Preliminary
Storm Drainage Report

FOR

Bullfrog – Phase J

Cle Elum, Washington

2024/11/21

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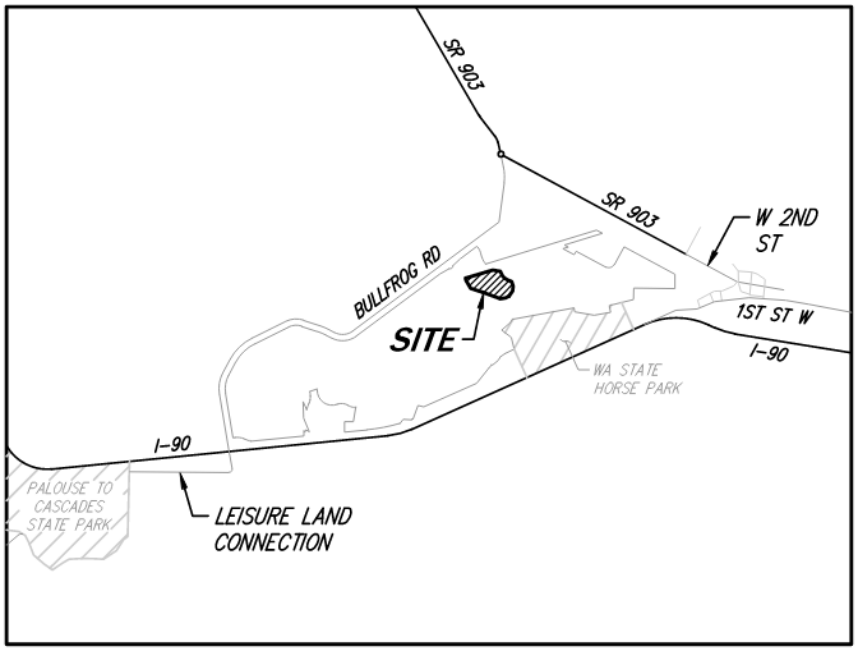
1. Project Overview

The Bullfrog project is a mixed-use phased development project located in the western portion of the City of Cle Elum, between Bullfrog Road and SR 903. This report addresses the stormwater design for Phase J of this project. Phase J will consist of townhouse development resulting in 164 lots. Phase J is located centrally within the overall development, with Phase S-1 to the southwest, future Phase S-2 to the southeast, and the development spine road to the south. See Figure 1-1 below for reference.

The existing site of Phase J generally slopes from northwest to southeast at slopes ranging between 1 and 10 percent.

All runoff from the site infiltrates prior to leaving the site in the present state, and this will be maintained post development. Basic water quality treatment will be provided by infiltration through bioretention soil mix. Stormwater management and facilities have been designed per the 2024 Stormwater Management Manual for Eastern Washington (SWMMEW).

Figure 1-1 Vicinity Map



2. Conditions and Requirement Summary

This project is considered a new development project and proposes greater than 5,000 square feet of new plus replaced hard surfaces; therefore, per Figure 2.1 of the SWMMEW, provided at the end of this section, Phase J is subject to all Core Elements.

2.1 Core Elements

2.1.1 Core Element #1: Preparation of a Stormwater Site Plan

This report, along with the civil plans submitted under separate cover, will satisfy this core element.

2.1.2 Core Element #2: Construction Stormwater Pollution Prevention Plan

In order to reduce the impacts of sediment laden runoff during construction, a Construction Stormwater Pollution Prevention Plan (CSWPPP) will be prepared for this project and included under separate cover at final design. This plan will address the 13 elements of pollution prevention and the appropriate BMPs which will be implemented to ensure the prevention of sediment laden runoff from leaving the site. Section 5 of this report will also provide an overview of the measures being taken to address this element at final design.

2.1.3 Core Element #3: Source Control of Pollution

Development of the project site consists of multifamily residential development and associated roads and utilities. Per Section 8.1 of the 2024 SWMMEW, this level of development is not required to implement Source Control BMPs. As such, this element is considered to have been addressed.

2.1.4 Core Element #4: Preservation of Natural Drainage Systems

Onsite natural drainage patterns consist of infiltration of runoff. The project proposes to mimic this condition. In doing such, the project will maintain the natural drainage outfall to the maximum extent practicable. See Section 3 of this report for a discussion of the existing outfall.

2.1.5 Core Element #5: Runoff Treatment

Runoff treatment for the project has been evaluated in accordance with the 2024 SWMMEW based on the location of project site discharge. Project site discharge is proposed to be through surface infiltration, and oil control is not required for the proposed level of development. As such, runoff treatment will be accomplished by filtering through bioretention soil mix prior to surface infiltration. This will occur at a bioretention facility, the design of which is discussed further in Section 4.3 of this report.

2.1.6 Core Element #6: Flow Control

Flow control is required for the project site and will be provided through the use of infiltration BMPs, designed to infiltrate 100 percent of the 25-year, 24-hour Type IA storm. Additional information regarding the proposed facilities in included in Section 4 of this report.

2.1.7 Core Element #7: Operation and Maintenance

Appropriate Operations and Maintenance (O&M) information for the proposed stormwater management BMPs will be provided at final design in Section 6 of this report.

2.1.8 Core Element #8: Wetlands Protection

Stormwater discharge from the project site will be via onsite infiltration, matching the existing condition. Therefore, stormwater discharge from the site does not discharge into a wetland directly or via a conveyance system, and Core Element #8 is not applicable.

2.2 Additional Protective Measures (APMs)

The City of Cle Elum does not require the APMs to be applied to project development. However, the project has reviewed the requirements as discussed below, for applicability and relevance.

2.2.1 APM1: Financial Liability

Bonding for the project will be determined at final design and per instruction from the City at that time.

2.2.2 APM2: Off-Site Analysis Report

Section 3 of this report provides discussion of the natural drainage patterns of the project site. In the existing condition, all runoff infiltrates on site. Therefore, an offsite analysis is not required.

2.2.3 APM3: Local Requirements

No additional Local Requirements per the City of Cle Elum are required.

