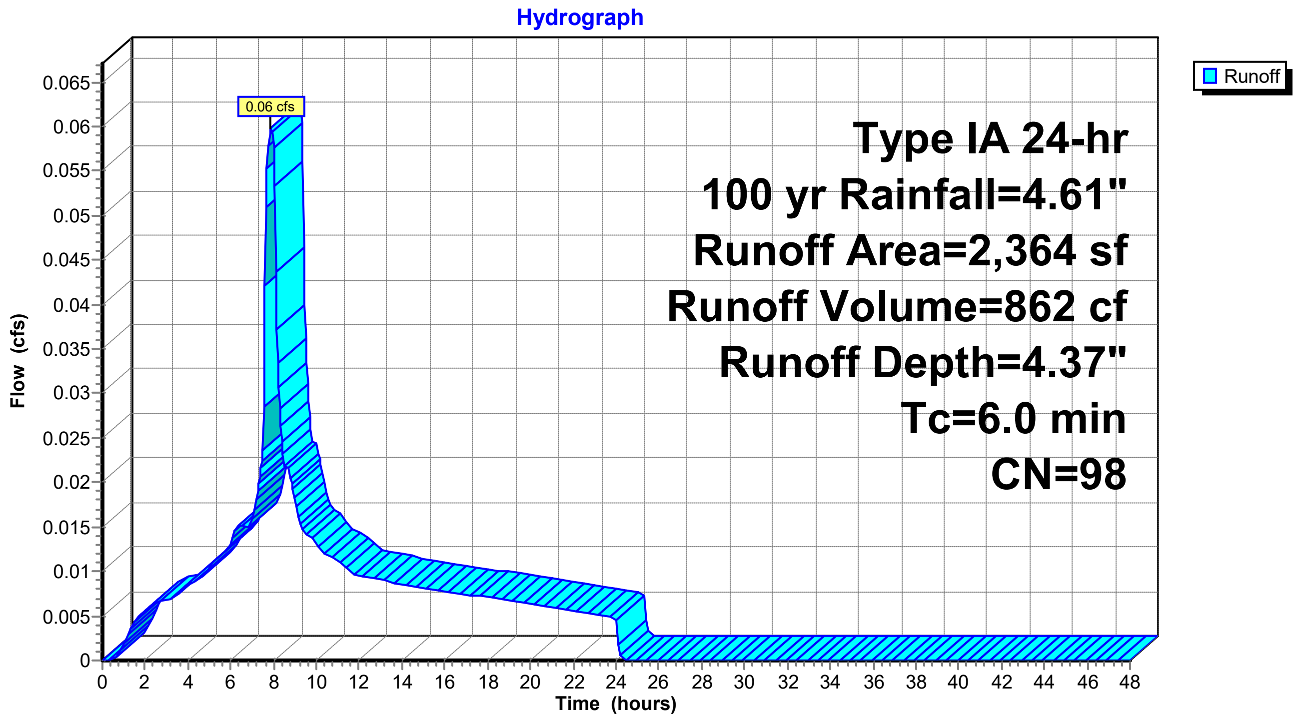
Runoff = 0.06 cfs @ 7.87 hrs, Volume= 862 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	2,364	98	Roadway
	2,364		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 22S:



Summary for Subcatchment 23S:

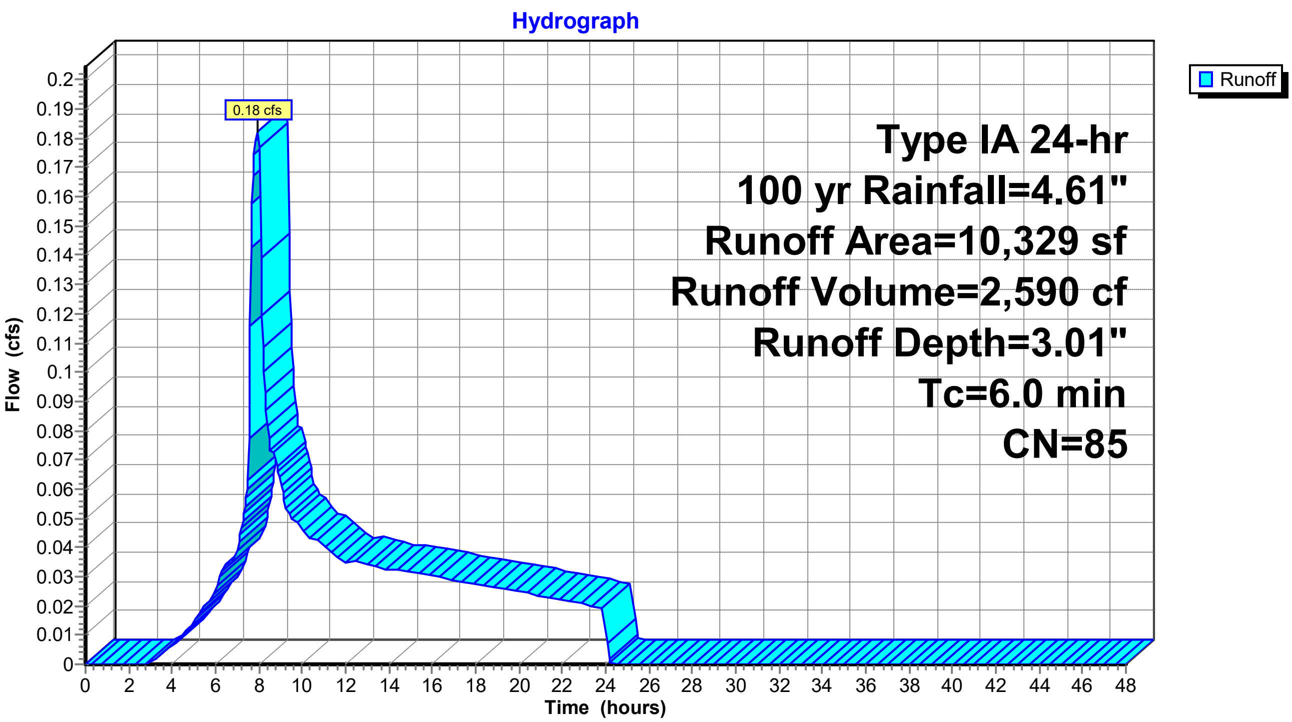
Runoff = 0.18 cfs @ 7.93 hrs, Volume= 2,590 cf, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 yr Rainfall=4.61"

	Area (sf)	CN	Description
*	2,600	98	Roofs
*	1,000	98	Driveways
*	6,729	78	Landscaping
	10,329	85	Weighted Average
	6,729		65.15% Pervious Area
	3,600		34.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 23S:



Summary for Reach 1R:

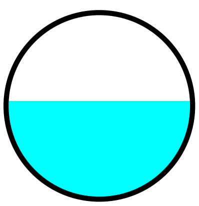
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 41,169 sf, 84.03% Impervious, Inflow Depth = 4.04" for 100 yr event
Inflow = 0.98 cfs @ 7.90 hrs, Volume= 13,844 cf
Outflow = 0.98 cfs @ 7.91 hrs, Volume= 13,844 cf, Atten= 0%, Lag= 0.9 min

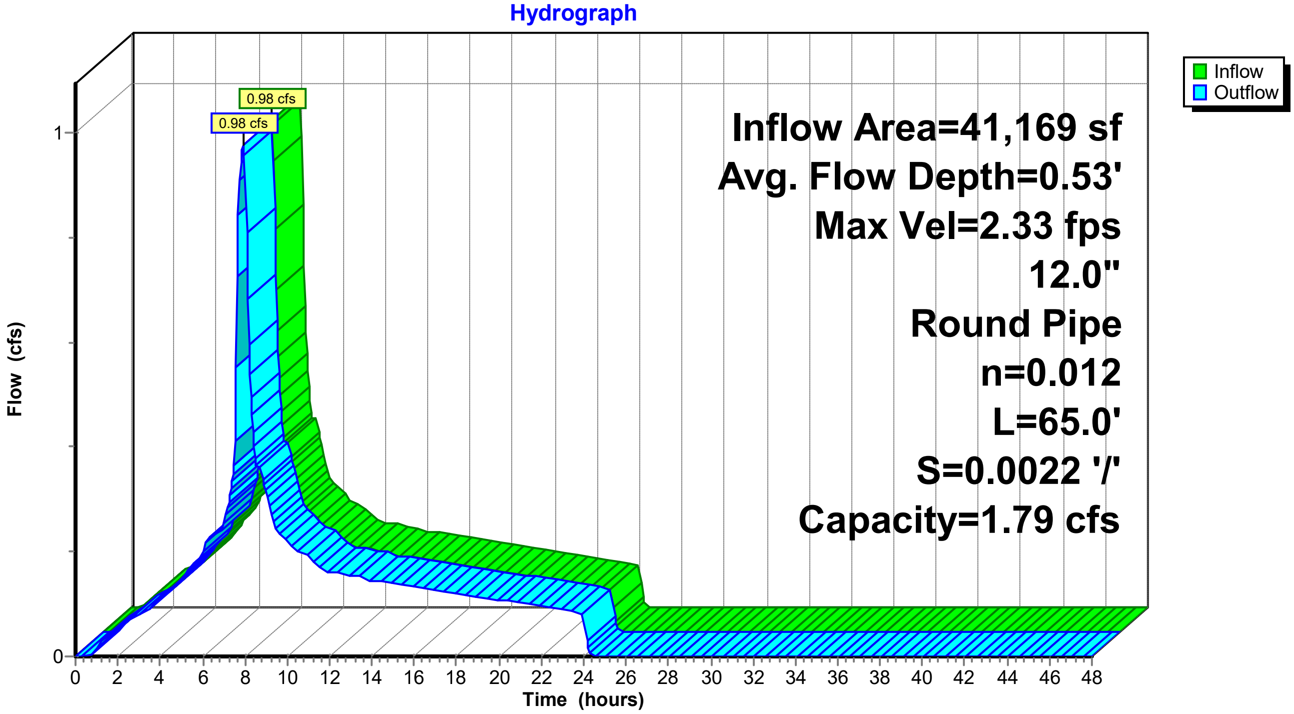
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.33 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 0.8 min

Peak Storage= 27 cf @ 7.91 hrs
Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 1.79 cfs

12.0" Round Pipe
n= 0.012
Length= 65.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.14'



Reach 1R:


Hydrograph
Inflow
Outflow
0.98 cfs
0.98 cfs
Inflow Area=41,169 sf
Avg. Flow Depth=0.53'
Max Vel=2.33 fps
12.0"
Round Pipe
n=0.012
L=65.0'
S=0.0022 '/'
Capacity=1.79 cfs
Flow (cfs)
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Reach 2R:

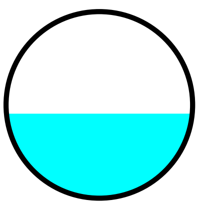
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 30,245 sf,100.00% Impervious, Inflow Depth = 4.37" for 100 yr event
Inflow = 0.77 cfs @ 7.87 hrs, Volume= 11,024 cf
Outflow = 0.76 cfs @ 7.94 hrs, Volume= 11,024 cf, Atten= 0%, Lag= 4.0 min

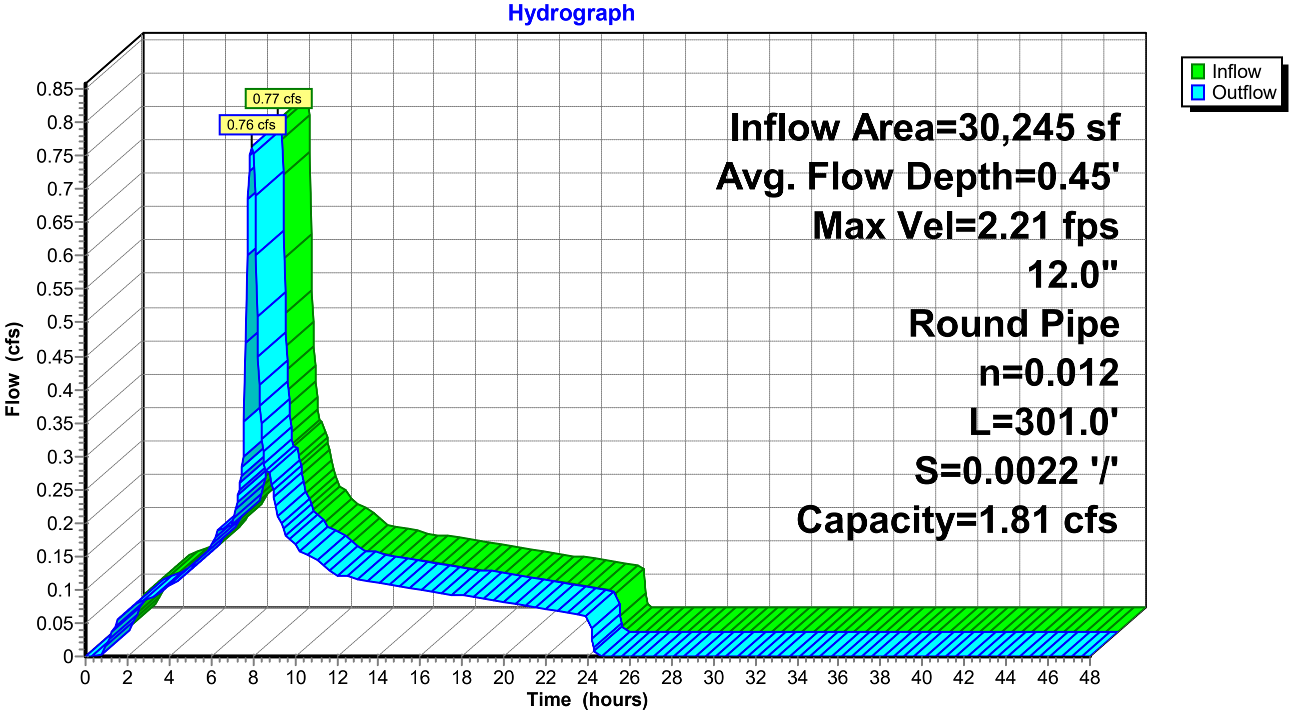
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.21 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.21 fps, Avg. Travel Time= 4.2 min

Peak Storage= 104 cf @ 7.90 hrs
Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 1.81 cfs

12.0" Round Pipe
n= 0.012
Length= 301.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.66'



Reach 2R:


Hydrograph
Inflow
Outflow
0.77 cfs
0.76 cfs
Inflow Area=30,245 sf
Avg. Flow Depth=0.45'
Max Vel=2.21 fps
12.0"
Round Pipe
n=0.012
L=301.0'
S=0.0022 '/'
Capacity=1.81 cfs
Flow (cfs)
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Reach 3R:

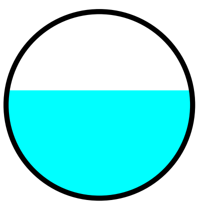
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 87,624 sf, 84.27% Impervious, Inflow Depth = 4.03" for 100 yr event
Inflow = 2.07 cfs @ 7.94 hrs, Volume= 29,460 cf
Outflow = 2.07 cfs @ 7.96 hrs, Volume= 29,460 cf, Atten= 0%, Lag= 1.2 min

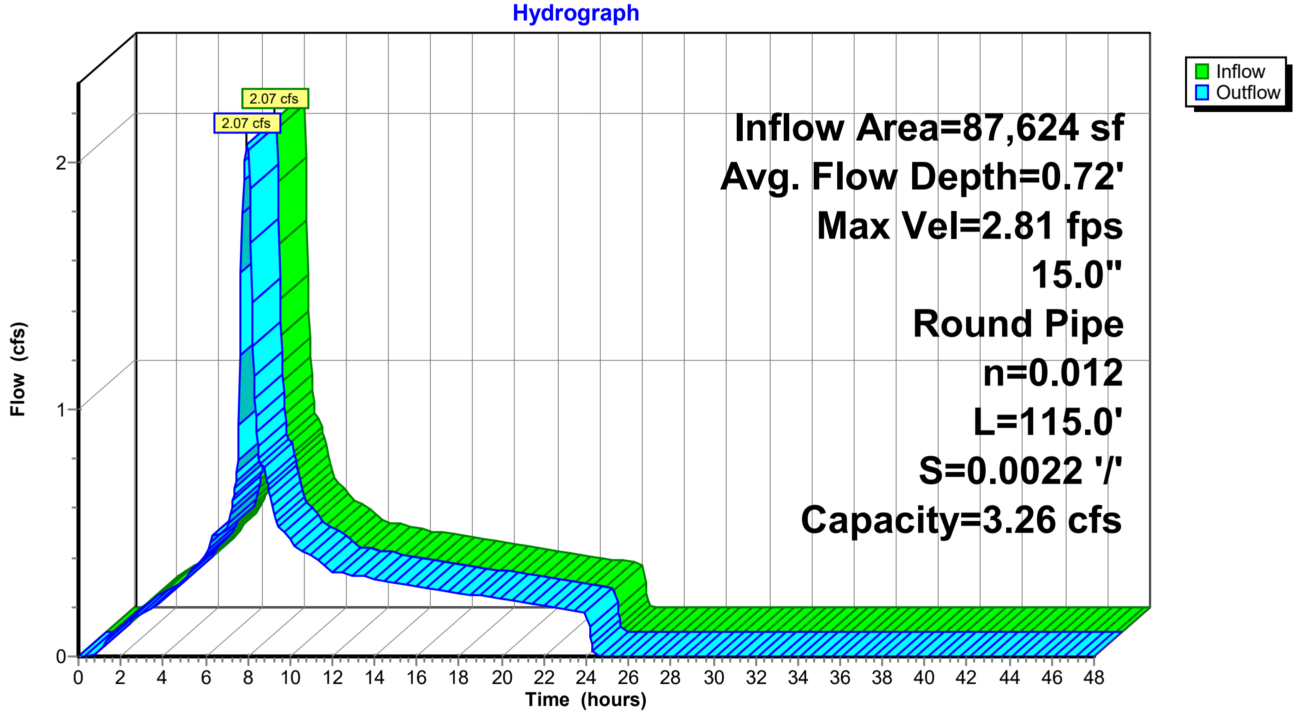
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.81 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.55 fps, Avg. Travel Time= 1.2 min

Peak Storage= 85 cf @ 7.94 hrs
Average Depth at Peak Storage= 0.72'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 3.26 cfs

15.0" Round Pipe
n= 0.012
Length= 115.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.25'



Reach 3R:


Hydrograph
Inflow
Outflow
2.07 cfs
2.07 cfs
Inflow Area=87,624 sf
Avg. Flow Depth=0.72'
Max Vel=2.81 fps
15.0"
Round Pipe
n=0.012
L=115.0'
S=0.0022 '/'
Capacity=3.26 cfs
Flow (cfs)
2
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Reach 4R:

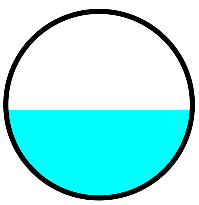
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 101,802 sf, 86.46% Impervious, Inflow Depth = 4.08" for 100 yr event
Inflow = 2.42 cfs @ 7.94 hrs, Volume= 34,627 cf
Outflow = 2.42 cfs @ 7.98 hrs, Volume= 34,627 cf, Atten= 0%, Lag= 2.2 min

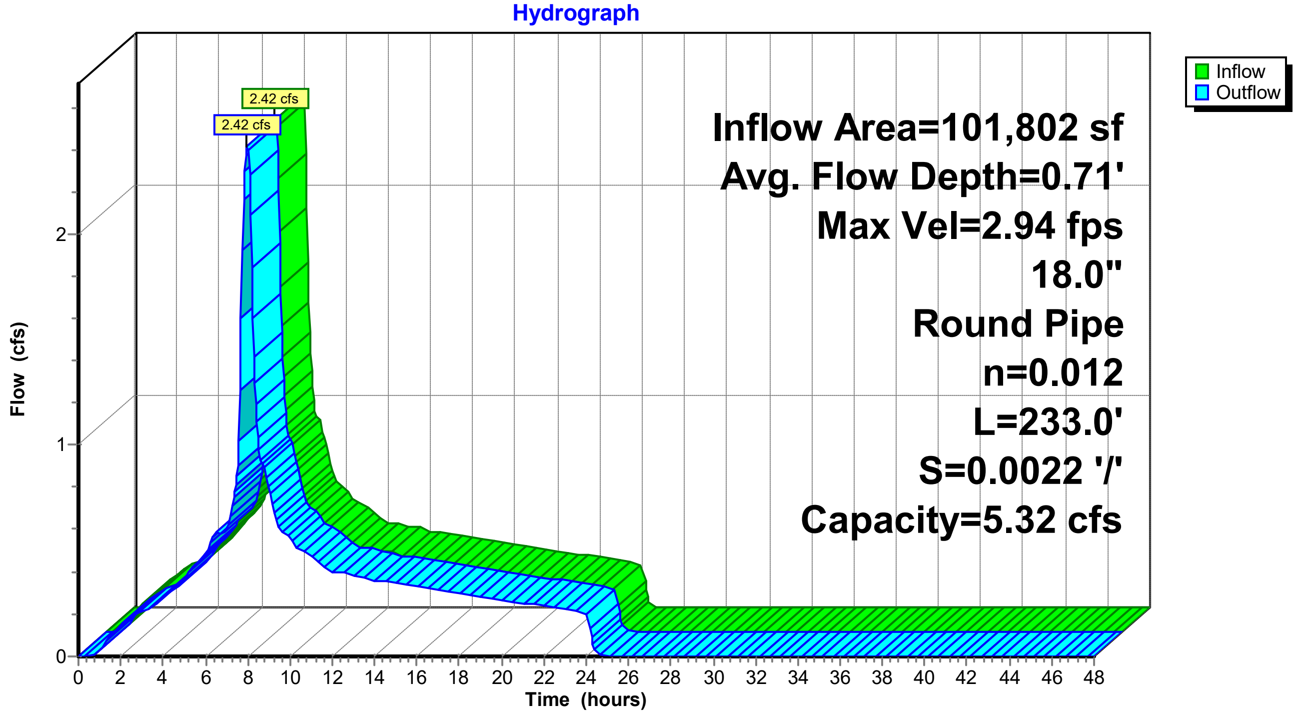
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.94 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 2.5 min

Peak Storage= 192 cf @ 7.96 hrs
Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 5.32 cfs

18.0" Round Pipe
n= 0.012
Length= 233.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.51'



Reach 4R:


Hydrograph
Inflow
Outflow
2.42 cfs
2.42 cfs
Inflow Area=101,802 sf
Avg. Flow Depth=0.71'
Max Vel=2.94 fps
18.0"
Round Pipe
n=0.012
L=233.0'
S=0.0022 '/'
Capacity=5.32 cfs
Flow (cfs)
0
1
2
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Time (hours)

Summary for Reach 5R:

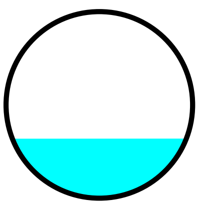
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 18,879 sf, 64.36% Impervious, Inflow Depth = 3.63" for 100 yr event
Inflow = 0.40 cfs @ 7.90 hrs, Volume= 5,707 cf
Outflow = 0.40 cfs @ 7.93 hrs, Volume= 5,707 cf, Atten= 0%, Lag= 1.9 min

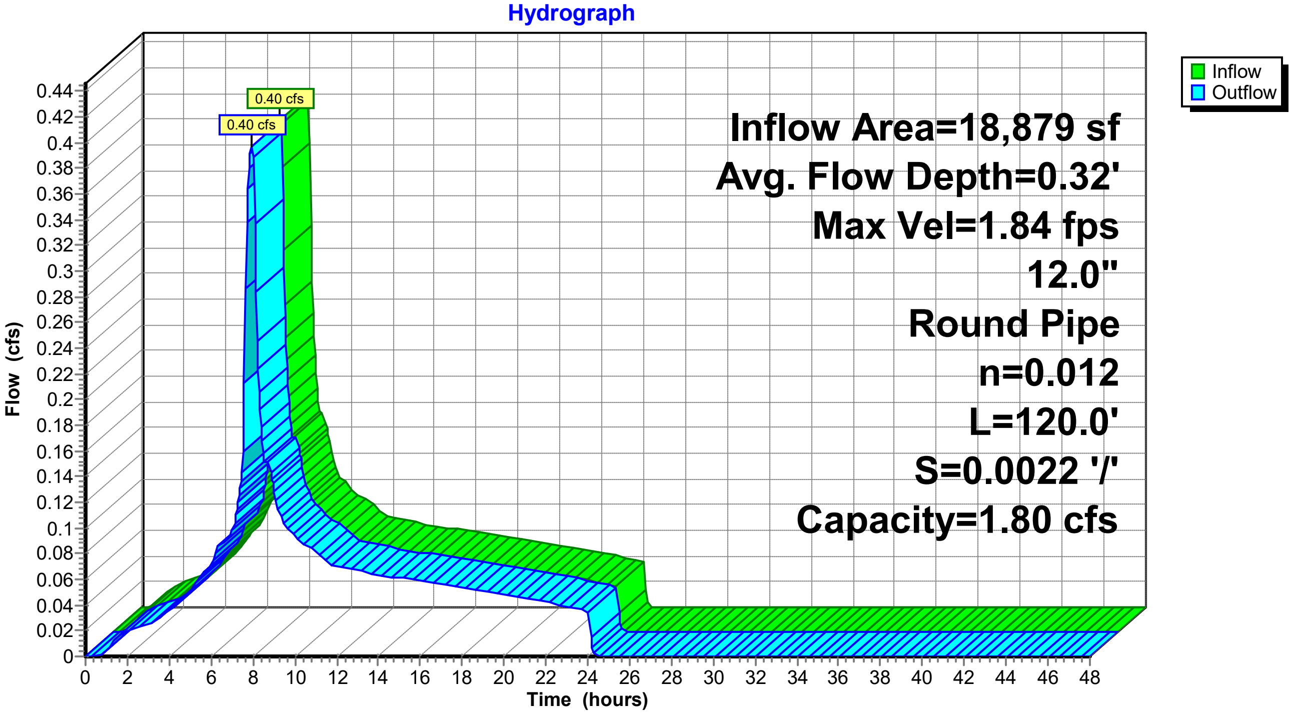
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.84 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.02 fps, Avg. Travel Time= 2.0 min

Peak Storage= 26 cf @ 7.91 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 1.80 cfs

12.0" Round Pipe
n= 0.012
Length= 120.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.26'



Reach 5R:


Hydrograph
Inflow
Outflow
0.40 cfs
0.40 cfs
Inflow Area=18,879 sf
Avg. Flow Depth=0.32'
Max Vel=1.84 fps
12.0"
Round Pipe
n=0.012
L=120.0'
S=0.0022 '/'
Capacity=1.80 cfs
Flow (cfs)
Time (hours)
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Reach 6R:

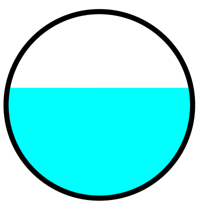
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 151,069 sf, 79.41% Impervious, Inflow Depth = 3.93" for 100 yr event
Inflow = 3.47 cfs @ 7.98 hrs, Volume= 49,462 cf
Outflow = 3.47 cfs @ 7.98 hrs, Volume= 49,462 cf, Atten= 0%, Lag= 0.1 min

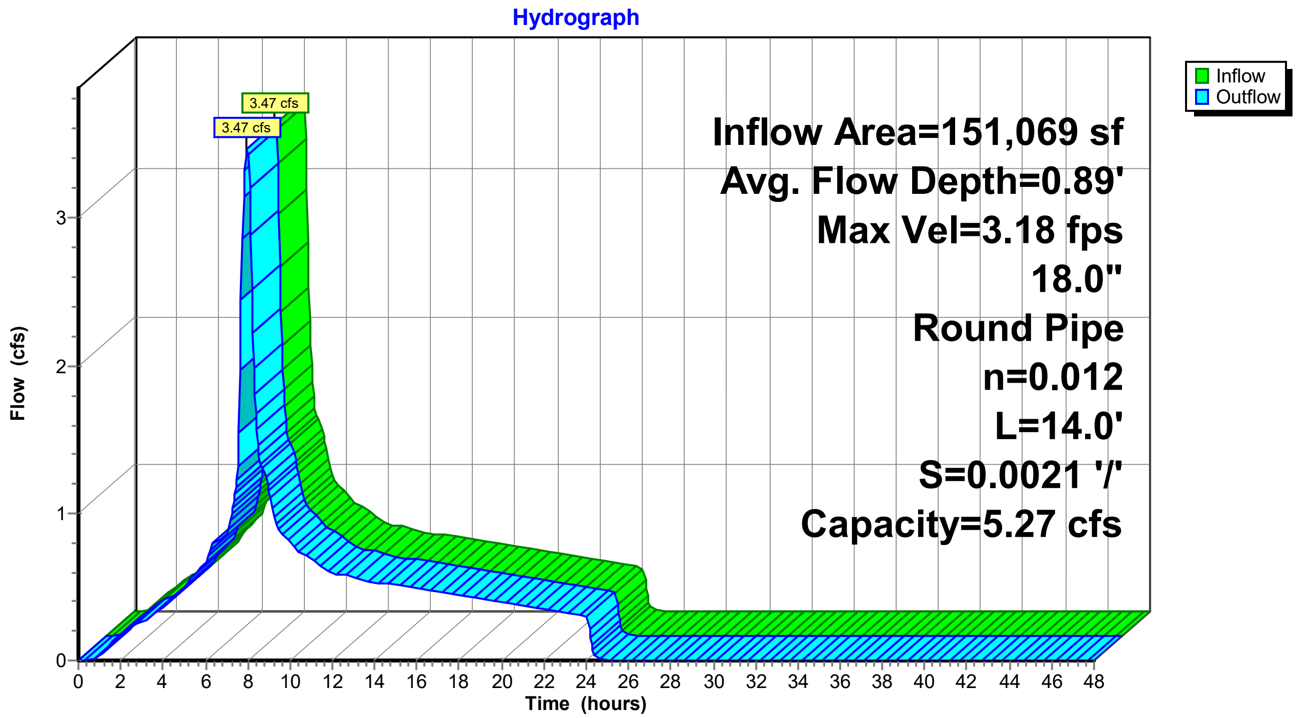
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.18 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.73 fps, Avg. Travel Time= 0.1 min

Peak Storage= 15 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.89'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 5.27 cfs

18.0" Round Pipe
n= 0.012
Length= 14.0' Slope= 0.0021 '/'
Inlet Invert= 0.00', Outlet Invert= -0.03'



Reach 6R:


Hydrograph
Inflow
Outflow
3.47 cfs
3.47 cfs
Inflow Area=151,069 sf
Avg. Flow Depth=0.89'
Max Vel=3.18 fps
18.0"
Round Pipe
n=0.012
L=14.0'
S=0.0021 '/'
Capacity=5.27 cfs
Flow (cfs)
0
1
2
3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Reach 7R:

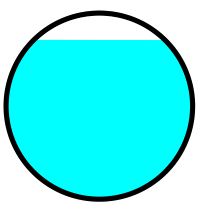
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified
[55] Hint: Peak inflow is 104% of Manning's capacity

Inflow Area = 246,108 sf, 73.61% Impervious, Inflow Depth = 3.81" for 100 yr event
Inflow = 5.53 cfs @ 7.97 hrs, Volume= 78,202 cf
Outflow = 5.52 cfs @ 7.98 hrs, Volume= 78,202 cf, Atten= 0%, Lag= 0.9 min

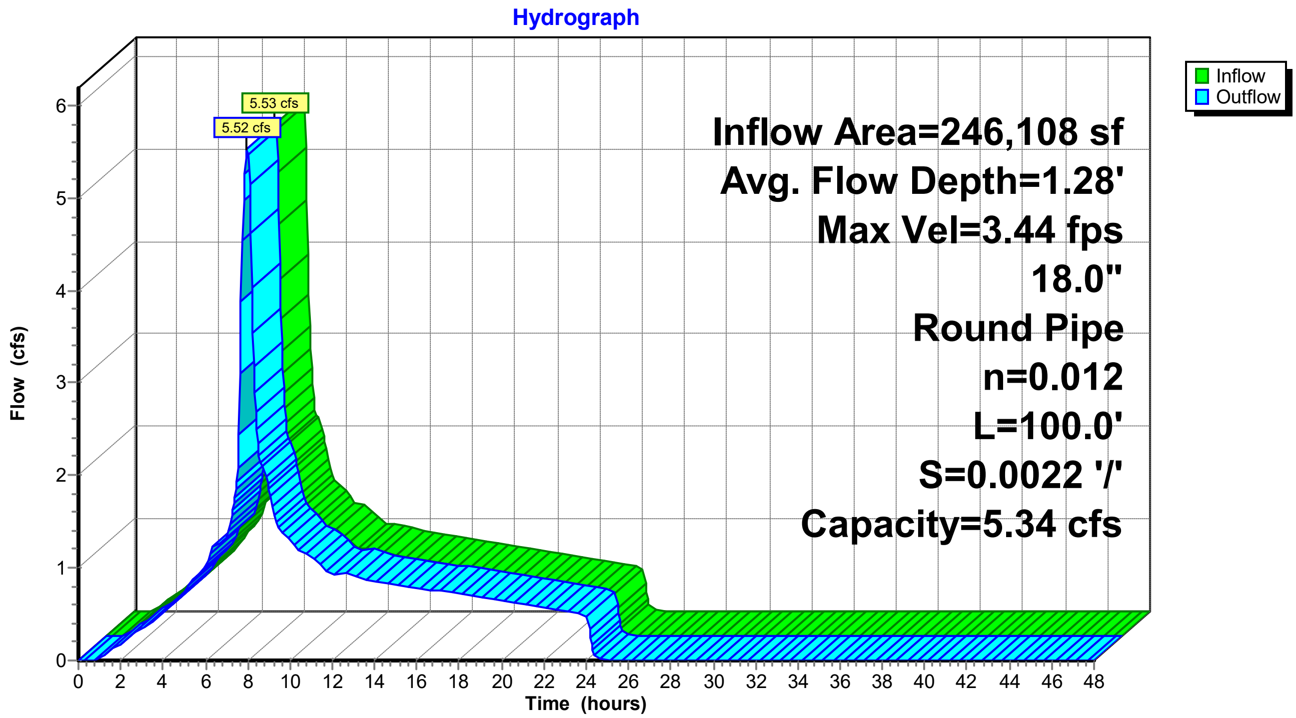
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.44 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 0.8 min

Peak Storage= 161 cf @ 7.98 hrs
Average Depth at Peak Storage= 1.28'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 5.34 cfs

18.0" Round Pipe
n= 0.012
Length= 100.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.22'



Reach 7R:


Hydrograph
Inflow
Outflow
5.53 cfs
5.52 cfs
Inflow Area=246,108 sf
Avg. Flow Depth=1.28'
Max Vel=3.44 fps
18.0"
Round Pipe
n=0.012
L=100.0'
S=0.0022 '/'
Capacity=5.34 cfs
Flow (cfs)
Time (hours)

Summary for Reach 8R:

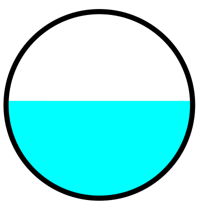
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 269,260 sf, 75.88% Impervious, Inflow Depth = 3.86" for 100 yr event
Inflow = 6.09 cfs @ 7.97 hrs, Volume= 86,641 cf
Outflow = 6.09 cfs @ 7.98 hrs, Volume= 86,641 cf, Atten= 0%, Lag= 0.5 min

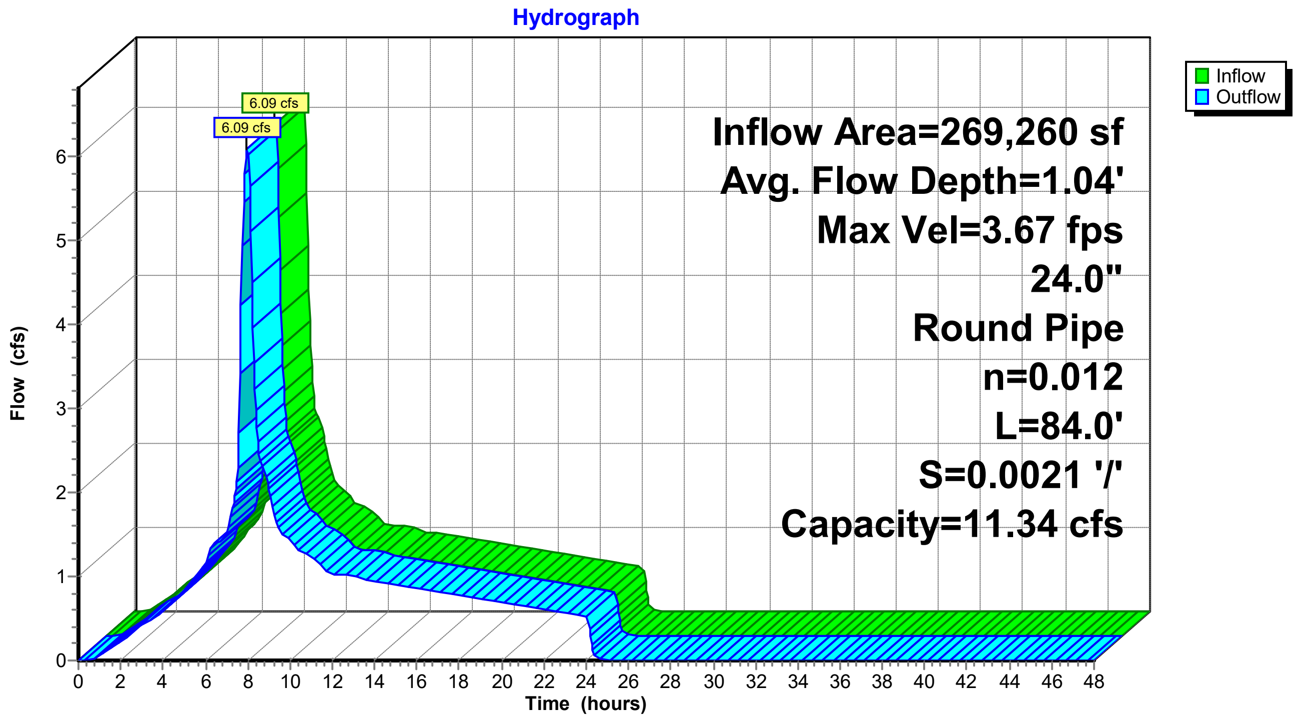
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.67 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.96 fps, Avg. Travel Time= 0.7 min

Peak Storage= 139 cf @ 7.98 hrs
Average Depth at Peak Storage= 1.04'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 11.34 cfs

24.0" Round Pipe
n= 0.012
Length= 84.0' Slope= 0.0021 '/'
Inlet Invert= 0.00', Outlet Invert= -0.18'



Reach 8R:


Hydrograph
Inflow
Outflow
6.09 cfs
6.09 cfs
Inflow Area=269,260 sf
Avg. Flow Depth=1.04'
Max Vel=3.67 fps
24.0"
Round Pipe
n=0.012
L=84.0'
S=0.0021 '/'
Capacity=11.34 cfs
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Reach 9R:

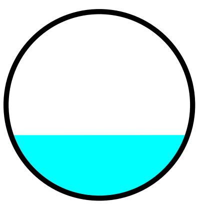
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 17,845 sf,100.00% Impervious, Inflow Depth = 4.37" for 100 yr event
Inflow = 0.45 cfs @ 7.87 hrs, Volume= 6,504 cf
Outflow = 0.45 cfs @ 7.89 hrs, Volume= 6,504 cf, Atten= 0%, Lag= 1.4 min

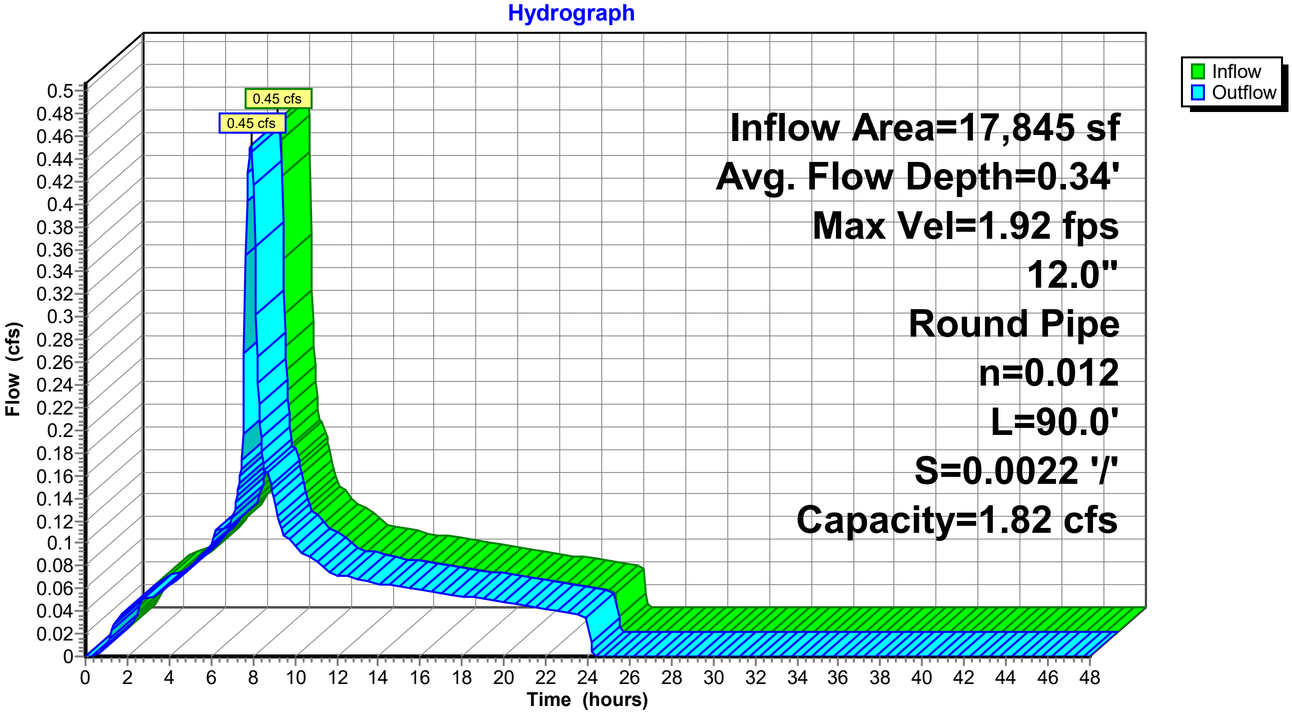
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.92 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.08 fps, Avg. Travel Time= 1.4 min

Peak Storage= 21 cf @ 7.88 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 1.82 cfs

12.0" Round Pipe
n= 0.012
Length= 90.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.20'



Reach 9R:


Hydrograph
Inflow
Outflow
0.45 cfs
0.45 cfs
Inflow Area=17,845 sf
Avg. Flow Depth=0.34'
Max Vel=1.92 fps
12.0"
Round Pipe
n=0.012
L=90.0'
S=0.0022 '/'
Capacity=1.82 cfs
Flow (cfs)
Time (hours)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
0.26
0.28
0.3
0.32
0.34
0.36
0.38
0.4
0.42
0.44
0.46
0.48
0.5
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48

Summary for Reach 10R:

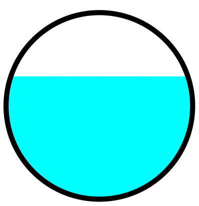
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 20,975 sf, 68.65% Impervious, Inflow Depth = 3.71" for 100 yr event
Inflow = 0.47 cfs @ 7.90 hrs, Volume= 6,483 cf
Outflow = 0.47 cfs @ 7.93 hrs, Volume= 6,483 cf, Atten= 0%, Lag= 2.1 min

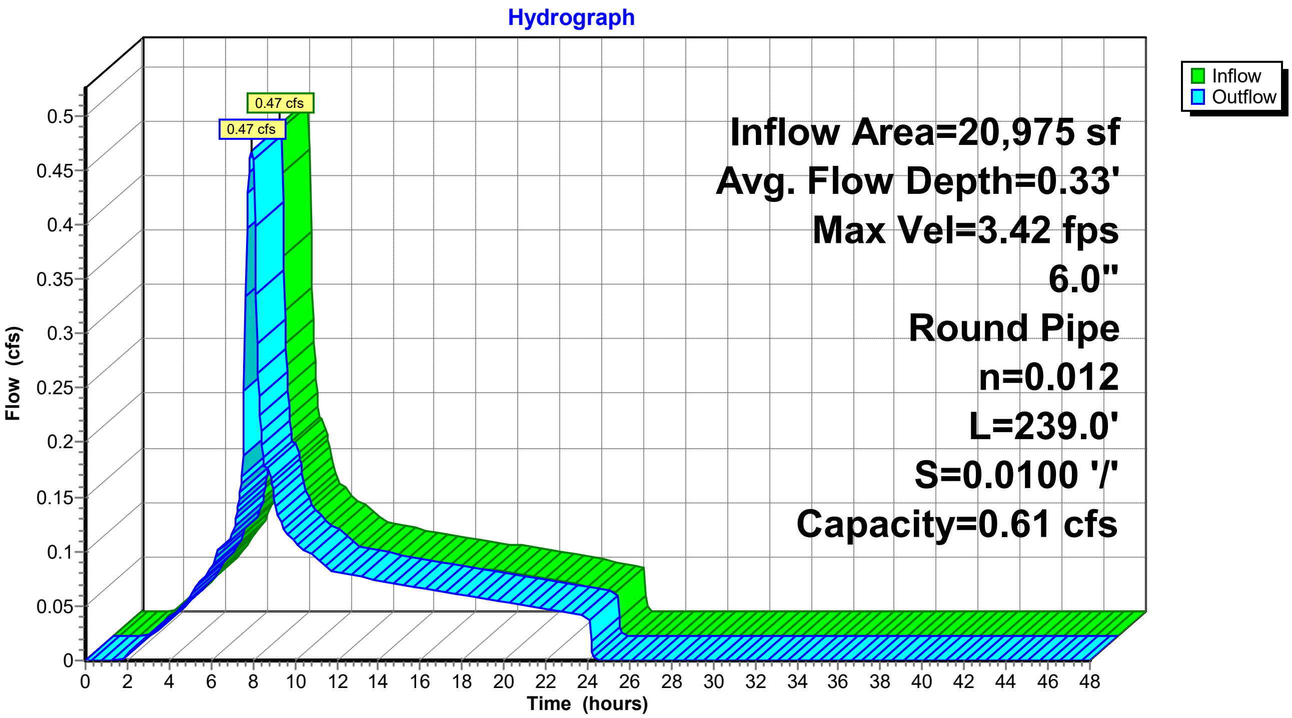
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.42 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.99 fps, Avg. Travel Time= 2.0 min

Peak Storage= 33 cf @ 7.91 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 239.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -2.39'



Reach 10R:


Hydrograph
Inflow
Outflow
0.47 cfs
0.47 cfs
Inflow Area=20,975 sf
Avg. Flow Depth=0.33'
Max Vel=3.42 fps
6.0"
Round Pipe
n=0.012
L=239.0'
S=0.0100 '/'
Capacity=0.61 cfs
Flow (cfs)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Reach 11R:

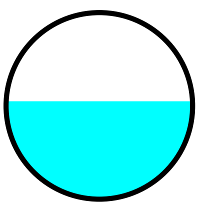
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 16,210 sf, 55.52% Impervious, Inflow Depth = 3.40" for 100 yr event
Inflow = 0.33 cfs @ 7.91 hrs, Volume= 4,592 cf
Outflow = 0.33 cfs @ 7.93 hrs, Volume= 4,592 cf, Atten= 0%, Lag= 0.8 min

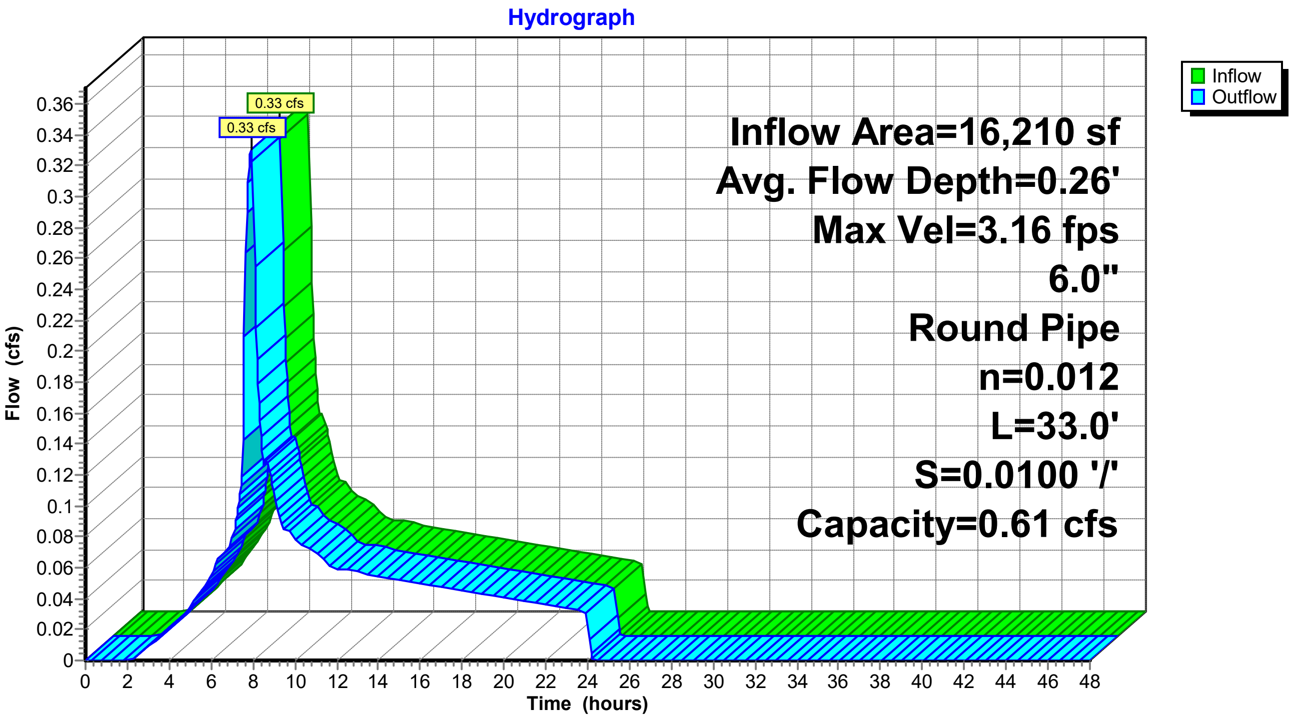
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.16 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.84 fps, Avg. Travel Time= 0.3 min

Peak Storage= 3 cf @ 7.92 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 33.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -0.33'



Reach 11R:


Hydrograph
Inflow
Outflow
0.33 cfs
0.33 cfs
Inflow Area=16,210 sf
Avg. Flow Depth=0.26'
Max Vel=3.16 fps
6.0"
Round Pipe
n=0.012
L=33.0'
S=0.0100 '/'
Capacity=0.61 cfs
Flow (cfs)
Time (hours)
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Reach 12R:

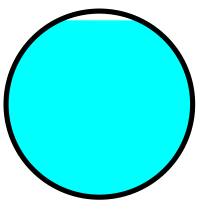
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified
[55] Hint: Peak inflow is 109% of Manning's capacity

Inflow Area = 30,388 sf, 65.16% Impervious, Inflow Depth = 3.60" for 100 yr event
Inflow = 0.66 cfs @ 7.90 hrs, Volume= 9,127 cf
Outflow = 0.65 cfs @ 8.00 hrs, Volume= 9,127 cf, Atten= 1%, Lag= 5.9 min

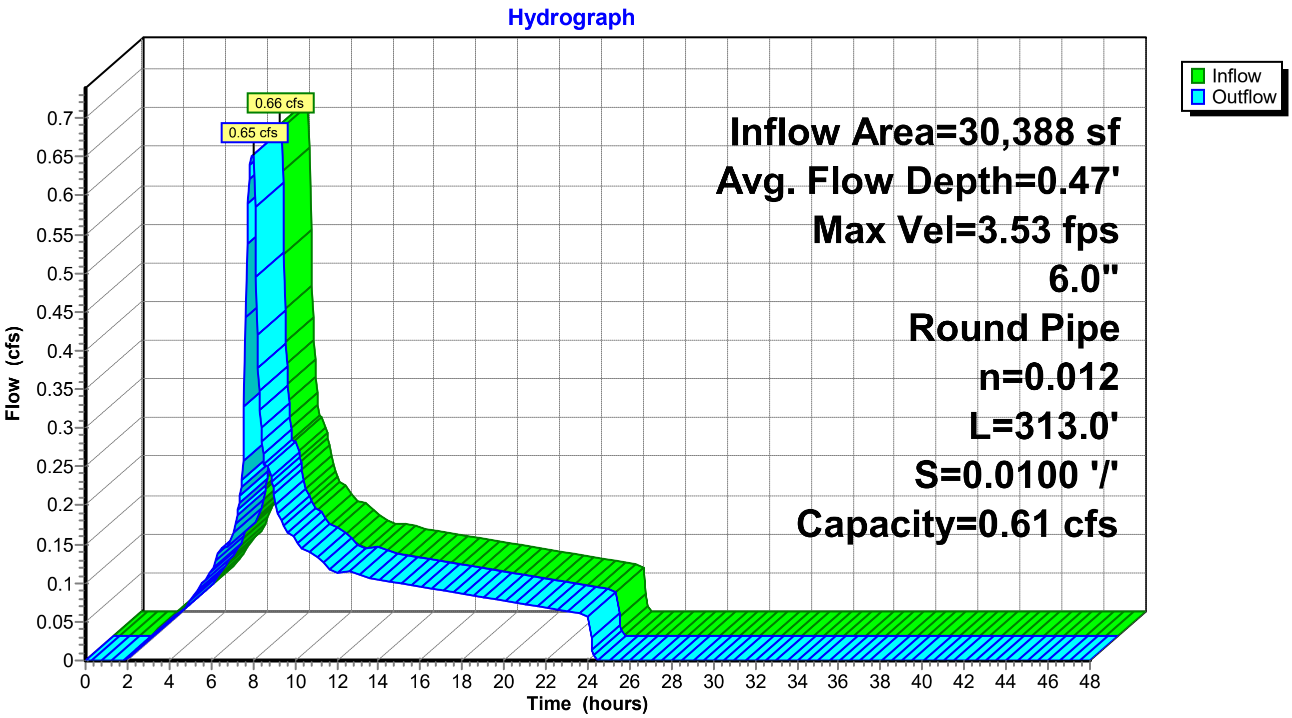
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.53 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 2.17 fps, Avg. Travel Time= 2.4 min

Peak Storage= 60 cf @ 7.95 hrs
Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 313.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -3.13'



Reach 12R:


Hydrograph
Inflow
Outflow
0.66 cfs
0.65 cfs
Inflow Area=30,388 sf
Avg. Flow Depth=0.47'
Max Vel=3.53 fps
6.0"
Round Pipe
n=0.012
L=313.0'
S=0.0100 '/'
Capacity=0.61 cfs
Flow (cfs)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Reach 13R:

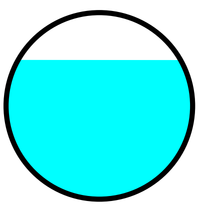
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 25,383 sf, 63.82% Impervious, Inflow Depth = 3.60" for 100 yr event
Inflow = 0.55 cfs @ 7.90 hrs, Volume= 7,624 cf
Outflow = 0.55 cfs @ 7.92 hrs, Volume= 7,624 cf, Atten= 0%, Lag= 1.1 min

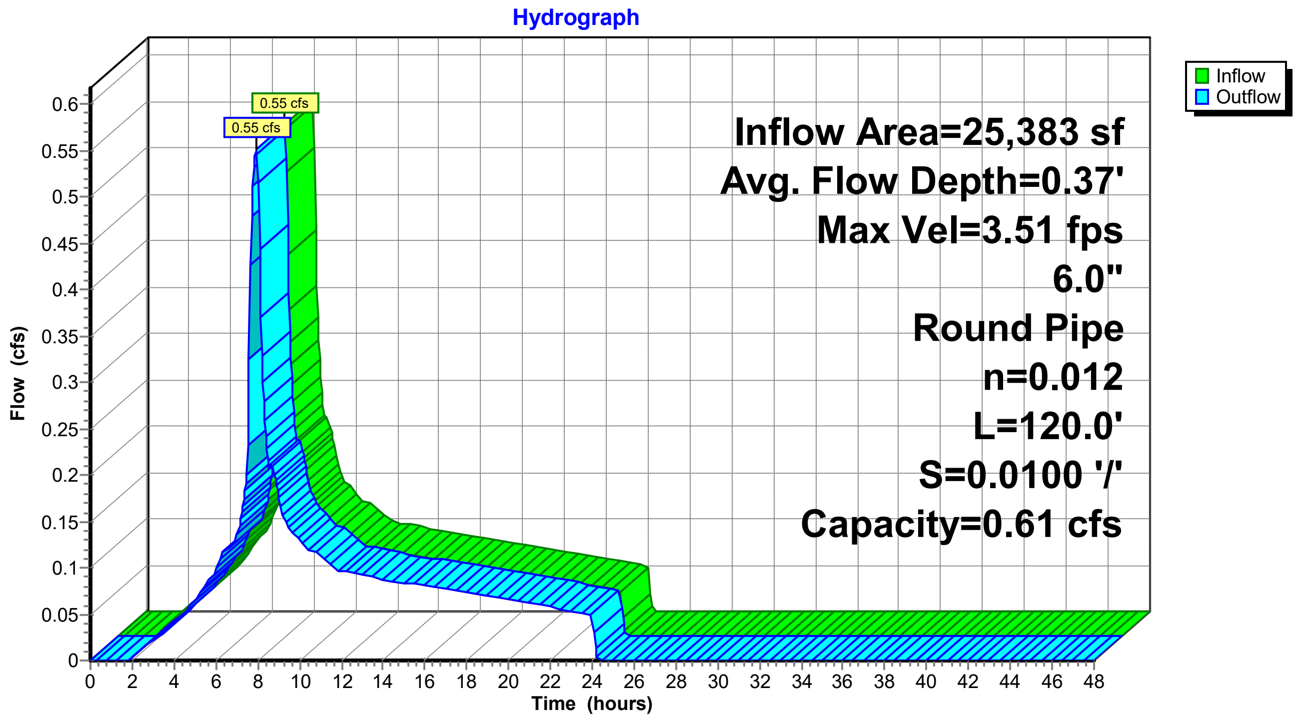
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.51 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 2.11 fps, Avg. Travel Time= 0.9 min

Peak Storage= 19 cf @ 7.91 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 120.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -1.20'



Reach 13R:


Hydrograph
Inflow
Outflow
0.55 cfs
0.55 cfs
Inflow Area=25,383 sf
Avg. Flow Depth=0.37'
Max Vel=3.51 fps
6.0"
Round Pipe
n=0.012
L=120.0'
S=0.0100 '/'
Capacity=0.61 cfs
Flow (cfs)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48

Summary for Reach 14R:

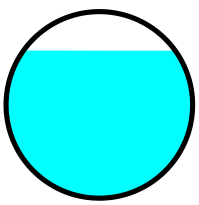
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 40,203 sf, 67.16% Impervious, Inflow Depth = 3.68" for 100 yr event
Inflow = 0.89 cfs @ 7.91 hrs, Volume= 12,336 cf
Outflow = 0.89 cfs @ 7.93 hrs, Volume= 12,336 cf, Atten= 0%, Lag= 1.0 min

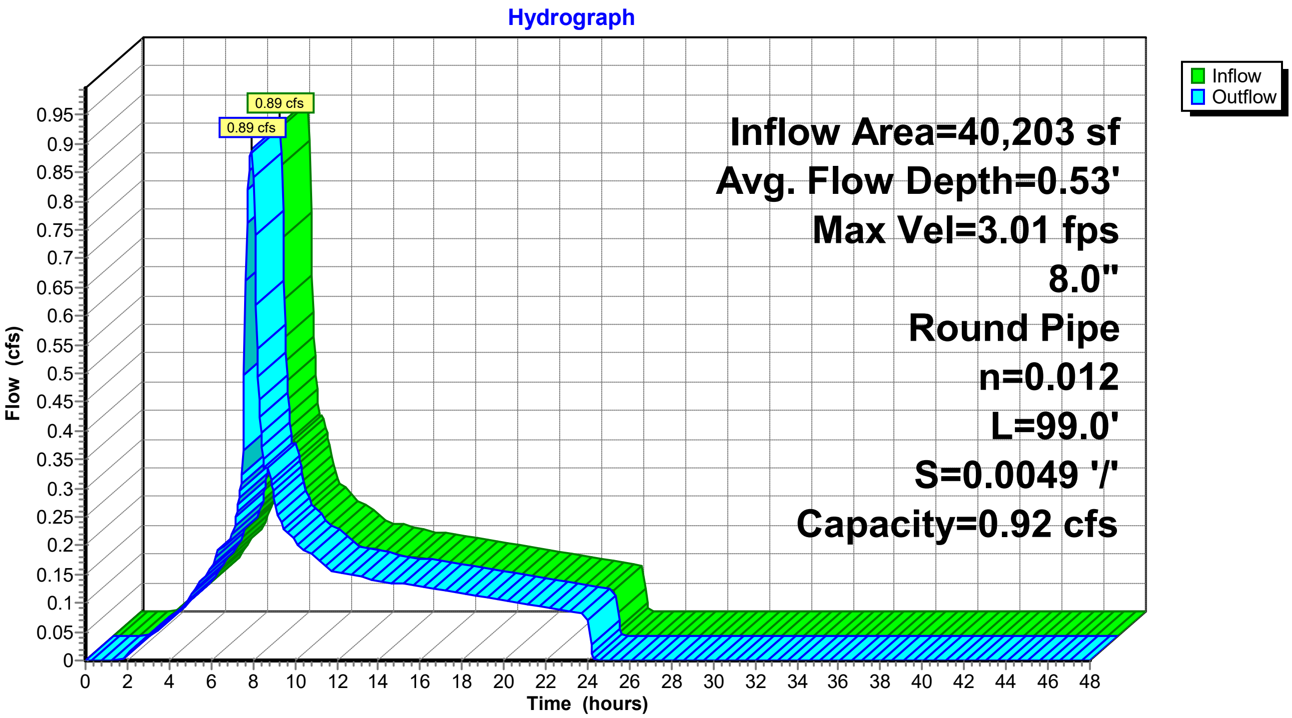
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.01 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.80 fps, Avg. Travel Time= 0.9 min

Peak Storage= 29 cf @ 7.92 hrs
Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 0.92 cfs

8.0" Round Pipe
n= 0.012
Length= 99.0' Slope= 0.0049 '/'
Inlet Invert= 0.00', Outlet Invert= -0.49'



Reach 14R:


Hydrograph
Inflow
Outflow
0.89 cfs
0.89 cfs
Inflow Area=40,203 sf
Avg. Flow Depth=0.53'
Max Vel=3.01 fps
8.0"
Round Pipe
n=0.012
L=99.0'
S=0.0049 '/'
Capacity=0.92 cfs
Flow (cfs)
Time (hours)

Summary for Reach 15R:

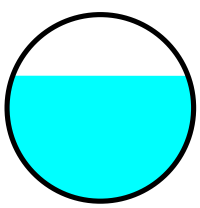
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 74,890 sf, 69.70% Impervious, Inflow Depth = 3.74" for 100 yr event
Inflow = 1.68 cfs @ 7.91 hrs, Volume= 23,365 cf
Outflow = 1.68 cfs @ 7.95 hrs, Volume= 23,365 cf, Atten= 0%, Lag= 2.6 min

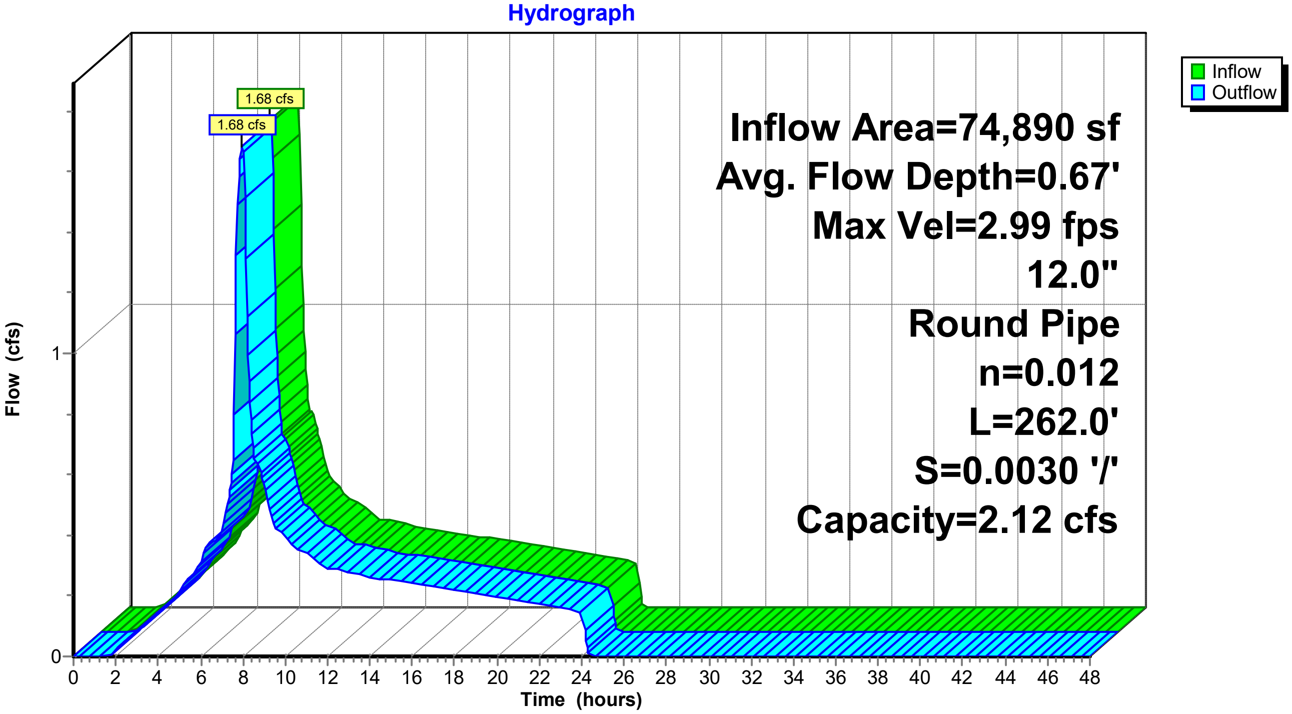
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.99 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 2.6 min

Peak Storage= 147 cf @ 7.93 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 2.12 cfs

12.0" Round Pipe
n= 0.012
Length= 262.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.79'



Reach 15R:


Hydrograph
Inflow
Outflow
1.68 cfs
1.68 cfs
Inflow Area=74,890 sf
Avg. Flow Depth=0.67'
Max Vel=2.99 fps
12.0"
Round Pipe
n=0.012
L=262.0'
S=0.0030 '/'
Capacity=2.12 cfs
Flow (cfs)
0
1
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Reach 17R:

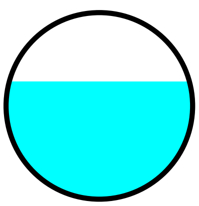
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 57,379 sf, 75.98% Impervious, Inflow Depth = 3.86" for 100 yr event
Inflow = 1.31 cfs @ 7.92 hrs, Volume= 18,436 cf
Outflow = 1.31 cfs @ 7.93 hrs, Volume= 18,436 cf, Atten= 0%, Lag= 1.1 min

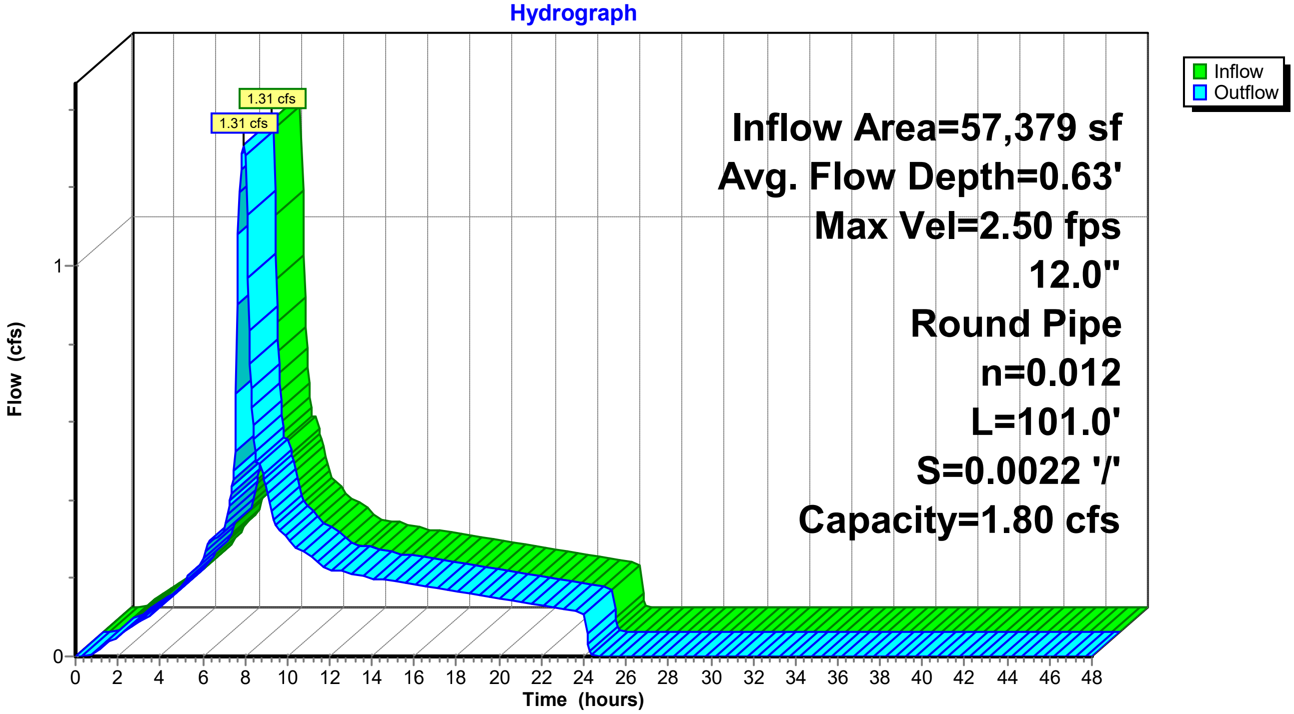
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.50 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.41 fps, Avg. Travel Time= 1.2 min

Peak Storage= 53 cf @ 7.92 hrs
Average Depth at Peak Storage= 0.63'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 1.80 cfs

12.0" Round Pipe
n= 0.012
Length= 101.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.22'



Reach 17R:


Hydrograph
1.31 cfs
1.31 cfs
Inflow
Outflow
Inflow Area=57,379 sf
Avg. Flow Depth=0.63'
Max Vel=2.50 fps
12.0"
Round Pipe
n=0.012
L=101.0'
S=0.0022 '/'
Capacity=1.80 cfs
Flow (cfs)
0
1
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Reach 18R:

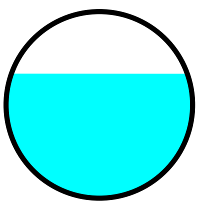
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area =	67,221 sf,	64.04% Impervious,	Inflow Depth = 3.58"	for 100 yr event	
Inflow =	1.42 cfs @	7.91 hrs,	Volume=	20,082 cf	
Outflow =	1.42 cfs @	7.96 hrs,	Volume=	20,082 cf,	Atten= 0%, Lag= 3.2 min

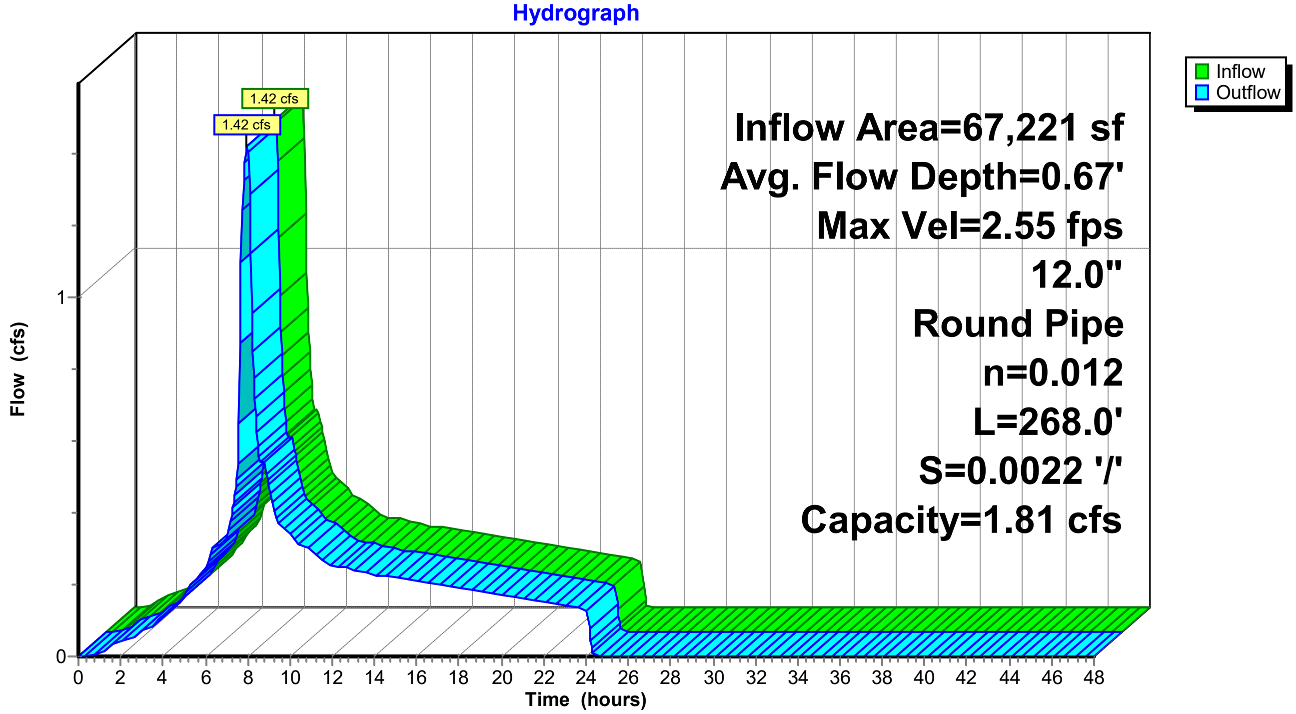
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.55 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.42 fps, Avg. Travel Time= 3.1 min

Peak Storage= 149 cf @ 7.93 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 1.81 cfs

12.0" Round Pipe
n= 0.012
Length= 268.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.59'



Reach 18R:


Hydrograph
Inflow
Outflow
1.42 cfs
1.42 cfs
Inflow Area=67,221 sf
Avg. Flow Depth=0.67'
Max Vel=2.55 fps
12.0"
Round Pipe
n=0.012
L=268.0'
S=0.0022 '/'
Capacity=1.81 cfs
Flow (cfs)
0
1
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48

Summary for Reach 19R:

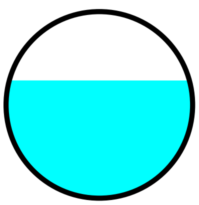
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 377,443 sf, 71.41% Impervious, Inflow Depth = 3.76" for 100 yr event
Inflow = 8.33 cfs @ 7.98 hrs, Volume= 118,193 cf
Outflow = 8.32 cfs @ 7.98 hrs, Volume= 118,193 cf, Atten= 0%, Lag= 0.5 min

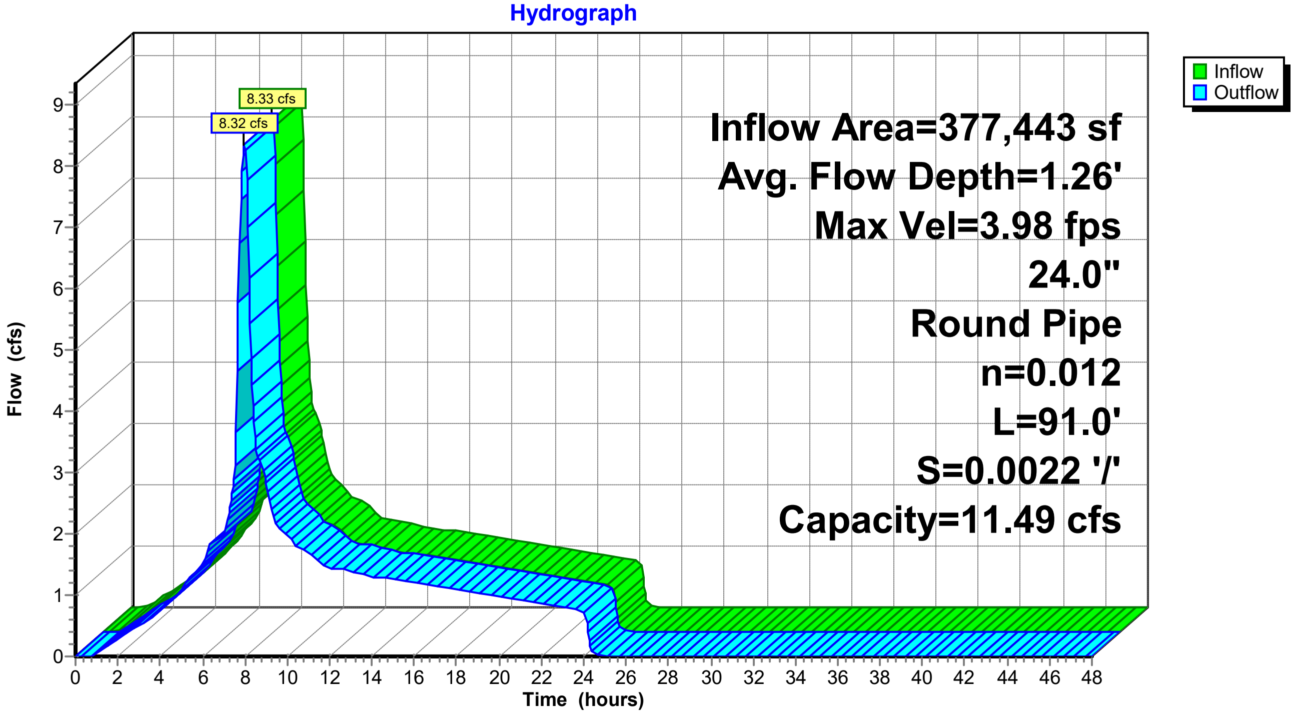
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.98 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.15 fps, Avg. Travel Time= 0.7 min

Peak Storage= 190 cf @ 7.98 hrs
Average Depth at Peak Storage= 1.26'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 11.49 cfs

24.0" Round Pipe
n= 0.012
Length= 91.0' Slope= 0.0022 '/'
Inlet Invert= 0.00', Outlet Invert= -0.20'



Reach 19R:


Hydrograph
Inflow
Outflow
8.33 cfs
8.32 cfs
Inflow Area=377,443 sf
Avg. Flow Depth=1.26'
Max Vel=3.98 fps
24.0"
Round Pipe
n=0.012
L=91.0'
S=0.0022 '/'
Capacity=11.49 cfs
Flow (cfs)
0
1
2
3
4
5
6
7
8
9
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Reach 20R:

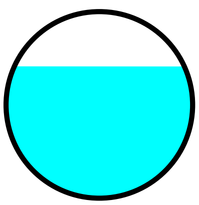
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow Area = 25,318 sf, 56.88% Impervious, Inflow Depth = 3.40" for 100 yr event
Inflow = 0.52 cfs @ 7.91 hrs, Volume= 7,173 cf
Outflow = 0.52 cfs @ 7.94 hrs, Volume= 7,173 cf, Atten= 0%, Lag= 1.9 min

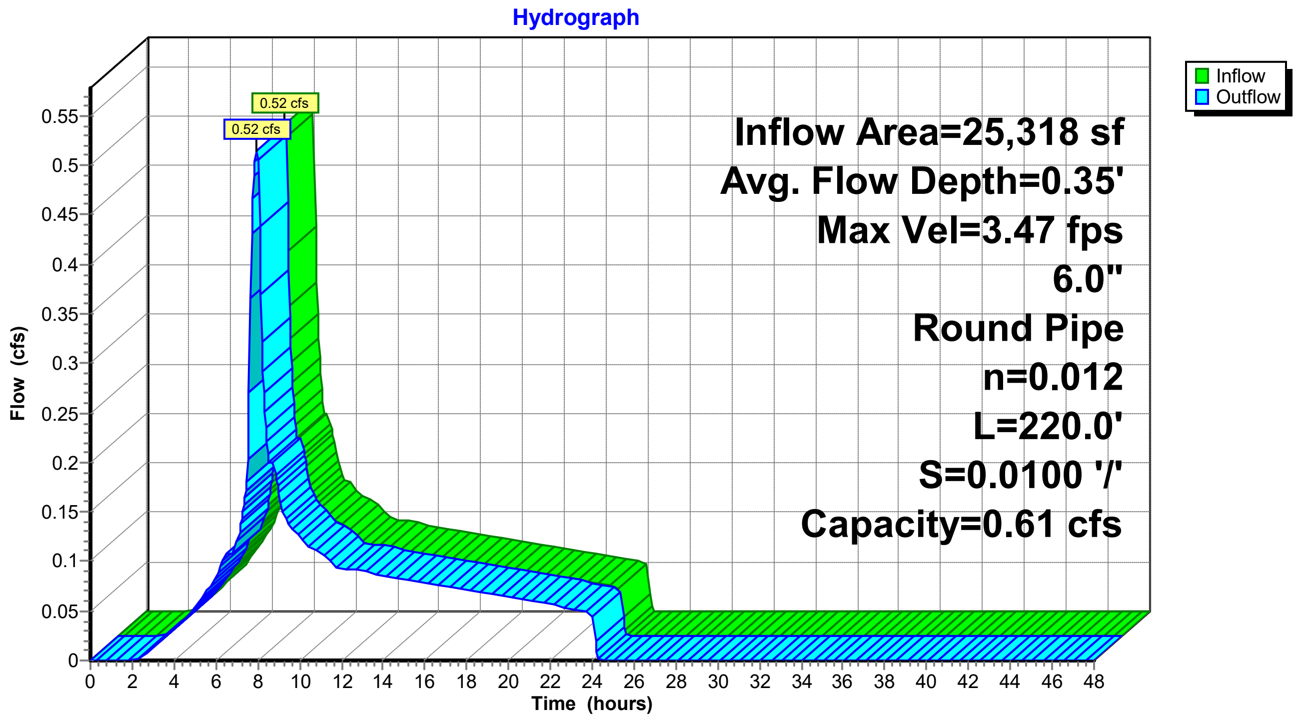
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.47 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.06 fps, Avg. Travel Time= 1.8 min

Peak Storage= 33 cf @ 7.93 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 220.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -2.20'



Reach 20R:


Hydrograph
Inflow
Outflow
0.52 cfs
0.52 cfs
Inflow Area=25,318 sf
Avg. Flow Depth=0.35'
Max Vel=3.47 fps
6.0"
Round Pipe
n=0.012
L=220.0'
S=0.0100 '/'
Capacity=0.61 cfs
Flow (cfs)
Time (hours)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

APPENDIX C

Geotechnical Report

REDMOND GEOTECHNICAL SERVICES

Geotechnical Investigation and Consultation Services

Proposed Riverfront Village Multi-Family Development Project

Parcel #'s 50650, 5065201, 506520300, 5065200400, 506520599 and 506520100

Lewis River Road

Woodland (Cowlitz County), Washington

for

Timberland, Inc.

Project No. 1171.006.G
October 31, 2022

REDMOND GEOTECHNICAL SERVICES

October 31, 2022

Mr. Sam Scheuble
Timberland, Inc.
9321 NE 72nd Avenue, Building C #7
Vancouver, Washington 98665

Dear Mr. Scheuble:

Re: Geotechnical Investigation and Consultation Services,
Proposed Riverfront Village Multi-Family Development Site,
Parcel #'s 50650, 5065201, 506520300, 5065200400, 506520599 and 506520100
Lewis River Road, Woodland (Cowlitz County), Washington

Submitted herewith is our report entitled "Geotechnical Investigation and Consultation Services, Proposed Riverfront Village Multi-Family Development Site, Parcel #'s 50650, 5065201, 506520300, 5065200400, 506520599 and 506520100, Woodland (Cowlitz County), Washington". The scope of our services was outlined in our formal proposal to Mr. Sam Scheuble of Timberland, Inc dated April 15, 2022. Authorization of our services was provided by Mr. Sam Scheuble of Timberland, Inc on April 15, 2022.

During the course of our investigation, we have kept you and/or others advised of our schedule and preliminary findings. We appreciate the opportunity to assist you with this phase of the project. Should you have any questions regarding this report, please do not hesitate to call.

Sincerely,

Daniel M. Redmond, P.E., G.E.
President/Principal Engineer

DANIEL M. REDMOND
STATE OF WASHINGTON
28881
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 3-22-23

Cc: Mr. Travis Johnson
PLS Engineering

TABLE OF CONTENTS

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GEOTECHNICAL INVESTIGATION AND CONSULTATION SERVICES
PROPOSED RIVERFRONT VILLAGE MULTI-FAMILY DEVELOPMENT SITE
PARCEL #'S 50650, 5065201, 506520300, 5065200400, 506520599 AND 506520100
LEWIS RIVER ROAD
WOODLAND (COWLITZ COUNTY), WASHINGTON

INTRODUCTION

Redmond Geotechnical Services, LLC is please to submit to you the results of our Geotechnical Investigation at the site of the proposed Riverfront Village multi-family development project which is to be located at an undeveloped property which is sited to the south of Lewis River Road and east of the intersection with Insel Road in Woodland (Cowlitz County), Washington. The general location of the subject site is shown on the Site Vicinity and Geologic Map, Figure No. 1. The purpose of our geotechnical investigation services at this time was to explore the existing subsurface soils and/or groundwater conditions across the subject site and to develop and/or provide appropriate geotechnical design and construction recommendations for the proposed new Riverfront Village multi-family development project.

PROJECT DESCRIPTION

Based on a review of the proposed site development plan, we understand that present plans for the project will consist of the construction of new multi-family apartment buildings across the northerly portion of the subject site. Reportedly, the new apartment buildings will be three-story wood-frame structures with concrete slab-on-grade floors. Support for the proposed multi-family structures is anticipated to consist primarily of conventional continuous (strip) footings although some individual (spread) column-type footings are also likely. Structural loading information, although currently unavailable, is expected to result in maximum dead plus live continuous (strip) and individual (spread) column-type footings loads on the order of about 2.0 to 4.0 kips per lineal foot (klf) and 25 to 75 kips, respectively.

Additionally, we understand that the project will also include new paved surfaces for both automobile parking and drive areas. Further, we understand that stormwater from hard and/or impervious surfaces (i.e., roofs and pavements) will be collected for on-site treatment and disposal.

While a detailed site grading plan is not available at this time, we understand that earthwork and grading operations associated with bringing the property to finish design grades will generally result in cuts (borrow) of about five (5) to ten (10) feet across the southerly portion of the site and/or south of the planned new site improvements. Additionally, we understand that the placement of about five (5) to six (6) feet of structural fills obtained from cuts to the south is also planned across the northerly portion of the site and/or within the area proposed for the new multi-family development.

WOODLAND QUADRANGLE
WASHINGTON
7.5-MINUTE SERIES

SCALE 1:24 000

1	0.5	0	KILOMETERS	1	2
1000	500	0	METERS	1000	2000

1 0.5 0 1
MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

SITE VICINITY AND GEOLOGIC MAP

Project No. 1171.006.G	RIVERFRONT VILLAGE LEWIS RIVER ROAD	Figure No. 1

SCOPE OF WORK

The purpose of our geotechnical studies was to evaluate the overall existing site subsurface soil and/or groundwater conditions underlying the site with regard to the proposed new multi-family construction and/or any associated impacts or concerns with respect to the proposed development at the site as well as to provide appropriate geotechnical design and construction recommendations for the project. Specifically, our geotechnical investigation included the following scope of work items:

1. Review of available and relevant geologic and/or geotechnical investigation reports for the site and/or subject area.

2. A detailed field reconnaissance and subsurface exploration program of the soil and ground water conditions underlying the site by means of two (2) exploratory drilled test borings and two (2) cone penetration tests as well as seven (7) exploratory test holes. The exploratory test borings and cone penetration tests were drilled and/or pushed to a depth of between twenty-six and one-half (26.5) and forty-one (41) feet beneath existing site grades while the test holes were excavated to depths ranging from about eight (8) to thirteen (13) feet beneath the existing site and/or surface grades. The approximate location of the test borings, cone penetration and test holes are shown on the Site Exploration Plan, Figure No. 2.

3. Laboratory testing to help evaluate and identify pertinent physical and engineering properties of the subsurface soils encountered at the site relative to the planned site development and construction at the site. The laboratory testing program included tests to help evaluate the natural (field) moisture content and dry density, Atterberg Limits and gradational characteristics as well as consolidation, direct shear strength and "R"-value tests.

4. A literature review and engineering evaluation and assessment of the regional seismicity to evaluate the potential ground motion hazard(s) at the subject site. The evaluation and assessment included a review of the regional earthquake history and sources such as potential seismic sources, maximum credible earthquakes, and reoccurrence intervals as well as a discussion of the possible ground response to the selected design earthquake(s), fault rupture, landsliding, liquefaction, and tsunami and seiche flooding.

5. Engineering analyses utilizing the field and laboratory data as a basis for furnishing recommendations for foundation support of the proposed new multi-family structures. Recommendations include maximum design allowable contact bearing pressure(s), depth of footing embedment, estimates of foundation settlement, lateral soil resistance as well as lateral earth pressures for any below grade and/or retaining walls. Additionally, our report includes recommendations regarding site preparation, placement and compaction of structural fill materials, suitability of the on-site soils for use as structural fill, criteria for import fill materials, and preparation of foundation and/or concrete floor slab subgrades. Further, we have provided seismic design parameters for the multi-family project.

6. Development of various flexible pavement design sections for the proposed new site improvements.

SITE CONDITIONS

Regional Geology

The site is located within the Lewis River Basin, which is part of the Columbia River geologic province. The Columbia River was formed when the volcanic rocks of the Oregon Coast Range, originally formed as submarine islands, were added onto the North American Continent. The addition of the volcanic rocks caused inland downwarping, forming a depression in which various types of marine sedimentary rocks accumulated. Approximately 15 million years ago, these marine sediments were covered by Columbia River Basalts that flowed down the Columbia River Gorge. Later, uplift and tilting of the Columbia River Basalts, the Oregon Coast Range, and the western Cascade Range formed the trough-like character of the Columbia River that we observe today.

The Columbia River Basin developed when the faulting and associated uplifting dropped the basin down. The Columbia River and Lewis River Basins were subsequently filled with non-marine clay, silt, sand, and a few gravel units derived from weathering of the adjacent hills. In addition to these sediments, sands, and gravels derived from the Columbia River were being deposited in the Woodland area.

Catastrophic floods later washed into the Columbia River and Woodland Basin approximately 12,000 to 15,000 years ago and deposited fine to course-grained sedimentary assemblages (Pleistocene Flood Deposits) mapped throughout the area, including wind blown silt (loess) deposited on the tops of the adjacent hills. In recent times, sand fill was placed in localized depressions in the area to level it for development.

Geologic Maps

Available geologic mapping of the area and/or subject site (Geologic Map of the Woodland Quadrangle, Clark and Cowlitz Counties, Washington dated 2004) indicates that the subject site is underlain by Holocene and Pleistocene aged alluvium (Qa) consisting of silt, sand, organic rich clay and minor amounts of gravel deposited by the Lewis and Columbia Rivers. This alluvium may be on the order of 100 to 150 feet in thickness and is underlain by the Troutdale Formation. The Troutdale Formation, consisting of conglomerate with minor sand and silt interbeds deposited by the Columbia River, is underlain by the Columbia River Basalts at depths ranging from approximately 400 to 800 feet. The mapping suggests that the Columbia River Basalts may be inter-fingered with the Lewis River Mudstones near the contact of the Troutdale Formation and underlying Columbia River Basalts.

Several faults are mapped in the area, the most notable being an unnamed fault located to the east of the Lewis River and Interstate I-5.

The available earthquake hazard mapping for Cowlitz County indicates that the site is located in an area with a relatively moderate to high earthquake hazard. The relative earthquake hazard is divided into seven (7) zones ranging from very low to high. The relative hazard is based on the evaluation of potential soil liquefaction, earthquake induced landsliding, and amplification of ground shaking during a seismic event. The resulting zoning indicates areas that have the greatest tendency to experience damage due to any of and/or a combination of these individual hazards. This mapping indicates that the subject site has a relatively high liquefaction hazard, a moderate hazard of amplification of ground shaking, and a low hazard of earthquake induced landsliding.

Surface Conditions

The subject and/or proposed new multi-family development property is composed of six (6) separate tax lots (parcels) and totals approximately 30 acres. The subject site is roughly bounded to the north by Lewis River Road, to the south by the Lewis River, and to the east and west by developed commercial and residential properties. At the time of our work, the subject site was generally unimproved and/or void of any structures and/or site improvements. However, the easterly portion of the site contains and existing natural gas line and easement.

Topographically, the site is characterized as relatively flat-lying terrain with overall topographic relief estimated at about seven (7) to eight (8) feet and is estimated to lie at about Elevation 25 feet. Surface vegetation across the site generally consists of a moderate growth of grass and weeds.

Subsurface Soil Conditions

Our understanding of the overall subsurface soil and groundwater conditions underlying the site was developed by means of seven (7) exploratory test holes excavated to depths ranging from about eight (8) to thirteen (13) feet beneath the existing site and/or surface grades on April 25, 2022 with tracked mounted excavating equipment. Additionally, two (2) cone penetration tests and two (2) exploratory test borings pushed and/or drilled to depths of between twenty-six and one-half (26.5) and forty-one (41) feet beneath existing site grades on April 25, 2022 with track-mounted CPT and/or mud-rotary drilling equipment. The location of the exploratory test holes, CPT and test borings were located in the field by marking off distances from existing and/or known site features and is shown in relation to the existing site features and/or proposed site improvements on the Site Exploration Plan, Figure No. 2. Detailed logs of the test boring, CPT and test holes, presenting conditions encountered at the location explored, is presented in the Appendix, Figure No's. A-5 through A-25.

The exploratory test holes, CPT and test borings were observed by staff from Redmond Geotechnical Services, LLC who logged the test hole and test boring explorations and obtained representative samples of the subsurface soils encountered beneath the site. Additionally, the elevation of the exploratory test holes and test boring were referenced from the USGS Woodland Quadrangle and should be considered as approximate. All subsurface soils encountered at the site and/or within the exploratory test holes and test boring were logged and classified in general conformance with the Unified Soil Classification System (USCS) which is outlined on Figure No. A-4.

SITE EXPLORATION PLAN

RIVERFRONT VILLAGE
LEWIS RIVER ROAD

Project No. 1171.006.G

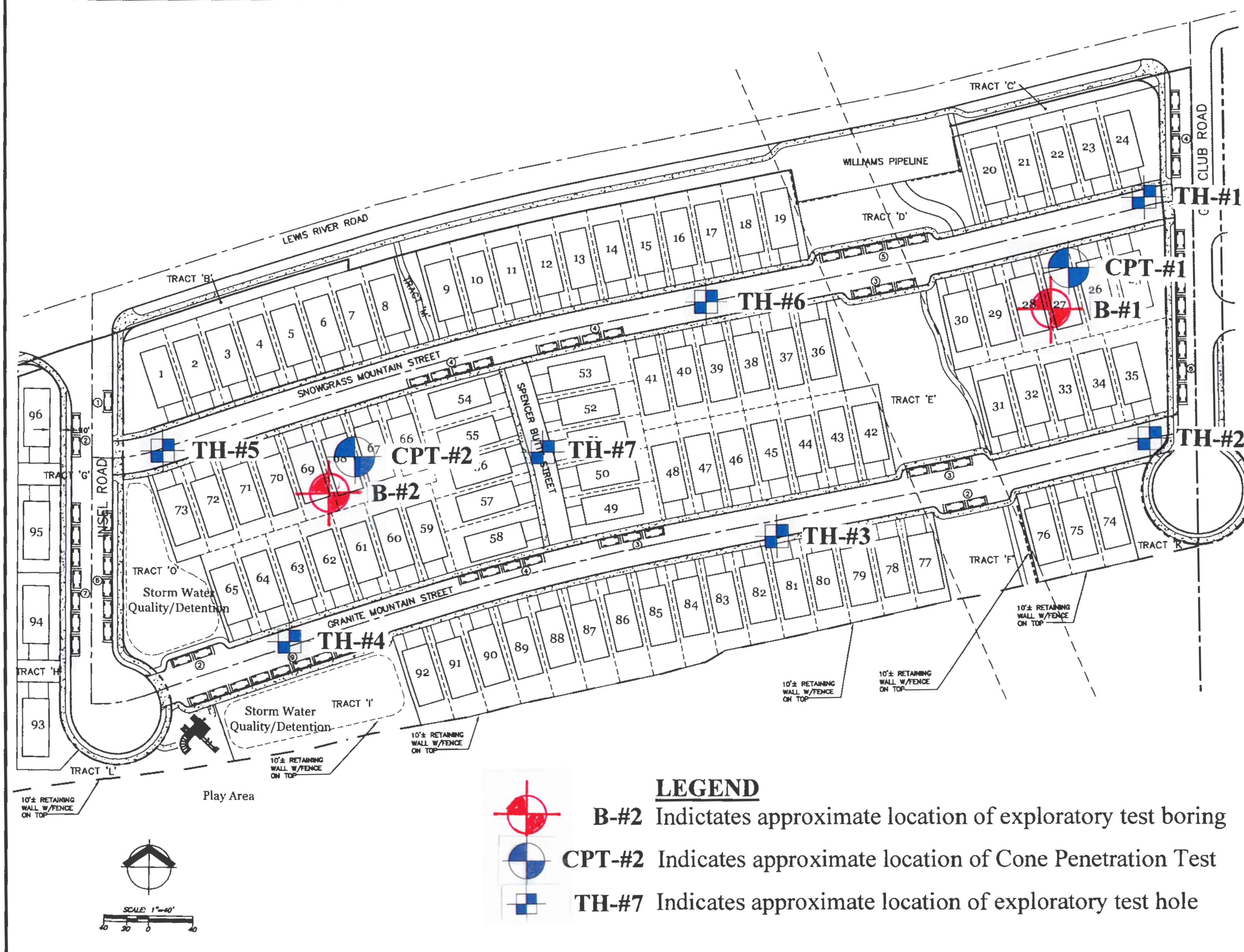


Figure No. 2

The test explorations revealed that the subject site is generally underlain at depth by native soil deposits comprised of lacustrine and fluvial sedimentary soil deposits of Holocene and Pleistocene age.

Specifically, the subsurface soils encountered beneath the proposed multi-family project area consist of an approximate 8- to 10-inch thick surficial layer of dark brown topsoil materials inturn underlain by an upper unit of medium brown, very moist, medium stiff to loose, slightly clayey, fine sandy silt to silty fine sand to a depth of about three (3) to five (5) feet beneath existing surface grades. These slightly clayey, fine sandy sandy silt to silty fine sand subgrade soils were intern underlain by an intermediate layer of gray-brown to gray, very moist to saturated, loose to medium dense, silty, fine to medium sand to a depth of about twenty-five (25) to twenty-six (26) feet beneath the existing site and/or surfaces grades. This intermediate layer of silty, fine to medium sand is best characterized by relatively low to moderate strength and moderate compressibility. All soils were found to underlain gray-brown to gray, saturated, medium dense to dense, silty to slightly silty, sandy gravel with cobbles to the maximum depth explored of forty-one (41) feet beneath existing site grades. These silty to slightly silty, sandy gravel with cobbles subgrade soil deposits are best characterized by relatively moderate to high strength and low compressibility.

Groundwater

The mud-rotary drilling methods used as part of our field exploration work limited the ability to measure the true groundwater depth at the time the our field explorations. However, based on the results of our laboratory testing program as well as the proximity of the nearby Lewis and Columbia River, we anticipate that groundwater will be encountered at a depth of about 15 feet beneath existing site grades. Additionally, although surface ponding of water was not present across the site at the time of our field work, groundwater elevations at the site may fluctuate seasonally in accordance with rainfall conditions and may seasonally perch near surface elevations and/or lower portions of the site during periods of prolonged and/or heavy rainfall conditions.

INFILTRATION TESTING

We performed two (2) field infiltration tests at the site on August 21, 2020. The infiltration tests were performed in test holes TH-#2 and TH-#4 at a depth of between nine (9) and ten (10) feet beneath the existing site and/or surface grades, respectively. The subgrade soils encountered in the infiltration test holes consisted of silty, fine to medium sand.

The infiltration testing was performed in general conformance with current EPA and/or the City of Woodland Encased Falling Head test method which consisted of advancing a 6-inch diameter PVC pipe approximately 6 inches into the exposed soil horizon at each test location. Using a steady water flow, water was discharged into the pipe and allowed to penetrate and saturate the subgrade soils. The water level was adjusted over a two (2) hour period and allowed to achieve a saturated subgrade soil condition consistent with the bottom elevation of the surrounding test pit excavation.

Following the required saturating period, water was again added into the PVC pipe and the time and/or rate at which the water level dropped was monitored and recorded. Each measurable drop in the water level was recorded until a consistent infiltration rate was observed and/or repeated.

Based on the results of the field infiltration testing at the site (see Field Infiltration Test Results, Figure No's. A-32 and A-33), we have found that the underlying silty to slightly silty, fine to medium sand subgrade soil deposits posses an ultimate infiltration rate of about 16 inches per hour (in/hr).

