STORMWATER DESIGN CALCULATIONS

FOR

Cheatham County Farmers Cooperative

114 Cumberland Street
Ashland City, TN

January 15, 2024

Prepared By

KLOBER ENGINEERING SERVICES
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STORM WATER CALCULATIONS

NOTE: Storm water runoff is calculated using the TR-55 Method. All flow calculations are based on methods established in the Nashville / Davidson County Stormwater Management Manual.

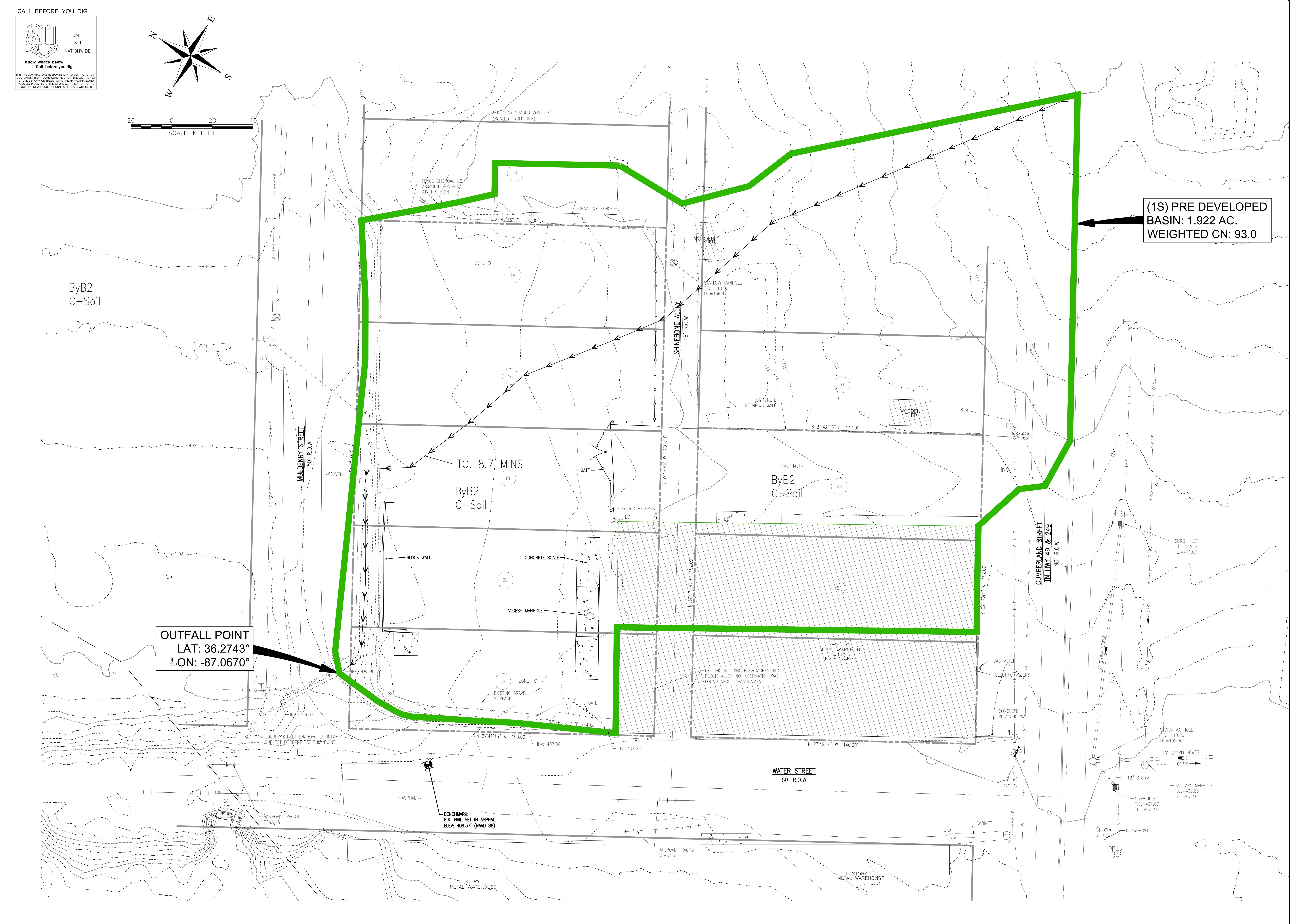
Stormwater Detention:

As seen on DM-1, the current site conditions convey runoff to the west towards the existing site outfall. The existing outfall drains towards Marks Creek, located approximately 1,690 feet west of the project location. The intention of this project is to construct a 8,000 square feet building with asphalt pavement. The post developed site will be conveyed towards a stormwater pond located along the northwest corner of the property and will be discharged at the existing outfall point. The supporting HydroCAD calculations are attached to this document along with maps, DM-1 and DM-2. See the table(s) below summarizing Pre-Developed vs. Post-Developed site conditions.