Figure 2.1: Flow Chart for Determining Requirements for New Development

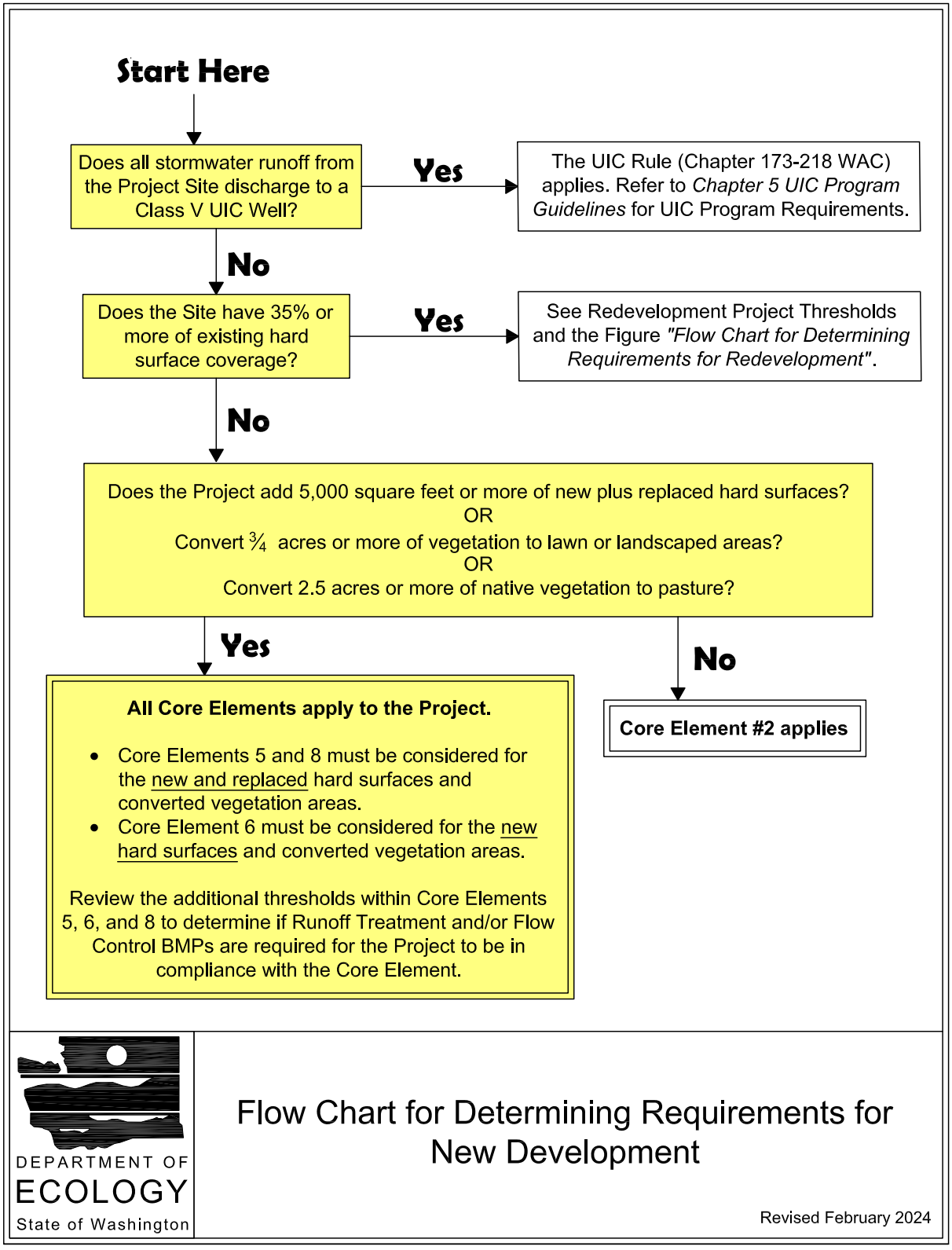