LABORATORY TESTING

Representative samples of the on-site subsurface soils were collected at selected depths and intervals from the test boring exploration and returned to our laboratory for further examination and testing and/or to aid in the classification of the subsurface soils as well as to help evaluate and identify their engineering strength and compressibility characteristics. The laboratory testing consisted of visual and textural sample inspection, moisture content and dry density determinations, maximum dry density and optimum moisture content, Atterberg Limits and gradation analyses as well as consolidation, direct shear strength and "R"-value tests. Results of the various laboratory tests are presented in the Appendix, Figure No's. A-26 through A-31.

SEISMICITY AND EARTHQUAKE SOURCES

The seismicity of the southwest Washington and northwest Oregon area, and hence the potential for ground shaking, is controlled by three separate fault mechanisms. These include the Cascadia Subduction Zone (CSZ), the mid-depth intraplate zone, and the relatively shallow crustal zone. Descriptions of these potential earthquake sources are presented below. The CSZ is located offshore and extends from northern California to British Columbia. Within this zone, the oceanic Juan de Fuca Plate is being subducted beneath the continental North American Plate to the east. The interface between these two plates is located at a depth of approximately 15 to 20 kilometers (km).

The seismicity of the CSZ is subject to several uncertainties, including the maximum earthquake magnitude and the recurrence intervals associated with various magnitude earthquakes. Anecdotal evidence of previous CSZ earthquakes has been observed within coastal marshes along the Washington and Oregon coastlines. Sequences of interlayered peat and sands have been interpreted to be the result of large Subduction zone earthquakes occurring at intervals on the order of 300 to 500 years, with the most recent event taking place approximately 300 years ago. A recent study by Geomatrix (1995) suggests that the maximum earthquake associated with the CSZ is moment magnitude (Mw) 8 to 9. This is based on an empirical expression relating moment magnitude to the area of fault rupture derived from earthquakes that have occurred within Subduction zones in other parts of the world. An Mw 9 earthquake would involve a rupture of the entire CSZ. As discussed by Geomatrix (1995) this has not occurred in other subduction zones that have exhibited much higher levels of historical seismicity than the CSZ and is considered unlikely. For the purpose of this study an earthquake of Mw 8.5 was assumed to occur within the CSZ.

The intraplate zone encompasses the portion of the subducting Juan de Fuca Plate located at a depth of approximately 30 to 50 km below western Washington and western Oregon. Very low levels of seismicity have been observed within the intraplate zone in western Oregon and western Washington. However, much higher levels of seismicity within this zone have been recorded in Washington and California. Several reasons for this seismic quiescence were suggested in the Geomatrix (1995) study and include changes in the direction of Subduction between Oregon, Washington, and British Columbia as well as the effects of volcanic activity along the Cascade Range. Historical activity associated with the intraplate zone includes the 1949 Olympia magnitude 7.1 and the 1965 Puget Sound magnitude 6.5 earthquakes. Based on the data presented within the Geomatrix (1995) report, an earthquake of magnitude 7.25 has been chosen to represent the seismic potential of the intraplate zone.

The third source of seismicity that can result in ground shaking within the northwest Oregon and southwest Washington area is near-surface crustal earthquakes occurring within the North American Plate. The historical seismicity of crustal earthquakes in this area is higher than the seismicity associated with the CSZ and the intraplate zone. The 1993 Scotts Mills (magnitude 5.6) and Klamath Falls (magnitude 6.0), Oregon earthquakes were crustal earthquakes.

Liquefaction

Seismic induced soil liquefaction is a phenomenon in which loose, granular soils and some silty soils, located below the water table, develop high pore water pressures and lose strength due to ground vibrations induced by earthquakes. Soil liquefaction can result in lateral flow of material into river channels, ground settlements and increased lateral and uplift pressures on underground structures. Buildings supported on soils that have liquefied often settle and tilt and may displace laterally. Soils located above the groundwater table cannot liquefy, but granular soils located above the water table may settle during the earthquake shaking.

The liquefaction analyses presented in the following paragraphs include "trigger analyses" to evaluate factors of safety against liquefaction for the design earthquakes described in this report. In addition, we have estimated the amount of seismically induced settlement and/or lateral spreading that could result during the design earthquake.

The "trigger analyses" were conducted using Seed-Idriss Procedures to estimate the stress ratio required to cause liquefaction in the subsurface soils, and average cyclic shear stress induced by the earthquake calculated from the computer code SHAKE. The Seed-Idriss Procedure uses empirical correlations between Standard Penetration Test N-values and ground performance during actual earthquakes to predict performance. Two (2) factors are required: the cyclic shear stress caused by the earthquake and the in-situ liquefaction resistance. SHAKE analyses calculate a maximum cyclic shear stress profile throughout the assumed ground profile above bedrock for a given strong motion record. The calculations also use representative shear wave velocities for the various geologic units. The soil shear wave velocity profile used in the SHAKE analysis was a combination of the shear wave velocities estimated from our test boring made at the site and data from deep soil borings made by DOGAMI in the vicinity of Woodland and the Columbia River.

The average shear stress induced by the earthquake is taken as 0.65 times the calculated maximum shear stress. The 0.65 reduction factor provides an equivalent average uniform cyclic stress history for the series of irregular cyclic shear stress calculated from strong motion records. The in-situ resistance to liquefaction is typically expressed as a cyclic stress ratio required to cause liquefaction, CSRL. Cyclic stress ratio is defined as the average uniform shear stress divided by the effective overburden stress.

Major factors that affect the resistance to liquefaction include the intensity and duration of the earthquake, and the relative density and grain size distribution of the soil. Seed and Idriss developed curves that relate CSRL to correlated Standard Penetration Test N-values and percentage of fines (i.e., percentage passing the No. 200 sieve) for a magnitude 7.5 earthquake. N-values are corrected for effective stress (depth), penetration test hammer type and energy delivered per blow, and other factors related to the test procedures. Additional correlations to the CSRL are made for the average number of equivalent cycles of strong motion based on magnitude, effective overburden stress, and site topography.

The two (2) design earthquakes for the site were M8.5 at 100 km and a M6.5 at 10 km. The computer program SHAKE was run for both crustal and subduction zone earthquakes in order to determine the seismic induced shear stresses in the soil. The ground water was assumed to be at a depth of about thirteen (15) feet.

The results of this analysis indicates that the M6.5 earthquake would produce a factor of safety against liquefaction greater than 1.0 in the underlying saturated loose to medium dense silty fine to medium sand while the M8.5 earthquake would produce a factor of safety less than 1.0. Factors of safety less than 1.0 are generally considered to have a high potential for liquefaction. Based on the results of the analysis, seismic induced settlements due to soil liquefaction during a M8.5 earthquake are estimated at about one (1) to one and one-half (1.5) inches.

Landslides

No ancient and/or active landslides were observed or are known to be present on the subject site. Additionally, due to the relatively flat-lying to gently sloping nature of the subject site, the risk of seismic induced slope instability at the site resulting in landslides and/or lateral earth movements do not appear to present a serious potential geologic hazard.

Surface Rupture

Although the site is generally located within a region of the country known for seismic activity, no known faults exist on and/or immediately adjacent to the subject site. As such, the risk of surface rupture due to faulting is considered low.

Tsunami and Seiche

A tsunami, or seismic sea wave, is produced when a major fault under the ocean floor moves vertically and shifts the water column above it. A seiche is a periodic oscillation of a body of water resulting in changing water levels, sometimes caused by an earthquake. Tsunami and seiche are not considered a potential hazard at this site because the site is not near to the coast and/or there are no adjacent significant bodies of water.

Flooding and Erosion

Stream flooding is a potential hazard that should be considered in lowland areas of Cowlitz County and Woodland. The FEMA (Federal Emergency Management Agency) flood maps should be reviewed as part of the design for the proposed new multi-family apartment structure and/or its associated site improvements. Elevations of structures on the site should be designed based upon consultants reports, FEMA (Federal Emergency Management Agency), and Cowlitz County requirements for the 100-year flood levels of any nearby creeks and/or streams such as the Lewis and Columbia River(s).

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our field exploration, laboratory testing and engineering analyses, it is our opinion that the site is suitable for the proposed Riverfront Village multi-family project provided that new structure and its associated site improvements described herein are designed and constructed in accordance with the recommendations contained within the following sections of this report.

The primary features of concern at the site are 1) the presence of the organic topsoil layer across the site, 2) the presence of moderately compressible soils beneath the site, and 3) the moisture sensitivity of the native slightly clayey, fine sandy silt to silty fine sand subgrade soils.

In regard to the organic layer of topsoil materials across the site, we anticipate that clearing and stripping depths of about 8 to 10 inches or more should be anticipated.

With regard to the moderate compressibility characteristics of the underlying slightly clayey, fine sandy silt to silty fine sand subgrade soils, we are generally of the opinion that the estimated relatively light to moderate foundation loads (i.e., 2.0 to 4.0 klf and/or 25 to 75 kips) will not likely be supported directly by the native medium stiff, slightly clayey, fine sandy silt to silty fine sand subgrade soils with conventional shallow foundations. Specifically, we understand that the subject site is presently planned to be filled some five (5) to six (6) feet above the existing site and/or surface grades such that the proposed new multi-family structures will be supported directly on new structural fill. As such, pre-loading and/or surcharging the existing native subgrade soils is generally not anticipated for the project.

In regard to the moisture sensitive slightly clayey, fine sandy silt to silty fine sand subgrade soils, we are generally of the opinion that all site grading and earthwork operations would benefit if scheduled for the drier summer months which is typically June through September.

The following sections of this report provide specific recommendations regarding subgrade preparation and grading as well as foundation and floor slab design and construction for the new Riverfront Village multi-family project.

Site Preparation

As an initial step in site preparation, we recommend that the proposed new multi-family buildings and the associated structural and/or site improvement area(s) be stripped and cleared of all existing surface improvements, any existing undocumented surficial fill materials, surface debris, existing vegetation, topsoil materials, and/or any other deleterious materials present at the time of construction. In general, we envision that the site stripping to remove existing vegetation and topsoil materials will generally be about 8 to 10 inches. However, localized areas requiring deeper stripping and removal may be encountered and should be evaluated and/or approved at the time of construction by the Geotechnical Engineer. The stripped and cleared materials should be properly disposed of as they are generally considered unsuitable for use/reuse as fill materials.

Following the completion of the site stripping and clearing work and prior to the placement of any new required structural fill materials and/or structural improvements, the exposed subgrade soils within the planned structural improvement area(s) should be inspected and approved by the Geotechnical Engineer and possibly proof-rolled with a half and/or fully loaded dump truck. Areas found to be soft or otherwise unsuitable should be over-excavated and removed or scarified and re-compacted as structural fill. During wet and/or inclement weather conditions, proof rolling and/or scarification and re-compaction as noted above may not be appropriate.

The on-site native sandy silt and/or silty sand subgrade soils are generally considered suitable for use/reuse as structural fill materials provided that they are free of organic materials, debris, and rock fragments in excess of about 6 inches in dimension. However, if site grading is performed during wet or inclement weather conditions, the use of the on-site native silty soil materials will be difficult at best. In this regard, during wet or inclement weather conditions, we recommend that an import structural fill material be utilized which should consist of a free-draining (clean) granular fill (sand & gravel) containing no more than about 5 percent fines. Representative samples of the materials which are to be used as structural fill materials should be submitted to the Geotechnical Engineer and/or laboratory for approval and determination of the maximum dry density and optimum moisture content for compaction.

In general, all site earthwork and grading activities should be scheduled for the drier summer months (June through September) if possible. However, if wet weather site preparation and grading is required, it is generally recommended that the stripping of topsoil materials be accomplished with a tracked excavator utilizing a large smooth-toothed bucket working from areas yet to be excavated.

Additionally, the loading of strippings into trucks and/or protection of moisture sensitive subgrade soils will also be required during wet weather grading and construction. In this regard, we recommend that areas in which construction equipment will be traveling be protected by covering the exposed subgrade soils with a woven geotextile fabric such as Mirafi FW404 followed by at least 12 inches or more of crushed aggregate base rock. Further, the geotextile fabric should have a minimum Mullen burst strength of at least 250 pounds per square inch for puncture resistance and an apparent opening size (AOS) between the U.S. Standard No. 70 and No. 100 sieves.

All structural fill materials placed within the new multi-family building area should be moistened or dried as necessary to near (within 3 percent) optimum moisture conditions and compacted by mechanical means to a minimum of 92 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Additionally, all fill materials placed within three (3) lineal feet of the perimeter (limits) of the proposed new structures should be considered structural fill which requires a minimum degree of compaction of 92 percent. However, structural fill materials required outside of the proposed new building area need only be compacted to a minimum of 90 percent of the maximum dry density. Structural fill materials should be placed in lifts (layers) such that when compacted do not exceed about 9 inches. All aspects of the site grading should be monitored and approved by a representative of Redmond Geotechnical Services, LLC.

Foundation Support

Based on the results of our investigation, it is our opinion that the site of the proposed new Riverfront Village multi-family development is generally suitable for support of the new two- and/or three-story wood-frame structures provided that the above site preparation and/or following foundation design recommendations are followed.

The following sections of this report present specific foundation design and construction recommendations for the planned new multi-family structures.

Conventional Shallow Foundations

In general, conventional shallow continuous (strip) footings and individual (spread) pad footings for relatively light to moderate foundation loads (i.e., 2.0 to 4.0 klf and/or 25 to 75 kips) may be supported by approved native medium stiff, slightly clayey, fine sandy silt to silty fine sand subgrade soil materials and/or properly placed and compacted structural fill soil materials based on an allowable contact bearing pressure of about 2,500 pounds per square foot (psf). However, where higher foundation loads are planned and/or required (i.e., 4.0 to 5.0 klf and/or 75 to 100 kps), we recommend that foundations be supported by a minimum of at least 12 inches of properly compacted (structural) crushed aggregate base rock fill based on an allowable contact bearing pressure of up to 3,000 psf. These recommended allowable contact bearing pressures are intended for dead loads and sustained live loads and may be increased by one-third for the total of all loads including short-term wind or seismic loads.

In general, shallow continuous (strip) footings should have a minimum width of at least 16 inches and be embedded at least 18 inches below the lowest adjacent finish grade (includes frost protection). Individual (spread) pad footings (where required) should be embedded at least 18 inches below grade and have a minimum width of at least 24 inches.

Total and differential settlements of conventional shallow foundations constructed as recommended above and supported by approved native slightly clayey, fine sandy silt to silty fine sand subgrade soils and/ or by properly compacted structural fill materials are expected to be well within the tolerable limits for this type of wood-frame structure and should generally be less than about 1-inch and 1/2-inch, respectively.

Allowable lateral frictional resistance between the base of the footing element and the supporting subgrade bearing soil can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.35 and 0.45 for native clayey, sandy silt subgrade soils and/or import gravel fill materials, respectively. In addition, lateral loads may be resisted by passive earth pressures on footings poured "neat" against in-situ (native) subgrade soils or properly backfilled with structural fill materials based on an equivalent fluid density of 250 pounds per cubic foot (pcf). These recommended values include a factor of safety of approximately 1.5 which is appropriate due to the amount of movement required to develop full passive resistance.

Floor Slab Support

For slab-on-grade structures, satisfactory subgrade support for building floor slab supporting up to 100 psf areal loading can be obtained from the upper medium stiff, silty subgrade soils as well as any new structural fills placed at the site when prepared in accordance with site preparation recommendations contained within this report. A minimum 6-inch layer of compacted crushed aggregate base rock should be placed over the prepared subgrade to assist as a capillary break. Additionally where the underslab aggregate base rock section and subgrade has been prepared and compacted as recommended above, we recommend that a modulus of subgrade reaction (ks) of 125 pci be used for design.

Floor slabs constructed as recommended herein will likely exhibit static and/or permanently applied dead load settlements of up to 1-inch. We recommend that slabs be jointed around columns and walls to permit slabs and foundations to settle differentially. Base rock material placed directly below the slab should be 3/4-inch maximum particle size or less. The surface of the base rock should filled with sand just prior to concrete placement to help reduce the lateral restraint on the bottom of the concrete during curing.

Retaining/Below Grade Walls

Retaining and/or below grade walls should be designed to resist lateral earth pressures imposed by native soils or granular backfill materials as well as any adjacent surcharge loads. For walls which are unrestrained at the top and free to rotate about their base, we recommend that active earth pressures be computed on the basis of the following equivalent fluid densities:

Table 2: Retaining Wall Earth Pressures

Non-Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Silt (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	35	30
3H:1V	60	50
2H:1V	90	80

For walls which are fully restrained at the top and prevented from rotation about their base, we recommend that at-rest earth pressures be computed on the basis of the following equivalent fluid densities:

Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Silt (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	55	50
3H:1V	75	70
2H:1V	95	90

The above recommended values assume that the walls will be adequately drained to prevent the buildup of hydrostatic pressures. Where wall drainage will not be present and/or if adjacent surcharge loading is present, the above recommended values will be significantly higher. For seismic loading, we recommend an additional uniform pressure of 6H where H is the height of the wall in feet.

Backfill materials behind walls should be compacted to 90 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Special care should be taken to avoid over-compaction near the walls which could result in higher lateral earth pressures than those indicated herein. In areas within three (3) to five (5) feet behind walls, we recommend the use of hand-operated compaction equipment.

Pavements

Flexible pavement design for the project was determined on the basis of projected (anticipated) traffic volume and loading conditions relative to laboratory subgrade soil strength ("R"-value) characteristics.

Based on an average laboratory subgrade "R"-value of 30 (Resilient Modulus = 5,000 to 10,000) and utilizing the Asphalt Institute Flexible Pavement Design Procedures and/or the American Association of State Highway and Transportation Officials (AASHTO) 1993 "Design of Pavement Structures" manual, we recommend that the asphaltic concrete pavement section(s) for the new Riverfront Village multi-family development areas at the site consist of the following:

	Asphaltic Concrete Thickness (inches)	Crushed Base Rock Thickness (inches)
Automobile Parking Areas	3.0	8.0
Automobile Drive Areas	3.0	10.0

Note: Where heavy vehicle traffic is anticipated such as those required for fire and/or garbage trucks, we recommend that the automobile drive area pavement section be increased by adding 1.0 inches of asphaltic concrete and 2.0 inches of aggregate base rock. Additionally, for wet weather construction, we recommend a minimum gravel base rock thickness of at least 12 inches. Further, the above recommended flexible pavement section(s) assumes a design life of 20 years.

Pavement Subgrade, Base Course & Asphalt Materials

The above recommended pavement section(s) were based on the design assumptions listed herein and on the assumption that construction of the access drive and parking section area(s) will be completed during an extended period of reasonably dry weather. However, if construction of the private access drive and parking area improvements is performed during wet and/or inclement weather conditions, we recommend that the aggregate base rock section be increased by at least 4 to 6 inches. Additionally, the use of an approved geotextile fabric is also recommended during wet and/or inclement weather construction. Further, we point out that the laboratory "R"-value test results generally reflect a re-compacted subgrade soil strength and not an undisturbed (in-situ) subgrade soil. In this regard, we are generally of the opinion that the exposed subgrade soils be scarified, moisture conditioned to near optimum moisture content and compacted to a minimum of at least 92 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures.

All thicknesses given are intended to be the minimum acceptable. Increased base rock sections and the use of geotextile fabric may be required during wet and/or inclement weather conditions and/or in order to adequately support construction traffic and protect the subgrade during construction. Additionally, the above recommended pavement section(s) assume that the subgrade will be prepared as recommended herein, that the exposed subgrade soils will be properly protected from rain and construction traffic, and that the subgrade is firm and unyielding at the time of paving. Further, it assumes that the subgrade is graded to prevent any ponding of water which may tend to accumulate in the base course.

Pavement base course materials should consist of well-graded 1-1/4 inch and/or 5/8-inch minus crushed base rock having less than 5 percent fine materials passing the No. 200 sieve. The base course and asphaltic concrete materials should conform to the requirements set forth in the latest edition of the Washington Department of Transportation, Standard Specifications for Highway Construction.

The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. The asphaltic concrete paving materials should be compacted to at least 92 percent of the theoretical maximum density as determined by the ASTM D-2041 (Rice Gravity) test method.

Excavation/Slopes

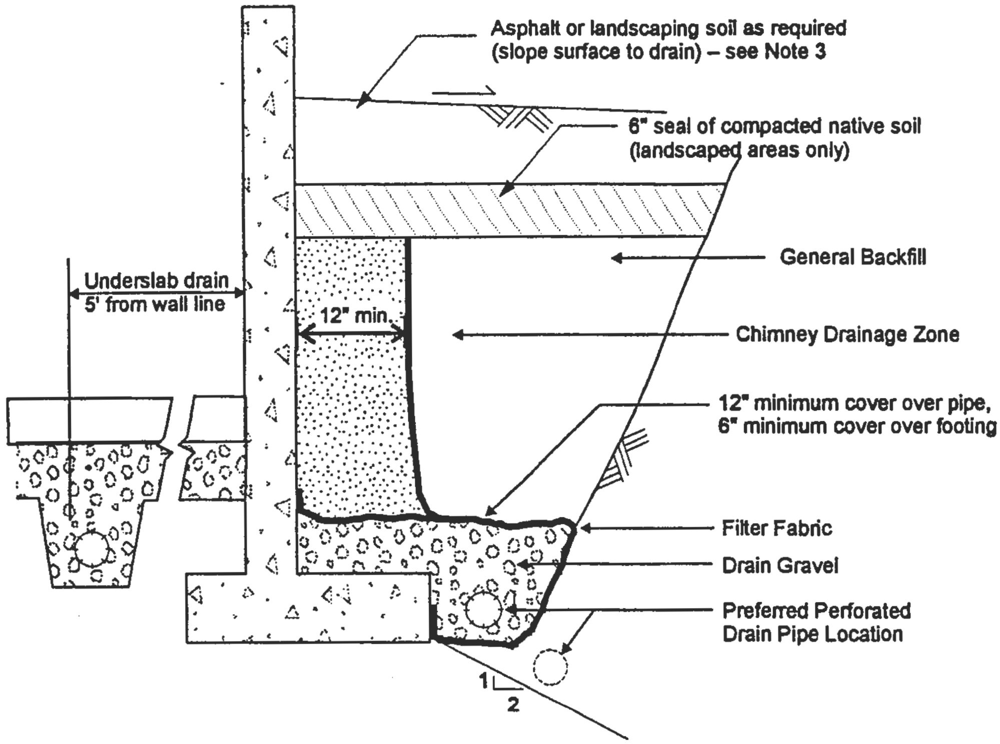
Temporary excavations of up to about four (4) feet in depth may be constructed with near vertical inclinations for short periods of time provided that groundwater seepage is not present. Temporary excavations greater than about four (4) feet but less than eight (8) feet should be excavated with inclinations of at least 1 to 1 (horizontal to vertical) or properly braced/shored. Where excavations are planned to exceed about eight (8) feet, this office should be consulted. Additionally, excavations which extend below a depth of about four (4) to five (5) feet should anticipate caving. All shoring systems and/or temporary excavations including bracing as well as dewatering for the project should be the responsibility of the excavation contractor and should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations.

Depending on the time of year in which trench excavations occur, trench dewatering may be required in order to maintain dry working conditions if the invert elevations of the proposed utilities are located at and/or below the groundwater level. If groundwater is encountered during utility excavation work, we recommend placing trench stabilization materials along the base of the excavation. Trench stabilization materials should consist of 1-foot of well-graded gravel, crushed gravel, or crushed rock with a maximum particle size of 4 inches and less than 5 percent fines passing the No. 200 sieve. The material should be free of organic matter and other deleterious material and placed in a single lift and compacted until well keyed.

Surface Drainage/Groundwater

We recommend that positive measures be taken to properly finish grade the site so that drainage waters from building and/or landscaping areas as well as adjacent properties or buildings are directed away from the new multi-family structures foundations. Any roof drains and/or subsurface drainage systems should be directed into non-perforated conduits (pipes) that carry runoff water away from any new building to a suitable outfall. Roof downspouts should not be connected to foundation drains. A minimum ground slope of about 2 percent is generally recommended in unpaved areas around the structure.

Groundwater was generally encountered at the site within the exploratory test borings at the time of drilling at a depth of about 15 to 16 feet beneath existing site grades. Additionally, although groundwater elevations in the area may fluctuate seasonally and may temporarily pond/perch near the ground surface during periods of prolonged rainfall, based on our current understanding of the project, we are generally of the opinion that the observed static groundwater levels encountered during our field work are likely near to the seasonal high groundwater elevation(s) at the site.



SCHEMATIC - NOT TO SCALE

NOTES:

1. Filter Fabric to be non-woven geotextile (Amoco 4545, Mirafi 140N, or equivalent)
2. Lay perforated drain pipe on minimum 0.5% gradient, widening excavation as required. Maintain pipe above 2:1 slope, as shown.
3. All-granular backfill is recommended for support of slabs, pavements, etc. (see text for structural fill).
4. Drain gravel to be clean, washed ¾" to 1½" gravel.
5. General backfill to be on-site gravels, or ¾"-0 or 1½"-0 crushed rock compacted to 92% Modified Proctor (AASHTO T-180).
6. Chimney drainage zone to be 12" wide (minimum) zone of clean washed, medium to coarse sand or drain gravel if protected with filter fabric. Alternatively, prefabricated drainage structures (Miradrain 6000 or similar) may be used.

TYPICAL PERIMETER FOOTING/RETAINING WALL DRAIN DETAIL		
Project No. 1171.006.G	RIVERFRONT VILLAGE LEWIS RIVER ROAD	Figure No. 3

As such, based on our current understand of the site grading required to bring the subject site to finish design grades as well as the type of structure which will be constructed at the site, we are of the opinion that an underslab drainage system is not required for the proposed new multi-family structures. However, due to the planned use of the ground floor level of the building, we are of the opinion that a perimeter foundation drainage system should be considered at the site.

Design Infiltration Rates

Based on the results of our field infiltration testing, we recommend using the following infiltration rate to design any on-site near surface storm water infiltration and/or disposal systems for the project:

Subgrade Soil Type	**Recommended Infiltration Rate**
Silty to slightly silty, fine to medium SAND (SM)	8.0 inches per hour (in/hr)

Note: A safety factor of two (2) was used to calculate the above recommended design infiltration rate(s). Additionally, given the gradational variability of the on-site fine sandy silt and/or silty fine to medium sand subgrade soils beneath the site, it is generally recommended that field testing be performed during and/or following construction of any on-site storm water infiltration system(s) in order to confirm that the above recommended design infiltration rates are appropriate.

Seismic Design Considerations

Structures at the site should be designed to resist earthquake loading in accordance with the methodology described in the latest edition of the State of Washington Structural Specialty Code (WSSC), ASCE 7-16 and/or the 2018 International Building Code (IBC). The maximum considered earthquake ground motion for short period and 1.0 period spectral response may be determined from the Washington Structural Specialty Code (WSSC), ASCE 7-16 and/or Figures 1613 (1) and 1613 (2) of the 2015 National Earthquake Hazard Reduction Program (NEHRP) "Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" published by the Building Seismic Safety Council. Assuming an IBC building category importance factor $I_E = 1.0$ and a seismic use group of III, we recommend a seismic design category "D" be used for design. Using this information, the structural engineer can select the appropriate site coefficient values (F_a and F_v) from ASCE 7-16 or the 2018 IBC to determine the maximum considered earthquake spectral response acceleration for the project. However, we have assumed the following response spectrum for the project:

Table 3: ASCE 7-16 Seismic Design Parameters

Site Class	S_D	S_1	F_a	F_v	S_{MS}	S_{M1}	S_{DS}	S_{D1}
D	0.818	0.389	1.200	1.911	0.981	0.743	0.654	0.496

Notes: 1. S_S and S_1 were established based on the USGS 2015 mapped maximum considered earthquake spectral acceleration maps for 2% probability of exceedence in 50 years.

2. Fa and Fv were established based on ASCE 7-16 using the selected S_S and S_1 values.

CONSTRUCTION MONITORING AND TESTING

We recommend that **Redmond Geotechnical Services, LLC** be retained to provide construction monitoring and testing services during all earthwork operations for the proposed new Riverfront Village multi-family project. The purpose of our monitoring services would be to confirm that the site conditions reported herein are as anticipated, provide field recommendations as required based on the actual conditions encountered, document the activities of the grading contractor and assess his/her compliance with the project specifications and recommendations. It is important that our representative meet with the contractor prior to grading to help establish a plan that will minimize costly over-excavation and site preparation work. Of primary importance will be observations made during site preparation, structural fill placement, foundation excavations and construction as well as any retaining wall backfill.

CLOSURE AND LIMITATIONS

This report is intended for the exclusive use of the addressee and/or their representative(s) to use to design and construct the proposed new multi-family structures and the associated site improvements described herein as well as to prepare any related construction documents. The conclusions and recommendations contained in this report are based on site conditions as they presently exist and assume that the explorations are representative of the subsurface conditions between the explorations and/or across the study area. The data, analyses, and recommendations herein may not be appropriate for other structures and/or purposes. We recommend that parties contemplating other structures and/or purposes contact our office. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. Additionally, the above recommendations are contingent on Redmond Geotechnical Services, LLC being retained to provide all site grading inspection and construction monitoring services for the project. Redmond Geotechnical Services, LLC will not assume any responsibility and/or liability for any engineering judgment, inspection, or testing services performed by others.

It is the owners/developer's responsibility for ensuring that the project designers and/or contractors involved with this project implement our recommendations into the final design plans, specifications and/or construction activities for the project. Further, in order to avoid delays during construction, we recommend that the final design plans and specifications for the project be reviewed by our office to evaluate as to whether our recommendations have been properly interpreted and incorporated into the project.

If during any future site grading and construction, subsurface conditions different from those encountered in the explorations are observed or appear to be present beneath excavations, we should be advised immediately so that we may review these conditions and evaluate whether modifications of the design criteria are required. We also should be advised if significant modifications of the proposed site development are anticipated so that we may review our conclusions and recommendations.

LEVEL OF CARE

The services performed by the Geotechnical Engineer for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in the area under similar budget and time restraints. No warranty or other conditions, either expressed or implied, is made.

REFERENCES

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Appendix "A"

Boring/CPT/Test Pit Logs and Laboratory Data

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATION

Subsurface conditions at the site under this scope of work were explored by excavating seven (7) exploratory test holes, pushing two (2) CPT's and drilling two (2) exploratory test borings on April 25 and 29, 2022, respectively. The approximate location of the test holes, CPT and test boring explorations are shown in relation to the existing site features and/or proposed new site improvements on the Site Exploration Plan, Figure No. 2.

The test holes were excavated with a tracked mounted excavator and the CPT and test borings under this scope of work were pushed and/or drilled using track-mounted CPT and/or mud-rotary drilling equipment in general conformance with ASTM Methods in Vol. 4.08, D-1586-94 and D-1587-83. The test holes were excavated to depths ranging from about eight (8) to thirteen (13) feet and the CPT and test borings were drilled and/or pushed to depths of between twenty-six and one-half (26.5) and forty-one (41) feet beneath existing site grades. Detailed logs of the CPT, test borings and test holes are presented on the Boring Log, CPT and Test Pit Logs, Figure No's. A-5 through A-25. The soils were classified in accordance with the Unified Soil Classification System (USCS), which is outlined on Figure No. A-4.

The exploration program was coordinated by a field engineer who monitored the excavating and drilling and exploration activity, obtained representative samples of the subsurface soils encountered, classified the soils by visual and textural examination, and maintained continuous logs of the subsurface conditions. Disturbed and/or undisturbed samples of the subsurface soils were obtained at appropriate depths and/or intervals and placed in plastic bags and/or with a thin walled ring sample.

Groundwater was estimated in the exploratory test borings (B-#1 and B-#2) at the time of drilling at a depth of about 15 to 16 feet beneath existing site grades.

LABORATORY TESTING

Pertinent physical and engineering characteristics of the soils encountered during our subsurface investigation were evaluated by a laboratory testing program to be used as a basis for selection of soil design parameters and for correlation purposes. Selected tests were conducted on representative soil samples. The program consisted of tests to evaluate the existing (in-situ) moisture-density, maximum dry density and optimum moisture content, Atterberg Limits and gradational characteristics as well as consolidation, direct shear strength and "R"-value tests.

Dry Density and Moisture Content Determinations

Density and moisture content determinations were performed on both disturbed and relatively undisturbed samples from the test boring exploration in general conformance with ASTM Vol. 4.08 Part D-216. The results of these tests were used to calculate existing overburden pressures and to correlate strength and compressibility characteristics of the soils. Test results are shown on the test boring log at the appropriate sample depths.

Maximum Dry Density

One (1) Maximum Dry Density and Optimum Moisture Content test was performed on a representative sample of the on-site clayey, sandy silt subgrade soils in accordance with ASTM Vol. 4.08 Part D-1557. The tests were conducted to help establish various engineering properties for use as structural fill. The test results are presented on Figure No. A-26.

Atterberg Limits

Liquid Limit (LL) and Plastic Limit (PL) tests were performed on a representative sample of the clayey, sandy silt subgrade soils in accordance with ASTM Vol. 4.08 Part D-4318-85. The tests were conducted to facilitate classification of the soils and for correlation purposes. The test results appear on Figure No. A-27.

Gradation Analysis

Gradation analyses were performed on representative samples of the subsurface soils in accordance with ASTM Vol. 4.08 Part D-422. The test results were used to classify the soil in accordance with the Unified Soil Classification System (USCS). The test results are shown graphically on Figure No. A-28.

Consolidation Test

One (1) Consolidation test was performed on a representative sample of the upper clayey, sandy silt subgrade soil to assess the compressibility characteristics of the near surface clayey, sandy silt subgrade soils in accordance with ASTM Vol. 4.08 Part D-2435-80.

Conventional loading increments of 100, 200, 400, ... 12,800 psf were applied after the 100 percent time of primary consolidation was identified for each loading increment. The samples were unloaded and allowed to rebound after the completion of the loading sequence. Deflection versus time readings were recorded for all load increments from 100 through 12,800 psf. The deflection corresponding to 100 percent primary consolidation was plotted on the consolidation strain versus consolidation pressure curve, which is presented on Figure No. A-29.

Direct Shear Strength Test

One (1) Direct Shear Strength test was performed on a undisturbed and/or remolded sample at a continuous rate of shearing deflection (0.02 inches per minute) in accordance with ASTM Vol. 4.08 Part D-3080-79. The test results were used to determine engineering strength properties and are shown graphically on Figure No. A-30.

"R"-Value Test

One (1) "R"-value test was performed on a remolded subgrade soil sample in accordance with ASTM Vol. 4.08 Part D-2844. The test results were used to help evaluate the subgrade soils supporting and performance capabilities when subjected to traffic loading. The test results are shown graphically on Figure No. A-31.

The following figures are attached and complete the Appendix:

Figure No. A-4	Key To Exploratory Boring Logs
Figure No's. A-5 and A-6	Boring Log
Figure No's. A-7 through A-21	CPT Logs
Figure No's. A-22 through A-25	Log of Test Pits
Figure No. A-26	Maximum Dry Density Test Results
Figure No. A-27	Atterberg Limits Test Results
Figure No. A-28	Gradation Test Results
Figure No. A-29	Consolidation Test Results
Figure No. A-30	Direct Shear Strength Test Results
Figure No. A-31	Results of "R" (Resistance) Value Tests
Figure No's. A-32 and A-33	Infiltration Test Results

PRIMARY DIVISIONS				GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS	MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
			GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
		SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines.
				SP	Poorly graded sands or gravelly sands, little or no fines.
			SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
				SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS	MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS 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.
		SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				Pt	Peat and other highly organic soils.

DEFINITION OF TERMS

U.S. STANDARD SERIES SIEVE — 200, 40, 10, 4

CLEAR SQUARE SIEVE OPENINGS — 3/4", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

GRAIN SIZES

SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS/FOOT †
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

CLAYS AND PLASTIC SILTS	STRENGTH ‡	BLOWS/FOOT †
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

† Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).

‡ Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

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KEY TO EXPLORATORY BORING LOGS
Unified Soil Classification System (ASTM D-2487)

RIVERFRONT VILLAGE
LEWIS RIVER ROAD

PROJECT NO.	DATE	Figure A-4
1171.006.G	10/31/22	

DRILLING COMPANY: Crisman Pacific	RIG: CME 75	DATE: 4/29/22	
BORING DIAMETER: 3.0"	DRIVE WEIGHT: 140#	DROP: 30"	ELEVATION: 26'±

SOIL DESCRIPTION

BORING NO. B-#1

DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					ML/ SM	Dark brown, wet, very soft, organic, clayey, fine sandy SILT to silty fine SAND (Topsoil)
	X	4		20.2	ML/ SM	Medium brown, very moist, medium stiff to loose, slightly clayey, fine sandy SILT to silty fine SAND
5	X	6		14.4	SM	Gray-brown to gray, very moist, silty, fine to medium SAND
10	X	7		15.1		
	X	9		16.1		
15						Becomes wet to saturated
	X	6				
20	X	6				
						Becomes medium dense
25	X	30			GM	Gray to gray-brown, saturated, medium dense to dense, silty to slightly silty, sandy GRAVEL with cobbles
						Total Depth = 26.5 feet
30						

BORING LOG

PROJECT NO. 1171.006.G	RIVERFRONT VILLAGE	FIGURE NO. A-5

DRILLING COMPANY: Crisman Pacific	RIG: CME 75	DATE: 4/29/22

BORING DIAMETER: 3.0"	DRIVE WEIGHT: 140#	DROP: 30"	ELEVATION: 25'±

SOIL DESCRIPTION

BORING NO. B-#2

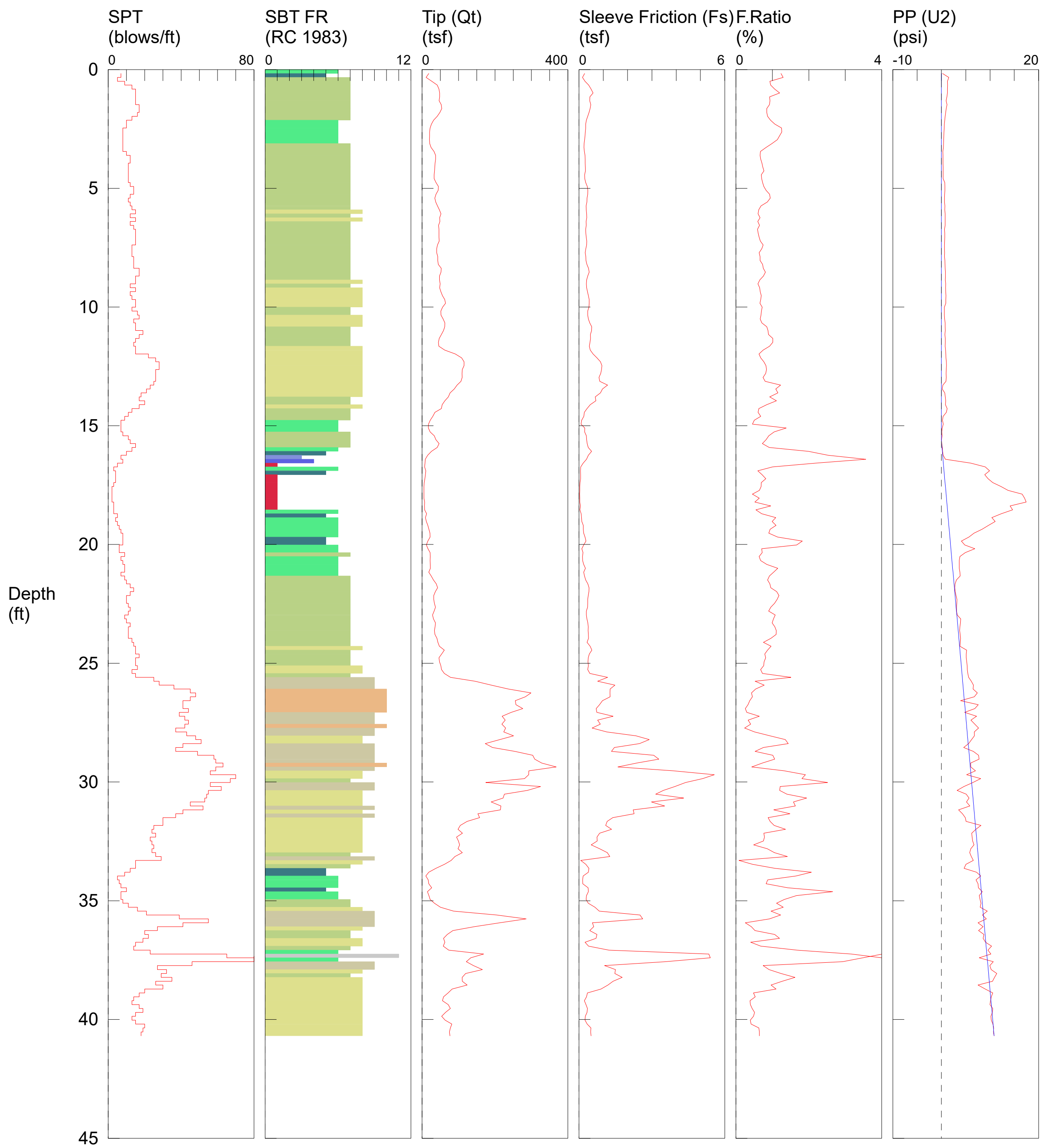
DEPTH (FEET)	BAG SAMPLE	DRIVE SAMPLE BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					ML/ SM	Dark brown, wet, very soft, organic, clayey, fine sandy SILT to silty fine SAND (Topsoil)
	X	5			ML/ SM	Medium brown, very moist, medium stiff to loose, slightly clayey, fine sandy SILT to silty fine SAND
5	X	7			SM	Gray-brown to gray, very moist, loose, silty, fine to medium SAND
10	X	8				
	X	9				
15	X	7				Becomes wet to saturated
20	X	7				
						Becomes medium dense
25	X	28			GM	Gray to gray-brown, saturated, medium dense to dense, silty to slightly silty, sandy GRAVEL with cobbles
						Total Depth = 26.5 feet
30						

BORING LOG

PROJECT NO. 1171.006.G	RIVERFRONT VILLAGE	FIGURE NO. A-6

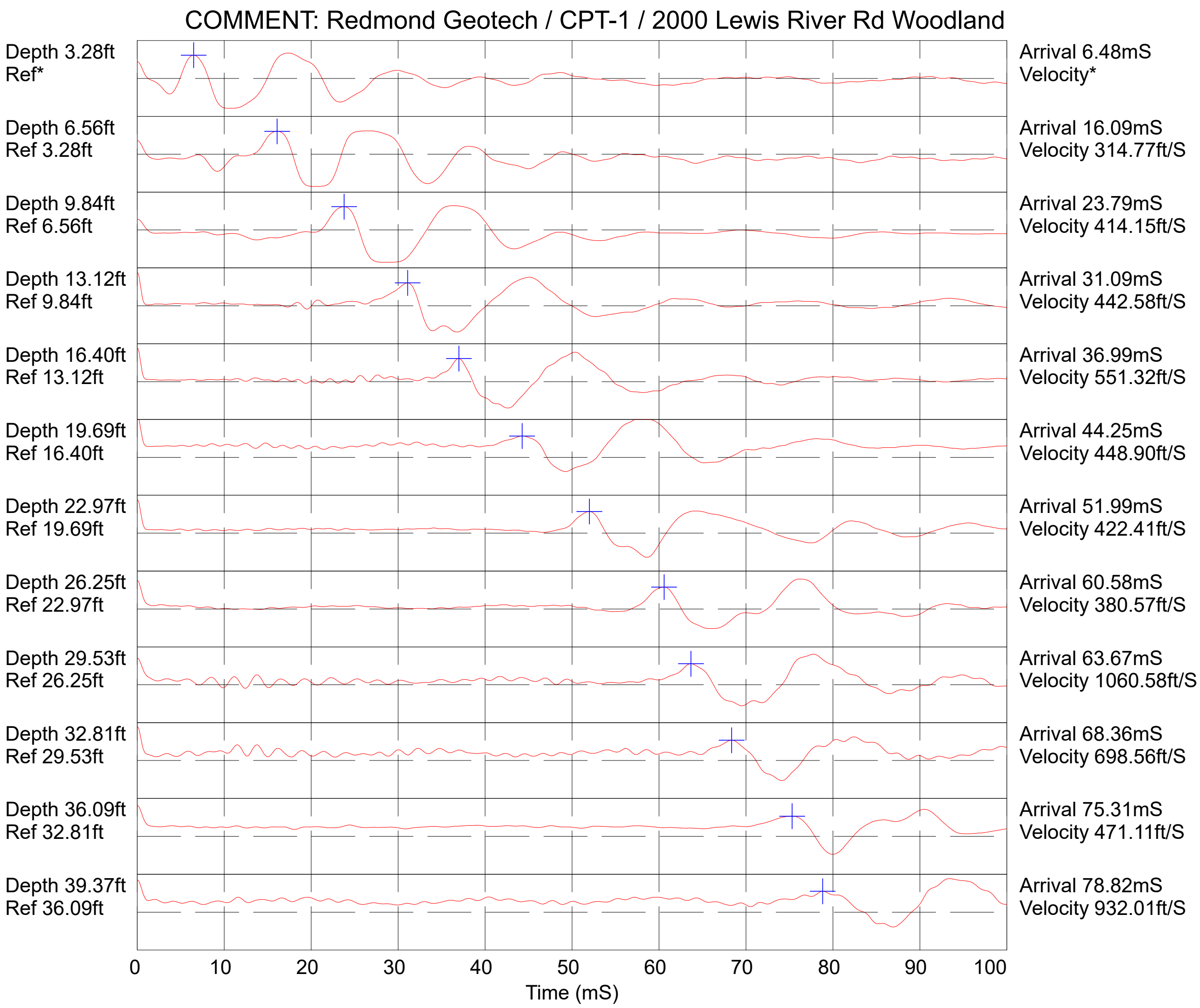
Redmond Geotech / CPT-1 / 2000 Lewis River Rd Woodland

OPERATOR: OGE DMM
CONE ID: DDG1532
HOLE NUMBER: CPT-1
TEST DATE: 4/25/2022 9:43:08 AM
TOTAL DEPTH: 40.682 ft



1	sensitive fine grained	4	silty clay to clay	7	silty sand to sandy silt	10	gravelly sand to sand
2	organic material	5	clayey silt to silty clay	8	sand to silty sand	11	very stiff fine grained (*)
3	clay	6	sandy silt to clayey silt	9	sand	12	sand to clayey sand (*)

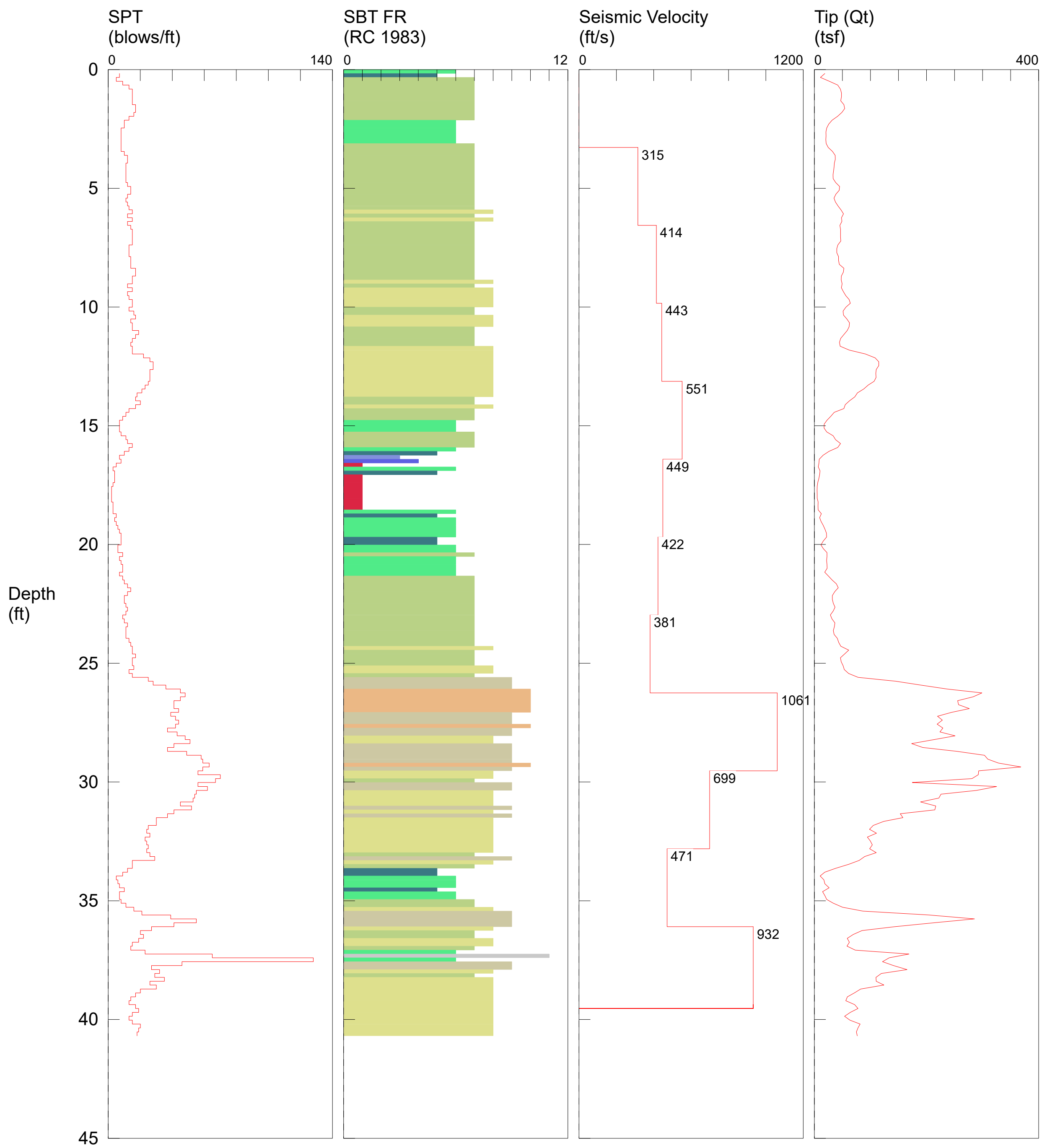
*SBT/SPT CORRELATION: UBC-1983



Hammer to Rod String Distance (ft): 1.97
* = Not Determined

Redmond Geotech / CPT-1 / 2000 Lewis River Rd Woodland

OPERATOR: OGE DMM
CONE ID: DDG1532
HOLE NUMBER: CPT-1
TEST DATE: 4/25/2022 9:43:08 AM
TOTAL DEPTH: 40.682 ft

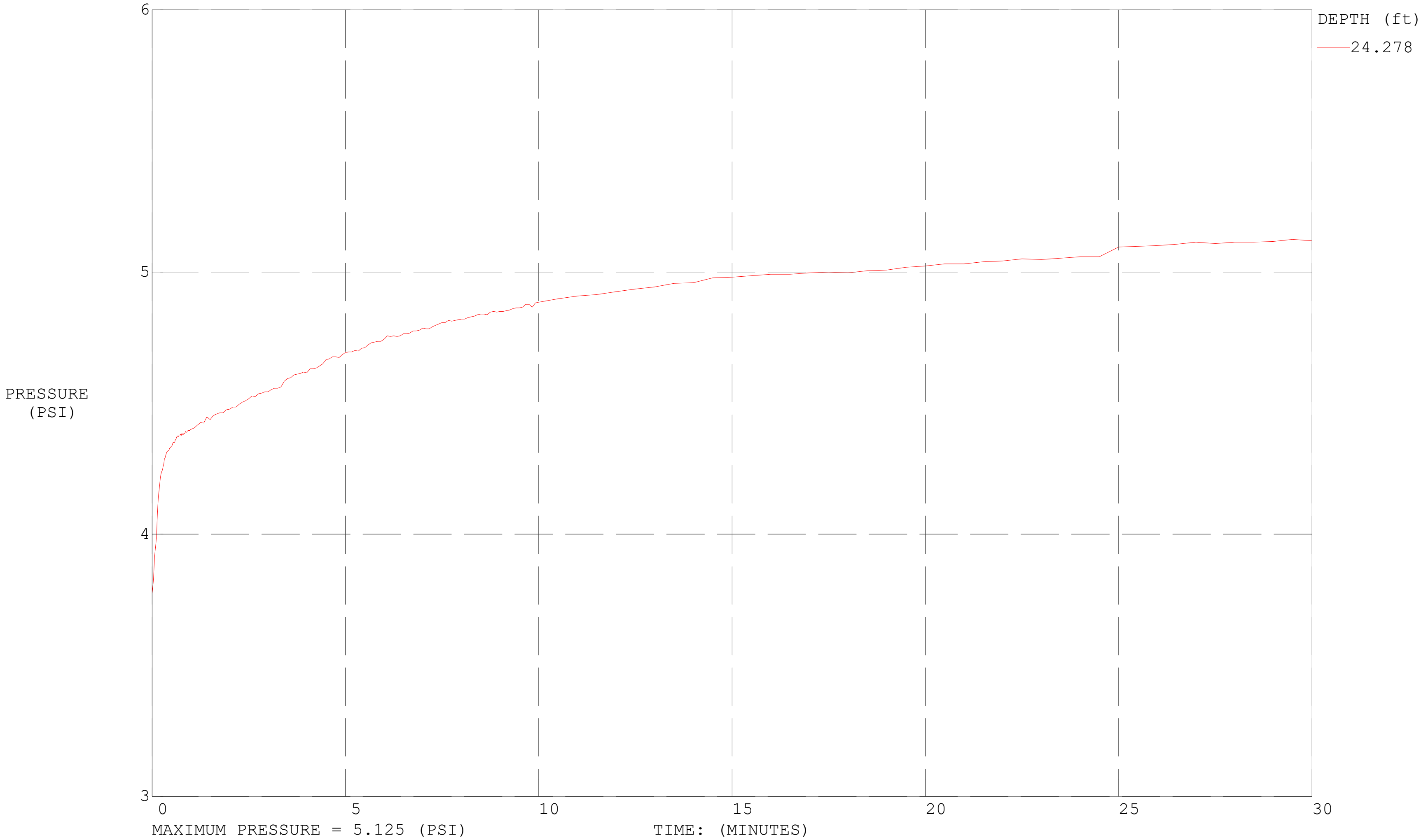


1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: Redmond Geotech / CPT-1 / 2000 Lewis River Rd Woodland

