PRELIMINARY STORM WATER MANAGEMENT SUMMARY

DELAWARE DEVELOPMENT PLAN
DELAWARE, OH

AUGUST 1, 2016

PREPARED FOR:
DELAWARE DEVELOPMENT PLAN LTD.

Mannik Smith GROUP

STORM WATER MANAGEMENT SUMMARY

DELAWARE DEVELOPMENT PLAN, LTD
9000 E. BROAD STREET
PATASKALA, OH 43062

AUGUST 1, 2016

PREPARED BY: THE MANNIK & SMITH GROUP
815 GRANDVIEW AVE.
COLUMBUS, OH 43215
614-441-4222

RANDY L. VANTILBURG, PE
PROJECT MANAGER
RVANTILBURG@MANNIKSMITHGROUP.COM

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1.0 INTRODUCTION

Delaware Development, LLC is planning a mixed use development for the area north of the new Meeker Way, east of US23, west of Stratford Road, and south of Chesrown Chevrolet. The site improvements will include new mixed retail, office space and residential uses with associated parking, greenspace, and circulation drives.

The Mannik & Smith Group, Inc. (MSG) performed a surface water delineation (SWD) on the site in summer 2015, to identify any areas on the site that could be considered a jurisdictional wetland or surface water. Five wetlands (Wetlands A-E), totaling 0.47-acre, were identified on the Site (Figure 3-Appendix C). However, Wetland C has since been determined to be part of the Meeker Way project and not part of this Development. One Pond was observed in the south east portion of the Site. This pond was in the same location as the National Wetland Inventory (NWI) mapped Freshwater Emergent wetland. The pond appeared to be used for farming activities and was surrounded by an upland forested fringe. Five streams were identified on the Site, of which all of them have a connection to Olentangy River. MSG confirmed with the USACE and OEPA on final classification of these 5 streams. Streams 1 & 2 have been classified as Perennial Streams with the other 3 being either Intermittent or Ephemeral Streams.

2.0 METHODOLOGY

Several storm water design and technology sources were utilized in conjunction with the City of Delaware, Ohio Infrastructure Design Guide for Land Development Activities for the analysis and development of this report.

Urban Hydrology for Small Watersheds - TR-55 and the Soil Conservation Service (SCS) TR-20 runoff method were used to model the site hydrology. The USDA - Natural Resources Conservation Service (NRCS) Soil Survey in conjunction with the Ohio Supplement to SCS TR-55 and the SCS TR-20 manuals were used to determine Hydrologic Soil Groups (HSG) and Runoff Curve Numbers (RCN). TR55 methods were used for sheet, shallow concentrated, and channel flows to determine the time of concentrations (Tc).

The methodologies were incorporated into a computer program, HydroCAD Stormwater Modeling System (Version 10.0), created by HydroCAD Software Solutions, LLC. The software was used to determine unit and flood hydrographs, as well as routing the detention facility.

The Ohio Environmental Protection Agency's (OEPA) Authorization for Storm Water Discharges to the Olentangy River Watershed associated with Construction Activity Under the National Pollutant Discharge Elimination System along with the Ohio Department of Natural Resources Division of Soil and Water Conservation's Rainwater and Land Development – Ohio's Standards for Stormwater Management Land Development and Urban Stream Protection were used to address water quality standards both during construction and post construction.

It is understood that the City Infrastructure Guidelines have stream mitigation requirements that are equal to or greater than the OEPA Olentangy Permit requirements, and therefore, these will be the guide to mitigation for this project.

3.0 EXISTING CONDITIONS

The existing area has four distinct release points, two large release points and two small release points. Generally, the site is split roughly in half with the north half draining west to east and crossing Stratford Road and on to the Olentangy River. The south half drains north to south via a natural ditch before crossing under US23 and eventually reaching the Olentangy River near the intersection of US23 and SR315. Large offsite areas of both developed and undeveloped lands to the west of US23 drain through the onsite streams. The offsite and existing areas are further described below in sections 3.2 and 3.3, respectively. Existing and Offsite drainage maps are included for clarity.

3.1 Hydrologic Soil Group

According to the Custom Soil Resource Report, generated by The USDA - Natural Resources Conservation Service (NRCS) Soil Survey, the site is situated on many soil types. The bulk of the site consists of Millgrove silty clay loam (MgA), Glynwood silt-loam, ground moraine (Gwg1B1), Scioto silt loam (ScB), and Rossburg silt loam (RoA) soils. Other soils constituting less than 10% of the site are Lybrand silt loam and silty clay loam (LyD2 & LzD3), Sloan silty clay loam, till substratum (SoA), Scioto silt loam (ScA), and Udorthents, clayey-Urban land complex (UdB). These soils range in hydrologic soil group (HSG) from B to D. A soils report has been included in Appendix B for your reference.

3.2 Off-site Drainage Area

A substantial volume of runoff from nearly 755 acres of offsite tributary area passes through the project site. Runoff from US23, the Drexel Commercial Development, and Stratford Woods residential neighborhood drains through the site. There are 5 outfall locations along the west side of US23: outfall 1, outfall 2, outfall 3, outfall 4, and outfall 5. Outfalls 1, 2, and 3 accommodate the west offsite tributary areas and impact the southern portion of the project site. The west offsite areas gather to two perennial streams: Stream 1 and Stream 2. Outfalls 4 and 5 accommodate the north offsite tributary areas and impact the northern portion of the project site. The north offsite areas gather to Stream 4 and Stream 5, and eventually into Stream 3. An offsite drainage map is included for clarity. The five outfalls along US23 are further described in the following sections.

3.2.1 Outfall 1

Outfall 1 along US23 is located in the southernmost region of the offsite tributary area pertaining to the project site. The outfall is a 30” culvert beneath US23 that provides adequate drainage capacity for area SW4. Area SW4 is nearly 28 acres and includes several houses in the Stratford Woods subdivision as well as the woodlands and fielded regions directly south of the residential neighborhood. The 30” culvert crosses US23 and eventually releases through Wetland A and directly into Stream 1.

3.2.2 Outfall 2

Outfall 2 along US23 accommodates 6 offsite areas that can be found on the offsite drainage map. These areas include: E06, E08, E08B, SW3, SW2, and SW1. Area E06 includes nearly 510 acres of agricultural land west of Liberty Road. Runoff from E06 drains through a 72” culvert and combines with the runoff from area E08, which includes a 25 acre commercial development directly west of Liberty Road. The runoff from these areas combines and drains through a 90” pipe to combine with runoff from area SW3. Area SW3 is nearly 26 acres and includes the west end of Hawthorn Boulevard and Thornapple Court and part of the wooded area directly south of the west end of the subdivision. Runoff from these three areas combines and flows through a 60” culvert to cross under Thornapple Trail. The 60” culvert is a documented part of the detention system for the

Stratford Woods Subdivision, which has been modeled accordingly as Pond "ThW" (60" @ Thornapple West).

Area E08B includes a 16 acre commercial development west of Liberty Road and is located directly north of area E08, which can be seen on the offsite drainage map. E08B runoff combines with the total runoff from SW3 and into area SW2. Area SW2 is 64 acres and includes a majority of the Stratford Woods subdivision, a park to the west of the neighborhood, and the surrounding woodlands. The runoff from SW2 and the aforementioned areas drain through a 76"x48" elliptical culvert underneath the east end of Thornapple Trail and into area SW1. The 76"x48" elliptical culvert is another documented part of the detention system for the Stratford Woods Subdivision, and has been modeled accordingly as Pond "ThE" (76"x48" Ellipse @ Thornapple East).

SW1 contains the east ends of Thornapple Trail and Hawthorn Boulevard, Aspen Court, and the surrounding woodlands and is nearly 20 acres in total. Runoff from all of the above-mentioned areas enters the site via a 60"x84" box culvert and eventually drains into Stream 1. The Stratford Woods Subdivision Plans indicate a detention basin before the 60"x84" box culvert, however, field evidence was not verifiable, and therefore, a detention analysis at the outfall has not been included.

3.2.3 Outfall 3

Outfall 3 contains a 30" culvert that crosses underneath US23 and drains directly into Stream 2. This area is also a detention basin that was modeled per the Drexel Engineering Plans. This detention area "DS" (Drexel South), provides sufficient drainage capacity to accommodate area D1, depicted on the offsite drainage map. Area D1 includes 62 acres of residential lots, the bulk of the northern portion of the Stratford Woods subdivision, as well as a small part of the Drexel Commercial Development and 6 acres of surrounding woodlands.

3.2.4 Auxiliary "West" Offsite Areas

There are two offsite tributary areas that account for the right of way of US23. These areas do not pertain to the aforementioned outfalls that are located to the west of US23, but do impact the west end of the site. Area CHES includes an auto dealership (Chesrown) with less than an acre of impervious area. The runoff from these areas flow onto the site as direct runoff from US23, and into Streams 1 and 2, respectively. The small areas are called US_23 and US23.

Table 3.1 West Offsite Area Flow Rates

Watershed	Area (AC.)	RCN	Tc (mins)	Q_1 (cfs)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Outfall 1										
SW4	27.70	73	35.8	7.69	9.96	20.55	26.50	34.39	42.66	46.12
Outfall 2										
E06	509.43	77	276.5	46.63	57.01	104.01	129.89	163.80	199.03	213.42
E08	25.21	82	42.2	14.05	16.64	27.75	33.60	41.11	48.75	51.84
SW3	25.90	77	23.6	14.42	17.73	32.42	40.39	50.89	61.65	66.02
ThW				48.65	59.33	107.56	134.07	168.76	204.79	219.50
SW2	64.10	80	22.9	46.57	55.95	96.01	117.33	144.78	172.88	184.25
E08B	15.70	77	36.2	6.50	8.03	14.80	18.49	23.30	28.28	30.32
ThE				73.03	87.81	151.42	185.12	228.34	272.37	290.13
US23	1.01	87	10	3.32	3.79	5.75	6.74	7.99	9.25	9.75
SW1	19.66	80	13.1	19.64	23.42	39.72	48.37	59.46	70.80	75.38
60x84				82.20	98.17	161.16	187.18	215.77	242.60	252.76
Outfall 3										
D1	68.30	82	18.2	66.19	78.07	128.68	155.24	189.18	223.68	237.59
DS				12.02	12.88	15.73	16.90	18.19	19.33	19.76
Auxiliary Offsite Areas										
US_23	1.77	85	10	2.74	3.16	4.93	5.84	6.99	8.14	8.61
U23	1.44	84	10	2.09	2.43	3.84	4.57	5.49	6.43	6.80
Total West Offsite Flows										
TOW				100.27	119.28	195.78	229.64	268.10	302.59	315.42

3.2.5 Outfall 4

Outfall 4 along US23 is located directly west of the northwest corner of the project site. There is an existing 12" culvert underneath US23 that provides adequate drainage capacity for area D2, via a modeled detention system "DN" (Drexel North). Area D2 includes the majority of the Drexel Commercial Development. The runoff from the 19 acre urban commercial development area enters the site via the 12" culvert and drains directly into Stream 5 which combines with Stream 4 and eventually with Stream 3 before leaving the project site.

3.2.6 Outfall 5

Outfall 5 contains a 5'x6' box culvert that crosses underneath US23 to the northwest corner of the project boundary. Runoff through this outfall location is a combination of three tributary areas shown on the offsite drainage map. The first area is area RS (Ravines at Stratford), which includes nearly 22.5 acres of residential lots. Runoff from area RS is combined with runoff from a 3 acre commercial development lot, (Best Western) BW, which has a modeled detention basin "BWP" (Best Wester Pond) and eventually another 5 acre commercial development lot, (Chipotle) CHIP. After draining through the 5'x6' box culvert, the runoff enters the site via Stream 4.

3.2.7 Auxiliary "North" Offsite Areas

There are two offsite tributary areas that are located east of US23 and directly north of the project site. These areas do not pertain to the aforementioned outfalls that are located to the west of US23, but do impact the north end of the site. Area CHES includes an auto dealership (Chesrown) with less than an acre of impervious area. The runoff from this area flows through an underground

chamber detention system "ChC" (Chesrown Chambers), which has been modeled to combine with the runoff from the 6 acres of residential lots to the east of the dealership, E23RO. The runoff from these two areas will enter the site via Stream 4 along the north boundary of the site.

Table 3.2 North Offsite Area Flow Rates

Watershed	Area (AC.)	RCN	Tc (mins)	Q_1 (cfs)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Outfall 4										
D2	19.11	94	10	46.85	51.87	71.83	81.75	94.09	106.38	111.29
DN				8.00	8.11	8.49	11.62	37.37	59.28	74.52
Outfall 5										
RS	22.46	79	26.6	13.72	16.59	29.11	35.82	44.50	53.41	57.03
BW	2.60	94	10	6.37	7.06	9.77	11.12	12.80	14.47	15.14
BWP				0.56	0.59	0.68	0.72	0.76	1.25	1.86
CHIP	4.76	94	10	11.67	12.92	17.90	20.37	23.45	26.51	27.73
5x6				18.29	21.20	34.85	42.14	51.70	61.51	65.47
Auxiliary Offsite Areas										
CHES	0.85	98	10	2.37	2.58	3.43	3.86	4.39	4.92	5.13
ChC				0.14	0.15	0.20	0.84	2.40	4.10	4.19
E23RO	6.96	80	10	7.75	9.23	15.58	18.95	23.27	27.67	29.45
Total North Offsite Flows										
TON				33.47	37.96	57.09	67.20	100.18	144.54	161.22

3.3 Pre-Developed Conditions – Existing Areas

The area includes nine existing houses along Stratford Drive, a horse stable and track accessed from Stratford Road, an existing home and barn off of Stratford Road, grassland, agriculture land, ravines, and dense woodland. The slopes in the area range from fairly steep (12 to 18 percent) along the western edge of the site to relatively flat (0 to 2 percent) through the remainder.

3.3.1 Existing Area 1

Existing Area 1, located at the northwest edge of the site, is just over an acre and is undeveloped. Runoff from this area drains to the north and joins Stream 5 along the north property line. This runoff leaves the site to the north and eventually comes back onsite into Area 2 via Stream 4. Analysis of this area will only be used in the off-site calculations for Area 2.

3.3.2 Existing Area 2

Existing Area 2 consists of 33 acres along the north of the project site. This area currently has 10 houses, 2 barns, an access road and drives and undeveloped greenspace. At the east edge of this area is a large stand of trees. The aforementioned stream, Stream 4, along the north property line comes onto the site and flows south and east to a culvert under Stratford Road. Runoff from this area generally drains from west to east. This runoff combines with the Total Offsite North flows to discharge through existing Study Point 2.

3.3.3 Existing Area 3

Existing Area 3 contains much of the remaining site on the south end of the property and is just over 38 acres in total. This area includes 2 streams, Stream 1 and Stream 2, a horse stable and track, and a heavily wooded area at the south property line. Runoff from this area is primarily to the south. Flooding in this area is of concern as the main stream over-tops its banks. The Meeker Way project includes a new culvert at the discharge point for this area and overflow culverts within this flood area. This runoff combines with the Total Offsite West flows to discharge through existing Study Point 3.

3.3.4 Existing Area 4

Existing Area 4 is less than half an acre at the southeast corner. This area is undeveloped woodland that drains east to the Olentangy River. This runoff discharges through existing Study Point 4.

Table 3.3 Existing Flow Rates

Watershed	Area (AC.)	RCN	Tc (mins)	Q_1 (cfs)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Study Point 1										
EX 1	1.07	74	10.0	0.72	0.91	1.74	2.20	2.80	3.43	3.69
Study Point 2										
EX 2	33.18	71	31.2	8.02	10.69	23.61	31.02	40.98	51.44	55.76
TON*				33.47	37.96	57.09	67.20	100.18	144.54	161.22
SP2				36.64	42.63	69.94	85.99	136.69	184.75	204.39
Study Point 3										
EX 3	38.47	78	32.6	18.74	22.89	41.17	51.05	63.88	77.11	82.49
TOW				100.27	119.28	195.78	229.64	268.10	302.59	315.42
SP3				118.05	141.20	236.47	280.64	331.96	379.58	397.75
Study Point 4										
EX 4	0.38	60	17.8	0.01	0.02	0.13	0.21	0.32	0.45	0.50

Notes: TON* is total North Offsite (including EX1) flowing to the onsite Study Point 2.

3.4 Existing Field Tiles

The Delaware Water and Soil Conservation District maintains a database containing known local field tile systems and drainage ditches. MSG reviewed this database via the office website (http://www.delawareswcd.org/) and contacted the Delaware SWCD directly and confirmed that no known or documented field tiles are present on the project site.

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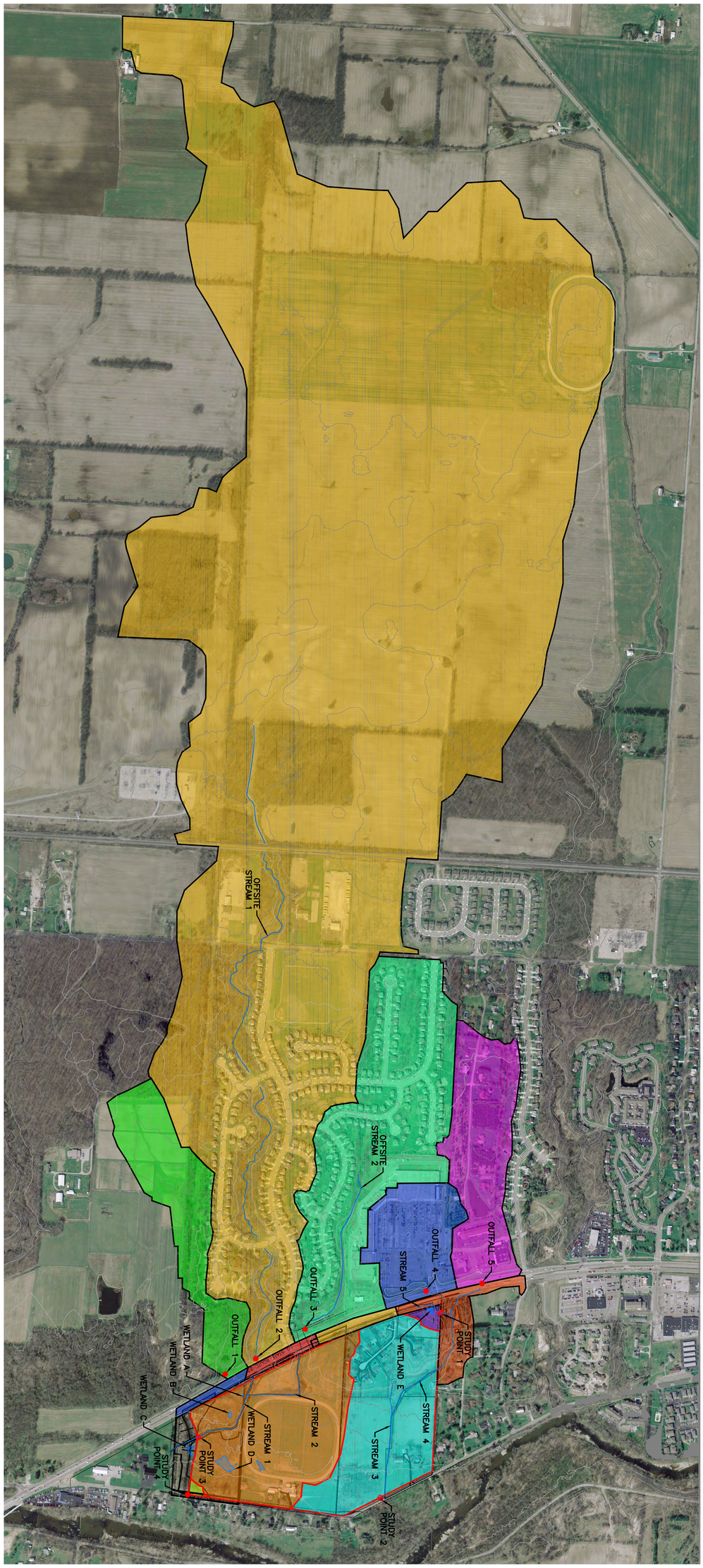


GRAPHIC SCALE
0 250 500 1000
1 INCH = 500 FEET

OVERALL EXISTING TRIBUTARY EXHIBIT

DELAWARE DEVELOPMENT
PRELIMINARY STORMWATER PLAN
US 23 & STRATFORD ROAD

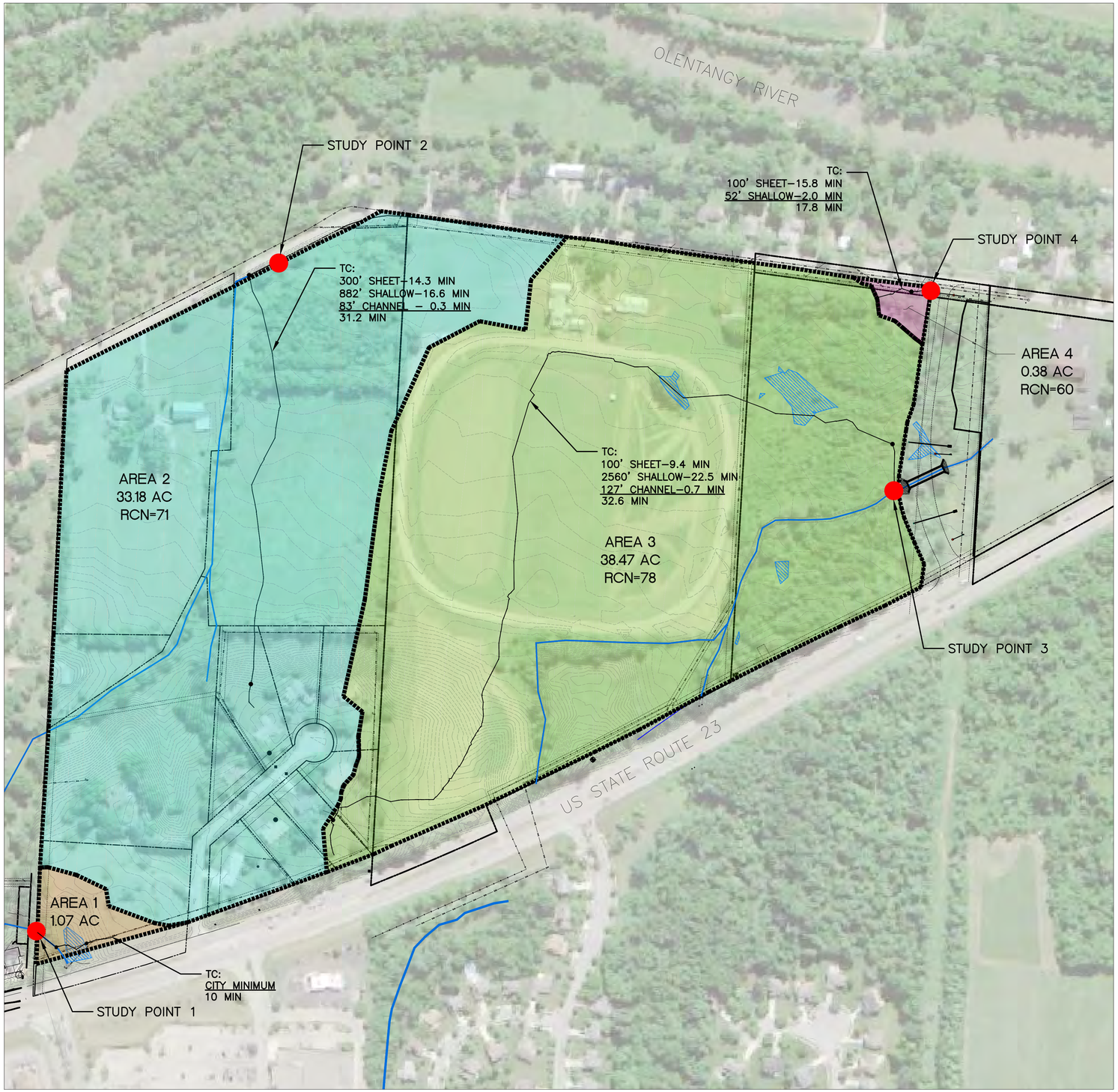
DELAWARE, OH 43015

Mannik Smith GROUP
www.MannikSmithGroup.com
TECHNICAL SKILL. CREATIVE SPIRIT.

815 GRANDVIEW AVENUE
SUITE 650
COLUMBUS, OH 43215
TEL: 614.441.4222
FAX: 888.488.7340

PROJECT DATE:
PROJECT NO.: D2910001
DRAWN BY: CLD/DJJ
CHECKED BY: RLV

NO.	DATE	BY	DESCRIPTION



AREA 1 BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
GRASS	C	1.07	74
TOTAL		1.07	74

AREA 2 BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
IMPERVIOUS		1.28	98
WOODS	D	3.69	79
GRASS	D	11.89	80
GRASS	B	16.32	61
TOTAL		33.18	71

AREA 3 BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
IMPERVIOUS		0.59	98
WOODS	C	1.15	73
WOODS	B	0.77	60
WOODS	D	9.20	79
GRASS	B	3.70	61
GRASS	C	3.70	74
GRASS	D	17.29	80
GRAVEL ROAD	D	2.07	91
TOTAL		38.47	78

AREA 4 BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
WOODS	B	0.38	60
TOTAL		0.38	60

TOTAL AREA BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
IMPERVIOUS		1.87	98
WOODS	C	1.15	73
WOODS	B	1.15	60
WOODS	D	12.89	79
GRASS	B	20.02	61
GRASS	C	4.77	74
GRASS	D	29.18	80
GRAVEL ROAD	D	2.07	91
TOTAL		73.10	75

GRAPHIC SCALE

0 75 150

1 INCH = 150 FEET

NO.	DATE	BY	DESCRIPTION

815 GRANDVIEW AVENUE
SUITE 650
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PRELIMINARY STORMWATER PLAN
US 23 & STRATFORD ROAD

DELAWARE, OH 43015

PRE DEVELOPED CONDITONS

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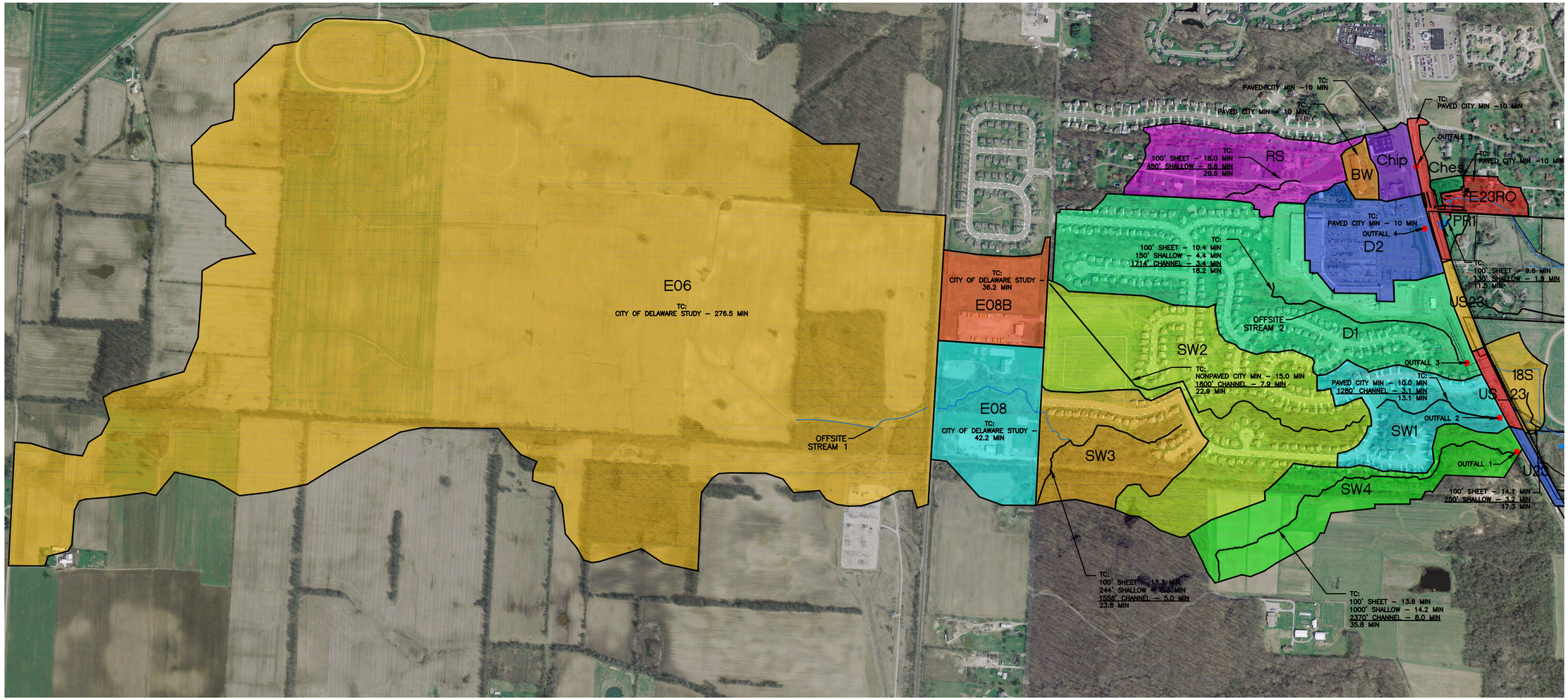

NORTH OFFSITE AREA BREAKDOWN

SECTION	DESCRIPTION	AREA (AC.)	RCN
RS	1 AC RESIDENTIAL LOTS	22.46	79
BW	URBAN COMMERCIAL	2.60	94
CHIP	URBAN COMMERCIAL	4.76	94
D2	URBAN COMMERCIAL	19.11	94
E23RO	1/2 AC RESIDENTIAL LOTS	6.96	80
CHES	PAVED PARKING	0.85	98

WEST OFFSITE AREA BREAKDOWN

SECTION	DESCRIPTION	AREA (AC.)	RCN
E06	AGRICULTURAL	509.43	77
E08	RURAL COMMERCIAL	25.21	82
E08B	RURAL COMMERCIAL	15.70	77
SW3	WOODS	12.50	70
	1/4 AC RESIDENTIAL LOTS	13.40	83
	TOTAL	25.90	77
SW2	GRASS	12.30	74
	WOODS	6.50	70
	1/4 AC RESIDENTIAL LOTS	45.30	83
	TOTAL	64.10	80
SW1	1/4 AC RESIDENTIAL LOTS	15.50	83
	WOODS	4.16	70
	TOTAL	19.66	80
D1	WOODS	6.05	70
	1/4 AC RESIDENTIAL LOTS	62.25	83
	TOTAL	68.30	82
US23	53% IMPER/47% PER	1.91	87
SW4	WOODS	3.77	70
	GRASS	23.93	74
	TOTAL	27.70	73
US_23	46% IMPER/54% PER	1.77	85
U23	43% IMPER/57% PER	1.44	84

*NOTE: AREAS 18S AND PR1 ARE CONSIDERED ON SITE. REFER TO PROPOSED DRAINAGE EXHIBIT

GRAPHIC SCALE
0 225 450
1 INCH = 450 FEET

NO.	DATE	BY	DESCRIPTION

815 GRANDVIEW AVENUE
SUITE 650
COLUMBUS, OH 43215
TEL: 614.441.4222
FAX: 888.488.7340

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US 23 & STRATFORD ROAD

DELAWARE, OH 43015

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4.0 PROPOSED CONDITIONS

The developed site will include new mixed retail, office space and residential uses with associated parking, greenspace, and circulation drives. An existing historic barn structure will be re-purposed and circulation drives will be added. The four drainage release points will generally be preserved, however, significant changes to the release rates will be requested due to the known flooding in Area 3 and the close proximity to the Olentangy River of Area 4. Generally, the proposed spine road will split the drainage areas. The northwest area and the southeast area will drain north to south and discharge at existing Study Point 4. The northeast portion of the site will drain west to east and outlet at existing Study Point 2. The existing streams 1 & 2 and the area west will discharge at existing Study Point 3. A proposed drainage map is included below for clarity.

4.1 Post Developed Conditions – Proposed Area 1

The small northwest portion of the site will remain undisturbed by this project. The size of the area will be reduced to capture as little runoff from the site as feasible. Runoff from this area will be uncontrolled and join the unnamed ditch along the north property line. This runoff will discharge through existing Study Point 1 and join the offsite runoff that ultimately re-enters the site via the north stream in Area 2. No storm water detention will be proposed for this area.

4.2 Post Developed Conditions – Proposed Area 2

The northeast portion of the site drains generally west to east. Most of the area near the stream and areas north will be undisturbed as part of this project. A future residential area is planned and they will be required to provide their own detention at the time of development. A small parking lot and drive will be added at the existing barn just north of the stream. Detention for this area will be provided via a small basin just west of the proposed parking lot, this basin is called “BP” (Barn Pond). The commercial development south of the stream will be routed through a wet detention basin, “NEP” (Northeast Pond). The remainder of Existing Area 2 will be encompassed in Proposed Area 4 as described below. Discharge in this area will occur at Study Point 2.

4.3 Post Developed Conditions – Proposed Area 3

Area 3 is bounded by the onsite streams 1 & 2 on the North and East, US23 to the West, and Meeker way to the South. This area primarily drains from north to south. The two existing on-site streams will remain essentially unchanged with a proposed backwater overflow area provided between the confluences of the two streams; this is called “CC” (Detention 1). This area will provide detention storage for offsite runoff and help control the flooding issues due to the low capacity of the streambanks. The Southwest commercial area will have a small bio-retention basin with some limited storage. Immediately downstream, discharge from Area 3 will occur at a 6.5’x8’ culvert under a commercial driveway, immediately upstream of Study Point 3, the new culvert at Meeker Way.

4.4 Post Developed Conditions – Proposed Area 4

Proposed Area 4 contains runoff from the proposed spine road and, much of the commercial development, the proposed residential homes, and adjacent areas. Detention for this runoff will occur in the proposed bioswale(s) along Stratford Road and a proposed wet basin near the south of the site by Meeker Way. Discharge from area 4 will occur via a proposed storm culvert/system under Stratford Road.

We also understand that within the Olentangy Permit provisions are offered for direct discharge to the Olentangy River if we are within 1,000 LF. For this reason, we are in contact with First Energy to obtain a drainage easement through their Utility Right of Way to outlet directly to the Olentangy

River east of the site. This would allow us to direct discharge to the River, after we meet the permit requirements for water quality.

Table 4.1 Proposed Flow Rates

Watershed	Area (AC.)	RCN	Tc (minutes)	Q_1 (cfs)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Study Point 1										
PR 1	0.79	74	10.0	0.54	0.67	1.29	1.63	2.08	2.54	2.73
Study Point 2										
PR2A	8.87	89	20.4	12.43	14.11	20.94	24.39	28.72	33.10	34.84
NEP				1.97	2.15	2.77	3.02	3.31	7.23	8.11
PR2B	10.22	69	20.4	2.52	3.51	8.33	11.13	14.89	18.88	20.54
PR2C	2.11	79	10.0	2.18	2.62	4.50	5.51	6.80	8.12	8.66
BP				0.34	0.37	0.49	0.54	0.60	2.64	3.77
TON*				33.47	37.96	57.09	67.20	100.18	144.54	161.22
A2				36.67	42.31	66.87	80.04	119.03	168.18	187.24
Study Point 3										
60x84**				82.20	98.17	161.16	187.18	215.77	242.60	252.76
DS**				12.02	12.88	15.73	16.90	18.19	19.33	19.76
US_23**				2.74	3.16	4.93	5.84	6.99	8.14	8.61
PR3A	5.83	77	17.3	3.96	4.85	8.8	10.94	13.71	16.58	17.74
CC				94.05	109.46	163.35	187.87	212.65	234.09	241.87
PR3B	2.76	94	10.0	6.77	7.49	10.37	11.81	13.59	15.36	16.07
SW Bio				6.23	7.01	10.04	11.42	13.21	14.92	15.60
PR3C	5.51	77	27.7	2.75	3.39	6.22	7.78	9.79	11.87	12.71
SW4**				7.69	9.96	20.55	26.50	34.39	42.66	46.12
U23**				2.18	2.62	4.50	5.51	6.80	8.12	8.66
Stream				105.83	124.08	186.59	215.02	245.45	271.81	281.52
Study Point 4										
PR4	32.96	94	31.5	45.84	50.85	70.85	80.80	93.18	105.52	110.44
CSP				26.65	30.24	44.47	51.48	60.06	68.38	72.15
PR4-N	4.34	94	15.0	9.11	10.10	14.01	15.95	18.38	20.79	21.75
NS				8.25	9.07	12.24	13.74	15.50	17.07	17.63
PR4-C	3.87	94	15.0	8.13	9.00	12.49	14.23	16.39	18.54	19.39
CS				15.34	16.83	22.44	24.99	27.49	30.51	31.38
PR4-S	1.68	94	15.0	3.53	3.91	5.42	6.18	7.11	8.05	8.42
SS				30.46	34.68	52.89	62.20	73.90	85.54	90.17

Notes: Lines in **Bold** are the overall respective Study Point outflows. TON* is total North Offsite (including PR1) flowing to the onsite Study Point 2. **Offsite flows from Table 3.1 above.

AREA 1 BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
GRASS	C	0.78	74
TOTAL		0.78	74

AREA 2 BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
GRASS	C	11.89	86
WOODS	D	3.18	79
COMMERCIAL		5.69	94
IMPERVIOUS		0.44	98
TOTAL		21.20	87

AREA 3 BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
BRUSH	C	5.51	77
COMMERCIAL		2.76	94
TOTAL		8.27	83

AREA 4 BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
COMMERCIAL		42.85	94
TOTAL		42.85	94

TOTAL AREA BREAKDOWN			
SECTION	HSG	AREA (AC)	CURVE NUMBER
GRASS	C	0.78	74
GRASS	C	11.89	86
BRUSH	C	5.51	77
WOODS	D	3.18	79
COMMERCIAL		51.30	94
IMPERVIOUS		0.44	98
TOTAL		73.10	91

GRAPHIC SCALE

0 75 150

1 INCH = 150 FEET

NO.	DATE	BY	DESCRIPTION

815 GRANDVIEW AVENUE
SUITE 650
COLUMBUS, OH 43215
TEL: 614.441.4222
FAX: 888.488.7340

PROJECT DATE:
PROJECT NO.: D2910001
DRAWN BY: CLD/DJJ
CHECKED BY: RLV

TECHNICAL SKILL. CREATIVE SPIRIT.

Mannik Smith GROUP

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DELAWARE DEVELOPMENT
PRELIMINARY STORMWATER PLAN
US 23 & STRATFORD ROAD

DELAWARE, OH 43015

POST DEVELOPED CONDITIONS

W:\Projects\Projects A-E\D2910001\CADD\EXHIBITS\PROPOSED DRAIN\GE.dwg - Last printed 7/19/2016 4:09 PM

5.0 BASIS OF DESIGN

Although, we plan to use the provisions of the Olentangy Permit to allow direct discharge as described in 4.4 above and that we are providing detention storage to assist in the management of flood control for the large offsite area to the west, we are providing the following methodology for comparison.

5.1 Critical Storm Calculation

The critical storm method as described in the MORPC Storm Water Design Manual and in Section 15 of the City of Delaware, Ohio Infrastructure Design Guide for Land Development Activities was used to determine the required post-development storm water runoff control. The critical storm method compares the volume of runoff from the 1-year frequency 24-hour storm for the pre-developed site condition to that of the post-developed site condition. The percent increase between the pre- and post-development runoff conditions is used to determine the runoff control limitation critical storm.

Pre-developed Runoff Volume = 3.268 acre-ft
Post-developed Runoff Volume = 8.748 acre-ft

$$\% \text{ Increase} = \frac{8.748 - 3.261}{3.261} \times 100\% = 168\% \text{ (25 – Year Storm)}$$

5.2 Allowable Peak Discharge

The Allowable Peak Discharge (APD) for this site for any storm frequency between the 1-year storm and the respective critical year storm events determined in section 5.1 should not exceed the pre-developed discharge for the 1-year storm event. For storms with less frequent return intervals than the critical year storm, the APD for each storm should not exceed the pre-developed discharge for that respective storm. For this project, the pre-developed off-site flows will be added to the APD to determine total site discharge.

Table 5.1 Allowable Peak Discharge

Study Point 2	Q_1 (cfs)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Allowable Peak Discharge	8.02	8.02	8.02	8.02	8.02	51.44	55.76
Off-site	31.28	35.58	54.04	63.82	90.91	125.36	138.26
Total Allowable	39.30	43.60	62.06	71.84	98.93	176.80	194.02
Study Point 3	Q_1 (cfs)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Allowable Peak Discharge	18.74	18.74	18.74	18.74	18.74	77.11	82.49
Off-site	101.42	119.34	184.26	213.85	243.96	269.88	279.41
Total Allowable	120.16	138.08	203.00	232.59	262.70	346.99	361.90
Study Point 4	Q_1 (cfs)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Allowable Peak Discharge	0.01	0.01	0.01	0.01	0.01	0.45	0.50

Study Point 1 is not included, since it almost immediately flows back onsite through SP2.

6.0 DETENTION DESIGN

A preliminary storage approximation to evaluate the detention needs for the whole site was completed based on the Allowable Release rates above, using HydroCAD.

Table 6.1 Storage Approximation

Total Site	Q_{25}	Q_{100}
Developed Peak Discharge (cfs)	181.59	222.48
Allowable Peak Discharge (cfs)	27.49	142.44
Storage Required (ac-ft)	9.1	0.4
20% Additional Safety Factor and WQ approximation (ac-ft)	10.9	0.5
Preliminary Storage Required (cf)	474,800	21,800
Total Storage Provided (cf)	769,200	

According to the approximations, we will need just less than 475,000 cf of detention storage volume for the whole site. Our current concept allows for approximately 769,000 cf of detention storage, of which near 375,000 is for control of offsite flows to Study Point 3. Although we have not specifically broken this out into the four study points, we believe that we are providing sufficient storage for the onsite water. That, along with the ability for direct discharge via the easement from First Energy will allow us to sufficiently manage the onsite stormwater as well as the existing flood routing for this development.

A brief description of the different types of storage areas and the water quality concepts are below.

6.1 Dry Detention Basins

The 'Barn Pond' will be a dry detention basin for the renovated barn and new associated parking facility. It will ultimately outlet into the existing stream and on to Study Point 2.

6.2 Bio swale / Detention

A series of bio-retention or bio-swales will be used along Stratford Road. These will be used to treat water quality as well as be a "natural" aesthetic feature along the bikepath and in front of the residential homes. We anticipate these to have a meandering quality with vegetation appropriate for the uptake of nutrients as well as having 3-4 feet of detention storage above.

A bio-retention basin will also be utilized east of the southwest commercial lot to provide water quality before discharging directly to existing Stream 1.

6.3 Wet Retention Basins

'Central Site Pond' (CSP) will be a wet detention basin at the south end of the project and the spine road. It will drain to the Study Point 4. 'NorthEast Pond' (NEP) will be a wet detention basin at the north end of the Stratford Road residential homes designed to handle flows from the commercial/retail centers. It will ultimately outlet to Study Point 2.

6.4 Outlot Detention

If additional detention will be required for each outlot and or the proposed residential area. We will dictate within the Final Stormwater Management Plan a maximum discharge rate, typically on a by acre basis. If required, discharge for each outlot will be into the onsite storm system along the spine road, or as a direct release into the nearest stream.

6.5 Off-site pass-through

Off-site runoff from the north and west of the site will pass through the site through the same streams as today. However, with the known flooding issues in Area 3, we are planning a backwater/detention area called Detention 1. This area will be controlled by backing up/metering the stream flows and allowing them to overflow into the detention area, then a small outlet drain will allow the detention area to drain back into the stream as it lowers back to its base flow levels. The other offsite areas will be un-detained.

Table 6.2 Storage Volumes

Area	Reference	Volume (cf)
Detention 1	CC	375,000
Stream	Stream	140,000
NorthEast Pond	NEP	60,000
Barn Pond	BP	9,800
Central Site Pond	CSP	138,500
North Swale	NS	12,500
Central Swale	CS	16,900
South Swale	SS	16,600

7.0 STORMWATER CONVEYANCE

The spine road and parking lots shall be graded to allow stormwater runoff to sheet flow directly into the proposed storm system for the site. The system will be designed per the City of Delaware Infrastructure Guidelines to convey this runoff to the above mentioned detention facilities near the discharge locations. Furthermore, the storm sewer conveyance system from the detention areas will only carry the detention discharge and the offsite pass through volume.

8.0 NPDES PERMIT

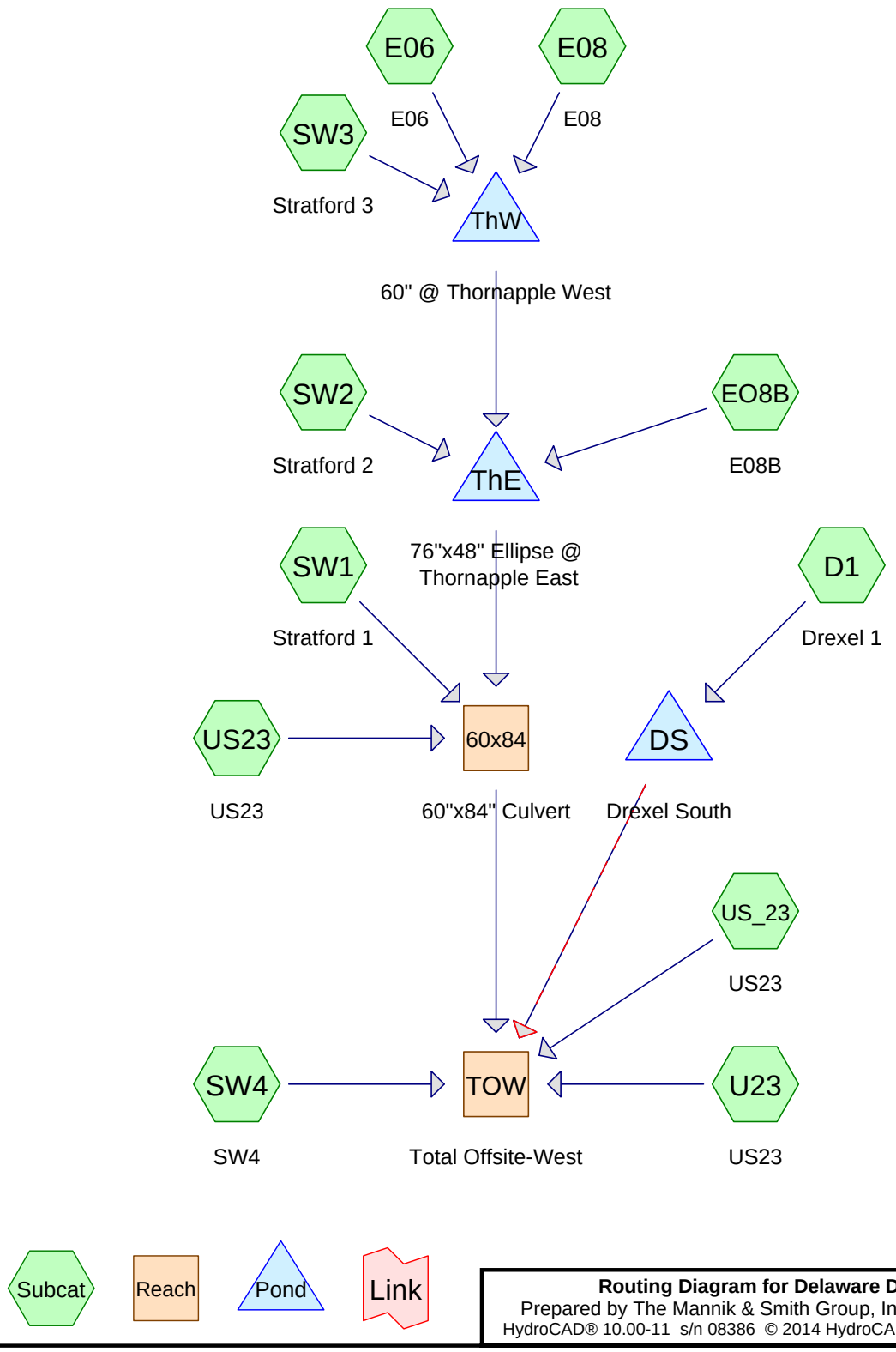
The OEPA administers the National Pollutant Discharge Elimination System (NPDES) and requires a General Permit for Construction Storm Water Discharge from Construction Sites. The policies are set to regulate the discharge of storm water from construction activities on sites where more than one (1) acre of soil is disturbed. For coverage under the General Permit, a Notice of Intent (NOI) form has been completed and sent to the OEPA. As a part of the contract documents, the contractor will be required to submit for coverage as a co-permittee as well.

The project will disturb about 65 acres and will be considered under the regulations for Large Construction Activities. A critical component of the NPDES regulation is the implementation of best management practices (BMPs) to be able to detain storm water runoff for protection of stream channels and improved water quality. The chosen BMP(s) must be of adequate size to treat the water quality volume (WQv) to the extent possible. For this project, we propose Wet Detention, Bio-swales and Bio-retention basins within the developed footprint of the proposed project area.

The WQv is based on the volume of runoff from 0.75 inches of rainfall and will be determined during final engineering and discussed in the Final Stormwater Management Plan. The “First Flush” or equivalent water quality storm event will be routed through the BMP facilities.

APPENDIX A
HYDROCAD REPORTS

Existing Offsite West



Routing Diagram for Delaware Development
Prepared by The Mannik & Smith Group, Inc., Printed 8/1/2016
HydroCAD® 10.00-11 s/n 08386 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment SW3: Stratford 3

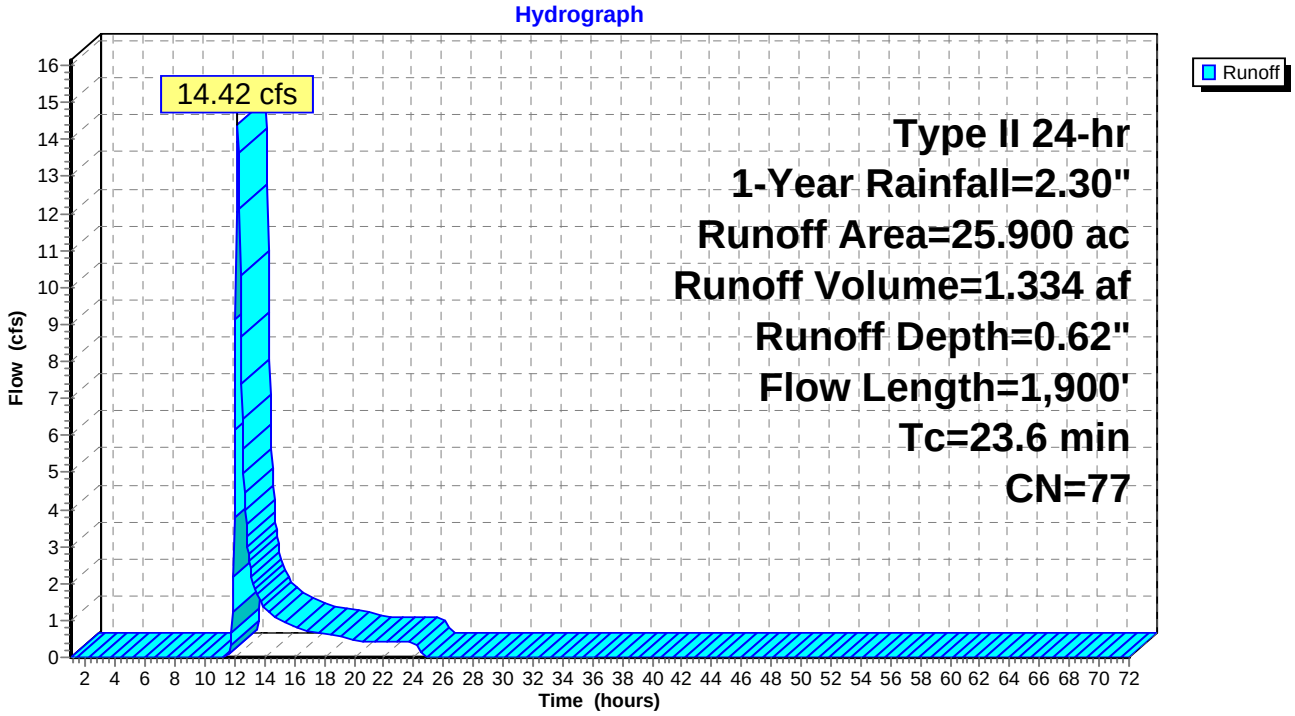
Runoff = 14.42 cfs @ 12.19 hrs, Volume= 1.334 af, Depth= 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

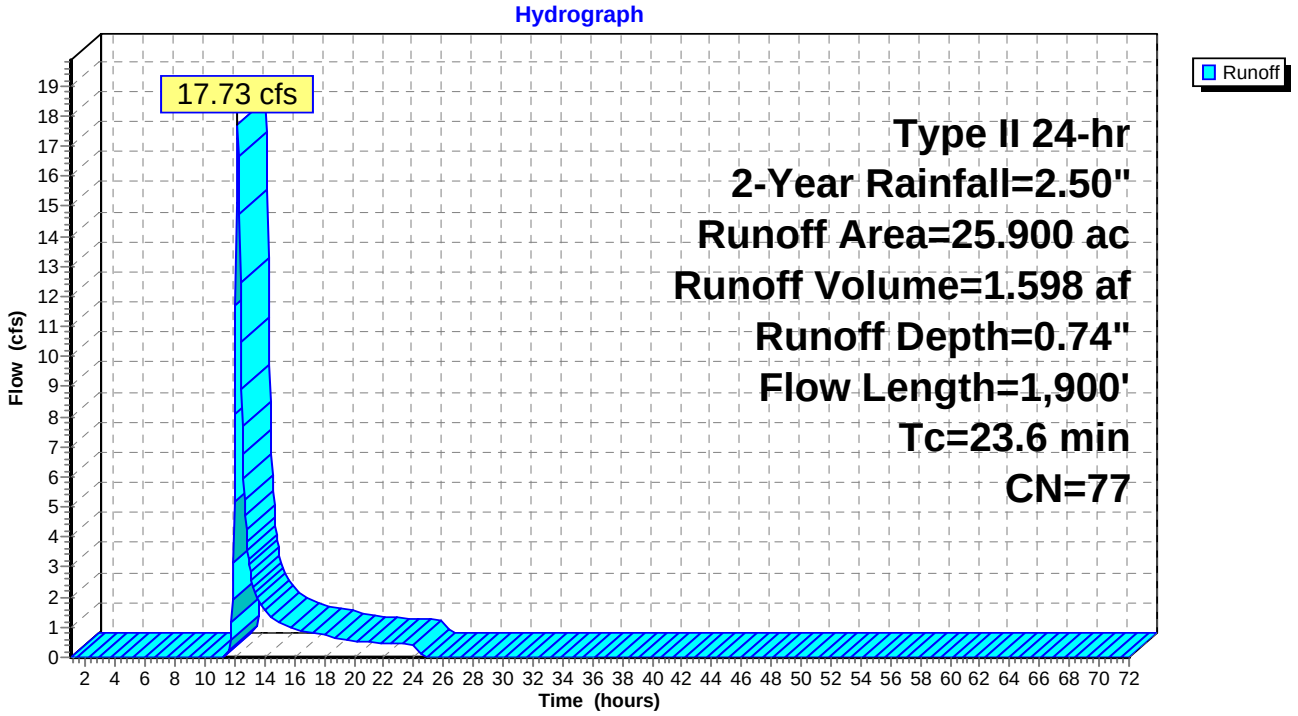
Area (ac)	CN	Description
12.500	70	Woods, Good, HSG C
13.400	83	1/4 acre lots, 38% imp, HSG C
25.900	77	Weighted Average
20.808		80.34% Pervious Area
5.092		19.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	100	0.0120	0.13		Sheet Flow, Grass: Short n= 0.150 P2= 2.63"
5.3	244	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.2	250	0.0640	22.24	3,876.43	Channel Flow, Area= 174.3 sf Perim= 58.5' r= 2.98' n= 0.035 Earth, dense weeds
0.7	250	0.0168	5.70	176.73	Channel Flow, Area= 31.0 sf Perim= 29.4' r= 1.05' n= 0.035 Earth, dense weeds
0.8	250	0.0076	5.11	366.09	Channel Flow, Area= 71.6 sf Perim= 44.1' r= 1.62' n= 0.035 Earth, dense weeds
0.4	250	0.0156	11.84	2,612.49	Channel Flow, Area= 220.6 sf Perim= 66.1' r= 3.34' n= 0.035 Earth, dense weeds
0.9	250	0.0079	4.67	148.15	Channel Flow, Area= 31.7 sf Perim= 23.0' r= 1.38' n= 0.035 Earth, dense weeds
1.4	250	0.0079	2.95	46.56	Channel Flow, Area= 15.8 sf Perim= 22.9' r= 0.69' n= 0.035 Earth, dense weeds
0.6	56	0.0010	1.47	36.66	Channel Flow, Area= 25.0 sf Perim= 21.9' r= 1.14' n= 0.035 Earth, dense weeds
23.6	1,900	Total			

Subcatchment SW3: Stratford 3



Subcatchment SW3: Stratford 3



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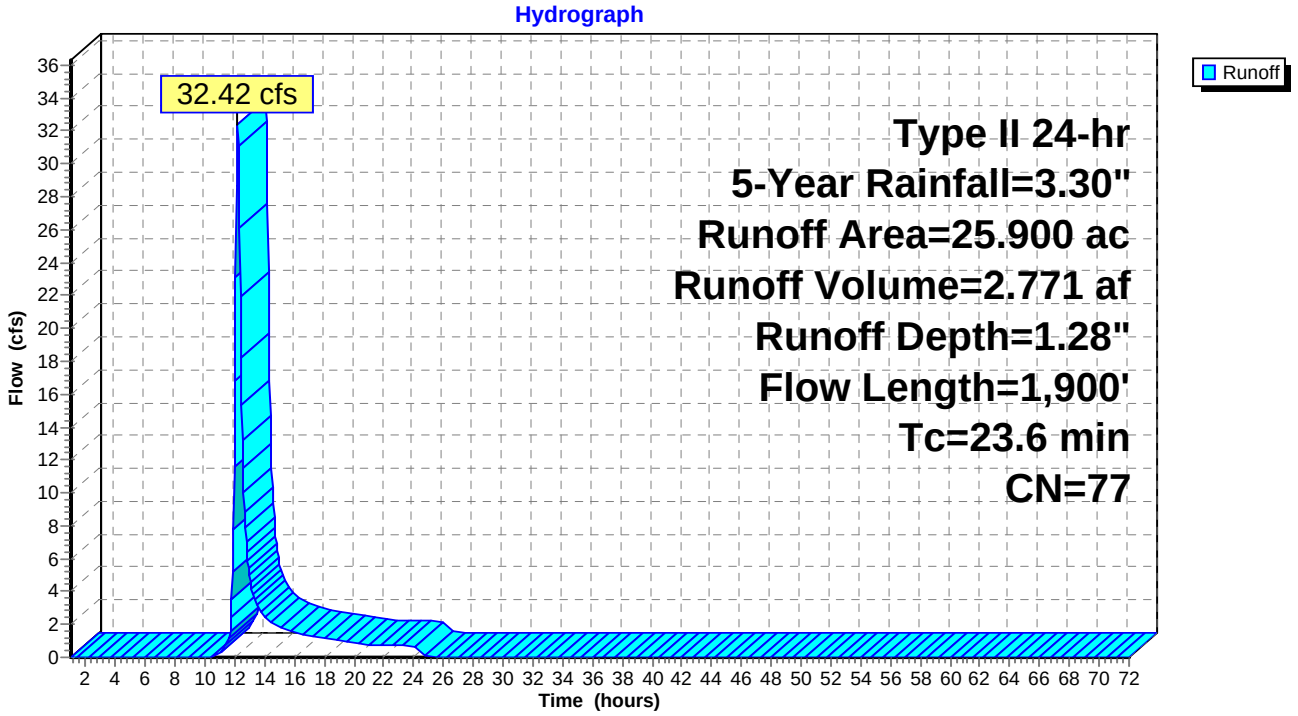
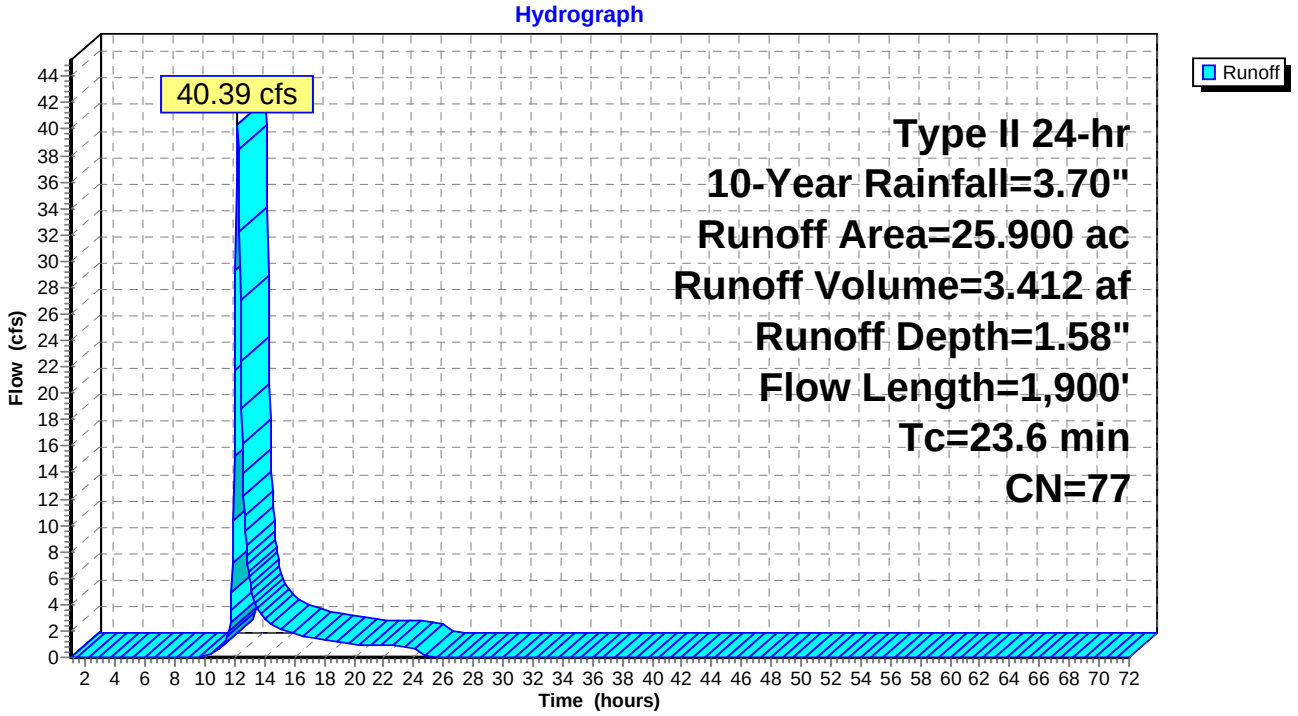
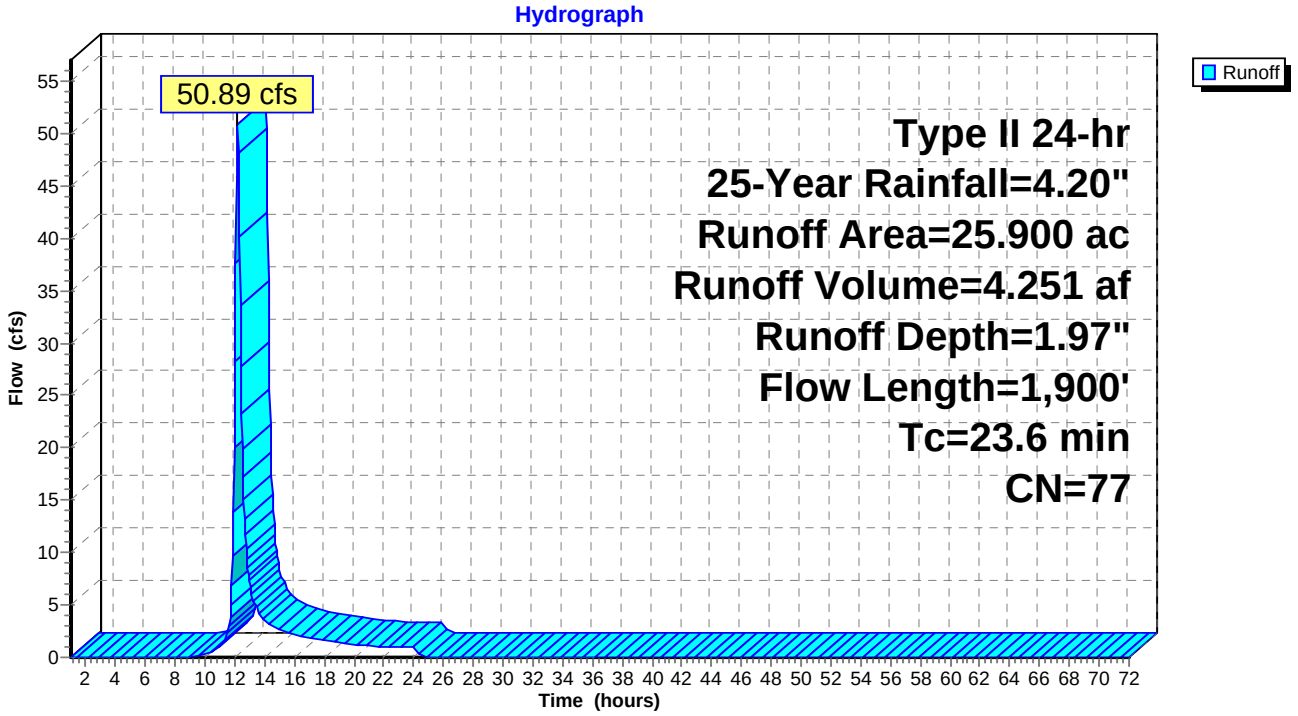


Subcatchment SW3: Stratford 3



Subcatchment SW3: Stratford 3



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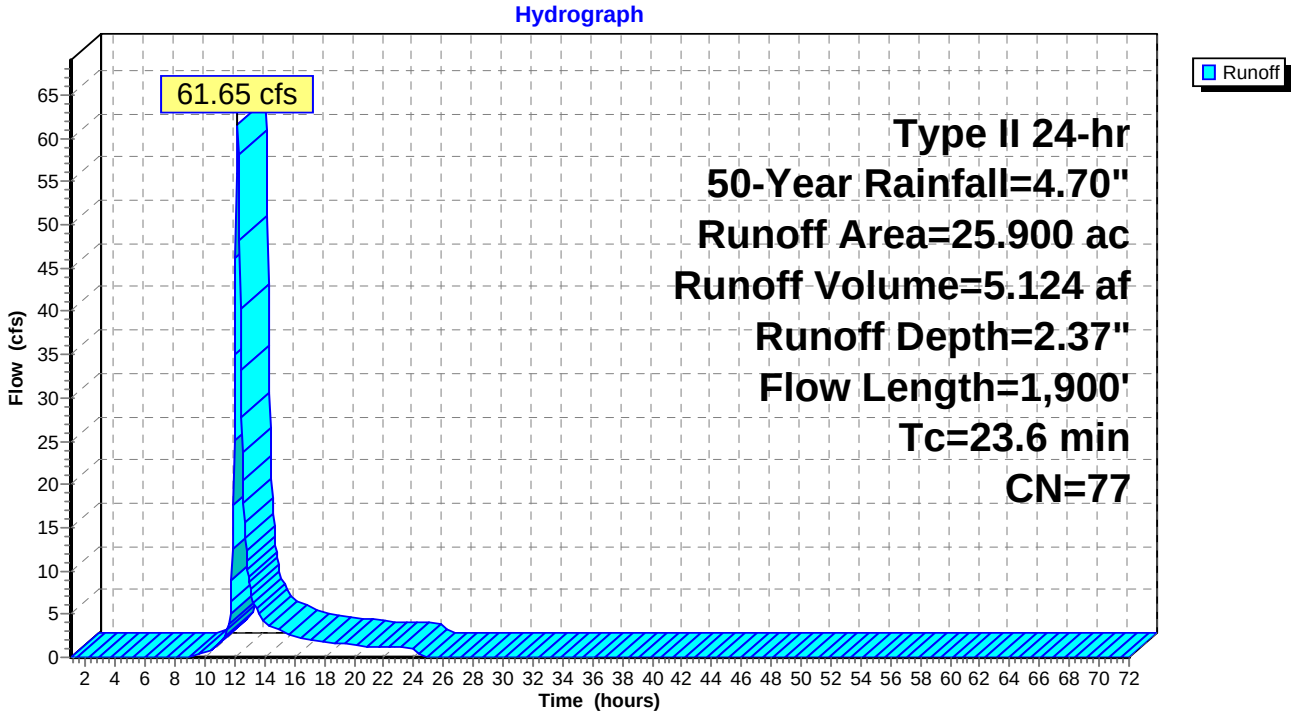
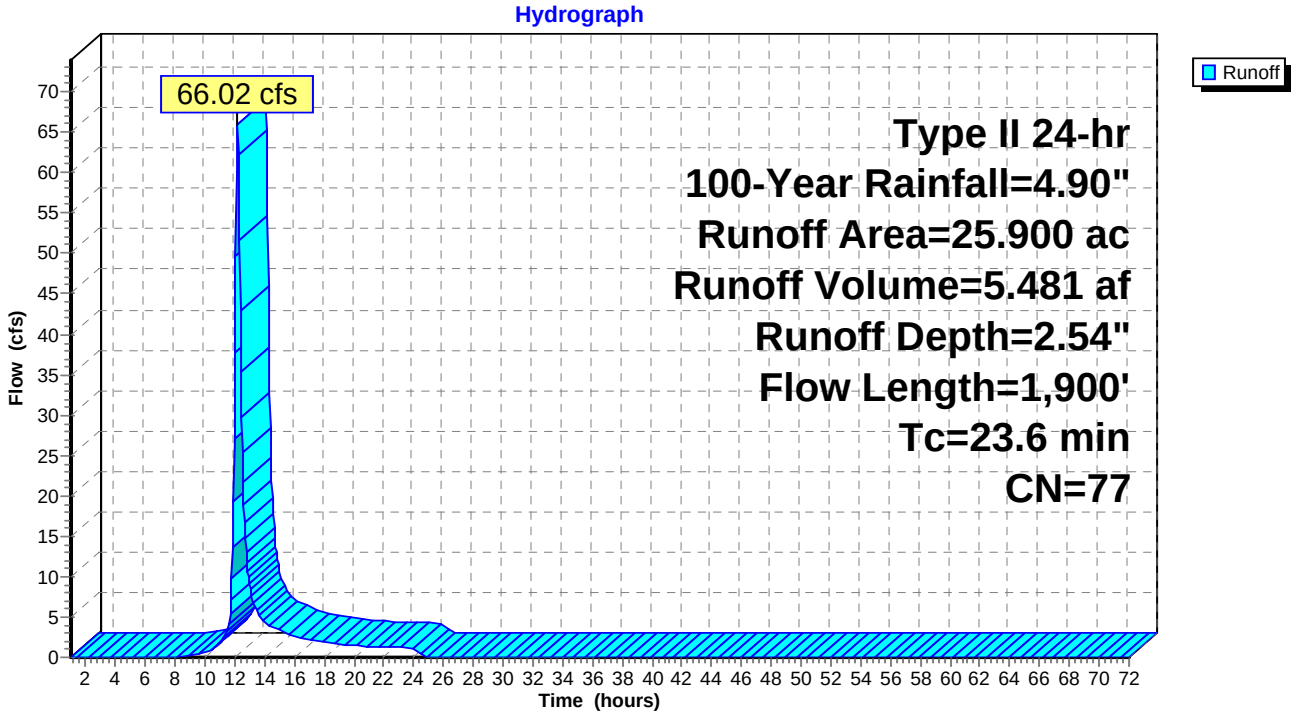


Subcatchment SW3: Stratford 3



Summary for Subcatchment E06: E06

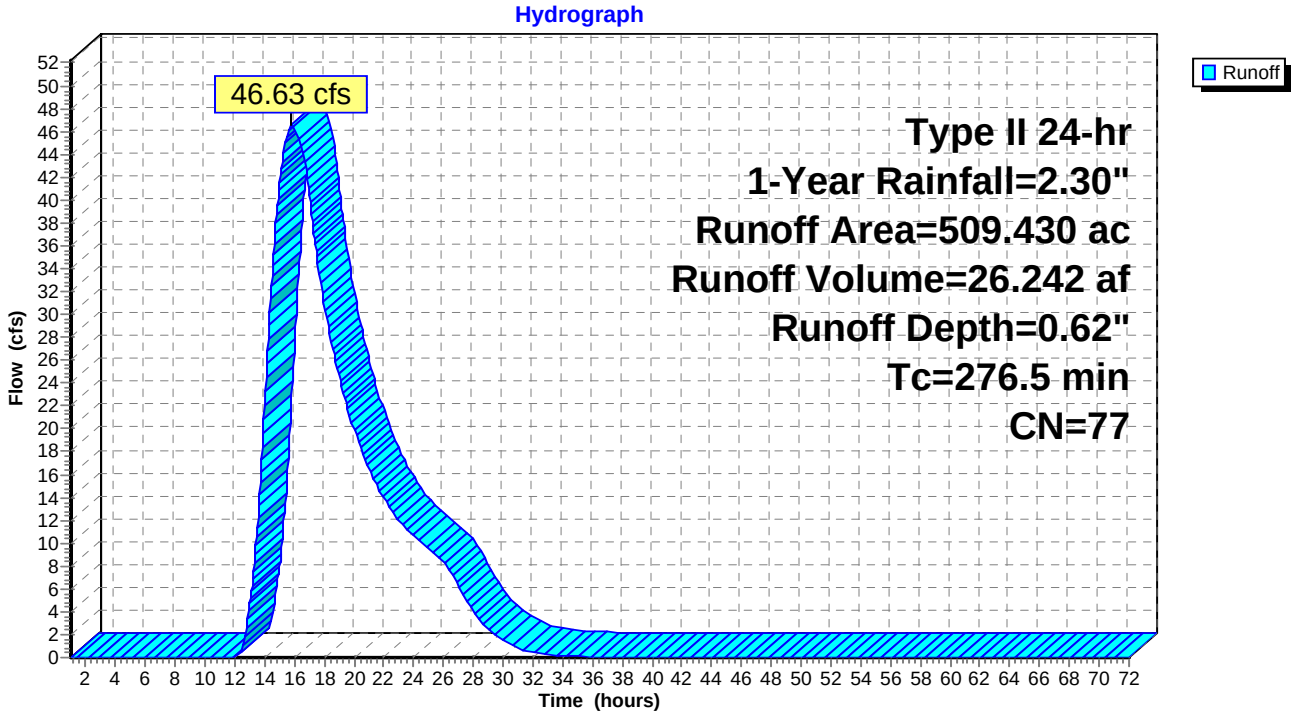
Runoff = 46.63 cfs @ 15.71 hrs, Volume= 26.242 af, Depth= 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

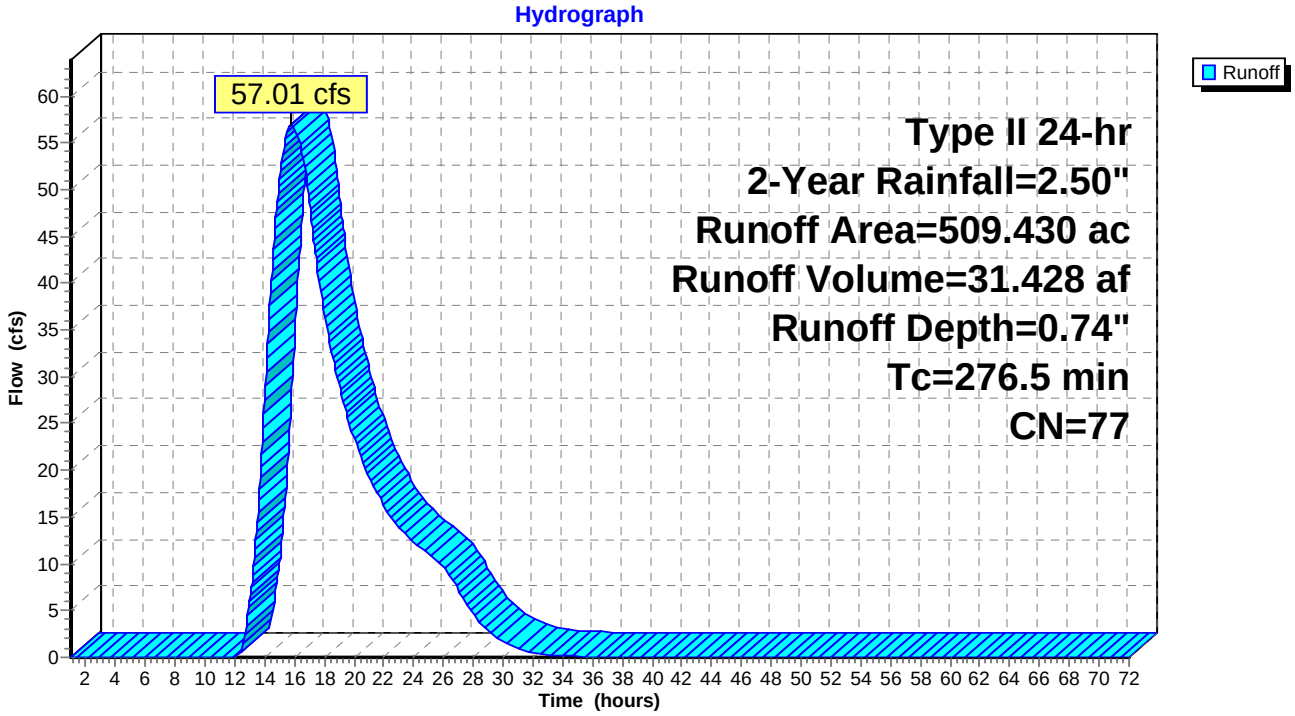
	Area (ac)	CN	Description
*	509.430	77	
	509.430		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
276.5					Direct Entry, From C.O.D.

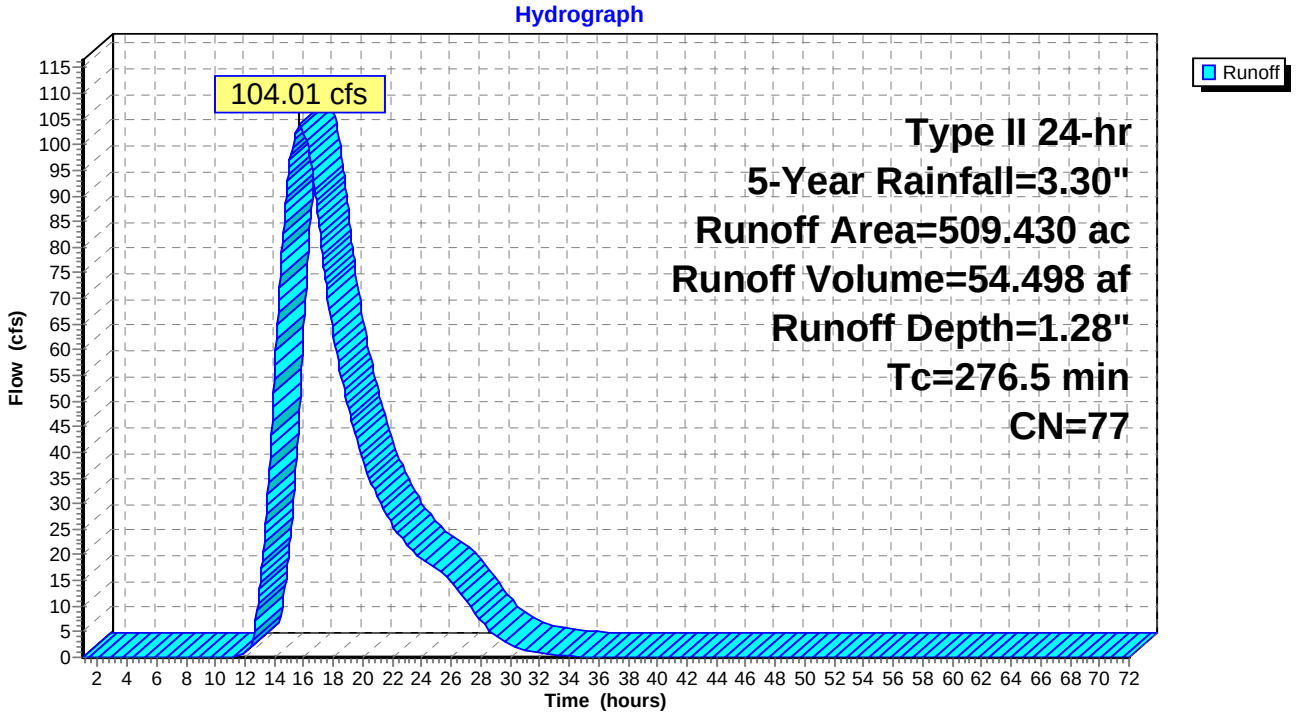
Subcatchment E06: E06



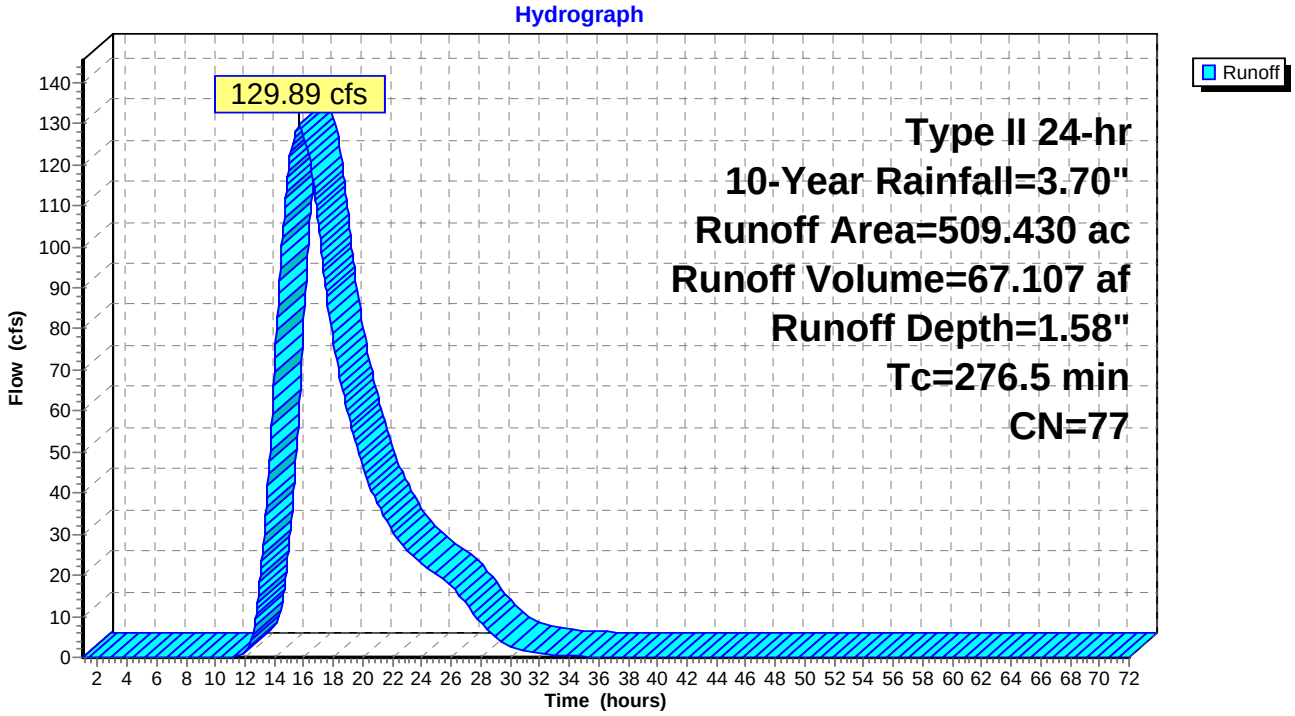
Subcatchment E06: E06



Subcatchment E06: E06



Subcatchment E06: E06



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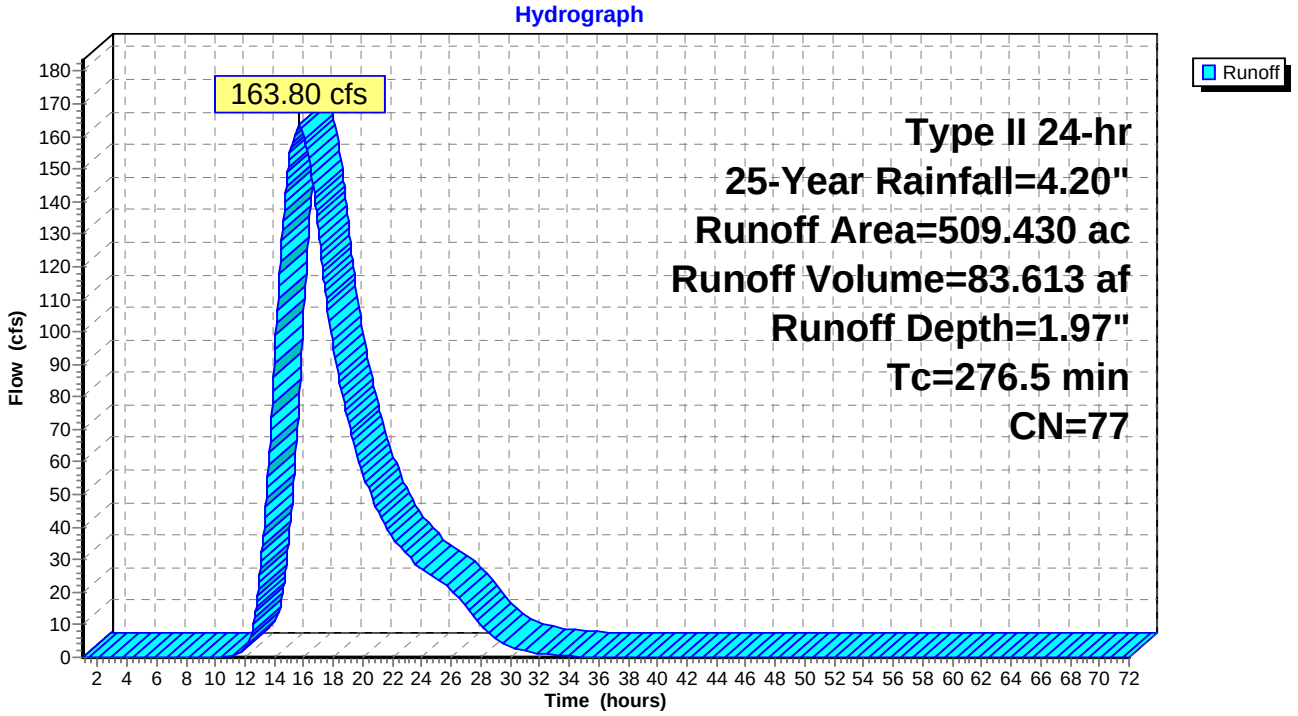
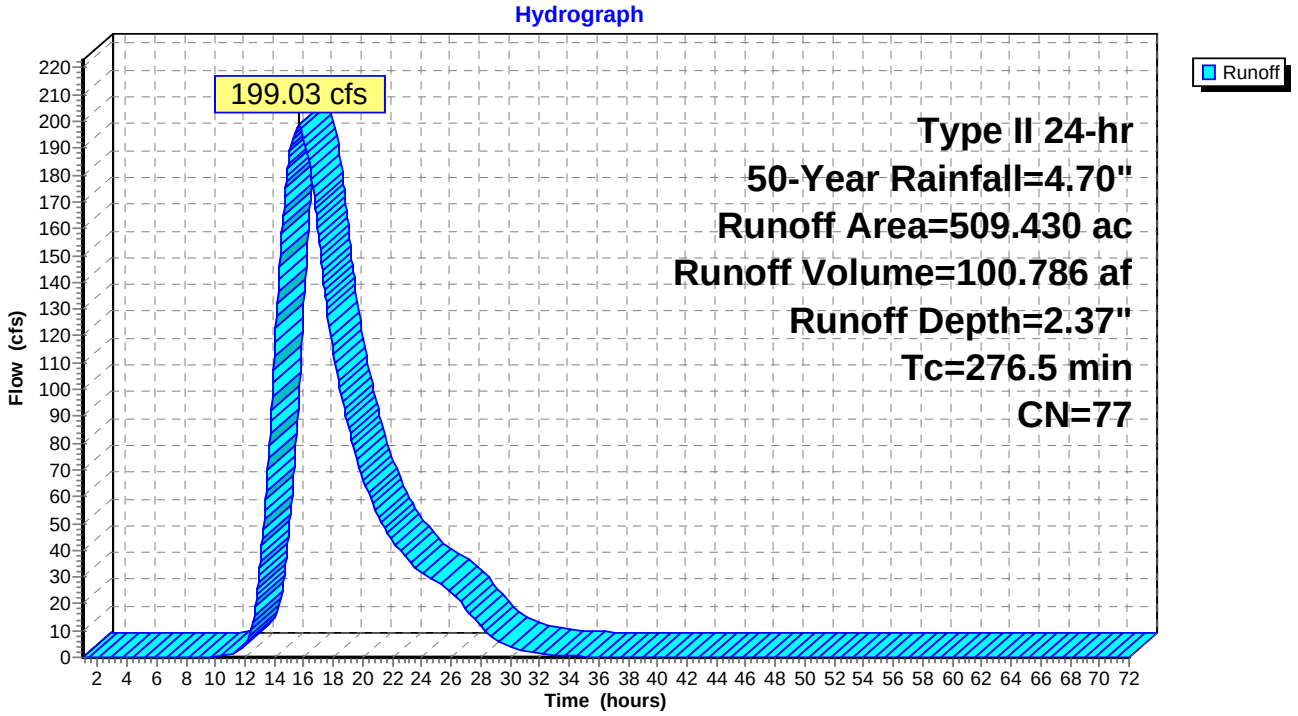
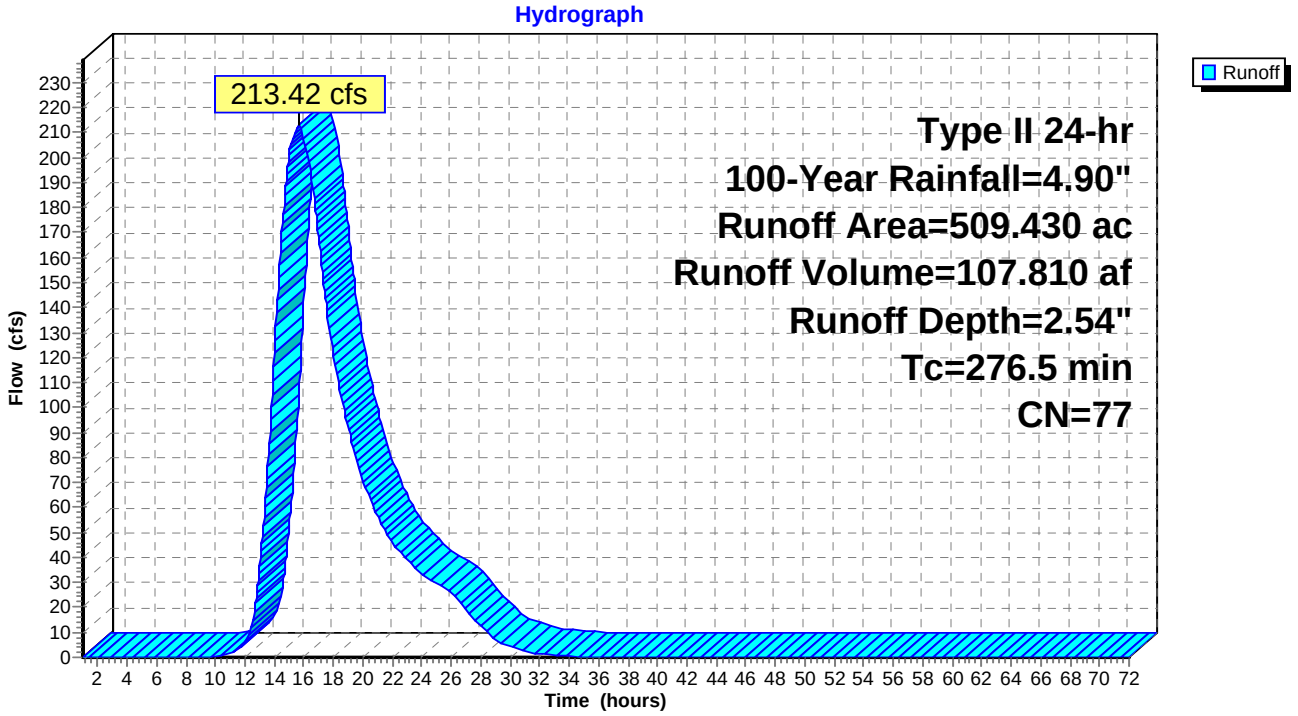


Subcatchment E06: E06



Subcatchment E06: E06



Summary for Subcatchment E08: E08

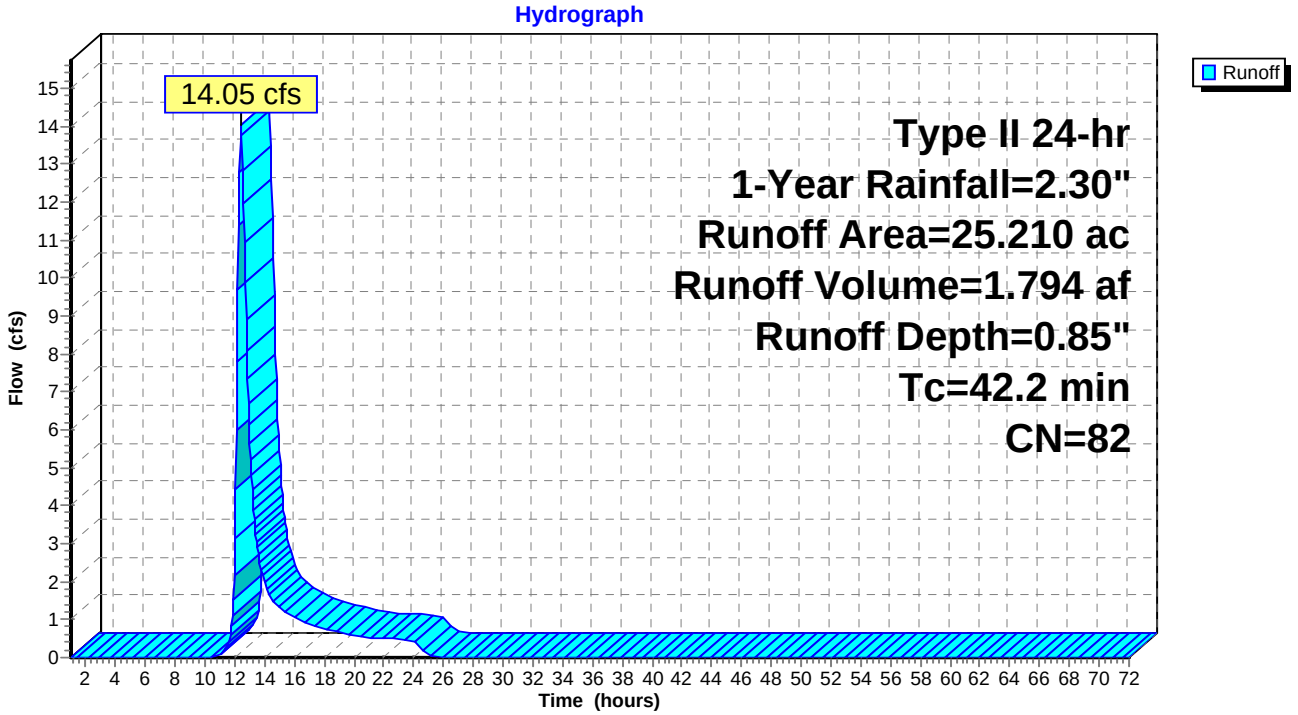
Runoff = 14.05 cfs @ 12.42 hrs, Volume= 1.794 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

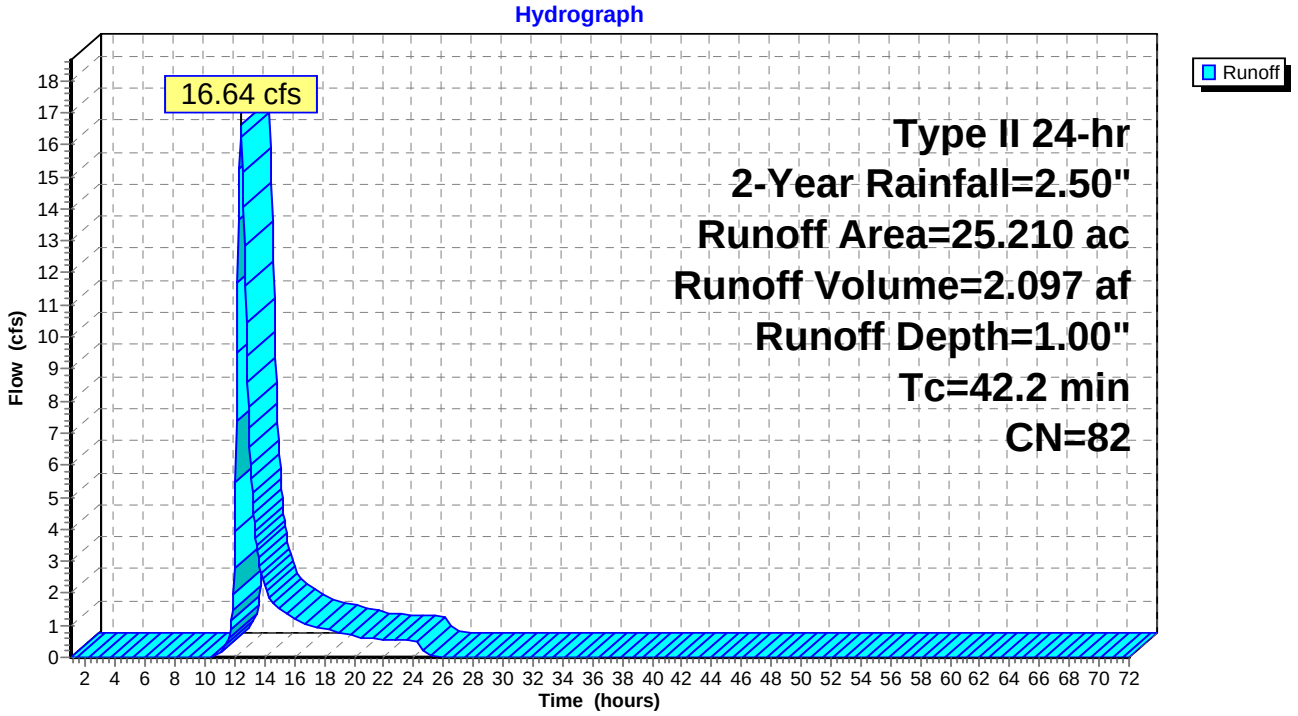
	Area (ac)	CN	Description
*	25.210	82	
	25.210		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.2					Direct Entry, From C.O.D.

