CARMINA WOOD
DESIGN

ENGINEER'S REPORT

for

Multi-Family Development

0, 46-84 S Linden Street
Town of Amherst, Erie County, New York

Prepared for

South Linden, LLC

493 Kennedy Road
Cheektowaga, NY 14227

Prepared by

Carmina Wood Design

80 Silo City Row, Suite 100
Buffalo, NY 14203

Telephone: (716) 842-3165
Fax: (716) 842-0263

September 2025
Rev. November 2025
Rev. December 2025

Table of Contents

Section 1 - Location & Description

This project is a development of a 2.4 acre site located of the vacant land on South Linden Street in the Town of Amherst. Construction will consist of two multi-family buildings totaling 28 units, with detached garage buildings, associated utility, lighting and landscaping improvements. Currently the site is undeveloped consisting of mostly wooded areas. The proposed site development area to be disturbed for this project is approximately 2.25 acres when construction is completed.

Section 2 - Water Service

Water service for the multi-family buildings will be tapped off the existing 8" ECWA water main on the north side of Wehrle Drive. The service will be a 6" Class 52 DI combined water service, then split into a 6" fire service and a 4" domestic service at the ROW line. Both services will continue into a proposed insulated enclosure and have a meter and RPZ. Proper heat and lighting will be provided in the enclosure, drainage due to testing or failure of the RPZ will be to the exterior grade. The owner will be responsible for keeping the drainage ports clear of snow and debris. Water inside the multi-family buildings will be used for typical domestic uses.

The multi-family buildings are to be sprinklered, interior fire protection system to be designed by others. One private hydrant will be installed on site to ensure fire hose coverage not exceeding 600'.

Domestic Summary:	
Peak Operating Demand:	14.52 gpm
Water Main:	8" on Wehrle Drive
Static Pressure:	52 psi (ECWA)
Friction Loss:	0.0 psi
Loss through meter/RPZ:	13.0 psi
Elevation Loss:	0.0 psi
Pressure after RPZ:	39.0 psi

Repairs to all devices will be made during off hours, dual backflow preventers are not required. The site is not located in a 100-year flood plain. Disinfection of the water service following installation will be continuous feed, according to AWWA C-651, latest revision.

Section 3 - Sanitary Sewer Service

The proposed multi-family buildings will each have a 6" SDR-35 PVC sanitary lateral at 1.0% minimum slope. These laterals will connect and ultimately connect to the nearest public sanitary sewer manhole on McIntire Road.

Design Parameters

1-bedroom townhouse:	110 gal/day/units x 12 units = 1,320 gpd
2-bedroom townhouse:	220 gal/day/units x12 units = 2,640 gpd
3-bedroom townhouse:	330 gal/day/units x 4 units = 1,320 gpd
	Total = 5,280 gpd

5,280 gpd * 4.31 = 22,756 gpd *use peaking factor of 4.31

The hydraulic loading rate is per "Design Standards for Intermediate Sized Wastewater Treatment Systems" 2014, NYSDEC.

Section 4 - Storm Sewer Service

The existing site currently sheet drains north to the existing ditches on site which ultimately discharge to McIntire Road.

Stormwater runoff collected onsite as a result of the proposed development will be routed through the proposed storm sewer system consisting of a bioretention area and dry detention system connected by a series of catch basins, yard drains and smooth interior HDPE pipe. The bioretention area on site is designed to provide 100% of the required runoff reduction volume (RRv). The soils in the vicinity of the bioretention area are mainly USDA hydrologic group 'D' and therefore the system will be installed with underdrains per NYSDEC requirements. The bioretention area will consist of 6" perforated HDPE underdrains in 8" of drainage gravel, followed by filter fabric and then finally 18" minimum of planting soil. Overflow yard drains will be installed to allow 6" maximum ponding for RRv treatment. Stormwater detention is required per NYSDEC standards and specifications. The dry detention field was designed to allow for stormwater to be temporarily stored and discharged at a controlled rate. A 4" orifice and 10" outlet control pipe along will be provided as the outlet control device for the dry detention basin. Discharge from the outlet pipe will flow through a proposed water quality treatment unit prior to outleting to the existing Town of Amherst storm sewer system on McIntire Road.

Runoff reduction volume (RRv), water quality volume (WQv) and stormwater volume attenuation for the site is designed in accordance with Chapter 4 of the NYSDEC Stormwater design manual. The bioretention area is provided as a "green infrastructure" practice to provide runoff reduction to meet the Chapter 4 requirements for the currently undeveloped areas. A Water Quality Treatment unit is proposed to satisfy the remaining NYSDEC water quality volume (WQv) treatment requirements. Runoff from the site was looked at as a whole for the calculation of volume attenuation requirements. The existing site has a pre-development total of 0.05 acres of impervious cover. The amount of impervious cover post-development is 1.05 acres. The proposed dry detention basin is designed to accommodate the 1-year through 100-year storm events controlling the offsite runoff rate to less than the existing runoff rates, as well as the below stated Town stormwater runoff requirements.

Town of Amherst Requirement:
The Town of Amherst requires that the 25-year proposed storm event be attenuated with detention and that the outlet flowrate be restricted to the 10-year existing storm event. This volume of 9,332 cf is accommodated in the dry detention basin at elevation 678.44. At this elevation, the outlet discharge will be restricted to 0.65 cfs, which is less than the existing 10-year peak runoff outflow of 1.44 cfs of the overall site.

Dry Detention Basin Summary:
Top of pond = 679.00
Bottom of pond = 675.90
100-year storm storage volume = 13,554 cf @ 678.97

Water Quality Summary:
WQv req'd = 3,866 cf (0.089 ac-ft)
RRv min. req'd = 724 cf (0.017 ac-ft)
RRv provided - bioretention areas = 732 cf (0.017 ac-ft)
WQv provided – Treatment unit = 3,314 cf (0.072 ac-ft)
Total RRv + WQv provided = 724 cf + 3,314 cf = 3,866 cf (0.089 ac-ft)

Bioretention: 100% of minimum post-development Runoff Reduction volume (RRv)
Area: 1,425 sf
Bottom Elevation: 680.80 & 680.00

Detention: Comparison of the existing 1-year vs. the proposed 1-year runoff
Comparison of the existing 10-year vs. the proposed 10-year runoff
Comparison of the existing 10-year vs. the proposed 25-year runoff
Comparison of the existing 100-year vs. the proposed 100-year runoff

Runoff Summary:

Event	Ex. Runoff (cfs)	Pro. Runoff (cfs)*	Result (cfs)
1-year	0.43	0.39	-0.04
10-year	1.44	0.58	-0.86
25-year	2.08	0.65	-1.43
100-year	3.46	1.75	-1.71

* Proposed runoff flowrate is the rate controlled by the 10" outlet pipe from the dry detention basin which ultimately discharges to the existing Town of Amherst storm sewer as shown Appendix B of this report.

Appendix A

Sanitary Sewer and Water Demand Calculations

CARMINA WOOD DESIGN
80 SILO CITY, SUITE 100
BUFFALO, NEW YORK, 14203
(716) 842-3165
FAX (716) 842-0263

Project No.: 23-4154 Date: 9/22/2025
Project Name: Multi-Family Development rev. 12/15/2025
Project Address: S Linden Street Amherst, NY
Subject: Sanitary Sewer & Water Demand Calcs
Sheet: 1 of 2

Sanitary Sewage Demand Calculations:

110	gal/d/unit	x	12 units	=	1,320	gpd	*use 110 gallons per unit per day (1-bdrm)
220	gal/d/unit	x	12 units	=	2,640	gpd	*use 220 gallons per unit per day (2-bdrm)
330	gal/d/unit	x	4 units	=	1,320	gpd	*use 330 gallons per unit per day (3-bdrm)

Total Site Sanitary Demand: = 5,280 gpd

Find Peak Sanitary Demand:

Peaking Factor based on Population:

Total demand: 5,280 gpd / 100 gpcd = 53 per capita

Population (P) = 53 people

Peaking Factor : $(18 + \sqrt{P}) / (4 + \sqrt{P})$ where P is in thousands

Peaking Factor = 4.31

Peak Sanitary Demand = 5,280 x 4.31 = 22,756 gpd
= 0.023 MGD
= 0.035 cfs

Required Infiltration and Inflow Mitigation:

Peak Sanitary Flow = 22,756 gpd = 15.80 gpm

4:1 offset flow per NYSDEC requirements = 15.80 x 4 = 63.21 gpm req'd

Mitigation Credit = $250 / gpm

Mitigation Agreement Amount = $15,802.83

CARMINA WOOD DESIGN
80 SILO CITY ROW, SUITE 100
BUFFALO, NEW YORK, 14203
(716) 842-3165
FAX (716) 842-0263

Project No.: 25-4154 Date: 9/22/2025
Project Name: Multi-Family Development rev. 12/15/2025
Project Address: S Linden Street Amherst, NY
Subject: Sanitary Sewer & Water Demand Calcs
Sheet: 2 of 2

Water Demand Calculations (domestic):

Proposed Multi-Family

5,280 gpd x 1.1 = 5,808 gpd *use 110% of sewage demand

*use 1.8 peaking factor and assume a 12 hour day

5,808 gpm x 1day/12hr x 1hr/60min = 8.07 gpm

8.07 gpm x 3.0 = 14.52 gpm Q_{peak} *use peaking factor 3 per ECDOH standards

Headlosses:

Q_{peak} = 14.52 gpm
Pipe = 6 inch Ductile Iron C = 140
Length = 100 LF (approx. distance from tap to RPZ in hot box)

$$H_L = \frac{10.44\ L\ Q^{1.85}}{C^{1.85}\ D^{4.866}} = \frac{10.44(100)(10.89)^{1.85}}{(140)^{1.85}\ (6)^{4.866}} = 0.00 \text{ ft} = 0.00 \text{ psi}$$

Δ elev = 0 ft = 0.00 psi
Loss through meter = 1 psi
Loss through RPZ = 12 psi
Total Losses = 13.0 psi
Static Pressure = 52 psi (per ECWA)
Residual Pressure Following RPZ = 52 - 13.0 = 39.0 psi (available after rpz & meter)

Residual Pressure 30" above 2nd Floor
Δ elev = 11 ft = 4.76 psi
Residual Pressure 30" above 2nd Floor = 34.2 psi

Water Demand Calculations (fire):

Proposed Multi-Family

Q = 1,000 gpd

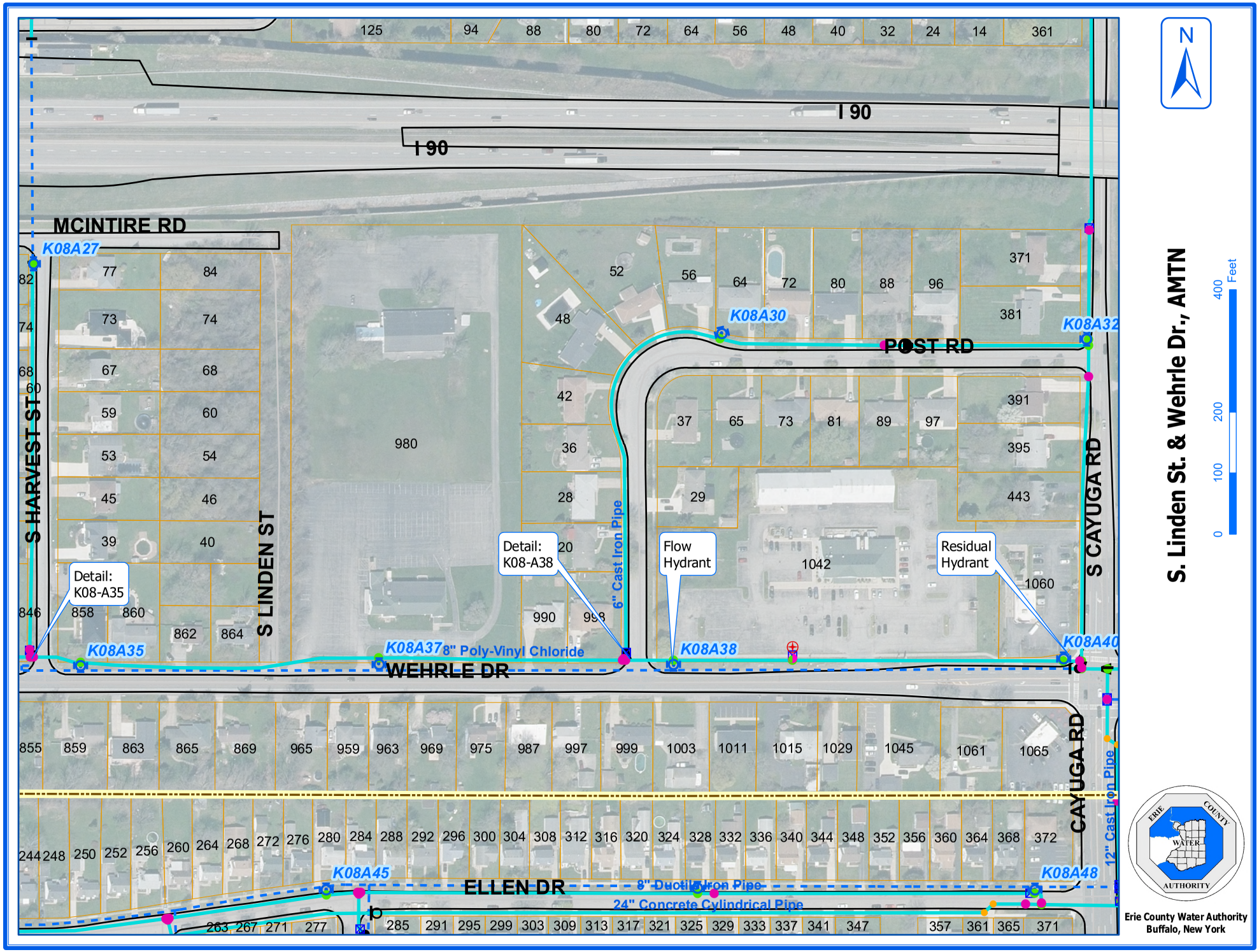
Headlosses:

Q_{peak} = 1000 gpm
Pipe = 6 inch PVC C = 140
Length = 135 LF (approx. distance from RPZ to farthest hydrant)

$$H_L = \frac{10.44\ L\ Q^{1.85}}{C^{1.85}\ D^{4.866}} = \frac{10.44(135)(1000)^{1.85}}{(140)^{1.85}\ (6)^{4.866}} = 8.75 \text{ ft} = 3.79 \text{ psi}$$

Δ elev = -3 ft = -1.30 psi

Static Pressure after RPZ = 52.0 psi (per ECWA)
Residual Pressure at hydrant = 52 - 2.5 = 49.5 psi


S. Linden St. & Wehrle Dr., AMTN
N
0
100
200
400
Feet
I 90
MCINTIRE RD
S HARVEST ST
S LINDEN ST
POST RD
S CAYUGA RD
WEHRLE DR
ELLEN DR
CAYUGA RD
K08A27
K08A30
K08A32
K08A35
K08A37
K08A38
K08A40
K08A45
K08A48
Detail: K08-A35
Detail: K08-A38
Flow Hydrant
Residual Hydrant
6" Cast Iron Pipe
8" Poly-Vinyl Chloride
8" Ductile Iron Pipe
24" Concrete Cylindrical Pipe
12" Cast Iron Pipe
Erie County Water Authority
Buffalo, New York

Hydrant FLow Test

Print Date: **9/03/2025**

Residual Hydrant: K08A40 **Test Date/Time:** 11/24/2020 13:12

Location.....: **1060 WEHRLE DR 1ST HYD W/O SOUTH CAYUGA DR**
TOWN OF AMHERST

Size of Main/Branch: **8"/6"** Fire District: **22022 FIRE DISTRICT 1** Water District: **184 ECWA AREA-TOWN OF AMHERST**

Performed By: **BPS/CDB** Comments: **HYDRANT FLOW TEST REQUESTED BY THOMAS YAGER, ISO**
EMAIL: TYAGER@ISO.COM

CW #52682

Dischrge Coef: **090** Elvtn Usgs(ft): Static(psi): **52** Residual(psi): **46** Required Residual Pressure(psi): **20**
Gallons Used..: **4,920** Total Flow(gpm): **1,644** Flow at Reqd Resid Pressure: **4,060**

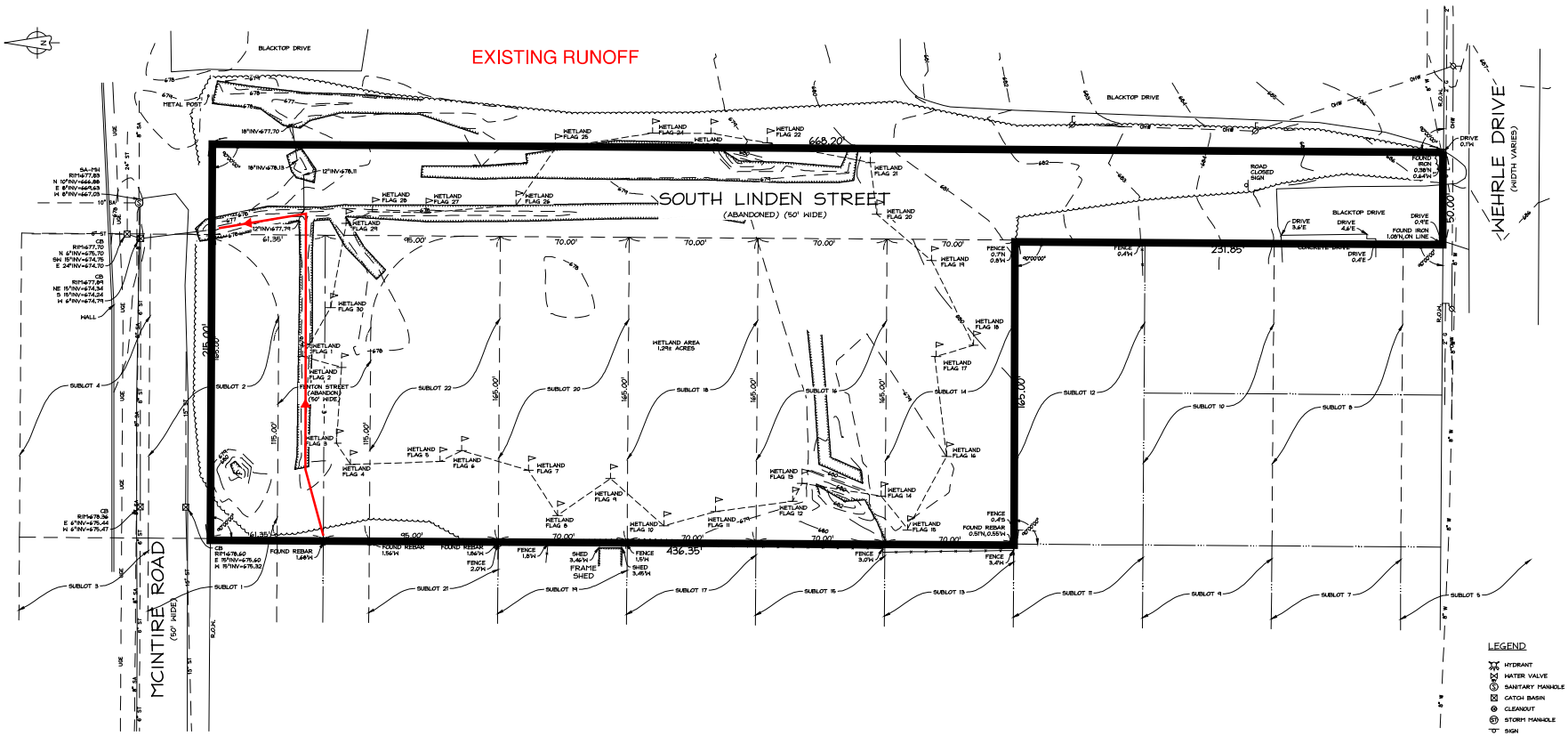
Flow Hydrants:

Flow Hyd	Location	Main/Brnch	Nzle	Size	Pitot	Flow	Comments
K08 A38	**OP 1003 WEHRLE DR**	**8"/6"**	1:	**2.50**	**24.0**	**822**	
	1ST W/O CAYUGA RD		2:	**2.50**	**24.0**	**822**	
			3:			Total Flow:	**1,644**

Appendix B

Storm Sewer System Drainage Calculations

Existing Runoff



LEGEND

- HYDRANT
- WATER VALVE
- SANITARY MANHOLE
- CATCH BASIN
- CLEANOUT
- STORM MANHOLE
- SIGN
- UTILITY POLE
- GUY WIRE
- UTILITY POLE W/ LIGHT
- W — UNDERGROUND WATER
- SA — UNDERGROUND SANITARY SEWER
- ST — UNDERGROUND STORM SEWER
- G — UNDERGROUND GAS LINE
- OHW — OVERHEAD WIRES
- UGE — UNDERGROUND ELECTRIC WIRES
- TREE LINE
- TOP OF BANK

NOTES

1. ELEVATIONS ARE BASED UPON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
2. HORIZONTAL DATUM REFERENCES THE NORTH AMERICAN DATUM 1983 (NAD 83) - NEW YORK STATE PLANE WEST ZONE.
3. THE LOCATION OF ANY UNDERGROUND UTILITIES SHOWN ARE APPROXIMATE AND ALL UTILITIES MAY NOT BE SHOWN. PRIOR TO ANY CONSTRUCTION ACTIVITIES, ALL UTILITY COMPANIES SHOULD BE NOTIFIED IN ORDER TO VERIFY OR AMEND THEIR LOCATIONS AND/OR EXISTENCE. FOR ASSISTANCE CALL UFPO AT 1-800-962-7962.
4. UDIGNY.ORG DESIGN TICKET No. 04105-001-288,04105-001-292,04105-001-299 WAS SUBMITTED TO REQUEST UTILITY RECORDS.
   - CHARTER COM NORTHEAST WESTERN NY: HAS RESPONDED, CLEAR NO FACILITIES WITHIN 15FT OF THE EXCAVATOR DEFINED WORK AREA.
   - G4S SECURE INTEGRATION LLC.: HAS NOT RESPONDED.
   - ERIE COUNTY WATER AUTHORITY: HAS RESPONDED, DRAWN HERON.
   - NATIONAL FUEL GAS / BUFFALO NFG-101: HAS RESPONDED, DRAWN HERON.
   - NATIONAL GRID: HAS RESPONDED, DRAWN HERON.
   - TOWN OF CHEEKTOWAGA / ELECTRIC: HAS RESPONDED, DRAWN HERON.
   - TOWN OF AMHERST / SEWER: HAS RESPONDED, DRAWN HERON.
   - VERIZON / BUFFALO: HAS RESPONDED, DESIGN CONFLICT, PLEASE SHARE DESIGN DRAWINGS WITH THEIR ENGINEERING DEPT. DRAWN HERON, ONLY AERIAL.
5. WETLANDS FLAGS WERE LOCATED BY THE SURVEY CREW ON AUGUST 15TH, 2025. THE APPROXIMATE AREA OF WETLANDS IS ±1.29 ACRES.

