Accepted Study/Report

Gene Williams
Digitally signed by Gene Williams
DN: CN=Gene Williams, OU=Development, OU=LS Users, DC=COLS, DC=LOC
Date: 2024.11.07 14:28:22-06'00'

DRAINAGE DESIGN SUMMARY

FOR

HCA LEE'S SUMMIT MEDICAL CENTER

REMOTE PARKING LOT & DIETARY EXPANSION

Lee's Summit, Missouri

October 28, 2024

Prepared by:

Catalyst Design Group
1524 Williams Drive, Suite 201
Murfreesboro, TN 37129
615.622.7200

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Drainage Design Summary

Overview

The proposed project consists of constructing a remote parking lot, pedestrian bridge, and dietary building addition within the HCA Lee's Summit Medical Center hospital campus in Lee's Summit. The project site is identified on Jackson County Tax Map 60 as Parcel 60-420-99-15-00-0-00-000. The development takes place in two areas of the hospital campus. The remote parking lot and pedestrian bridge will be constructed on the western portion of the undeveloped parcel, adjacent to SE Cumberland Drive, while the dietary expansion will take place within the hospital's current building envelop.

Pre-Development Conditions

Currently, the 24.48-acre site is mostly developed with peripheral areas along SE Cumberland Drive remaining undeveloped. The existing hospital campus directs its stormwater runoff to an extended detention pond for treatment and attenuation. Situated between the hospital campus and undeveloped area is a tributary of Prairie Lee Lake, which is the properties discharge outfall. The undeveloped portion of the site drains via sheet and shallow concentrated flow to the tributary, while the developed campus is collected via a storm sewer collection system, directed to an extended detention pond, and discharges to the tributary through an outlet control structure.

Due to the fact that the dietary expansion will have its runoff discharge to existing storm sewer infrastructure, which was sized to accommodate its expansion, this report will only analyze the remote parking lot expansion area. See the attached predevelopment drainage area map for a detailed view of the predeveloped 1.31 acre remote parking lot site.

The existing site consists of all C-group soils (CN 79), within the Hospital Campus property.

The overall pre-development flows to the outfall are as follows:

PREDEVELOPMENT PEAK FLOWS	
Storm Event	**Flow (cfs)**
2-year	4.693
5-year	7.023
10-year	9.146
25-year	12.24
50-year	14.77
100-year	17.43

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Pre-development flows were calculated using the SCS/NRCS Curve Number method, and results were prepared by Hydrology Studio software. Routing calculations produced by this software are attached.

Post-Development Conditions

The proposed remote parking lot project consists of constructing a 75-space parking lot with a pedestrian bridge providing connectivity to the existing hospital campus. The post-development site will have a much larger quantity of impervious areas than the pre-development site; however, a combination of low-impact development BMPs will provide stormwater treatment and a reduction in post-developed run-off. Stormwater runoff will discharge into a dry extended detention pond with a pre-treatment forebay, by sheet flowing through curb cuts.

The proposed dry extended detention pond will provide 40-hour extended detention of the 90% mean annual event (1.37"/24-hour rainfall) with the use of a low flow orifice. The pond will also utilize an outlet control structure to detain the runoff from the parking lot to provide attenuation of the 2-year through 100—year storm events.

The emergency spillway has been designed in accordance with APWA & Lee's Summit standards. The 100-year storm event reaches a maximum water surface elevation of 994.44, which is 6" below the bottom of the spillway. Additionally, there is 1' of freeboard from the top of the spillway to the 100-year storm event assuming zero storage in the pond and outlet structure.

For the downstream analysis, data from USGS Stream state was used to determine the adjacent streams peak flow and drainage area. With this data, the stream channel was modeled using the existing conditions and with the reduced volume and provided by the extended detention pond. Please refer to the attachments where the model results show a reduction in the peak flow and water surface elevation for the 100-year storm event, and each subsequent event considering the post developed site provides a runoff reduction for all storm events.

In post-development condition, the impervious area the site is treated by the onsite LID BMPs and conveyed by the proposed stormwater management system to the site outfall. However, a peripheral area will bypass the onsite system to the outfall. These areas are outlined in detail on the attached post-development drainage area map.

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The overall post-development peak flows to the outfall are as follows:

POST-DEVELOPMENT PEAK FLOWS		
Storm Event	**Proposed Flow (cfs)**	**Max. Allowed Flow (cfs)**
2-year	0.607	0.655 (0.5 cfs / ac.)
5-year	1.125	
10-year	1.635	2.62 (2.0 cfs / ac.)
25-year	2.325	
50-year	2.880	
100-year	3.555	3.93 (3.0 cfs / ac.)

Please see the attached routing calculations for a detailed breakdown of the peak flows from each contributing drainage area.

Post-development flows were calculated using the SCS/NRCS Curve Number Method, and results were prepared by Hydrology Studio software. Routing calculations produced by this software are attached.

Conclusion

The stormwater management system for the proposed development maintains post-development peak flows below pre-development levels, as required by the City of Lee's Summit, while simultaneously meeting the City's Comprehensive Control Strategy. In addition, the use of low-impact development BMPs as part of the stormwater management system results in runoff reduction and 40-hour extended detention of the 90% mean annual storm event as required by The City of Lee's Summit stormwater regulations.

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PRE- AND POST-PEAK FLOW COMPARISON			
Storm Event	**Post-Development Flow (cfs)**	**Pre-Development Flow (cfs)**	**Difference +/- (cfs)**
2-year	0.607	2.757	-2.15
5-year	1.125	4.126	-3.001
10-year	1.635	5.373	-3.738
25-year	2.325	7.193	-4.868
50-year	2.880	8.679	-5.799
100-year	3.555	10.24	-6.685

Attachment(s):

- Attachment 1 – Site Drainage Area Maps
- Attachment 2 – Hydraflow Hydrographs Routing Calculations

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Attachment 1

Site Drainage Area Maps

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LEGEND	
EXISTING PERVIOUS AREA	

PROJECT AREA	
EXISTING PERVIOUS AREA	57,241 SQ FT (1.31 AC)

N

0 15 30 60 90
GRAPHIC SCALE

Catalyst DESIGN GROUP
5100 TENNESSEE AVENUE, NASHVILLE, TN 37209
(615) 622-7200 | WWW.CATALYST-DG.COM

HCA LEE'S SUMMIT MEDICAL CENTER
2100 SE BLUE PKWY, LEE'S SUMMIT, MO 64063

NO.	DATE	DESCRIPTION

DRAWING TITLE
PRE-DEVELOPMENT IMPERVIOUS EXHIBIT

PROJECT NUMBER 20240037

DRAWING NUMBER
1 OF 2

P:\2024\20240037_Devenney - HCA Lee's Summit Medical Center_Med Surg Exp\Engineering\dwg\Pre & Post Dev\20240037_PreDev Impervious.dwg-C1.0 EXISTING CONDITIONS OR SITE SURVEY Oct 28, 2024 wblissard

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LEGEND	
PROPOSED PERVIOUS AREA	
PROPOSED IMPERVIOUS AREA	

PROJECT AREA	
PROPOSED PERVIOUS AREA	23,221 FT (0.53 AC)
PROPOSED IMPERVIOUS AREA	34,020 SQ FT (0.78 AC)

PROJECT AREA

TEMPORARY GRAVEL PARKING LOT

SE CUMBERLAND DR.

60' STREAM BUFFER

POND TREATMENT AREA: 1.34 AC.
CN: 91

N

0 15 30 60 90
GRAPHIC SCALE

Catalyst DESIGN GROUP
5100 TENNESSEE AVENUE, NASHVILLE, TN 37209
(615) 522-7200 | WWW.CATALYST-DG.COM

HCA LEE'S SUMMIT
MEDICAL CENTER
2100 SE BLUE PKWY, LEE'S SUMMIT, MO 64063

NO.	DATE	DESCRIPTION

DRAWING TITLE
POST-DEVELOPMENT IMPERVIOUS EXHIBIT

PROJECT NUMBER
20240037

DRAWING NUMBER
2 OF 2

P:\2024\20240037_Devenney - HCA Lee's Summit Medical Center_Med Surg Exp\Engineering\dwg\Pre & Post Dev\20240037_PostDev_Impervious.dwg-C5.0 LAYOUT PLAN Oct 28, 2024 whelsand

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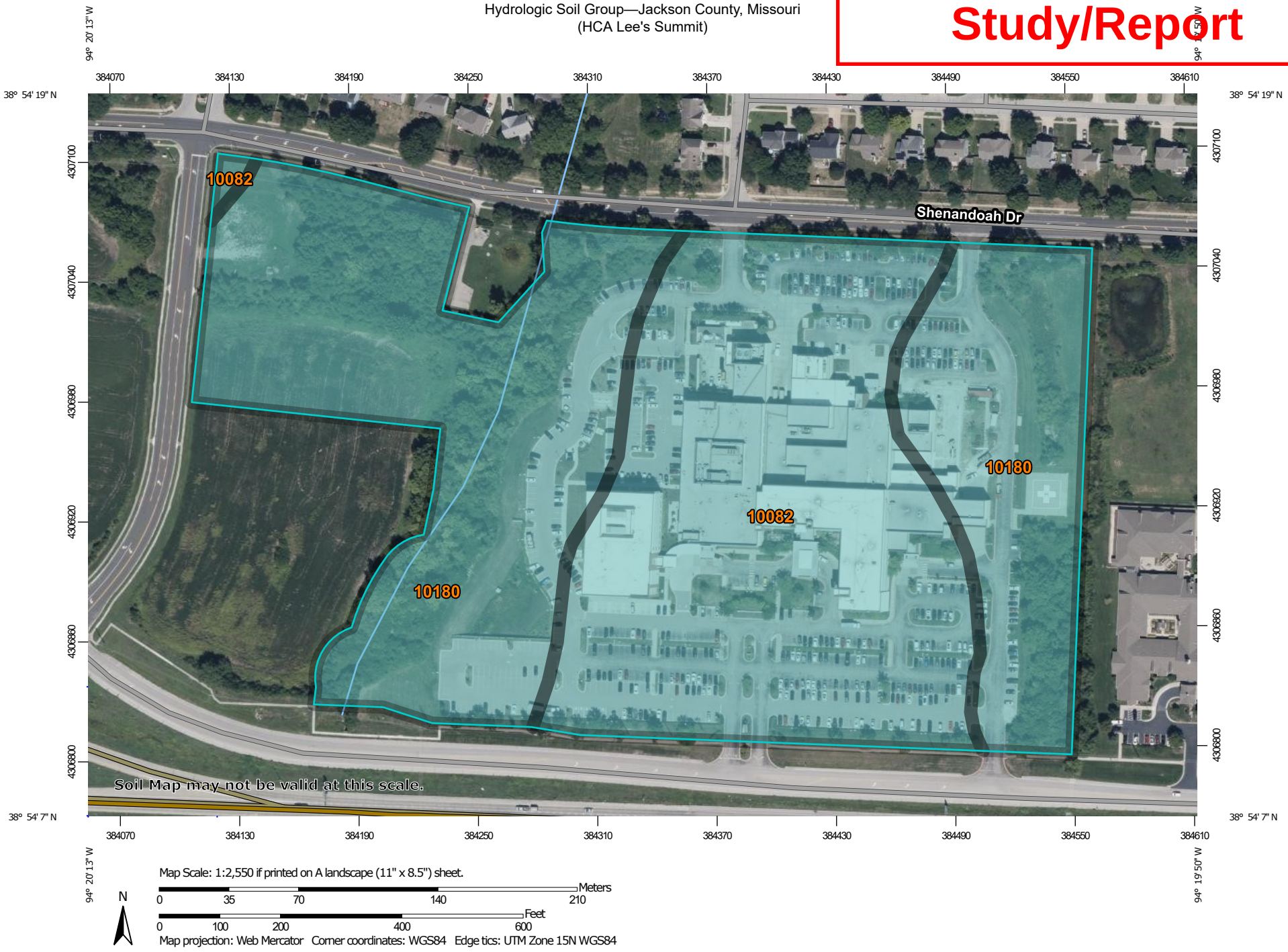
Hydrologic Soil Group—Jackson County, Missouri
(HCA Lee's Summit)



Map Scale: 1:2,550 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 35 70 140 210

Feet
0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

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MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:24,000.

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: Jackson County, Missouri
Survey Area Data: Version 25, Aug 22, 2023

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

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.

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	C	10.9	44.7%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	C	13.5	55.3%
Totals for Area of Interest			**24.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

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Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

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94°20'15"W 38°54'26"N

94°19'38"W 38°53'58"N

Feet 0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/28/2024 at 5:10 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

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Attachment 2

Hydraflow Hydrographs Routing Calculations

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Basin Model

Hydrology Studio v 3.0.0.33

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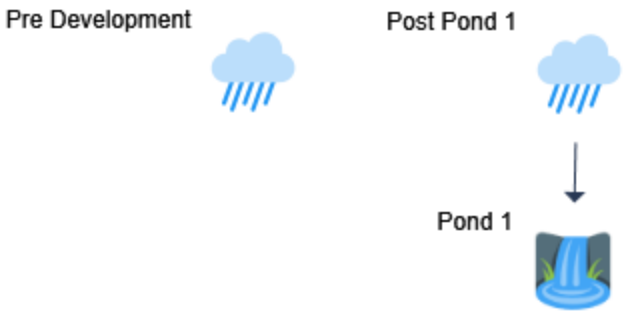
Project Name:

10-28-2024



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Hydrograph by Return Period

Hydrology Studio v 3.0.0.33

Project Name:

10-28-2024

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	NRCS Runoff	Pre Development		2.757		4.126	5.373	7.193	8.679	10.24
2	NRCS Runoff	Post Pond 1		4.819		6.481	7.936	10.00	11.67	13.41
3	Pond Route	Pond 1		0.607		1.125	1.635	2.325	2.880	3.555

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Hydrograph 2-yr Summary

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre Development	2.757	12.03	7,768	----		
2	NRCS Runoff	Post Pond 1	4.819	12.00	12,791	----		
3	Pond Route	Pond 1	0.607	12.43	12,728	2	992.07	7,027

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Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

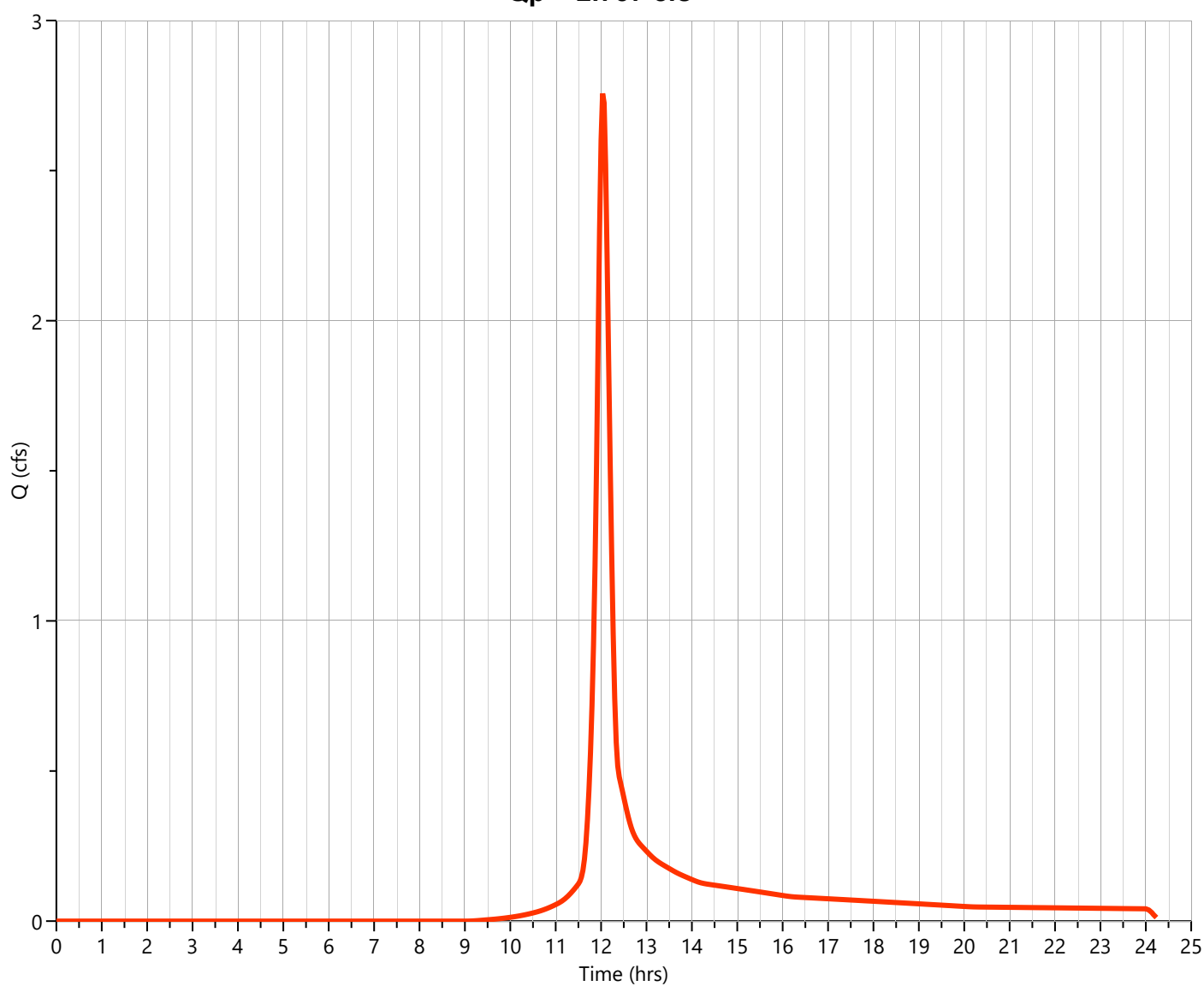
Pre Development

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 2.757 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.03 hrs
Time Interval	= 2 min	Runoff Volume	= 7,768 cuft
Drainage Area	= 1.31 ac	Curve Number	= 79*
Tc Method	= User	Time of Conc. (Tc)	= 15.39 min
Total Rainfall	= 3.64 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
1.31	79	Pervious
1.31	**79**	Weighted CN Method Employed



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Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

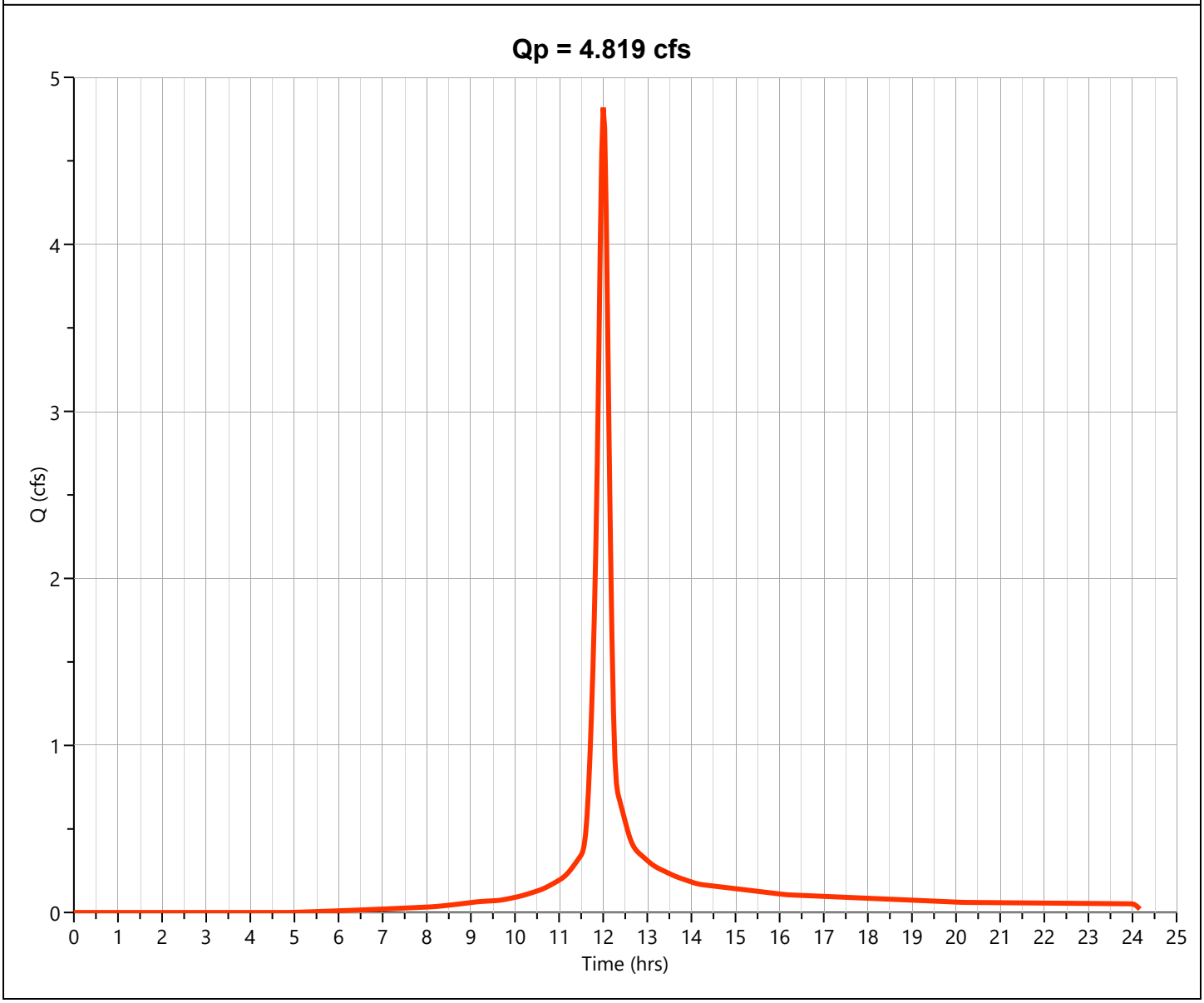
Post Pond 1

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 4.819 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.00 hrs
Time Interval	= 2 min	Runoff Volume	= 12,791 cuft
Drainage Area	= 1.31 ac	Curve Number	= 90.31*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 3.64 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.53	79	Pervious
0.78	98	Impervious
1.31	**90**	Weighted CN Method Employed



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Hydrograph Report

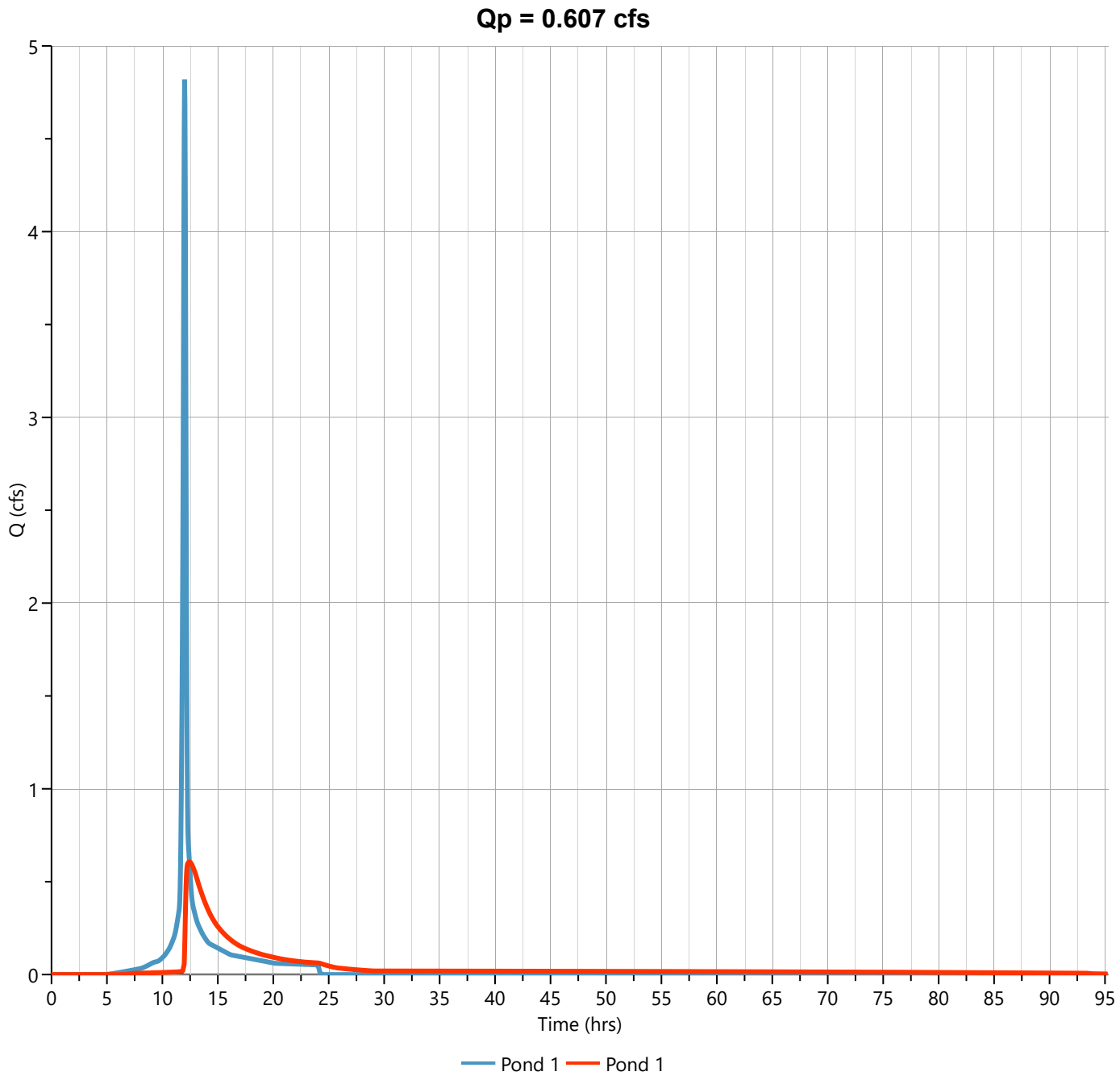
Pond 1

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 0.607 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.43 hrs
Time Interval	= 2 min	Hydrograph Volume	= 12,728 cuft
Inflow Hydrograph	= 2 - Pond 1	Max. Elevation	= 992.07 ft
Pond Name	= Pond 1	Max. Storage	= 7,027 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 13.83 hrs



