PRELIMINARY DRAINAGE ANALYSIS
FOR

Baxter Apartments
Salem, Oregon

December 20, 2024

Renew date: 6.30.2025

MULTI/TECH
ENGINEERING SERVICES, INC.

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INTRODUCTION

The Baxter Apartments is a 135 unit multi-family development project located at 1709 Baxter Road. The parcel of land to be developed includes Tax Lot 200 and 100 of Marion County Assessor's Map 08 3W 14BD. The project site area is approximately 7.47 acres in size. The property is bound by Baxter Road to the south, with Abbie Ave, Mac Street, and Snowball Ave all stubbing to the property boundaries on the west and east. An aerial image can be seen below, with the approximate project area outlined in ORANGE.

Figure 1: Project Site

Green Stormwater Infrastructure (GSI) to the Maximum Extent Feasible (MEF) will be used for the new developed areas per City of Salem Administrative Rules, Chapter 109, Division 004, Stormwater System, (Standards). All facilities will be constructed to meet the City of Salem standards.

EXISTING CONDITIONS

The portion of the property to be developed is roughly square in shape. The property is bound by Baxter Road to the south. Surface conditions consist of lawn, with the property having one residential home and three additional out-buildings. The topographical high point of the property is at the approximate location

of the residential home, with the property sloping away in all directions. The average slope across the property ranges from 3 to 6%. There are no offsite properties draining to or through the subject property.

Given the topography, this property drains to two different drainage basins. The majority of the property drains to the east, with a smaller portion draining to the west. The attached Existing Conditions map shows the area that drains to the west, measuring to be 84,918 square feet. This design considers the development of the multi-family project as well as the accompanying public improvements. For this reason, the area used for the total site in this analysis is 7.47 acres (325,321 square feet). The portion draining to the west is approximately 5.52 acres (240,403 square feet).

There are some existing trees on the property. The majority of the significant trees are in the location of proposed public improvements and will need to be removed.

Time of concentration was calculated separately for the property draining to the east and the west. The worksheets can be found in Appendix C.

Table 1: Pre-developed Drainage Basin Summary

| Basin | Contributing Area (ft^2) | | | CN | Tc (min) |
	Impervious CN = 98	Pervious CN = 74	Predeveloped CN = 72		
West			84,918	72	26.45
East			240,403	72	30.35

SOILS

The preliminary soils information was obtained from the National Resource Conservation Services Web Soil Survey. The soil map and accompanying information can be found in Appendix B. The soils on the site consists of Nekia Silty Clay which is classified as hydrologic soil group C. As required by the City of Salem Stormwater Standards, the existing conditions curve number of HSG C of 72 is used for the analysis.

A geotechnical investigation has not been formalized at this time. For the purposes of preliminary design, it will be assumed that the soil does not allow for infiltration. As such, the facility will not include an output for natural infiltration and the sizing of the facility will be conservative. An percolation test will be conducted and used for the final design.

DEVELOPED CONDITIONS

The multi-family project will consist of 135 living units, varying from 1 bedroom/1 bathroom units to 3 bedroom/2 bathroom units. Additional structures included in the project are a recreation building,

pavilion, covered mail area, and a pump house. A total of 230 parking stalls are proposed as well as 138 bike parking stalls.

The development of the site also includes the construction of Snowline Street around the project as well as constructing cul-de-sac bulbs for Abbie Ave and Snowball Ave.

The table below summaries the impervious and pervious surface totals. For this analysis, a curve number of 98 is used for the impervious surfaces and a curve number of 74 is used for the pervious surfaces, which consist of landscaping. A time of concentration of 5 was used for both basins.

<div align="center">

Table 2: Developed Drainage Basin Summary

Basin	Contributing Area (ft^2)			CN	Tc (min)
	Impervious CN = 98	Pervious CN = 74	TOTAL		
West	34203	22795	56998	88	5
East	178796	91198	269994	90	5

</div>

The total area draining to the west does not equal the predeveloped area draining to the west. This will be discussed in the next section, but is a function of grading the total site for accessibility.

EXPLANATION OF DESIGN

The propose site straddles two drainage basins, with a portion draining to the west while the majority drains to the east. The proposed design takes a portion of the proposed project to a facility located in the southwest corner of the property to be treated, detained and outlet to the west. Areas draining to the west include Buildings B, C, D, E, H, I, and M, the walkways in front of Building D, and the landscaped area surrounding Buildings C, D, and E. The remaining portion of the property will be routed to a stormwater facility located east of Snowline Street.

The culs-de-sac will be routed to the public system located east of Snowline Street (the east facility). This is done to keep all of the publicly generated stormwater together and routed to a public system. Routing the culs-de-sac to the west basin would require the west basin to also be a publicly maintained facility. By routing the runoff to the east facility, only one facility will need to be maintained by the public.

Because the proposed design is rerouting runoff that historically flows to the west to a different drainage basin, the east facility will be oversized to ensure the flowrate out does not exceed the predeveloped rate for the east basin. While more area will be draining to the east in the developed condition than in the predeveloped condition, the flowrate will not exceed the predeveloped flowrate.

The east facility will be designed for this project, including the construction of Snowline Street. Plans for the development of the remaining property are not known at this time. Because of this, the facility is

design for this project only. However, the facility could be expanded with a new flow control structure in the future to be used for future development.

Both the east and west facilities will be designed as combination facilities, with the treatment of the stormwater being achieved through the filtration through the growing media. The facilities will use above ground detention and a flow control structure to restrict the flow to less than or equal to the predeveloped rate for each basin.

STORMWATER ANALYSIS

Stormwater analysis was conducted using HydroCAD 10.20 and the Santa Barbara Unit Hydrograph. This analysis considers the water quality event as well as controlling the ½ the 2, 10, 25, and 100 year storm events to their predeveloped rates. Based on the region, these storms are modeled with the NRCS Type 1A rainfall distribution. The precipitation depths listed in the table below come from the City of Salem Stormwater Design Standards.

Table 3: City of Salem 24-hour Rainfall Depths (in)

Storm Event	24-hour Rainfall Depth (in)
Water Quality	1.38
1/2 - 2 year	1.1
10 year	3.2
25 year	3.6
100 year	4.4

Analysis was done for the west and east basins independently. The flow from each facility is designed to not exceed the predeveloped rate. Because infiltration is not considered in the preliminary design and to provide the most conservative preliminary design, storage is only considered above the growing media.

The table below shows the predeveloped flowrates calculated for both the west and east basins. Please note that these values are based on only the area impacted by this project. This means that the area of property left undeveloped has not been included in any of the analysis and is not artificially inflating the allowable runoff rate.

Table 4: Allowable Predeveloped Flowrate (cfs)

Storm Event	Basin	
	West	East
1/2 - 2 year	0.006	0.017
10 year	0.312	0.882
25 year	0.439	1.243
100 year	0.723	2.047

WATER QUALITY ANALYSIS

For the analysis of the water quality storm, treatment is assumed to be achieved to the City of Salem standards once the water infiltrates through the growing media. The infiltration rate through the growing media is assumed to be 2 inches per hour.

The west facility is modeled in the preliminary phase as 1,200 square feet, with the growing media at an elevation of 502.00. The east facility is modeled in the preliminary phase as 7,000 square feet, with the growing media at an elevation of 482.00. These elevations are preliminary and subject to change during the final design phase. It is likely that the east facility will require retaining walls do to the topography sloping down in this area. The west facility will likely need some retaining walls as well for the same reason. The slope in both of these areas exceeds 5% for the west and 8% to the east. These are the low points in both directions.

The table below gives a summary of the proposed facilities and the water depth modeled.

Table 5: Water Quality Summary

Basin	Facility Size (ft^2)	Growing Media Elevation	WQ Water Depth (feet)
West	1670	502.00	0.22
East	7000	482.00	0.51

Both facilities are able to treat the stormwater through the growing media.

WATER QUANTITY ANALYSIS

The west and east facilities are both design to detain the stormwater to the predeveloped rate for each basin. The east facility is designed for only the runoff generated from this project. The table below summarizes the facilities.

Table 6: Flow Control Summary

Basin		Storm Event	Predeveloped Flowrate (cfs)	Orifice #	Orifice Diameter	Orifice Elevation	Developed Flowrate (cfs)	Water Depth (ft)
Basin	West	1/2 - 2 year	0.006	1	0.3	502.00	0.003	1.42
		10 year	0.312	2	4.5	504.00	0.209	2.34
		25 year	0.439	2	4.5	504.00	0.287	2.47
		100 year	0.723	2	4.5	504.00	0.448	2.88
	East	1/2 - 2 year	0.017	1	0.3	482.00	0.003	1.91
		10 year	0.882	2	11	485.00	0.750	3.45
		25 year	1.243	2	11	485.00	1.061	3.55
		100 year	2.047	2	11	485.00	2.017	3.85

The maximum water depth for both facilities is less than 4 feet. The flows are able to be controlled to at or below the predeveloped flowrates for each basin. The east basin overdetains to allow for some of the area that historically drains to the west to flow to the east, without increasing the overall flowrate into the east basin.

OPERATION AND MAINTENANCE

Both facilities would include public stormwater and therefore would be the responsibility of the City of Salem to maintain. The facilities will be placed in easements for the City to access for maintenance. In the future, the east facility could be placed on its own parcel, but that is not proposed at this time, since the facility may be used in the future for additional stormwater and may need to get larger.

CONCLUSIONS

This report demonstrates a preliminary feasibility for the Compass Point Apartments. Additional design work will need to be done during the final design phase in order to more fulling comply with the City of Salem Design Standards. This will likely include acquiring design exceptions for the retaining walls that will likely be needed in the stormwater facilities and for redirecting some of the flow from the west basin to the east. If there are any questions, please contact Natalie Janney at NJanney@mtengineering.net.

APPENDIX A: MAPS

08 3W 14BD SALEM

MARION COUNTY, OREGON
SE1/4 NW1/4 SEC14 T8S R3W W.M.
SCALE 1" = 100'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
Road Right-of-Way	Easement
Railroad Right-of-Way	Railroad Centerline
Private Road ROW	Taxcode Line
Subdivision/Plat Bndry	Map Boundary
Waterline - Taxlot Bndry	Waterline - Non Bndry

CORNER TYPES

+ 1/16TH Section Cor.	1/4 Section Cor.
DLC Corner	16 15
	Section Corner
	21 22

NUMBERS

Tax Code Number
00 00 0

Acreage All acres listed are Net Acres, excluding any
0.25 AC portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the
labeled dimension extends into the public ROW

200.00
175.00

CANCELLED NUMBERS

300		
400		
500		
601		
801		

DISCLAIMER: THIS MAP WAS PREPARED
FOR ASSESSMENT PURPOSES ONLY

Assessors Office Cartography Dept
OREGON

FOR ADDITIONAL MAPS VISIT OUR WEBSITE AT
www.co.marion.or.us

PLOT DATE: 10/16/2020

SALEM
08 3W 14BD

--- Map body labels ---

HARLANDALE AVE

SEE MAP 083W14BA

SEE MAP 083W14AB

SNOWFLAKE ST

SNOWBALL AVE

SNOWFLAKE ST

1/16 COR

KILGORE HTS. A REPLAT

KILGORE HTS.

2200 2400 200 100
2300 4.78 AC 5.98 AC
2100 2500
2000 30
1900 SNOWBALL AVENUE
1800 2600 2700 2800
1700 3100 3000 2900
1600 3800 TR 'A' 1' RES. STRIP
1500 MAC STREET SE ABBIE AVE
1400 3900 TR 'B' 1' RES. STRIP
1300 HEIGHTS 3200 3400
1200 3300
1100 3700 3600 3500

SEE MAP 083W14BC

24 01 0

GRABENHORST NO. 1

24 01 0

NOTE - REMAINDER OF THIS PARCEL ON MAP 08 3W 14BA

ROAD SE

BAXTER ROAD SE (CR 827)

BAXTER

600 800 900 1000 1001
1.65 AC 0.89 AC 4.39 AC PARCEL 1 PARCEL 2
10.90 AC 0.59 AC

FRUIT FARMS

P.P. 1990-66

700
0.75 AC

STREET (HWY 99E)

SUGAR PLUM ST SE

SNOWFLAKE ST

LAVONNE AVE SE

1/16 COR

SEE MAP 083W14CB

SEE MAP 083W14CA

CTR SEC

SEE MAP 083W14DB

SEE MAP 083W14AC

Pre-developed Basin Map

EXISTING CONDITIONS PLAN

COMPASS POINTS MULTI-FAMILY HOUSING

Basin	Contributing Area (ft²)			CN	Tc (min)
	Impervious	Pervious	Predeveloped		
	CN = 98	CN = 74	CN = 72		
West			84,918	72	26.45
East			240,403	72	30.35

WEST

EAST

L = 300 ft
S = (516-506.7)/300 = 0.031 ft/ft

L = 88 ft
S = (506.7-502)/88 = 0.053 ft/ft

L = 300 ft
S = (518-505)/300 = 0.037 ft/ft

L = 350 ft
S = (505-477)/350 = 0.08 ft/ft

EX. HOUSE

EX. SHOP

EX. POLE BARN

LOT 43
GRABENHORST FRUIT FARMS No.
S04-009, MCSR
1.78 ACRES

4 AND PART OF 2
GRABENHORST FRUIT FARMS No.
1
S04-009, MCSR
5.98 ACRES

GEELAN, DONALD C
& GEELAN, SUSAN M
1640 BARNES AVE SE
SALEM, OR. 97306

HAMLIN, JASON
& HAMLIN, KACEY K
1700 BARNES AVE SE
SALEM, OR. 97306

PATEL, MANUBHAI
& PATEL, MANNA M
1760 BARNES AVE SE
SALEM, OR. 97306

KILGORE HEIGHTS
V. 45, P. 42, MCSR

BAXTER ADDITION
V. 44, P. 32, MCSR

SHILOH ST.

SNOWBALL AV.

SNOWFLAKE ST.

ABBIE AV.

MAC ST.

BAXTER RD.