TEST DATE: 4/25/2022 9:43:08 AM



MAXIMUM PRESSURE = 5.125 (PSI)

HYDROSTATIC PRESSURE = 3.728 (PSI), WATER TABLE: 15.68 ft

Redmond Geotech / CPT-1 / 2000 Lewis River Rd Woodland

OPERATOR: OGE DMM
CONE ID: DDG1532
HOLE NUMBER: CPT-1
TEST DATE: 4/25/2022 9:43:08 AM
TOTAL DEPTH: 40.682 ft

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
0.164	18.48	0.2286	1.237	0.237	7	6	sandy silt to clayey silt
0.328	10.85	0.1404	1.294	1.504	5	5	clayey silt to silty clay
0.492	26.82	0.2495	0.931	1.219	9	7	silty sand to sandy silt
0.656	41.39	0.3939	0.952	1.261	13	7	silty sand to sandy silt
0.820	46.32	0.4922	1.062	1.227	15	7	silty sand to sandy silt
0.984	48.24	0.5782	1.199	1.224	15	7	silty sand to sandy silt
1.148	48.29	0.4464	0.924	1.101	15	7	silty sand to sandy silt
1.312	46.78	0.4361	0.932	0.941	15	7	silty sand to sandy silt
1.476	52.59	0.4842	0.921	1.144	17	7	silty sand to sandy silt
1.640	54.07	0.4568	0.845	0.976	17	7	silty sand to sandy silt
1.804	48.79	0.4116	0.844	0.869	16	7	silty sand to sandy silt
1.969	41.31	0.3590	0.869	0.773	13	7	silty sand to sandy silt
2.133	31.52	0.2987	0.948	0.675	10	7	silty sand to sandy silt
2.297	25.47	0.2707	1.063	0.589	10	6	sandy silt to clayey silt
2.461	21.87	0.2736	1.251	0.552	8	6	sandy silt to clayey silt
2.625	20.60	0.2592	1.259	0.520	8	6	sandy silt to clayey silt
2.789	20.65	0.2472	1.197	0.483	8	6	sandy silt to clayey silt
2.953	20.19	0.2295	1.136	0.451	8	6	sandy silt to clayey silt
3.117	20.95	0.2067	0.987	0.424	8	6	sandy silt to clayey silt
3.281	24.60	0.2040	0.829	0.405	8	7	silty sand to sandy silt
3.445	32.38	0.2177	0.672	0.280	10	7	silty sand to sandy silt
3.609	37.13	0.2454	0.661	0.296	12	7	silty sand to sandy silt
3.773	37.24	0.2534	0.681	0.307	12	7	silty sand to sandy silt
3.937	35.46	0.2520	0.711	0.312	11	7	silty sand to sandy silt
4.101	35.01	0.2563	0.732	0.331	11	7	silty sand to sandy silt
4.265	34.06	0.2617	0.768	0.336	11	7	silty sand to sandy silt
4.429	33.18	0.2302	0.694	0.344	11	7	silty sand to sandy silt
4.593	33.22	0.2343	0.705	0.355	11	7	silty sand to sandy silt
4.757	37.95	0.2772	0.730	0.667	12	7	silty sand to sandy silt
4.921	44.85	0.3420	0.763	0.699	14	7	silty sand to sandy silt
5.085	44.26	0.3653	0.825	0.688	14	7	silty sand to sandy silt
5.249	38.18	0.3522	0.923	0.653	12	7	silty sand to sandy silt
5.413	34.80	0.3274	0.941	0.627	11	7	silty sand to sandy silt
5.577	37.46	0.3214	0.858	0.640	12	7	silty sand to sandy silt
5.741	42.15	0.2897	0.687	0.699	13	7	silty sand to sandy silt
5.906	47.23	0.2949	0.624	0.685	15	7	silty sand to sandy silt
6.070	51.78	0.3122	0.603	0.739	12	8	sand to silty sand
6.234	48.25	0.3177	0.659	0.752	15	7	silty sand to sandy silt
6.398	48.80	0.2918	0.598	0.760	12	8	sand to silty sand
6.562	45.19	0.2928	0.648	0.741	14	7	silty sand to sandy silt
6.726	46.45	0.2753	0.593	0.637	15	7	silty sand to sandy silt
6.890	46.41	0.2829	0.610	0.683	15	7	silty sand to sandy silt
7.054	46.40	0.2944	0.635	0.667	15	7	silty sand to sandy silt
7.218	47.07	0.3153	0.670	0.653	15	7	silty sand to sandy silt

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
7.382	41.95	0.3122	0.744	0.637	13	7	silty sand to sandy silt
7.546	39.85	0.2822	0.708	0.632	13	7	silty sand to sandy silt
7.710	39.94	0.2534	0.634	0.653	13	7	silty sand to sandy silt
7.874	42.87	0.2829	0.660	0.637	14	7	silty sand to sandy silt
8.038	42.91	0.2843	0.663	0.704	14	7	silty sand to sandy silt
8.202	44.38	0.3241	0.730	0.715	14	7	silty sand to sandy silt
8.366	52.39	0.3924	0.749	0.757	17	7	silty sand to sandy silt
8.530	51.70	0.4171	0.807	0.821	17	7	silty sand to sandy silt
8.694	47.99	0.3604	0.751	0.819	15	7	silty sand to sandy silt
8.858	47.77	0.3117	0.653	0.797	15	7	silty sand to sandy silt
9.022	49.38	0.2969	0.601	0.856	12	8	sand to silty sand
9.186	48.07	0.3125	0.650	0.837	15	7	silty sand to sandy silt
9.350	51.56	0.3435	0.666	0.861	12	8	sand to silty sand
9.514	55.87	0.3870	0.693	0.928	13	8	sand to silty sand
9.678	61.89	0.4191	0.677	0.909	15	8	sand to silty sand
9.843	63.96	0.4205	0.657	0.885	15	8	sand to silty sand
10.007	56.14	0.4053	0.722	0.584	13	8	sand to silty sand
10.171	51.14	0.3572	0.698	0.579	16	7	silty sand to sandy silt
10.335	51.85	0.3563	0.687	0.576	17	7	silty sand to sandy silt
10.499	57.77	0.3837	0.664	0.659	14	8	sand to silty sand
10.663	62.59	0.4433	0.708	0.736	15	8	sand to silty sand
10.827	61.83	0.5209	0.842	0.760	15	8	sand to silty sand
10.991	58.53	0.5139	0.878	0.784	19	7	silty sand to sandy silt
11.155	52.65	0.4706	0.894	0.704	17	7	silty sand to sandy silt
11.319	46.85	0.4724	1.008	0.800	15	7	silty sand to sandy silt
11.483	44.74	0.4529	1.012	0.784	14	7	silty sand to sandy silt
11.647	45.86	0.4237	0.924	0.733	15	7	silty sand to sandy silt
11.811	61.95	0.4617	0.745	0.837	15	8	sand to silty sand
11.975	90.96	0.5756	0.633	0.891	22	8	sand to silty sand
12.139	108.33	0.7347	0.678	0.931	26	8	sand to silty sand
12.303	114.89	0.8791	0.765	0.992	28	8	sand to silty sand
12.467	114.92	0.9444	0.822	1.021	28	8	sand to silty sand
12.631	110.29	0.9248	0.838	0.973	26	8	sand to silty sand
12.795	109.49	0.8943	0.817	0.960	26	8	sand to silty sand
12.959	109.93	0.8168	0.743	0.981	26	8	sand to silty sand
13.123	106.42	0.8518	0.800	0.936	25	8	sand to silty sand
13.287	95.88	1.1726	1.223	0.291	23	8	sand to silty sand
13.451	87.97	0.9601	1.091	0.144	21	8	sand to silty sand
13.615	76.82	0.8837	1.150	0.680	18	8	sand to silty sand
13.780	72.05	0.6674	0.926	0.800	17	8	sand to silty sand
13.944	62.56	0.6956	1.112	0.867	20	7	silty sand to sandy silt
14.108	54.78	0.4622	0.844	0.808	17	7	silty sand to sandy silt
14.272	52.68	0.3311	0.628	1.192	13	8	sand to silty sand
14.436	35.27	0.2146	0.608	1.003	11	7	silty sand to sandy silt
14.600	29.02	0.1968	0.678	0.339	9	7	silty sand to sandy silt
14.764	22.25	0.1117	0.502	0.224	7	7	silty sand to sandy silt
14.928	17.33	0.0782	0.451	0.373	7	6	sandy silt to clayey silt
15.092	17.20	0.2367	1.376	0.141	7	6	sandy silt to clayey silt
15.256	21.90	0.2296	1.048	0.077	8	6	sandy silt to clayey silt
15.420	33.53	0.3019	0.900	0.131	11	7	silty sand to sandy silt
15.584	37.69	0.3107	0.824	0.016	12	7	silty sand to sandy silt
15.748	46.55	0.3369	0.724	0.053	15	7	silty sand to sandy silt
15.912	41.54	0.3778	0.910	0.160	13	7	silty sand to sandy silt

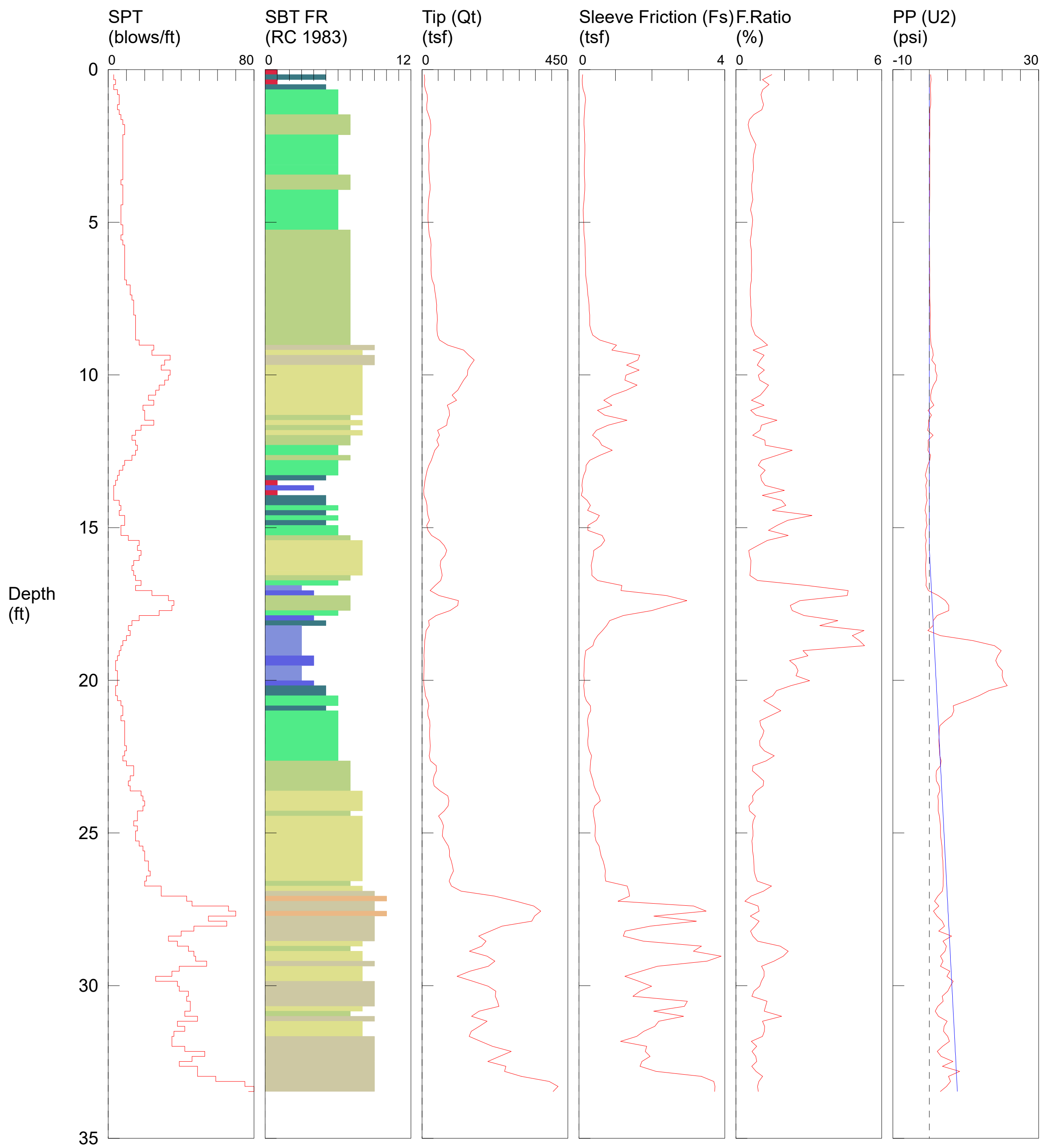
Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
16.076	25.85	0.5148	1.992	0.227	10	6	sandy silt to clayey silt
16.240	15.31	0.3865	2.524	0.341	7	5	clayey silt to silty clay
16.404	8.64	0.3075	3.561	0.821	8	3	clay
16.568	7.89	0.1722	2.182	6.048	5	4	silty clay to clay
16.732	6.86	0.0687	1.002	9.007	3	1	sensitive fine grained
16.896	9.99	0.0598	0.599	9.911	4	6	sandy silt to clayey silt
17.060	9.12	0.0652	0.715	8.919	4	5	clayey silt to silty clay
17.224	7.80	0.0639	0.819	9.586	4	1	sensitive fine grained
17.388	5.88	0.0408	0.694	10.546	3	1	sensitive fine grained
17.552	4.92	0.0339	0.691	12.236	2	1	sensitive fine grained
17.717	4.76	0.0305	0.641	13.695	2	1	sensitive fine grained
17.881	5.00	0.0226	0.452	16.596	2	1	sensitive fine grained
18.045	4.96	0.0316	0.637	17.105	2	1	sensitive fine grained
18.209	6.65	0.0344	0.517	17.431	3	1	sensitive fine grained
18.373	6.42	0.0610	0.950	14.114	3	1	sensitive fine grained
18.537	6.67	0.0365	0.547	14.644	3	1	sensitive fine grained
18.701	12.31	0.0869	0.706	12.327	5	6	sandy silt to clayey silt
18.865	9.26	0.1011	1.092	10.354	4	5	clayey silt to silty clay
19.029	11.78	0.1167	0.991	11.039	5	6	sandy silt to clayey silt
19.193	15.74	0.1729	1.098	9.663	6	6	sandy silt to clayey silt
19.357	18.83	0.1768	0.939	8.354	7	6	sandy silt to clayey silt
19.521	21.39	0.1921	0.898	6.669	8	6	sandy silt to clayey silt
19.685	21.68	0.2481	1.145	5.642	8	6	sandy silt to clayey silt
19.849	15.78	0.2873	1.821	4.104	8	5	clayey silt to silty clay
20.013	11.63	0.1936	1.665	4.797	6	5	clayey silt to silty clay
20.177	16.00	0.1128	0.705	6.874	6	6	sandy silt to clayey silt
20.341	22.24	0.1605	0.722	4.877	9	6	sandy silt to clayey silt
20.505	22.26	0.1415	0.636	3.813	7	7	silty sand to sandy silt
20.669	21.81	0.1474	0.676	3.666	8	6	sandy silt to clayey silt
20.833	22.24	0.1878	0.844	3.642	9	6	sandy silt to clayey silt
20.997	22.74	0.2608	1.147	3.642	9	6	sandy silt to clayey silt
21.161	18.36	0.1899	1.035	3.802	7	6	sandy silt to clayey silt
21.325	24.75	0.2274	0.919	3.845	9	6	sandy silt to clayey silt
21.490	31.43	0.2726	0.867	3.061	10	7	silty sand to sandy silt
21.654	39.05	0.3632	0.930	2.800	12	7	silty sand to sandy silt
21.818	42.54	0.4075	0.958	2.746	14	7	silty sand to sandy silt
21.982	36.23	0.4049	1.118	2.829	12	7	silty sand to sandy silt
22.146	31.96	0.3773	1.180	3.005	10	7	silty sand to sandy silt
22.310	31.83	0.3590	1.128	3.173	10	7	silty sand to sandy silt
22.474	33.63	0.3562	1.059	3.157	11	7	silty sand to sandy silt
22.638	36.73	0.3501	0.953	3.109	12	7	silty sand to sandy silt
22.802	33.24	0.2975	0.895	3.122	11	7	silty sand to sandy silt
22.966	28.40	0.3059	1.077	3.237	9	7	silty sand to sandy silt
23.130	31.37	0.3222	1.027	3.962	10	7	silty sand to sandy silt
23.294	36.51	0.3628	0.994	3.898	12	7	silty sand to sandy silt
23.458	35.53	0.3793	1.068	3.784	11	7	silty sand to sandy silt
23.622	33.61	0.3725	1.108	3.738	11	7	silty sand to sandy silt
23.786	35.14	0.3879	1.104	3.848	11	7	silty sand to sandy silt
23.950	40.93	0.3923	0.959	3.944	13	7	silty sand to sandy silt
24.114	43.34	0.3275	0.756	3.877	14	7	silty sand to sandy silt
24.278	47.14	0.4540	0.963	3.776	15	7	silty sand to sandy silt
24.442	61.12	0.5313	0.869	5.157	15	8	sand to silty sand
24.606	53.55	0.4241	0.792	5.088	17	7	silty sand to sandy silt

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
24.770	46.18	0.3768	0.816	5.093	15	7	silty sand to sandy silt
24.934	47.89	0.3688	0.770	5.205	15	7	silty sand to sandy silt
25.098	51.11	0.3881	0.759	5.274	16	7	silty sand to sandy silt
25.262	53.34	0.3598	0.675	5.304	13	8	sand to silty sand
25.427	61.02	0.4442	0.728	5.416	15	8	sand to silty sand
25.591	78.03	1.1751	1.506	5.578	25	7	silty sand to sandy silt
25.755	145.20	0.7625	0.525	6.136	28	9	sand
25.919	190.01	1.4754	0.777	6.597	36	9	sand
26.083	236.54	1.2784	0.540	6.493	45	9	sand
26.247	298.74	1.2759	0.427	7.362	48	10	gravelly sand to sand
26.411	283.18	1.2784	0.451	6.738	45	10	gravelly sand to sand
26.575	255.53	0.9621	0.377	3.917	41	10	gravelly sand to sand
26.739	257.32	0.8408	0.327	7.578	41	10	gravelly sand to sand
26.903	276.44	0.7048	0.255	6.861	44	10	gravelly sand to sand
27.067	244.76	0.7318	0.299	4.744	39	10	gravelly sand to sand
27.231	219.63	1.3999	0.637	7.202	42	9	sand
27.395	228.17	0.7657	0.336	6.058	44	9	sand
27.559	218.80	0.8762	0.400	6.861	42	9	sand
27.723	229.11	0.5378	0.235	7.615	37	10	gravelly sand to sand
27.887	223.88	1.1393	0.509	6.738	43	9	sand
28.051	250.82	2.3423	0.934	6.778	48	9	sand
28.215	213.54	2.8890	1.353	6.186	51	8	sand to silty sand
28.379	173.23	2.4875	1.436	5.565	41	8	sand to silty sand
28.543	193.30	1.4556	0.753	4.560	37	9	sand
28.707	254.72	1.3340	0.524	6.562	49	9	sand
28.871	303.38	3.0745	1.013	7.615	58	9	sand
29.035	309.28	3.2828	1.061	7.735	59	9	sand
29.199	328.28	2.3742	0.723	6.024	63	9	sand
29.364	368.13	1.5960	0.434	6.037	59	10	gravelly sand to sand
29.528	292.88	3.8922	1.329	6.994	56	9	sand
29.692	292.35	5.5673	1.904	5.181	70	8	sand to silty sand
29.856	281.11	5.0911	1.811	8.071	67	8	sand to silty sand
30.020	174.61	4.3872	2.513	6.464	56	7	silty sand to sandy silt
30.184	325.04	3.9412	1.213	4.634	62	9	sand
30.348	289.11	3.4699	1.200	3.208	55	9	sand
30.512	225.67	3.1587	1.400	5.090	54	8	sand to silty sand
30.676	221.99	4.3025	1.938	5.666	53	8	sand to silty sand
30.840	189.21	2.9821	1.576	5.141	45	8	sand to silty sand
31.004	216.30	3.5217	1.628	5.826	52	8	sand to silty sand
31.168	214.78	2.2249	1.036	3.536	41	9	sand
31.332	153.01	2.2679	1.482	4.317	37	8	sand to silty sand
31.496	157.64	1.3875	0.880	4.877	30	9	sand
31.660	123.65	1.1587	0.937	5.080	30	8	sand to silty sand
31.824	104.82	1.0973	1.047	8.135	25	8	sand to silty sand
31.988	98.32	1.3376	1.361	7.079	24	8	sand to silty sand
32.152	110.64	0.8446	0.763	6.218	26	8	sand to silty sand
32.316	94.39	0.7377	0.782	6.306	23	8	sand to silty sand
32.480	99.61	0.7489	0.752	6.416	24	8	sand to silty sand
32.644	103.21	0.4997	0.484	6.685	25	8	sand to silty sand
32.808	98.54	0.8457	0.858	6.034	24	8	sand to silty sand
32.972	110.33	1.1642	1.055	5.808	26	8	sand to silty sand
33.136	89.73	1.2659	1.411	6.152	29	7	silty sand to sandy silt
33.301	79.78	0.0667	0.084	6.554	15	9	sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
33.465	61.25	0.2788	0.455	5.053	15	8	sand to silty sand
33.629	37.71	0.4035	1.070	4.650	12	7	silty sand to sandy silt
33.793	18.35	0.3796	2.069	7.202	9	5	clayey silt to silty clay
33.957	10.26	0.1690	1.648	8.066	5	5	clayey silt to silty clay
34.121	16.86	0.1470	0.872	7.090	6	6	sandy silt to clayey silt
34.285	18.47	0.1523	0.824	7.509	7	6	sandy silt to clayey silt
34.449	26.33	0.3738	1.419	7.594	10	6	sandy silt to clayey silt
34.613	14.58	0.3872	2.656	8.397	7	5	clayey silt to silty clay
34.777	18.57	0.3086	1.662	7.751	7	6	sandy silt to clayey silt
34.941	21.92	0.2908	1.327	7.935	8	6	sandy silt to clayey silt
35.105	33.75	0.3754	1.112	8.138	11	7	silty sand to sandy silt
35.269	50.23	0.6524	1.299	7.970	16	7	silty sand to sandy silt
35.433	86.50	0.8332	0.963	9.418	21	8	sand to silty sand
35.597	204.91	2.5076	1.224	8.429	39	9	sand
35.761	285.45	2.6175	0.917	9.242	55	9	sand
35.925	212.74	0.5482	0.258	7.533	41	9	sand
36.089	143.39	0.6074	0.424	8.575	27	9	sand
36.253	84.66	0.4411	0.521	7.629	20	8	sand to silty sand
36.417	69.13	0.7344	1.062	8.717	22	7	silty sand to sandy silt
36.581	58.60	0.7008	1.196	8.575	19	7	silty sand to sandy silt
36.745	62.36	0.2505	0.402	9.063	15	8	sand to silty sand
36.909	57.97	0.3932	0.678	10.322	14	8	sand to silty sand
37.073	73.05	1.2267	1.679	9.562	23	7	silty sand to sandy silt
37.238	168.64	5.3434	3.169	10.173	65	6	sandy silt to clayey silt
37.402	133.42	5.3996	4.047	7.770	128	11	very stiff fine grained (*)
37.566	121.37	3.5571	2.931	10.663	46	6	sandy silt to clayey silt
37.730	140.89	1.0522	0.747	9.954	27	9	sand
37.894	165.21	1.5011	0.909	10.215	32	9	sand
38.058	119.28	1.4729	1.235	11.383	29	8	sand to silty sand
38.222	109.77	1.7755	1.618	10.917	35	7	silty sand to sandy silt
38.386	110.35	1.4004	1.269	10.498	26	8	sand to silty sand
38.550	123.76	1.1923	0.963	7.511	30	8	sand to silty sand
38.714	82.26	0.9031	1.098	9.010	20	8	sand to silty sand
38.878	71.22	0.3438	0.483	10.562	17	8	sand to silty sand
39.042	58.81	0.3095	0.526	10.239	14	8	sand to silty sand
39.206	55.81	0.2152	0.386	10.082	13	8	sand to silty sand
39.370	71.77	0.2835	0.395	9.978	17	8	sand to silty sand
39.534	77.59	0.3452	0.445	10.562	19	8	sand to silty sand
39.698	64.05	0.3256	0.508	10.479	15	8	sand to silty sand
39.862	53.65	0.2582	0.481	10.170	13	8	sand to silty sand
40.026	63.20	0.2473	0.391	10.234	15	8	sand to silty sand
40.190	81.47	0.3381	0.415	10.581	20	8	sand to silty sand
40.354	77.48	0.4862	0.628	10.741	19	8	sand to silty sand
40.518	74.87	0.4801	0.641	10.714	18	8	sand to silty sand
40.682	76.32	0.4901	0.642	10.826	18	8	sand to silty sand

Redmond Geotech / CPT-2 / 2000 Lewis River Rd Woodland

OPERATOR: OGE DMM
CONE ID: DDG1532
HOLE NUMBER: CPT-2
TEST DATE: 4/25/2022 11:11:49 AM
TOTAL DEPTH: 33.465 ft



1 sensitive fine grained	7 silty sand to sandy silt
2 organic material	8 sand to silty sand
3 clay	9 sand
4 silty clay to clay	10 gravelly sand to sand
5 clayey silt to silty clay	11 very stiff fine grained (*)
6 sandy silt to clayey silt	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Redmond Geotech / CPT-2 / 2000 Lewis River Rd Woodland

OPERATOR: OGE DMM
CONE ID: DDG1532
HOLE NUMBER: CPT-2
TEST DATE: 4/25/2022 11:11:49 AM
TOTAL DEPTH: 33.465 ft

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
0.164	6.58	0.0972	1.476	0.376	3	1	sensitive fine grained
0.328	7.94	0.0868	1.092	0.488	4	5	clayey silt to silty clay
0.492	6.75	0.0917	1.360	0.341	3	1	sensitive fine grained
0.656	10.29	0.1135	1.103	0.283	5	5	clayey silt to silty clay
0.820	15.38	0.1586	1.032	0.373	6	6	sandy silt to clayey silt
0.984	16.44	0.1769	1.076	0.405	6	6	sandy silt to clayey silt
1.148	14.34	0.1630	1.136	0.357	5	6	sandy silt to clayey silt
1.312	14.41	0.1532	1.063	0.160	6	6	sandy silt to clayey silt
1.476	19.53	0.1436	0.735	0.160	7	6	sandy silt to clayey silt
1.640	24.51	0.1353	0.552	0.152	8	7	silty sand to sandy silt
1.804	27.04	0.1355	0.501	0.147	9	7	silty sand to sandy silt
1.969	26.95	0.1460	0.542	0.157	9	7	silty sand to sandy silt
2.133	25.18	0.1540	0.611	0.144	8	7	silty sand to sandy silt
2.297	20.98	0.1511	0.720	0.093	8	6	sandy silt to clayey silt
2.461	19.65	0.1608	0.818	0.125	8	6	sandy silt to clayey silt
2.625	20.53	0.1593	0.776	0.139	8	6	sandy silt to clayey silt
2.789	21.44	0.1557	0.726	0.107	8	6	sandy silt to clayey silt
2.953	21.39	0.1508	0.705	0.117	8	6	sandy silt to clayey silt
3.117	20.59	0.1472	0.715	0.115	8	6	sandy silt to clayey silt
3.281	20.25	0.1464	0.723	0.093	8	6	sandy silt to clayey silt
3.445	21.64	0.1452	0.671	0.107	8	6	sandy silt to clayey silt
3.609	22.77	0.1540	0.676	0.088	7	7	silty sand to sandy silt
3.773	24.95	0.1609	0.645	0.080	8	7	silty sand to sandy silt
3.937	24.43	0.1576	0.645	0.109	8	7	silty sand to sandy silt
4.101	21.94	0.1471	0.670	0.096	8	6	sandy silt to clayey silt
4.265	19.91	0.1386	0.696	0.075	8	6	sandy silt to clayey silt
4.429	19.17	0.1226	0.640	0.067	7	6	sandy silt to clayey silt
4.593	18.84	0.1125	0.597	0.048	7	6	sandy silt to clayey silt
4.757	17.80	0.1162	0.653	0.016	7	6	sandy silt to clayey silt
4.921	18.05	0.1235	0.684	0.008	7	6	sandy silt to clayey silt
5.085	19.63	0.1318	0.671	0.016	8	6	sandy silt to clayey silt
5.249	20.40	0.1313	0.644	0.008	8	6	sandy silt to clayey silt
5.413	22.05	0.1384	0.628	0.003	7	7	silty sand to sandy silt
5.577	26.33	0.1553	0.590	0.045	8	7	silty sand to sandy silt
5.741	27.55	0.1649	0.599	0.040	9	7	silty sand to sandy silt
5.906	26.91	0.1697	0.631	0.056	9	7	silty sand to sandy silt
6.070	26.73	0.1695	0.634	0.053	9	7	silty sand to sandy silt
6.234	27.54	0.1753	0.637	0.072	9	7	silty sand to sandy silt
6.398	27.90	0.1784	0.640	0.069	9	7	silty sand to sandy silt
6.562	27.58	0.1787	0.648	0.077	9	7	silty sand to sandy silt
6.726	28.39	0.1800	0.634	0.067	9	7	silty sand to sandy silt
6.890	30.91	0.1975	0.639	0.077	10	7	silty sand to sandy silt
7.054	37.00	0.2206	0.596	0.083	12	7	silty sand to sandy silt
7.218	38.74	0.2286	0.590	0.104	12	7	silty sand to sandy silt

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
7.382	41.48	0.2437	0.588	0.128	13	7	silty sand to sandy silt
7.546	43.65	0.2647	0.607	0.165	14	7	silty sand to sandy silt
7.710	44.98	0.2718	0.604	0.200	14	7	silty sand to sandy silt
7.874	44.68	0.2792	0.625	0.211	14	7	silty sand to sandy silt
8.038	46.44	0.2938	0.633	0.240	15	7	silty sand to sandy silt
8.202	47.00	0.2917	0.621	0.221	15	7	silty sand to sandy silt
8.366	46.00	0.2917	0.634	0.205	15	7	silty sand to sandy silt
8.530	45.87	0.3239	0.706	0.211	15	7	silty sand to sandy silt
8.694	47.29	0.3751	0.793	0.259	15	7	silty sand to sandy silt
8.858	53.79	0.5711	1.062	0.357	17	7	silty sand to sandy silt
9.022	79.28	1.0318	1.301	0.499	25	7	silty sand to sandy silt
9.186	127.90	0.9006	0.704	0.920	24	9	sand
9.350	143.95	1.6666	1.158	1.075	34	8	sand to silty sand
9.514	160.88	1.6147	1.004	0.656	31	9	sand
9.678	149.65	1.3072	0.873	1.685	29	9	sand
9.843	140.98	1.6470	1.168	1.611	34	8	sand to silty sand
10.007	139.71	1.2886	0.922	2.075	33	8	sand to silty sand
10.171	128.49	1.2573	0.979	1.957	31	8	sand to silty sand
10.335	118.93	1.5931	1.340	1.125	28	8	sand to silty sand
10.499	110.23	1.3001	1.180	0.621	26	8	sand to silty sand
10.663	92.51	0.9261	1.001	0.381	22	8	sand to silty sand
10.827	106.22	0.6811	0.641	0.397	25	8	sand to silty sand
10.991	77.58	0.9007	1.161	1.259	19	8	sand to silty sand
11.155	83.54	0.5067	0.607	-0.376	20	8	sand to silty sand
11.319	84.97	0.7022	0.826	0.576	20	8	sand to silty sand
11.483	77.87	1.3168	1.691	-0.200	25	7	silty sand to sandy silt
11.647	76.08	0.7983	1.049	-0.179	18	8	sand to silty sand
11.811	48.06	0.4781	0.995	-0.504	15	7	silty sand to sandy silt
11.975	53.95	0.3705	0.687	1.051	13	8	sand to silty sand
12.139	45.61	0.5437	1.192	-0.328	15	7	silty sand to sandy silt
12.303	51.63	0.6216	1.204	-0.299	16	7	silty sand to sandy silt
12.467	39.27	0.9113	2.320	-0.387	15	6	sandy silt to clayey silt
12.631	33.96	0.5769	1.699	0.352	13	6	sandy silt to clayey silt
12.795	28.20	0.2941	1.043	0.107	9	7	silty sand to sandy silt
12.959	21.01	0.1936	0.922	-0.451	8	6	sandy silt to clayey silt
13.123	15.69	0.1884	1.201	-0.760	6	6	sandy silt to clayey silt
13.287	12.35	0.1249	1.011	-1.101	5	6	sandy silt to clayey silt
13.451	9.08	0.0957	1.054	-0.645	4	5	clayey silt to silty clay
13.615	6.74	0.0811	1.203	-0.987	3	1	sensitive fine grained
13.780	4.92	0.0980	1.993	-0.795	3	4	silty clay to clay
13.944	5.67	0.0616	1.088	-0.869	3	1	sensitive fine grained
14.108	11.77	0.2208	1.876	-0.637	6	5	clayey silt to silty clay
14.272	15.12	0.3106	2.054	-0.936	7	5	clayey silt to silty clay
14.436	15.54	0.2332	1.501	-1.184	6	6	sandy silt to clayey silt
14.600	17.86	0.5584	3.127	-0.843	9	5	clayey silt to silty clay
14.764	22.36	0.4779	2.137	-0.883	9	6	sandy silt to clayey silt
14.928	14.57	0.2469	1.694	-0.667	7	5	clayey silt to silty clay
15.092	17.97	0.2410	1.341	-1.032	7	6	sandy silt to clayey silt
15.256	29.34	0.6316	2.153	-1.131	11	6	sandy silt to clayey silt
15.420	54.28	0.7040	1.297	-0.861	17	7	silty sand to sandy silt
15.584	67.83	0.6086	0.897	-1.067	16	8	sand to silty sand
15.748	76.02	0.4036	0.531	-0.941	18	8	sand to silty sand
15.912	70.91	0.3937	0.555	-0.864	17	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
16.076	58.15	0.3588	0.617	-0.923	14	8	sand to silty sand
16.240	55.58	0.3344	0.602	-1.029	13	8	sand to silty sand
16.404	59.36	0.3522	0.593	-0.976	14	8	sand to silty sand
16.568	61.92	0.3533	0.570	-0.936	15	8	sand to silty sand
16.732	57.31	0.5091	0.888	-0.816	18	7	silty sand to sandy silt
16.896	40.31	1.1745	2.914	-0.909	15	6	sandy silt to clayey silt
17.060	24.92	1.1510	4.618	-0.237	24	3	clay
17.224	52.28	2.3961	4.583	2.413	33	4	silty clay to clay
17.388	112.08	2.9568	2.638	4.402	36	7	silty sand to sandy silt
17.552	110.25	2.4659	2.237	5.322	35	7	silty sand to sandy silt
17.717	86.27	1.9983	2.316	5.352	28	7	silty sand to sandy silt
17.881	43.43	1.2170	2.802	2.163	17	6	sandy silt to clayey silt
18.045	20.01	0.8391	4.193	1.064	13	4	silty clay to clay
18.209	21.96	0.7581	3.452	1.016	11	5	clayey silt to silty clay
18.373	12.13	0.6397	5.275	-0.397	12	3	clay
18.537	10.65	0.5102	4.790	3.064	10	3	clay
18.701	8.27	0.4198	5.073	11.922	8	3	clay
18.865	7.18	0.3799	5.292	17.884	7	3	clay
19.029	6.72	0.1852	2.758	19.727	6	3	clay
19.193	5.60	0.1660	2.964	18.769	5	3	clay
19.357	6.47	0.1428	2.206	18.212	4	4	silty clay to clay
19.521	5.74	0.1414	2.461	18.833	4	4	silty clay to clay
19.685	5.45	0.1391	2.553	20.049	5	3	clay
19.849	5.29	0.1307	2.469	19.964	5	3	clay
20.013	4.84	0.1465	3.027	20.385	5	3	clay
20.177	5.57	0.1262	2.265	21.388	4	4	silty clay to clay
20.341	8.47	0.1416	1.672	16.394	4	5	clayey silt to silty clay
20.505	10.11	0.1529	1.513	13.604	5	5	clayey silt to silty clay
20.669	17.42	0.1984	1.139	10.349	7	6	sandy silt to clayey silt
20.833	20.48	0.3086	1.507	6.544	8	6	sandy silt to clayey silt
20.997	17.28	0.3193	1.848	6.709	8	5	clayey silt to silty clay
21.161	18.06	0.2560	1.417	6.173	7	6	sandy silt to clayey silt
21.325	23.40	0.2298	0.982	4.336	9	6	sandy silt to clayey silt
21.490	24.28	0.2464	1.015	2.874	9	6	sandy silt to clayey silt
21.654	23.01	0.2647	1.150	2.717	9	6	sandy silt to clayey silt
21.818	23.01	0.2504	1.089	2.709	9	6	sandy silt to clayey silt
21.982	24.12	0.2355	0.976	2.616	9	6	sandy silt to clayey silt
22.146	25.08	0.2469	0.984	2.704	10	6	sandy silt to clayey silt
22.310	24.02	0.2807	1.168	2.797	9	6	sandy silt to clayey silt
22.474	21.70	0.3423	1.578	2.896	8	6	sandy silt to clayey silt
22.638	25.77	0.3189	1.238	3.224	10	6	sandy silt to clayey silt
22.802	43.95	0.3068	0.698	3.080	14	7	silty sand to sandy silt
22.966	44.31	0.3001	0.677	1.976	14	7	silty sand to sandy silt
23.130	37.05	0.3390	0.915	1.840	12	7	silty sand to sandy silt
23.294	33.92	0.3869	1.141	1.925	11	7	silty sand to sandy silt
23.458	36.80	0.4108	1.116	2.680	12	7	silty sand to sandy silt
23.622	55.93	0.4666	0.834	2.888	18	7	silty sand to sandy silt
23.786	79.50	0.5416	0.681	2.309	19	8	sand to silty sand
23.950	82.90	0.5824	0.703	2.456	20	8	sand to silty sand
24.114	80.14	0.4296	0.536	2.424	19	8	sand to silty sand
24.278	68.28	0.3829	0.561	2.437	16	8	sand to silty sand
24.442	50.63	0.4035	0.797	2.776	16	7	silty sand to sandy silt
24.606	60.51	0.4290	0.709	2.904	14	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
24.770	66.23	0.4480	0.676	3.032	16	8	sand to silty sand
24.934	63.53	0.4439	0.699	3.048	15	8	sand to silty sand
25.098	62.56	0.4362	0.697	3.112	15	8	sand to silty sand
25.262	71.16	0.4666	0.656	3.269	17	8	sand to silty sand
25.427	81.11	0.5503	0.678	3.458	19	8	sand to silty sand
25.591	84.87	0.5781	0.681	3.514	20	8	sand to silty sand
25.755	84.13	0.6055	0.720	3.517	20	8	sand to silty sand
25.919	90.14	0.6588	0.731	3.717	22	8	sand to silty sand
26.083	93.73	0.6977	0.744	3.754	22	8	sand to silty sand
26.247	96.75	0.7244	0.749	3.802	23	8	sand to silty sand
26.411	89.43	0.7125	0.797	3.848	21	8	sand to silty sand
26.575	83.57	0.7300	0.874	3.808	20	8	sand to silty sand
26.739	90.26	1.3201	1.462	3.818	29	7	silty sand to sandy silt
26.903	120.33	1.3657	1.135	3.570	29	8	sand to silty sand
27.067	224.03	1.3868	0.619	2.291	43	9	sand
27.231	289.66	1.0716	0.370	1.453	46	10	gravelly sand to sand
27.395	344.68	3.1467	0.913	2.602	66	9	sand
27.559	366.04	3.4865	0.953	1.133	70	9	sand
27.723	347.14	2.0509	0.591	2.075	55	10	gravelly sand to sand
27.887	338.66	3.2183	0.950	3.522	65	9	sand
28.051	246.80	1.9532	0.791	4.154	47	9	sand
28.215	210.62	1.2628	0.600	2.578	40	9	sand
28.379	174.67	1.2102	0.693	6.114	33	9	sand
28.543	197.48	1.7643	0.893	3.752	38	9	sand
28.707	184.10	3.3580	1.824	4.664	44	8	sand to silty sand
28.871	145.83	3.1383	2.152	4.309	47	7	silty sand to sandy silt
29.035	200.50	3.9033	1.947	3.056	48	8	sand to silty sand
29.199	224.71	3.5126	1.563	3.741	54	8	sand to silty sand
29.364	204.44	2.1542	1.054	3.064	39	9	sand
29.528	147.58	1.7032	1.154	5.608	35	8	sand to silty sand
29.692	108.18	1.2565	1.161	4.813	26	8	sand to silty sand
29.856	156.70	1.6399	1.046	6.557	38	8	sand to silty sand
30.020	203.78	1.9896	0.976	5.722	39	9	sand
30.184	227.71	1.6724	0.734	5.042	44	9	sand
30.348	226.13	1.4770	0.653	3.536	43	9	sand
30.512	232.44	2.9714	1.278	3.792	45	9	sand
30.676	236.99	2.8940	1.221	2.320	45	9	sand
30.840	176.06	2.0496	1.164	1.640	42	8	sand to silty sand
31.004	152.41	2.8685	1.882	2.501	49	7	silty sand to sandy silt
31.168	200.48	2.1859	1.090	4.922	38	9	sand
31.332	176.60	2.0763	1.176	4.040	42	8	sand to silty sand
31.496	151.96	1.7763	1.169	3.885	36	8	sand to silty sand
31.660	145.44	1.5839	1.089	5.024	35	8	sand to silty sand
31.824	180.73	1.1414	0.632	5.528	35	9	sand
31.988	217.55	1.8568	0.854	3.661	42	9	sand
32.152	275.39	1.8150	0.659	2.192	53	9	sand
32.316	239.26	1.9495	0.815	3.229	46	9	sand
32.480	202.71	1.7234	0.850	6.485	39	9	sand
32.644	258.45	1.6745	0.648	3.592	49	9	sand
32.808	254.47	2.1125	0.830	8.319	49	9	sand
32.972	306.26	3.3557	1.096	5.280	59	9	sand
33.136	392.53	3.6968	0.942	5.810	75	9	sand
33.301	419.50	3.7309	0.889	4.701	80	9	sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
33.465	404.51	3.7210	0.920	3.000	77	9	sand

BACKHOE COMPANY: Inland Company BUCKET SIZE: 24 inches DATE: 4/25/22

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION TEST PIT NO. TH-#1 ELEVATION 27'±
0	X				ML/SM	Dark brown, wet, soft to loose, organic, slightly clayey, fine sandy SILT to silty fine SAND (Topsoil)
					ML/SM	Medium brown, very moist, medium stiff to loose, slightly clayey, fine sandy SILT to silty fine SAND
5	X				SM	Gray-brown to gray, very moist, loose, silty fine to medium SAND
10						Total Depth = 8.0 feet No groundwater encountered at time f exploration
15						

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	TEST PIT NO. TH-#2 ELEVATION 26'±
0					ML/SM	Dark brown, wet, soft to loose, organic, slightly clayey, fine sandy SILT to silty fine SAND (Topsoil)
					ML/SM	Medium brown, very moist, medium stiff to loose, slightly clayey, fine sandy SILT to silty fine SAND
5					SM	Gray-brown to gray, very moist, loose, silty fine to medium SAND Becomes dark gray
10						Total Depth = 9.0 feet No groundwater encountered at time of exploration
15						

LOG OF TEST PITS

PROJECT NO. 1171.006.G RIVERFRONT VILLAGE FIGURE NO. A-22

REDMOND GEOTECHNICAL SERVICES

BACKHOE COMPANY: Inland Company BUCKET SIZE: 24 inches DATE: 4/25/22

TEST PIT NO. TH-#3 ELEVATION 24'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					ML/SM	Dark brown, wet, soft to loose, organic, slightly clayey, fine sandy SILT to silty fine SAND (Topsoil)
					ML/SM	Medium brown, very moist, soft to loose, slightly clayey, fine sandy SILT to silty fine SAND
5					SM	Geay0brown to gray, very moist, loose, silty fine to medium SAND Becomes dark gray and very moist to wet
10						Becomes gravelly
						Total Depth = 13.0 feet (Caving) No groundwater encountered at time of exploration
15						

TEST PIT NO. TH-#4 ELEVATION 24'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					ML/SM	Dark brown, wet, soft to loose, organic, slightly clayey, fine sandy SILT to silty fine SAND (Topsoil)
					ML/SM	Medium brown, very moist, soft to loose, slightly clayey, fine sandy SILT to silty fine SAND
5					SM	Gray-brown to gray, very moist, loose, silty fine to medium SAND Becomes dark gray and very moist to wet
10						Total Depth = 10.0 feet (Caving) No groundwater encountered at time of exploration
15						

LOG OF TEST PITS

PROJECT NO. 1171.006.G | RIVERFRONT VILLAGE | FIGURE NO. A-23

BACKHOE COMPANY: Inland Company	BUCKET SIZE: 24 inches	DATE: 4/25/22

SOIL DESCRIPTION

TEST PIT NO. TH-#5 ELEVATION 25'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0	X				ML/SM	Dark brown, wet, soft to loose, organic, slightly clayey, fine sandy SILT to silty fine SAND (Topsoil)
					ML/SM	Medium brown, very moist, medium stiff to loose, slightly clayey, fine sandy SILT to silty fine SAND
5					SM	Gray-brown to gray, very moist, loose, silty fine to medium SAND
10						Total Depth = 9.0 feet No groundwater encountered at time of exploration
15						

TEST PIT NO. TH-#6 ELEVATION 25'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					ML/SM	Dark brown, wet, soft to loose, organic, slightly clayey, fine sandy SILT to silty fine SAND (Topsoil)
					ML/SM	Medium brown, very moist, medium stiff to loose, slightly clayey, fine sandy SILT to silty fine SAND
5					SM	Gray-brown to gray, very moist, loose, silty fine to medium SAND
10						Total Depth = 10.0 feet No groundwater encountered at time of exploration
15						

LOG OF TEST PITS

PROJECT NO. 1171.006.G	RIVERFRONT VILLAGE	FIGURE NO. A-24

BACKHOE COMPANY: Inland Company BUCKET SIZE: 24 inches DATE: 4/25/22

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION TEST PIT NO. TH-#7 ELEVATION 25'±
0					ML/SM	Dark brown, wet, soft to loose, organic, slightly clayey, fine sandy SILT to silty fine SAND (Topsoil)
					ML/SM	Medium brown, very moist, medium stiff to loose, slightly clayey, fine sandy SILT to silty fine SAND
5					SM	Gray to gray-brown, very moist, loose, silty, fine to medium SAND
10						Total Depth = 10.0 feet No groundwater encountered at time of exploration
15						

DEPTH (FEET)						TEST PIT NO. ELEVATION
0						
5						
10						
15						

LOG OF TEST PITS

PROJECT NO. 1171.006.G | RIVERFRONT VILLAGE | FIGURE NO. A-25

MAXIMUM DENSITY TEST RESULTS

SAMPLE LOCATION	SOIL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
TH-#1 @ 2.0'	Medium brown, slightly clayey, fine sandy SILT to silty fine SAND (ML/SM)	108.0	15.0

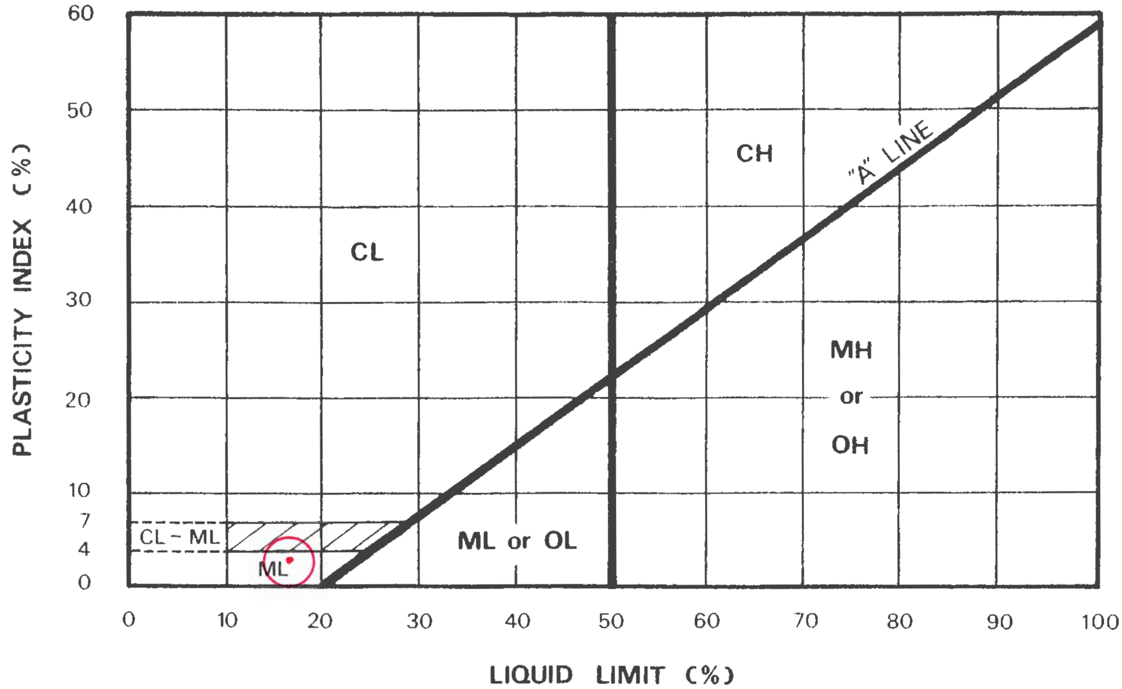
EXPANSION INDEX TEST RESULTS

SAMPLE LOCATION	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (pcf)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (%)	EXPANSION INDEX	EXPANSIVE CLASS.

