

# YANNACCONE, VILLA & ALDRICH, LLC

*Civil Engineers & Land Surveyors*



460 MAIN STREET, P.O. BOX 459  
CHESTER, NEW JERSEY 07930  
PHONE: 908-879-6646  
www.yvallc.com

Gregory E. Yannaccone, PE  
Christopher J. Aldrich, PLS, PP

Ryan L. Smith, PE, PLS, CME  
Rudy L. Holzmann, PE, CME

## **Stormwater Management Report: Proposed Residence**

**For the  
Chowdhury Property  
93 Sunset Drive  
Block 62.09 Lot 13  
Township of Chatham**

**WO # 222096**

**July 7, 2023**

A handwritten signature in black ink, appearing to read 'Rudy L. Holzmann', written over a horizontal line.

Rudy L. Holzmann, PE  
NJPE Lic. No. 43842

## **Table of Contents**

Project Narrative	1-2
-------------------	-----

### **Appendices**

Key Map	A
Summary of Results: Pre & Post Peak Flow Reduction for 2 & 10 Year Events, 100 Yr	B
Drywell Calculations	C
Hydrologic & Hydraulic Analysis of Existing Drainage Areas	D
Hydrologic & Hydraulic Analysis of Proposed Drainage Areas	E
Reference Material and Soil Testing Results	F

### **Inserts**

Drainage Area Map	1 of 1
-------------------	--------

## **Project Description**

The site is known as Block 62.09, Lot 13, located in the Township of Chatham, Morris County, New Jersey. The property consists of 0.64 acres with frontage along Sunset Drive. The lot is developed with an existing single-family dwelling, patio, and a paved driveway entering from Sunset Drive. The remainder of the property is covered by lawn with sparse tree coverage. No known wetlands or transition areas exist within the subject property or within 150 feet of any proposed disturbance. No known Category One Waters exist within the subject property or within 300 feet of any proposed disturbance.

The purpose of this development is to raze the existing on-site dwelling and attached improvements and construct a new single-family residence. A new paved driveway will provide access to the dwelling. The existing drainage characteristics of the lot have been maintained to the greatest extent possible under proposed conditions.

The analysis shows that stormwater runoff from the site flows overland to rear of the property.

The stormwater management system for this project consists of non-structural and structural measures to control the quantity of runoff. Proposed non-structural measures include minimized soil disturbance and preservation of existing drainage paths. The stormwater runoff from impervious cover will be controlled through a system of drywells. The drywells also have been designed to accommodate future build out of impervious areas up to the allowable zoning maximum of 7,575 sq. ft.

## **Design Standards**

The following standards were used to design the stormwater management system for this site:

1. Stormwater Runoff Quantity Control

The stormwater runoff quantity control for the proposed development includes detention and infiltration through a drywell system. The design demonstrates that post-construction peak runoff rates for the 2 and 10-year storm events are 50 and 75% respectively, of the pre-construction peak runoff rates. The design also demonstrates that the 100-year peak flows from the post development conditions do not exceed pre-development conditions.

2. Stormwater Runoff Quality Control

Per N.J.A.C. 7:8, since the proposed development does not create more than 0.25 net acres of additional impervious coverage, the measures to control stormwater runoff quality were not included as part of this report.

### 3. Groundwater Recharge

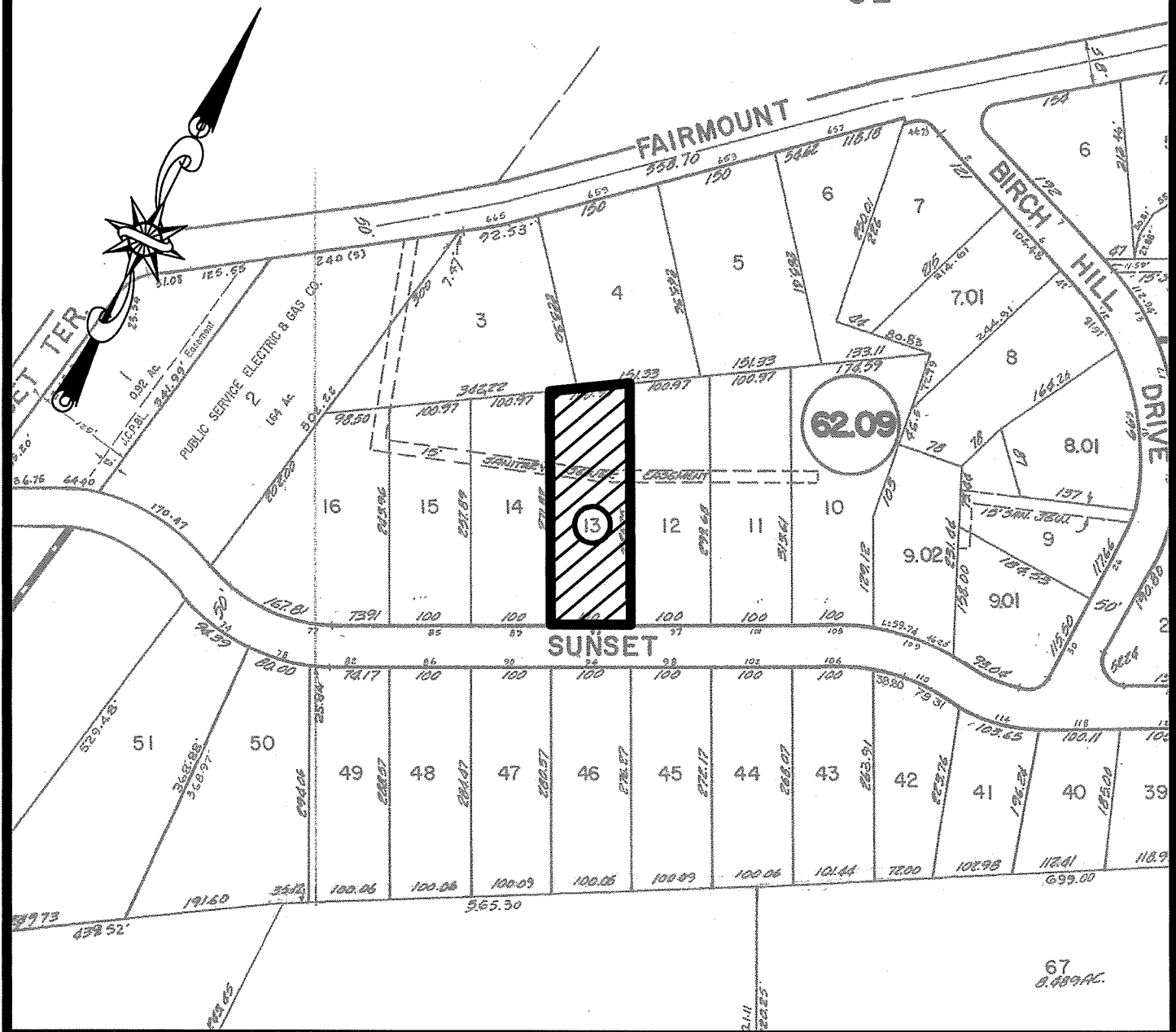
Per N.J.A.C. 7:8, since the proposed development does not create more than 0.25 net acres of additional impervious coverage or disturb more than one acre, an analysis of the annual groundwater recharge was not included as part of this report. We note that through the drywell system a significant portion of the runoff from more frequent storm events will be infiltrated.

### **Conclusion**

It has been demonstrated through hydrologic and hydraulic analysis that the stormwater management measures proposed comply with the quantity reductions required by the Township of Chatham.

# Appendix A

## Key Map



**KEY MAP**  
NOT TO SCALE

## Appendix B

Summary of Results: Pre & Post Peak  
Flow Reduction for 2 & 10 Year Events  
and 100 Year Event Analysis

**SUMMARY OF RESULTS**

**Total Drainage Area**

**Existing Peak Flows: HydroCAD Node 1S**

*(From HydroCAD Analysis)*

	2-Year Storm Event	10-Year Storm Event	100-Year Storm Event
Existing Peak Flow (Q,cfs)	0.56	1.26	2.75
Peak Flow (Q) Reduced to (%)	50%	75%	100%
Allowable Proposed Flow (cfs)	0.28	0.95	2.75
Existing Runoff Volume (ac-ft)	0.049	0.105	0.226

**Proposed Peak Flows: HydroCAD Node 5R**

*(From HydroCAD Analysis)*

	2-Year Storm Event	10-Year Storm Event	100-Year Storm Event
Proposed Peak Flow with routing (Q,cfs) (utilizes hydrograph summation)	0.25	0.68	2.62
Proposed Runoff Volume (ac-ft)	0.024	0.076	0.195

**RESULTS**

Peak Flow Reduction (Q,cfs)	2-Year	0.25 proposed <= 0.28 allowable	<b>O.K.</b>
	10-Year	0.68 proposed <= 0.95 allowable	<b>O.K.</b>
	100-Year	2.62 proposed <= 2.75 allowable	<b>O.K.</b>

Runoff Volume Reduction (ac-ft)	0.025	0.029	0.031
---------------------------------	-------	-------	-------

***Therefore, proposed peak flows from the drainage area meet the required peak flow reductions.***



## Appendix C

### Drywell Stage-Storage Calculations

STAGE-STORAGE ANALYSIS

Underground Detention :

4

STORAGE VOLUME - STONE VOIDS - TANK VOL.