3556 Lake Shore Road, Suite 500, Buffalo, NY 14219
p (716) 827-9000 f (716) 270-6091 www.nussclarke.com

NUSSBAUMER & CLARKE, INC. ENGINEERS AND SURVEYORS EST. 1892

TOPOGRAPHIC SURVEY

Project No. : 25J2-0406

46,60,68,74,&84 South Linden Avenue

Part of Lot 22, Township 11, Range 7

Holland Land Company's Survey

Town of Amherst

County of Erie, State of New York

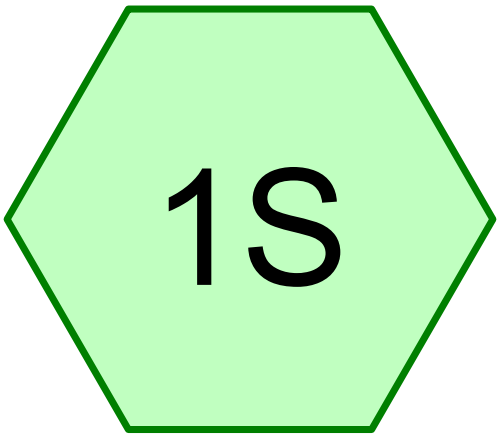
Date of Survey: 05/09/2025 Rev:8/15/2025

Scale : 1" = 30'

Member Land Surveyor Association Inc. 1960 MEMBER

Events for Subcatchment 1S: Existing

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
1-Year	1.87	0.43	3,905	0.45
2-Year	2.20	0.66	5,605	0.64
5-Year	2.69	1.05	8,426	0.97
10-Year	3.14	1.44	11,254	1.29
25-Year	3.84	2.08	15,981	1.83
50-Year	4.48	2.71	20,558	2.36
100-Year	**5.23**	**3.46**	**26,142**	**3.00**



Existing

Subcat Reach Pond Link

Routing Diagram for 23-4154 existing
Prepared by Carmina Wood Design, Printed 9/25/2025

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	Type II 24-hr		Default	24.00	1	1.87	2
2	10-Year	Type II 24-hr		Default	24.00	1	3.14	2
3	100-Year	Type II 24-hr		Default	24.00	1	5.23	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
104,544	79	Woods, Fair, HSG D (1S)
104,544	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
104,544	HSG D	1S
0	Other	
104,544		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	0	104,544	0	104,544	Woods, Fair	1S
0	**0**	**0**	**104,544**	**0**	**104,544**	**TOTAL AREA**	

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Existing Runoff Area=2.400 ac 0.00% Impervious Runoff Depth=0.45"
Flow Length=185' Slope=0.0200 '/' Tc=69.2 min CN=79 Runoff=0.43 cfs 3,905 cf

Total Runoff Area = 104,544 sf Runoff Volume = 3,905 cf Average Runoff Depth = 0.45"
100.00% Pervious = 104,544 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1S: Existing

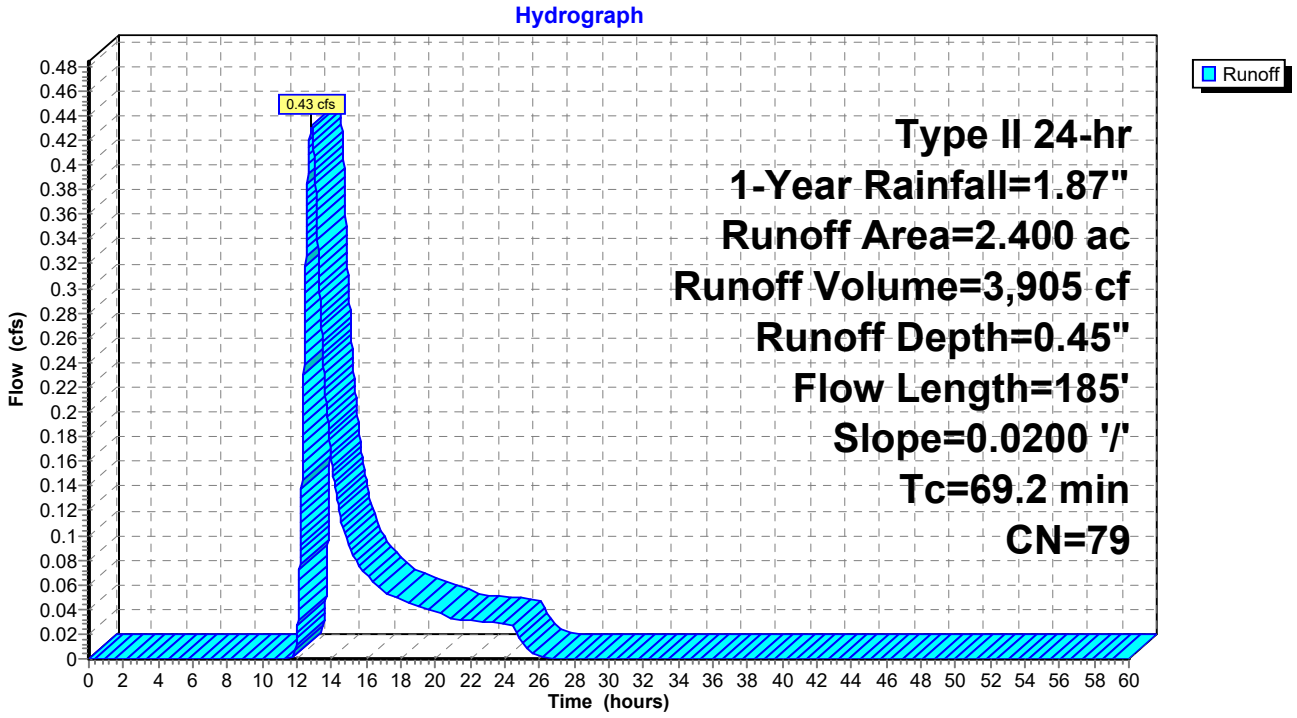
Runoff = 0.43 cfs @ 12.84 hrs, Volume= 3,905 cf, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=1.87"

Area (ac)	CN	Description
2.400	79	Woods, Fair, HSG D
2.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
69.2	185	0.0200	0.04		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"

Subcatchment 1S: Existing



Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Existing Runoff Area=2.400 ac 0.00% Impervious Runoff Depth=1.29"
Flow Length=185' Slope=0.0200 '/' Tc=69.2 min CN=79 Runoff=1.44 cfs 11,254 cf

Total Runoff Area = 104,544 sf Runoff Volume = 11,254 cf Average Runoff Depth = 1.29"
100.00% Pervious = 104,544 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1S: Existing

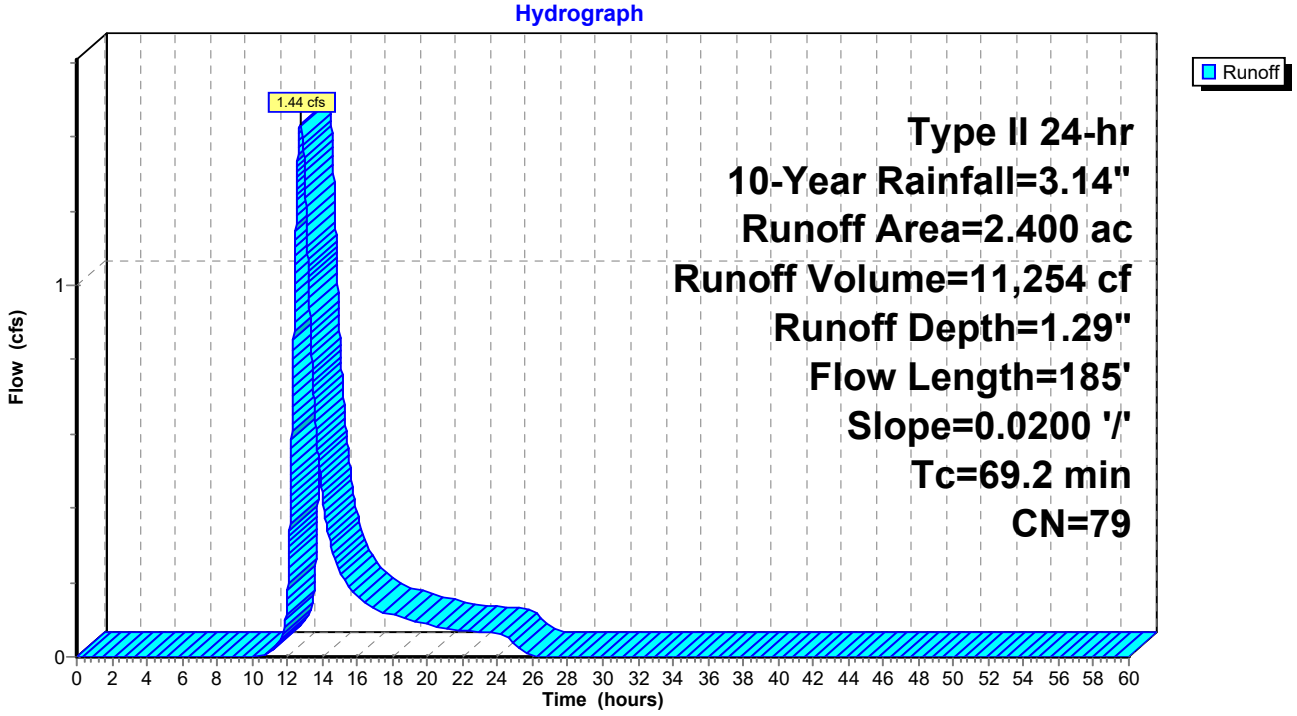
Runoff = 1.44 cfs @ 12.77 hrs, Volume= 11,254 cf, Depth= 1.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.14"

Area (ac)	CN	Description
2.400	79	Woods, Fair, HSG D
2.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
69.2	185	0.0200	0.04		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"

Subcatchment 1S: Existing



Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Existing Runoff Area=2.400 ac 0.00% Impervious Runoff Depth=3.00"
Flow Length=185' Slope=0.0200 '/' Tc=69.2 min CN=79 Runoff=3.46 cfs 26,142 cf

Total Runoff Area = 104,544 sf Runoff Volume = 26,142 cf Average Runoff Depth = 3.00"
100.00% Pervious = 104,544 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1S: Existing

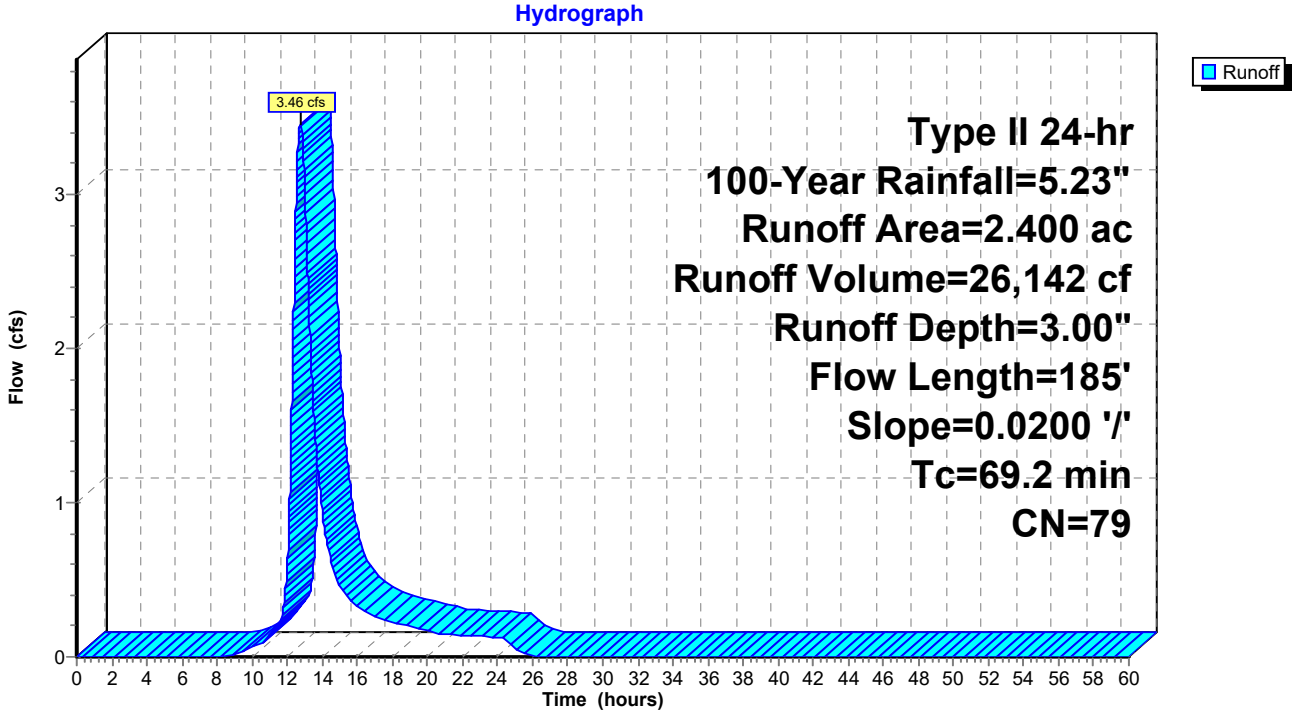
Runoff = 3.46 cfs @ 12.76 hrs, Volume= 26,142 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.23"

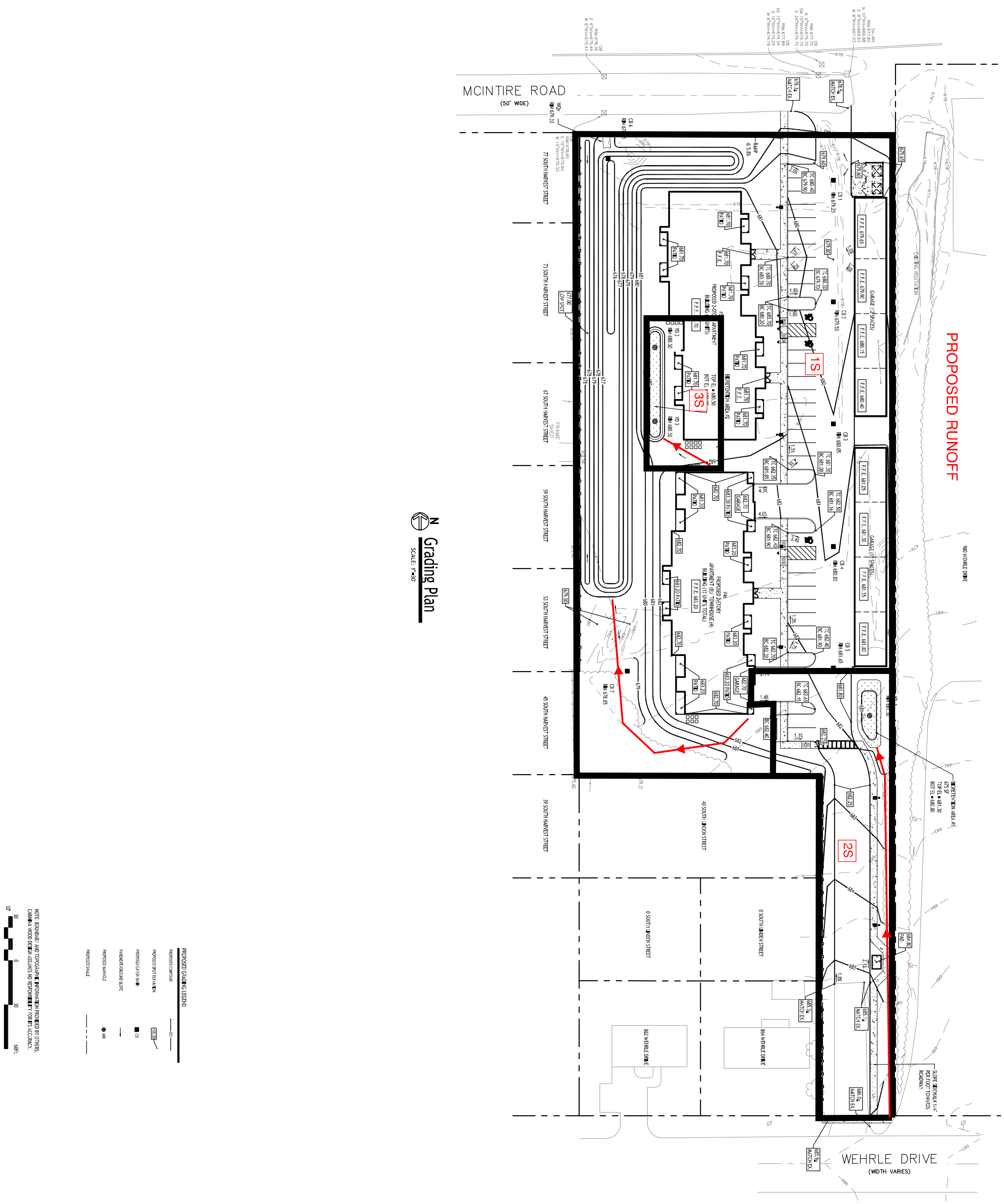
Area (ac)	CN	Description
2.400	79	Woods, Fair, HSG D
2.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
69.2	185	0.0200	0.04		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"

Subcatchment 1S: Existing



Proposed Runoff



REVISIONS:		
No.	Description	Date
1	Rev. per Town comments	11/10/25
2	Rev. per Town comments	11/19/25

