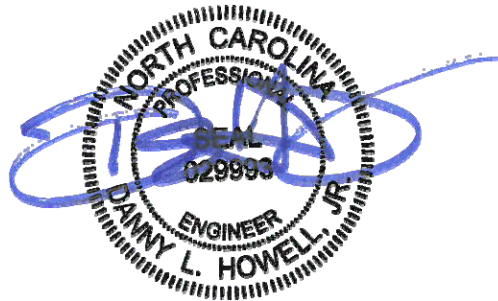


STORMWATER CALCULATIONS

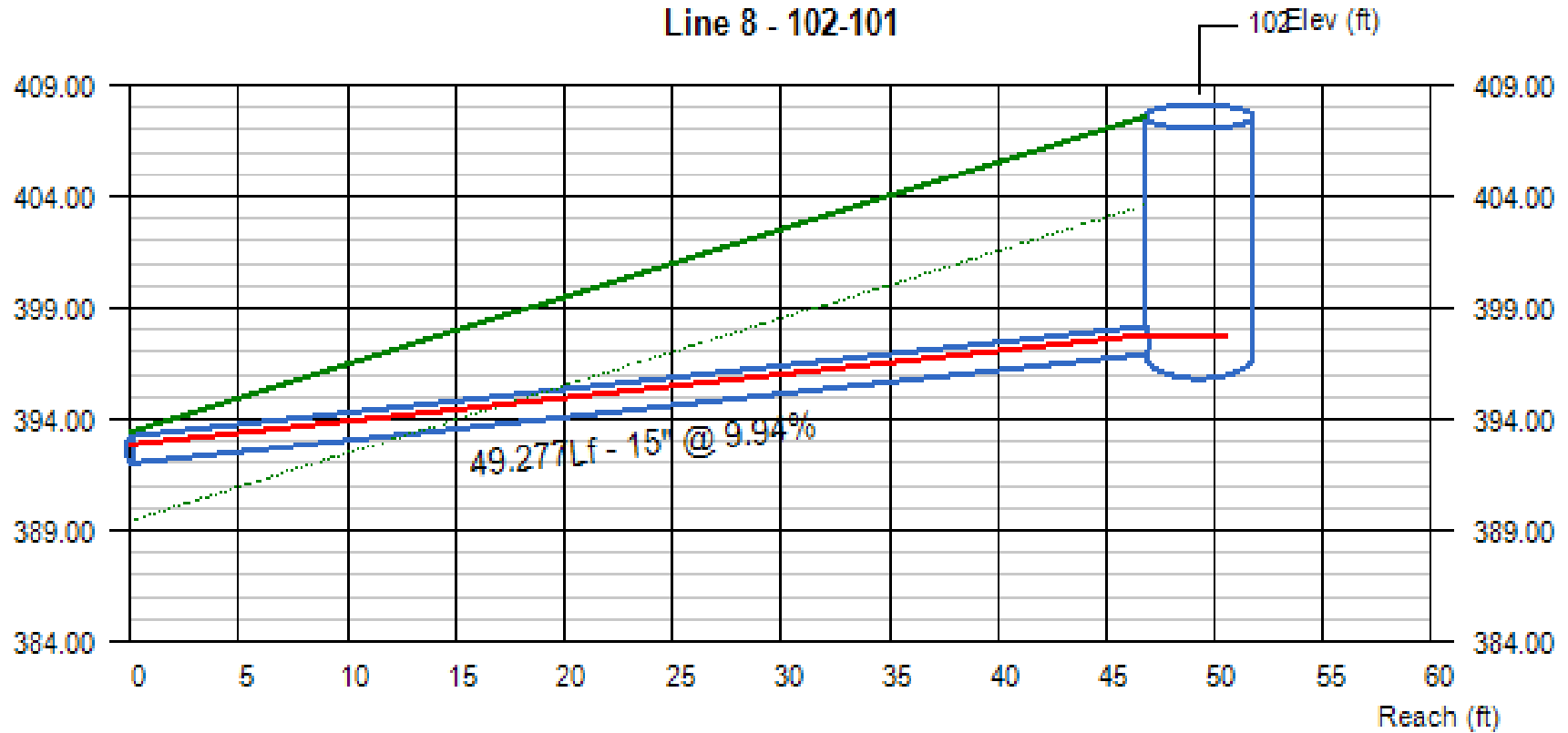
**NORTH WAKE EYE CARE
971 GRANITE FALLS BOULEVARD
ROLESVILLE, NORTH CAROLINA**



**PREPARED BY
DANNY L. HOWELL, JR., PE
REAL ENGINEERING, INC.
REV: JUNE 2, 2023**

STORMWATER RUNOFF
CALCULATIONS
10-YR DESIGN STORM CALCULATIONS
10-YR HGL PROFILES

Inlet No. Up	Inlet No. Dn	Runoff Coeff.	Intensity (in/hr)	DA (ac)	Total DA (ac)	Runoff (cfs)	Rim Up	Invert Up	Invert Dn	Pipe Length (ft)	Pipe Dia (in)	Material	Pipe Slope (%)	HGL Up (ft)	HGL Dn (ft)	Velocity (fps)
YI# 10	CI# 9	0.59	7.21	0.20	0.20	0.85	413.40	410.40	408.40	106.72	15	RCP	1.87	410.76	408.79	2.76
CI# 9	CI# 8	0.77	6.52	0.15	0.35	1.52	412.90	408.30	407.50	75.62	15	RCP	1.06	408.79	407.95	3.61
CI# 8	MH/JB# 5	0.91	6.31	0.08	0.43	1.93	412.50	407.40	406.85	52.91	15	RCP	1.04	407.95	407.54	3.23
CI# 7	MH/JB# 5	0.83	7.21	0.19	0.19	1.14	411.20	407.20	406.85	32.84	15	RCP	1.07	407.62	407.54	2.39
YI# 6	CI# 5	0.83	7.21	0.19	0.19	1.14	413.00	409.00	406.85	80.23	15	RCP	2.68	409.42	407.54	2.39
MH/JB# 5	CI# 4	0.00	6.20	0.00	0.81	3.85	412.00	406.75	406.30	40.95	15	RCP	1.10	407.54	407.00	5.07
CI# 4	EW# 3	0.78	6.15	0.02	0.83	3.92	412.30	406.20	406.10	6.25	15	RCP	1.60	407.00	406.90	4.73
SCM# 2	FES# 1	0.68	7.21	0.94	0.94	4.61	407.60	396.90	392.00	49.28	15	RCP	9.94	397.77	392.87	5.06

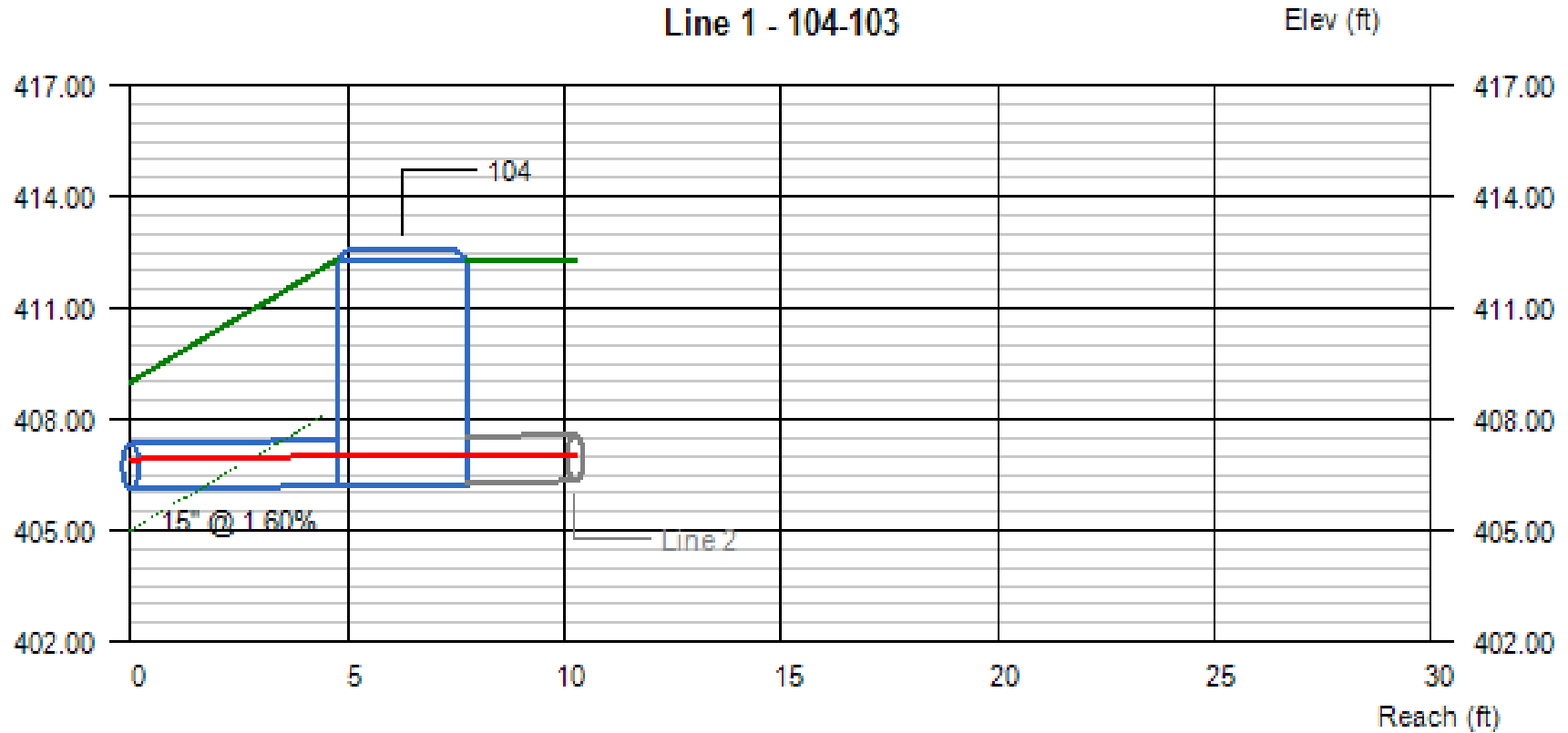


Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
8	4.61	392.00	396.90	0.87	0.87	0.87	392.87	397.77	397.77	5.06	5.06	0.19	9.45

Project File:

No. Lines: 8

Run Date: 6/2/2023

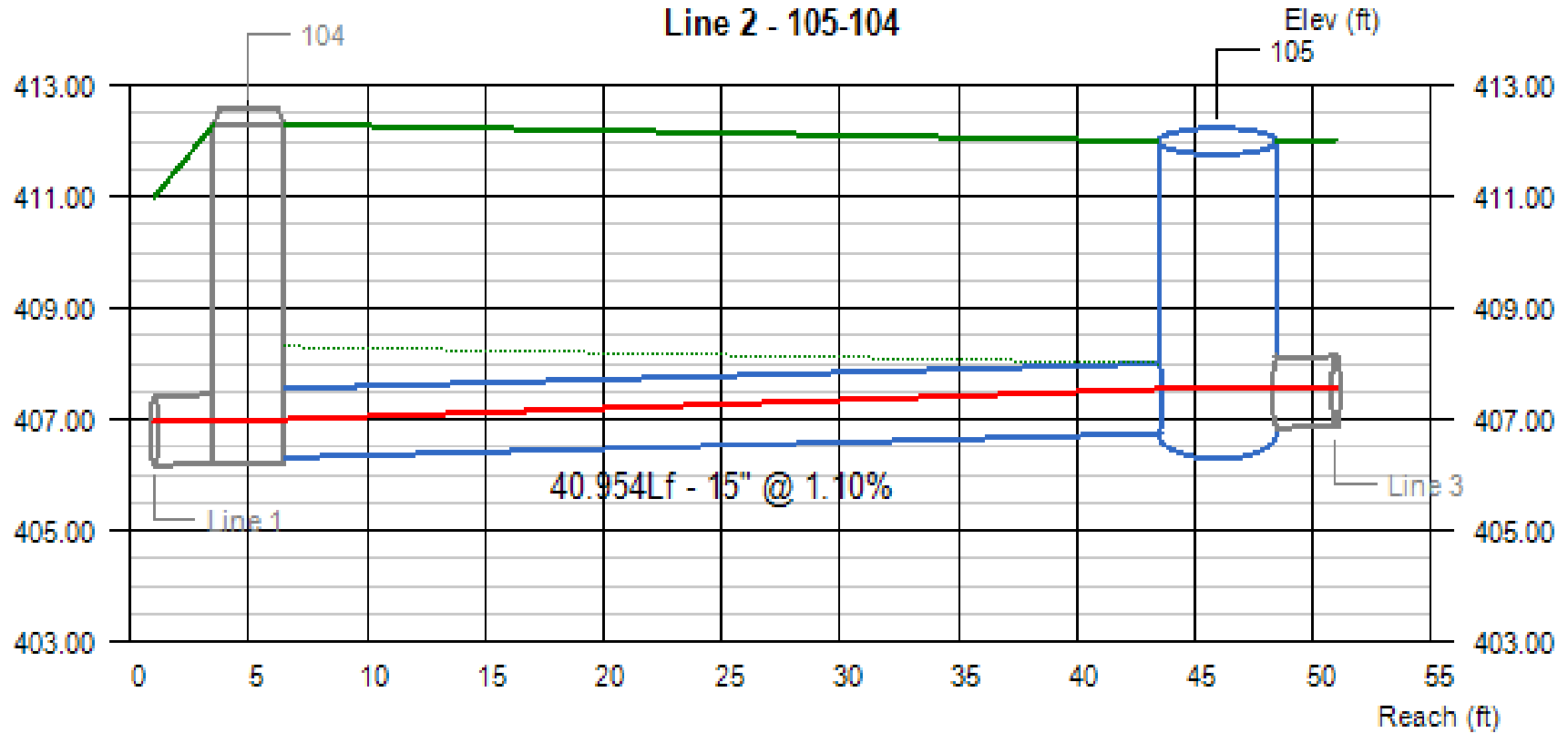


Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
1	3.92	406.10	406.20	0.80	0.80	0.80	406.90	407.00	407.00	4.73	4.73	1.65	4.85

Project File:

No. Lines: 8

Run Date: 6/2/2023

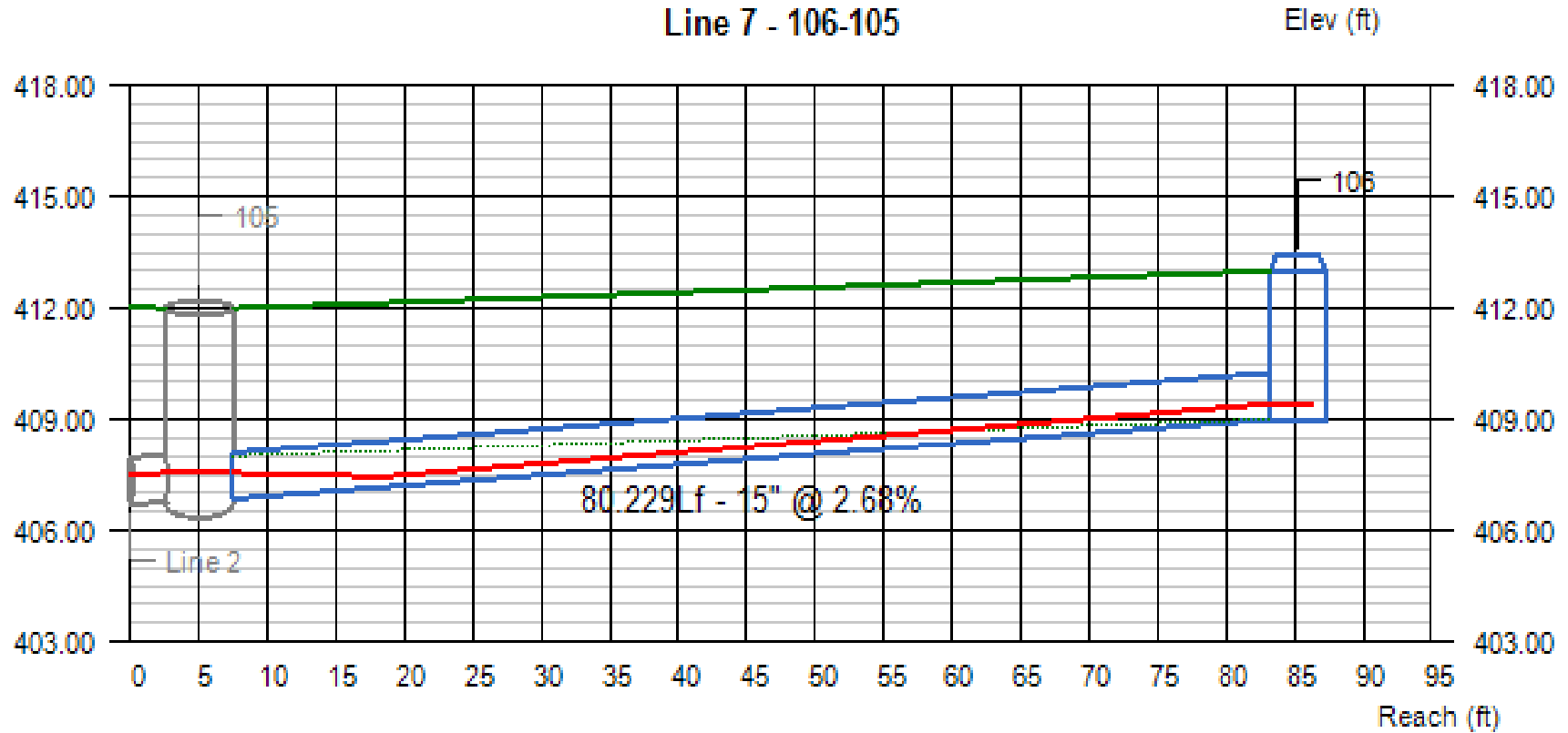


Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
2	3.85	406.30	406.75	0.70	0.79	0.79	407.00	407.54	407.54	5.45	4.69	4.75	4.00