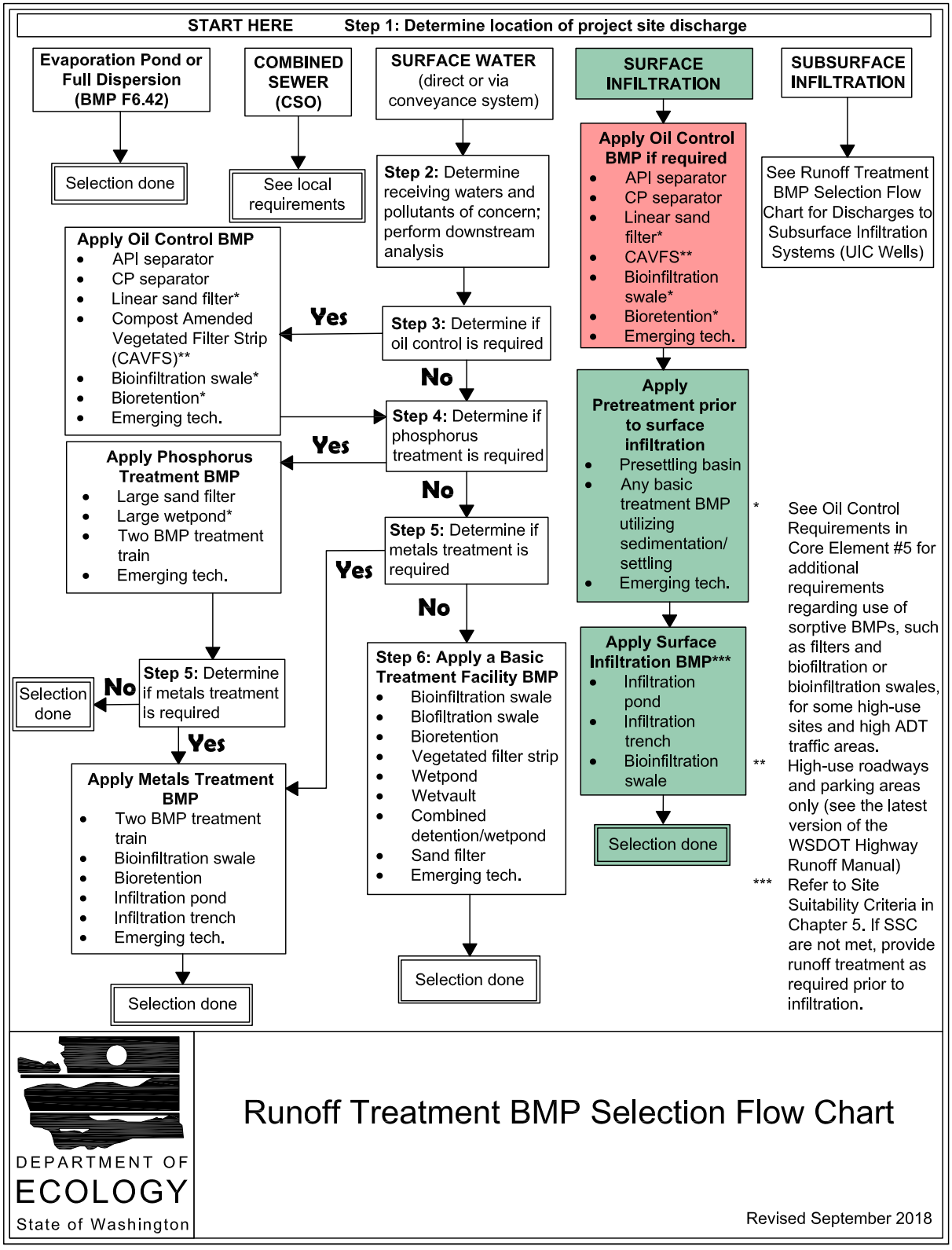
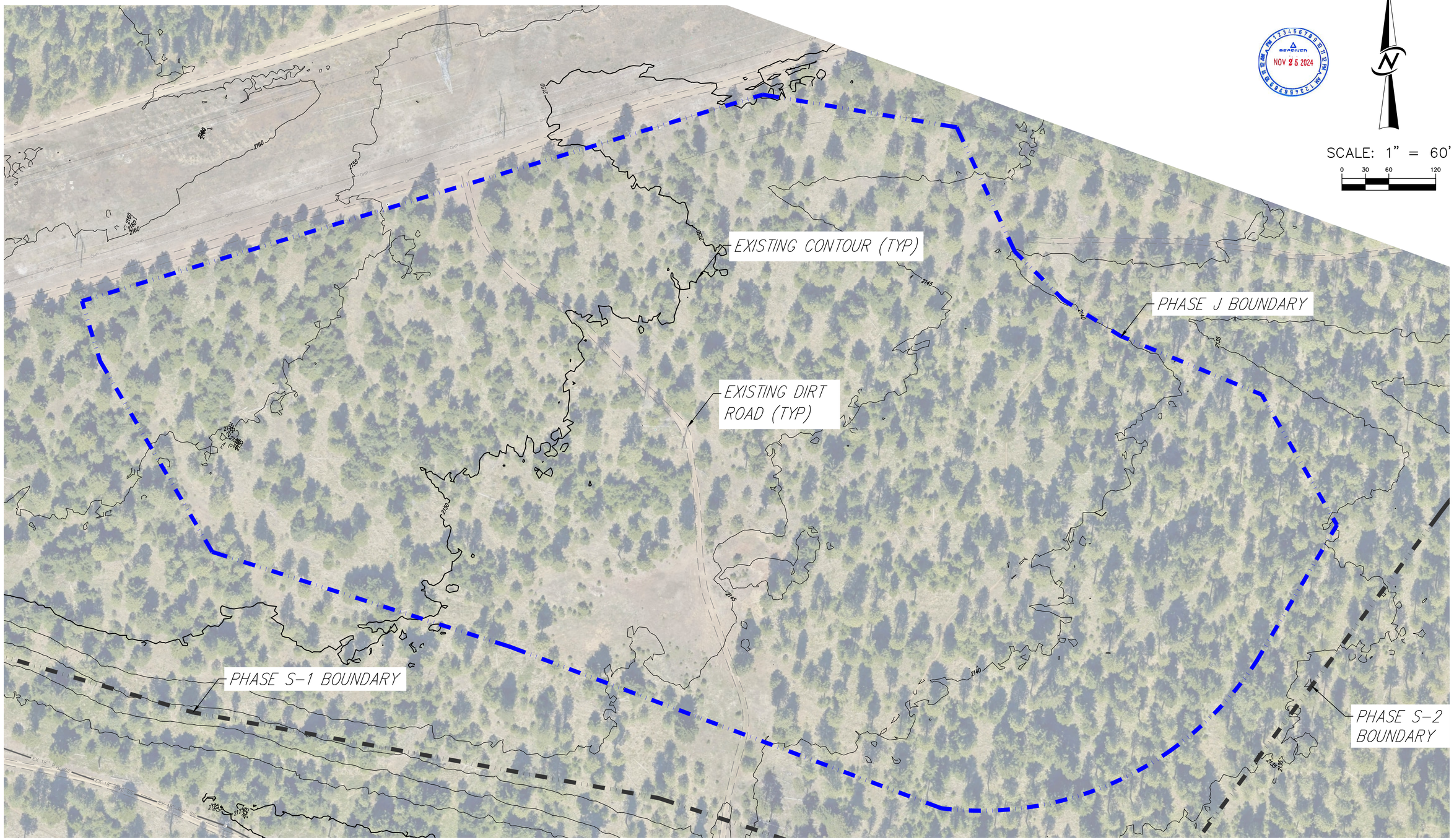


Figure 6.1: Runoff Treatment BMP Selection Flow Chart



3. Off-Site Analysis

Due to the high infiltration rate of onsite soils, this project proposes to infiltrate 100 percent of the 25-year, Type IA 24-hour storm event, plus 24-hour snowmelt. Therefore, there is no anticipated discharge from the site. As such, there is no downstream path to analyze. The natural drainage pattern is concluded to be infiltrated through on-site soils, so analysis did not extend off-site. See the Existing Basin Map in the following pages for an overview of the existing site.



RECEIVED NOV 25 2024

SCALE: 1" = 60'

0 30 60 120

BULLFROG - PHASE J

EXISTING CONDITIONS EXHIBIT

CORE DESIGN
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4. Permanent Stormwater Control Analysis and Design

In order to mitigate the impacts of increased runoff from the developed site in comparison to the undeveloped site, flow control is required for this project. To meet this requirement, infiltration facilities are proposed to mitigate all impervious surfaces. All pervious surfaces are assumed to infiltrate all surface runoff, and are not included in the sizing for the infiltration facilities.

4.1 Stormwater Design Overview

This project proposes construction of a bioretention area and an infiltration pond. The proposed bioretention area will provide runoff treatment for all NPGIS and PGIS associated with project development.

4.2 Basin Information

As discussed in Section 4.1, the proposed infiltration pond will be downstream of the bioretention area. The basin tributary to this system is detailed in Table 4-1 below. The extents of the basin is also detailed in the Developed Conditions Exhibit, provided at the end of this section.

Table 4-1 Basin Areas

	Area (sf)	Area (ac)
Phase J Impervious	582138 sf	13.36 ac

4.3 Bioretention Design

The proposed bioretention area has been designed for treatment based on the 24-hour Water Quality design storm, as directed under the Cle Elum 2024 Construction Standards. This storm event is the 6-month, 24-hour storm, equivalent to 1.22 inches of precipitation.

4.3.2 Modeling Results

The bioretention sizing has been determined utilizing SBUH in HydroCAD, the report of which is provided in Appendix A of this report. The bioretention area has been designed using an infiltration rate of 3.0 inches per hour across the vertical surface area only. Geometry of the proposed facility is detailed in Table 4-2 and will provide one foot of freeboard. Overflow for the bioretention facility will be provided via an overflow structure, which will route all flows which do not infiltrate through the facility to the infiltration pond. See Section 4.4 for additional information regarding the design of the infiltration pond.

Table 4-2 Bioretention Design Information

Basin	Bottom Length	Bottom Width	Base Area	Maximum Stage	Overflow Stage	Total Depth	Side Slope
Phase J	40'	230'	9200 sf	1.0'	2.0'	3.0'	3H : 1V

All proposed bioretention areas will match the required design at minimum. Confirmation of this match will be provided at final design and again at as-builts.

4.4 Infiltration Pond Design

The proposed infiltration pond has been designed utilizing HydroCAD for the Type IA, 25-year, 24-hour storm event and 24-hour snow melt for the region. The precipitation depth was determined per the 2024 City of Cle Elum Design Standards. The estimated average daily snow depth was determined utilizing the methodology presented in the 2024 SWMMEW based on the data of Table 4.9 within the 2024 SWMMEW. This calculation is provided in Section 4.4.1 of this report for reference.

4.4.1 Snowmelt Adjustment Factor Calculation

According to the 2024 SWMMEW, the project site is located within Climate Region 1. No snowfall data for the project location is provided in the 2024 SWMMEW. As a result, the closest data available in Wenatchee was used to determine the average daily snow depth in Cle Elum.

The average annual precipitation for Wenatchee, per Figure 4.1 of the 2024 SWMMEW, is 10 inches. The average annual precipitation for Cle Elum from the same figure is 26 inches. The estimated average daily snow depth for Cle Elum was determined by multiplying the ratio of average annual precipitation between Cle Elum and Wenatchee against the average daily snow depth and all other adjustment factors.

$$S_{Cle\ Elum} = S_{Wenatchee} * \frac{P_{Cle\ Elum}}{P_{Wenatchee}}$$

Where: S_{City} is the average daily snow depth of that city in inches, and
P_{City} is the average annual precipitation of that city in inches.

The calculated Average Daily Snow Depth of Cle Elum is 6.94 inches. A summary of the values used for this calculation is provided in Table 4-3 below.

Table 4-3 Average Daily Snow Depth Calculation

$P_{Wenatchee}$	10 in
$P_{Cle\ Elum}$	26 in
$P_{Cle\ Elum}$ / $P_{Wenatchee}$	2.6
$S_{Wenatchee}$	2.67 in
$S_{Cle\ Elum}$	6.94 in

The equivalent snowmelt depth was determined utilizing a 20 percent snow moisture content, matching the relationship presented in Table 4.9 of the 2024 SWMMEW. As such, the Cle Elum Snowmelt 24-hour Adjustment utilized in sizing the infiltration pond was found to be 1.39 inches. See Table 4-4 for the referenced and calculated snowmelt factors.

Table 4-4 Snowmelt Adjustment Factors as adopted from the 2024 SWMMEW

Location	Average Daily Snow Depth (inches)	Water Equivalent (inches) 24-Hour Storm Precipitation Adjustment
Wenatchee	2.67	0.53
*Cle Elum**	*6.94*	*1.39*

**Per calculations provided above*

4.4.2 Design Storm

In order to determine the design storm rainfall depth, the Type IA 25-year, 24-hour storm depth was combined with the Cle Elum Snowmelt 24-hour Adjustment. As discussed at the beginning of this section, the 25-year, 24-hour storm depth foe the Type IA storm was determined by the City of Cle Elum Design Standards. This depth was found to be 3.48 inches. Upon combination with the Snowmelt 24-hour Adjustment, the design precipitation depth utilized for Flow Control modeling was determined to be 4.87 inches. See Table 4-6 below for a summary of this calculation.

Table 4-5 Design Storm Calculation

Snowmelt Adjustment	1.39 in
25-yr, 24-hr Depth	3.48 in
Design Storm Depth	4.87 in

4.4.3 Modeling Results

The proposed infiltration pond sizing has been determined utilizing SBUH in HydroCAD, the report of which is provided in Appendix B of this report. The model has been set up such that the overflow from the bioretention area, as designed in Section 4.3 of this report, is routed to the proposed infiltration pond. The proposed pond has been designed assuming 3 to 1 side slopes and one foot of freeboard. Detailed information regarding the geometry of the proposed pond is provided in Table 4-6 below.

