STORMWATER MANAGEMENT FACILITIES REPORT FOR

Site Address:

250 NW McNary Court
Lee's Summit, MO 64086

Developer:
TM Crowley
501 Pennsylvania Parkway Suite 160
Indianapolis, IN 46280
630-441-0165

Prepared By:

PREMIER
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Dated: March 23, 2021

STORMWATER FACILITIES MANAGEMENT REPORT
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Introduction

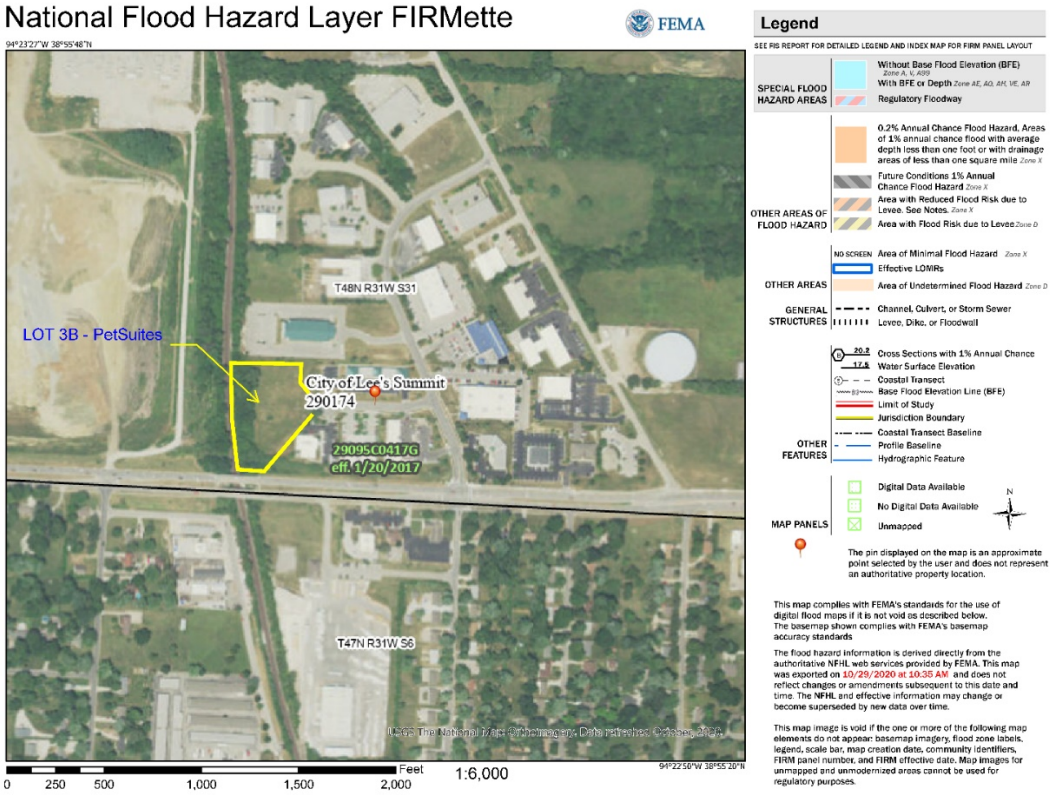
The proposed improvements that are depicted on the Preliminary Development Plan provides the design for the proposed development for Petsuites located at 250 NW McNary court. The development will increase the impervious area of the site therefore changing the characteristics of the stormwater runoff. The information supplied in this report will provide evidence that the Post Developed Stormwater Runoff has been mitigated appropriately with the Best Management Practices proposed for this development.

Project Narrative

TM Crowley is developing the subject property for Petsuites of America. The property size is ±2.11 acres and is located at the west end of the cul-de-sac on McNary Court. The proposed building will consist of a veterinary clinic and PetSuites for a total of 14,100 sq. ft. The overall drainage patterns of the existing area drain east to west towards the existing railroad.

FEMA Classification

This property is classified as Zone "X" areas outside the 100 year floodplain per 29095C0417G map effective date of 1/20/2017. There are no known flooding issues associated with this property.



Wetland and USACE Involvement

There are no wetlands listed associated with the national wetlands inventory.

U.S. Fish and Wildlife Service
National Wetlands Inventory

National Wetlands Inventory Map

November 2, 2020

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

Site Area Calculations

Property Size	2.11 Acres
Pre-Development Condition	
2.11 Acres of Grass	CN=74
Post-Development Condition	
0.69 Acres of Impervious Area (Buildings and Pavement)	CN=98
1.42 Acres of Pervious Area	CN=74
"CN" Value Weighted Average	CN=82

Methodology

The methodology used for the project is Hydro CAD 10.10-3a for determination of SCS TR-55 hydrographs. The hydraulics for the project will be determined using Autodesk Civil 3D 2020 Storm Sewer Analysis. To determine the Storm Intensity and Frequency the overall project pre-development condition and post development condition was determined by the SCS method using NOAA's precipitation intensity data from their website.

Existing Condition Analysis

The summary of comprehensive control requirements shall be per 5601.5.A.4.and 5608.4 the "Comprehensive Control" release rate strategy. Assumed time of concentration associated with the areas were used to due to the minimal area to discharge locations.

The default strategy of comprehensive protection of the 1% (100 year event), 10% (10 year event) and 50% (2 year event) is being provided with this development. Comprehensive controls shall be the following:

- 50% storm peak rate less than nor equal to 0.5 cfs per site acre
- 10% storm peak rate less than nor equal to 2.0 cfs per site acre
- 1% storm peak rate less than nor equal to 3.0 cfs per site acre

Existing Conditions Summary Table

ID	RUNOFF (cfs)	TC	IMPERVIOUS AREA (ac.)	PERVIOUS AREA (ac.)	Total Area (ac.)	COMPOSITE CN
AREA A						
2-Year	2.79	30	0.99	0.175	1.17	94
10-Year	4.43	30	0.99	0.175	1.17	94
100-Year	6.58	30	0.99	0.175	1.17	94
AREA B						
2-Year	0.12	5	0.00	0.05	0.05	74
10-Year	0.24	5	0.00	0.05	0.05	74
100-Year	0.42	5	0.00	0.05	0.05	74
AREA C						
2-Year	0.35	5	0.00	0.15	0.15	74
10-Year	0.73	5	0.00	0.15	0.15	74
100-Year	1.27	5	0.00	0.15	0.15	74
AREA D						
2-Year	0.14	5	0.00	0.06	0.06	74
10-Year	0.29	5	0.00	0.06	0.06	74
100-Year	0.51	5	0.00	0.06	0.06	74
AREA E						
2-Year	6.56	20	1.84	0.325	2.17	94
10-Year	10.38	20	1.84	0.325	2.17	94
100-Year	15.41	20	1.84	0.325	2.17	94
AREA F						
2-Year	3.57	10	0.00	1.89	1.89	74
10-Year	7.6	10	0.00	1.89	1.89	74
100-Year	13.44	10	0.00	1.89	1.89	74
AREA G						
2-Year	0.04	10	0.00	0.02	0.02	74
10-Year	0.08	10	0.00	0.02	0.02	74
100-Year	0.14	10	0.00	0.02	0.02	74
AREA H						
2-Year	0.02	10	0.00	0.01	0.01	74
10-Year	0.04	10	0.00	0.01	0.01	74
100-Year	0.07	10	0.00	0.01	0.01	74

The site is an open field with a wooded area to the west. It is surrounded by commercial properties except the west which is railroad right of way. The existing runoff drains to the west. Due to the minimal TC and unknown relationship of discharge for the offsite basin we determined a 30 minute TC for Area A otherwise areas B, C and D were five minute time of concentrations. Area F, G, and H were given 10 minute time of concentrations representing the existing onsite conditions.

There are two points of interest associated with the existing conditions.

Existing Point of Interest #1

Point of Interest #1 – Existing Runoff to West of Site

This is in relationship to the property and the overland flow to the existing railway. The discharge associated with this is shown in Areas C, D, F, G and H. Area D drains offsite to the existing inlet at the street however its discharge associated with the project remains along with a small area of Area H that drains offsite however it is nominal of an area.

ID	RUNOFF (cfs)	TC	IMPERVIOUS AREA (ac.)	PERVIOUS AREA (ac.)	Total Area (ac.)	COMPOSITE CN
AREA C						
1-Year	0.01	5	0.00	0.15	0.15	74
2-Year	0.35	5	0.00	0.15	0.15	74
10-Year	0.73	5	0.00	0.15	0.15	74
100-Year	1.27	5	0.00	0.15	0.15	74
AREA D						
1-Year	0.01	5	0.00	0.06	0.06	74
2-Year	0.14	5	0.00	0.06	0.06	74
10-Year	0.29	5	0.00	0.06	0.06	74
100-Year	0.51	5	0.00	0.06	0.06	74
AREA F						
1-Year	0.13	10	0.00	1.89	1.89	74
2-Year	3.57	10	0.00	1.89	1.89	74
10-Year	7.6	10	0.00	1.89	1.89	74
100-Year	13.44	10	0.00	1.89	1.89	74
AREA G						
1-Year	0.00	10	0.00	0.02	0.02	74
2-Year	0.04	10	0.00	0.02	0.02	74
10-Year	0.08	10	0.00	0.02	0.02	74
100-Year	0.14	10	0.00	0.02	0.02	74
AREA H						
1-Year	0.00	10	0.00	0.01	0.01	74
2-Year	0.02	10	0.00	0.01	0.01	74
10-Year	0.04	10	0.00	0.01	0.01	74
100-Year	0.07	10	0.00	0.01	0.01	74

Existing Point of Interest #2

This point of interest is in relationship with the neighboring stormwater runoff that is collected in what appears to be a water quality basin. This is noted as area A. A longer time of concentration was provided to address the ponding area and reduced release rate and timing. We considering this 30 minute TC as conservative and protects the proposed project from potentially overcompensating with a larger TC and our calculations would not handle to the correct amount of stormwater.

ID	RUNOFF (cfs)	TC	IMPERVIOUS AREA (ac.)	PERVIOUS AREA (ac.)	Total Area (ac.)	COMPOSITE CN
AREA A						
1-Year	0.84	30	0.99	0.175	1.17	94
2-Year	2.79	30	0.99	0.175	1.17	94
10-Year	4.43	30	0.99	0.175	1.17	94
100-Year	6.58	30	0.99	0.175	1.17	94

Allowable Release Rate Calculation

Due to this project providing the comprehensive control strategy that is listed in the existing condition analysis, our storm peak rate is based on the Existing Point of Interest #1. Since our site area is larger than the area listed in Existing Point of Interest #1 a table has been provided of the allowed release rates.

	Release Rate Per Acre (ac per cfs)	Site Area (ac.)	Allowable release rate (c.f.s.)
2 Year	0.50	2.11	1.06
10 Year	2.00	2.11	4.22
100 Year	3.00	2.11	6.33

Proposed Development Analysis

The proposed project will change the existing stormwater runoff by the increase of impervious area. The bypass areas have been mitigated to the maximum extent practical and the detention has accommodated for such areas. There is an overall reduction in the total runoff based on the proposed conditions as referenced in the Differential Runoff Table. The table was derived per the event tables from HydroCAD.

The proposed project will increase the impervious surface however it will reduce the runoff for the overall disturbed area per APWA 5600. This project proposes that areas that will route through the detention will meet the allowable release rate. The bypass areas consist of existing woodlands that will remain in place therefore to meet the requirements we would have to remove the existing vegetation in place.

Proposed Drainage Conditions Analysis

The proposed drainage area map that is referenced in the attachments provide a visual indicator for the runoff of each drainage area map. The proposed project will change the existing stormwater runoff by the increase of impervious area. The bypass areas have been mitigated to the maximum extent practical and the detention has accommodated for such areas. There is an overall reduction in the total runoff based on the proposed conditions as referenced in the Differential Runoff Table. The table was derived per the event tables from HydroCAD.

Detention Basin Summary

1. Top of Basin = 1000
2. Top of Spillway = 999.06
3. 1 Year/WQv HW = 994.37
4. 2 Year HW = 996.01
5. 10 Year HW = 997.17
6. 100 Year HW = 998.18

Proposed Runoff Table

Row Labels	Peak Runoff (cfs)	Impervious Area	Pervious Area	Total Area	Composite CN	TC
AREA 1						
1-Year	0.25	0.15	0.06	0.21	91	5
2-Year	0.94	0.15	0.06	0.21	91	5
10-Year	1.52	0.15	0.06	0.21	91	5
100-Year	2.29	0.15	0.06	0.21	91	5
AREA 2						
1-Year	0.26	0.16	0.08	0.24	90	5
2-Year	1.04	0.16	0.08	0.24	90	5
10-Year	1.71	0.16	0.08	0.24	90	5
100-Year	2.6	0.16	0.08	0.24	90	5
AREA 3						
1-Year	1.55	1.01	0.75	1.76	172	10
2-Year	7.07	1.01	0.75	1.76	172	10
10-Year	11.99	1.01	0.75	1.76	172	10
100-Year	18.5	1.01	0.75	1.76	172	10
AREA 4						
1-Year	0.63	0.33	0	0.33	98	5
2-Year	1.69	0.33	0	0.33	98	5
10-Year	2.57	0.33	0	0.33	98	5
100-Year	3.74	0.33	0	0.33	98	5
AREA 5						
1-Year	0.07	0.05	0.05	0.1	86	5
2-Year	0.38	0.05	0.05	0.1	86	5
10-Year	0.66	0.05	0.05	0.1	86	5
100-Year	1.04	0.05	0.05	0.1	86	5
AREA 6						
1-Year	0.11	0.06	0.45	0.51	77	5
2-Year	1.36	0.06	0.45	0.51	77	5
10-Year	2.7	0.06	0.45	0.51	77	5
100-Year	4.59	0.06	0.45	0.51	77	5
AREA 7						
1-Year	0.03	0.02	0.05	0.07	81	5
2-Year	0.22	0.02	0.05	0.07	81	5
10-Year	0.41	0.02	0.05	0.07	81	5
100-Year	0.68	0.02	0.05	0.07	81	5
AREA TO AI 11						
1-Year	0	0	0.02	0.02	74	5
2-Year	0.05	0	0.02	0.02	74	5
10-Year	0.1	0	0.02	0.02	74	5
100-Year	0.17	0	0.02	0.02	74	5
OFFSITE TO CI 12						
1-Year	1.98	1.844	0.325	2.17	94	20
2-Year	6.56	1.844	0.325	2.17	94	20
10-Year	10.38	1.844	0.325	2.17	94	20
100-Year	15.41	1.844	0.325	2.17	94	20

Proposed Drainage Area Description

1. Area to proposed inlet south of building. Routed through storm sewer.
2. Area east of building routed to inlet. Routed through storm sewer.
3. Overland flow path east of basin and basin area. Parking area through opening in trash enclosure.
4. Proposed Building Footprint
5. Areas that have turf that have underdrain systems.
6. Area onsite to the west of the property that slope to the existing railroad right of way. This area bypasses the detention basin.
7. Area onsite that drain to the existing curb inlet in the cul-de-sac. This area bypasses the detention basin.
8. Area to AI 11 – Offsite Area to onsite.
9. Offsite Area to Curb Inlet in cul-de-sac.

Proposed Areas of Interest

The areas of interest and their corresponding runoff information is listed below. There are three points of interest for this project. The flowrate out of the basin, the discharge from the existing storm sewer outfall and the onsite areas that flow offsite due to the existing topography.

Proposed Area of Interest #1 – Discharge from Basin

Event	Inflow to Basin (ac.)	Peak Inflow (cfs)	Peak Storage (ac. ft.)	HW Elevation (Feet)	Discharge (cfs)
DETENTION BASIN					
1-Year	1.32	1.45	0.038	994.37	0.04
2-Year	1.32	5.56	0.129	996.01	0.67
10-Year	1.32	9.19	0.228	997.17	0.91
100-Year	1.32	14.04	0.342	998.18	3.22

Proposed Area of Interest #2 – Onsite to Offsite Discharge

Event	Peak Runoff (cfs)	Sum of Pervious	Impervious Area
AREA 6			
1-Year	0.11	0.45	0.06
2-Year	1.36	0.45	0.06
10-Year	2.7	0.45	0.06
100-Year	4.59	0.45	0.06
AREA 7			
1-Year	0.03	0.05	0.02
2-Year	0.22	0.05	0.02
10-Year	0.41	0.05	0.02
100-Year	0.68	0.05	0.02

Proposed Area of Interest #3 – Combined discharge existing storm sewer

Events	Peak Outflow
11-10	
1-Year	5.45
2-Year	18.74
10-Year	29.58
100-Year	45.36

40 Hour Water Quality Calculations

WATER QUALITY CALCULATIONS

PROJECT LOCATION:	Petsuites Lee's Summit, Missouri	**DATE:**	3/9/2021
		BY:	M. FOGARTY
PROJECT OWNER:	TM Crowley		

WATER QUALITY VOLUME REQUIRED (WQ_v)

WQ_v = P x Rv

where WQv = Water Quality Volume (acre-ft)
P= rainfall event in inches
Rv= Volumetric runoff coefficient
I= Percent site imperviousness

Runoff Coefficient, Rv=	0.8	
Precipitation Depth, P =	1.37	inches
Disturbed Area, A =	1.63	acres
WQ_v =	0.08	ac. ft.
Minimum Required WQ_v =	**3,550**	**ft^3**

EXTENDED DETENTION VOLUME (EDv)

☐ Wet Extended Detention

☑ Dry Extended Detention

EDv = 0.9 x WQ_v (for Wet Extended Detention Basins)
= 2,663 ft^3

EDv = WQ_v (for all other structural BMPs)
= 3,550 ft^3

DESIGN PARAMETERS

BMP Type = Detention System

DESIGN PARAMETERS 40 hrs.

Outlet structure for the post-construction BMP must not discharge more than the first half of the WQv or Extended Detention Volume (ED_v) in less than one-third of the drain time.

WQv or EDv =	3,550	ft^3.		
1/2 of WQv or EDv =	1,775	ft^3.		
1/3 of draw-down time =	13.3	hrs		
Maximum Volume Allowed to be discharged in	13.3	hrs	= 1,183	cf

Oriface Diamter Sizing for Extended Detention (Not provided for this project)

(Calculations based on EDv parameters provided above)

Orifice D =	**0.96**	**in**	
Maximum Hydraulic Head, H_{max} =	2.20	ft	(measured from orifice invert to WQv elevation)
Orifice Coefficient, C =	0.60		
Average Discharge, Q_{avg} =	0.03	cfs	(this is the average discharge corresponding to the draw-down time)
Draw-down time =	38.85	hrs	
Volume discharged in 1/3 of draw-down time =	1,218	cf	**Does not meet requirements.**

METHOD 1 (for sizing Water Quality Orifice)

Average Discharge, Q_{avg} =	0.02	cfs	
Maximum Discharge, Q_{max} =	0.05	cfs	
Maximum Hydraulic Head, H_{max} =	2.22	ft	
Orifice Coefficient, C =	0.60		
Orifice Area, A =	$Q_{max}/[C(2gH_{max})^{0.5}]$		
=	0.007	ft^2	
Orifice Diameter, D =	**1.12**	**in**	**(This is a preliminary estimate only)**

METHOD 2 (for sizing Water Quality Orifice using same parameters above)

Average Discharge, Q_{avg} =	0.02	cfs	(this is the average discharge corresponding to the draw-down time)
Maximum Hydraulic Head, H_{max} =	2.22	ft	(measured from orifice invert to WQv elevation)
Average Hydraulic Head, H_{avg} =	1.11	ft	
Orifice Coefficient, C =	0.60		
Orifice Area, A =	$Q_{avg}/[C(2gH_{avg})^{0.5}]$		
=	0.005	ft^2	
Orifice Diameter, D =	**0.94**	**in**	
Volume discharged in 1/3 of draw-down time =	1,183	cf	**Design parameters met. Orifice size OK.**

Summarization and Conclusions

Impacts to downstream sewers and streams have been mitigated to the maximum extent practical. This project provides filters via catch basin inserts for interim stormwater protection and a vegetated basin which meets the requirements for orifice size for water quality. Due to the existing conditions and topography of the site, we have mitigated the water quality and detention requirements set forth by the city for the area that is being disturbed. The area that is not being disturbed is the existing woodland which will remain in place. The basin location as shown on the plans is best suited based on the existing storm sewer and protecting the existing woodland to the west.

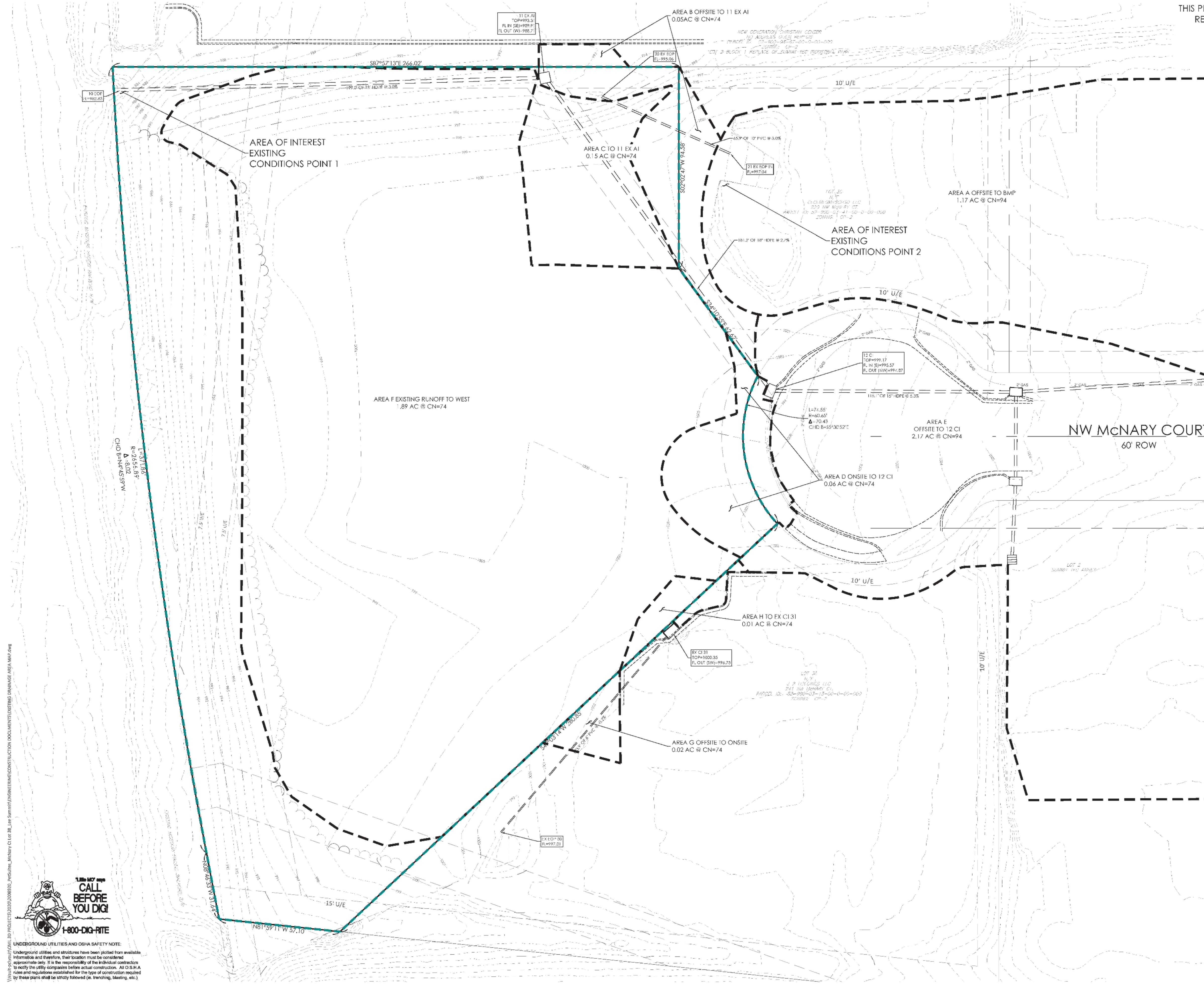
The listed waivers as shown below are being requested for the post developed condition to allow the increase from the allowable release rate due to the Bypass Areas associated with the existing vegetation to remain instead of routing those areas to the basin. This waiver would be for the 2 Year, 10 Year and 100 Year Events. The proposed project will increase the impervious surface however it will reduce the runoff for the overall disturbed area per APWA 5600. This project proposes that areas that will route through the detention will meet the allowable release rate. The bypass areas consist of existing woodlands that will remain in place therefore to meet the requirements we would have to remove the existing vegetation in place.

The water quality orifice size is 1" for this project. This will allow for the water quality orifice size to meet the City's requirements while being slightly lower for the volume due to the decreased area to the basin. We are reducing the overall runoff for this project. While we are requesting waivers, this is only due to limiting the disturbed area to keep the woodlands in place.

	Column A	Column B	Column C	Column D	Column E	Column F	Column G	Column H
	Existing Conditions (c.f.s.)	Post Developed Condition Overall Site (No Detention) (c.f.s.)	Allowable release rate (c.f.s.)	Post Developed Basin Discharge (c.f.s.)	Undisturbed Bypass Areas (c.f.s.)	Post Developed Condition Final Routing (Column D + Column E) (c.f.s.)	Differential Runoff Post Developed to Existing (Column F - Column A) (c.f.s.)	Increase or Reduction for Runoff from Existing to Proposed Condition
2 Year	4.12	6.76	1.06	0.92	1.58	2.50	-1.62	Reduction
10 Year	8.74	12.44	4.22	3.45	3.11	6.56	-2.18	Reduction
100 Year	15.43	20.17	6.33	5.11	5.27	10.38	-5.05	Reduction

Appendix A Existing Drainage Area Map

Appendix A Existing Drainage Area Map



THIS PLAN IS FOR DRAINAGE PURPOSES AND REFERENCE ONLY. DO NOT USE FOR CONSTRUCTION.

MINIMUM TIME OF CONCENTRATION = 5 MINUTES
EXISTING SOILS TYPE = C
CN PVMT = 98
CN GRASS = 74
CN COMMERCIAL AREAS = 94

MASTER DRAINAGE PLAN NOTES

1. MBOE - (MINIMUM BUILDING OPENING ELEVATION) ELEV = 1001.00
2. THE INDIVIDUAL LOT OWNER(S) SHALL NOT CHANGE OR OBSTRUCT THE OVERALL DRAINAGE FLOW LINES OR PATHS ON THE LOT AS SHOWN ON THE MASTER DRAINAGE PLAN, UNLESS SPECIFIC APPLICATION IS MADE AND APPROVED BY THE CITY ENGINEER.

1" = 20'
SCALE IN FEET

EXISTING RUNOFF TABLE

ID	EXISTING Q (CFS)
AREA A	
2-Year	2.79
10-Year	4.43
100-Year	6.58
AREA B	
2-Year	0.12
10-Year	0.24
100-Year	0.42
AREA C	
2-Year	0.35
10-Year	0.73
100-Year	1.27
AREA D	
2-Year	0.14
10-Year	0.29
100-Year	0.51
AREA E	
2-Year	6.56
10-Year	10.38
100-Year	15.41
AREA F	
2-Year	3.57
10-Year	7.6
100-Year	13.44
AREA G	
2-Year	0.04
10-Year	0.08
100-Year	0.14
AREA H	
2-Year	0.02
10-Year	0.04
100-Year	0.07

PREMIER DESIGN GROUP
100 MIDLAND PARK DRIVE
WENTZVILLE, MO 63385
MISSOURI CERTIFICATE OF AUTHORITY #E-2011000031
MISSOURI CERTIFICATE OF AUTHORITY #LS-2012007849
MISSOURI CERTIFICATE OF AUTHORITY #LA-2016007538

Project: PETSUITES OF AMERICA
LEE'S SUMMIT, MO
250 NW MCNARY CT.
LEE'S SUMMIT, MO 64086
TIM CROWLEY
501 PENNSYLVANIA PARKWAY SUITE 160
INDIANAPOLIS, IN 46280

Date: 1-27-2021

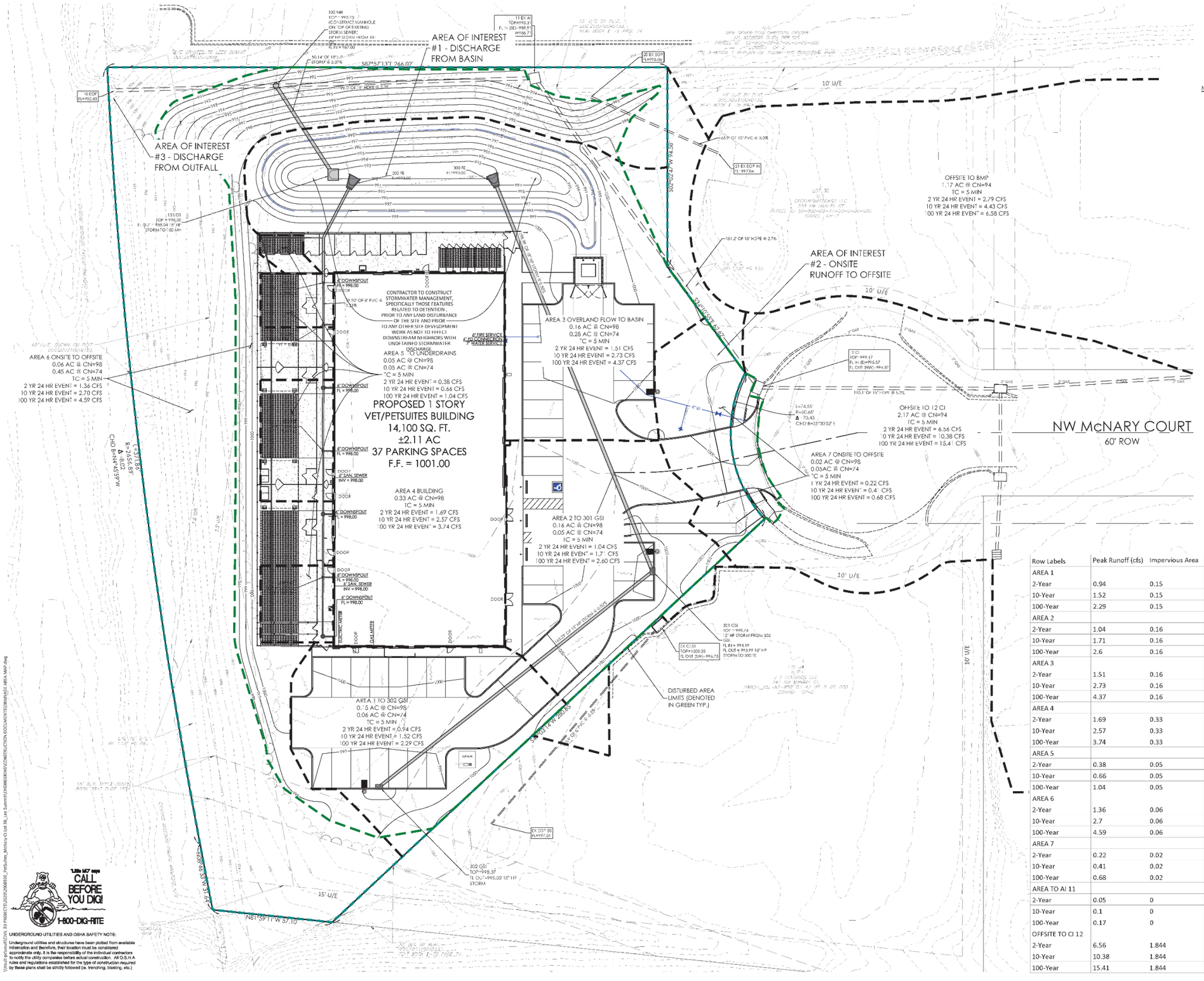
Sheet Title: EXISTING DRAINAGE AREA MAP

Sheet Number: C-500

Project No.	2008920
Drawn By	Z. KUNTZ/A. JONES
Checked By	M.FOGARTY

NOT RELEASED FOR CONSTRUCTION

Appendix B Proposed Drainage Area Map



MINIMUM TIME OF CONCENTRATION = 5 MINUTES
EXISTING SOILS TYPE = C
CN PVMT = 98
CN GRASS = 74
CN COMMERCIAL AREAS = 94

MASTER DRAINAGE PLAN NOTES

1. MBOE = (MINIMUM BUILDING OPENING ELEVATION) ELEV = 1001.00
2. THE INDIVIDUAL LOT OWNER(S) SHALL NOT CHANGE OR OBSTRUCT THE OVERALL DRAINAGE FLOW LINES OR PATHS ON THE LOT AS SHOWN ON THE MASTER DRAINAGE PLAN, UNLESS SPECIFIC APPLICATION IS MADE AND APPROVED BY THE CITY ENGINEER.

Row Labels	Peak Runoff (cfs)	Impervious Area	Pervious Area	Total Area	Composite CN	TC
AREA 1						
2-Year	0.94	0.15	0.06	0.21	91	5
10-Year	1.52	0.15	0.06	0.21	91	5
100-Year	2.29	0.15	0.06	0.21	91	5
AREA 2						
2-Year	1.04	0.16	0.08	0.24	90	5
10-Year	1.71	0.16	0.08	0.24	90	5
100-Year	2.6	0.16	0.08	0.24	90	5
AREA 3						
2-Year	1.51	0.16	0.28	0.44	83	5
10-Year	2.73	0.16	0.28	0.44	83	5
100-Year	4.37	0.16	0.28	0.44	83	5
AREA 4						
2-Year	1.69	0.33	0	0.33	98	5
10-Year	2.57	0.33	0	0.33	98	5
100-Year	3.74	0.33	0	0.33	98	5
AREA 5						
2-Year	0.38	0.05	0.05	0.1	86	5
10-Year	0.66	0.05	0.05	0.1	86	5
100-Year	1.04	0.05	0.05	0.1	86	5
AREA 6						
2-Year	1.36	0.06	0.45	0.51	77	5
10-Year	2.7	0.06	0.45	0.51	77	5
100-Year	4.59	0.06	0.45	0.51	77	5
AREA 7						
2-Year	0.22	0.02	0.05	0.07	81	5
10-Year	0.41	0.02	0.05	0.07	81	5
100-Year	0.68	0.02	0.05	0.07	81	5
AREA TO AI 11						
2-Year	0.05	0	0.02	0.02	74	5
10-Year	0.1	0	0.02	0.02	74	5
100-Year	0.17	0	0.02	0.02	74	5
OFFSITE TO CI 12						
2-Year	6.56	1.844	0.325	2.17	94	20
10-Year	10.38	1.844	0.325	2.17	94	20
100-Year	15.41	1.844	0.325	2.17	94	20

"Little MO" 8888
CALL BEFORE YOU DIG!
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UNDERGROUND UTILITIES AND OSHA SAFETY NOTE:
Underground utilities and structures have been plotted from available information and therefore, their location must be considered approximate only. It is the responsibility of the individual contractors to notify the utility companies before actual construction. All O.S.H.A rules and regulations established for the type of construction required by these plans shall be strictly followed (ie. trenching, blasting, etc.)

PREMIER DESIGN GROUP
1100 MIDLAND PARK DRIVE
LEWISVILLE, TX 75057
MISSOURI CERTIFICATE OF AUTHORITY #LC2020007899
MISSOURI CERTIFICATE OF AUTHORITY #LA 2006007558

ENGINEERS AUTHENTICATION
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI.
STEVEN D. MARION P.E.
PROFESSIONAL ENGINEER
PE 2006007165

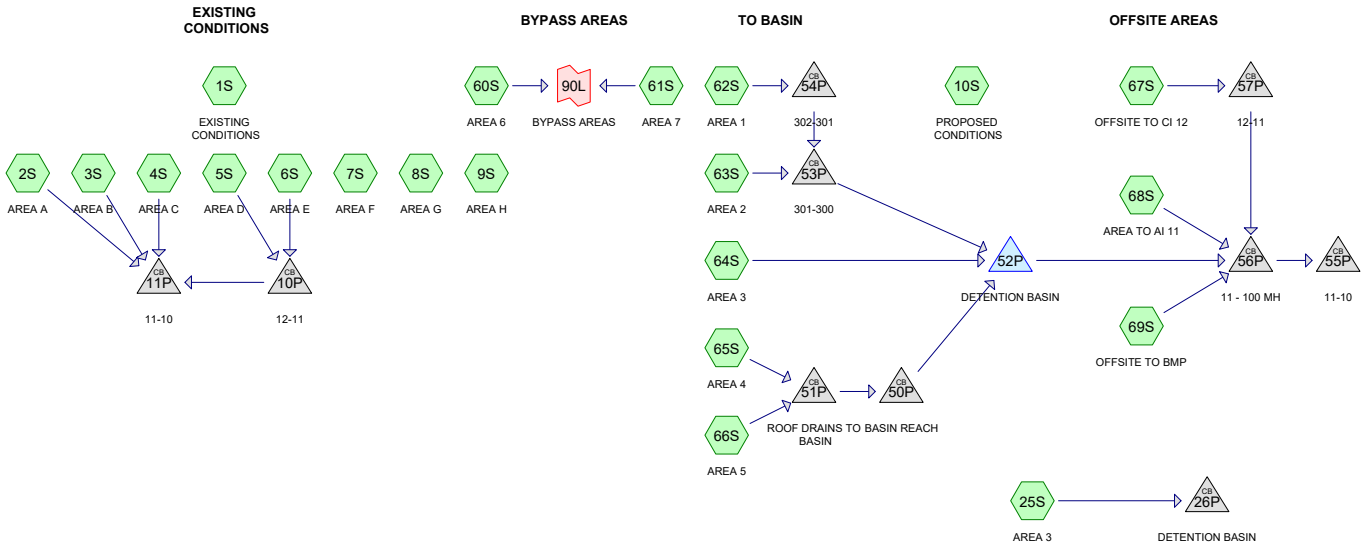
PETSUITES OF AMERICA
LEE'S SUMMIT, MO
250 NW MCNARY CT.
LEE'S SUMMIT, MO 64086
TIM CROWLEY
501 PENNSYLVANIA PARKWAY SUITE 160
INDIANAPOLIS, IN 46280

Date 1-27-2021
Description of Changes
Revision Date
Sheet Title STORMWATER MANAGEMENT PLAN
Sheet Number C-501

Project No. 2008920
Drawn By Z. KUNTZ/A. JONES
Checked By M.FOGARTY

NOT RELEASED FOR CONSTRUCTION

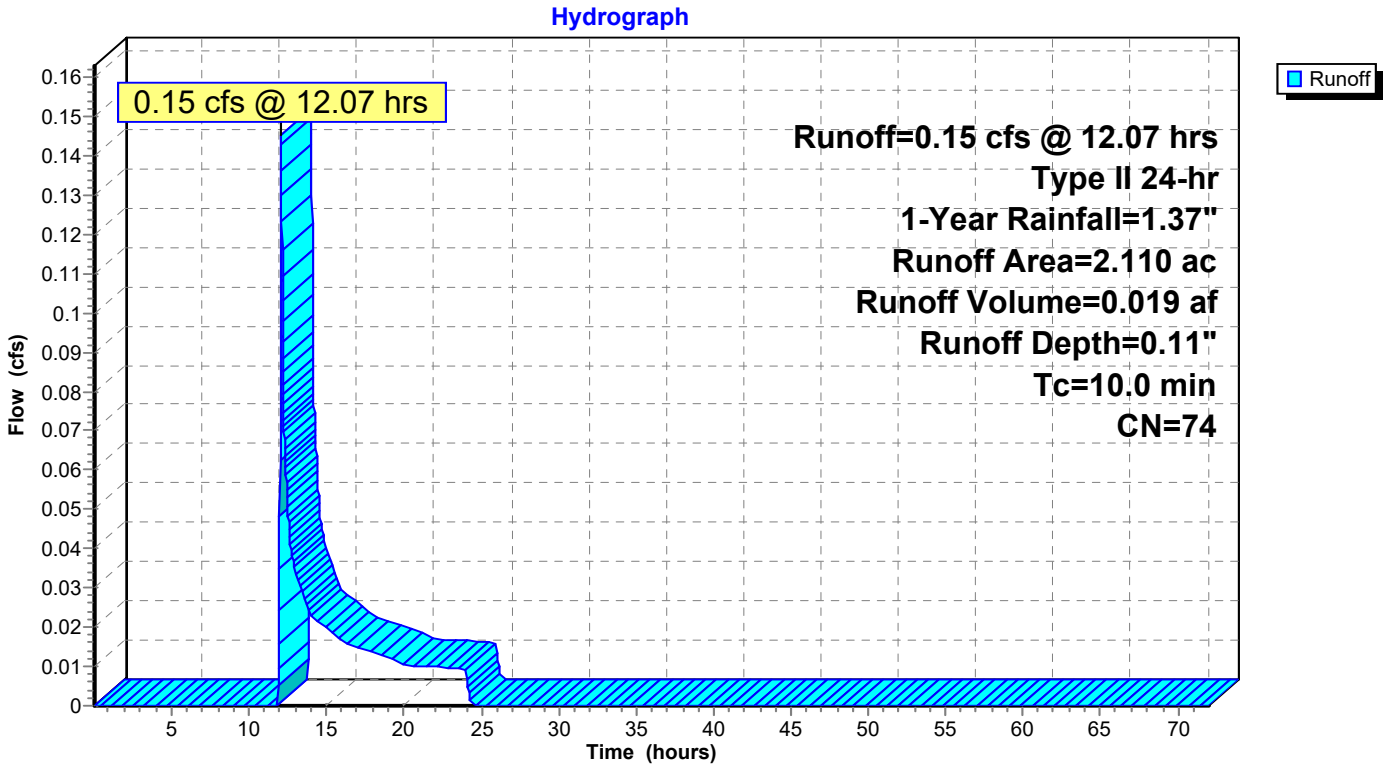
Appendix C HydroCAD Hydrographs



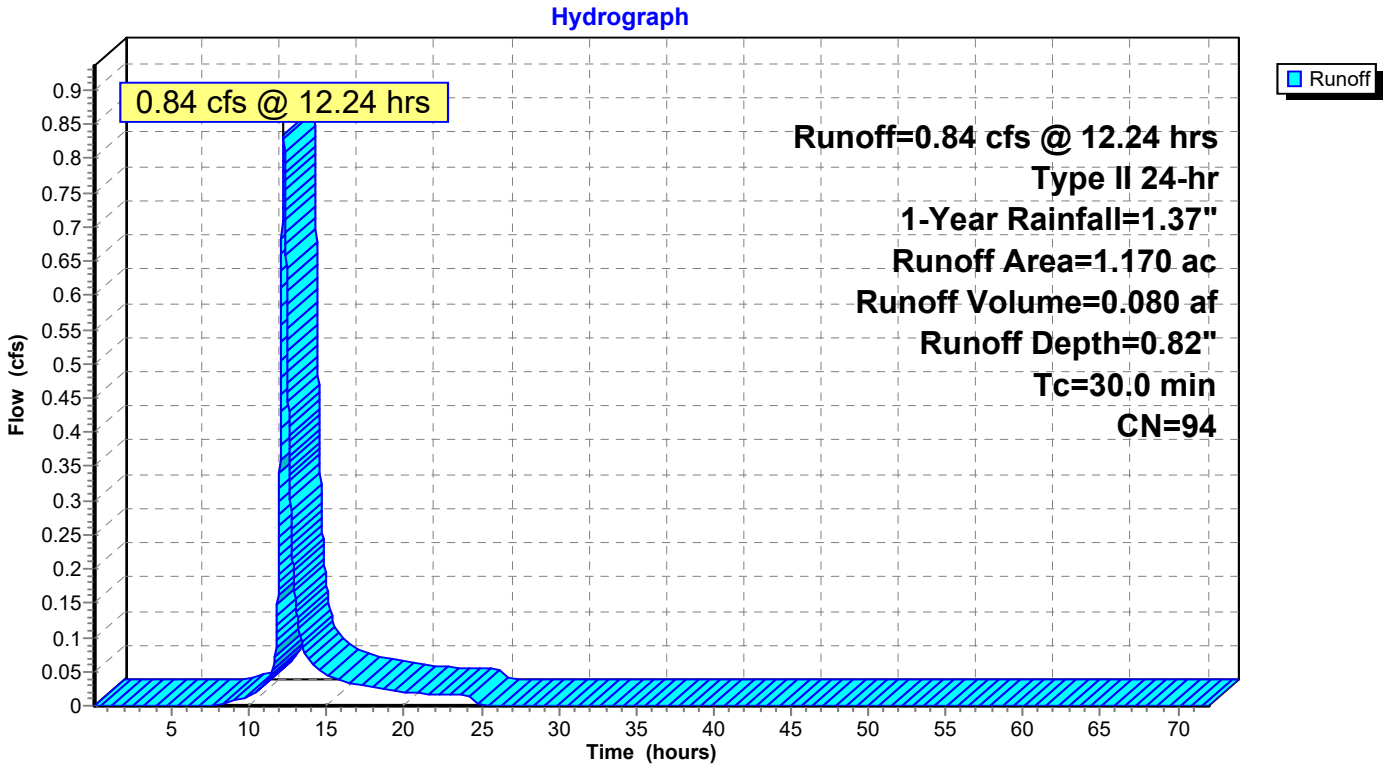
Subcat Reach Pond Link

Routing Diagram for 2020-10-31 ANALYSIS
Prepared by Premier Design Group, Printed 3/10/2021

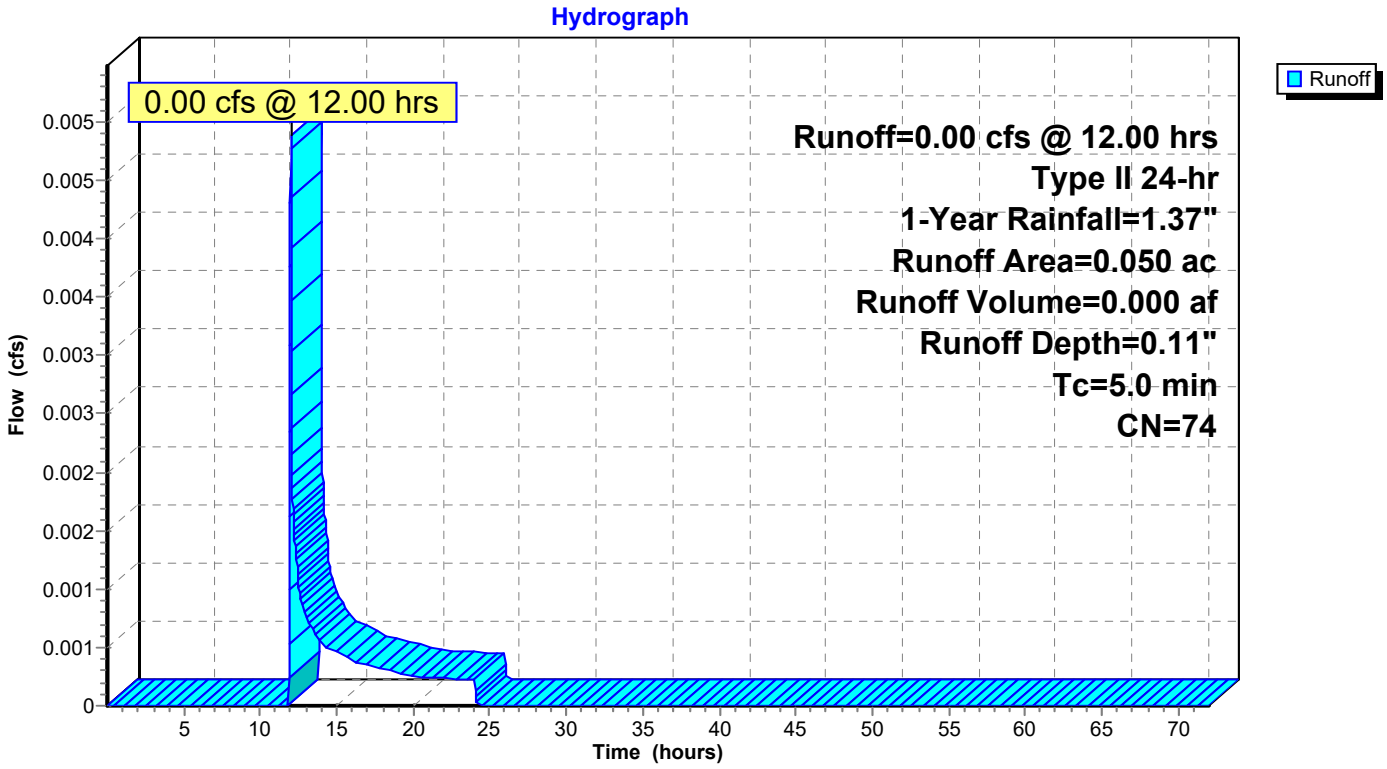
Subcatchment 1S: EXISTING CONDITIONS



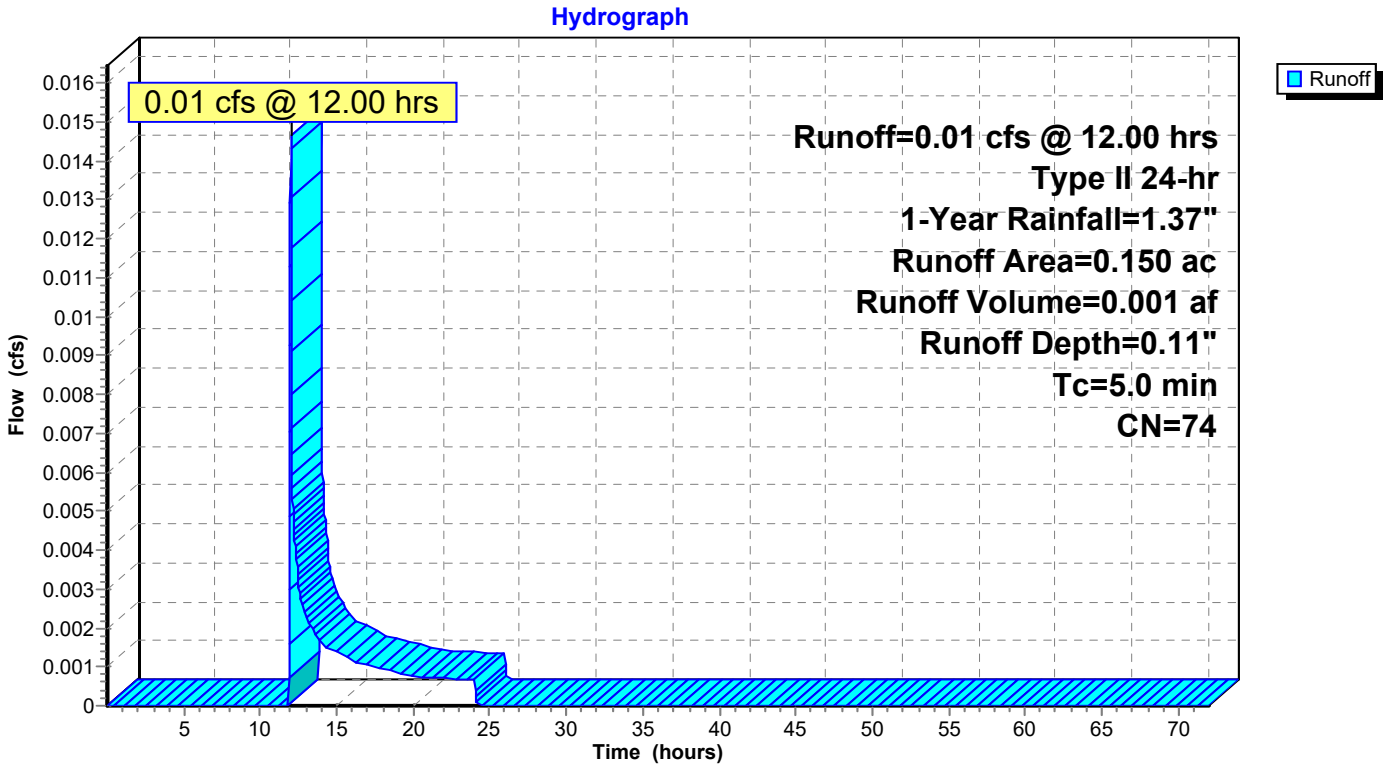
Subcatchment 2S: AREA A



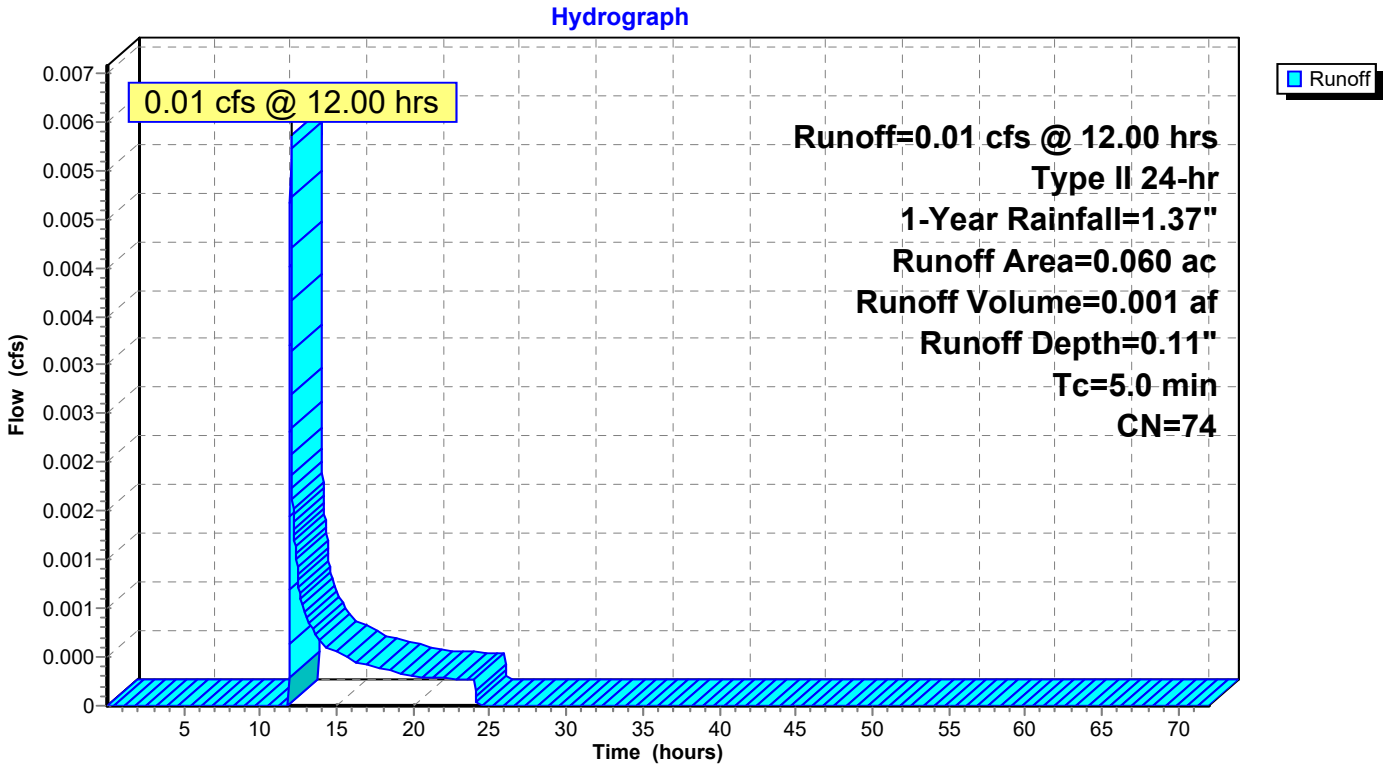
Subcatchment 3S: AREA B



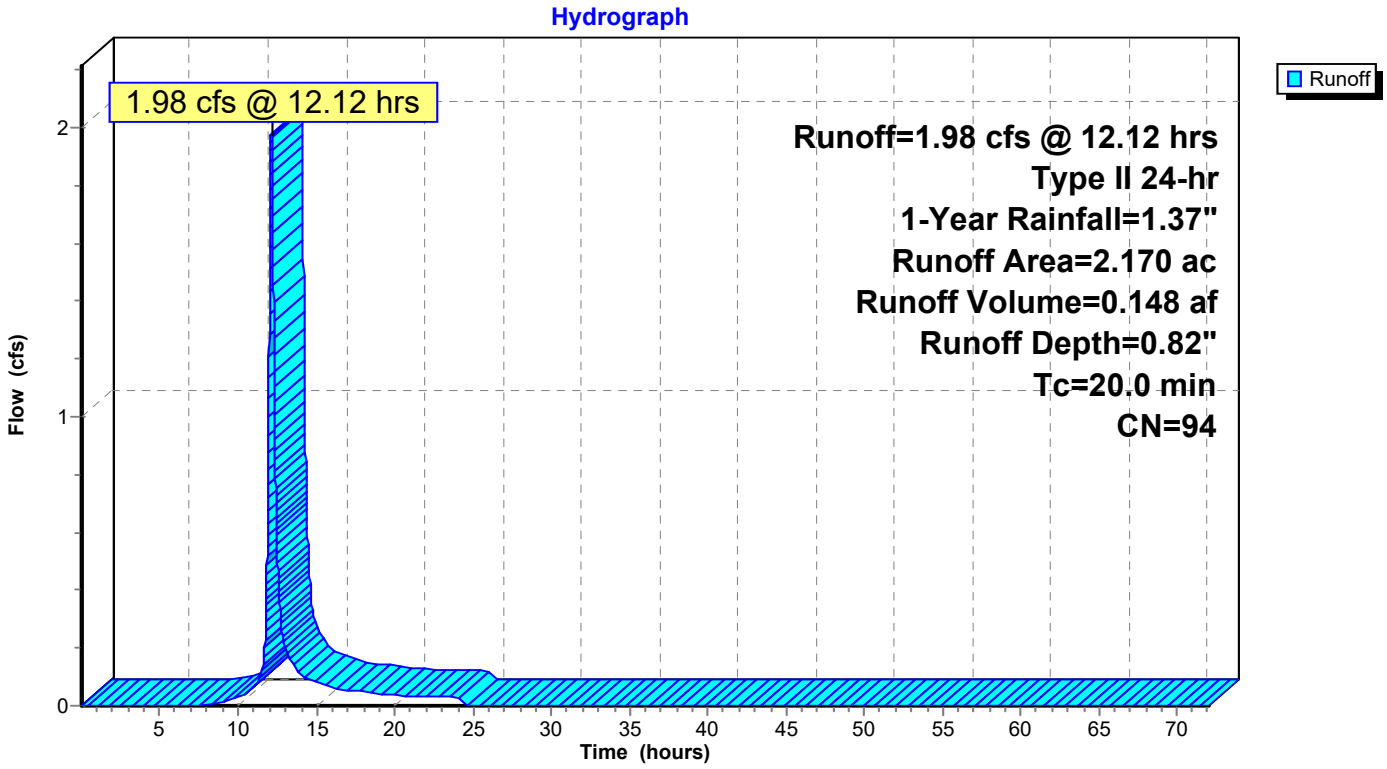
Subcatchment 4S: AREA C



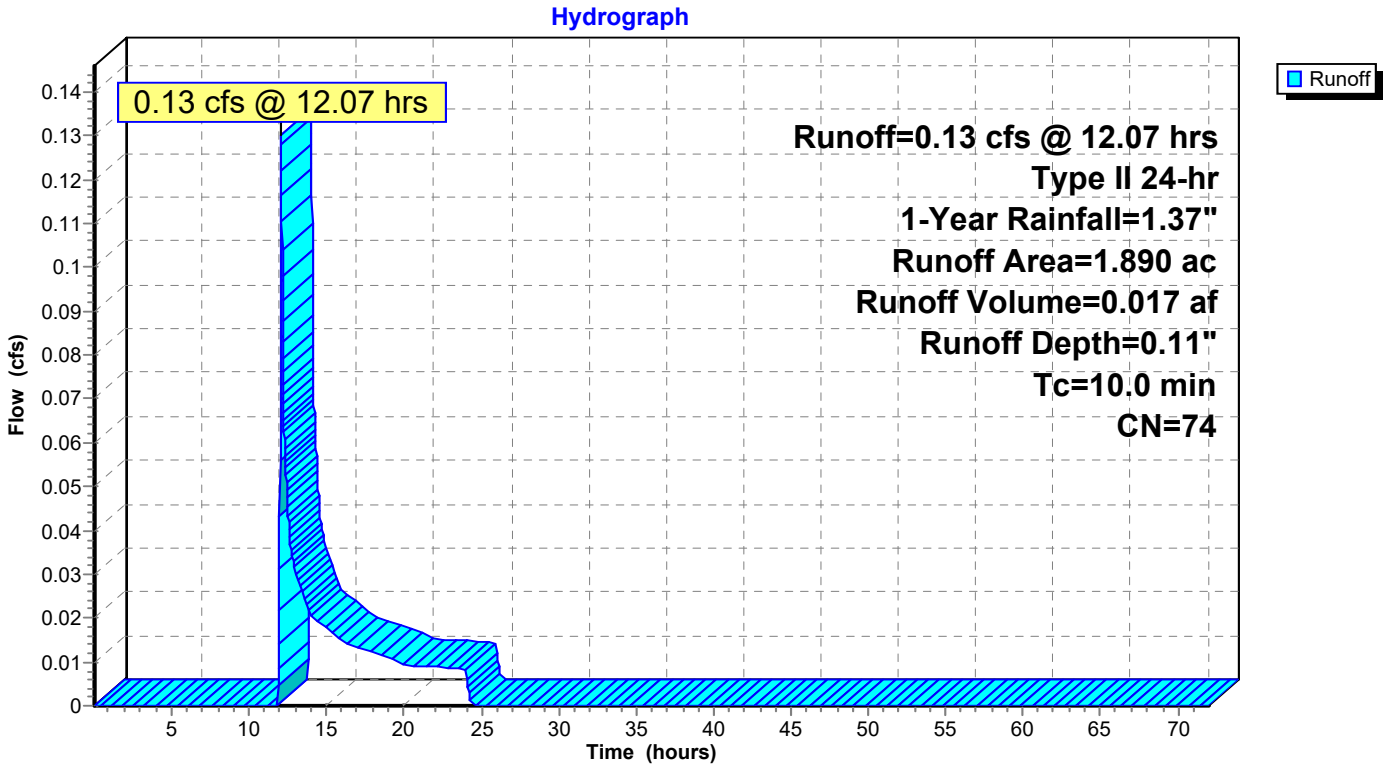
Subcatchment 5S: AREA D



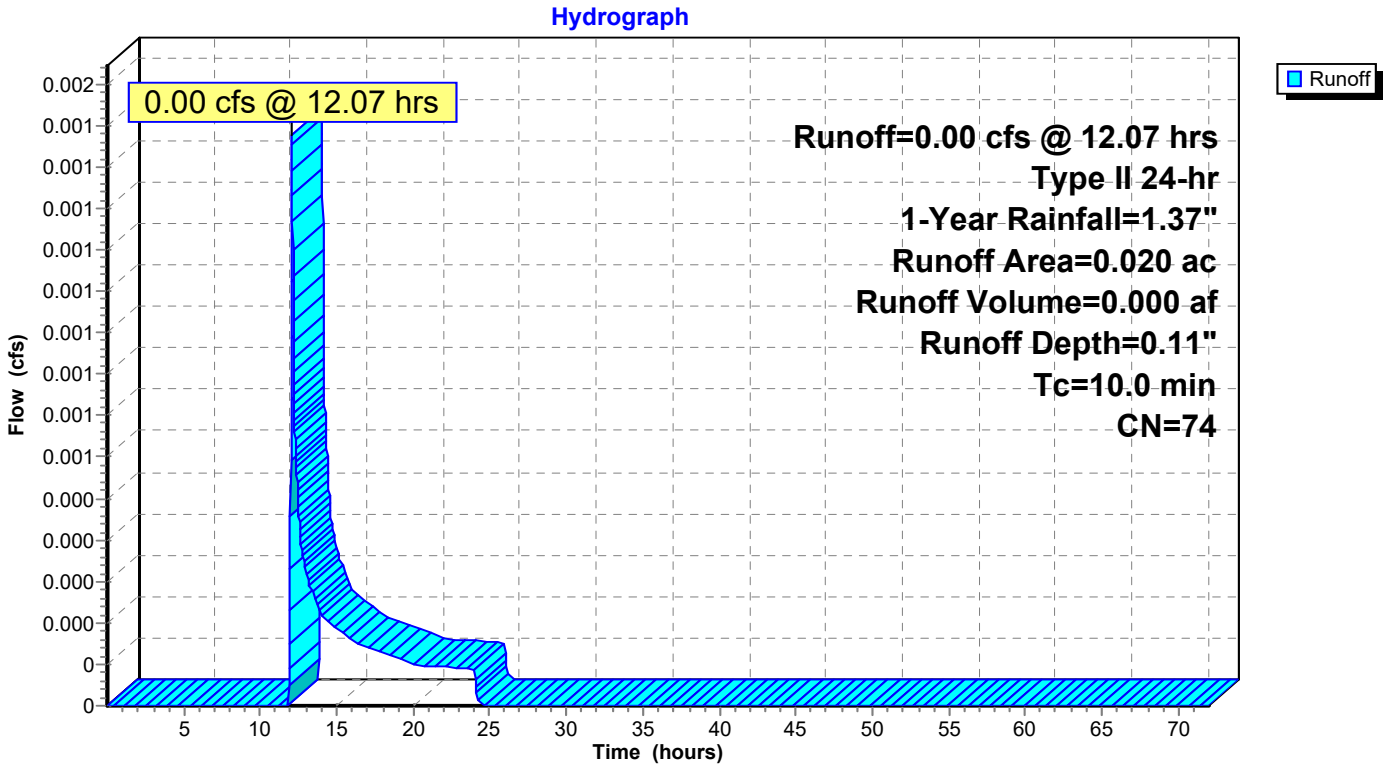
Subcatchment 6S: AREA E



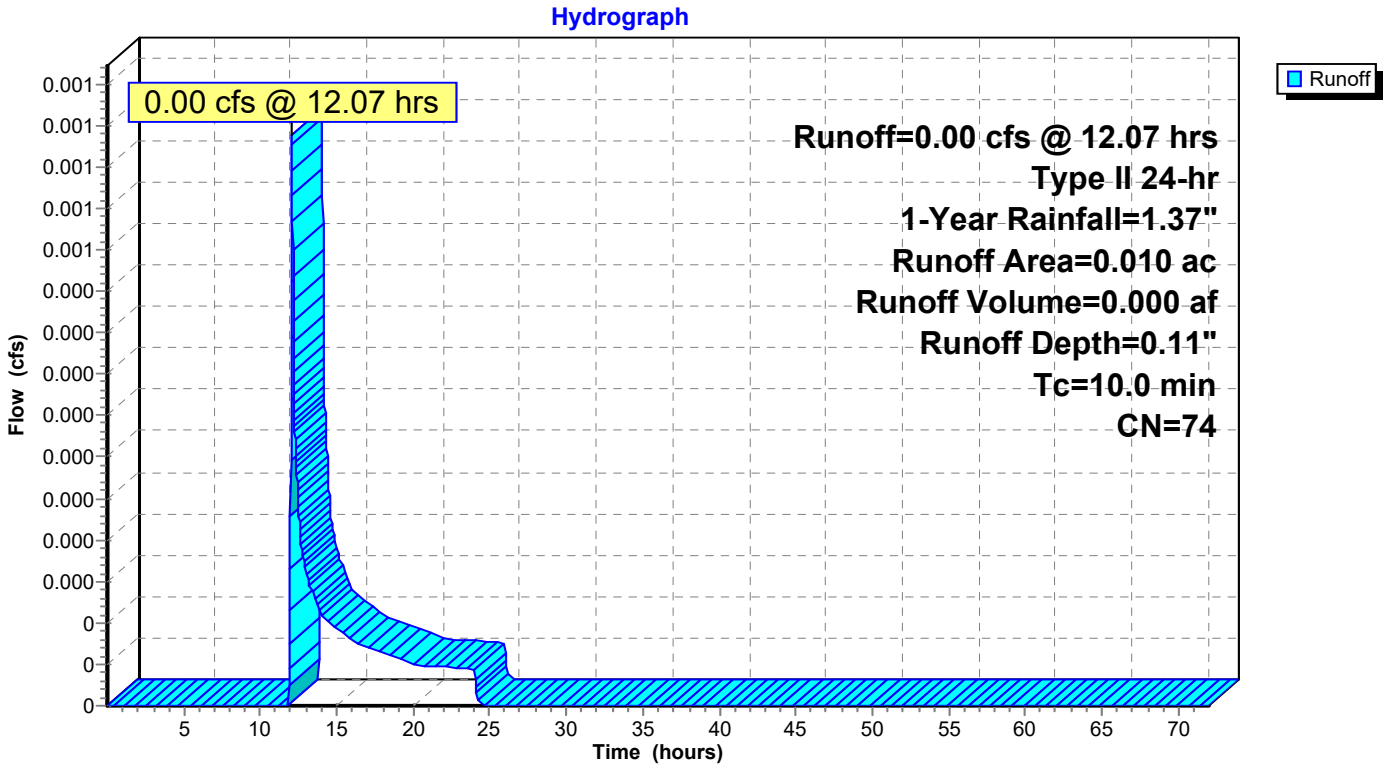
Subcatchment 7S: AREA F



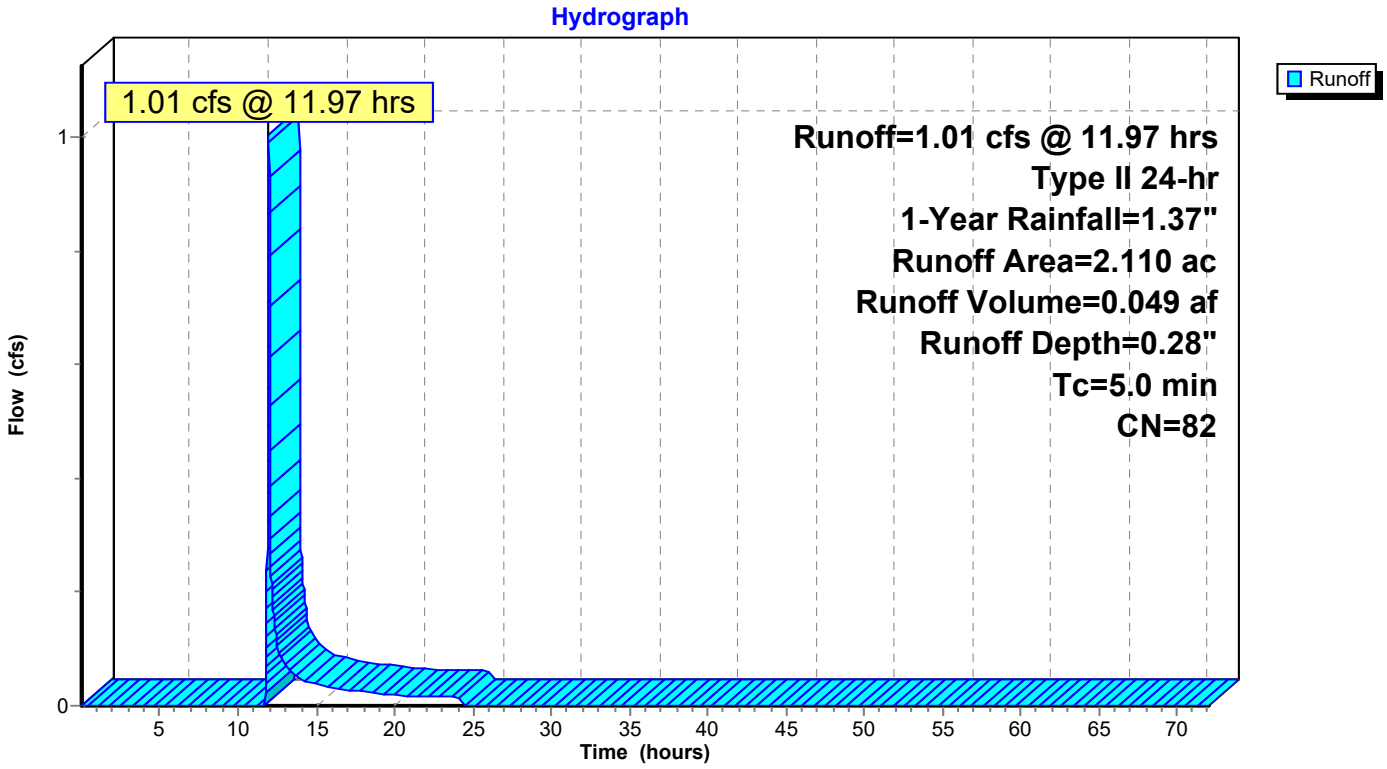
Subcatchment 8S: AREA G



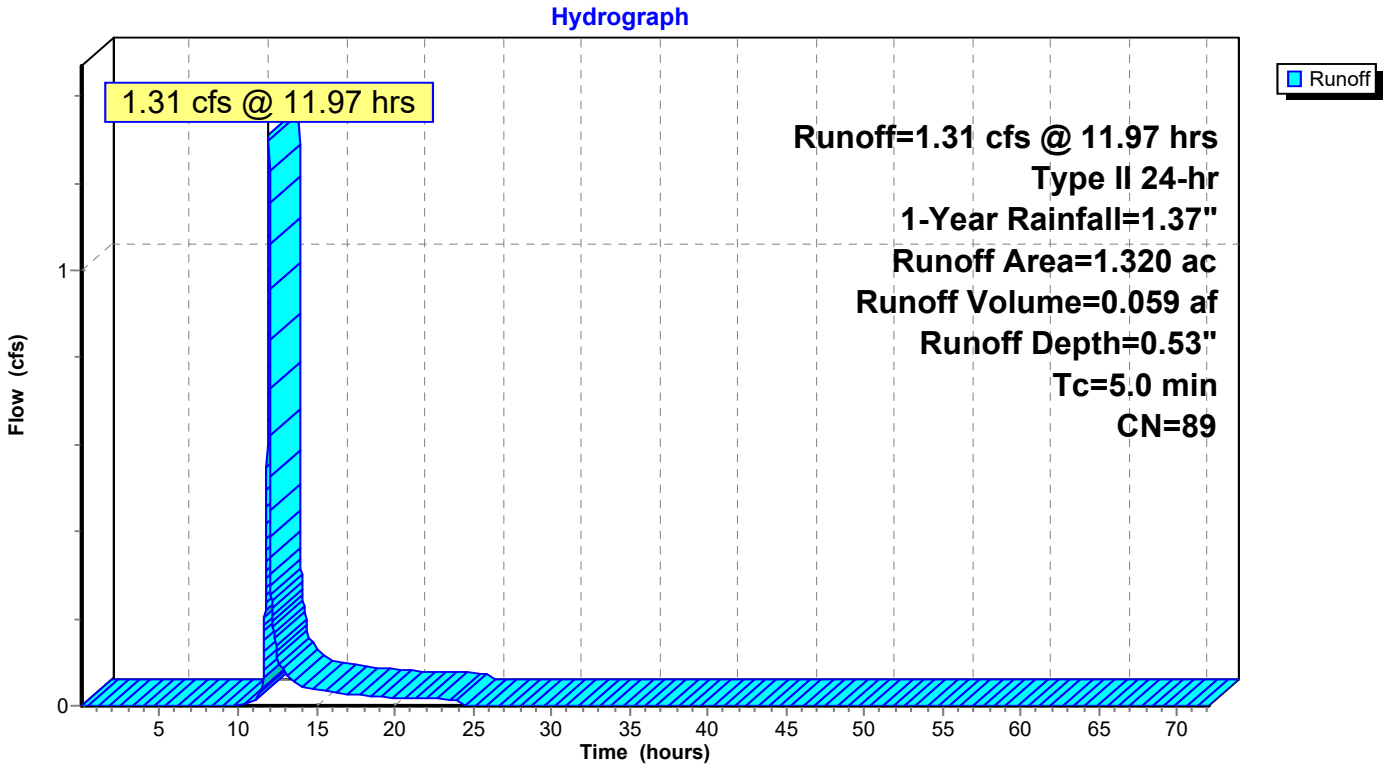
Subcatchment 9S: AREA H



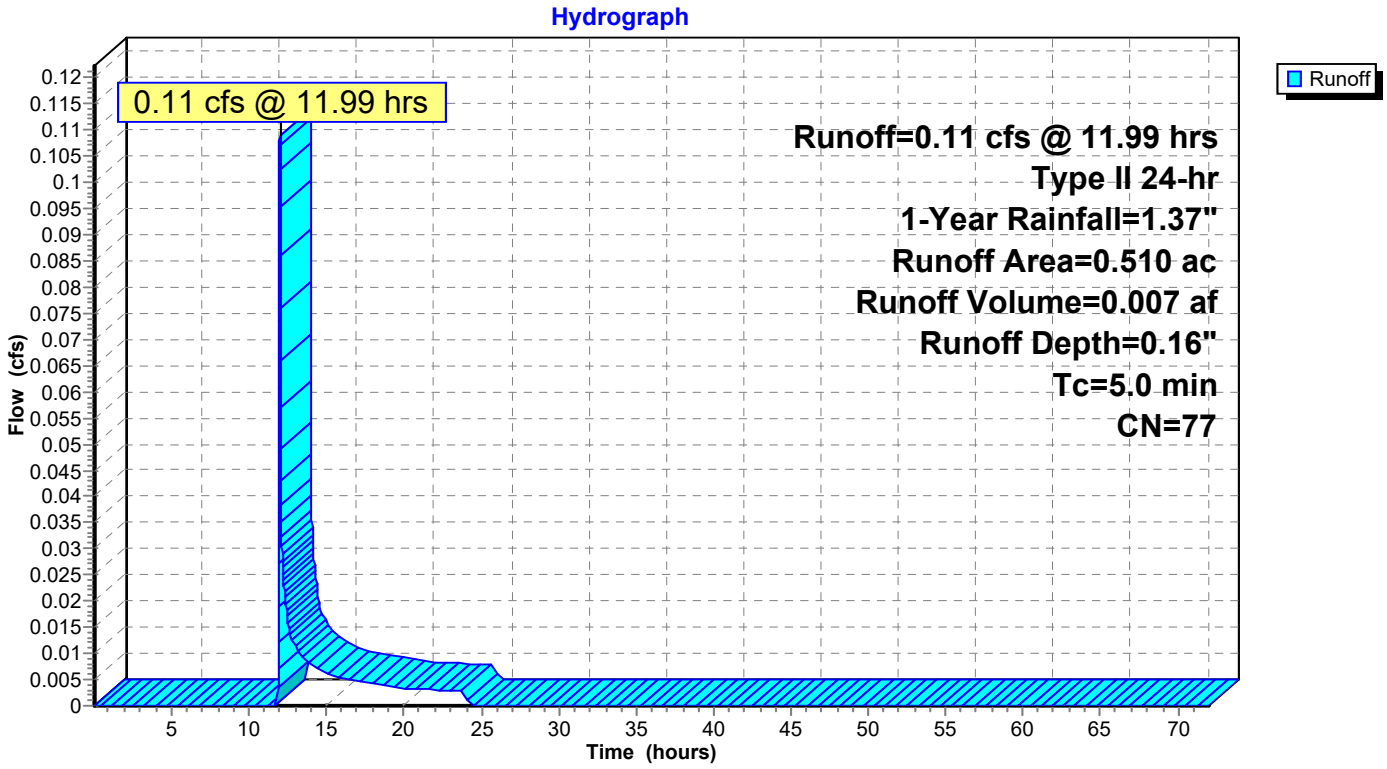
Subcatchment 10S: PROPOSED CONDITIONS



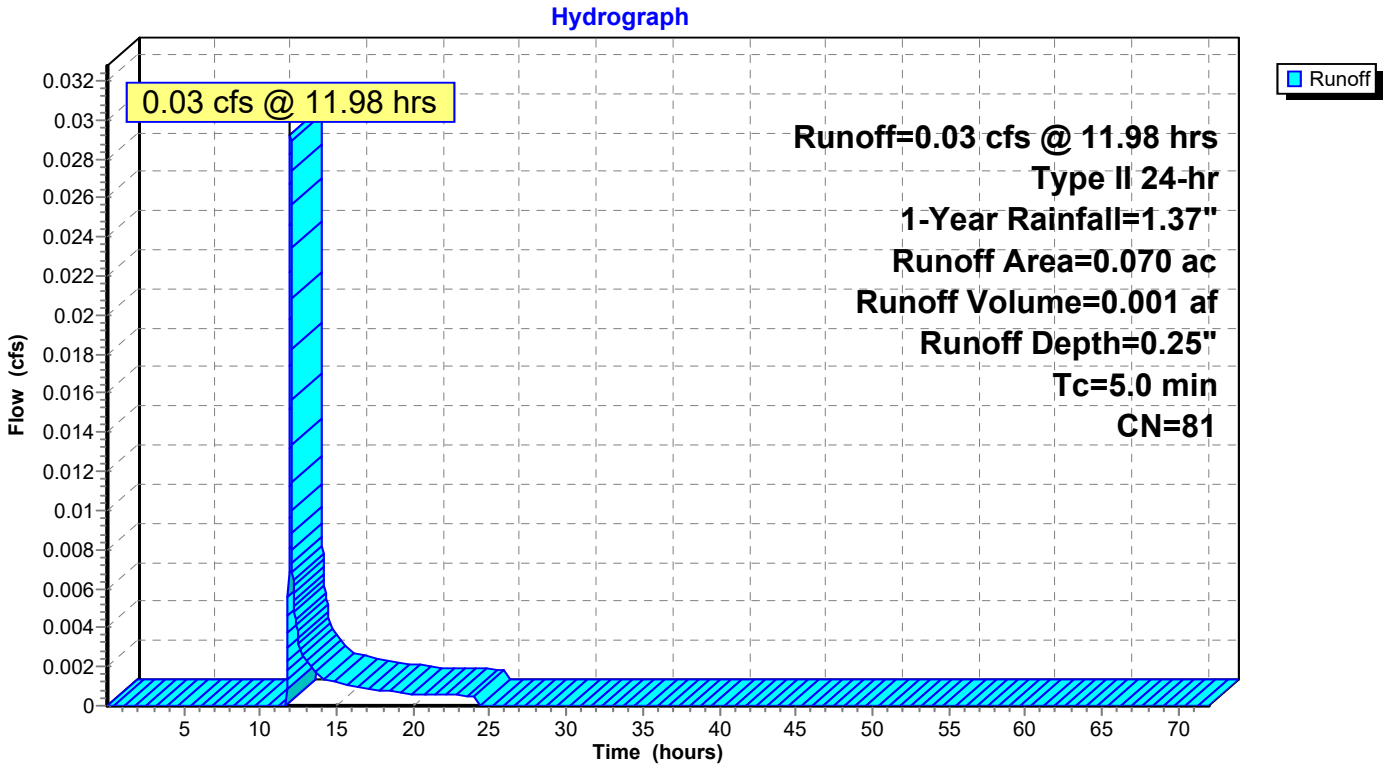
Subcatchment 25S: AREA 3



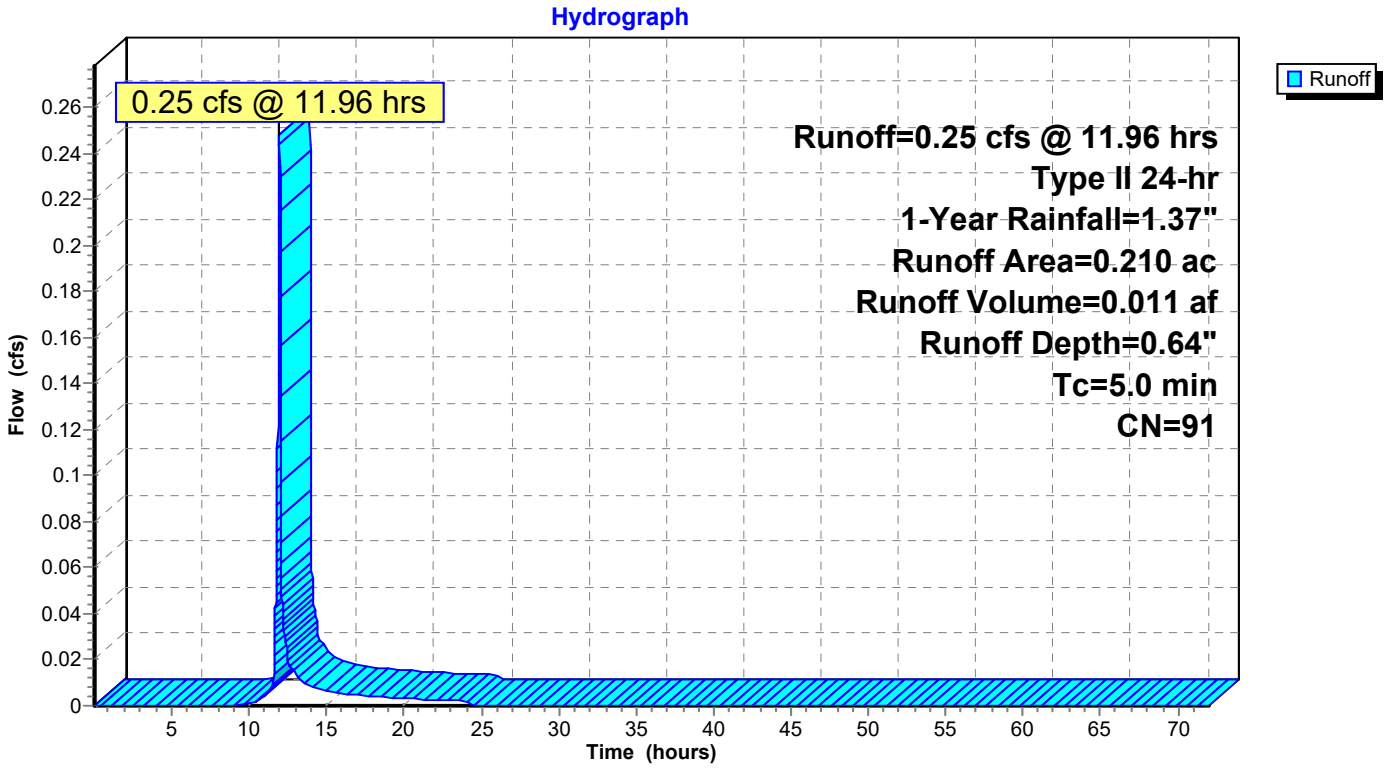
Subcatchment 60S: AREA 6



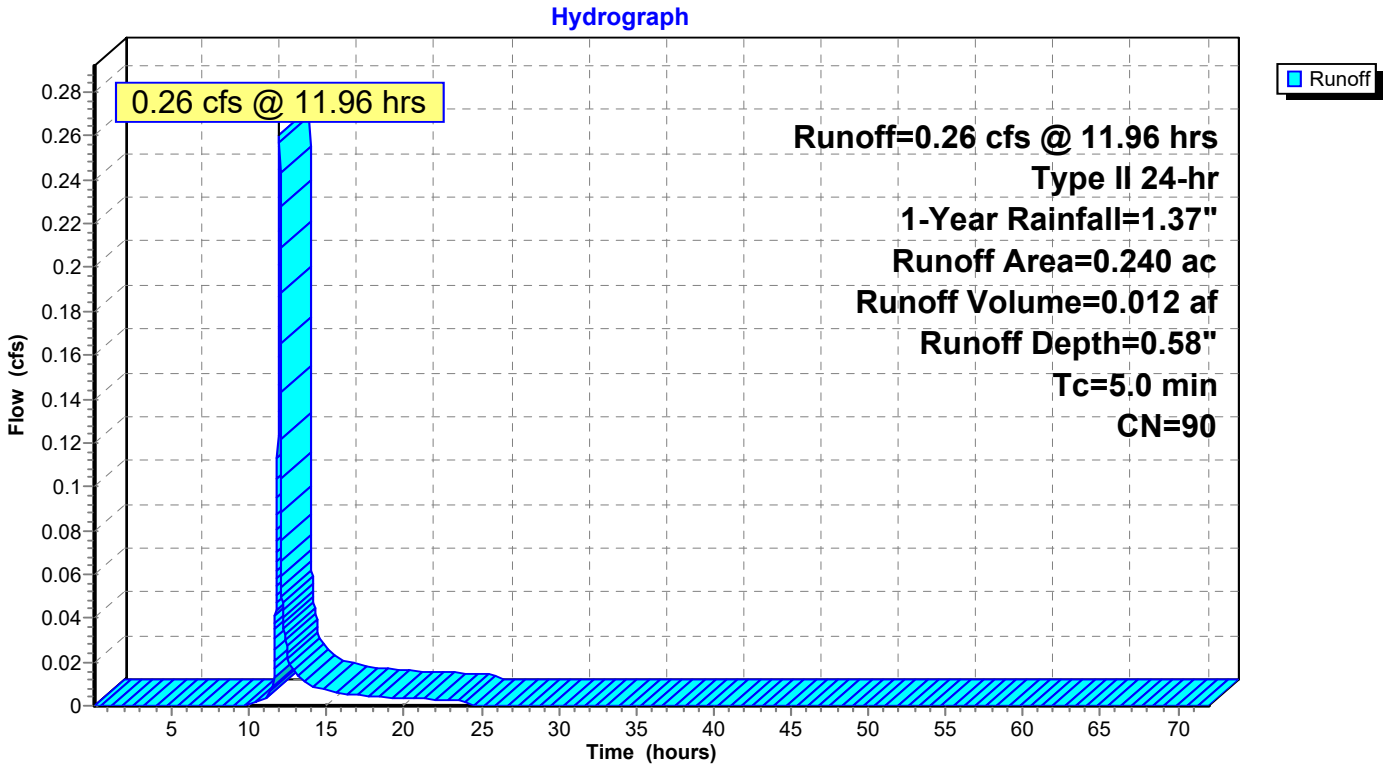
Subcatchment 61S: AREA 7



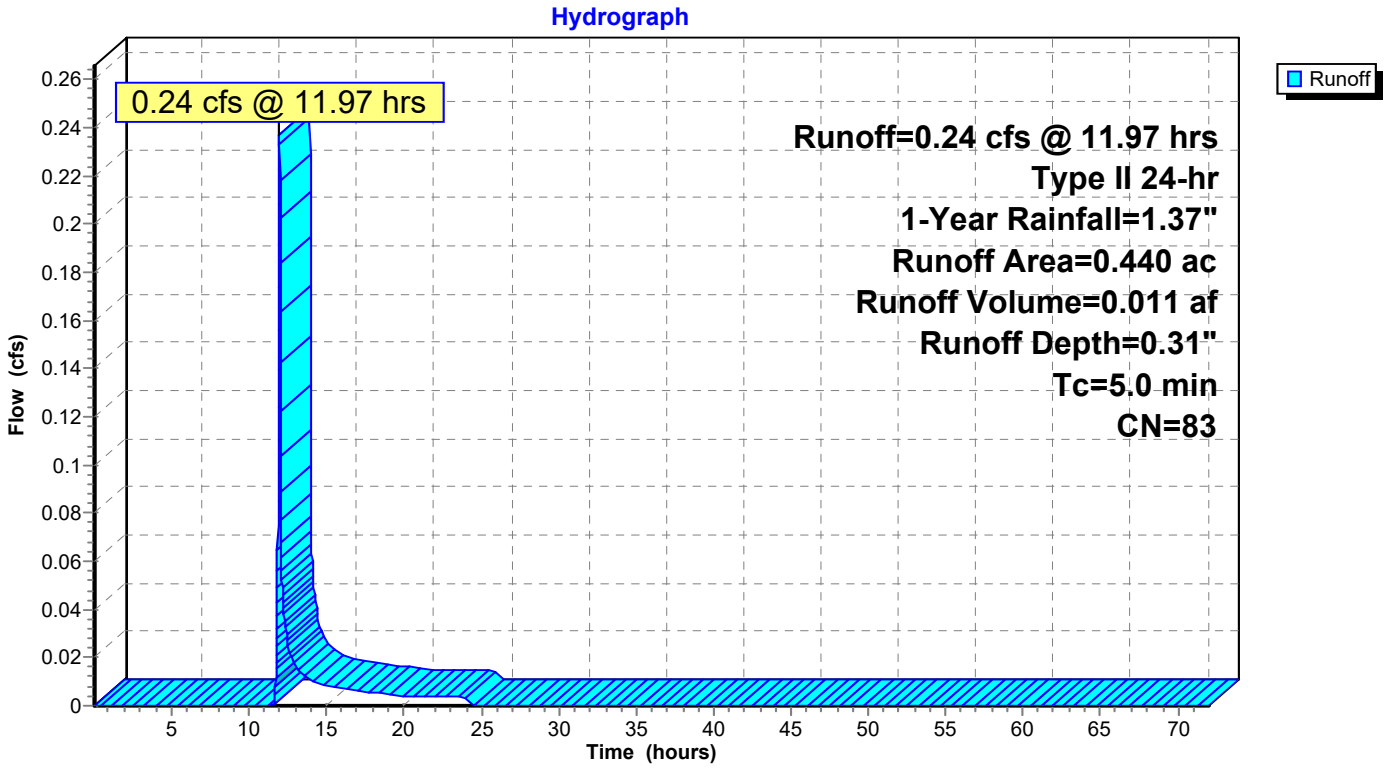
Subcatchment 62S: AREA 1



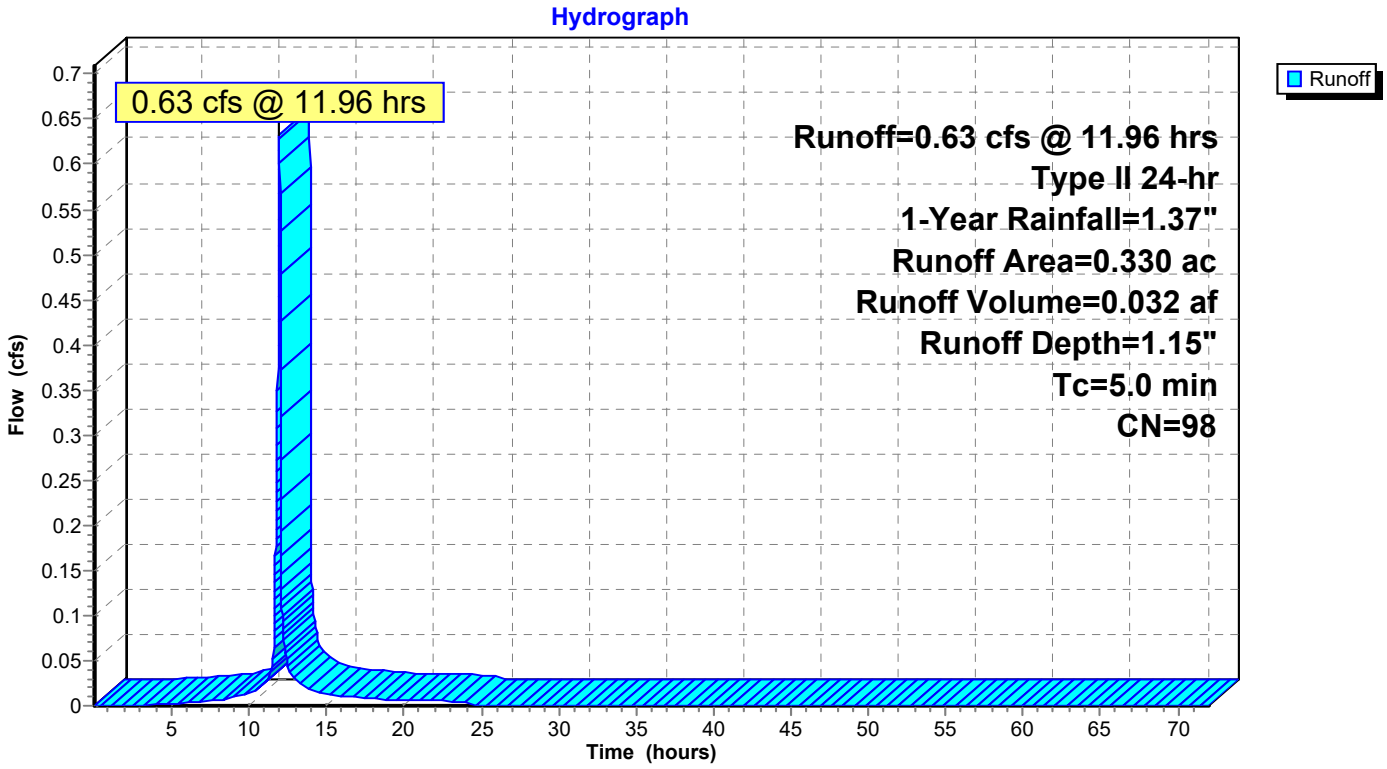
Subcatchment 63S: AREA 2



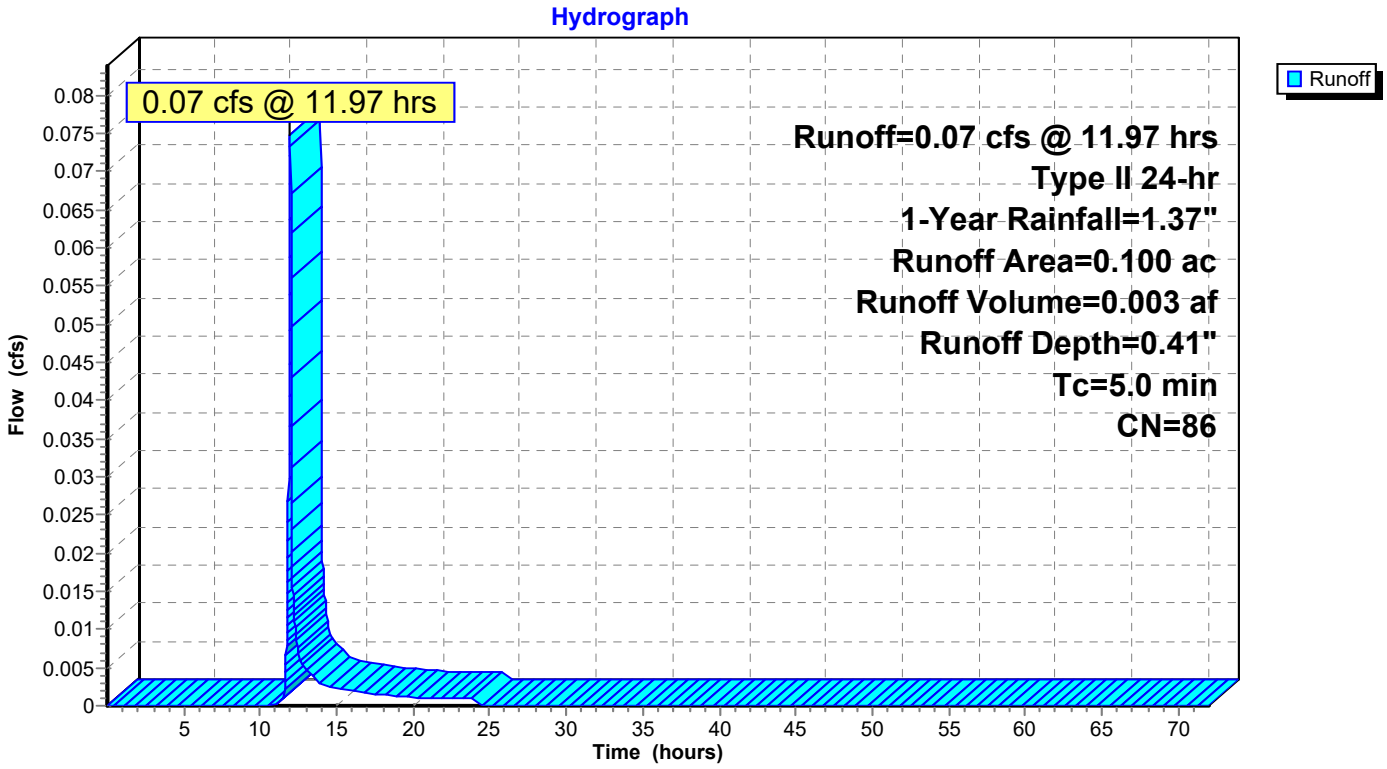
Subcatchment 64S: AREA 3



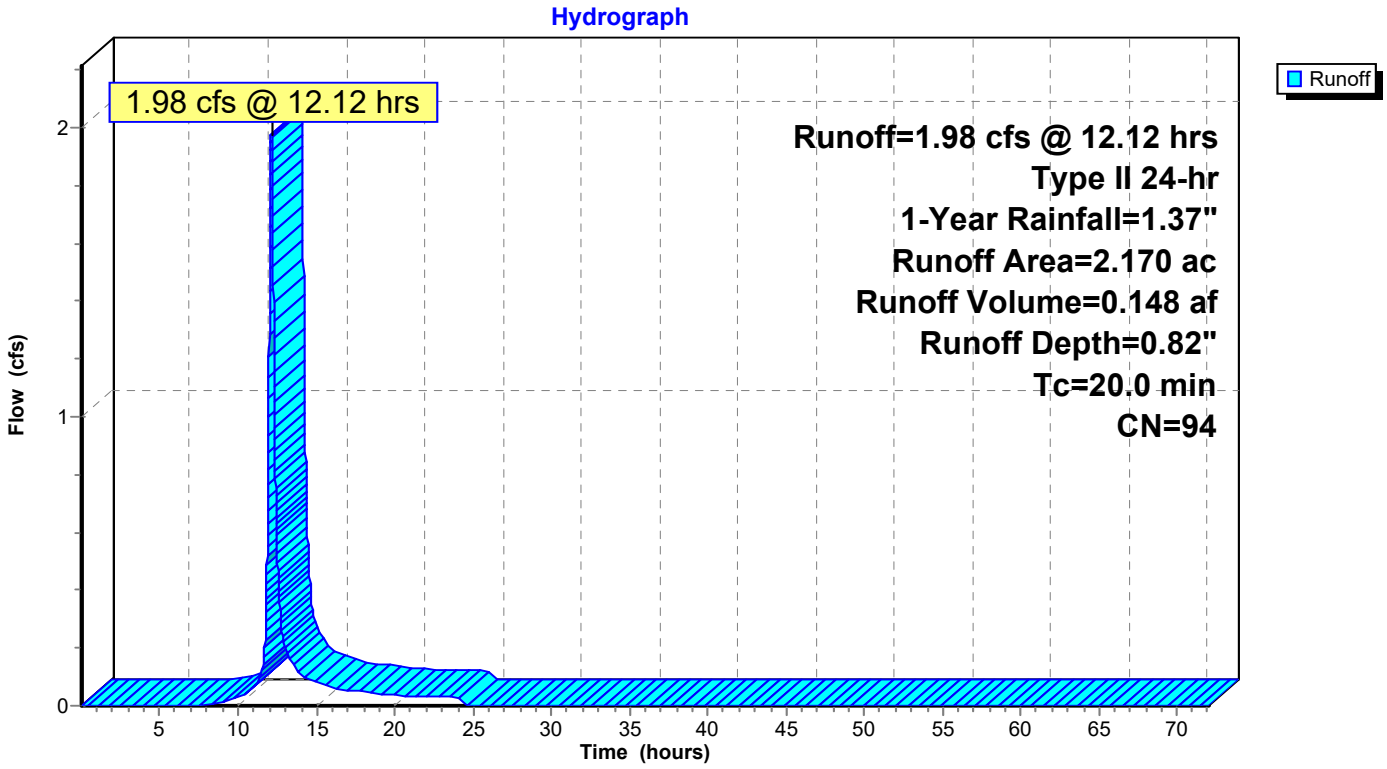
Subcatchment 65S: AREA 4



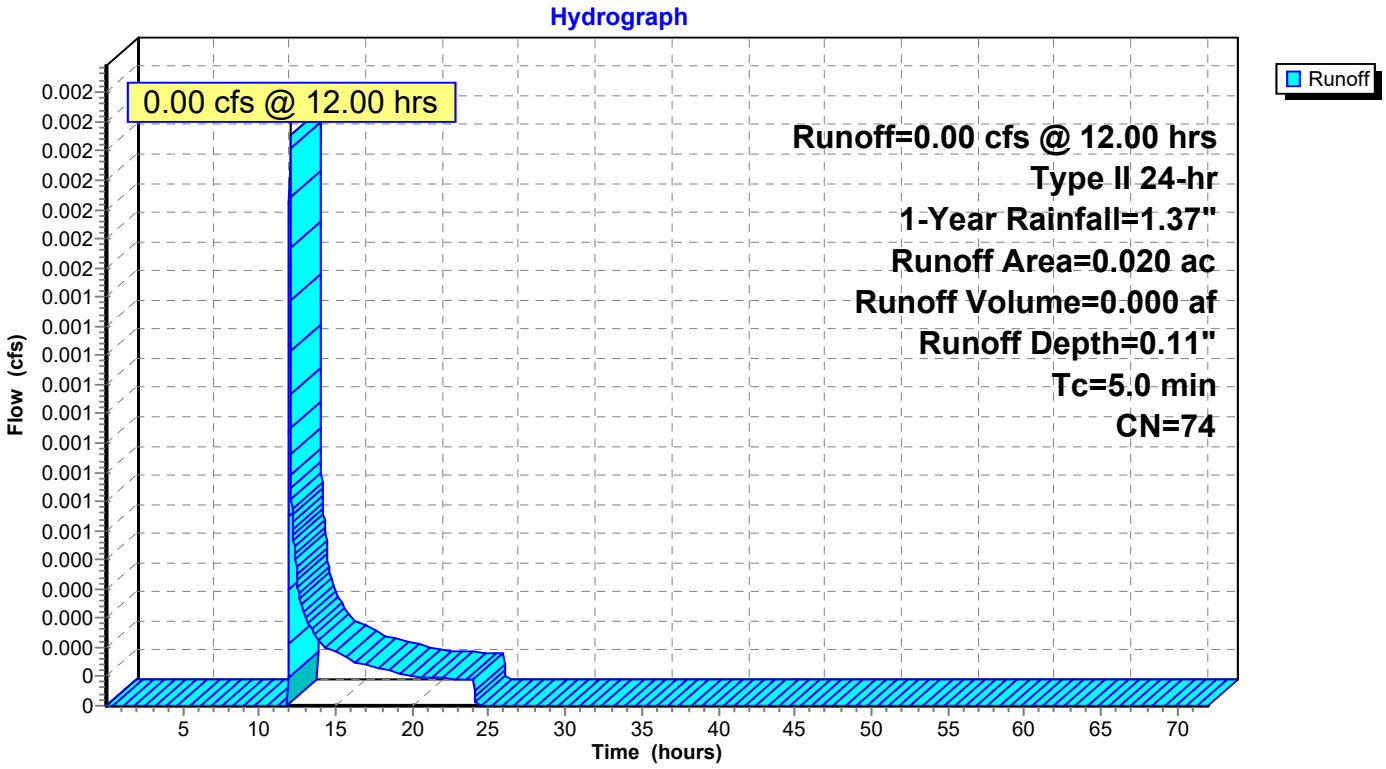
Subcatchment 66S: AREA 5



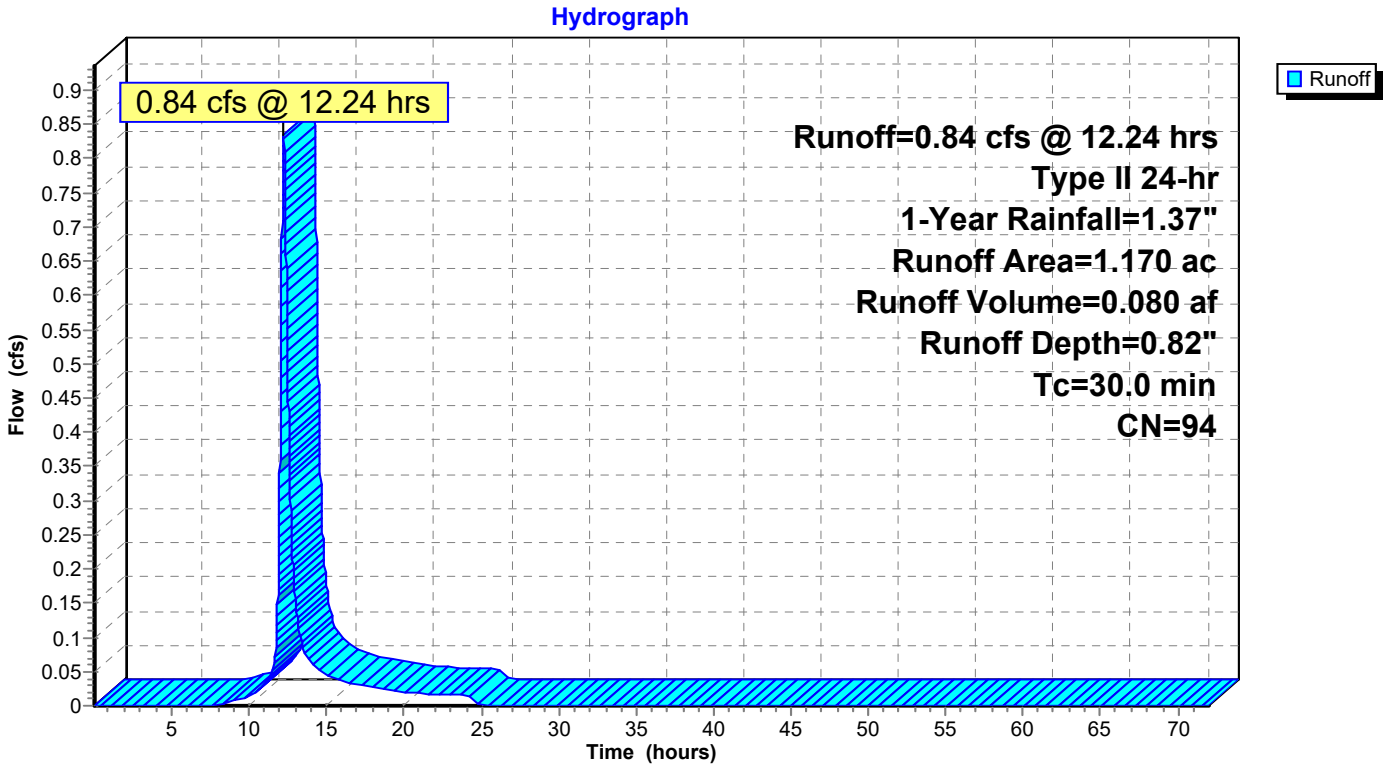
Subcatchment 67S: OFFSITE TO CI 12



Subcatchment 68S: AREA TO AI 11

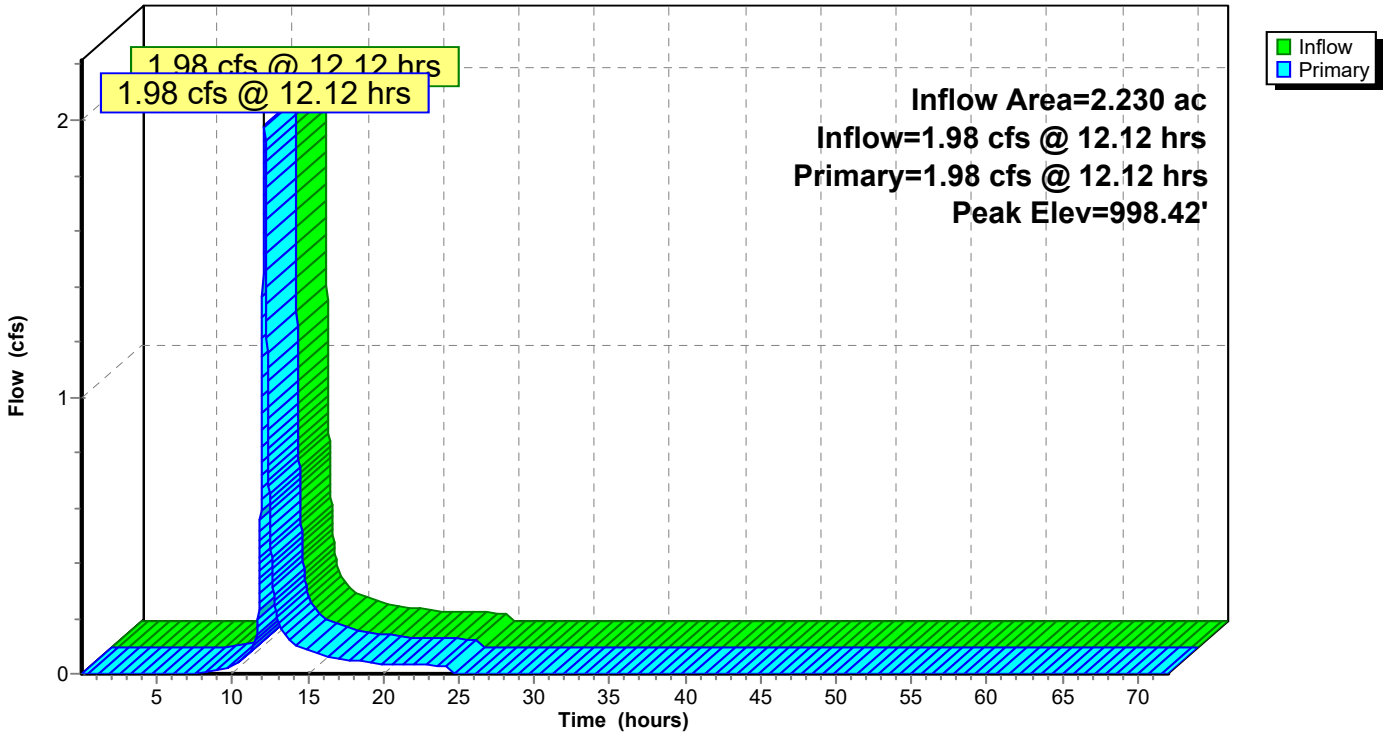


Subcatchment 69S: OFFSITE TO BMP



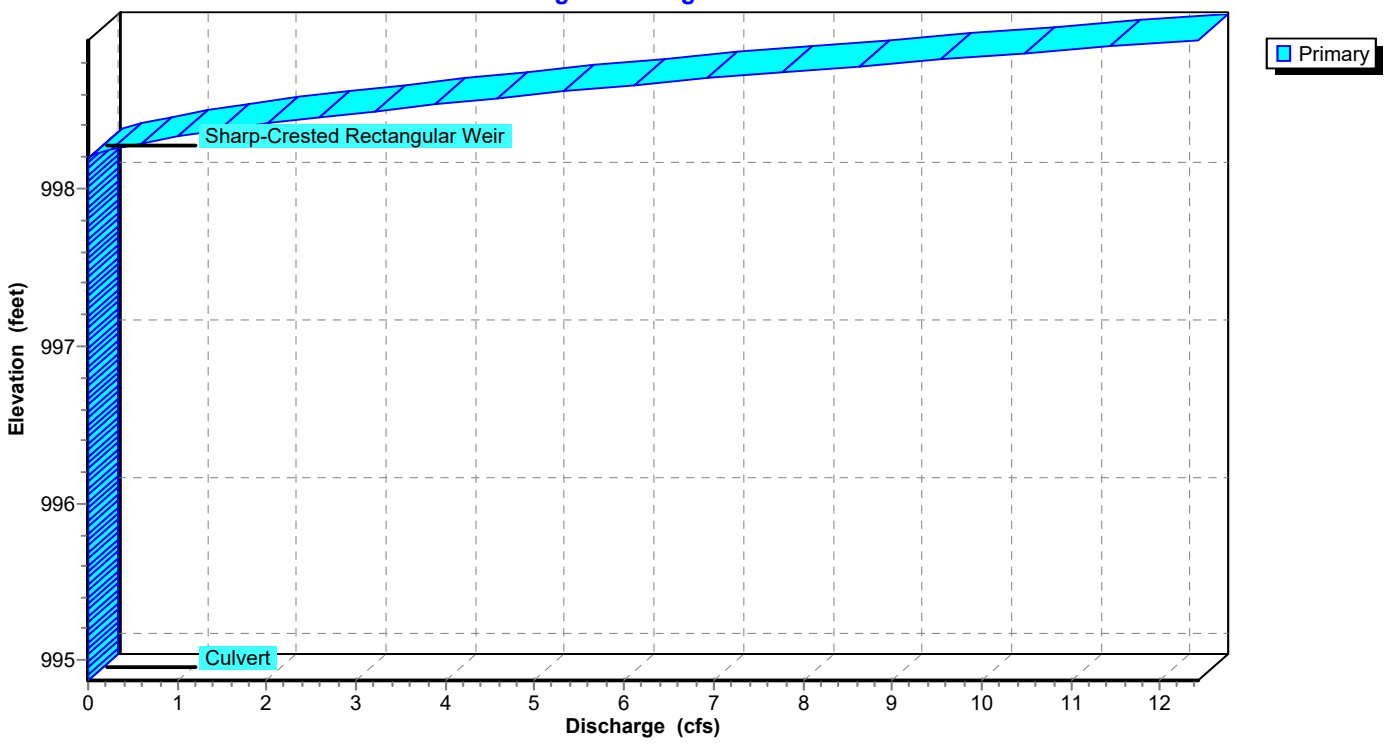
Pond 10P: 12-11

Hydrograph

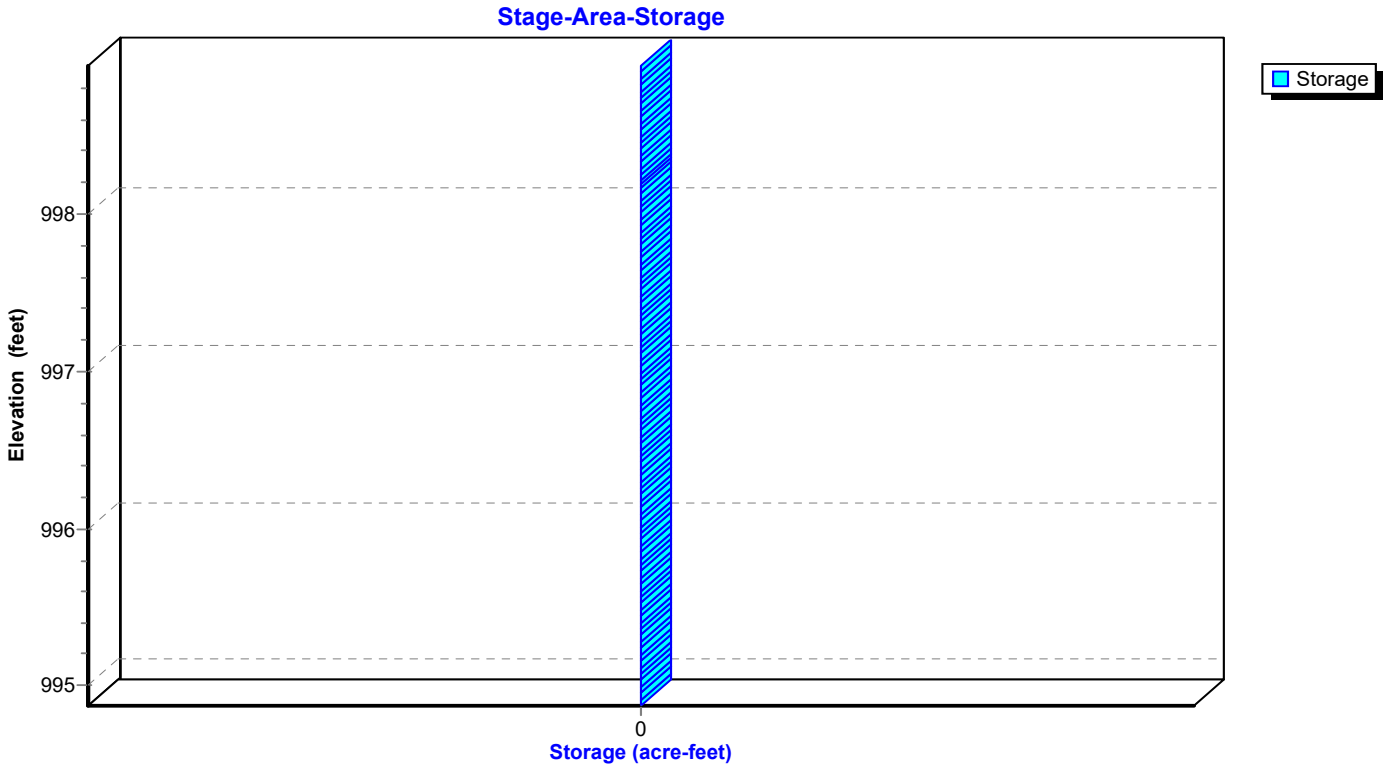


Pond 10P: 12-11

Stage-Discharge

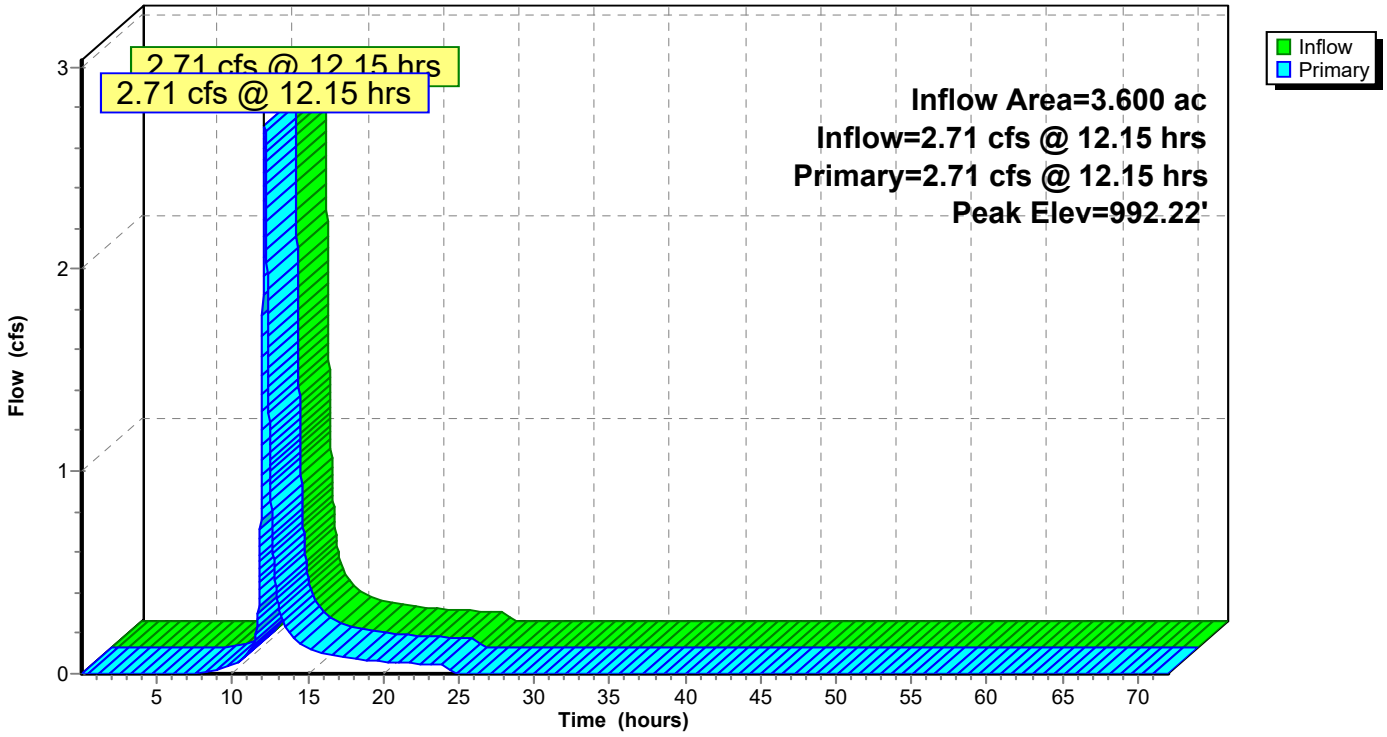


Pond 10P: 12-11



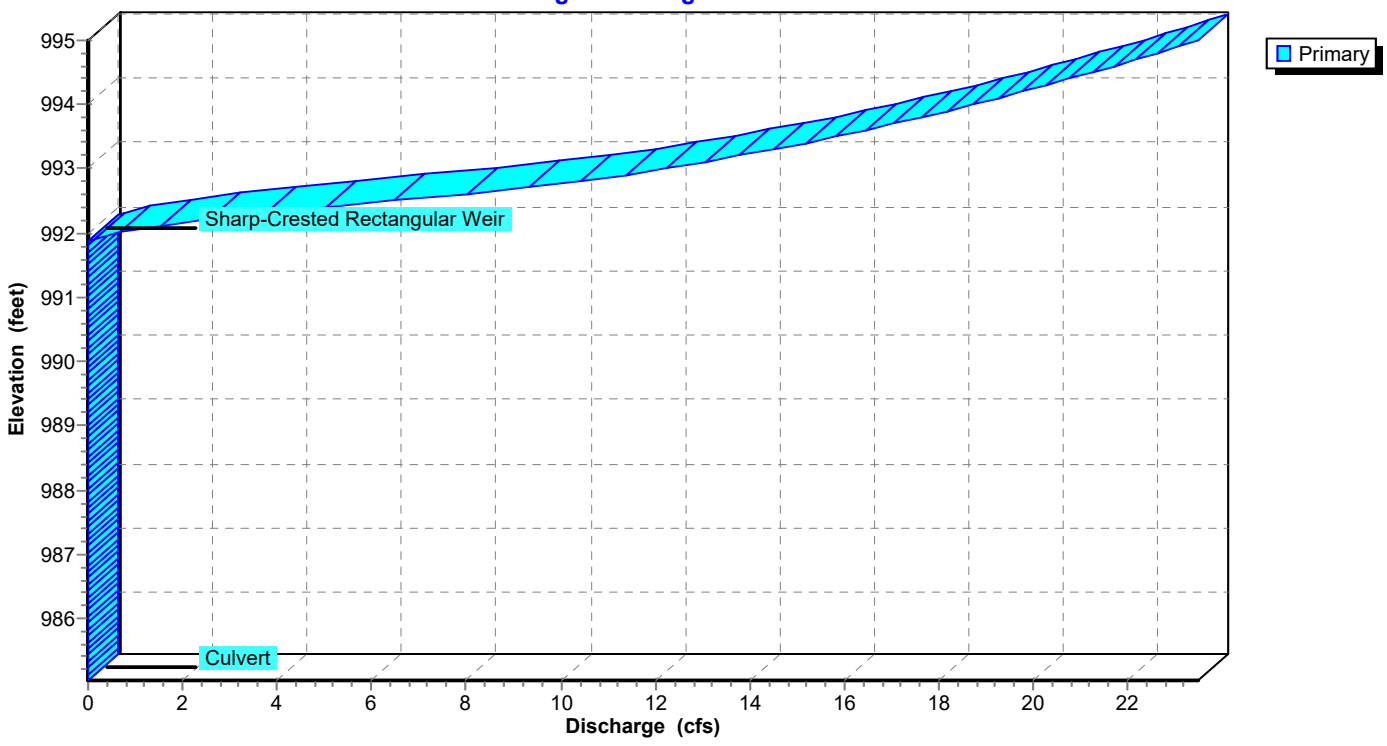
Pond 11P: 11-10

Hydrograph

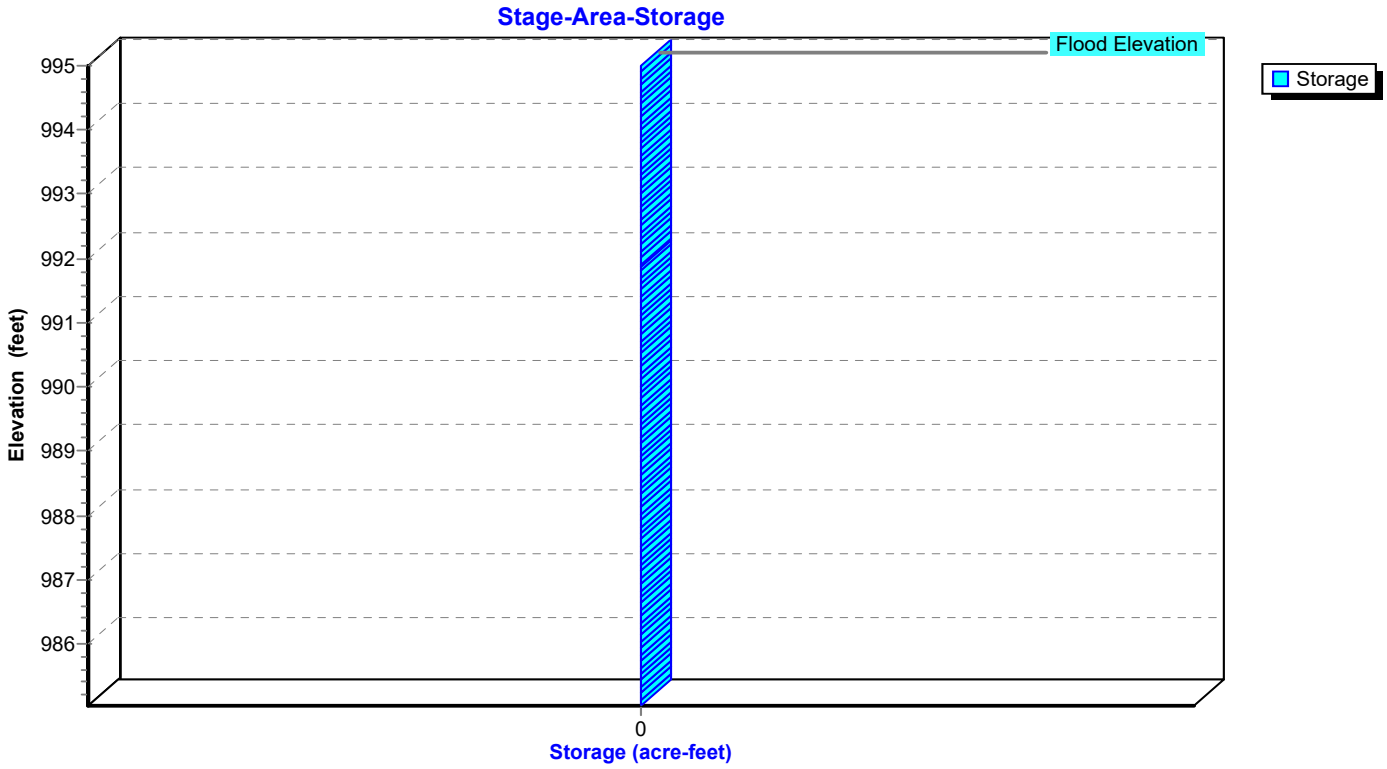


Pond 11P: 11-10

Stage-Discharge

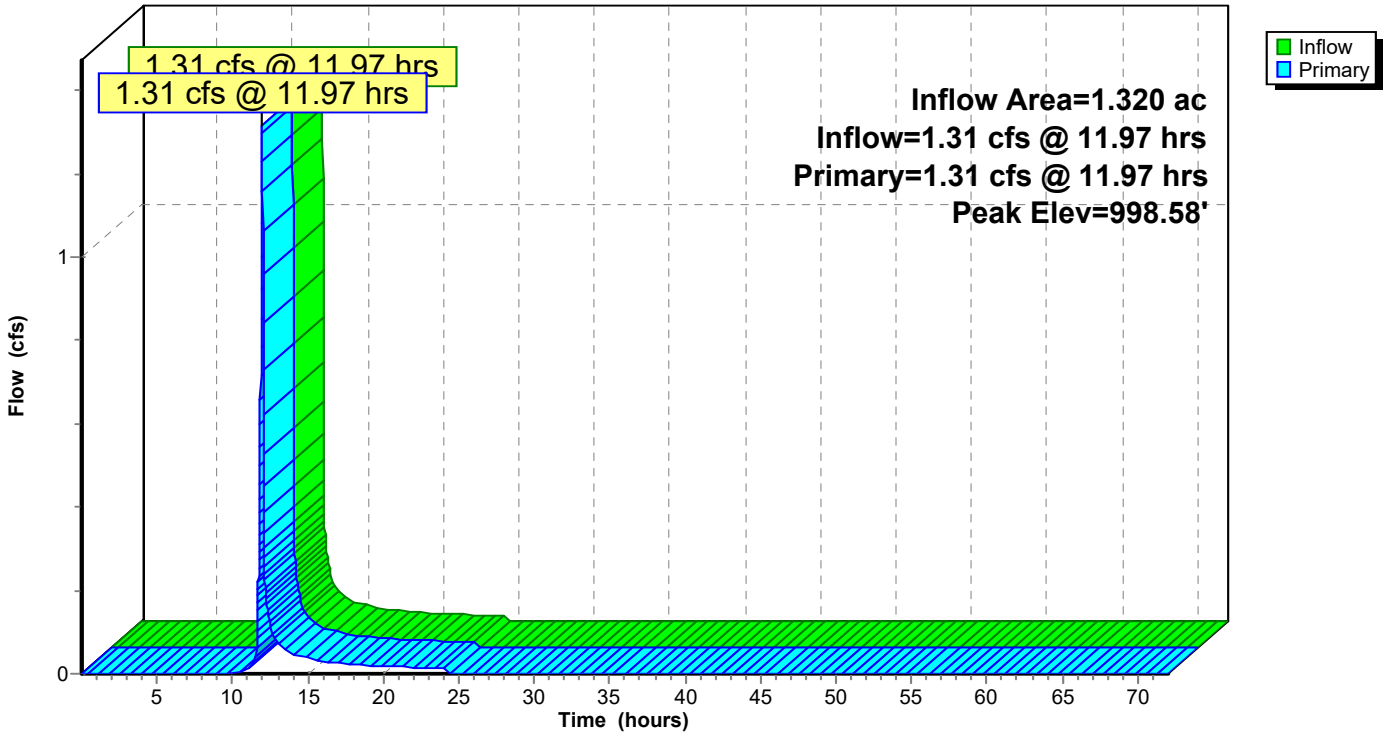


Pond 11P: 11-10



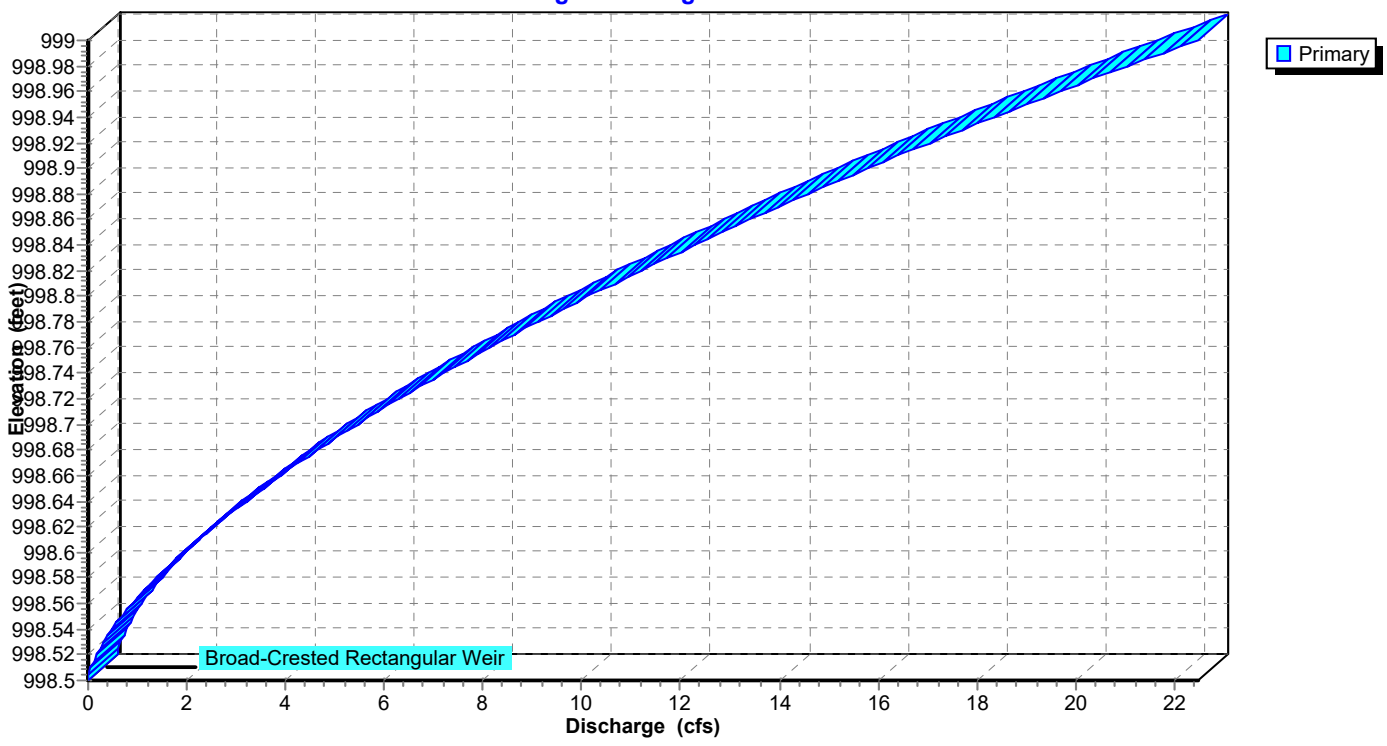
Pond 26P: DETENTION BASIN

Hydrograph

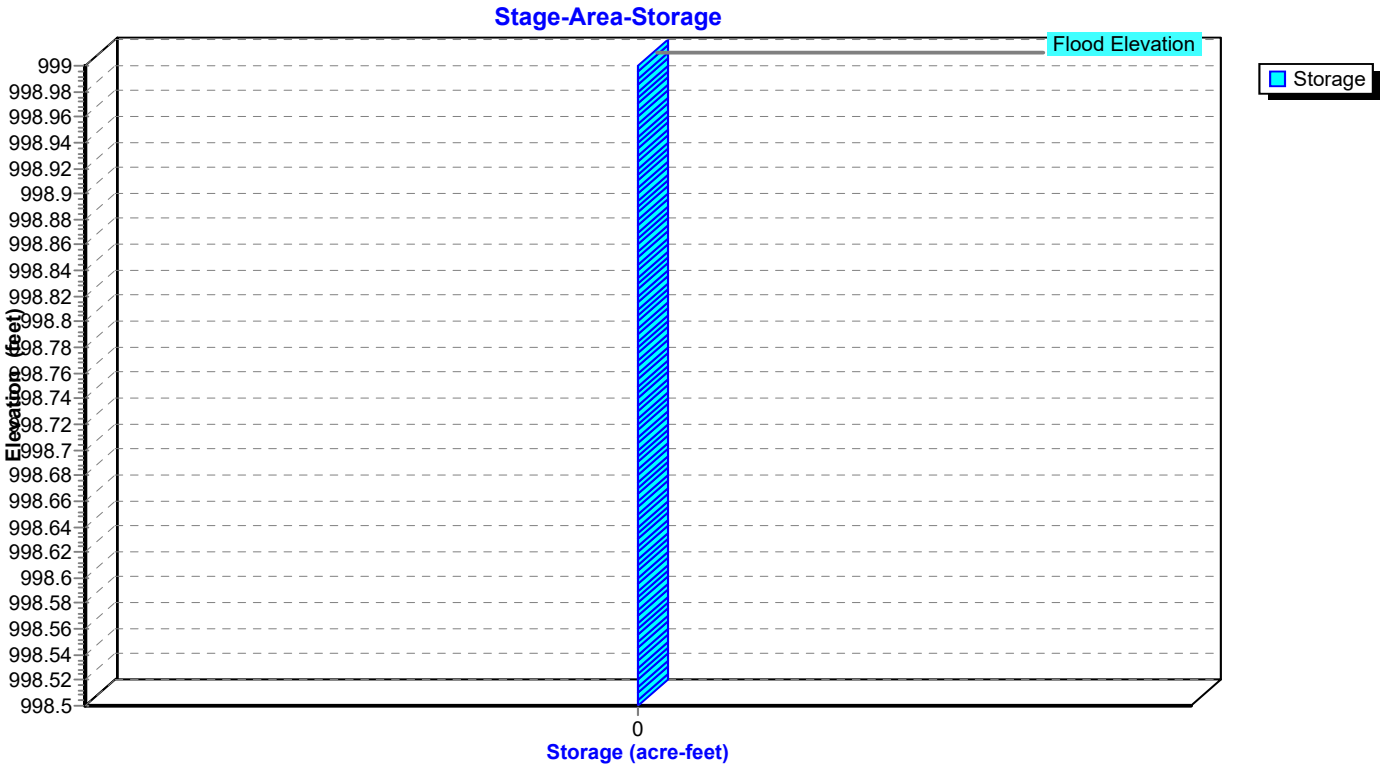


Pond 26P: DETENTION BASIN

Stage-Discharge

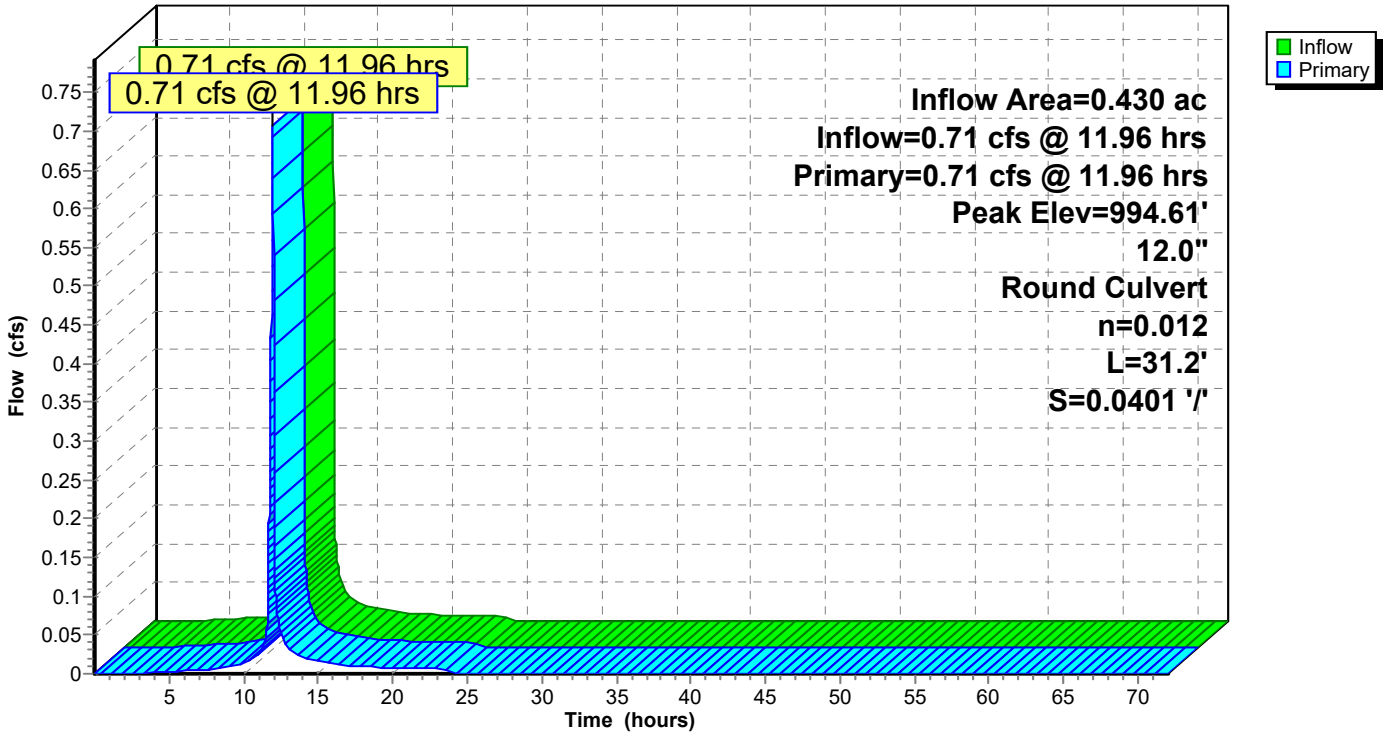


Pond 26P: DETENTION BASIN



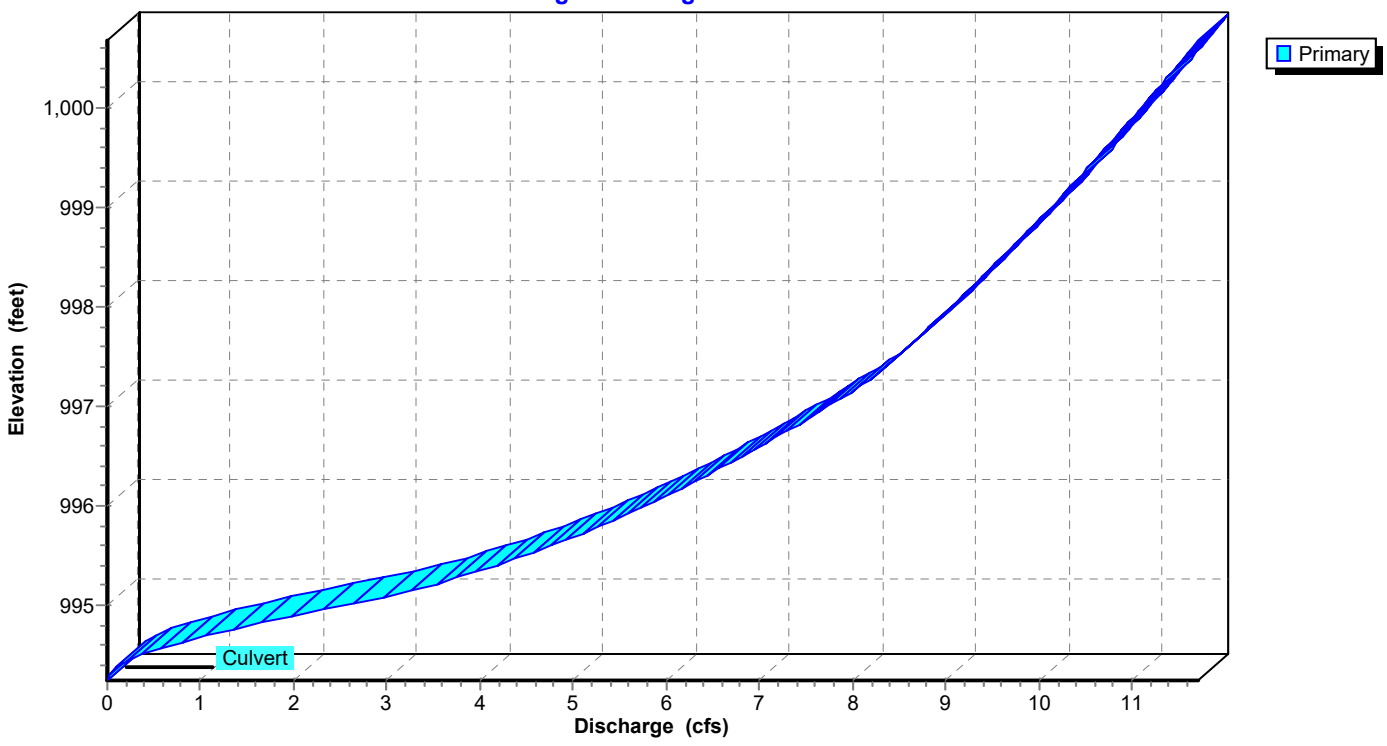
Pond 50P: BASIN REACH

Hydrograph

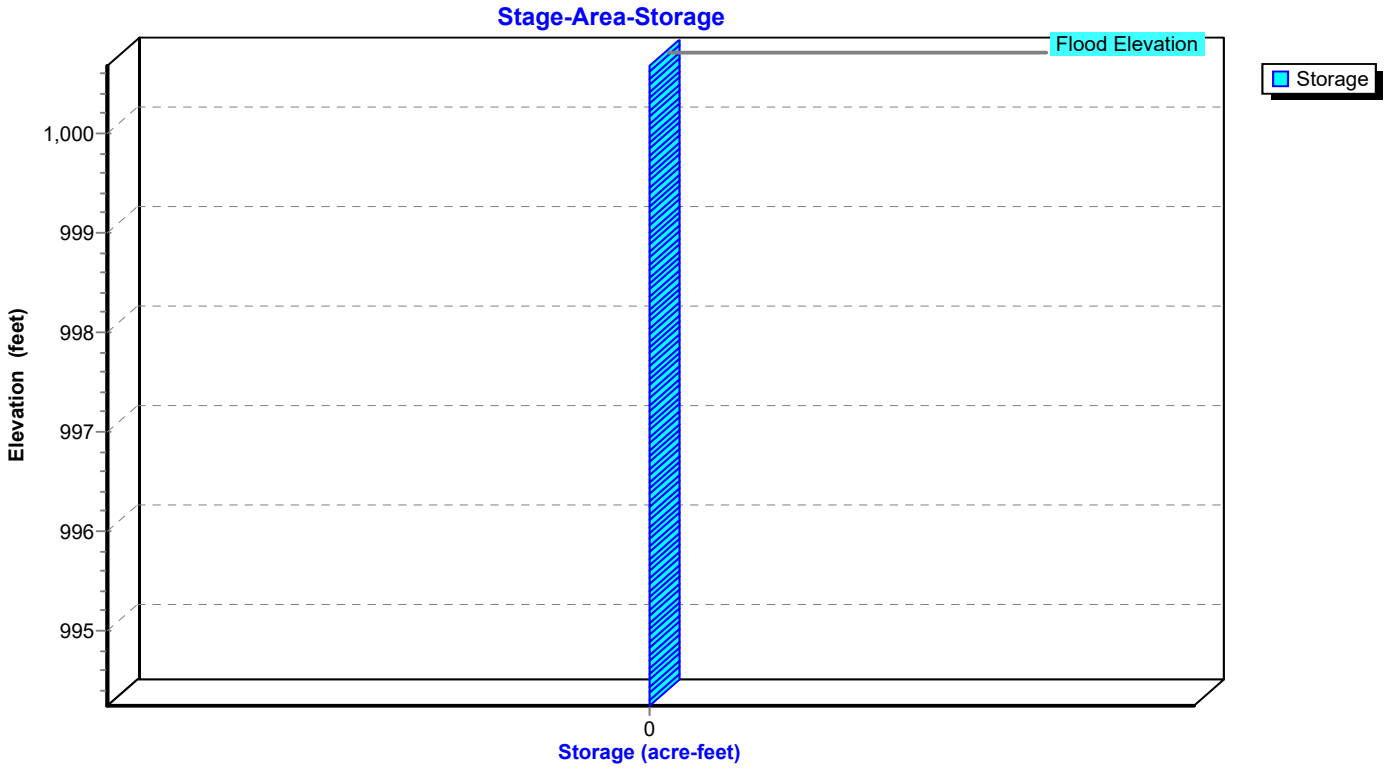


Pond 50P: BASIN REACH

Stage-Discharge

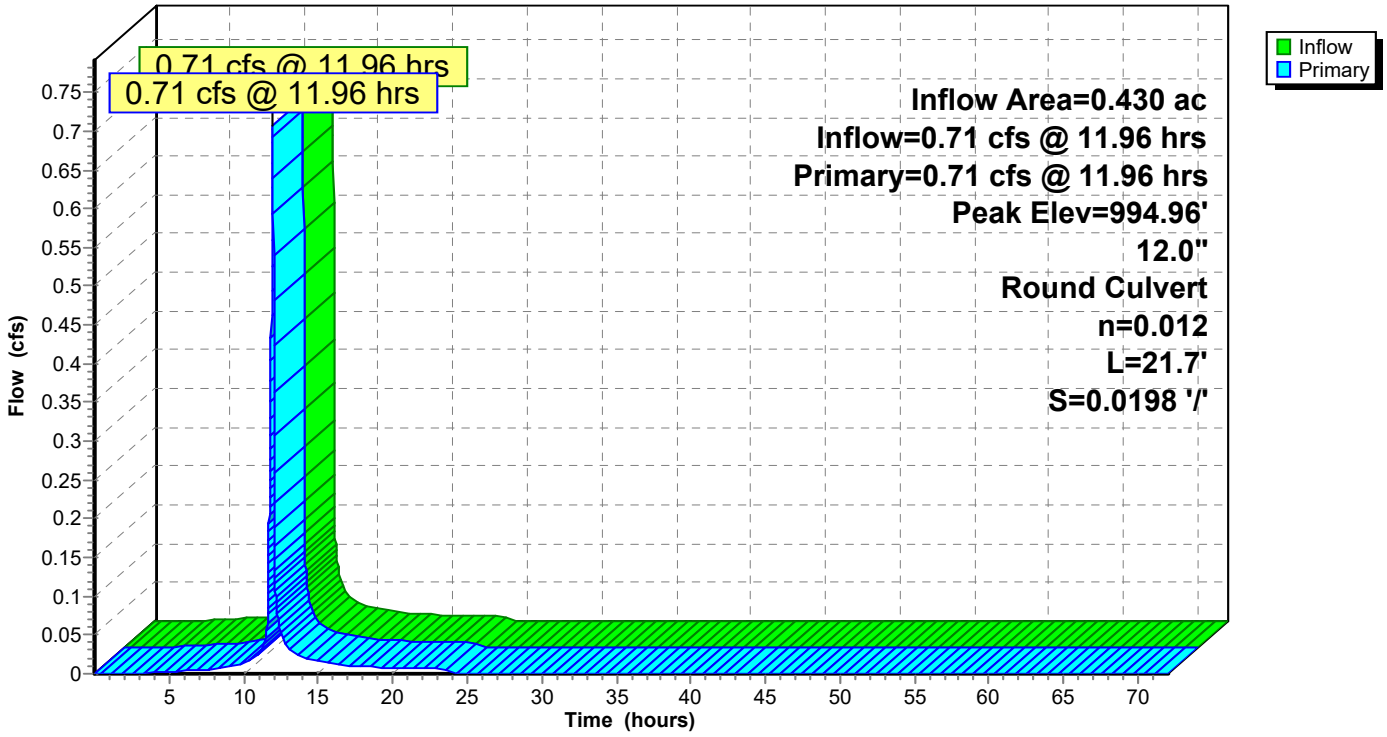


Pond 50P: BASIN REACH



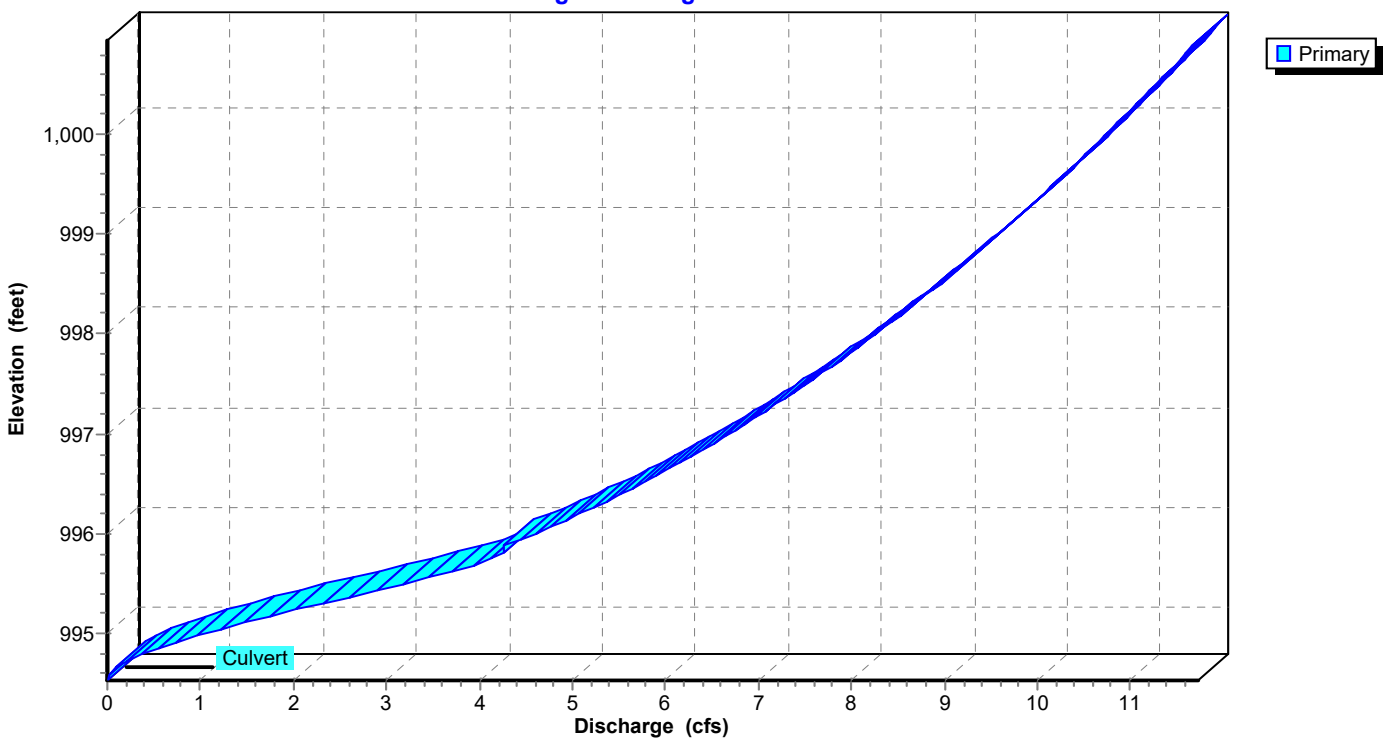
Pond 51P: ROOF DRAINS TO BASIN

Hydrograph

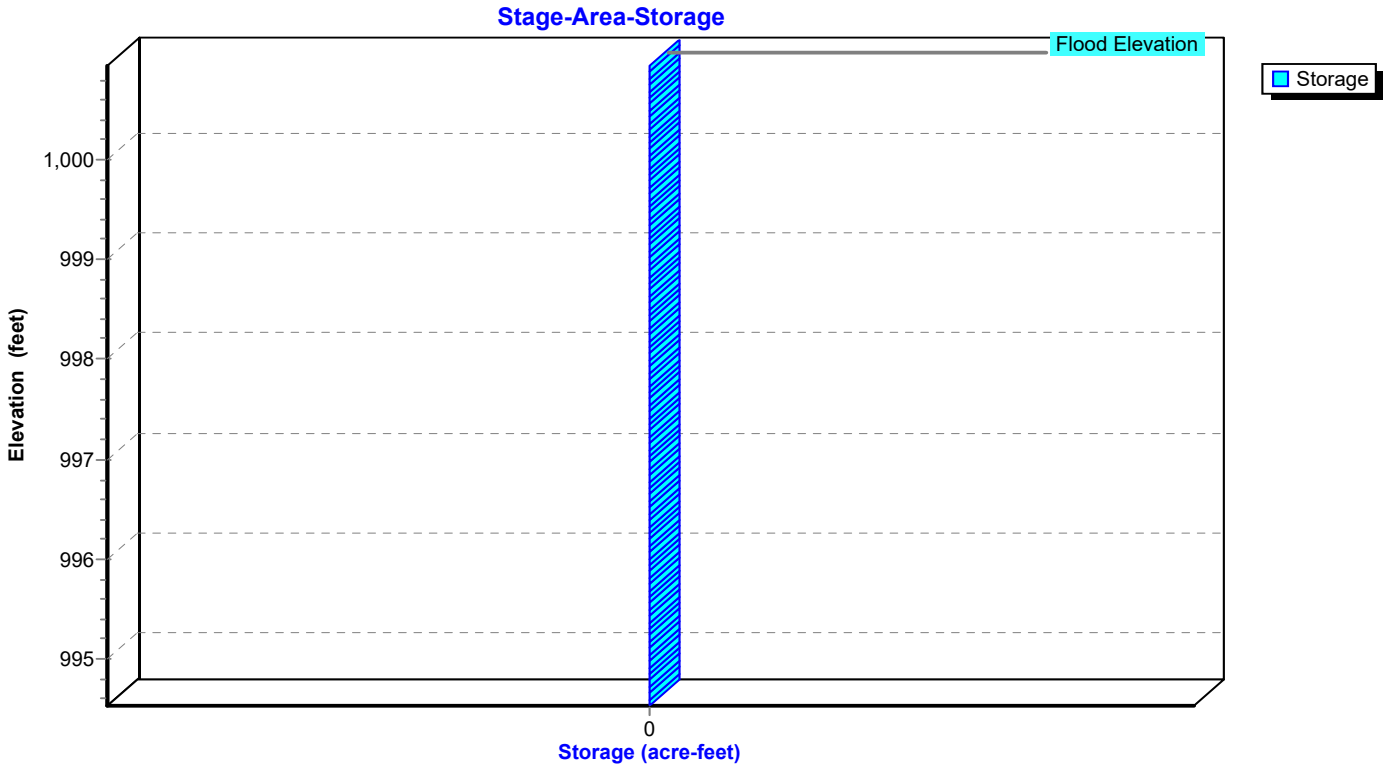


Pond 51P: ROOF DRAINS TO BASIN

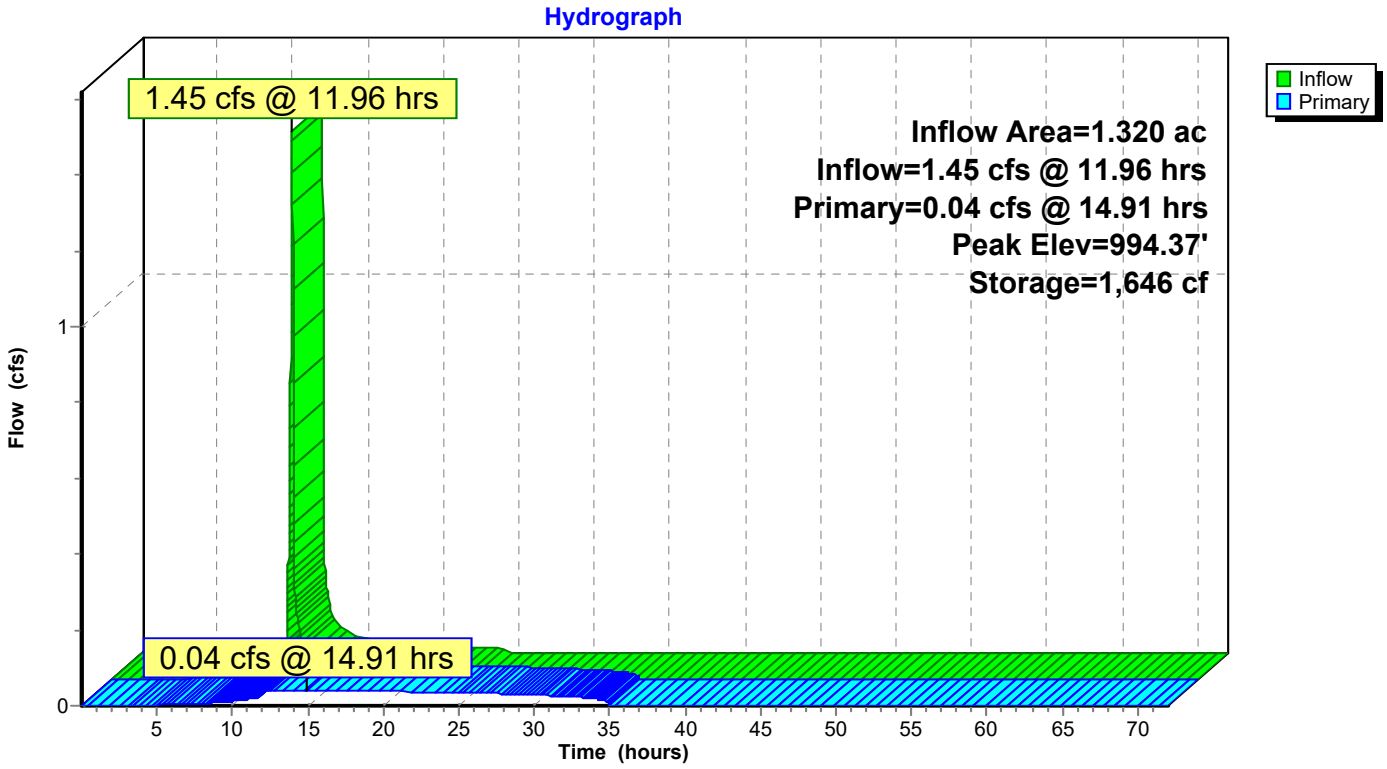
Stage-Discharge



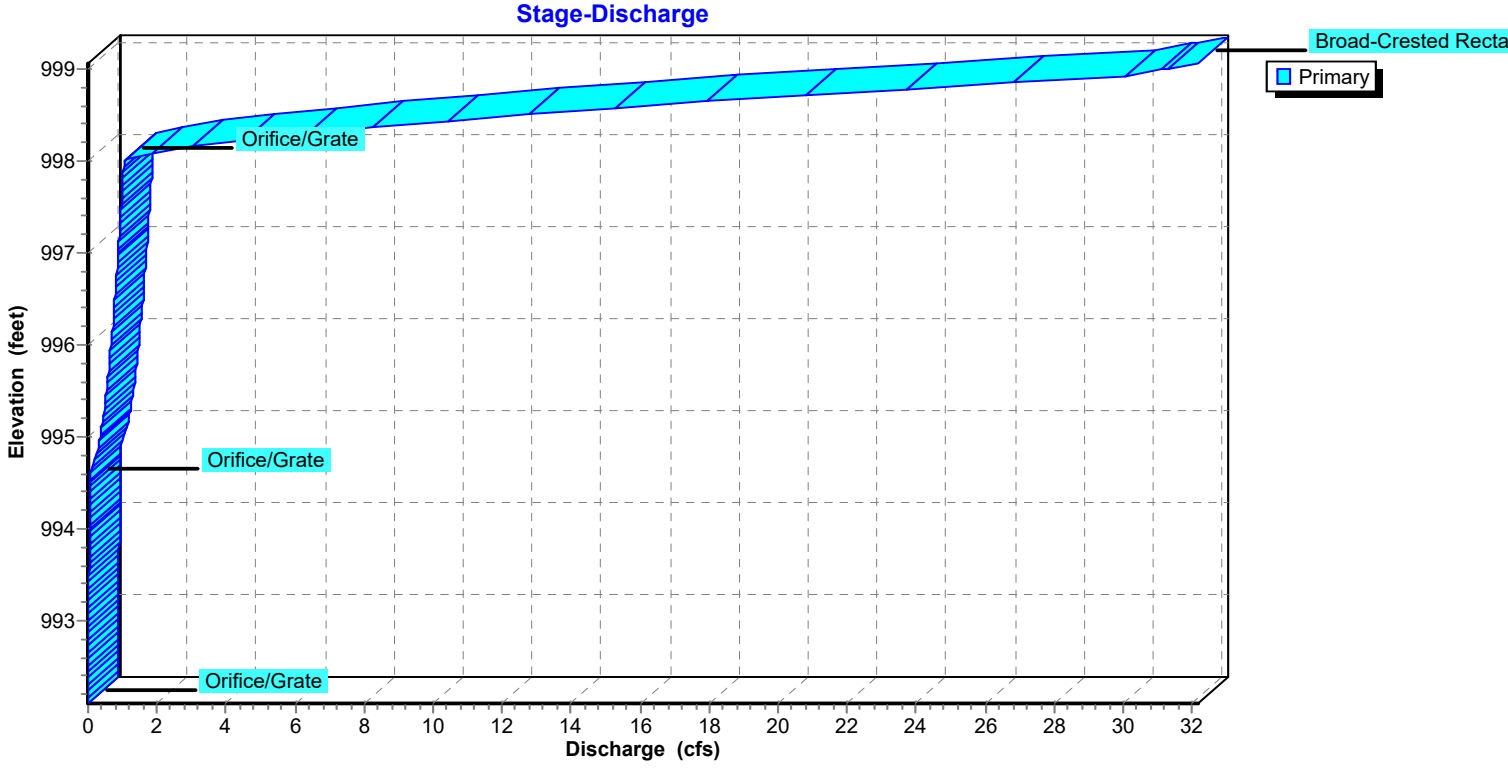
Pond 51P: ROOF DRAINS TO BASIN



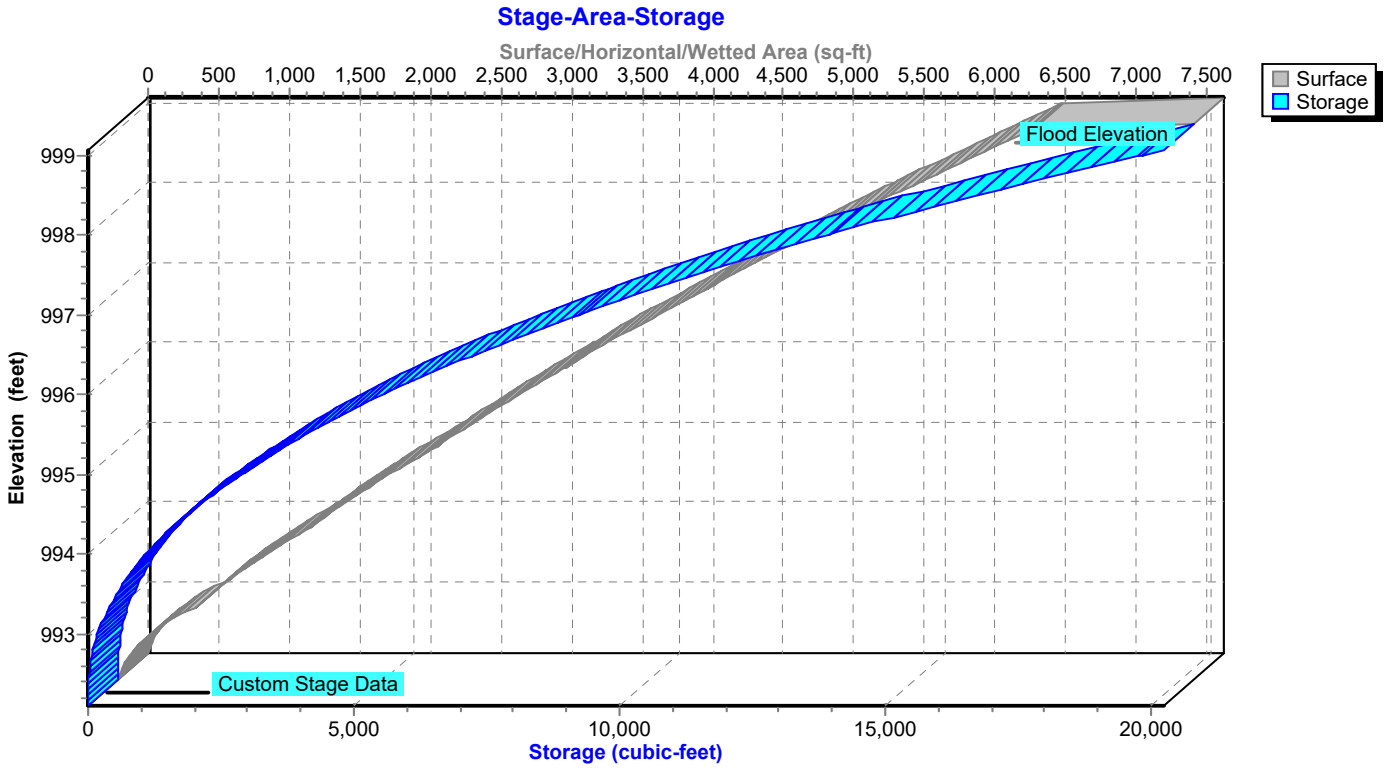
Pond 52P: DETENTION BASIN



Pond 52P: DETENTION BASIN

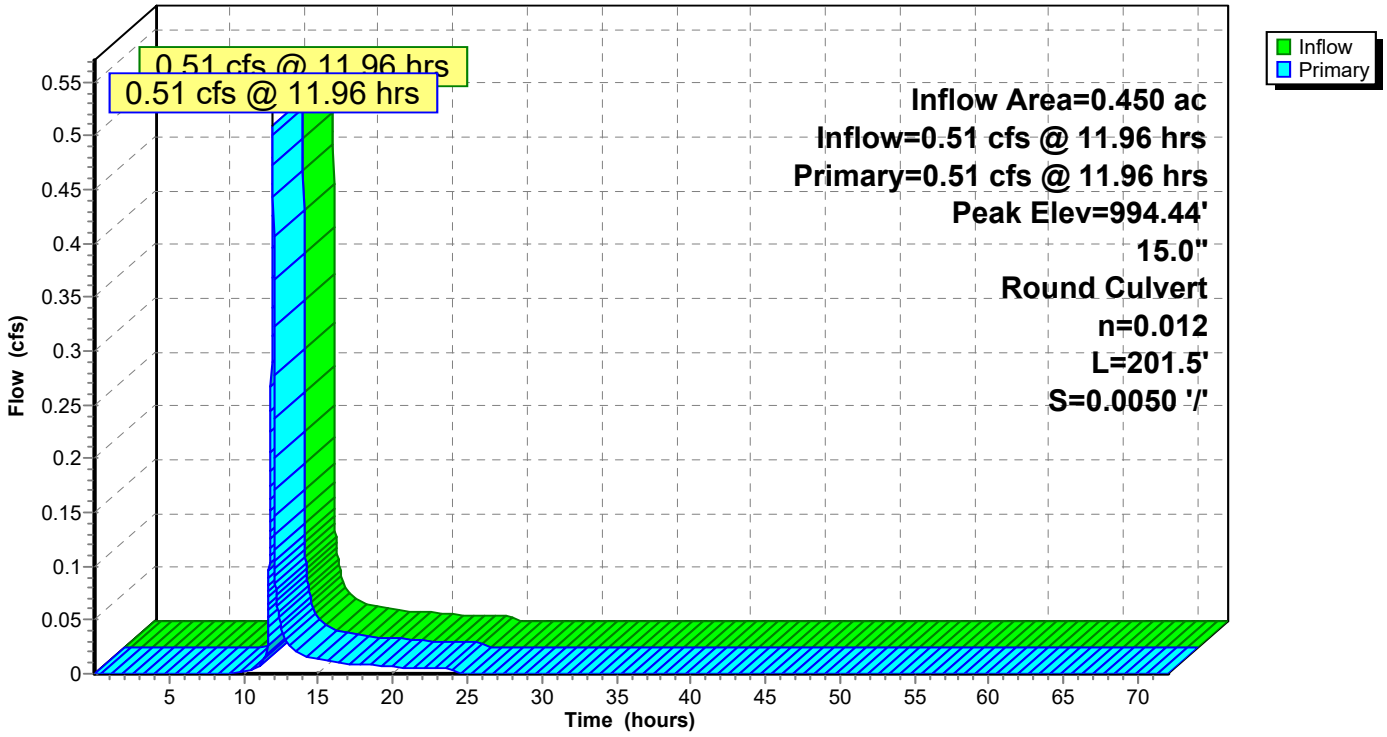


Pond 52P: DETENTION BASIN



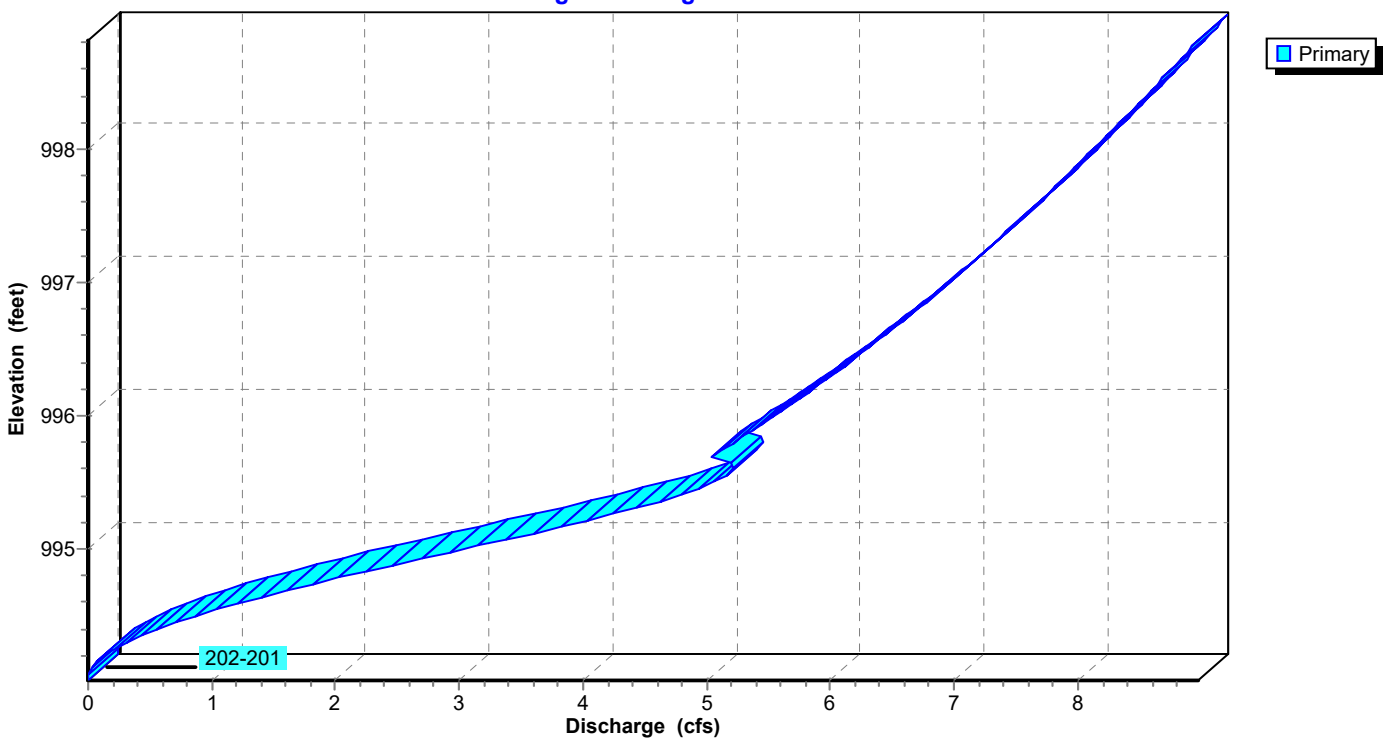
Pond 53P: 301-300

Hydrograph

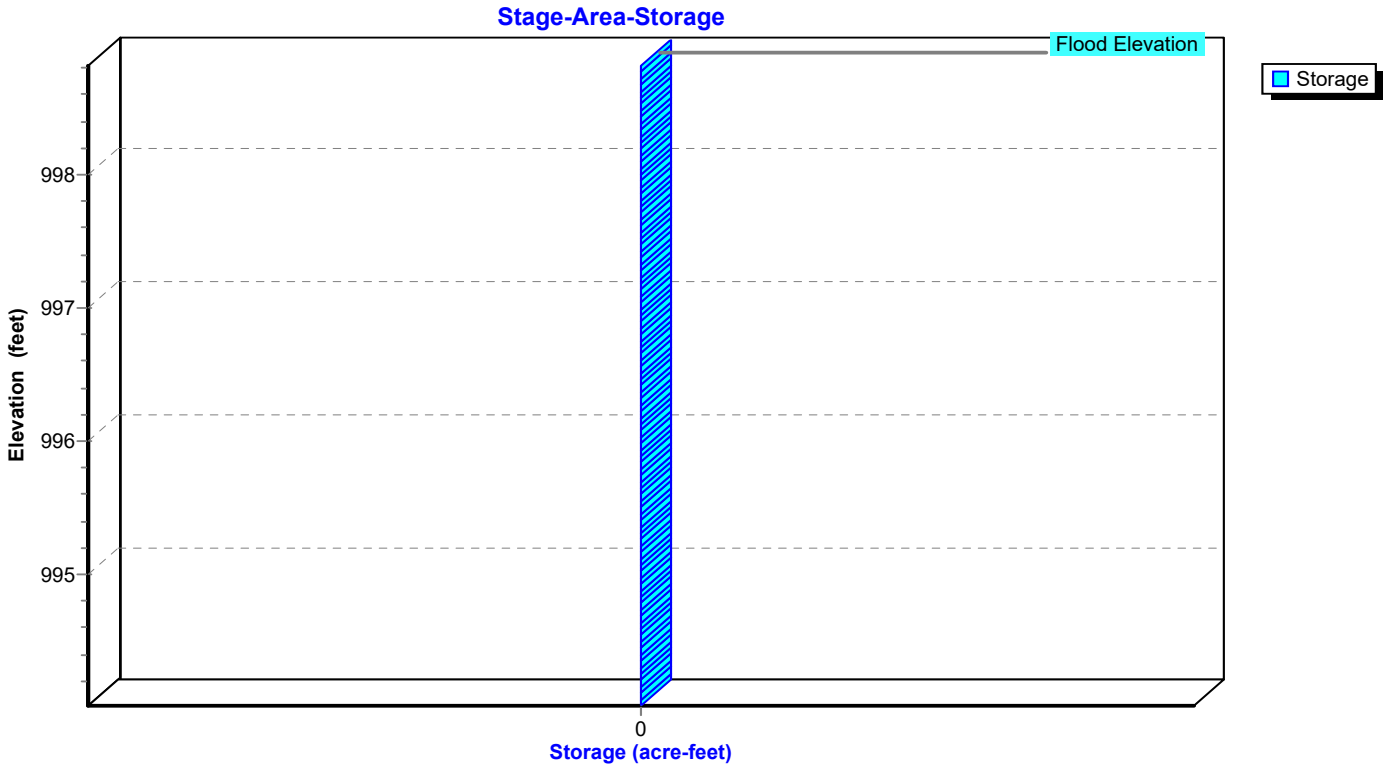


Pond 53P: 301-300

Stage-Discharge

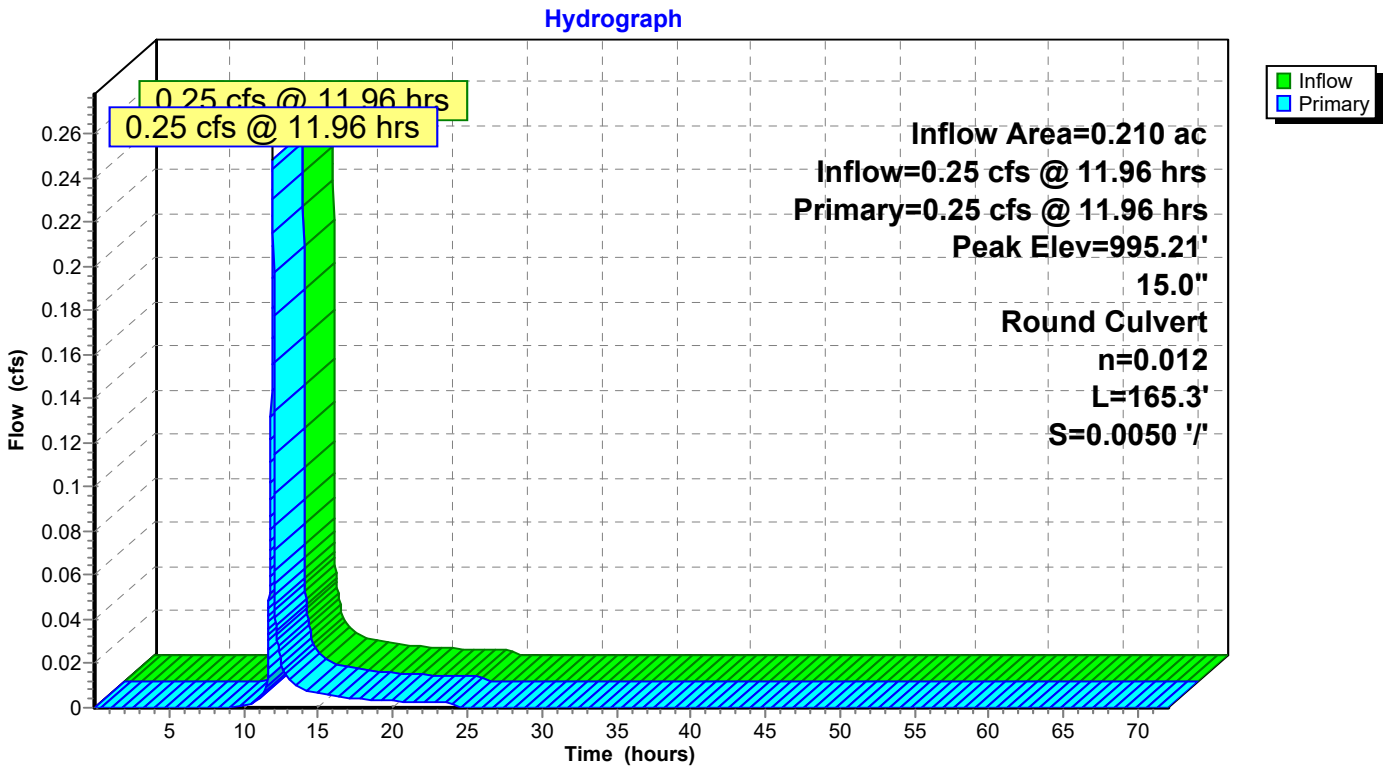


Pond 53P: 301-300



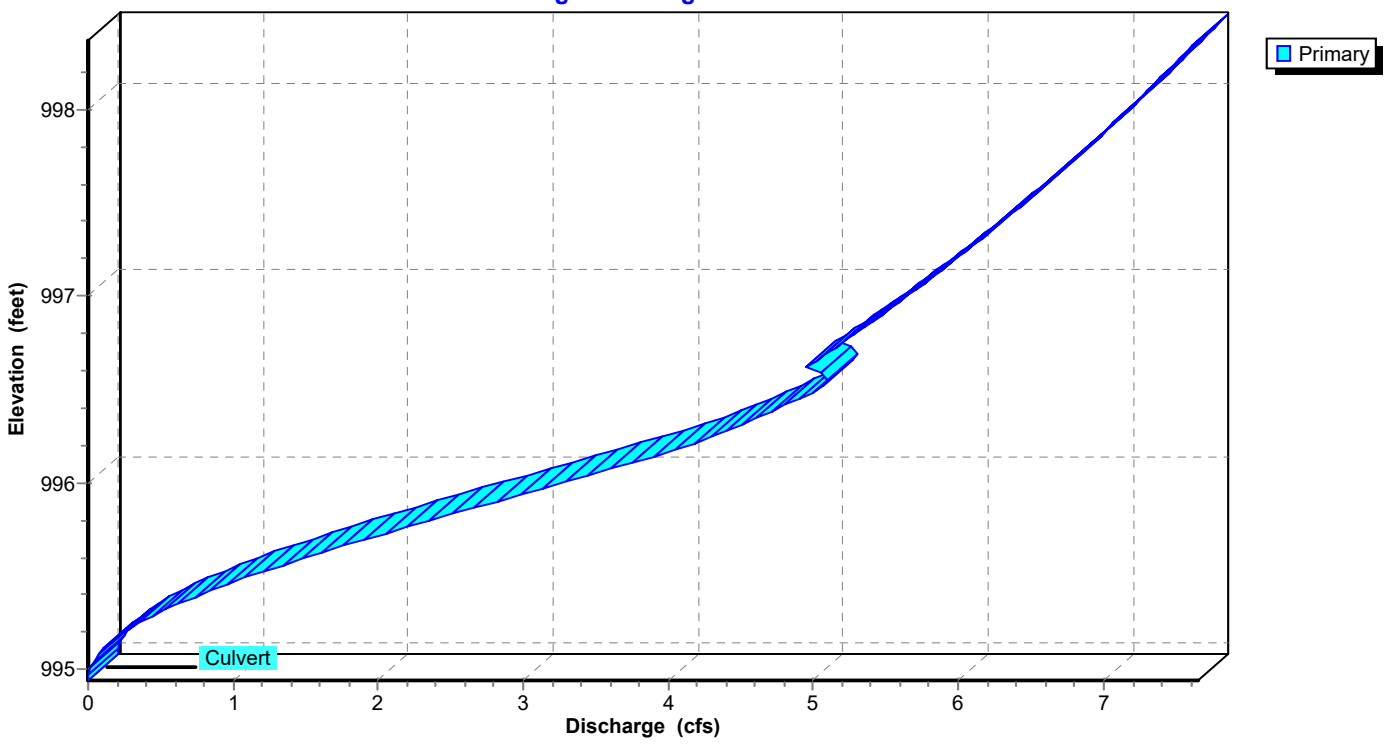
Pond 54P: 302-301

Hydrograph

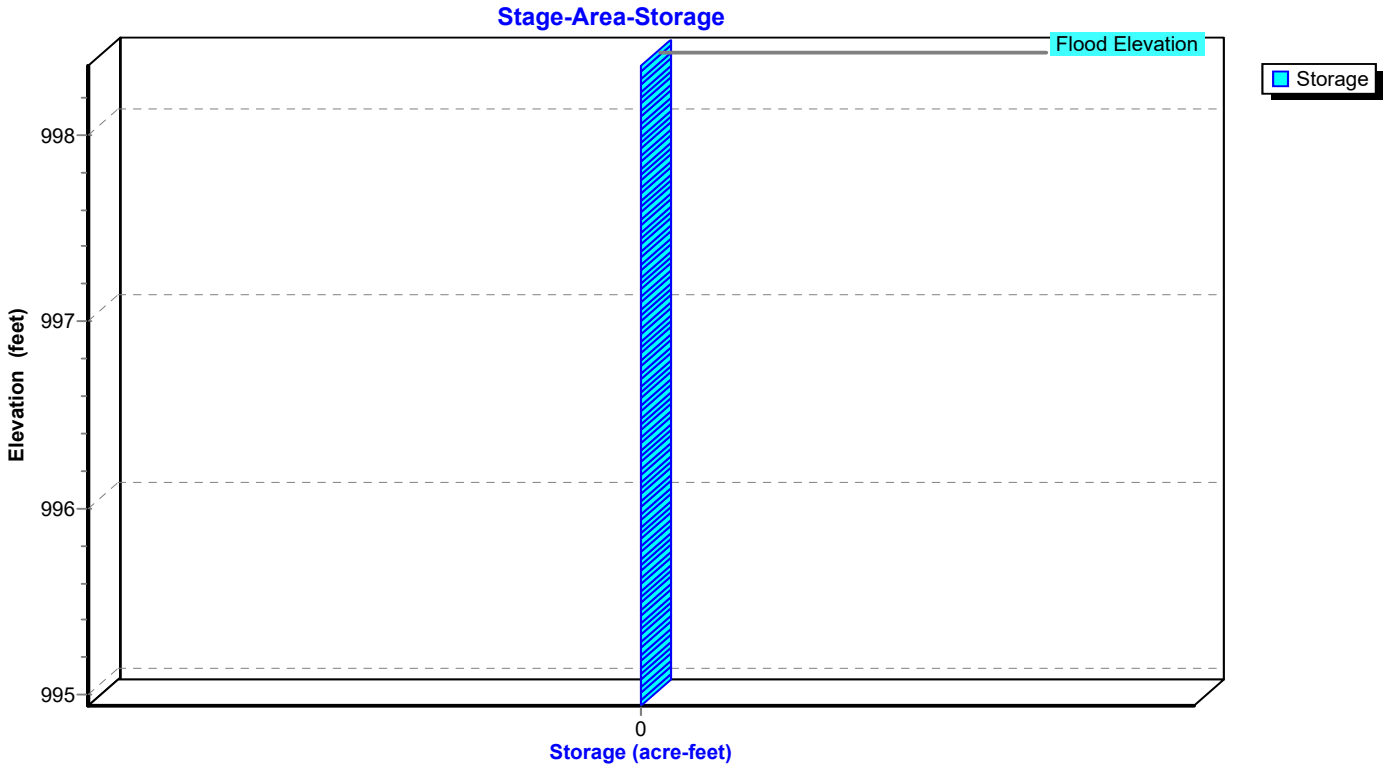


Pond 54P: 302-301

Stage-Discharge

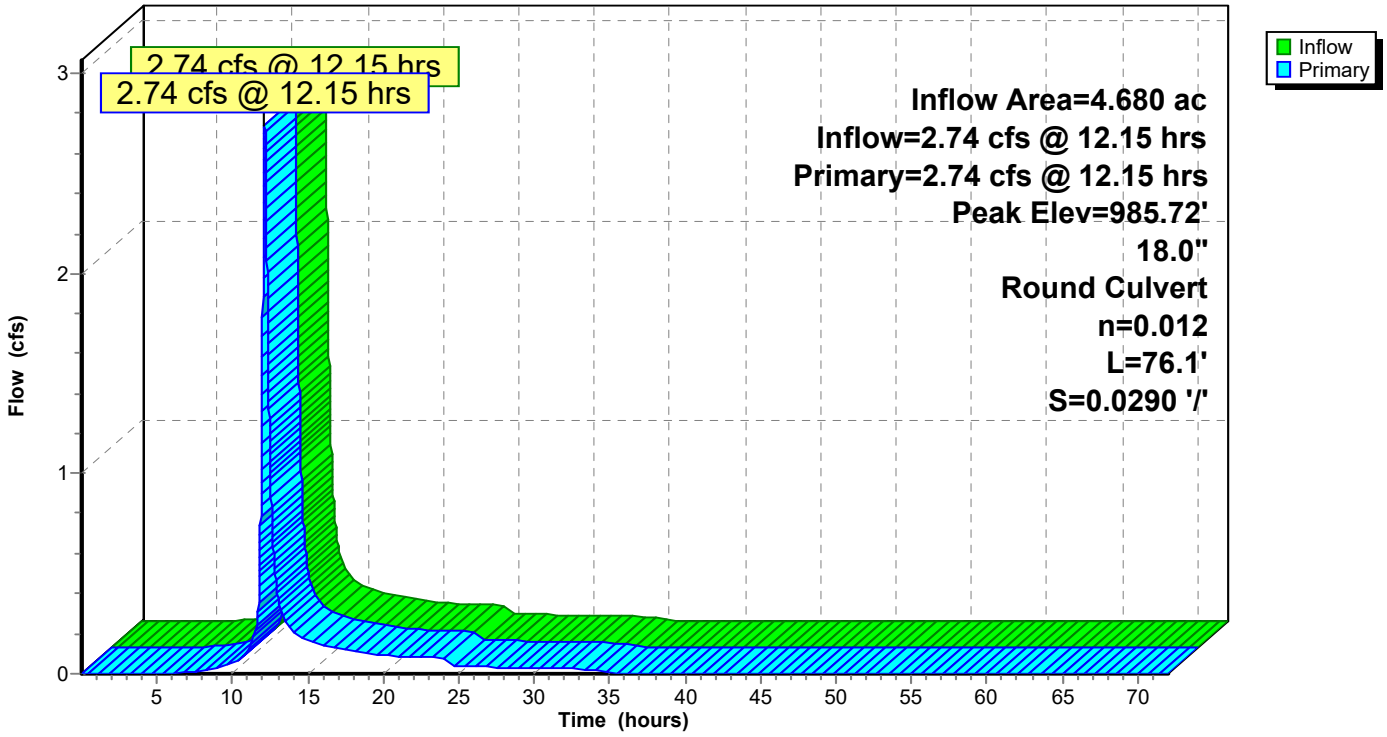


Pond 54P: 302-301



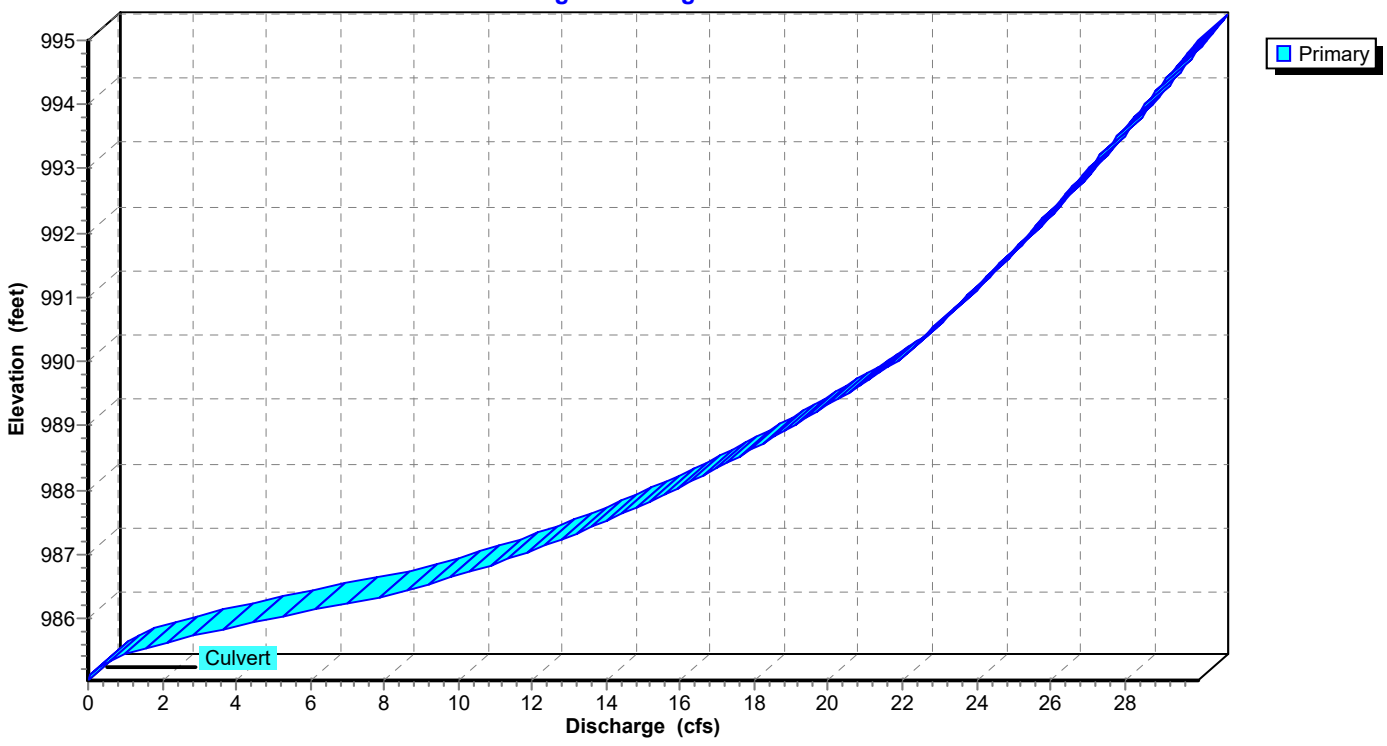
Pond 55P: 11-10