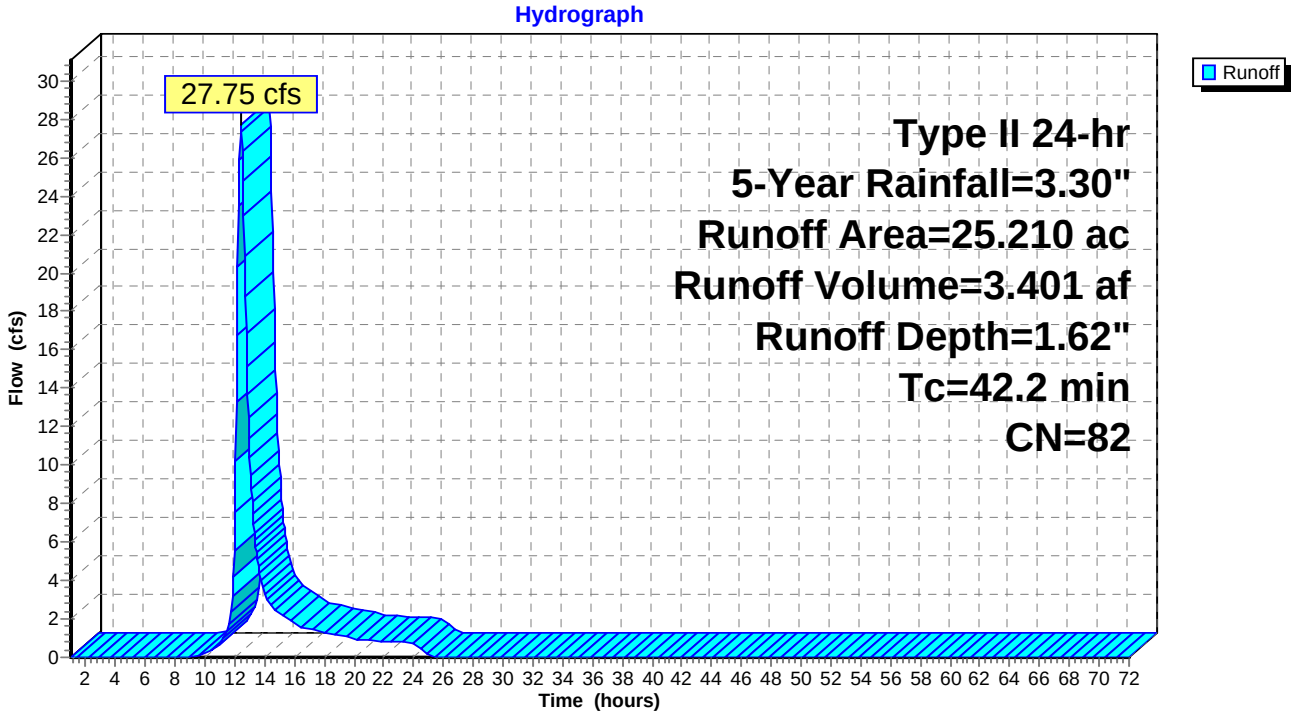
Subcatchment E08: E08



Subcatchment E08: E08



Subcatchment E08: E08



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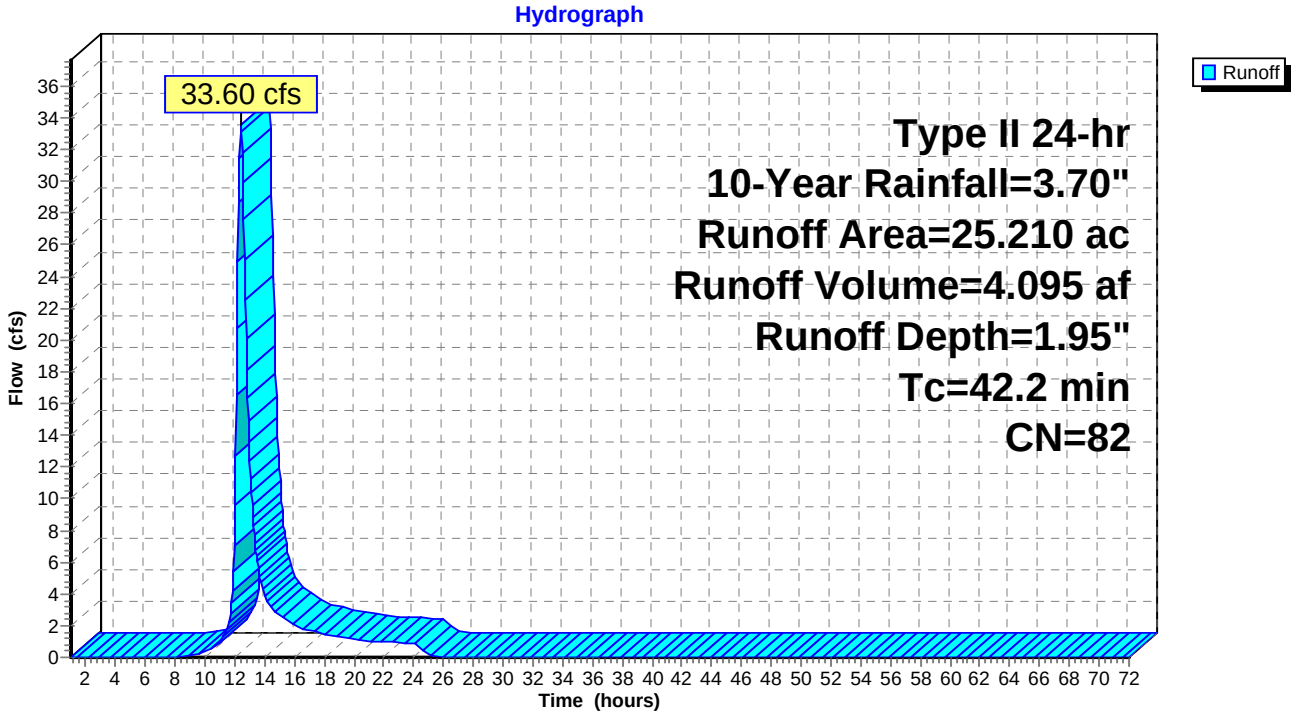

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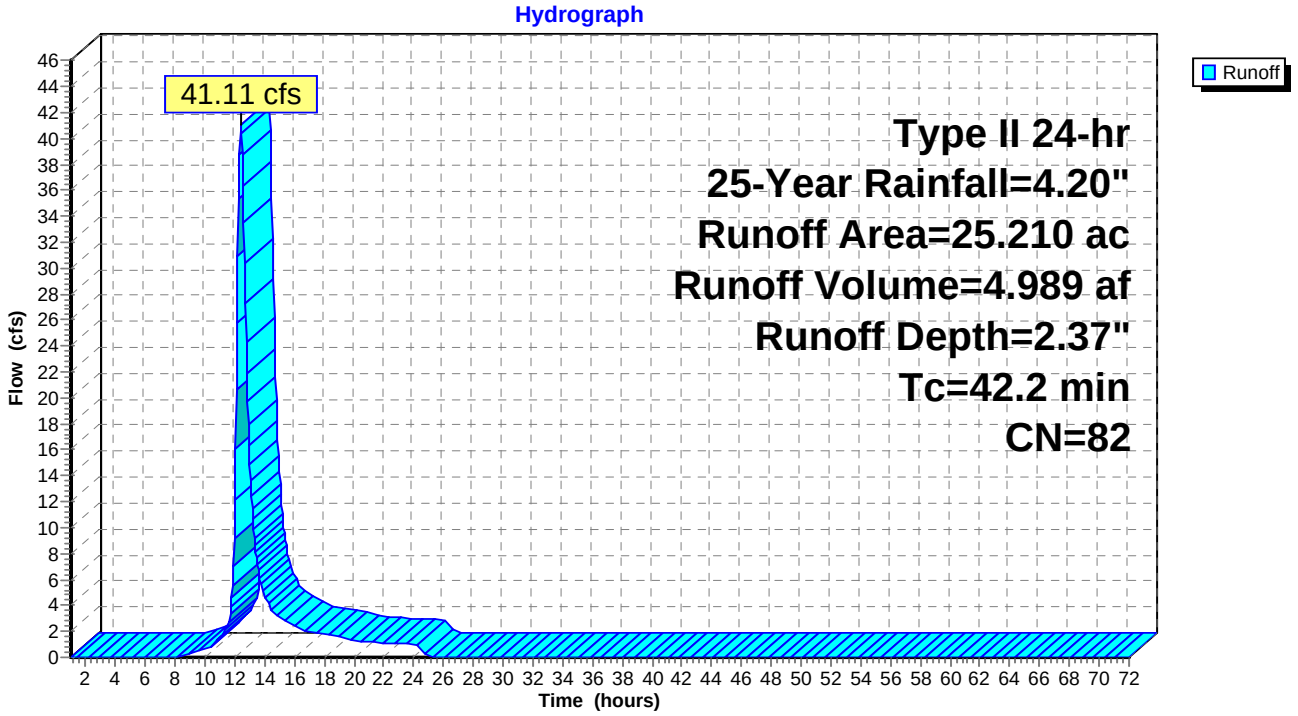
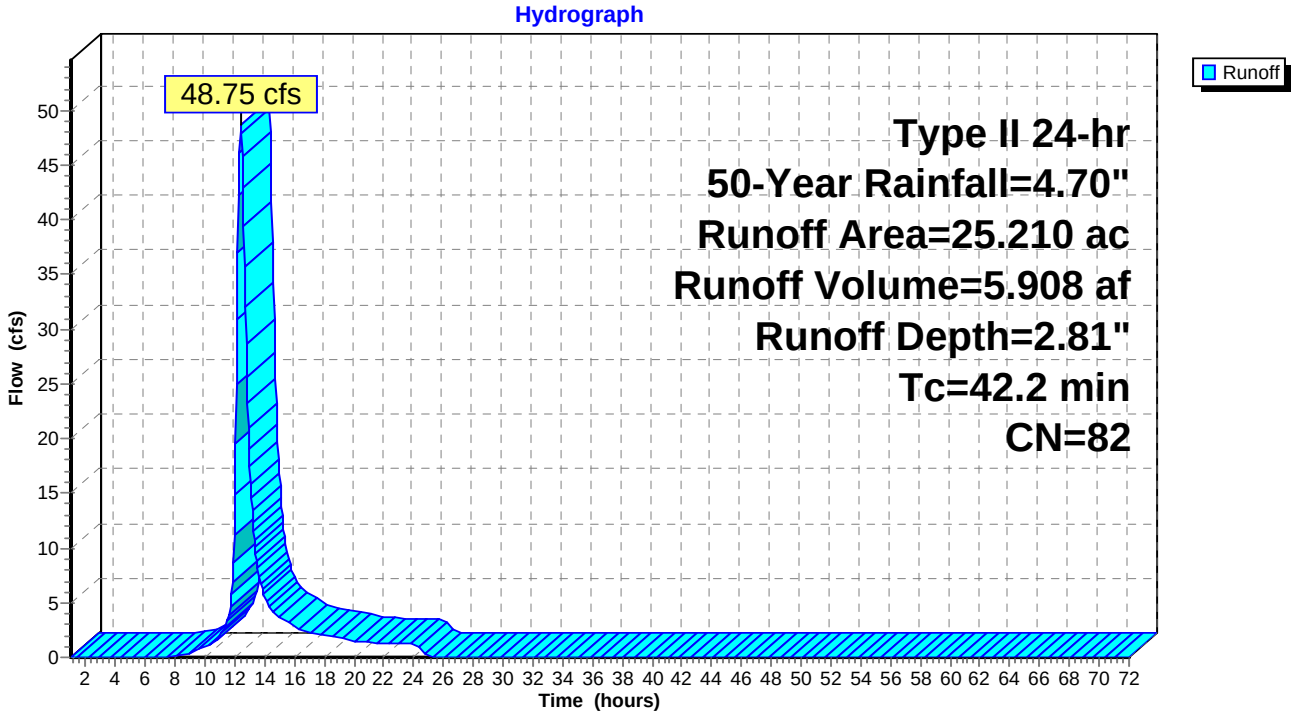
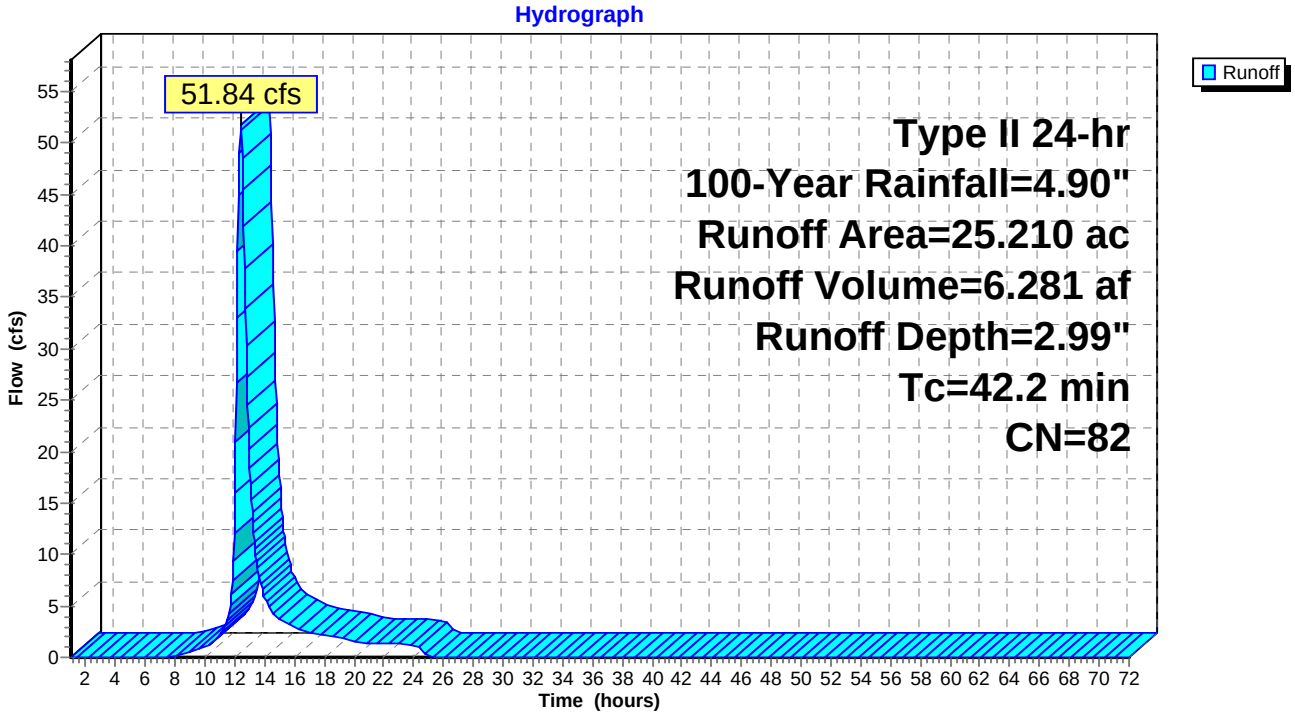


Subcatchment E08: E08



Subcatchment E08: E08



Summary for Pond ThW: 60" @ Thornapple West

Inflow Area = 560.540 ac, 0.91% Impervious, Inflow Depth = 1.99" for 25-Year event
Inflow = 168.76 cfs @ 15.66 hrs, Volume= 92.853 af
Outflow = 164.37 cfs @ 16.01 hrs, Volume= 92.853 af, Atten= 3%, Lag= 20.9 min
Primary = 164.37 cfs @ 16.01 hrs, Volume= 92.853 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 904.24' @ 16.01 hrs Surf.Area= 51,068 sf Storage= 104,324 cf

Plug-Flow detention time= 6.2 min calculated for 92.788 af (100% of inflow)
Center-of-Mass det. time= 6.2 min (1,070.4 - 1,064.1)

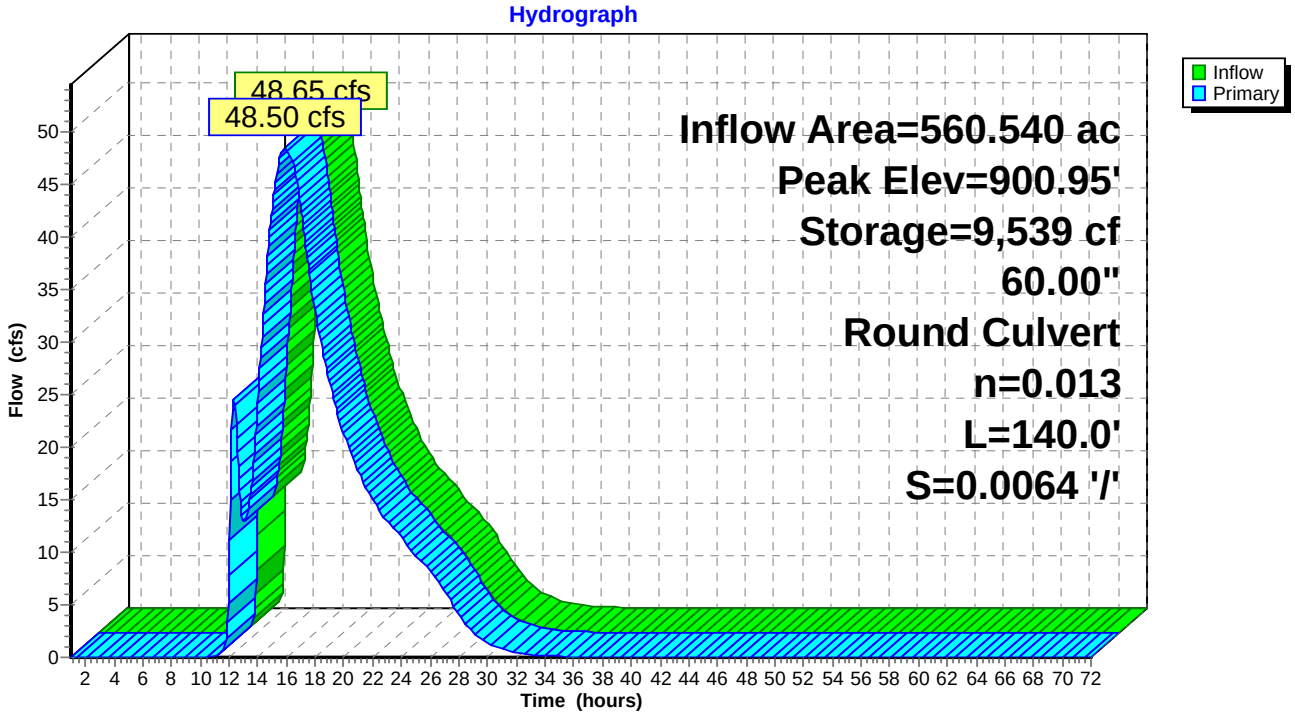
Volume	Invert	Avail.Storage	Storage Description
#1	898.35'	666,587 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
898.35	0	0.0	0	0	0
900.00	4,445	631.0	2,445	2,445	31,689
902.00	21,183	1,567.0	23,554	25,999	195,421
904.00	47,239	1,746.0	66,704	92,703	242,728
906.00	84,326	2,377.0	129,787	222,489	449,799
908.00	111,511	2,522.0	195,205	417,694	506,539
910.00	137,847	3,050.0	248,893	666,587	740,724

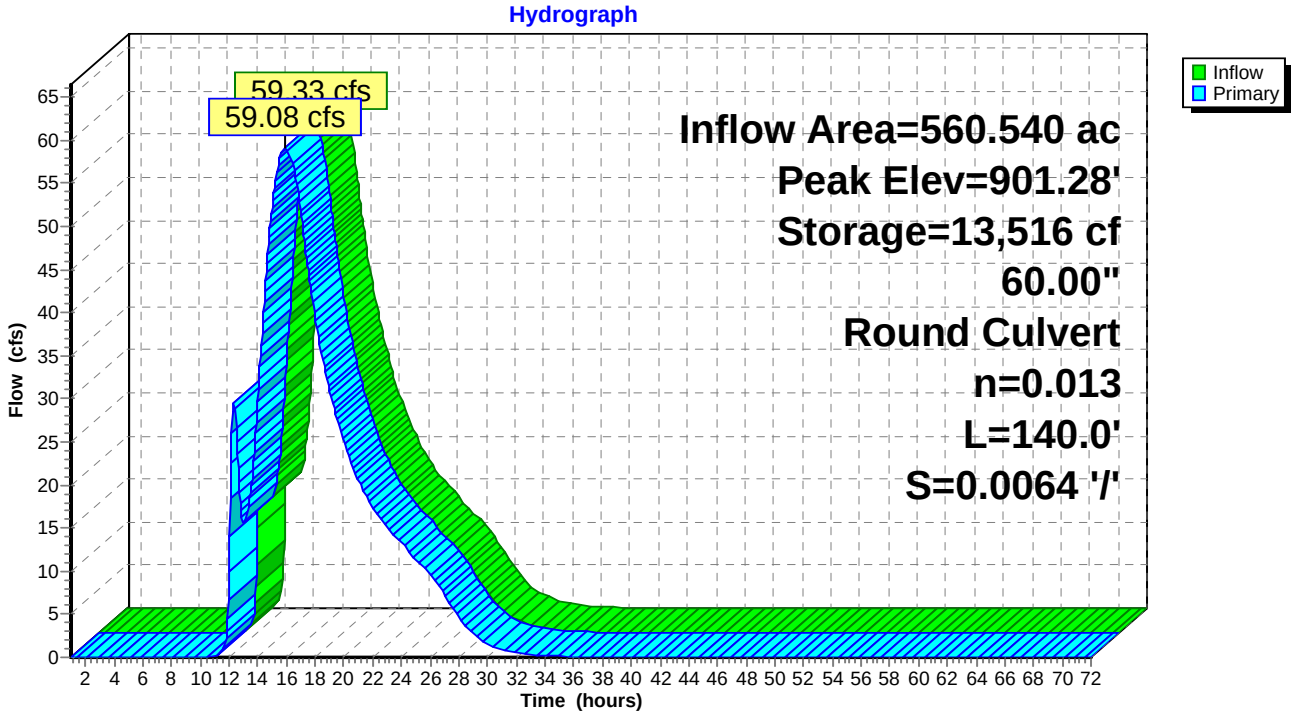
Device	Routing	Invert	Outlet Devices
#1	Primary	898.35'	**60.00" Round RCP_Round 60"** L= 140.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 898.35' / 897.45' S= 0.0064 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 19.63 sf

Primary OutFlow Max=164.39 cfs @ 16.01 hrs HW=904.24' (Free Discharge)
└─1=RCP_Round 60" (Barrel Controls 164.39 cfs @ 8.96 fps)

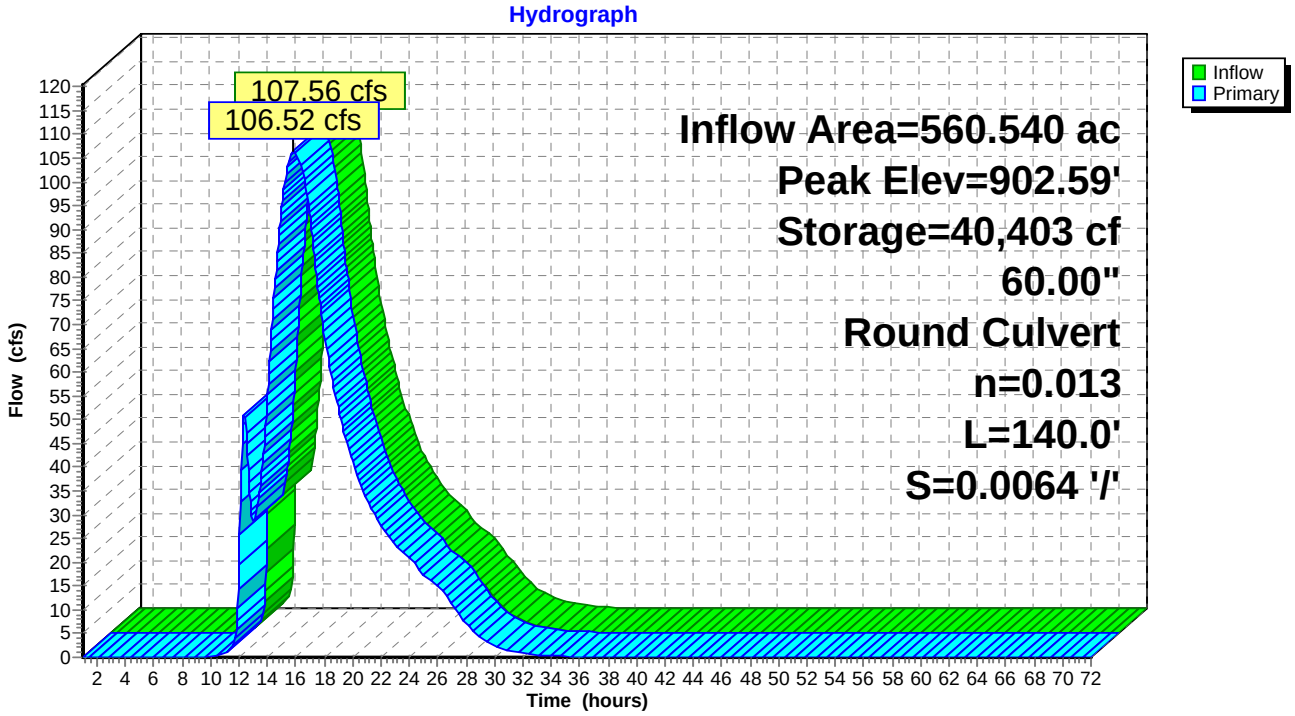
Pond ThW: 60" @ Thornapple West



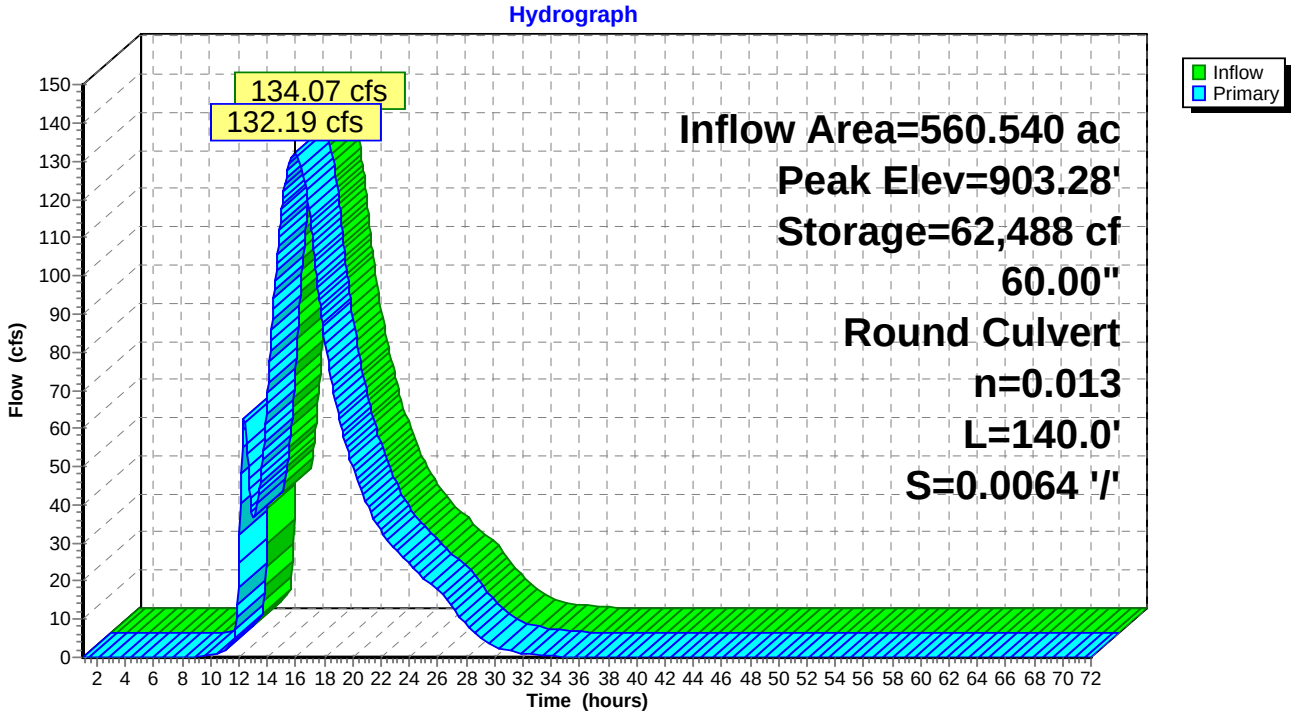
Pond ThW: 60" @ Thornapple West



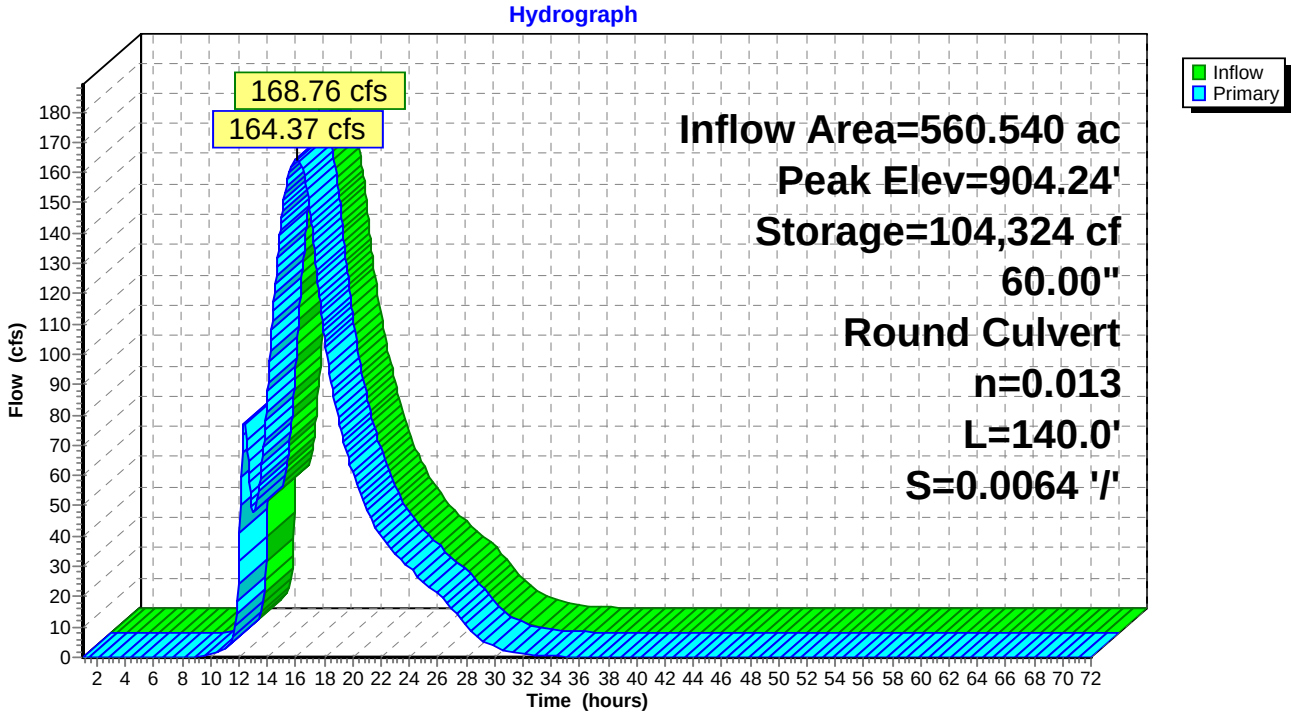
Pond ThW: 60" @ Thornapple West



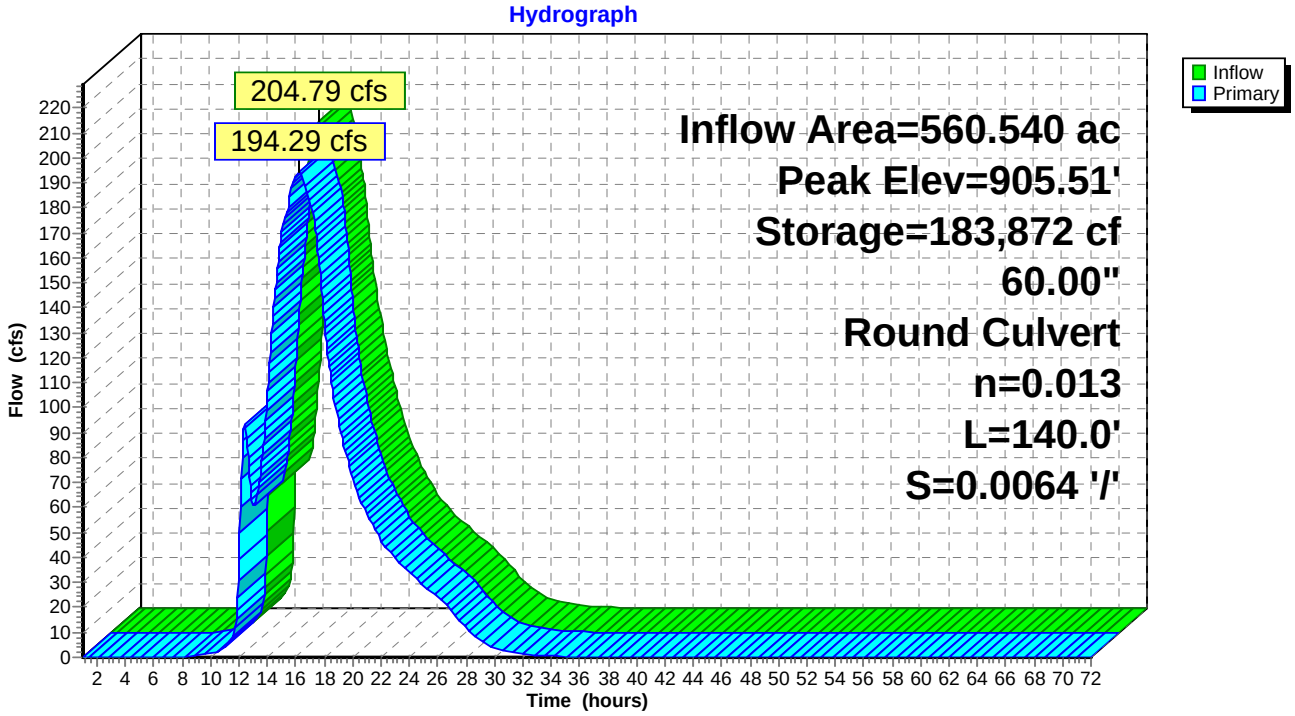
Pond ThW: 60" @ Thornapple West



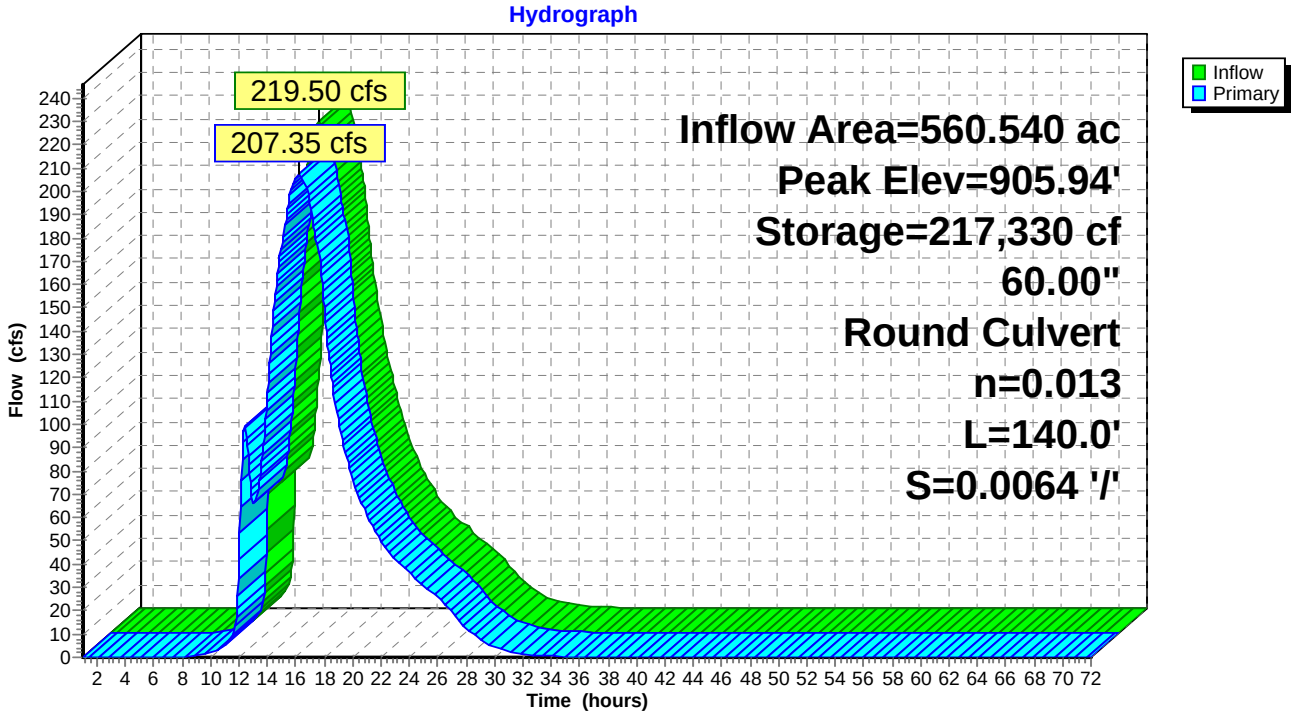
Pond ThW: 60" @ Thornapple West



Pond ThW: 60" @ Thornapple West



Pond ThW: 60" @ Thornapple West



Stage-Discharge for Pond ThW: 60" @ Thornapple West

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
898.35	0.00	900.39	31.75	902.43	100.50	904.47	170.69	906.51	223.70	908.55	262.34
898.38	0.01	900.42	32.58	902.46	101.63	904.50	171.42	906.54	224.52	908.58	262.85
898.41	0.02	900.45	33.41	902.49	102.76	904.53	172.14	906.57	225.35	908.61	263.36
898.44	0.06	900.48	34.25	902.52	103.89	904.56	172.83	906.60	226.16	908.64	263.87
898.47	0.11	900.51	35.10	902.55	105.01	904.59	173.51	906.63	226.98	908.67	264.38
898.50	0.18	900.54	35.95	902.58	106.14	904.62	174.16	906.66	227.79	908.70	264.89
898.53	0.26	900.57	36.82	902.61	107.27	904.65	174.78	906.69	228.47	908.73	265.39
898.56	0.36	900.60	37.69	902.64	108.40	904.68	175.37	906.72	229.06	908.76	265.90
898.59	0.48	900.63	38.56	902.67	109.53	904.71	175.94	906.75	229.64	908.79	266.40
898.62	0.62	900.66	39.45	902.70	110.66	904.74	176.47	906.78	230.22	908.82	266.90
898.65	0.77	900.69	40.34	902.73	111.79	904.77	176.97	906.81	230.81	908.85	267.40
898.68	0.94	900.72	41.24	902.76	112.92	904.80	177.43	906.84	231.39	908.88	267.91
898.71	1.12	900.75	42.14	902.79	114.05	904.83	177.85	906.87	231.96	908.91	268.41
898.74	1.33	900.78	43.05	902.82	115.17	904.86	178.21	906.90	232.54	908.94	268.90
898.77	1.54	900.81	43.97	902.85	116.30	904.89	178.51	906.93	233.12	908.97	269.40
898.80	1.78	900.84	44.89	902.88	117.43	904.92	178.74	906.96	233.69	909.00	269.90
898.83	2.02	900.87	45.82	902.91	118.55	904.95	178.87	906.99	234.27	909.03	270.40
898.86	2.29	900.90	46.76	902.94	119.67	904.98	178.83	907.02	234.84	909.06	270.89
898.89	2.57	900.93	47.70	902.97	120.80	905.01	178.40	907.05	235.41	909.09	271.39
898.92	2.86	900.96	48.65	903.00	121.92	905.04	178.67	907.08	235.98	909.12	271.88
898.95	3.17	900.99	49.60	903.03	123.04	905.07	179.70	907.11	236.54	909.15	272.37
898.98	3.49	901.02	50.56	903.06	124.16	905.10	180.73	907.14	237.11	909.18	272.86
899.01	3.83	901.05	51.53	903.09	125.27	905.13	181.75	907.17	237.67	909.21	273.36
899.04	4.18	901.08	52.50	903.12	126.38	905.16	182.76	907.20	238.24	909.24	273.85
899.07	4.55	901.11	53.47	903.15	127.50	905.19	183.77	907.23	238.80	909.27	274.33
899.10	4.93	901.14	54.46	903.18	128.60	905.22	184.77	907.26	239.36	909.30	274.82
899.13	5.32	901.17	55.44	903.21	129.71	905.25	185.77	907.29	239.92	909.33	275.31
899.16	5.73	901.20	56.44	903.24	130.81	905.28	186.76	907.32	240.48	909.36	275.80
899.19	6.14	901.23	57.43	903.27	131.91	905.31	187.75	907.35	241.04	909.39	276.28
899.22	6.58	901.26	58.44	903.30	133.01	905.34	188.73	907.38	241.59	909.42	276.77
899.25	7.02	901.29	59.45	903.33	134.11	905.37	189.71	907.41	242.15	909.45	277.25
899.28	7.48	901.32	60.46	903.36	135.20	905.40	190.68	907.44	242.70	909.48	277.73
899.31	7.94	901.35	61.48	903.39	136.28	905.43	191.65	907.47	243.25	909.51	278.22
899.34	8.42	901.38	62.50	903.42	137.36	905.46	192.61	907.50	243.80	909.54	278.70
899.37	8.92	901.41	63.53	903.45	138.44	905.49	193.57	907.53	244.35	909.57	279.18
899.40	9.42	901.44	64.56	903.48	139.52	905.52	194.52	907.56	244.90	909.60	279.66
899.43	9.94	901.47	65.59	903.51	140.59	905.55	195.47	907.59	245.44	909.63	280.14
899.46	10.46	901.50	66.63	903.54	141.65	905.58	196.41	907.62	245.99	909.66	280.62
899.49	11.00	901.53	67.68	903.57	142.71	905.61	197.35	907.65	246.53	909.69	281.09
899.52	11.55	901.56	68.73	903.60	143.76	905.64	198.29	907.68	247.08	909.72	281.57
899.55	12.11	901.59	69.78	903.63	144.81	905.67	199.22	907.71	247.62	909.75	282.05
899.58	12.68	901.62	70.84	903.66	145.86	905.70	200.14	907.74	248.16	909.78	282.52
899.61	13.27	901.65	71.90	903.69	146.89	905.73	201.07	907.77	248.70	909.81	282.99
899.64	13.86	901.68	72.96	903.72	147.93	905.76	201.98	907.80	249.24	909.84	283.47
899.67	14.46	901.71	74.03	903.75	148.95	905.79	202.90	907.83	249.78	909.87	283.94
899.70	15.08	901.74	75.10	903.78	149.97	905.82	203.81	907.86	250.31	909.90	284.41
899.73	15.70	901.77	76.18	903.81	150.98	905.85	204.71	907.89	250.85	909.93	284.88
899.76	16.33	901.80	77.26	903.84	151.98	905.88	205.61	907.92	251.38	909.96	285.35
899.79	16.98	901.83	78.34	903.87	152.98	905.91	206.51	907.95	251.91	909.99	285.82
899.82	17.63	901.86	79.42	903.90	153.96	905.94	207.40	907.98	252.45		
899.85	18.29	901.89	80.51	903.93	154.94	905.97	208.29	908.01	252.98		
899.88	18.96	901.92	81.60	903.96	155.92	906.00	209.18	908.04	253.51		
899.91	19.65	901.95	82.70	903.99	156.88	906.03	210.06	908.07	254.03		
899.94	20.34	901.98	83.79	904.02	157.83	906.06	210.94	908.10	254.56		
899.97	21.04	902.01	84.89	904.05	158.77	906.09	211.81	908.13	255.09		
900.00	21.75	902.04	86.00	904.08	159.71	906.12	212.68	908.16	255.61		
900.03	22.47	902.07	87.10	904.11	160.63	906.15	213.55	908.19	256.14		
900.06	23.19	902.10	88.21	904.14	161.54	906.18	214.41	908.22	256.66		
900.09	23.93	902.13	89.32	904.17	162.44	906.21	215.28	908.25	257.18		
900.12	24.67	902.16	90.43	904.20	163.33	906.24	216.13	908.28	257.70		
900.15	25.43	902.19	91.54	904.23	164.20	906.27	216.99	908.31	258.22		
900.18	26.19	902.22	92.66	904.26	165.07	906.30	217.84	908.34	258.74		
900.21	26.96	902.25	93.77	904.29	165.91	906.33	218.68	908.37	259.26		
900.24	27.74	902.28	94.89	904.32	166.75	906.36	219.53	908.40	259.78		
900.27	28.52	902.31	96.01	904.35	167.57	906.39	220.37	908.43	260.29		
900.30	29.32	902.34	97.13	904.38	168.37	906.42	221.21	908.46	260.81		
900.33	30.12	902.37	98.26	904.41	169.16	906.45	222.04	908.49	261.32		
900.36	30.93	902.40	99.38	904.44	169.94	906.48	222.87	908.52	261.83		

Stage-Area-Storage for Pond ThW: 60" @ Thornapple West

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
898.35	0	0	902.43	25,915	36,108	906.51	90,898	267,161
898.41	6	0	902.49	26,613	37,684	906.57	91,687	272,638
898.47	24	1	902.55	27,321	39,302	906.63	92,480	278,163
898.53	53	3	902.61	28,037	40,963	906.69	93,276	283,736
898.59	94	8	902.67	28,763	42,666	906.75	94,076	289,357
898.65	147	15	902.73	29,499	44,414	906.81	94,879	295,025
898.71	212	25	902.79	30,243	46,206	906.87	95,685	300,742
898.77	288	40	902.85	30,997	48,044	906.93	96,495	306,508
898.83	376	60	902.91	31,760	49,926	906.99	97,309	312,322
898.89	476	86	902.97	32,532	51,855	907.05	98,125	318,185
898.95	588	118	903.03	33,314	53,830	907.11	98,945	324,097
899.01	711	156	903.09	34,105	55,853	907.17	99,769	330,058
899.07	846	203	903.15	34,905	57,923	907.23	100,596	336,069
899.13	993	258	903.21	35,715	60,042	907.29	101,426	342,130
899.19	1,152	323	903.27	36,534	62,209	907.35	102,260	348,240
899.25	1,322	397	903.33	37,362	64,426	907.41	103,097	354,401
899.31	1,505	482	903.39	38,199	66,693	907.47	103,938	360,612
899.37	1,699	578	903.45	39,046	69,010	907.53	104,782	366,874
899.43	1,904	686	903.51	39,902	71,378	907.59	105,629	373,186
899.49	2,122	806	903.57	40,767	73,798	907.65	106,480	379,549
899.55	2,351	940	903.63	41,641	76,271	907.71	107,334	385,964
899.61	2,592	1,089	903.69	42,525	78,796	907.77	108,192	392,429
899.67	2,845	1,252	903.75	43,418	81,374	907.83	109,053	398,947
899.73	3,109	1,430	903.81	44,320	84,006	907.89	109,917	405,516
899.79	3,386	1,625	903.87	45,232	86,692	907.95	110,785	412,137
899.85	3,674	1,837	903.93	46,153	89,434	908.01	111,636	418,810
899.91	3,973	2,066	903.99	47,083	92,231	908.07	112,386	425,530
899.97	4,285	2,314	904.05	48,036	95,084	908.13	113,138	432,296
900.03	4,604	2,580	904.11	49,001	97,996	908.19	113,893	439,107
900.09	4,931	2,866	904.17	49,976	100,965	908.25	114,650	445,963
900.15	5,269	3,172	904.23	50,961	103,993	908.31	115,410	452,865
900.21	5,618	3,499	904.29	51,955	107,080	908.37	116,173	459,813
900.27	5,978	3,847	904.35	52,959	110,228	908.43	116,938	466,806
900.33	6,350	4,217	904.41	53,972	113,436	908.49	117,705	473,845
900.39	6,732	4,609	904.47	54,995	116,705	908.55	118,475	480,931
900.45	7,126	5,025	904.53	56,028	120,035	908.61	119,248	488,062
900.51	7,531	5,464	904.59	57,070	123,428	908.67	120,023	495,241
900.57	7,948	5,929	904.65	58,122	126,884	908.73	120,800	502,465
900.63	8,375	6,418	904.71	59,183	130,403	908.79	121,580	509,737
900.69	8,814	6,934	904.77	60,254	133,986	908.85	122,363	517,055
900.75	9,264	7,476	904.83	61,335	137,634	908.91	123,148	524,420
900.81	9,725	8,046	904.89	62,425	141,346	908.97	123,936	531,833
900.87	10,197	8,643	904.95	63,525	145,125	909.03	124,726	539,293
900.93	10,681	9,270	905.01	64,634	148,970	909.09	125,518	546,800
900.99	11,175	9,925	905.07	65,753	152,881	909.15	126,313	554,355
901.05	11,681	10,611	905.13	66,882	156,860	909.21	127,111	561,957
901.11	12,198	11,327	905.19	68,020	160,907	909.27	127,911	569,608
901.17	12,726	12,075	905.25	69,168	165,023	909.33	128,714	577,307
901.23	13,266	12,855	905.31	70,325	169,207	909.39	129,519	585,054
901.29	13,817	13,667	905.37	71,492	173,462	909.45	130,327	592,849
901.35	14,378	14,513	905.43	72,669	177,787	909.51	131,137	600,693
901.41	14,951	15,393	905.49	73,855	182,182	909.57	131,949	608,586
901.47	15,536	16,307	905.55	75,051	186,650	909.63	132,765	616,527
901.53	16,131	17,257	905.61	76,257	191,189	909.69	133,582	624,517
901.59	16,738	18,243	905.67	77,472	195,801	909.75	134,402	632,557
901.65	17,356	19,266	905.73	78,696	200,486	909.81	135,225	640,646
901.71	17,985	20,326	905.79	79,930	205,244	909.87	136,050	648,784
901.77	18,625	21,424	905.85	81,174	210,077	909.93	136,878	656,972
901.83	19,276	22,561	905.91	82,428	214,985	909.99	137,708	665,209
901.89	19,939	23,738	905.97	83,691	219,969			
901.95	20,613	24,954	906.03	84,706	225,025			
902.01	21,288	26,211	906.09	85,468	230,130			
902.07	21,921	27,508	906.15	86,233	235,281			
902.13	22,563	28,842	906.21	87,002	240,478			
902.19	23,215	30,215	906.27	87,775	245,721			
902.25	23,876	31,628	906.33	88,550	251,011			
902.31	24,546	33,081	906.39	89,329	256,347			
902.37	25,226	34,574	906.45	90,112	261,730			

Summary for Subcatchment SW2: Stratford 2

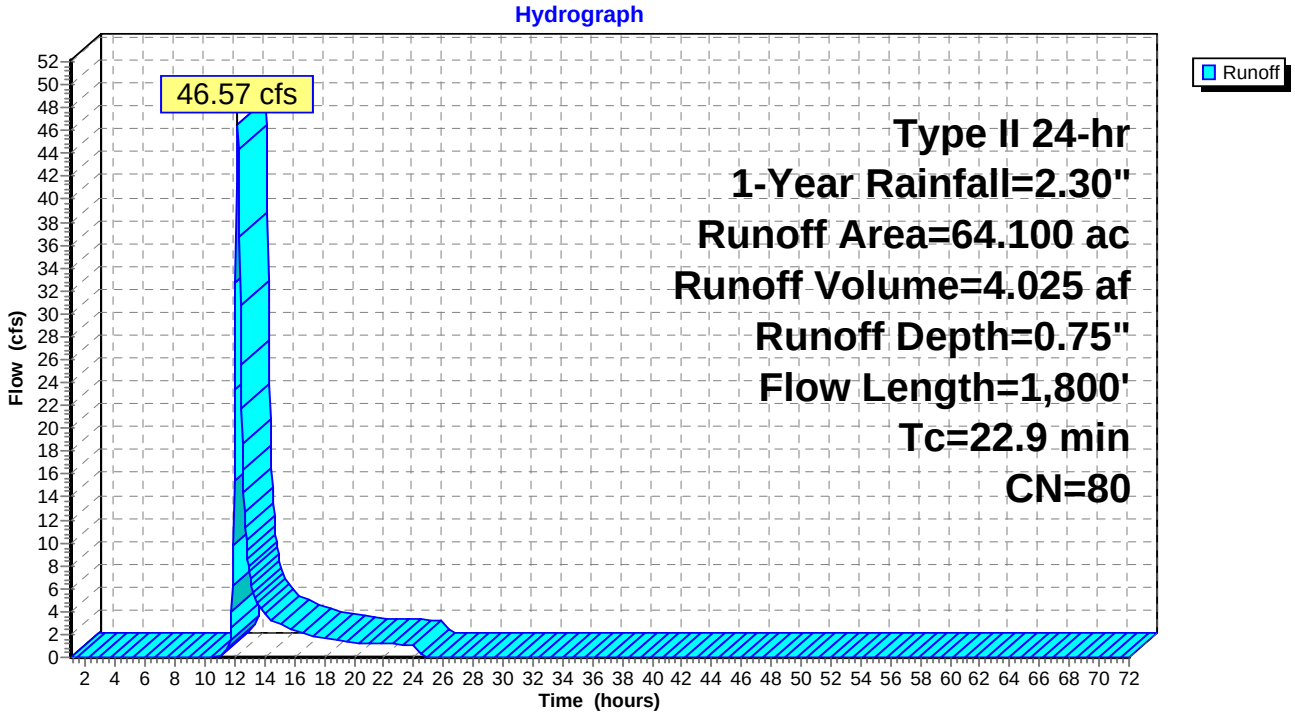
Runoff = 46.57 cfs @ 12.18 hrs, Volume= 4.025 af, Depth= 0.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

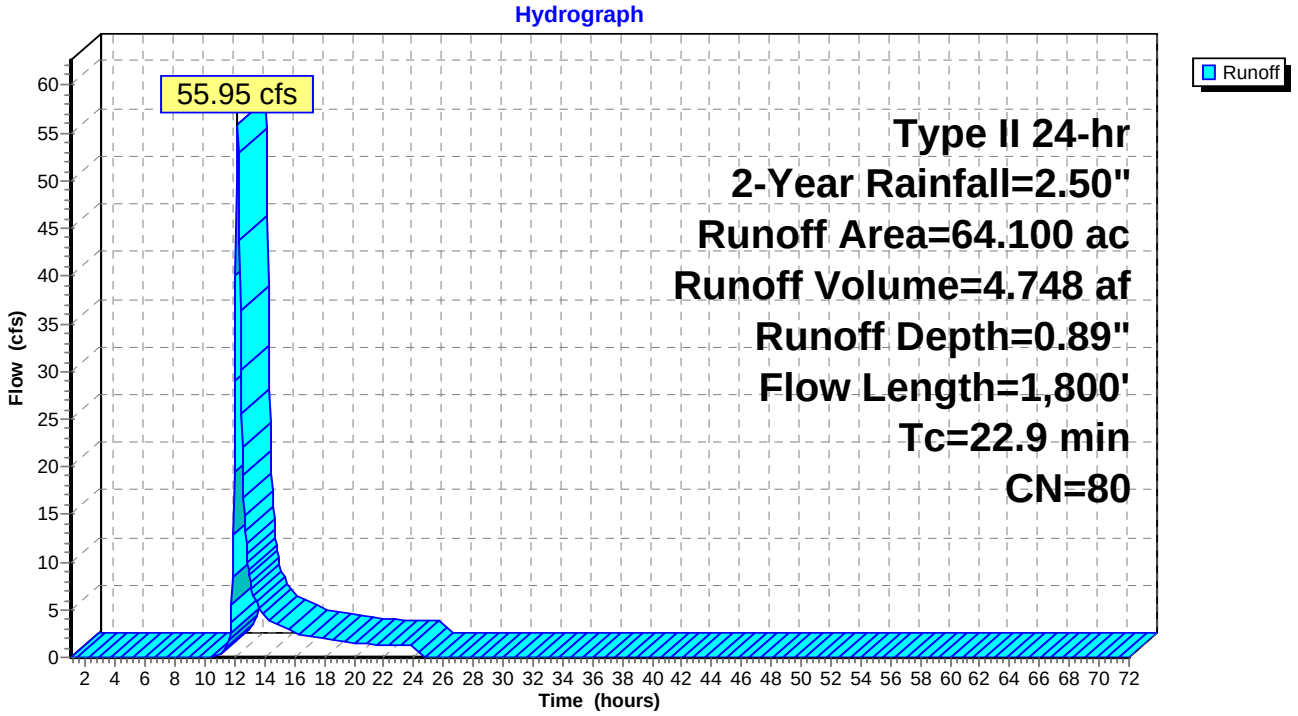
Area (ac)	CN	Description
12.300	74	>75% Grass cover, Good, HSG C
6.500	70	Woods, Good, HSG C
45.300	83	1/4 acre lots, 38% imp, HSG C
64.100	80	Weighted Average
46.886		73.15% Pervious Area
17.214		26.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					Direct Entry, nonpaved min - thru park
0.8	250	0.0152	5.36	158.53	Channel Flow, Area= 29.6 sf Perim= 28.6' r= 1.03' n= 0.035 Earth, dense weeds
1.0	250	0.0080	3.97	193.89	Channel Flow, Area= 48.8 sf Perim= 45.6' r= 1.07' n= 0.035 Earth, dense weeds
1.2	250	0.0160	3.40	55.37	Channel Flow, Area= 16.3 sf Perim= 32.4' r= 0.50' n= 0.035 Earth, dense weeds
1.1	250	0.0080	3.88	82.33	Channel Flow, Area= 21.2 sf Perim= 20.5' r= 1.03' n= 0.035 Earth, dense weeds
0.7	250	0.0160	5.78	182.66	Channel Flow, Area= 31.6 sf Perim= 28.3' r= 1.12' n= 0.035 Earth, dense weeds
2.1	250	0.0084	2.02	12.70	Channel Flow, Area= 6.3 sf Perim= 16.9' r= 0.37' n= 0.035 Earth, dense weeds
0.9	250	0.0080	4.48	224.44	Channel Flow, Area= 50.1 sf Perim= 39.1' r= 1.28' n= 0.035 Earth, dense weeds
0.1	50	0.0300	5.90	75.55	Channel Flow, Area= 12.8 sf Perim= 17.8' r= 0.72' n= 0.035 Earth, dense weeds
22.9	1,800	Total			

Subcatchment SW2: Stratford 2



Subcatchment SW2: Stratford 2



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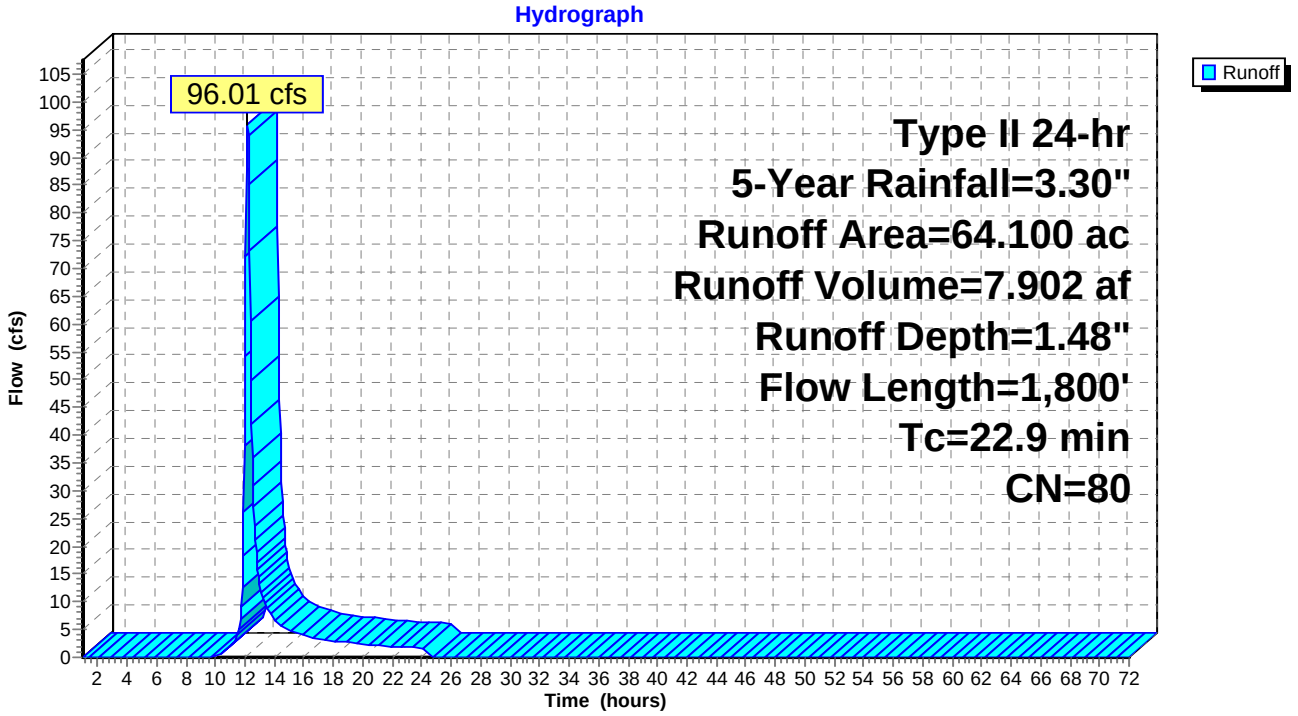

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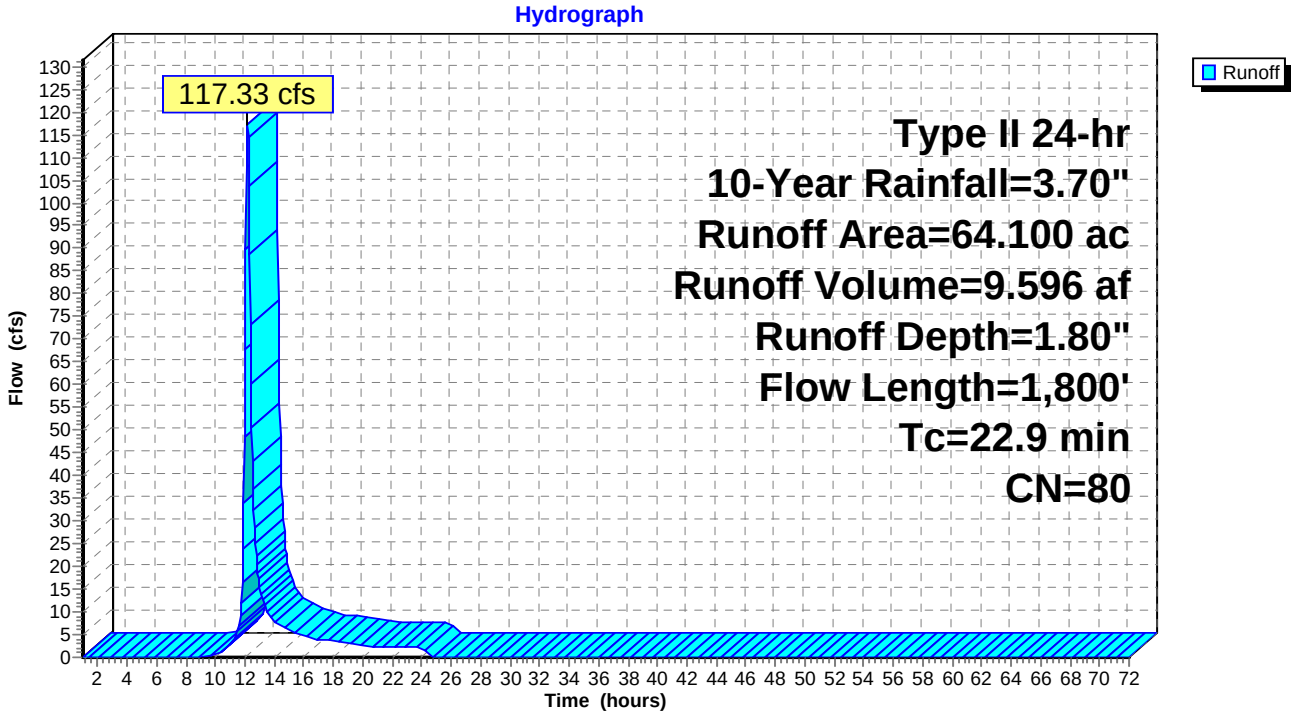

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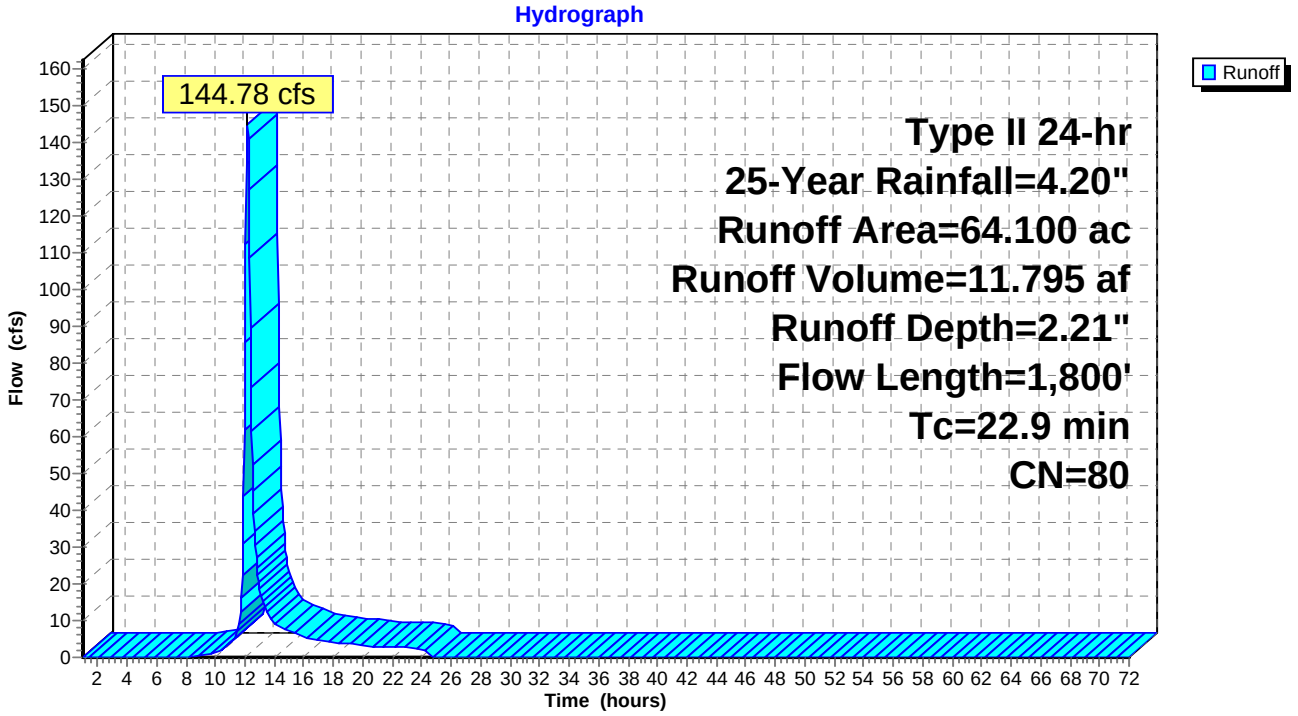

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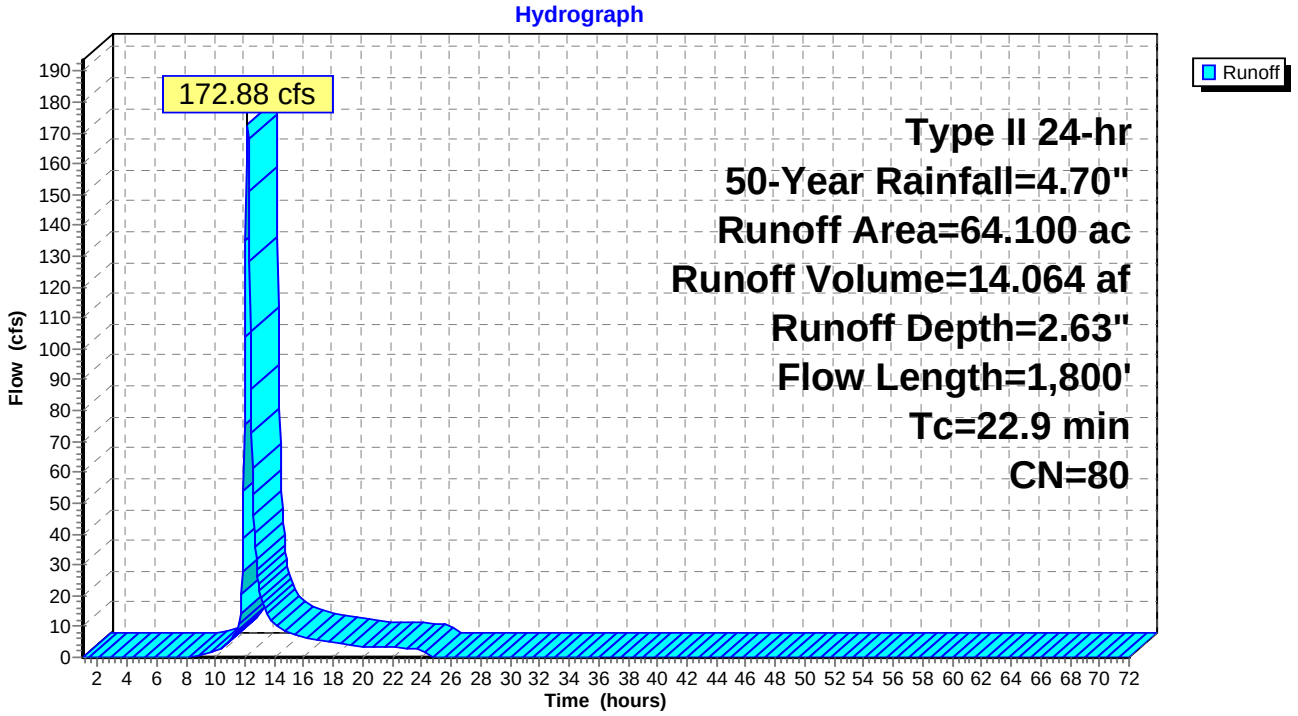
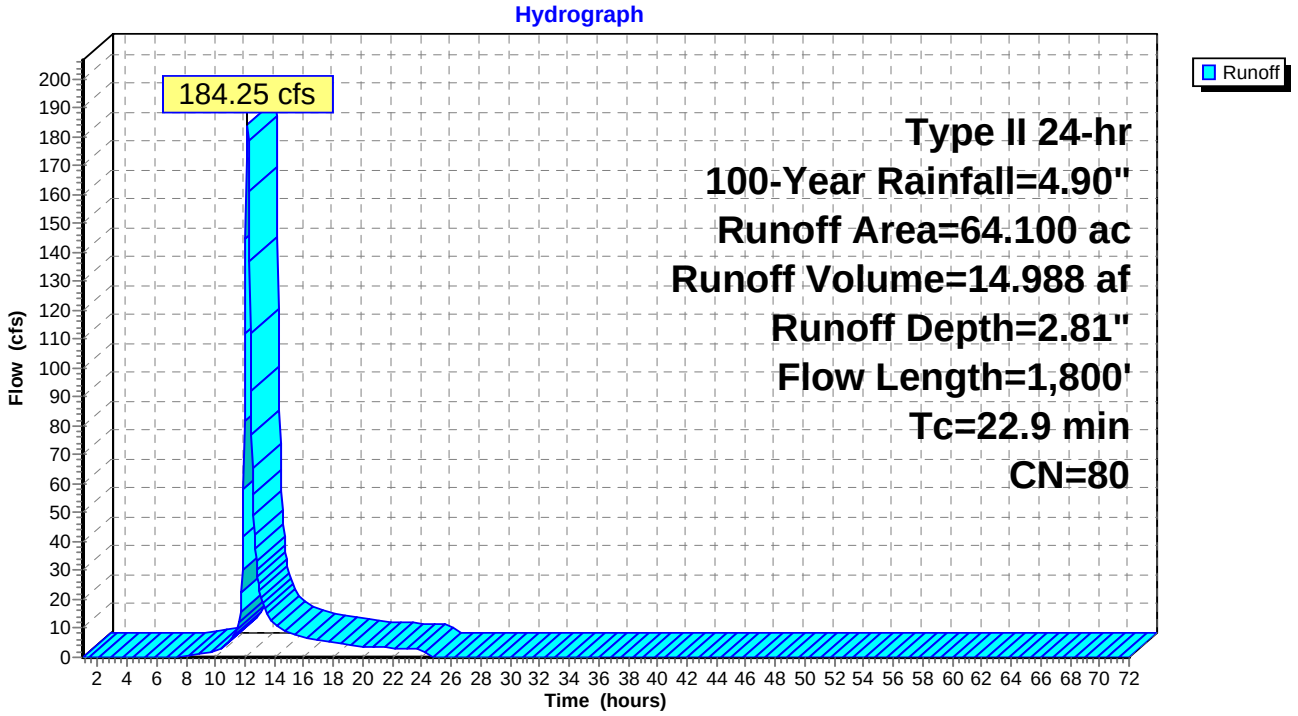


Subcatchment SW2: Stratford 2



Summary for Subcatchment EO8B: E08B

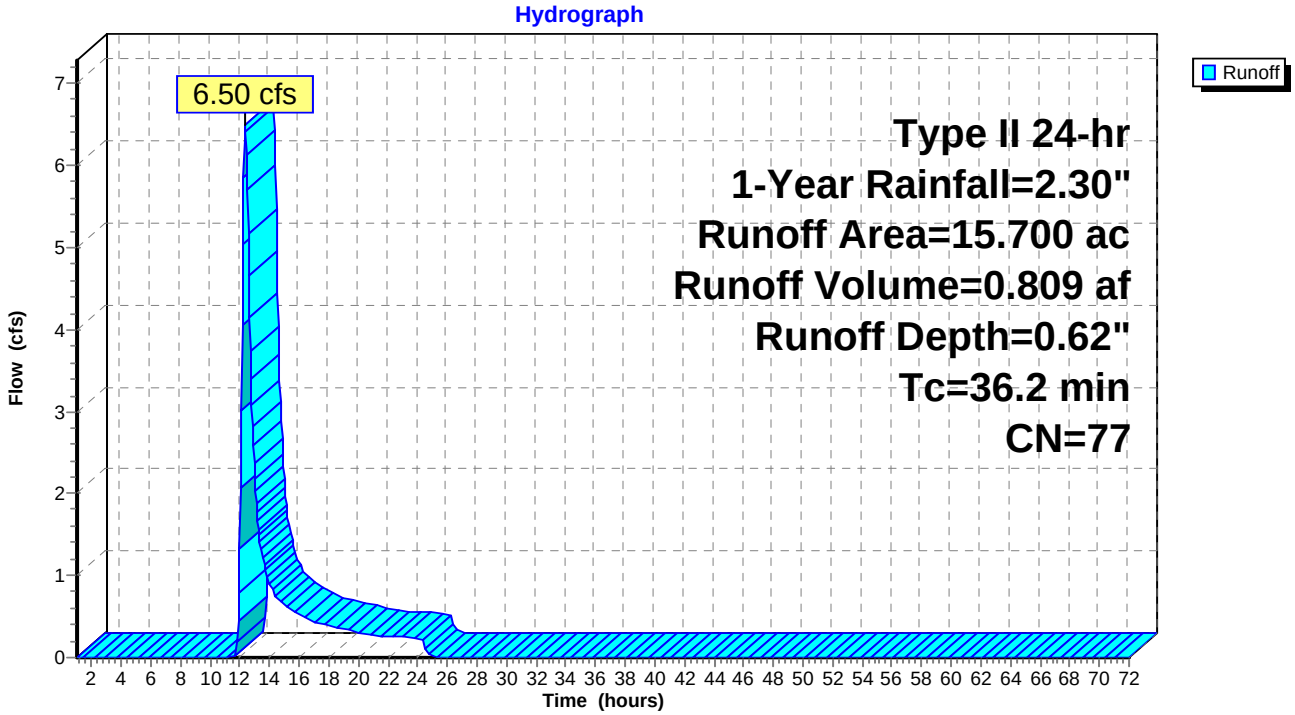
Runoff = 6.50 cfs @ 12.36 hrs, Volume= 0.809 af, Depth= 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

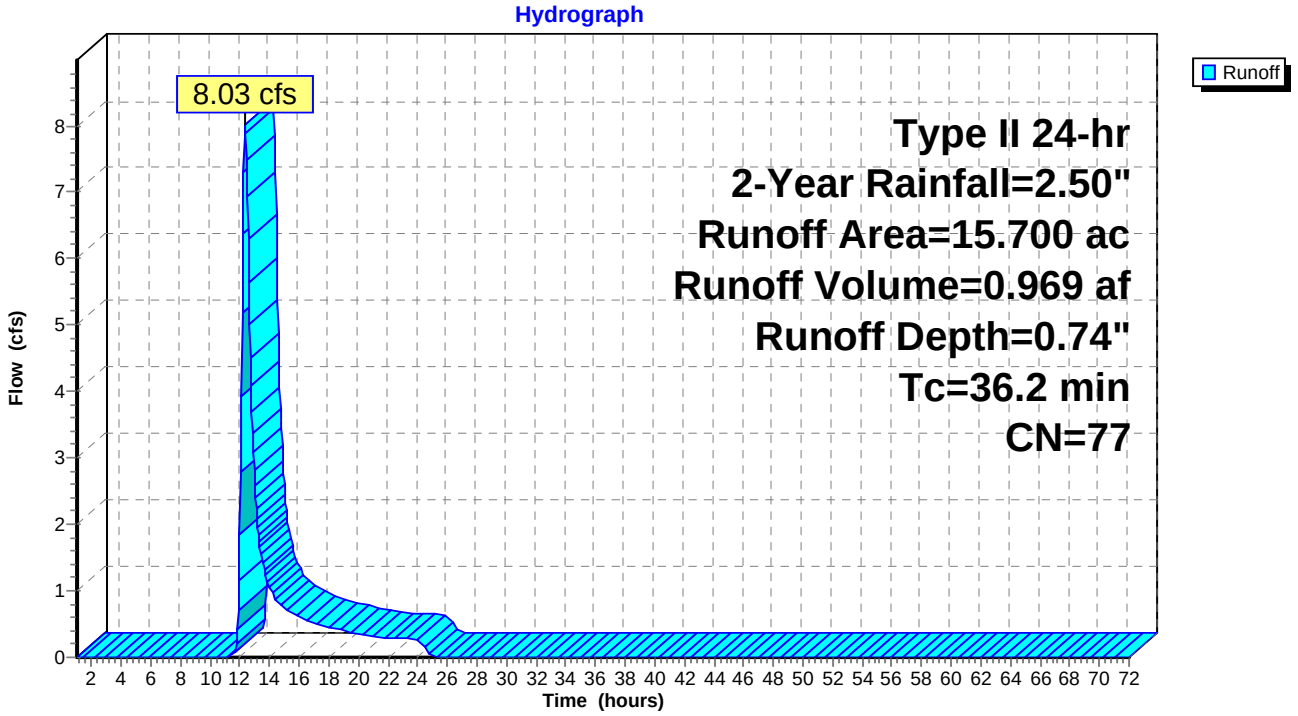
	Area (ac)	CN	Description
*	15.700	77	
	15.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.2					Direct Entry, From C.O.D

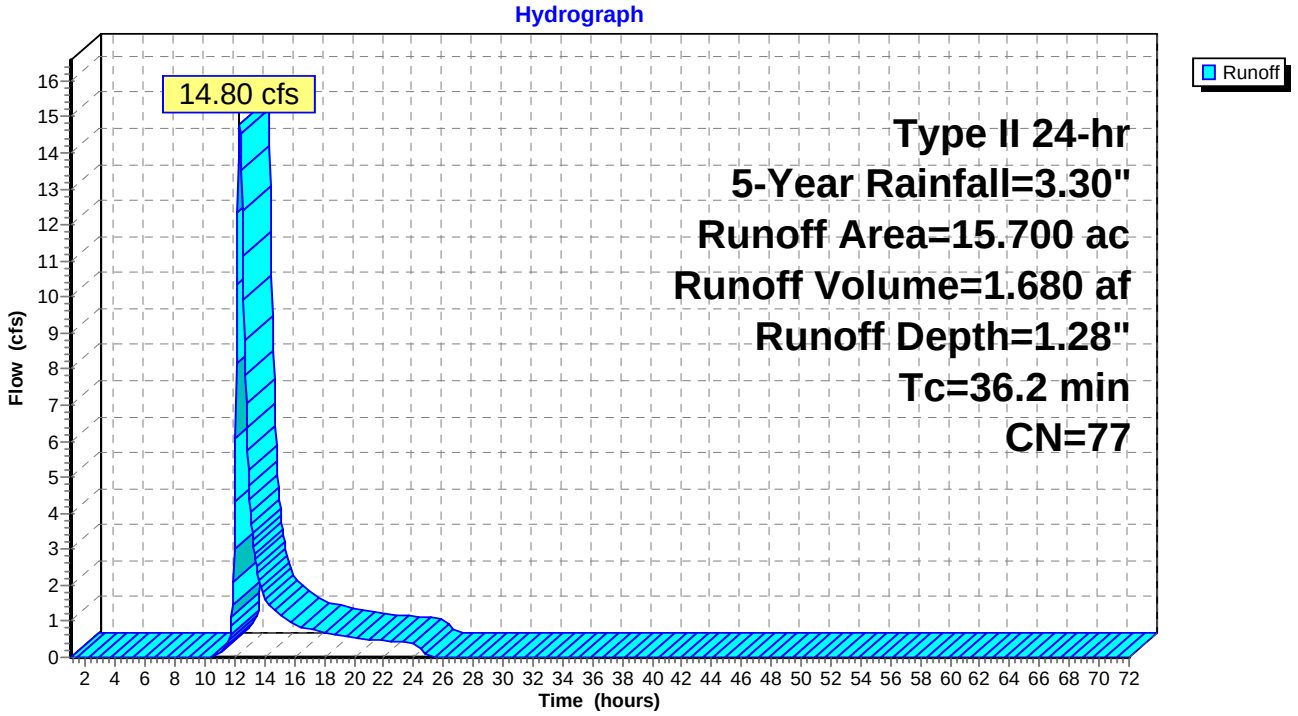
Subcatchment EO8B: E08B



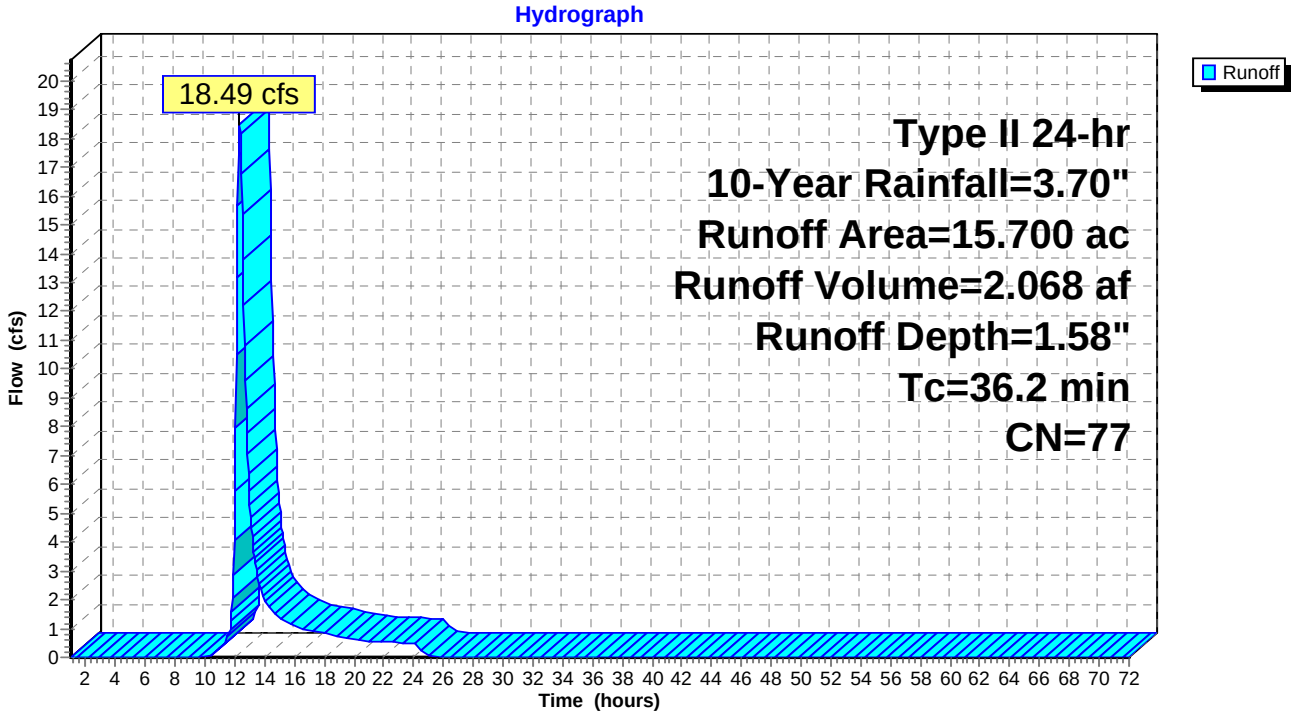
Subcatchment EO8B: E08B



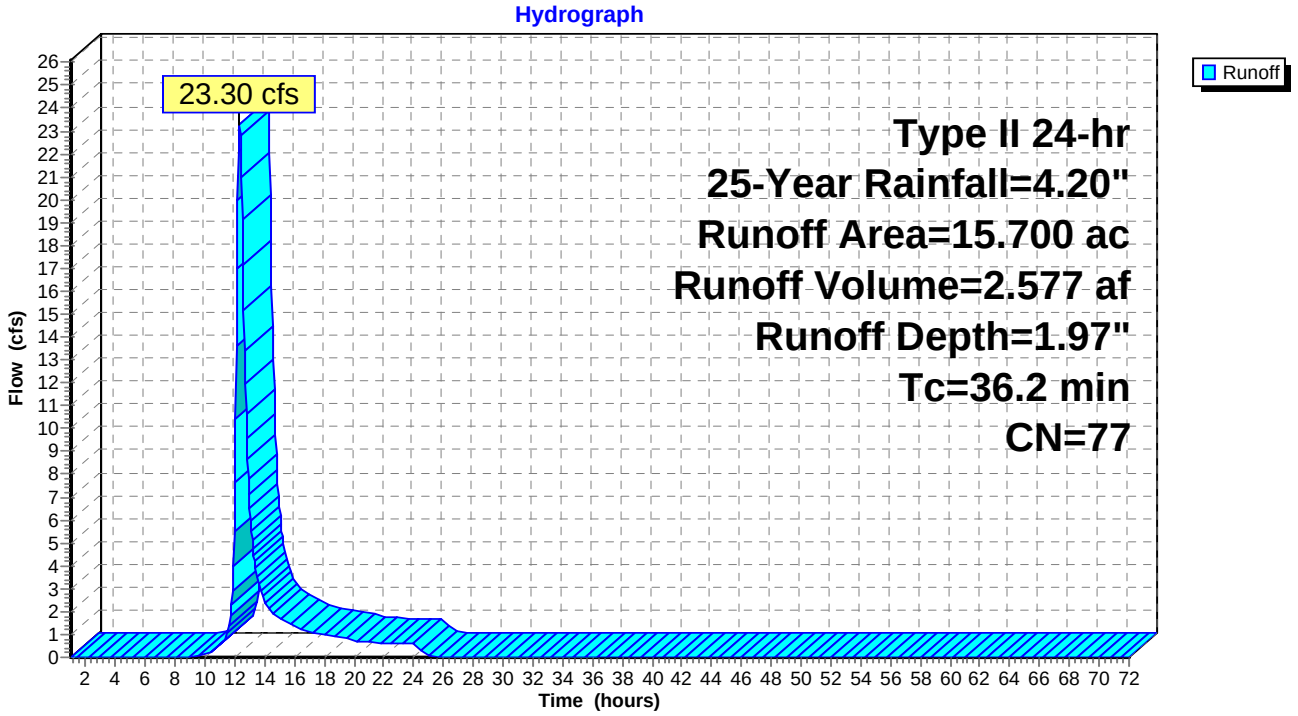
Subcatchment EO8B: E08B



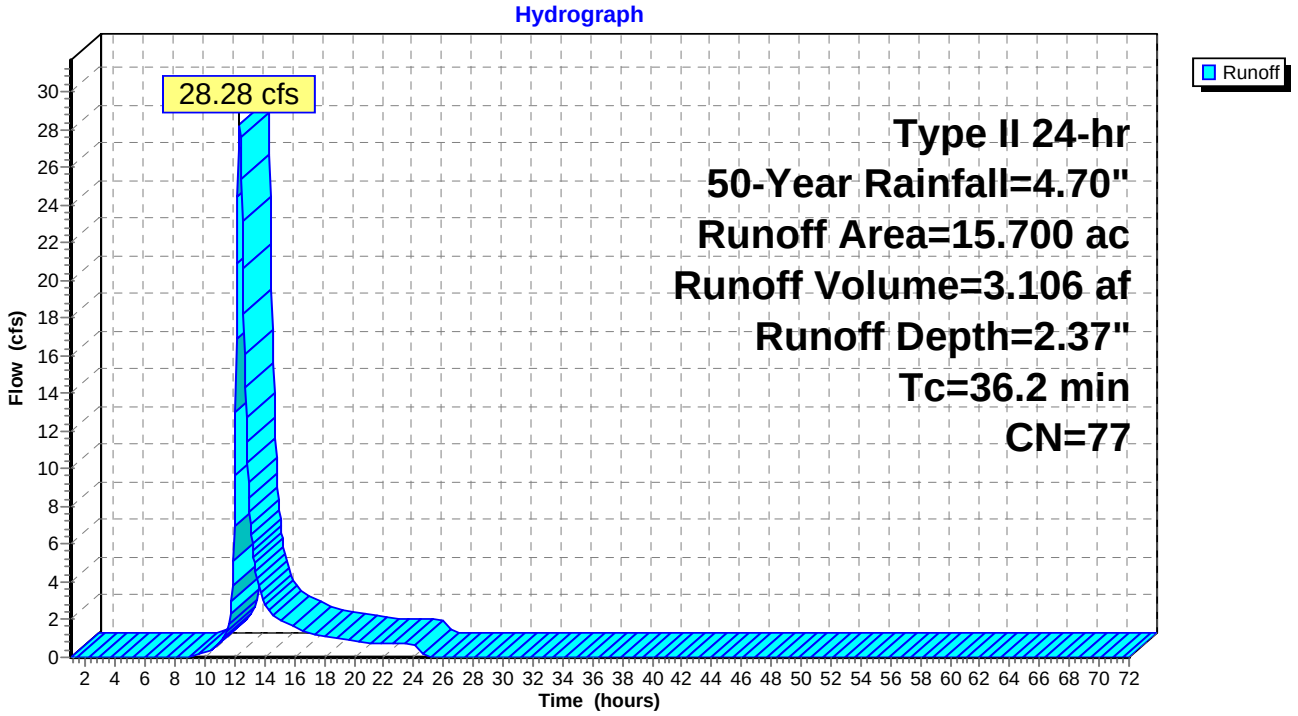
Subcatchment EO8B: E08B



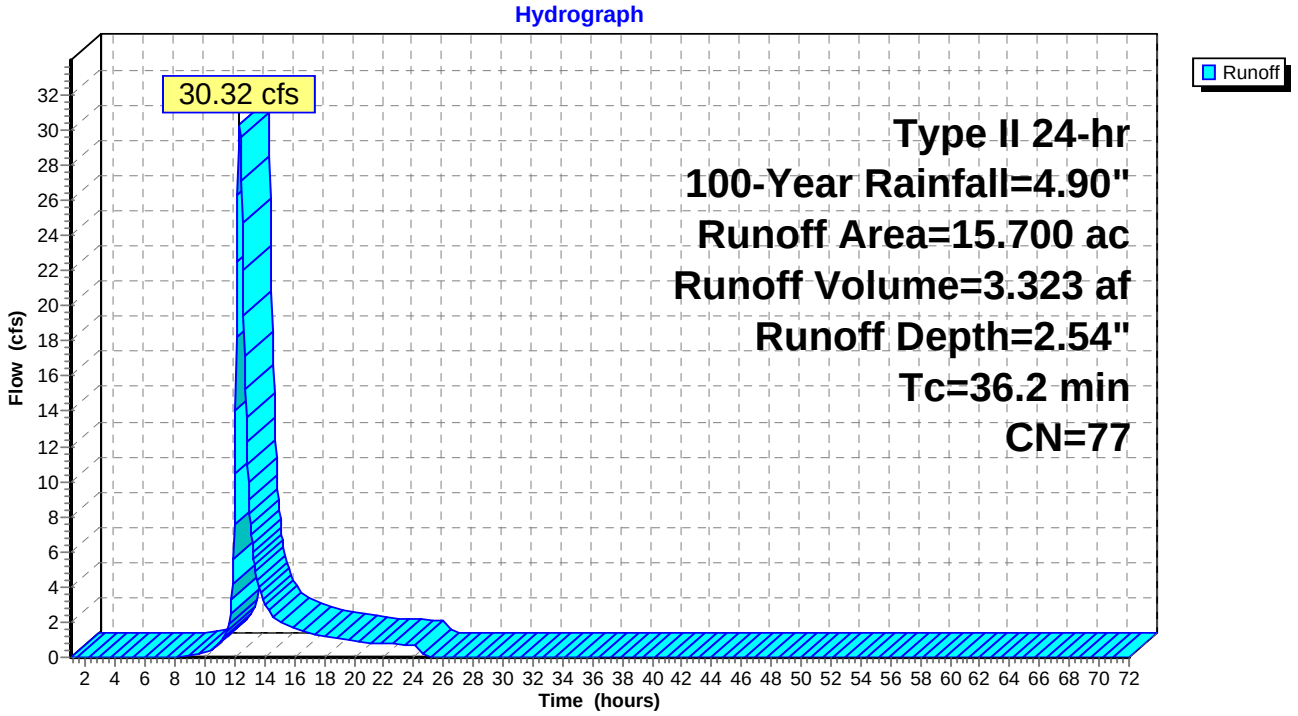
Subcatchment EO8B: E08B



Subcatchment EO8B: E08B



Subcatchment EO8B: E08B



Summary for Pond ThE: 76"x48" Ellipse @ Thornapple East

Inflow Area = 640.340 ac, 3.48% Impervious, Inflow Depth = 2.01" for 25-Year event
Inflow = 228.34 cfs @ 12.20 hrs, Volume= 107.225 af
Outflow = 197.15 cfs @ 12.33 hrs, Volume= 107.225 af, Atten= 14%, Lag= 7.8 min
Primary = 197.15 cfs @ 12.33 hrs, Volume= 107.225 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 882.84' @ 12.33 hrs Surf.Area= 23,540 sf Storage= 46,272 cf