Table 4-6 Infiltration Pond Design Geometry

Basin	Bottom Length	Bottom Width	Base Area	Maximum Stage	Overflow Stage	Total Depth	Storage Volume
Phase J	50'	126'	6300 sf	6.0'	7.0'	12.0'	86184 cf

The proposed infiltration pond will match the required design at minimum. Confirmation of this match will be provided at final design and again at as-builts. The hydrograph produced by HydroCAD shows that all runoff routed to the infiltration pond is infiltrated within 40 hours, less than the required 72 hours. As such, the proposed stormwater design will provide treatment and flow control via infiltration for all runoff from the project site through the 25-year storm. See the Hydrograph provided in the HydroCAD report in Appendix B for reference.

SCALE: 1" = 60'

0 30 60 120

PGIS (TYP)

5' CONTOUR (TYP)

NPGIS (TYP)

PHASE J BOUNDARY

INFILTRATION POND

BIORETENTION

FUTURE DEVELOPMENT PHASE S-1

FUTURE DEVELOPMENT PHASE S-2

12" PVC W

BULLFROG - PHASE J

DEVELOPED CONDITIONS EXHIBIT

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LANDSCAPE ARCHITECTURE
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5. Construction Stormwater Pollution Prevention Analysis

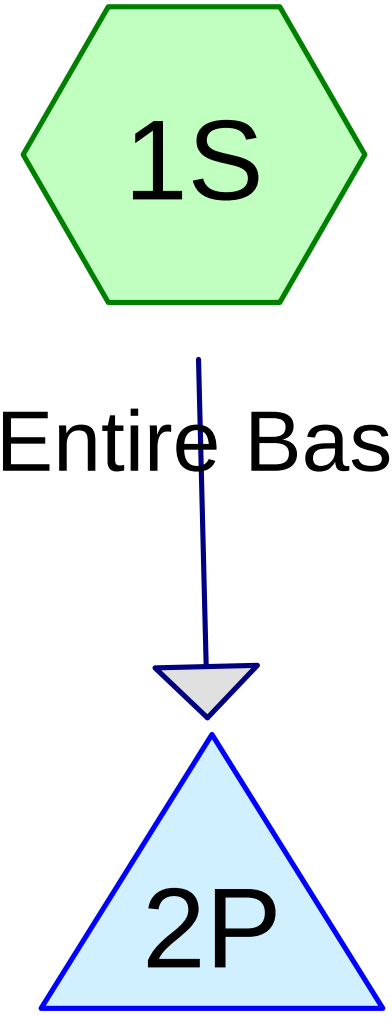
Erosion and sediment control for the project will be provided per the requirements of the 2024 SWMMEW. Additional information and analysis will be provided at final design.

6. Operations and Maintenance Manual

Operations and maintenance details for the applicable proposed stormwater facilities will be provided at final engineering design.

Appendix A

Bioretention Water Quality HydroCAD Report



Subcat Reach Pond Link

Routing Diagram for J Bioretention Area (WQ)
Prepared by Core Design, Printed 2024-11-18

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	6-Month	Type IA 24-hr		Default	24.00	1	1.22	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
13.360	98	Roads & Buildings (1S)
13.360	**98**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
13.360	Other	1S
13.360		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	13.360	13.360	Roads & Buildings	1S
0.000	**0.000**	**0.000**	**0.000**	**13.360**	**13.360**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: J Entire Basin Runoff Area=13.360 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=3.47 cfs 1.119 af

Pond 2P: J Bioretention Area Peak Elev=100.96' Storage=0.221 af Inflow=3.47 cfs 1.119 af
Discarded=0.75 cfs 1.119 af Primary=0.00 cfs 0.000 af Outflow=0.75 cfs 1.119 af

Total Runoff Area = 13.360 ac Runoff Volume = 1.119 af Average Runoff Depth = 1.01"
0.00% Pervious = 0.000 ac 100.00% Impervious = 13.360 ac

Summary for Subcatchment 1S: J Entire Basin

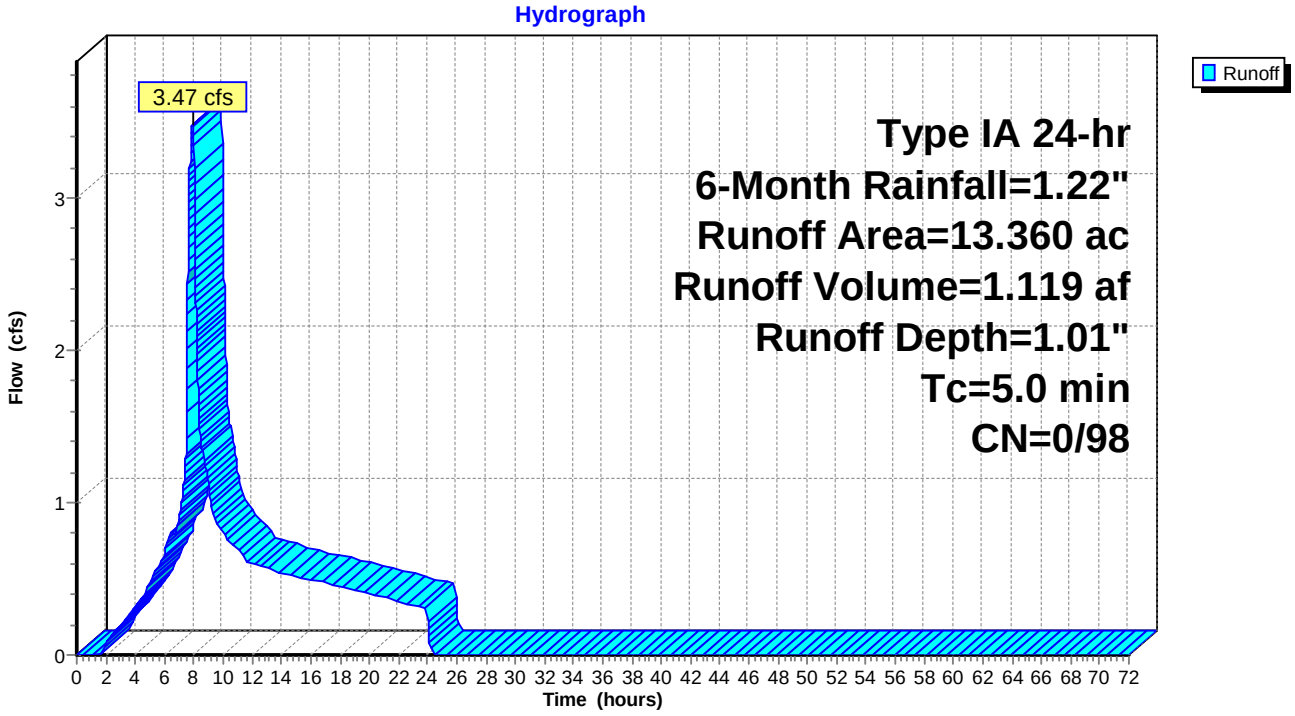
Runoff = 3.47 cfs @ 7.89 hrs, Volume= 1.119 af, Depth= 1.01"
Routed to Pond 2P : J Bioretention Area

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 6-Month Rainfall=1.22"

	Area (ac)	CN	Description
*	13.360	98	Roads & Buildings
	13.360	98	100.00% Impervious Area

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

Subcatchment 1S: J Entire Basin



Summary for Pond 2P: J Bioretention Area

Inflow Area = 13.360 ac,100.00% Impervious, Inflow Depth = 1.01" for 6-Month event
Inflow = 3.47 cfs @ 7.89 hrs, Volume= 1.119 af
Outflow = 0.75 cfs @ 10.30 hrs, Volume= 1.119 af, Atten= 78%, Lag= 144.5 min
Discarded = 0.75 cfs @ 10.30 hrs, Volume= 1.119 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 100.96' @ 10.30 hrs Surf.Area= 0.248 ac Storage= 0.221 af

Plug-Flow detention time= 116.6 min calculated for 1.119 af (100% of inflow)
Center-of-Mass det. time= 116.6 min (818.7 - 702.1)

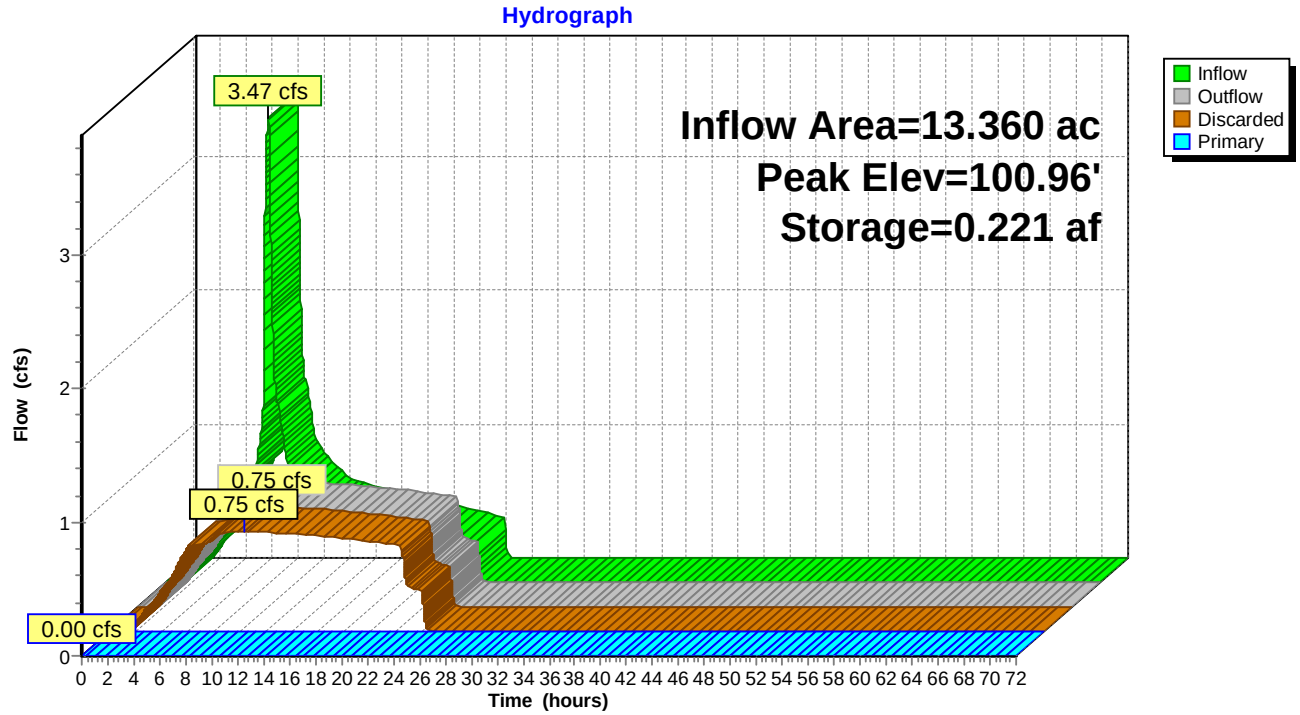
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	0.808 af	**40.00'W x 230.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	101.00'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	100.00'	**3.000 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.75 cfs @ 10.30 hrs HW=100.96' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.75 cfs)

