Run-on and Run-off Control System Plan

For Compliance with the Coal Combustion Residuals Rule
(40 CFR 257.81)

Pawnee Station – East CCR Landfill
Public Service Company of Colorado
Denver, Colorado

December 27, 2018

PREPARED FOR

PAWNEE STATION

14940 Morgan County Road 24,
Brush, Colorado 80723

Table of Contents

List of Tables

List of Figures

List of Appendices

Table of Abbreviations and Acronyms

Abbreviation	Definition
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
CN	Curve Number
EPA	Environmental Protection Agency
HSG	Hydrologic Soil Group
Landfill	Pawnee Landfill
NOAA	National Oceanic and Atmospheric Administration
PSCo	Public Service Company of Colorado
SCS	Soil Conservation Service
TR-20	Technical Release 20

1.0 Introduction

On April 17, 2015, the U.S. Environmental Protection Agency (EPA) published regulations under Subtitle D of the Resource Conservation and Recovery Act meant to control the safe disposal of coal combustion residuals (CCR) generated by coal fired electric utilities. The rule defines a set of requirements for the disposal and handling of CCR within CCR units (defined as either landfills or surface impoundments). The requirements include preparation of a Run-on and Run-off Control System Plan for all existing and new CCR landfills.

This Run-on and Run-off Control System Plan was prepared for the East CCR Landfill at the Pawnee Station operated by Public Service Company of Colorado (PSCo), an Xcel Energy Company. It was prepared in accordance with the requirements of 40 Code of Federal Regulations (CFR) 257.81. The East CCR Landfill is a newly constructed CCR unit. As such, the regulation requires that an initial Run-on and Run-off Control System Plan be prepared prior to taking receipt of CCR.

1.1 Facility Description

The Pawnee Station East CCR Landfill is located at the Pawnee Station Power Plant at 14940 Morgan County Road 24, Brush, Colorado, approximately one-half mile southeast of the main power plant building. Pawnee Station is approximately four miles southwest of Brush, Colorado. Refer to **Figure 1** for the Site Location Map.

The East CCR Landfill encompasses an area of approximately 13 acres. This landfill provides disposal capacity for CCR and lime solids from plant operations as well as relocation of lime solids from the South Landfill. The East CCR Landfill was constructed in the footprint of the former Bottom Ash Storage Pond. The Bottom Ash Storage Pond was constructed in 1980 with a composite liner system, was taken out of service in 2005 and was closed in 2017. The pond was closed by removal of all CCR, the liner system, and soil confirmatory sampling; closure was overseen and certified by a Professional Engineer. Construction of the East CCR Landfill occurred in 2018.

Stormwater falling on the East CCR Landfill flows to either the Southeast Non-Contact Stormwater Pond, Northwest Non-Contact Stormwater Pond, or the East Stormwater Collection Area. Refer to Figure 2 for the Area designations and conveyance paths.

The Southeast Non-Contact Stormwater Pond is located to the southeast of the East CCR Landfill. Runoff from the western and southern faces of the landfill (**Figure 2**, Area 1B) will be directed to the pond through the perimeter channel and a series of drop inlets and HDPE pipes and out to a riprap splash pad and pond.

The Northwest Non-Contact Stormwater Pond is located to the northwest of the East CCR Landfill. Run-off from the top deck and north and northwest faces of the landfill (**Figure 2**, Areas 7-9) will travel along the access road and perimeter channels to the northwest drop-inlet and out to a riprap splash pad and pond.

The East Stormwater Collection Area is a low lying area directly to the east of the landfill. Run-off from the eastern and southern portions of the landfill, as well as the drop chute area (**Figure 2**, Areas 1A, 2A, 2B, and drop chute area) will drain towards a drop chute or the perimeter channel and discharge at the riprap drainage channel.

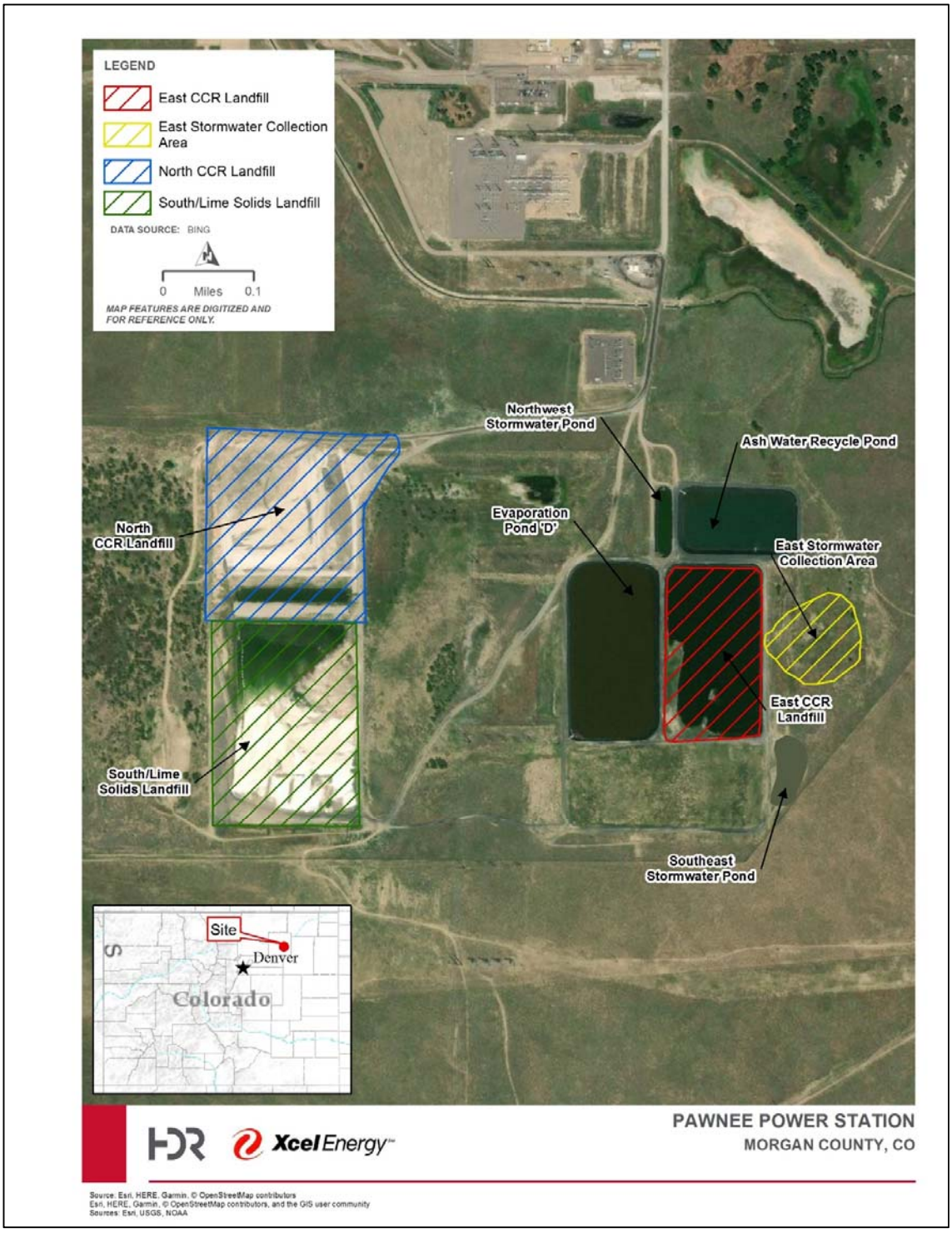


Figure 1. Pawnee Power Station Facility Location Map

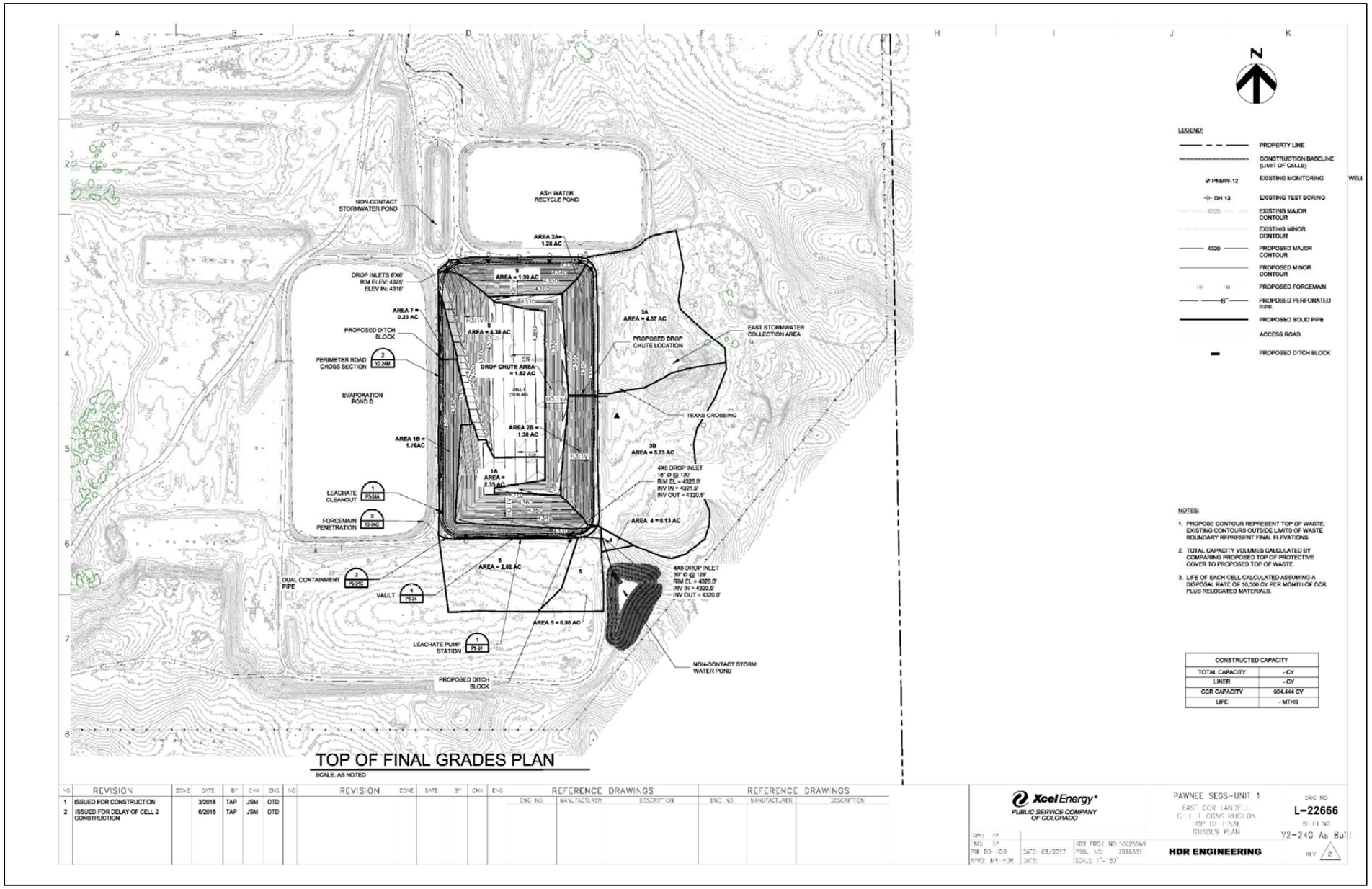


Figure 2. Stormwater Drainage Paths

1.2 Regulatory Requirements

40 CFR 257.81 requires that an owner or operator of an existing or new CCR landfill, or any lateral expansion of a CCR landfill, design, construct, operate, and maintain:

1) a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm;
2) a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm; and
3) a run-off control system designed to handle run-off so that it does not cause a discharge of pollutants to waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under Section 402 of the Clean Water Act.

Every five years, the owner or operator of the CCR unit is required to revise the Run-on and Run-off control system plan. This plan conservatively assumes the planned closed condition of the Pawnee East CCR Landfill, which represents the maximum runoff condition, since the landfill is planned to be closed within the first five years of operation. This assumption encompasses the maximum active area of the landfill. However, contact water from active areas during landfill operations will be collected by the leachate collection system and contained in adjacent Evaporation Pond D.

1.3 Run-on / Run-off Controls for CCR Landfill

A hydrologic and hydraulic analysis was completed for the East CCR Landfill in accordance with 40 CFR 257.81. Per §257.53 the active portion means "*that part of the CCR unit that has received or is receiving CCR or non-CCR waste and that has not completed closure in accordance with §257.102."*

The evaluation included preparation of a surface water run-off model using HydroCAD 10.00. This modeling system was used to determine whether planned run-on and run-off control systems meet the required criteria for controlling run-on and run-off from the 24-hour, 25-year storm event. The evaluation was completed using the best available information at the time and was based on final design grades developed in 2018.

1.4 Description of CCR Landfill and Drainage Area

The landfill active area is approximately 13 acres. The Southeast Non-Contact Stormwater Pond is approximately 1.23 acres and the Northwest Non-Contact Stormwater is approximately 0.95 acres. The East Stormwater Collection Area is approximately 10 acres. The landfill area at final design grades and delineated drainage basins are shown on **Figure 2**.

1.5 Description of Run-on / Run-off Controls

1.5.1 Run-on Controls

With the exception of the topography to the south, the grades around the perimeter of the East CCR landfill are below the perimeter road. The perimeter channel will provide added run-on protection during early landfill operations. Run-off from the south has been included in the HydroCAD model which shows that the perimeter channel has sufficient capacity to prevent run-on into the landfill cell.

1.5.2 Run-off Controls

The run-off from the landfill will be directed towards the northwest and southeast Non-Contact Stormwater Ponds or the East Stormwater Collection Area. All run-off has been modeled and explained within this report.

1.6 Surface Water Run-off Model

A surface water run-off model was prepared using HydroCAD 10.00, which utilizes parameters developed following the Soil Conservation Service (SCS) Technical Release 20 (TR-20) for computing curve numbers and times of concentration in order to generate runoff hydrographs. The model is included as **Appendix A**.

1.6.1 Rainfall Data

Rainfall data was taken from the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Data Server. Rainfall data input into the model included the 25-year, 24-hour storm events. The 24-hour precipitation amounts are summarized in **Table 1** and the information from the NOAA Precipitation Frequency Data Server is included as **Appendix B**.

Table 1. Rainfall Data

24-Hour Rainfall Event	Precipitation (inches)
25-year	3.34

The Frequency Storm rainfall distribution method was utilized within the HydroCAD model. Precipitation depths were analyzed within the time span of 1 to 100-hours to develop the hydrograph.

1.6.2 Weighted Curve Number

The weighted curve number (CN) is determined according to a hydrologic soil group (HSG) and ground cover for a delineated drainage basin. The East CCR Landfill was delineated into five drainage basins and 13 sub-catchments. The East CCR Landfill will have a synthetic turf cap in the closed condition.

To compute the weighted CN, the Soil Conservation District Web Soil Survey map was consulted to identify the hydrologic soil group for the native soil where synthetic turf cap will not be present at closure, roughly 14.01 acres (Areas 3A, 3B, 4, 5, and 6). According to the web soil map, the ground cover consists of 50-75% grass, which has the soil type as HSG B. The other 14.85 acres were modeled to reflect the synthetic turf cap (Areas 1A, 1B, 2A, 2B, 7, 8, 9). A summary of the breakdown used to calculate the weighted CN is provided in **Table 2**.

Table 2. Summary of Area Breakdown

Cover Type	HSG	Area (Acres)	Curve Number
50-75% Grass Cover	B	14.010	69
synthetic turf cap	Other	14.850	95
Weighted CN		**28.860**	**82**

1.6.3 Time of Concentration

The time of concentration is defined as the time required for runoff to travel from the most hydrologically distant point of a sub-catchment to the point of collection. It is determined by summing the travel time for consecutive flow segments along the sub-catchment's hydraulic path. Refer to **Appendix A** for the reach routing evaluation in the HydroCAD Model Results.

1.6.4 Stormwater Ponds

To comply with 40 Part 257.81, the ponds must be sufficient size to collect and control runoff resulting from the 24-hour, 25-year storm event. The models were run to evaluate whether the Northwest and Southeast Non-Contact Stormwater Ponds and the East Stormwater Collection Area were sufficiently sized to contain the design storm event. The ponds were modeled as infiltration basins with no outlet. The volume lost due to evaporation during the modeled storm event was assumed to be negligible. Based on the model results, the ponds are sufficiently sized to prevent discharge of surface water run-off from the landfill during the 24-hour, 25-year storm event.

1.7 Evaluation of Run-on / Run-off Controls

The model and calculations resulted in a total volume of approximately 4.446 acre-feet of stormwater generated from the East CCR Landfill, with an average runoff depth of 1.85 inches. This will raise the level of the Southeast Stormwater Pond to approximately 5.63 feet, Northwest Stormwater Pond to approximately 8.5 feet, and the East Stormwater Collection Area to approximately 7.45 feet. Based on the model, there is sufficient freeboard to contain the desired storm event.

1.8 Improvements to Run-on / Run-off Controls

Based on the available information and the model results, the existing run-on and run-off controls in place for the Pawnee East CCR landfill meet the requirements of 40 CFR Part 257.81. There are no improvements proposed for the existing run-on and run-off control systems for the East CCR landfill.

2.0 Professional Engineer Certification

Pawnee Station East CCR Landfill Run-on and Run-off Controls Compliance with the Federal Coal Combustion Residuals Rule.

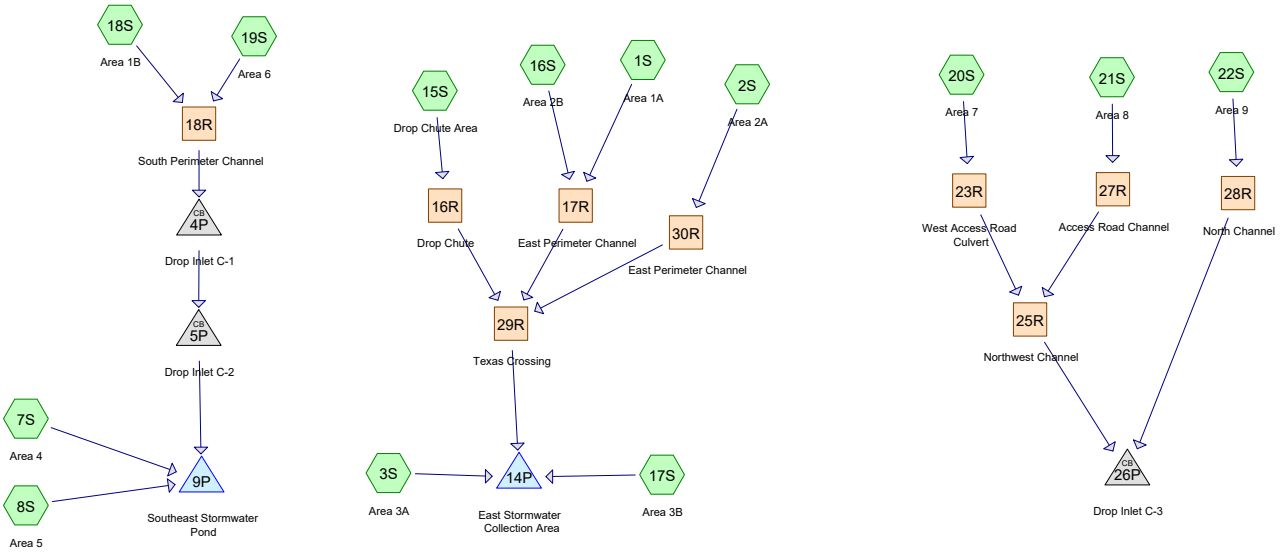
The undersigned Registered Professional Engineer is familiar with the requirements of Part 257 of Title 40 of the Code of Federal Regulations (40 CFR Part 257) and has visited and examined the facility, or has supervised examination of the facility by appropriately qualified personnel. The undersigned Registered Professional Engineer attests that this Run-on and Run-off Controls System Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR Part 257.

This Plan is valid only to the extent that the facility owner or operator maintains existing run-on and run-off controls described in this Plan to prevent flow onto the active portion and prevent surface discharges of CCR in solution or suspension.

I am a duly licensed Professional Engineer under the laws of the State of Colorado. My license renewal date is October 31, 2019.

Matthew M. Rohr, PE Colorado PE 0053467

APPENDIX A - HydroCAD MODEL RESULTS



Subcat Reach Pond Link

Routing Diagram for Pawnee Cell 1 Stormwater As-Built_20181018

Prepared by HDR, Inc, Printed 11/28/2018

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
14.010	69	50-75% Grass cover, Fair, HSG B (3S, 7S, 8S, 17S, 19S)
14.484	95	Closure Turf (1S, 2S, 15S, 16S, 18S, 20S, 21S, 22S)
0.366	96	Gravel surface, HSG B (21S)
28.860	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
14.376	HSG B	3S, 7S, 8S, 17S, 19S, 21S
0.000	HSG C	
0.000	HSG D	
14.484	Other	1S, 2S, 15S, 16S, 18S, 20S, 21S, 22S
28.860		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	14.010	0.000	0.000	0.000	14.010	50-75% Grass cover, Fair	3S, 7S, 8S, 17S, 19S
0.000	0.000	0.000	0.000	14.484	14.484	Closure Turf	1S, 2S, 15S, 16S, 18S, 20S, 21S, 22S
0.000	0.366	0.000	0.000	0.000	0.366	Gravel surface	21S
0.000	**14.376**	**0.000**	**0.000**	**14.484**	**28.860**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	23R	4,327.00	4,326.50	64.0	0.0078	0.011	24.0	0.0	0.0
2	4P	4,321.50	4,320.50	130.0	0.0077	0.013	18.0	0.0	0.0
3	5P	4,320.50	4,320.00	129.0	0.0039	0.013	36.0	0.0	0.0
4	26P	4,318.00	4,317.00	75.0	0.0133	0.011	42.0	0.0	0.0

Time span=0.00-100.00 hrs, dt=0.01 hrs, 10001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Area 1A Runoff Area=2.930 ac 0.00% Impervious Runoff Depth=2.78"
Tc=11.4 min CN=95 Runoff=11.08 cfs 0.679 af

Subcatchment2S: Area 2A Runoff Area=1.240 ac 0.00% Impervious Runoff Depth=2.78"
Tc=8.7 min CN=95 Runoff=5.12 cfs 0.287 af

Subcatchment3S: Area 3A Runoff Area=4.370 ac 0.00% Impervious Runoff Depth=0.86"
Tc=7.3 min CN=69 Runoff=6.13 cfs 0.313 af

Subcatchment7S: Area 4 Runoff Area=0.130 ac 0.00% Impervious Runoff Depth=0.86"
Tc=5.0 min CN=69 Runoff=0.20 cfs 0.009 af

Subcatchment8S: Area 5 Runoff Area=0.960 ac 0.00% Impervious Runoff Depth=0.86"
Tc=15.4 min CN=69 Runoff=0.96 cfs 0.069 af

Subcatchment15S: Drop Chute Area Runoff Area=1.620 ac 0.00% Impervious Runoff Depth=2.78"
Tc=5.0 min CN=95 Runoff=7.54 cfs 0.376 af

Subcatchment16S: Area 2B Runoff Area=1.300 ac 0.00% Impervious Runoff Depth=2.78"
Tc=8.7 min CN=95 Runoff=5.36 cfs 0.301 af

Subcatchment17S: Area 3B Runoff Area=5.730 ac 0.00% Impervious Runoff Depth=0.86"
Tc=7.3 min CN=69 Runoff=8.04 cfs 0.410 af

Subcatchment18S: Area 1B Runoff Area=1.760 ac 0.00% Impervious Runoff Depth=2.78"
Tc=13.4 min CN=95 Runoff=6.25 cfs 0.408 af

Subcatchment19S: Area 6 Runoff Area=2.820 ac 0.00% Impervious Runoff Depth=0.86"
Tc=12.2 min CN=69 Runoff=3.21 cfs 0.202 af

Subcatchment20S: Area 7 Runoff Area=0.230 ac 0.00% Impervious Runoff Depth=2.78"
Tc=5.0 min CN=95 Runoff=1.07 cfs 0.053 af

Subcatchment21S: Area 8 Runoff Area=4.380 ac 0.00% Impervious Runoff Depth=2.78"
Tc=10.2 min CN=95 Runoff=17.20 cfs 1.015 af

Subcatchment22S: Area 9 Runoff Area=1.390 ac 0.00% Impervious Runoff Depth=2.78"
Tc=5.7 min CN=95 Runoff=6.32 cfs 0.322 af

Reach 16R: Drop Chute Avg. Flow Depth=0.23' Max Vel=8.76 fps Inflow=7.54 cfs 0.376 af
n=0.030 L=110.0' S=0.2818 '/' Capacity=117.59 cfs Outflow=7.52 cfs 0.376 af

Reach 17R: East Perimeter Channel Avg. Flow Depth=1.49' Max Vel=2.02 fps Inflow=16.28 cfs 0.981 af
n=0.030 L=485.0' S=0.0021 '/' Capacity=28.70 cfs Outflow=14.94 cfs 0.981 af

Reach 18R: South Perimeter Channel Avg. Flow Depth=1.54' Max Vel=1.81 fps Inflow=9.46 cfs 0.610 af
n=0.030 L=457.0' S=0.0022 '/' Capacity=17.21 cfs Outflow=8.62 cfs 0.610 af

Reach 23R: West Access Road Culvert Avg. Flow Depth=0.29' Max Vel=3.81 fps Inflow=1.07 cfs 0.053 af
24.0" Round Pipe n=0.011 L=64.0' S=0.0078 '/' Capacity=23.63 cfs Outflow=1.07 cfs 0.053 af

Reach 25R: Northwest Channel Avg. Flow Depth=1.35' Max Vel=4.76 fps Inflow=17.30 cfs 1.069 af
n=0.030 L=55.0' S=0.0182 '/' Capacity=49.60 cfs Outflow=17.28 cfs 1.069 af

Reach 27R: Access Road Channel Avg. Flow Depth=0.55' Max Vel=6.61 fps Inflow=17.20 cfs 1.015 af
n=0.030 L=698.0' S=0.0616 '/' Capacity=333.05 cfs Outflow=16.85 cfs 1.015 af

Reach 28R: North Channel Avg. Flow Depth=1.45' Max Vel=1.18 fps Inflow=6.32 cfs 0.322 af
n=0.030 L=492.0' S=0.0010 '/' Capacity=11.73 cfs Outflow=5.01 cfs 0.322 af

Reach 29R: Texas Crossing Avg. Flow Depth=0.56' Max Vel=2.38 fps Inflow=20.71 cfs 1.644 af
n=0.070 L=145.0' S=0.0414 '/' Capacity=484.57 cfs Outflow=20.61 cfs 1.644 af

Reach 30R: East Perimeter Channel Avg. Flow Depth=0.82' Max Vel=1.48 fps Inflow=5.12 cfs 0.287 af
n=0.030 L=480.0' S=0.0021 '/' Capacity=28.85 cfs Outflow=4.43 cfs 0.287 af

Pond 4P: Drop Inlet C-1 Peak Elev=4,325.31' Inflow=8.62 cfs 0.610 af
Outflow=8.62 cfs 0.610 af

Pond 5P: Drop Inlet C-2 Peak Elev=4,326.31' Inflow=8.62 cfs 0.610 af
Outflow=8.62 cfs 0.610 af

Pond 9P: Southeast Stormwater Pond Peak Elev=4,316.63' Storage=0.688 af Inflow=9.46 cfs 0.688 af
Outflow=0.00 cfs 0.000 af

Pond 14P: East Stormwater Collection Peak Elev=4,316.45' Storage=2.367 af Inflow=31.43 cfs 2.367 af
Outflow=0.00 cfs 0.000 af

Pond 26P: Drop Inlet C-3 Peak Elev=4,326.50' Inflow=21.45 cfs 1.391 af
Outflow=21.45 cfs 1.391 af

Total Runoff Area = 28.860 ac Runoff Volume = 4.446 af Average Runoff Depth = 1.85"
100.00% Pervious = 28.860 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Area 1A

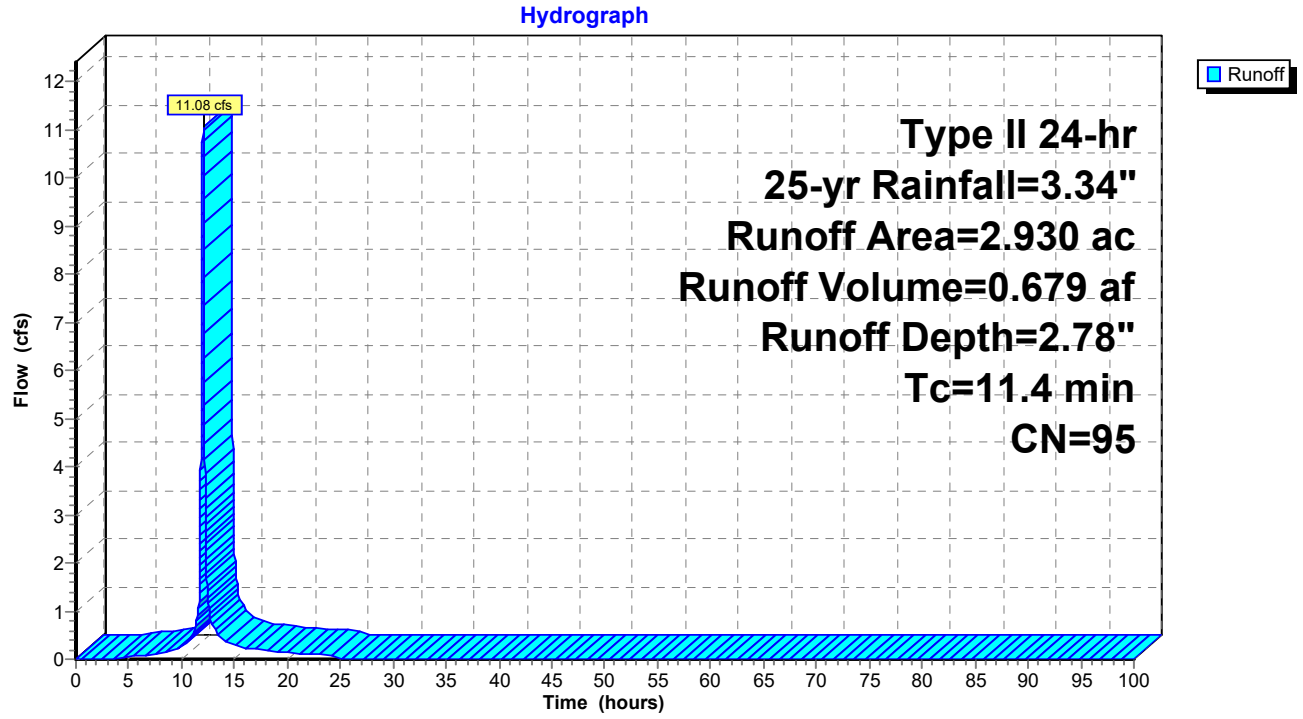
Runoff = 11.08 cfs @ 12.02 hrs, Volume= 0.679 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