Multi-Family Development

0, 46-84 S Linden Street
Amherst, NY

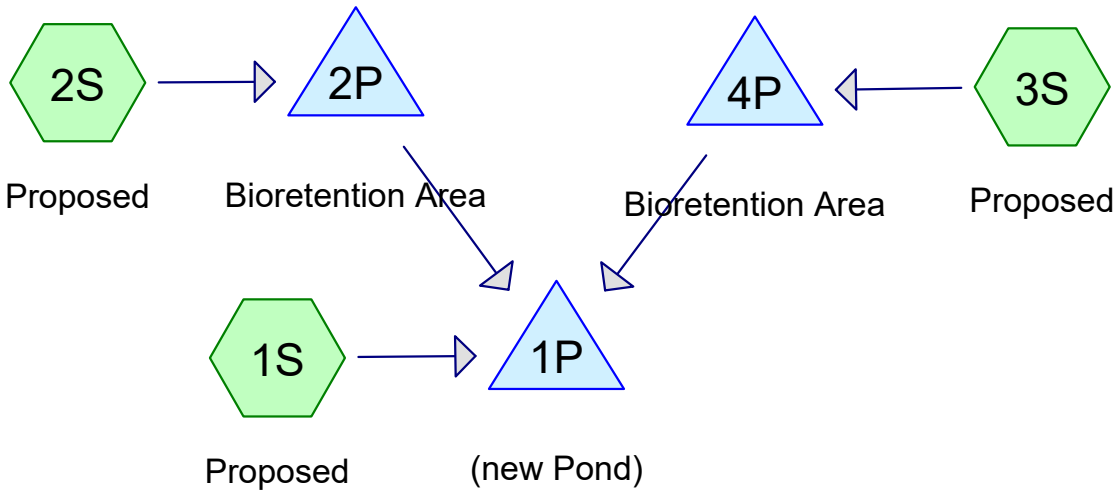
CARMINAWOOD DESIGN
Buffalo | Utica | Greensboro

DRAWING NAME:
Grading Plan

Date: 9/22/25
Drawn By: C. Wood
Scale: As Noted
DRAWING NO.
C-200
Project No. 23-4154

Events for Pond 1P: (new Pond)

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
1-Year	0.81	0.39	676.94	1,555
2-Year	1.08	0.46	677.24	2,504
5-Year	1.49	0.53	677.63	4,204
10-Year	1.88	0.58	677.95	5,991
25-Year	2.49	0.64	678.40	9,053
50-Year	3.06	0.69	678.79	12,039
100-Year	**3.73**	**1.75**	**678.97**	**13,513**



Subcat Reach Pond Link

Routing Diagram for 23-4154 proposed
Prepared by Carmina Wood Design, Printed 12/18/2025

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	Type II 24-hr		Default	24.00	1	1.87	2
2	10-Year	Type II 24-hr		Default	24.00	1	3.14	2
3	25-Year	Type II 24-hr		Default	24.00	1	3.84	2
4	100-Year	Type II 24-hr		Default	24.00	1	5.23	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
50,094	80	>75% Grass cover, Good, HSG D (1S, 2S, 3S)
28,314	98	Paved parking, HSG D (1S, 2S, 3S)
17,424	98	Roofs, HSG D (1S)
8,712	79	Woods, Fair, HSG D (1S, 2S)
104,544	**88**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
104,544	HSG D	1S, 2S, 3S
0	Other	
104,544		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	0	0	50,094	0	50,094	>75% Grass cover, Good	
0	0	0	28,314	0	28,314	Paved parking	
0	0	0	17,424	0	17,424	Roofs	
0	0	0	8,712	0	8,712	Woods, Fair	
0	**0**	**0**	**104,544**	**0**	**104,544**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1P	675.90	675.60	30.0	0.0100	0.013	0.0	10.0	0.0
2	2P	678.30	678.11	61.0	0.0031	0.013	0.0	6.0	0.0
3	4P	677.36	677.30	22.0	0.0027	0.013	0.0	6.0	0.0

Time span=0.00-60.00 hrs, dt=0.05 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Proposed Runoff Area=1.750 ac 40.00% Impervious Runoff Depth=0.81"
Flow Length=200' Slope=0.0100 '/' Tc=79.9 min CN=87 Runoff=0.59 cfs 5,116 cf

Subcatchment2S: Proposed Runoff Area=0.400 ac 62.50% Impervious Runoff Depth=1.05"
Flow Length=250' Slope=0.0200 '/' Tc=67.4 min CN=91 Runoff=0.21 cfs 1,526 cf

Subcatchment3S: Proposed Runoff Area=0.250 ac 40.00% Impervious Runoff Depth=0.81"
Flow Length=40' Slope=0.0080 '/' Tc=7.7 min CN=87 Runoff=0.33 cfs 731 cf

Pond 1P: (new Pond) Peak Elev=676.94' Storage=1,555 cf Inflow=0.81 cfs 7,372 cf
Outflow=0.39 cfs 7,372 cf

Pond 2P: Bioretention Area Peak Elev=681.39' Storage=361 cf Inflow=0.21 cfs 1,526 cf
Outflow=0.20 cfs 1,526 cf

Pond 4P: Bioretention Area Peak Elev=680.52' Storage=331 cf Inflow=0.33 cfs 731 cf
Outflow=0.05 cfs 731 cf

Total Runoff Area = 104,544 sf Runoff Volume = 7,372 cf Average Runoff Depth = 0.85"
56.25% Pervious = 58,806 sf 43.75% Impervious = 45,738 sf

Summary for Subcatchment 1S: Proposed

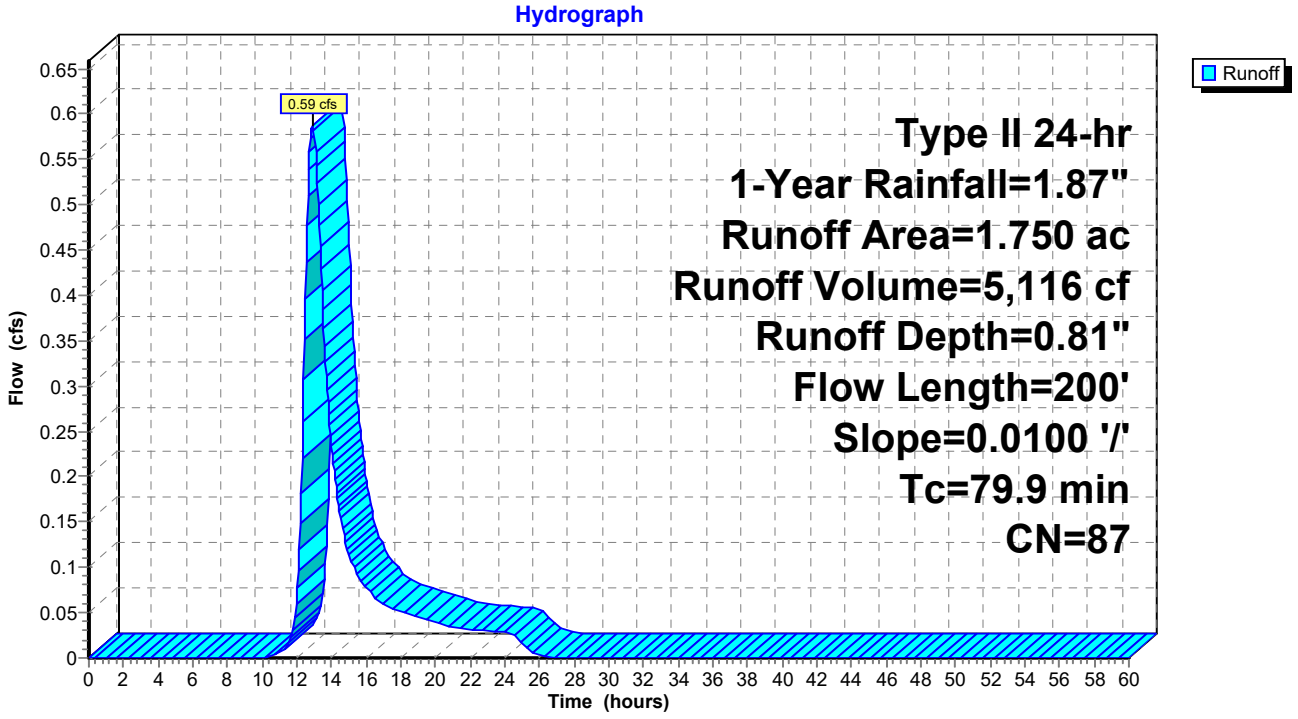
Runoff = 0.59 cfs @ 12.91 hrs, Volume= 5,116 cf, Depth= 0.81"
Routed to Pond 1P : (new Pond)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=1.87"

Area (ac)	CN	Description
0.150	79	Woods, Fair, HSG D
0.400	98	Roofs, HSG D
0.300	98	Paved parking, HSG D
0.900	80	>75% Grass cover, Good, HSG D
1.750	87	Weighted Average
1.050		60.00% Pervious Area
0.700		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
68.9	130	0.0100	0.03		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
11.0	70	0.0100	0.11		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"
79.9	200	Total			

Subcatchment 1S: Proposed



Summary for Subcatchment 2S: Proposed

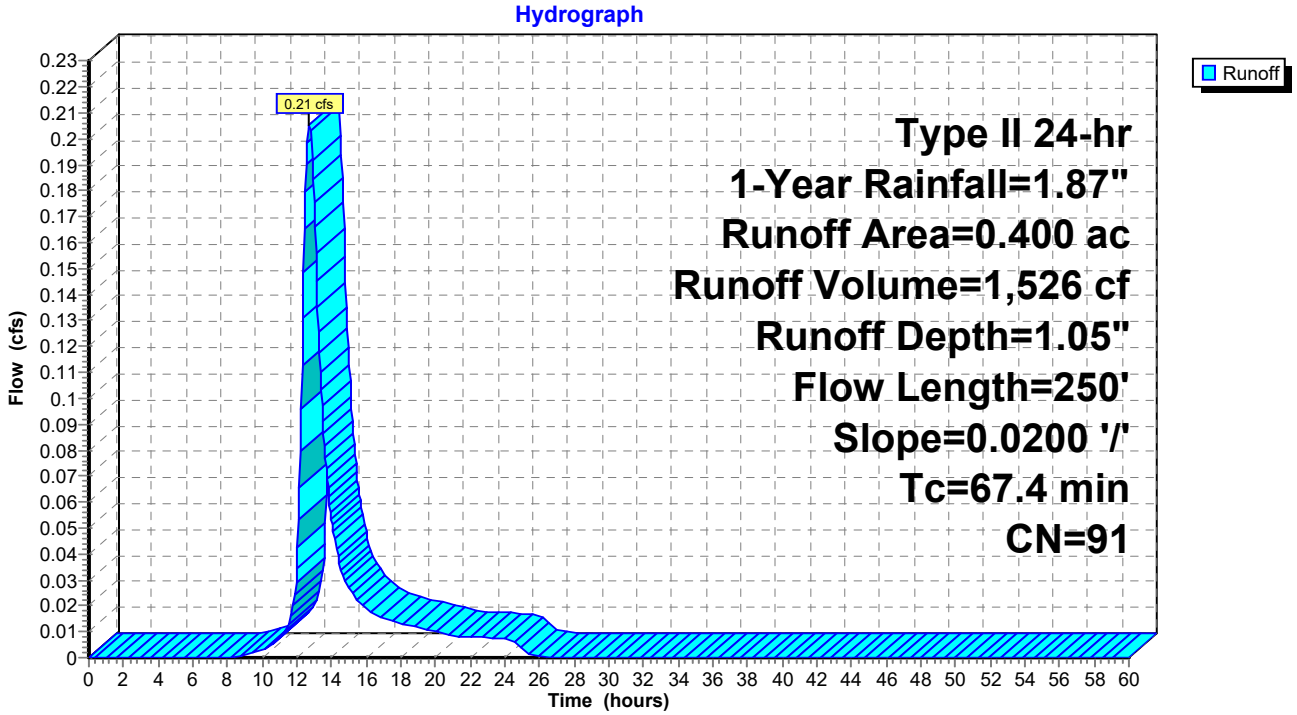
Runoff = 0.21 cfs @ 12.72 hrs, Volume= 1,526 cf, Depth= 1.05"
Routed to Pond 2P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=1.87"

Area (ac)	CN	Description
0.050	79	Woods, Fair, HSG D
0.100	80	>75% Grass cover, Good, HSG D
0.250	98	Paved parking, HSG D
0.400	91	Weighted Average
0.150		37.50% Pervious Area
0.250		62.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	110	0.0200	0.15		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"
55.4	140	0.0200	0.04		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
67.4	250	Total			

Subcatchment 2S: Proposed



Summary for Subcatchment 3S: Proposed

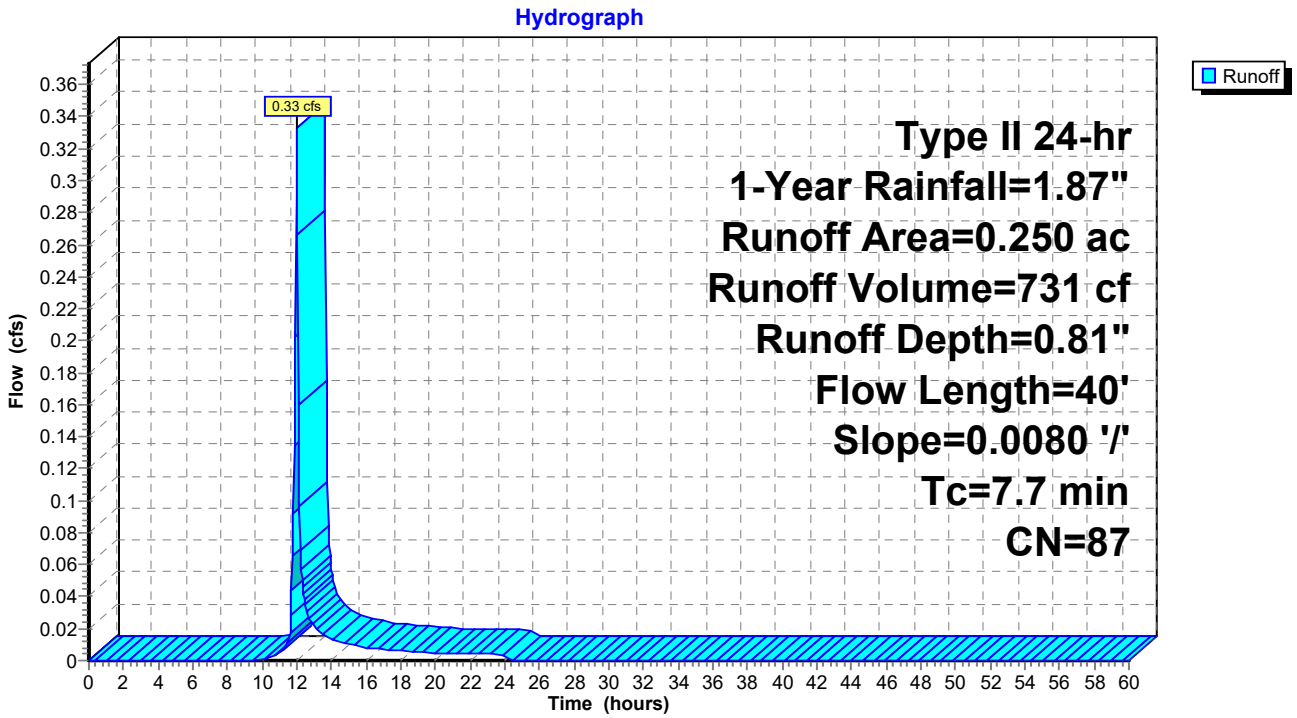
Runoff = 0.33 cfs @ 11.99 hrs, Volume= 731 cf, Depth= 0.81"
Routed to Pond 4P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Year Rainfall=1.87"

Area (ac)	CN	Description
0.150	80	>75% Grass cover, Good, HSG D
0.100	98	Paved parking, HSG D
0.250	87	Weighted Average
0.150		60.00% Pervious Area
0.100		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	40	0.0080	0.09		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"

Subcatchment 3S: Proposed



Summary for Pond 1P: (new Pond)

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 104,544 sf, 43.75% Impervious, Inflow Depth = 0.85" for 1-Year event
Inflow = 0.81 cfs @ 12.89 hrs, Volume= 7,372 cf
Outflow = 0.39 cfs @ 13.74 hrs, Volume= 7,372 cf, Atten= 51%, Lag= 50.9 min
Primary = 0.39 cfs @ 13.74 hrs, Volume= 7,372 cf

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 676.94' @ 13.74 hrs Surf.Area= 2,701 sf Storage= 1,555 cf

Plug-Flow detention time= 35.2 min calculated for 7,366 cf (100% of inflow)
Center-of-Mass det. time= 35.2 min (1,050.5 - 1,015.3)

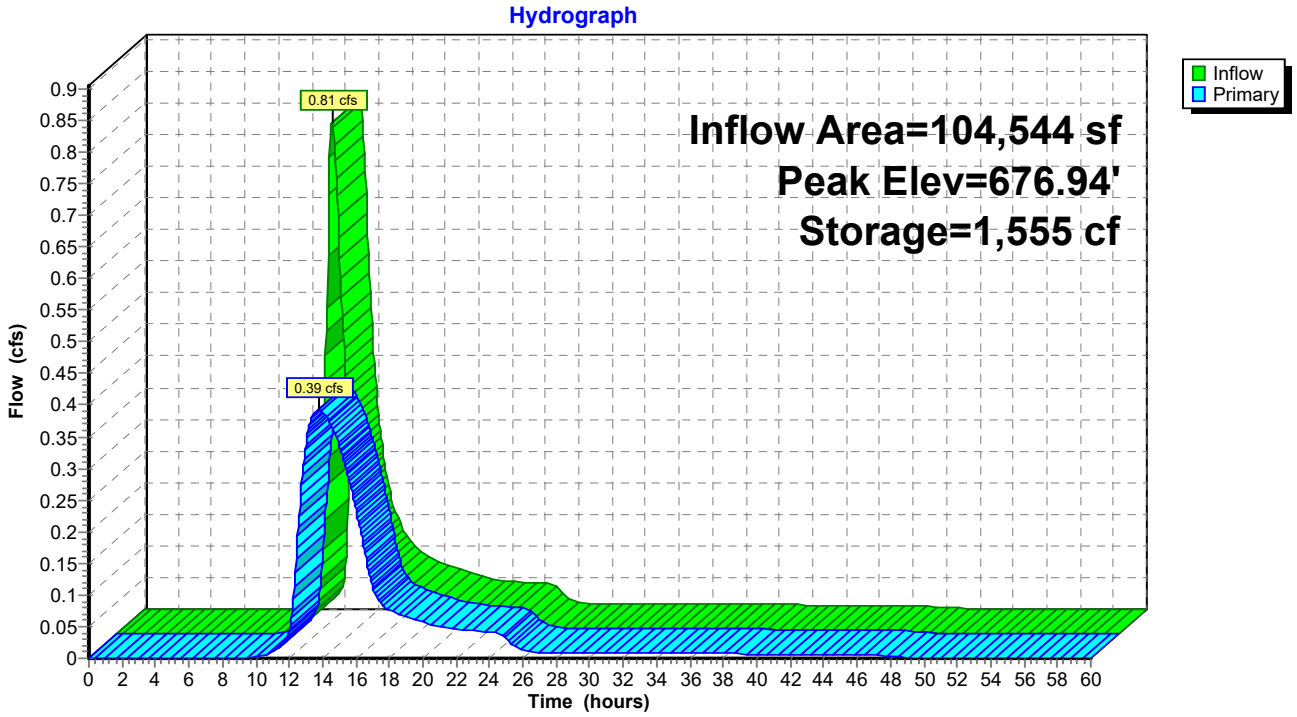
Volume	Invert	Avail.Storage	Storage Description
#1	676.00'	13,810 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
676.00	600	0	0
677.00	2,830	1,715	1,715
678.00	6,340	4,585	6,300
679.00	8,680	7,510	13,810

Device	Routing	Invert	Outlet Devices
#1	Primary	675.90'	**10.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 675.90' / 675.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf
#2	Device 1	675.90'	**4.0" Vert. 4" orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	678.85'	**24.0" x 24.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.39 cfs @ 13.74 hrs HW=676.94' (Free Discharge)
└─**1=Culvert** (Passes 0.39 cfs of 2.02 cfs potential flow)
  ├─**2=4" orifice** (Orifice Controls 0.39 cfs @ 4.50 fps)
  └─**3=Grate** (Controls 0.00 cfs)