Plug-Flow detention time= 1.5 min calculated for 107.150 af (100% of inflow)
Center-of-Mass det. time= 1.5 min (1,041.7 - 1,040.3)

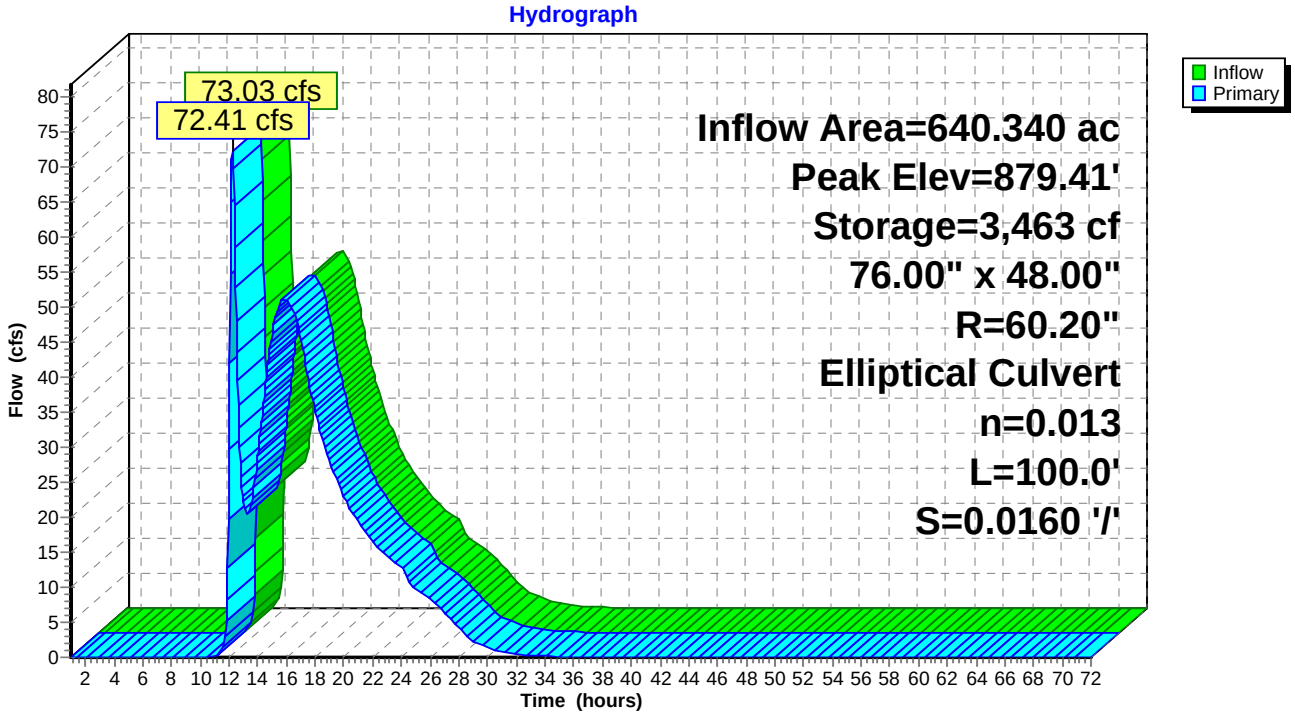
Volume	Invert	Avail.Storage	Storage Description
#1	876.70'	454,909 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
876.70	0	0.0	0	0	0
878.00	829	490.0	359	359	19,109
880.00	5,928	791.0	5,983	6,342	49,819
882.00	17,830	1,263.0	22,693	29,034	126,996
884.00	32,811	1,634.0	49,885	78,920	212,574
886.00	51,343	1,996.0	83,465	162,385	317,207
888.00	73,312	2,423.0	124,005	286,390	467,427
890.00	95,704	2,501.0	168,519	454,909	498,385

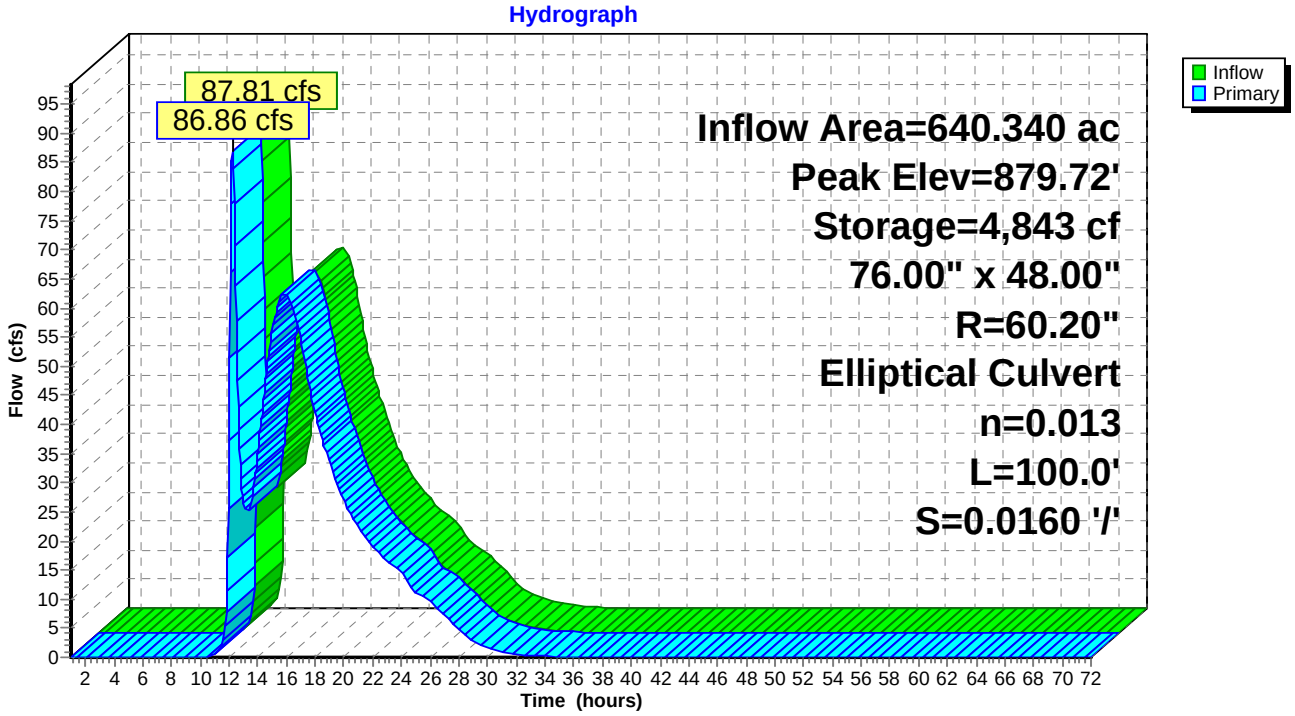
Device	Routing	Invert	Outlet Devices
#1	Primary	876.70'	**76.00" W x 48.00" H, R=60.20" Elliptical Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 876.70' / 875.10' S= 0.0160 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 20.29 sf

Primary OutFlow Max=196.80 cfs @ 12.33 hrs HW=882.82' (Free Discharge)
└1=**Culvert** (Inlet Controls 196.80 cfs @ 9.70 fps)

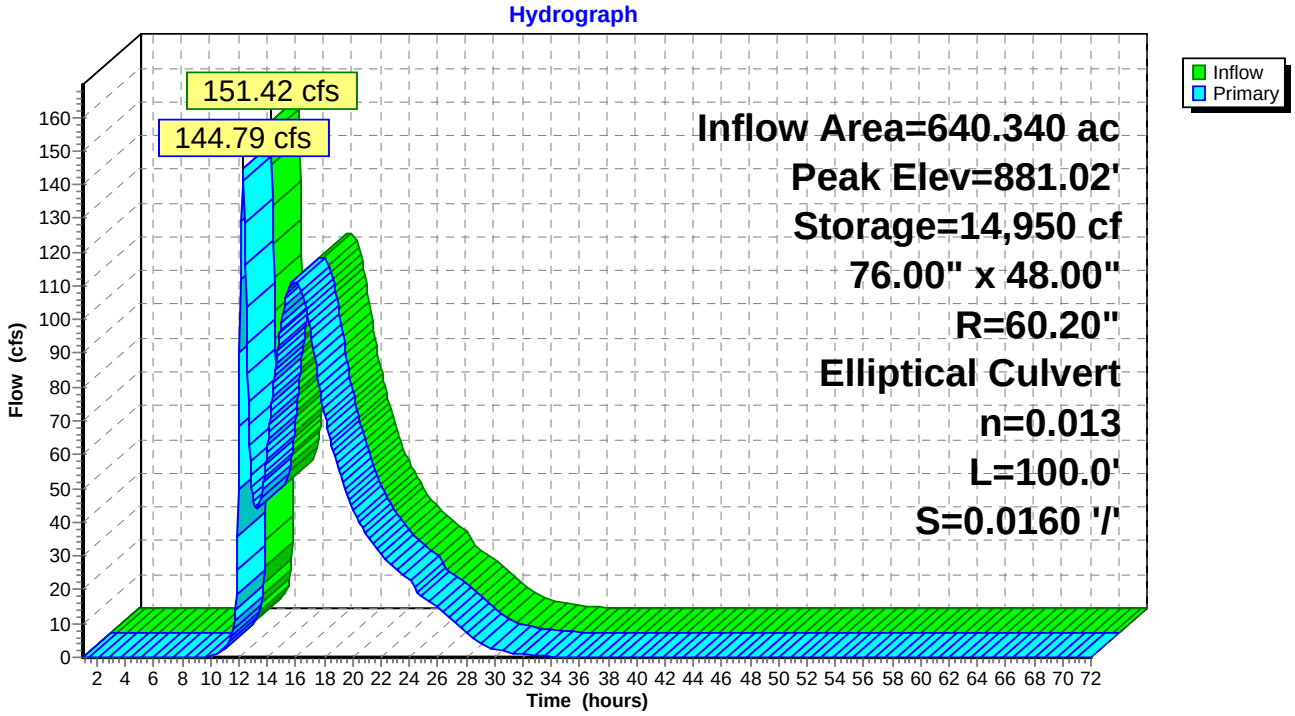
Pond ThE: 76"x48" Ellipse @ Thornapple East



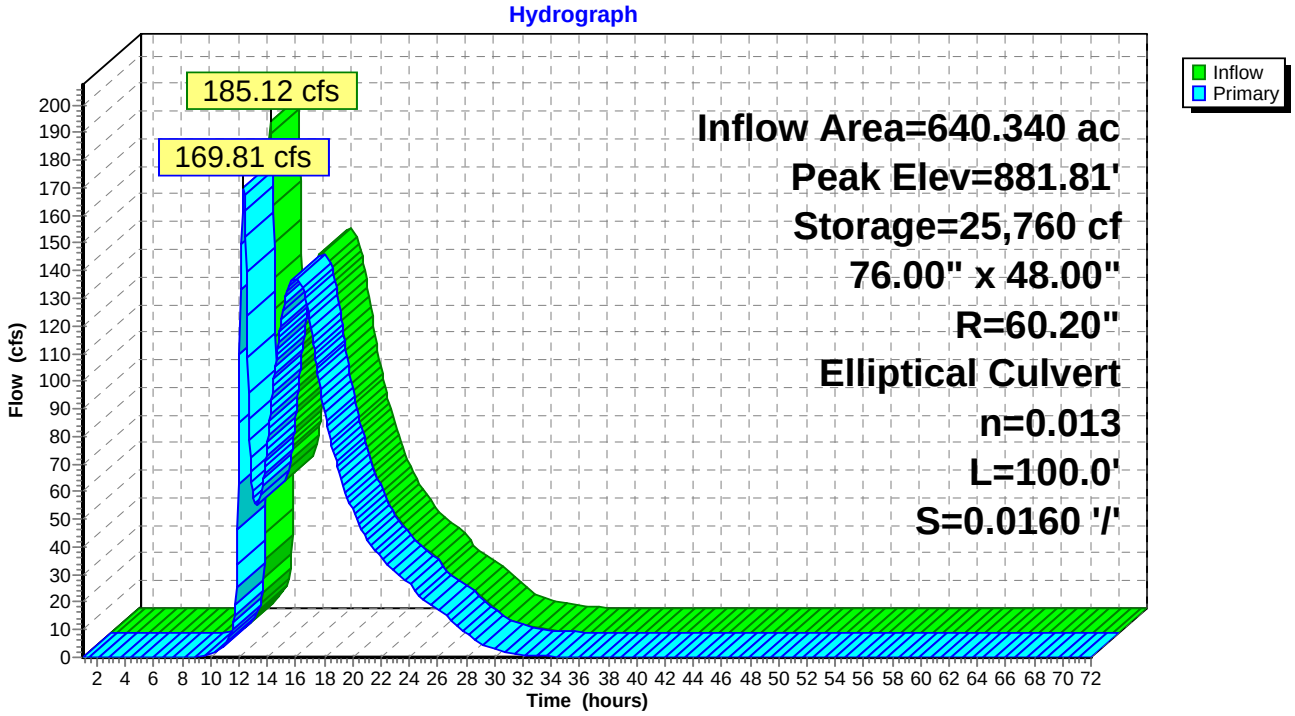
Pond ThE: 76"x48" Ellipse @ Thornapple East



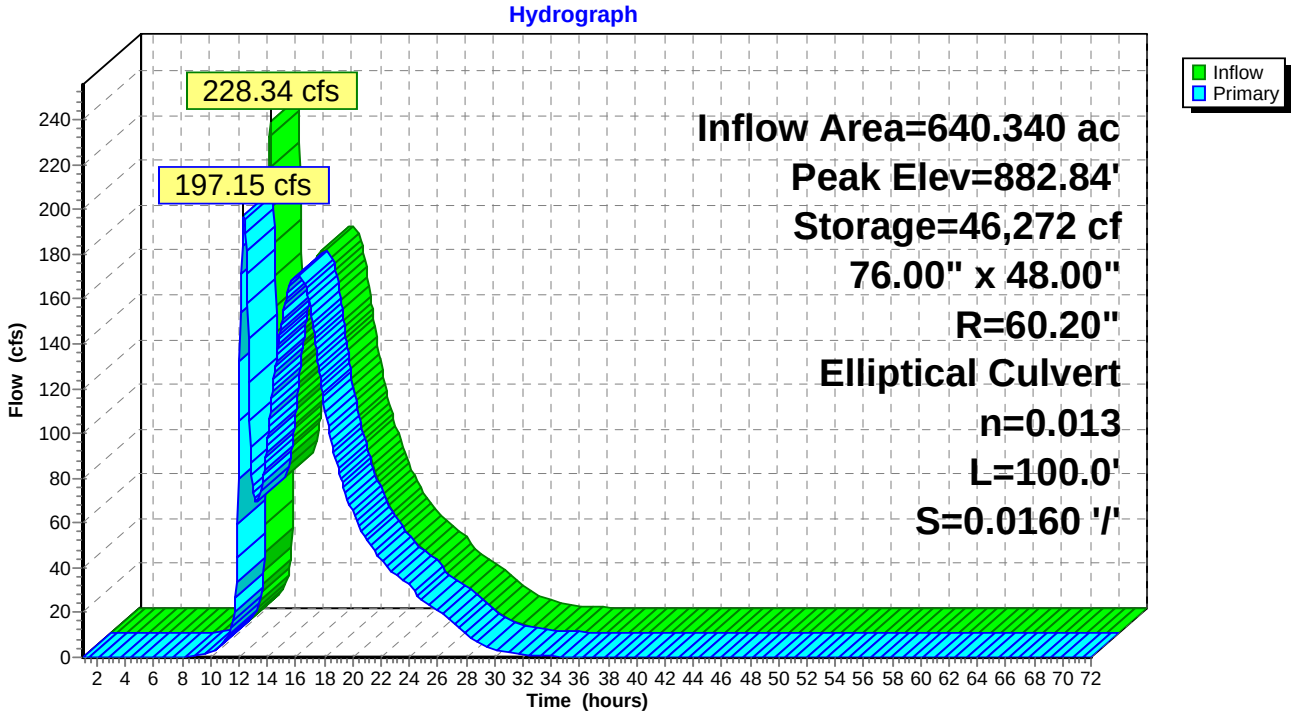
Pond ThE: 76"x48" Ellipse @ Thornapple East



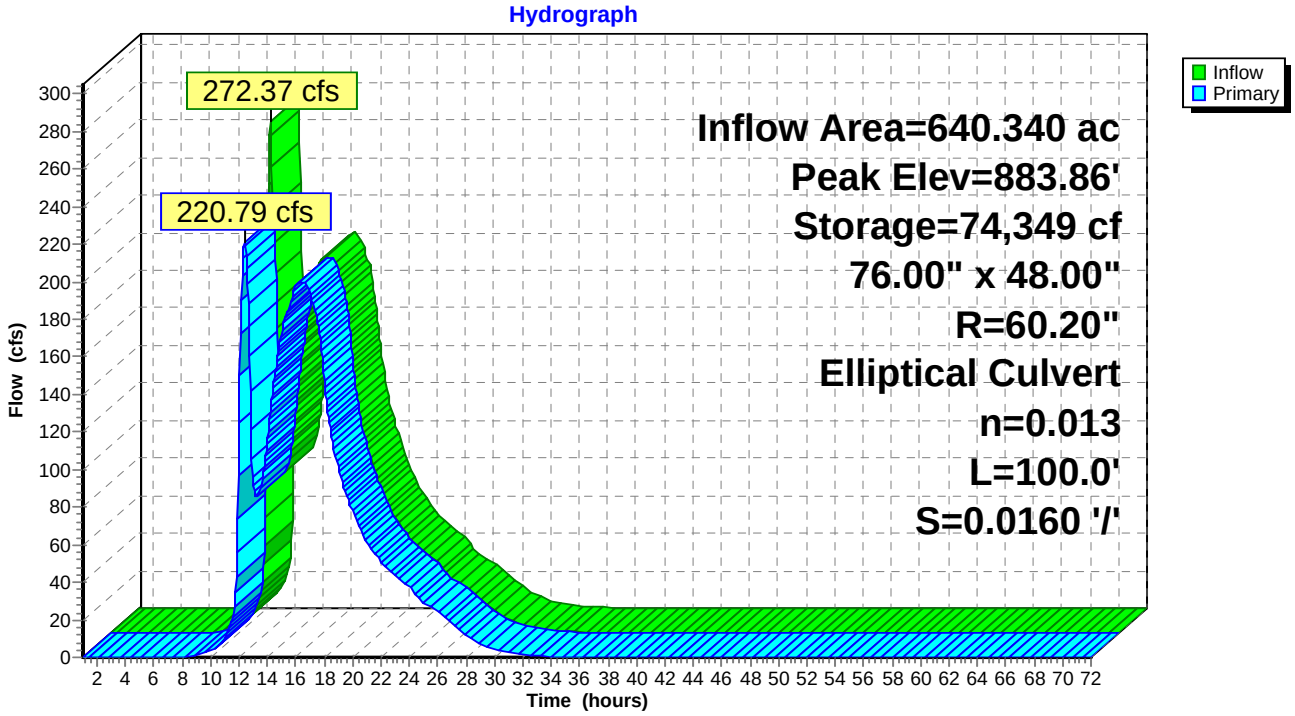
Pond ThE: 76"x48" Ellipse @ Thornapple East



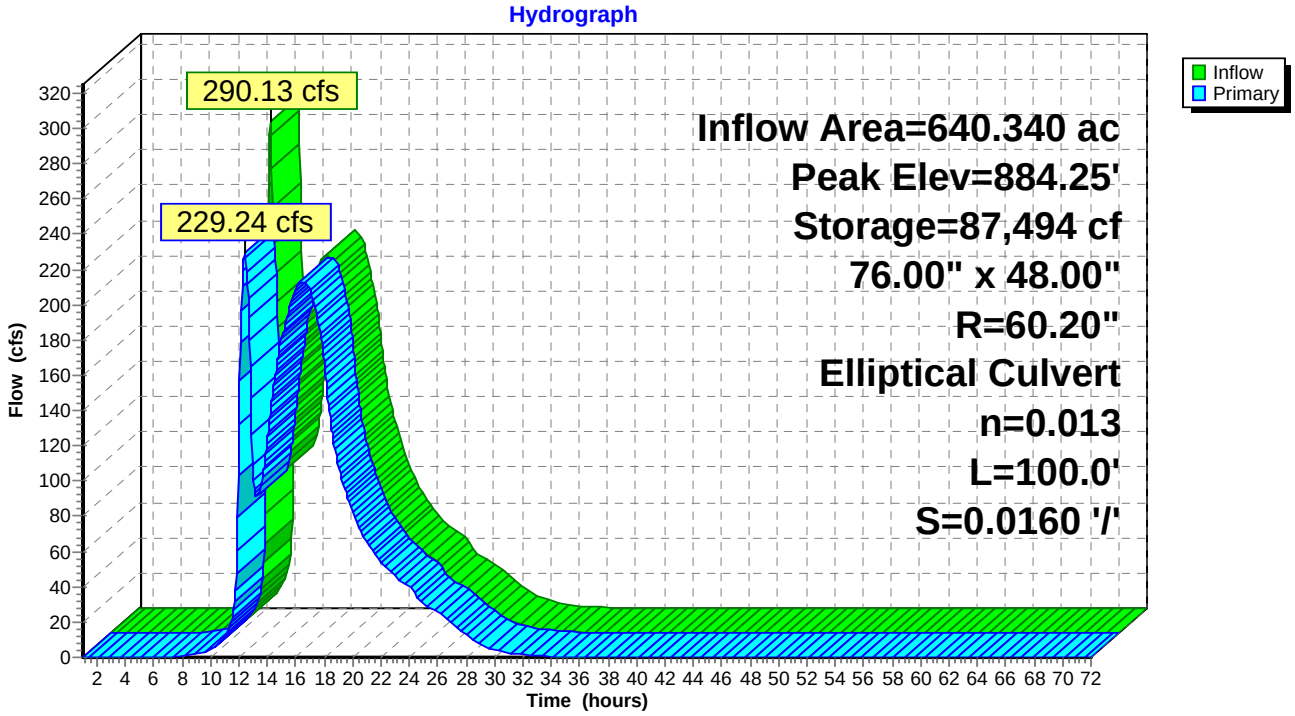
Pond ThE: 76"x48" Ellipse @ Thornapple East



Pond ThE: 76"x48" Ellipse @ Thornapple East



Pond ThE: 76"x48" Ellipse @ Thornapple East



Stage-Discharge for Pond ThE: 76"x48" Ellipse @ Thornapple East

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
876.70	0.00	880.78	135.84	884.86	241.64	888.94	312.23
876.76	0.05	880.84	138.16	884.92	242.83	889.00	313.15
876.82	0.18	880.90	140.41	884.98	244.01	889.06	314.06
876.88	0.39	880.96	142.60	885.04	245.19	889.12	314.98
876.94	0.69	881.02	144.75	885.10	246.37	889.18	315.89
877.00	1.08	881.08	146.85	885.16	247.53	889.24	316.79
877.06	1.55	881.14	148.91	885.22	248.69	889.30	317.70
877.12	2.10	881.20	150.94	885.28	249.85	889.36	318.60
877.18	2.74	881.26	152.93	885.34	251.00	889.42	319.50
877.24	3.45	881.32	154.88	885.40	252.14	889.48	320.40
877.30	4.26	881.38	156.81	885.46	253.28	889.54	321.29
877.36	5.14	881.44	158.71	885.52	254.42	889.60	322.18
877.42	6.11	881.50	160.58	885.58	255.55	889.66	323.07
877.48	7.14	881.56	162.42	885.64	256.67	889.72	323.96
877.54	8.26	881.62	164.25	885.70	257.79	889.78	324.84
877.60	9.44	881.68	166.04	885.76	258.90	889.84	325.72
877.66	10.71	881.74	167.82	885.82	260.01	889.90	326.60
877.72	12.03	881.80	169.57	885.88	261.12	889.96	327.48
877.78	13.43	881.86	171.30	885.94	262.22		
877.84	14.89	881.92	173.02	886.00	263.31		
877.90	16.43	881.98	174.71	886.06	264.40		
877.96	18.02	882.04	176.39	886.12	265.49		
878.02	19.68	882.10	178.04	886.18	266.57		
878.08	21.39	882.16	179.69	886.24	267.65		
878.14	23.17	882.22	181.31	886.30	268.72		
878.20	25.00	882.28	182.92	886.36	269.79		
878.26	26.89	882.34	184.51	886.42	270.85		
878.32	28.83	882.40	186.09	886.48	271.91		
878.38	30.84	882.46	187.65	886.54	272.97		
878.44	32.89	882.52	189.20	886.60	274.02		
878.50	35.00	882.58	190.74	886.66	275.06		
878.56	37.15	882.64	192.26	886.72	276.11		
878.62	39.35	882.70	193.77	886.78	277.15		
878.68	41.60	882.76	195.27	886.84	278.18		
878.74	43.90	882.82	196.76	886.90	279.21		
878.80	46.24	882.88	198.23	886.96	280.24		
878.86	48.63	882.94	199.69	887.02	281.26		
878.92	51.05	883.00	201.14	887.08	282.28		
878.98	53.52	883.06	202.58	887.14	283.30		
879.04	56.02	883.12	204.01	887.20	284.31		
879.10	58.57	883.18	205.43	887.26	285.32		
879.16	61.14	883.24	206.84	887.32	286.33		
879.22	63.76	883.30	208.23	887.38	287.33		
879.28	66.40	883.36	209.62	887.44	288.33		
879.34	69.09	883.42	211.00	887.50	289.32		
879.40	71.79	883.48	212.37	887.56	290.31		
879.46	74.53	883.54	213.73	887.62	291.30		
879.52	77.29	883.60	215.08	887.68	292.28		
879.58	80.08	883.66	216.42	887.74	293.26		
879.64	82.88	883.72	217.75	887.80	294.24		
879.70	85.72	883.78	219.08	887.86	295.22		
879.76	88.56	883.84	220.39	887.92	296.19		
879.82	91.42	883.90	221.70	887.98	297.16		
879.88	94.29	883.96	223.00	888.04	298.12		
879.94	97.18	884.02	224.30	888.10	299.08		
880.00	100.07	884.08	225.58	888.16	300.04		
880.06	102.97	884.14	226.86	888.22	301.00		
880.12	105.86	884.20	228.13	888.28	301.95		
880.18	108.75	884.26	229.39	888.34	302.90		
880.24	111.63	884.32	230.65	888.40	303.84		
880.30	114.49	884.38	231.89	888.46	304.79		
880.36	117.33	884.44	233.14	888.52	305.73		
880.42	120.14	884.50	234.37	888.58	306.67		
880.48	122.92	884.56	235.60	888.64	307.60		
880.54	125.65	884.62	236.82	888.70	308.53		
880.60	128.33	884.68	238.03	888.76	309.46		
880.66	130.94	884.74	239.24	888.82	310.39		
880.72	133.45	884.80	240.44	888.88	311.31		

Stage-Area-Storage for Pond ThE: 76"x48" Ellipse @ Thornapple East

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
876.70	0	0
876.85	11	1
877.00	44	4
877.15	99	15
877.30	177	35
877.45	276	69
877.60	397	119
877.75	541	189
877.90	706	283
878.05	900	402
878.20	1,130	554
878.35	1,386	743
878.50	1,668	971
878.65	1,976	1,244
878.80	2,311	1,566
878.95	2,672	1,939
879.10	3,058	2,368
879.25	3,471	2,858
879.40	3,910	3,411
879.55	4,376	4,032
879.70	4,867	4,725
879.85	5,384	5,494
880.00	5,928	6,342
880.15	6,599	7,281
880.30	7,306	8,323
880.45	8,049	9,474
880.60	8,827	10,740
880.75	9,642	12,124
880.90	10,493	13,634
881.05	11,379	15,274
881.20	12,302	17,050
881.35	13,261	18,966
881.50	14,255	21,030
881.65	15,286	23,245
881.80	16,352	25,617
881.95	17,455	28,152
882.10	18,471	30,849
882.25	19,455	33,693
882.40	20,464	36,687
882.55	21,498	39,834
882.70	22,558	43,138
882.85	23,643	46,602
883.00	24,754	50,232
883.15	25,890	54,030
883.30	27,052	58,000
883.45	28,239	62,147
883.60	29,452	66,473
883.75	30,690	70,984
883.90	31,954	75,682
884.05	33,224	80,571
884.20	34,478	85,648
884.35	35,756	90,915
884.50	37,057	96,376
884.65	38,381	102,033
884.80	39,728	107,891
884.95	41,099	113,953
885.10	42,492	120,222
885.25	43,909	126,702
885.40	45,350	133,396
885.55	46,813	140,308
885.70	48,300	147,441
885.85	49,810	154,799
886.00	51,343	162,385
886.15	52,855	170,200
886.30	54,390	178,243
886.45	55,946	186,518
886.60	57,524	195,028
886.75	59,124	203,776
886.90	60,746	212,766
887.05	62,390	222,001
887.20	64,056	231,484
887.35	65,744	241,219
887.50	67,454	251,208
887.65	69,186	261,456
887.80	70,939	271,965
887.95	72,715	282,739
888.10	74,361	293,773
888.25	75,948	305,046
888.40	77,552	316,559
888.55	79,173	328,313
888.70	80,810	340,311
888.85	82,465	352,557
889.00	84,136	365,051
889.15	85,823	377,798
889.30	87,528	390,799
889.45	89,249	404,057
889.60	90,987	417,575
889.75	92,742	431,354
889.90	94,514	445,398

Summary for Subcatchment SW1: Stratford 1

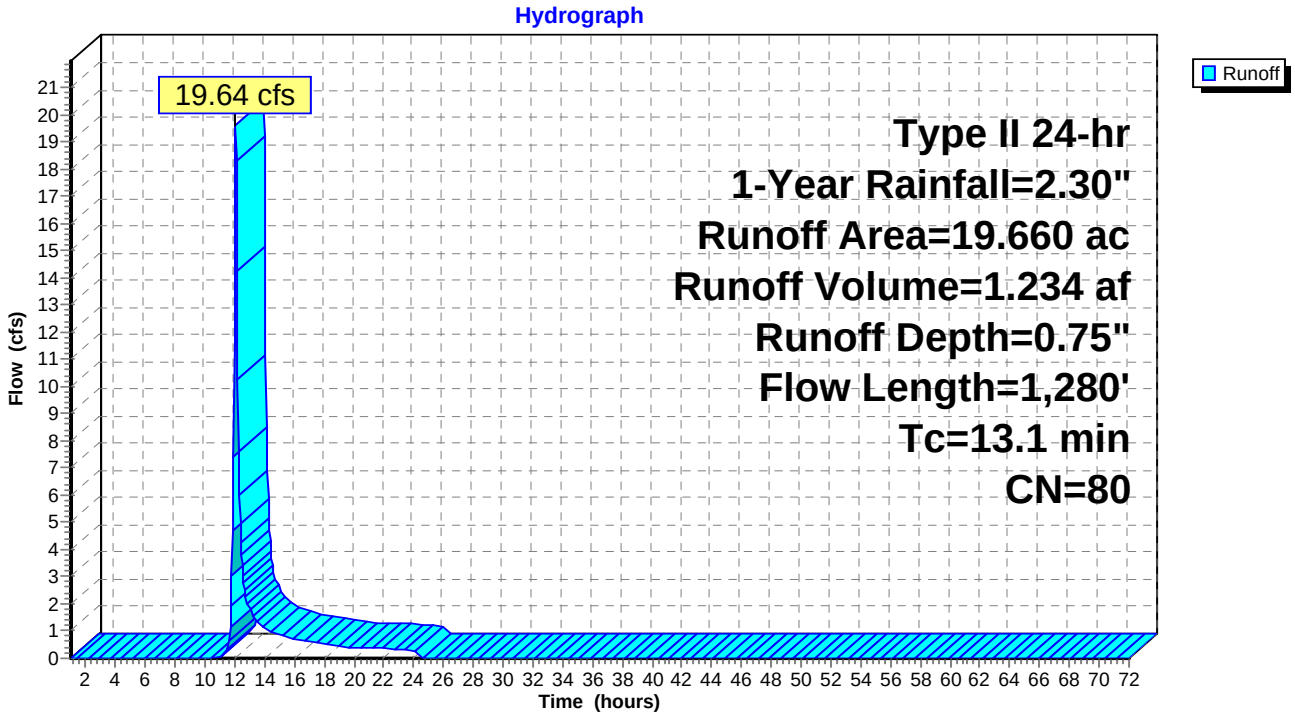
Runoff = 19.64 cfs @ 12.06 hrs, Volume= 1.234 af, Depth= 0.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

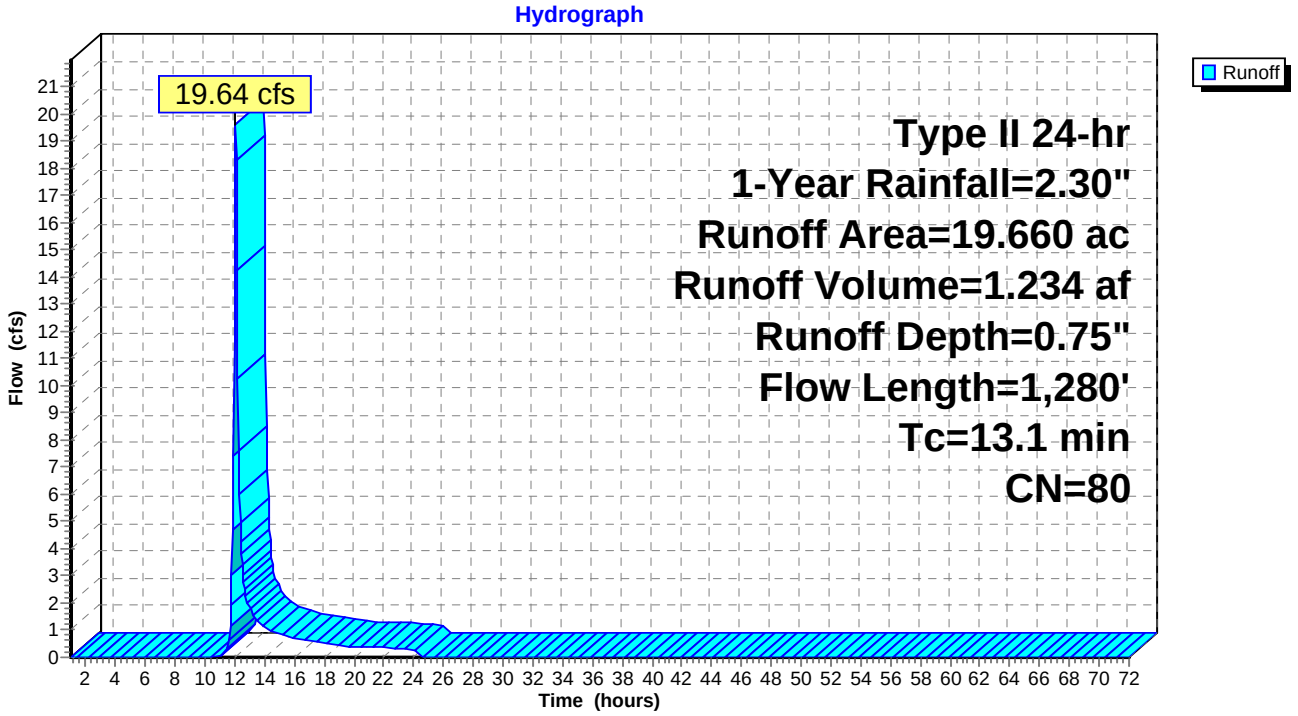
Area (ac)	CN	Description
4.160	70	Woods, Good, HSG C
15.500	83	1/4 acre lots, 38% imp, HSG C
19.660	80	Weighted Average
13.770		70.04% Pervious Area
5.890		29.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, city min
0.5	250	0.0120	8.94	878.58	Channel Flow, Area= 98.3 sf Perim= 36.9' r= 2.66' n= 0.035 Earth, dense weeds
0.8	250	0.0160	5.24	86.53	Channel Flow, Area= 16.5 sf Perim= 17.1' r= 0.96' n= 0.035 Earth, dense weeds
0.8	250	0.0160	5.28	85.60	Channel Flow, Area= 16.2 sf Perim= 16.6' r= 0.98' n= 0.035 Earth, dense weeds
0.7	250	0.0160	6.31	143.88	Channel Flow, Area= 22.8 sf Perim= 17.9' r= 1.27' n= 0.035 Earth, dense weeds
0.3	280	0.0205	13.93	3,288.58	Channel Flow, Area= 236.0 sf Perim= 68.0' r= 3.47' n= 0.035 Earth, dense weeds
13.1	1,280	Total			

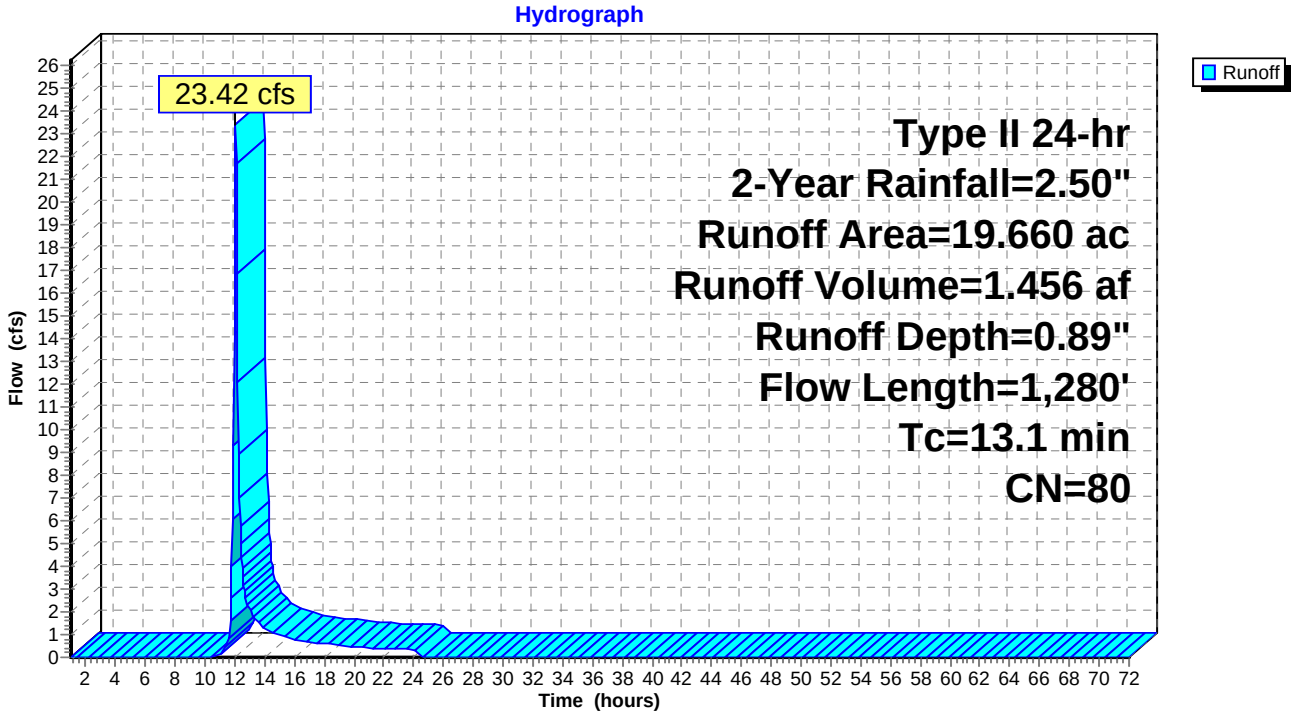
Subcatchment SW1: Stratford 1



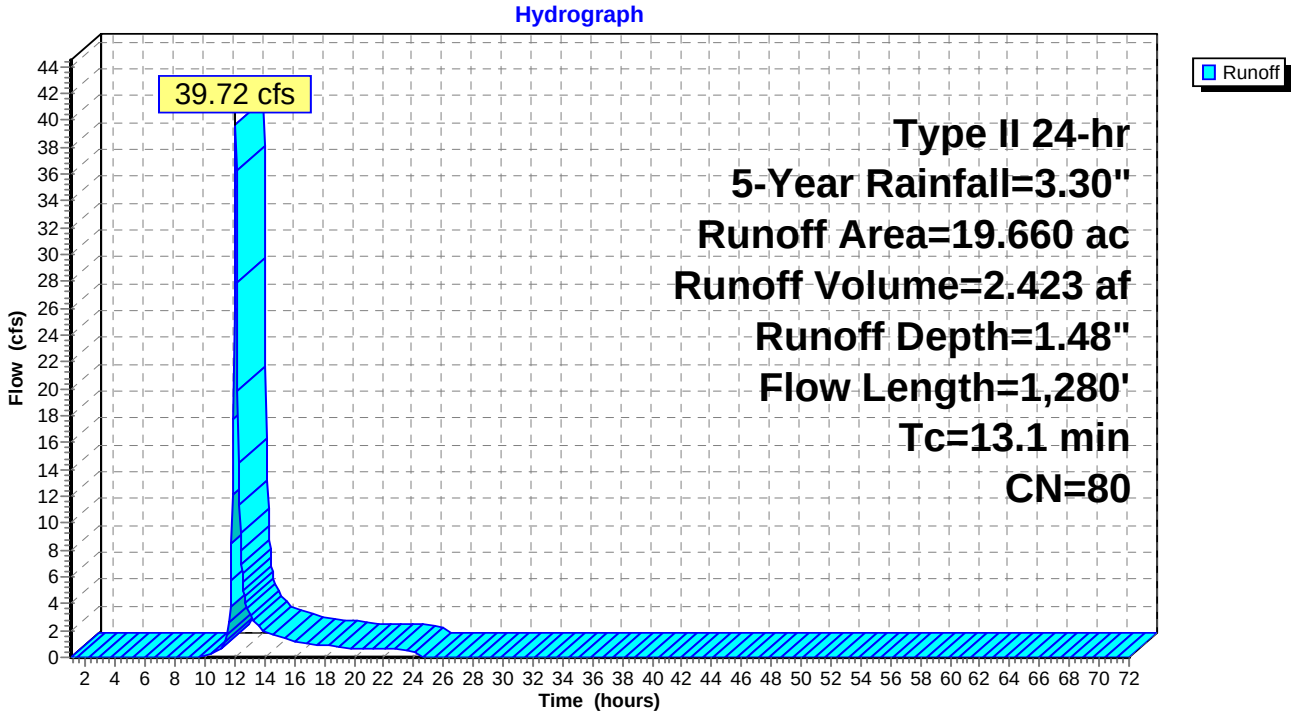
Subcatchment SW1: Stratford 1



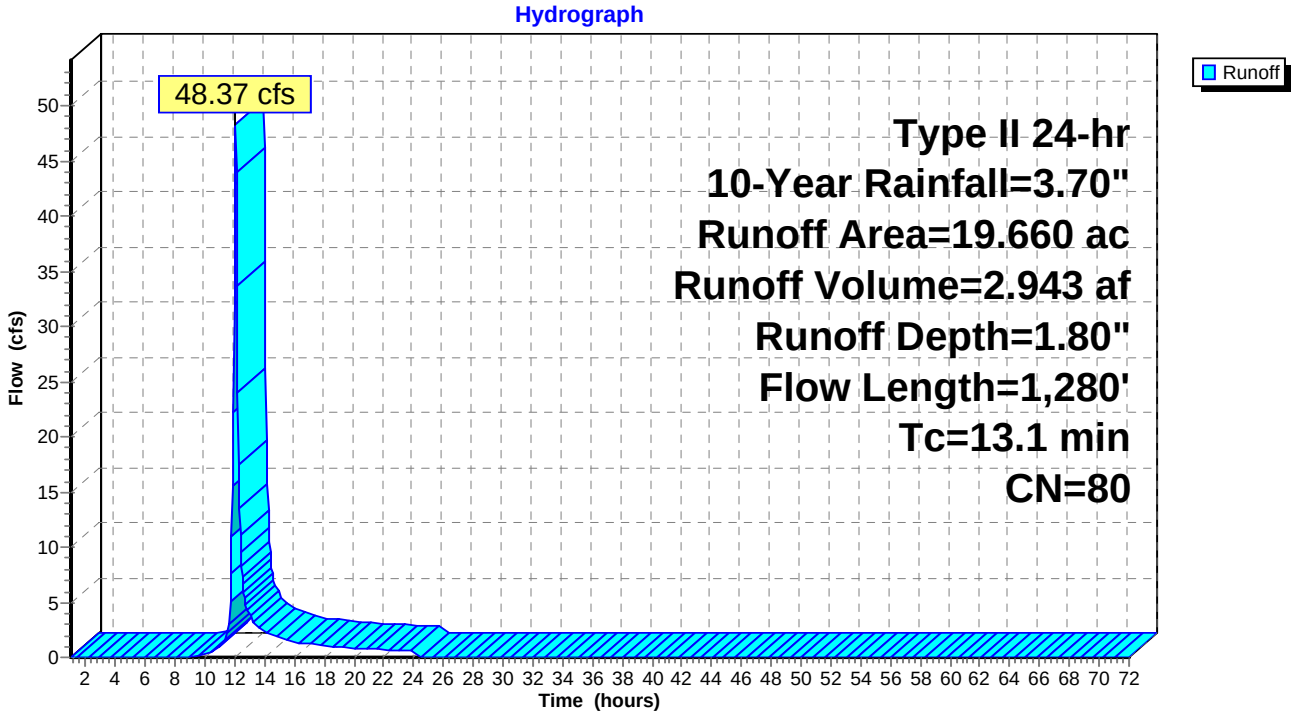
Subcatchment SW1: Stratford 1



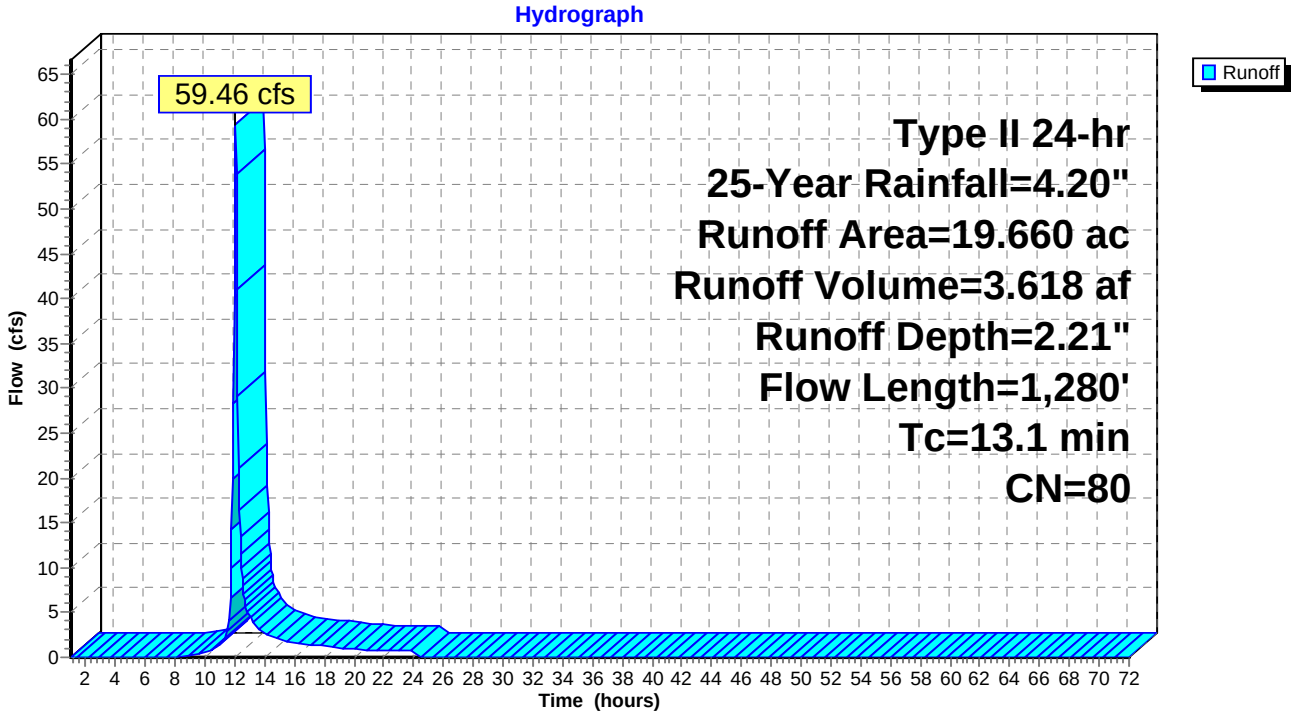
Subcatchment SW1: Stratford 1



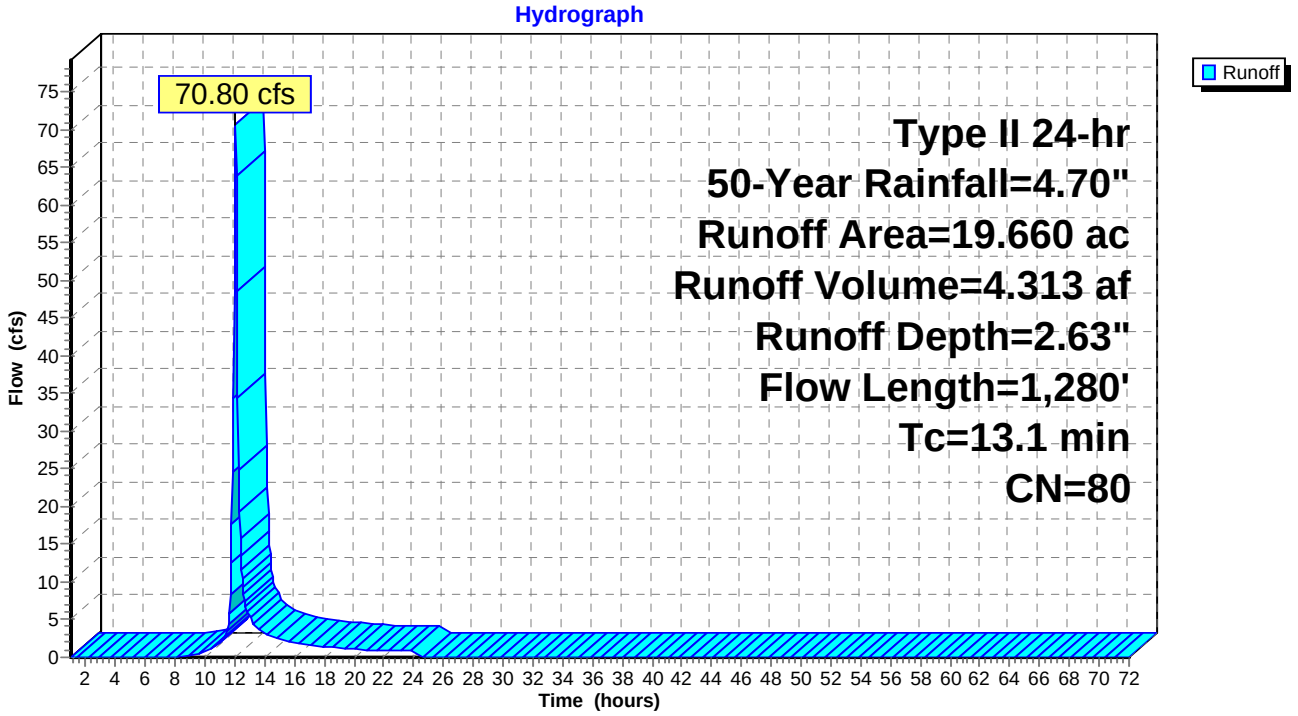
Subcatchment SW1: Stratford 1



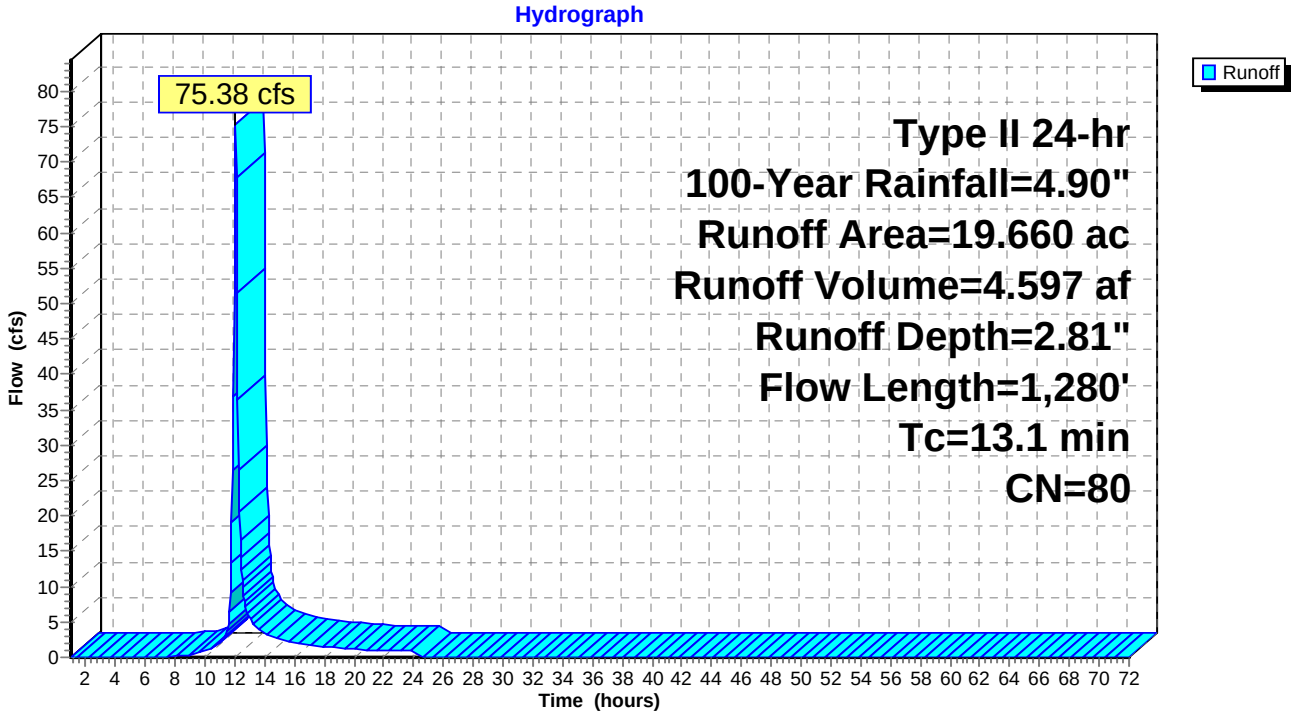
Subcatchment SW1: Stratford 1



Subcatchment SW1: Stratford 1



Subcatchment SW1: Stratford 1



Summary for Subcatchment US23: US23

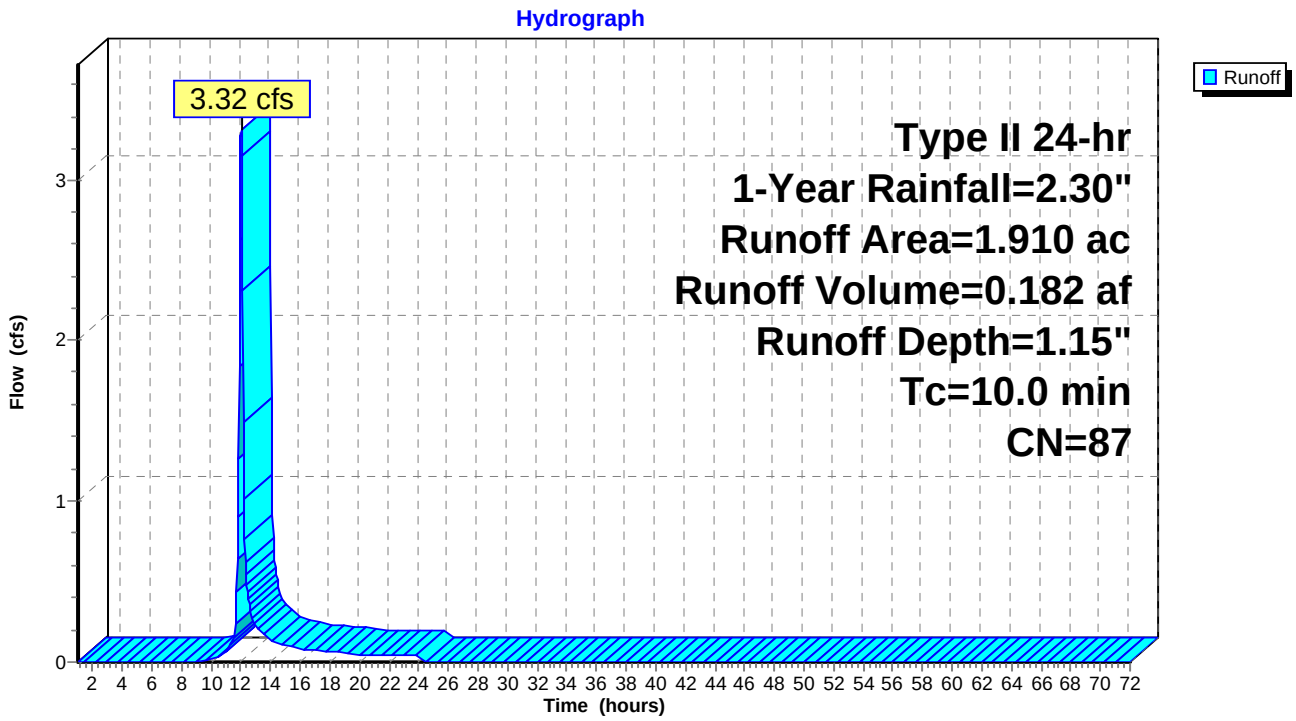
Runoff = 3.32 cfs @ 12.02 hrs, Volume= 0.182 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

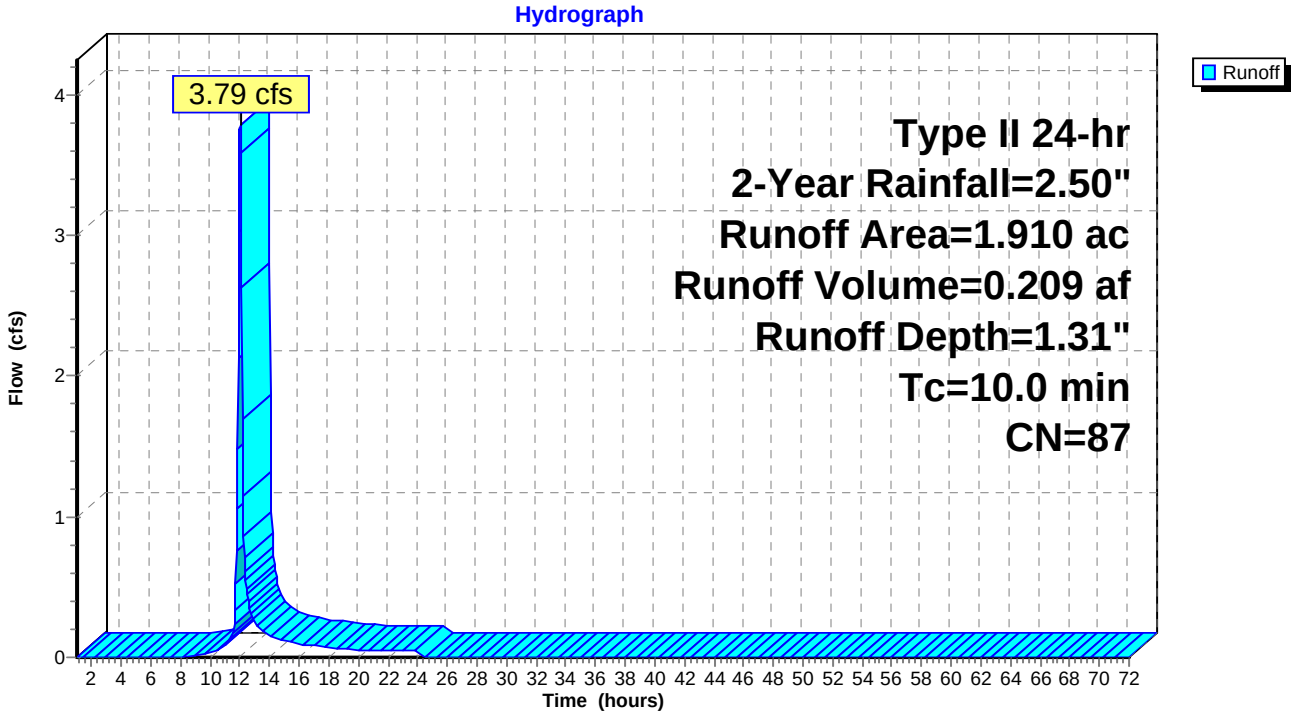
Area (ac)	CN	Description
1.010	98	Paved parking, HSG C
0.900	74	>75% Grass cover, Good, HSG C
1.910	87	Weighted Average
0.900		47.12% Pervious Area
1.010		52.88% Impervious Area

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

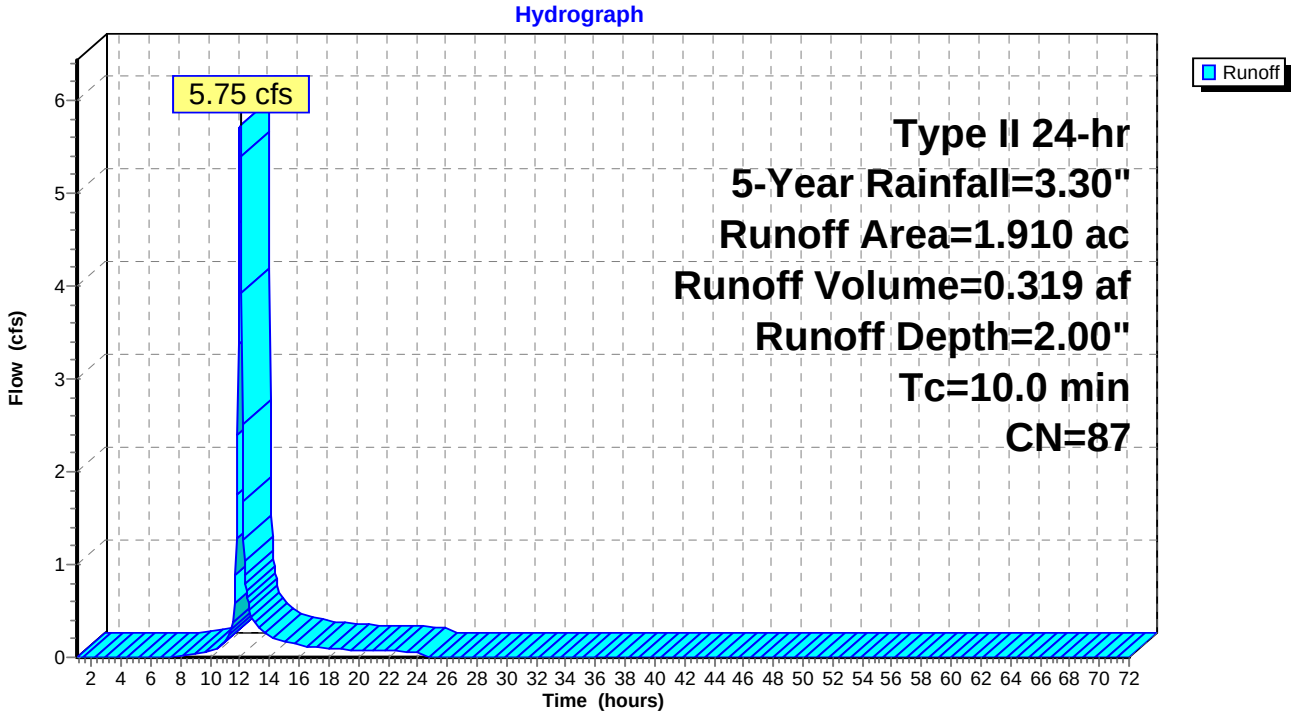
Subcatchment US23: US23



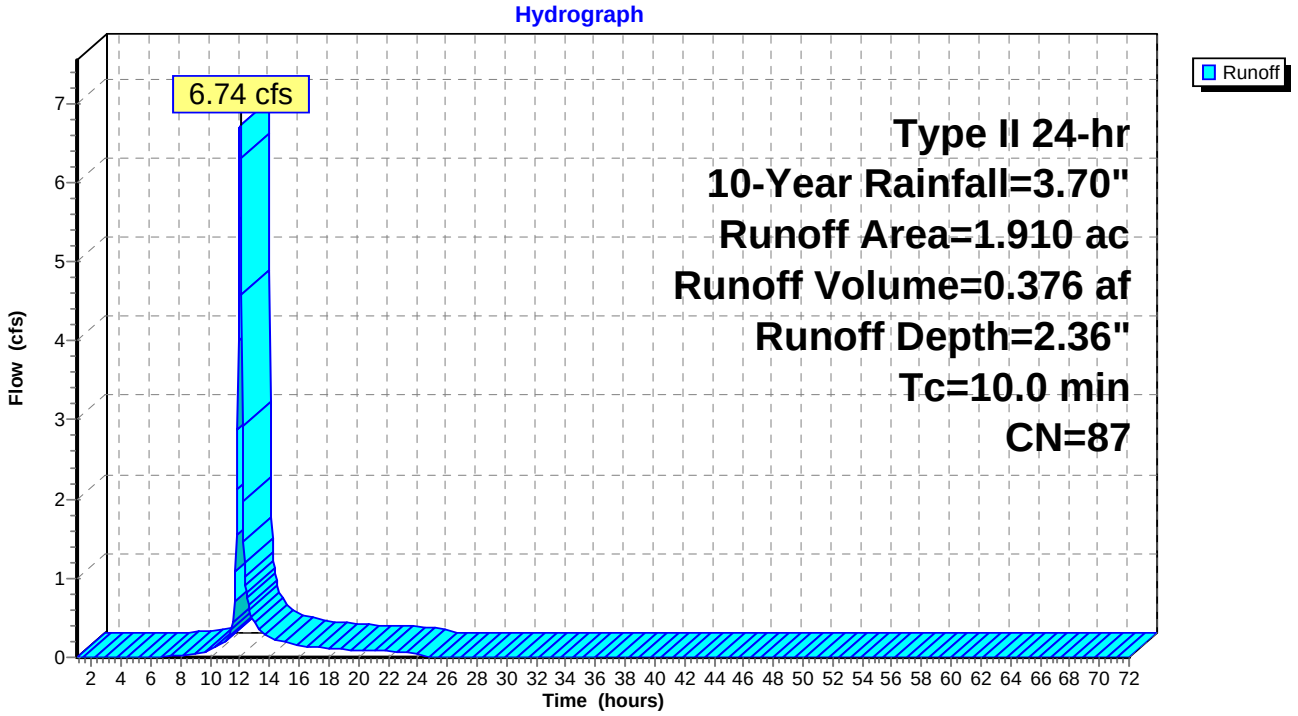
Subcatchment US23: US23



Subcatchment US23: US23



Subcatchment US23: US23



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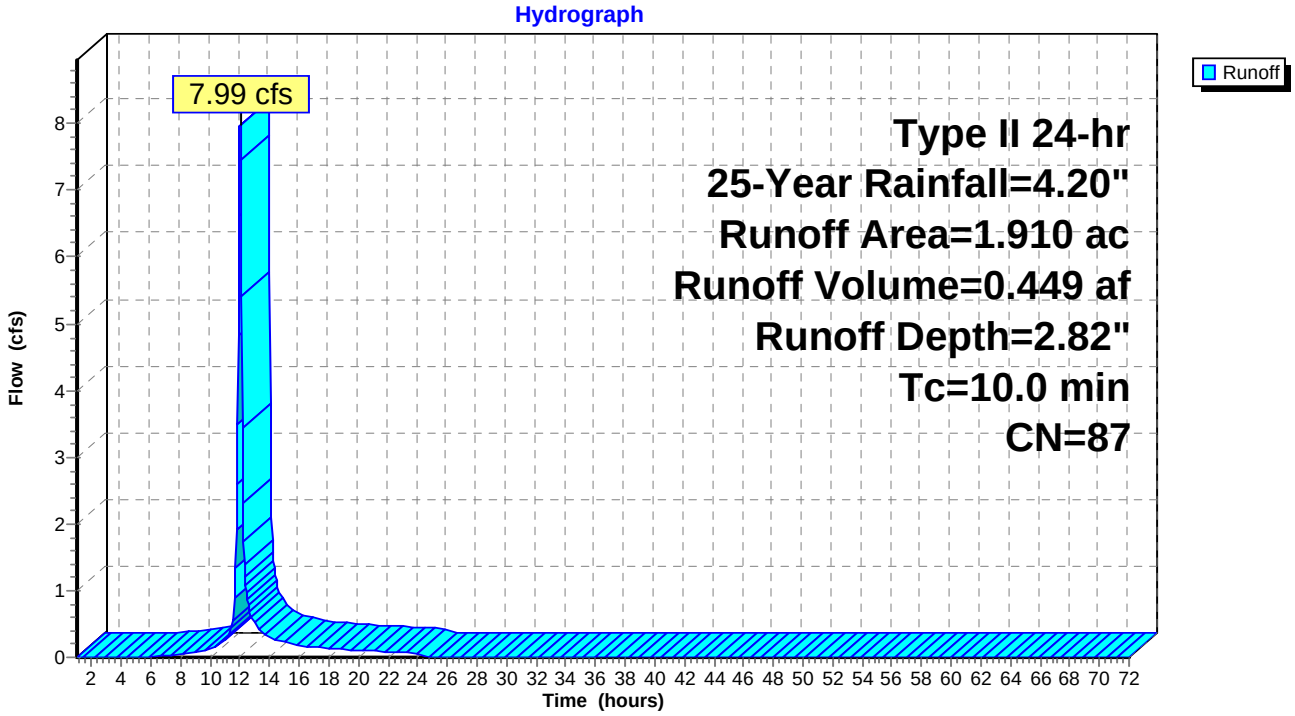
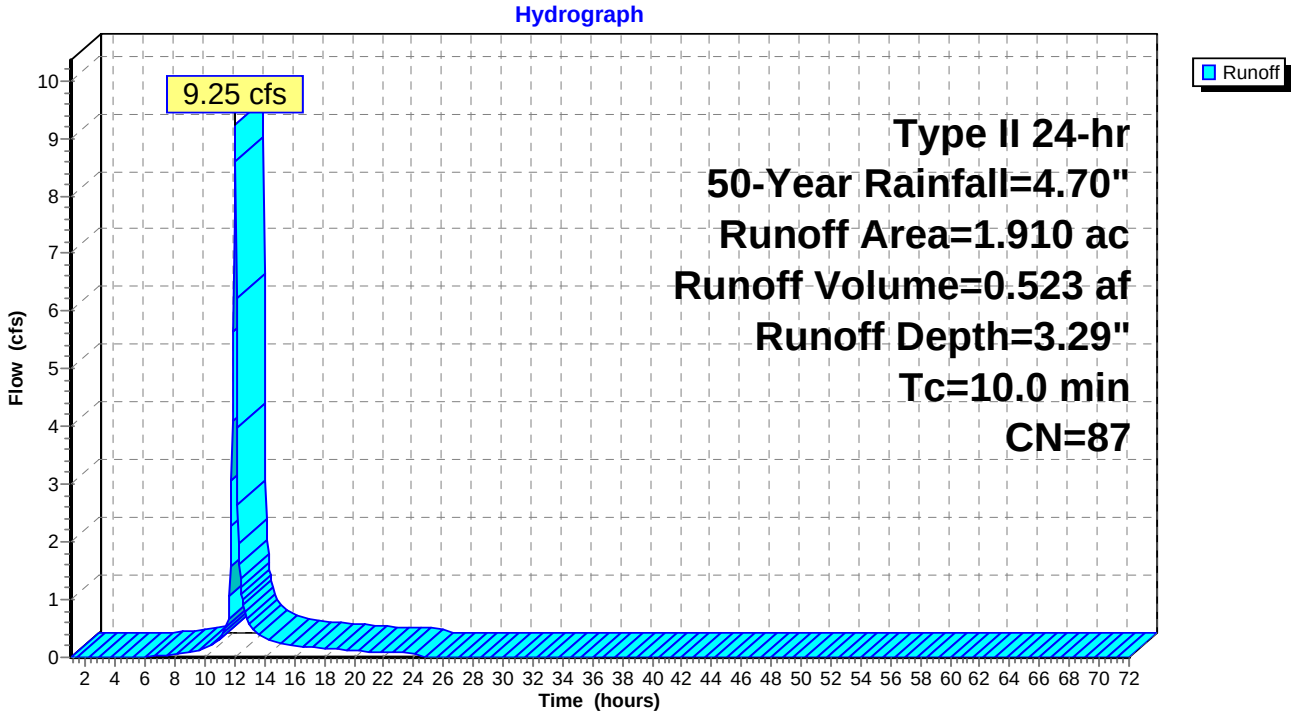
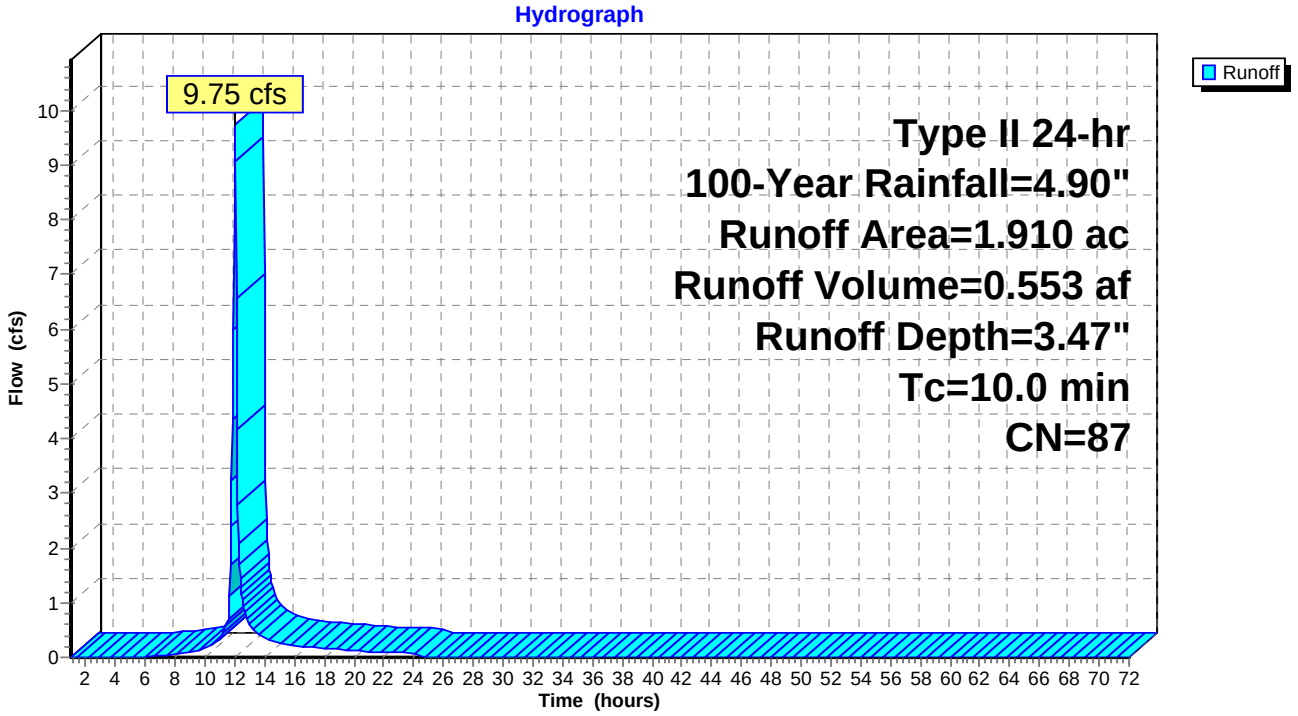


Subcatchment US23: US23



Subcatchment US23: US23



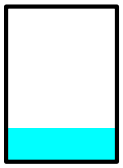
Summary for Reach 60x84: 60"x84" Culvert

Inflow Area = 661.910 ac, 4.41% Impervious, Inflow Depth = 0.65" for 1-Year event
Inflow = 82.33 cfs @ 12.20 hrs, Volume= 35.620 af
Outflow = 82.20 cfs @ 12.21 hrs, Volume= 35.620 af, Atten= 0%, Lag= 0.5 min

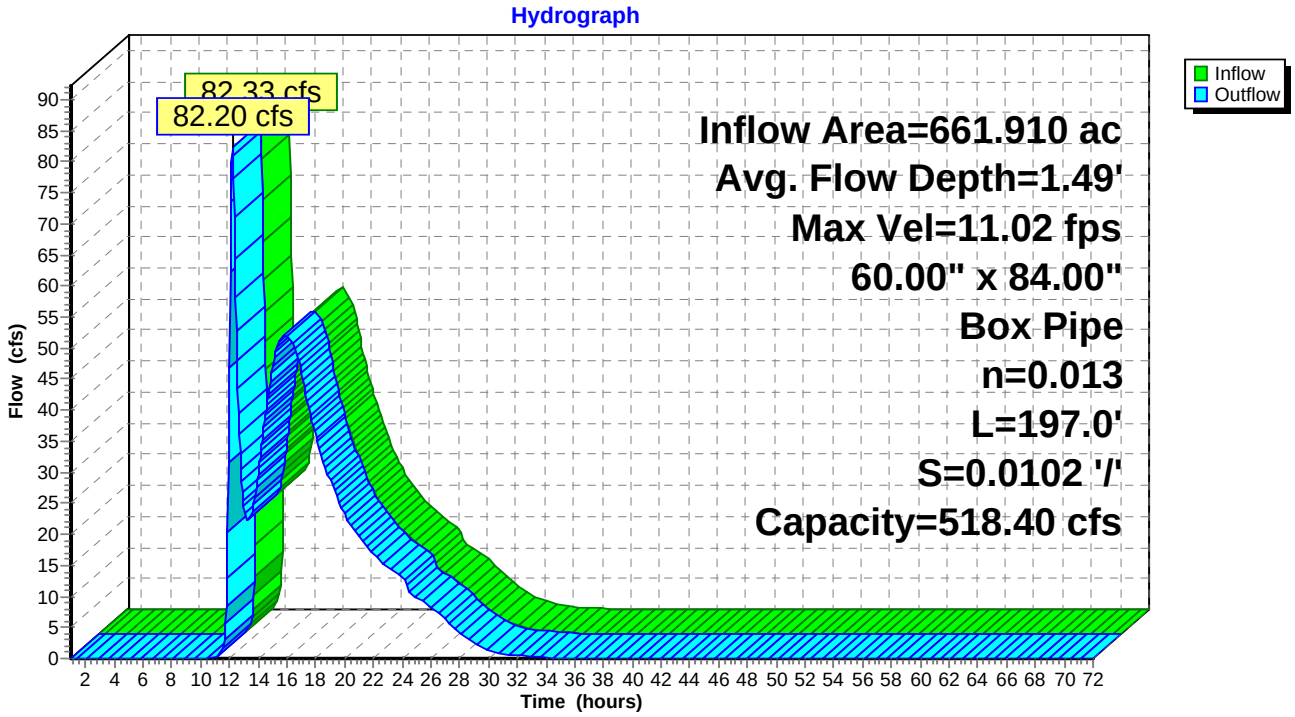
Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.02 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 4.82 fps, Avg. Travel Time= 0.7 min

Peak Storage= 1,472 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.49'
Bank-Full Depth= 7.00' Flow Area= 35.0 sf, Capacity= 518.40 cfs

60.00" W x 84.00" H Box Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 197.0' Slope= 0.0102 '/'
Inlet Invert= 854.00', Outlet Invert= 852.00'



Reach 60x84: 60"x84" Culvert



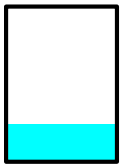
Summary for Reach 60x84: 60"x84" Culvert

Inflow Area = 661.910 ac, 4.41% Impervious, Inflow Depth = 0.77" for 2-Year event
Inflow = 98.32 cfs @ 12.20 hrs, Volume= 42.505 af
Outflow = 98.17 cfs @ 12.21 hrs, Volume= 42.505 af, Atten= 0%, Lag= 0.5 min

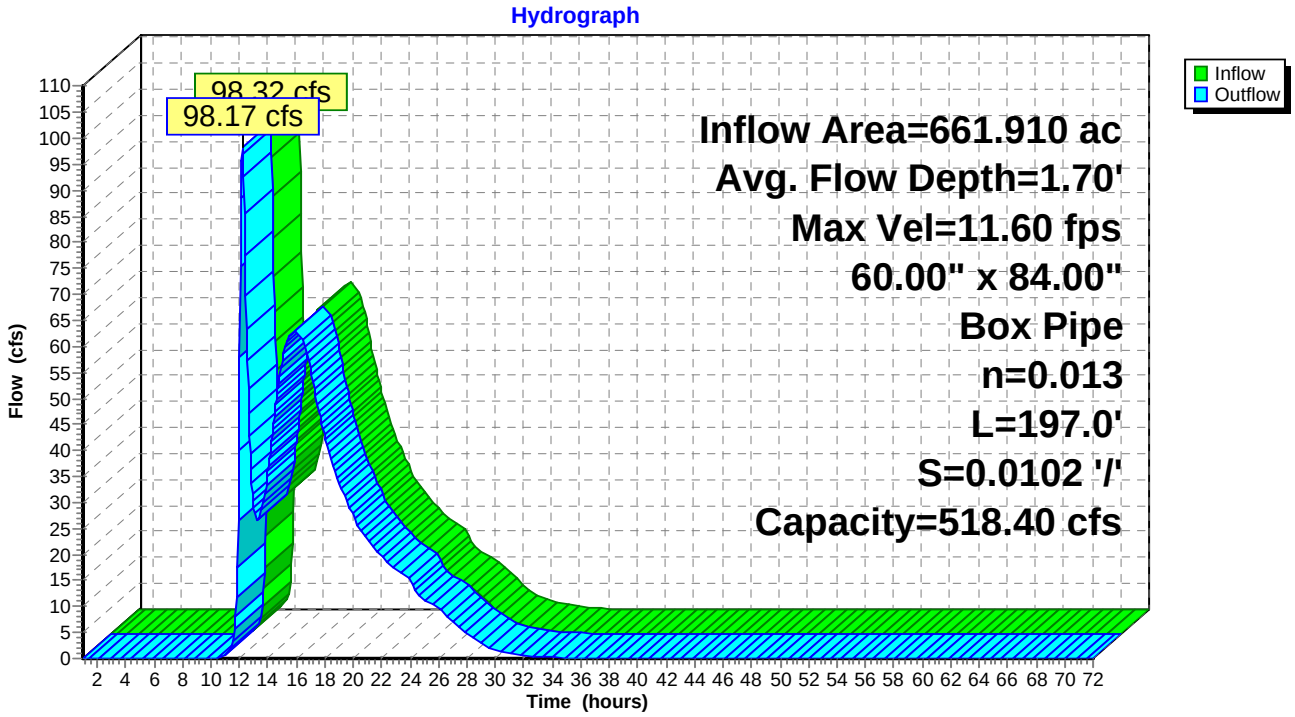
Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.60 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 5.03 fps, Avg. Travel Time= 0.7 min

Peak Storage= 1,670 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.70'
Bank-Full Depth= 7.00' Flow Area= 35.0 sf, Capacity= 518.40 cfs

60.00" W x 84.00" H Box Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 197.0' Slope= 0.0102 '/'
Inlet Invert= 854.00', Outlet Invert= 852.00'



Reach 60x84: 60"x84" Culvert



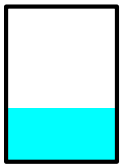
Summary for Reach 60x84: 60"x84" Culvert

Inflow Area = 661.910 ac, 4.41% Impervious, Inflow Depth = 1.32" for 5-Year event
Inflow = 161.22 cfs @ 12.20 hrs, Volume= 72.994 af
Outflow = 161.16 cfs @ 12.21 hrs, Volume= 72.994 af, Atten= 0%, Lag= 0.5 min

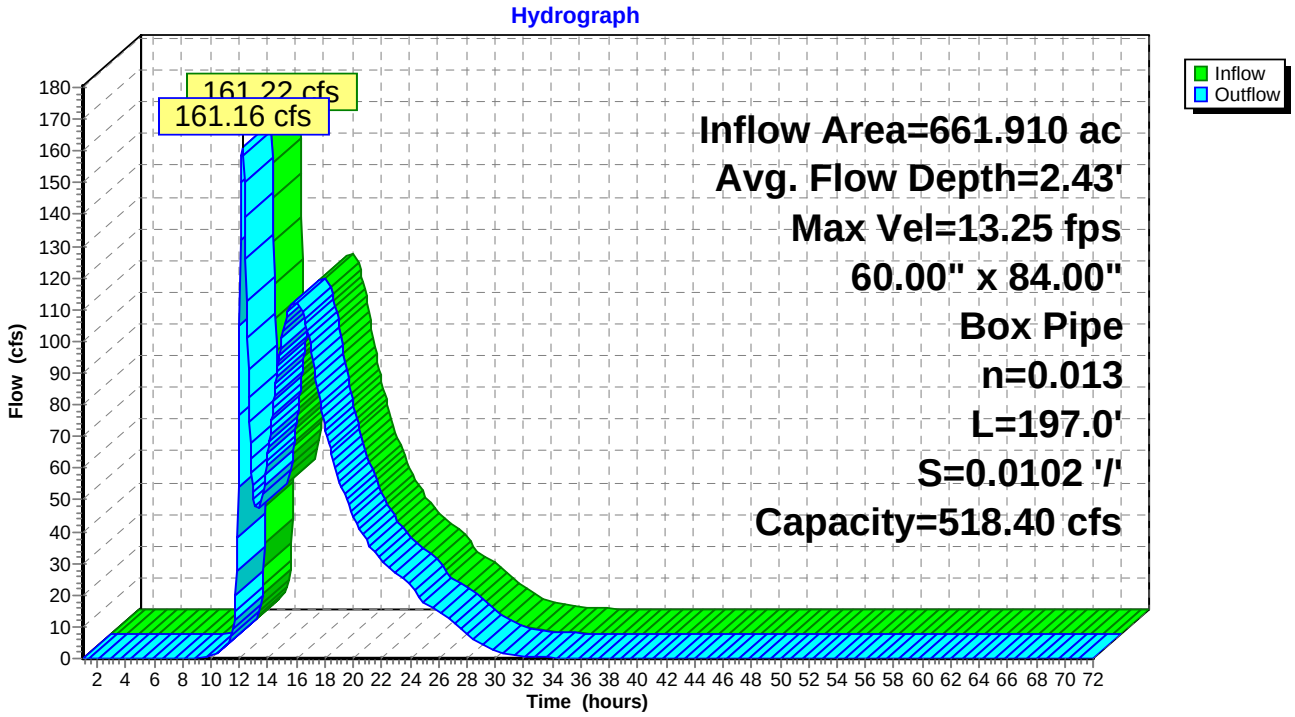
Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.25 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 5.71 fps, Avg. Travel Time= 0.6 min

Peak Storage= 2,398 cf @ 12.21 hrs
Average Depth at Peak Storage= 2.43'
Bank-Full Depth= 7.00' Flow Area= 35.0 sf, Capacity= 518.40 cfs

60.00" W x 84.00" H Box Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 197.0' Slope= 0.0102 '/'
Inlet Invert= 854.00', Outlet Invert= 852.00'



Reach 60x84: 60"x84" Culvert



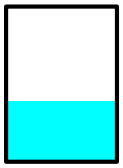
Summary for Reach 60x84: 60"x84" Culvert

Inflow Area = 661.910 ac, 4.41% Impervious, Inflow Depth = 1.62" for 10-Year event
Inflow = 187.23 cfs @ 12.21 hrs, Volume= 89.597 af
Outflow = 187.18 cfs @ 12.22 hrs, Volume= 89.597 af, Atten= 0%, Lag= 0.6 min

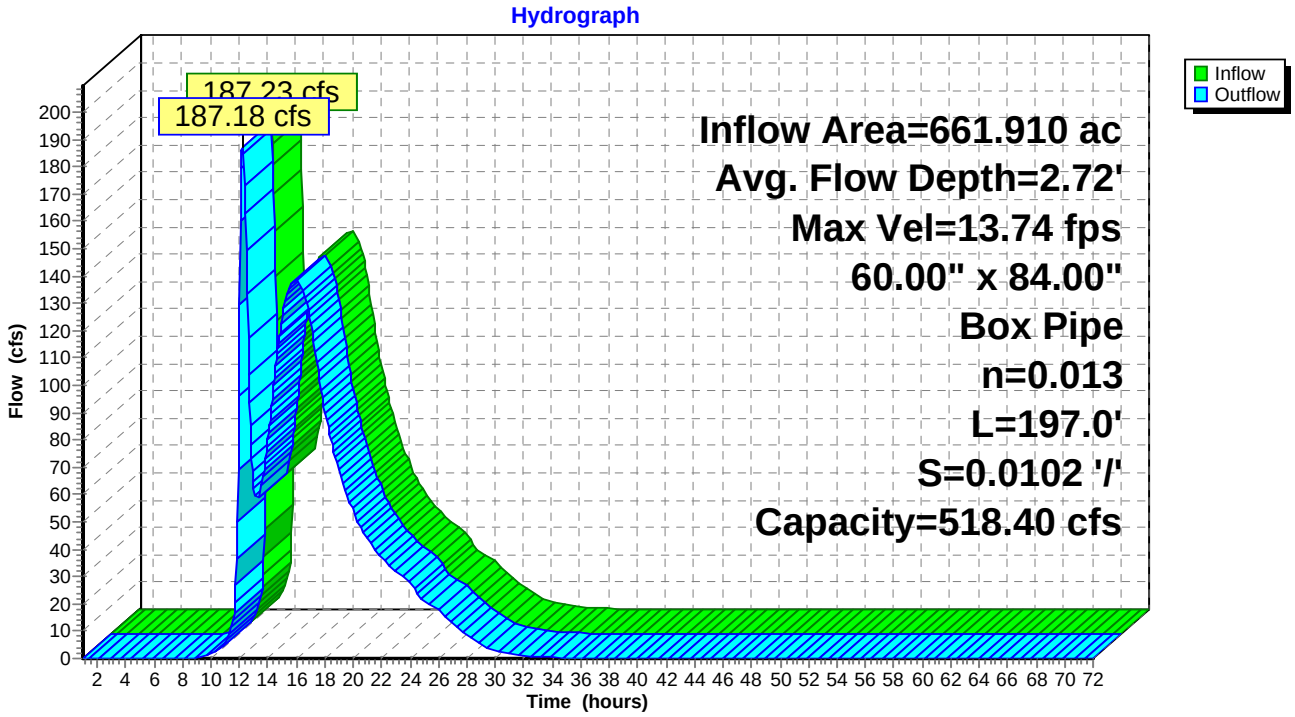
Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.74 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 5.98 fps, Avg. Travel Time= 0.5 min

Peak Storage= 2,683 cf @ 12.21 hrs
Average Depth at Peak Storage= 2.72'
Bank-Full Depth= 7.00' Flow Area= 35.0 sf, Capacity= 518.40 cfs