	Area (ac)	CN	Description
*	2.930	95	Closure Turf
	2.930		100.00% Pervious Area

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

Subcatchment 1S: Area 1A



Summary for Subcatchment 2S: Area 2A

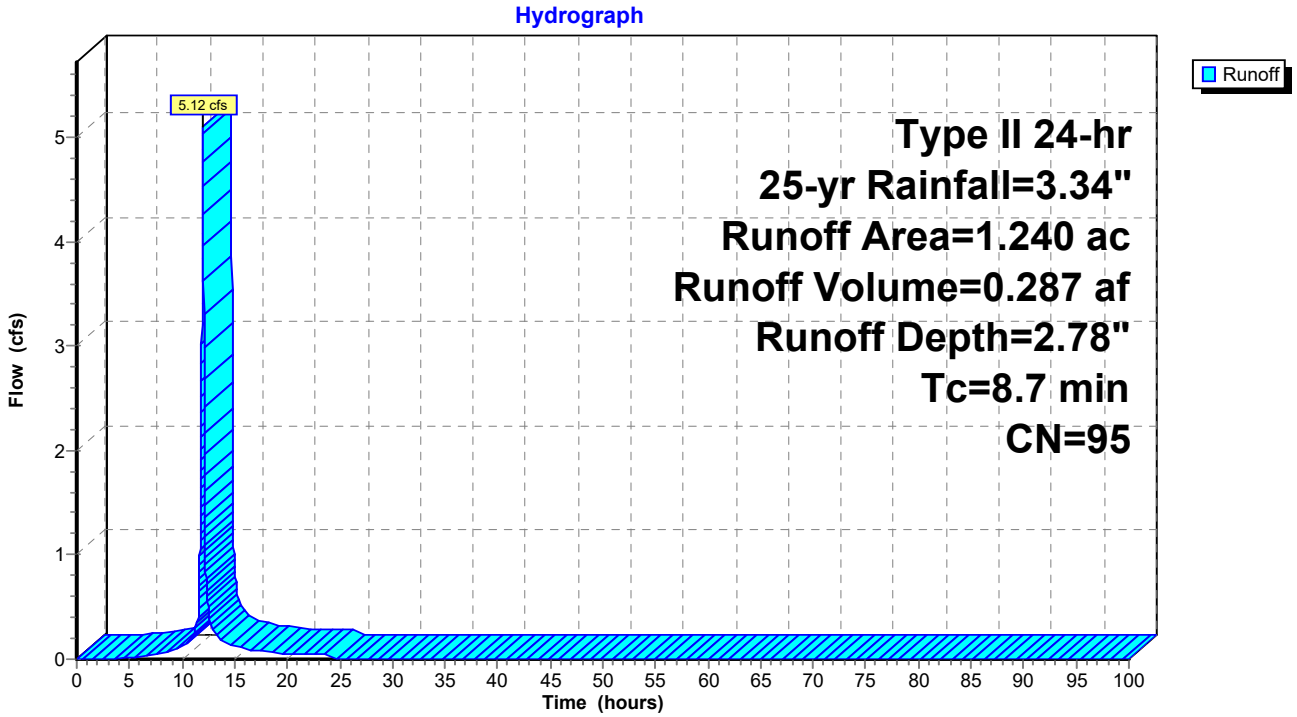
Runoff = 5.12 cfs @ 12.00 hrs, Volume= 0.287 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

	Area (ac)	CN	Description
*	1.240	95	Closure Turf
	1.240		100.00% Pervious Area

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

Subcatchment 2S: Area 2A



Summary for Subcatchment 3S: Area 3A

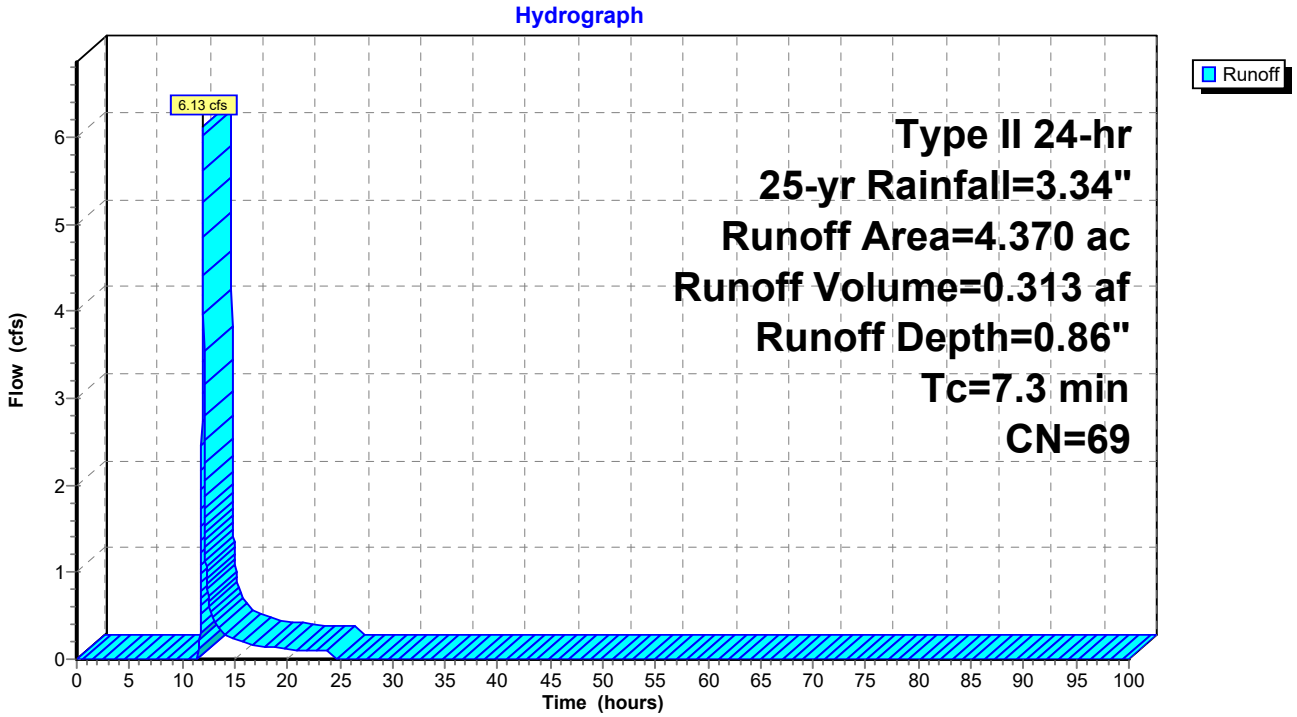
Runoff = 6.13 cfs @ 12.00 hrs, Volume= 0.313 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

Area (ac)	CN	Description
4.370	69	50-75% Grass cover, Fair, HSG B
4.370		100.00% Pervious Area

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

Subcatchment 3S: Area 3A



Summary for Subcatchment 7S: Area 4

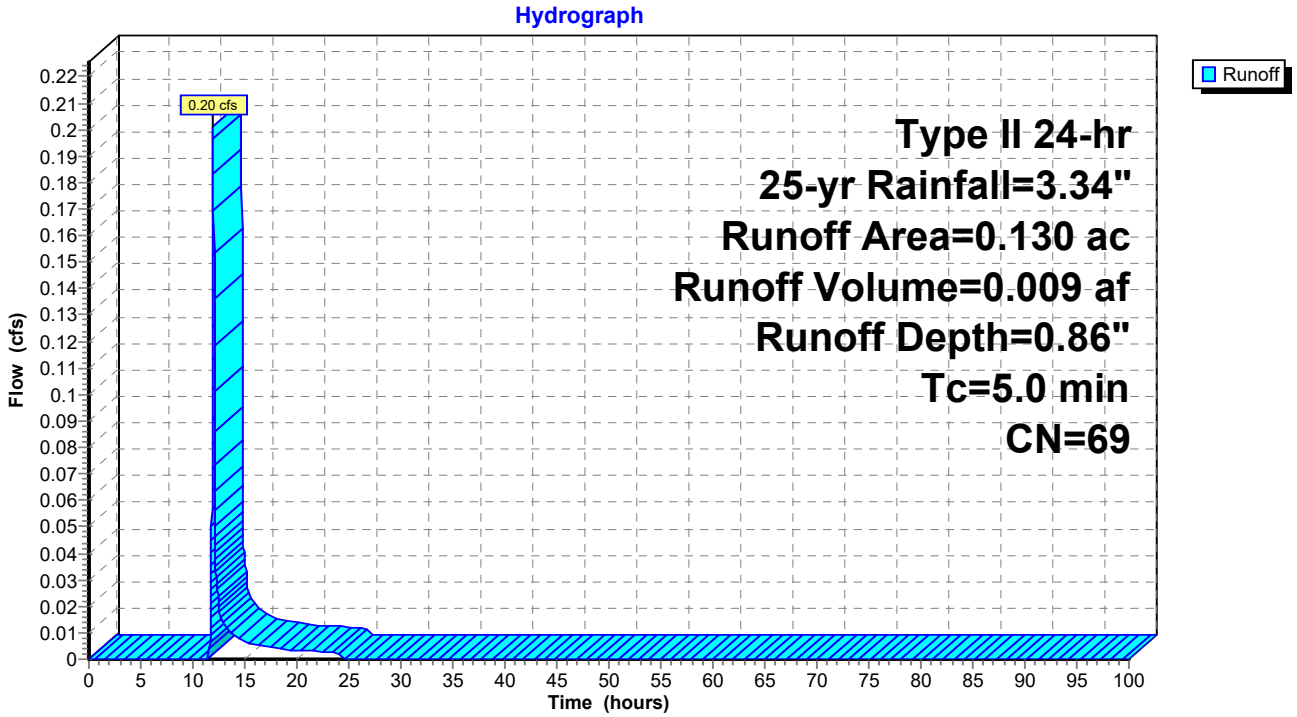
Runoff = 0.20 cfs @ 11.97 hrs, Volume= 0.009 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

Area (ac)	CN	Description
0.130	69	50-75% Grass cover, Fair, HSG B
0.130		100.00% Pervious Area

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

Subcatchment 7S: Area 4



Summary for Subcatchment 8S: Area 5

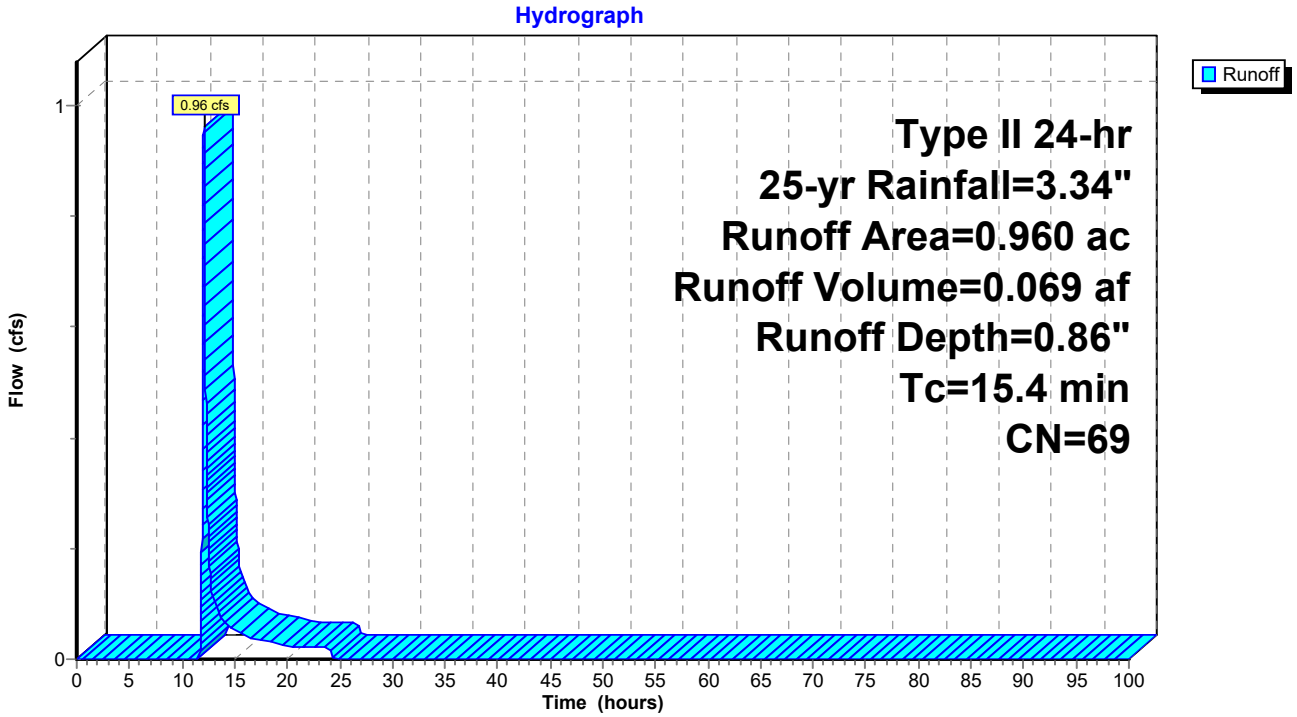
Runoff = 0.96 cfs @ 12.09 hrs, Volume= 0.069 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

Area (ac)	CN	Description
0.960	69	50-75% Grass cover, Fair, HSG B
0.960		100.00% Pervious Area

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

Subcatchment 8S: Area 5



Summary for Subcatchment 15S: Drop Chute Area

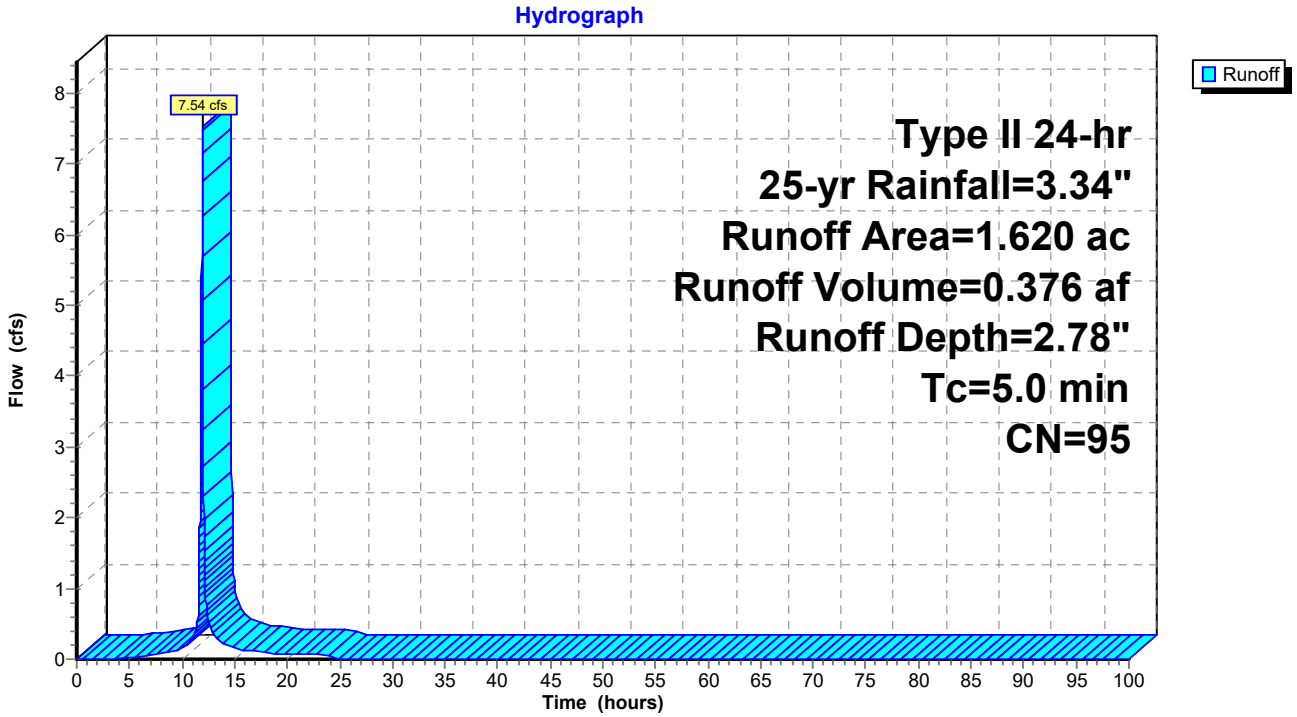
Runoff = 7.54 cfs @ 11.96 hrs, Volume= 0.376 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

	Area (ac)	CN	Description
*	1.620	95	Closure Turf
	1.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, SW Package Page 3**

Subcatchment 15S: Drop Chute Area



Summary for Subcatchment 16S: Area 2B

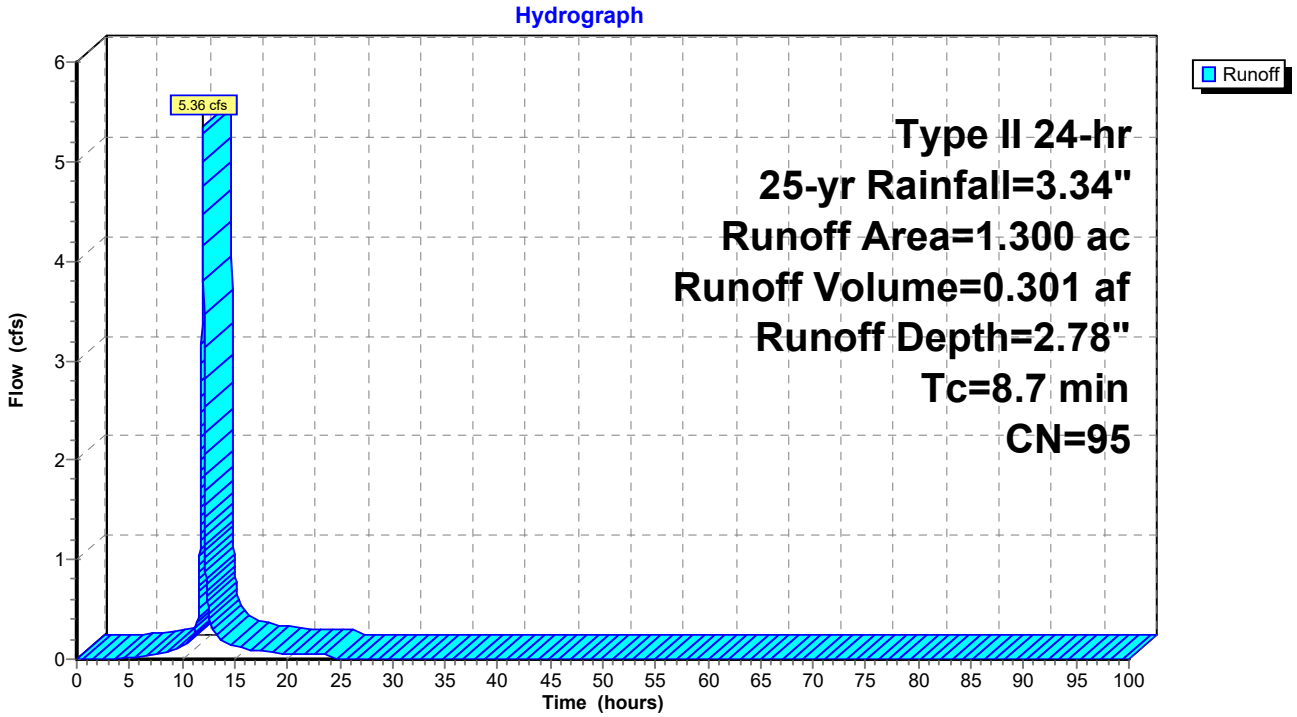
Runoff = 5.36 cfs @ 12.00 hrs, Volume= 0.301 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

	Area (ac)	CN	Description
*	1.300	95	Closure Turf
	1.300		100.00% Pervious Area

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

Subcatchment 16S: Area 2B



Summary for Subcatchment 17S: Area 3B

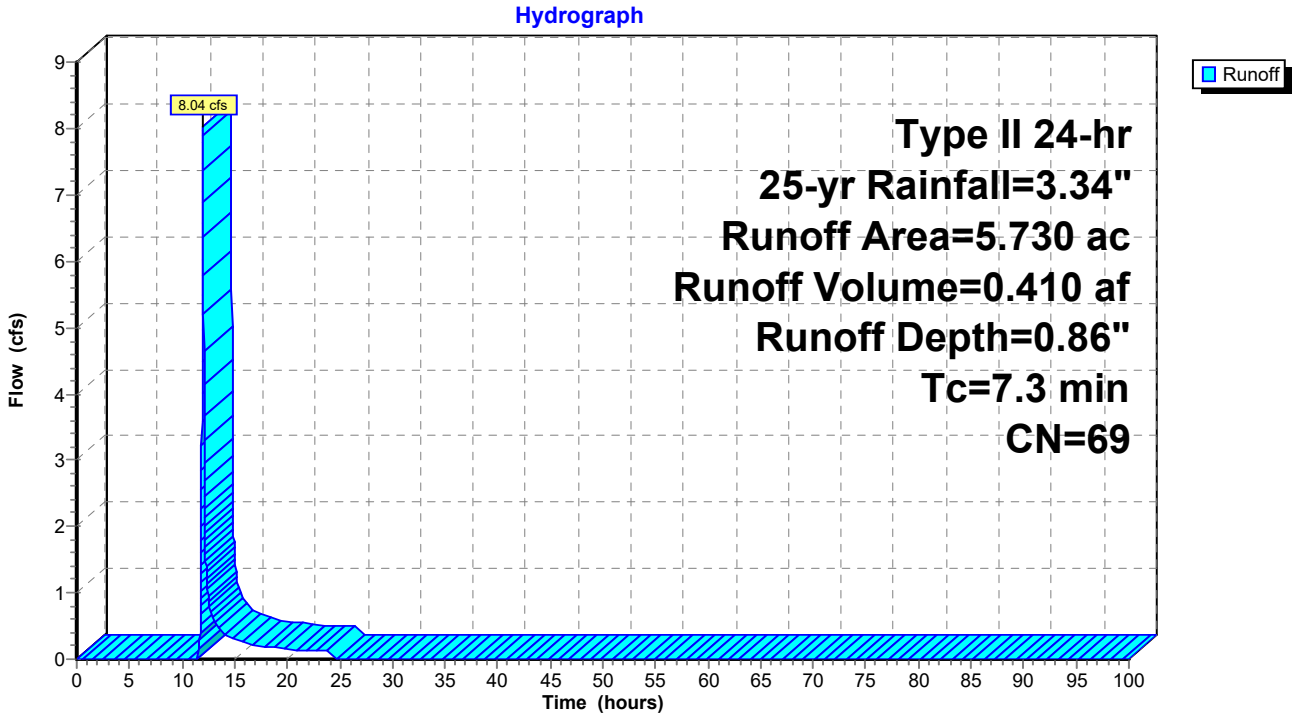
Runoff = 8.04 cfs @ 12.00 hrs, Volume= 0.410 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

Area (ac)	CN	Description
5.730	69	50-75% Grass cover, Fair, HSG B
5.730		100.00% Pervious Area

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

Subcatchment 17S: Area 3B



Summary for Subcatchment 18S: Area 1B

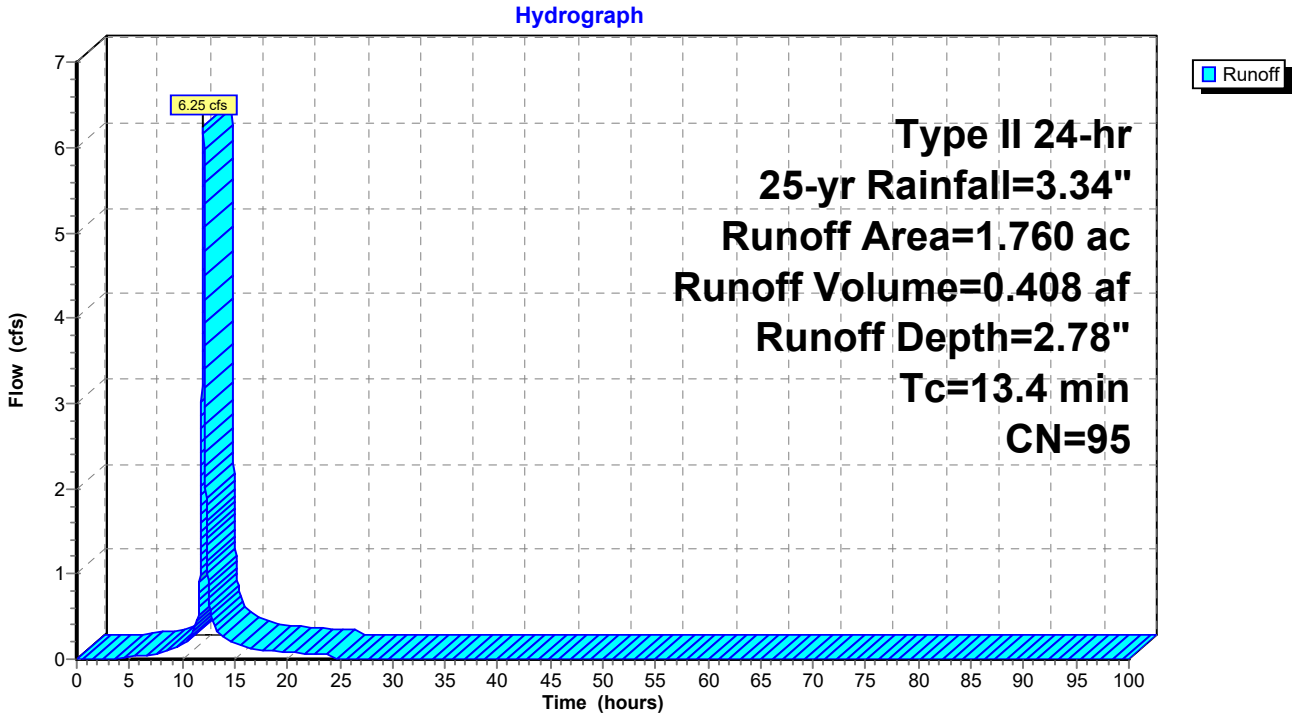
Runoff = 6.25 cfs @ 12.05 hrs, Volume= 0.408 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

	Area (ac)	CN	Description
*	1.760	95	Closure Turf
	1.760		100.00% Pervious Area

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

Subcatchment 18S: Area 1B



Summary for Subcatchment 19S: Area 6

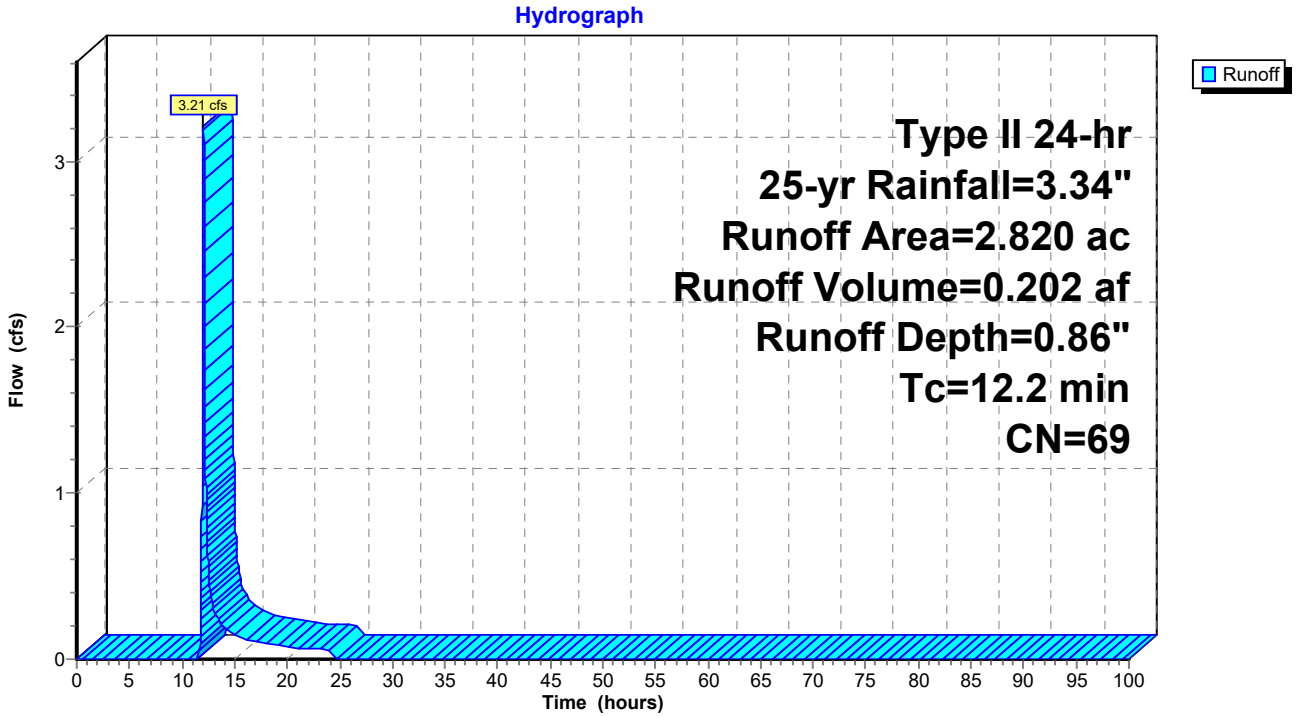
Runoff = 3.21 cfs @ 12.05 hrs, Volume= 0.202 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

Area (ac)	CN	Description
2.820	69	50-75% Grass cover, Fair, HSG B
2.820		100.00% Pervious Area

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

Subcatchment 19S: Area 6



Summary for Subcatchment 20S: Area 7

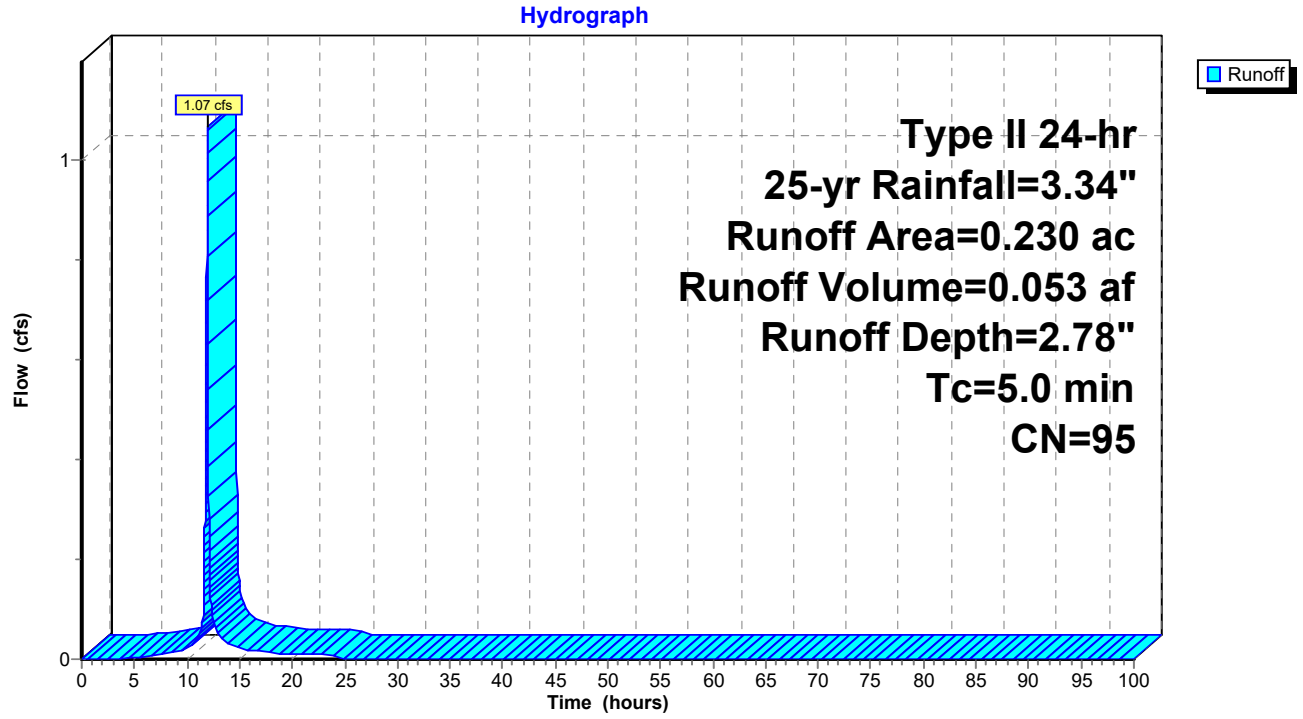
Runoff = 1.07 cfs @ 11.96 hrs, Volume= 0.053 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

	Area (ac)	CN	Description
*	0.230	95	Closure Turf
	0.230		100.00% Pervious Area

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

Subcatchment 20S: Area 7



Summary for Subcatchment 21S: Area 8

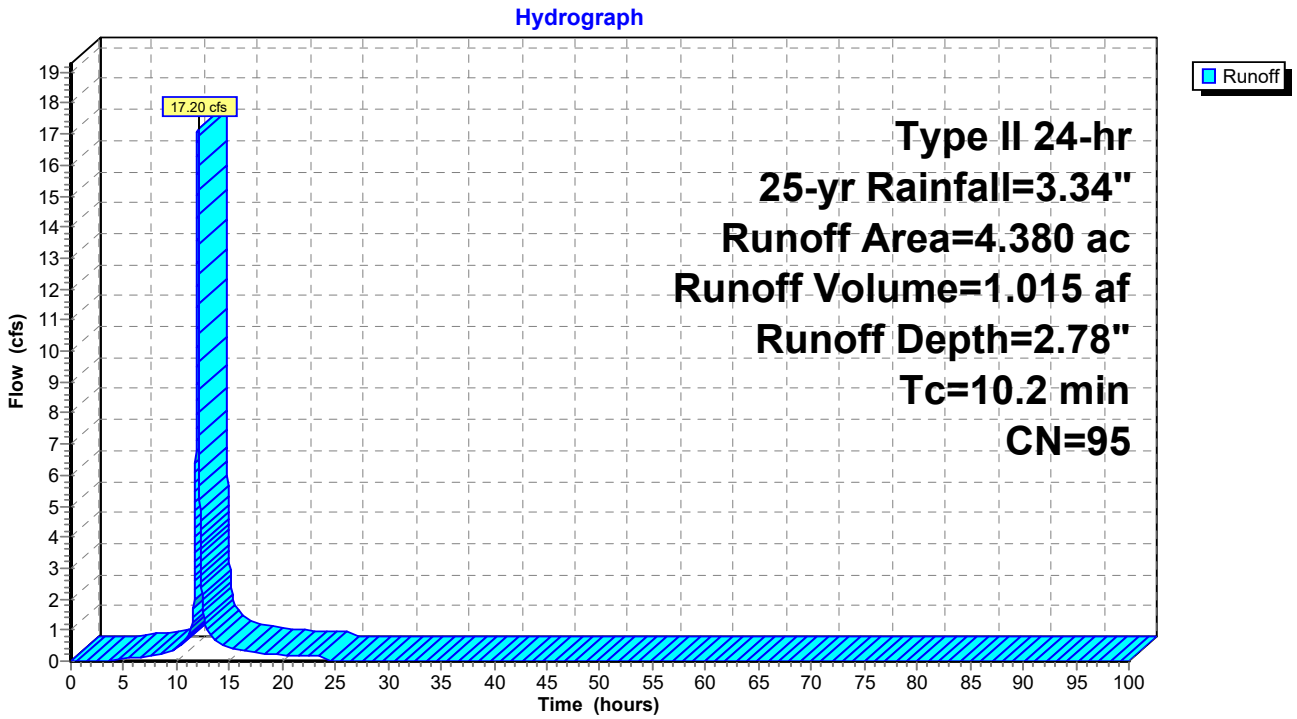
Runoff = 17.20 cfs @ 12.01 hrs, Volume= 1.015 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

	Area (ac)	CN	Description
*	4.014	95	Closure Turf
	0.366	96	Gravel surface, HSG B
	4.380	95	Weighted Average
	4.380		100.00% Pervious Area

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

Subcatchment 21S: Area 8



Summary for Subcatchment 22S: Area 9

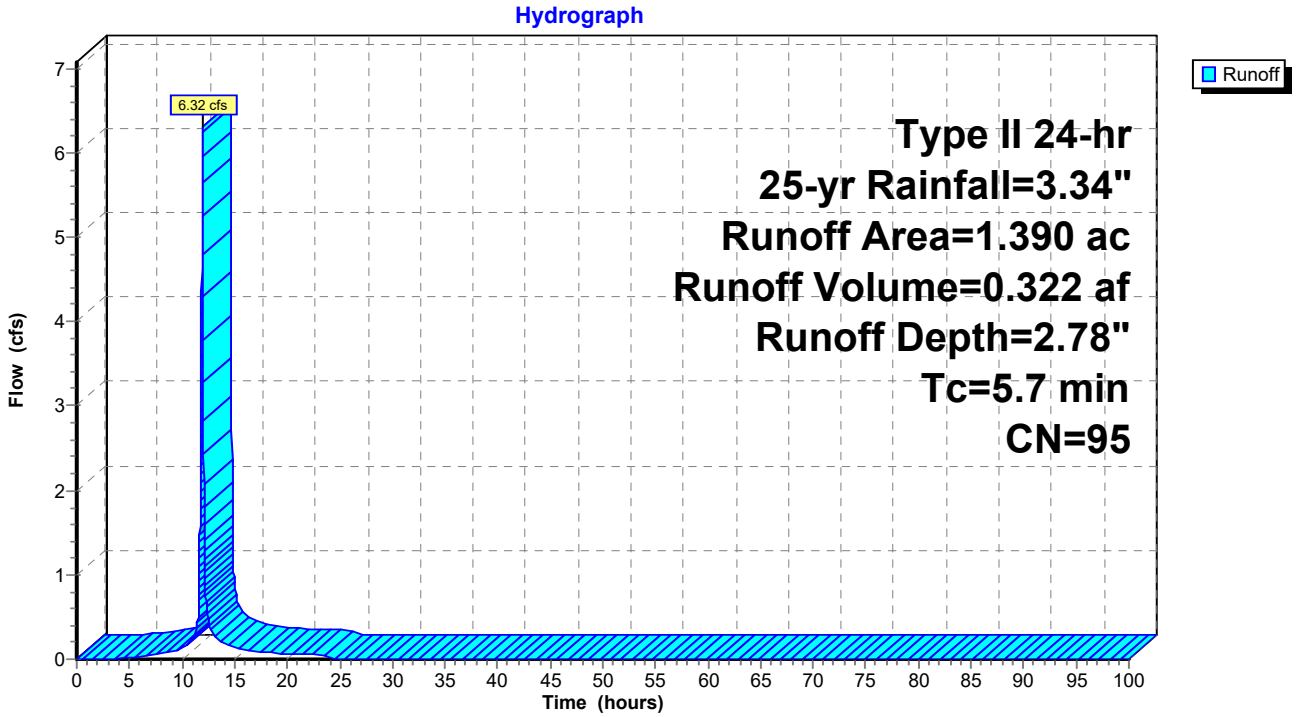
Runoff = 6.32 cfs @ 11.96 hrs, Volume= 0.322 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-yr Rainfall=3.34"

	Area (ac)	CN	Description
*	1.390	95	Closure Turf
	1.390		100.00% Pervious Area

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

Subcatchment 22S: Area 9



Summary for Reach 16R: Drop Chute

Inflow Area = 1.620 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 7.54 cfs @ 11.96 hrs, Volume= 0.376 af
Outflow = 7.52 cfs @ 11.96 hrs, Volume= 0.376 af, Atten= 0%, Lag= 0.3 min

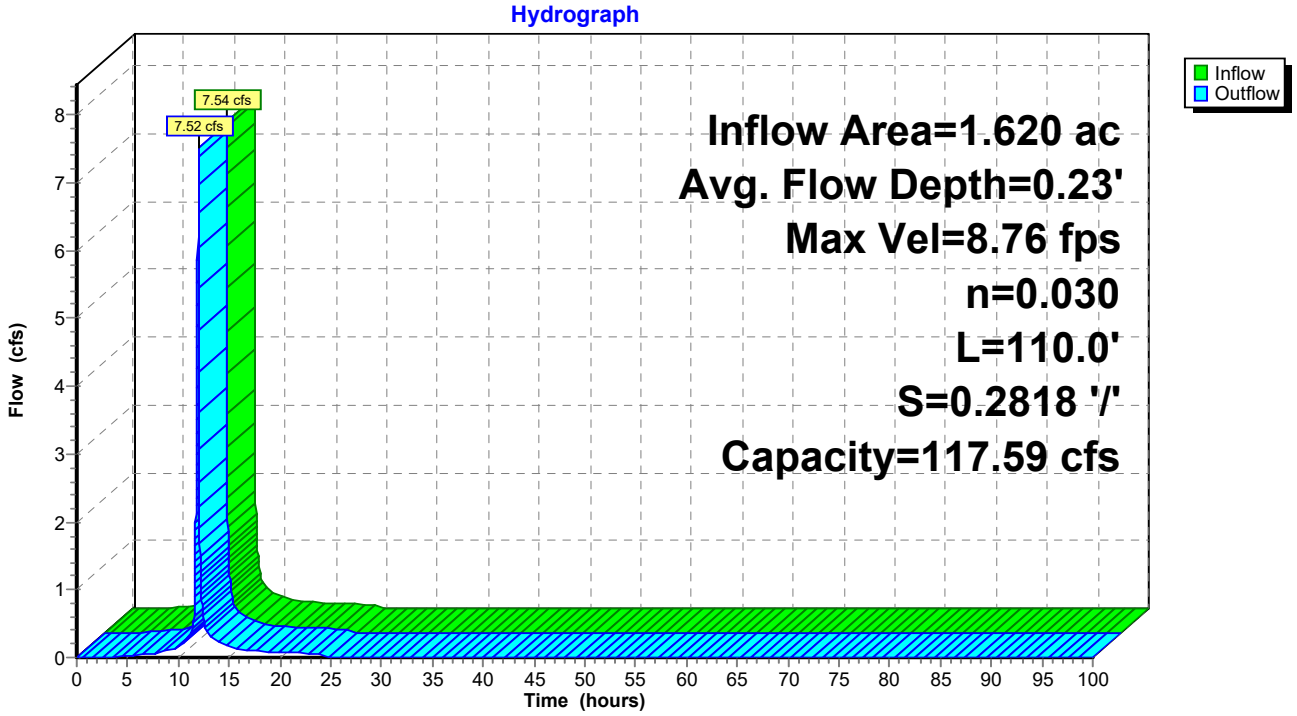
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.76 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 0.9 min

Peak Storage= 95 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 117.59 cfs

3.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 110.0' Slope= 0.2818 '/'
Inlet Invert= 4,359.00', Outlet Invert= 4,328.00'

‡

Reach 16R: Drop Chute



Summary for Reach 17R: East Perimeter Channel

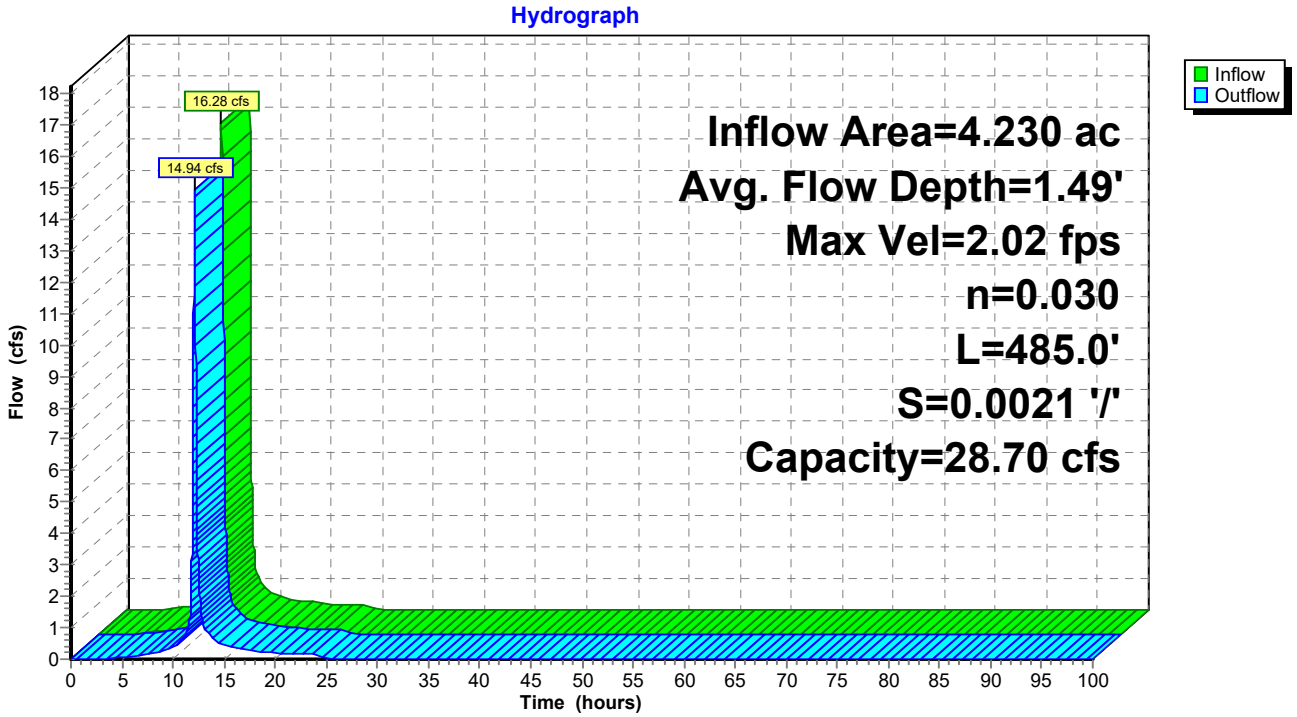
Inflow Area = 4.230 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 16.28 cfs @ 12.02 hrs, Volume= 0.981 af
Outflow = 14.94 cfs @ 12.12 hrs, Volume= 0.981 af, Atten= 8%, Lag= 6.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.02 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.54 fps, Avg. Travel Time= 14.9 min

Peak Storage= 3,581 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.49'
Defined Flood Depth= 1.50' Flow Area= 7.5 sf, Capacity= 15.27 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 28.70 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 485.0' Slope= 0.0021 '/'
Inlet Invert= 4,328.00', Outlet Invert= 4,327.00'

Reach 17R: East Perimeter Channel



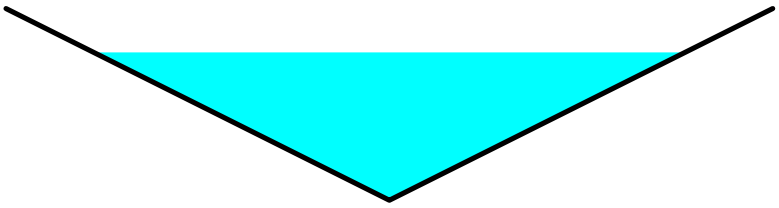
Summary for Reach 18R: South Perimeter Channel

Inflow Area = 4.580 ac, 0.00% Impervious, Inflow Depth = 1.60" for 25-yr event
Inflow = 9.46 cfs @ 12.05 hrs, Volume= 0.610 af
Outflow = 8.62 cfs @ 12.17 hrs, Volume= 0.610 af, Atten= 9%, Lag= 7.0 min

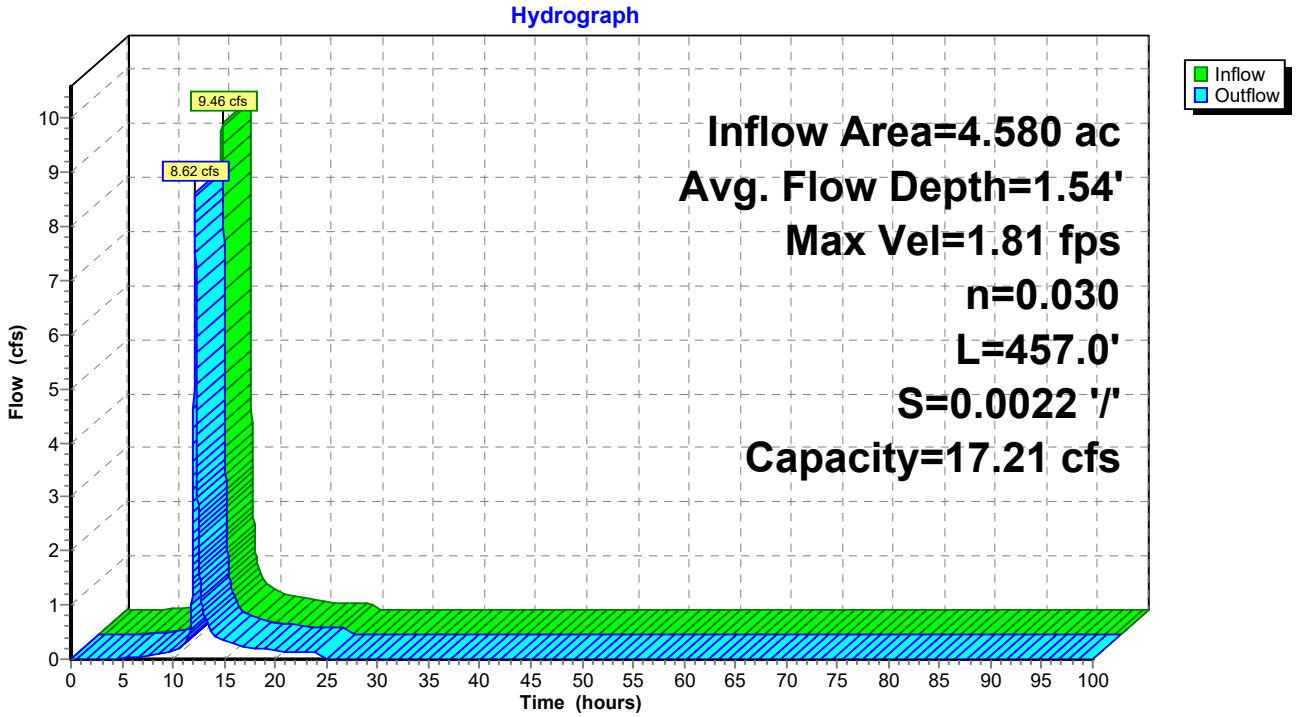
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 1.81 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 13.5 min

Peak Storage= 2,176 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.54'
Defined Flood Depth= 3.00' Flow Area= 16.0 sf, Capacity= 39.96 cfs
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 17.21 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 457.0' Slope= 0.0022 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,326.00'



Reach 18R: South Perimeter Channel



Summary for Reach 23R: West Access Road Culvert

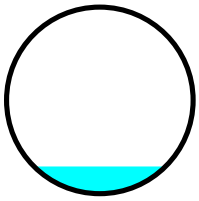
[52] Hint: Inlet/Outlet conditions not evaluated

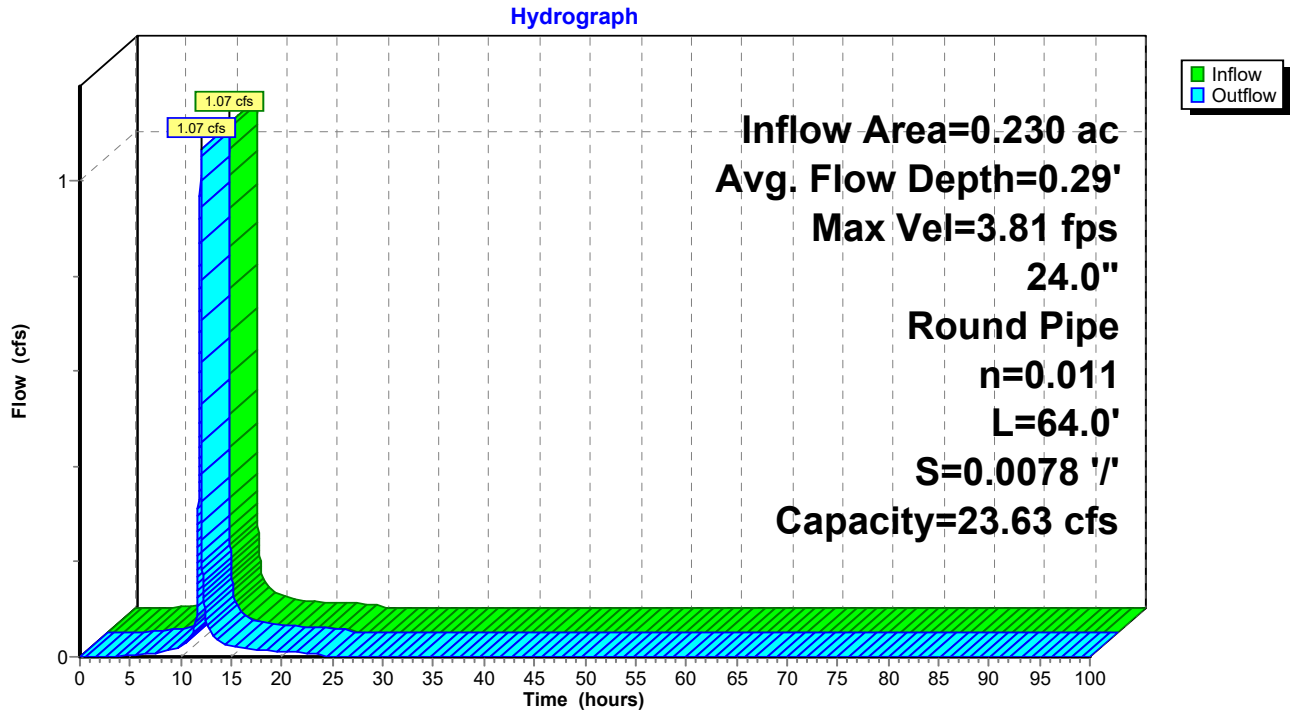
Inflow Area = 0.230 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 1.07 cfs @ 11.96 hrs, Volume= 0.053 af
Outflow = 1.07 cfs @ 11.96 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.81 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.09 fps, Avg. Travel Time= 1.0 min

Peak Storage= 18 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 23.63 cfs

24.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 64.0' Slope= 0.0078 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,326.50'





Summary for Reach 25R: Northwest Channel

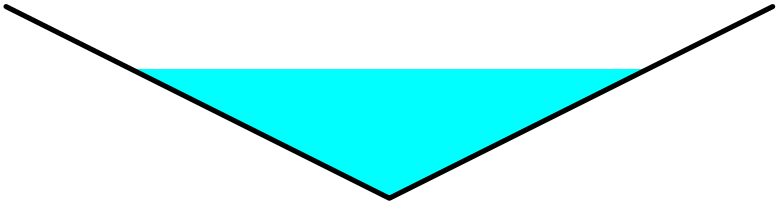
[63] Warning: Exceeded Reach 23R INLET depth by 1.18' @ 12.08 hrs
[61] Hint: Exceeded Reach 27R outlet invert by 0.35' @ 12.06 hrs

Inflow Area = 4.610 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 17.30 cfs @ 12.06 hrs, Volume= 1.069 af
Outflow = 17.28 cfs @ 12.06 hrs, Volume= 1.069 af, Atten= 0%, Lag= 0.3 min

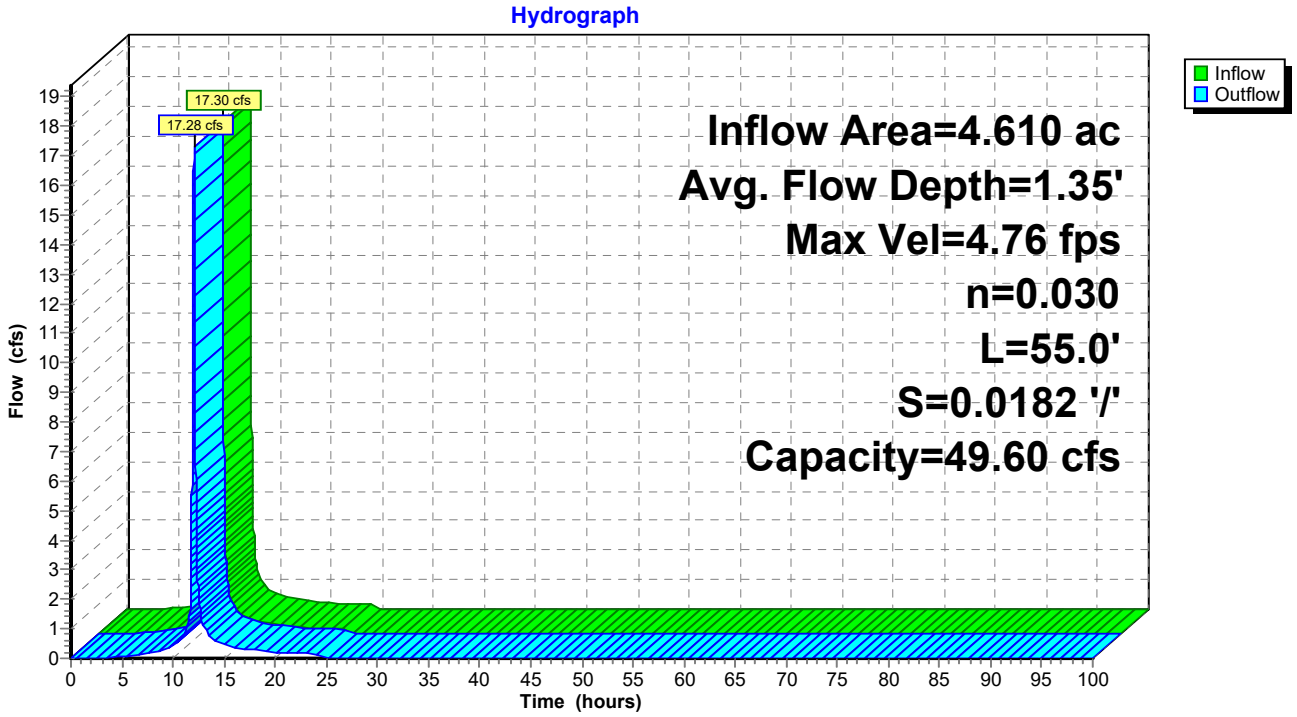
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.76 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 0.6 min

Peak Storage= 200 cf @ 12.06 hrs
Average Depth at Peak Storage= 1.35'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 49.60 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 55.0' Slope= 0.0182 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,326.00'



Reach 25R: Northwest Channel



Summary for Reach 27R: Access Road Channel

Inflow Area = 4.380 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 17.20 cfs @ 12.01 hrs, Volume= 1.015 af
Outflow = 16.85 cfs @ 12.06 hrs, Volume= 1.015 af, Atten= 2%, Lag= 2.9 min