Pond 1P: (new Pond)



Summary for Pond 2P: Bioretention Area

Inflow Area = 17,424 sf, 62.50% Impervious, Inflow Depth = 1.05" for 1-Year event
Inflow = 0.21 cfs @ 12.72 hrs, Volume= 1,526 cf
Outflow = 0.20 cfs @ 12.87 hrs, Volume= 1,526 cf, Atten= 5%, Lag= 9.3 min
Primary = 0.20 cfs @ 12.87 hrs, Volume= 1,526 cf
Routed to Pond 1P : (new Pond)

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 681.39' @ 12.87 hrs Surf.Area= 711 sf Storage= 361 cf

Plug-Flow detention time= 291.2 min calculated for 1,526 cf (100% of inflow)
Center-of-Mass det. time= 291.0 min (1,169.0 - 878.1)

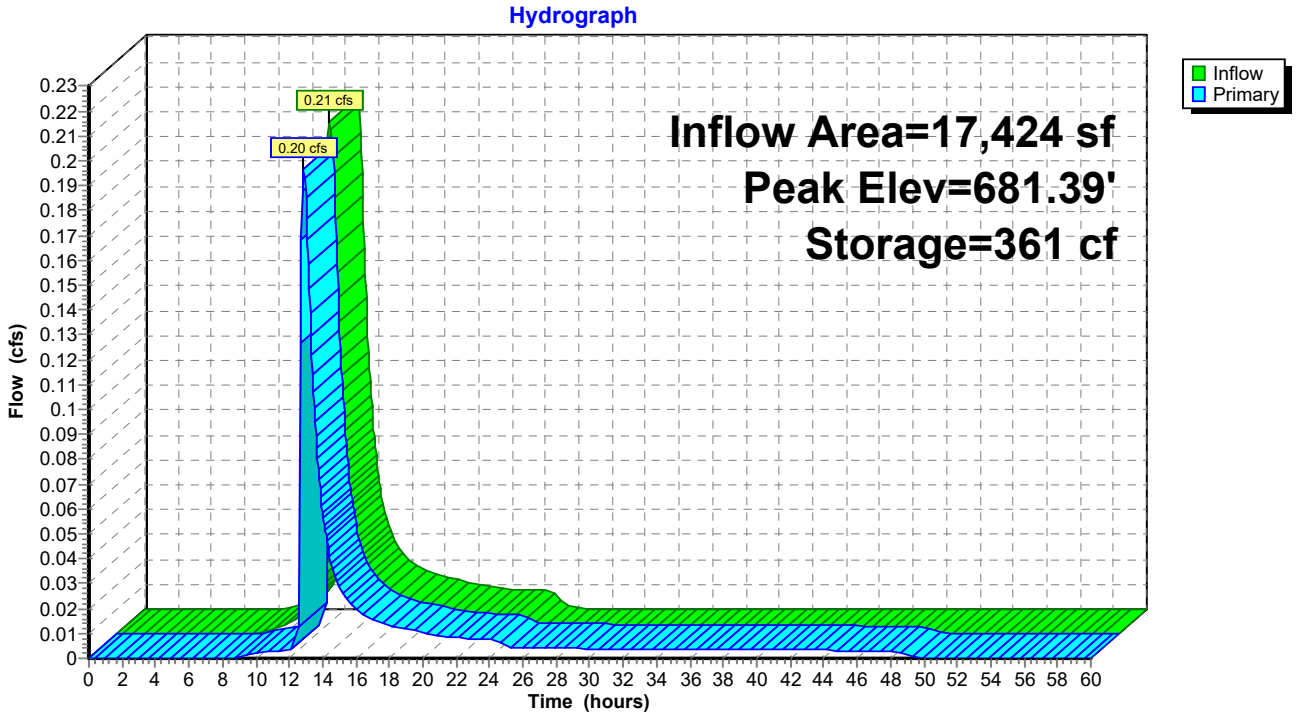
Volume	Invert	Avail.Storage	Storage Description
#1	680.80'	684 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.80	515	0	0
681.30	675	298	298
681.80	870	386	684

Device	Routing	Invert	Outlet Devices
#1	Primary	678.30'	**6.0" Round 6" pipe** L= 61.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 678.30' / 678.11' S= 0.0031 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	681.30'	**8.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	680.80'	**0.250 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 670.00'

Primary OutFlow Max=0.20 cfs @ 12.87 hrs HW=681.39' (Free Discharge)
└**1=6" pipe** (Passes 0.20 cfs of 1.04 cfs potential flow)
└**2=Grate** (Weir Controls 0.19 cfs @ 0.99 fps)
└**3=Exfiltration** (Controls 0.00 cfs)

Pond 2P: Bioretention Area



Summary for Pond 4P: Bioretention Area

Inflow Area = 10,890 sf, 40.00% Impervious, Inflow Depth = 0.81" for 1-Year event
Inflow = 0.33 cfs @ 11.99 hrs, Volume= 731 cf
Outflow = 0.05 cfs @ 12.34 hrs, Volume= 731 cf, Atten= 86%, Lag= 20.5 min
Primary = 0.05 cfs @ 12.34 hrs, Volume= 731 cf
Routed to Pond 1P : (new Pond)

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 680.52' @ 12.34 hrs Surf.Area= 760 sf Storage= 331 cf

Plug-Flow detention time= 593.7 min calculated for 730 cf (100% of inflow)
Center-of-Mass det. time= 594.5 min (1,436.7 - 842.2)

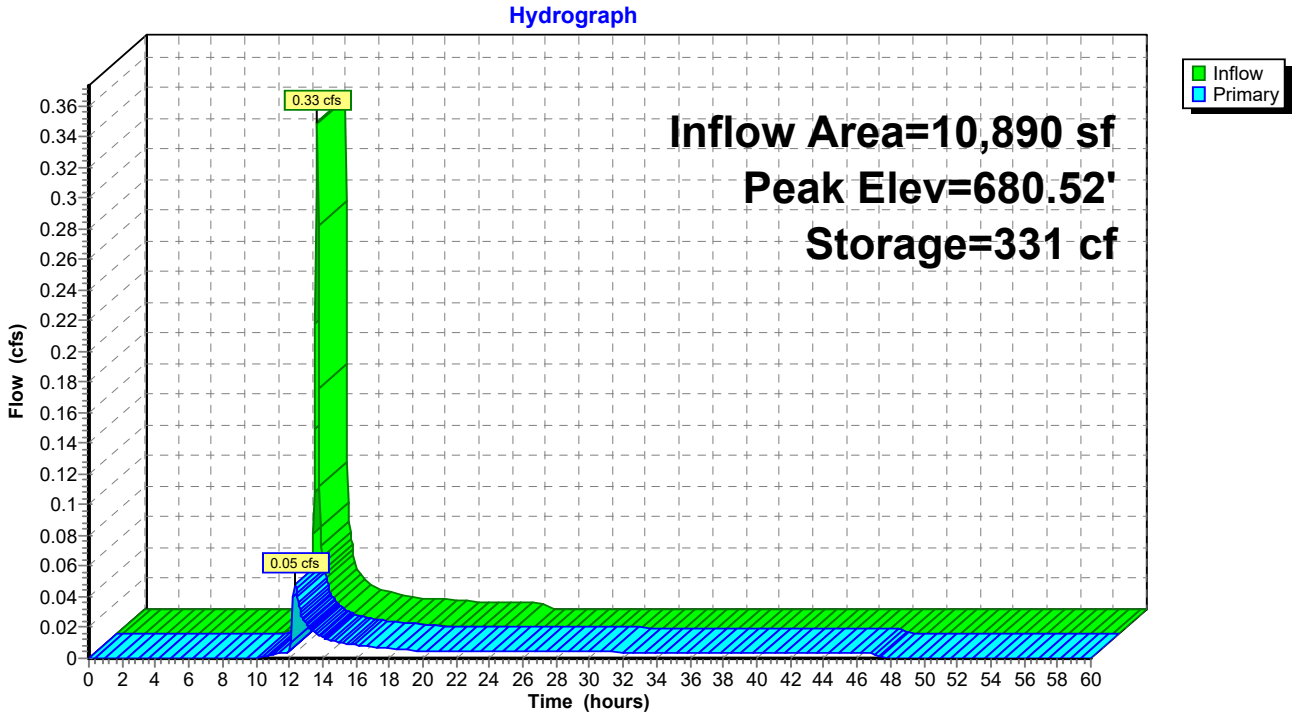
Volume	Invert	Avail.Storage	Storage Description
#1	680.00'	751 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.00	510	0	0
680.50	750	315	315
681.00	995	436	751

Device	Routing	Invert	Outlet Devices
#1	Primary	677.36'	**6.0" Round 6" pipe** L= 22.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 677.36' / 677.30' S= 0.0027 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	680.50'	**8.0" Horiz. Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	680.00'	**0.250 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 670.00'

Primary OutFlow Max=0.05 cfs @ 12.34 hrs HW=680.52' (Free Discharge)
└**1=6" pipe** (Passes 0.05 cfs of 1.44 cfs potential flow)
└**2=Grate** (Weir Controls 0.04 cfs @ 0.48 fps)
└**3=Exfiltration** (Controls 0.00 cfs)

Pond 4P: Bioretention Area



Time span=0.00-60.00 hrs, dt=0.05 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Proposed Runoff Area=1.750 ac 40.00% Impervious Runoff Depth=1.86"
Flow Length=200' Slope=0.0100 '/' Tc=79.9 min CN=87 Runoff=1.41 cfs 11,828 cf

Subcatchment2S: Proposed Runoff Area=0.400 ac 62.50% Impervious Runoff Depth=2.20"
Flow Length=250' Slope=0.0200 '/' Tc=67.4 min CN=91 Runoff=0.43 cfs 3,197 cf

Subcatchment3S: Proposed Runoff Area=0.250 ac 40.00% Impervious Runoff Depth=1.86"
Flow Length=40' Slope=0.0080 '/' Tc=7.7 min CN=87 Runoff=0.76 cfs 1,690 cf

Pond 1P: (new Pond) Peak Elev=677.95' Storage=5,991 cf Inflow=1.88 cfs 16,715 cf
Outflow=0.58 cfs 16,715 cf

Pond 2P: Bioretention Area Peak Elev=681.46' Storage=408 cf Inflow=0.43 cfs 3,197 cf
Outflow=0.43 cfs 3,197 cf

Pond 4P: Bioretention Area Peak Elev=680.64' Storage=424 cf Inflow=0.76 cfs 1,690 cf
Outflow=0.71 cfs 1,690 cf

Total Runoff Area = 104,544 sf Runoff Volume = 16,715 cf Average Runoff Depth = 1.92"
56.25% Pervious = 58,806 sf 43.75% Impervious = 45,738 sf

Summary for Subcatchment 1S: Proposed

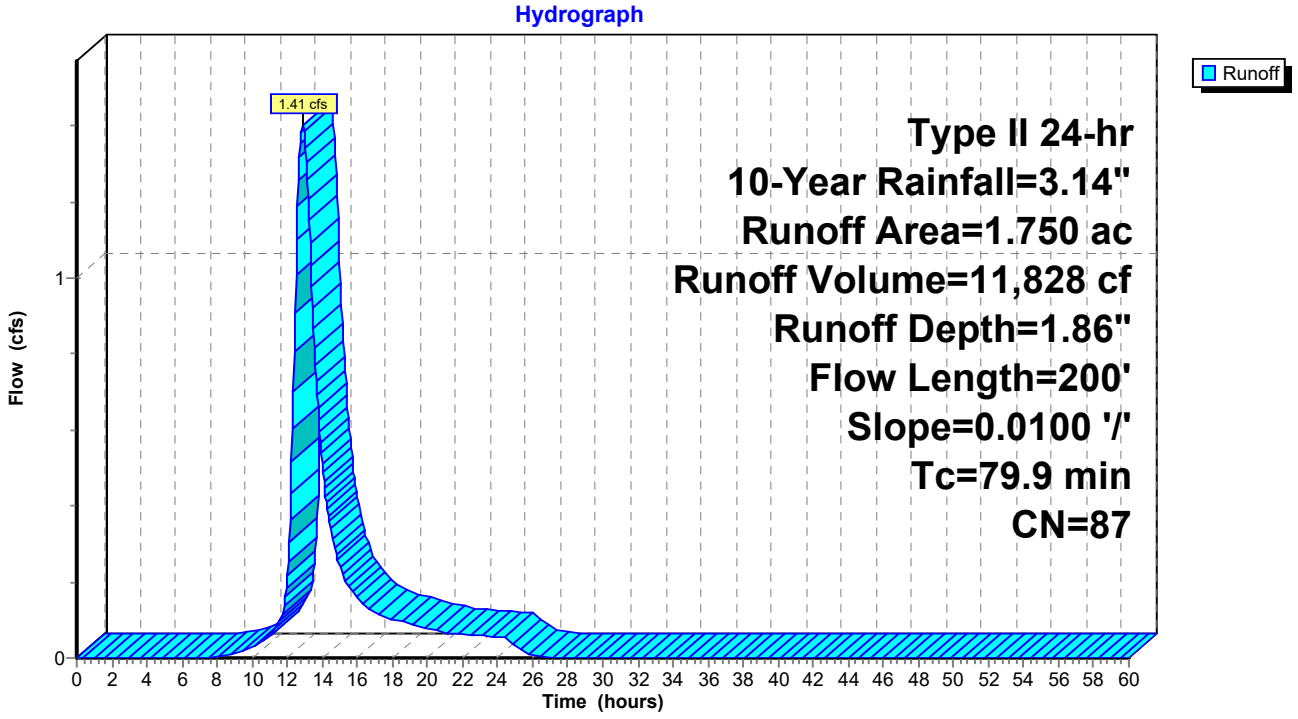
Runoff = 1.41 cfs @ 12.88 hrs, Volume= 11,828 cf, Depth= 1.86"
Routed to Pond 1P : (new Pond)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=3.14"

Area (ac)	CN	Description
0.150	79	Woods, Fair, HSG D
0.400	98	Roofs, HSG D
0.300	98	Paved parking, HSG D
0.900	80	>75% Grass cover, Good, HSG D
1.750	87	Weighted Average
1.050		60.00% Pervious Area
0.700		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
68.9	130	0.0100	0.03		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
11.0	70	0.0100	0.11		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"
79.9	200	Total			

Subcatchment 1S: Proposed



Summary for Subcatchment 2S: Proposed

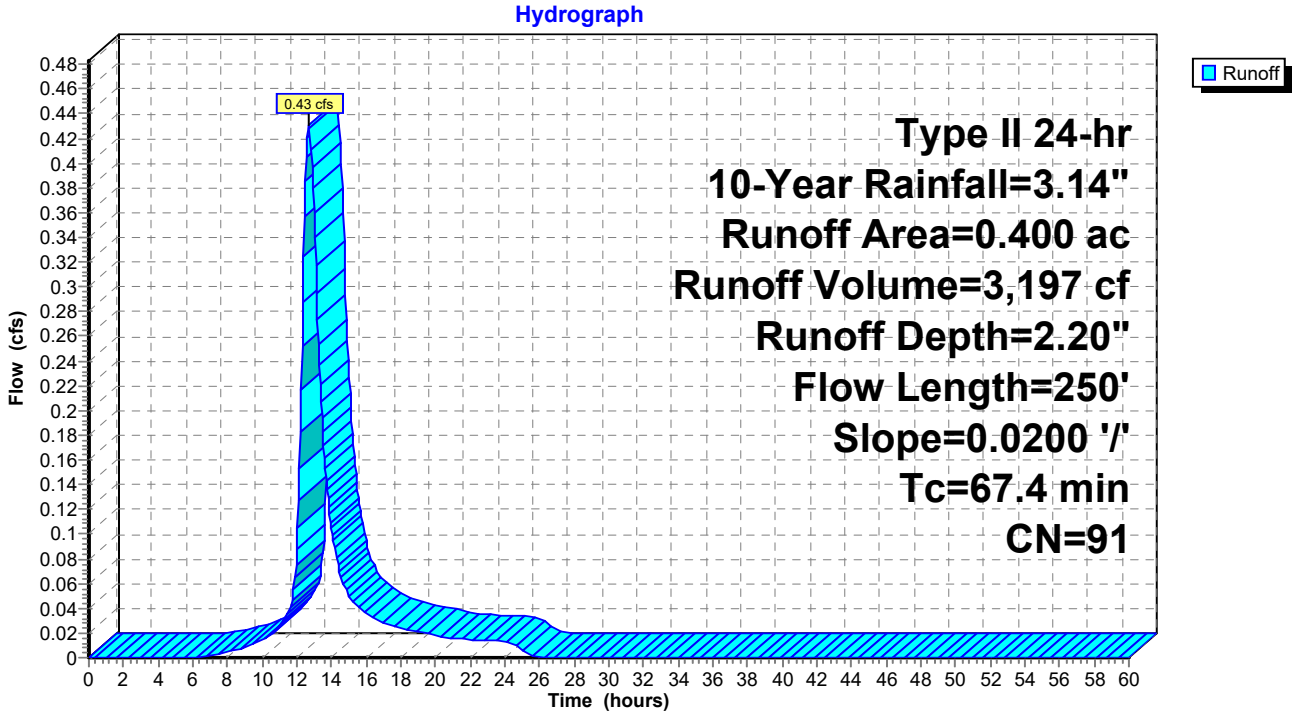
Runoff = 0.43 cfs @ 12.69 hrs, Volume= 3,197 cf, Depth= 2.20"
Routed to Pond 2P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=3.14"

Area (ac)	CN	Description
0.050	79	Woods, Fair, HSG D
0.100	80	>75% Grass cover, Good, HSG D
0.250	98	Paved parking, HSG D
0.400	91	Weighted Average
0.150		37.50% Pervious Area
0.250		62.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	110	0.0200	0.15		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"
55.4	140	0.0200	0.04		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
67.4	250	Total			

Subcatchment 2S: Proposed



Summary for Subcatchment 3S: Proposed

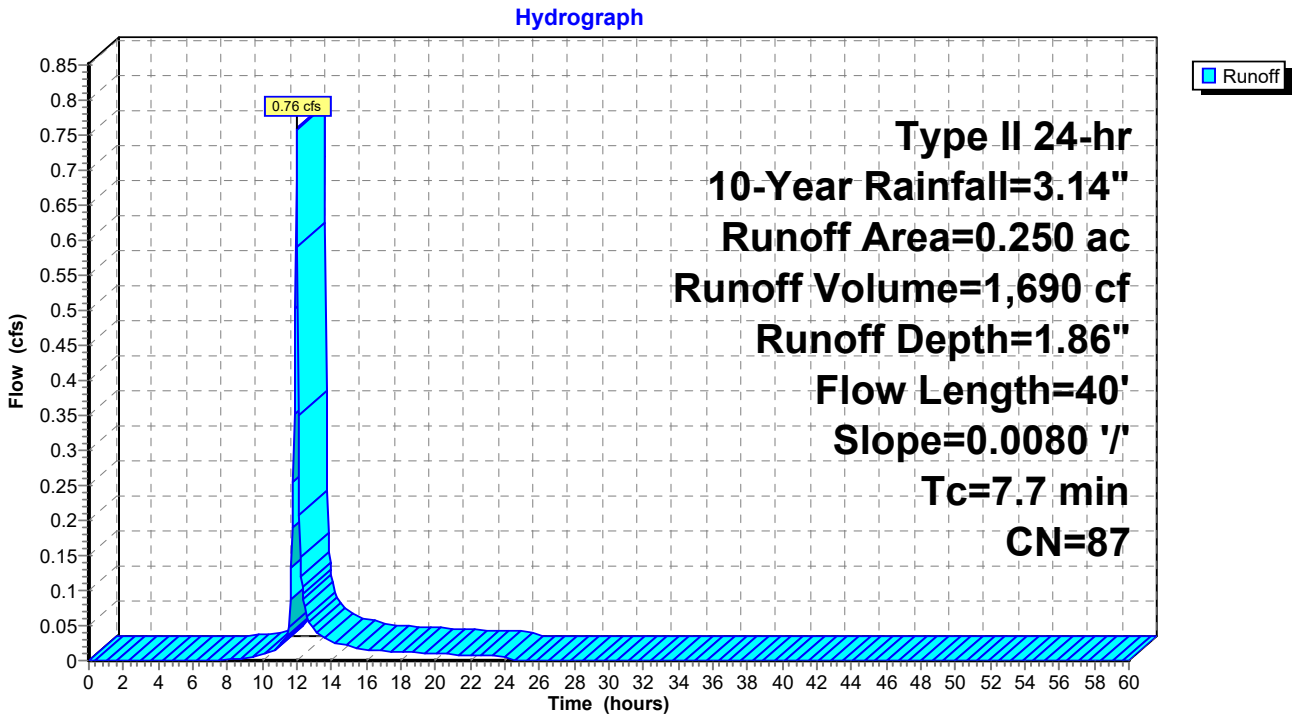
Runoff = 0.76 cfs @ 11.99 hrs, Volume= 1,690 cf, Depth= 1.86"
Routed to Pond 4P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=3.14"

