

Vineyard Pine Commercial
4502 Vineyard Pine Lane

Rolesville, NC
Wake County

STORMWATER PERMIT
ANALYSIS

August 28, 2023



Prepared for:

MRR Development, LLC
10121 Capital Blvd., Suite 105
Wake Forest, NC 27587

Vineyard Pine Commercial Stormwater Management Analysis

Project Name: Vineyard Pine Commercial

Project Address: 4502 Vineyard Pine Lane
Rolesville, NC

Pins: 175843022

Latitude: N 35.906083
Longitude: W -79.688333

Zoning: OP- CZ

River Basin: Neuse

Watershed: Lower Neuse

HUC: 0302020107

Developer: MRR Development, LLC
10121 Capital Blvd., Suite 105
Wake Forest, NC 27587

Telephone: (330) 573-4030

Email: Omar@Meinekenc.com

Site Description

The project consists of a single parcel located at the intersection of Jonesville and Vineyard Pine Lane in Rolesville. The lot is approximately 1.45 acres (63,259 sq feet). The parcel is vacant with grassy vegetation with approximately 0 sq ft of impervious area. The project will consist of a commercial building and associated parking.

The impervious area post development will be 1.09 acres.

The site is in the Neuse River Basin, Lower Neuse Watershed and subject to those rules regarding nutrient management and post storm water runoff.

Based on the Wake County SCS soils map (attached) the onsite soils are primarily Durham Series (DuB), soil group B, throughout the tract. The Durham Series soil type is considered to be well drained soils and based on information in the Soil Survey.

Proposed Development

The stormwater analysis considers a proposed development that will include one commercial building and associated parking on the site. One underground Storm Filter with pipe detention is proposed for the stormwater requirements. The treatment associated with Storm Filter accounts for the impervious area for the parcel and the device is proposed to treat the first inch of rainfall and control runoff within the drainage areas as shown on the attached drainage map EX1.

The Storm Filter SCM is a proprietary device approved by NCDNR and developed by Contech Engineered Solutions LLC. Detail design calculations are included within this report.

The device is designed in accordance with NCDENR DWR's BMP Manual, and will manage the 2, and 10 year, 24-hour storm events as noted below. The post development runoff from the noted storm events is less than the pre-development rates for the site.

Methodology (Peak Flow and Nutrient Management)

The project is located within the Town of Rolesville's / Wake County permitting authority, and within the Neuse River / Milburnie Lake watershed and the project is subjected to those rules listed in the LDO, Appendix B, Section 1.2 Stormwater Management, Adopted 6-1-2021.

Under the Town's LDO stormwater requirements as noted below. The project is considered a High-Density project.

Development Standards for High-Density

Projects High-Density Projects shall implement stormwater control measures that comply with each of the following standards, in addition to the General Standards found in subsection B of this section:

- a. The measures shall control and treat runoff from the first inch of rain. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.*
- b. All structural stormwater treatment systems used to meet these requirements shall be designed to have a minimum of 85 percent average annual removal for Total Suspended Solids (TSS).*
- c. All Development and Redevelopment projects required to manage storm water shall provide permanent on-site BMPs to lower the nitrogen export amounts as part of the storm water management plan. BMPs are to be in accordance with and as specified in the Design Manual*

- d. *Structural and Non-structural BMPs shall be used to ensure there is no net increase in peak flow leaving the site from the pre-Development conditions for the one-year, 24-hour storm. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.*
- e. *General engineering design criteria for all projects shall be in accordance with 15A NCAC 2H .1008(c), as explained in the Design Manual*

The POI (point of interest) for the project is at the southeast corner of the site as shown on EX1.

Based on the proposed stormwater management system for the project no adverse impact is anticipated on adjacent parcels. The BMP system will tie into an existing junction box located along the eastern property line. The existing pipe system discharges into a ditch along the southern portion of the site.

Using the SCS Method, the modeling of the BMP at the POI provides the following results in peak flow management. **The methodology used to determine the runoff is the SCS Method and the Time of Concentration used in both the pre and post analysis is 5 minutes.**

Runoff Summary

Total site peak runoff in cfs (noted in the attached Hydraflow report) is as follows.

<u>Storm Event</u>	<u>Pre</u>	<u>Post</u>
Q1	1.38	.94
Q10	4.74	1.82

Nutrient Management

The BMP provides treatment for drainage area within the project and also provides the TSS removal of 85%.

O&M Manual

A copy of the project's O&M manual is attached for the Storm Filter device.

Flood Hazard Area

The parcel is not located within a flood zone as noted per FEMA map 3720175800K, Dated July 19, 2022.

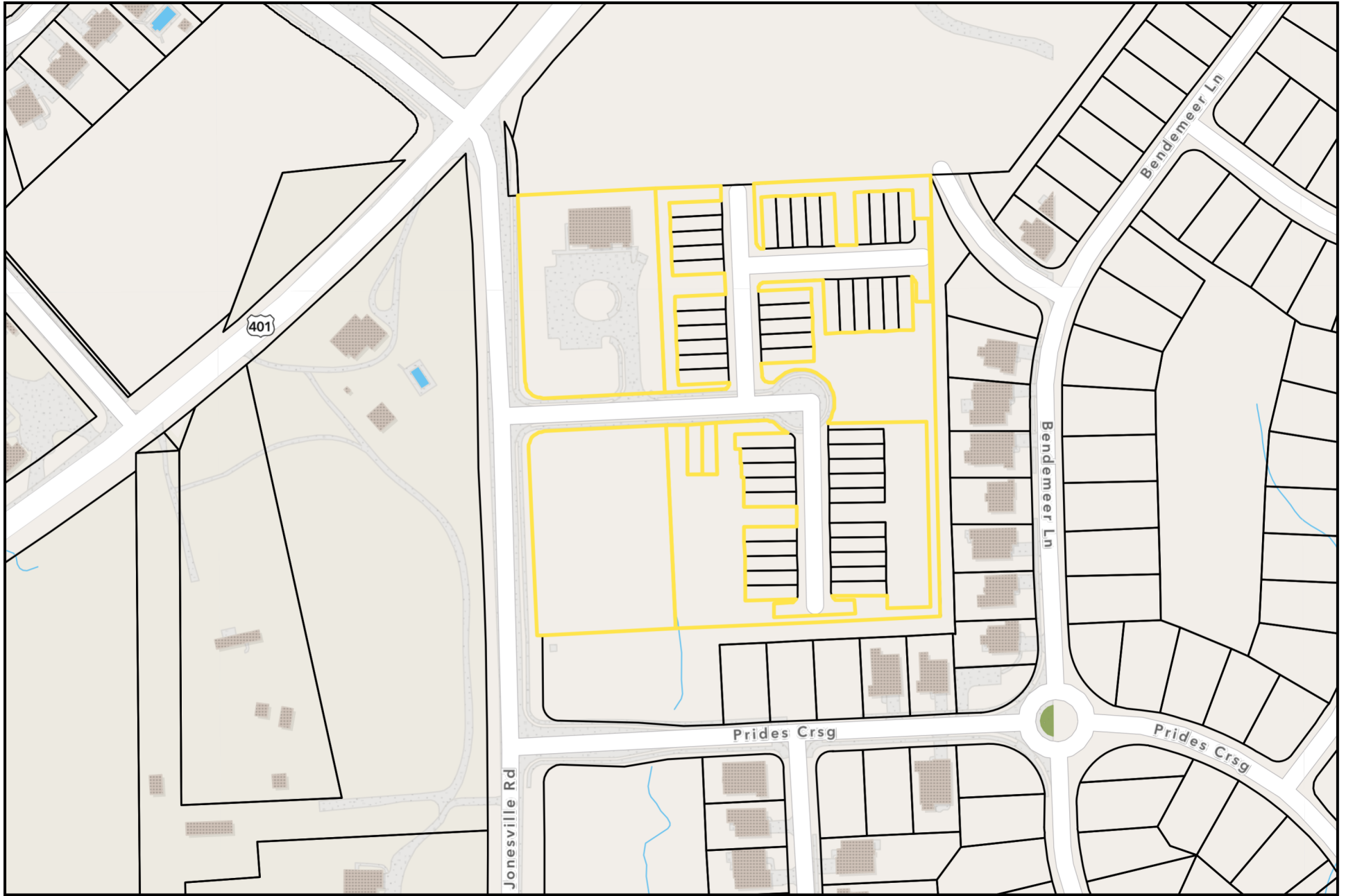
Q100 Backwater Effect at BMP (13. Z Wake County Checklist)

There is no storm pipe from the ROW that discharges to the BMP and as a result Q100 backwater review not needed.

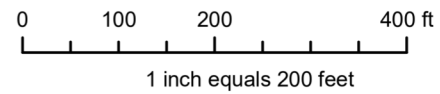
Downstream Impact Analysis (DIA)

The Town of Rolesville requires a DIA to be performed with the 10% rule. As a result of the proposed Storm Filter BMP; the post runoff from the development of the project for the post Q10 will be reduced from the peak stormwater runoff (pre Q10) to below the predevelopment standards. The post stormwater runoff increase is less than 10% on adjacent properties at the POI noted on EX1.

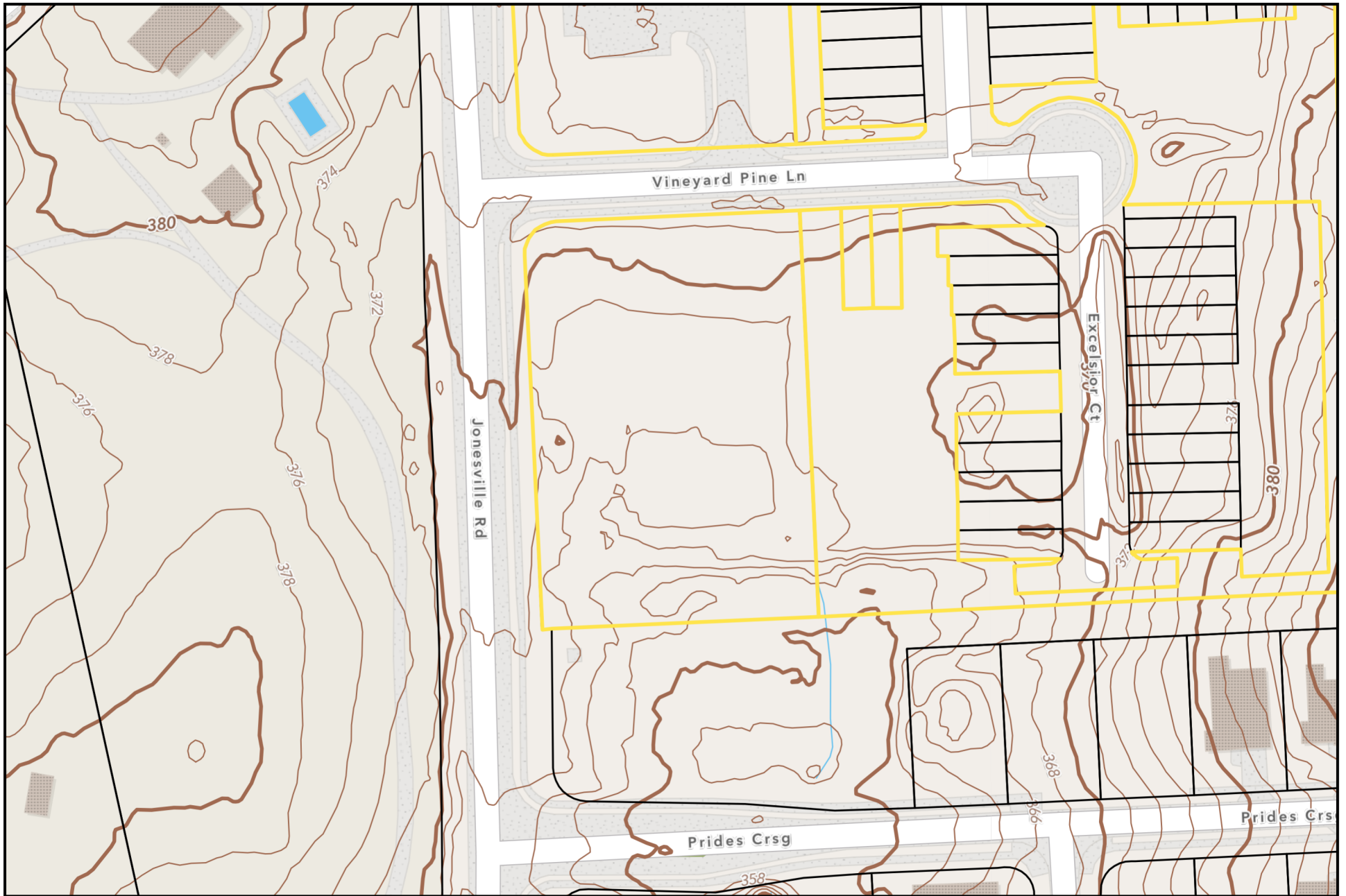
Attachments.