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Pond Report

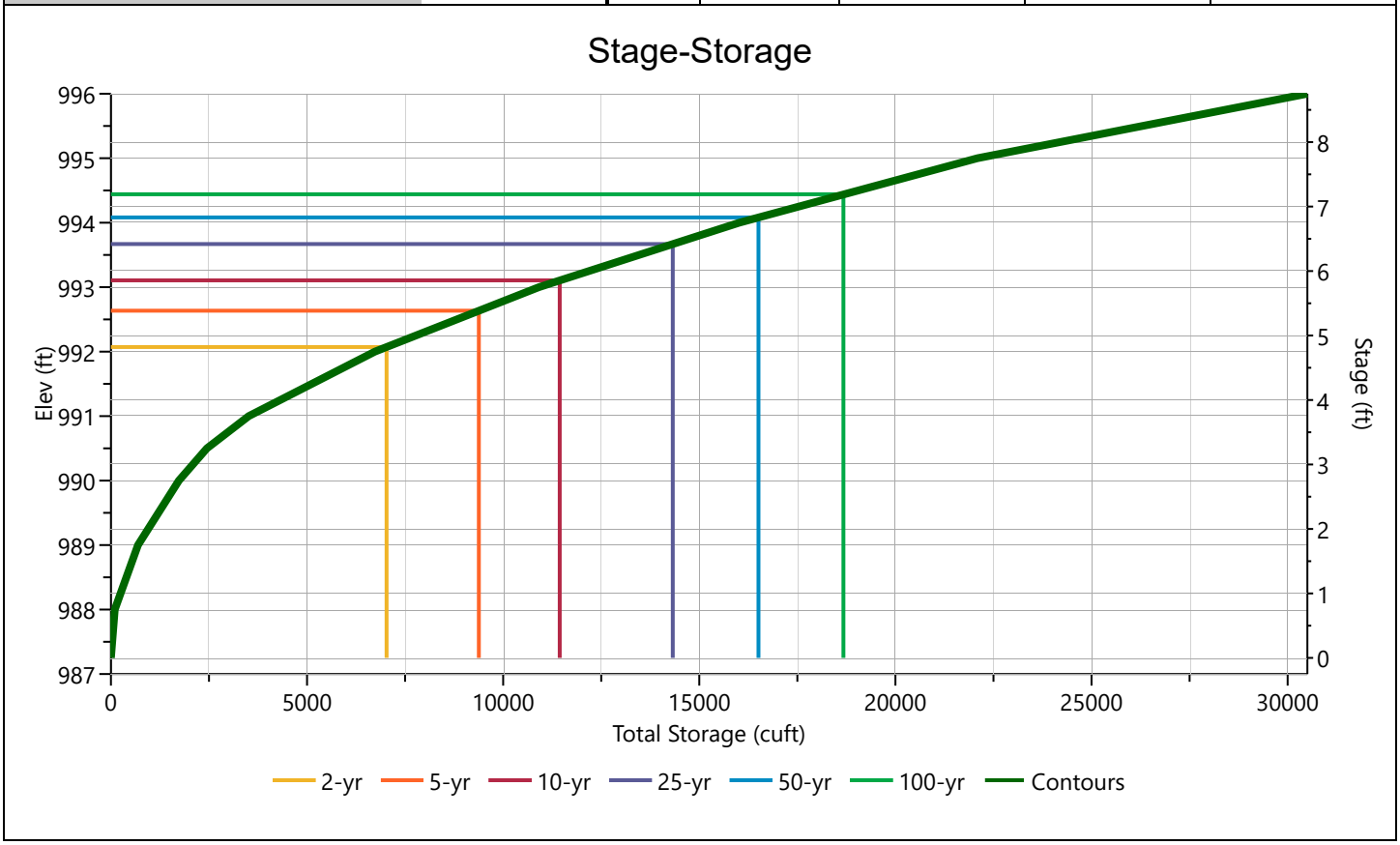
Pond 1

Stage-Storage

User Defined Contours	
Description	**Input**
Bottom Elevation, ft	987.25
Voids (%)	100.00
Volume Calc	Circular

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
0.00	987.25	1	0.000	0.000
0.50	988.00	389	97.5	97.5
1.50	989.00	795	592	690
2.50	990.00	1,289	1,042	1,732
3.00	990.50	1,570	715	2,446
3.50	991.00	2,698	1,067	3,513
4.50	992.00	3,732	3,215	6,728
5.50	993.00	4,634	4,183	10,911
6.50	994.00	5,580	5,107	16,018
7.50	995.00	6,568	6,074	22,092
8.75	996.00	6,889	8,411	30,503



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Pond Report

Hydrology Studio v 3.0.0.33

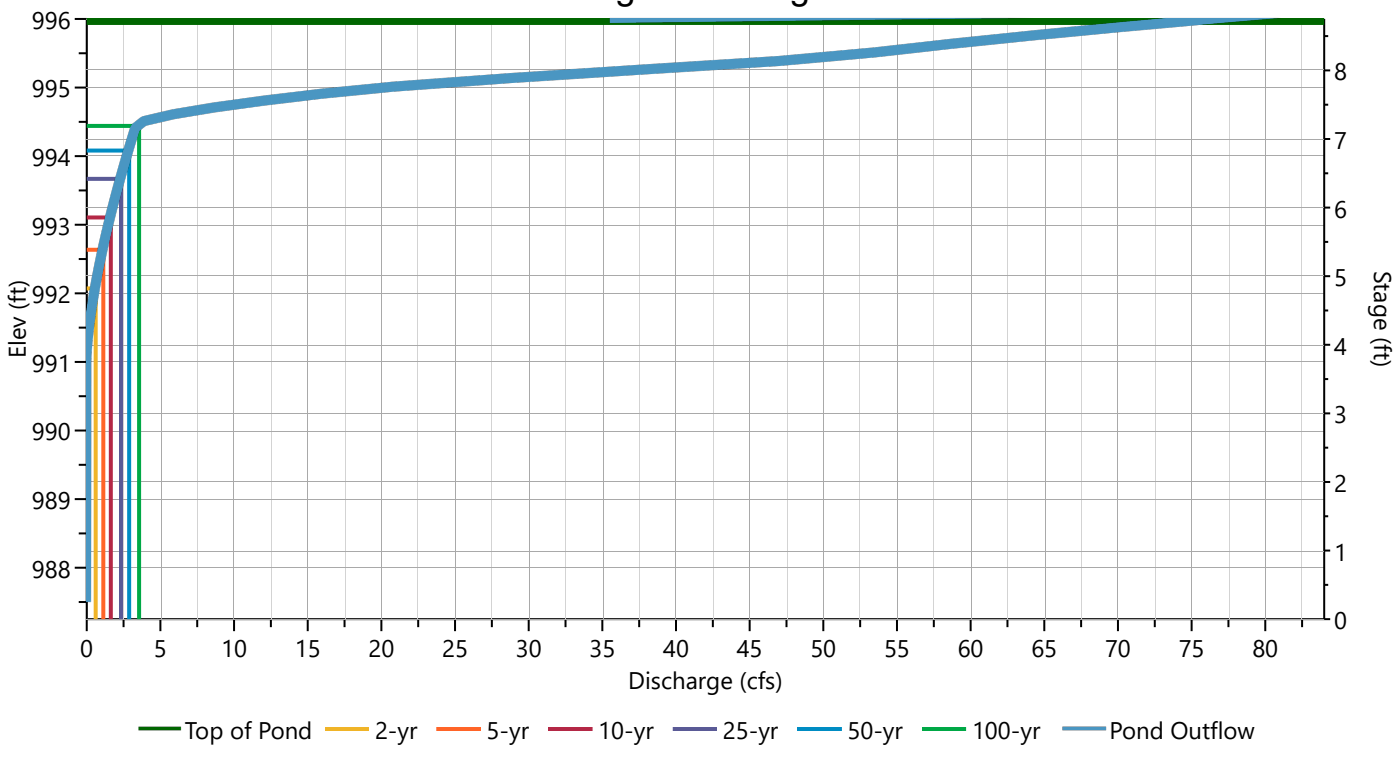
10-28-2024

Pond 1

Stage-Discharge

Culvert / Orifices	Culvert	Orifice			Orifice Plate	
		1 (m)	2	3		
Rise, in	24	.63			Orifice Dia, in	
Span, in	24	.63			No. Orifices	
No. Barrels	1	1			Invert Elevation, ft	
Invert Elevation, ft	987.50	987.25			Height, ft	
Orifice Coefficient, Co	0.60	0.60			Orifice Coefficient, Co	
Length, ft	50					
Barrel Slope, %	.25					
N-Value, n	0.013					
Weirs	**Riser**	**Weir**			**Ancillary**	
		1 (m)	2 (i)	3		
Shape / Type	Box	Rectangular	Broad Crested		Exfiltration, in/hr	
Crest Elevation, ft	994.45	991	994.95			
Crest Length, ft	12	.16	120			
Angle, deg						
Weir Coefficient, Cw	3.3	3.3	3.3			

m = Flows through Culvert, i = Independent



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Pond Report

Pond 1

Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	987.25	0.000	0.000	0.000			0.000	0.000	0.000	0.000				0.000
0.50	988.00	97.5	0.007 oc	0.007			0.000	0.000	0.000	0.000				0.007
1.50	989.00	690	0.013 oc	0.013			0.000	0.000	0.000	0.000				0.013
2.50	990.00	1,732	0.016 oc	0.016			0.000	0.000	0.000	0.000				0.016
3.00	990.50	2,446	0.018 oc	0.018			0.000	0.000	0.000	0.000				0.018
3.50	991.00	3,513	0.019 oc	0.019			0.000	0.000	0.000	0.000				0.019
4.50	992.00	6,728	0.549 oc	0.021			0.000	0.528	0.000	0.000				0.549
5.50	993.00	10,911	1.516 oc	0.023			0.000	1.493	0.000	0.000				1.516
6.50	994.00	16,018	2.768 oc	0.025			0.000	2.744	0.000	0.000				2.768
7.50	995.00	22,092	20.40 oc	0.021			16.15	4.224	0.369	0.000				20.77
8.75	996.00	30,503	0.000	0.000			0.000	0.000	35.51	0.000				35.51

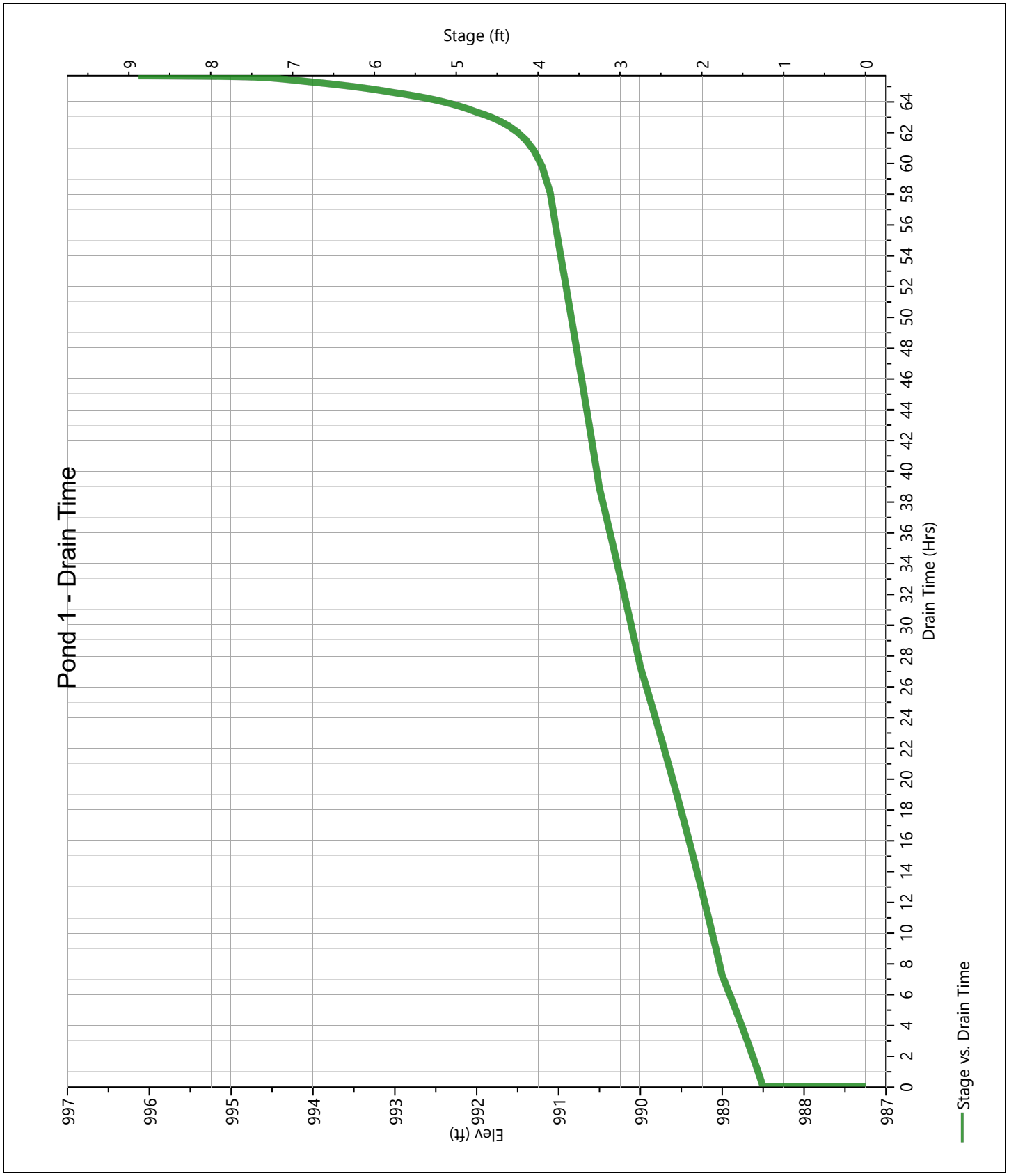
Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

Accepted
Study/Report

Pond Report

Pond 1

Pond Drawdown



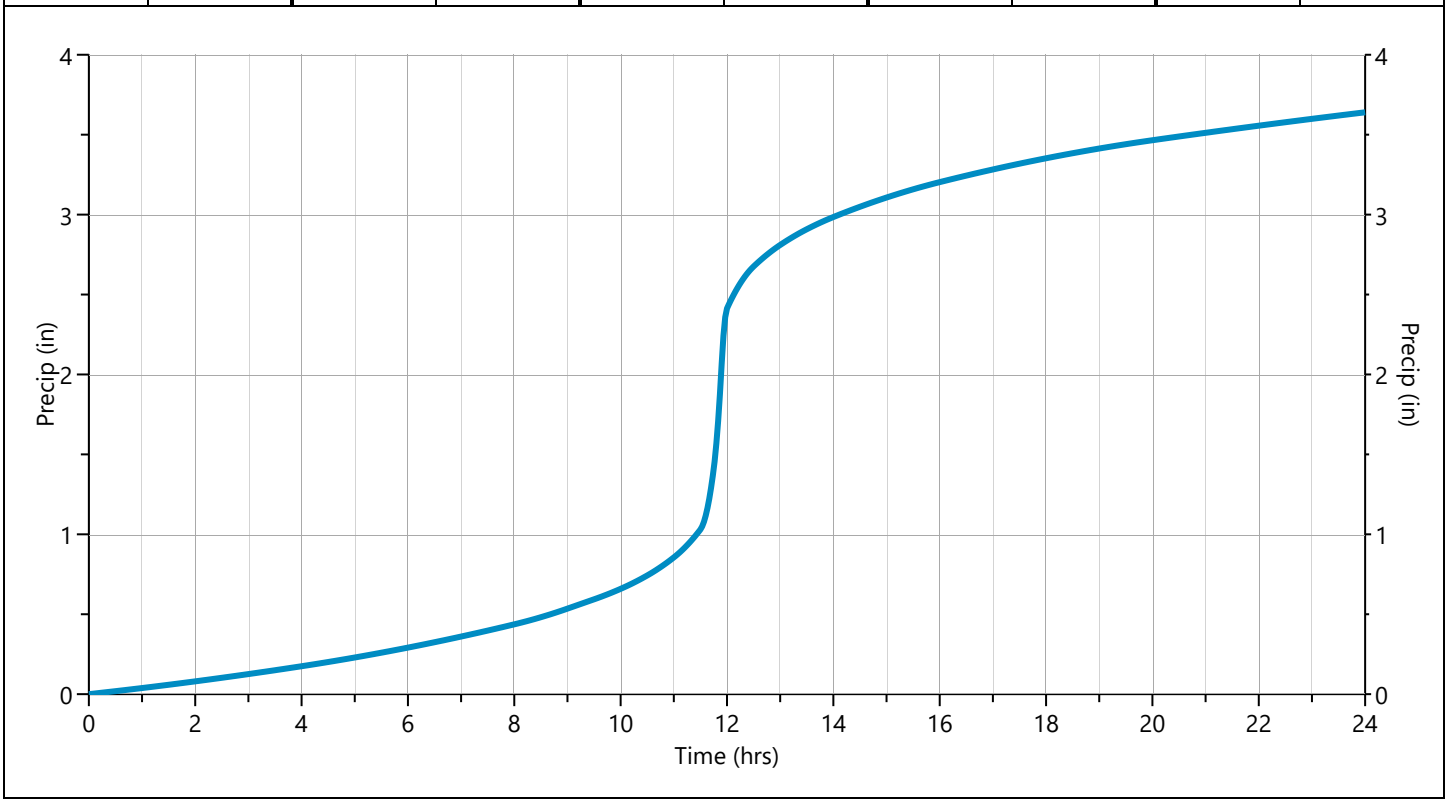
Accepted
Study/Report

Design Storm Report

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	✔ 2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
24 hrs	3.06	3.64	0.00	4.64	5.52	6.78	7.80	8.87	

Incremental Rainfall Distribution, 2-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.008170	11.27	0.011648	11.63	0.048080	12.00	0.054701	12.37	0.014706
10.93	0.008332	11.30	0.012036	11.67	0.057658	12.03	0.024334	12.40	0.013783
10.97	0.008493	11.33	0.012425	11.70	0.067235	12.07	0.023005	12.43	0.012861
11.00	0.008655	11.37	0.012813	11.73	0.076812	12.10	0.022083	12.47	0.011939
11.03	0.008929	11.40	0.013201	11.77	0.088167	12.13	0.021161	12.50	0.011017
11.07	0.009318	11.43	0.013589	11.80	0.113024	12.17	0.020238	12.53	0.010452
11.10	0.009707	11.47	0.013978	11.83	0.139663	12.20	0.019316	12.57	0.010241
11.13	0.010095	11.50	0.014366	11.87	0.166302	12.23	0.018394	12.60	0.010030
11.17	0.010483	11.53	0.019376	**11.90**	**0.192942**	12.27	0.017472	12.63	0.009820
11.20	0.010871	11.57	0.028926	11.93	0.176076	12.30	0.016550	12.67	0.009609
11.23	0.011260	11.60	0.038503	11.97	0.115327	12.33	0.015628	12.70	0.009399



Accepted
Study/Report

Hydrograph 5-yr Summary

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre Development	4.126	12.03	11,565	----		
2	NRCS Runoff	Post Pond 1	6.481	12.00	17,467	----		
3	Pond Route	Pond 1	1.125	12.27	17,399	2	992.64	9,380

Accepted
Study/Report

Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

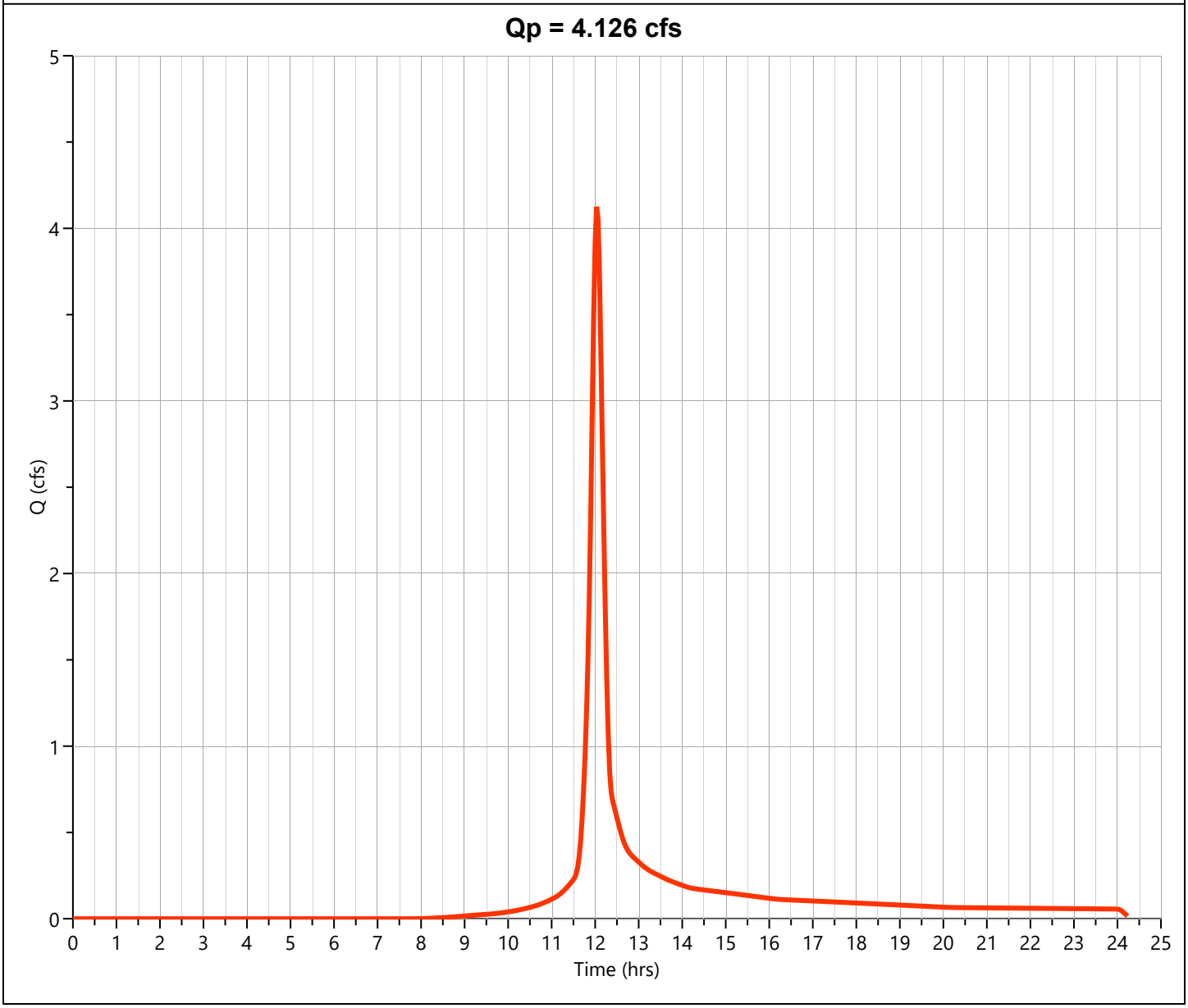
Pre Development

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 4.126 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.03 hrs
Time Interval	= 2 min	Runoff Volume	= 11,565 cuft
Drainage Area	= 1.31 ac	Curve Number	= 79*
Tc Method	= User	Time of Conc. (Tc)	= 15.39 min
Total Rainfall	= 4.64 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
1.31	79	Pervious
1.31	**79**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