Area (ac)	CN	Description
0.150	80	>75% Grass cover, Good, HSG D
0.100	98	Paved parking, HSG D
0.250	87	Weighted Average
0.150		60.00% Pervious Area
0.100		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	40	0.0080	0.09		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"

Subcatchment 3S: Proposed



Summary for Pond 1P: (new Pond)

[44] Hint: Outlet device #2 is below defined storage
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.59'

Inflow Area = 104,544 sf, 43.75% Impervious, Inflow Depth = 1.92" for 10-Year event
Inflow = 1.88 cfs @ 12.85 hrs, Volume= 16,715 cf
Outflow = 0.58 cfs @ 14.14 hrs, Volume= 16,715 cf, Atten= 69%, Lag= 77.5 min
Primary = 0.58 cfs @ 14.14 hrs, Volume= 16,715 cf

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 677.95' @ 14.14 hrs Surf.Area= 6,166 sf Storage= 5,991 cf

Plug-Flow detention time= 99.1 min calculated for 16,715 cf (100% of inflow)
Center-of-Mass det. time= 99.0 min (1,027.8 - 928.8)

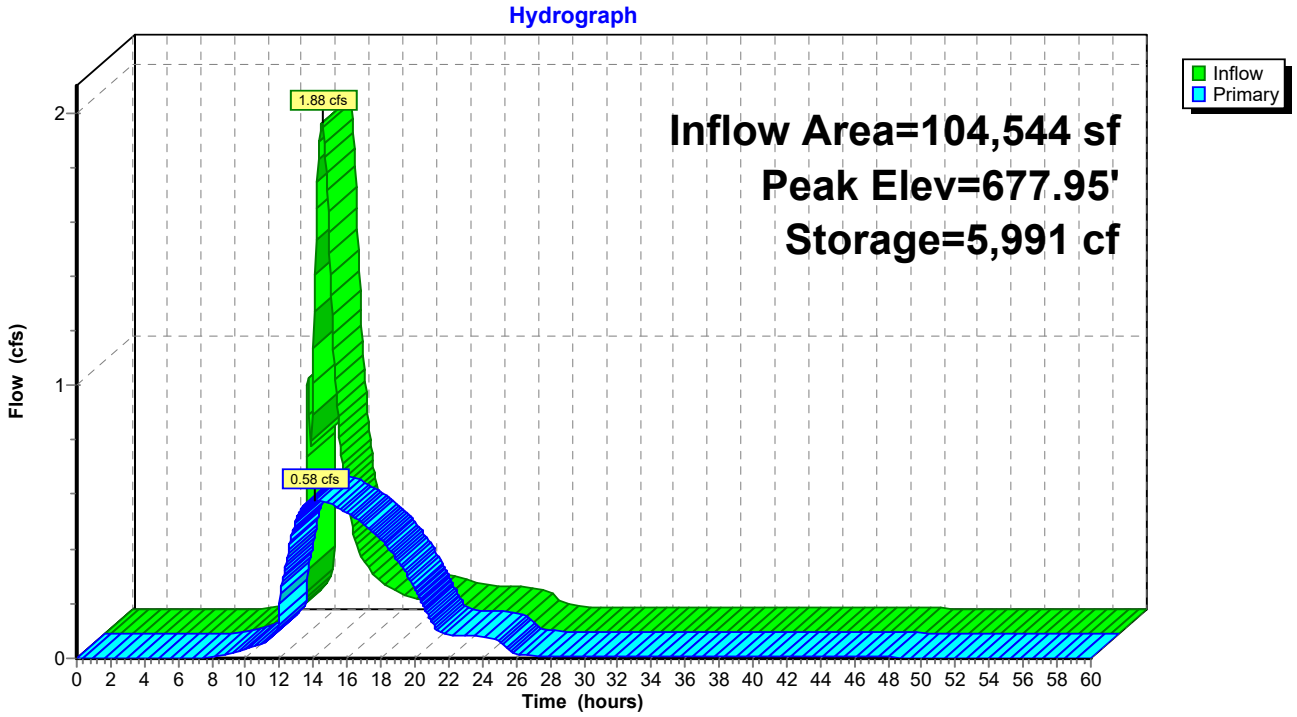
Volume	Invert	Avail.Storage	Storage Description
#1	676.00'	13,810 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
676.00	600	0	0
677.00	2,830	1,715	1,715
678.00	6,340	4,585	6,300
679.00	8,680	7,510	13,810

Device	Routing	Invert	Outlet Devices
#1	Primary	675.90'	**10.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 675.90' / 675.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf
#2	Device 1	675.90'	**4.0" Vert. 4" orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	678.85'	**24.0" x 24.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.58 cfs @ 14.14 hrs HW=677.95' (Free Discharge)
└**1=Culvert** (Passes 0.58 cfs of 3.28 cfs potential flow)
  ├**2=4" orifice** (Orifice Controls 0.58 cfs @ 6.61 fps)
  └**3=Grate** (Controls 0.00 cfs)

Pond 1P: (new Pond)



Summary for Pond 2P: Bioretention Area

Inflow Area = 17,424 sf, 62.50% Impervious, Inflow Depth = 2.20" for 10-Year event
Inflow = 0.43 cfs @ 12.69 hrs, Volume= 3,197 cf
Outflow = 0.43 cfs @ 12.76 hrs, Volume= 3,197 cf, Atten= 1%, Lag= 3.7 min
Primary = 0.43 cfs @ 12.76 hrs, Volume= 3,197 cf
Routed to Pond 1P : (new Pond)

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 681.46' @ 12.76 hrs Surf.Area= 736 sf Storage= 408 cf

Plug-Flow detention time= 149.9 min calculated for 3,197 cf (100% of inflow)
Center-of-Mass det. time= 149.7 min (1,006.7 - 857.0)

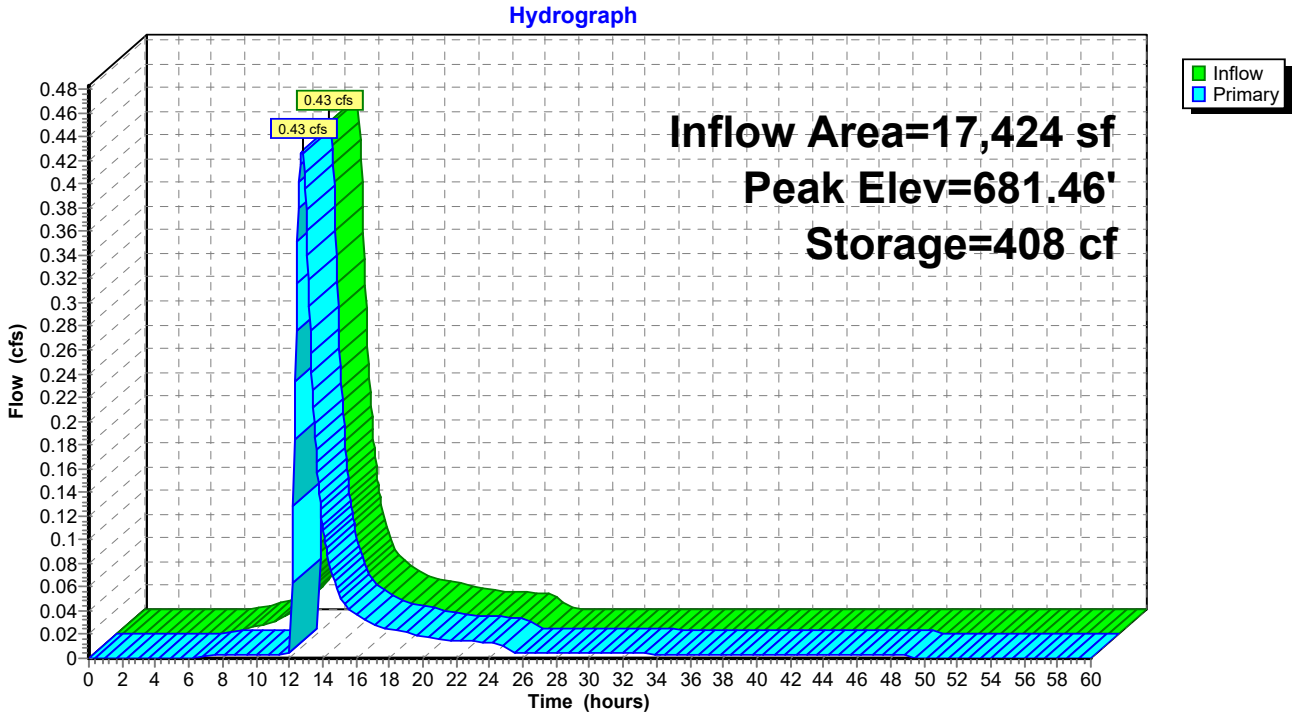
Volume	Invert	Avail.Storage	Storage Description
#1	680.80'	684 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.80	515	0	0
681.30	675	298	298
681.80	870	386	684

Device	Routing	Invert	Outlet Devices
#1	Primary	678.30'	**6.0" Round 6" pipe** L= 61.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 678.30' / 678.11' S= 0.0031 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	681.30'	**8.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	680.80'	**0.250 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 670.00'

Primary OutFlow Max=0.43 cfs @ 12.76 hrs HW=681.46' (Free Discharge)
└─**1=6" pipe** (Passes 0.43 cfs of 1.06 cfs potential flow)
  ├─**2=Grate** (Weir Controls 0.42 cfs @ 1.29 fps)
  └─**3=Exfiltration** (Controls 0.00 cfs)

Pond 2P: Bioretention Area



Summary for Pond 4P: Bioretention Area

Inflow Area = 10,890 sf, 40.00% Impervious, Inflow Depth = 1.86" for 10-Year event
Inflow = 0.76 cfs @ 11.99 hrs, Volume= 1,690 cf
Outflow = 0.71 cfs @ 12.02 hrs, Volume= 1,690 cf, Atten= 6%, Lag= 1.9 min
Primary = 0.71 cfs @ 12.02 hrs, Volume= 1,690 cf
Routed to Pond 1P : (new Pond)

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 680.64' @ 12.02 hrs Surf.Area= 818 sf Storage= 424 cf

Plug-Flow detention time= 268.8 min calculated for 1,690 cf (100% of inflow)
Center-of-Mass det. time= 268.6 min (1,086.8 - 818.2)

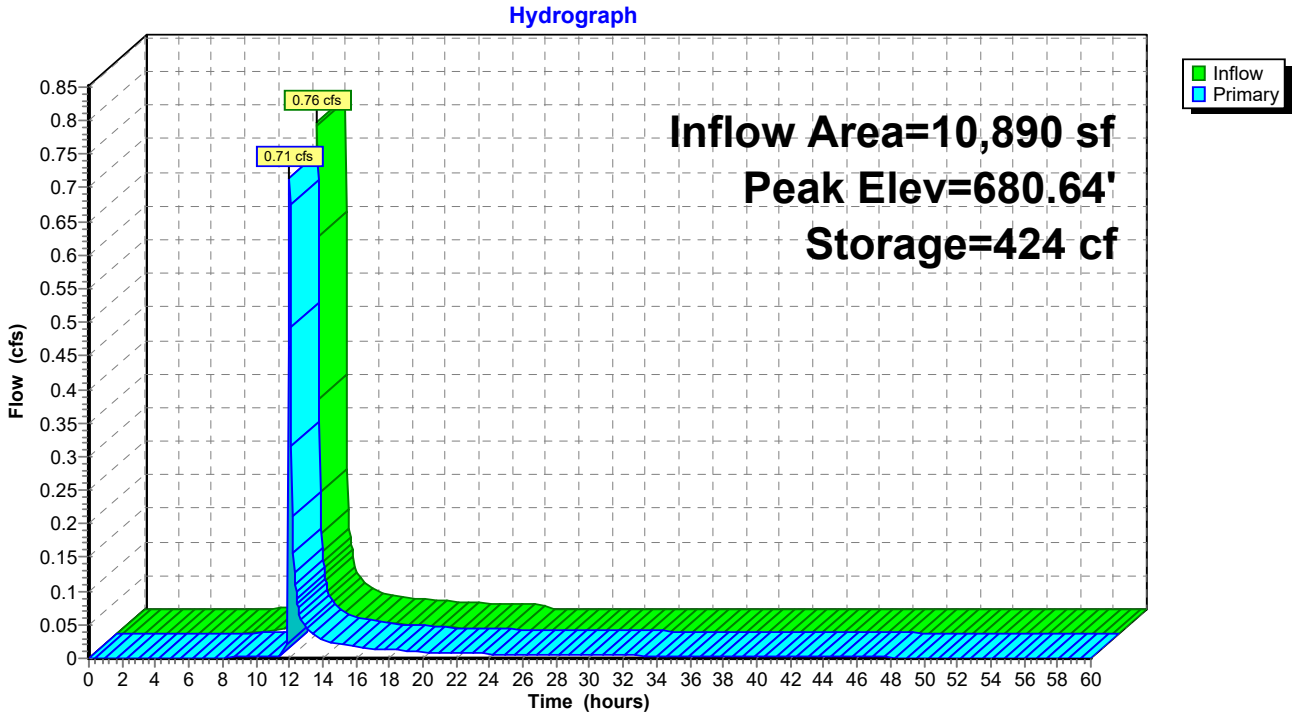
Volume	Invert	Avail.Storage	Storage Description
#1	680.00'	751 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.00	510	0	0
680.50	750	315	315
681.00	995	436	751

Device	Routing	Invert	Outlet Devices
#1	Primary	677.36'	**6.0" Round 6" pipe** L= 22.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 677.36' / 677.30' S= 0.0027 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	680.50'	**8.0" Horiz. Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	680.00'	**0.250 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 670.00'

Primary OutFlow Max=0.68 cfs @ 12.02 hrs HW=680.63' (Free Discharge)
└**1=6" pipe** (Passes 0.68 cfs of 1.47 cfs potential flow)
└**2=Grate** (Weir Controls 0.68 cfs @ 1.20 fps)
└**3=Exfiltration** (Controls 0.00 cfs)

Pond 4P: Bioretention Area



Time span=0.00-60.00 hrs, dt=0.05 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Proposed Runoff Area=1.750 ac 40.00% Impervious Runoff Depth=2.49"
Flow Length=200' Slope=0.0100 '/' Tc=79.9 min CN=87 Runoff=1.88 cfs 15,820 cf

Subcatchment2S: Proposed Runoff Area=0.400 ac 62.50% Impervious Runoff Depth=2.86"
Flow Length=250' Slope=0.0200 '/' Tc=67.4 min CN=91 Runoff=0.56 cfs 4,159 cf

Subcatchment3S: Proposed Runoff Area=0.250 ac 40.00% Impervious Runoff Depth=2.49"
Flow Length=40' Slope=0.0080 '/' Tc=7.7 min CN=87 Runoff=1.01 cfs 2,260 cf

Pond 1P: (new Pond) Peak Elev=678.40' Storage=9,053 cf Inflow=2.49 cfs 22,239 cf
Outflow=0.64 cfs 22,239 cf

Pond 2P: Bioretention Area Peak Elev=681.49' Storage=430 cf Inflow=0.56 cfs 4,159 cf
Outflow=0.56 cfs 4,159 cf

Pond 4P: Bioretention Area Peak Elev=680.67' Storage=448 cf Inflow=1.01 cfs 2,260 cf
Outflow=0.95 cfs 2,260 cf

Total Runoff Area = 104,544 sf Runoff Volume = 22,239 cf Average Runoff Depth = 2.55"
56.25% Pervious = 58,806 sf 43.75% Impervious = 45,738 sf

Summary for Subcatchment 1S: Proposed

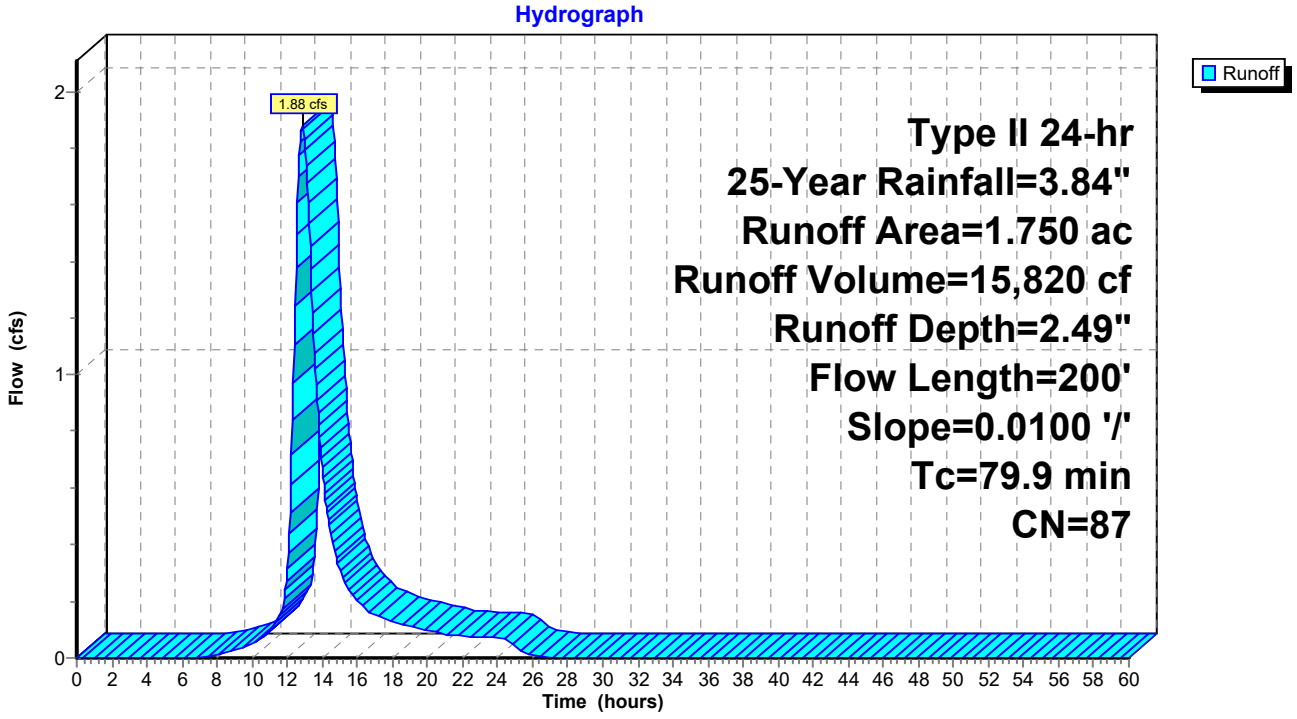
Runoff = 1.88 cfs @ 12.87 hrs, Volume= 15,820 cf, Depth= 2.49"
Routed to Pond 1P : (new Pond)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-Year Rainfall=3.84"

Area (ac)	CN	Description
0.150	79	Woods, Fair, HSG D
0.400	98	Roofs, HSG D
0.300	98	Paved parking, HSG D
0.900	80	>75% Grass cover, Good, HSG D
1.750	87	Weighted Average
1.050		60.00% Pervious Area
0.700		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
68.9	130	0.0100	0.03		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
11.0	70	0.0100	0.11		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"
79.9	200	Total			

Subcatchment 1S: Proposed



Summary for Subcatchment 2S: Proposed

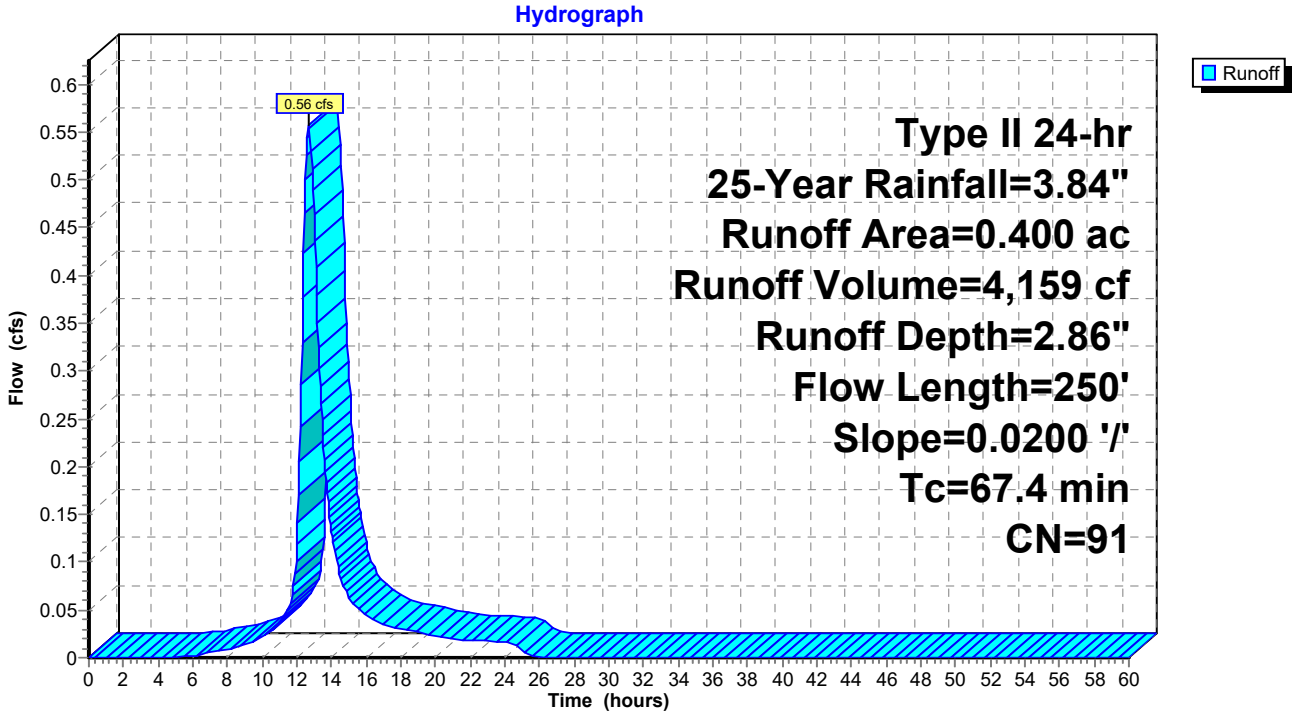
Runoff = 0.56 cfs @ 12.69 hrs, Volume= 4,159 cf, Depth= 2.86"
Routed to Pond 2P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-Year Rainfall=3.84"

Area (ac)	CN	Description
0.050	79	Woods, Fair, HSG D
0.100	80	>75% Grass cover, Good, HSG D
0.250	98	Paved parking, HSG D
0.400	91	Weighted Average
0.150		37.50% Pervious Area
0.250		62.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	110	0.0200	0.15		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"
55.4	140	0.0200	0.04		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
67.4	250	Total			

Subcatchment 2S: Proposed



Summary for Subcatchment 3S: Proposed

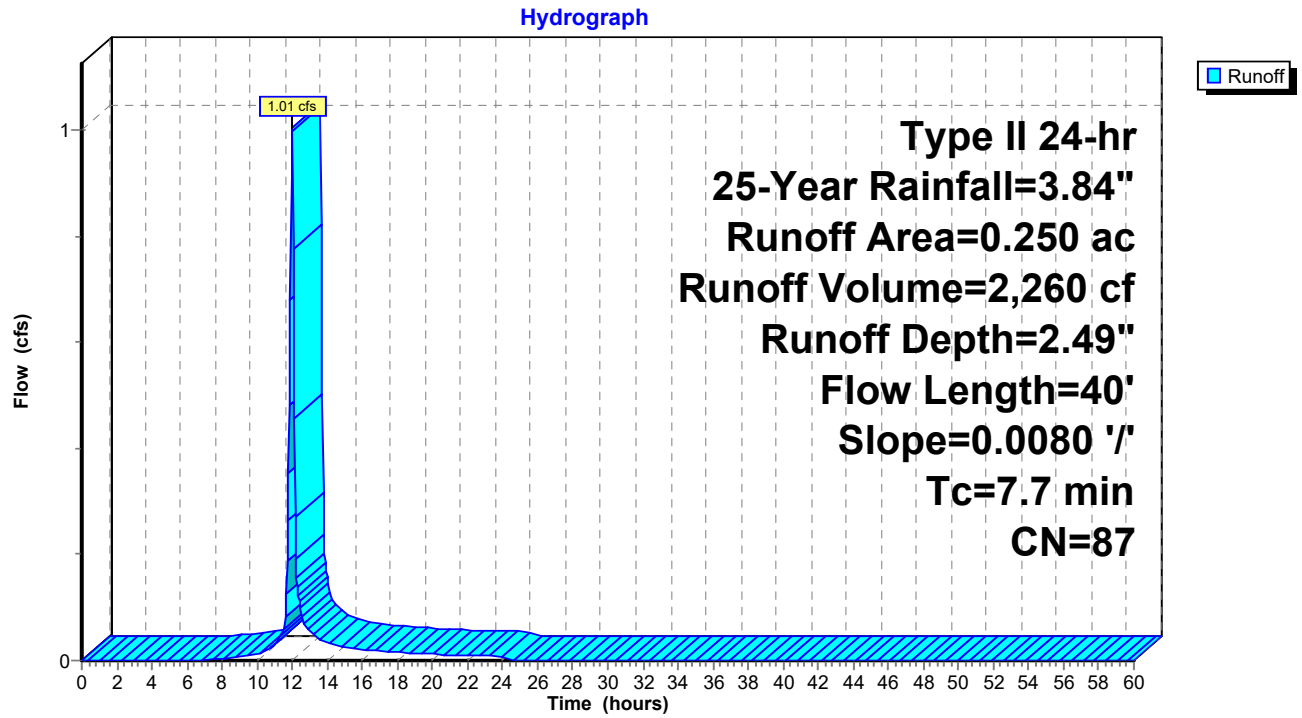
Runoff = 1.01 cfs @ 11.99 hrs, Volume= 2,260 cf, Depth= 2.49"
Routed to Pond 4P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-Year Rainfall=3.84"

Area (ac)	CN	Description
0.150	80	>75% Grass cover, Good, HSG D
0.100	98	Paved parking, HSG D
0.250	87	Weighted Average
0.150		60.00% Pervious Area
0.100		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	40	0.0080	0.09		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"

Subcatchment 3S: Proposed



Summary for Pond 1P: (new Pond)

[44] Hint: Outlet device #2 is below defined storage
[79] Warning: Submerged Pond 2P Primary device # 1 INLET by 0.10'
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 1.04'

Inflow Area = 104,544 sf, 43.75% Impervious, Inflow Depth = 2.55" for 25-Year event
Inflow = 2.49 cfs @ 12.84 hrs, Volume= 22,239 cf
Outflow = 0.64 cfs @ 14.31 hrs, Volume= 22,239 cf, Atten= 74%, Lag= 88.4 min
Primary = 0.64 cfs @ 14.31 hrs, Volume= 22,239 cf

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 678.40' @ 14.31 hrs Surf.Area= 7,285 sf Storage= 9,053 cf

Plug-Flow detention time= 138.9 min calculated for 22,220 cf (100% of inflow)
Center-of-Mass det. time= 138.7 min (1,047.0 - 908.3)

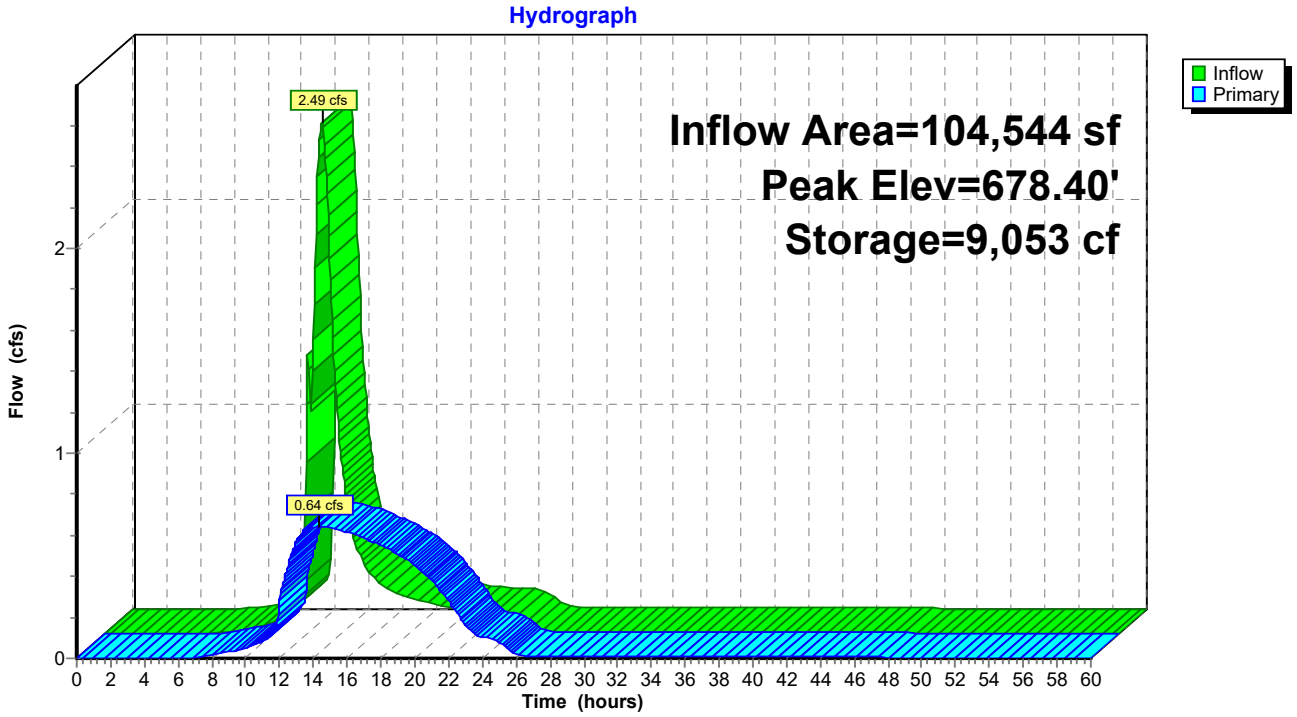
Volume	Invert	Avail.Storage	Storage Description
#1	676.00'	13,810 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
676.00	600	0	0
677.00	2,830	1,715	1,715
678.00	6,340	4,585	6,300
679.00	8,680	7,510	13,810

Device	Routing	Invert	Outlet Devices
#1	Primary	675.90'	**10.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 675.90' / 675.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf
#2	Device 1	675.90'	**4.0" Vert. 4" orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	678.85'	**24.0" x 24.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.64 cfs @ 14.31 hrs HW=678.40' (Free Discharge)
└**1=Culvert** (Passes 0.64 cfs of 3.74 cfs potential flow)
  ├**2=4" orifice** (Orifice Controls 0.64 cfs @ 7.36 fps)
  └**3=Grate** (Controls 0.00 cfs)

Pond 1P: (new Pond)



Summary for Pond 2P: Bioretention Area

Inflow Area = 17,424 sf, 62.50% Impervious, Inflow Depth = 2.86" for 25-Year event
Inflow = 0.56 cfs @ 12.69 hrs, Volume= 4,159 cf
Outflow = 0.56 cfs @ 12.75 hrs, Volume= 4,159 cf, Atten= 1%, Lag= 3.5 min
Primary = 0.56 cfs @ 12.75 hrs, Volume= 4,159 cf
Routed to Pond 1P : (new Pond)

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 681.49' @ 12.75 hrs Surf.Area= 748 sf Storage= 430 cf

Plug-Flow detention time= 120.3 min calculated for 4,159 cf (100% of inflow)
Center-of-Mass det. time= 120.1 min (969.7 - 849.6)

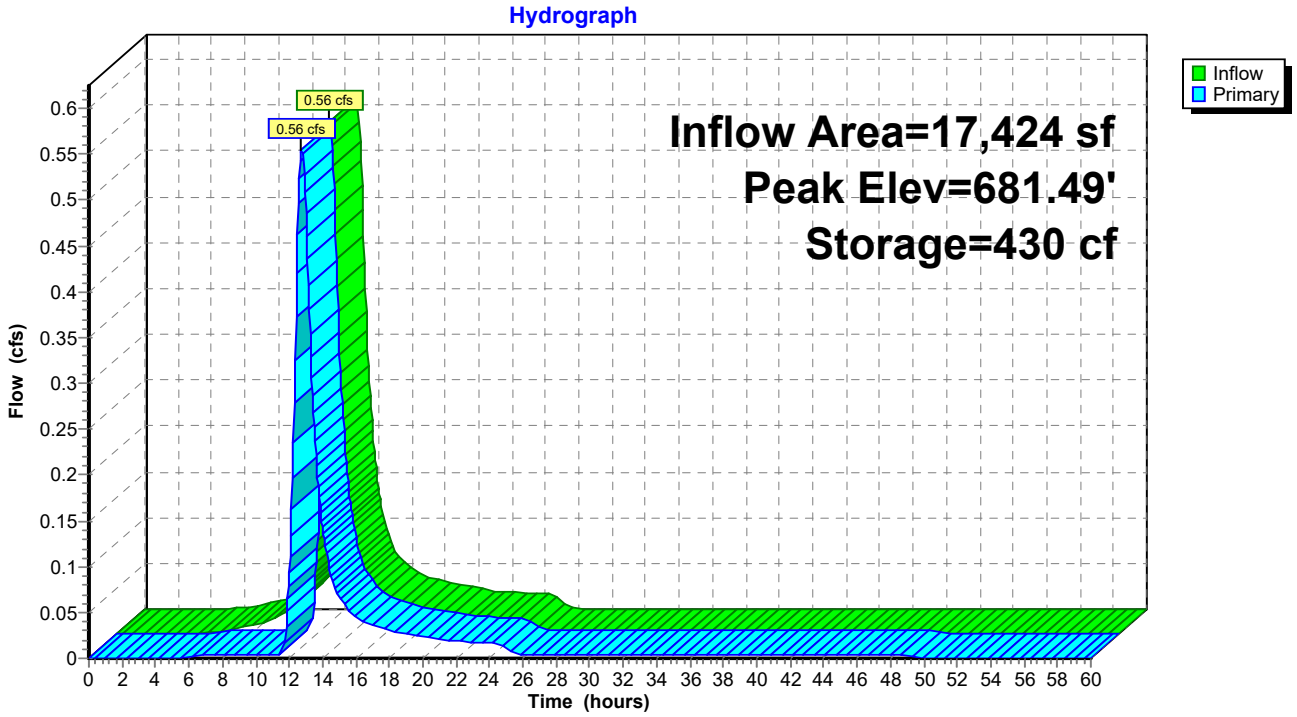
Volume	Invert	Avail.Storage	Storage Description
#1	680.80'	684 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.80	515	0	0
681.30	675	298	298
681.80	870	386	684

Device	Routing	Invert	Outlet Devices
#1	Primary	678.30'	**6.0" Round 6" pipe** L= 61.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 678.30' / 678.11' S= 0.0031 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	681.30'	**8.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	680.80'	**0.250 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 670.00'

Primary OutFlow Max=0.55 cfs @ 12.75 hrs HW=681.49' (Free Discharge)
└**1=6" pipe** (Passes 0.55 cfs of 1.06 cfs potential flow)
└**2=Grate** (Weir Controls 0.55 cfs @ 1.41 fps)
└**3=Exfiltration** (Controls 0.00 cfs)

Pond 2P: Bioretention Area



Summary for Pond 4P: Bioretention Area

Inflow Area = 10,890 sf, 40.00% Impervious, Inflow Depth = 2.49" for 25-Year event
Inflow = 1.01 cfs @ 11.99 hrs, Volume= 2,260 cf
Outflow = 0.95 cfs @ 12.01 hrs, Volume= 2,260 cf, Atten= 5%, Lag= 1.5 min
Primary = 0.95 cfs @ 12.01 hrs, Volume= 2,260 cf
Routed to Pond 1P : (new Pond)

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 680.67' @ 12.01 hrs Surf.Area= 833 sf Storage= 448 cf

Plug-Flow detention time= 205.6 min calculated for 2,260 cf (100% of inflow)
Center-of-Mass det. time= 205.3 min (1,015.2 - 809.9)

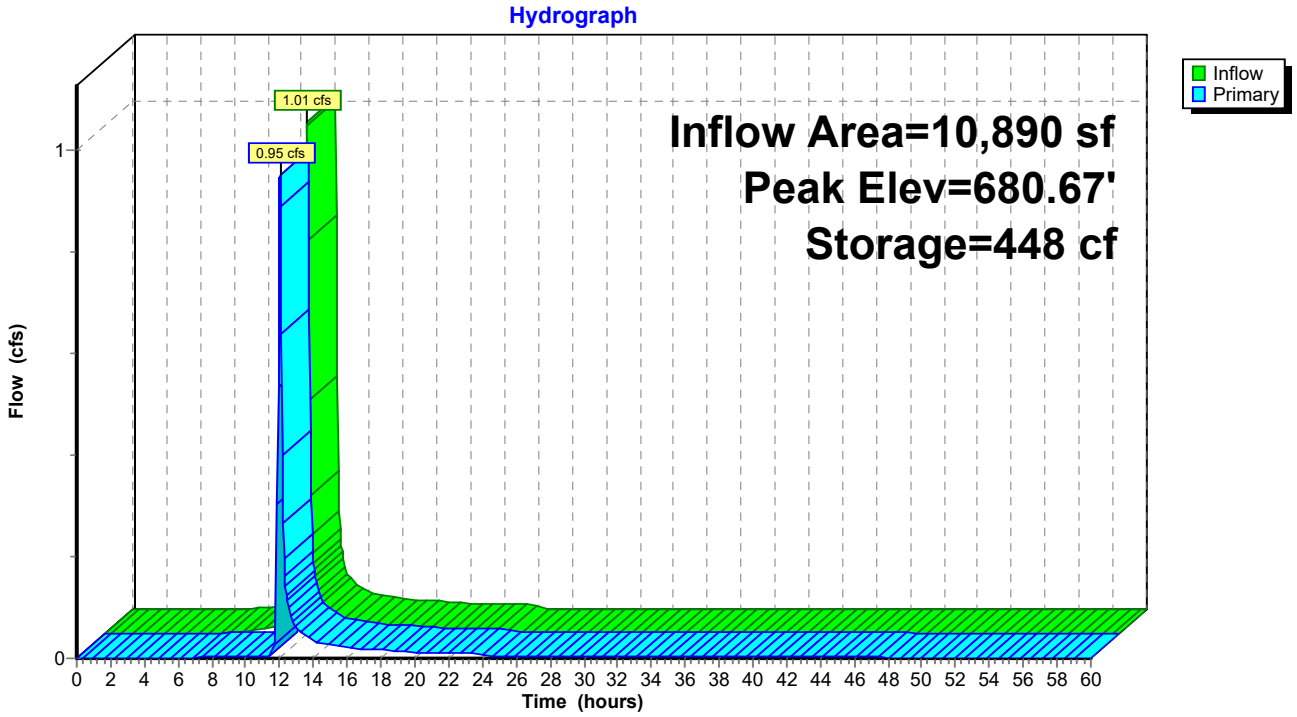
Volume	Invert	Avail.Storage	Storage Description
#1	680.00'	751 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.00	510	0	0
680.50	750	315	315
681.00	995	436	751

Device	Routing	Invert	Outlet Devices
#1	Primary	677.36'	**6.0" Round 6" pipe** L= 22.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 677.36' / 677.30' S= 0.0027 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	680.50'	**8.0" Horiz. Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	680.00'	**0.250 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 670.00'

Primary OutFlow Max=0.93 cfs @ 12.01 hrs HW=680.67' (Free Discharge)
└**1=6" pipe** (Passes 0.93 cfs of 1.48 cfs potential flow)
└**2=Grate** (Weir Controls 0.93 cfs @ 1.33 fps)
└**3=Exfiltration** (Controls 0.01 cfs)