TOTAL DRAINAGE SUMMARY								
	PRE-DEVELOPMENT		POST-DEVELOPMENT				TOTAL POST DEVELOPED	
	AREA=	1.922 AC	AREA TO POND=		1.834 AC	POND BYPASS AREA=	0.089 AC.	TOTAL POST DEVELOPED AREA TO CULVERT=	1.923 AC.
STORM EVENT (yr)	CN=	93	CN=		94	CN=	96		
	T_C=	8.7 MIN.	T_C=		8.1 MIN.	T_C=	5 MIN.		
	(1S) PRE-DEVELOPED DISCHARGE (cfs)		(2S) RUNOFF To POND (cfs)	(1P) POND DISCHARGE (cfs)	PEAK ELEVATION TOP=405.25	(3S) POND BYPASS (cfs)		(C1) DISCHARGE (cfs)	
2	6.70		6.69	6.12	402.93	0.37		6.34	
5	8.42		8.36	7.55	403.17	0.46		7.83	
10	9.81		9.70	8.57	403.39	0.53		8.89	
25	11.74		11.57	10.07	403.71	0.62		10.40	
50	13.30		13.09	11.11	403.95	0.70		11.50	
100	14.93		14.66	12.04	404.25	0.79		12.47	

Table 1: Total Drainage Basin Runoff Results

PRE-DEVELOPED



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REVISIONS		
NO. BY	DATE	DESCRIPTION

JOSHUA M. LYON, P.E. TN#112331

CONSTRUCTION DOCUMENTS

CHEATHAM COUNTY FARMERS COOPERATIVE

114 CUMBERLAND STREET
ASHLAND CITY, TN
CHEATHAM COUNTY

DRAWN BY:	RWS
CHECKED BY:	JML
PROJECT NO.:	C06023

PRE DEVELOPED DRAINAGE MAP

SHEET NUMBER
DM-1

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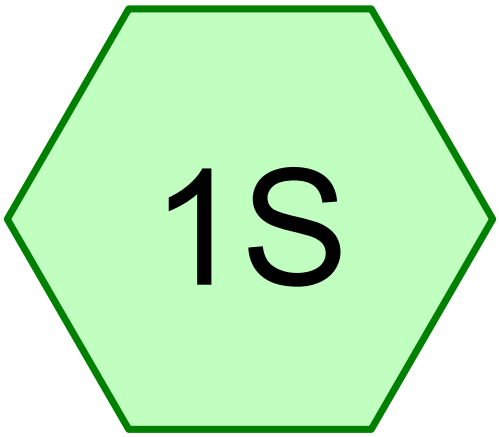

Pre-Developed Basin

Subcat Reach Pond Link

Routing Diagram for RC Farmers- Drainage
Prepared by Klober Engineering, Printed 1/15/2024
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Summary for Subcatchment 1S: Pre-Developed Basin

Runoff = 6.70 cfs @ 12.16 hrs, Volume= 0.424 af, Depth> 2.65"
Routed to nonexistent node 5R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=3.56"

Area (ac)	CN	Description
0.715	98	Unconnected pavement, HSG C
0.777	96	Gravel surface, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.922	93	Weighted Average
1.207		62.80% Pervious Area
0.715		37.20% Impervious Area
0.715		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
2.3	407	0.0344	2.99		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.7	507	Total			

Summary for Subcatchment 1S: Pre-Developed Basin

Runoff = 8.42 cfs @ 12.16 hrs, Volume= 0.541 af, Depth> 3.38"
Routed to nonexistent node 5R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 5-Year Rainfall=4.35"

Area (ac)	CN	Description
0.715	98	Unconnected pavement, HSG C
0.777	96	Gravel surface, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.922	93	Weighted Average
1.207		62.80% Pervious Area
0.715		37.20% Impervious Area
0.715		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
2.3	407	0.0344	2.99		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.7	507	Total			

Summary for Subcatchment 1S: Pre-Developed Basin

Runoff = 9.81 cfs @ 12.15 hrs, Volume= 0.636 af, Depth> 3.97"
Routed to nonexistent node 5R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.99"

Area (ac)	CN	Description
0.715	98	Unconnected pavement, HSG C
0.777	96	Gravel surface, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.922	93	Weighted Average
1.207		62.80% Pervious Area
0.715		37.20% Impervious Area
0.715		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
2.3	407	0.0344	2.99		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.7	507	Total			

Summary for Subcatchment 1S: Pre-Developed Basin

Runoff = 11.74 cfs @ 12.15 hrs, Volume= 0.770 af, Depth> 4.81"
Routed to nonexistent node 5R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 25-Year Rainfall=5.89"

Area (ac)	CN	Description
0.715	98	Unconnected pavement, HSG C
0.777	96	Gravel surface, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.922	93	Weighted Average
1.207		62.80% Pervious Area
0.715		37.20% Impervious Area
0.715		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
2.3	407	0.0344	2.99		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.7	507	Total			

Summary for Subcatchment 1S: Pre-Developed Basin

Runoff = 13.30 cfs @ 12.15 hrs, Volume= 0.879 af, Depth> 5.49"
Routed to nonexistent node 5R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 50-Year Rainfall=6.62"

Area (ac)	CN	Description
0.715	98	Unconnected pavement, HSG C
0.777	96	Gravel surface, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.922	93	Weighted Average
1.207		62.80% Pervious Area
0.715		37.20% Impervious Area
0.715		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
2.3	407	0.0344	2.99		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.7	507	Total			

Summary for Subcatchment 1S: Pre-Developed Basin

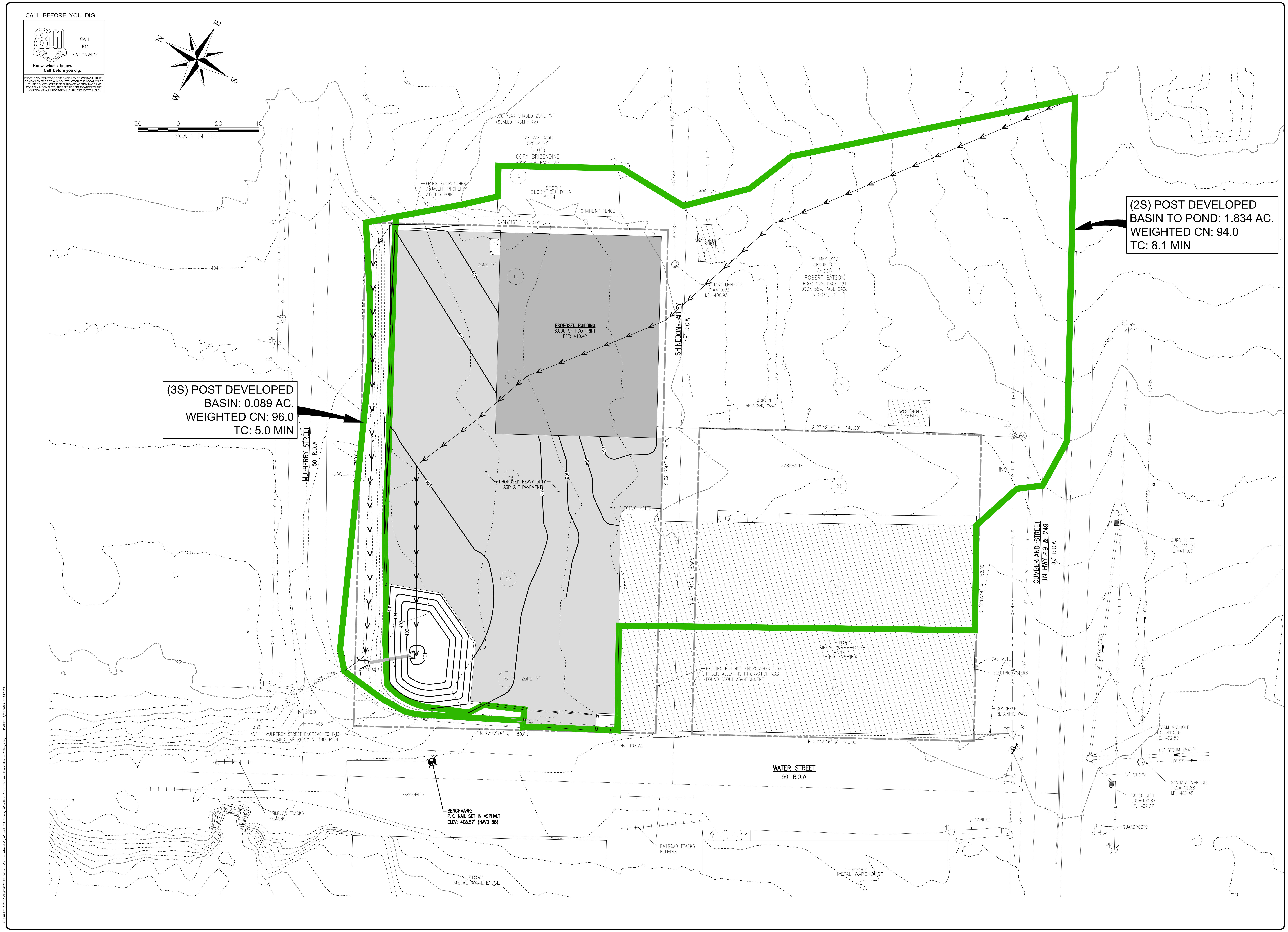
Runoff = 14.93 cfs @ 12.15 hrs, Volume= 0.992 af, Depth> 6.20"
Routed to nonexistent node 5R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=7.38"

Area (ac)	CN	Description
0.715	98	Unconnected pavement, HSG C
0.777	96	Gravel surface, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.922	93	Weighted Average
1.207		62.80% Pervious Area
0.715		37.20% Impervious Area
0.715		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
2.3	407	0.0344	2.99		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.7	507	Total			