60.00" W x 84.00" H Box Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 197.0' Slope= 0.0102 '/'
Inlet Invert= 854.00', Outlet Invert= 852.00'



Reach 60x84: 60"x84" Culvert



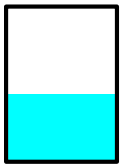
Summary for Reach 60x84: 60"x84" Culvert

Inflow Area = 661.910 ac, 4.41% Impervious, Inflow Depth = 2.02" for 25-Year event
Inflow = 216.04 cfs @ 12.15 hrs, Volume= 111.292 af
Outflow = 215.77 cfs @ 12.15 hrs, Volume= 111.292 af, Atten= 0%, Lag= 0.0 min

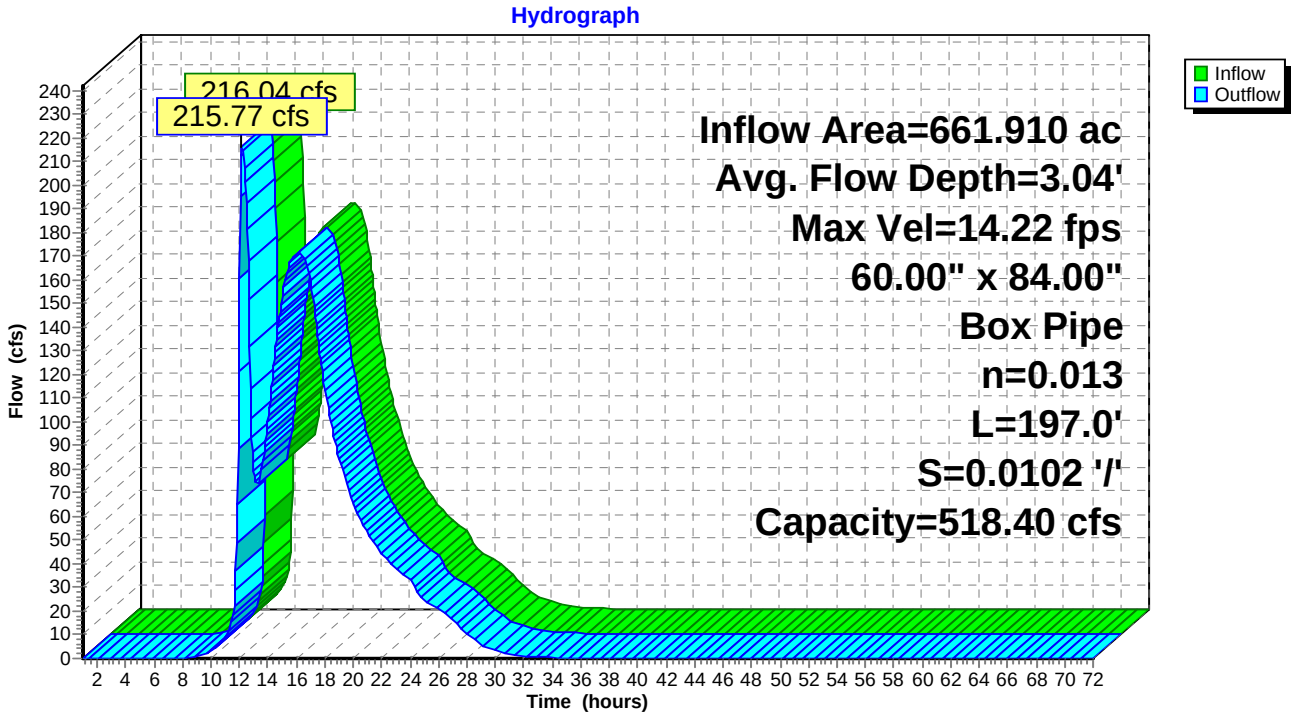
Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.22 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 6.29 fps, Avg. Travel Time= 0.5 min

Peak Storage= 2,993 cf @ 12.15 hrs
Average Depth at Peak Storage= 3.04'
Bank-Full Depth= 7.00' Flow Area= 35.0 sf, Capacity= 518.40 cfs

60.00" W x 84.00" H Box Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 197.0' Slope= 0.0102 '/'
Inlet Invert= 854.00', Outlet Invert= 852.00'



Reach 60x84: 60"x84" Culvert



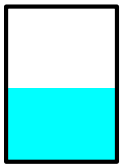
Summary for Reach 60x84: 60"x84" Culvert

Inflow Area = 661.910 ac, 4.41% Impervious, Inflow Depth = 2.43" for 50-Year event
Inflow = 242.63 cfs @ 12.13 hrs, Volume= 133.824 af
Outflow = 242.60 cfs @ 12.15 hrs, Volume= 133.824 af, Atten= 0%, Lag= 1.1 min

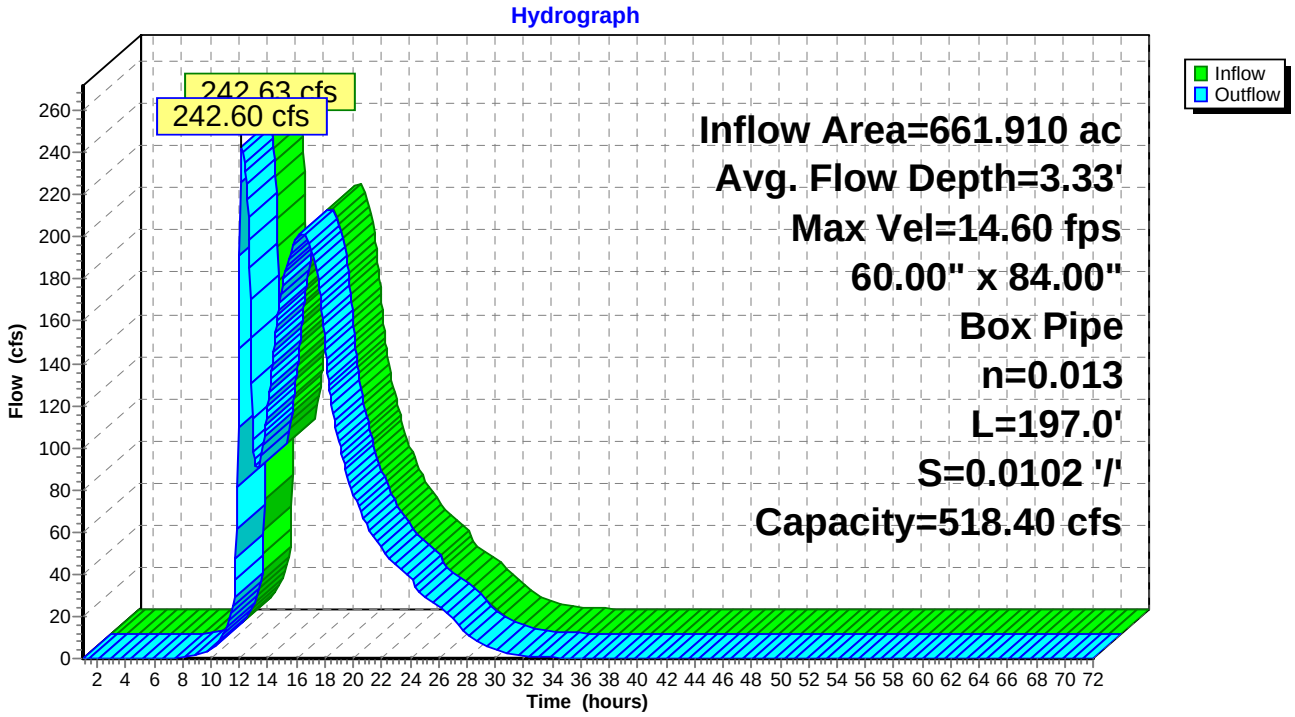
Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.60 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 6.57 fps, Avg. Travel Time= 0.5 min

Peak Storage= 3,275 cf @ 12.14 hrs
Average Depth at Peak Storage= 3.33'
Bank-Full Depth= 7.00' Flow Area= 35.0 sf, Capacity= 518.40 cfs

60.00" W x 84.00" H Box Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 197.0' Slope= 0.0102 '/'
Inlet Invert= 854.00', Outlet Invert= 852.00'



Reach 60x84: 60"x84" Culvert



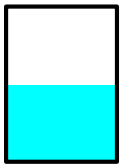
Summary for Reach 60x84: 60"x84" Culvert

Inflow Area = 661.910 ac, 4.41% Impervious, Inflow Depth = 2.59" for 100-Year event
Inflow = 254.22 cfs @ 12.12 hrs, Volume= 143.032 af
Outflow = 252.76 cfs @ 12.14 hrs, Volume= 143.032 af, Atten= 1%, Lag= 0.9 min

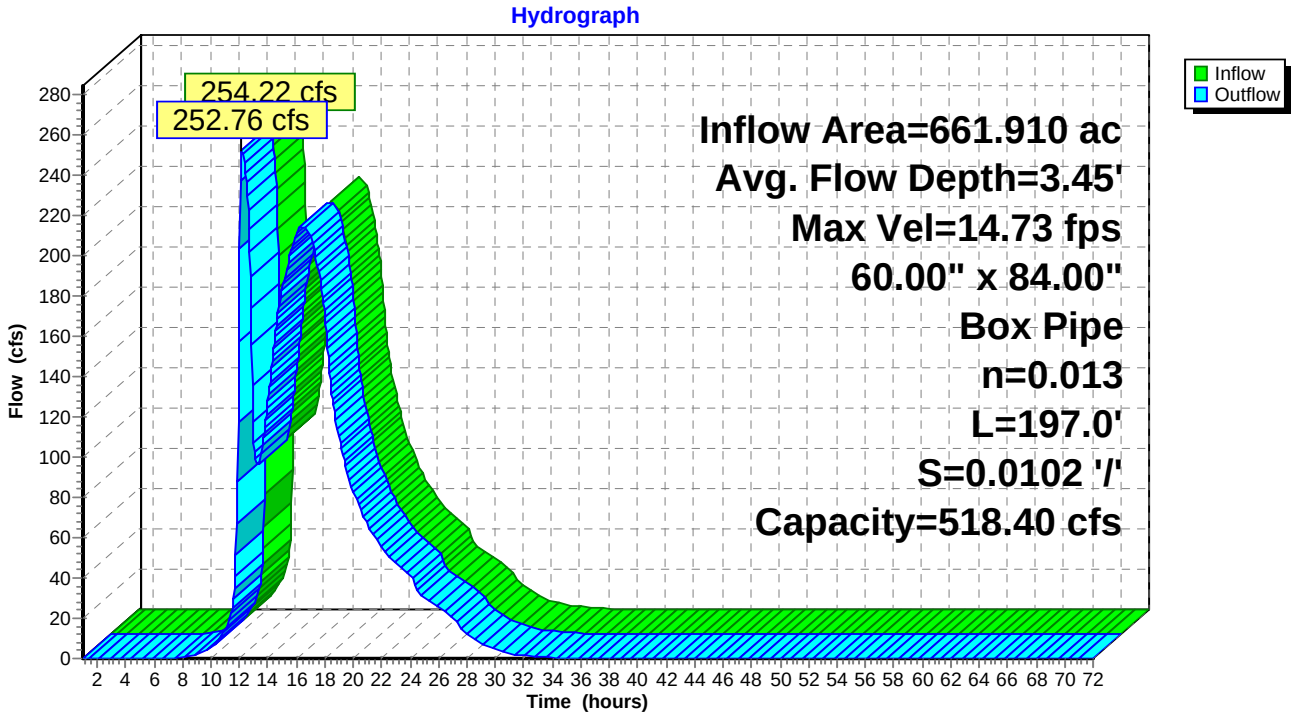
Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.73 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 6.68 fps, Avg. Travel Time= 0.5 min

Peak Storage= 3,396 cf @ 12.12 hrs
Average Depth at Peak Storage= 3.45'
Bank-Full Depth= 7.00' Flow Area= 35.0 sf, Capacity= 518.40 cfs

60.00" W x 84.00" H Box Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 197.0' Slope= 0.0102 '/'
Inlet Invert= 854.00', Outlet Invert= 852.00'



Reach 60x84: 60"x84" Culvert



Summary for Subcatchment D1: Drexel 1

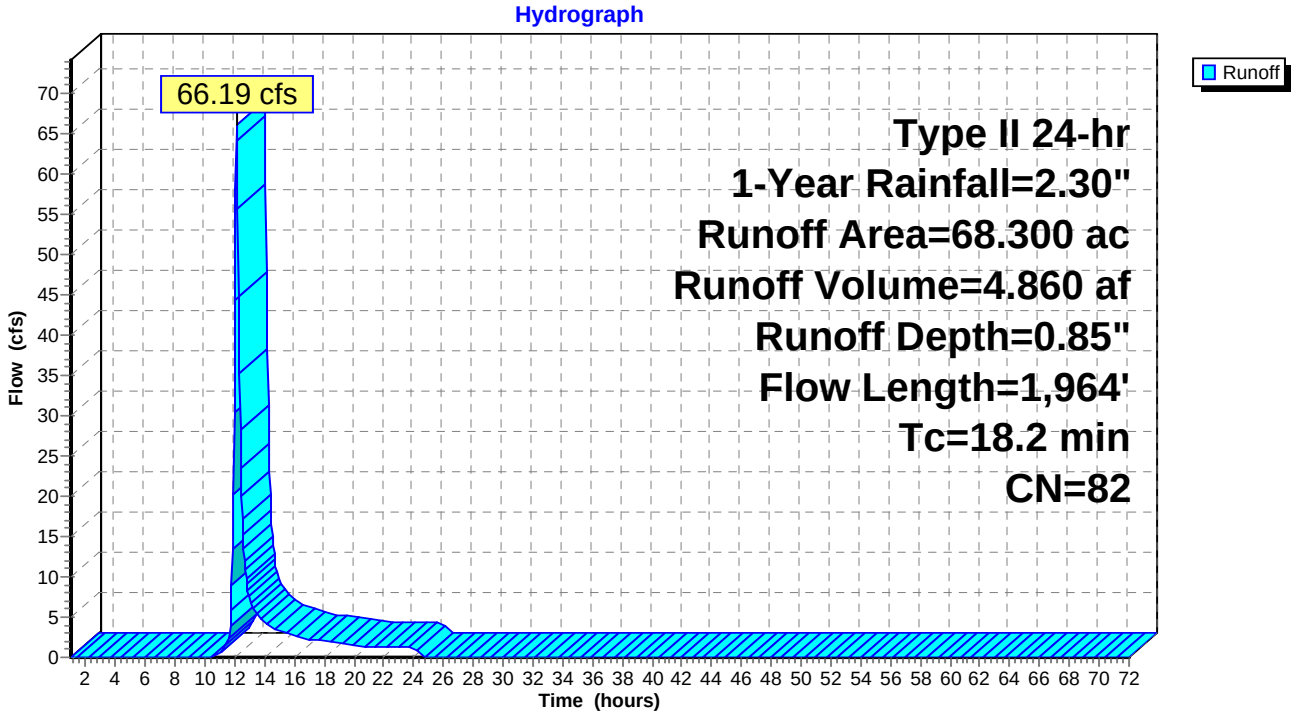
Runoff = 66.19 cfs @ 12.12 hrs, Volume= 4.860 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

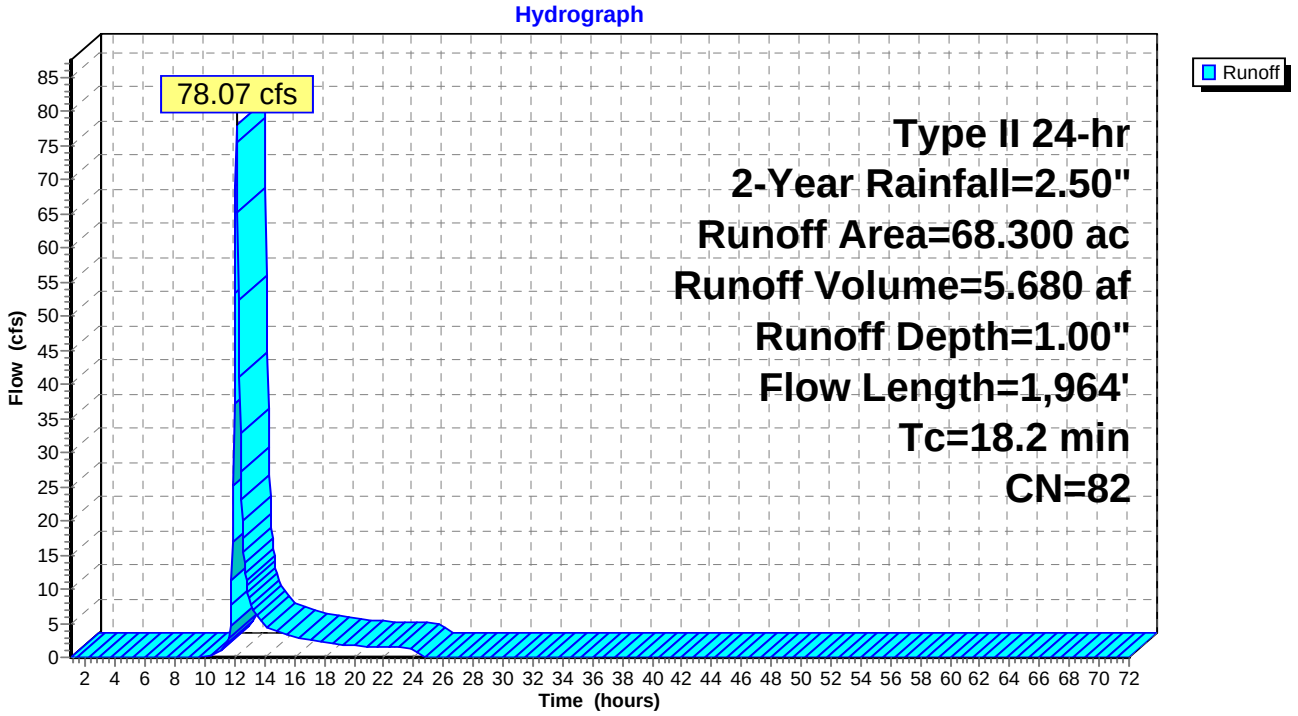
Area (ac)	CN	Description
6.050	70	Woods, Good, HSG C
62.250	83	1/4 acre lots, 38% imp, HSG C
68.300	82	Weighted Average
44.645		65.37% Pervious Area
23.655		34.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	100	0.1560	0.16		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.63"
4.4	150	0.0130	0.57		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.6	250	0.0160	7.18	408.60	Channel Flow, Area= 56.9 sf Perim= 36.8' r= 1.55' n= 0.035 Earth, dense weeds
0.3	250	0.0244	14.75	2,314.43	Channel Flow, Area= 156.9 sf Perim= 47.3' r= 3.32' n= 0.035 Earth, dense weeds
0.8	250	0.0152	5.01	128.38	Channel Flow, Area= 25.6 sf Perim= 27.3' r= 0.94' n= 0.035 Earth, dense weeds
0.4	250	0.0236	11.05	806.73	Channel Flow, Area= 73.0 sf Perim= 33.1' r= 2.21' n= 0.035 Earth, dense weeds
0.2	250	0.0324	18.16	2,632.53	Channel Flow, Area= 145.0 sf Perim= 39.6' r= 3.66' n= 0.035 Earth, dense weeds
0.4	250	0.0160	9.48	857.76	Channel Flow, Area= 90.5 sf Perim= 38.6' r= 2.34' n= 0.035
0.7	214	0.0180	5.35	285.58	Channel Flow, Area= 53.4 sf Perim= 58.7' r= 0.91' n= 0.035
18.2	1,964	Total			

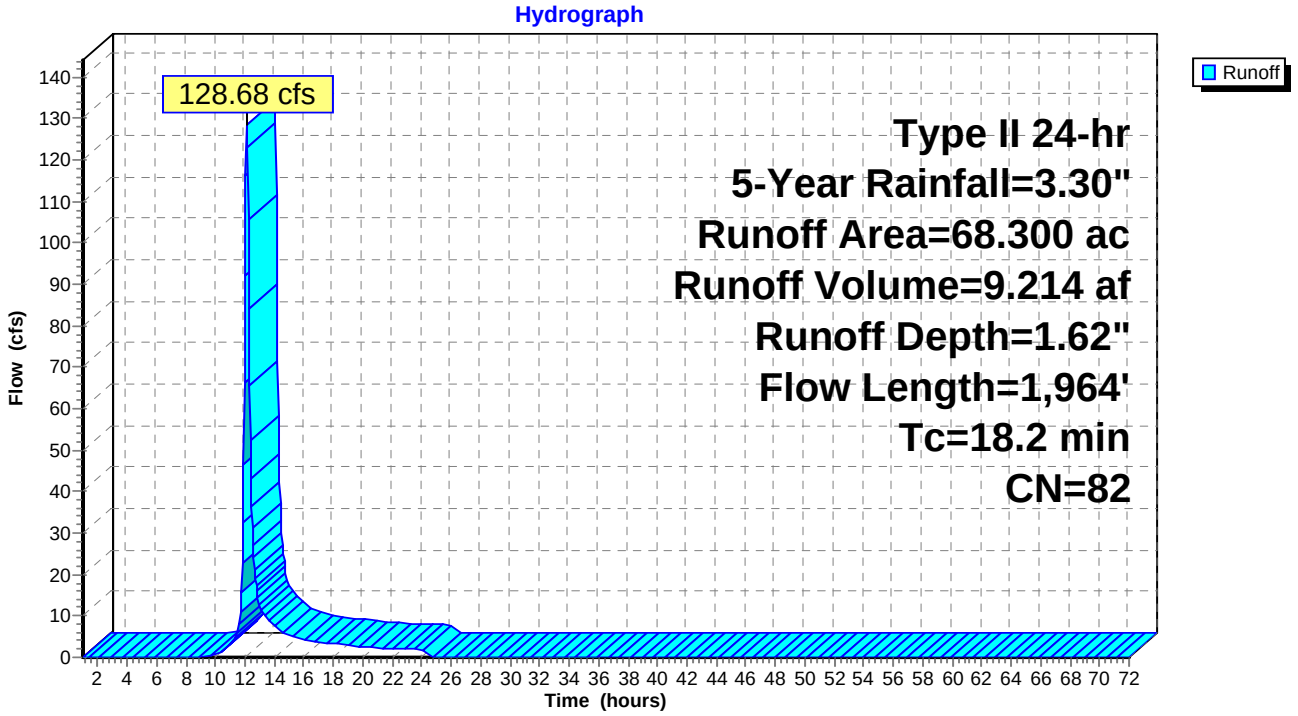
Subcatchment D1: Drexel 1



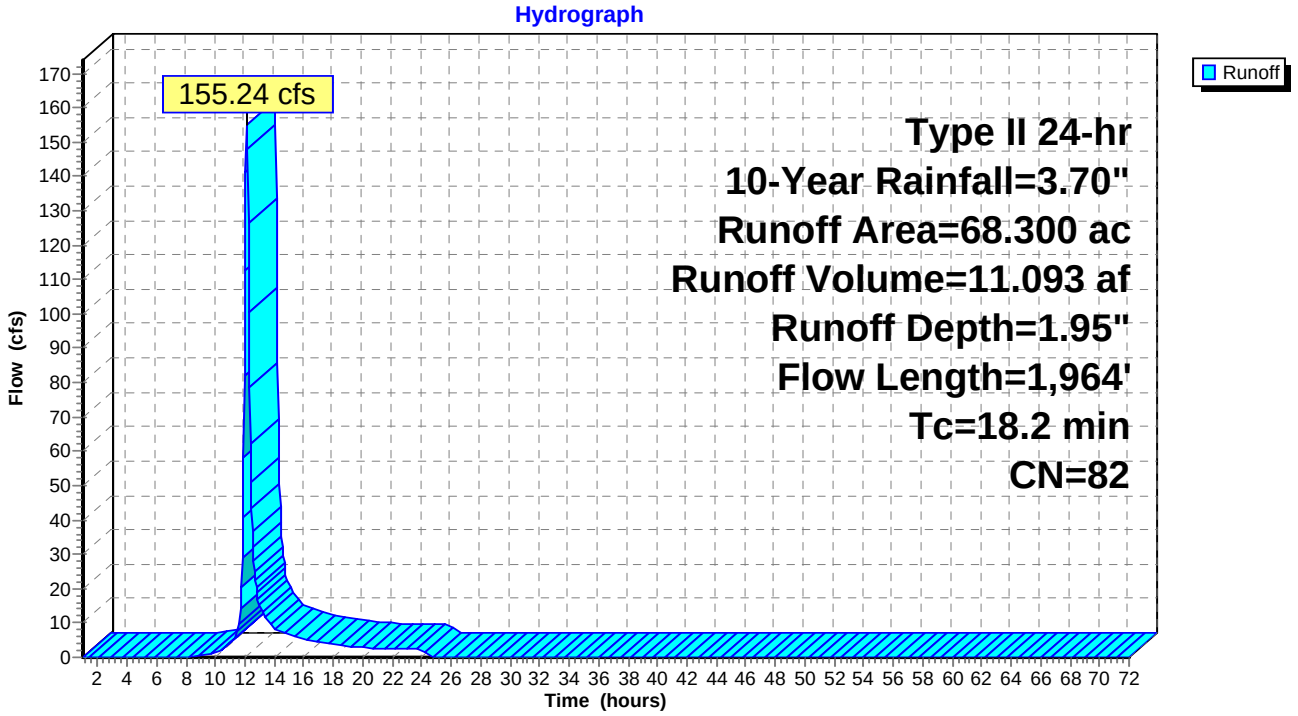
Subcatchment D1: Drexel 1



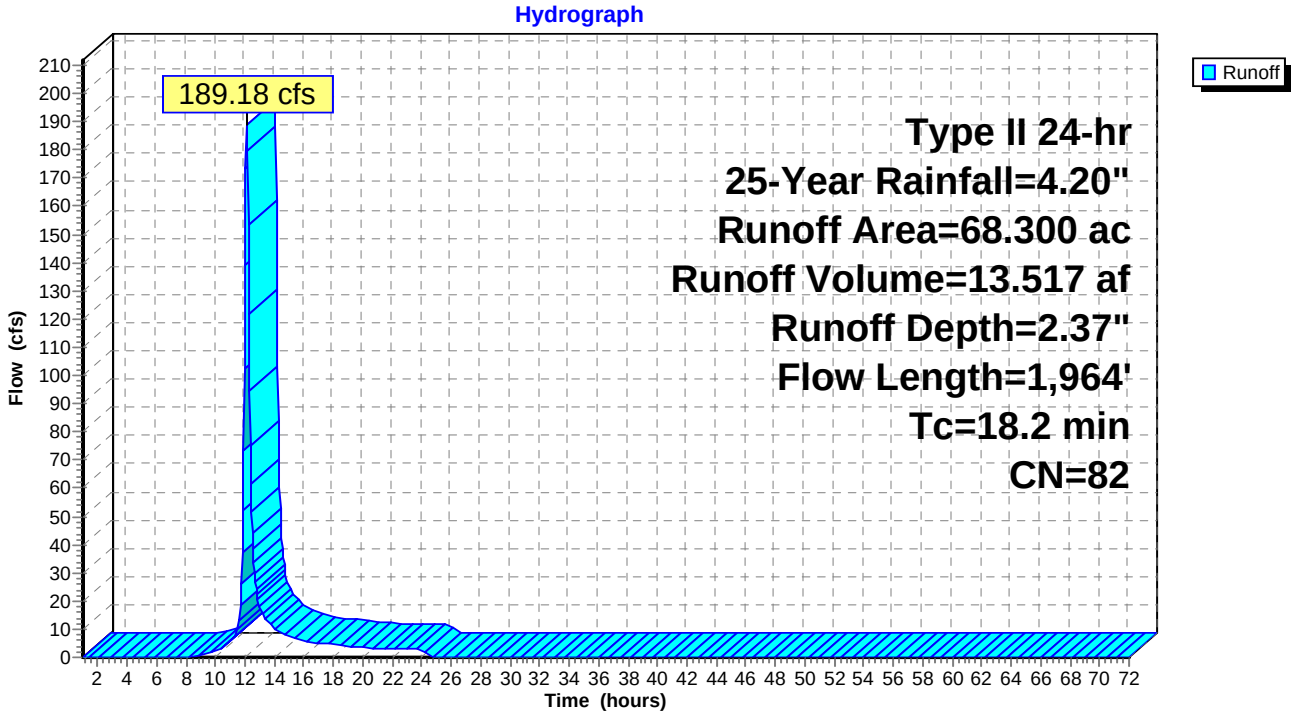
Subcatchment D1: Drexel 1



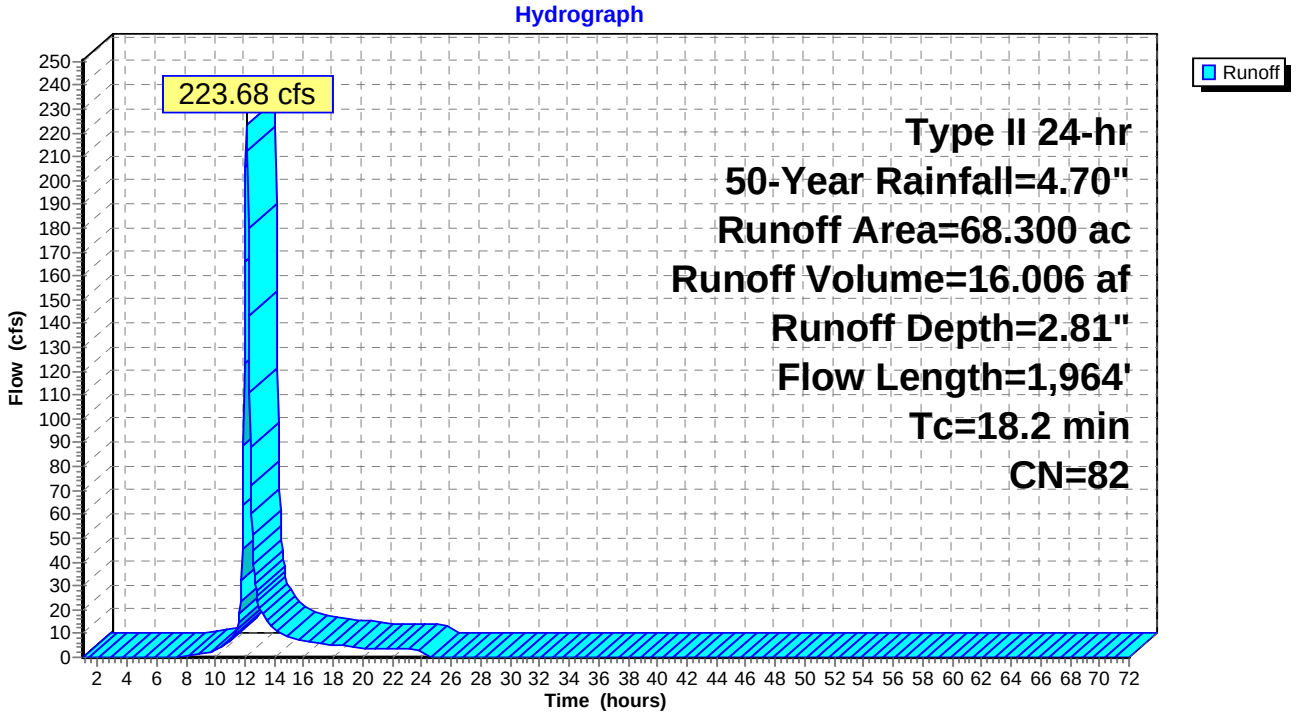
Subcatchment D1: Drexel 1



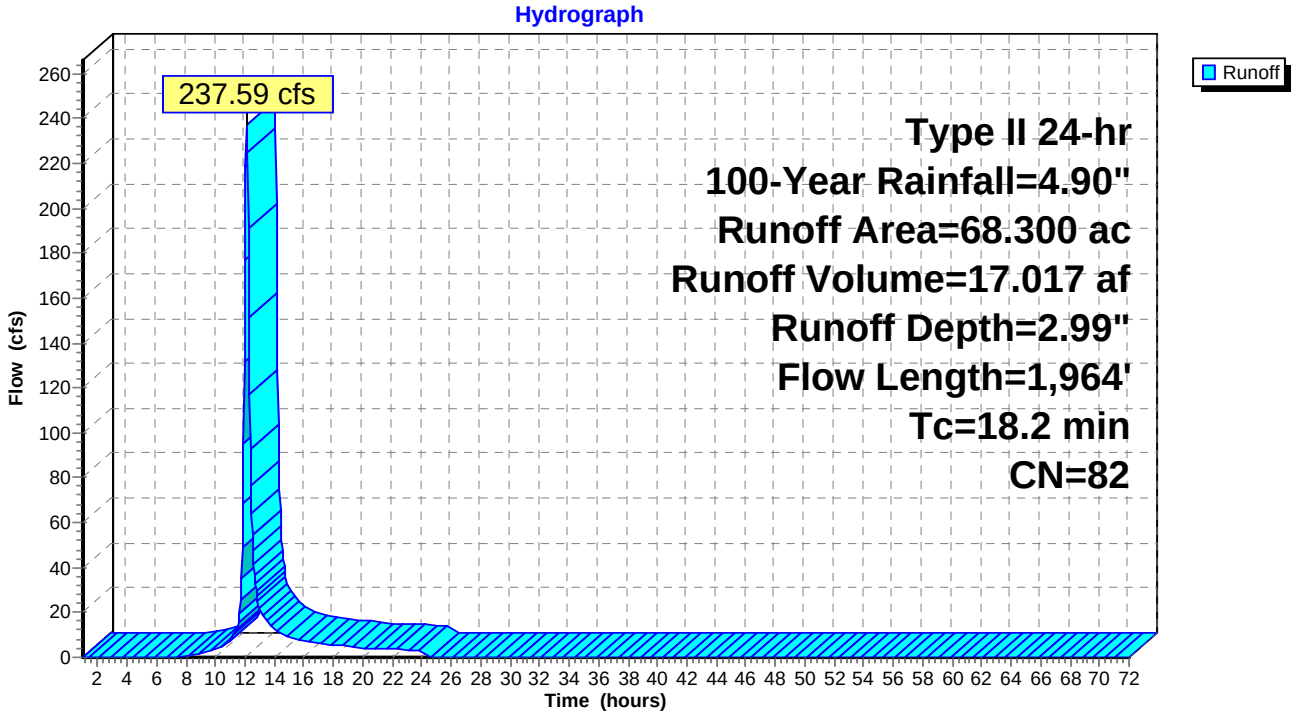
Subcatchment D1: Drexel 1



Subcatchment D1: Drexel 1



Subcatchment D1: Drexel 1



Summary for Pond DS: Drexel South

Inflow Area = 68.300 ac, 34.63% Impervious, Inflow Depth = 2.37" for 25-Year event
Inflow = 189.18 cfs @ 12.11 hrs, Volume= 13.517 af
Outflow = 18.19 cfs @ 12.98 hrs, Volume= 13.517 af, Atten= 90%, Lag= 52.3 min
Primary = 18.19 cfs @ 12.98 hrs, Volume= 13.517 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 881.10' @ 12.98 hrs Surf.Area= 47,723 sf Storage= 273,666 cf

Plug-Flow detention time= 156.0 min calculated for 13.517 af (100% of inflow)
Center-of-Mass det. time= 155.6 min (987.6 - 831.9)

Volume	Invert	Avail.Storage	Storage Description
#1	871.00'	427,768 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

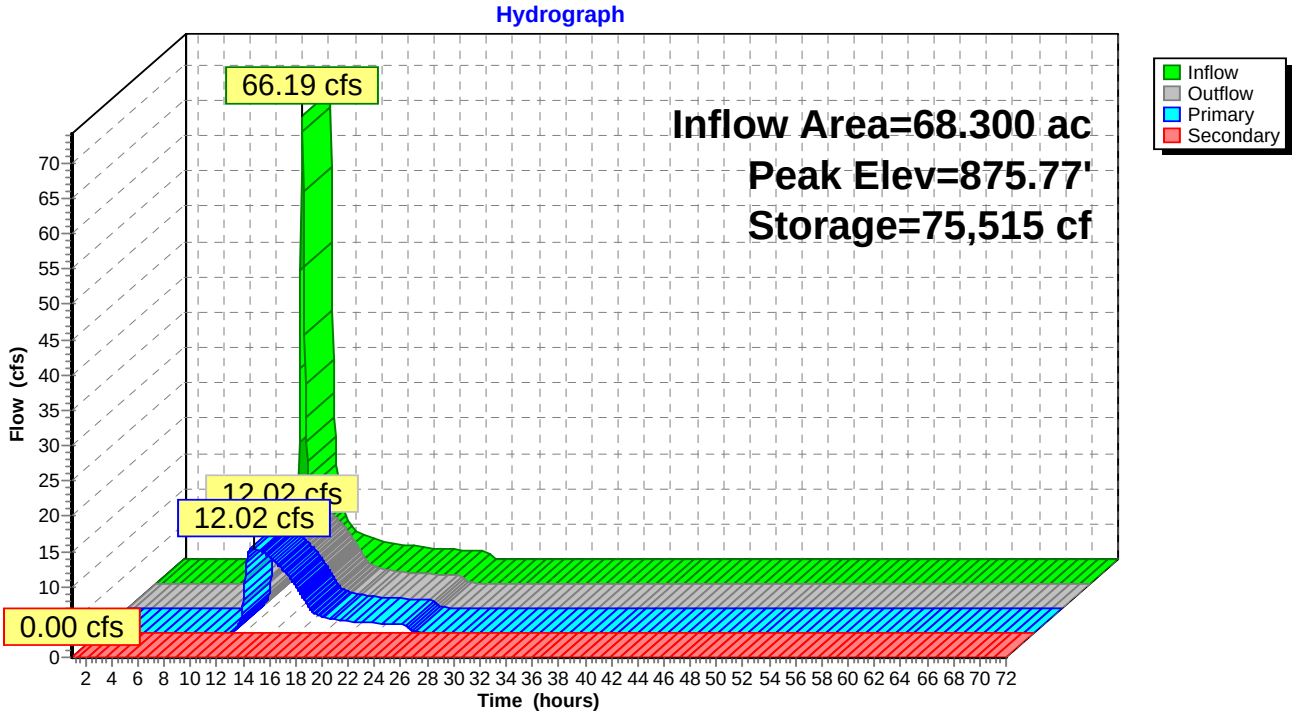
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
871.00	1,626	273.0	0	0	1,626
872.00	8,950	570.0	4,797	4,797	21,554
874.00	20,580	835.0	28,734	33,531	51,216
876.00	28,070	907.0	48,457	81,988	61,348
878.00	35,474	981.0	63,400	145,388	72,625
880.00	42,916	1,075.0	78,272	223,660	88,142
882.00	51,812	1,182.0	94,588	318,248	107,491
883.00	54,098	1,446.0	52,951	371,199	162,717
884.00	59,076	1,501.0	56,569	427,768	175,700

Device	Routing	Invert	Outlet Devices
#1	Primary	870.46'	**30.00" Round Culvert** L= 140.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 870.46' / 869.90' S= 0.0040 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 4.91 sf
#2	Device 1	871.00'	**15.00" Vert. Orifice/Grate** C= 0.600
#3	Secondary	883.00'	**25.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height

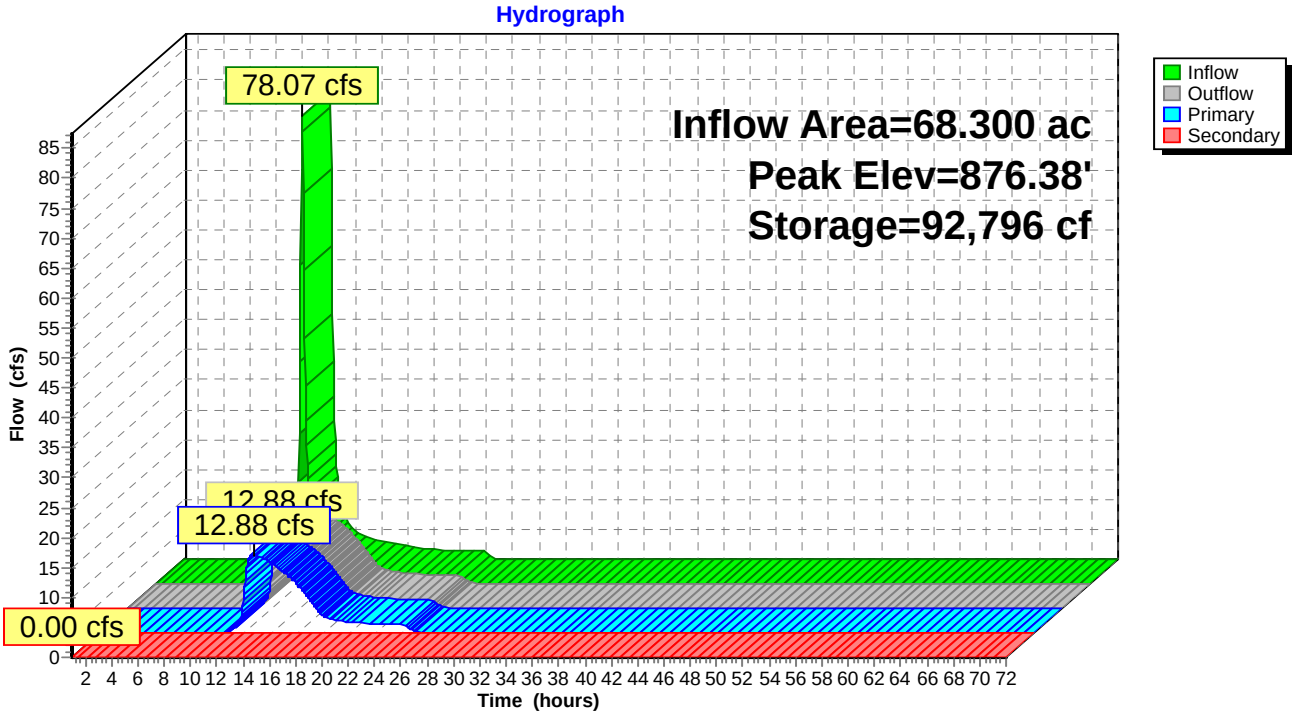
Primary OutFlow Max=18.19 cfs @ 12.98 hrs HW=881.10' (Free Discharge)
└─1=**Culvert** (Passes 18.19 cfs of 44.92 cfs potential flow)
  └─2=**Orifice/Grate** (Orifice Controls 18.19 cfs @ 14.82 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=871.00' (Free Discharge)
└─3=**Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond DS: Drexel South



Pond DS: Drexel South



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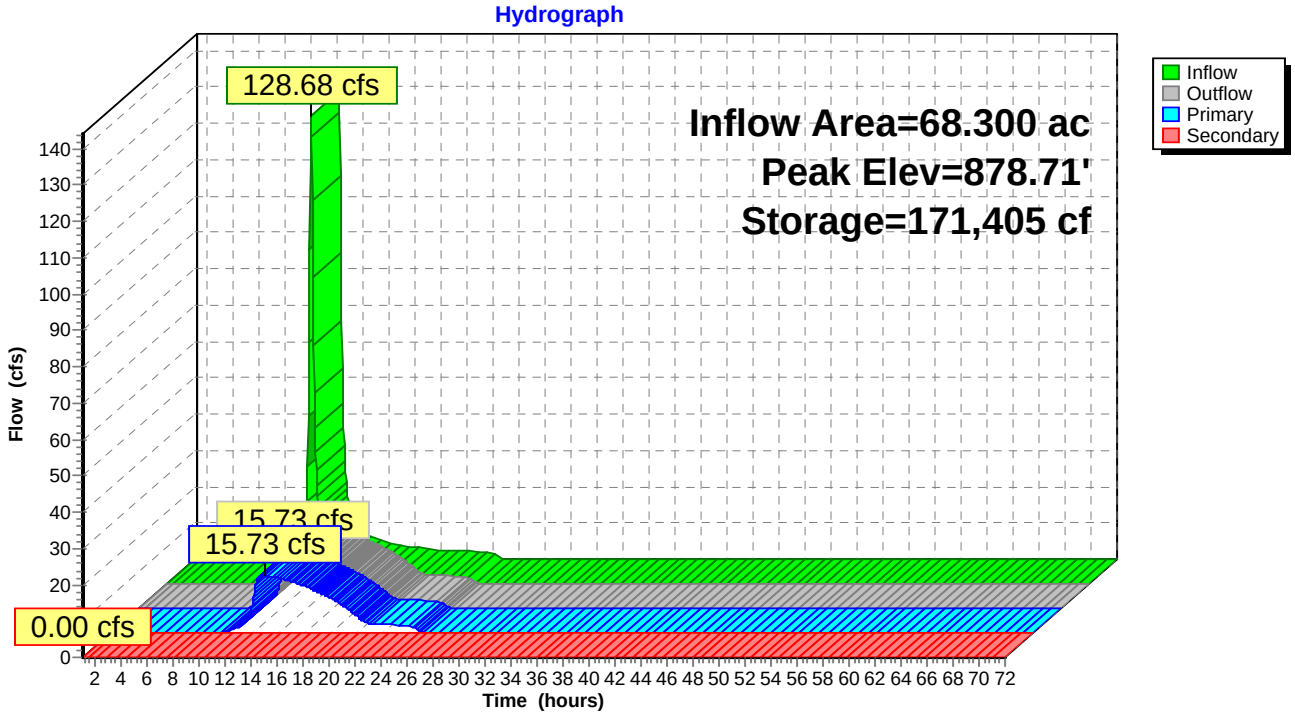
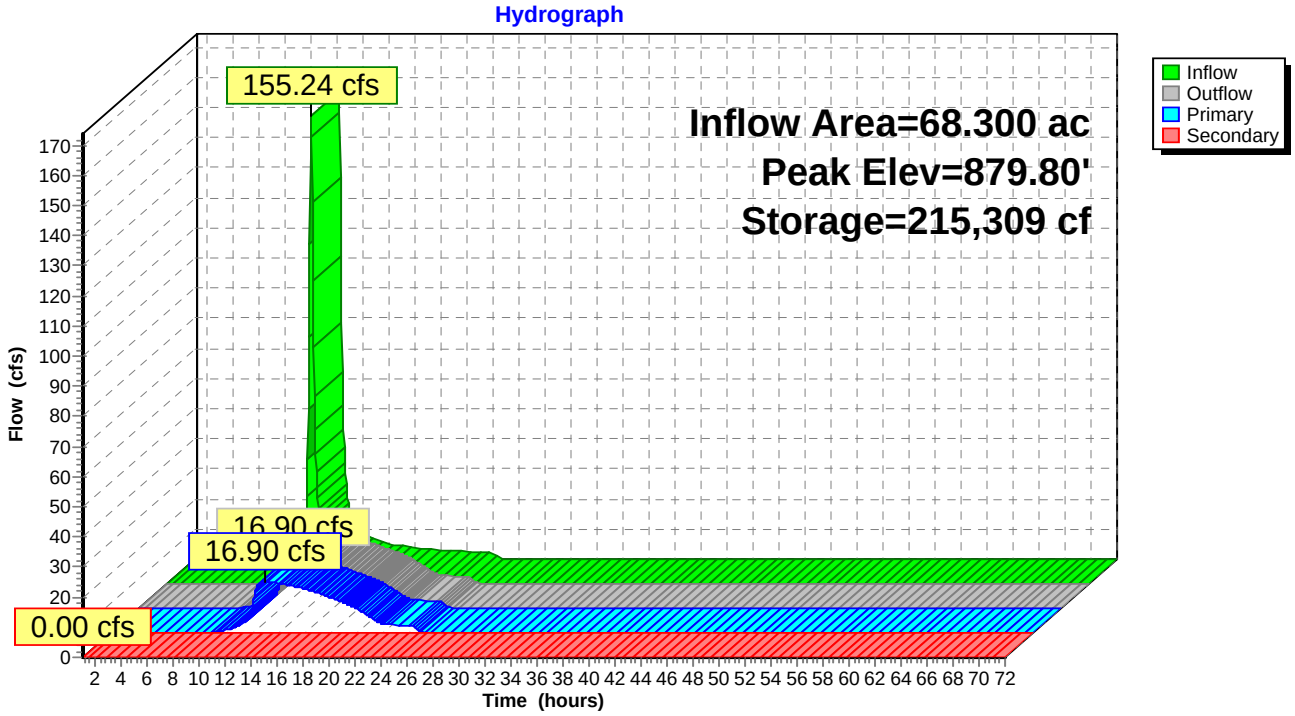
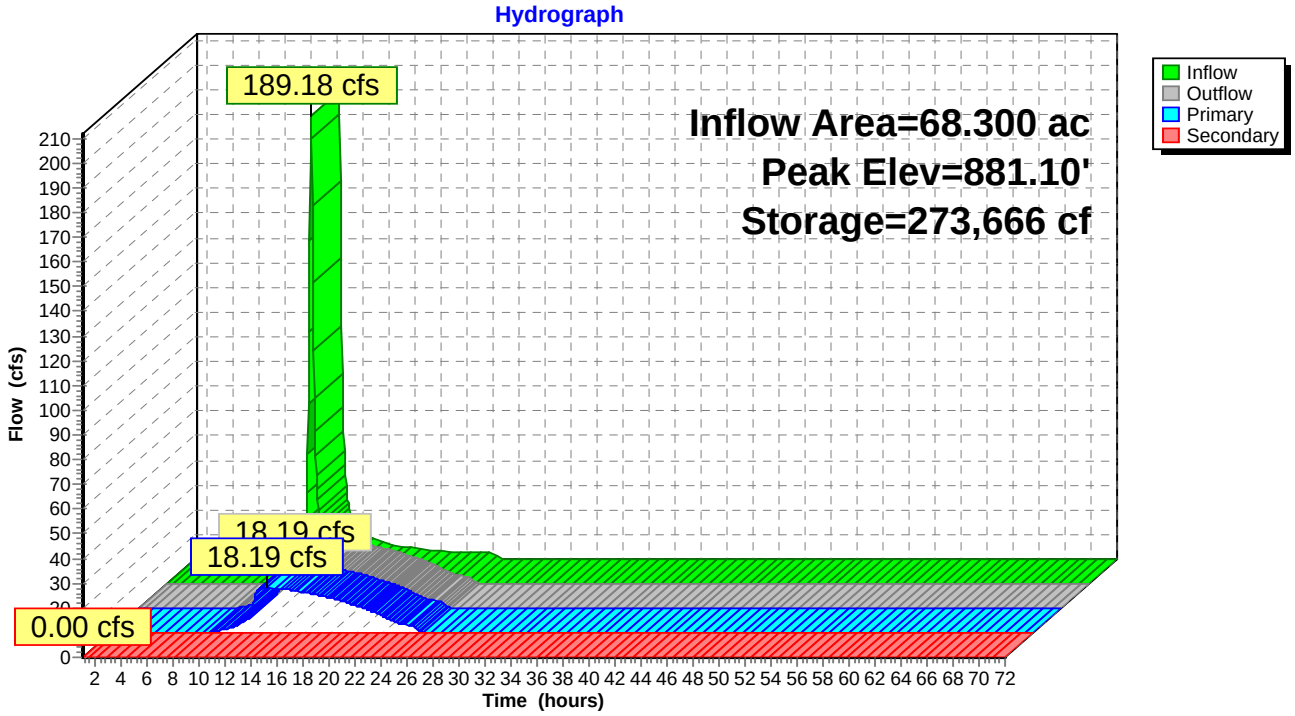


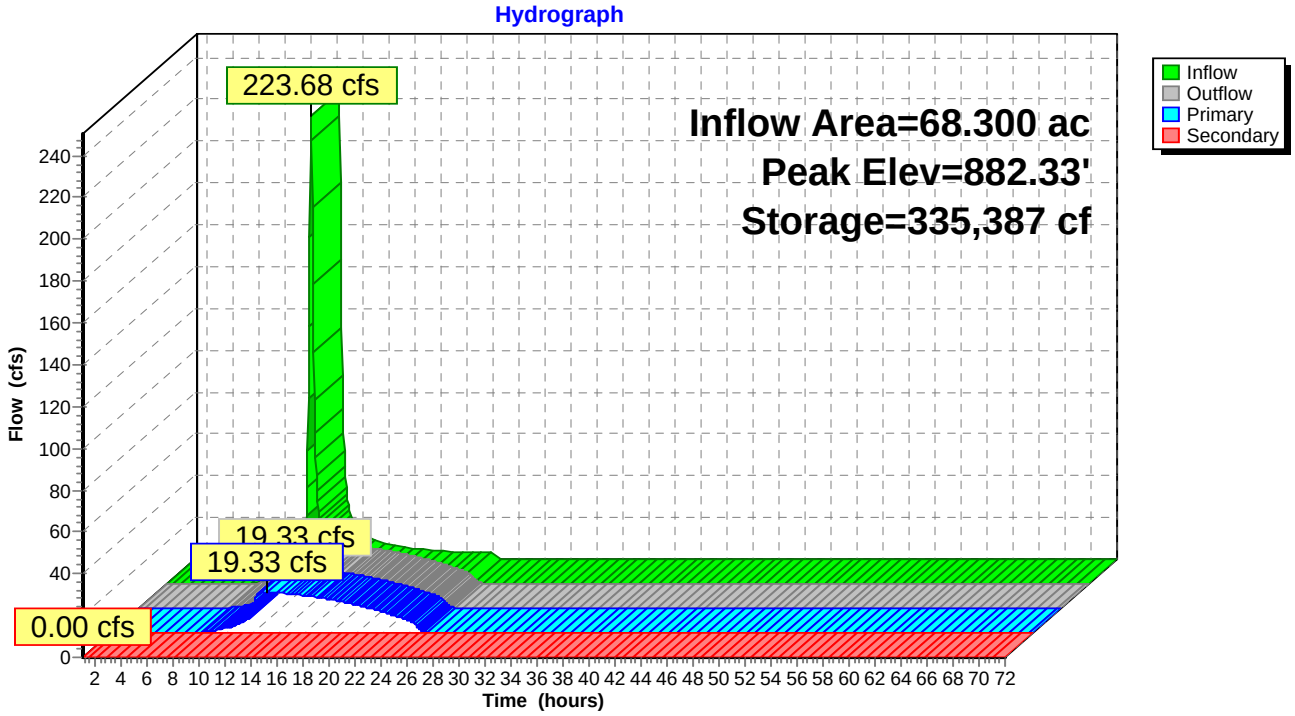
Pond DS: Drexel South



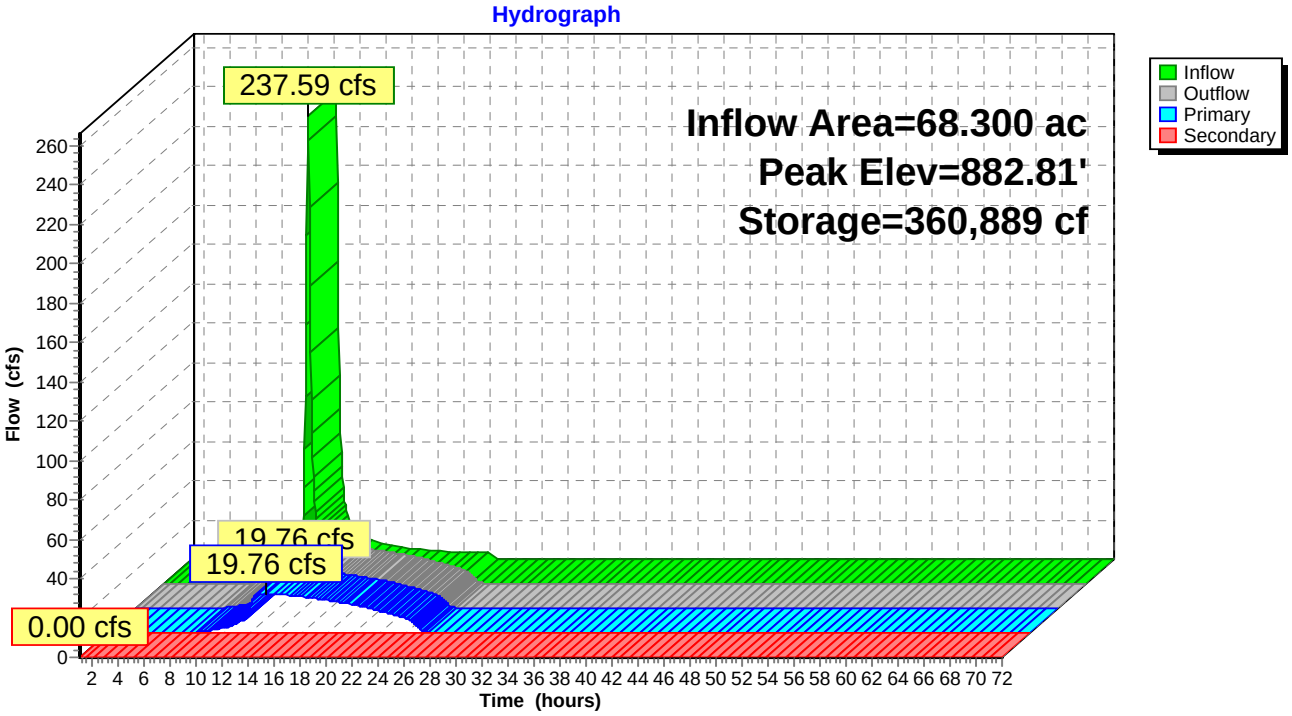
Pond DS: Drexel South



Pond DS: Drexel South



Pond DS: Drexel South



Stage-Discharge for Pond DS: Drexel South

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
871.00	0.00	0.00	0.00
871.15	0.11	0.11	0.00
871.30	0.42	0.42	0.00
871.45	0.91	0.91	0.00
871.60	1.54	1.54	0.00
871.75	2.27	2.27	0.00
871.90	3.06	3.06	0.00
872.05	3.84	3.84	0.00
872.20	4.52	4.52	0.00
872.35	5.03	5.03	0.00
872.50	5.53	5.53	0.00
872.65	5.98	5.98	0.00
872.80	6.41	6.41	0.00
872.95	6.80	6.80	0.00
873.10	7.18	7.18	0.00
873.25	7.53	7.53	0.00
873.40	7.87	7.87	0.00
873.55	8.20	8.20	0.00
873.70	8.51	8.51	0.00
873.85	8.81	8.81	0.00
874.00	9.11	9.11	0.00
874.15	9.39	9.39	0.00
874.30	9.66	9.66	0.00
874.45	9.93	9.93	0.00
874.60	10.19	10.19	0.00
874.75	10.45	10.45	0.00
874.90	10.69	10.69	0.00
875.05	10.94	10.94	0.00
875.20	11.17	11.17	0.00
875.35	11.40	11.40	0.00
875.50	11.63	11.63	0.00
875.65	11.85	11.85	0.00
875.80	12.07	12.07	0.00
875.95	12.29	12.29	0.00
876.10	12.50	12.50	0.00
876.25	12.71	12.71	0.00
876.40	12.91	12.91	0.00
876.55	13.11	13.11	0.00
876.70	13.31	13.31	0.00
876.85	13.51	13.51	0.00
877.00	13.70	13.70	0.00
877.15	13.89	13.89	0.00
877.30	14.08	14.08	0.00
877.45	14.26	14.26	0.00
877.60	14.44	14.44	0.00
877.75	14.62	14.62	0.00
877.90	14.80	14.80	0.00
878.05	14.98	14.98	0.00
878.20	15.15	15.15	0.00
878.35	15.32	15.32	0.00
878.50	15.49	15.49	0.00
878.65	15.66	15.66	0.00
878.80	15.83	15.83	0.00
878.95	15.99	15.99	0.00
879.10	16.16	16.16	0.00
879.25	16.32	16.32	0.00
879.40	16.48	16.48	0.00
879.55	16.63	16.63	0.00
879.70	16.79	16.79	0.00
879.85	16.95	16.95	0.00
880.00	17.10	17.10	0.00
880.15	17.25	17.25	0.00
880.30	17.40	17.40	0.00
880.45	17.55	17.55	0.00
880.60	17.70	17.70	0.00
880.75	17.85	17.85	0.00
880.90	18.00	18.00	0.00
881.05	18.14	18.14	0.00
881.20	18.28	18.28	0.00
881.35	18.43	18.43	0.00
881.50	18.57	18.57	0.00
881.65	18.71	18.71	0.00
881.80	18.85	18.85	0.00
881.95	18.99	18.99	0.00
882.10	19.12	19.12	0.00
882.25	19.26	19.26	0.00
882.40	19.40	19.40	0.00
882.55	19.53	19.53	0.00
882.70	19.66	19.66	0.00
882.85	19.80	19.80	0.00
883.00	19.93	19.93	0.00
883.15	24.89	20.06	4.83
883.30	34.08	20.19	13.89
883.45	46.26	20.32	25.94
883.60	61.03	20.45	40.59
883.75	78.20	20.58	57.62
883.90	97.63	20.70	76.93

Stage-Area-Storage for Pond DS: Drexel South

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
871.00	1,626	0
871.15	2,349	296
871.30	3,204	711
871.45	4,193	1,264
871.60	5,313	1,976
871.75	6,567	2,865
871.90	7,952	3,952
872.05	9,183	5,250
872.20	9,898	6,681
872.35	10,641	8,221
872.50	11,410	9,875
872.65	12,206	11,645
872.80	13,029	13,538
872.95	13,879	15,555
873.10	14,756	17,703
873.25	15,659	19,984
873.40	16,590	22,402
873.55	17,547	24,962
873.70	18,531	27,667
873.85	19,542	30,523
874.00	20,580	33,531
874.15	21,102	36,657
874.30	21,630	39,862
874.45	22,164	43,147
874.60	22,705	46,512
874.75	23,253	49,959
874.90	23,807	53,488
875.05	24,368	57,101
875.20	24,935	60,799
875.35	25,509	64,582
875.50	26,089	68,451
875.65	26,676	72,409
875.80	27,269	76,454
875.95	27,869	80,590
876.10	28,420	84,813
876.25	28,948	89,115
876.40	29,482	93,497
876.55	30,020	97,960
876.70	30,563	102,503
876.85	31,111	107,129
877.00	31,664	111,837
877.15	32,222	116,628
877.30	32,784	121,504
877.45	33,352	126,464
877.60	33,924	131,509
877.75	34,501	136,641
877.90	35,083	141,860
878.05	35,651	147,166
878.20	36,186	152,554
878.35	36,725	158,022
878.50	37,268	163,571
878.65	37,815	169,203
878.80	38,366	174,916
878.95	38,921	180,713
879.10	39,479	186,593
879.25	40,042	192,557
879.40	40,609	198,605
879.55	41,180	204,740
879.70	41,755	210,960
879.85	42,333	217,266
880.00	42,916	223,660
880.15	43,554	230,145
880.30	44,197	236,726
880.45	44,845	243,404
880.60	45,497	250,180
880.75	46,154	257,054
880.90	46,816	264,026
881.05	47,482	271,099
881.20	48,153	278,271
881.35	48,829	285,545
881.50	49,510	292,920
881.65	50,195	300,398
881.80	50,885	307,979
881.95	51,579	315,663
882.10	52,038	323,441
882.25	52,379	331,272
882.40	52,720	339,154
882.55	53,063	347,088
882.70	53,407	355,073
882.85	53,752	363,110
883.00	54,098	371,199
883.15	54,831	379,369
883.30	55,568	387,649
883.45	56,311	396,039
883.60	57,059	404,542
883.75	57,811	413,157
883.90	58,568	421,886

Summary for Subcatchment US_23: US23

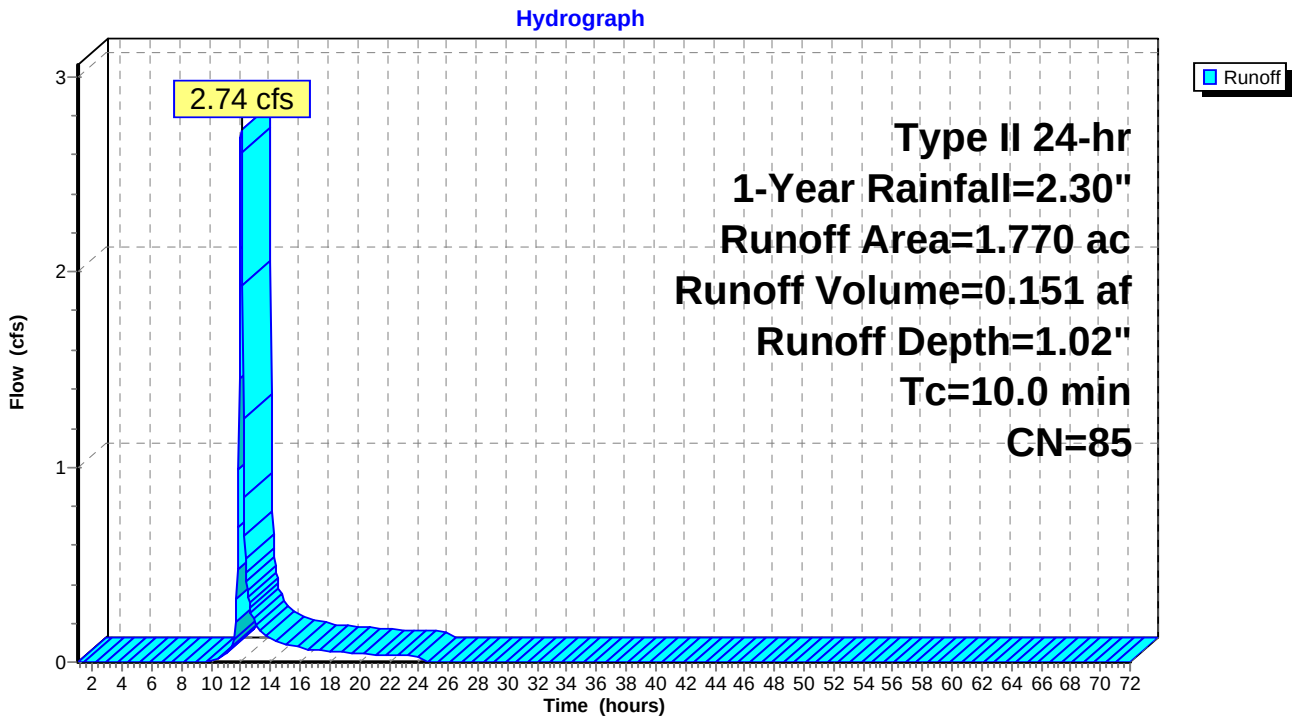
Runoff = 2.74 cfs @ 12.02 hrs, Volume= 0.151 af, Depth= 1.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

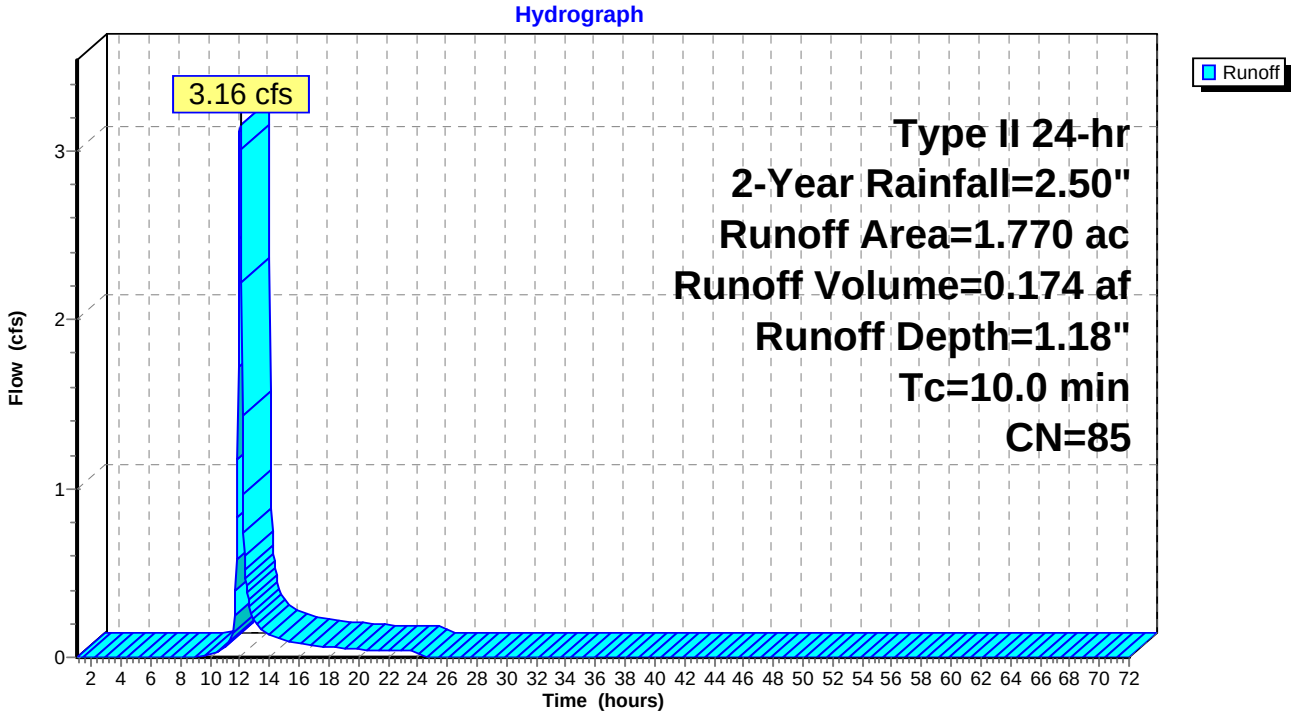
Area (ac)	CN	Description
0.815	98	Paved parking, HSG C
0.955	74	>75% Grass cover, Good, HSG C
1.770	85	Weighted Average
0.955		53.95% Pervious Area
0.815		46.05% Impervious Area

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

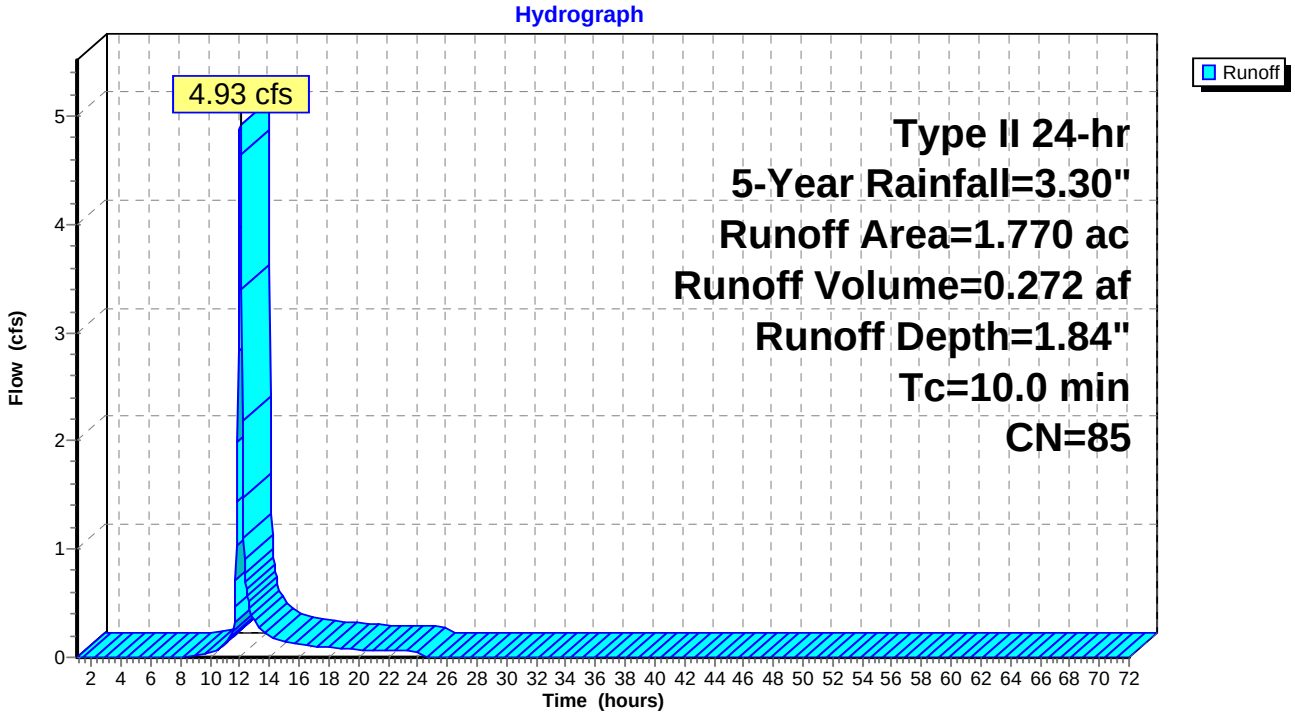
Subcatchment US_23: US23



Subcatchment US_23: US23



Subcatchment US_23: US23



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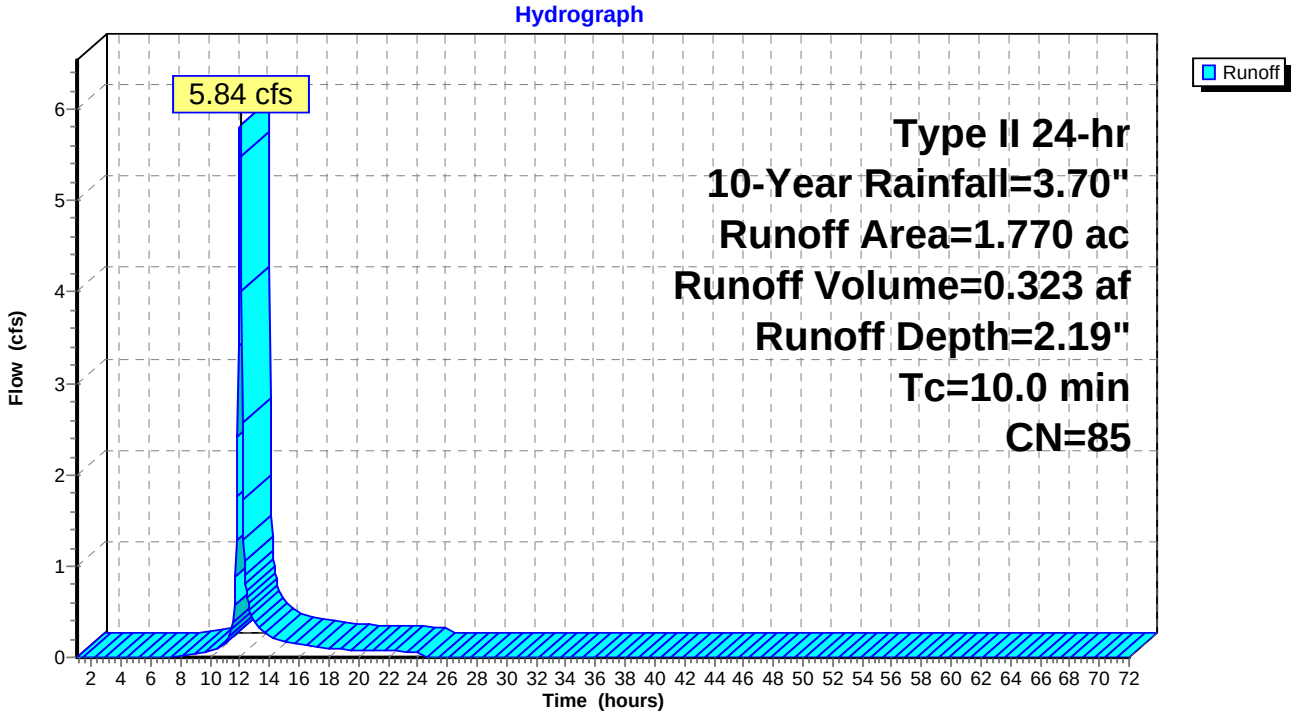
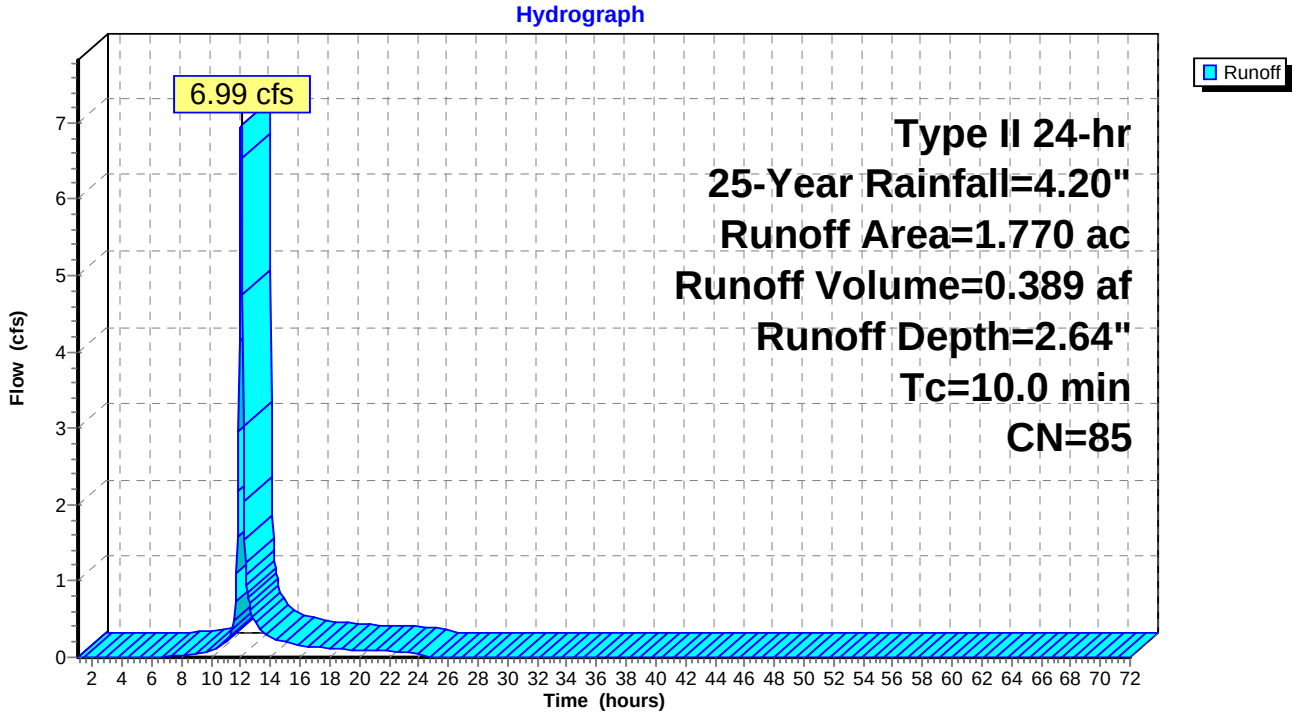
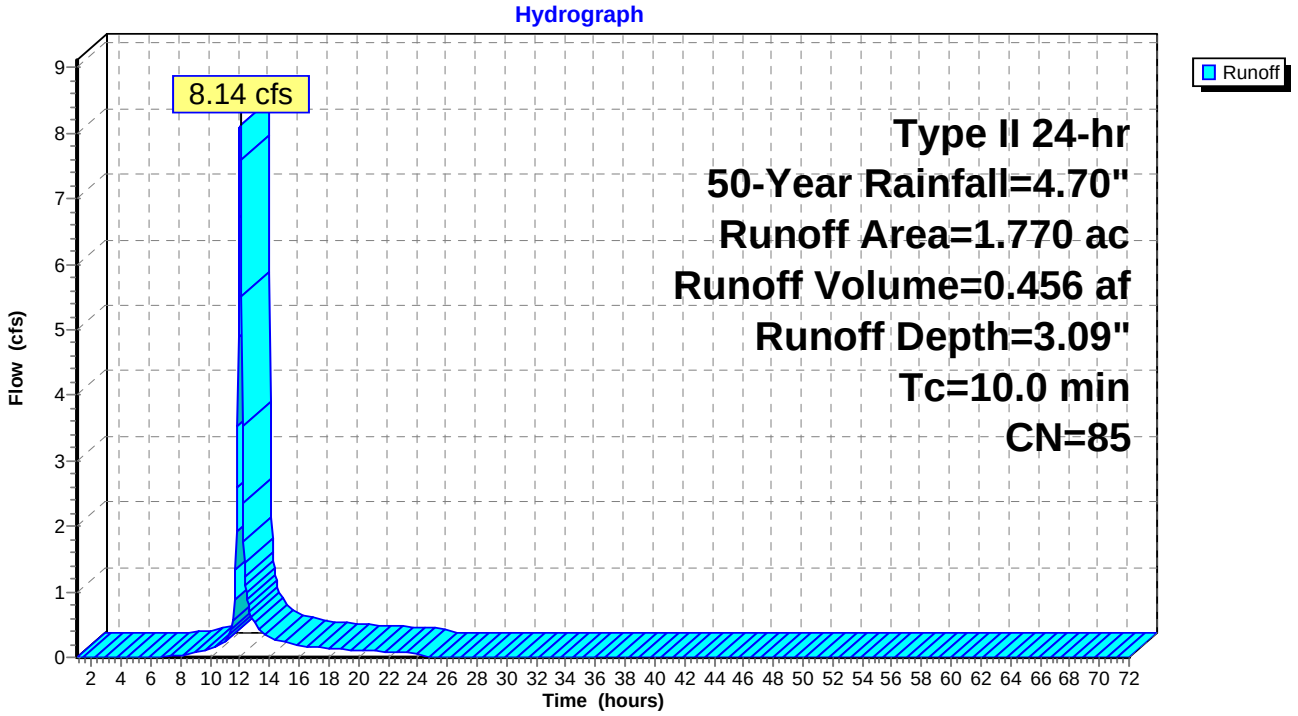


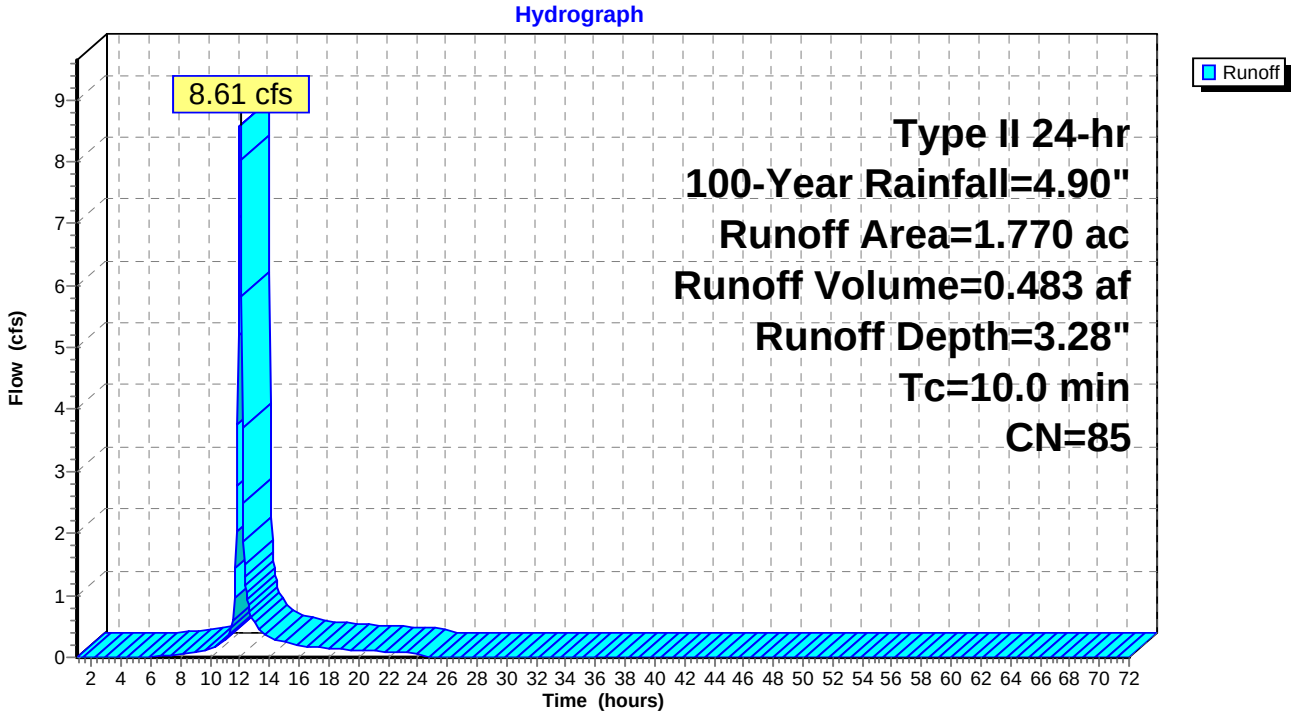
Subcatchment US_23: US23



Subcatchment US_23: US23



Subcatchment US_23: US23



Summary for Subcatchment U23: US23

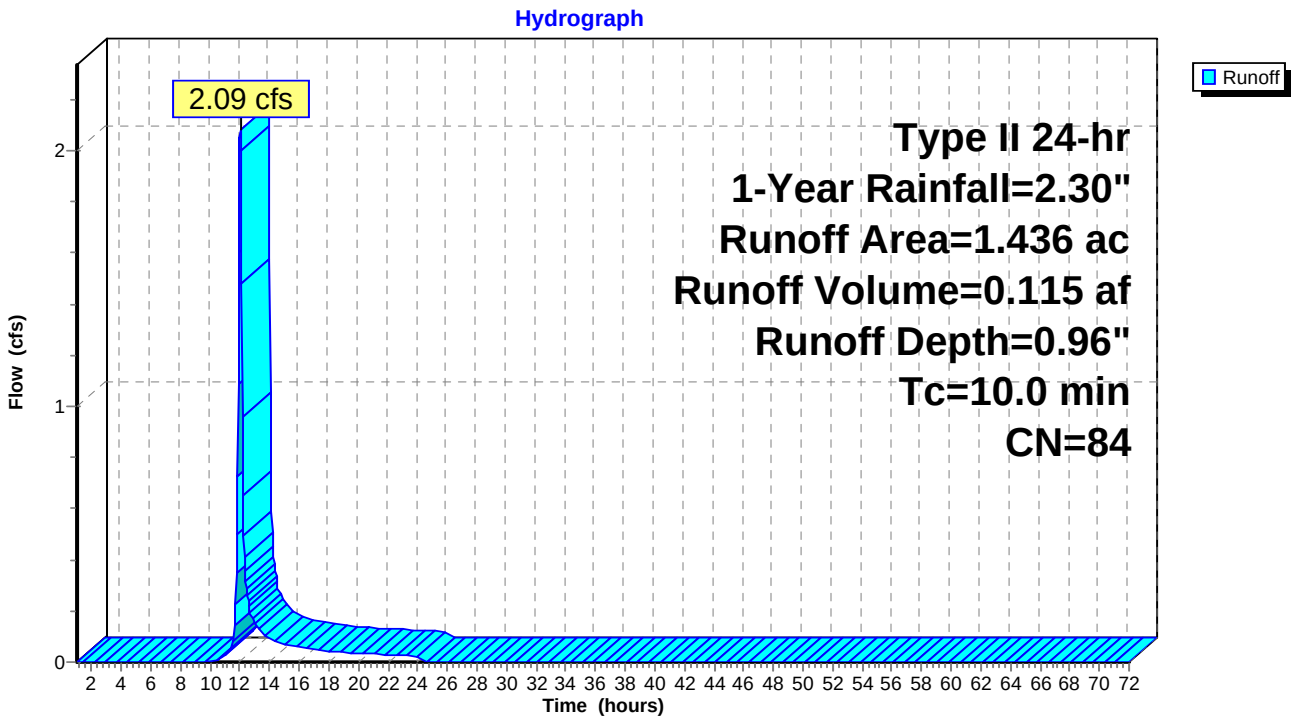
Runoff = 2.09 cfs @ 12.02 hrs, Volume= 0.115 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

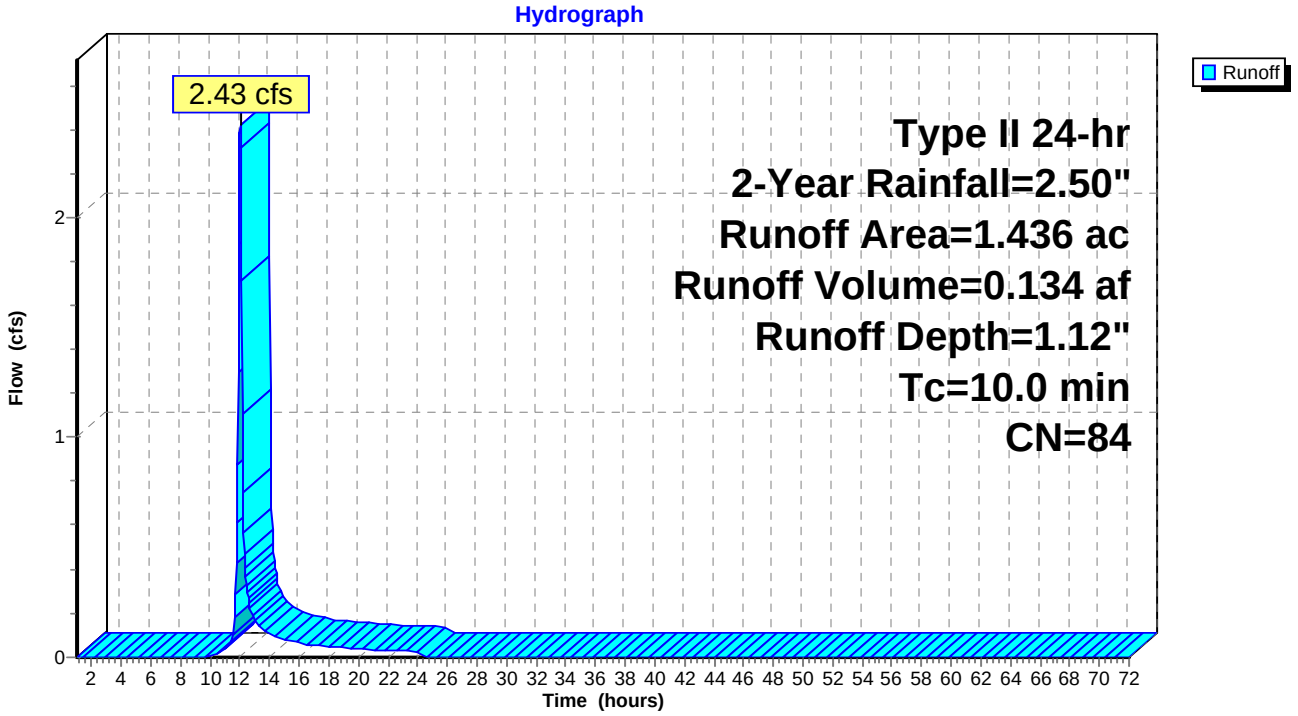
Area (ac)	CN	Description
0.617	98	Paved parking, HSG C
0.819	74	>75% Grass cover, Good, HSG C
1.436	84	Weighted Average
0.819		57.03% Pervious Area
0.617		42.97% Impervious Area