MAXIMUM DENSITY & EXPANSION INDEX TEST RESULTS

PROJECT NO.: 1171.006.G | RIVERFRONT VILLAGE | FIGURE NO.: A-26

REDMOND GEOTECHNICAL SERVICES



KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	NATURAL WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX %	PASSING NO. 200 SIEVE %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
⊙	TH-#1	2.0	14.3	16.8	3.8	61.2		ML/SM

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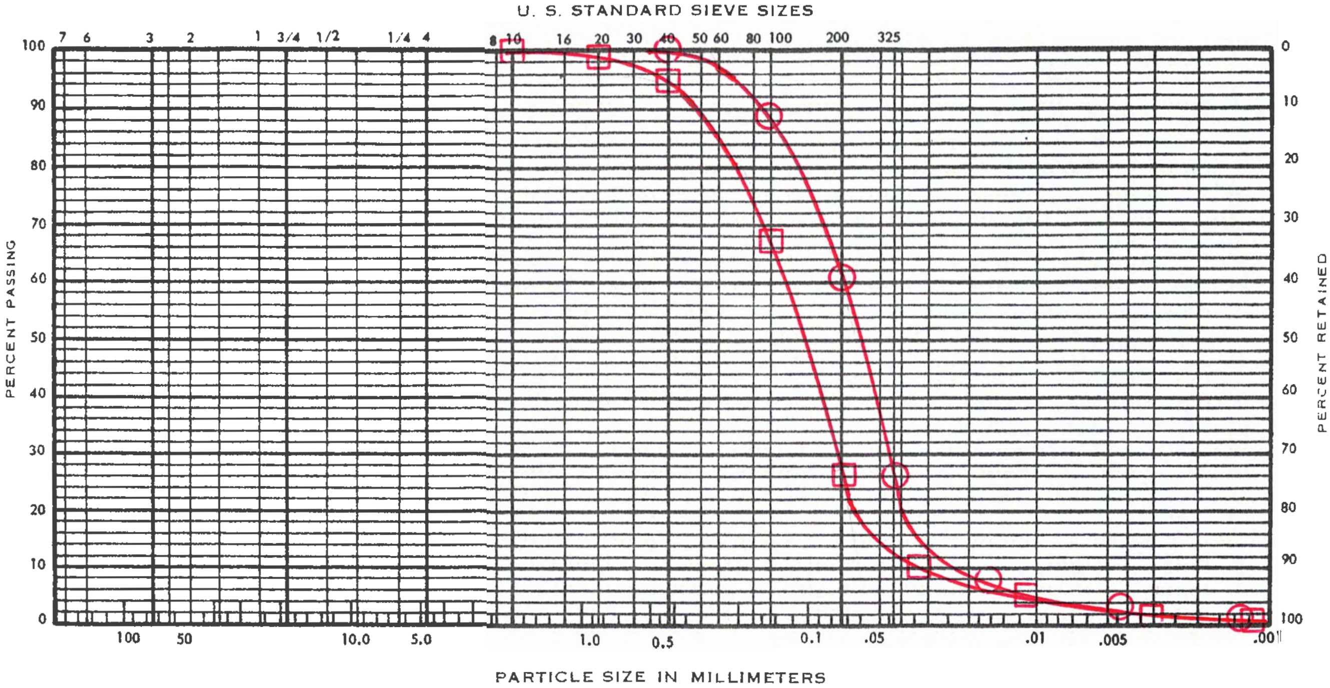
PLASTICITY CHART AND DATA

RIVERFRONT VILLAGE
LEWIS RIVER ROAD

PROJECT NO.	DATE	Figure A-27
1171.006.G	10/31/22	

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
⊟	TH-#1	2.0		ML/SM	Medium brown, slightly clayey, fine sandy SILT to silty fine SAND
⊖	TH-#1	6.0		SM	Gray-brown to gray, silty, fine to medium SAND

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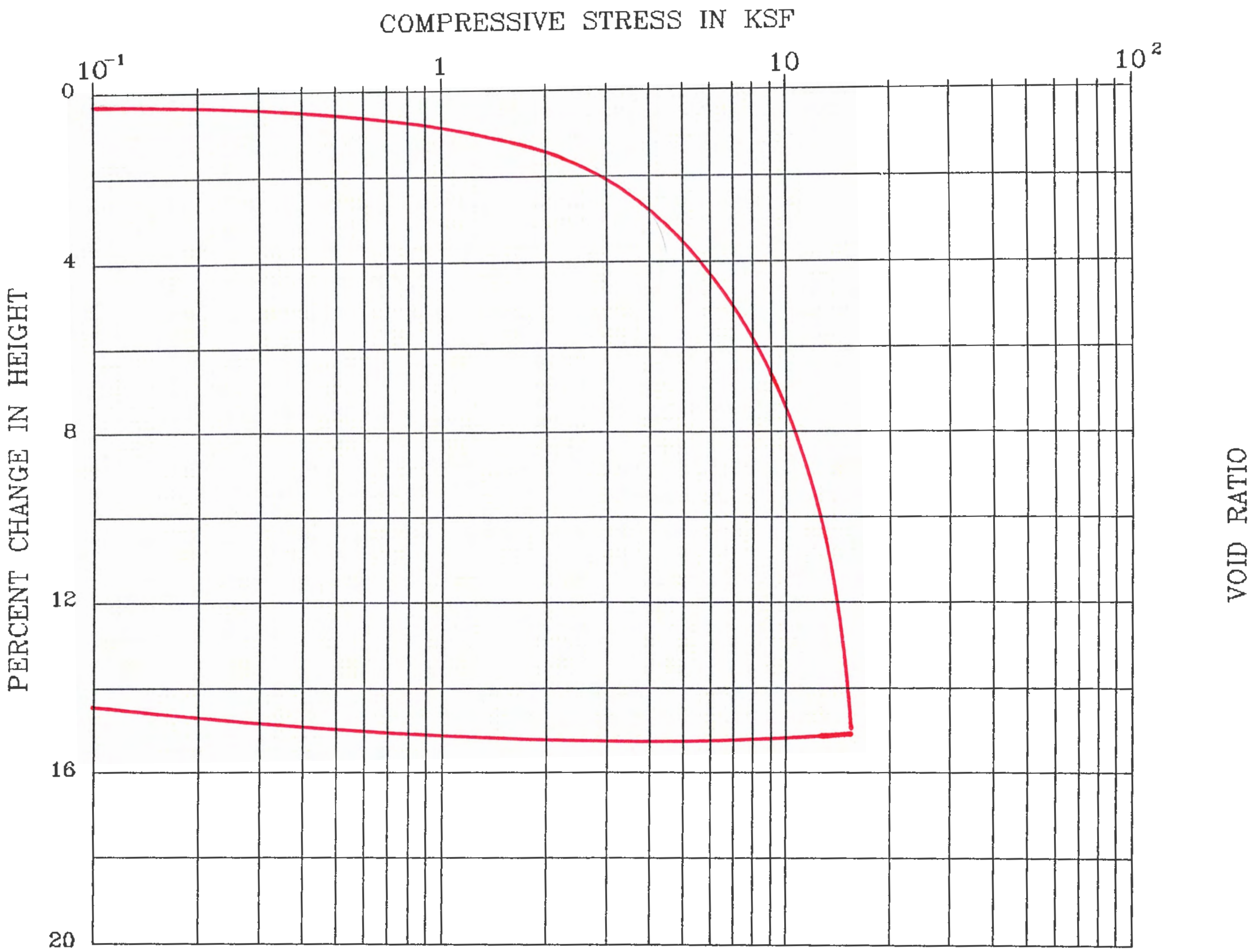
GRADATION TEST DATA

RIVERFRONT VILLAGE
LEWIS RIVER ROAD

PROJECT NO.	DATE	FIGURE
1171.006.G	10/31/22	A-28



BORING : TH-#1
DEPTH (ft) : 2.0
SPEC. GRAVITY : 2.5 (assumed)

DESCRIPTION : slightly clayey, sandy SILT
LIQUID LIMIT : 16.8
PLASTIC LIMIT : 13.0

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	14.3	84.4	81.1	
FINAL	6.6	107.7	94.2	

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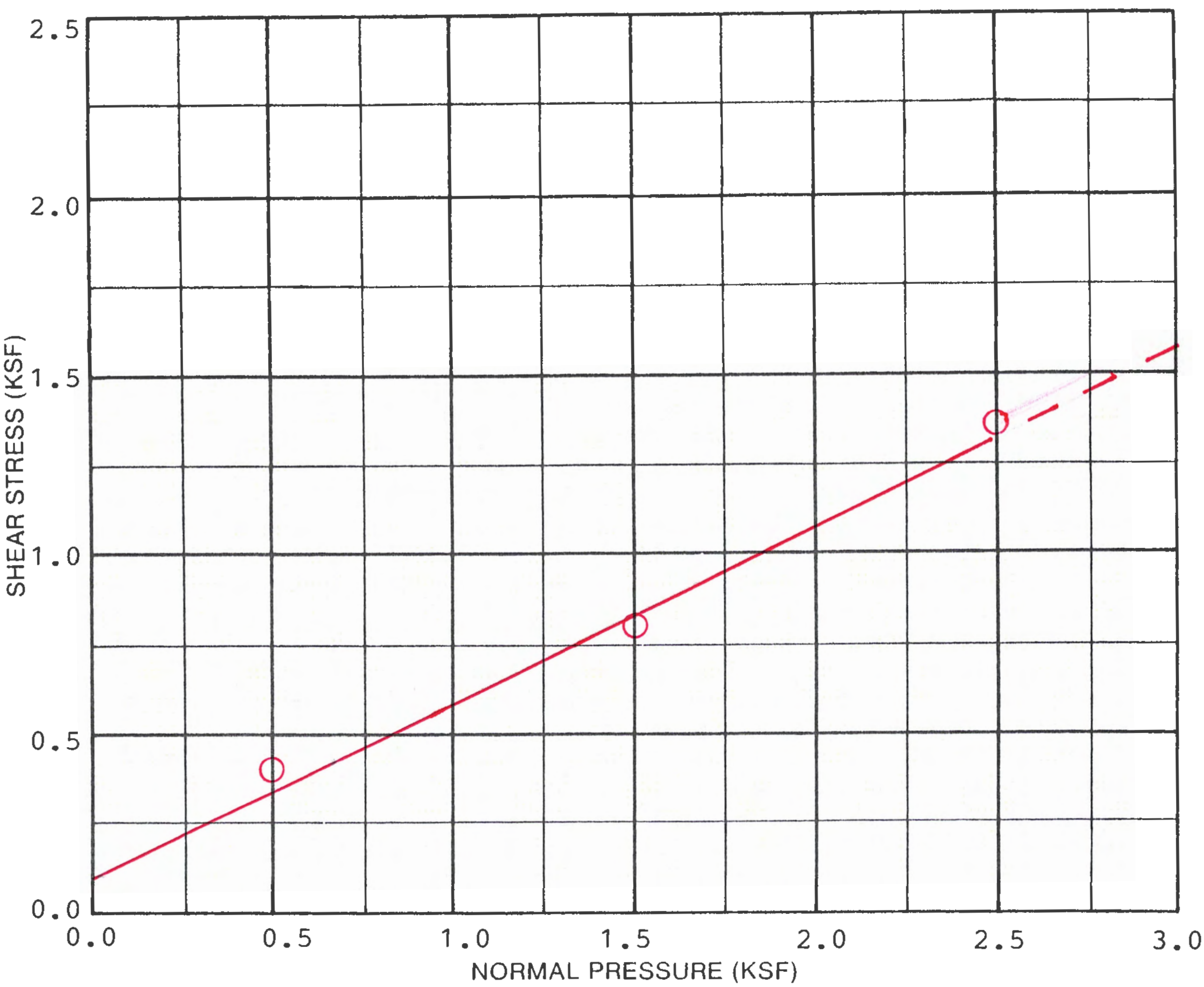
CONSOLIDATION TEST DATA

RIVERFRONT VILLAGE
LEWIS RIVER ROAD

PROJECT NO.	DATE	
1171.006.G	10/31/22	Figure A-29



SAMPLE DATA	
DESCRIPTION: Medium brown, slightly clayey, fine sandy SILT to silty fine SAND (ML/SM)	
BORING NO.: TH-#1	
DEPTH (ft.): 2.0	ELEVATION (ft):
TEST RESULTS	
APPARENT COHESION (C): 100 psf	
APPARENT ANGLE OF INTERNAL FRICTION (ϕ): 26°	

TEST DATA				
TEST NUMBER	1	2	3	4
NORMAL PRESSURE (KSF)	0.5	1.5	2.5	
SHEAR STRENGTH (KSF)	0.4	0.8	1.3	
INITIAL H_2O CONTENT (%)	14.3	14.3	14.3	
FINAL H_2O CONTENT (%)	14.4	10.5	6.8	
INITIAL DRY DENSITY (PCF)	84.4.	84.4	84.4	
FINAL DRY DENSITY (PCF)	86.6	98.8	108.4	
STRAIN RATE: 0.02 inches per minute				

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DIRECT SHEAR TEST DATA		
RIVERFRONT VILLAGE LEWIS RIVER ROAD		
PROJECT NO.	DATE	Figure A-30
1171.006.G	10/31/22	

RESULTS OF R (RESISTANCE) VALUE TESTS

SAMPLE LOCATION: TH-#1

SAMPLE DEPTH: 2.0 feet bgs

Specimen	A	B	C
Exudation Pressure (psi)	219	322	431
Expansion Dial (o.ooo1")	0	0	0
Expansion Pressure (psf)	0	0	0
Moisture Content (%)	17.6	14.4	11.1
Dry Density (pcf)	102.7	107.4	111.5
Resistance Value, "R"	18	32	45
"R"-Value at 300 psi Exudation Pressure = 31			

SAMPLE LOCATION: TH-#5

SAMPLE DEPTH: 2.0 feet bgs

Specimen	A	B	C
Exudation Pressure (psi)	211	323	438
Expansion Dial (0.0001")	0	0	0
Expansion Pressure (psf)	0	0	0
Moisture Content (%)	18.0	14.6	11.3
Dry Density (pcf)	101.6	106.8	110.5
Resistance Value "R"	16	30	43
"R"-Value at 300 psi Exudation Pressure = 29			

Field Infiltration Test Results

Location: Riverfront Village	**Date:** April 25, 2022	**Test Hole:** TH-#2
Depth to Bottom of Hole: 9.0 feet	**Hole Diameter:** 6 inches	**Test Method:** Encased Falling Head
Tester's Name: Daniel M. Redmond, P.E., G.E. **Tester's Company:** Redmond Geotechnical Services, LLC		**Tester's Contact Number:** 503-285-0598

Depth (feet)	Soil Characteristics
0.0-1.0	Dark brown, slightly clayey, fine sandy SILT (Topsoil)
1.0-4.0	Medium brown, slightly clayey, sandy SILT to silty SAND (ML/SM)
4.0-9.0	Gray-brown, silty to slightly silty, sandy GRAVEL (GM)

Time	Time Interval (Minutes)	Measurement (inches)	Drop in Water (inches)	Infiltration Rate (inches/hour)	Remarks
11:00	0	96.0	----		Filled w/12" water
11:10	10	99.5	3.5	21.0	
11:20	10	102.6	3.1	18.6	
11:30	10	98.9	2.9	17.4	Filled w/12" water
11:40	10	101.7	2.8	16.8	
11:50	10	98.7	2.7	16.2	Filled w/12" water
12:00	10	101.4	2.7	16.2	
12:10	10	98.6	2.6	15.6	Filled w/12" water
12:20	10	101.2	2.6	15.6	

Infiltration Test Data Table

Field Infiltration Test Results

Location: Riverfront Village	**Date:** April 25, 2022	**Test Hole:** TH-#4
Depth to Bottom of Hole: 10.0 feet	**Hole Diameter:** 6 inches	**Test Method:** Encased Falling Head
Tester's Name: Daniel M. Redmond, P.E., G.E. **Tester's Company:** Redmond Geotechnical Services, LLC		**Tester's Contact Number:** 503-285-0598

Depth (feet)	**Soil Characteristics**
0.0-1.0	Dark brown, slightly clayey, fine sandy SILT (Topsoil)
1.0-3.0	Medium brown, slightly clayey, sandy SILT to silty SAND (ML/SM)
3.0-10.0	Gray-brown, silty to slightly silty, sandy GRAVEL (GM)

Time	Time Interval (Minutes)	Measurement (inches)	Drop in Water (inches)	Infiltration Rate (inches/hour)	Remarks
11:05	0	108.0	----		Filled w/12" water
11:15	10	111.5	3.5	21.0	
11:25	10	114.7	3.2	19.2	
11:35	10	111.0	3.0	18.0	Filled w/12" water
11:45	10	113.9	2.9	17.4	
11:55	10	110.9	2.9	17.4	Filled w/12" water
12:05	10	113.7	2.8	16.8	
12:15	10	110.8	2.8	16.8	Filled w/12" water
12:25	10	113.6	2.8	16.8	

Infiltration Test Data Table

APPENDIX D

Critical Areas Report

CRITICAL AREAS REPORT & MITIGATION PLAN

Project:

Lewis River Subdivision
Woodland, WA

Applicant:

Luke Sasse
Timberland, Inc.
9321 NE 72nd Avenue, Bldg. C #7
Vancouver, WA 98665

Prepared By:

AshECO SOLUTIONS, LLC

April 1, 2024

The information in this report was compiled to meet the requirements of the City of Woodland Shoreline Master Program and Appendix B – Critical Areas Regulations. This report has been prepared under the supervision and direction of the undersigned, a qualified professional following Woodland SMP Section 2.

____

Andrea W. Aberle, Sr. Biologist
AshEco Solutions, LLC

____

Mackenzie Stamey, Biologist
AshEco Solutions, LLC

SITE INFORMATION:

Parcel No(s):	506520500, 506520400, 506520300, 50650,
Acreage:	20.14 acres (total)
Local Jurisdiction:	City of Woodland, Washington
Section/Township/Range:	S18, T5N, R1E, W.M.
Site Address:	1910, 1920, 1930, 1940 Lewis River Road, Woodland, WA
Legal Landowner:	A5 Partners, LLC *(Per Current GIS Parcel Info)*

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INTRODUCTION

Project Description

AshEco Solutions, LLC (AES) was contracted by Luke Sasse of Timberland, Inc. to assess the critical areas present within the City of Woodland (City) subject property and develop a restoration plan to offset proposed project impacts. This Critical Areas Report and Mitigation Plan follows the City of Woodland Municipal Code (WMC) 15.08 Critical Areas Regulation and the City of Woodland Shoreline Master Program. The applicant proposes to construct a single-family residential development within the High Density Residential (HDR) zone. The development will include 85 single-family residential detached lots within the northern limits of the subject site. The proposal also includes the construction of a new recreational pedestrian trail system providing public shoreline access for the City of Woodland residents and a large shoreline and floodplain restoration area.

Project Location and Background Information

The Lewis River Subdivision subject property consists of four parcels under the jurisdiction of the City of Woodland, addressed as 1910, 1920, 1930 and 1940 Lewis River Road, Woodland, Washington. The City has assigned parcel numbers, 506520500, 506520400, 506520300, and 50650 to the subject property, see Figure 9. The total acreage of the subject property is 20.14 acres. The single-family residential development project is located within the northern limits of the overall subject property and directly south of Lewis River Road and directly north of the Lewis River, a Type S Water and Shoreline of the State. East and west of the site are urban residential lots and two churches.

EXISTING CONDITIONS

The northern section of the project site has been in agricultural use since at least the 1950s. The area has been maintained in grass and hay. The southern section of the subject site is dominated in mature black cottonwood trees, mixed native shrubs, and invasive shrubs and herbs. No structures are present on the site. A dirt and gravel road is present crossing the property which provides unauthorized public access to the Lewis River. Additionally, a city stormwater easement 30 feet wide crosses the subject property north to south in the westernmost subject parcel, a city utility and access easement crosses over the central parcels, and a 75-foot natural gas line easement crosses diagonally just east of the subject site (offsite). The southcentral parcel located directly south of the subject site is owned by the City of Woodland, no structures or site access are currently within the parcel. The subject site is highly constrained due to easements, the Lewis River floodway and 100-Year floodplain, riparian habitat areas, shorelines, and wetland buffers. AES visited the subject site on May 25, 2022 to assess the critical areas onsite.

The City of Woodland and its surroundings are currently in a housing crisis, there is a severe lack of affordable single-family residential lots in the area. There are few places within city limits that can accommodate large housing developments and most sites are highly constrained by geography and critical areas. The proposed project will greatly benefit the City of Woodland providing 85 detached single-family residential lots, a new recreational pedestrian trail system providing public access to the Lewis River shoreline, while restoring a degraded shoreline habitat area within the city.

CRITICAL AREAS MAP RESEARCH

Topography

The site drops south from Lewis River Road forming a slightly undulating terrace within the northern section of the parcel. The site drops down again and continues undulating until the OHWM and wetland along the banks of the Lewis River. Topography maps show that the site drops approximately twenty-two feet in elevation from Lewis River Road to the OHWM, Figure 2.

Soil Survey

Soils within the study area are mapped as non-hydric Newberg fine sandy loam, 0 to 3 percent slopes (141) and Pilchuck loamy fine sand, 0 to 8 percent slopes (160), and hydric Riverwash (172) by the NRCS USDA Soil Conservation Service, Soil Survey of Cowlitz County (2006), Washington, Figure 3.

Newberg fine sandy loam, 0 to 3 percent slopes (141) is found on floodplains in the region with a mixed alluvium parent material . The soil is very deep and well drained with moderately rapid permeability. The available water capacity is moderate, runoff is slow and there is a slight hazard of water erosion. A typical profile is 0 to 10 inches—very dark greyish brown fine sandy loam, 10 to 28 inches— brown and very dark greyish brown fine sandy loam and very fine sandy loam, 28 to 60 inches—dark brown loamy fine sand. The principal vegetation found on these soils include Douglas-fir, red alder, bigleaf maple, black cottonwood, western redcedar, Oregon ash, trailing blackberry, western bracken fern, vine maple, cascara, and willows. The #141 soil type is not listed on the Washington State Hydric Soils List for Cowlitz County (NRCS 2022).

Pilchuck loamy fine sand, 0 to 8 percent slopes (160) is found on floodplains in the region with alluvium parent material . The soil is very deep and somewhat excessively drained with rapid permeability. The available water capacity is low, runoff is slow and there is a slight hazard of water erosion. A typical profile is 0 to 8 inches—very dark greyish brown loamy fine sandy, 8 to 12 inches— dark greyish brown loamy fine sand, 12-36 inches – dark brown fine sand, and 36 to 60 inches—very dark greyish brown gravelly sand. The principal vegetation found on these soils include Douglas-fir, red alder, bigleaf maple, black cottonwood, western redcedar, salmonberry, western swordfern, western bracken fern, vine maple, and snowberry. The #160 soil type is not listed on the Washington State Hydric Soils List for Cowlitz County (NRCS 2022).

Riverwash (172) is found on active river bottoms in the region with alluvium parent material. The soil is very deep and somewhat poorly drained to somewhat excessively drained with rapid or very rapid permeability. The available water capacity is low to high, runoff is slow and there is a severe hazard of water erosion. A typical profile is 0 to 6inches—gravelly sand, 6 to 60 inches—stratified gravelly sand to extremely gravelly-course sand. The #172 soil type is listed on the Washington State Hydric Soils List for Cowlitz County (NRCS 2022).

Mapped hydric soils do not necessarily mean that the area is a wetland; hydrology and wetland vegetation must be present to classify an area as a wetland. The same is true for soils that are not mapped as hydric. Wetlands can be found in areas without mapped hydric soils. The onsite wetland was identified within areas of the hydric mapped soil type #172.

Wetlands

A wetland is mapped directly offsite and south of the parcel by the Cowlitz County EPIC Maps software and by the National Wetland Inventory (NWI). NWI maps Palustrine Scrub-Shrub Seasonally Flooded (PSSC) and Riverine Upper Perennial Unconsolidated Shore Seasonally Flooded (R3USC) wetlands in this location, Figure 4. Site reconnaissance by AshEco Solutions (AES) identified one riverine wetland associated with the floodplain of the Lewis River within the same general location as mapped. The wetland boundary is located off site and south of the proposed project.

Riparian Habitat

Cowlitz County EPIC Maps, City of Woodland, and the Washington State Department of Natural Resources (DNR) show the Lewis River (Type S Water) south of the subject property, Figure 5. The OHWM of the Lewis River was delineated by AES.

An un-named stream (Type F) is mapped crossing the northeastern part of the subject site. AES did not identify waters on or adjacent to the subject site in addition to the Lewis River. WDFW Salmonscape also does not map the Type F water, Figure 7. It is assumed that this water was mapped in error by DNR has not been updated. The Type F water as mapped by DNR is depicted initiating north of the subject property within a high-density residential neighborhood located north of Lewis River Road. There is no indication that there is a channel located within this area and AES considers it highly unlikely that it is present. Therefore, it is assumed that the Type F water was mapped in error. The Type S Water (Lewis River) present near the subject property is considered a Shoreline of the State and therefore governed also by the City of Woodland Shoreline Master Plan, the Washington State Department of Ecology, and the Washington Department of Fish and Wildlife. See Shoreline and Shoreline Designation under the Methodology section of this report.

WDFW Priority Habitat

The Washington Department of Fish and Wildlife (WDFW) maps “Freshwater Forested/Shrub Wetland” and “Riverine” habitats within or adjacent to the subject parcels in the same general locations as the Lewis River and the onsite wetlands. Big brown bat (*Eptesicus fuscus*) was also mapped as with potential presence within the general area though no priority species of bats were identified onsite.

Floodplain

FIRM Panel 53015C0996G of the FEMA maps a Floodway and 100-Year Floodplain associated with the Lewis River across the project site. The outer limits of the floodway or Flood Hazard Zone (FLHZ) as mapped by FEMA is depicted on Figure 6. The Floodway encompasses the southern half of the subject site while the 100-Year Floodplain encompasses the entirety of the project site, continuing off site to the north and beyond Lewis River Highway.

METHODOLOGY

Wetlands

The study area was evaluated for the presence of wetlands using the Routine Determination Method per the U.S. Army Corps of Engineers’ (USACE’s) *Wetland Delineation Manual* (1987), the *Washington State Wetlands Identification and Delineation Manual* (1997), and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region, Version 2.0* (USACE 2010). The Routine Determination Method examines three parameters to determine if wetlands exist in a given area: vegetation, hydrology, and soils. The presence of hydrology is critical in identifying wetlands; however, since hydrologic conditions can change periodically (hourly, daily, or seasonally), it is necessary to determine if hydrophytic vegetation and hydric soils are also present. By definition, wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands are regulated as “Waters of the United States” by the USACE, “Waters of the State” by Washington State Department of Ecology (ECY), and locally by WMC section 15.08.350 Wetlands. One riverine wetland was identified onsite north of the Lewis River. See Appendix B for formal test plot data collected onsite by AES.

Riparian Habitat

The methodology used for determining the location of the OHWM of the Lewis River followed the Washington State Department of Ecology’s (ECY) Determining the OHWM on Streams in Washington State (2010).

Floodplain
Floodplain is generally defied as the 100-year floodplain, referring to the land area susceptible to inundation with a one percent (1%) chance of being equaled or exceeded in any given year. The limit of this area shall be based upon flood hazard maps. The area must remain relatively free from obstruction so that the 100-year flood can be conveyed downstream. The 100-Year Floodplain encompasses the entire site and the floodway encompasses the southern half the project site, Figures 6 and 9. The project has been designed to meet the “Floodplain Management” regulations – Chapter 14.40 of Woodland Municipal Code and 14.40.050, as the residential project will be located outside the floodway, and the lowest proposed residential floor will be elevated one foot above the base flood elevation. The proposed cut and fill will not result in an increase of the flood level during the occurrence of the base flood discharge.

Shorelines
The City of Woodland Shoreline Master Program (SMP) defines shorelines as *“extending landward for two hundred (200) feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways, and contiguous floodplain areas landward two hundred (200) feet from such floodways; and all wetlands and river deltas associated with the streams, lakes and tidal waters that are subject to the provisions of the Shoreline Management Act (RCW 90.58.030); the same to be designated as to location by Ecology.”*

Therefore, the shoreline designation encompasses the entire subject site as 200-feet landward of the mapped floodway extends beyond the northern property boundary and beyond Lewis River Road, Figures 8 and 9.

Shoreline Designation Area
The City of Woodland SMP Shoreline Environmental Designation Map maps the shoreline designation area for the subject property as both “Residential” and “Urban Conservancy” with the site located along the “W-10” reach of the Lewis River, Figure 8.

The City of Woodland SMP Table B-4, Reach-Based Riparian Habitat Areas (RHA) for Shoreline Waters, further defines the specific shoreline designation area for the subject property “W-10” as Parallel: Urban Conservancy Between Floodway Boundary and OHWM/High Intensity/Residential. The jurisdictional RHA width listed for the W-10 shoreline designation area “extends from the OHWM to 10 feet landward of the FEMA Floodway, or 75 feet, whichever is greater.” The floodway and the 10-foot landward offset, or the regulated RHA boundary, is depicted on Figure 9.

DOCUMENTED VEGETATION
Native and non-invasive vegetation within forested and wetland areas onsite:
Oregon ash (*Fraxinus latifolia* FACW), black cottonwood (*Populus trichocarpa* FAC), Oregon white oak saplings (*Quercus garryana* FACU), beaked hazelnut (*Corylus cornuta* FACU), red-osier dogwood (*Cornus sericea* FACW), Pacific ninebark (*Physocarpus capitatus* FACW), Nootka rose (*Rosa nutkana* FAC), Douglas spiraea (*Spiraea douglasii* FACW), Sitka willow (*Salix sitchensis* FACW), Pacific willow (*Salix lasiandra* FACW), Pacific crabapple (*Malus fusca* FACW), swamp gooseberry (*Ribes lacustre* FAC), tall Oregon grape (*Mahonia aquifolium* FACU), Douglas hawthorne (*Crataegus douglasii* FAC), Indian plum (*Oemleria cerasiformis* FACU), cascara (*Frangula purshiana* FAC), snowberry (*Symphoricarpos albus* FACU), manroot (*Marah oreganus* NI), piggyback plant (*Tolmiea menziesii* FAC), birdsfoot trefoil (*Lotus corniculatus* FAC), garden vetch (*Vicia sativa* UPL), black medick (*Medicago lupulina* FACU), sheep sorrel (*Rumex acetosella* FACU), sweet vernal grass (*Anthoxanthum odoratum* FACU), orchard grass (*Dactylis glomerata* FACU), brome grass (Bromus sp. FACU), scouringrush horsetail (*Equisetum hyemale* FACW), lanceleaf plantain

(*Plantago lanceolata* FACU), centaury (*Centaurium erythraea* FAC), lady fern (*Athyrium filix-femina* FAC), colonial bentgrass (*Agrostis capillaris* FAC), tall fescue (*Schedonorus arundinaceus* FAC), cleavers (*Galium aparine* FACU), hedgenettle (*Stachys mexicana* FACW), dames rocket (*Hesperis matronalis* FACU), and slough sedge (*Carex obnupta* OBL).

Invasive species:
English hawthorne (*Crataegus monogyna* FAC), Scotch broom (*Cytisus scoparius* FACU), Himalayan blackberry (*Rubus armeniacus* FAC), common periwinkle (*Vinca minor* NI), Japanese knotweed (*Polygonum cuspidatum* FACU), common St. Johnswort (*Hypericum perforatum* FACU), English ivy (*Hedera helix* FACU), old man's beard (*Clematis vitalba* FAC), yellow archangel (*Lamium galeobdolon,* FACU), hairy cats ear (*Hypochaeris radicata* FACU), Canada thistle (*Cirsium arvense* FACU), reed canarygrass (*Phalaris arundinacea* FACW), and bird vetch (*Vicia cracca* NI).

The indicator categories following the common and scientific name of each vegetation species indicate the likelihood of the species to be found in wetlands. Listed from most-likely to least-likely to be found in wetlands, the indicator categories are:

- **OBL (obligate wetland) –** Occur almost always under natural conditions in wetlands.
- **FACW (facultative wetland) –** Usually occur in wetlands but occasionally found in non-wetlands.
- **FAC (facultative) –** Equally likely to occur in wetlands or non-wetlands.
- **FACU (facultative upland) –** Usually occur in non-wetlands but occasionally found in wetlands.
- **UPL (obligate upland) –** Occur almost always under natural conditions in non-wetlands.
- **NI (no indicator) –** Insufficient data to assign to an indicator category.

CRITICAL AREA CONCLUSIONS

Wetlands

One Category II wetland with habitat score of 8 was delineated just south of the subject site. AES rated the wetland using the Washington State Department of Ecology Wetland Rating Form (2014), Appendix B. The onsite wetland has multiple hydrogeomorphic (HGM) characteristics slope, depressional, and riverine, and was rated as a riverine wetland. The wetland has forested, scrub-shrub, and emergent dominated sections and is located along the northern bank of the Lewis River. The wetland is shares hydrology with the Lewis River and is within 200 ft of the OHWM, making it an associated shoreline wetland.

Following Appendix B - Section 5.5 of the City of Woodland SMP, wetland buffer widths are established by comparing the wetland rating category, the habitat score, and the intensity of land uses proposed on development sites. The proposal includes cut, fill, grading, and construction of a single-family residential development, which meets the High Land Use Intensity definition following Section 2 of the City of Woodland SMP. The proposal also includes the addition of dedicated shoreline access with proposed construction of a pervious pedestrian trail (considered low land intensity uses). The wetland buffer required to protect habitat functions for Category II Wetlands with a habitat score of 8 and a proposed high land use intensity is 300 feet, 225 feet for moderate land use intensities, and 150 feet for low land use intensities, Figures 9 and 10. The proposed project will have buffer impacts to the outer portion of the onsite wetland. However, no significant vegetation removal is proposed within this area and the outer buffer area will ultimately be restored with implementation of the proposed mitigation plan.

Riparian Habitat

The Lewis River flows south of the subject property and is considered a Type S Water. Type S Waters are afforded a Riparian Habitat Area that extends from the OHWM to 10 feet landward of the FEMA Floodway, or 75 feet, whichever is greater by the City of Woodland SMP Table B-4. In this case, the Floodway is greater, Figure 9. The project will have unavoidable temporary impacts to the riparian habitat buffer due to the cut and fill requirements of the project. However, the proposed residential development has been located within the flat upland pasture terrace directly adjacent to Lewis River Road and outside of the regulated RHA to avoid permanent impacts to the onsite RHA and significant shoreline habitat.

Shoreline Designation Area

The local shoreline designation area is defined within the project site as lands extending landward for 200 feet in all directions as measured on a horizontal plane from the OHWM, or the mapped floodway (SMP). The City of Woodland SMP designates the shoreline associated with Lewis River within the subject site area as Reach W-10. Reach 10 has parallel environmental designations. Within the subject site the Shoreline is designated as Urban Conservancy between the OHWM and the Floodway boundary, followed by Residential from the Floodway boundary landward to the extent of the 100-Year Floodplain, Figure 6. This shoreline designation area is mapped by the Official Shoreline Environmental Designation (SED) Map of City of Woodland. The proposed project will have unavoidable impacts within the Residential designation of the jurisdictional shoreline areas, see the Proposed Site Plan, Figure 6.

The purpose of the “Urban Conservancy” shoreline designation is to protect and restore ecological functions of open space, floodplain, and other sensitive lands where they exist in urban and developed settings, while allowing a variety of compatible uses. Activities permitted in these areas are intended to have minimal adverse impacts upon the shoreline. Urban Conservancy is assigned to shoreline areas appropriate and planned for development that are compatible with maintaining or restoring ecological functions.

The purpose of the “Residential” shoreline designation is to accommodate residential development and appurtenant structures that are consistent with this Program. The Residential SED is assigned to shoreline areas if they are predominantly single-family or multi-family residential development or are planned and platted for residential development.

Single-family residential construction is permitted within the Residential SED if the project demonstrates that it meets the general SMP criteria applicable to the project site as well as that specific to the designation area criteria. Single-family residential construction is also allowed within the Urban Conservancy SED. Specific criteria for single-family use within the Residential and Urban Conservancy shoreline designation areas include a 10-foot additional setback from the boundary of the RHA, a requirement for providing public access to the shoreline and a building height of 35 feet (Section 5.3.2, Table 7-1, Shoreline Use, Modification, and Development Standards). The project has been designed to meet the building height requirements with the proposed average height of the gabled roof to be 35 feet or less.

The project proposes a dedicated pedestrian trail that can be utilized by the future residents of the development as well as the general public, with a trailhead located in the southwest corner of the development. The trailhead will also be accessible as far north as Lewis River Road due to the future sidewalk and street improvements proposed by the project with additional connections to the inner local access street loop which will provide extend the total linear distance of available dedicated pedestrian walking pathways. The project will provide public access, viewing and enjoyment of the shoreline by providing a pervious wood-chip trail approximately 1,721 feet in length. The pedestrian trail will provide dedicated access along the Lewis River shoreline where there currently is none. The addition of the pedestrian trail will therefore fill a need for the existing community of Woodland as well as the future residents of the proposed development, which is a use that meets both the Residential and Urban Conservancy designation area criteria as defined by the SMP.

The single-family residential development project has been designed to meet the building setback and RHA setback requirement, and has been located outside of the floodway, but the required cut and associated grading required to construct the project above the 100-Year floodplain will have unavoidable impacts within the onsite shoreline habitat. A floodplain mitigation and shoreline restoration plan has been designed to offset the critical area impacts proposed onsite. The proposal will additionally provide public access and public enjoyment of the Lewis River shoreline. This will prevent public trespass that has historically occurred across the site and adjacent properties. The public has created multiple pedestrian and vehicular access paths, deposited debris and generally disturbed the shoreline habitat.

Floodplain

Floodplain is generally defied as the 100-year Floodplain, referring to the land area susceptible to inundation with a one percent (1%) chance of being equaled or exceeded in any given year. The limit of this area shall be based upon flood hazard maps. The area must remain relatively free from obstruction so that the 100-year flood can be conveyed downstream. The entire subject parcel lies within the designated floodplain and the southern half of the project site is within the designated floodway, Figures 6 and 9.

Table 1. Critical Areas Summary.

Critical Area	Designation Area/Setback	Buffer Width
Type S Water (Lewis River)	Shoreline Jurisdiction offset 200-feet from the OHWM and/or “contiguous floodplain areas landward two hundred (200) feet from such floodway” and 10-foot building setback from the edge of the RHA	RHA extends 10-feet landward of the FEMA Floodway
Category II Wetland Habitat Score: 8	N/A	300-foot High Land Use Intensity Buffer 225-foot Moderate LUI Buffer 150-foot Low LUI Buffer
Floodway / 100-Year Floodplain	N/A	N/A

PROPOSED PROJECT

The applicant proposes to construct a single-family residential development within the High Density Residential (HDR) zone. The development will include 85 single-family detached within the northern portion of the subject site. The proposal also includes a recreational pedestrian trail system to allow public access and public enjoyment of the Lewis River shoreline and a large shoreline and floodplain restoration area. The project has been designed following City of Woodland Municipal Code (CMC) Section 15.08 Critical Areas Regulation and the City of Woodland Shoreline Master Program. The site is undeveloped with no structures or formal site access is present. With the full site encumbered by the 100-Year floodplain and critical areas, impacts are unavoidable. The permanent and temporary impacts proposed within the project site have been minimized to the greatest extent practicable and the restoration proposed will allow for no net loss of habitat functions for the onsite critical area habitat.

Avoidance and Minimization

The onsite shoreline habitat associated with the Lewis River overlaps with the onsite floodplain (and floodway), wetland buffer and riparian habitat area (RHA). These critical area constraints when compounded with the numerous easements the cross the subject parcels highly constrain the buildable land onsite. There is a need for affordable single-family housing within the City of Woodland and within the region. There are limited sites within the city limits where new single-family residential lots can be constructed, and many are constrained with critical areas or geographic limitations. The proposed project is in one of the last remaining areas that has the capacity for a single-family residential development (also zoned for medium density), doesn't require the elimination or demolition of existing housing, has the necessary utilities in place, and has the opportunity to create public shoreline access and protected public greenspace near the Lewis River. Due to geographic and critical area constraints within the overall 20.14-acre project area, critical area impacts are unavoidable, and restoration and mitigation will be required.

The proposed construction has been designed to avoid direct impacts to the onsite wetland and will be landward of the OHWM. The permanent impacts from the proposed residential development have been located outside of the riparian and wetland buffers, the floodway, and has been designed outside of all shoreline setbacks. The impacts from the cut and fill will be temporary and will be restored in place, creating more flood storage and creating more varied and diverse native shoreline habitat. Impacts to the onsite Type S riparian and wetland buffers, and the onsite floodplain were avoided and minimized to the greatest extent practicable.

The upland terrace closest to Lewis River Road and outside of the standard critical area buffers is the most realistic building location available onsite. The building area is currently an open grass field, requiring no significant vegetation removal to construct the residential development. Due to the floodplain that encompasses the project site, fill is needed to raise the project site 12-inches above the base flood elevation onsite. The large amount of fill needed will be sourced from the subject site. The proposed stormwater pond and the fill cut required onsite will temporarily impact the onsite shoreline habitat and vegetation.

The proposed recreational pedestrian trail system has avoided permanent impacts to the riparian buffer and shoreline. A pervious wood-chip trail will be installed from the southwest corner of the residential development lot and extend south-southeast to the City of Woodland property where it will loop around the providing recreation and viewing opportunities of the Lewis River shoreline. The trail has been designed to avoid impacting mature vegetation within the city's ownership and utilizes existing trails and open areas to the full extent possible.
Considering the large setbacks, buffer constraints, floodway and as well as minimization used, the proposed building site is in the most realistic location and will impact the least functioning habitat, see Figures 9 and 10. The project avoids impacts to the highest functioning shoreline habitat present onsite. The highest functioning habitat includes the wetland and wetland buffer, inner riparian RHA (225' from OHWM) and the forested area located outside of the wetland buffer within the City's parcel. The project has been designed to minimize impacts to the onsite critical areas by locating the permanent project impacts outside of these areas to the fullest extent possible. The bulk of the project construction and excavation will occur within areas dominated by pasture grasses. The project site has also had historic site disturbance including installation of the underground stormwater pipe within the western portion of the property, installation of the underground natural gas utility in the eastern portion of the property, and the general public trespass and disturbance from driving and trail making.

The project has been designed to offset the floodplain fill proposed by the project by excavating a cut within the onsite floodway over the same volume as that filled. This will allow for a net balance result between the cut and fill volume within the onsite floodplain, thereby fully mitigating for the proposed floodplain impacts due to the proposed fill.

The project proposes shoreline restoration in the form of habitat restoration and enhancement to offset the temporary impacts proposed due to vegetation removal over the cut area required by the project.

There will be no net loss of critical areas or functions with implementation of the following restoration plan.

CRITICAL AREA IMPACTS

The shoreline habitat is generally overlapped by the floodplain, floodway, riparian RHA and wetland buffer habitat. For the purposes of this plan, all of the onsite critical area habitat will be referred to as "shoreline habitat." With the cut and fill required for the project consisting of a very large volume, the onsite shoreline habitat will be impacted to achieve the cut and fill goals and engineering/design requirements for the project. The impacted critical areas are the floodplain (fill) and the shoreline habitat (vegetation disturbance).

The shoreline habitat impacts are considered to be short-term as the onsite habitat to be impacted will be restored within 20-years' time by following the proposed "shoreline restoration" outlined by this plan. Floodplain impacts will result due to the large quantity of fill material required to construct the project above the base flood elevation.

Floodplain Impacts

The floodplain impact proposed by the project is due to the need to fill within the floodplain to allow for the residential project site to be elevated above the floodplain. This fill is a requirement to allow for the safe construction of the residential buildings and the fill volume can be offset onsite by the associated cut area, or the site of the onsite fill source. To provide the necessary fill volume required to bring the project site above the floodplain, the applicant proposes to cut approximately 150,000 cubic yards of material from the onsite floodplain (floodway) and shoreline habitat. This proposal will allow for the project to meet the construction requirements for the project site located within the floodplain and allow the project to provide a net balance of cut and fill within the floodplain.

The entire subject parcel lies within the designated floodplain and the southern half of the project site is within the designated Floodway, Figures 6 and 9. As such, floodplain and floodplain impacts are unavoidable for reasonable use of the parcel. The existing elevation of the project area ranges between 20 to 30 feet, and the base flood elevation onsite is mapped at approximately 37 feet. Therefore, the project will require a very large quantity of fill material to bring the proposed project site 12-inches above the floodplain to meet the design standards outlined by Floodplain Management" regulations – Chapter 14.40 of Woodland Municipal Code and 14.40.050.

By sourcing the fill material from onsite, the project can thereby create 150,000 cubic yards of additional flood storage for the Lewis River onsite. The onsite fill sourcing will also allow the project to ensure the net balance result between the cut and fill volume within the floodplain, as it is not realistic or cost effective to acquire the full 150,000 cubic yards if delivered by dump truck (which equates to 15,000 10-yard dump truck loads). Additionally, the traffic and emissions required for this effort would be much greater overall than sourcing from the site itself.

Shoreline Habitat Impacts

The existing shoreline habitat consists of degraded pasture with some scrub-shrub and forested patches of vegetation. The bulk of the subject property will be impacted by the required grade and fill activities. The existing vegetation present within the shoreline habitat and project area to be impacted by the project has been quantified and is presented on Figure 11 – Vegetation Impacts. The vegetation impacts proposed are considered temporary as the restoration plan will offset and mitigate for the temporary impact of vegetation onsite.

The herbaceous dominated shoreline habitat present within the project limits (construction and cut areas) has been quantified to be 639,234 square feet as depicted on Figure 11 – Vegetation Impacts. The impacts to this herbaceous habitat will be offset onsite within the proposed herbaceous and scrub-shrub restoration area.

The scrub-shrub habitat present within the project limits has been quantified to be 215,665 square feet as depicted on Figure 11. There is also a high dominance of invasive species intertwined within this habitat including Scotch broom, Himalayan blackberry, English ivy, Hawthorn, Japanese knotweed, and clematis. Vegetation Plot data was collected onsite to record the existing native and non-native/invasive species, Appendix B. The proposed excavation will effectively irradicate the existing invasive and non-native species present within the onsite shoreline and the temporary impacts due to the removal of this scrub-shrub/invasive habitat will be offset onsite within the proposed scrub-shrub restoration area.

The forested habitat present within the project limits has been quantified to be 129,175 square feet as depicted on Figure 11. English ivy and wisteria were observed growing up the trunks of multiple trees within this area. The forested tree cover is dominated by black cottonwood with some Oregon ash also present. There will be some temporal loss due to the removal of the forested canopy, but this can be replaced (within twenty years' time) with more vigorous and a greater variety of native conifer and deciduous tree species.

The construction of the recreational pedestrian trail system providing public shoreline access may have some temporary impacts due to potential minor grading required to level the proposed trail pathway. The trail itself will consist of wood-chips thereby maintaining the impervious nature of the trail footprint and avoiding permanent impacts to the shoreline. The trail will utilize existing trails to the full extent possible and avoid impacting mature vegetation. Any exposed soils due to required grading for the trail are to be re-seeded with native seed mix, thereby offsetting the temporary impact of the herbaceous vegetation present. These temporary impacts are required to allow for the proposed dedicated trail limits, public enjoyment of the shoreline and prevent the historic public trespass of the shoreline habitat that has occurred onsite.

RESTORATION AND MITIGATION PLAN

The mitigation proposed will offset the onsite critical area impacts for no net loss of functions or area. The proposal includes floodplain mitigation for no net loss of floodplain storage volume and shoreline restoration in the form of onsite restoration and habitat enhancement.

The City of Woodland SMP includes the document "Cowlitz County Shoreline Restoration Plan for Shorelines in Cowlitz County and the Cities of Castle Rock, Kalama, Kelso, and Woodland" (2015). This restoration plan guidance document includes a "Map of Potential Restoration Project Sites" within its Appendix A. This map calls the subject property out under the "Woodland Assessment Unit" and labeled it #130 on the map. The recommended habitat-related restoration measures for the subject site were to "maintain and restore riparian vegetation within the designated floodway." By implementing the proposed shoreline restoration plan outlined below, the project intends to bring the previously identified need for onsite restoration full circle.

Floodplain Mitigation
To mitigate for the unavoidable impacts to the onsite floodplain, mitigation for no net increase in flood levels during the occurrence of the base flood discharge is proposed within the onsite floodplain. A 1:1 offset to the floodplain fill is proposed, or 142,000 cubic yards. This will allow for the project to meet the construction requirements for the residential project site located within the floodplain and allow the project to provide a net balance of cut and fill within the floodplain.

