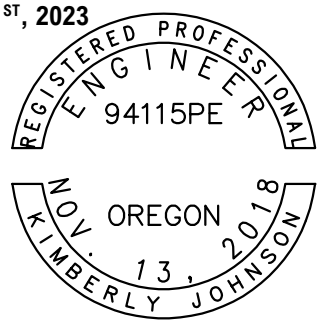
PRELIMINARY STORMWATER MANAGEMENT REPORT

FOR

THE PROPOSED 13-UNIT APARTMENT COMPLEX
at
1600 SE LAVA DRIVE
MILWAUKIE, OR.

JUNE 1ST, 2023



PREPARED BY:

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PRELIMIANRY-NOT FOR CONSTRUCTION

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Contents

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I. PURPOSE OF REPORT

This report describes the proposed improvements compliance with the City of Milwaukie stormwater design standards, which defers to the City of Portland 2020 Stormwater Management Manual and the 2020 City of Portland/Bureau of Environmental Services Sewer and Drainage Facilities Design Manual.

II. PROJECT DESCRIPTION

This site is located at the southwest corner of SE Lava Drive and SE River Lane. The property is bordered by SE Lava Drive to the north, SE River Lane to the east, and private property to the west and south.

A. EXISTING CONDITION

The existing site is currently a single-family residential home with an asphalt drive. The remaining of the existing site is undeveloped and covered with grass. The existing site has a ridge midway at the north property line, with one-half of the property sheet flowing to the southwest corner of the property and one-half of the property sheet flowing to the southeast corner of the property. There are currently no stormwater management facilities located onsite. There is approximately 6% fall across the site.

No run-on is anticipated.

The existing site is not located within a FEMA floodway, and is located within Zone X per FEMA Map No. 41005C0009D, effective on 06/17/2008..

The Geotechnical Report from GeoPacific dated May 30th, 2023, Project No. 23-6332, utilized the open-hole falling-head method. The test was performed at 6 feet and exhibited an infiltration rate of 2 in/hr. Infiltration rates have been reported without applying a factor of safety. A factor of safety of 4 should be used in design for a resulting infiltration rate of 0.5 in/hr.

Full infiltration is considered not feasible base on factored rate.

B. PROPOSED CONDITION

The proposed development includes a 13-unit multi-story apartment complex, a parking lot, walkways and proposed landscape. Additionally, SE Lava Drive will be improved with curb, gutter and sidewalk.

The project site is located less than ¼ mile away from the Willamette River and is ultimately tributary to the river.

As such, we are required to comply with the flow control requirements set forth by the City of Portland 2020 Stormwater Management. A proposed planter with underdrain has been designed to collect the site runoff and mitigate the required flow. A low-flow pipe will be installed at the bottom of the planter that connects to the existing storm drain main in SE Lava Drive. Additionally, the beehive overflow will connect to the existing storm drain main in SE Lava Drive

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III. METHODOLOGY

The City of Portland's 2020 Stormwater Management Manual requires stormwater to be selected based on a hierarchy system;

LEVEL 1: Full onsite infiltration, Level 1, is required to the maximum extent practicable for sites with design infiltration rates of 2 in/hr or more, unless site constraints prevent infiltration or the site qualifies for the ecoroof exception. Fully infiltrate the 10-year design storm.

LEVEL 2: Offsite discharge to the separated stormwater system.

Pollution Reduction required:

- Achieve 70% TSS removal from the runoff resulting from 90% of the average annual rainfall.
- In watershed with a TMDL or on DEQ's 303(d) list of impaired waters, use a pollution reduction facility that will reduce pollutants of concern.

Flow Control Required:

- For discharge to surface water bodies directly or indirectly (such as via a piped system), limit post-development peak runoff rates to pre-development rates for the one-half the 2-year event and for the 5-, 10-, and 25-year events.
- **For discharge to storm-only systems that drain to large water bodies including the Willamette, Columbia Slough and Columbia River when there is a system need, limit the post-development peak runoff rates to pre-development rates for the 2-, 5-, and 10-year event.**

LEVEL 3: Offsite discharge to the combined sewer system; flow control required.

The project will utilize Level 2, Offsite Discharge to the Separated Stormwater System. And due to the projects close proximity to the Willamette River, the project will only need to limit the 2-, 5-, and 10- year event. The Geotechnical Engineer tested the infiltration rates onsite and found them to be 2in/hr, not including a factor of safety, therefore this site will not allow for full onsite infiltration. The performance approach method was used to size the proposed stormwater facilities.

Flow Control Requirements:

Table 2-13. Flow Control Requirements[1]

Storm Recurrence Interval (years)	24-hr Rainfall Depth (inches)	Requirements by the Receiving System		
		Drainageway or Stream	Columbia Slough, Willamette River, or Columbia River[2]	Combined Sewer Pipe
2	2.4	Limit 1/2 the 2-year post-development peak flow to 1/2 the 2-year pre-development peak flow	Do not exceed pre-development peak flows	N/A
5	2.9	Do not exceed pre-development peak flows	Do not exceed pre-development peak flows	N/A
10	3.4	Do not exceed pre-development peak flows	Do not exceed pre-development peak flows	N/A
25	3.8	Do not exceed pre-development peak flows[3]	N/A	Limit the 25-year post-development peak flow to the 10-year pre-development peak flow

1 Facilities with catchment areas too small to meet these requirements within the design parameters must instead be sized to filter the post-development runoff from the 25-year design storm without overflow.
2 Projects may be exempt from flow control requirements if they discharge stormwater runoff to one of these waterbodies and the storm sewer system has available capacity.
3 This does not apply to vegetated surface facilities in the right-of-way with a ponding depth up to 9 inches.

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Method: Performance Approach

Requirements: Infiltrate 10-Year Storm. 30 Hour Drawdown
Computer Program: HydroCAD 10.20-2f
Method: SBUH
Storm Event: NRCS 24-Hour Type 1A Hyetograph
Soil Group: C
Rainfall Depths:

Table A-9. 24-Hour Rainfall Depths at Portland Airport

Recurrence Interval (years)	24-Hour Rainfall Depth (inches)
2	2.4
5	2.9
10	3.4
25	3.8
100	4.7

Table 2-12. Water Quality Storm[1,2]

Stormwater Facility Sizing Basis	Site's Time of Concentration (min)	Water Quality Storm	
		Rainfall Intensity (in/hr)	24-hr Storm Depth (in)
Combination Rate-Volume-Based Facilities and Volume-Based Facilities	N/A	N/A	1.61
Rate-Based Facilities	5	0.19	N/A
	10	0.16	
	20	0.13	

1 Stormwater facilities designed under the Performance Approach may be sized using continuous simulation in lieu of a design storm. If sizing using continuous simulation, a minimum of 20 years of Portland rainfall data must be used to demonstrate that the stormwater runoff generated from 90% of the average annual rainfall will be treated from the site's impervious area.

2 Facilities designed under the Performance Approach may be combination rate-volume-based, volume-based, or rate-based facilities. Facilities designed under the Presumptive Approach are combination rate-volume-based facilities.

Curve Numbers:

Table A-8. Curve Numbers

Development Status	Area Description		Curve Number
Pre-development	Soil Group	A	65
		B	72
		C	79
		D	81
		Unidentified	81
Post-development	Impervious area		98
	Ecoroof		61

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HydroCAD Results:

PRE DEVELOPMENT INPUT PARAMETERS									
AREA	TOTAL AREA (SF)/(AC.)	IMPERVIOUS AREA (SF)	PERVIOUS AREA (SF)	IMPERVIOUS PERCENTAGE (%)	CN (PRE)	SOIL TYPE	LENGTH	SLOPE	CALC.TC
EX	17,987/0.41	2,362	15,625	13%	79	C	115	6.1%	8.1

POST DEVELOPMENT INPUT PARAMETERS									
AREA	TOTAL AREA (SF)/(AC.)	IMPERVIOUS AREA (SF)	PERVIOUS AREA (SF)	IMPERVIOUS PERCENTAGE (%)	CN (POST)	SOIL TYPE	LENGTH	SLOPE	CALC.TC
A	17,987/0.41	11,431	6,556	63.5%	91(WEIGHTED)	C	-	-	5

TOTAL SITE-RESULTS			
AREA	PRE-DEVELOPMENT (CFS)	POST-DEVELOPMENT INFILTRATION DISCARDED RATE (CFS)	VOLUME STORED IN BASIN
WQV		0.04 CFS @ 12.65 HRS	705
2-YR	0.08	0.05 CFS @ 13.15 HRS	1,279
5-YR	0.11	0.05 CFS @ 13.5 HRS	1,689
10-YR	0.12	0.06 CFS @ 13.7 HRS	2,124

IV. SUMMARY

In conclusion, the proposed development will not increase the post-development flow rate from the pre-development flow rate for the 2-year, 5-year, and 10-year storm event, via implementation of a basin with underdrains. The proposed development preliminarily complies with the City of Milwaukie which defers to the City of Portland Stormwater and Hydrology standards.

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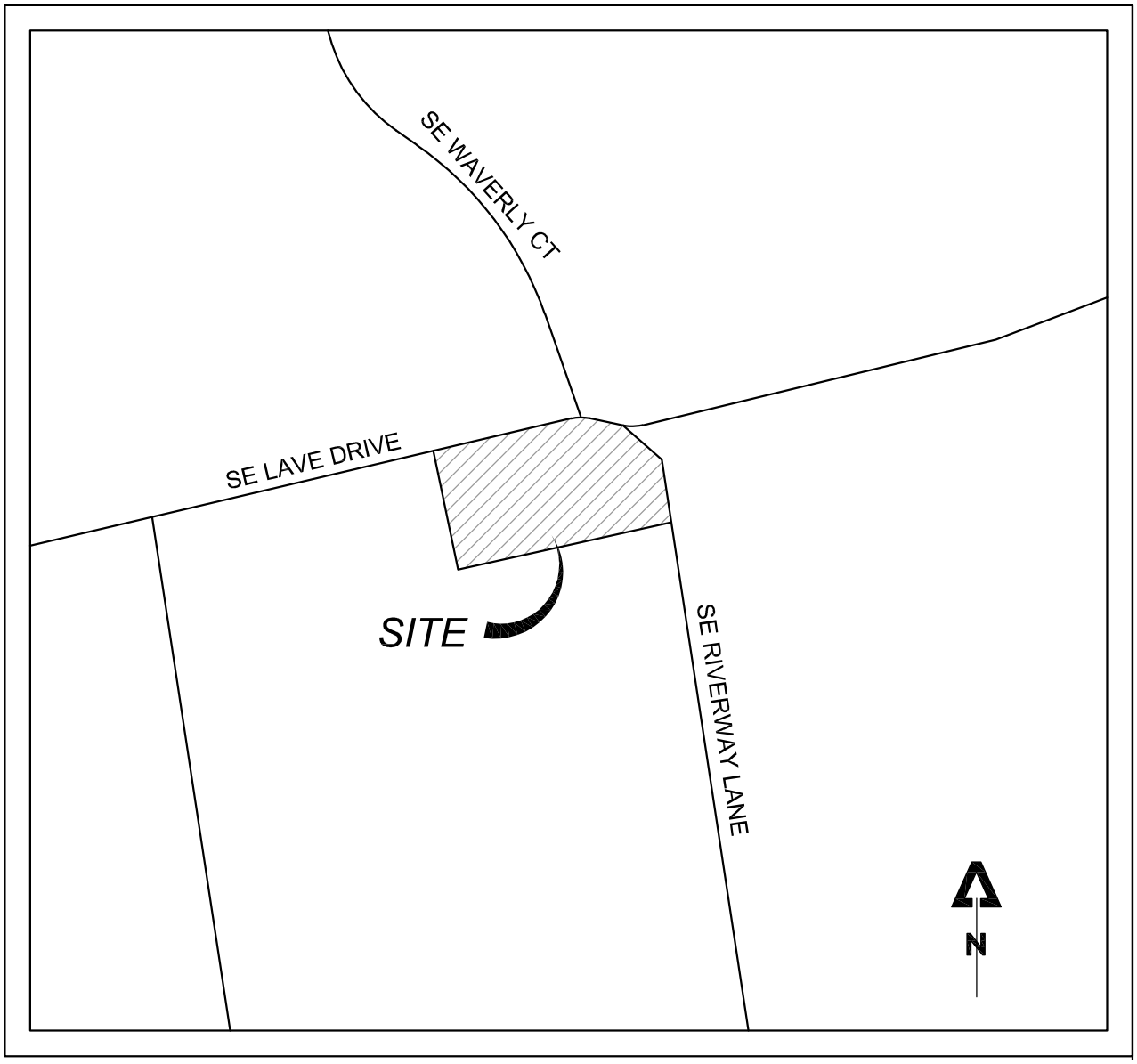
APPENDIX A – MAPS



VICINITY MAP

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APPENDIX B – CALCULATIONS

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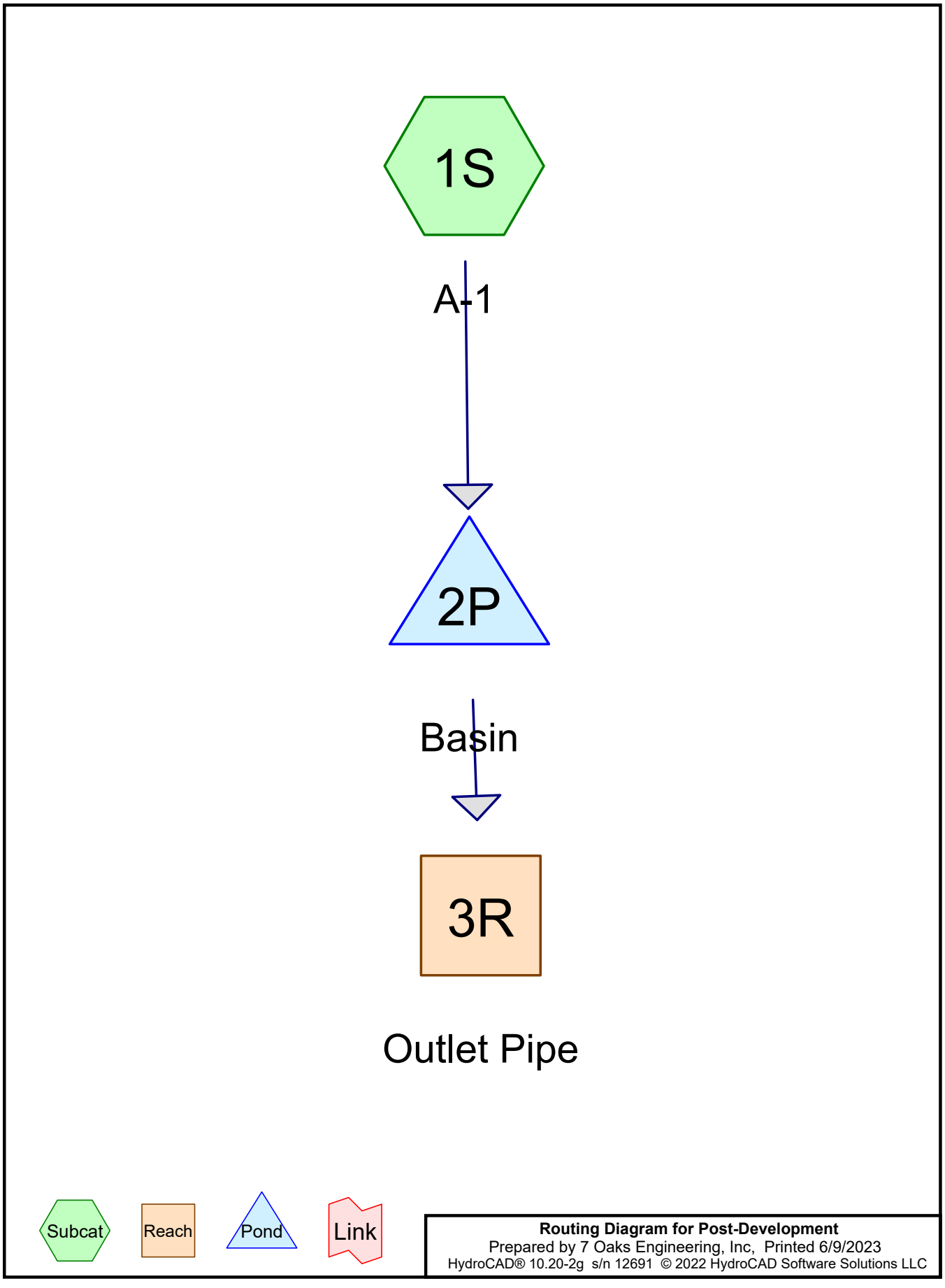
POST DEVELOPMENT



Routing Diagram for Post-Development
Prepared by 7 Oaks Engineering, Inc, Printed 6/9/2023
HydroCAD® 10.20-2g s/n 12691 © 2022 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YR	Type II 24-hr		Default	24.00	1	2.40	2
2	5-YR	Type II 24-hr		Default	24.00	1	2.90	2
3	10-YR	Type II 24-hr		Default	24.00	1	3.40	2
4	WQV	Type II 24-hr		Default	24.00	1	1.61	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.262	98	(1S)
0.151	79	50-75% Grass cover, Fair, HSG C (1S)
0.413	**91**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.151	HSG C	1S
0.000	HSG D	
0.262	Other	1S
0.413		**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	0.262	0.262		1S
0.000	0.000	0.151	0.000	0.000	0.151	50-75% Grass cover, Fair	1S
0.000	**0.000**	**0.151**	**0.000**	**0.262**	**0.413**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	3R	0.00	-2.03	203.0	0.0100	0.012	0.0	6.0	0.0

Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: A-1 Runoff Area=17,987 sf 63.55% Impervious Runoff Depth=1.66"
Tc=5.0 min CN=79/98 Runoff=0.94 cfs 0.057 af

Reach 3R: Outlet Pipe Avg. Flow Depth=0.10' Max Vel=1.87 fps Inflow=0.05 cfs 0.057 af
6.0" Round Pipe n=0.012 L=203.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.05 cfs 0.057 af

Pond 2P: Basin Peak Elev=3.70' Storage=1,279 cf Inflow=0.94 cfs 0.057 af
Discarded=0.00 cfs 0.000 af Primary=0.05 cfs 0.057 af Outflow=0.05 cfs 0.057 af

Total Runoff Area = 0.413 ac Runoff Volume = 0.057 af Average Runoff Depth = 1.66"
36.45% Pervious = 0.151 ac 63.55% Impervious = 0.262 ac

Summary for Subcatchment 1S: A-1

[49] Hint: Tc<2dt may require smaller dt

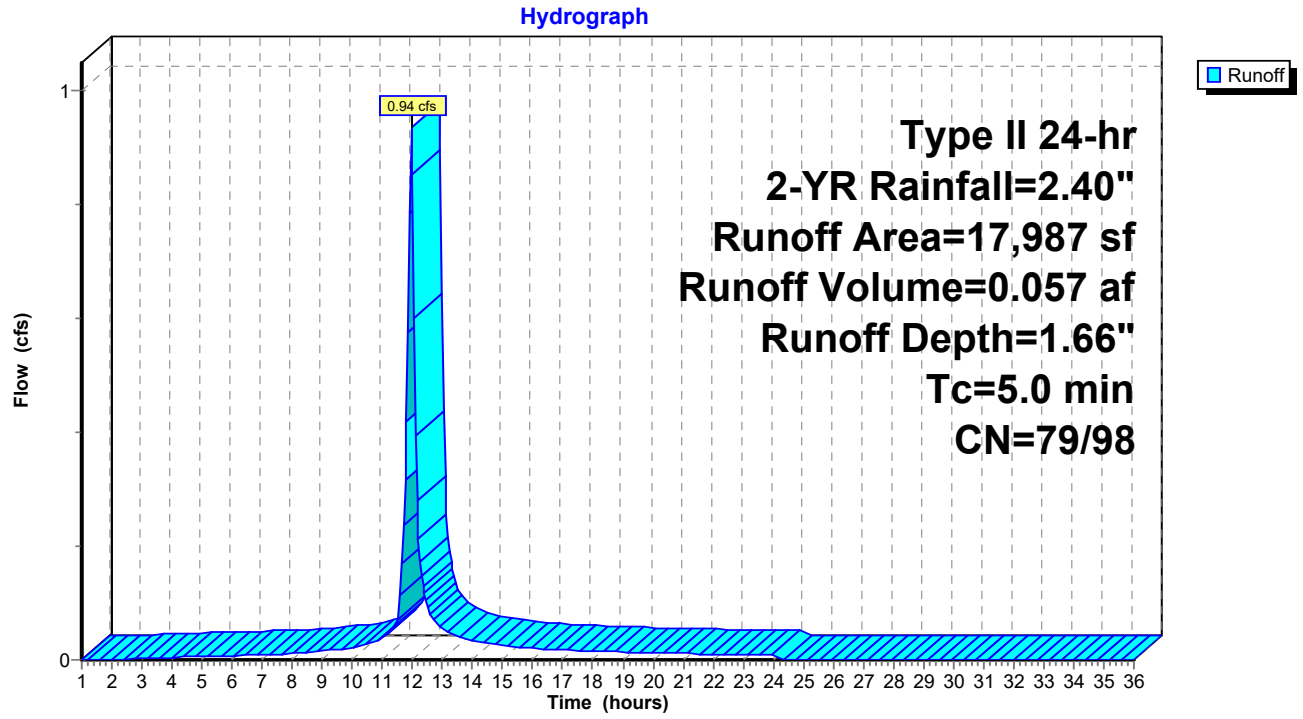
Runoff = 0.94 cfs @ 11.96 hrs, Volume= 0.057 af, Depth= 1.66"
Routed to Pond 2P : Basin

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=2.40"

	Area (sf)	CN	Description
*	11,431	98	
	6,556	79	50-75% Grass cover, Fair, HSG C
	17,987	91	Weighted Average
	6,556	79	36.45% Pervious Area
	11,431	98	63.55% Impervious Area

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

Subcatchment 1S: A-1



Summary for Reach 3R: Outlet Pipe

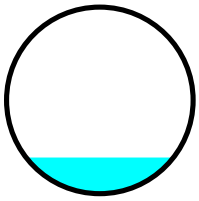
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified
[79] Warning: Submerged Pond 2P Primary device # 2 by 0.10'

Inflow Area = 0.413 ac, 63.55% Impervious, Inflow Depth > 1.66" for 2-YR event
Inflow = 0.05 cfs @ 13.15 hrs, Volume= 0.057 af
Outflow = 0.05 cfs @ 13.20 hrs, Volume= 0.057 af, Atten= 0%, Lag= 3.2 min

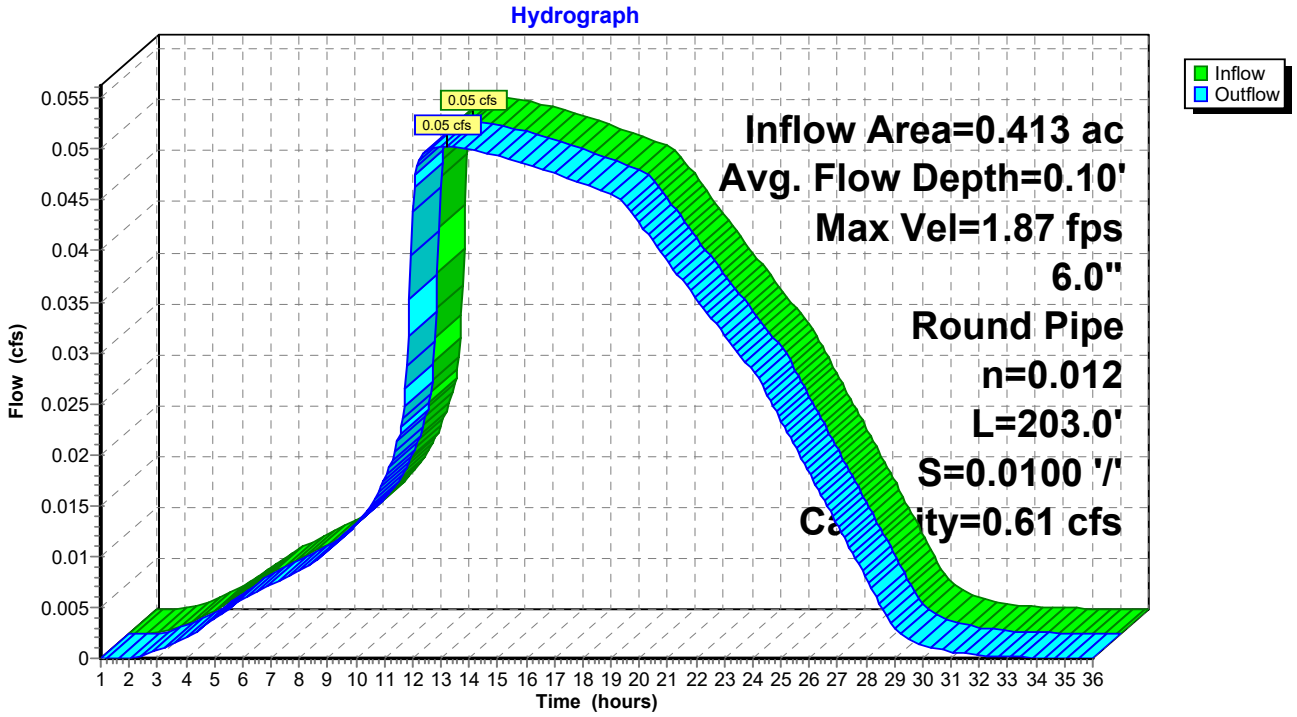
Routing by Stor-Ind+Trans method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.87 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.22 fps, Avg. Travel Time= 2.8 min

Peak Storage= 5 cf @ 13.17 hrs
Average Depth at Peak Storage= 0.10' , Surface Width= 0.40'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 203.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -2.03'



Reach 3R: Outlet Pipe



Summary for Pond 2P: Basin

Inflow Area = 0.413 ac, 63.55% Impervious, Inflow Depth = 1.66" for 2-YR event
Inflow = 0.94 cfs @ 11.96 hrs, Volume= 0.057 af
Outflow = 0.05 cfs @ 13.15 hrs, Volume= 0.057 af, Atten= 95%, Lag= 71.3 min
Discarded = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af
Primary = 0.05 cfs @ 13.15 hrs, Volume= 0.057 af
Routed to Reach 3R : Outlet Pipe

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.70' @ 13.15 hrs Surf.Area= 800 sf Storage= 1,279 cf

Plug-Flow detention time= 270.0 min calculated for 0.057 af (100% of inflow)
Center-of-Mass det. time= 269.9 min (1,046.9 - 777.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2,184 cf	**Custom Stage Data (Irregular)** Listed below

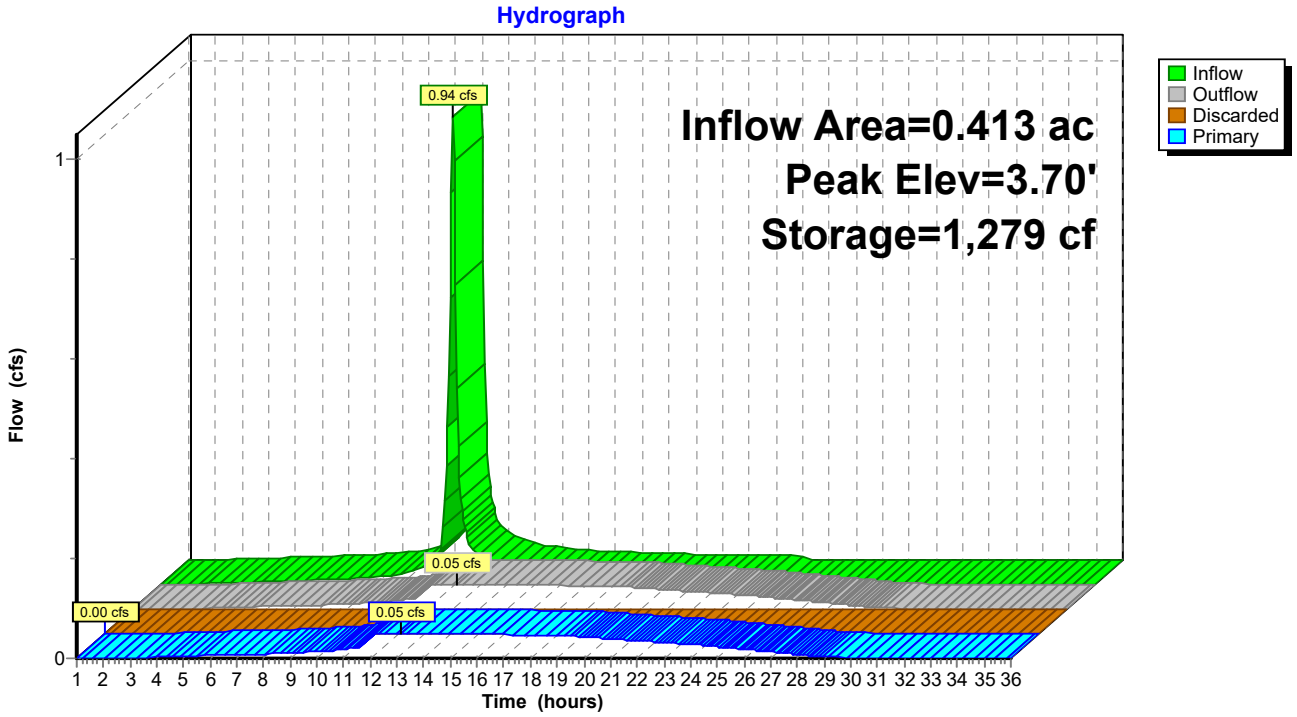
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
0.00	800	140.0	0.0	0	0	800
1.00	800	140.0	30.0	240	240	940
3.00	800	140.0	30.0	480	720	1,220
4.67	800	140.0	100.0	1,336	2,056	1,454
4.83	800	140.0	100.0	128	2,184	1,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**1.000 in/hr Exfiltration over Wetted area below -5.00'** Conductivity to Groundwater Elevation = -10.00'
#2	Primary	0.00'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	4.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 1.00 hrs HW=0.00' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.05 cfs @ 13.15 hrs HW=3.70' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.05 cfs @ 9.21 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: Basin



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: A-1 Runoff Area=17,987 sf 63.55% Impervious Runoff Depth=2.10"
Tc=5.0 min CN=79/98 Runoff=1.18 cfs 0.072 af

Reach 3R: Outlet Pipe Avg. Flow Depth=0.10' Max Vel=1.91 fps Inflow=0.05 cfs 0.072 af
6.0" Round Pipe n=0.012 L=203.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.05 cfs 0.072 af

Pond 2P: Basin Peak Elev=4.21' Storage=1,689 cf Inflow=1.18 cfs 0.072 af
Discarded=0.00 cfs 0.000 af Primary=0.05 cfs 0.072 af Outflow=0.05 cfs 0.072 af

Total Runoff Area = 0.413 ac Runoff Volume = 0.072 af Average Runoff Depth = 2.10"
36.45% Pervious = 0.151 ac 63.55% Impervious = 0.262 ac

Summary for Subcatchment 1S: A-1

[49] Hint: Tc<2dt may require smaller dt

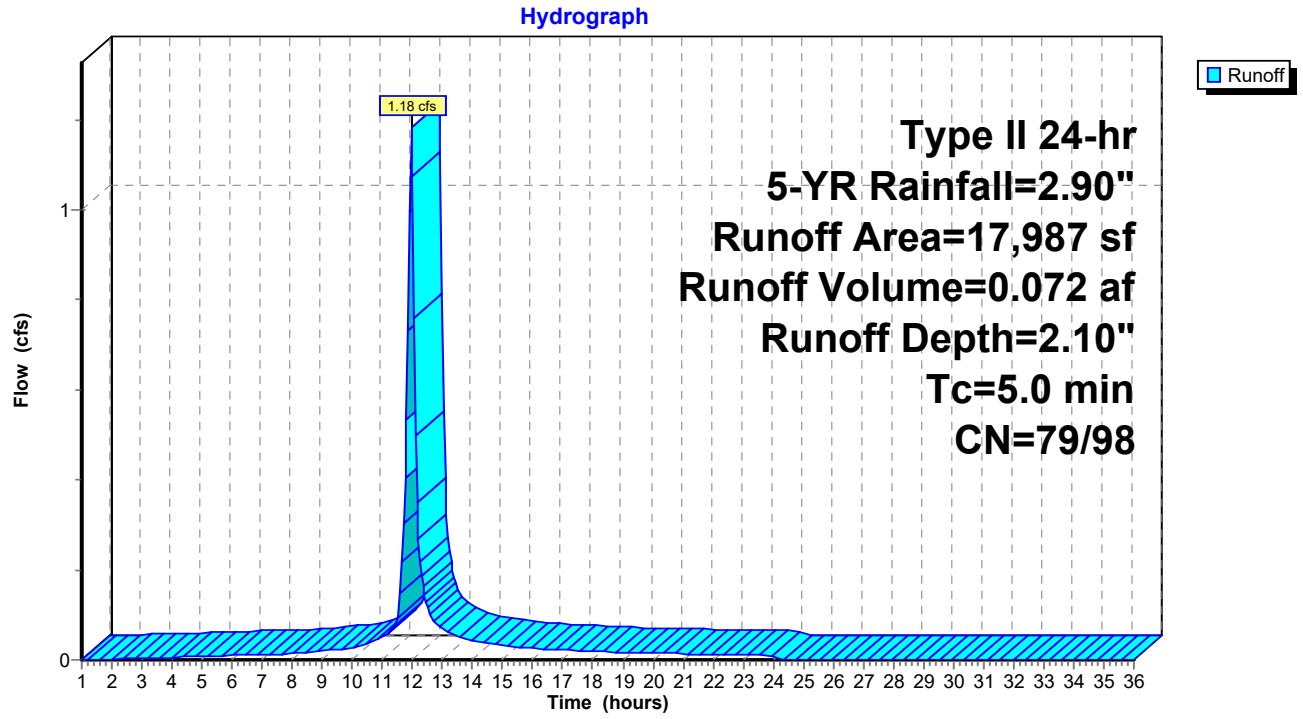
Runoff = 1.18 cfs @ 11.96 hrs, Volume= 0.072 af, Depth= 2.10"
Routed to Pond 2P : Basin

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 5-YR Rainfall=2.90"

	Area (sf)	CN	Description
*	11,431	98	
	6,556	79	50-75% Grass cover, Fair, HSG C
	17,987	91	Weighted Average
	6,556	79	36.45% Pervious Area
	11,431	98	63.55% Impervious Area

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

Subcatchment 1S: A-1



Summary for Reach 3R: Outlet Pipe

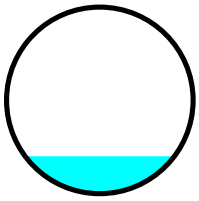
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified
[79] Warning: Submerged Pond 2P Primary device # 2 by 0.10'

Inflow Area = 0.413 ac, 63.55% Impervious, Inflow Depth > 2.10" for 5-YR event
Inflow = 0.05 cfs @ 13.45 hrs, Volume= 0.072 af
Outflow = 0.05 cfs @ 13.50 hrs, Volume= 0.072 af, Atten= 0%, Lag= 3.0 min

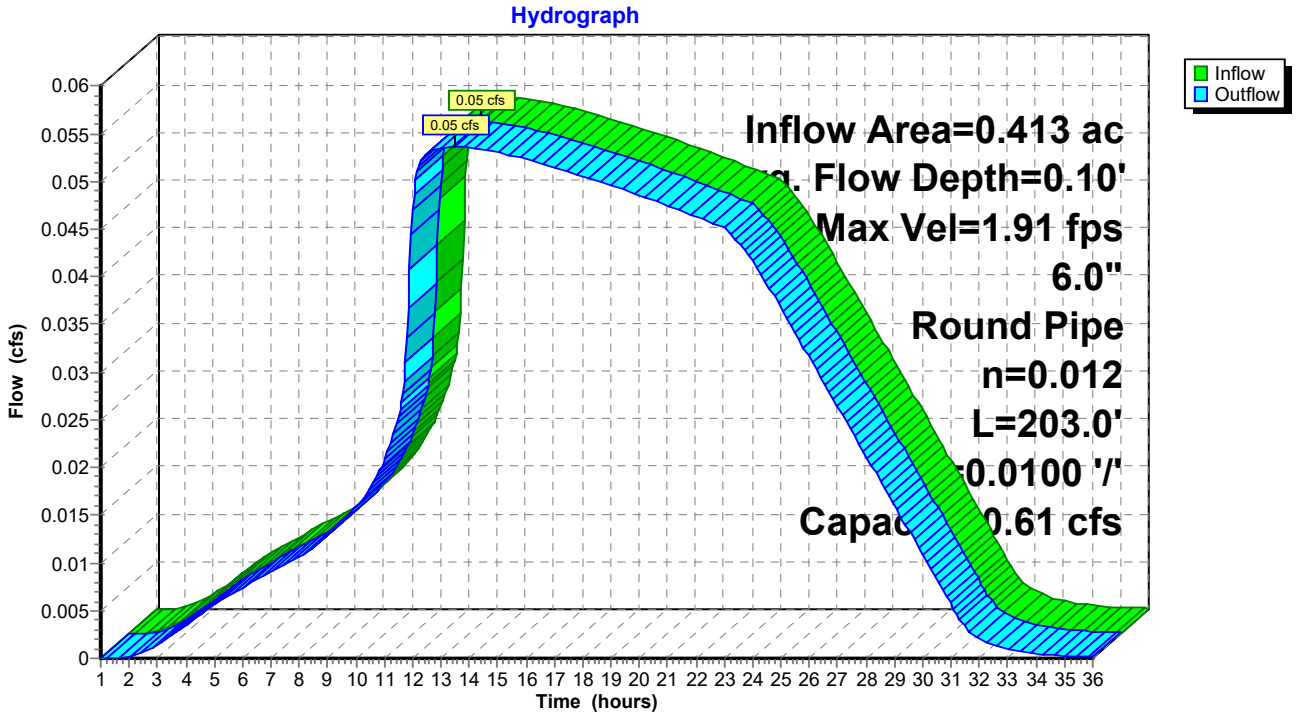
Routing by Stor-Ind+Trans method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.91 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.35 fps, Avg. Travel Time= 2.5 min

Peak Storage= 6 cf @ 13.47 hrs
Average Depth at Peak Storage= 0.10' , Surface Width= 0.40'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 203.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -2.03'



Reach 3R: Outlet Pipe



Summary for Pond 2P: Basin

Inflow Area = 0.413 ac, 63.55% Impervious, Inflow Depth = 2.10" for 5-YR event
Inflow = 1.18 cfs @ 11.96 hrs, Volume= 0.072 af
Outflow = 0.05 cfs @ 13.45 hrs, Volume= 0.072 af, Atten= 95%, Lag= 89.7 min
Discarded = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af
Primary = 0.05 cfs @ 13.45 hrs, Volume= 0.072 af
Routed to Reach 3R : Outlet Pipe

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 4.21' @ 13.45 hrs Surf.Area= 800 sf Storage= 1,689 cf

Plug-Flow detention time= 333.8 min calculated for 0.072 af (100% of inflow)
Center-of-Mass det. time= 334.0 min (1,107.7 - 773.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2,184 cf	**Custom Stage Data (Irregular)** Listed below

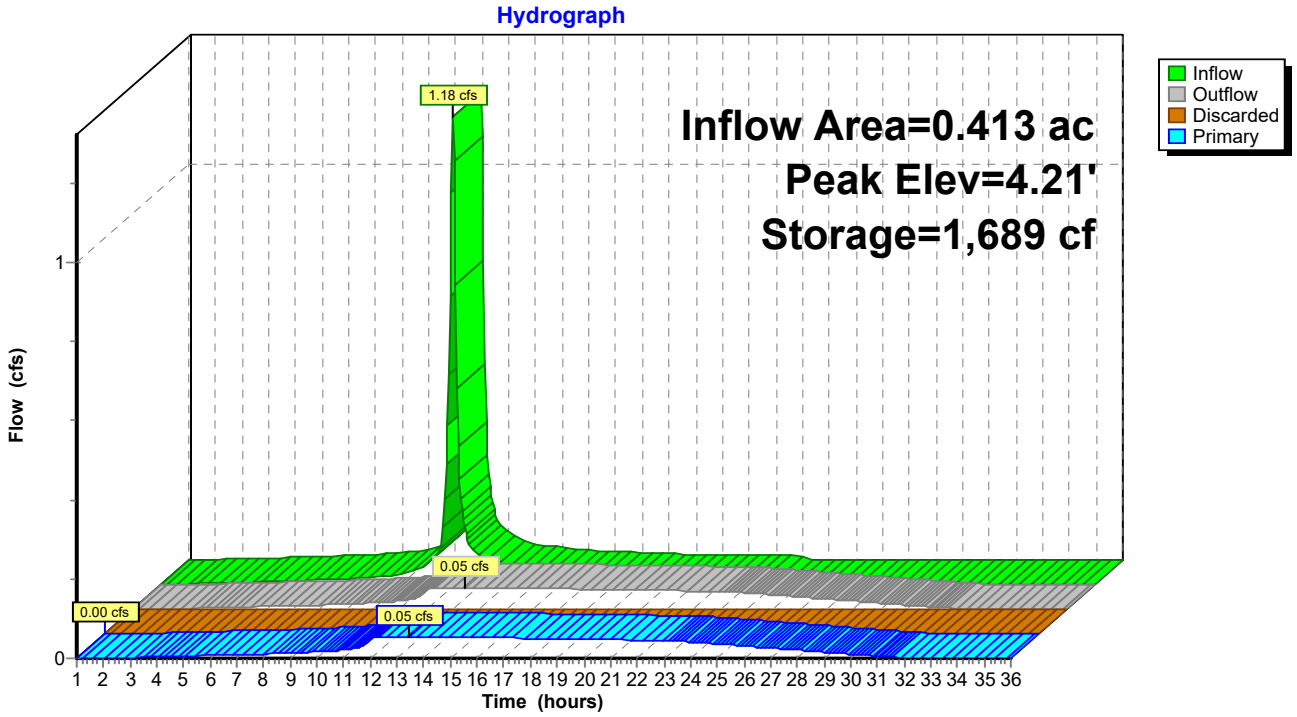
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
0.00	800	140.0	0.0	0	0	800
1.00	800	140.0	30.0	240	240	940
3.00	800	140.0	30.0	480	720	1,220
4.67	800	140.0	100.0	1,336	2,056	1,454
4.83	800	140.0	100.0	128	2,184	1,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**1.000 in/hr Exfiltration over Wetted area below -5.00'** Conductivity to Groundwater Elevation = -10.00'
#2	Primary	0.00'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	4.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 1.00 hrs HW=0.00' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.05 cfs @ 13.45 hrs HW=4.21' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.05 cfs @ 9.83 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: Basin



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: A-1 Runoff Area=17,987 sf 63.55% Impervious Runoff Depth=2.56"
Tc=5.0 min CN=79/98 Runoff=1.44 cfs 0.088 af

Reach 3R: Outlet Pipe Avg. Flow Depth=0.10' Max Vel=1.94 fps Inflow=0.06 cfs 0.088 af
6.0" Round Pipe n=0.012 L=203.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.06 cfs 0.088 af

Pond 2P: Basin Peak Elev=4.75' Storage=2,124 cf Inflow=1.44 cfs 0.088 af
Discarded=0.00 cfs 0.000 af Primary=0.06 cfs 0.088 af Outflow=0.06 cfs 0.088 af

Total Runoff Area = 0.413 ac Runoff Volume = 0.088 af Average Runoff Depth = 2.56"
36.45% Pervious = 0.151 ac 63.55% Impervious = 0.262 ac

Summary for Subcatchment 1S: A-1

[49] Hint: Tc<2dt may require smaller dt

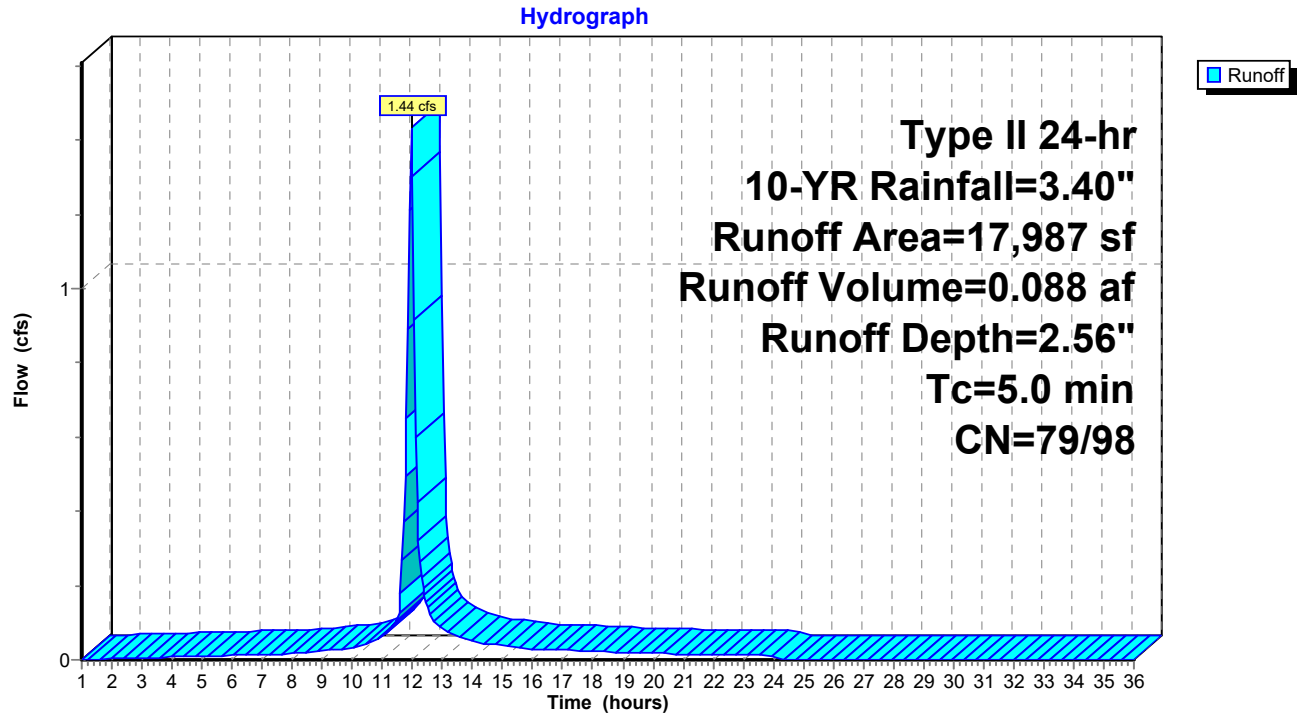
Runoff = 1.44 cfs @ 11.96 hrs, Volume= 0.088 af, Depth= 2.56"
Routed to Pond 2P : Basin

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=3.40"

	Area (sf)	CN	Description
*	11,431	98	
	6,556	79	50-75% Grass cover, Fair, HSG C
	17,987	91	Weighted Average
	6,556	79	36.45% Pervious Area
	11,431	98	63.55% Impervious Area

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

Subcatchment 1S: A-1



Summary for Reach 3R: Outlet Pipe

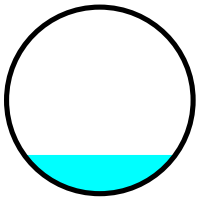
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified
[79] Warning: Submerged Pond 2P Primary device # 2 by 0.10'

Inflow Area = 0.413 ac, 63.55% Impervious, Inflow Depth > 2.55" for 10-YR event
Inflow = 0.06 cfs @ 13.69 hrs, Volume= 0.088 af
Outflow = 0.06 cfs @ 13.74 hrs, Volume= 0.088 af, Atten= 0%, Lag= 3.0 min

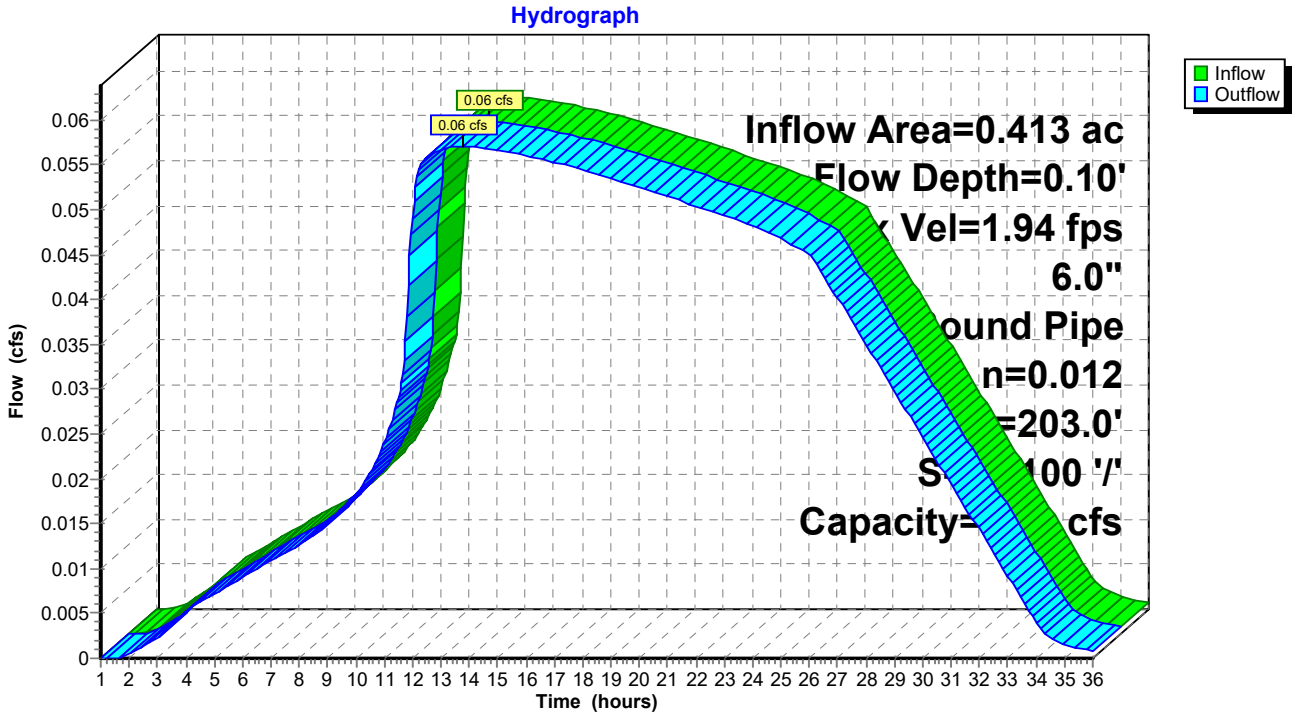
Routing by Stor-Ind+Trans method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.94 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.49 fps, Avg. Travel Time= 2.3 min

Peak Storage= 6 cf @ 13.72 hrs
Average Depth at Peak Storage= 0.10' , Surface Width= 0.41'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 203.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -2.03'



Reach 3R: Outlet Pipe



Summary for Pond 2P: Basin

Inflow Area = 0.413 ac, 63.55% Impervious, Inflow Depth = 2.56" for 10-YR event
Inflow = 1.44 cfs @ 11.96 hrs, Volume= 0.088 af
Outflow = 0.06 cfs @ 13.69 hrs, Volume= 0.088 af, Atten= 96%, Lag= 104.3 min
Discarded = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af
Primary = 0.06 cfs @ 13.69 hrs, Volume= 0.088 af
Routed to Reach 3R : Outlet Pipe

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 4.75' @ 13.69 hrs Surf.Area= 800 sf Storage= 2,124 cf

Plug-Flow detention time= 397.6 min calculated for 0.088 af (100% of inflow)
Center-of-Mass det. time= 397.1 min (1,168.0 - 770.9)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2,184 cf	**Custom Stage Data (Irregular)** Listed below

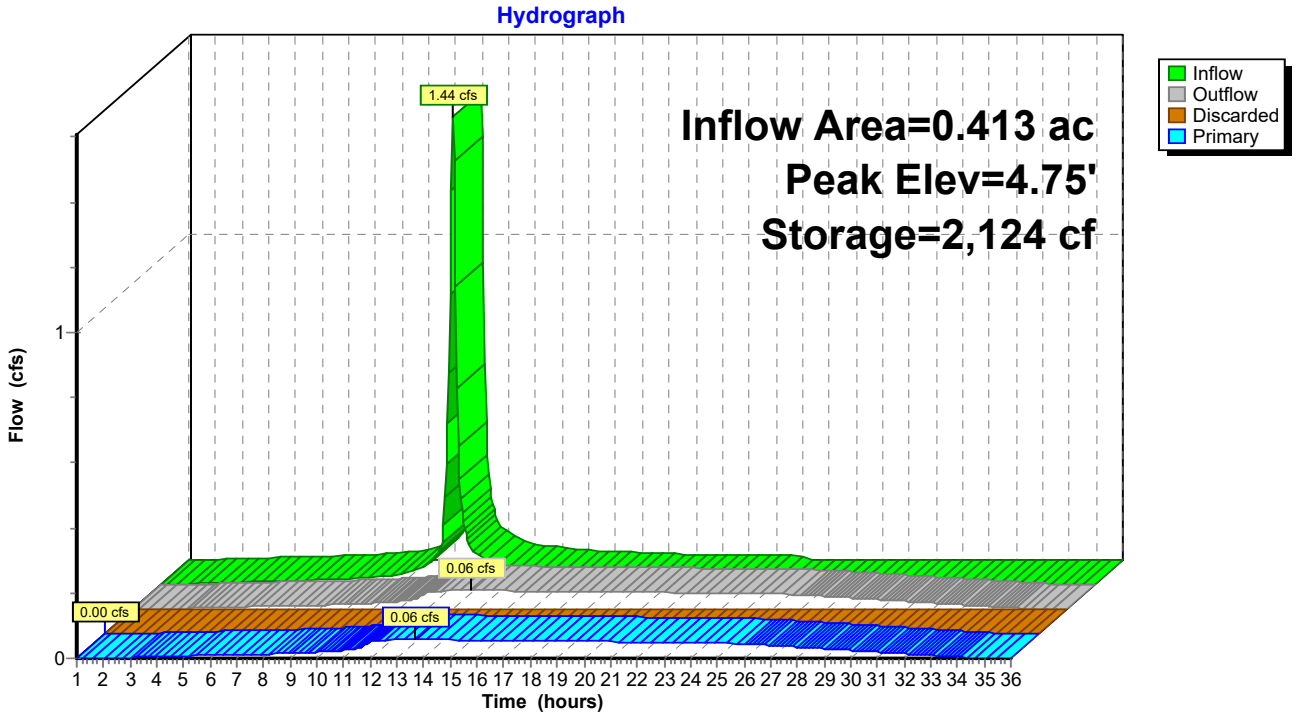
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
0.00	800	140.0	0.0	0	0	800
1.00	800	140.0	30.0	240	240	940
3.00	800	140.0	30.0	480	720	1,220
4.67	800	140.0	100.0	1,336	2,056	1,454
4.83	800	140.0	100.0	128	2,184	1,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**1.000 in/hr Exfiltration over Wetted area below -5.00'** Conductivity to Groundwater Elevation = -10.00'
#2	Primary	0.00'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	4.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 1.00 hrs HW=0.00' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.06 cfs @ 13.69 hrs HW=4.75' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.06 cfs @ 10.45 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: Basin



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: A-1 Runoff Area=17,987 sf 63.55% Impervious Runoff Depth=1.00"
Tc=5.0 min CN=79/98 Runoff=0.56 cfs 0.034 af

Reach 3R: Outlet Pipe Avg. Flow Depth=0.09' Max Vel=1.81 fps Inflow=0.04 cfs 0.034 af
6.0" Round Pipe n=0.012 L=203.0' S=0.0100 '/' Capacity=0.61 cfs Outflow=0.04 cfs 0.034 af

Pond 2P: Basin Peak Elev=2.94' Storage=705 cf Inflow=0.56 cfs 0.034 af
Discarded=0.00 cfs 0.000 af Primary=0.04 cfs 0.034 af Outflow=0.04 cfs 0.034 af

Total Runoff Area = 0.413 ac Runoff Volume = 0.034 af Average Runoff Depth = 1.00"
36.45% Pervious = 0.151 ac 63.55% Impervious = 0.262 ac

Summary for Subcatchment 1S: A-1

[49] Hint: Tc<2dt may require smaller dt

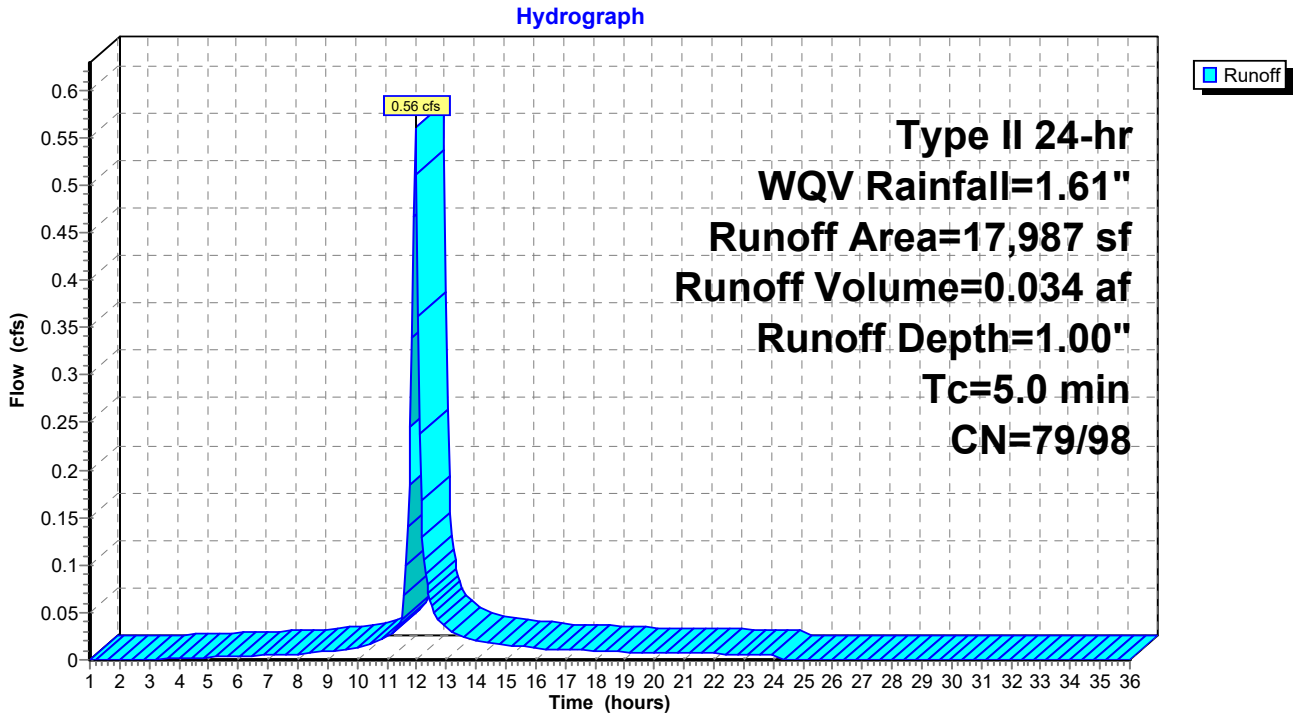
Runoff = 0.56 cfs @ 11.96 hrs, Volume= 0.034 af, Depth= 1.00"
Routed to Pond 2P : Basin

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr WQV Rainfall=1.61"

	Area (sf)	CN	Description
*	11,431	98	
	6,556	79	50-75% Grass cover, Fair, HSG C
	17,987	91	Weighted Average
	6,556	79	36.45% Pervious Area
	11,431	98	63.55% Impervious Area

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

Subcatchment 1S: A-1



Summary for Reach 3R: Outlet Pipe

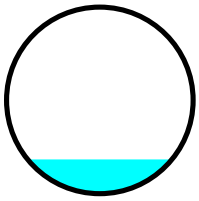
[52] Hint: Inlet/Outlet conditions not evaluated
[65] Warning: Inlet elevation not specified
[79] Warning: Submerged Pond 2P Primary device # 2 by 0.09'

Inflow Area = 0.413 ac, 63.55% Impervious, Inflow Depth = 1.00" for WQV event
Inflow = 0.04 cfs @ 12.65 hrs, Volume= 0.034 af
Outflow = 0.04 cfs @ 12.71 hrs, Volume= 0.034 af, Atten= 0%, Lag= 3.4 min

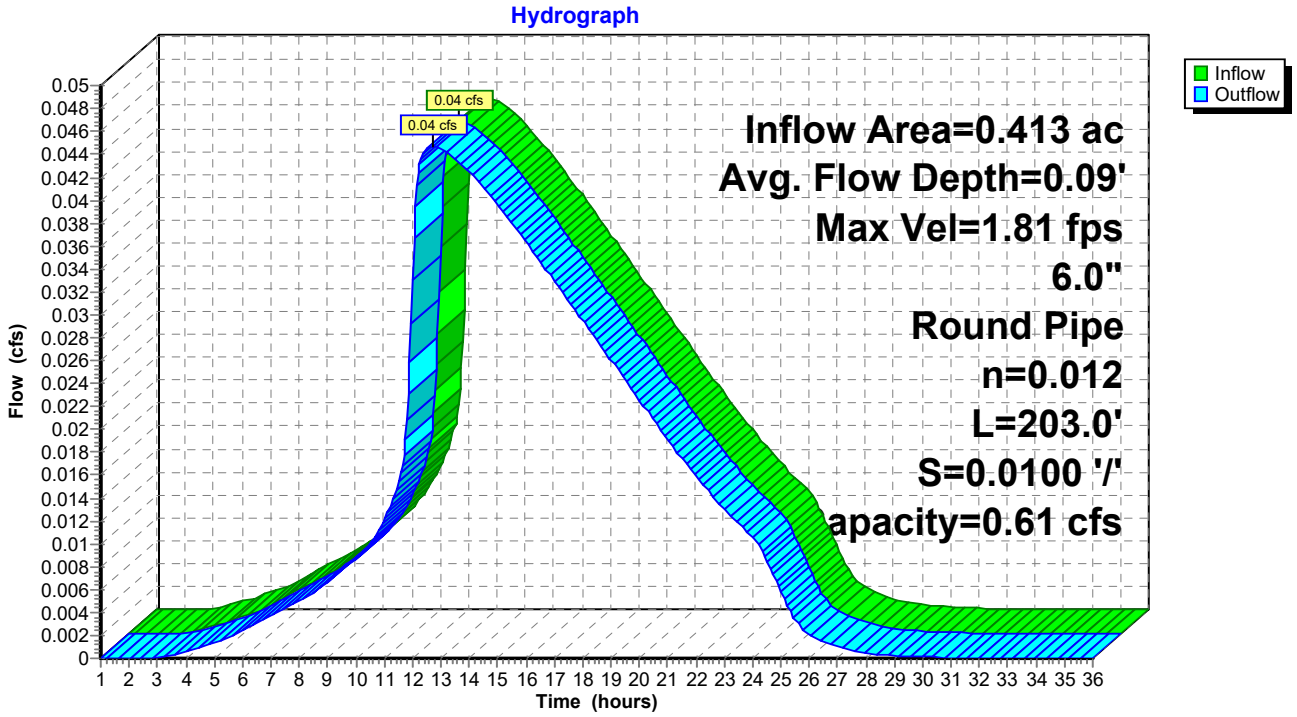
Routing by Stor-Ind+Trans method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.81 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.07 fps, Avg. Travel Time= 3.2 min

Peak Storage= 5 cf @ 12.67 hrs
Average Depth at Peak Storage= 0.09' , Surface Width= 0.39'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 0.61 cfs

6.0" Round Pipe
n= 0.012
Length= 203.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -2.03'



Reach 3R: Outlet Pipe



Summary for Pond 2P: Basin

Inflow Area = 0.413 ac, 63.55% Impervious, Inflow Depth = 1.00" for WQV event
Inflow = 0.56 cfs @ 11.96 hrs, Volume= 0.034 af
Outflow = 0.04 cfs @ 12.65 hrs, Volume= 0.034 af, Atten= 92%, Lag= 41.5 min
Discarded = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af
Primary = 0.04 cfs @ 12.65 hrs, Volume= 0.034 af
Routed to Reach 3R : Outlet Pipe

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 2.94' @ 12.65 hrs Surf.Area= 800 sf Storage= 705 cf

Plug-Flow detention time= 179.5 min calculated for 0.034 af (100% of inflow)
Center-of-Mass det. time= 179.7 min (964.2 - 784.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2,184 cf	**Custom Stage Data (Irregular)** Listed below

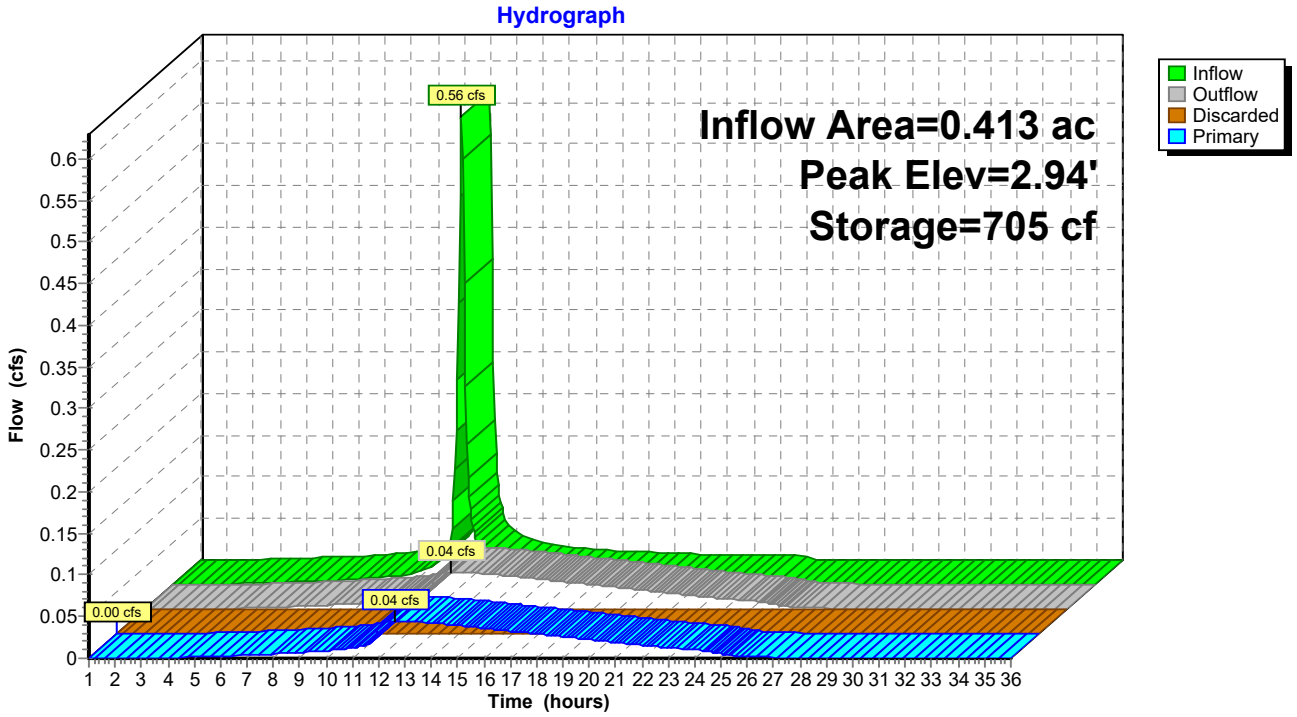
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
0.00	800	140.0	0.0	0	0	800
1.00	800	140.0	30.0	240	240	940
3.00	800	140.0	30.0	480	720	1,220
4.67	800	140.0	100.0	1,336	2,056	1,454
4.83	800	140.0	100.0	128	2,184	1,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**1.000 in/hr Exfiltration over Wetted area below -5.00'** Conductivity to Groundwater Elevation = -10.00'
#2	Primary	0.00'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	4.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

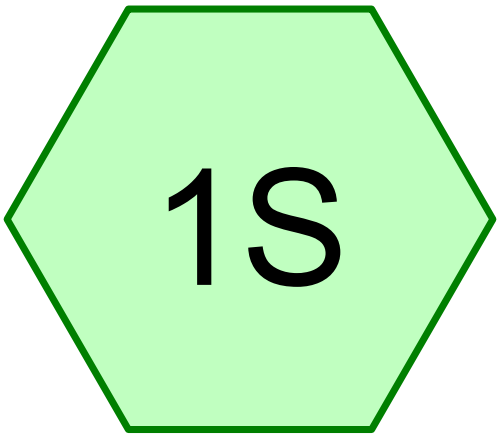
Discarded OutFlow Max=0.00 cfs @ 1.00 hrs HW=0.00' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.04 cfs @ 12.65 hrs HW=2.94' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.04 cfs @ 8.19 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: Basin



PRE-DEVELOPMENT



EX

Subcat Reach Pond Link

Routing Diagram for Pre-Development
Prepared by 7 Oaks Engineering, Inc, Printed 5/30/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YR	Type IA 24-hr		Default	24.00	1	2.40	2
2	5-YR	Type IA 24-hr		Default	24.00	1	2.90	2
3	10-YR	Type IA 24-hr		Default	24.00	1	3.40	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.359	79	(1S)
0.054	98	(1S)
0.413	**81**	**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	
0.413	Other	1S
0.413		**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	0.413	0.413		1S
0.000	**0.000**	**0.000**	**0.000**	**0.413**	**0.413**	**TOTAL AREA**	

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Runoff Area=17,987 sf 13.13% Impervious Runoff Depth>0.93"
Flow Length=115' Slope=0.0610 '/' Tc=8.1 min CN=79/98 Runoff=0.08 cfs 0.032 af

Total Runoff Area = 0.413 ac Runoff Volume = 0.032 af Average Runoff Depth = 0.93"
86.87% Pervious = 0.359 ac 13.13% Impervious = 0.054 ac

Summary for Subcatchment 1S: EX

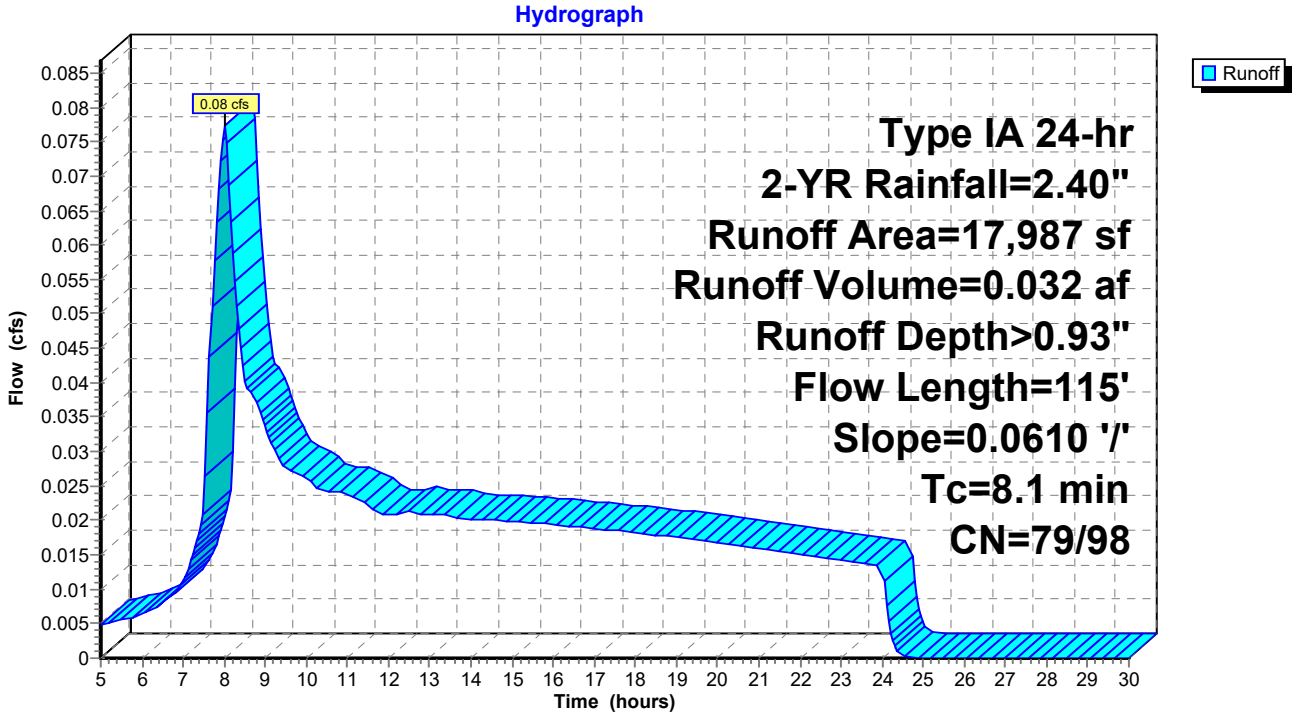
Runoff = 0.08 cfs @ 8.00 hrs, Volume= 0.032 af, Depth> 0.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=2.40"

	Area (sf)	CN	Description
*	15,625	79	
*	2,362	98	
	17,987	81	Weighted Average
	15,625	79	86.87% Pervious Area
	2,362	98	13.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	115	0.0610	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"

Subcatchment 1S: EX



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Runoff Area=17,987 sf 13.13% Impervious Runoff Depth>1.29"
Flow Length=115' Slope=0.0610 '/' Tc=8.1 min CN=79/98 Runoff=0.11 cfs 0.044 af

Total Runoff Area = 0.413 ac Runoff Volume = 0.044 af Average Runoff Depth = 1.29"
86.87% Pervious = 0.359 ac 13.13% Impervious = 0.054 ac

Summary for Subcatchment 1S: EX

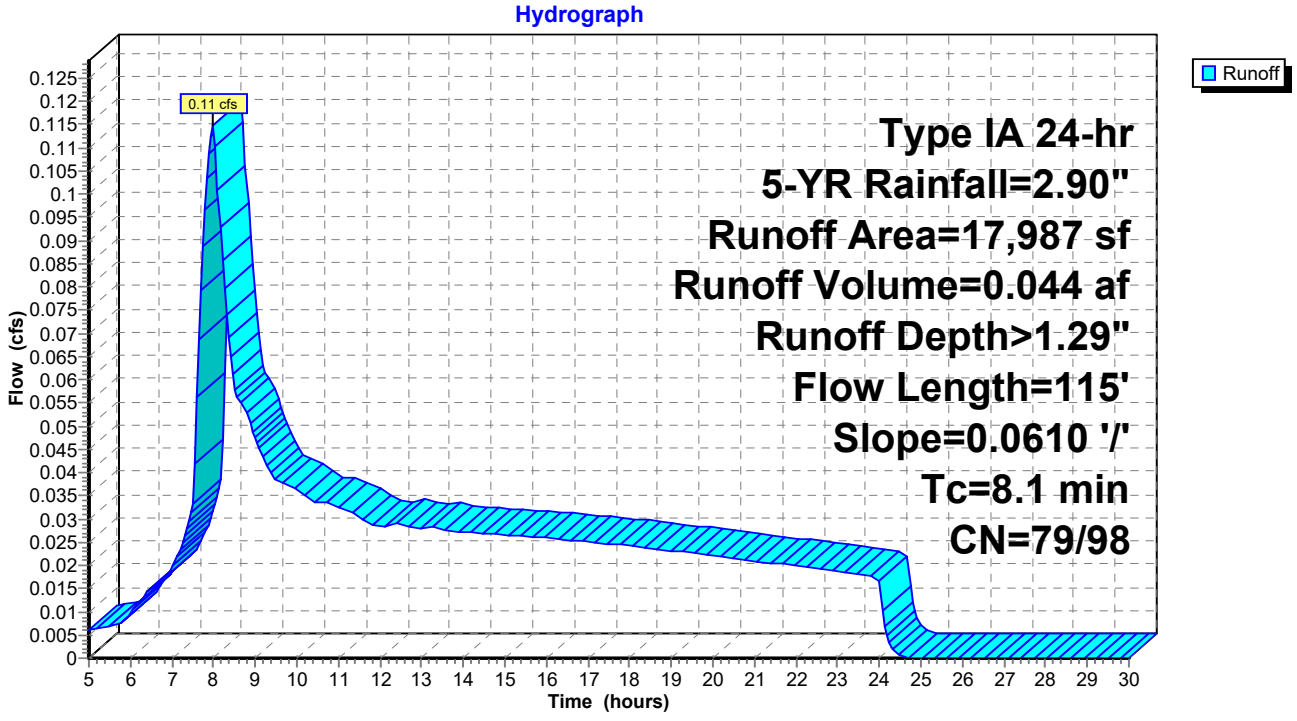
Runoff = 0.11 cfs @ 7.99 hrs, Volume= 0.044 af, Depth> 1.29"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YR Rainfall=2.90"

	Area (sf)	CN	Description
*	15,625	79	
*	2,362	98	
	17,987	81	Weighted Average
	15,625	79	86.87% Pervious Area
	2,362	98	13.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	115	0.0610	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"

Subcatchment 1S: EX



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Runoff Area=17,987 sf 13.13% Impervious Runoff Depth>1.67"
Flow Length=115' Slope=0.0610 '/' Tc=8.1 min CN=79/98 Runoff=0.16 cfs 0.057 af

Total Runoff Area = 0.413 ac Runoff Volume = 0.057 af Average Runoff Depth = 1.67"
86.87% Pervious = 0.359 ac 13.13% Impervious = 0.054 ac

Summary for Subcatchment 1S: EX

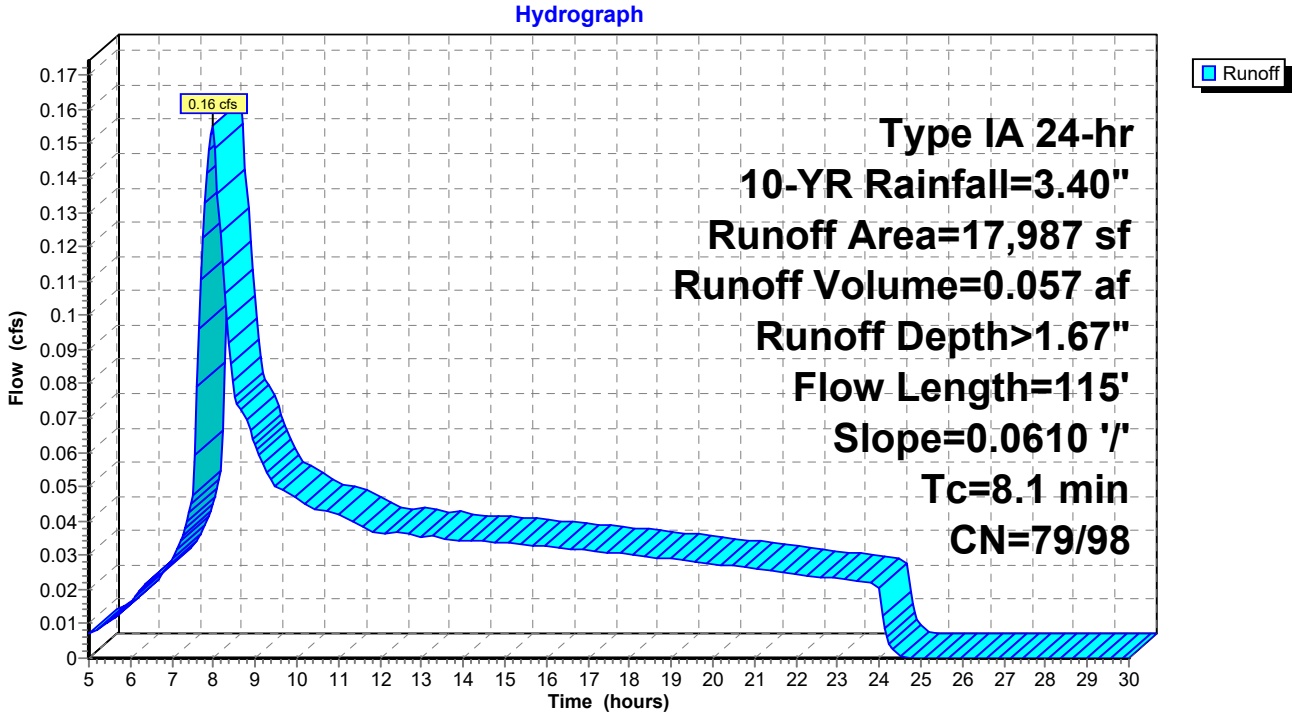
Runoff = 0.16 cfs @ 7.99 hrs, Volume= 0.057 af, Depth> 1.67"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.40"

	Area (sf)	CN	Description
*	15,625	79	
*	2,362	98	
	17,987	81	Weighted Average
	15,625	79	86.87% Pervious Area
	2,362	98	13.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	115	0.0610	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"

Subcatchment 1S: EX



PAC Report

Project Details

Project Name	Permit No	Created
LAVA		5/29/2023 9:10:53 PM
Project Address	**Designer**	**Last Modified**
1600 SE LAVA DRIVE		6/9/2023 11:14:27 PM
	Company	**Report Generated**
		6/9/2023 4:39:27 PM

Project Summary

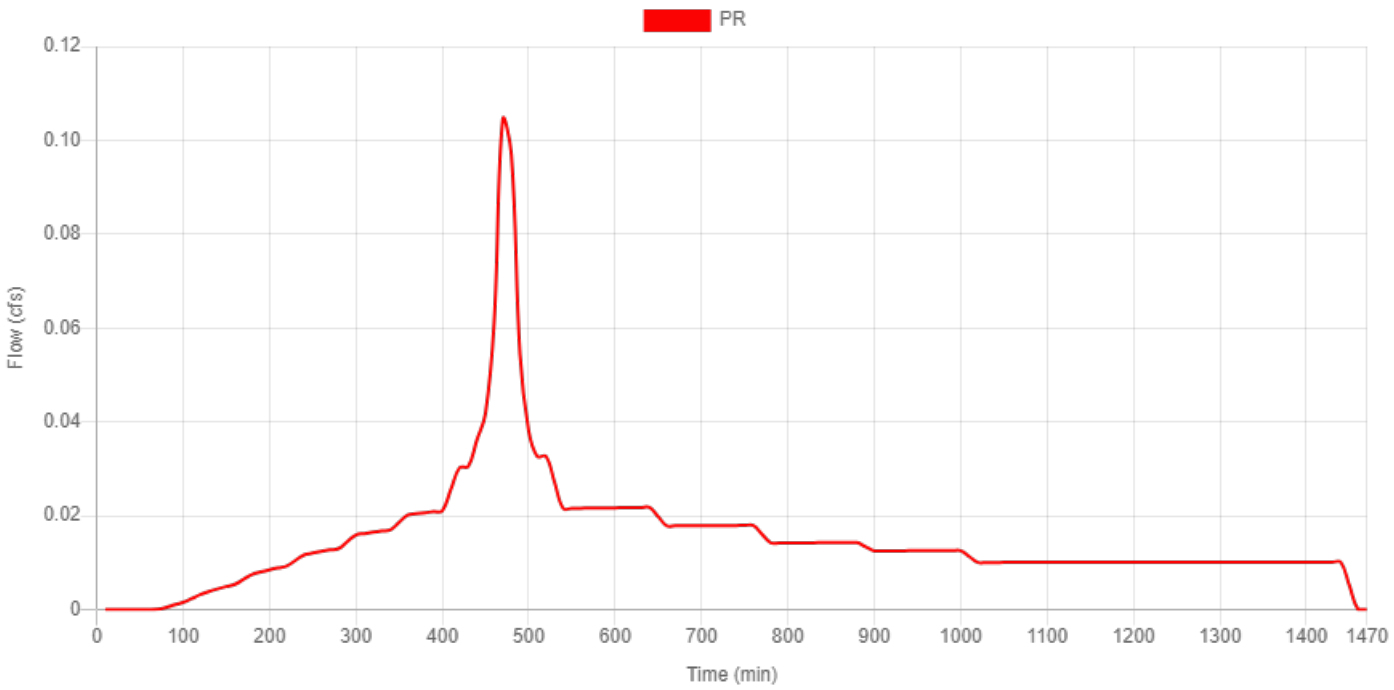
Catchment Name	Imper-vious Area (sq ft)	Native Soil Design Infilt-ration Rate (in/hr)	Level	Category	Config	Facility Area (excl. free board) (sq ft)	Facility Sizing Ratio (%)	PR Results	Infilt-ration Results	Flow Control Results
A	11431	1	2A	FlatPlanter	C	679.00	5.94	Pass	NA	NA

A

Site Soils & Infiltration Testing	Infiltration Testing Procedure OpenPit Tested Native Soil Infiltration Rate 2.00 in/hr
Correction Factor	CF test 2
Design Infiltration Rates	Native Soil 1 in/hr Imported Blended Soil 6 in/hr
Catchment Information	Hierarchy Level 2A Hierarchy Description Offsite flow to the Willamette River, Columbia River, or Columbia Slough, or discharge to a storm-only pipe system or the Multnomah County Drainage District System (with capacity) that directly discharges to one of the three waterways named above. Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil. Infiltration Requirement N/A Flow Control Requirement N/A Impervious Area 11431 sq ft 0.262 acre Pre-Development Time of Concentration (Tc pre) 5 min Post-Development Time of Concentration (Tc post) 5 min Pre-Development Curve Number (CN pre) 79 Post-Development Curve Number (CN post) 98

SBUH Results

Post-Development Runoff



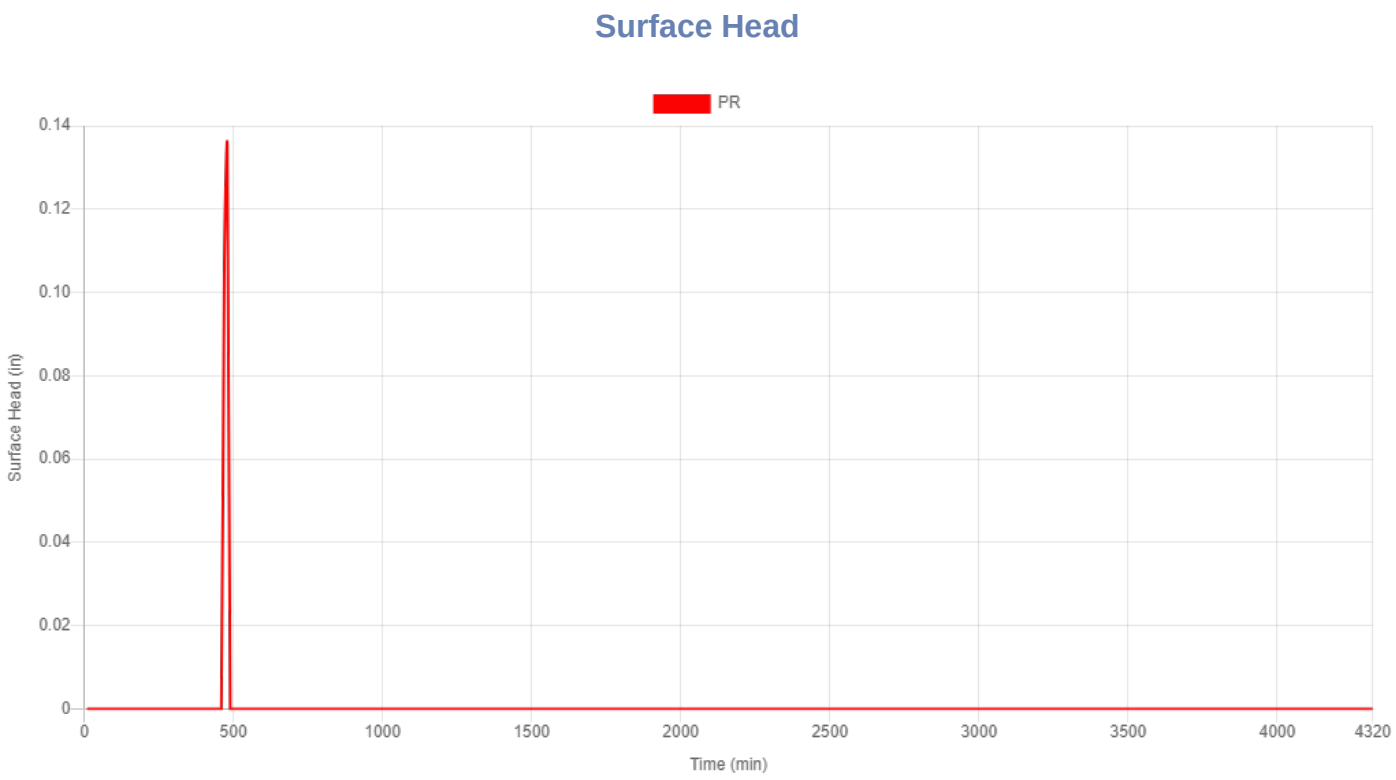
	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0087	296.5	0.1044	1322.7

	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.039	387.1	0.016	935.7

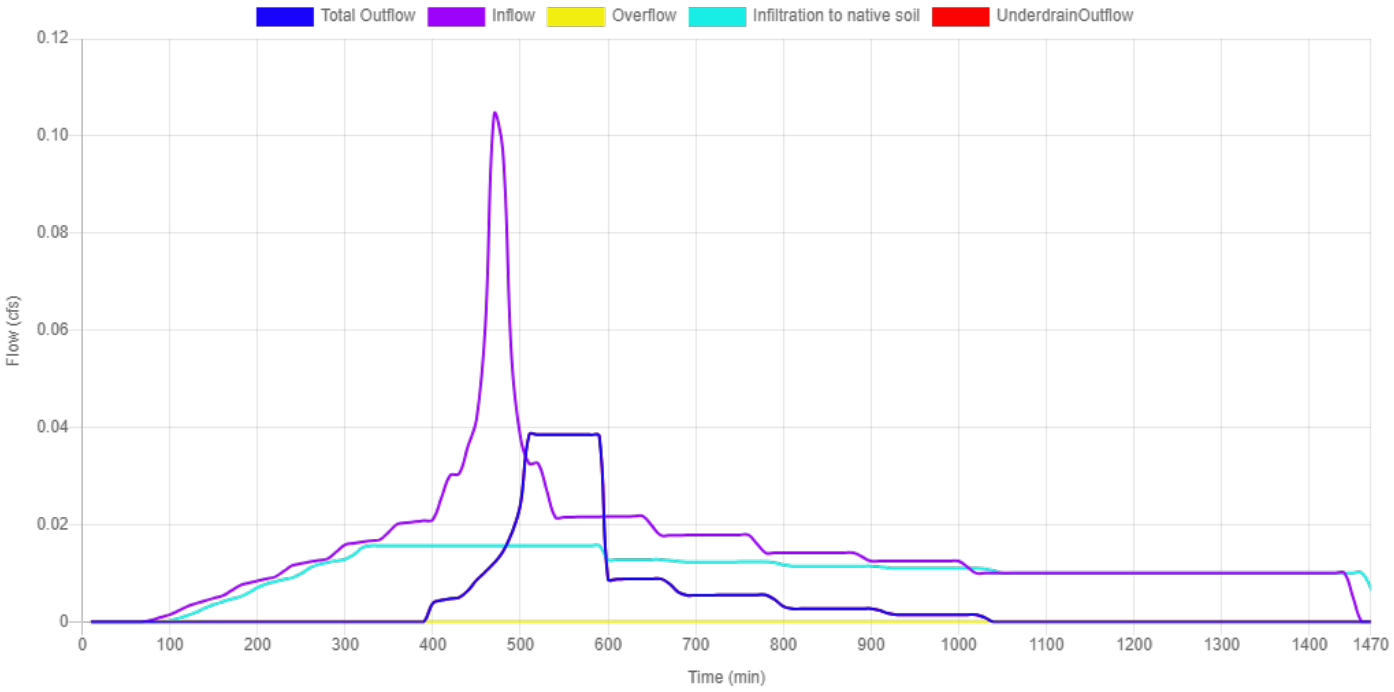
Flat Planter

Site Soils & Infiltration Testing	Category Flat Planter Shape Null Location Parcel Configuration C: Infiltration with RS & UnderDrain[Ud] **Above Grade Storage Data** Bottom Area 679 sq ft Bottom Width 10 ft Overflow Height 20.0 in Total Depth of Blended Soil plus Rock 36 in Surface Storage Capacity at Overflow 1131.67 cu ft Design Infiltration Rate to Soil Underlying the Facility 0.016 cfs Design Infiltration Rate for Imported Blended Soil in the Facility 0.094 cfs **Below Grade Storage Data** Catchment is too small for flow control? No Rock Area 50.92 sq ft Rock Width 3.00 ft Rock Storage Depth 12.0 in Rock Porosity 0.3 Underdrain Height

	1.0 in Percent of Facility Base that Allows Infiltration 100 % Orifice (Y/N)? Yes Orifice Diameter 1.000 in
Facility Facts	Total Facility Area (excluding freeboard) 679.00 sq ft Sizing Ratio 5.94 %
Pollution Reduction Results	Pollution Reduction Score Pass Overflow Volume 0.00 cf Surface Capacity Used 0.68 %



Water Quality



Water Quality