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

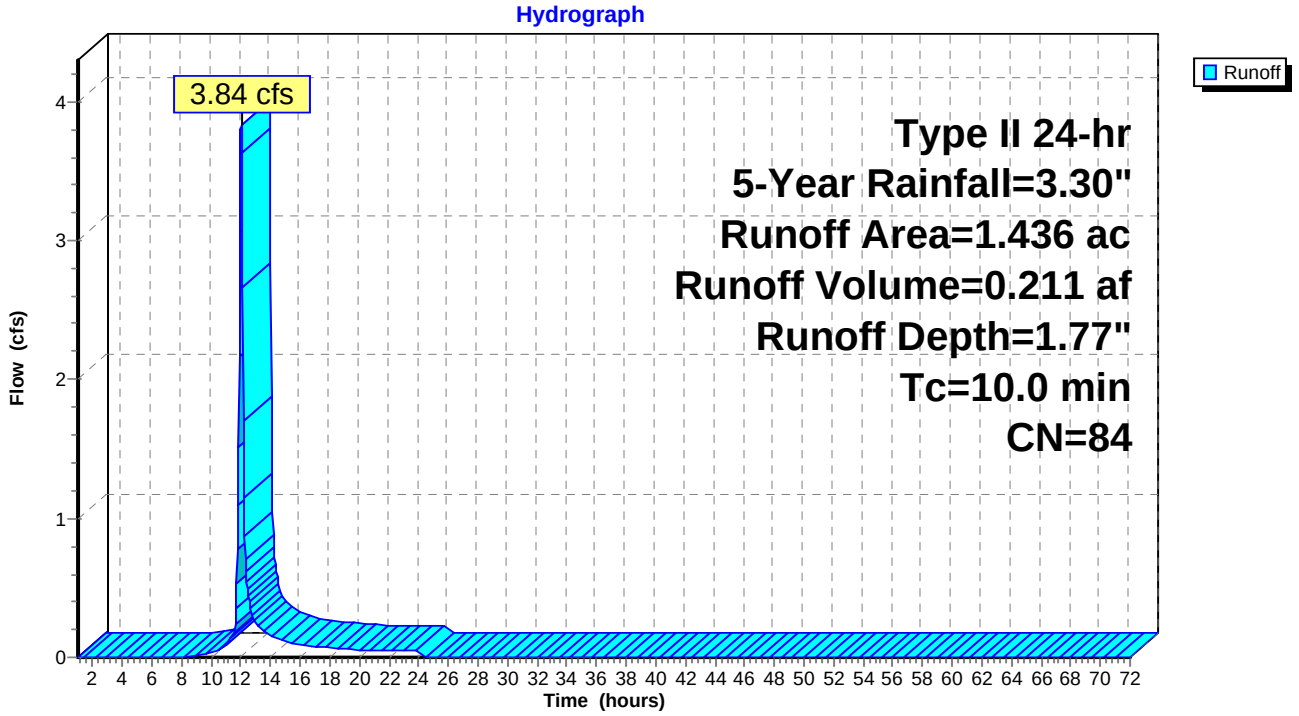
Subcatchment U23: US23



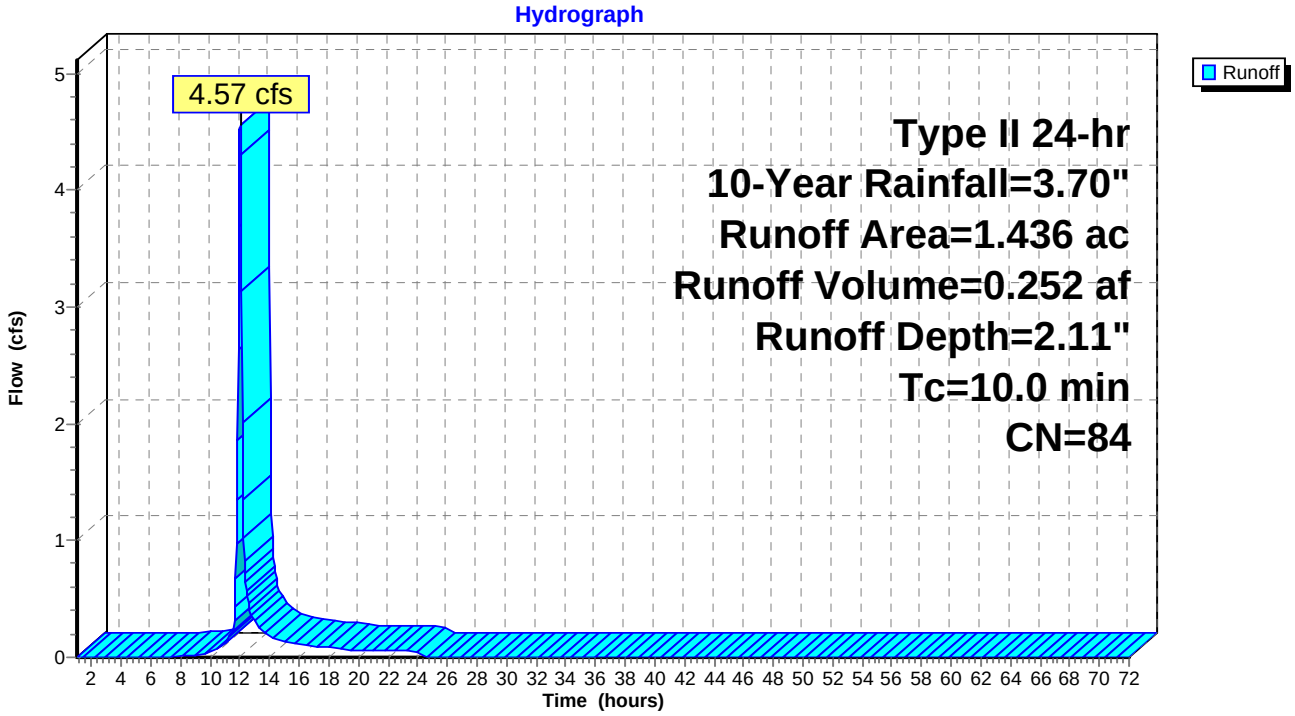
Subcatchment U23: US23



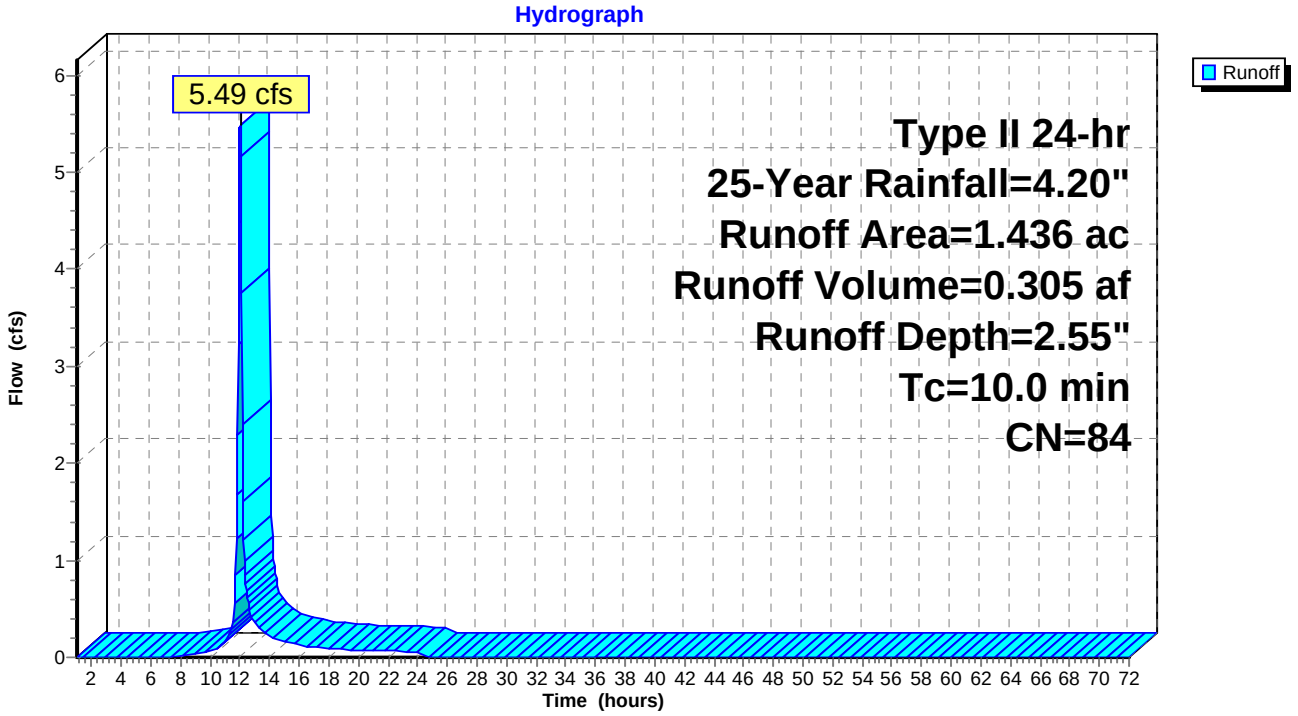
Subcatchment U23: US23



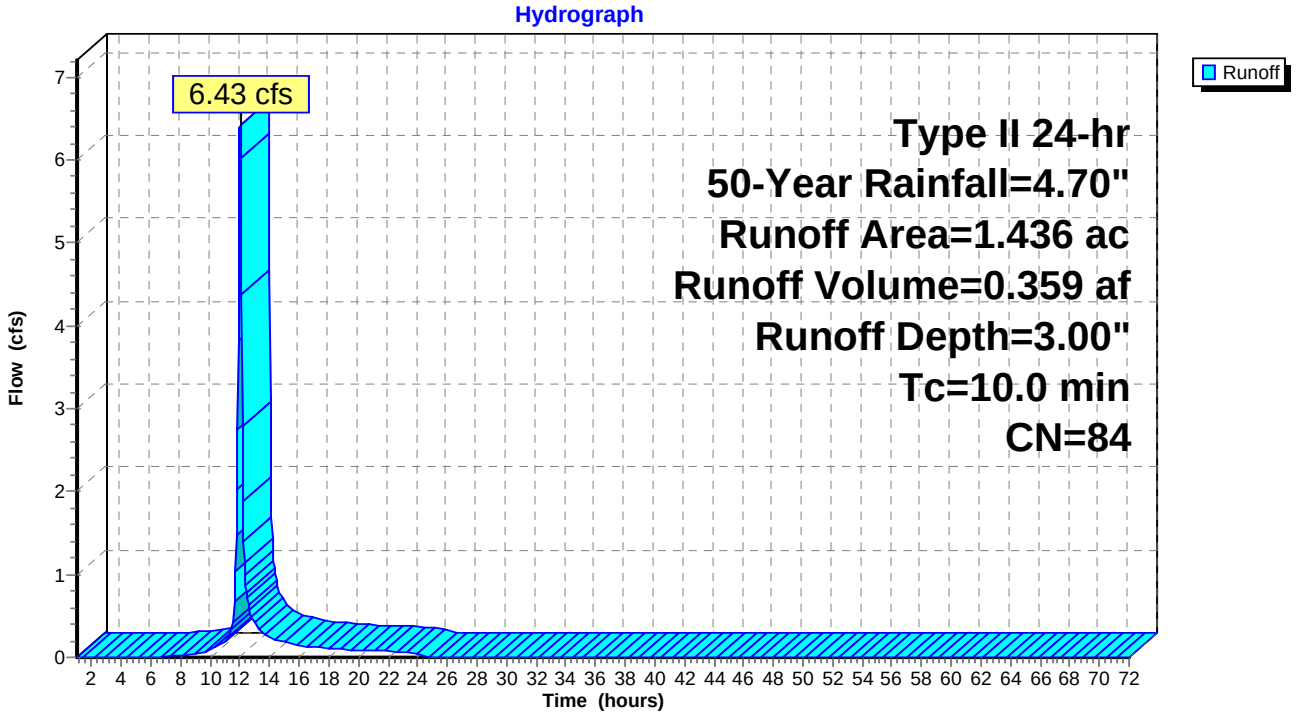
Subcatchment U23: US23



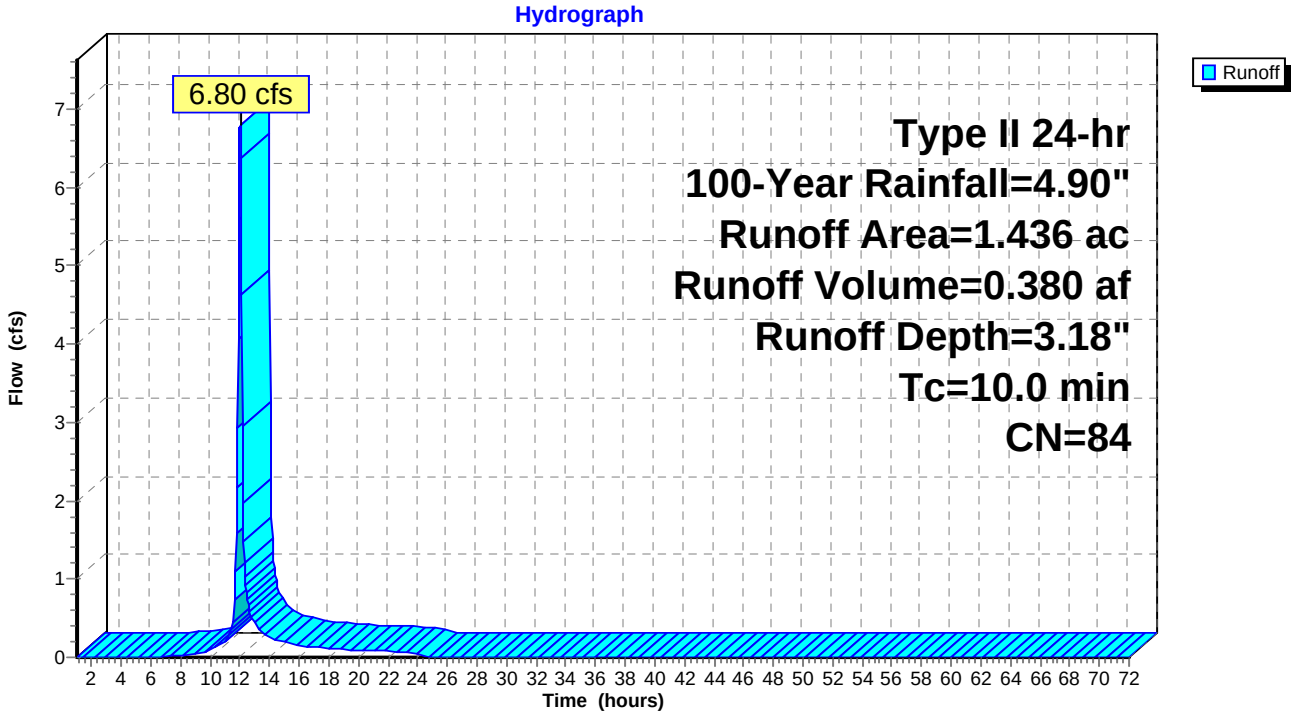
Subcatchment U23: US23



Subcatchment U23: US23



Subcatchment U23: US23



Summary for Subcatchment SW4: SW4

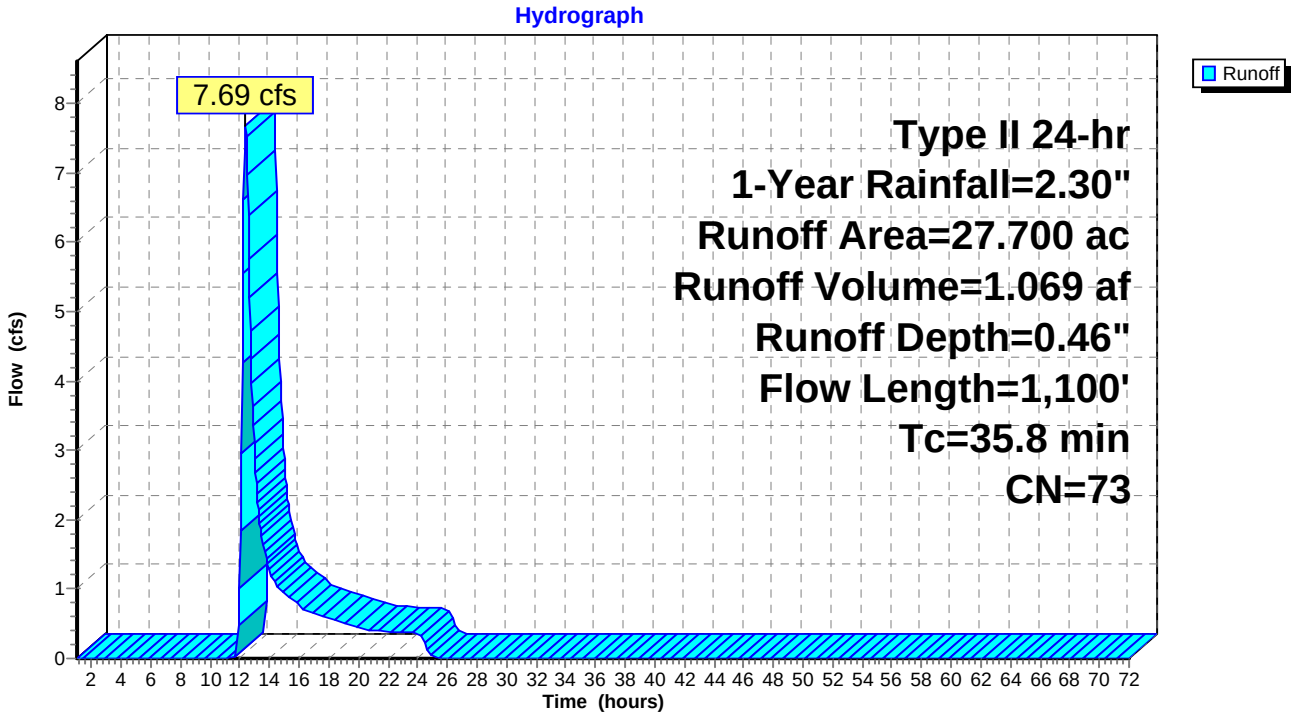
Runoff = 7.69 cfs @ 12.38 hrs, Volume= 1.069 af, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

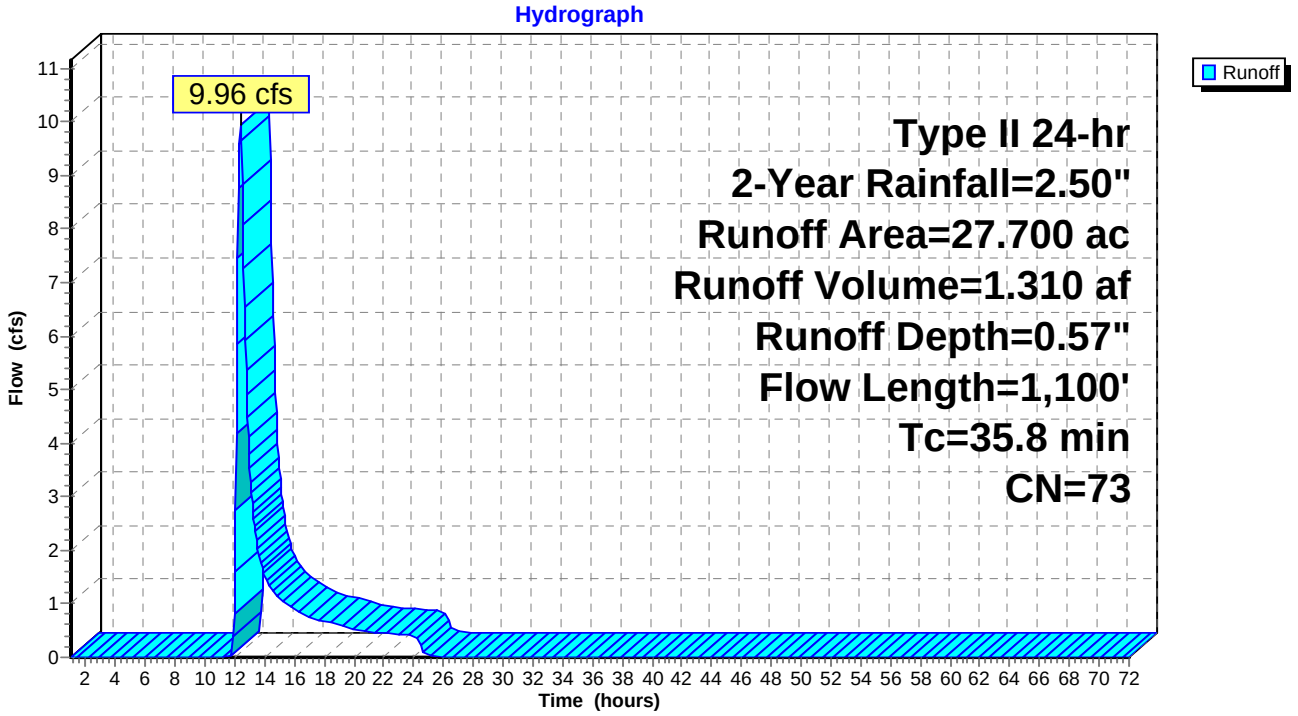
Area (ac)	CN	Description
3.770	70	Woods, Good, HSG C
23.930	74	>75% Grass cover, Good, HSG C
27.700	73	Weighted Average
27.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.6	100	0.0290	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 2.63"
14.2	1,000	0.0283	1.18		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.0					Direct Entry, channel
35.8	1,100	Total			

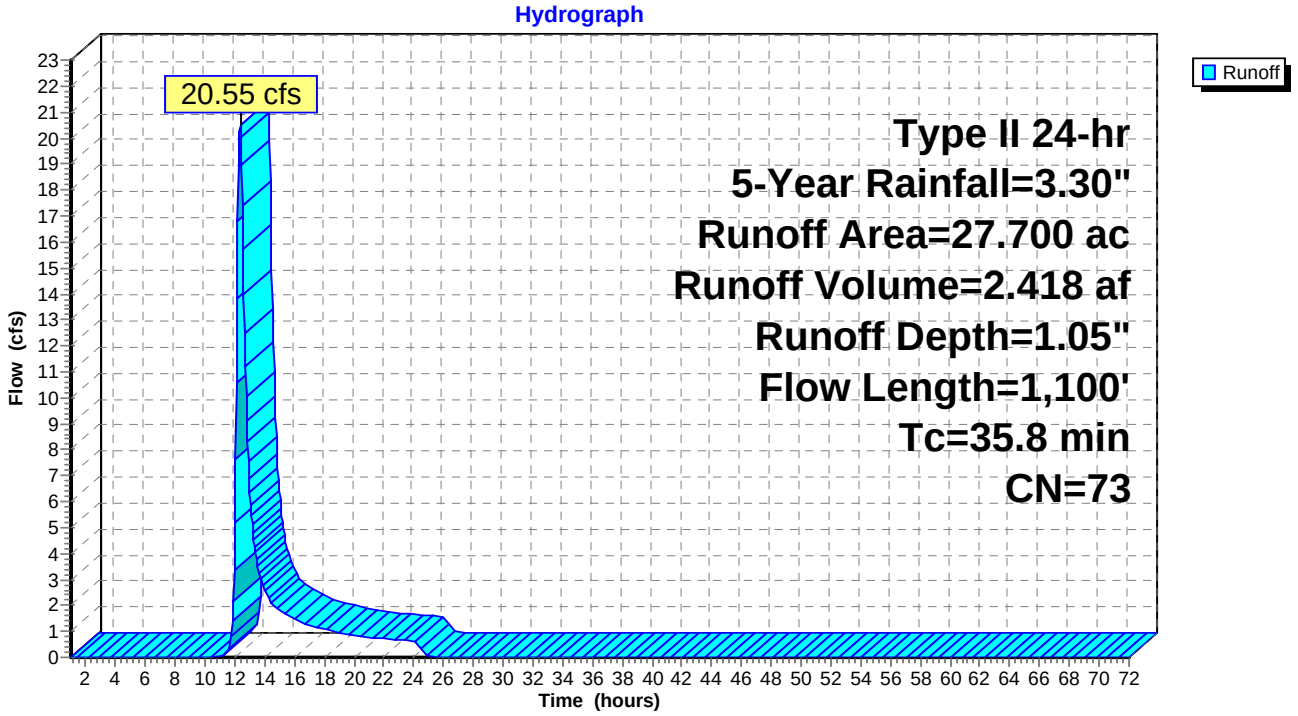
Subcatchment SW4: SW4



Subcatchment SW4: SW4



Subcatchment SW4: SW4



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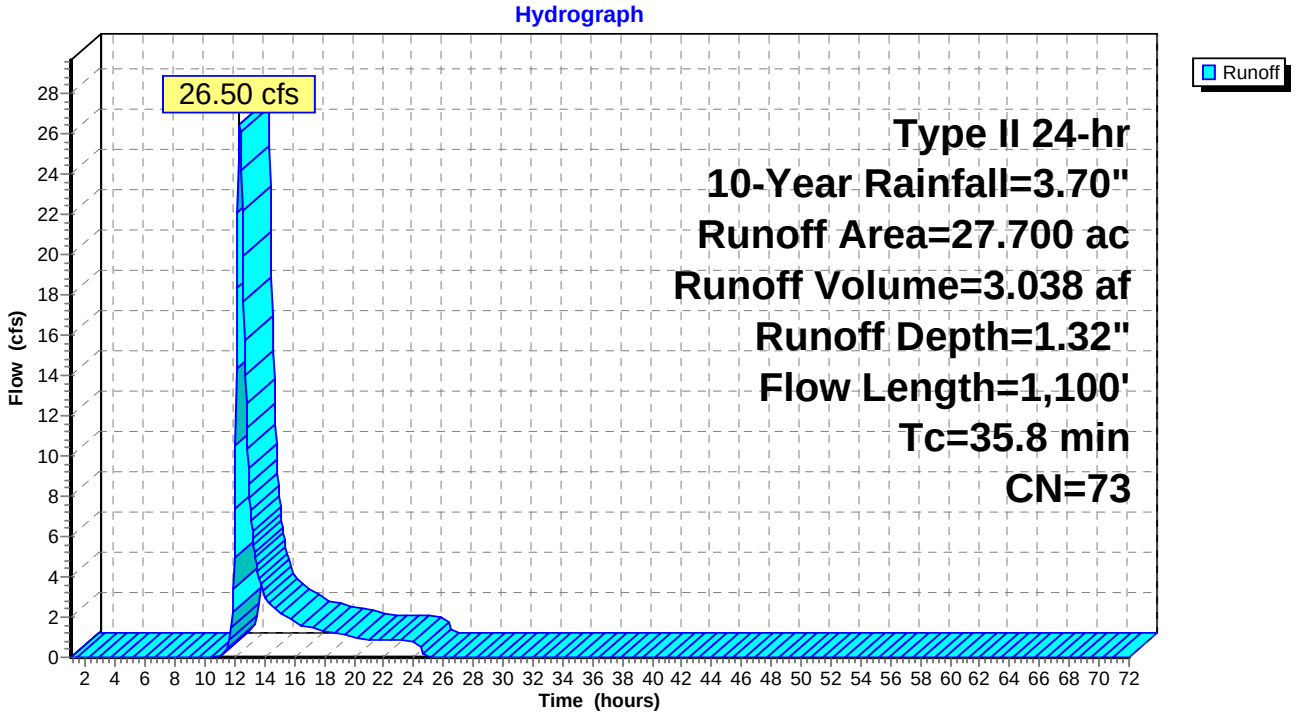
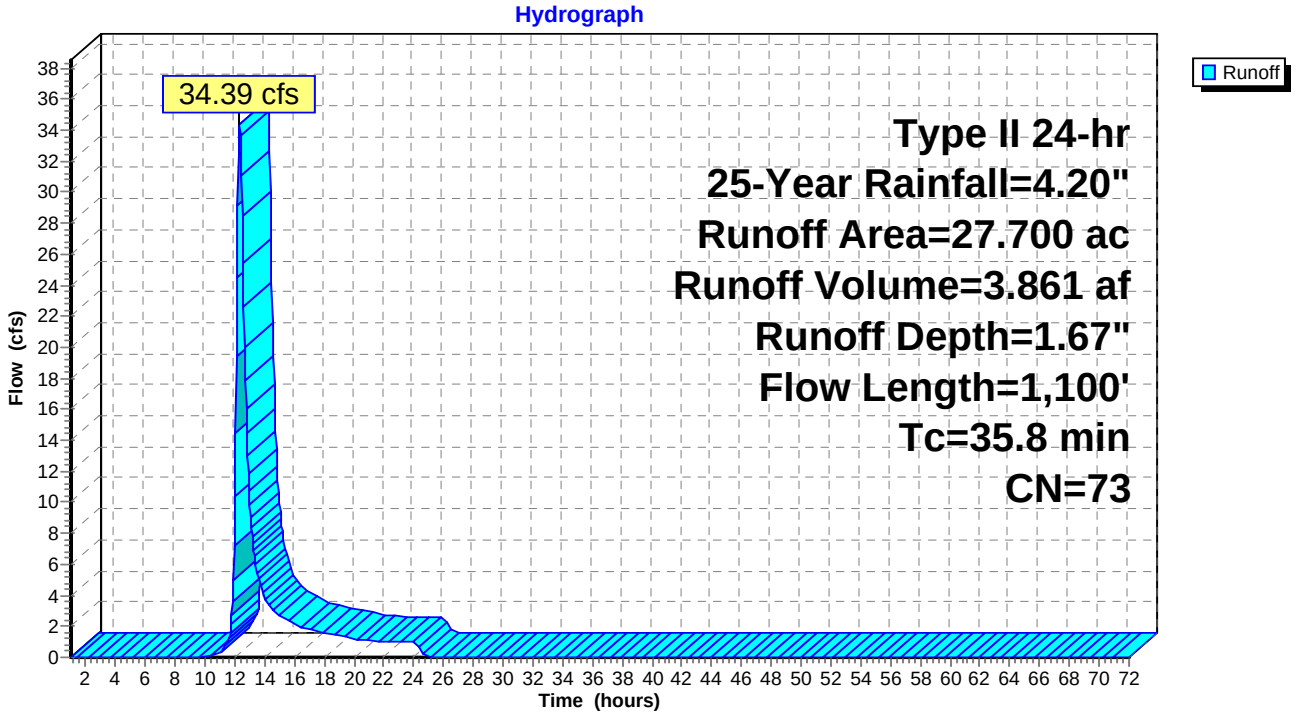


Subcatchment SW4: SW4



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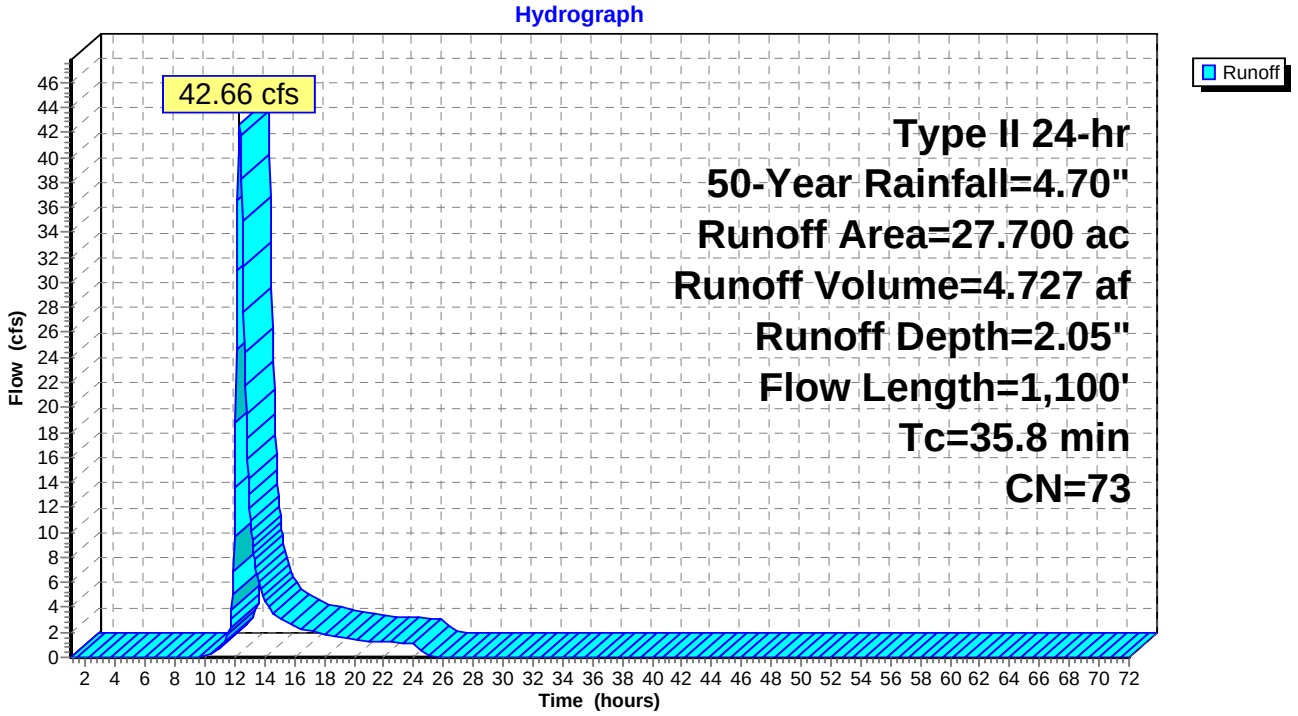
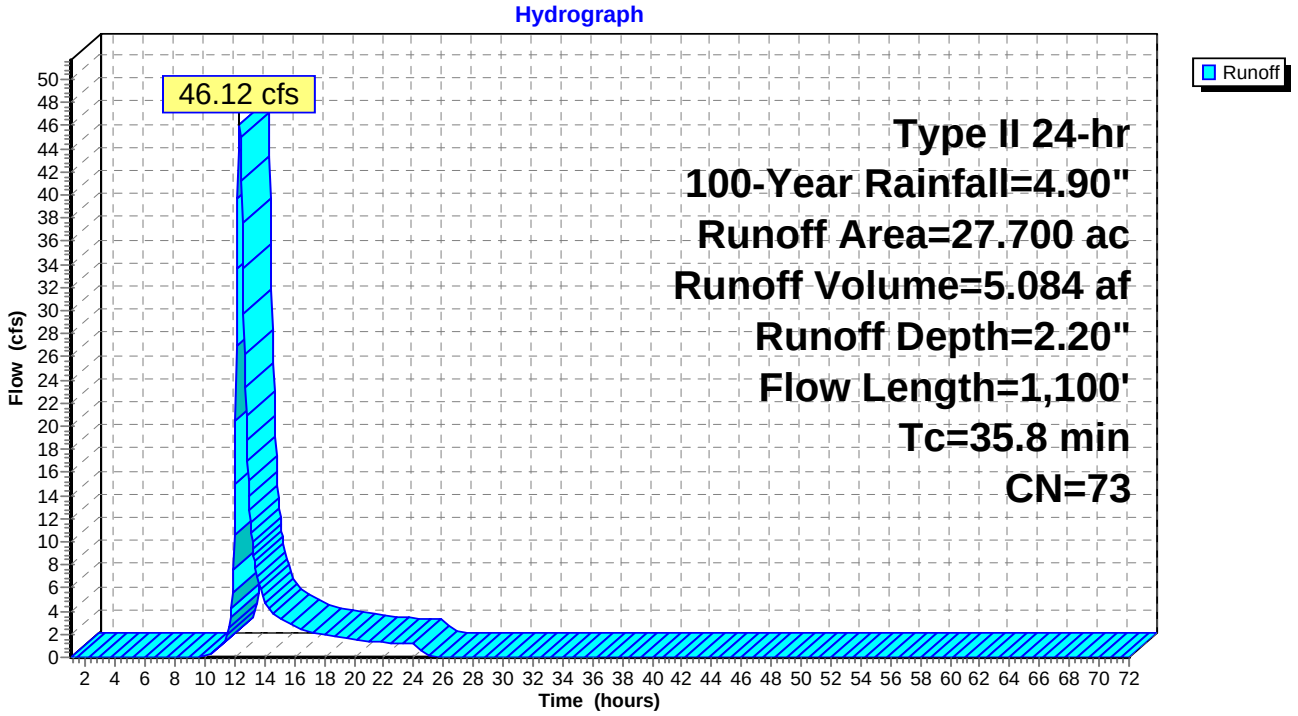


Subcatchment SW4: SW4

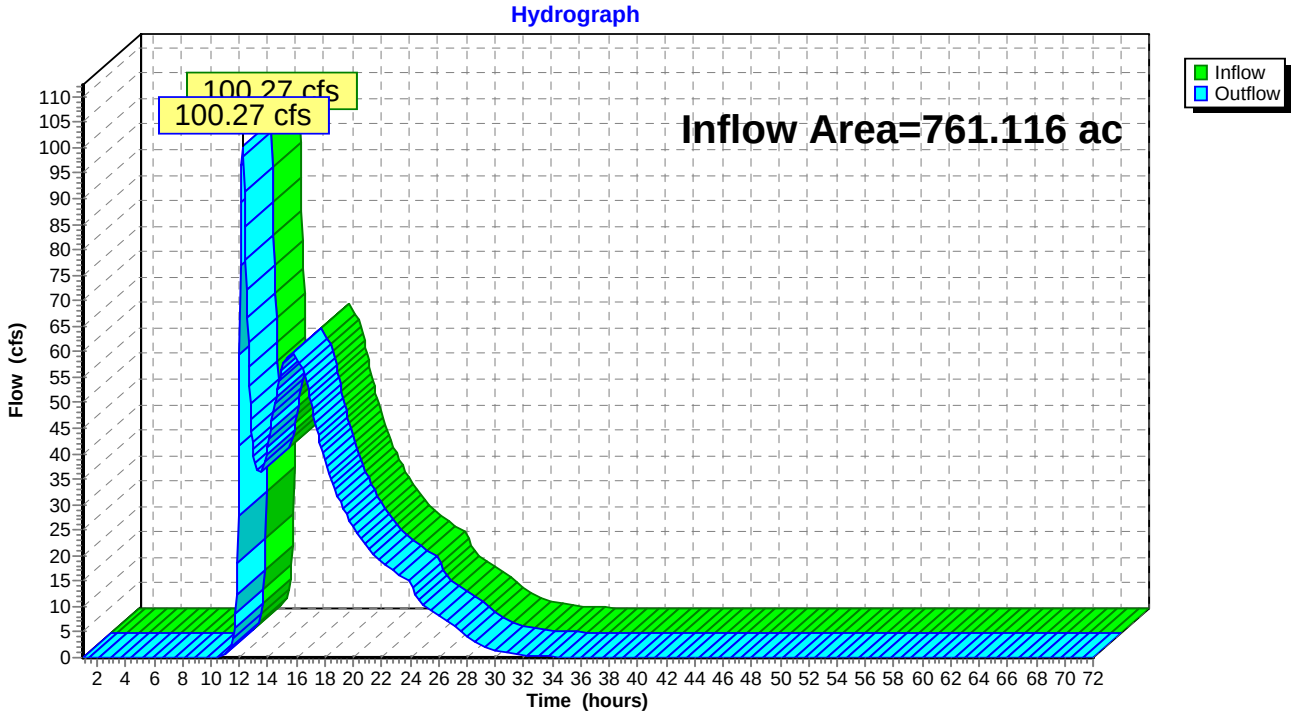


Summary for Reach TOW: Total Offsite-West

Inflow Area = 761.116 ac, 7.13% Impervious, Inflow Depth = 0.66" for 1-Year event
Inflow = 100.27 cfs @ 12.23 hrs, Volume= 41.814 af
Outflow = 100.27 cfs @ 12.23 hrs, Volume= 41.814 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TOW: Total Offsite-West

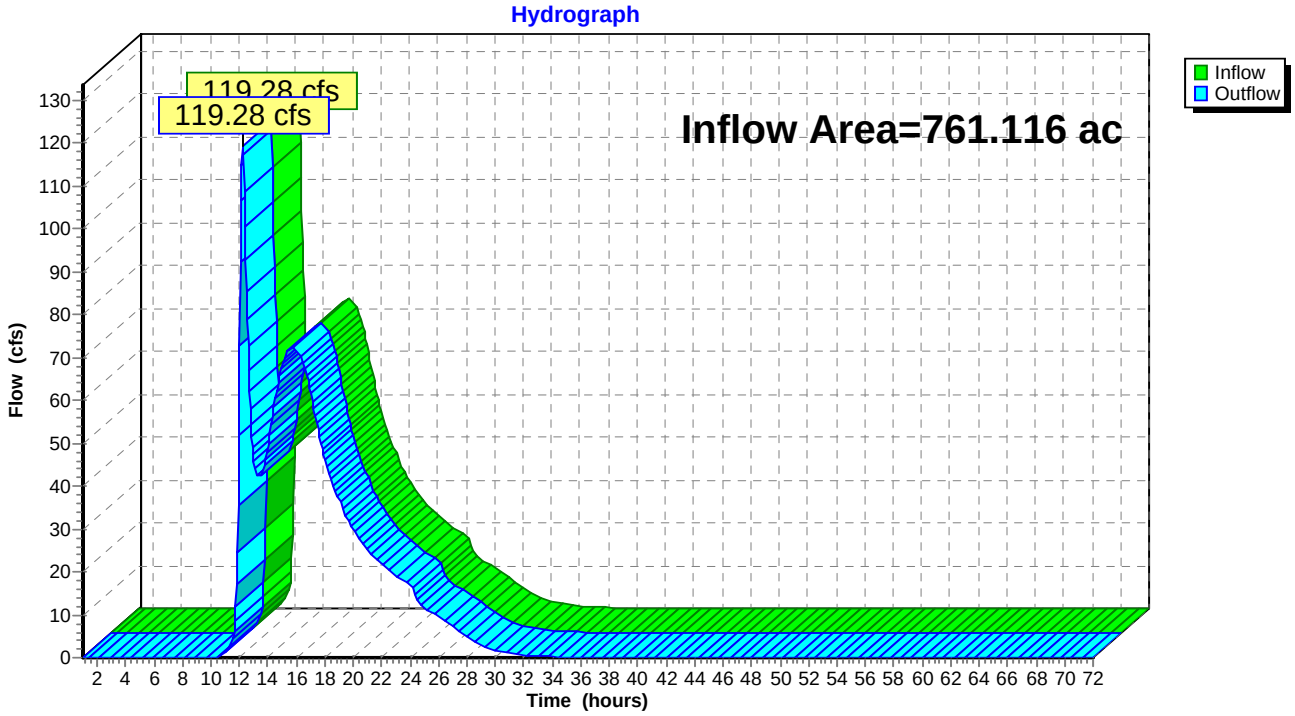


Summary for Reach TOW: Total Offsite-West

Inflow Area = 761.116 ac, 7.13% Impervious, Inflow Depth = 0.79" for 2-Year event
Inflow = 119.28 cfs @ 12.23 hrs, Volume= 49.803 af
Outflow = 119.28 cfs @ 12.23 hrs, Volume= 49.803 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TOW: Total Offsite-West

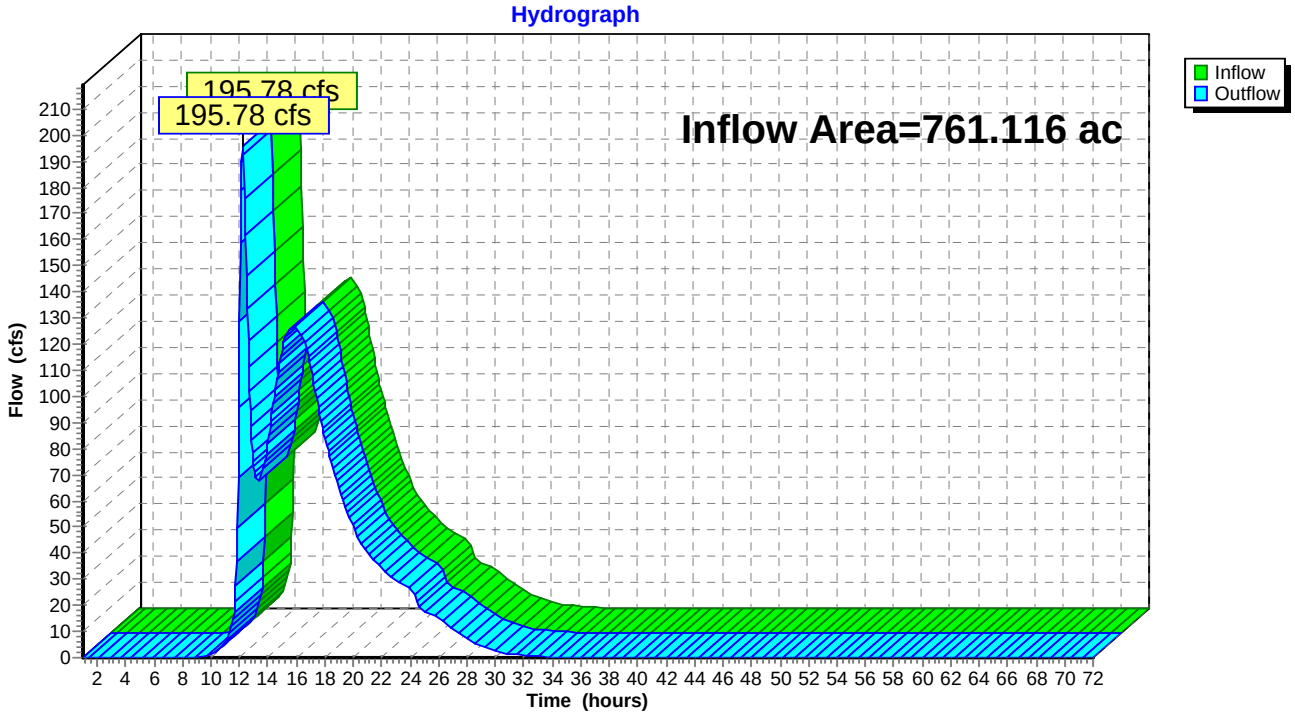


Summary for Reach TOW: Total Offsite-West

Inflow Area = 761.116 ac, 7.13% Impervious, Inflow Depth = 1.34" for 5-Year event
Inflow = 195.78 cfs @ 12.24 hrs, Volume= 85.109 af
Outflow = 195.78 cfs @ 12.24 hrs, Volume= 85.109 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TOW: Total Offsite-West

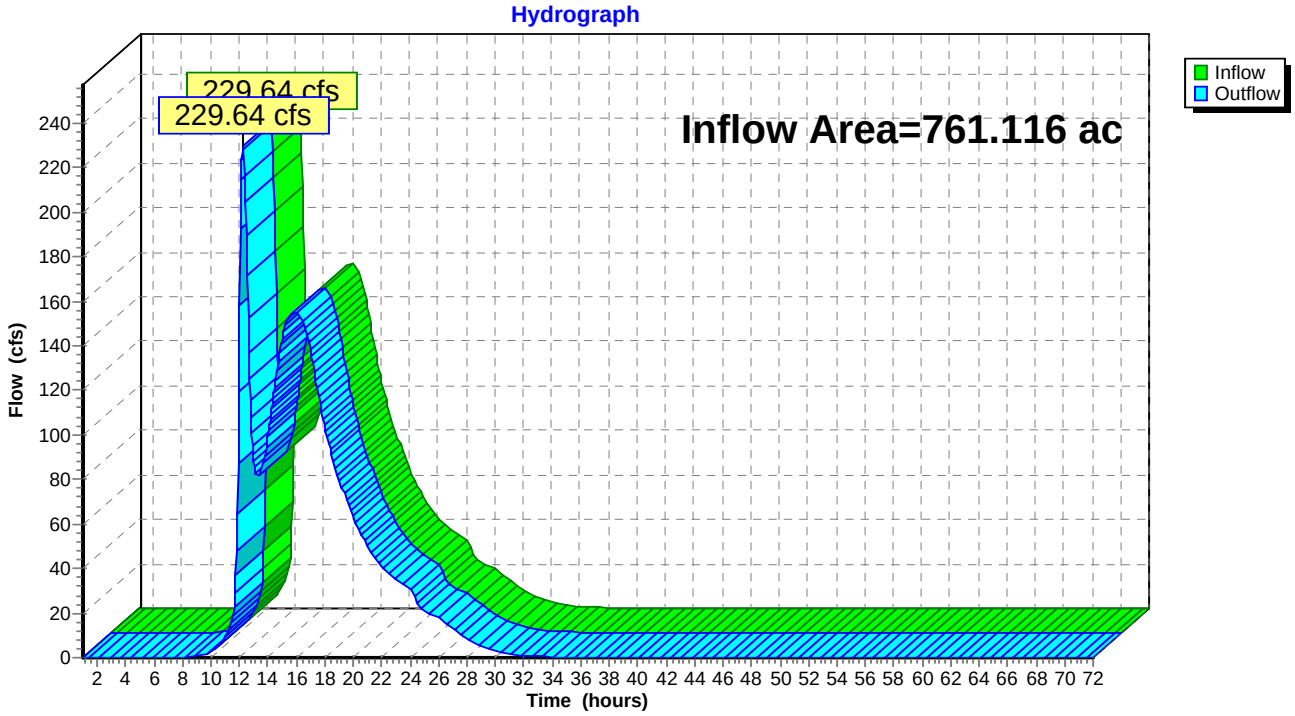


Summary for Reach TOW: Total Offsite-West

Inflow Area = 761.116 ac, 7.13% Impervious, Inflow Depth = 1.64" for 10-Year event
Inflow = 229.64 cfs @ 12.27 hrs, Volume= 104.303 af
Outflow = 229.64 cfs @ 12.27 hrs, Volume= 104.303 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TOW: Total Offsite-West

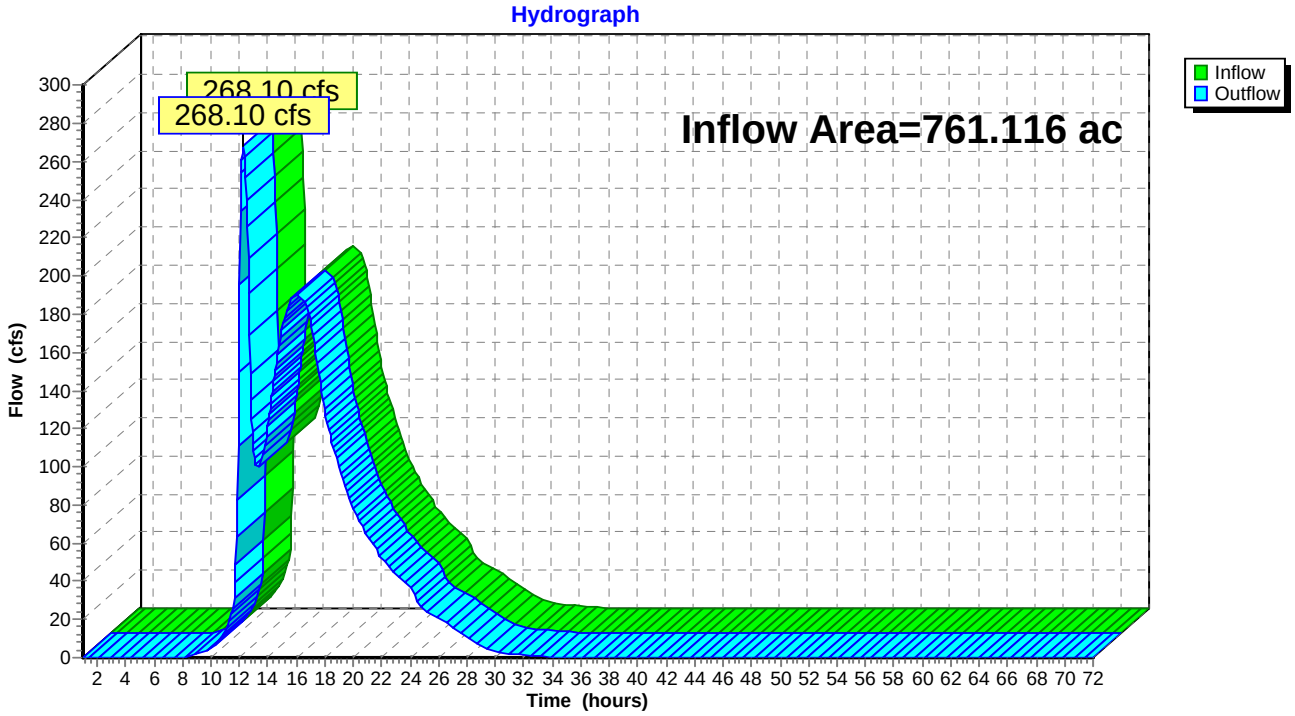


Summary for Reach TOW: Total Offsite-West

Inflow Area = 761.116 ac, 7.13% Impervious, Inflow Depth = 2.04" for 25-Year event
Inflow = 268.10 cfs @ 12.29 hrs, Volume= 129.363 af
Outflow = 268.10 cfs @ 12.29 hrs, Volume= 129.363 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TOW: Total Offsite-West

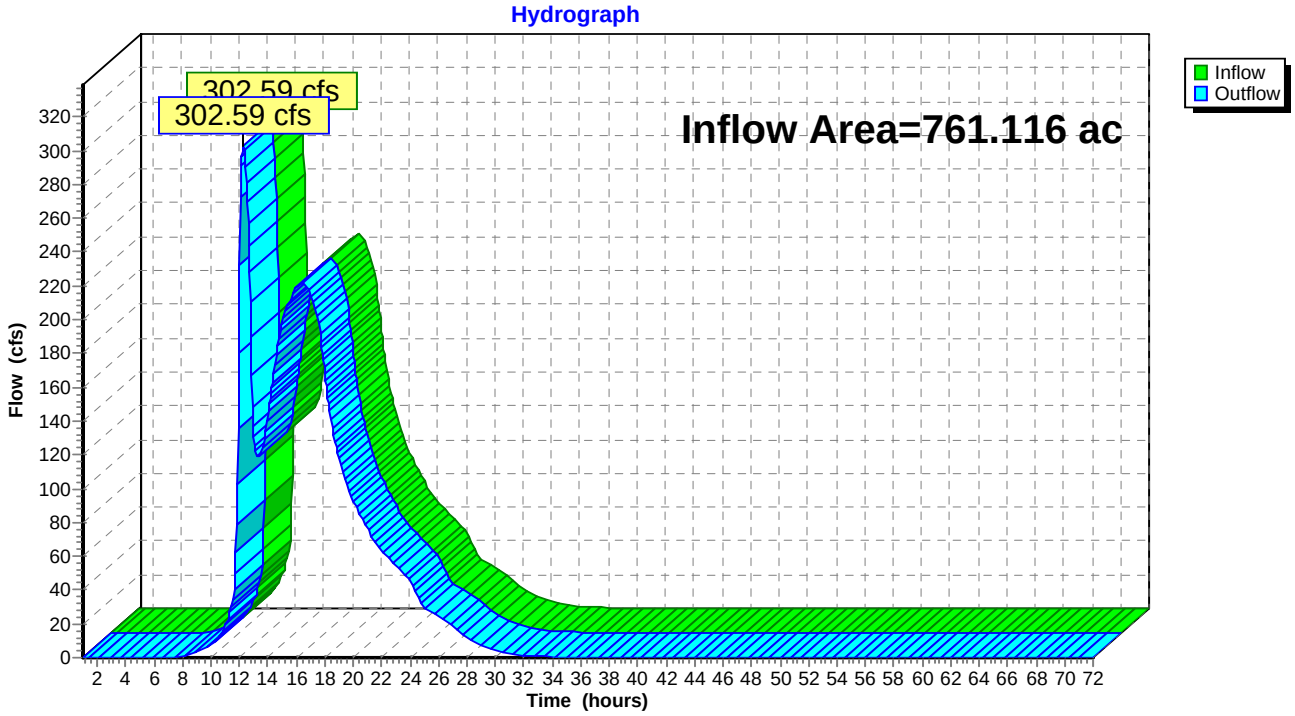


Summary for Reach TOW: Total Offsite-West

Inflow Area = 761.116 ac, 7.13% Impervious, Inflow Depth = 2.45" for 50-Year event
Inflow = 302.59 cfs @ 12.30 hrs, Volume= 155.372 af
Outflow = 302.59 cfs @ 12.30 hrs, Volume= 155.372 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TOW: Total Offsite-West

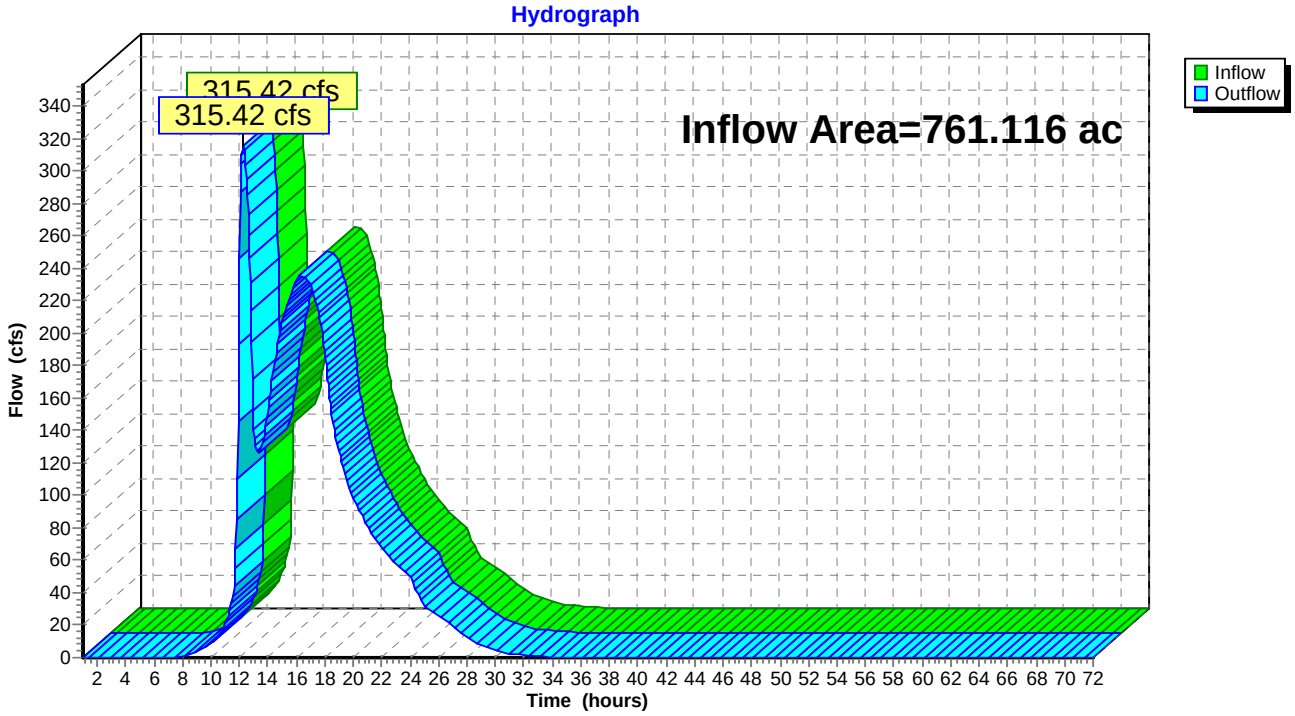


Summary for Reach TOW: Total Offsite-West

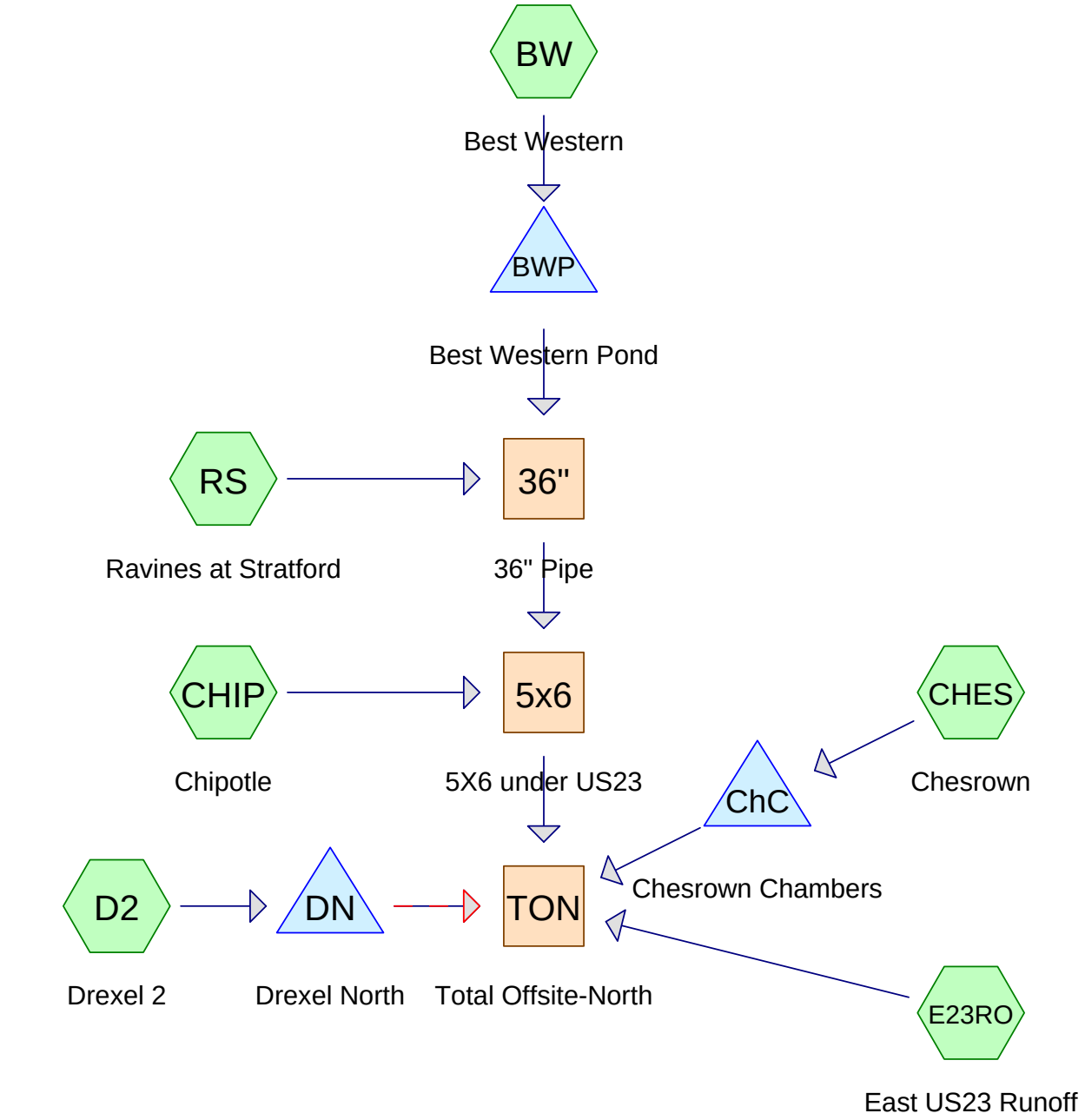
Inflow Area = 761.116 ac, 7.13% Impervious, Inflow Depth = 2.62" for 100-Year event
Inflow = 315.42 cfs @ 12.30 hrs, Volume= 165.997 af
Outflow = 315.42 cfs @ 12.30 hrs, Volume= 165.997 af, Atten= 0%, Lag= 0.0 min

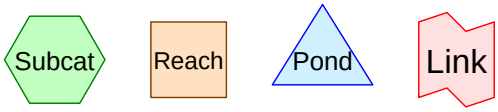
Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TOW: Total Offsite-West



Existing Offsite North





Routing Diagram for Delaware Development
Prepared by The Mannik & Smith Group, Inc., Printed 8/1/2016
HydroCAD® 10.00-11 s/n 08386 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment BW: Best Western

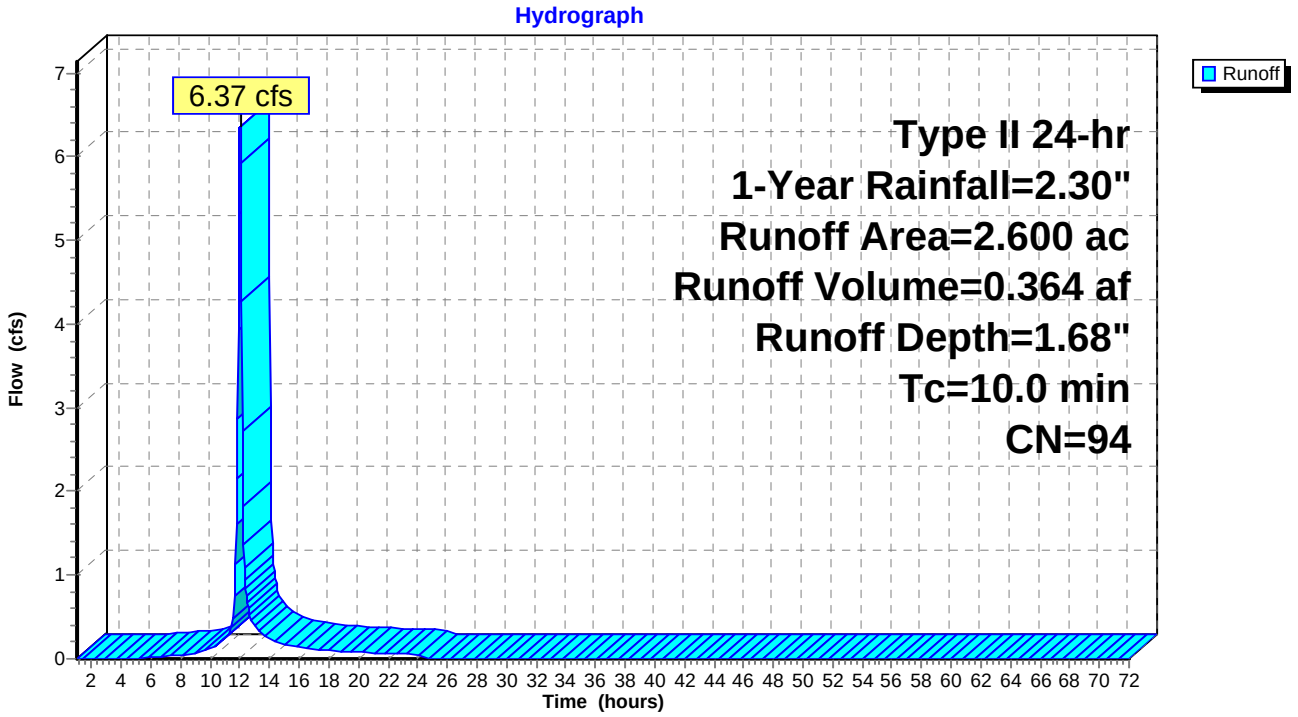
Runoff = 6.37 cfs @ 12.01 hrs, Volume= 0.364 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

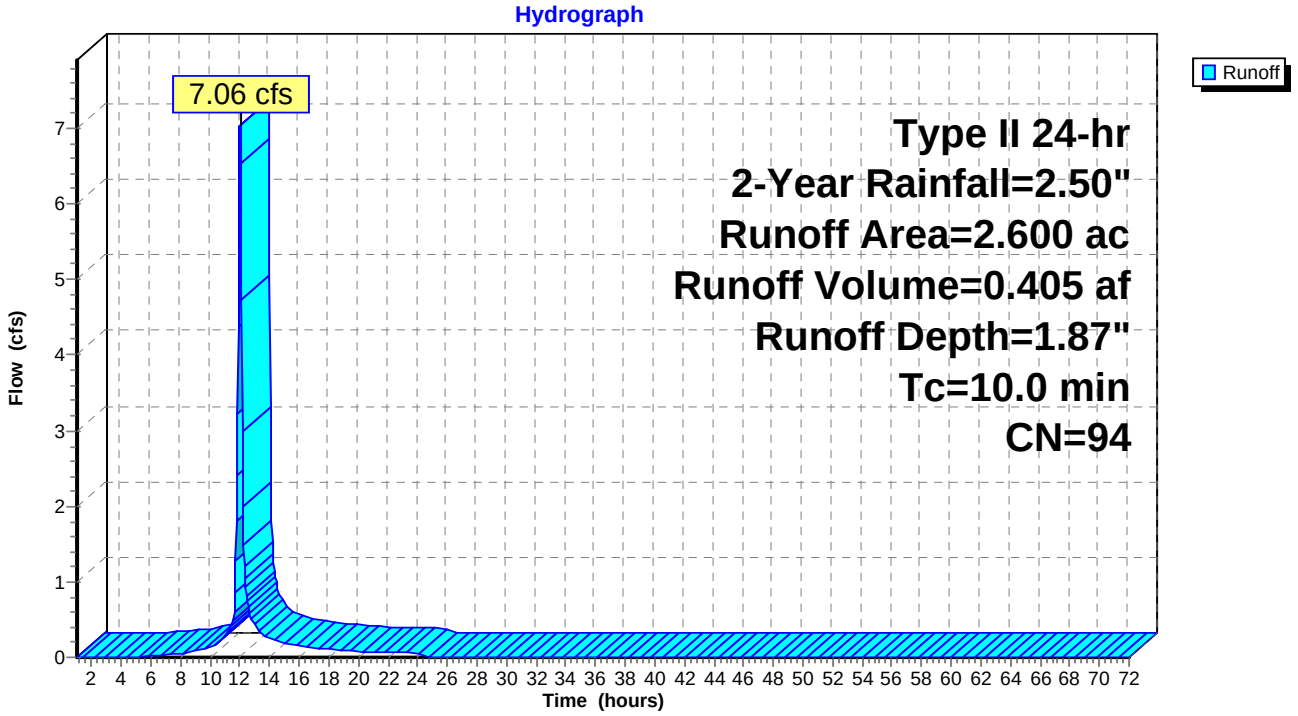
Area (ac)	CN	Description
2.600	94	Urban commercial, 85% imp, HSG C
0.390		15.00% Pervious Area
2.210		85.00% Impervious Area

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

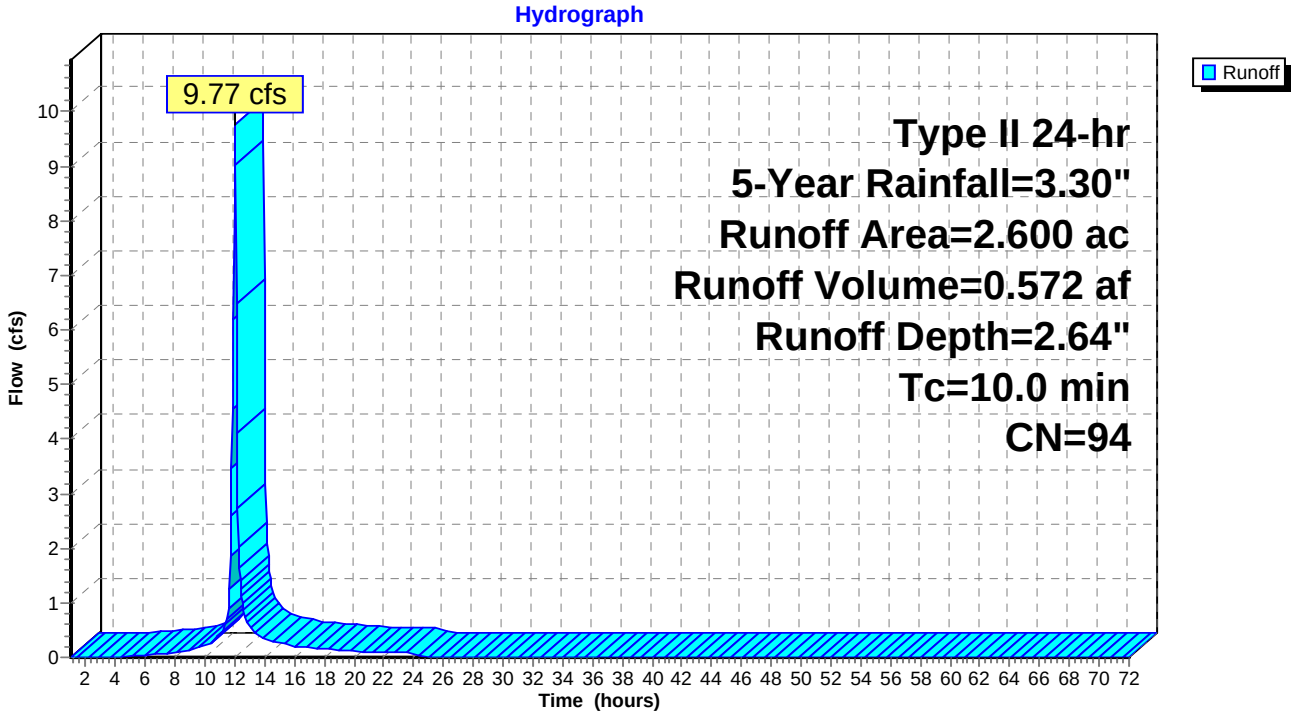
Subcatchment BW: Best Western



Subcatchment BW: Best Western



Subcatchment BW: Best Western



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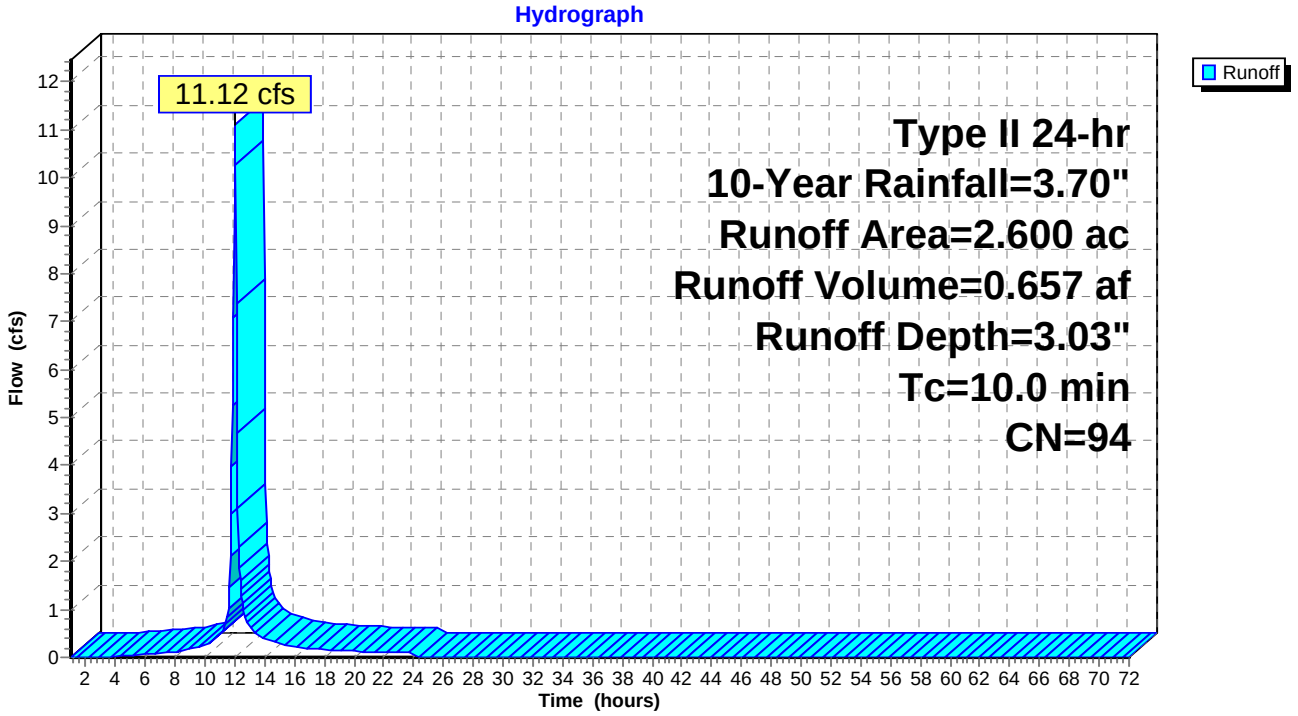

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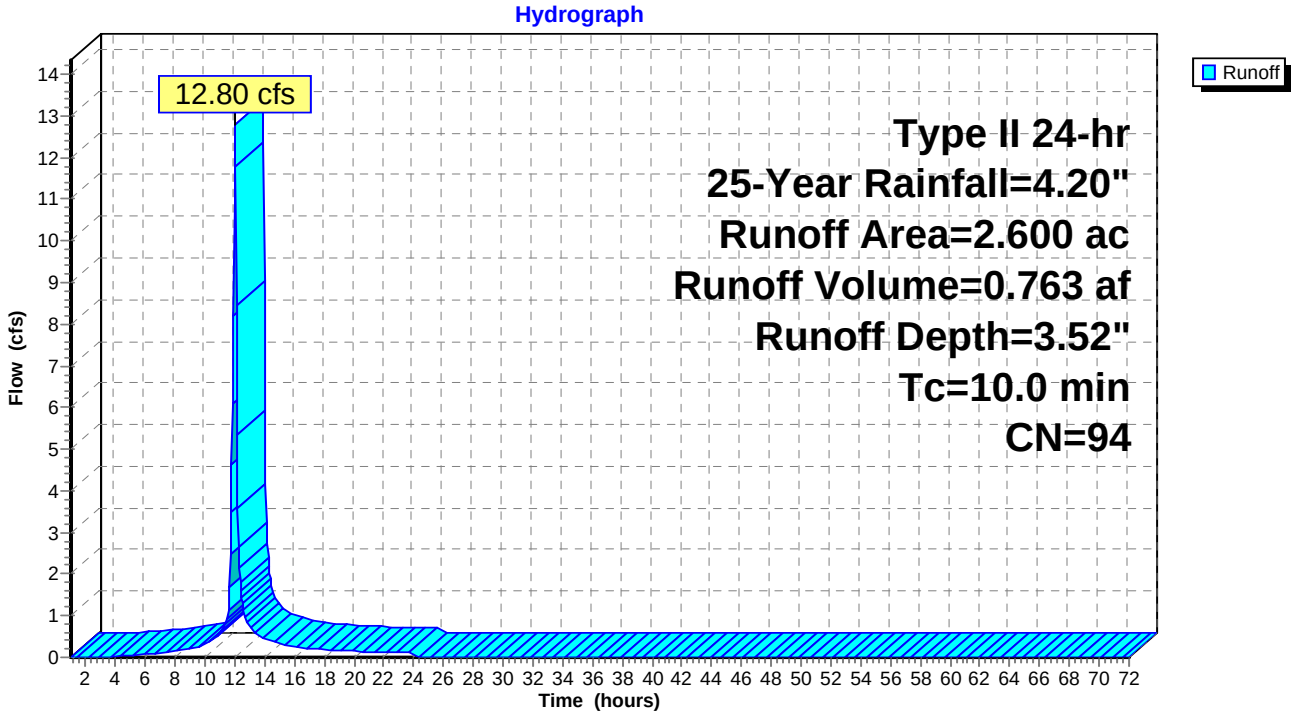
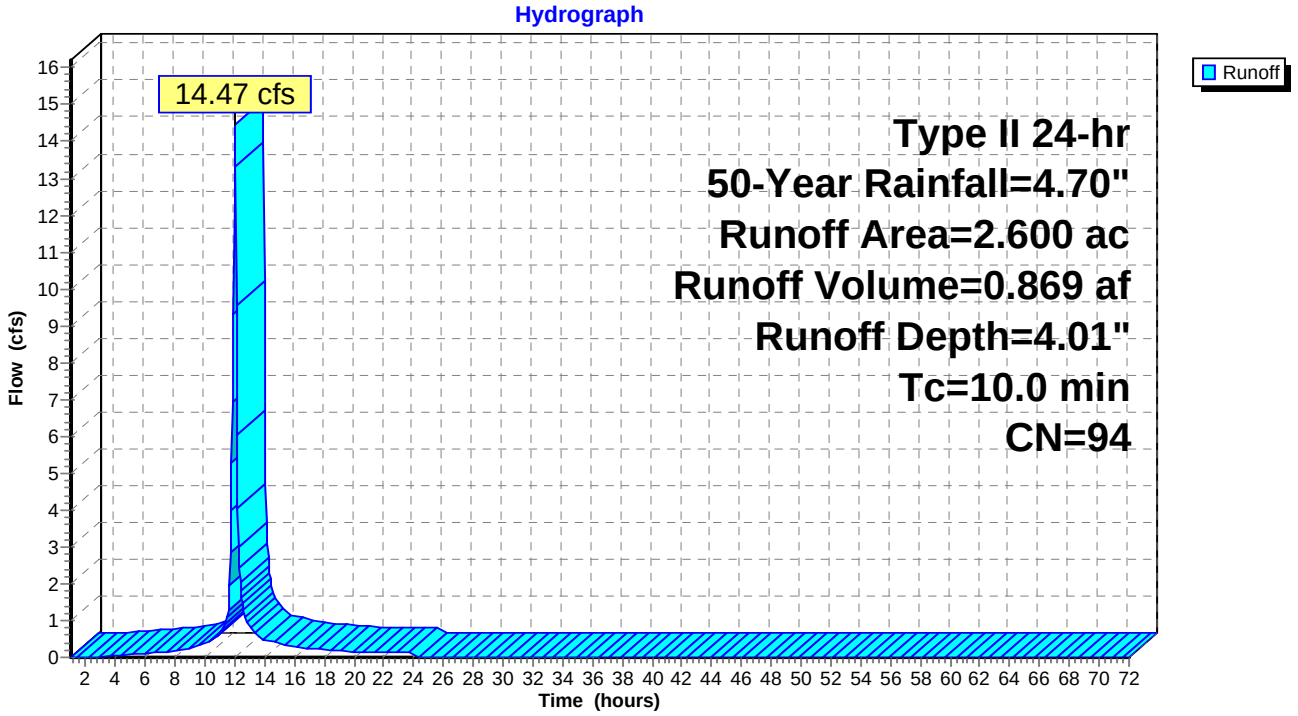
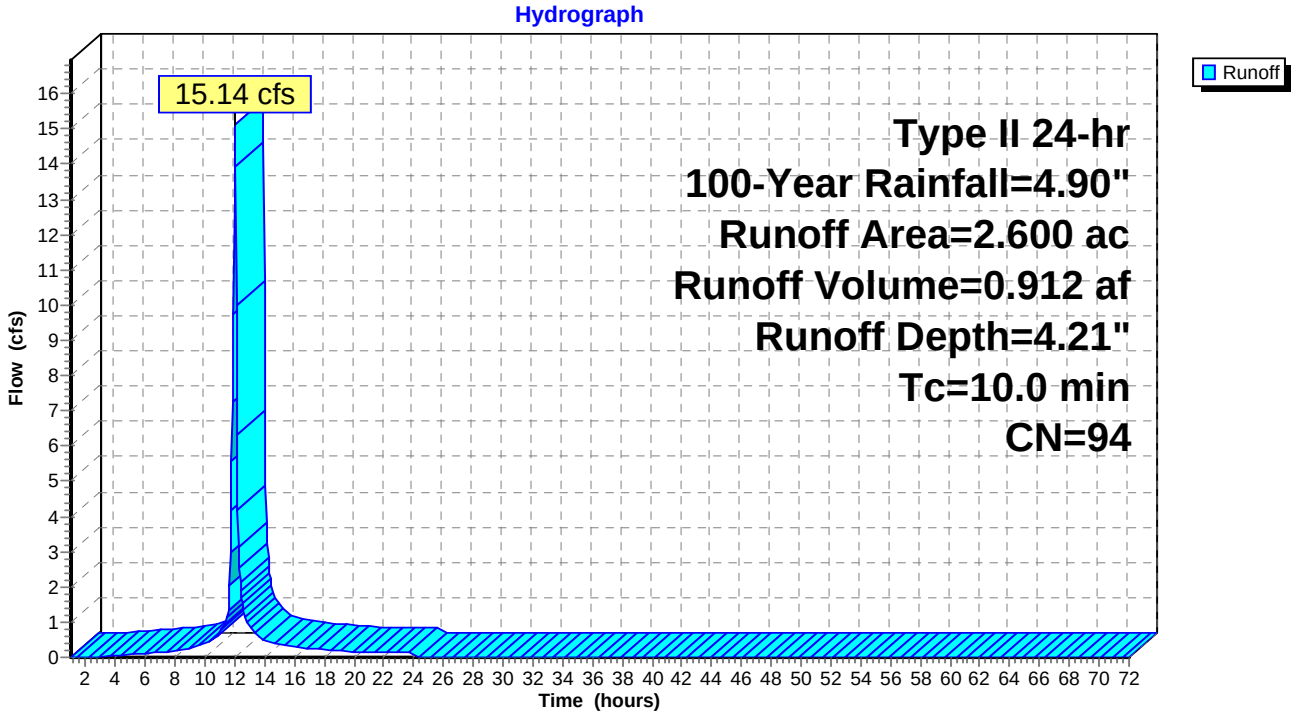


Subcatchment BW: Best Western



Subcatchment BW: Best Western



Summary for Pond BWP: Best Western Pond

Inflow Area = 2.600 ac, 85.00% Impervious, Inflow Depth = 3.52" for 25-Year event
Inflow = 12.80 cfs @ 12.01 hrs, Volume= 0.763 af
Outflow = 0.76 cfs @ 12.96 hrs, Volume= 0.763 af, Atten= 94%, Lag= 57.3 min
Primary = 0.76 cfs @ 12.96 hrs, Volume= 0.763 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 905.21' @ 12.96 hrs Surf.Area= 12,618 sf Storage= 16,986 cf

Plug-Flow detention time= 234.5 min calculated for 0.763 af (100% of inflow)
Center-of-Mass det. time= 234.3 min (1,013.2 - 778.9)

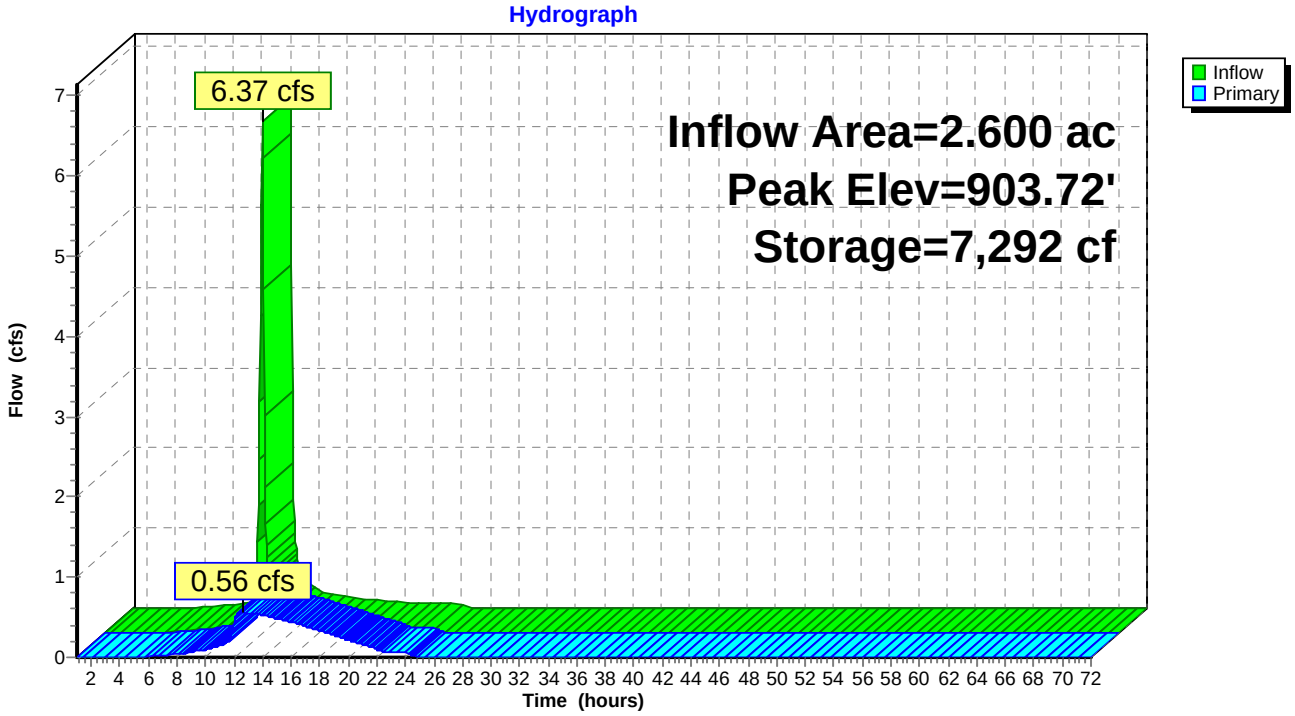
Volume	Invert	Avail.Storage	Storage Description
#1	902.00'	40,029 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
902.00	3,319	344.0	0	0	3,319
903.00	4,393	371.0	3,843	3,843	4,896
904.00	5,549	399.0	4,960	8,803	6,655
905.00	6,786	426.0	6,157	14,960	8,475
906.00	50,000	1,000.0	25,069	40,029	73,615

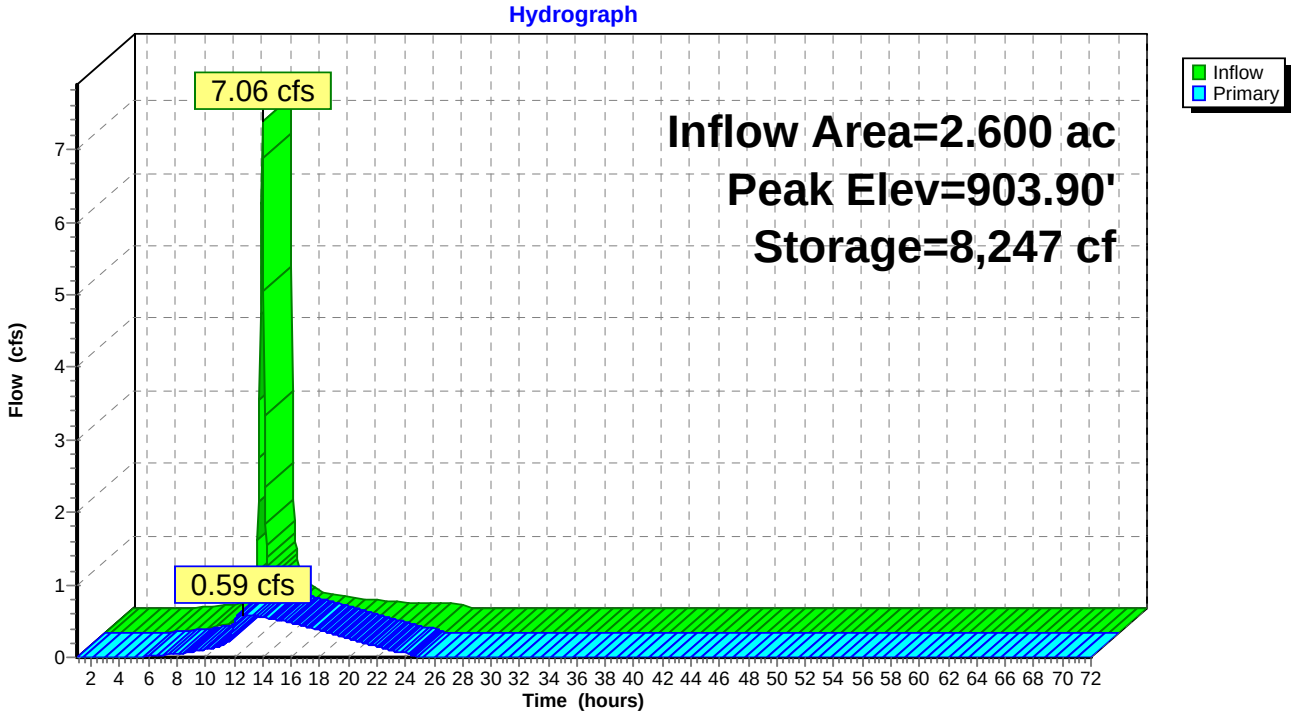
Device	Routing	Invert	Outlet Devices
#1	Primary	901.79'	**12.00" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 901.79' / 901.59' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	901.79'	**4.00" Vert. Orifice/Grate** C= 0.600
#3	Device 1	905.33'	**1.50" x 22.00" Horiz. Orifice/Grate X 8.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.76 cfs @ 12.96 hrs HW=905.21' (Free Discharge)
└─1=**Culvert** (Passes 0.76 cfs of 5.10 cfs potential flow)
  ├─2=**Orifice/Grate** (Orifice Controls 0.76 cfs @ 8.69 fps)
  └─3=**Orifice/Grate** (Controls 0.00 cfs)