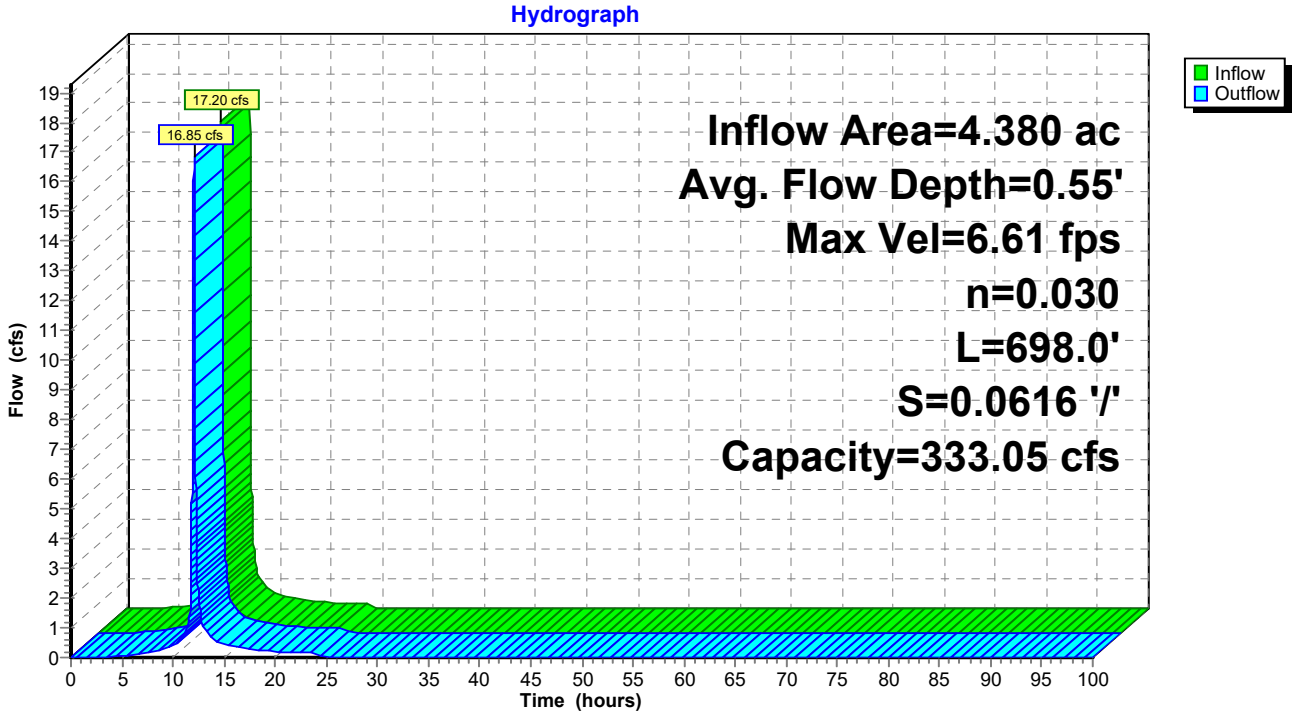
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.61 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 6.8 min

Peak Storage= 1,780 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 2.30' Flow Area= 22.8 sf, Capacity= 333.05 cfs

3.00' x 2.30' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 16.80'
Length= 698.0' Slope= 0.0616 '/'
Inlet Invert= 4,371.00', Outlet Invert= 4,328.00'

‡

Reach 27R: Access Road Channel



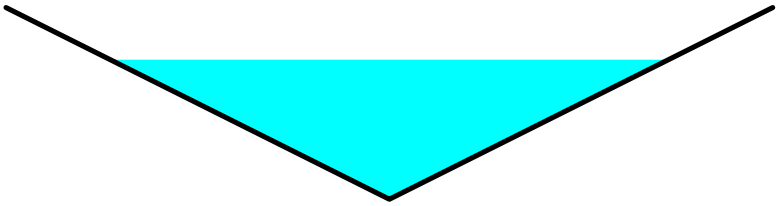
Summary for Reach 28R: North Channel

Inflow Area = 1.390 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 6.32 cfs @ 11.96 hrs, Volume= 0.322 af
Outflow = 5.01 cfs @ 12.13 hrs, Volume= 0.322 af, Atten= 21%, Lag= 10.0 min

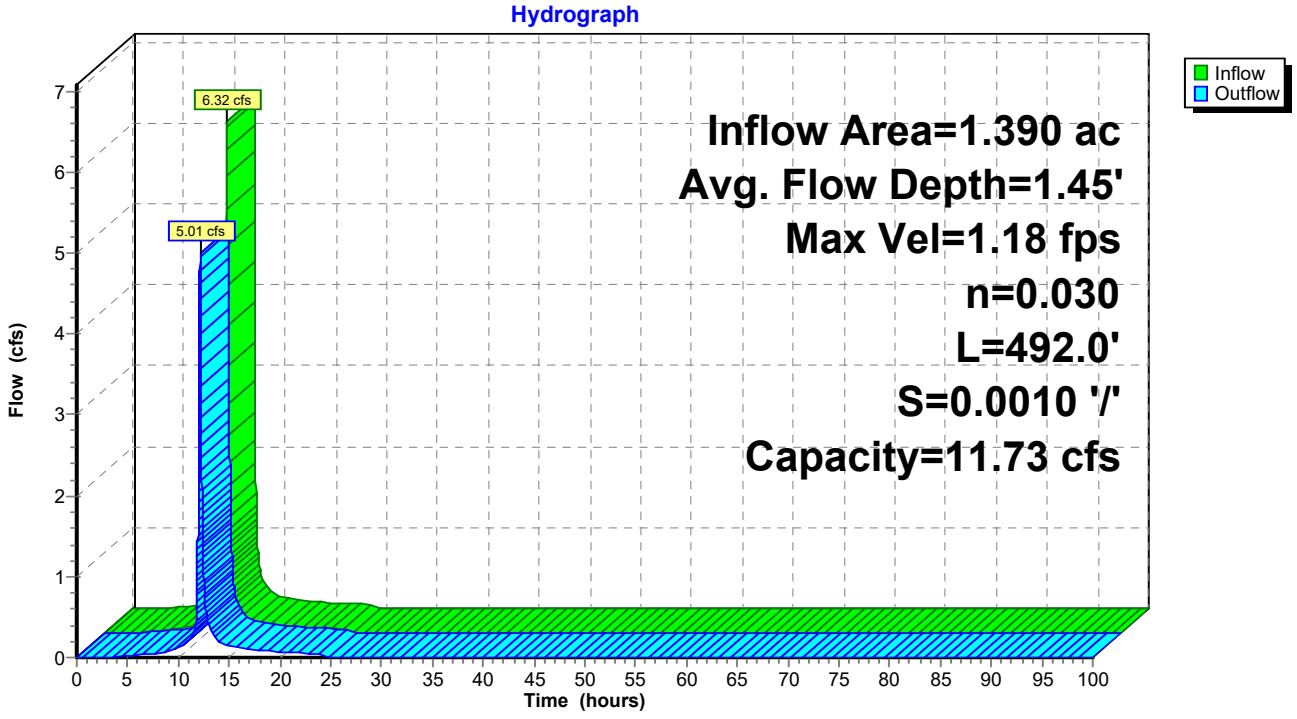
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.18 fps, Min. Travel Time= 6.9 min
Avg. Velocity = 0.34 fps, Avg. Travel Time= 24.4 min

Peak Storage= 2,081 cf @ 12.02 hrs
Average Depth at Peak Storage= 1.45'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 11.73 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 492.0' Slope= 0.0010 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,326.50'



Reach 28R: North Channel



Summary for Reach 29R: Texas Crossing

[61] Hint: Exceeded Reach 17R outlet invert by 0.56' @ 12.13 hrs
[61] Hint: Exceeded Reach 30R outlet invert by 0.56' @ 12.13 hrs

Inflow Area = 7.090 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 20.71 cfs @ 12.12 hrs, Volume= 1.644 af
Outflow = 20.61 cfs @ 12.14 hrs, Volume= 1.644 af, Atten= 0%, Lag= 1.7 min

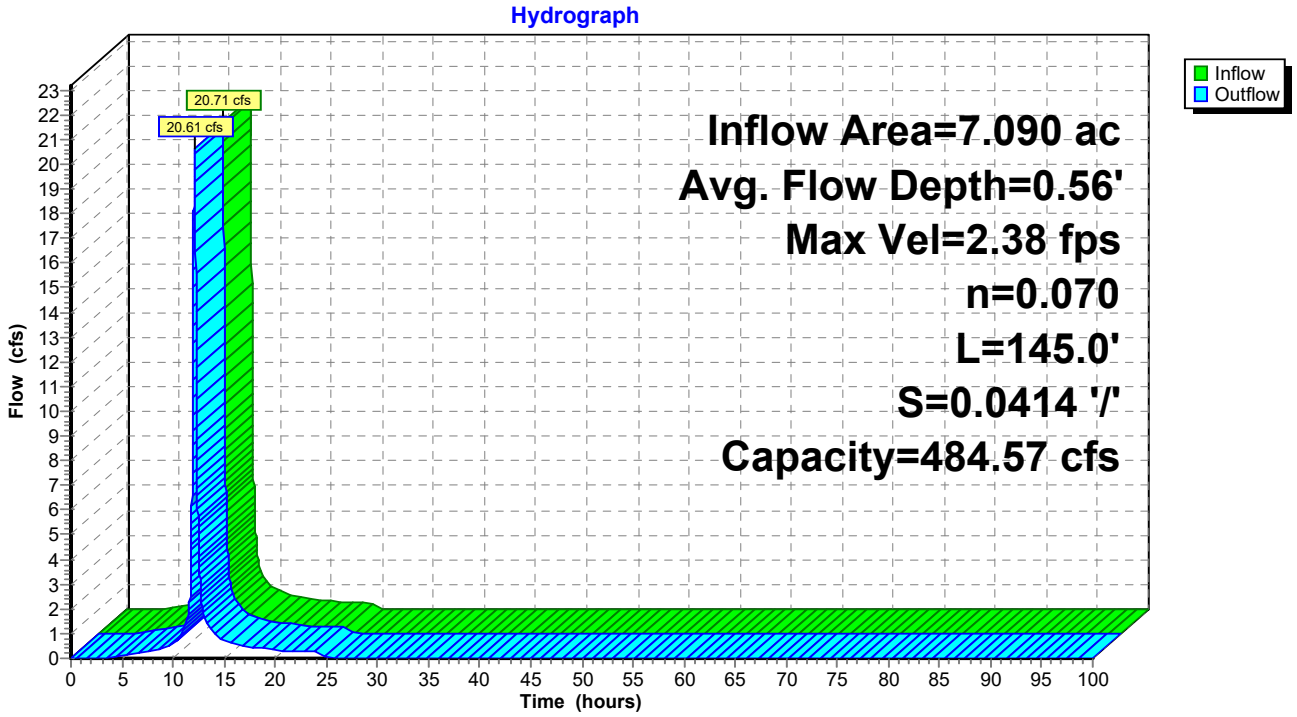
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.38 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 3.9 min

Peak Storage= 1,257 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.56'
Defined Flood Depth= 3.00' Flow Area= 117.4 sf, Capacity= 706.01 cfs
Bank-Full Depth= 2.50' Flow Area= 87.5 sf, Capacity= 484.57 cfs

10.00' x 2.50' deep channel, n= 0.070
Side Slope Z-value= 10.0 '/' Top Width= 60.00'
Length= 145.0' Slope= 0.0414 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,321.00'

‡

Reach 29R: Texas Crossing



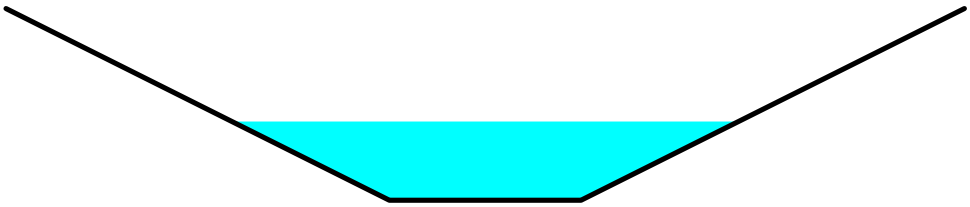
Summary for Reach 30R: East Perimeter Channel

Inflow Area = 1.240 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 5.12 cfs @ 12.00 hrs, Volume= 0.287 af
Outflow = 4.43 cfs @ 12.13 hrs, Volume= 0.287 af, Atten= 13%, Lag= 8.2 min

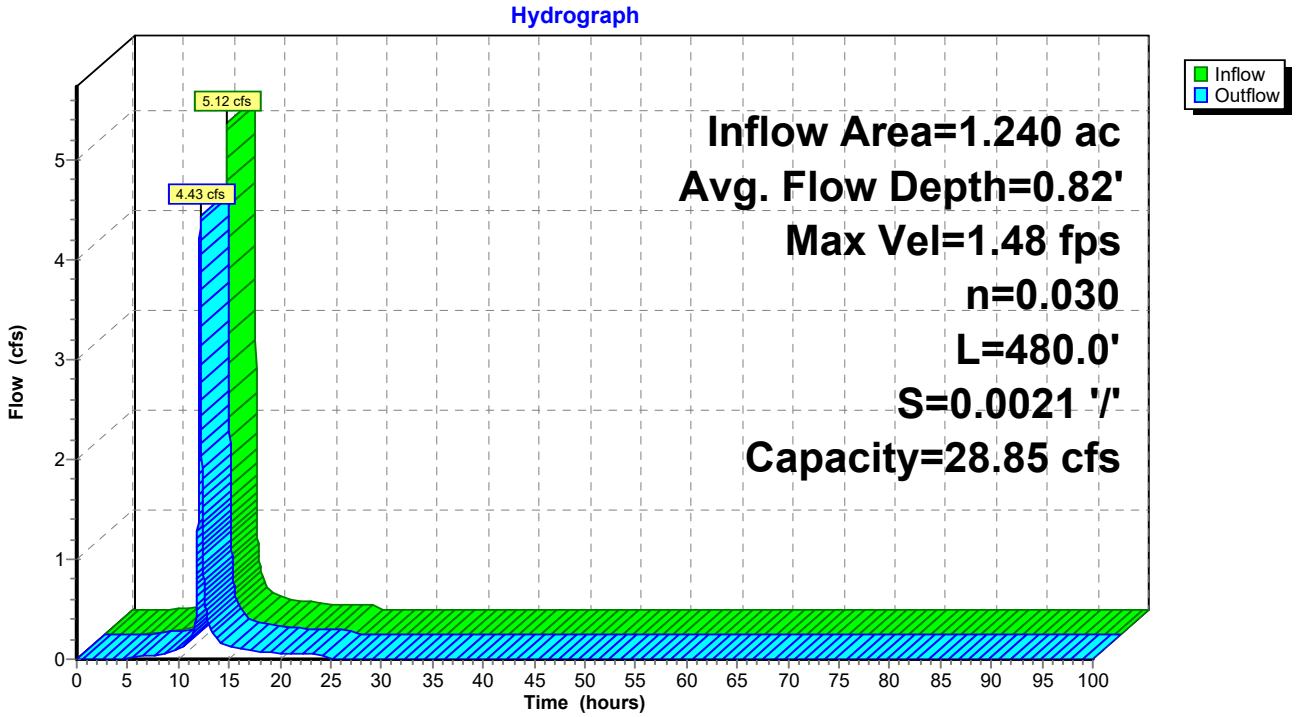
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 1.48 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.37 fps, Avg. Travel Time= 21.4 min

Peak Storage= 1,440 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.82'
Defined Flood Depth= 1.50' Flow Area= 7.5 sf, Capacity= 15.35 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 28.85 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 480.0' Slope= 0.0021 '/'
Inlet Invert= 4,328.00', Outlet Invert= 4,327.00'



Reach 30R: East Perimeter Channel



Summary for Pond 4P: Drop Inlet C-1

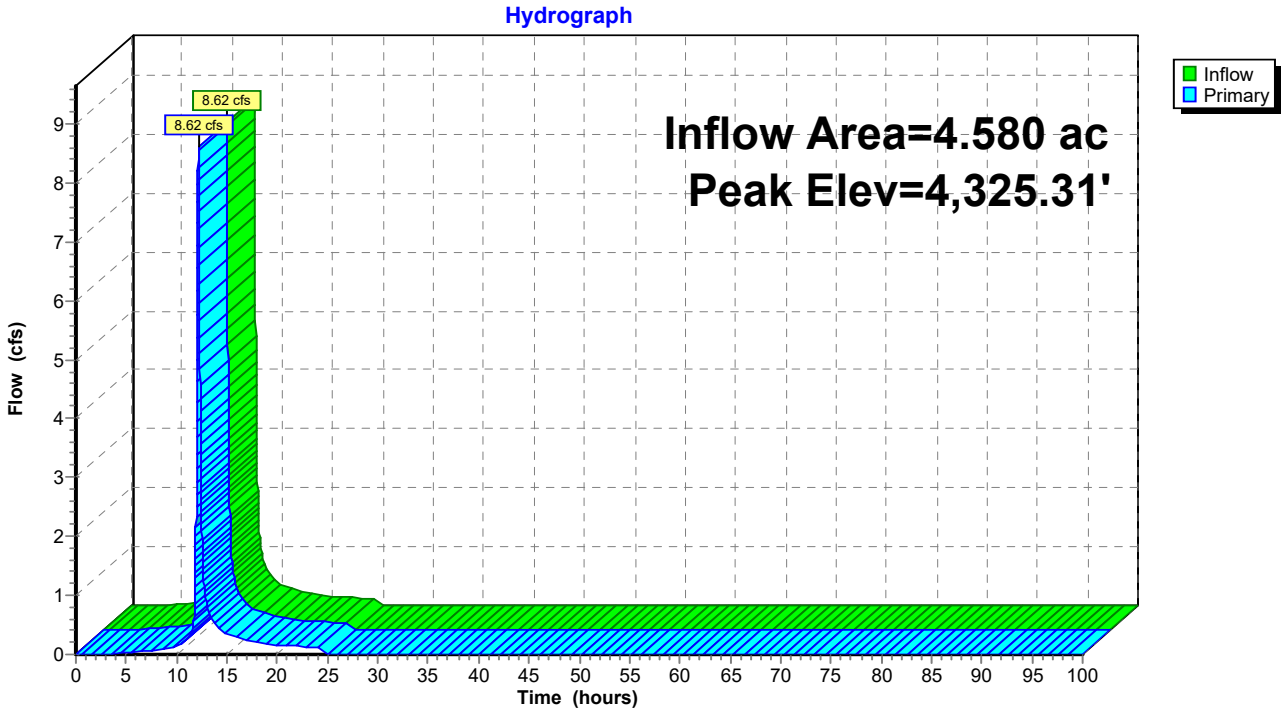
Inflow Area = 4.580 ac, 0.00% Impervious, Inflow Depth = 1.60" for 25-yr event
Inflow = 8.62 cfs @ 12.17 hrs, Volume= 0.610 af
Outflow = 8.62 cfs @ 12.17 hrs, Volume= 0.610 af, Atten= 0%, Lag= 0.0 min
Primary = 8.62 cfs @ 12.17 hrs, Volume= 0.610 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,325.31' @ 12.17 hrs
Flood Elev= 4,327.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	4,321.50'	**18.0" Round RCP_Round 18"** L= 130.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 4,321.50' / 4,320.50' S= 0.0077 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	4,325.00'	**5.7' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	4,325.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=8.57 cfs @ 12.17 hrs HW=4,325.31' (Free Discharge)
└**1=RCP_Round 18"** (Passes 8.57 cfs of 13.10 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 5.62 cfs @ 1.59 fps)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 2.96 cfs @ 1.59 fps)

Pond 4P: Drop Inlet C-1



Summary for Pond 5P: Drop Inlet C-2

[81] Warning: Exceeded Pond 4P by 1.00' @ 11.71 hrs

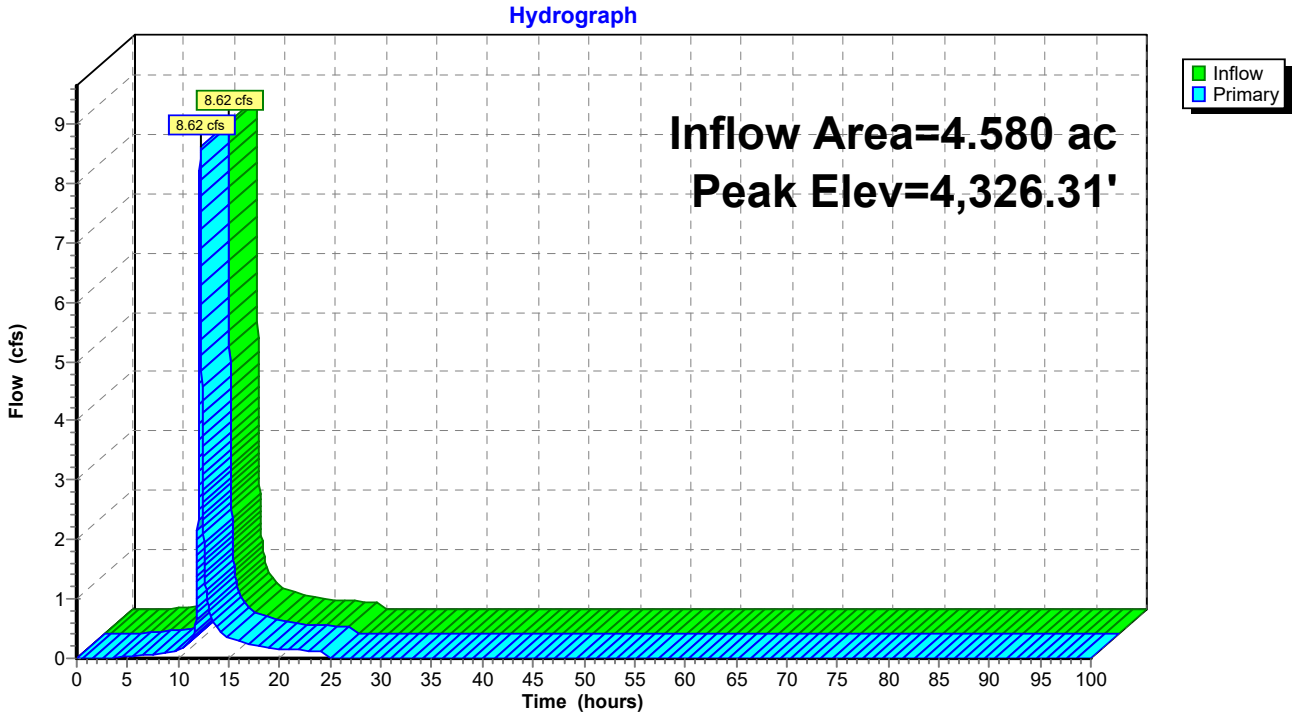
Inflow Area = 4.580 ac, 0.00% Impervious, Inflow Depth = 1.60" for 25-yr event
Inflow = 8.62 cfs @ 12.17 hrs, Volume= 0.610 af
Outflow = 8.62 cfs @ 12.17 hrs, Volume= 0.610 af, Atten= 0%, Lag= 0.0 min
Primary = 8.62 cfs @ 12.17 hrs, Volume= 0.610 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,326.31' @ 12.17 hrs
Flood Elev= 4,328.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	4,320.50'	**36.0" Round RCP_Round 36"** L= 129.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 4,320.50' / 4,320.00' S= 0.0039 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	4,326.00'	**5.7' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	4,326.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=8.55 cfs @ 12.17 hrs HW=4,326.31' (Free Discharge)
└**1=RCP_Round 36"** (Passes 8.55 cfs of 66.10 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Weir Controls 5.60 cfs @ 1.59 fps)
  └**3=Broad-Crested Rectangular Weir** (Weir Controls 2.95 cfs @ 1.59 fps)

Pond 5P: Drop Inlet C-2



Summary for Pond 9P: Southeast Stormwater Pond

Inflow Area = 5.670 ac, 0.00% Impervious, Inflow Depth = 1.46" for 25-yr event
Inflow = 9.46 cfs @ 12.16 hrs, Volume= 0.688 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

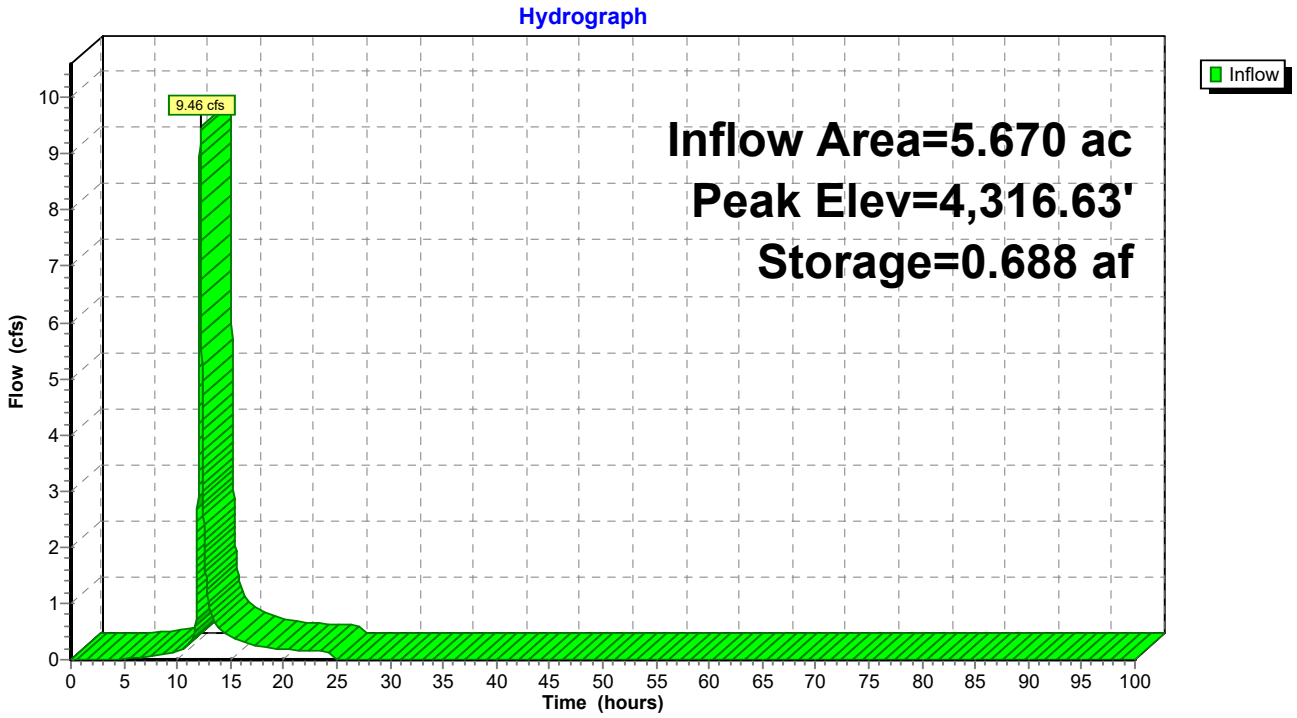
Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,316.63' @ 52.39 hrs Surf.Area= 0.000 ac Storage= 0.688 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	4,311.00'	2.378 af	**Custom Stage Data**Listed below

Elevation (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
4,311.00	0.000	0.000
4,313.00	0.171	0.171
4,315.00	0.247	0.418
4,317.00	0.331	0.749
4,319.00	0.420	1.169
4,321.00	0.514	1.683
4,325.00	0.695	2.378

Pond 9P: Southeast Stormwater Pond



Summary for Pond 14P: East Stormwater Collection Area

Inflow Area = 17.190 ac, 0.00% Impervious, Inflow Depth = 1.65" for 25-yr event
Inflow = 31.43 cfs @ 12.01 hrs, Volume= 2.367 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

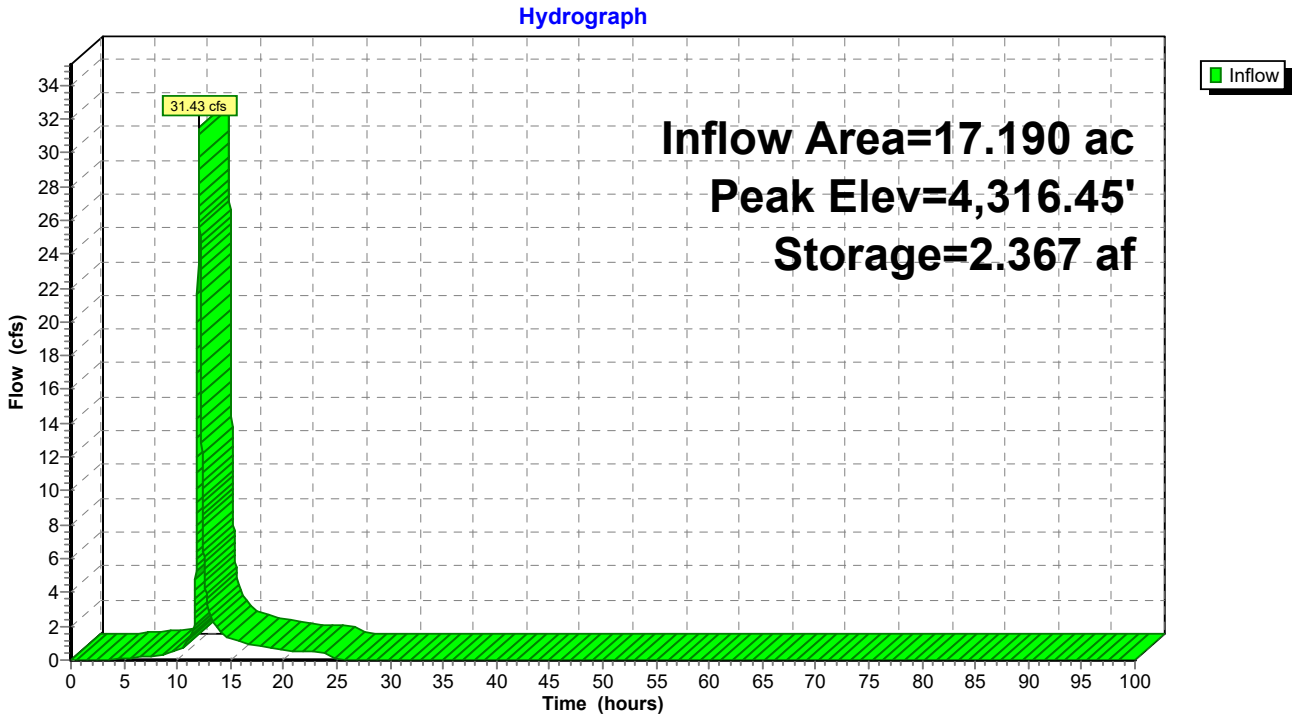
Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,316.45' @ 44.11 hrs Surf.Area= 0.000 ac Storage= 2.367 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	4,309.00'	3.760 af	**Custom Stage Data**Listed below

Elevation (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
4,309.00	0.000	0.000
4,310.00	0.132	0.132
4,311.00	0.191	0.323
4,312.00	0.250	0.573
4,313.00	0.306	0.879
4,314.00	0.417	1.296
4,315.00	0.504	1.800
4,320.00	1.960	3.760