Shoreline Restoration
The herbaceous shoreline habitat impacts of 470,955 square feet will be offset within the proposed herbaceous and scrub-shrub restoration area onsite. The shoreline restoration area will provide a total of 435,611 square feet of shoreline habitat dominated by native herbaceous species and enhanced with clusters of scrub-shrub vegetation and woody habitat features. The open field present onsite today does not provide shelter or forage opportunities for wildlife. The minimal functions provided by the existing field dominated in herbaceous vegetation will be offset by the restoration area consisting of a mixed mosaic of open herbaceous meadow areas, clusters of native scrub-shrub vegetation and woody habitat features. This mixed mosaic will provide a higher functioning habitat to the wildlife than that currently present onsite. See Figures 13 and 14 for representative cross-sections of the restoration area. The restoration ratio provided for the herbaceous shoreline habitat is 0.92:1, as depicted on Figure 12 – Restoration Plan.

The scrub-shrub shoreline habitat impacts of 186,163 square feet will be offset within the proposed scrub-shrub restoration area onsite. The shoreline restoration area will provide a total of 435,611 square feet of shoreline habitat that is dominated by native scrub-shrub species and enhanced with woody habitat features. The restoration ratio provided for the scrub-shrub shoreline habitat is 2.34:1, as depicted on Figure 12 – Restoration Plan. The scrub-shrub habitat present onsite today is dominated by invasive species and provides minimal habitat functions. Large areas of the site are dominated in monotypic Scotch broom or Himalayan blackberry shrub cover (included within the shrub impact area calculation). The restoration area will provide a mixed mosaic of native scrub-shrub habitat and also have associated herbaceous and forested areas and woody habitat elements providing an overall higher functioning and diverse habitat over that provided by the scrub-shrub habitat present onsite today. See Figures 13 and 14 for representative cross-sections of the restoration area. The side slopes associated with the perimeter of the cut area have been designed to keep a 4:1 slope, allowing for shrub and herbaceous enhancement which will help to stabilize the slope over time. Native shrub species naturally occurring and recorded onsite will be called for by the planting plan to ensure that the habitat is consistent with its surroundings and the native Lewis River shoreline.

The forested habitat impacts of 129,175 square feet will be offset within the proposed forested restoration areas onsite. The shoreline restoration area will provide a total of 134,550 square feet of shoreline habitat dominated in native forested cover. The restoration ratio provided for the forested shoreline habitat is 1.04:1, as depicted on Figure 12 – Restoration Plan. The forested areas will be located along the western and eastern portions of the property providing a faux perimeter buffer to the overall restoration area over time. Tree species will also be located within an upland hummock created within the central portion of the restoration area. Topsoil from the project site will be retained and deposited within the cut area to create this upland hummock approximately four feet in height to further enhance and uplift and diversify the overall habitat function provided by the restoration area. See Figures 13 and 14 for representative cross-sections of the restoration area. These soils are anticipated to include native subsurface soils as documented by the Geotech report that consist of dark topsoil underlain by an upper unit of medium brown, very moist, medium still to-loose, slightly clayey, fine sandy silt to silty fine sand. These three forested areas (combined with the retention of the forested area to the south on the city's parcel) along with the proposed scrub-shrub and herbaceous meadow areas will provide a highly functioning and diverse forested habitat corridor where none is currently present within the onsite shoreline habitat.

A mix of tree stock sizes will also be utilized in an effort to replace the temporal loss of the forested canopy in the near future. The woody materials removed from the shoreline habitat will be retained onsite and re-purposed within the restoration area to ensure that a mix of functional habitat elements are present and offset the temporary disturbance of these elements during construction activities. The woody habitat elements will be retained and temporarily stored within the available open areas of the City's parcel to minimize the disturbance to wildlife potentially utilizing them for food or shelter.

The recreational pedestrian trail proposed within project site and the adjacent city owned parcel has been designed to retain the mature forested habitat present and will avoid and minimize impacts to the existing native vegetation by utilizing existing trails or open spaces void of vegetationThe mature trees present over the adjacent 6.19 acre City of Woodland owned parcel will help to provide refuge and habitat for wildlife until the onsite restoration area becomes fully established. The mature trees will also provide shade to the adjacent restoration area until the forested cover becomes established and act as a native seed source into the future which will help to ensure the success of the forested restoration area onsite.

Additionally, the proposed shoreline restoration area will have protections placed on it in the form of perimeter boundary signage, invasive species management, monitoring activities and establishment of a conservation covenant. The perimeter boundary signage will notify and educate the public ("Protected Critical Area to be Maintained in a Natural State"). This signage combined with the annual maintenance and monitoring and conservation covenant will help to ensure the shoreline restoration area remains and is successful into the future. These protective elements will also prevent the historic trespass and impact of the onsite shoreline habitat from occurring in the future. The designation of the future City park will further help to minimize the degradation of the onsite shoreline habitat while providing dedicated public access, pedestrian trail and viewing enjoyment within designated areas. The pedestrian trail design includes a dedicated wood chip walking path approximately 1,721 linear feet in length, with connection to the sidewalk system within the proposed development and north along Lewis Road.

Table 2. Impacts & Restoration/Mitigation Summary.

Critical Area	Impact (Area)	Restoration/Mitigation (Area)
Shoreline Habitat		
Shoreline (RHA/Wetland Buffer)	*Temporary Impacts:* Vegetation Impacts Herbaceous = 470,955 sf. Scrub-shrub = 186,163 sf. Forested = 129,175 sf.	*Shoreline Restoration:* Herbaceous Restoration @ 0.92:1 ratio (435,611sf.) Scrub-shrub Restoration @ 2.34:1 ratio (435,611 sf.) Forested Restoration @ 1.04:1 ratio (134,550 sf.)
Floodplain		
Floodplain	100-year Floodplain Fill (142,000 cubic yards)	*Floodplain Mitigation:* Creation of Floodplain Storage w/in Floodway @ 1:1 ratio to fill (142,000 cubic yards)

PLANTING PLAN

Site Preparation

1. Stake or flag the on-site mitigation area boundaries and install tree protection fencing.
2. Mow grasses and herbaceous vegetation present within mitigation areas prior to planting.
3. Mechanically control invasive species prior to native plant enhancement as necessary. No herbicide is to be used within shoreline jurisdiction per SMP Chapter 6.7 Water Quality and Quantity.
4. For control of English ivy (and wisteria) the runners found at/around base of native tree trunks are to be cut, bagged, and disposed of at an approved offsite location as the stem and root fragments can re-sprout. Wearing of gloves is recommended to protect hands from the ivy's irritating sap.

   <u>Additional English Ivy Control Methods (as Required):</u>

- Plants can successfully be pulled from moist soils by hand in fall (or spring).
- Ivy stems or roots left in the soil (after initial control efforts) may re-sprout, so continual removal of sprouts may be needed.
- Ivy climbing trees can be cut from waist to chest height, pulling the lower part of the stems away from the base of the tree (to kill the upper portions of the vine). The leaves remaining in the tree on the cut stems will slowly die and fall off.

Plant Materials

The plants specified for the on-site restoration and mitigation areas are native species designed to diversify the existing plant community, provide an increase in woody structure and wildlife habitat on a short- and long-term basis, thereby increasing the habitat functions for the riparian habitat. The specified shrubs will grow quickly forming an intertwining shrub layer forming a native understory to complement the native tree canopy proposed within the restoration/mitigation area.

Container Stock

Plants will be purchased from a native-plant nursery and meet size outlined by planting plan.

Bareroot/Cutting Species

1. Plants will be purchased from a native plant nursery and meet size outlined by planting plan.
2. Bareroot sock will be kept cool and moist prior to being planted.
3. Bareroot stock will have well-developed roots and sturdy stems with a good root-to-shoot ratio.
4. No damaged or desiccated roots or diseased plants will be used.
5. Cutting stock is to remain damp and either partially submerged within water or wrapped inside a damp plastic bag to help retain moisture.
6. Unplanted bareroot stock will be stored properly at end of planting day(s) to prevent desiccation.

Native Seed Mix

The native seed mixes specified in this plan were chosen as they are well suited for reclaiming disturbed upland and riparian plant communities and includes a mix of native grasses and forbs that provide stabilization and color. The mixes are both excellent for restoration areas as it is drought tolerant and/or saturation, provide quick cover and deep roots for soil stabilization and effective erosion control, and attracts pollinators for excellent wildlife habitat, Table 3.

Planting Methods

Plant in winter through early spring (February-April) at specified spacing following the planting plan.

Container/bareroot stock

1. Dig hole using a tree shovel/auger or comparable tool 16-inches wide and 4-inches deeper than the root system, scarify sides of hole to 4 inches. Remove plant from container and loosen roots with hand or score vertically on sides and bottom with knife. Set plant upright and plumb in hole so the crown is just above the finish grade. Ensure that roots are extended down entirely and do not bend upward.
2. Replace loose soil around plant and firmly compact the soil around the plant to eliminate air spaces. Do not use frozen soil for backfilling.
3. Firmly compact the soil around the planted species to eliminate air spaces.
4. Install woody mulch around the base of planted species to insulate plantings, maintain moisture content of soil and reduce invasive plant competition (when deemed necessary).
5. Irrigate according to performance standards for the first three summers after planting or as site and weather conditions warrant.

Planting Specifications

Planting will begin in Winter of 2023 or Winter/Spring of 2024 while onsite soils are saturated (and stock is dormant). The following tables summarize the native plant selection, spacing, size, and quantity for the on-site mitigation area:

Table 3. Planting Plan Details.

Common Name	*Scientific Name* *(Facultative Class)*	*Stock*	*Spacing*	*Quantity*
Forested Shoreline Restoration (134,550 sf)				
Western red cedar	*Thuja plicata, FAC*	1-gallon or 24-36” bareroot	12 ft.	200
Western red cedar	*Thuja plicata, FAC*	5-gallon	12 ft.	100
Western hemlock	*Tsuga heterophylla, FACU*	1-gallon or 24-36” bareroot	12 ft.	200
Western hemlock	*Tsuga heterophylla, FACU*	5-gallon	12 ft.	100
Black cottonwood	*Populus trichocarpa,* FAC	1-gallon or 24-36” bareroot	12 ft.	200
Dougals-fir	*Pseudotsuga menziesii, FACU*	5-gallon	12 ft.	100
Bitter cherry	*Prunus emarginata, FACU*	1-gallon or 24-36” bareroot	12 ft.	100
			Trees Total =	**1,000**
Vine maple	*Acer circinatum, FAC*	1-gallon or 24-36” bareroot	6 ft.	200
Oregon grape	*Mahonia aquifolium, FACU*	1-gallon or 24-36” bareroot	6 ft.	100
Common snowberry	*Symphoricarpos albus, FACU*	1-gallon or 24-36” bareroot	6 ft.	200
Douglas hawthorn	*Crataegus douglasii, FAC*	1-gallon or 24-36” bareroot	6 ft.	100
			Shrubs Total =	**600**
Scrub-shrub Shoreline Restoration (435,611 sf)				
Black cottonwood	*Populus trichocarpa,* FAC	1-gallon or 24-36” bareroot	3-6 ft. on center/clusters	100
Oregon ash	*Fraxinus latifolia, FACW*	1-gallon or 24-36” bareroot	3-6 ft. on center/clusters	100

Pacific crabapple	*Malus fusca, FACW*	1-gallon or 24-36" bareroot	3-6 ft. on center/clusters	100
			Trees Total =	300
Sitka willow	*Salix sitchensis, FACW*	4-6' cutting	2-4 ft. on center/clusters	500
Pacific willow	*Salix lasiandra, FACW*	4-6' cutting	2-4 ft. on center/clusters	500
Red-osier dogwood	*Cornus sericea, FACW*	1-gallon or 24-36" bareroot	2-4 ft. on center/clusters	400
Pacific ninebark	*Physocarpus capitatus, FACW*	1-gallon or 24-36" bareroot	3-6 ft. on center/clusters	400
Douglas spiraea	*Spiraea douglasii FACW*	1-gallon or 24-36" bareroot	3-6 ft. on center/clusters	400
Salmonberry	*Rubus spectabilis, FAC*	1-gallon or 24-36" bareroot	3-6 ft. on center/clusters	400
Swamp rose	*Rosa pisocarpa FAC*	1-gallon or 24-36" bareroot	3-6 ft. on center/clusters	400
			Shrubs Total =	**3,000**
Native Seed Mix Specifications				
Herbaceous Restoration (435,611 sf)				
"Native Wetland Grass Mix #10" or "Bio Swale Mix #8" (*or similar*) (Recommended Seeding Rate: 1 lb. per 1,000 square feet, or as directed by supplier) Note: The above seed mixes can be sourced from River Refuge Seed Company, LLC.				
Temporary Impact Areas				
Recommended for Re-vegetating Exposed Soils Adjacent to Pedestrian Trail **(*As Required*)** "Native Upland Grass Mix #9" (*or similar*) 40% Elymus glaucus (Blue wildrye) 25% Bromus carinatus (California brome) 10% Hordeum brachyantherum (Meadow barley) 10% Festuca romeri (Roemer's fescue) 10% Deschampsia elongate (Slender hairgrass) 5% Agrostis exerata (Spike bentgrass) (Recommended Seeding Rate: 25 lbs. per acre, or as directed by supplier) Note: The "Native Upland Grass Mix" can be sourced from River Refuge Seed Company, LLC.				

Maintenance Plan

Maintenance at the on-site restoration area is a ten-year period and will involve removing persisting invasive plant species in addition to watering and re-installing failed native species as necessary. The maintenance will include the following activities when necessary:

1. Remove and control non-native/noxious vegetation around all newly installed plants. During years 1 through 3 invasive species will be removed and suppressed as often as necessary to meet a performance standard of no greater than 20 percent cover by invasive species, measured by monitoring plots, and less than 10 percent cover by Year 7.
2. Irrigate planted species as necessary during the dry season, approximately July 1 through October 15. Irrigation is recommended to occur on a two-week cycle (minimum) during the dry season for the first three years. Water will be provided by a temporary above-ground irrigation system or a water truck.
3. Replace dead or failed plants as described for the original installation to meet the minimum annual performance standard of 100% survival in the first year, 90% survival in the second year. For Years 3

– 10 the percent cover of the woody vegetation will be monitored and is to ultimately achieve 50 percent cover by Year 10, or prior to sign off.

Monitoring Plan

The restoration site will be monitored for a 10-year period following project construction; monitoring will take place in years 1, 2, 3, 5, 7 and 10. Monitoring reports will be submitted to City of Woodland by the end of each monitored year. The goal of monitoring is to determine if the previously stated performance standards are being met. The mitigation area will be monitored once during the growing season, preferably during the same two-week period each year to better compare the data.

During the first annual monitoring and maintenance event, two representative photo plots will be selected in the restoration areas permanently marked with metal posts. Monitoring photo plot locations will be placed on an as-built drawing and included in the annual monitoring reports.

Vegetation

Vegetative monitoring will document the woody scrub-shrub canopy developing within the mitigation area. The following information will be included at each sample plot:

- Percent cover and frequency of herbaceous species
- Percent cover and frequency of sapling/shrub species
- Species composition of herbs, shrubs, and trees, including non-native/noxious, invasive species
- Photo documentation of vegetative changes over time

<u>Monitoring Report Contents</u>

The annual monitoring reports will contain at least the following:

- Location map and as-built drawing.
- Photographs from permanent photo points (x2 for each defined vegetation polygon minimum).
- Historic description of project, including dates of plant installation, current year of monitoring, and restatement of restoration goals.
- Documentation of plant survival, cover, and overall development of the plant community.
- Assessment of non-native, invasive plant species and recommendations for management.
- Summary of maintenance and contingency measures proposed for the next season and completed for the past season.

Contingency Plan

If the performance standards are not met by the tenth year following project completion, or at an earlier time if specified above, a contingency plan will be developed and implemented. All contingency actions will be undertaken only after consulting and gaining approval from the City of Woodland. The applicant will be required to complete a contingency plan that describes (1) the causes of failure, (2) proposed corrective actions, (3) a schedule for completing corrective actions, and (4) whether additional maintenance and monitoring are necessary.

Site Protection

The on-site restoration/mitigation area will be owned and managed by the applicant or assignee. AshEco Solutions, LLC or similar entity will be responsible for supervising the maintenance and conducting the monitoring of the on-site mitigation area for the 10-year period at expense of the applicant. The applicant will establish and record a permanent and irrevocable conservation covenant on the mitigation property.

MITIGATION/RESTORATION GOALS, OBJECTIVES AND PERFORMANCE STANDARDS

Objective 1: Mitigate the fill within the onsite floodplain by excavation within the onsite floodway to provide no net loss of floodplain storage onsite.

Performance Standard 1a. Document the cubic yards of fill material deposited within the onsite floodplain for the project (estimated to be 150,000 cubic yards).

Performance Standard 1b. Document the excavation within the onsite floodway to provide a 1:1 offset of the floodplain fill deposited within the onsite floodplain for the project.

Performance Standard 1c. Stabilize the floodplain excavation area with native seed-mix immediately upon completion of onsite grading activities and follow BMPS of the approved erosion control and prevention plan.

Objective 2: Restore forested vegetation cover over 134,550 square feet of the onsite shoreline habitat.

Performance Standard 2a. Document the installation of native plant species vegetation over 189,230 square feet of the onsite shoreline habitat as depicted by Figure 12 and as specified by Table 3. Submit As-built documenting planting locations, plant species, and plant quantities.

Performance Standard 2b. In Year 1, planted species are to achieve 100 percent (100%) survival one year after the site is planted. The survival rate is to be determined by comparison of baseline vegetation data and the data collected during production of the As-built Map. (If dead plants are replaced in Year 1 to achieve the 100 percent survival rate, this performance standard will be met).

Performance Standard 2c. In Year 5, restoration plant communities will achieve the densities listed in Table 5.

Performance Standard 2d. In Year 7, the restoration plant community will achieve 30-percent (30%) aerial cover of woody species. (If plants are added, that achieve this cover requirement, this performance standard will be met).

Performance Standard 2e. In All Years, non-native/invasive plant species will not exceed 20-percent (20%) aerial cover across the onsite mitigation area.

Objective 3: Restore scrub-shrub and herbaceous vegetation cover over 435,611 square feet of the onsite shoreline habitat.

Performance Standard 3a. Document the installation of native shrub plant species in clusters surrounded by herbaceous vegetation cover over 443,667 square feet of the onsite shoreline habitat as depicted by Figure 12 and as specified by Table 3. Submit As-built documenting planting locations, plant species, and plant quantities.

Performance Standard 3b. In Year 1, planted species are to achieve 100 percent (100%) survival one year after the site is planted. The survival rate is to be determined by comparison of baseline vegetation data and the data collected during production of the As-built Map. (If dead plants are replaced in Year 1 to achieve the 100 percent survival rate, this performance standard will be met).

Performance Standard 3c. Document the native re-seeding of any exposed soils disturbed in association of the pedestrian trail construction post project completion within shorelines. Submit As-built documenting the required re-seeding locations, native seed mix used and quantity.

Performance Standard 3d. In Year 1, re-seeded areas are to achieve 100 percent (100%) survival one year after the site is planted. The survival rate is to be determined by comparison of baseline vegetation data and the data collected during production of the As-built Map. (If re-seeding is required in Year 1 to achieve the 100 percent survival rate, this performance standard will be met).

Performance Standard 3e. In Year 5, restoration plant communities will achieve the densities listed in Table 5.

Performance Standard 3f. In Year 7, the restoration plant community will achieve 30-percent (30%) aerial cover of woody species. (If plants are added, that achieve this cover requirement, this performance standard will be met).
Performance Standard 3g. In All Years, non-native/invasive plant species will not exceed 20-percent (20%) aerial cover across the onsite mitigation area.

Objective 4: Re-seed with native cover any temporary exposed soils (adjacent to the pedestrian trail).
Performance Standard 4a. Document the native re-seeding of any exposed soils disturbed in association of the pedestrian trail construction post project completion within shorelines. Submit As-built documenting the required re-seeding locations, native seed mix used and quantity.
Performance Standard 4b. In Year 1, re-seeded areas are to achieve 100 percent (100%) survival one year after the site is planted. The survival rate is to be determined by comparison of baseline vegetation data and the data collected during production of the As-built Map. (If re-seeding is required in Year 1 to achieve the 100 percent survival rate, this performance standard will be met).

Objective 5: Provide long-term protection for the onsite critical areas and mitigation areas.
Performance Standard 5a. Record a conservation covenant with Clark County. This performance standard will be met when the Year 1 monitoring report is submitted that includes a copy of the conservation covenant.
Performance Standard 5b. Post permanent boundary signage every 100 feet along the outer edge of the onsite mitigation boundaries *or as otherwise determined by City of Woodland*. Signs are to read (or similar as approved by permit):

"Critical Areas and Buffer – Please Retain in a Natural State"

Signage will remain in legible condition; if they are missing or illegible, they will be replaced. This performance standard will be met when signs are reported to be in place in the final monitoring report.

The following table summarizes vegetative performance standards for each of the monitoring years:

Table 4. Performance Standards by Monitoring Year.

Habitat Type	*Performance Standards by Year*				
	Year 1	Year 2	Year 3	Year 5	Years 7 - 10
Forested/Shrub Restoration Areas					
Planted Vegetation Survival	100%	90%	--	--	--
Woody Species Aerial Cover	---	---	20%	30%	50%
Invasive Plant Species					
Invasive/ Non-native plant species	*< 20%*				< 10% for Years 2-10

CONCLUSIONS

The mitigation and restoration proposed will adequately offset the critical area impacts to allow for the construction of the single-family residential development, installation of a pedestrian trail and replacement of the floodplain storage with no net loss of critical area functions and values. With issuance of the approved critical areas permits, the proposed shoreline and floodplain habitat enhancement activities will be implemented, and a conservation covenant recorded to protect the onsite critical areas under the applicant's ownership in perpetuity.

DISCLAIMER

This report documents the investigation, best professional judgment, and conclusions of the investigator. It is correct and complete to the best of our knowledge. It should be considered a preliminary mitigation and restoration plan and used at your own risk until it has been reviewed and approved in writing by the local agency with jurisdiction over the site. AES personnel base the above listed conclusions on standard scientific methodology and best professional judgment.

REFERENCES

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City of Woodland Shoreline Master Program. June 2021 (Amended).

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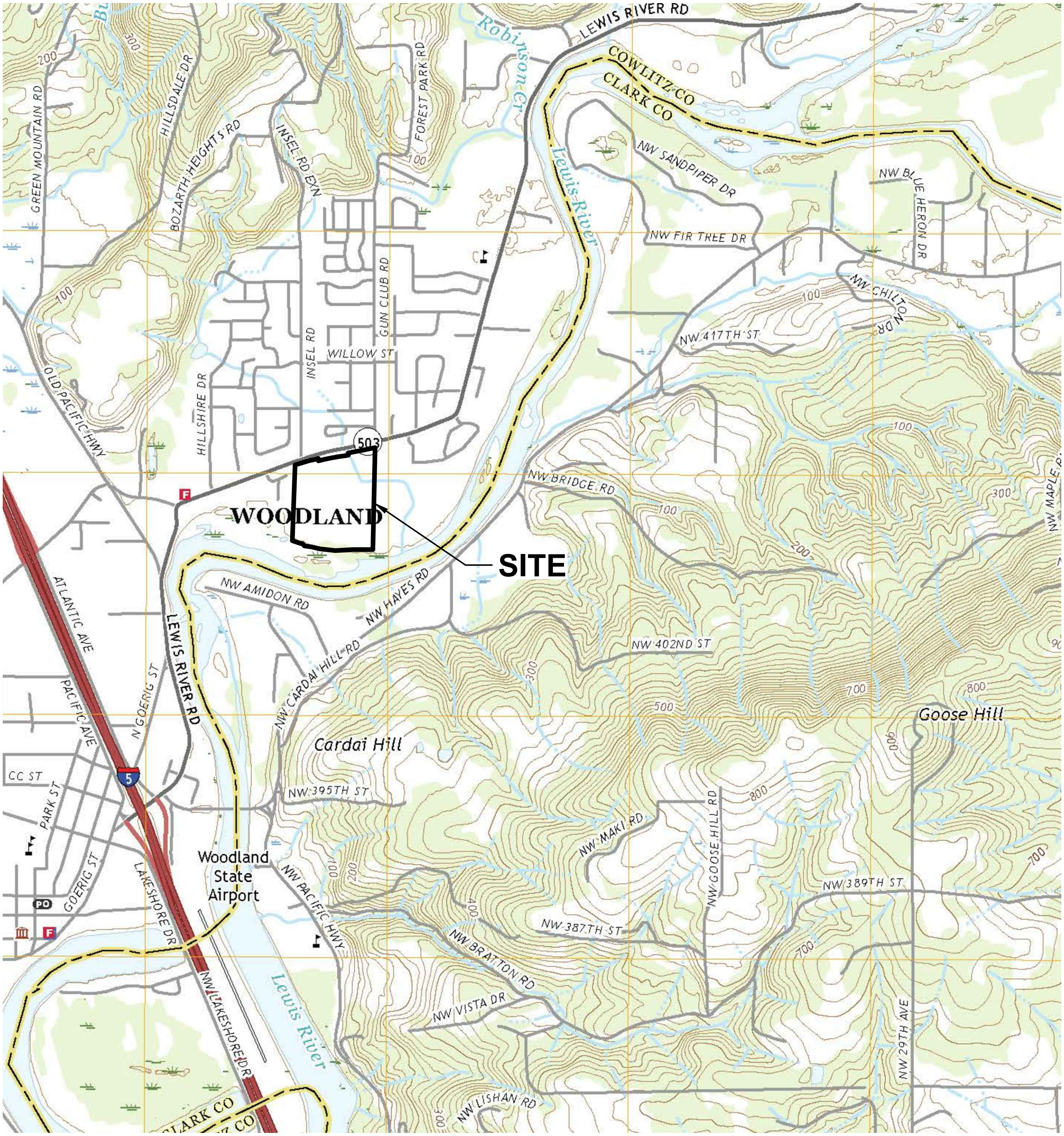

NOTE(S):
USGS, WOODLAND QUADRANGLE
WASHINGTON
7.5 MINUTE SERIES (TOPOGRAPHIC)

AshECO SOLUTIONS, LLC

PURPOSE: XX Line 1 Line 2 **DATUM:** NAVD 88 **ADJACENT PROPERTY OWNERS:** Adj 1 Adj 2	VICINITY MAP **APPLICANT:** Timberland, Inc. **PROJECT NAME:** Lewis River Subdivision **PARCELS #:** 50650, 506520300, 506520400, 506520500 **SITE ADDRESS:** 1940 Lewis River Rd.	**PROPOSED:** XX Add 2 **IN:** Woodland **NEAR:** XX **COUNTY:** Cowlitz **STATE:** WA **FIGURE:** 1 **DATE:** 4-11-24

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N

0 400 800

SCALE IN FEET
SCALE IS APPROXIMATE

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AshECO SOLUTIONS, LLC

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

AERIAL PHOTO & TOPO MAP
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500
SITE ADDRESS: 1940 Lewis River Rd.

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 2
DATE: 4-11-24

141 - Newberg fine sand loam, 0-3% slopes

160 - Pilchuck loamy fine sand, 0-8% slopes

172 - Riverwash

263 - Water

N

0 300 600

SCALE IN FEET
SCALE IS APPROXIMATE

Ash ECO SOLUTIONS, LLC

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

SOIL SURVEY MAP
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500

SITE ADDRESS: 1940 Lewis River Rd.

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 3
DATE: 4-11-24

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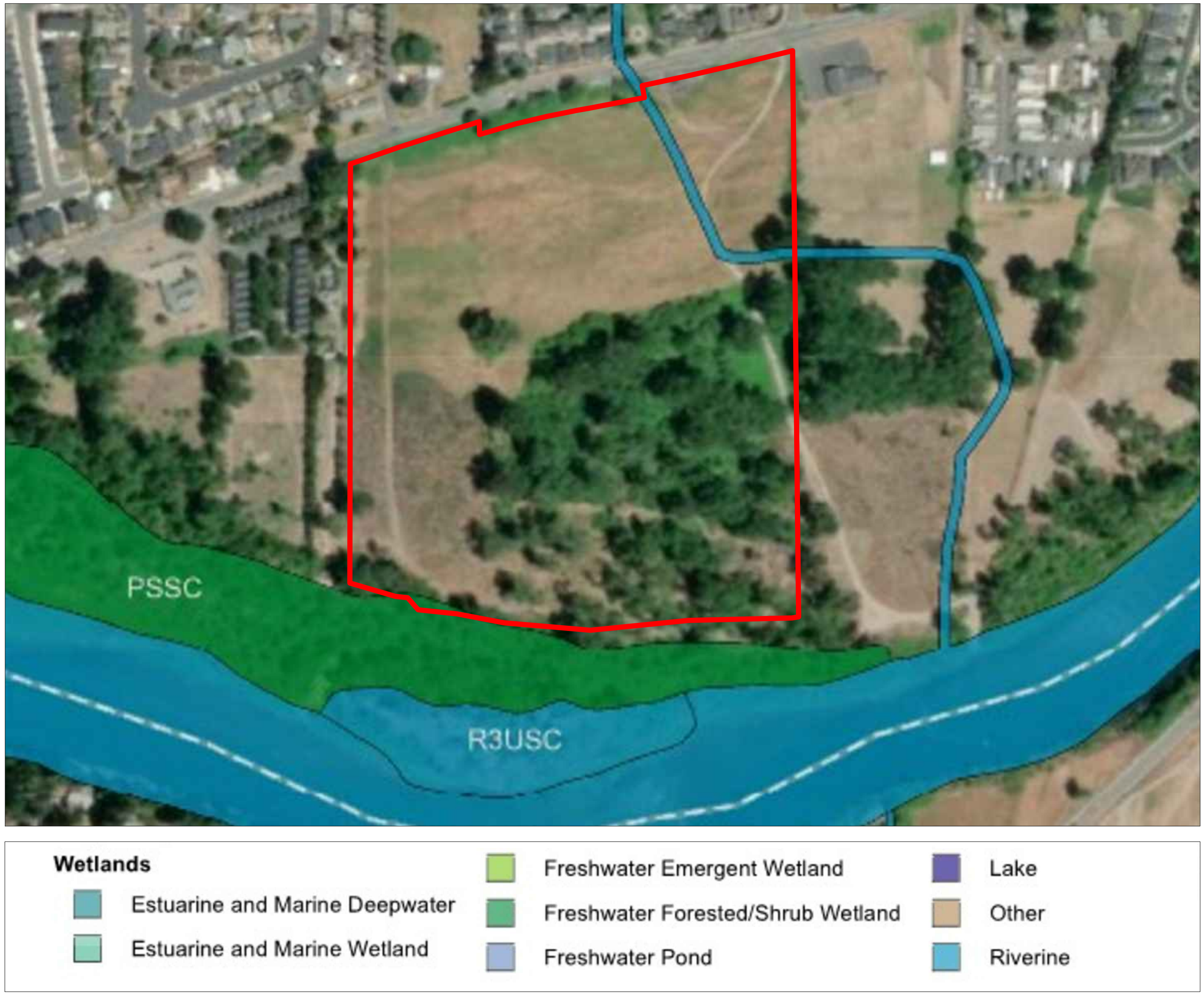

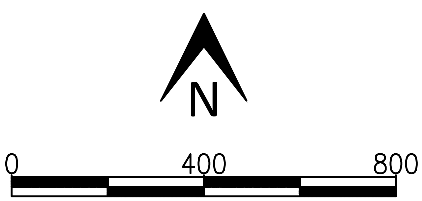

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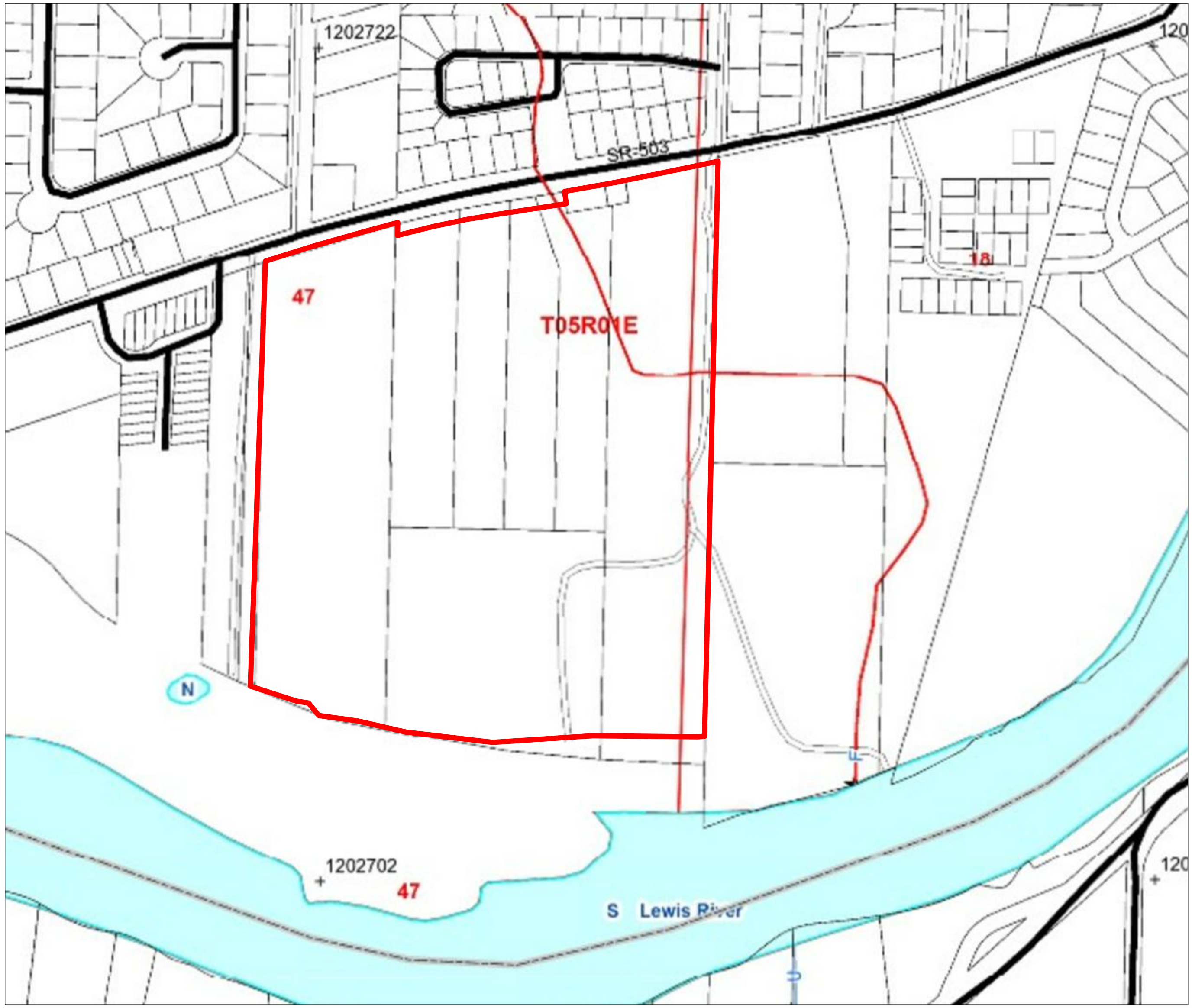
AshECO SOLUTIONS, LLC

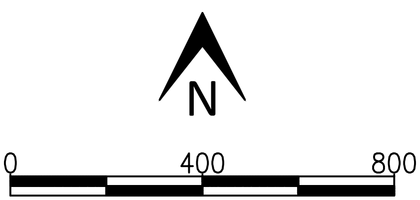
PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

NATIONAL WETLANDS INVENTORY MAP
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500

SITE ADDRESS: 1940 Lewis River Rd.

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 4
DATE: 4-11-24





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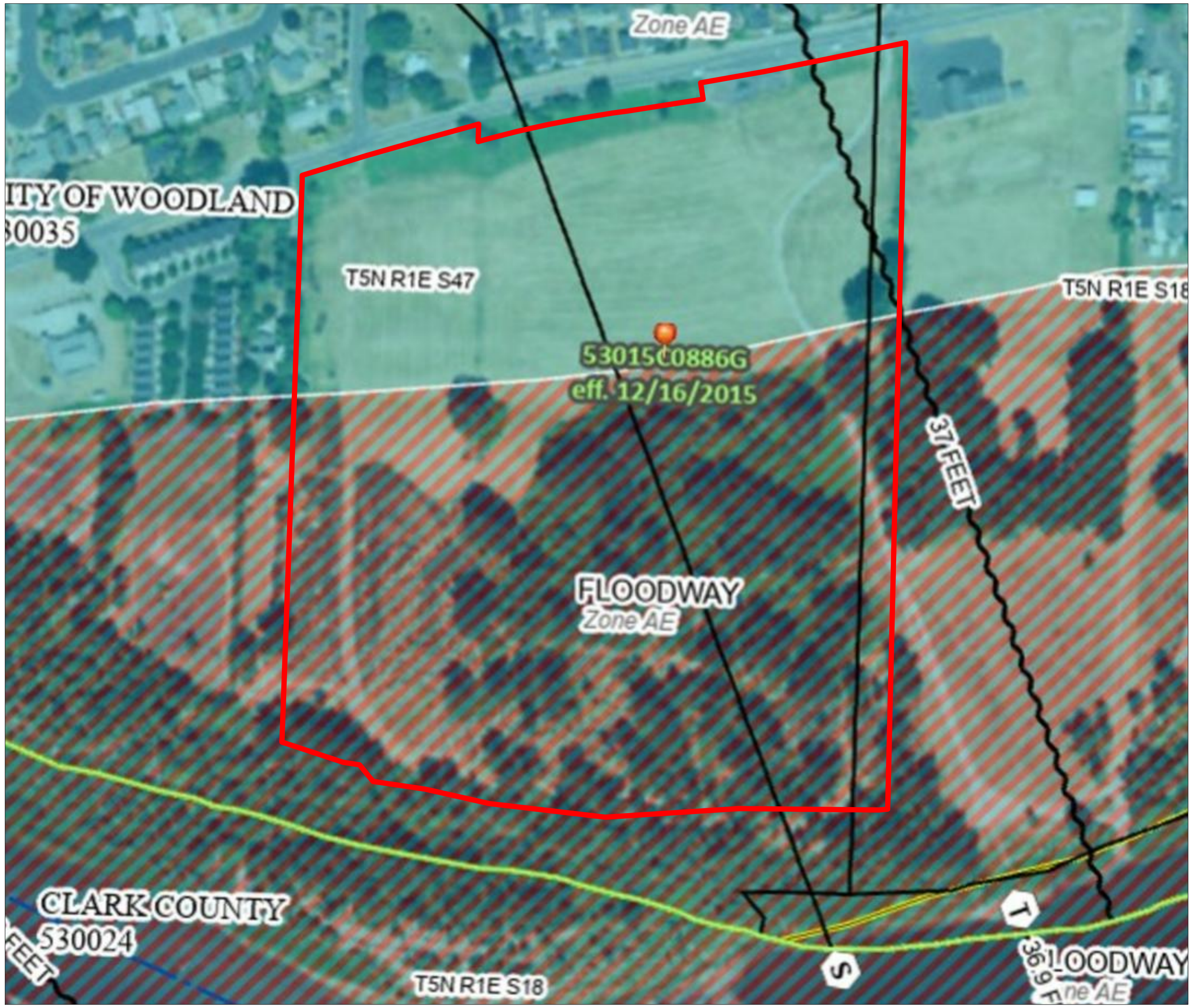
AshECO SOLUTIONS, LLC

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

DNR FPARS MAP
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500

SITE ADDRESS: 1940 Lewis River Rd.

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 5
DATE: 4-11-24



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SCALE IN FEET
SCALE IS APPROXIMATE

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AshECO
SOLUTIONS, LLC

	PURPOSE: XX Line 1 Line 2 **DATUM:** NAVD 88 **ADJACENT PROPERTY OWNERS:** Adj 1 Adj 2	FEMA FLOODWAY MAP **APPLICANT:** Timberland, Inc. **PROJECT NAME:** Lewis River Subdivision **PARCELS #:** 50650, 506520300, 506520400, 506520500 **SITE ADDRESS:** 1940 Lewis River Rd.	**PROPOSED:** XX Add 2 **IN:** Woodland **NEAR:** XX **COUNTY:** Cowlitz **STATE:** WA **FIGURE:** 6 **DATE:** 4-11-24

N

0 500 1000

SCALE IN FEET
SCALE IS APPROXIMATE

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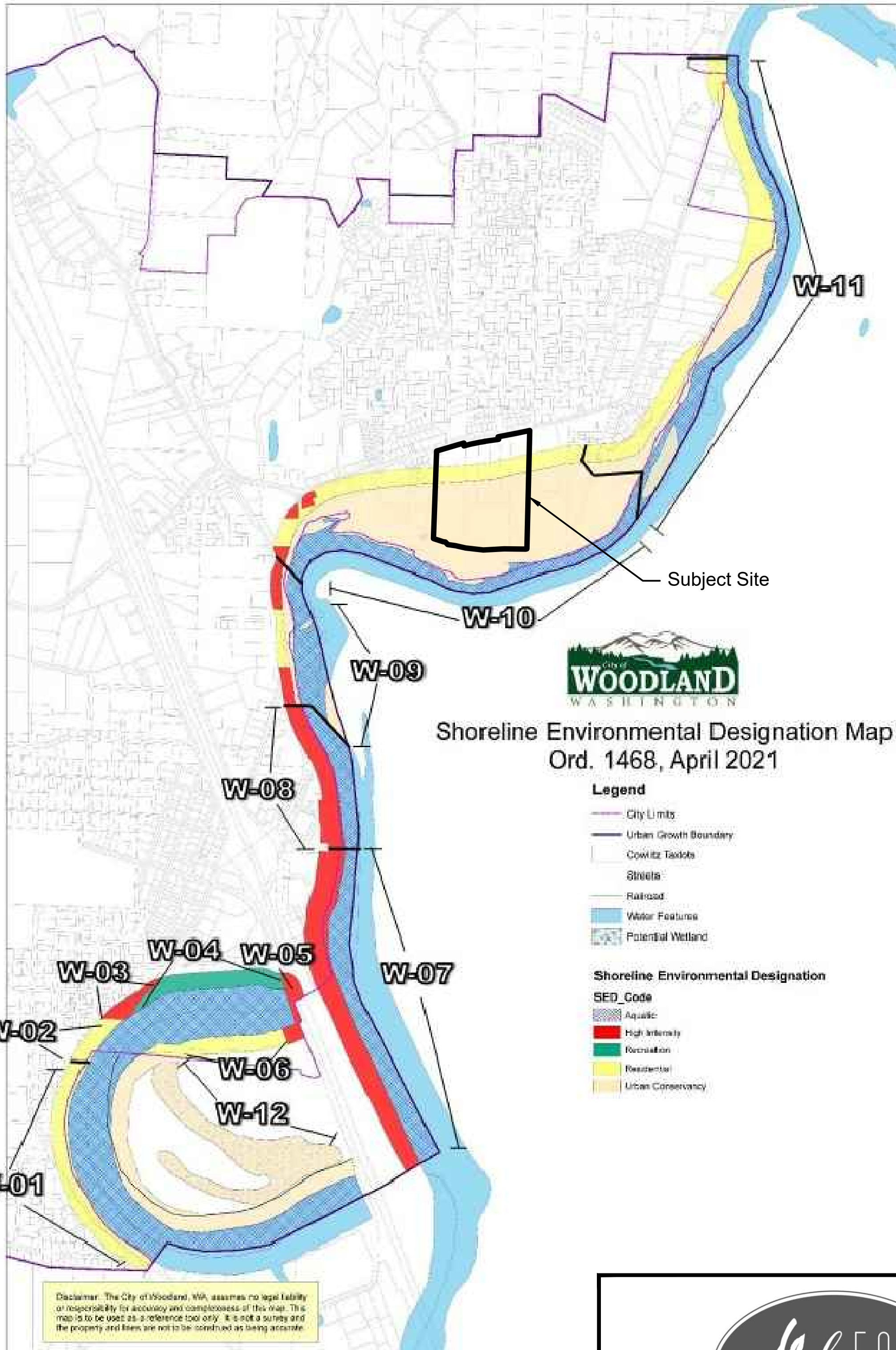
AshECO SOLUTIONS, LLC

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

WDFW SALMONSCAPE MAP
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500
SITE ADDRESS: 1940 Lewis River Rd.

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 7
DATE: 4-11-24



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PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

SMP SHORELINE DESIGNATION MAP
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500

SITE ADDRESS: 1940 Lewis River Rd.

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 8
DATE: 4-11-24

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz
FIGURE: 9
DATE: 4-11-24
STATE: WA

EXISTING CONDITIONS
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500
SITE ADDRESS: 1940 Lewis River Rd.

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

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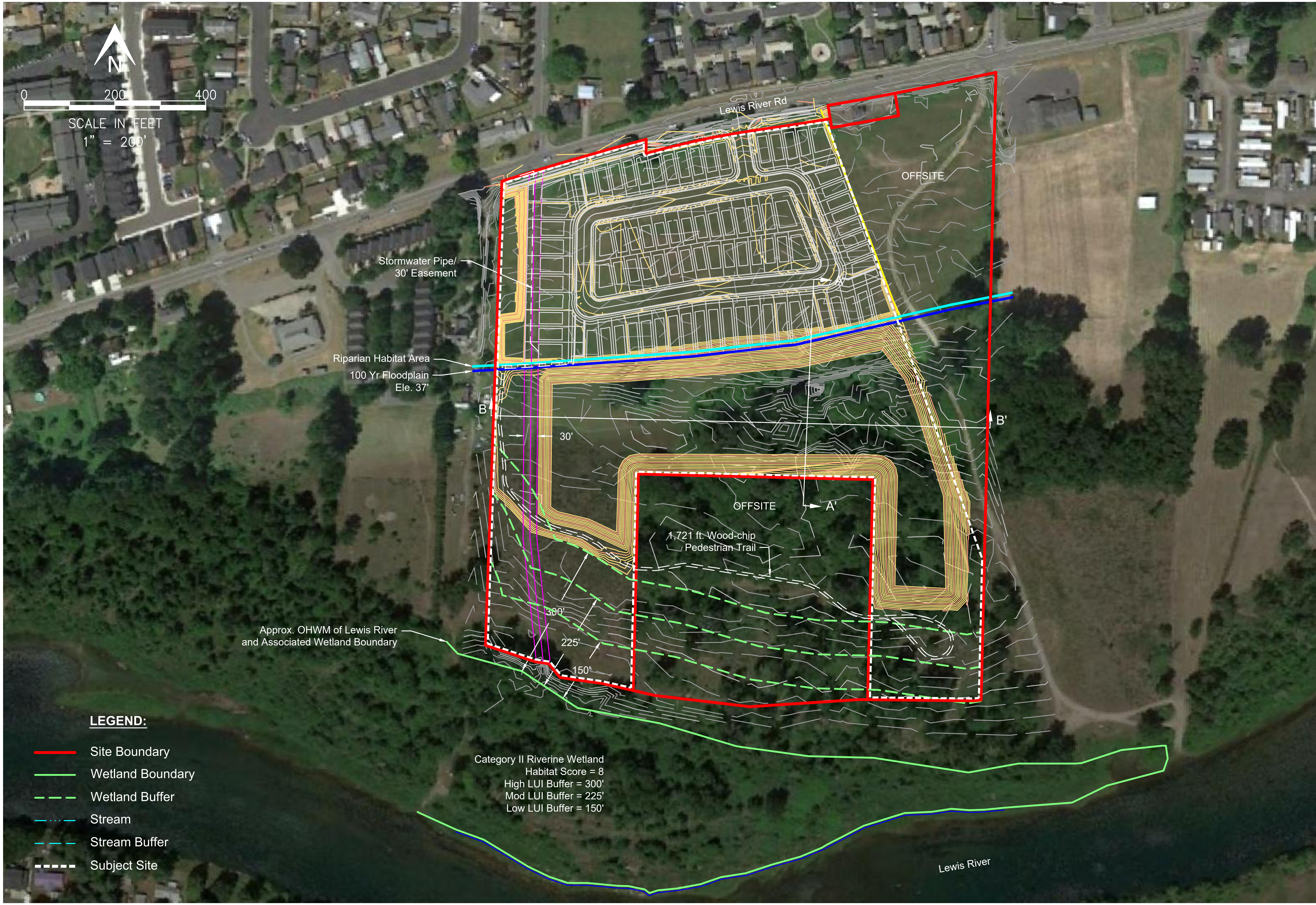

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz
FIGURE: 10
DATE: 4-11-24
STATE: WA

PROPOSED SITE PLAN & PROJECT IMPACTS
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500
SITE ADDRESS: 1940 Lewis River Rd.

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

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PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 11
DATE: 4-11-24

VEGETATION IMPACTS
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500
SITE ADDRESS: 1940 Lewis River Rd.

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

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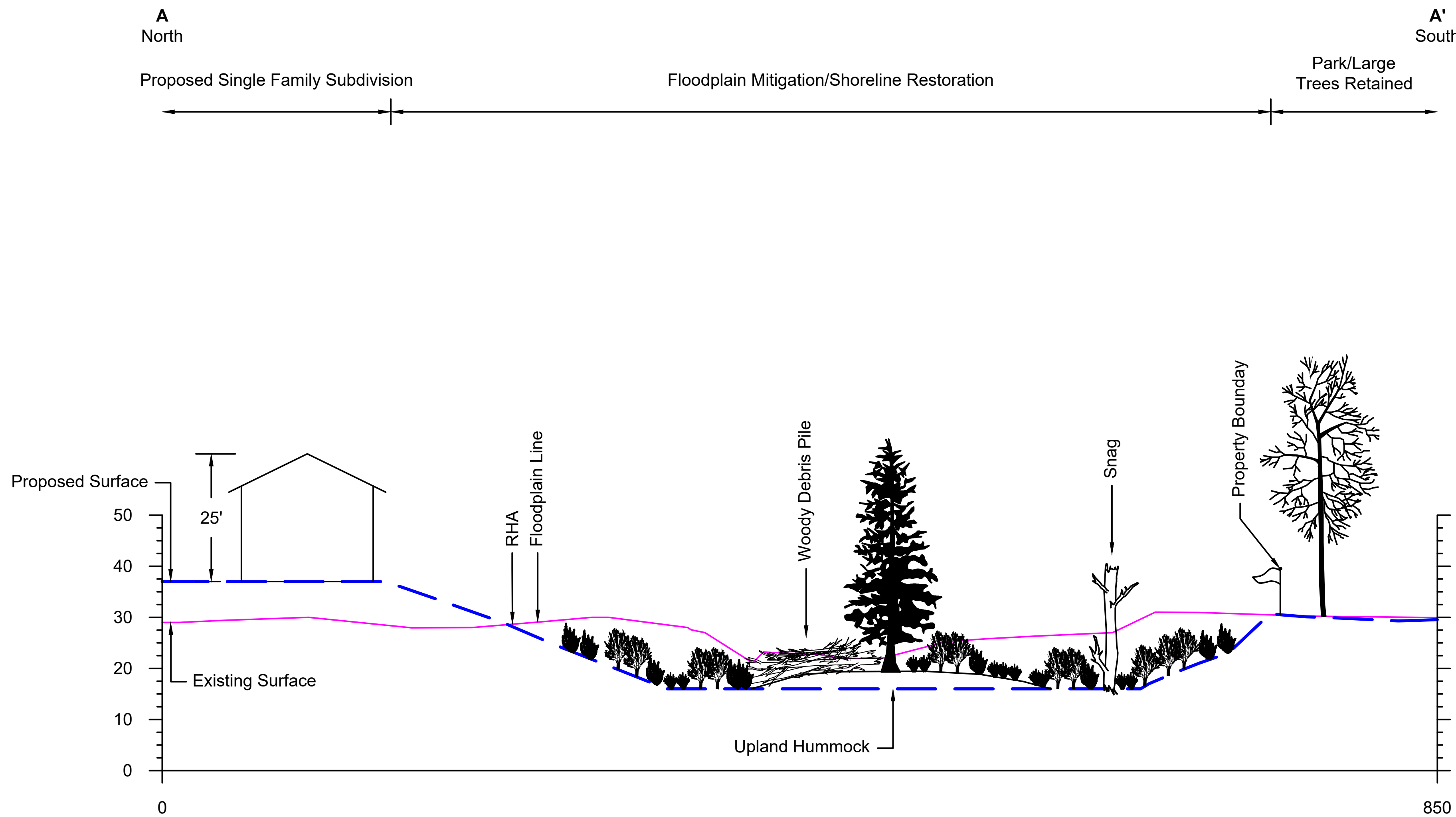
PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz
FIGURE: 12
DATE: 4-11-24
STATE: WA

RESTORATION PLAN
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500
SITE ADDRESS: 1940 Lewis River Rd.