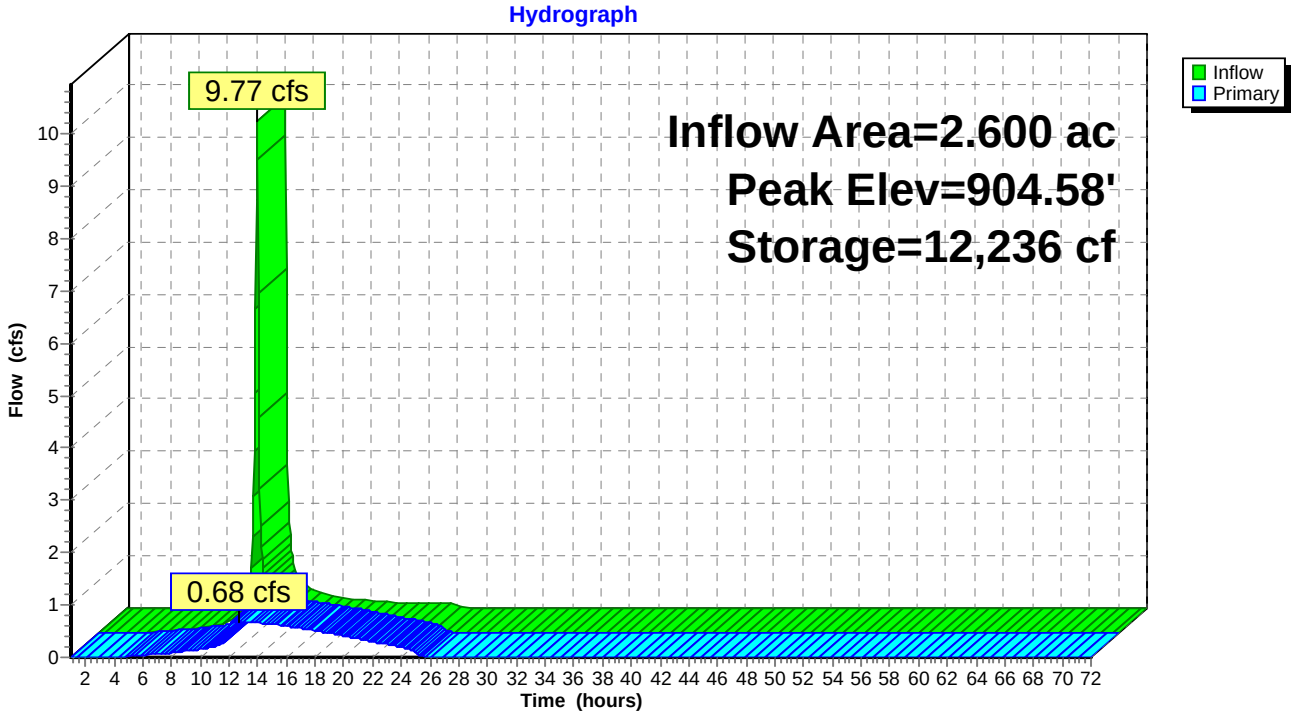
Pond BWP: Best Western Pond



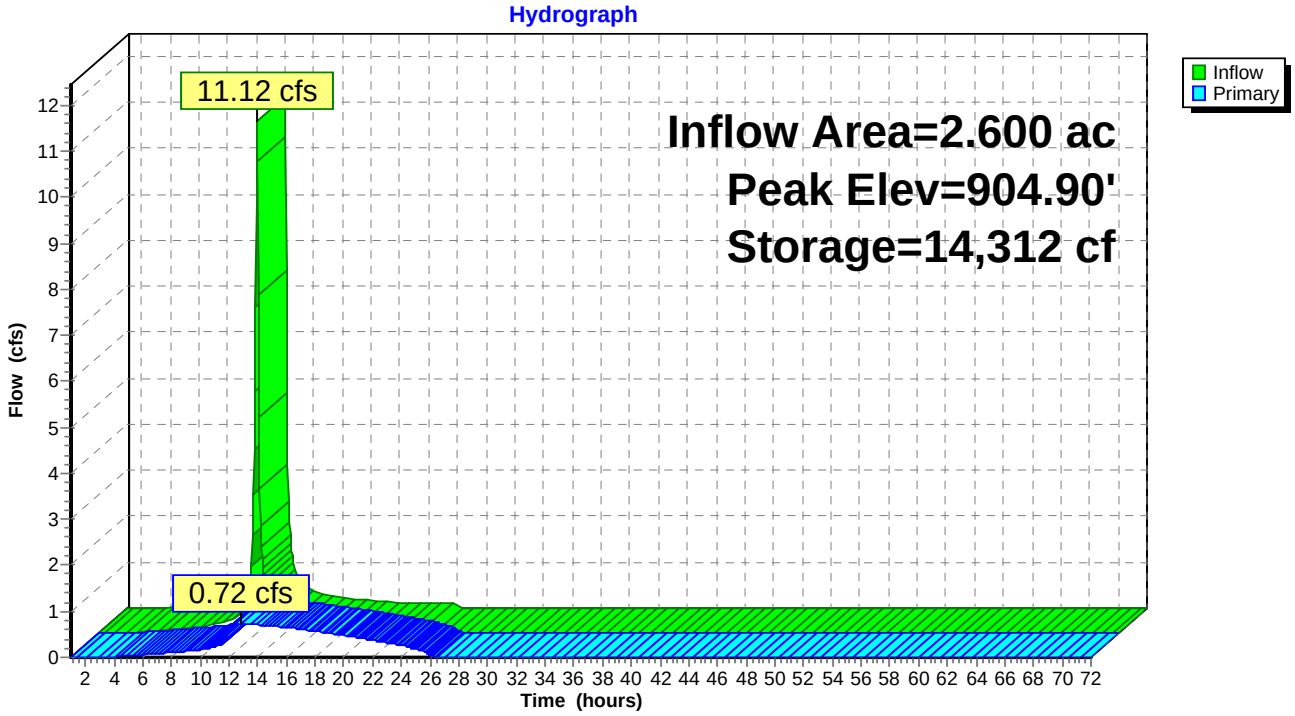
Pond BWP: Best Western Pond



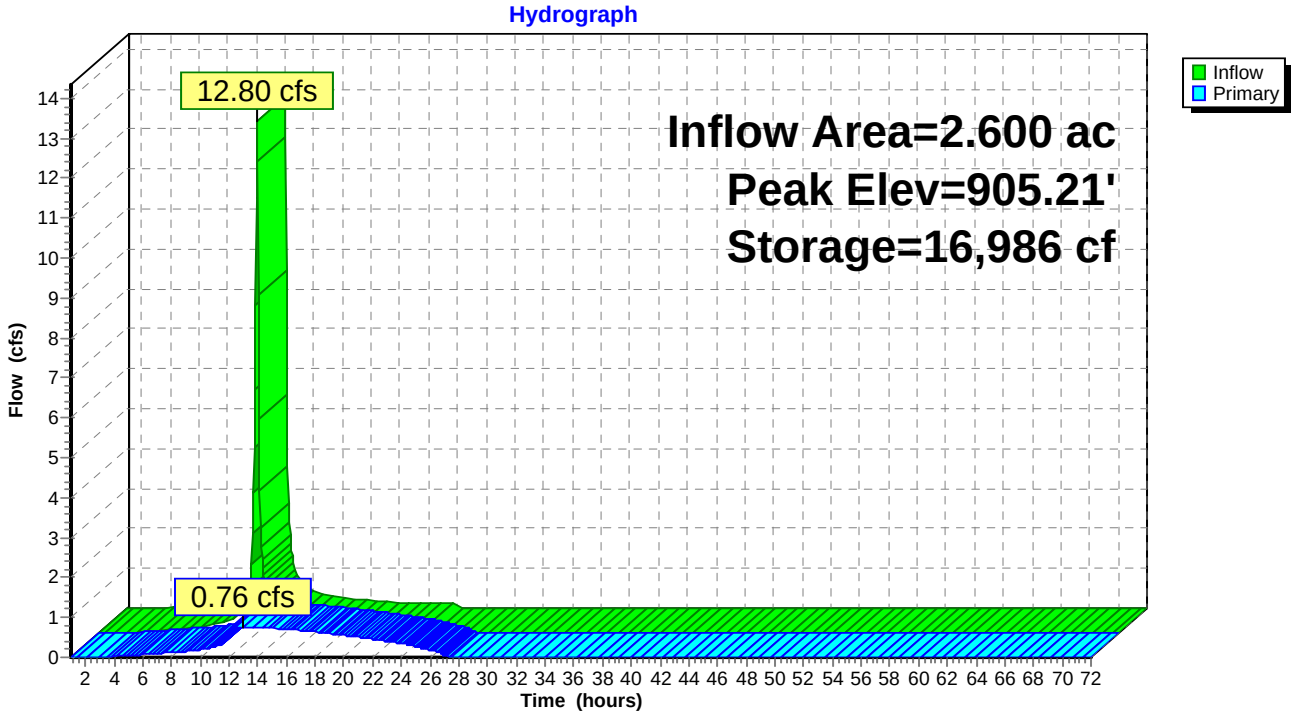
Pond BWP: Best Western Pond



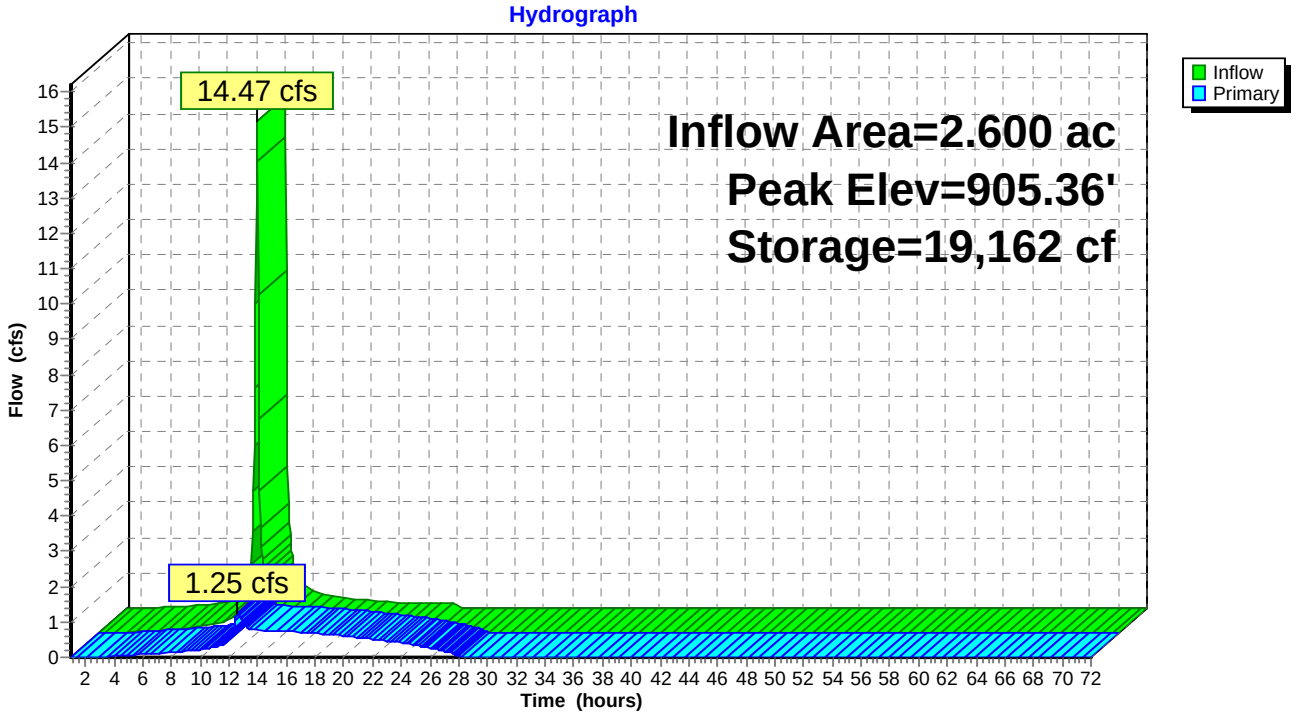
Pond BWP: Best Western Pond



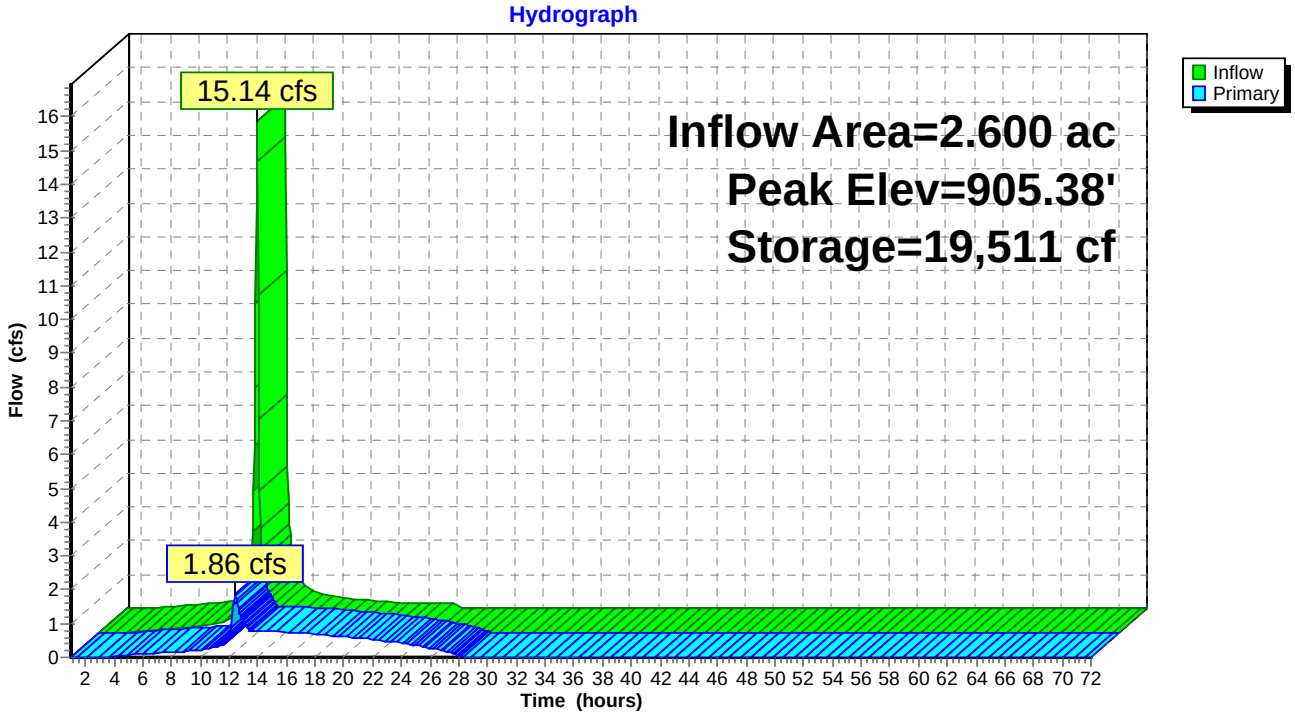
Pond BWP: Best Western Pond



Pond BWP: Best Western Pond



Pond BWP: Best Western Pond



Stage-Discharge for Pond BWP: Best Western Pond

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
902.00	0.00	902.68	0.36	903.36	0.50	904.04	0.61	904.72	0.70	905.40	2.68
902.01	0.10	902.69	0.36	903.37	0.50	904.05	0.61	904.73	0.70	905.41	3.10
902.02	0.10	902.70	0.36	903.38	0.50	904.06	0.61	904.74	0.70	905.42	3.43
902.03	0.11	902.71	0.36	903.39	0.50	904.07	0.61	904.75	0.70	905.43	3.57
902.04	0.12	902.72	0.37	903.40	0.50	904.08	0.61	904.76	0.70	905.44	3.71
902.05	0.13	902.73	0.37	903.41	0.51	904.09	0.61	904.77	0.70	905.45	3.84
902.06	0.13	902.74	0.37	903.42	0.51	904.10	0.62	904.78	0.71	905.46	3.97
902.07	0.14	902.75	0.37	903.43	0.51	904.11	0.62	904.79	0.71	905.47	4.09
902.08	0.15	902.76	0.38	903.44	0.51	904.12	0.62	904.80	0.71	905.48	4.21
902.09	0.15	902.77	0.38	903.45	0.51	904.13	0.62	904.81	0.71	905.49	4.32
902.10	0.16	902.78	0.38	903.46	0.52	904.14	0.62	904.82	0.71	905.50	4.43
902.11	0.17	902.79	0.38	903.47	0.52	904.15	0.62	904.83	0.71	905.51	4.54
902.12	0.17	902.80	0.39	903.48	0.52	904.16	0.62	904.84	0.71	905.52	4.64
902.13	0.17	902.81	0.39	903.49	0.52	904.17	0.63	904.85	0.71	905.53	4.74
902.14	0.18	902.82	0.39	903.50	0.52	904.18	0.63	904.86	0.72	905.54	4.84
902.15	0.18	902.83	0.39	903.51	0.52	904.19	0.63	904.87	0.72	905.55	4.94
902.16	0.19	902.84	0.39	903.52	0.53	904.20	0.63	904.88	0.72	905.56	5.03
902.17	0.19	902.85	0.40	903.53	0.53	904.21	0.63	904.89	0.72	905.57	5.12
902.18	0.20	902.86	0.40	903.54	0.53	904.22	0.63	904.90	0.72	905.58	5.21
902.19	0.20	902.87	0.40	903.55	0.53	904.23	0.63	904.91	0.72	905.59	5.30
902.20	0.21	902.88	0.40	903.56	0.53	904.24	0.63	904.92	0.72	905.60	5.39
902.21	0.21	902.89	0.41	903.57	0.53	904.25	0.64	904.93	0.72	905.61	5.44
902.22	0.22	902.90	0.41	903.58	0.54	904.26	0.64	904.94	0.73	905.62	5.45
902.23	0.22	902.91	0.41	903.59	0.54	904.27	0.64	904.95	0.73	905.63	5.46
902.24	0.22	902.92	0.41	903.60	0.54	904.28	0.64	904.96	0.73	905.64	5.46
902.25	0.23	902.93	0.41	903.61	0.54	904.29	0.64	904.97	0.73	905.65	5.47
902.26	0.23	902.94	0.42	903.62	0.54	904.30	0.64	904.98	0.73	905.66	5.48
902.27	0.24	902.95	0.42	903.63	0.54	904.31	0.64	904.99	0.73	905.67	5.49
902.28	0.24	902.96	0.42	903.64	0.55	904.32	0.65	905.00	0.73	905.68	5.50
902.29	0.24	902.97	0.42	903.65	0.55	904.33	0.65	905.01	0.73	905.69	5.51
902.30	0.25	902.98	0.43	903.66	0.55	904.34	0.65	905.02	0.74	905.70	5.51
902.31	0.25	902.99	0.43	903.67	0.55	904.35	0.65	905.03	0.74	905.71	5.52
902.32	0.25	903.00	0.43	903.68	0.55	904.36	0.65	905.04	0.74	905.72	5.53
902.33	0.26	903.01	0.43	903.69	0.55	904.37	0.65	905.05	0.74	905.73	5.54
902.34	0.26	903.02	0.43	903.70	0.55	904.38	0.65	905.06	0.74	905.74	5.55
902.35	0.26	903.03	0.44	903.71	0.56	904.39	0.66	905.07	0.74	905.75	5.55
902.36	0.27	903.04	0.44	903.72	0.56	904.40	0.66	905.08	0.74	905.76	5.56
902.37	0.27	903.05	0.44	903.73	0.56	904.41	0.66	905.09	0.74	905.77	5.57
902.38	0.27	903.06	0.44	903.74	0.56	904.42	0.66	905.10	0.74	905.78	5.58
902.39	0.28	903.07	0.44	903.75	0.56	904.43	0.66	905.11	0.75	905.79	5.59
902.40	0.28	903.08	0.45	903.76	0.56	904.44	0.66	905.12	0.75	905.80	5.59
902.41	0.28	903.09	0.45	903.77	0.57	904.45	0.66	905.13	0.75	905.81	5.60
902.42	0.29	903.10	0.45	903.78	0.57	904.46	0.66	905.14	0.75	905.82	5.61
902.43	0.29	903.11	0.45	903.79	0.57	904.47	0.67	905.15	0.75	905.83	5.62
902.44	0.29	903.12	0.45	903.80	0.57	904.48	0.67	905.16	0.75	905.84	5.63
902.45	0.30	903.13	0.46	903.81	0.57	904.49	0.67	905.17	0.75	905.85	5.63
902.46	0.30	903.14	0.46	903.82	0.57	904.50	0.67	905.18	0.75	905.86	5.64
902.47	0.30	903.15	0.46	903.83	0.58	904.51	0.67	905.19	0.76	905.87	5.65
902.48	0.30	903.16	0.46	903.84	0.58	904.52	0.67	905.20	0.76	905.88	5.66
902.49	0.31	903.17	0.46	903.85	0.58	904.53	0.67	905.21	0.76	905.89	5.66
902.50	0.31	903.18	0.46	903.86	0.58	904.54	0.68	905.22	0.76	905.90	5.67
902.51	0.31	903.19	0.47	903.87	0.58	904.55	0.68	905.23	0.76	905.91	5.68
902.52	0.32	903.20	0.47	903.88	0.58	904.56	0.68	905.24	0.76	905.92	5.69
902.53	0.32	903.21	0.47	903.89	0.58	904.57	0.68	905.25	0.76	905.93	5.70
902.54	0.32	903.22	0.47	903.90	0.59	904.58	0.68	905.26	0.76	905.94	5.70
902.55	0.32	903.23	0.47	903.91	0.59	904.59	0.68	905.27	0.76	905.95	5.71
902.56	0.33	903.24	0.48	903.92	0.59	904.60	0.68	905.28	0.77	905.96	5.72
902.57	0.33	903.25	0.48	903.93	0.59	904.61	0.68	905.29	0.77	905.97	5.73
902.58	0.33	903.26	0.48	903.94	0.59	904.62	0.69	905.30	0.77	905.98	5.74
902.59	0.33	903.27	0.48	903.95	0.59	904.63	0.69	905.31	0.77	905.99	5.74
902.60	0.34	903.28	0.48	903.96	0.59	904.64	0.69	905.32	0.77	906.00	5.75
902.61	0.34	903.29	0.49	903.97	0.60	904.65	0.69	905.33	0.77		
902.62	0.34	903.30	0.49	903.98	0.60	904.66	0.69	905.34	0.88		
902.63	0.34	903.31	0.49	903.99	0.60	904.67	0.69	905.35	1.06		
902.64	0.35	903.32	0.49	904.00	0.60	904.68	0.69	905.36	1.31		
902.65	0.35	903.33	0.49	904.01	0.60	904.69	0.69	905.37	1.60		
902.66	0.35	903.34	0.49	904.02	0.60	904.70	0.70	905.38	1.92		
902.67	0.35	903.35	0.50	904.03	0.61	904.71	0.70	905.39	2.28		

Stage-Area-Storage for Pond BWP: Best Western Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
902.00	3,319	0	903.36	4,794	5,497	904.72	6,427	13,111
902.02	3,339	67	903.38	4,816	5,593	904.74	6,452	13,240
902.04	3,359	134	903.40	4,839	5,689	904.76	6,478	13,369
902.06	3,379	201	903.42	4,862	5,786	904.78	6,503	13,499
902.08	3,399	269	903.44	4,885	5,884	904.80	6,529	13,629
902.10	3,420	337	903.46	4,908	5,982	904.82	6,554	13,760
902.12	3,440	406	903.48	4,931	6,080	904.84	6,580	13,891
902.14	3,460	475	903.50	4,954	6,179	904.86	6,605	14,023
902.16	3,481	544	903.52	4,977	6,278	904.88	6,631	14,155
902.18	3,501	614	903.54	5,000	6,378	904.90	6,657	14,288
902.20	3,522	684	903.56	5,024	6,478	904.92	6,682	14,422
902.22	3,542	755	903.58	5,047	6,579	904.94	6,708	14,556
902.24	3,563	826	903.60	5,070	6,680	904.96	6,734	14,690
902.26	3,584	897	903.62	5,094	6,782	904.98	6,760	14,825
902.28	3,605	969	903.64	5,117	6,884	905.00	6,786	14,960
902.30	3,625	1,041	903.66	5,141	6,986	905.02	7,259	15,101
902.32	3,646	1,114	903.68	5,164	7,089	905.04	7,749	15,251
902.34	3,667	1,187	903.70	5,188	7,193	905.06	8,254	15,411
902.36	3,688	1,261	903.72	5,212	7,297	905.08	8,775	15,581
902.38	3,709	1,335	903.74	5,235	7,401	905.10	9,312	15,762
902.40	3,731	1,409	903.76	5,259	7,506	905.12	9,865	15,954
902.42	3,752	1,484	903.78	5,283	7,612	905.14	10,434	16,157
902.44	3,773	1,559	903.80	5,307	7,718	905.16	11,020	16,371
902.46	3,794	1,635	903.82	5,331	7,824	905.18	11,621	16,598
902.48	3,816	1,711	903.84	5,355	7,931	905.20	12,237	16,836
902.50	3,837	1,787	903.86	5,379	8,038	905.22	12,870	17,087
902.52	3,859	1,864	903.88	5,403	8,146	905.24	13,519	17,351
902.54	3,880	1,942	903.90	5,427	8,254	905.26	14,184	17,628
902.56	3,902	2,020	903.92	5,452	8,363	905.28	14,865	17,919
902.58	3,924	2,098	903.94	5,476	8,472	905.30	15,562	18,223
902.60	3,945	2,177	903.96	5,500	8,582	905.32	16,274	18,541
902.62	3,967	2,256	903.98	5,525	8,693	905.34	17,003	18,874
902.64	3,989	2,335	904.00	5,549	8,803	905.36	17,748	19,221
902.66	4,011	2,415	904.02	5,573	8,914	905.38	18,508	19,584
902.68	4,033	2,496	904.04	5,596	9,026	905.40	19,285	19,962
902.70	4,055	2,577	904.06	5,620	9,138	905.42	20,077	20,355
902.72	4,077	2,658	904.08	5,643	9,251	905.44	20,886	20,765
902.74	4,099	2,740	904.10	5,667	9,364	905.46	21,710	21,191
902.76	4,122	2,822	904.12	5,691	9,478	905.48	22,550	21,633
902.78	4,144	2,905	904.14	5,715	9,592	905.50	23,407	22,093
902.80	4,166	2,988	904.16	5,739	9,706	905.52	24,279	22,570
902.82	4,189	3,071	904.18	5,762	9,821	905.54	25,167	23,064
902.84	4,211	3,155	904.20	5,786	9,937	905.56	26,071	23,577
902.86	4,234	3,240	904.22	5,810	10,053	905.58	26,991	24,107
902.88	4,256	3,325	904.24	5,835	10,169	905.60	27,927	24,656
902.90	4,279	3,410	904.26	5,859	10,286	905.62	28,879	25,224
902.92	4,302	3,496	904.28	5,883	10,403	905.64	29,847	25,812
902.94	4,324	3,582	904.30	5,907	10,521	905.66	30,831	26,418
902.96	4,347	3,669	904.32	5,931	10,640	905.68	31,831	27,045
902.98	4,370	3,756	904.34	5,956	10,759	905.70	32,847	27,692
903.00	4,393	3,843	904.36	5,980	10,878	905.72	33,879	28,359
903.02	4,415	3,932	904.38	6,004	10,998	905.74	34,927	29,047
903.04	4,437	4,020	904.40	6,029	11,118	905.76	35,991	29,756
903.06	4,459	4,109	904.42	6,053	11,239	905.78	37,070	30,487
903.08	4,481	4,198	904.44	6,078	11,360	905.80	38,166	31,239
903.10	4,503	4,288	904.46	6,103	11,482	905.82	39,277	32,013
903.12	4,525	4,379	904.48	6,127	11,604	905.84	40,405	32,810
903.14	4,547	4,469	904.50	6,152	11,727	905.86	41,549	33,630
903.16	4,569	4,560	904.52	6,177	11,850	905.88	42,708	34,472
903.18	4,591	4,652	904.54	6,202	11,974	905.90	43,883	35,338
903.20	4,613	4,744	904.56	6,226	12,099	905.92	45,075	36,228
903.22	4,636	4,837	904.58	6,251	12,223	905.94	46,282	37,141
903.24	4,658	4,929	904.60	6,276	12,349	905.96	47,506	38,079
903.26	4,681	5,023	904.62	6,301	12,474	905.98	48,745	39,042
903.28	4,703	5,117	904.64	6,326	12,601	906.00	50,000	40,029
903.30	4,726	5,211	904.66	6,351	12,727			
903.32	4,748	5,306	904.68	6,377	12,855			
903.34	4,771	5,401	904.70	6,402	12,982			

Summary for Subcatchment RS: Ravines at Stratford

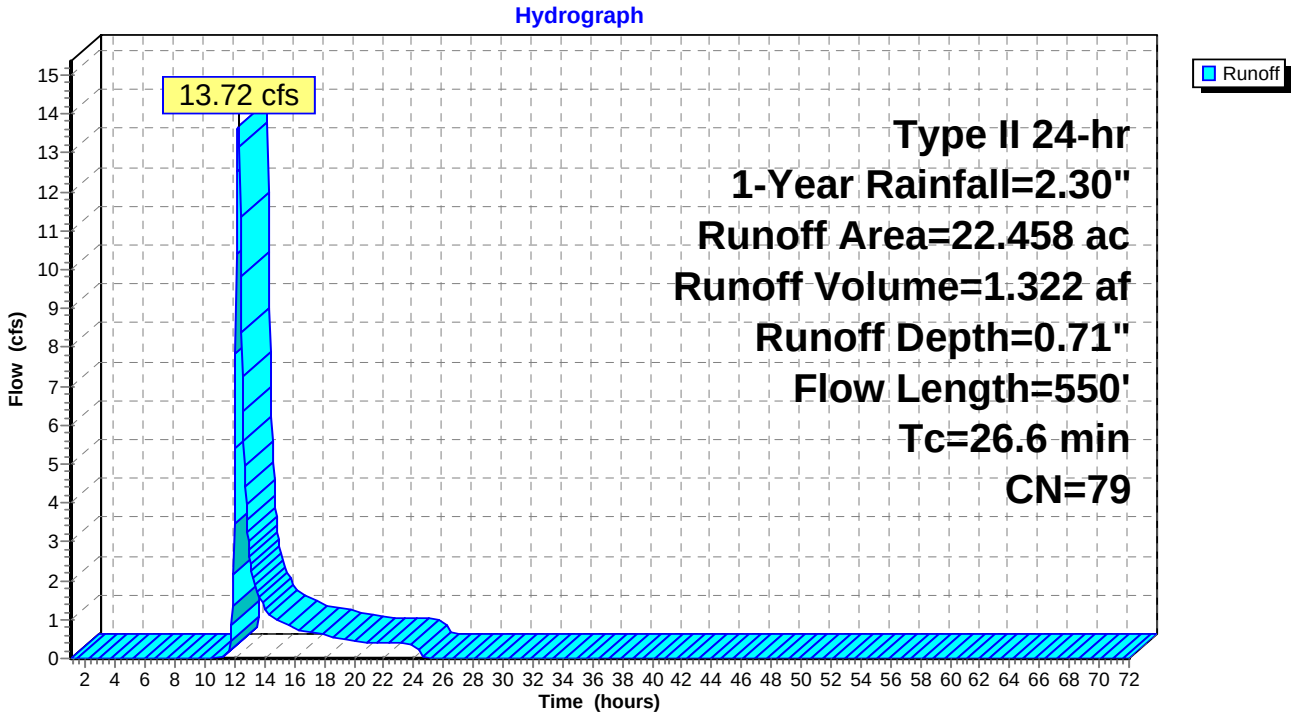
Runoff = 13.72 cfs @ 12.22 hrs, Volume= 1.322 af, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

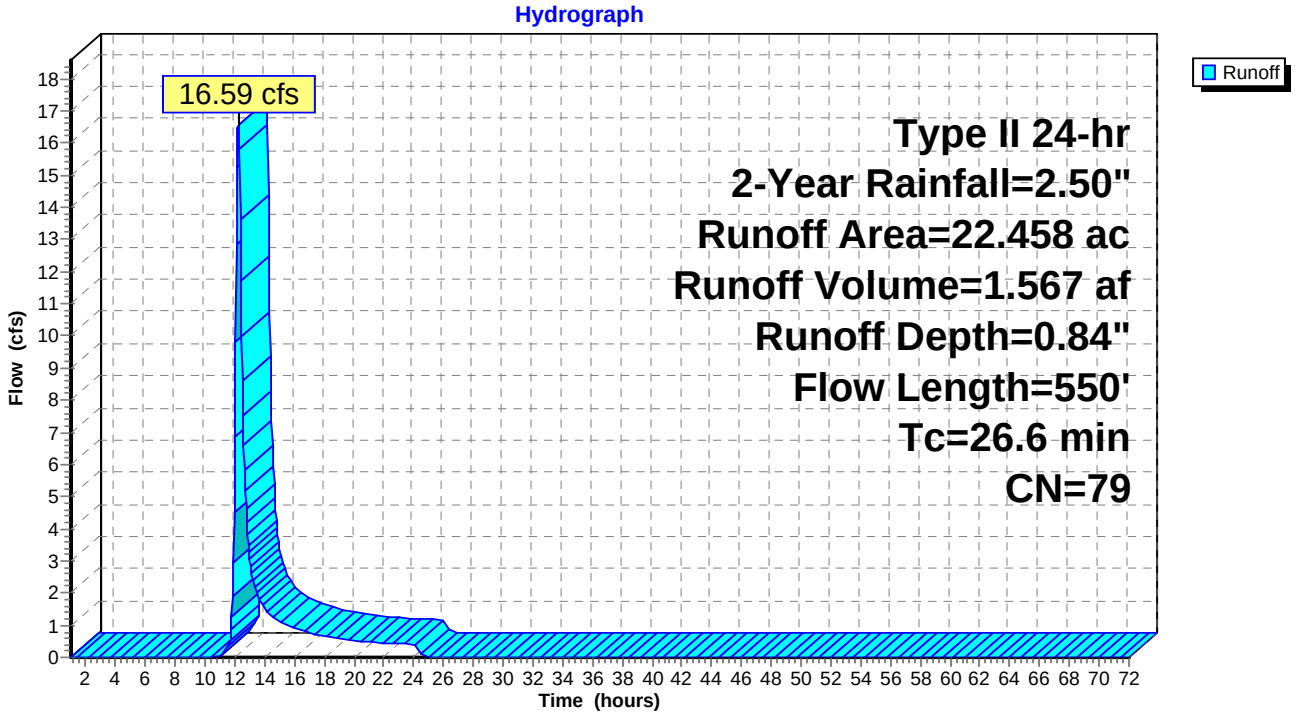
Area (ac)	CN	Description
22.458	79	1 acre lots, 20% imp, HSG C
17.966		80.00% Pervious Area
4.492		20.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0	100	0.0400	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.63"
2.5	150	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.1	300	0.0267	0.82		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
26.6	550	Total			

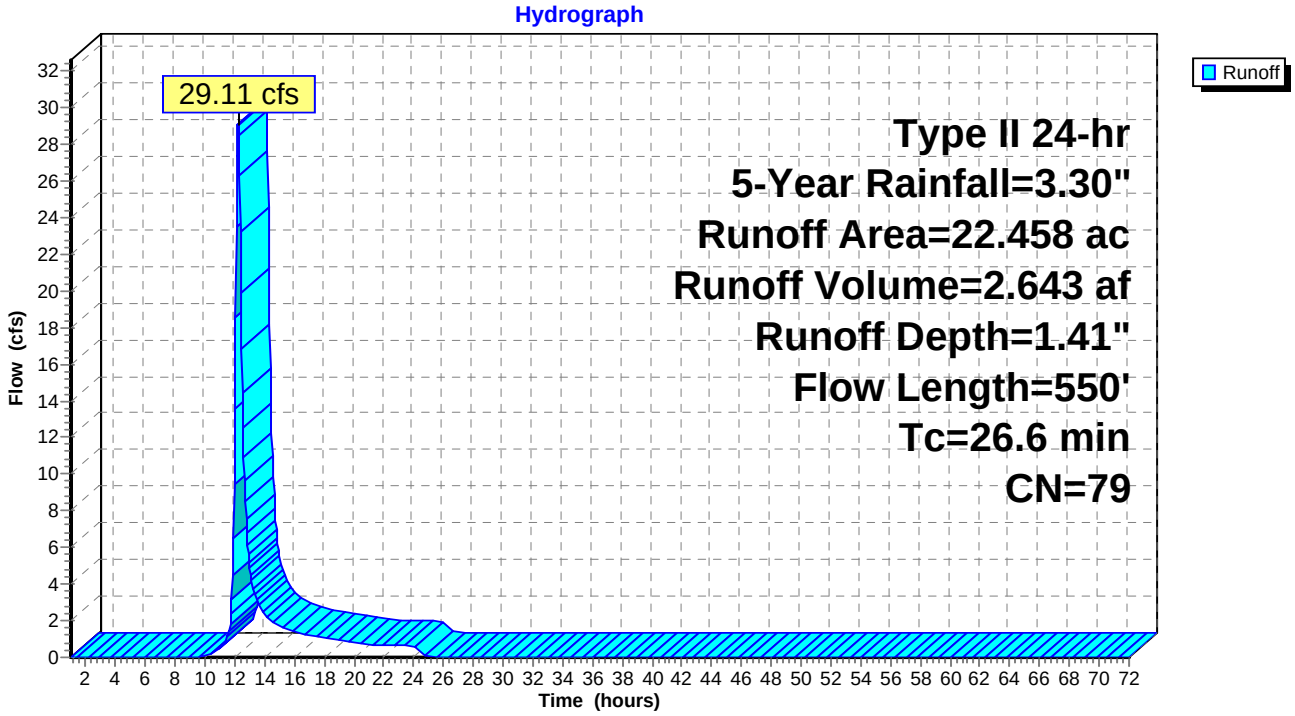
Subcatchment RS: Ravines at Stratford



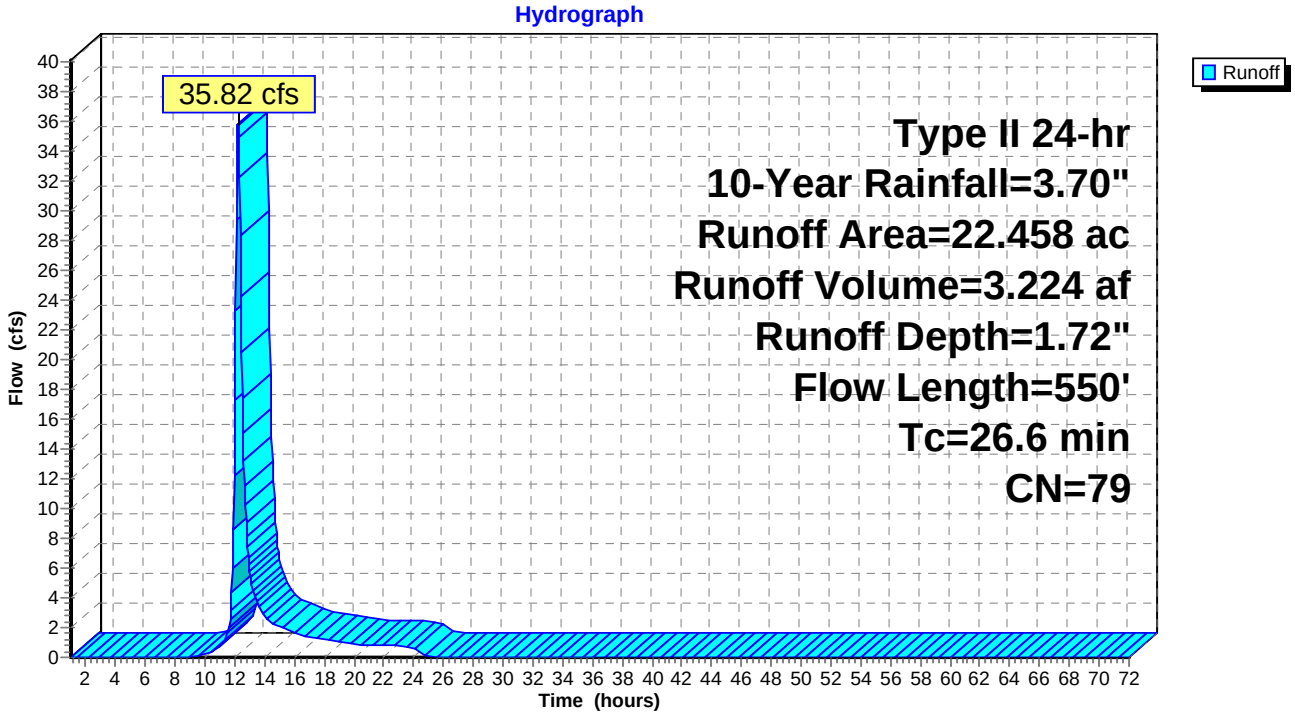
Subcatchment RS: Ravines at Stratford



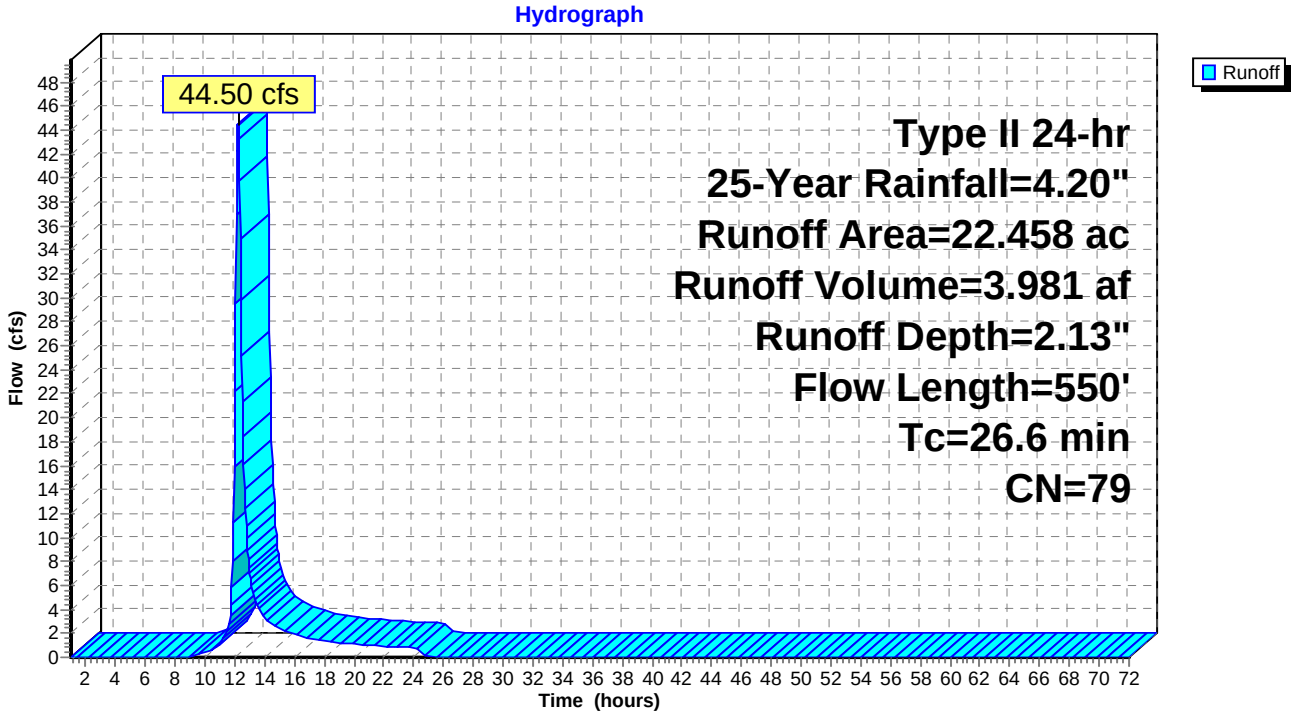
Subcatchment RS: Ravines at Stratford



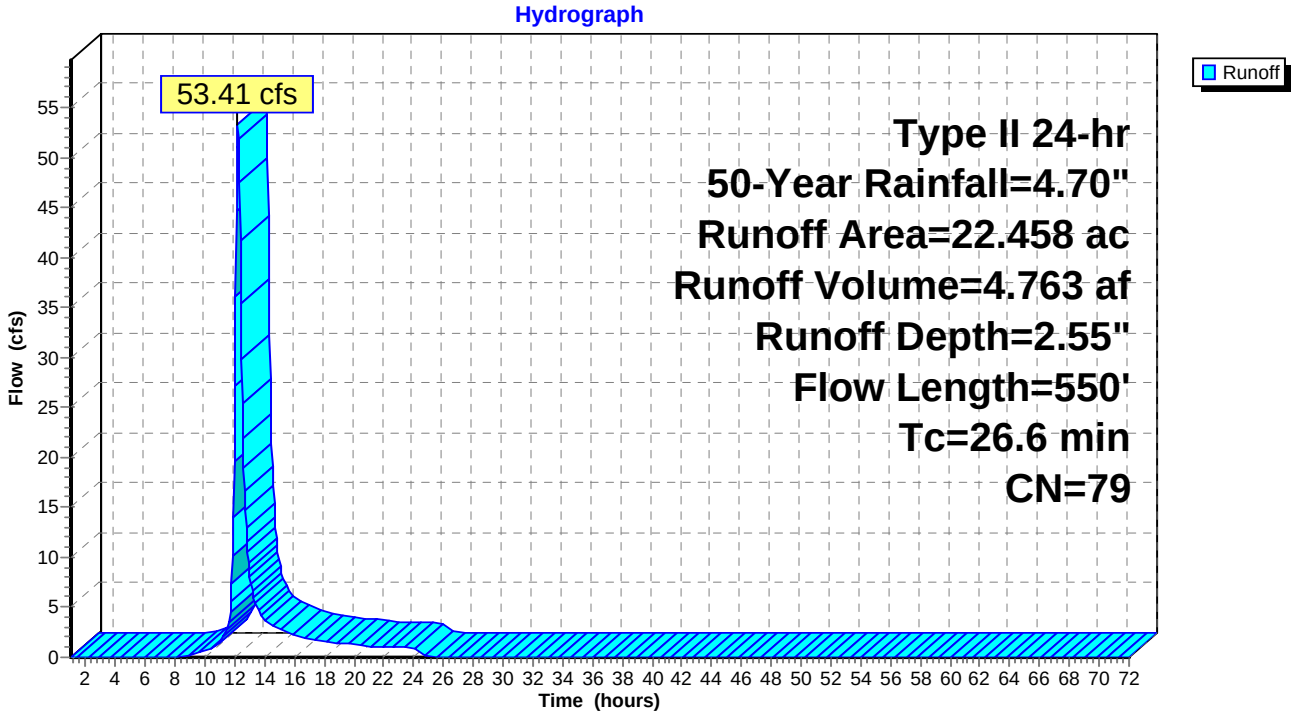
Subcatchment RS: Ravines at Stratford



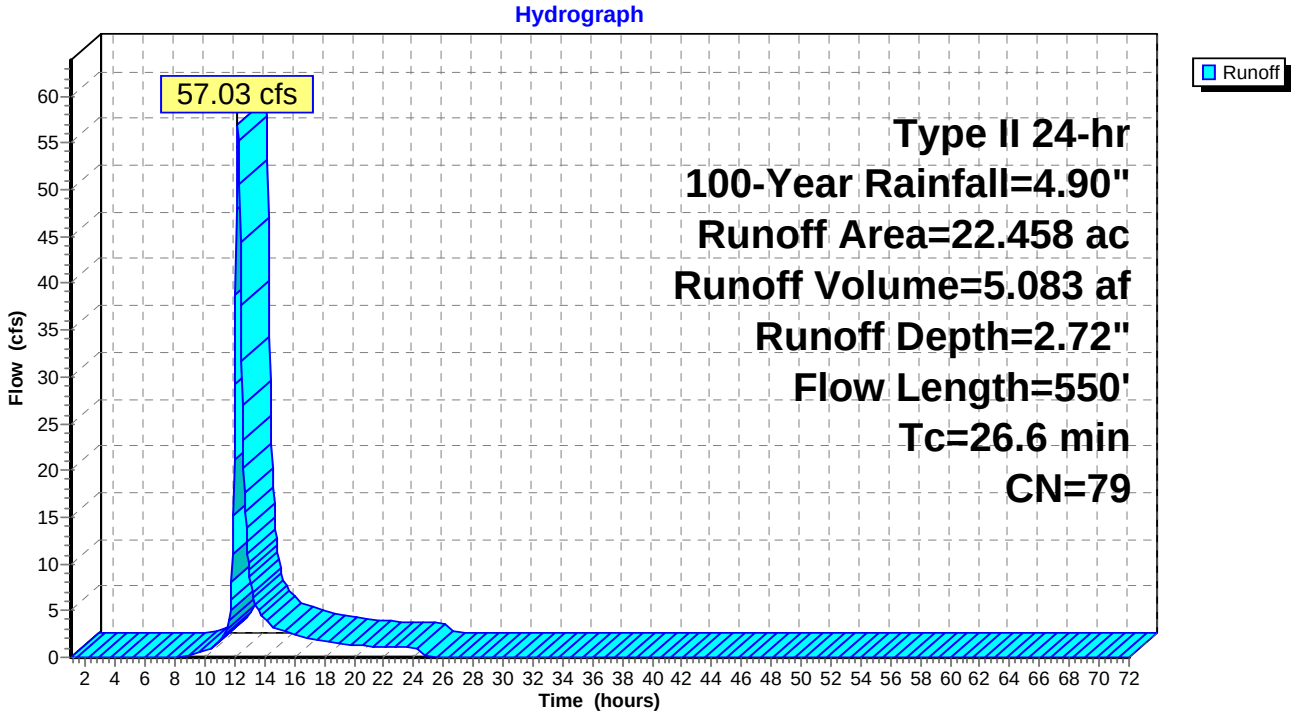
Subcatchment RS: Ravines at Stratford



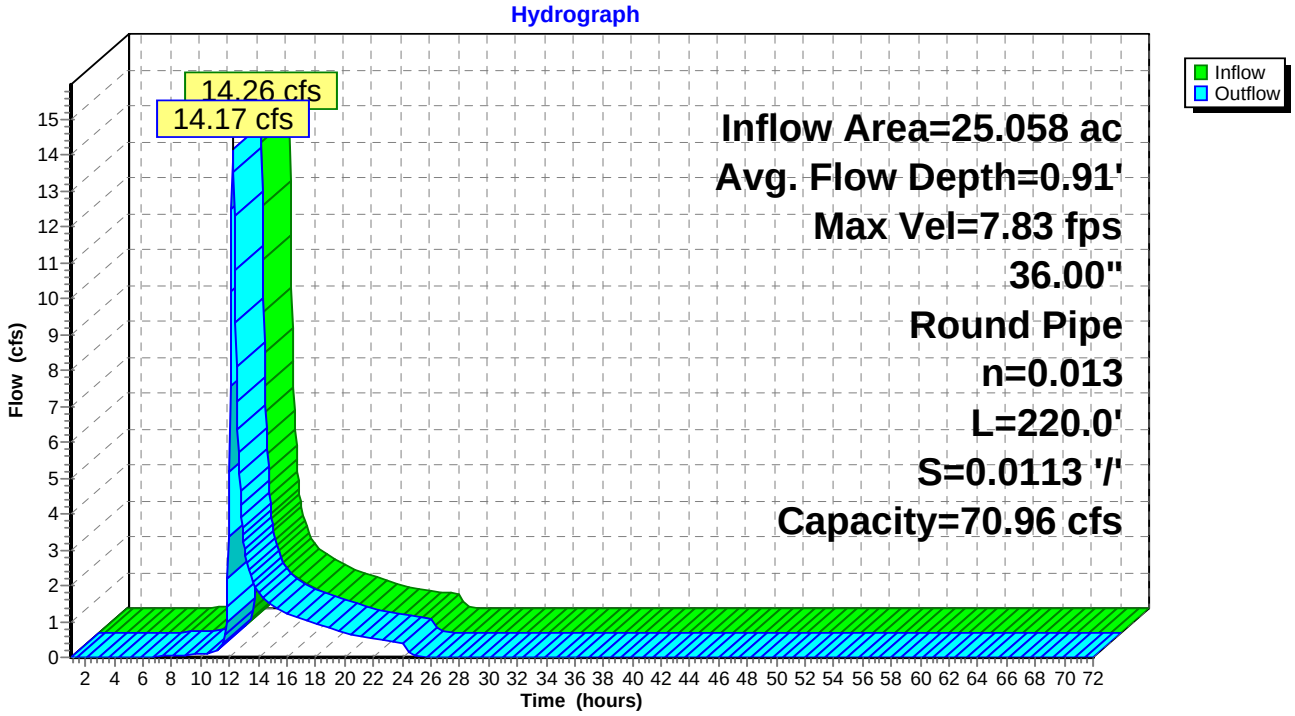
Subcatchment RS: Ravines at Stratford



Subcatchment RS: Ravines at Stratford



Reach 36": 36" Pipe



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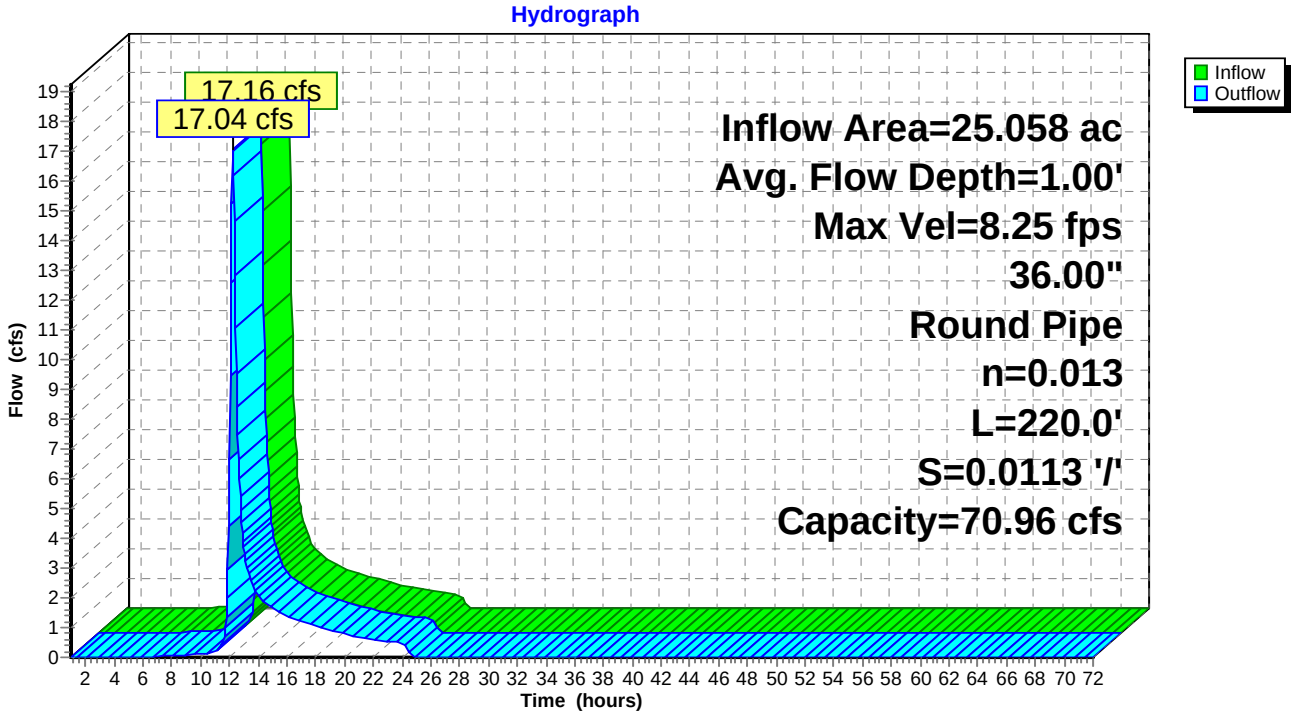

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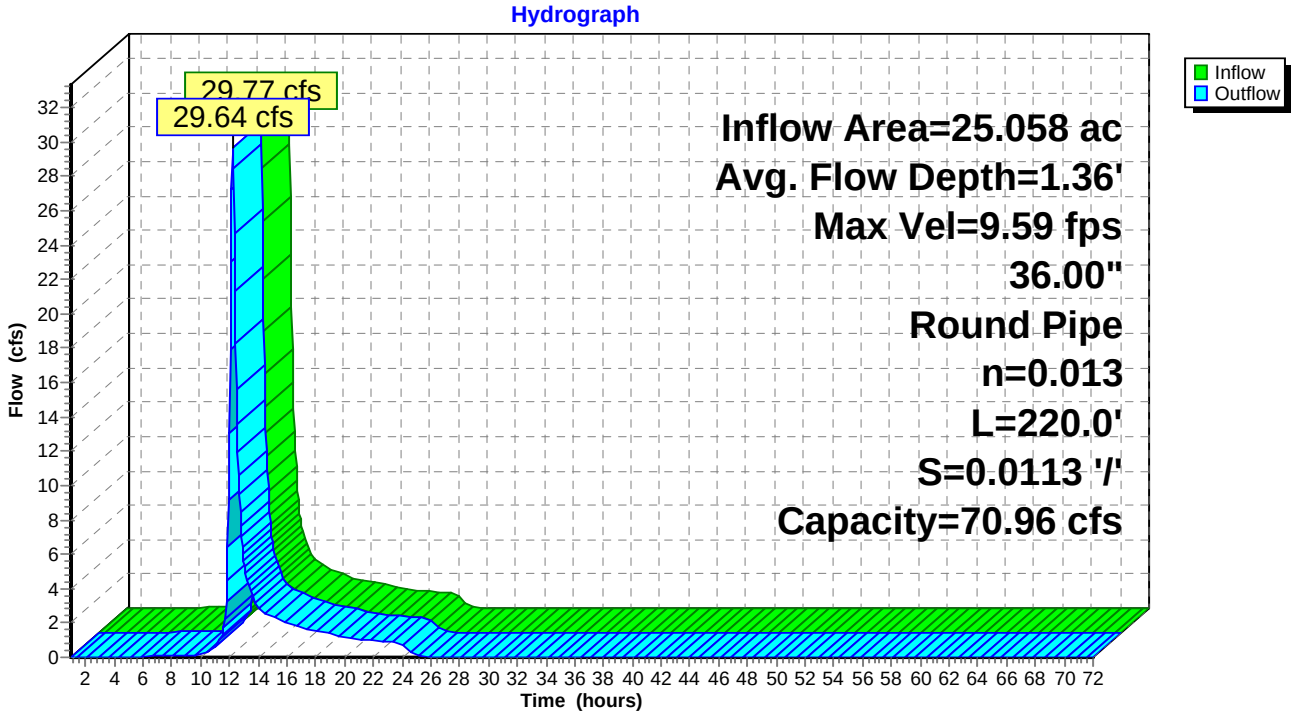

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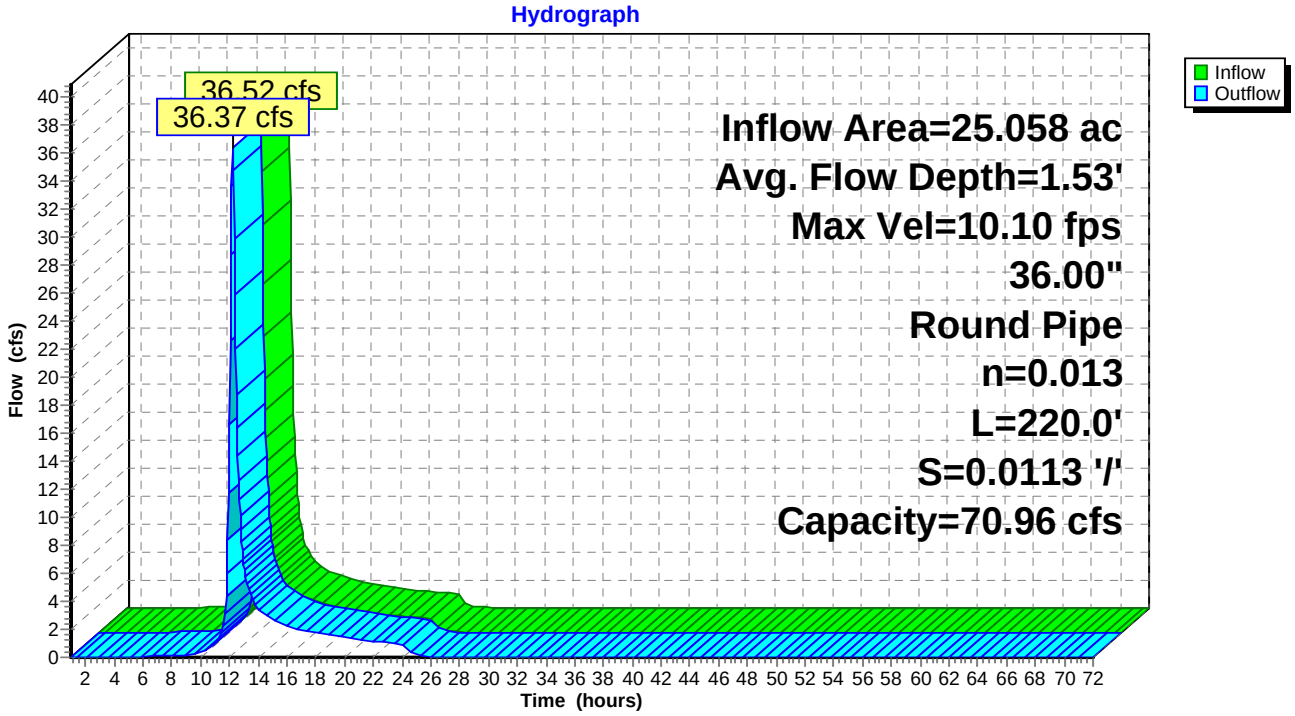

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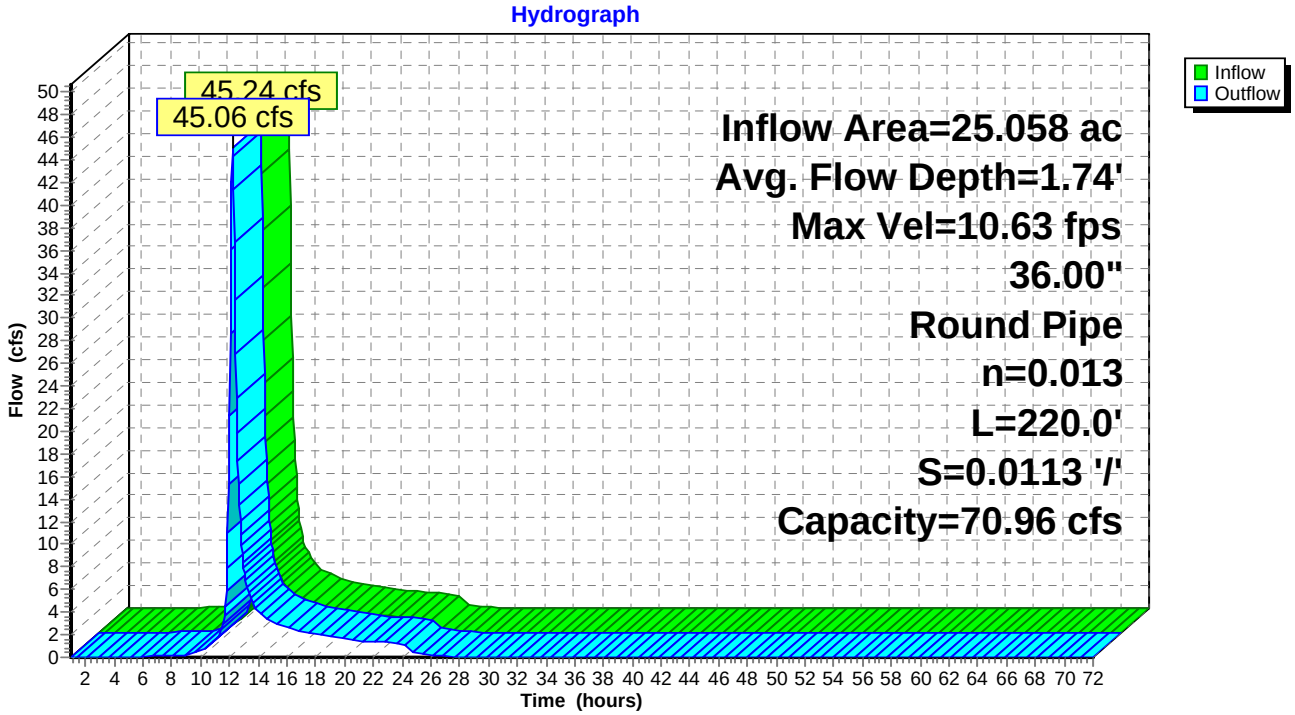

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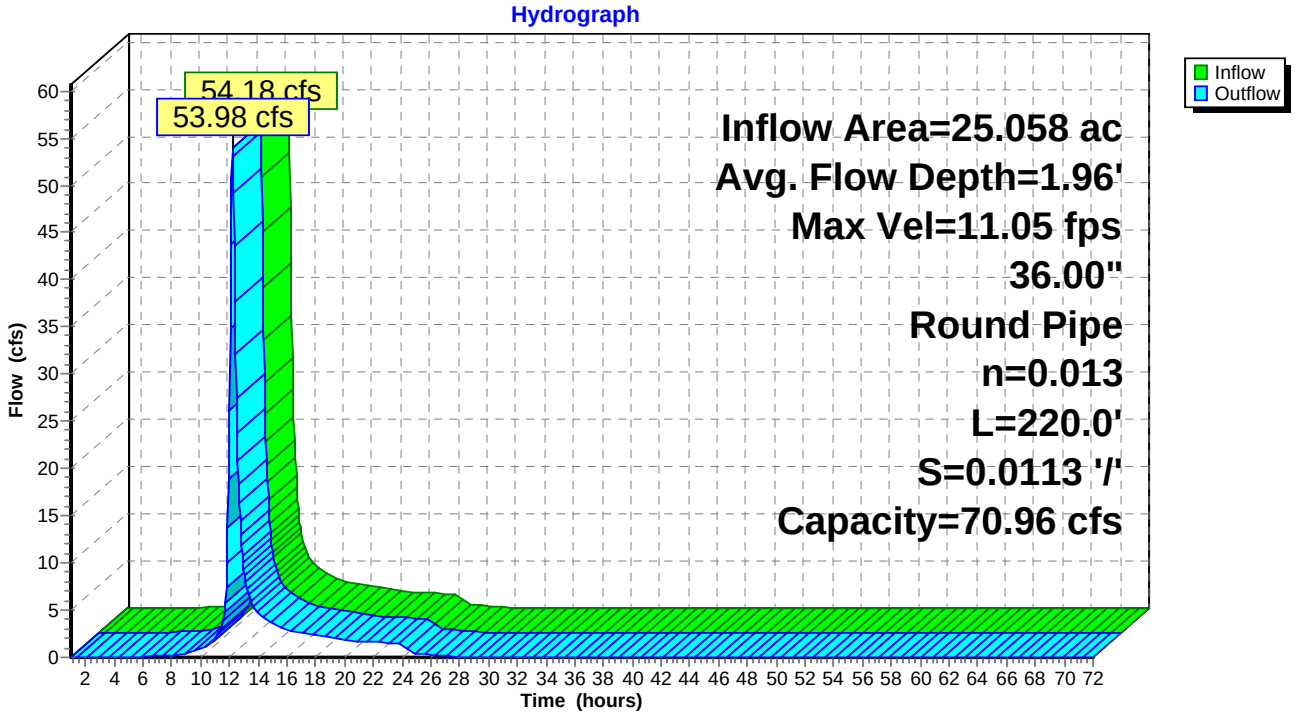

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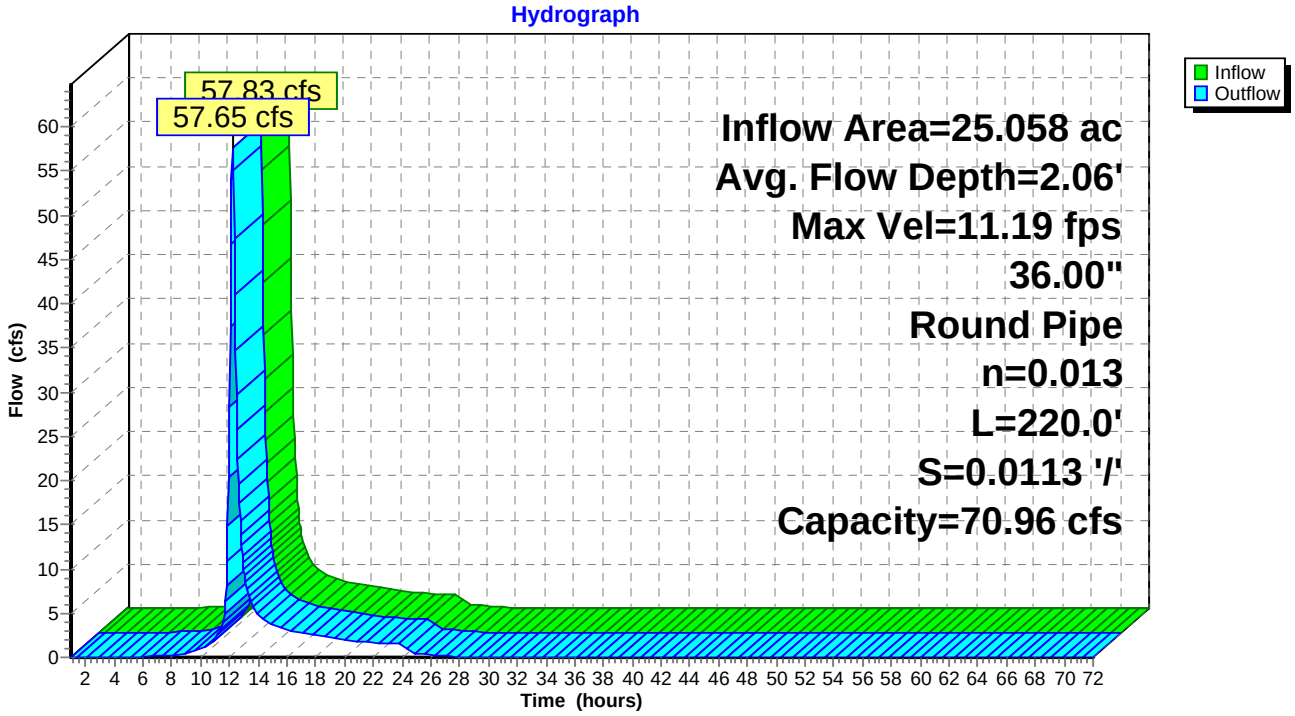


Summary for Subcatchment CHIP: Chipotle

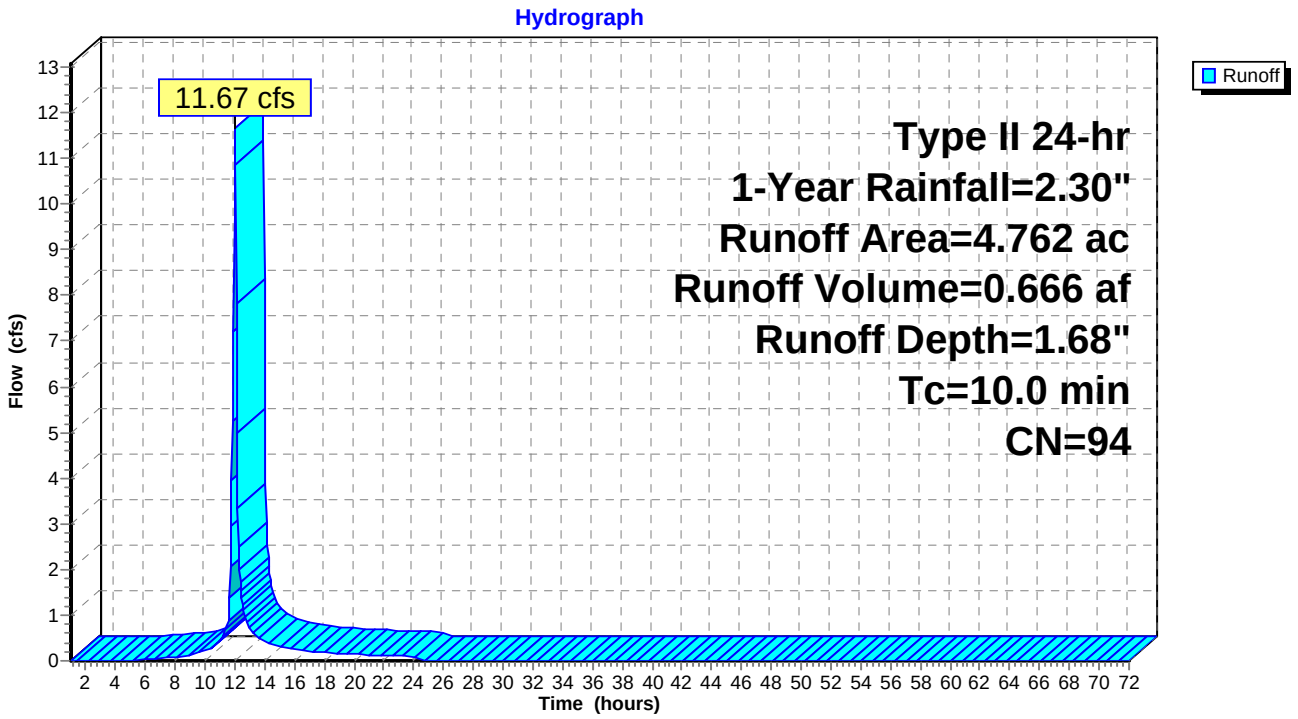
Runoff = 11.67 cfs @ 12.01 hrs, Volume= 0.666 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

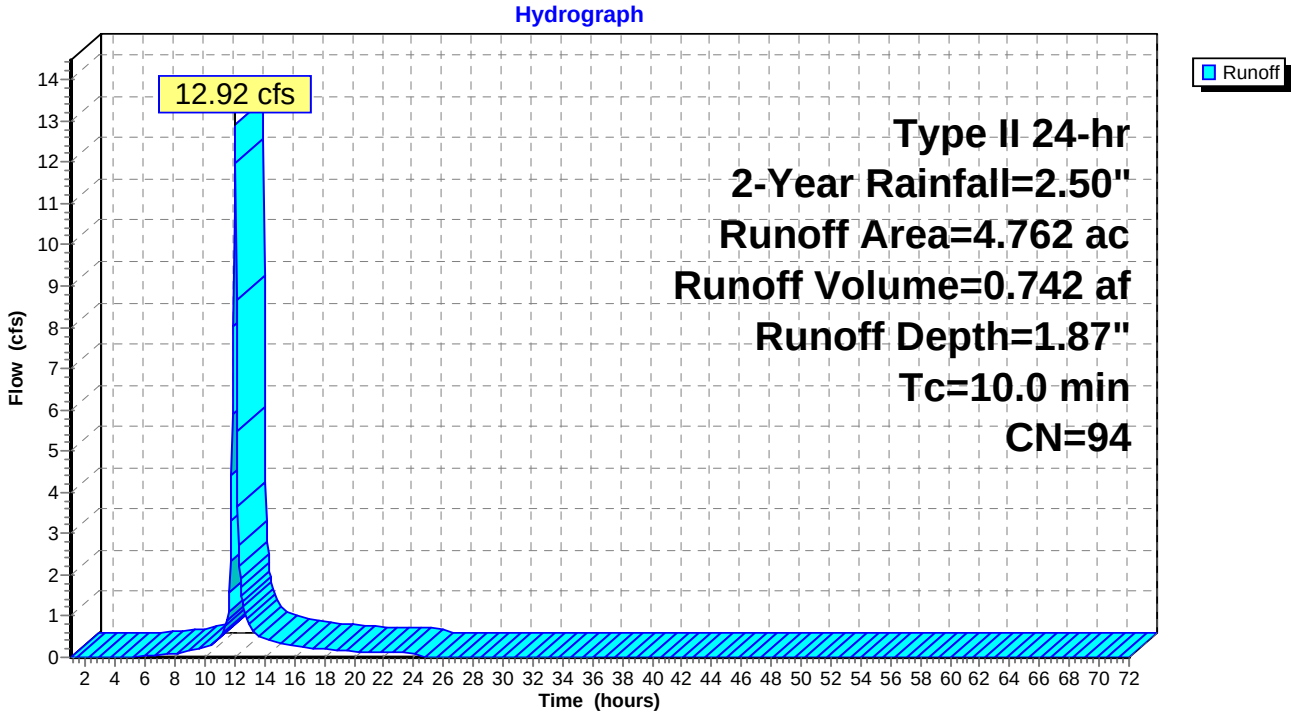
Area (ac)	CN	Description
4.762	94	Urban commercial, 85% imp, HSG C
0.714		15.00% Pervious Area
4.048		85.00% Impervious Area

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

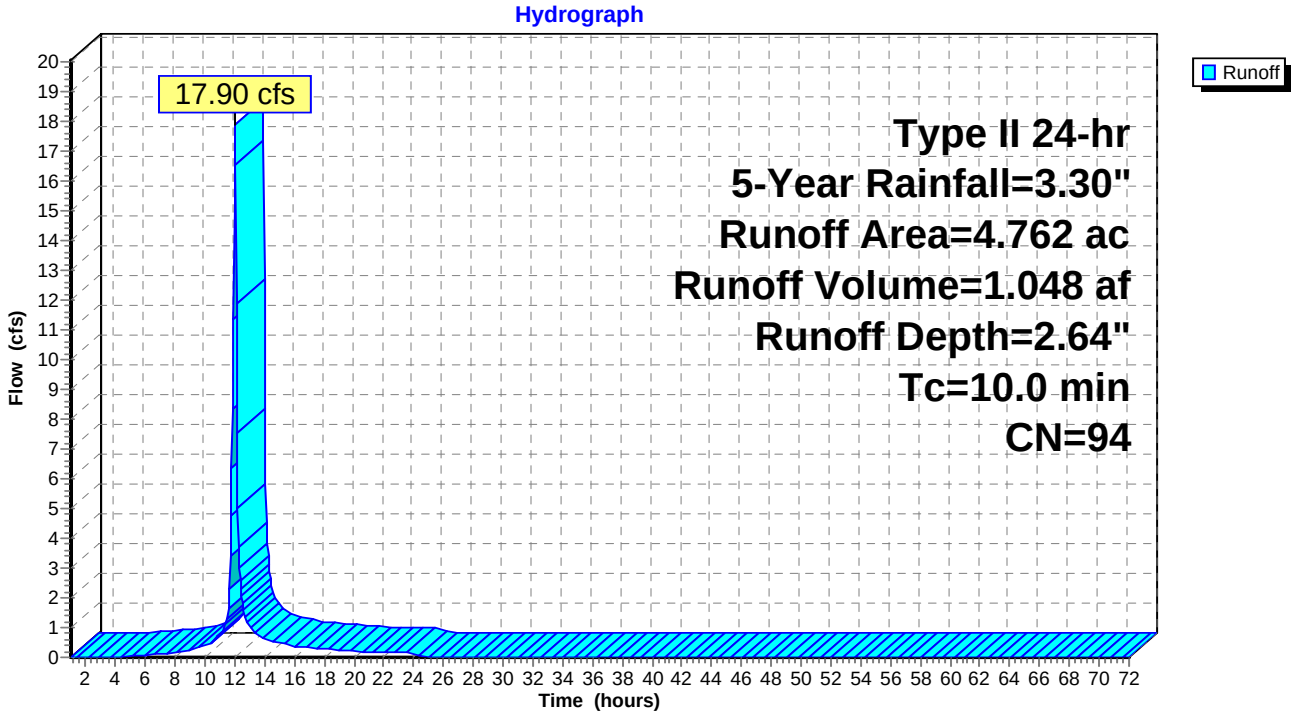
Subcatchment CHIP: Chipotle



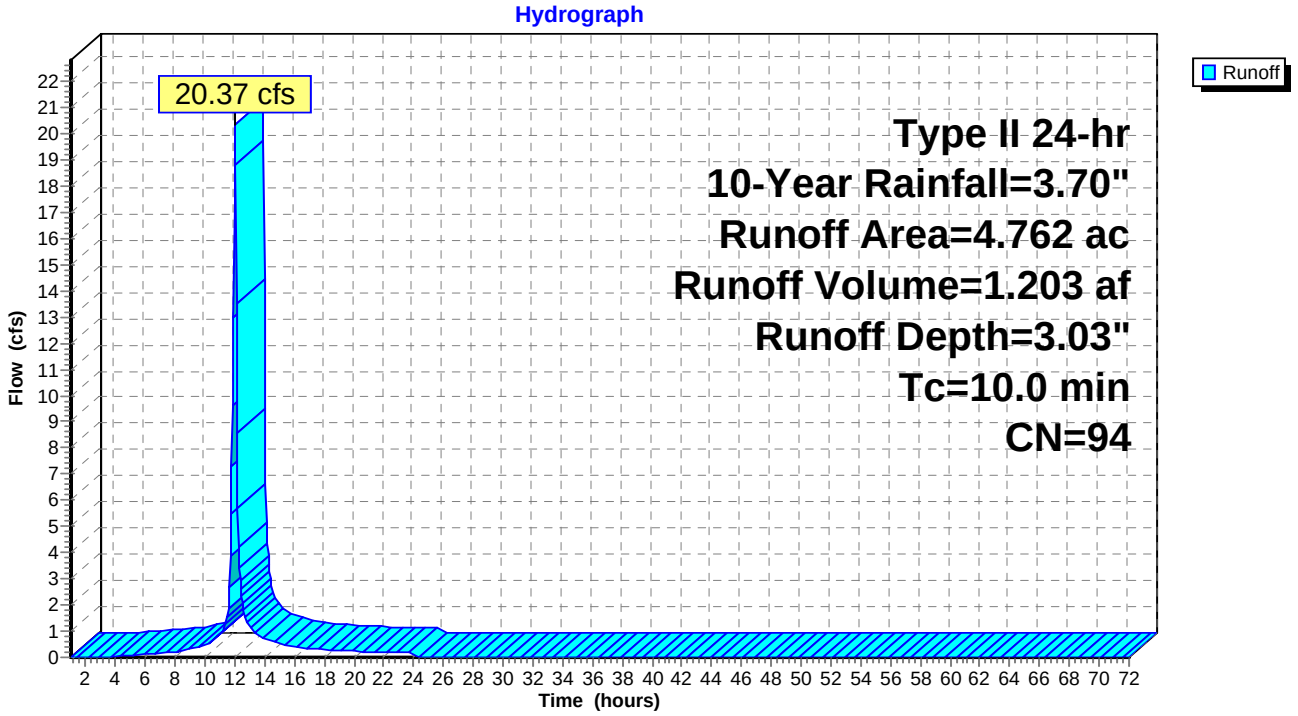
Subcatchment CHIP: Chipotle



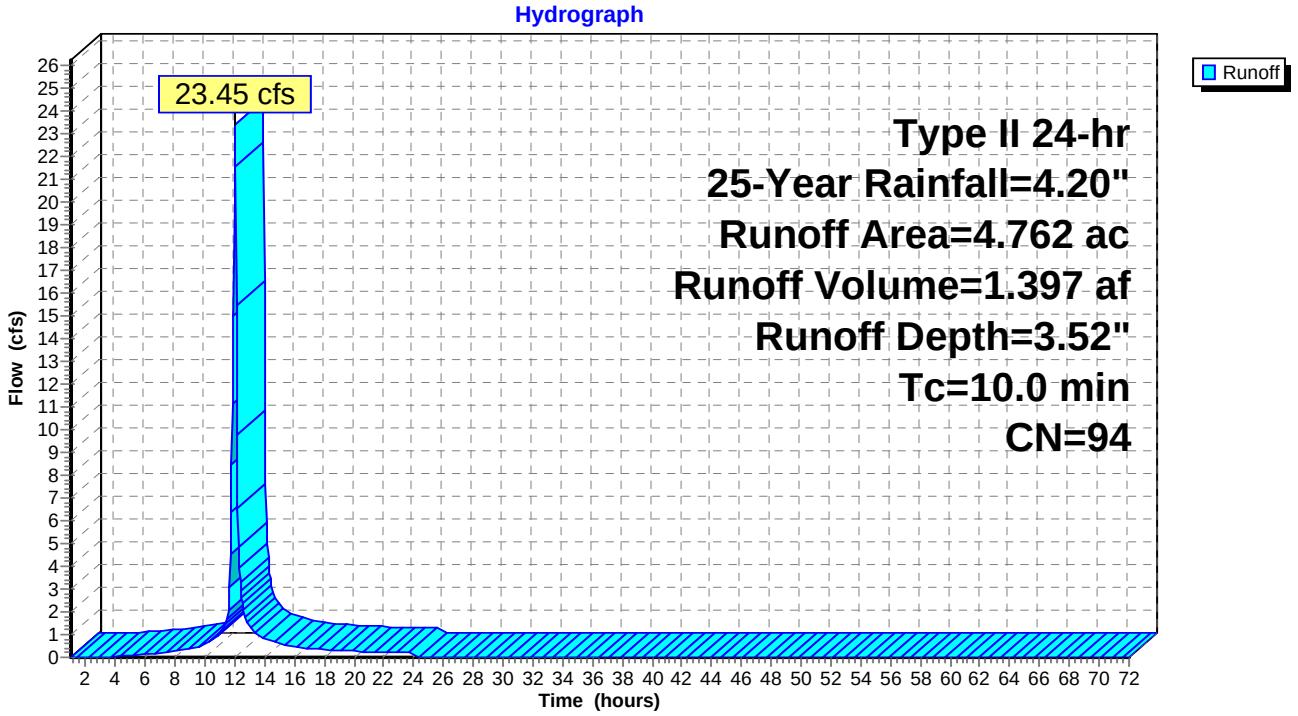
Subcatchment CHIP: Chipotle



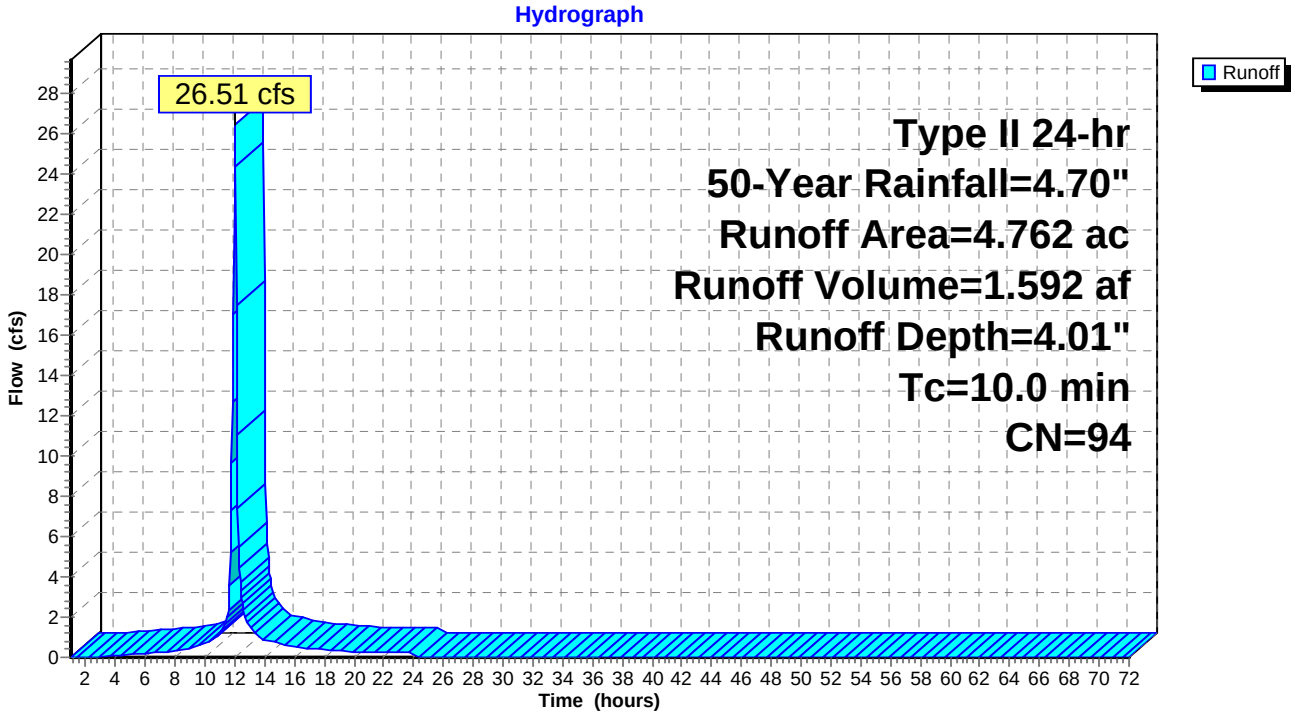
Subcatchment CHIP: Chipotle



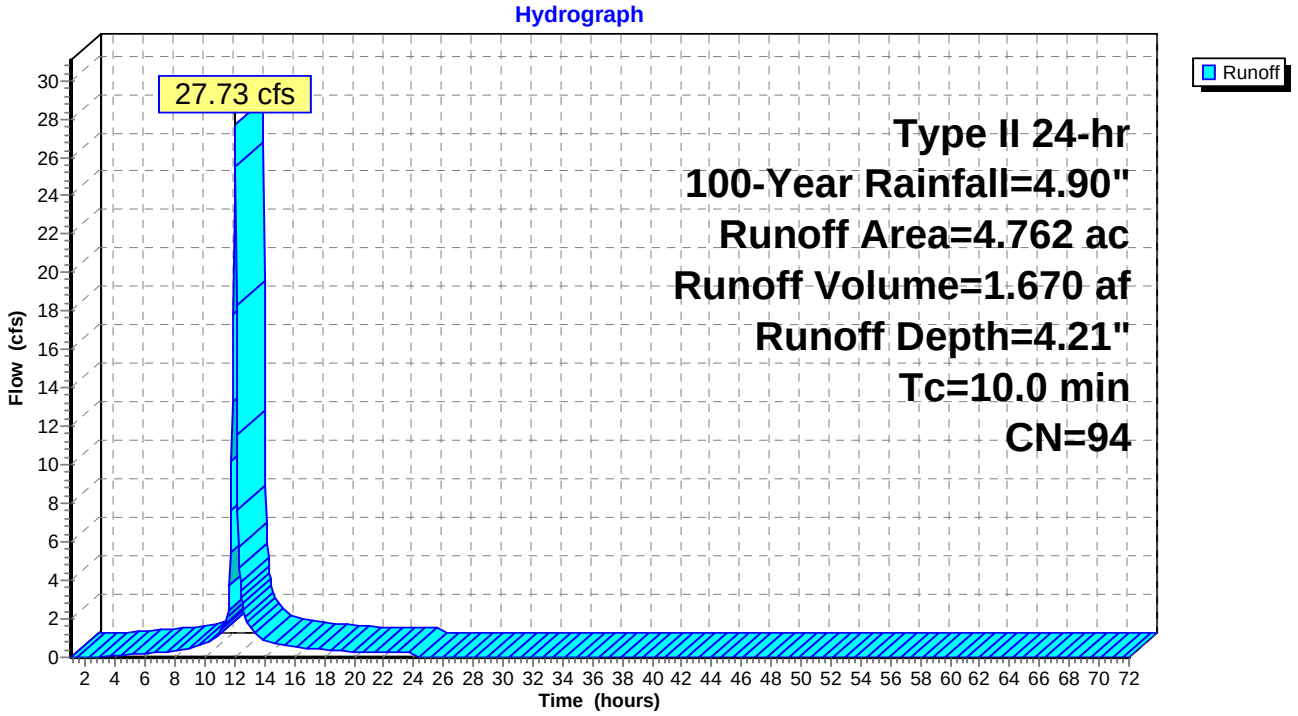
Subcatchment CHIP: Chipotle



Subcatchment CHIP: Chipotle



Subcatchment CHIP: Chipotle



Summary for Reach 5x6: 5X6 under US23

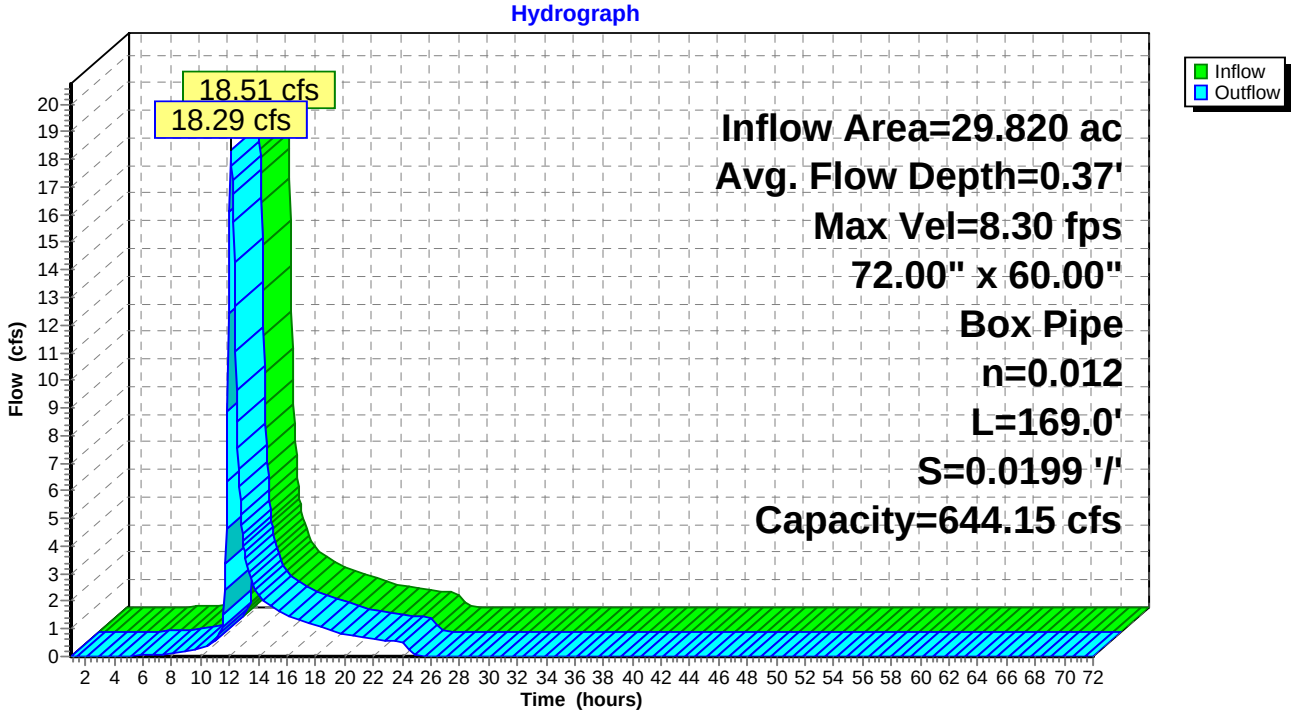
Inflow Area = 29.820 ac, 36.05% Impervious, Inflow Depth = 0.95" for 1-Year event
Inflow = 18.51 cfs @ 12.07 hrs, Volume= 2.352 af
Outflow = 18.29 cfs @ 12.07 hrs, Volume= 2.352 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 8.30 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.90 fps, Avg. Travel Time= 1.0 min

Peak Storage= 374 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 5.00' Flow Area= 30.0 sf, Capacity= 644.15 cfs

72.00" W x 60.00" H Box Pipe
n= 0.012 Concrete pipe, finished
Length= 169.0' Slope= 0.0199 '/'
Inlet Invert= 886.32', Outlet Invert= 882.96'

Reach 5x6: 5X6 under US23



Summary for Reach 5x6: 5X6 under US23

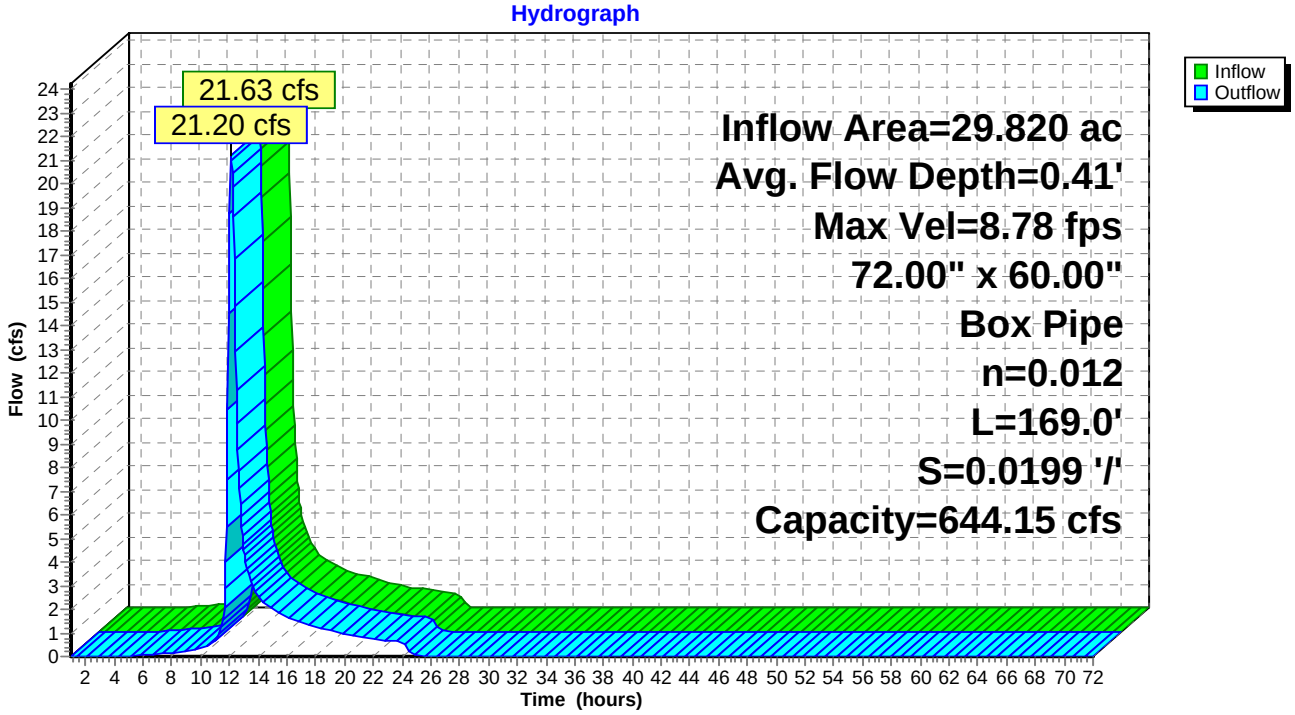
Inflow Area = 29.820 ac, 36.05% Impervious, Inflow Depth = 1.09" for 2-Year event
Inflow = 21.63 cfs @ 12.07 hrs, Volume= 2.714 af
Outflow = 21.20 cfs @ 12.09 hrs, Volume= 2.714 af, Atten= 2%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 8.78 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.98 fps, Avg. Travel Time= 0.9 min

Peak Storage= 413 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 5.00' Flow Area= 30.0 sf, Capacity= 644.15 cfs

72.00" W x 60.00" H Box Pipe
n= 0.012 Concrete pipe, finished
Length= 169.0' Slope= 0.0199 '/'
Inlet Invert= 886.32', Outlet Invert= 882.96'

Reach 5x6: 5X6 under US23



Summary for Reach 5x6: 5X6 under US23

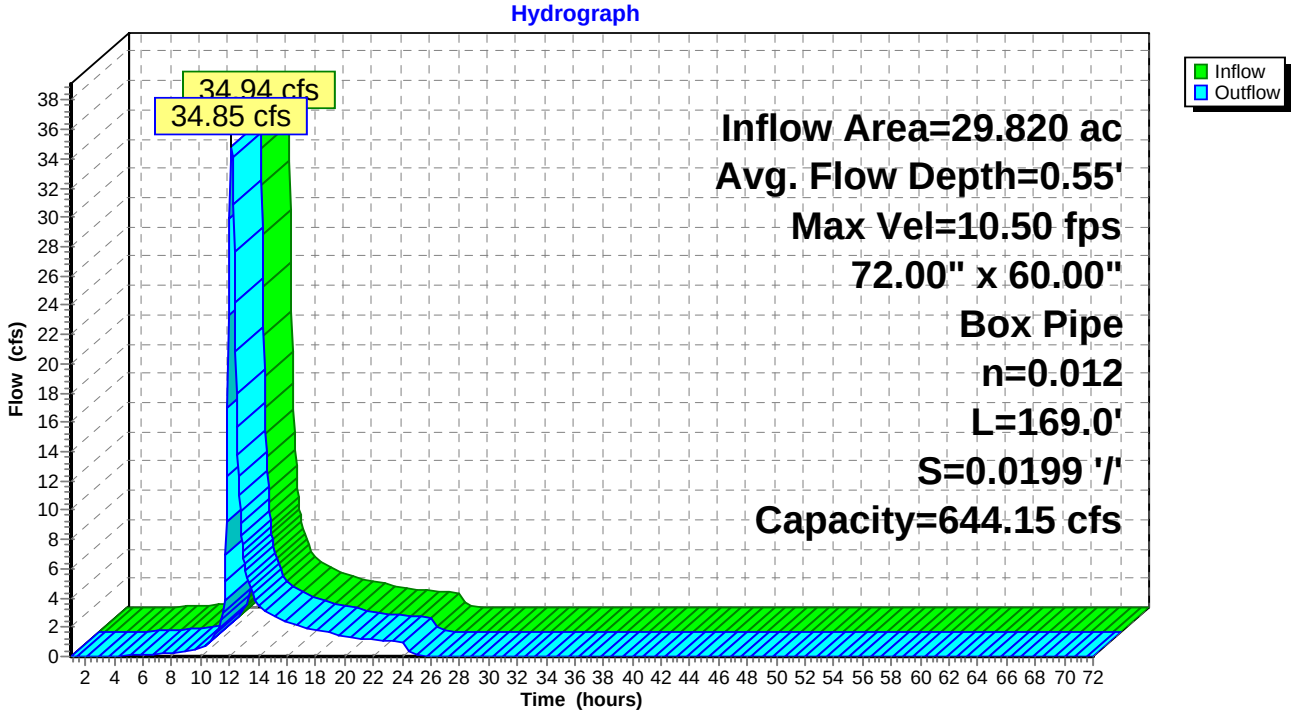
Inflow Area = 29.820 ac, 36.05% Impervious, Inflow Depth = 1.72" for 5-Year event
Inflow = 34.94 cfs @ 12.11 hrs, Volume= 4.263 af
Outflow = 34.85 cfs @ 12.12 hrs, Volume= 4.263 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 10.50 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.29 fps, Avg. Travel Time= 0.9 min