Pond 4P: Bioretention Area



Time span=0.00-60.00 hrs, dt=0.05 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Proposed Runoff Area=1.750 ac 40.00% Impervious Runoff Depth=3.78"
Flow Length=200' Slope=0.0100 '/' Tc=79.9 min CN=87 Runoff=2.85 cfs 24,040 cf

Subcatchment2S: Proposed Runoff Area=0.400 ac 62.50% Impervious Runoff Depth=4.21"
Flow Length=250' Slope=0.0200 '/' Tc=67.4 min CN=91 Runoff=0.81 cfs 6,107 cf

Subcatchment3S: Proposed Runoff Area=0.250 ac 40.00% Impervious Runoff Depth=3.78"
Flow Length=40' Slope=0.0080 '/' Tc=7.7 min CN=87 Runoff=1.50 cfs 3,434 cf

Pond 1P: (new Pond) Peak Elev=678.97' Storage=13,513 cf Inflow=3.73 cfs 33,581 cf
Outflow=1.75 cfs 33,581 cf

Pond 2P: Bioretention Area Peak Elev=681.54' Storage=470 cf Inflow=0.81 cfs 6,107 cf
Outflow=0.81 cfs 6,107 cf

Pond 4P: Bioretention Area Peak Elev=680.72' Storage=493 cf Inflow=1.50 cfs 3,434 cf
Outflow=1.43 cfs 3,434 cf

Total Runoff Area = 104,544 sf Runoff Volume = 33,581 cf Average Runoff Depth = 3.85"
56.25% Pervious = 58,806 sf 43.75% Impervious = 45,738 sf

Summary for Subcatchment 1S: Proposed

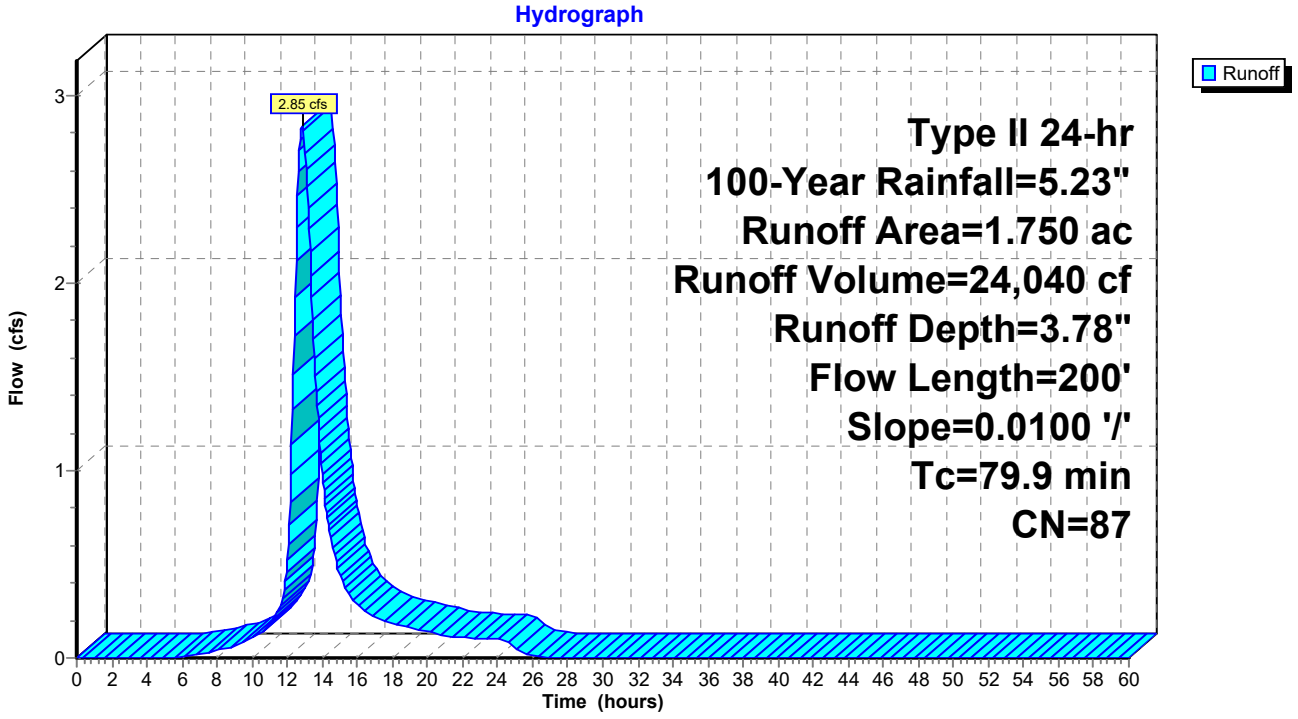
Runoff = 2.85 cfs @ 12.86 hrs, Volume= 24,040 cf, Depth= 3.78"
Routed to Pond 1P : (new Pond)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=5.23"

Area (ac)	CN	Description
0.150	79	Woods, Fair, HSG D
0.400	98	Roofs, HSG D
0.300	98	Paved parking, HSG D
0.900	80	>75% Grass cover, Good, HSG D
1.750	87	Weighted Average
1.050		60.00% Pervious Area
0.700		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
68.9	130	0.0100	0.03		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
11.0	70	0.0100	0.11		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"
79.9	200	Total			

Subcatchment 1S: Proposed



Summary for Subcatchment 2S: Proposed

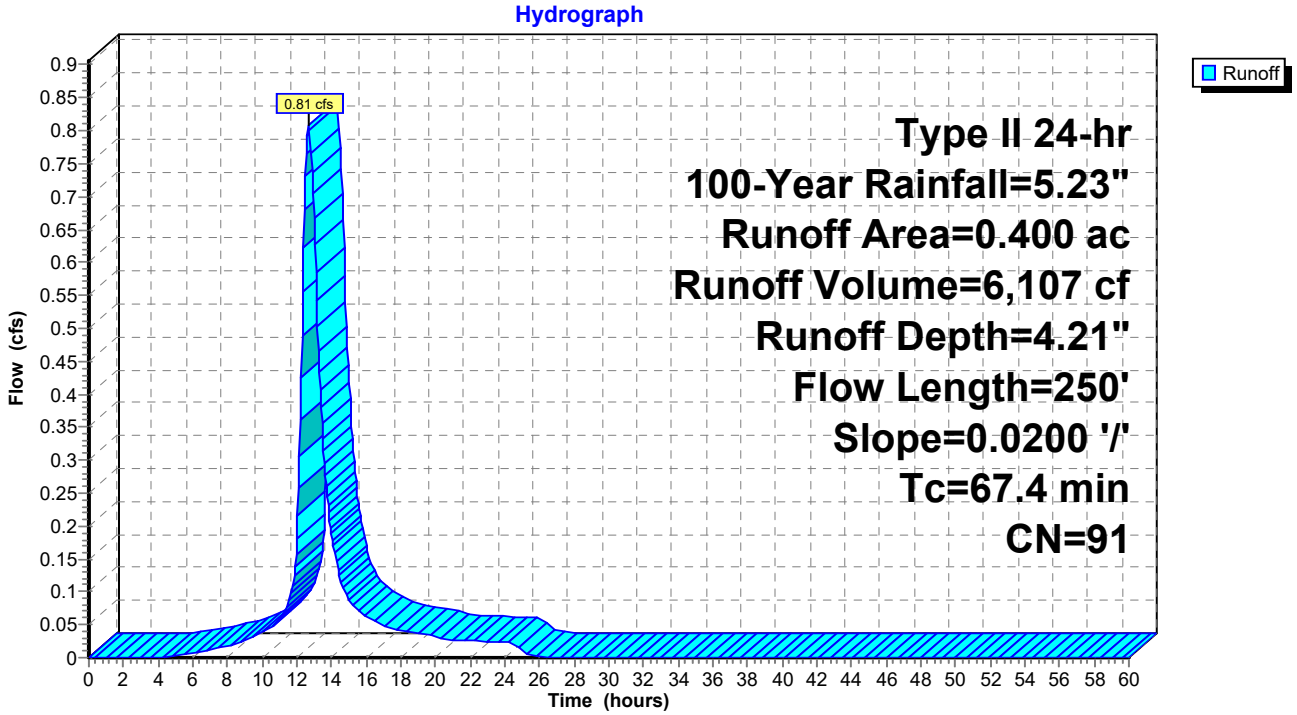
Runoff = 0.81 cfs @ 12.68 hrs, Volume= 6,107 cf, Depth= 4.21"
Routed to Pond 2P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=5.23"

Area (ac)	CN	Description
0.050	79	Woods, Fair, HSG D
0.100	80	>75% Grass cover, Good, HSG D
0.250	98	Paved parking, HSG D
0.400	91	Weighted Average
0.150		37.50% Pervious Area
0.250		62.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	110	0.0200	0.15		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"
55.4	140	0.0200	0.04		**Sheet Flow, woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
67.4	250	Total			

Subcatchment 2S: Proposed



Summary for Subcatchment 3S: Proposed

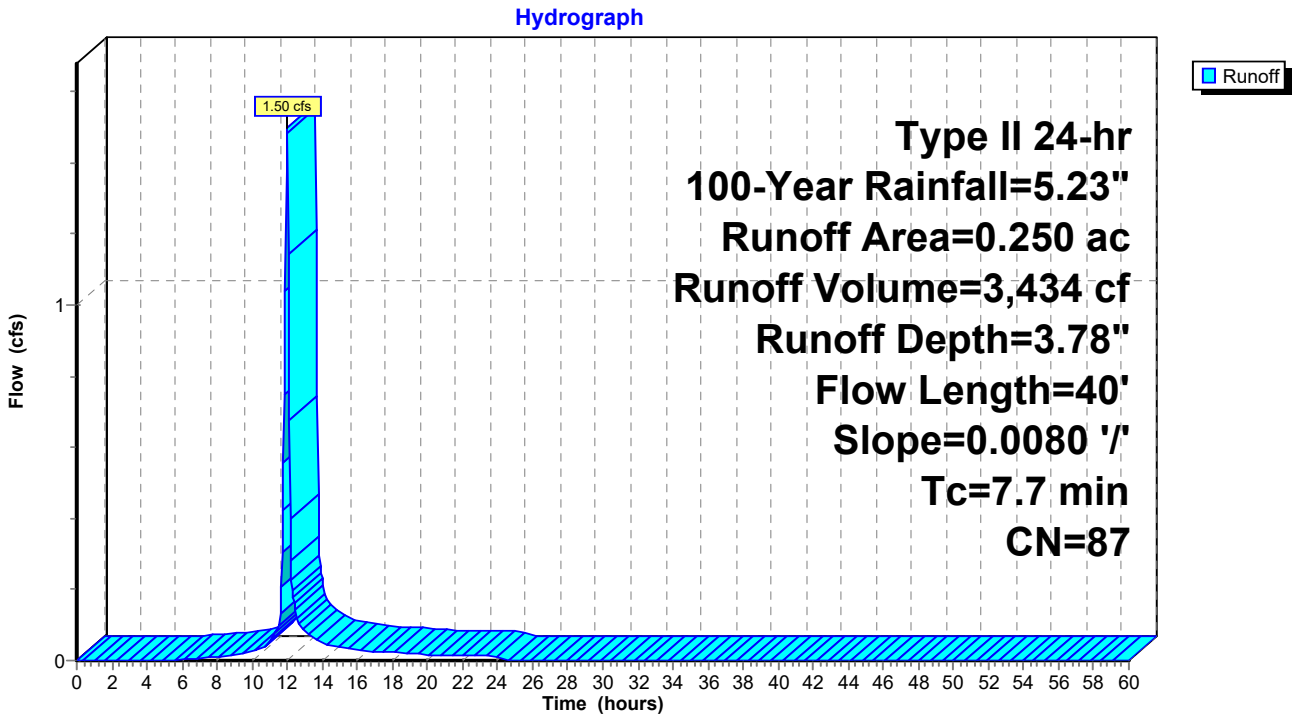
Runoff = 1.50 cfs @ 11.99 hrs, Volume= 3,434 cf, Depth= 3.78"
Routed to Pond 4P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=5.23"

Area (ac)	CN	Description
0.150	80	>75% Grass cover, Good, HSG D
0.100	98	Paved parking, HSG D
0.250	87	Weighted Average
0.150		60.00% Pervious Area
0.100		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	40	0.0080	0.09		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 2.50"

Subcatchment 3S: Proposed



Summary for Pond 1P: (new Pond)

[44] Hint: Outlet device #2 is below defined storage
[79] Warning: Submerged Pond 2P Primary device # 1 INLET by 0.67'
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 1.61'

Inflow Area = 104,544 sf, 43.75% Impervious, Inflow Depth = 3.85" for 100-Year event
Inflow = 3.73 cfs @ 12.83 hrs, Volume= 33,581 cf
Outflow = 1.75 cfs @ 13.67 hrs, Volume= 33,581 cf, Atten= 53%, Lag= 50.2 min
Primary = 1.75 cfs @ 13.67 hrs, Volume= 33,581 cf

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 678.97' @ 13.67 hrs Surf.Area= 8,600 sf Storage= 13,513 cf

Plug-Flow detention time= 171.5 min calculated for 33,553 cf (100% of inflow)
Center-of-Mass det. time= 171.3 min (1,055.3 - 884.0)

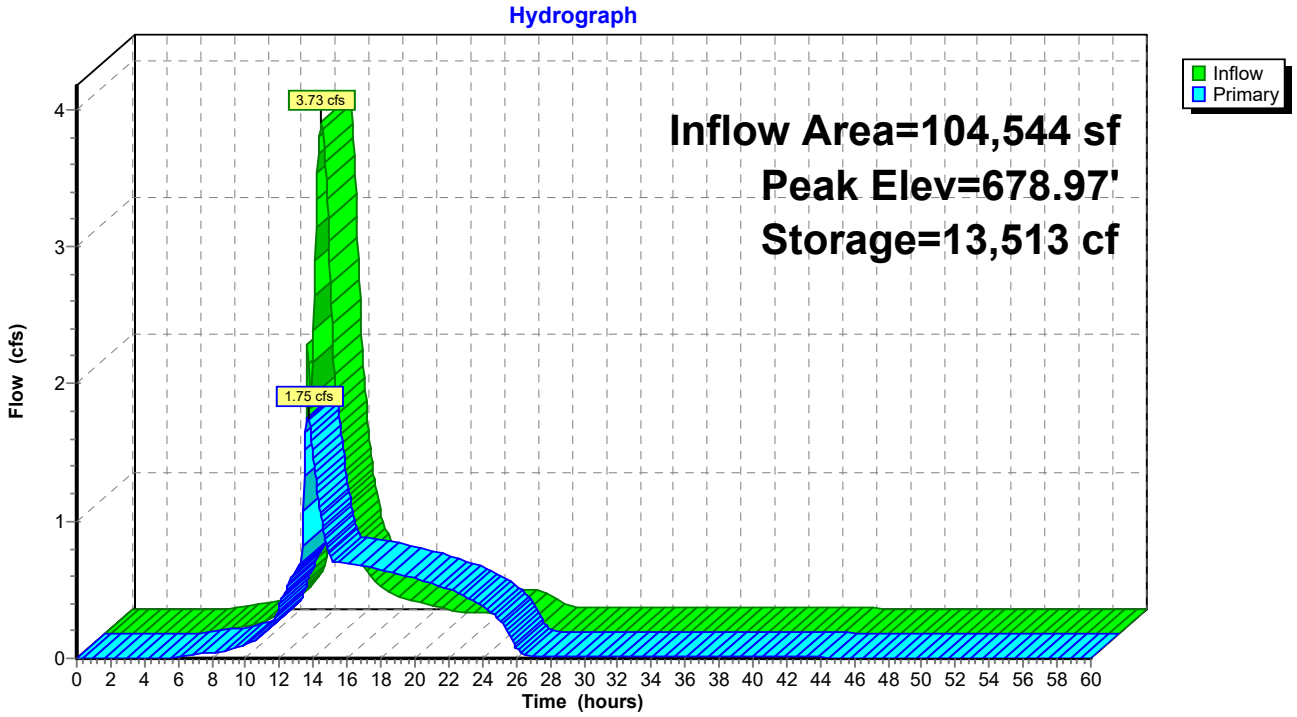
Volume	Invert	Avail.Storage	Storage Description
#1	676.00'	13,810 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
676.00	600	0	0
677.00	2,830	1,715	1,715
678.00	6,340	4,585	6,300
679.00	8,680	7,510	13,810

Device	Routing	Invert	Outlet Devices
#1	Primary	675.90'	**10.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 675.90' / 675.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf
#2	Device 1	675.90'	**4.0" Vert. 4" orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	678.85'	**24.0" x 24.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.74 cfs @ 13.67 hrs HW=678.97' (Free Discharge)
└**1=Culvert** (Passes 1.74 cfs of 4.24 cfs potential flow)
  ├**2=4" orifice** (Orifice Controls 0.72 cfs @ 8.20 fps)
  └**3=Grate** (Weir Controls 1.02 cfs @ 1.11 fps)

Pond 1P: (new Pond)



Summary for Pond 2P: Bioretention Area

Inflow Area = 17,424 sf, 62.50% Impervious, Inflow Depth = 4.21" for 100-Year event
Inflow = 0.81 cfs @ 12.68 hrs, Volume= 6,107 cf
Outflow = 0.81 cfs @ 12.73 hrs, Volume= 6,107 cf, Atten= 0%, Lag= 3.2 min
Primary = 0.81 cfs @ 12.73 hrs, Volume= 6,107 cf
Routed to Pond 1P : (new Pond)

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 681.54' @ 12.73 hrs Surf.Area= 768 sf Storage= 470 cf

Plug-Flow detention time= 88.3 min calculated for 6,107 cf (100% of inflow)
Center-of-Mass det. time= 88.1 min (927.1 - 839.0)

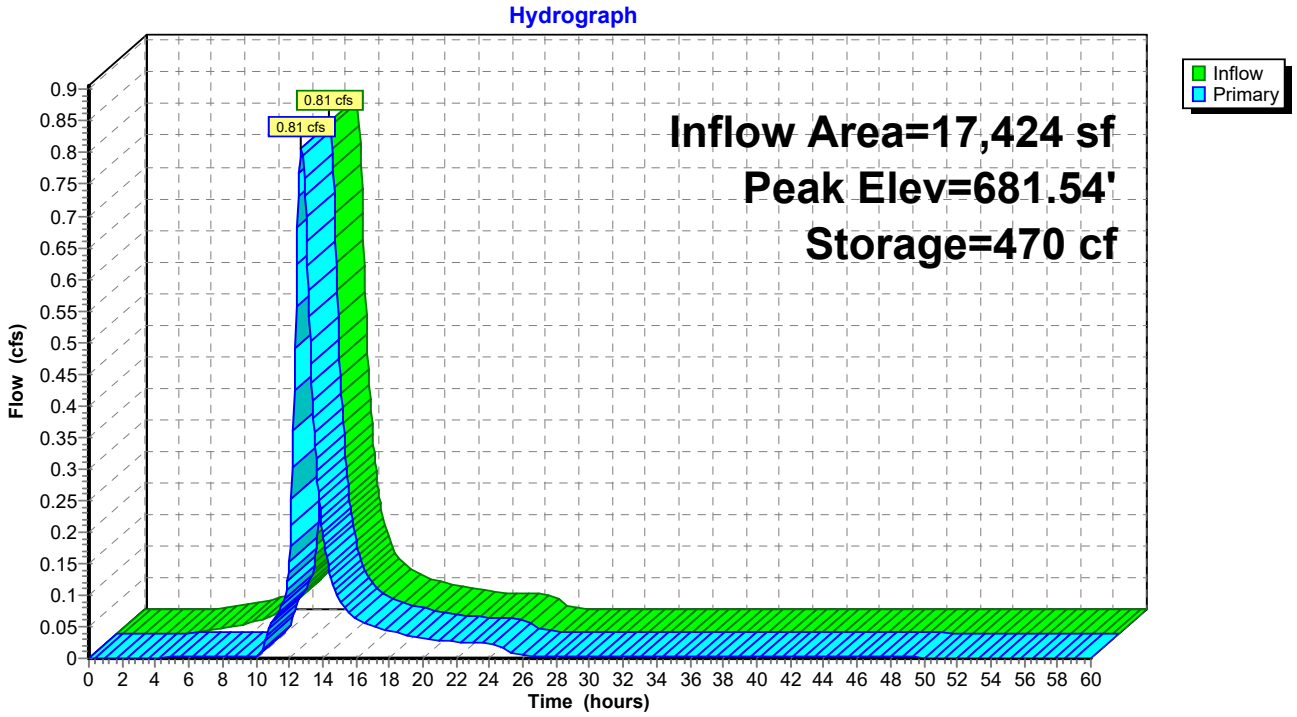
Volume	Invert	Avail.Storage	Storage Description
#1	680.80'	684 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.80	515	0	0
681.30	675	298	298
681.80	870	386	684