Pond 14P: East Stormwater Collection Area



Summary for Pond 26P: Drop Inlet C-3

[61] Hint: Exceeded Reach 25R outlet invert by 0.50' @ 12.08 hrs

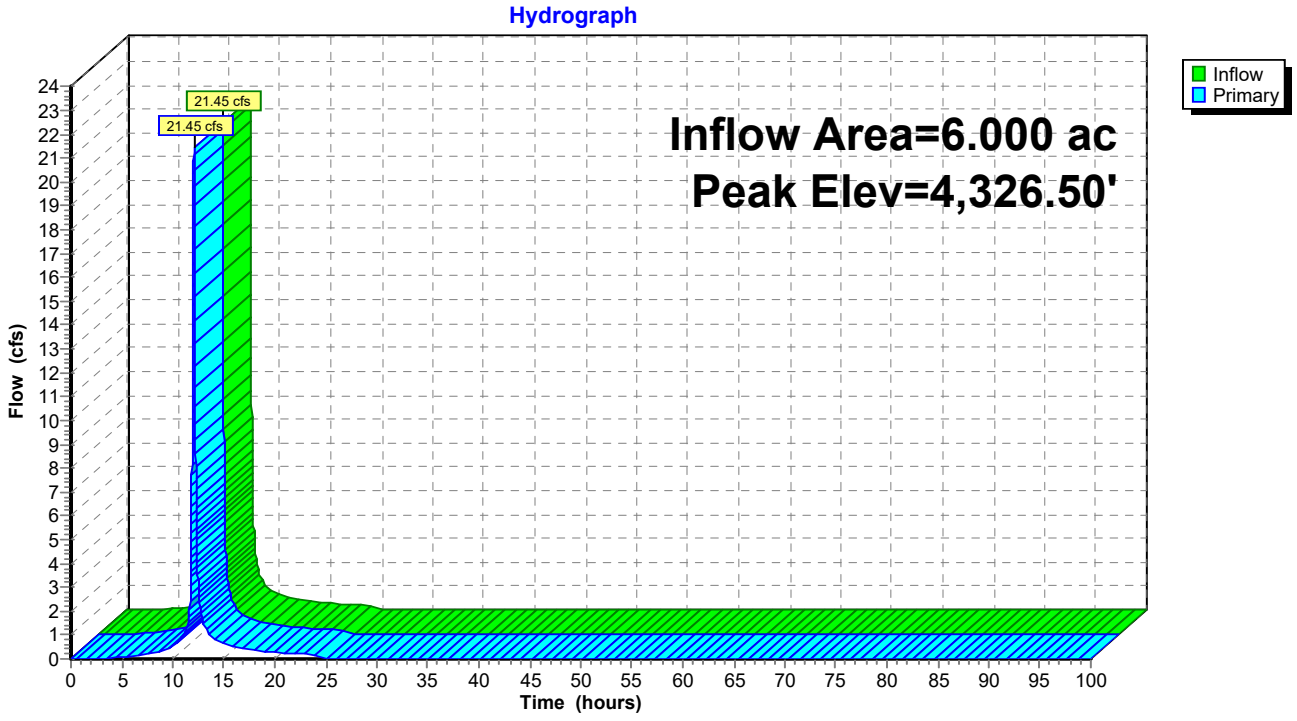
Inflow Area = 6.000 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 21.45 cfs @ 12.08 hrs, Volume= 1.391 af
Outflow = 21.45 cfs @ 12.08 hrs, Volume= 1.391 af, Atten= 0%, Lag= 0.0 min
Primary = 21.45 cfs @ 12.08 hrs, Volume= 1.391 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,326.50' @ 12.08 hrs
Flood Elev= 4,327.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	4,326.00'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 4.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Device 1	4,318.00'	**42.0" Round RCP_Round 42"** L= 75.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 4,318.00' / 4,317.00' S= 0.0133 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 9.62 sf

Primary OutFlow Max=21.34 cfs @ 12.08 hrs HW=4,326.50' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 21.34 cfs @ 2.13 fps)
↑**2=RCP_Round 42"** (Passes 21.34 cfs of 32.82 cfs potential flow)

Pond 26P: Drop Inlet C-3



Time span=0.00-100.00 hrs, dt=0.01 hrs, 10001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Area 1A Runoff Area=2.930 ac 0.00% Impervious Runoff Depth=3.85"
Tc=11.4 min CN=95 Runoff=15.03 cfs 0.939 af

Subcatchment2S: Area 2A Runoff Area=1.240 ac 0.00% Impervious Runoff Depth=3.85"
Tc=8.7 min CN=95 Runoff=6.93 cfs 0.397 af

Subcatchment3S: Area 3A Runoff Area=4.370 ac 0.00% Impervious Runoff Depth=1.55"
Tc=7.3 min CN=69 Runoff=11.44 cfs 0.563 af

Subcatchment7S: Area 4 Runoff Area=0.130 ac 0.00% Impervious Runoff Depth=1.55"
Tc=5.0 min CN=69 Runoff=0.37 cfs 0.017 af

Subcatchment8S: Area 5 Runoff Area=0.960 ac 0.00% Impervious Runoff Depth=1.55"
Tc=15.4 min CN=69 Runoff=1.85 cfs 0.124 af

Subcatchment15S: Drop Chute Area Runoff Area=1.620 ac 0.00% Impervious Runoff Depth=3.85"
Tc=5.0 min CN=95 Runoff=10.20 cfs 0.519 af

Subcatchment16S: Area 2B Runoff Area=1.300 ac 0.00% Impervious Runoff Depth=3.85"
Tc=8.7 min CN=95 Runoff=7.26 cfs 0.417 af

Subcatchment17S: Area 3B Runoff Area=5.730 ac 0.00% Impervious Runoff Depth=1.55"
Tc=7.3 min CN=69 Runoff=15.00 cfs 0.739 af

Subcatchment18S: Area 1B Runoff Area=1.760 ac 0.00% Impervious Runoff Depth=3.85"
Tc=13.4 min CN=95 Runoff=8.48 cfs 0.564 af

Subcatchment19S: Area 6 Runoff Area=2.820 ac 0.00% Impervious Runoff Depth=1.55"
Tc=12.2 min CN=69 Runoff=6.10 cfs 0.364 af

Subcatchment20S: Area 7 Runoff Area=0.230 ac 0.00% Impervious Runoff Depth=3.85"
Tc=5.0 min CN=95 Runoff=1.45 cfs 0.074 af

Subcatchment21S: Area 8 Runoff Area=4.380 ac 0.00% Impervious Runoff Depth=3.85"
Tc=10.2 min CN=95 Runoff=23.31 cfs 1.404 af

Subcatchment22S: Area 9 Runoff Area=1.390 ac 0.00% Impervious Runoff Depth=3.85"
Tc=5.7 min CN=95 Runoff=8.55 cfs 0.445 af

Reach 16R: Drop Chute Avg. Flow Depth=0.28' Max Vel=9.66 fps Inflow=10.20 cfs 0.519 af
n=0.030 L=110.0' S=0.2818 '/' Capacity=117.59 cfs Outflow=10.17 cfs 0.519 af

Reach 17R: East Perimeter Channel Avg. Flow Depth=1.72' Max Vel=2.19 fps Inflow=22.06 cfs 1.356 af
n=0.030 L=485.0' S=0.0021 '/' Capacity=28.70 cfs Outflow=20.46 cfs 1.356 af

Reach 18R: South Perimeter Channel Avg. Flow Depth=1.83' Max Vel=2.02 fps Inflow=14.58 cfs 0.928 af
n=0.030 L=457.0' S=0.0022 '/' Capacity=17.21 cfs Outflow=13.49 cfs 0.928 af

Reach 23R: West Access Road Culvert Avg. Flow Depth=0.34' Max Vel=4.16 fps Inflow=1.45 cfs 0.074 af
24.0" Round Pipe n=0.011 L=64.0' S=0.0078 '/' Capacity=23.63 cfs Outflow=1.44 cfs 0.074 af

Reach 25R: Northwest Channel Avg. Flow Depth=1.51' Max Vel=5.14 fps Inflow=23.53 cfs 1.477 af
n=0.030 L=55.0' S=0.0182 '/' Capacity=49.60 cfs Outflow=23.51 cfs 1.477 af

Reach 27R: Access Road Channel Avg. Flow Depth=0.64' Max Vel=7.21 fps Inflow=23.31 cfs 1.404 af
n=0.030 L=698.0' S=0.0616 '/' Capacity=333.05 cfs Outflow=22.88 cfs 1.404 af

Reach 28R: North Channel Avg. Flow Depth=1.64' Max Vel=1.29 fps Inflow=8.55 cfs 0.445 af
n=0.030 L=492.0' S=0.0010 '/' Capacity=11.73 cfs Outflow=6.94 cfs 0.445 af

Reach 29R: Texas Crossing Avg. Flow Depth=0.66' Max Vel=2.61 fps Inflow=28.53 cfs 2.272 af
n=0.070 L=145.0' S=0.0414 '/' Capacity=484.57 cfs Outflow=28.43 cfs 2.272 af

Reach 30R: East Perimeter Channel Avg. Flow Depth=0.97' Max Vel=1.61 fps Inflow=6.93 cfs 0.397 af
n=0.030 L=480.0' S=0.0021 '/' Capacity=28.85 cfs Outflow=6.10 cfs 0.397 af

Pond 4P: Drop Inlet C-1 Peak Elev=4,325.51' Inflow=13.49 cfs 0.928 af
Outflow=13.49 cfs 0.928 af

Pond 5P: Drop Inlet C-2 Peak Elev=4,326.41' Inflow=13.49 cfs 0.928 af
Outflow=13.49 cfs 0.928 af

Pond 9P: Southeast Stormwater Pond Peak Elev=4,318.52' Storage=1.068 af Inflow=15.16 cfs 1.068 af
Outflow=0.00 cfs 0.000 af

Pond 14P: East Stormwater Collection Peak Elev=4,319.53' Storage=3.574 af Inflow=50.66 cfs 3.574 af
Outflow=0.00 cfs 0.000 af

Pond 26P: Drop Inlet C-3 Peak Elev=4,326.61' Inflow=29.49 cfs 1.923 af
Outflow=29.49 cfs 1.923 af

Total Runoff Area = 28.860 ac Runoff Volume = 6.565 af Average Runoff Depth = 2.73"
100.00% Pervious = 28.860 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Area 1A

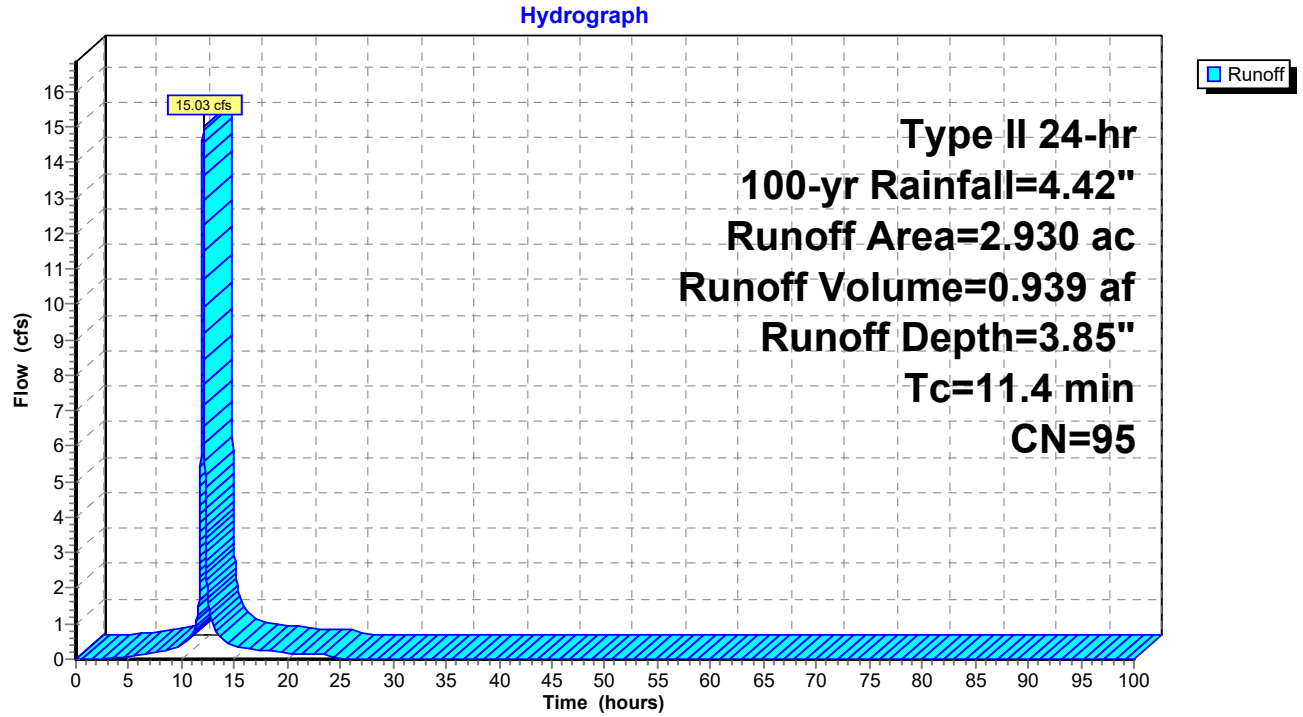
Runoff = 15.03 cfs @ 12.02 hrs, Volume= 0.939 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

	Area (ac)	CN	Description
*	2.930	95	Closure Turf
	2.930		100.00% Pervious Area

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

Subcatchment 1S: Area 1A



Summary for Subcatchment 2S: Area 2A

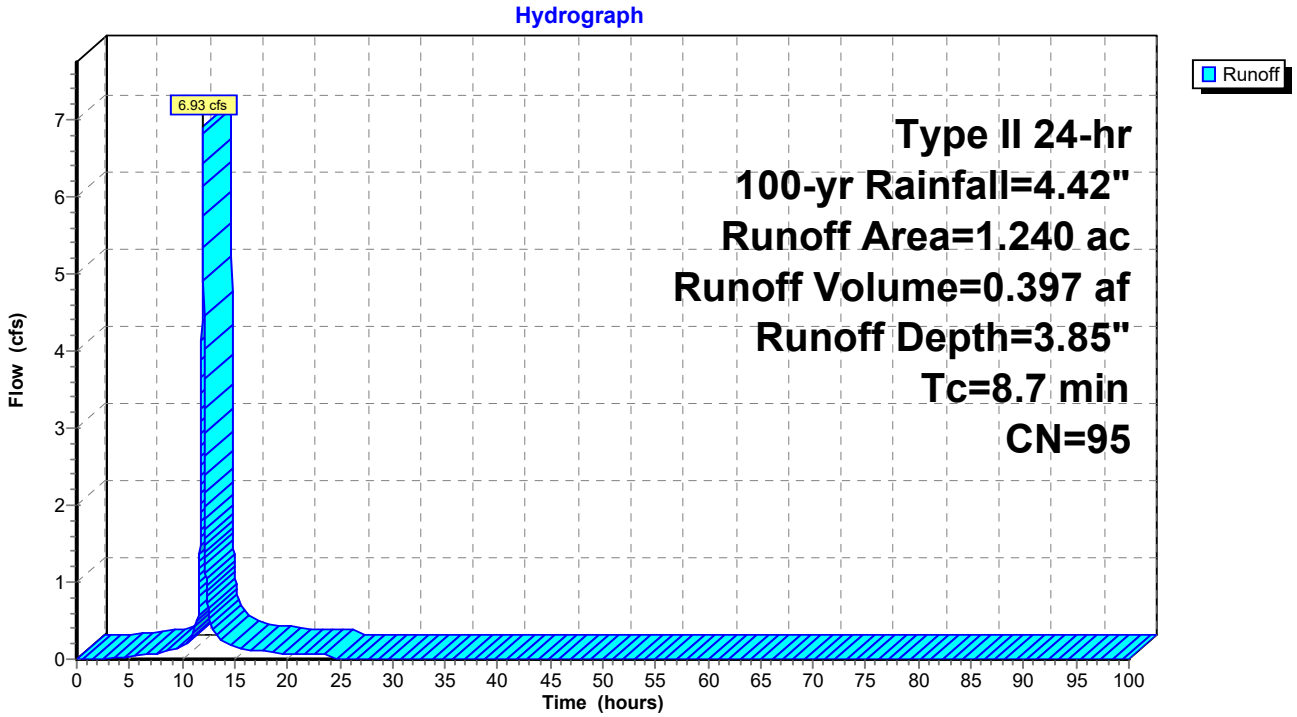
Runoff = 6.93 cfs @ 12.00 hrs, Volume= 0.397 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

	Area (ac)	CN	Description
*	1.240	95	Closure Turf
	1.240		100.00% Pervious Area

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

Subcatchment 2S: Area 2A



Summary for Subcatchment 3S: Area 3A

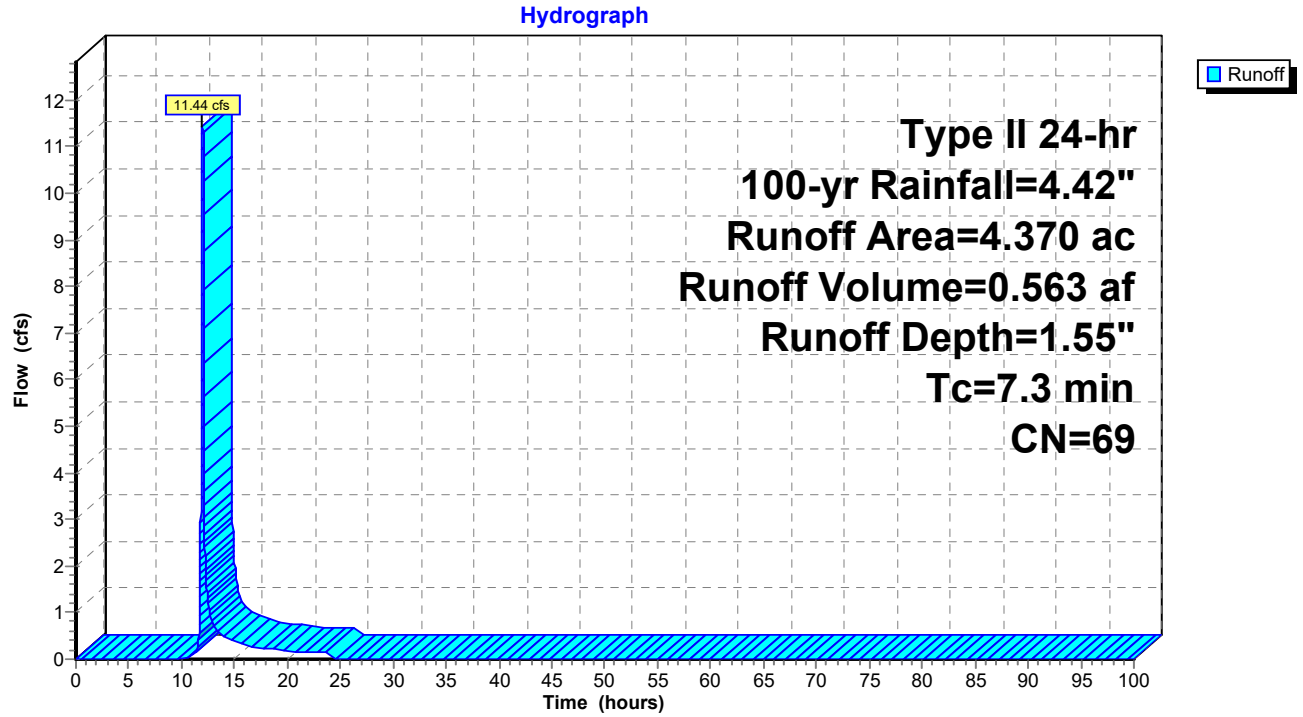
Runoff = 11.44 cfs @ 11.99 hrs, Volume= 0.563 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

Area (ac)	CN	Description
4.370	69	50-75% Grass cover, Fair, HSG B
4.370		100.00% Pervious Area

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

Subcatchment 3S: Area 3A



Summary for Subcatchment 7S: Area 4

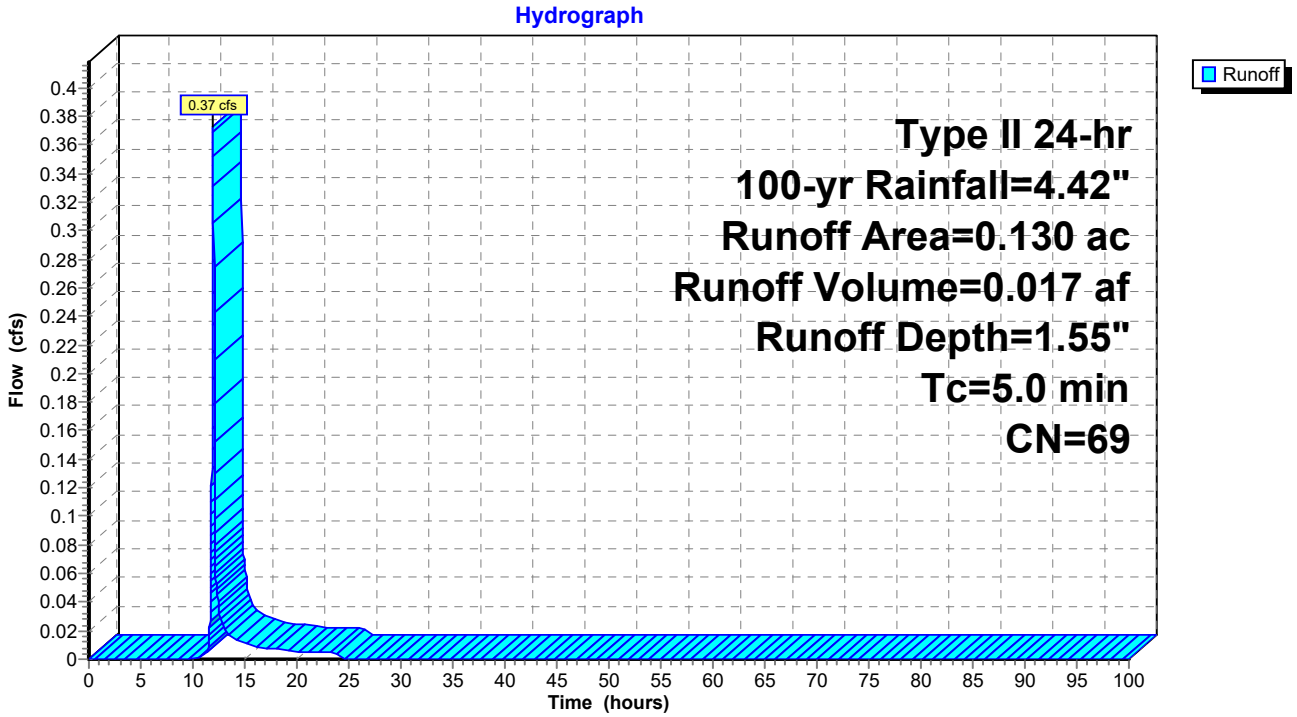
Runoff = 0.37 cfs @ 11.97 hrs, Volume= 0.017 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

Area (ac)	CN	Description
0.130	69	50-75% Grass cover, Fair, HSG B
0.130		100.00% Pervious Area

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

Subcatchment 7S: Area 4



Summary for Subcatchment 8S: Area 5

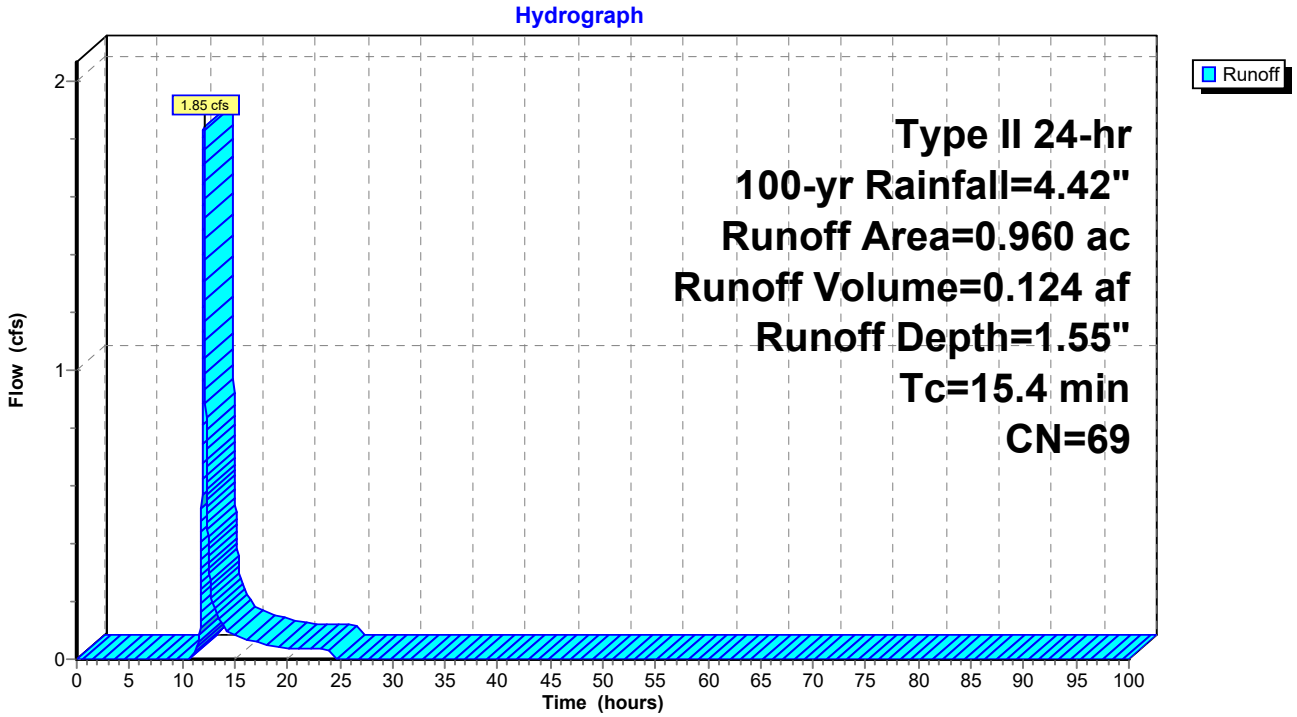
Runoff = 1.85 cfs @ 12.08 hrs, Volume= 0.124 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

Area (ac)	CN	Description
0.960	69	50-75% Grass cover, Fair, HSG B
0.960		100.00% Pervious Area

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

Subcatchment 8S: Area 5



Summary for Subcatchment 15S: Drop Chute Area

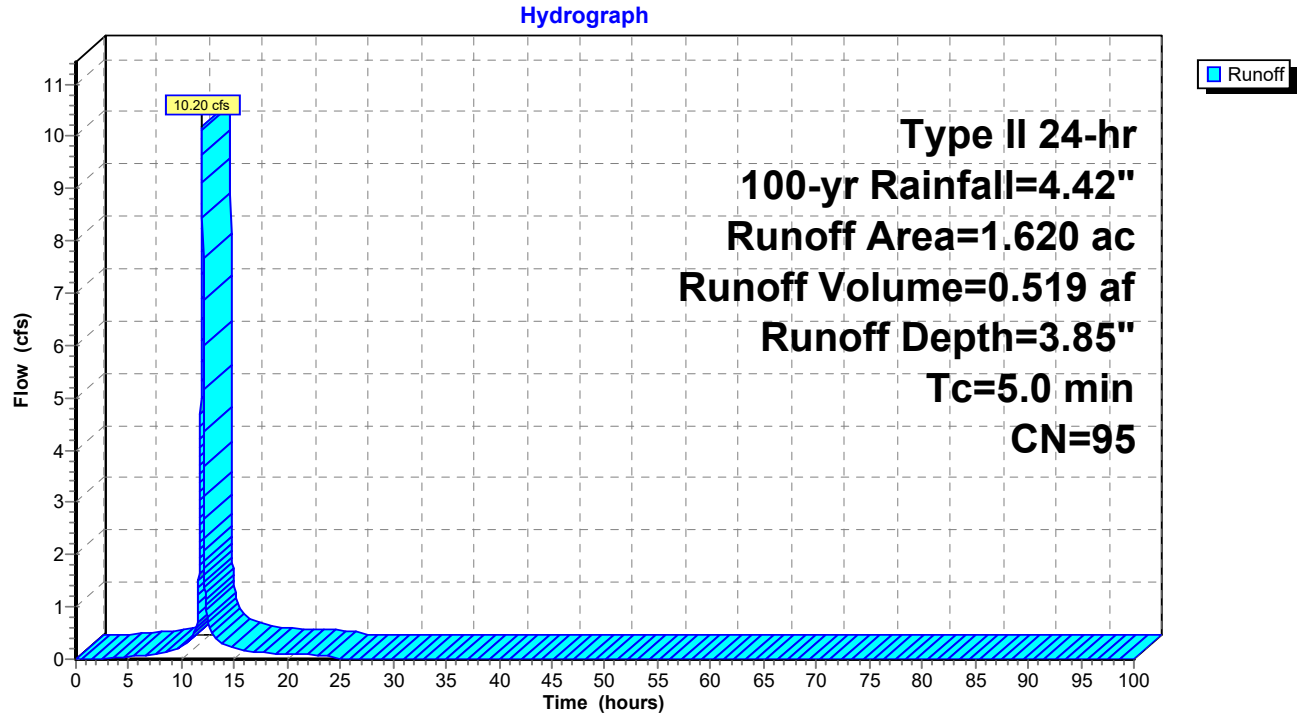
Runoff = 10.20 cfs @ 11.96 hrs, Volume= 0.519 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

	Area (ac)	CN	Description
*	1.620	95	Closure Turf
	1.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, SW Package Page 3**