ELEV (FT)	X-Sect.Pit Vol. 11 X11 Dry. (CU.FT.)	X-Sect.O.D.Vol. Per 8' Dia.TANK (CU.FT.)	X-Sect.O.D.Vol. * # Tanks (CU.FT.)	X-Sect. Stone Stor. Vol. (CU.FT.)	X-Sect.Storage Vol. @40% Void (CU.FT.)	X-Sect.Cum. Storage Vol. (CU.FT.)
82.9	0	0	0	0	0	0
83.9	484	0.00	0.00	484.00	193.60	193.60
84.9	484	50.27	201.06	282.94	113.2	306.78
85.9	484	50.27	201.06	282.94	113.2	419.95
86.9	484	50.27	201.06	282.94	113.2	533.13
87.9	484	50.27	201.06	282.94	113.2	646.30
88.9	484	50.27	201.06	282.94	113.2	759.48
89.9	484	50.27	201.06	282.94	113.2	872.65

STORAGE VOLUME - 8' DIA. TANKS

ELEV ( <u>FT.</u> )	Tot. Vol. Per Tank ( <u>CU.FT.</u> )	Tot. Vol. * # Tanks ( <u>CU.FT.</u> )	Cum.Tot.Vol. # Tanks ( <u>CU.FT./FT.</u> )
82.9	0	0	0
83.9	0.00	0.00	0.00
84.9	42.24	168.95	168.95
85.9	42.24	168.95	337.89
86.9	42.24	168.95	506.84
87.9	42.24	168.95	675.79
88.9	42.24	168.95	844.73
89.9	42.24	168.95	1013.68

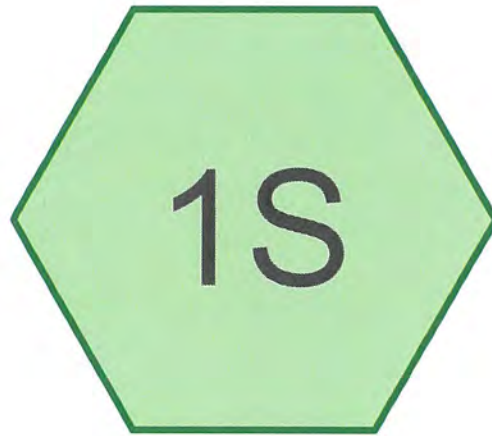
4

TOTAL CUMULATIVE STORAGE VOLUME - DRYWELLS :

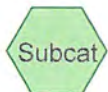
ELEV (FT)	STONE VOL. (CU.FT.)	TANK VOLUME (CU.FT.)	TOTAL VOLUME (CU.FT.)	TOTAL VOLUME (AC.-FT.)
82.9	0	0	0	0
83.9	194	0	194	0.0044
84.9	307	169	476	0.0109
85.9	420	338	758	0.0174
86.9	533	507	1040	0.0239
87.9	646	676	1322	0.0304
88.9	759	845	1604	0.0368
89.9	873	1014	1886	0.0433

## Appendix D

# Hydrologic & Hydraulic Analysis of Existing Drainage Areas



# Lot 13 EDA



**Routing Diagram for Existing Conditions**

Prepared by {enter your company name here}, Printed 7/13/2023  
HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

**Existing Conditions**

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.50"

Printed 7/13/2023

Page 2

**Summary for Subcatchment 1S: Lot 13 EDA**

Runoff = 0.56 cfs @ 12.16 hrs, Volume= 0.049 af, Depth> 1.06"

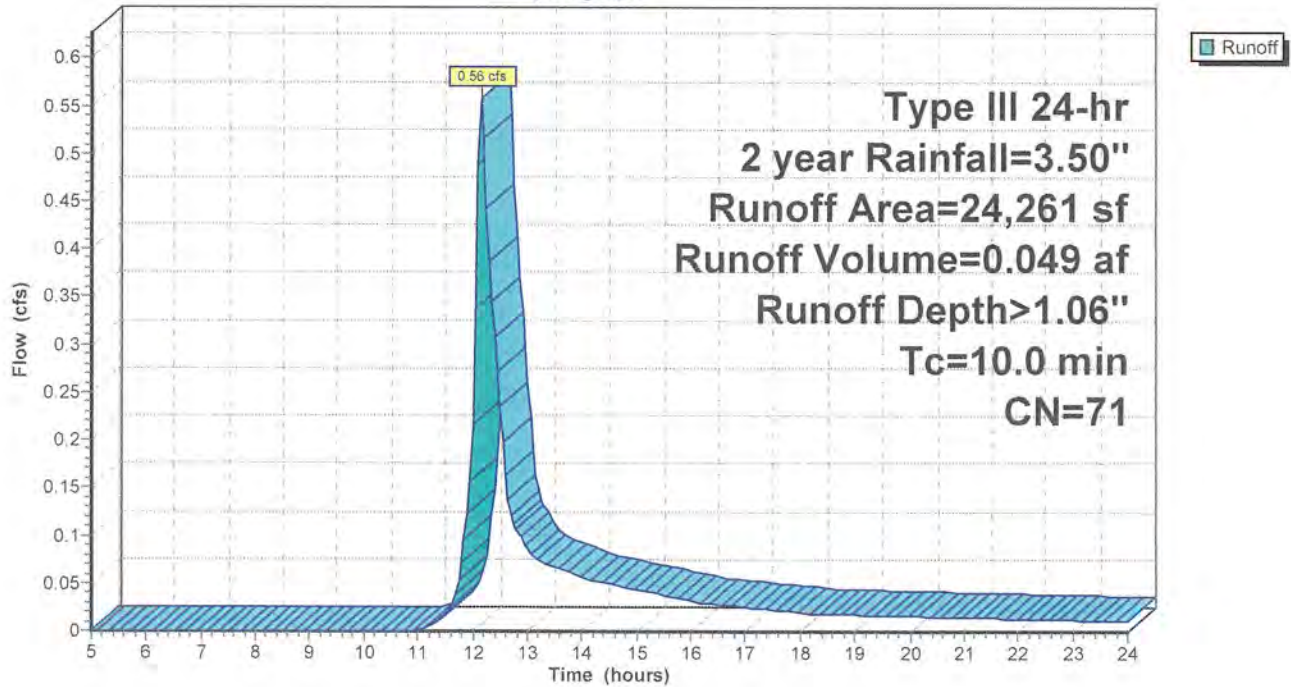
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2 year Rainfall=3.50"

	Area (sf)	CN	Description
	17,574	61	>75% Grass cover, Good, HSG B
*	6,583	98	Impervious
*	104	98	Impervious within R.O.W.
	24,261	71	Weighted Average
	17,574		72.44% Pervious Area
	6,687		27.56% Impervious Area

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

**Subcatchment 1S: Lot 13 EDA**

Hydrograph



**Existing Conditions**

Type III 24-hr 10 year Rainfall=5.20"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 3

**Summary for Subcatchment 1S: Lot 13 EDA**

Runoff = 1.26 cfs @ 12.15 hrs, Volume= 0.105 af, Depth> 2.26"

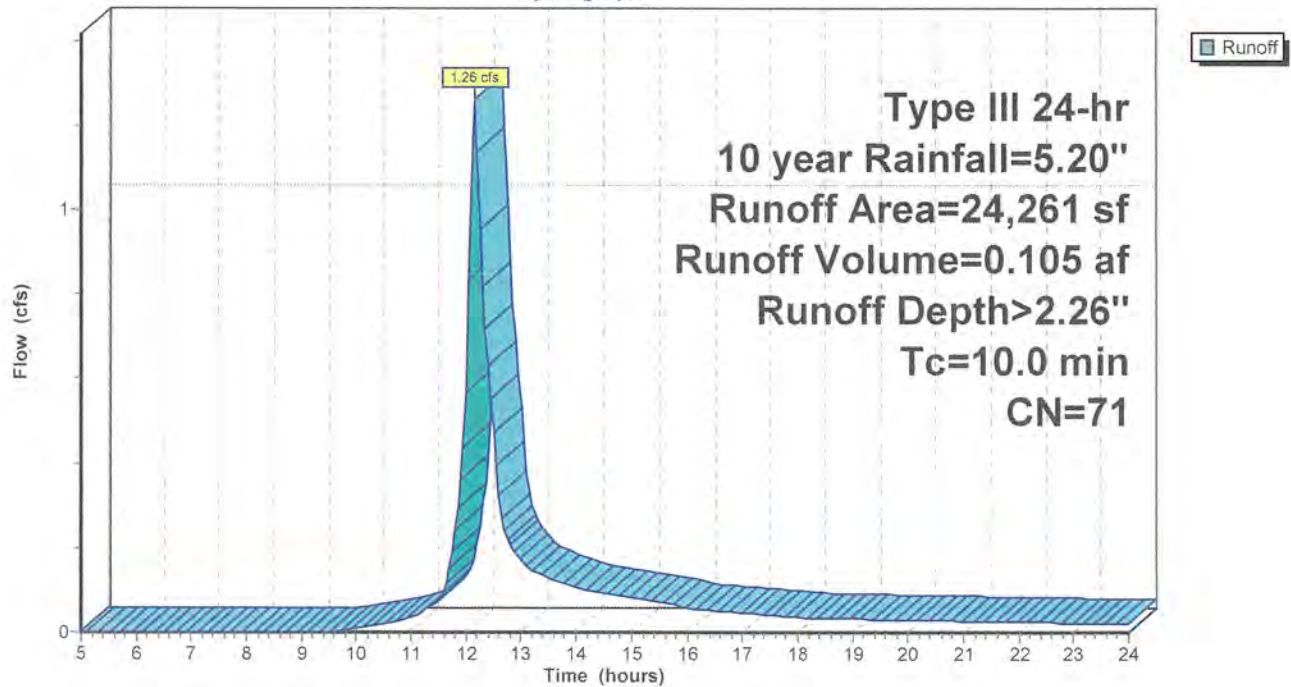
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10 year Rainfall=5.20"

Area (sf)	CN	Description
17,574	61	>75% Grass cover, Good, HSG B
* 6,583	98	Impervious
* 104	98	Impervious within R.O.W.
24,261	71	Weighted Average
17,574		72.44% Pervious Area
6,687		27.56% Impervious Area

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

**Subcatchment 1S: Lot 13 EDA**

Hydrograph





**Existing Conditions**

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100 yr Rainfall=8.35"

Printed 7/13/2023

Page 4

**Summary for Subcatchment 1S: Lot 13 EDA**

Runoff = 2.75 cfs @ 12.14 hrs, Volume= 0.226 af, Depth> 4.88"

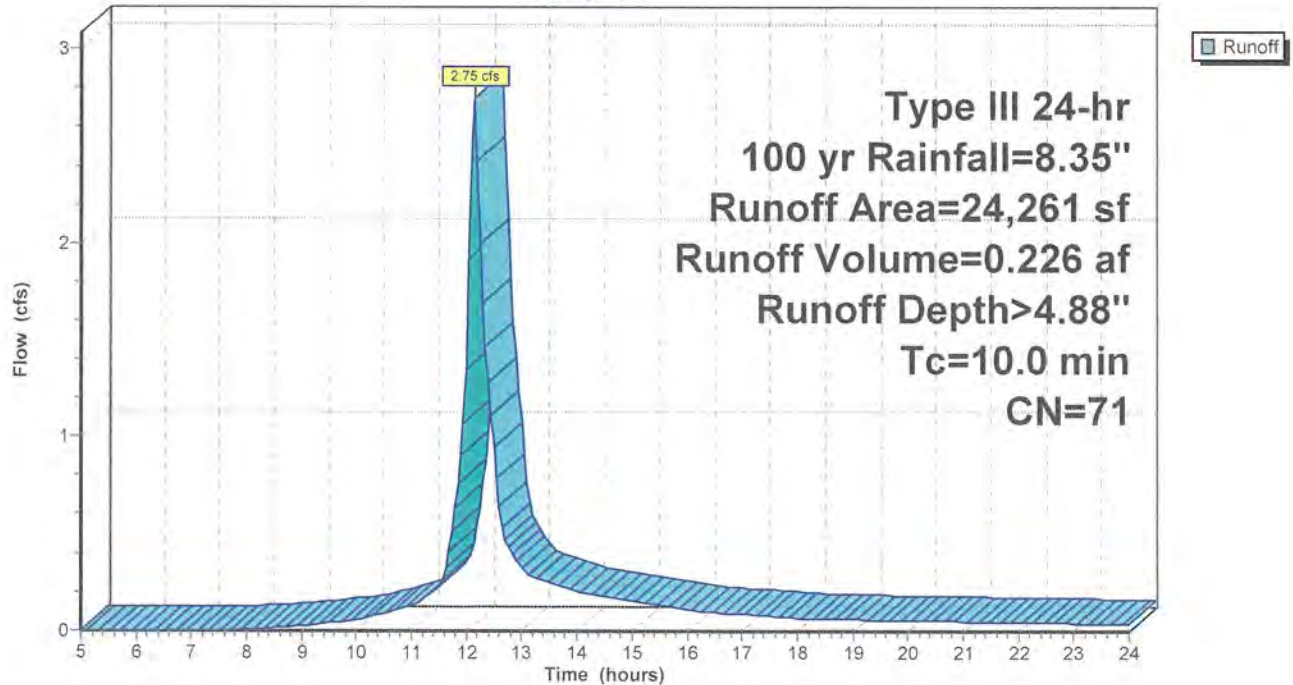
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100 yr Rainfall=8.35"

Area (sf)	CN	Description
17,574	61	>75% Grass cover, Good, HSG B
* 6,583	98	Impervious
* 104	98	Impervious within R.O.W.
24,261	71	Weighted Average
17,574		72.44% Pervious Area
6,687		27.56% Impervious Area

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

**Subcatchment 1S: Lot 13 EDA**

Hydrograph



## Appendix E

# Hydrologic & Hydraulic Analysis of Proposed Drainage Areas



PDA- Collected



Drywell



PDA



PDA-Overland



**Routing Diagram for Proposed Conditions**

Prepared by {enter your company name here}, Printed 7/13/2023  
HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

**Proposed Conditions**

Type III 24-hr 2 year Rainfall=3.50"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 2

**Summary for Subcatchment 2S: PDA- Collected**

Runoff = 0.43 cfs @ 12.14 hrs, Volume= 0.036 af, Depth> 2.54"

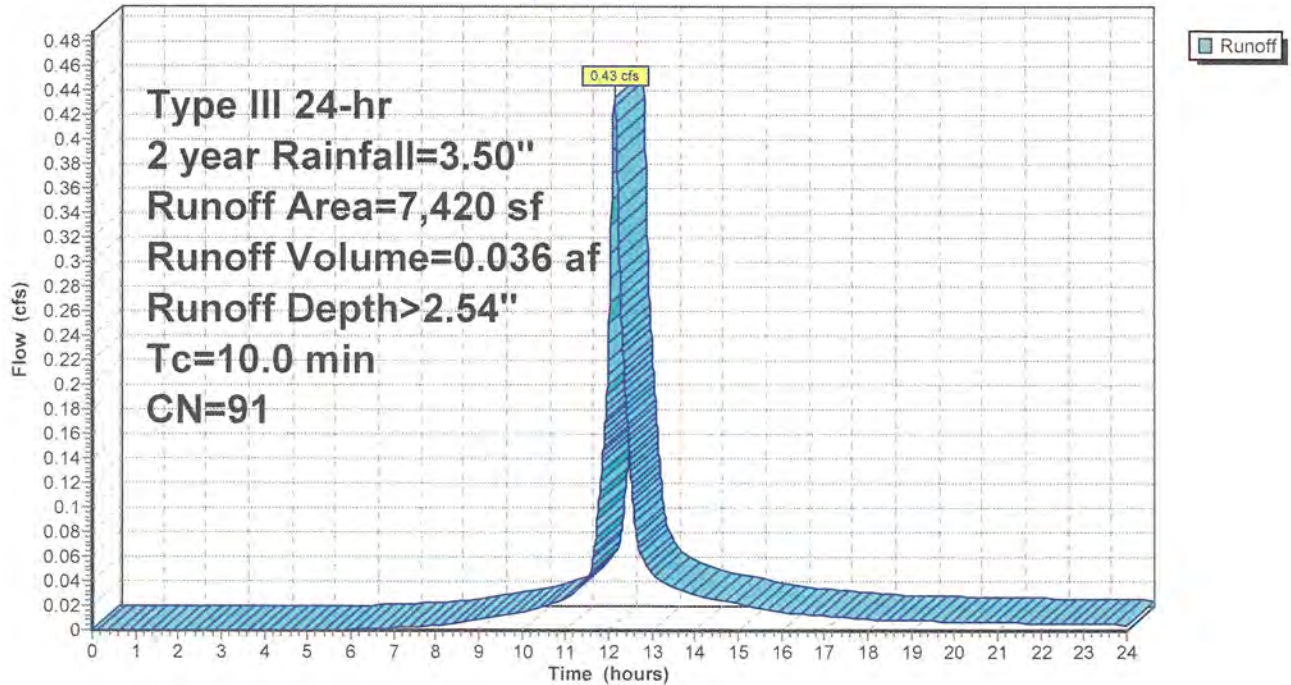
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2 year Rainfall=3.50"

	Area (sf)	CN	Description
*	5,916	98	Impervious
*	152	98	Impervious in R.O.W.
	1,352	61	>75% Grass cover, Good, HSG B
<hr/>			
	7,420	91	Weighted Average
	1,352		18.22% Pervious Area
	6,068		81.78% Impervious Area

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

**Subcatchment 2S: PDA- Collected**

Hydrograph



**Proposed Conditions**

Type III 24-hr 2 year Rainfall=3.50"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 3

**Summary for Subcatchment 3S: PDA-Overland**

Runoff = 0.25 cfs @ 12.16 hrs, Volume= 0.024 af, Depth> 0.75"