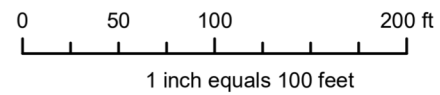
GIS Site Map



Disclaimer
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GIS Topo Map



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GIS Aerial



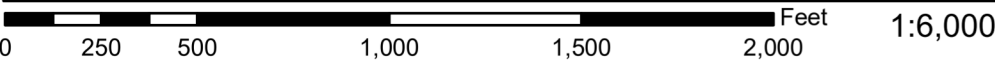
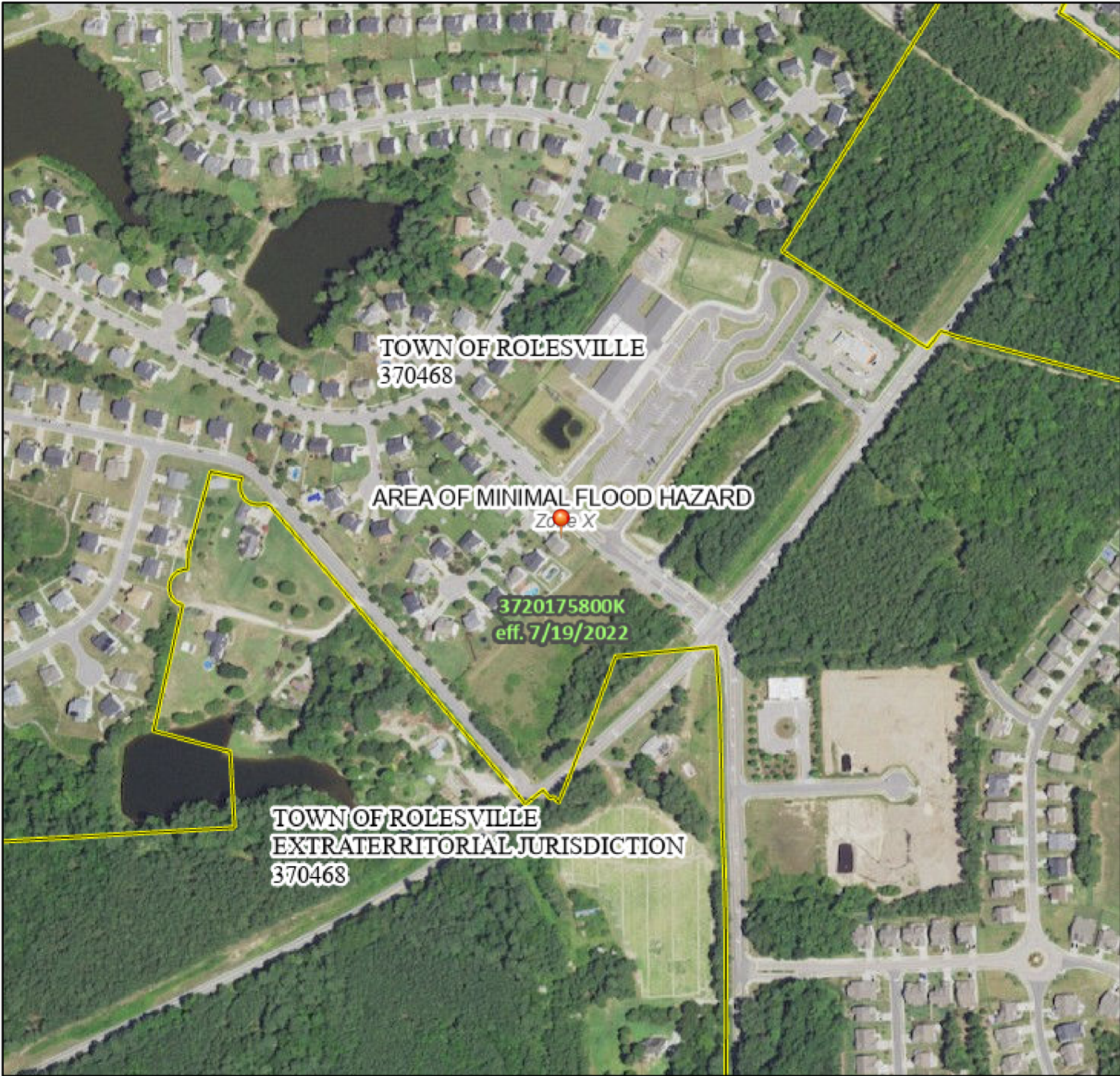
0 100 200 400 ft
1 inch equals 200 feet

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National Flood Hazard Layer FIRMMette



78°29'10"W 35°54'44"N



Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



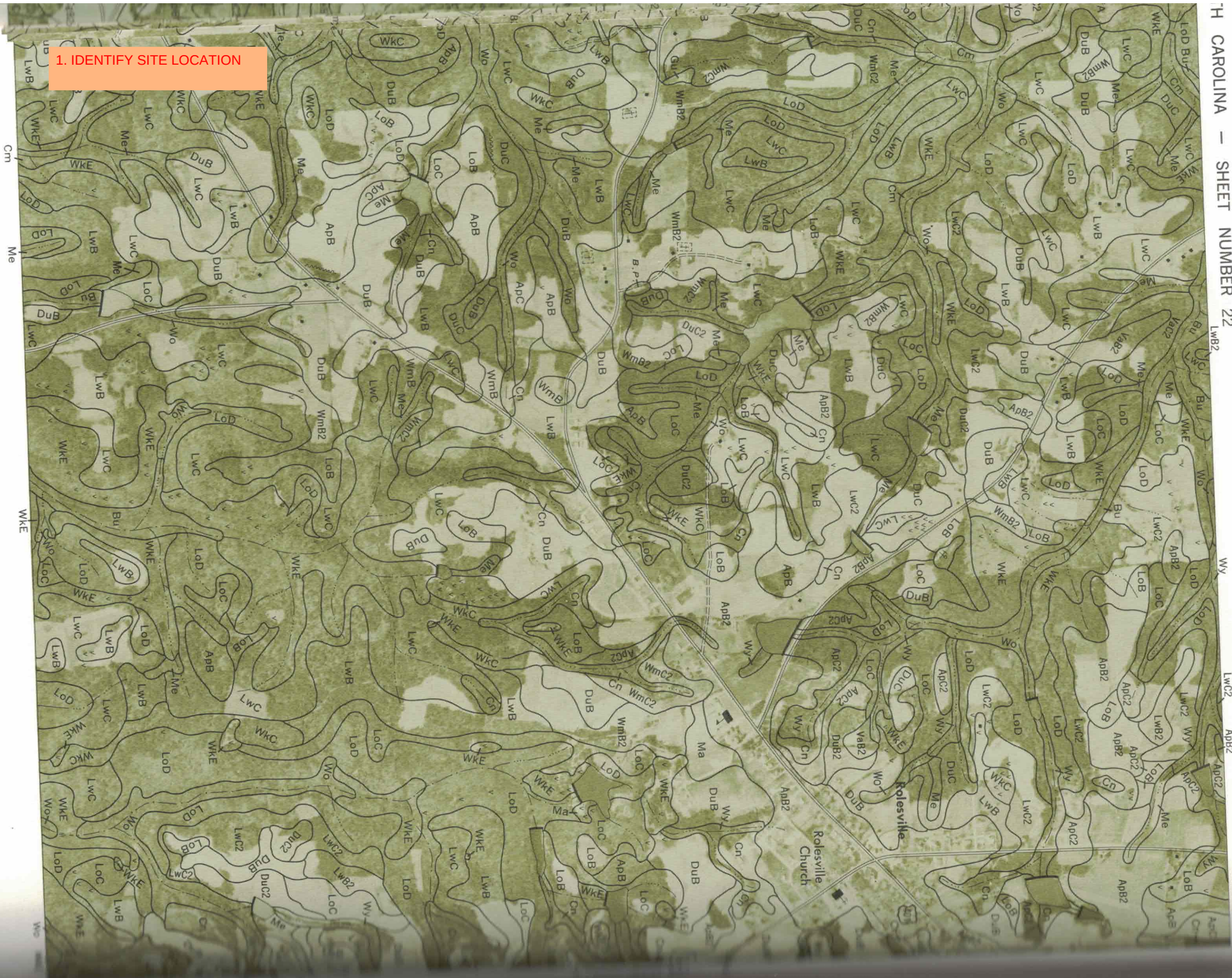
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/25/2023 at 5:37 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