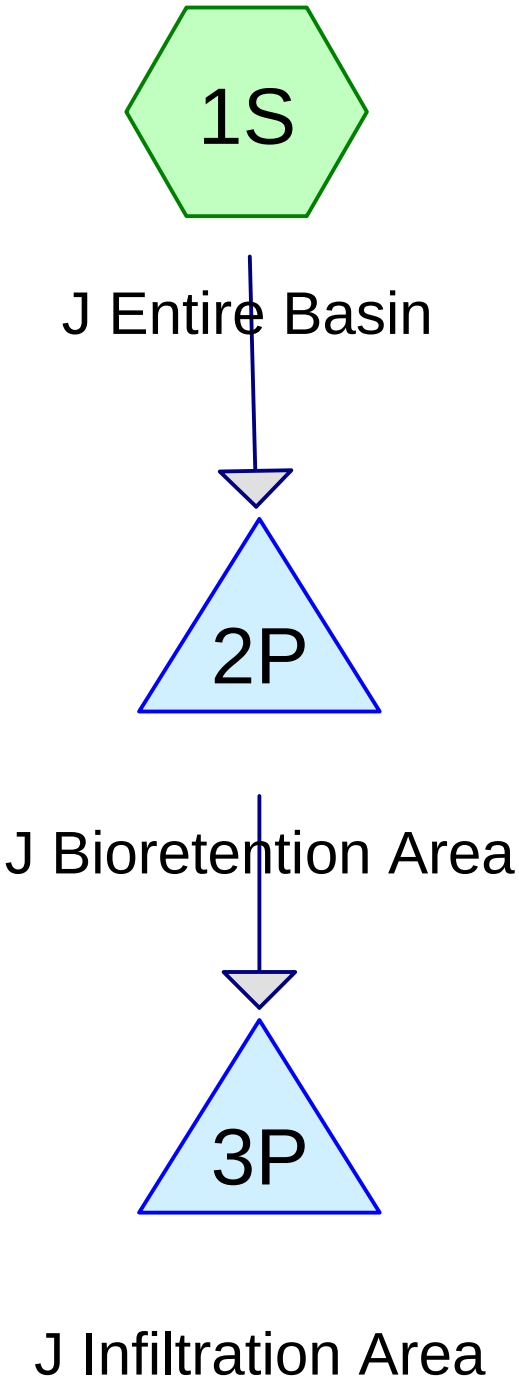
Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=100.00' (Free Discharge)
└**1=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: J Bioretention Area



Appendix B

Overall HydroCAD Report



Subcat Reach Pond Link

Routing Diagram for J Bioretention Area & Infiltration Pond Connected
Prepared by Core Design, Printed 2024-11-18

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25 Year + Snowmelt	Type IA 24-hr		Default	24.00	1	4.87	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
13.360	98	Roads & Buildings (1S)
13.360	**98**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
13.360	Other	1S
13.360		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	13.360	13.360	Roads & Buildings	1S
0.000	**0.000**	**0.000**	**0.000**	**13.360**	**13.360**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: J Entire Basin Runoff Area=13.360 ac 100.00% Impervious Runoff Depth=4.63"
Tc=5.0 min CN=0/98 Runoff=15.37 cfs 5.158 af

Pond 2P: J Bioretention Area Peak Elev=102.57' Storage=0.669 af Inflow=15.37 cfs 5.158 af
Discarded=0.94 cfs 1.826 af Primary=11.26 cfs 3.333 af Outflow=12.20 cfs 5.158 af

Pond 3P: J Infiltration Area Peak Elev=0.07' Storage=0.010 af Inflow=11.26 cfs 3.333 af
Discarded=11.25 cfs 3.333 af Primary=0.00 cfs 0.000 af Outflow=11.25 cfs 3.333 af

Total Runoff Area = 13.360 ac Runoff Volume = 5.158 af Average Runoff Depth = 4.63"
0.00% Pervious = 0.000 ac 100.00% Impervious = 13.360 ac

Summary for Subcatchment 1S: J Entire Basin

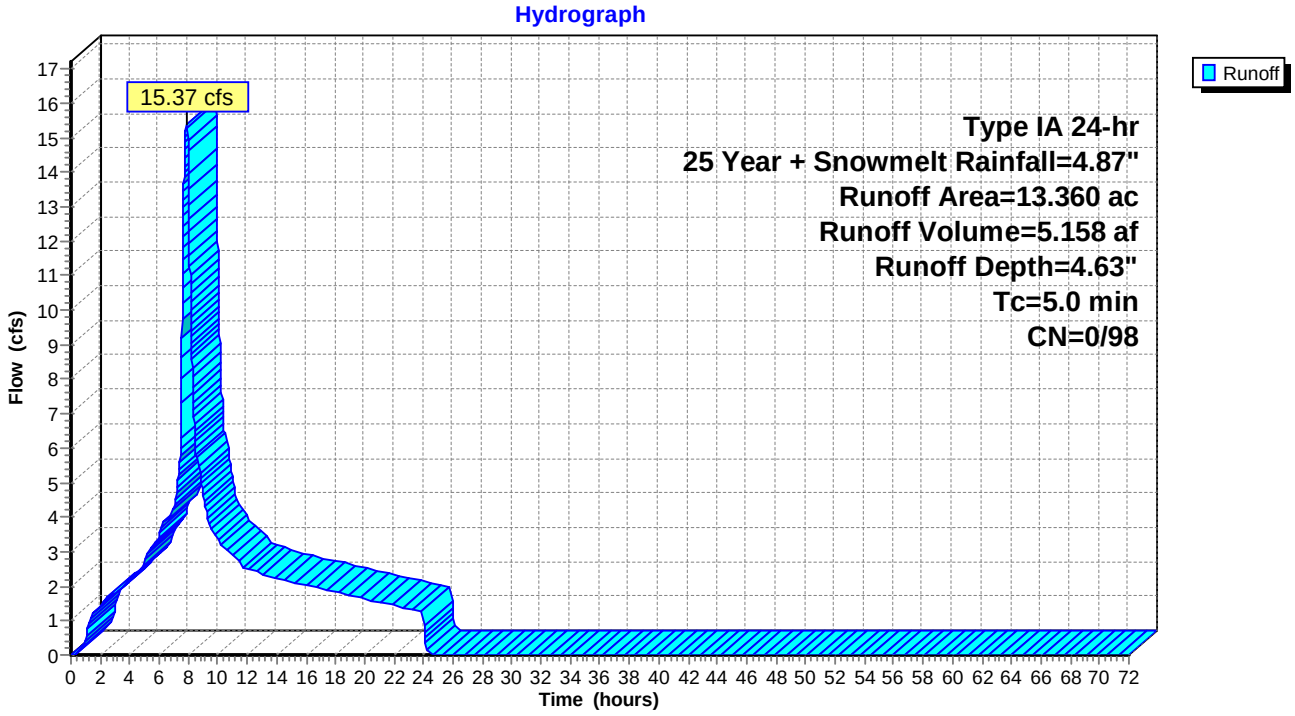
Runoff = 15.37 cfs @ 7.88 hrs, Volume= 5.158 af, Depth= 4.63"
Routed to Pond 2P : J Bioretention Area

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year + Snowmelt Rainfall=4.87"

	Area (ac)	CN	Description
*	13.360	98	Roads & Buildings
	13.360	98	100.00% Impervious Area

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

Subcatchment 1S: J Entire Basin



Summary for Pond 2P: J Bioretention Area

Inflow Area = 13.360 ac,100.00% Impervious, Inflow Depth = 4.63" for 25 Year + Snowmelt event
Inflow = 15.37 cfs @ 7.88 hrs, Volume= 5.158 af
Outflow = 12.20 cfs @ 8.06 hrs, Volume= 5.158 af, Atten= 21%, Lag= 11.2 min
Discarded = 0.94 cfs @ 8.06 hrs, Volume= 1.826 af
Primary = 11.26 cfs @ 8.06 hrs, Volume= 3.333 af
Routed to Pond 3P : J Infiltration Area

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 102.57' @ 8.06 hrs Surf.Area= 0.312 ac Storage= 0.669 af

Plug-Flow detention time= 98.5 min calculated for 5.158 af (100% of inflow)
Center-of-Mass det. time= 98.5 min (753.8 - 655.2)

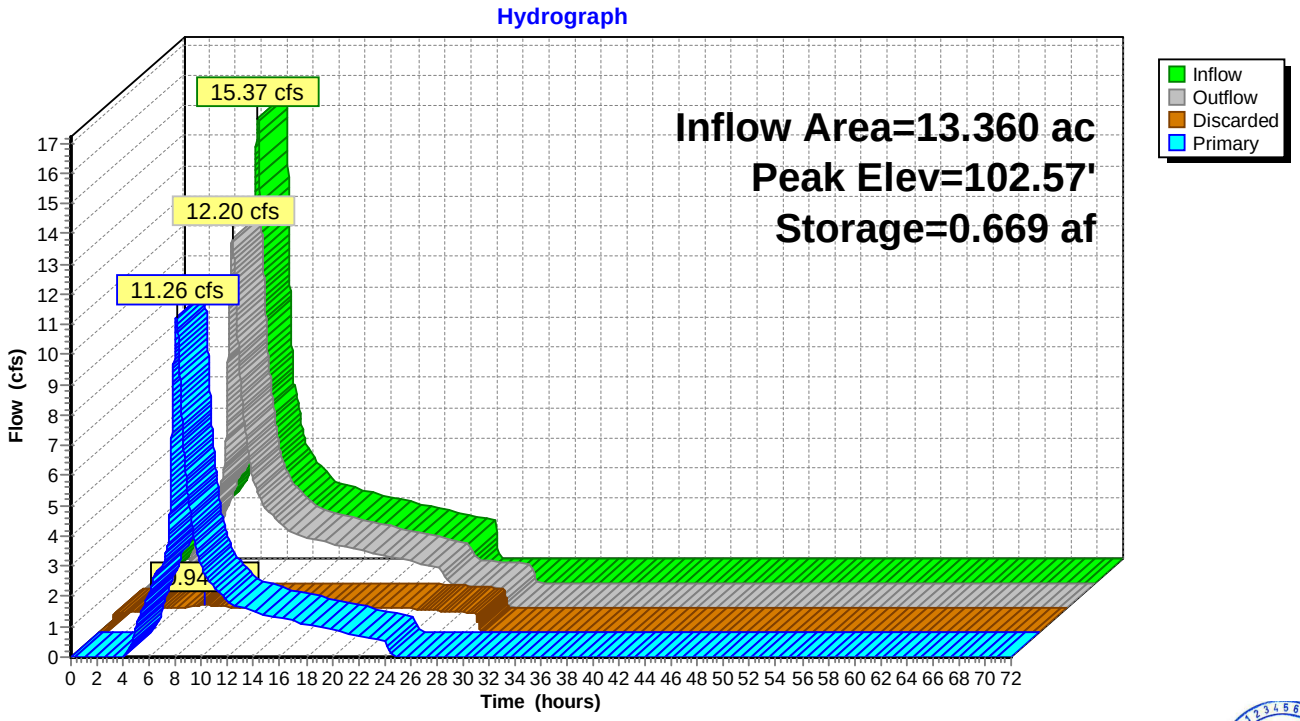
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	0.808 af	**40.00'W x 230.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	101.00'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	100.00'	**3.000 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.94 cfs @ 8.06 hrs HW=102.57' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.94 cfs)

Primary OutFlow Max=11.26 cfs @ 8.06 hrs HW=102.57' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 11.26 cfs @ 4.26 fps)

Pond 2P: J Bioretention Area



Summary for Pond 3P: J Infiltration Area

Inflow Area = 13.360 ac,100.00% Impervious, Inflow Depth = 2.99" for 25 Year + Snowmelt event
Inflow = 11.26 cfs @ 8.06 hrs, Volume= 3.333 af
Outflow = 11.25 cfs @ 8.07 hrs, Volume= 3.333 af, Atten= 0%, Lag= 0.6 min
Discarded = 11.25 cfs @ 8.07 hrs, Volume= 3.333 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 0.07' @ 8.07 hrs Surf.Area= 0.146 ac Storage= 0.010 af

Plug-Flow detention time= 0.6 min calculated for 3.333 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (679.1 - 678.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	1.701 af	**50.00'W x 126.00'L x 7.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	6.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	0.00'	**81.400 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=12.00 cfs @ 8.07 hrs HW=0.07' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 12.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**1=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: J Infiltration Area