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

AshECO SOLUTIONS, LLC



0 60 120

HORIZONTAL SCALE IN FEET

1" = 60'

AshECO SOLUTIONS, LLC

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

CROSS SECTION A-A'
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500

SITE ADDRESS: 1940 Lewis River Rd.

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 13
DATE: 4-11-24

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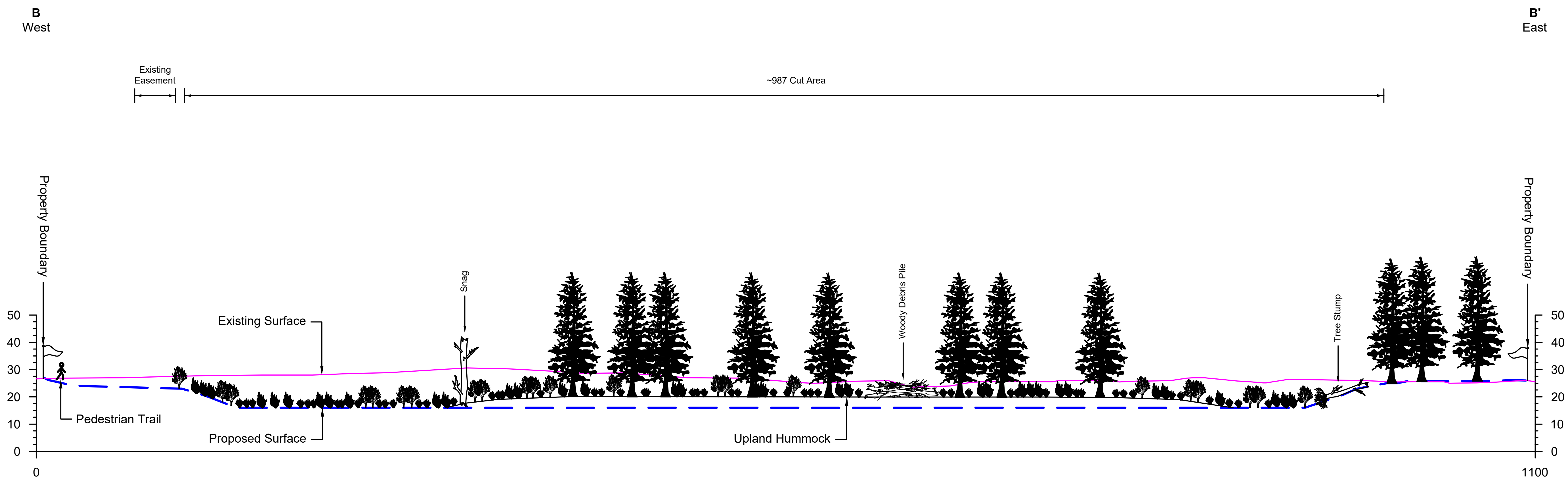

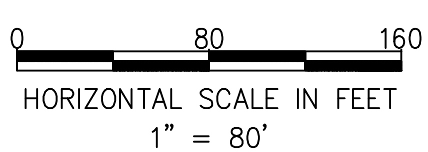

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AshECO SOLUTIONS, LLC

PURPOSE: XX
Line 1
Line 2
DATUM: NAVD 88
ADJACENT PROPERTY OWNERS:
Adj 1
Adj 2

CROSS SECTION B-B'
APPLICANT: Timberland, Inc.
PROJECT NAME: Lewis River Subdivision
PARCELS #: 50650, 506520300, 506520400, 506520500
SITE ADDRESS: 1940 Lewis River Rd.

PROPOSED: XX
Add 2
IN: Woodland
NEAR: XX
COUNTY: Cowlitz **STATE:** WA
FIGURE: 14
DATE: 4-11-24

Appendix A

Site Photos

Photo 1.
View north across northern field onsite. Single-family residences present north of Lewis River Road are visible in the distance. The open field represents the existing conditions over the bulk of the project site and proposed restoration area.

Photo 2.
View east across northern field and the northern limits of the existing treeline.

Photo 3.
View down one of the unauthorized access roads present onsite that has been historically used by the public to gain access to the site and Lewis River shoreline.

Photo 4.
Photo of the invasive Scotch broom present onsite within the sparse shrub layer. The taller tree in upper left of photo is being overcome by invasive English ivy. Both are common sights across the site.

Photo 5.
Photo of the invasive Scotch broom present onsite within more open western portion of the site.

Photo 6.
Photo of the dense invasive Scotch broom presence onsite along the stormwater outfall easement area. The existing access road to the outfall location is visible in the lower left of the photo.

View of the existing stormwater outfall onsite. The stormwater conveyed from the development north of Lewis River Rd.

Photo 7.
Representative photo of the Lewis River Type S Water present directly offsite to the south. A riverine wetland flanks the river. There is currently no dedicated public access present.

Photo 8.
Representative photo of invasive/non-native species present onsite; English ivy, Himalayan blackberry, and potato vine.

Photo 9.
Representative photo of invasive/non-native species present onsite; English ivy, English hawthorn.

Photo 10.
Representative photo of invasive/non-native species present onsite (English ivy). The ivy is overcoming many trees and shrubs onsite.

Photo 11.
Representative photo of invasive/non-native Old man's beard (Clematis vitalba) that is overcoming many trees and shrubs onsite.

Photo 12.
Representative photo of the fairly open and unstructured understory generally present over a large portion of the site. There is a lack of dense native shrubs and variety of coniferous and deciduous tree species with invasives filling in the open areas.

Appendix B

Test Plot Data Sheets & Vegetation Plot Data

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Timberland - Lewis River City/County: Clark Sampling Date: 9/14/2022
Applicant/Owner: Luke Sasse - Timberalnd Inc. State: WA Sampling Point: TP-1
Investigator(s): Andrea Aberle Section, Township, Range: S47, T5N, R1E
Landform (hillslope, terrace, etc.): hillslope Local relief: Concave Slope (%): 0-8%
Subregion (LRR): LRR A Lat: 45.920273 Long: 122.730763 Datum: NAD 83
Soil Map Unit Name: 141, 160, 172 NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain Remarks.)
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☒ No ☐	**Is the Sampled Area within a Wetland?** **Yes ☒ No ☐**
Hydric Soils Present?	Yes ☒ No ☐	
Wetland Hydrology Present?	Yes ☒ No ☐	

Remarks: South of Flag OHWM #5

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.	%		
2.	%		
3.	%		
4.	%		
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Salix lasiandra*	40%	yes	FACW
2. *Cornus sericea*	15%	yes	FACW
3. *Spiraea douglasii*	10%	no	FACW
4. *Rosa nutkana*	10%	no	FAC
5.	%		
Total Cover:	75%		
Herb Stratum			
1. *Phalaris arundinacea*	60%	yes	FACW
2.	%		
3.	%		
4.	%		
5.	%		
6.	%		
7.	%		
8.	%		
Total Cover:	60%		
Woody Vine Stratum			
1.	%		
2.	%		
Total Cover:	%		

% Bare Ground in Herb Stratum ____%

Dominance Test Worksheet

Number of Dominant Species That Are OBL, FACW, or FAC:	**3**	(A)
Total Number of Dominant Species Across All Strata:	3	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC	100%	(A/B)

Prevalence Index worksheet

Total % Cover of:		Multiply by:	
OBL species		x 1=	
FACW species		x 2=	
FAC species		x 3=	
FACU species		x 4=	
UPL species		x 5=	
Column Totals:		(A)	(B)

Prevalence Index = B/A=______

Hydrophytic Vegetation Indicators:

☒ Dominance Test is >50%
☐ Prevalence Index is ≤3.0[1]
☐ Morphological Adaptations[1] (Providing supporting data In Remarks or on a separate sheet)
☐ Wetland Non-Vascular Plants[1]
☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? **Yes ☒ No ☐**

Remarks:

SOIL

Sampling Point: TP-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-16	10YR 4/1	95%	7.5YR 4/6	5%	C	PL	L	
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosal
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Minerals (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present

Restrictive Layer (if present):

Type: ______

Depth (inches):_____

Hydric Soil Present? Yes☒ No☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9) (**except NW coast**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☒ Oxidized Rhizoshperes along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☒ Water Stained Leaves
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☒ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D2)
- ☐ Frost-Heave Hummocks (D4)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)

Field Observations:

Surface Water Present?	Yes ☐	No ☒	Depth (Inches): _____
Water Table Present?	Yes ☐	No ☒	Depth (Inches): _____
Saturation Present? (Includes capillary fringe)	Yes ☐	No ☒	Depth (Inches): _____

Wetland Hydrology Present? Yes ☒ No ☐

Describe Recorded Data (Stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

The three wetland criteria have been met.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Timberland - Lewis River City/County: Clark Sampling Date: 9/14/2022
Applicant/Owner: Luke Sasse - Timberalnd Inc. State: WA Sampling Point: TP-2
Investigator(s): Andrea Aberle Section, Township, Range: S47, T5N, R1E
Landform (hillslope, terrace, etc.): hillslope Local relief: Concave Slope (%): 0-8%
Subregion (LRR): LRR A Lat: 45.920273 Long: 122.730763 Datum: NAD 83
Soil Map Unit Name: 141, 160, 172 NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain Remarks.)
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☒	No ☐	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒
Hydric Soils Present?	Yes ☐	No ☒	
Wetland Hydrology Present?	Yes ☐	No ☒	

Remarks:

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.	%		
2.	%		
3.	%		
4.	%		
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Corylus cornuta*	15%	yes	FACU
2. *Cytisus scoparius*	15%	yes	FACU
3. *Populus trichocarpa (saplings)*	10%	yes	FAC
4. *Fraxinus latifolia (saplings)*	10%	yes	FACW
5.	%		
Total Cover:	50%		
Herb Stratum			
1. *Anthoxanthum odoratum*	15%	yes	FACU
2. *Agrostis capillaris*	10%	yes	FAC
3. *Holcus lanatus*	10%	yes	FAC
4. *Danthonia californica*	5%	yes	FAC
5. *Rumex acetosella*	5%	yes	FACU
6. *Vicia sativa*	5%	yes	UPL
7.	%		
8.	%		
Total Cover:	50%		
Woody Vine Stratum			
1. *Rubus armeniacus*	10%	yes	FAC
2.	%		
Total Cover:	10%		

% Bare Ground in Herb Stratum ____%

Dominance Test Worksheet

Number of Dominant Species That Are OBL, FACW, or FAC:	**6**	(A)
Total Number of Dominant Species Across All Strata:	11	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC	55%	(A/B)

Prevalence Index worksheet

Total % Cover of:		Multiply by:	
OBL species		x 1=	
FACW species		x 2=	
FAC species		x 3=	
FACU species		x 4=	
UPL species		x 5=	
Column Totals:		(A)	(B)

Prevalence Index = B/A=________

Hydrophytic Vegetation Indicators:

☒ Dominance Test is >50%
☐ Prevalence Index is ≤3.0[1]
☐ Morphological Adaptations[1] (Providing supporting data In Remarks or on a separate sheet)
☐ Wetland Non-Vascular Plants[1]
☐ Problematic Hydrophytic Vegetation[1] (Explain)

Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? **Yes** ☒ **No** ☐

Remarks:

SOIL

Sampling Point: TP-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16	10YR 4/1	100%		%			Sand	Riverwash sand
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosal
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Minerals (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present

Restrictive Layer (if present):

Type: _____

Depth (inches):_____

Hydric Soil Present? Yes☐ No☒

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9) (**except NW coast**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizoshperes along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D2)
- ☐ Frost-Heave Hummocks (D4)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)

Field Observations:

Surface Water Present?	Yes ☐	No ☒	Depth (Inches): _____
Water Table Present?	Yes ☐	No ☒	Depth (Inches): _____
Saturation Present? (Includes capillary fringe)	Yes ☐	No ☒	Depth (Inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (Stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

The three wetland criteria have NOT been met.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Timberland - Lewis River City/County: Clark Sampling Date: 9/14/2022
Applicant/Owner: Luke Sasse - Timberalnd Inc. State: WA Sampling Point: TP-3
Investigator(s): Andrea Aberle Section, Township, Range: S47, T5N, R1E
Landform (hillslope, terrace, etc.): hillslope Local relief: Concave Slope (%): 0-8%
Subregion (LRR): LRR A Lat: 45.920273 Long: 122.730763 Datum: NAD 83
Soil Map Unit Name: 141, 160, 172 NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain Remarks.)
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐ Hydric Soils Present? Yes ☒ No ☐ Wetland Hydrology Present? Yes ☒ No ☐	**Is the Sampled Area within a Wetland? Yes ☒ No ☐**

Remarks: Near Flag OHWM #13

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Fraxinus latifolia*	30%	yes	FACW
2.	%		
3.	%		
4.	%		
Total Cover:	30%		
Sapling/Shrub Stratum			
1. *Cornus sericea*	25%	yes	FACW
2. *Spiraea douglasii*	10%	yes	FACW
3. *Symphoricarpos albus*	10%	yes	FACU
4.	%		
5.	%		
Total Cover:	45%		
Herb Stratum			
1. *Carex obnupta*	25%	yes	FACW
2. *Phalaris arundinacea*	20%	yes	FACW
3. *Rubus ursinus*	10%	yes	FACU
4.	%		
5.	%		
6.	%		
7.	%		
8.	%		
Total Cover:	55%		
Woody Vine Stratum			
1.	%		
2.	%		
Total Cover:	%		

% Bare Ground in Herb Stratum ____%

Dominance Test Worksheet

Number of Dominant Species That Are OBL, FACW, or FAC: **5** (A)
Total Number of Dominant Species Across All Strata: 7 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 71% (A/B)

Prevalence Index worksheet

Total % Cover of:		Multiply by:	
OBL species		x 1=	
FACW species		x 2=	
FAC species		x 3=	
FACU species		x 4=	
UPL species		x 5=	
Column Totals:		(A)	(B)

Prevalence Index = B/A=______

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Providing supporting data In Remarks or on a separate sheet)
- ☐ Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ☒ No ☐

Remarks:

SOIL

Sampling Point: TP-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-16	10YR 4/1	85%		%			L	Mixed Matrix
0-16	7.5YR 4/6	15%		%			L	Mixed Matrix
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosal
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Minerals (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present

Restrictive Layer (if present):

Type: ______

Depth (inches):_____

Hydric Soil Present? Yes☒ No☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9) (**except NW coast**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☒ Oxidized Rhizoshperes along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☒ Water Stained Leaves
- ☒ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☒ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D2)
- ☐ Frost-Heave Hummocks (D4)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)

Field Observations:

Surface Water Present?	Yes ☐	No ☒	Depth (Inches): _____
Water Table Present?	Yes ☐	No ☒	Depth (Inches): _____
Saturation Present? (Includes capillary fringe)	Yes ☒	No ☐	Depth (Inches): 0

Wetland Hydrology Present? Yes ☒ No ☐

Describe Recorded Data (Stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
The three wetland criteria have been met.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Timberland - Lewis River City/County: Clark Sampling Date: 9/14/2022
Applicant/Owner: Luke Sasse - Timberalnd Inc. State: WA Sampling Point: TP-4
Investigator(s): Andrea Aberle Section, Township, Range: S47, T5N, R1E
Landform (hillslope, terrace, etc.): hillslope Local relief: Concave Slope (%): 0-8%
Subregion (LRR): LRR A Lat: 45.920273 Long: 122.730763 Datum: NAD 83
Soil Map Unit Name: 141, 160, 172 NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain Remarks.)
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☐	No ☒	**Is the Sampled Area within a Wetland?** **Yes** ☐ **No** ☒
Hydric Soils Present?	Yes ☐	No ☒	
Wetland Hydrology Present?	Yes ☐	No ☒	

Remarks:

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Populus trichocarpa*	30%	yes	FAC
2. *Fraxinus latifolia*	20%	yes	FACW
3.	%		
4.	%		
Total Cover:	50%		
Sapling/Shrub Stratum			
1. *Oemleria cerasiformis*	20%	yes	FACU
2. *Symphoricarpos albus*	20%	yes	FACU
3. *Mahonia aquifolium*	5%	yes	FACU
4.	%		
5.	%		
Total Cover:	45%		
Herb Stratum			
1. *Dactylis glomerata*	10%	yes	FACU
2. *Rubus ursinus*	10%	yes	FACU
3.	%		
4.	%		
5.	%		
6.	%		
7.	%		
8.	%		
Total Cover:	20%		
Woody Vine Stratum			
1. *Rubus armeniacus*	10%	yes	FAC
2.	%		
Total Cover:	10%		

% Bare Ground in Herb Stratum ____%

Dominance Test Worksheet

Number of Dominant Species That Are OBL, FACW, or FAC:	**3**	(A)
Total Number of Dominant Species Across All Strata:	8	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC	37%	(A/B)

Prevalence Index worksheet

Total % Cover of:		Multiply by:	
OBL species		x 1=	
FACW species	20	x 2=	40
FAC species	40	x 3=	120
FACU species	65	x 4=	260
UPL species		x 5=	
Column Totals:	125 (A)		420 (B)

Prevalence Index = B/A= 3.36

Hydrophytic Vegetation Indicators:
- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Providing supporting data In Remarks or on a separate sheet)
- ☐ Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks:

SOIL

Sampling Point: TP-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-16	10YR 3/2	100%		%			L	Sandy
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				
		%		%				

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosal
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Minerals (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present

Restrictive Layer (if present):

Type: ______

Depth (inches):_____

Hydric Soil Present? Yes☐ No☒

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9) (**except NW coast**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizoshperes along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D2)
- ☐ Frost-Heave Hummocks (D4)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)

Field Observations:

Surface Water Present?	Yes ☐	No ☒	Depth (Inches): _____
Water Table Present?	Yes ☐	No ☒	Depth (Inches): _____
Saturation Present? (Includes capillary fringe)	Yes ☐	No ☒	Depth (Inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (Stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
The three wetland criteria have NOT been met.

Vegetation Plot Data - Lewis River Site

<u>VP#1</u>
^Mature Cottonwood x2
^Oregon ash saplings (2-4in)
*English hawthorn
Black (Douglas) hawthorn
Pacific ninebark
Snowberry
Velvetgrass
*Scotch broom!
Lanceleaf plantain
Orchard grass
Hairy cat's ear
Oatgrass
Sheep sorrel

<u>VP#2 (Large opening in the canopy at least 100ft diameter – sparce tree and shrub vegetation)</u>
^Sparce cottonwood trees
^Oregon ash saplings
*Scotch Broom!
Beaked hazelnut
Tall Oregon grape
Manroot
Indian plum
Trailing blackberry
*Himalayan blackberry
Sweet vernal grass
Velvet grass
Sheep sorrel
^Oregon white oak sapling
(no jurisdictionsl oak habitat will be impacted)

<u>VP#3 (Includes 150ft towards the River)</u>
*J. knotweed island
^Mature cottonwoods
^Oregon ash
Beaked hazelnut
Snowberry
*Himalayan blackberry
Black (Douglas) hawthorn
Pacific ninebark
*Reed canarygrass
Bentgrass
Old man's beard

<u>VP#4 (Central open area along trail – Woodland property)</u>
^B. cottonwood
*Scotch broom!
Black (Douglas) hawthorn
*Himalayan blackberry
Bracken fern
Bentgrass
Beaked hazelnut
Common St Johnswort
Perennial ryegrass
Trailing blackberry

<u>VP#5</u>
Tall Oregon grape
Trailing blackberry
Bracken fern
Pacific crabapple
Black (Douglas) hawthorn
Gooseberry

<u>VP#6 (Along trail- Dense shrubs)</u>
^B. cottonwoods
Pacific crabapple
*English holly
Tall Oregon grape
Beaked hazelnut
Indian plum
Snowberry
Black (Douglas) hawthorn
Swordfern
Trailing blackberry
*Himalayan blackberry
*English ivy (densely growing up large tree)

<u>VP#7</u>
*Scotch broom!
Sheep sorrel
Sweet vernal grass
Bentgrass
Oxeye daisy
Hairy cat's ear
Brackenfern
Rabbitfoot clover

<u>VP#8 (Approximate open 100 ft radius)</u>
*Scotch broom!
Sweet vernal grass
^B. cottonwood saplings
^O. ash saplings
Sheet sorrel
Trailing blackberry
Common St Johnswort

<u>VP#9</u>
*Himalayan blackberry!
Beaked hazelnut
Mature cottonwood
*Scotch broom
Manroot
Goldenrod

Vegetation	VP#1	VP#2 (Opening in the canopy ~100ft diameter – sparce veg)	VP#3 (~150ft towards River)	VP#4 (Opening along trail - Woodland property)	VP#5	VP#6 (Along trail – dense shrub)	VP#7	VP#8 (Canopy opening ~100ft diameter – sparce veg)	VP#9
^Black Cottonwood (*Populus trichocarpa*)									
*Scotch broom (*Cytisus scoparius)*									
*Himalayan blackberry (*Rubus armeniacus)*									
Beaked hazelnut (*Corylus cornuta)*									
Black (Douglas) hawthorn (*Crataegus douglasii)*									
Trailing blackberry (*Rubus ursinus)*									
^Oregon ash (*Fraxinus latifolia)*									
Sheep sorrel (*Rumex acetosella)*									
Snowberry (*Symphoricarpos albus)*									
Tall Oregon grape (*Mahonia aquifolium)*									
Bracken fern (*Pteridium aquilinum)*									
Bentgrass (*Agrostis capillaris)*									
Sweet vernalgrass (*Anthoxanthum odoratum)*									
Pacific crabapple (*Malus fusca)*									
Pacific ninebark (*Physocarpus capitatus)*									
Indian plum (*Oemleria cerasiformis)*									
Manroot (*Marah oreganus)*									
St Johnswort (*Hypericum perforatum)*									
Hairy cat's ear (*Hypochaeris radicata)*									
Velvet grass (*Holcus lanatus)*									
*English hawthorn (*Crataegus monogyna)*									
*English ivy (*Hedera helix*)									
^Oregon white oak (*Quercus garryana) -saplings*									
*English holly (*Ilex aquifolium)*									
Gooseberry (*Ribes lacustre)*									
*Japanese Knotweed (*Polygonum cuspidatum)*									
Swordfern (*Polystichum munitum)*									
Goldenrod (*Solidago canadensis)*									
Rabbitfoot clover (*Trifolium arvense)*									
Oxeye daisy (*Leucanthemum vulgare)*									
Perennial ryegrass (*Lolium perenne)*									
*Old man's beard (*Clematis vitalba)*									
*Reed canarygrass (*Phalaris arundinacea)*									
Oatgrass (*Danthonia californica)*									
Orchard grass (*Dactylis glomerata)*									
Lanceleaf plantain (*Plantago lanceolata)*									

(*) = Invasive. Noxious, or non-native species

(^) = Tree Species providing forested canopy

Appendix C

Wetland Rating Form and Figures
(Off site)

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland A Date of site visit: 5/25/22

Rated by Mackenzie Stamey Trained by Ecology? ✓ Yes ___No Date of training 10/20

HGM Class used for rating Riverine Wetland has multiple HGM classes? ✓ Y ____N

NOTE: **Form is not complete without the figures requested** *(figures can be combined)*.

Source of base aerial photo/map Google Earth

OVERALL WETLAND CATEGORY II (based on functions ✓ or special characteristics___)

1. Category of wetland based on FUNCTIONS

_______**Category I** – Total score = 23 - 27

✓ **Category II** – Total score = 20 - 22

_______**Category III** – Total score = 16 - 19

_______**Category IV** – Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
			Circle the appropriate ratings	
Site Potential	H **M** L	H **M** L	**H** M L	
Landscape Potential	**H** M L	H **M** L	H **M** L	
Value	H M **L**	**H** M L	**H** M L	**TOTAL**
Score Based on Ratings	6	7	8	21

Score for each function based on three ratings
(order of ratings is not important)

9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	I II
Wetland of High Conservation Value	I
Bog	I
Mature Forest	I
Old Growth Forest	I
Coastal Lagoon	I II
Interdunal	I II III IV
None of the above	

Maps and figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	
Hydroperiods	D 1.4, H 1.2	
Location of outlet (*can be added to map of hydroperiods)*	D 1.1, D 4.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	D 2.2, D 5.2	
Map of the contributing basin	D 4.3, D 5.3	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	WRF Fig 1
Hydroperiods	H 1.2	WRF Fig 2
Ponded depressions	R 1.1	WRF Fig 2
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	R 2.4	WRF Fig 1
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	WRF Fig 1
Width of unit vs. width of stream *(can be added to another figure)*	R 4.1	WRF Fig 2
Map of the contributing basin	R 2.2, R 2.3, R 5.2	WRF Fig 2
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	WRF Fig 3
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	R 3.1	WRF Fig 4
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	WRF Fig 4

Lake Fringe Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	L 1.1, L 4.1, H 1.1, H 1.4	
Plant cover of trees, shrubs, and herbaceous plants	L 1.2	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	L 2.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	L 3.1, L 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	L 3.3	

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of **dense** trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of **dense, rigid** trees, shrubs, and herbaceous plants (*can be added to figure above)*	S 4.1	
Boundary of 150 ft buffer (can be added to another figure)	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

HGM Classification of Wetlands in Western Washington

For questions 1-7, the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

NO – go to 2 **YES –** the wetland class is **Tidal Fringe –** go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

NO – Saltwater Tidal Fringe (Estuarine) **YES – Freshwater Tidal Fringe**
*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is an **Estuarine** wetland and is not scored. This method **cannot** be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

NO – go to 3 **YES –** The wetland class is **Flats**
*If your wetland can be classified as a Flats wetland, use the form for **Depressional** wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?
   ___The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;
   ___At least 30% of the open water area is deeper than 6.6 ft (2 m).

NO – go to 4 **YES –** The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?
   ✓The wetland is on a slope (*slope can be very gradual*),
   ___The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks,
   ✓The water leaves the wetland **without being impounded**.

NO – go to 5 **YES –** The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?
   ✓The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,
   ✓The overbank flooding occurs at least once every 2 years.

NO – go to 6 **YES** – The wetland class is **Riverine**
NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

NO – go to 7 **YES** – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

NO – go to 8 **YES** – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

If you are still unable to determine which of the above criteria apply to your wetland, or if you have ***more than 2 HGM classes*** *within a wetland boundary, classify the wetland as Depressional for the rating.*

Wetland name or number _____

RIVERINE AND FRESHWATER TIDAL FRINGE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

R 1.0. Does the site have the potential to improve water quality?		
R 1.1. Area of surface depressions within the Riverine wetland that can trap sediments during a flooding event: Depressions cover > $^3/_4$ area of wetland Depressions cover > ½ area of wetland Depressions present but cover < ½ area of wetland No depressions present	 points = 8 points = 4 points = 2 points = 0	2
R 1.2. Structure of plants in the wetland (areas with >90% cover at person height, **not** Cowardin classes) Trees or shrubs > $^2/_3$ area of the wetland Trees or shrubs > $^1/_3$ area of the wetland Herbaceous plants (> 6 in high) > $^2/_3$ area of the wetland Herbaceous plants (> 6 in high) > $^1/_3$ area of the wetland Trees, shrubs, and ungrazed herbaceous < $^1/_3$ area of the wetland	 points = 8 points = 6 points = 6 points = 3 points = 0	8
Total for R 1	Add the points in the boxes above	10

Rating of Site Potential If score is:___**12-16 = H** ✓**6-11 = M** ___**0-5 = L** *Record the rating on the first page*

R 2.0. Does the landscape have the potential to support the water quality function of the site?		
R 2.1. Is the wetland within an incorporated city or within its UGA?	Yes = 2 No = 0	2
R 2.2. Does the contributing basin to the wetland include a UGA or incorporated area?	Yes = 1 No = 0	1
R 2.3. Does at least 10% of the contributing basin contain tilled fields, pastures, or forests that have been clearcut within the last 5 years?	Yes = 1 No = 0	1
R 2.4. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants?	Yes = 1 No = 0	0
R 2.5. Are there other sources of pollutants coming into the wetland that are not listed in questions R 2.1-R 2.4 Other sources watefowl, wildlife, fishermen/unauthorized boat launch	Yes = 1 No = 0	1
Total for R 2	Add the points in the boxes above	5

Rating of Landscape Potential If score is:✓**3-6 = H** ___**1 or 2 = M** ___**0 = L** *Record the rating on the first page*

R 3.0. Is the water quality improvement provided by the site valuable to society?		
R 3.1. Is the wetland along a stream or river that is on the 303(d) list or on a tributary that drains to one within 1 mi?	Yes = 1 No = 0	0
R 3.2. Is the wetland along a stream or river that has TMDL limits for nutrients, toxics, or pathogens?	Yes = 1 No = 0	0
R 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality? (*answer YES if there is a TMDL for the drainage in which the unit is found*)	Yes = 2 No = 0	0
Total for R 3	Add the points in the boxes above	

Rating of Value If score is:___**2-4 = H** ___**1 = M** ✓**0 = L** *Record the rating on the first page*

Wetland name or number _____

RIVERINE AND FRESHWATER TIDAL FRINGE WETLANDS

Hydrologic Functions - Indicators that site functions to reduce flooding and stream erosion

R 4.0. Does the site have the potential to reduce flooding and erosion?	
R 4.1. Characteristics of the overbank storage the wetland provides: *Estimate the average width of the wetland perpendicular to the direction of the flow and the width of the stream or river channel (distance between banks). Calculate the ratio: (average width of wetland)/(average width of stream between banks).* If the ratio is more than 20 — points = 9 If the ratio is 10-20 — points = 6 If the ratio is 5-<10 — 360 ft (wetland) / 298 ft (stream) = 1.21 — points = 4 If the ratio is 1-<5 — points = 2 If the ratio is < 1 — points = 1	2
R 4.2. Characteristics of plants that slow down water velocities during floods: *Treat large woody debris as forest or shrub. Choose the points appropriate for the best description (polygons need to have >90% cover at person height. These are NOT Cowardin classes).* Forest or shrub for >$^1/_3$ area OR emergent plants > $^2/_3$ area — points = 7 Forest or shrub for > $^1/_{10}$ area OR emergent plants > $^1/_3$ area — points = 4 Plants do not meet above criteria — points = 0	7
Total for R 4 — Add the points in the boxes above	9

Rating of Site Potential If score is:___**12-16 = H** ✓**6-11 = M** ___**0-5 = L** *Record the rating on the first page*

R 5.0. Does the landscape have the potential to support the hydrologic functions of the site?	
R 5.1. Is the stream or river adjacent to the wetland downcut? Yes = 0 No = 1	1
R 5.2. Does the up-gradient watershed include a UGA or incorporated area? Yes = 1 No = 0	1
R 5.3. Is the up-gradient stream or river controlled by dams? Yes = 0 No = 1	0
Total for R 5 — Add the points in the boxes above	2

Rating of Landscape Potential If score is:___**3 = H** ✓**1 or 2 = M** ___**0 = L** *Record the rating on the first page*

R 6.0. Are the hydrologic functions provided by the site valuable to society?	
R 6.1. Distance to the nearest areas downstream that have flooding problems? *Choose the description that best fits the site*. The sub-basin immediately down-gradient of the wetland has flooding problems that result in damage to human or natural resources (e.g., houses or salmon redds) — points = 2 Surface flooding problems are in a sub-basin farther down-gradient — points = 1 No flooding problems anywhere downstream — points = 0	2
R 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for R 6 — Add the points in the boxes above	2

Rating of Value If score is:✓**2-4 = H** ___**1 = M** ___**0 = L** *Record the rating on the first page*

Wetland name or number _____

These questions apply to wetlands of all HGM classes.

HABITAT FUNCTIONS - Indicators that site functions to provide important habitat

H 1.0. Does the site have the potential to provide habitat?

H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class.* Check the Cowardin plant classes in the wetland. *Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.*

____Aquatic bed	4 structures or more: points = 4	4
✓ Emergent	3 structures: points = 2	
✓ Scrub-shrub (areas where shrubs have > 30% cover)	2 structures: points = 1	
✓ Forested (areas where trees have > 30% cover)	1 structure: points = 0	

If the unit has a Forested class, check if:

✓ The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon

H 1.2. Hydroperiods

Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*).

____Permanently flooded or inundated	4 or more types present: points = 3	3
✓ Seasonally flooded or inundated	3 types present: points = 2	
✓ Occasionally flooded or inundated	2 types present: points = 1	
✓ Saturated only	1 type present: points = 0	
✓ Permanently flowing stream or river in, or adjacent to, the wetland		
____Seasonally flowing stream in, or adjacent to, the wetland		
____**Lake Fringe wetland**	**2 points**	
____**Freshwater tidal wetland**	**2 points**	

H 1.3. Richness of plant species

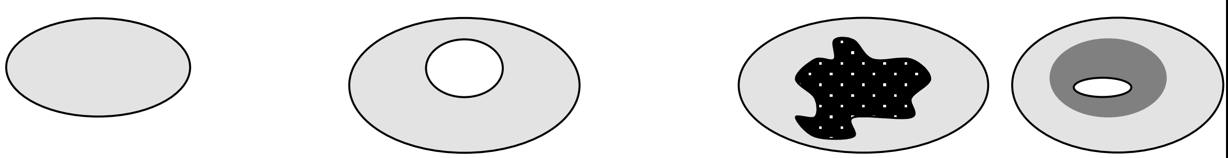
Count the number of plant species in the wetland that cover at least 10 ft^2.

Different patches of the same species can be combined to meet the size threshold and you do not have to name the species. ***Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle***

If you counted: > 19 species	points = 2	2
5 - 19 species	points = 1	
< 5 species	points = 0	

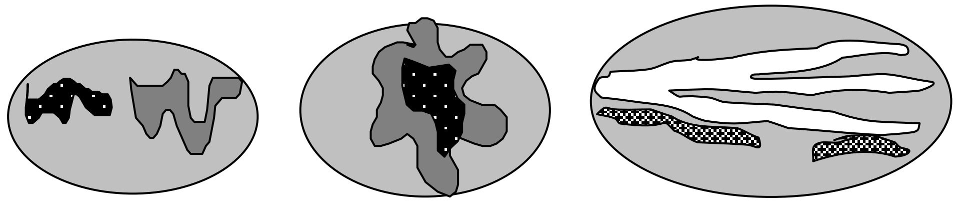
H 1.4. Interspersion of habitats

Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*



None = 0 points **Low** = 1 point **Moderate** = 2 points

All three diagrams in this row are **HIGH** = 3points



3

H 1.5. Special habitat features: Check the habitat features that are present in the wetland. *The number of checks is the number of points.* ✓ Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long). ✓ Standing snags (dbh > 4 in) within the wetland ____Undercut banks are present for at least 6.6 ft (2 m) **and/or** overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m) ✓ Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present *(cut shrubs or trees that have not yet weathered where wood is exposed)* ✓ At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated *(structures for egg-laying by amphibians)* ____Invasive plants cover less than 25% of the wetland area in every stratum of plants (*see H 1.1 for list of strata*)	4
Total for H 1 — Add the points in the boxes above	16

Rating of Site Potential If score is: ✓ **15-18 = H** ____**7-14 = M** ____**0-6 = L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat functions of the site?

H 2.1. Accessible habitat (include *only habitat that directly abuts wetland unit*). *Calculate:* % undisturbed habitat 1.4 + [(% moderate and low intensity land uses)/2] 3.02 = 4.42 % If total accessible habitat is: > $^{1}/_{3}$ (33.3%) of 1 km Polygon — points = 3 20-33% of 1 km Polygon — points = 2 10-19% of 1 km Polygon — points = 1 < 10% of 1 km Polygon — points = 0	0
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* % undisturbed habitat 21.5 + [(% moderate and low intensity land uses)/2] 15.8 = 37.3 % Undisturbed habitat > 50% of Polygon — points = 3 Undisturbed habitat 10-50% and in 1-3 patches — points = 2 Undisturbed habitat 10-50% and > 3 patches — points = 1 Undisturbed habitat < 10% of 1 km Polygon — points = 0	1
H 2.3. Land use intensity in 1 km Polygon: If > 50% of 1 km Polygon is high intensity land use — points = (- 2) ≤ 50% of 1 km Polygon is high intensity — points = 0	0
Total for H 2 — Add the points in the boxes above	1

Rating of Landscape Potential If score is:____**4-6 = H** ✓ **1-3 = M** ____**< 1 = L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?

H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose only the highest score that applies to the wetland being rated.* Site meets ANY of the following criteria: — points = 2 ✓ It has 3 or more priority habitats within 100 m (see next page) — It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) — It is mapped as a location for an individual WDFW priority species — It is a Wetland of High Conservation Value as determined by the Department of Natural Resources — It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats (listed on next page) within 100 m — points = 1 Site does not meet any of the criteria above — points = 0	2

Rating of Value If score is: ✓ **2 = H** ____**1 = M** ____**0 = L** *Record the rating on the first page*

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here: http://wdfw.wa.gov/conservation/phs/list/)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: ***NOTE:*** *This question is independent of the land use between the wetland unit and the priority habitat.*

— **Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).

— **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).

— **Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock.

— **Old-growth/Mature forests:** Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.

— **Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).

✓ **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.

— **Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).

✓ **Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.

— **Nearshore**: Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page).*

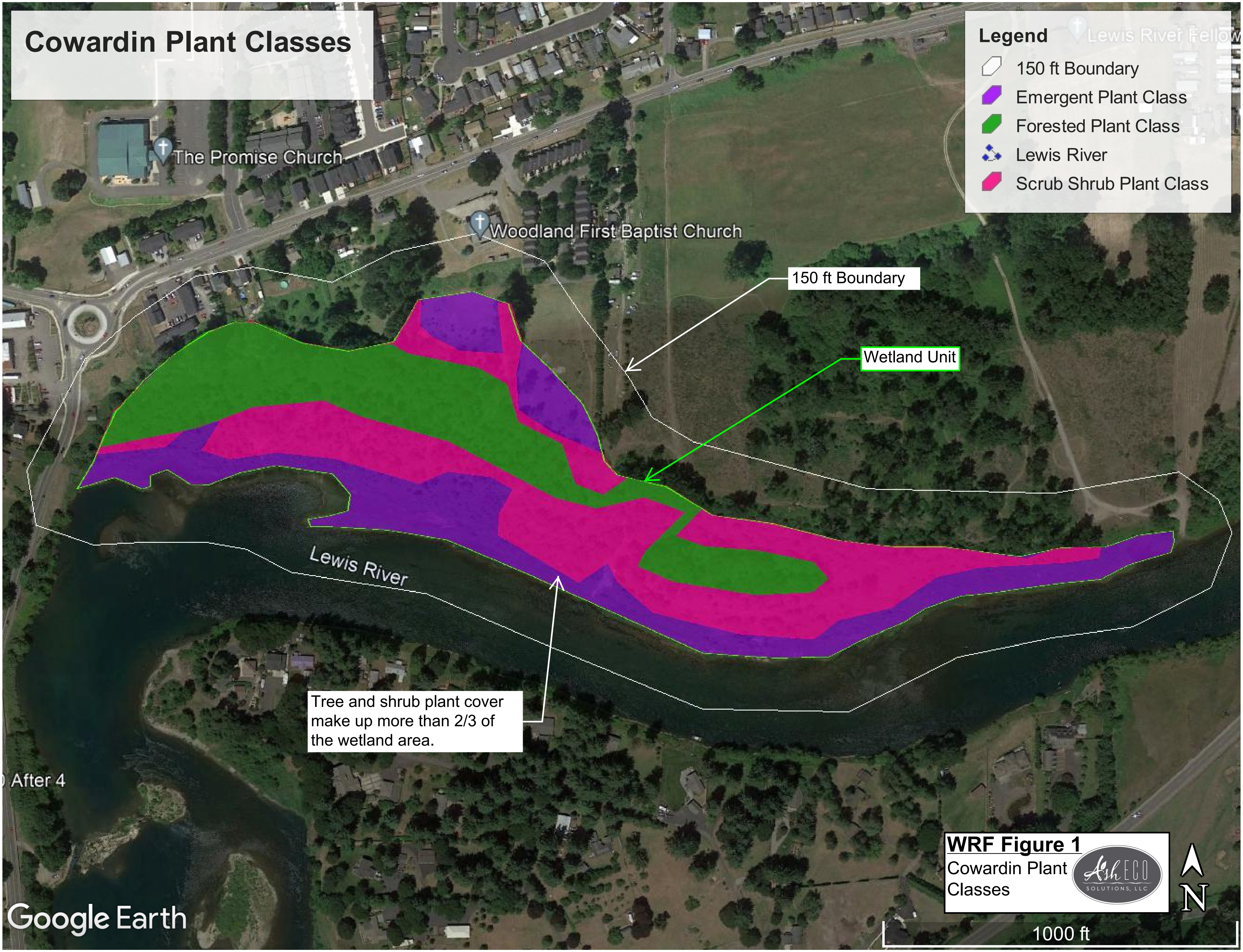
— **Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.

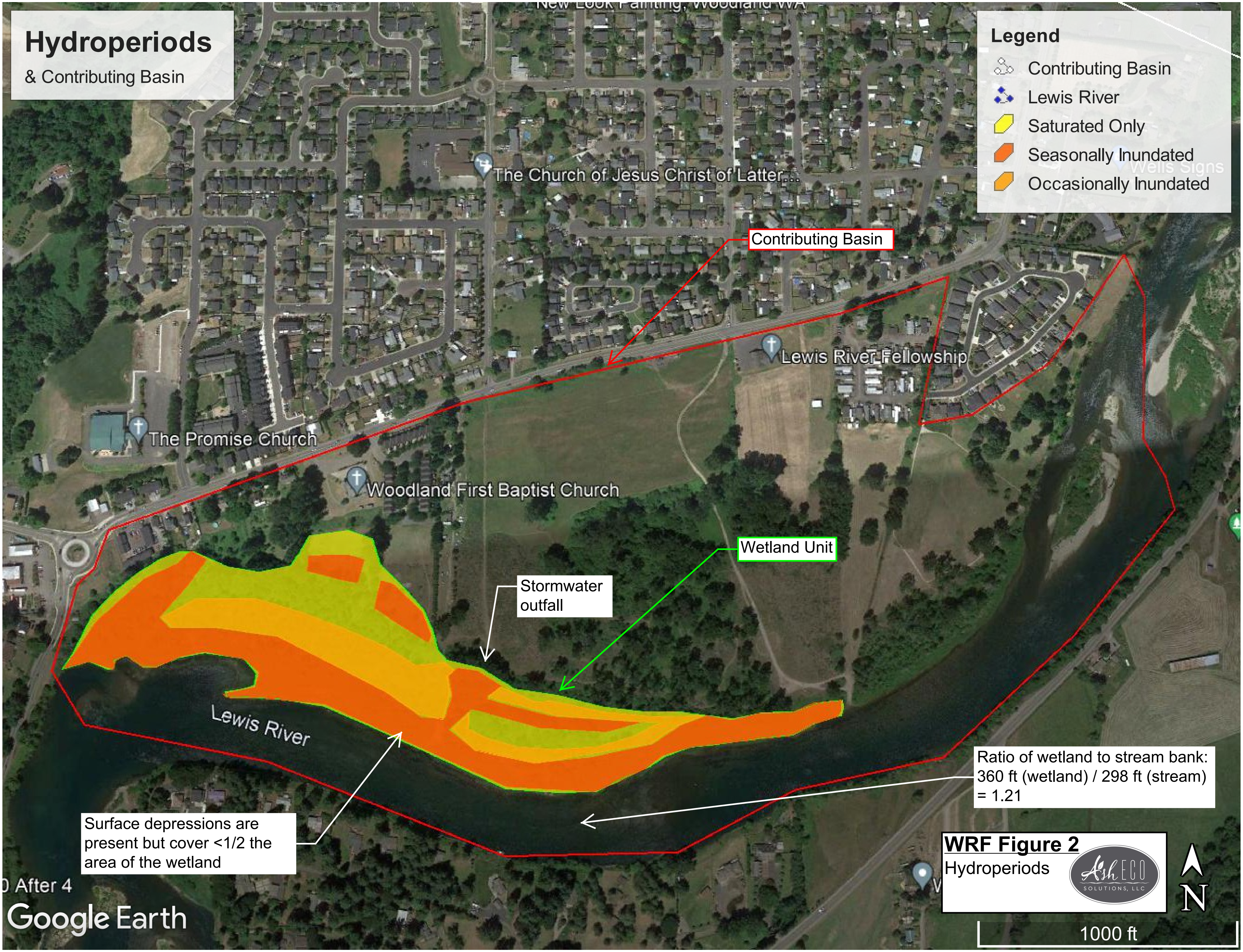
— **Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.

— **Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.

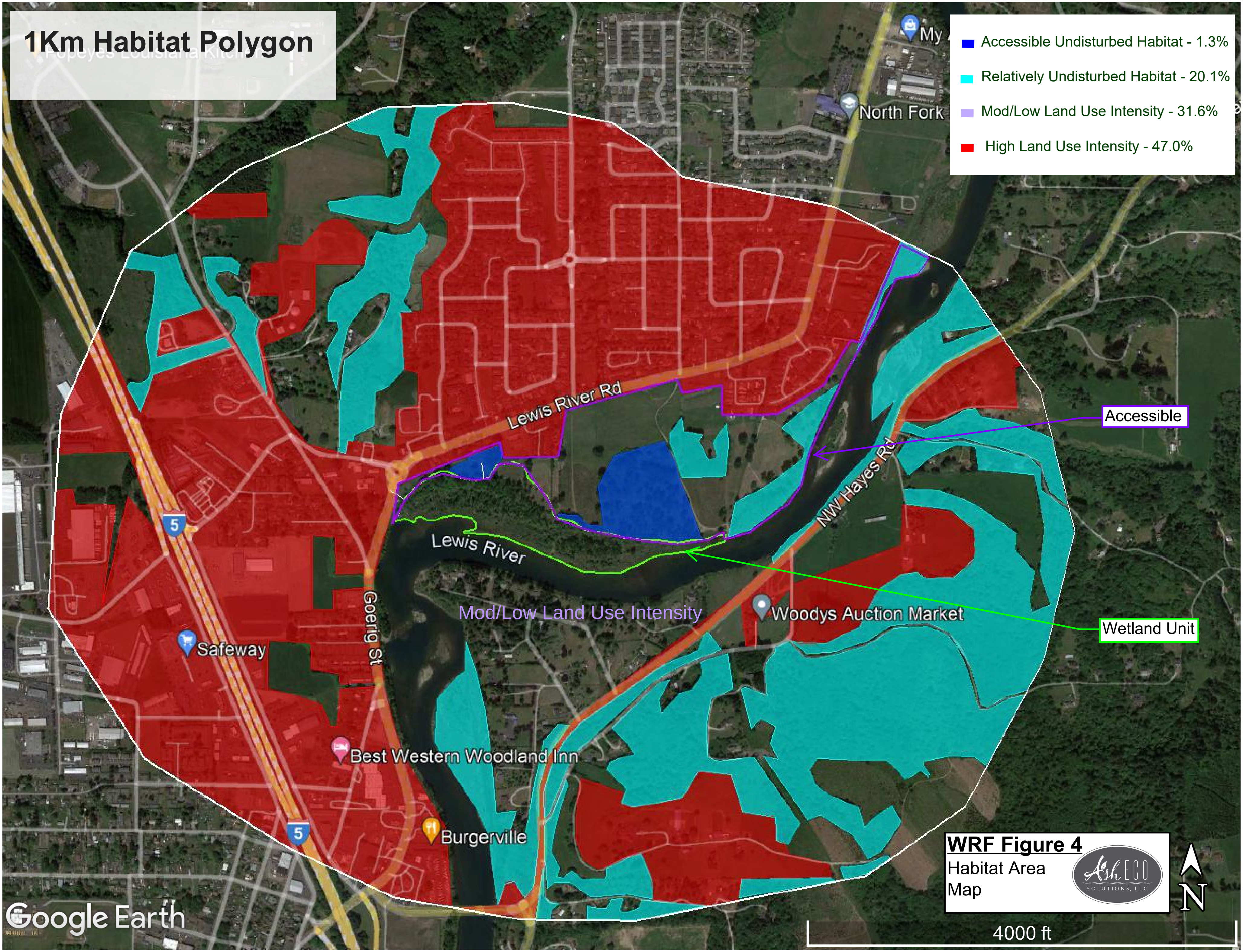
✓ **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.


Cowardin Plant Classes
Legend
150 ft Boundary
Emergent Plant Class
Forested Plant Class
Lewis River
Scrub Shrub Plant Class
The Promise Church
Woodland First Baptist Church
150 ft Boundary
Wetland Unit
Lewis River
Tree and shrub plant cover make up more than 2/3 of the wetland area.
After 4
Google Earth
WRF Figure 1
Cowardin Plant Classes
Ash ECO SOLUTIONS, LLC
N
1000 ft

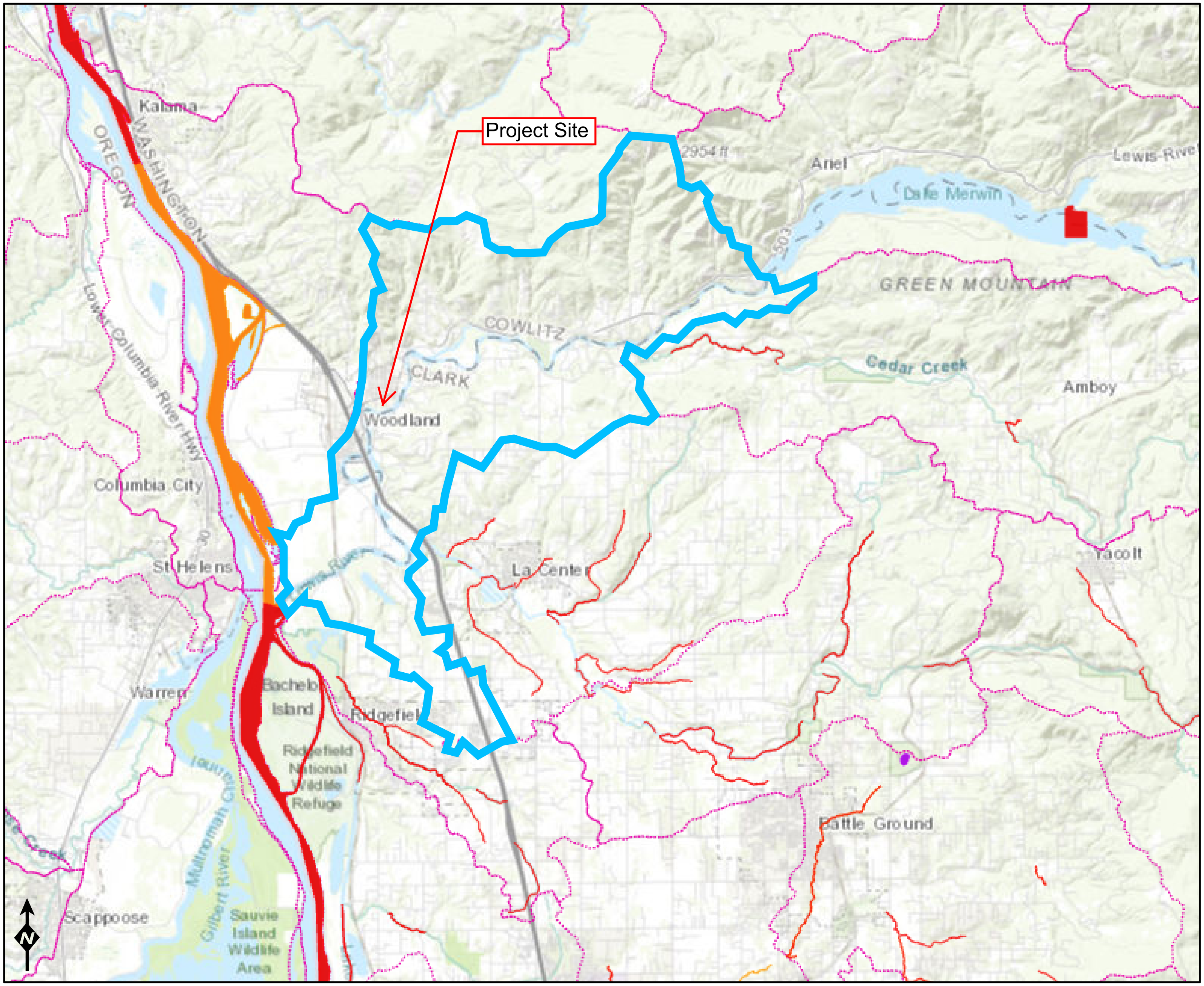


Hydroperiods
& Contributing Basin
Legend
Contributing Basin
Lewis River
Saturated Only
Seasonally Inundated
Occasionally Inundated
The Church of Jesus Christ of Latter...
Contributing Basin
Lewis River Fellowship
The Promise Church
Woodland First Baptist Church
Wetland Unit
Stormwater outfall
Lewis River
Ratio of wetland to stream bank:
360 ft (wetland) / 298 ft (stream)
= 1.21
Surface depressions are present but cover <1/2 the area of the wetland
WRF Figure 2
Hydroperiods
N
1000 ft
Google Earth


1Km Habitat Polygon
Accessible Undisturbed Habitat - 1.3%
Relatively Undisturbed Habitat - 20.1%
Mod/Low Land Use Intensity - 31.6%
High Land Use Intensity - 47.0%
North Fork
Lewis River Rd
Accessible
NW Hayes Rd
Lewis River
Goerig St
Mod/Low Land Use Intensity
Woodys Auction Market
Wetland Unit
Safeway
Best Western Woodland Inn
Burgerville
5
5
Google Earth
WRF Figure 4
Habitat Area
Map
Ash ECO SOLUTIONS, LLC
N
4000 ft

August 24, 2022

303(d) Map



Assessed Water/Sediment

Water
- Category 5 - 303d
- Category 4C
- Category 4B
- Category 4A
- Category 2
- Category 1

Sediment
- Category 5 - 303d
- Category 4C
- Category 4B
- Category 4A
- Category 2
- Category 1

Subbasins (12 digit HUCs)
- HUC boundary

WRF Figure 4
303(d) & TMDL

Esri, NASA, NGA, USGS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri

Miles
0 2 4 8

DEPARTMENT OF ECOLOGY State of Washington

APPENDIX E

Operations and Maintenance Manual

Catch Basin

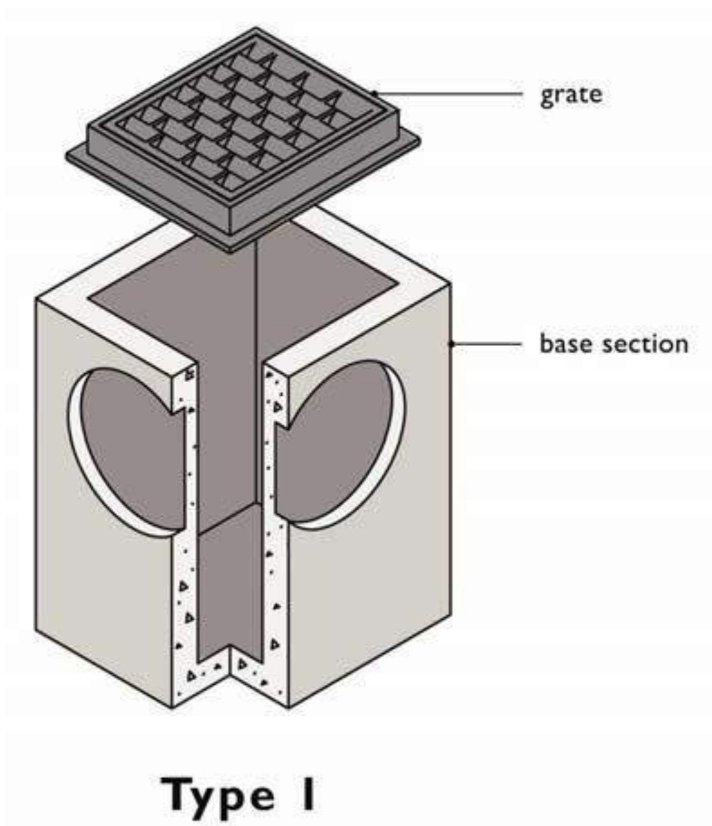
A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

A Type 2 catch basin, also commonly referred to as a storm manhole, is listed separately under "Manhole" in this book.

Catch basins typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or debris.

Catch basins are frequently associated with all stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning catch basins is an industrial vacuum truck with a tank and vacuum hose (e.g. Vactor® truck) to remove sediment and debris from the sump.
- A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Catch Basin			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.

	Basin Walls/ Bottom	Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Oil/Debris Trap (If Applicable)	Dislodged	Oil or debris trap is misaligned with or dislodged from the outlet pipe.	Trap is connected to and aligned with outlet pipe.

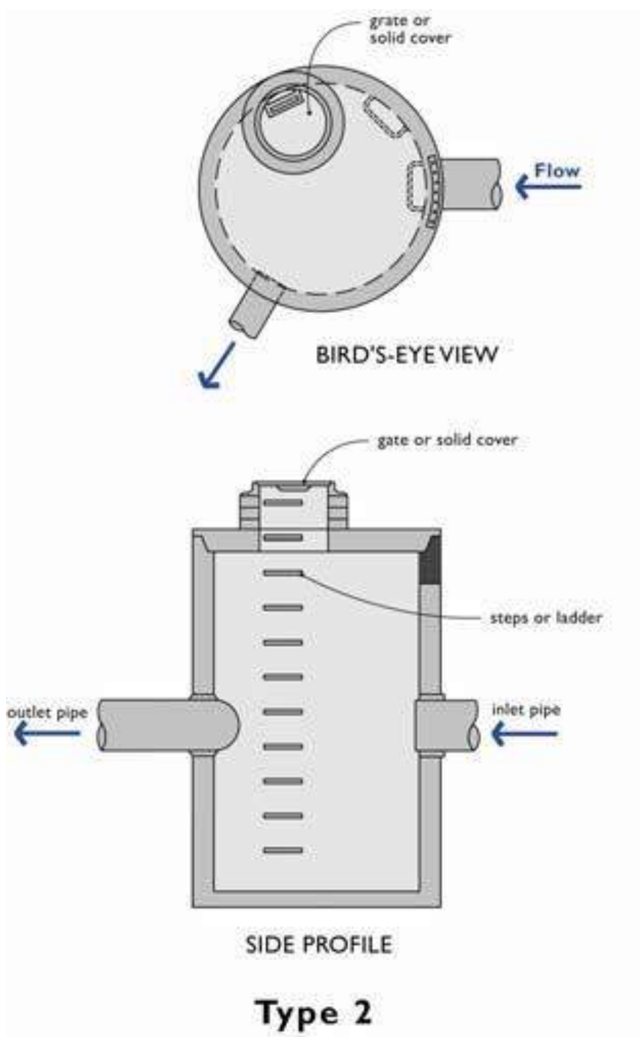
Manhole

A manhole is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Manholes can also be used as a junction in a pipe system and may have a solid lid. A manhole is also known as a Type 2 catch basin.

Manholes are round concrete structures ranging in diameter from 4 feet to 8 feet. They are used when the connecting conveyance pipe is 18 inches or greater or the depth from grate to pipe bottom exceeds 5 feet. Manholes typically have steps mounted on the side of the structure to allow access.

Manholes typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some manholes are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils.

Manholes are often associated with other stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning manholes is a truck with a tank and vacuum hose (Vactor® truck) to remove sediment and debris from the sump.
- A manhole may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a manhole, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

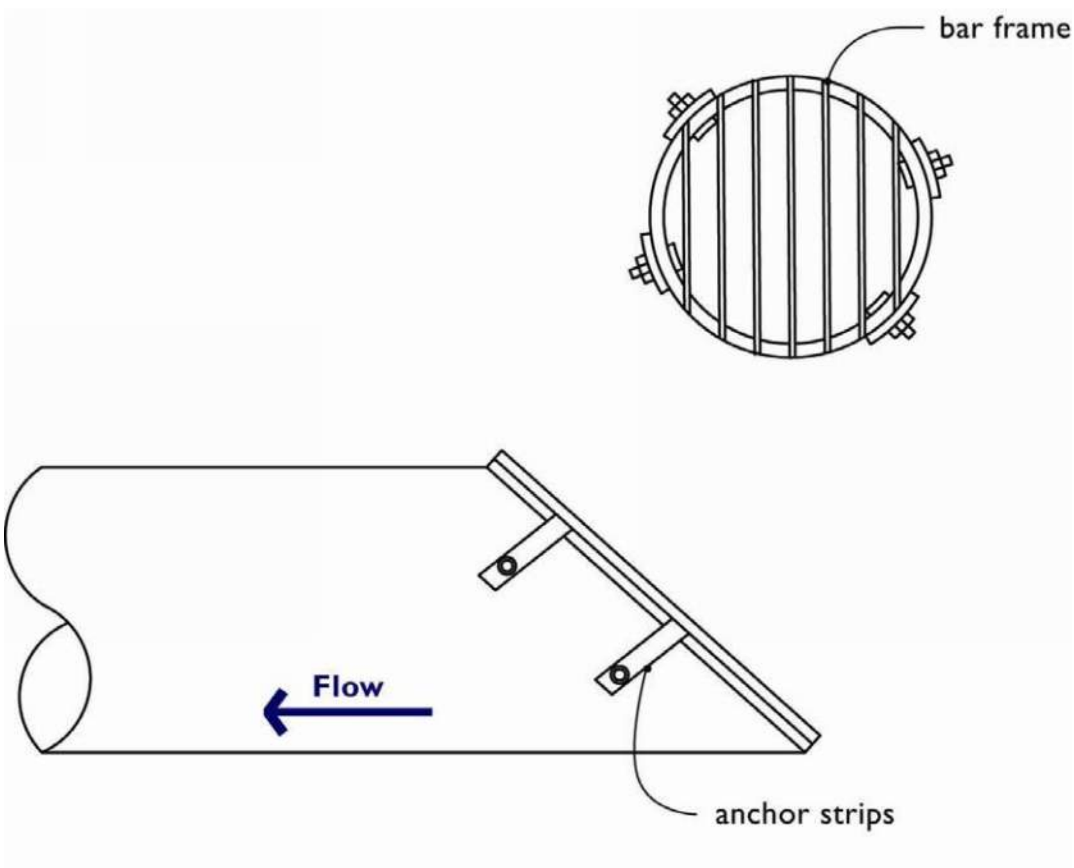
Manhole			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
			Note: table spans multiple pages.
General	Trash and Debris	Trash or debris which is located immediately in front of the opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of manhole or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into manhole.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering manhole through cracks.	Pipe is regrouted and secure at basin wall.

	Settlement/ Misalignment	If failure of manhole has created a safety, function, or design problem.	Manhole replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the opening.	No vegetation blocking opening to manhole.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
Manhole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open manhole is a safety hazard and requires immediate maintenance.	Manhole cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to manhole wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Debris Barrier & Access Barrier (e.g. Trash Rack)

A debris barrier is a bar grate over the open end of a culvert or stormwater conveyance pipe. The intent of a debris barrier is to prevent large materials from entering a closed pipe system. Debris barriers are typically located on the outlet pipe from a detention pond to the control structure. If a debris barrier is not located on an outlet pipe of 18-inch diameter or greater, one should be installed to prevent plugging of the control structure and possible flooding.

An access barrier is installed on a pipe end that is large enough to allow entry. Their function is to prevent debris and unauthorized access into the storm conveyance pipe. Only qualified personnel should attempt to maintain or remove debris from the barrier when water is flowing through the conveyance pipe.



Key Operations and Maintenance Considerations

- The most common tool for cleaning debris and access barriers are hand tools such as a rake to remove collected debris.

Debris Barrier			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
	Damaged/ Missing Bars	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design specifications.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design specifications.
	Missing or Damaged Debris Barrier	Debris barrier missing or not attached to inlet/ outlet pipe.	Barrier is in place and firmly attached to pipe.

Infiltration Basin			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
			Note: table spans multiple pages.
General	Trash and Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Site is free of trash and debris.
	Poisonous Plants and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with Clark County Weed Management department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. (Coordinate removal/cleanup with local water quality response agency.)	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with Clark County Maintenance and Operations department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
Storage Area	Sediment Reducing Infiltration Rate	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events. (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove.)	Sediment is removed and/or facility is cleaned so that infiltration system works according design standards.
Filter Bags (If Applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag has been replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.

Infiltration Basin			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s), e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Pond Berms (Dikes)	Settlement	Any part of berm which has settled 4 inches lower than the design elevation.	Dike has been built back to the design elevation.
		If settlement is apparent, measure berm to determine amount of settlement.	
		Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	
Emergency Overflow/ Spillway and Berms Over 4 Feet in Height	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
	Piping	Discernible water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.)	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Rock Missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
Emergency Overflow/ Spillway	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s), e.g., rock reinforcement, planting of grass, compaction.

Infiltration Basin			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
			If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Presettling Ponds and Vaults	Facility or Sump Filled With Sediment and/or Debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Stormwater Conveyance Pipe

Storm sewer pipes convey stormwater. Inlet and outlet stormwater pipes convey stormwater in, through, and out of stormwater facilities.

Pipes are built from many materials and are sometimes perforated to allow stormwater to infiltrate into the ground. Pipes are cleaned to remove sediment or blockages when problems are identified. Stormwater pipes must be clear of obstructions and breaks to prevent localized flooding. All stormwater pipes should be in proper working order and free of the possible defects listed below.

Key Operations and Maintenance Considerations

- The most common tool for cleaning stormwater conveyance pipes is a truck with a tank, vacuum hose, and a jet hose (Vactor® truck) to flush sediment and debris from the pipes.

Stormwater Conveyance Pipe			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
	Drainage Slow	Decreased capacity that indicates slow drainage. Does not meet facility design infiltration rate. The Water Quality Design Storm Volume does not infiltrate within 48 hours (if perforated pipe). Water remains in the pipe for greater than 24 hours after the end of most moderate rainfall events.	Perforated drain pipe has been cleaned and drainage rates are per design specifications. (Do not allow removed sediment and water to discharge back into the storm sewer.)
	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Roots have been removed from pipe (using mechanical methods; do not put root-dissolving chemicals in storm sewer pipes). If necessary, vegetation over the line removed.
	Pipe Dented or Broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced per design standards.
	Pipe Rusted or Deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced per design standards.
	Sediment and Debris	Sediment depth is greater than 20% of pipe diameter.	Pipe has been cleaned and is free of sediment/ debris. (Upstream debris traps installed where applicable.)
	Debris Barrier or Trash Rack Missing	Stormwater pipes > than 18 inches need debris barrier.	Debris barrier present on all stormwater pipes 18 inches and greater.

APPENDIX F

Stormwater Pollution Prevention Plan

Stormwater Pollution Prevention Plan

For
Lewis River Subdivision

Prepared For
Luke Sasse
9321 NE 72nd Avenue Bldg. C #7
Vancouver, WA 98665

Owner	Developer	Operator/Contractor
A5 Partners 9321 NE 72nd Avenue Bldg. C #7 Vancouver, WA 98665	Same as Owner	Unknown

Project Site Location
Section 18, T5N, R1E, WM
Woodland, WA 98674
Parcel #s 50650, 506520100, 5065201, 506520300, 506520400, and 506520500

SWPPP Prepared By
PLS Engineering, Inc.
604 W Evergreen Blvd
Vancouver, WA 98660
(360) 944-6519

SWPPP Preparation Date
February 2024

Approximate Project Construction Dates
April 2024

Contents

Appendix A Site plans

- Vicinity map (with all discharge points)
- Site plan with TESC measures

Appendix B Construction BMPs

- Possibly reference in BMPs, but likely it will be a consolidated list so that the applicant can photocopy from the list from the SWMMWW.

Appendix C Alternative Construction BMP list

- List of BMPs not selected, but can be referenced if needed in each of the 12 elements

Appendix D General Permit

Appendix E Site Log and Inspection Forms

Appendix F Engineering Calculations

1.0 Introduction

This Stormwater Pollution Prevention Plan (SWPPP) has been prepared for the Lewis Subdivision Plan construction project in Woodland, Washington. The site is located on Parcel #s 50650, 5065201, 506520300, 506520400, and 506520500. There is not currently a site address. The area disturbed as part of this construction project is approximately 19 acres. Current proposed development associated with this SWPPP includes the construction of 87 lot subdivision with associated roadways and utilities. The stormwater plan associated with this project provides for stormwater management of all runoff from the site using an existing ditch inlet. Stormwater runoff from the parking lot and sidewalks will be treated by an existing swale.

Construction activities will include excavation, grading, construction of paving and sidewalk to serve the site, and installation of utilities to serve the site including sanitary sewer, storm sewer, potable water, electrical, phone, and cable TV. The purpose of this SWPPP is to describe the proposed construction activities and all temporary and permanent erosion and sediment control (TESC) measures, pollution prevention measures, inspection/monitoring activities, and recordkeeping that will be implemented during the proposed construction project. The objectives of the SWPPP are to:

1. Implement Best Management Practices (BMPs) to prevent erosion and sedimentation, and to identify, reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.

2. Prevent violations of surface water quality, ground water quality, or sediment management standards.

3. Prevent, during the construction phase, adverse water quality impacts including impacts on beneficial uses of the receiving water by controlling peak flow rates and volumes of stormwater runoff at the Permittee's outfalls and downstream of the outfalls.

This SWPPP was prepared using the Ecology SWPPP Template downloaded from the Ecology website. This SWPPP was prepared based on the requirements set forth in the Construction Stormwater General Permit and the *Stormwater Management Manual for Western Washington* (SWMMWW). The report is divided into seven main sections with several appendices that include stormwater related reference materials. The topics presented in the each of the main sections are:

- Section 1 – INTRODUCTION. This section provides a summary description of the project, and the organization of the SWPPP document.

- Section 2 – SITE DESCRIPTION. This section provides a detailed description of the existing site conditions, proposed construction activities, and calculated stormwater flow rates for existing conditions and post–construction conditions.

- Section 3 – CONSTRUCTION BMPs. This section provides a detailed description of the BMPs to be implemented based on the 12 required elements of the SWPPP (SWMMEW 2004).

- Section 4 – CONSTRUCTION PHASING AND BMP IMPLEMENTATION. This section provides a description of the timing of the BMP implementation in relation to the project schedule.

- Section 5 – POLLUTION PREVENTION TEAM. This section identifies the appropriate contact names (emergency and non-emergency), monitoring personnel, and the onsite temporary erosion and sedimentation control inspector

- Section 6 – INSPECTION AND MONITORING. This section provides a description of the inspection and monitoring requirements such as the parameters of concern to be monitored, sample locations, sample frequencies, and sampling methods for all stormwater discharge locations from the site.

- Section 7 – RECORDKEEPING. This section describes the requirements for documentation of the BMP implementation, site inspections, monitoring results, and changes to the implementation of certain BMPs due to site factors experienced during construction.

Supporting documentation and standard forms are provided in the following Appendices:

Appendix A – Site plans
Appendix B – Construction BMPs
Appendix C – Alternative Construction BMP list
Appendix D – General Permit
Appendix E – Site Log and Inspection Forms
Appendix F – Engineering Calculations

2.0 Site Description

2.1 Existing Conditions

The site is located on Parcel #s 50650, 5065201, 506520300, 506520400, and 506520500. There is not currently a site address. The area disturbed as part of this construction project is approximately 19 acres. The property's topography is flat, with less than 3' elevation change across the entire site. The existing site is a field.

According to Soils Conservation Service mapping for the site vicinity, soil in the construction area are classified as Clato silt loam.

2.2 Proposed Construction Activities

The project proposes to develop the parcel into an apartment complex with the associated parking lot. The disturbed area will be approximately 23.3 acres. Construction activities will include excavation, grading, construction of paving and sidewalk to serve the site, construction of stormwater facilities, and installation of utilities to serve the site including sanitary sewer, storm sewer, potable water, electrical, phone, and cable TV.

Temporary erosion and sediment control facilities will be installed prior to site construction to handle construction-phase stormwater runoff. The schedule and phasing of BMPs during construction is provided in Section 4.0.

Stormwater runoff has been calculated using the Puget Sounds stormwater manual. The existing bioswale was designed to treat 100% of the runoff generated by the site.

After the site has been graded and all new utilities are installed, the building construction will commence. Trees will also be planted in the landscape areas noted in the Landscape Plan. Temporary seeding will occur over the lots to establish vegetative cover until such time as individual buildings are developed and permanent landscaping occurs.

3.0 Construction Stormwater BMPs

3.1 The 13 BMP Elements

3.1.1 Element #1 – Mark Clearing Limits

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin. Trees that are to be preserved, as well as all sensitive areas and their buffers, shall be clearly delineated, both in the field and on the plans. In general, natural vegetation and native topsoil shall be retained in an undisturbed state to the maximum extent possible. The BMPs relevant to marking the clearing limits that will be applied for this project include:

- Preserving Native Vegetation (BMP C101)
- Silt Fence (BMP C233)

Alternate BMPs for marking clearing limits are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

3.1.2 Element #2 – Establish Construction Access

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, and wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters. All wash wastewater shall be controlled on site. The specific BMPs related to establishing construction access that will be used on this project include:

- Stabilized Construction Entrance (BMP C105)

Alternate construction access BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

3.1.3 Element #3 – Control Flow Rates

In order to protect the properties and waterways downstream of the project site, stormwater discharges from the site will be controlled. The specific BMPs for flow control that shall be used on this project include:

- Outlet Protection (BMP C209).
- Sediment Trap (BMP C240).

Alternate flow control BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

The project site is located west of the Cascade Mountain Crest. As such, the project must comply with Minimum Requirement 7 (Ecology 2005).

In general, discharge rates of stormwater from the site will be controlled where increases in impervious area or soil compaction during construction could lead to downstream erosion, or where necessary to meet local agency stormwater discharge requirements (e.g. discharge to combined sewer systems).

3.1.4 Element #4 – Install Sediment Controls

All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction site or prior to being discharged to an infiltration facility. The specific BMPs to be used for controlling sediment on this project include:

- Silt Fence (BMP C233)
- Storm Drain Inlet Protection (BMP C220)

Silt fencing and storm drain inlet protection will be adequate for sediment control during summer months. Alternate sediment control BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

In addition, sediment will be removed from paved areas in and adjacent to construction work areas manually or using mechanical sweepers, as needed, to minimize tracking of sediments on vehicle tires away from the site and to minimize washoff of sediments from adjacent streets in runoff.

Whenever possible, sediment laden water shall be discharged into onsite, relatively level, vegetated areas (BMP C240 paragraph 5, page 4-102).

In some cases, sediment discharge in concentrated runoff can be controlled using permanent stormwater BMPs (e.g., infiltration swales, ponds, trenches). Sediment loads can limit the effectiveness of some permanent stormwater BMPs, such as those used for infiltration or biofiltration; however, those BMPs designed to remove solids by settling (wet ponds or detention ponds) can be used during the construction phase. When permanent stormwater BMPs will be used to control sediment discharge during construction, the structure will be protected from excessive sedimentation with adequate erosion and sediment control BMPs. Any accumulated sediment shall be removed after construction is complete and the permanent stormwater BMP will be restabilized with vegetation per applicable design requirements once the remainder of the site has been stabilized.

The following BMPs will be implemented as end-of-pipe sediment controls as required to meet permitted turbidity limits in the site discharge(s). Prior to the implementation of these technologies, sediment sources and erosion control and soil stabilization BMP efforts will be maximized to reduce the need for end-of-pipe sedimentation controls.

- Construction Stormwater Filtration (BMP C251)
- Construction Stormwater Chemical Treatment (BMP C 250) (implemented only with prior written approval from Ecology).

3.1.5 Element #5 – Stabilize Soils

Exposed and unworked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project. The specific BMPs for soil stabilization that shall be used on this project include:

- Temporary and Permanent Seeding (BMP C120)
- Mulching (BMP C121)
- Nets and Blankets (BMP C122)
- Plastic Covering (BMP C123)
- Topsoiling (BMP C125)
- Surface Roughening (BMP C130)
- Dust Control (BMP C140)
- Early application of gravel base on areas to be paved

Alternate soil stabilization BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

The project site is located west of the Cascade Mountain Crest. As such, no soils shall remain exposed and unworked for more than 7 days during the dry season (May 1 to September 30) and 2 days during the wet season (October 1 to April 30). Regardless of the time of year, all soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on weather forecasts.

In general, cut and fill slopes will be stabilized as soon as possible and soil stockpiles will be temporarily covered with plastic sheeting. All stockpiled soils shall be stabilized from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels.

3.1.6 Element #6 – Protect Slopes

All cut and fill slopes will be designed, constructed, and protected in a manner that minimizes erosion. The following specific BMPs will be used to protect slopes for this project:

- Temporary and Permanent Seeding (BMP C120)

Alternate slope protection BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

3.1.7 Element #7 – Protect Drain Inlets

All storm drain inlets and culverts made operable during construction or inlets near the site that could potentially receive surface runoff from the construction site shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. However, the first priority is to keep all access roads clean of sediment and keep street wash water separate from entering storm drains until treatment can be provided. Storm Drain Inlet Protection (BMP C220) will be implemented for all drainage inlets and culverts that could potentially be impacted by sediment-laden runoff on and near the project site. The following inlet protection measures will be applied on this project:

Drop Inlet Protection

- Block and Gravel Drop Inlet Protection
- Gravel and Wire Drop Inlet Protection
- Catch Basin Filter

If the BMP options listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D), or if no BMPs are listed above but deemed necessary during construction, the Certified Erosion and Sediment Control Lead shall implement one or more of the alternative BMP inlet protection options listed in Appendix C.

3.1.8 Element #8 – Stabilize Channels and Outlets

Where site runoff is to be conveyed in channels or discharged to a stream or some other natural drainage point, efforts will be taken to prevent downstream erosion. The specific BMPs for channel and outlet stabilization that shall be used on this project include:

- Outlet Protection (BMP C209)

Alternate channel and outlet stabilization BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

The project site is located west of the Cascade Mountain Crest. As such, all temporary on-site conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected peak 10-minute velocity of flow from a Type 1A, 10-year, 24-hour recurrence interval storm for the developed condition. Alternatively, the 10-year, 1-hour peak flow rate indicated by an approved continuous runoff simulation model, increased by a factor of 1.6, shall be used. Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems.

3.1.9 Element #9 – Control Pollutants

All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants are discussed below.

Vehicles, construction equipment, and/or petroleum product storage/dispensing:

- All vehicles, equipment, and petroleum product storage/dispensing areas will be inspected regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills.
- On-site fueling tanks and petroleum product storage containers shall include secondary containment.
- Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment.
- In order to perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle.
- Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

Chemical storage:

- Any chemicals stored in the construction areas will conform to the appropriate source control BMPs listed in Volume IV of the Ecology stormwater manual. In Western WA, all chemicals shall have cover, containment, and protection provided on site, per BMPC153 for Material Delivery, Storage and Containment in SWMMWW 2005
- Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations for application procedures and rates shall be followed.

Excavation and tunneling spoils dewatering waste:

- Dewatering BMPs and BMPs specific to the excavation and tunneling (including handling of contaminated soils) are discussed under Element 10.

Demolition:

- Dust released from demolished sidewalks, buildings, or structures will be controlled using Dust Control measures (BMP C140).
- Storm drain inlets vulnerable to stormwater discharge carrying dust, soil, or debris will be protected using Storm Drain Inlet Protection (BMP C220 as described above for Element 7).
- Process water and slurry resulting from sawcutting and surfacing operations will be prevented from entering the waters of the State by implementing Sawcutting and Surfacing Pollution Prevention measures (BMP C152).

Concrete and grout:

- Process water and slurry resulting from concrete work will be prevented from entering the waters of the State by implementing Concrete Handling measures (BMP C151).

Sanitary wastewater:

- Portable sanitation facilities will be firmly secured, regularly maintained, and emptied when necessary.
- Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer as part of Wheel Wash implementation (BMP C106).

Solid Waste:

- Solid waste will be stored in secure, clearly marked containers.

Other:

- Other BMPs will be administered as necessary to address any additional pollutant sources on site.

The facility does not require a Spill Prevention, Control, and Countermeasure (SPCC) Plan under the Federal regulations of the Clean Water Act (CWA).

3.1.10 Element #10 – Control Dewatering

No dewatering is anticipated as part of this construction project. If it is necessary, appropriate BMP's will be implemented to insure that dewatering water meets state water quality requirements before being discharged from the site.

3.1.11 Element #11 – Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMPs specifications (attached). Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency will be reduced to once every month.

All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

3.1.12 Element #12 – Manage the Project

Erosion and sediment control BMPs for this project have been designed based on the following principles:

- Design the project to fit the existing topography, soils, and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.
- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures.
- Schedule major earthwork during the dry season.

In addition, project management will incorporate the key components listed below:

As this project site is located west of the Cascade Mountain Crest, the project will be managed according to the following key project components:

Phasing of Construction

- The construction project is being phased to the extent practicable in order to prevent soil erosion, and, to the maximum extent possible, the transport of sediment from the site during construction.

- Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities during each phase of construction, per the Scheduling BMP (C 162).

Seasonal Work Limitations

- From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site through a combination of the following:

- ☐ Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters; and

- ☐ Limitations on activities and the extent of disturbed areas; and

- ☐ Proposed erosion and sediment control measures.

- Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance.

- The following activities are exempt from the seasonal clearing and grading limitations:

- ☐ Routine maintenance and necessary repair of erosion and sediment control BMPs;

- ☐ Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and

- ◻ Activities where there is 100 percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Coordination with Utilities and Other Jurisdictions

- ▪ Care has been taken to coordinate with utilities, other construction projects, and the local jurisdiction in preparing this SWPPP and scheduling the construction work.

Inspection and Monitoring

- ▪ All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. This person has the necessary skills to:

- ◻ Assess the site conditions and construction activities that could impact the quality of stormwater, and

- ◻ Assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

- ▪ A Certified Erosion and Sediment Control Lead shall be on-site or on-call at all times.

- ▪ Whenever inspection and/or monitoring reveals that the BMPs identified in this SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

Maintaining an Updated Construction SWPPP

- ▪ This SWPPP shall be retained on-site or within reasonable access to the site.

- ▪ The SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.

- ▪ The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

3.1.13 Element #13 – Protect Low Impact Development BMPs

- Protect all bioretention and rain garden BMP’s from sedimentation through installation and maintenance of erosion control BMP’s on portions of the site that drain into them. Restore the BMP’s to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden bioretention/ rain garden soils, and replacing the removed soils with soils meeting the design specification.
- Prevent compacting bioretention and rain garden BMP’s by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction by construction equipment.
- Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff into permeable pavements or base materials.
- Pavements fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures from Book 4 of the manufacturer’s procedures.
- Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils

3.2 Site Specific BMPs

Site specific BMPs are shown on the TESC Plan Sheets and Details in Appendix A. These site-specific plan sheets will be updated annually.

3.3 Additional Advanced BMPs

- The following BMPs are advanced and are only recommended if construction activities are complex enough to warrant them; or if the site has the potential for significant impacts to water quality. The following BMPs are directed at “end-of-pipe” treatment for sedimentation issues related to turbid runoff from construction sites. Effective BMPs are most often the simple BMPs and focus on the minimization of erosion before sedimentation is an issue. The following BMPs will most likely be implemented only after other BMP options are exhausted, or if the construction activity is large and off-site sedimentation or turbid runoff occurs or is inevitable.

- For BMP 250, written pre-approval, through Ecology is required (see SWMMWW 2005):
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration.

4.0 Construction Phasing and BMP Implementation

The BMP implementation schedule will be driven by the construction schedule. The following provides a sequential list of the proposed construction schedule milestones and the corresponding BMP implementation schedule. The list contains key milestones such as wet season construction.

The BMP implementation schedule listed below is keyed to proposed phases of the construction project and reflects differences in BMP installations and inspections that relate to wet season construction. The project site is located west of the Cascade Mountain Crest. As such, the dry season is considered to be from May 1 to September 30 and the wet season is considered to be from October 1 to April 30.

- Estimate of Construction start date: 5/01/23
- Estimate of Construction finish date (Phase 1): 9/30/25
- Mobilize equipment on site: 5/01/23
- Mobilize and store all ESC and soil stabilization products: 5/01/23
- Install ESC measures: 5/01/23
- Install stabilized construction entrance: 5/01/23
- Begin clearing and grubbing: 5/01/23
- Demolish existing structures: 5/01/23
- Begin site grading 5/01/23
- Site grading ends 9/30/23
- Excavate and install new utilities and services: 6/01/23
- Excavation for building foundations 7/01/23
- Begin building construction: 7/01/23
- Complete utility construction 7/01/23
- Begin implementing soil stabilization and sediment control BMPs throughout the site in preparation for wet season: 5/01/23
- Wet Season starts: 10/01/23
- Site inspections and monitoring conducted weekly and for applicable rain events as detailed in Section 6 of this SWPPP: 5/01/23
- Implement Element #12 BMPs and manage site to minimize soil disturbance during the wet season: 10/01/23
- Complete road paving 9/30/23
- Building construction complete: 7/01/24
- Dry Season starts: 5/01/23

5.0 Pollution Prevention Team

5.1 Roles and Responsibilities

The pollution prevention team consists of personnel responsible for implementation of the SWPPP, including the following:

- Certified Erosion and Sediment Control Lead (CESCL) – primary contractor contact, responsible for site inspections (BMPs, visual monitoring, sampling, etc.); to be called upon in case of failure of any ESC measures.
- Resident Engineer – For projects with engineered structures only (sediment ponds/traps, sand filters, etc.): site representative for the owner that is the project's supervising engineer responsible for inspections and issuing instructions and drawings to the contractor's site supervisor or representative
- Emergency Ecology Contact – individual to be contacted at Ecology in case of emergency.
- Emergency Owner Contact – individual that is the site owner or representative of the site owner to be contacted in the case of an emergency.
- Non-Emergency Ecology Contact – individual that is the site owner or representative of the site owner than can be contacted if required.
- Monitoring Personnel – personnel responsible for conducting water quality monitoring; for most sites this person is also the Certified Erosion and Sediment Control Lead.

5.2 Team Members

Names and contact information for those identified as members of the pollution prevention team are provided in the following table.

Title	Name(s)	Phone Number
Certified Erosion and Sediment Control Lead (CESCL)	Unknown	
Resident Engineer	Travis Johnson	(360)944-6519
Emergency Ecology Contact	Unknown	
Emergency Owner Contact	Unknown	
Non-Emergency Ecology Contact	Unknown	
Monitoring Personnel	Unknown	

6.0 Site Inspections and Monitoring

Monitoring includes visual inspection, monitoring for water quality parameters of concern, and documentation of the inspection and monitoring findings in a site log book. A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements;
- Site inspections; and,
- Stormwater quality monitoring.

For convenience, the inspection form and water quality monitoring forms included in this SWPPP include the required information for the site log book. This SWPPP may function as the site log book if desired, or the forms may be separated and included in a separate site log book. However, if separated, the site log book but must be maintained on-site or within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

6.1 Site Inspection

All BMPs will be inspected, maintained, and repaired as needed to assure continued performance of their intended function. The inspector will be a Certified Erosion and Sediment Control Lead (CESCL) per BMP C160. The name and contact information for the CESCL is provided in Section 5 of this SWPPP.

Site inspection will occur in all areas disturbed by construction activities and at all stormwater discharge points. Stormwater will be examined for the presence of suspended sediment, turbidity, discoloration, and oily sheen. The site inspector will evaluate and document the effectiveness of the installed BMPs and determine if it is necessary to repair or replace any of the BMPs to improve the quality of stormwater discharges. All maintenance and repairs will be documented in the site log book or forms provided in this document. All new BMPs or design changes will be documented in the SWPPP as soon as possible.

6.1.1 Site Inspection Frequency

Site inspections will be conducted at least once a week and within 24 hours following any discharge from the site. For sites with temporary stabilization measures, the site inspection frequency can be reduced to once every month.

6.1.2 Site Inspection Documentation

The site inspector will record each site inspection using the site log inspection forms provided in Appendix E. The site inspection log forms may be separated from this SWPPP document, but will be maintained on-site or within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

6.2 Stormwater Quality Monitoring

The construction site will comply with the requirements set forth in the 2015 Construction Stormwater General Permit (revised 2017) seen in Appendix D. A Certified Erosion and Sediment Control Lead shall be on-site or on-call at all times.

The following text describes the monitoring for the proposed development.

6.2.1 Turbidity Sampling

The receiving water body, Lacamas Creek Watershed, is impaired for turbidity. Mandatory BMPs (Best Management Practices) and erosion control practices put in place by the permit will appropriately minimize the turbidity of the stormwater discharge. Monitoring requirements for the proposed project will include weekly turbidity sampling to monitor site discharges for water quality compliance as required by the NPDES Construction Stormwater General Permit, provided that site discharges occur. It should be noted that the site is designed such that all site runoff will be infiltrated so it is likely that discharges will be rare or may not occur at all. Sampling will be conducted at all discharge points at least once per calendar week.

Turbidity sampling during construction will be completed weekly in order to confirm that erosion control measures are meeting the water quality standards for turbidity (Where an applicable TMDL has not specified a waste load allocation for construction stormwater discharge, but has not excluded these discharges, compliance with special Conditions S4 (monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL (S8.E.1.c)). Special Conditions S4 establishes that the key benchmark values that require action are 25 NTU for turbidity (equivalent to 32 cm transparency) and 250 NTU for turbidity (equivalent to 6 cm transparency). If the 25 NTU benchmark for turbidity (equivalent to 32 cm transparency) is exceeded, the following steps will be conducted:

1. Ensure all BMPs specified in this SWPPP are installed and functioning as intended.
2. Assess whether additional BMPs should be implemented, and document revisions to the SWPPP as necessary.
3. Sample discharge location daily until the analysis results are less than 25 NTU (turbidity) or greater than 32 cm (transparency).

If the turbidity is greater than 25 NTU (or transparency is less than 32 cm) but less than 250 NTU (transparency greater than 6 cm) for more than 3 days, additional treatment BMPs will be implemented within 24 hours of the third consecutive sample that exceeded the benchmark value. Additional treatment BMPs to be considered will include, but are not limited to, off-site treatment, infiltration, filtration and chemical treatment.

If the 250 NTU benchmark for turbidity (or less than 6 cm transparency) is exceeded at any time, the following steps will be conducted:

1. Notify Ecology by phone within 24 hours of analysis (see Section 5.0 of this SWPPP for contact information).
2. Continue daily sampling until the turbidity is less than 25 NTU (or transparency is greater than 32 cm).

3. Initiate additional treatment BMPs such as off-site treatment, infiltration, filtration and chemical treatment within 24 hours of the first 250 NTU exceedance.
4. Implement additional treatment BMPs as soon as possible, but within 7 days of the first 250 NTU exceedance.
5. Describe inspection results and remedial actions taken in the site log book and in monthly discharge monitoring reports as described in Section 7.0 of this SWPPP.

In the event that Turbidity results are greater than 25 NTUs, or the site is determined to be out of compliance with surface water quality standards for turbidity, the following BMPs should be established, re-established or implemented as determined necessary by the Certified Erosion and Sediment Control lead (CESCL) in order to bring the site back into compliance:

BMP C105: Stabilized Construction Entrance / Exit (repair construction entrance as necessary)

BMP C106: Wheel Wash (repair wheel wash as necessary)

BMP C120: Temporary and permanent Seeding

BMP C124: Sodding

BMP C140: Dust Control

BMP C209: Outlet Protection

BMP C220: Storm Drain Inlet Protection (add more inlet protection, as necessary

BMP C233: Silt Fence (add more silt fencing as necessary)

7.0 Reporting and Recordkeeping

7.1 Recordkeeping

7.1.1 Site Log Book

A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements;
- Site inspections; and,
- Stormwater quality monitoring.

For convenience, the inspection form and water quality monitoring forms included in this SWPPP include the required information for the site log book.

7.1.2 Records Retention

Records of all monitoring information (site log book, inspection reports/checklists, etc.), this Stormwater Pollution Prevention Plan, and any other documentation of compliance with permit requirements will be retained during the life of the construction project and for a minimum of three years following the termination of permit coverage in accordance with permit condition S5.C.

7.1.3 Access to Plans and Records

The SWPPP, General Permit, Notice of Authorization letter, and Site Log Book will be retained on site or within reasonable access to the site and will be made immediately available upon request to Ecology or the local jurisdiction. A copy of this SWPPP will be provided to Ecology within 14 days of receipt of a written request for the SWPPP from Ecology. Any other information requested by Ecology will be submitted within a reasonable time. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with permit condition S5.G.

7.1.4 Updating the SWPPP

In accordance with Conditions S3, S4.B, and S9.B.3 of the General Permit, this SWPPP will be modified if the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site or there has been a change in design, construction, operation, or maintenance at the site that has a significant effect on the discharge, or potential for discharge, of pollutants to the waters of the State. The SWPPP will be modified within seven days of determination based on inspection(s) that additional or modified BMPs are necessary to correct problems identified, and an updated timeline for BMP implementation will be prepared.

7.2 Reporting

7.2.1 Discharge Monitoring Reports

Discharge Monitoring Reports (DMRs) will be submitted to Ecology monthly. If there was no discharge during a given monitoring period, the Permittee shall submit the form as required, with the words "No discharge" entered in the place of monitoring results. The DMR due date is 15 days following the end of each month.

Water quality sampling results will be submitted to Ecology monthly on Discharge Monitoring Report (DMR) forms in accordance with permit condition S5.B. If there was no discharge during a given monitoring period, the form will be submitted with the words "no discharge" entered in place of the monitoring results. If a benchmark was exceeded, a brief summary of inspection results and remedial actions taken will be included. If sampling could not be performed during a monitoring period, a DMR will be submitted with an explanation of why sampling could not be performed.

7.2.2 Notification of Noncompliance

If any of the terms and conditions of the permit are not met, and it causes a threat to human health or the environment, the following steps will be taken in accordance with permit section S5.F:

1. Ecology will be immediately notified of the failure to comply.
2. Immediate action will be taken to control the noncompliance issue and to correct the problem. If applicable, sampling and analysis of any noncompliance will be repeated immediately and the results submitted to Ecology within five (5) days of becoming aware of the violation.
3. A detailed written report describing the noncompliance will be submitted to Ecology within five (5) days, unless requested earlier by Ecology.

Any time turbidity sampling indicates turbidity is 250 nephelometric turbidity units (NTU) or greater or water transparency is 6 centimeters or less, the Ecology regional office will be notified by phone within 24 hours of analysis as required by permit condition S5.A (see Section 5.0 of this SWPPP for contact information).

In accordance with permit condition S2.A, a complete application form will be submitted to Ecology and the appropriate local jurisdiction (if applicable) to be covered by the General Permit.

Appendix A – Site Plans

Appendix B – Construction BMPs

Stabilized Construction Entrance (BMP C105)

Silt Fence (BMP C233)

Storm Drain Inlet Protection (BMP C220)

Infiltration Trench (BMP T7.20)

Temporary and Permanent Seeding (BMP C120)

Mulching (BMP C121)

Nets and Blankets (BMP C122)

Plastic Covering (BMP C123)

Topsoiling (BMP C125)

Dust Control (BMP C140)

Early application of gravel base on areas to be paved

Outlet Protection (BMP C209)

Appendix C – Alternative BMPs

The following includes a list of possible alternative BMPs for each of the 12 elements not described in the main SWPPP text. This list can be referenced in the event a BMP for a specific element is not functioning as designed and an alternative BMP needs to be implemented.

Element #1 - Mark Clearing Limits
High Visibility Plastic or Metal Fence (BMP C103)
Stake and Wire Fence (BMP C104)
Element #2 - Establish Construction Access
Wheel Wash (BMP C106)
Water Bars (BMP C203)
Element #3 - Control Flow Rates
Wattles (BMP C235)

Element #4 - Install Sediment Controls
Straw Bale Barrier (BMP C230)
Gravel Filter Berm (BMP C232)
Straw Wattles (BMP C235)
Portable Water Storage Tanks (Baker Tanks)
Construction Stormwater Chemical Treatment (BMP C250)
Construction Stormwater Filtration (BMP C251)

Element #5 - Stabilize Soils
Polyacrylamide (BMP C126)

Element #6 - Protect Slopes
Straw Wattles (BMP C235)
Surface Roughening (BMP C240)

Element #8 - Stabilize Channels and Outlets
Level Spreader (BMP C206)
Check Dams (BMP C207)

Element #9 – Control Pollutants
Concrete Handling (BMP C151)
Construction Stormwater Chemical Treatment (BMP C250)
Construction Stormwater Filtration (BMP C251)

Element #10 - Control Dewatering
Vegetated Filtration (BMP C236)
Additional Advanced BMPs to Control Dewatering:

Appendix D – General Permit

Appendix E – Site Inspection Forms (and Site Log)

The results of each inspection shall be summarized in an inspection report or checklist that is entered into or attached to the site log book. It is suggested that the inspection report or checklist be included in this appendix to keep monitoring and inspection information in one document, but this is optional. However, it is mandatory that this SWPPP and the site inspection forms be kept onsite at all times during construction, and that inspections be performed and documented as outlined below.

At a minimum, each inspection report or checklist shall include:

a. Inspection date/times

b. Weather information: general conditions during inspection, approximate amount of precipitation since the last inspection, and approximate amount of precipitation within the last 24 hours.

c. A summary or list of all BMPs that have been implemented, including observations of all erosion/sediment control structures or practices.

d. The following shall be noted:

   i. locations of BMPs inspected,

   ii. locations of BMPs that need maintenance,

   iii. the reason maintenance is needed,

   iv. locations of BMPs that failed to operate as designed or intended, and

   v. locations where additional or different BMPs are needed, and the reason(s) why

e. A description of stormwater discharged from the site. The presence of suspended sediment, turbid water, discoloration, and/or oil sheen shall be noted, as applicable.

f. A description of any water quality monitoring performed during inspection, and the results of that monitoring.

g. General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.

h. A statement that, in the judgment of the person conducting the site inspection, the site is either in compliance or out of compliance with the terms and conditions of the SWPPP and the NPDES permit. If the site inspection indicates that the site is out of compliance, the inspection report shall include a summary of the remedial actions required to bring the site back into compliance, as well as a schedule of implementation.

i. Name, title, and signature of person conducting the site inspection; and the following statement: "I certify under penalty of law that this report is true, accurate, and complete, to the best of my knowledge and belief".

When the site inspection indicates that the site is not in compliance with any terms and conditions of the NPDES permit, the Permittee shall take immediate action(s) to: stop, contain, and clean up the unauthorized discharges, or otherwise stop the noncompliance; correct the problem(s); implement appropriate Best Management Practices (BMPs), and/or conduct maintenance of existing BMPs; and achieve compliance with all applicable standards and permit conditions. In addition, if the noncompliance causes a threat to human health or the environment, the Permittee shall comply with the Noncompliance Notification requirements in Special Condition S5.F of the permit.

Site Inspection Form

General Information			
Project Name:			
Inspector Name:		**Title:** **CESCL # :**	
Date:		**Time:**	
Inspection Type:	□ After a rain event □ Weekly □ Turbidity/transparency benchmark exceedance □ Other		
Weather			
Precipitation	Since last inspection		In last 24 hours
Description of General Site Conditions:			

Inspection of BMPs						
Element 1: Mark Clearing Limits						
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	
Element 2: Establish Construction Access						
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

Element 3: Control Flow Rates

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

Element 4: Install Sediment Controls

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

Element 5: Stabilize Soils

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

Element 6: Protect Slopes

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

BMP:

Location	Inspected Y	Inspected N	Functioning Y	Functioning N	Functioning NIP	Problem/Corrective Action

Element 7: Protect Drain Inlets

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

Element 8: Stabilize Channels and Outlets

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

Element 9: Control Pollutants						
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

Element 10: Control Dewatering						
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	
BMP:						
Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

Stormwater Discharges From the Site			
	Observed?		Problem/Corrective Action
	Y	N	
Location			
Turbidity			
Discoloration			
Sheen			
Location			
Turbidity			
Discoloration			
Sheen			

Water Quality Monitoring	
Was any water quality monitoring conducted?	☐ Yes ☐ No
If water quality monitoring was conducted, record results here:	
If water quality monitoring indicated turbidity 250 NTU or greater; or transparency 6 cm or less, was Ecology notified by phone within 24 hrs?	☐ Yes ☐ No
If Ecology was notified, indicate the date, time, contact name and phone number below:	
Date:	
Time:	
Contact Name:	
Phone #:	
General Comments and Notes	
Include BMP repairs, maintenance, or installations made as a result of the inspection.	
Were Photos Taken?	☐ Yes ☐ No
If photos taken, describe photos below:	