Project File:

No. Lines: 8

Run Date: 6/2/2023

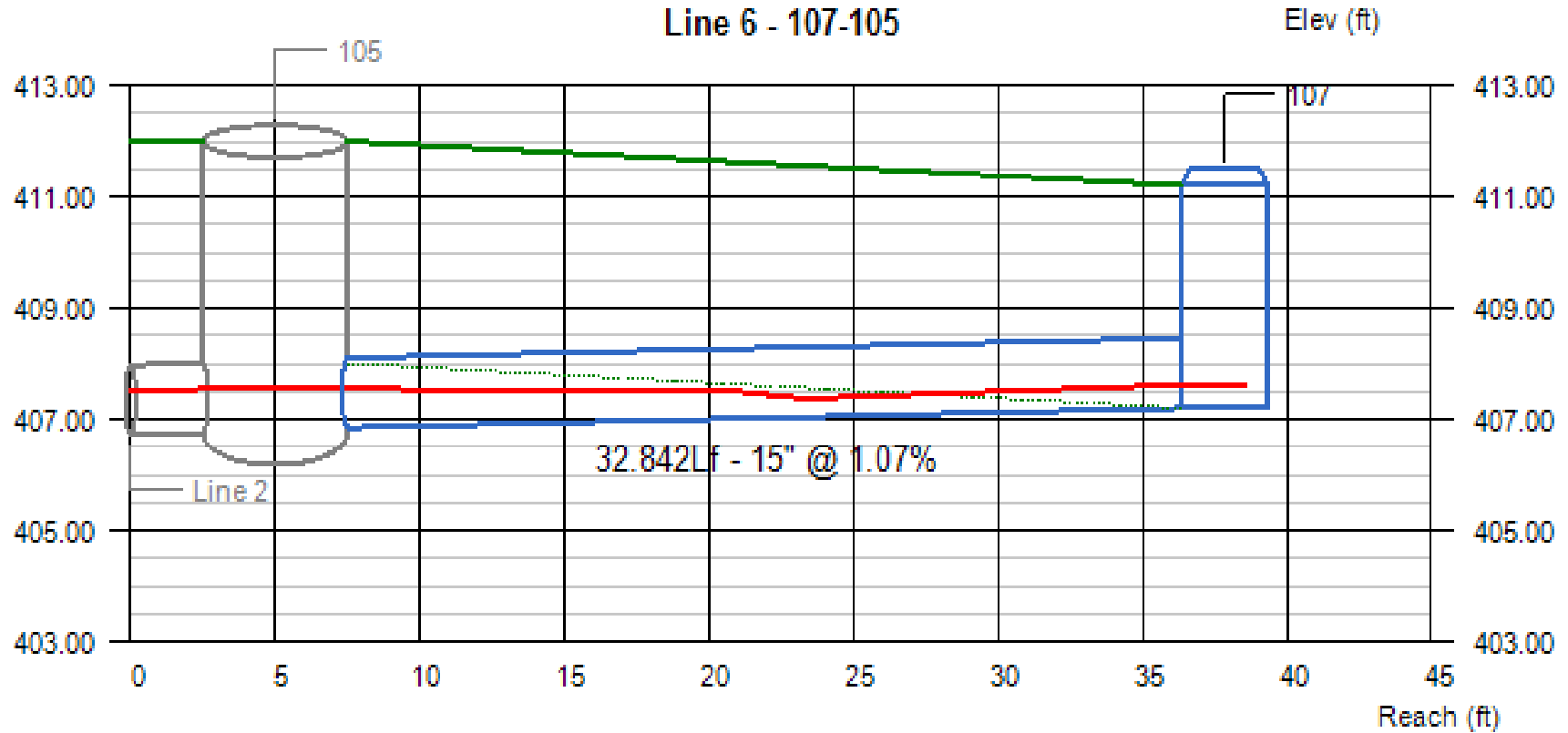


Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
7	1.14	406.85	409.00	0.69	0.42	0.42	407.54	409.42 j	409.42	1.63	3.15	3.90	2.75

Project File:

No. Lines: 8

Run Date: 6/2/2023

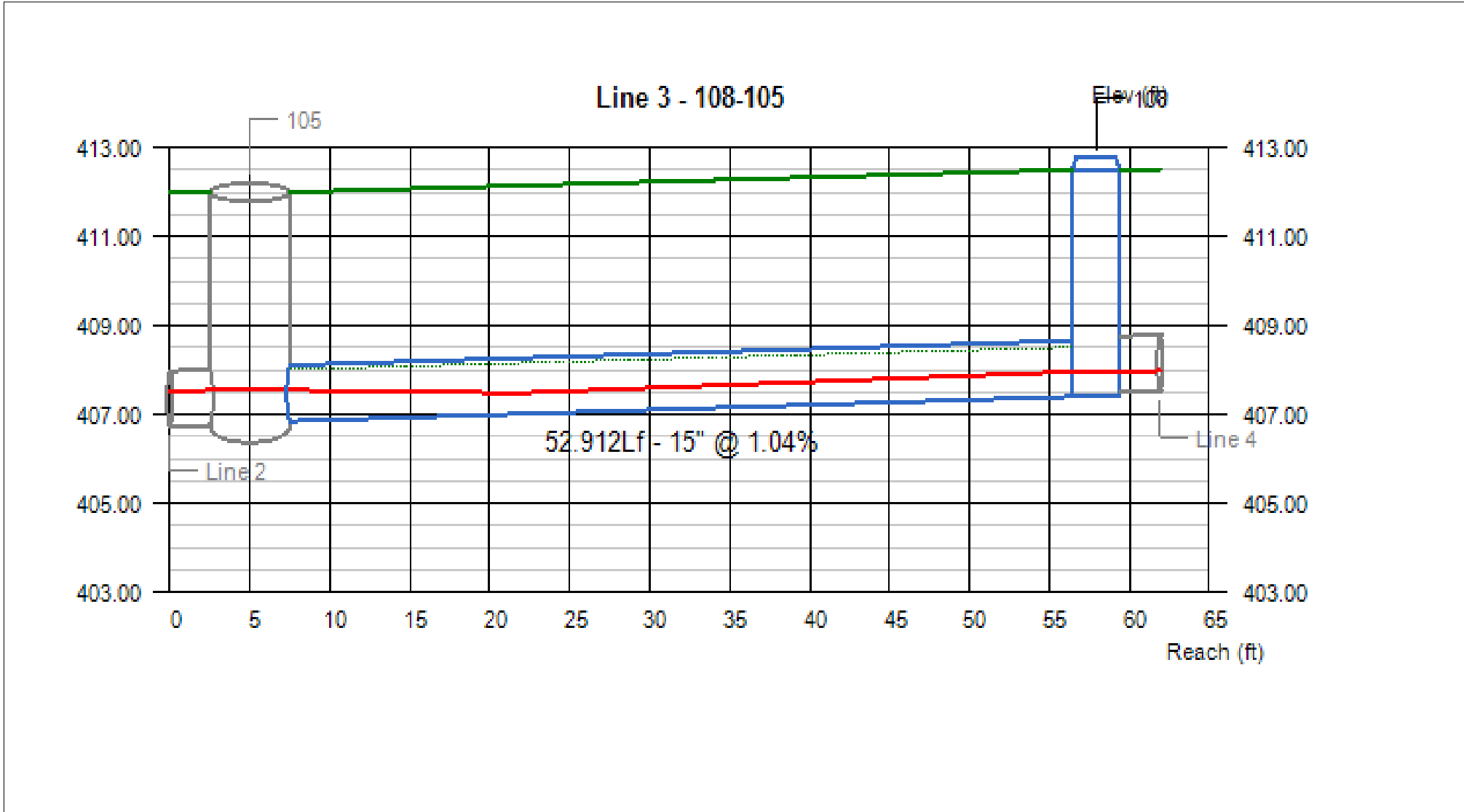


Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
6	1.14	406.85	407.20	0.69	0.42	0.42	407.54	407.62 j	407.62	1.63	3.15	3.90	2.75

Project File:

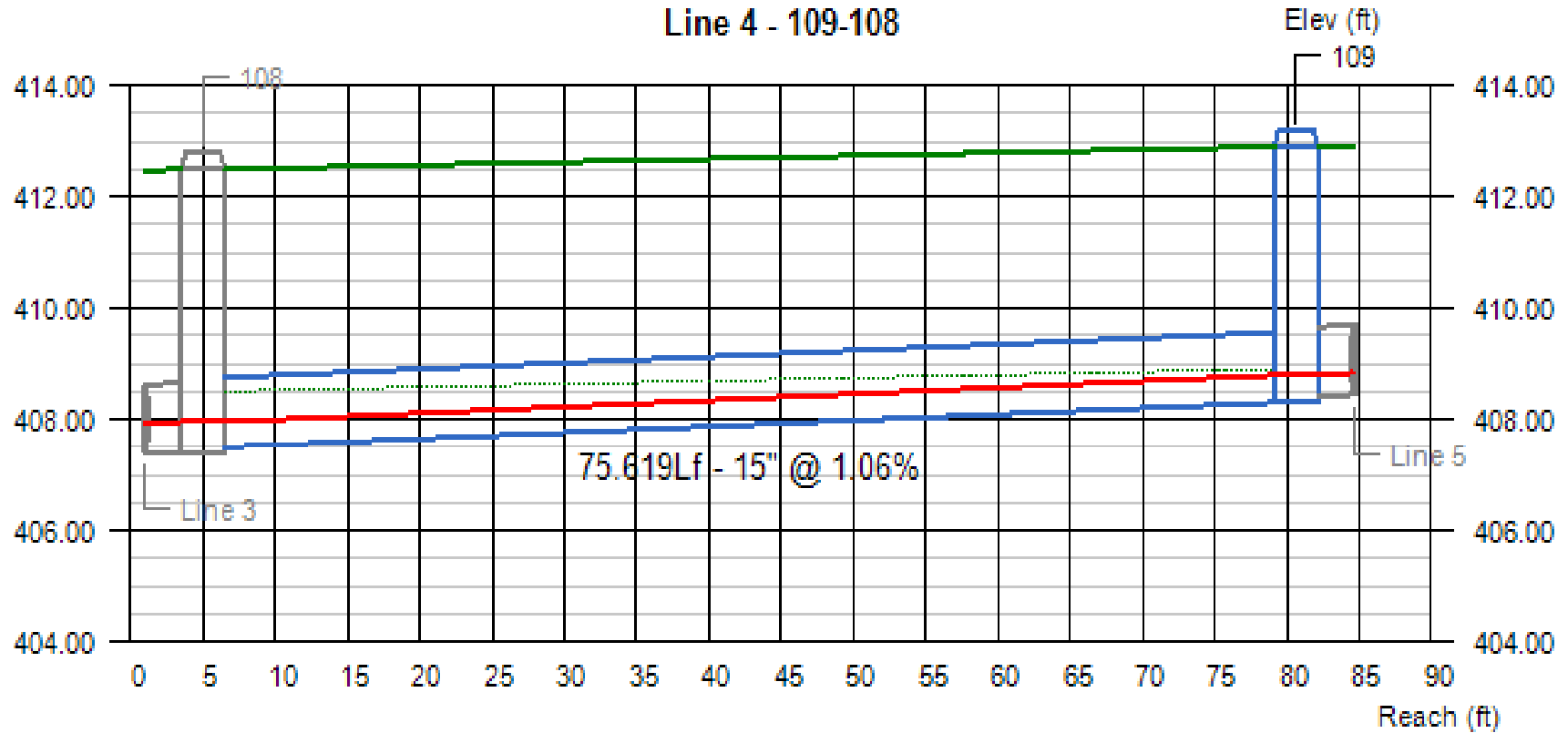
No. Lines: 8

Run Date: 6/2/2023



Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
3	1.93	406.85	407.40	0.69	0.55	0.55	407.54	407.95 j	407.95	2.77	3.69	3.90	3.85

Project File: _____ No. Lines: 8 Run Date: 6/2/2023

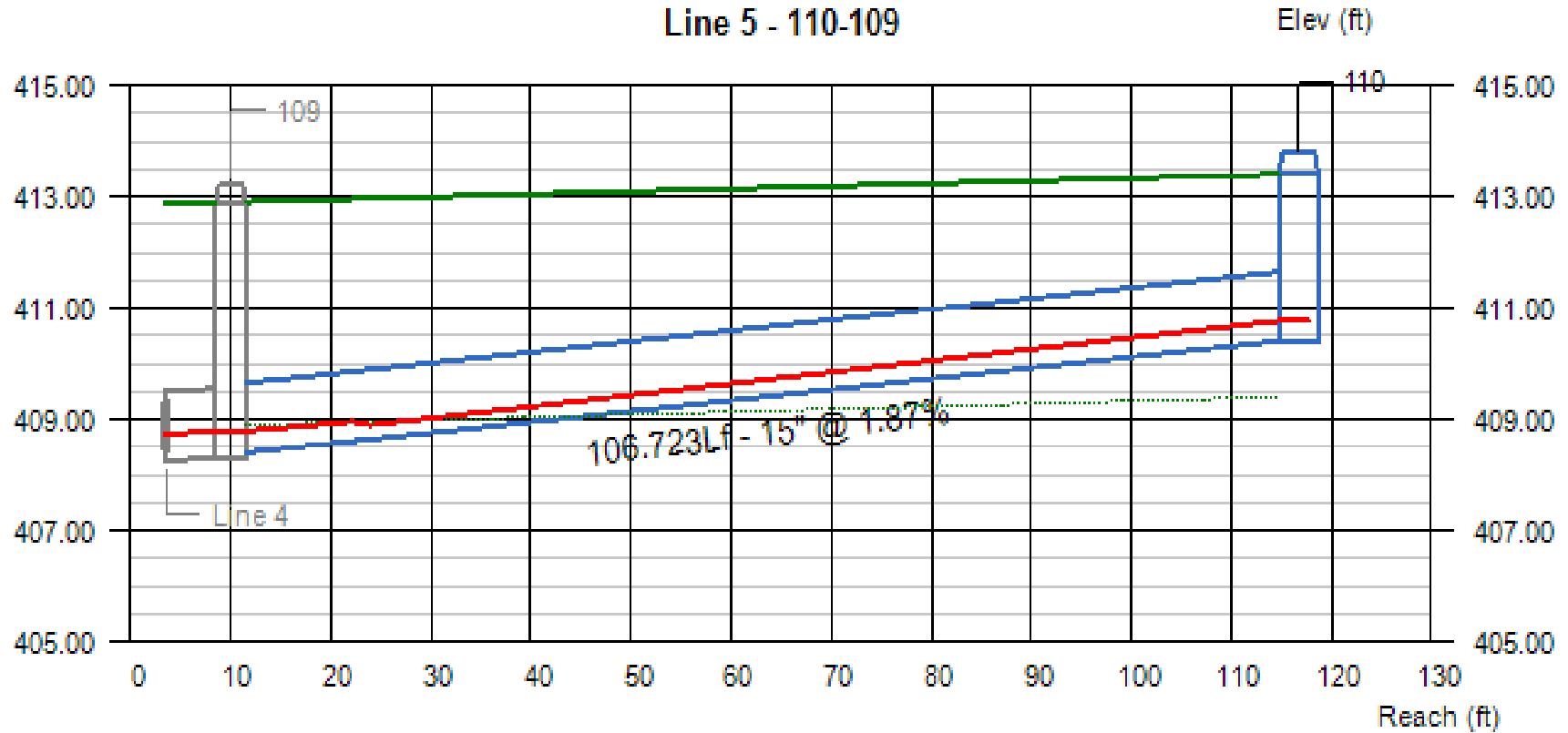


Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
4	1.52	407.50	408.30	0.45	0.49	0.49	407.95	408.79	408.79	3.80	3.43	3.75	3.35