1. IDENTIFY SITE LOCATION





NOAA Atlas 14, Volume 2, Version 3
Location name: Raleigh, North Carolina, USA*
Latitude: 35.8332°, Longitude: -78.5409°
Elevation: 224 ft**
* source: ESRI Maps
** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.405 (0.371-0.443)	0.472 (0.433-0.515)	0.540 (0.495-0.589)	0.603 (0.552-0.658)	0.668 (0.609-0.728)	0.718 (0.651-0.781)	0.762 (0.687-0.830)	0.801 (0.718-0.873)	0.844 (0.751-0.920)	0.881 (0.777-0.963)
10-min	0.647 (0.592-0.708)	0.755 (0.692-0.824)	0.864 (0.793-0.943)	0.965 (0.883-1.05)	1.06 (0.970-1.16)	1.14 (1.04-1.24)	1.21 (1.09-1.32)	1.27 (1.14-1.38)	1.34 (1.19-1.46)	1.39 (1.22-1.52)
15-min	0.808 (0.740-0.885)	0.949 (0.870-1.04)	1.09 (1.00-1.19)	1.22 (1.12-1.33)	1.35 (1.23-1.47)	1.45 (1.31-1.58)	1.53 (1.38-1.67)	1.60 (1.44-1.75)	1.68 (1.49-1.83)	1.74 (1.54-1.90)
30-min	1.11 (1.02-1.21)	1.31 (1.20-1.43)	1.55 (1.42-1.70)	1.77 (1.62-1.93)	2.00 (1.82-2.18)	2.18 (1.98-2.37)	2.34 (2.11-2.55)	2.49 (2.24-2.72)	2.67 (2.38-2.92)	2.82 (2.49-3.08)
60-min	1.38 (1.26-1.51)	1.64 (1.51-1.80)	1.99 (1.83-2.17)	2.30 (2.11-2.51)	2.66 (2.42-2.90)	2.95 (2.68-3.22)	3.23 (2.91-3.52)	3.50 (3.14-3.81)	3.84 (3.41-4.18)	4.12 (3.63-4.50)
2-hr	1.62 (1.47-1.78)	1.93 (1.76-2.12)	2.36 (2.15-2.60)	2.76 (2.50-3.03)	3.23 (2.92-3.54)	3.64 (3.27-3.99)	4.03 (3.59-4.41)	4.43 (3.92-4.84)	4.94 (4.34-5.40)	5.38 (4.68-5.90)
3-hr	1.71 (1.56-1.89)	2.04 (1.87-2.25)	2.52 (2.29-2.77)	2.96 (2.68-3.25)	3.50 (3.16-3.84)	3.98 (3.57-4.36)	4.45 (3.96-4.87)	4.94 (4.36-5.40)	5.59 (4.88-6.12)	6.17 (5.33-6.76)
6-hr	2.06 (1.88-2.26)	2.46 (2.25-2.70)	3.02 (2.76-3.32)	3.56 (3.24-3.90)	4.23 (3.83-4.62)	4.82 (4.34-5.26)	5.42 (4.83-5.90)	6.04 (5.33-6.57)	6.88 (6.00-7.49)	7.63 (6.57-8.32)
12-hr	2.42 (2.22-2.66)	2.90 (2.66-3.18)	3.58 (3.27-3.92)	4.23 (3.86-4.64)	5.07 (4.59-5.54)	5.82 (5.23-6.33)	6.58 (5.85-7.15)	7.39 (6.50-8.02)	8.51 (7.36-9.23)	9.52 (8.11-10.3)
24-hr	2.88 (2.68-3.11)	3.48 (3.24-3.76)	4.38 (4.07-4.72)	5.08 (4.71-5.48)	6.05 (5.59-6.52)	6.82 (6.28-7.34)	7.60 (6.98-8.20)	8.42 (7.71-9.08)	9.53 (8.69-10.3)	10.4 (9.46-11.3)
2-day	3.34 (3.10-3.59)	4.02 (3.74-4.33)	5.01 (4.66-5.40)	5.80 (5.38-6.24)	6.86 (6.34-7.39)	7.70 (7.10-8.30)	8.56 (7.88-9.23)	9.45 (8.66-10.2)	10.7 (9.73-11.5)	11.6 (10.6-12.6)
3-day	3.54 (3.30-3.80)	4.25 (3.96-4.56)	5.28 (4.92-5.66)	6.08 (5.66-6.53)	7.19 (6.66-7.71)	8.06 (7.45-8.65)	8.96 (8.25-9.62)	9.88 (9.07-10.6)	11.1 (10.2-12.0)	12.1 (11.0-13.1)
4-day	3.74 (3.49-4.00)	4.48 (4.19-4.80)	5.54 (5.17-5.92)	6.38 (5.94-6.81)	7.52 (6.98-8.04)	8.43 (7.80-9.01)	9.36 (8.63-10.0)	10.3 (9.48-11.1)	11.6 (10.6-12.5)	12.7 (11.5-13.6)
7-day	4.33 (4.06-4.62)	5.17 (4.84-5.52)	6.31 (5.90-6.73)	7.21 (6.74-7.69)	8.45 (7.87-9.02)	9.44 (8.76-10.1)	10.4 (9.67-11.2)	11.5 (10.6-12.3)	12.9 (11.8-13.8)	14.0 (12.8-15.0)
10-day	4.94 (4.63-5.26)	5.88 (5.51-6.26)	7.07 (6.63-7.53)	8.01 (7.50-8.53)	9.28 (8.66-9.89)	10.3 (9.57-11.0)	11.3 (10.5-12.0)	12.3 (11.4-13.2)	13.7 (12.6-14.7)	14.8 (13.6-15.8)
20-day	6.61 (6.22-7.04)	7.81 (7.34-8.32)	9.25 (8.68-9.84)	10.4 (9.74-11.0)	11.9 (11.1-12.7)	13.1 (12.2-14.0)	14.3 (13.3-15.3)	15.6 (14.4-16.6)	17.2 (15.9-18.4)	18.5 (17.0-19.8)
30-day	8.21 (7.74-8.72)	9.66 (9.11-10.3)	11.3 (10.6-12.0)	12.5 (11.7-13.3)	14.1 (13.2-15.0)	15.4 (14.4-16.3)	16.6 (15.5-17.7)	17.8 (16.6-19.0)	19.5 (18.1-20.8)	20.8 (19.2-22.2)
45-day	10.5 (9.92-11.0)	12.3 (11.6-12.9)	14.0 (13.3-14.8)	15.4 (14.6-16.3)	17.2 (16.3-18.2)	18.6 (17.5-19.6)	19.9 (18.7-21.0)	21.2 (19.9-22.4)	22.9 (21.5-24.3)	24.2 (22.6-25.7)
60-day	12.5 (11.9-13.2)	14.7 (13.9-15.4)	16.6 (15.7-17.4)	18.1 (17.2-19.0)	20.0 (19.0-21.1)	21.5 (20.3-22.6)	22.8 (21.6-24.1)	24.2 (22.8-25.6)	26.0 (24.4-27.5)	27.3 (25.6-28.9)

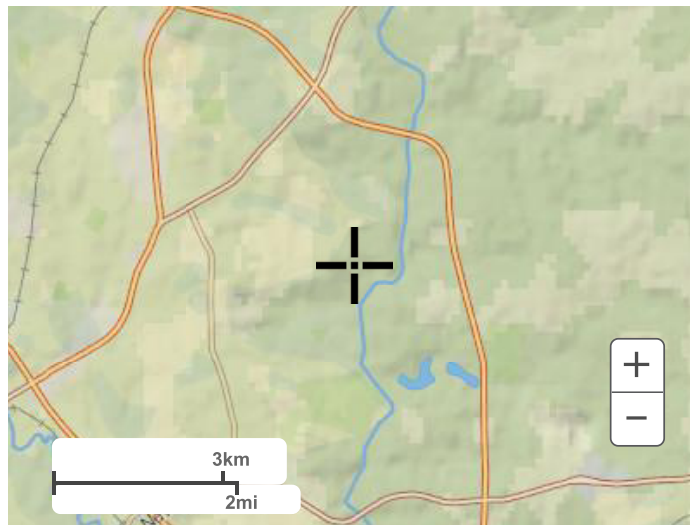
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

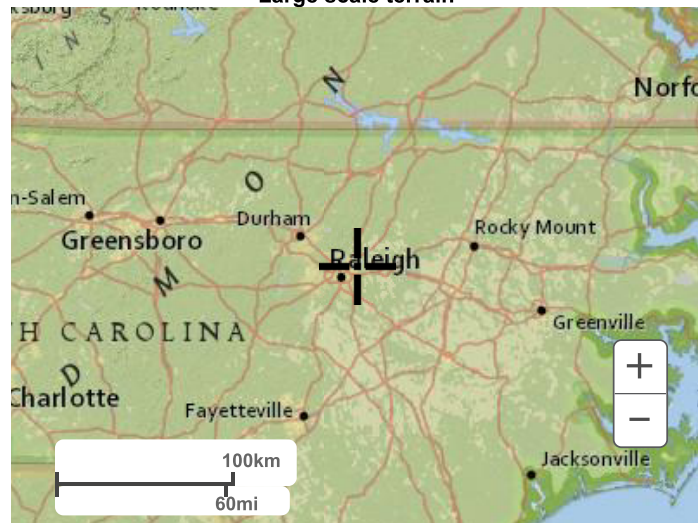
Please refer to NOAA Atlas 14 document for more information.

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PF graphical



Large scale terrain



Large scale map



Large scale aerial

Determining Number of Cartridges for Volume-Based Design in NC

Design Engineer:
Date

Irs
8/2/2023

Blue Cells = Input
Black Cells = Calculation

Site Information

Project Name
Project State
Project Location
Drainage Area, Ad
Impervious Area, Ai
Pervious Area, Ap
% Impervious
Runoff Coefficient, Rv

Jonesville Road Commercial
NC
Rolesville

1.10 ac
1.10 ac
0.00
100%
0.95 =0.05+0.9*(Ai/Ad)

Water Quality Volume Calculations

Design storm rainfall depth, Rd
Water quality volume, WQV

1.0 in
3793.4 ft³ =Ad*Rv*Rd*(43560/12)

Storage Component Calculations

Capture 75% of WQV
Pretreatment credit (estimated or calculated), %pre

2845.0 ft³ =0.75*WQV
30%

Mass loading calculations

Mean Annual Rainfall, P
Agency required % removal
Percent Runoff Capture (% capture)
Mean Annual Runoff, V_i
Event Mean Concentration of Pollutant, EMC
Annual Mass Load, M_{total}

46 in
85%
90%
157,045 ft³ =P*Ad*Rv*(43560/12)*%capture
70.0 mg/l (Suggestion: Use 60 for residential, 70 for Commercial, 100 for Industrial)
685.86 lbs =EMC*Vt*(28.3)*(0.000001)*(2.2046)

Filter System

Filtration brand
Cartridge height

StormFilter
18 in

Cartridge Quantity Calculation

Mass removed by pretreatment system, M_{pre}
Mass load to filters after pretreatment, M_{pass1}
Estimate the required filter efficiency, E_{filter}
Mass to be captured by filters, M_{filter}
Maximum Cartridge Flow rate, Q_{cart}
Mass load per cartridge, M_{cart} (lbs)
Number of Cartridges required, N_{mass}
Maximum Treatment Capacity

206 lbs =Mtotal * %removal
480 lbs =Mtotal - Mpre
79% =1+(%removal - 1)/(1 - %pre)
377 lbs =Mpass1 * Efilter
7.5 gpm =q * (7.5 ft2/cartridge)
36 lbs =lookup mass load per cartridge
11 =ROUNDUP(Mfilter/Mcart,0)
0.18 =Nmass*(Qcart/449)

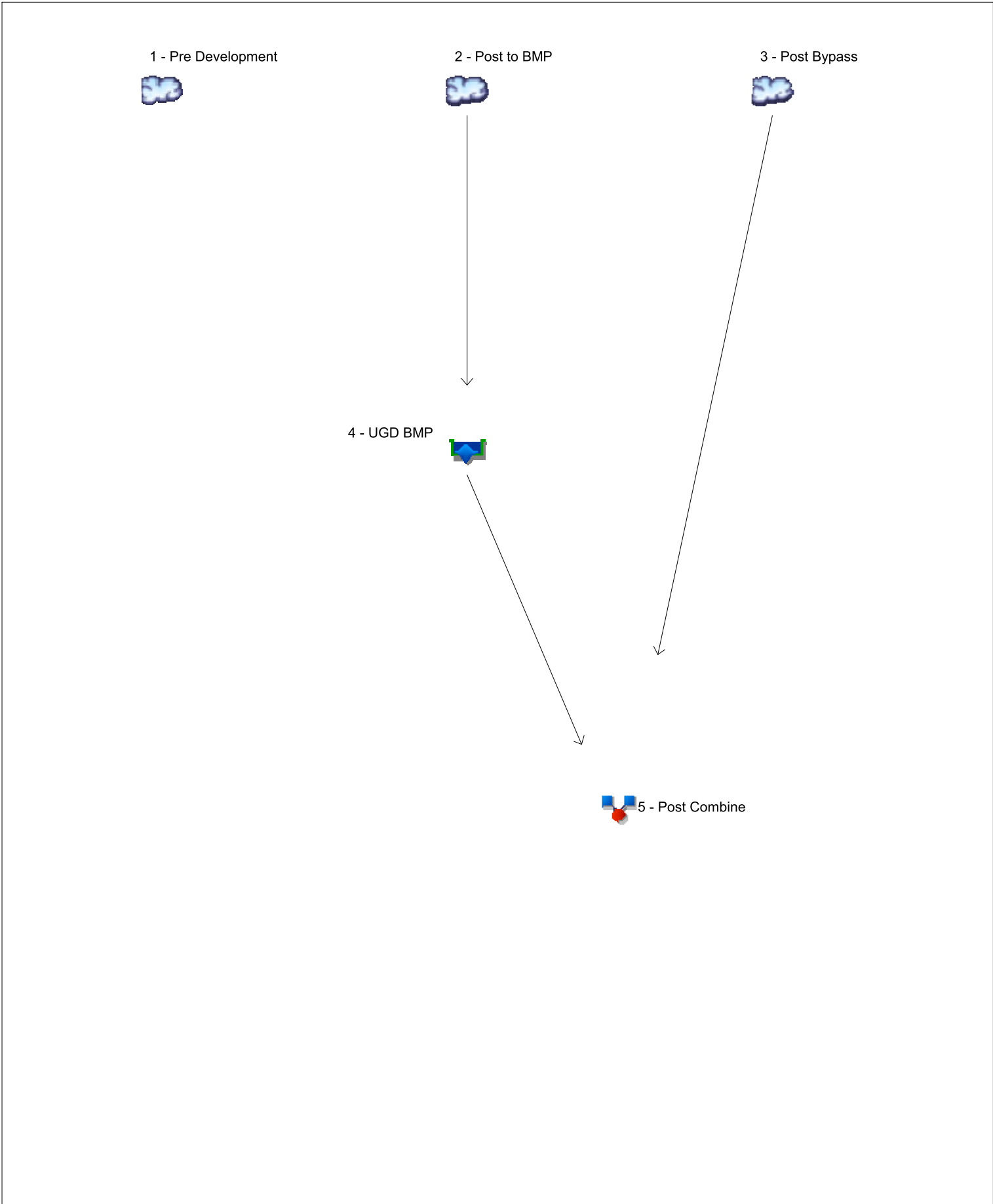
SUMMARY

Maximum Treatment Flow Rate, cfs	0.18
Cartridge Flow Rate, gpm	7.5
Number of Cartridges	11
Stormfilter Size	96" MH

Target Pollutant(s):	TSS, N & P
Media:	Phosphosorb

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.358	2	718	2,890	-----	-----	-----	Pre Development
2	SCS Runoff	4.170	2	716	9,259	-----	-----	-----	Post to BMP
3	SCS Runoff	0.194	2	718	476	-----	-----	-----	Post Bypass
4	Reservoir	0.787	2	726	9,158	2	366.17	3,076	UGD BMP
5	Combine	0.941	2	720	9,634	3, 4	-----	-----	Post Combine
Storm Water Review Revised SCS.gpw					Return Period: 1 Year			Saturday, 08 / 26 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

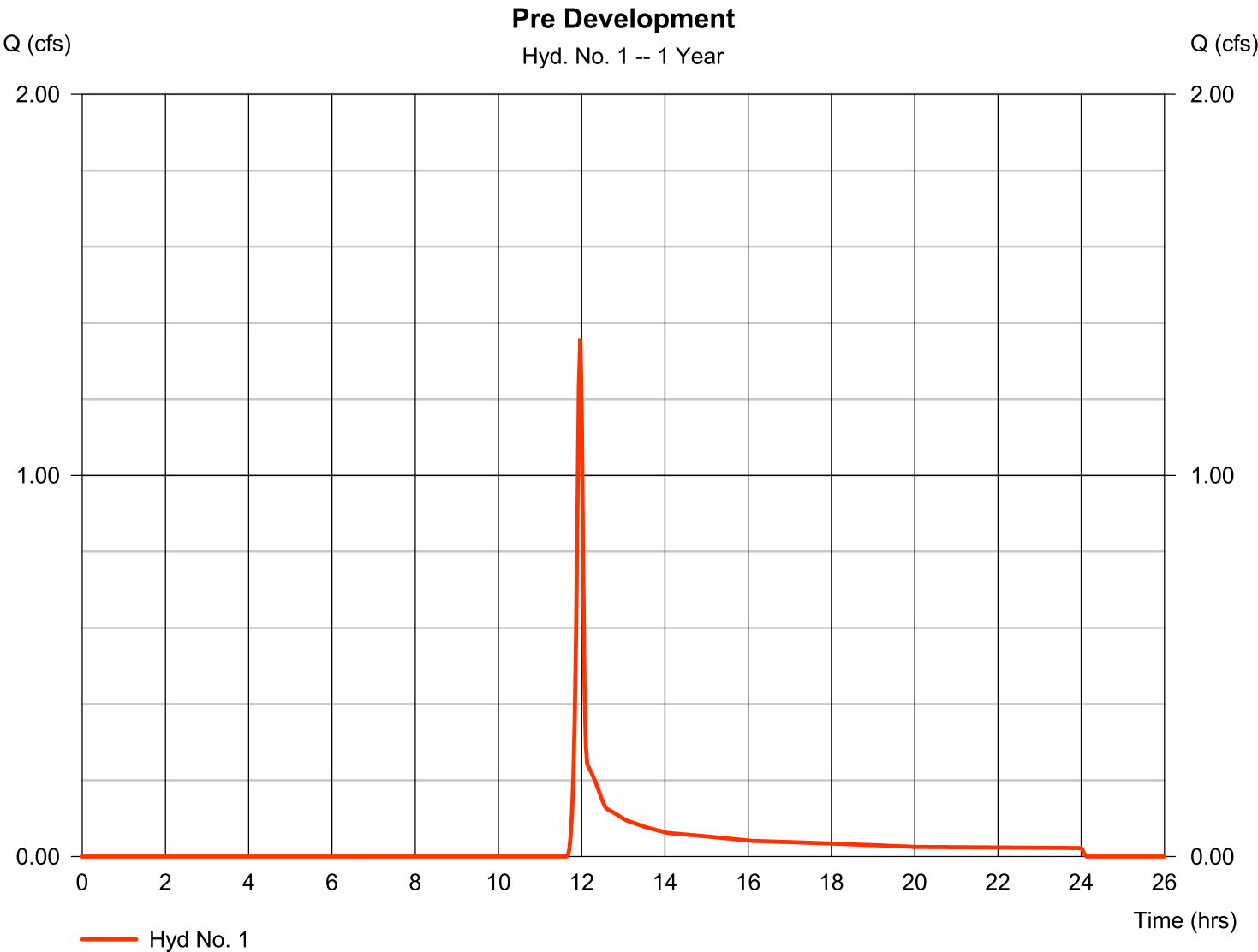
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.743	2	718	9,486	-----	-----	-----	Pre Development
2	SCS Runoff	7.457	2	716	17,191	-----	-----	-----	Post to BMP
3	SCS Runoff	0.917	2	718	1,843	-----	-----	-----	Post Bypass
4	Reservoir	0.991	2	728	17,090	2	368.23	6,194	UGD BMP
5	Combine	1.822	2	718	18,932	3, 4	-----	-----	Post Combine
Storm Water Review Revised SCS.gpw					Return Period: 10 Year			Saturday, 08 / 26 / 2023	

Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	= SCS Runoff	Peak discharge	= 1.358 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 2,890 cuft
Drainage area	= 1.450 ac	Curve number	= 68
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

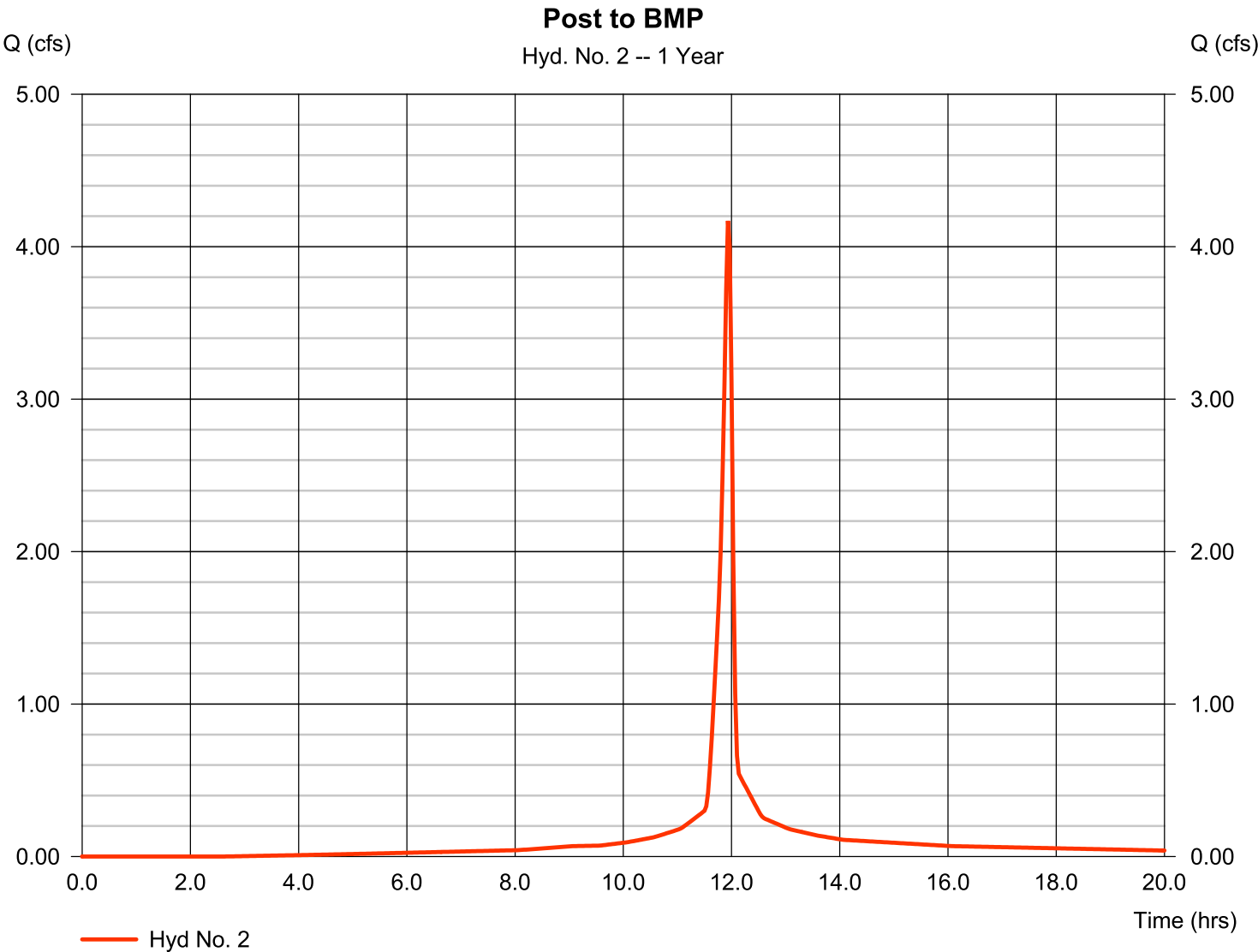


Hydrograph Report

Hyd. No. 2

Post to BMP

Hydrograph type	= SCS Runoff	Peak discharge	= 4.170 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 9,259 cuft
Drainage area	= 1.100 ac	Curve number	= 96
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

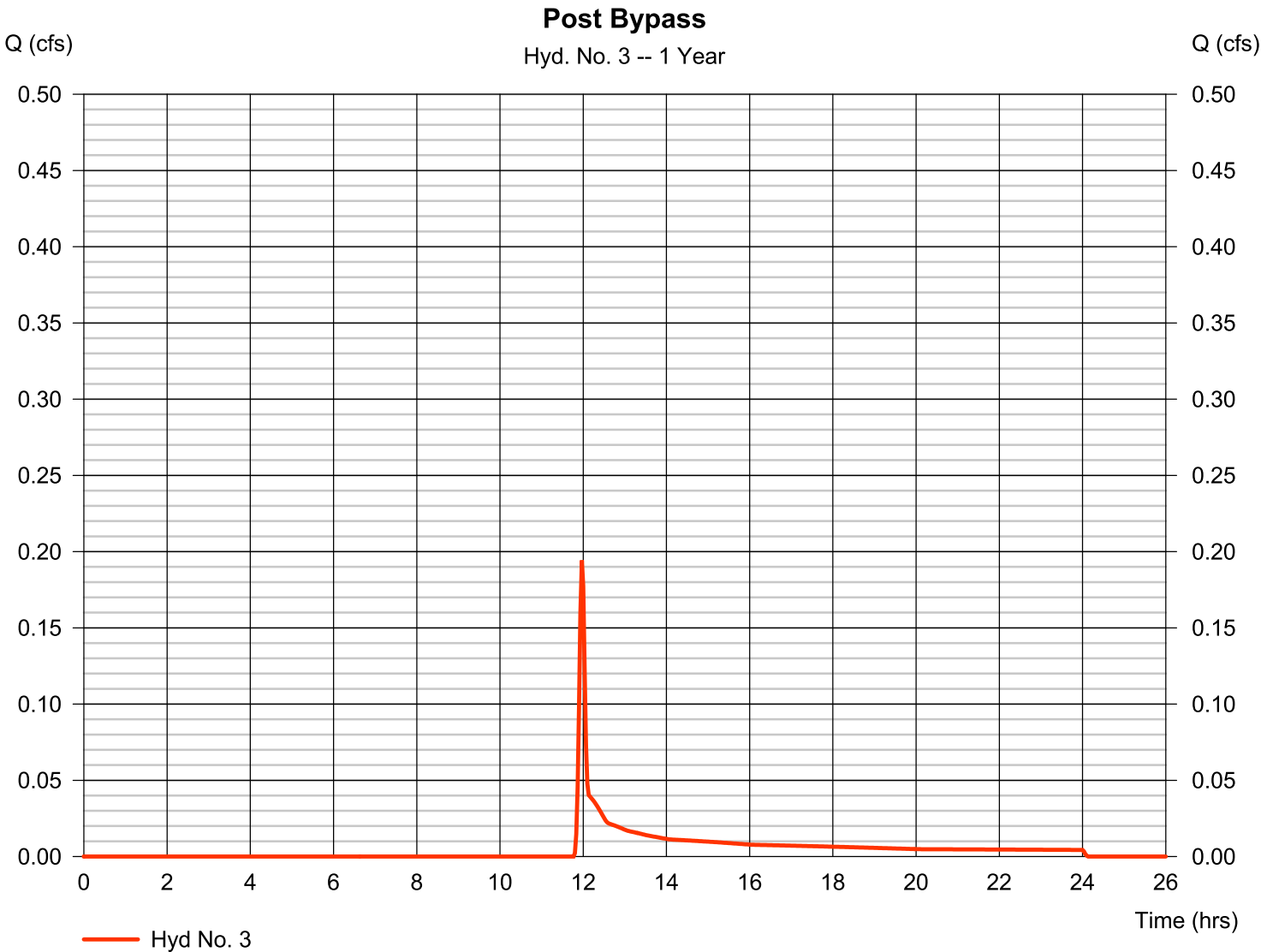


Hydrograph Report

Hyd. No. 3

Post Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 0.194 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 476 cuft
Drainage area	= 0.350 ac	Curve number	= 63
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



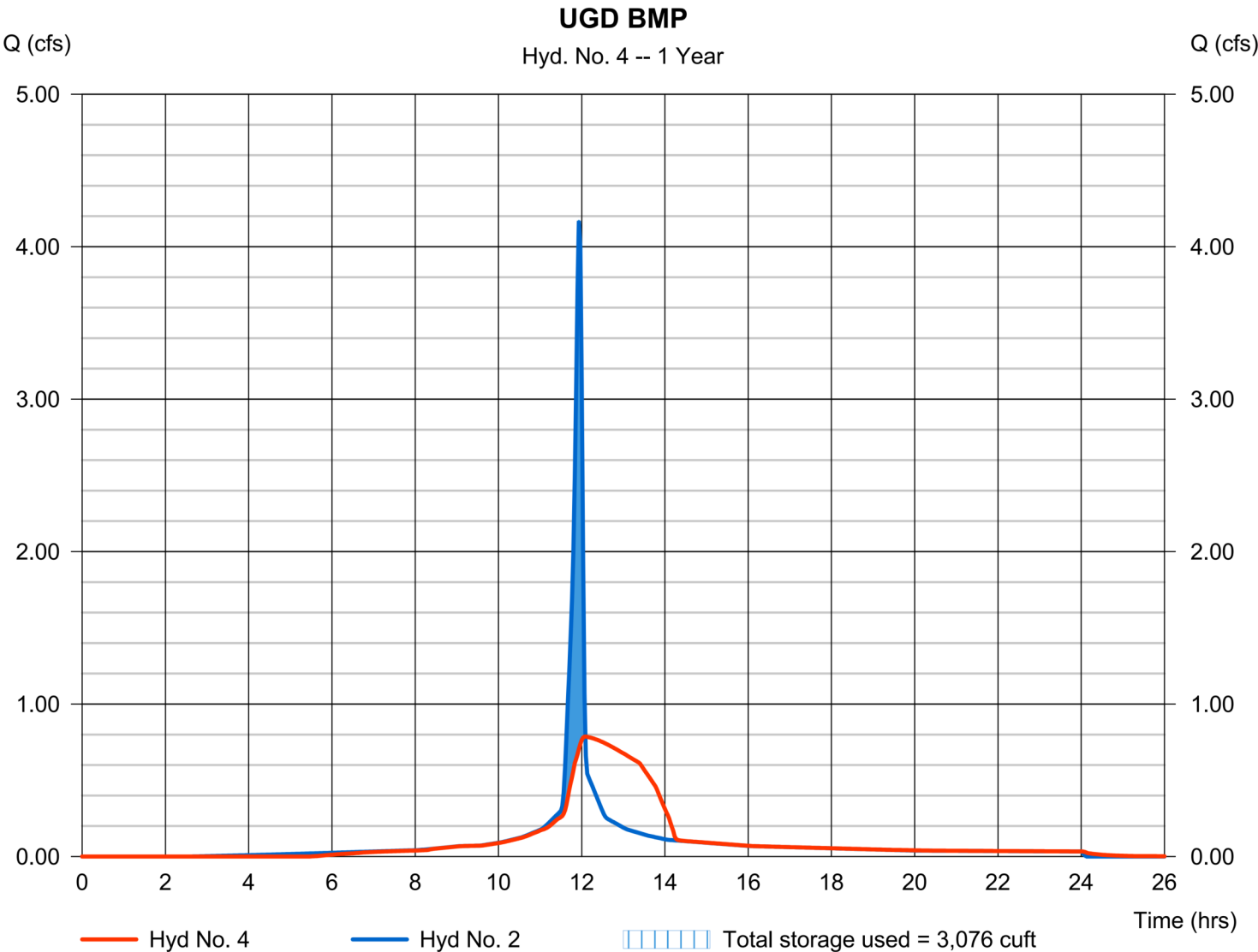
Hydrograph Report

Hyd. No. 4

UGD BMP

Hydrograph type	= Reservoir	Peak discharge	= 0.787 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 9,158 cuft
Inflow hyd. No.	= 2 - Post to BMP	Max. Elevation	= 366.17 ft
Reservoir name	= Underground	Max. Storage	= 3,076 cuft

Storage Indication method used.

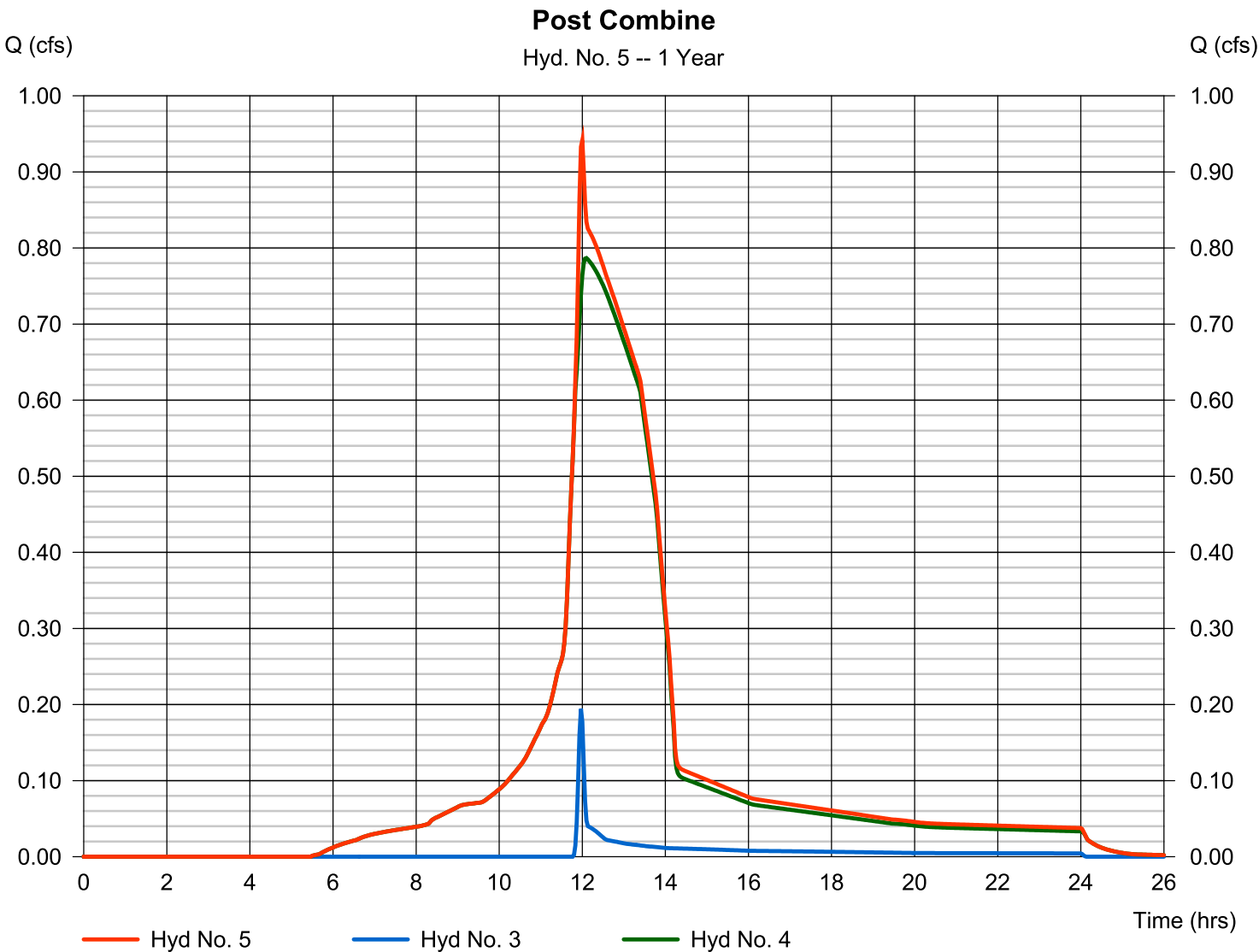


Hydrograph Report

Hyd. No. 5

Post Combine

Hydrograph type	= Combine	Peak discharge	= 0.941 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 9,634 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.350 ac

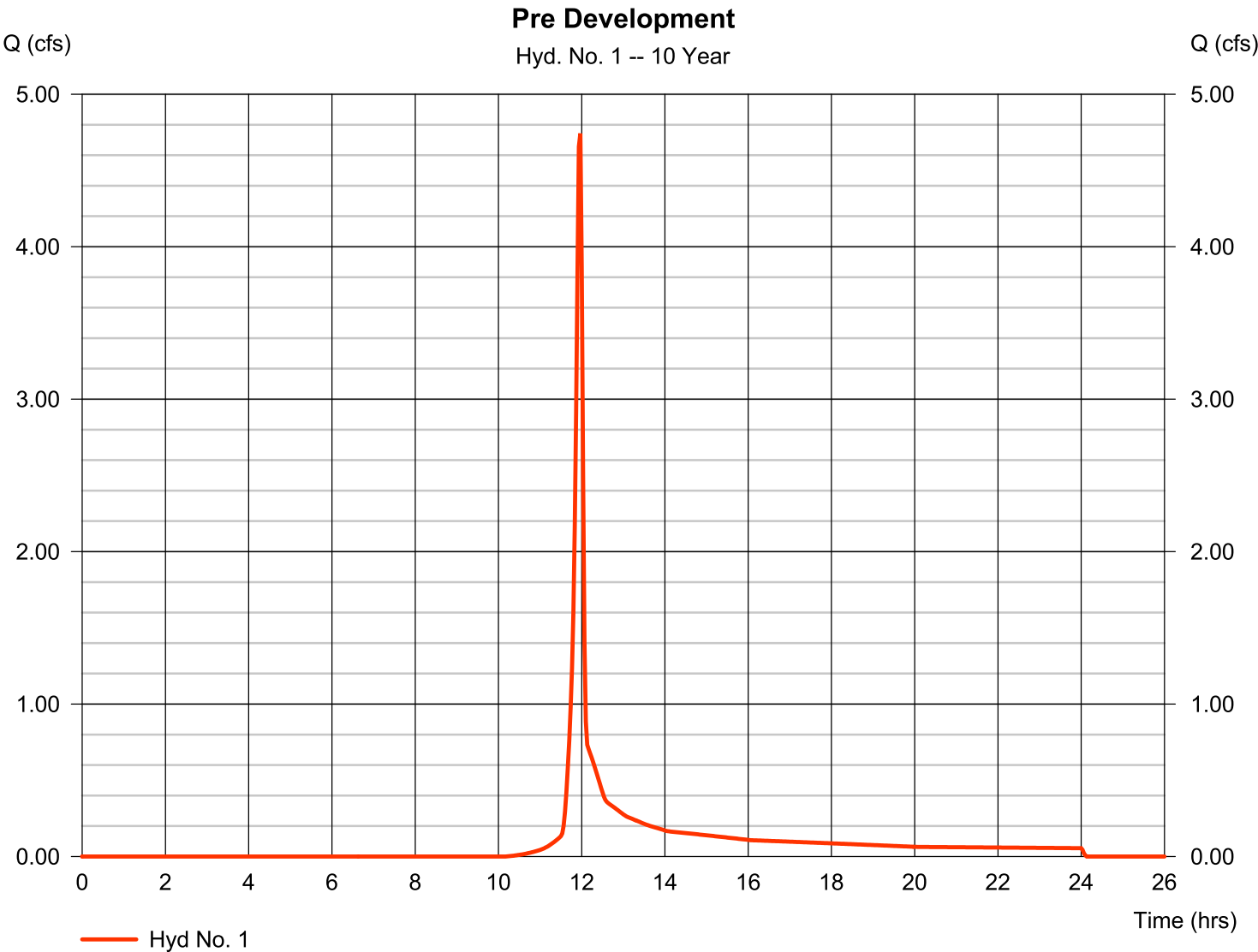


Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	= SCS Runoff	Peak discharge	= 4.743 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 9,486 cuft
Drainage area	= 1.450 ac	Curve number	= 68
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.06 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

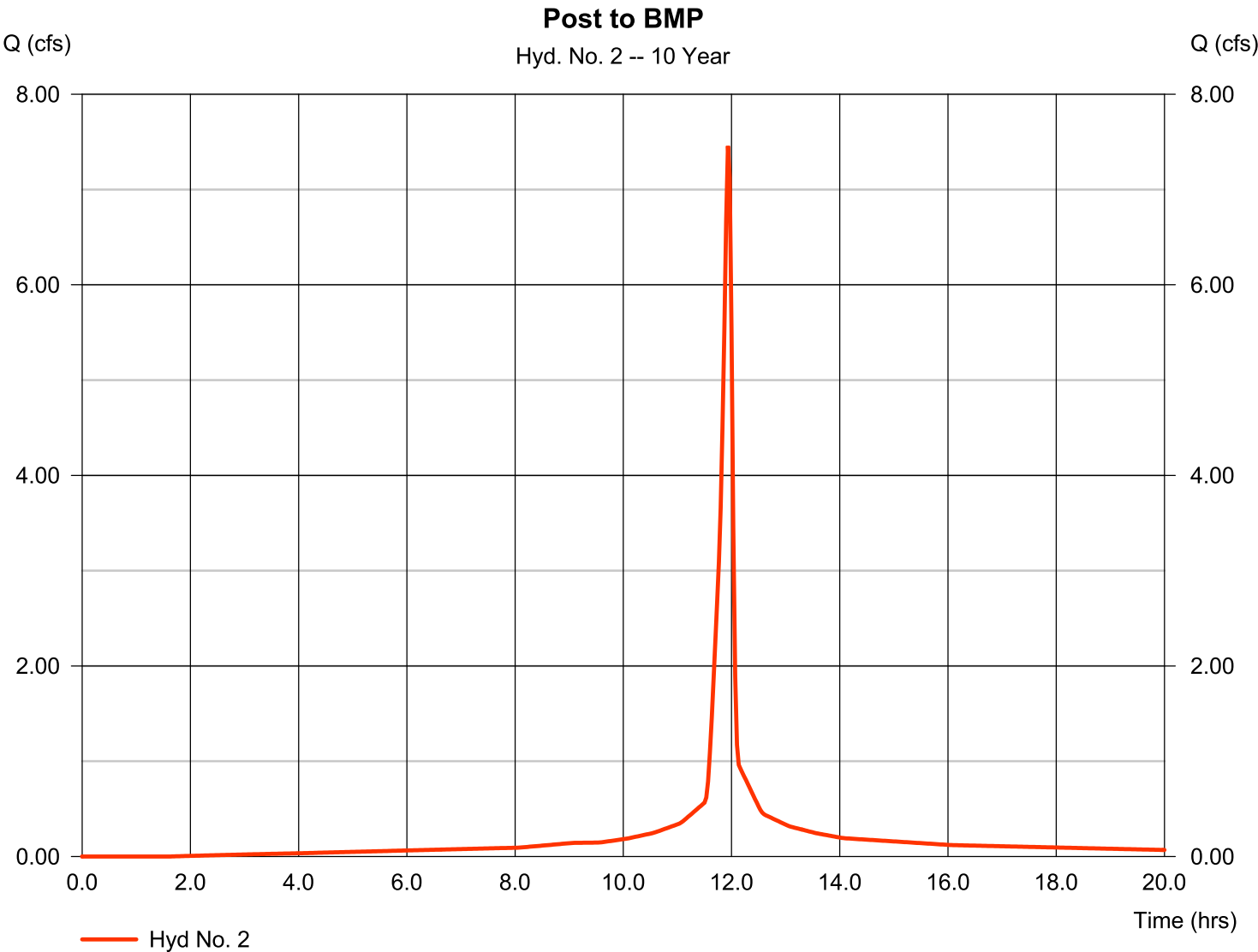


Hydrograph Report

Hyd. No. 2

Post to BMP

Hydrograph type	= SCS Runoff	Peak discharge	= 7.457 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 17,191 cuft
Drainage area	= 1.100 ac	Curve number	= 96
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.06 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

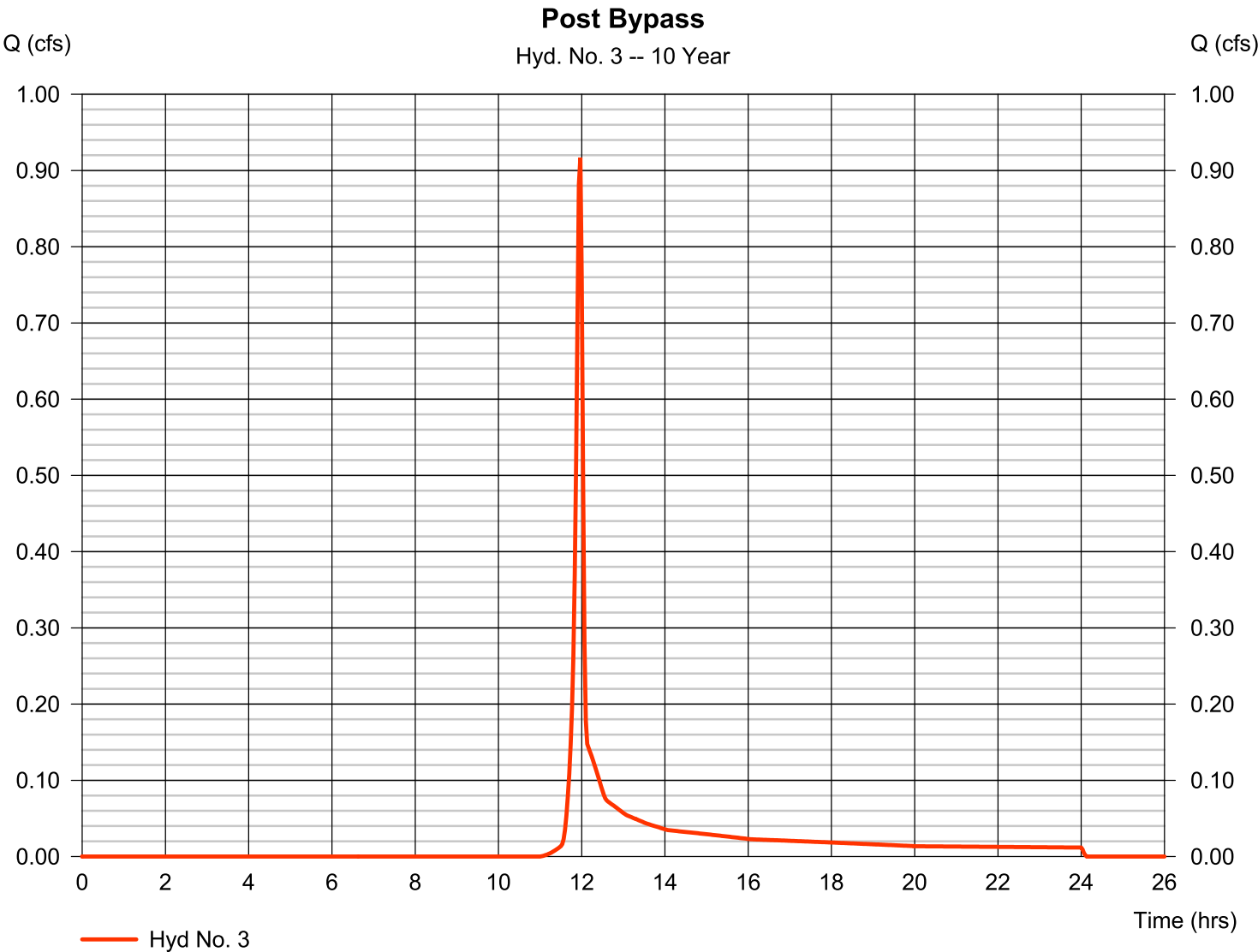


Hydrograph Report

Hyd. No. 3

Post Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 0.917 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 1,843 cuft
Drainage area	= 0.350 ac	Curve number	= 63
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.06 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



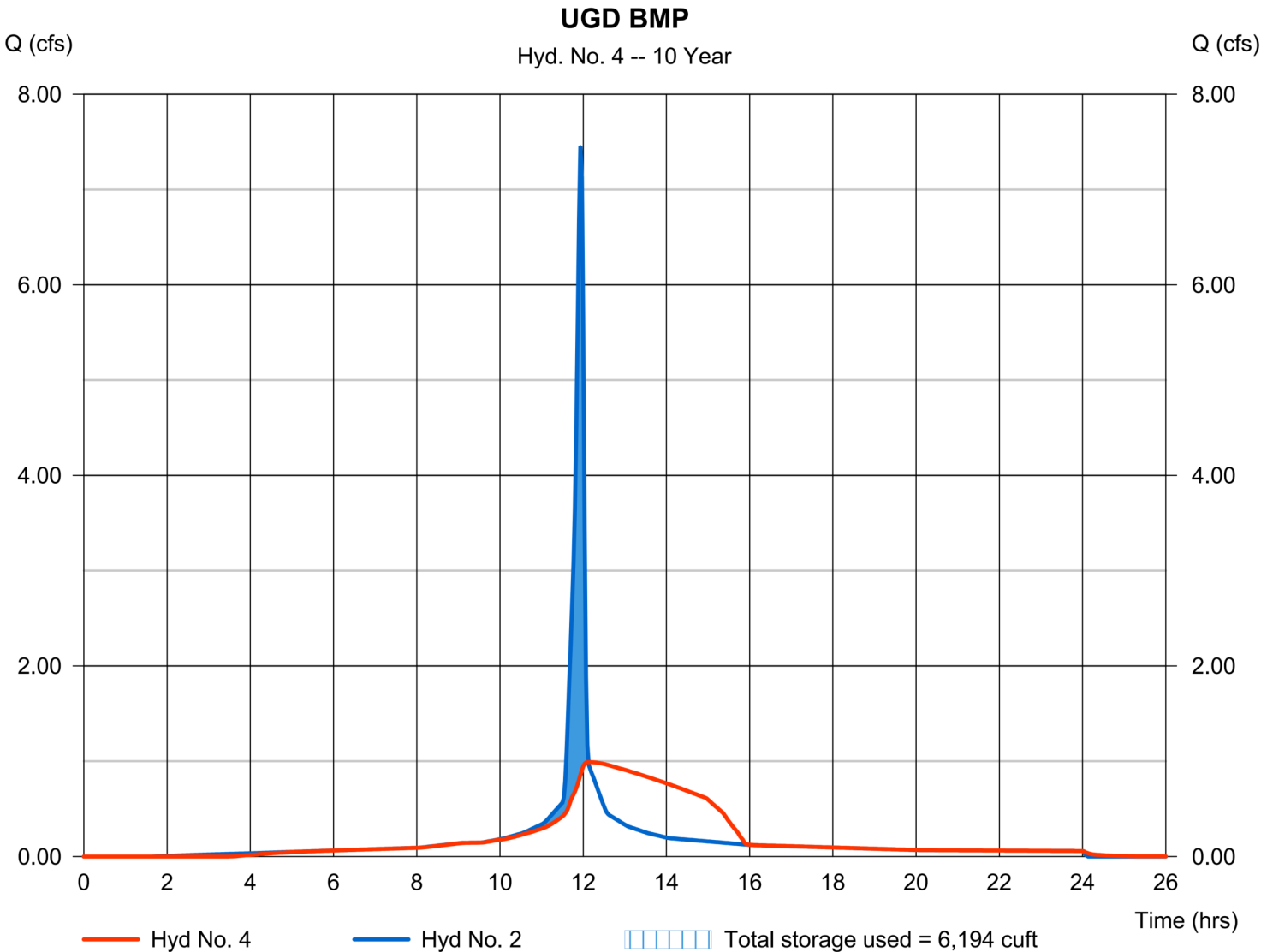
Hydrograph Report

Hyd. No. 4

UGD BMP

Hydrograph type	= Reservoir	Peak discharge	= 0.991 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 17,090 cuft
Inflow hyd. No.	= 2 - Post to BMP	Max. Elevation	= 368.23 ft
Reservoir name	= Underground	Max. Storage	= 6,194 cuft

Storage Indication method used.

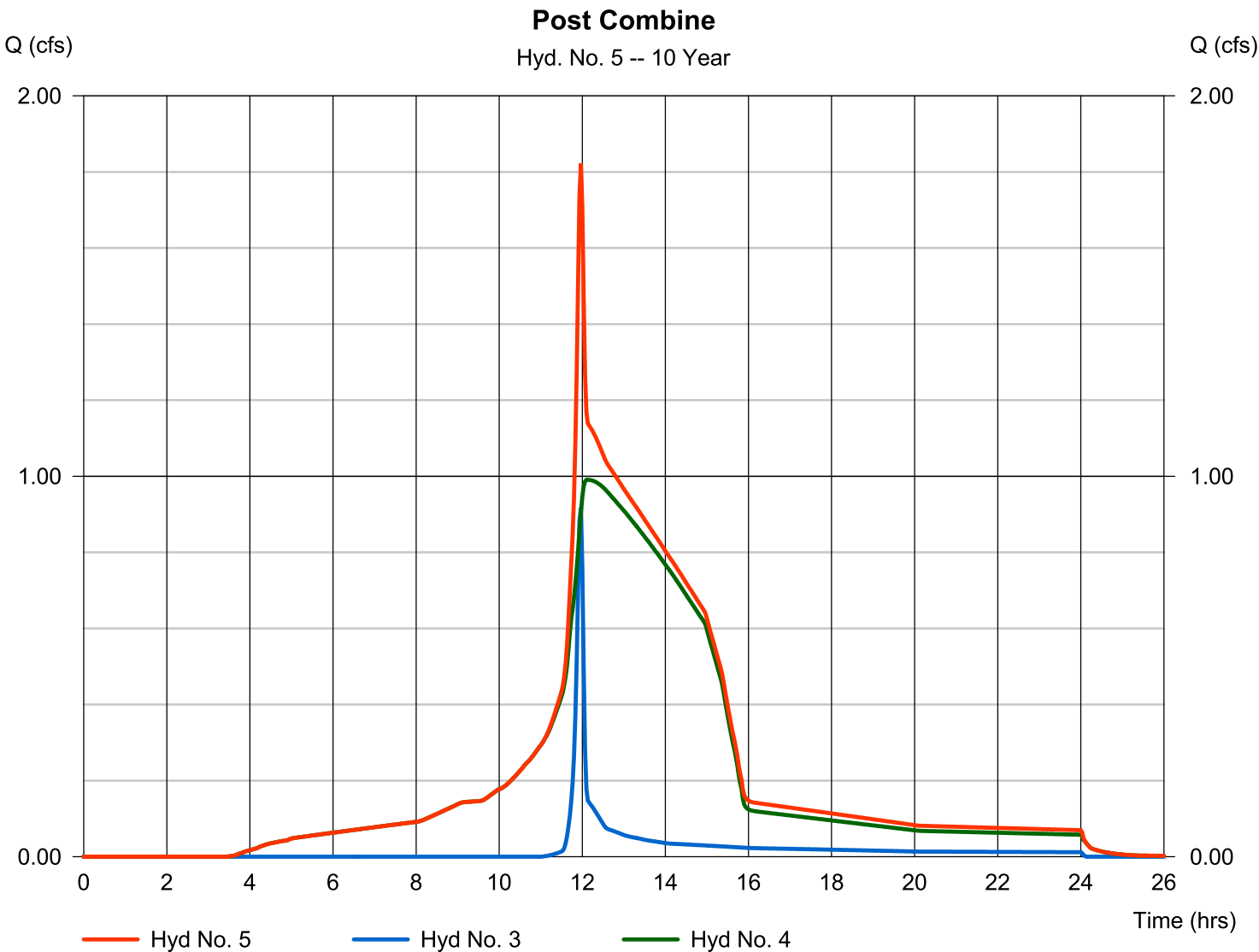


Hydrograph Report

Hyd. No. 5

Post Combine

Hydrograph type	= Combine	Peak discharge	= 1.822 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 18,932 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.350 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	74.0559	13.3000	0.8788	-----
3	0.0000	0.0000	0.0000	-----
5	83.5112	14.8000	0.8514	-----
10	105.7041	16.8000	0.8710	-----
25	118.9252	17.6000	0.8582	-----
50	137.0265	18.6000	0.8630	-----
100	157.1769	19.6000	0.8692	-----

File name: Raleigh-2002.IDF

$$\text{Intensity} = B / (T_c + D)^E$$

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.76	4.65	3.92	3.40	3.01	2.70	2.45	2.25	2.08	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.64	4.07	3.63	3.28	3.00	2.76	2.57	2.40	2.25	2.12
10	7.22	6.03	5.19	4.57	4.09	3.71	3.40	3.13	2.91	2.72	2.56	2.41
25	8.19	6.90	5.98	5.29	4.75	4.32	3.97	3.67	3.41	3.20	3.01	2.84
50	8.95	7.59	6.60	5.86	5.27	4.80	4.41	4.08	3.81	3.57	3.36	3.17
100	9.71	8.27	7.22	6.42	5.79	5.28	4.86	4.50	4.20	3.93	3.70	3.50

Tc = time in minutes. Values may exceed 60.

Precip. file name: raleigh.pcp

[illegible]



SITE DATA

Project Information	
Project Name:	Vineyard Pine Commercial
Permit No (if known):	
Applicant:	Gettle Engineering and Design, PLLC
Applicant Contact Name:	Keith P. Gettle, PE
Applicant Contact Number:	919-210-3934
Contact Email:	kpgettle@gmail.com
Last Modified Date:	Tuesday, September 26, 2023
Site Data:	
River Basin:	Neuse
Regulatory Watershed:	N/A
Physiographic/Geologic Region:	Piedmont
Type of Development (Select from Dropdown menu):	Non-Residential
Zoning:	General Business
Total Site Area (Ac):	1.45
Existing Lake/Pond Area (Ac):	0.00
Proposed Disturbed Area (Ac):	1.39
Proposed Impervious Surface Area from DA Sheets (acre):	1.09
Percent Built Upon Area (BUA):	75%
Is the proposed project a site expansion?	No
Number of Drainage Areas on Site (Points of Analysis):	1
Annual Rainfall (in):	45.41
One-year, 24-hour rainfall (in):	3.00
Two-year, 24-hour rainfall (in):	3.60
Proposed Residential Stormwater Details (if applicable):	
Site Square Footage:	63,162
Total Acreage in Lots:	
Lot Square Footage:	
Number of Lots:	
Average Lot Size (SF):	
Proposed Impervious Surface Area from DA sheets (SF):	47,480
Proposed Impervious Surface Area Devoted to Lots (SF):	
Total Impervious Surface Area Devoted to Roads (SF):	
Other Impervious Surface Area (SF):	



Project Name:

Vineyard Pine Commercial

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA		PRE-DEVELOPMENT								POST-DEVELOPMENT							
Drainage Area (Acres)=		1.45								1.45							
Site Acreage within Drainage=		1.45								1.45							
One-year, 24-hour rainfall (in)=		3.00															
Land Use (acres) by Soil Group:		A Soils		B Soils		C Soils		D Soils		A Soils		B Soils		C Soils		D Soils	
Commercial		Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot												0.67					
Roof												0.42					
Open/Landscaped												0.19					
Industrial		Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																	
Roof																	
Open/Landscaped																	
Transportation		Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
High Density (interstate, main)																	
High Density (Grassed Right-of-ways)																	
Low Density (secondary, feeder)																	
Low Density (Grassed Right-of-ways)																	
Rural																	
Rural (Grassed Right-of-ways)																	
Sidewalk																	
Misc. Pervious		Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Managed pervious (Open Space)				1.45								0.17					
Unmanaged (pasture)																	
Woods (not on lots)																	
Residential		Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Roadway																	
Grassed Right-of-ways																	
Driveway																	
Parking lot																	
Roof																	
Sidewalk (Includes Patios)																	
Lawn																	
Managed pervious (Open Space)																	
Woods (on lots)																	
Land Taken up by BMP																	
JURISDICTIONAL LANDS		Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Natural wetland																	
Riparian buffer (Zone 1 only)																	
Open water																	
Totals (Ac)=		0.00	0.00	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.45	0.00	0.00	0.00	0.00	0.00

SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT T_c
Sheet Flow		
Length (ft)=	50.00	100.00
Slope (ft/ft)=	7.00	0.01
Surface Cover:	Grass	Paved, Gravel, or Bare Soil
n-value=	0.24	0.011
T_i (hrs)=	0.01	0.03
Shallow Flow		
Length (ft)=	297.00	
Slope (ft/ft)=	7.00	
Surface Cover:	Unpaved	
Average Velocity (ft/sec)=	42.69	0.00
T_i (hrs)=	0.00	0.00
Channel Flow 1		
Length (ft)=		315.00
Slope (ft/ft)=		0.01
Cross Sectional Flow Area (ft ²)=		0.87
Wetted Perimeter (ft)=		2.39
Channel Lining:		Concrete, finished
n-value=		0.012
Hydraulic Radius (ft)=	0.00	0.36
Average Velocity (ft/sec)=	0.00	6.33
T_i (hrs)=	0.00	0.01
T_c (hrs)=		
RESULTS	PRE-DEVELOPMENT	POST-DEVELOPMENT
Site Impervious Surface Area (Ac) =	0.00	1.09
Lot Impervious Surface Area (Ac) =	0.00	0.00
1-year, 24-hour storm (Peak Flow)		
Volume of runoff (ft ³) =	1,922	11,430
Volume change (ft ³) =	9,509	
Runoff (inches) = Q^* =	0.3651	2.1716
Peak Discharge (cfs)= Q =		
Composite Curve Number (DA)=	61	89
Composite Curve Number (Site only)=	61	89
DISCONNECTED IMPERVIOUS - Credit given only to residential development with drainage area with less than 30% impervious		
Percent Disconnected Impervious Credit (Residential Only) =		
Disconnected impervious area (Ac) =	0.00	
Drainage Area $CN_{adjusted}$ =	89	
Site Only $CN_{adjusted}$ =	89	

Project Name: **Vineyard Pine Commercial**
**DRAINAGE AREA 1
BMP CALCULATIONS**
DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS

DA1 Site Acreage=	1.45			
DA1 Off-Site Acreage=	0.00			
Total Required Storage Volume for Site TCN Requirement (ft³)=				
Will site use underground water harvesting?		Enter % volume reduction in decimal form=		Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER AREA TREATED BY BMP

Land Use (acres)	Sub-DA1(a) (Ac)		Sub-DA1(b) (Ac)		Sub-DA1(c) (Ac)		Sub-DA1(d) (Ac)		Sub-DA1(e) (Ac)	
Commercial	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Parking lot	0.67									
Roof	0.42									
Open/Landscaped	0.01									
Industrial	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Parking lot										
Roof										
Open/Landscaped										
Transportation	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
High Density (interstate, main)										
High Density (Grassed Right-of-ways)										
Low Density (secondary, feeder)										
Low Density (Grassed Right-of-ways)										
Rural										
Rural (Grassed Right-of-ways)										
Sidewalk										
Misc. Pervious	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Managed pervious										
Unmanaged (pasture)										
Woods (not on lots)										
Residential	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Roadway										
Grassed Right-of-ways										
Driveway										
Parking lot										
Roof										
Sidewalk										
Lawn										
Managed pervious										
Woods (on lots)										
Land Taken up by BMP	Site	Off-site	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Natural wetland										
Riparian buffer (Zone 1 only)										
Totals (Ac)=	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Storm Filter	Sand Filter	3,761	1.30	12.62	0.16	1.52	0.96	8.82	0.14	1.30	
Outflow Total Nitrogen (lb/ac/yr)=			8.82		Outflow Total Phosphorus (lb/ac/yr)=					1.30	

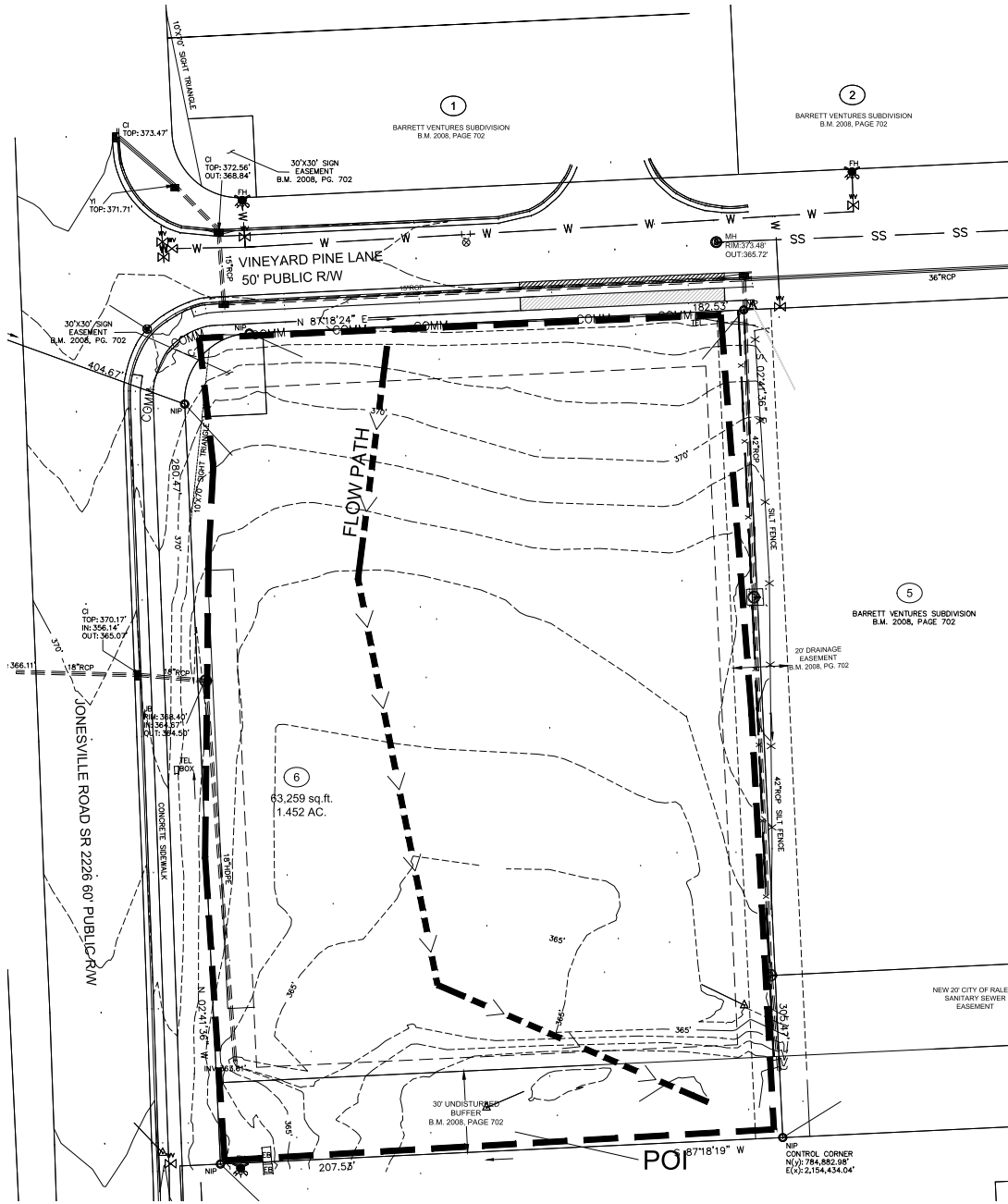
Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream sub-basin(s), select all contributing sub-basin(s) from dropdown menus:											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Outflow Total Nitrogen (lb/ac/yr)=				Outflow Total Phosphorus (lb/ac/yr)=							
Sub-DA1 (c) BMP(s)											
If Sub-DA1(c) is connected to upstream sub-basin(s), select all contributing sub-basin(s):											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Outflow Total Nitrogen (lb/ac/yr)=				Outflow Total Phosphorus (lb/ac/yr)=							
Sub-DA1 (d) BMP(s)											
If Sub-DA1(d) is connected to upstream sub-basin(s), select all contributing sub-basin(s):											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Outflow Total Nitrogen (lb/ac/yr)=				Outflow Total Phosphorus (lb/ac/yr)=							
Sub-DA1 (e) BMP(s)											
If Sub-DA1(e) is connected to upstream sub-basin(s), select all contributing sub-basin(s):											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Outflow Total Nitrogen (lb/ac/yr)=				Outflow Total Phosphorus (lb/ac/yr)=							
DA1 BMP SUMMARY											
Total Volume Treated (c.f.)=			0								
DA1 Outflow Total Nitrogen (lb/ac/yr)=			8.82								
DA1 Outflow Total Phosphorus (lb/ac/yr)=			1.30								
1-year, 24-hour storm											
Pre Development Peak Discharge (cfs)= Q_{1-year} =											
Post BMP Peak Discharge (cfs)= Q_{1-year} =											

Project Name: **Vineyard Pine Commercial**

DA SITE SUMMARY
BMP CALCULATIONS

BMP SUMMARY						
DRAINAGE AREA SUMMARIES						
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6
Post-Development (1-year, 24-hour storm)						
Peak Flow (cfs)= Q_{1-year} =						
Post-Development with BMPs (1-year, 24-hour storm)						
% Impervious =	75%					
Volume Managed (CF)=	0					
Post BMP Peak Discharge (cfs)= Q_{1-year} =						
Have Target Curve Number Requirements been met?	N/A					
Pre Development Nitrogen and Phosphorus Load						
Total Nitrogen (lb/ac/yr)=	1.57					
Total Phosphorus (lb/ac/yr)=	N/A					
Post Development Nitrogen and Phosphorus Load						
Total Nitrogen (lb/ac/yr)=	9.90					
Total Phosphorus (lb/ac/yr)=	N/A					
Post-BMP Nitrogen Loading						
Outflow Total Nitrogen (lb/ac/yr)=	7.02					
Outflow Total Phosphorus (lb/ac/yr)=	1.05					
Has site met the Target?	NO					
Has site met requirements for offsetting?	YES					



Gettle Engineering and Design, PLLC
 3616 Waxwing Court,
 Wake Forest, North Carolina 27587
 (919) 210-3934 Firm License P-2538

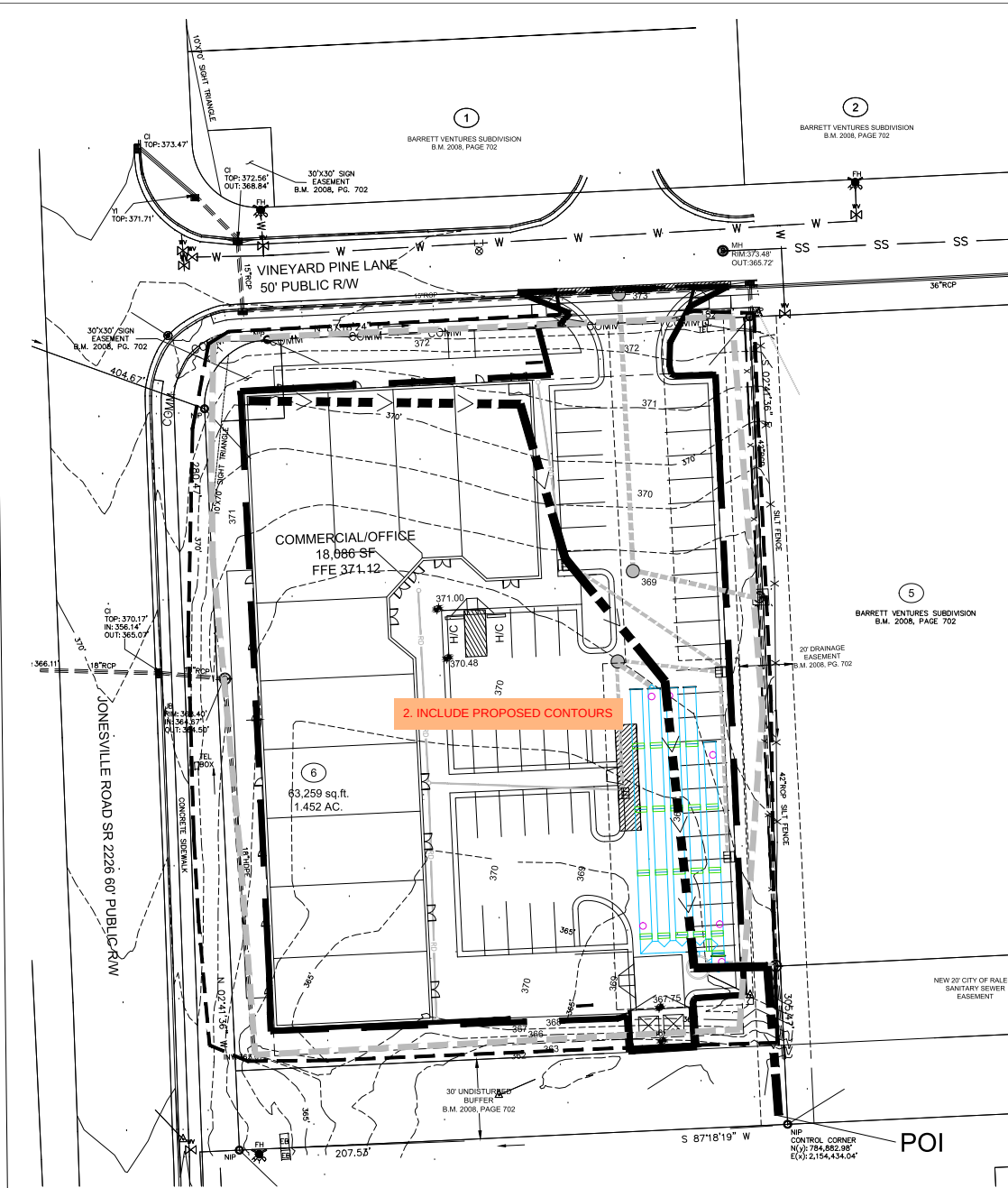
NO.	DATE	COMMENT	BY
1		COMMENT	BY
2		COMMENT	BY
3		COMMENT	BY
4		COMMENT	BY
5		COMMENT	BY
6		COMMENT	BY
7		COMMENT	BY
8		COMMENT	BY
9		COMMENT	BY
10		COMMENT	BY

PRELIMINARY
 DO NOT USE FOR
 CONSTRUCTION

Pre Development Drainage Map
 Vineyard Pine Commercial
 MRR Development, LLC
 Rolesville, Wake County, North Carolina

Project No.
 Dwg No.

EX1



Drainage Area to BMP = 1.1 Ac (47,916 sf)
Impervious Area = 1.09 Ac (47,480 sf)

Stormwater Summary

	Square Feet	Acres
Overall Site	63,162.00	1.45
Impervious Summary		
Pre		
Parking Lot	9,000	0.60
Managed Pervious	63,162.00	1.45
Total		
Post		
Parking Lot	29,364.00	0.67
Roof	18,068.00	0.42
Open Landscape	8,436.00	0.19
Managed Pervious	7,245.00	0.17
Total		1.45

1	DATE	COMMENT	BY
2	DATE	COMMENT	BY
3	DATE	COMMENT	BY
4	DATE	COMMENT	BY
5	DATE	COMMENT	BY
6	DATE	COMMENT	BY
7	DATE	COMMENT	BY
8	DATE	COMMENT	BY

PRELIMINARY
DO NOT USE FOR
CONSTRUCTION