Hydrograph

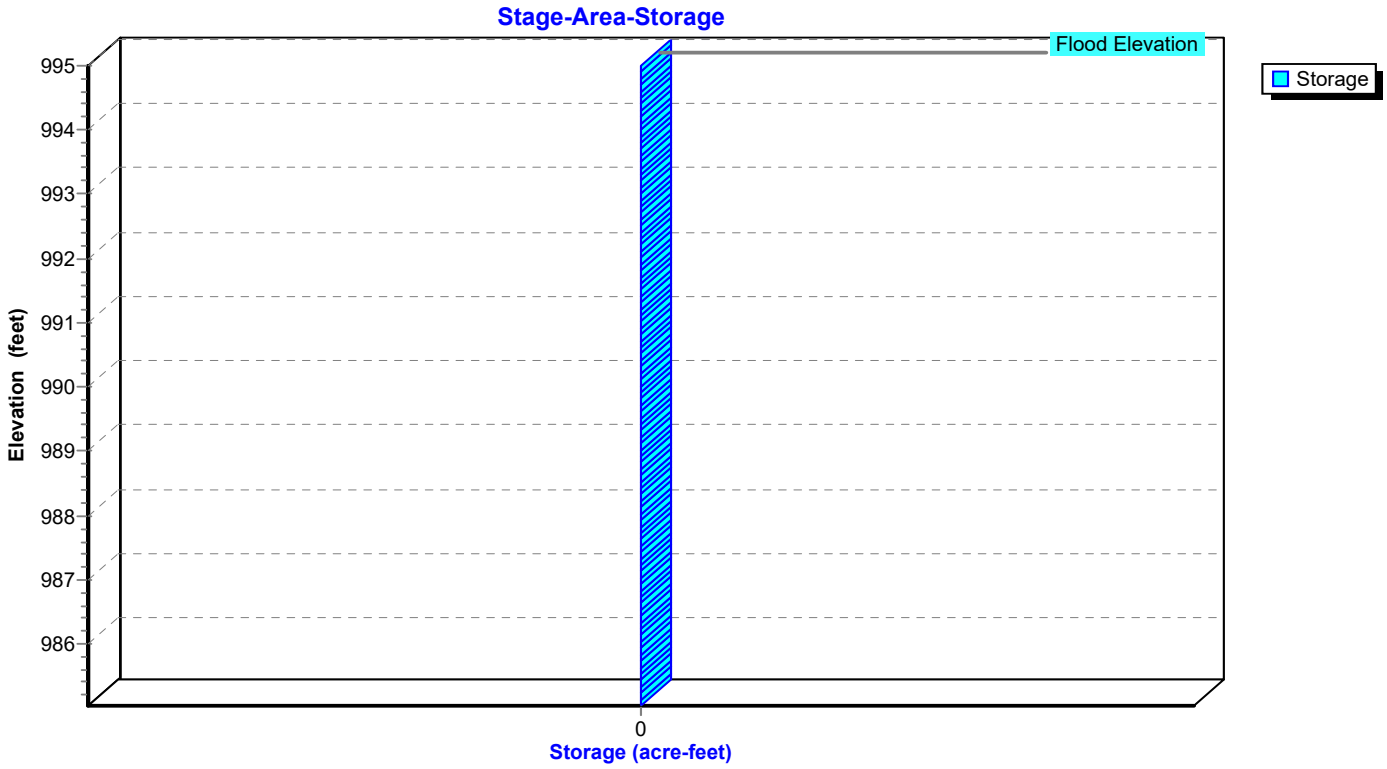


Pond 55P: 11-10

Stage-Discharge

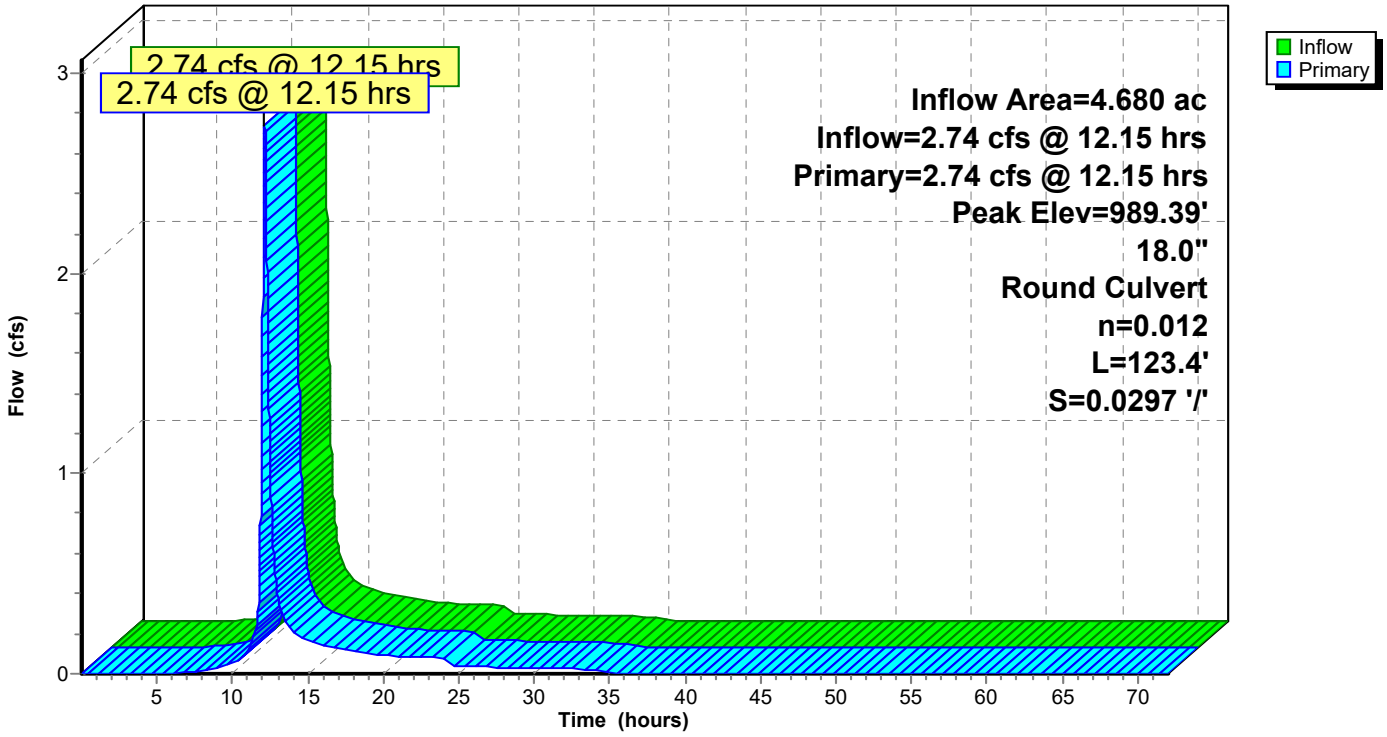


Pond 55P: 11-10



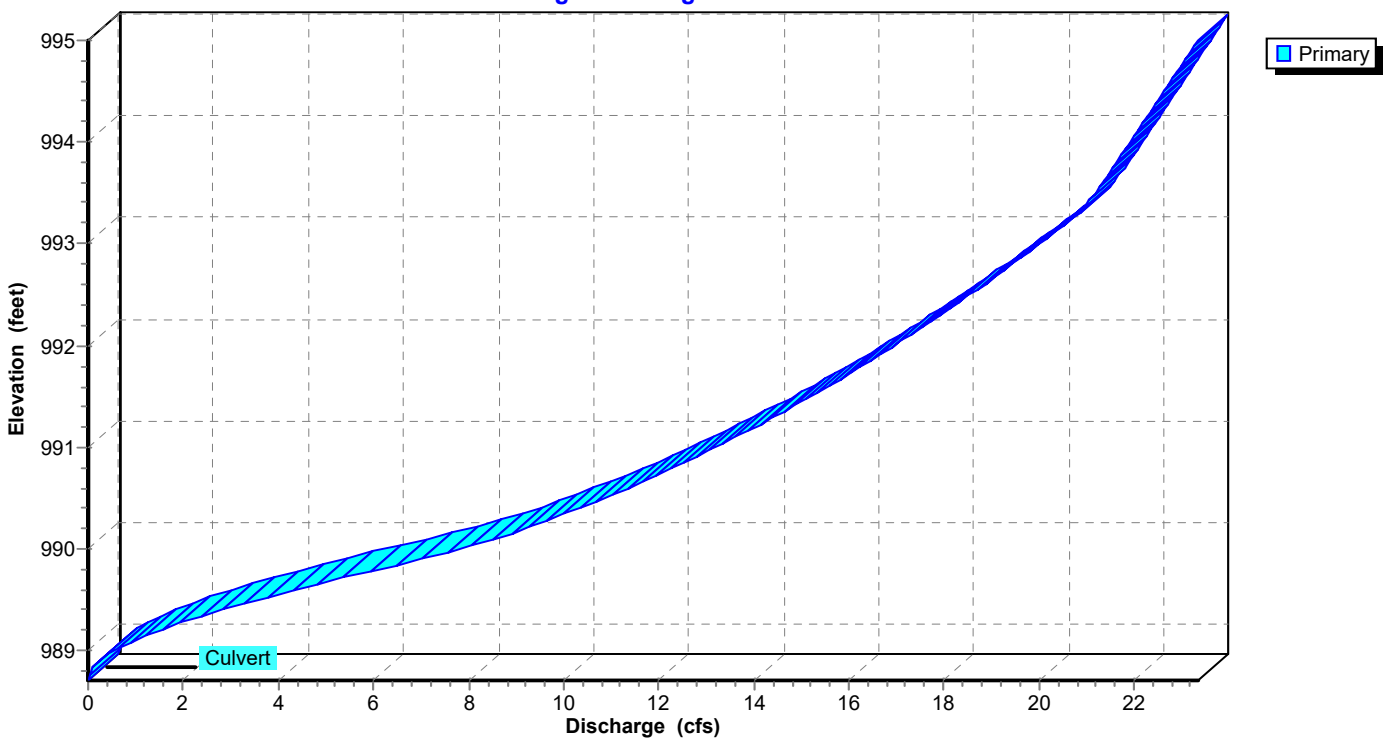
Pond 56P: 11 - 100 MH

Hydrograph

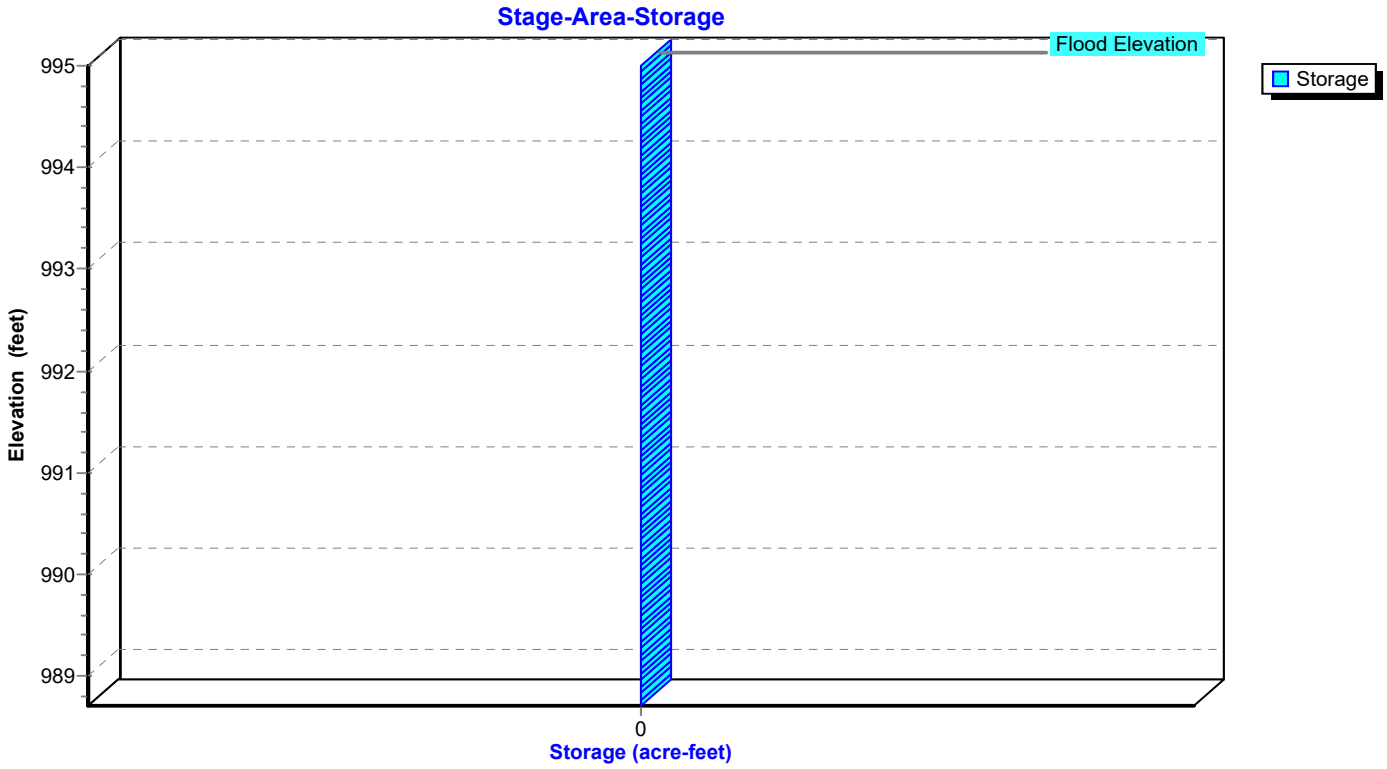


Pond 56P: 11 - 100 MH

Stage-Discharge

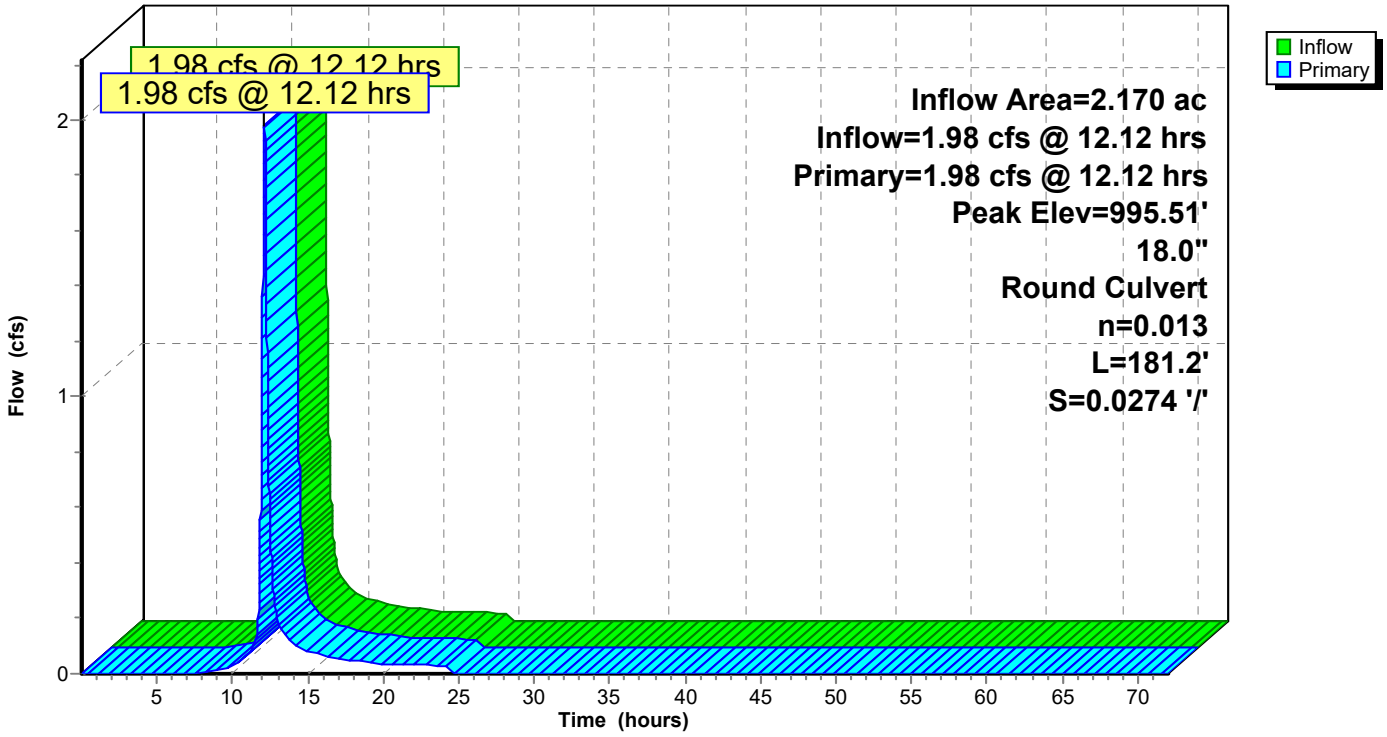


Pond 56P: 11 - 100 MH



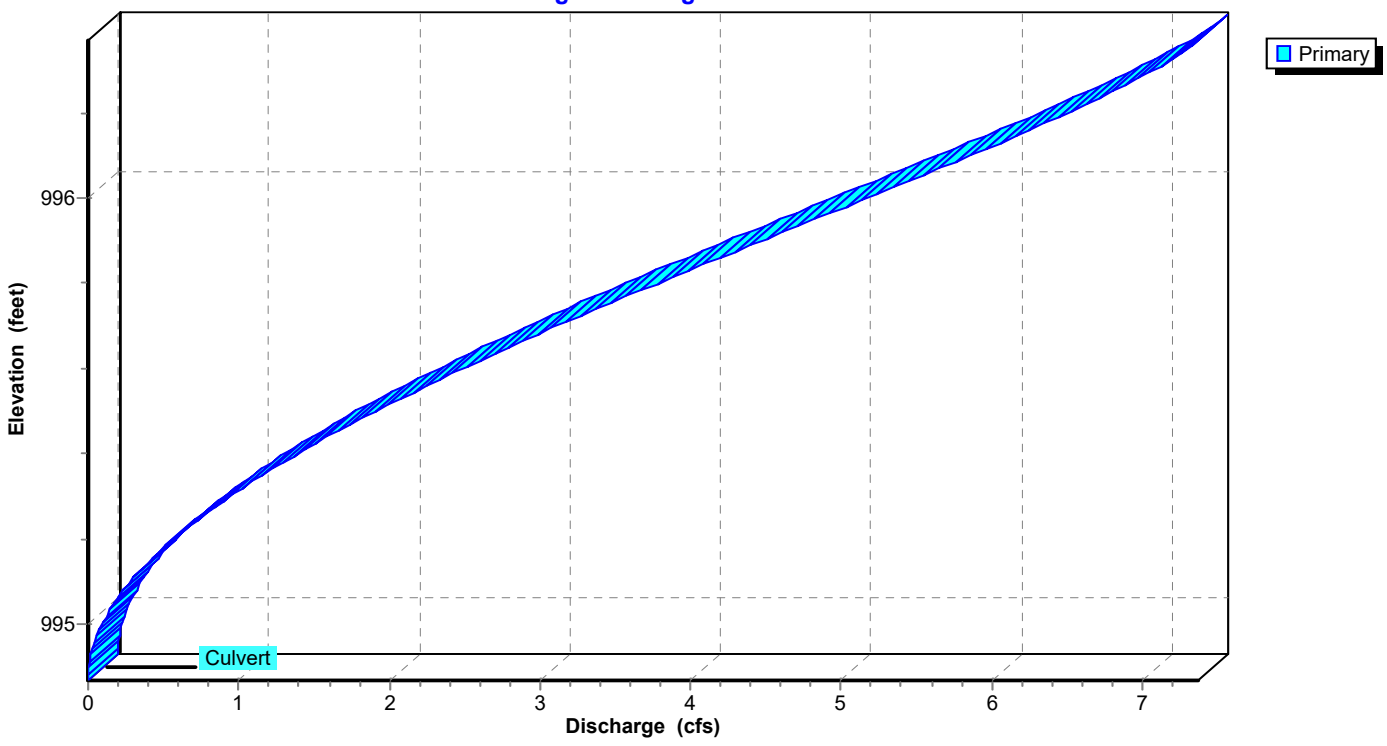
Pond 57P: 12-11

Hydrograph

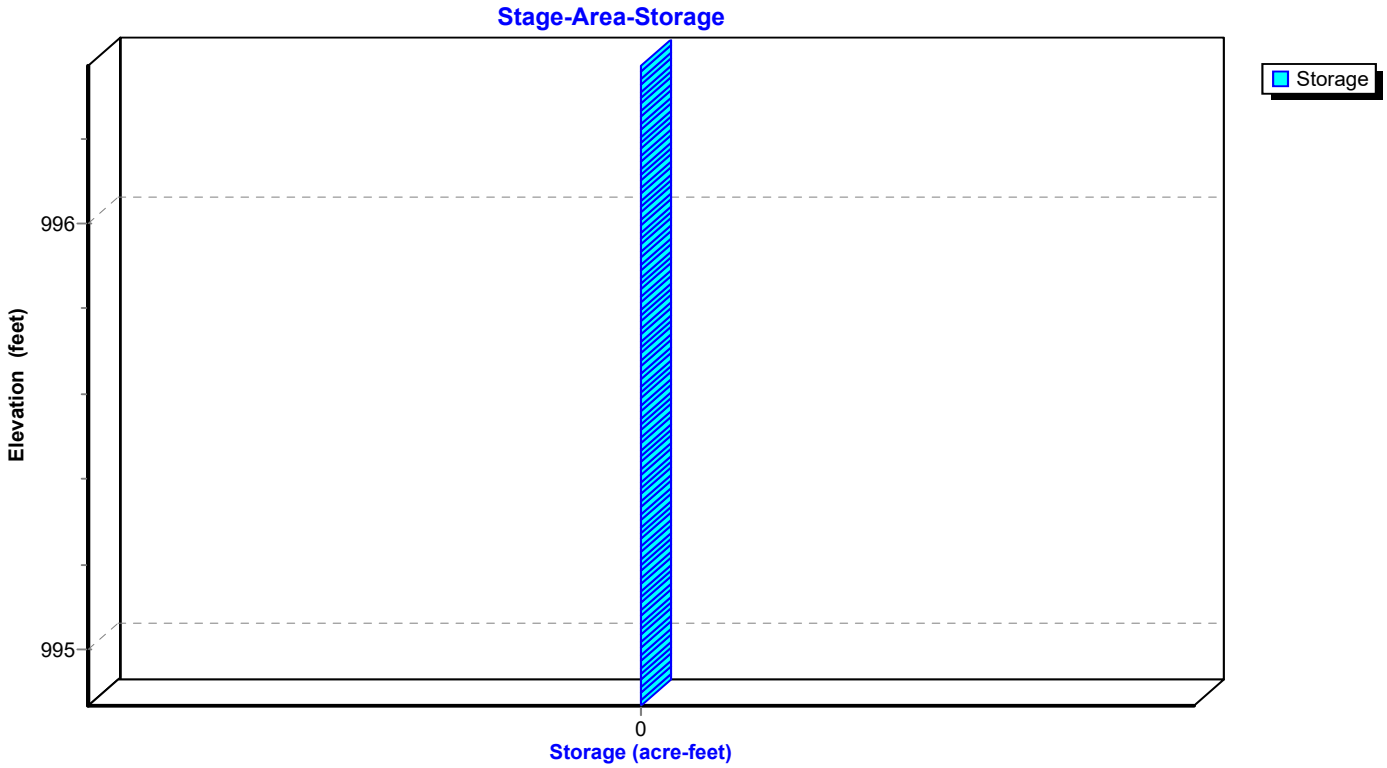


Pond 57P: 12-11

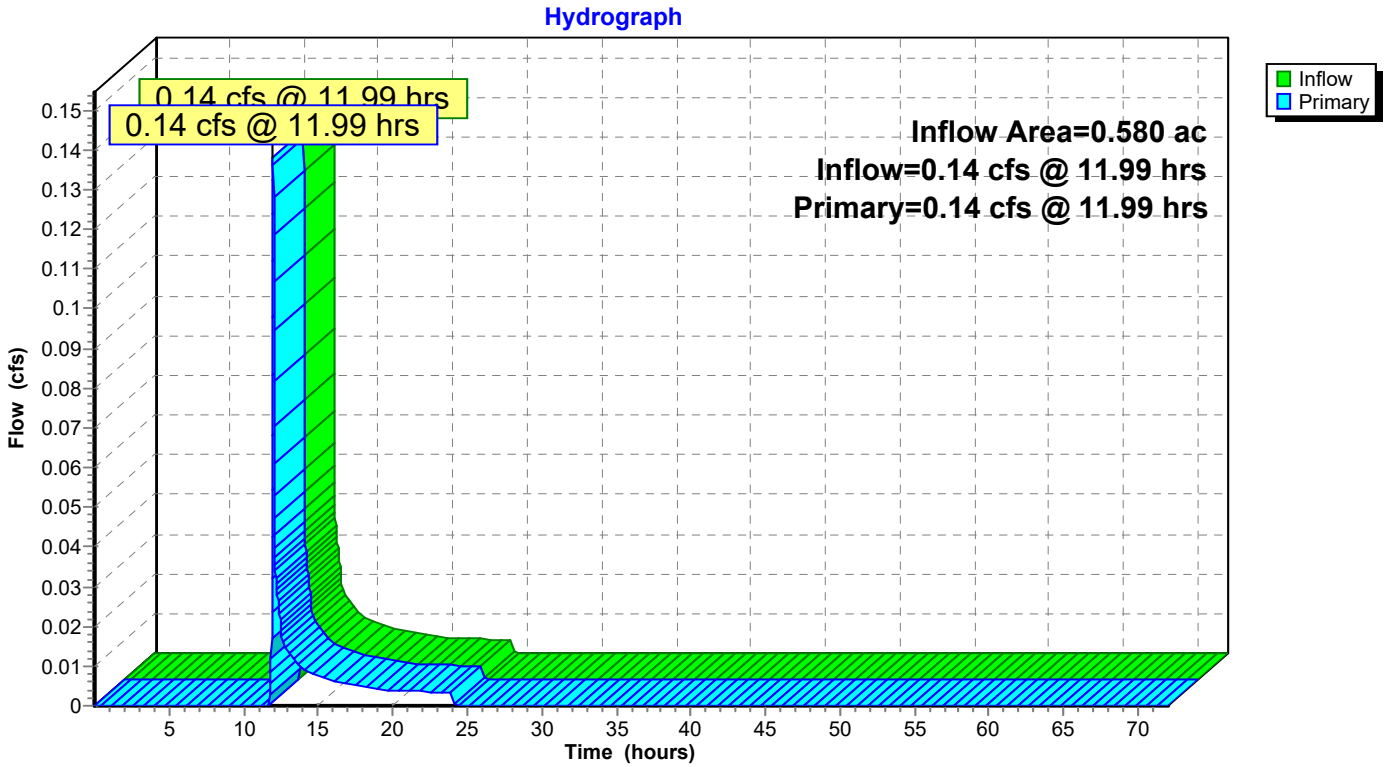
Stage-Discharge



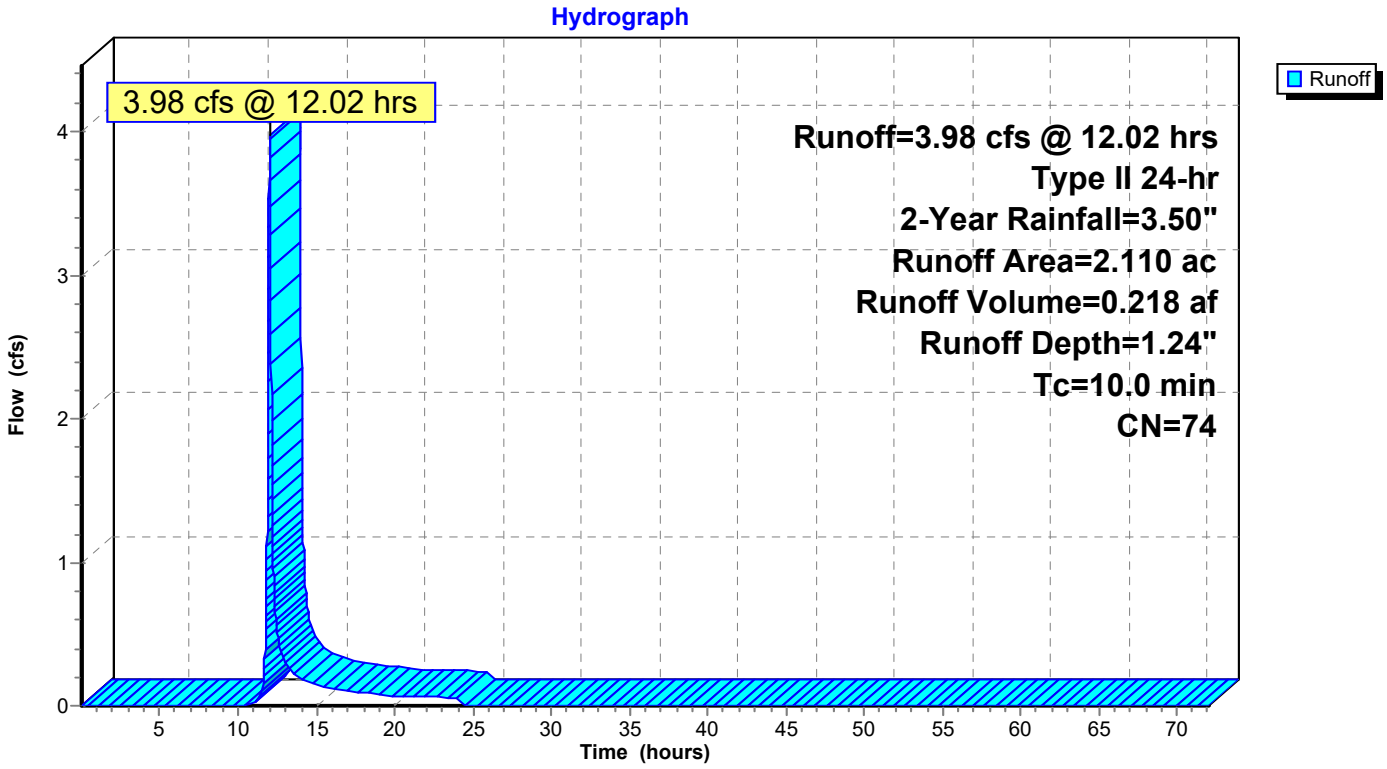
Pond 57P: 12-11



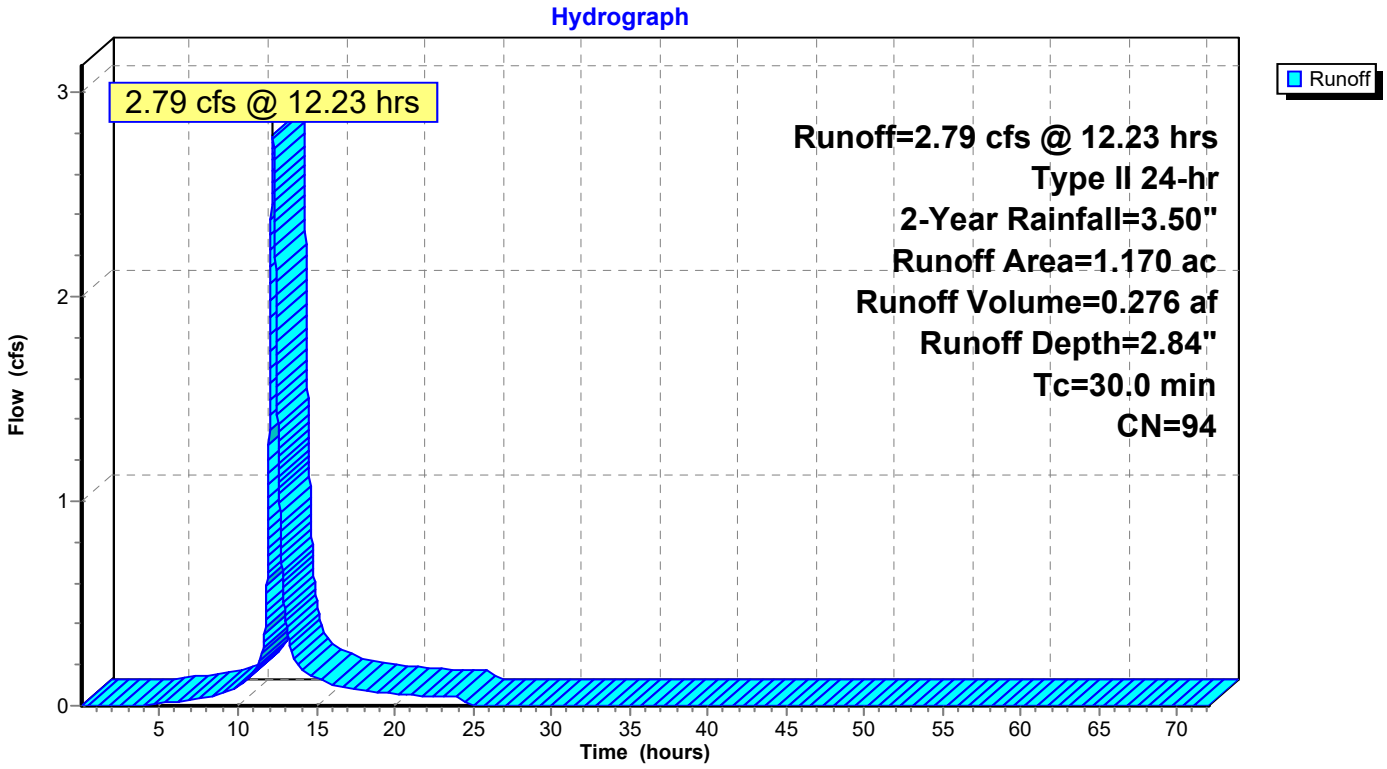
Link 90L: BYPASS AREAS



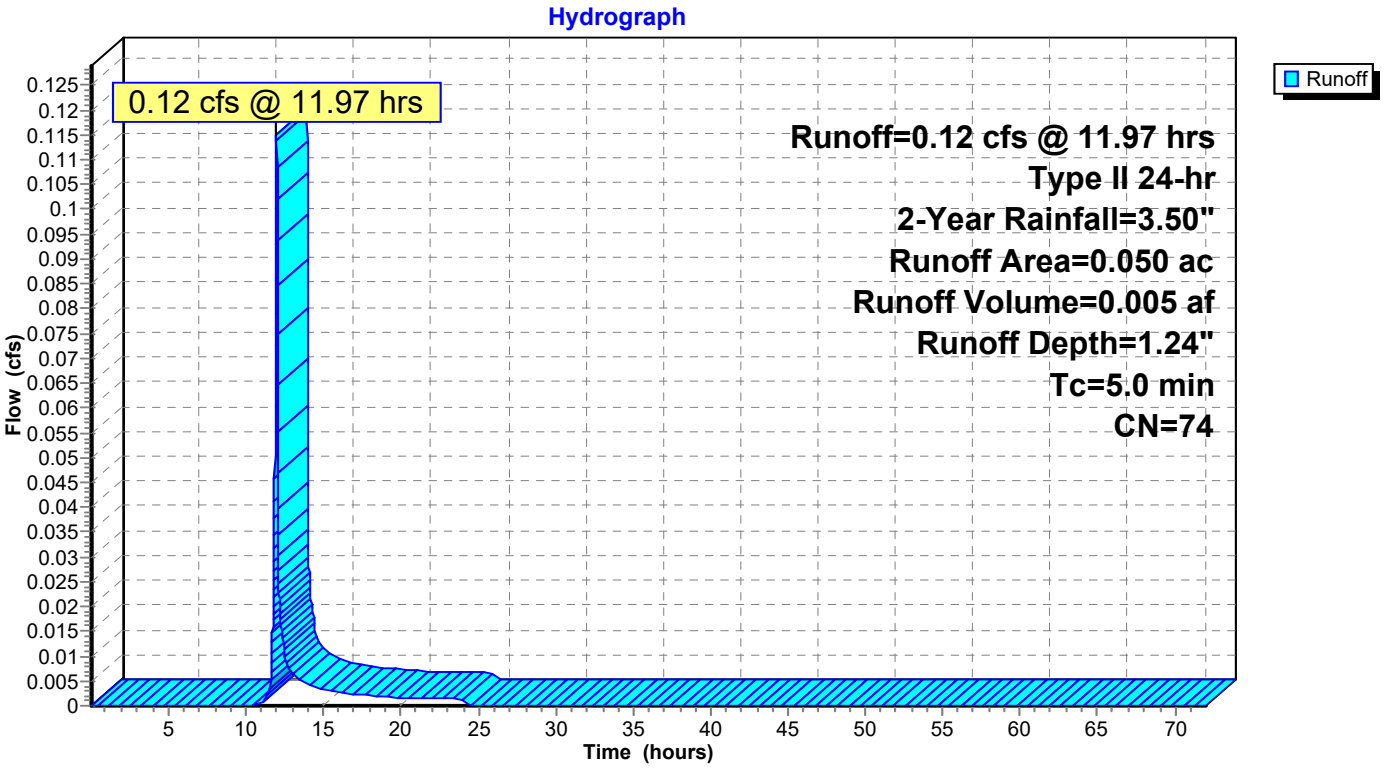
Subcatchment 1S: EXISTING CONDITIONS



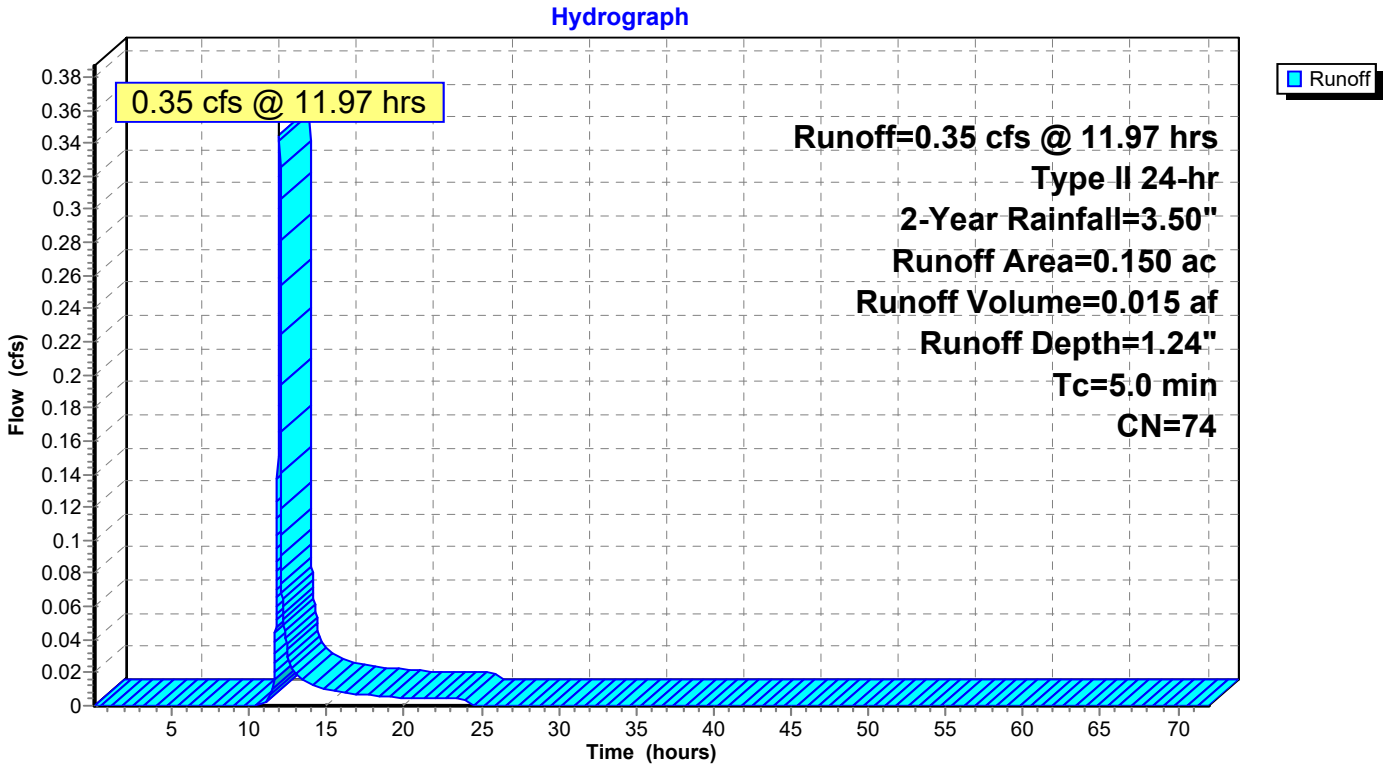
Subcatchment 2S: AREA A



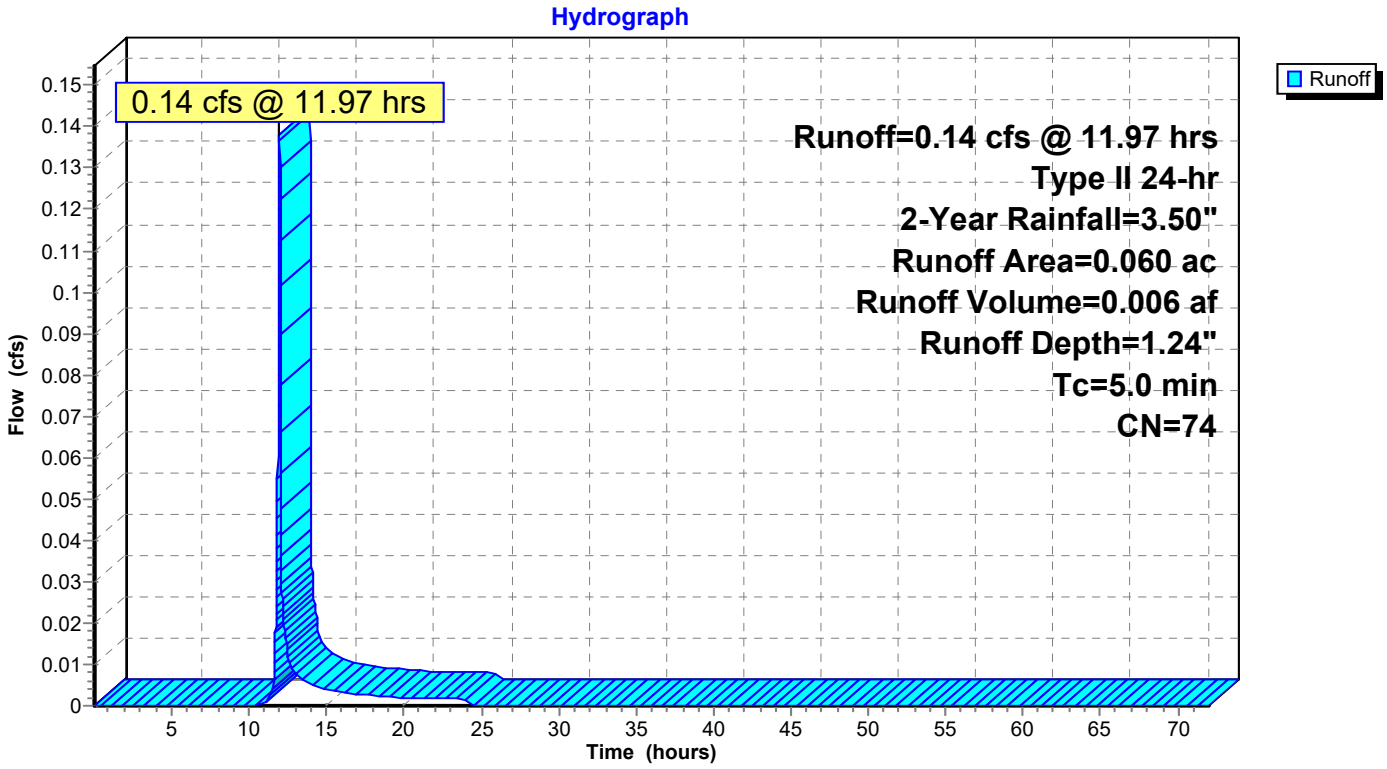
Subcatchment 3S: AREA B



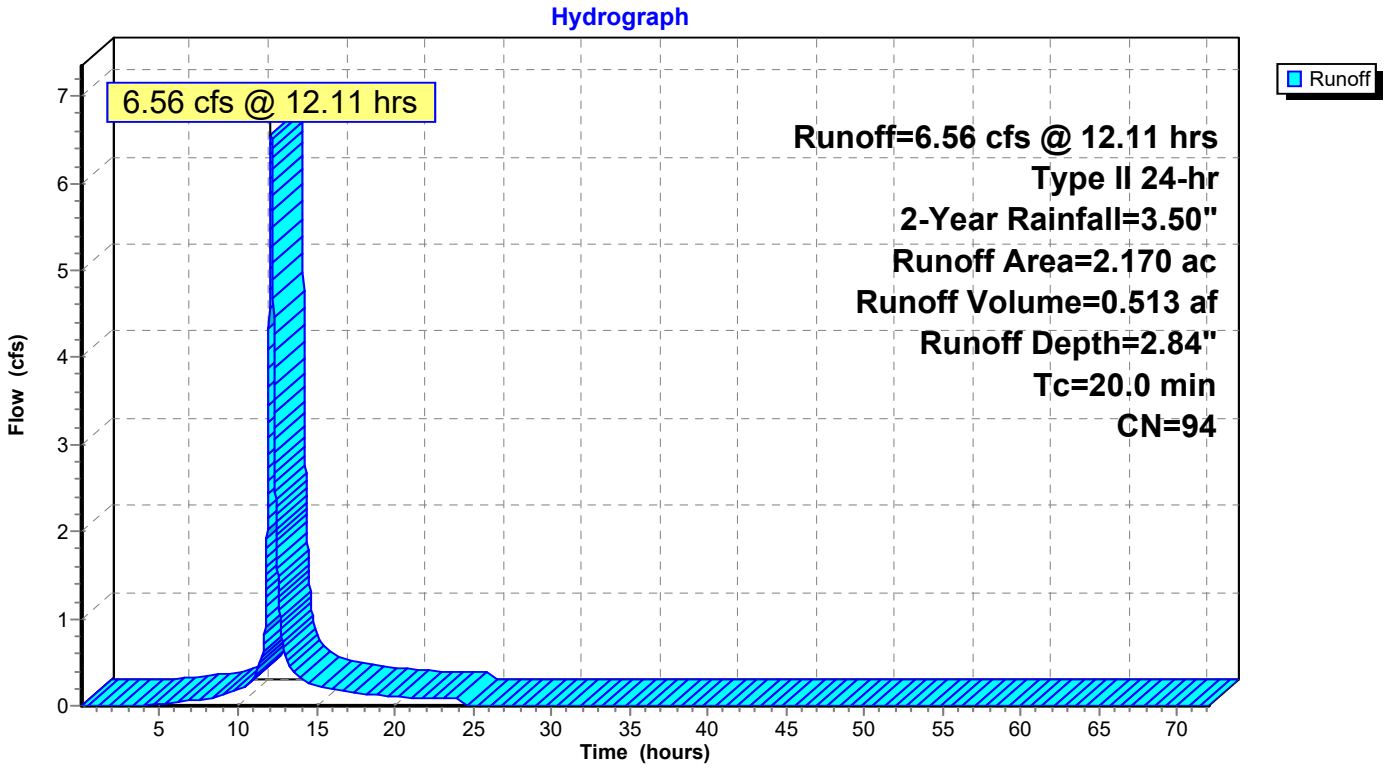
Subcatchment 4S: AREA C



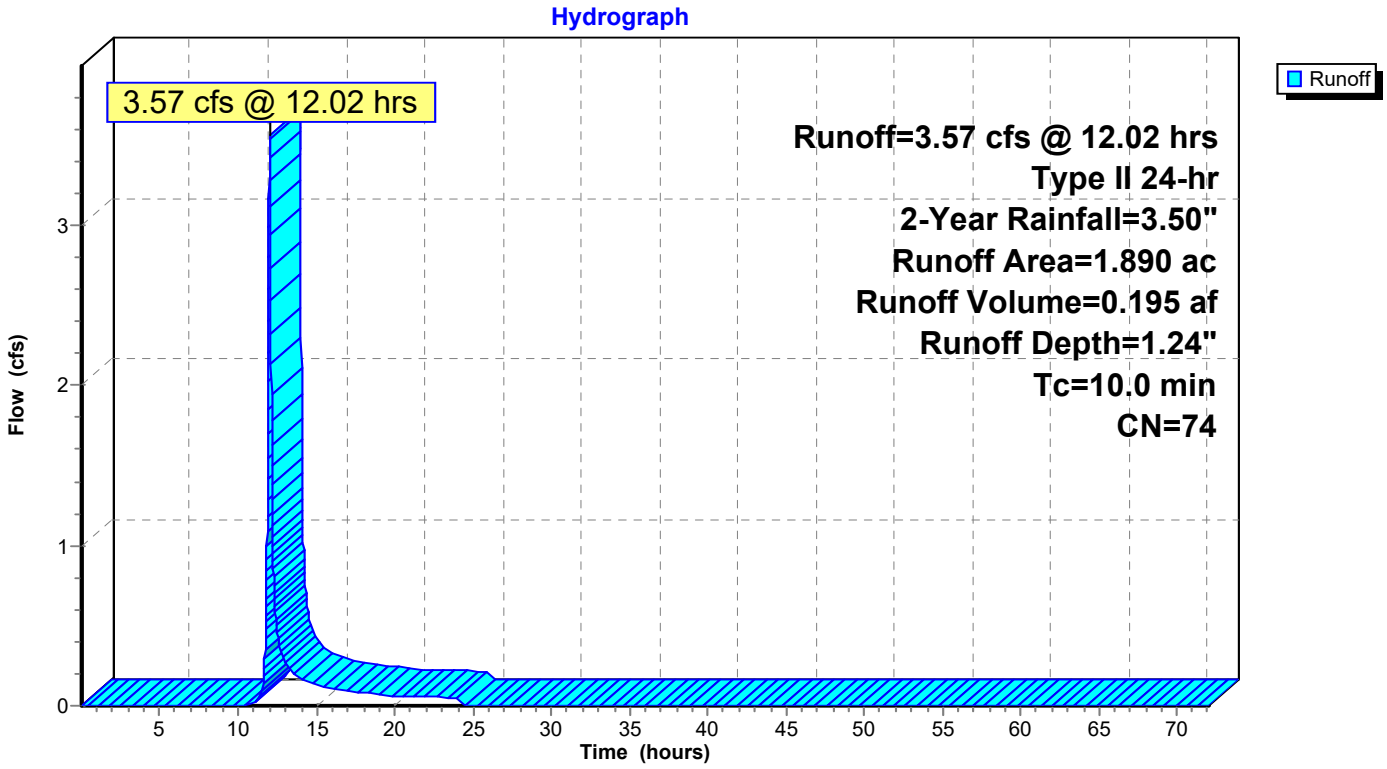
Subcatchment 5S: AREA D



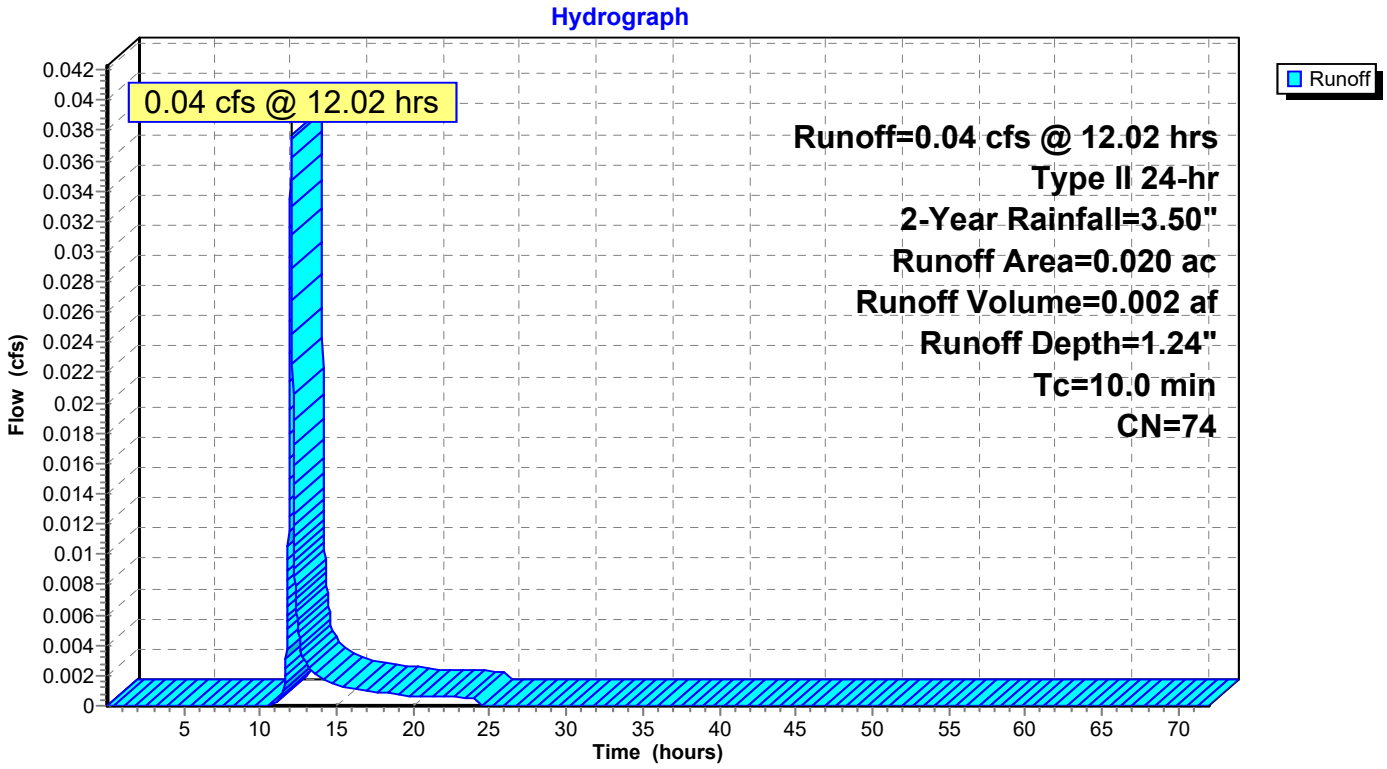
Subcatchment 6S: AREA E



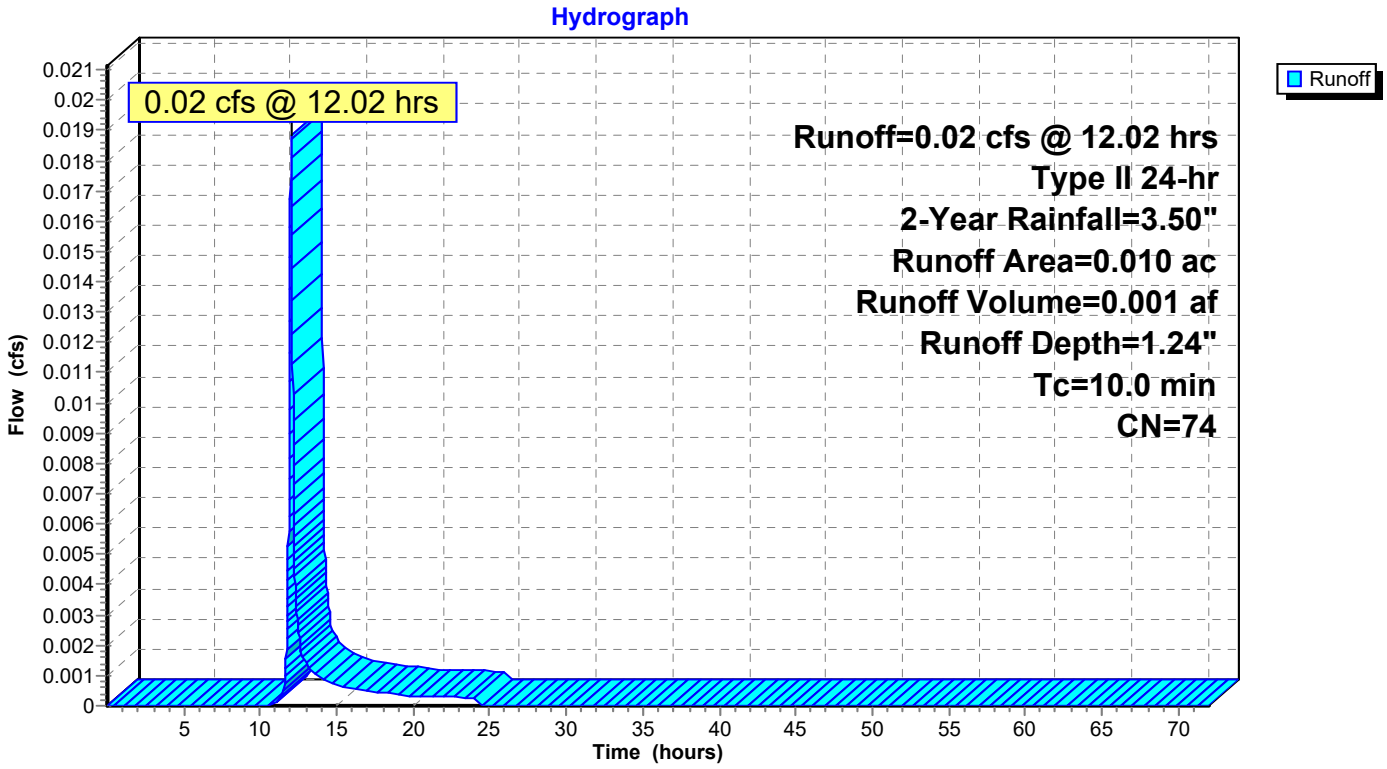
Subcatchment 7S: AREA F



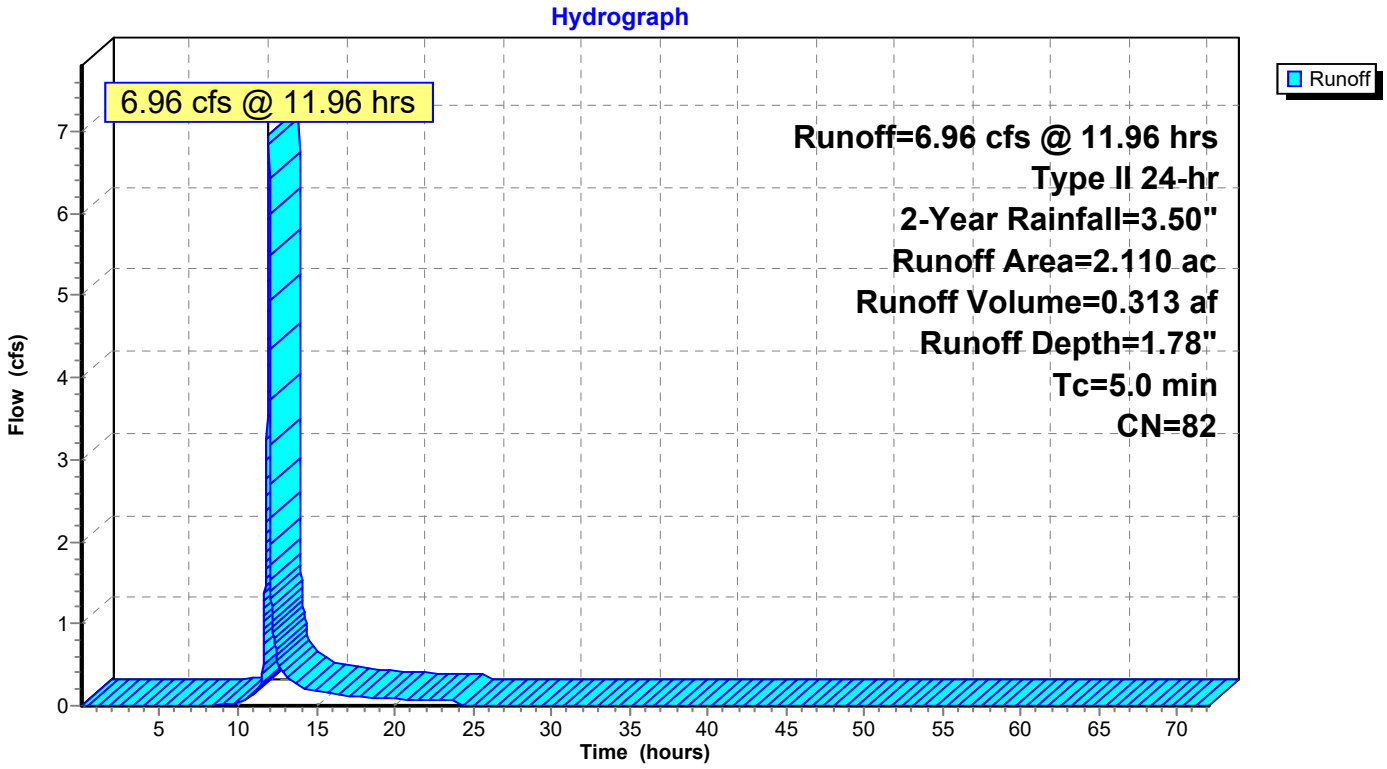
Subcatchment 8S: AREA G



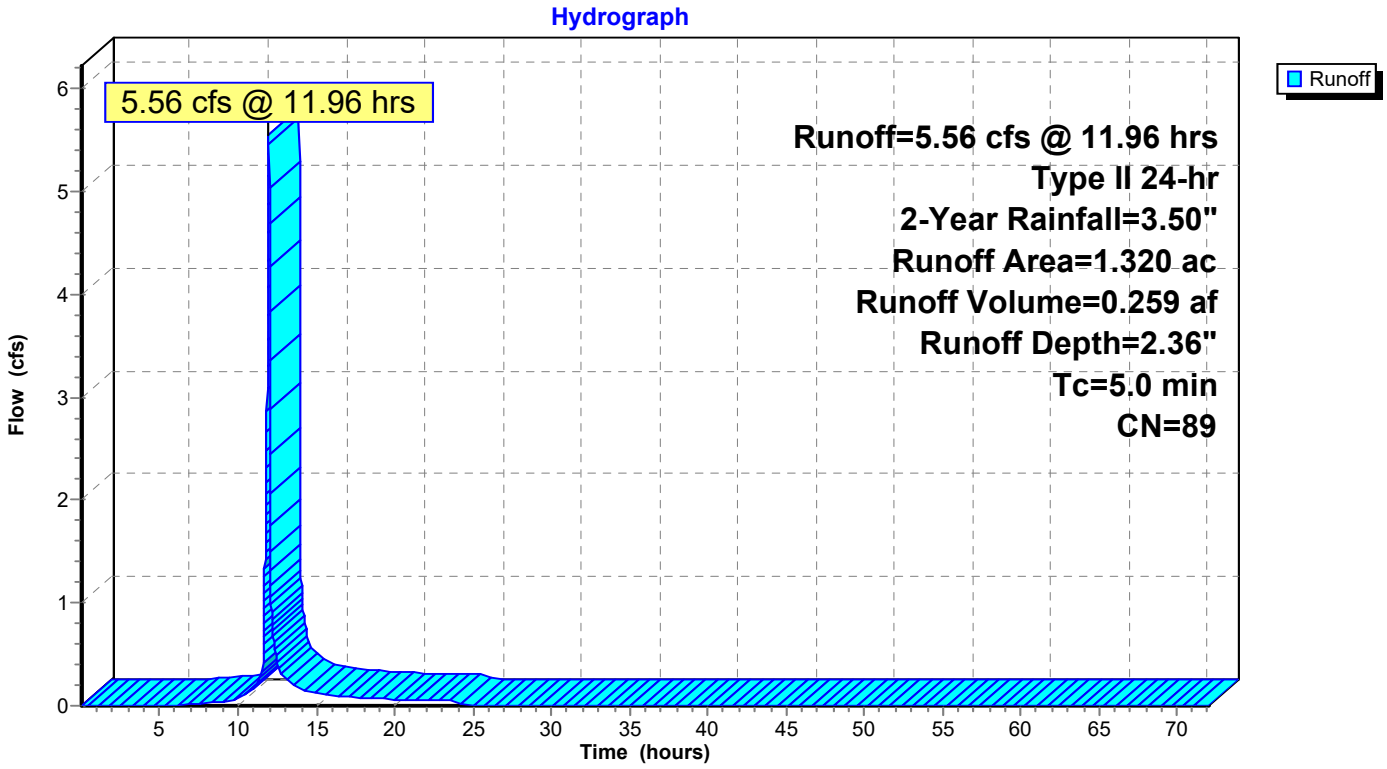
Subcatchment 9S: AREA H



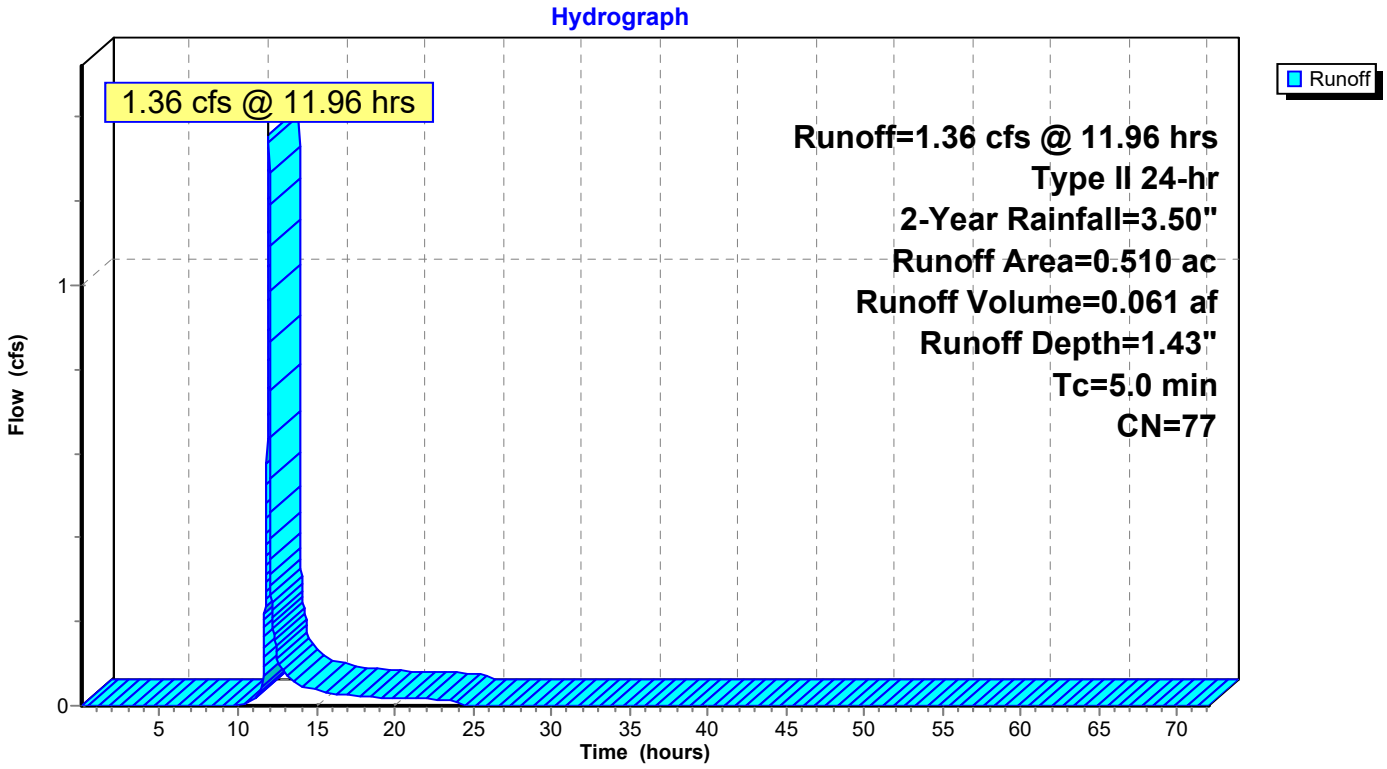
Subcatchment 10S: PROPOSED CONDITIONS



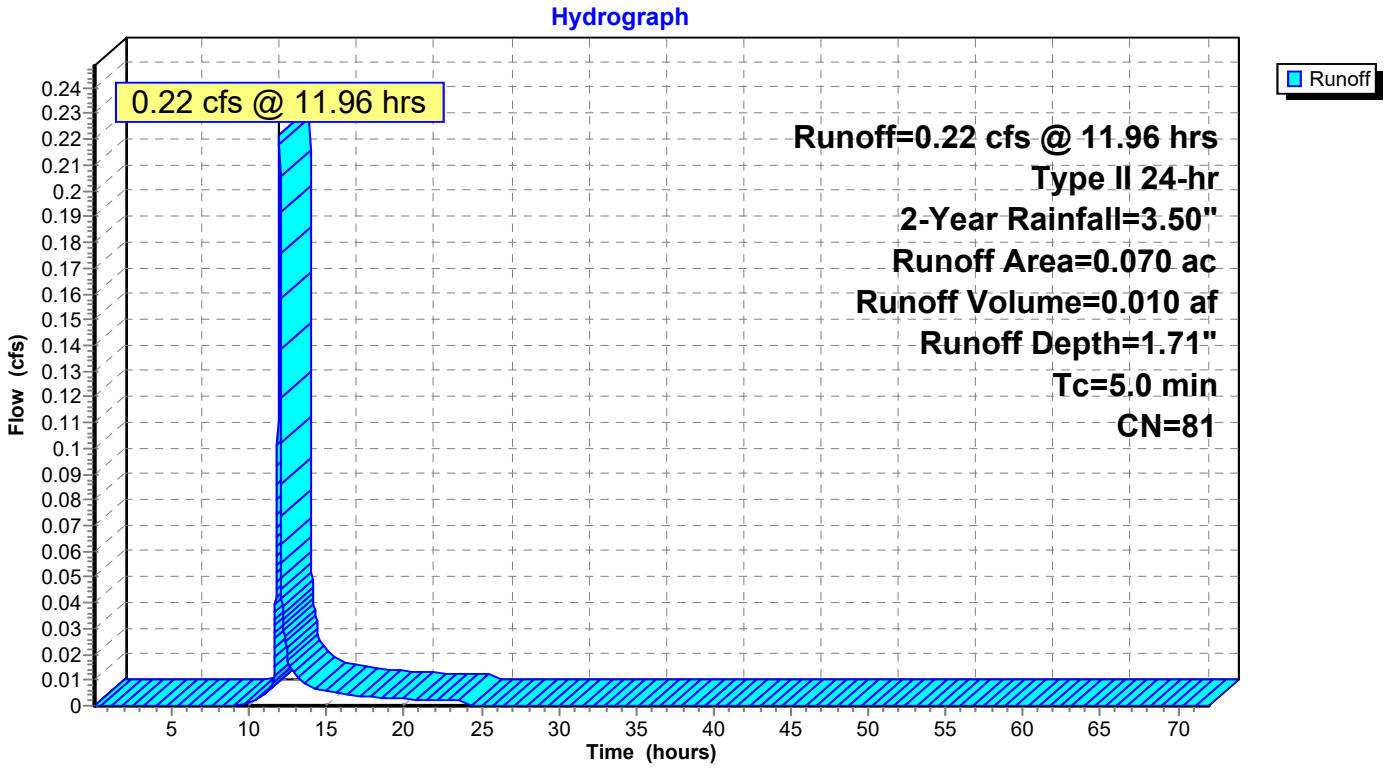
Subcatchment 25S: AREA 3



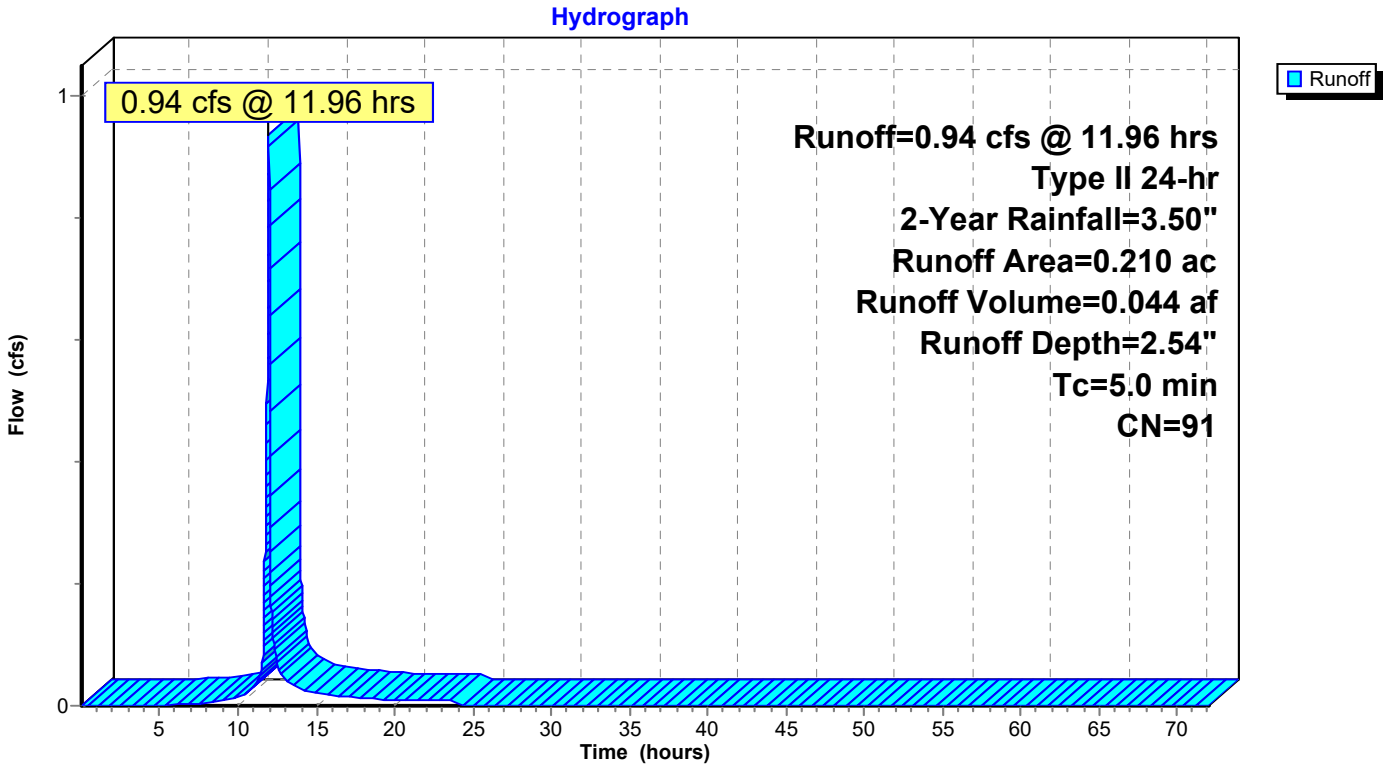
Subcatchment 60S: AREA 6



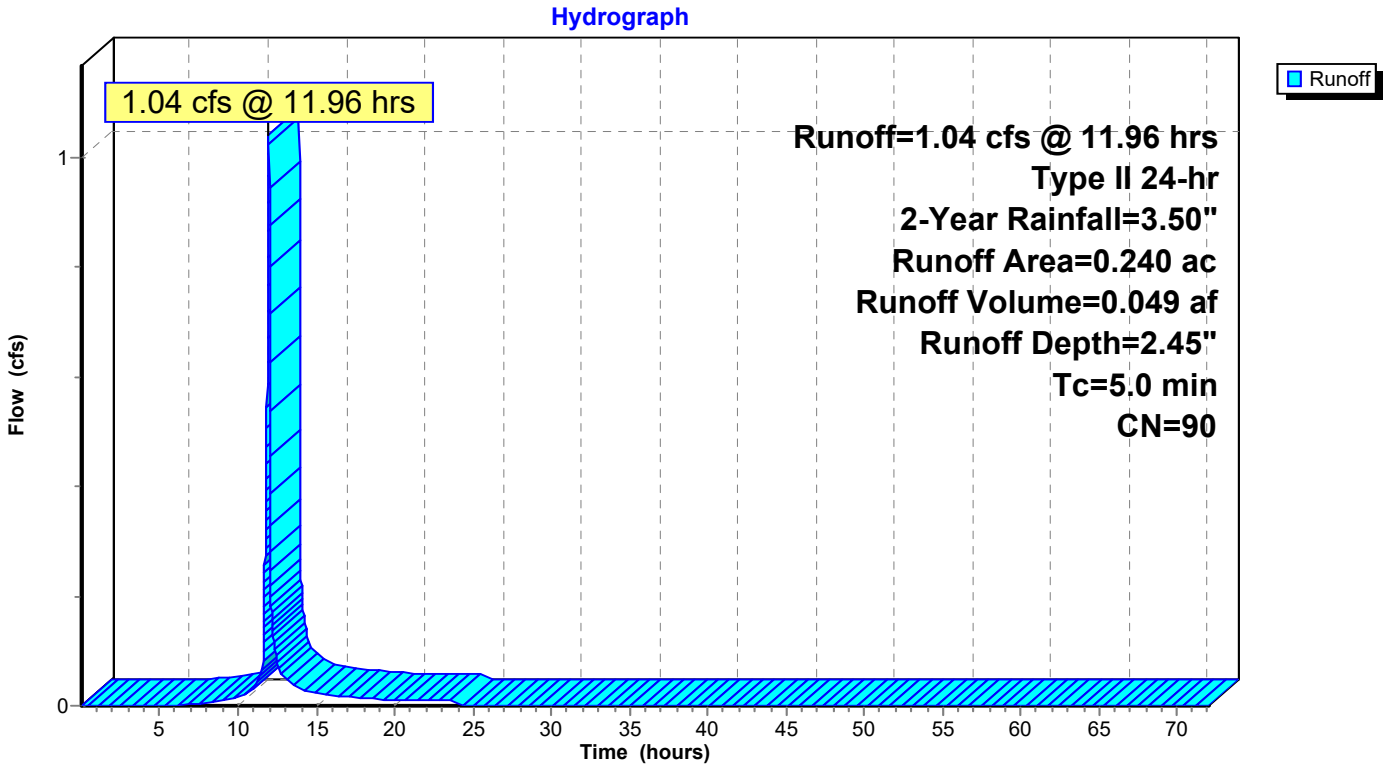
Subcatchment 61S: AREA 7



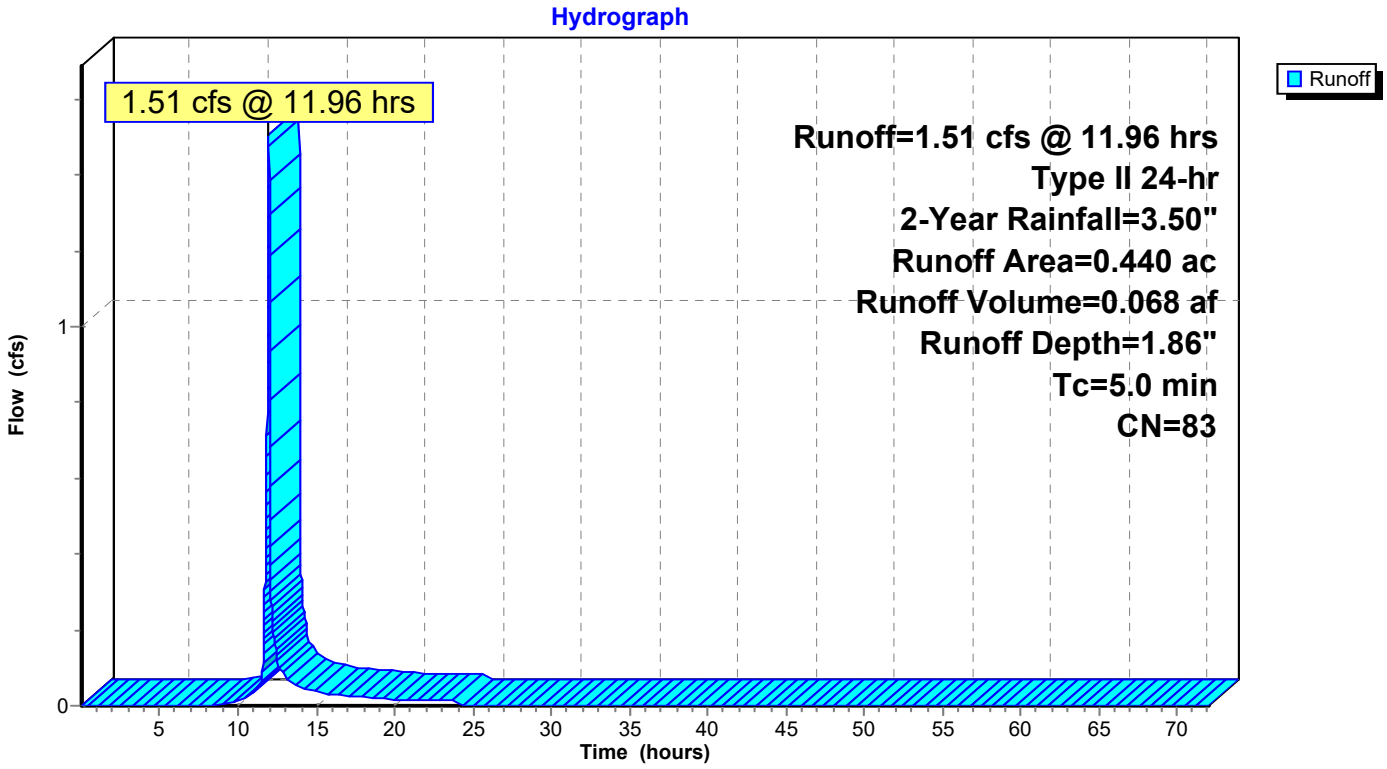
Subcatchment 62S: AREA 1



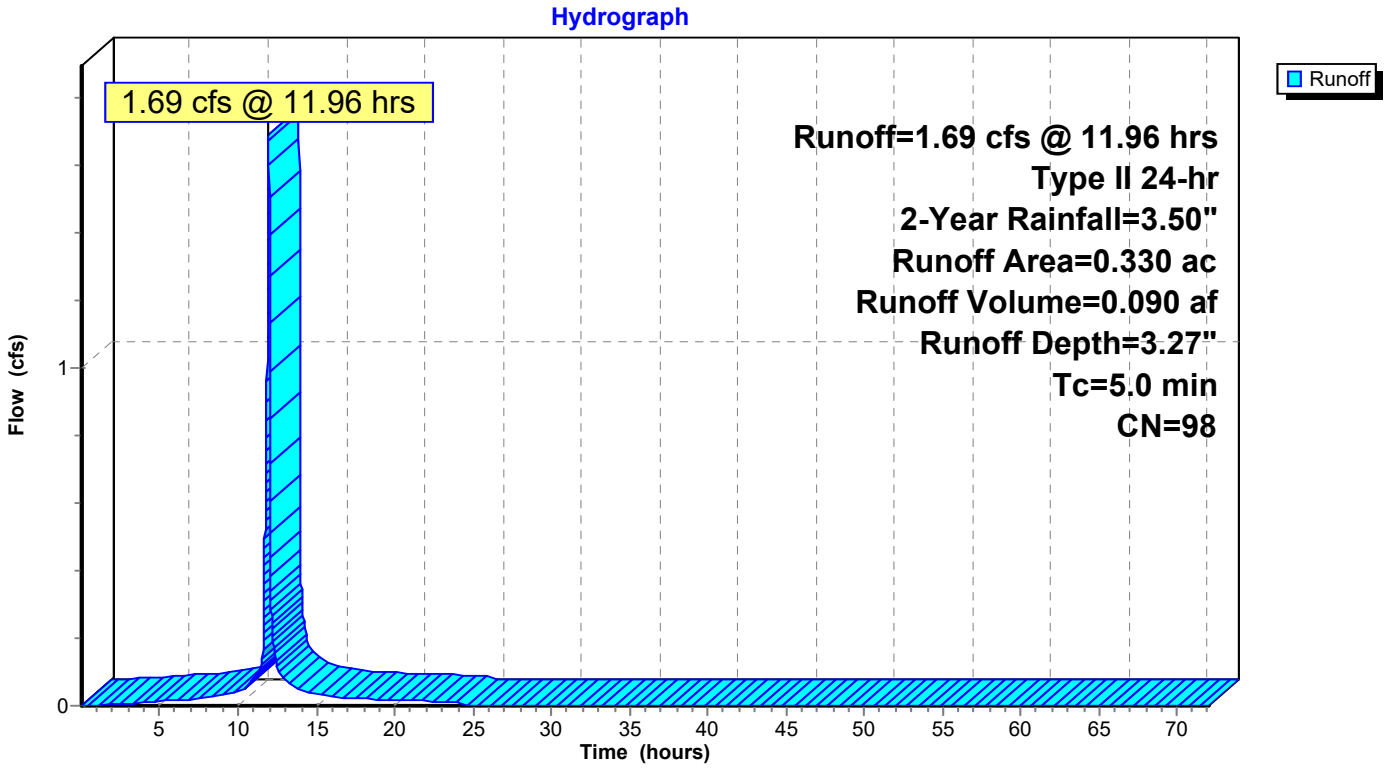
Subcatchment 63S: AREA 2



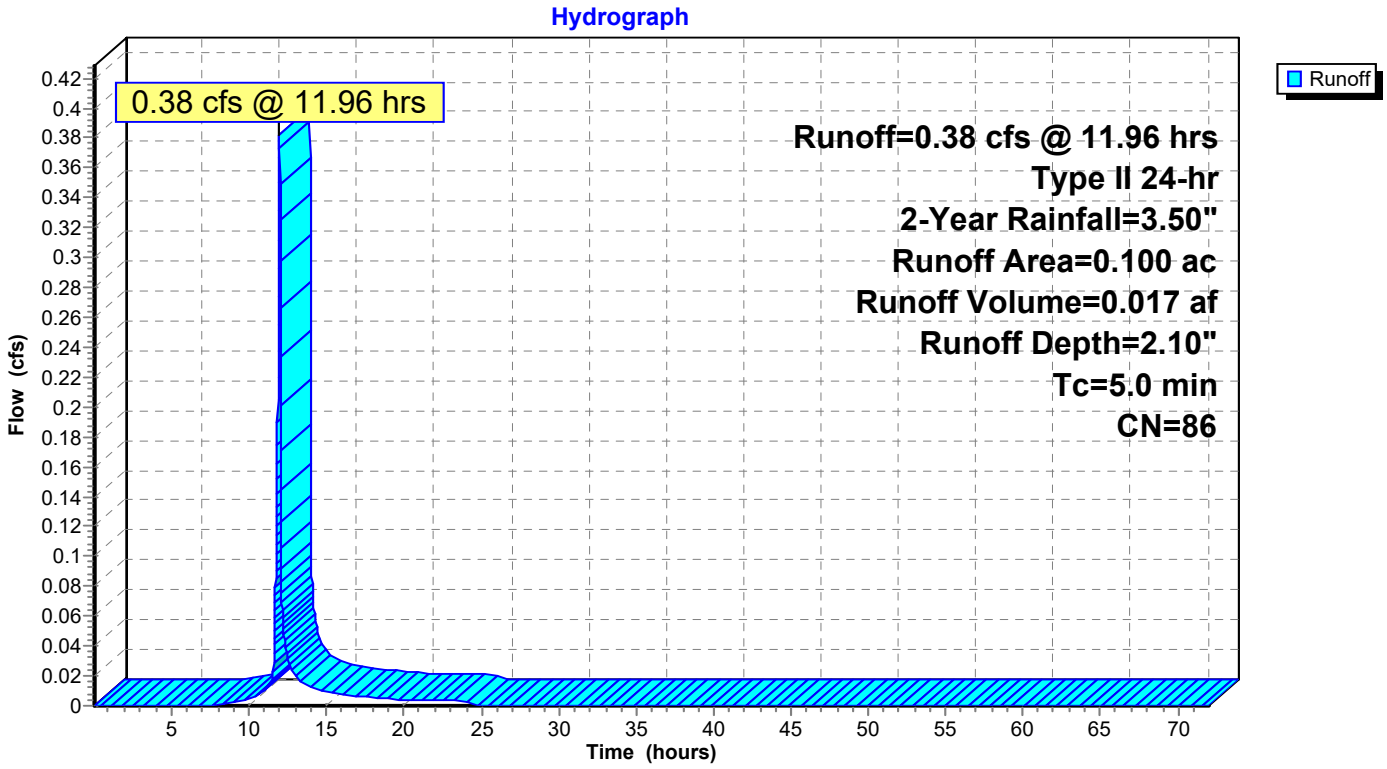
Subcatchment 64S: AREA 3



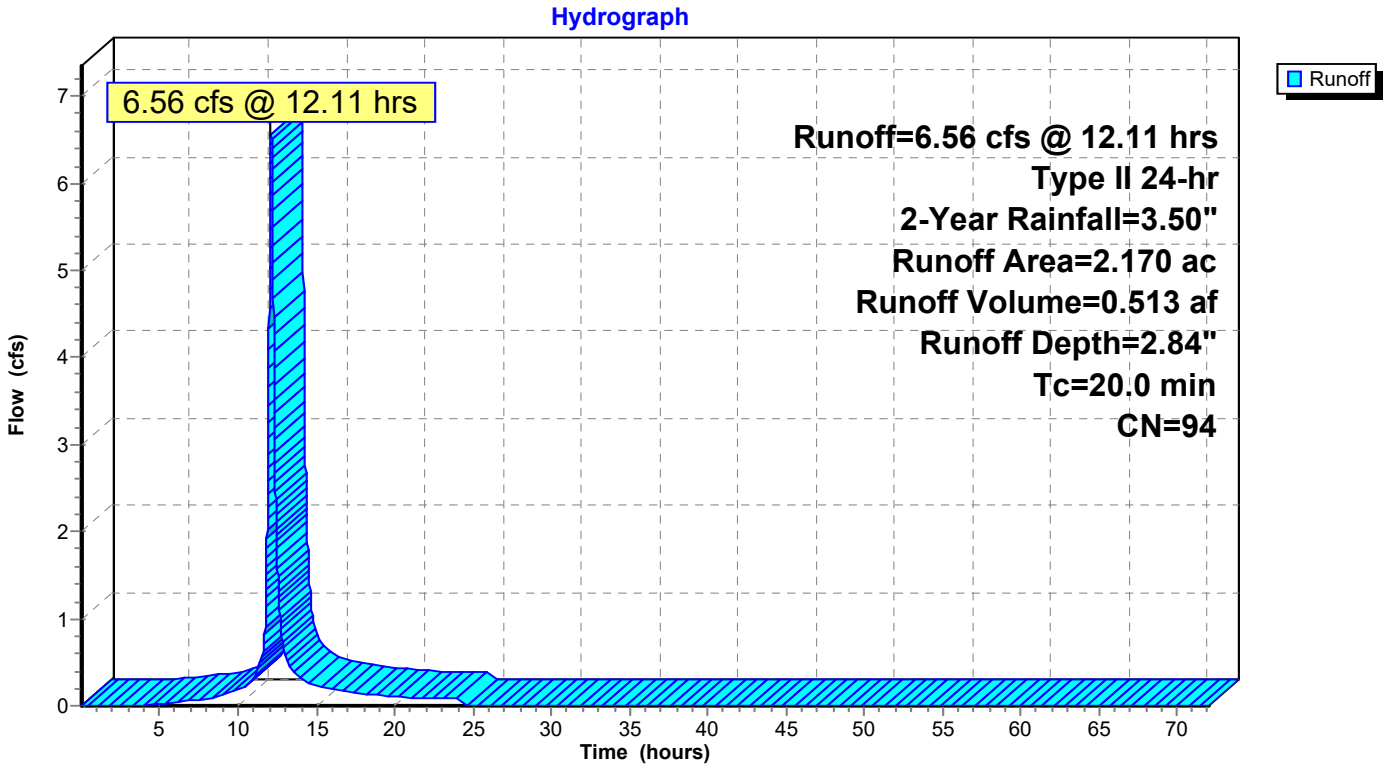
Subcatchment 65S: AREA 4



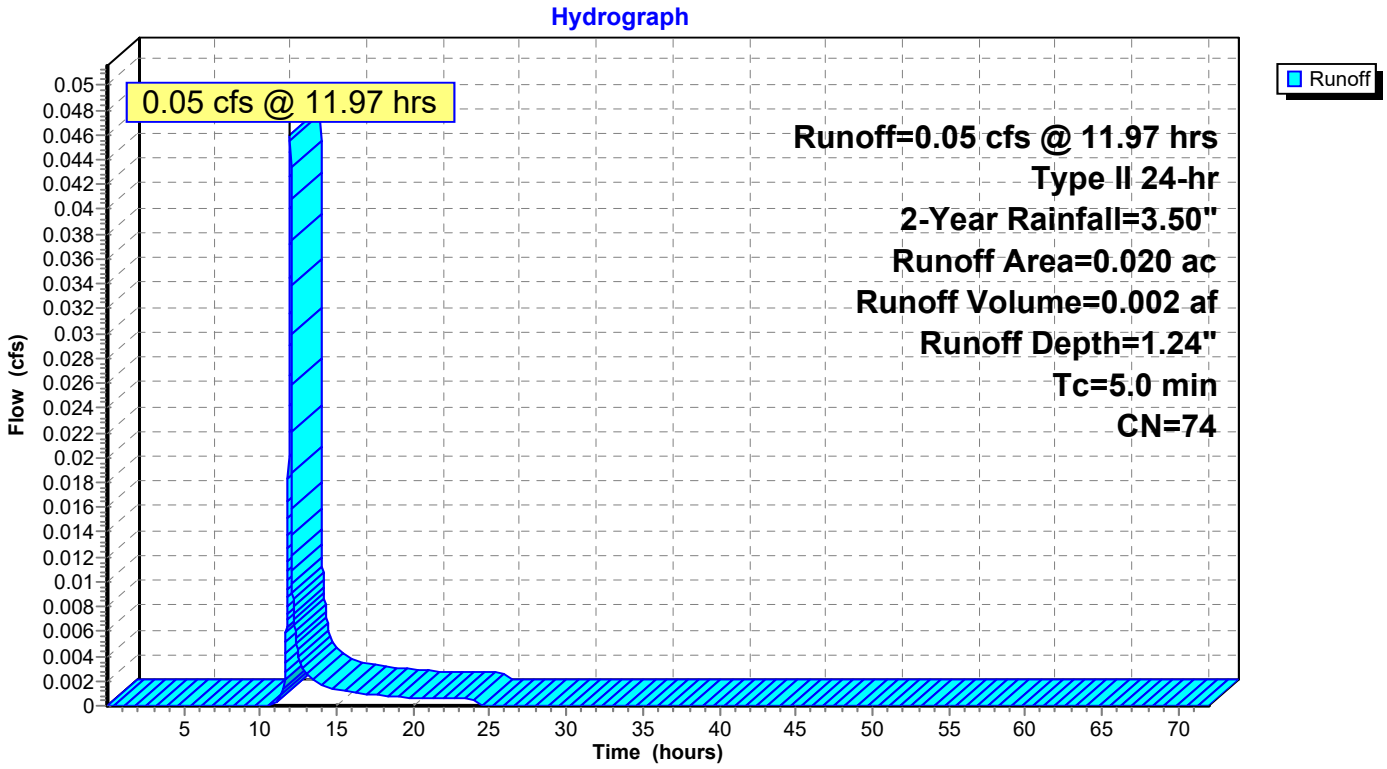
Subcatchment 66S: AREA 5



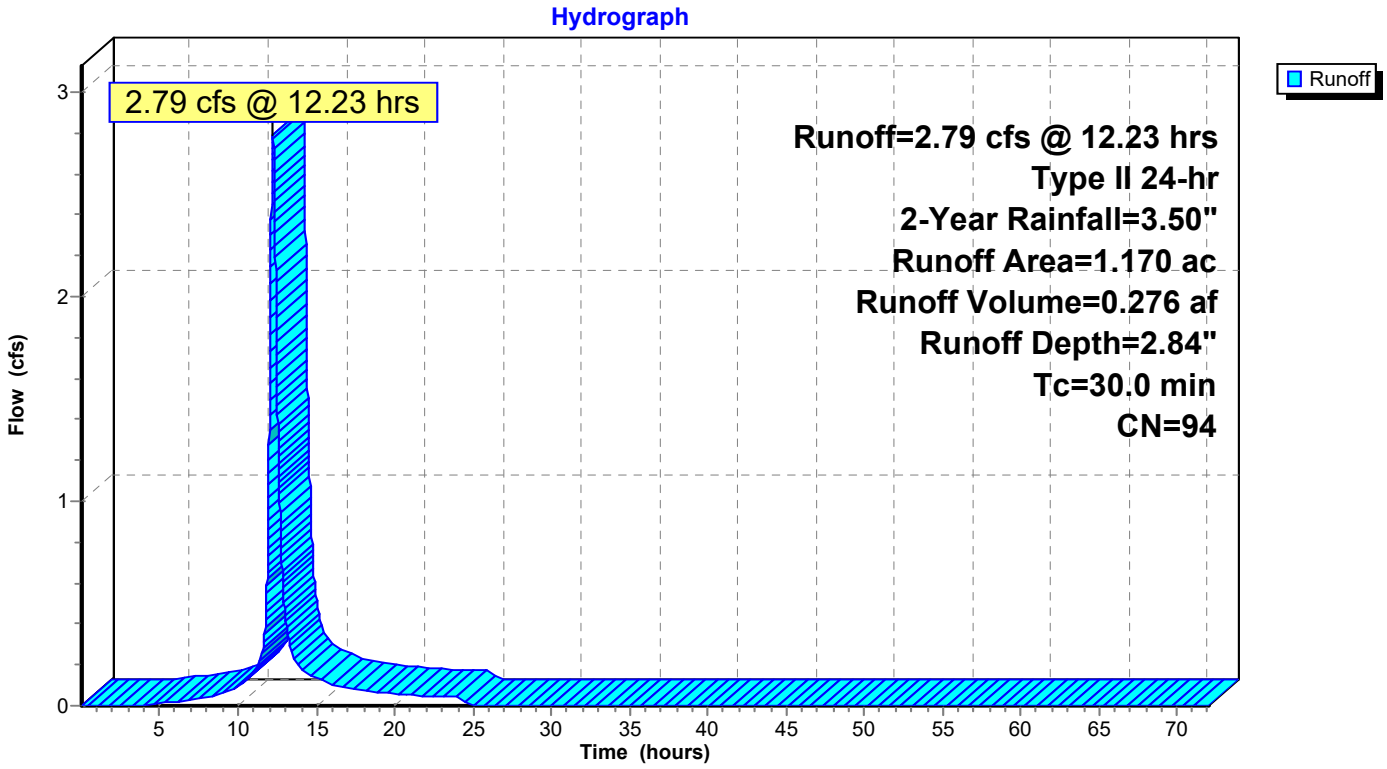
Subcatchment 67S: OFFSITE TO CI 12



Subcatchment 68S: AREA TO AI 11

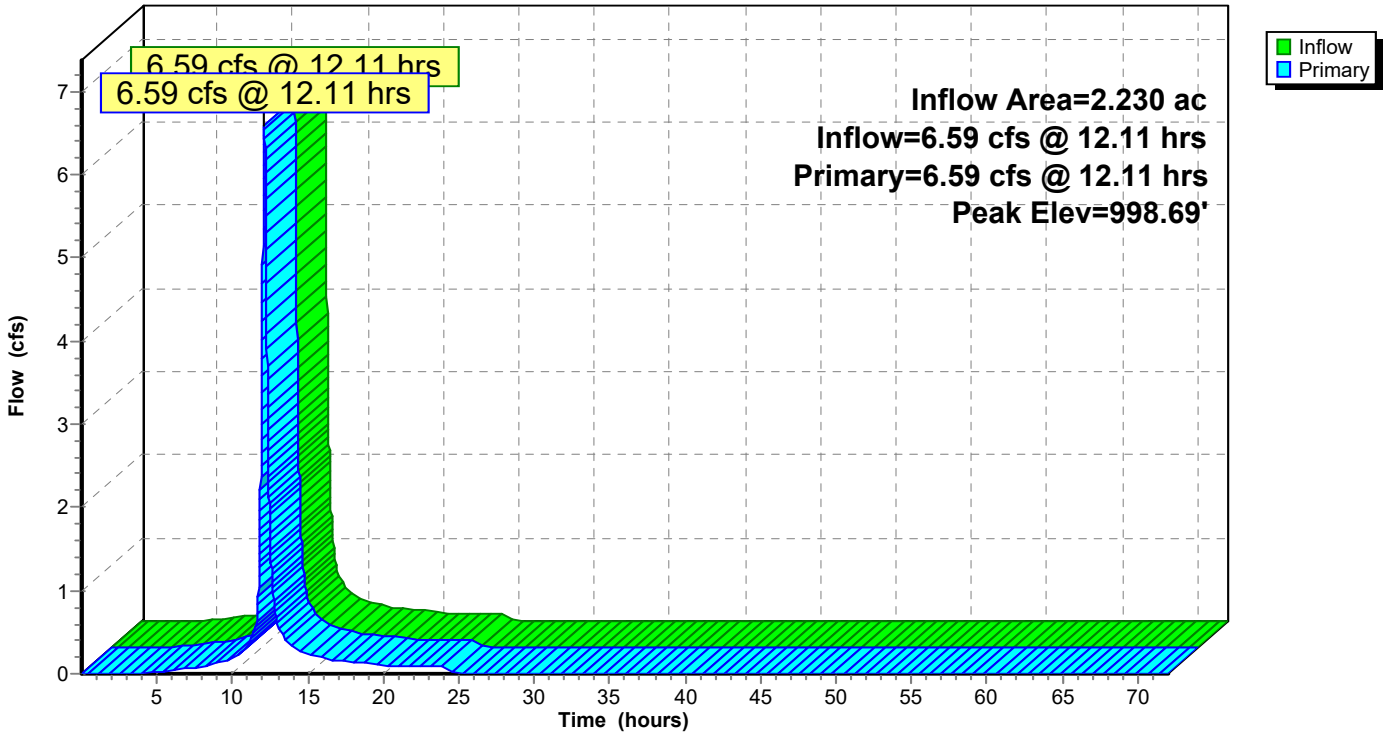


Subcatchment 69S: OFFSITE TO BMP



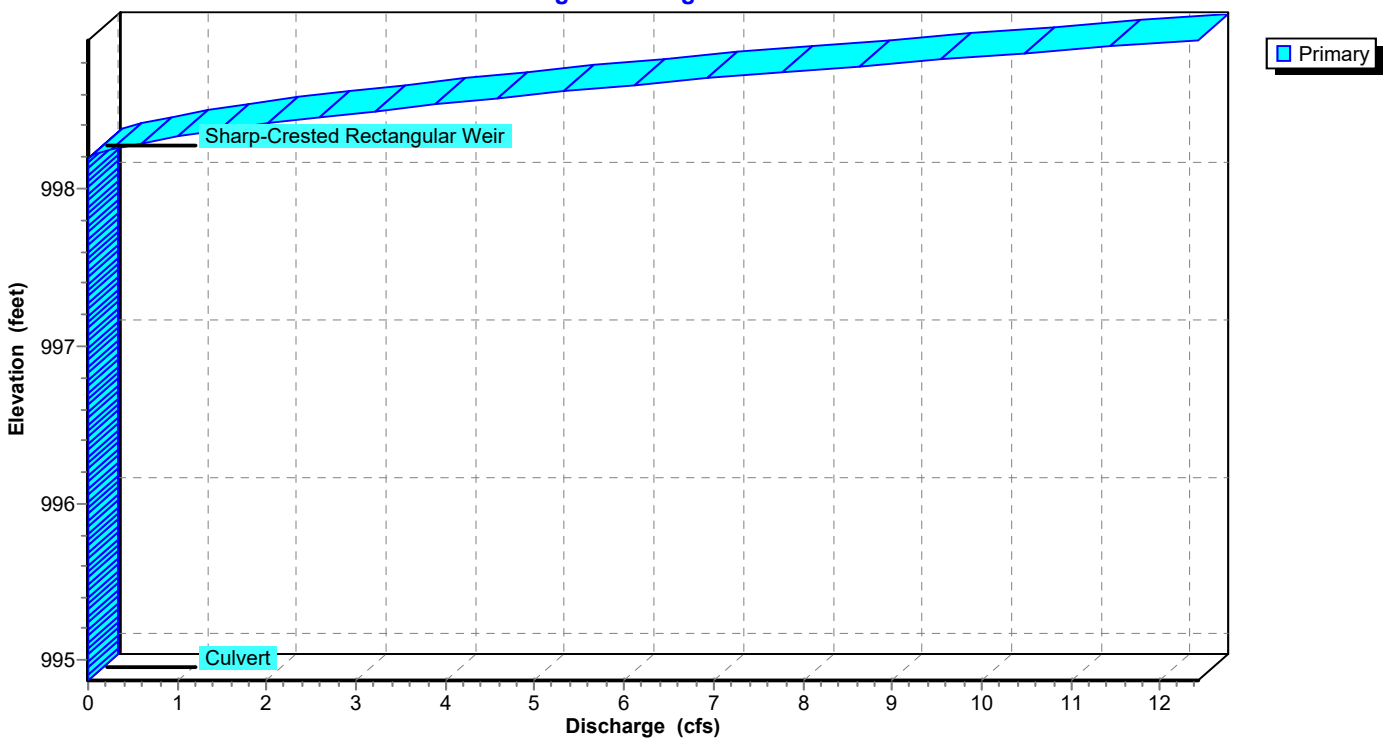
Pond 10P: 12-11

Hydrograph

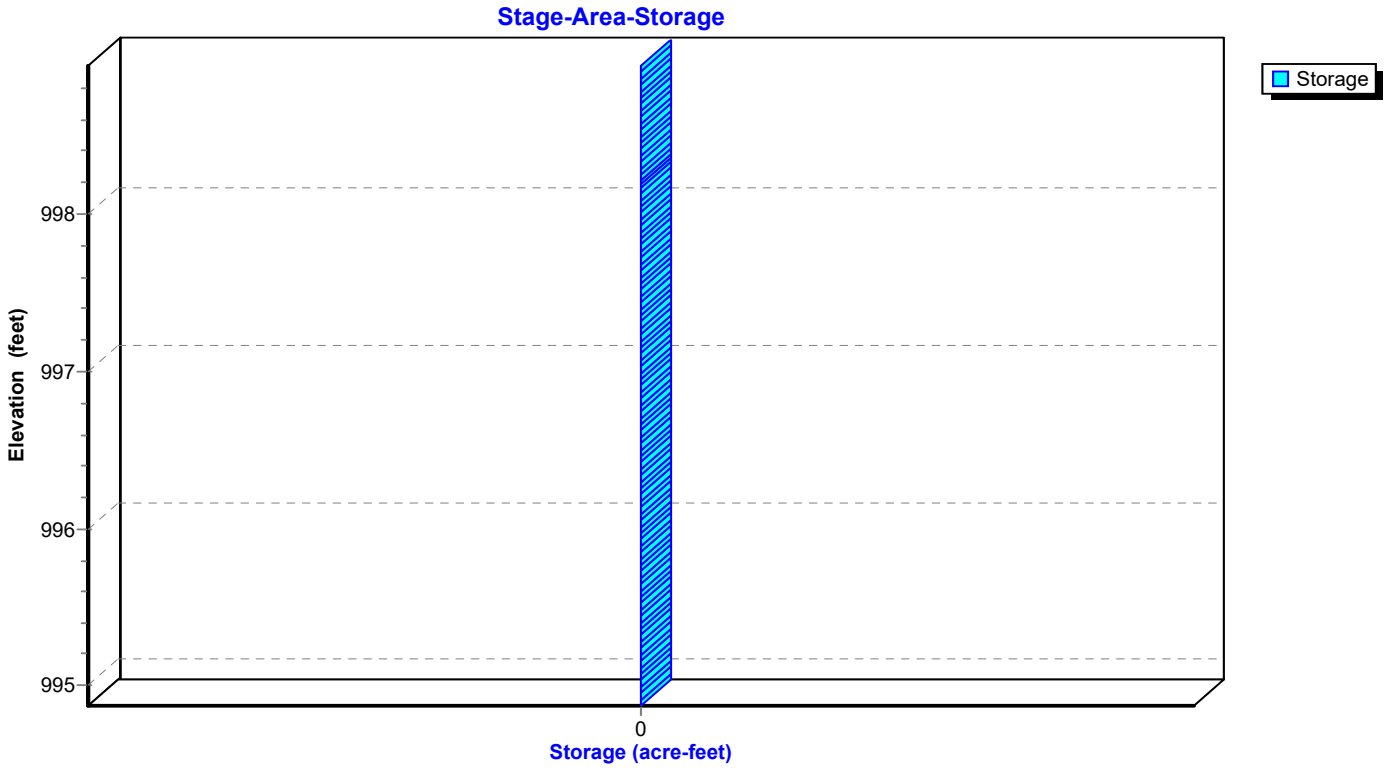


Pond 10P: 12-11

Stage-Discharge

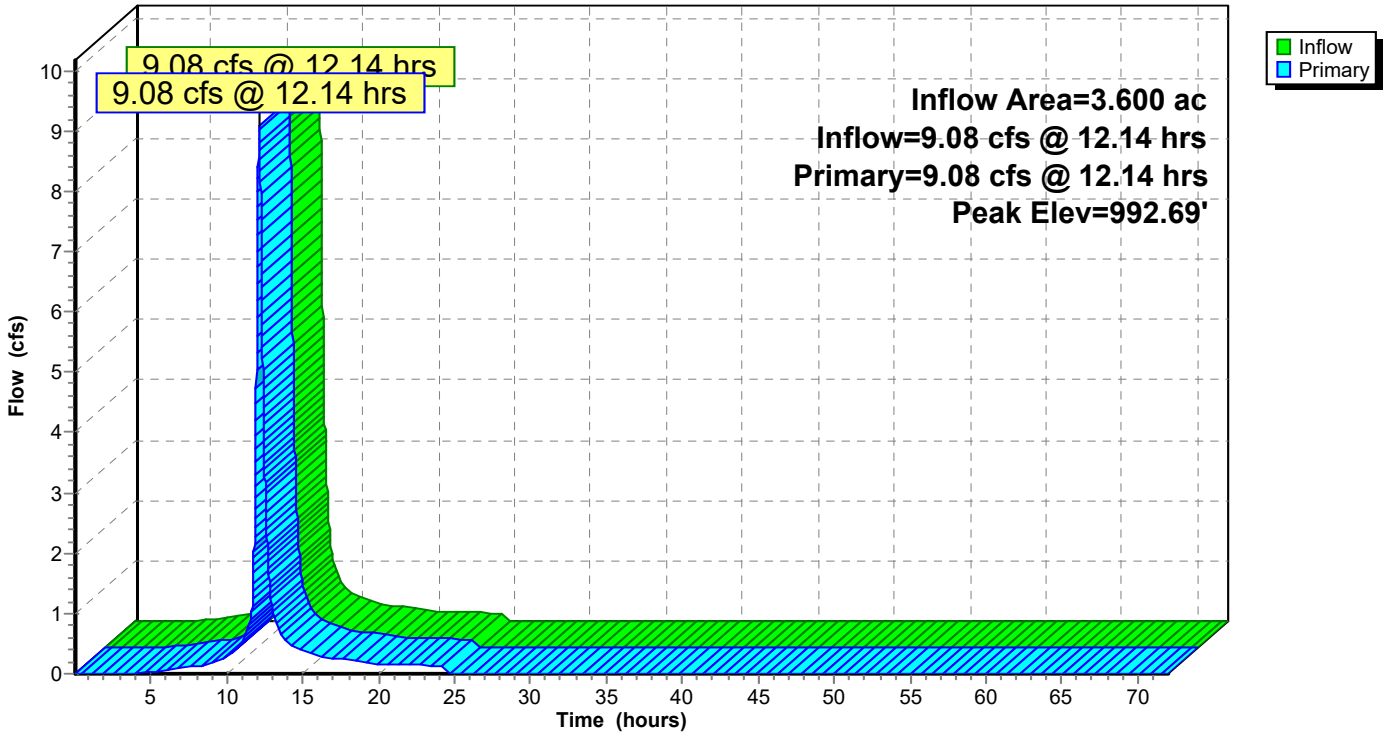


Pond 10P: 12-11



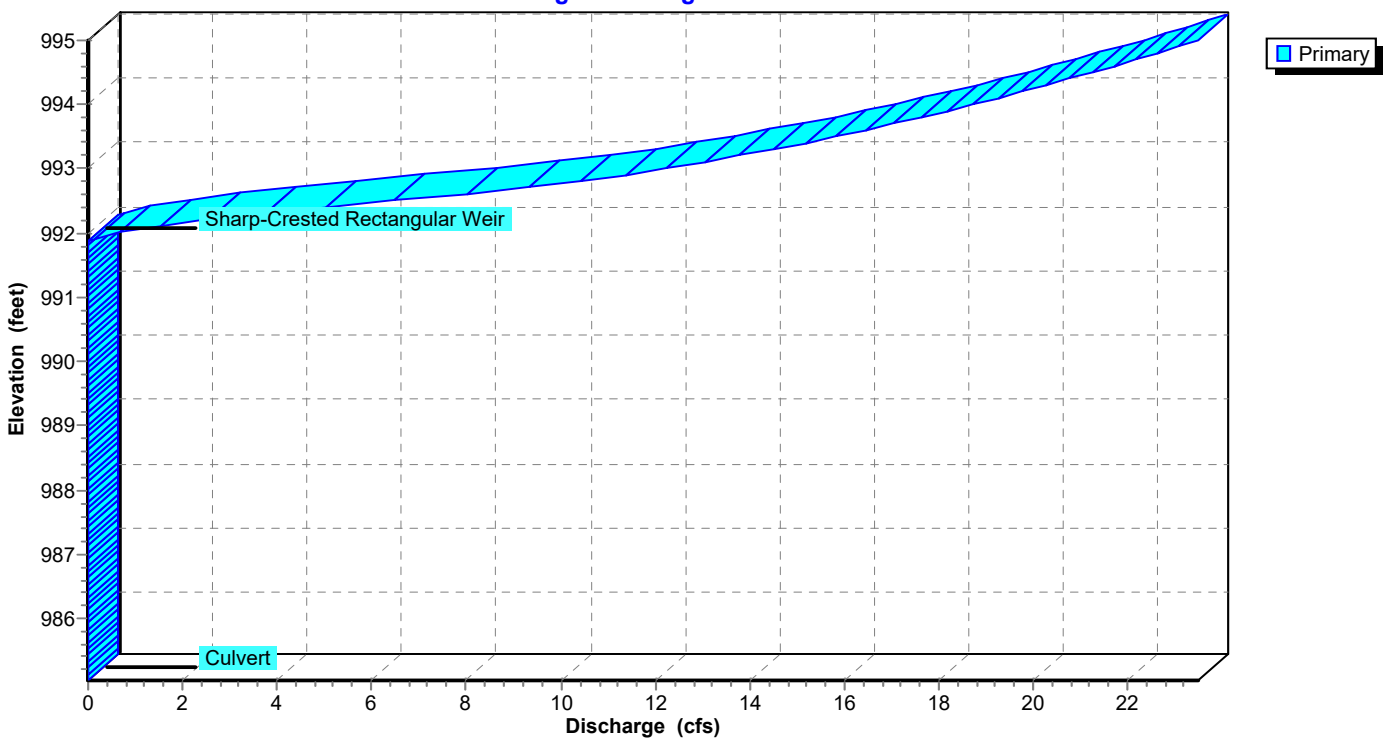
Pond 11P: 11-10

Hydrograph

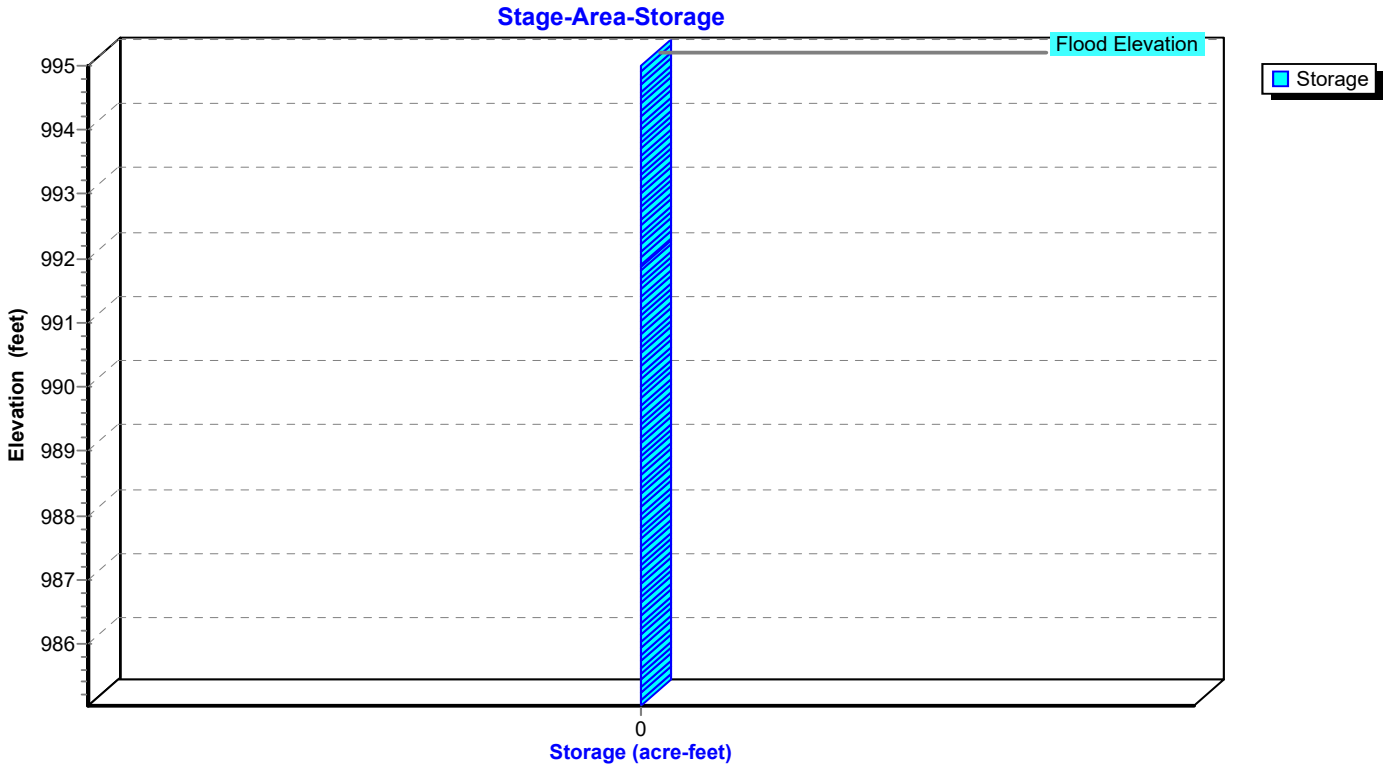


Pond 11P: 11-10

Stage-Discharge

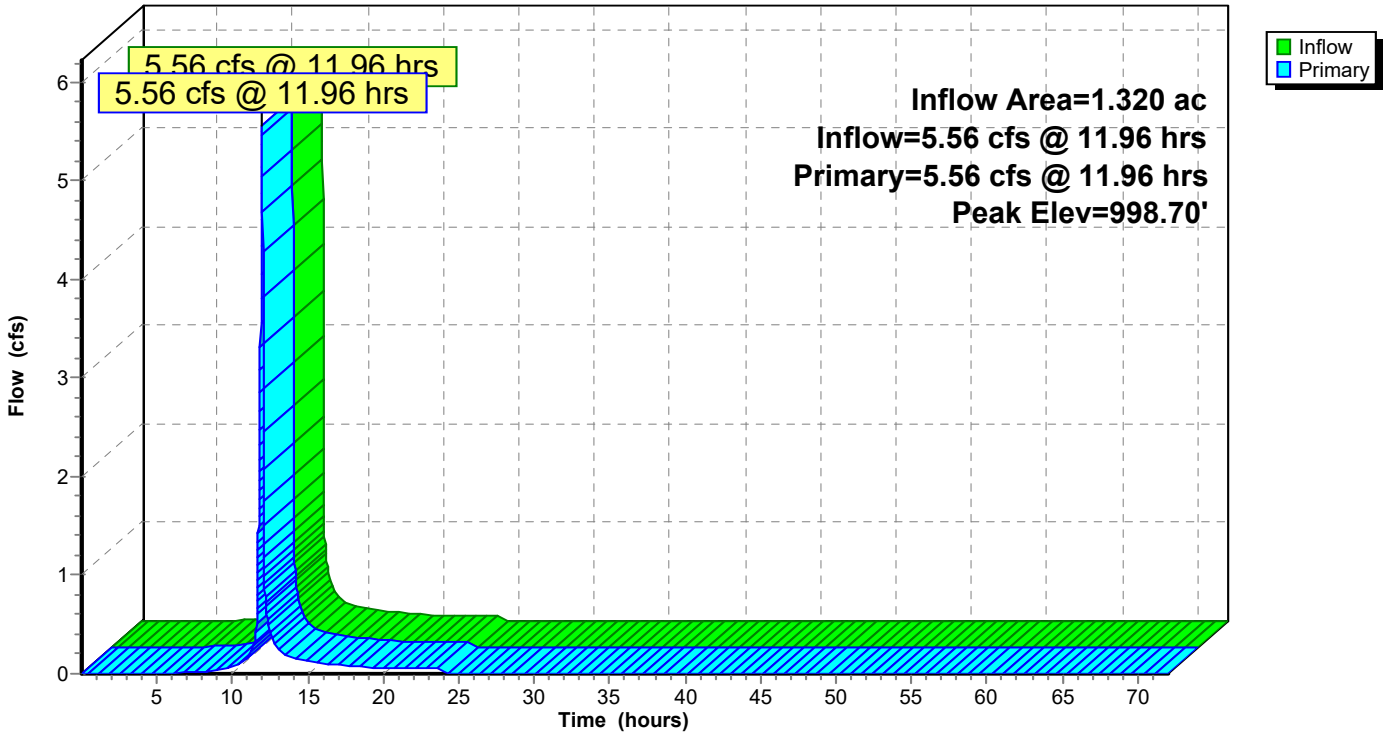


Pond 11P: 11-10



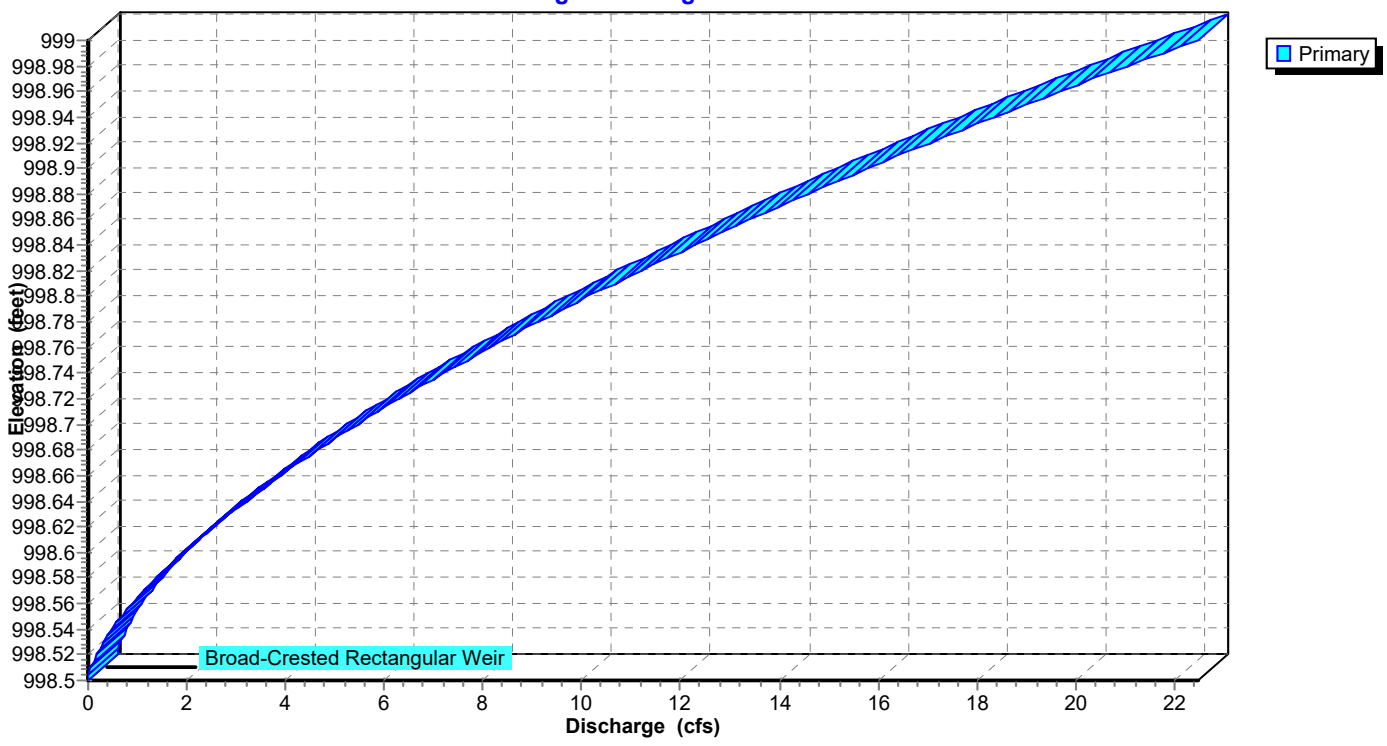
Pond 26P: DETENTION BASIN

Hydrograph

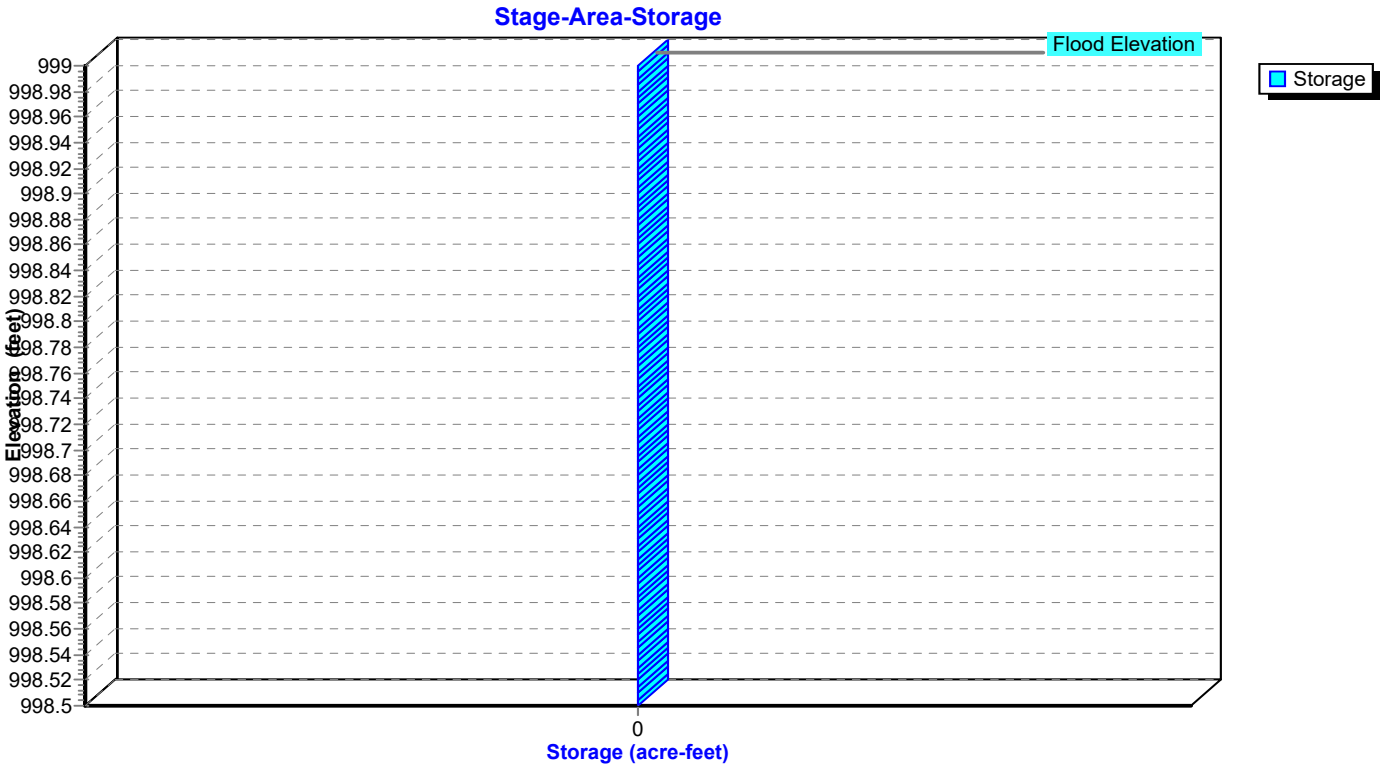


Pond 26P: DETENTION BASIN

Stage-Discharge

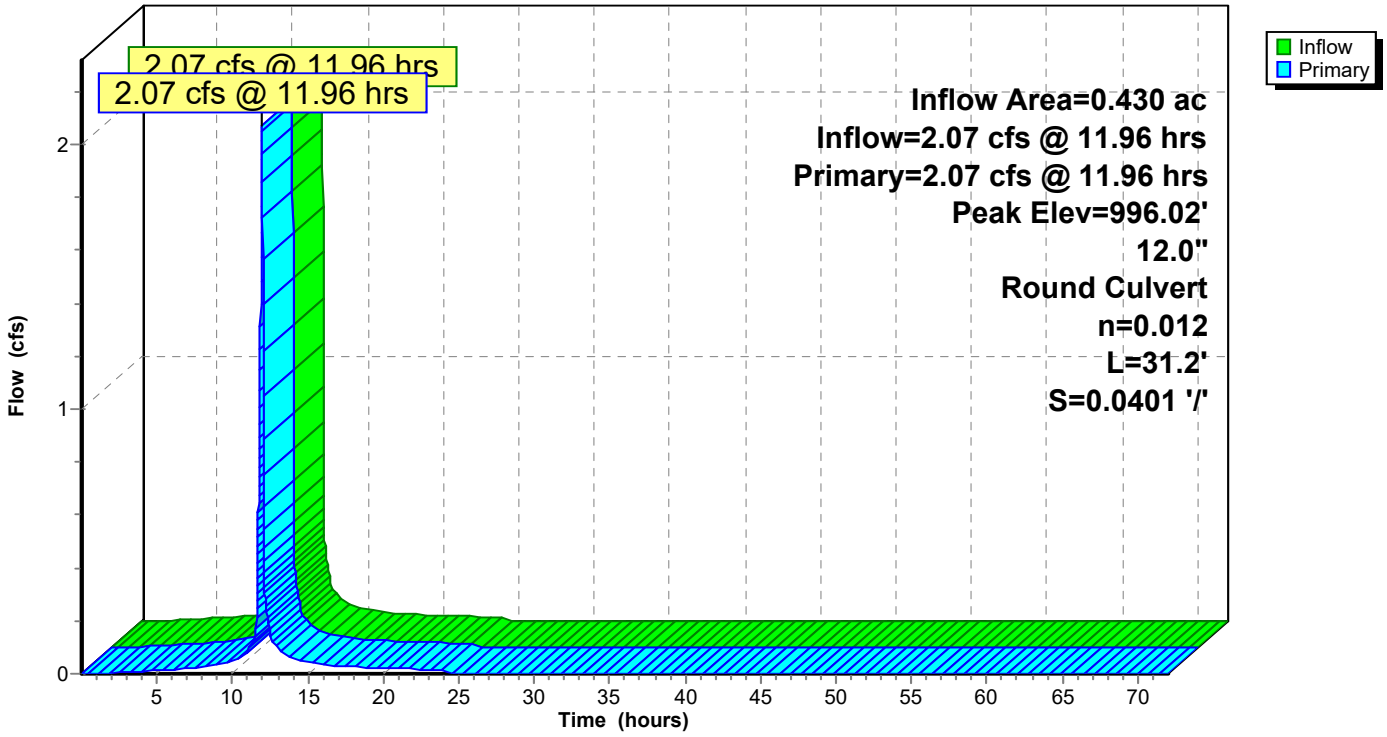


Pond 26P: DETENTION BASIN



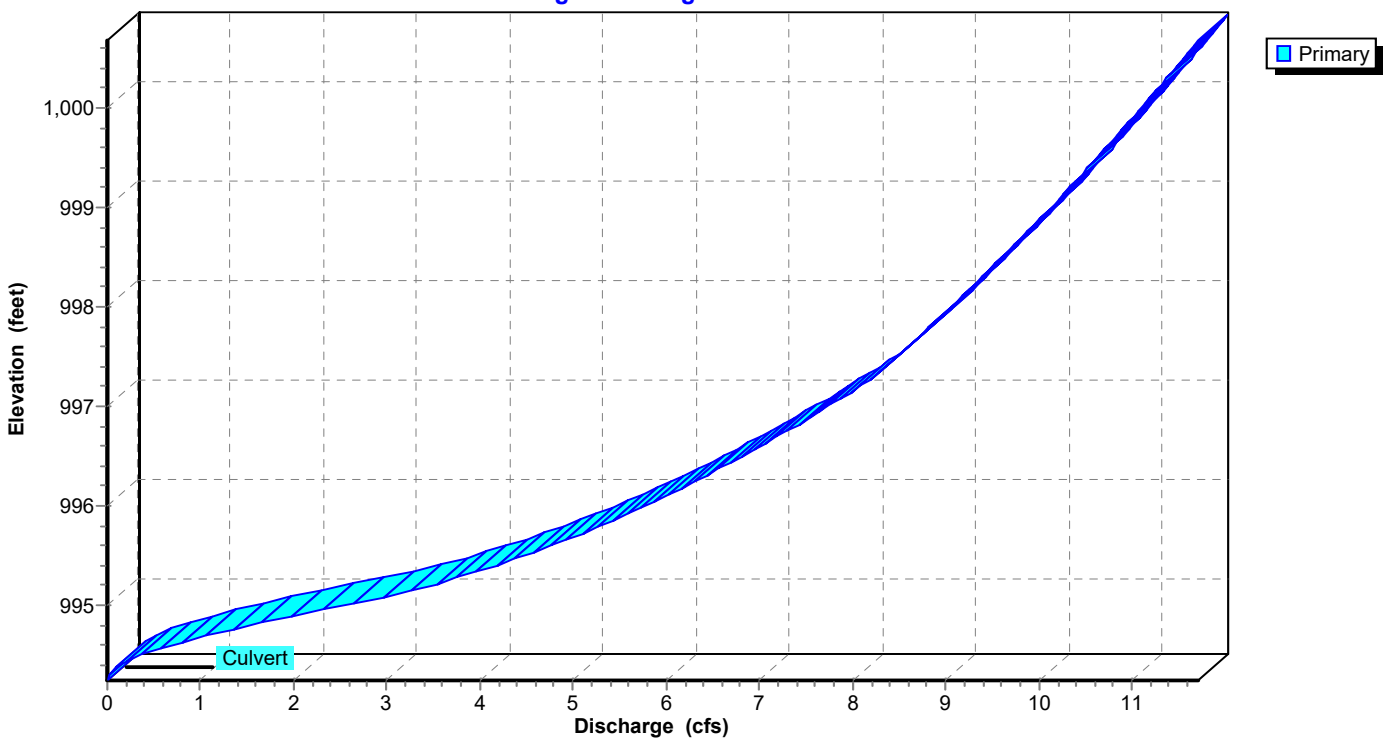
Pond 50P: BASIN REACH

Hydrograph

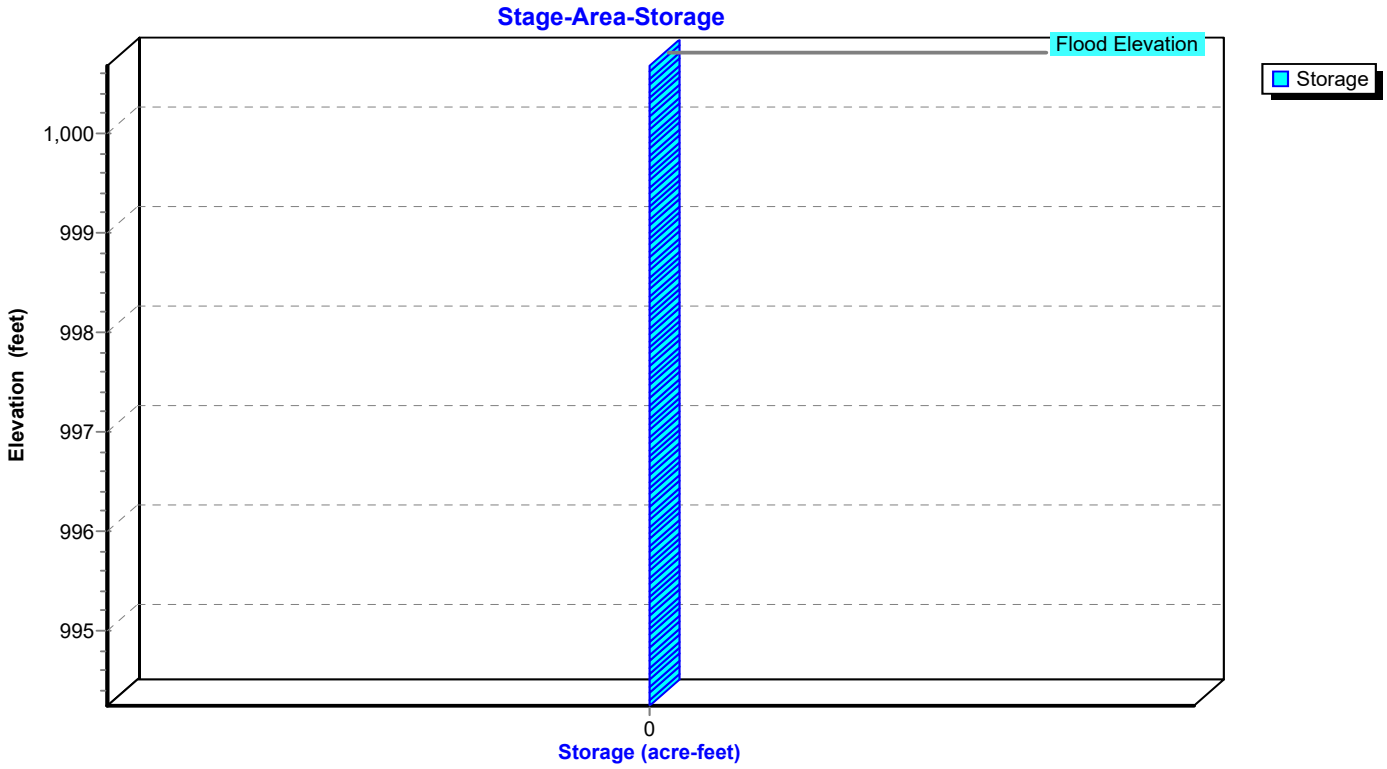


Pond 50P: BASIN REACH

Stage-Discharge

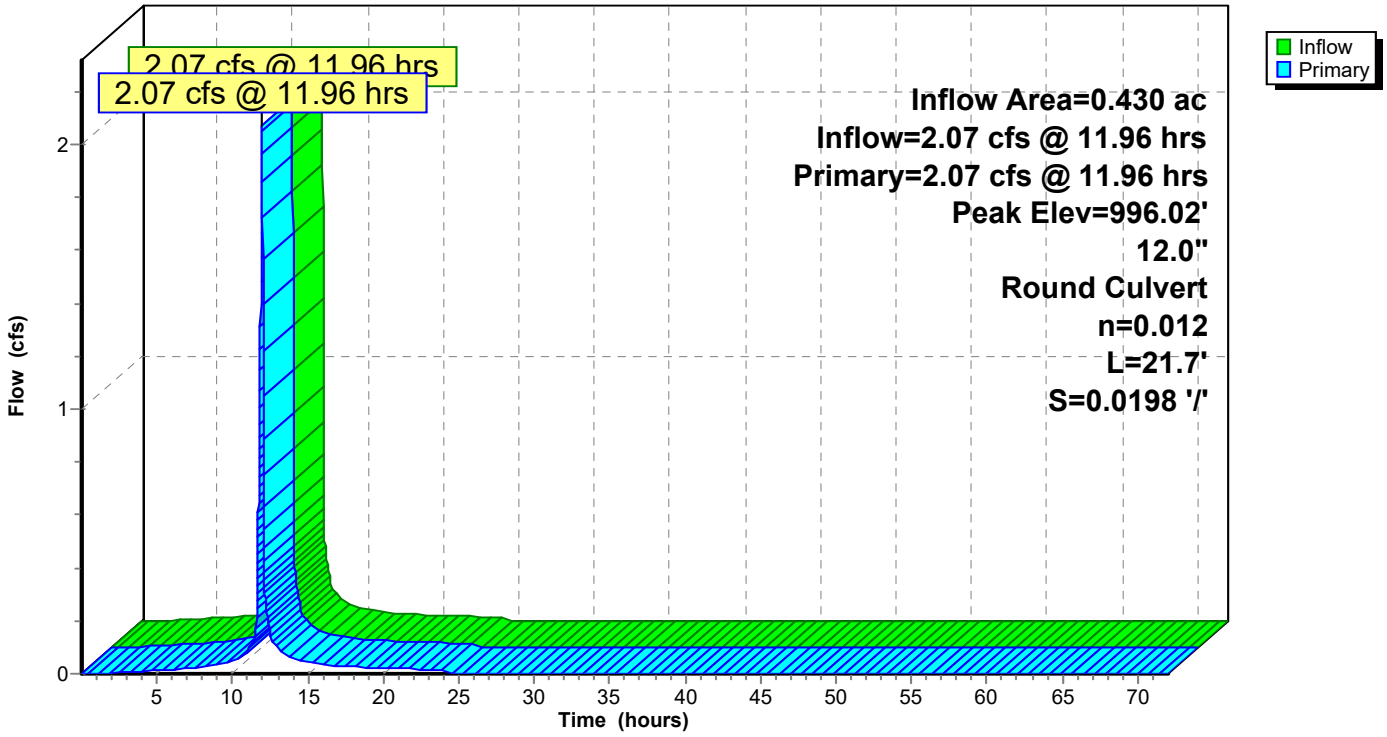


Pond 50P: BASIN REACH



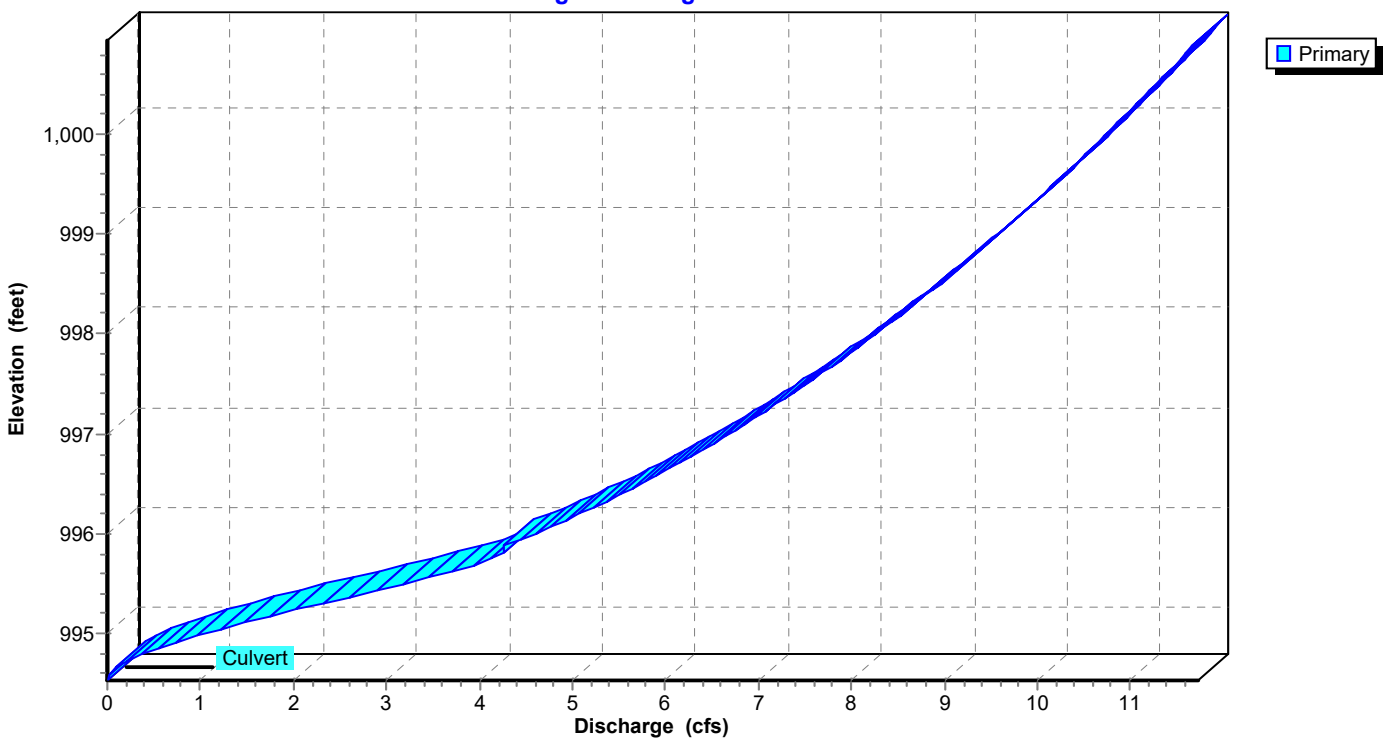
Pond 51P: ROOF DRAINS TO BASIN

Hydrograph

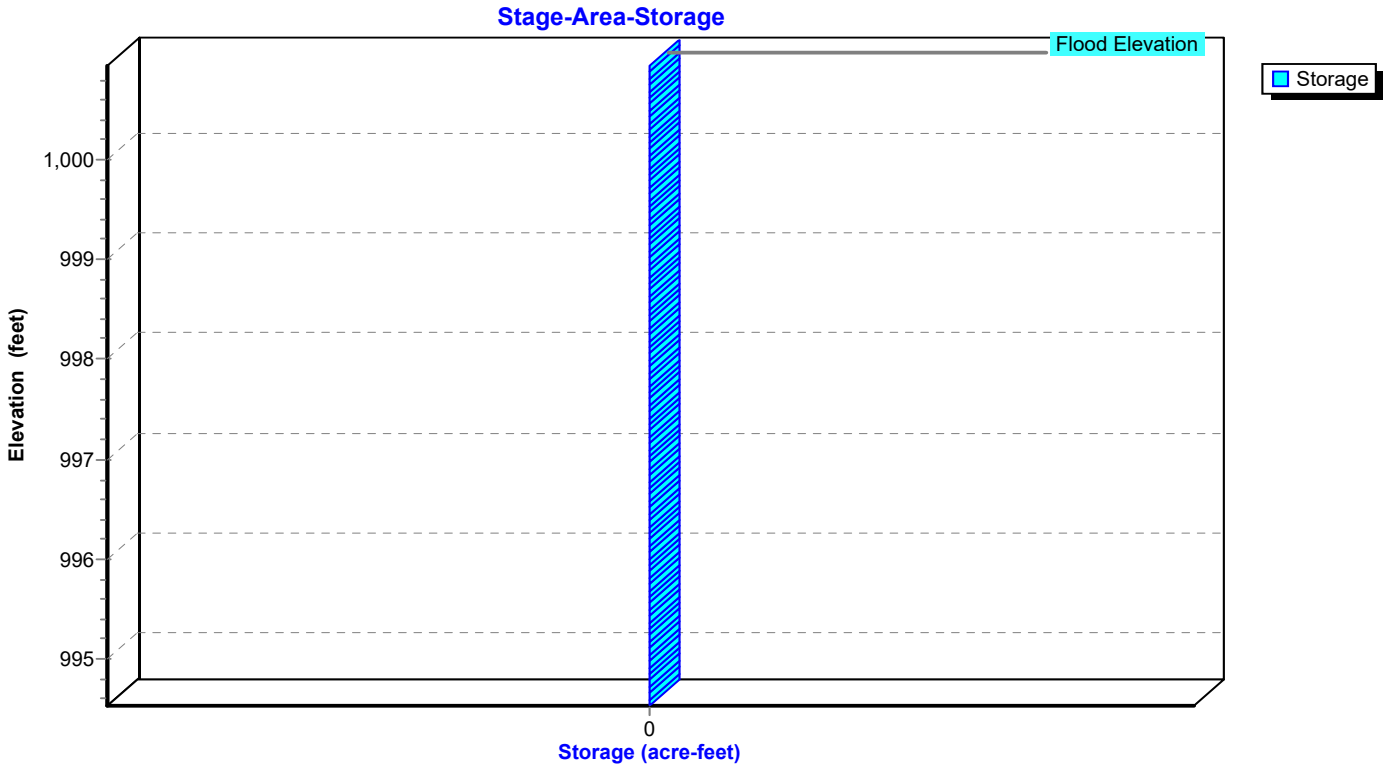


Pond 51P: ROOF DRAINS TO BASIN

Stage-Discharge

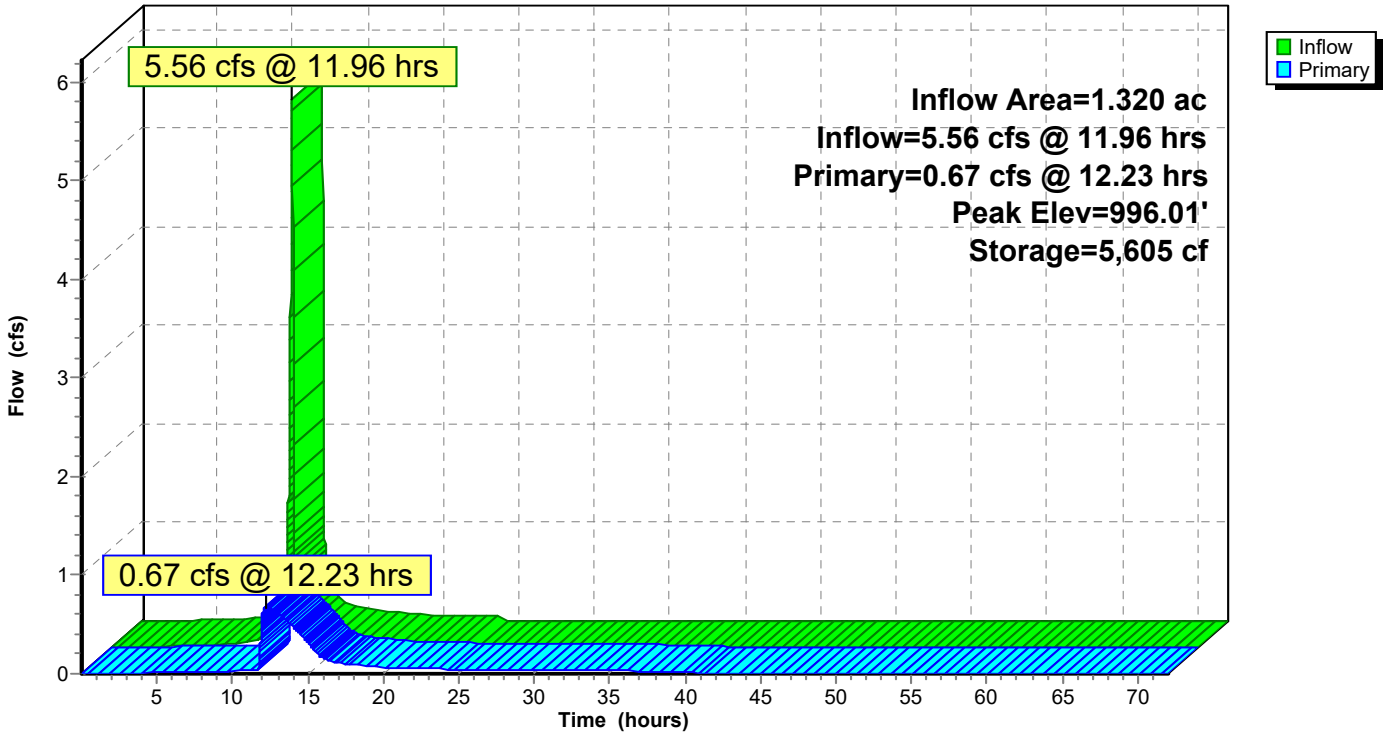


Pond 51P: ROOF DRAINS TO BASIN



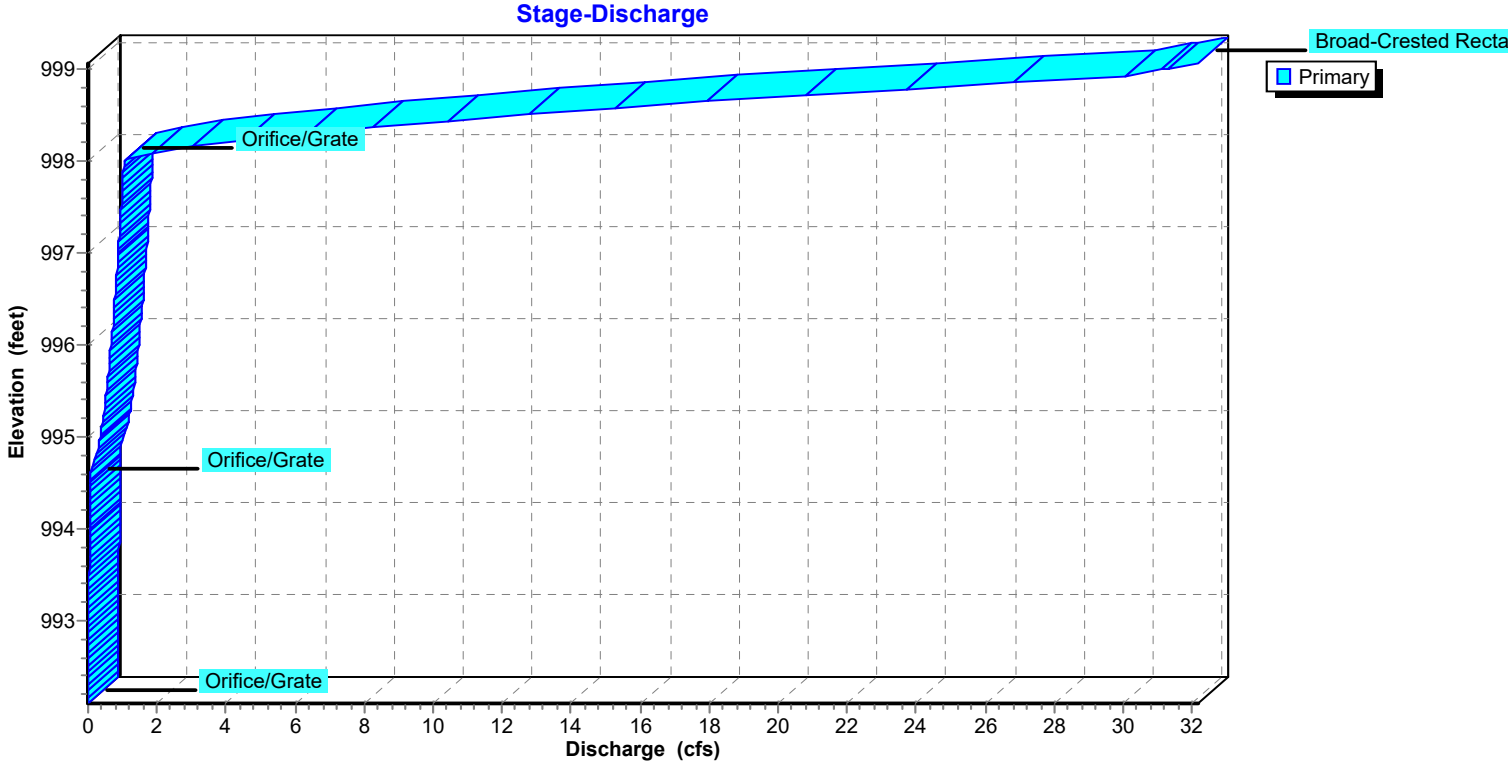
Pond 52P: DETENTION BASIN

Hydrograph

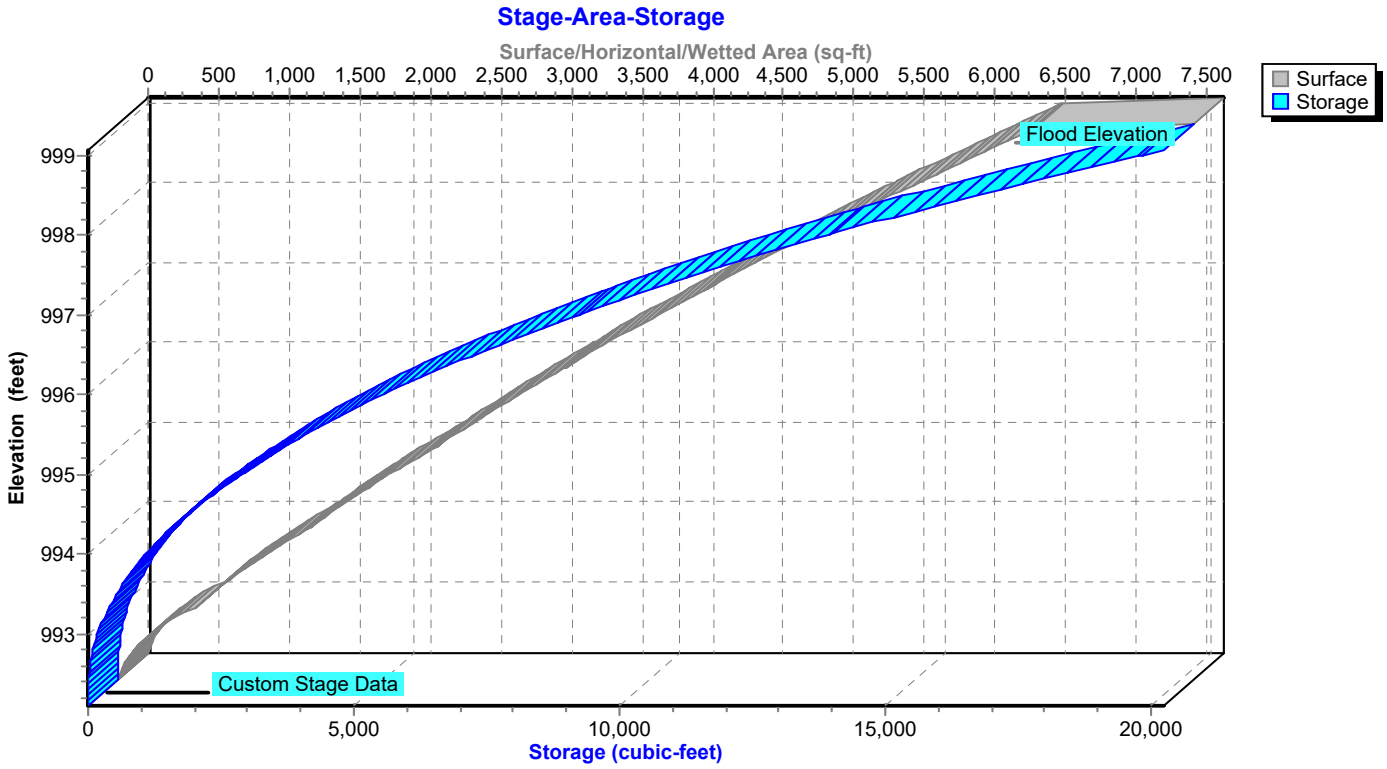


Pond 52P: DETENTION BASIN

Stage-Discharge

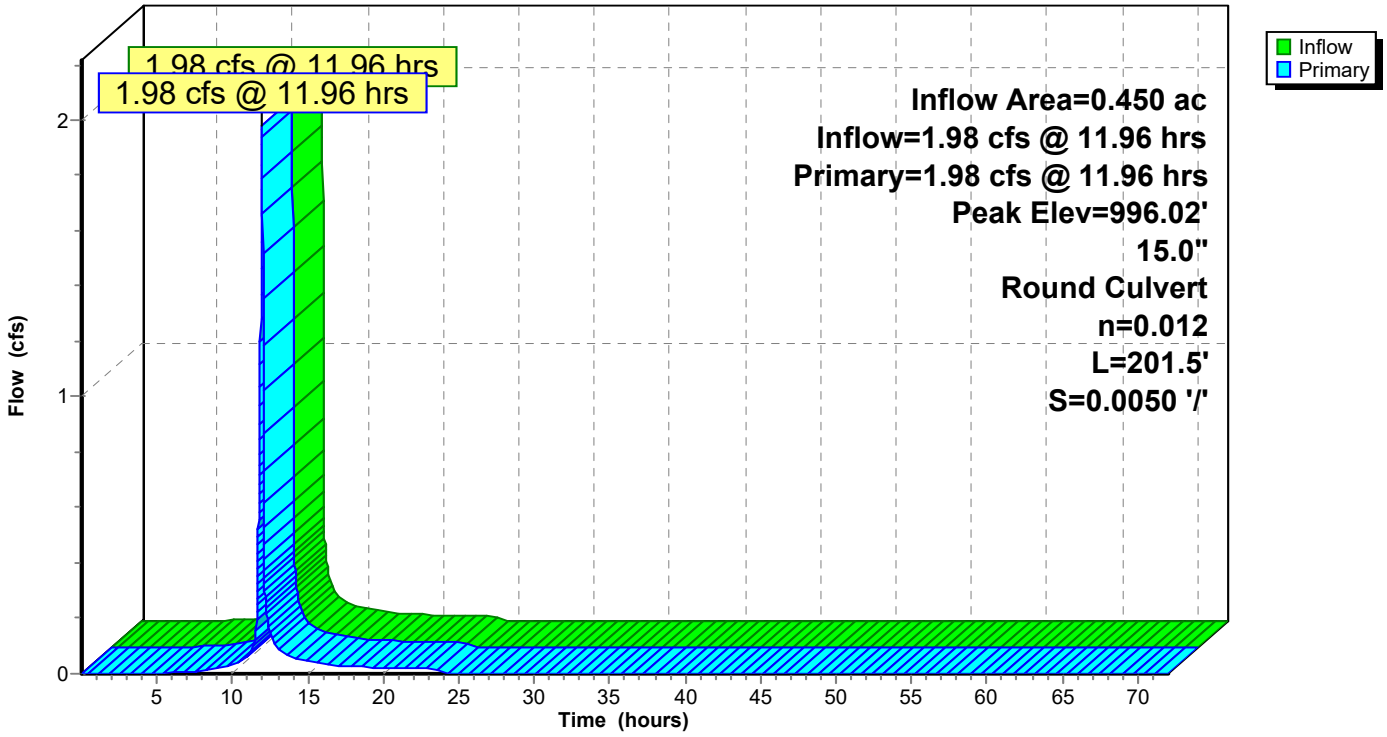


Pond 52P: DETENTION BASIN



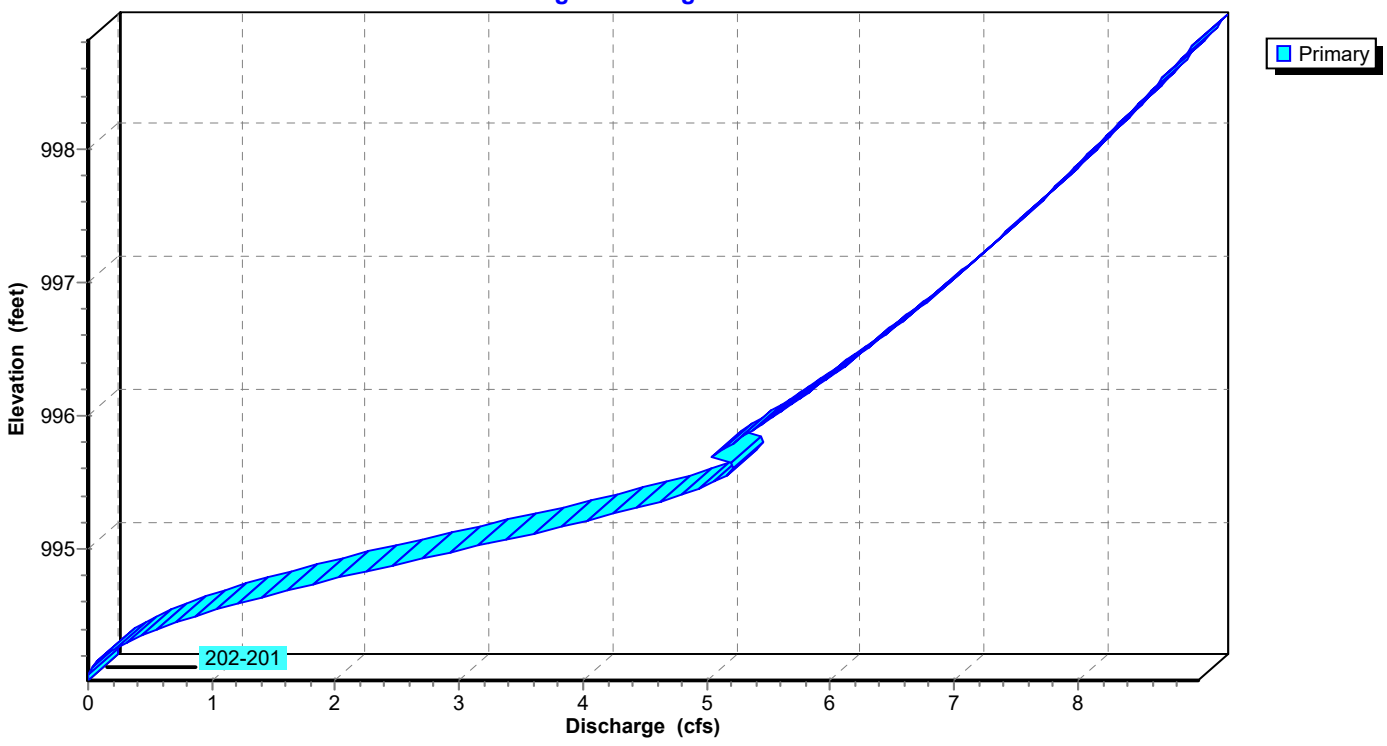
Pond 53P: 301-300

Hydrograph

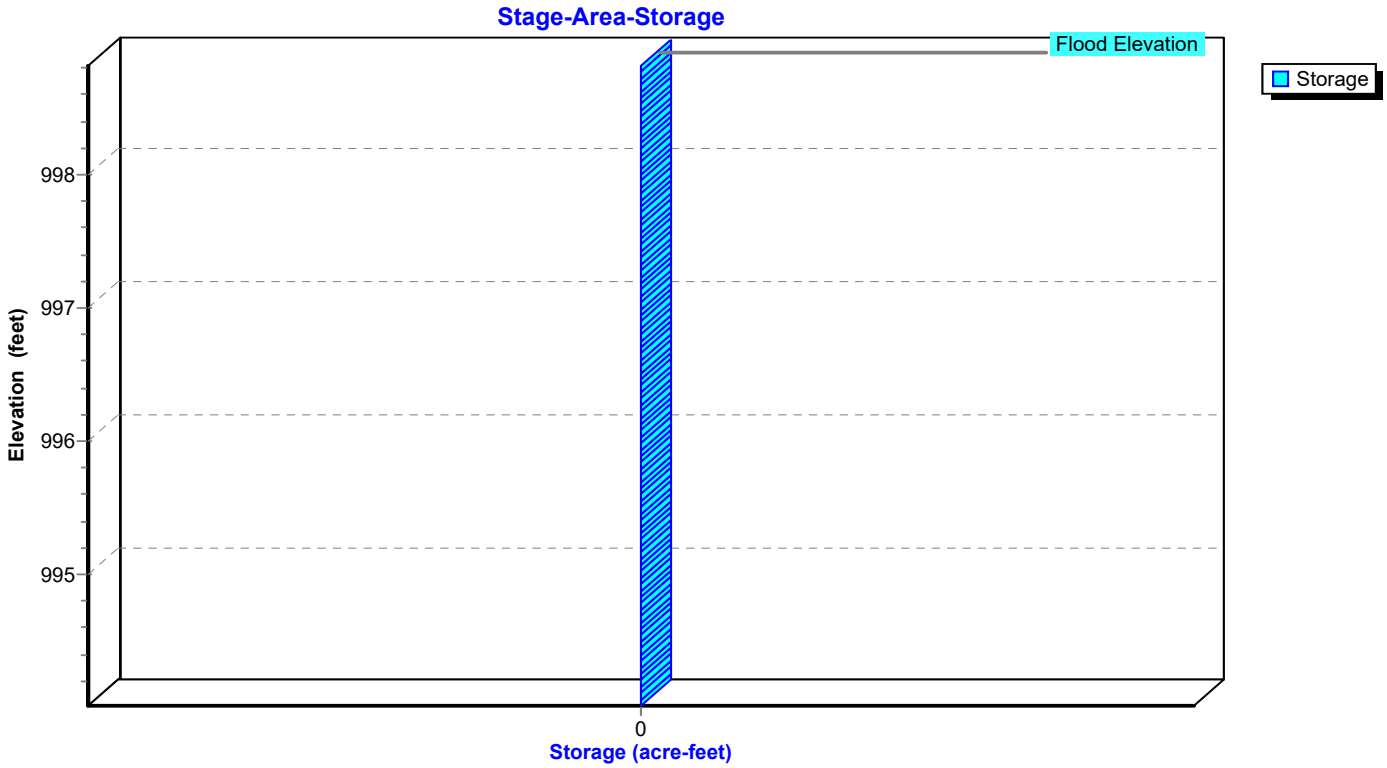


Pond 53P: 301-300

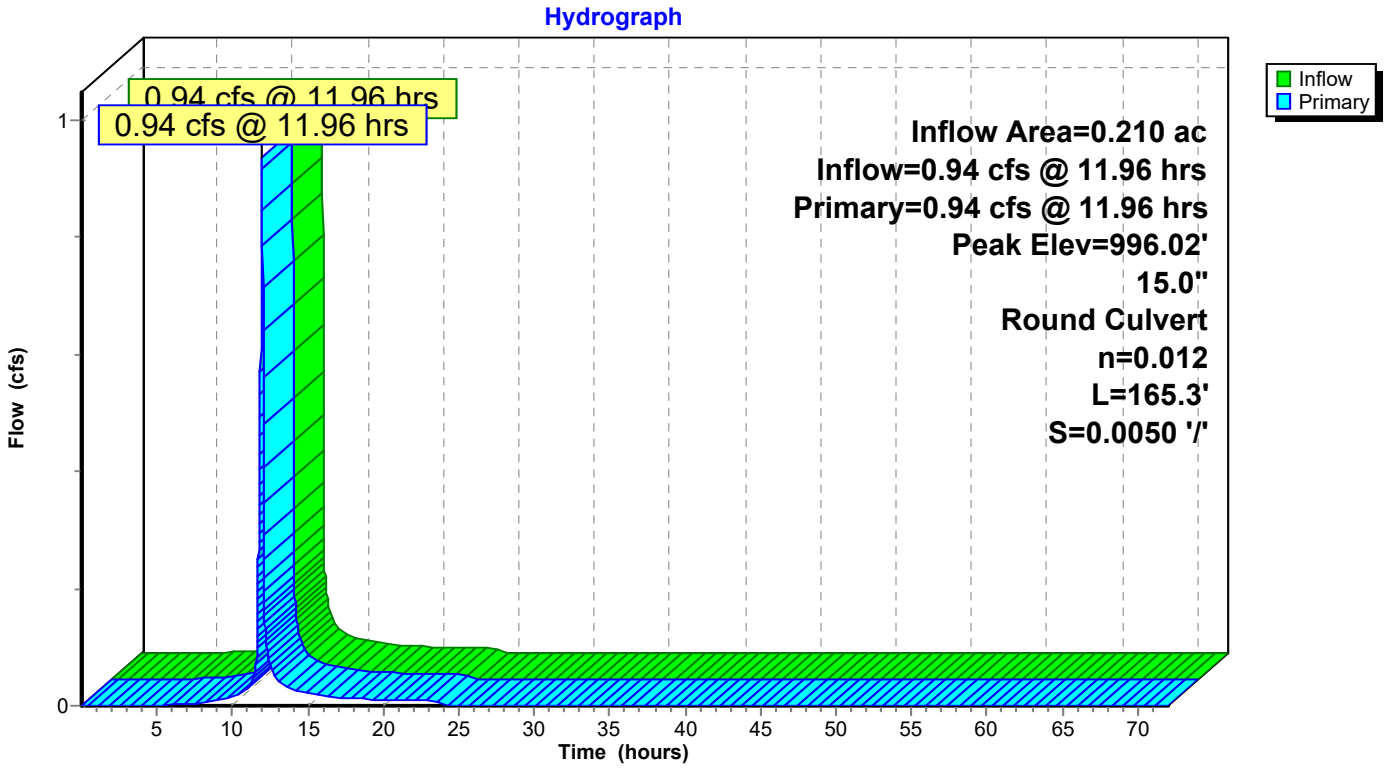
Stage-Discharge



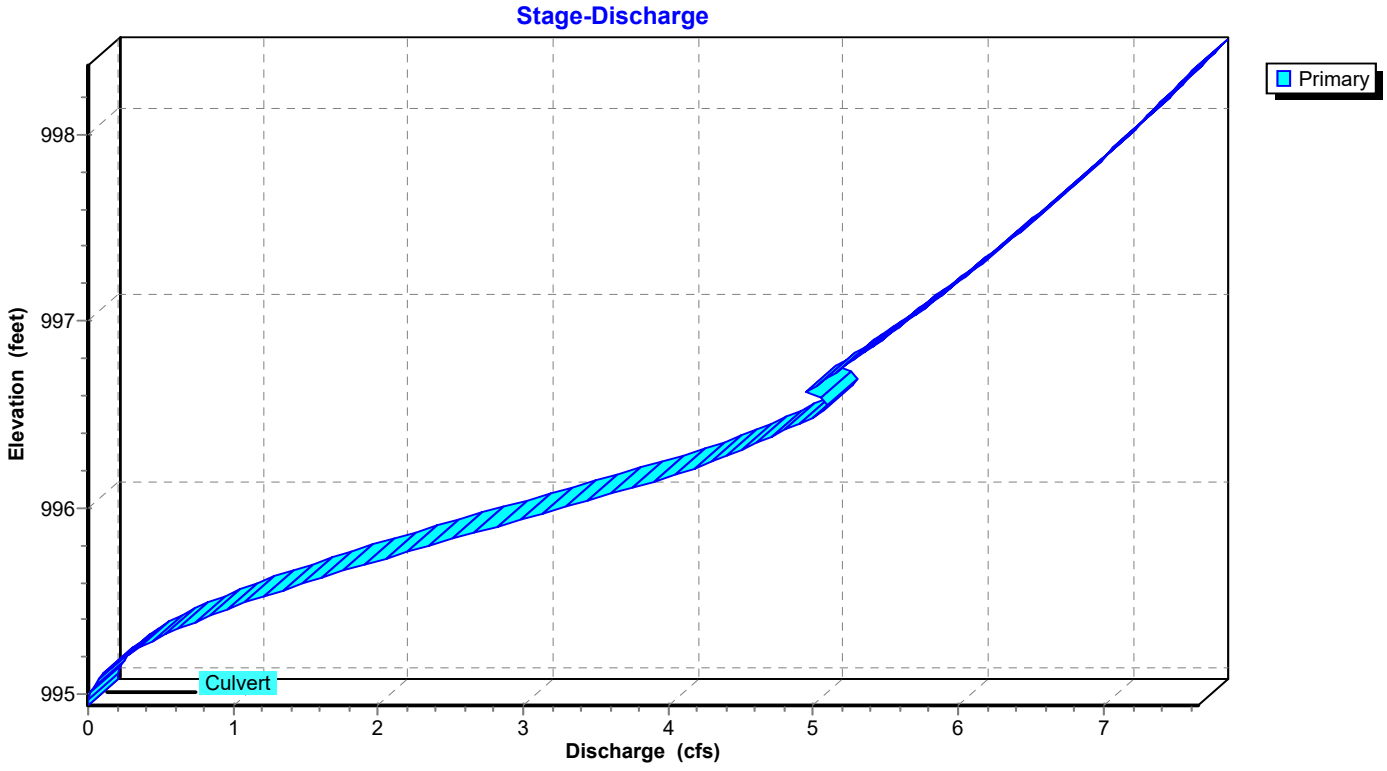
Pond 53P: 301-300



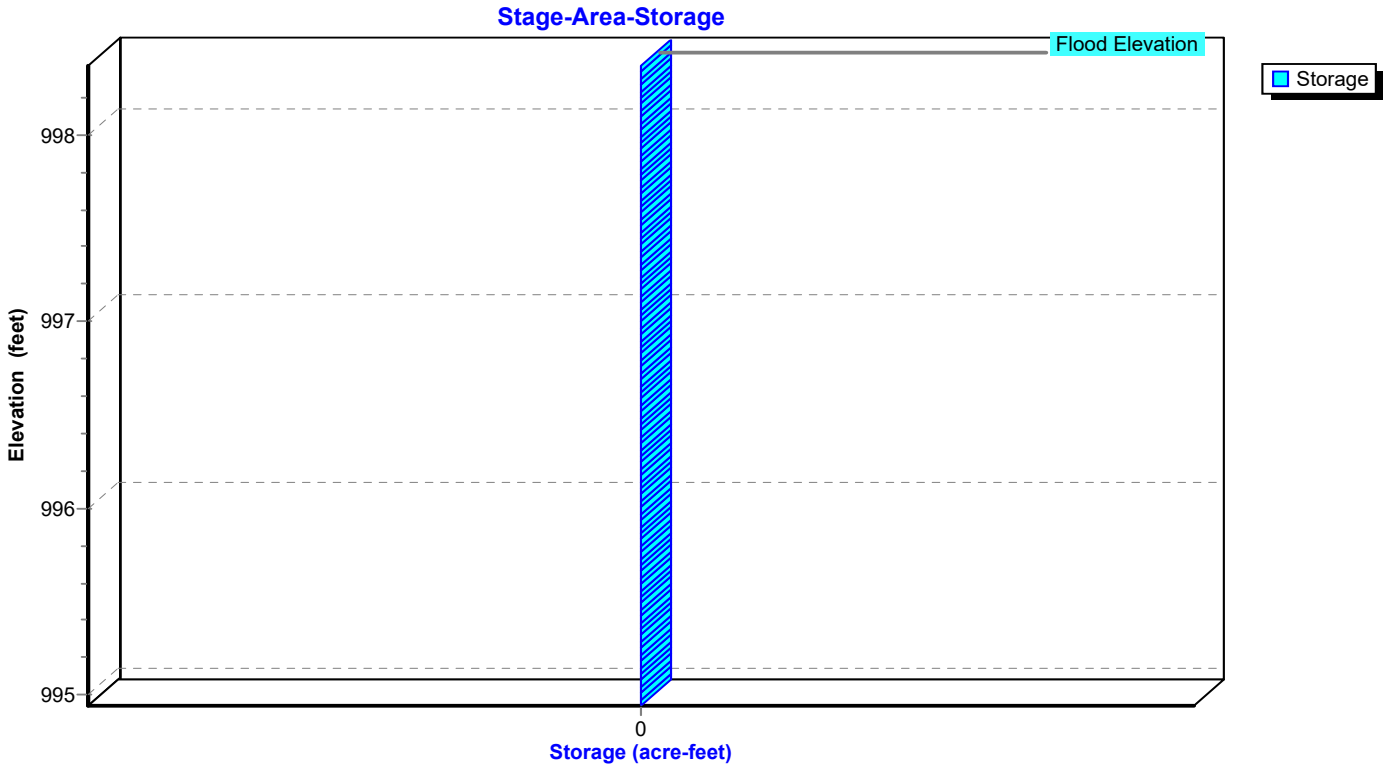
Pond 54P: 302-301



Pond 54P: 302-301

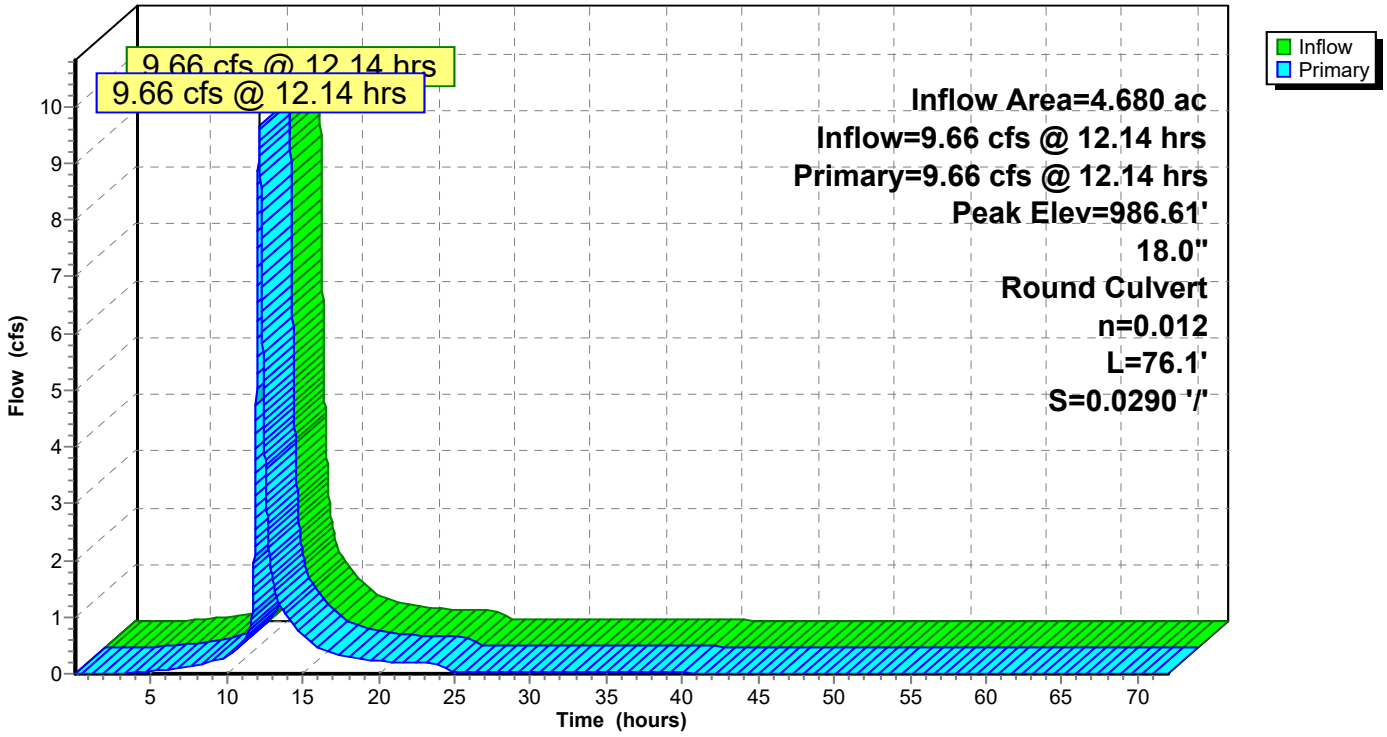


Pond 54P: 302-301



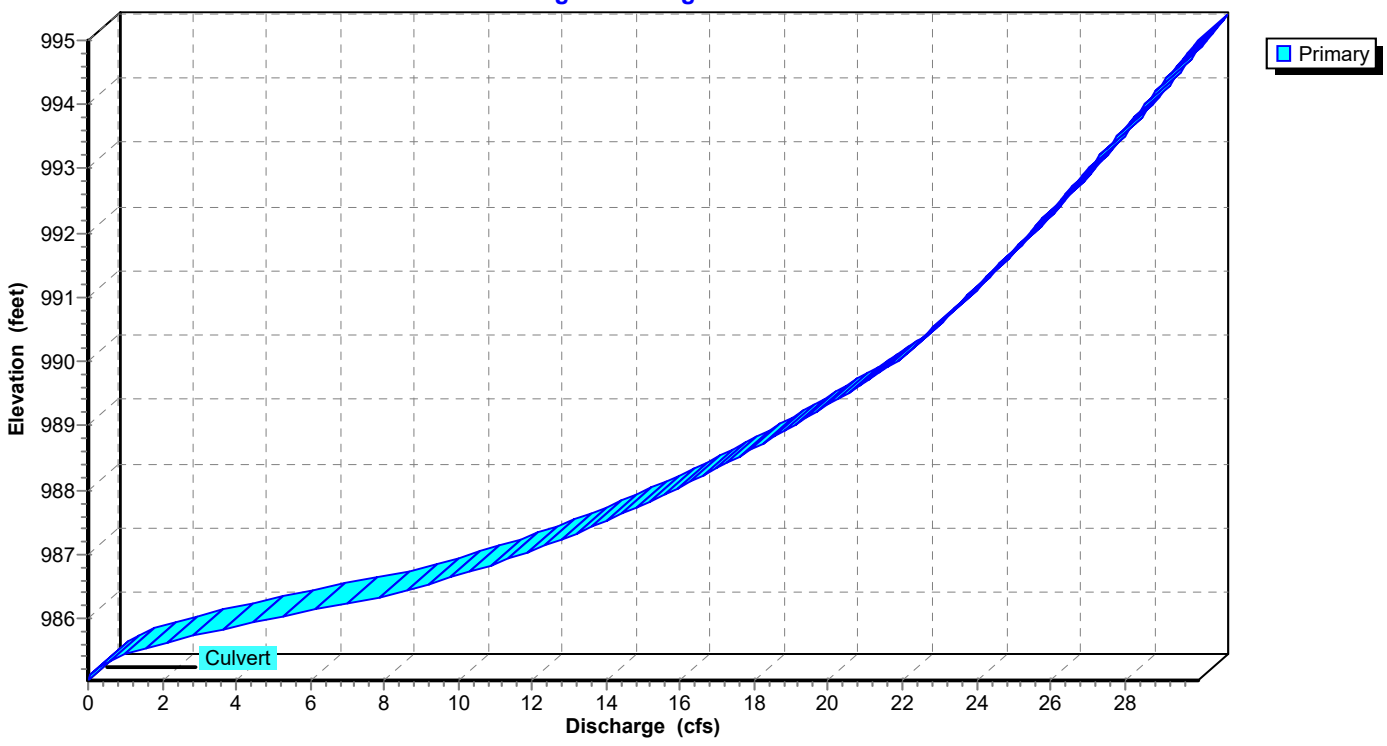
Pond 55P: 11-10

Hydrograph

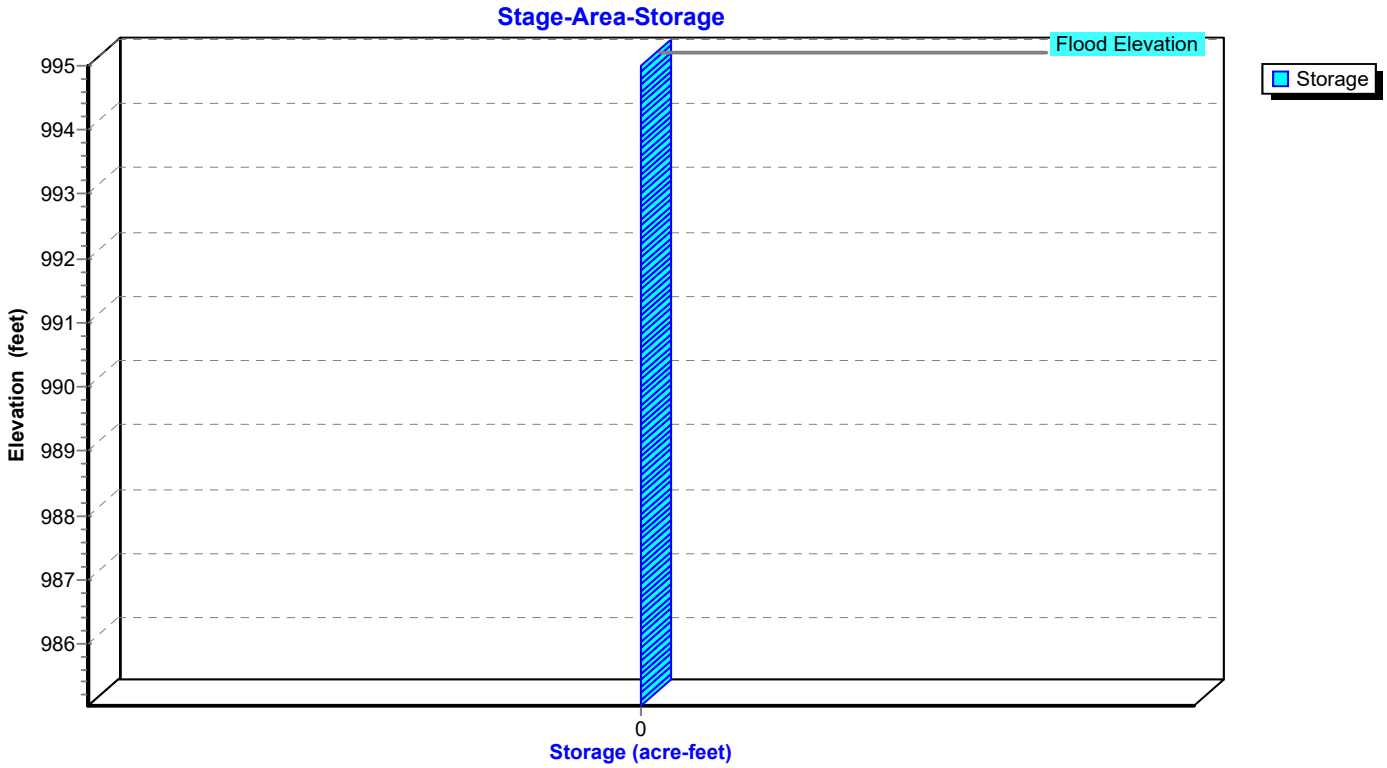


Pond 55P: 11-10

Stage-Discharge

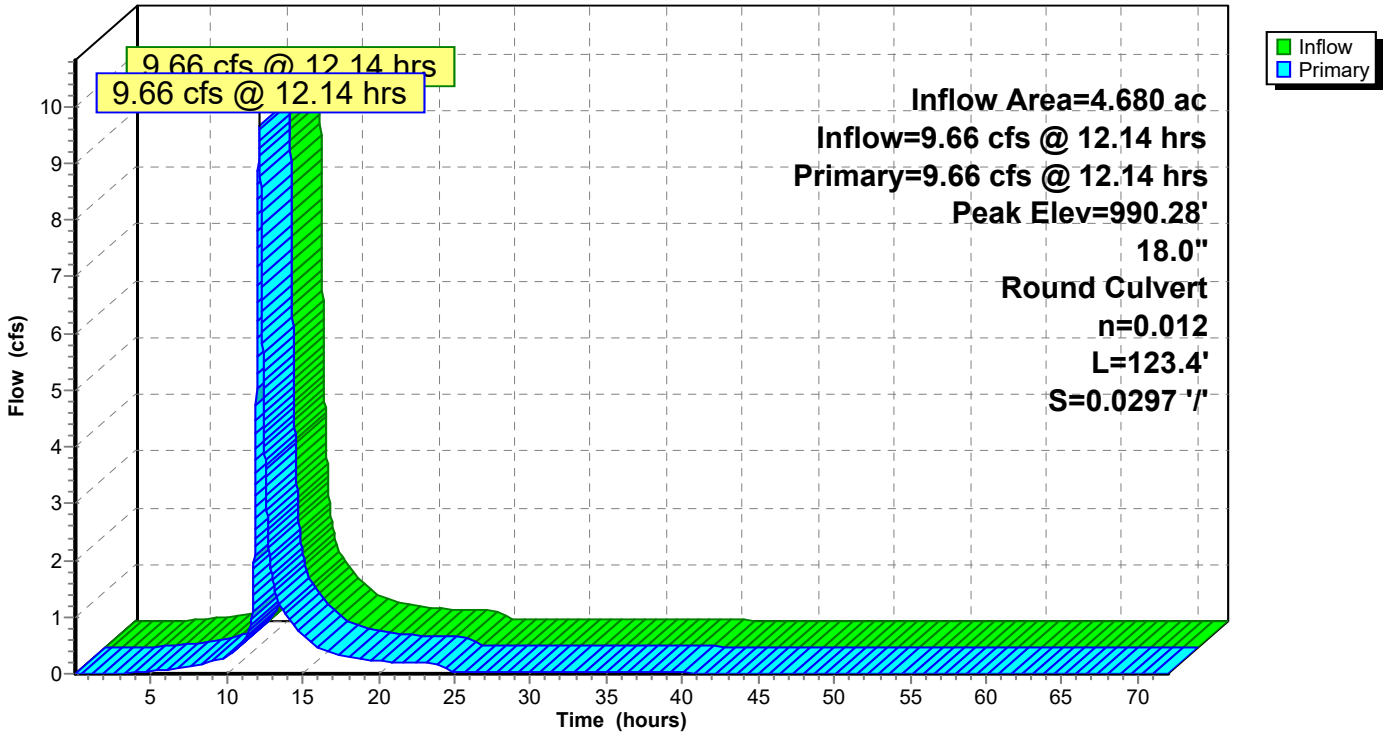


Pond 55P: 11-10



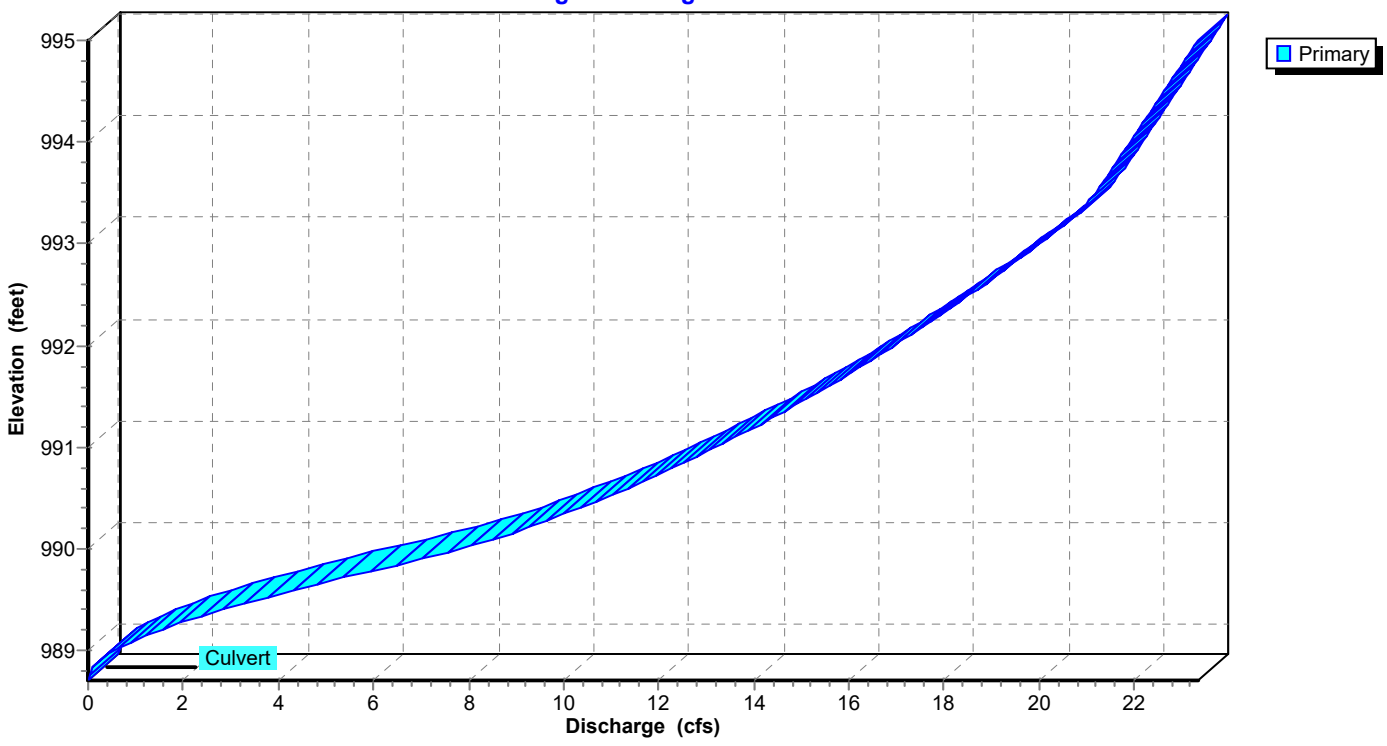
Pond 56P: 11 - 100 MH

Hydrograph

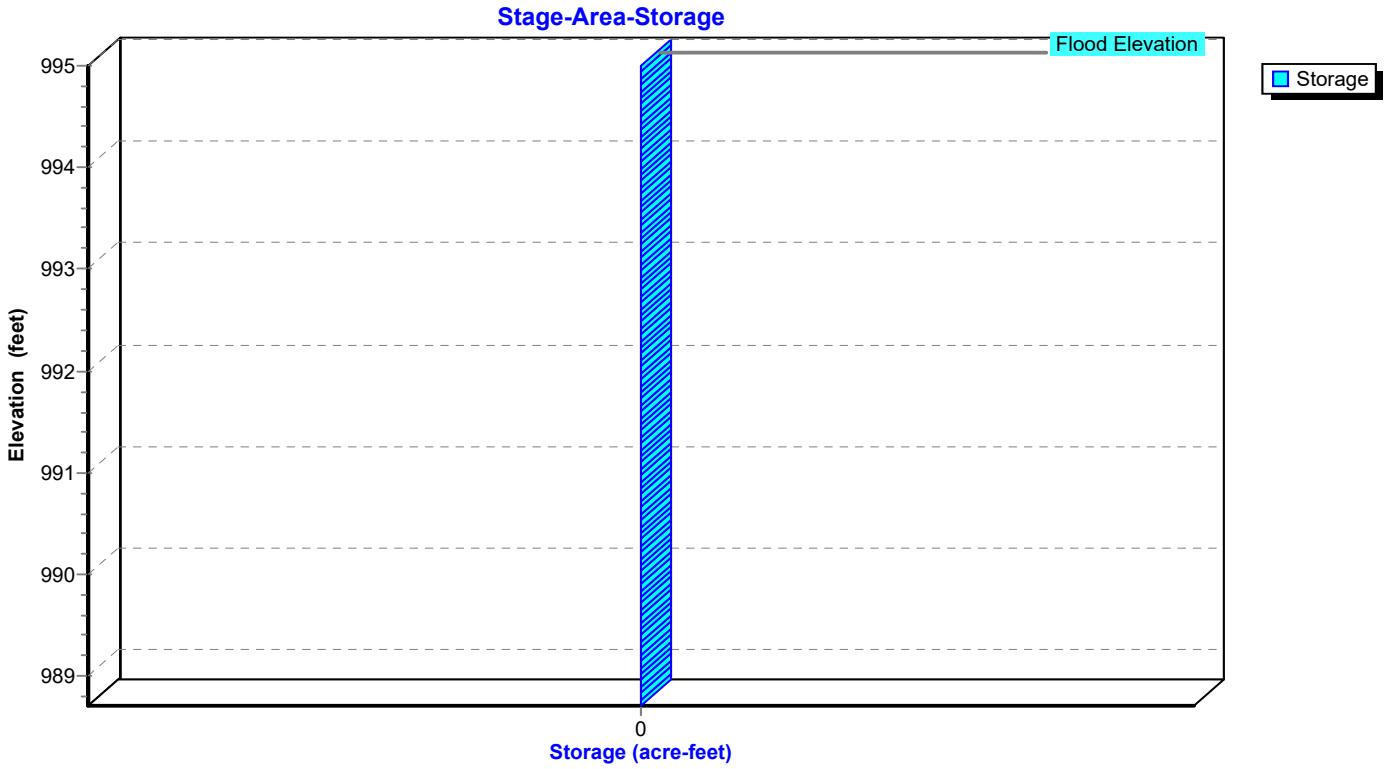


Pond 56P: 11 - 100 MH

Stage-Discharge

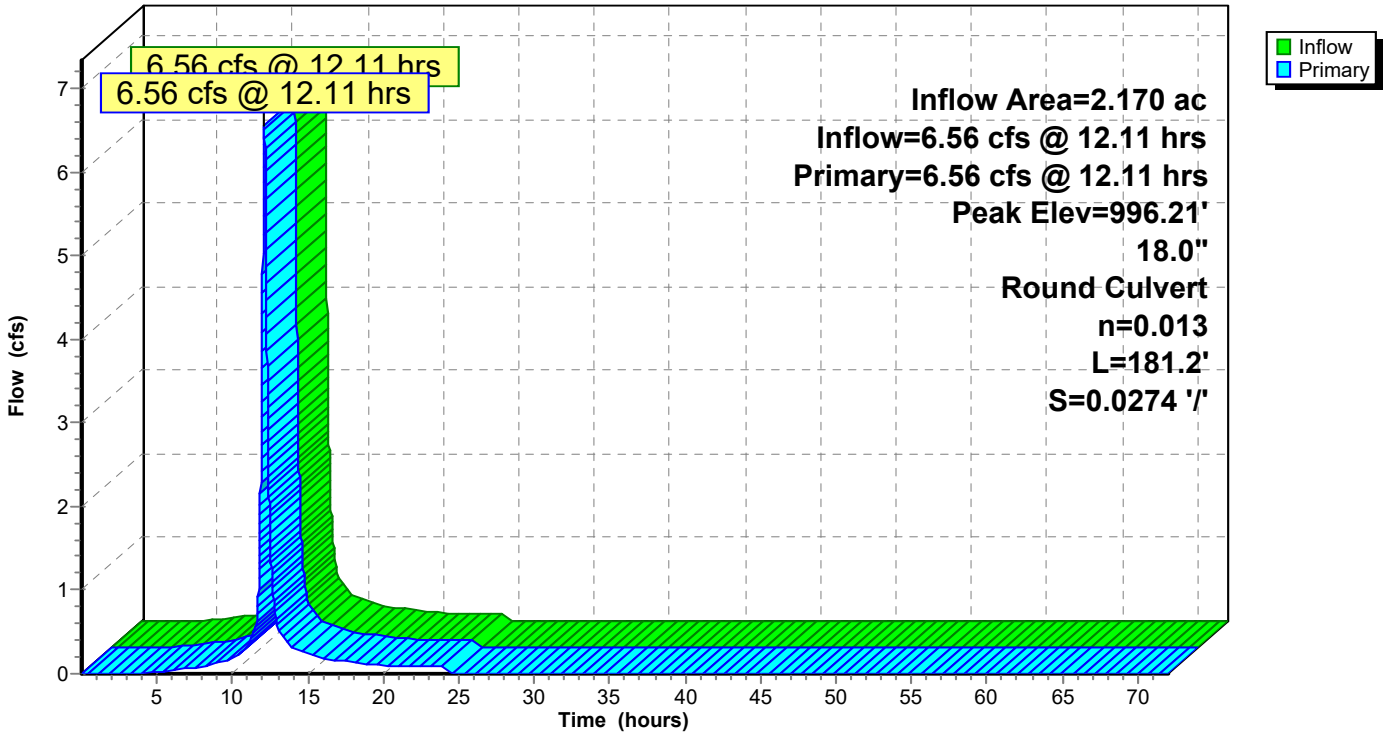


Pond 56P: 11 - 100 MH



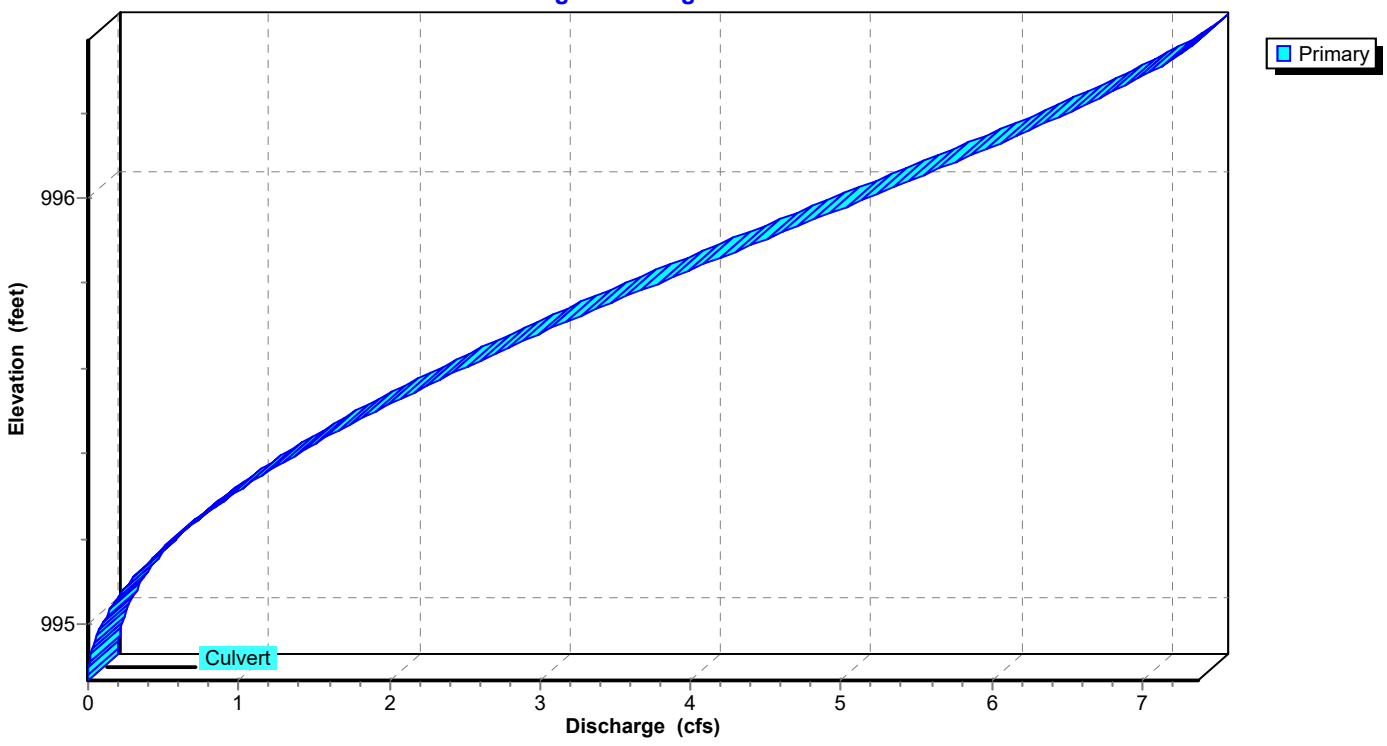
Pond 57P: 12-11

Hydrograph

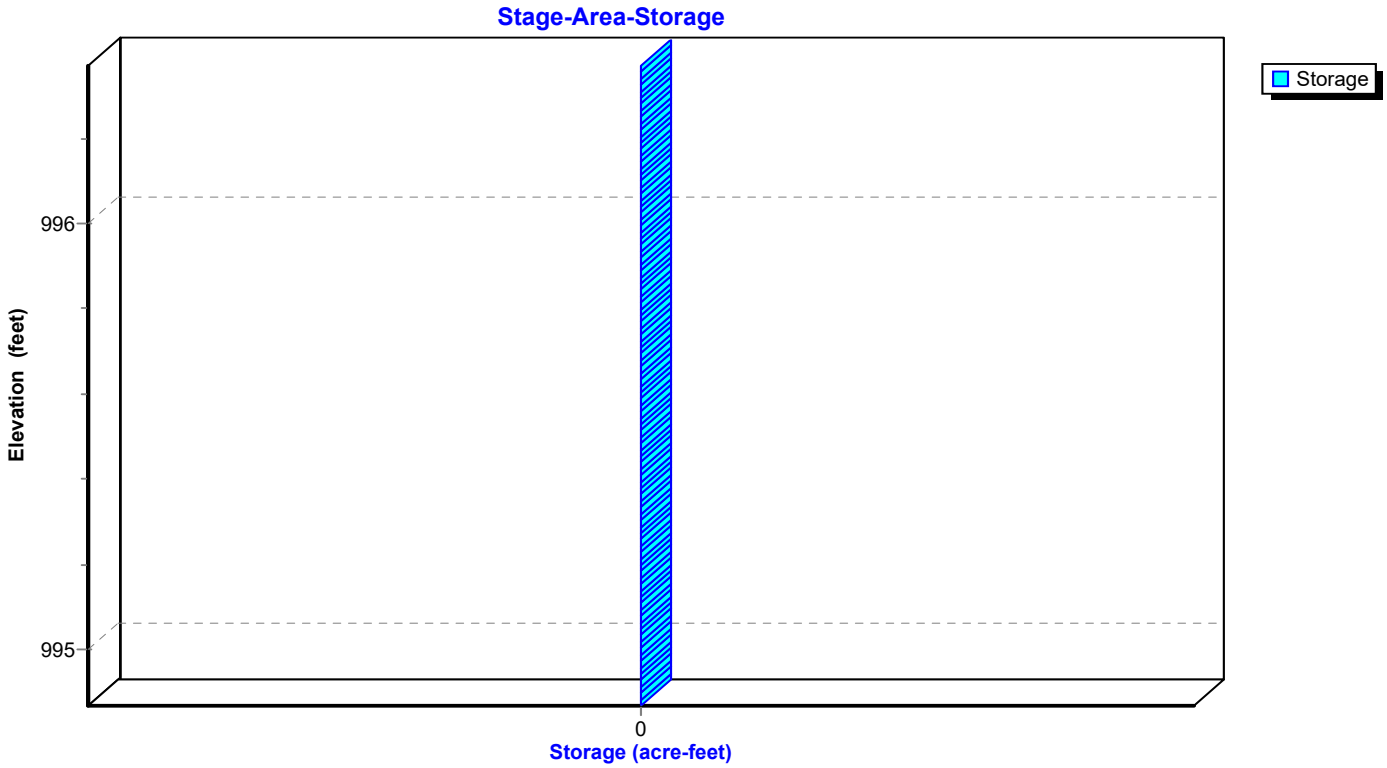


Pond 57P: 12-11

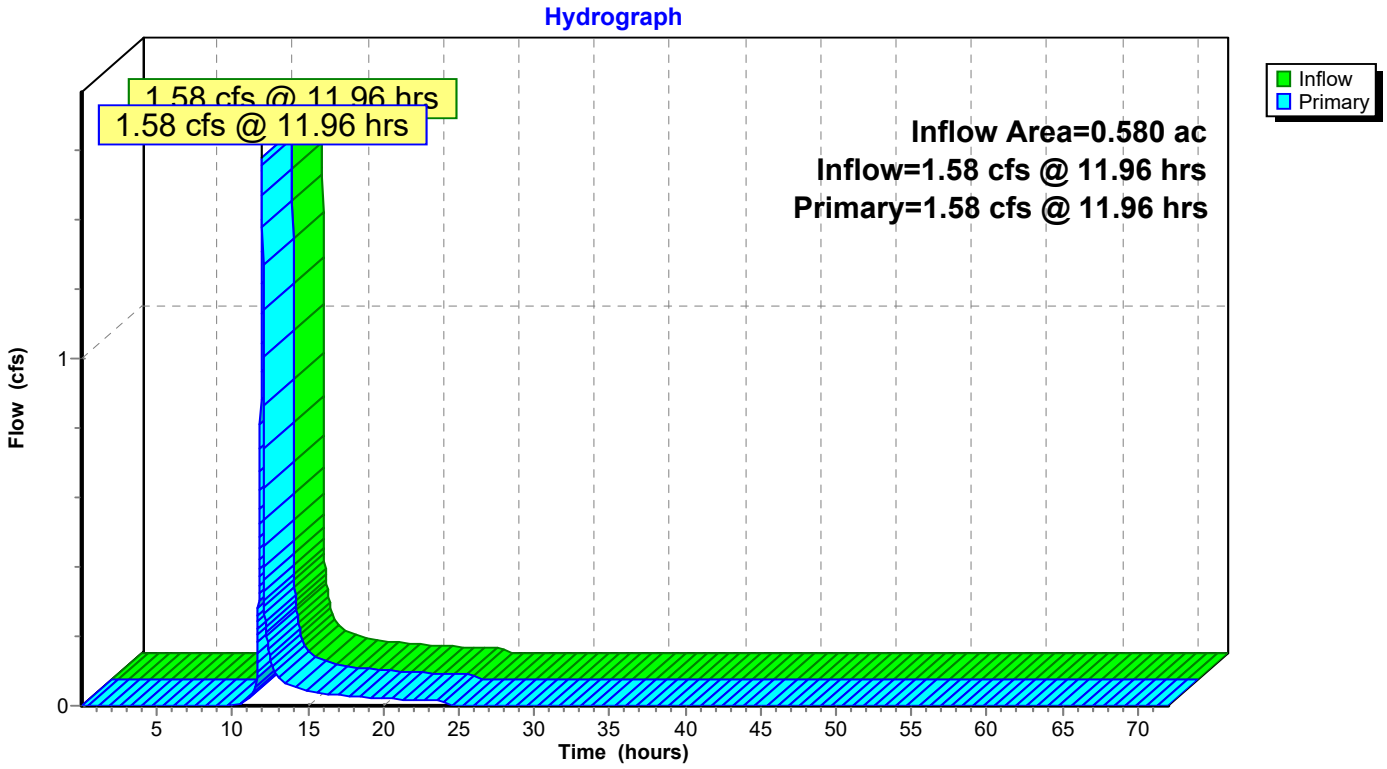
Stage-Discharge



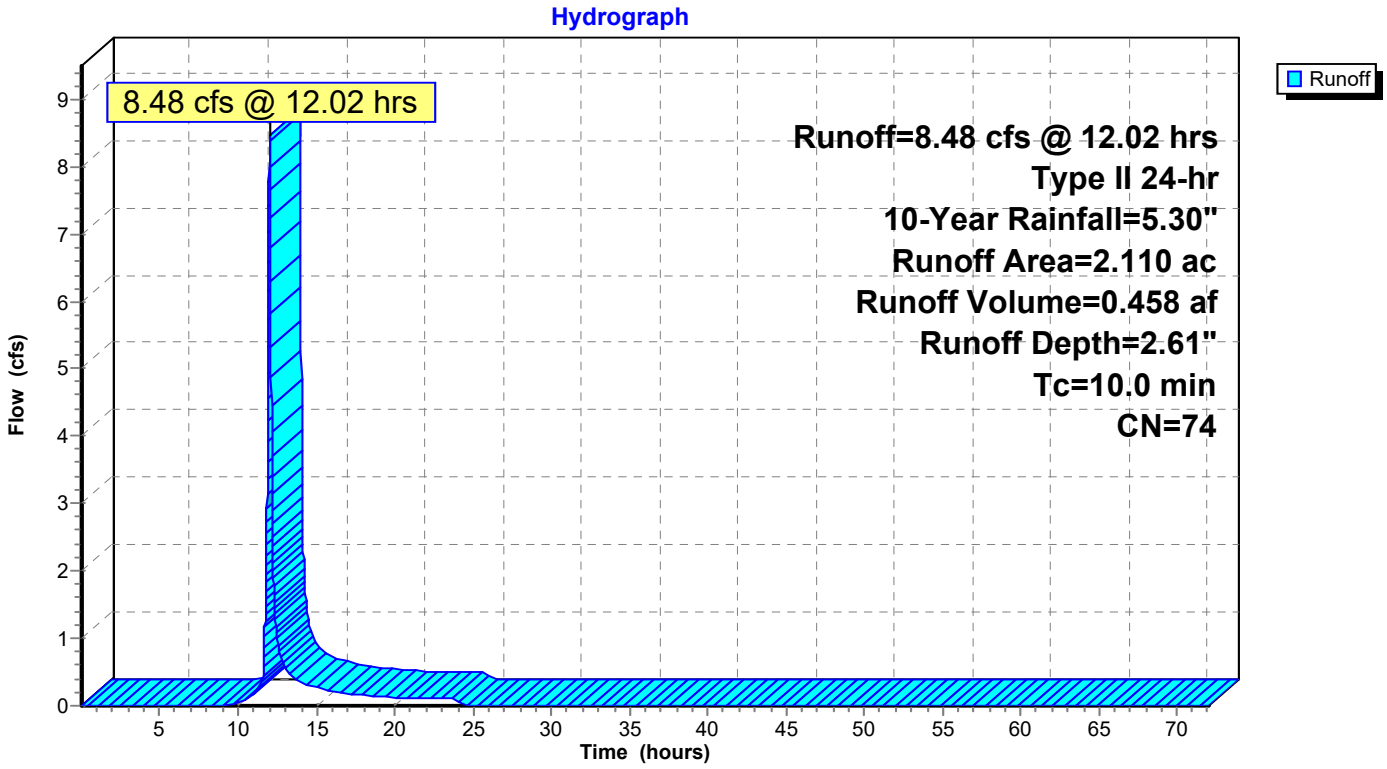
Pond 57P: 12-11



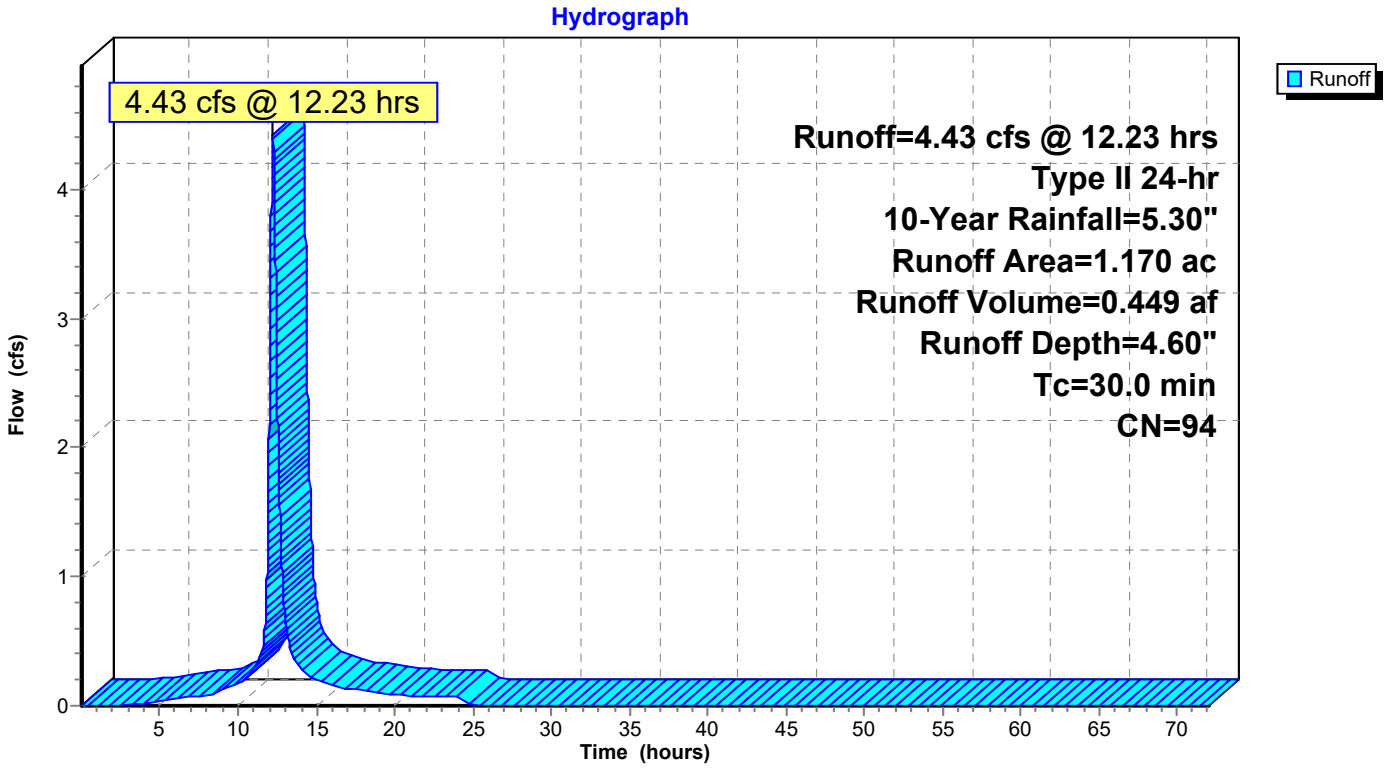
Link 90L: BYPASS AREAS



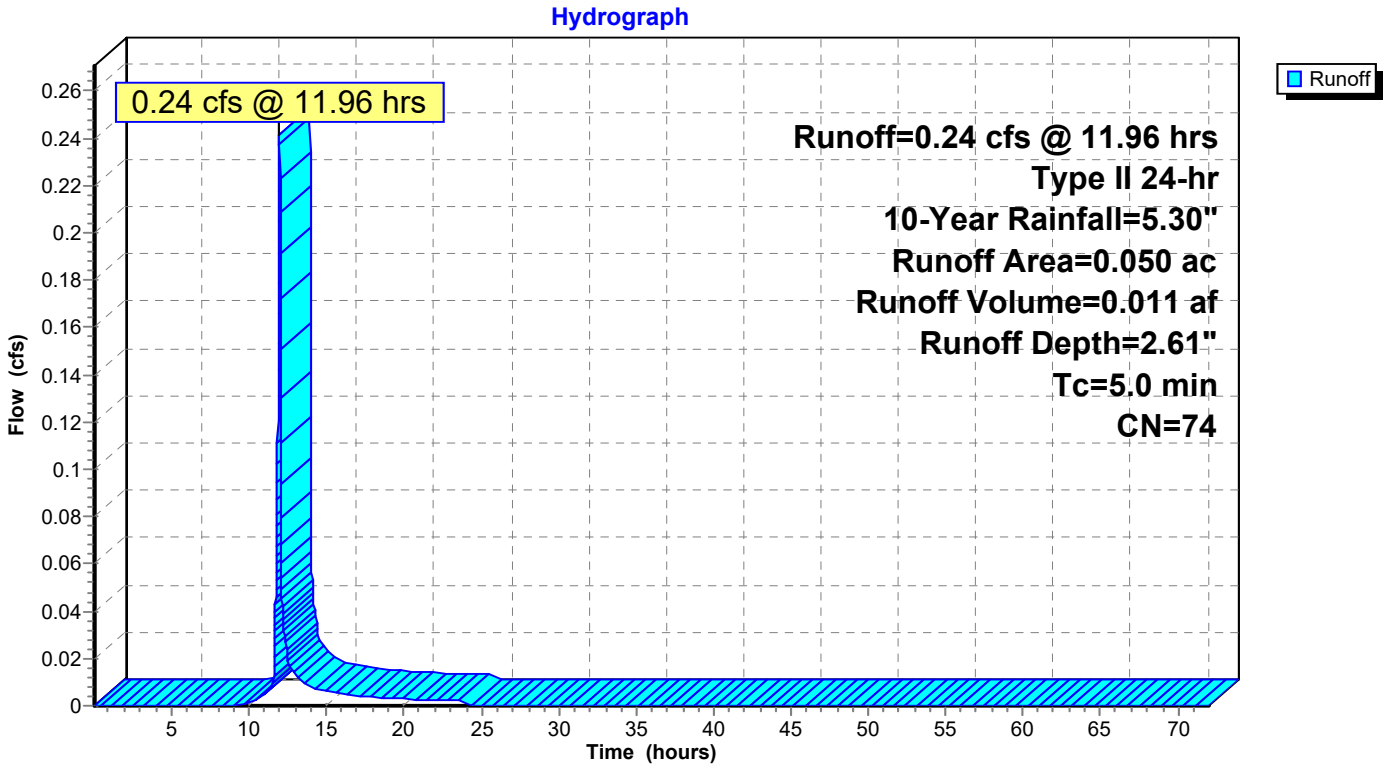
Subcatchment 1S: EXISTING CONDITIONS



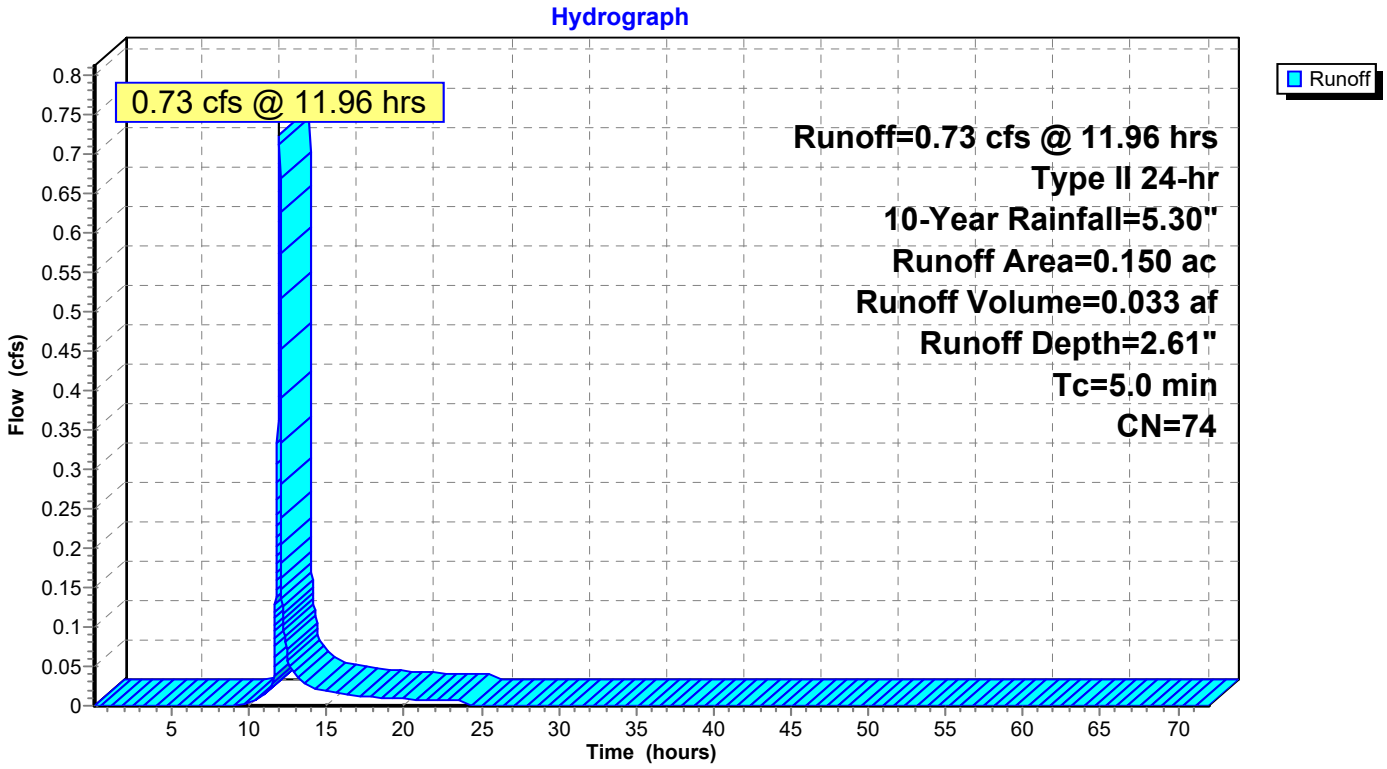
Subcatchment 2S: AREA A



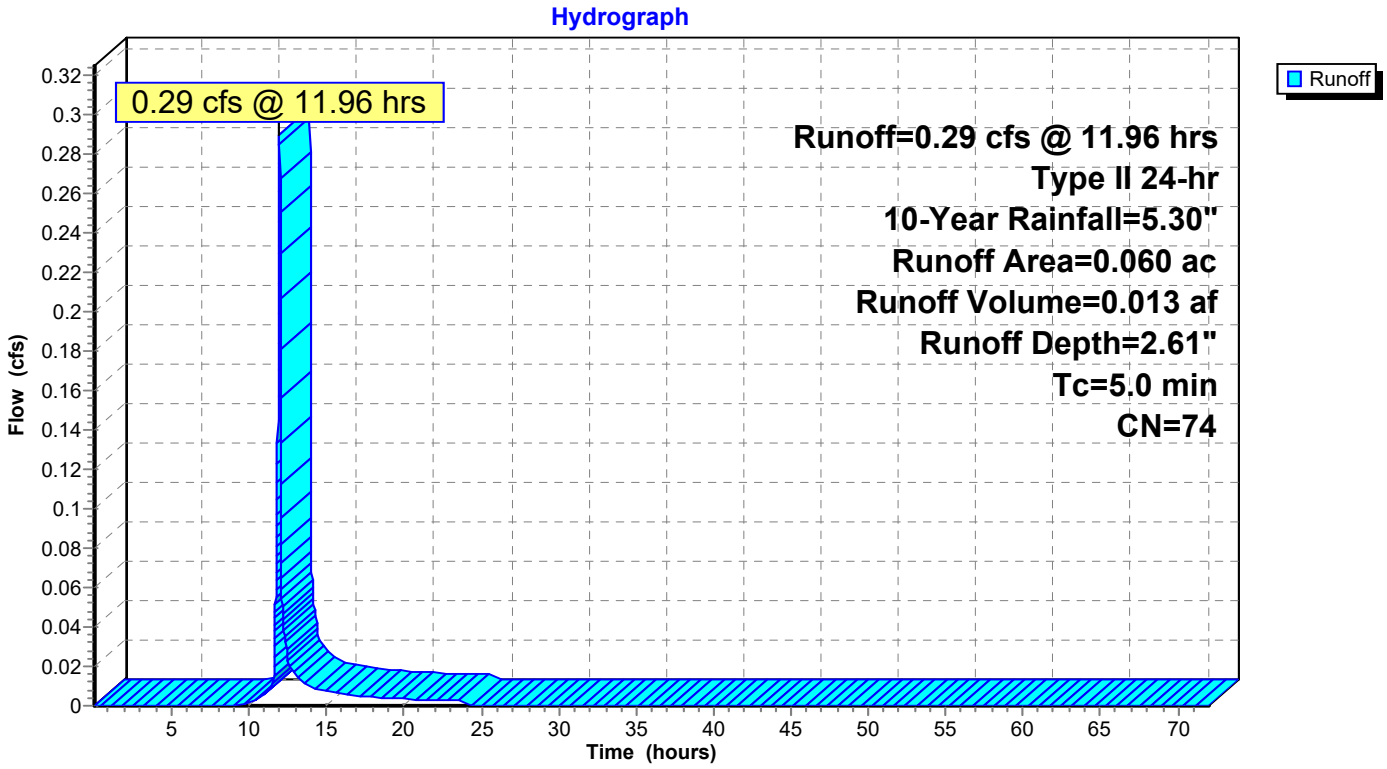
Subcatchment 3S: AREA B



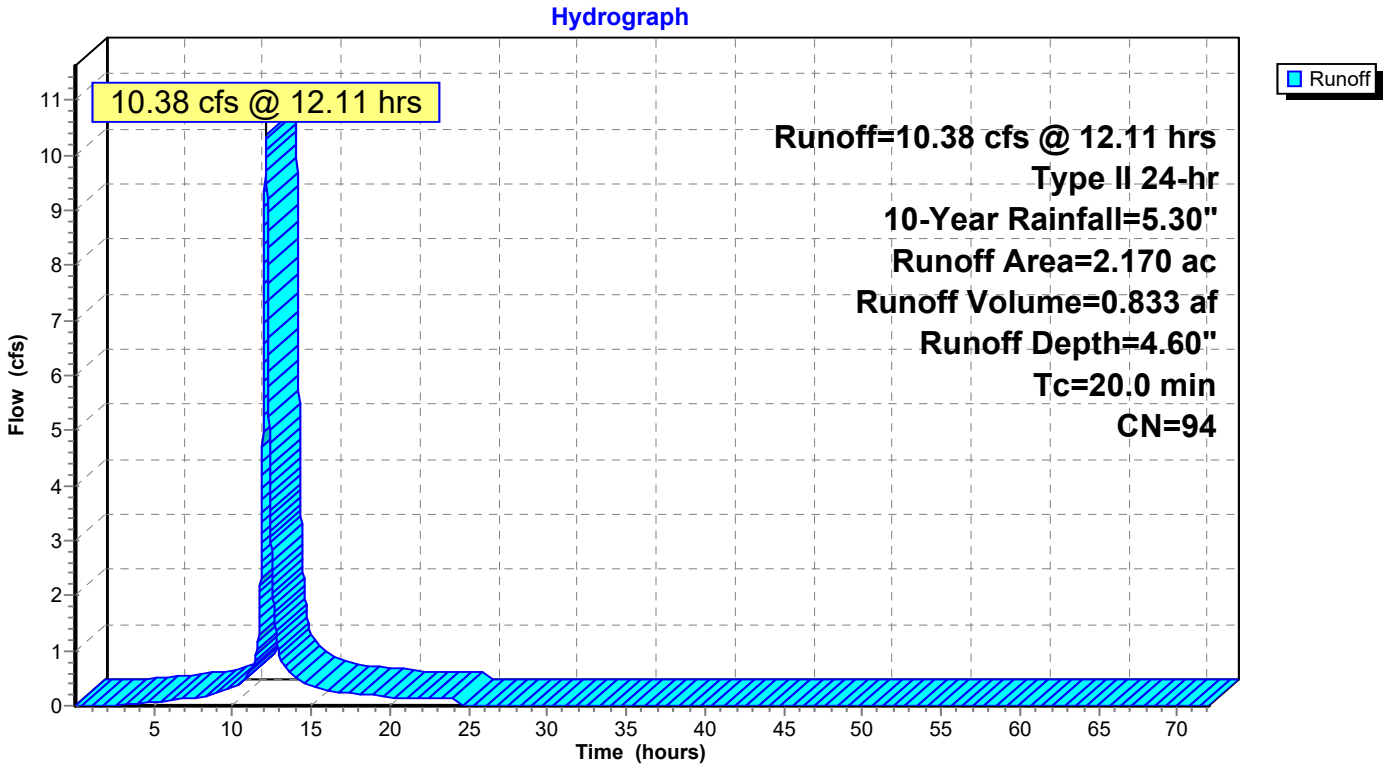
Subcatchment 4S: AREA C



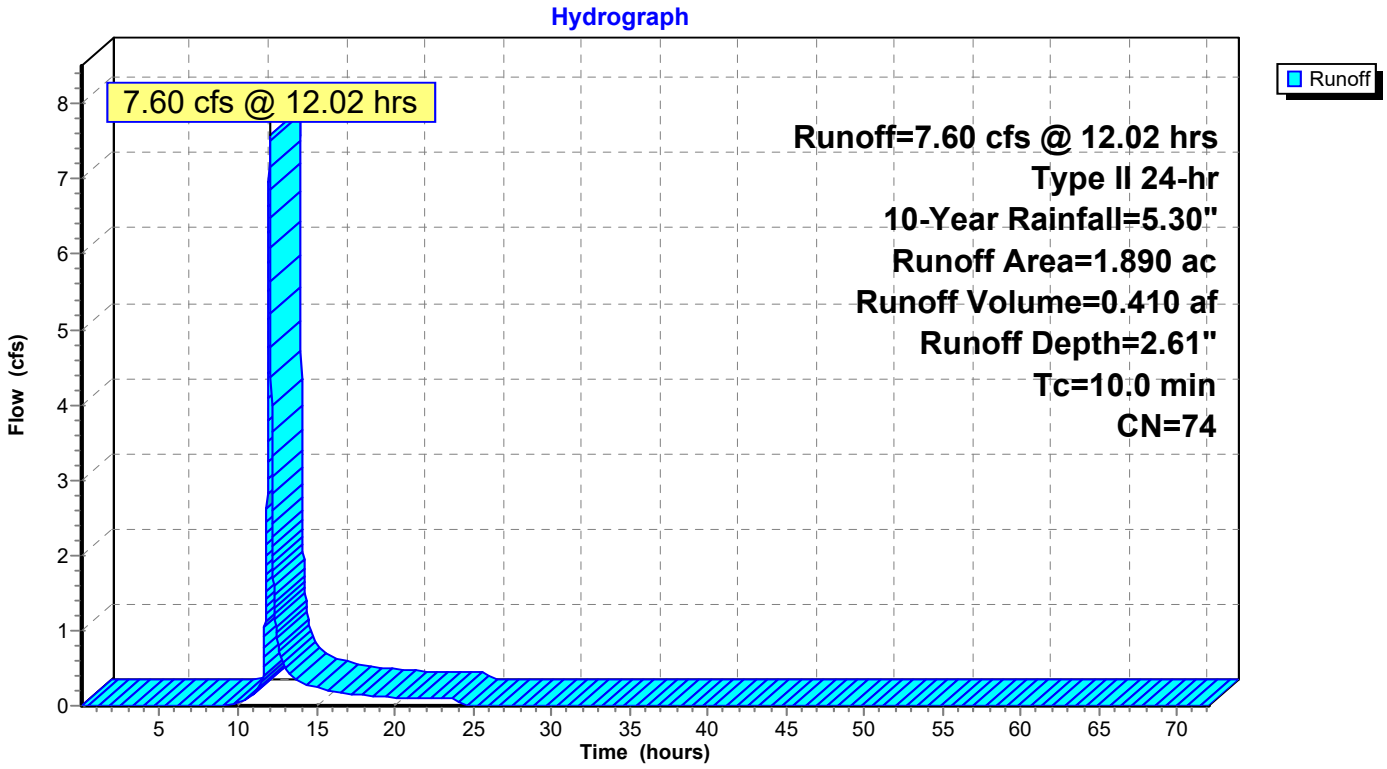
Subcatchment 5S: AREA D



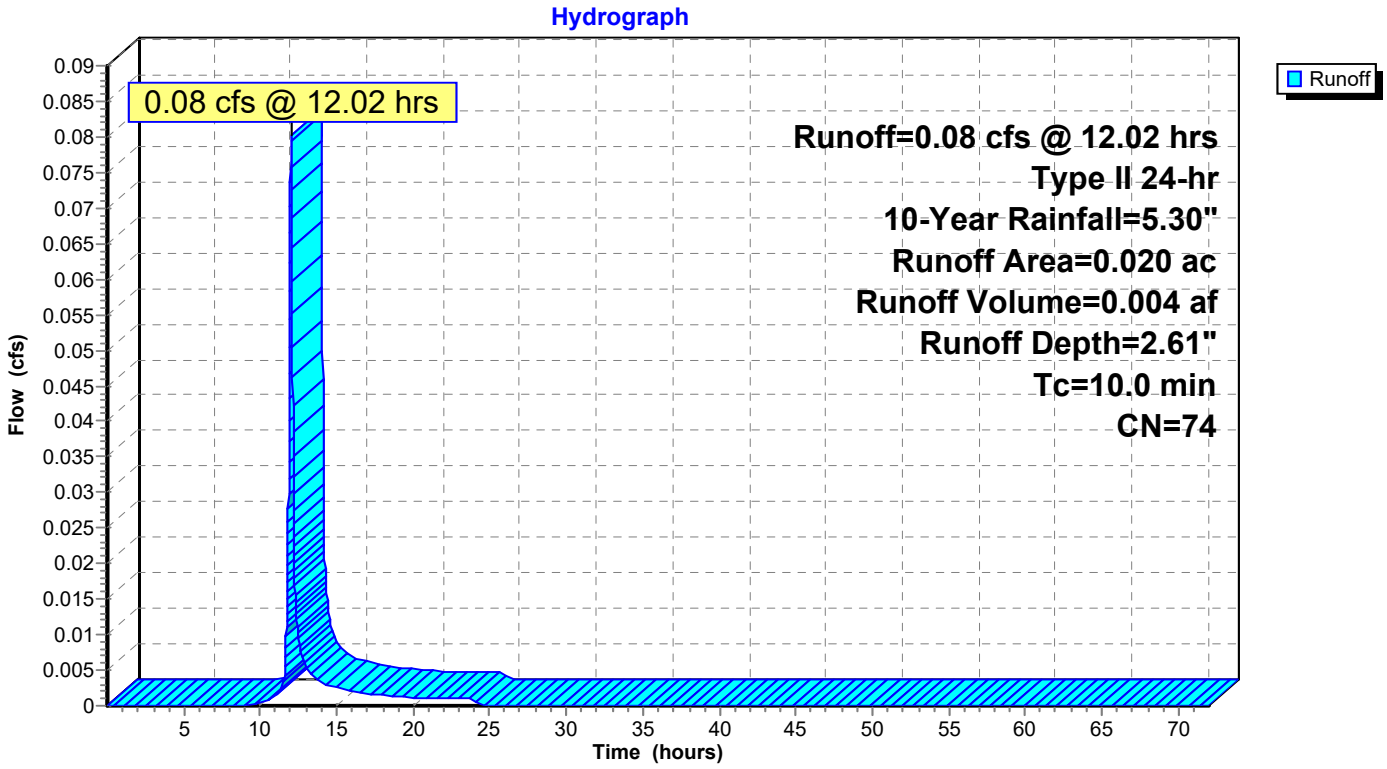
Subcatchment 6S: AREA E



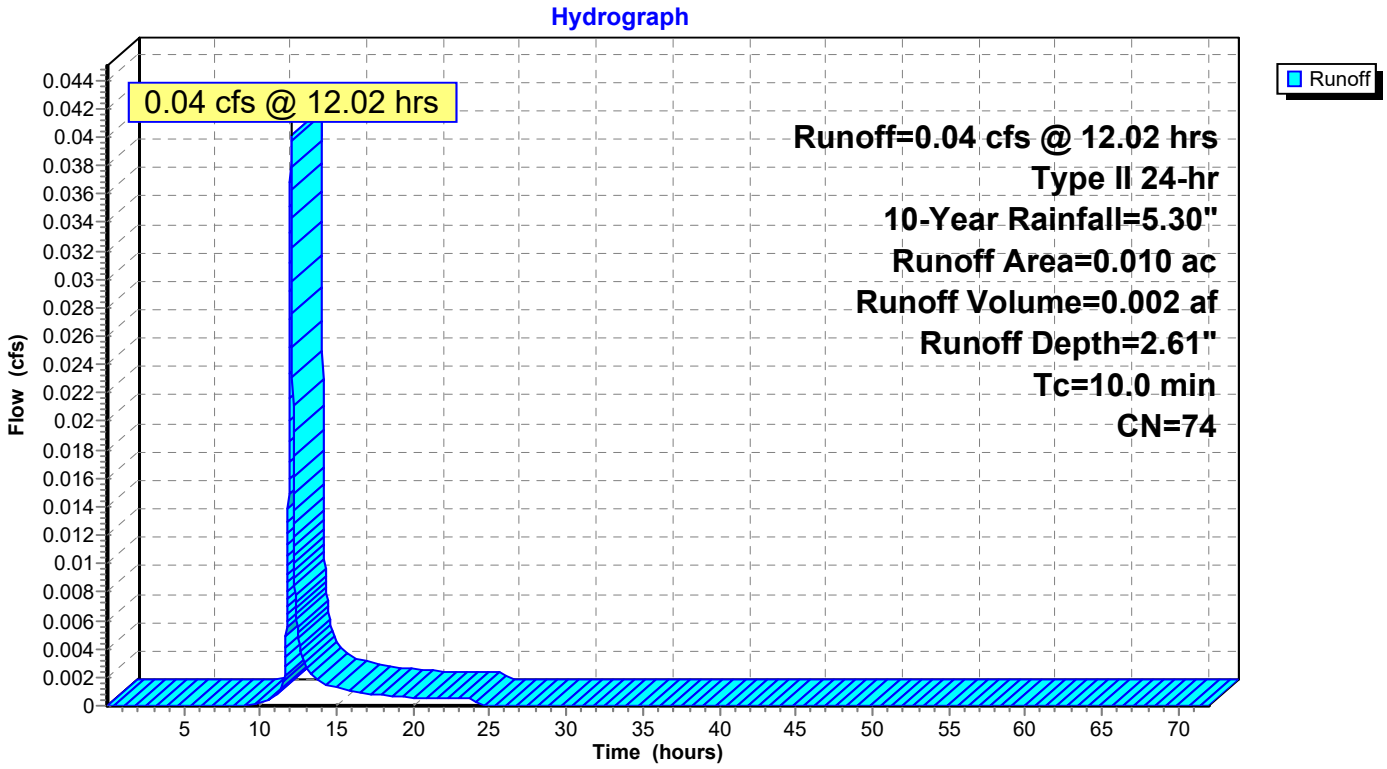
Subcatchment 7S: AREA F



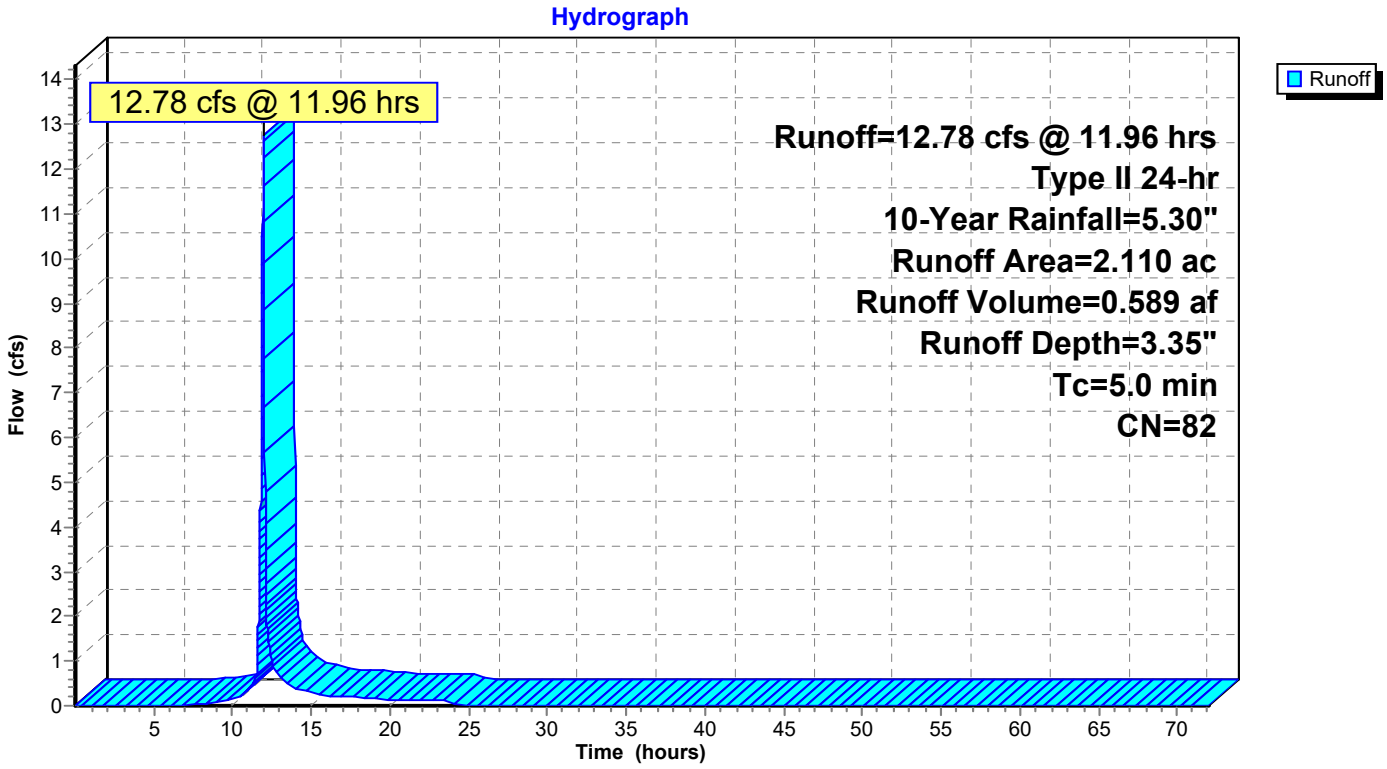
Subcatchment 8S: AREA G



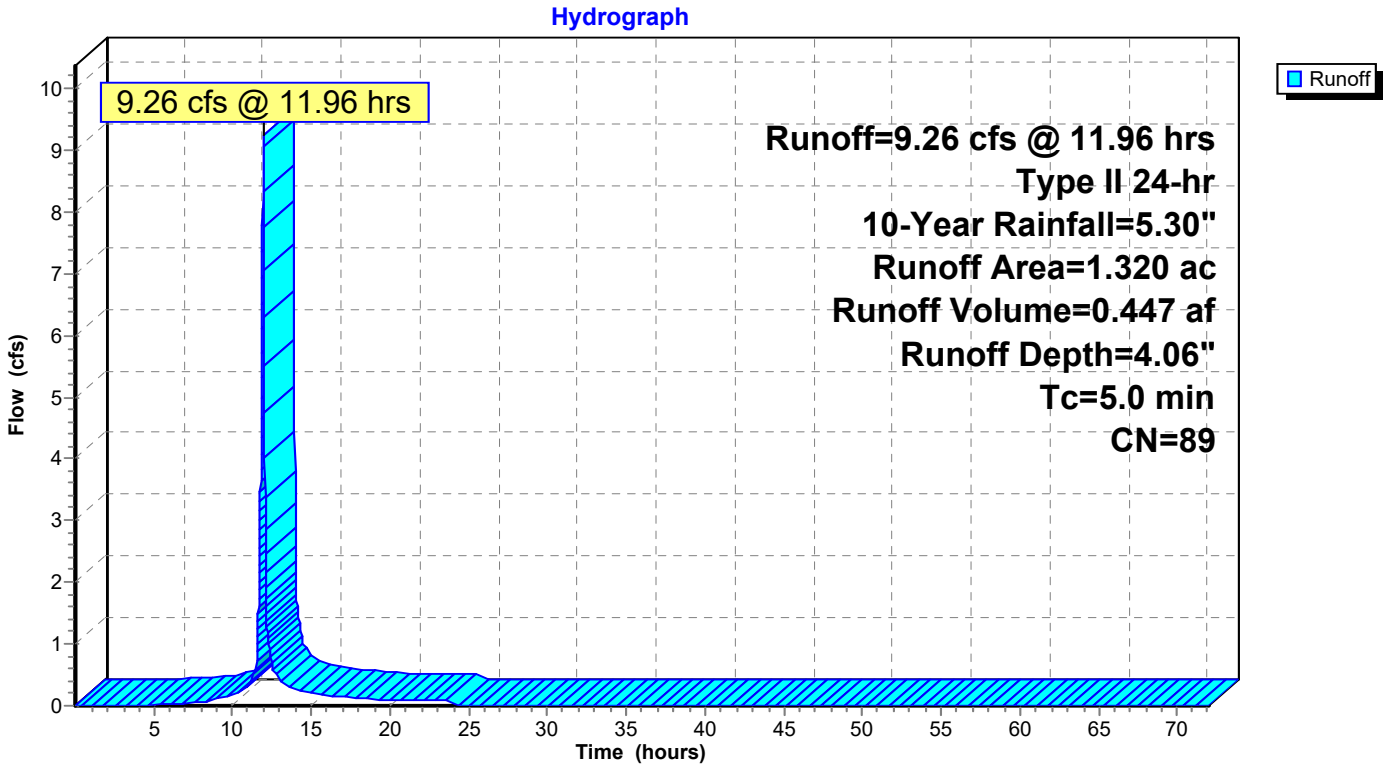
Subcatchment 9S: AREA H



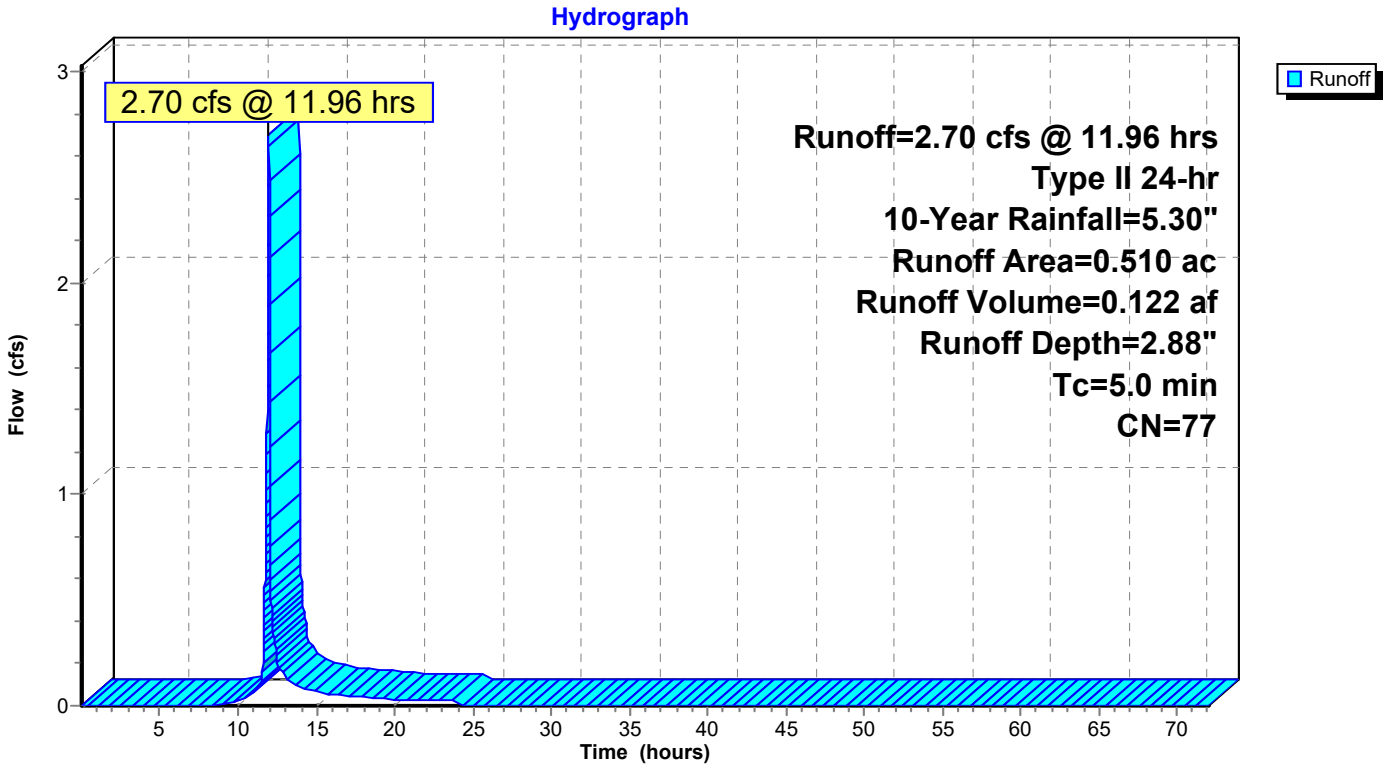
Subcatchment 10S: PROPOSED CONDITIONS



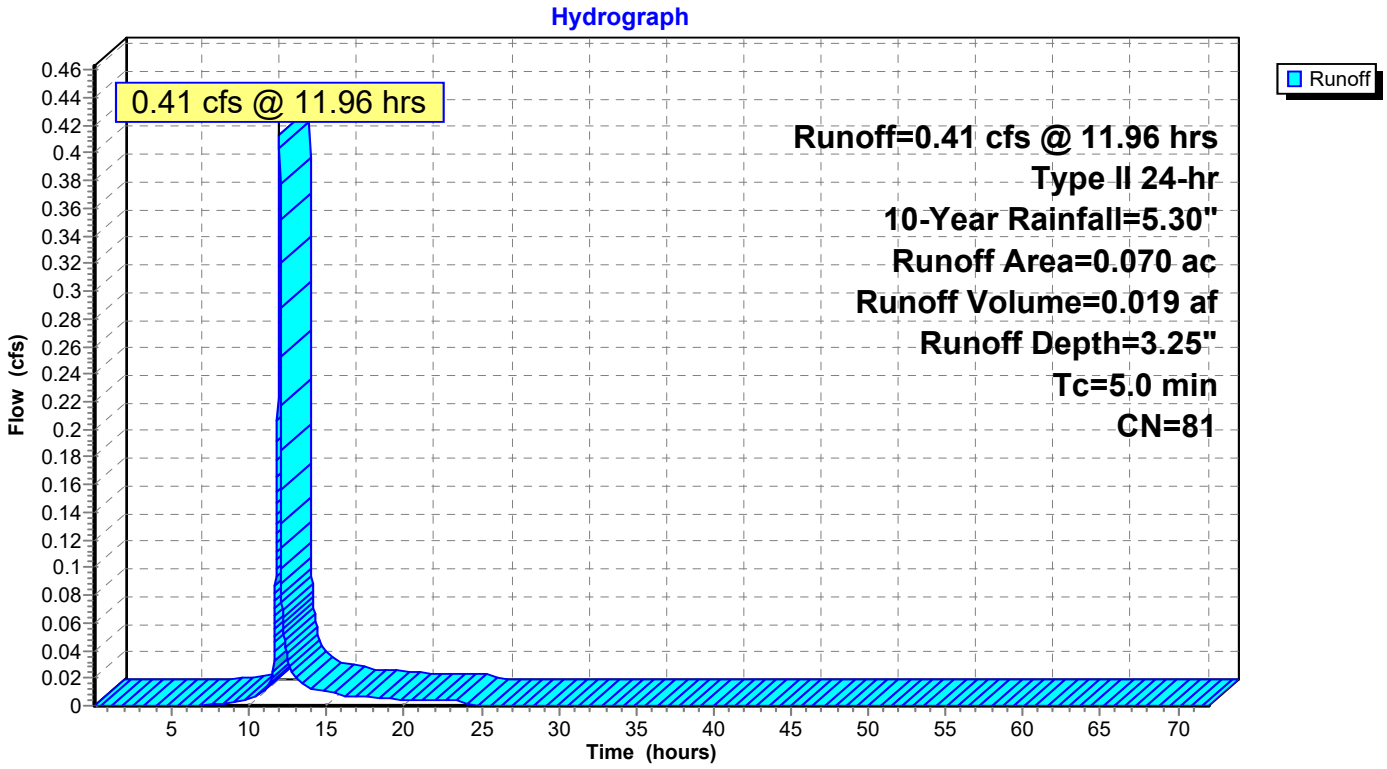
Subcatchment 25S: AREA 3



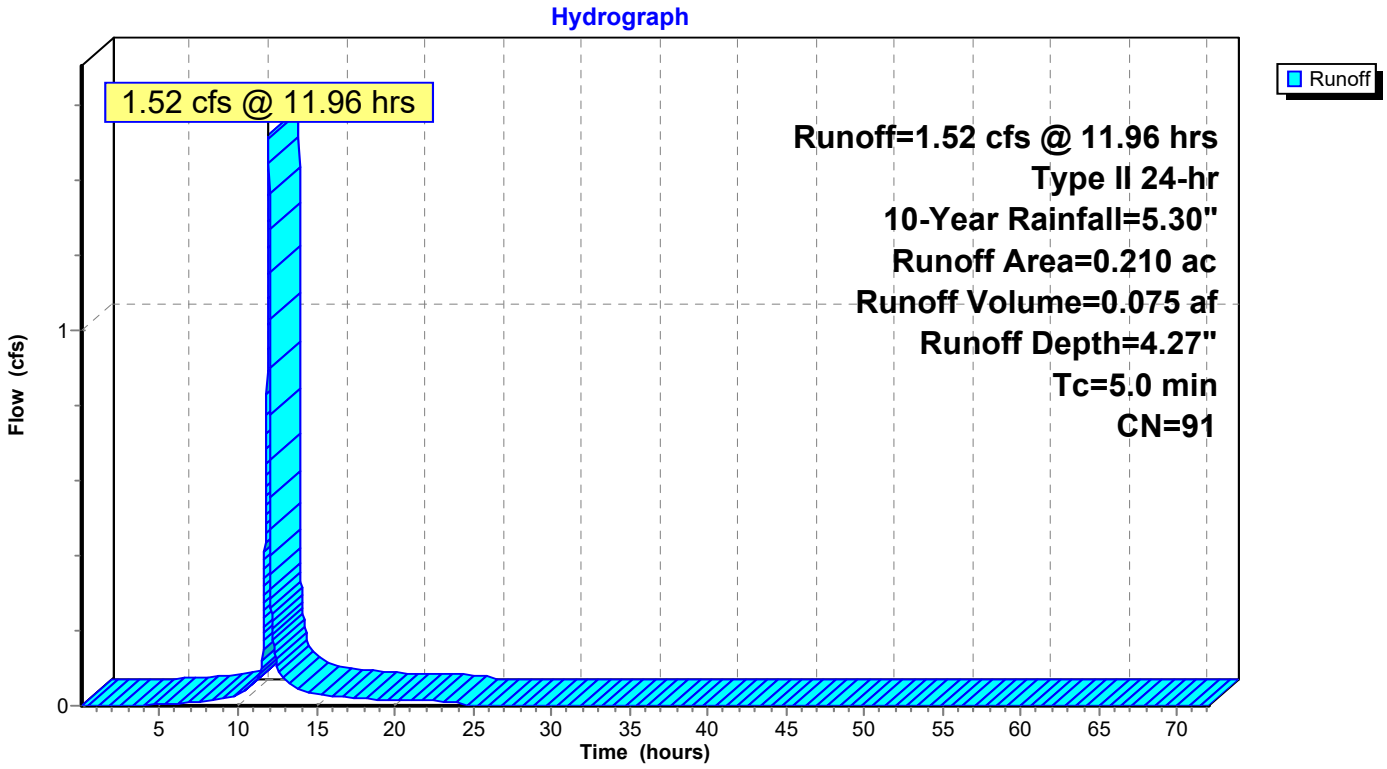
Subcatchment 60S: AREA 6



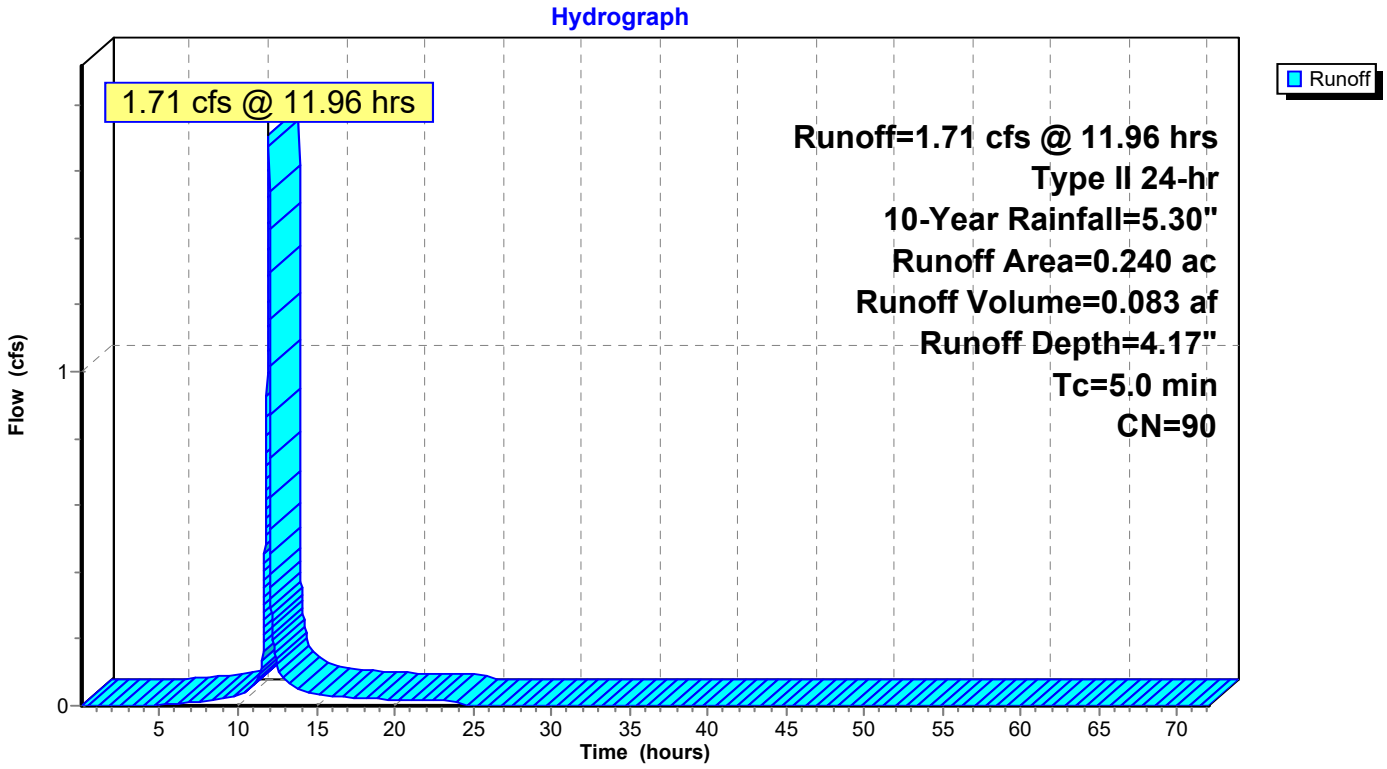
Subcatchment 61S: AREA 7



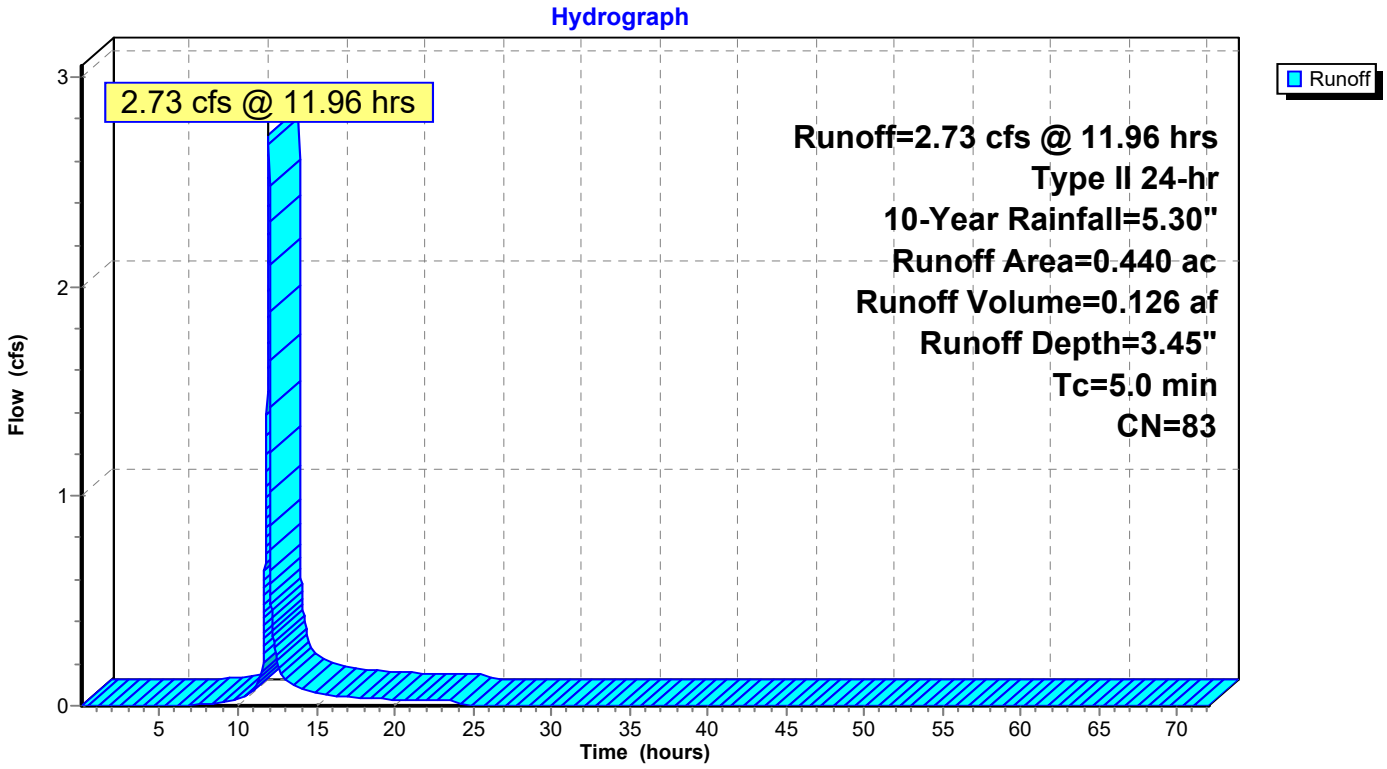
Subcatchment 62S: AREA 1



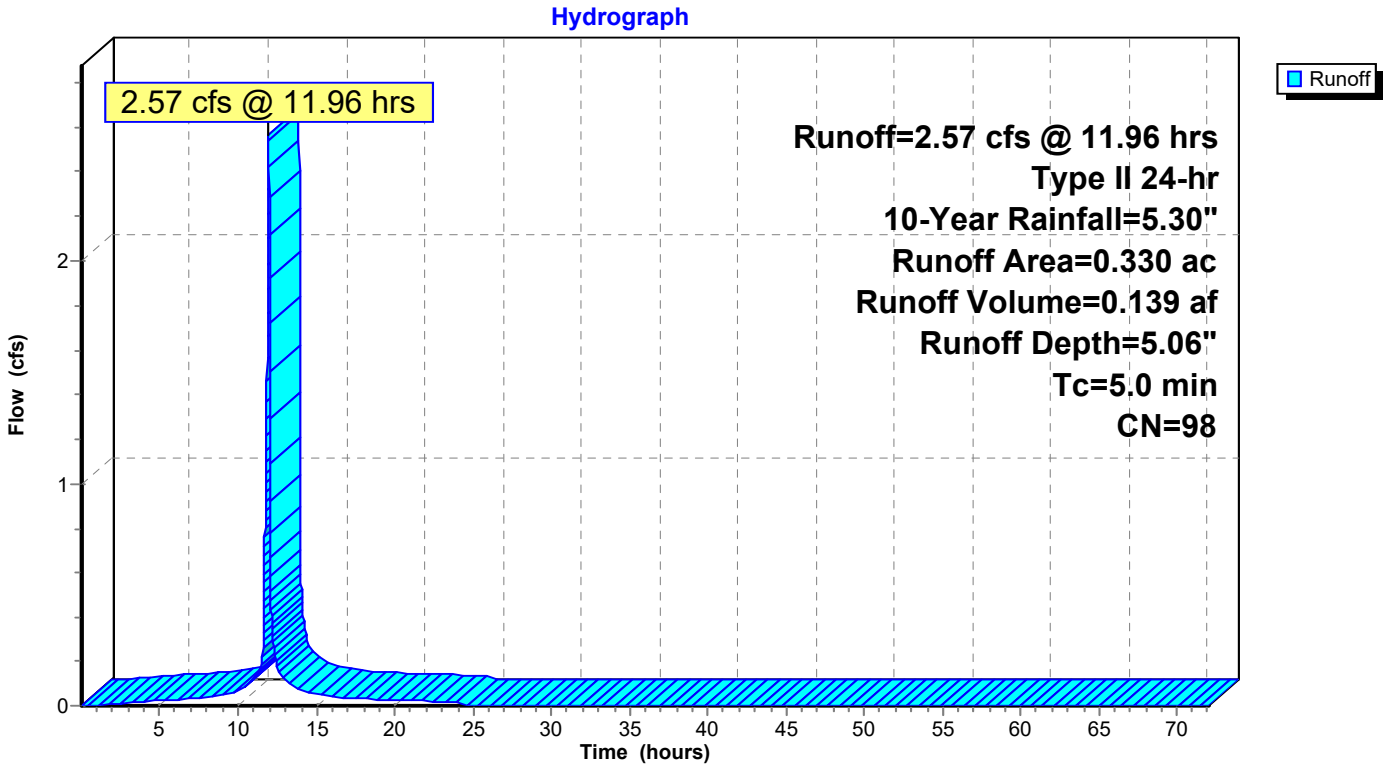
Subcatchment 63S: AREA 2



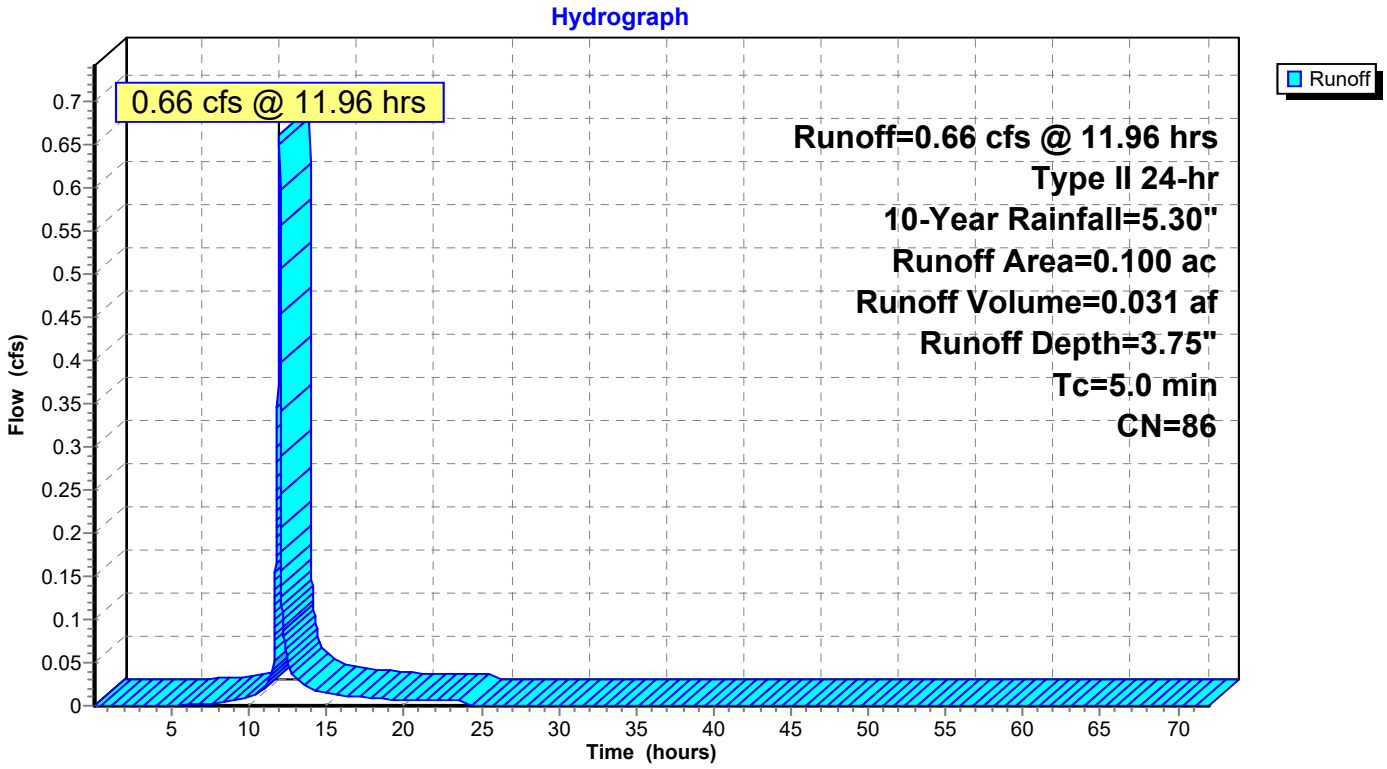
Subcatchment 64S: AREA 3



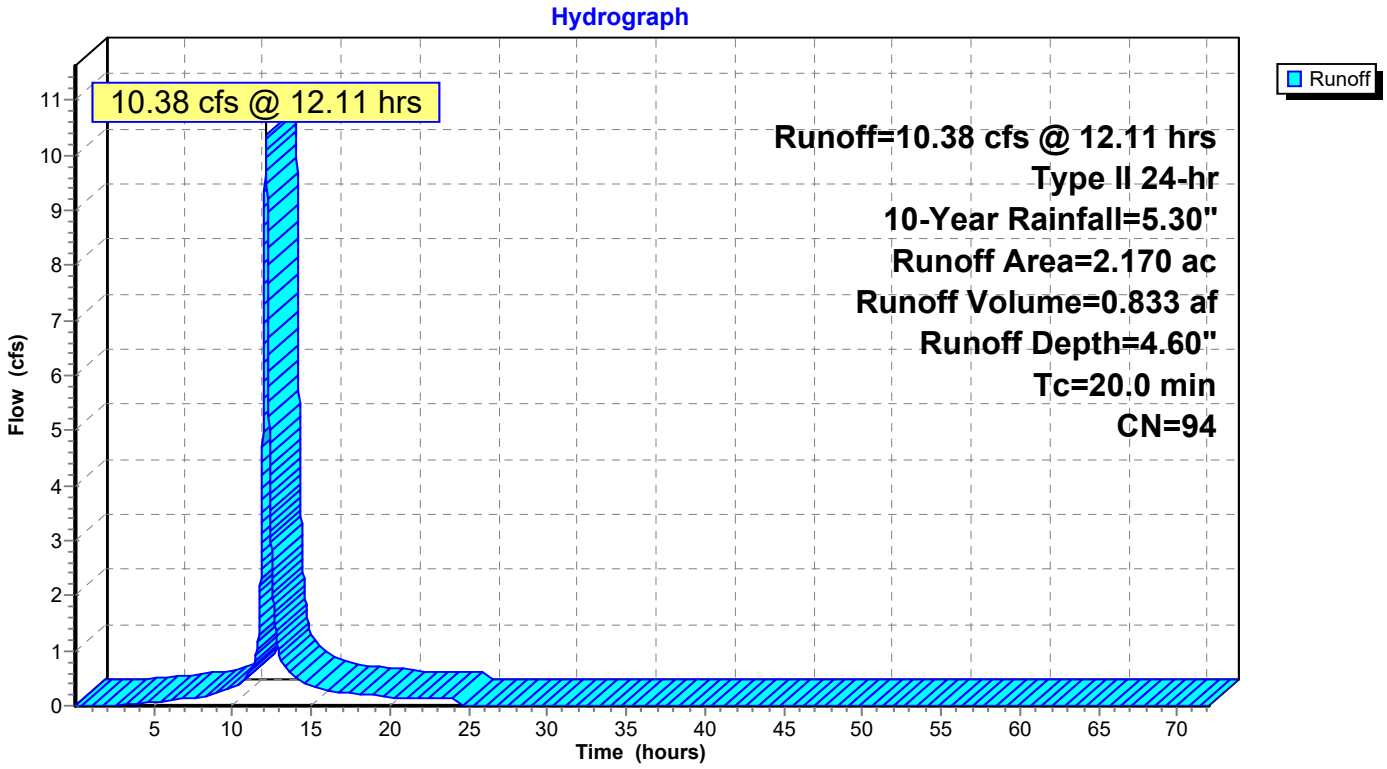
Subcatchment 65S: AREA 4



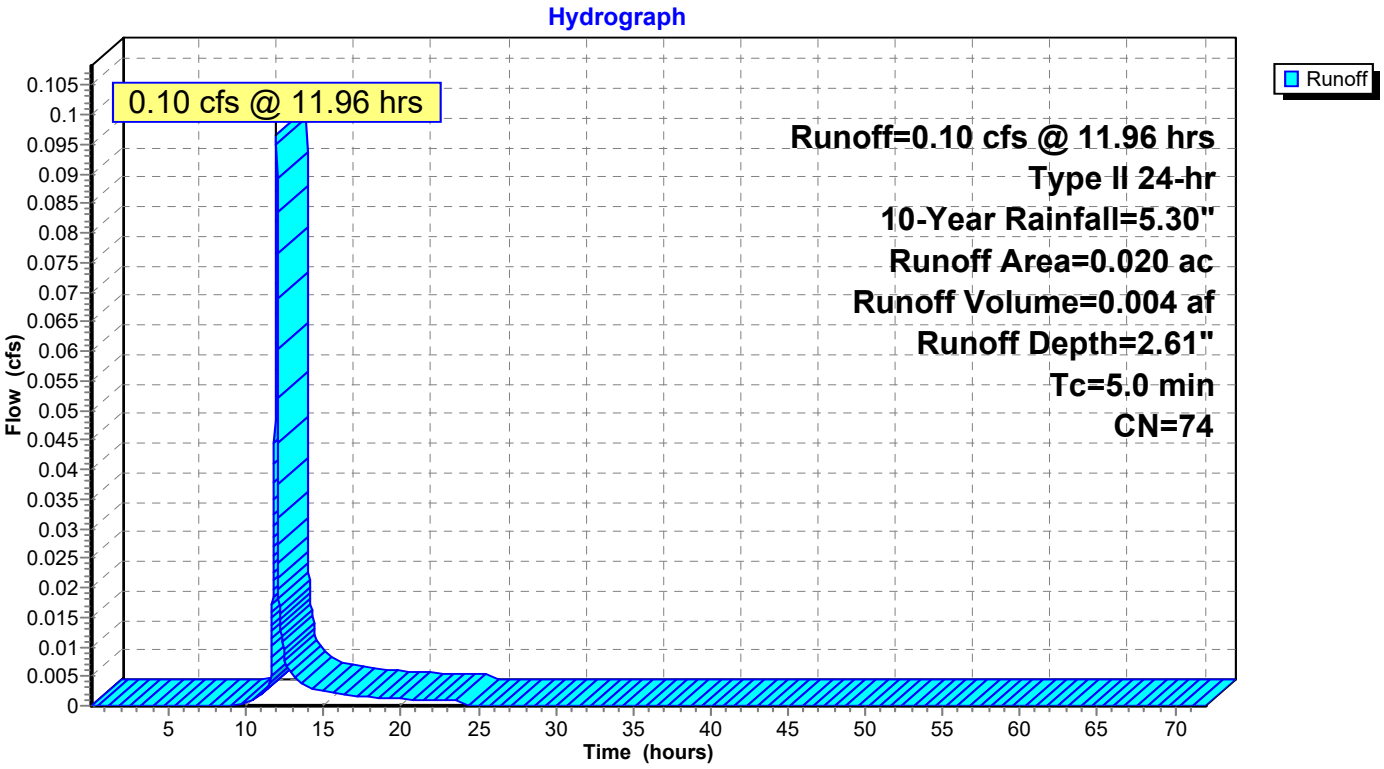
Subcatchment 66S: AREA 5



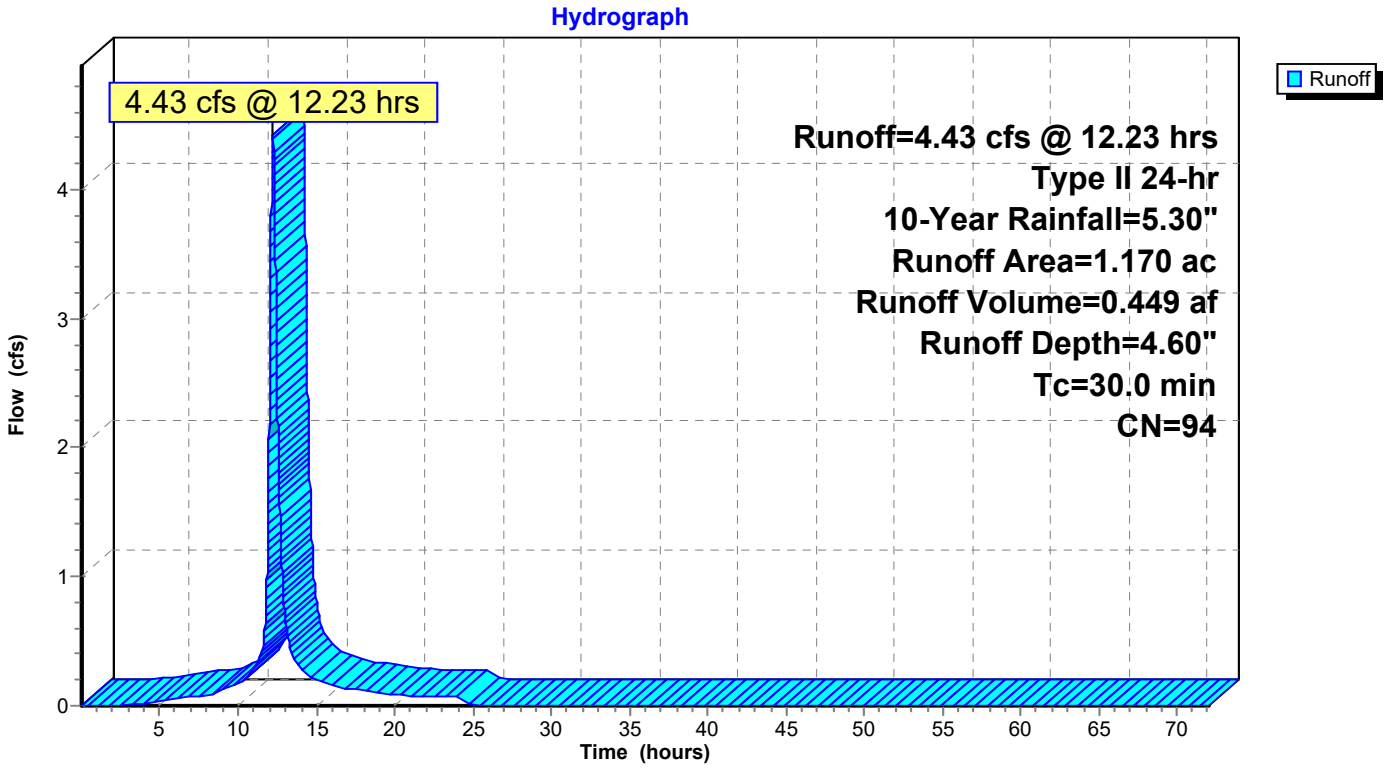
Subcatchment 67S: OFFSITE TO CI 12



Subcatchment 68S: AREA TO AI 11

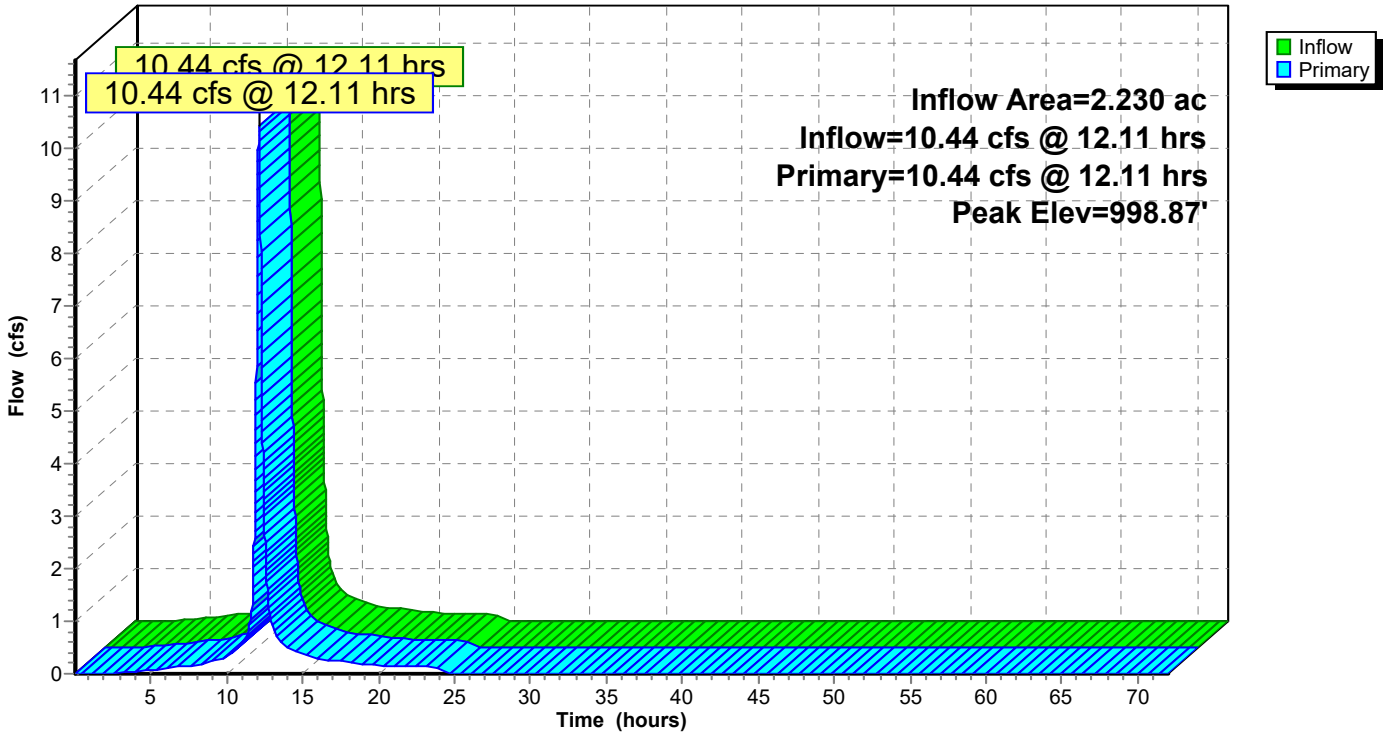


Subcatchment 69S: OFFSITE TO BMP



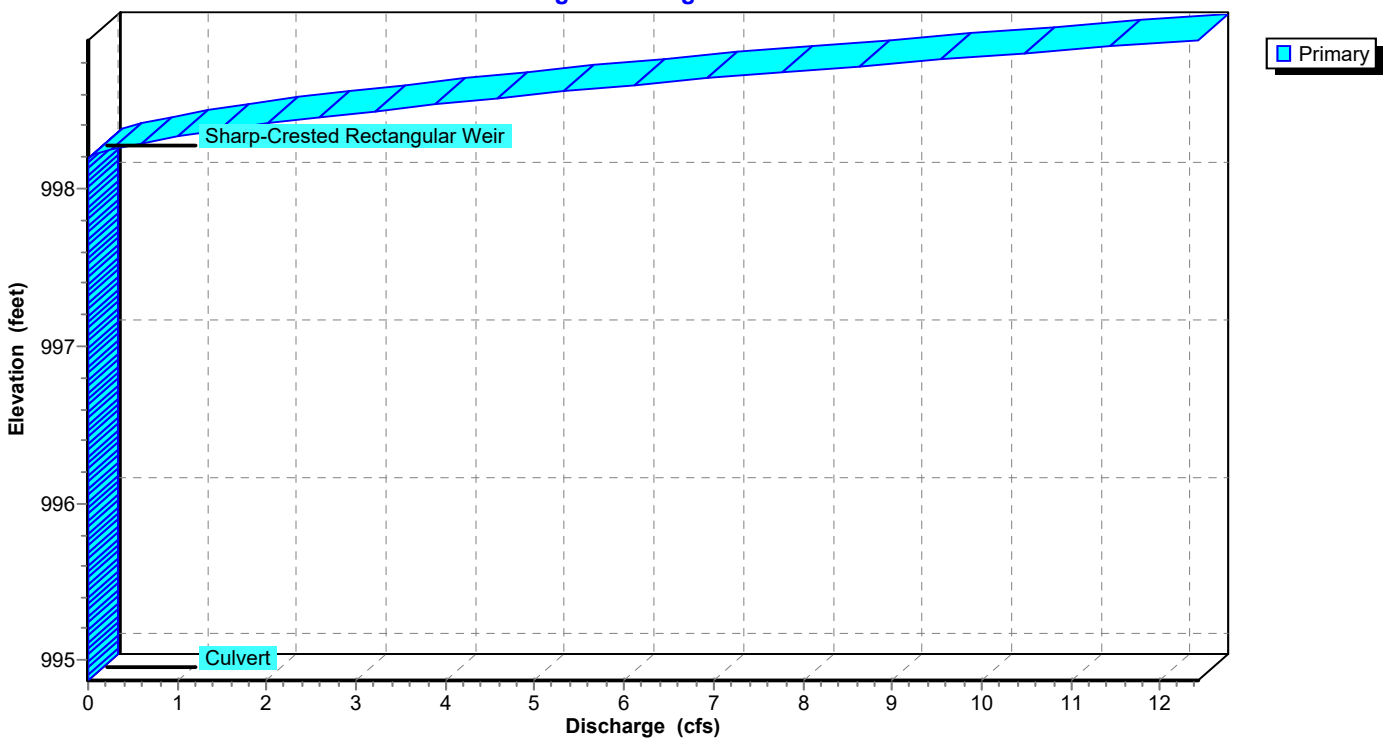
Pond 10P: 12-11

Hydrograph

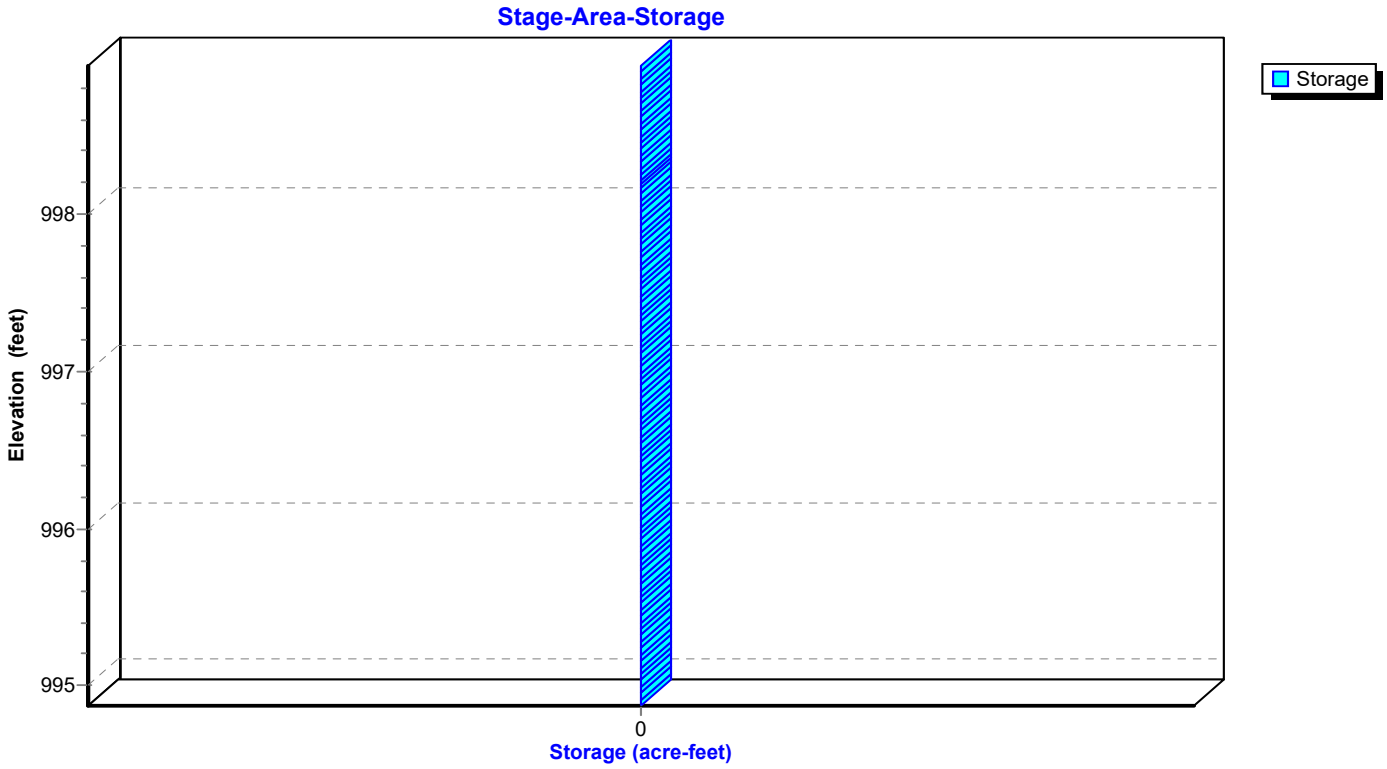


Pond 10P: 12-11

Stage-Discharge

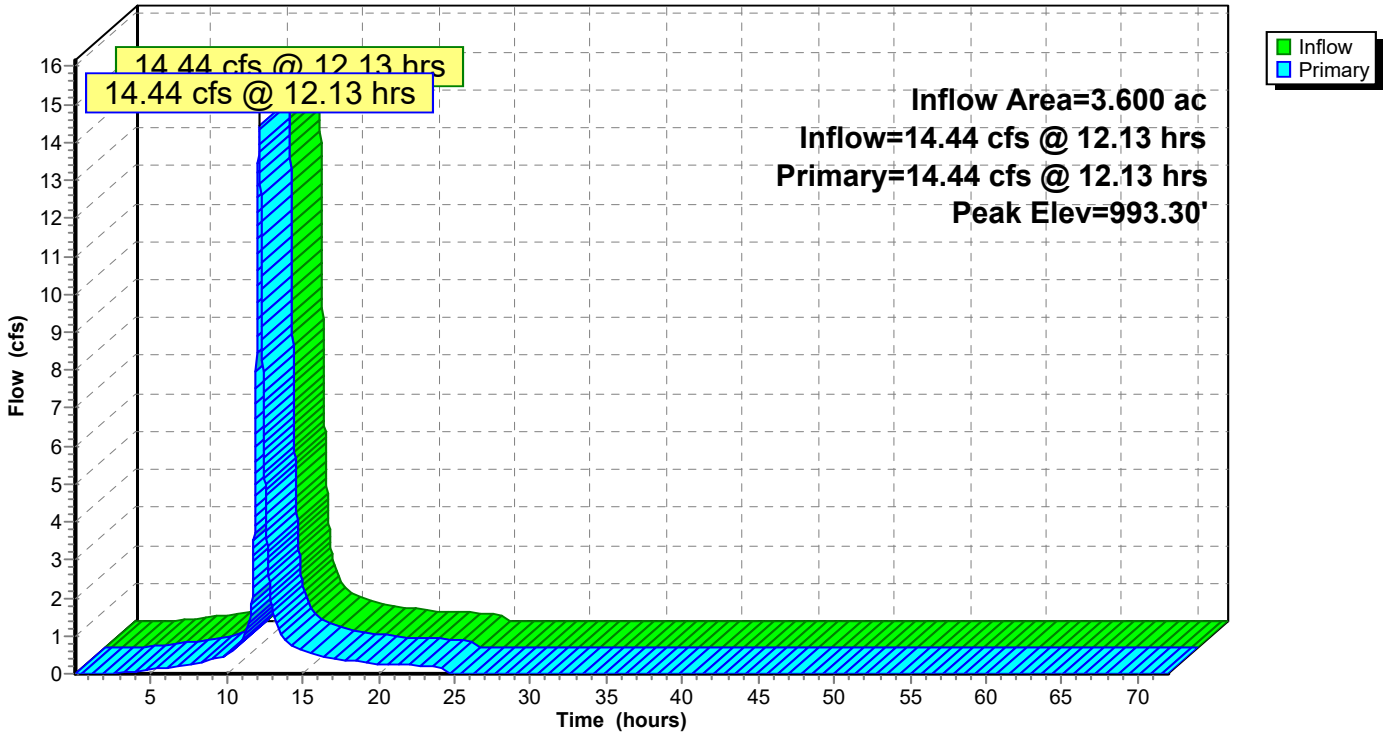


Pond 10P: 12-11



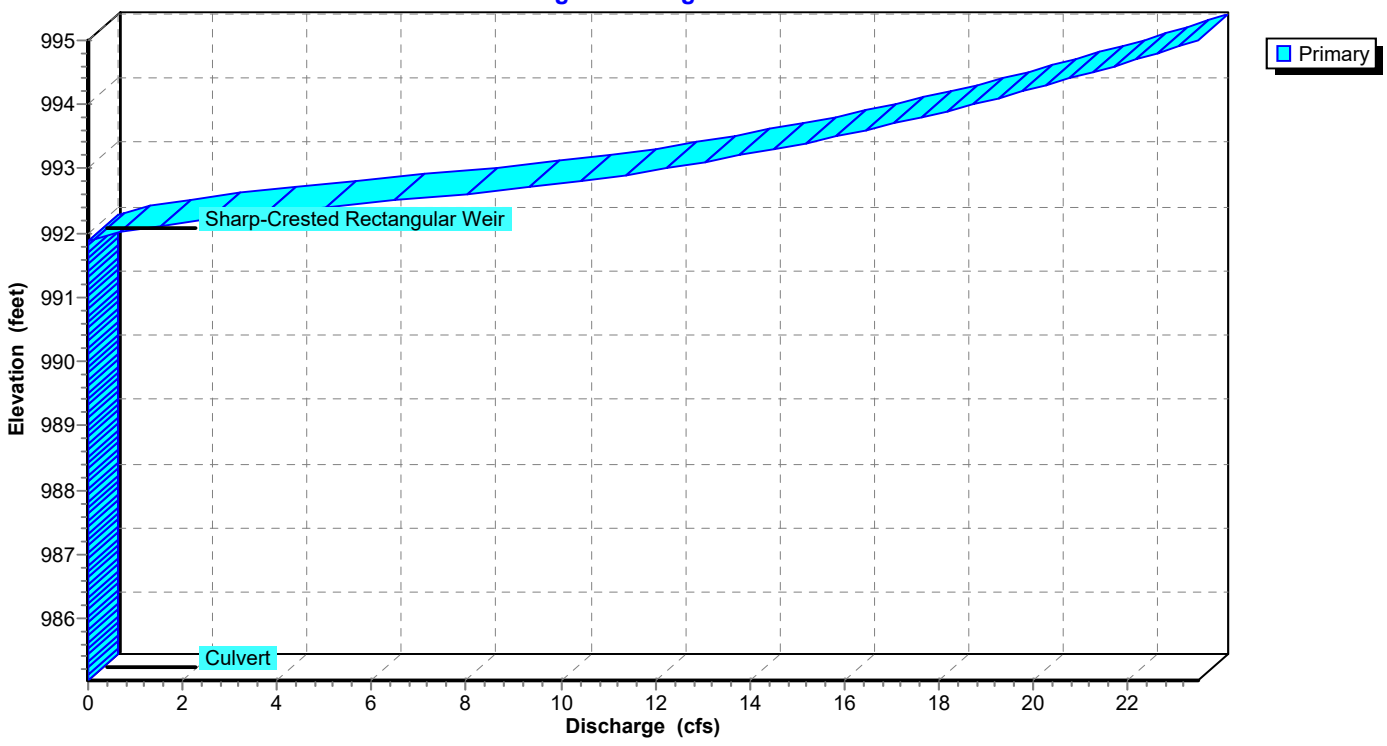
Pond 11P: 11-10

Hydrograph

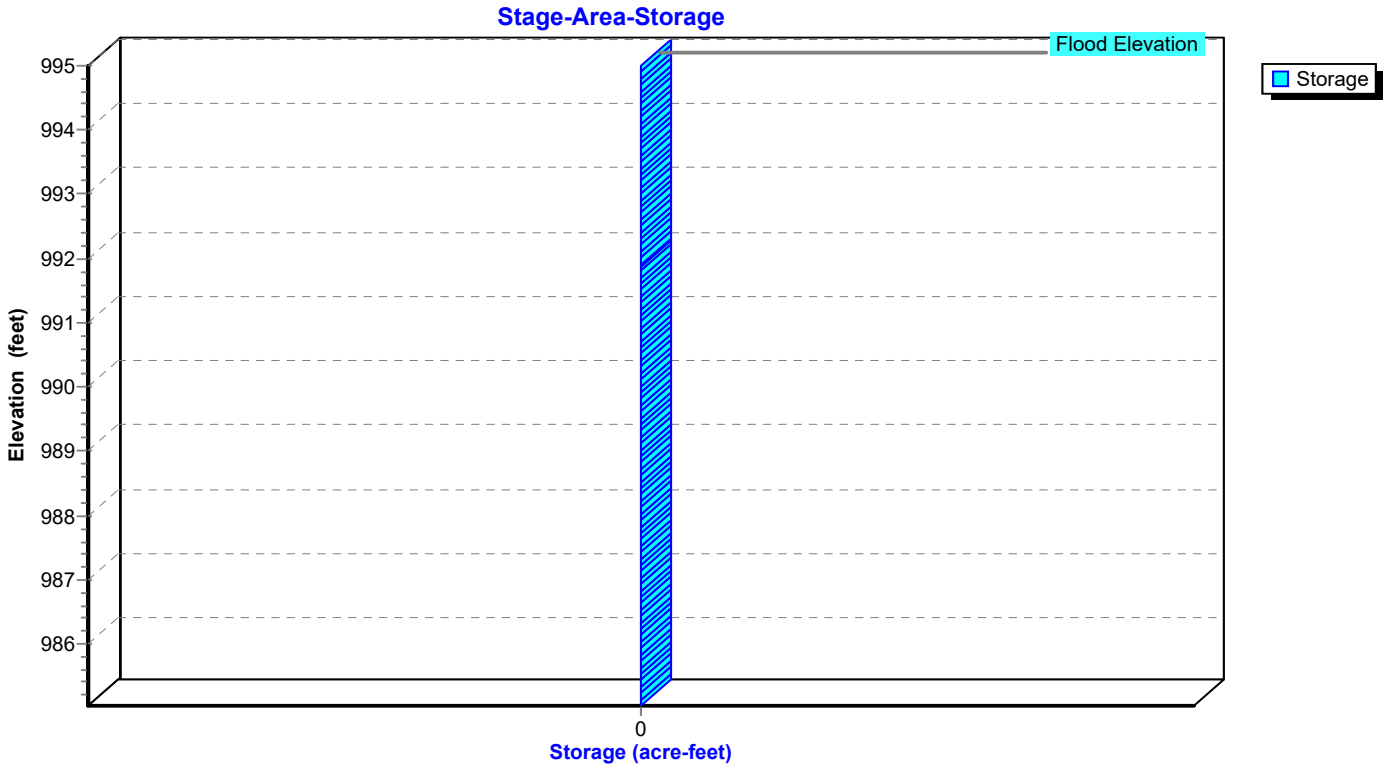


Pond 11P: 11-10

Stage-Discharge

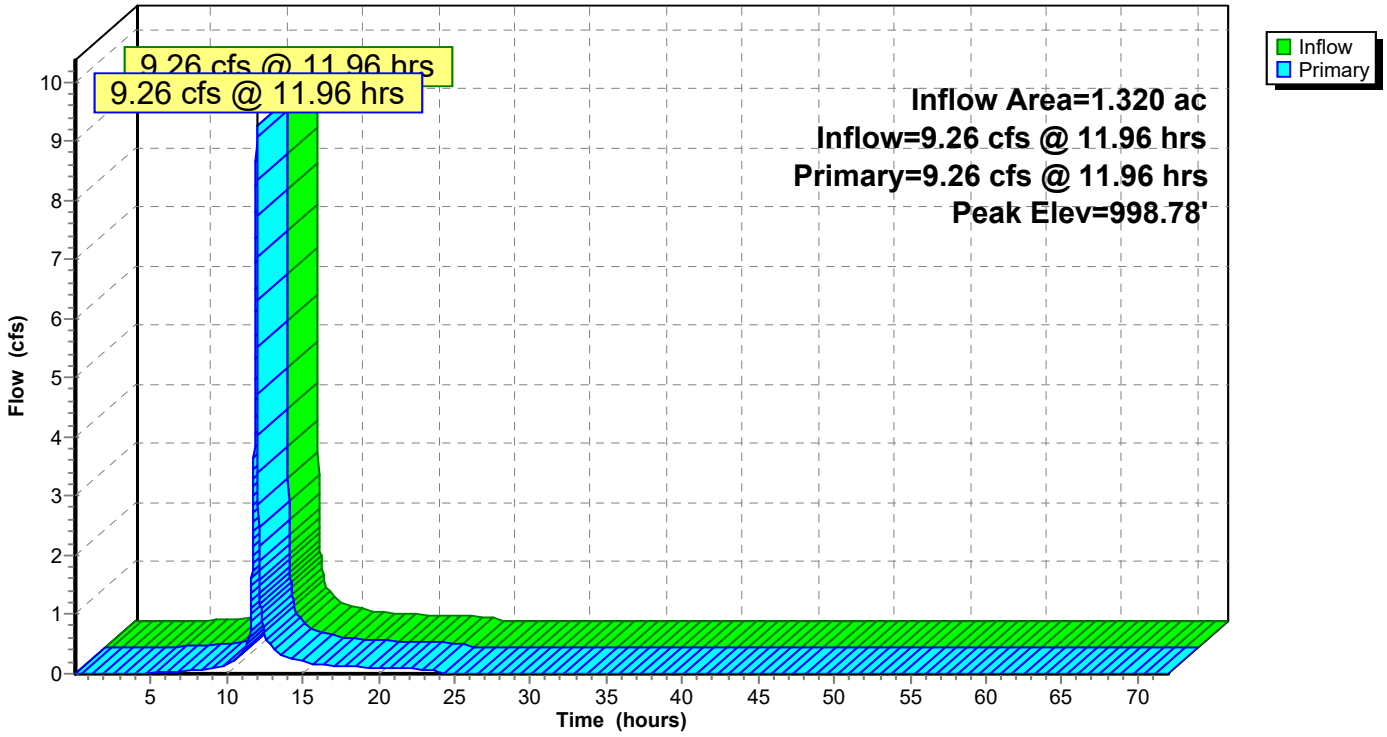


Pond 11P: 11-10



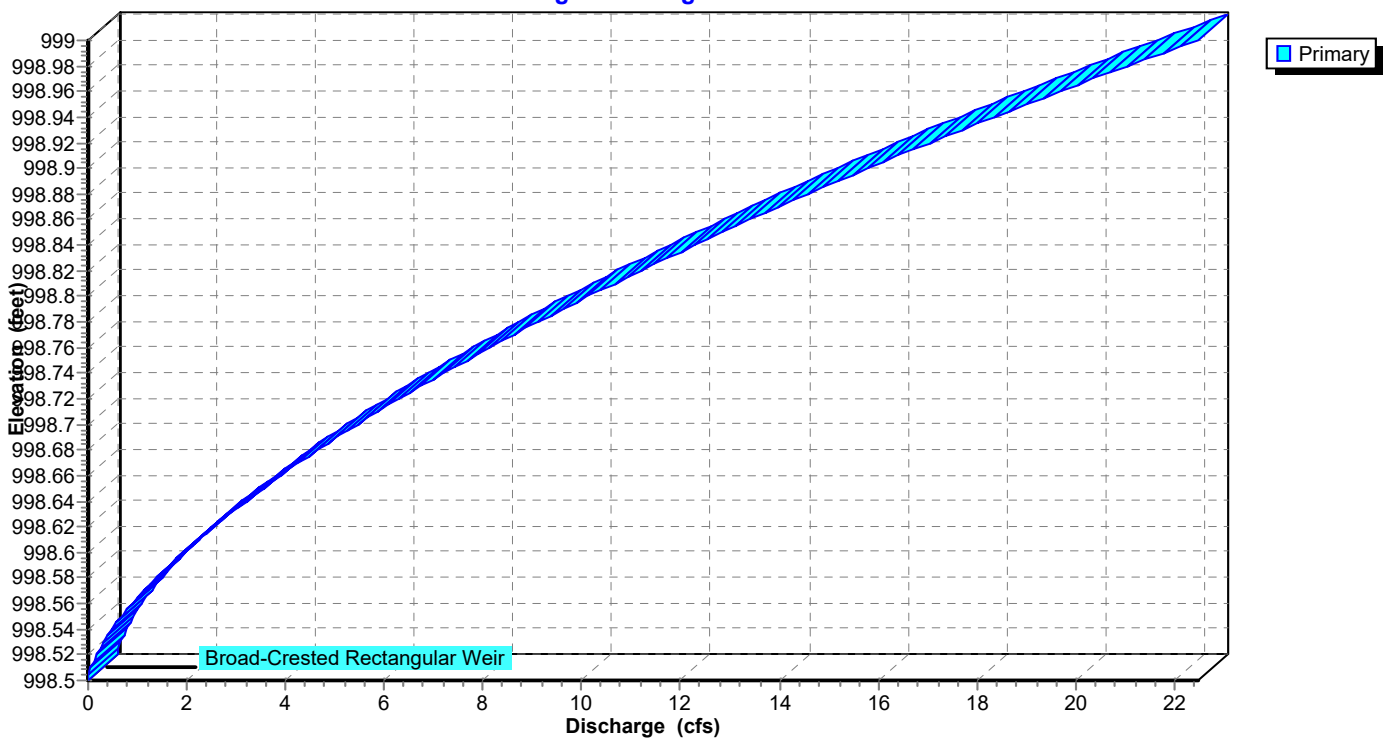
Pond 26P: DETENTION BASIN

Hydrograph

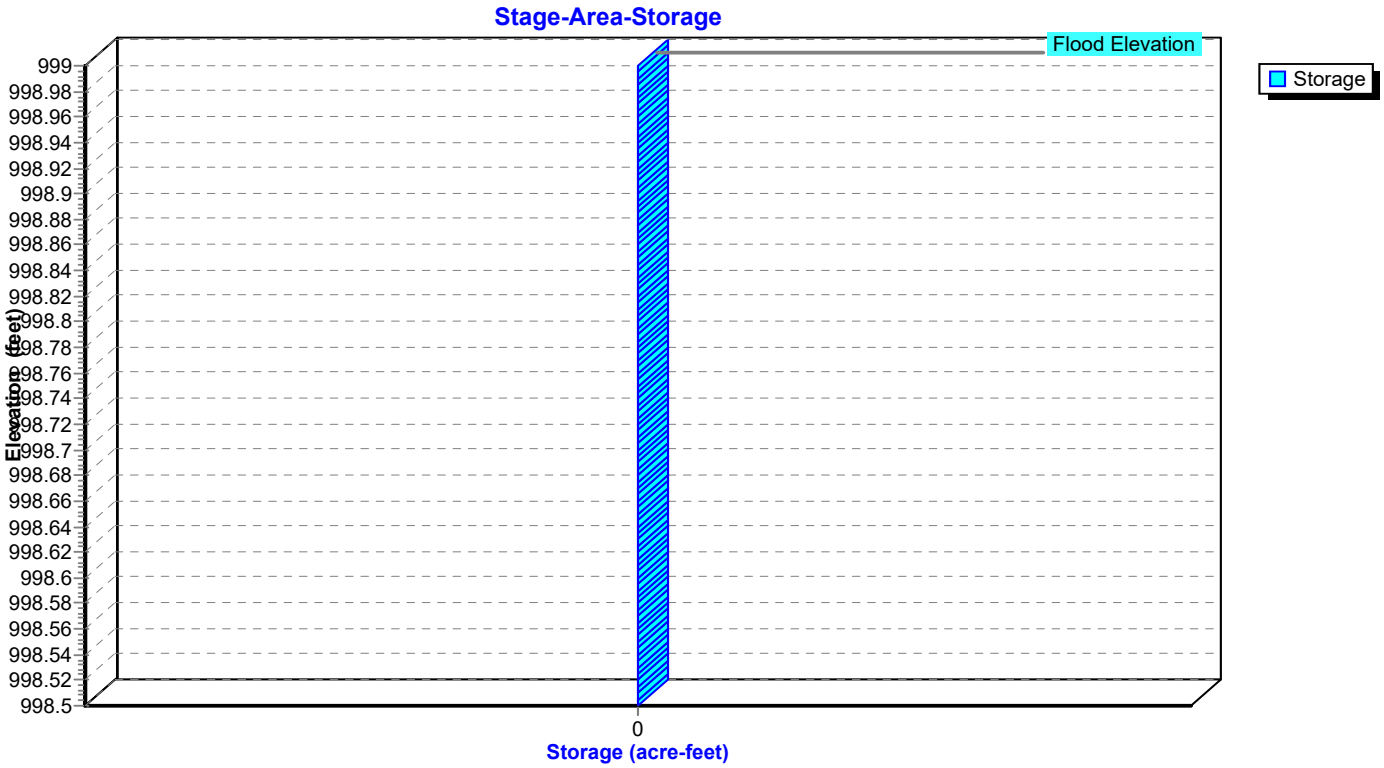


Pond 26P: DETENTION BASIN

Stage-Discharge

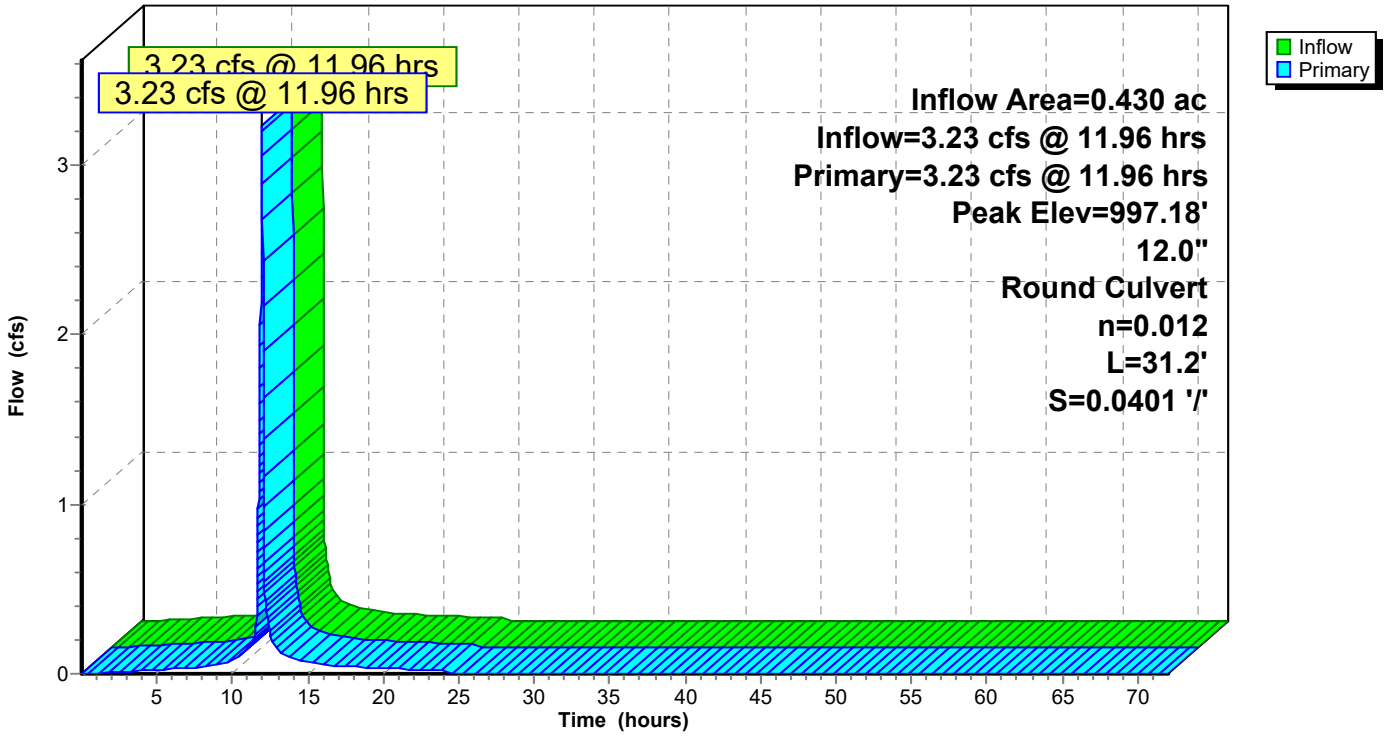


Pond 26P: DETENTION BASIN



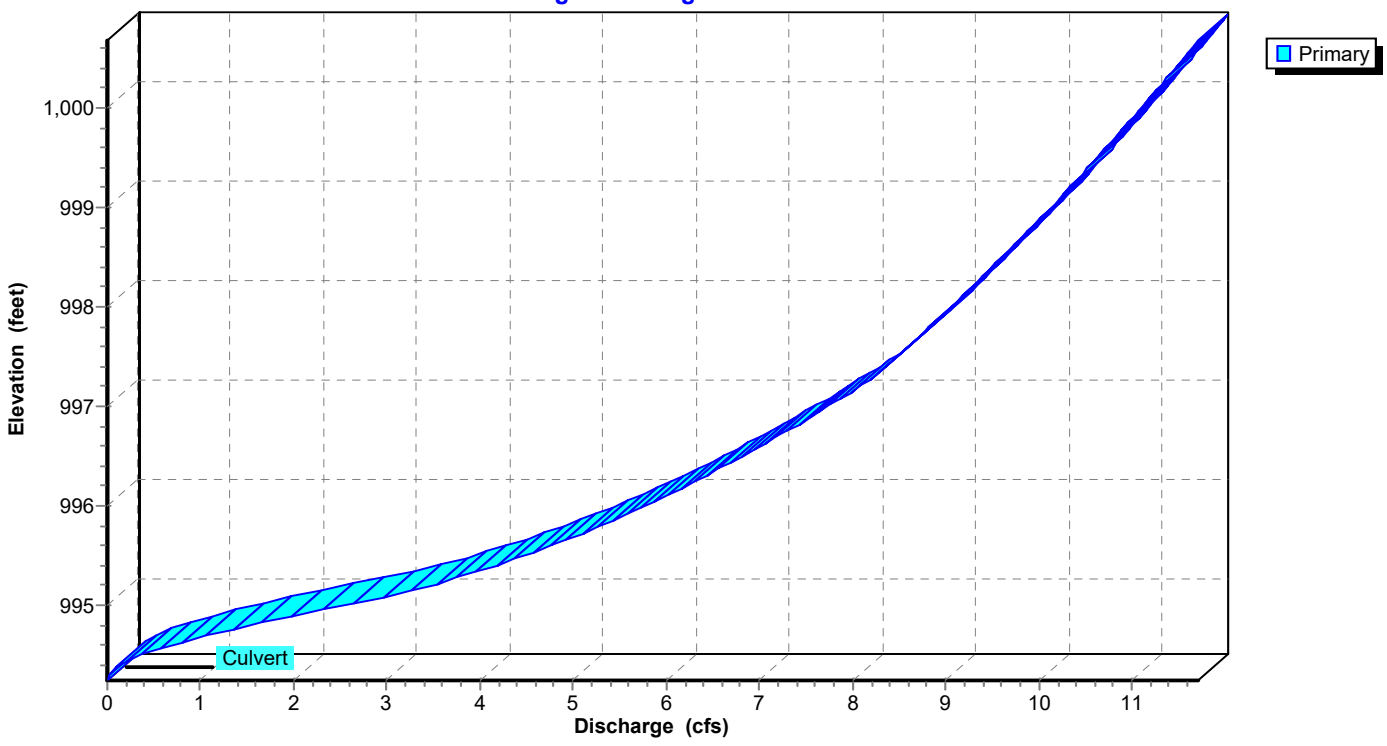
Pond 50P: BASIN REACH

Hydrograph

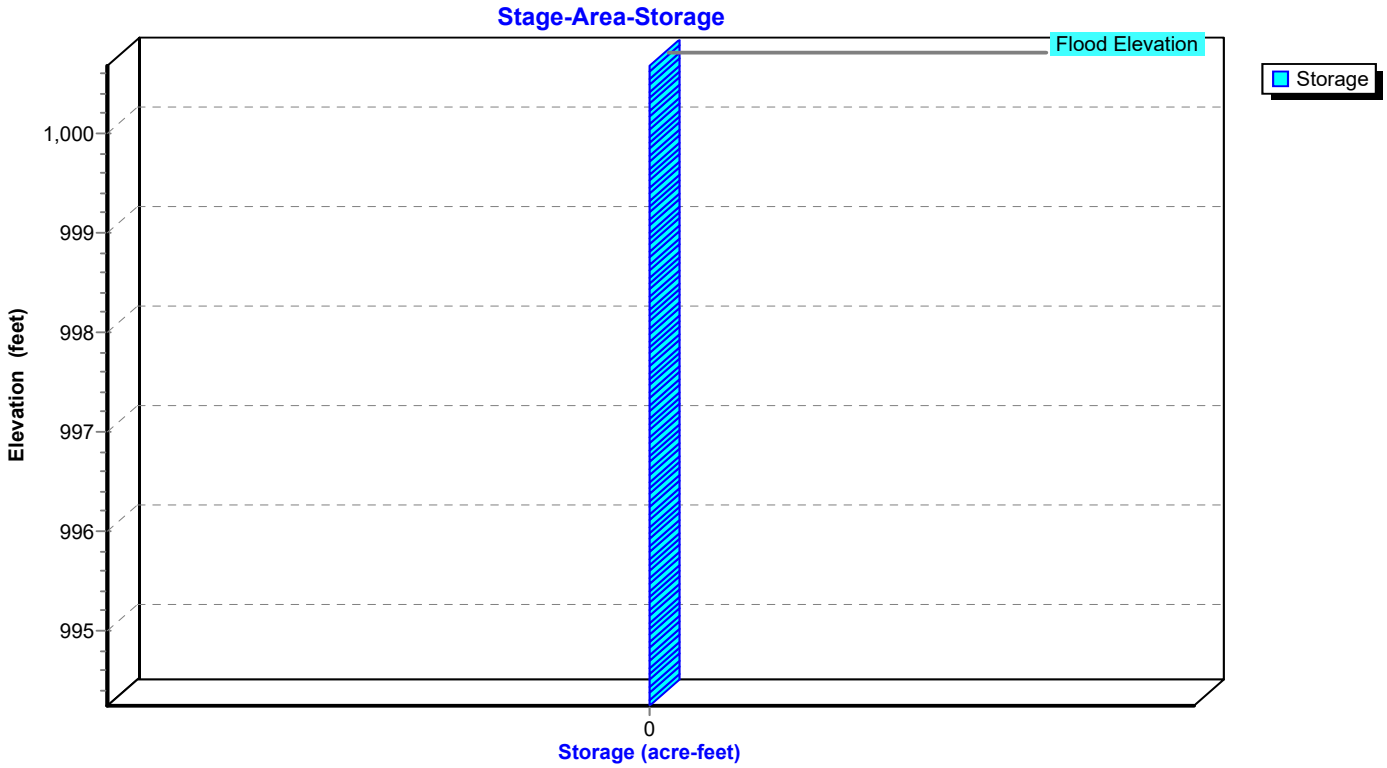


Pond 50P: BASIN REACH

Stage-Discharge

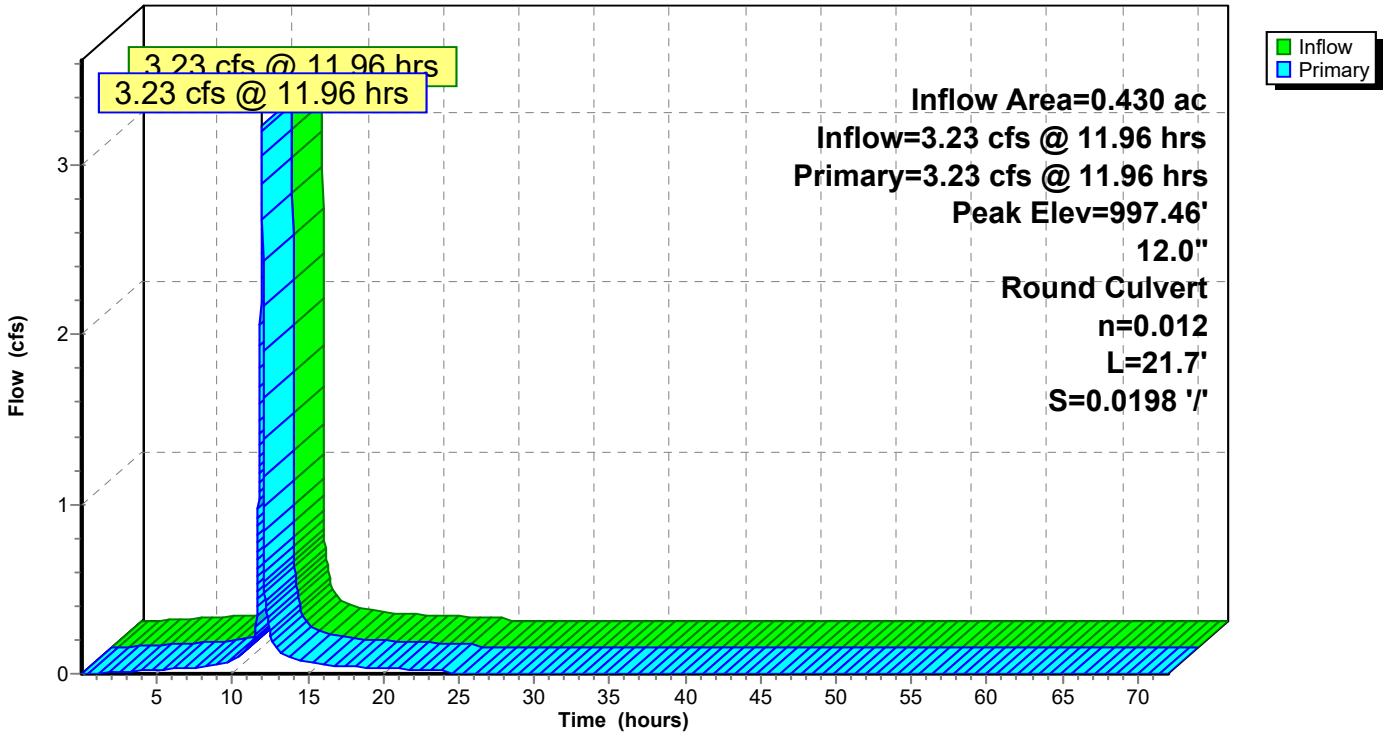


Pond 50P: BASIN REACH



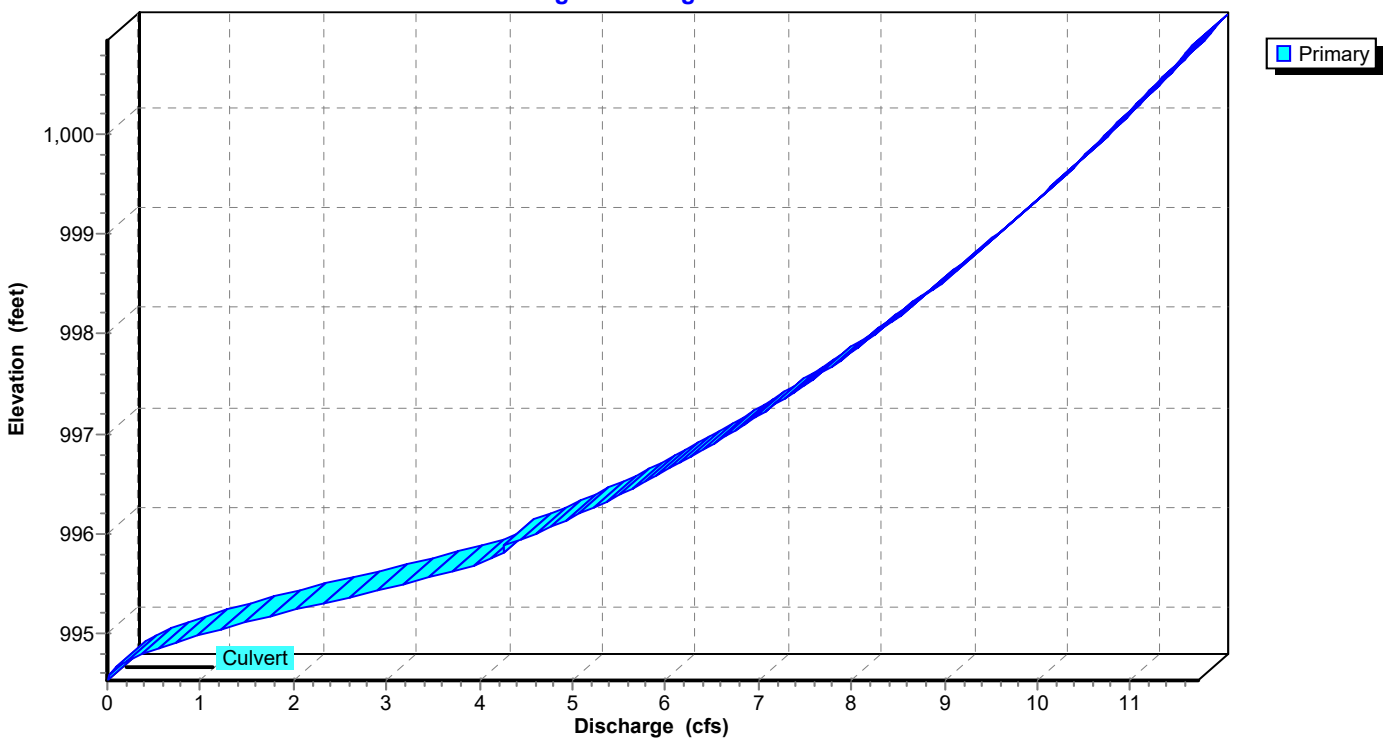
Pond 51P: ROOF DRAINS TO BASIN

Hydrograph

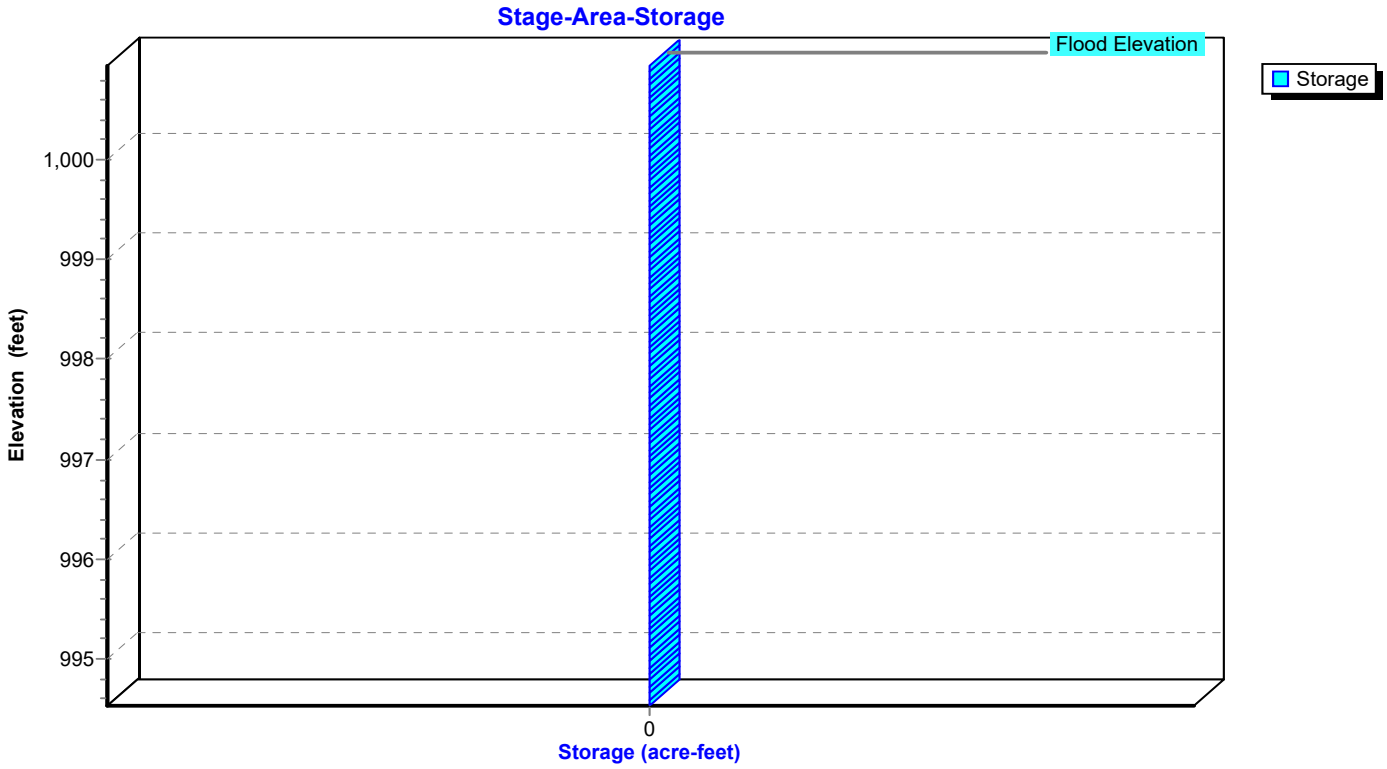


Pond 51P: ROOF DRAINS TO BASIN

Stage-Discharge

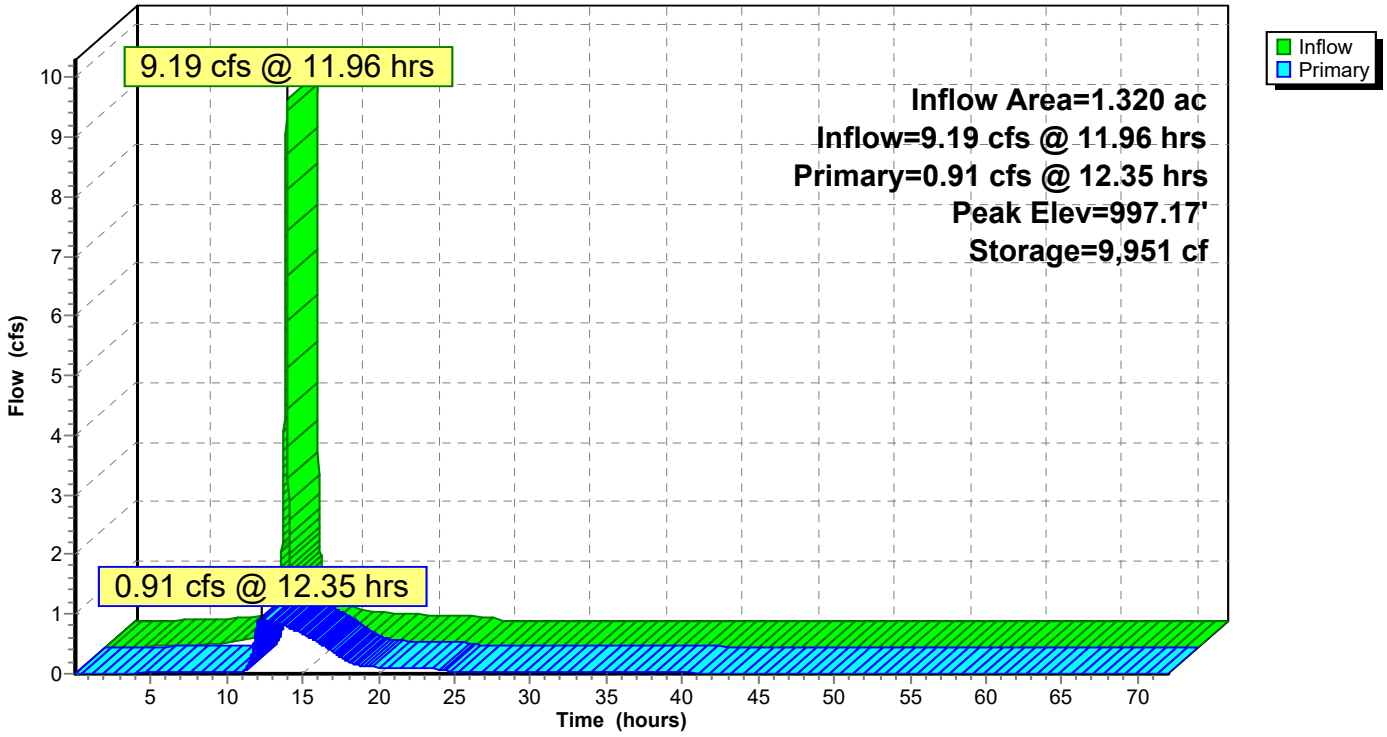


Pond 51P: ROOF DRAINS TO BASIN



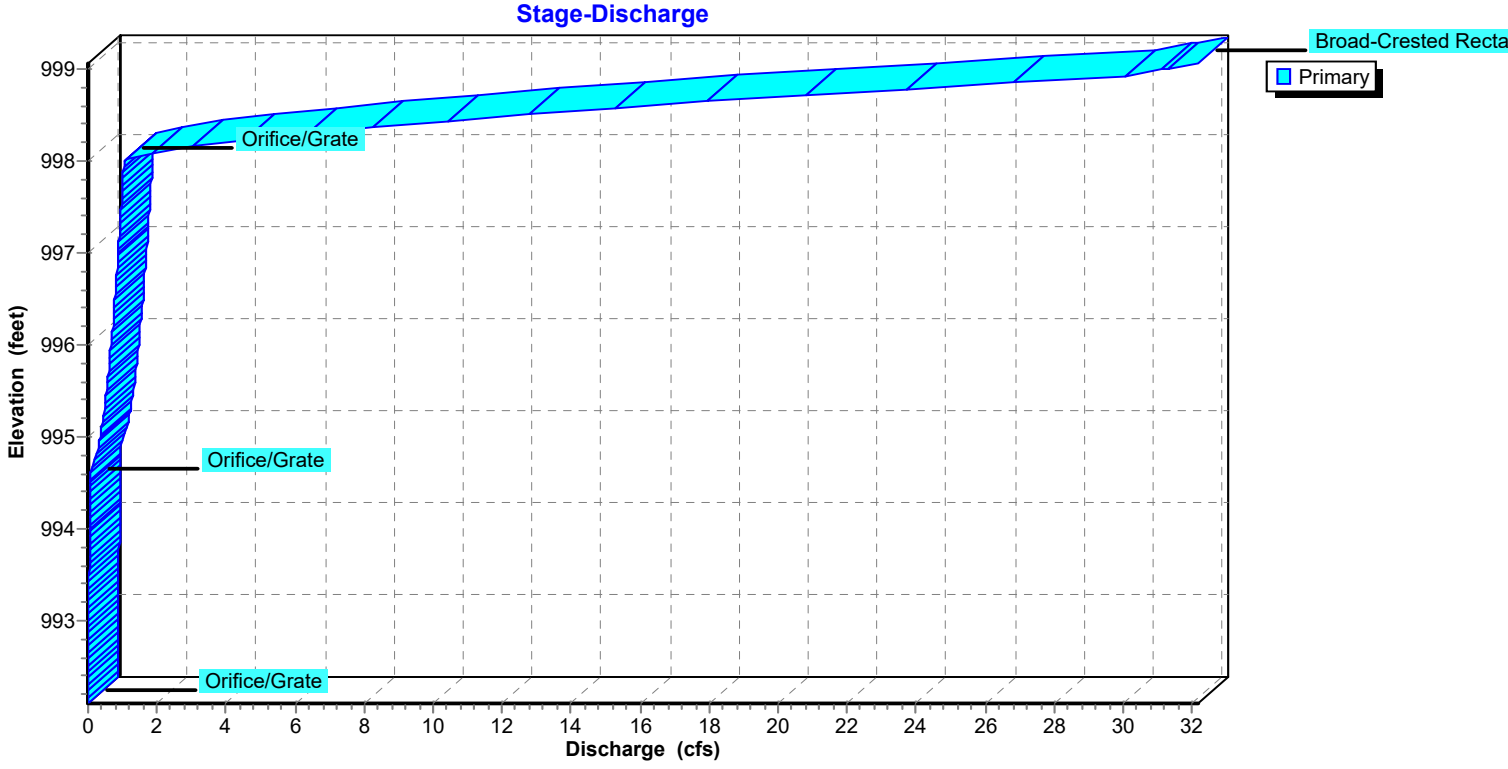
Pond 52P: DETENTION BASIN

Hydrograph

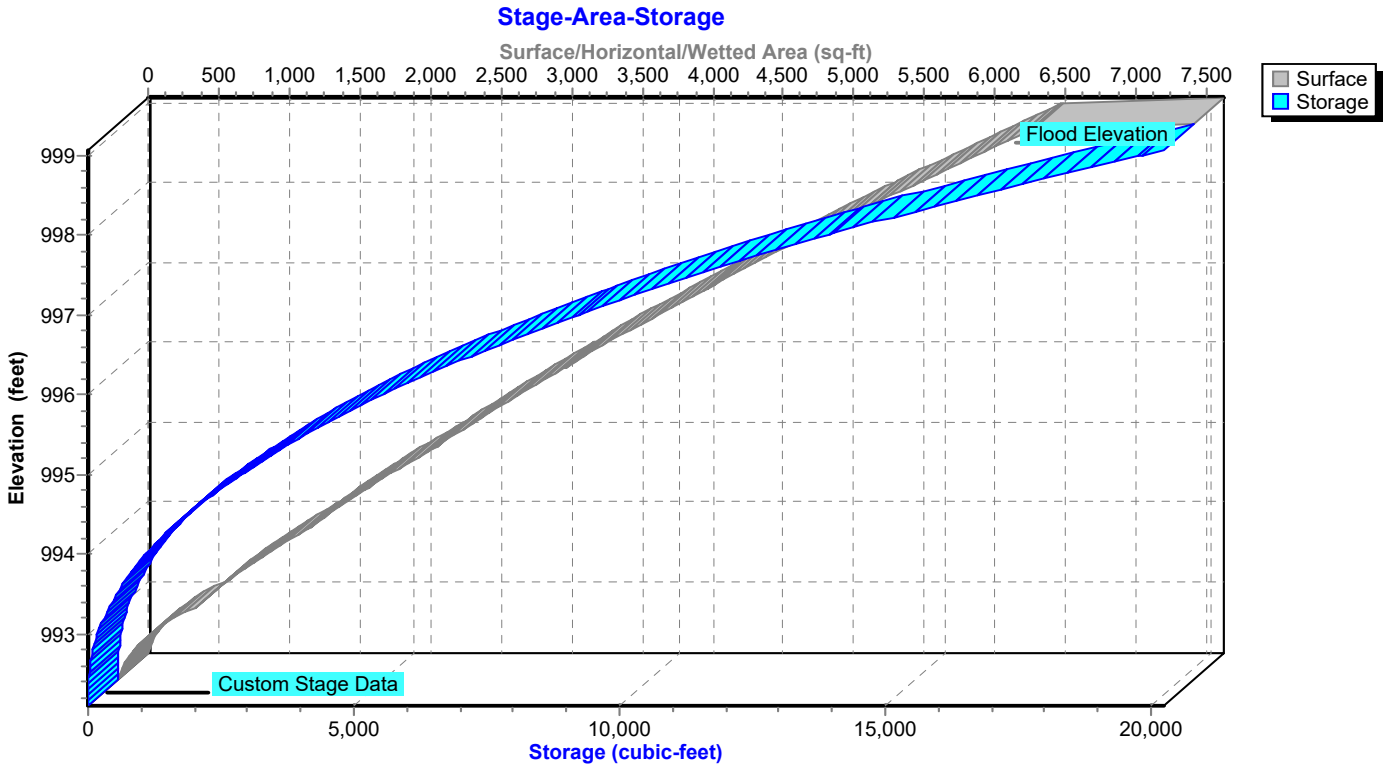


Pond 52P: DETENTION BASIN

Stage-Discharge

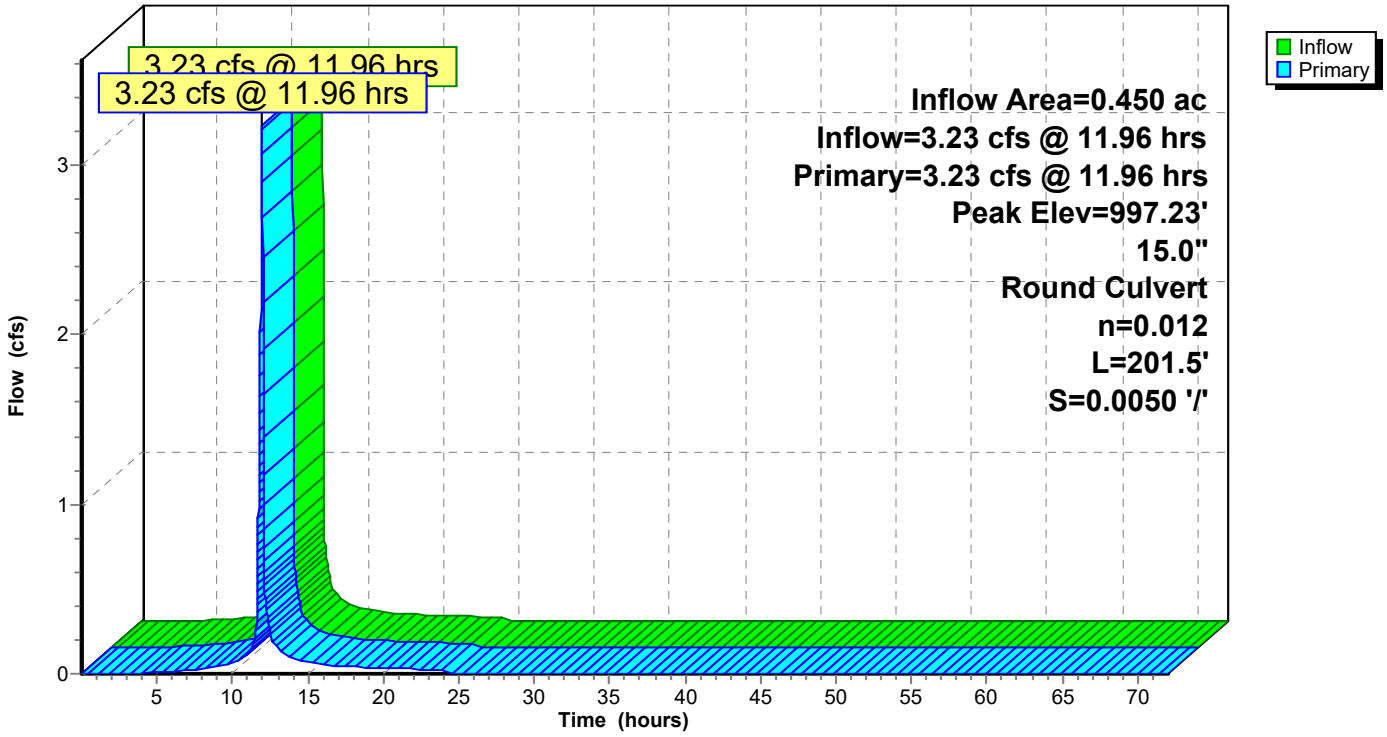


Pond 52P: DETENTION BASIN



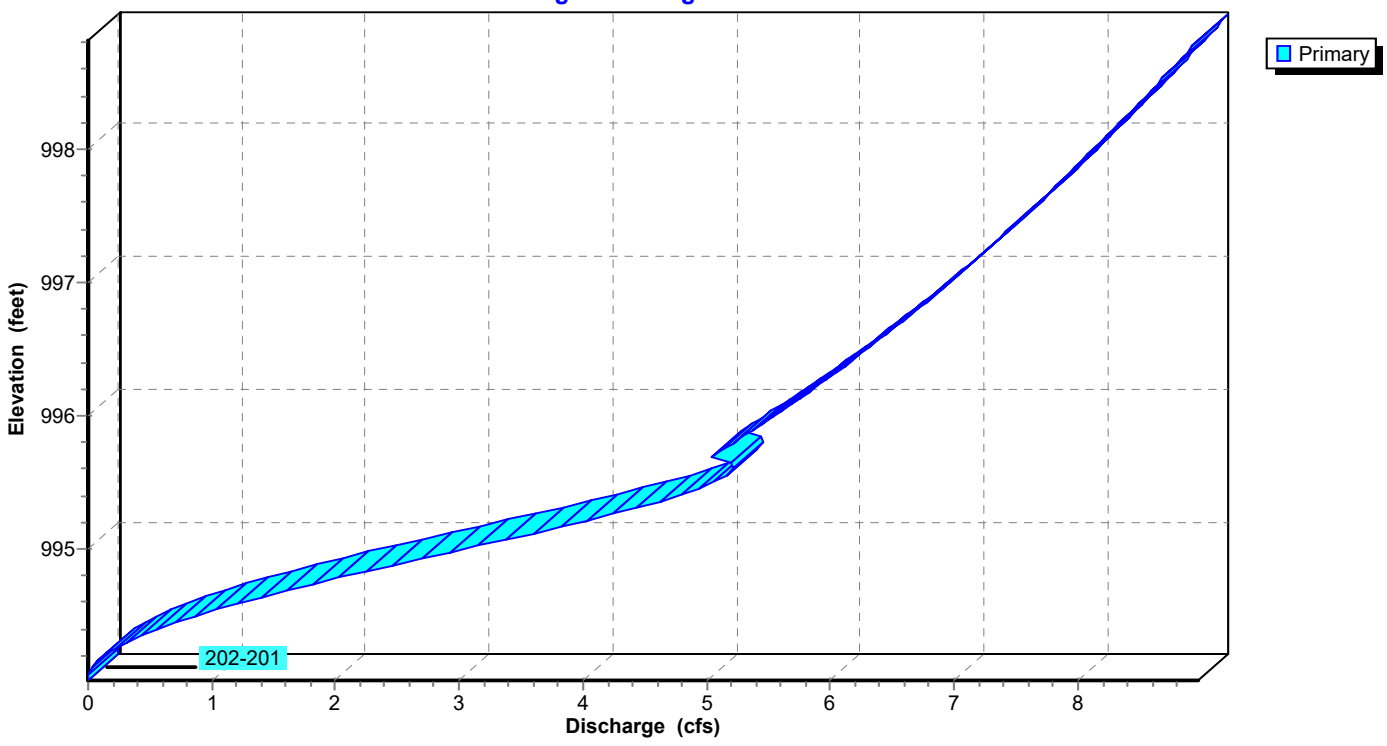
Pond 53P: 301-300

Hydrograph

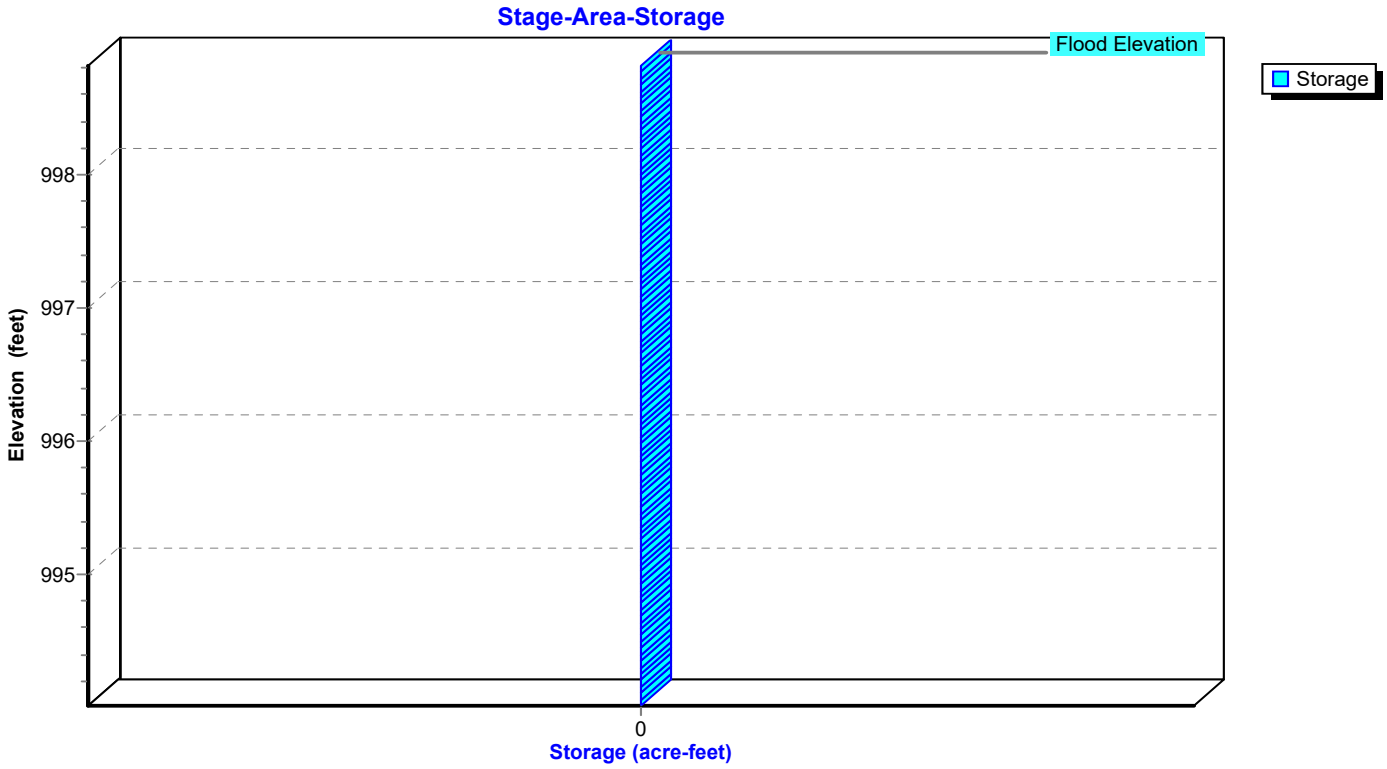


Pond 53P: 301-300

Stage-Discharge

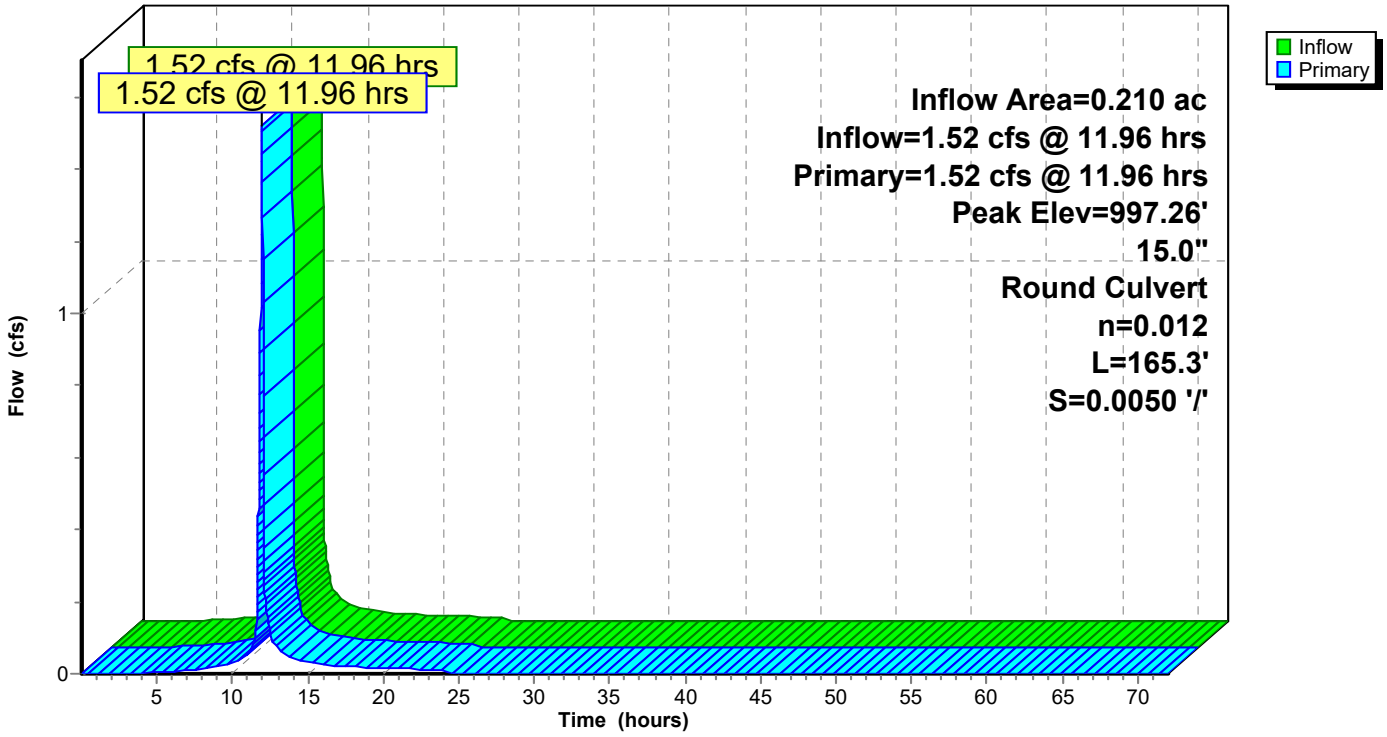


Pond 53P: 301-300



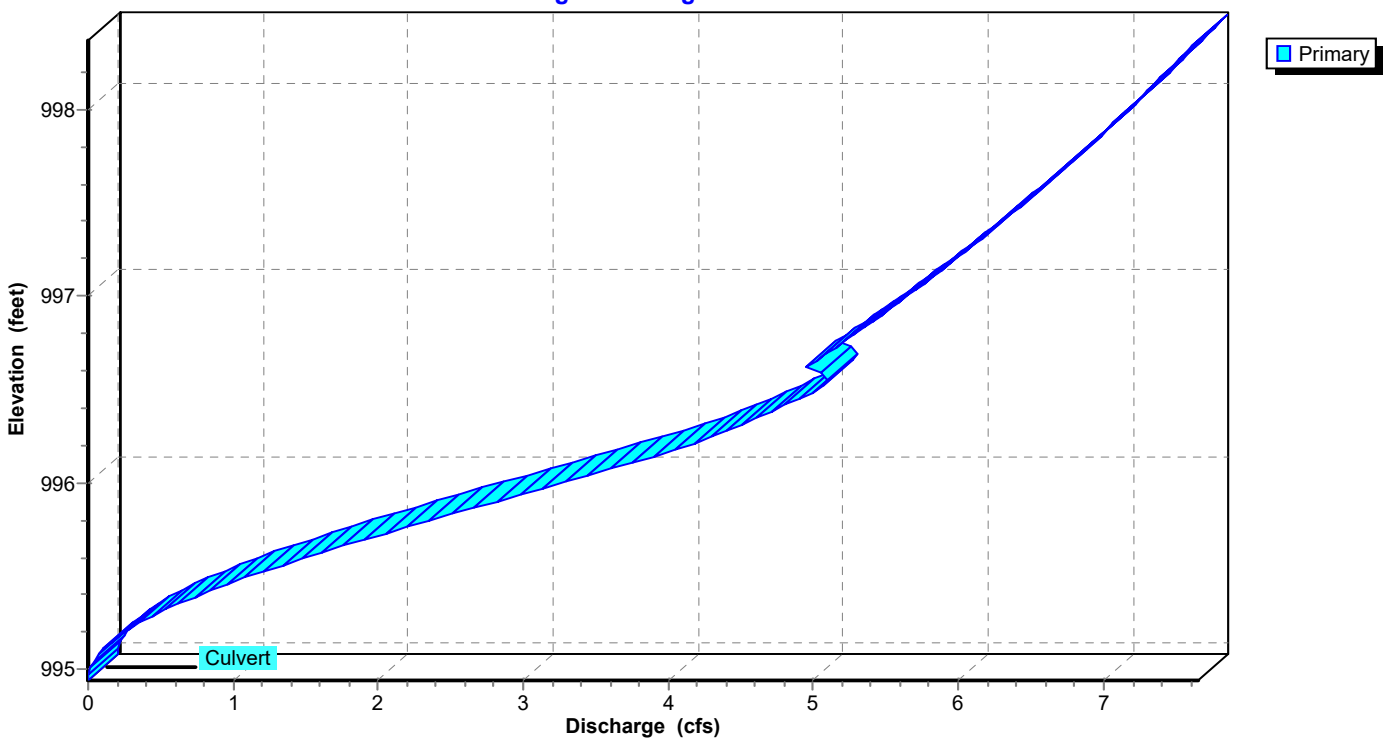
Pond 54P: 302-301

Hydrograph

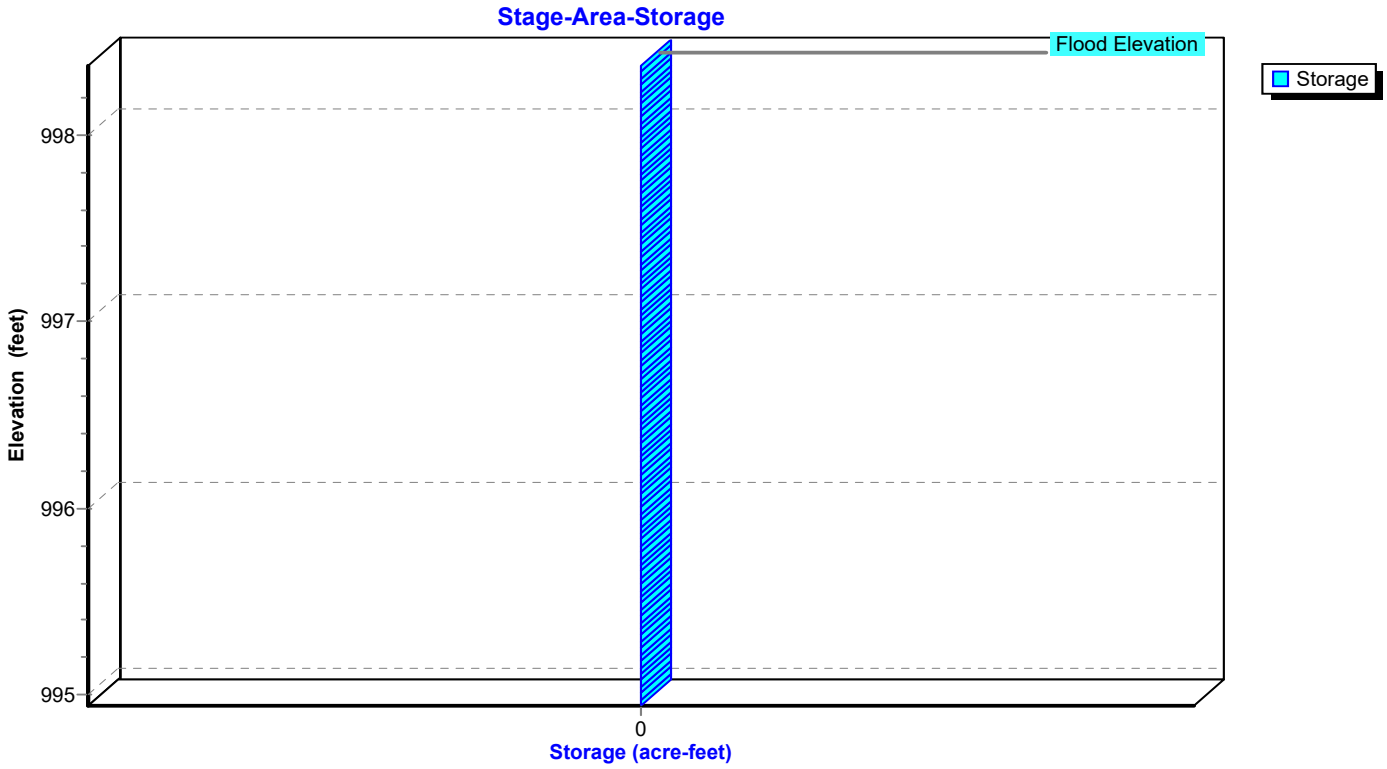


Pond 54P: 302-301

Stage-Discharge

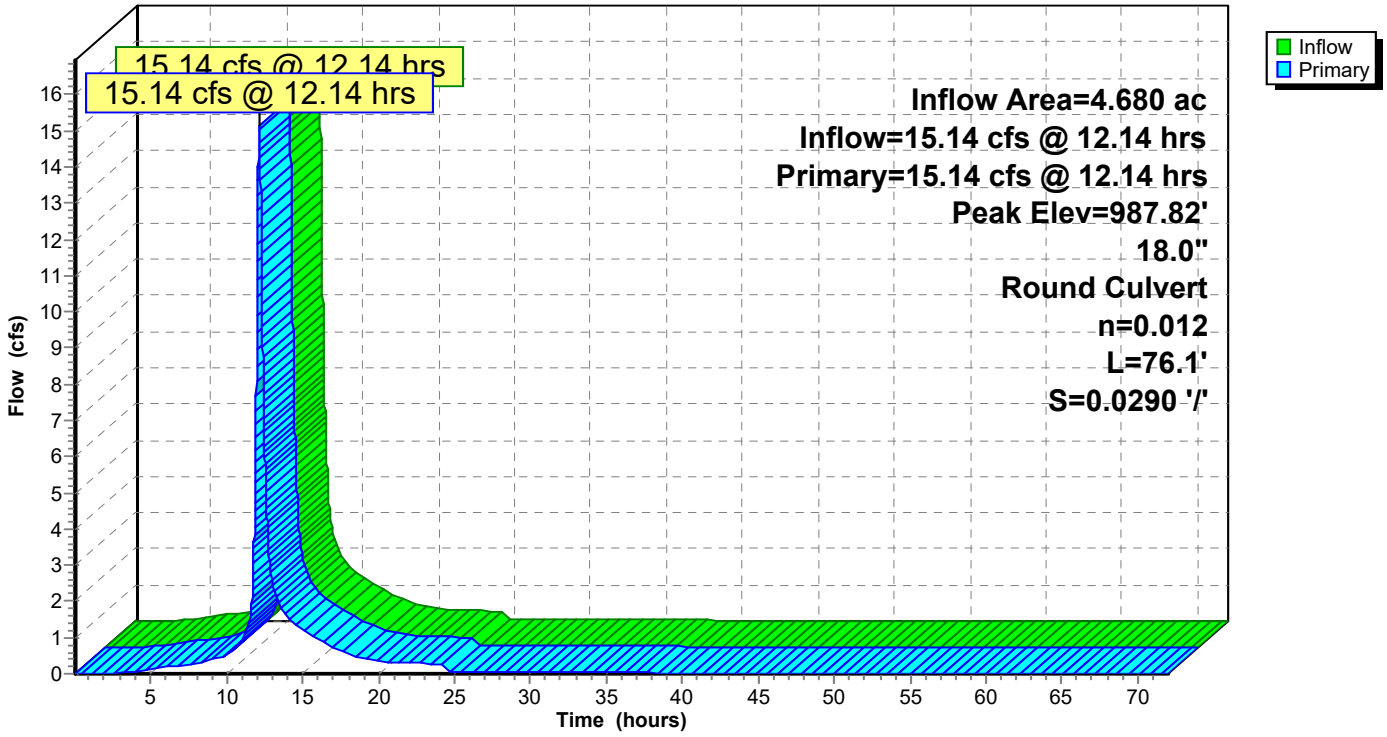


Pond 54P: 302-301



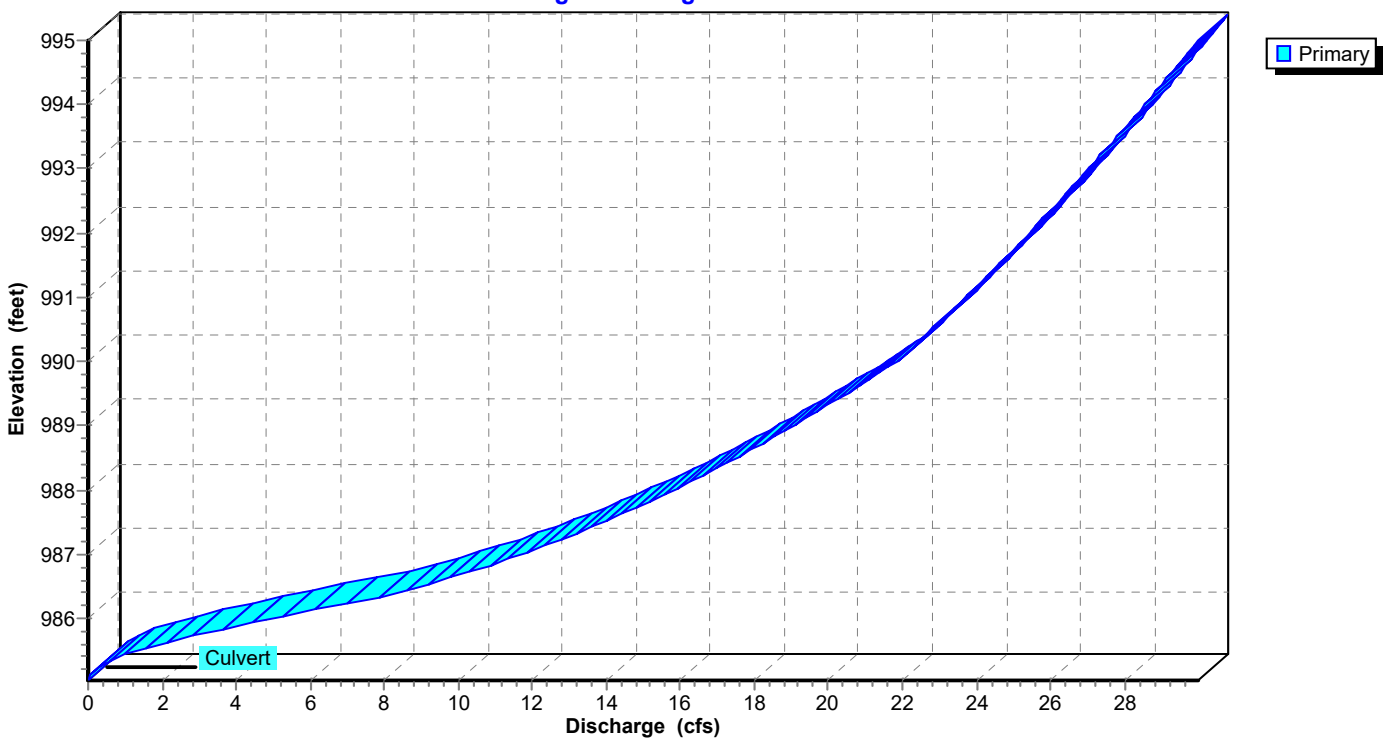
Pond 55P: 11-10

Hydrograph

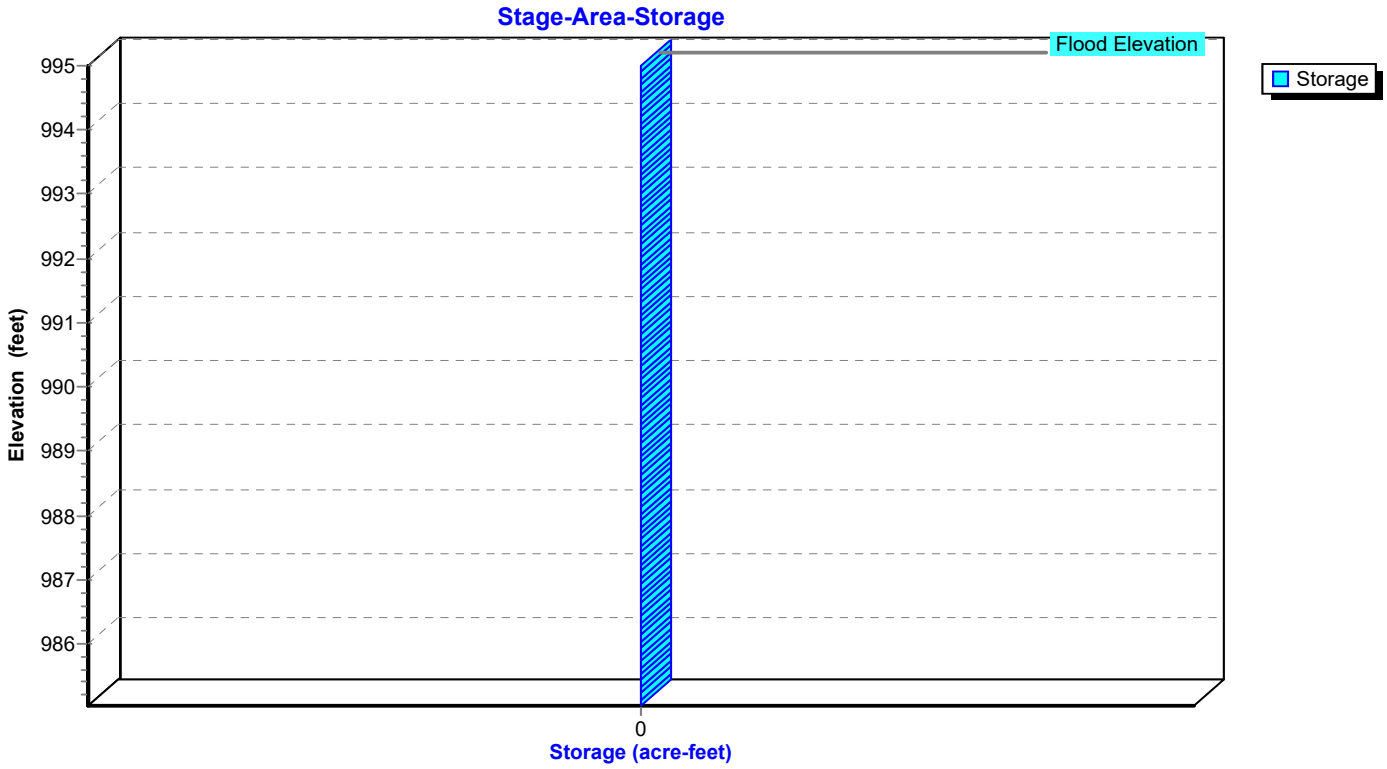


Pond 55P: 11-10

Stage-Discharge

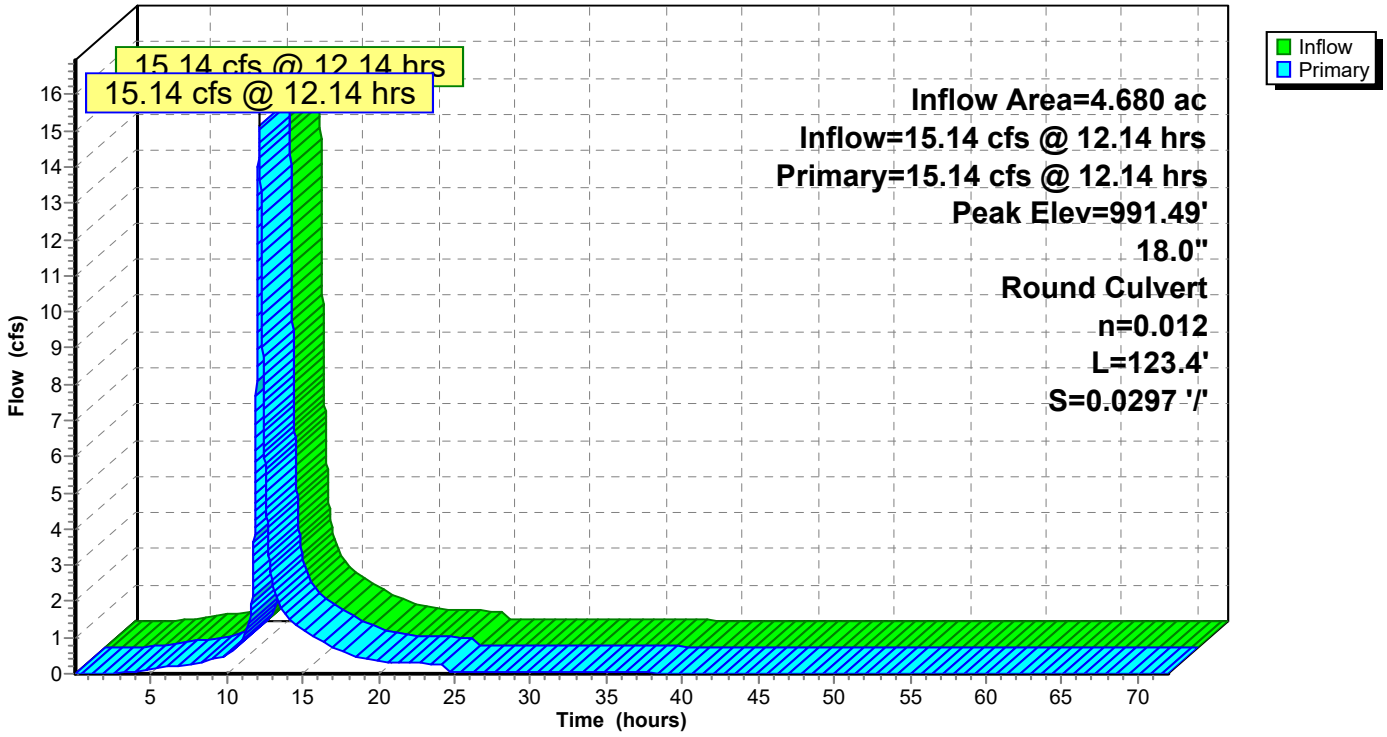


Pond 55P: 11-10



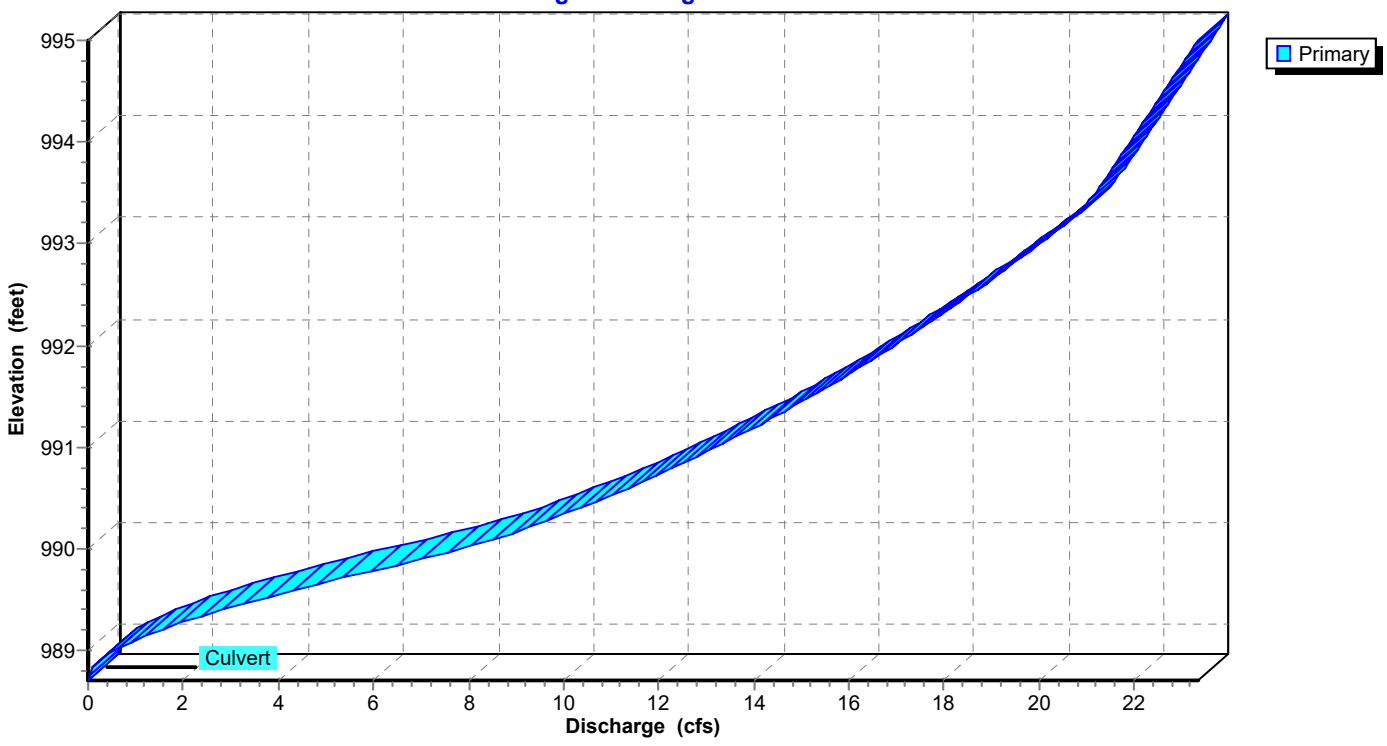
Pond 56P: 11 - 100 MH

Hydrograph

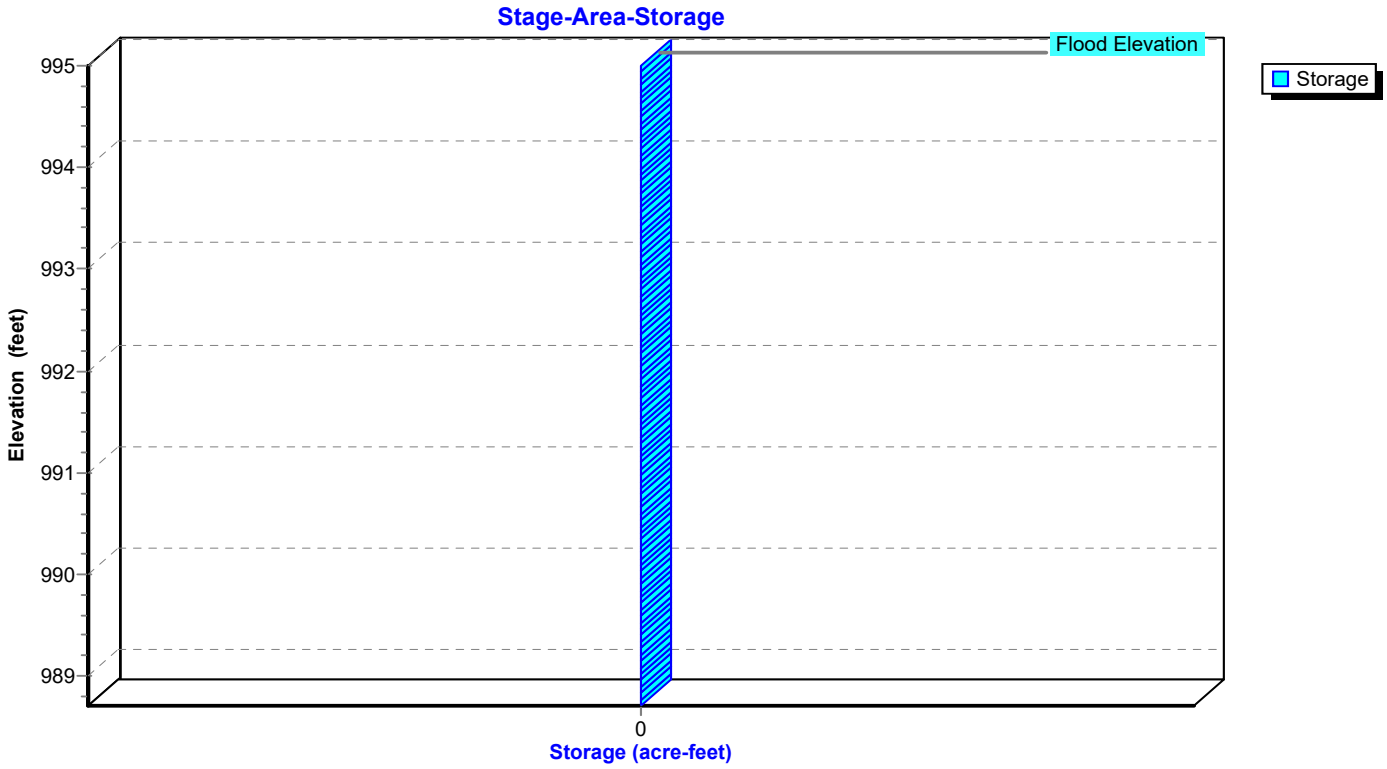


Pond 56P: 11 - 100 MH

Stage-Discharge

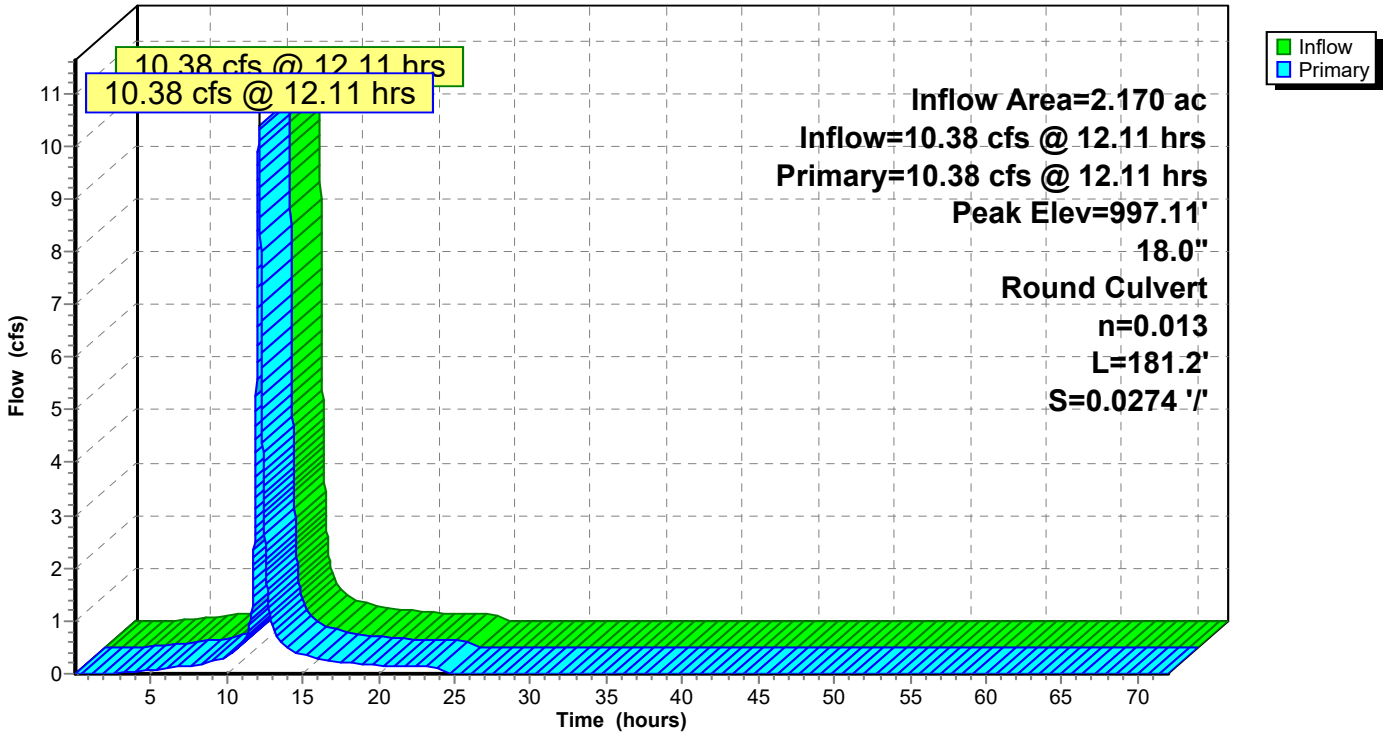


Pond 56P: 11 - 100 MH



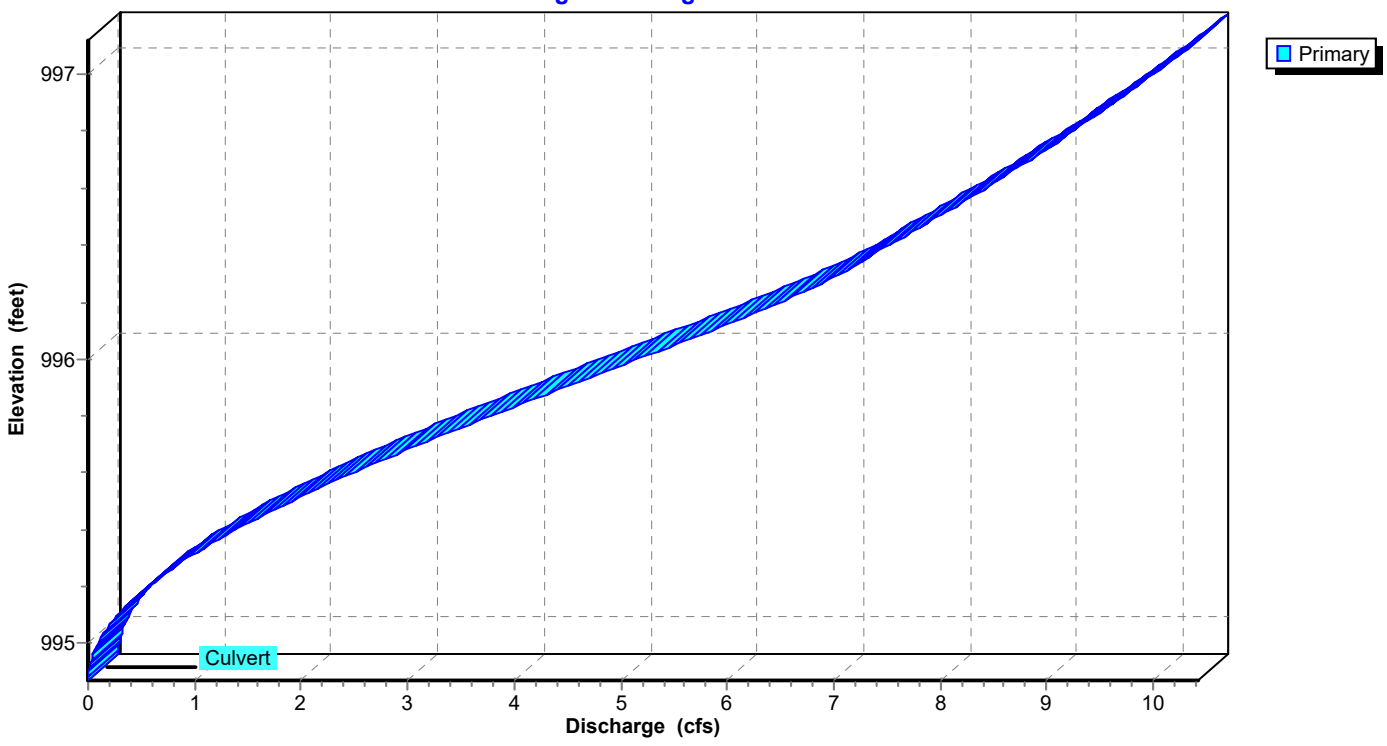
Pond 57P: 12-11

Hydrograph

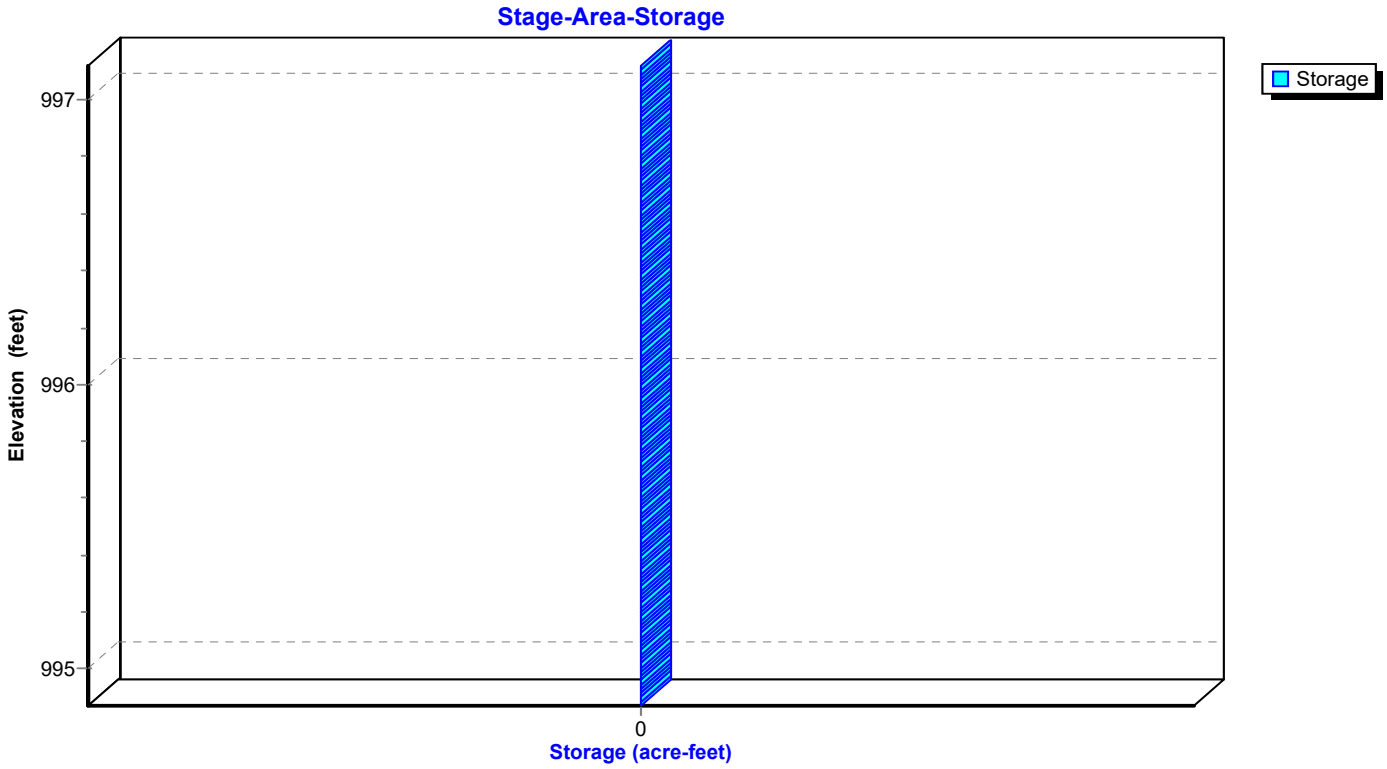


Pond 57P: 12-11

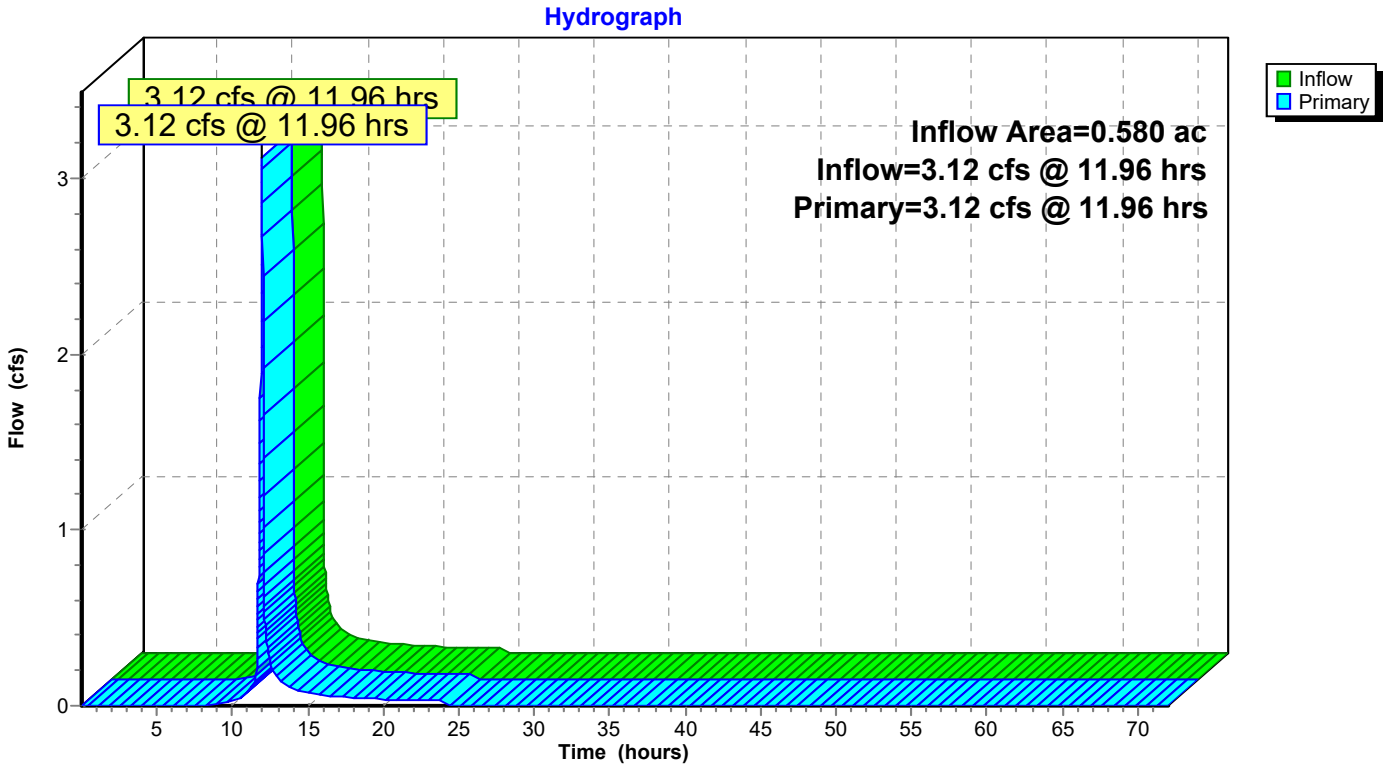
Stage-Discharge



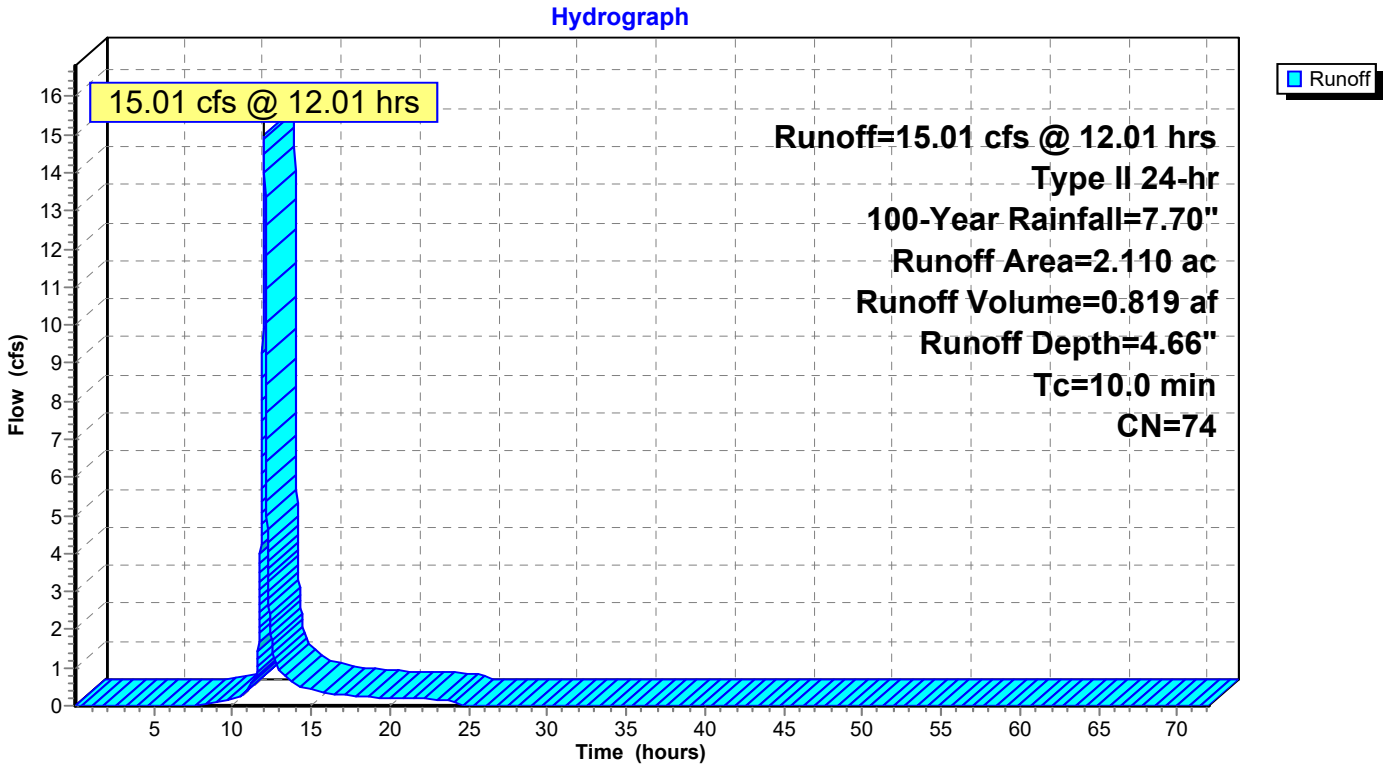
Pond 57P: 12-11



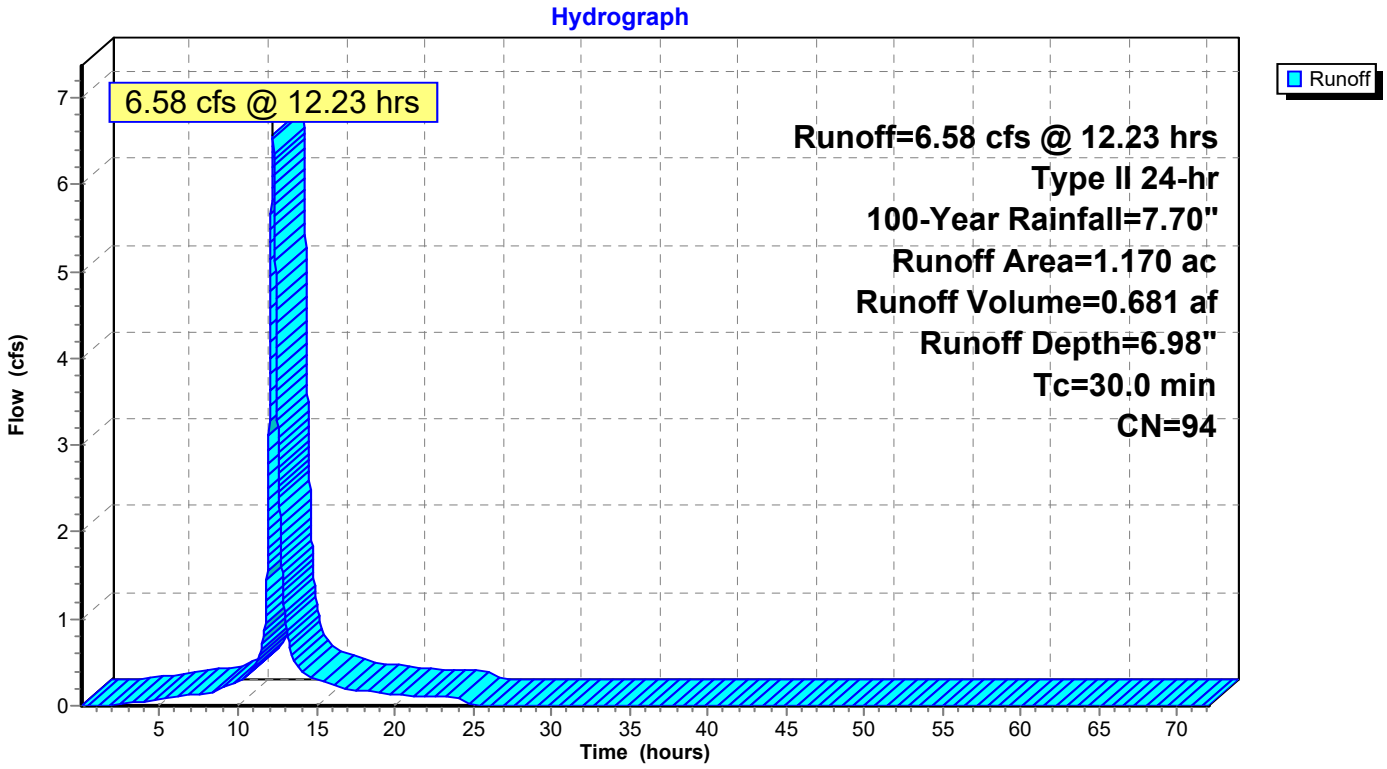
Link 90L: BYPASS AREAS



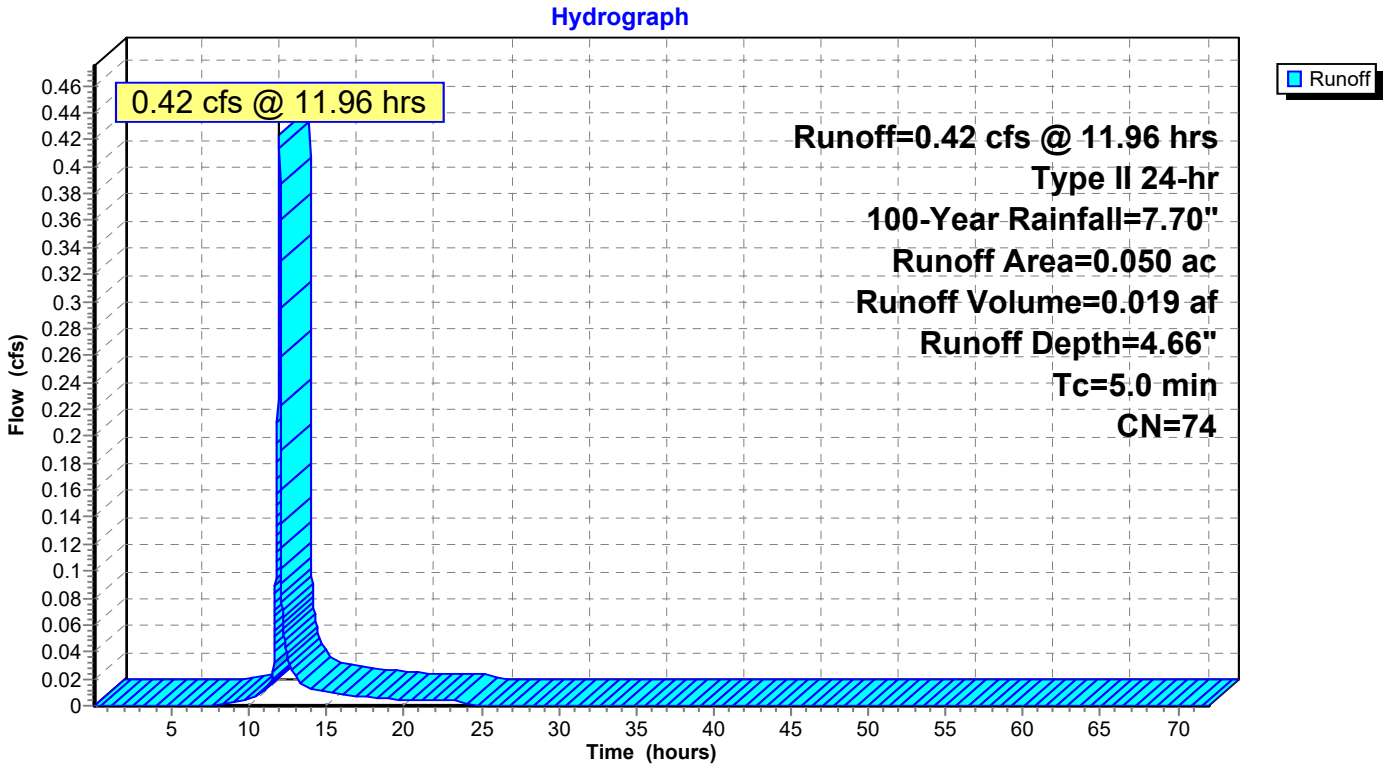
Subcatchment 1S: EXISTING CONDITIONS



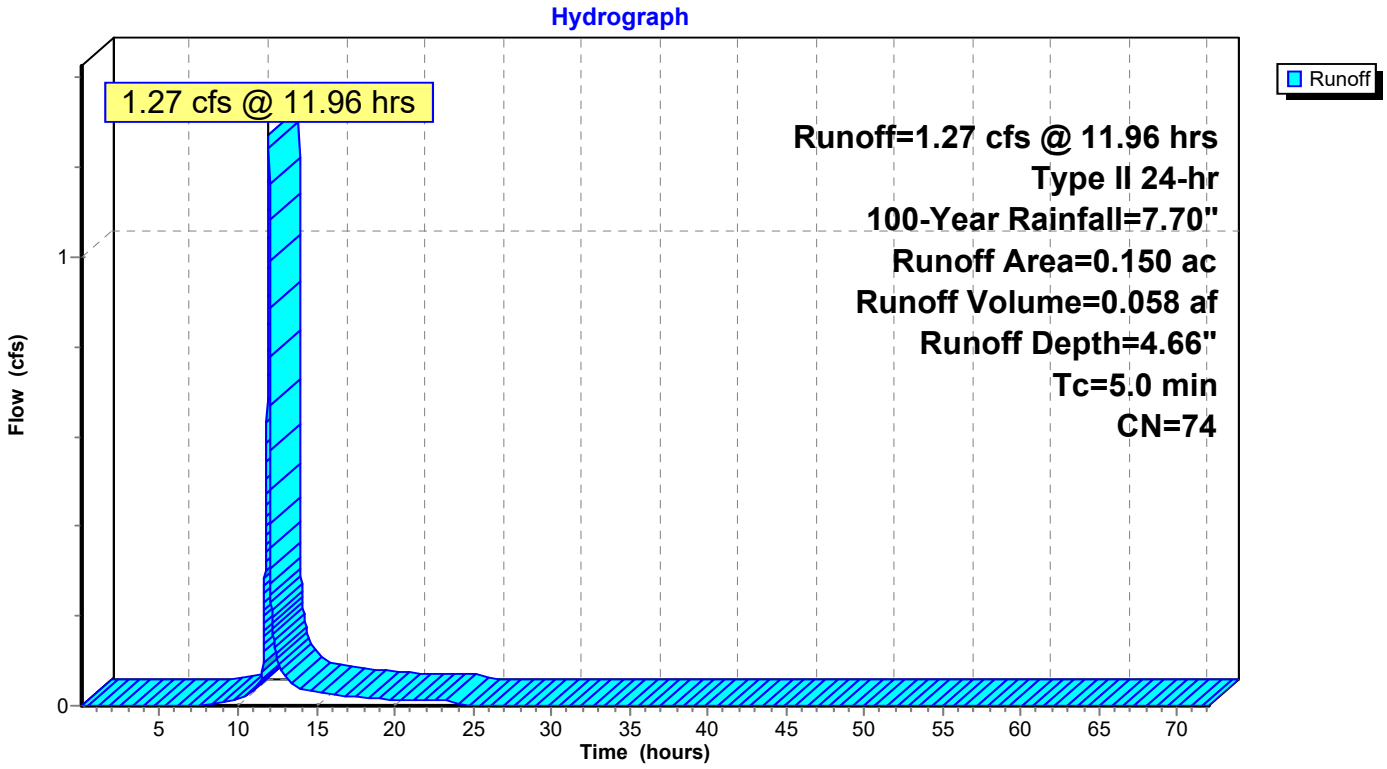
Subcatchment 2S: AREA A



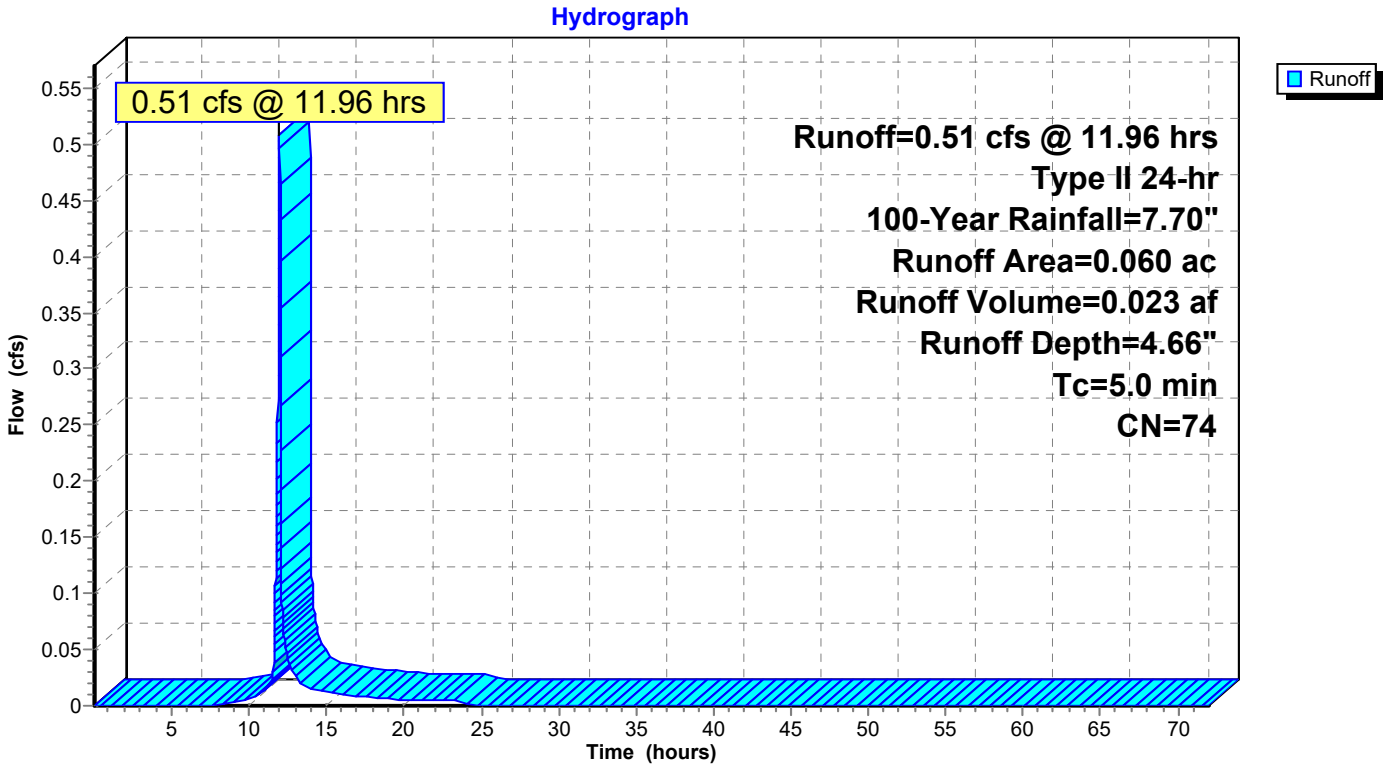
Subcatchment 3S: AREA B



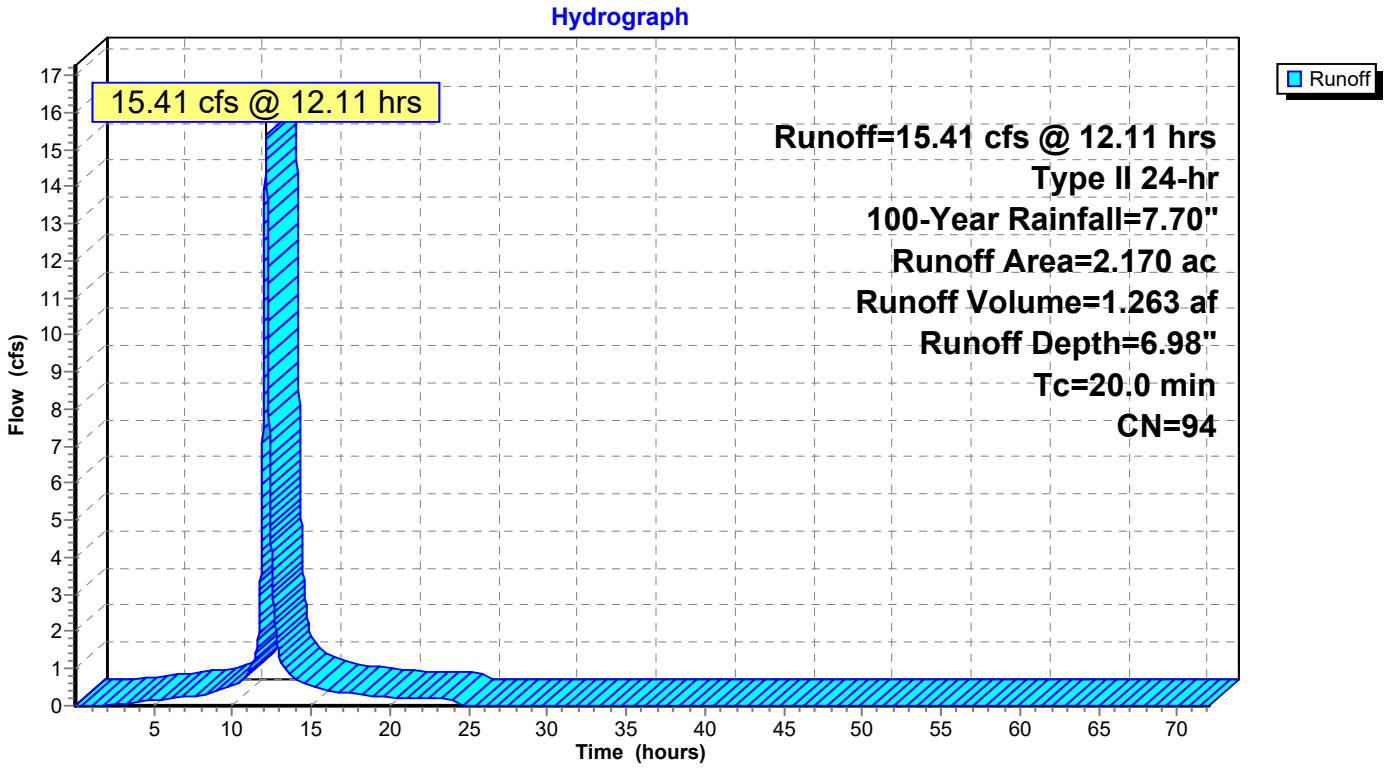
Subcatchment 4S: AREA C



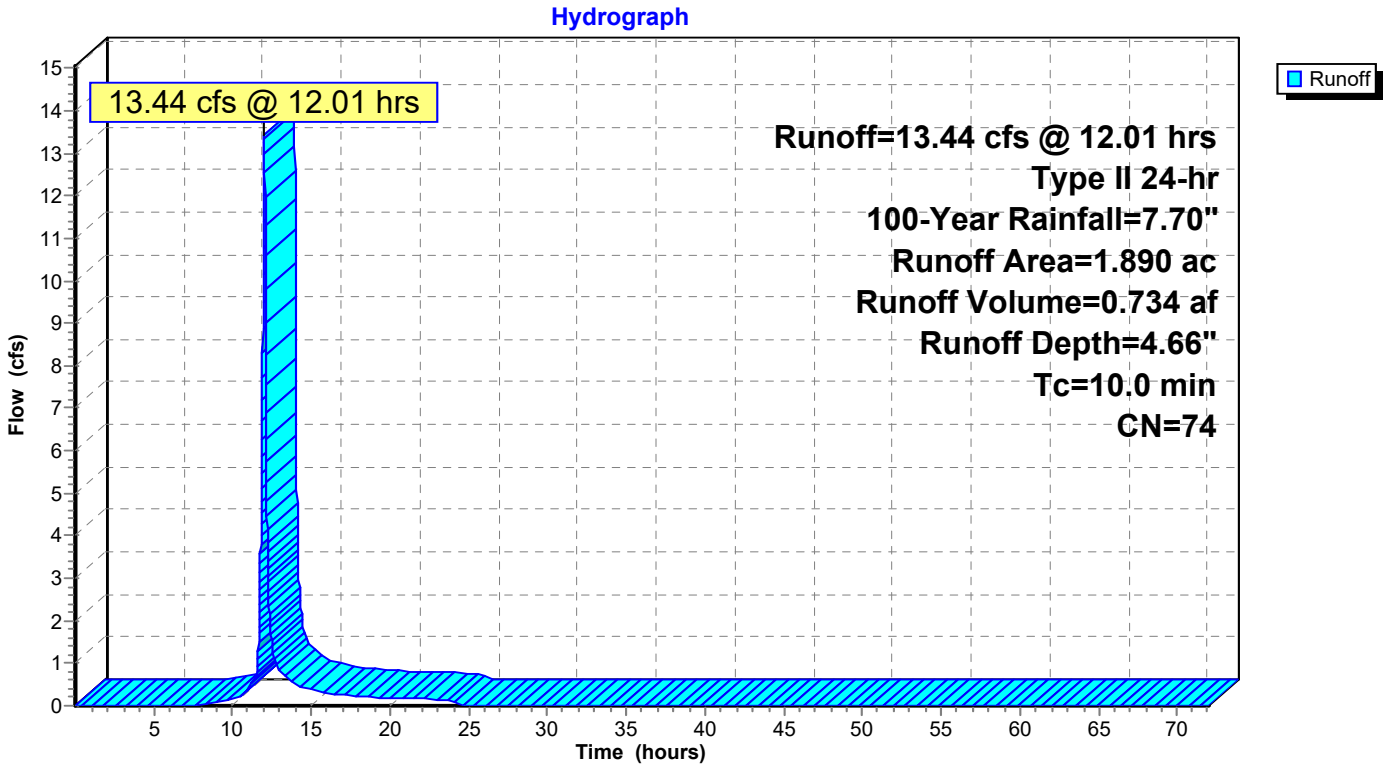
Subcatchment 5S: AREA D



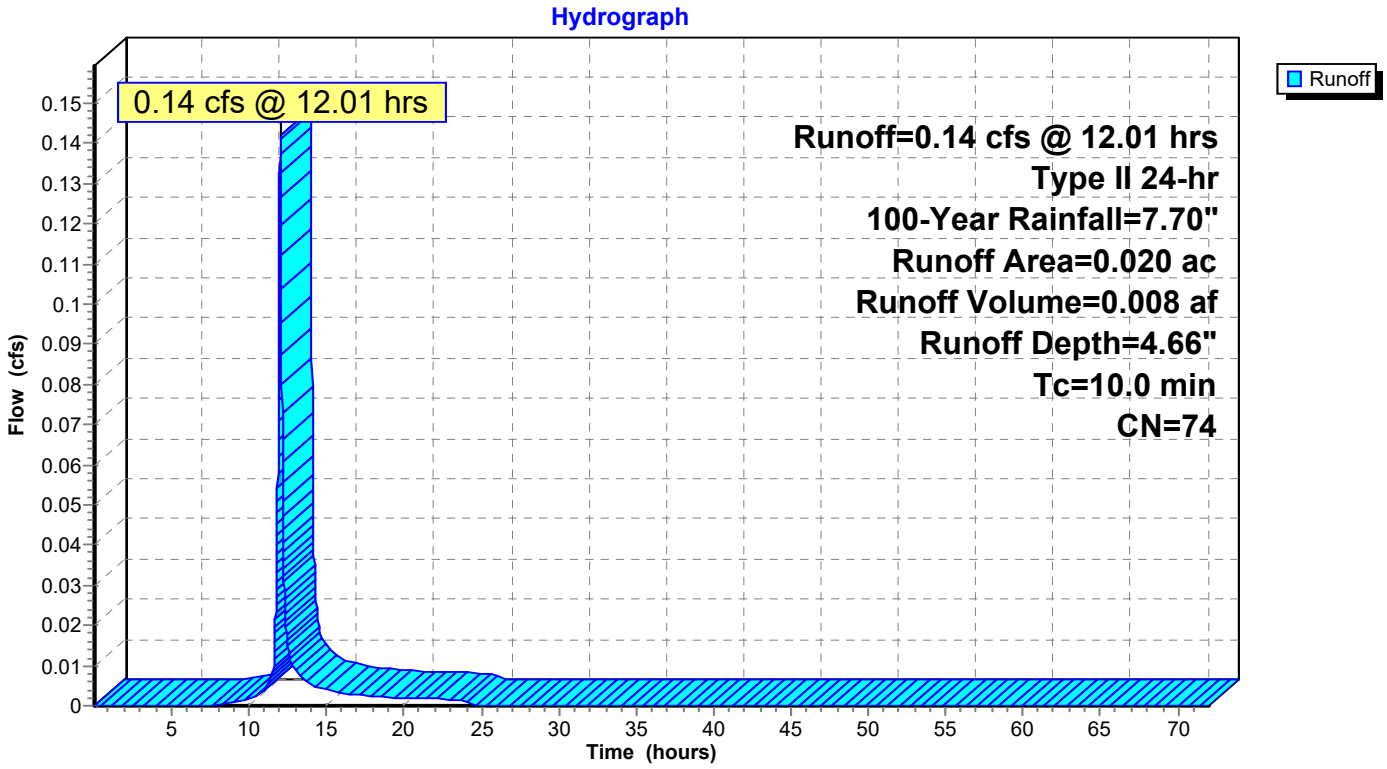
Subcatchment 6S: AREA E



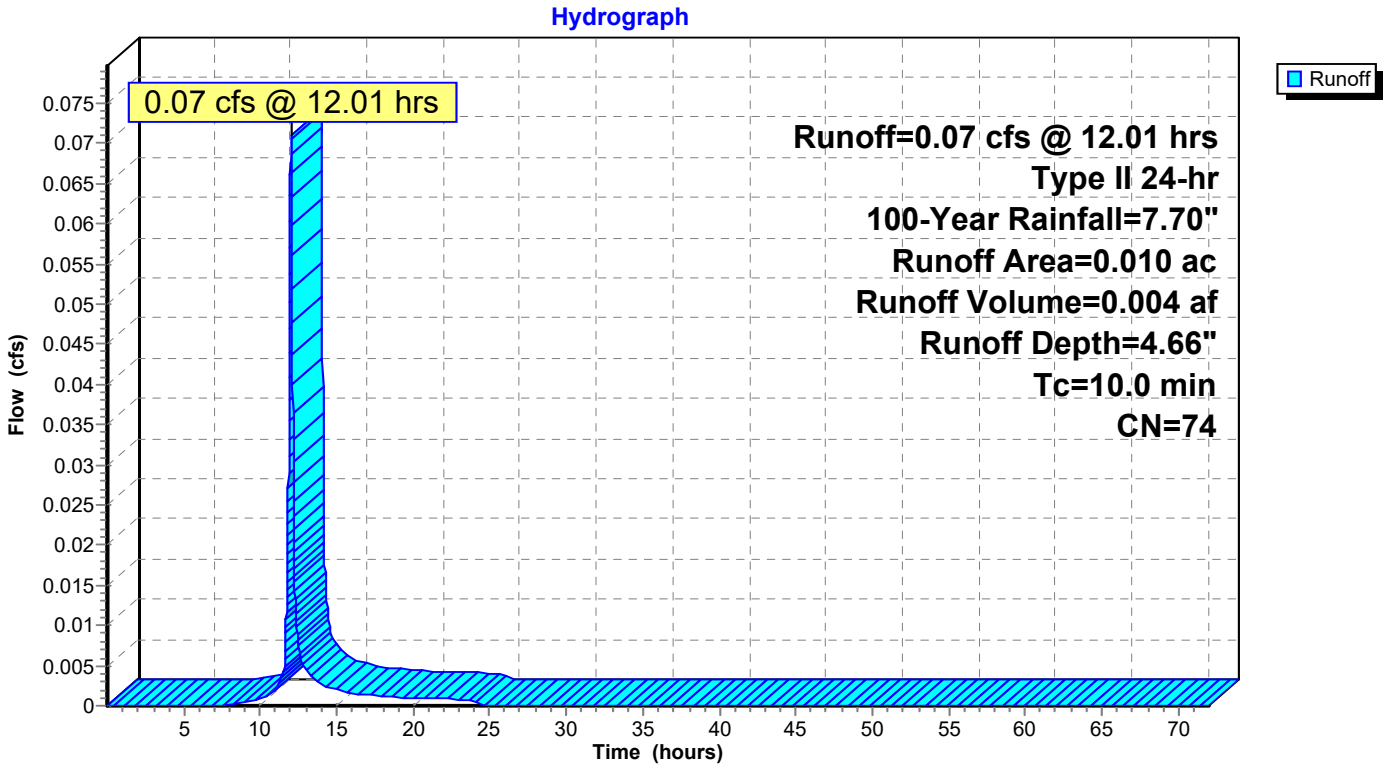
Subcatchment 7S: AREA F



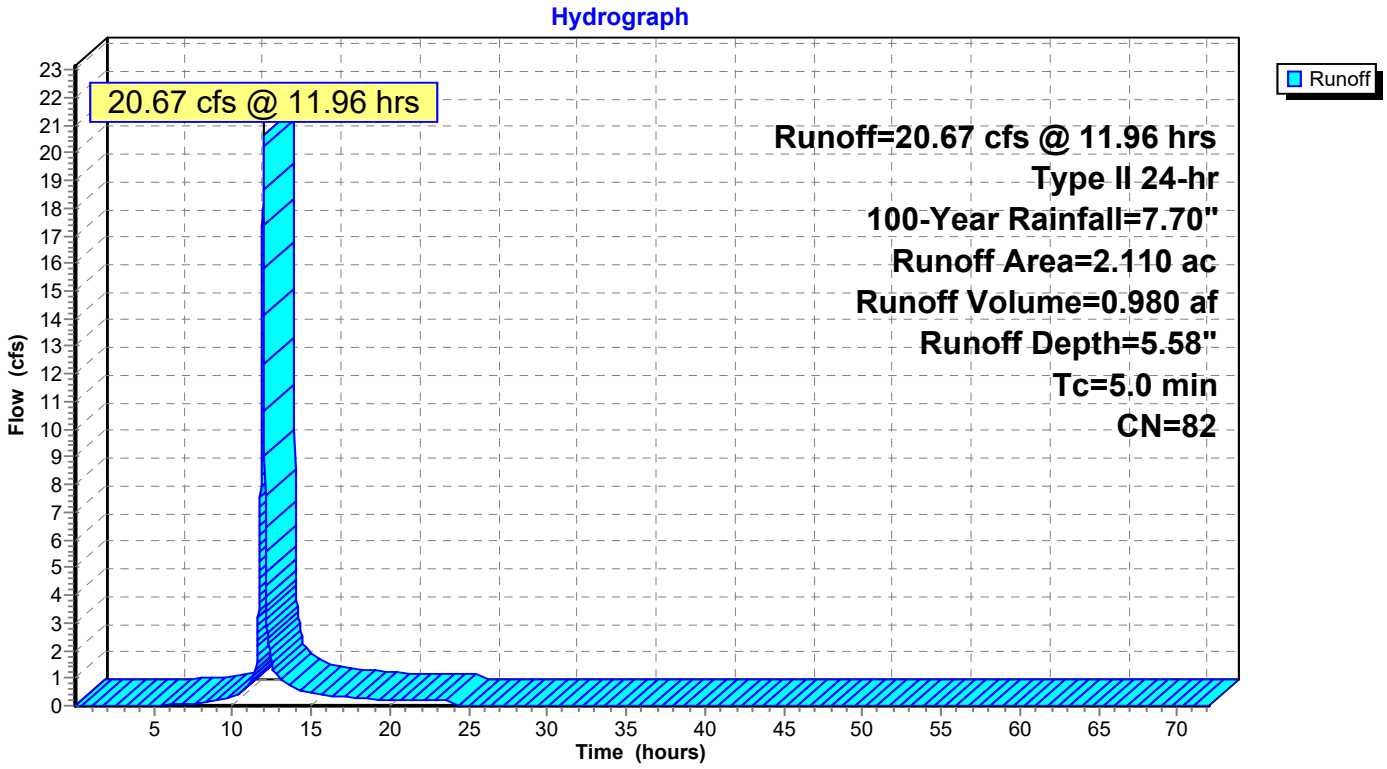
Subcatchment 8S: AREA G



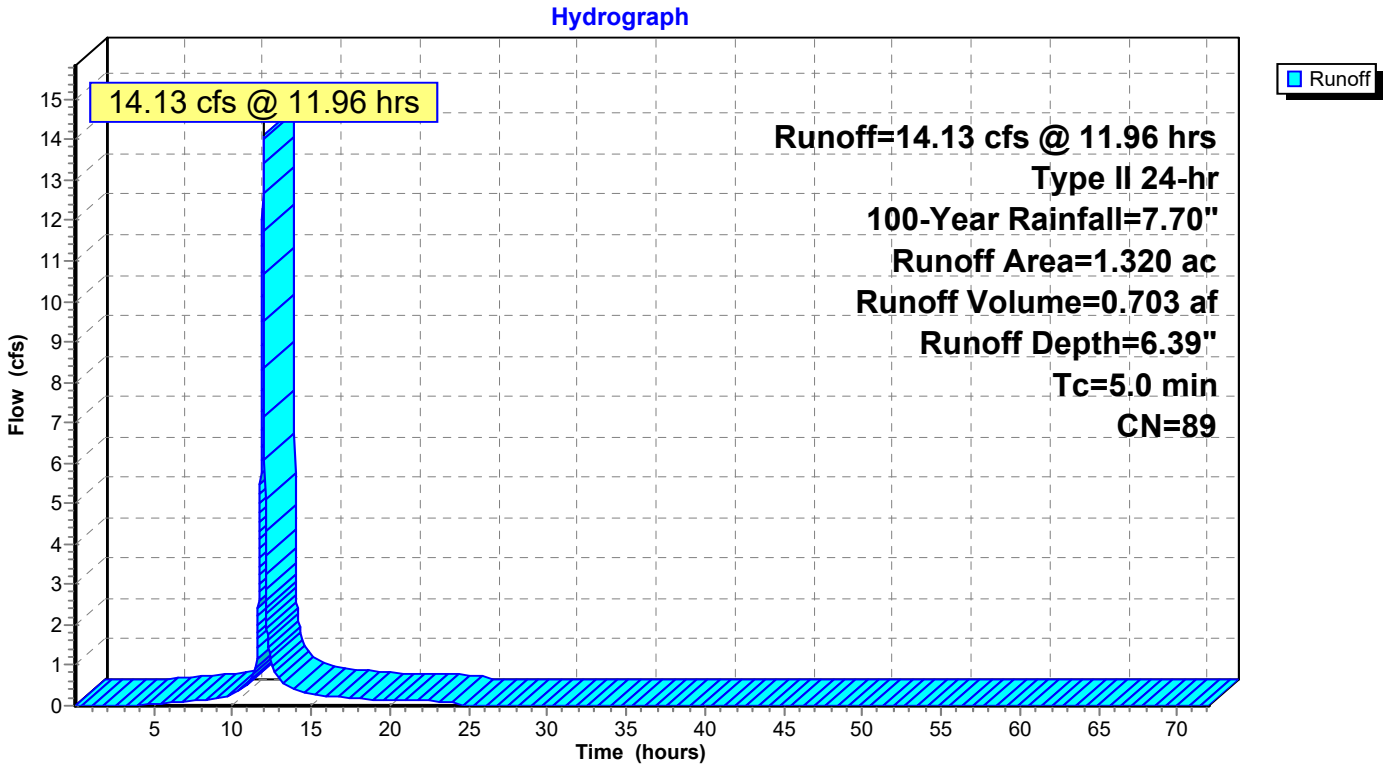
Subcatchment 9S: AREA H



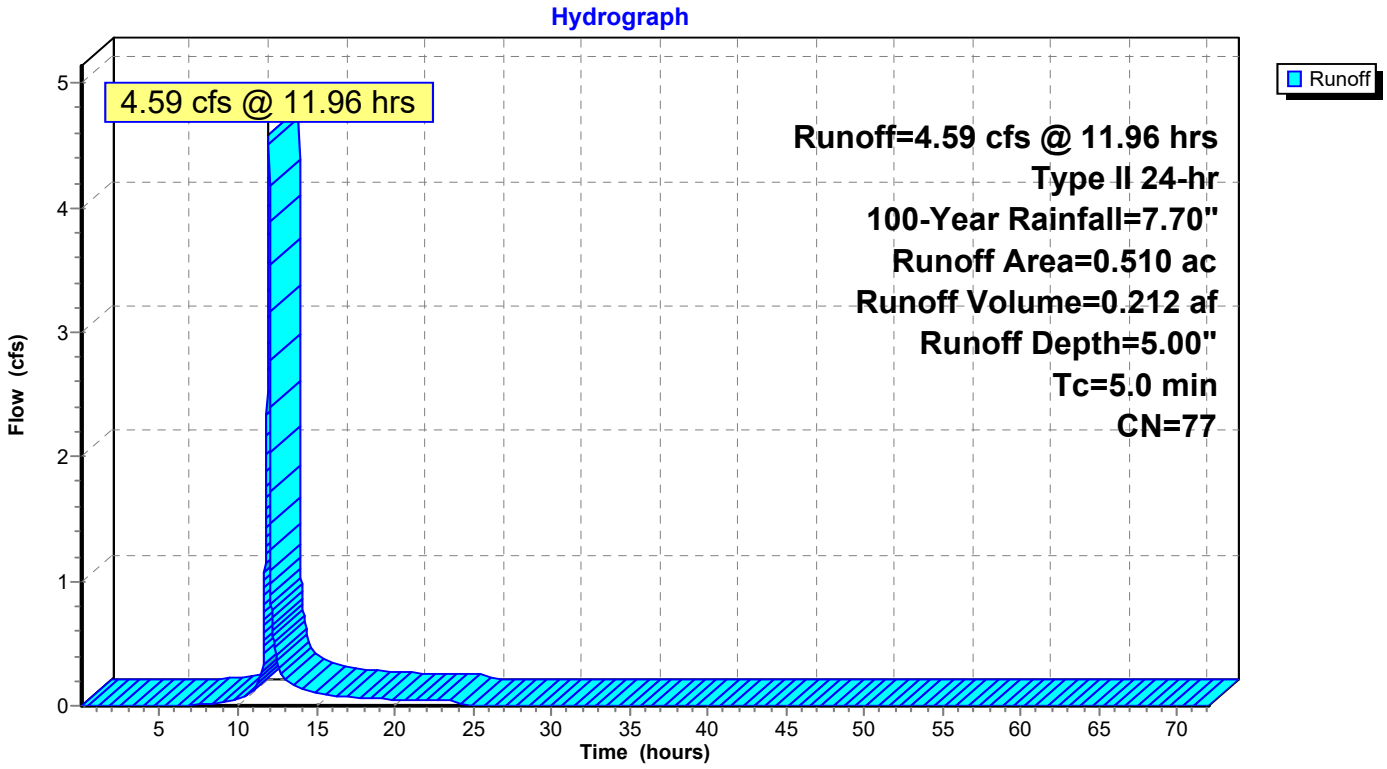
Subcatchment 10S: PROPOSED CONDITIONS



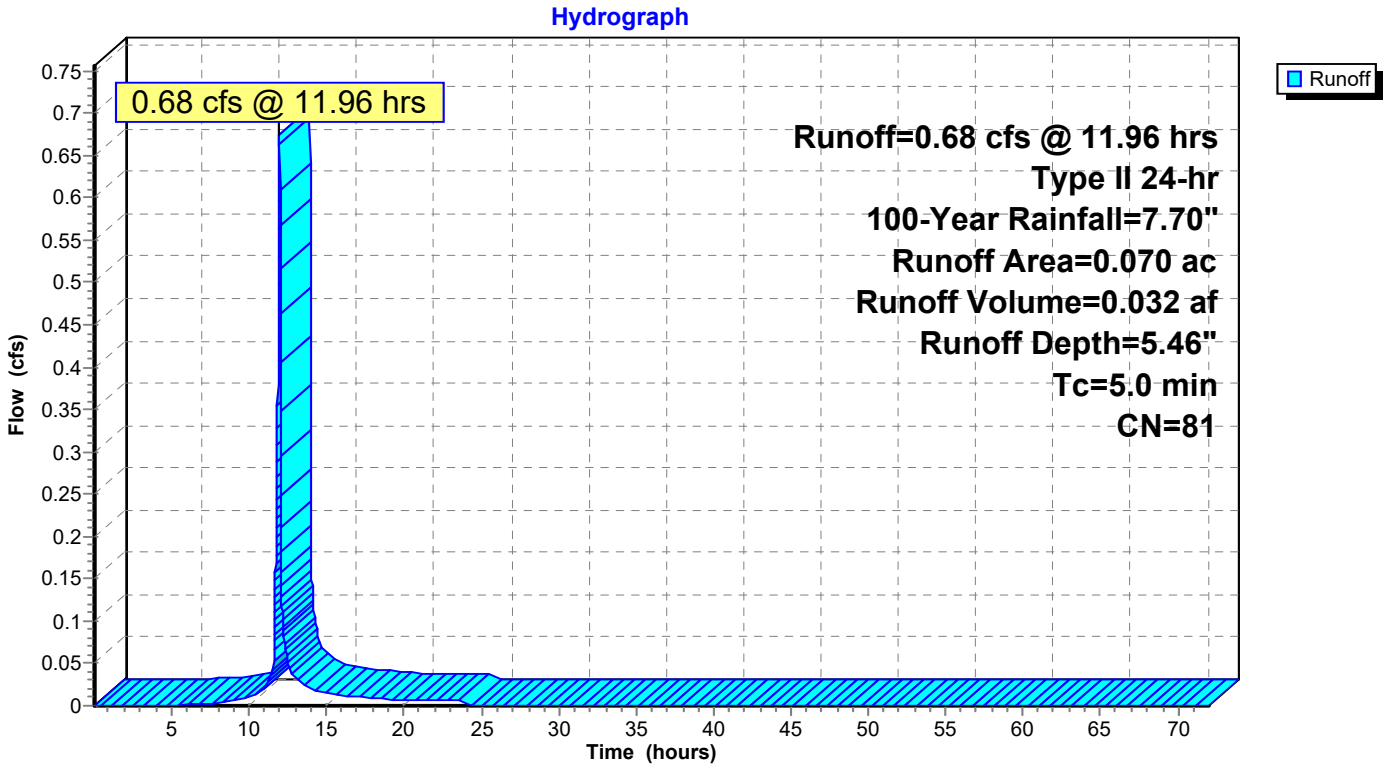
Subcatchment 25S: AREA 3



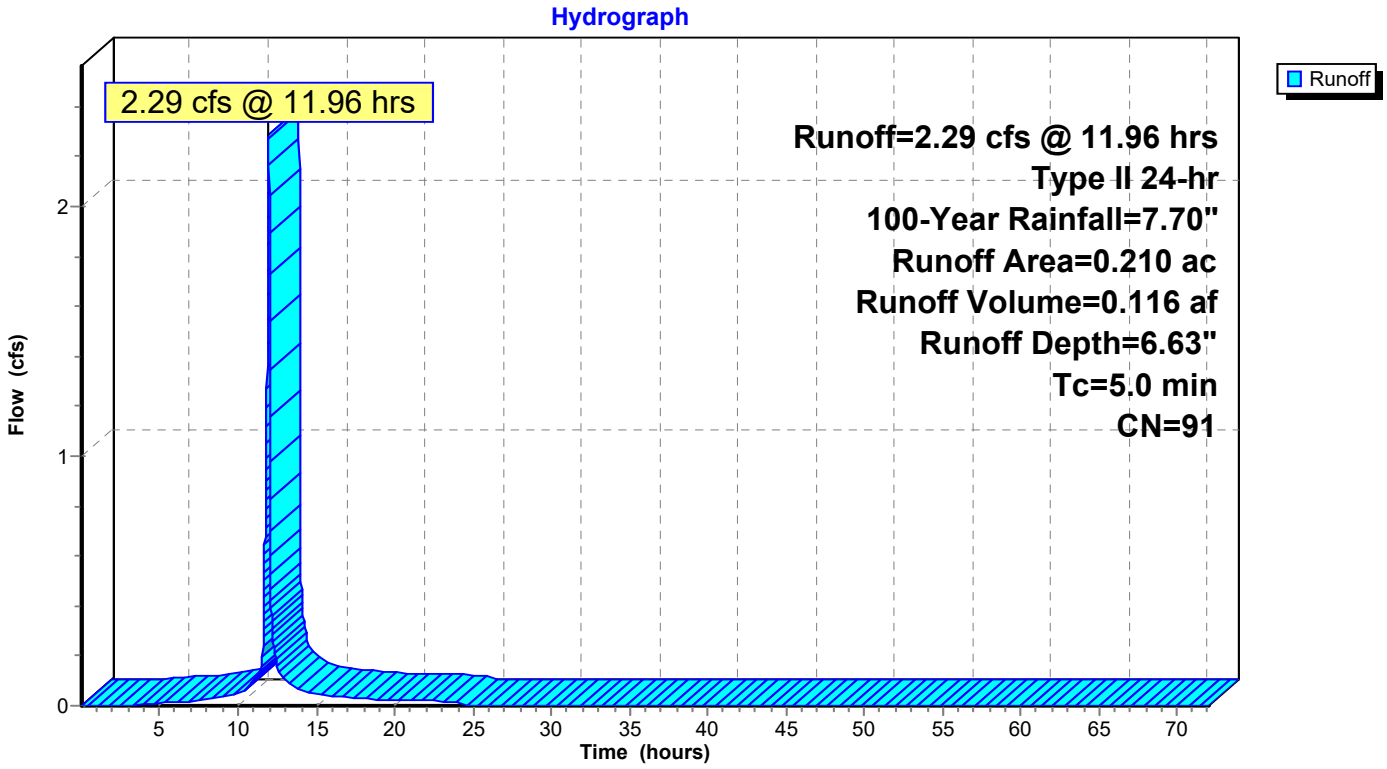
Subcatchment 60S: AREA 6



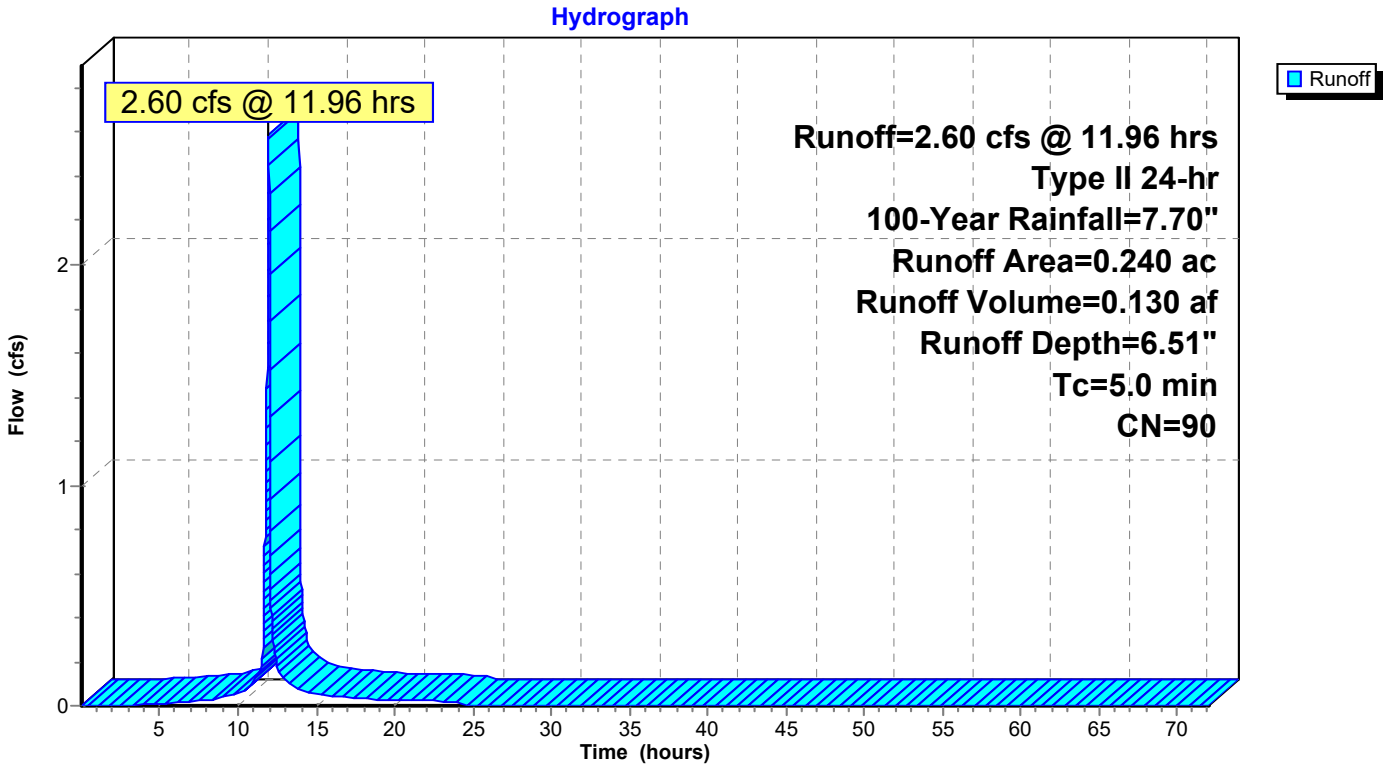
Subcatchment 61S: AREA 7



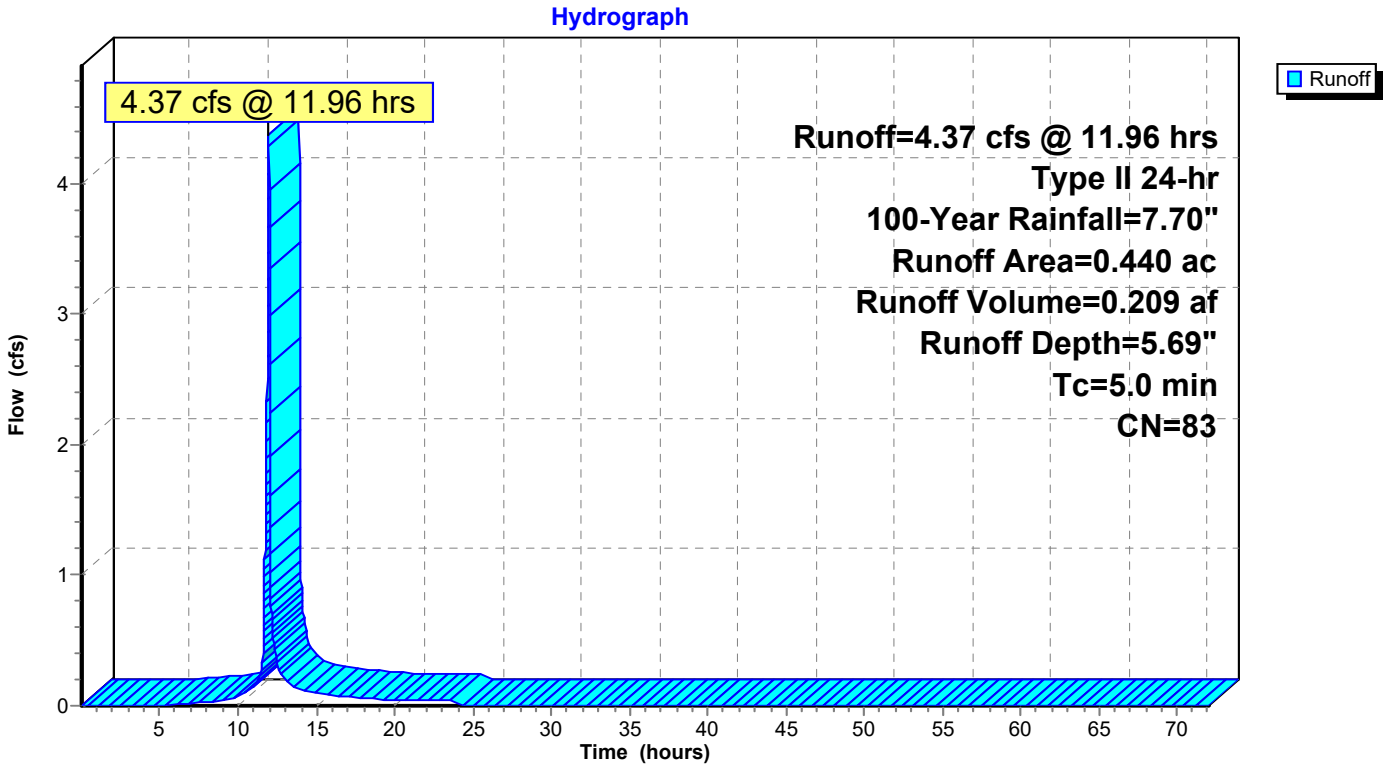
Subcatchment 62S: AREA 1



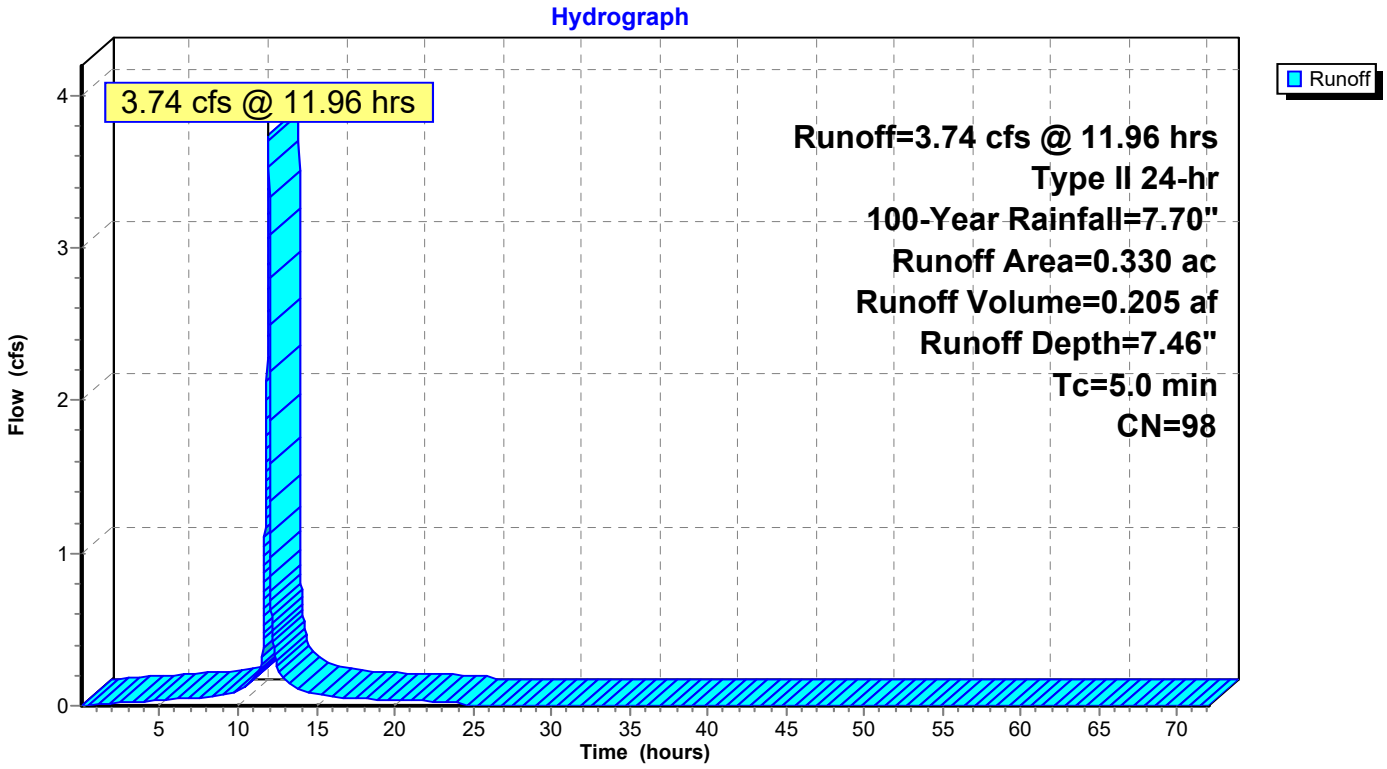
Subcatchment 63S: AREA 2



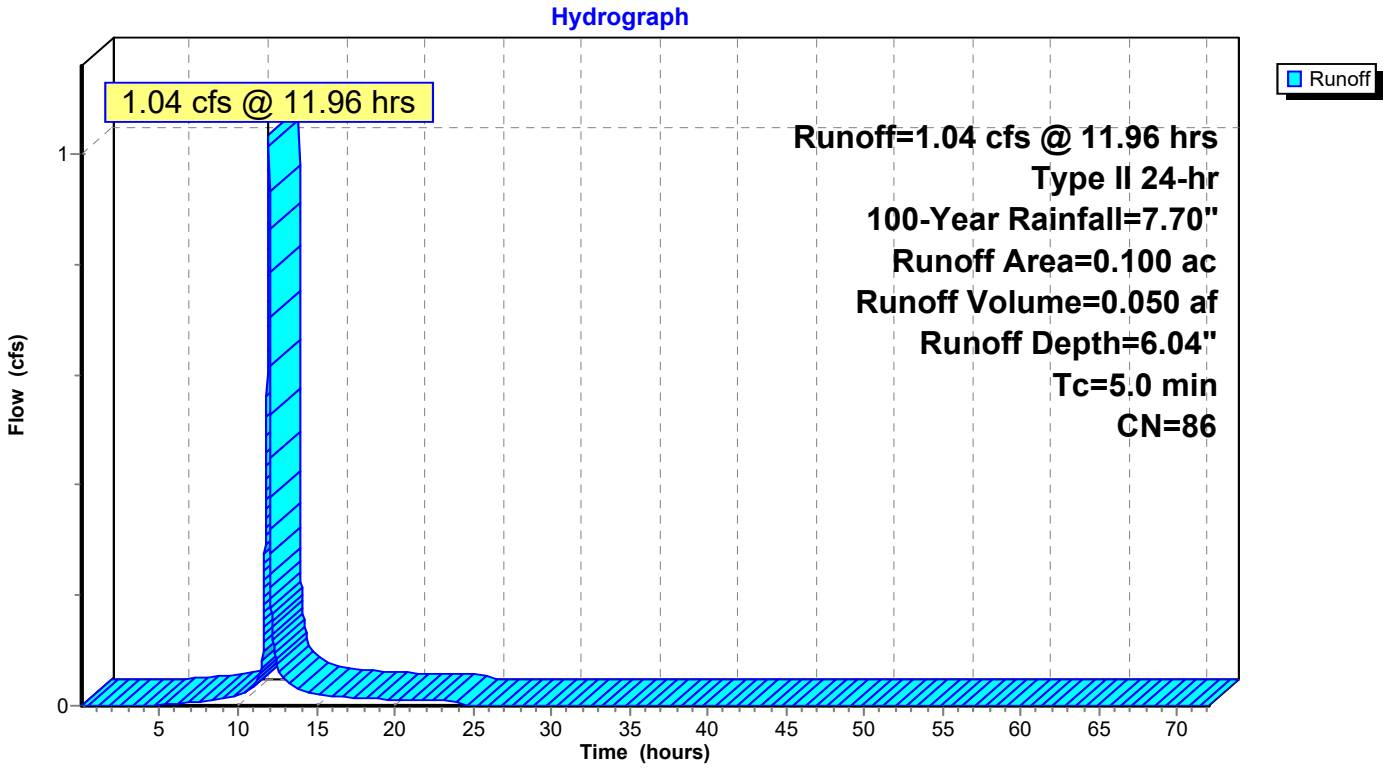
Subcatchment 64S: AREA 3



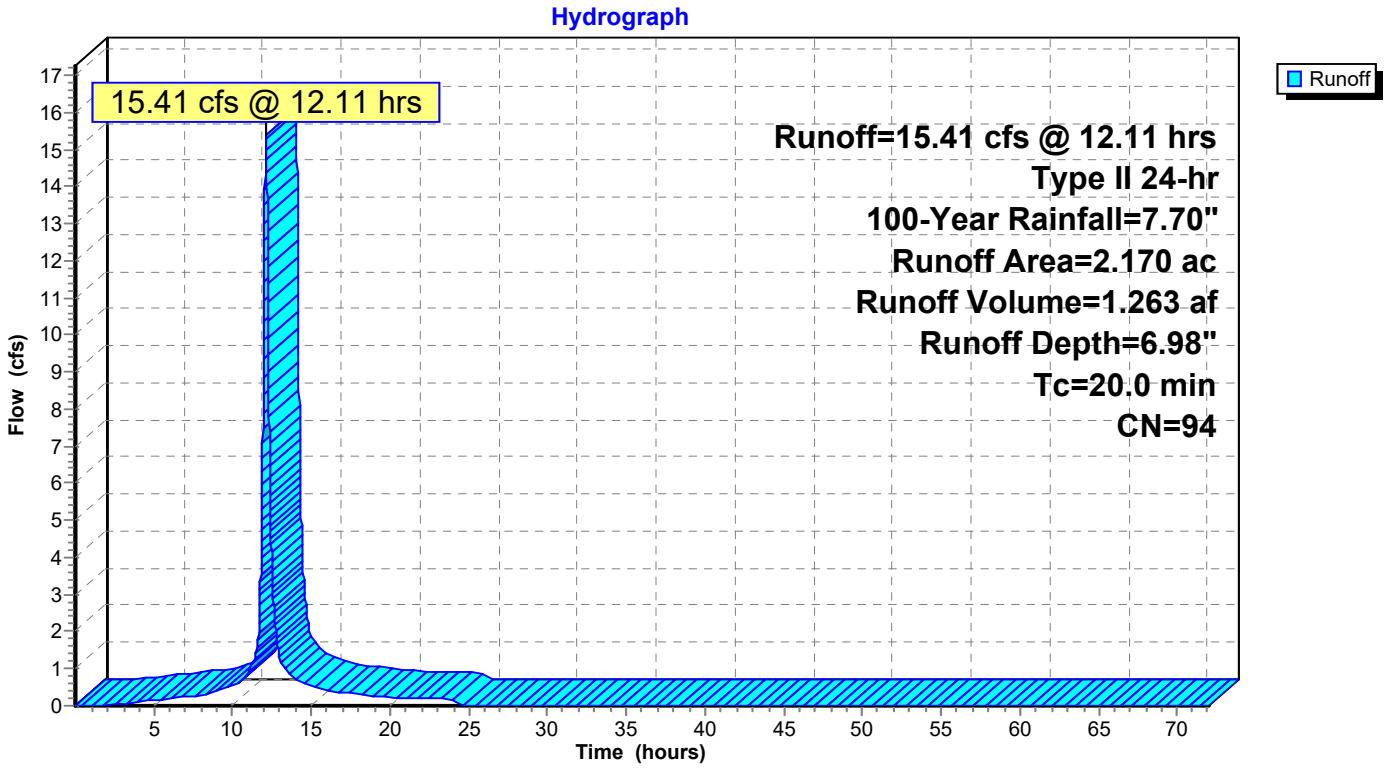
Subcatchment 65S: AREA 4



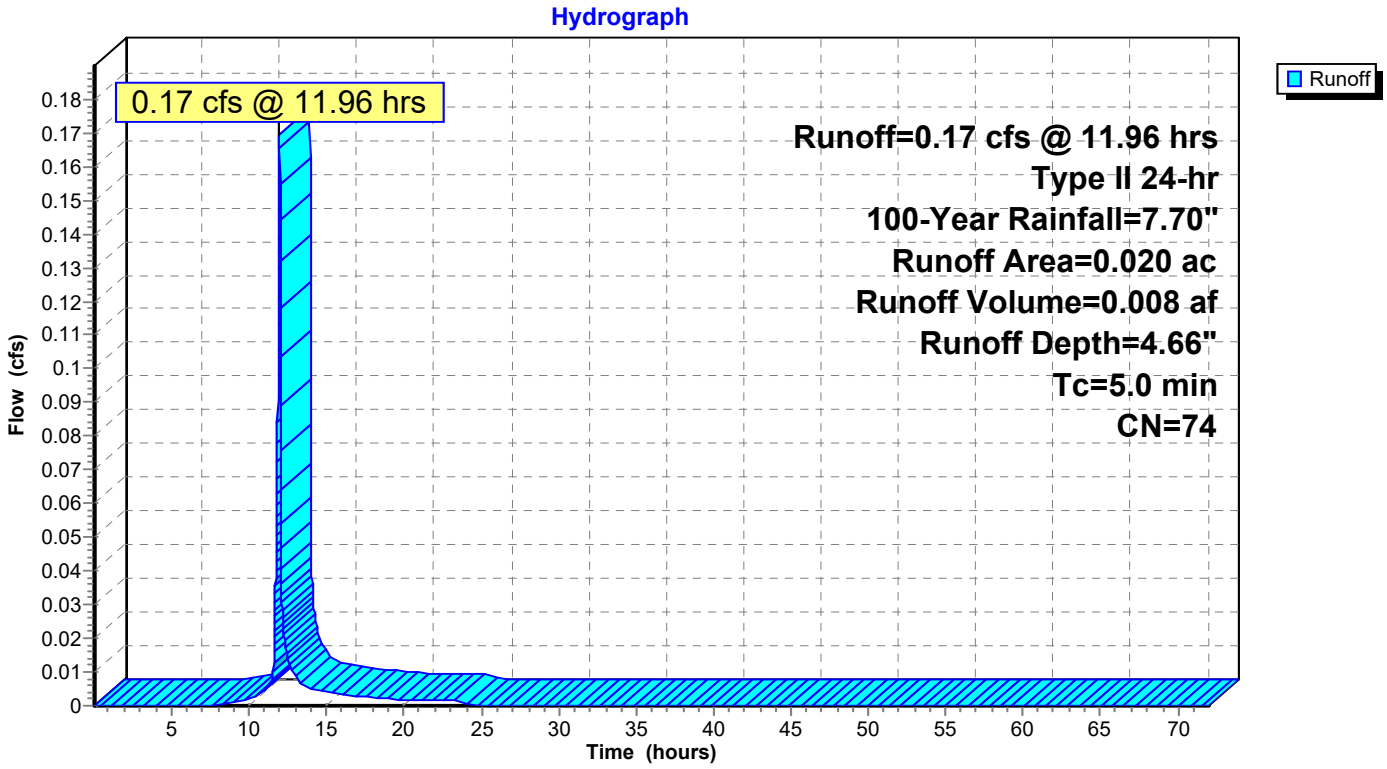
Subcatchment 66S: AREA 5



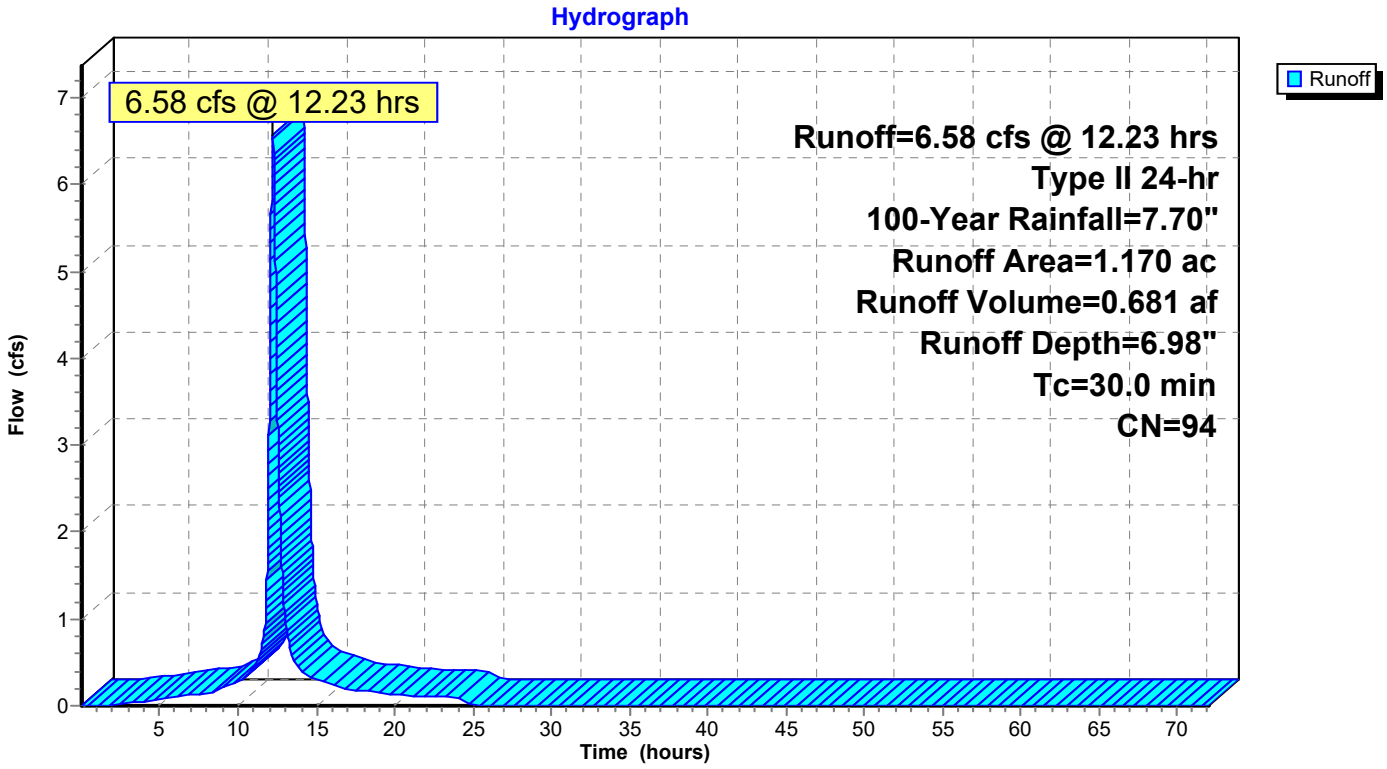
Subcatchment 67S: OFFSITE TO CI 12



Subcatchment 68S: AREA TO AI 11

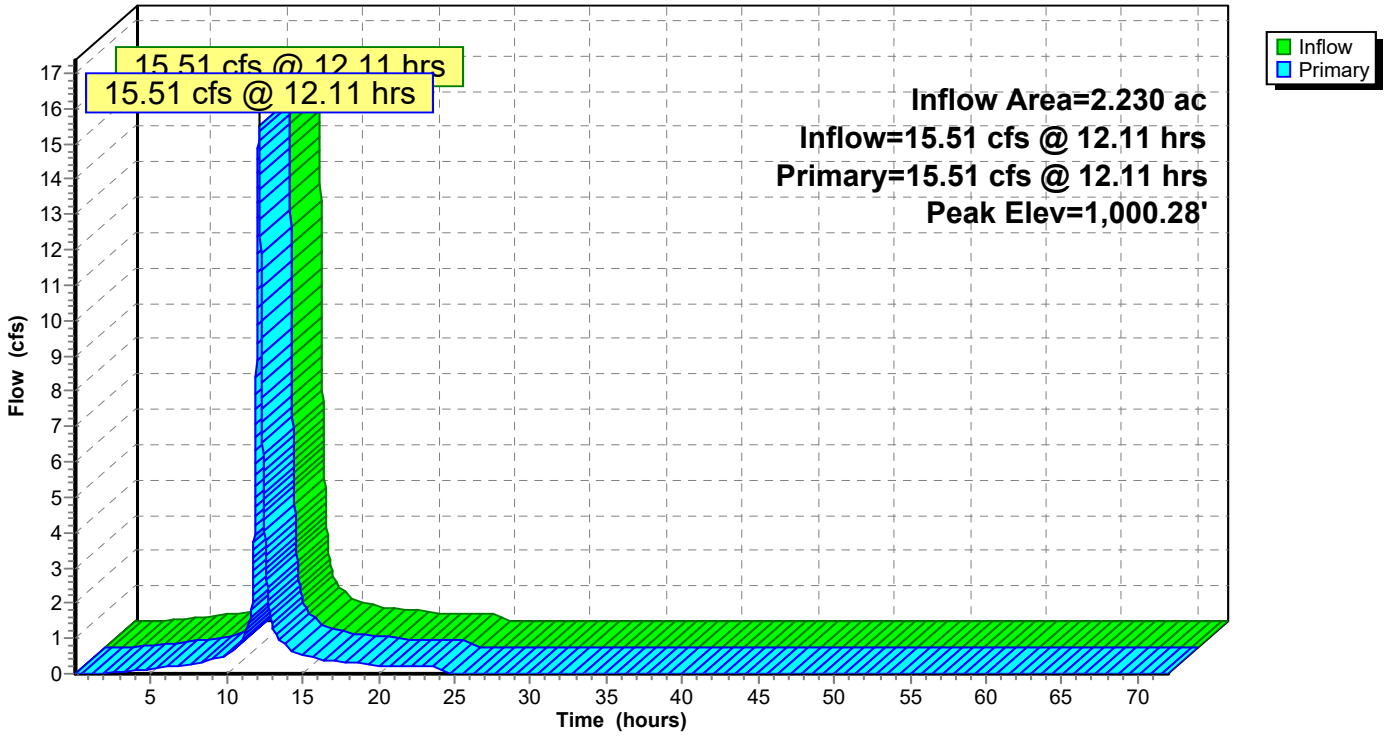


Subcatchment 69S: OFFSITE TO BMP



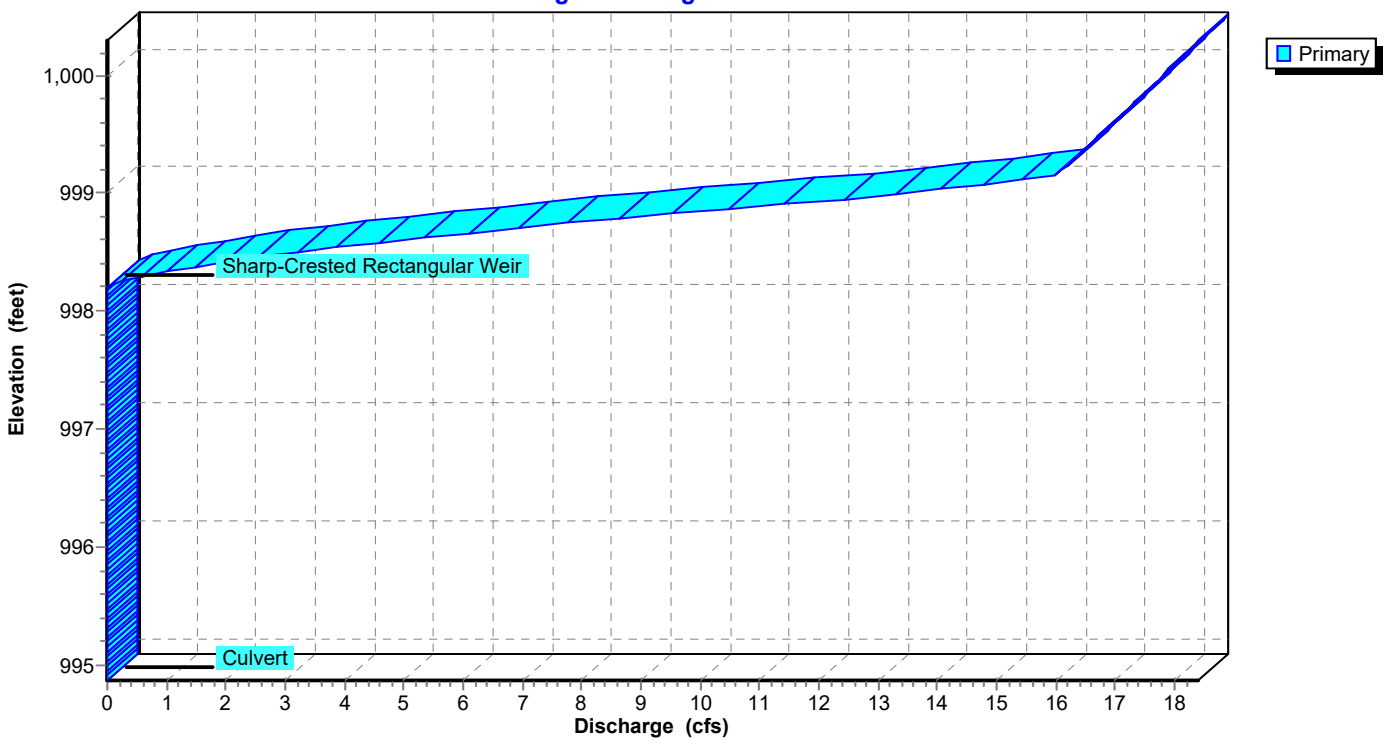
Pond 10P: 12-11

Hydrograph

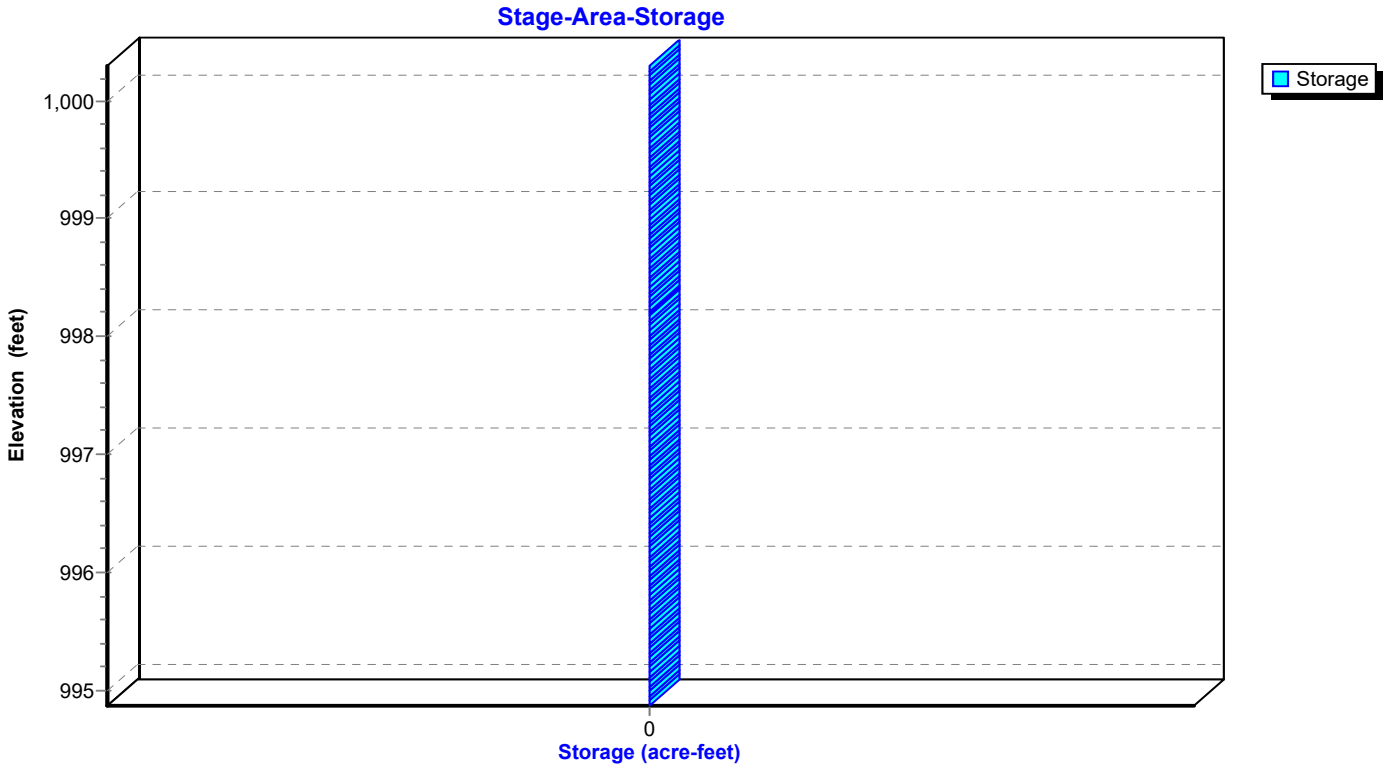


Pond 10P: 12-11

Stage-Discharge

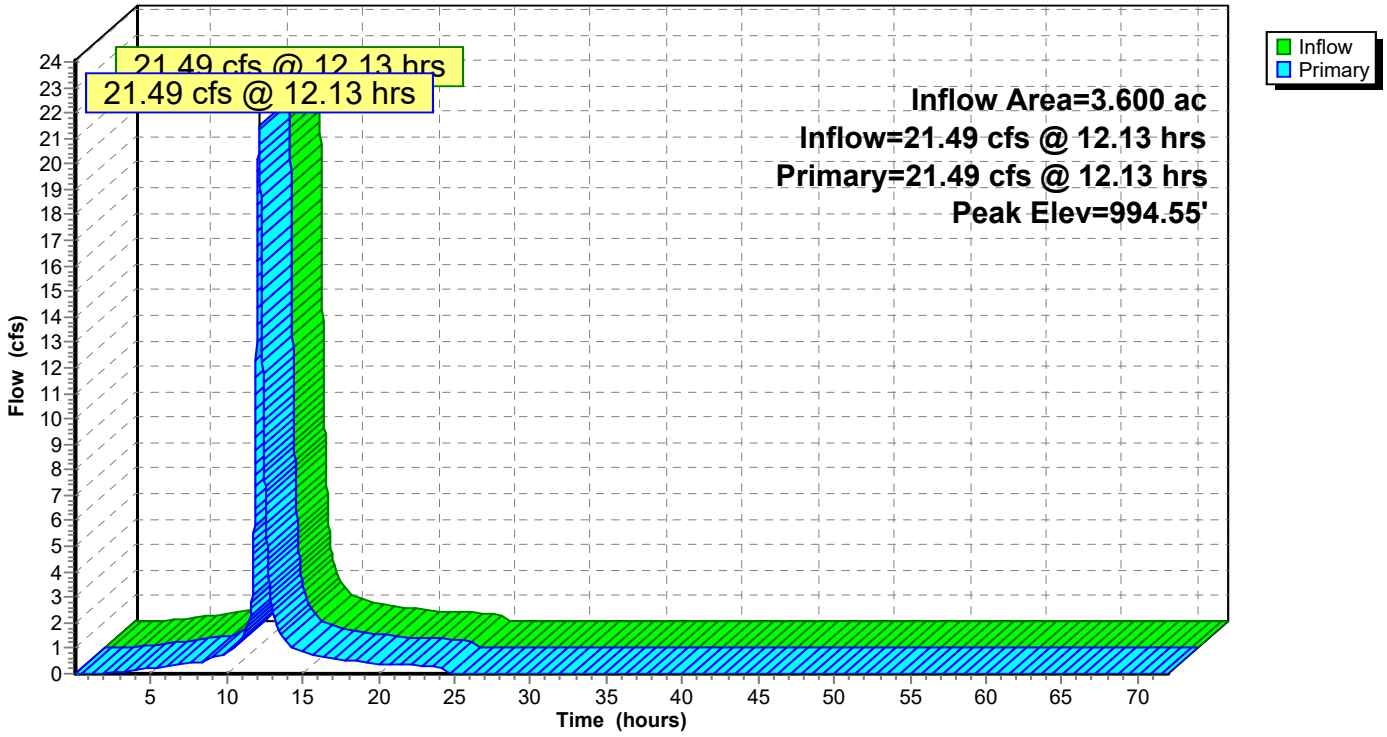


Pond 10P: 12-11



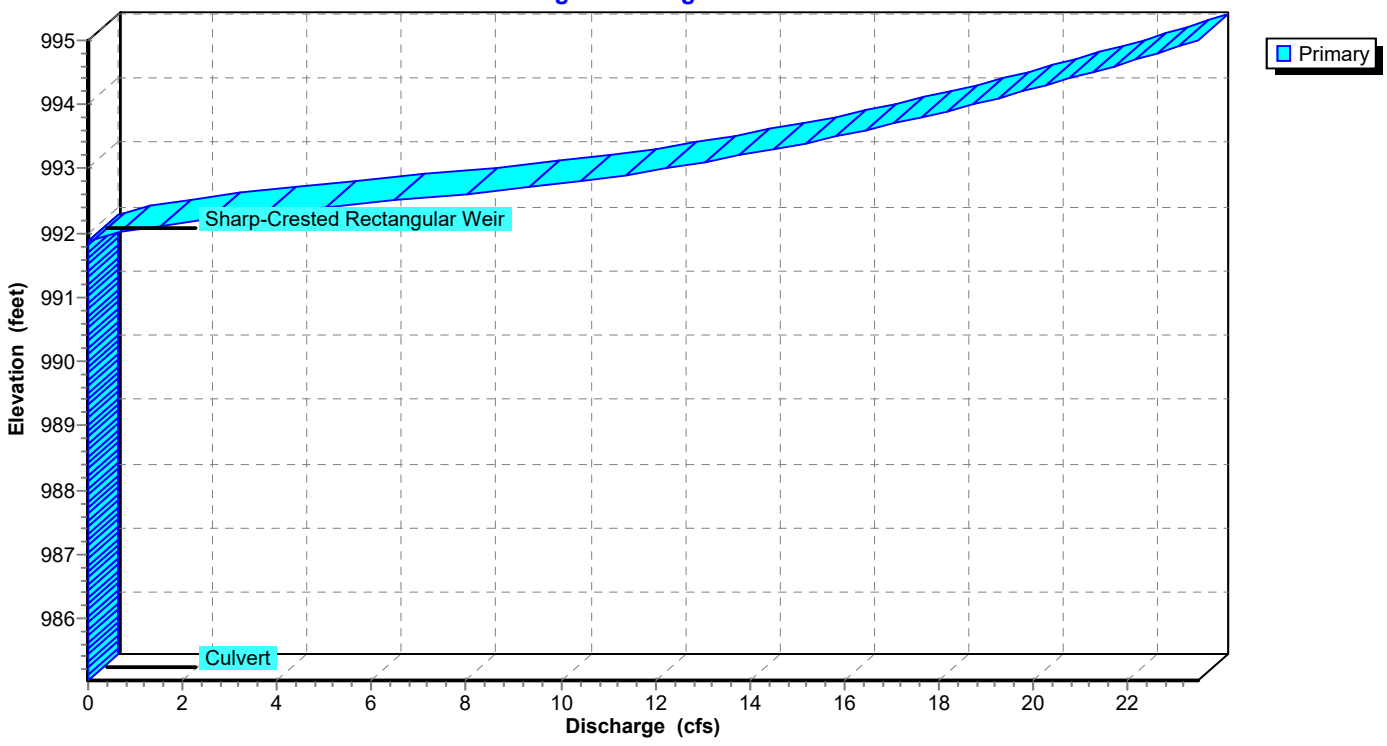
Pond 11P: 11-10

Hydrograph

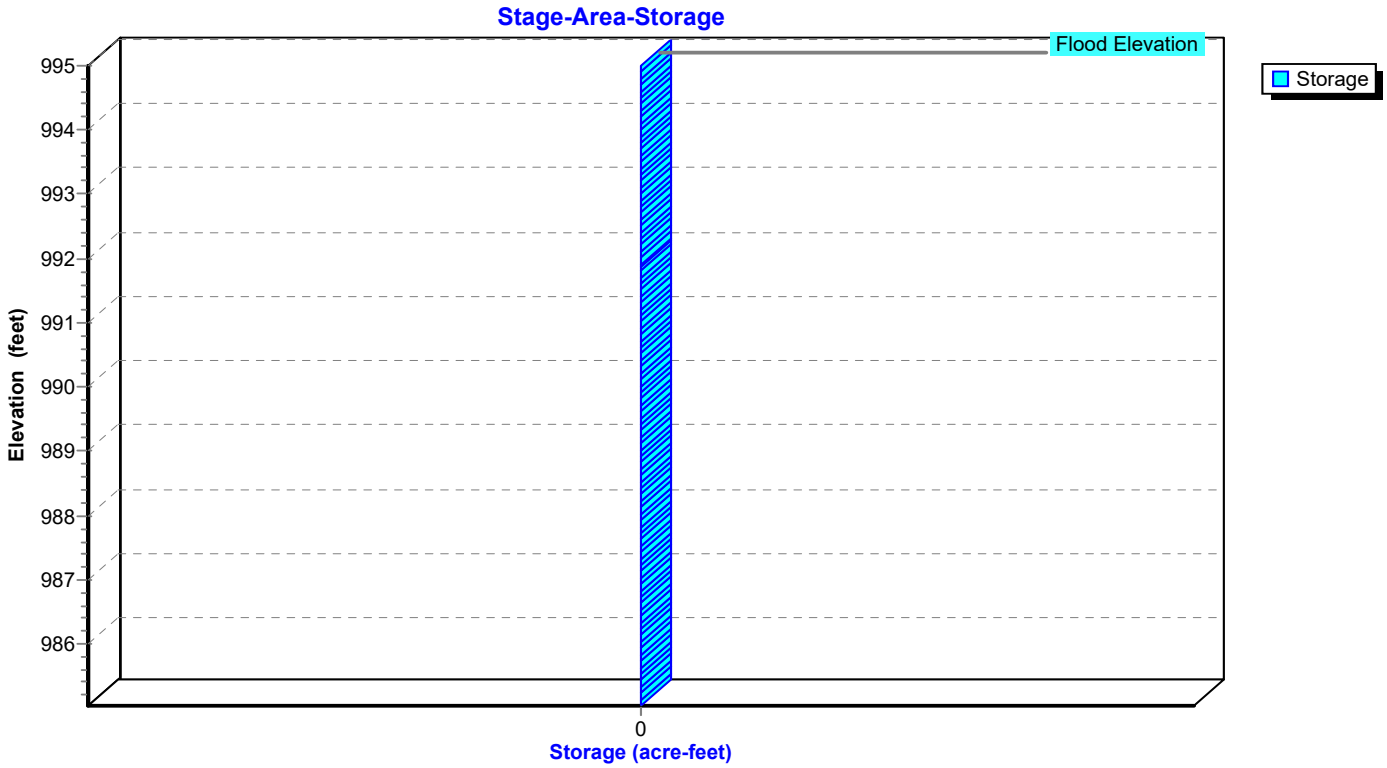


Pond 11P: 11-10

Stage-Discharge

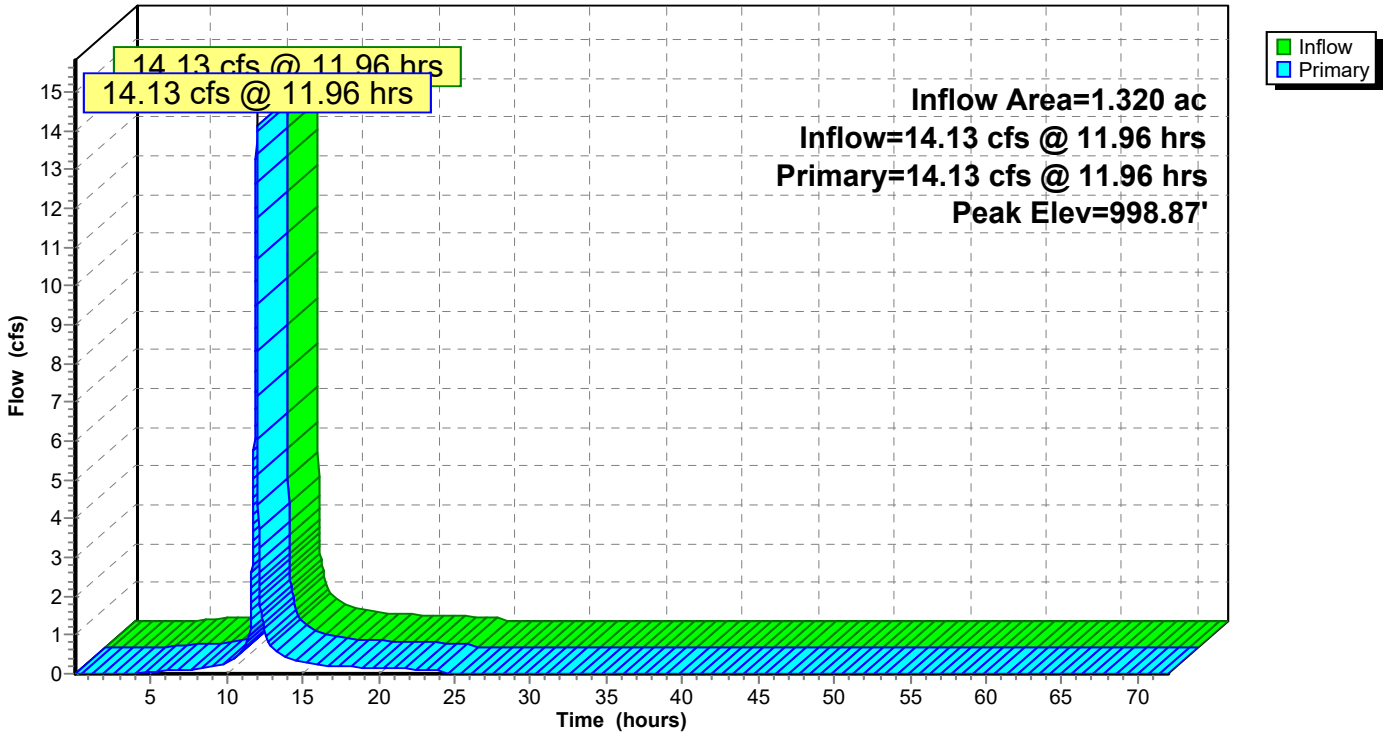


Pond 11P: 11-10



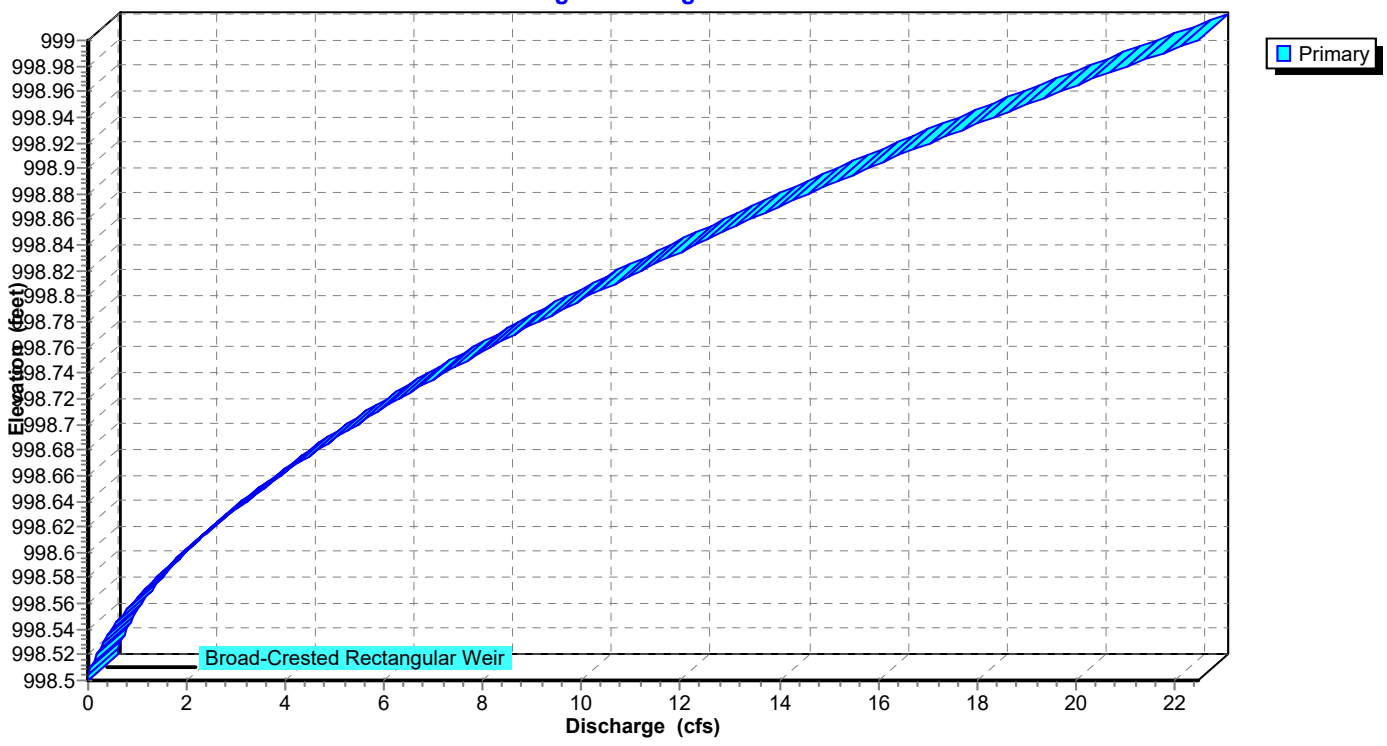
Pond 26P: DETENTION BASIN

Hydrograph

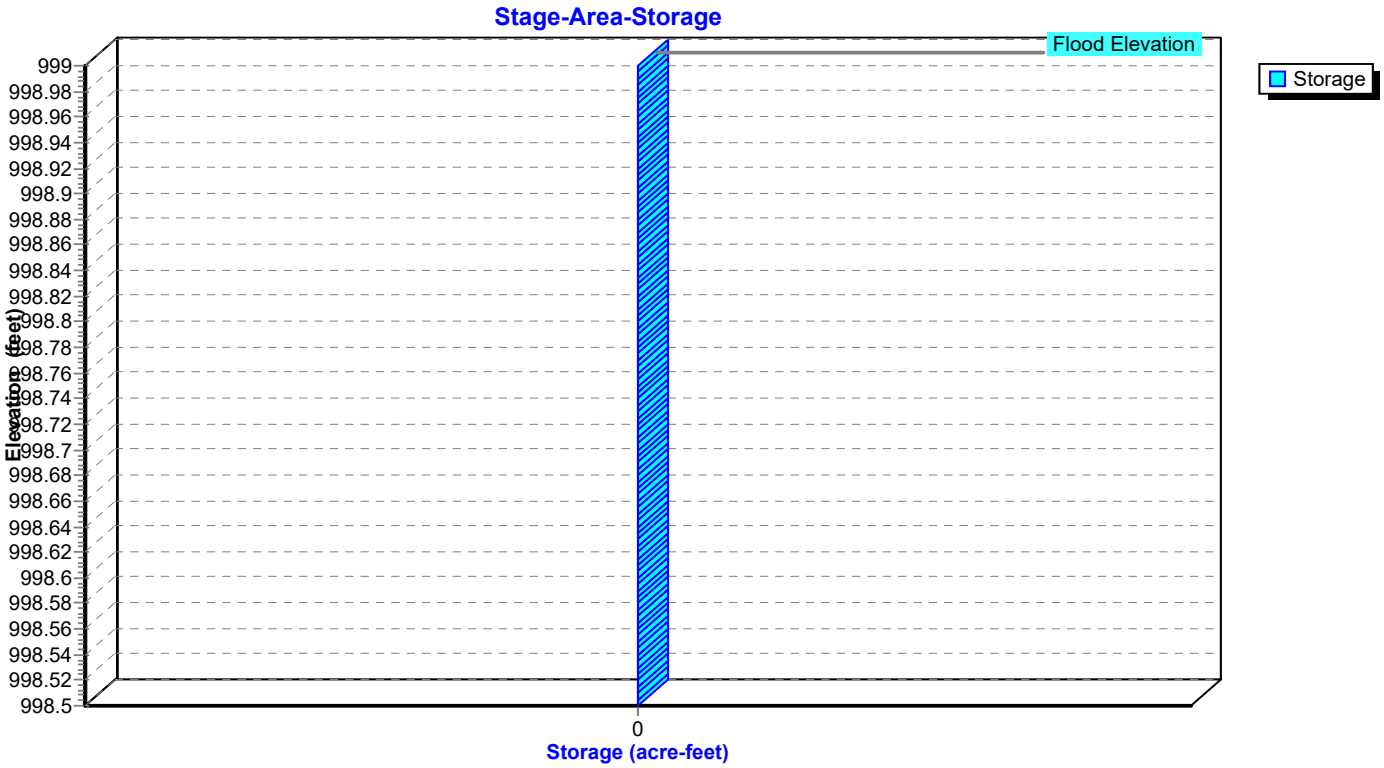


Pond 26P: DETENTION BASIN

Stage-Discharge

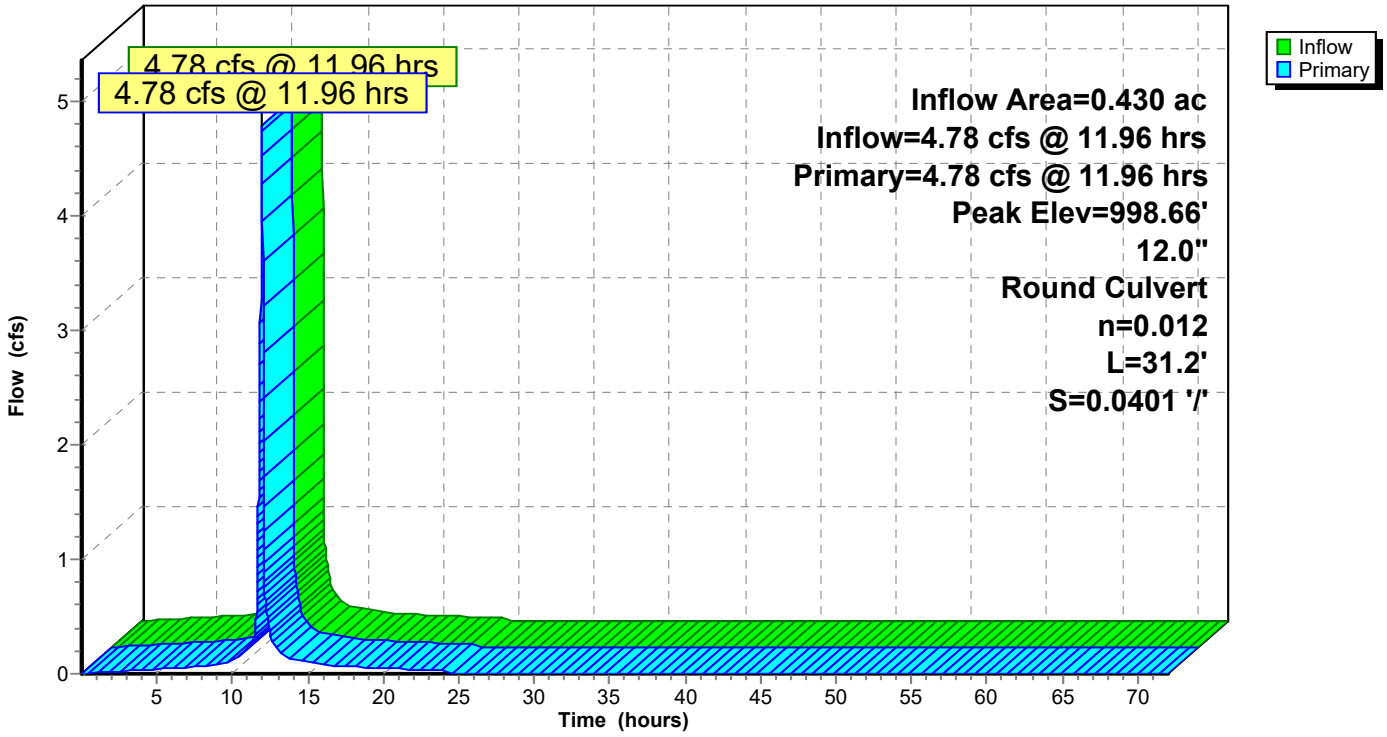


Pond 26P: DETENTION BASIN



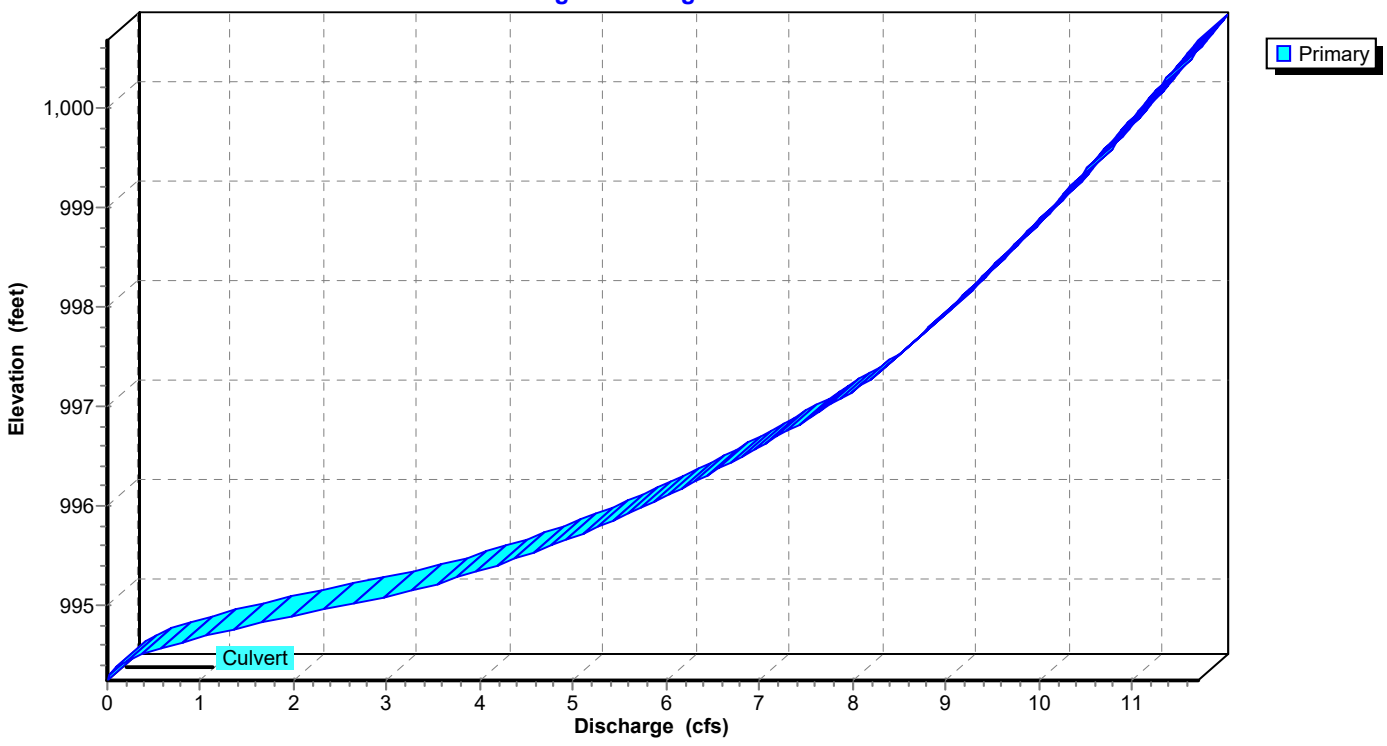
Pond 50P: BASIN REACH

Hydrograph

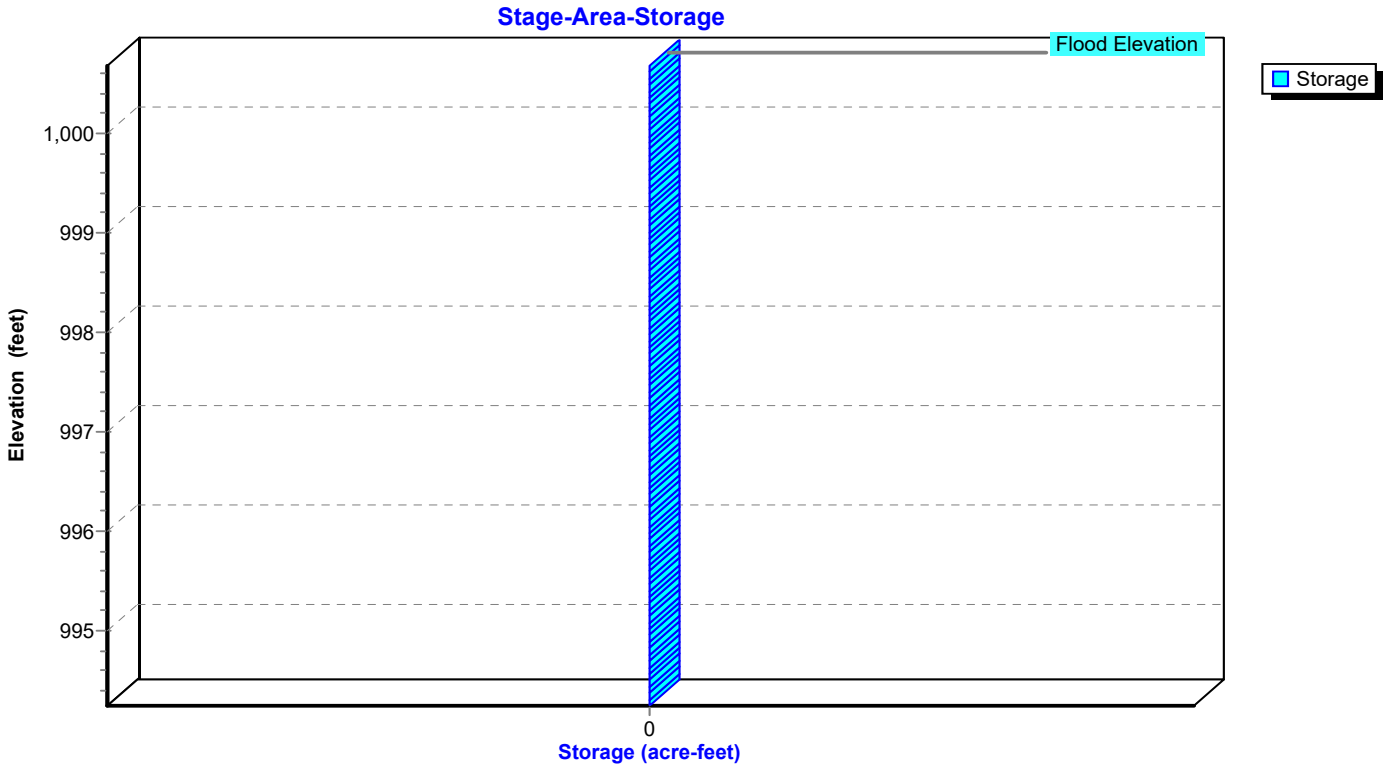


Pond 50P: BASIN REACH

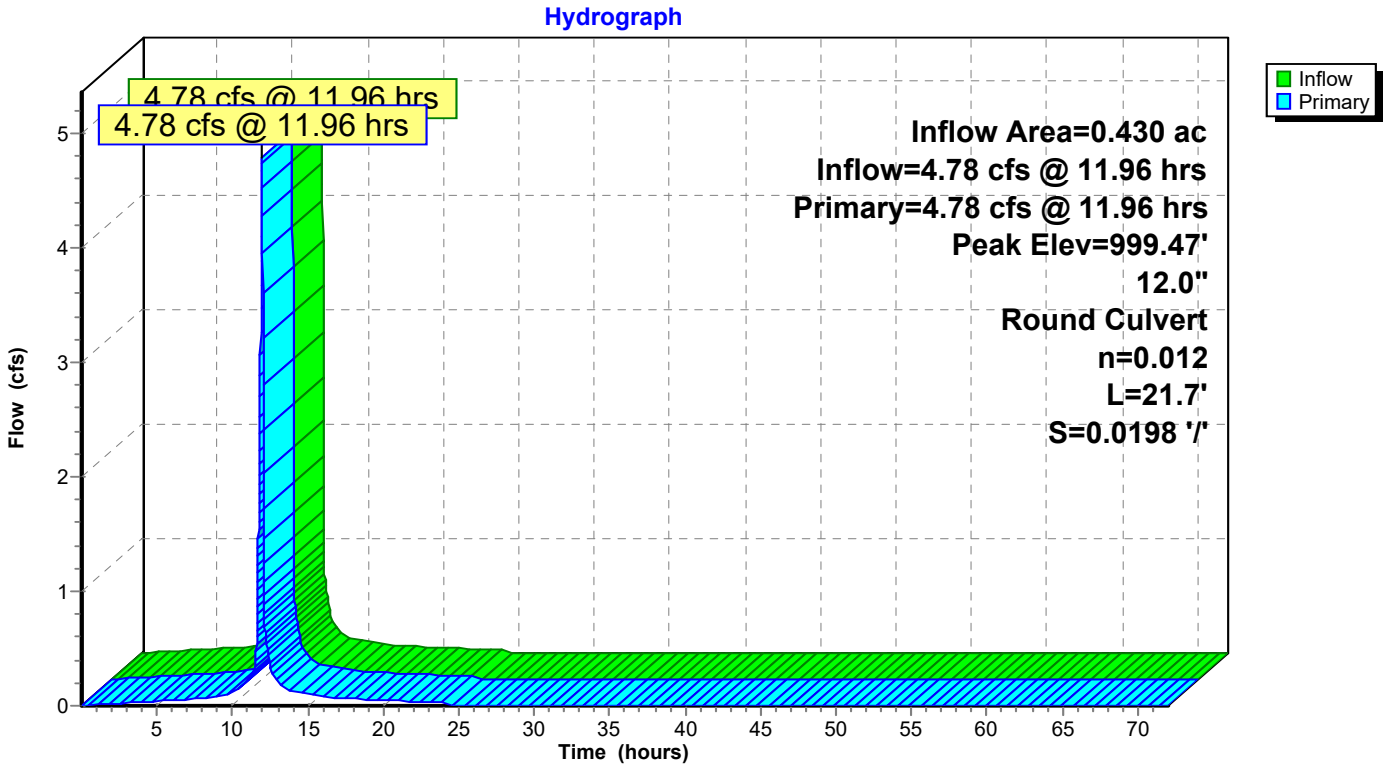
Stage-Discharge



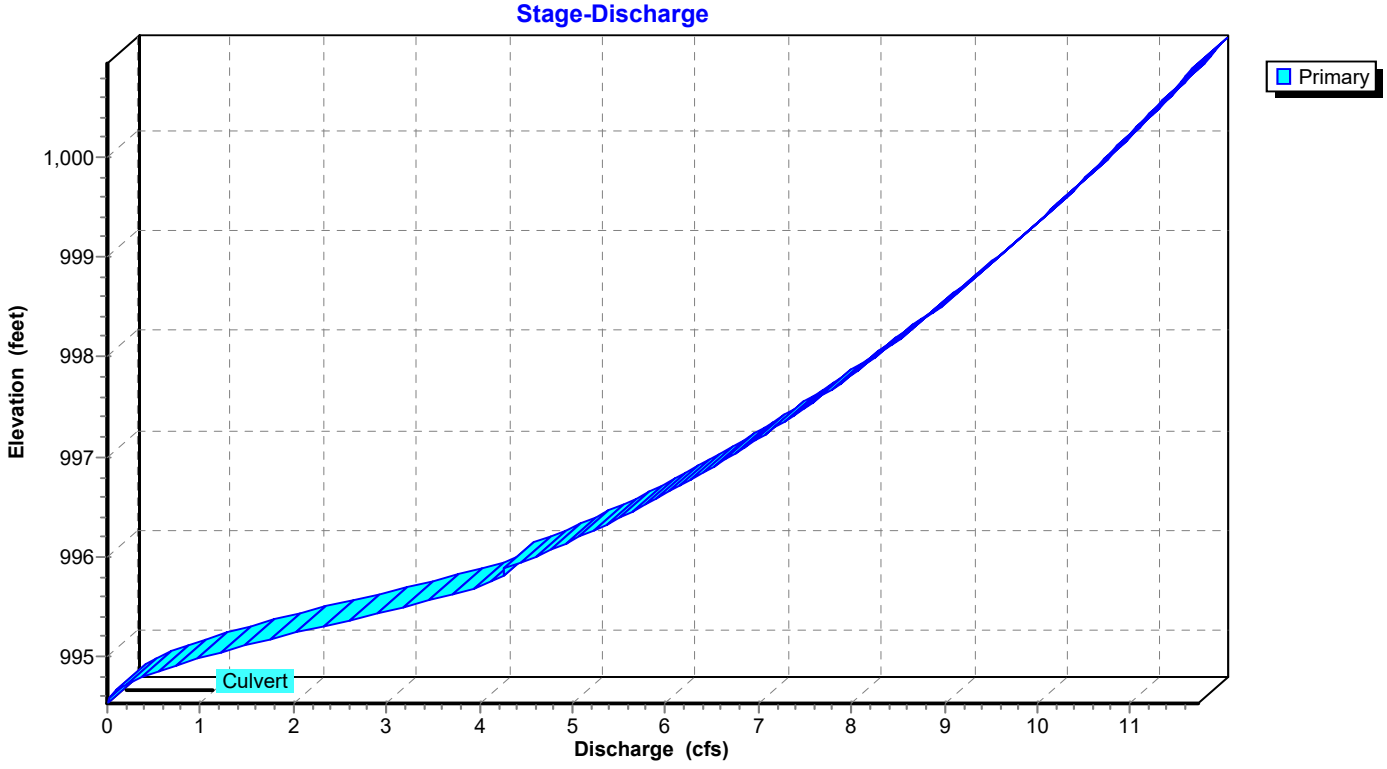
Pond 50P: BASIN REACH



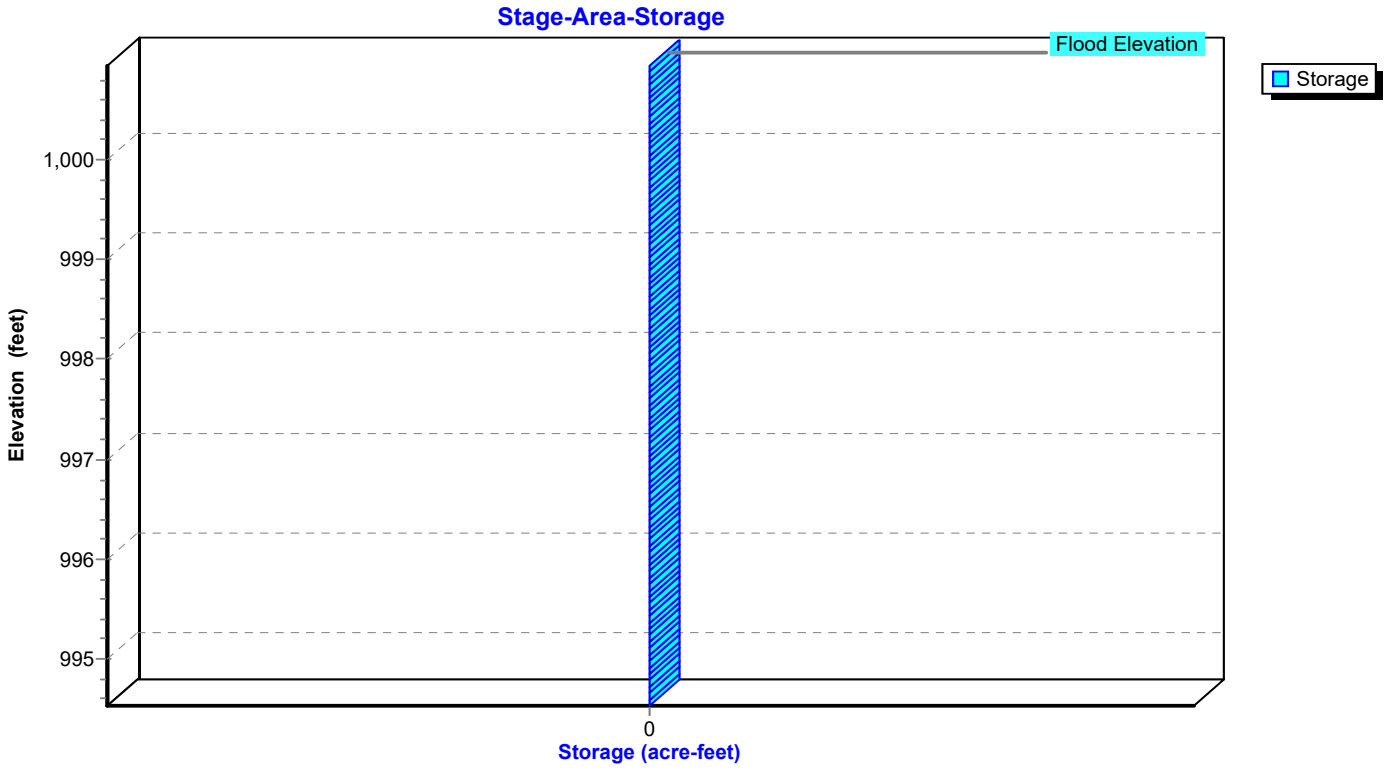
Pond 51P: ROOF DRAINS TO BASIN



Pond 51P: ROOF DRAINS TO BASIN

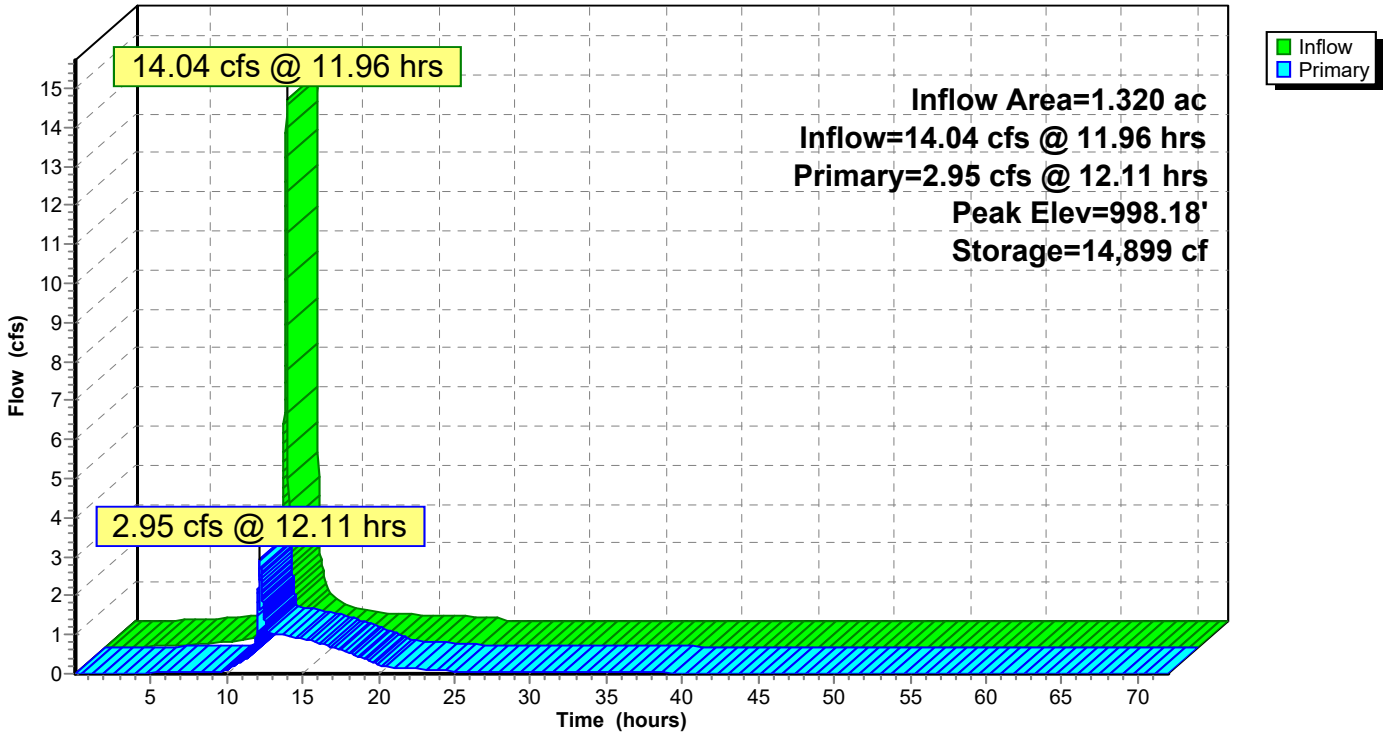


Pond 51P: ROOF DRAINS TO BASIN



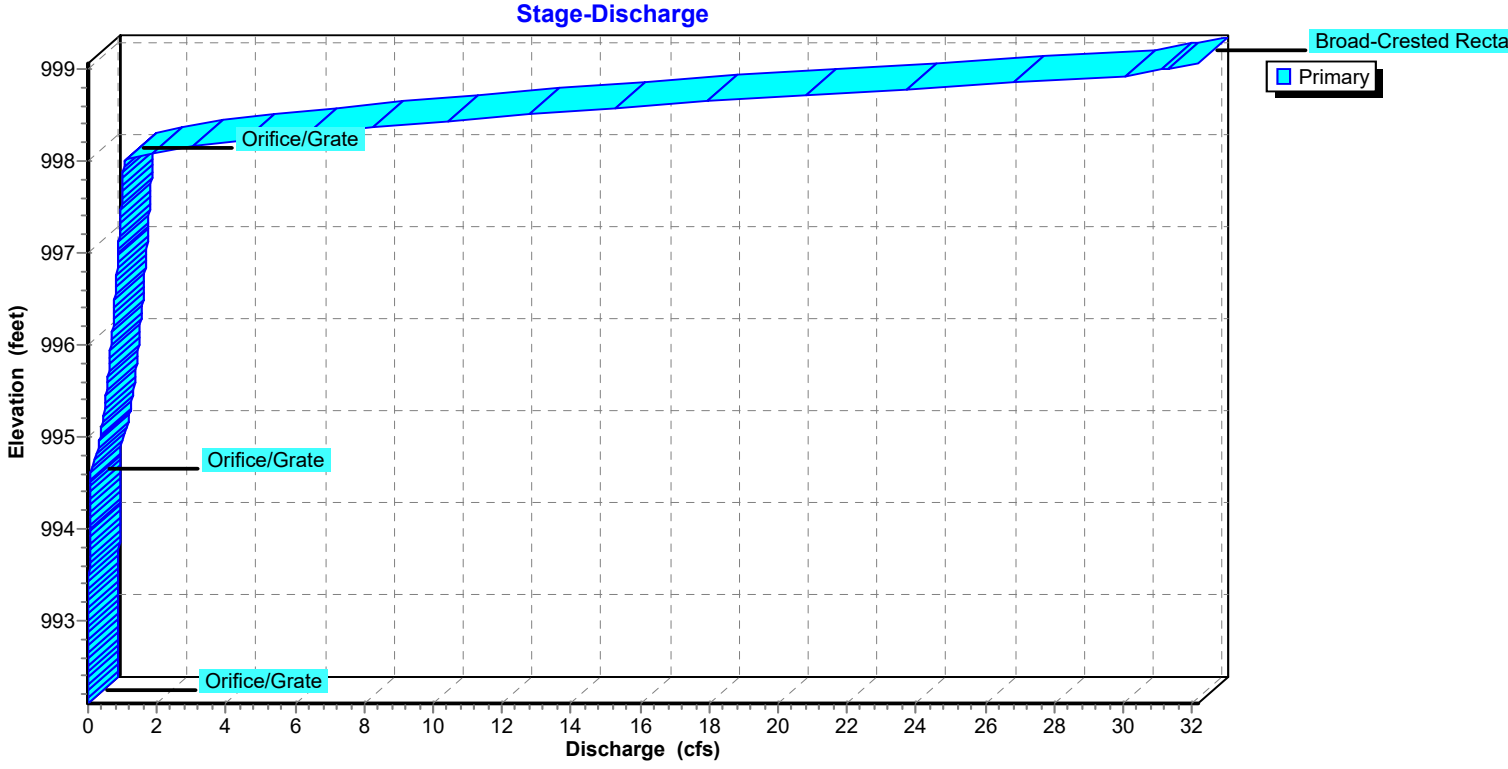
Pond 52P: DETENTION BASIN

Hydrograph

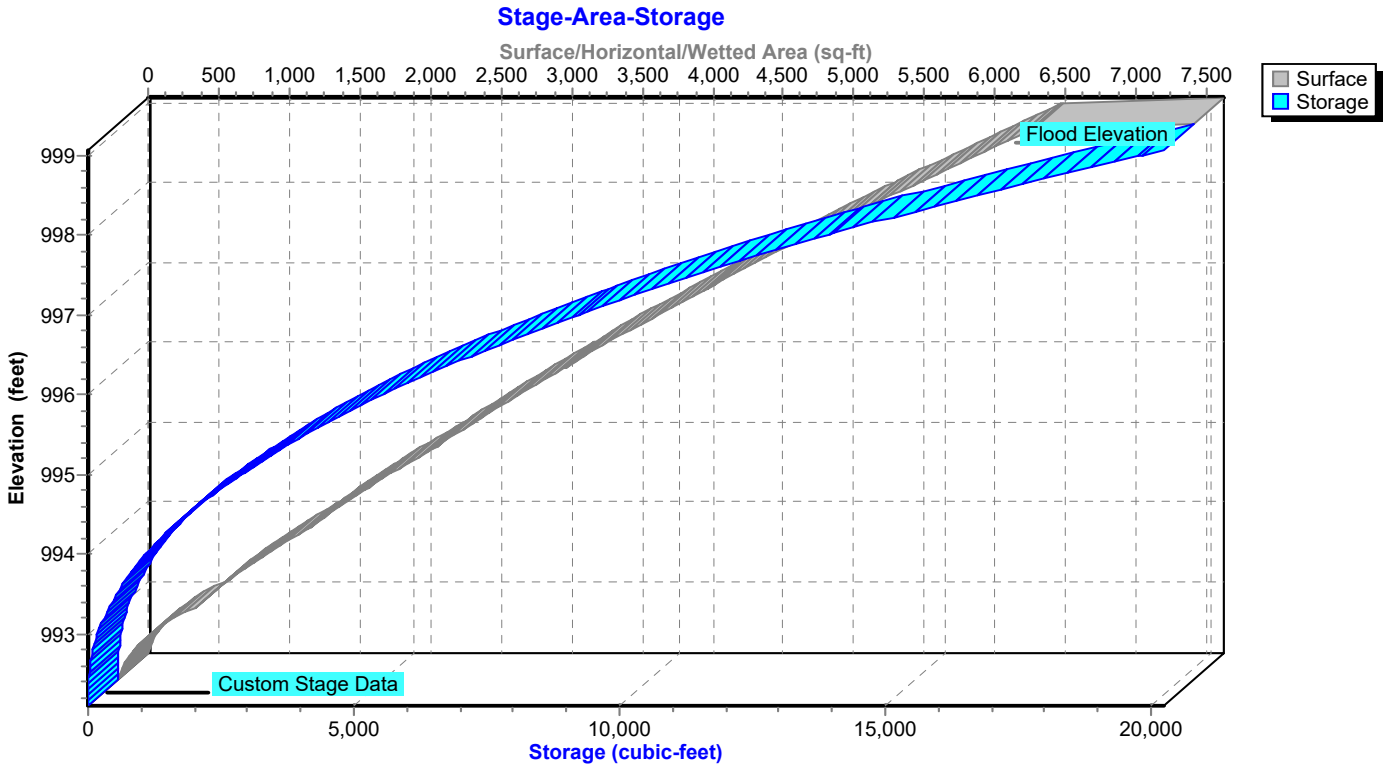


Pond 52P: DETENTION BASIN

Stage-Discharge

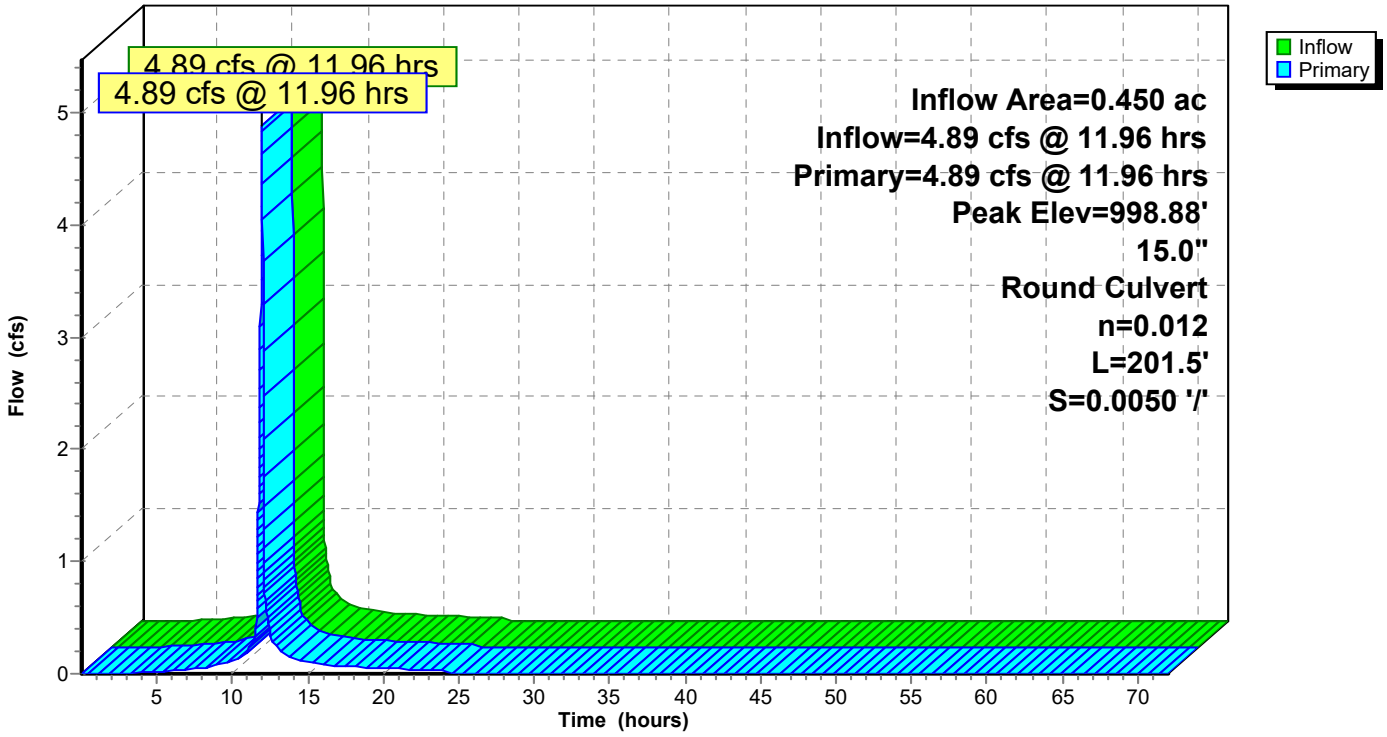


Pond 52P: DETENTION BASIN



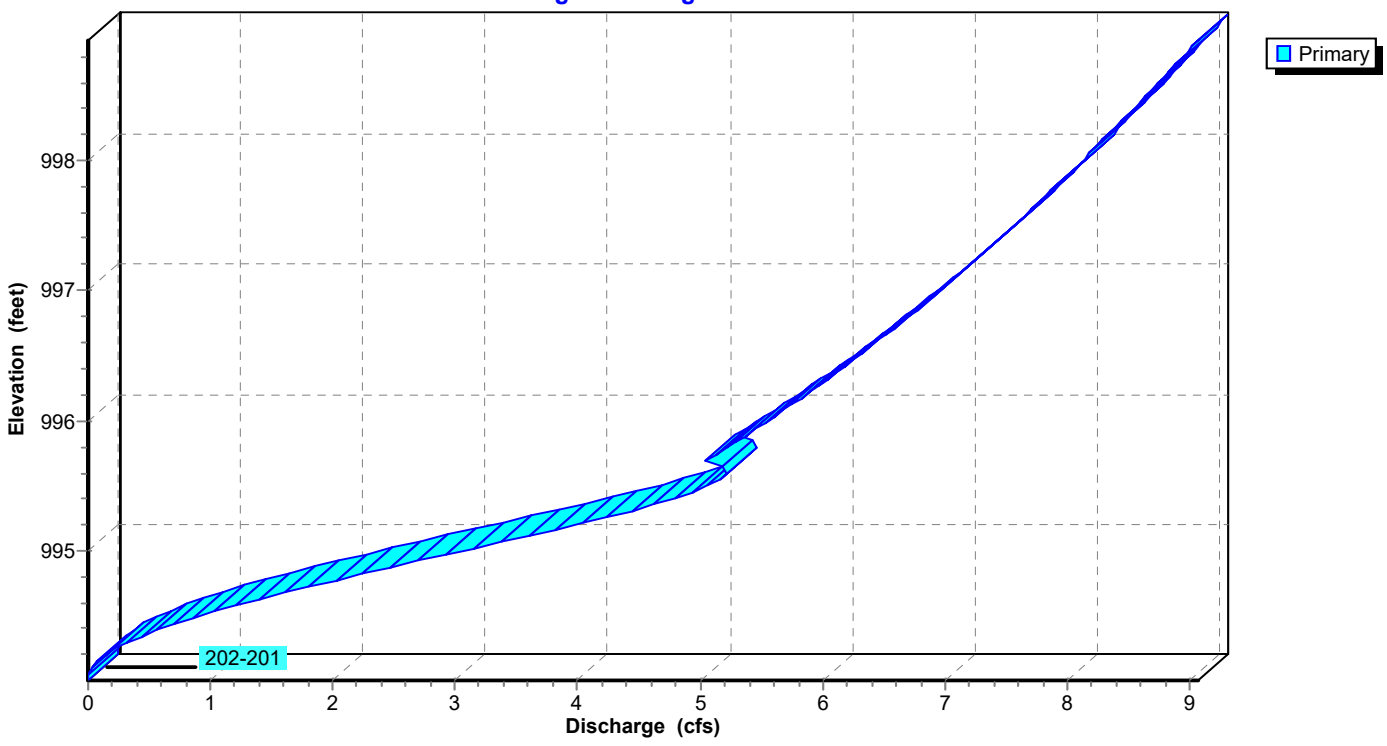
Pond 53P: 301-300

Hydrograph

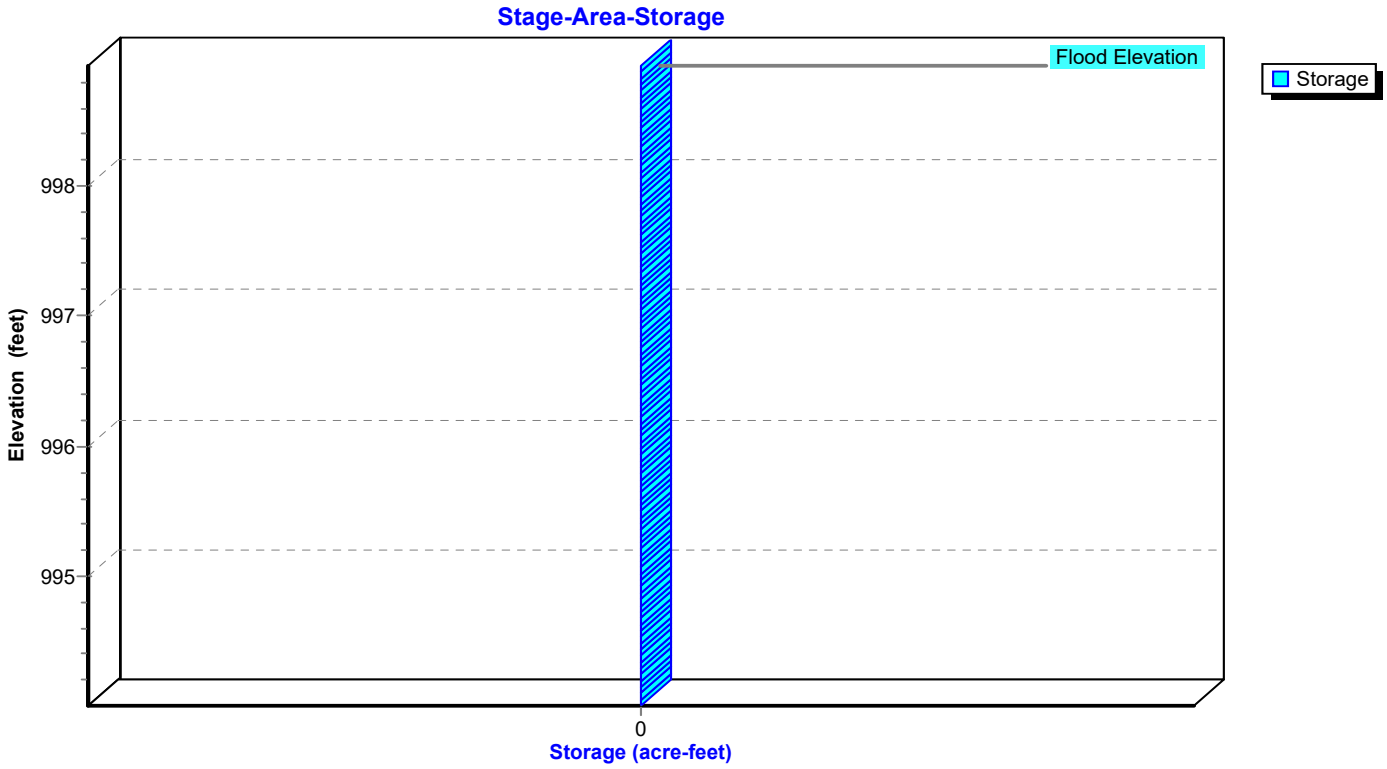


Pond 53P: 301-300

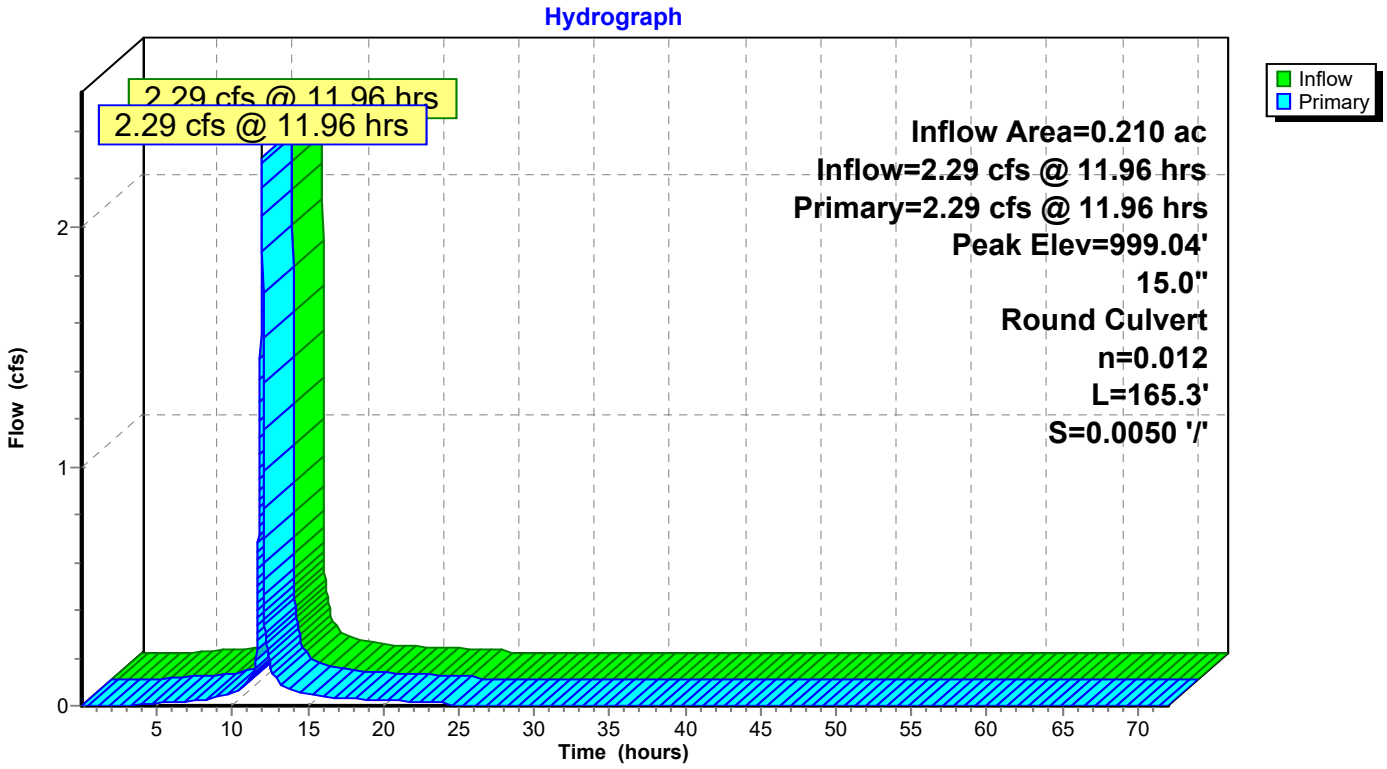
Stage-Discharge



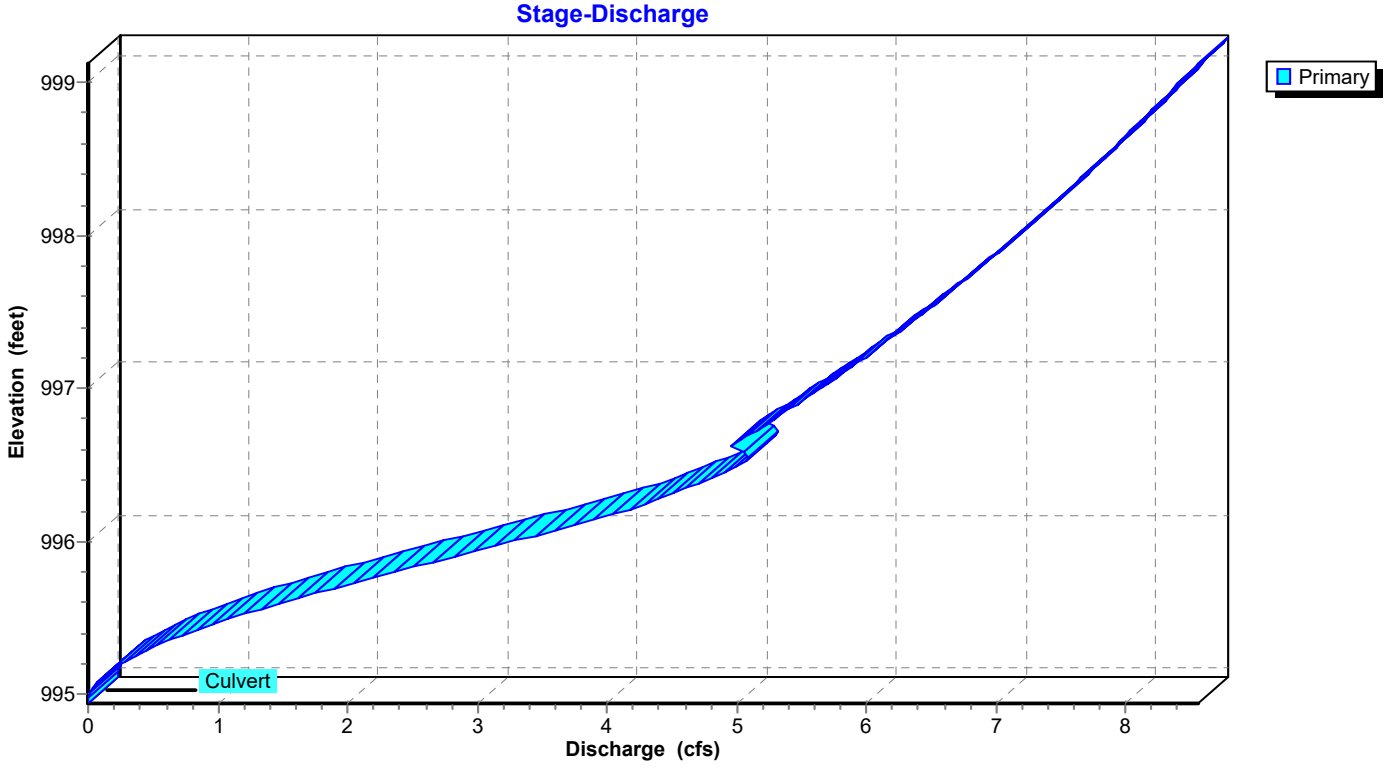
Pond 53P: 301-300



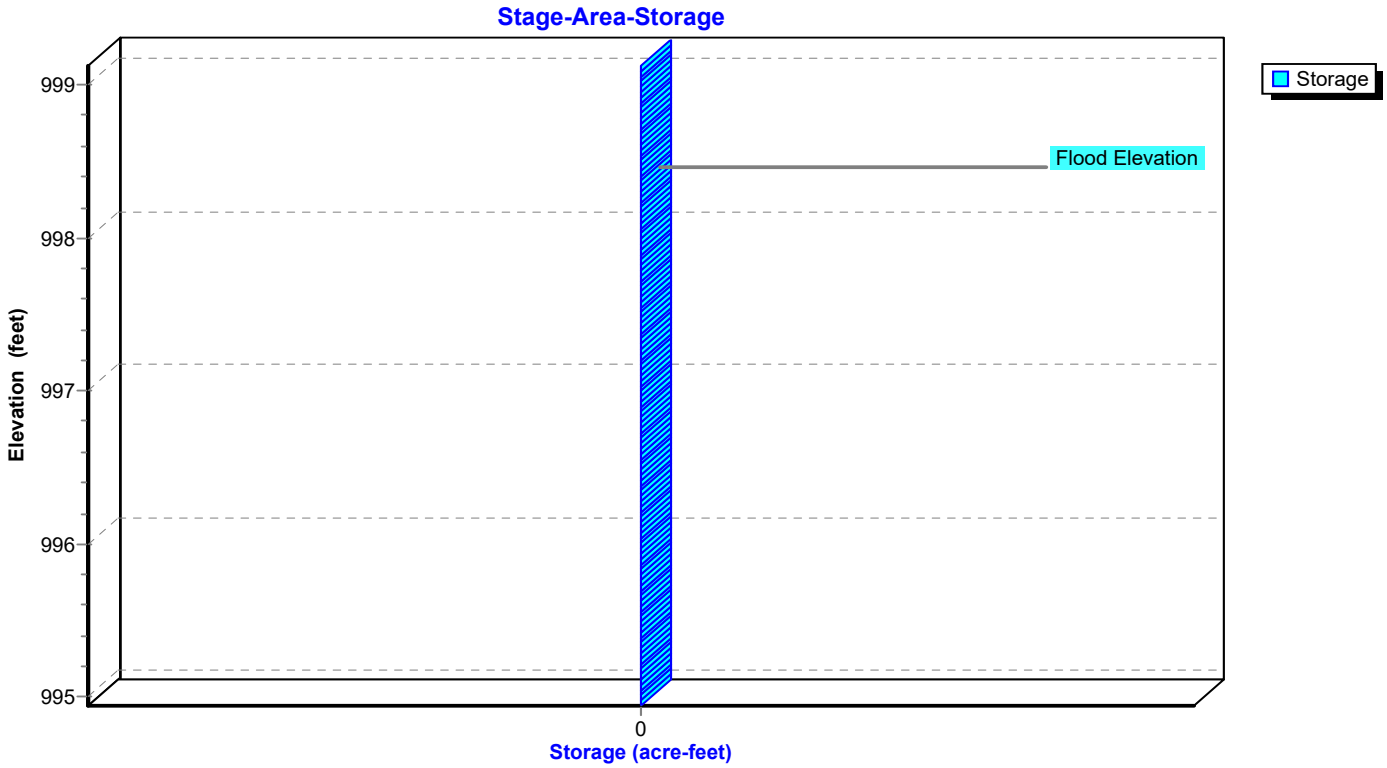
Pond 54P: 302-301



Pond 54P: 302-301

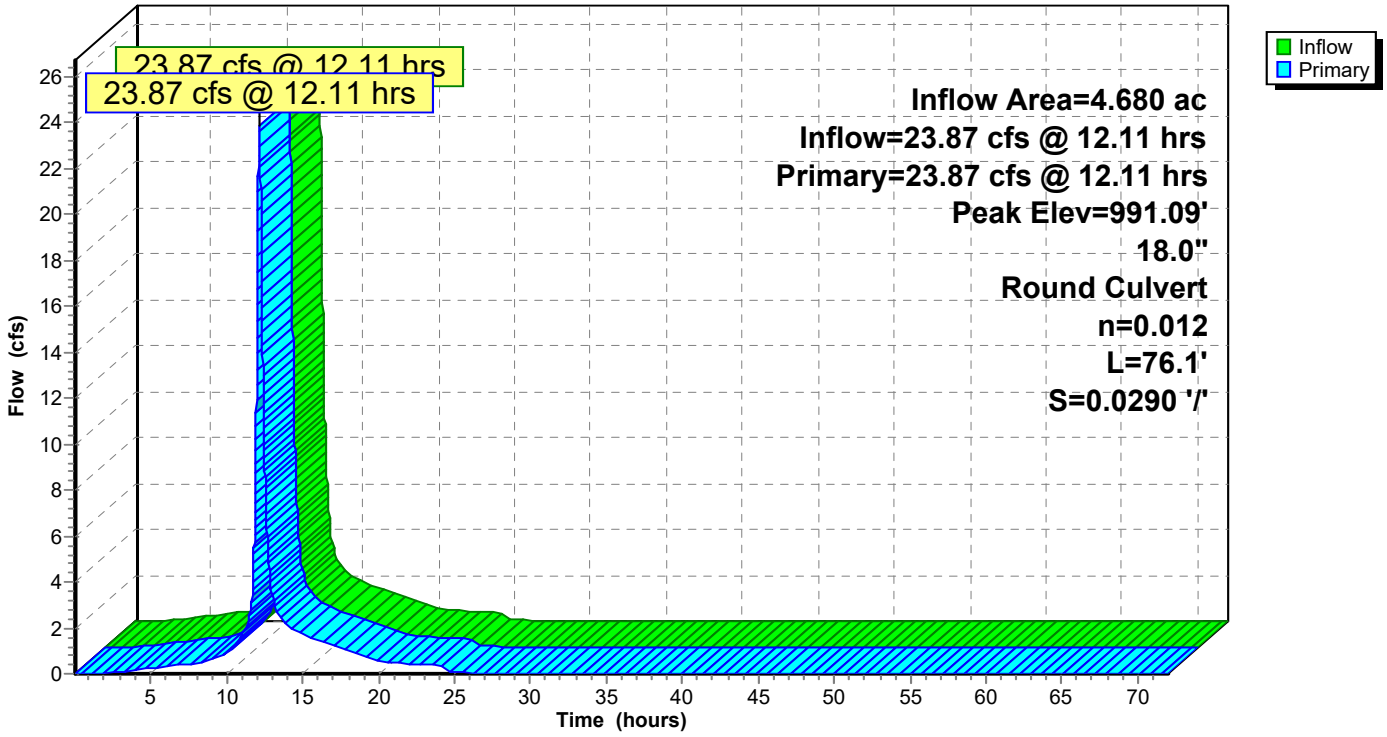


Pond 54P: 302-301



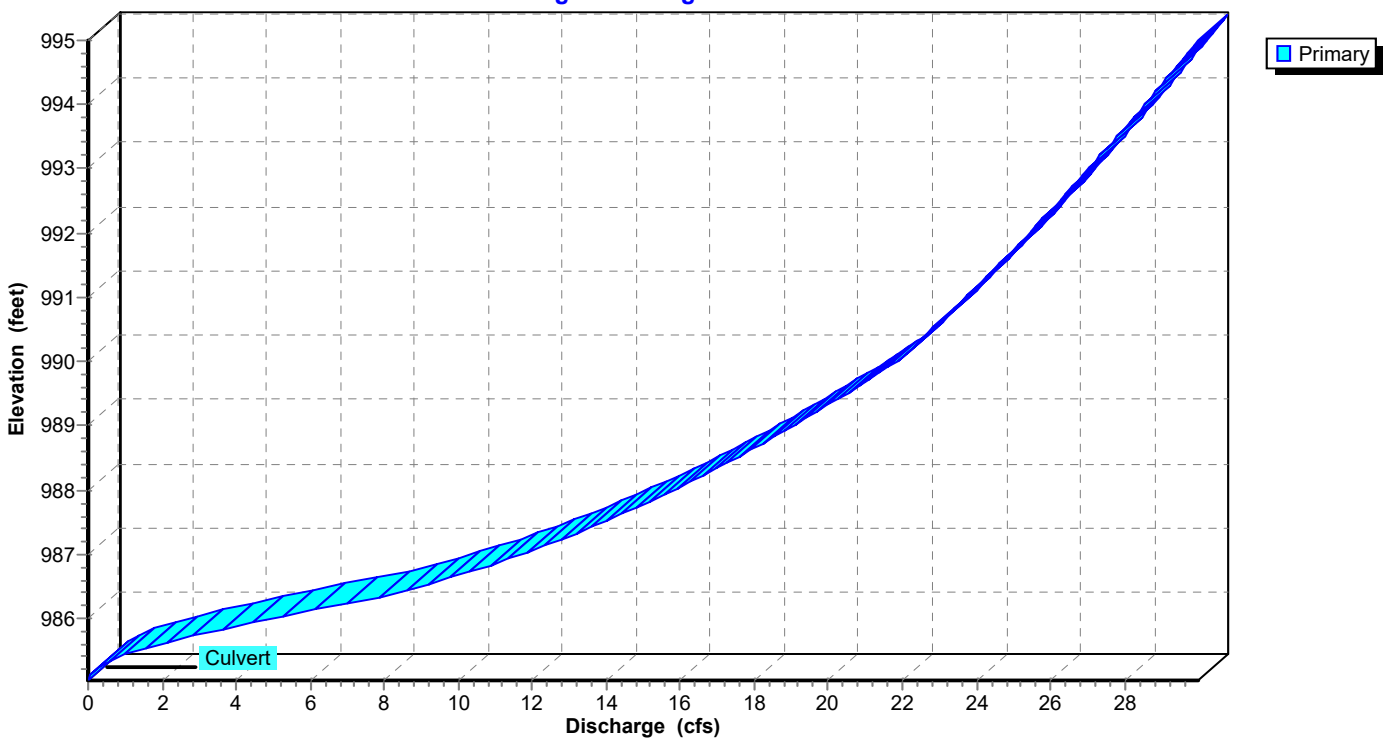
Pond 55P: 11-10

Hydrograph

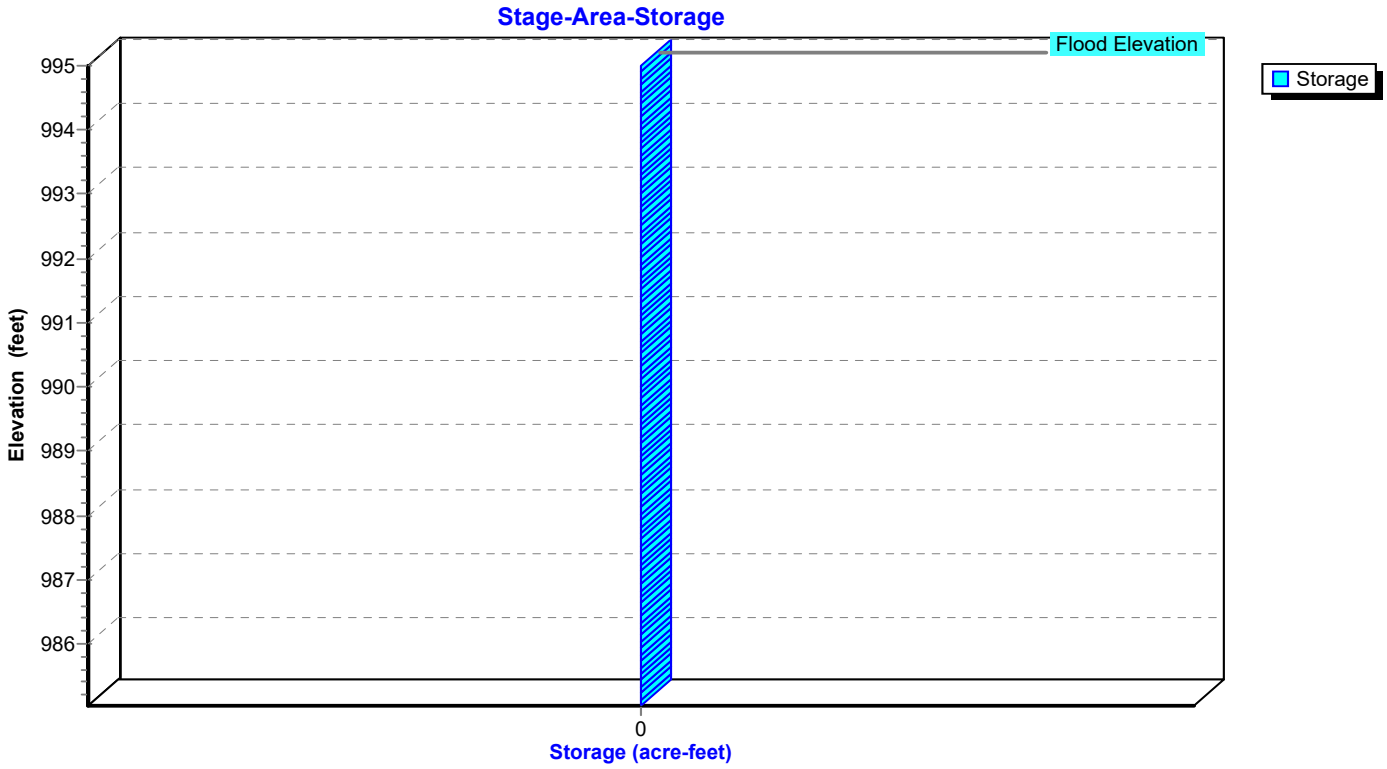


Pond 55P: 11-10

Stage-Discharge

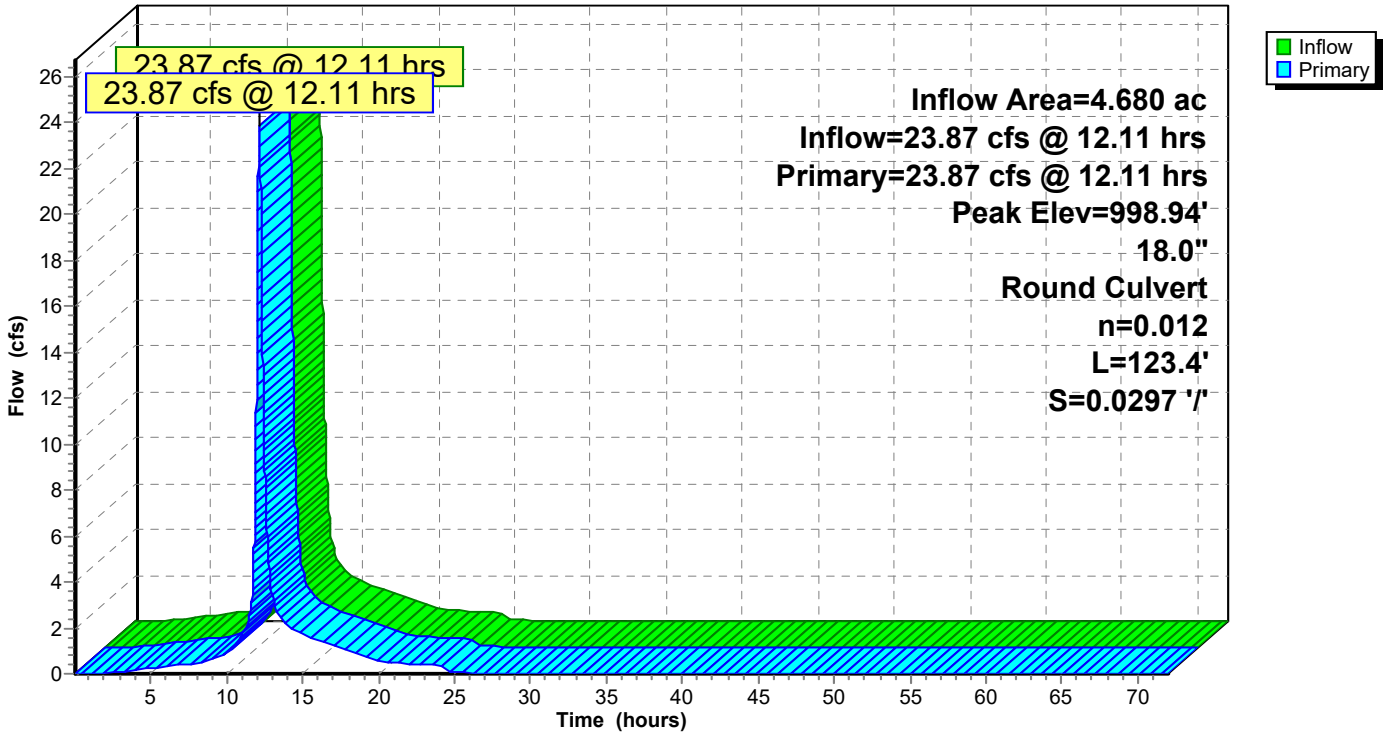


Pond 55P: 11-10



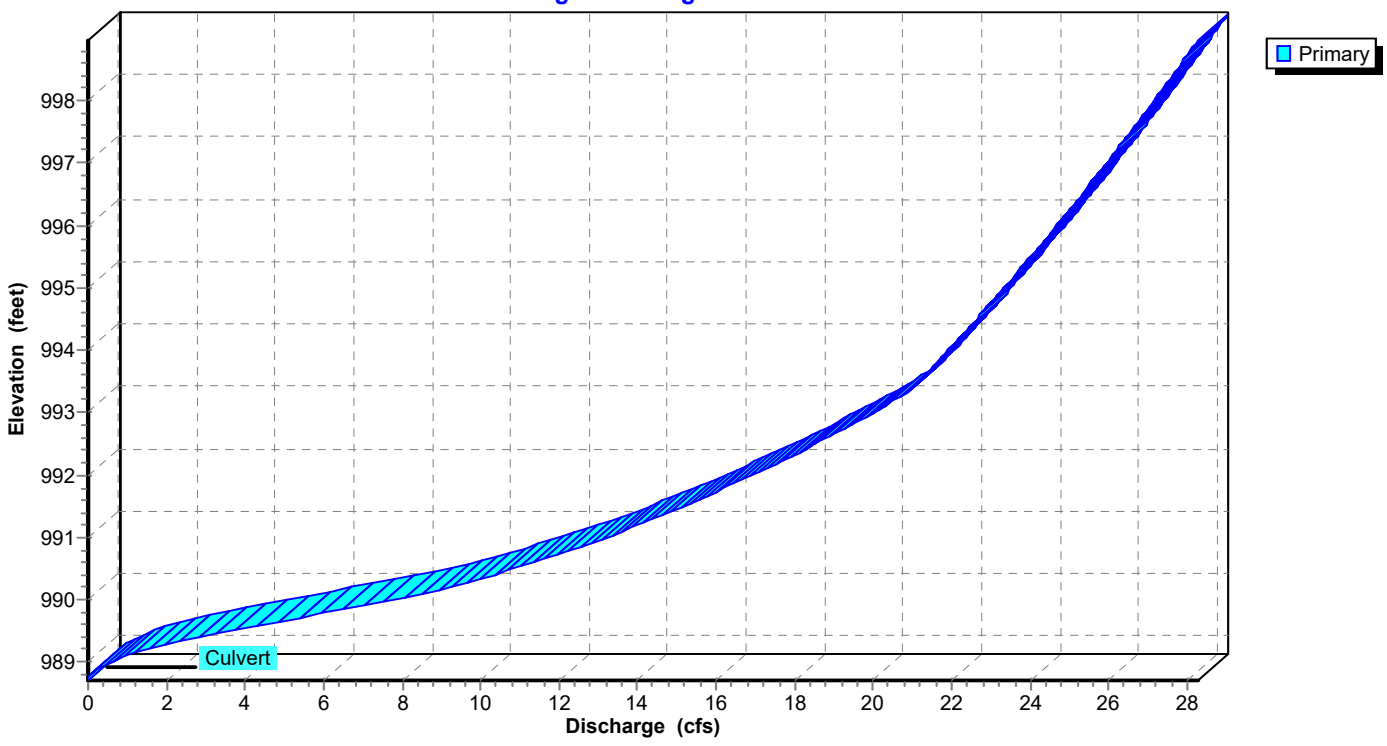
Pond 56P: 11 - 100 MH

Hydrograph

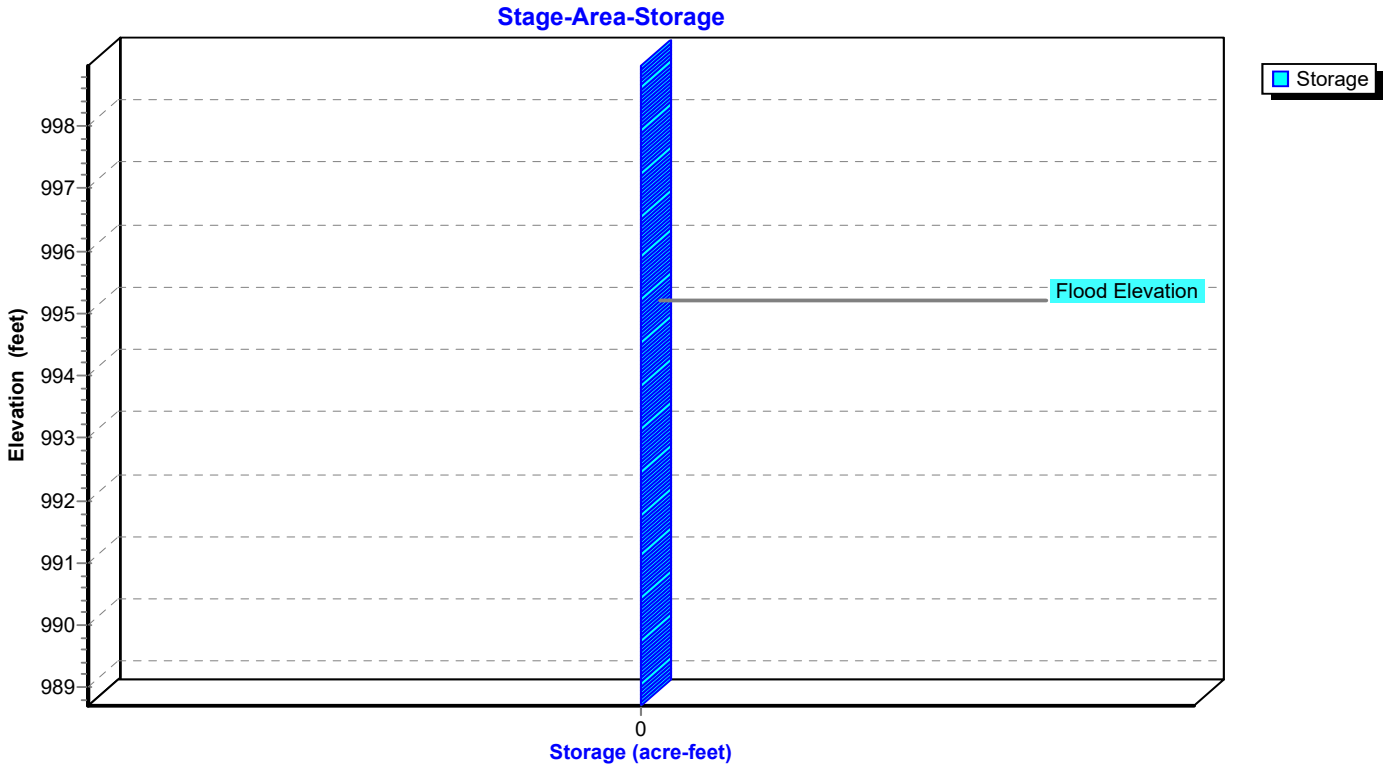


Pond 56P: 11 - 100 MH

Stage-Discharge

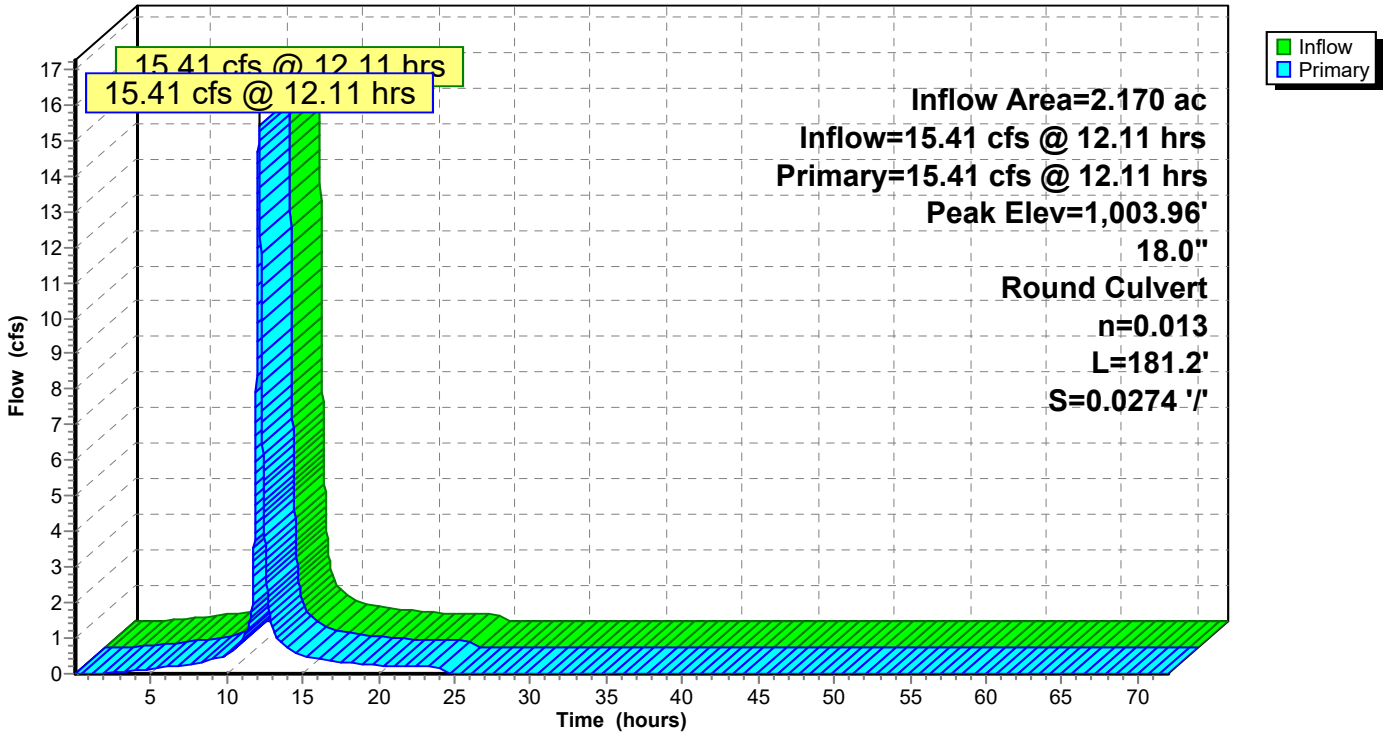


Pond 56P: 11 - 100 MH



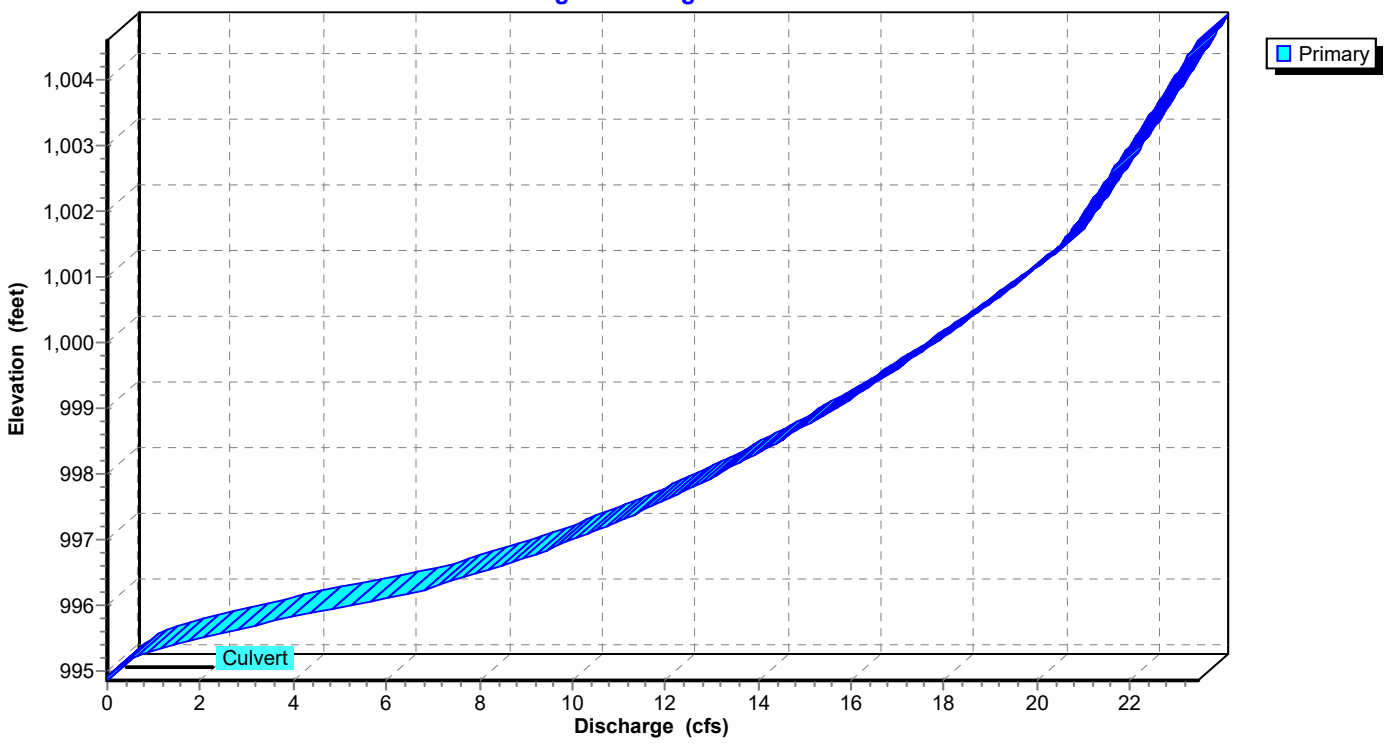
Pond 57P: 12-11

Hydrograph

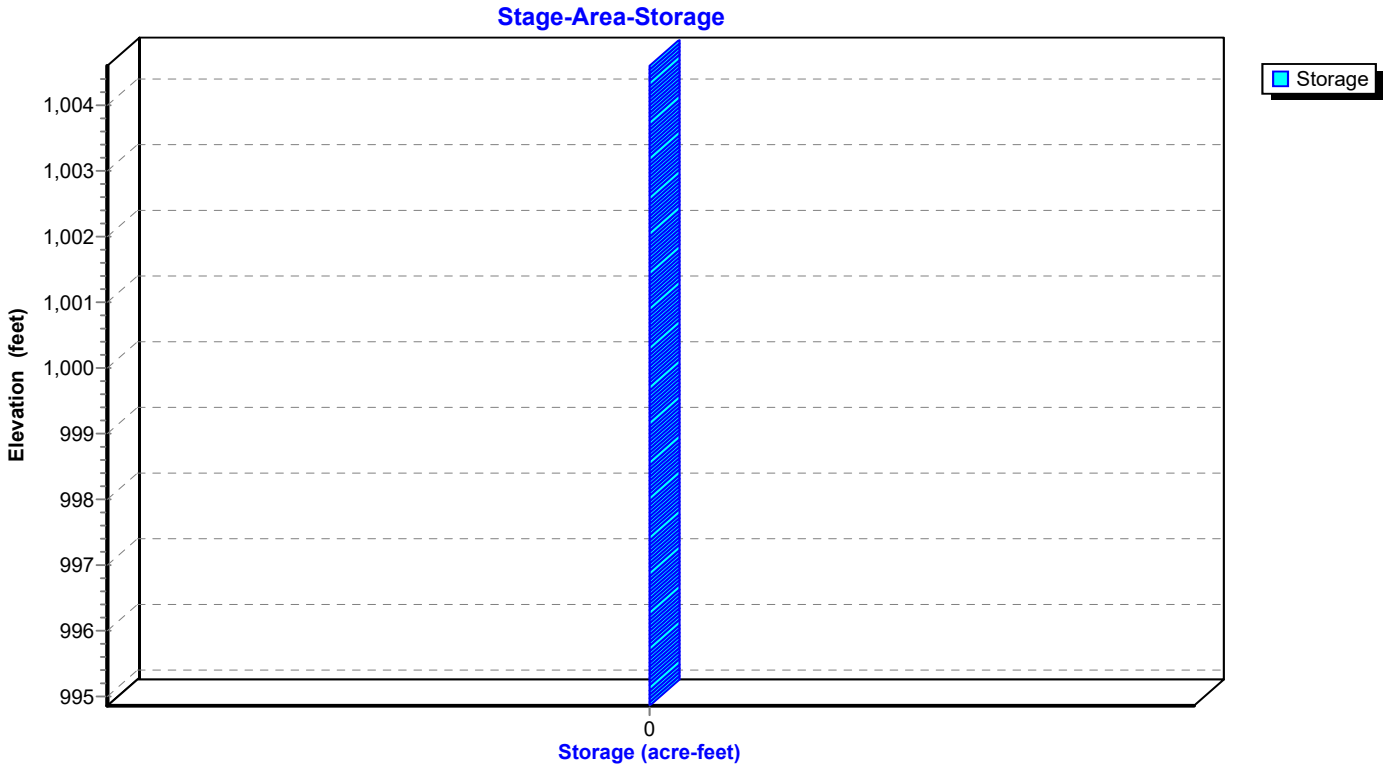


Pond 57P: 12-11

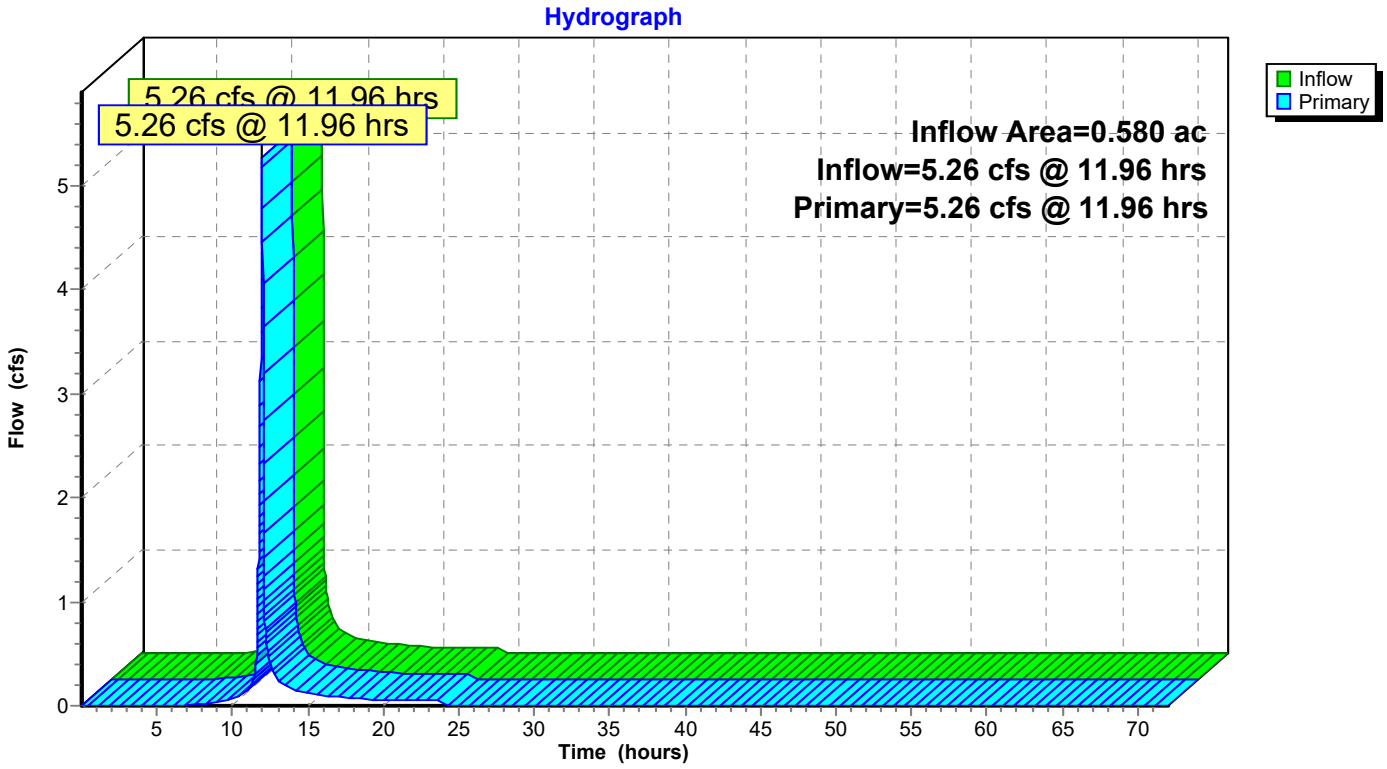
Stage-Discharge



Pond 57P: 12-11



Link 90L: BYPASS AREAS



Events for Subcatchment 1S: EXISTING CONDITIONS

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.15	0.019	0.11
2-Year	3.50	3.98	0.218	1.24
10-Year	5.30	8.48	0.458	2.61
100-Year	**7.70**	**15.01**	**0.819**	**4.66**

Events for Subcatchment 2S: AREA A

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.84	0.080	0.82
2-Year	3.50	2.79	0.276	2.84
10-Year	5.30	4.43	0.449	4.60
100-Year	**7.70**	**6.58**	**0.681**	**6.98**

Events for Subcatchment 3S: AREA B

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.00	0.000	0.11
2-Year	3.50	0.12	0.005	1.24
10-Year	5.30	0.24	0.011	2.61
100-Year	**7.70**	**0.42**	**0.019**	**4.66**

Events for Subcatchment 4S: AREA C

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.01	0.001	0.11
2-Year	3.50	0.35	0.015	1.24
10-Year	5.30	0.73	0.033	2.61
100-Year	**7.70**	**1.27**	**0.058**	**4.66**

Events for Subcatchment 5S: AREA D

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.01	0.001	0.11
2-Year	3.50	0.14	0.006	1.24
10-Year	5.30	0.29	0.013	2.61
100-Year	**7.70**	**0.51**	**0.023**	**4.66**

Events for Subcatchment 6S: AREA E

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	1.98	0.148	0.82
2-Year	3.50	6.56	0.513	2.84
10-Year	5.30	10.38	0.833	4.60
100-Year	**7.70**	**15.41**	**1.263**	**6.98**

Events for Subcatchment 7S: AREA F

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.13	0.017	0.11
2-Year	3.50	3.57	0.195	1.24
10-Year	5.30	7.60	0.410	2.61
100-Year	**7.70**	**13.44**	**0.734**	**4.66**

Events for Subcatchment 8S: AREA G

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.00	0.000	0.11
2-Year	3.50	0.04	0.002	1.24
10-Year	5.30	0.08	0.004	2.61
100-Year	**7.70**	**0.14**	**0.008**	**4.66**

Events for Subcatchment 9S: AREA H

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.00	0.000	0.11
2-Year	3.50	0.02	0.001	1.24
10-Year	5.30	0.04	0.002	2.61
100-Year	**7.70**	**0.07**	**0.004**	**4.66**

Events for Subcatchment 10S: PROPOSED CONDITIONS

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	1.01	0.049	0.28
2-Year	3.50	6.96	0.313	1.78
10-Year	5.30	12.78	0.589	3.35
100-Year	**7.70**	**20.67**	**0.980**	**5.58**

Events for Subcatchment 25S: AREA 3

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	1.31	0.059	0.53
2-Year	3.50	5.56	0.259	2.36
10-Year	5.30	9.26	0.447	4.06
100-Year	**7.70**	**14.13**	**0.703**	**6.39**

Events for Subcatchment 60S: AREA 6

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.11	0.007	0.16
2-Year	3.50	1.36	0.061	1.43
10-Year	5.30	2.70	0.122	2.88
100-Year	**7.70**	**4.59**	**0.212**	**5.00**

Events for Subcatchment 61S: AREA 7

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.03	0.001	0.25
2-Year	3.50	0.22	0.010	1.71
10-Year	5.30	0.41	0.019	3.25
100-Year	**7.70**	**0.68**	**0.032**	**5.46**

Events for Subcatchment 62S: AREA 1

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.25	0.011	0.64
2-Year	3.50	0.94	0.044	2.54
10-Year	5.30	1.52	0.075	4.27
100-Year	**7.70**	**2.29**	**0.116**	**6.63**

Events for Subcatchment 63S: AREA 2

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.26	0.012	0.58
2-Year	3.50	1.04	0.049	2.45
10-Year	5.30	1.71	0.083	4.17
100-Year	**7.70**	**2.60**	**0.130**	**6.51**

Events for Subcatchment 64S: AREA 3

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.24	0.011	0.31
2-Year	3.50	1.51	0.068	1.86
10-Year	5.30	2.73	0.126	3.45
100-Year	**7.70**	**4.37**	**0.209**	**5.69**

Events for Subcatchment 65S: AREA 4

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.63	0.032	1.15
2-Year	3.50	1.69	0.090	3.27
10-Year	5.30	2.57	0.139	5.06
100-Year	**7.70**	**3.74**	**0.205**	**7.46**

Events for Subcatchment 66S: AREA 5

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.07	0.003	0.41
2-Year	3.50	0.38	0.017	2.10
10-Year	5.30	0.66	0.031	3.75
100-Year	**7.70**	**1.04**	**0.050**	**6.04**

Events for Subcatchment 67S: OFFSITE TO CI 12

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	1.98	0.148	0.82
2-Year	3.50	6.56	0.513	2.84
10-Year	5.30	10.38	0.833	4.60
100-Year	**7.70**	**15.41**	**1.263**	**6.98**

Events for Subcatchment 68S: AREA TO AI 11

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.00	0.000	0.11
2-Year	3.50	0.05	0.002	1.24
10-Year	5.30	0.10	0.004	2.61
100-Year	**7.70**	**0.17**	**0.008**	**4.66**

Events for Subcatchment 69S: OFFSITE TO BMP

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	1.37	0.84	0.080	0.82
2-Year	3.50	2.79	0.276	2.84
10-Year	5.30	4.43	0.449	4.60
100-Year	**7.70**	**6.58**	**0.681**	**6.98**

Events for Pond 10P: 12-11

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	1.98	1.98	998.42	**0.000**
2-Year	6.59	6.59	998.69	0.000
10-Year	10.44	10.44	998.87	0.000
100-Year	**15.51**	**15.51**	**1,000.28**	0.000

Events for Pond 11P: 11-10

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	2.71	2.71	992.22	**0.000**
2-Year	9.08	9.08	992.69	0.000
10-Year	14.44	14.44	993.30	0.000
100-Year	**21.49**	**21.49**	**994.55**	0.000

Events for Pond 26P: DETENTION BASIN

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	1.31	1.31	998.58	**0.000**
2-Year	5.56	5.56	998.70	0.000
10-Year	9.26	9.26	998.78	0.000
100-Year	**14.13**	**14.13**	**998.87**	0.000

Events for Pond 50P: BASIN REACH

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	0.71	0.71	994.61	**0.000**
2-Year	2.07	2.07	996.02	0.000
10-Year	3.23	3.23	997.18	0.000
100-Year	**4.78**	**4.78**	**998.66**	0.000

Events for Pond 51P: ROOF DRAINS TO BASIN

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	0.71	0.71	994.96	**0.000**
2-Year	2.07	2.07	996.02	0.000
10-Year	3.23	3.23	997.46	0.000
100-Year	**4.78**	**4.78**	**999.47**	0.000

Events for Pond 52P: DETENTION BASIN

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
1-Year	1.45	0.04	994.37	1,646
2-Year	5.56	0.67	996.01	5,605
10-Year	9.19	0.91	997.17	9,951
100-Year	**14.04**	**2.95**	**998.18**	**14,899**

Events for Pond 53P: 301-300

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	0.51	0.51	994.44	**0.000**
2-Year	1.98	1.98	996.02	0.000
10-Year	3.23	3.23	997.23	0.000
100-Year	**4.89**	**4.89**	**998.88**	0.000

Events for Pond 54P: 302-301

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	0.25	0.25	995.21	**0.000**
2-Year	0.94	0.94	996.02	0.000
10-Year	1.52	1.52	997.26	0.000
100-Year	**2.29**	**2.29**	**999.04**	0.000

Events for Pond 55P: 11-10

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	2.74	2.74	985.72	**0.000**
2-Year	9.66	9.66	986.61	0.000
10-Year	15.14	15.14	987.82	0.000
100-Year	**23.87**	**23.87**	**991.09**	0.000

Events for Pond 56P: 11 - 100 MH

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	2.74	2.74	989.39	**0.000**
2-Year	9.66	9.66	990.28	0.000
10-Year	15.14	15.14	991.49	0.000
100-Year	**23.87**	**23.87**	**998.94**	0.000

Events for Pond 57P: 12-11

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
1-Year	1.98	1.98	995.51	**0.000**
2-Year	6.56	6.56	996.21	0.000
10-Year	10.38	10.38	997.11	0.000
100-Year	**15.41**	**15.41**	**1,003.96**	0.000

Events for Link 90L: BYPASS AREAS

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)
1-Year	0.14	0.14	**0.00**
2-Year	1.58	1.58	0.00
10-Year	3.12	3.12	0.00
100-Year	**5.26**	**5.26**	0.00

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