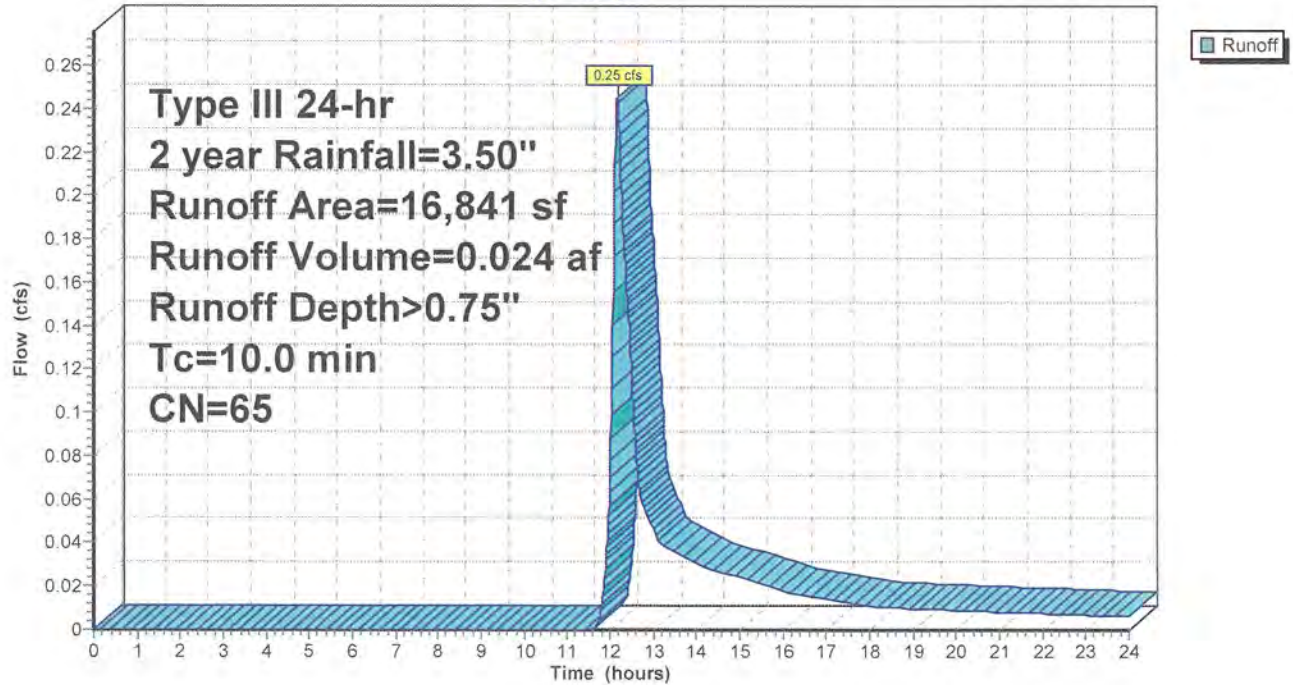
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 year Rainfall=3.50"

Area (sf)	CN	Description
15,158	61	>75% Grass cover, Good, HSG B
* 24	98	Impervious - (AC/Gen)
* 1,659	98	Impervious - Possible future build out
16,841	65	Weighted Average
15,158		90.01% Pervious Area
1,683		9.99% Impervious Area

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

**Subcatchment 3S: PDA-Overland**

Hydrograph



### Proposed Conditions

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.50"

Printed 7/13/2023

Page 4

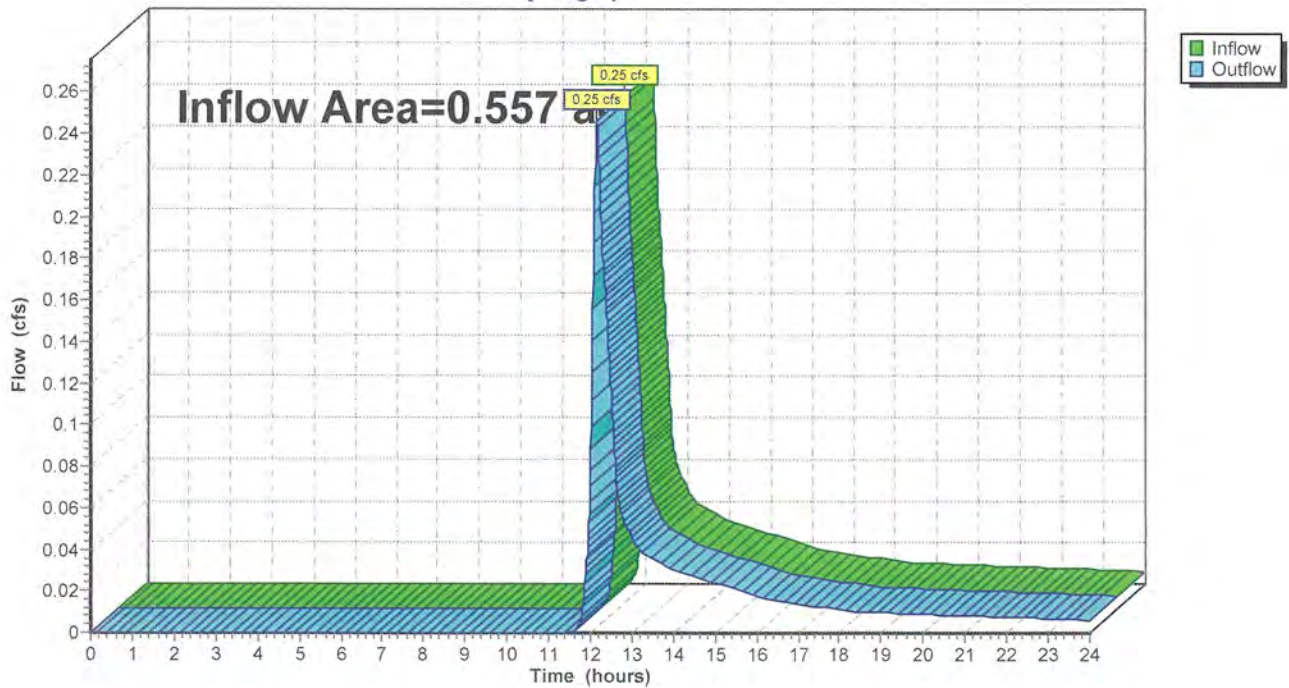
### Summary for Reach 5R: PDA

Inflow Area = 0.557 ac, 31.95% Impervious, Inflow Depth > 0.52" for 2 year event  
Inflow = 0.25 cfs @ 12.16 hrs, Volume= 0.024 af  
Outflow = 0.25 cfs @ 12.16 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 5R: PDA

Hydrograph



**Proposed Conditions**

Type III 24-hr 2 year Rainfall=3.50"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 5

**Summary for Pond 4P: Drywell**

Inflow Area = 0.170 ac, 81.78% Impervious, Inflow Depth > 2.54" for 2 year event  
 Inflow = 0.43 cfs @ 12.14 hrs, Volume= 0.036 af  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 401.31' @ 24.00 hrs Surf.Area= 0 sf Storage= 1,569 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	395.50'	1,928 cf	<b>Custom Stage Data</b> Listed below x 4

Elevation (feet)	Cum.Store (cubic-feet)
395.50	0
396.50	49
397.50	119
398.50	189
399.50	260
400.00	331
401.50	401
402.50	472
403.50	482

Device	Routing	Invert	Outlet Devices
#1	Primary	402.00'	<b>6.0" Vert. Orifice/Grate X 2.00</b> C= 0.600

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=395.50' (Free Discharge)  
 ↑1=Orifice/Grate ( Controls 0.00 cfs)

**Proposed Conditions**

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

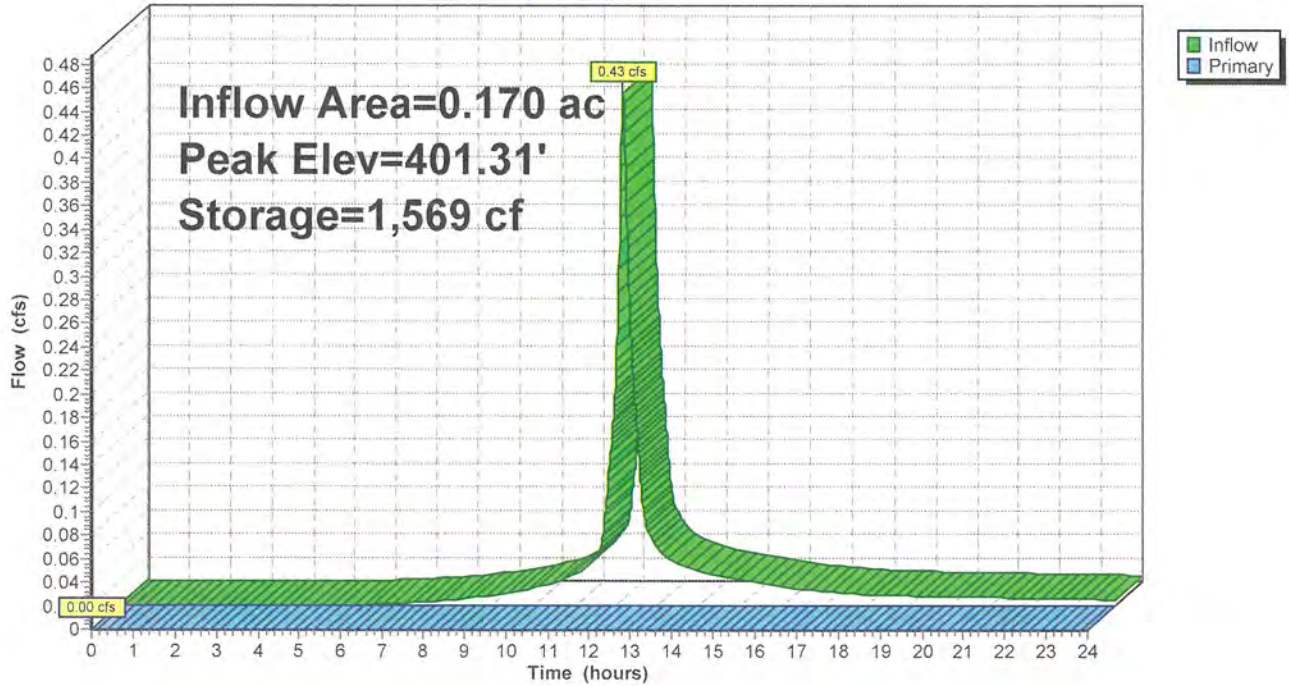
Type III 24-hr 2 year Rainfall=3.50"