Peak Storage= 560 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 5.00' Flow Area= 30.0 sf, Capacity= 644.15 cfs

72.00" W x 60.00" H Box Pipe
n= 0.012 Concrete pipe, finished
Length= 169.0' Slope= 0.0199 '/'
Inlet Invert= 886.32', Outlet Invert= 882.96'

Reach 5x6: 5X6 under US23



Summary for Reach 5x6: 5X6 under US23

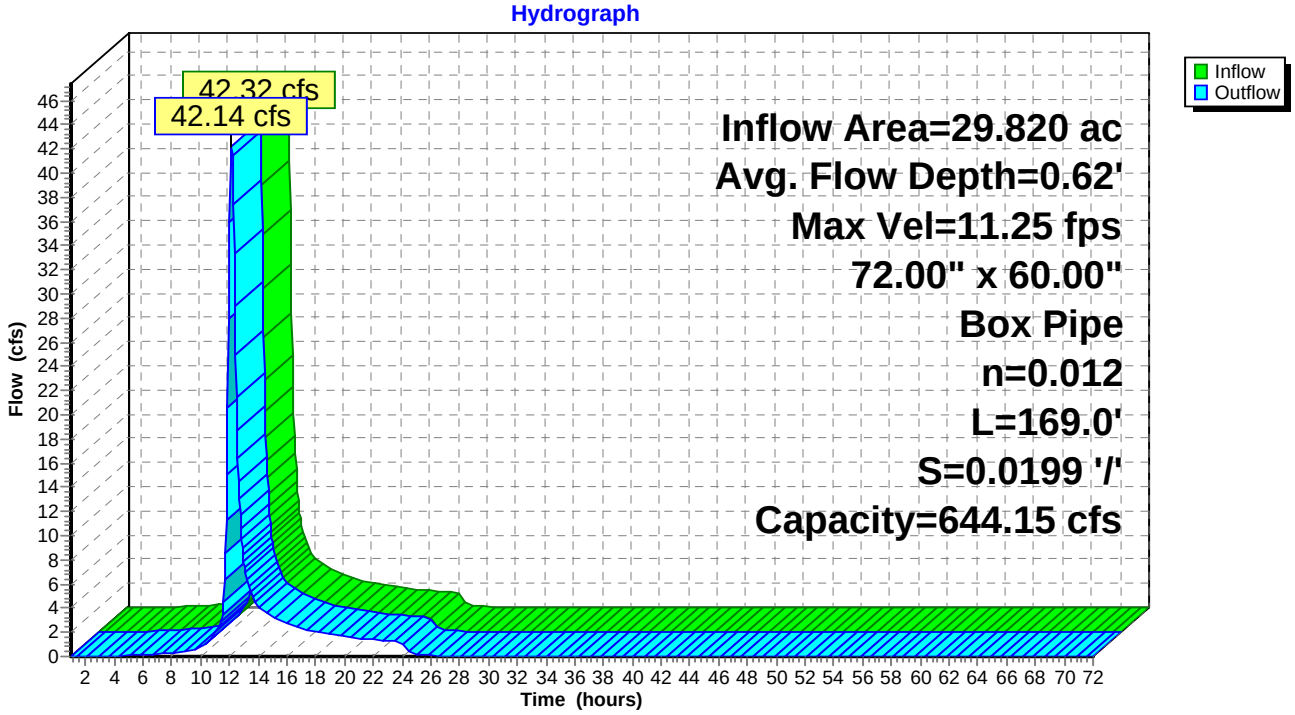
Inflow Area = 29.820 ac, 36.05% Impervious, Inflow Depth = 2.05" for 10-Year event
Inflow = 42.32 cfs @ 12.12 hrs, Volume= 5.084 af
Outflow = 42.14 cfs @ 12.14 hrs, Volume= 5.084 af, Atten= 0%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 11.25 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.39 fps, Avg. Travel Time= 0.8 min

Peak Storage= 633 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.62'
Bank-Full Depth= 5.00' Flow Area= 30.0 sf, Capacity= 644.15 cfs

72.00" W x 60.00" H Box Pipe
n= 0.012 Concrete pipe, finished
Length= 169.0' Slope= 0.0199 '/'
Inlet Invert= 886.32', Outlet Invert= 882.96'

Reach 5x6: 5X6 under US23



Summary for Reach 5x6: 5X6 under US23

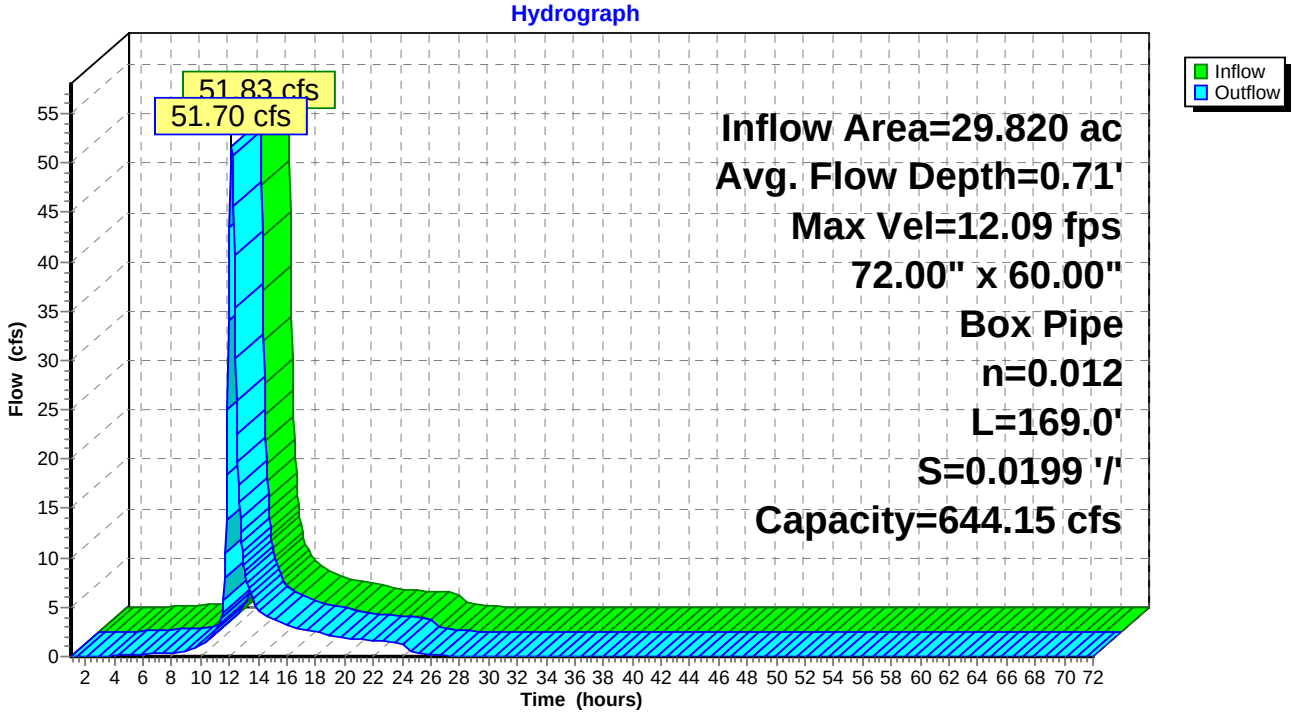
Inflow Area = 29.820 ac, 36.05% Impervious, Inflow Depth = 2.47" for 25-Year event
Inflow = 51.83 cfs @ 12.14 hrs, Volume= 6.141 af
Outflow = 51.70 cfs @ 12.15 hrs, Volume= 6.141 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 12.09 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.50 fps, Avg. Travel Time= 0.8 min

Peak Storage= 723 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 5.00' Flow Area= 30.0 sf, Capacity= 644.15 cfs

72.00" W x 60.00" H Box Pipe
n= 0.012 Concrete pipe, finished
Length= 169.0' Slope= 0.0199 '/'
Inlet Invert= 886.32', Outlet Invert= 882.96'

Reach 5x6: 5X6 under US23



Summary for Reach 5x6: 5X6 under US23

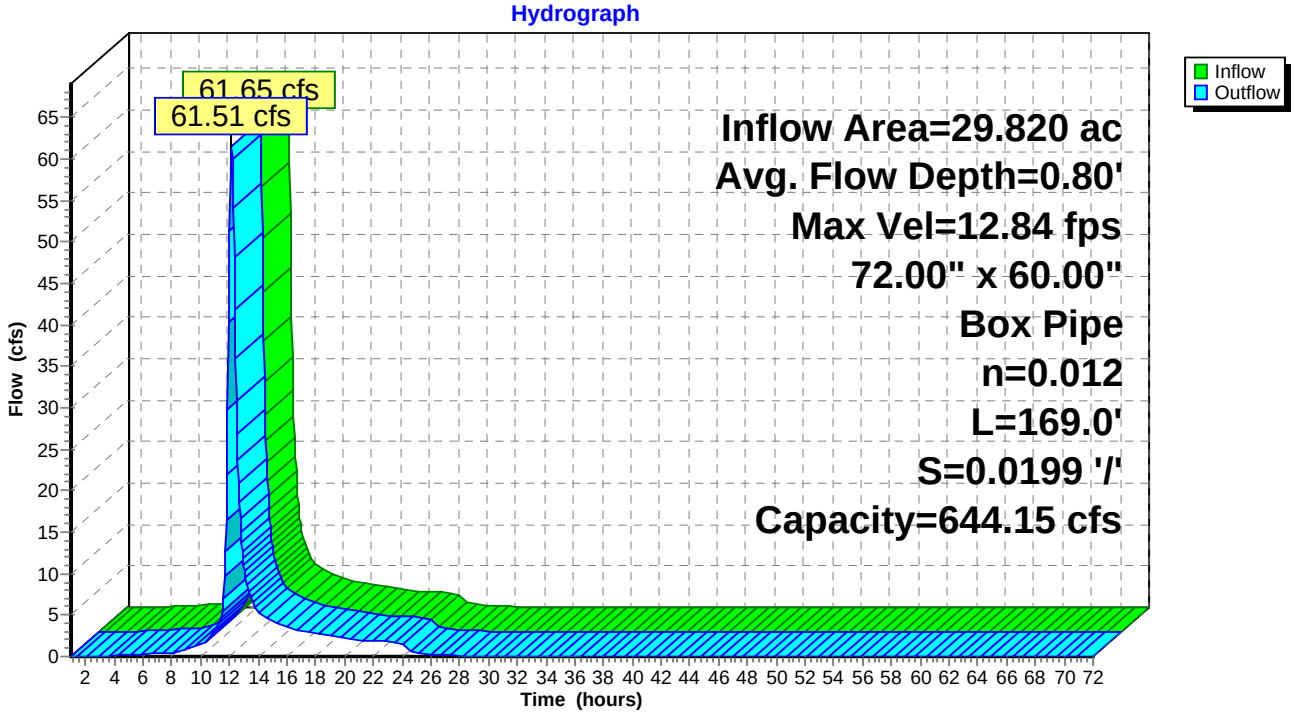
Inflow Area = 29.820 ac, 36.05% Impervious, Inflow Depth = 2.91" for 50-Year event
Inflow = 61.65 cfs @ 12.15 hrs, Volume= 7.225 af
Outflow = 61.51 cfs @ 12.16 hrs, Volume= 7.225 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 12.84 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.60 fps, Avg. Travel Time= 0.8 min

Peak Storage= 810 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 5.00' Flow Area= 30.0 sf, Capacity= 644.15 cfs

72.00" W x 60.00" H Box Pipe
n= 0.012 Concrete pipe, finished
Length= 169.0' Slope= 0.0199 '/'
Inlet Invert= 886.32', Outlet Invert= 882.96'

Reach 5x6: 5X6 under US23



Summary for Reach 5x6: 5X6 under US23

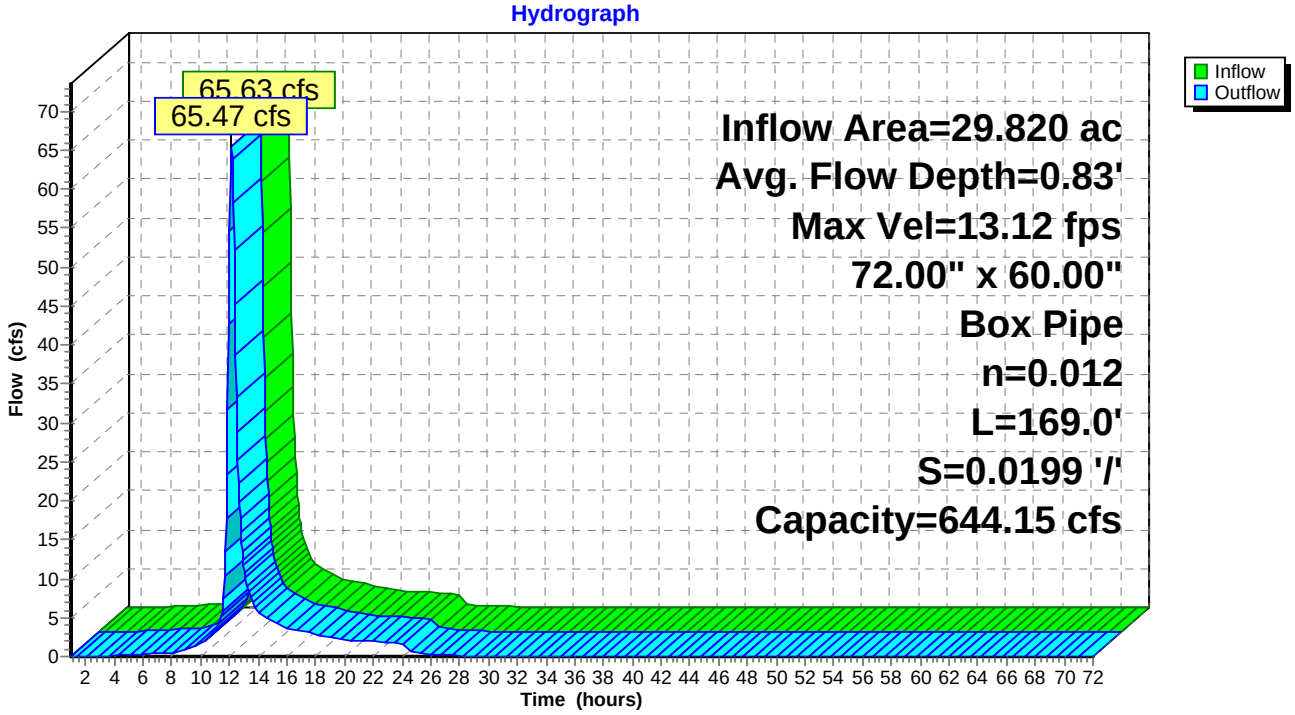
Inflow Area = 29.820 ac, 36.05% Impervious, Inflow Depth = 3.08" for 100-Year event
Inflow = 65.63 cfs @ 12.15 hrs, Volume= 7.665 af
Outflow = 65.47 cfs @ 12.16 hrs, Volume= 7.665 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 13.12 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.64 fps, Avg. Travel Time= 0.8 min

Peak Storage= 844 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.83'
Bank-Full Depth= 5.00' Flow Area= 30.0 sf, Capacity= 644.15 cfs

72.00" W x 60.00" H Box Pipe
n= 0.012 Concrete pipe, finished
Length= 169.0' Slope= 0.0199 '/'
Inlet Invert= 886.32', Outlet Invert= 882.96'

Reach 5x6: 5X6 under US23



Summary for Subcatchment CHES: Chesrown

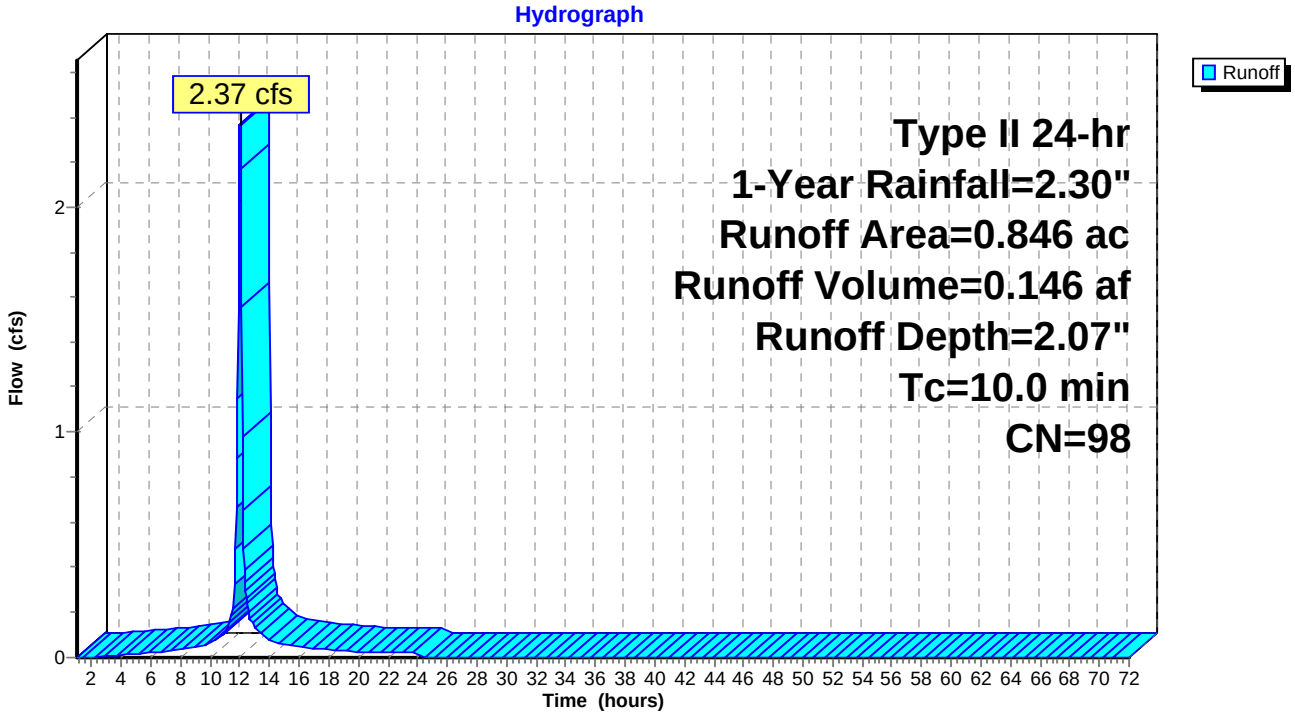
Runoff = 2.37 cfs @ 12.01 hrs, Volume= 0.146 af, Depth= 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

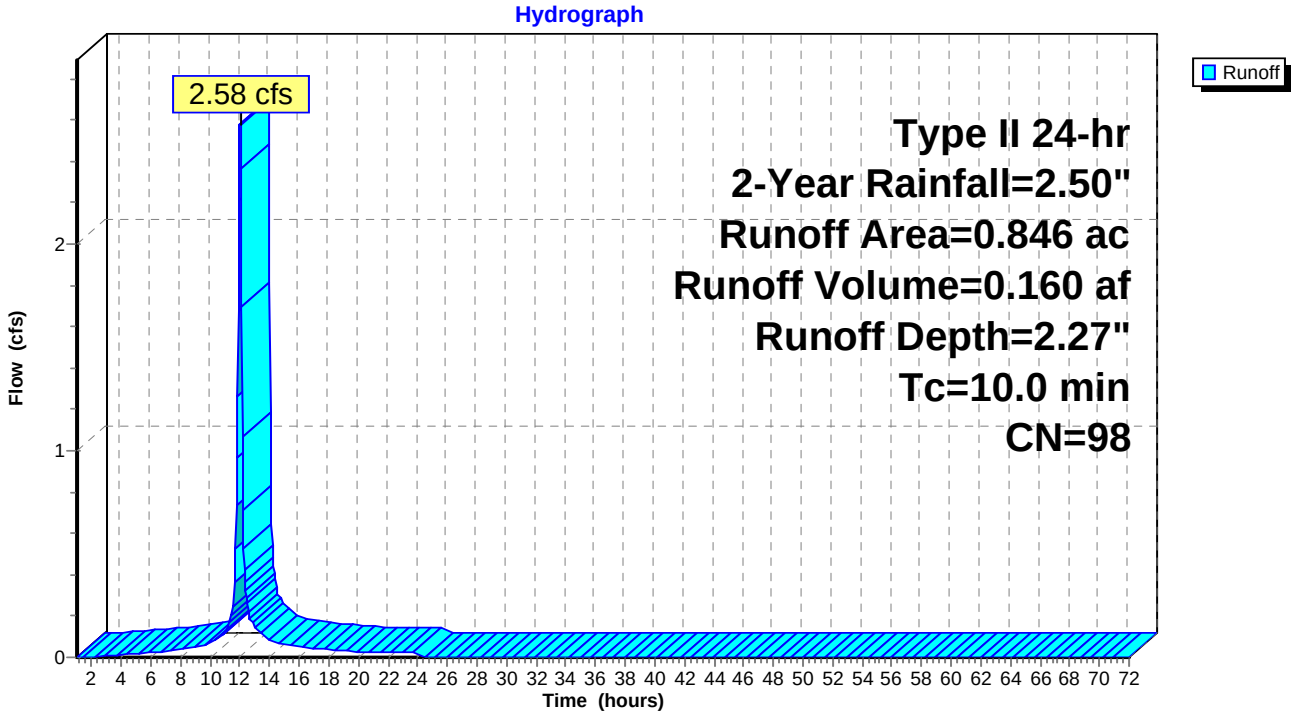
Area (ac)	CN	Description
0.846	98	Paved parking, HSG C
0.846		100.00% Impervious Area

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

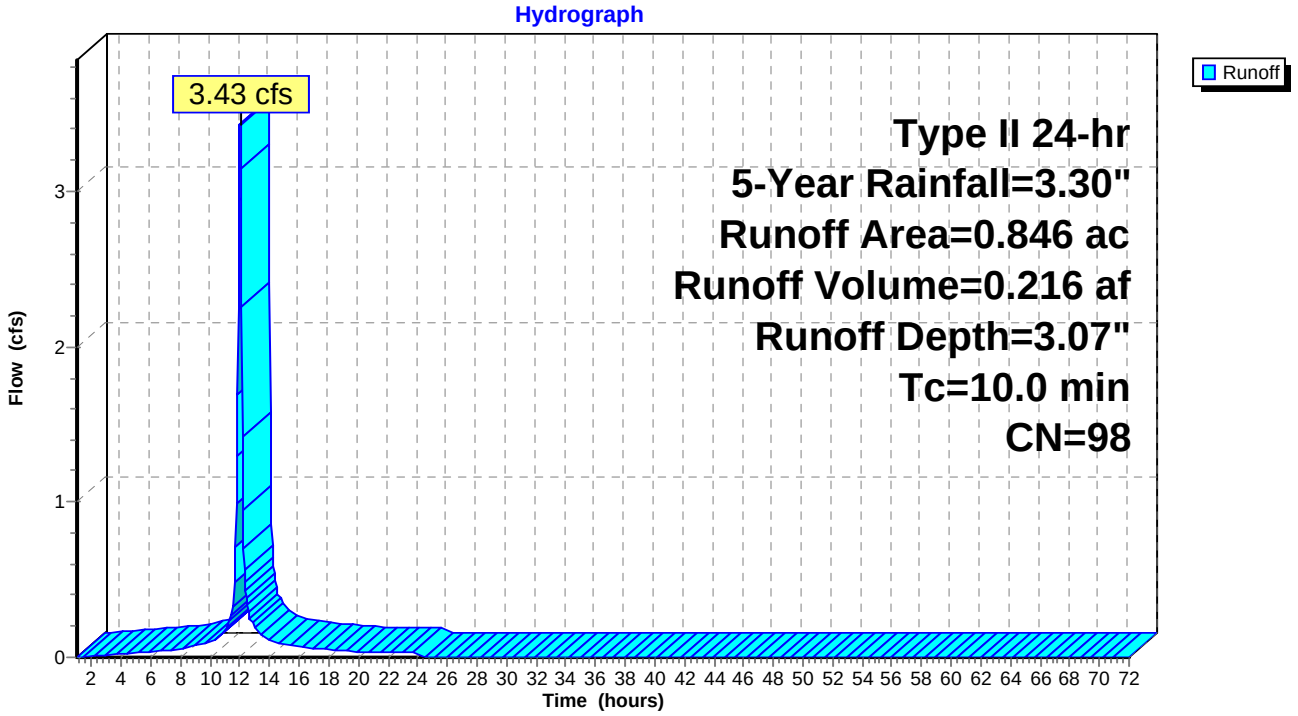
Subcatchment CHES: Chesrown



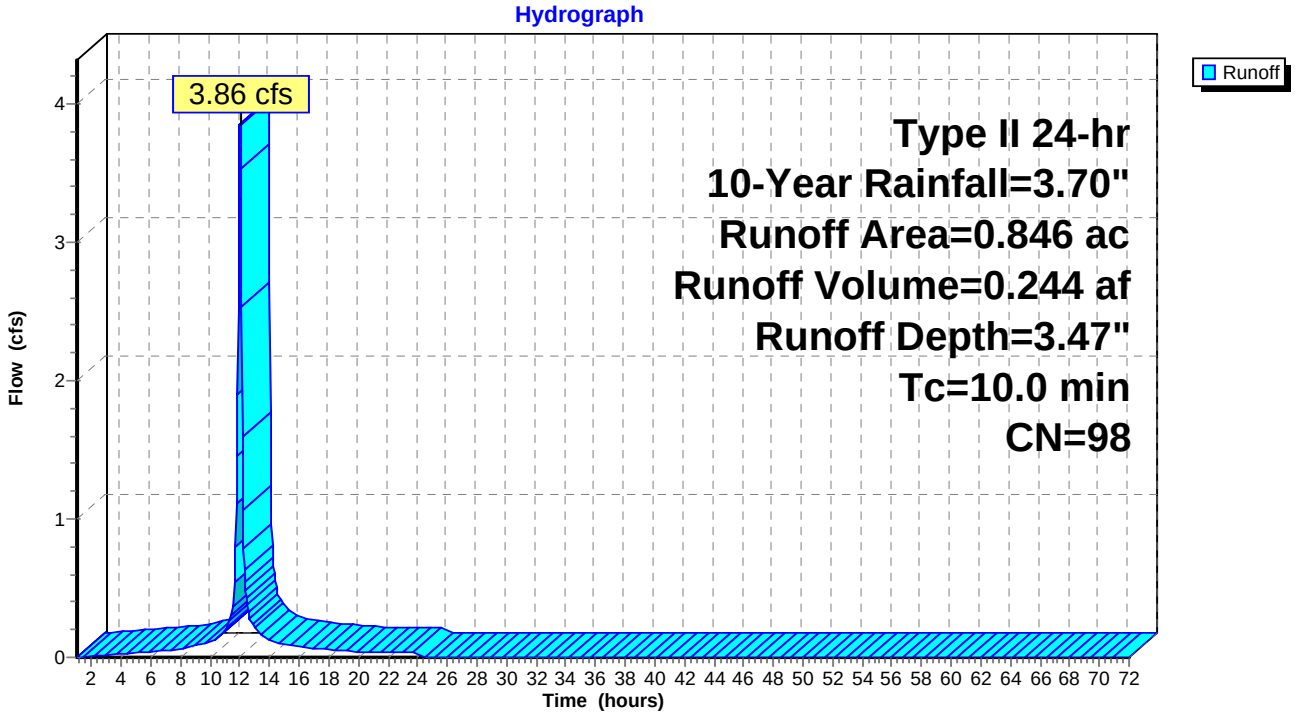
Subcatchment CHES: Chesrown



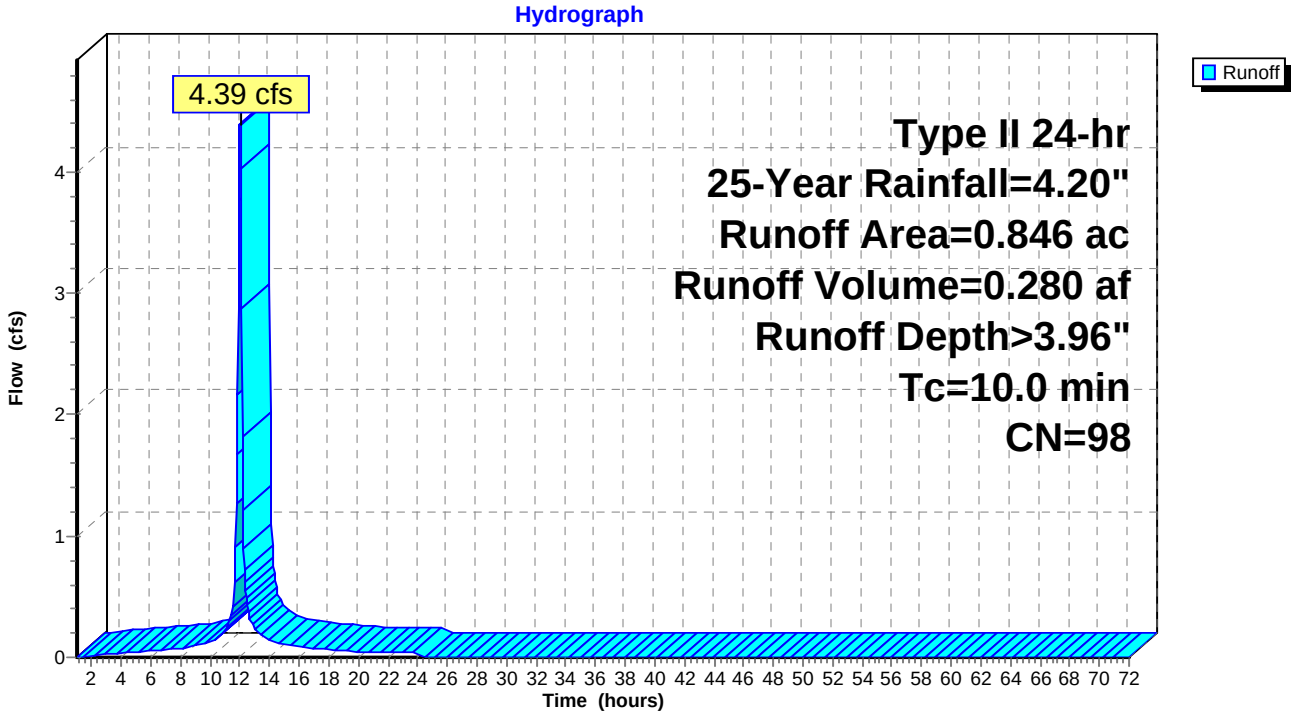
Subcatchment CHES: Chesrown



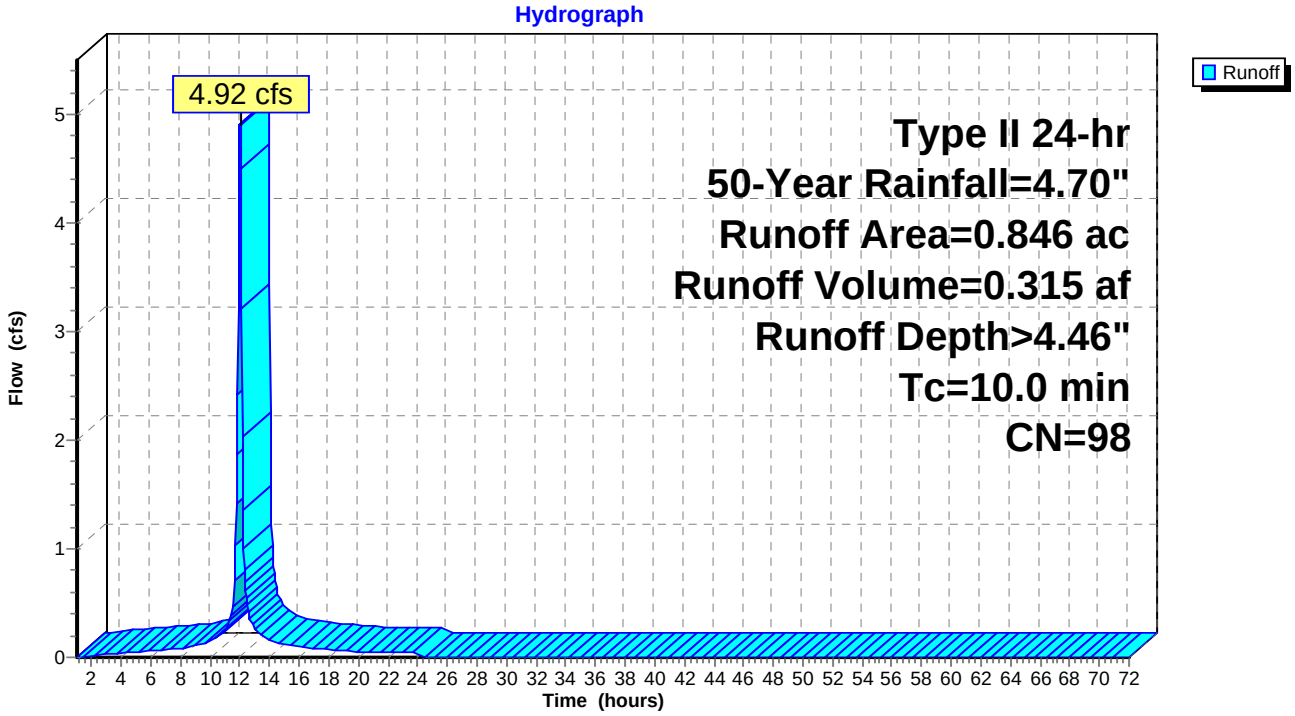
Subcatchment CHES: Chesrown



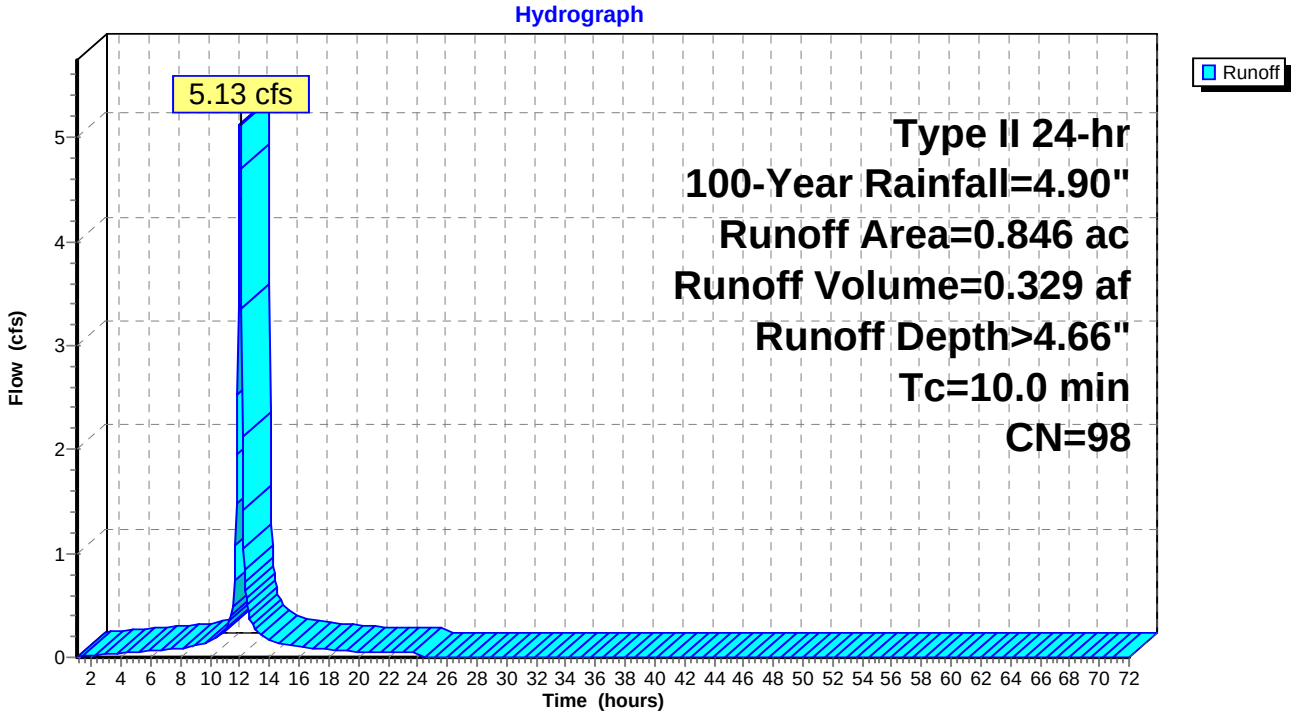
Subcatchment CHES: Chesrown



Subcatchment CHES: Chesrown



Subcatchment CHES: Chesrown



Summary for Pond ChC: Chesrown Chambers

Inflow Area = 0.846 ac,100.00% Impervious, Inflow Depth > 3.96" for 25-Year event
Inflow = 4.39 cfs @ 12.01 hrs, Volume= 0.280 af
Outflow = 2.40 cfs @ 12.15 hrs, Volume= 0.247 af, Atten= 45%, Lag= 8.6 min
Primary = 2.40 cfs @ 12.15 hrs, Volume= 0.247 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 888.06' @ 12.15 hrs Surf.Area= 1,958 sf Storage= 6,520 cf

Plug-Flow detention time= 385.5 min calculated for 0.247 af (88% of inflow)
Center-of-Mass det. time= 328.1 min (1,078.8 - 750.7)

Volume	Invert	Avail.Storage	Storage Description
#1	882.75'	2,746 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
			10,822 cf Overall - 3,958 cf Embedded = 6,864 cf x 40.0% Voids
#2	883.50'	3,958 cf	**ADS_StormTech MC-3500 c +Cap** x 36 Inside #1
			Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
			Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
#3	887.25'	2,329 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		9,033 cf	Total Available Storage

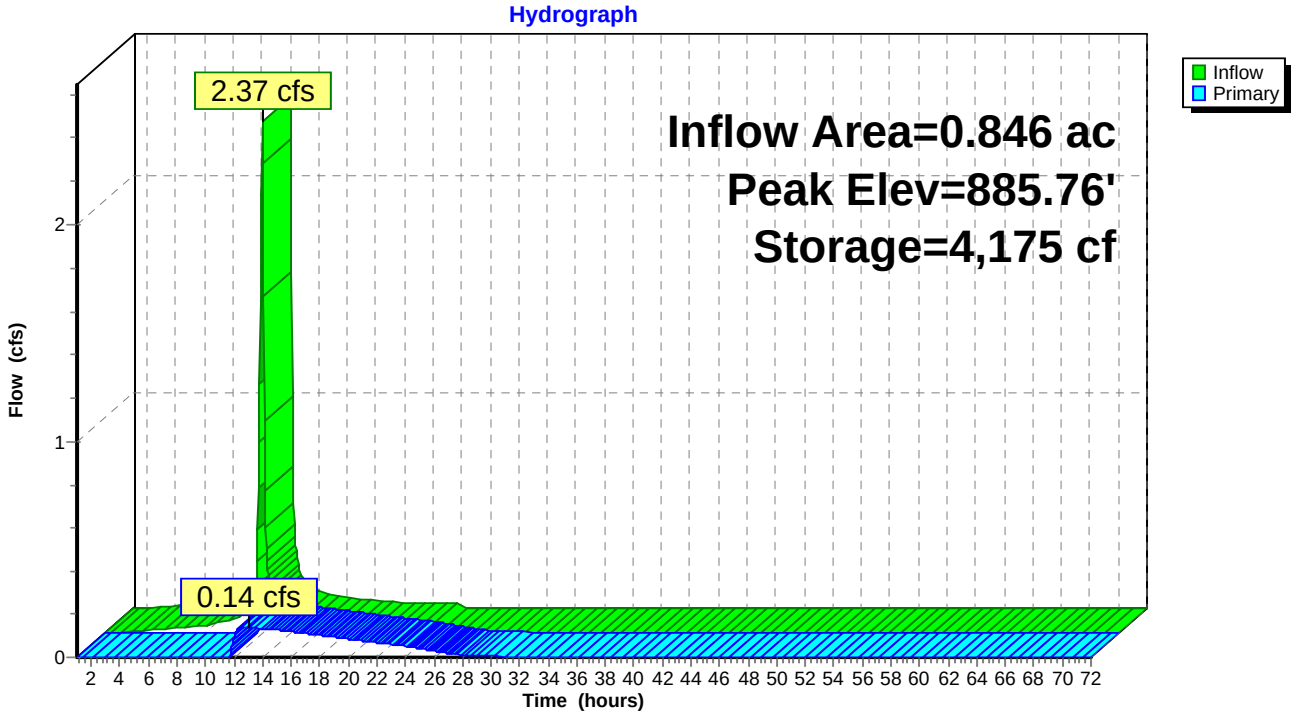
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
882.75	1,950	0	0
888.30	1,950	10,822	10,822

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
887.25	8	0	0
889.30	8	16	16
890.00	6,600	2,313	2,329

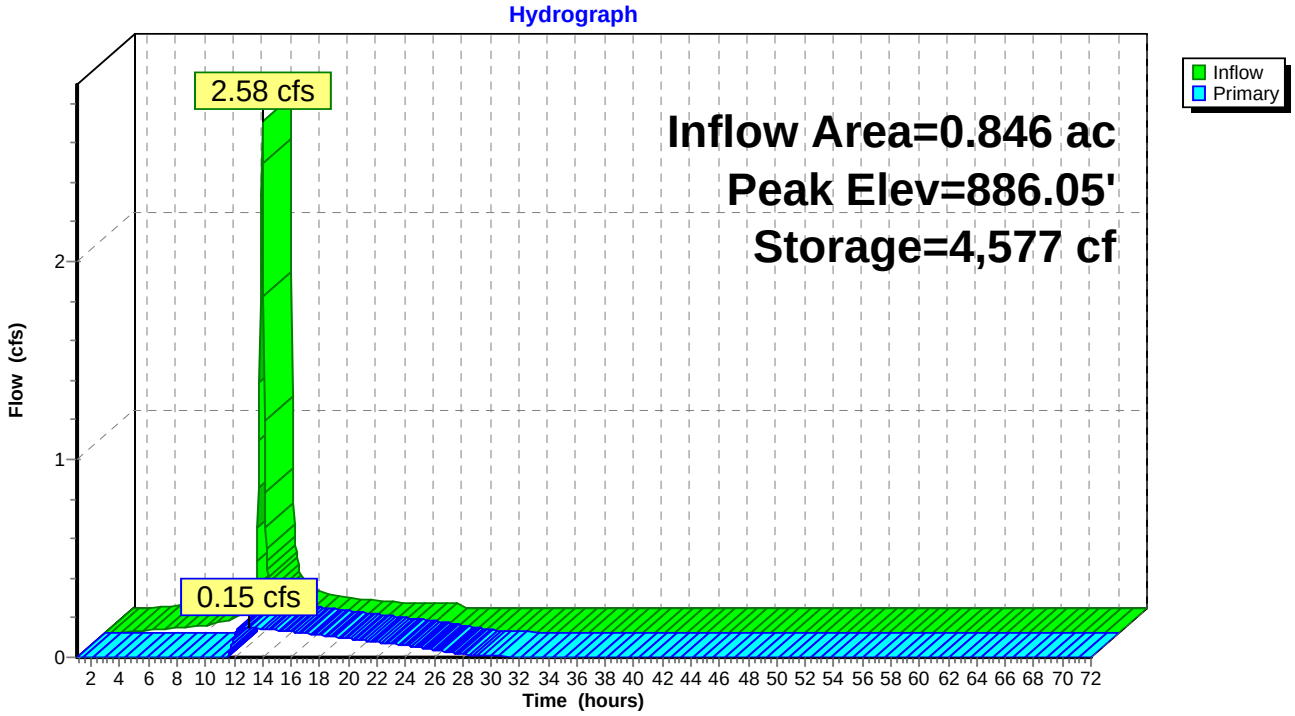
Device	Routing	Invert	Outlet Devices
#1	Primary	882.75'	**12.00" Round Culvert** L= 100.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 882.75' / 882.00' S= 0.0075 '/' Cc= 0.900
			n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	884.00'	**2.00" Vert. Orifice/Grate** C= 0.600
#3	Device 1	887.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.37 cfs @ 12.15 hrs HW=888.05' (Free Discharge)
└─1=**Culvert** (Passes 2.37 cfs of 6.58 cfs potential flow)
  ├─2=**Orifice/Grate** (Orifice Controls 0.21 cfs @ 9.60 fps)
  └─3=**Sharp-Crested Rectangular Weir** (Weir Controls 2.16 cfs @ 1.80 fps)

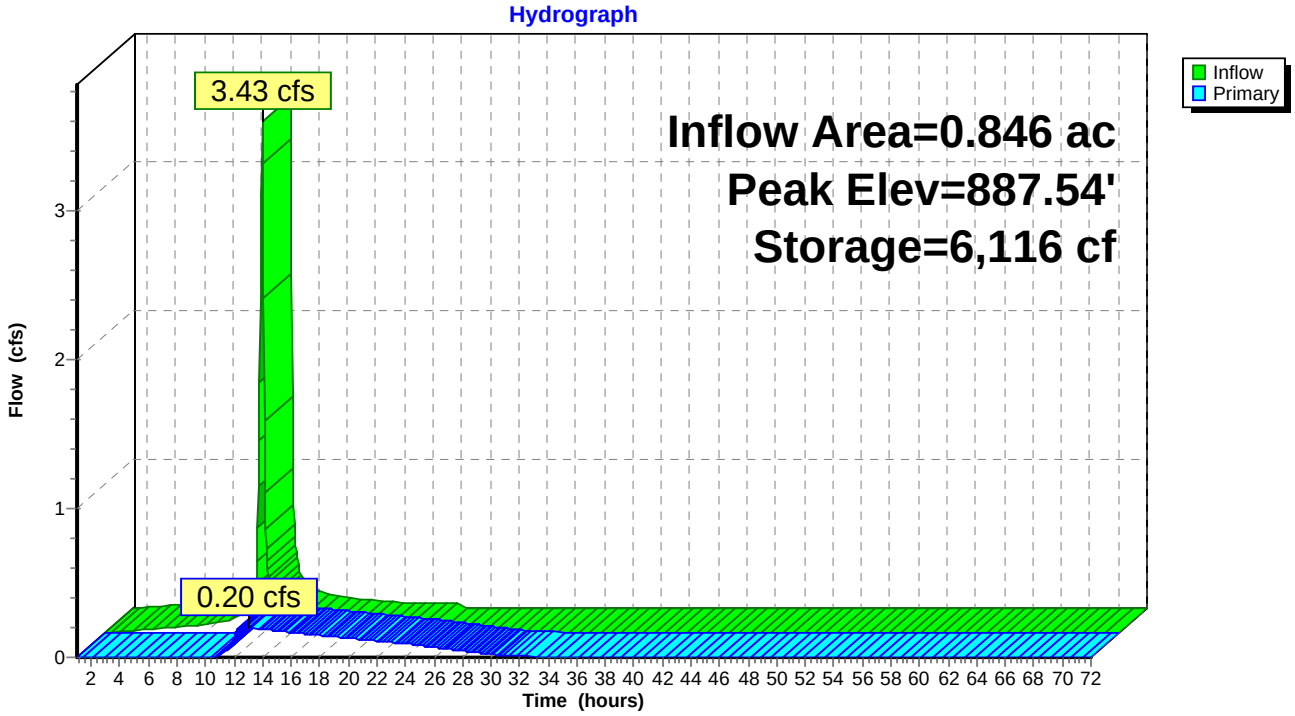
Pond ChC: Chesrown Chambers



Pond ChC: Chesrown Chambers



Pond ChC: Chesrown Chambers



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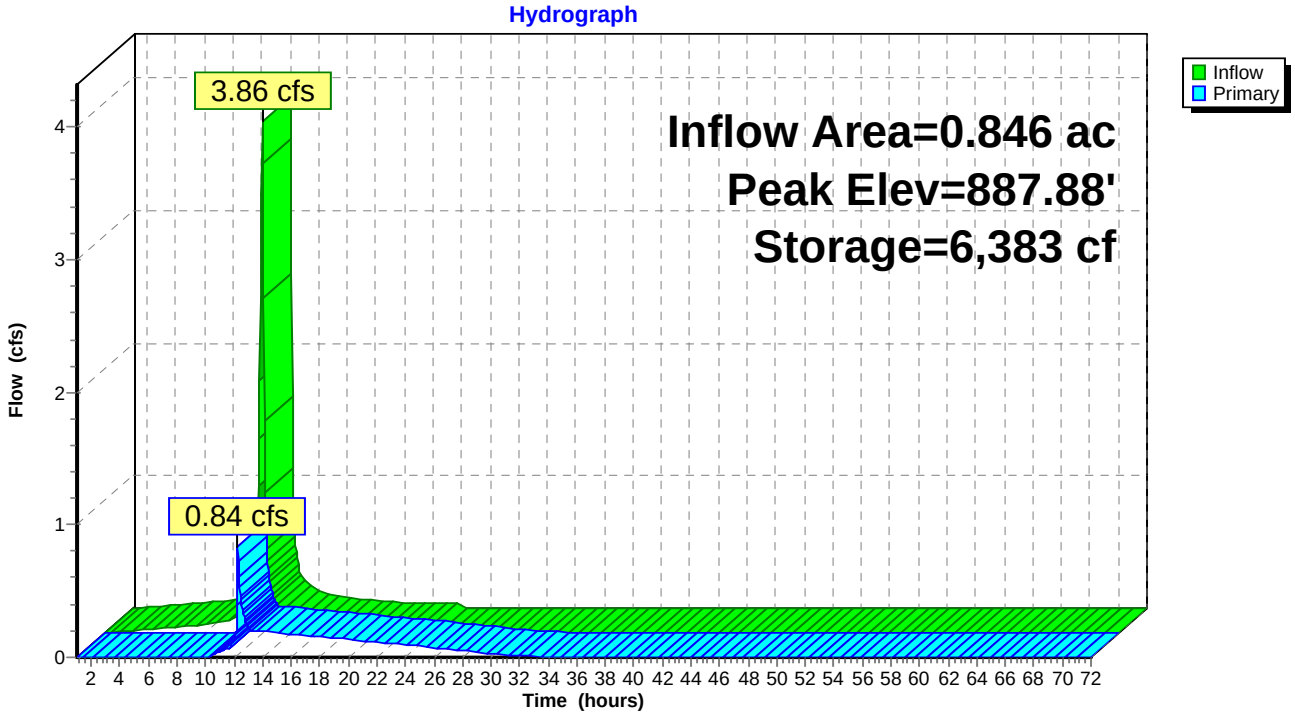
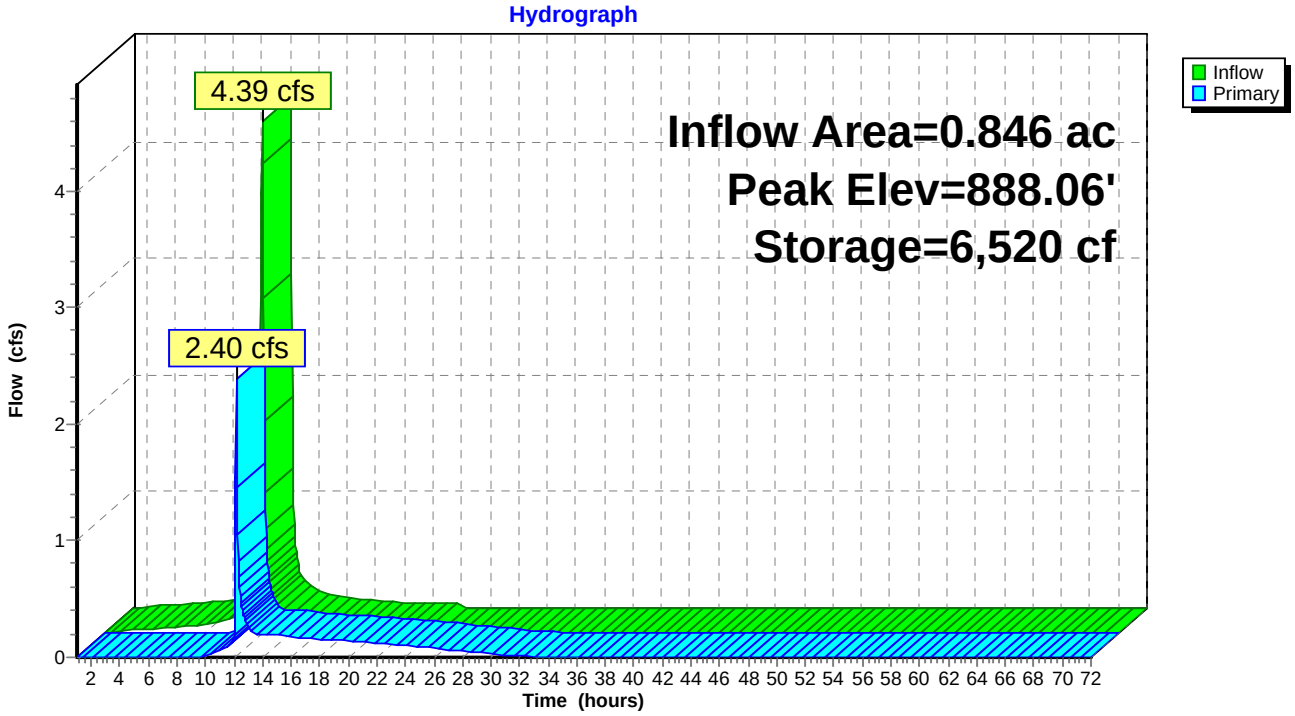
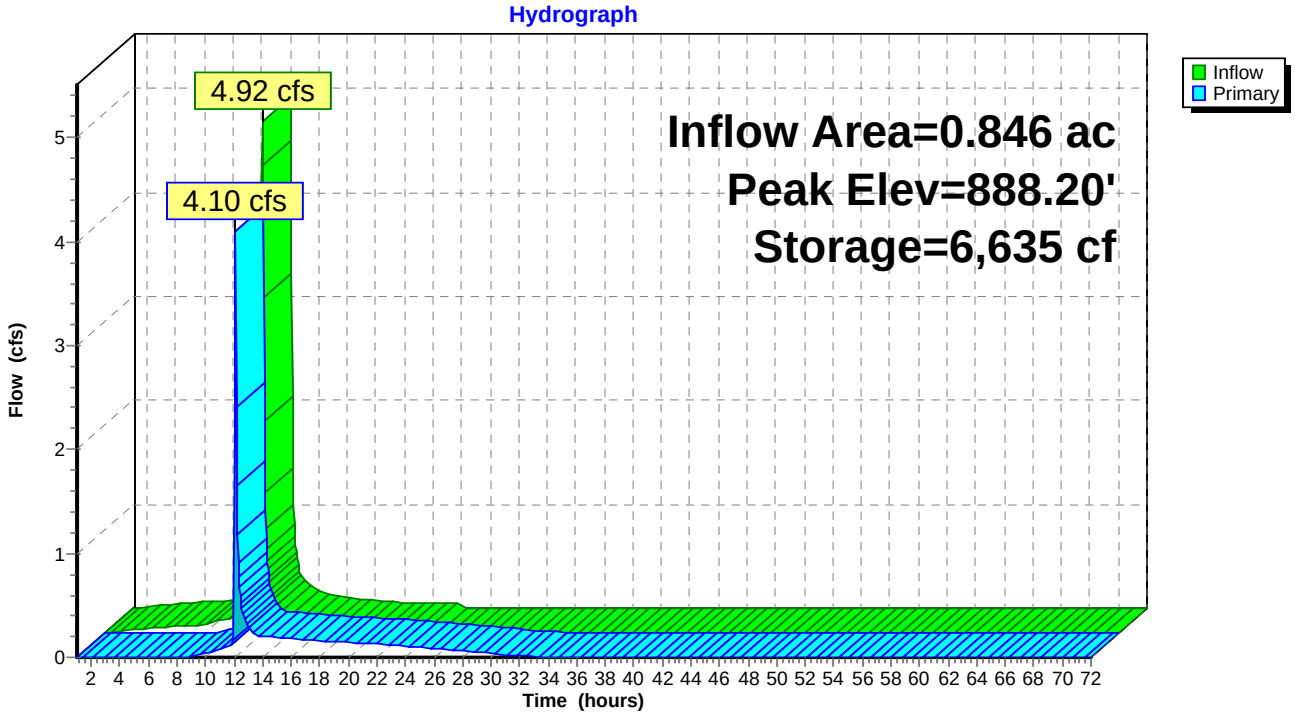


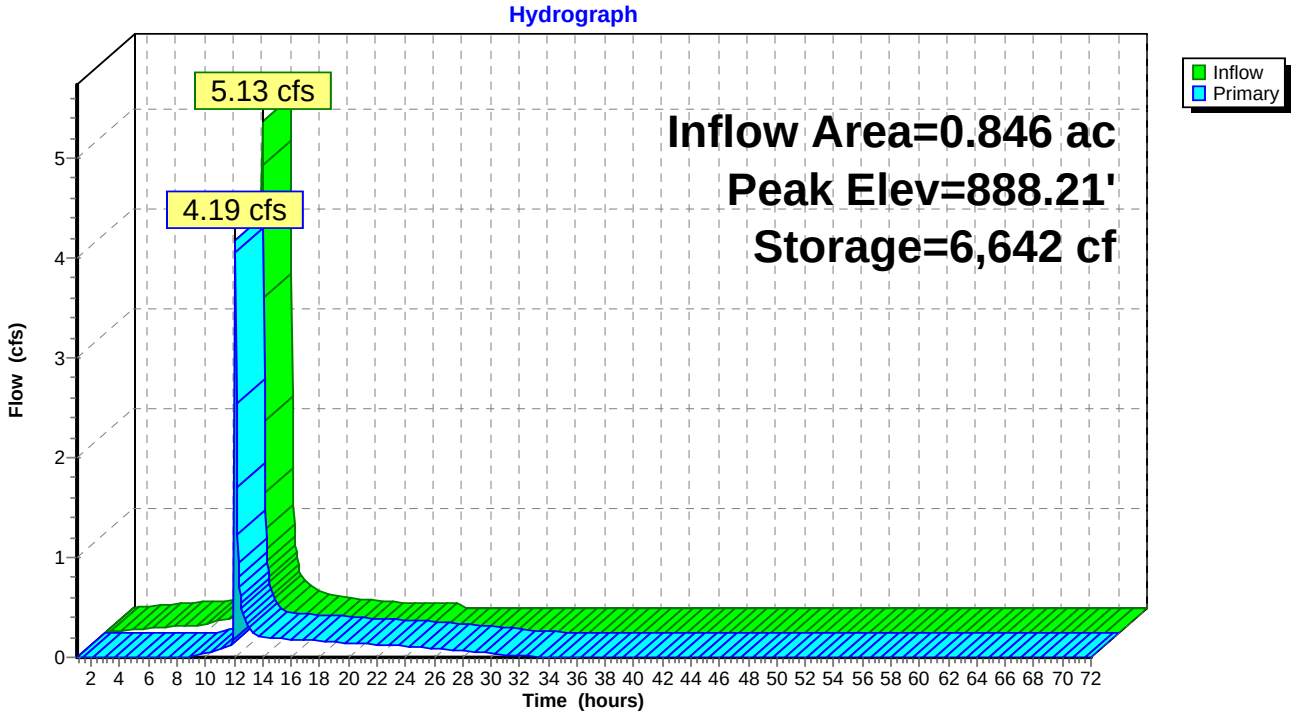
Pond ChC: Chesrown Chambers



Pond ChC: Chesrown Chambers



Pond ChC: Chesrown Chambers



Stage-Discharge for Pond ChC: Chesrown Chambers

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
882.75	0.00	884.11	0.02	885.47	0.12	886.83	0.17	888.19	3.95	889.55	7.49
882.77	0.00	884.13	0.02	885.49	0.12	886.85	0.17	888.21	4.20	889.57	7.50
882.79	0.00	884.15	0.03	885.51	0.13	886.87	0.18	888.23	4.46	889.59	7.51
882.81	0.00	884.17	0.03	885.53	0.13	886.89	0.18	888.25	4.72	889.61	7.52
882.83	0.00	884.19	0.03	885.55	0.13	886.91	0.18	888.27	4.99	889.63	7.53
882.85	0.00	884.21	0.04	885.57	0.13	886.93	0.18	888.29	5.27	889.65	7.55
882.87	0.00	884.23	0.04	885.59	0.13	886.95	0.18	888.31	5.54	889.67	7.56
882.89	0.00	884.25	0.04	885.61	0.13	886.97	0.18	888.33	5.83	889.69	7.57
882.91	0.00	884.27	0.05	885.63	0.13	886.99	0.18	888.35	6.11	889.71	7.58
882.93	0.00	884.29	0.05	885.65	0.13	887.01	0.18	888.37	6.41	889.73	7.59
882.95	0.00	884.31	0.05	885.67	0.13	887.03	0.18	888.39	6.70	889.75	7.60
882.97	0.00	884.33	0.05	885.69	0.13	887.05	0.18	888.41	6.81	889.77	7.61
882.99	0.00	884.35	0.05	885.71	0.13	887.07	0.18	888.43	6.82	889.79	7.62
883.01	0.00	884.37	0.06	885.73	0.13	887.09	0.18	888.45	6.83	889.81	7.64
883.03	0.00	884.39	0.06	885.75	0.14	887.11	0.18	888.47	6.84	889.83	7.65
883.05	0.00	884.41	0.06	885.77	0.14	887.13	0.18	888.49	6.86	889.85	7.66
883.07	0.00	884.43	0.06	885.79	0.14	887.15	0.18	888.51	6.87	889.87	7.67
883.09	0.00	884.45	0.06	885.81	0.14	887.17	0.18	888.53	6.88	889.89	7.68
883.11	0.00	884.47	0.07	885.83	0.14	887.19	0.19	888.55	6.89	889.91	7.69
883.13	0.00	884.49	0.07	885.85	0.14	887.21	0.19	888.57	6.91	889.93	7.70
883.15	0.00	884.51	0.07	885.87	0.14	887.23	0.19	888.59	6.92	889.95	7.71
883.17	0.00	884.53	0.07	885.89	0.14	887.25	0.19	888.61	6.93	889.97	7.73
883.19	0.00	884.55	0.07	885.91	0.14	887.27	0.19	888.63	6.94	889.99	7.74
883.21	0.00	884.57	0.07	885.93	0.14	887.29	0.19	888.65	6.96		
883.23	0.00	884.59	0.07	885.95	0.14	887.31	0.19	888.67	6.97		
883.25	0.00	884.61	0.08	885.97	0.14	887.33	0.19	888.69	6.98		
883.27	0.00	884.63	0.08	885.99	0.15	887.35	0.19	888.71	6.99		
883.29	0.00	884.65	0.08	886.01	0.15	887.37	0.19	888.73	7.00		
883.31	0.00	884.67	0.08	886.03	0.15	887.39	0.19	888.75	7.02		
883.33	0.00	884.69	0.08	886.05	0.15	887.41	0.19	888.77	7.03		
883.35	0.00	884.71	0.08	886.07	0.15	887.43	0.19	888.79	7.04		
883.37	0.00	884.73	0.08	886.09	0.15	887.45	0.19	888.81	7.05		
883.39	0.00	884.75	0.09	886.11	0.15	887.47	0.19	888.83	7.07		
883.41	0.00	884.77	0.09	886.13	0.15	887.49	0.19	888.85	7.08		
883.43	0.00	884.79	0.09	886.15	0.15	887.51	0.19	888.87	7.09		
883.45	0.00	884.81	0.09	886.17	0.15	887.53	0.20	888.89	7.10		
883.47	0.00	884.83	0.09	886.19	0.15	887.55	0.20	888.91	7.11		
883.49	0.00	884.85	0.09	886.21	0.15	887.57	0.20	888.93	7.13		
883.51	0.00	884.87	0.09	886.23	0.15	887.59	0.20	888.95	7.14		
883.53	0.00	884.89	0.09	886.25	0.15	887.61	0.20	888.97	7.15		
883.55	0.00	884.91	0.10	886.27	0.16	887.63	0.20	888.99	7.16		
883.57	0.00	884.93	0.10	886.29	0.16	887.65	0.20	889.01	7.17		
883.59	0.00	884.95	0.10	886.31	0.16	887.67	0.20	889.03	7.19		
883.61	0.00	884.97	0.10	886.33	0.16	887.69	0.20	889.05	7.20		
883.63	0.00	884.99	0.10	886.35	0.16	887.71	0.20	889.07	7.21		
883.65	0.00	885.01	0.10	886.37	0.16	887.73	0.20	889.09	7.22		
883.67	0.00	885.03	0.10	886.39	0.16	887.75	0.20	889.11	7.23		
883.69	0.00	885.05	0.10	886.41	0.16	887.77	0.24	889.13	7.24		
883.71	0.00	885.07	0.10	886.43	0.16	887.79	0.31	889.15	7.26		
883.73	0.00	885.09	0.11	886.45	0.16	887.81	0.39	889.17	7.27		
883.75	0.00	885.11	0.11	886.47	0.16	887.83	0.50	889.19	7.28		
883.77	0.00	885.13	0.11	886.49	0.16	887.85	0.62	889.21	7.29		
883.79	0.00	885.15	0.11	886.51	0.16	887.87	0.74	889.23	7.30		
883.81	0.00	885.17	0.11	886.53	0.16	887.89	0.89	889.25	7.32		
883.83	0.00	885.19	0.11	886.55	0.16	887.91	1.04	889.27	7.33		
883.85	0.00	885.21	0.11	886.57	0.17	887.93	1.20	889.29	7.34		
883.87	0.00	885.23	0.11	886.59	0.17	887.95	1.36	889.31	7.35		
883.89	0.00	885.25	0.11	886.61	0.17	887.97	1.54	889.33	7.36		
883.91	0.00	885.27	0.11	886.63	0.17	887.99	1.73	889.35	7.37		
883.93	0.00	885.29	0.12	886.65	0.17	888.01	1.92	889.37	7.39		
883.95	0.00	885.31	0.12	886.67	0.17	888.03	2.12	889.39	7.40		
883.97	0.00	885.33	0.12	886.69	0.17	888.05	2.33	889.41	7.41		
883.99	0.00	885.35	0.12	886.71	0.17	888.07	2.54	889.43	7.42		
884.01	0.00	885.37	0.12	886.73	0.17	888.09	2.76	889.45	7.43		
884.03	0.00	885.39	0.12	886.75	0.17	888.11	2.99	889.47	7.44		
884.05	0.00	885.41	0.12	886.77	0.17	888.13	3.22	889.49	7.45		
884.07	0.01	885.43	0.12	886.79	0.17	888.15	3.45	889.51	7.47		
884.09	0.01	885.45	0.12	886.81	0.17	888.17	3.70	889.53	7.48		

Stage-Area-Storage for Pond ChC: Chesrown Chambers

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
882.75	0	885.47	3,748	888.19	6,626
882.79	31	885.51	3,807	888.23	6,657
882.83	62	885.55	3,866	888.27	6,689
882.87	94	885.59	3,924	888.31	6,712
882.91	125	885.63	3,982	888.35	6,713
882.95	156	885.67	4,040	888.39	6,713
882.99	187	885.71	4,098	888.43	6,713
883.03	218	885.75	4,155	888.47	6,714
883.07	250	885.79	4,212	888.51	6,714
883.11	281	885.83	4,268	888.55	6,714
883.15	312	885.87	4,325	888.59	6,715
883.19	343	885.91	4,380	888.63	6,715
883.23	374	885.95	4,436	888.67	6,715
883.27	406	885.99	4,491	888.71	6,716
883.31	437	886.03	4,545	888.75	6,716
883.35	468	886.07	4,600	888.79	6,716
883.39	499	886.11	4,653	888.83	6,717
883.43	530	886.15	4,707	888.87	6,717
883.47	562	886.19	4,759	888.91	6,717
883.51	602	886.23	4,812	888.95	6,718
883.55	669	886.27	4,864	888.99	6,718
883.59	737	886.31	4,915	889.03	6,718
883.63	804	886.35	4,966	889.07	6,719
883.67	871	886.39	5,016	889.11	6,719
883.71	938	886.43	5,065	889.15	6,719
883.75	1,005	886.47	5,114	889.19	6,719
883.79	1,072	886.51	5,163	889.23	6,720
883.83	1,139	886.55	5,210	889.27	6,720
883.87	1,206	886.59	5,257	889.31	6,721
883.91	1,272	886.63	5,304	889.35	6,733
883.95	1,339	886.67	5,349	889.39	6,759
883.99	1,405	886.71	5,393	889.43	6,801
884.03	1,471	886.75	5,437	889.47	6,858
884.07	1,537	886.79	5,479	889.51	6,930
884.11	1,603	886.83	5,520	889.55	7,017
884.15	1,669	886.87	5,560	889.59	7,119
884.19	1,735	886.91	5,597	889.63	7,236
884.23	1,801	886.95	5,634	889.67	7,368
884.27	1,866	886.99	5,669	889.71	7,515
884.31	1,932	887.03	5,704	889.75	7,677
884.35	1,997	887.07	5,738	889.79	7,855
884.39	2,062	887.11	5,772	889.83	8,047
884.43	2,127	887.15	5,805	889.87	8,255
884.47	2,191	887.19	5,837	889.91	8,477
884.51	2,256	887.23	5,869	889.95	8,715
884.55	2,320	887.27	5,901	889.99	8,968
884.59	2,385	887.31	5,932		
884.63	2,449	887.35	5,964		
884.67	2,513	887.39	5,995		
884.71	2,576	887.43	6,027		
884.75	2,640	887.47	6,058		
884.79	2,703	887.51	6,090		
884.83	2,767	887.55	6,121		
884.87	2,830	887.59	6,153		
884.91	2,892	887.63	6,184		
884.95	2,955	887.67	6,216		
884.99	3,017	887.71	6,247		
885.03	3,080	887.75	6,279		
885.07	3,141	887.79	6,310		
885.11	3,203	887.83	6,342		
885.15	3,265	887.87	6,374		
885.19	3,326	887.91	6,405		
885.23	3,387	887.95	6,437		
885.27	3,448	887.99	6,468		
885.31	3,508	888.03	6,500		
885.35	3,568	888.07	6,531		
885.39	3,628	888.11	6,563		
885.43	3,688	888.15	6,594		

Summary for Subcatchment D2: Drexel 2

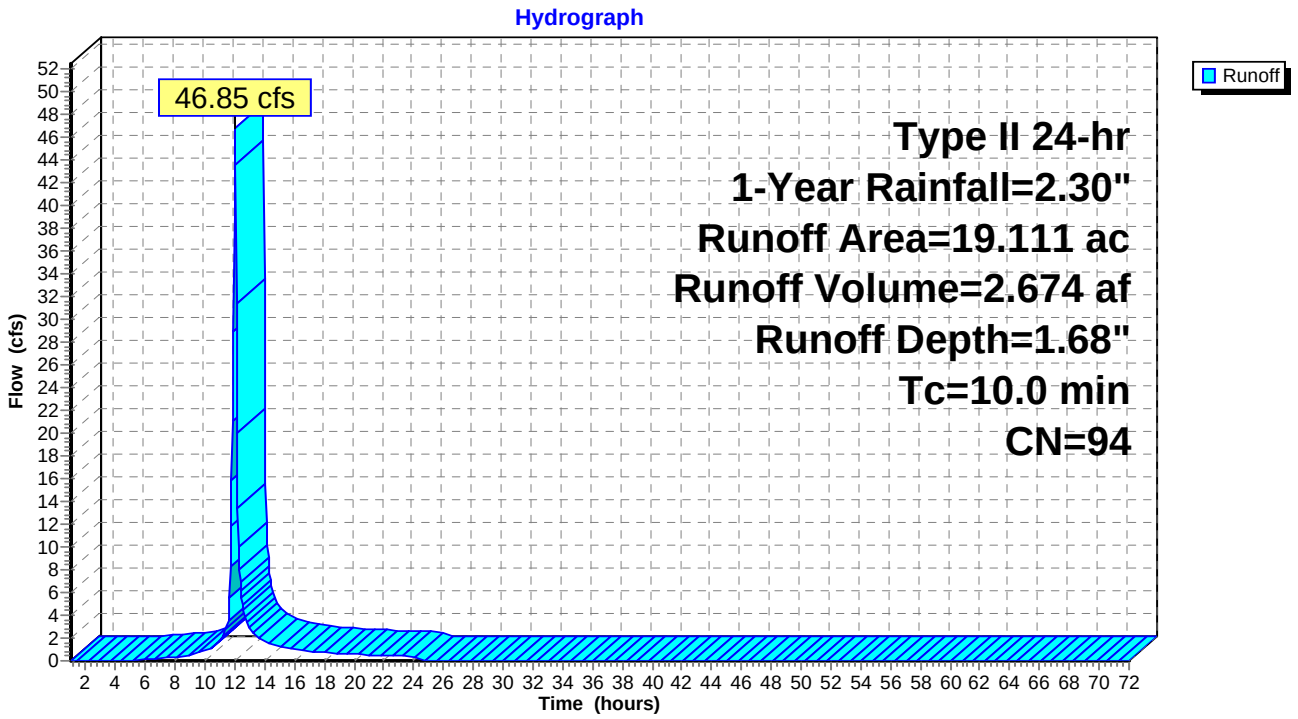
Runoff = 46.85 cfs @ 12.01 hrs, Volume= 2.674 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

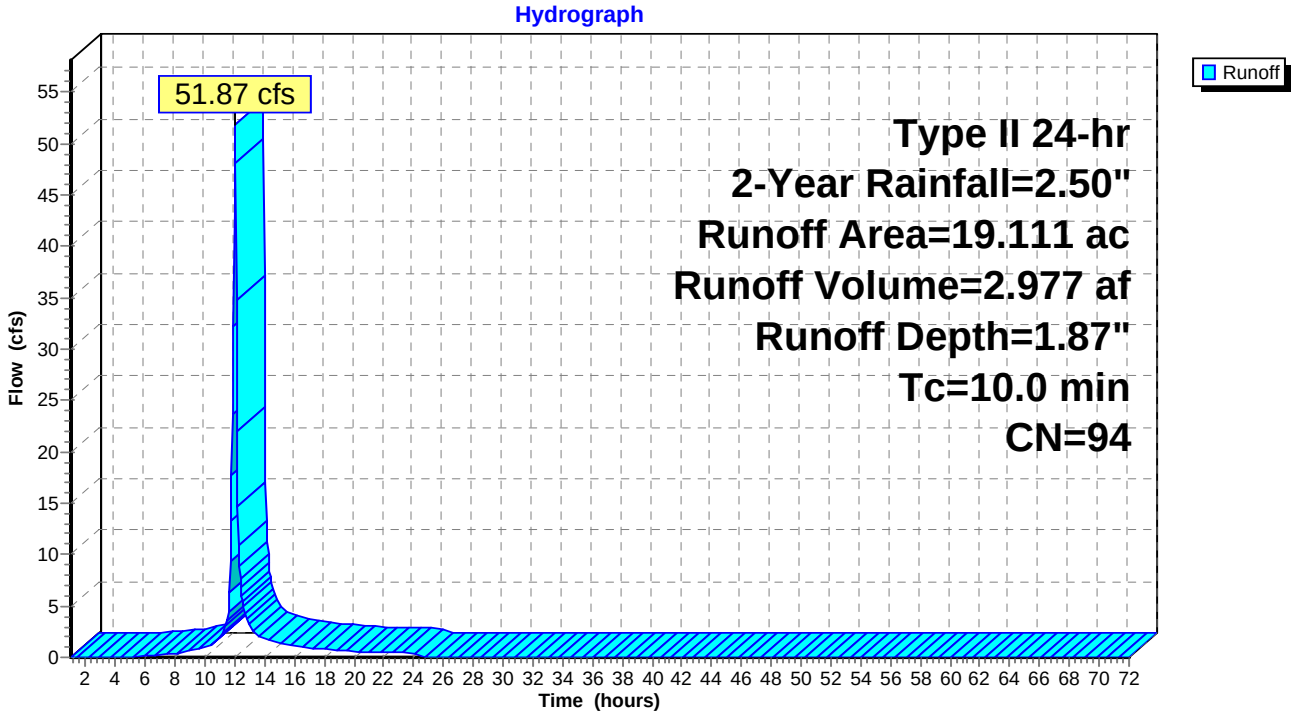
Area (ac)	CN	Description
19.111	94	Urban commercial, 85% imp, HSG C
2.867		15.00% Pervious Area
16.244		85.00% Impervious Area

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

Subcatchment D2: Drexel 2



Subcatchment D2: Drexel 2



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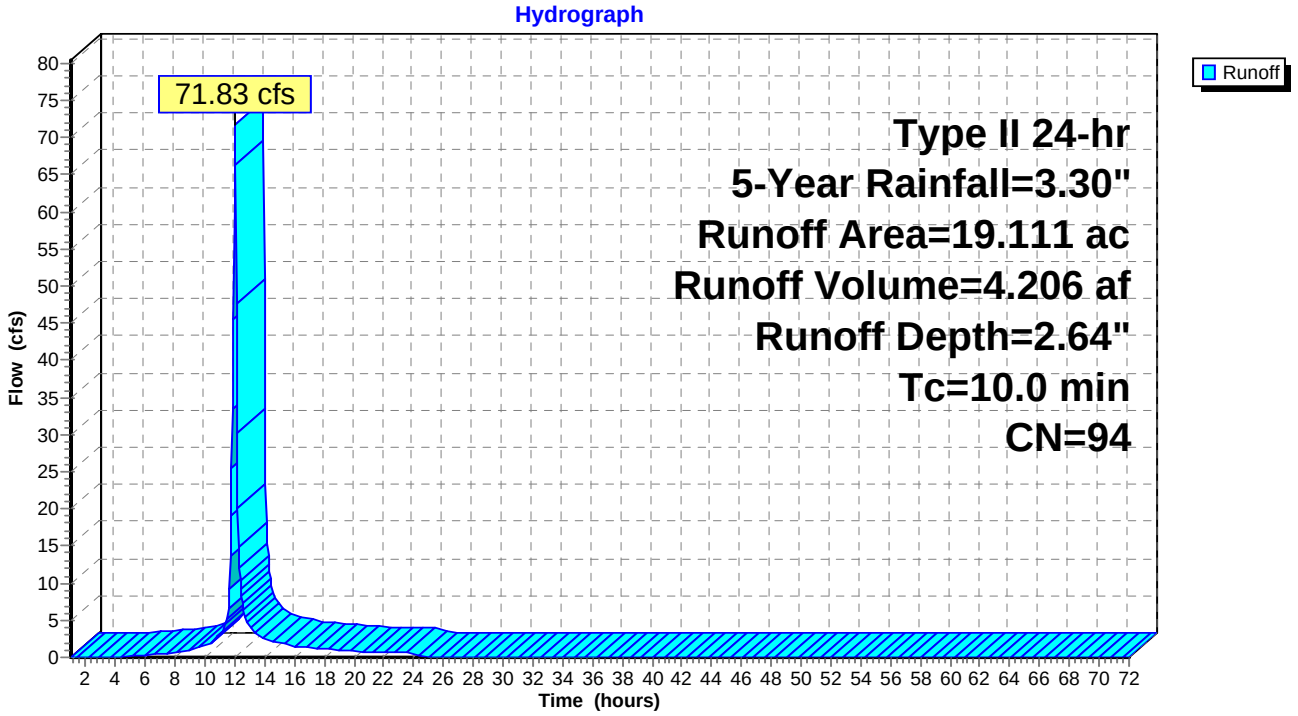

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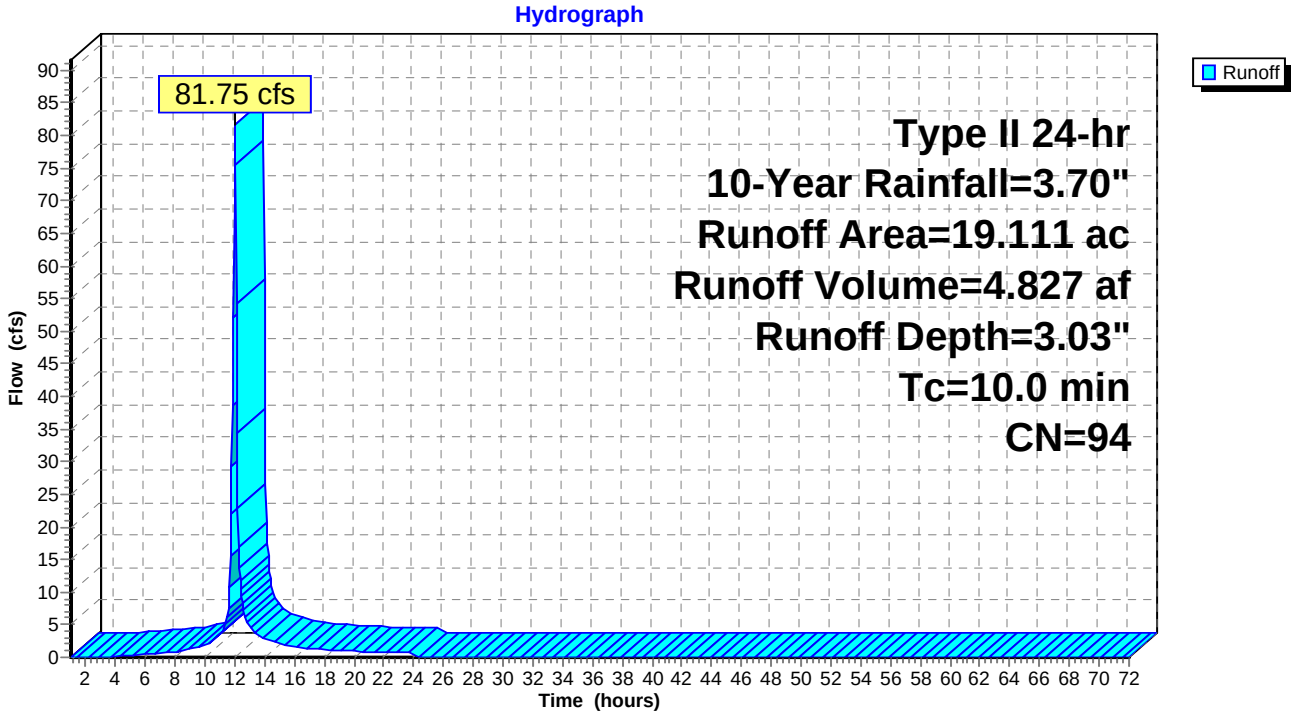

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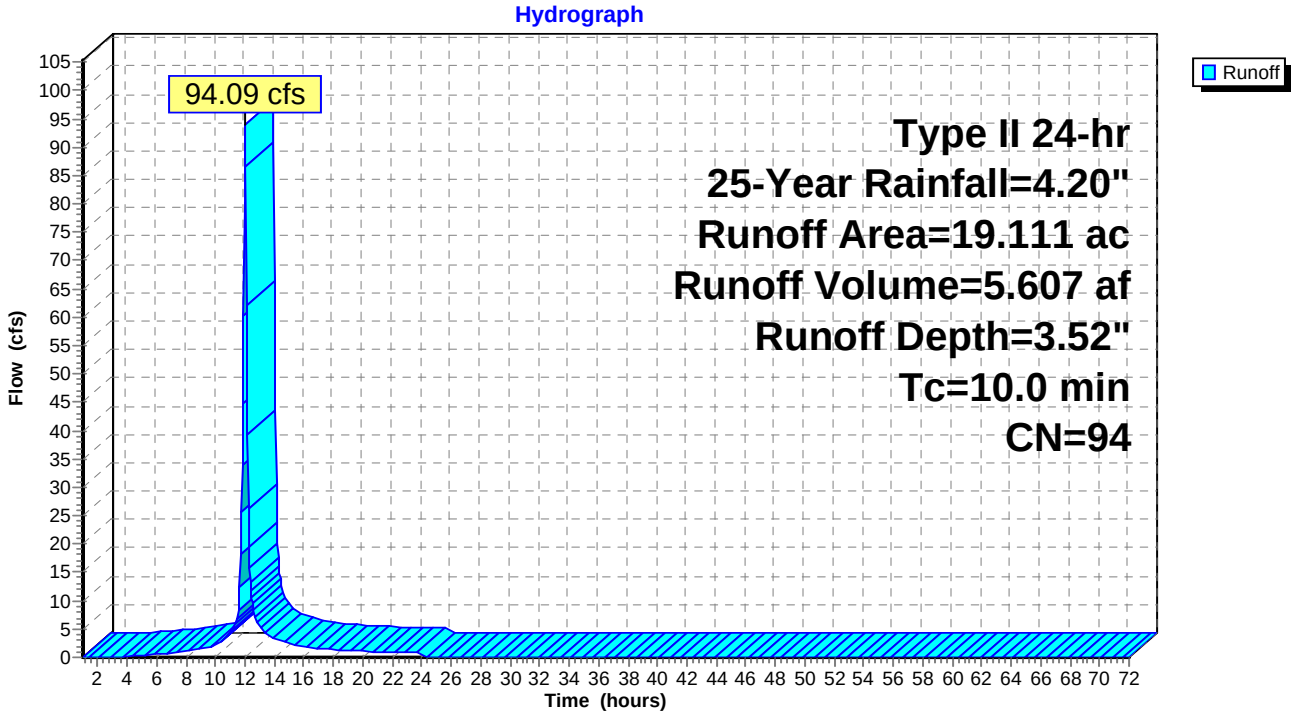
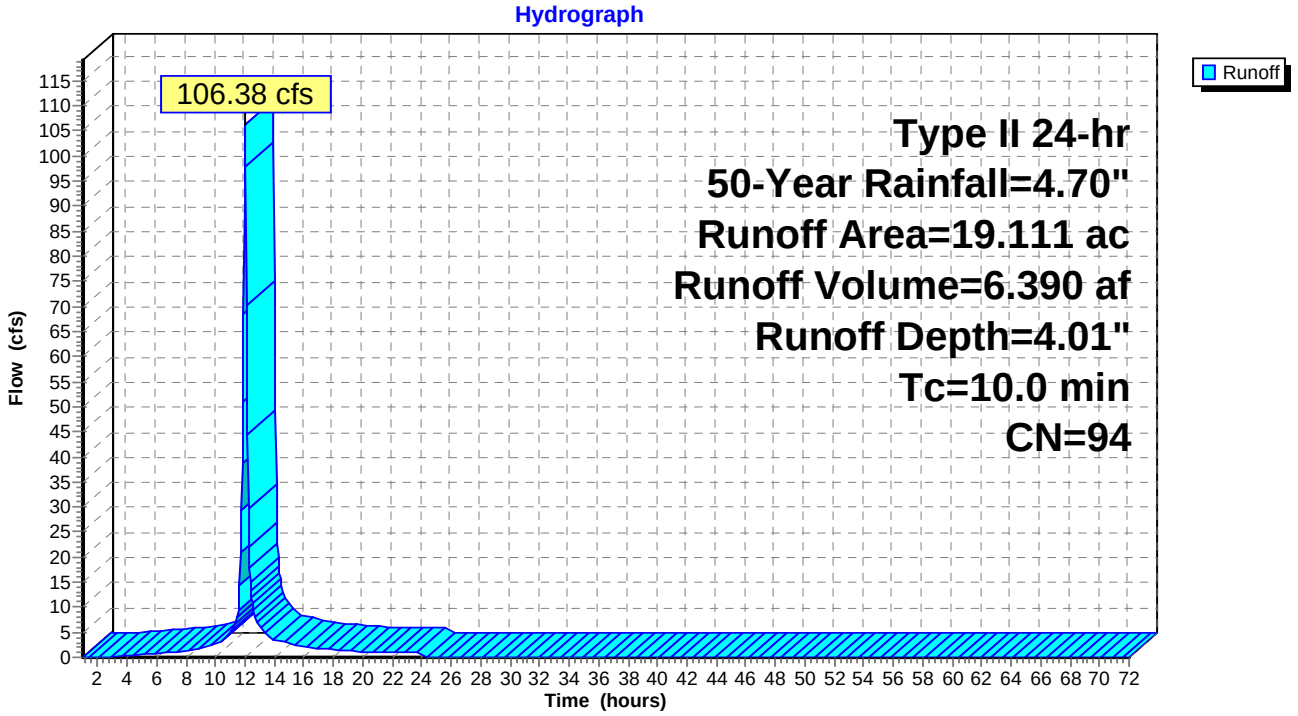
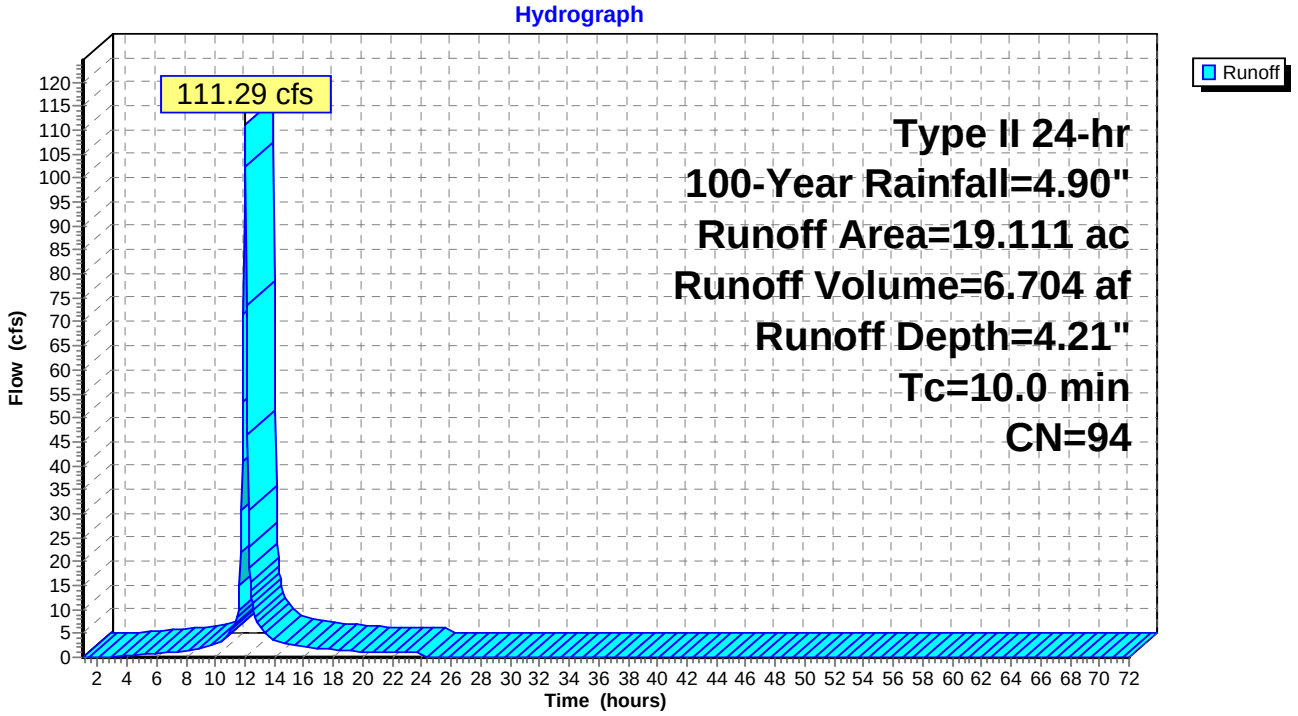


Subcatchment D2: Drexel 2



Subcatchment D2: Drexel 2



Summary for Pond DN: Drexel North

Inflow Area = 19.111 ac, 85.00% Impervious, Inflow Depth = 3.52" for 25-Year event
Inflow = 94.09 cfs @ 12.01 hrs, Volume= 5.607 af
Outflow = 37.37 cfs @ 12.17 hrs, Volume= 5.607 af, Atten= 60%, Lag= 9.9 min
Primary = 8.70 cfs @ 12.17 hrs, Volume= 5.191 af
Secondary = 28.67 cfs @ 12.17 hrs, Volume= 0.416 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 901.94' @ 12.17 hrs Surf.Area= 24,326 sf Storage= 81,529 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 56.3 min (835.2 - 778.9)

Volume	Invert	Avail.Storage	Storage Description
#1	895.50'	96,008 cf	Custom Stage Data (Irregular) Listed below (Recalc)

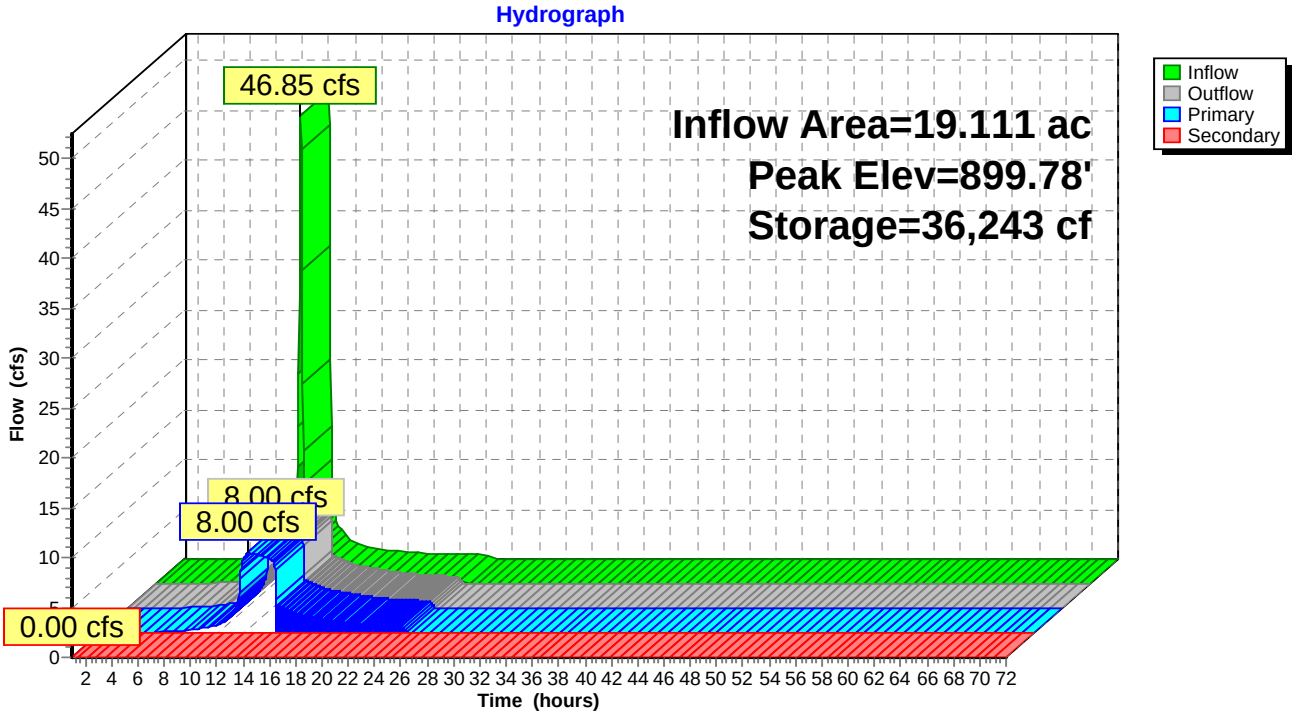
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
895.50	4	4.0	0	0	4
896.00	1,499	196.0	263	263	3,060
897.00	2,877	254.0	2,151	2,414	5,149
898.00	12,561	809.0	7,150	9,564	52,100
899.00	15,337	836.0	13,926	23,490	55,729
900.00	18,276	865.0	16,785	40,275	59,746
901.00	21,419	890.0	19,827	60,102	63,346
902.00	24,527	916.0	22,955	83,057	67,190
902.50	27,302	935.0	12,951	96,008	70,027