EX. WATER
& PIPELINE
EASEMENT

TO BE
VACATED

SCALE: 1" = 50'

Design: M.D.G.
Drawn: J.P.H.
Checked: B.M.G.
Issue Date: 9/13/24
Scale: AS SHOWN
As-Built: -----

EXPIRES: 06-30-2025

JOB # 7707

SDR2

N89°53'46"E 330.29'
S89°49'41"E 165.33'
N89°59'22"W 660.67'
N0°02'58"E 318.61
S0°06'57"W 319.79

Post-Developed Basin Map

SCALE: 1" = 30'
1 INCH = 30'

Basin	Contributing Area (ft²)			CN	Tc (min)
	Impervious CN = 98	Pervious CN = 74	TOTAL		
West	34203	22795	56998	88	5
East	178796	91198	269994	90	5

WEST

EAST

Basin	Storm Event	Predeveloped Flowrate (cfs)	Orifice #	Orifice Diameter	Orifice Elevation	Developed Flowrate (cfs)	Water Depth (ft)
West	1/2 - 2 year	0.006	1	0.3	502.00	0.003	1.42
	10 year	0.312	2	4.5	504.00	0.209	2.34
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	100 year	0.723	2	4.5	504.00	0.448	2.88
East	1/2 - 2 year	0.017	1	0.3	482.00	0.003	1.91
	10 year	0.882	2	11	485.00	0.750	3.45
	25 year	1.243	2	11	485.00	1.061	3.55
	100 year	2.047	2	11	485.00	2.017	3.85

BLD. F   F.F. 506.25
BLD. G   F.F. 505.00
BLD. H   F.F. 505.00   F.F. 507.00
BLD. E   F.F. 508.25
BLD. I   F.F. 506.00   F.F. 504.00   F.F. 503.25
BLD. M   F.F. 506.20   CLUBHOUSE
BLD. D   F.F. 506.25   F.F. 507.75
BLD. C   F.F. 507.25   F.F. 506.25
BLD. B   F.F. 504.75   F.F. 502.75
BLD. A   F.F. 501.00   F.F. 499.00

WATER PUMP STATION
SPORT COURT
STORMWATER QUALITY FACILITY
S.D. EASEMENT

SNOWBALL AV.
ABBIE AV.
BAXTER RD.
SNOWLINE ST.

KILGORE HEIGHTS, V. 45, P. 42, MCSR
BAXTER ADDITION V. 44, P. 32, MCSR

LOT 14, LOT 15, LOT 16, LOT 17, LOT 18, LOT 19, LOT 20, LOT 23, LOT 24, LOT 25, LOT 27

GRADING PLAN

BAXTER DEVELOPMENT

Design: M.D.G.
Drawn: J.P.H.
Checked: B.M.G.
Issue Date: 12/18/24
Scale: AS SHOWN

EXPIRES: 06-30-2025

JOB # 7707

SDR6

APPENDIX B: SOIL INFORMATION

Soil Map—Marion County Area, Oregon

Snowbell Ave SE

NeC

NeB

Map Scale: 1:1,670 if printed on A landscape (11" x 8.5") sheet.

Soil Map may not be valid at this scale.

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

N

Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

USDA

MAP LEGEND

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

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

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

Spoil Area
Stony Spot
Very Stony Spot
Wet Spot
Other
Special Line Features

Water Features
Streams and Canals

Transportation
Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background
Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023

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

Date(s) aerial images were photographed: May 17, 2023—Jun 3, 2023

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

Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

6/28/2024
Page 2 of 3

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NeB	Nekia silty clay loam, 2 to 7 percent slopes	3.9	41.0%
NeC	Nekia silty clay loam, 7 to 12 percent slopes	5.7	59.0%
Totals for Area of Interest		**9.6**	**100.0%**

Marion County Area, Oregon

NeB—Nekia silty clay loam, 2 to 7 percent slopes

Map Unit Setting
National map unit symbol: 24qt
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Nekia and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting
Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile
H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities
Slope: 2 to 7 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.2 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R002XC012OR - Red Hill Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)

Other vegetative classification: Well drained < 15% Slopes
(G002XY002OR)
Hydric soil rating: No

Minor Components

Aquults

Percent of map unit: 2 percent
Landform: Hills
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023

Marion County Area, Oregon

NeC—Nekia silty clay loam, 7 to 12 percent slopes

Map Unit Setting
National map unit symbol: 24qv
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Nekia and similar soils: 86 percent
Minor components: 2 percent
*Estimates are based on observations, descriptions, and transects of
the mapunit.*

Description of Nekia

Setting
Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile
H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities
Slope: 7 to 12 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
*Capacity of the most limiting layer to transmit water
(Ksat):* Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.2 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R002XC012OR - Red Hill Group
Forage suitability group: Well drained < 15% Slopes
(G002XY002OR)

Other vegetative classification: Well drained < 15% Slopes
(G002XY002OR)
Hydric soil rating: No

Minor Components

Aquults
Percent of map unit: 2 percent
Landform: Hills
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023

APPENDIX C: TIME OF CONCENTRATION

Worksheet 3: Time of Concentration (T_c) or travel time (T_t)

Project Compass Points Apartments	By N. Janney	Date 9/16/2024
Location Baxter Road, Salem, Oregon	Checked	Date

Check one: ☒ Present ☐ Developed

Check one: ☒ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID	East	West	
1.	Surface description (table 3-1)	Pre-developed	Pre-developed	
2.	Manning's roughness coefficient, n (table 3-1)	0.15	0.15	
3.	Flow length, L (total L † 300 ft) .... ft	300	300	
4.	Two-year 24-hour rainfall, P_2 .... in	2.2	2.2	
5.	Land slope, s .... ft/ft	0.037	0.031	
6.	$T_t = \dfrac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t .... hr	0.370	0.398	=

Shallow concentrated flow

	Segment ID	East	West	
7.	Surface description (paved or unpaved)	Pre-developed	Pre-developed	
8.	Flow length, L ....ft	350	88	
9.	Watercourse slope, s .... ft/ft	0.080	0.053	
10.	Average velocity, V (figure 3-1) .... ft/s	0.72	0.57	
11.	$T_t = \dfrac{L}{3600\ V}$ Compute T_t .... hr	0.135	0.042	=

Channel flow

	Segment ID			
12.	Cross sectional flow area, a .... ft²			
13.	Wetted perimeter, p_w .... ft			
14.	Hydraulic radius, $r = \dfrac{a}{p_w}$ Compute r .... ft			
15	Channel slope, s .... ft/ft			
16.	Manning's roughness coefficient, n			
17.	$V = \dfrac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ....ft/s			
18.	Flow length, L .... ft			
19.	$T_t = \dfrac{L}{3600\ V}$ Compute T_t .... hr		+	=
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) .... Hr			

T(east) = 0.370 + 0.135 = 0.505 hours =
30.35 min

T(west) = 0.398 + 0.0.42 = 0.0.440 hours =
26.45 min

APPENDIX D: WATER QUALITY HYDROGRAPHS
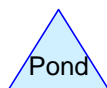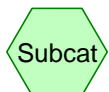
W-WQ
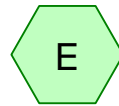
West - WQ

W

West - POST

E

East - POST

E-WQ

East - WQ

Subcat Reach Pond Link

Prelim Hydrographs 121424
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Type IA 24-hr Water Quality Rainfall=1.38"
Printed 12/20/2024
Page 2

Summary for Subcatchment E: East - POST

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

Runoff   =   1.231 cfs @   7.91 hrs, Volume=   0.417 af, Depth= 0.81"
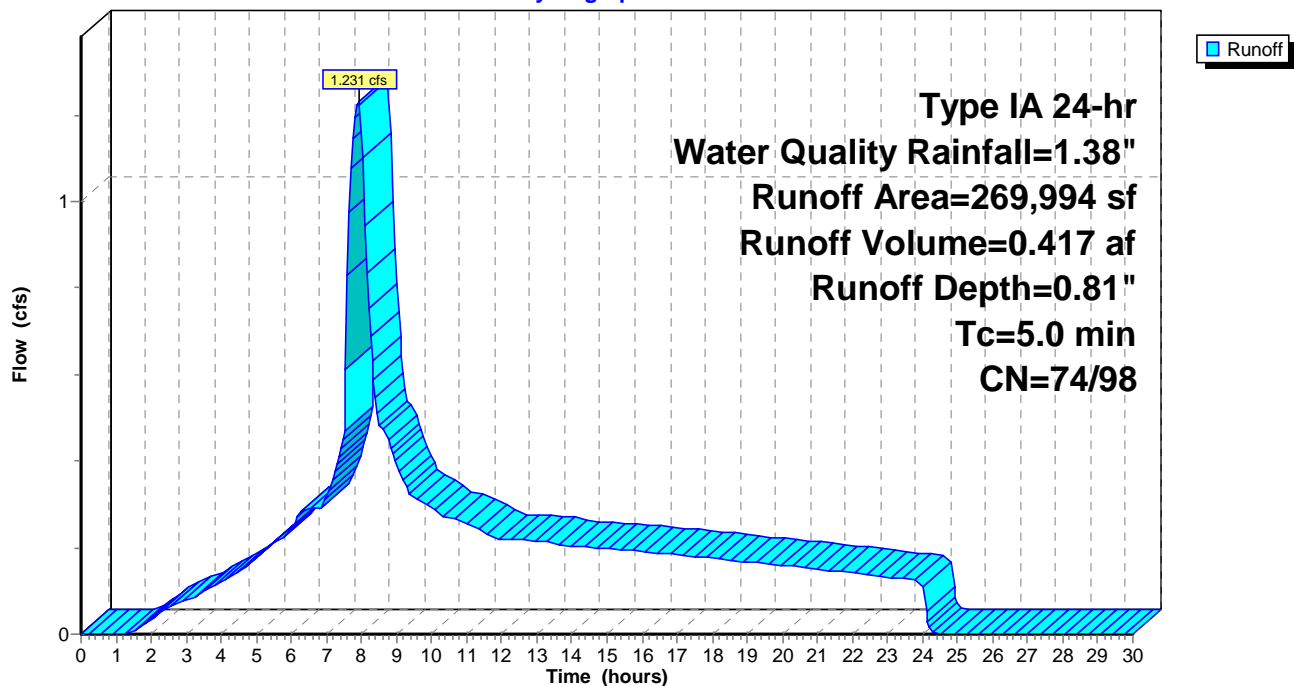   Routed to Pond E-WQ : East - WQ

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr Water Quality Rainfall=1.38"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Hydrograph

Type IA 24-hr
Water Quality Rainfall=1.38"
Runoff Area=269,994 sf
Runoff Volume=0.417 af
Runoff Depth=0.81"
Tc=5.0 min
CN=74/98

Prelim Hydrographs 121424
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Type IA 24-hr Water Quality Rainfall=1.38"
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Page 3

Summary for Subcatchment W: West - POST

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

Runoff   =   0.224 cfs @   7.91 hrs, Volume=   0.079 af, Depth= 0.72"
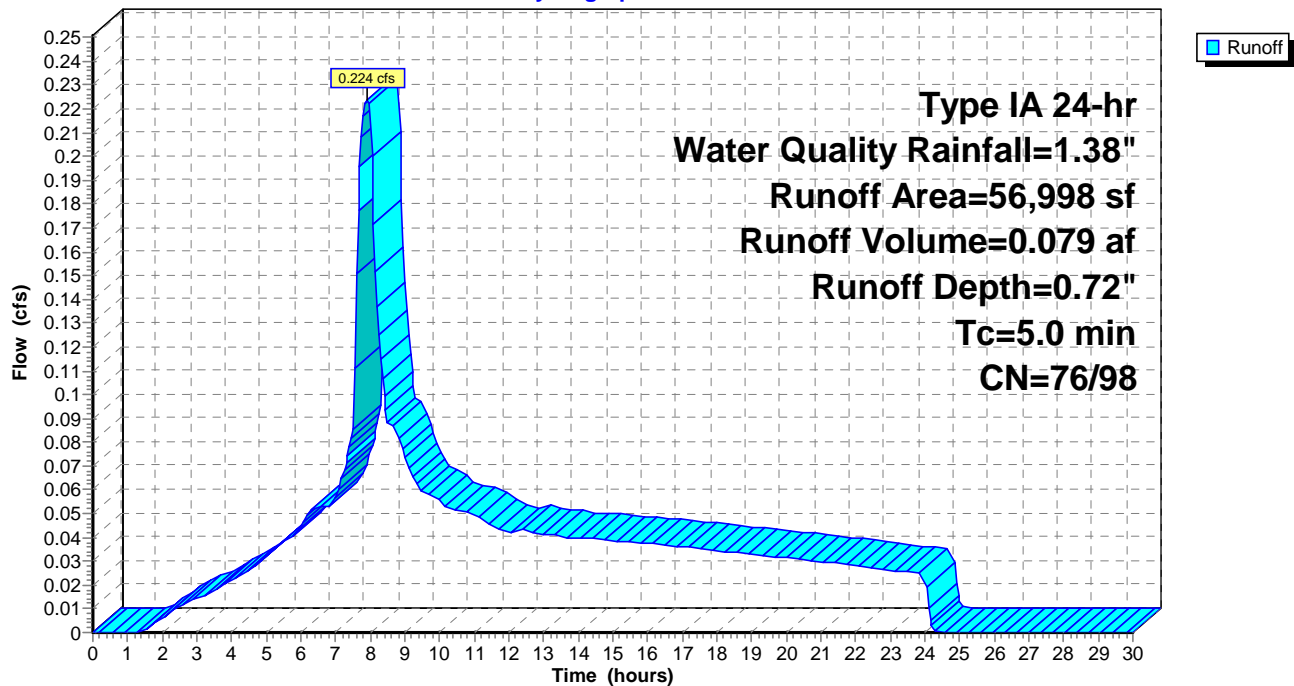   Routed to Pond W-WQ : West - WQ

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr Water Quality Rainfall=1.38"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

Hydrograph

Type IA 24-hr
Water Quality Rainfall=1.38"
Runoff Area=56,998 sf
Runoff Volume=0.079 af
Runoff Depth=0.72"
Tc=5.0 min
CN=76/98