Project File:

No. Lines: 8

Run Date: 6/2/2023



Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
5	0.85	408.40	410.40	0.39	0.36	0.36	408.79	410.76 j	410.76	2.62	2.89	3.25	1.75

Project File:

No. Lines: 8

Run Date: 6/2/2023

DETENTION CALCULATIONS

PRE V. POST DETENTION SUMMARY

PRE VS. POST (1, 2, 10 & 100-YR)

1" WQV BIORETENTION CALCULATIONS

1, 2, 10 & 100-YR ROUTING CALCULATIONS

North Wake Eye Care
RALEIGH, NORTH CAROLINA

POI #1

Stormwater Attenuation Requirements

PRE-DEVELOPED STORMWATER RUNOFF CALCULATIONS

Pre-Developed Q1, Q2 and Q10 Calculations:

	DA (sf)	CN	DA*CN
Grassed Area	4,396	84	369,264
Wooded Area	50,055	79	3,954,345
Impervious Area (0%)	0	98	0
Total	54,451		4,323,609

Drainage Area (DA)	=	54,451	sf
	=	1.25	ac
Composite CN	=	79	
Q1 Pre-Developed	=	2.66	cfs
Q2 Pre-Developed	=	3.67	cfs
Q10 Pre-Developed	=	6.89	cfs
Q25 Pre-Developed	=	8.82	cfs
Q100 Pre-Developed	=	11.81	cfs

POST-DEVELOPED STORMWATER RUNOFF CALCULATIONS

Post-Developed Q1, Q2 and Q10 Calculations:

	DA (sf)	CN	DA*CN
Grassed Area	28,264	84	2,374,176
Wooded Area	607	79	47,953
Impervious Area (47%)	25,580	98	2,506,840
Total	54,451		4,928,969

Drainage Area (DA)	=	54,451	sf
	=	1.25	ac
Composite C	=	91	
Q1 Post-Developed	=	4.44	cfs
Q2 Post-Developed	=	5.56	cfs
Q10 Post-Developed	=	8.89	cfs
Q25 Post-Developed	=	10.80	cfs
Q100 Post-Developed	=	13.72	cfs

STORMWATER DETENTION FACILITY DESIGN SUMMARY

Stormwater attenuation will be provided by Bioretention Cell #1. The following summarizes information of the design of the systems as well as the attenuation provided using HydroCAD computer software: (HSG D Soils)

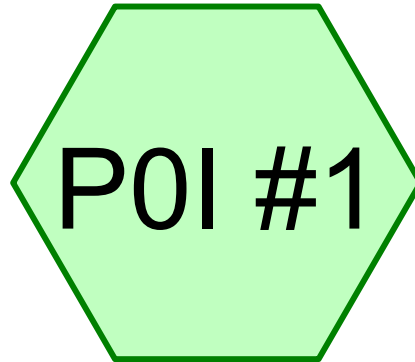
Summary of Area Draining to Bioretention Cell #1

	DA (sf)	CN	DA*CN
Grassed Area	17,070	84	1,433,880
Wooded Area	0	79	0
Impervious Area (53%)	23,894	98	2,341,612
Total	44,820		3,775,492

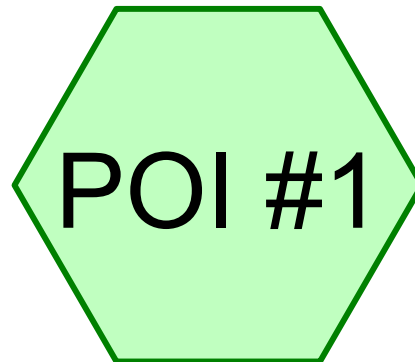
Drainage Area (DA)	=	44,820	sf
	=	1.03	ac
Composite C	=	84	

Description	POI #1 TR-55 Storm Event (cfs)				
	Q1 Storm	Q2 Storm	Q10 Storm	Q25 Storm	Q100 Storm
Pre Discharge	2.66	3.67	6.89	8.82	11.81
Post Discharge	4.44	5.56	8.89	10.80	13.72
Attenuation Required	-1.78	-1.89	-2.00	-NONE-	-NONE-
BIO #1 - Inflow	3.35	4.18	7.16	8.00	10.14
BIO #1 - Outflow	0.35	1.91	6.61	7.92	10.04
Attenuation Provided	-3.00	-2.27	-0.55	-0.08	-0.10
Water Surface Elev	407.62	407.69	407.84	407.85	407.89

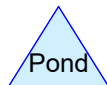
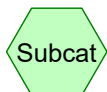
The proposed attenuation provided by the bioretention cell provides enough stormwater attenuation so that the Q2 and Q10 post-developed discharge does not exceed the pre-developed discharge at POI #1



PRE



POST



04-03-23 PRE-POST

Prepared by Windows User

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

NWEC

Type II 24-hr 1-YR Rainfall=3.00"

Printed 6/2/2023

Page 2

Summary for Subcatchment P01 #1: PRE

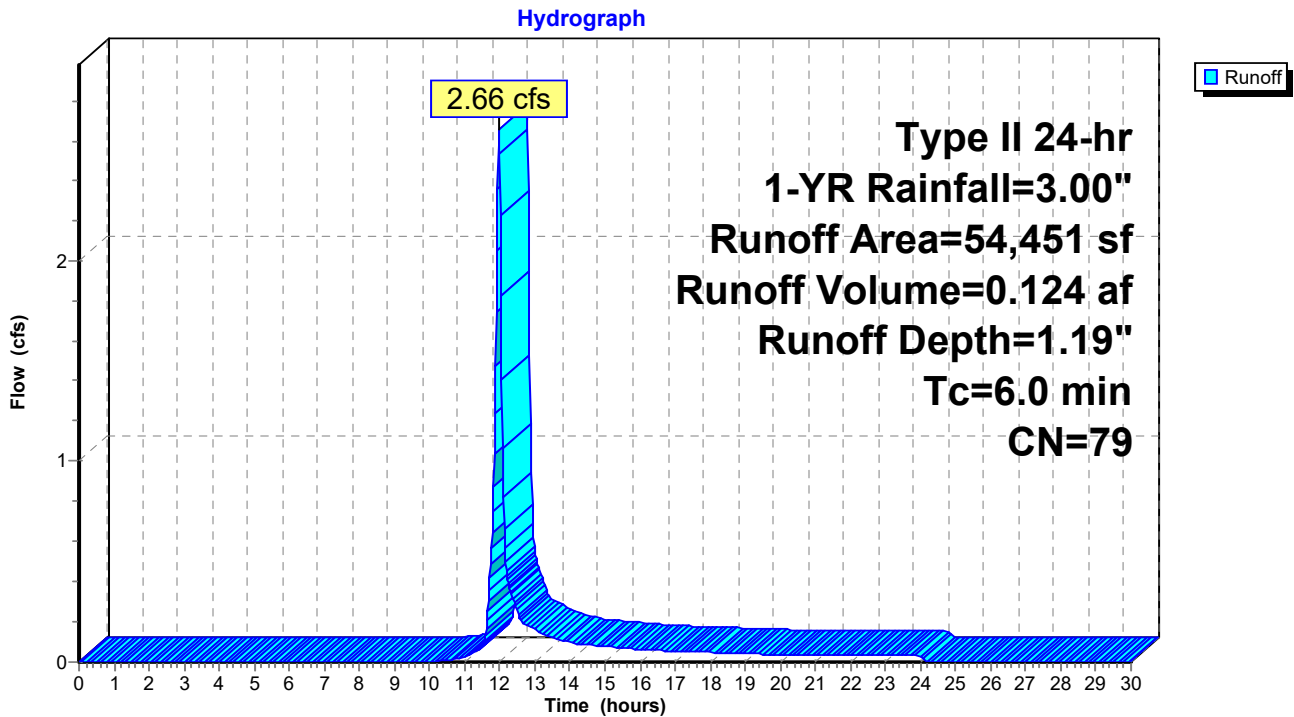
Runoff = 2.66 cfs @ 11.98 hrs, Volume= 0.124 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 1-YR Rainfall=3.00"

Area (sf)	CN	Description
4,396	84	Pasture/grassland/range, Fair, HSG D
50,055	79	Woods, Fair, HSG D
0	98	Paved parking, HSG D
54,451	79	Weighted Average
54,451		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment P01 #1: PRE



04-03-23 PRE-POST

Prepared by Windows User

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

NWEC

Type II 24-hr 1-YR Rainfall=3.00"

Printed 6/2/2023

Page 3

Summary for Subcatchment POI #1: POST

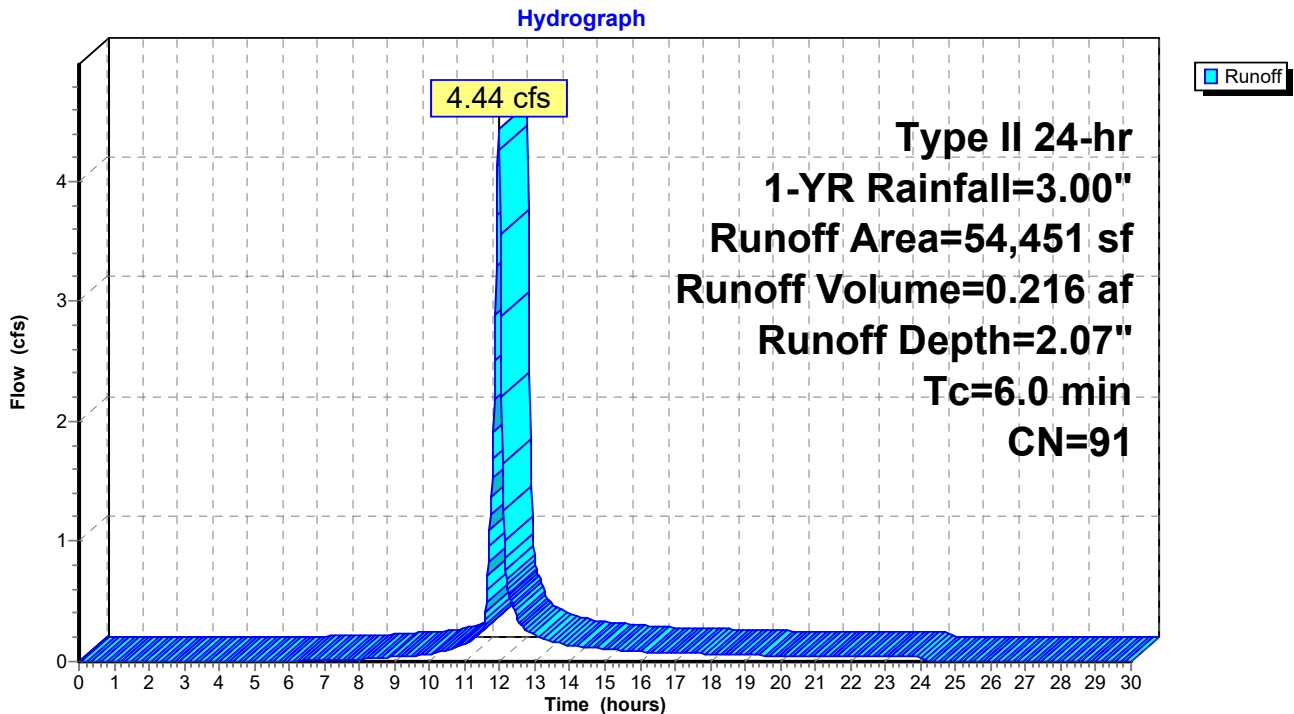
Runoff = 4.44 cfs @ 11.97 hrs, Volume= 0.216 af, Depth= 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 1-YR Rainfall=3.00"

Area (sf)	CN	Description
28,264	84	Pasture/grassland/range, Fair, HSG D
607	79	Woods, Fair, HSG D
25,580	98	Paved parking, HSG D
54,451	91	Weighted Average
28,871		53.02% Pervious Area
25,580		46.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment POI #1: POST



Summary for Subcatchment P01 #1: PRE

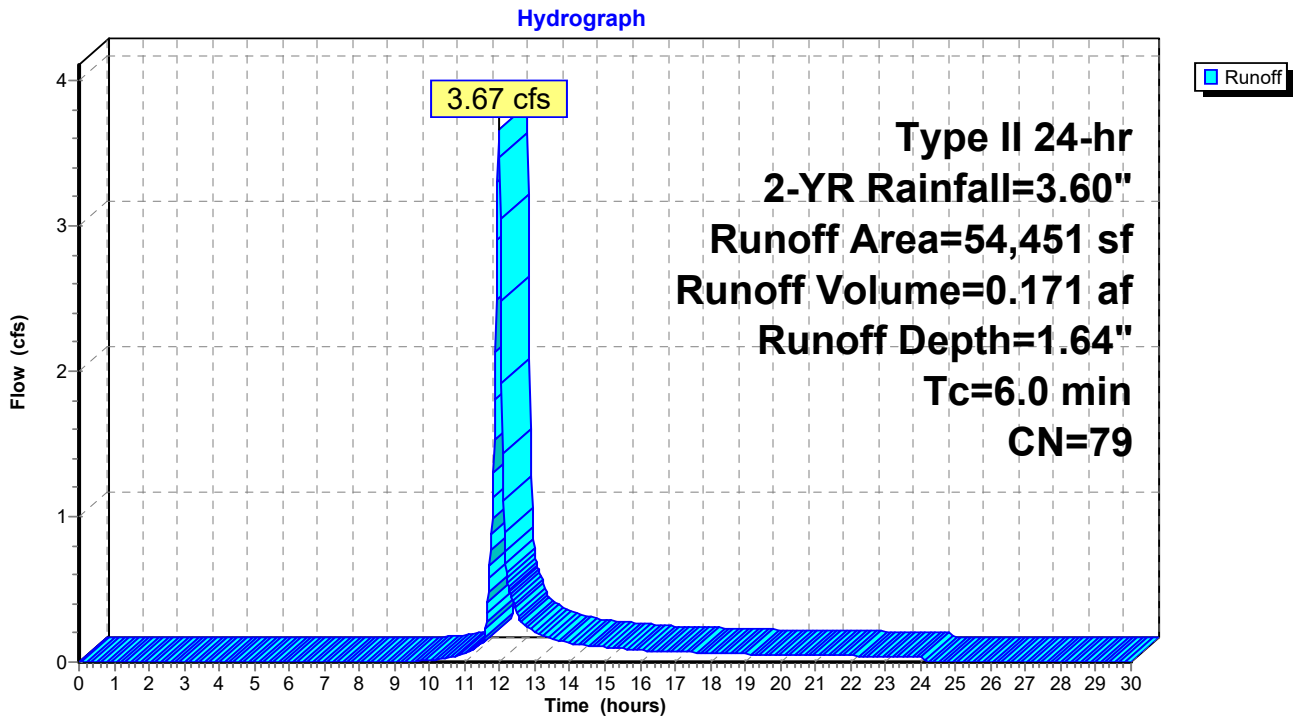
Runoff = 3.67 cfs @ 11.98 hrs, Volume= 0.171 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 2-YR Rainfall=3.60"

Area (sf)	CN	Description
4,396	84	Pasture/grassland/range, Fair, HSG D
50,055	79	Woods, Fair, HSG D
0	98	Paved parking, HSG D
54,451	79	Weighted Average
54,451		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment P01 #1: PRE



04-03-23 PRE-POST

Prepared by Windows User

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

NWEC
Type II 24-hr 2-YR Rainfall=3.60"

Printed 6/2/2023

Page 5

Summary for Subcatchment POI #1: POST

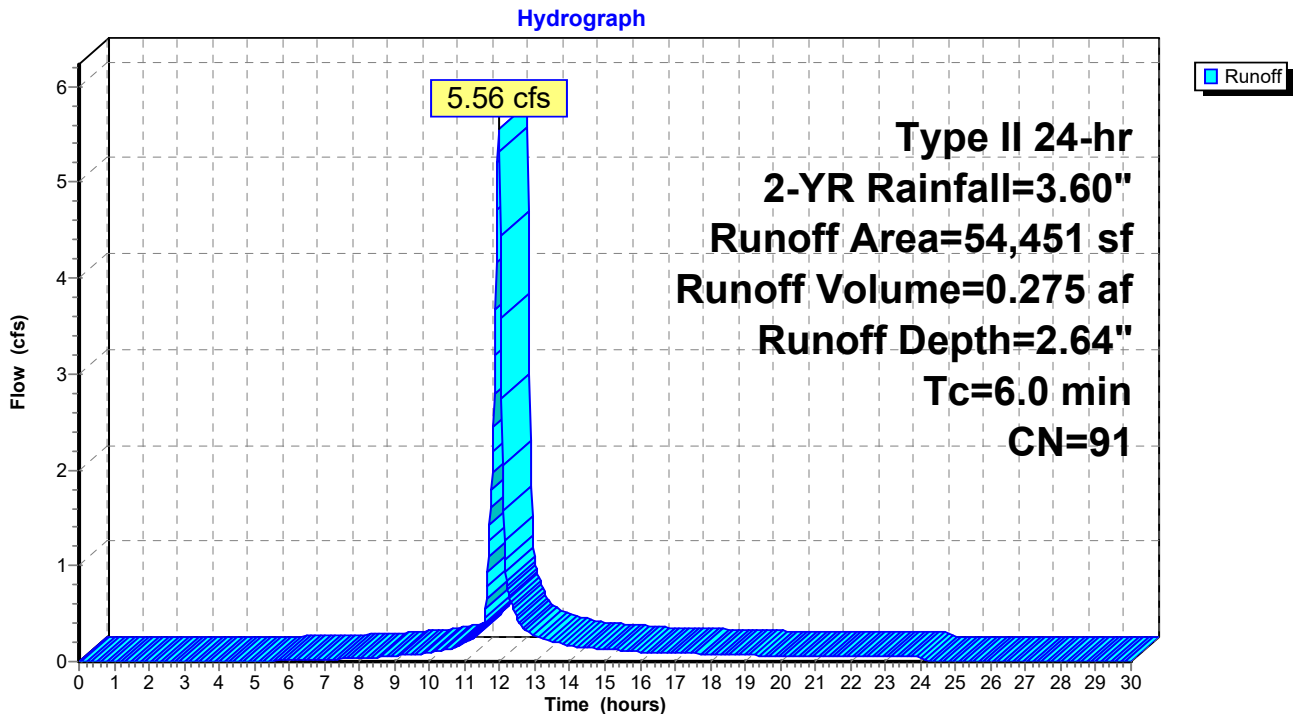
Runoff = 5.56 cfs @ 11.97 hrs, Volume= 0.275 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 2-YR Rainfall=3.60"

Area (sf)	CN	Description
28,264	84	Pasture/grassland/range, Fair, HSG D
607	79	Woods, Fair, HSG D
25,580	98	Paved parking, HSG D
54,451	91	Weighted Average
28,871		53.02% Pervious Area
25,580		46.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment POI #1: POST



04-03-23 PRE-POST

Type II 24-hr 10-YR Rainfall=5.38"

Prepared by Windows User

Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Page 6

Summary for Subcatchment P01 #1: PRE

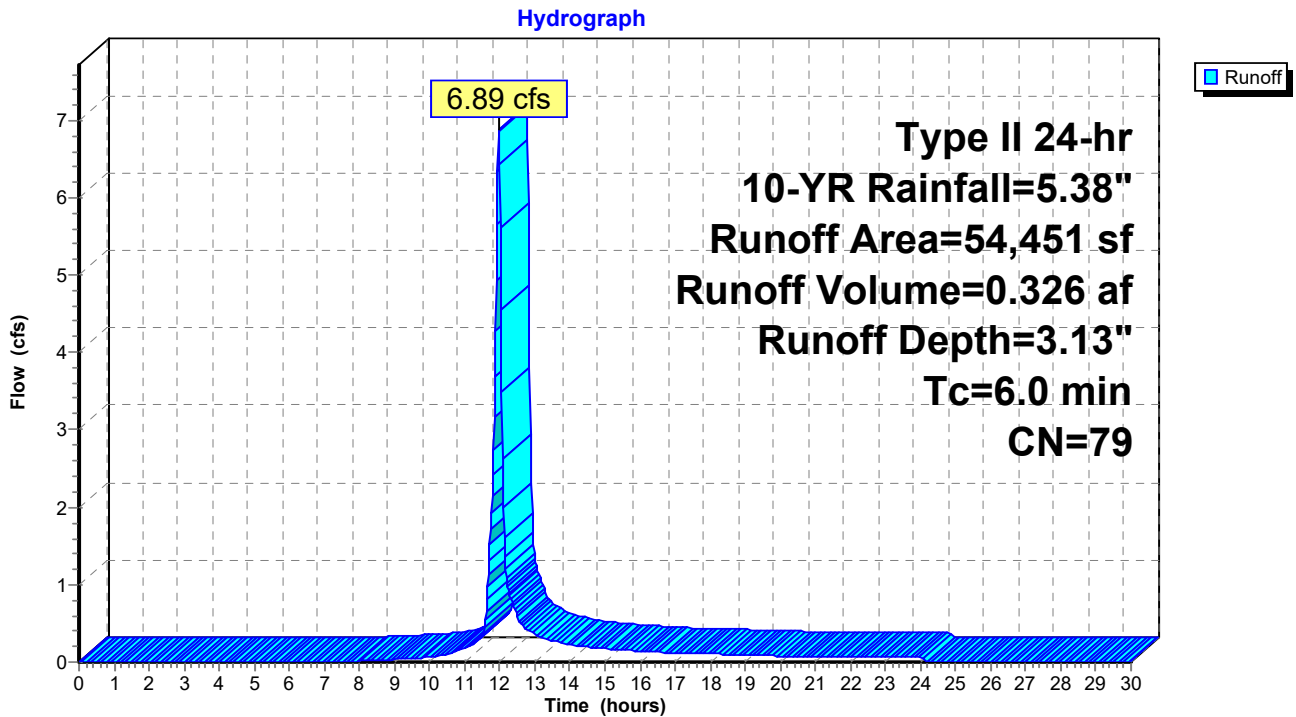
Runoff = 6.89 cfs @ 11.97 hrs, Volume= 0.326 af, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 10-YR Rainfall=5.38"

Area (sf)	CN	Description
4,396	84	Pasture/grassland/range, Fair, HSG D
50,055	79	Woods, Fair, HSG D
0	98	Paved parking, HSG D
54,451	79	Weighted Average
54,451		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment P01 #1: PRE



04-03-23 PRE-POST

Prepared by Windows User

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

NWEC
Type II 24-hr 10-YR Rainfall=5.38"

Printed 6/2/2023

Page 7

Summary for Subcatchment POI #1: POST

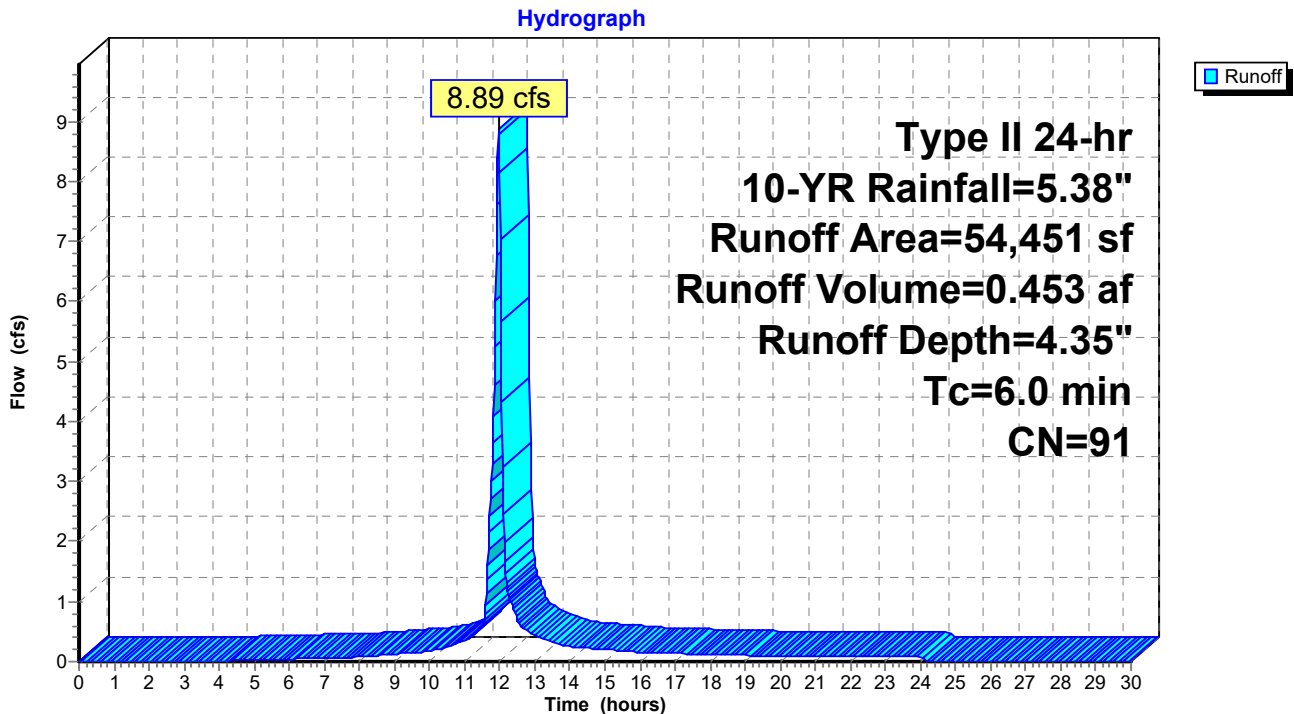
Runoff = 8.89 cfs @ 11.97 hrs, Volume= 0.453 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 10-YR Rainfall=5.38"

Area (sf)	CN	Description
28,264	84	Pasture/grassland/range, Fair, HSG D
607	79	Woods, Fair, HSG D
25,580	98	Paved parking, HSG D
54,451	91	Weighted Average
28,871		53.02% Pervious Area
25,580		46.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment POI #1: POST



04-03-23 PRE-POST

Type II 24-hr 25-YR Rainfall=6.41"

Prepared by Windows User

Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Page 8

Summary for Subcatchment P01 #1: PRE

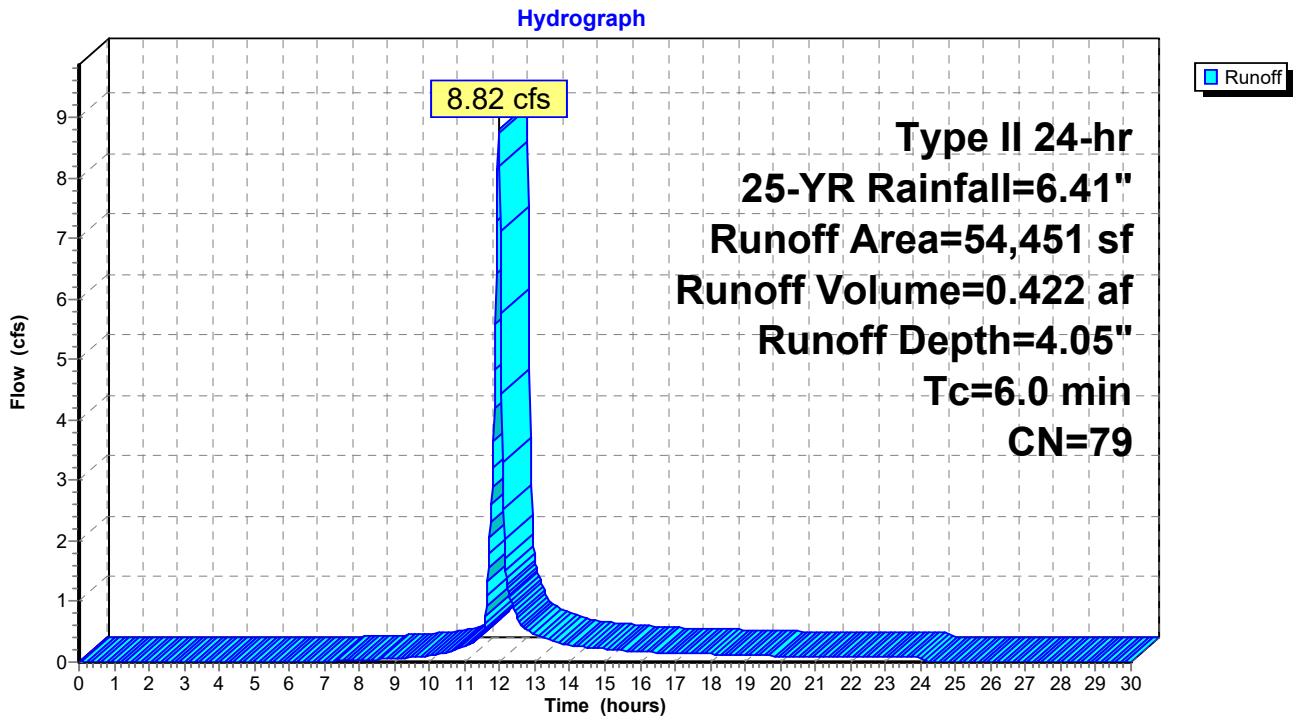
Runoff = 8.82 cfs @ 11.97 hrs, Volume= 0.422 af, Depth= 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
 Type II 24-hr 25-YR Rainfall=6.41"

Area (sf)	CN	Description
4,396	84	Pasture/grassland/range, Fair, HSG D
50,055	79	Woods, Fair, HSG D
0	98	Paved parking, HSG D
54,451	79	Weighted Average
54,451		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment P01 #1: PRE



04-03-23 PRE-POST

Type II 24-hr 25-YR Rainfall=6.41"

Prepared by Windows User

Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Page 9

Summary for Subcatchment POI #1: POST

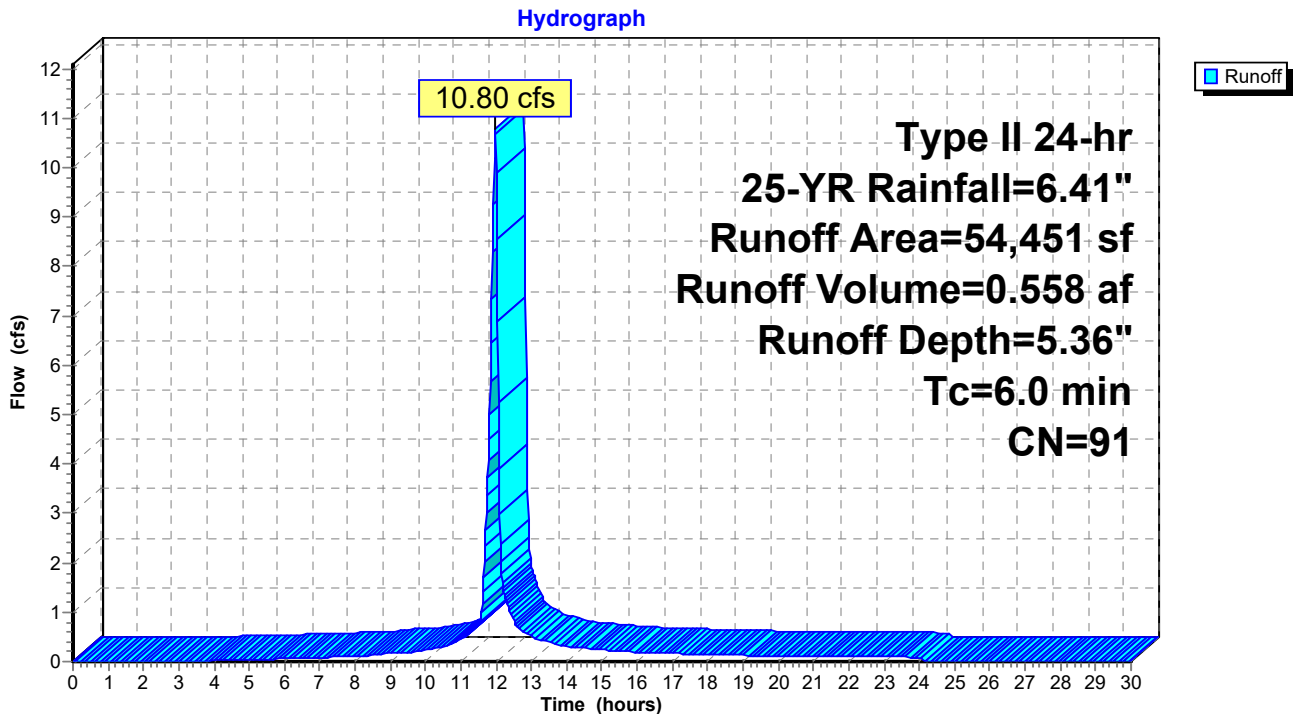
Runoff = 10.80 cfs @ 11.97 hrs, Volume= 0.558 af, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 25-YR Rainfall=6.41"

Area (sf)	CN	Description
28,264	84	Pasture/grassland/range, Fair, HSG D
607	79	Woods, Fair, HSG D
25,580	98	Paved parking, HSG D
54,451	91	Weighted Average
28,871		53.02% Pervious Area
25,580		46.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment POI #1: POST



04-03-23 PRE-POST

Type II 24-hr 100-YR Rainfall=8.00"

Prepared by Windows User

Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Page 10

Summary for Subcatchment P01 #1: PRE

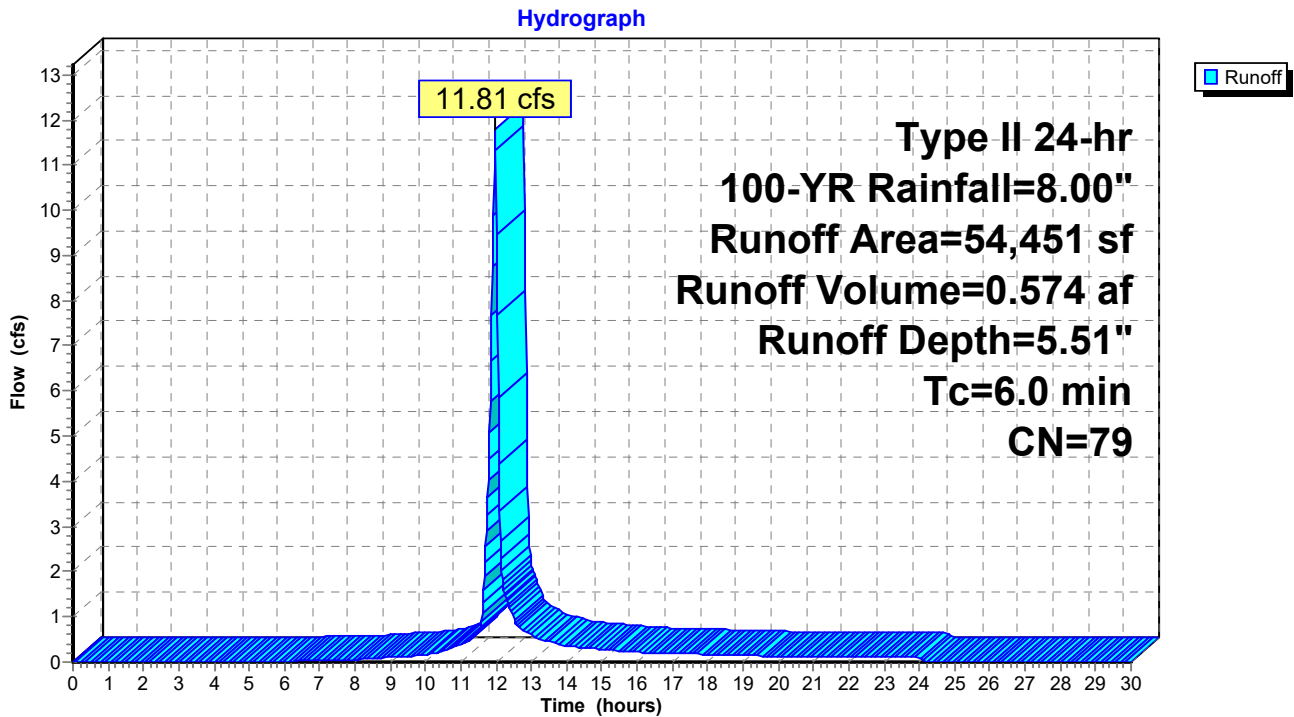
Runoff = 11.81 cfs @ 11.97 hrs, Volume= 0.574 af, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YR Rainfall=8.00"

Area (sf)	CN	Description
4,396	84	Pasture/grassland/range, Fair, HSG D
50,055	79	Woods, Fair, HSG D
0	98	Paved parking, HSG D
54,451	79	Weighted Average
54,451		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment P01 #1: PRE



04-03-23 PRE-POST

Prepared by Windows User

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

NWEC

Type II 24-hr 100-YR Rainfall=8.00"

Printed 6/2/2023

Page 11

Summary for Subcatchment POI #1: POST

Runoff = 13.72 cfs @ 11.97 hrs, Volume= 0.721 af, Depth= 6.92"

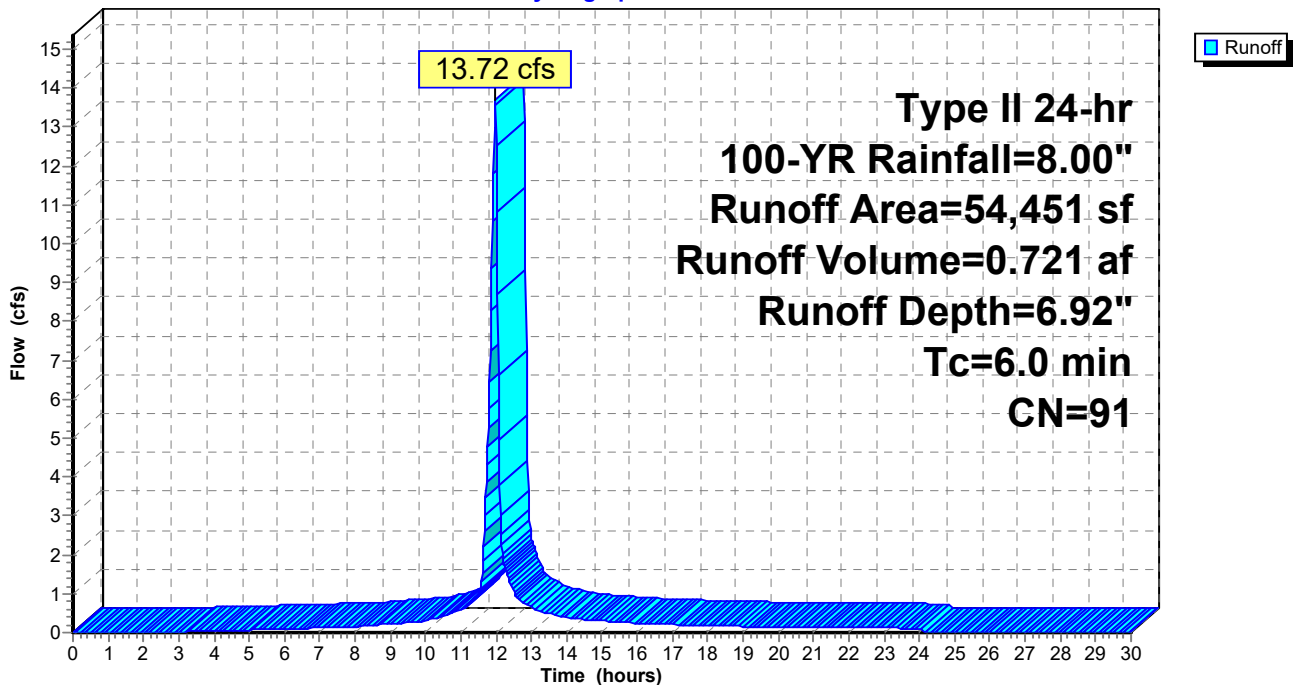
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YR Rainfall=8.00"

Area (sf)	CN	Description
28,264	84	Pasture/grassland/range, Fair, HSG D
607	79	Woods, Fair, HSG D
25,580	98	Paved parking, HSG D
54,451	91	Weighted Average
28,871		53.02% Pervious Area
25,580		46.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, TR55 Minimum

Subcatchment POI #1: POST

Hydrograph



Bioretention Calculations

Project Name: **NORTH WAKE EYE CARE**
Design Criteria: DWQ BMP Manual/MDC
Cell Number: **1**

Step 1: Determine Drainage Area and Impervious Surface

Drainage Area: 0.94 ac = 40,964 sf
Impervious Area: 0.55 ac = 23,894 sf

Impervious Rational C Value: **0.95**
Pervious Rational C Value: **0.30**

Percent Impervious: 58%
Composite Rational C Value: 0.68

Step 2: Determine the Volume of Water to Treat

Rainfall to Treat: (First Flush) **1** in

Runoff Coefficient (Rv) = $0.05 + 0.009 * (\% \text{ Impervious})$
Runoff Coefficient (Rv): 0.57 in/in

Runoff Volume (WQV) = Rainfall * (Rv) * (Drainage Area)
Runoff Volume (WQV): **1,963** cf

Step 3: Determine the Surface Area and Depth Required

Ponding Elevation Between: 407.00 and 407.50
Ponding Elevation: 407.10
Ponding Depth: 12 in = 1.00 ft
Required Surface Area: 1,963 sf

Provided Surface Area @ Ponding Depth: **2,110** sf

Step 4: Select Soil Media Type

Permeability (1 or 2 in/hr): **2.00** in/hr = 4 ft/day
Percent Fines Required in Mixture: 8% fines by volume

Step 5: Determine the Soil Media Depth

Depth of Soil Media (d_i): **30** in = 2.5 ft
Duration of Ponding: 6.0 hrs = 0.250 days
Time to Drain WQV thru 24" of Media: 18.0 hrs = 0.750 days

Step 6: Select the Appropriate Overflow Structure

Bottom/Surface Elevation: 406.10
Weir Elevation: **407.60**
Maximum Allowable Elevation: 408.00 (1' Freeboard)
Weir Coefficient: (C_w) **3.33**
100-Yr Flow to Bioretention based on DA above: **10.14** cfs
Min. Weir Length (L): $= \frac{Q}{C_w H^{3/2}}$ 12.04 ft

Selected Weir Length: **19.60** ft
Top of Berm Elevation: 409.00

Step 7: Determine Outflow Through Media

Modified Darcy's Equation :

$$Q = \frac{KA d_h}{24(3600)d_i}$$

Q = Peak Flow through Cell (cfs)

K = Permeability of Soil Media

A = Surface Area of Cell (sf)

d_h = depth of max head (ft)

d_i = depth of soil media (ft)

$$Q_n = \frac{4(2110)(d_h n)}{24(3600)(2.5)}$$

Rating Curve for Outflow Through Media:

Stage (ft)	Outflow (cfs)
0.0	0.00
0.5	0.02
1.0	0.04
1.5	0.06
2.0	0.08
2.5	0.10
3.0	0.12
3.5	0.14
4.0	0.16
4.5	0.18
5.0	0.20

Stage at First Flush Elevation: 3.55 ft
 Outflow through Media at First Flush Elevation: 0.14 cfs

Step 8: Size the Underdrains

Underdrain Sizing:

$$D = 16 \times [Q \times n / s]^{0.5 \cdot 3/8}$$

Q = Flow Rate to be Carried by Underdrain (cfs)

n = Manning's Roughness Coefficient of Underdrain

s = Slope of Underdrain Pipe (ft/ft)

D = Pipe Diameter (in)

Flow Rate to be Carried by Underdrain: 0.14 cfs
 Safety Factor for Flow Rate: 4.85
 New Flow Rate to be Carried: 0.67
 Manning's Roughness Coefficient: 0.011 (PVC)
 Slope of Underdrain Pipe: 0.005 ft/ft
 Diameter of Pipe Required: 6.87 in
Choose 4, 6, 8, or 10" diameter PVC: 6 in
Number of Pipes Required: 2
Number of Clean-outs: 2

OVERALL BASIN VOLUME

ELEV	AREA (sf)	AVERAGE AREA (sf)	VOLUME (cf)	ACC. VOLUME (cf) STORAGE (S)	STAGE (ft) Z	AREA (ac)	ELEV	ELEV STEP (ft) ΔZ
406.10	1,650	825	0	0	0	0.038	406.10	0.4
406.50	1,800	1,725	690	690	0.4	0.041	406.50	0.5
407.00	2,000	1,900	950	1,640	0.9	0.046	407.00	0.5
407.50	2,220	2,110	1,055	2,695	1.4	0.051	407.50	0.5
408.00	2,445	2,333	1,166	3,861	1.9	0.056	408.00	0.5
408.50	2,680	2,563	1,281	5,142	2.4	0.062	408.50	0.5
409.00	3,200	2,940	1,470	6,612	2.9	0.073	409.00	0

Manning's Roughness Coefficient: 0.011 (PVC)
 Slope of Pipes: 0.005 ft/ft
 Flow Through 4": 0.159 cfs
 Flow Through 6": 0.470 cfs
 Flow Through 8": 1.012 cfs
 Flow Through 10": 1.836 cfs

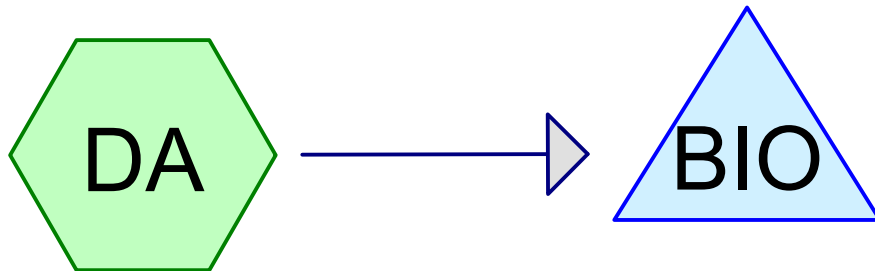
Table 5-1
 Number of Pipes Required in the Underdrain

If D is less than	# of 4" pipes	If D is less than	# of 6" pipes	If D is less than	# of 8" pipes	If D is less than	# of 10" pipes
5.13	2	7.84	2	10.37	2	12.97	2
5.95	3	9.11	3	12.08	3	15.10	3
6.66	4	10.13	4	13.45	4	16.82	4
7.22	5	10.97	5	14.63	5	18.29	5
7.75	6	11.75	6	15.66	6	19.58	6
8.20	7	12.45	7	16.60	7	20.74	7
8.72	8	13.09	8	17.45	8	21.81	8
9.12	9	13.68	9	18.24	9	22.80	9
9.49	10	14.23	10	18.97	10	23.71	10
9.83	11	14.75	11	19.66	11	24.58	11
10.16	12	15.24	12	20.31	12	25.39	12
10.47	13	15.70	13	20.93	13	26.17	13
10.76	14	16.14	14	21.52	14	26.90	14
11.04	15	16.56	15	22.09	15	27.61	15
11.31	16	16.97	16	22.63	16	28.28	16
11.57	17	17.36	17	23.15	17	28.93	17
11.82	18	17.74	18	23.65	18	29.56	18
12.07	19	18.10	19	24.13	19	30.17	19
12.30	20	18.45	20	24.60	20	30.75	20

= Calculated (not in manual)

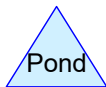
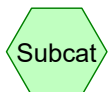
DESIGN SUMMARY (BIORETENTION CELL #1)

Berm Elevation	409.00	1" WQV Required	1,963 cf
Bottom/Surface Elevation	406.10	1" WQV Provided	2,110 cf
Media Depth	2.5 ft	1" WQV Surface Area Required	1,963 sf
Media Bottom Elevation	403.60	1" WQV Surface Area Provided	2,110 sf
Sand/Stone Depth	1.17 ft	1" WQV Pool Elevation	407.10 (12" Depth)
Stone Bottom Elevation	402.43		
Max. Run of Underdrain	70 ft		
Add'l Excavation (@ 0.5%)	0.35 ft		
Excavation Elevation @ Outlet	402.08		



CELL 1

BIORETENTION



04-03-23 Bioretention Cell 1 - Staged Rating Curve

Type II 24-hr 1-YR Rainfall=3.00"

Prepared by Windows User

Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Summary for Subcatchment DA: CELL 1

Runoff = 3.35 cfs @ 11.97 hrs, Volume= 0.159 af, Depth> 2.02"

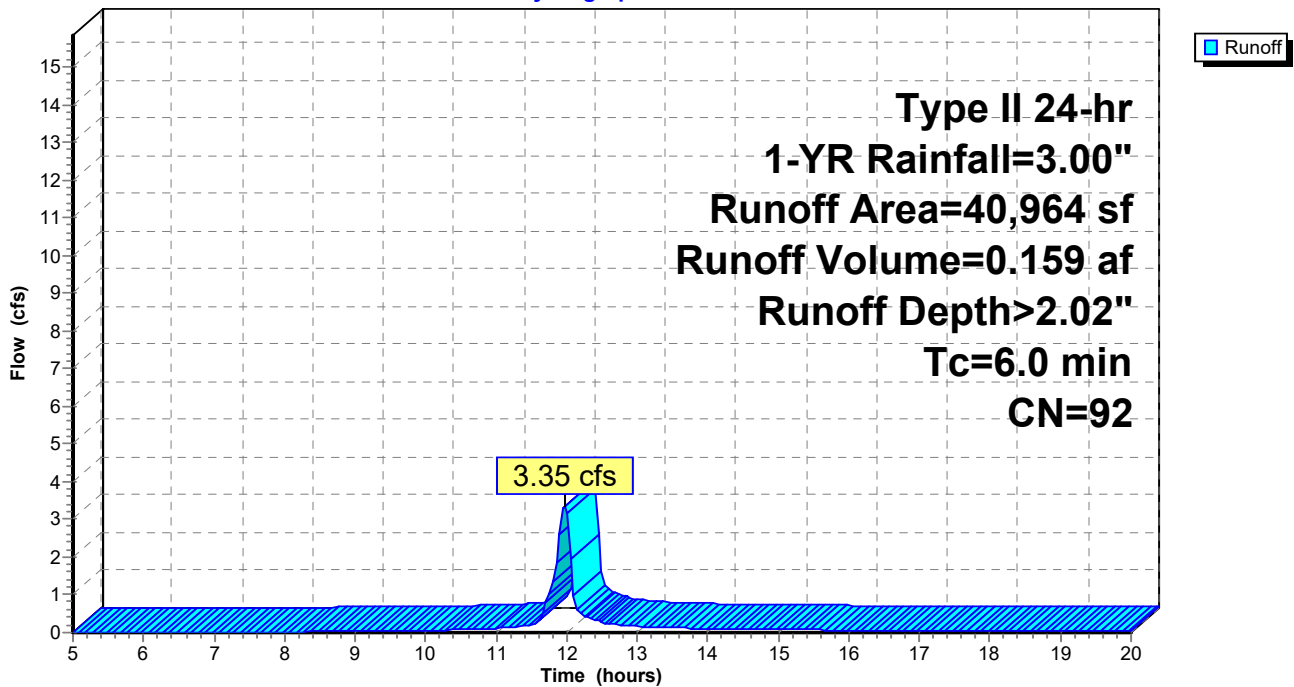
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YR Rainfall=3.00"

Area (sf)	CN	Description
17,070	84	Pasture/grassland/range, Fair, HSG D
0	79	Woods, Fair, HSG D
23,894	98	Paved parking, HSG D
40,964	92	Weighted Average
17,070		41.67% Pervious Area
23,894		58.33% Impervious Area

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

Subcatchment DA: CELL 1

Hydrograph



04-03-23 Bioretention Cell 1 - Staged Rating Curve

Type II 24-hr 1-YR Rainfall=3.00"

Prepared by Windows User

Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Page 3

Summary for Pond BIO: BIORETENTION

Inflow Area = 0.940 ac, 58.33% Impervious, Inflow Depth > 2.02" for 1-YR event
 Inflow = 3.35 cfs @ 11.97 hrs, Volume= 0.159 af
 Outflow = 0.35 cfs @ 12.40 hrs, Volume= 0.126 af, Atten= 90%, Lag= 26.2 min
 Primary = 0.14 cfs @ 11.25 hrs, Volume= 0.119 af
 Secondary = 0.21 cfs @ 12.40 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 407.62' @ 12.40 hrs Surf.Area= 3,759 sf Storage= 3,267 cf

Plug-Flow detention time= 173.7 min calculated for 0.126 af (79% of inflow)
 Center-of-Mass det. time= 118.2 min (879.4 - 761.2)

Volume	Invert	Avail.Storage	Storage Description
#1	402.08'	303 cf	Soil Media - (e = 0.20) 10% Clogged (Prismatic) Listed below (Recalc) x 0.1515 1,515 cf Overall x 20.0% Voids
#2	406.10'	6,612 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,915 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
402.08	1,650	0	0
403.10	1,650	1,683	1,683

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
406.10	1,650	0	0
406.50	1,800	690	690
407.00	2,000	950	1,640
407.50	2,220	1,055	2,695
408.00	2,445	1,166	3,861
408.50	2,680	1,281	5,142
409.00	3,200	1,470	6,612

Device	Routing	Invert	Outlet Devices
#1	Primary	402.08'	0.14 cfs Exfiltration at all elevations
#2	Secondary	396.90'	15.0" Round Culvert L= 49.3' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 396.90' / 392.00' S= 0.0994 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	407.60'	19.6' long Overflow Structure 2 End Contraction(s)

Primary OutFlow Max=0.14 cfs @ 11.25 hrs HW=402.16' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.14 cfs)

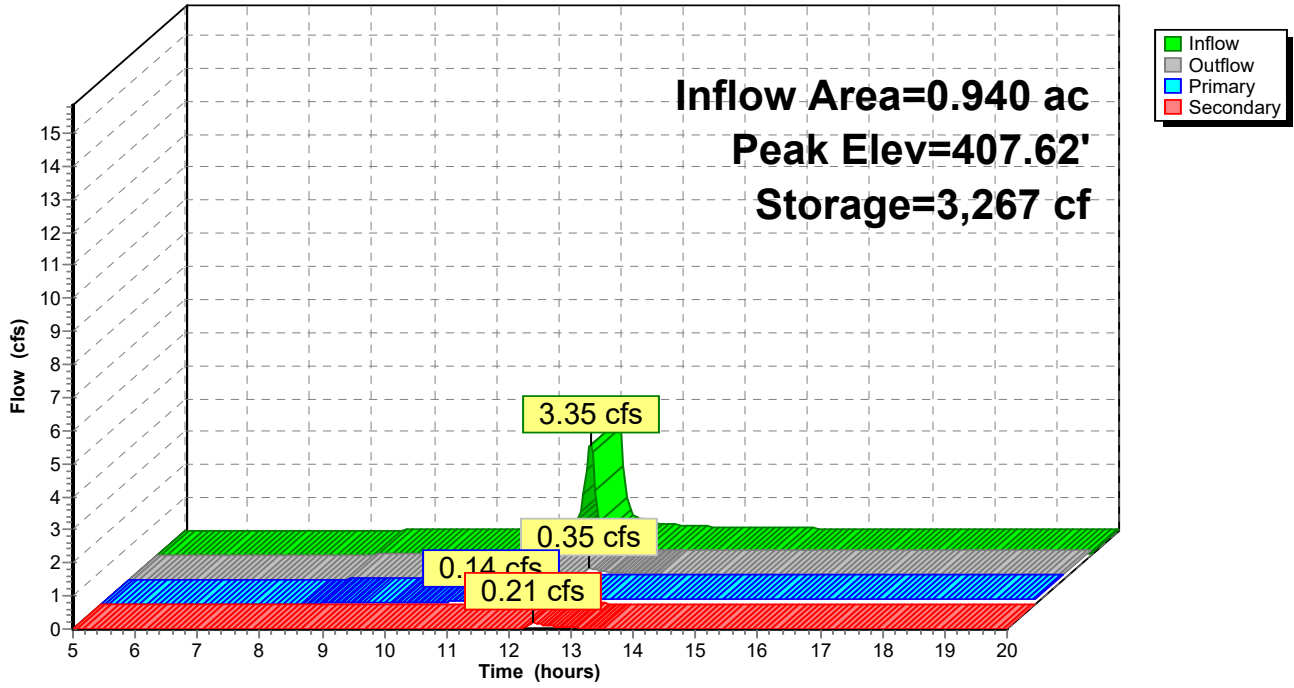
Secondary OutFlow Max=0.18 cfs @ 12.40 hrs HW=407.62' (Free Discharge)

↑2=Culvert (Passes 0.18 cfs of 23.47 cfs potential flow)

↑3=Overflow Structure (Weir Controls 0.18 cfs @ 0.46 fps)

Pond BIO: BIORETENTION

Hydrograph



04-03-23 Bioretention Cell 1 - Staged Rating Curve

Type II 24-hr 2-YR Rainfall=3.60"

Prepared by Windows User

Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Summary for Subcatchment DA: CELL 1

Runoff = 4.18 cfs @ 11.96 hrs, Volume= 0.201 af, Depth> 2.56"

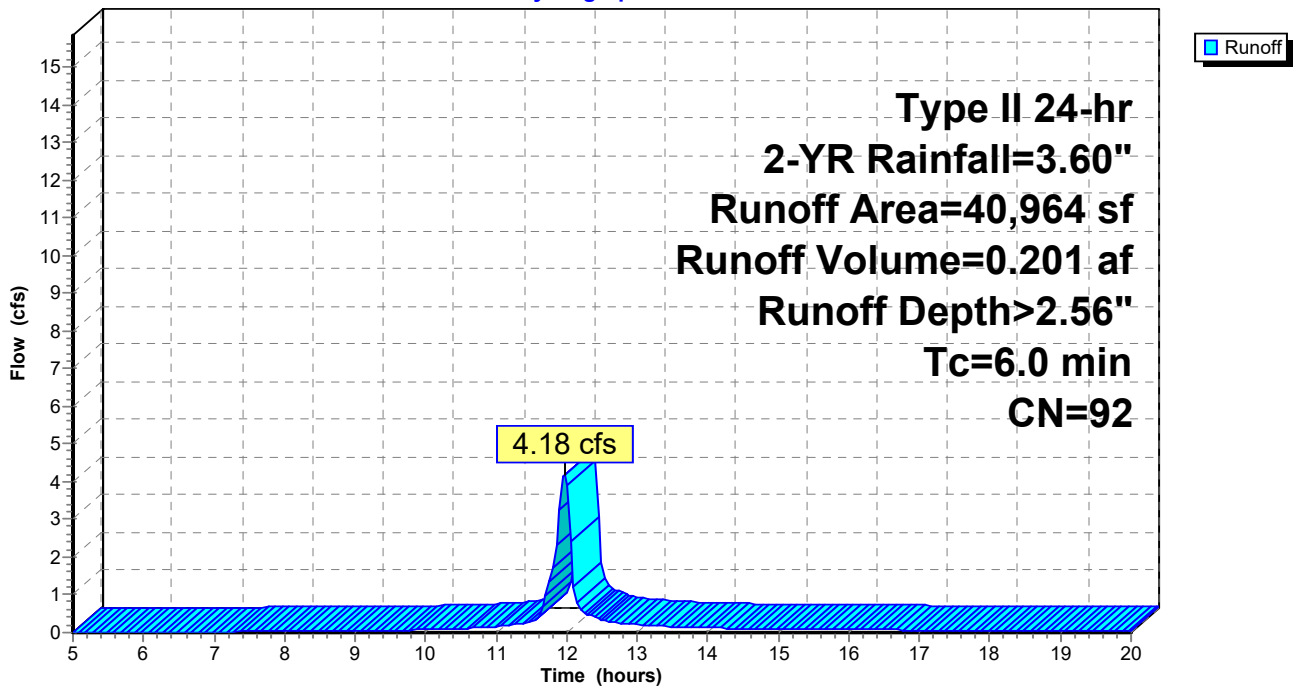
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.60"

Area (sf)	CN	Description
17,070	84	Pasture/grassland/range, Fair, HSG D
0	79	Woods, Fair, HSG D
23,894	98	Paved parking, HSG D
40,964	92	Weighted Average
17,070		41.67% Pervious Area
23,894		58.33% Impervious Area

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

Subcatchment DA: CELL 1

Hydrograph



04-03-23 Bioretention Cell 1 - Staged Rating Curve

Type II 24-hr 2-YR Rainfall=3.60"

Prepared by Windows User

Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Page 6

Summary for Pond BIO: BIORETENTION

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.940 ac, 58.33% Impervious, Inflow Depth > 2.56" for 2-YR event
 Inflow = 4.18 cfs @ 11.96 hrs, Volume= 0.201 af
 Outflow = 1.91 cfs @ 12.08 hrs, Volume= 0.161 af, Atten= 54%, Lag= 7.0 min
 Primary = 0.14 cfs @ 10.90 hrs, Volume= 0.125 af
 Secondary = 1.77 cfs @ 12.08 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 407.69' @ 12.08 hrs Surf.Area= 3,791 sf Storage= 3,432 cf

Plug-Flow detention time= 137.9 min calculated for 0.160 af (80% of inflow)
 Center-of-Mass det. time= 84.1 min (840.1 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1	402.08'	303 cf	Soil Media - (e = 0.20) 10% Clogged (Prismatic) Listed below (Recalc) x 0.1515 1,515 cf Overall x 20.0% Voids
#2	406.10'	6,612 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,915 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
402.08	1,650	0	0
403.10	1,650	1,683	1,683

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
406.10	1,650	0	0
406.50	1,800	690	690
407.00	2,000	950	1,640
407.50	2,220	1,055	2,695
408.00	2,445	1,166	3,861
408.50	2,680	1,281	5,142
409.00	3,200	1,470	6,612

Device	Routing	Invert	Outlet Devices
#1	Primary	402.08'	0.14 cfs Exfiltration at all elevations
#2	Secondary	396.90'	15.0" Round Culvert L= 49.3' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 396.90' / 392.00' S= 0.0994 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	407.60'	19.6' long Overflow Structure 2 End Contraction(s)

Primary OutFlow Max=0.14 cfs @ 10.90 hrs HW=402.15' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.14 cfs)

Secondary OutFlow Max=1.65 cfs @ 12.08 hrs HW=407.69' (Free Discharge)

↑2=Culvert (Passes 1.65 cfs of 23.55 cfs potential flow)

↑3=Overflow Structure (Weir Controls 1.65 cfs @ 0.97 fps)

04-03-23 Bioretention Cell 1 - Staged Rating Curve

NWEC
Type II 24-hr 2-YR Rainfall=3.60"

Prepared by Windows User

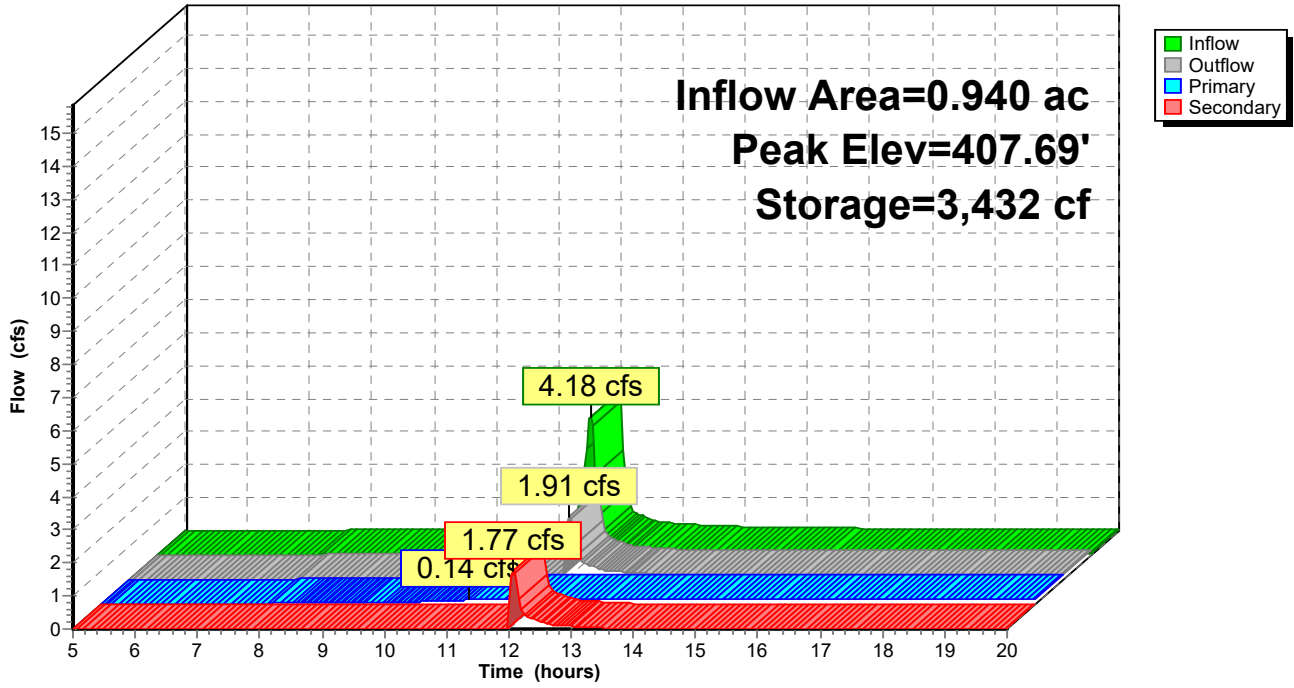
Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Page 7

Pond BIO: BIORETENTION

Hydrograph



Summary for Subcatchment DA: CELL 1

Runoff = 6.61 cfs @ 11.96 hrs, Volume= 0.328 af, Depth> 4.18"

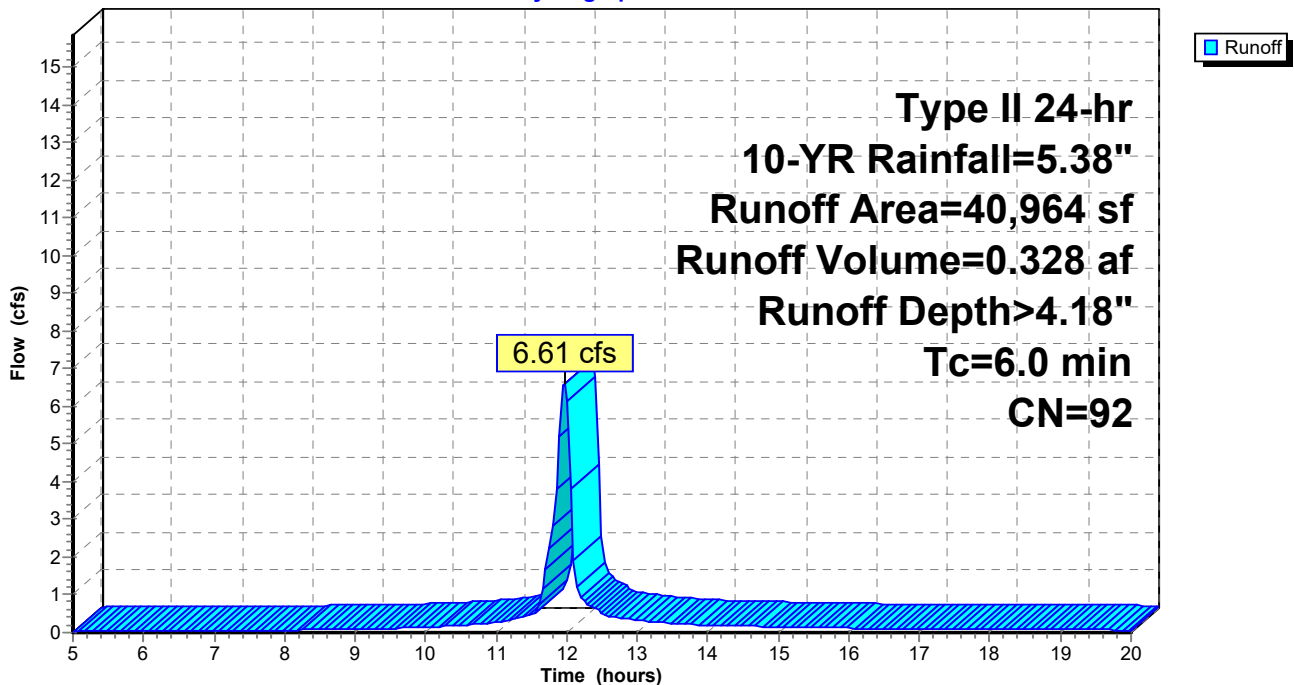
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=5.38"

Area (sf)	CN	Description
17,070	84	Pasture/grassland/range, Fair, HSG D
0	79	Woods, Fair, HSG D
23,894	98	Paved parking, HSG D
40,964	92	Weighted Average
17,070		41.67% Pervious Area
23,894		58.33% Impervious Area

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

Subcatchment DA: CELL 1

Hydrograph



Summary for Pond BIO: BIORETENTION

[82] Warning: Early inflow requires earlier time span
 [88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.940 ac, 58.33% Impervious, Inflow Depth > 4.18" for 10-YR event
 Inflow = 6.61 cfs @ 11.96 hrs, Volume= 0.328 af
 Outflow = 7.16 cfs @ 11.97 hrs, Volume= 0.271 af, Atten= 0%, Lag= 0.6 min
 Primary = 0.14 cfs @ 10.05 hrs, Volume= 0.143 af
 Secondary = 7.02 cfs @ 11.97 hrs, Volume= 0.128 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 407.84' @ 11.97 hrs Surf.Area= 3,856 sf Storage= 3,769 cf

Plug-Flow detention time= 86.0 min calculated for 0.270 af (82% of inflow)
 Center-of-Mass det. time= 36.4 min (783.0 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1	402.08'	303 cf	Soil Media - (e = 0.20) 10% Clogged (Prismatic) Listed below (Recalc) x 0.1515 1,515 cf Overall x 20.0% Voids
#2	406.10'	6,612 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,915 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
402.08	1,650	0	0
403.10	1,650	1,683	1,683

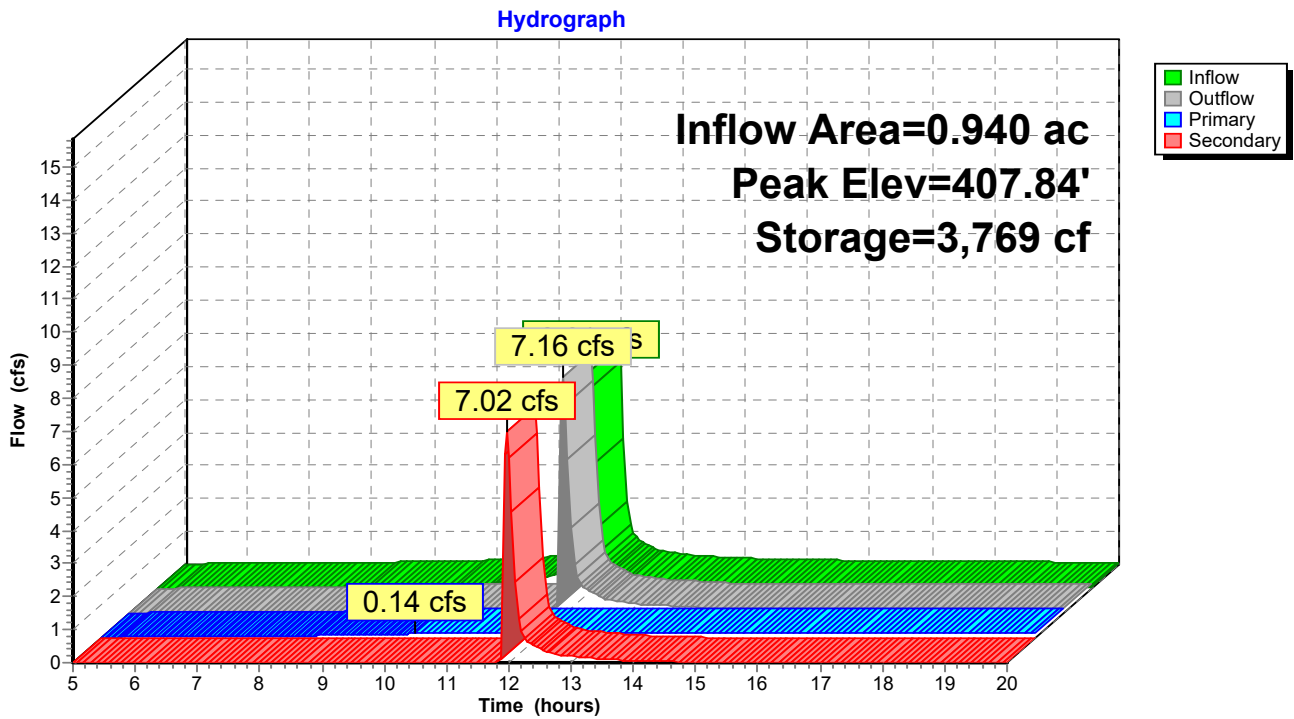
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
406.10	1,650	0	0
406.50	1,800	690	690
407.00	2,000	950	1,640
407.50	2,220	1,055	2,695
408.00	2,445	1,166	3,861
408.50	2,680	1,281	5,142
409.00	3,200	1,470	6,612

Device	Routing	Invert	Outlet Devices
#1	Primary	402.08'	0.14 cfs Exfiltration at all elevations
#2	Secondary	396.90'	15.0" Round Culvert L= 49.3' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 396.90' / 392.00' S= 0.0994 ' / Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	407.60'	19.6' long Overflow Structure 2 End Contraction(s)

Primary OutFlow Max=0.14 cfs @ 10.05 hrs HW=402.15' (Free Discharge)
↑1=Exfiltration (Exfiltration Controls 0.14 cfs)

Secondary OutFlow Max=6.20 cfs @ 11.97 hrs HW=407.81' (Free Discharge)
↑2=Culvert (Passes 6.20 cfs of 23.69 cfs potential flow)
↑3=Overflow Structure (Weir Controls 6.20 cfs @ 1.50 fps)

Pond BIO: BIORETENTION



Summary for Subcatchment DA: CELL 1

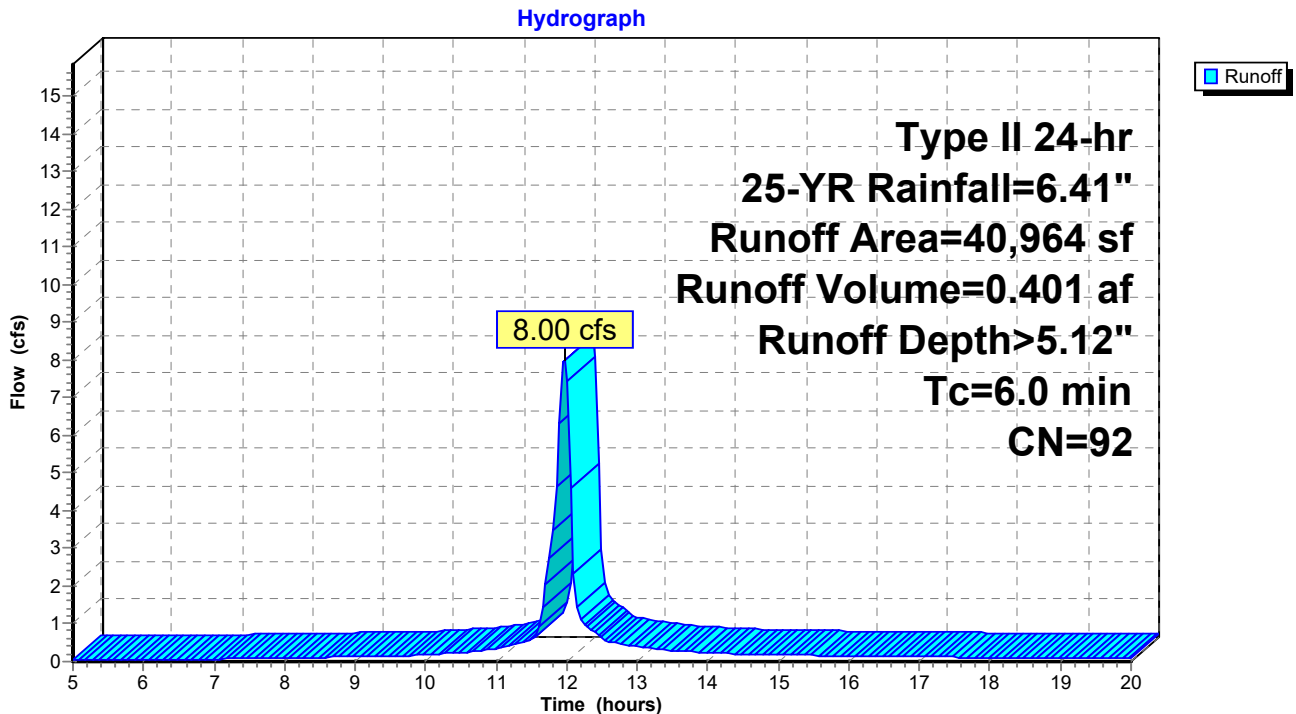
Runoff = 8.00 cfs @ 11.96 hrs, Volume= 0.401 af, Depth> 5.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type II 24-hr 25-YR Rainfall=6.41"

Area (sf)	CN	Description
17,070	84	Pasture/grassland/range, Fair, HSG D
0	79	Woods, Fair, HSG D
23,894	98	Paved parking, HSG D
40,964	92	Weighted Average
17,070		41.67% Pervious Area
23,894		58.33% Impervious Area

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

Subcatchment DA: CELL 1



Summary for Pond BIO: BIORETENTION

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.940 ac, 58.33% Impervious, Inflow Depth > 5.12" for 25-YR event
 Inflow = 8.00 cfs @ 11.96 hrs, Volume= 0.401 af
 Outflow = 7.92 cfs @ 11.98 hrs, Volume= 0.338 af, Atten= 1%, Lag= 1.1 min
 Primary = 0.14 cfs @ 9.20 hrs, Volume= 0.151 af
 Secondary = 7.78 cfs @ 11.98 hrs, Volume= 0.187 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 407.85' @ 11.98 hrs Surf.Area= 3,860 sf Storage= 3,791 cf

Plug-Flow detention time= 72.6 min calculated for 0.338 af (84% of inflow)
 Center-of-Mass det. time= 24.8 min (768.0 - 743.2)

Volume	Invert	Avail.Storage	Storage Description
#1	402.08'	303 cf	Soil Media - (e = 0.20) 10% Clogged (Prismatic) Listed below (Recalc) x 0.1515 1,515 cf Overall x 20.0% Voids
#2	406.10'	6,612 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,915 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
402.08	1,650	0	0
403.10	1,650	1,683	1,683

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
406.10	1,650	0	0
406.50	1,800	690	690
407.00	2,000	950	1,640
407.50	2,220	1,055	2,695
408.00	2,445	1,166	3,861
408.50	2,680	1,281	5,142
409.00	3,200	1,470	6,612

Device	Routing	Invert	Outlet Devices
#1	Primary	402.08'	0.14 cfs Exfiltration at all elevations
#2	Secondary	396.90'	15.0" Round Culvert L= 49.3' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 396.90' / 392.00' S= 0.0994 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	407.60'	19.6' long Overflow Structure 2 End Contraction(s)

Primary OutFlow Max=0.14 cfs @ 9.20 hrs HW=402.15' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.14 cfs)

Secondary OutFlow Max=7.45 cfs @ 11.98 hrs HW=407.84' (Free Discharge)

↑2=Culvert (Passes 7.45 cfs of 23.72 cfs potential flow)

↑3=Overflow Structure (Weir Controls 7.45 cfs @ 1.60 fps)

04-03-23 Bioretention Cell 1 - Staged Rating Curve

Type II 24-hr 25-YR Rainfall=6.41"

Prepared by Windows User

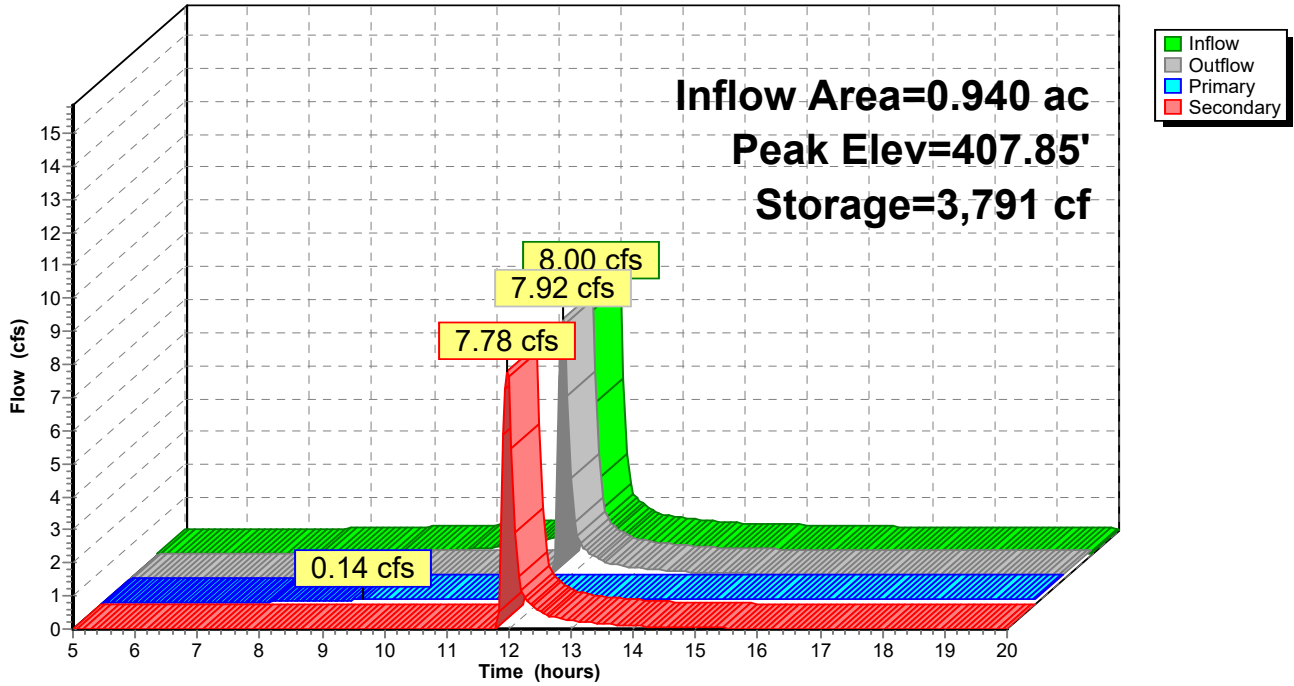
Printed 6/2/2023

HydroCAD® 10.00-22 s/n 09989 © 2018 HydroCAD Software Solutions LLC

Page 13

Pond BIO: BIORETENTION

Hydrograph



Summary for Subcatchment DA: CELL 1

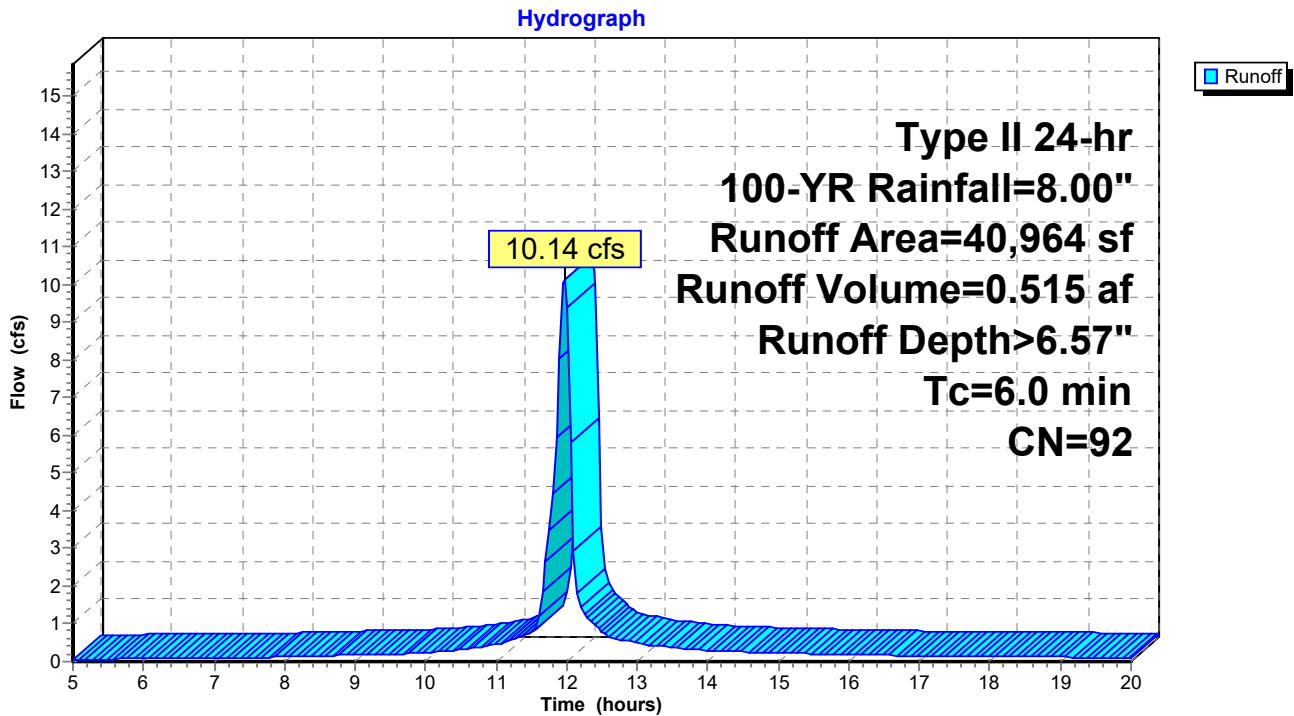
Runoff = 10.14 cfs @ 11.96 hrs, Volume= 0.515 af, Depth> 6.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.00"

Area (sf)	CN	Description
17,070	84	Pasture/grassland/range, Fair, HSG D
0	79	Woods, Fair, HSG D
23,894	98	Paved parking, HSG D
40,964	92	Weighted Average
17,070		41.67% Pervious Area
23,894		58.33% Impervious Area

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

Subcatchment DA: CELL 1



Summary for Pond BIO: BIORETENTION

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.940 ac, 58.33% Impervious, Inflow Depth > 6.57" for 100-YR event
 Inflow = 10.14 cfs @ 11.96 hrs, Volume= 0.515 af
 Outflow = 10.04 cfs @ 11.98 hrs, Volume= 0.445 af, Atten= 1%, Lag= 1.0 min
 Primary = 0.14 cfs @ 8.45 hrs, Volume= 0.160 af
 Secondary = 9.90 cfs @ 11.98 hrs, Volume= 0.285 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 407.89' @ 11.98 hrs Surf.Area= 3,880 sf Storage= 3,894 cf

Plug-Flow detention time= 59.6 min calculated for 0.443 af (86% of inflow)
 Center-of-Mass det. time= 16.9 min (756.4 - 739.5)

Volume	Invert	Avail.Storage	Storage Description
#1	402.08'	303 cf	Soil Media - (e = 0.20) 10% Clogged (Prismatic) Listed below (Recalc) x 0.15 1,515 cf Overall x 20.0% Voids
#2	406.10'	6,612 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,915 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
402.08	1,650	0	0
403.10	1,650	1,683	1,683

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
406.10	1,650	0	0
406.50	1,800	690	690
407.00	2,000	950	1,640
407.50	2,220	1,055	2,695
408.00	2,445	1,166	3,861
408.50	2,680	1,281	5,142
409.00	3,200	1,470	6,612

Device	Routing	Invert	Outlet Devices
#1	Primary	402.08'	0.14 cfs Exfiltration at all elevations
#2	Secondary	396.90'	15.0" Round Culvert L= 49.3' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 396.90' / 392.00' S= 0.0994 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	407.60'	19.6' long Overflow Structure 2 End Contraction(s)

Primary OutFlow Max=0.14 cfs @ 8.45 hrs HW=402.15' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.14 cfs)

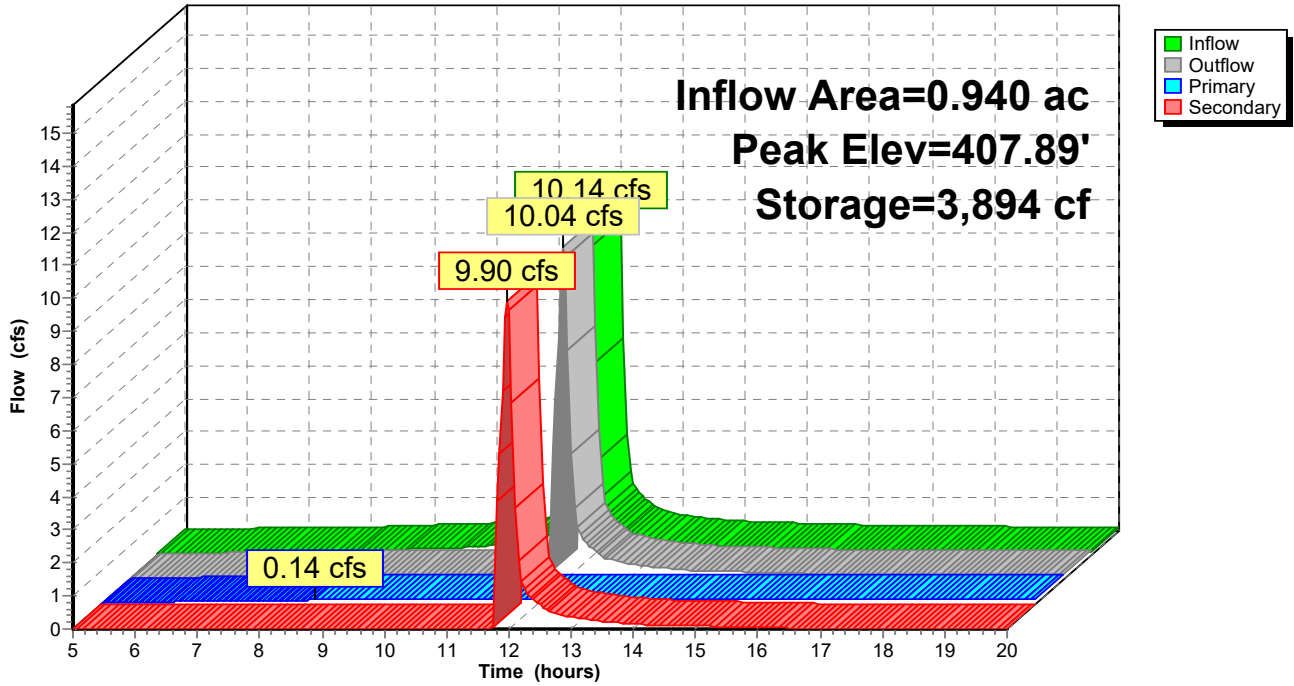
Secondary OutFlow Max=9.50 cfs @ 11.98 hrs HW=407.88' (Free Discharge)

↑2=Culvert (Passes 9.50 cfs of 23.77 cfs potential flow)

↑3=Overflow Structure (Weir Controls 9.50 cfs @ 1.73 fps)

Pond BIO: BIORETENTION

Hydrograph



MAPS

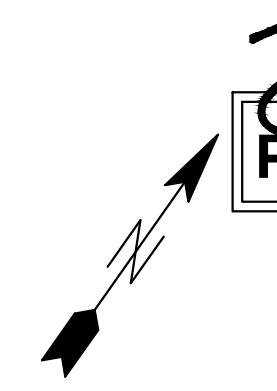
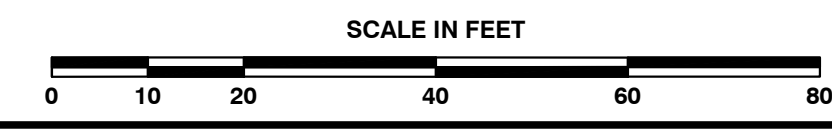
PRE-DEVELOPMENT DRAINAGE AREA MAP
POST-DEVELOPMENT DRAINAGE AREA MAP
WEBSOILS MAP/DATA



ROGERS ROAD
(MCSR 2052)
VARIABLE WIDTH PUBLIC R/W

GRANITE FALLS BOULEVARD
60' PUBLIC R/W

POI #1



PRELIMINARY

NO.	DATE	DESCRIPTION
2	06-02-23	PER TOR COMMENTS
1	04-03-23	PER TOR COMMENTS

SHEET
DA1.1

NorthWake
Eye Care
A MEMBER OF *Worship Source*
971 GRANITE FALLS BOULEVARD
TOWN OF ROLESVILLE, WAKE COUNTY, NORTH CAROLINA

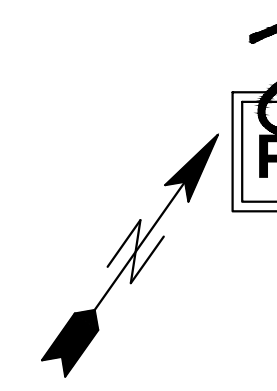
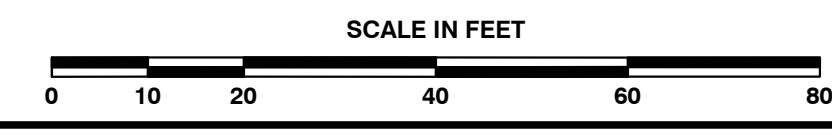
JOB NO: 21027 DATE: 10-03-22
**PRE-DEVELOPMENT
DRAINAGE AREA
MAP**
SCALE: 1" = 20'



REAL ENGINEERING
6109 WILKINSBURG ROAD
RALEIGH, NC 27612
(919) 539-7340
NCBELS FIRM NO: C-4406

DRAINAGE AREA LEGEND

NO.	TYPE	INLET DA (SF)	INLET DA (AC)	DA (AC)	INLET IMP (SF)	INLET IMP (AC)	% IMP	C-VALUE
10	YI	8,848	0.20	0.20	3,975	0.09	45%	0.59
9	CI	6,465	0.15	0.35	4,701	0.11	73%	0.77
8	CI	3,671	0.08	0.44	3,461	0.08	94%	0.91
7	CI	8,063	0.19	0.19	6,521	0.15	81%	0.83
6	YI	8,478	0.19	0.19	4,354	0.10	51%	0.63
5	MH/JB	0	0.00	0.82	0	0.00	---	---
4	CI	1,011	0.02	0.84	753	0.02	74%	0.78
2	SCM	4,428	0.10	0.94	129	0.00	3%	0.32
		40,964		0.94	23,894	0.55	58%	0.68



G&G BUILDERS, INC.

TJ ARCHITECTURE

REAL ENGINEERING

6109 WILKINSBURG ROAD
RALEIGH, NC 27612
(919) 539-7340
NCBELS FIRM NO: C-4406

JOB NO: 21027 DATE: 10-03-22
POST-DEVELOPMENT
DRAINAGE AREA
MAP
SCALE: 1" = 20'

NorthWake Eye Care
A MEMBER OF *WakeSource*
971 GRANITE FALLS BOULEVARD
TOWN OF ROLESVILLE, WAKE COUNTY, NORTH CAROLINA

NO.	DATE	DESCRIPTION
2	06-02-23	PER TOR COMMENTS
1	04-03-23	PER TOR COMMENTS

PRELIMINARY

06-02-23

SHEET
DA1.2

Custom Soil Resource Report for Wake County, North Carolina

NORTH WAKE EYE CARE



Custom Soil Resource Report Soil Map



Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ur	Urban land	1.0	32.6%
WaD	Wake-Rolesville complex, 10 to 15 percent slopes, very rocky	2.0	64.9%
WfB	Wedowee-Saw complex, 2 to 6 percent slopes	0.1	2.5%
Totals for Area of Interest		3.1	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

Custom Soil Resource Report

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Wake County, North Carolina

Ur—Urban land

Map Unit Setting

National map unit symbol: 2qwpc
Elevation: 70 to 1,400 feet
Mean annual precipitation: 39 to 51 inches
Mean annual air temperature: 54 to 63 degrees F
Frost-free period: 190 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Impervious layers over human-transported material

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

WaD—Wake-Rolesville complex, 10 to 15 percent slopes, very rocky

Map Unit Setting

National map unit symbol: 2xhbf
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Wake, very rocky, and similar soils: 50 percent
Rolesville, very rocky, and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wake, Very Rocky

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Custom Soil Resource Report

Typical profile

Ap - 0 to 7 inches: gravelly loamy coarse sand
C - 7 to 11 inches: gravelly loamy sand
R - 11 to 80 inches: bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: F136XY870GA - Outer piedmont acidic upland woodlands and glades, dry
Hydric soil rating: No

Description of Rolesville, Very Rocky

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

Ap - 0 to 12 inches: loamy sand
Bw - 12 to 26 inches: loamy sand
C - 26 to 32 inches: loamy coarse sand
Cr - 32 to 38 inches: bedrock
R - 38 to 80 inches: bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock; 20 to 80 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A

Custom Soil Resource Report

Ecological site: F136XY870GA - Outer piedmont acidic upland woodlands and glades, dry
Hydric soil rating: No

WfB—Wedowee-Saw complex, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2xn42
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Wedowee and similar soils: 60 percent
Saw and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wedowee

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Saprolite residuum weathered from granite and gneiss and/or saprolite residuum weathered from schist

Typical profile

Ap - 0 to 4 inches: sandy loam
E - 4 to 7 inches: sandy loam
BC - 23 to 35 inches: clay loam
C - 35 to 80 inches: sandy clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Custom Soil Resource Report

Ecological site: F136XY820GA - Acidic upland forest, moist
Hydric soil rating: No

Description of Saw

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 20 inches: clay
BC - 20 to 26 inches: sandy clay loam
C - 26 to 29 inches: sandy loam
R - 29 to 80 inches: bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F136XY830NC - Acidic upland forest, dry-moist
Hydric soil rating: No