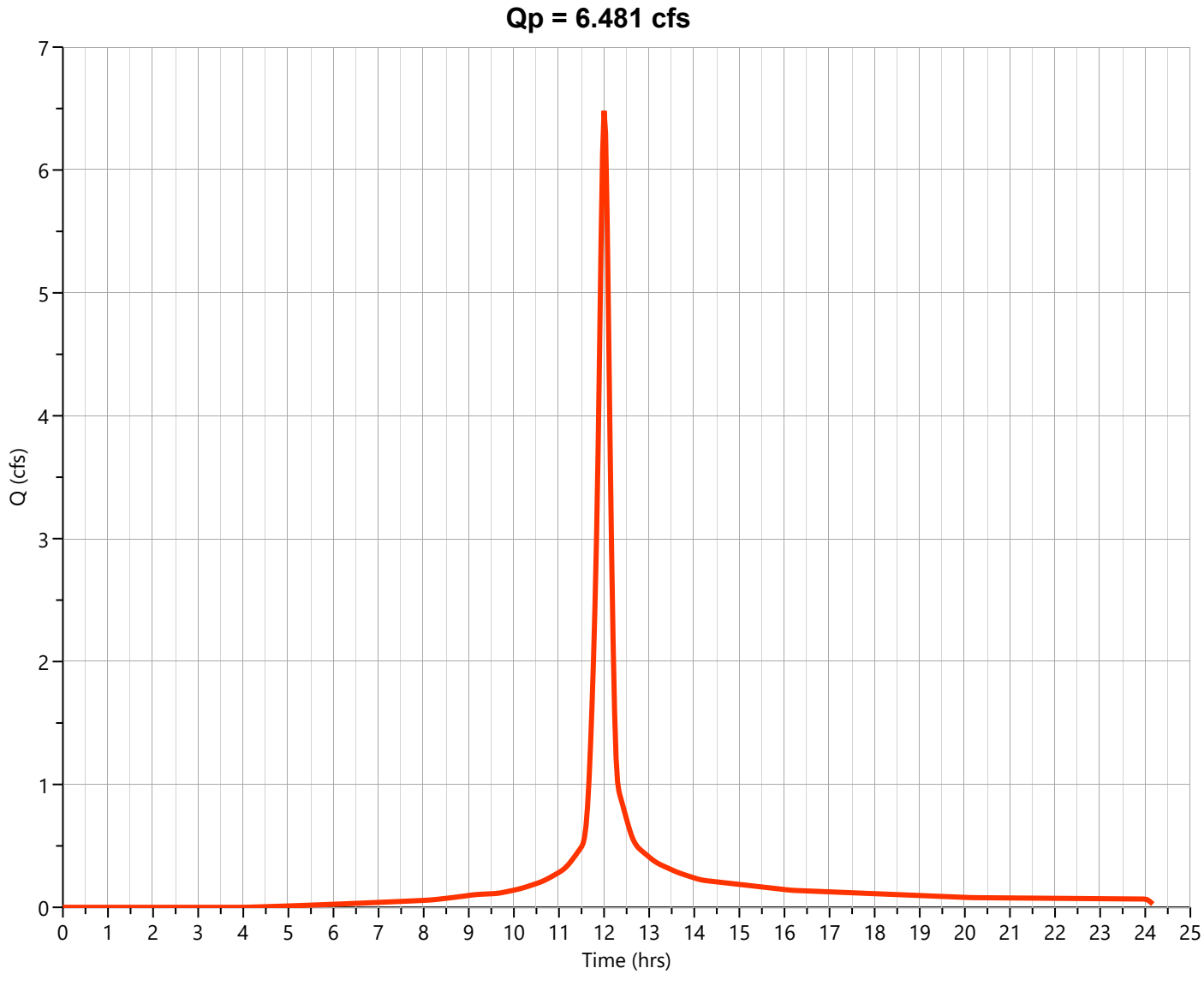
Post Pond 1

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 6.481 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.00 hrs
Time Interval	= 2 min	Runoff Volume	= 17,467 cuft
Drainage Area	= 1.31 ac	Curve Number	= 90.31*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 4.64 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.53	79	Pervious
0.78	98	Impervious
1.31	**90**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

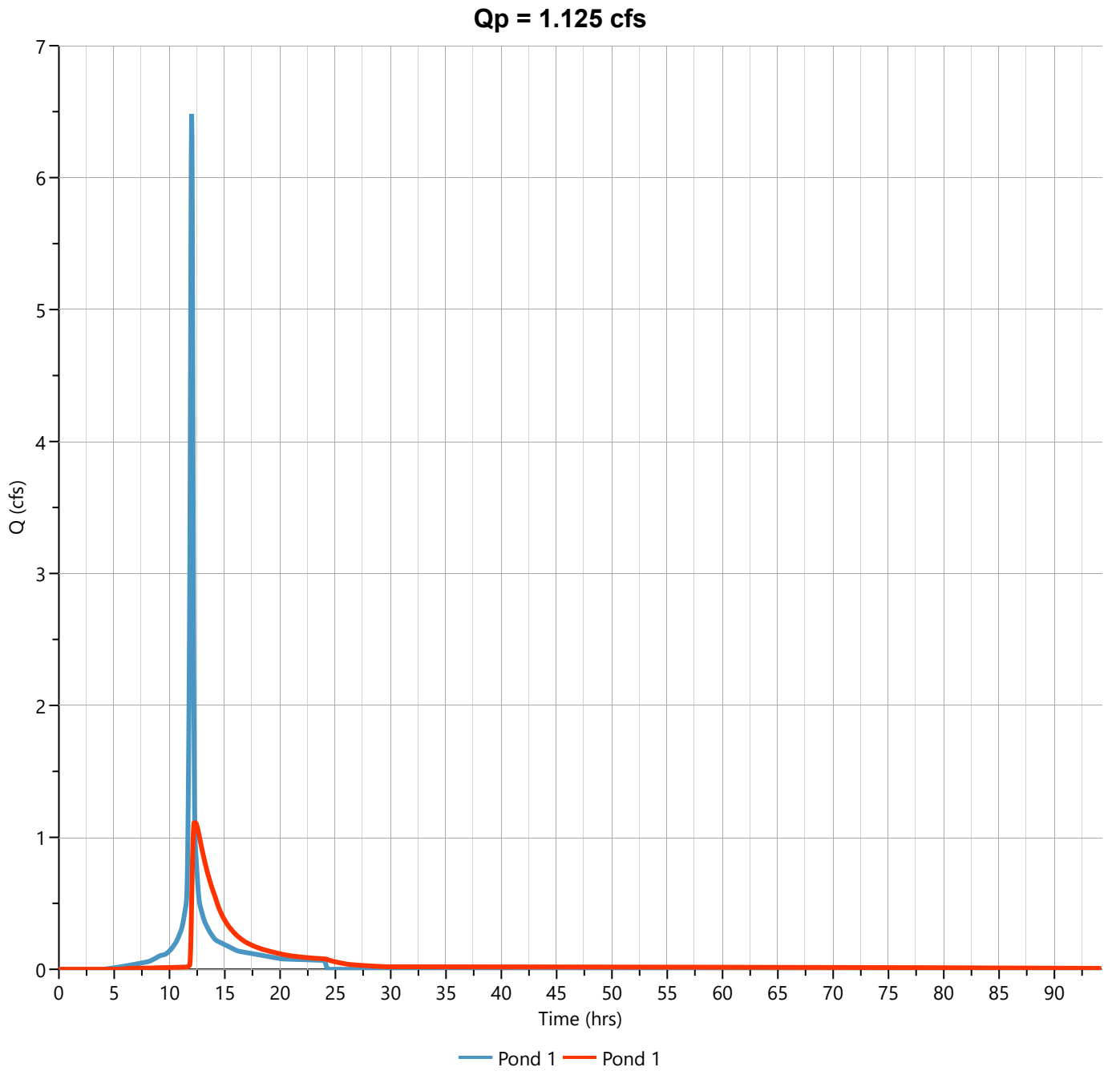
Pond 1

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 1.125 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.27 hrs
Time Interval	= 2 min	Hydrograph Volume	= 17,399 cuft
Inflow Hydrograph	= 2 - Pond 1	Max. Elevation	= 992.64 ft
Pond Name	= Pond 1	Max. Storage	= 9,380 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 9.16 hrs



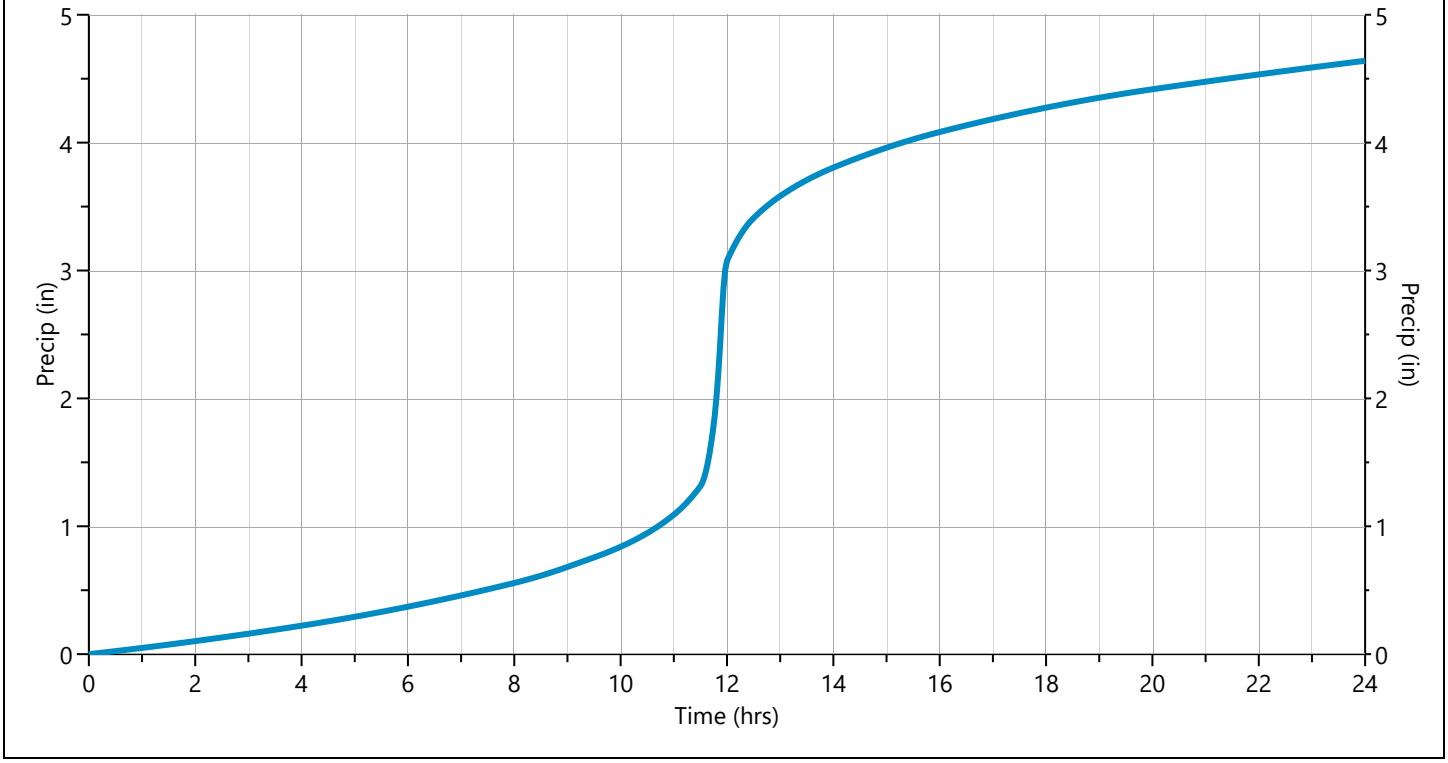
Accepted
Study/Report

Design Storm Report

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	✔ 5-yr	10-yr	25-yr	50-yr	100-yr	
24 hrs	3.06	3.64	0.00	4.64	5.52	6.78	7.80	8.87	

Incremental Rainfall Distribution, 5-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.010414	11.27	0.014848	11.63	0.061289	12.00	0.069728	12.37	0.018745
10.93	0.010620	11.30	0.015343	11.67	0.073498	12.03	0.031020	12.40	0.017570
10.97	0.010827	11.33	0.015838	11.70	0.085706	12.07	0.029325	12.43	0.016395
11.00	0.011033	11.37	0.016333	11.73	0.097914	12.10	0.028149	12.47	0.015219
11.03	0.011382	11.40	0.016828	11.77	0.112389	12.13	0.026974	12.50	0.014044
11.07	0.011878	11.43	0.017323	11.80	0.144074	12.17	0.025799	12.53	0.013323
11.10	0.012373	11.47	0.017818	11.83	0.178032	12.20	0.024623	12.57	0.013054
11.13	0.012868	11.50	0.018313	11.87	0.211990	12.23	0.023448	12.60	0.012786
11.17	0.013363	11.53	0.024699	**11.90**	**0.245948**	12.27	0.022272	12.63	0.012518
11.20	0.013858	11.57	0.036873	11.93	0.224449	12.30	0.021097	12.67	0.012249
11.23	0.014353	11.60	0.049081	11.97	0.147010	12.33	0.019921	12.70	0.011981



Accepted
Study/Report

Hydrograph 10-yr Summary

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre Development	5.373	12.03	15,088	----		
2	NRCS Runoff	Post Pond 1	7.936	12.00	21,641	----		
3	Pond Route	Pond 1	1.635	12.27	21,568	2	993.11	11,442

Accepted
Study/Report

Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

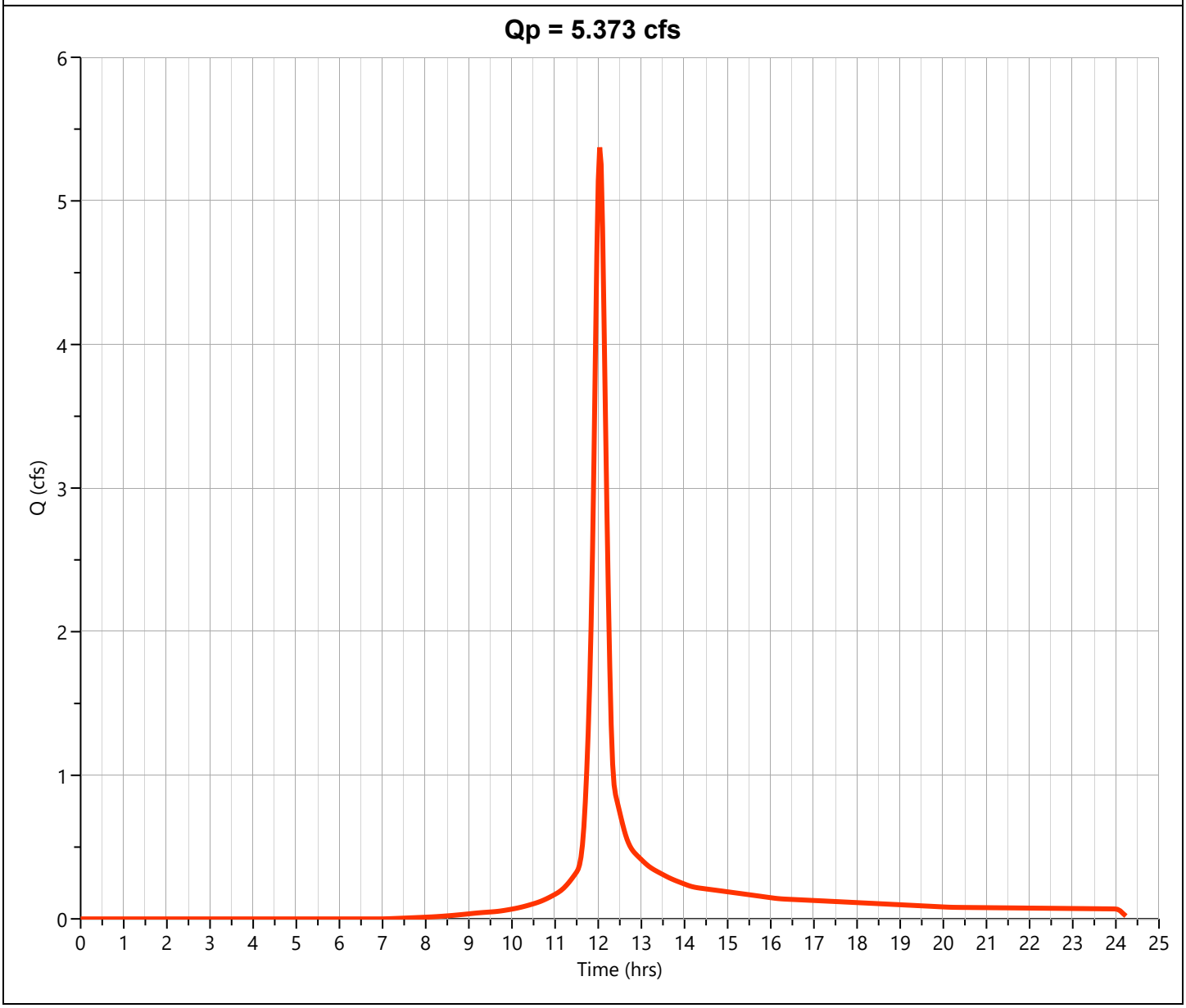
Pre Development

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 5.373 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.03 hrs
Time Interval	= 2 min	Runoff Volume	= 15,088 cuft
Drainage Area	= 1.31 ac	Curve Number	= 79*
Tc Method	= User	Time of Conc. (Tc)	= 15.39 min
Total Rainfall	= 5.52 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
1.31	79	Pervious
1.31	**79**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

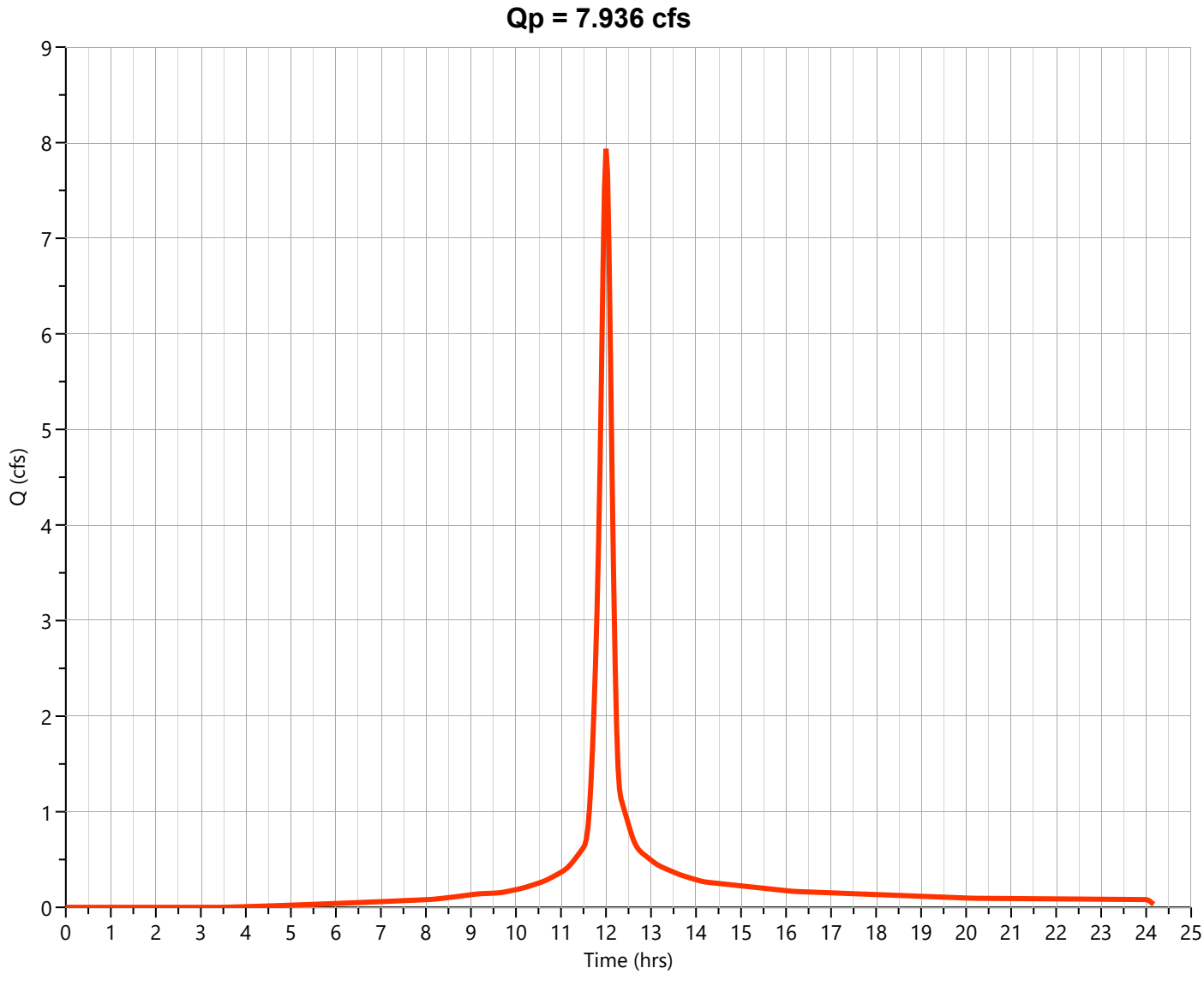
Post Pond 1

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 7.936 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.00 hrs
Time Interval	= 2 min	Runoff Volume	= 21,641 cuft
Drainage Area	= 1.31 ac	Curve Number	= 90.31*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 5.52 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.53	79	Pervious
0.78	98	Impervious
1.31	**90**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

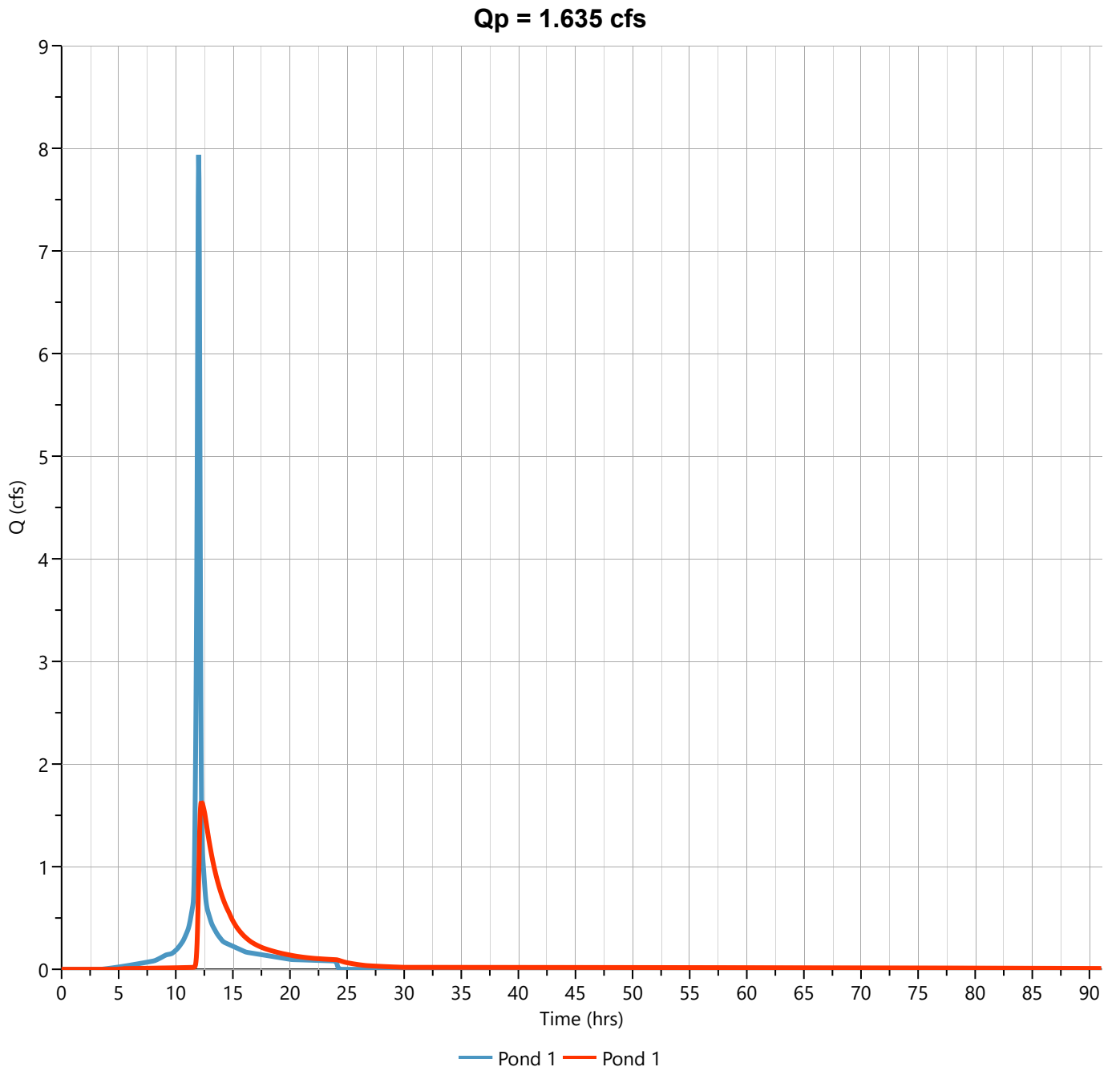
Pond 1

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 1.635 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.27 hrs
Time Interval	= 2 min	Hydrograph Volume	= 21,568 cuft
Inflow Hydrograph	= 2 - Pond 1	Max. Elevation	= 993.11 ft
Pond Name	= Pond 1	Max. Storage	= 11,442 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 4.81 hrs



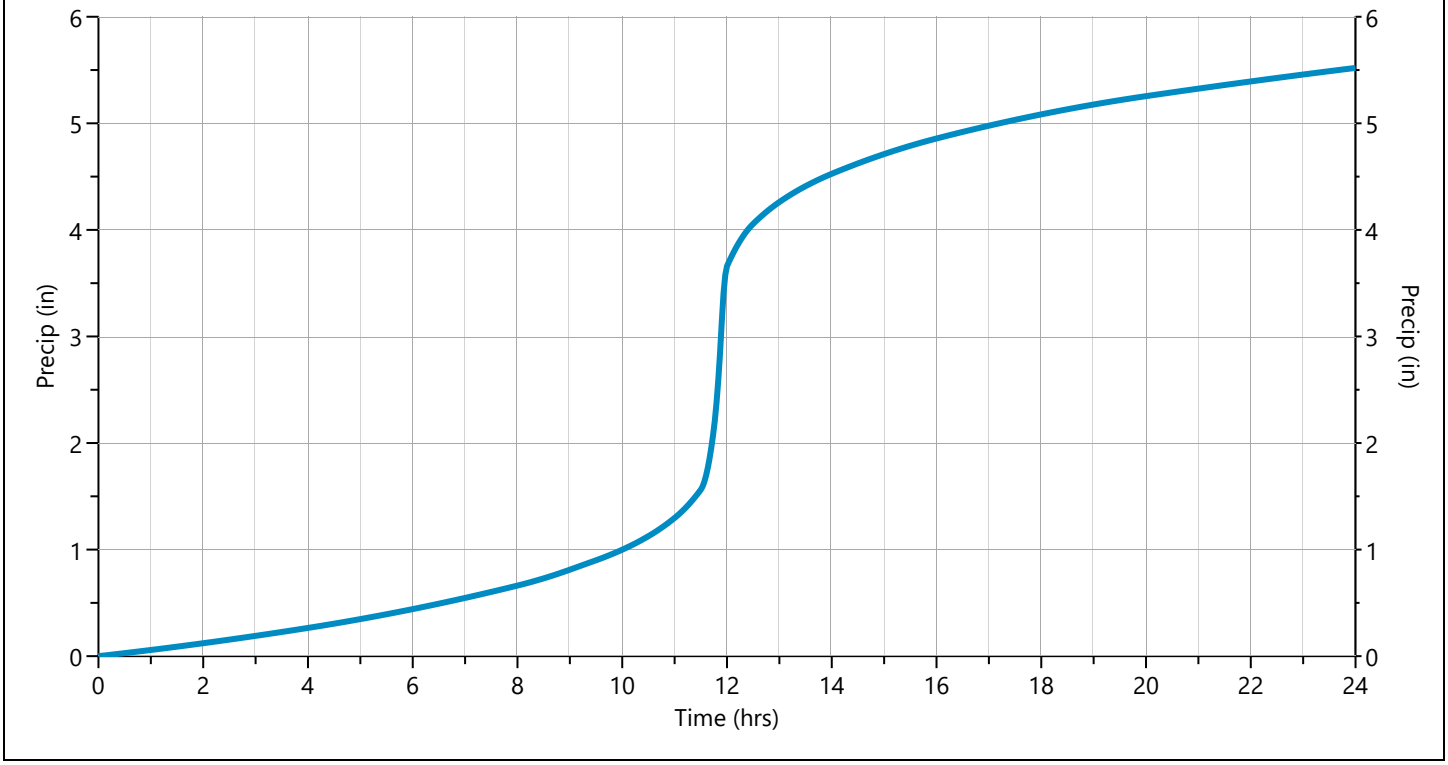
Accepted
Study/Report

Design Storm Report

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	✔ 10-yr	25-yr	50-yr	100-yr	
24 hrs	3.06	3.64	0.00	4.64	5.52	6.78	7.80	8.87	

Incremental Rainfall Distribution, 10-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.012389	11.27	0.017664	11.63	0.072913	12.00	0.082953	12.37	0.022301
10.93	0.012635	11.30	0.018253	11.67	0.087437	12.03	0.036903	12.40	0.020902
10.97	0.012880	11.33	0.018842	11.70	0.101961	12.07	0.034886	12.43	0.019504
11.00	0.013125	11.37	0.019430	11.73	0.116484	12.10	0.033488	12.47	0.018106
11.03	0.013541	11.40	0.020019	11.77	0.133704	12.13	0.032090	12.50	0.016707
11.07	0.014131	11.43	0.020608	11.80	0.171398	12.17	0.030691	12.53	0.015850
11.10	0.014720	11.47	0.021197	11.83	0.211796	12.20	0.029293	12.57	0.015530
11.13	0.015309	11.50	0.021786	11.87	0.252195	12.23	0.027895	12.60	0.015211
11.17	0.015898	11.53	0.029383	**11.90**	**0.292593**	12.27	0.026496	12.63	0.014892
11.20	0.016486	11.57	0.043866	11.93	0.267017	12.30	0.025098	12.67	0.014573
11.23	0.017075	11.60	0.058390	11.97	0.174891	12.33	0.023699	12.70	0.014254



Accepted
Study/Report

Hydrograph 25-yr Summary

Project Name:

10-28-2024

Hydrology Studio v 3.0.0.33

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre Development	7.193	12.03	20,324	----		
2	NRCS Runoff	Post Pond 1	10.00	12.00	27,673	----		
3	Pond Route	Pond 1	2.325	12.23	27,596	2	993.67	14,324

Accepted
Study/Report

Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

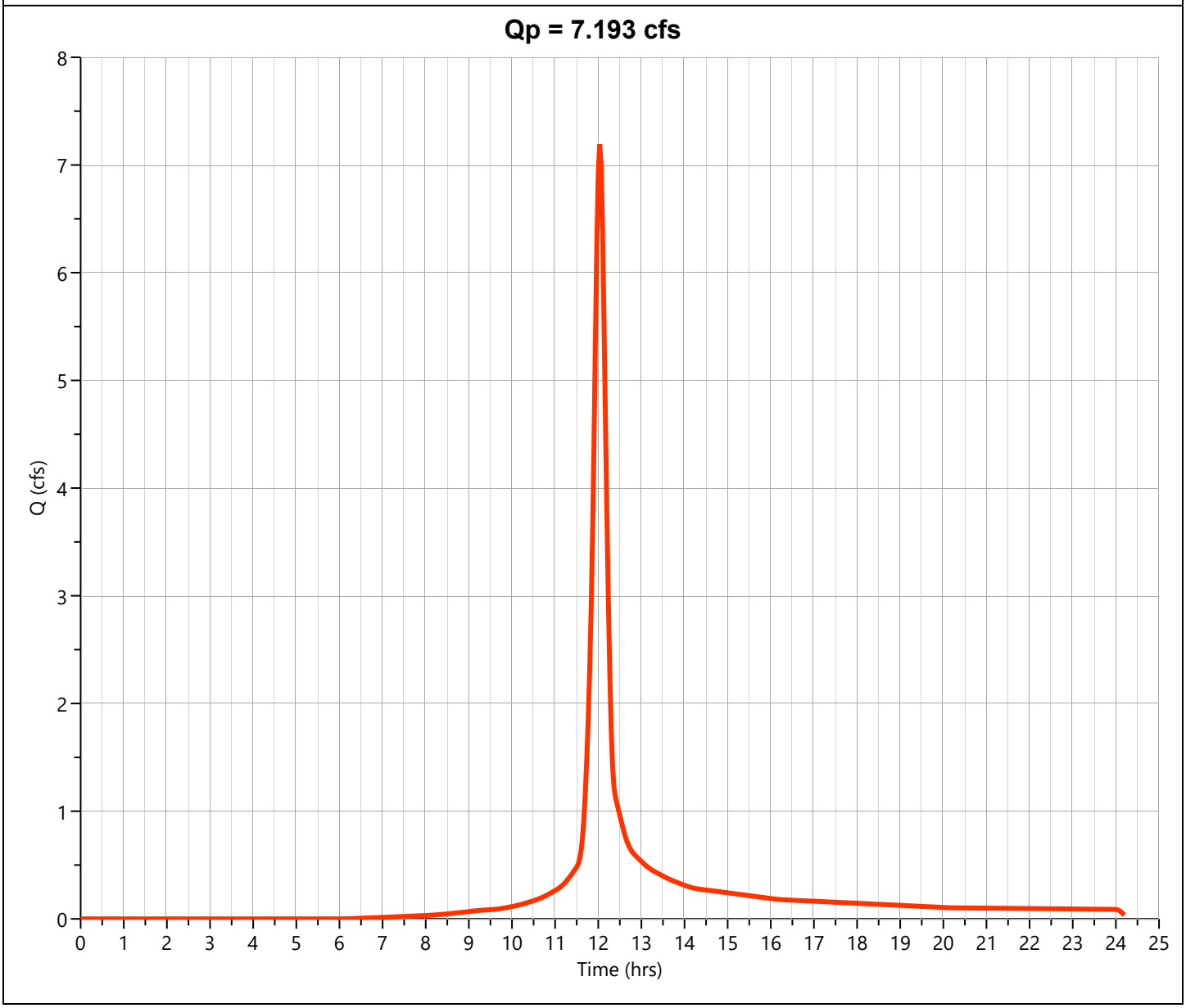
Pre Development

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 7.193 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.03 hrs
Time Interval	= 2 min	Runoff Volume	= 20,324 cuft
Drainage Area	= 1.31 ac	Curve Number	= 79*
Tc Method	= User	Time of Conc. (Tc)	= 15.39 min
Total Rainfall	= 6.78 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
1.31	79	Pervious
1.31	**79**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

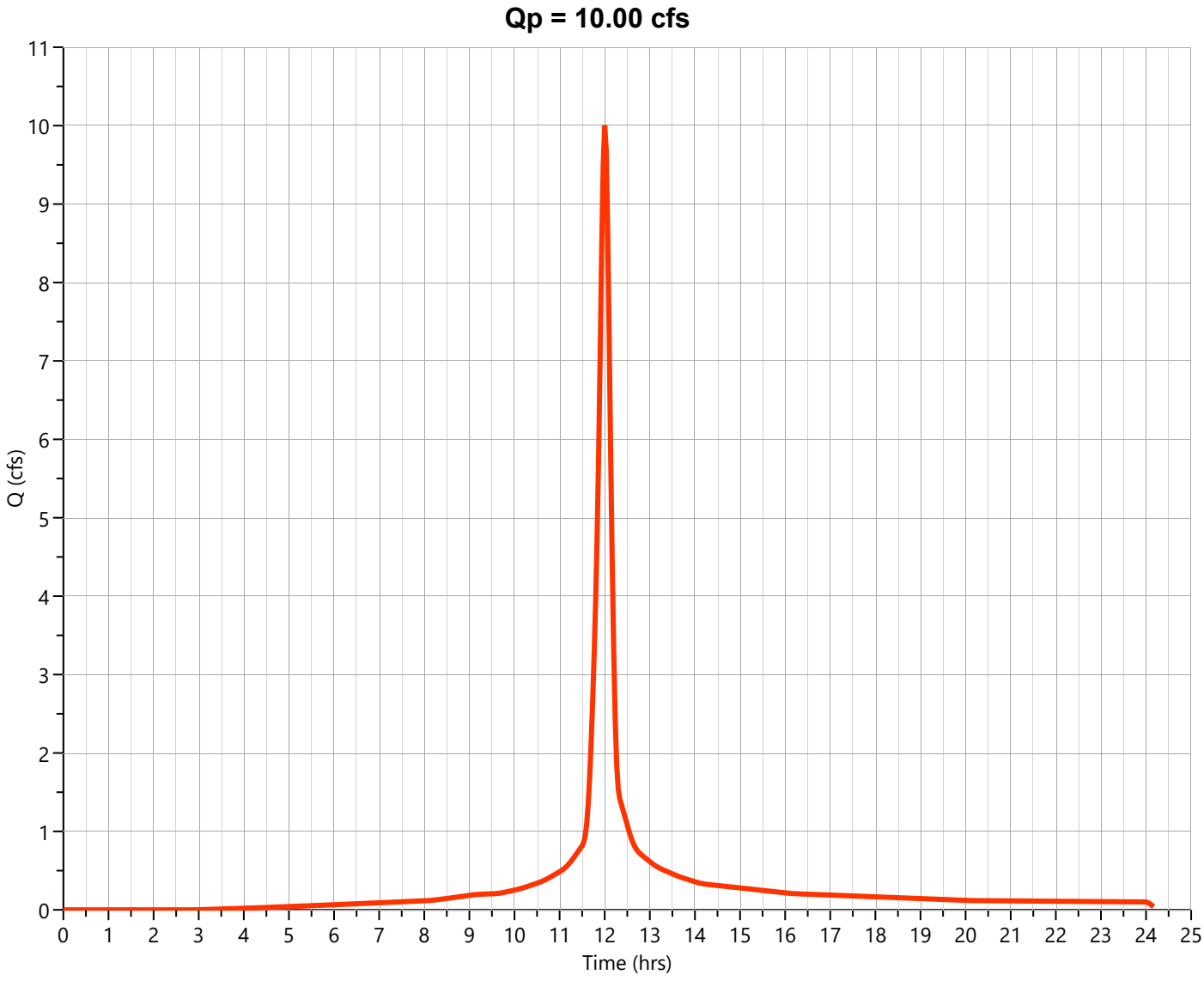
Post Pond 1

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 10.00 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.00 hrs
Time Interval	= 2 min	Runoff Volume	= 27,673 cuft
Drainage Area	= 1.31 ac	Curve Number	= 90.31*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 6.78 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.53	79	Pervious
0.78	98	Impervious
1.31	**90**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

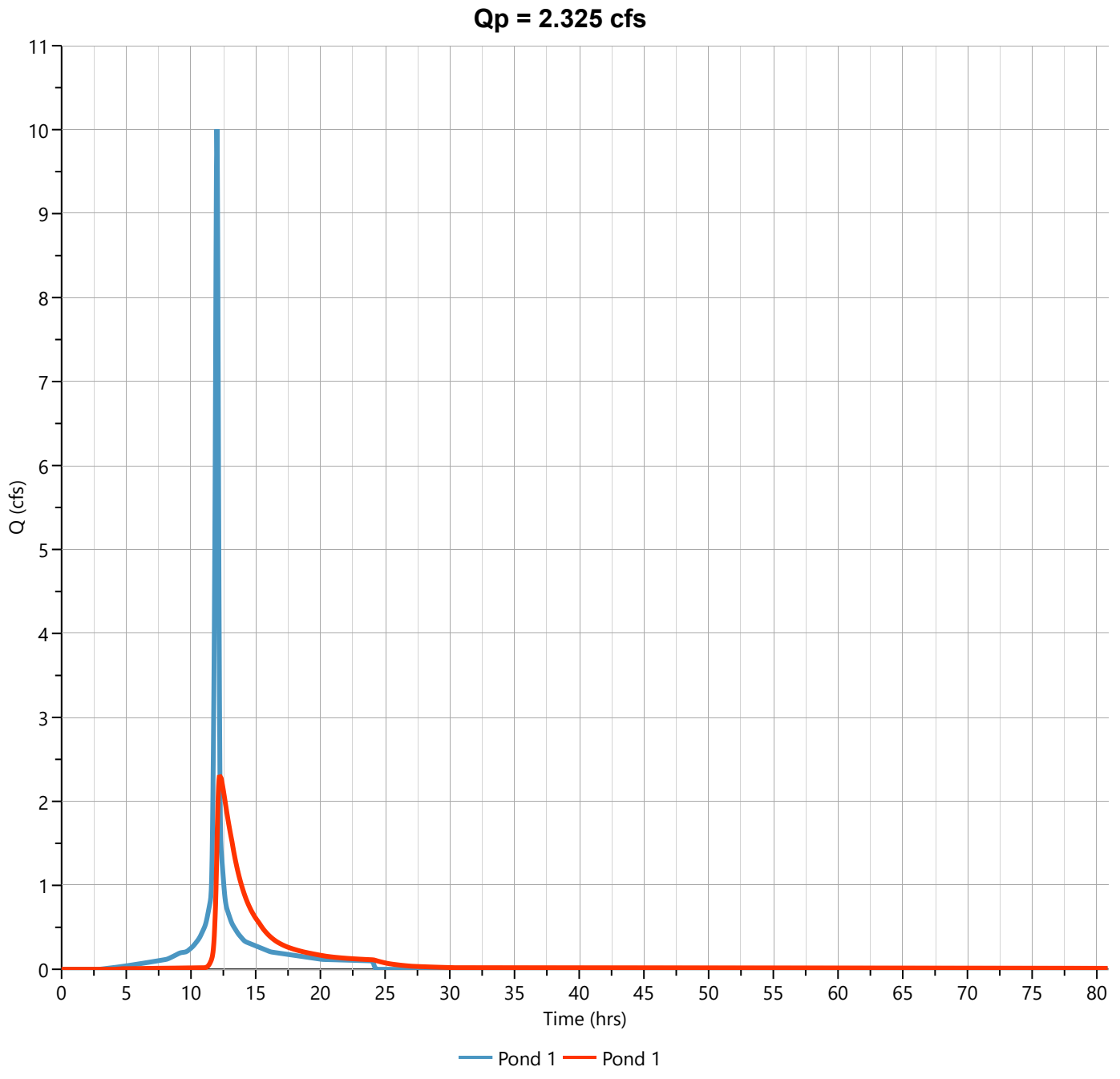
Pond 1

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 2.325 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.23 hrs
Time Interval	= 2 min	Hydrograph Volume	= 27,596 cuft
Inflow Hydrograph	= 2 - Pond 1	Max. Elevation	= 993.67 ft
Pond Name	= Pond 1	Max. Storage	= 14,324 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.16 hrs



Accepted
Study/Report

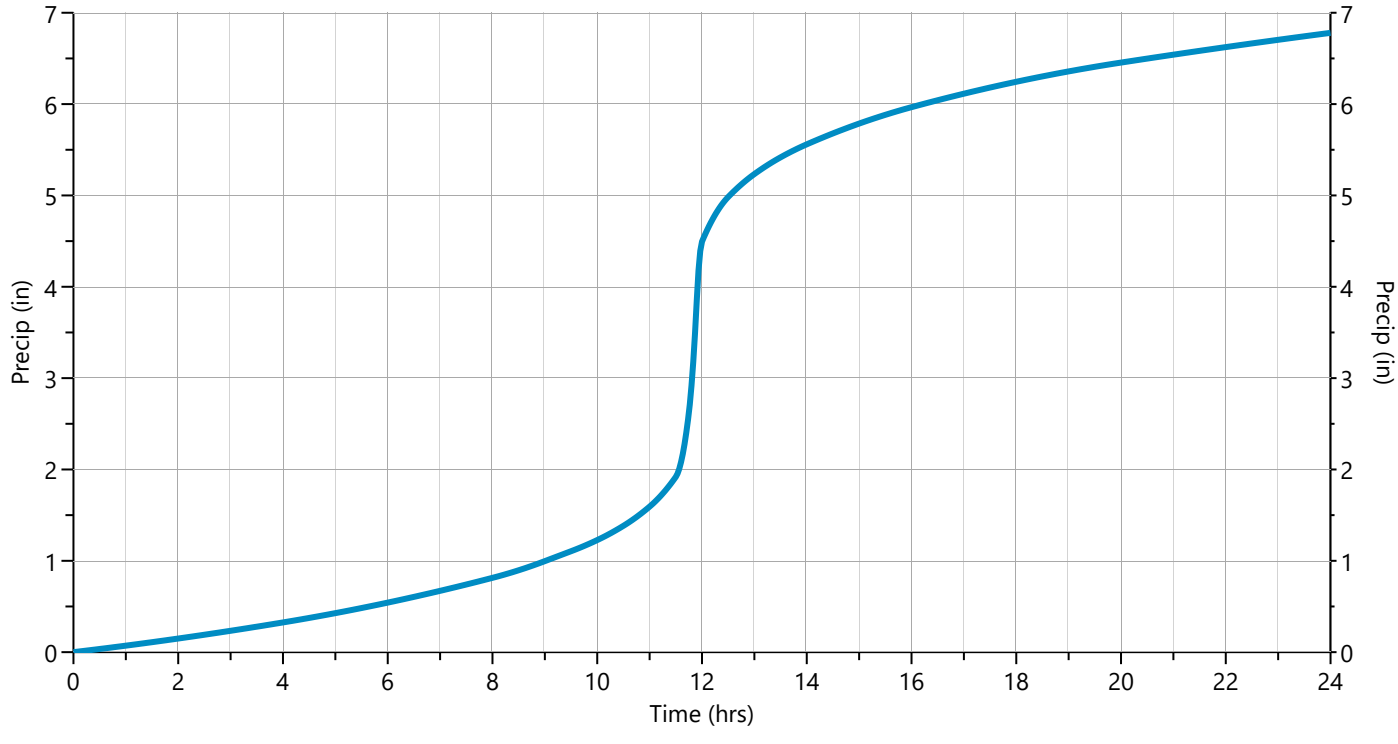
Design Storm Report

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	✔ 25-yr	50-yr	100-yr	
24 hrs	3.06	3.64	0.00	4.64	5.52	6.78	7.80	8.87	

Incremental Rainfall Distribution, 25-yr

Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.015217	11.27	0.021696	11.63	0.089556	12.00	0.101888	12.37	0.027391
10.93	0.015519	11.30	0.022419	11.67	0.107395	12.03	0.045326	12.40	0.025673
10.97	0.015820	11.33	0.023142	11.70	0.125234	12.07	0.042850	12.43	0.023956
11.00	0.016121	11.37	0.023866	11.73	0.143073	12.10	0.041132	12.47	0.022238
11.03	0.016632	11.40	0.024589	11.77	0.164224	12.13	0.039414	12.50	0.020521
11.07	0.017357	11.43	0.025312	11.80	0.210522	12.17	0.037697	12.53	0.019468
11.10	0.018080	11.47	0.026035	11.83	0.260141	12.20	0.035979	12.57	0.019074
11.13	0.018803	11.50	0.026758	11.87	0.309761	12.23	0.034262	12.60	0.018682
11.17	0.019526	11.53	0.036090	**11.90**	**0.359380**	12.27	0.032544	12.63	0.018291
11.20	0.020250	11.57	0.053879	11.93	0.327967	12.30	0.030827	12.67	0.017899
11.23	0.020973	11.60	0.071718	11.97	0.214812	12.33	0.029109	12.70	0.017508



Accepted
Study/Report

Hydrograph 50-yr Summary

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre Development	8.679	12.03	24,675	----		
2	NRCS Runoff	Post Pond 1	11.67	12.00	32,588	----		
3	Pond Route	Pond 1	2.880	12.23	32,507	2	994.08	16,509

Accepted
Study/Report

Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

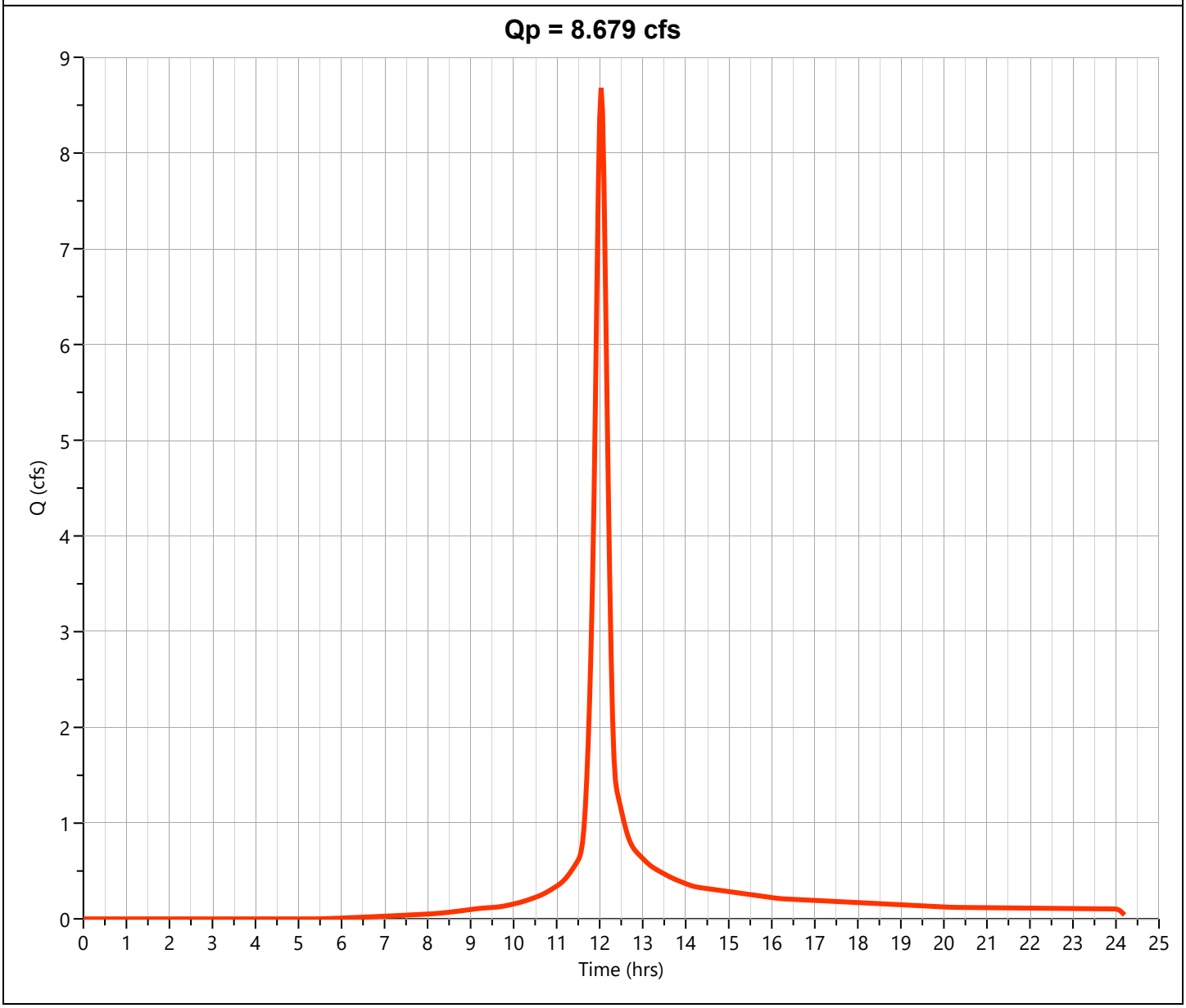
Pre Development

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 8.679 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.03 hrs
Time Interval	= 2 min	Runoff Volume	= 24,675 cuft
Drainage Area	= 1.31 ac	Curve Number	= 79*
Tc Method	= User	Time of Conc. (Tc)	= 15.39 min
Total Rainfall	= 7.80 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
1.31	79	Pervious
1.31	**79**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

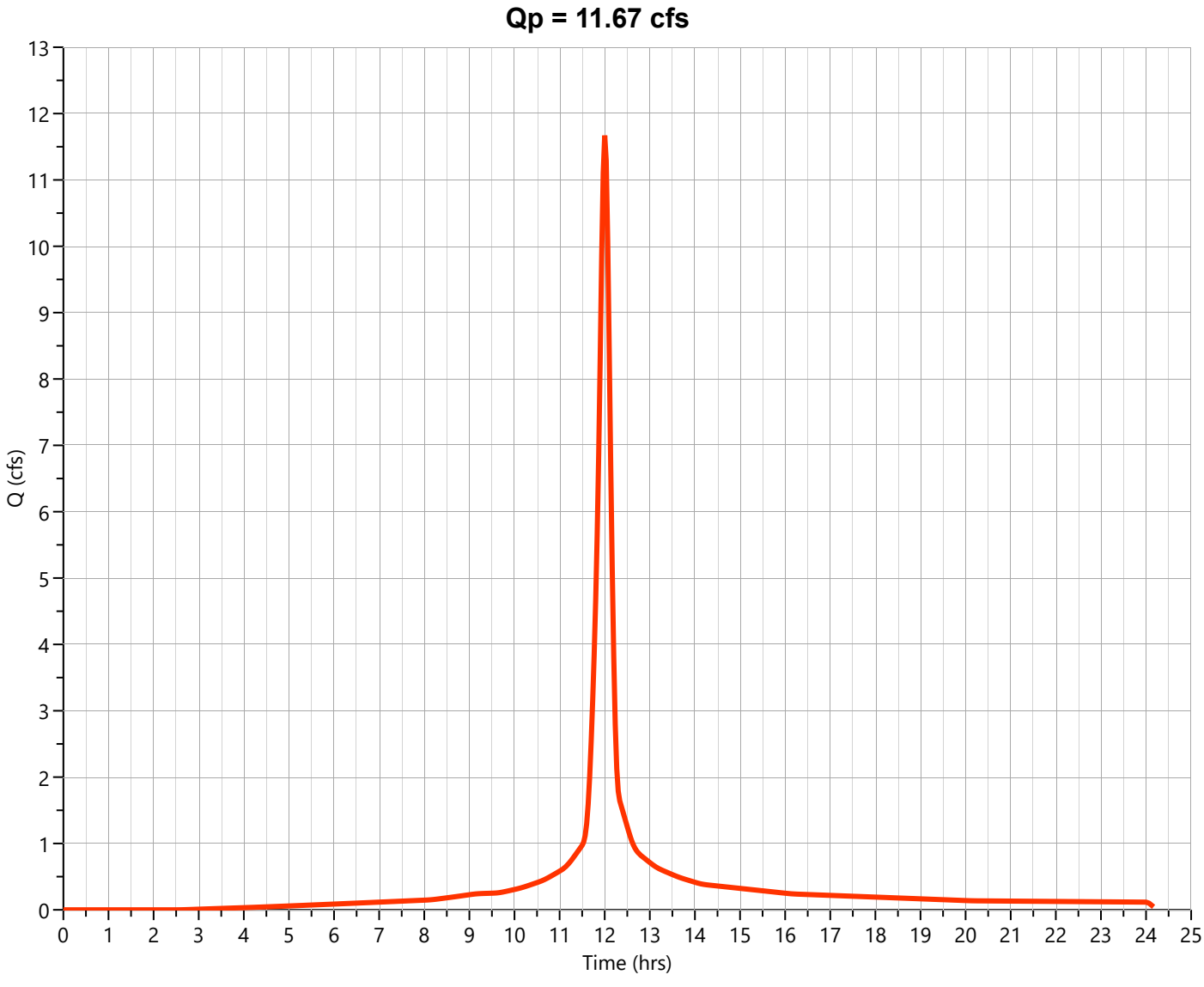
Post Pond 1

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 11.67 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.00 hrs
Time Interval	= 2 min	Runoff Volume	= 32,588 cuft
Drainage Area	= 1.31 ac	Curve Number	= 90.31*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 7.80 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.53	79	Pervious
0.78	98	Impervious
1.31	**90**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

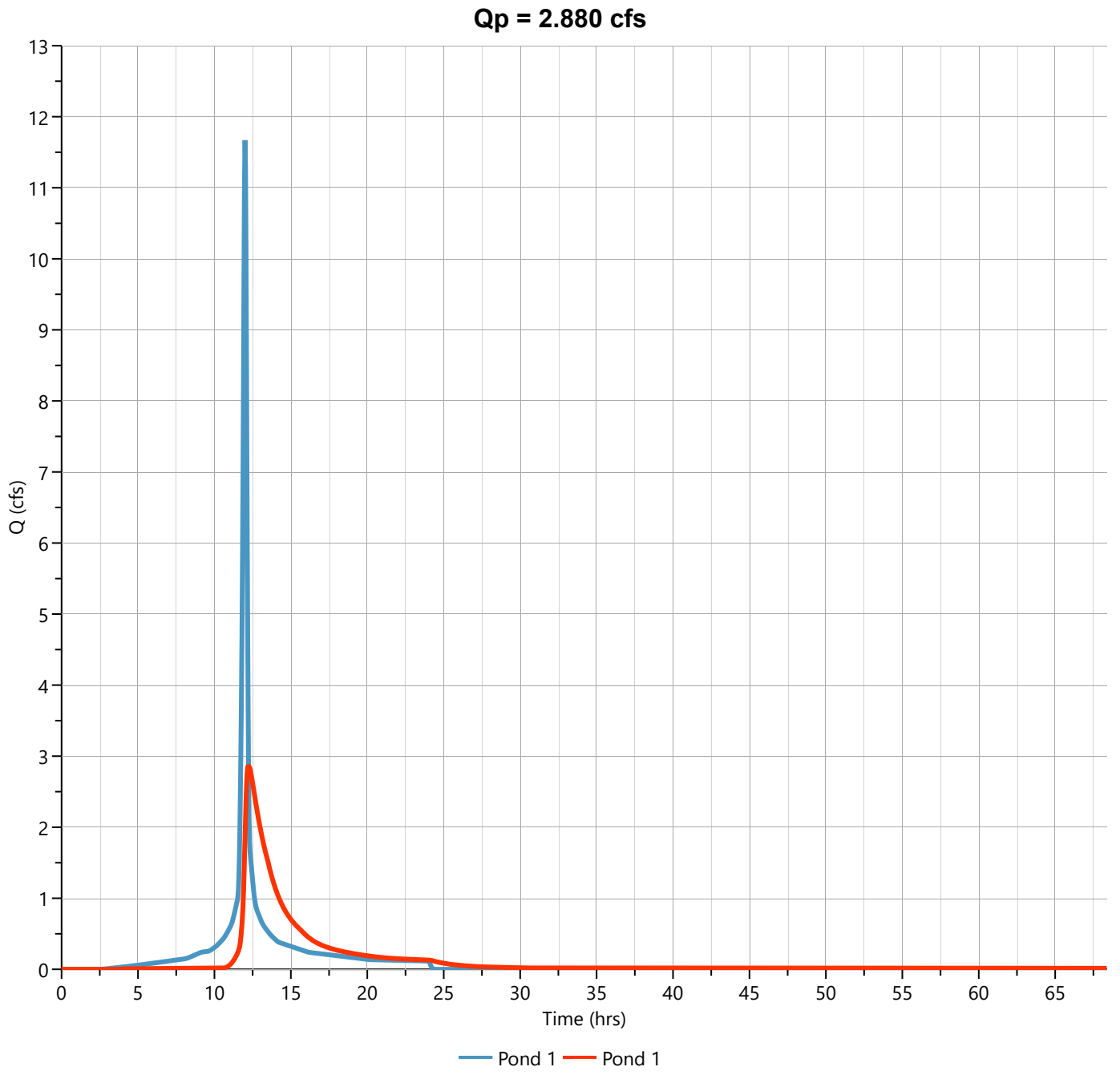
Pond 1

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 2.880 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.23 hrs
Time Interval	= 2 min	Hydrograph Volume	= 32,507 cuft
Inflow Hydrograph	= 2 - Pond 1	Max. Elevation	= 994.08 ft
Pond Name	= Pond 1	Max. Storage	= 16,509 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.06 hrs



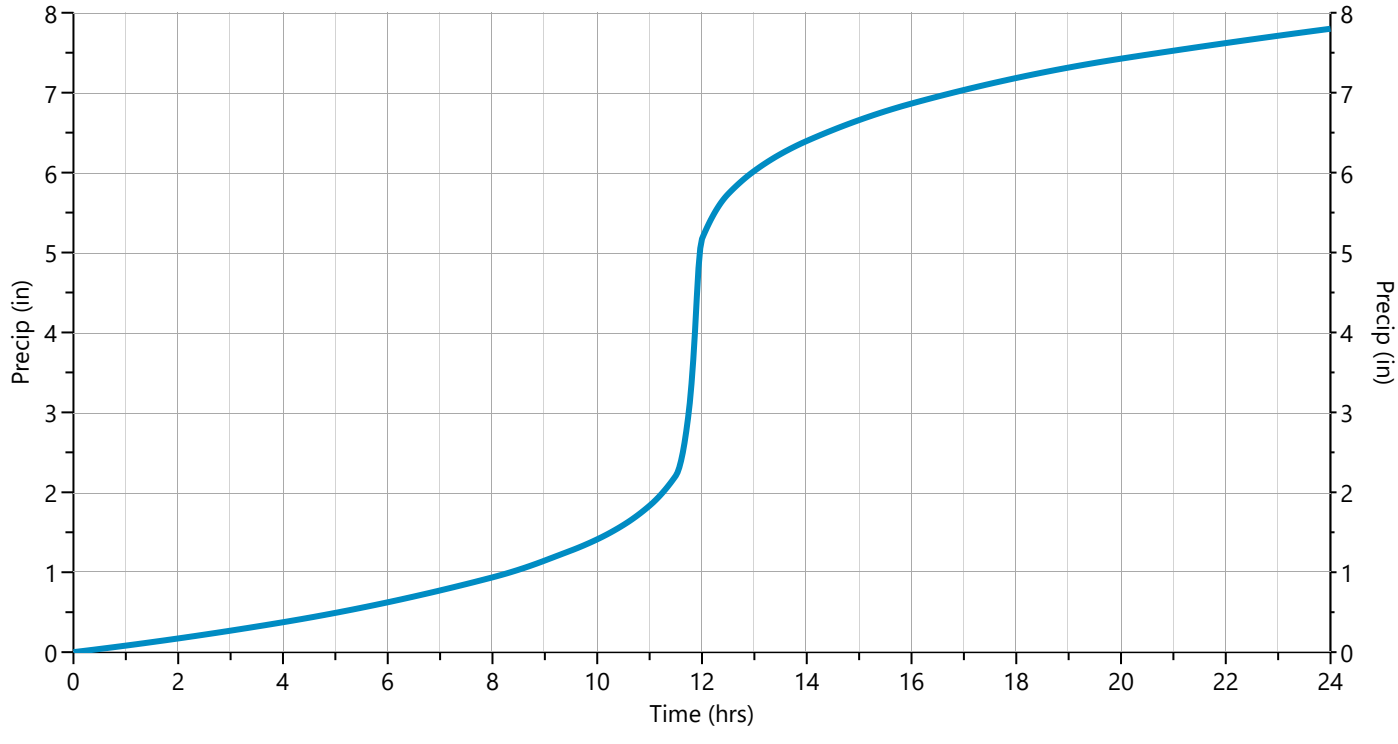
Accepted
Study/Report

Design Storm Report

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	✔ 50-yr	100-yr	
24 hrs	3.06	3.64	0.00	4.64	5.52	6.78	7.80	8.87	

Incremental Rainfall Distribution, 50-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.017507	11.27	0.024960	11.63	0.103030	12.00	0.117216	12.37	0.031512
10.93	0.017853	11.30	0.025792	11.67	0.123552	12.03	0.052145	12.40	0.029536
10.97	0.018200	11.33	0.026624	11.70	0.144075	12.07	0.049296	12.43	0.027560
11.00	0.018547	11.37	0.027456	11.73	0.164598	12.10	0.047320	12.47	0.025584
11.03	0.019134	11.40	0.028288	11.77	0.188930	12.13	0.045344	12.50	0.023608
11.07	0.019968	11.43	0.029120	11.80	0.242193	12.17	0.043368	12.53	0.022397
11.10	0.020800	11.47	0.029952	11.83	0.299278	12.20	0.041392	12.57	0.021944
11.13	0.021632	11.50	0.030784	11.87	0.356362	12.23	0.039416	12.60	0.021493
11.17	0.022464	11.53	0.041520	**11.90**	**0.413446**	12.27	0.037440	12.63	0.021043
11.20	0.023296	11.57	0.061984	11.93	0.377307	12.30	0.035464	12.67	0.020592
11.23	0.024128	11.60	0.082507	11.97	0.247129	12.33	0.033488	12.70	0.020142



Accepted
Study/Report

Hydrograph 100-yr Summary

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre Development	10.24	12.03	29,315	----		
2	NRCS Runoff	Post Pond 1	13.41	12.00	37,764	----		
3	Pond Route	Pond 1	3.555	12.23	37,680	2	994.44	18,674

Accepted
Study/Report

Hydrograph Report

Hydrology Studio v 3.0.0.33

10-28-2024

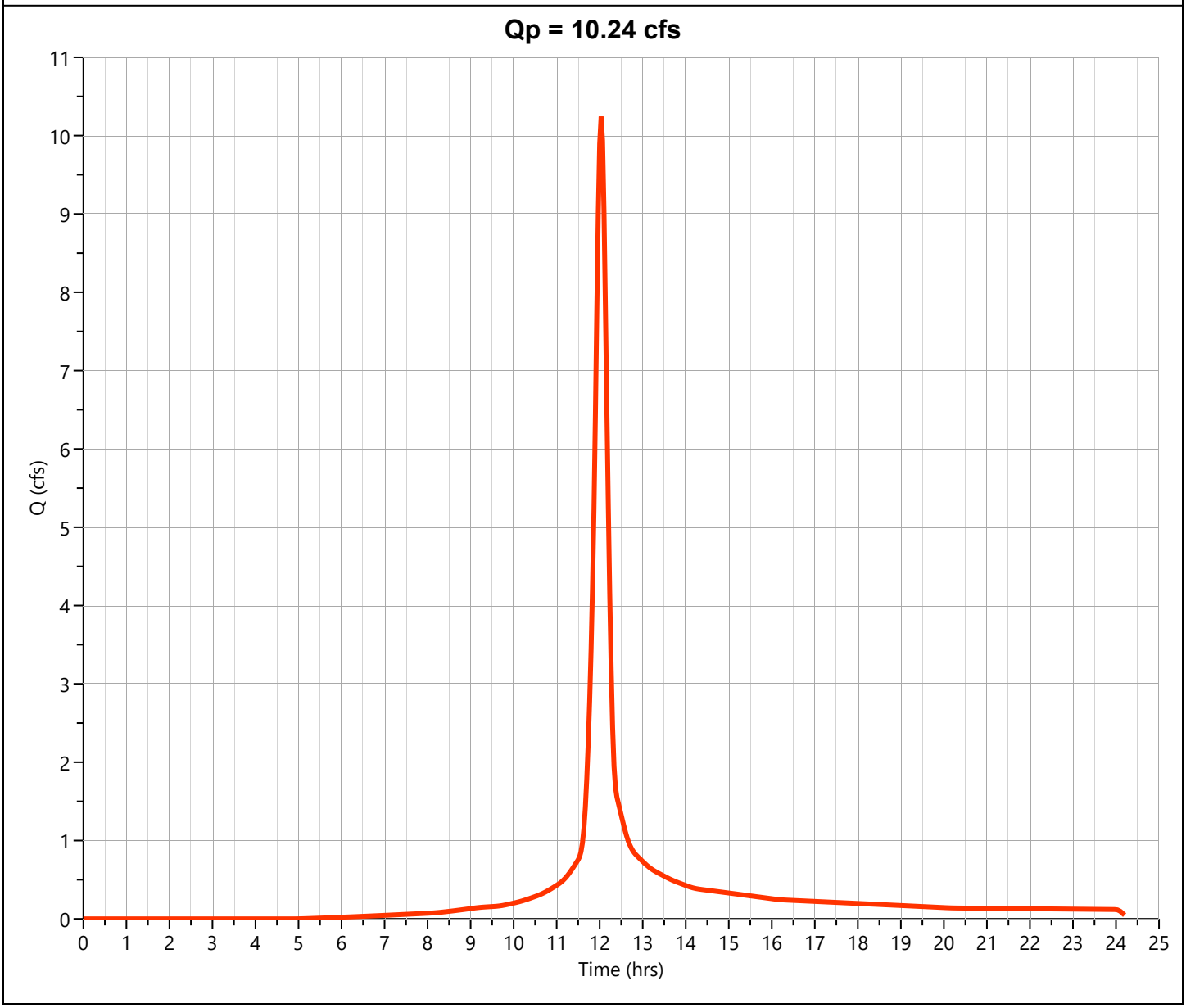
Pre Development

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 10.24 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.03 hrs
Time Interval	= 2 min	Runoff Volume	= 29,315 cuft
Drainage Area	= 1.31 ac	Curve Number	= 79*
Tc Method	= User	Time of Conc. (Tc)	= 15.39 min
Total Rainfall	= 8.87 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
1.31	79	Pervious
1.31	**79**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

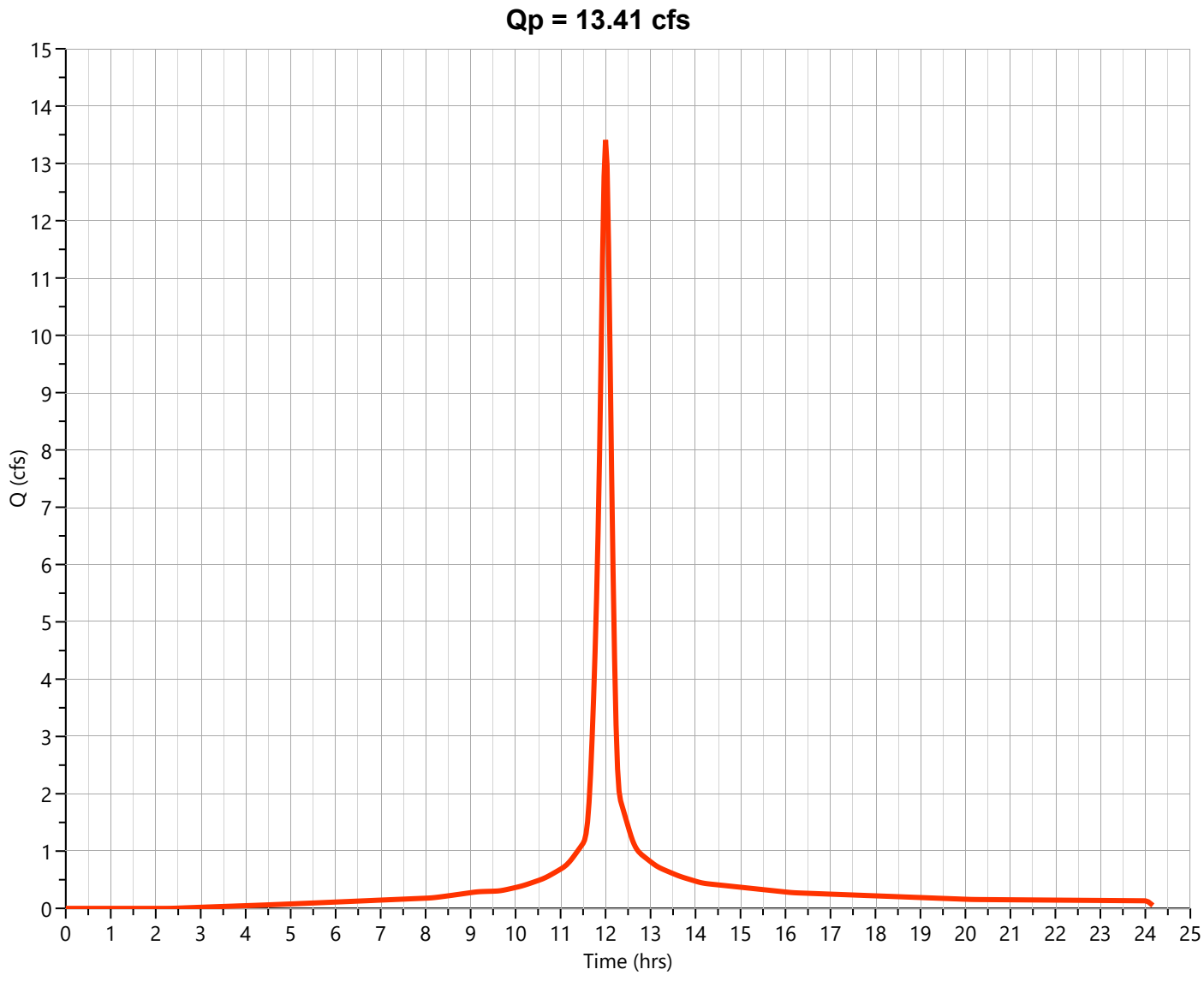
Post Pond 1

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 13.41 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.00 hrs
Time Interval	= 2 min	Runoff Volume	= 37,764 cuft
Drainage Area	= 1.31 ac	Curve Number	= 90.31*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 8.87 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.53	79	Pervious
0.78	98	Impervious
1.31	**90**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

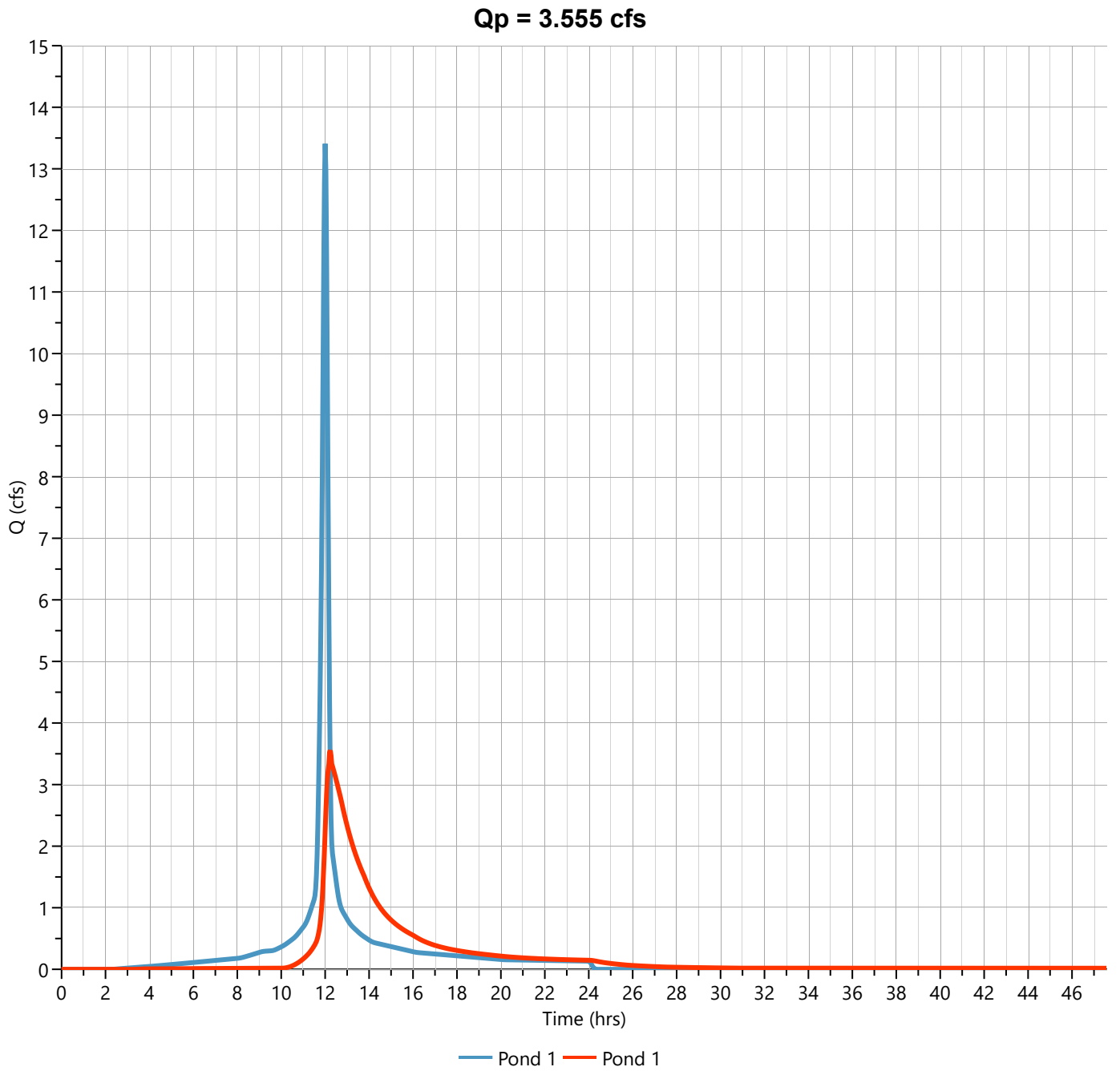
Pond 1

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 3.555 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.23 hrs
Time Interval	= 2 min	Hydrograph Volume	= 37,680 cuft
Inflow Hydrograph	= 2 - Pond 1	Max. Elevation	= 994.44 ft
Pond Name	= Pond 1	Max. Storage	= 18,674 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 1.98 hrs



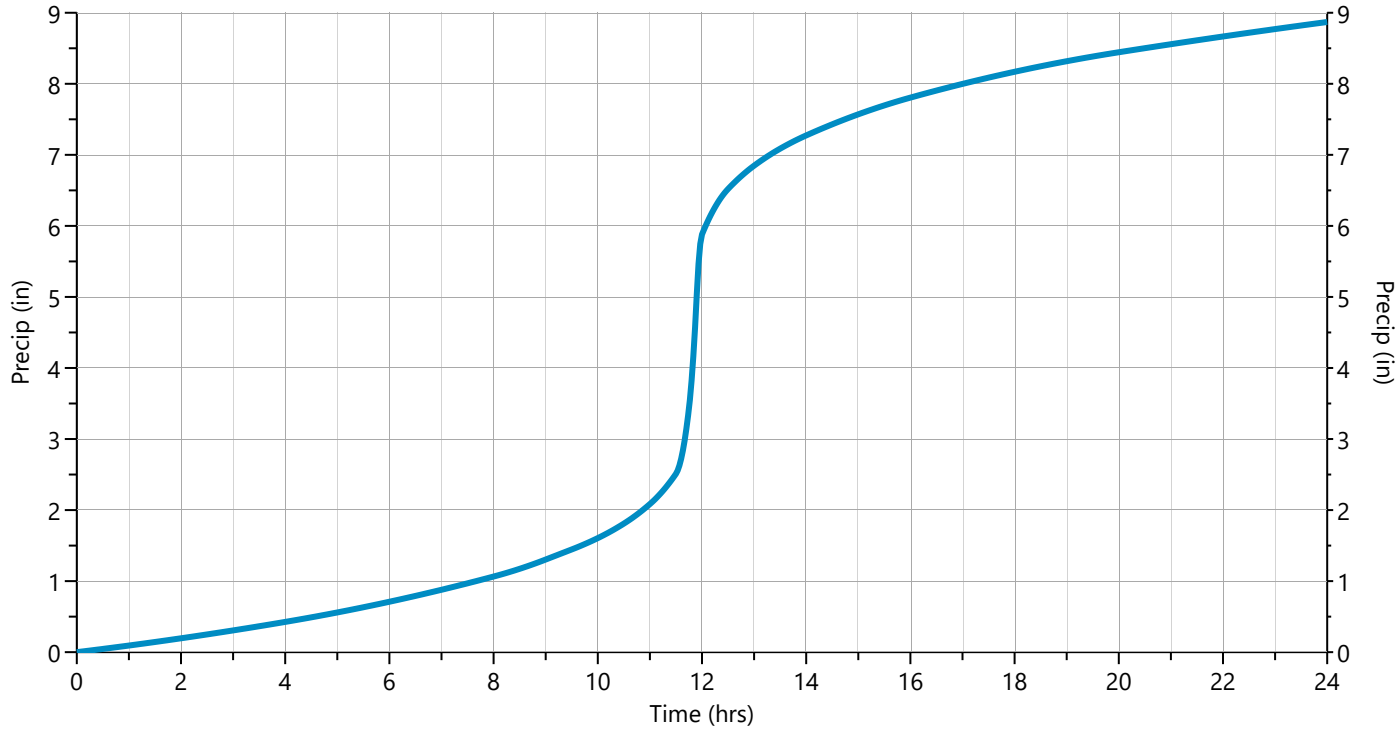
Accepted
Study/Report

Design Storm Report

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	✔ 100-yr	
24 hrs	3.06	3.64	0.00	4.64	5.52	6.78	7.80	8.87	

Incremental Rainfall Distribution, 100-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.019908	11.27	0.028384	11.63	0.117163	12.00	0.133296	12.37	0.035835
10.93	0.020302	11.30	0.029330	11.67	0.140501	12.03	0.059299	12.40	0.033587
10.97	0.020697	11.33	0.030276	11.70	0.163839	12.07	0.056058	12.43	0.031341
11.00	0.021091	11.37	0.031222	11.73	0.187177	12.10	0.053811	12.47	0.029093
11.03	0.021758	11.40	0.032168	11.77	0.214847	12.13	0.051564	12.50	0.026847
11.07	0.022707	11.43	0.033115	11.80	0.275417	12.17	0.049317	12.53	0.025469
11.10	0.023654	11.47	0.034061	11.83	0.340332	12.20	0.047070	12.57	0.024954
11.13	0.024599	11.50	0.035007	11.87	0.405247	12.23	0.044823	12.60	0.024442
11.17	0.025546	11.53	0.047216	**11.90**	**0.470163**	12.27	0.042576	12.63	0.023929
11.20	0.026492	11.57	0.070487	11.93	0.429066	12.30	0.040329	12.67	0.023417
11.23	0.027438	11.60	0.093825	11.97	0.281030	12.33	0.038082	12.70	0.022904



Accepted
Study/Report

IDF Report

Hydrology Studio v 3.0.0.33

IDF filename: KansasCityMO.idf

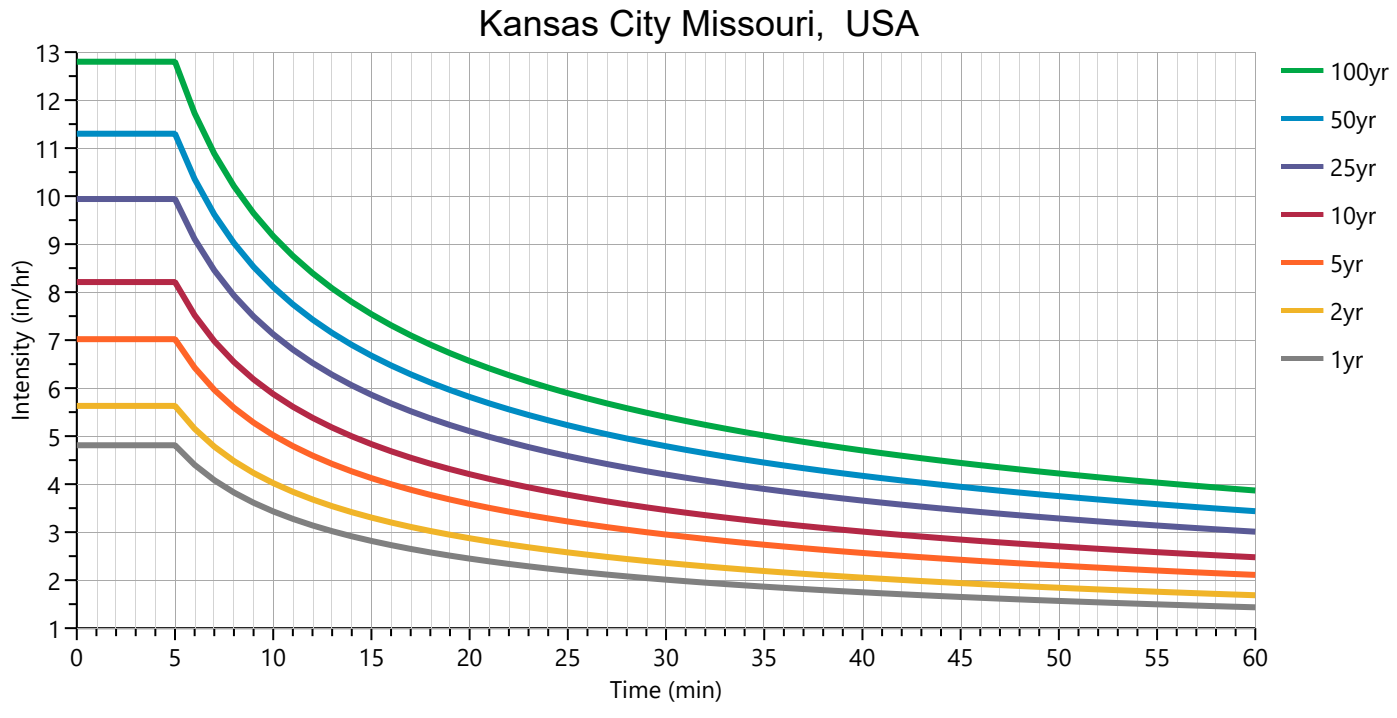
10-28-2024

Equation Coefficients	Intensity = B / (Tc + D)^E (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
B	10.5326	12.2937	0.0000	15.2947	17.8412	21.5503	24.4283	27.7899	
D	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
E	0.4870	0.4852	0.0000	0.4839	0.4823	0.4808	0.4790	0.4817	

Minimum Tc = 5 minutes

Tc (min)	Intensity Values (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
Cf	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
5	4.81	5.63	0	7.02	8.21	9.94	11.30	12.80	
10	3.43	4.02	0	5.02	5.88	7.12	8.11	9.17	
15	2.82	3.30	0	4.13	4.83	5.86	6.68	7.54	
20	2.45	2.87	0	3.59	4.21	5.10	5.82	6.56	
25	2.20	2.58	0	3.22	3.78	4.58	5.23	5.90	
30	2.01	2.36	0	2.95	3.46	4.20	4.79	5.40	
35	1.86	2.19	0	2.74	3.21	3.90	4.45	5.01	
40	1.75	2.05	0	2.57	3.01	3.66	4.17	4.70	
45	1.65	1.94	0	2.42	2.85	3.46	3.94	4.44	
50	1.57	1.84	0	2.30	2.70	3.29	3.75	4.22	
55	1.50	1.76	0	2.20	2.58	3.14	3.58	4.03	
60	1.43	1.69	0	2.11	2.48	3.01	3.44	3.87	

Cf = Correction Factor applied to Rational Method runoff coefficient.



Accepted
Study/Report

Precipitation Report

Hydrology Studio v 3.0.0.33 (Rainfall totals in Inches)

10-28-2024

	Active	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Active			✔		✔	✔	✔	✔	✔
SCS Storms	**> SCS Dimensionless Storms**								
SCS 6hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
Type I, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Type IA, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Type II, 24-hr	✔	3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Type II FL, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Type III, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Synthetic Storms	**> IDF-Based Synthetic Storms**								
1-hr		1.43	1.69	0	2.11	2.48	3.01	3.44	3.87
2-hr		2.05	2.41	0	3.02	3.55	4.31	4.93	5.54
3-hr		2.52	2.97	0	3.72	4.37	5.32	6.09	6.83
6-hr		3.60	4.24	0	5.32	6.26	7.63	8.74	9.79
12-hr		5.13	6.06	0	7.61	8.97	10.94	12.54	14.02
24-hr		7.32	8.66	0	10.88	12.84	15.67	18.00	20.08
Huff Distribution	**> 1st Quartile (0 to 6 hrs)**								
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
Huff Distribution	**> 2nd Quartile (>6 to 12 hrs)**								
8-hr		0	0	0	0	0	0	0	0
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
Huff Distribution	**> 3rd Quartile (>12 to 24 hrs)**								
18-hr		0	0	0	0	0	0	0	0
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Custom Storms	**> Custom Storm Distributions**								
My Custom Storm 1		0	0	0	0	0	0	0	0
My Custom Storm 2		0	0	0	0	0	0	0	0
My Custom Storm 3		0	0	0	0	0	0	0	0
My Custom Storm 4		0	0	0	0	0	0	0	0
My Custom Storm 5		0	0	0	0	0	0	0	0
My Custom Storm 6		0	0	0	0	0	0	0	0
My Custom Storm 7		0	0	0	0	0	0	0	0
My Custom Storm 8		0	0	0	0	0	0	0	0
My Custom Storm 9		0	0	0	0	0	0	0	0
My Custom Storm 10		0	0	0	0	0	0	0	0

Accepted
Study/Report

Precipitation Report Cont'd

Rainfall totals in Inches

	Active	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Active			✔		✔	✔	✔	✔	✔
Huff Indiana	**> Indianapolis**								
30-min		1.01	1.18	0	1.48	1.73	2.10	2.39	2.70
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Huff Indiana	**> Evansville**								
30-min		1.01	1.18	0	1.48	1.73	2.10	2.39	2.70
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Huff Indiana	**> Fort Wayne**								
30-min		1.01	1.18	0	1.48	1.73	2.10	2.39	2.70
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Huff Indiana	**> South Bend**								
30-min		1.01	1.18	0	1.48	1.73	2.10	2.39	2.70
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87

Accepted
Study/Report

Precipitation Report Cont'd

Rainfall totals in Inches

	Active	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Active			✔		✔	✔	✔	✔	✔
NRCS Storms	**> NRCS Dimensionless Storms**								
NRCS MSE1, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE2, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE3, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE4, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE5, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE6, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NOAA-A, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NOAA-B, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NOAA-C, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NOAA-D, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCC-A, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCC-B, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCC-C, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCC-D, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-1, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-2, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-3, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-4, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-5, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-6, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
FDOT Storms	**> Florida DOT Storms**								
FDOT, 1-hr		0	2.14	2.36	2.58	2.92	3.35	3.66	3.95
FDOT, 2-hr		0	2.70	3.00	3.26	3.69	4.24	4.64	5.00
FDOT, 4-hr		0	3.28	3.76	4.00	4.80	5.50	6.20	6.80
FDOT, 8-hr		0	3.76	4.32	4.80	5.60	6.20	7.20	8.00
FDOT, 24-hr		0	4.28	4.75	5.21	6.11	7.53	8.78	10.20
FDOT, 72-hr		0	5.44	6.10	6.74	7.98	9.92	11.60	13.40
SFWMD, 72-hr		0	5.44	6.10	6.74	7.98	9.92	11.60	13.40
Austin Storms	**> Austin Frequency Storms**								
Austin Zone 1, 24-hr		0	4.14	0	5.51	6.84	8.90	10.69	12.80
Austin Zone 2, 24-hr		0	4.06	0	5.38	6.65	8.59	10.28	12.23

Accepted
Study/Report

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Basin Model

NO STORAGE HYDROGRAPH RESULTS

Accepted
Study/Report

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

Accepted
Study/Report
NO STORAGE HYDROGRAPH RESULTS

Hydrograph by Return Period

Hydrology Studio v 3.0.0.33

Project Name:

10-28-2024

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	NRCS Runoff	Post Pond 1		4.691		6.274	7.658	9.627	11.21	12.86
2	Pond Route	Pond 1		4.398		6.201	7.577	9.520	11.09	12.73

Accepted
Study/Report
NO STORAGE HYDROGRAPH RESULTS

Hydrograph 100-yr Summary

Project Name:

10-28-2024

Hydrology Studio v 3.0.0.33

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Post Pond 1	12.86	12.00	36,426	----		
2	Pond Route	Pond 1	12.73	12.00	33,423	1	995.05	3,977

Accepted
Study/Report

Hydrograph Report

NO STORAGE HYDROGRAPH RESULTS

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

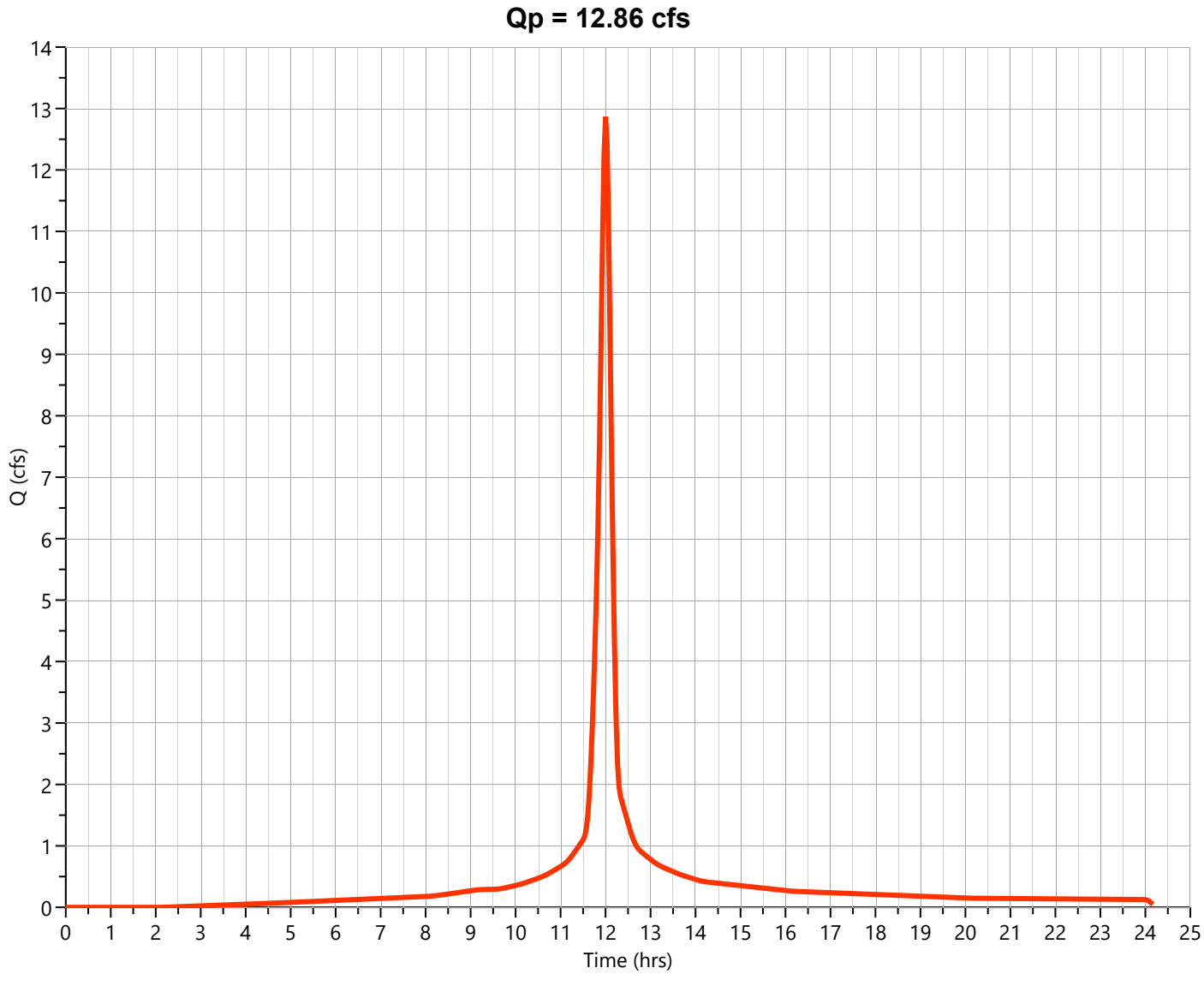
Post Pond 1

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 12.86 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.00 hrs
Time Interval	= 2 min	Runoff Volume	= 36,426 cuft
Drainage Area	= 1.25 ac	Curve Number	= 91*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 8.87 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.53	79	Pervious
0.78	98	Impervious
1.25	**91**	Weighted CN Method Employed



Accepted
Study/Report

Hydrograph Report

NO STORAGE HYDROGRAPH RESULTS

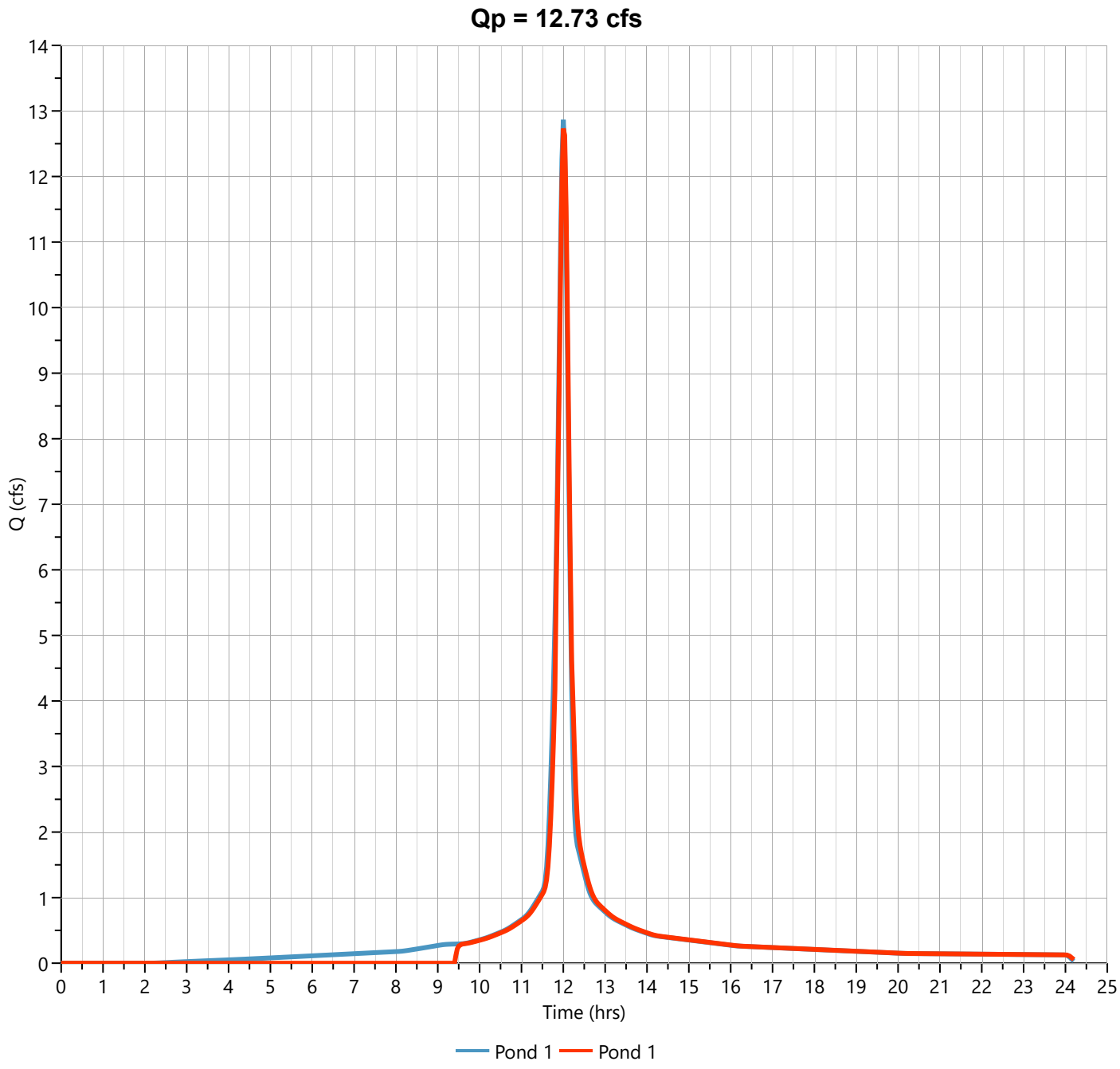
Pond 1

Hyd. No. 2

Hydrograph Type	= Pond Route	Peak Flow	= 12.73 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= 33,423 cuft
Inflow Hydrograph	= 1 - Pond 1	Max. Elevation	= 995.05 ft
Pond Name	= Pond 1	Max. Storage	= 3,977 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 35 min



Accepted
Study/Report
NO STORAGE HYDROGRAPH RESULTS

Pond Report

Hydrology Studio v 3.0.0.33

10-28-2024

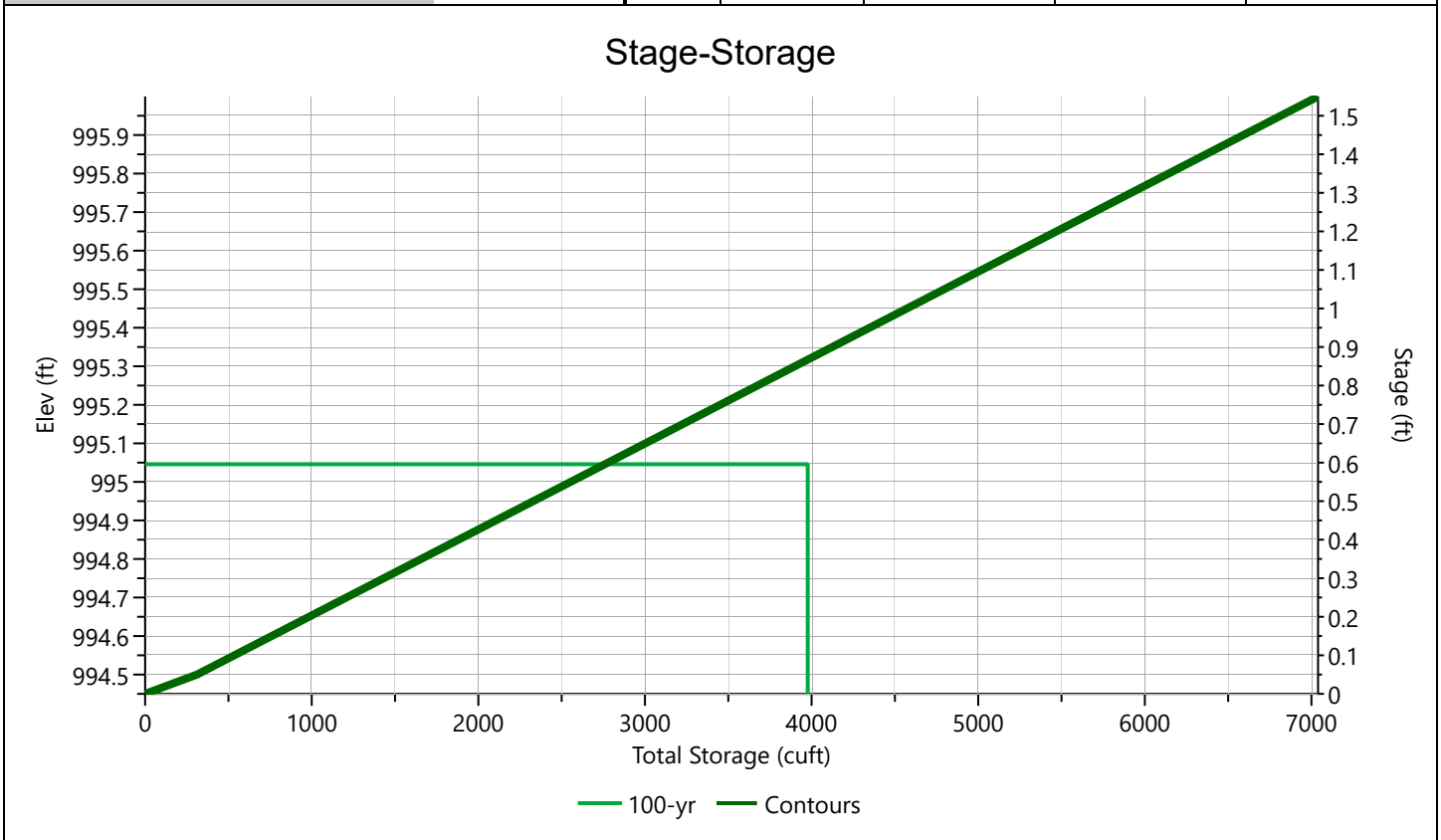
Pond 1

Stage-Storage

User Defined Contours	
Description	**Input**
Bottom Elevation, ft	994.45
Voids (%)	100.00
Volume Calc	None

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
0.00	994.45	5,880	0.000	0.000
0.05	994.50	6,568	311	311
1.05	996.00	6,889	6,729	7,040



Accepted
Study/Report

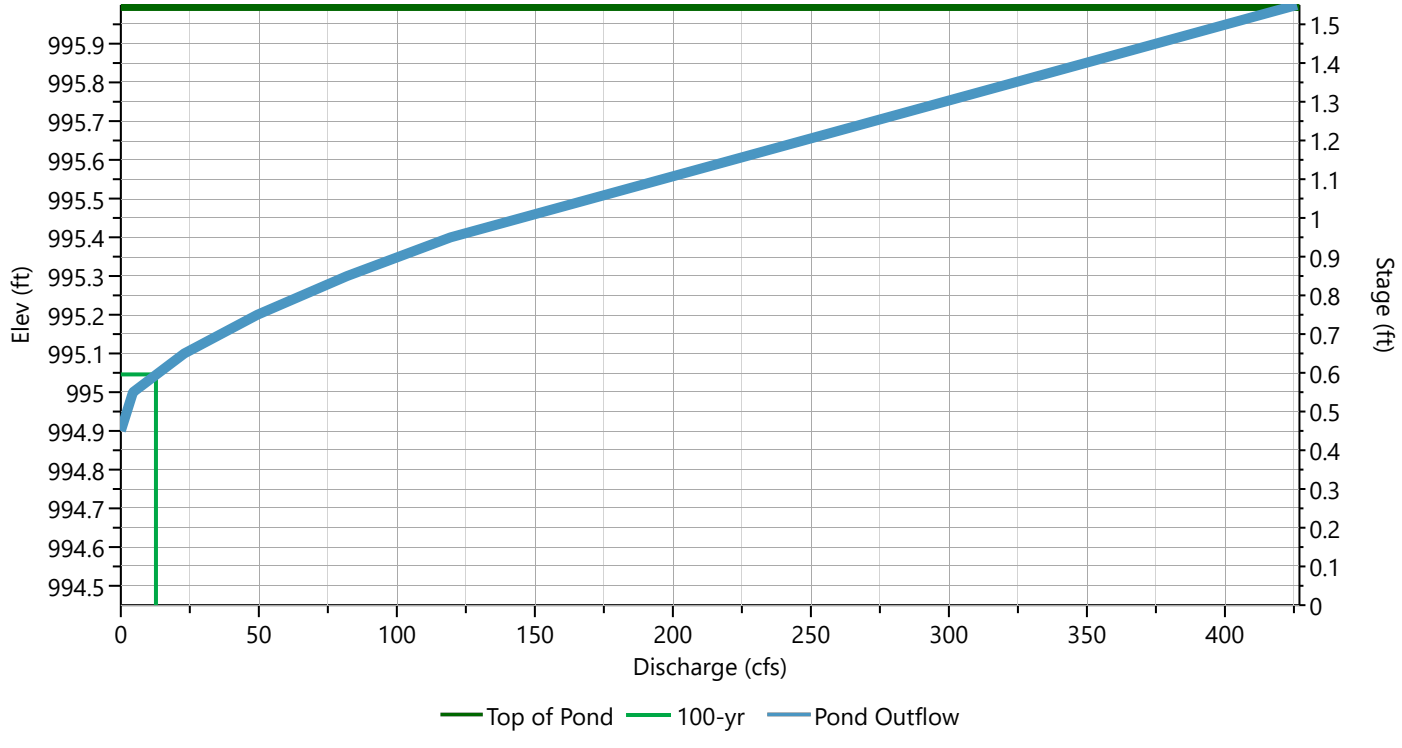
Pond Report

Pond 1

Stage-Discharge

Culvert / Orifices	Culvert	Orifice			Perforated Riser	
		1	2	3		
Rise, in					Hole Diameter, in	
Span, in					No. holes	
No. Barrels					Invert Elevation, ft	
Invert Elevation, ft					Height, ft	
Orifice Coefficient, Co					Orifice Coefficient, Co	
Length, ft						
Barrel Slope, %						
N-Value, n						
Weirs	**Riser**	**Weir**			**Ancillary**	
		1 (m)	2 (i)	3		
Shape / Type		Rectangular	Broad Crested		Exfiltration, in/hr	
Crest Elevation, ft			994.95			
Crest Length, ft			120			
Angle, deg						
Weir Coefficient, Cw			3.3			

m = Flows through Culvert, i = Independent



Accepted
Study/Report

Pond Report

NO STORAGE HYDROGRAPH RESULTS

Project Name:

Hydrology Studio v 3.0.0.33

10-28-2024

Pond 1

Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	994.45	0.000	0.000	0.000			0.000	0.000	0.000	0.000				0.000
0.05	994.50	311	0.000	0.000			0.000	0.000	0.000	0.000				0.000
1.05	996.00	7,040	0.000	0.000			0.000	0.000	426.1	0.000				426.1

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

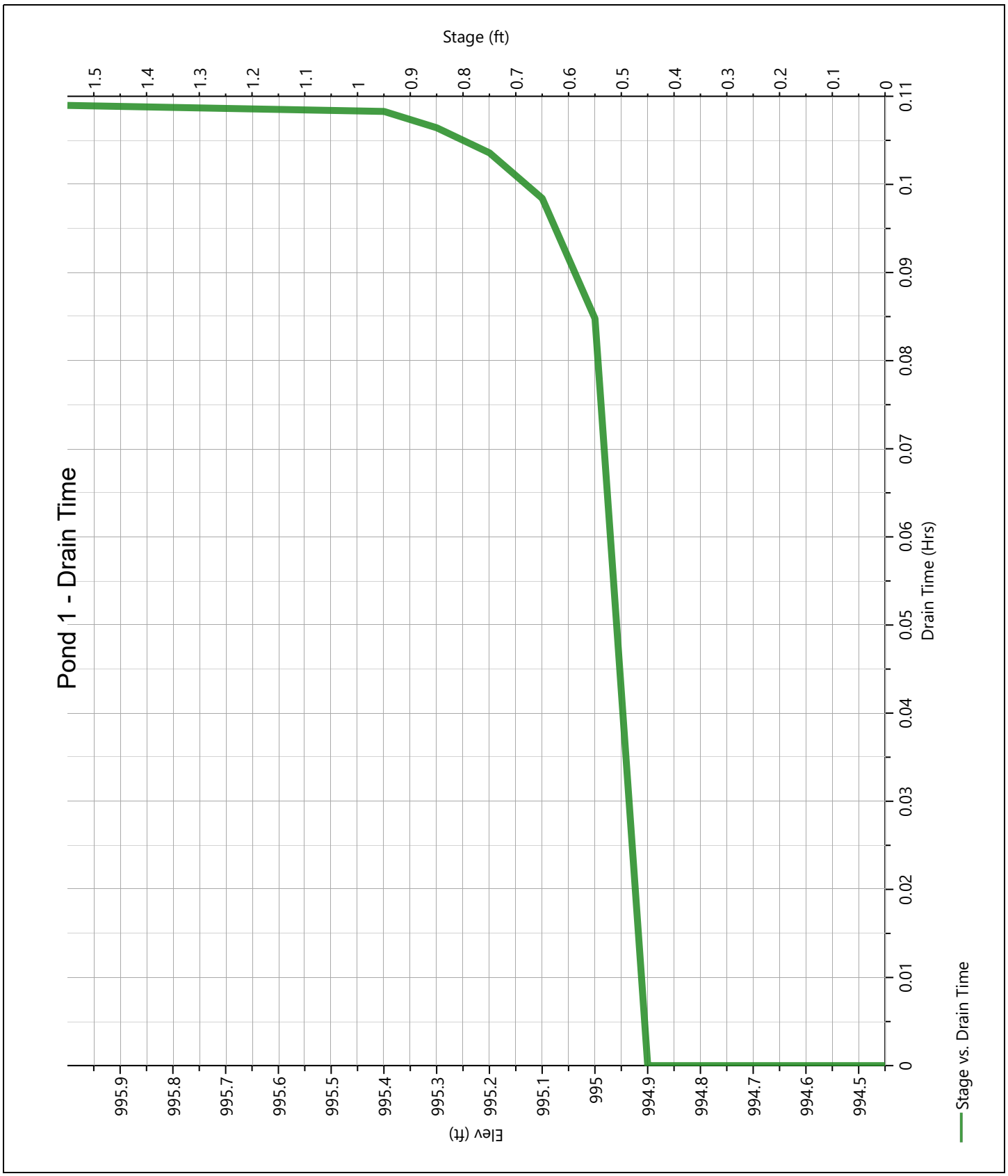
Accepted
Study/Report

Pond Report

NO STORAGE HYDROGRAPHS/TABLES

Pond 1

Pond Drawdown



Accepted
Study/Report

Design Storm Report

NO STORAGE HYDROGRAPH RESULTS

Hydrology Studio v 3.0.0.33

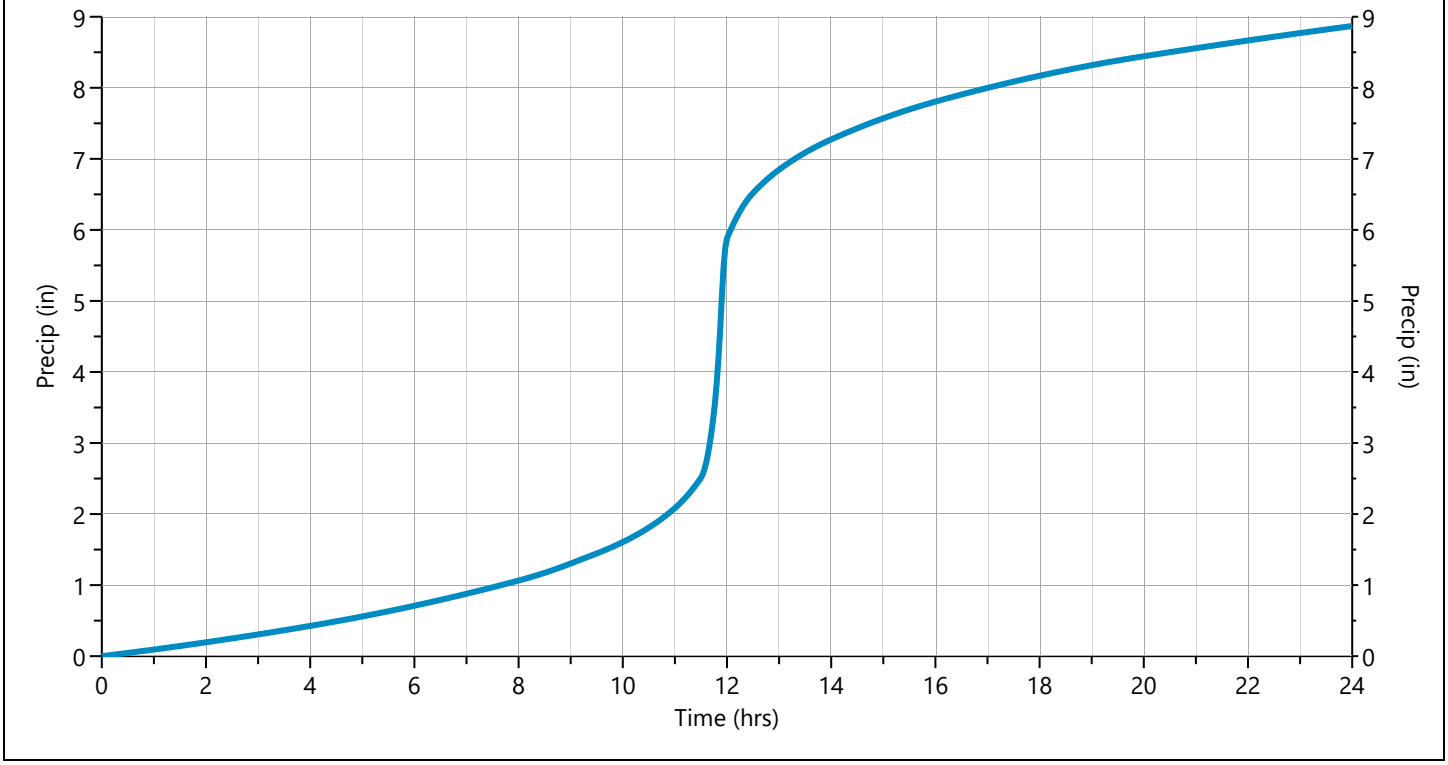
10-28-2024

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	✔ 100-yr	
24 hrs	3.06	3.64	0.00	4.64	5.52	6.78	7.80	8.87	

Incremental Rainfall Distribution, 100-yr

Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.019908	11.27	0.028384	11.63	0.117163	12.00	0.133296	12.37	0.035835
10.93	0.020302	11.30	0.029330	11.67	0.140501	12.03	0.059299	12.40	0.033587
10.97	0.020697	11.33	0.030276	11.70	0.163839	12.07	0.056058	12.43	0.031341
11.00	0.021091	11.37	0.031222	11.73	0.187177	12.10	0.053811	12.47	0.029093
11.03	0.021758	11.40	0.032168	11.77	0.214847	12.13	0.051564	12.50	0.026847
11.07	0.022707	11.43	0.033115	11.80	0.275417	12.17	0.049317	12.53	0.025469
11.10	0.023654	11.47	0.034061	11.83	0.340332	12.20	0.047070	12.57	0.024954
11.13	0.024599	11.50	0.035007	11.87	0.405247	12.23	0.044823	12.60	0.024442
11.17	0.025546	11.53	0.047216	**11.90**	**0.470163**	12.27	0.042576	12.63	0.023929
11.20	0.026492	11.57	0.070487	11.93	0.429066	12.30	0.040329	12.67	0.023417
11.23	0.027438	11.60	0.093825	11.97	0.281030	12.33	0.038082	12.70	0.022904



IDF Report

Hydrology Studio v 3.0.0.33

NO STORAGE HYDROGRAPH RESULTS

Accepted Study/Report

IDF filename: KansasCityMO.idf

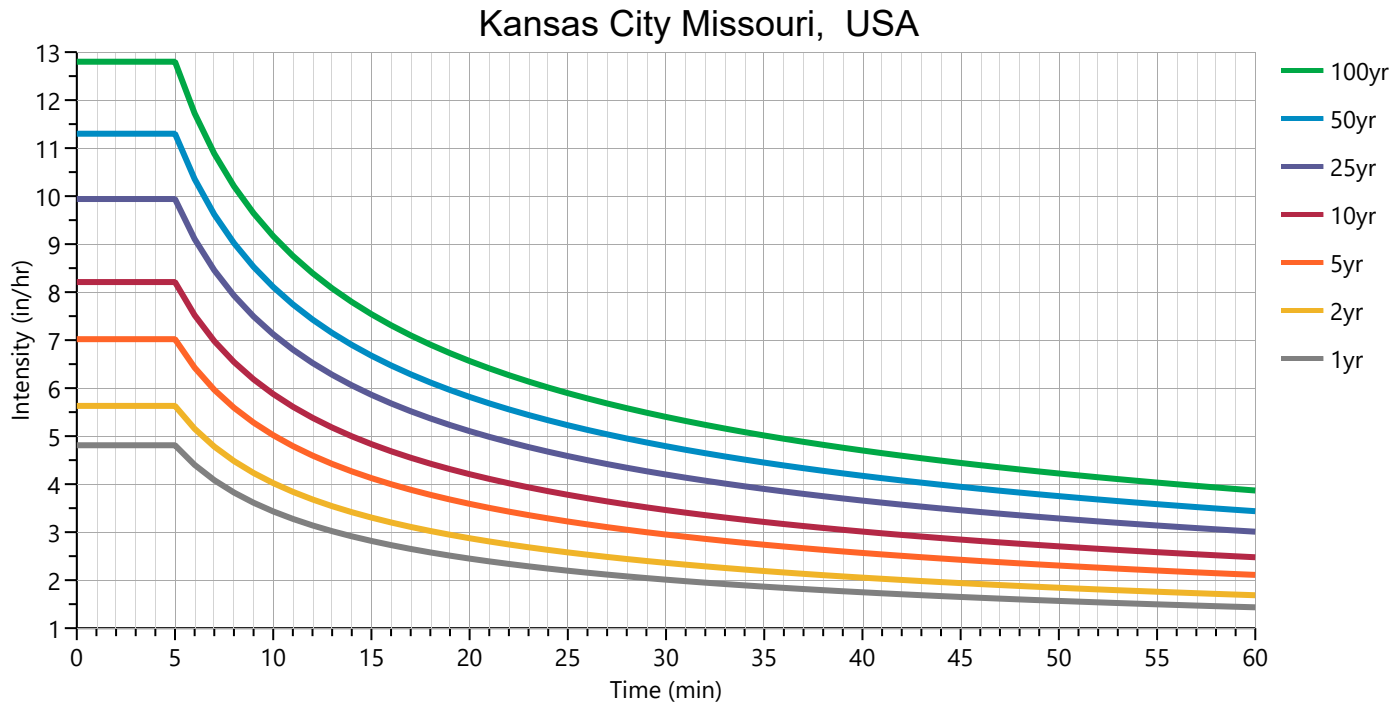
10-28-2024

Equation Coefficients	Intensity = B / (Tc + D)^E (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
B	10.5326	12.2937	0.0000	15.2947	17.8412	21.5503	24.4283	27.7899	
D	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
E	0.4870	0.4852	0.0000	0.4839	0.4823	0.4808	0.4790	0.4817	

Minimum Tc = 5 minutes

Tc (min)	Intensity Values (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
Cf	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
5	4.81	5.63	0	7.02	8.21	9.94	11.30	12.80	
10	3.43	4.02	0	5.02	5.88	7.12	8.11	9.17	
15	2.82	3.30	0	4.13	4.83	5.86	6.68	7.54	
20	2.45	2.87	0	3.59	4.21	5.10	5.82	6.56	
25	2.20	2.58	0	3.22	3.78	4.58	5.23	5.90	
30	2.01	2.36	0	2.95	3.46	4.20	4.79	5.40	
35	1.86	2.19	0	2.74	3.21	3.90	4.45	5.01	
40	1.75	2.05	0	2.57	3.01	3.66	4.17	4.70	
45	1.65	1.94	0	2.42	2.85	3.46	3.94	4.44	
50	1.57	1.84	0	2.30	2.70	3.29	3.75	4.22	
55	1.50	1.76	0	2.20	2.58	3.14	3.58	4.03	
60	1.43	1.69	0	2.11	2.48	3.01	3.44	3.87	

Cf = Correction Factor applied to Rational Method runoff coefficient.



Accepted
Study/Report

Precipitation Report

NO STORAGE HYDROGRAPH REQUESTS

Precipitation file name: Kansas City MO.pcp

Hydrology Studio v 3.0.0.33 (Rainfall totals in Inches)

10-28-2024

	Active	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Active			✔		✔	✔	✔	✔	✔
SCS Storms	**> SCS Dimensionless Storms**								
SCS 6hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
Type I, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Type IA, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Type II, 24-hr	✔	3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Type II FL, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Type III, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Synthetic Storms	**> IDF-Based Synthetic Storms**								
1-hr		1.43	1.69	0	2.11	2.48	3.01	3.44	3.87
2-hr		2.05	2.41	0	3.02	3.55	4.31	4.93	5.54
3-hr		2.52	2.97	0	3.72	4.37	5.32	6.09	6.83
6-hr		3.60	4.24	0	5.32	6.26	7.63	8.74	9.79
12-hr		5.13	6.06	0	7.61	8.97	10.94	12.54	14.02
24-hr		7.32	8.66	0	10.88	12.84	15.67	18.00	20.08
Huff Distribution	**> 1st Quartile (0 to 6 hrs)**								
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
Huff Distribution	**> 2nd Quartile (>6 to 12 hrs)**								
8-hr		0	0	0	0	0	0	0	0
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
Huff Distribution	**> 3rd Quartile (>12 to 24 hrs)**								
18-hr		0	0	0	0	0	0	0	0
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Custom Storms	**> Custom Storm Distributions**								
My Custom Storm 1		0	0	0	0	0	0	0	0
My Custom Storm 2		0	0	0	0	0	0	0	0
My Custom Storm 3		0	0	0	0	0	0	0	0
My Custom Storm 4		0	0	0	0	0	0	0	0
My Custom Storm 5		0	0	0	0	0	0	0	0
My Custom Storm 6		0	0	0	0	0	0	0	0
My Custom Storm 7		0	0	0	0	0	0	0	0
My Custom Storm 8		0	0	0	0	0	0	0	0
My Custom Storm 9		0	0	0	0	0	0	0	0
My Custom Storm 10		0	0	0	0	0	0	0	0

Accepted
Study/Report

Precipitation Report Cont'd

NO STORAGE HYDROGRAPH RESULTS

Rainfall totals in Inches

	Active	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Active			✔		✔	✔	✔	✔	✔
Huff Indiana	**> Indianapolis**								
30-min		1.01	1.18	0	1.48	1.73	2.10	2.39	2.70
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Huff Indiana	**> Evansville**								
30-min		1.01	1.18	0	1.48	1.73	2.10	2.39	2.70
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Huff Indiana	**> Fort Wayne**								
30-min		1.01	1.18	0	1.48	1.73	2.10	2.39	2.70
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
Huff Indiana	**> South Bend**								
30-min		1.01	1.18	0	1.48	1.73	2.10	2.39	2.70
1-hr		1.32	1.56	0	1.97	2.32	2.83	3.24	3.66
2-hr		1.63	1.93	0	2.46	2.91	3.56	4.09	4.63
3-hr		1.83	2.19	0	2.80	3.33	4.09	4.71	5.35
6-hr		2.21	2.66	0	3.42	4.08	5.03	5.80	6.61
12-hr		2.61	3.14	0	4.04	4.82	5.96	6.87	7.83
24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87

Accepted
Study/Report

Precipitation Report Cont'd

NO STORAGE HYDROGRAPH RESULTS

Rainfall totals in Inches

	Active	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Active			✔		✔	✔	✔	✔	✔
NRCS Storms	**> NRCS Dimensionless Storms**								
NRCS MSE1, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE2, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE3, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE4, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE5, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCS MSE6, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NOAA-A, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NOAA-B, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NOAA-C, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NOAA-D, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCC-A, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCC-B, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCC-C, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
NRCC-D, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-1, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-2, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-3, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-4, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-5, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
CA-6, 24-hr		3.06	3.64	0	4.64	5.52	6.78	7.80	8.87
FDOT Storms	**> Florida DOT Storms**								
FDOT, 1-hr		0	2.14	2.36	2.58	2.92	3.35	3.66	3.95
FDOT, 2-hr		0	2.70	3.00	3.26	3.69	4.24	4.64	5.00
FDOT, 4-hr		0	3.28	3.76	4.00	4.80	5.50	6.20	6.80
FDOT, 8-hr		0	3.76	4.32	4.80	5.60	6.20	7.20	8.00
FDOT, 24-hr		0	4.28	4.75	5.21	6.11	7.53	8.78	10.20
FDOT, 72-hr		0	5.44	6.10	6.74	7.98	9.92	11.60	13.40
SFWMD, 72-hr		0	5.44	6.10	6.74	7.98	9.92	11.60	13.40
Austin Storms	**> Austin Frequency Storms**								
Austin Zone 1, 24-hr		0	4.14	0	5.51	6.84	8.90	10.69	12.80
Austin Zone 2, 24-hr		0	4.06	0	5.38	6.65	8.59	10.28	12.23

Accepted
Study/Report

Attachment 3

Hydraflow Storm Sewers Calculations

Accepted
Study/Report

1524 Williams Drive, Suite 201
Murfreesboro, TN 37129
Phone: 615-622-7200
catalyst-dg.com

Catalyst DESIGN GROUP

Stormwater Calculations

Project Name:	HCA Lee's Summit
Date:	10/28/2024
Project #:	20240037
By:	Wesley Blissard

Pre-Development Pond 1 Drainage Basin

Pre-Development Pond 1 Basin Area				
Soil Name:				
Udarents - Urban Land - Sampsel Complex, 2 to 5 percent slopes				
	Acres	Soil Class	CN	
	1.31	C	79	

Post-Development Pond 1 Drainage Basin

Post-Development Pond 1 Basin Area					
	Square Feet	Acres	Soil Class	CN	Rv
Pervious	23087	0.53	C	79	0.23
Impervious	33977	0.78	C	98	0.75
Total	96596	1.31			
				Weighted Rv	0.54

Pond 1 Basin Area - WQV		
WQV =	1.37	in. (90% Local Mean Annual Event)
	Short Cut Hydrology Method	
	WQv = P*Rv	
	Rv	0.503166 in.
	$WQV_{(req'd)}$	0.075842 in.
	$WQV_{(req'd)}$	2392.704 ft^3

Pond 1 Forebay Volume

El.	Area	Inc. Vol.	Cum. Vol.
991	844	0	0
992	1280	1062	1062
993	1760	1520	2582

Forebay $WQV_{(provided)}$		
Provided WQV @ Elevation 963:	730	ft^3
Percent of WQV:	30.51	%

Pond 1 Pond Volume

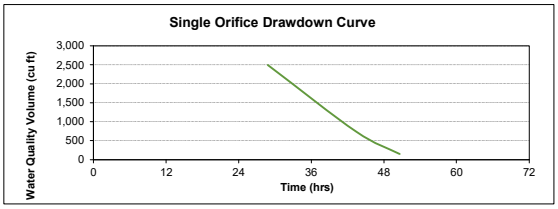
El.	Area	Inc. Vol.	Cum. Vol.
987.25	1	0	0
988	389	146	146
989	795	592	738
990	1289	1042	1780
990.5	1570	715	2495
991	2698	1067	3562
992	3732	3215	6777
993	4634	4183	10960
994	5580	5107	16067
995	6568	6074	22141
996	6889	6729	28870

$WQV_{(req'd)}$	2393
Provided WQV @ Elevation:	991
Provided WQV:	3562

Orifice Sizing

Enter orifice diameter (in): 0.63

Cumulative Volume (ft^3)	Depth Interval From (ft)	Depth Interval To (ft)	Avg H (ft)	Q (cfs)	Incremental Volume (ft^3)	Incremental Time (hrs)	Cumulative Time (hrs)
2,495	1.50	3.00	2.25	0.02	1,757	28.83	28.83
738	0.50	1.50	1.00	0.01	592	14.57	43.41
146	0.00	0.50	0.25	0.01	146	7.19	50.59



Orifice Coef - 0.66
Orifice Equation - Q = C*A(2gh)^0.5

Accepted
Study/Report

Channel Report

Outlet Pipe

Channel 1

CIRCULAR PIPE

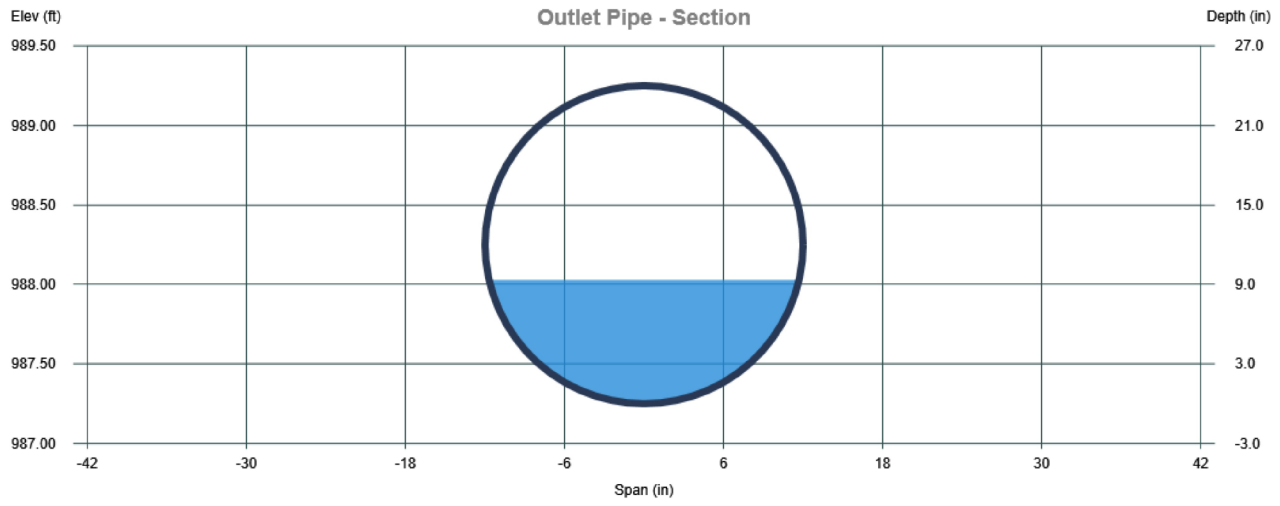
Diameter	= 24.0 in
Invert Elevation	= 987.25 ft
Pipe Slope	= 0.250 %
Manning's n	= 0.013

DISCHARGE

Method	= Known Q
Known Q	= 3.55 cfs

CALCULATION SAMPLE

Flow	Depth	Area	Velocity	WP	n-value	Crit Depth	HGL	EGL	Max Shear	Top Width
(cfs)	(in)	(sqft)	(ft/s)	(ft)		(in)	(ft)	(ft)	(lb/sqft)	(ft)
3.55	9.2	1.11	3.18	2.68	0.013	7.9	988.0	988.18	0.12	1.95



Accepted
Study/Report

Channel Report

Studio Express by Hydrology Studio v 1.0.0.15

10-28-2024

Pre-Development - Downstream Analysis

Channel 2

TRAPEZOIDAL

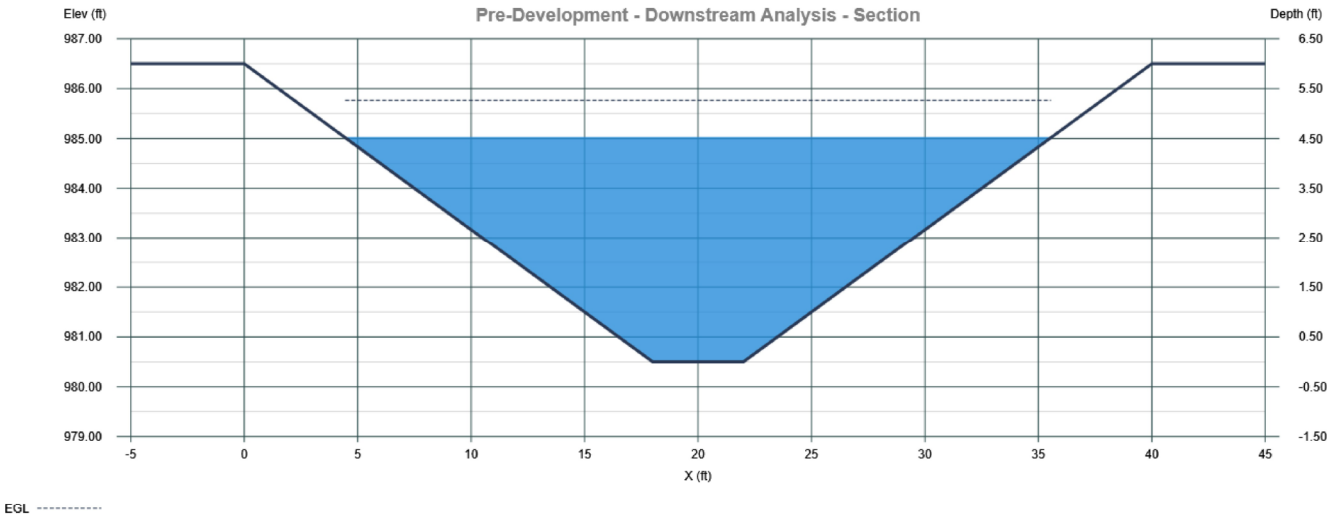
Bottom Width	= 4.00 ft
Side Slope Left, z:1	= 3.00
Side Slope Right, z:1	= 3.00
Total Depth	= 6.00 ft
Invert Elevation	= 980.50 ft
Channel Slope	= 1.670 %
Manning's n	= 0.050

DISCHARGE

Method	= Known Q
Known Q	= 550.00 cfs

CALCULATION SAMPLE

Flow	Depth	Area	Velocity	WP	n-value	Crit Depth	HGL	EGL	Max Shear	Top Width
(cfs)	(ft)	(sqft)	(ft/s)	(ft)		(ft)	(ft)	(ft)	(lb/sqft)	(ft)
550.00	4.52	79.37	6.93	32.59	0.050	4.01	985.02	985.77	4.71	31.12



Accepted
Study/Report

Channel Report

Studio Express by Hydrology Studio v 1.0.0.15

10-28-2024

Post-Development - Downstream Analysis

Channel 2

TRAPEZOIDAL

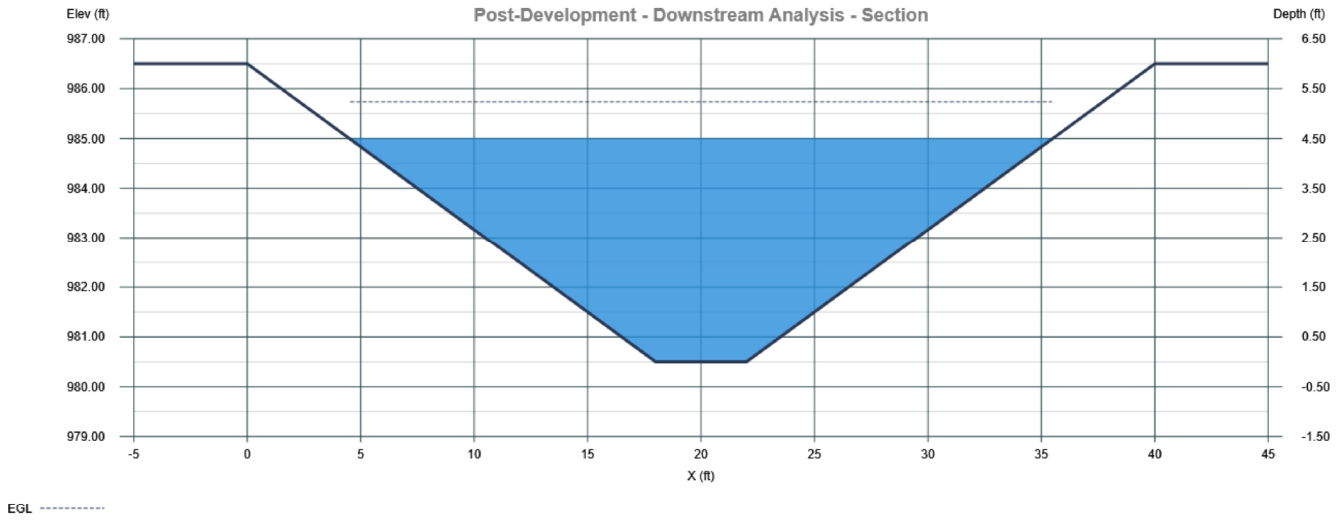
Bottom Width	= 4.00 ft
Side Slope Left, z:1	= 3.00
Side Slope Right, z:1	= 3.00
Total Depth	= 6.00 ft
Invert Elevation	= 980.50 ft
Channel Slope	= 1.670 %
Manning's n	= 0.050

DISCHARGE

Method	= Known Q
Known Q	= 543.32 cfs

CALCULATION SAMPLE

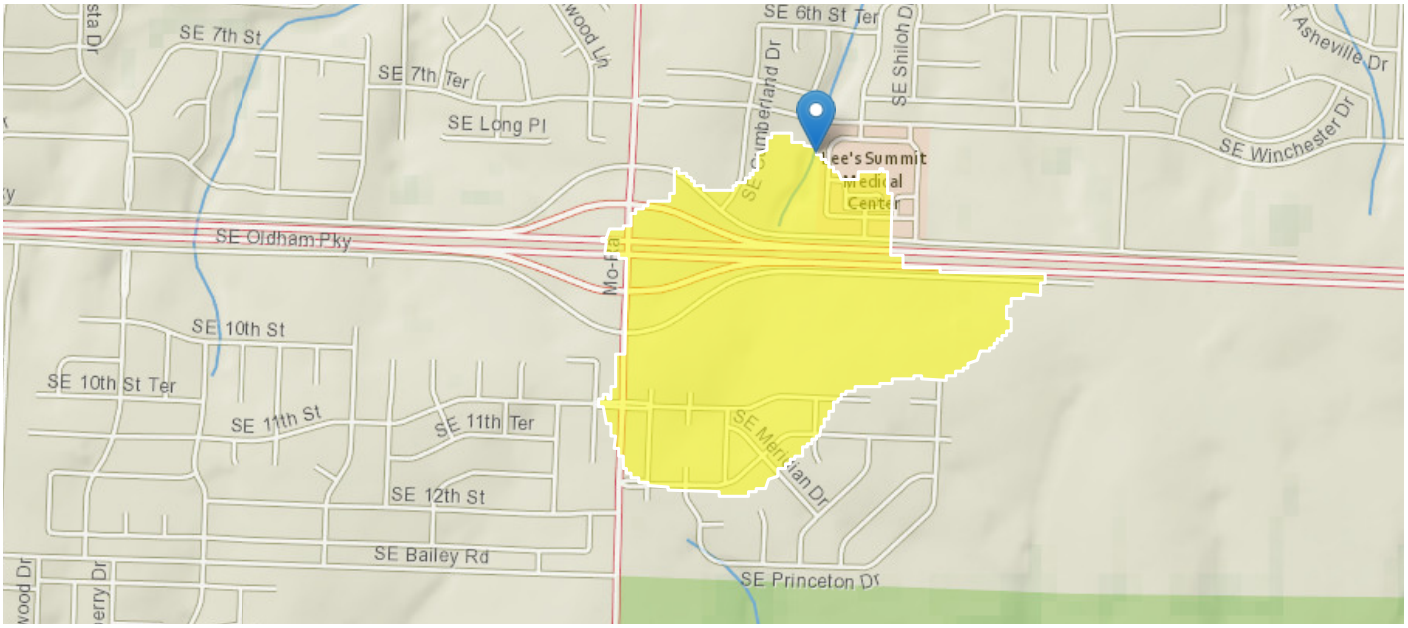
Flow	Depth	Area	Velocity	WP	n-value	Crit Depth	HGL	EGL	Max Shear	Top Width
(cfs)	(ft)	(sqft)	(ft/s)	(ft)		(ft)	(ft)	(ft)	(lb/sqft)	(ft)
543.32	4.49	78.44	6.93	32.40	0.050	3.99	984.99	985.74	4.68	30.94



Accepted
Study/Report

Lee's Summit Medical Center

Region ID: MO
Workspace ID: MO20241028175914825000
Clicked Point (Latitude, Longitude): 38.90426, -94.33466
Time: 2024-10-28 12:59:49 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSHAPE	Basin Shape Factor for Area	2.14	dimensionless
DRNAREA	Area that drains to a point on a stream	0.2	square miles
IMPNLCD01	Percentage of impervious area determined from NLCD 2001 impervious dataset	24.2	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Rural Statewide Region 1 SIR 2014 5165]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.2	square miles	0.11	8212.38
BSHAPE	Basin Shape Factor	2.14	dimensionless	2.25	26.59

Peak-Flow Statistics Parameters [Peak Urban Statewide SIR 2010 5073]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.2	square miles	0.28	189
IMPNLCD01	Percent Impervious NLCD2001	24.2	percent	2.3	46

Accepted
Study/Report

Peak-Flow Statistics Disclaimers [Peak Rural Statewide Region 1 SIR 2014 5165]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Rural Statewide Region 1 SIR 2014 5165]

Statistic	Value	Unit
50-percent AEP flood	117	ft^3/s
20-percent AEP flood	228	ft^3/s
10-percent AEP flood	316	ft^3/s
4-percent AEP flood	438	ft^3/s
2-percent AEP flood	534	ft^3/s
1-percent AEP flood	632	ft^3/s
0.5-percent AEP flood	730	ft^3/s
0.2-percent AEP flood	863	ft^3/s

Peak-Flow Statistics Disclaimers [Peak Urban Statewide SIR 2010 5073]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Urban Statewide SIR 2010 5073]

Statistic	Value	Unit
50-percent AEP flood	156	ft^3/s
20-percent AEP flood	251	ft^3/s
10-percent AEP flood	325	ft^3/s
4-percent AEP flood	400	ft^3/s
2-percent AEP flood	488	ft^3/s
1-percent AEP flood	550	ft^3/s
0.2-percent AEP flood	733	ft^3/s

Peak-Flow Statistics Citations

Southard, R.E.,2010, Estimation of the Magnitude and Frequency of Floods in Urban Basins in Missouri: U.S. Geological Survey Scientific Investigations Report 2010-5073, 27 p. (http://pubs.usgs.gov/sir/2010/5073/)
Southard, R.E., and Veilleux, A.G.,2014, Methods for estimating annual exceedance-probability discharges and largest recorded floods for unregulated streams in rural Missouri: U.S. Geological Survey Scientific Investigations Report 2014–5165, 39 p. (http://pubs.usgs.gov/sir/2014/5165/)

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Study/Report

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Application Version: 4.24.0
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1