Summary for Pond E-WQ: East - WQ

[92] Warning: Device #2 is above defined storage

Inflow Area =   6.198 ac, 66.22% Impervious, Inflow Depth = 0.81"   for Water Quality event
Inflow   =   1.231 cfs @   7.91 hrs, Volume=   0.417 af
Outflow   =   0.324 cfs @   7.65 hrs, Volume=   0.416 af, Atten= 74%, Lag= 0.0 min
Discarded =   0.324 cfs @   7.65 hrs, Volume=   0.416 af
Primary   =   0.000 cfs @   0.00 hrs, Volume=   0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 482.51' @ 9.38 hrs   Surf.Area= 7,000 sf   Storage= 3,597 cf

Plug-Flow detention time= 111.3 min calculated for 0.416 af (100% of inflow)
Center-of-Mass det. time= 111.4 min (824.7 - 713.4)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	28,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	7,000	0	0
486.00	7,000	28,000	28,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	482.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Primary	503.00'	**18.0" Horiz. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads

Discarded OutFlow Max=0.324 cfs @ 7.65 hrs HW=482.22'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.324 cfs)

Primary OutFlow Max=0.000 cfs @ 0.00 hrs HW=482.00'   (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.000 cfs)

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Type IA 24-hr Water Quality Rainfall=1.38"
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Page 5

Pond E-WQ: East - WQ

Hydrograph
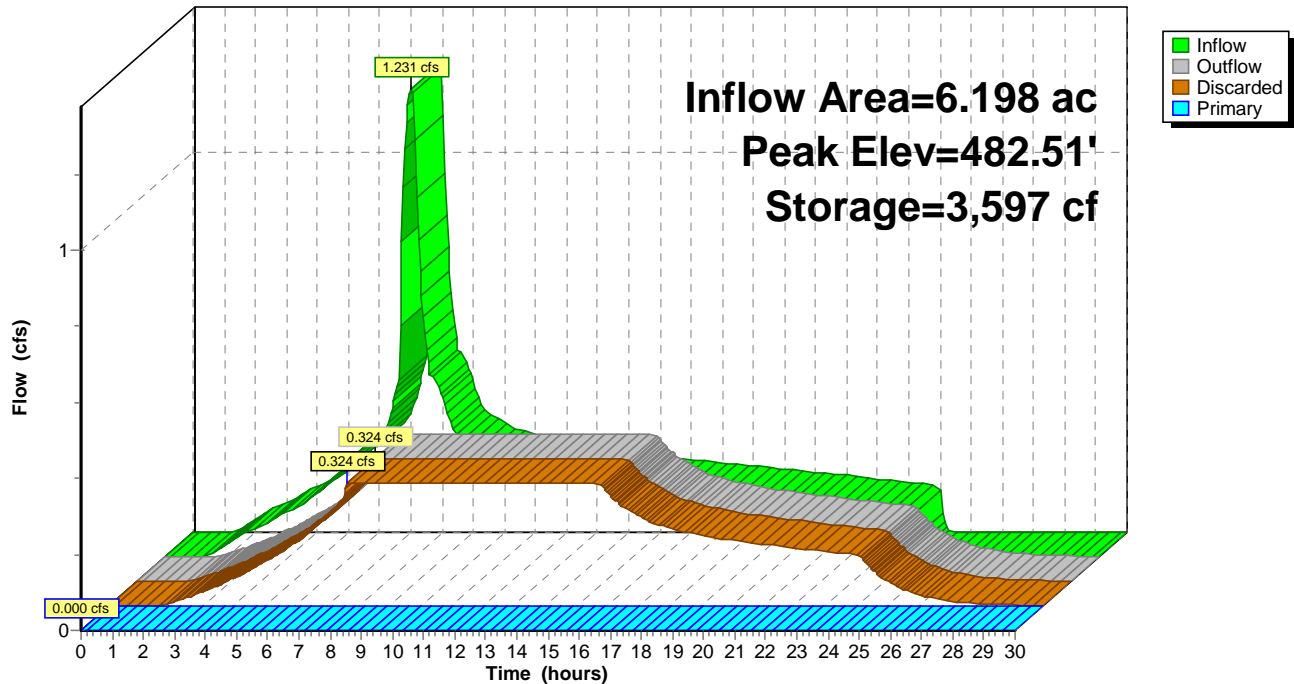
Inflow Area=6.198 ac
Peak Elev=482.51'
Storage=3,597 cf

Legend:
- Inflow
- Outflow
- Discarded
- Primary

1.231 cfs
0.324 cfs
0.324 cfs
0.000 cfs

Flow (cfs)

Time (hours)

Summary for Pond W-WQ: West - WQ

Inflow Area =   1.308 ac, 57.08% Impervious, Inflow Depth = 0.72"   for Water Quality event
Inflow   =   0.224 cfs @   7.91 hrs, Volume=   0.079 af
Outflow   =   0.077 cfs @   7.55 hrs, Volume=   0.079 af, Atten= 65%, Lag= 0.0 min
Discarded =   0.077 cfs @   7.55 hrs, Volume=   0.079 af
Primary   =   0.000 cfs @   0.00 hrs, Volume=   0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 502.22' @ 8.93 hrs   Surf.Area= 1,670 sf   Storage= 364 cf

Plug-Flow detention time= 27.3 min calculated for 0.079 af (100% of inflow)
Center-of-Mass det. time= 27.3 min (751.5 - 724.1)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	5,010 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,670	0	0
505.00	1,670	5,010	5,010

Device	Routing	Invert	Outlet Devices
#1	Discarded	502.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Primary	503.00'	**18.0" Horiz. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads

Discarded OutFlow Max=0.077 cfs @ 7.55 hrs HW=502.03' (Free Discharge)
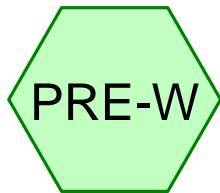└─**1=Exfiltration** (Exfiltration Controls 0.077 cfs)

Primary OutFlow Max=0.000 cfs @ 0.00 hrs HW=502.00' (Free Discharge)
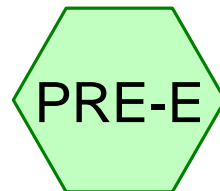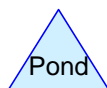└─**2=Orifice/Grate** (Controls 0.000 cfs)

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Type IA 24-hr Water Quality Rainfall=1.38"
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Pond W-WQ: West - WQ

Hydrograph

Inflow Area=1.308 ac
Peak Elev=502.22'
Storage=364 cf

Legend:
- Inflow
- Outflow
- Discarded
- Primary

0.224 cfs
0.077 cfs
0.077 cfs
0.000 cfs

Flow (cfs)

Time (hours)
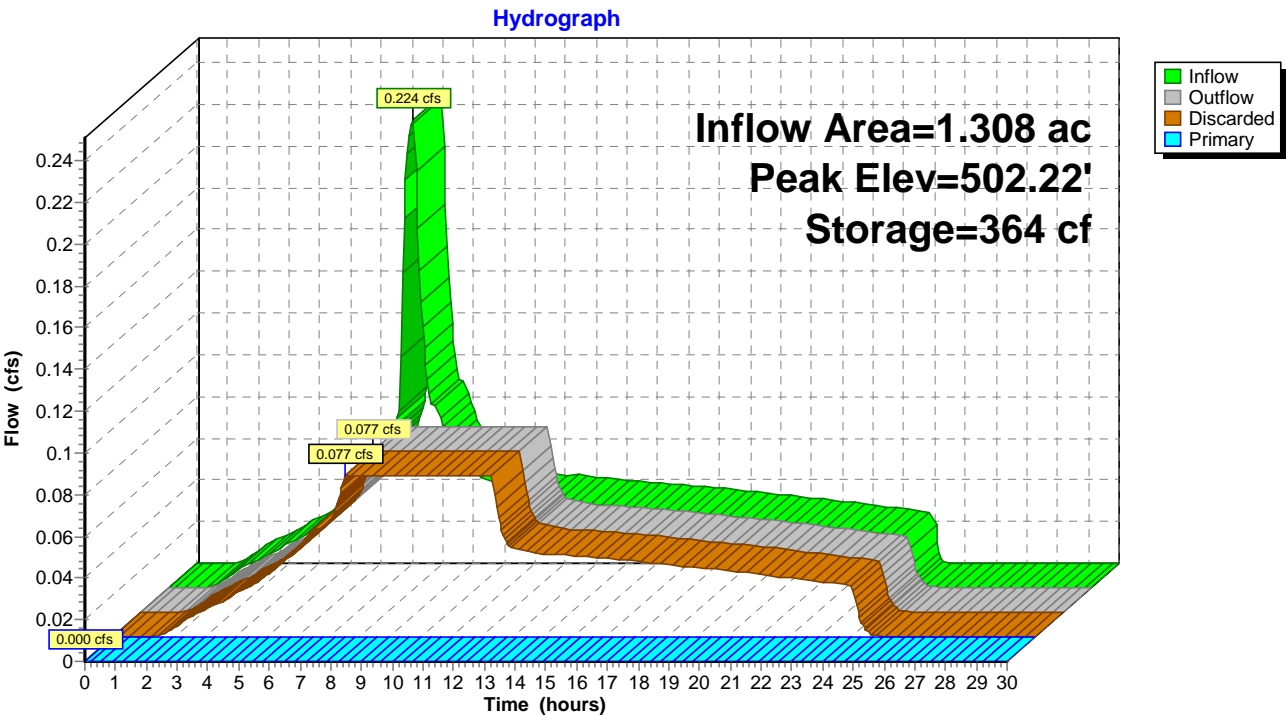
APPENDIX E: PREDEVELOPED HYDROGRAPHS
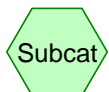
PRE-W

West - PRE

PRE-E

East - PRE

Subcat   Reach   Pond   Link

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1/2 - 2 year	Type IA 24-hr		Default	24.00	1	1.10	2
2	10 year	Type IA 24-hr		Default	24.00	1	3.20	2
3	25 year	Type IA 24-hr		Default	24.00	1	3.60	2
4	100 year	Type IA 24-hr		Default	24.00	1	4.40	2

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Type IA 24-hr 1/2 - 2 year Rainfall=1.10"
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Page 3

Summary for Subcatchment PRE-E: East - PRE

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

Runoff   =   0.017 cfs @   22.60 hrs, Volume=   0.011 af, Depth= 0.02"

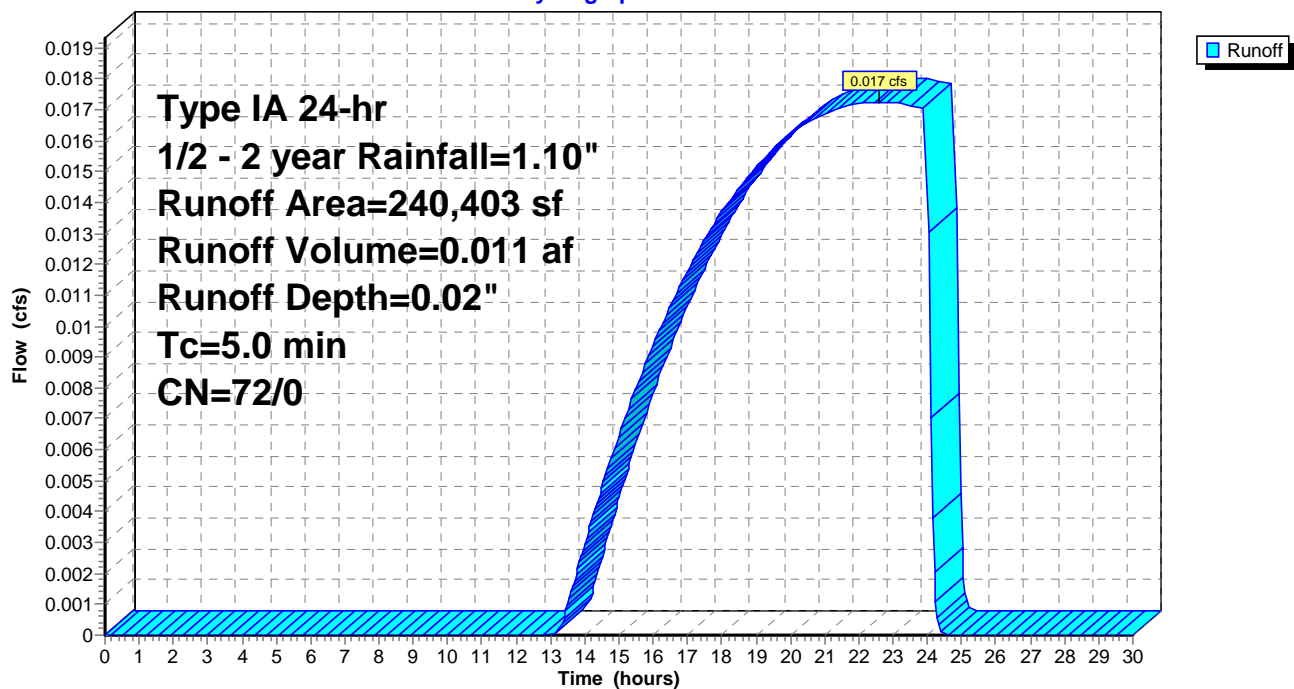Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

	Area (sf)	CN	Description
*	240,403	72	City of Salem, Predeveloped HSG C
	240,403	72	100.00% Pervious Area

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

Subcatchment PRE-E: East - PRE

Hydrograph

Type IA 24-hr
1/2 - 2 year Rainfall=1.10"
Runoff Area=240,403 sf
Runoff Volume=0.011 af
Runoff Depth=0.02"
Tc=5.0 min
CN=72/0

Summary for Subcatchment PRE-W: West - PRE

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

Runoff   =   0.006 cfs @   22.60 hrs, Volume=   0.004 af, Depth= 0.02"