Device	Routing	Invert	Outlet Devices
#1	Primary	891.55'	12.00" Round Culvert L= 185.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 891.55' / 887.00' S= 0.0246 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	891.55'	10.90" Vert. Orifice/Grate C= 0.600
#3	Device 2	895.00'	22.00" W x 6.00" H Vert. Orifice/Grate C= 0.600
#4	Device 2	895.50'	1.50" x 22.00" Horiz. Orifice/Grate X 8.00 C= 0.600 Limited to weir flow at low heads
#5	Secondary	901.70'	80.0' long x 0.30' rise Sharp-Crested Rectangular Weir 2 End Contraction(s)

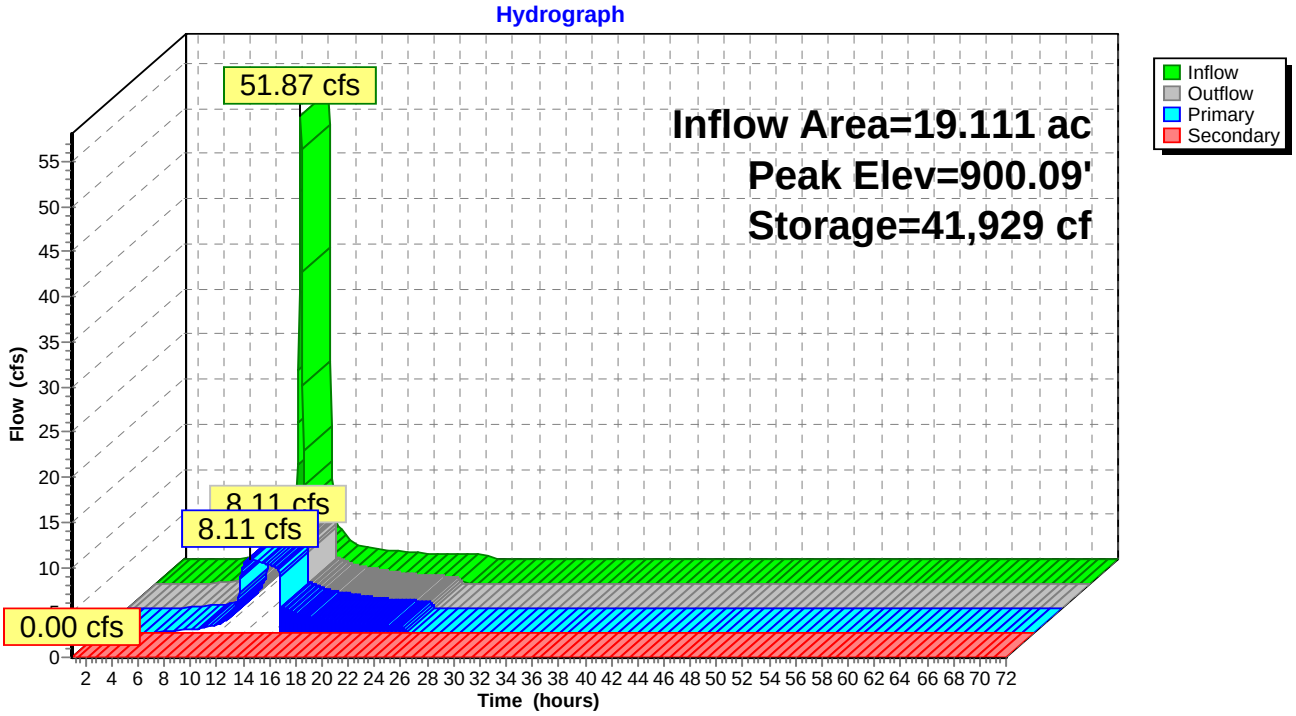
Primary OutFlow Max=8.69 cfs @ 12.17 hrs HW=901.91' (Free Discharge)
└─1=Culvert (Barrel Controls 8.69 cfs @ 11.07 fps)
  └─2=Orifice/Grate (Passes 8.69 cfs of 9.82 cfs potential flow)
    ├─3=Orifice/Grate (Passes < 11.39 cfs potential flow)
    └─4=Orifice/Grate (Passes < 22.35 cfs potential flow)

Secondary OutFlow Max=25.02 cfs @ 12.17 hrs HW=901.91' (Free Discharge)
└─5=Sharp-Crested Rectangular Weir (Weir Controls 25.02 cfs @ 1.50 fps)

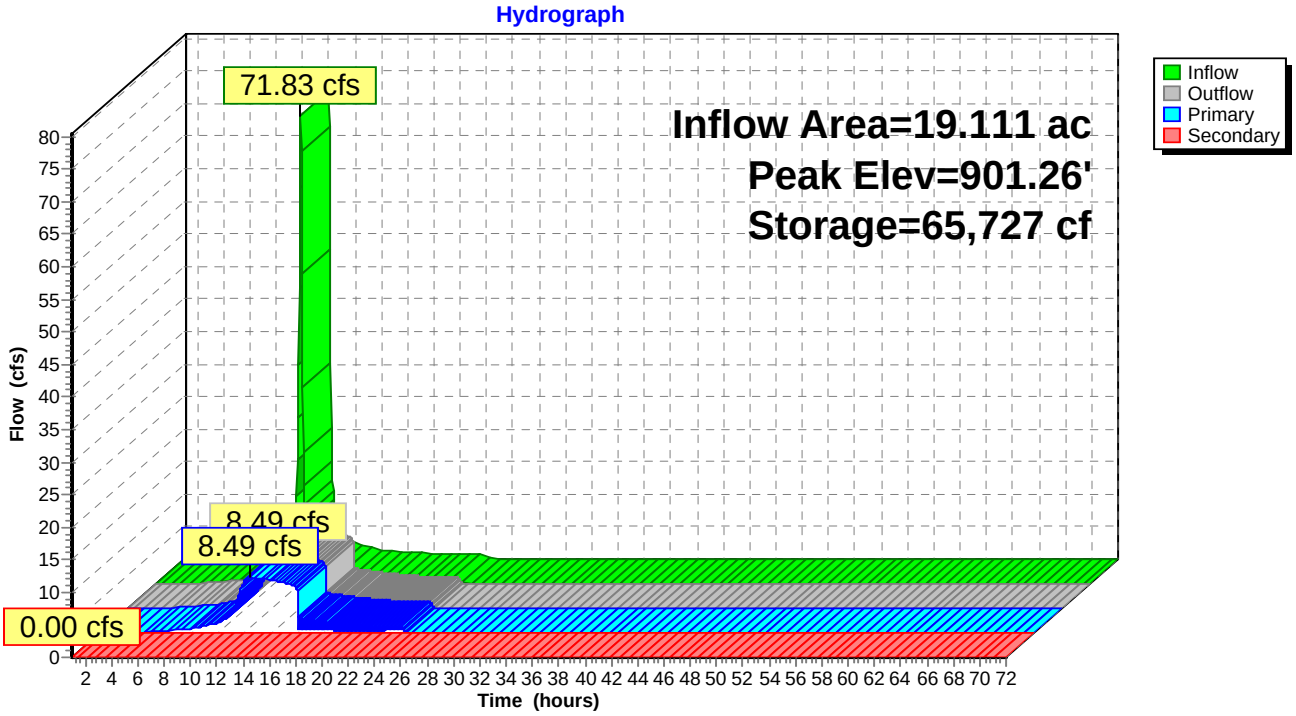
Pond DN: Drexel North



Pond DN: Drexel North



Pond DN: Drexel North



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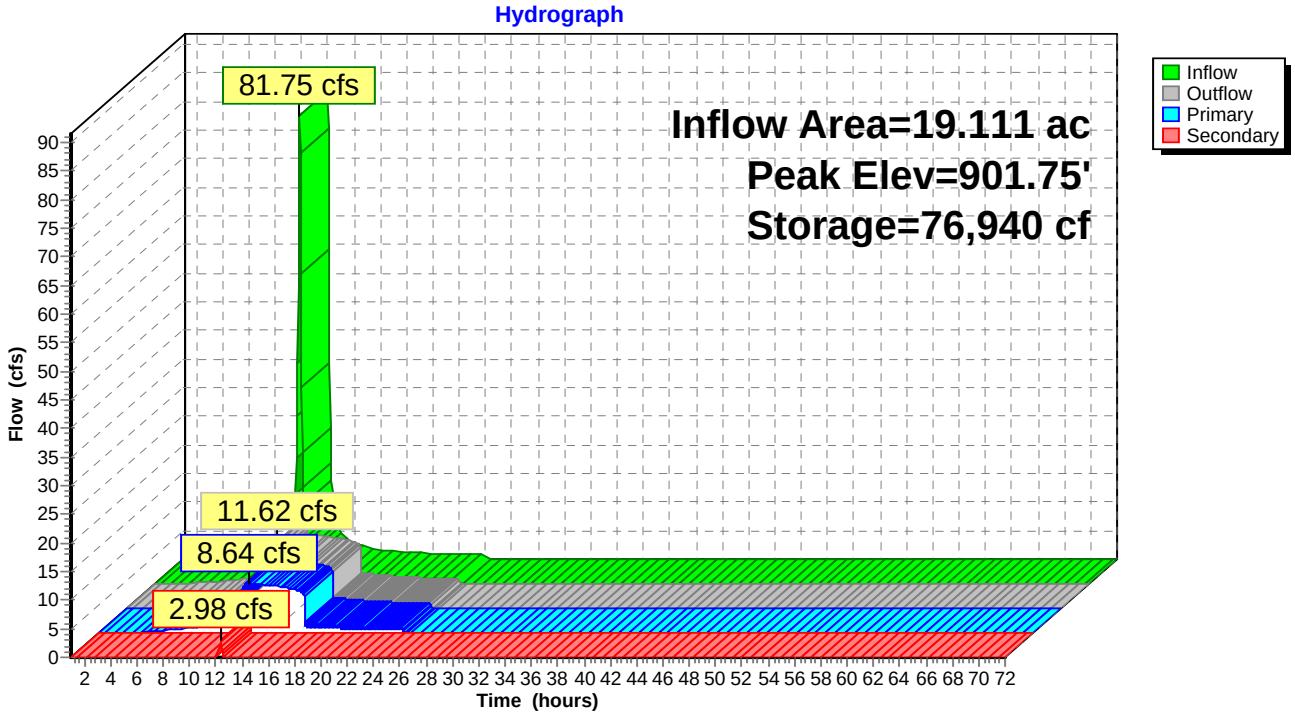
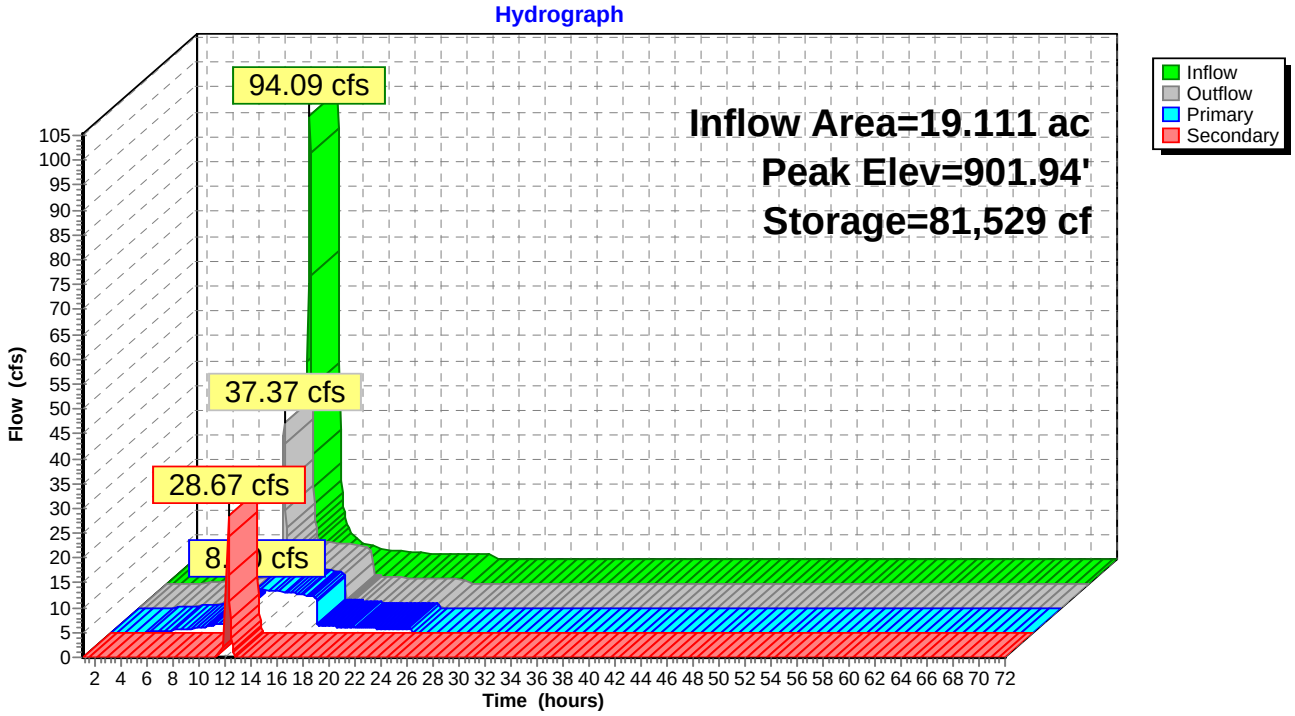


Pond DN: Drexel North



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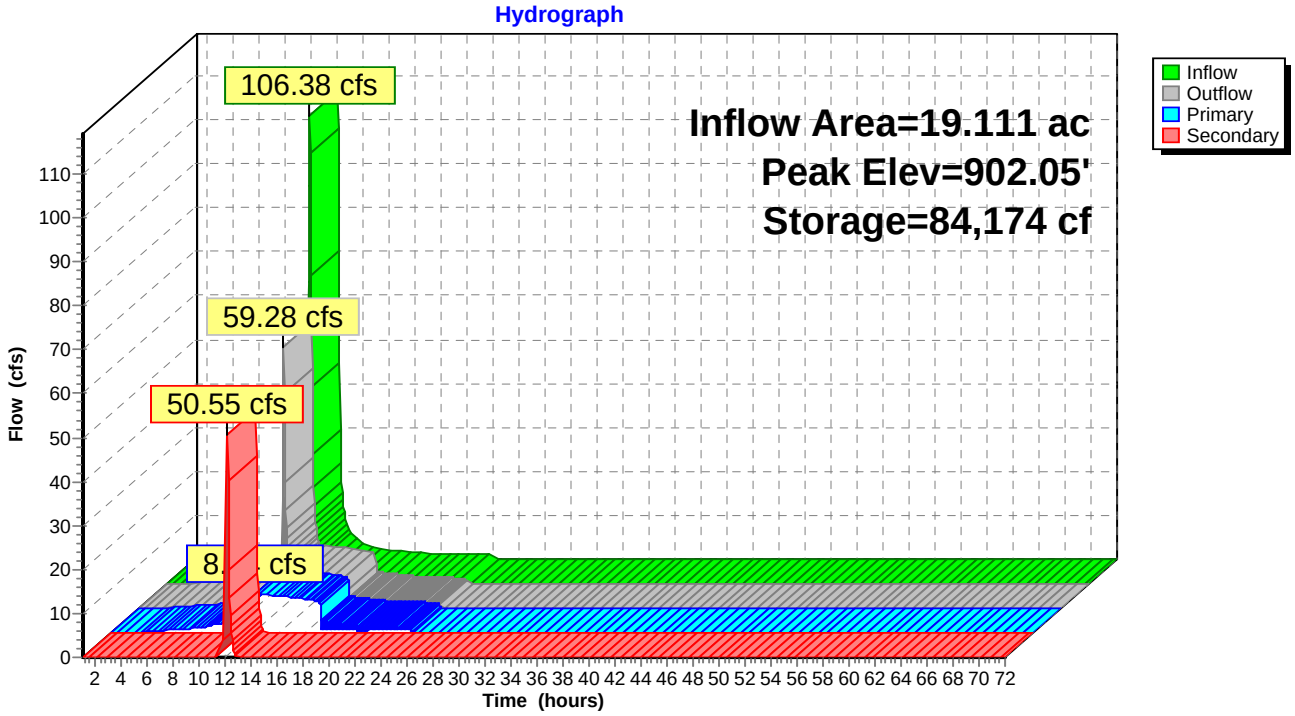

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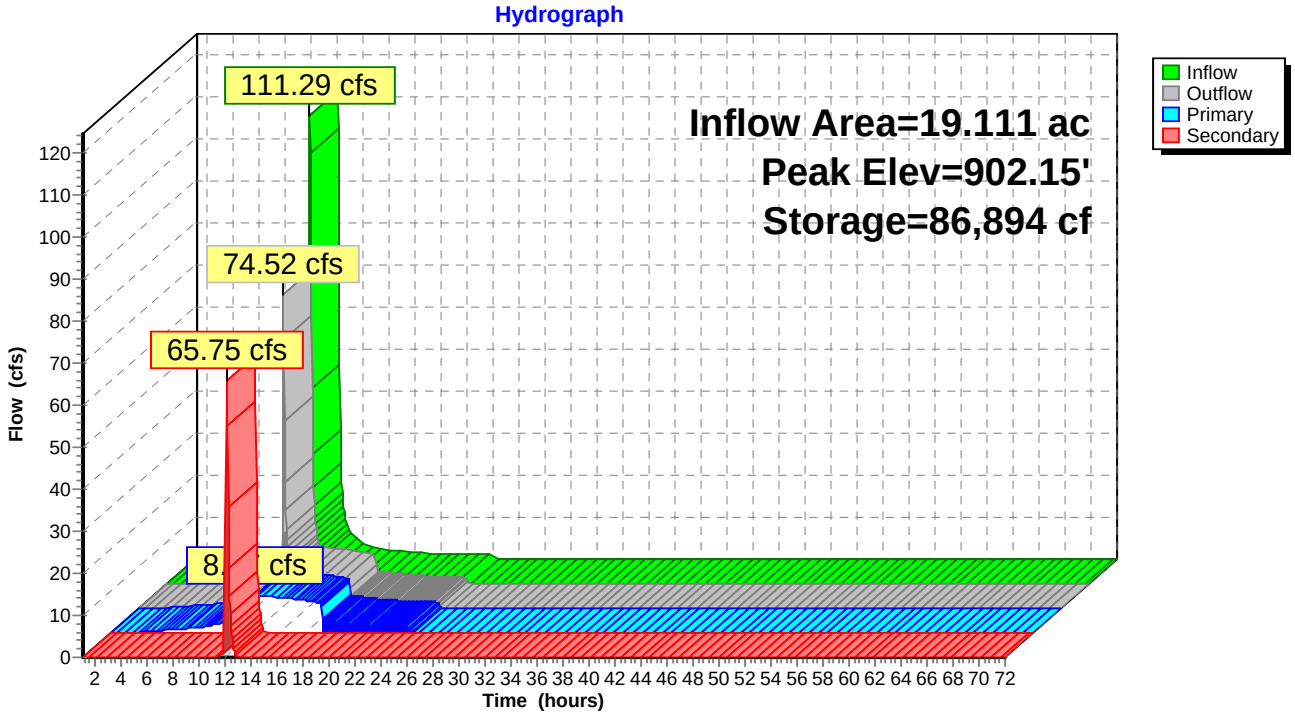


Stage-Discharge for Pond DN: Drexel North

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
895.50	0.00	0.00	0.00
895.54	3.11	3.11	0.00
895.58	4.78	4.78	0.00
895.62	5.69	5.69	0.00
895.66	5.97	5.97	0.00
895.70	6.00	6.00	0.00
895.74	6.03	6.03	0.00
895.78	6.06	6.06	0.00
895.82	6.09	6.09	0.00
895.86	6.13	6.13	0.00
895.90	6.16	6.16	0.00
895.94	6.19	6.19	0.00
895.98	6.22	6.22	0.00
896.02	6.25	6.25	0.00
896.06	6.28	6.28	0.00
896.10	6.31	6.31	0.00
896.14	6.35	6.35	0.00
896.18	6.38	6.38	0.00
896.22	6.41	6.41	0.00
896.26	6.44	6.44	0.00
896.30	6.47	6.47	0.00
896.34	6.50	6.50	0.00
896.38	6.53	6.53	0.00
896.42	6.56	6.56	0.00
896.46	6.59	6.59	0.00
896.50	6.62	6.62	0.00
896.54	6.65	6.65	0.00
896.58	6.67	6.67	0.00
896.62	6.70	6.70	0.00
896.66	6.73	6.73	0.00
896.70	6.76	6.76	0.00
896.74	6.79	6.79	0.00
896.78	6.82	6.82	0.00
896.82	6.85	6.85	0.00
896.86	6.88	6.88	0.00
896.90	6.90	6.90	0.00
896.94	6.93	6.93	0.00
896.98	6.96	6.96	0.00
897.02	6.99	6.99	0.00
897.06	7.02	7.02	0.00
897.10	7.03	7.03	0.00
897.14	7.05	7.05	0.00
897.18	7.06	7.06	0.00
897.22	7.08	7.08	0.00
897.26	7.09	7.09	0.00
897.30	7.11	7.11	0.00
897.34	7.13	7.13	0.00
897.38	7.14	7.14	0.00
897.42	7.16	7.16	0.00
897.46	7.17	7.17	0.00
897.50	7.19	7.19	0.00
897.54	7.20	7.20	0.00
897.58	7.22	7.22	0.00
897.62	7.23	7.23	0.00
897.66	7.25	7.25	0.00
897.70	7.26	7.26	0.00
897.74	7.28	7.28	0.00
897.78	7.29	7.29	0.00
897.82	7.31	7.31	0.00
897.86	7.32	7.32	0.00
897.90	7.34	7.34	0.00
897.94	7.35	7.35	0.00
897.98	7.37	7.37	0.00
898.02	7.38	7.38	0.00
898.06	7.39	7.39	0.00
898.10	7.41	7.41	0.00
898.14	7.42	7.42	0.00
898.18	7.44	7.44	0.00
898.22	7.45	7.45	0.00
898.26	7.47	7.47	0.00
898.30	7.48	7.48	0.00
898.34	7.50	7.50	0.00
898.38	7.51	7.51	0.00
898.42	7.53	7.53	0.00
898.46	7.54	7.54	0.00
898.50	7.55	7.55	0.00
898.54	7.57	7.57	0.00
898.58	7.58	7.58	0.00
898.62	7.60	7.60	0.00
898.66	7.61	7.61	0.00
898.70	7.63	7.63	0.00
898.74	7.64	7.64	0.00
898.78	7.65	7.65	0.00
898.82	7.67	7.67	0.00
898.86	7.68	7.68	0.00
898.90	7.70	7.70	0.00
898.94	7.71	7.71	0.00
898.98	7.73	7.73	0.00
899.02	7.74	7.74	0.00
899.06	7.75	7.75	0.00
899.10	7.77	7.77	0.00
899.14	7.78	7.78	0.00
899.18	7.80	7.80	0.00
899.22	7.81	7.81	0.00
899.26	7.82	7.82	0.00
899.30	7.84	7.84	0.00
899.34	7.85	7.85	0.00
899.38	7.86	7.86	0.00
899.42	7.88	7.88	0.00
899.46	7.89	7.89	0.00
899.50	7.91	7.91	0.00
899.54	7.92	7.92	0.00
899.58	7.93	7.93	0.00
899.62	7.95	7.95	0.00
899.66	7.96	7.96	0.00
899.70	7.97	7.97	0.00
899.74	7.99	7.99	0.00
899.78	8.00	8.00	0.00
899.82	8.02	8.02	0.00
899.86	8.03	8.03	0.00
899.90	8.04	8.04	0.00
899.94	8.06	8.06	0.00
899.98	8.07	8.07	0.00
900.02	8.08	8.08	0.00
900.06	8.10	8.10	0.00
900.10	8.11	8.11	0.00
900.14	8.12	8.12	0.00
900.18	8.14	8.14	0.00
900.22	8.15	8.15	0.00
900.26	8.16	8.16	0.00
900.30	8.18	8.18	0.00
900.34	8.19	8.19	0.00
900.38	8.20	8.20	0.00
900.42	8.22	8.22	0.00
900.46	8.23	8.23	0.00
900.50	8.24	8.24	0.00
900.54	8.26	8.26	0.00
900.58	8.27	8.27	0.00
900.62	8.28	8.28	0.00
900.66	8.30	8.30	0.00
900.70	8.31	8.31	0.00
900.74	8.32	8.32	0.00
900.78	8.33	8.33	0.00
900.82	8.35	8.35	0.00
900.86	8.36	8.36	0.00
900.90	8.37	8.37	0.00
900.94	8.39	8.39	0.00
900.98	8.40	8.40	0.00
901.02	8.41	8.41	0.00
901.06	8.43	8.43	0.00
901.10	8.44	8.44	0.00
901.14	8.45	8.45	0.00
901.18	8.46	8.46	0.00
901.22	8.48	8.48	0.00
901.26	8.49	8.49	0.00
901.30	8.50	8.50	0.00
901.34	8.52	8.52	0.00
901.38	8.53	8.53	0.00
901.42	8.54	8.54	0.00
901.46	8.55	8.55	0.00
901.50	8.57	8.57	0.00
901.54	8.58	8.58	0.00
901.58	8.59	8.59	0.00
901.62	8.60	8.60	0.00
901.66	8.62	8.62	0.00
901.70	8.63	8.63	0.00
901.74	10.73	8.64	2.09
901.78	14.57	8.65	5.92
901.82	19.54	8.67	10.87
901.86	25.42	8.68	16.74
901.90	32.08	8.69	23.39
901.94	39.44	8.70	30.74
901.98	47.45	8.72	38.73
902.02	55.31	8.73	46.58
902.06	61.36	8.74	52.62
902.10	66.62	8.75	57.86
902.14	71.37	8.77	62.60
902.18	75.75	8.78	66.97
902.22	79.84	8.79	71.05
902.26	83.69	8.80	74.89
902.30	87.35	8.82	78.54
902.34	90.84	8.83	82.01
902.38	94.19	8.84	85.35
902.42	97.40	8.85	88.55
902.46	100.50	8.87	91.64
902.50	103.50	8.88	94.63

Stage-Area-Storage for Pond DN: Drexel North

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
895.50	4	0	898.22	13,148	12,392	900.94	21,223	58,823
895.54	24	1	898.26	13,256	12,920	900.98	21,354	59,674
895.58	62	2	898.30	13,365	13,452	901.02	21,479	60,531
895.62	117	6	898.34	13,474	13,989	901.06	21,600	61,392
895.66	189	12	898.38	13,583	14,530	901.10	21,720	62,259
895.70	278	21	898.42	13,693	15,076	901.14	21,841	63,130
895.74	385	34	898.46	13,804	15,626	901.18	21,963	64,006
895.78	509	52	898.50	13,914	16,180	901.22	22,085	64,887
895.82	650	75	898.54	14,026	16,739	901.26	22,207	65,773
895.86	809	104	898.58	14,137	17,302	901.30	22,329	66,664
895.90	984	140	898.62	14,249	17,870	901.34	22,452	67,559
895.94	1,177	183	898.66	14,362	18,442	901.38	22,575	68,460
895.98	1,387	235	898.70	14,475	19,019	901.42	22,699	69,365
896.02	1,522	294	898.74	14,589	19,600	901.46	22,823	70,276
896.06	1,569	355	898.78	14,703	20,186	901.50	22,947	71,191
896.10	1,617	419	898.82	14,817	20,776	901.54	23,071	72,111
896.14	1,665	485	898.86	14,932	21,371	901.58	23,196	73,037
896.18	1,714	552	898.90	15,047	21,971	901.62	23,321	73,967
896.22	1,764	622	898.94	15,163	22,575	901.66	23,447	74,902
896.26	1,814	694	898.98	15,279	23,184	901.70	23,572	75,843
896.30	1,866	767	899.02	15,393	23,797	901.74	23,699	76,788
896.34	1,918	843	899.06	15,506	24,415	901.78	23,825	77,739
896.38	1,970	921	899.10	15,619	25,038	901.82	23,952	78,694
896.42	2,024	1,000	899.14	15,733	25,665	901.86	24,079	79,655
896.46	2,078	1,082	899.18	15,847	26,296	901.90	24,207	80,621
896.50	2,132	1,167	899.22	15,961	26,933	901.94	24,335	81,591
896.54	2,188	1,253	899.26	16,076	27,573	901.98	24,463	82,567
896.58	2,244	1,342	899.30	16,192	28,219	902.02	24,635	83,549
896.62	2,301	1,433	899.34	16,307	28,869	902.06	24,852	84,539
896.66	2,359	1,526	899.38	16,423	29,523	902.10	25,070	85,537
896.70	2,417	1,621	899.42	16,540	30,183	902.14	25,289	86,544
896.74	2,476	1,719	899.46	16,657	30,847	902.18	25,509	87,560
896.78	2,536	1,819	899.50	16,774	31,515	902.22	25,730	88,585
896.82	2,596	1,922	899.54	16,892	32,189	902.26	25,951	89,619
896.86	2,657	2,027	899.58	17,010	32,867	902.30	26,174	90,661
896.90	2,719	2,135	899.62	17,129	33,549	902.34	26,398	91,713
896.94	2,782	2,245	899.66	17,248	34,237	902.38	26,622	92,773
896.98	2,845	2,357	899.70	17,367	34,929	902.42	26,848	93,842
897.02	3,004	2,473	899.74	17,487	35,626	902.46	27,075	94,921
897.06	3,265	2,598	899.78	17,607	36,328	902.50	27,302	96,008
897.10	3,538	2,734	899.82	17,728	37,035			
897.14	3,822	2,882	899.86	17,849	37,746			
897.18	4,116	3,040	899.90	17,971	38,463			
897.22	4,421	3,211	899.94	18,092	39,184			
897.26	4,738	3,394	899.98	18,215	39,910			
897.30	5,065	3,590	900.02	18,336	40,641			
897.34	5,403	3,800	900.06	18,458	41,377			
897.38	5,752	4,023	900.10	18,579	42,118			
897.42	6,112	4,260	900.14	18,701	42,863			
897.46	6,483	4,512	900.18	18,823	43,614			
897.50	6,865	4,779	900.22	18,946	44,369			
897.54	7,258	5,061	900.26	19,069	45,130			
897.58	7,662	5,360	900.30	19,193	45,895			
897.62	8,077	5,674	900.34	19,317	46,665			
897.66	8,502	6,006	900.38	19,441	47,440			
897.70	8,939	6,355	900.42	19,566	48,220			
897.74	9,386	6,721	900.46	19,691	49,005			
897.78	9,845	7,106	900.50	19,816	49,796			
897.82	10,314	7,509	900.54	19,942	50,591			
897.86	10,794	7,931	900.58	20,069	51,391			
897.90	11,285	8,372	900.62	20,195	52,196			
897.94	11,787	8,834	900.66	20,322	53,007			
897.98	12,300	9,316	900.70	20,450	53,822			
898.02	12,614	9,816	900.74	20,578	54,643			
898.06	12,720	10,323	900.78	20,706	55,468			
898.10	12,826	10,833	900.82	20,835	56,299			
898.14	12,933	11,349	900.86	20,964	57,135			
898.18	13,040	11,868	900.90	21,093	57,976			

Summary for Subcatchment E23RO: East US23 Runoff

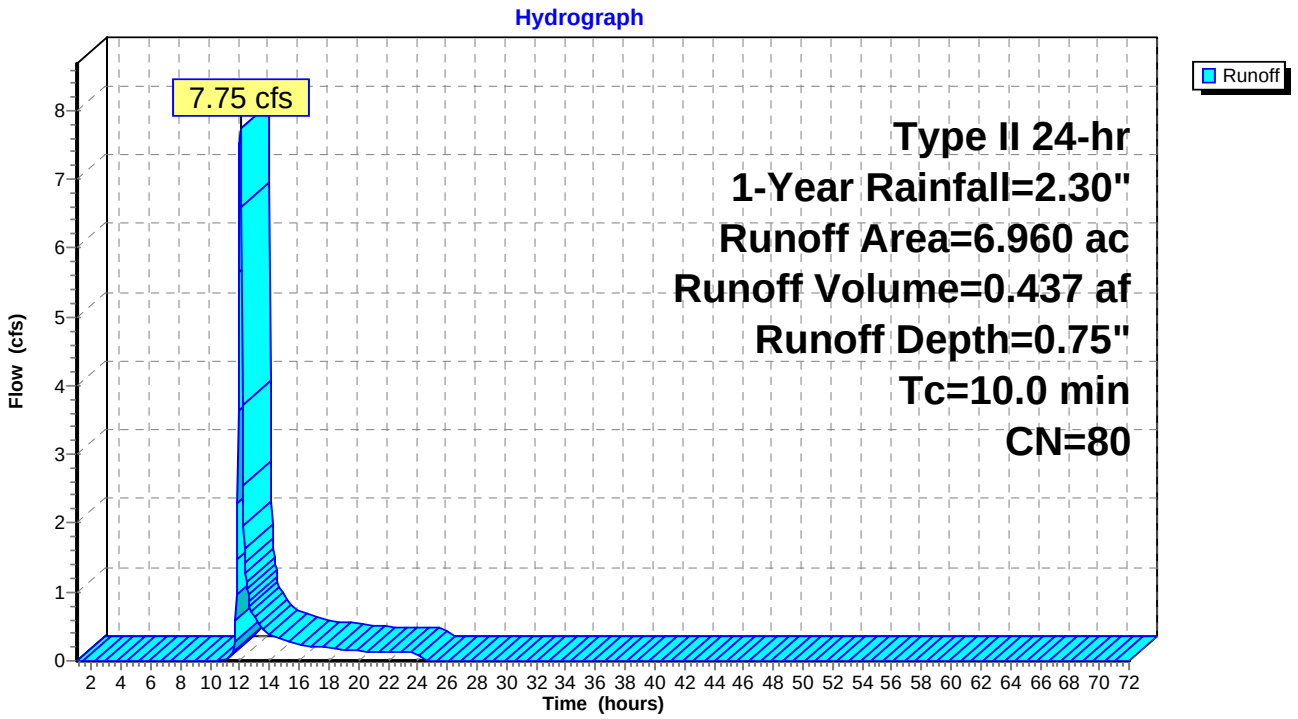
Runoff = 7.75 cfs @ 12.03 hrs, Volume= 0.437 af, Depth= 0.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

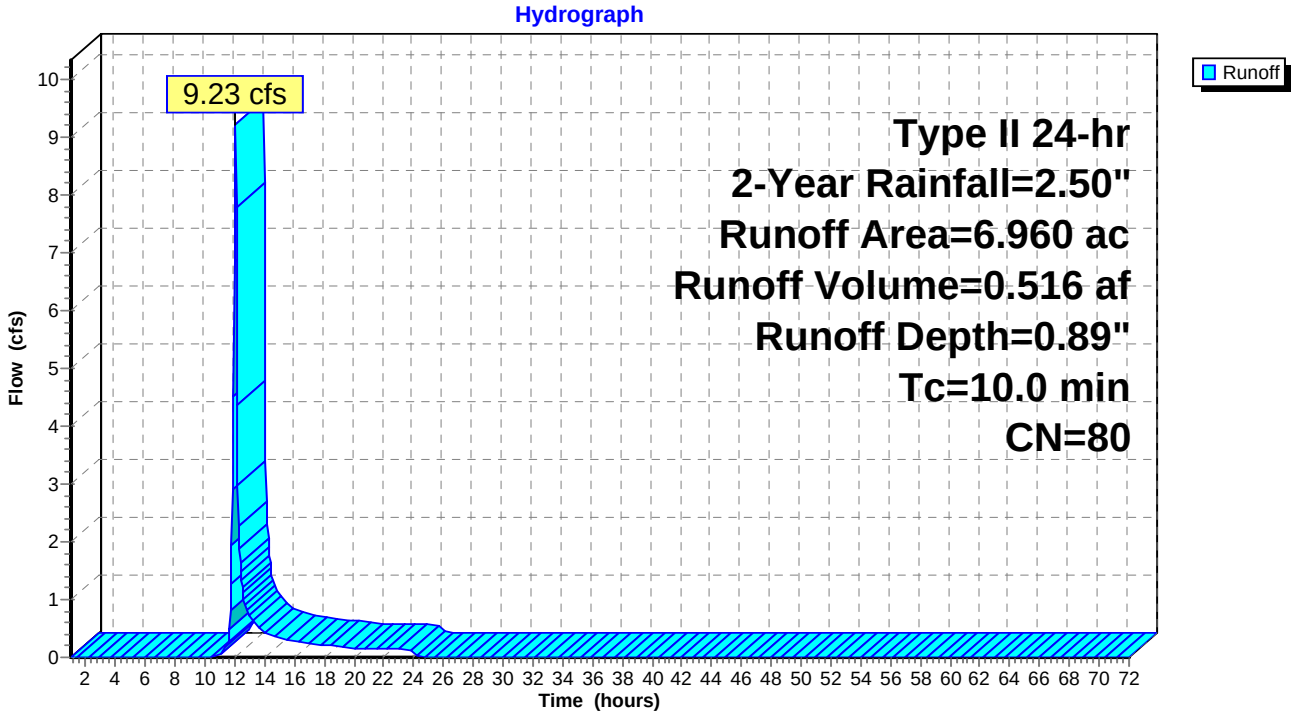
Area (ac)	CN	Description
6.960	80	1/2 acre lots, 25% imp, HSG C
5.220		75.00% Pervious Area
1.740		25.00% Impervious Area

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

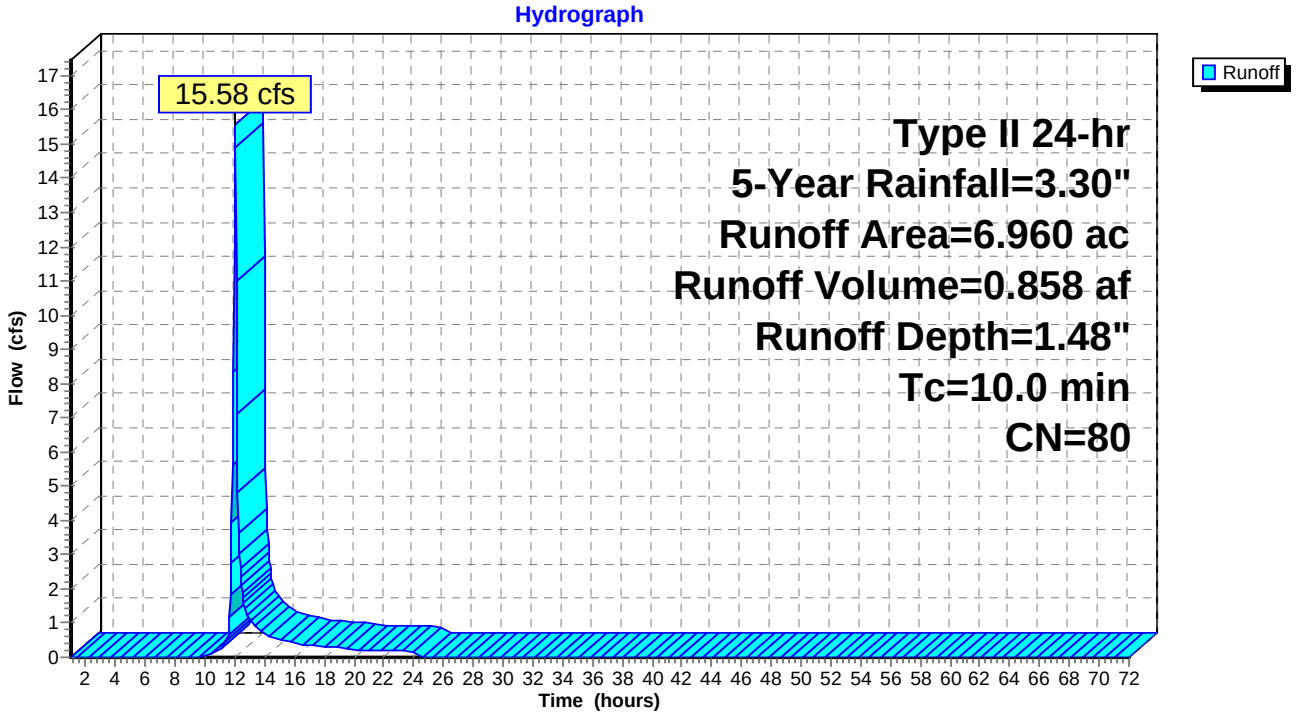
Subcatchment E23RO: East US23 Runoff



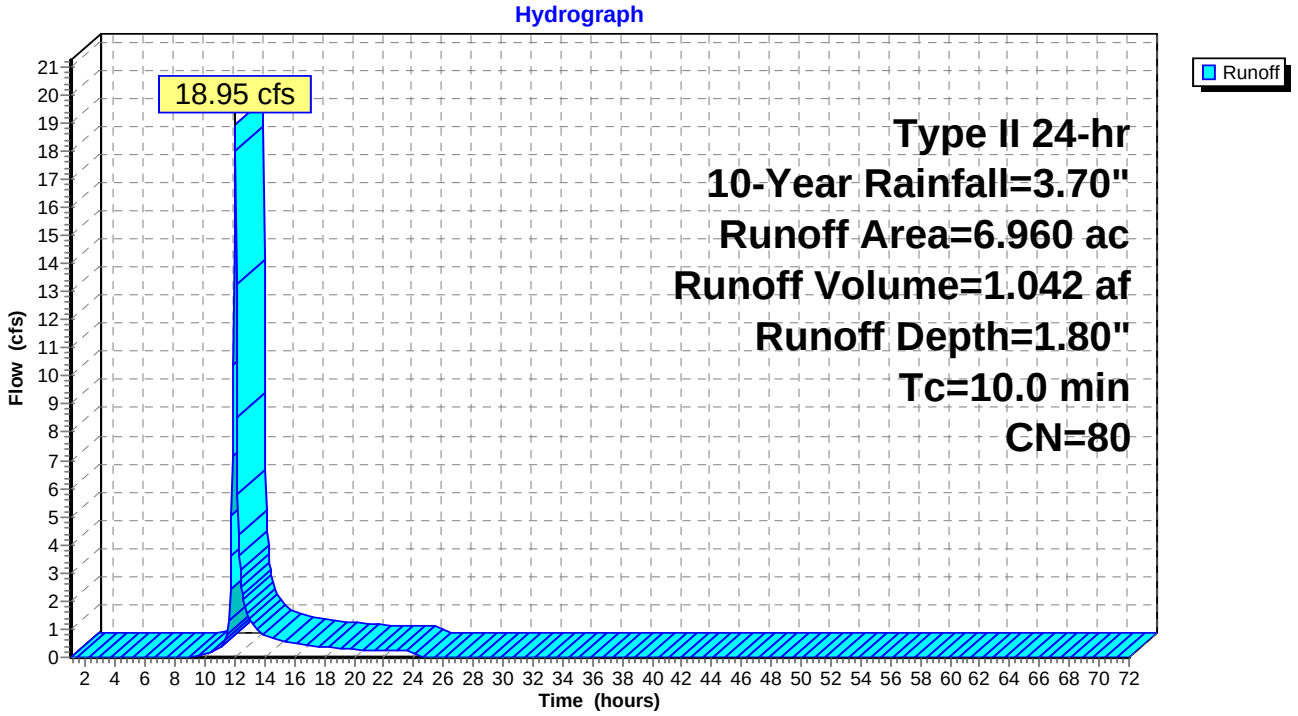
Subcatchment E23RO: East US23 Runoff



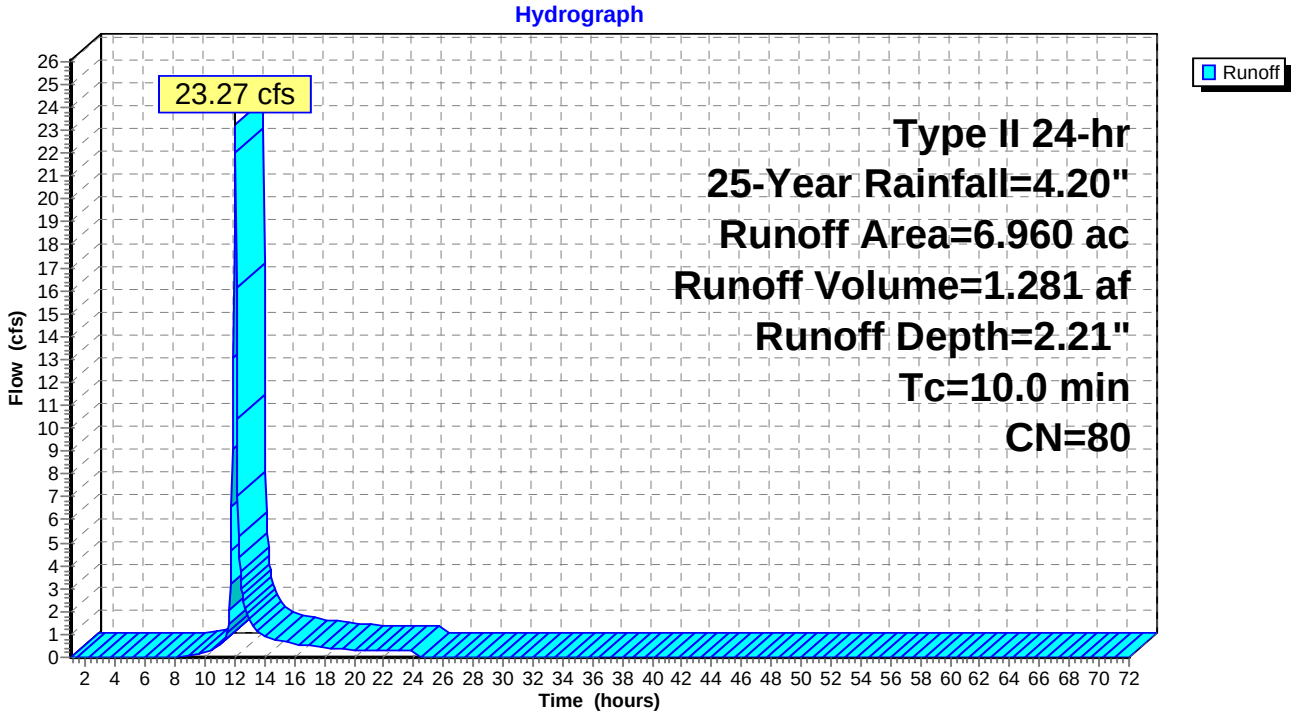
Subcatchment E23RO: East US23 Runoff



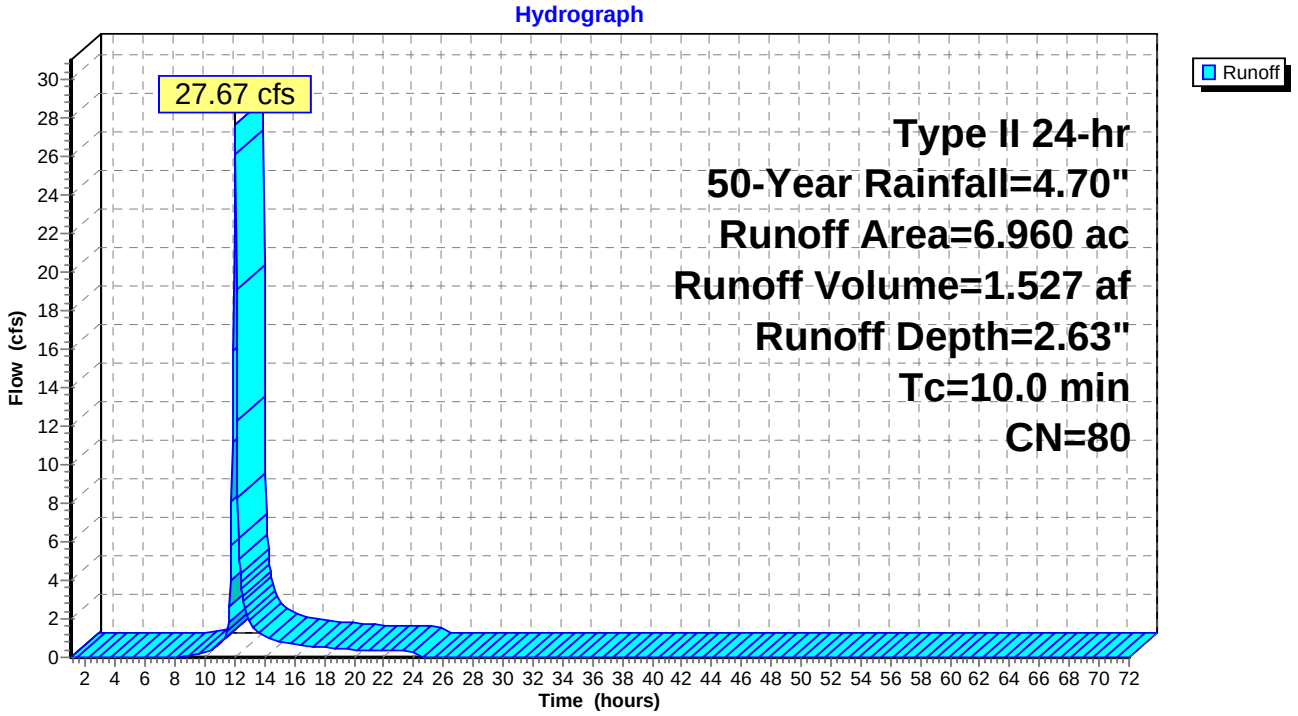
Subcatchment E23RO: East US23 Runoff



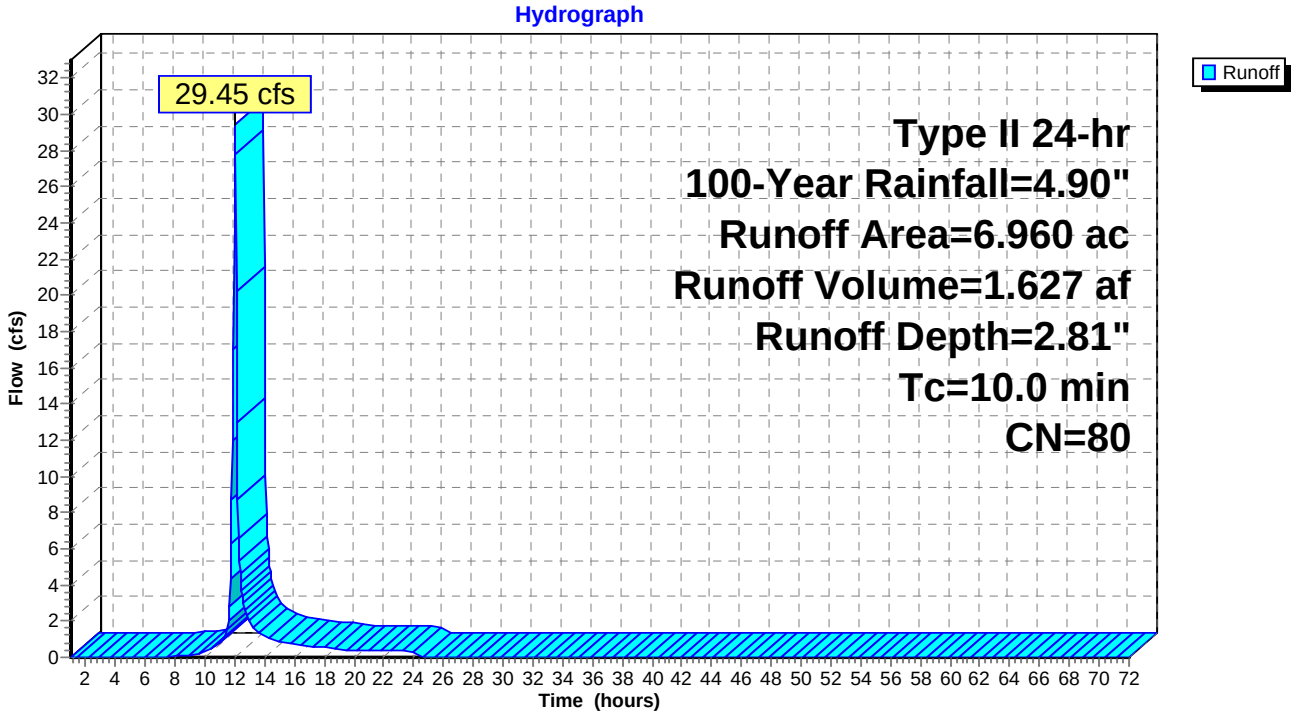
Subcatchment E23RO: East US23 Runoff



Subcatchment E23RO: East US23 Runoff



Subcatchment E23RO: East US23 Runoff

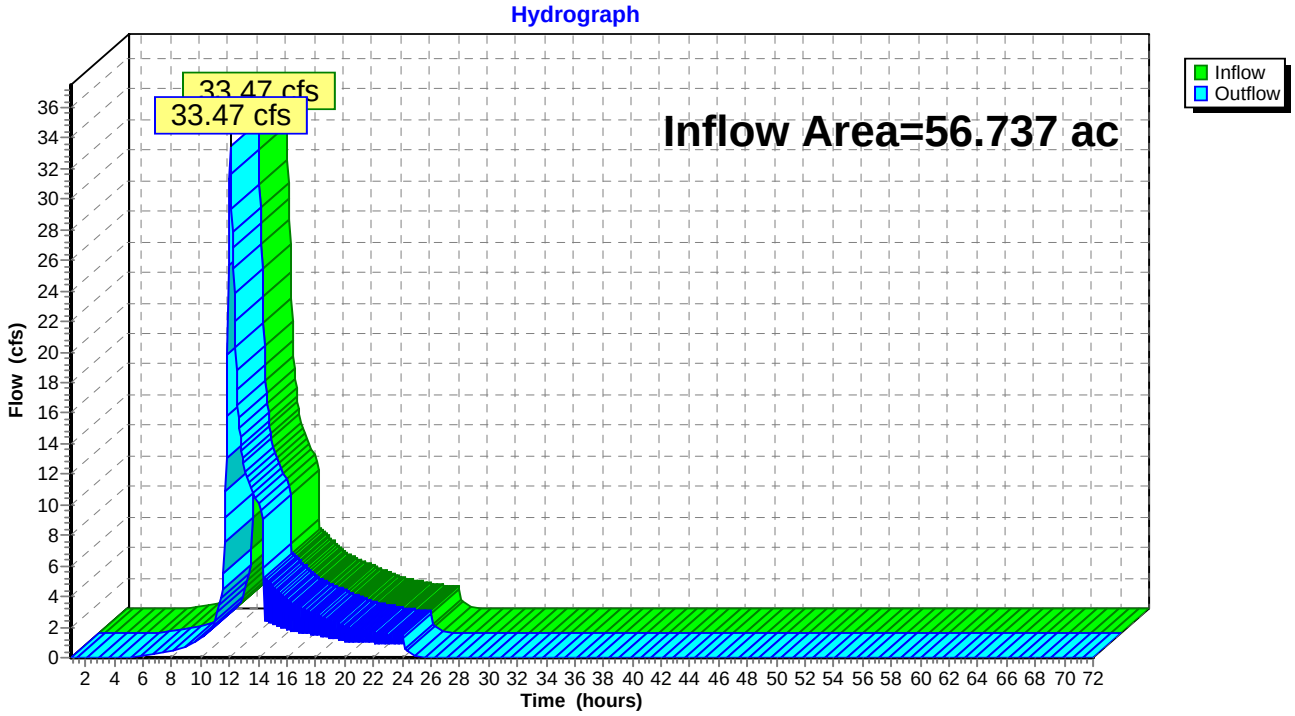


Summary for Reach TON: Total Offsite-North

Inflow Area = 56.737 ac, 52.13% Impervious, Inflow Depth = 1.18" for 1-Year event
Inflow = 33.47 cfs @ 12.05 hrs, Volume= 5.578 af
Outflow = 33.47 cfs @ 12.05 hrs, Volume= 5.578 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TON: Total Offsite-North

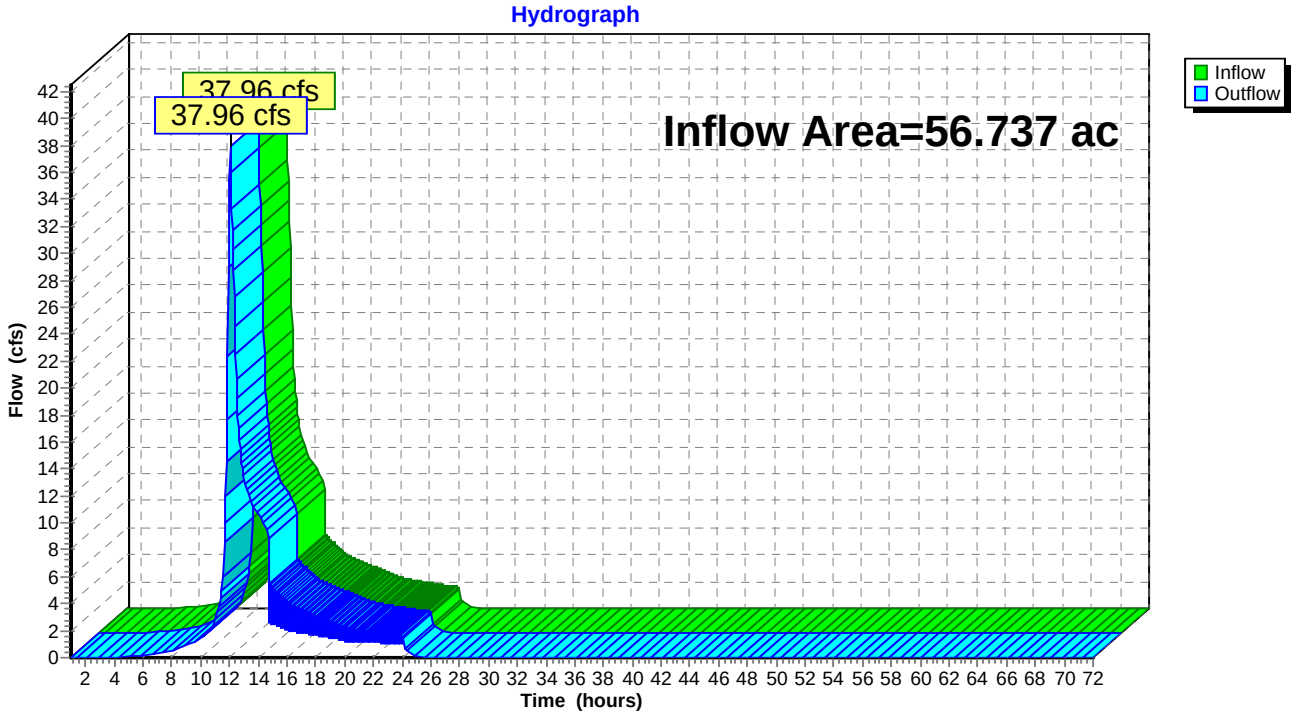


Summary for Reach TON: Total Offsite-North

Inflow Area = 56.737 ac, 52.13% Impervious, Inflow Depth = 1.34" for 2-Year event
Inflow = 37.96 cfs @ 12.05 hrs, Volume= 6.338 af
Outflow = 37.96 cfs @ 12.05 hrs, Volume= 6.338 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TON: Total Offsite-North

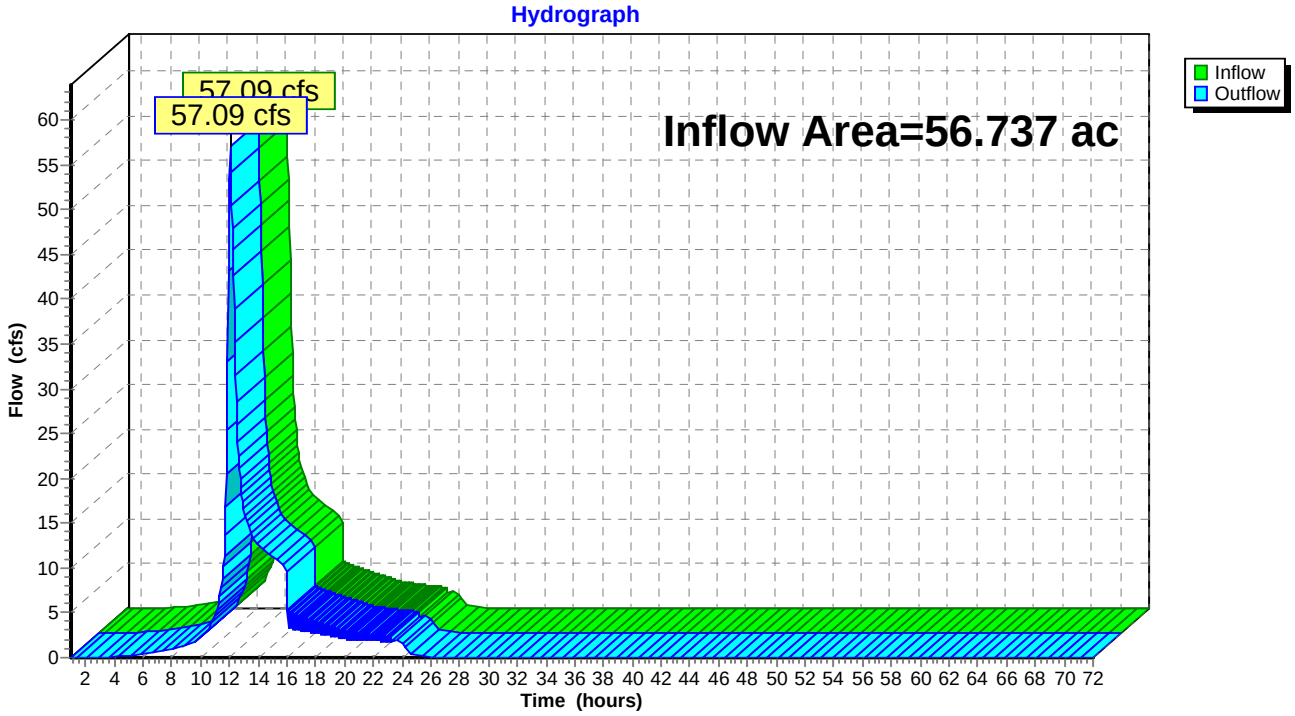


Summary for Reach TON: Total Offsite-North

Inflow Area = 56.737 ac, 52.13% Impervious, Inflow Depth = 2.01" for 5-Year event
Inflow = 57.09 cfs @ 12.05 hrs, Volume= 9.511 af
Outflow = 57.09 cfs @ 12.05 hrs, Volume= 9.511 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TON: Total Offsite-North

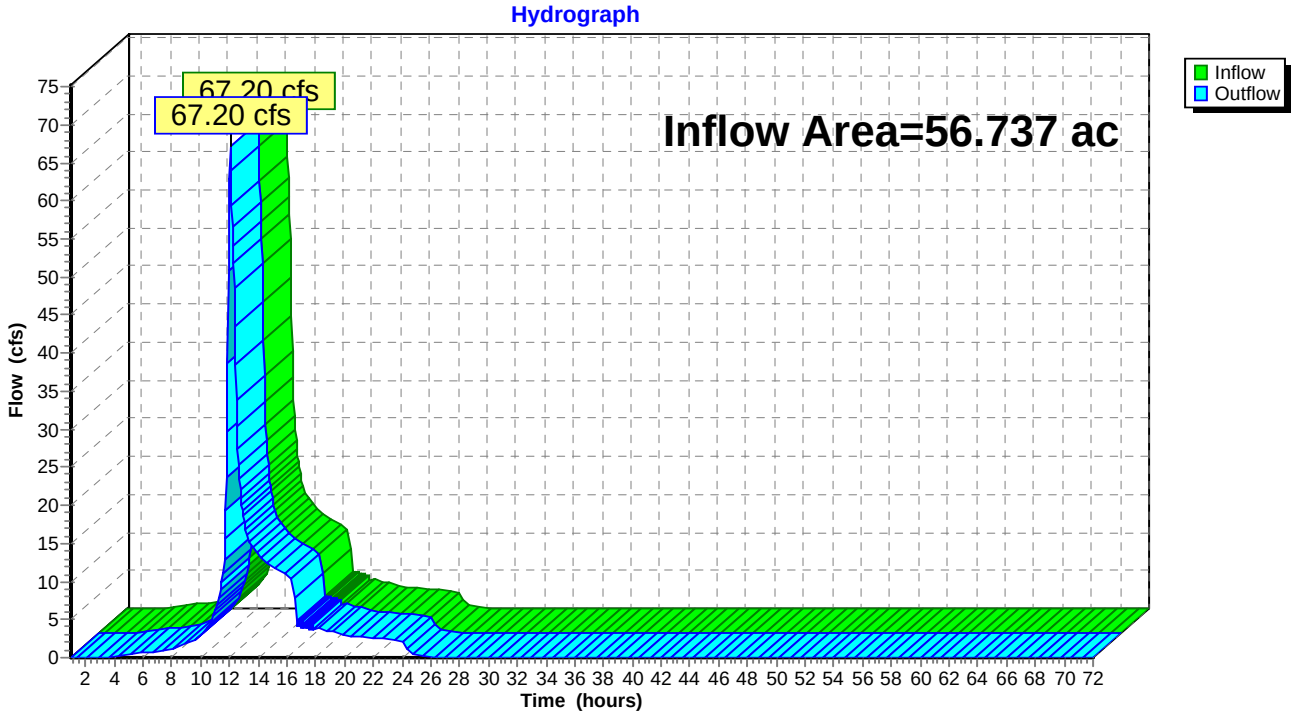


Summary for Reach TON: Total Offsite-North

Inflow Area = 56.737 ac, 52.13% Impervious, Inflow Depth = 2.36" for 10-Year event
Inflow = 67.20 cfs @ 12.05 hrs, Volume= 11.165 af
Outflow = 67.20 cfs @ 12.05 hrs, Volume= 11.165 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TON: Total Offsite-North

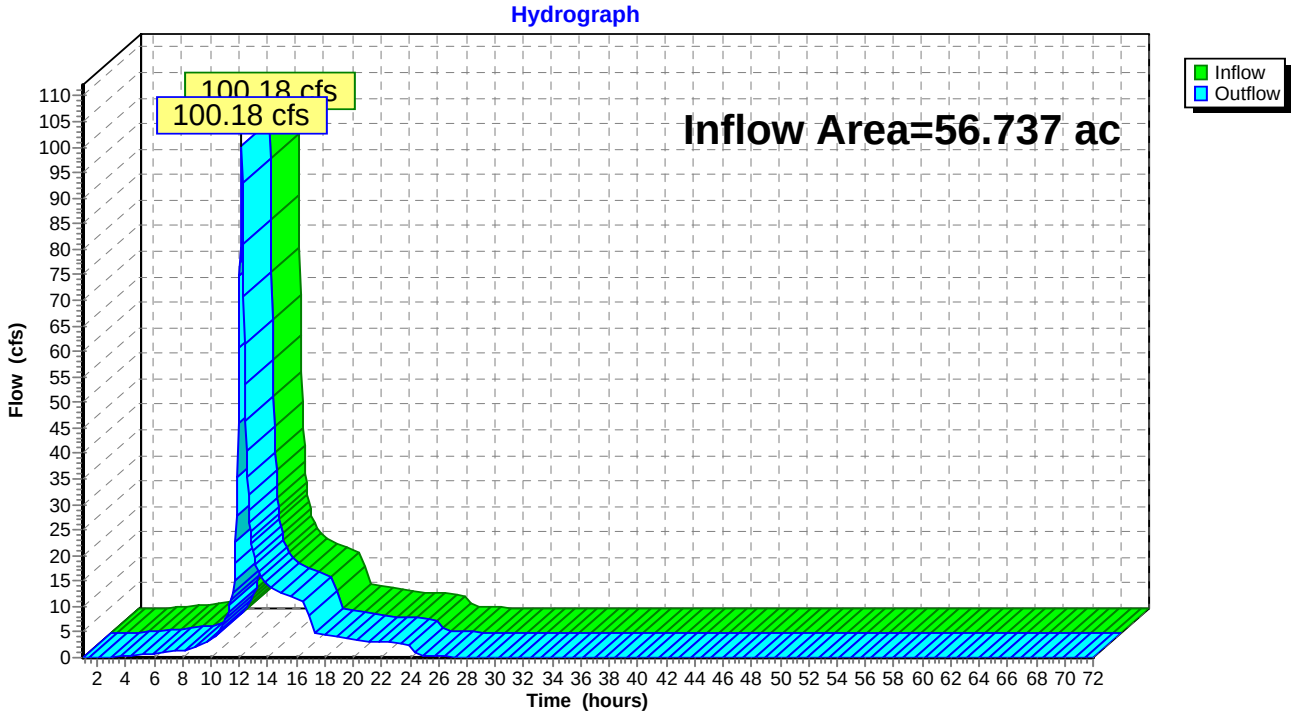


Summary for Reach TON: Total Offsite-North

Inflow Area = 56.737 ac, 52.13% Impervious, Inflow Depth = 2.81" for 25-Year event
Inflow = 100.18 cfs @ 12.16 hrs, Volume= 13.275 af
Outflow = 100.18 cfs @ 12.16 hrs, Volume= 13.275 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TON: Total Offsite-North

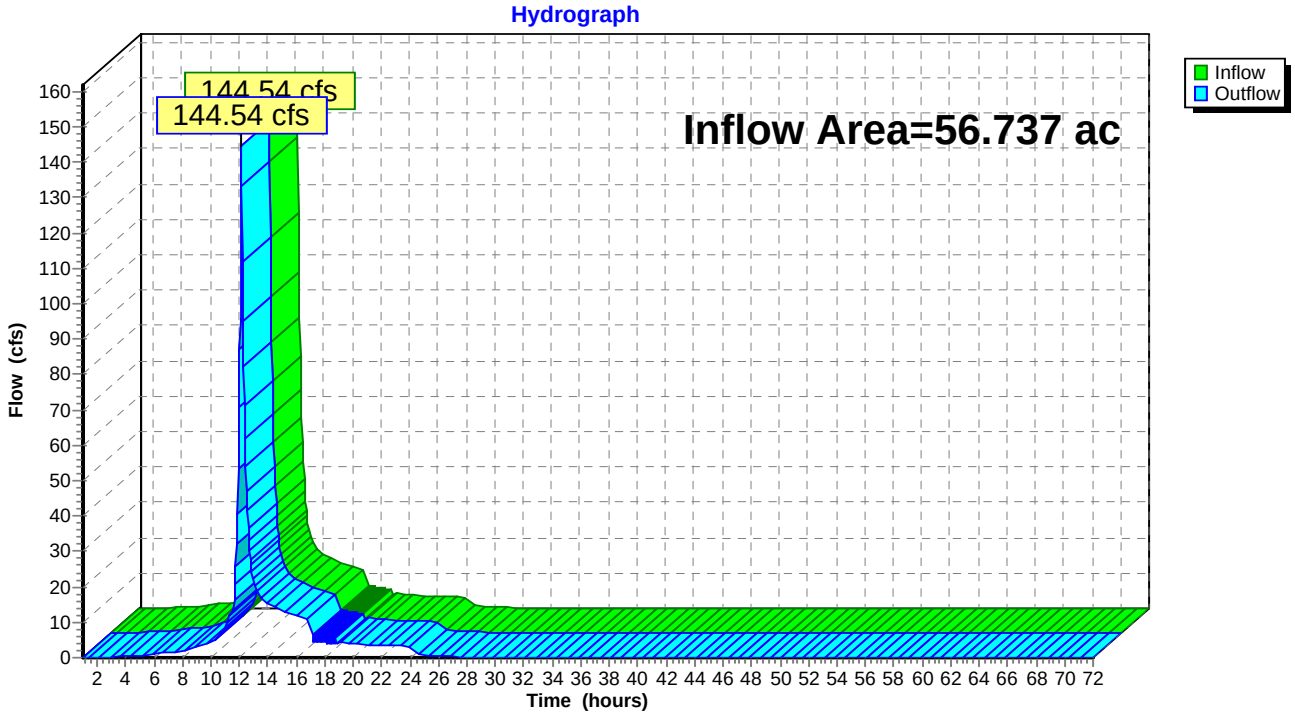


Summary for Reach TON: Total Offsite-North

Inflow Area = 56.737 ac, 52.13% Impervious, Inflow Depth = 3.26" for 50-Year event
Inflow = 144.54 cfs @ 12.12 hrs, Volume= 15.425 af
Outflow = 144.54 cfs @ 12.12 hrs, Volume= 15.425 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TON: Total Offsite-North

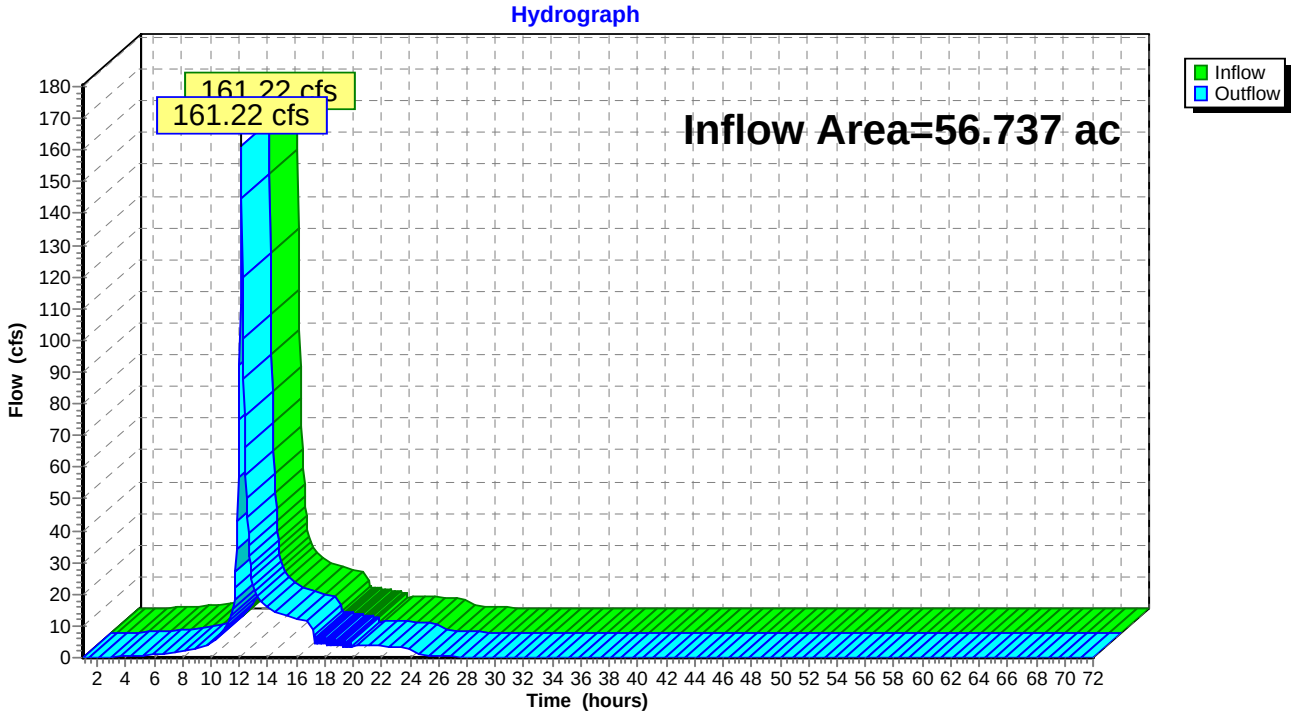


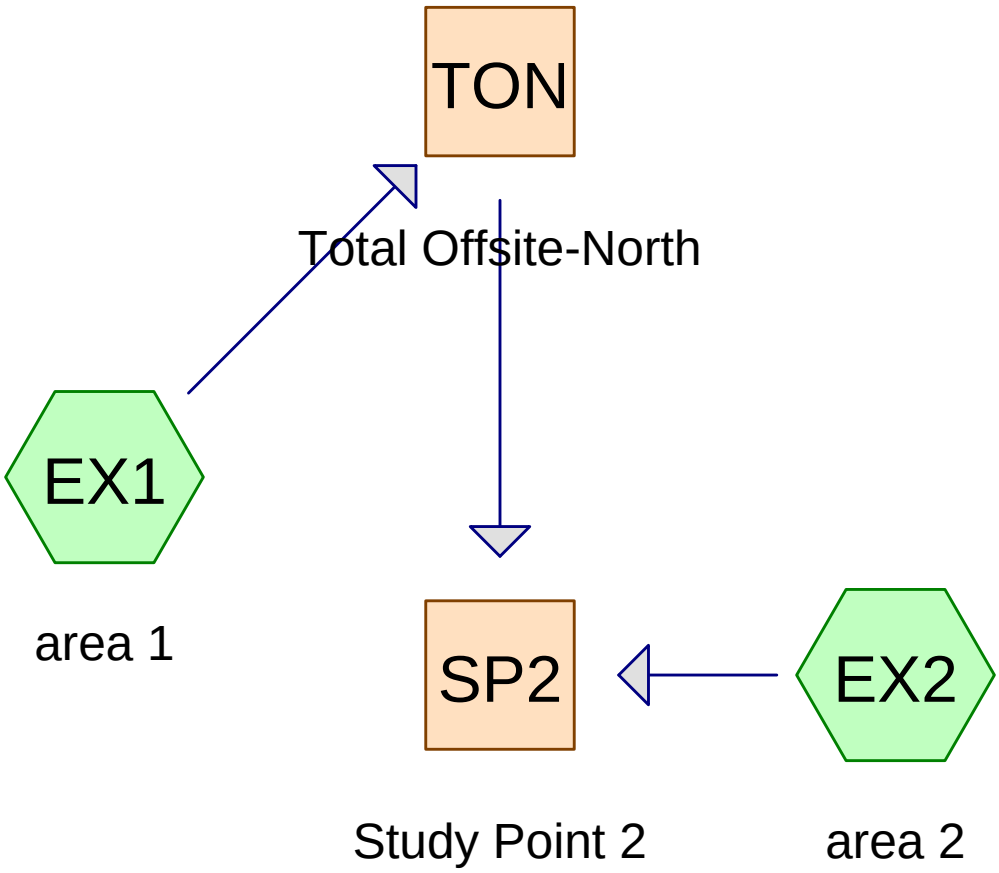
Summary for Reach TON: Total Offsite-North

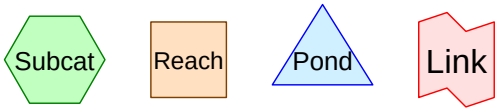
Inflow Area = 56.737 ac, 52.13% Impervious, Inflow Depth = 3.45" for 100-Year event
Inflow = 161.22 cfs @ 12.11 hrs, Volume= 16.293 af
Outflow = 161.22 cfs @ 12.11 hrs, Volume= 16.293 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach TON: Total Offsite-North







Routing Diagram for Delaware Development
Prepared by The Mannik & Smith Group, Inc., Printed 8/1/2016
HydroCAD® 10.00-11 s/n 08386 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment EX1: area 1

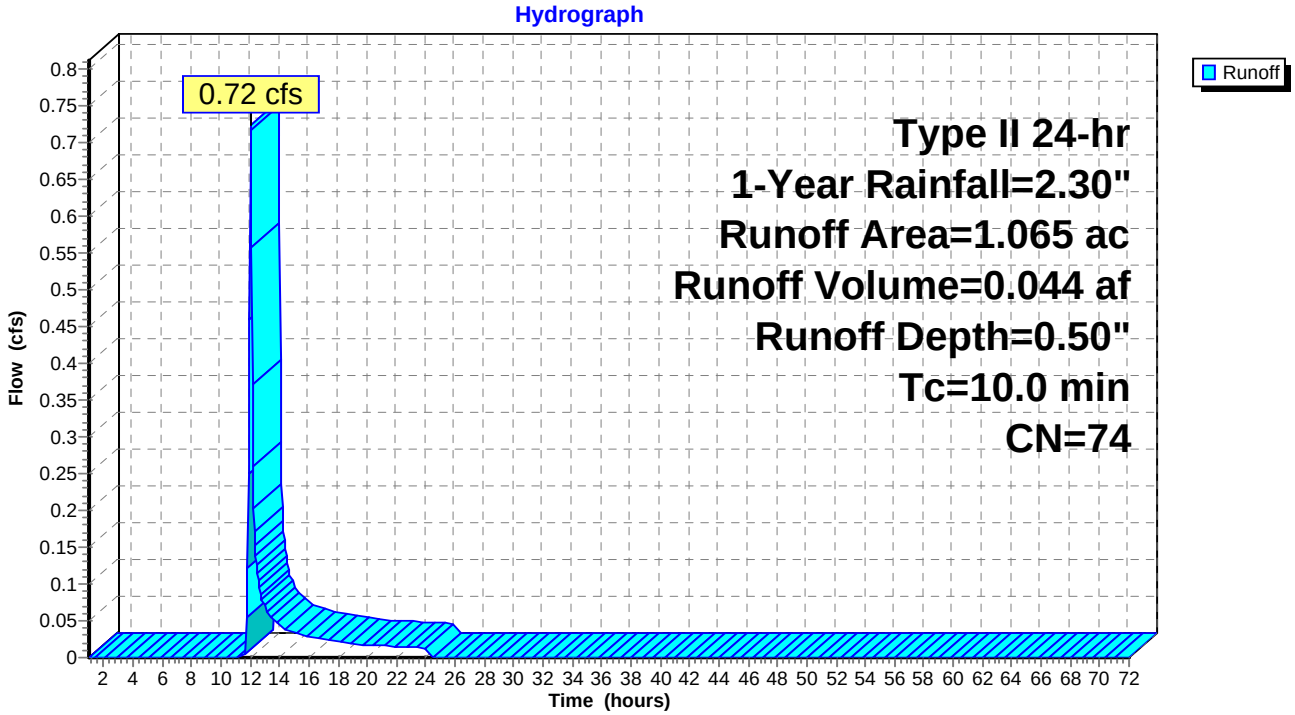
Runoff = 0.72 cfs @ 12.04 hrs, Volume= 0.044 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=2.30"

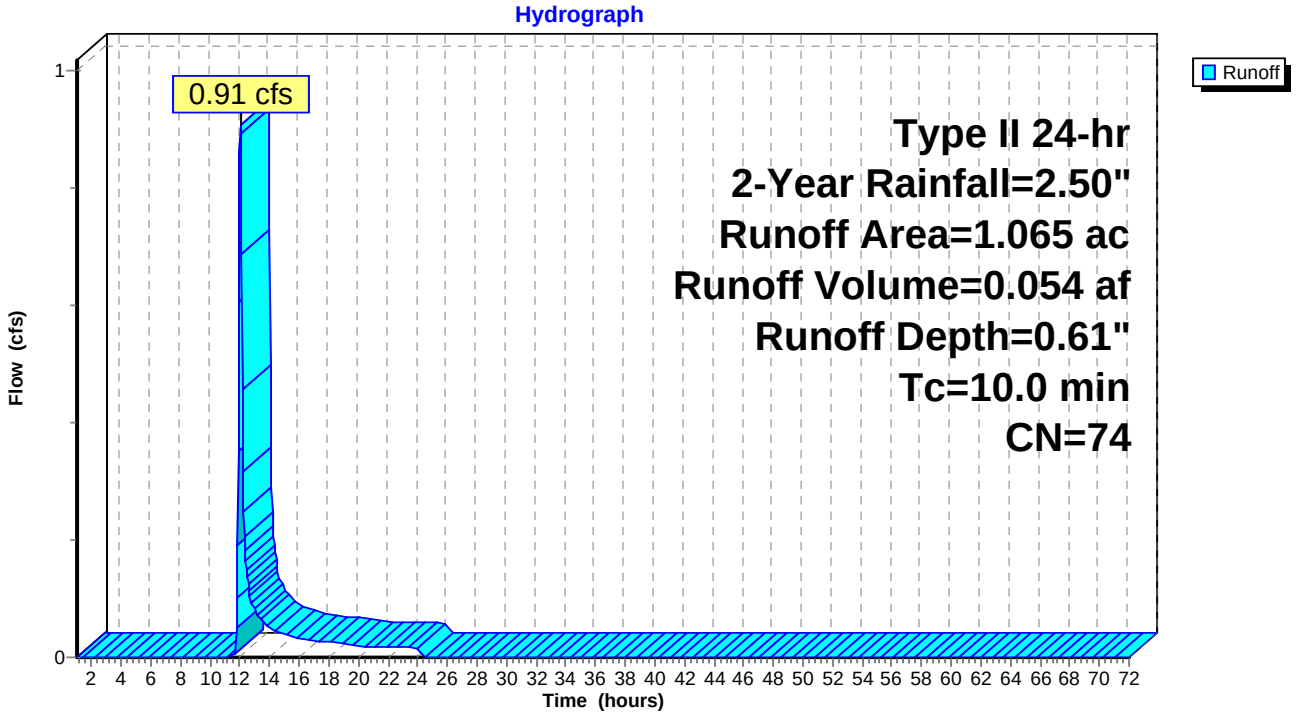
Area (ac)	CN	Description
1.065	74	>75% Grass cover, Good, HSG C
1.065		100.00% Pervious Area

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

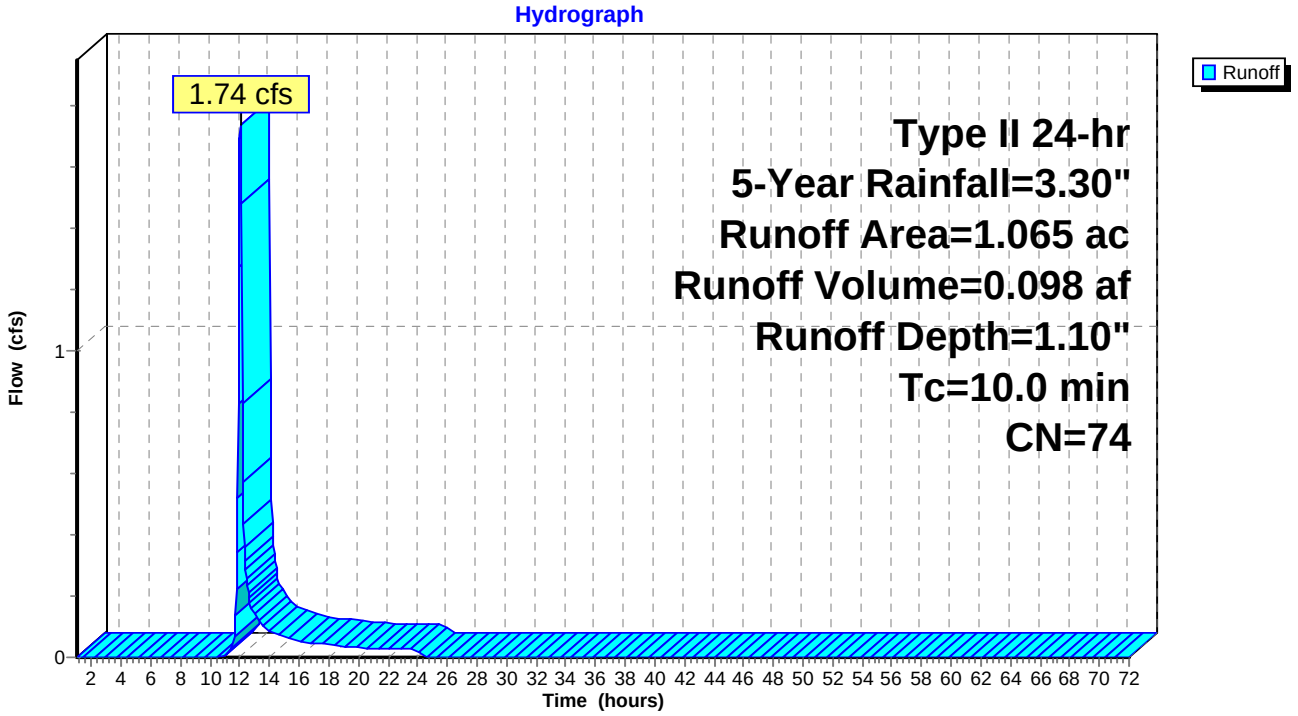
Subcatchment EX1: area 1



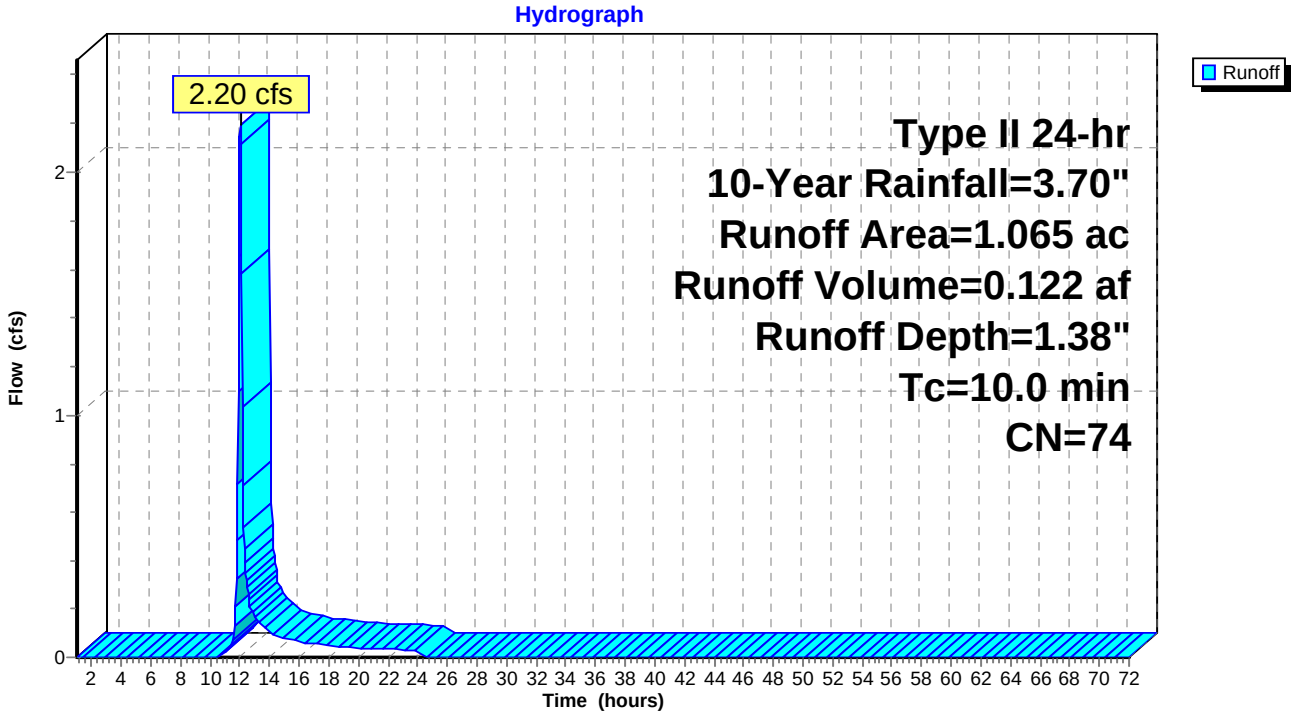
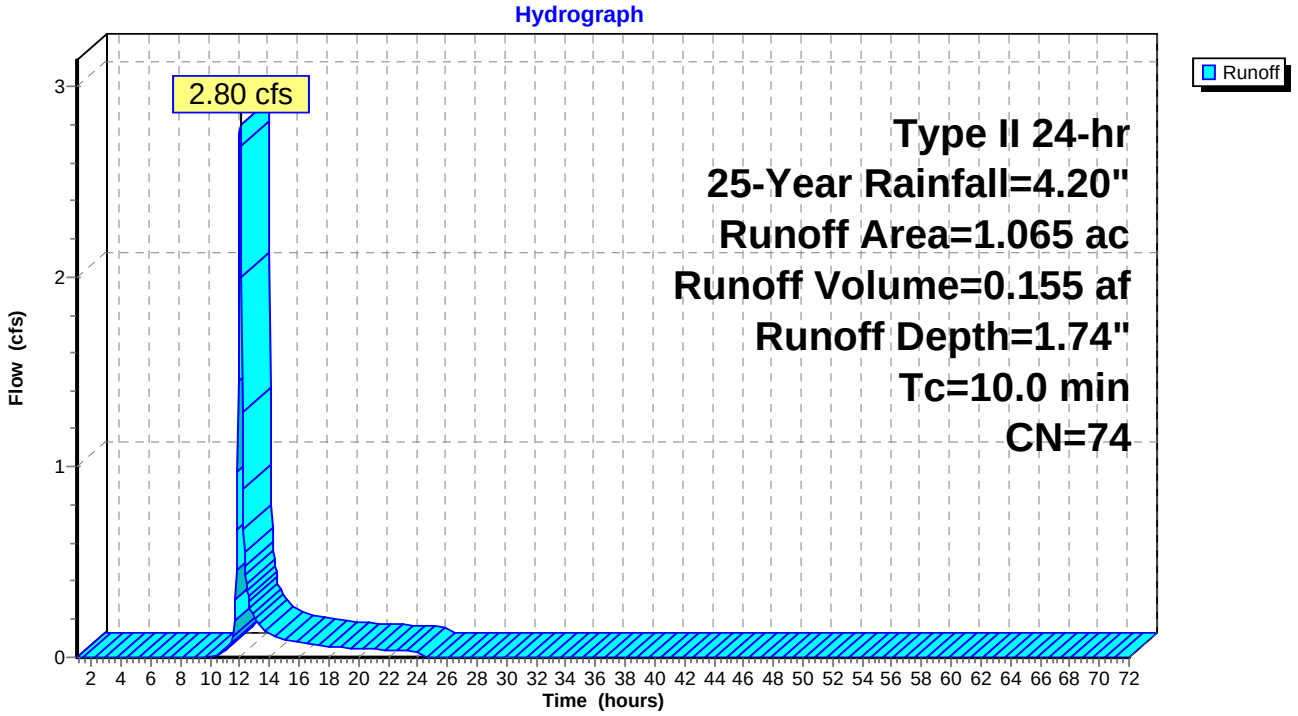
Subcatchment EX1: area 1



Subcatchment EX1: area 1



Subcatchment EX1: area 1



Subcatchment EX1: area 1