Subcatchment 15S: Drop Chute Area



Summary for Subcatchment 16S: Area 2B

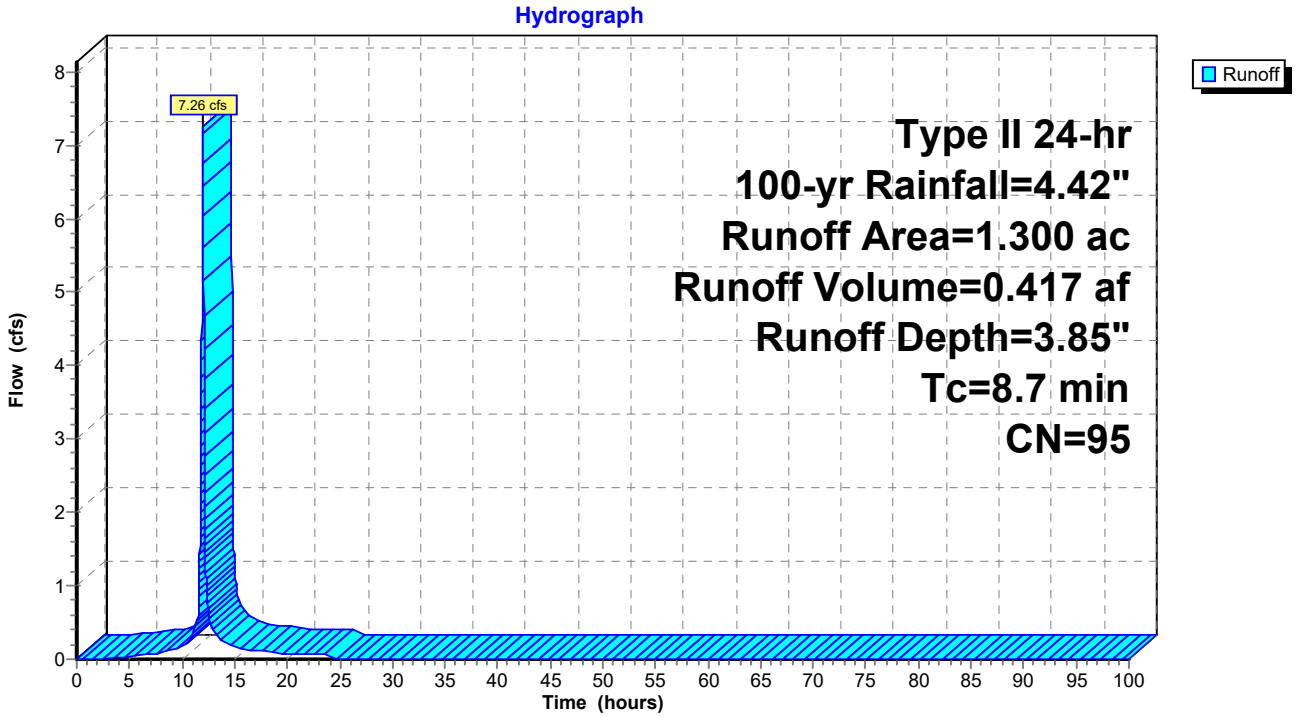
Runoff = 7.26 cfs @ 12.00 hrs, Volume= 0.417 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

	Area (ac)	CN	Description
*	1.300	95	Closure Turf
	1.300		100.00% Pervious Area

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

Subcatchment 16S: Area 2B



Summary for Subcatchment 17S: Area 3B

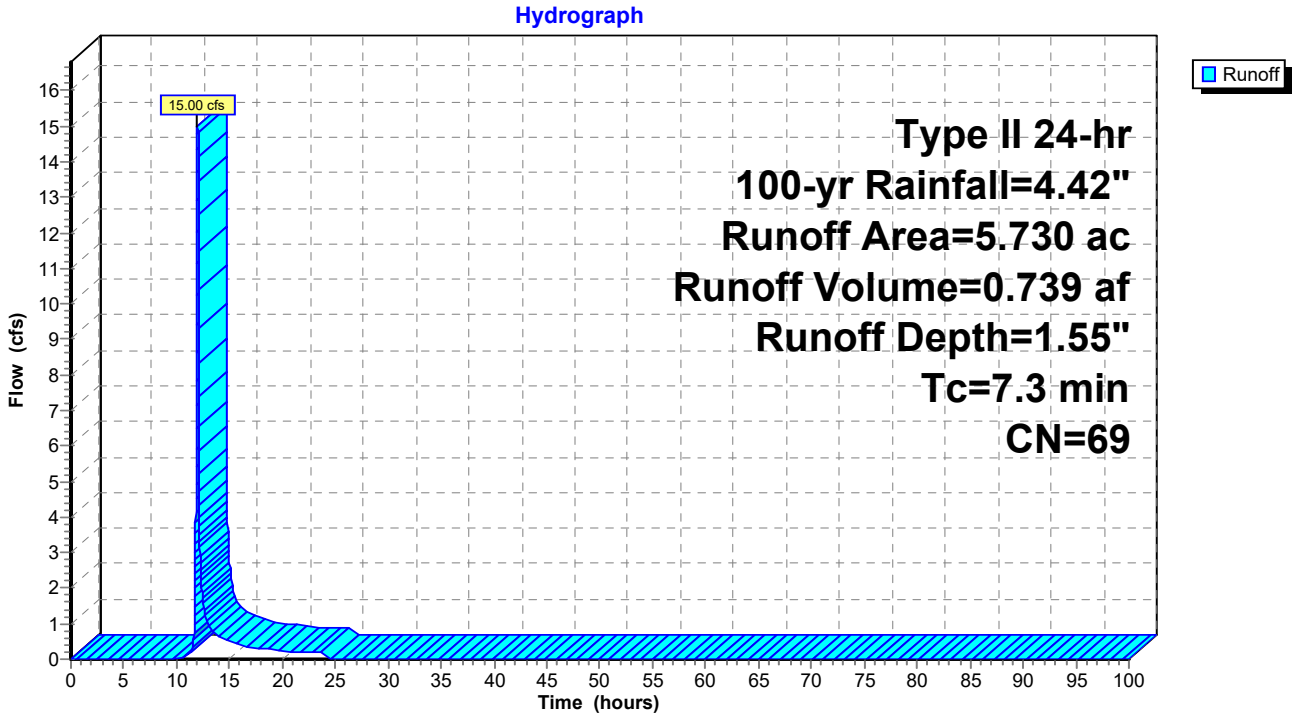
Runoff = 15.00 cfs @ 11.99 hrs, Volume= 0.739 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

Area (ac)	CN	Description
5.730	69	50-75% Grass cover, Fair, HSG B
5.730		100.00% Pervious Area

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

Subcatchment 17S: Area 3B



Summary for Subcatchment 18S: Area 1B

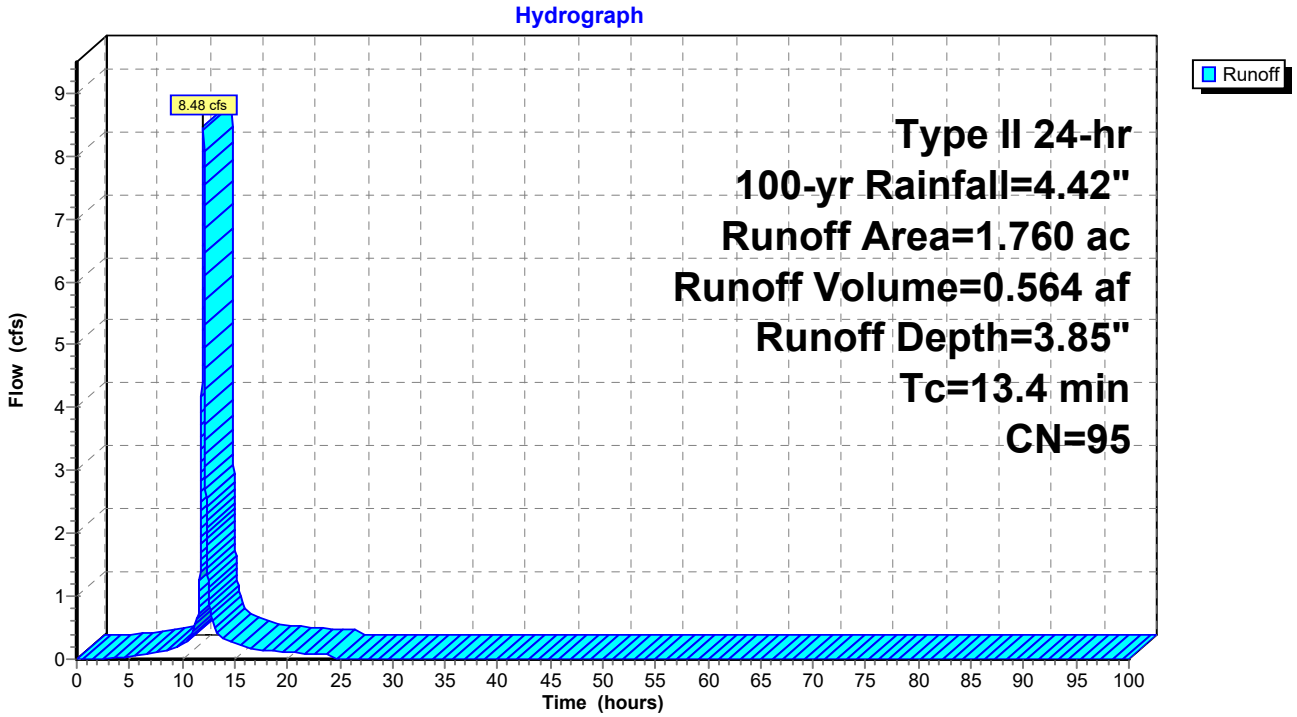
Runoff = 8.48 cfs @ 12.05 hrs, Volume= 0.564 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

	Area (ac)	CN	Description
*	1.760	95	Closure Turf
	1.760		100.00% Pervious Area

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

Subcatchment 18S: Area 1B



Summary for Subcatchment 19S: Area 6

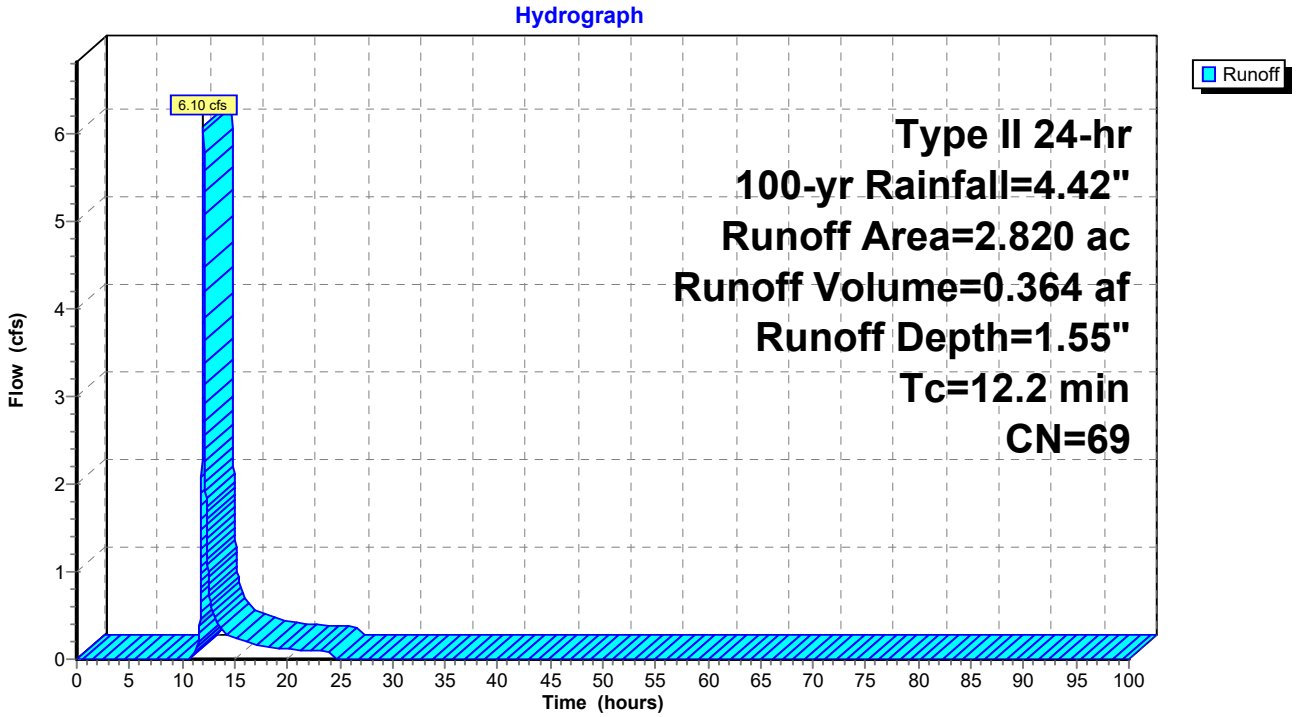
Runoff = 6.10 cfs @ 12.05 hrs, Volume= 0.364 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

Area (ac)	CN	Description
2.820	69	50-75% Grass cover, Fair, HSG B
2.820		100.00% Pervious Area

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

Subcatchment 19S: Area 6



Summary for Subcatchment 20S: Area 7

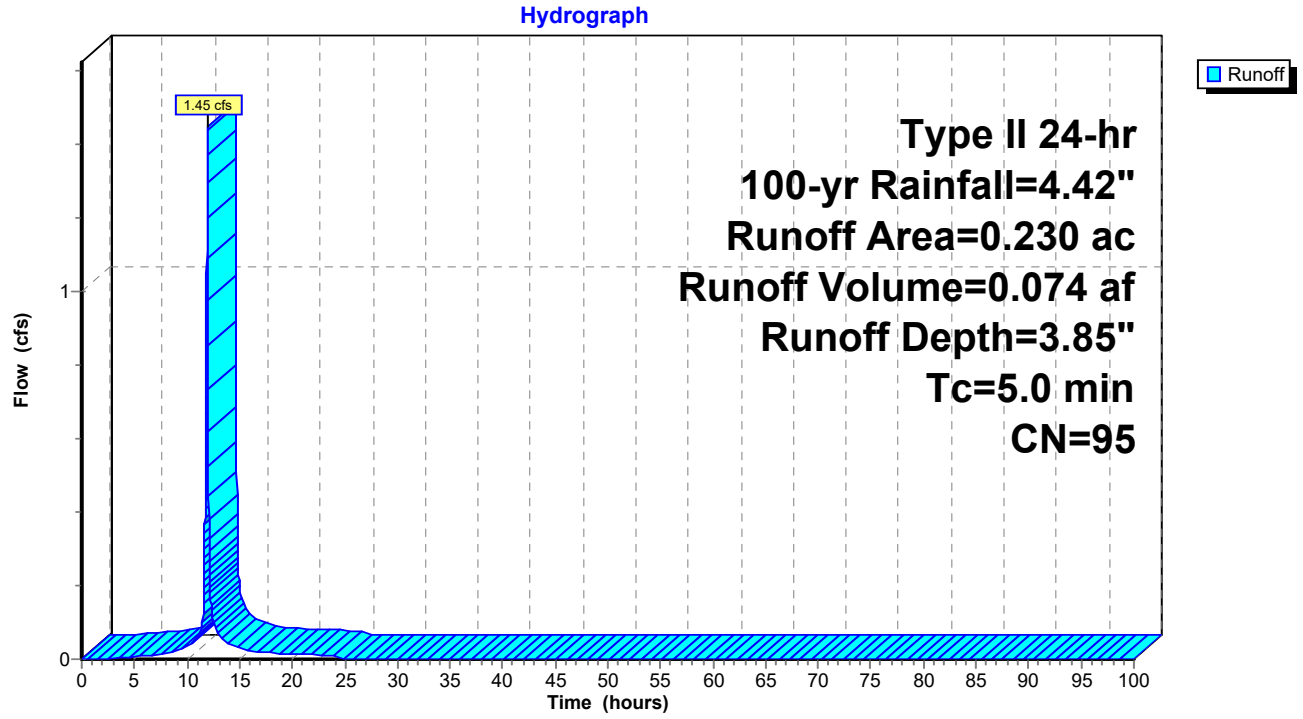
Runoff = 1.45 cfs @ 11.96 hrs, Volume= 0.074 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

	Area (ac)	CN	Description
*	0.230	95	Closure Turf
	0.230		100.00% Pervious Area

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

Subcatchment 20S: Area 7



Summary for Subcatchment 21S: Area 8

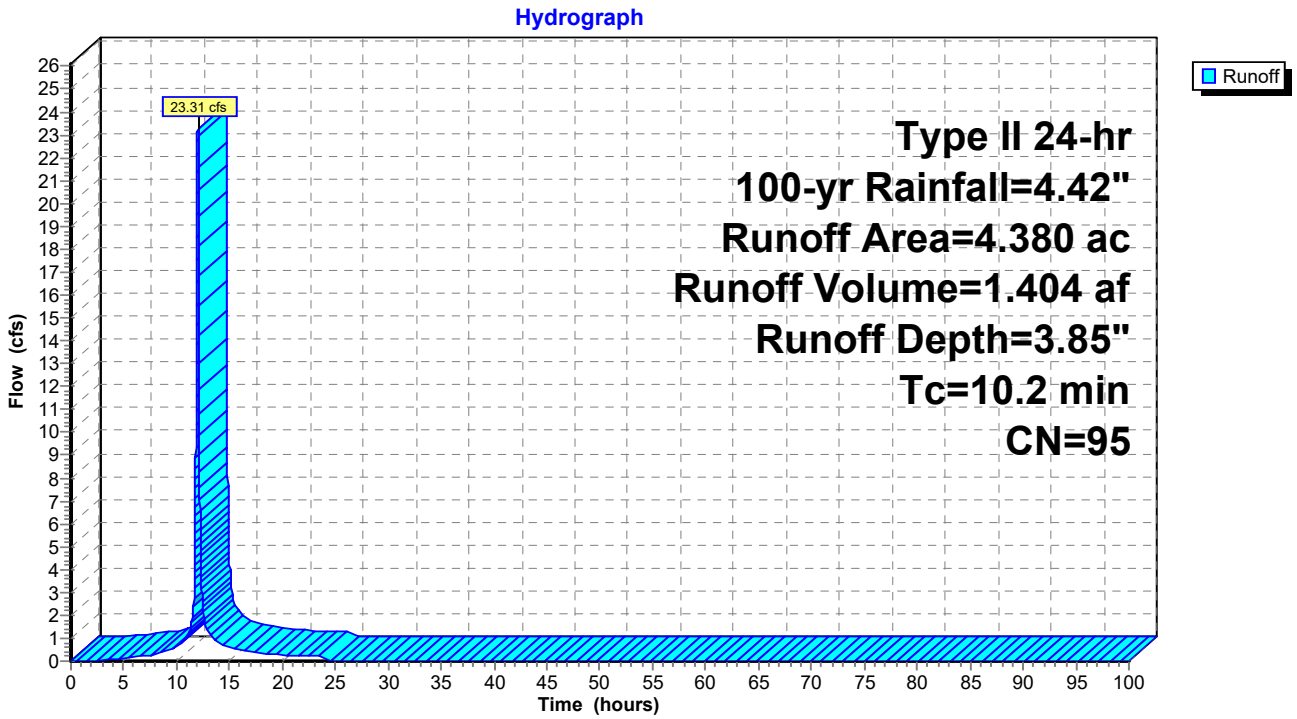
Runoff = 23.31 cfs @ 12.01 hrs, Volume= 1.404 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

	Area (ac)	CN	Description
*	4.014	95	Closure Turf
	0.366	96	Gravel surface, HSG B
	4.380	95	Weighted Average
	4.380		100.00% Pervious Area

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

Subcatchment 21S: Area 8



Summary for Subcatchment 22S: Area 9

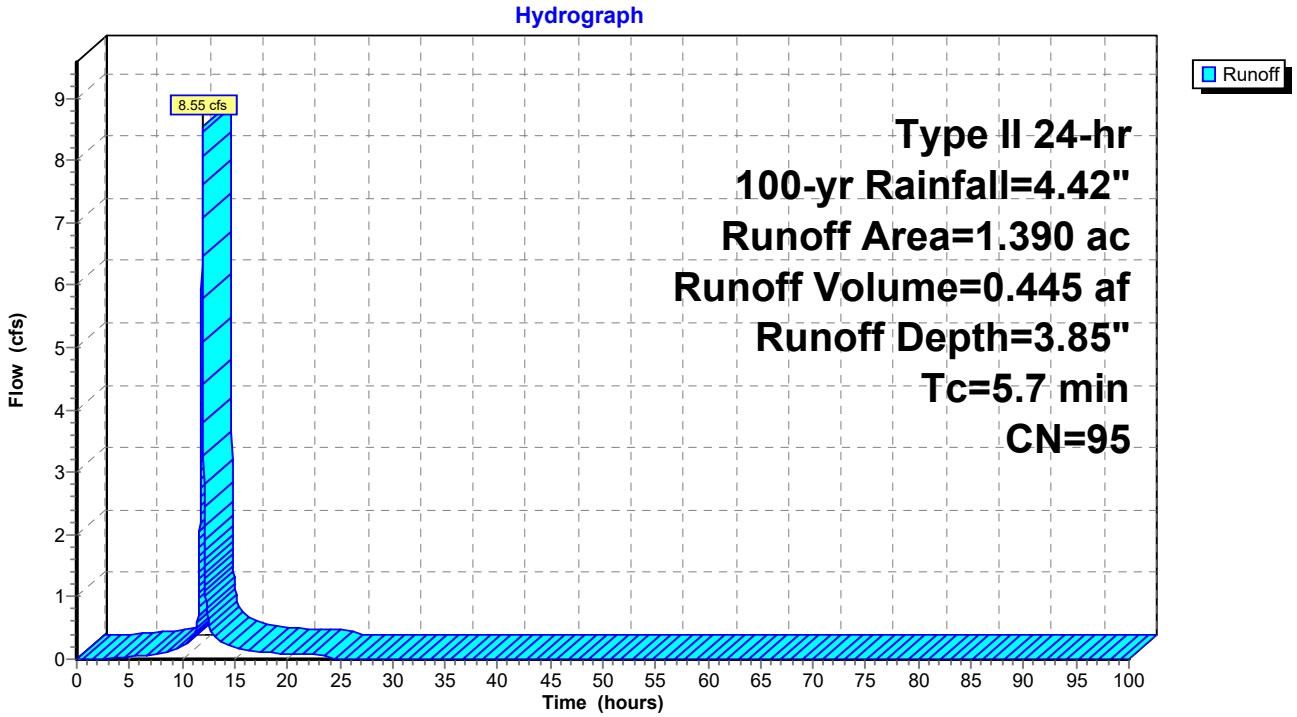
Runoff = 8.55 cfs @ 11.96 hrs, Volume= 0.445 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=4.42"

	Area (ac)	CN	Description
*	1.390	95	Closure Turf
	1.390		100.00% Pervious Area

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

Subcatchment 22S: Area 9



Summary for Reach 16R: Drop Chute

Inflow Area = 1.620 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 10.20 cfs @ 11.96 hrs, Volume= 0.519 af
Outflow = 10.17 cfs @ 11.96 hrs, Volume= 0.519 af, Atten= 0%, Lag= 0.3 min

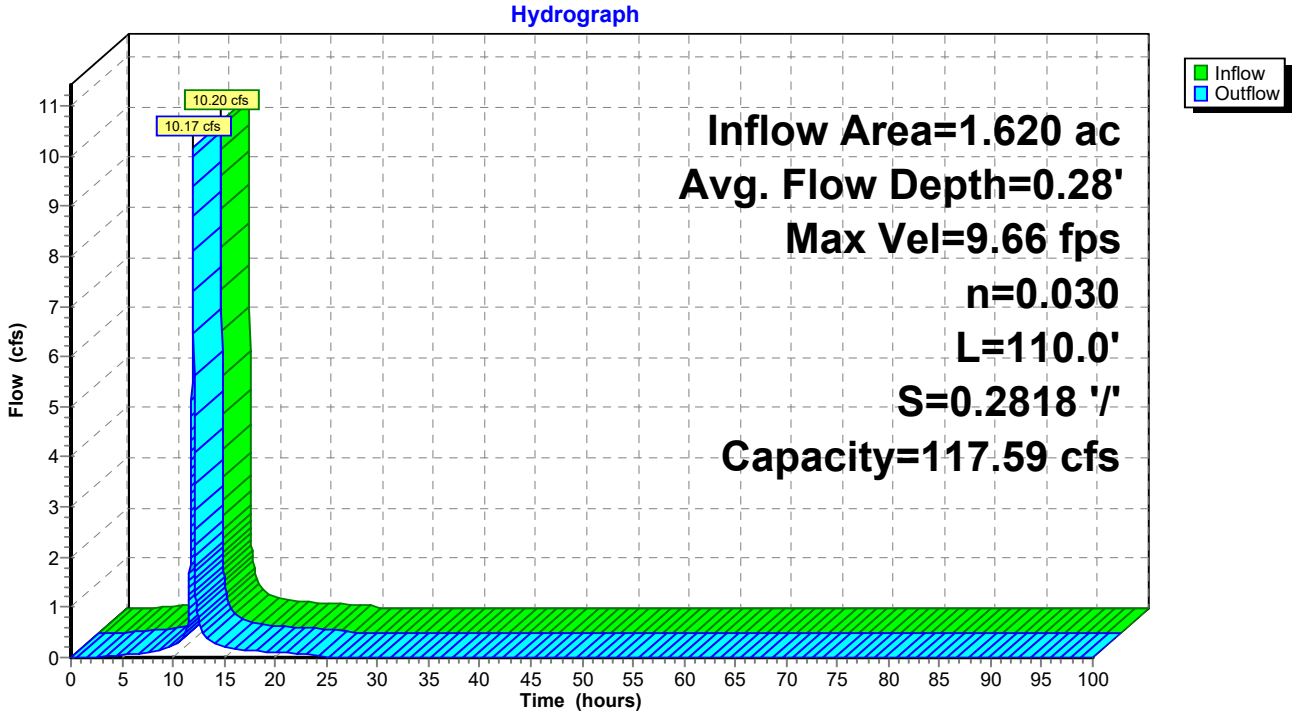
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.66 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.18 fps, Avg. Travel Time= 0.8 min

Peak Storage= 116 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 117.59 cfs

3.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 110.0' Slope= 0.2818 '/'
Inlet Invert= 4,359.00', Outlet Invert= 4,328.00'

‡

Reach 16R: Drop Chute



Summary for Reach 17R: East Perimeter Channel

[58] Hint: Peaked 0.22' above defined flood level

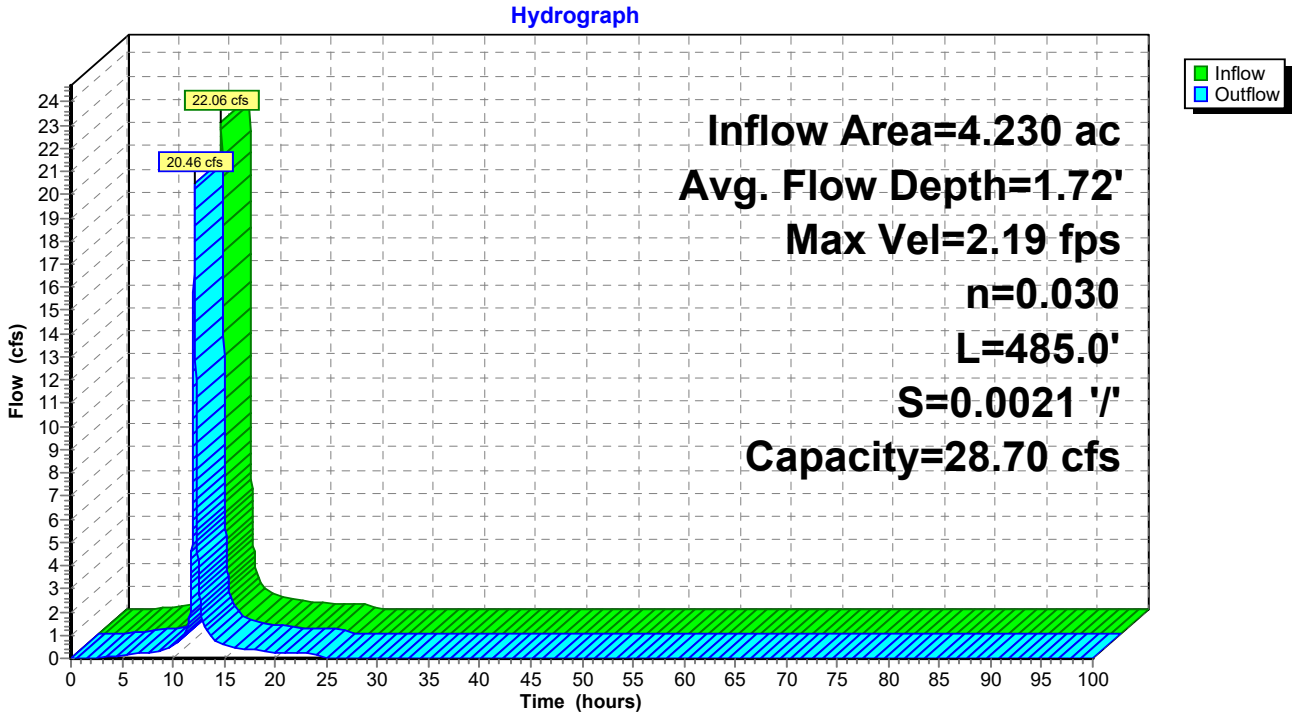
Inflow Area = 4.230 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 22.06 cfs @ 12.01 hrs, Volume= 1.356 af
Outflow = 20.46 cfs @ 12.11 hrs, Volume= 1.356 af, Atten= 7%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.19 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.60 fps, Avg. Travel Time= 13.6 min

Peak Storage= 4,524 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.72'
Defined Flood Depth= 1.50' Flow Area= 7.5 sf, Capacity= 15.27 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 28.70 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 485.0' Slope= 0.0021 '/'
Inlet Invert= 4,328.00', Outlet Invert= 4,327.00'

Reach 17R: East Perimeter Channel



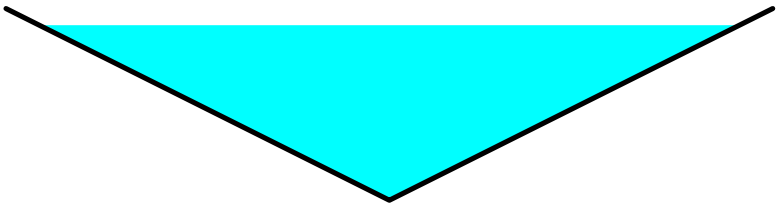
Summary for Reach 18R: South Perimeter Channel

Inflow Area = 4.580 ac, 0.00% Impervious, Inflow Depth = 2.43" for 100-yr event
Inflow = 14.58 cfs @ 12.05 hrs, Volume= 0.928 af
Outflow = 13.49 cfs @ 12.15 hrs, Volume= 0.928 af, Atten= 7%, Lag= 6.2 min