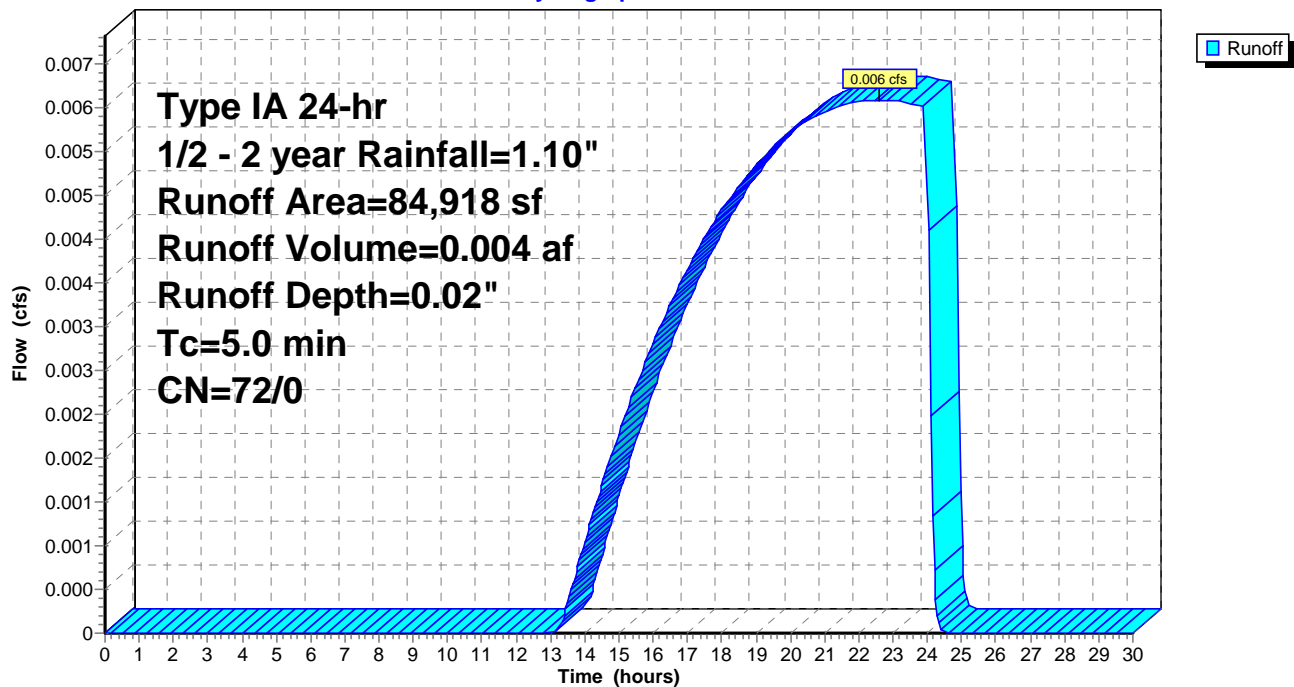Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

	Area (sf)	CN	Description
*	84,918	72	City of Salem, Predeveloped HSG C
	84,918	72	100.00% Pervious Area

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

Subcatchment PRE-W: West - PRE

Hydrograph

Type IA 24-hr
1/2 - 2 year Rainfall=1.10"
Runoff Area=84,918 sf
Runoff Volume=0.004 af
Runoff Depth=0.02"
Tc=5.0 min
CN=72/0

0.006 cfs

Runoff

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Type IA 24-hr 10 year Rainfall=3.20"
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Summary for Subcatchment PRE-E: East - PRE

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

Runoff   =   0.882 cfs @   8.00 hrs, Volume=   0.428 af, Depth= 0.93"

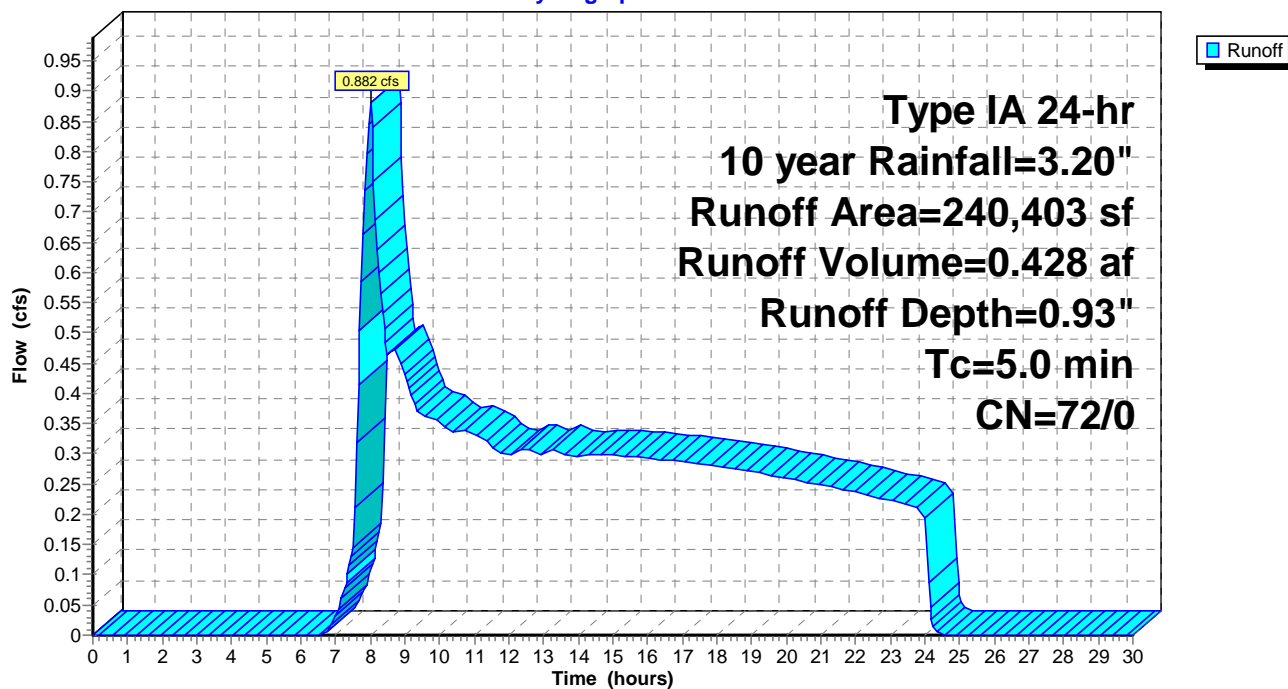Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.20"

	Area (sf)	CN	Description
*	240,403	72	City of Salem, Predeveloped HSG C
	240,403	72	100.00% Pervious Area

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

Subcatchment PRE-E: East - PRE

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Type IA 24-hr 10 year Rainfall=3.20"
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Summary for Subcatchment PRE-W: West - PRE

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

Runoff   =   0.312 cfs @   8.00 hrs, Volume=   0.151 af, Depth= 0.93"

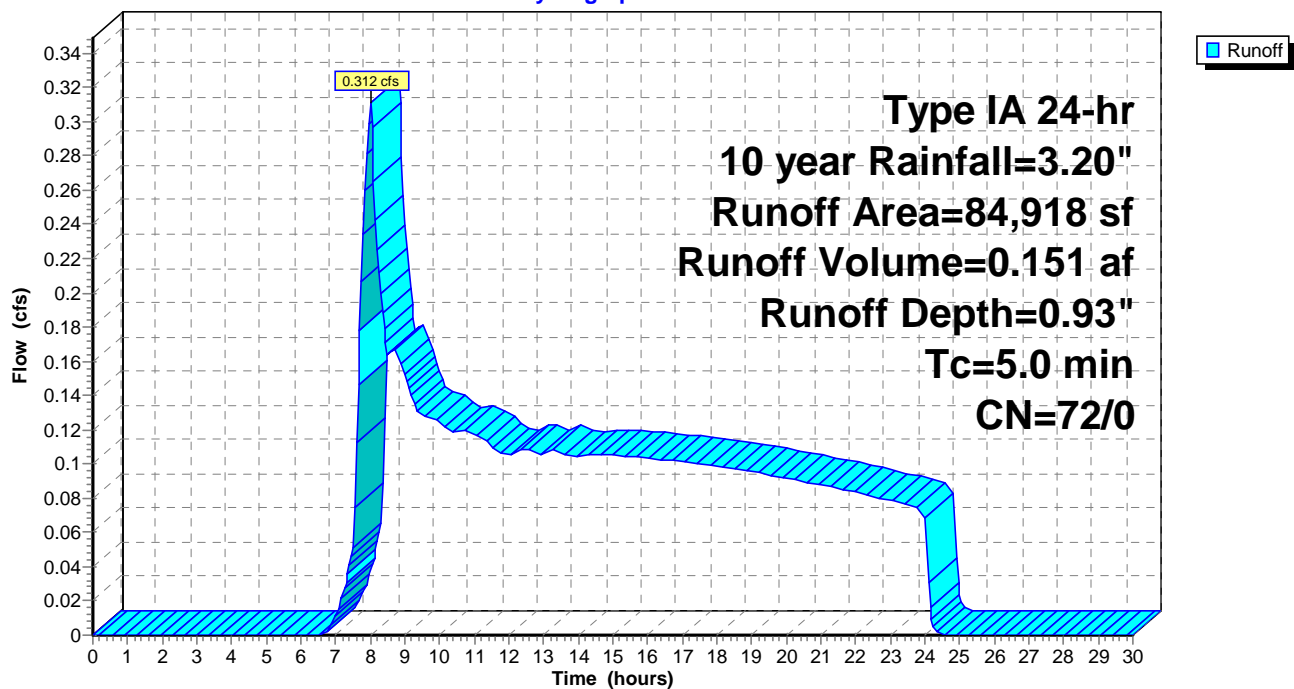Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.20"

	Area (sf)	CN	Description
*	84,918	72	City of Salem, Predeveloped HSG C
	84,918	72	100.00% Pervious Area

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

Subcatchment PRE-W: West - PRE

Hydrograph

Type IA 24-hr
10 year Rainfall=3.20"
Runoff Area=84,918 sf
Runoff Volume=0.151 af
Runoff Depth=0.93"
Tc=5.0 min
CN=72/0

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Type IA 24-hr 25 year Rainfall=3.60"
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Page 7

Summary for Subcatchment PRE-E: East - PRE

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

Runoff   =   1.243 cfs @   7.99 hrs, Volume=   0.546 af, Depth= 1.19"

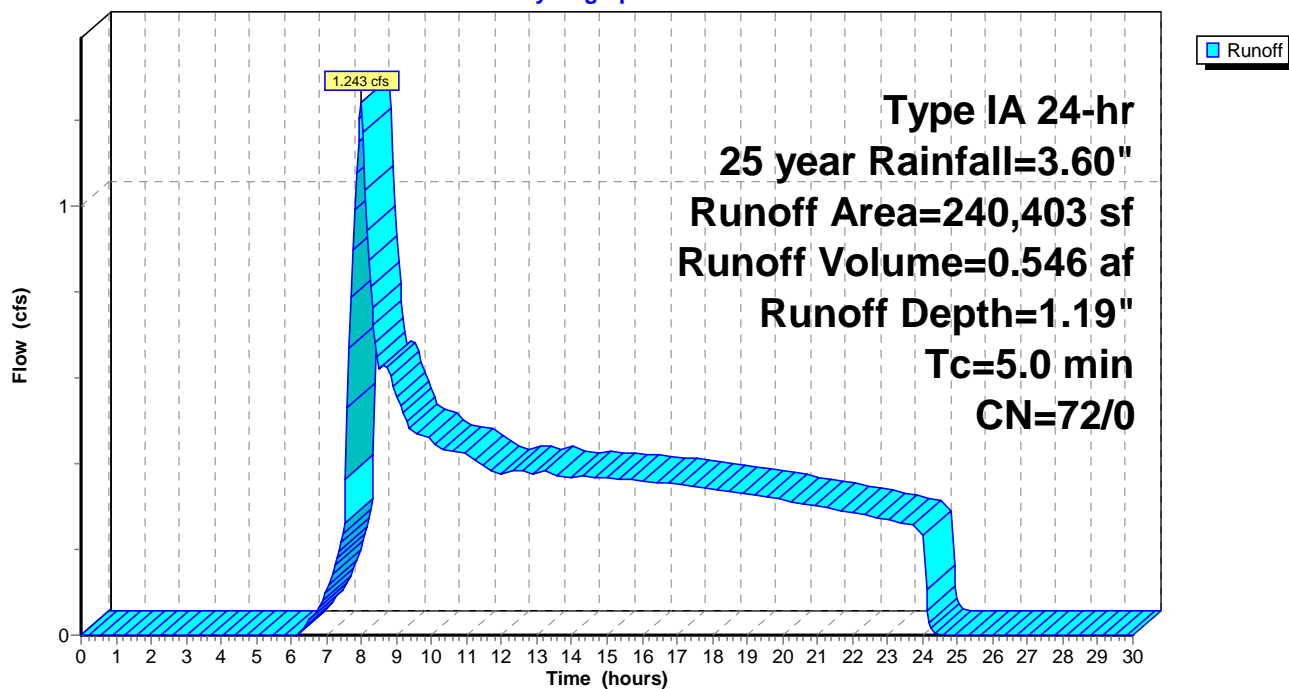Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.60"

	Area (sf)	CN	Description
*	240,403	72	City of Salem, Predeveloped HSG C
	240,403	72	100.00% Pervious Area

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

Subcatchment PRE-E: East - PRE

Hydrograph

Type IA 24-hr
25 year Rainfall=3.60"
Runoff Area=240,403 sf
Runoff Volume=0.546 af
Runoff Depth=1.19"
Tc=5.0 min
CN=72/0

1.243 cfs

Prelim Hydrographs 121424
Type IA 24-hr 25 year Rainfall=3.60"
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Summary for Subcatchment PRE-W: West - PRE

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

Runoff   =   0.439 cfs @   7.99 hrs, Volume=   0.193 af, Depth= 1.19"

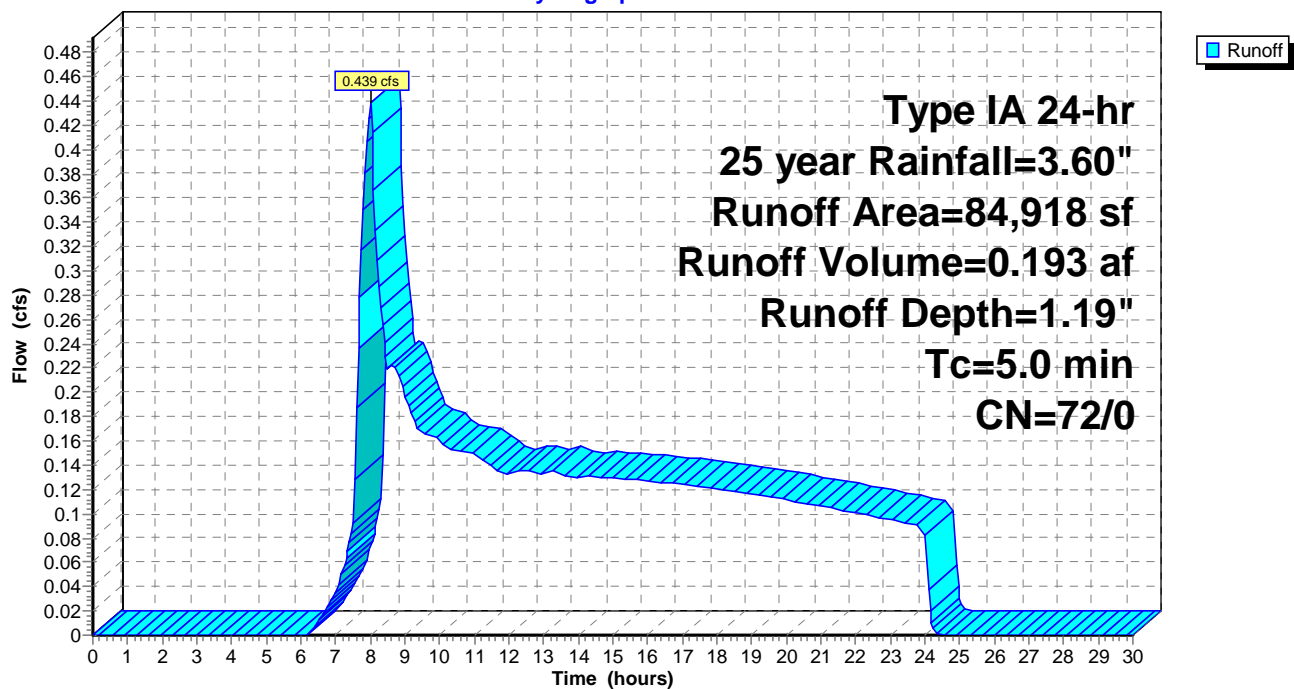Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.60"

	Area (sf)	CN	Description
*	84,918	72	City of Salem, Predeveloped HSG C
	84,918	72	100.00% Pervious Area

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

Subcatchment PRE-W: West - PRE

Hydrograph

Type IA 24-hr
25 year Rainfall=3.60"
Runoff Area=84,918 sf
Runoff Volume=0.193 af
Runoff Depth=1.19"
Tc=5.0 min
CN=72/0

Prelim Hydrographs 121424
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Type IA 24-hr 100 year Rainfall=4.40"
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Summary for Subcatchment PRE-E: East - PRE
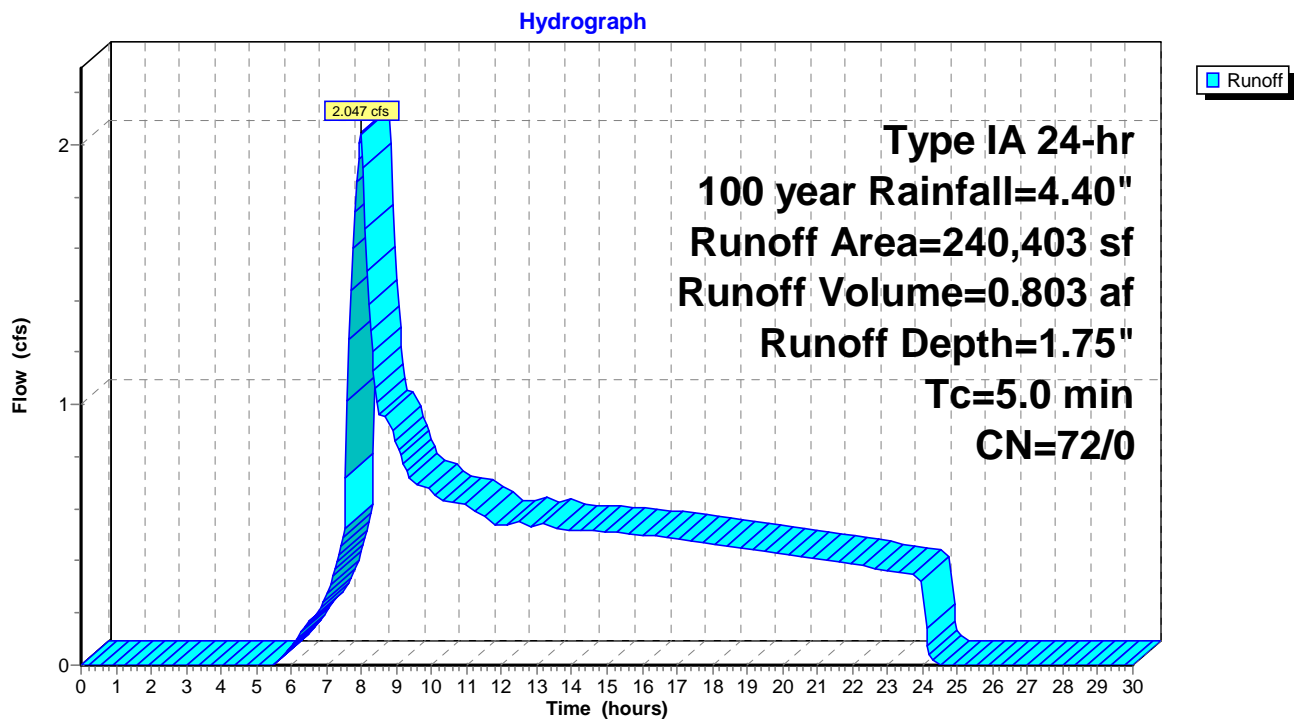
[49] Hint: Tc<2dt may require smaller dt

Runoff   =   2.047 cfs @   7.99 hrs, Volume=   0.803 af, Depth= 1.75"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year Rainfall=4.40"

	Area (sf)	CN	Description
*	240,403	72	City of Salem, Predeveloped HSG C
	240,403	72	100.00% Pervious Area

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

Subcatchment PRE-E: East - PRE

Hydrograph

Type IA 24-hr
100 year Rainfall=4.40"
Runoff Area=240,403 sf
Runoff Volume=0.803 af
Runoff Depth=1.75"
Tc=5.0 min
CN=72/0

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Type IA 24-hr 100 year Rainfall=4.40"
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Summary for Subcatchment PRE-W: West - PRE

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

Runoff   =   0.723 cfs @   7.99 hrs, Volume=   0.284 af, Depth= 1.75"

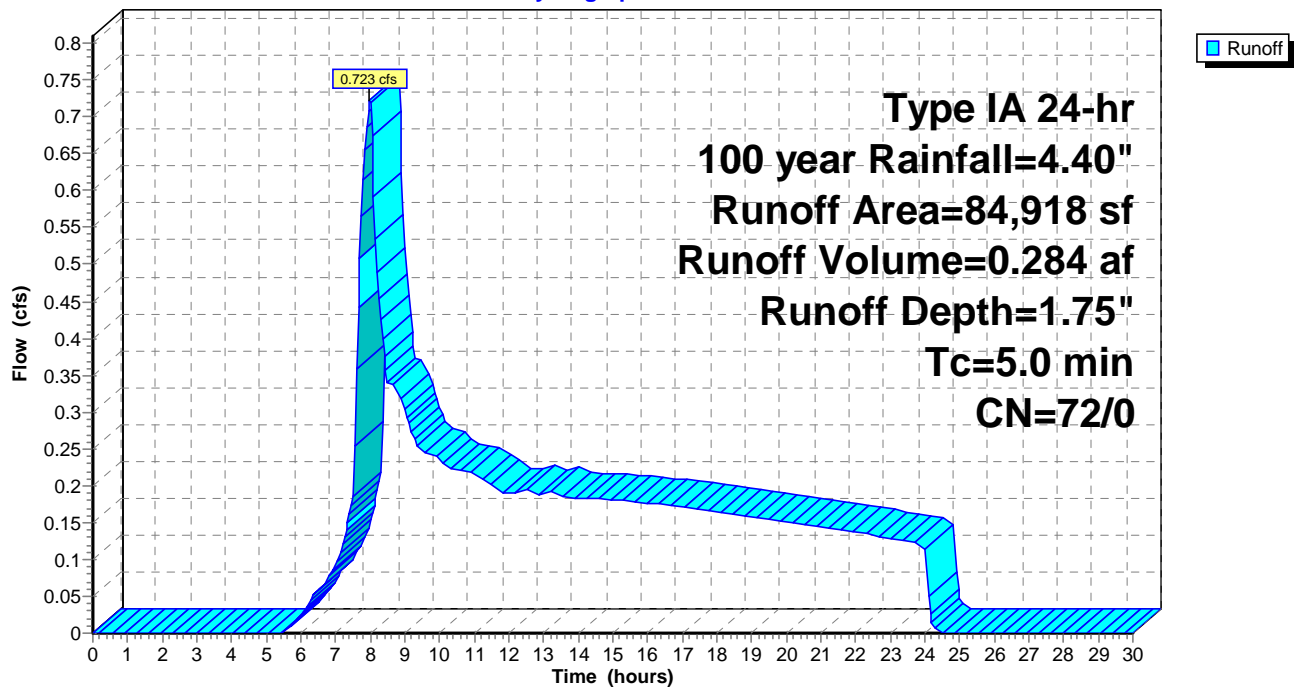Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year Rainfall=4.40"

	Area (sf)	CN	Description
*	84,918	72	City of Salem, Predeveloped HSG C
	84,918	72	100.00% Pervious Area

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

Subcatchment PRE-W: West - PRE

**Type IA 24-hr
100 year Rainfall=4.40"
Runoff Area=84,918 sf
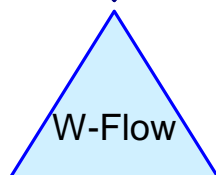Runoff Volume=0.284 af
Runoff Depth=1.75"
Tc=5.0 min
CN=72/0**

APPENDIX F: WATER QUANTITY HYDROGRAPHS
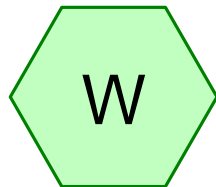
W
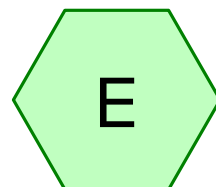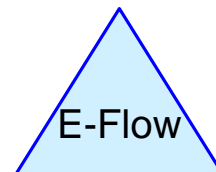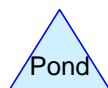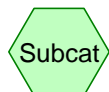
West - POST

W-Flow

West

E

East - POST

E-Flow

East

Subcat   Reach   Pond   Link

Prelim Hydrographs 121424
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"
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Summary for Subcatchment E: East - POST

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

Runoff   =   0.944 cfs @   7.92 hrs, Volume=   0.311 af, Depth= 0.60"
     Routed to Pond E-Flow : East

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Type IA 24-hr
1/2 - 2 year Rainfall=1.10"
Runoff Area=269,994 sf
Runoff Volume=0.311 af
Runoff Depth=0.60"
Tc=5.0 min
CN=74/98

Summary for Pond E-Flow: East

Inflow Area =   6.198 ac, 66.22% Impervious, Inflow Depth =   0.60"   for 1/2 - 2 year event
Inflow   =   0.944 cfs @   7.92 hrs, Volume=   0.311 af
Outflow   =   0.003 cfs @ 24.31 hrs, Volume=   0.006 af, Atten= 100%, Lag= 983.4 min
Primary   =   0.003 cfs @ 24.31 hrs, Volume=   0.006 af
Secondary =   0.000 cfs @   0.00 hrs, Volume=   0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 483.91' @ 24.31 hrs   Surf.Area= 7,000 sf   Storage= 13,359 cf

Plug-Flow detention time= 956.7 min calculated for 0.006 af (2% of inflow)
Center-of-Mass det. time= 415.0 min (1,133.4 - 718.4)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	28,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	7,000	0	0
486.00	7,000	28,000	28,000

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	**0.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	485.00'	**11.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.003 cfs @ 24.31 hrs HW=483.91' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.003 cfs @ 6.65 fps)

Secondary OutFlow Max=0.000 cfs @ 0.00 hrs HW=482.00' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.000 cfs)

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Type IA 24-hr 1/2 - 2 year Rainfall=1.10"
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Pond E-Flow: East

Hydrograph

Inflow Area=6.198 ac
Peak Elev=483.91'
Storage=13,359 cf

Legend:
- Inflow
- Outflow
- Primary
- Secondary

0.944 cfs
0.003 cfs
0.003 cfs
0.000 cfs

Flow (cfs)
Time (hours)
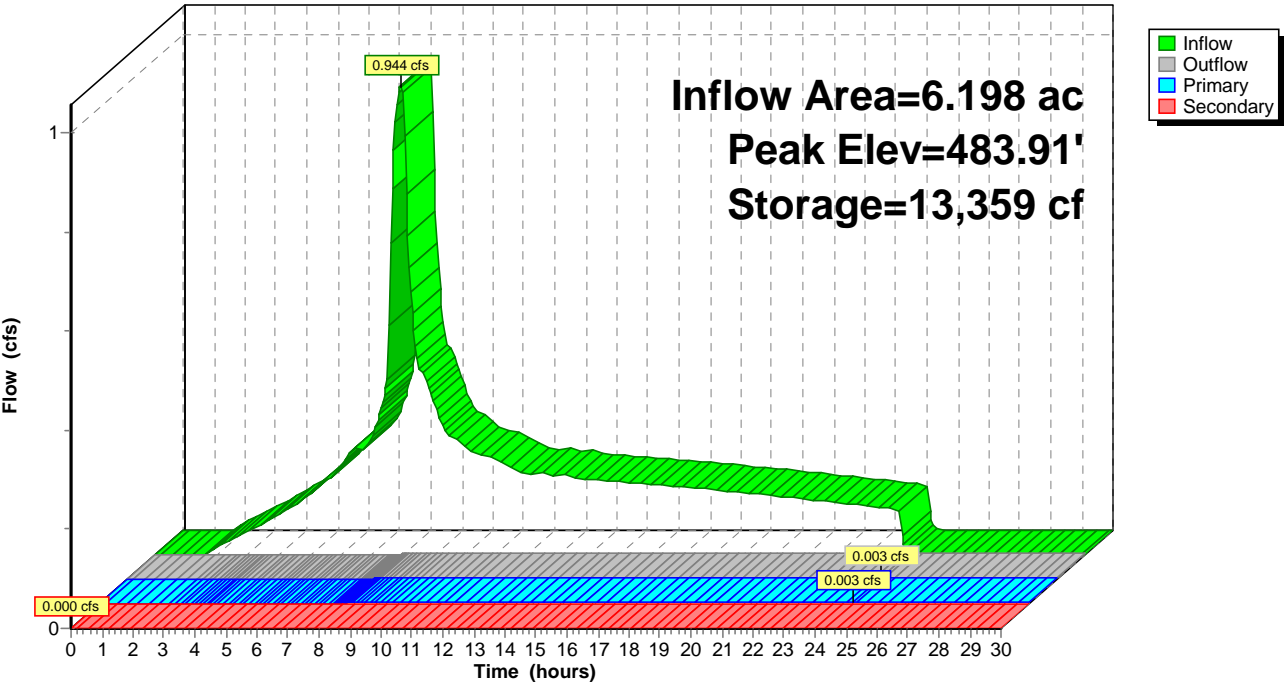
Prelim Hydrographs 121424
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Type IA 24-hr 1/2 - 2 year Rainfall=1.10"
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Page 3

Summary for Subcatchment W: West - POST

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

Runoff   =   0.172 cfs @   7.92 hrs, Volume=   0.058 af, Depth= 0.53"
    Routed to Pond W-Flow : West

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

Hydrograph

Type IA 24-hr
1/2 - 2 year Rainfall=1.10"
Runoff Area=56,998 sf
Runoff Volume=0.058 af
Runoff Depth=0.53"
Tc=5.0 min
CN=76/98

Summary for Pond W-Flow: West

Inflow Area =   1.308 ac, 57.08% Impervious, Inflow Depth = 0.53"   for 1/2 - 2 year event
Inflow   =   0.172 cfs @   7.92 hrs, Volume=   0.058 af
Outflow   =   0.003 cfs @ 24.19 hrs, Volume=   0.005 af, Atten= 98%, Lag= 976.1 min
Primary   =   0.003 cfs @ 24.19 hrs, Volume=   0.005 af
Secondary =   0.000 cfs @   0.00 hrs, Volume=   0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 503.42' @ 24.19 hrs   Surf.Area= 1,670 sf   Storage= 2,377 cf

Plug-Flow detention time= 863.1 min calculated for 0.005 af (8% of inflow)
Center-of-Mass det. time= 405.0 min (1,132.4 - 727.4)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	5,010 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,670	0	0
505.00	1,670	5,010	5,010

Device	Routing	Invert	Outlet Devices
#1	Primary	502.00'	**0.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	504.00'	**4.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.003 cfs @ 24.19 hrs HW=503.42'   (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.003 cfs @ 5.74 fps)

Secondary OutFlow Max=0.000 cfs @ 0.00 hrs HW=502.00'   (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.000 cfs)

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Type IA 24-hr 1/2 - 2 year Rainfall=1.10"
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Pond W-Flow: West

Hydrograph

Inflow Area=1.308 ac
Peak Elev=503.42'
Storage=2,377 cf

Legend:
- Inflow
- Outflow
- Primary
- Secondary

0.172 cfs
0.003 cfs
0.003 cfs
0.000 cfs

Flow (cfs) vs Time (hours)

Prelim Hydrographs 121424
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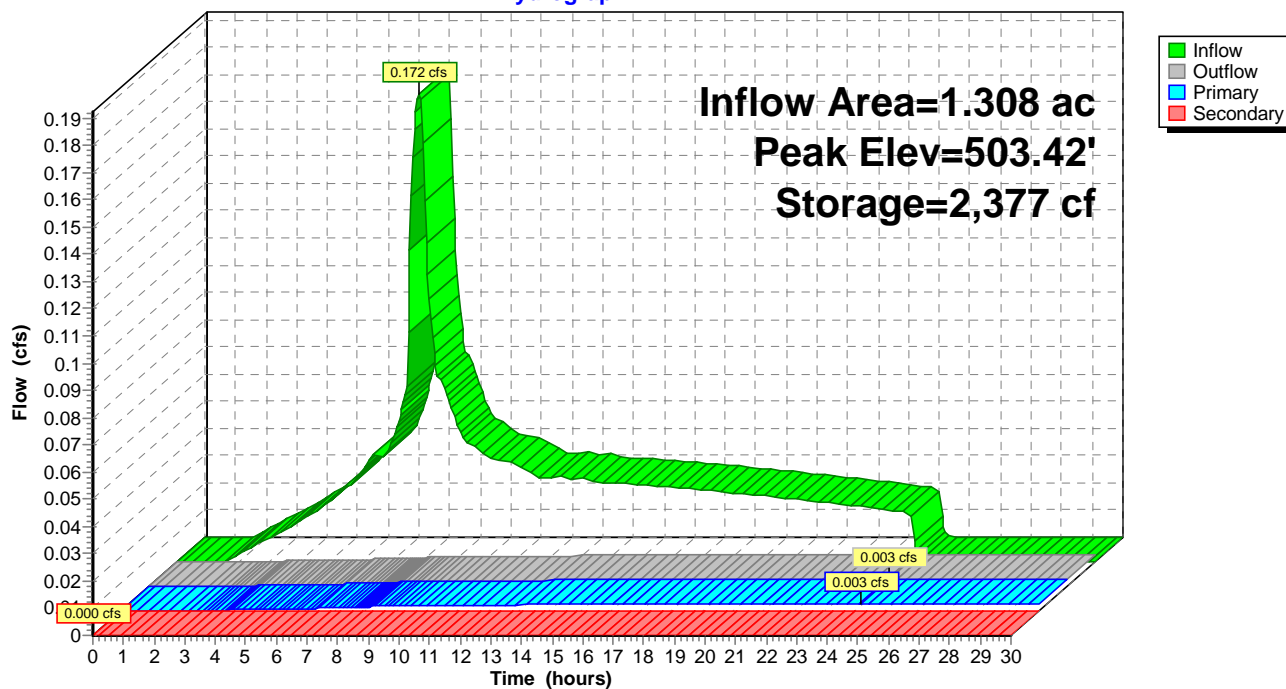HydroCAD® 10.20-5c s/n 00948 © 2023 HydroCAD Software Solutions LLC

Type IA 24-hr 10 year Rainfall=3.20"
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Summary for Subcatchment E: East - POST

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

Runoff = 3.445 cfs @ 7.92 hrs, Volume= 1.196 af, Depth= 2.32"
Routed to Pond E-Flow : East

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.20"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Hydrograph

Type IA 24-hr
10 year Rainfall=3.20"
Runoff Area=269,994 sf
Runoff Volume=1.196 af
Runoff Depth=2.32"
Tc=5.0 min
CN=74/98

Summary for Pond E-Flow: East

Inflow Area =   6.198 ac, 66.22% Impervious, Inflow Depth = 2.32"   for 10 year event
Inflow   =   3.445 cfs @   7.92 hrs, Volume=   1.196 af
Outflow   =   0.750 cfs @   10.82 hrs, Volume=   0.705 af, Atten= 78%, Lag= 173.8 min
Primary   =   0.004 cfs @   10.82 hrs, Volume=   0.009 af
Secondary =   0.745 cfs @   10.82 hrs, Volume=   0.696 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 485.45' @ 10.82 hrs   Surf.Area= 7,000 sf   Storage= 24,170 cf

Plug-Flow detention time= 521.4 min calculated for 0.705 af (59% of inflow)
Center-of-Mass det. time= 282.3 min (978.7 - 696.4)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	28,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	7,000	0	0
486.00	7,000	28,000	28,000

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	**0.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	485.00'	**11.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.004 cfs @ 10.82 hrs HW=485.45'   (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 8.95 fps)

Secondary OutFlow Max=0.745 cfs @ 10.82 hrs HW=485.45'   (Free Discharge)
└─**2=Orifice/Grate** (Orifice Controls 0.745 cfs @ 2.29 fps)

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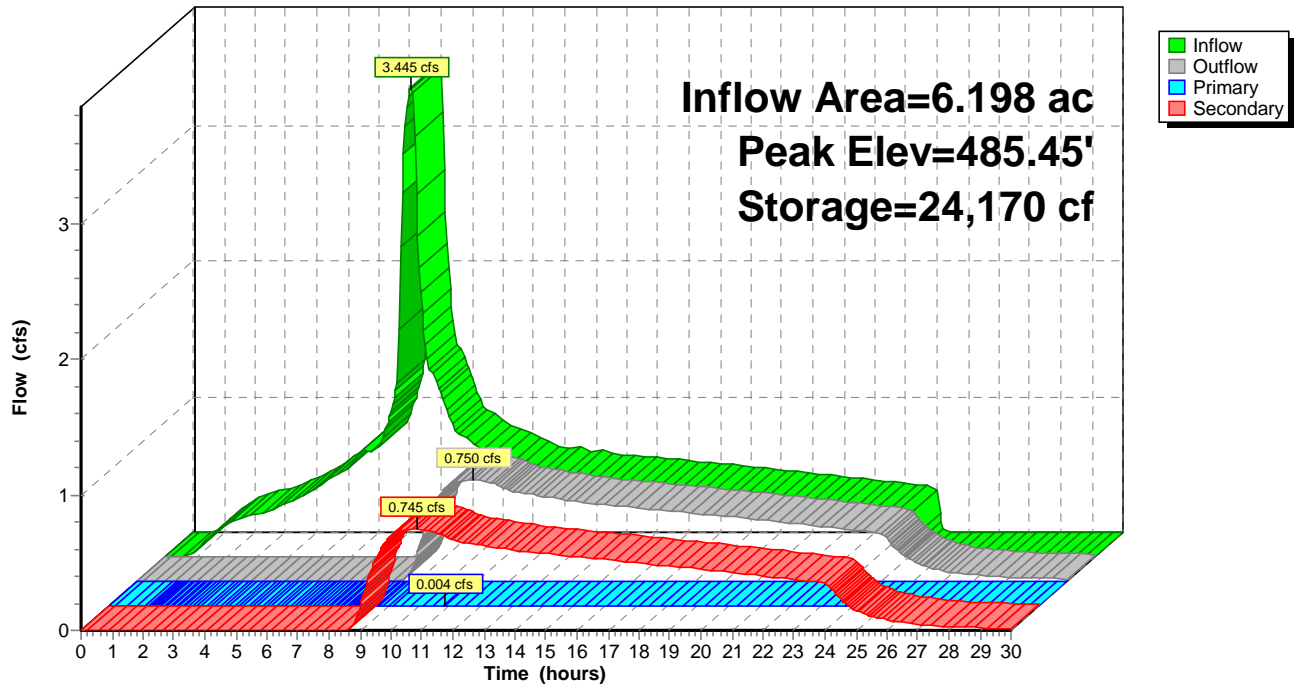
Type IA 24-hr 10 year Rainfall=3.20"
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Pond E-Flow: East

Hydrograph

Inflow Area=6.198 ac
Peak Elev=485.45'
Storage=24,170 cf

Legend: Inflow, Outflow, Primary, Secondary

3.445 cfs
0.750 cfs
0.745 cfs
0.004 cfs

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Type IA 24-hr 10 year Rainfall=3.20"
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Summary for Subcatchment W: West - POST

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

Runoff   =   0.681 cfs @   7.93 hrs, Volume=   0.239 af, Depth= 2.19"
    Routed to Pond W-Flow : West

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.20"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

Hydrograph

Type IA 24-hr
10 year Rainfall=3.20"
Runoff Area=56,998 sf
Runoff Volume=0.239 af
Runoff Depth=2.19"
Tc=5.0 min
CN=76/98

Summary for Pond W-Flow: West

Inflow Area =   1.308 ac, 57.08% Impervious, Inflow Depth = 2.19"   for 10 year event
Inflow   =   0.681 cfs @   7.93 hrs, Volume=   0.239 af
Outflow   =   0.209 cfs @   9.16 hrs, Volume=   0.162 af, Atten= 69%, Lag= 74.0 min
Primary   =   0.004 cfs @   9.16 hrs, Volume=   0.007 af
Secondary =   0.205 cfs @   9.16 hrs, Volume=   0.155 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 504.34' @ 9.16 hrs   Surf.Area= 1,670 sf   Storage= 3,900 cf

Plug-Flow detention time= 409.9 min calculated for 0.162 af (68% of inflow)
Center-of-Mass det. time= 212.4 min (920.3 - 707.9)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	5,010 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,670	0	0
505.00	1,670	5,010	5,010

Device	Routing	Invert	Outlet Devices
#1	Primary	502.00'	**0.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	504.00'	**4.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.004 cfs @ 9.16 hrs HW=504.34'   (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 7.36 fps)

Secondary OutFlow Max=0.205 cfs @ 9.16 hrs HW=504.34'   (Free Discharge)
└─**2=Orifice/Grate** (Orifice Controls 0.205 cfs @ 1.97 fps)

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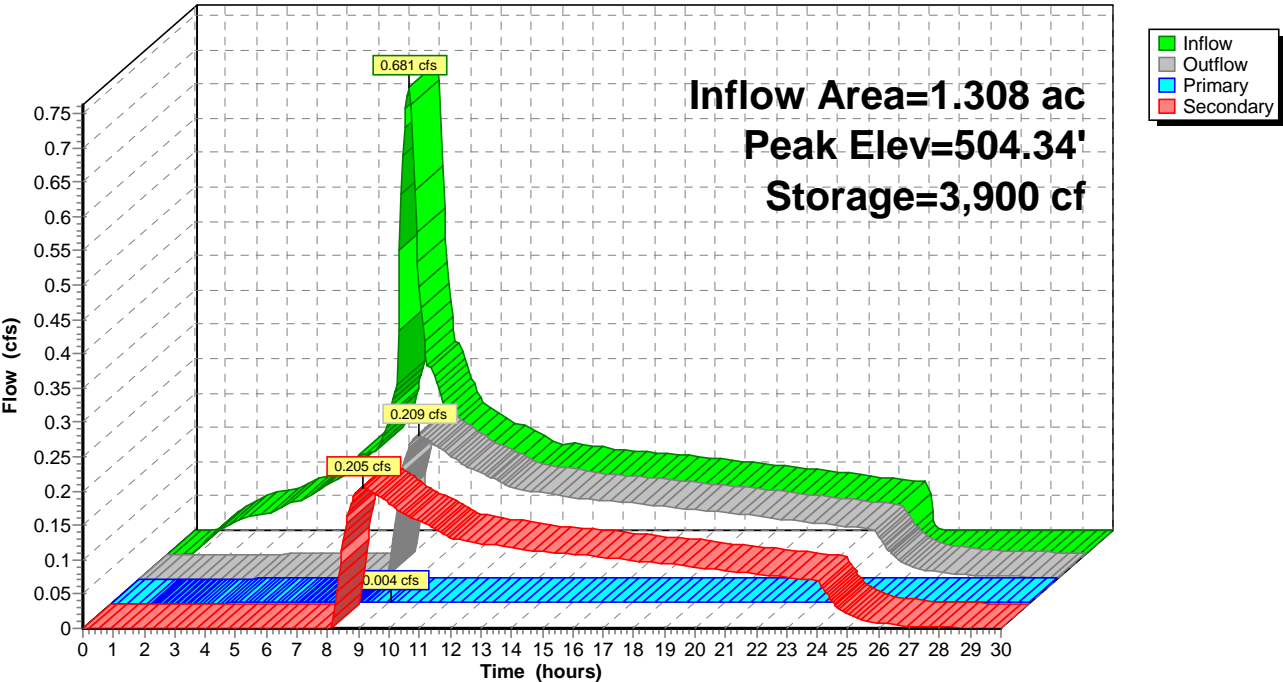
Type IA 24-hr 10 year Rainfall=3.20"
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Pond W-Flow: West

Hydrograph

Inflow Area=1.308 ac
Peak Elev=504.34'
Storage=3,900 cf

Legend: Inflow, Outflow, Primary, Secondary

0.681 cfs
0.209 cfs
0.205 cfs
0.004 cfs

Flow (cfs)

Time (hours)

Summary for Subcatchment E: East - POST

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

Runoff   =   3.988 cfs @   7.92 hrs, Volume=   1.380 af, Depth= 2.67"
        Routed to Pond E-Flow : East

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.60"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Hydrograph

Type IA 24-hr
25 year Rainfall=3.60"
Runoff Area=269,994 sf
Runoff Volume=1.380 af
Runoff Depth=2.67"
Tc=5.0 min
CN=74/98

3.988 cfs

Summary for Pond E-Flow: East

Inflow Area =   6.198 ac, 66.22% Impervious, Inflow Depth = 2.67"   for 25 year event
Inflow   =   3.988 cfs @   7.92 hrs, Volume=   1.380 af
Outflow   =   1.061 cfs @   9.42 hrs, Volume=   0.889 af, Atten= 73%, Lag= 89.7 min
Primary   =   0.004 cfs @   9.42 hrs, Volume=   0.009 af
Secondary =   1.056 cfs @   9.42 hrs, Volume=   0.880 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 485.55' @ 9.42 hrs   Surf.Area= 7,000 sf   Storage= 24,877 cf

Plug-Flow detention time= 457.7 min calculated for 0.889 af (64% of inflow)
Center-of-Mass det. time= 243.2 min (937.2 - 694.0)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	28,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	7,000	0	0
486.00	7,000	28,000	28,000

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	**0.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	485.00'	**11.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.004 cfs @ 9.42 hrs HW=485.55' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 9.08 fps)

Secondary OutFlow Max=1.056 cfs @ 9.42 hrs HW=485.55' (Free Discharge)
└─**2=Orifice/Grate** (Orifice Controls 1.056 cfs @ 2.53 fps)

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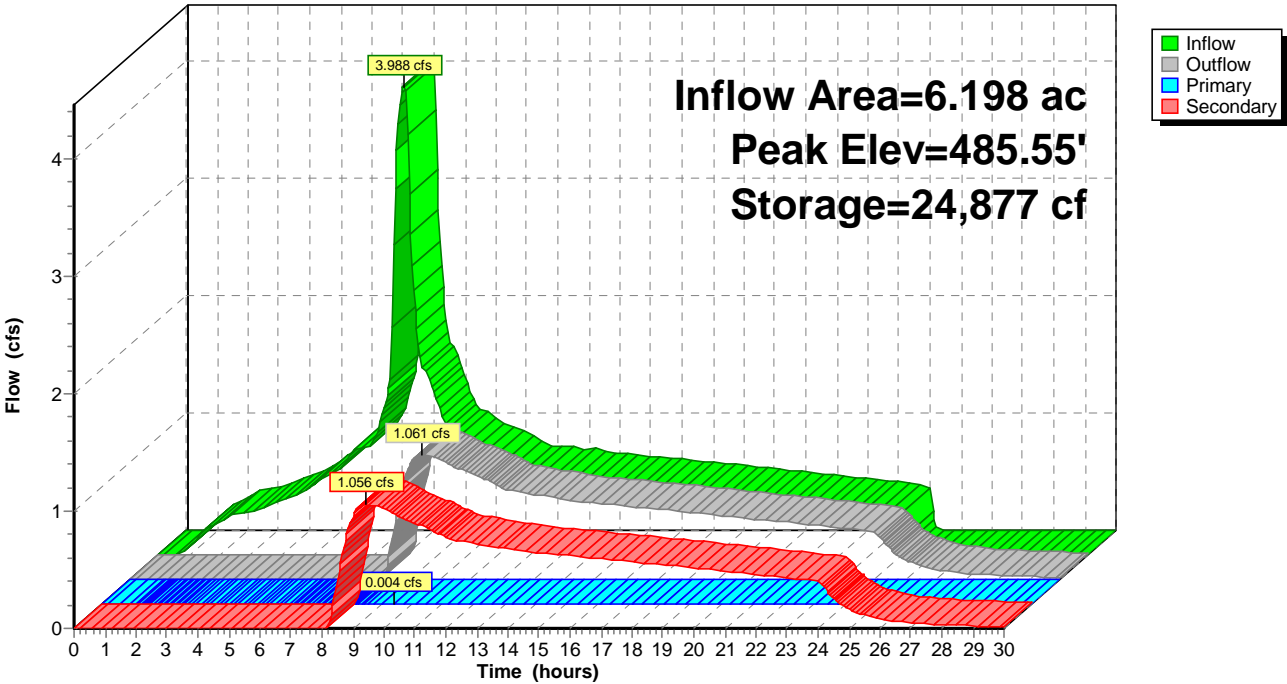
Type IA 24-hr 25 year Rainfall=3.60"
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Pond E-Flow: East

Hydrograph

Inflow Area=6.198 ac
Peak Elev=485.55'
Storage=24,877 cf

Legend:
- Inflow
- Outflow
- Primary
- Secondary

3.988 cfs
1.061 cfs
1.056 cfs
0.004 cfs

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Type IA 24-hr 25 year Rainfall=3.60"
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Summary for Subcatchment W: West - POST

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

Runoff   =   0.795 cfs @   7.93 hrs, Volume=   0.277 af, Depth= 2.54"
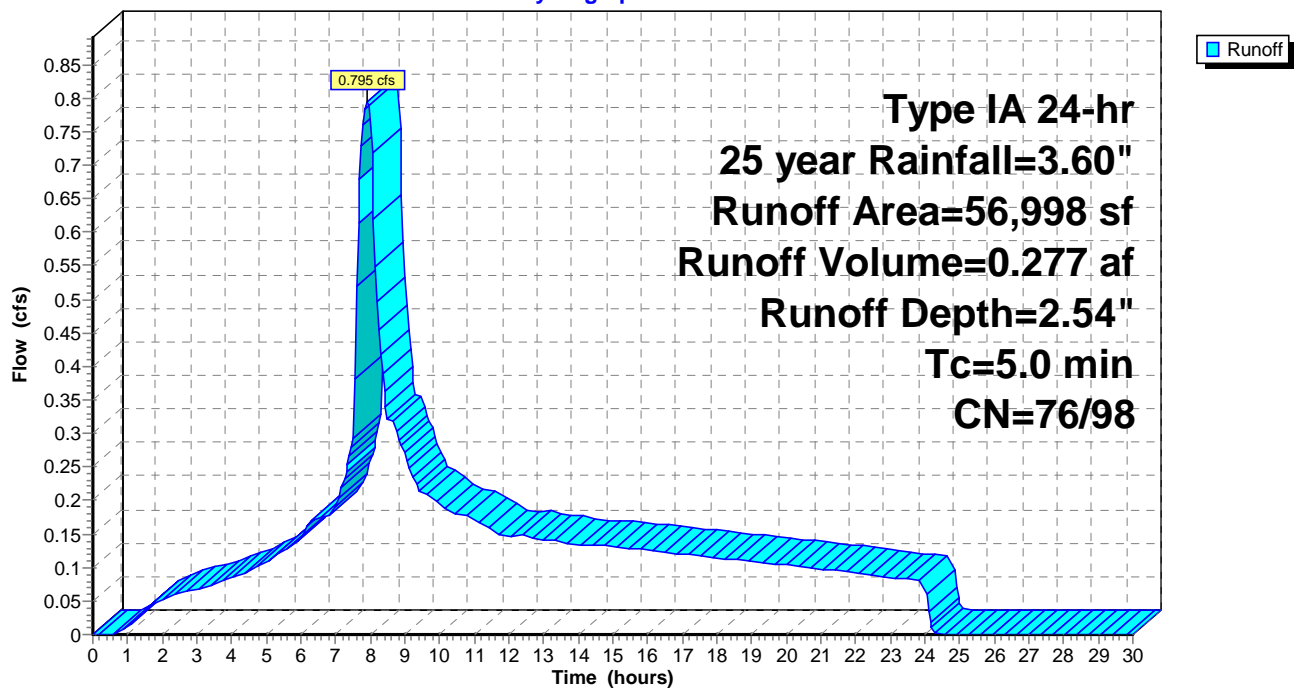   Routed to Pond W-Flow : West

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.60"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

Hydrograph

Type IA 24-hr
25 year Rainfall=3.60"
Runoff Area=56,998 sf
Runoff Volume=0.277 af
Runoff Depth=2.54"
Tc=5.0 min
CN=76/98

Summary for Pond W-Flow: West

Inflow Area = 1.308 ac, 57.08% Impervious, Inflow Depth = 2.54" for 25 year event
Inflow = 0.795 cfs @ 7.93 hrs, Volume= 0.277 af
Outflow = 0.287 cfs @ 8.87 hrs, Volume= 0.200 af, Atten= 64%, Lag= 56.6 min
Primary = 0.004 cfs @ 8.87 hrs, Volume= 0.007 af
Secondary = 0.283 cfs @ 8.87 hrs, Volume= 0.193 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 504.47' @ 8.87 hrs Surf.Area= 1,670 sf Storage= 4,128 cf

Plug-Flow detention time= 359.2 min calculated for 0.200 af (72% of inflow)
Center-of-Mass det. time= 185.4 min (890.6 - 705.2)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	5,010 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,670	0	0
505.00	1,670	5,010	5,010

Device	Routing	Invert	Outlet Devices
#1	Primary	502.00'	**0.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	504.00'	**4.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

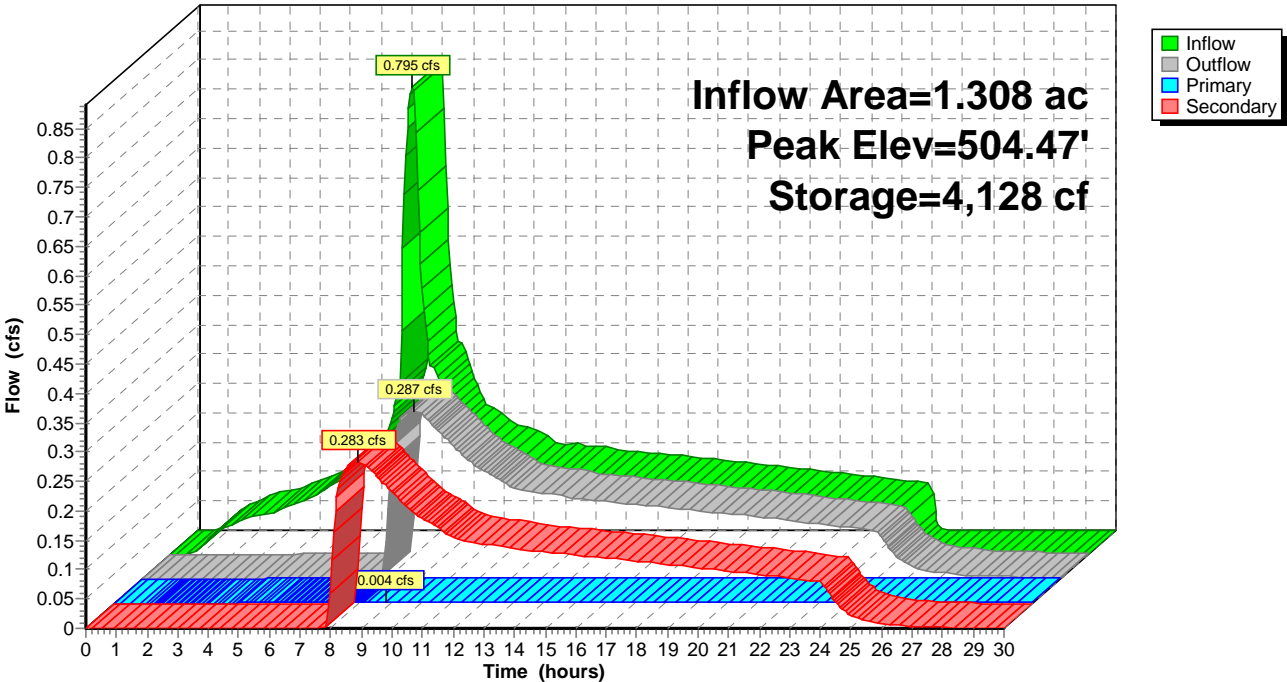**Primary OutFlow** Max=0.004 cfs @ 8.87 hrs HW=504.47' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 7.57 fps)

Secondary OutFlow Max=0.283 cfs @ 8.87 hrs HW=504.47' (Free Discharge)
└─**2=Orifice/Grate** (Orifice Controls 0.283 cfs @ 2.57 fps)

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Type IA 24-hr 25 year Rainfall=3.60"
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Pond W-Flow: West

Hydrograph

Inflow Area=1.308 ac
Peak Elev=504.47'
Storage=4,128 cf

Legend:
- Inflow
- Outflow
- Primary
- Secondary

Labeled values: 0.795 cfs, 0.287 cfs, 0.283 cfs, 0.004 cfs

Flow (cfs) vs Time (hours)

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Type IA 24-hr 100 year Rainfall=4.40"
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Summary for Subcatchment E: East - POST

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

Runoff   =   5.100 cfs @   7.92 hrs, Volume=   1.755 af, Depth= 3.40"
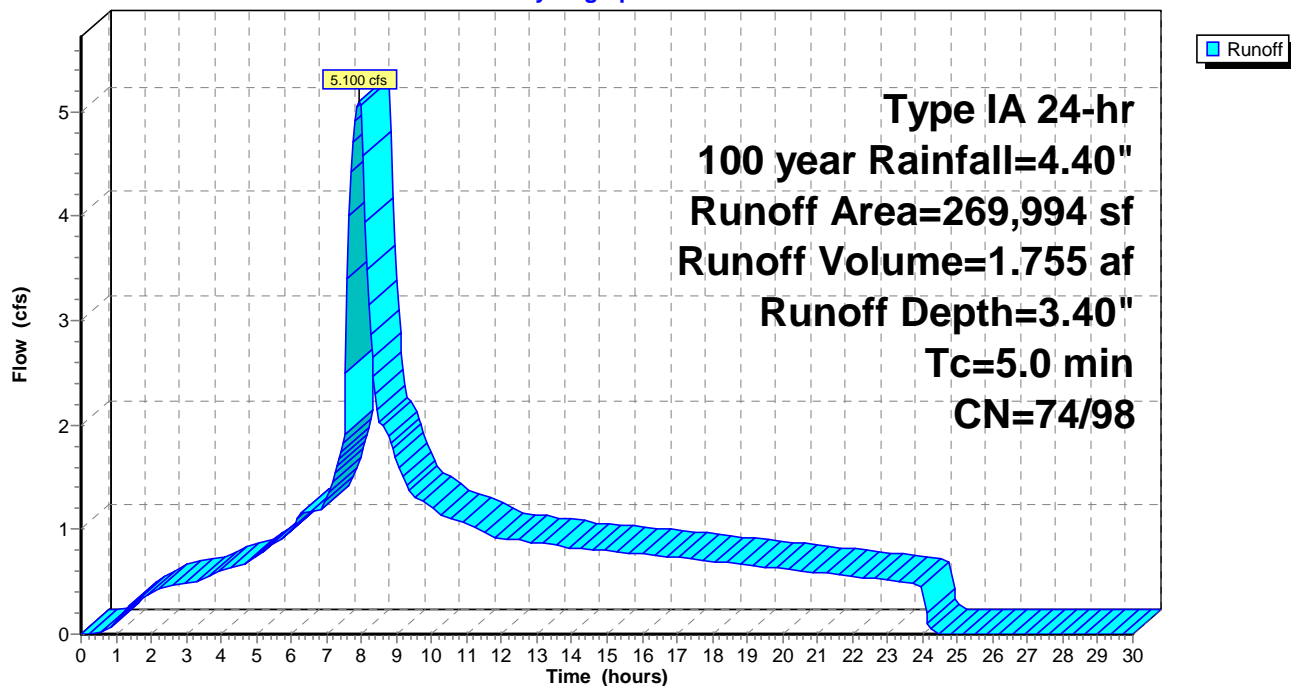Routed to Pond E-Flow : East

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year Rainfall=4.40"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Hydrograph

Type IA 24-hr
100 year Rainfall=4.40"
Runoff Area=269,994 sf
Runoff Volume=1.755 af
Runoff Depth=3.40"
Tc=5.0 min
CN=74/98

Summary for Pond E-Flow: East

Inflow Area =   6.198 ac, 66.22% Impervious, Inflow Depth = 3.40"   for 100 year event
Inflow   =   5.100 cfs @   7.92 hrs, Volume=   1.755 af
Outflow   =   2.017 cfs @   8.50 hrs, Volume=   1.264 af, Atten= 60%, Lag= 34.9 min
Primary   =   0.005 cfs @   8.50 hrs, Volume=   0.009 af
Secondary =   2.012 cfs @   8.50 hrs, Volume=   1.254 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 485.85' @ 8.50 hrs   Surf.Area= 7,000 sf   Storage= 26,976 cf

Plug-Flow detention time= 370.4 min calculated for 1.262 af (72% of inflow)
Center-of-Mass det. time= 194.4 min (884.2 - 689.8)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	28,000 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	7,000	0	0
486.00	7,000	28,000	28,000

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	**0.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	485.00'	**11.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.005 cfs @ 8.50 hrs HW=485.85'   (Free Discharge)
└—**1=Orifice/Grate** (Orifice Controls 0.005 cfs @ 9.45 fps)

Secondary OutFlow Max=2.014 cfs @ 8.50 hrs HW=485.85'   (Free Discharge)
└—**2=Orifice/Grate** (Orifice Controls 2.014 cfs @ 3.15 fps)

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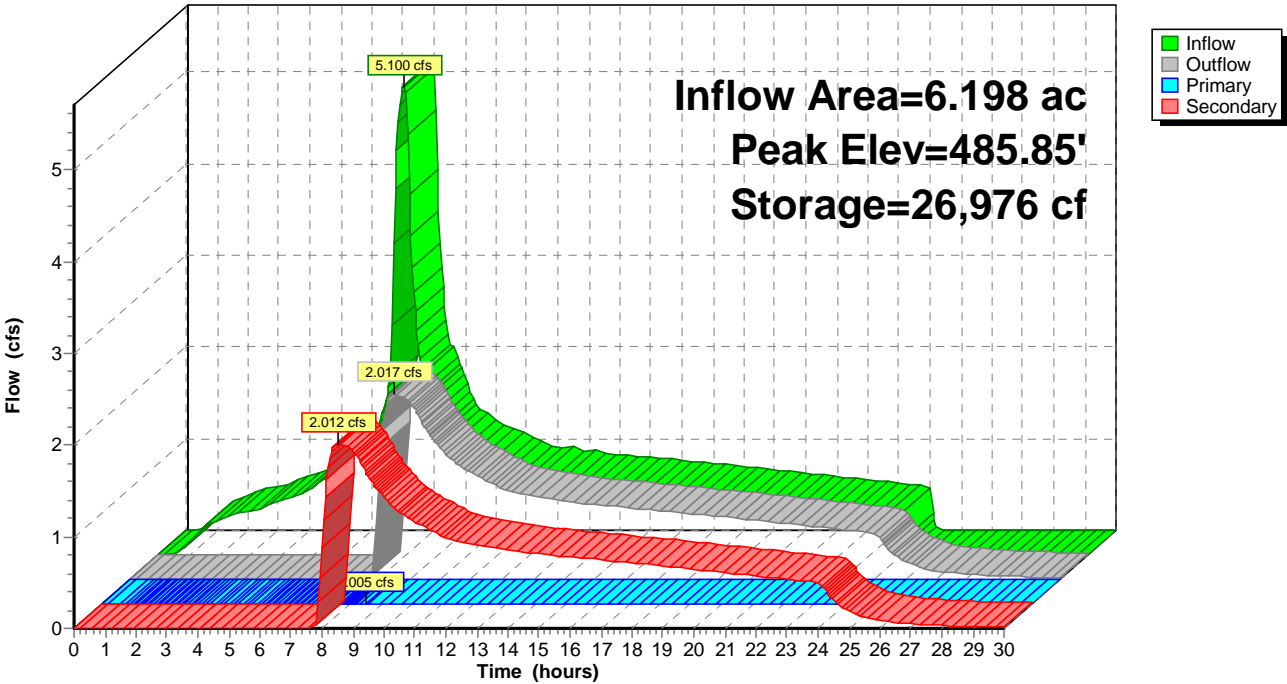
Type IA 24-hr 100 year Rainfall=4.40"
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Pond E-Flow: East

Hydrograph

Inflow Area=6.198 ac
Peak Elev=485.85'
Storage=26,976 cf

Legend: Inflow, Outflow, Primary, Secondary

5.100 cfs
2.017 cfs
2.012 cfs
.005 cfs

Flow (cfs)

Time (hours)

Summary for Subcatchment W: West - POST

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

Runoff   =   1.030 cfs @   7.93 hrs, Volume=   0.355 af, Depth= 3.26"
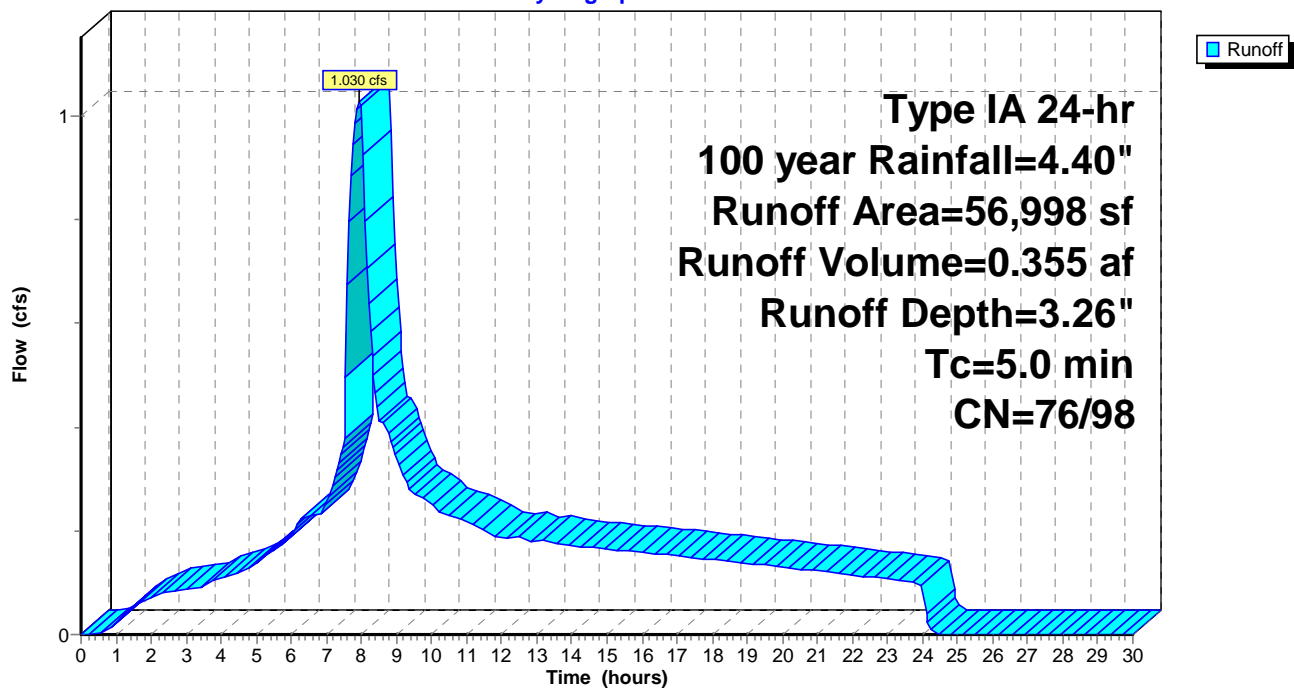   Routed to Pond W-Flow : West

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year Rainfall=4.40"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

**Type IA 24-hr
100 year Rainfall=4.40"
Runoff Area=56,998 sf
Runoff Volume=0.355 af
Runoff Depth=3.26"
Tc=5.0 min
CN=76/98**

Summary for Pond W-Flow: West

Inflow Area =   1.308 ac, 57.08% Impervious, Inflow Depth = 3.26"   for 100 year event
Inflow   =   1.030 cfs @   7.93 hrs, Volume=   0.355 af
Outflow   =   0.448 cfs @   8.43 hrs, Volume=   0.278 af, Atten= 57%, Lag= 30.6 min
Primary   =   0.004 cfs @   8.43 hrs, Volume=   0.008 af
Secondary =   0.444 cfs @   8.43 hrs, Volume=   0.271 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 504.88' @ 8.43 hrs   Surf.Area= 1,670 sf   Storage= 4,816 cf

Plug-Flow detention time= 296.1 min calculated for 0.278 af (78% of inflow)
Center-of-Mass det. time= 155.0 min (855.2 - 700.2)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	5,010 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,670	0	0
505.00	1,670	5,010	5,010

Device	Routing	Invert	Outlet Devices
#1	Primary	502.00'	**0.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	504.00'	**4.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.004 cfs @ 8.43 hrs HW=504.88' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 8.18 fps)

Secondary OutFlow Max=0.444 cfs @ 8.43 hrs HW=504.88' (Free Discharge)
└─**2=Orifice/Grate** (Orifice Controls 0.444 cfs @ 4.02 fps)

Prelim Hydrographs 121424
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Type IA 24-hr 100 year Rainfall=4.40"
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Pond W-Flow: West

Hydrograph

Inflow Area=1.308 ac
Peak Elev=504.88'
Storage=4,816 cf

Legend:
- Inflow
- Outflow
- Primary
- Secondary

1.030 cfs
0.448 cfs
0.444 cfs
0.004 cfs

Flow (cfs)

Time (hours)