Printed 7/13/2023

Page 6

**Pond 4P: Drywell**

**Hydrograph**





**Proposed Conditions**

Type III 24-hr 2 year Rainfall=3.50"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 7

**Stage-Area-Storage for Pond 4P: Drywell**

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
395.50	0	400.70	1,455
395.60	20	400.80	1,473
395.70	39	400.90	1,492
395.80	59	401.00	1,511
395.90	78	401.10	1,529
396.00	98	401.20	1,548
396.10	118	401.30	1,567
396.20	137	401.40	1,585
396.30	157	401.50	1,604
396.40	176	401.60	1,632
396.50	196	401.70	1,661
396.60	224	401.80	1,689
396.70	252	401.90	1,718
396.80	280	402.00	1,746
396.90	308	402.10	1,774
397.00	336	402.20	1,803
397.10	364	402.30	1,831
397.20	392	402.40	1,860
397.30	420	402.50	1,888
397.40	448	402.60	1,892
397.50	476	402.70	1,896
397.60	504	402.80	1,900
397.70	532	402.90	1,904
397.80	560	403.00	1,908
397.90	588	403.10	1,912
398.00	616	403.20	1,916
398.10	644	403.30	1,920
398.20	672	403.40	1,924
398.30	700	403.50	1,928
398.40	728		
398.50	756		
398.60	784		
398.70	813		
398.80	841		
398.90	870		
399.00	898		
399.10	926		
399.20	955		
399.30	983		
399.40	1,012		
399.50	1,040		
399.60	1,097		
399.70	1,154		
399.80	1,210		
399.90	1,267		
400.00	1,324		
400.10	1,343		
400.20	1,361		
400.30	1,380		
400.40	1,399		
400.50	1,417		
400.60	1,436		

**Proposed Conditions**

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=5.20"

Printed 7/13/2023

Page 8

**Summary for Subcatchment 2S: PDA- Collected**

Runoff = 0.70 cfs @ 12.14 hrs, Volume= 0.059 af, Depth> 4.17"

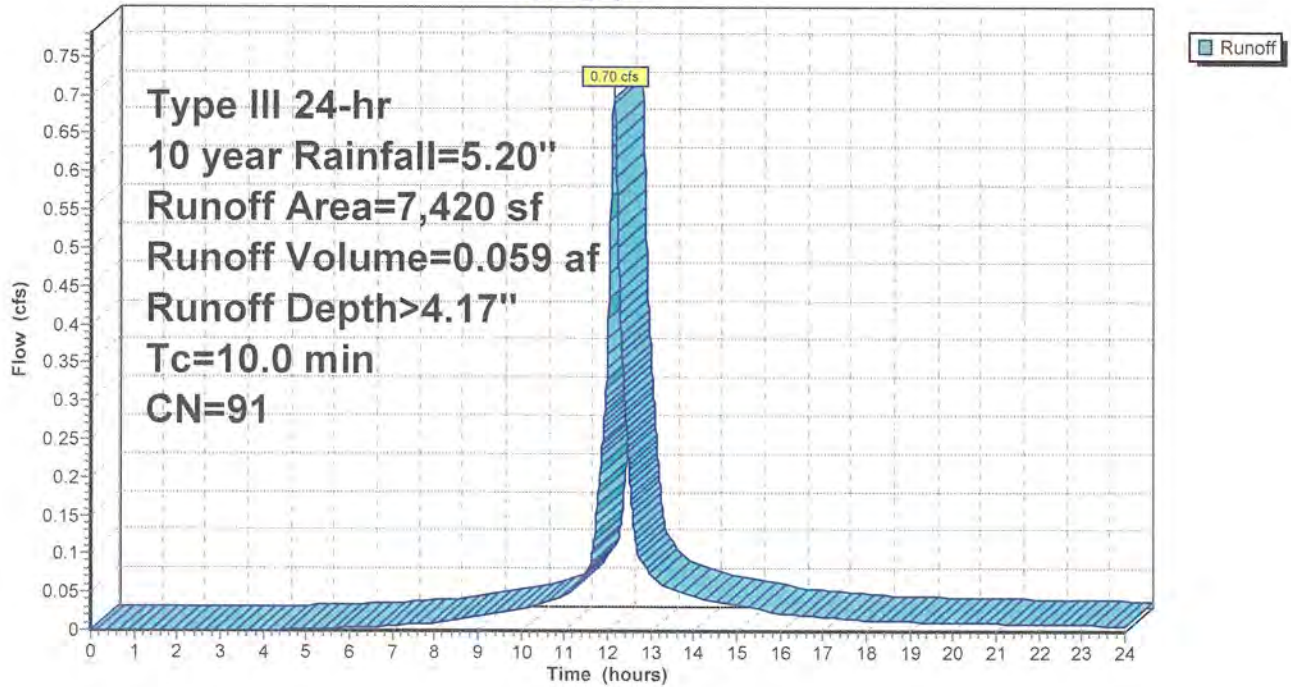
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 year Rainfall=5.20"

	Area (sf)	CN	Description
*	5,916	98	Impervious
*	152	98	Impervious in R.O.W.
	1,352	61	>75% Grass cover, Good, HSG B
	7,420	91	Weighted Average
	1,352		18.22% Pervious Area
	6,068		81.78% Impervious Area

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

**Subcatchment 2S: PDA- Collected**

Hydrograph



**Proposed Conditions**

Type III 24-hr 10 year Rainfall=5.20"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 9

**Summary for Subcatchment 3S: PDA-Overland**

Runoff = 0.68 cfs @ 12.15 hrs, Volume= 0.057 af, Depth> 1.78"

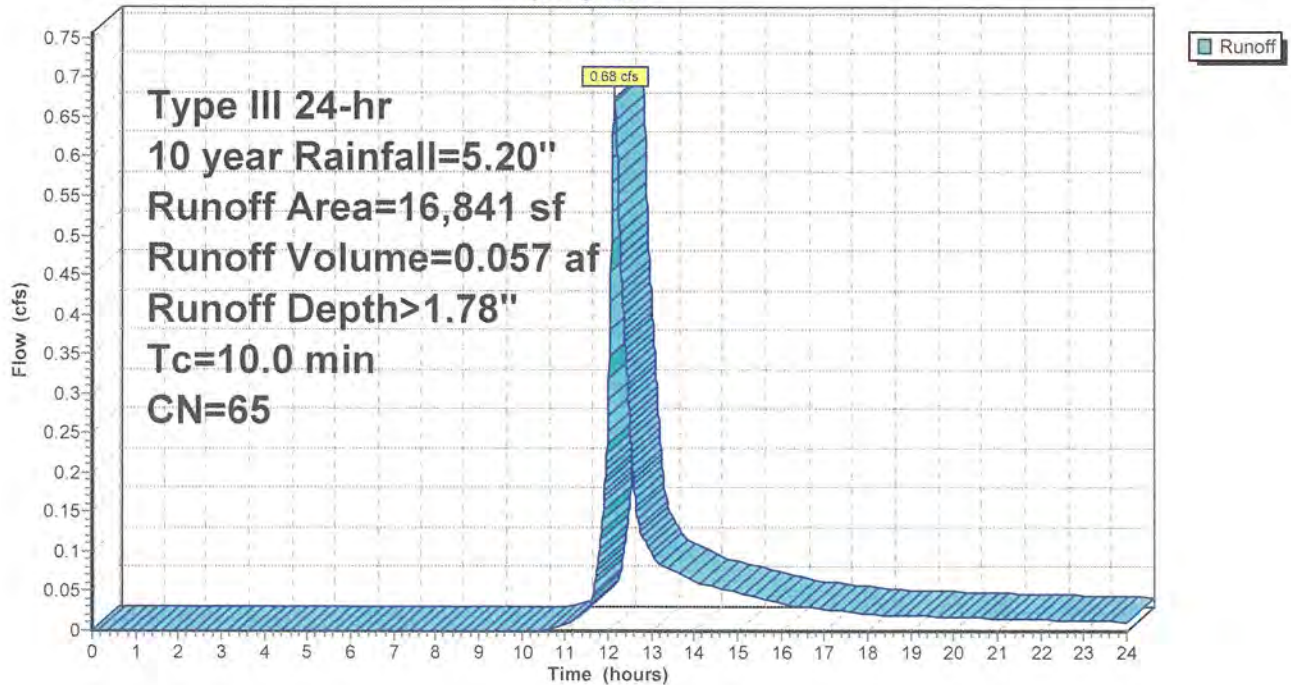
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 year Rainfall=5.20"

Area (sf)	CN	Description
15,158	61	>75% Grass cover, Good, HSG B
* 24	98	Impervious - (AC/Gen)
* 1,659	98	Impervious - Possible future build out
16,841	65	Weighted Average
15,158		90.01% Pervious Area
1,683		9.99% Impervious Area

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

**Subcatchment 3S: PDA-Overland**

Hydrograph



# Proposed Conditions

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=5.20"

Printed 7/13/2023

Page 10

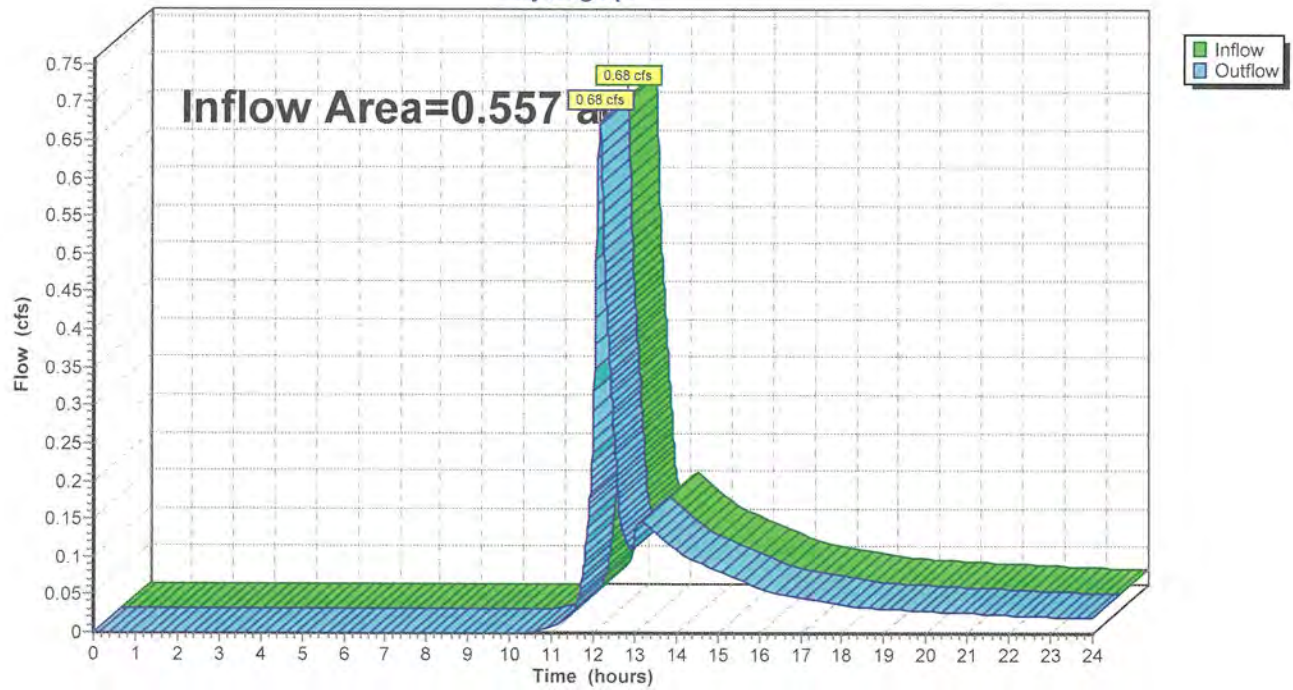
## Summary for Reach 5R: PDA

Inflow Area = 0.557 ac, 31.95% Impervious, Inflow Depth > 1.65" for 10 year event  
Inflow = 0.68 cfs @ 12.15 hrs, Volume= 0.076 af  
Outflow = 0.68 cfs @ 12.15 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 5R: PDA

Hydrograph



## Proposed Conditions

Type III 24-hr 10 year Rainfall=5.20"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 11

### Summary for Pond 4P: Drywell

Inflow Area = 0.170 ac, 81.78% Impervious, Inflow Depth > 4.17" for 10 year event  
Inflow = 0.70 cfs @ 12.14 hrs, Volume= 0.059 af  
Outflow = 0.06 cfs @ 13.18 hrs, Volume= 0.019 af, Atten= 91%, Lag= 62.7 min  
Primary = 0.06 cfs @ 13.18 hrs, Volume= 0.019 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Peak Elev= 402.10' @ 13.18 hrs Surf.Area= 0 sf Storage= 1,773 cf

Plug-Flow detention time= 348.2 min calculated for 0.019 af (32% of inflow)  
Center-of-Mass det. time= 204.5 min ( 992.7 - 788.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	395.50'	1,928 cf	<b>Custom Stage Data</b> Listed below x 4

Elevation (feet)	Cum.Store (cubic-feet)
395.50	0
396.50	49
397.50	119
398.50	189
399.50	260
400.00	331
401.50	401
402.50	472
403.50	482

Device	Routing	Invert	Outlet Devices
#1	Primary	402.00'	<b>6.0" Vert. Orifice/Grate X 2.00</b> C= 0.600

**Primary OutFlow** Max=0.05 cfs @ 13.18 hrs HW=402.10' (Free Discharge)  
↑1=Orifice/Grate (Orifice Controls 0.05 cfs @ 1.05 fps)

**Proposed Conditions**

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

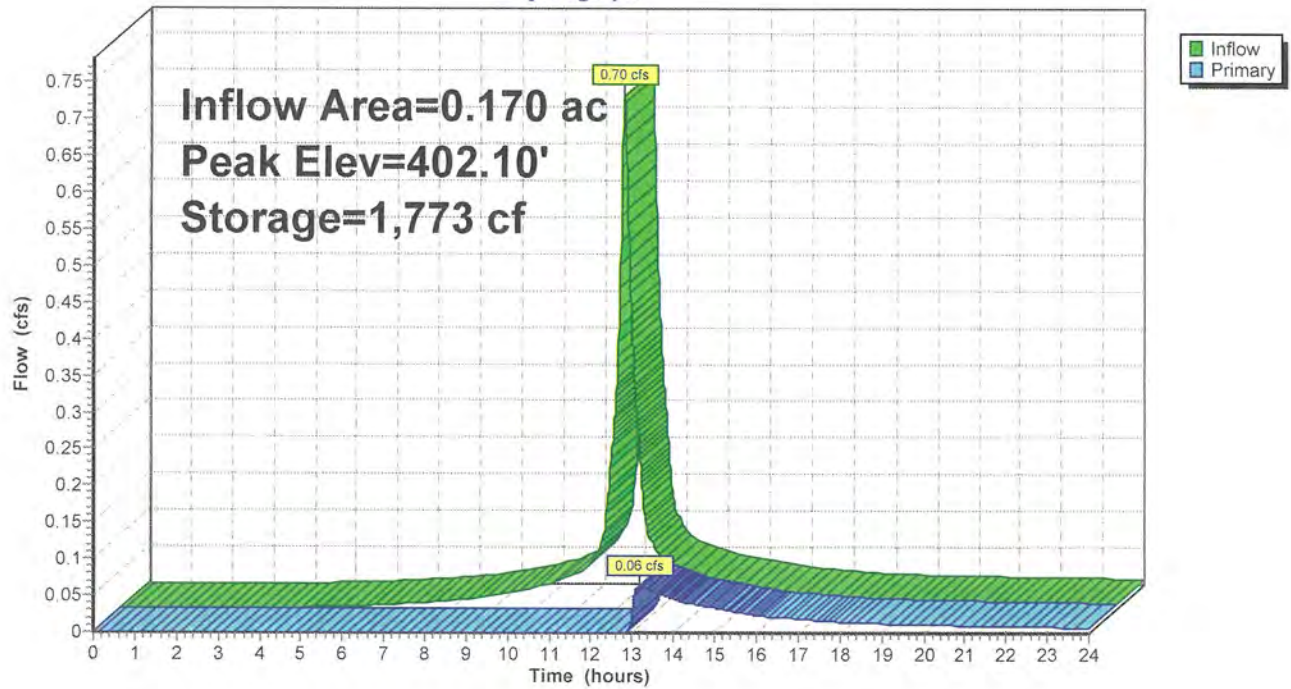
Type III 24-hr 10 year Rainfall=5.20"

Printed 7/13/2023

Page 12

**Pond 4P: Drywell**

Hydrograph



**Proposed Conditions**

Type III 24-hr 10 year Rainfall=5.20"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 13

**Stage-Area-Storage for Pond 4P: Drywell**

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
395.50	0	400.70	1,455
395.60	20	400.80	1,473
395.70	39	400.90	1,492
395.80	59	401.00	1,511
395.90	78	401.10	1,529
396.00	98	401.20	1,548
396.10	118	401.30	1,567
396.20	137	401.40	1,585
396.30	157	401.50	1,604
396.40	176	401.60	1,632
396.50	196	401.70	1,661
396.60	224	401.80	1,689
396.70	252	401.90	1,718
396.80	280	402.00	1,746
396.90	308	402.10	1,774
397.00	336	402.20	1,803
397.10	364	402.30	1,831
397.20	392	402.40	1,860
397.30	420	402.50	1,888
397.40	448	402.60	1,892
397.50	476	402.70	1,896
397.60	504	402.80	1,900
397.70	532	402.90	1,904
397.80	560	403.00	1,908
397.90	588	403.10	1,912
398.00	616	403.20	1,916
398.10	644	403.30	1,920
398.20	672	403.40	1,924
398.30	700	403.50	<b>1,928</b>
398.40	728		
398.50	756		
398.60	784		
398.70	813		
398.80	841		
398.90	870		
399.00	898		
399.10	926		
399.20	955		
399.30	983		
399.40	1,012		
399.50	1,040		
399.60	1,097		
399.70	1,154		
399.80	1,210		
399.90	1,267		
400.00	1,324		
400.10	1,343		
400.20	1,361		
400.30	1,380		
400.40	1,399		
400.50	1,417		
400.60	1,436		

**Proposed Conditions**

Type III 24-hr 100 year Rainfall=8.30"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 14