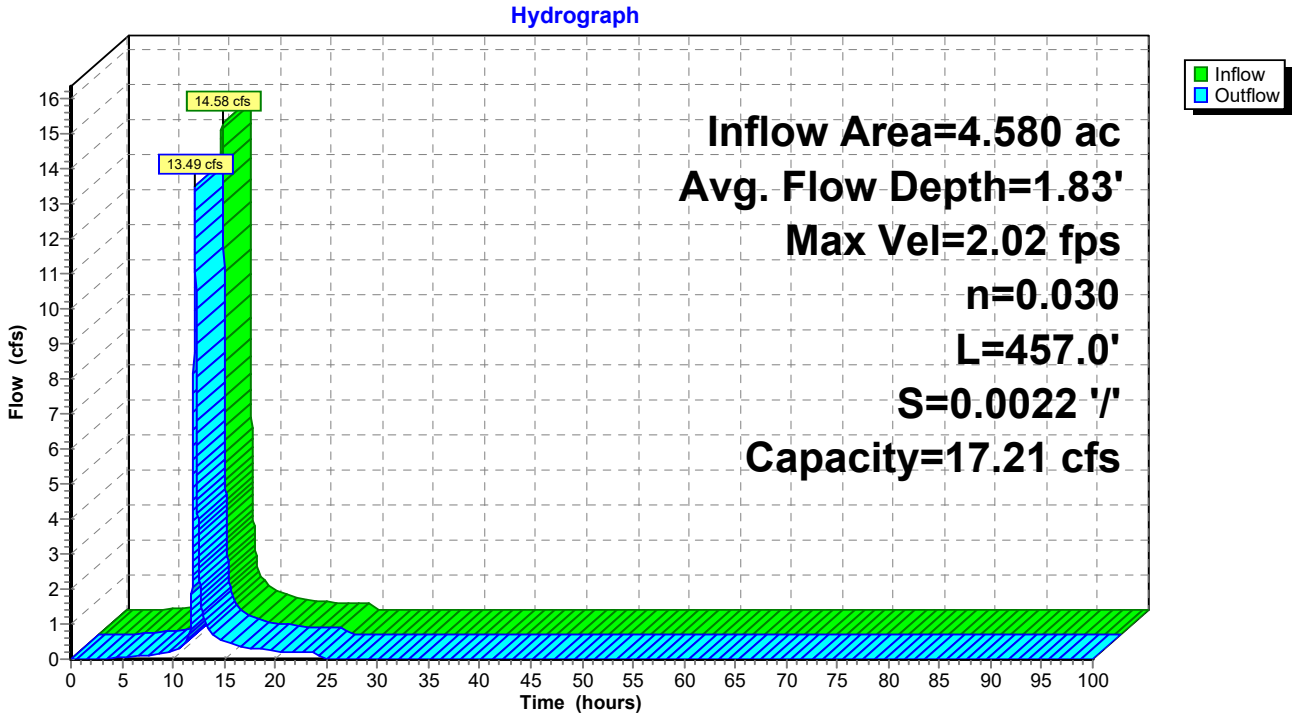
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.02 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.62 fps, Avg. Travel Time= 12.3 min

Peak Storage= 3,048 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.83'
Defined Flood Depth= 3.00' Flow Area= 16.0 sf, Capacity= 39.96 cfs
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 17.21 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 457.0' Slope= 0.0022 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,326.00'



Reach 18R: South Perimeter Channel



Summary for Reach 23R: West Access Road Culvert

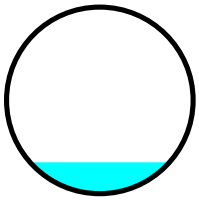
[52] Hint: Inlet/Outlet conditions not evaluated

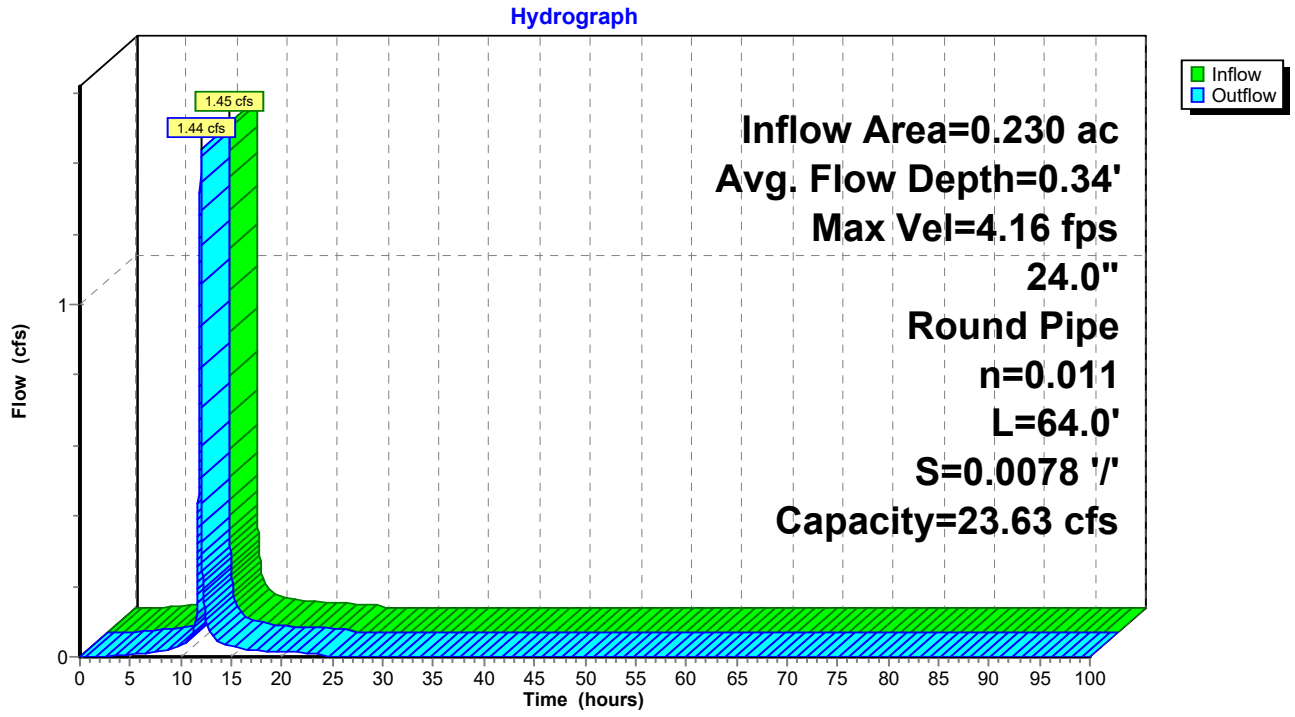
Inflow Area = 0.230 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 1.45 cfs @ 11.96 hrs, Volume= 0.074 af
Outflow = 1.44 cfs @ 11.96 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.16 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.18 fps, Avg. Travel Time= 0.9 min

Peak Storage= 22 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 23.63 cfs

24.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 64.0' Slope= 0.0078 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,326.50'





Summary for Reach 25R: Northwest Channel

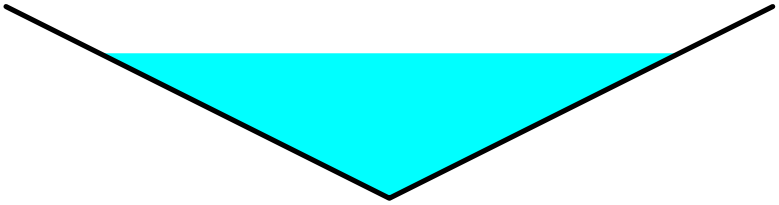
[63] Warning: Exceeded Reach 23R INLET depth by 1.31' @ 12.08 hrs
[61] Hint: Exceeded Reach 27R outlet invert by 0.51' @ 12.05 hrs

Inflow Area = 4.610 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 23.53 cfs @ 12.05 hrs, Volume= 1.477 af
Outflow = 23.51 cfs @ 12.06 hrs, Volume= 1.477 af, Atten= 0%, Lag= 0.3 min

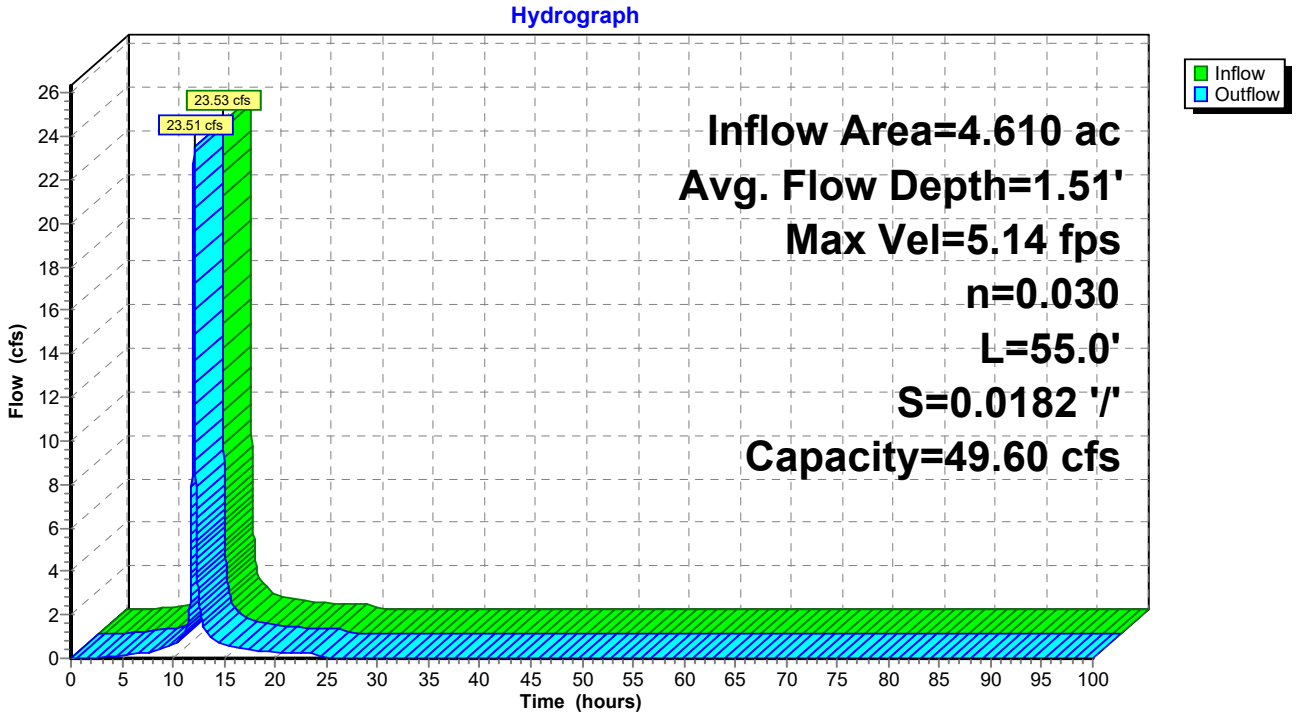
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.14 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.77 fps, Avg. Travel Time= 0.5 min

Peak Storage= 251 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.51'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 49.60 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 55.0' Slope= 0.0182 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,326.00'



Reach 25R: Northwest Channel



Summary for Reach 27R: Access Road Channel

Inflow Area = 4.380 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 23.31 cfs @ 12.01 hrs, Volume= 1.404 af
Outflow = 22.88 cfs @ 12.06 hrs, Volume= 1.404 af, Atten= 2%, Lag= 2.7 min

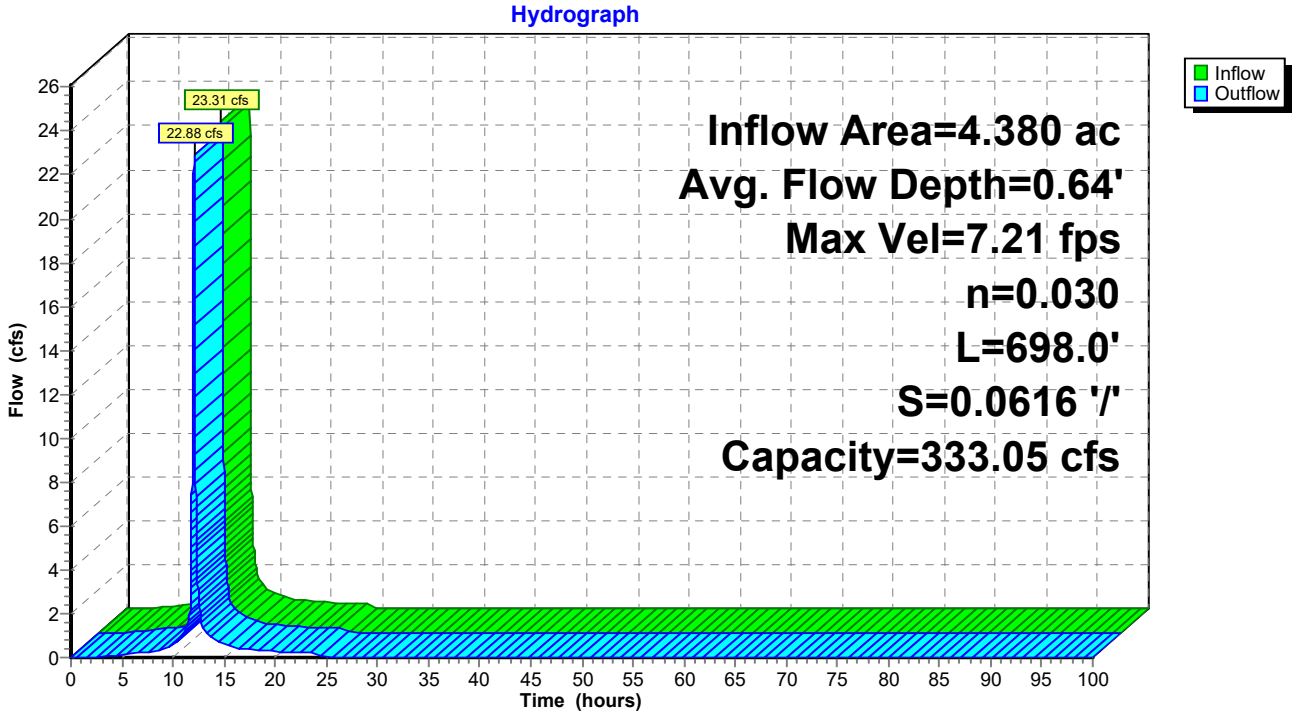
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.21 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.90 fps, Avg. Travel Time= 6.1 min

Peak Storage= 2,217 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 2.30' Flow Area= 22.8 sf, Capacity= 333.05 cfs

3.00' x 2.30' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 16.80'
Length= 698.0' Slope= 0.0616 '/'
Inlet Invert= 4,371.00', Outlet Invert= 4,328.00'

‡

Reach 27R: Access Road Channel



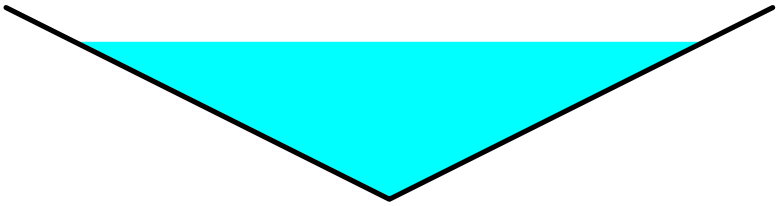
Summary for Reach 28R: North Channel

Inflow Area = 1.390 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 8.55 cfs @ 11.96 hrs, Volume= 0.445 af
Outflow = 6.94 cfs @ 12.12 hrs, Volume= 0.445 af, Atten= 19%, Lag= 9.3 min

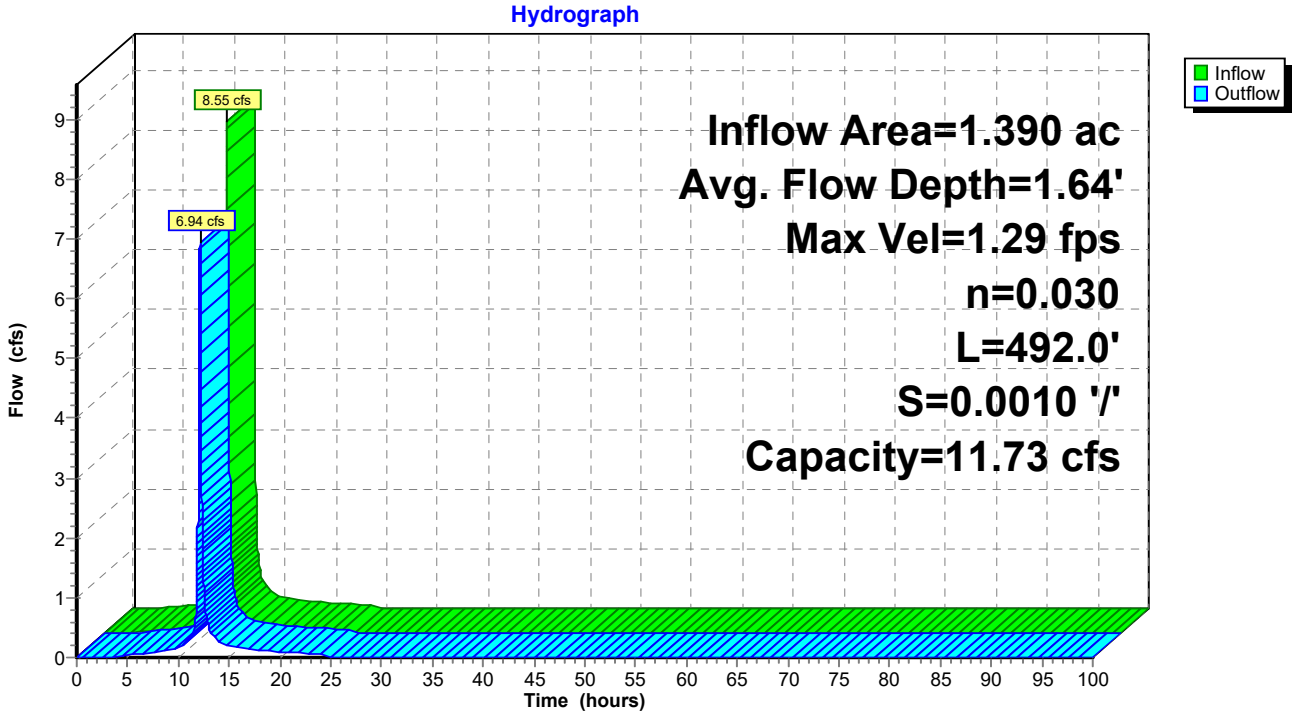
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.29 fps, Min. Travel Time= 6.4 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 22.6 min

Peak Storage= 2,659 cf @ 12.01 hrs
Average Depth at Peak Storage= 1.64'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 11.73 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 492.0' Slope= 0.0010 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,326.50'



Reach 28R: North Channel



Summary for Reach 29R: Texas Crossing

[61] Hint: Exceeded Reach 17R outlet invert by 0.66' @ 12.12 hrs
[61] Hint: Exceeded Reach 30R outlet invert by 0.66' @ 12.12 hrs

Inflow Area = 7.090 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 28.53 cfs @ 12.11 hrs, Volume= 2.272 af
Outflow = 28.43 cfs @ 12.13 hrs, Volume= 2.272 af, Atten= 0%, Lag= 1.5 min

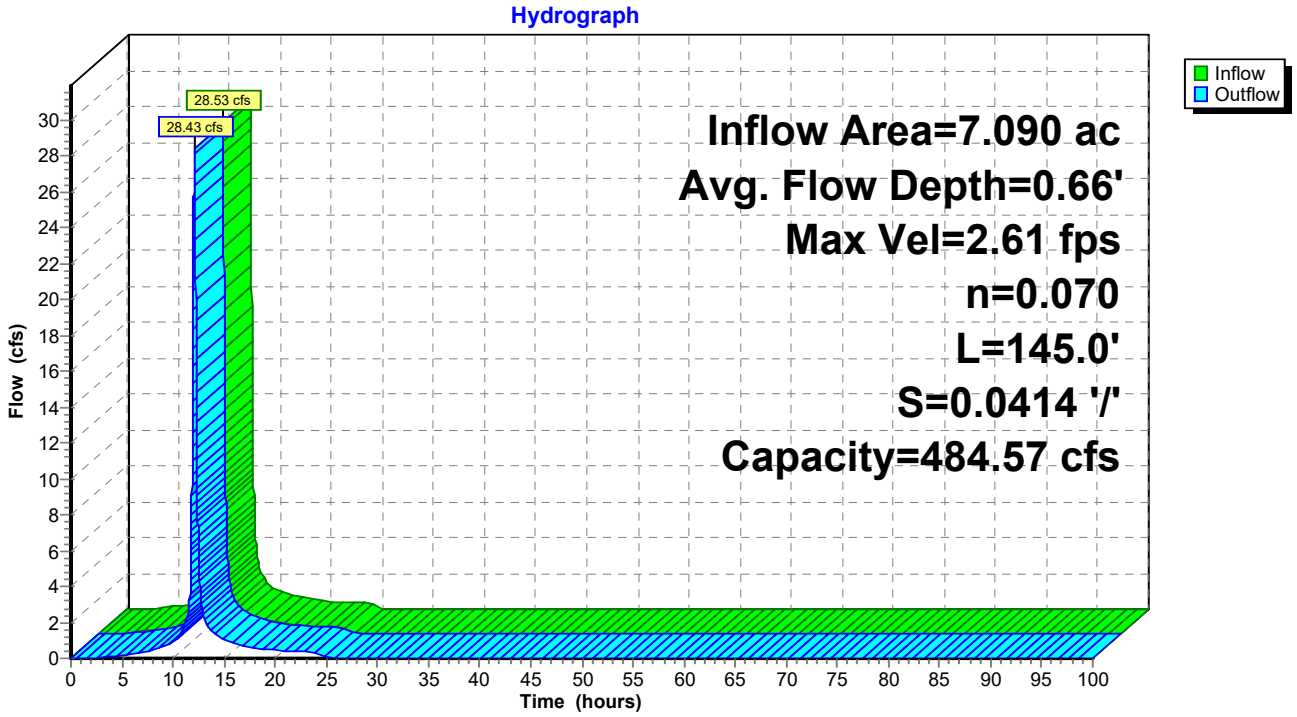
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.61 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 3.5 min

Peak Storage= 1,581 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.66'
Defined Flood Depth= 3.00' Flow Area= 117.4 sf, Capacity= 706.01 cfs
Bank-Full Depth= 2.50' Flow Area= 87.5 sf, Capacity= 484.57 cfs

10.00' x 2.50' deep channel, n= 0.070
Side Slope Z-value= 10.0 '/' Top Width= 60.00'
Length= 145.0' Slope= 0.0414 '/'
Inlet Invert= 4,327.00', Outlet Invert= 4,321.00'

‡

Reach 29R: Texas Crossing



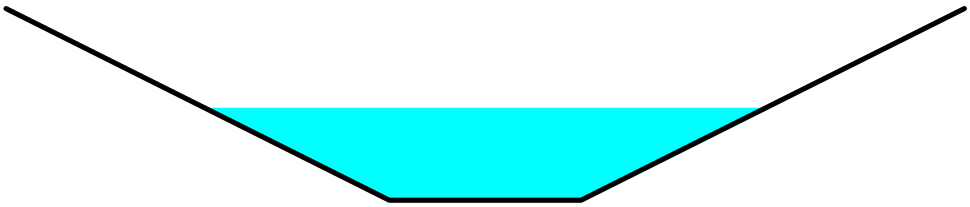
Summary for Reach 30R: East Perimeter Channel

Inflow Area = 1.240 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 6.93 cfs @ 12.00 hrs, Volume= 0.397 af
Outflow = 6.10 cfs @ 12.12 hrs, Volume= 0.397 af, Atten= 12%, Lag= 7.6 min

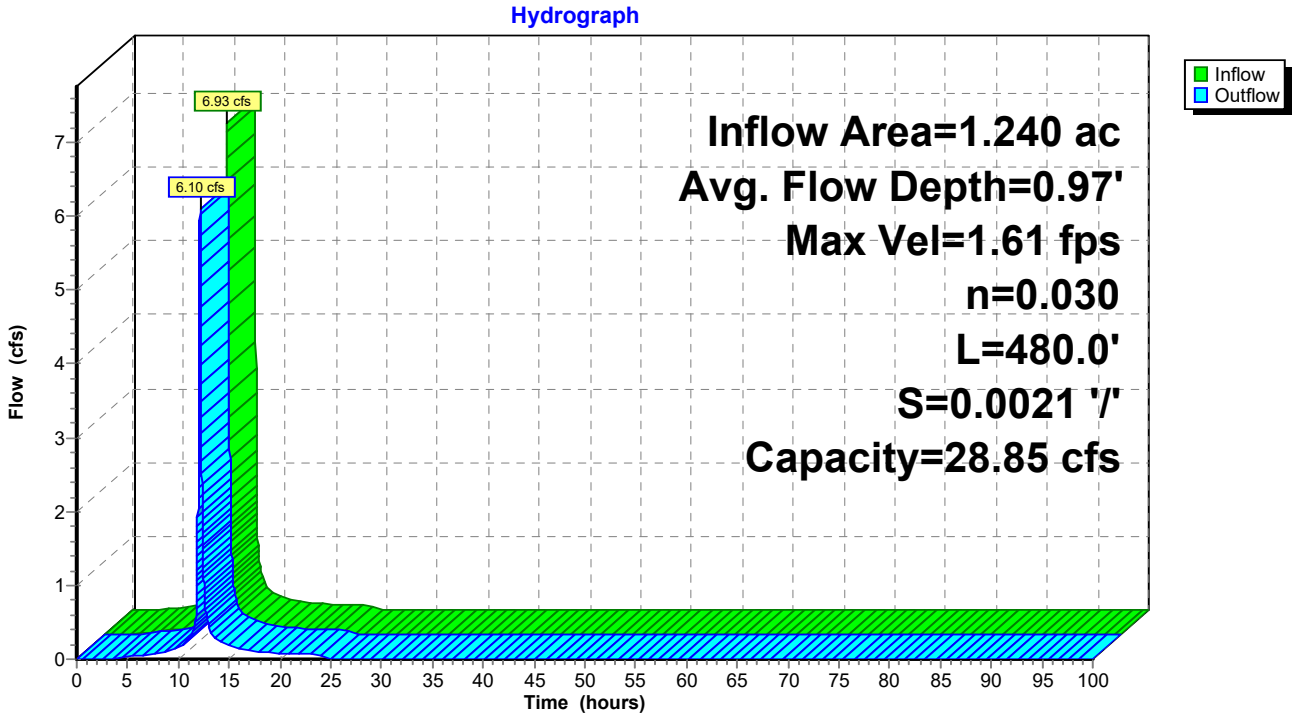
Routing by Stor-Ind+Trans method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 1.61 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 0.41 fps, Avg. Travel Time= 19.4 min

Peak Storage= 1,821 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.97'
Defined Flood Depth= 1.50' Flow Area= 7.5 sf, Capacity= 15.35 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 28.85 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 480.0' Slope= 0.0021 '/'
Inlet Invert= 4,328.00', Outlet Invert= 4,327.00'



Reach 30R: East Perimeter Channel



Summary for Pond 4P: Drop Inlet C-1

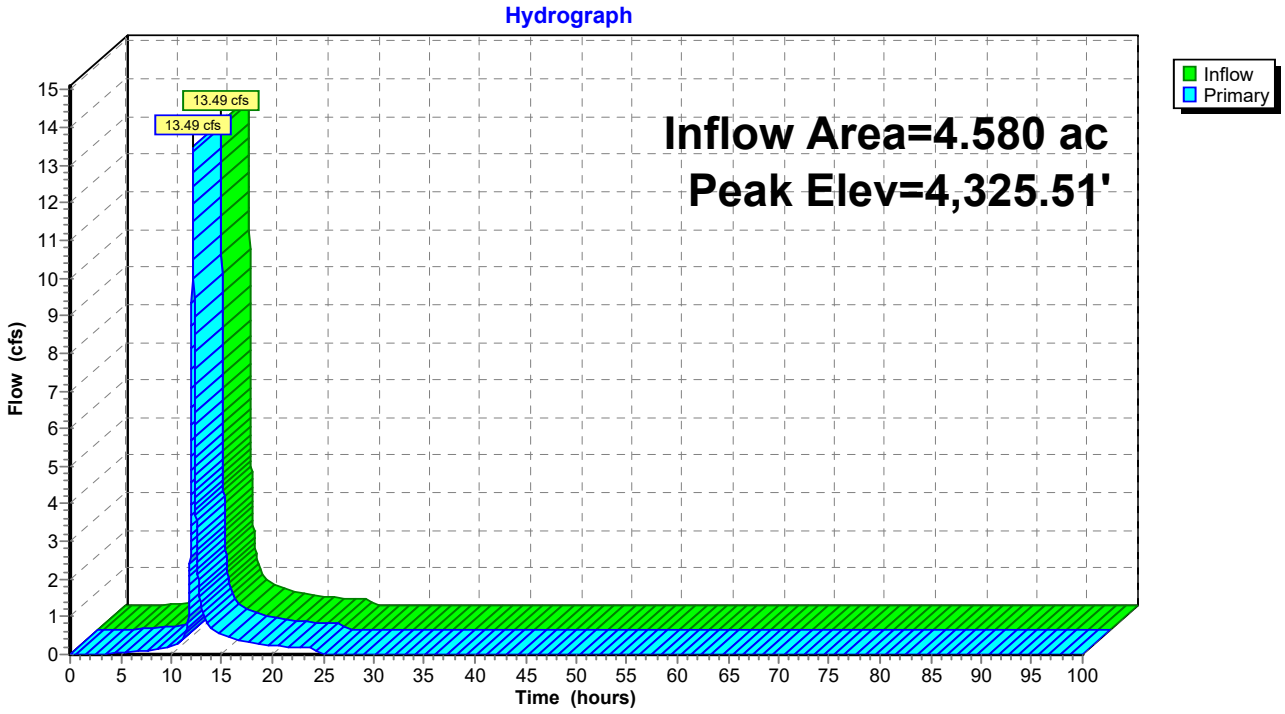
Inflow Area = 4.580 ac, 0.00% Impervious, Inflow Depth = 2.43" for 100-yr event
Inflow = 13.49 cfs @ 12.15 hrs, Volume= 0.928 af
Outflow = 13.49 cfs @ 12.15 hrs, Volume= 0.928 af, Atten= 0%, Lag= 0.0 min
Primary = 13.49 cfs @ 12.15 hrs, Volume= 0.928 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,325.51' @ 12.15 hrs
Flood Elev= 4,327.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	4,321.50'	**18.0" Round RCP_Round 18"** L= 130.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 4,321.50' / 4,320.50' S= 0.0077 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	4,325.00'	**5.7' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	4,325.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=13.49 cfs @ 12.15 hrs HW=4,325.51' (Free Discharge)
└**1=RCP_Round 18"** (Barrel Controls 13.49 cfs @ 7.63 fps)
└**2=Broad-Crested Rectangular Weir** (Passes < 12.38 cfs potential flow)
└**3=Broad-Crested Rectangular Weir** (Passes < 6.52 cfs potential flow)

Pond 4P: Drop Inlet C-1



Summary for Pond 5P: Drop Inlet C-2

[81] Warning: Exceeded Pond 4P by 1.00' @ 14.63 hrs

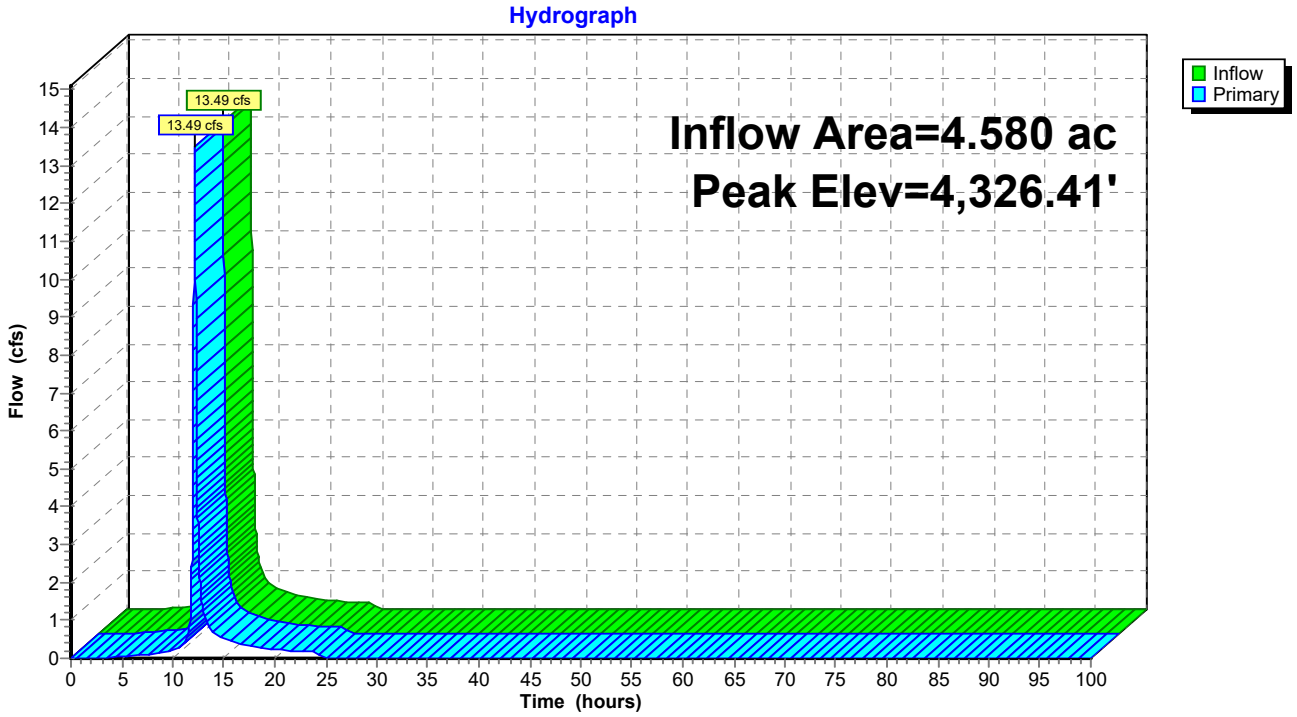
Inflow Area = 4.580 ac, 0.00% Impervious, Inflow Depth = 2.43" for 100-yr event
Inflow = 13.49 cfs @ 12.15 hrs, Volume= 0.928 af
Outflow = 13.49 cfs @ 12.15 hrs, Volume= 0.928 af, Atten= 0%, Lag= 0.0 min
Primary = 13.49 cfs @ 12.15 hrs, Volume= 0.928 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,326.41' @ 12.15 hrs
Flood Elev= 4,328.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	4,320.50'	**36.0" Round RCP_Round 36"** L= 129.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 4,320.50' / 4,320.00' S= 0.0039 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	4,326.00'	**5.7' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	4,326.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=13.44 cfs @ 12.15 hrs HW=4,326.41' (Free Discharge)
└**1=RCP_Round 36"** (Passes 13.44 cfs of 67.12 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Weir Controls 8.81 cfs @ 1.88 fps)
  └**3=Broad-Crested Rectangular Weir** (Weir Controls 4.64 cfs @ 1.88 fps)

Pond 5P: Drop Inlet C-2



Summary for Pond 9P: Southeast Stormwater Pond

Inflow Area = 5.670 ac, 0.00% Impervious, Inflow Depth = 2.26" for 100-yr event
Inflow = 15.16 cfs @ 12.14 hrs, Volume= 1.068 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

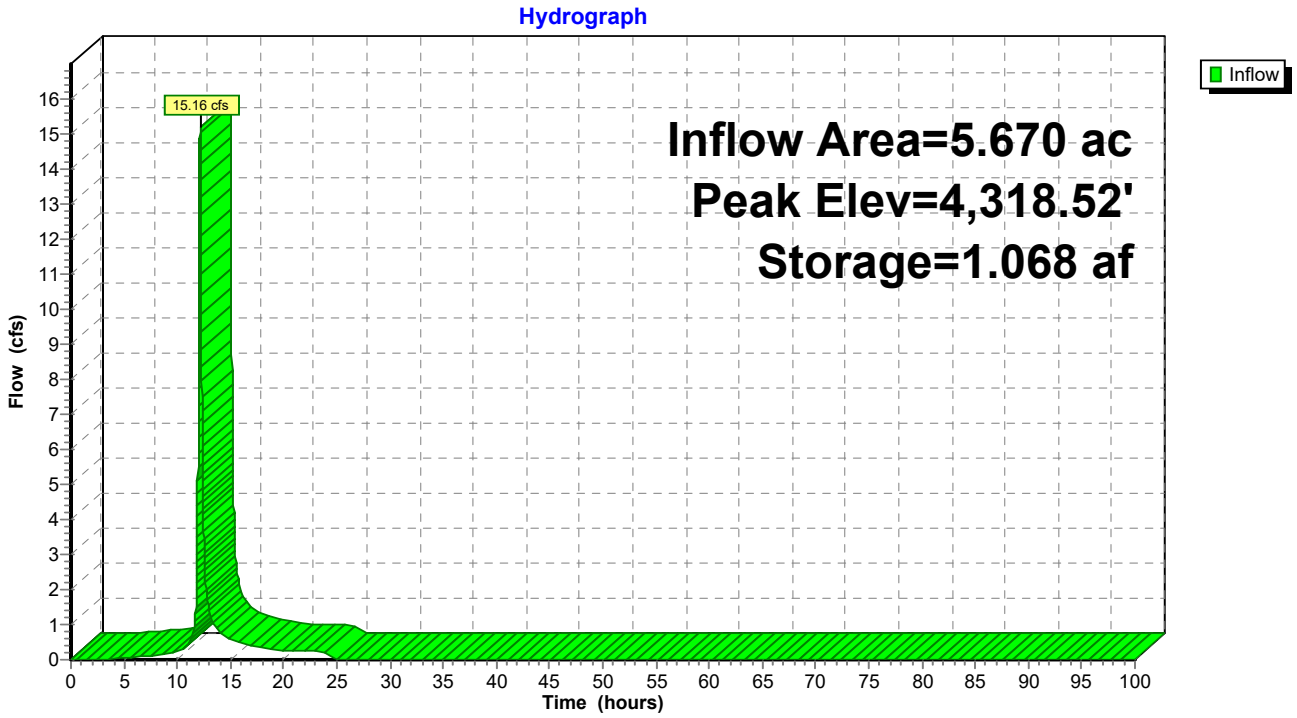
Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,318.52' @ 51.26 hrs Surf.Area= 0.000 ac Storage= 1.068 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	4,311.00'	2.378 af	**Custom Stage Data**Listed below

Elevation (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
4,311.00	0.000	0.000
4,313.00	0.171	0.171
4,315.00	0.247	0.418
4,317.00	0.331	0.749
4,319.00	0.420	1.169
4,321.00	0.514	1.683
4,325.00	0.695	2.378

Pond 9P: Southeast Stormwater Pond



Summary for Pond 14P: East Stormwater Collection Area

Inflow Area = 17.190 ac, 0.00% Impervious, Inflow Depth = 2.50" for 100-yr event
Inflow = 50.66 cfs @ 12.01 hrs, Volume= 3.574 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

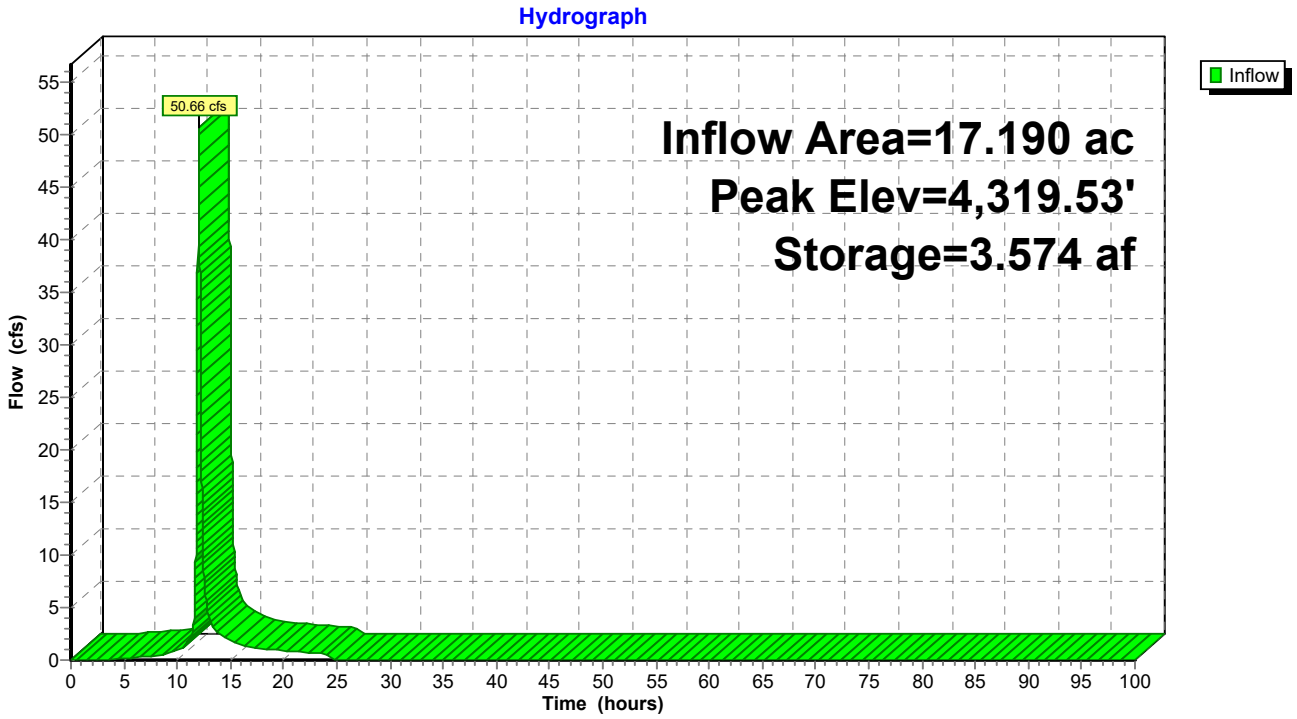
Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,319.53' @ 44.21 hrs Surf.Area= 0.000 ac Storage= 3.574 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	4,309.00'	3.760 af	**Custom Stage Data**Listed below

Elevation (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
4,309.00	0.000	0.000
4,310.00	0.132	0.132
4,311.00	0.191	0.323
4,312.00	0.250	0.573
4,313.00	0.306	0.879
4,314.00	0.417	1.296
4,315.00	0.504	1.800
4,320.00	1.960	3.760

Pond 14P: East Stormwater Collection Area



Summary for Pond 26P: Drop Inlet C-3

[61] Hint: Exceeded Reach 25R outlet invert by 0.61' @ 12.07 hrs
[61] Hint: Exceeded Reach 28R outlet invert by 0.11' @ 12.07 hrs

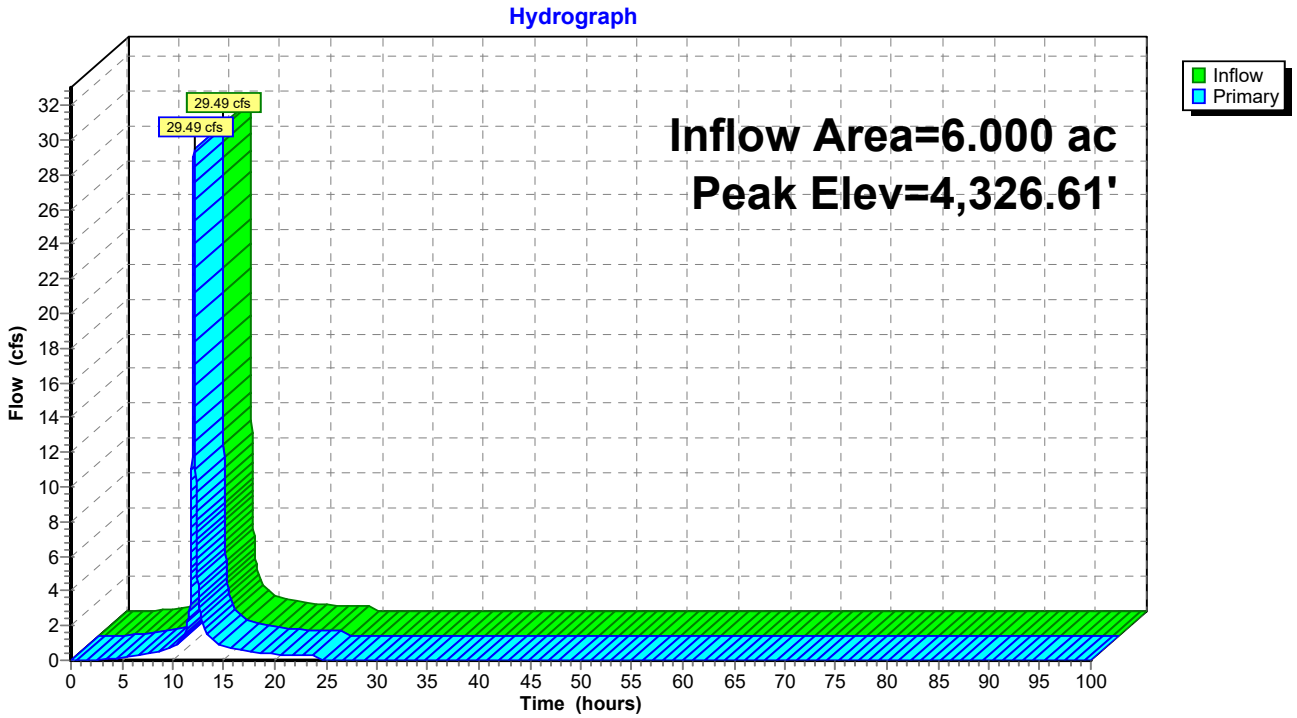
Inflow Area = 6.000 ac, 0.00% Impervious, Inflow Depth = 3.85" for 100-yr event
Inflow = 29.49 cfs @ 12.07 hrs, Volume= 1.923 af
Outflow = 29.49 cfs @ 12.07 hrs, Volume= 1.923 af, Atten= 0%, Lag= 0.0 min
Primary = 29.49 cfs @ 12.07 hrs, Volume= 1.923 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 4,326.61' @ 12.07 hrs
Flood Elev= 4,327.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	4,326.00'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 4.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Device 1	4,318.00'	**42.0" Round RCP_Round 42"** L= 75.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 4,318.00' / 4,317.00' S= 0.0133 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 9.62 sf

Primary OutFlow Max=29.34 cfs @ 12.07 hrs HW=4,326.61' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 29.34 cfs @ 2.41 fps)
└**2=RCP_Round 42"** (Passes 29.34 cfs of 36.14 cfs potential flow)

Pond 26P: Drop Inlet C-3



APPENDIX B - NOAA RAINFALL DATA

NOAA Atlas 14, Volume 8, Version 2 FT MORGAN
Station ID: 05-3038
Location name: Fort Morgan, Colorado, US*
Latitude: 40.2600°, Longitude: -103.8156°
Elevation:
Elevation (station metadata): 4359 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.269** (0.214-0.348)	**0.326** (0.260-0.422)	**0.430** (0.341-0.558)	**0.526** (0.415-0.686)	**0.673** (0.517-0.929)	**0.798** (0.595-1.11)	**0.933** (0.669-1.33)	**1.08** (0.740-1.59)	**1.29** (0.847-1.95)	**1.46** (0.928-2.22)
10-min	**0.394** (0.314-0.509)	**0.477** (0.380-0.618)	**0.630** (0.499-0.817)	**0.770** (0.607-1.00)	**0.986** (0.758-1.36)	**1.17** (0.871-1.63)	**1.37** (0.980-1.95)	**1.58** (1.08-2.32)	**1.89** (1.24-2.85)	**2.14** (1.36-3.26)
15-min	**0.480** (0.383-0.621)	**0.582** (0.463-0.754)	**0.768** (0.609-0.997)	**0.940** (0.741-1.23)	**1.20** (0.924-1.66)	**1.43** (1.06-1.99)	**1.67** (1.20-2.38)	**1.93** (1.32-2.83)	**2.31** (1.51-3.48)	**2.61** (1.66-3.97)
30-min	**0.651** (0.519-0.841)	**0.785** (0.625-1.02)	**1.03** (0.819-1.34)	**1.26** (0.996-1.65)	**1.62** (1.25-2.24)	**1.92** (1.44-2.68)	**2.25** (1.62-3.22)	**2.62** (1.79-3.85)	**3.14** (2.06-4.74)	**3.56** (2.26-5.42)
60-min	**0.796** (0.634-1.03)	**0.964** (0.767-1.25)	**1.27** (1.01-1.65)	**1.56** (1.23-2.04)	**2.01** (1.54-2.77)	**2.39** (1.78-3.33)	**2.80** (2.01-4.01)	**3.26** (2.23-4.79)	**3.91** (2.56-5.91)	**4.44** (2.82-6.75)
2-hr	**0.940** (0.759-1.20)	**1.14** (0.921-1.46)	**1.51** (1.22-1.93)	**1.86** (1.49-2.39)	**2.40** (1.87-3.26)	**2.85** (2.16-3.92)	**3.35** (2.44-4.72)	**3.90** (2.71-5.64)	**4.68** (3.12-6.97)	**5.32** (3.43-7.97)
3-hr	**1.01** (0.823-1.28)	**1.23** (1.00-1.56)	**1.63** (1.32-2.07)	**2.01** (1.61-2.56)	**2.58** (2.03-3.48)	**3.08** (2.34-4.18)	**3.61** (2.65-5.04)	**4.19** (2.94-6.01)	**5.03** (3.38-7.42)	**5.71** (3.71-8.48)
6-hr	**1.14** (0.941-1.42)	**1.40** (1.15-1.74)	**1.86** (1.53-2.32)	**2.28** (1.85-2.85)	**2.89** (2.29-3.82)	**3.41** (2.63-4.54)	**3.96** (2.94-5.41)	**4.55** (3.23-6.40)	**5.38** (3.67-7.79)	**6.05** (4.00-8.84)
12-hr	**1.34** (1.12-1.64)	**1.61** (1.34-1.97)	**2.09** (1.73-2.56)	**2.51** (2.07-3.10)	**3.14** (2.52-4.05)	**3.65** (2.85-4.78)	**4.20** (3.16-5.63)	**4.78** (3.44-6.60)	**5.59** (3.87-7.95)	**6.24** (4.19-8.97)
24-hr	**1.59** (1.35-1.92)	**1.85** (1.56-2.23)	**2.31** (1.94-2.78)	**2.72** (2.27-3.30)	**3.34** (2.72-4.25)	**3.86** (3.06-4.98)	**4.42** (3.38-5.84)	**5.02** (3.68-6.83)	**5.88** (4.13-8.23)	**6.57** (4.48-9.29)
2-day	**1.85** (1.58-2.19)	**2.11** (1.81-2.50)	**2.58** (2.20-3.07)	**3.00** (2.55-3.58)	**3.63** (3.00-4.54)	**4.16** (3.34-5.26)	**4.71** (3.66-6.12)	**5.31** (3.95-7.10)	**6.16** (4.40-8.47)	**6.84** (4.74-9.51)
3-day	**2.03** (1.75-2.38)	**2.29** (1.98-2.69)	**2.76** (2.38-3.25)	**3.19** (2.72-3.77)	**3.82** (3.18-4.72)	**4.34** (3.52-5.44)	**4.90** (3.84-6.30)	**5.51** (4.13-7.29)	**6.36** (4.59-8.66)	**7.04** (4.93-9.70)
4-day	**2.17** (1.88-2.52)	**2.44** (2.12-2.84)	**2.92** (2.52-3.41)	**3.34** (2.87-3.92)	**3.98** (3.33-4.88)	**4.51** (3.68-5.60)	**5.07** (3.99-6.46)	**5.67** (4.28-7.44)	**6.51** (4.73-8.80)	**7.19** (5.07-9.83)
7-day	**2.47** (2.17-2.84)	**2.79** (2.45-3.21)	**3.33** (2.91-3.84)	**3.79** (3.30-4.39)	**4.46** (3.76-5.36)	**4.99** (4.11-6.09)	**5.54** (4.41-6.94)	**6.12** (4.68-7.89)	**6.91** (5.08-9.18)	**7.53** (5.38-10.2)
10-day	**2.74** (2.42-3.11)	**3.10** (2.74-3.53)	**3.70** (3.26-4.23)	**4.21** (3.68-4.83)	**4.91** (4.16-5.83)	**5.46** (4.53-6.58)	**6.02** (4.82-7.45)	**6.59** (5.07-8.40)	**7.36** (5.45-9.67)	**7.95** (5.73-10.6)
20-day	**3.56** (3.19-3.98)	**4.02** (3.60-4.50)	**4.78** (4.26-5.36)	**5.40** (4.79-6.09)	**6.24** (5.35-7.24)	**6.87** (5.77-8.11)	**7.50** (6.09-9.09)	**8.13** (6.34-10.1)	**8.95** (6.73-11.5)	**9.56** (7.01-12.5)
30-day	**4.26** (3.85-4.71)	**4.81** (4.34-5.33)	**5.70** (5.13-6.33)	**6.41** (5.74-7.16)	**7.37** (6.36-8.44)	**8.08** (6.84-9.42)	**8.77** (7.19-10.5)	**9.46** (7.45-11.7)	**10.3** (7.84-13.1)	**11.0** (8.13-14.2)
45-day	**5.15** (4.69-5.64)	**5.82** (5.30-6.38)	**6.88** (6.25-7.57)	**7.72** (6.97-8.53)	**8.82** (7.68-9.98)	**9.63** (8.21-11.1)	**10.4** (8.59-12.3)	**11.1** (8.84-13.6)	**12.0** (9.22-15.1)	**12.7** (9.51-16.3)
60-day	**5.91** (5.41-6.42)	**6.69** (6.13-7.28)	**7.91** (7.22-8.63)	**8.87** (8.05-9.72)	**10.1** (8.82-11.3)	**11.0** (9.40-12.5)	**11.8** (9.78-13.8)	**12.5** (10.0-15.1)	**13.5** (10.4-16.7)	**14.1** (10.6-17.9)

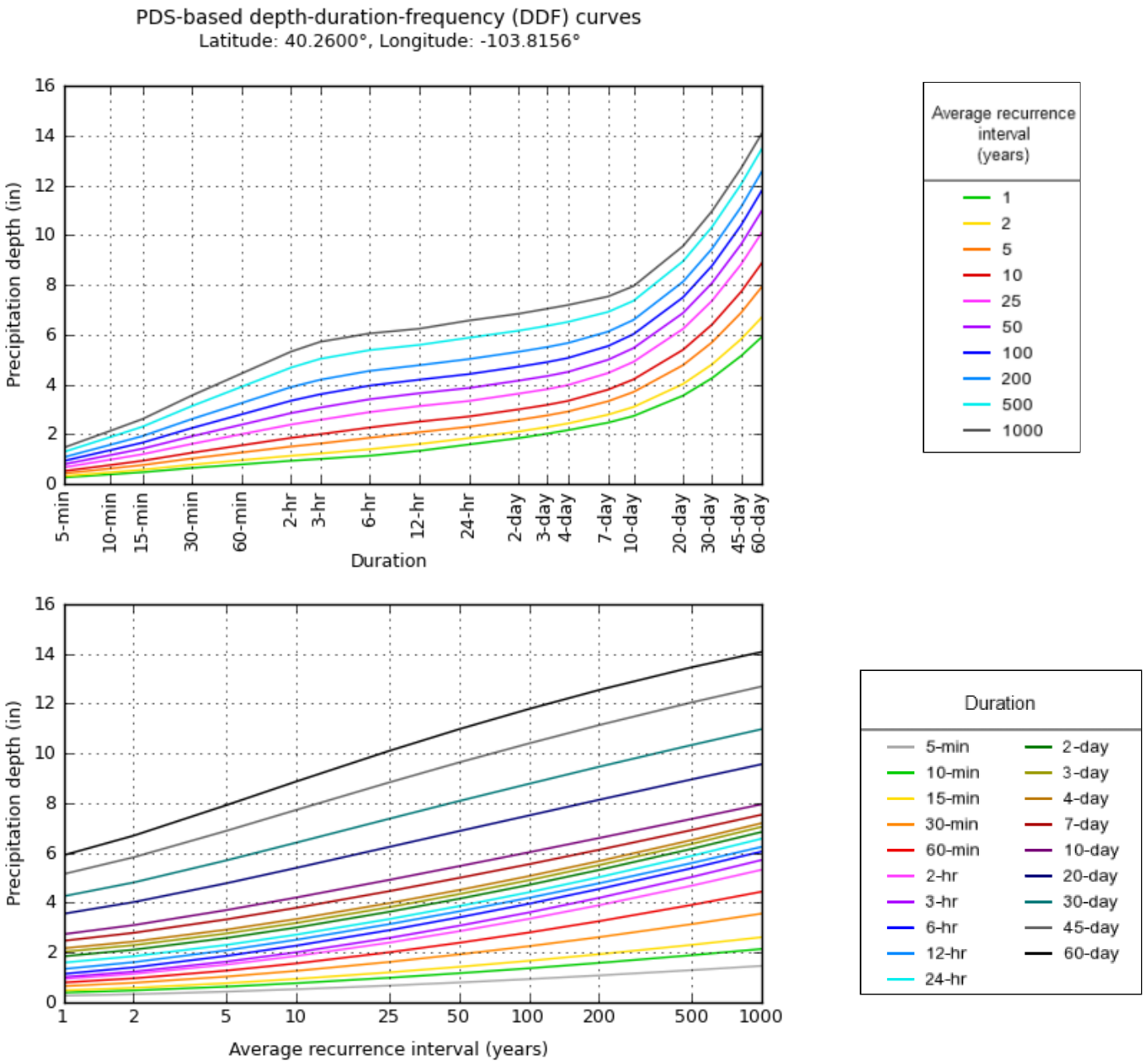
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



NOAA Atlas 14, Volume 8, Version 2

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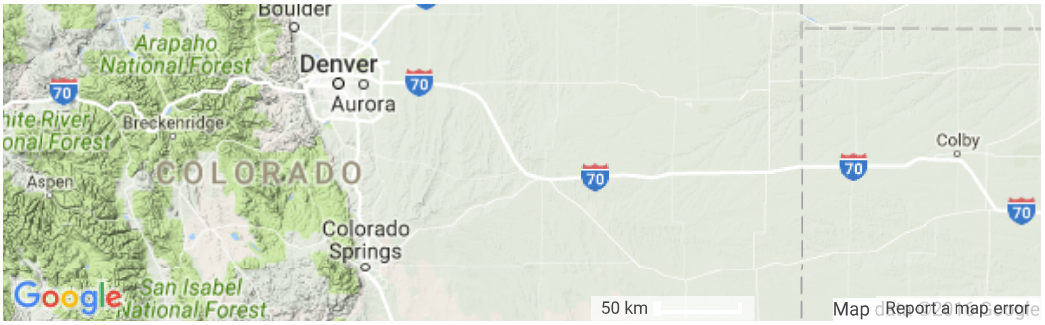
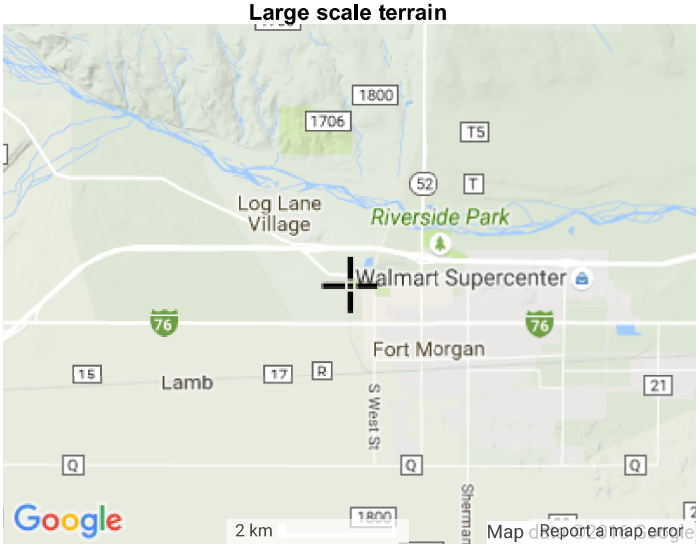
Back to Top

Maps & aerials

Small scale terrain

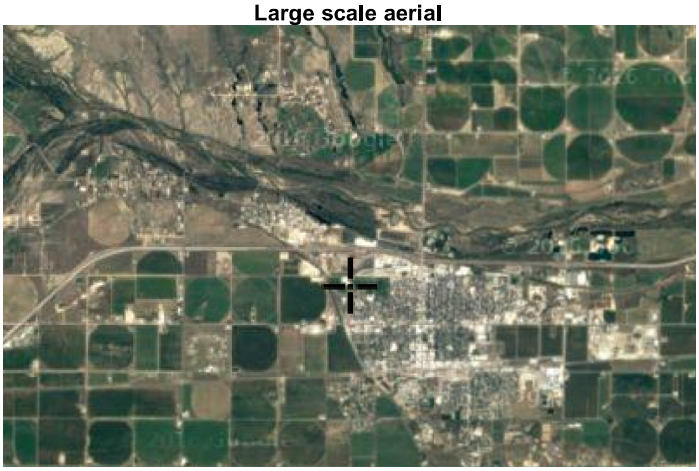


Large scale terrain



Large scale map

Large scale aerial



Back to Top

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