Device	Routing	Invert	Outlet Devices
#1	Primary	678.30'	**6.0" Round 6" pipe** L= 61.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 678.30' / 678.11' S= 0.0031 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	681.30'	**8.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	680.80'	**0.250 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 670.00'

Primary OutFlow Max=0.80 cfs @ 12.73 hrs HW=681.54' (Free Discharge)
└**1=6" pipe** (Passes 0.80 cfs of 1.07 cfs potential flow)
└**2=Grate** (Weir Controls 0.80 cfs @ 1.60 fps)
└**3=Exfiltration** (Controls 0.00 cfs)

Pond 2P: Bioretention Area



Summary for Pond 4P: Bioretention Area

Inflow Area = 10,890 sf, 40.00% Impervious, Inflow Depth = 3.78" for 100-Year event
Inflow = 1.50 cfs @ 11.99 hrs, Volume= 3,434 cf
Outflow = 1.43 cfs @ 12.01 hrs, Volume= 3,434 cf, Atten= 4%, Lag= 1.3 min
Primary = 1.43 cfs @ 12.01 hrs, Volume= 3,434 cf
Routed to Pond 1P : (new Pond)

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Peak Elev= 680.72' @ 12.01 hrs Surf.Area= 858 sf Storage= 493 cf

Plug-Flow detention time= 141.1 min calculated for 3,431 cf (100% of inflow)
Center-of-Mass det. time= 142.2 min (940.2 - 798.0)

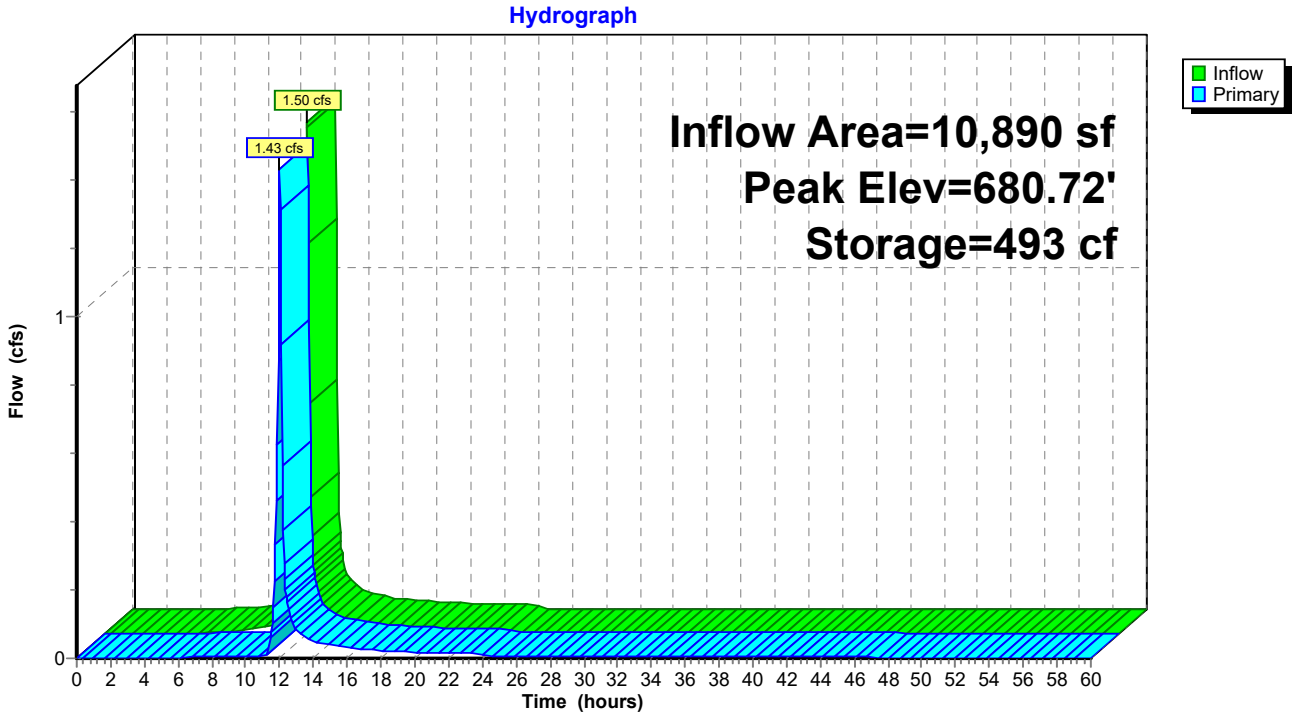
Volume	Invert	Avail.Storage	Storage Description
#1	680.00'	751 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.00	510	0	0
680.50	750	315	315
681.00	995	436	751

Device	Routing	Invert	Outlet Devices
#1	Primary	677.36'	**6.0" Round 6" pipe** L= 22.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 677.36' / 677.30' S= 0.0027 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	680.50'	**8.0" Horiz. Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	680.00'	**0.250 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 670.00'

Primary OutFlow Max=1.41 cfs @ 12.01 hrs HW=680.72' (Free Discharge)
└**1=6" pipe** (Passes 1.41 cfs of 1.50 cfs potential flow)
└**2=Grate** (Weir Controls 1.40 cfs @ 1.53 fps)
└**3=Exfiltration** (Controls 0.01 cfs)

Pond 4P: Bioretention Area



Green Infrastructure & Water Quality Calculations

Step 2 - Calculate Water Quality Volume

Is this project subject to Section 4.3 of the NYS Design Manual for Enhanced Phosphorus Removal?	No
What is the nature of this construction project?	

Design Point:	1		
P=	1.00	inches	*Enter 90% Rainfall Event as P*

Calculate Required WQv

Drainage Area Number	Contributing Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (cf)	SMP Description
1	0.40	0.25	63	0.61	889	
2	0.25	0.10	40	0.41	372	
3	1.75	0.70	40	0.41	2,605	
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
Total	2.40	1.05	44	0.44	**3866**	**Required WQv**

Minimum RRv

Enter the Soils Data for the site		
Soil Group	Acres	S
A		55%
B		40%
C		30%
D	**2.40**	20%
Total Area	2.4	
Calculate the Minimum RRv		
S =	**0.20**	
Impervious =	1.05	*acre*
Precipitation	1	*in*
Rv	0.95	
Minimum RRv	**724**	***ft3***
	0.02	af

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)

k — The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point:	1

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
1	0.40	0.25	0.63	0.61	889.35	1.00	
Enter Impervious Area Reduced by Disconnection of Rooftops			63%	0.61	889	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.						*ft^3*	

Soil Information			
Soil Group	D		
Soil Infiltration Rate	0.00	*in/hour*	*Okay*
Using Underdrains?	Yes	*Okay*	

Calculate the Minimum Filter Area				
		Value	Units	Notes
WQv		889	*ft^3*	
Enter Depth of Soil Media	*df*	1.5	*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity	*k*	0.5	*ft/day*	
Enter Average Height of Ponding	*hf*	0.5	*ft*	*6 inches max.*
Enter Filter Time	*tf*	2	*days*	
Required Filter Area	***Af***	**667**	***ft^2***	

Determine Actual Bio-Retention Area			
Filter Width	25	*ft*	
Filter Length	27	*ft*	
Filter Area	675	*ft^2*	
Actual Volume Provided	900	*ft^3*	

Determine Runoff Reduction			
Is the Bioretention contributing flow to another practice?	No	Select Practice	
RRv	360		
RRv applied	**360**	***ft^3***	***This is 40% of the storage provided or WQv whichever is less.***
Volume Treated	529	*ft^3*	*This is the portion of the WQv that is not reduced in the practice.*
Volume Directed	0	*ft^3*	This volume is directed another practice
Sizing √	OK		*Check to be sure Area provided ≥ Af*

Bioretention Worksheet

(For use on HSG C or D Soils with underdrains)

Af=WQv*(df)/[k*(hf+df)(tf)]

Af	Required Surface Area (ft2)
WQv	Water Quality Volume (ft3)
df	Depth of the Soil Medium (feet)
hf	Average height of water above the planter bed
tf	Volume Through the Filter Media (days)

k — The hydraulic conductivity [ft/day], can be varied depending on the properties of the soil media. Some reported conductivity values are: ***Sand*** - 3.5 ft/day (City of Austin 1988); ***Peat*** - 2.0 ft/day (Galli 1990); ***Leaf Compost*** - 8.7 ft/day (Claytor and Schueler, 1996); ***Bioretention Soil*** (0.5 ft/day (Claytor &

Design Point:	1

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
2	0.25	0.10	0.40	0.41	372.08	1.00	
Enter Impervious Area Reduced by Disconnection of Rooftops			40%	0.41	372	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.						*ft^3*	

Soil Information			
Soil Group	D		
Soil Infiltration Rate	0.00	*in/hour*	*Okay*
Using Underdrains?	Yes	*Okay*	

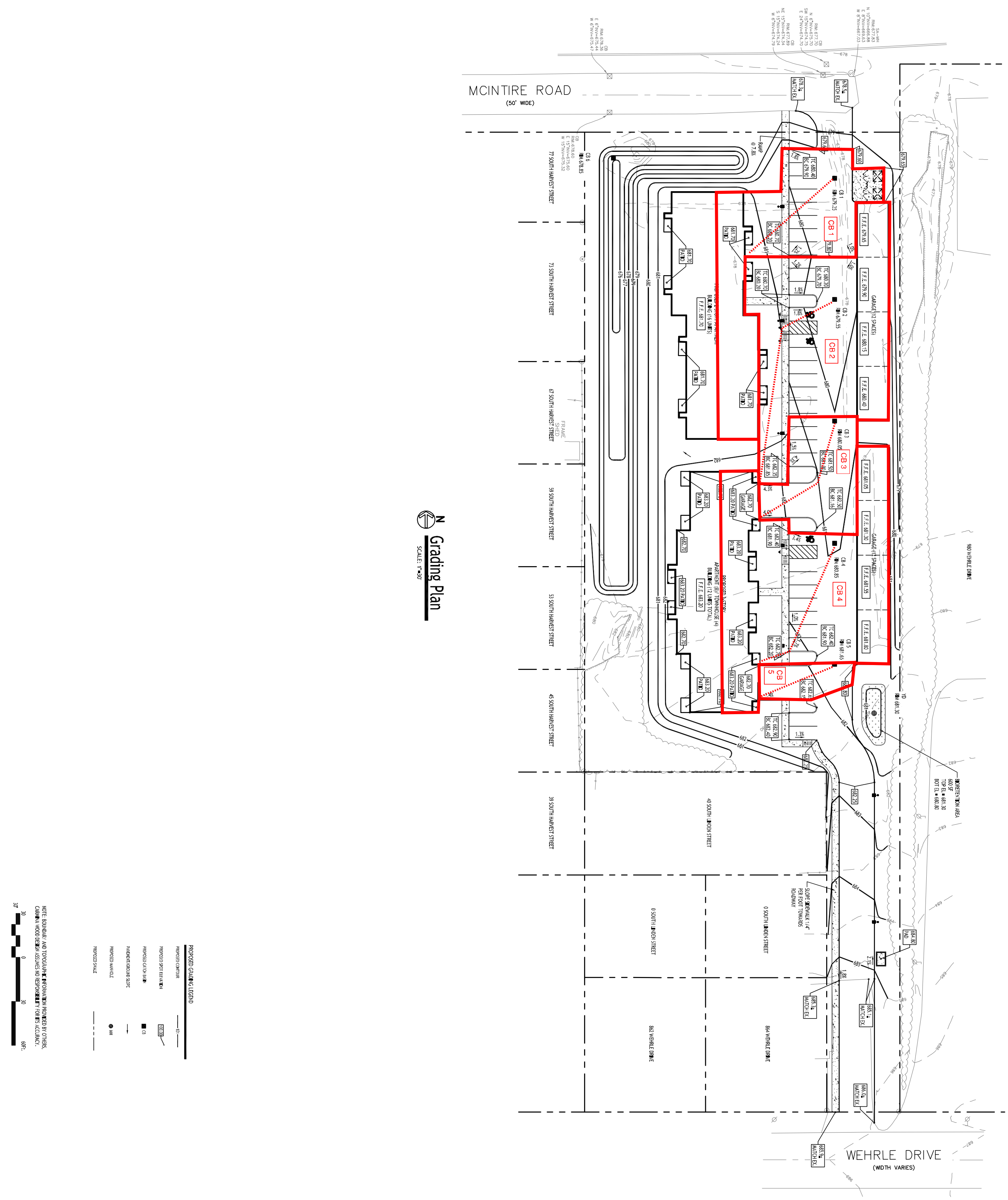
Calculate the Minimum Filter Area				
		Value	Units	Notes
WQv		372	*ft^3*	
Enter Depth of Soil Media	*df*	1.5	*ft*	*2.5-4 ft*
Enter Hydraulic Conductivity	*k*	0.5	*ft/day*	
Enter Average Height of Ponding	*hf*	0.5	*ft*	*6 inches max.*
Enter Filter Time	*tf*	2	*days*	
Required Filter Area	***Af***	**279**	***ft^2***	

Determine Actual Bio-Retention Area			
Filter Width	75	*ft*	
Filter Length	10	*ft*	
Filter Area	750	*ft^2*	
Actual Volume Provided	1000	*ft^3*	

Determine Runoff Reduction			
Is the Bioretention contributing flow to another practice?	No	Select Practice	
RRv	400		
RRv applied	**372**	***ft^3***	***This is 40% of the storage provided or WQv whichever is less.***
Volume Treated	0	*ft^3*	*This is the portion of the WQv that is not reduced in the practice.*
Volume Directed	0	*ft^3*	This volume is directed another practice
Sizing √	OK		*Check to be sure Area provided ≥ Af*

Appendix C

Storm Pipe Sizing Calculations



REVISIONS:

No.	Description	Date

Multi-Family Development

0, 46-84 S Linden Street
Amherst, NY

CARMINA WOOD DESIGN
Buffalo | Utica | Greensboro

DRAWING NAME:
Grading Plan

Date: 9/22/25
Drawn By: C. Wood
Scale: As Noted

DRAWING NO.
C-200

Project No: 23-4154

Storm Drainage Pipe Size																				
Structure CB/MH			Runoff Areas (acres)			Overland Flow				Pipe Flow		C	Tc				I	Q	Slope	Pipe Size
			Runoff Area (acres)	Green Space (acres)	Impervious area (acres)	Green D	Green Slope	Imp. D	Imp. Slope	Pipe Length	Vel.		Green Tc	Imp. Tc	Pipe Tc	Tc				
CB 5	to	CB 4	0.037	0.000	0.037	0	0.00	55	1.50			0.90	0.00	2.33		2.33	5.50	0.18	0.3%	12" HDPE
CB 4	to	CB 3	0.347	0.034	0.314					82	2.70	0.83			0.51	2.84	5.50	1.59	0.3%	12" HDPE
CB 3	to	CB 2	0.444	0.041	0.403					82	2.70	0.84			0.51	3.34	5.50	2.04	0.3%	12" HDPE
CB 2	to	CB 1	0.717	0.103	0.614					82	3.62	0.80			0.38	3.72	5.50	3.15	0.4%	15" HDPE
CB 1	to	POND	0.918	0.128	0.790					65	3.62	0.80			0.30	4.02	5.50	4.05	0.4%	15" HDPE

Manning's Equation for Circular Pipes Flowing Full

Slope(%) = 0.3

n = 0.012 hdpe

n = 0.013 concrete

n = 0.02 cmp

Diameter (ft)	Diameter (in)	Area (ft^2)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	HDPE		CONCRETE		CMP	
					Flow (cfs)	Velocity (ft/s)	Flow (cfs)	Velocity (ft/s)	Flow (cfs)	Velocity (ft/s)
0.33	4	0.1	1.05	0.08	0.11	1.30	0.10	1.20	0.07	0.78
0.5	6	0.2	1.57	0.13	0.33	1.70	0.31	1.57	0.20	1.02
0.67	8	0.3	2.09	0.17	0.72	2.06	0.66	1.90	0.43	1.24
0.83	10	0.5	2.62	0.21	1.30	2.39	1.20	2.21	0.78	1.43
1	12	0.8	3.14	0.25	2.12	2.70	1.96	2.49	1.27	1.62
1.25	15	1.2	3.93	0.31	3.84	3.13	3.55	2.89	2.31	1.88
1.5	18	1.8	4.71	0.38	6.25	3.54	5.77	3.26	3.75	2.12
1.75	21	2.4	5.50	0.44	9.43	3.92	8.70	3.62	5.66	2.35
2	24	3.1	6.28	0.50	13.46	4.28	12.42	3.95	8.08	2.57
2.5	30	4.9	7.85	0.63	24.40	4.97	22.53	4.59	14.64	2.98
3	36	6.1	9.04	0.67	31.57	5.21	29.14	4.81	18.94	3.13
3.5	42	9.6	11.00	0.88	59.86	6.22	55.25	5.74	35.92	3.73
4	48	12.6	12.57	1.00	85.46	6.80	78.89	6.28	51.28	4.08
4.5	54	15.9	14.14	1.13	117.00	7.36	108.00	6.79	70.20	4.41
5	60	19.6	15.71	1.25	154.95	7.89	143.03	7.28	92.97	4.74
6	72	28.3	18.85	1.50	251.97	8.91	232.59	8.23	151.18	5.35
7	84	38.5	21.99	1.75	380.08	9.88	350.84	9.12	228.05	5.93
8	96	50.3	25.13	2.00	542.65	10.80	500.91	9.97	325.59	6.48

Manning's Equation for Circular Pipes Flowing Full

Slope(%) = 0.4

n = 0.012 hdpe

n = 0.013 concrete

n = 0.02 cmp

Diameter (ft)	Diameter (in)	Area (ft^2)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	HDPE		CONCRETE		CMP	
					Flow (cfs)	Velocity (ft/s)	Flow (cfs)	Velocity (ft/s)	Flow (cfs)	Velocity (ft/s)
0.33	4	0.1	1.05	0.08	0.13	1.50	0.12	1.38	0.08	0.90
0.5	6	0.2	1.57	0.13	0.39	1.96	0.36	1.81	0.23	1.18
0.67	8	0.3	2.09	0.17	0.83	2.38	0.77	2.20	0.50	1.43
0.83	10	0.5	2.62	0.21	1.51	2.76	1.39	2.55	0.90	1.66
1	12	0.8	3.14	0.25	2.45	3.12	2.26	2.88	1.47	1.87
1.25	15	1.2	3.93	0.31	4.44	3.62	4.10	3.34	2.66	2.17
1.5	18	1.8	4.71	0.38	7.22	4.08	6.66	3.77	4.33	2.45
1.75	21	2.4	5.50	0.44	10.89	4.53	10.05	4.18	6.53	2.72
2	24	3.1	6.28	0.50	15.54	4.95	14.35	4.57	9.33	2.97
2.5	30	4.9	7.85	0.63	28.18	5.74	26.01	5.30	16.91	3.44
3	36	6.1	9.04	0.67	36.45	6.02	33.65	5.55	21.87	3.61
3.5	42	9.6	11.00	0.88	69.12	7.18	63.80	6.63	41.47	4.31
4	48	12.6	12.57	1.00	98.68	7.85	91.09	7.25	59.21	4.71
4.5	54	15.9	14.14	1.13	135.10	8.49	124.71	7.84	81.06	5.10
5	60	19.6	15.71	1.25	178.93	9.11	165.16	8.41	107.36	5.47
6	72	28.3	18.85	1.50	290.95	10.29	268.57	9.50	174.57	6.17
7	84	38.5	21.99	1.75	438.88	11.40	405.12	10.53	263.33	6.84
8	96	50.3	25.13	2.00	626.60	12.47	578.40	11.51	375.96	7.48