**Summary for Subcatchment 2S: PDA- Collected**

Runoff = 1.17 cfs @ 12.13 hrs, Volume= 0.102 af, Depth> 7.21"

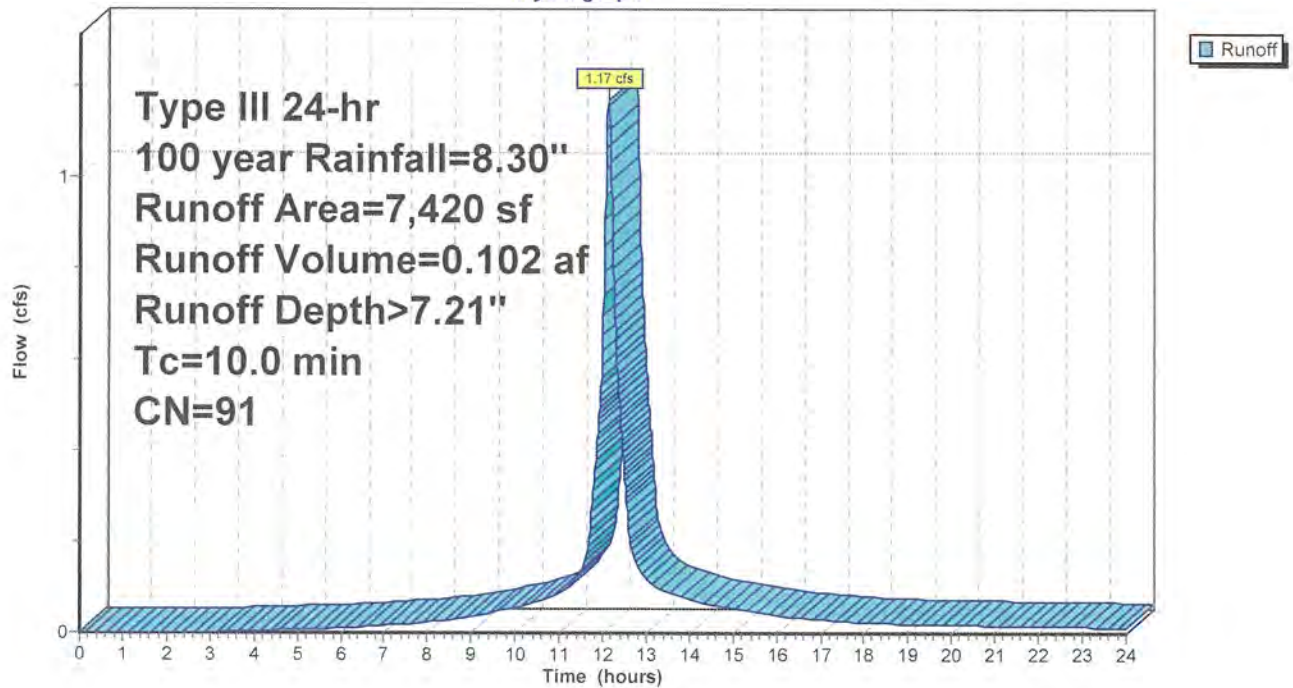
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 year Rainfall=8.30"

	Area (sf)	CN	Description
*	5,916	98	Impervious
*	152	98	Impervious in R.O.W.
	1,352	61	>75% Grass cover, Good, HSG B
	7,420	91	Weighted Average
	1,352		18.22% Pervious Area
	6,068		81.78% Impervious Area

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

**Subcatchment 2S: PDA- Collected**

Hydrograph





**Proposed Conditions**

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100 year Rainfall=8.30"

Printed 7/13/2023

Page 15

**Summary for Subcatchment 3S: PDA-Overland**

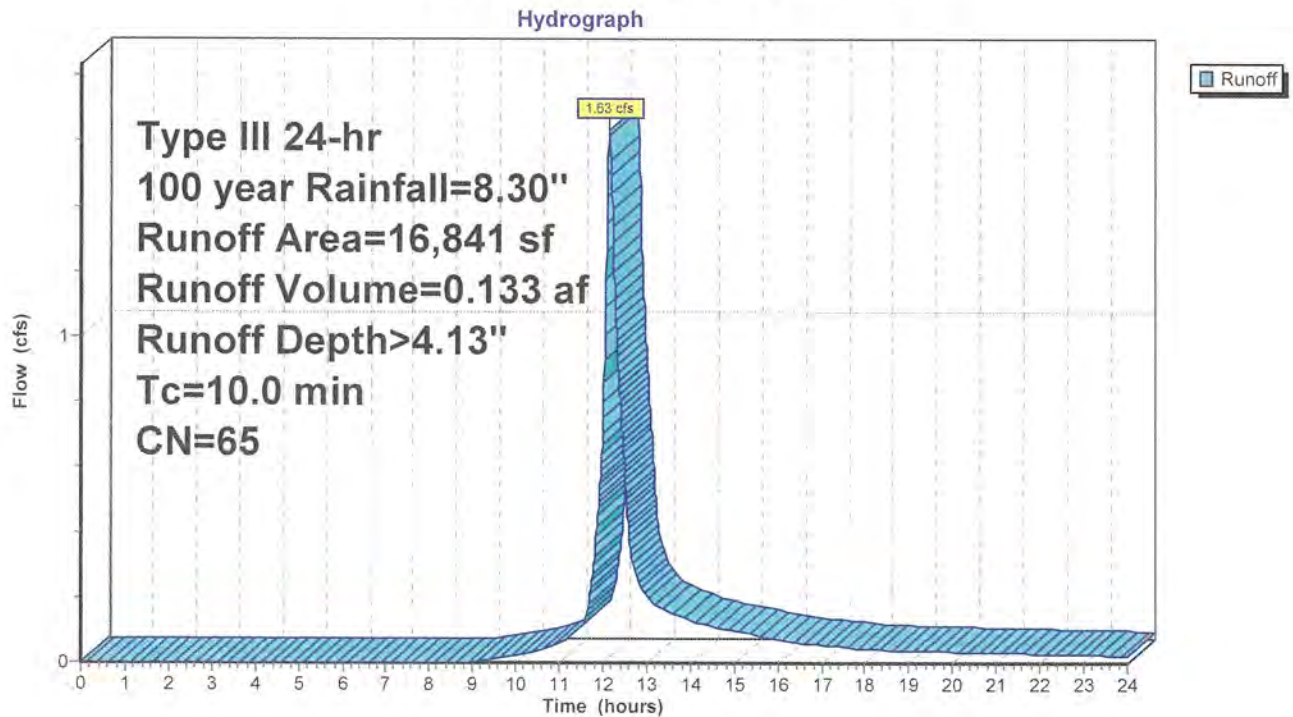
Runoff = 1.63 cfs @ 12.14 hrs, Volume= 0.133 af, Depth> 4.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 year Rainfall=8.30"

Area (sf)	CN	Description
15,158	61	>75% Grass cover, Good, HSG B
* 24	98	Impervious - (AC/Gen)
* 1,659	98	Impervious - Possible future build out
16,841	65	Weighted Average
15,158		90.01% Pervious Area
1,683		9.99% Impervious Area

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

**Subcatchment 3S: PDA-Overland**



**Proposed Conditions**

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100 year Rainfall=8.30"

Printed 7/13/2023

Page 16

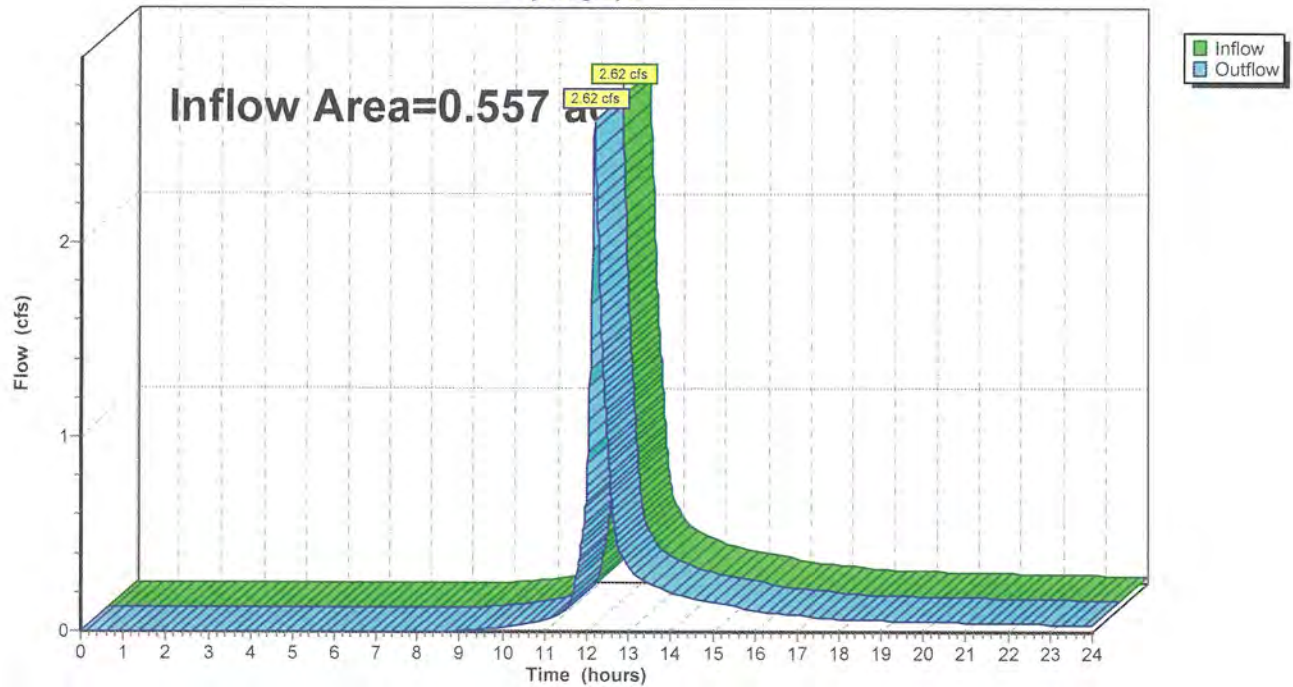
**Summary for Reach 5R: PDA**

Inflow Area = 0.557 ac, 31.95% Impervious, Inflow Depth > 4.20" for 100 year event  
Inflow = 2.62 cfs @ 12.18 hrs, Volume= 0.195 af  
Outflow = 2.62 cfs @ 12.18 hrs, Volume= 0.195 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Reach 5R: PDA**

Hydrograph



**Proposed Conditions**

Type III 24-hr 100 year Rainfall=8.30"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 17

**Summary for Pond 4P: Drywell**

Inflow Area = 0.170 ac, 81.78% Impervious, Inflow Depth > 7.21" for 100 year event  
 Inflow = 1.17 cfs @ 12.13 hrs, Volume= 0.102 af  
 Outflow = 1.08 cfs @ 12.18 hrs, Volume= 0.062 af, Atten= 8%, Lag= 2.8 min  
 Primary = 1.08 cfs @ 12.18 hrs, Volume= 0.062 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 402.58' @ 12.18 hrs Surf.Area= 0 sf Storage= 1,891 cf

Plug-Flow detention time= 195.5 min calculated for 0.062 af (61% of inflow)  
 Center-of-Mass det. time= 92.7 min ( 867.0 - 774.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	395.50'	1,928 cf	<b>Custom Stage Data</b> Listed below x 4

Elevation (feet)	Cum.Store (cubic-feet)
395.50	0
396.50	49
397.50	119
398.50	189
399.50	260
400.00	331
401.50	401
402.50	472
403.50	482

Device	Routing	Invert	Outlet Devices
#1	Primary	402.00'	<b>6.0" Vert. Orifice/Grate X 2.00</b> C= 0.600

**Primary OutFlow** Max=1.08 cfs @ 12.18 hrs HW=402.58' (Free Discharge)  
 ↑ **1=Orifice/Grate** (Orifice Controls 1.08 cfs @ 2.75 fps)

**Proposed Conditions**

Prepared by {enter your company name here}

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

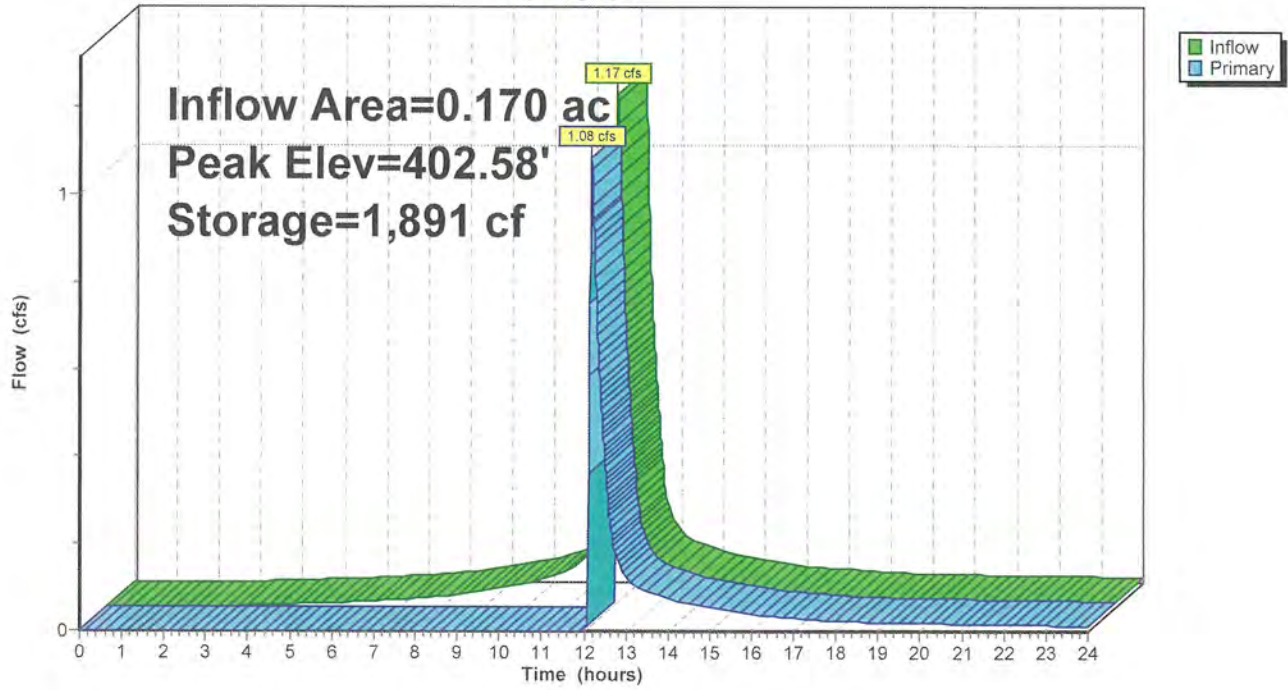
Type III 24-hr 100 year Rainfall=8.30"

Printed 7/13/2023

Page 18

**Pond 4P: Drywell**

Hydrograph



**Proposed Conditions**

Type III 24-hr 100 year Rainfall=8.30"

Prepared by {enter your company name here}

Printed 7/13/2023

HydroCAD® 10.00-21 s/n 03860 © 2018 HydroCAD Software Solutions LLC

Page 19

**Stage-Area-Storage for Pond 4P: Drywell**

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
395.50	0	400.70	1,455
395.60	20	400.80	1,473
395.70	39	400.90	1,492
395.80	59	401.00	1,511
395.90	78	401.10	1,529
396.00	98	401.20	1,548
396.10	118	401.30	1,567
396.20	137	401.40	1,585
396.30	157	401.50	1,604
396.40	176	401.60	1,632
396.50	196	401.70	1,661
396.60	224	401.80	1,689
396.70	252	401.90	1,718
396.80	280	402.00	1,746
396.90	308	402.10	1,774
397.00	336	402.20	1,803
397.10	364	402.30	1,831
397.20	392	402.40	1,860
397.30	420	402.50	1,888
397.40	448	402.60	1,892
397.50	476	402.70	1,896
397.60	504	402.80	1,900
397.70	532	402.90	1,904
397.80	560	403.00	1,908
397.90	588	403.10	1,912
398.00	616	403.20	1,916
398.10	644	403.30	1,920
398.20	672	403.40	1,924
398.30	700	403.50	<b>1,928</b>
398.40	728		
398.50	756		
398.60	784		
398.70	813		
398.80	841		
398.90	870		
399.00	898		
399.10	926		
399.20	955		
399.30	983		
399.40	1,012		
399.50	1,040		
399.60	1,097		
399.70	1,154		
399.80	1,210		
399.90	1,267		
400.00	1,324		
400.10	1,343		
400.20	1,361		
400.30	1,380		
400.40	1,399		
400.50	1,417		
400.60	1,436		

# Appendix F

## Reference Material and Soil Logs

Chowdhury  
93 Sunset Drive  
Chatham Township, Morris County  
Block 62.09 Lot 13  
Soil Logs  
3/28/2023

**Soil Log #1**

0"-4" Topsoil  
4"-72" Mixed fill.  
72"-76" Topsoil  
76"-120" Strong brown (7.5YR 4/6), subangular blocky, friable, sandy clay loam,  
10% gravel, 5% cobbles  
120"-144" Reddish brown (2.5YR 4/4), subangular blocky, friable, sandy clay loam,  
20% gravel, 10% stones  
No groundwater. No mottles.

**Percolation Test 1A**

Depth of test = 96"  
Bottom width = 8"  
Parameter 'a' = 22  
Percolation Rate ( $p_m$ ) = 3.25 min/inch  
Permeability Rate  $K = a / p_m = 22 / 3.25 = 6.8$  in/hr

**Percolation Test 1B**

Depth of test = 120"  
Bottom width = 8"  
Parameter 'a' = 22  
Percolation Rate ( $p_m$ ) = 3.5 min/inch  
Permeability Rate  $K = a / p_m = 22 / 3.5 = 6.3$  in/hr

**Soil Log #2**

0"-24" Mixed fill  
24"-72" Dark grey (7.5YR 4/1) compacted mixed fill  
72"-78" Topsoil  
78"-144" Reddish brown (5YR 5/4) subangular blocky, friable, sandy clay loam  
No groundwater. No mottles.

**Percolation Test 2A**

Depth of test = 120"  
Bottom width = 8"  
Parameter 'a' = 22  
Percolation Rate ( $p_m$ ) = 3.0 min/inch  
Permeability Rate  $K = a / p_m = 22 / 3.0 = 7.3$  in/hr

**NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA**

Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at <http://www.nws.noaa.gov/ohd/hdsc/>

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.