POST-DEVELOPED



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CHEATHAM COUNTY

DRAWN BY:	RWS
CHECKED BY:	JML
PROJECT NO.:	C06023

POST DEVELOPED DRAINAGE MAP

SHEET NUMBER
DM-2

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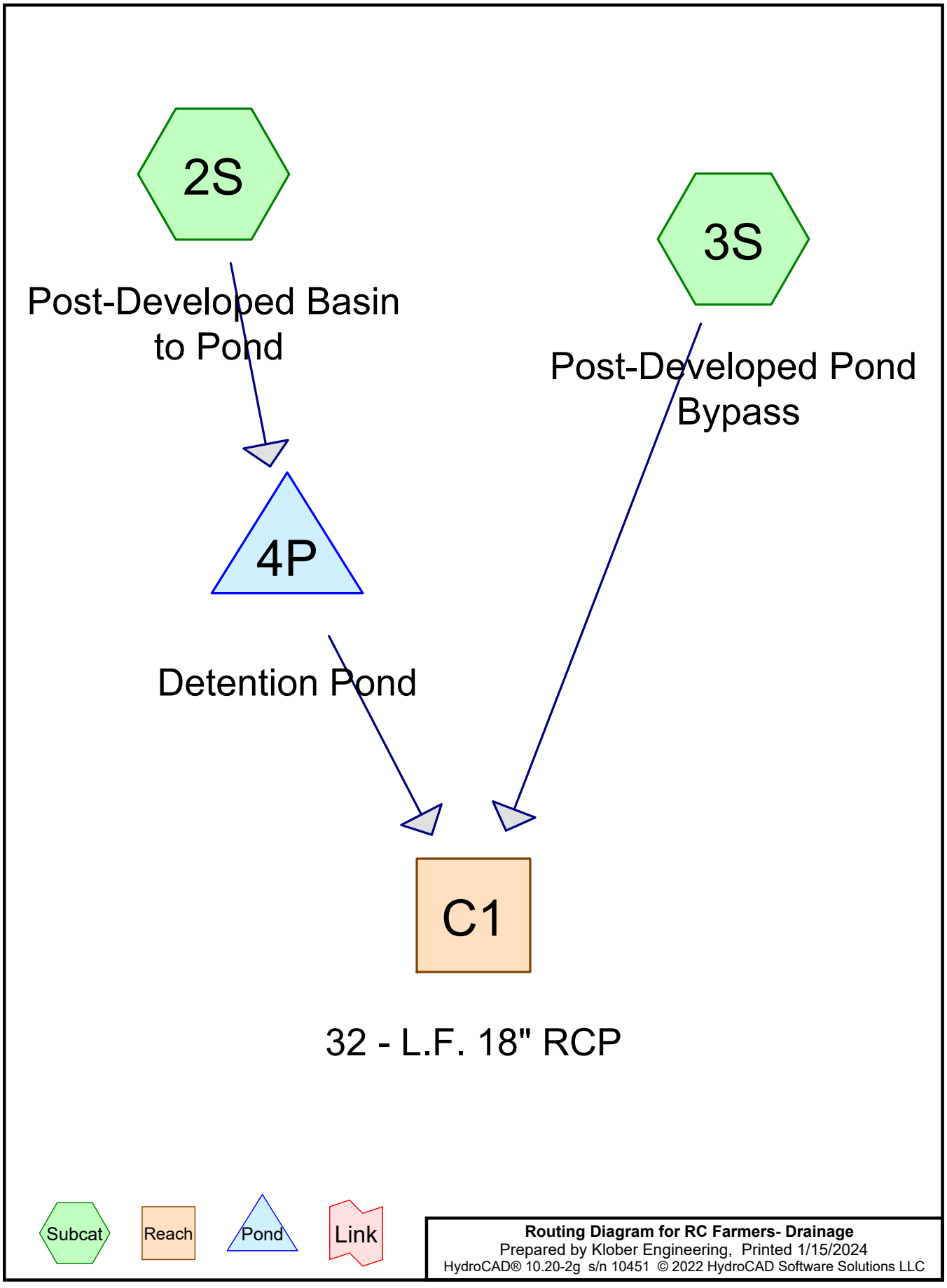


Routing Diagram for RC Farmers- Drainage
Prepared by Klober Engineering, Printed 1/15/2024
HydroCAD® 10.20-2g s/n 10451 © 2022 HydroCAD Software Solutions LLC

Summary for Subcatchment 2S: Post-Developed Basin to Pond

Runoff = 6.69 cfs @ 12.15 hrs, Volume= 0.420 af, Depth> 2.75"
Routed to Pond 4P : Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=3.56"

Area (ac)	CN	Description
0.759	98	Paved parking, HSG C
0.516	98	Unconnected roofs, HSG C
0.129	98	Paved parking, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.834	94	Weighted Average
0.430		23.45% Pervious Area
1.404		76.55% Impervious Area
0.516		36.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.7	373	0.0326	3.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.1	473	Total			

Summary for Subcatchment 3S: Post-Developed Pond Bypass

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.37 cfs @ 12.11 hrs, Volume= 0.022 af, Depth> 2.94"
Routed to Reach C1 : 32 - L.F. 18" RCP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=3.56"

Area (ac)	CN	Description
0.089	96	Gravel surface, HSG C
0.089		100.00% Pervious Area

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

Summary for Reach C1: 32 - L.F. 18" RCP

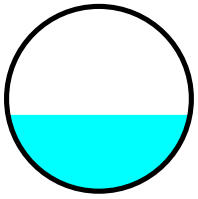
[52] Hint: Inlet/Outlet conditions not evaluated
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.01'

Inflow Area = 1.923 ac, 73.01% Impervious, Inflow Depth > 2.76" for 2-Year event
Inflow = 6.35 cfs @ 12.18 hrs, Volume= 0.442 af
Outflow = 6.34 cfs @ 12.18 hrs, Volume= 0.442 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.24 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.27 fps, Avg. Travel Time= 0.2 min

Peak Storage= 22 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.62' , Surface Width= 1.48'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.91 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 32.0' Slope= 0.0291 '/'
Inlet Invert= 400.90', Outlet Invert= 399.97'



Summary for Pond 4P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 1.834 ac, 76.55% Impervious, Inflow Depth > 2.75" for 2-Year event
Inflow = 6.69 cfs @ 12.15 hrs, Volume= 0.420 af
Outflow = 6.12 cfs @ 12.19 hrs, Volume= 0.420 af, Atten= 9%, Lag= 2.2 min
Primary = 6.12 cfs @ 12.19 hrs, Volume= 0.420 af
Routed to Reach C1 : 32 - L.F. 18" RCP

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 402.93' @ 12.19 hrs Surf.Area= 977 sf Storage= 885 cf

Plug-Flow detention time= 1.9 min calculated for 0.420 af (100% of inflow)
Center-of-Mass det. time= 1.8 min (756.9 - 755.2)

Volume	Invert	Avail.Storage	Storage Description
#1	401.50'	3,800 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
401.50	16	16.0	0	0	16
402.00	661	103.0	130	130	840
403.00	1,004	125.0	827	957	1,256
404.00	1,411	147.0	1,202	2,158	1,751
405.00	1,884	168.0	1,642	3,800	2,300

Device	Routing	Invert	Outlet Devices
#1	Primary	401.50'	**18.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 401.50' / 401.30' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=6.00 cfs @ 12.19 hrs HW=402.91' (Free Discharge)
1=Culvert (Barrel Controls 6.00 cfs @ 4.51 fps)

Summary for Subcatchment 2S: Post-Developed Basin to Pond

Runoff = 8.36 cfs @ 12.15 hrs, Volume= 0.532 af, Depth> 3.48"
Routed to Pond 4P : Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 5-Year Rainfall=4.35"

Area (ac)	CN	Description
0.759	98	Paved parking, HSG C
0.516	98	Unconnected roofs, HSG C
0.129	98	Paved parking, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.834	94	Weighted Average
0.430		23.45% Pervious Area
1.404		76.55% Impervious Area
0.516		36.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.7	373	0.0326	3.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.1	473	Total			

Summary for Subcatchment 3S: Post-Developed Pond Bypass

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.46 cfs @ 12.11 hrs, Volume= 0.027 af, Depth> 3.68"
Routed to Reach C1 : 32 - L.F. 18" RCP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 5-Year Rainfall=4.35"

Area (ac)	CN	Description
0.089	96	Gravel surface, HSG C
0.089		100.00% Pervious Area

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

Summary for Reach C1: 32 - L.F. 18" RCP

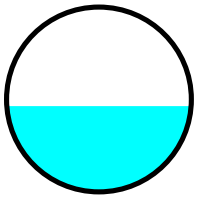
[52] Hint: Inlet/Outlet conditions not evaluated
[82] Warning: Early inflow requires earlier time span
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.09'

Inflow Area = 1.923 ac, 73.01% Impervious, Inflow Depth > 3.49" for 5-Year event
Inflow = 7.84 cfs @ 12.18 hrs, Volume= 0.559 af
Outflow = 7.83 cfs @ 12.18 hrs, Volume= 0.559 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.77 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.54 fps, Avg. Travel Time= 0.2 min

Peak Storage= 26 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.69' , Surface Width= 1.50'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.91 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 32.0' Slope= 0.0291 '/'
Inlet Invert= 400.90', Outlet Invert= 399.97'



Summary for Pond 4P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 1.834 ac, 76.55% Impervious, Inflow Depth > 3.48" for 5-Year event
Inflow = 8.36 cfs @ 12.15 hrs, Volume= 0.532 af
Outflow = 7.55 cfs @ 12.19 hrs, Volume= 0.532 af, Atten= 10%, Lag= 2.3 min
Primary = 7.55 cfs @ 12.19 hrs, Volume= 0.532 af
Routed to Reach C1 : 32 - L.F. 18" RCP

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 403.17' @ 12.19 hrs Surf.Area= 1,069 sf Storage= 1,136 cf

Plug-Flow detention time= 2.0 min calculated for 0.532 af (100% of inflow)
Center-of-Mass det. time= 1.8 min (752.9 - 751.1)

Volume	Invert	Avail.Storage	Storage Description
#1	401.50'	3,800 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
401.50	16	16.0	0	0	16
402.00	661	103.0	130	130	840
403.00	1,004	125.0	827	957	1,256
404.00	1,411	147.0	1,202	2,158	1,751
405.00	1,884	168.0	1,642	3,800	2,300

Device	Routing	Invert	Outlet Devices
#1	Primary	401.50'	**18.0" Round Culvert**
			L= 20.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 401.50' / 401.30' S= 0.0100 '/' Cc= 0.900
			n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=7.43 cfs @ 12.19 hrs HW=403.15' (Free Discharge)
1=Culvert (Barrel Controls 7.43 cfs @ 4.76 fps)

Summary for Subcatchment 2S: Post-Developed Basin to Pond

Runoff = 9.70 cfs @ 12.15 hrs, Volume= 0.623 af, Depth> 4.07"
Routed to Pond 4P : Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.99"

Area (ac)	CN	Description
0.759	98	Paved parking, HSG C
0.516	98	Unconnected roofs, HSG C
0.129	98	Paved parking, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.834	94	Weighted Average
0.430		23.45% Pervious Area
1.404		76.55% Impervious Area
0.516		36.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.7	373	0.0326	3.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.1	473	Total			

Summary for Subcatchment 3S: Post-Developed Pond Bypass

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.53 cfs @ 12.11 hrs, Volume= 0.032 af, Depth> 4.27"
Routed to Reach C1 : 32 - L.F. 18" RCP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.99"

Area (ac)	CN	Description
0.089	96	Gravel surface, HSG C
0.089		100.00% Pervious Area

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

Summary for Reach C1: 32 - L.F. 18" RCP

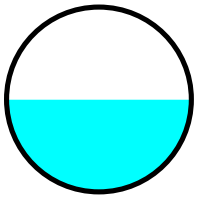
[52] Hint: Inlet/Outlet conditions not evaluated
[82] Warning: Early inflow requires earlier time span
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.14'

Inflow Area = 1.923 ac, 73.01% Impervious, Inflow Depth > 4.08" for 10-Year event
Inflow = 8.89 cfs @ 12.18 hrs, Volume= 0.654 af
Outflow = 8.89 cfs @ 12.19 hrs, Volume= 0.654 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.10 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.73 fps, Avg. Travel Time= 0.1 min

Peak Storage= 28 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.75' , Surface Width= 1.50'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.91 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 32.0' Slope= 0.0291 '/'
Inlet Invert= 400.90', Outlet Invert= 399.97'



Summary for Pond 4P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 1.834 ac, 76.55% Impervious, Inflow Depth > 4.07" for 10-Year event
Inflow = 9.70 cfs @ 12.15 hrs, Volume= 0.623 af
Outflow = 8.57 cfs @ 12.19 hrs, Volume= 0.623 af, Atten= 12%, Lag= 2.5 min
Primary = 8.57 cfs @ 12.19 hrs, Volume= 0.623 af
Routed to Reach C1 : 32 - L.F. 18" RCP

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 403.39' @ 12.19 hrs Surf.Area= 1,153 sf Storage= 1,373 cf

Plug-Flow detention time= 2.1 min calculated for 0.623 af (100% of inflow)
Center-of-Mass det. time= 1.9 min (750.5 - 748.7)

Volume	Invert	Avail.Storage	Storage Description
#1	401.50'	3,800 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
401.50	16	16.0	0	0	16
402.00	661	103.0	130	130	840
403.00	1,004	125.0	827	957	1,256
404.00	1,411	147.0	1,202	2,158	1,751
405.00	1,884	168.0	1,642	3,800	2,300

Device	Routing	Invert	Outlet Devices
#1	Primary	401.50'	**18.0" Round Culvert**
			L= 20.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 401.50' / 401.30' S= 0.0100 '/' Cc= 0.900
			n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=8.49 cfs @ 12.19 hrs HW=403.37' (Free Discharge)
1=Culvert (Barrel Controls 8.49 cfs @ 4.95 fps)

Summary for Subcatchment 2S: Post-Developed Basin to Pond

Runoff = 11.57 cfs @ 12.15 hrs, Volume= 0.751 af, Depth> 4.91"
Routed to Pond 4P : Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 25-Year Rainfall=5.89"

Area (ac)	CN	Description
0.759	98	Paved parking, HSG C
0.516	98	Unconnected roofs, HSG C
0.129	98	Paved parking, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.834	94	Weighted Average
0.430		23.45% Pervious Area
1.404		76.55% Impervious Area
0.516		36.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.7	373	0.0326	3.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.1	473	Total			

Summary for Subcatchment 3S: Post-Developed Pond Bypass

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.62 cfs @ 12.11 hrs, Volume= 0.038 af, Depth> 5.10"
Routed to Reach C1 : 32 - L.F. 18" RCP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 25-Year Rainfall=5.89"

Area (ac)	CN	Description
0.089	96	Gravel surface, HSG C
0.089		100.00% Pervious Area

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

Summary for Reach C1: 32 - L.F. 18" RCP

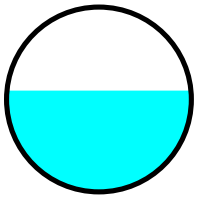
[52] Hint: Inlet/Outlet conditions not evaluated
[82] Warning: Early inflow requires earlier time span
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.22'

Inflow Area = 1.923 ac, 73.01% Impervious, Inflow Depth > 4.92" for 25-Year event
Inflow = 10.43 cfs @ 12.19 hrs, Volume= 0.788 af
Outflow = 10.40 cfs @ 12.19 hrs, Volume= 0.788 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.51 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.96 fps, Avg. Travel Time= 0.1 min

Peak Storage= 32 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.82' , Surface Width= 1.49'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.91 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 32.0' Slope= 0.0291 '/'
Inlet Invert= 400.90', Outlet Invert= 399.97'



Summary for Pond 4P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 1.834 ac, 76.55% Impervious, Inflow Depth > 4.91" for 25-Year event
Inflow = 11.57 cfs @ 12.15 hrs, Volume= 0.751 af
Outflow = 10.07 cfs @ 12.20 hrs, Volume= 0.750 af, Atten= 13%, Lag= 2.9 min
Primary = 10.07 cfs @ 12.20 hrs, Volume= 0.750 af
Routed to Reach C1 : 32 - L.F. 18" RCP

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 403.71' @ 12.20 hrs Surf.Area= 1,288 sf Storage= 1,772 cf

Plug-Flow detention time= 2.2 min calculated for 0.750 af (100% of inflow)
Center-of-Mass det. time= 2.0 min (748.0 - 746.0)

Volume	Invert	Avail.Storage	Storage Description
#1	401.50'	3,800 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
401.50	16	16.0	0	0	16
402.00	661	103.0	130	130	840
403.00	1,004	125.0	827	957	1,256
404.00	1,411	147.0	1,202	2,158	1,751
405.00	1,884	168.0	1,642	3,800	2,300

Device	Routing	Invert	Outlet Devices
#1	Primary	401.50'	**18.0" Round Culvert**
			L= 20.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 401.50' / 401.30' S= 0.0100 '/' Cc= 0.900
			n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=10.02 cfs @ 12.20 hrs HW=403.71' (Free Discharge)
1=Culvert (Barrel Controls 10.02 cfs @ 5.67 fps)

Summary for Subcatchment 2S: Post-Developed Basin to Pond

Runoff = 13.09 cfs @ 12.15 hrs, Volume= 0.854 af, Depth> 5.59"
Routed to Pond 4P : Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 50-Year Rainfall=6.62"

Area (ac)	CN	Description
0.759	98	Paved parking, HSG C
0.516	98	Unconnected roofs, HSG C
0.129	98	Paved parking, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.834	94	Weighted Average
0.430		23.45% Pervious Area
1.404		76.55% Impervious Area
0.516		36.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.7	373	0.0326	3.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.1	473	Total			

Summary for Subcatchment 3S: Post-Developed Pond Bypass

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.70 cfs @ 12.11 hrs, Volume= 0.043 af, Depth> 5.78"
Routed to Reach C1 : 32 - L.F. 18" RCP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 50-Year Rainfall=6.62"

Area (ac)	CN	Description
0.089	96	Gravel surface, HSG C
0.089		100.00% Pervious Area

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

Summary for Reach C1: 32 - L.F. 18" RCP

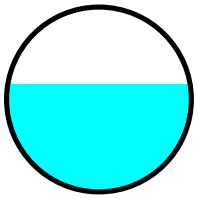
[52] Hint: Inlet/Outlet conditions not evaluated
[82] Warning: Early inflow requires earlier time span
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.27'

Inflow Area = 1.923 ac, 73.01% Impervious, Inflow Depth > 5.60" for 50-Year event
Inflow = 11.50 cfs @ 12.19 hrs, Volume= 0.897 af
Outflow = 11.50 cfs @ 12.19 hrs, Volume= 0.897 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.76 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 4.13 fps, Avg. Travel Time= 0.1 min

Peak Storage= 34 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.87' , Surface Width= 1.48'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.91 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 32.0' Slope= 0.0291 '/'
Inlet Invert= 400.90', Outlet Invert= 399.97'



Summary for Pond 4P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 1.834 ac, 76.55% Impervious, Inflow Depth > 5.59" for 50-Year event
Inflow = 13.09 cfs @ 12.15 hrs, Volume= 0.854 af
Outflow = 11.11 cfs @ 12.20 hrs, Volume= 0.854 af, Atten= 15%, Lag= 3.0 min
Primary = 11.11 cfs @ 12.20 hrs, Volume= 0.854 af
Routed to Reach C1 : 32 - L.F. 18" RCP

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 403.95' @ 12.20 hrs Surf.Area= 1,391 sf Storage= 2,093 cf

Plug-Flow detention time= 2.2 min calculated for 0.854 af (100% of inflow)
Center-of-Mass det. time= 2.0 min (746.4 - 744.3)

Volume	Invert	Avail.Storage	Storage Description
#1	401.50'	3,800 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
401.50	16	16.0	0	0	16
402.00	661	103.0	130	130	840
403.00	1,004	125.0	827	957	1,256
404.00	1,411	147.0	1,202	2,158	1,751
405.00	1,884	168.0	1,642	3,800	2,300

Device	Routing	Invert	Outlet Devices
#1	Primary	401.50'	**18.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 401.50' / 401.30' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=11.09 cfs @ 12.20 hrs HW=403.95' (Free Discharge)
1=Culvert (Inlet Controls 11.09 cfs @ 6.28 fps)

Summary for Subcatchment 2S: Post-Developed Basin to Pond

Runoff = 14.66 cfs @ 12.15 hrs, Volume= 0.962 af, Depth> 6.30"
Routed to Pond 4P : Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=7.38"

Area (ac)	CN	Description
0.759	98	Paved parking, HSG C
0.516	98	Unconnected roofs, HSG C
0.129	98	Paved parking, HSG C
0.430	79	50-75% Grass cover, Fair, HSG C
1.834	94	Weighted Average
0.430		23.45% Pervious Area
1.404		76.55% Impervious Area
0.516		36.75% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	100	0.0509	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.7	373	0.0326	3.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.1	473	Total			

Summary for Subcatchment 3S: Post-Developed Pond Bypass

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.79 cfs @ 12.11 hrs, Volume= 0.048 af, Depth> 6.48"
Routed to Reach C1 : 32 - L.F. 18" RCP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=7.38"

Area (ac)	CN	Description
0.089	96	Gravel surface, HSG C
0.089		100.00% Pervious Area

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

Summary for Reach C1: 32 - L.F. 18" RCP

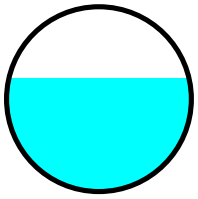
[52] Hint: Inlet/Outlet conditions not evaluated
[82] Warning: Early inflow requires earlier time span
[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.32'

Inflow Area = 1.923 ac, 73.01% Impervious, Inflow Depth > 6.30" for 100-Year event
Inflow = 12.46 cfs @ 12.19 hrs, Volume= 1.010 af
Outflow = 12.47 cfs @ 12.20 hrs, Volume= 1.010 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.95 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 4.29 fps, Avg. Travel Time= 0.1 min

Peak Storage= 36 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.92' , Surface Width= 1.46'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.91 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 32.0' Slope= 0.0291 '/'
Inlet Invert= 400.90', Outlet Invert= 399.97'



Summary for Pond 4P: Detention Pond

[82] Warning: Early inflow requires earlier time span

Inflow Area = 1.834 ac, 76.55% Impervious, Inflow Depth > 6.30" for 100-Year event
Inflow = 14.66 cfs @ 12.15 hrs, Volume= 0.962 af
Outflow = 12.04 cfs @ 12.20 hrs, Volume= 0.962 af, Atten= 18%, Lag= 3.4 min
Primary = 12.04 cfs @ 12.20 hrs, Volume= 0.962 af
Routed to Reach C1 : 32 - L.F. 18" RCP

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 404.25' @ 12.20 hrs Surf.Area= 1,524 sf Storage= 2,529 cf

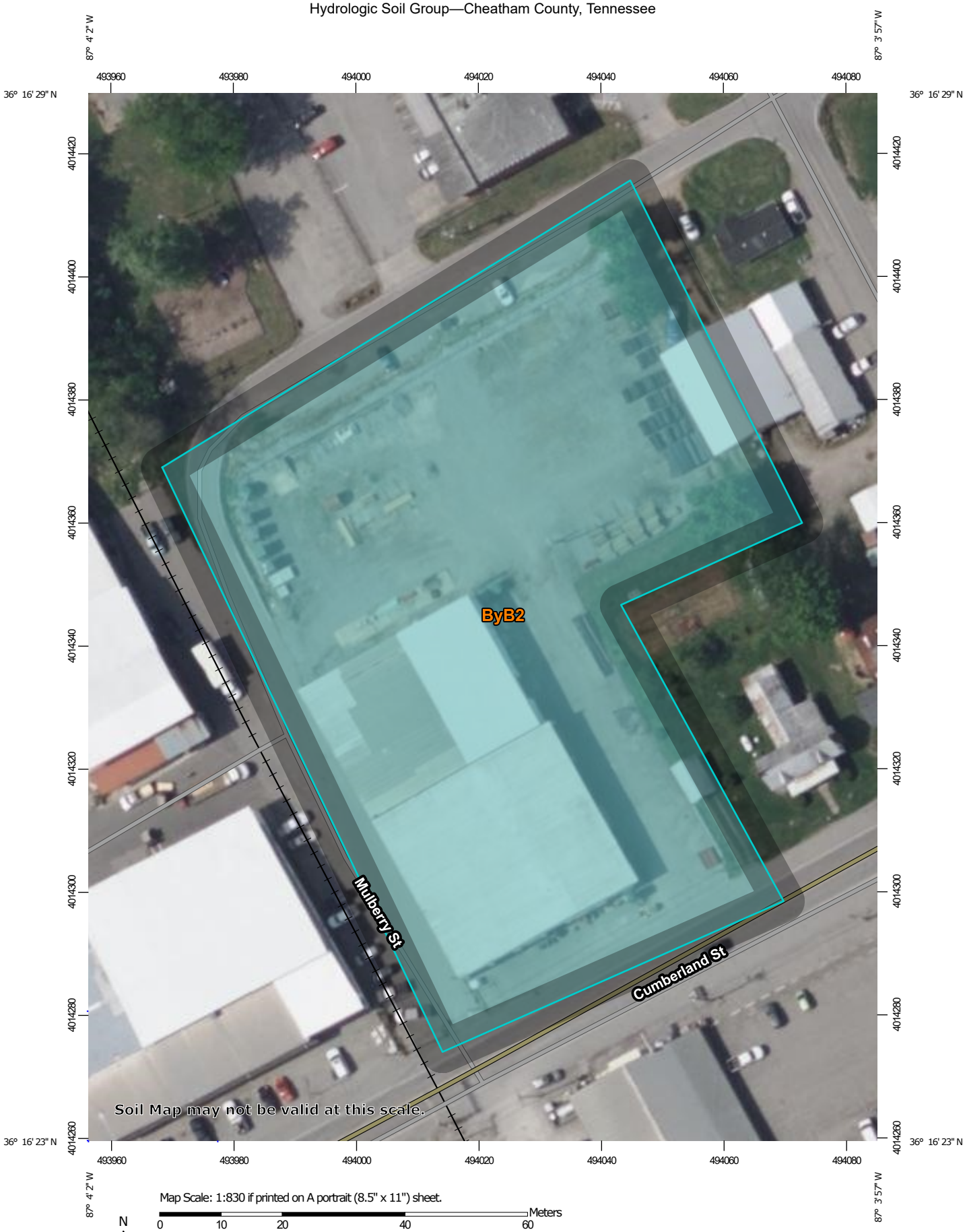
Plug-Flow detention time= 2.3 min calculated for 0.962 af (100% of inflow)
Center-of-Mass det. time= 2.1 min (745.0 - 742.9)

Volume	Invert	Avail.Storage	Storage Description
#1	401.50'	3,800 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
401.50	16	16.0	0	0	16
402.00	661	103.0	130	130	840
403.00	1,004	125.0	827	957	1,256
404.00	1,411	147.0	1,202	2,158	1,751
405.00	1,884	168.0	1,642	3,800	2,300

Device	Routing	Invert	Outlet Devices
#1	Primary	401.50'	**18.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 401.50' / 401.30' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=12.00 cfs @ 12.20 hrs HW=404.24' (Free Discharge)
1=Culvert (Inlet Controls 12.00 cfs @ 6.79 fps)



Map Scale: 1:830 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 40 80 160 240

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cheatham County, Tennessee
Survey Area Data: Version 17, Sep 12, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 21, 2021—May 1, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ByB2	Byler silt loam, 2 to 5 percent slopes, eroded	C	2.1	100.0%
Totals for Area of Interest			**2.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher