Stormwater Calculations for

West Hills Townhomes
For
MWSH West Salem LLC

Devco Job No. 22440

January 2023

Table of Contents

Stormwater Narrative – West Hills Townhomes Private Improvements

- Description

    - The existing site is at the northwest corner of Orchard Heights Rd NW and Linwood St NW and consists of a grassy meadow. The lowest elevation of the site is at the northeast corner. Stormwater currently is collected in a catch basin and conveyed offsite through the apartment complex to the north.

    - The private improvements consist of new townhouse units, asphalt parking and access, concrete walks, and a subsurface wetland. The total site area is 4.86 acres.

- Design Premise

    - The manual used for these calculations is the City of Salem Public Works Design Standards.

    - Water quality is treated using a subsurface gravel wetland. The pond was sized to discharge ponded water between 24 and 48 hours. The pond outlet will be set at the pond water quality elevation to ensure runoff up to the water quality storm event is treated by the subsurface gravel layer before being discharged off site.

    - Water quantity is also treated using the subsurface gravel wetland. The orifices in the control manhole are designed to discharge one-half of the post-developed peak runoff rate of the two-year, 24-hour storm to one-half of the peak runoff rate of the pre-developed two-year, 24-hour storm; and the peak runoff rate of the post-developed ten-year, 24-hour storm to the pre-developed ten-year, 24-hour storm. The 100-year post-developed storm is also discharged at the historical 100-year storm runoff rate.

    - The private development collects runoff into catch basins to route water to the subsurface gravel wetland. After treatment, the stormwater is discharged to the existing planned stormwater pipe connection at the north end of the property to be conveyed off-site. An emergency overflow inlet discharges to the existing pipe in Linwood Street to be conveyed off-site.

FILE: I:\CIVIL3D Projects\22440\Reports\Stormwater\Figures\22440STRM-FIG_EX.dwg [11X17] 1/18/2023 8:50 AM – Trevor

SCALE: 1" = 60'

0 15 30 60 120

SCALE IN FEET

PRELIMINARY

DATE:

DRAWING STATUS:
- [ ] PRELIMINARY
- [ ] SUBMITTED
- [ ] BID SET
- [ ] PERMIT SET
- [ ] CONST. SET

DEVCO engineering Inc.
245 NE CONIFER, P.O. BOX 1211
CORVALLIS, OR 97339
WWW.DEVCOENGINEERING.COM
Corvallis Oregon
(541) 757-8991

PROJECT:
WEST HILLS TOWNHOMES

PROJECT LOCATION:
SALEM, OREGON

CLIENT:
MWSH WEST SALEM LLC

JOB NO. 22440

DRAWN BY: DEVCO

SHEET TITLE:
EXISTING

DRAWING:
STRM1

SCALE: 1" = 60'

0 15 30 60 120

SCALE IN FEET

PRELIMINARY

DRAWING STATUS: DATE:
- ☐ PRELIMINARY
- ☐ SUBMITTED
- ☐ BID SET
- ☐ PERMIT SET
- ☐ CONST. SET

DEVCO engineering inc.
Corvallis Oregon
(541) 757-6841
245 NE CONIFER, P.O. BOX 1221
CORVALLIS, OR 97339
WWW.DEVCOENGINEERING.COM

PROJECT: WEST HILLS TOWNHOMES

PROJECT LOCATION: SALEM, OREGON

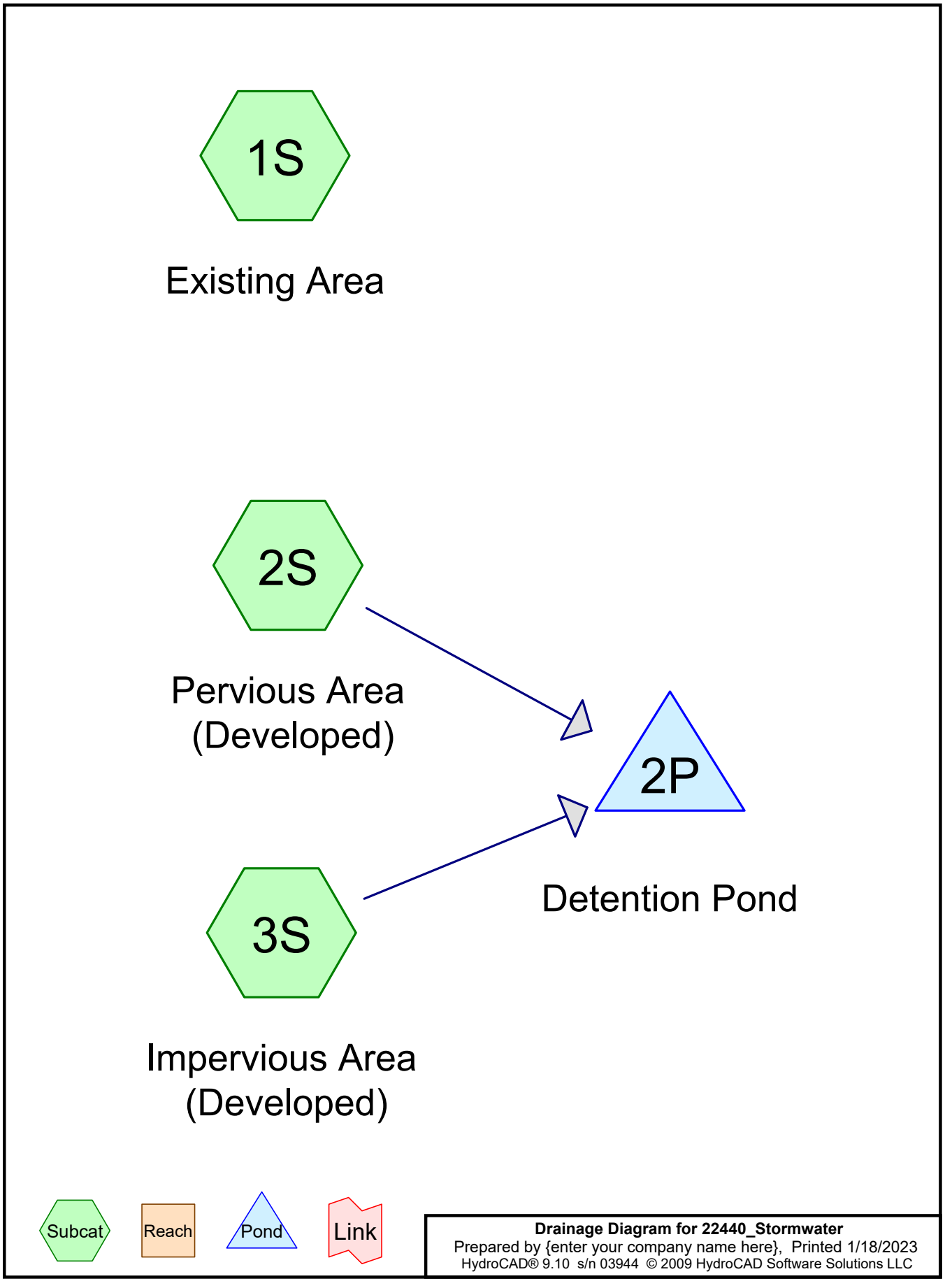
CLIENT: MWSH WEST SALEM LLC

JOB NO. 22440

DRAWN BY: DEVCO

SHEET TITLE: DEVELOPED

DRAWING: STRM2



Drainage Diagram for 22440_Stormwater
Prepared by {enter your company name here}, Printed 1/18/2023
HydroCAD® 9.10 s/n 03944 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
211,854	72	City of Salem Pre-Development (1S)
74,048	74	>75% Grass cover, Good, HSG C (2S)
78,373	98	Paved Surfaces (3S)
59,433	98	Roofs (3S)
423,708		**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
74,048	HSG C	2S
0	HSG D	
349,660	Other	1S, 3S
423,708		**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)	Fill (inches)
1	2P	234.30	234.06	50.0	0.0048	0.010	12.0	0.0	0.0

Time span=2.00-30.00 hrs, dt=0.05 hrs, 561 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Existing Area Runoff Area=211,854 sf 0.00% Impervious Runoff Depth=0.38"
Flow Length=690' Tc=32.8 min CN=72/0 Runoff=0.121 cfs 6,724 cf

Subcatchment2S: Pervious Area Runoff Area=74,048 sf 0.00% Impervious Runoff Depth=0.45"
Tc=5.0 min CN=74/0 Runoff=0.082 cfs 2,761 cf

Subcatchment3S: Impervious Area Runoff Area=137,806 sf 100.00% Impervious Runoff Depth>1.96"
Tc=5.0 min CN=0/98 Runoff=1.591 cfs 22,496 cf

Pond 2P: Detention Pond Peak Elev=237.51' Storage=18,064 cf Inflow=1.655 cfs 25,257 cf
Outflow=0.120 cfs 9,669 cf

Total Runoff Area = 423,708 sf Runoff Volume = 31,980 cf Average Runoff Depth = 0.91"
67.48% Pervious = 285,902 sf 32.52% Impervious = 137,806 sf

Summary for Subcatchment 1S: Existing Area

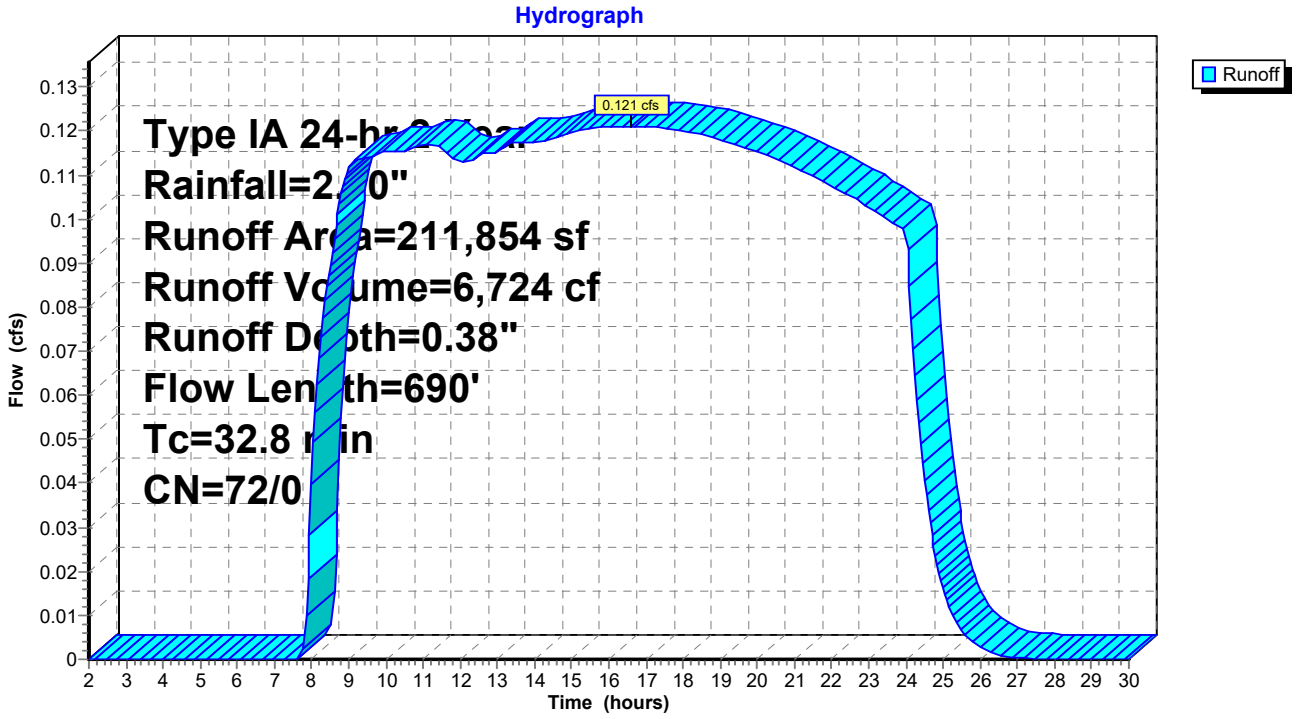
Runoff = 0.121 cfs @ 16.58 hrs, Volume= 6,724 cf, Depth= 0.38"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-Year Rainfall=2.20"

	Area (sf)	CN	Description
*	211,854	72	City of Salem Pre-Development
	211,854	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.8	300	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.00"
3.0	390	0.0210	2.17		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
32.8	690	Total			

Subcatchment 1S: Existing Area



Summary for Subcatchment 2S: Pervious Area (Developed)

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

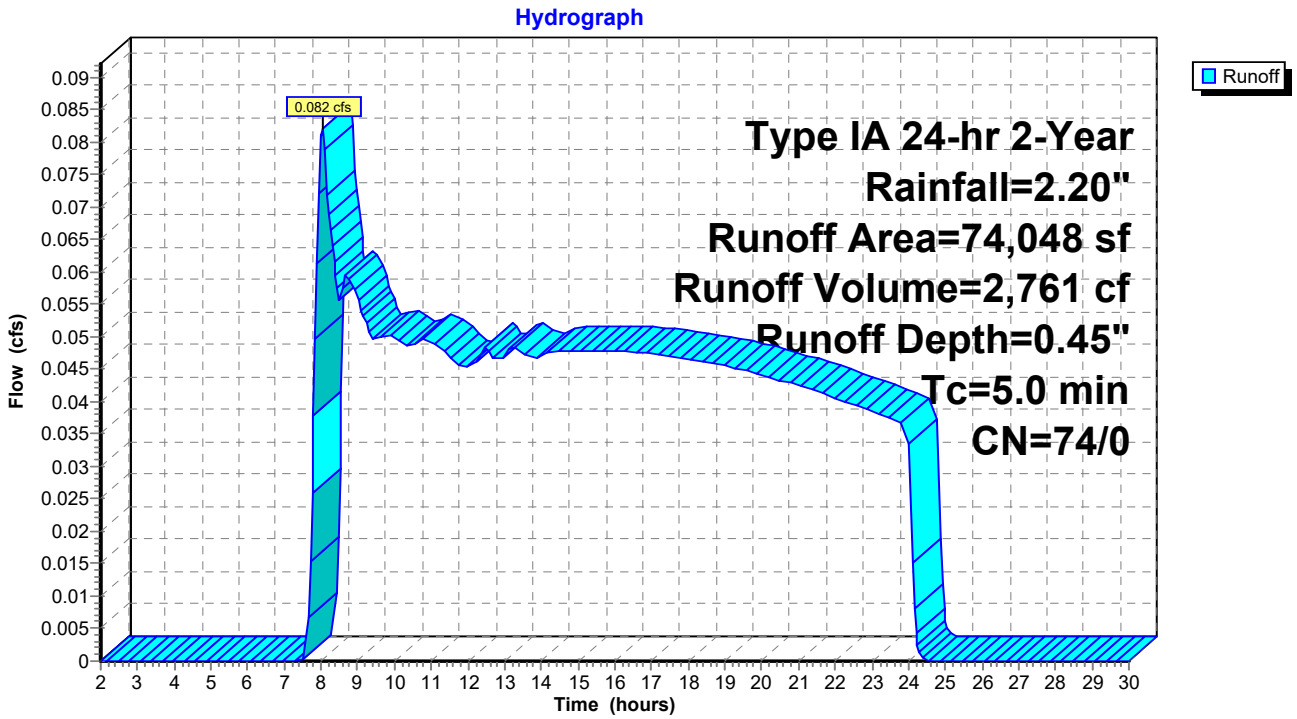
Runoff = 0.082 cfs @ 8.03 hrs, Volume= 2,761 cf, Depth= 0.45"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-Year Rainfall=2.20"

Area (sf)	CN	Description
74,048	74	>75% Grass cover, Good, HSG C
74,048	74	100.00% Pervious Area

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

Subcatchment 2S: Pervious Area (Developed)



Summary for Subcatchment 3S: Impervious Area (Developed)

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

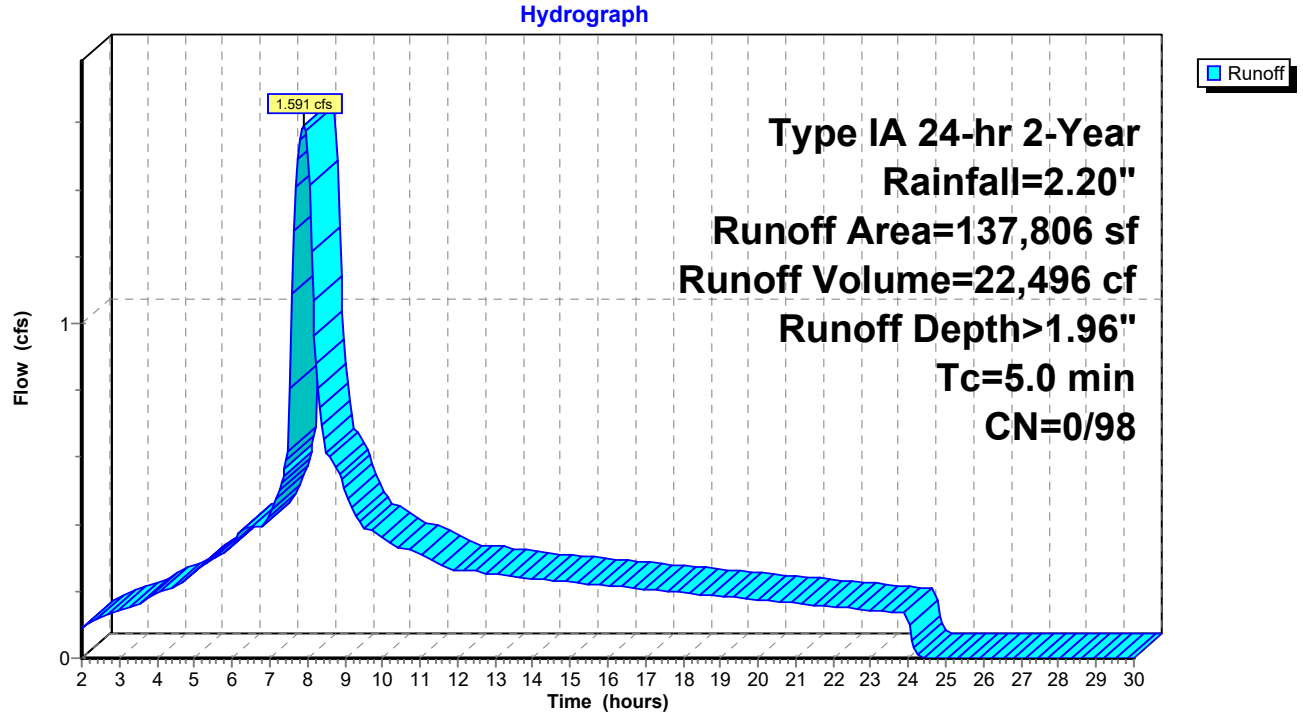
Runoff = 1.591 cfs @ 7.90 hrs, Volume= 22,496 cf, Depth> 1.96"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-Year Rainfall=2.20"

	Area (sf)	CN	Description
*	78,373	98	Paved Surfaces
*	59,433	98	Roofs
	137,806	98	Weighted Average
	137,806	98	100.00% Impervious Area

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

Subcatchment 3S: Impervious Area (Developed)



Summary for Pond 2P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 211,854 sf, 65.05% Impervious, Inflow Depth > 1.43" for 2-Year event
Inflow = 1.655 cfs @ 7.93 hrs, Volume= 25,257 cf
Outflow = 0.120 cfs @ 24.05 hrs, Volume= 9,669 cf, Atten= 93%, Lag= 967.5 min
Primary = 0.120 cfs @ 24.05 hrs, Volume= 9,669 cf

Routing by Stor-Ind method, Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 237.51' @ 24.05 hrs Surf.Area= 6,748 sf Storage= 18,064 cf

Plug-Flow detention time= 697.3 min calculated for 9,644 cf (38% of inflow)
Center-of-Mass det. time= 386.6 min (1,095.5 - 708.9)

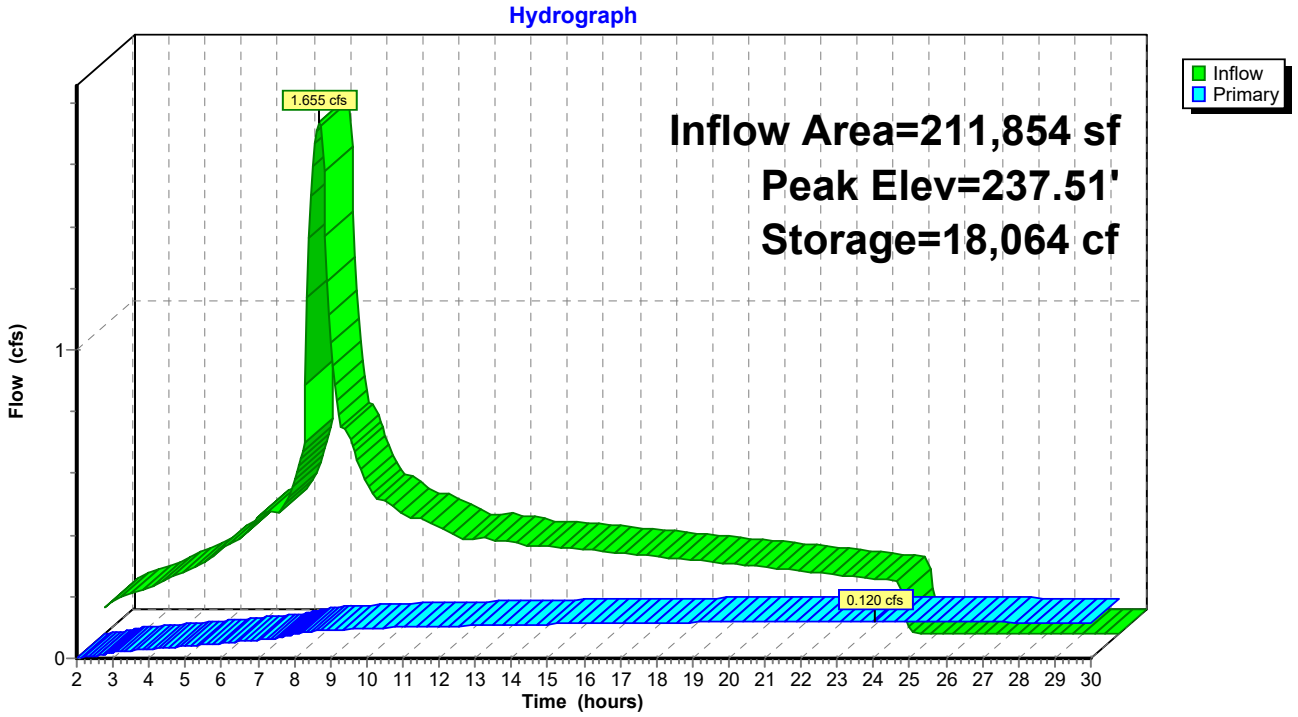
Volume	Invert	Avail.Storage	Storage Description
#1	234.30'	31,250 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
234.30	4,500	0	0
239.30	8,000	31,250	31,250

Device	Routing	Invert	Outlet Devices
#1	Primary	234.30'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 234.30' / 234.06' S= 0.0048 '/' Cc= 0.900 n= 0.010
#2	Device 1	232.30'	**1.6" Vert. Orifice/Grate - 2 Year** C= 0.600
#3	Device 1	237.52'	**5.0" Vert. Orifice/Grate - 10 Year** C= 0.600
#4	Device 1	237.94'	**10.0" Vert. Orifice/Grate - Overflow** C= 0.600

Primary OutFlow Max=0.120 cfs @ 24.05 hrs HW=237.51' (Free Discharge)
└**1=Culvert** (Passes 0.120 cfs of 4.916 cfs potential flow)
  ├**2=Orifice/Grate - 2 Year** (Orifice Controls 0.120 cfs @ 8.63 fps)
  ├**3=Orifice/Grate - 10 Year** (Controls 0.000 cfs)
  └**4=Orifice/Grate - Overflow** (Controls 0.000 cfs)

Pond 2P: Detention Pond



Time span=2.00-30.00 hrs, dt=0.05 hrs, 561 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Existing Area Runoff Area=211,854 sf 0.00% Impervious Runoff Depth=0.93"
Flow Length=690' Tc=32.8 min CN=72/0 Runoff=0.463 cfs 16,413 cf

Subcatchment2S: Pervious Area Runoff Area=74,048 sf 0.00% Impervious Runoff Depth=1.04"
Tc=5.0 min CN=74/0 Runoff=0.331 cfs 6,402 cf

Subcatchment3S: Impervious Area Runoff Area=137,806 sf 100.00% Impervious Runoff Depth>2.93"
Tc=5.0 min CN=0/98 Runoff=2.362 cfs 33,659 cf

Pond 2P: Detention Pond Peak Elev=237.93' Storage=20,936 cf Inflow=2.671 cfs 40,062 cf
Outflow=0.422 cfs 23,169 cf

Total Runoff Area = 423,708 sf Runoff Volume = 56,474 cf Average Runoff Depth = 1.60"
67.48% Pervious = 285,902 sf 32.52% Impervious = 137,806 sf

Summary for Subcatchment 1S: Existing Area

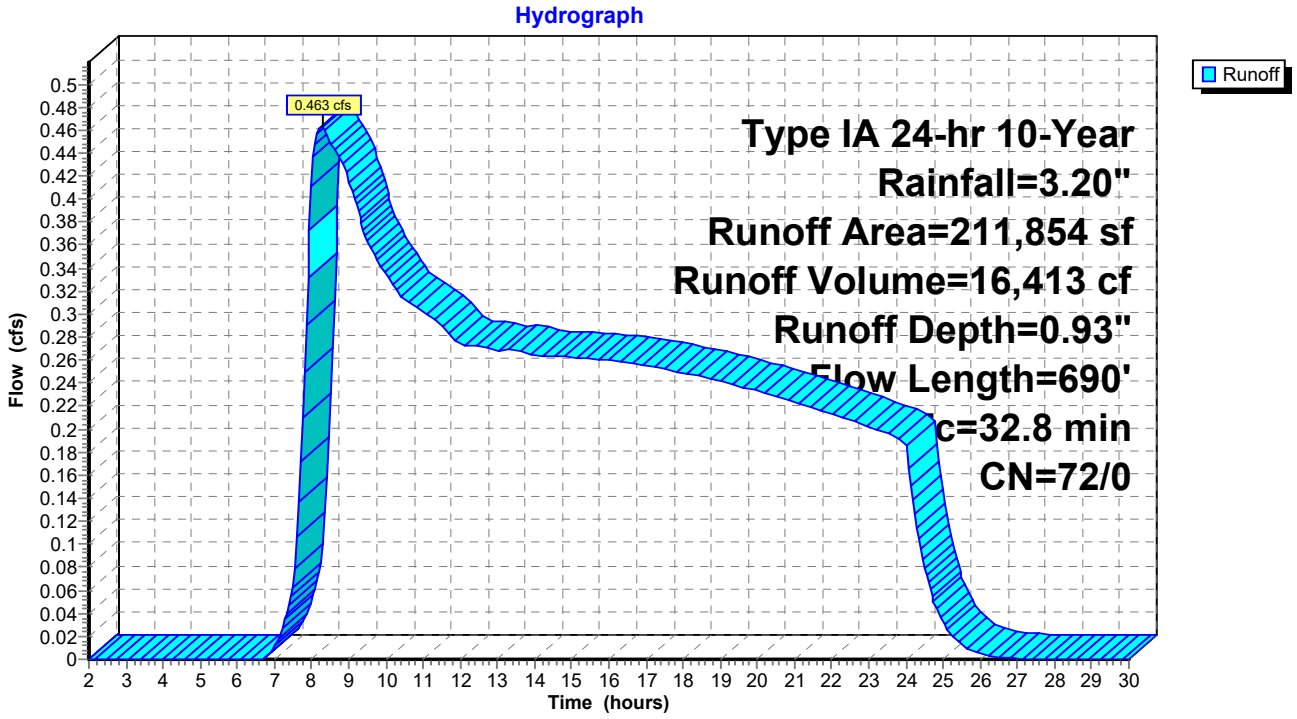
Runoff = 0.463 cfs @ 8.27 hrs, Volume= 16,413 cf, Depth= 0.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	211,854	72	City of Salem Pre-Development
	211,854	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.8	300	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.00"
3.0	390	0.0210	2.17		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
32.8	690	Total			

Subcatchment 1S: Existing Area



Summary for Subcatchment 2S: Pervious Area (Developed)

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

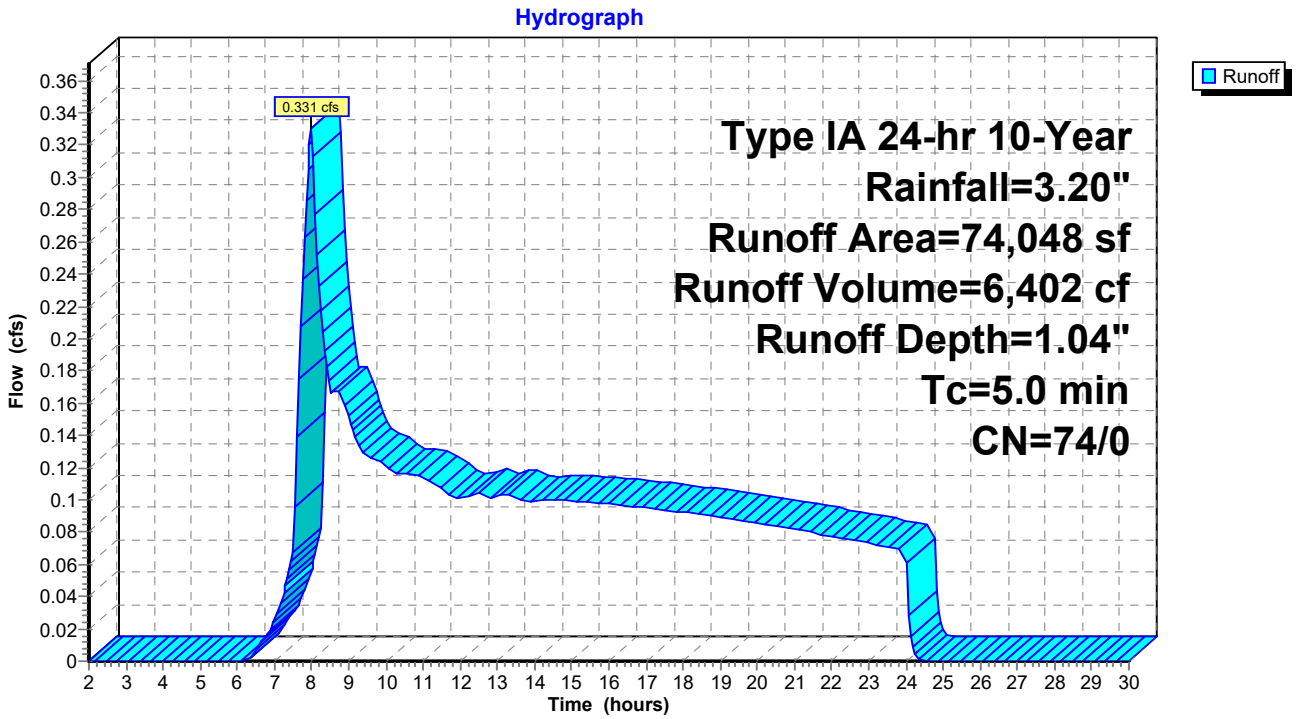
Runoff = 0.331 cfs @ 7.99 hrs, Volume= 6,402 cf, Depth= 1.04"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-Year Rainfall=3.20"

Area (sf)	CN	Description
74,048	74	>75% Grass cover, Good, HSG C
74,048	74	100.00% Pervious Area

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

Subcatchment 2S: Pervious Area (Developed)



Summary for Subcatchment 3S: Impervious Area (Developed)

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

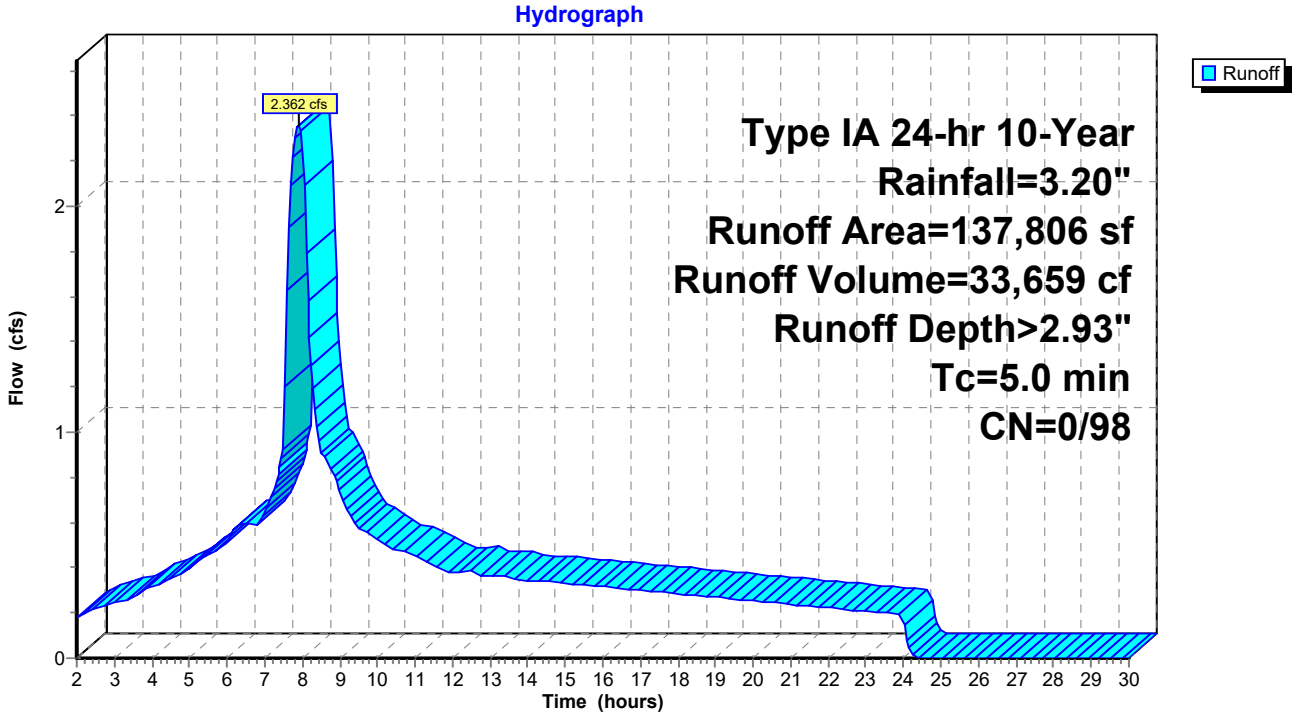
Runoff = 2.362 cfs @ 7.90 hrs, Volume= 33,659 cf, Depth> 2.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	78,373	98	Paved Surfaces
*	59,433	98	Roofs
	137,806	98	Weighted Average
	137,806	98	100.00% Impervious Area

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

Subcatchment 3S: Impervious Area (Developed)



Summary for Pond 2P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 211,854 sf, 65.05% Impervious, Inflow Depth > 2.27" for 10-Year event
Inflow = 2.671 cfs @ 7.92 hrs, Volume= 40,062 cf
Outflow = 0.422 cfs @ 15.50 hrs, Volume= 23,169 cf, Atten= 84%, Lag= 454.5 min
Primary = 0.422 cfs @ 15.50 hrs, Volume= 23,169 cf

Routing by Stor-Ind method, Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 237.93' @ 15.50 hrs Surf.Area= 7,040 sf Storage= 20,936 cf

Plug-Flow detention time= 598.2 min calculated for 23,112 cf (58% of inflow)
Center-of-Mass det. time= 356.3 min (1,060.4 - 704.0)

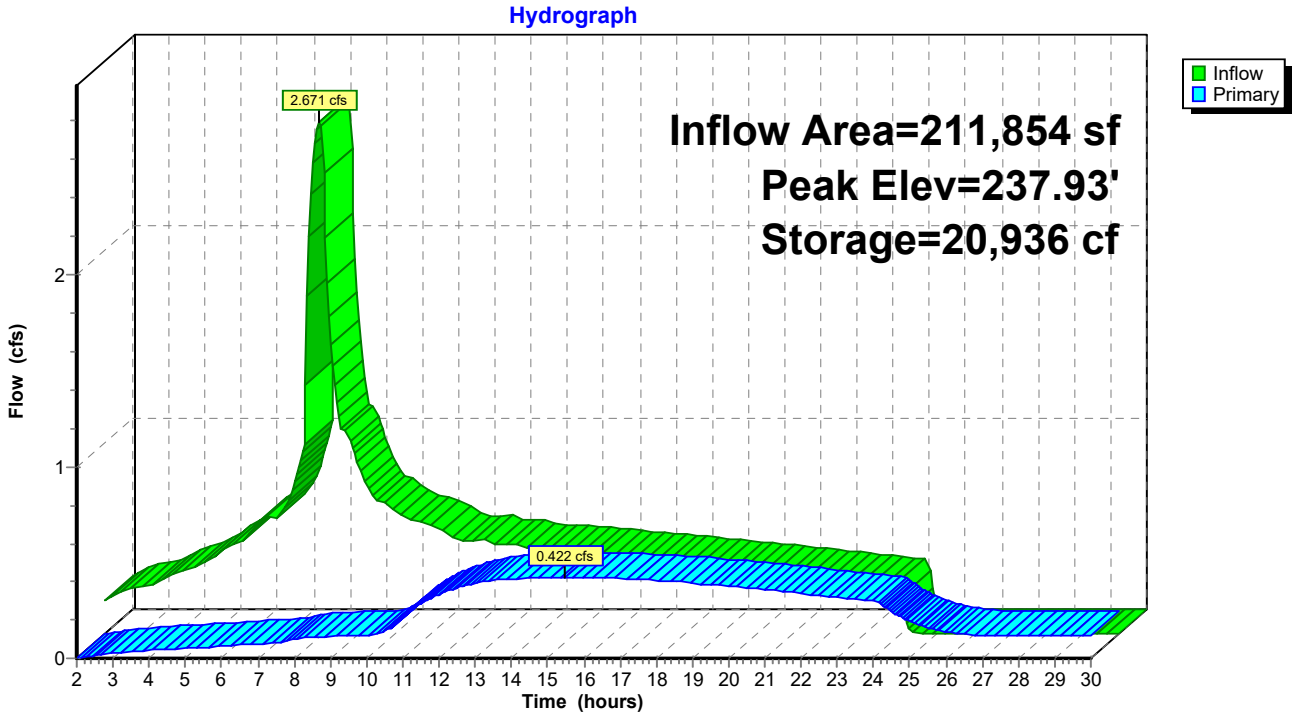
Volume	Invert	Avail.Storage	Storage Description
#1	234.30'	31,250 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
234.30	4,500	0	0
239.30	8,000	31,250	31,250

Device	Routing	Invert	Outlet Devices
#1	Primary	234.30'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 234.30' / 234.06' S= 0.0048 '/' Cc= 0.900 n= 0.010
#2	Device 1	232.30'	**1.6" Vert. Orifice/Grate - 2 Year** C= 0.600
#3	Device 1	237.52'	**5.0" Vert. Orifice/Grate - 10 Year** C= 0.600
#4	Device 1	237.94'	**10.0" Vert. Orifice/Grate - Overflow** C= 0.600

Primary OutFlow Max=0.423 cfs @ 15.50 hrs HW=237.93' (Free Discharge)
└**1=Culvert** (Passes 0.423 cfs of 5.281 cfs potential flow)
  ├**2=Orifice/Grate - 2 Year** (Orifice Controls 0.128 cfs @ 9.17 fps)
  ├**3=Orifice/Grate - 10 Year** (Orifice Controls 0.295 cfs @ 2.18 fps)
  └**4=Orifice/Grate - Overflow** (Controls 0.000 cfs)

Pond 2P: Detention Pond



Time span=2.00-30.00 hrs, dt=0.05 hrs, 561 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Existing Area Runoff Area=211,854 sf 0.00% Impervious Runoff Depth=1.75"
Flow Length=690' Tc=32.8 min CN=72/0 Runoff=1.134 cfs 30,839 cf

Subcatchment2S: Pervious Area Runoff Area=74,048 sf 0.00% Impervious Runoff Depth=1.90"
Tc=5.0 min CN=74/0 Runoff=0.712 cfs 11,698 cf

Subcatchment3S: Impervious Area Runoff Area=137,806 sf 100.00% Impervious Runoff Depth>4.09"
Tc=5.0 min CN=0/98 Runoff=3.280 cfs 47,002 cf

Pond 2P: Detention Pond Peak Elev=238.25' Storage=23,202 cf Inflow=3.966 cfs 58,700 cf
Outflow=0.947 cfs 41,486 cf

Total Runoff Area = 423,708 sf Runoff Volume = 89,539 cf Average Runoff Depth = 2.54"
67.48% Pervious = 285,902 sf 32.52% Impervious = 137,806 sf

Summary for Subcatchment 1S: Existing Area

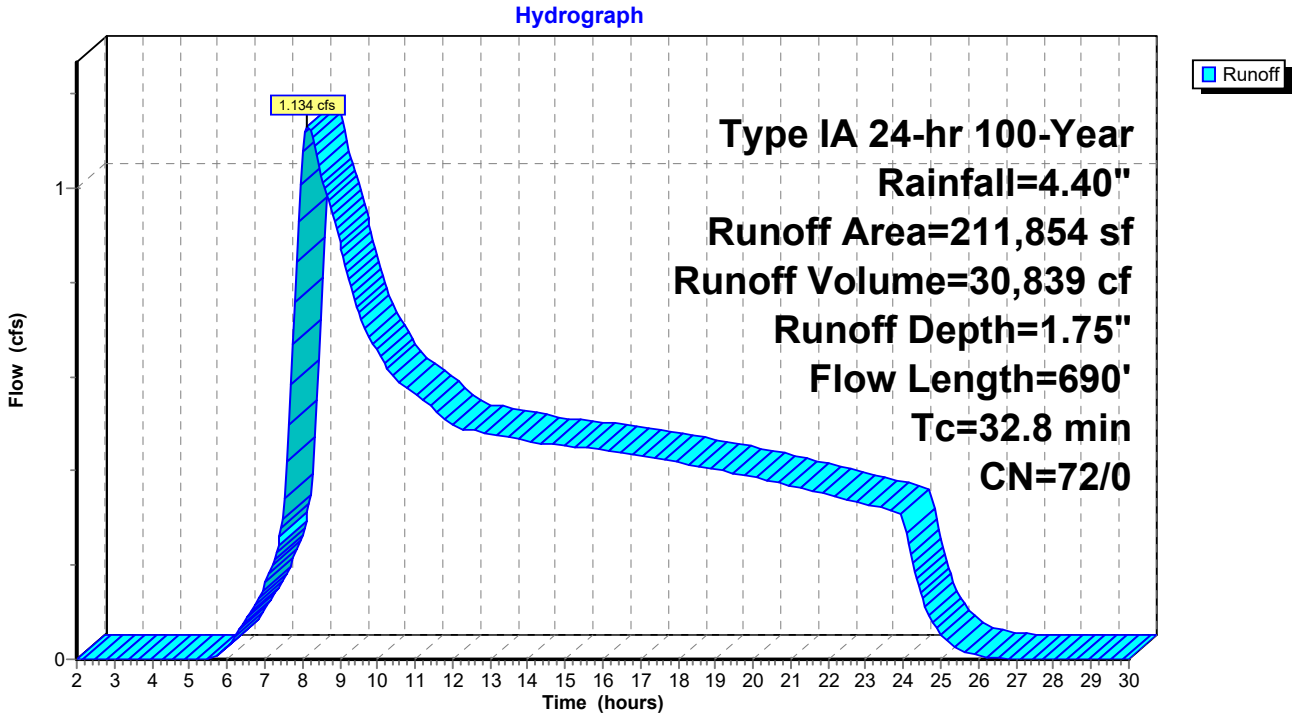
Runoff = 1.134 cfs @ 8.15 hrs, Volume= 30,839 cf, Depth= 1.75"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.40"

	Area (sf)	CN	Description
*	211,854	72	City of Salem Pre-Development
	211,854	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.8	300	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.00"
3.0	390	0.0210	2.17		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
32.8	690	Total			

Subcatchment 1S: Existing Area



Summary for Subcatchment 2S: Pervious Area (Developed)

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

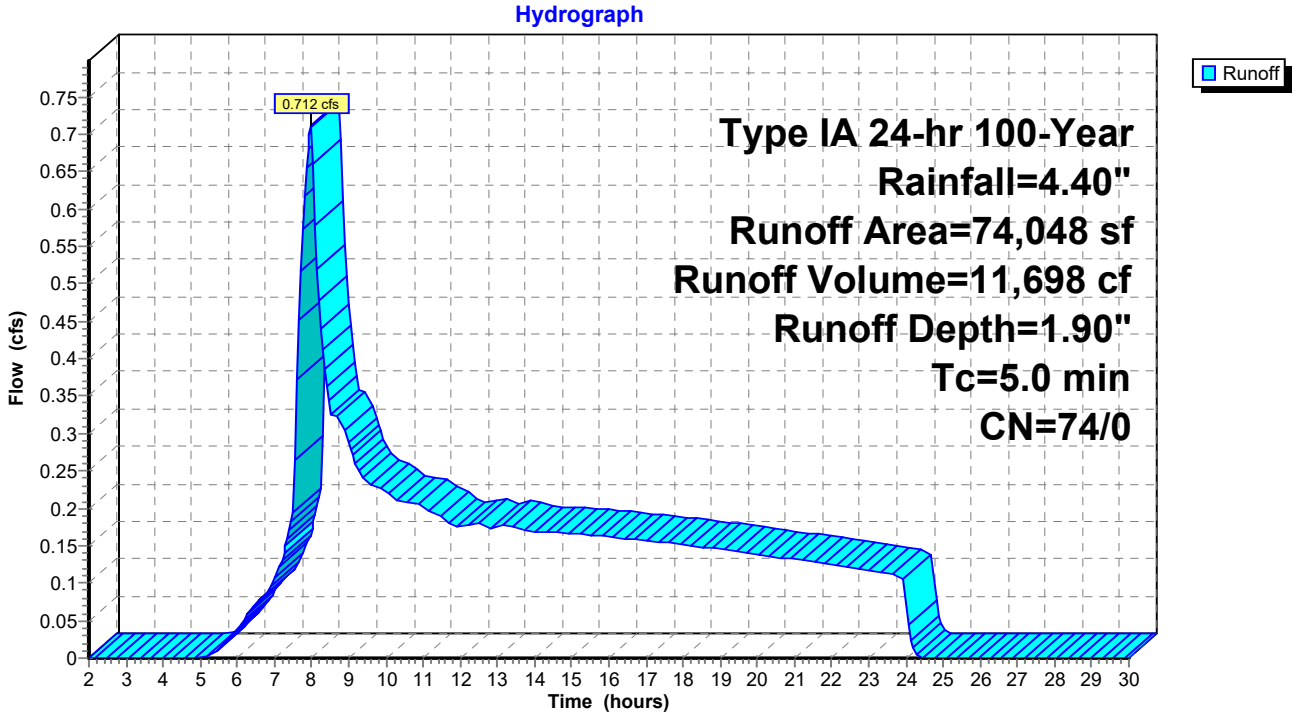
Runoff = 0.712 cfs @ 7.98 hrs, Volume= 11,698 cf, Depth= 1.90"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.40"

Area (sf)	CN	Description
74,048	74	>75% Grass cover, Good, HSG C
74,048	74	100.00% Pervious Area

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

Subcatchment 2S: Pervious Area (Developed)



Summary for Subcatchment 3S: Impervious Area (Developed)

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

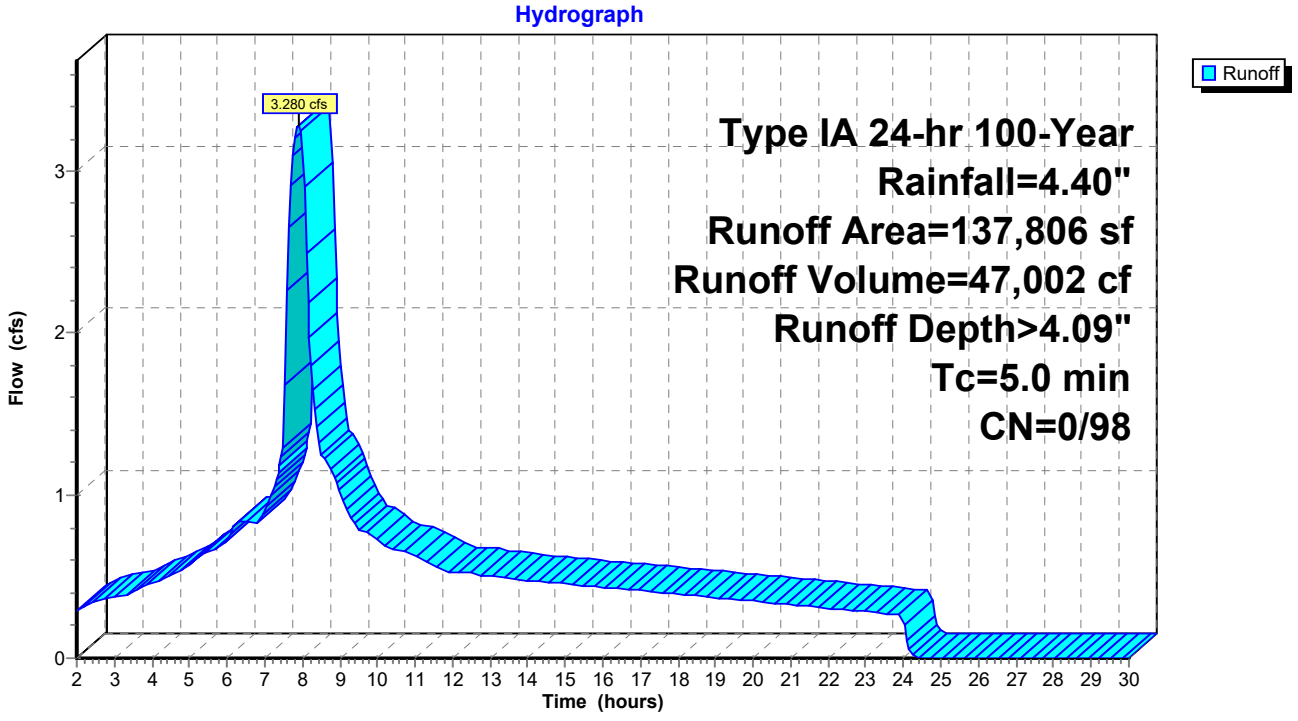
Runoff = 3.280 cfs @ 7.90 hrs, Volume= 47,002 cf, Depth> 4.09"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.40"

	Area (sf)	CN	Description
*	78,373	98	Paved Surfaces
*	59,433	98	Roofs
	137,806	98	Weighted Average
	137,806	98	100.00% Impervious Area

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

Subcatchment 3S: Impervious Area (Developed)



Summary for Pond 2P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 211,854 sf, 65.05% Impervious, Inflow Depth > 3.32" for 100-Year event
Inflow = 3.966 cfs @ 7.92 hrs, Volume= 58,700 cf
Outflow = 0.947 cfs @ 10.02 hrs, Volume= 41,486 cf, Atten= 76%, Lag= 126.1 min
Primary = 0.947 cfs @ 10.02 hrs, Volume= 41,486 cf

Routing by Stor-Ind method, Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 238.25' @ 10.02 hrs Surf.Area= 7,262 sf Storage= 23,202 cf

Plug-Flow detention time= 442.3 min calculated for 41,460 cf (71% of inflow)
Center-of-Mass det. time= 259.7 min (959.2 - 699.6)

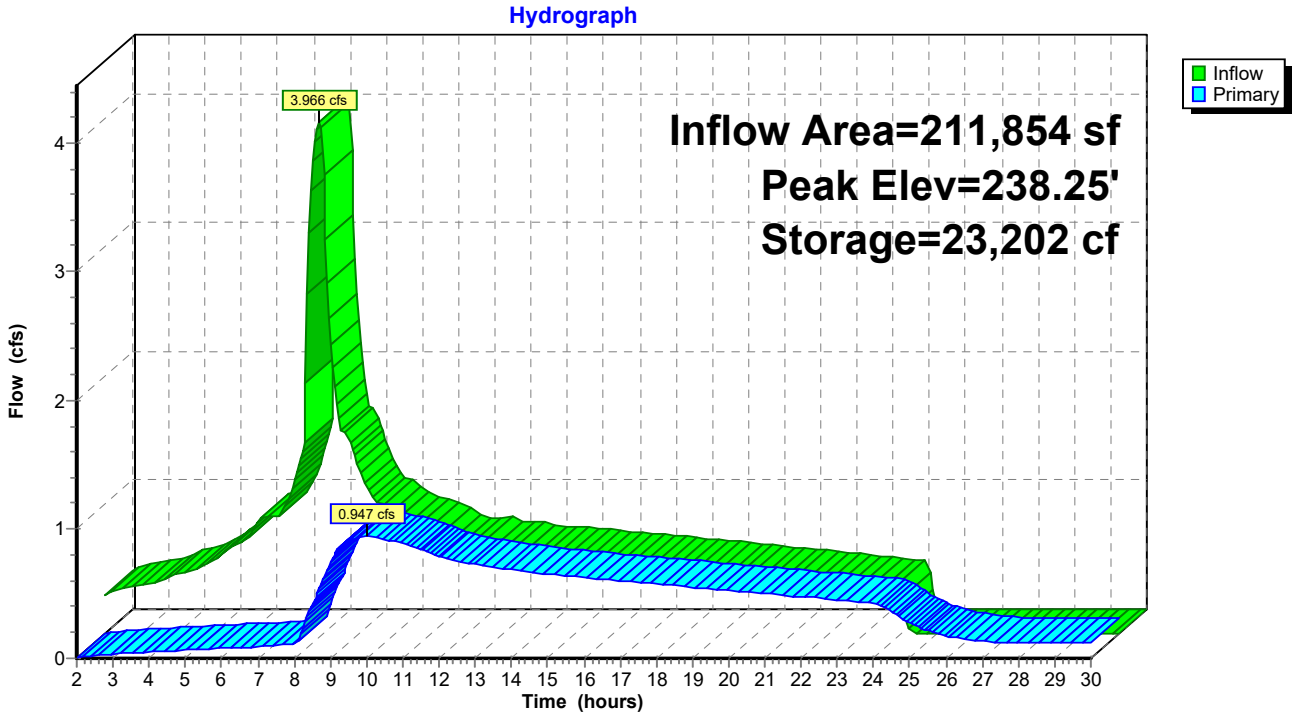
Volume	Invert	Avail.Storage	Storage Description
#1	234.30'	31,250 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
234.30	4,500	0	0
239.30	8,000	31,250	31,250

Device	Routing	Invert	Outlet Devices
#1	Primary	234.30'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 234.30' / 234.06' S= 0.0048 '/' Cc= 0.900 n= 0.010
#2	Device 1	232.30'	**1.6" Vert. Orifice/Grate - 2 Year** C= 0.600
#3	Device 1	237.52'	**5.0" Vert. Orifice/Grate - 10 Year** C= 0.600
#4	Device 1	237.94'	**10.0" Vert. Orifice/Grate - Overflow** C= 0.600

Primary OutFlow Max=0.946 cfs @ 10.02 hrs HW=238.25' (Free Discharge)
└**1=Culvert** (Passes 0.946 cfs of 5.542 cfs potential flow)
  ├**2=Orifice/Grate - 2 Year** (Orifice Controls 0.134 cfs @ 9.56 fps)
  ├**3=Orifice/Grate - 10 Year** (Orifice Controls 0.472 cfs @ 3.46 fps)
  └**4=Orifice/Grate - Overflow** (Orifice Controls 0.341 cfs @ 1.88 fps)

Pond 2P: Detention Pond



Time span=2.00-30.00 hrs, dt=0.05 hrs, 561 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Existing Area Runoff Area=211,854 sf 0.00% Impervious Runoff Depth=0.08"
Flow Length=690' Tc=32.8 min CN=72/0 Runoff=0.035 cfs 1,426 cf

Subcatchment2S: Pervious Area Runoff Area=74,048 sf 0.00% Impervious Runoff Depth=0.11"
Tc=5.0 min CN=74/0 Runoff=0.015 cfs 675 cf

Subcatchment3S: Impervious Area Runoff Area=137,806 sf 100.00% Impervious Runoff Depth>1.16"
Tc=5.0 min CN=0/98 Runoff=0.949 cfs 13,319 cf

Pond 2P: Detention Pond Peak Elev=236.01' Storage=8,736 cf Inflow=0.949 cfs 13,994 cf
Outflow=0.088 cfs 7,038 cf

Total Runoff Area = 423,708 sf Runoff Volume = 15,420 cf Average Runoff Depth = 0.44"
67.48% Pervious = 285,902 sf 32.52% Impervious = 137,806 sf

Summary for Subcatchment 1S: Existing Area

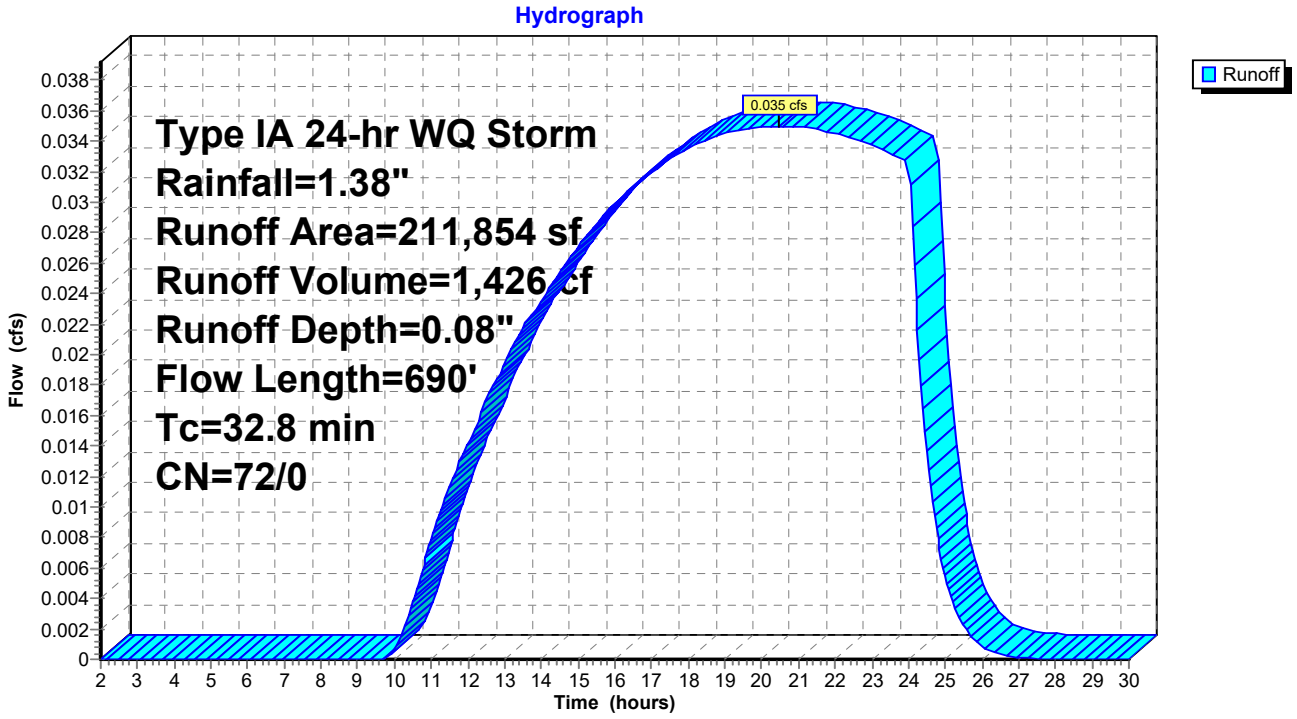
Runoff = 0.035 cfs @ 20.48 hrs, Volume= 1,426 cf, Depth= 0.08"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr WQ Storm Rainfall=1.38"

	Area (sf)	CN	Description
*	211,854	72	City of Salem Pre-Development
	211,854	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.8	300	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.00"
3.0	390	0.0210	2.17		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
32.8	690	Total			

Subcatchment 1S: Existing Area



Summary for Subcatchment 2S: Pervious Area (Developed)

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

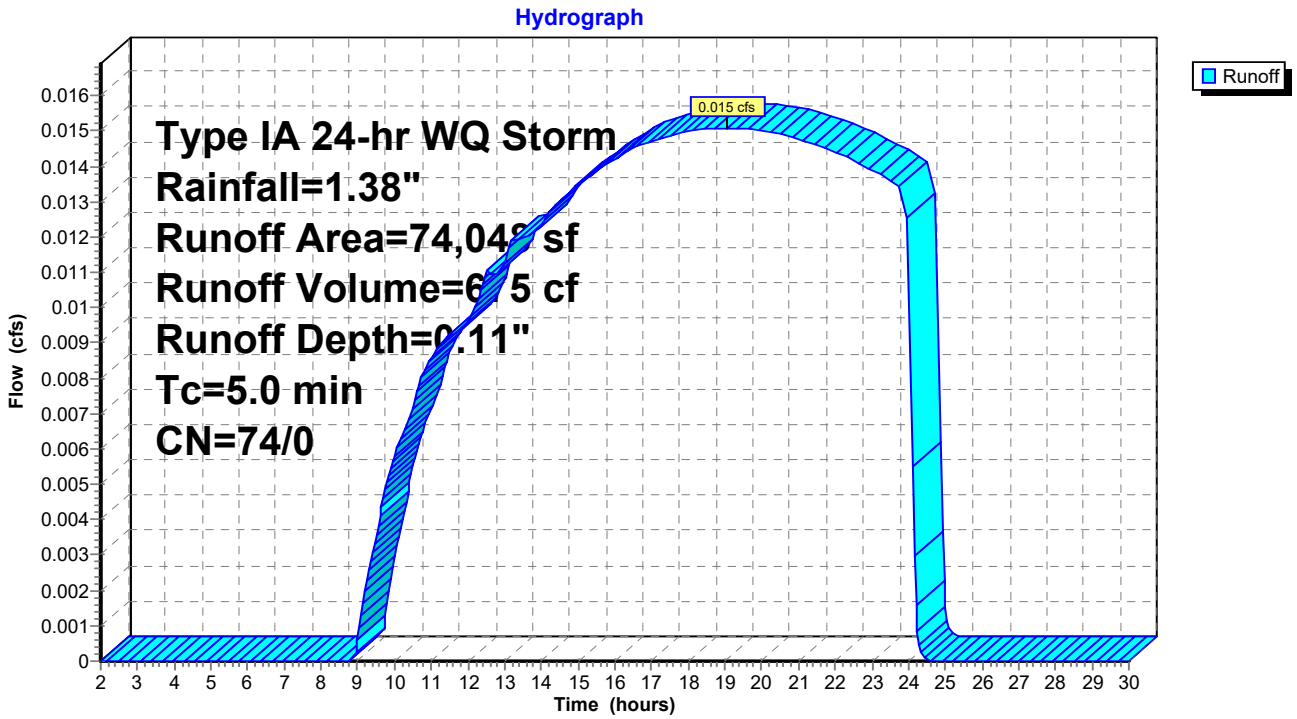
Runoff = 0.015 cfs @ 19.03 hrs, Volume= 675 cf, Depth= 0.11"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr WQ Storm Rainfall=1.38"

Area (sf)	CN	Description
74,048	74	>75% Grass cover, Good, HSG C
74,048	74	100.00% Pervious Area

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

Subcatchment 2S: Pervious Area (Developed)



Summary for Subcatchment 3S: Impervious Area (Developed)

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

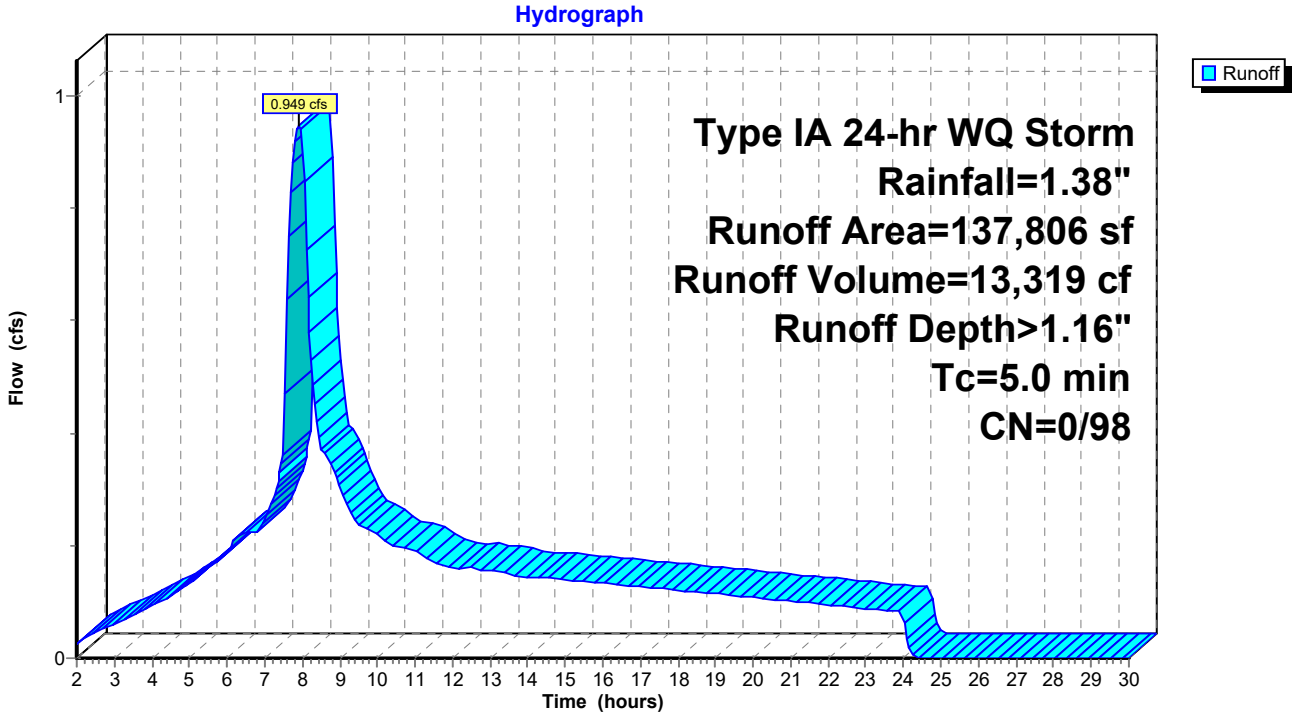
Runoff = 0.949 cfs @ 7.91 hrs, Volume= 13,319 cf, Depth> 1.16"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr WQ Storm Rainfall=1.38"

	Area (sf)	CN	Description
*	78,373	98	Paved Surfaces
*	59,433	98	Roofs
	137,806	98	Weighted Average
	137,806	98	100.00% Impervious Area

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

Subcatchment 3S: Impervious Area (Developed)



Summary for Pond 2P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 211,854 sf, 65.05% Impervious, Inflow Depth > 0.79" for WQ Storm event
Inflow = 0.949 cfs @ 7.91 hrs, Volume= 13,994 cf
Outflow = 0.088 cfs @ 24.01 hrs, Volume= 7,038 cf, Atten= 91%, Lag= 965.9 min
Primary = 0.088 cfs @ 24.01 hrs, Volume= 7,038 cf

Routing by Stor-Ind method, Time Span= 2.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 236.01' @ 24.01 hrs Surf.Area= 5,699 sf Storage= 8,736 cf

Plug-Flow detention time= 652.0 min calculated for 7,023 cf (50% of inflow)
Center-of-Mass det. time= 381.8 min (1,097.2 - 715.3)

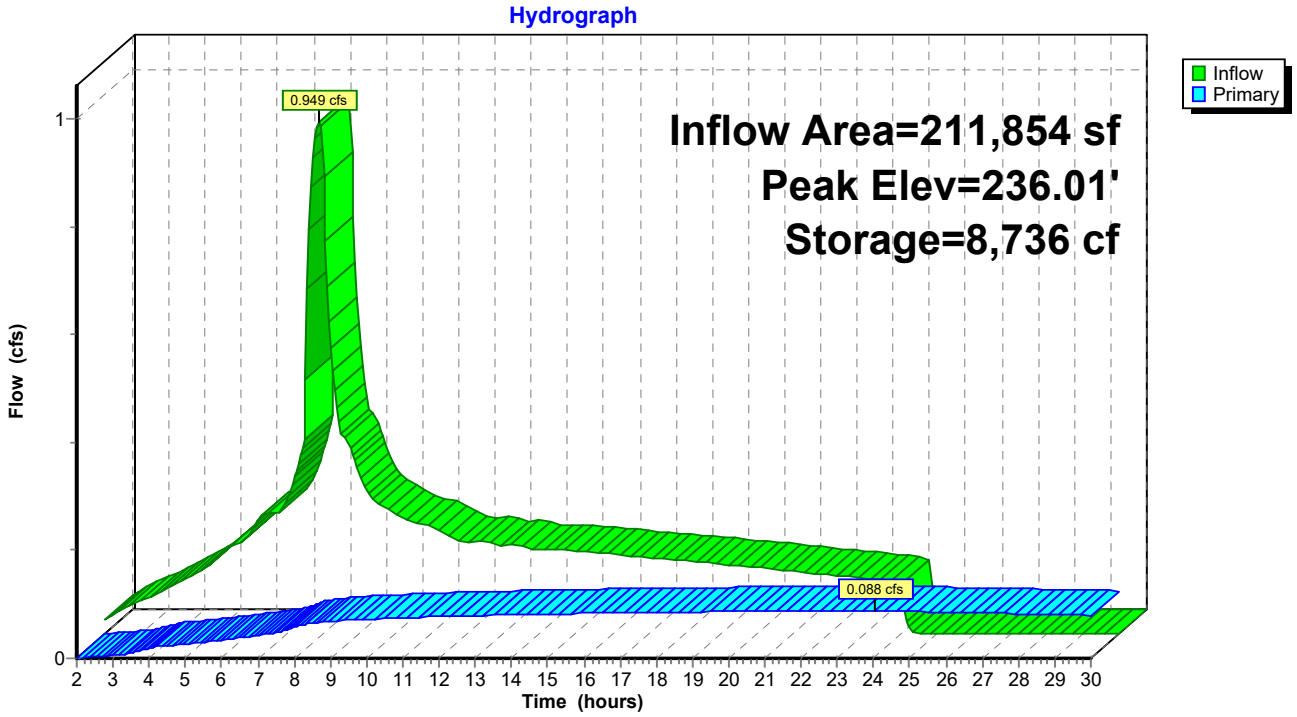
Volume	Invert	Avail.Storage	Storage Description
#1	234.30'	31,250 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
234.30	4,500	0	0
239.30	8,000	31,250	31,250

Device	Routing	Invert	Outlet Devices
#1	Primary	234.30'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 234.30' / 234.06' S= 0.0048 '/' Cc= 0.900 n= 0.010
#2	Device 1	232.30'	**1.6" Vert. Orifice/Grate - 2 Year** C= 0.600
#3	Device 1	237.52'	**5.0" Vert. Orifice/Grate - 10 Year** C= 0.600
#4	Device 1	237.94'	**10.0" Vert. Orifice/Grate - Overflow** C= 0.600

Primary OutFlow Max=0.088 cfs @ 24.01 hrs HW=236.01' (Free Discharge)
└**1=Culvert** (Passes 0.088 cfs of 3.288 cfs potential flow)
  ├**2=Orifice/Grate - 2 Year** (Orifice Controls 0.088 cfs @ 6.30 fps)
  ├**3=Orifice/Grate - 10 Year** (Controls 0.000 cfs)
  └**4=Orifice/Grate - Overflow** (Controls 0.000 cfs)

Pond 2P: Detention Pond



Appendix

(2). Total 24-hour rainfall amount.

(3). Basin area characteristics.

(4). Curve Number (CN).

(5). Time of Concentration.

(c) Rainfall Distribution

The rainfall distribution to use within the City is the design storm for a 24-hour duration based on the standard NRCS Type 1A rainfall distribution. This distribution is contained in Table 4D-5.

(d) Rainfall Depth

Table 4D-3 contains the 24-hour rainfall totals that shall be used in determining the runoff hydrograph for various sized storm events.

24-Hour Rainfall Depths for Salem, OR						
Recurrence Interval, Years	2	5	10	25	50	100
24-Hour Depths, Inches	2.2	2.7	3.2	3.6	4.1	4.4

Table 4D-3. Salem Rainfall Amount Based on the Storm Size.

(e) Basin Area Characteristics

For the highest degree of accuracy in hydrograph analysis, proper selection of homogeneous basin areas is needed. Significant differences in land use within a given basin must be addressed by dividing the basin area into sub-basins with similar land use and/or runoff characteristics. Hydrographs should be computed for each sub-basin area and superimposed to form the total runoff hydrograph for the basin.

All pervious and impervious areas within a given basin or sub-basin shall be analyzed separately. By analyzing pervious and impervious areas separately, the cumulative errors associated with averaging these areas are avoided, resulting in a more accurate runoff hydrograph.

(f) Runoff Curve Numbers

Runoff curve numbers were developed by the Natural Resources Conservation Service after studying the runoff characteristics of various types of land. Curve numbers (CN) were developed to consolidate diverse characteristics such as soil type, land usage, and vegetation into a single variable for computing runoff. Runoff CNs to be used in the hydrograph methods are included in Table 4D-6 at the end of this appendix.

(2). Engineered Method

The Engineered Method **shall be used** to design residential, commercial, industrial, and institutional projects with 10,000 square feet (0.23 acres) or greater of new and/or replaced impervious surface and for all public stormwater facilities. It can be applied to size facilities on smaller projects where the more detailed hydrologic calculations allow the facility to be sized more accurately than with the Simplified Method. This methodology shall be performed by a licensed Professional Engineer.

The Engineered method consists of sizing stormwater facilities by applying hydraulic and hydrologic engineering calculations to determine runoff, flow, volume, storage, conveyance capacity, etc. These standards provide requirements for the various hydrologic and hydraulic calculations necessary. Impervious area utilized in calculations may be reduced per the guidelines in subsection 4.2(g)—Impervious Area Reduction Techniques. Hydrologic analysis requirements can be found in subsection 4.2(o)—Hydrologic Analysis. Subsection 4.2(p)—Stormwater Treatment and Flow Control Design Storm Events provide design storm requirements for hydrologic calculations. See the table of contents for other applicable sections required to design and size facilities.

The Engineered Method analysis shall be submitted as part of the Stormwater Management Report (See Appendix 4A—Stormwater Submittal Requirements).

(o) Hydrologic Analysis

To meet Design Standard requirements according to the Engineered Method, stormwater facility design flows and volumes shall be determined using the methods described in this section. Additional information and supporting documentation for these methods can be found in Appendix 4D—Hydrologic Analysis.

(1). For every project, the impervious area shall include the total proposed impervious area, including all streets, driveways, redeveloped areas, and tentative building footprints based on the allowed building coverage and setbacks per the zoning code.

A. Drainage Areas

All hydrologic analyzes must include the drainage area of the site being evaluated and all of the upstream contributing basin area including those areas outside the proposed development site. Drainage calculations for flow control analysis shall include both the pre-developed and the post-developed drainage conditions.

B. Acceptable Analytical Methods

Calculation of stormwater runoff for stormwater treatment and flow control shall be analyzed using the Santa Barbara Urban Hydrograph (SBUH)

Method, Natural Resource Conservation Service (NRCS) TR 55, or the Stormwater Management Model SWMM.

C. Rational Method

The Rational Method may only be used to determine the peak flow for conveyance systems in conformance with these Standards. The Rational Method shall be used for sizing conveyance facilities and for determining the peak flow capacity of conveyance facilities with contributing drainage areas less than ten acres. The minimum time of concentration shall be five minutes.

D. Hydrograph Methods

The following conditions shall be met when evaluating the basin area characteristics using a hydrograph method.

(i). Pre-development Conditions

A homogeneous basin area will be assumed, regardless of the current conditions, when determining the peak runoff for pre-development conditions. The runoff characteristics for calculating allowable outflow are based on the combination of woods and grassland. These curve numbers have been calculated and provided in Appendix 4D—Hydrologic Analysis, Table 4D-6, "City of Salem Pre-development." These curve numbers shall always be used for determining pre-development flow condition selected for the predominate soil type where the project is located.

(ii). Post-development Conditions

A runoff hydrograph shall be created from an accurate characterization of the post-development site conditions. The runoff hydrograph shall include the contributing pervious and impervious areas along with their associated runoff curve numbers. Sub-basins shall be delineated and routed together when appropriate. A separate analysis of just the impervious area shall also be performed. The larger of the two hydrographs shall be used for design.

(p) Stormwater Treatment and Flow Control Design Storm Events

As specified in SRC Chapter 71, where stormwater treatment facilities are required, they must be designed to treat 80 percent of the annual rainfall. Properly designing a treatment facility utilizing the following storm event meets this requirement:

(1). The physical characteristics of the site and the design storm shall be used to determine the magnitude, volume, and duration of the runoff hydrographs. Either the Santa Barbara Urban Hydrograph (SBUH), Natural Resource Conservation Service (NRCS) TR-55 method, or Stormwater Management

Model (SWMM) may be used to generate the hydrograph. The Soil Conservation Service Type 1-A, 24-hour rainfall distribution, shall be used in all applications. A more detailed description of the hydrologic methods and parameters to be used to fulfill these Standards is provided in Appendix 4D—Hydrologic Analysis.

(2). Water Quality

The water quality design storm event shall be 1.38 inches per 24-hour period.

(3). Flow Control

A. One-half of the post-development peak runoff rate of the two-year storm must be equal to or less than one-half of the peak runoff rate of the pre-developed two-year, 24-hour storm; and the peak runoff rate of the post-development ten-year, 24-hour storm must be equal to or less than the peak runoff rate of the pre-developed ten-year, 24-hour storm event.

B. All volume-based facilities shall be sized to detain the post-developed 100-year design storm with a release rate no greater than the pre-developed, 100-year design storm.

C. Runoff volumes and flow rates shall be determined in accordance with the hydrologic calculation methods contained in Appendix 4D—Hydrologic Analysis.

(q) Site Disturbance

Soil compaction where the footprint of facilities designed for full or partial infiltration are to be located shall be avoided during construction. The location of these facilities shall be clearly marked on the plans. These areas must be protected with barriers or other means during construction. No vehicle traffic, except that specifically used to construct the facility, shall be allowed within ten feet of infiltration area.

(r) As-Builts

All facilities shall be field verified after construction to demonstrate they meet all design parameters including, but not limited to, storage volume, slope, overflow elevation, etc. As-built drawings shall be submitted in accordance with the requirements in Division 002—Drafting and Drawing Standards.

(s) Operations and Maintenance Requirements

Operations and Maintenance (O&M) requirements apply to all private stormwater treatment facilities and related facility components. Owners are required to provide access to the City and check their facilities regularly to determine maintenance needs.

In addition, privately owned and maintained stormwater facilities require the submittal of a "Private Facility Agreement" and a "Facility Maintenance Form". See Administrative Rule 109-011—Operations and Maintenance of Stormwater Facilities.

(t) All Weather Access

All weather vehicle access shall be provided to all stormwater facilities maintained by the City, as approved by the City. The type of surface treatment (i.e., asphalt, concrete or gravel) will be determined as appropriate for the location, slope and expected operation and maintenance traffic. Access easements are required per Division 001—General.

(u) Plant Material Landscaping Requirements

Green stormwater facilities and other facilities as required in this Division shall be landscaped with approved plant selection, soil amendments, fertilizers, etc., per Appendix 4B—Plant Material and Landscaping Requirements for Stormwater Facilities. Plans shall include complete landscape design per Appendix 4B—Plant Material and Landscaping Requirements for Stormwater Facilities.

4.3—Combined Stormwater Flow Control and Treatment Facilities

This section of the Stormwater Design Standards specifies the requirements for designing stormwater facilities that provide both flow control and treatment.

(a) Stormwater Planters, Rain Gardens, and Combination Swales (GSI)

Stormwater planters, rain gardens, and combination swales have many similar design features. All three can be designed as combined stormwater flow control and treatment facilities. These facilities are designed as infiltration, partial infiltration, or filtration systems. The type of facility chosen is site specific and based on the measured infiltration rates, geological conditions, and physical site limitations.

(1). Description

A. Stormwater Planters (GSI) (See Standard Plans 215 and 216)

Stormwater planters are smaller structural landscaped reservoirs used to collect, filter, and (where feasible) infiltrate stormwater runoff, allowing pollutants to settle and filter out as the water percolates through the planter growing medium before infiltrating into the ground below or piped to an approved point of discharge.

B. Rain Gardens (GSI) (See Standard Plan 217)

Rain gardens are landscaped reservoirs or depressions in the ground surface used to collect, filter, and/or infiltrate stormwater runoff. In rain gardens, pollutants settle and filter out as the water percolates through the growing medium, then infiltrates into the ground below or piped to an approved point

of discharge. Numerous design variations of shape and planting scheme can be used to fit the design to a particular site.

C. Combination Swales (See Standard Plan 219)

Combination swales have very similar design features as rain gardens and planters but are more linear and narrow in shape and can be adapted to steeper slopes. As with the other two alternatives, pollutants settle and filter out as the water percolates through the growing medium, then infiltrates into the ground. Combination swales are different than the flow through vegetated swales that provide treatment only described in Subsection 4.4(b)–Vegetated Swales (GSI).

(2). Infiltration Requirements

A. Infiltration Facilities

If on-site testing demonstrates the infiltration rate is 0.5 inch/hour or greater, the stormwater facility shall be designed as an infiltration facility. Infiltration testing requirements are included in Subsection 4.2(l)–Infiltration Testing and in Appendix 4C—Infiltration Testing.

A partial infiltration facility will be allowed if:

(i). The size of the infiltration facility is greater than ten percent of the total impervious area it serves and;

(ii). The rock storage area used in the sizing calculation has reached the maximum depth of 48-inches.

(3). Partial Infiltration Facilities

If the measured infiltration rate is less than 0.5 inches/hour, the treatment facility shall be designed as a partial infiltration facility. These facilities are similar to an infiltration facility with the addition of a perforated collection pipe running the length of the facility. The perforated pipe collects the flow passing through the growing medium to an approved point of discharge. See Standard Plan 221 for piping configuration details.

(4). Filtration Facilities

For private facilities only, the rock reservoir may extend under the pavement as designed by the EOR. Filtration facilities have an impermeable liner to prevent any flow leaving the facility and infiltrating into the ground and provide water treatment by filtering through soil and plants. Stormwater is then collected in a perforated pipe for conveyance.

Filtration facilities are required whenever the following site conditions are encountered regardless of the measured infiltration rate:

A. Sites with slope stability concerns. These sites require a Geotechnical Engineering or geologist report to determine the suitability for infiltration and facility recommendations.

B. Sites with a high groundwater table. A Geotechnical Engineering or geologist investigation and a report is required to determine the seasonally high groundwater level which must be more than three feet below the lowest elevation of the stormwater infiltration facilities.

C. Sites with contaminated soils. See Administrative Rule 109-112—Stormwater Source Control.

D. Where physical limitations of the site do not allow for the setback from building foundations required for infiltration facilities.

(5). General Design Requirements for Planters, Rain Gardens, and Combination Swales.

A. General Sizing Requirements

Large projects shall be designed using the engineered method as defined in Subsection 4.2(n)(2)—Engineered Method:

B. Sizing Infiltration Facilities

(i). Inflow to the facility shall consist of the design storm per Subsection 4.2(p)–Stormwater Treatment and Flow Control Design Storm Events, post-development runoff rate.

(ii). The outflow equals the infiltration rate times the wetted bottom (invert) surface area of the facility.

(iii). The storage volume consists of the rock storage beneath the growing medium, assuming a 40 percent void ratio and the volume above the growing medium to the overflow. The storage volume shall contain the design storm hydrograph inflow less outflow.

(iv). All stormwater treated by the facility has to drain from the surface within 24 hours after a storm event ends and the storage reservoir must be drained within 30 hours after a storm event ends.

(v). The size of the infiltration facility is determined by the wetted bottom surface area associated with the peak water surface elevation prior to overflow.

C. Sizing partial infiltration and filtration facilities:

Post-development runoff rates and pre-development runoff rates shall be determined utilizing the design storms described in Subsection 4.2(p)–Stormwater Treatment and Flow Control Design Storm Events. These storm events shall not overflow the facility.

(i). The outflow through the growing medium is controlled by the infiltration rate of the growing medium at two-inches per hour times the bottom (invert) wetted surface area of the facility. Additional flow control may be provided by an orifice outlet if needed.

(ii). The facility may be sized based on the flow rate through the facility as determined by the Darcy equation. This equation cannot be used for facilities without underdrains.

$$\boldsymbol{Q = kiA = k\left(\frac{d + D}{D}\right) \times A \times 43200}$$

Where:

Q = Outflow (cfs)

k = Infiltration of growing medium (2-inches per hour)

d = Depth of water above growing medium (inches)

D = Depth of growing medium (inches)

A = Bottom wetted surface area (square feet)

(6). Piping Requirements

A. In streets or parking lots, stormwater may flow directly into the stormwater treatment facility via curb openings.

B. An overflow to an approved point of discharge is required for all stormwater treatment facilities.

C. On private property, the overflow drain and piping must meet OPSC requirements and shall direct excess stormwater to an approved point of discharge as identified on the subdivision's Public Works Permit drawings.

D. Within the ROW, this overflow drain and piping must meet City Public Works Standards and shall direct excess stormwater to an approved point of discharge.

(7). Setbacks

A. Infiltration facilities shall be located at least ten feet from building foundations and shall not be located immediately upslope of building structures.

B. Filtration facilities can be located within ten feet of a building foundation.

C. All stormwater treatment facilities shall be set back a minimum of five feet from side lot property lines and easements where the adjoining property is downslope. Where the adjoining property is at the same grade or upslope from the facility, there are no set back requirements from the property lines.

(b) Flow Dispersion (GSI)

(1). Description

Full dispersion is a combined flow control and treatment strategy that utilizes the natural capacity of vegetated surfaces to mitigate runoff quantity and quality impacts associated with impervious surfaces, such as driveways, parking areas, and roofs. Fully dispersed surface runoff must be discharged using one of the methods summarized in Table 4-1.

Flow Dispersion Method	Flow Path Length	Maximum Impervious Surface
Splash Block	100 feet	700 sq ft
Rock Pad	100 feet	700 sq ft
10-foot Gravel Trench	100 feet	1,400 sq ft
50-foot Gravel Trench	100 feet	5,000 sq ft
Sheet Flow Dispersion	100 feet	25-ft strip width
	200 feet	50-ft strip width
Paved Walkways and Recreational Trails	25 feet	Up to 15 feet wide

Table 4-1. Summary of Approved Dispersion Methods.

(2). General Design Requirements

A. The total area of the impervious surface being dispersed must not exceed 15 percent of the total post construction vegetated area. The dispersion area being utilized must be delineated on the site plan and designated as the approved point of discharge.

B. A vegetated flow path at least 100 feet in length must be available along the flow path that runoff will follow upon discharge from a dispersion device. The vegetated flow path must meet all of the following criteria:

(i). The flow path must be a vegetated surface.

(ii). The flow path must be onsite or in an offsite easement area reserved for dispersion.

(iv). Forebay: A relatively deep zone placed where influent water discharges to a stormwater wetland. It traps coarse sediments, reduces incoming velocity, and helps distribute runoff evenly over the wetland.

(v). Micropool: A deep (four to six feet) pool placed at the outlet of a stormwater wetland forebay.

(vi). Dead zone storage: The additional storage volume provided to allow for sediment accumulation. For a Treatment Wetland, the additional storage is provided in the Forebay.

(vii). Deep-water: The area within a stormwater wetland that has a water depth greater than 18 inches.

(viii). Deep wetland: The area within a stormwater wetland that has a water depth between six and 18 inches.

(ix). Shallow wetland: The area within a stormwater wetland that has a water depth less than six inches.

See Standard Plan 222 for more specific details and sizing requirements for Treatment Wetlands.

C. Soil Suitability

(i). Treatment Wetlands are appropriate for NRCS type C and D soils.

(ii). Topsoil shall be used within the top 12 inches of the facility, or the soil shall be amended to support plant growth.

(iii). A certified soil scientist, or a person with suitable wetland design training and expertise, shall evaluate the soils at the bottom of the facility to confirm that they are suitable for wetland vegetation planting.

(3). Subsurface Gravel Wetland (GSI)

A. Description (See Standard Plan 223)

The Subsurface Gravel Wetland is a horizontal-flow filtration system that relies on a dense root mat, crushed stone, and an anaerobic, microbe rich environment to provide stormwater treatment. It approximates the look and function of a natural wetland, effectively removing sediments and other stormwater pollutants. This facility can be designed to provide both treatment and flow control.

B. Specific design requirements of a Subsurface Gravel Wetland

(i). Subsurface Gravel Wetlands are suitable for projects with a minimum of one acre of impervious surfaces. The shape of the wetland can be configured to match the specific site conditions.

(ii). The subsurface gravel storage shall have a residence time based on the stormwater volume (calculated as the treatment design storm volume divided by the average facility outflow rate) of no less than 24 hours.

(iii). The Subsurface Gravel Wetland shall be designed so that ponded water is drained within 48 hours.

(iv). Forebay: Shallow area used to trap any coarse sediment which escaped the upstream pretreatment manhole, reduces incoming velocity, and helps distribute runoff evenly over the wetland. Runoff exits the forebay through a perforated standpipe and flows into the vegetated treatment basin.

(v). Vegetated treatment basins: Water flows evenly over the vegetated treatment basins, where it is treated through a variety of physical, chemical, and biological processes.

(vi). Perforated riser pipes: Water in the vegetated treatment basins is conveyed to the subsurface gravel layer through perforated riser pipes. This ensures the gravel subsurface area fills quickly.

(vii). Subsurface gravel layer: Biological processes with anaerobic microbes take place in this layer along with the uptake of pollutants by the vegetative root system. Physical and chemical treatment, through the trapping of contaminants, occurs on and within the gravel filter media and root mat.

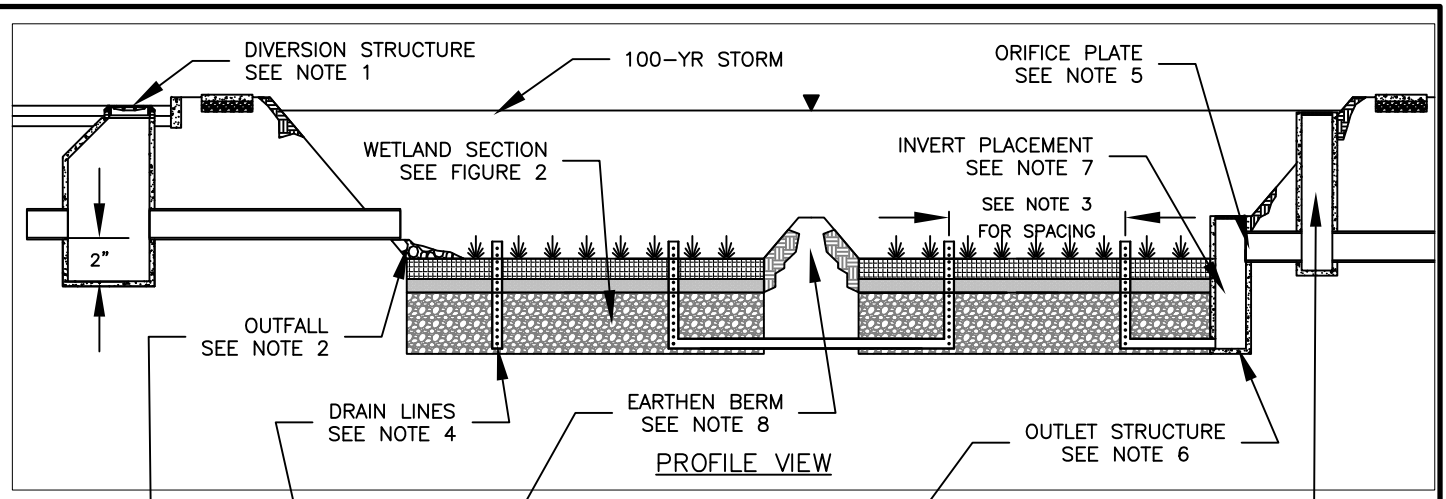
(viii). Outlet Structure: The outlet structure is used for flow control and also to regulate the level of water within the wetland. The outlet elevation shall be set to ensure the soil stays wet but water is not ponded on the surface of the wetland.

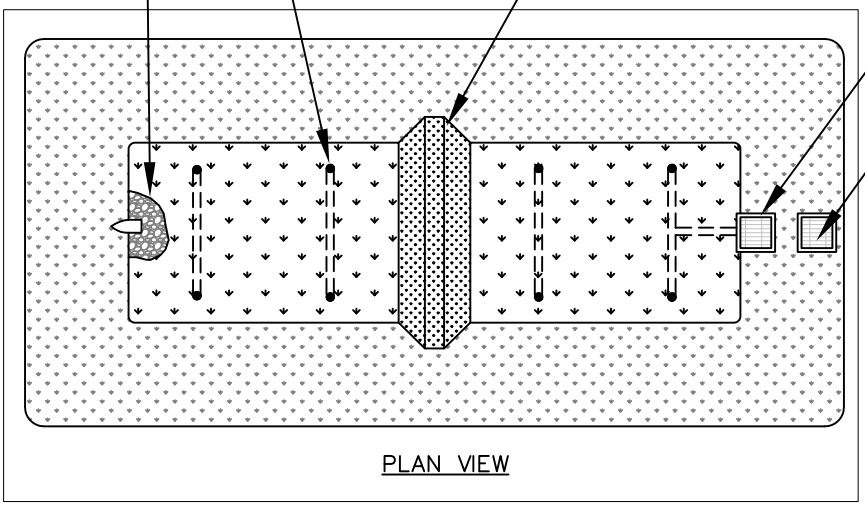
See Standard Plan 223 for more specific details and sizing requirements for Subsurface Gravel Wetlands.

C. Soil Suitability

(i). Subsurface Gravel Wetlands are appropriate for NRCS type C and D soils. Infiltration rates should be 0.5 inches per hour or less.

(ii). Topsoil shall be used within the top 12 inches of the facility, or the soil shall be amended to support plant growth.





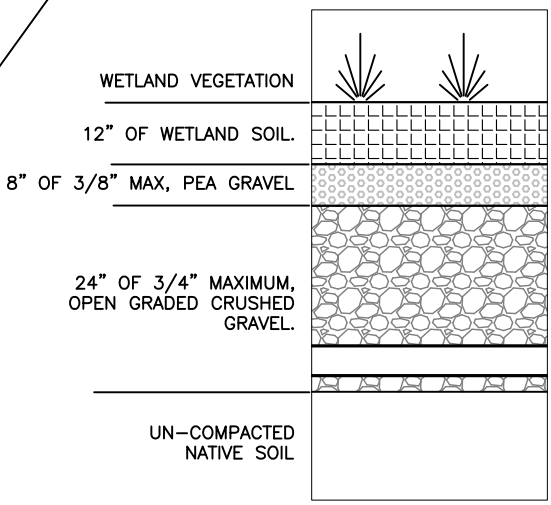


FIGURE 2

NOTES:

1. DIVERSION STRUCTURE TO BE CONSTRUCTED AS DESCRIBED IN CITY OF SALEM, STANDARD PLAN 101. STRUCTURE SHALL HAVE A 2 FT SETTLING SUMP.

2. OUTFALL SHALL BE CONSTRUCTED OF CLASS 50 RIP-RAP AND SHALL BE A MINIMUM OF 2 FT LONG BY 2 FT WIDE

3. STANDPIPES SHALL BE PERFORATED 6 INCH PVC WRAPPED IN FILTER FABRIC. STANDPIPES SHALL BE PLACED IN A PATTERN THAT HAS A MAXIMUM SPACING OF 15 FT IN ALL DIRECTIONS

4. DRAIN LINES SHALL BE PLACED IN THE BOTTOM OF THE ROCK LAYER. VERTICAL DRAIN PIPES SHALL BE FABRIC WRAPPED PERFORATED PVC. HORIZONTAL LINES SHALL BE SOLID PVC. CLEANOUTS SHALL BE PLACED IN A MANNER THAT ALLOWS FOR EVERY DRAIN LINE TO BE CLEANED

5. ORIFICE PLATE SHALL BE CONSTRUCTED OF STEEL. ORIFICE SHALL BE SIDED IN ACCORDANCE WITH THE CITY OF SALEM STORMWATER DESIGN STANDARDS PERTAINING TO ALLOWABLE DISCHARGE

6. THE OUTLET SHALL BE INSTALLED ADJACENT TO THE SECOND TREATMENT BAY AND SHALL BE CONNECTED TO THE UNDERDRAIN SYSTEM IN THE GRAVEL LAYER . THE GRATE ELEVATION SHALL BE SET TO ENSURE 100% OF THE TREATMENT DESIGN STORM VOLUME TRAVELS THROUGH THE GRAVEL LAYER. STRUCTURES SHALL CONFORM TO THE CITY OF SALEM STANDARD PLAN 201 OR 202

7. THE INVERT ELEVATION OF THE OUTLET PIPE SHALL BE INSTALLED A MINIMUM OF 1/2 INCH BELOW THE WETLAND SOIL SURFACE ELEVATION AND A MAXIMUM OF 4 INCHES BELOW THE WETLAND SOIL SURFACE ELEVATION

8. AN EARTHEN BERM SHALL BE CONSTRUCTED BETWEEN THE TWO BAYS. THE TOP OF THE EARTHEN BERM SHALL BE THE SAME ELEVATION AS THE ELEVATION OF THE FIRST OUTLET STRUCTURE'S GRATE ELEVATION

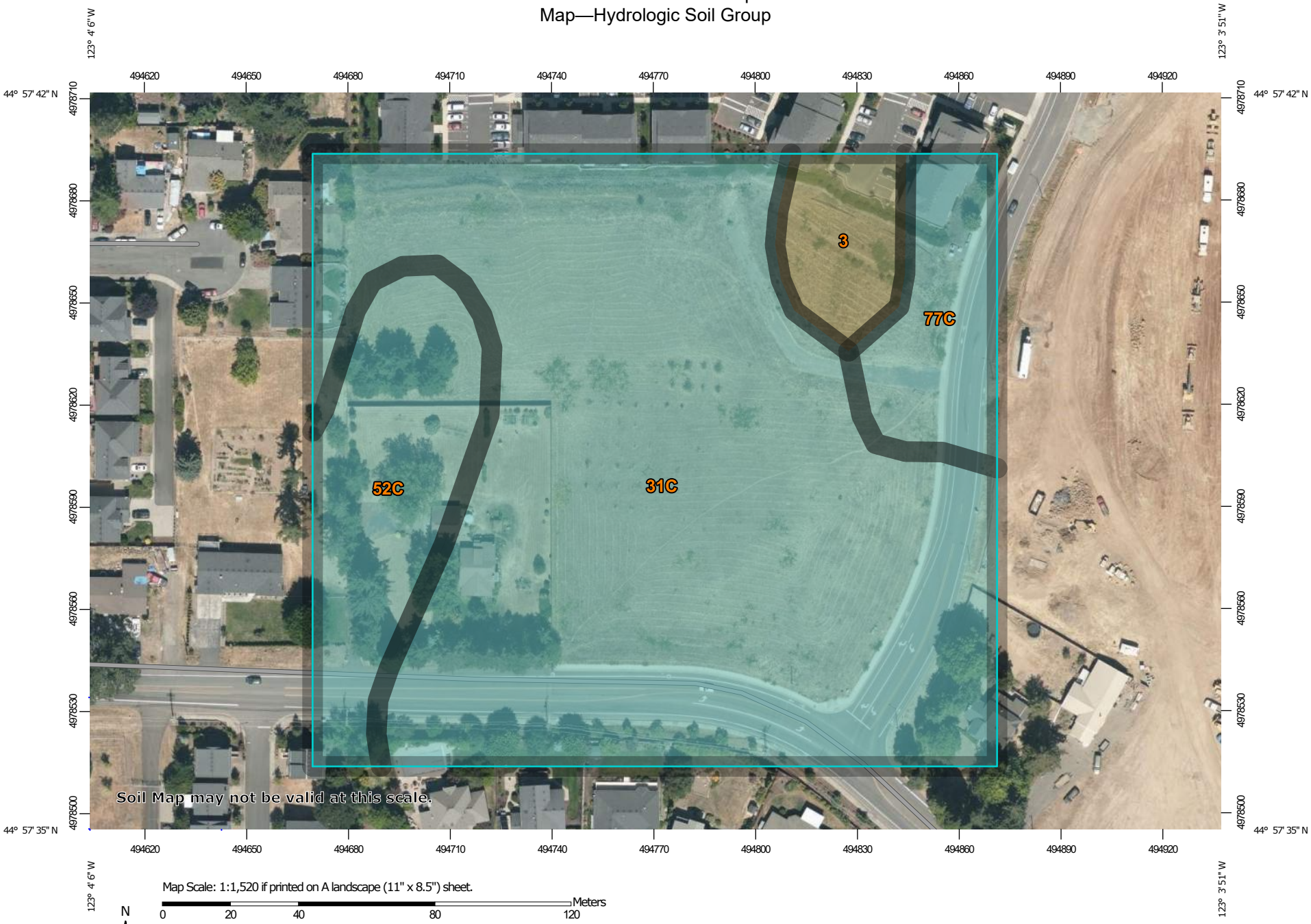
CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS

STANDARD PLAN

SUBSURFACE GRAVEL WETLAND

APPROVED	CITY ENGINEER	1/01/14	DRAWN BY	CL	12/2013	**NO. 223**	
		DATE	CHECKED BY	KR	12/2013		

Map—Hydrologic Soil Group



Map Scale: 1:1,520 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3	Amity silt loam	C/D	0.5	5.1%
31C	Helvetia silt loam, 0 to 12 percent slopes	C	6.6	72.8%
52C	Nekia silty clay loam, 2 to 12 percent slopes	C	1.3	14.1%
77C	Woodburn silt loam, 3 to 12 percent slopes	C	0.7	8.0%
Totals for Area of Interest			**9.0**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher