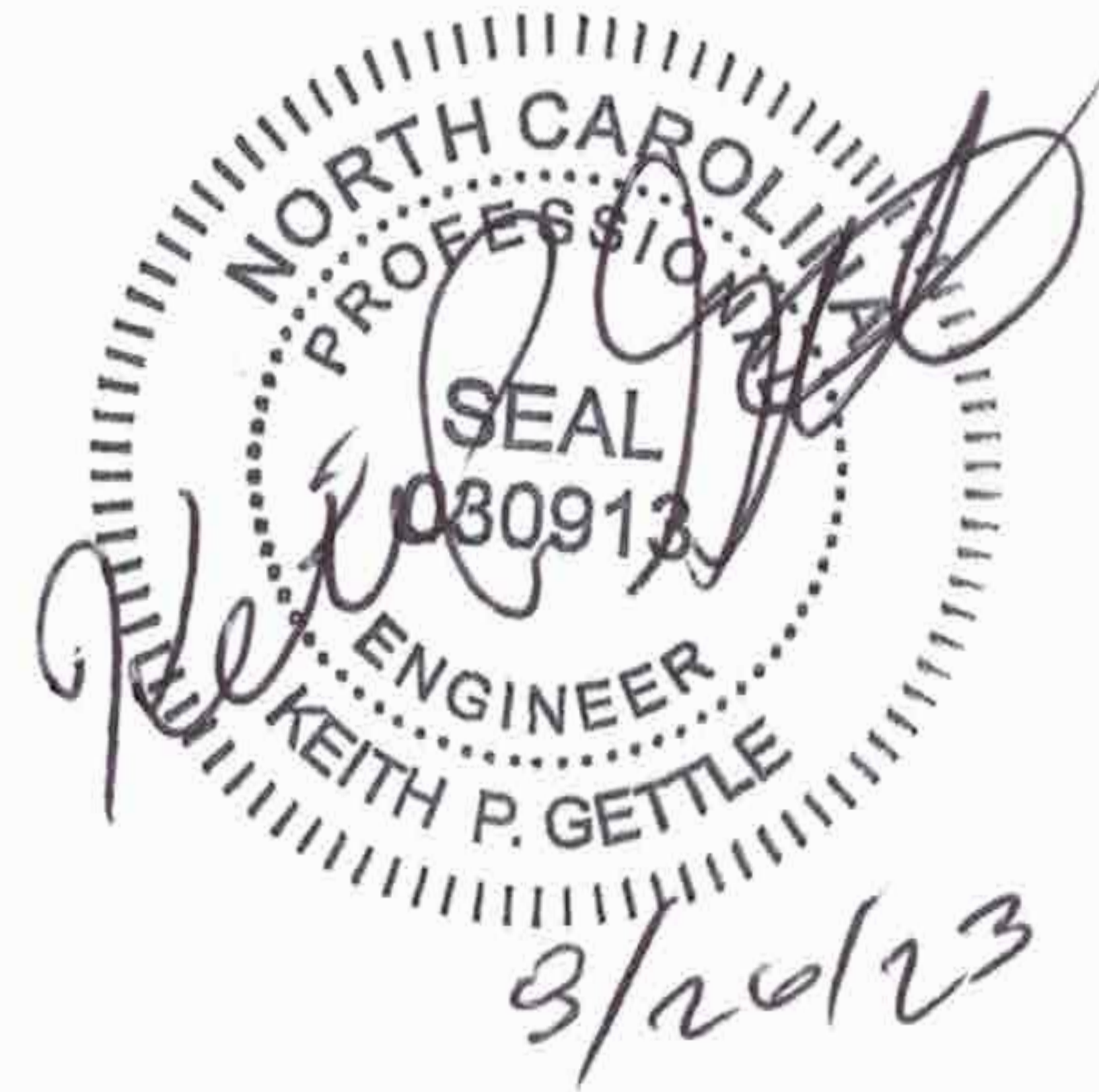


**Vineyard Pine Commercial**  
4502 Vineyard Pine Lane

**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.

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

### **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)**

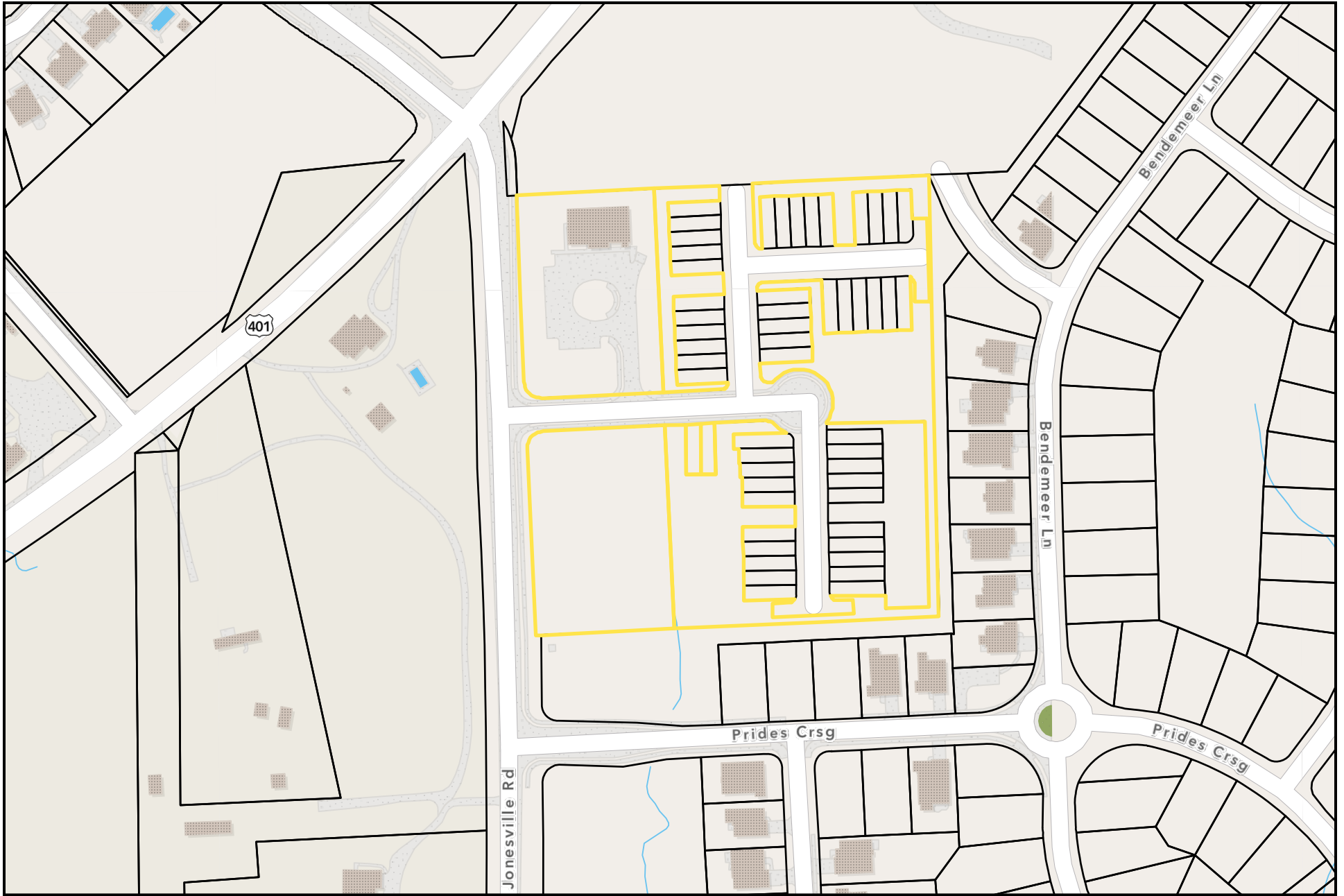


There is no storm pipe from the ROW that discharges to the BMP and as a result Q100 backwater review not needed.

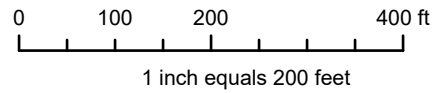
### **Downstream Impact Analysis (DIA)**

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.

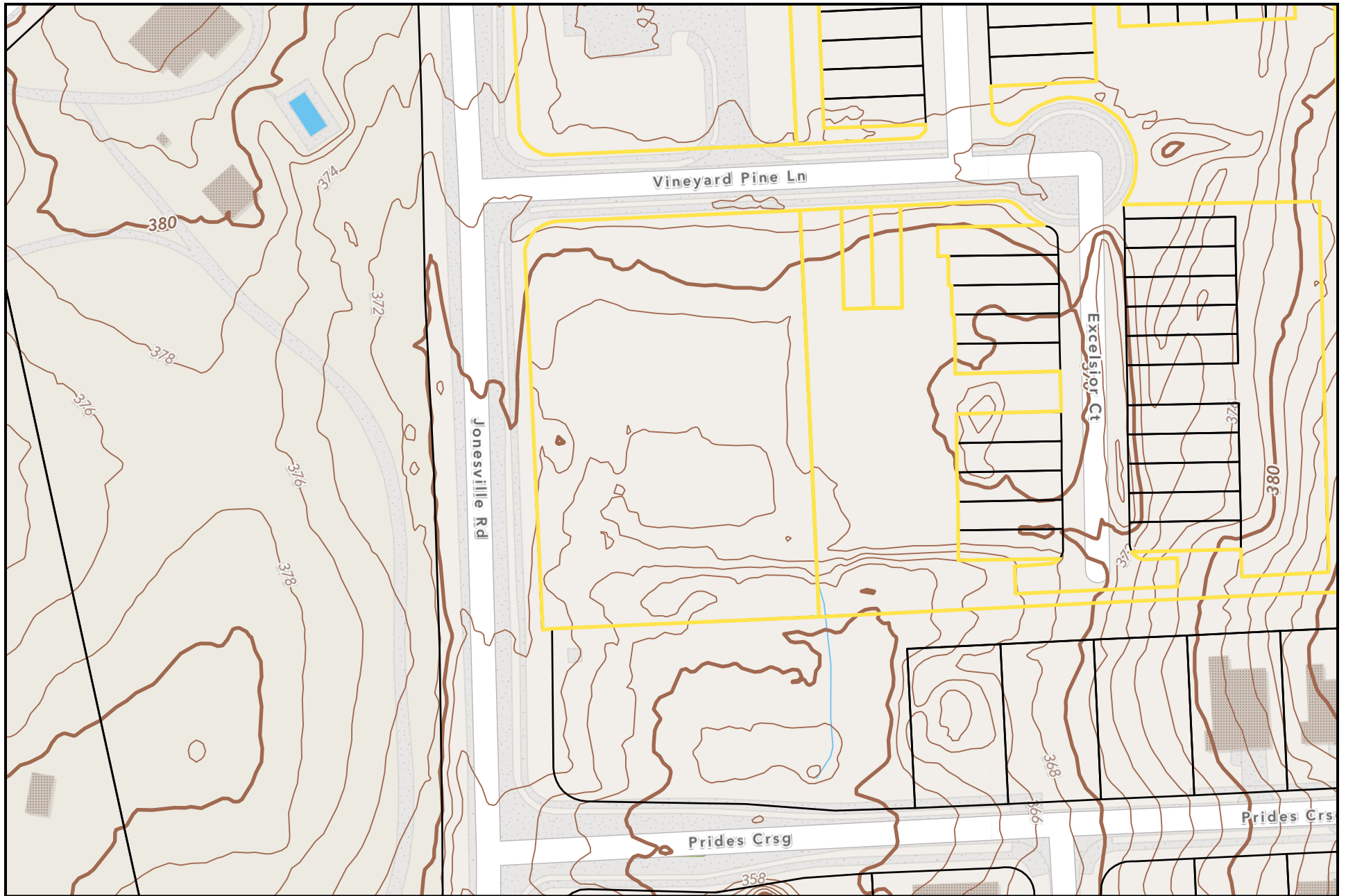
Attachments.



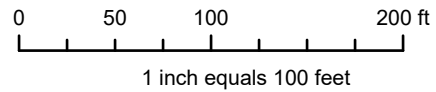
**GIS Site Map**



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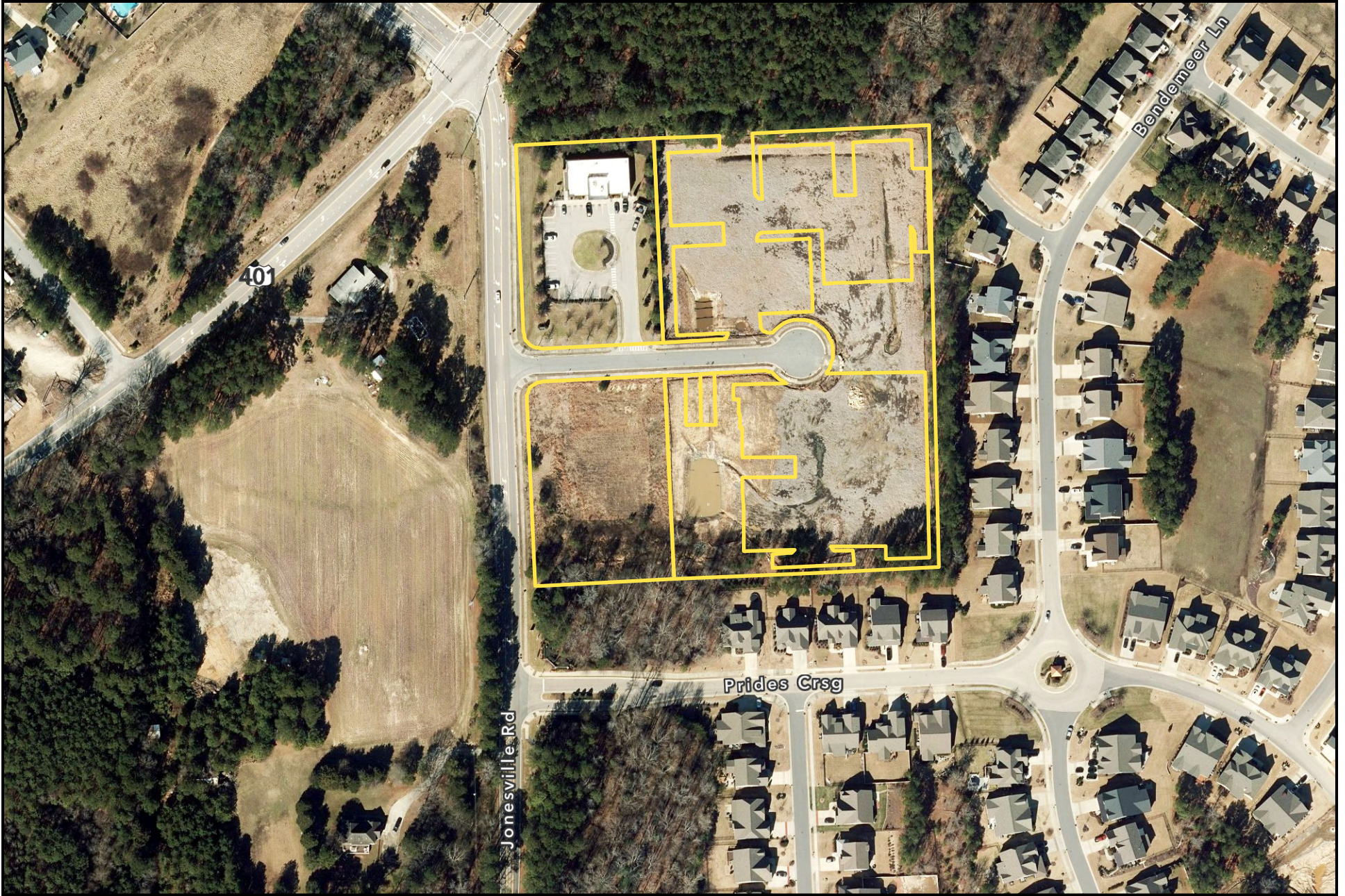


## GIS Topo Map

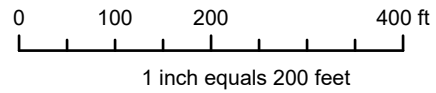


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**GIS Aerial**



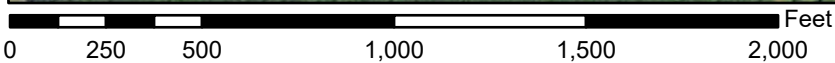
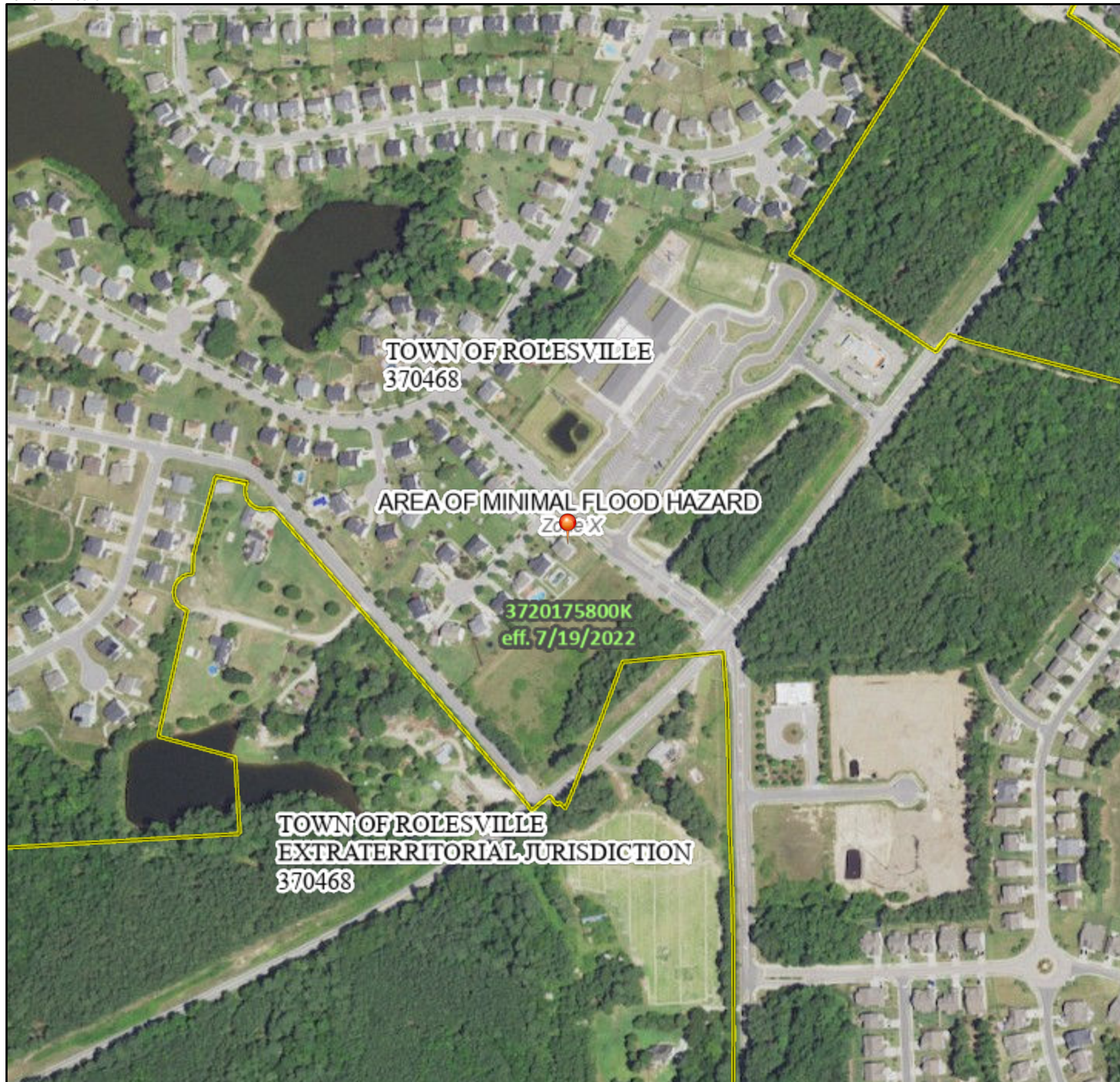
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# National Flood Hazard Layer FIRMMette



78°29'10"W 35°54'44"N



1:6,000

78°28'33"W 35°54'15"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) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		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 <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		Cross Sections with 1% Annual Chance Water Surface Elevation
MAP PANELS		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		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.









**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 & aerials](#)

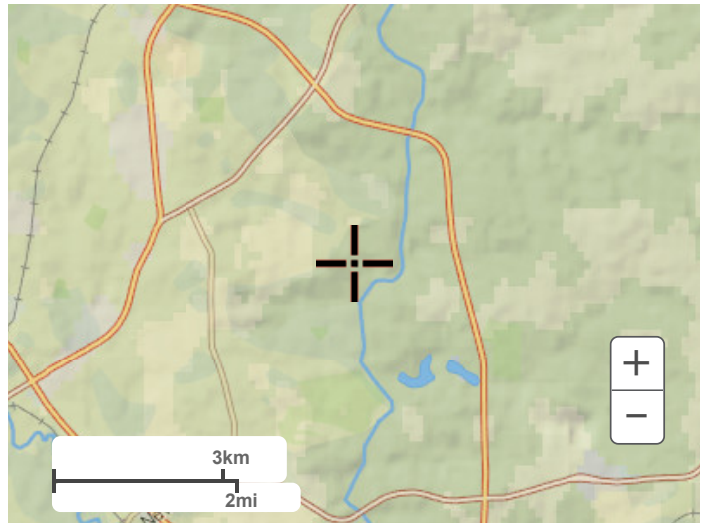
**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
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)

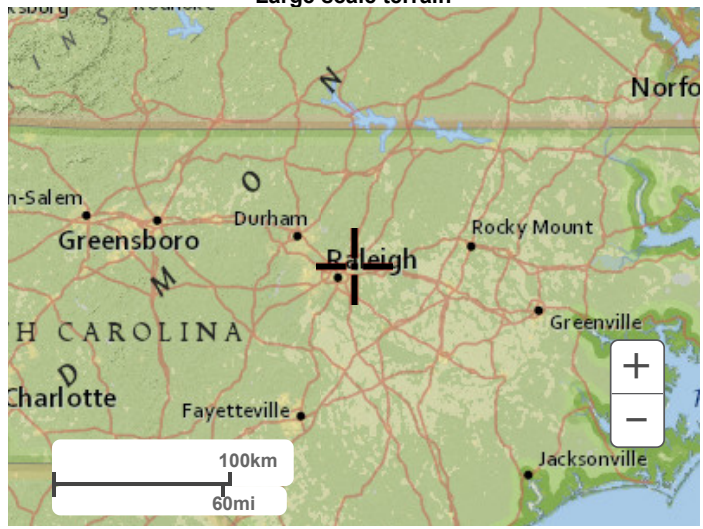
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration 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.

[Back to Top](#)

**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 **Jonesville Road Commercial**  
 Project State **NC**  
 Project Location **Rolesville**  
 Drainage Area, Ad **1.10** ac  
 Impervious Area, Ai **1.10** ac  
 Pervious Area, Ap **0.00**  
 % Impervious **100%**  
 Runoff Coefficient, Rv **0.95** =0.05+0.9\*(Ai/Ad)

## Water Quality Volume Calculations

Design storm rainfall depth, Rd **1.0** in  
 Water quality volume, WQV **3793.4** ft<sup>3</sup> =Ad\*Rv\*Rd\*(43560/12)

## Storage Component Calculations

Capture 75% of WQV **2845.0** ft<sup>3</sup> =0.75\*WQV  
 Pretreatment credit (estimated or calculated), %pre **30%**

## Mass loading calculations

Mean Annual Rainfall, P **46** in  
 Agency required % removal **85%**  
 Percent Runoff Capture (% capture) **90%**  
 Mean Annual Runoff, V<sub>i</sub> **157,045** ft<sup>3</sup> =P\*Ad\*Rv\*(43560/12)\*%capture  
 Event Mean Concentration of Pollutant, EMC **70.0** mg/l (Suggestion: Use 60 for residential, 70 for Commercial, 100 for Industrial)  
 Annual Mass Load, M<sub>total</sub> **685.86** lbs =EMC\*V<sub>i</sub>\*(28.3)\*(0.000001)\*(2.2046)

## Filter System

Filtration brand **StormFilter**  
 Cartridge height **18** in

## Cartridge Quantity Calculation

Mass removed by pretreatment system, M<sub>pre</sub> **206** lbs =Mtotal \* %removal  
 Mass load to filters after pretreatment, M<sub>pass1</sub> **480** lbs =Mtotal - Mpre  
 Estimate the required filter efficiency, E<sub>filter</sub> **79%** =1+(%removal - 1)/(1 - %pre)  
 Mass to be captured by filters, M<sub>filter</sub> **377** lbs =Mpass1 \* Efilter  
 Maximum Cartridge Flow rate, Q<sub>cart</sub> **7.5** gpm =q \* (7.5 ft2/cartridge)  
 Mass load per cartridge, M<sub>cart</sub> (lbs) **36** lbs =lookup mass load per cartridge  
 Number of Cartridges required, N<sub>mass</sub> **11** =ROUNDUP(Mfilter/Mcart,0)  
 Maximum Treatment Capacity **0.18** =Nmass\*(Qcart/449)

## SUMMARY

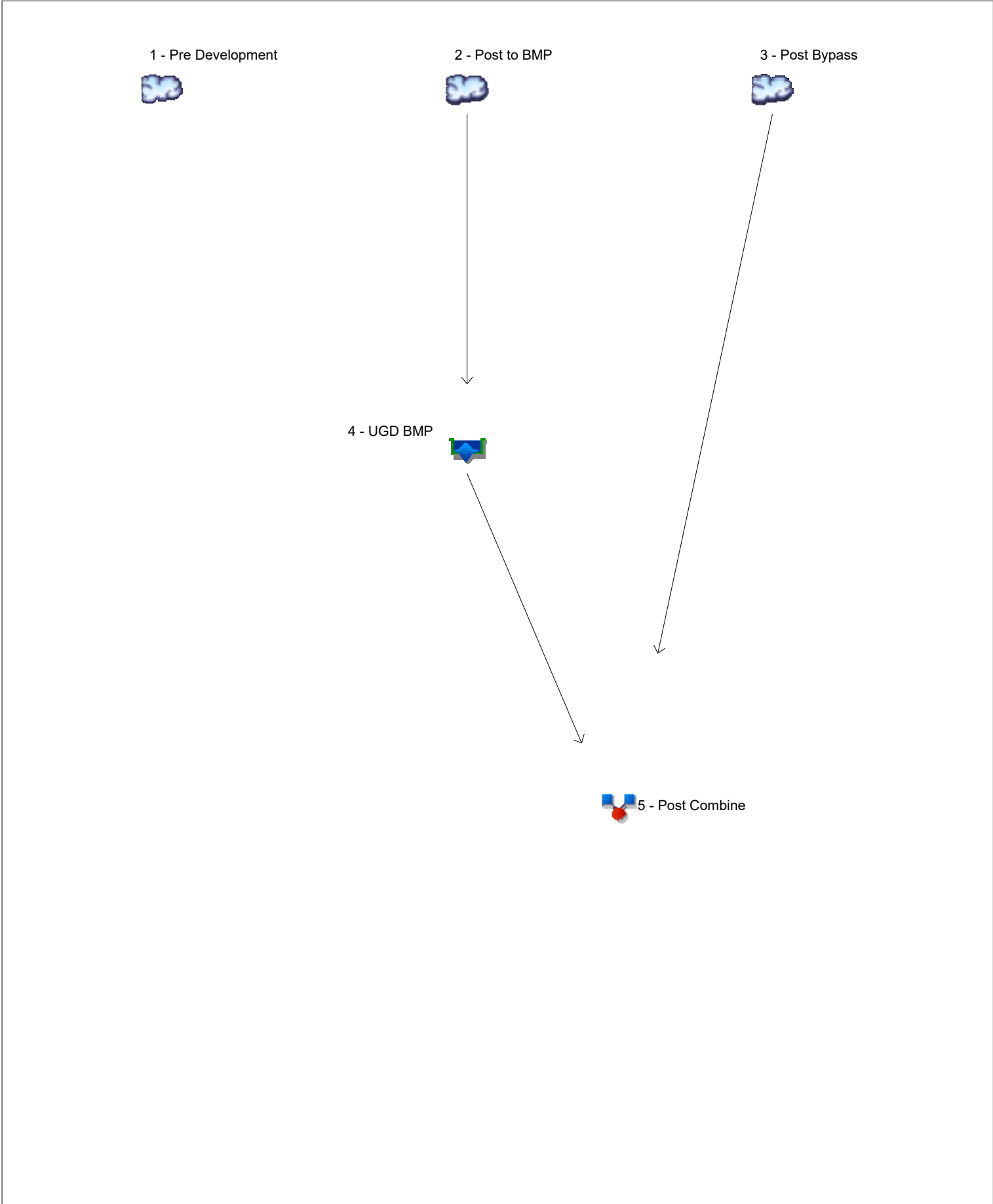
Maximum Treatment Flow Rate, cfs	0.18
Cartridge Flow Rate, gpm	7.5
Number of Cartridges	11
Stormfilter Size	96" MH

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

# Hydrograph Summary Report

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

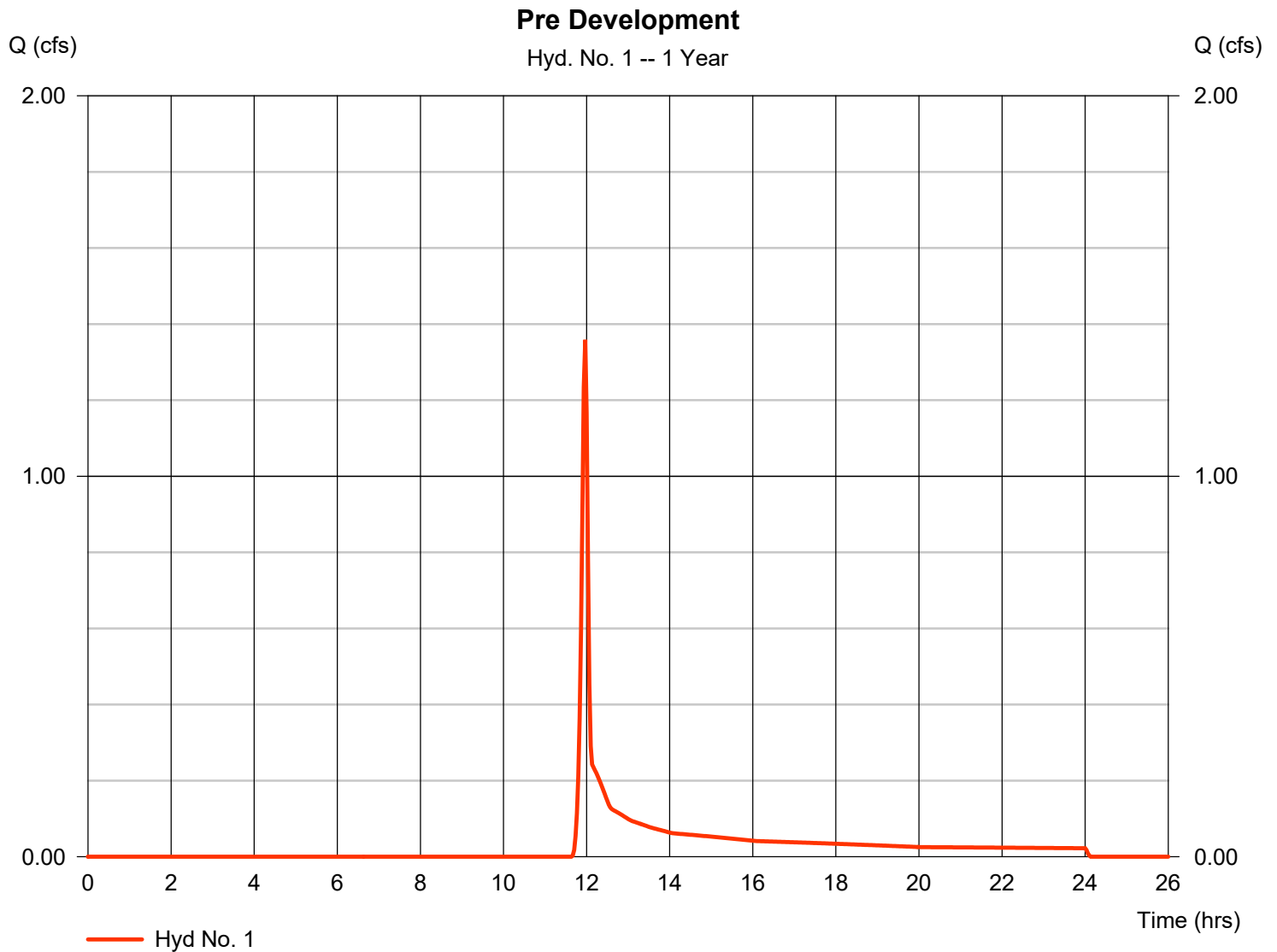
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	SCS Runoff	4.743	2	718	9,486	-----	-----	-----	Pre Development	
2	SCS Runoff	7.457	2	716	17,191	-----	-----	-----	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



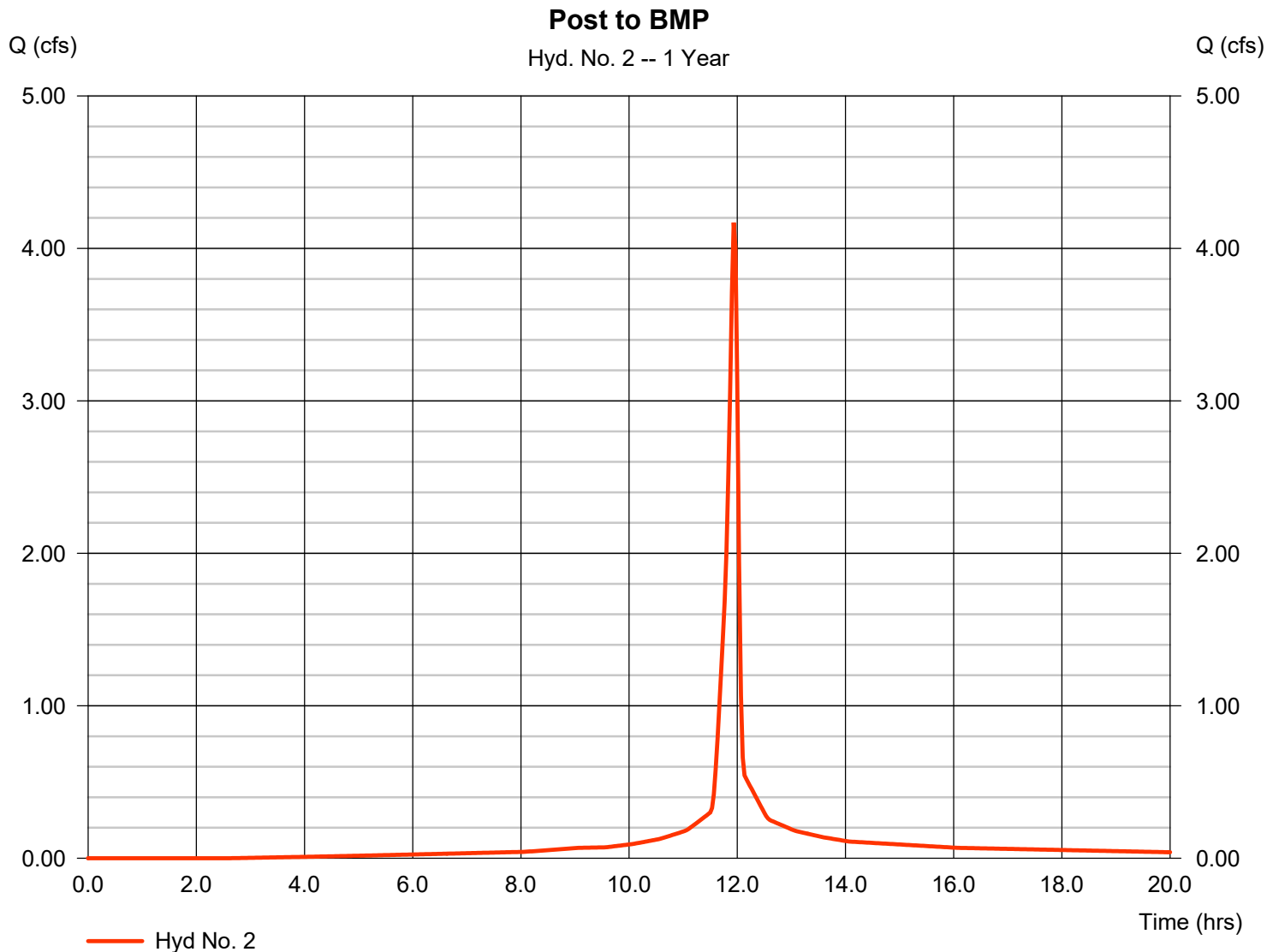


# Hydrograph Report

## 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

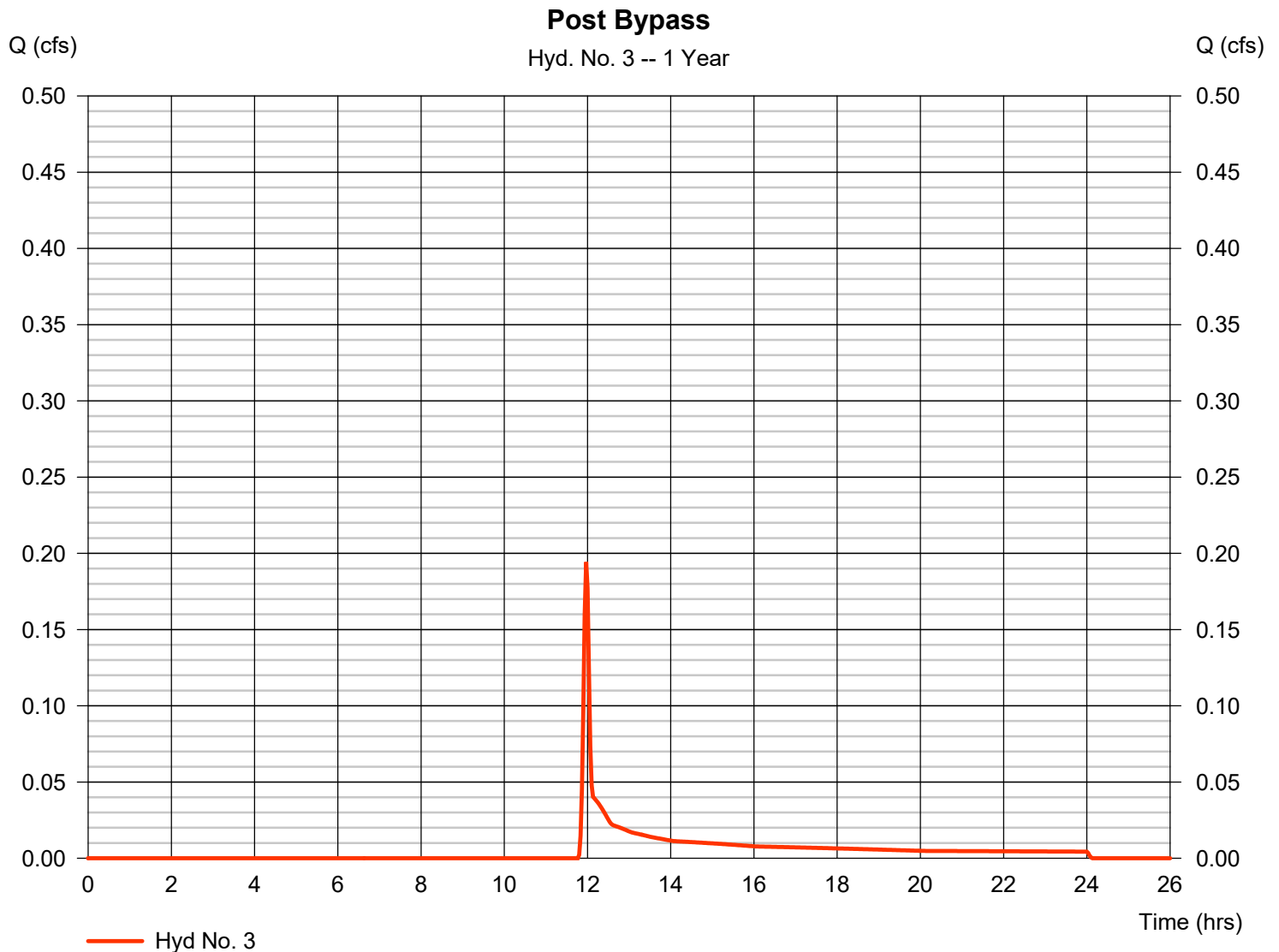


# Hydrograph Report

## 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



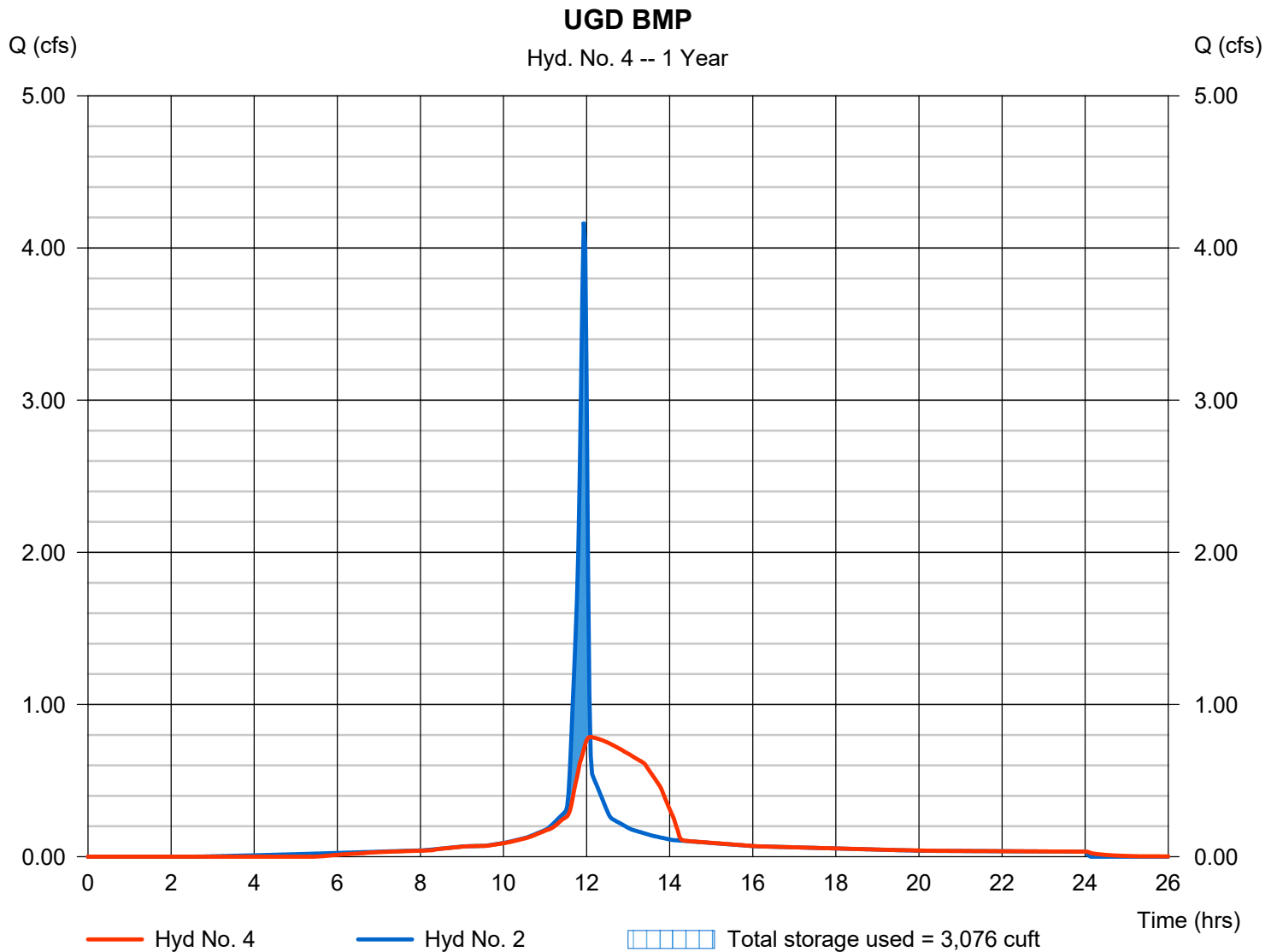
# Hydrograph Report

## 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.



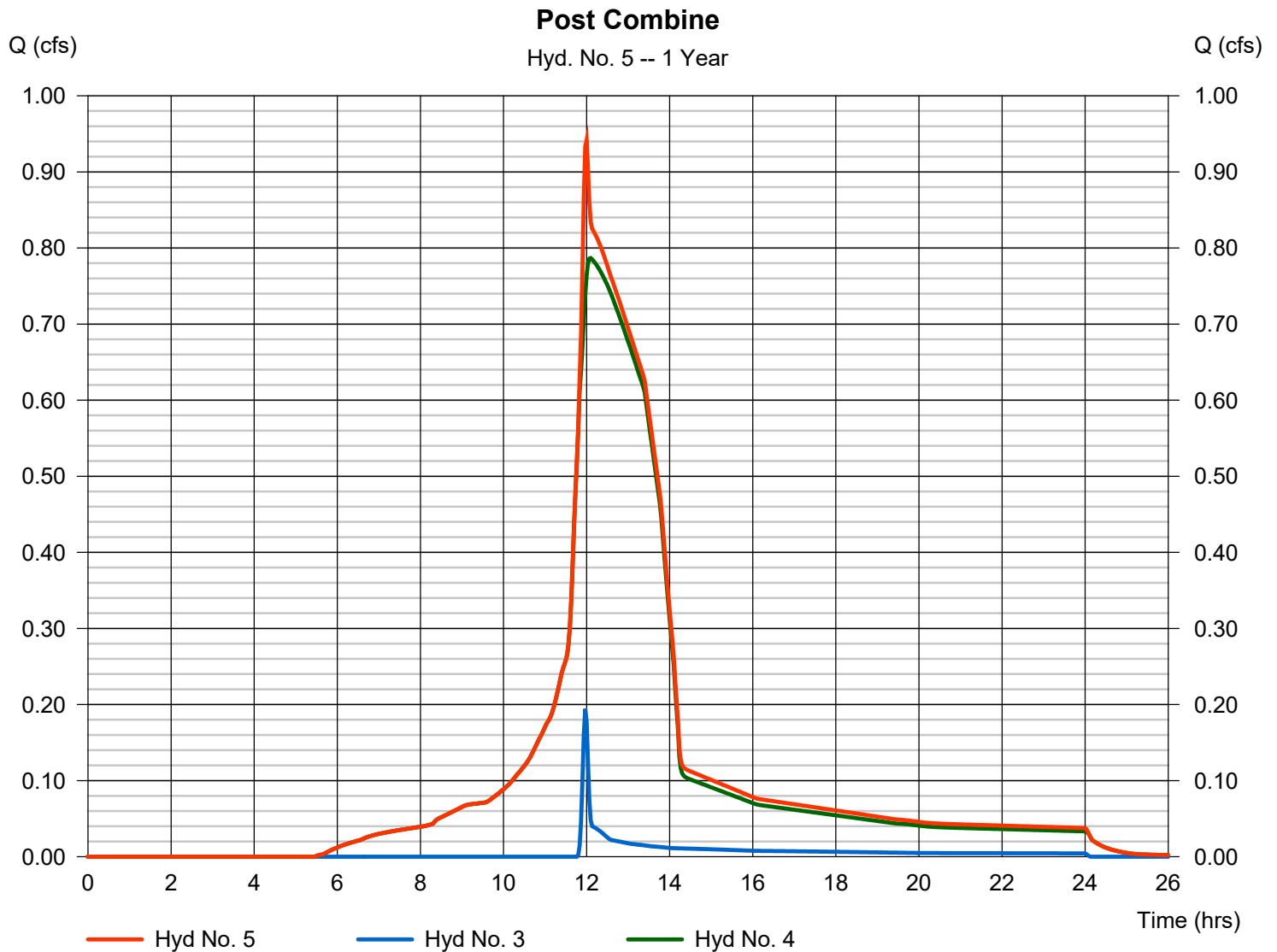
# Hydrograph Report

## Hyd. No. 5

Post Combine

Hydrograph type = Combine  
Storm frequency = 1 yrs  
Time interval = 2 min  
Inflow hyds. = 3, 4

Peak discharge = 0.941 cfs  
Time to peak = 12.00 hrs  
Hyd. volume = 9,634 cuft  
Contrib. drain. area = 0.350 ac



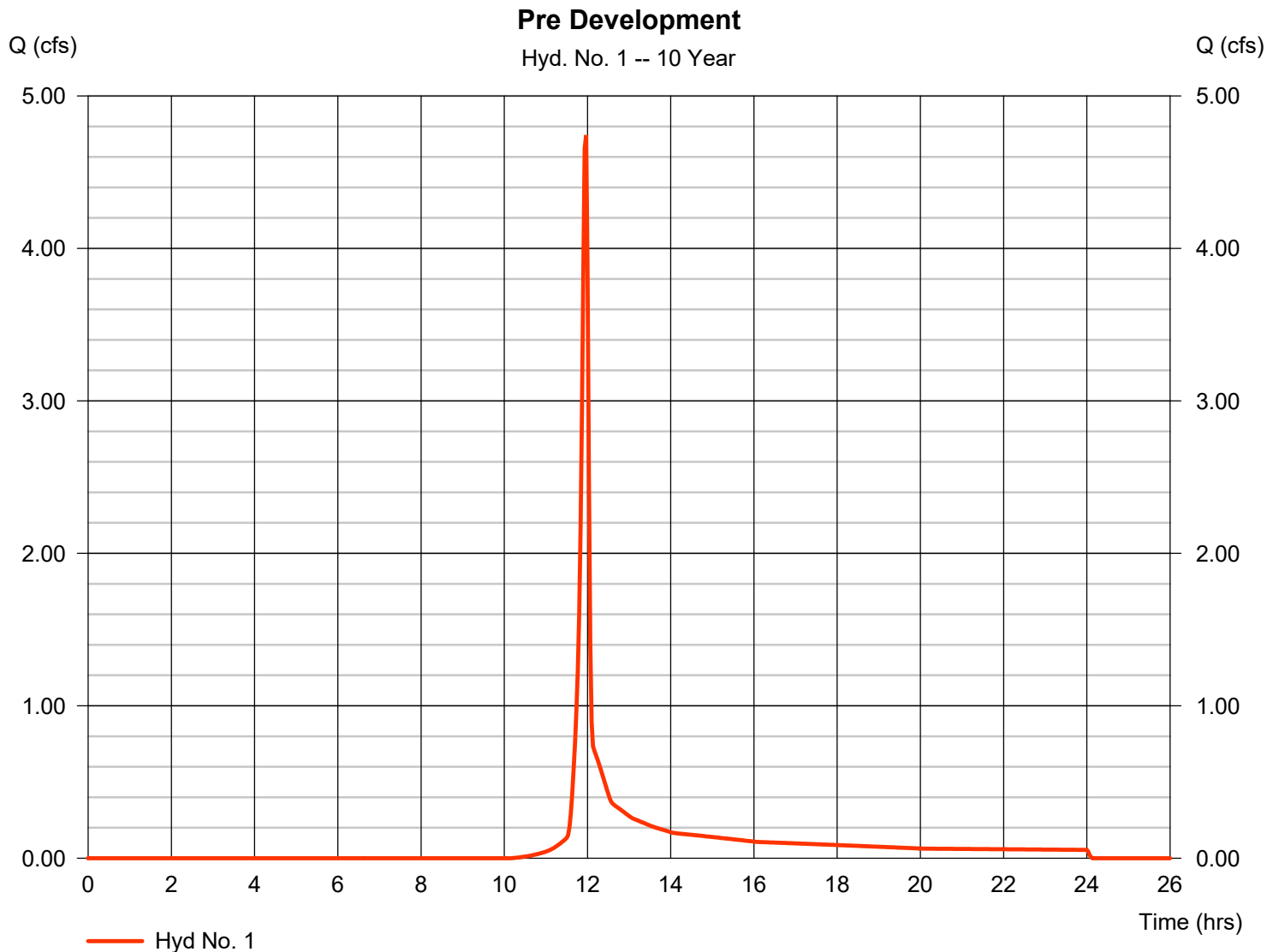


# Hydrograph Report

## 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

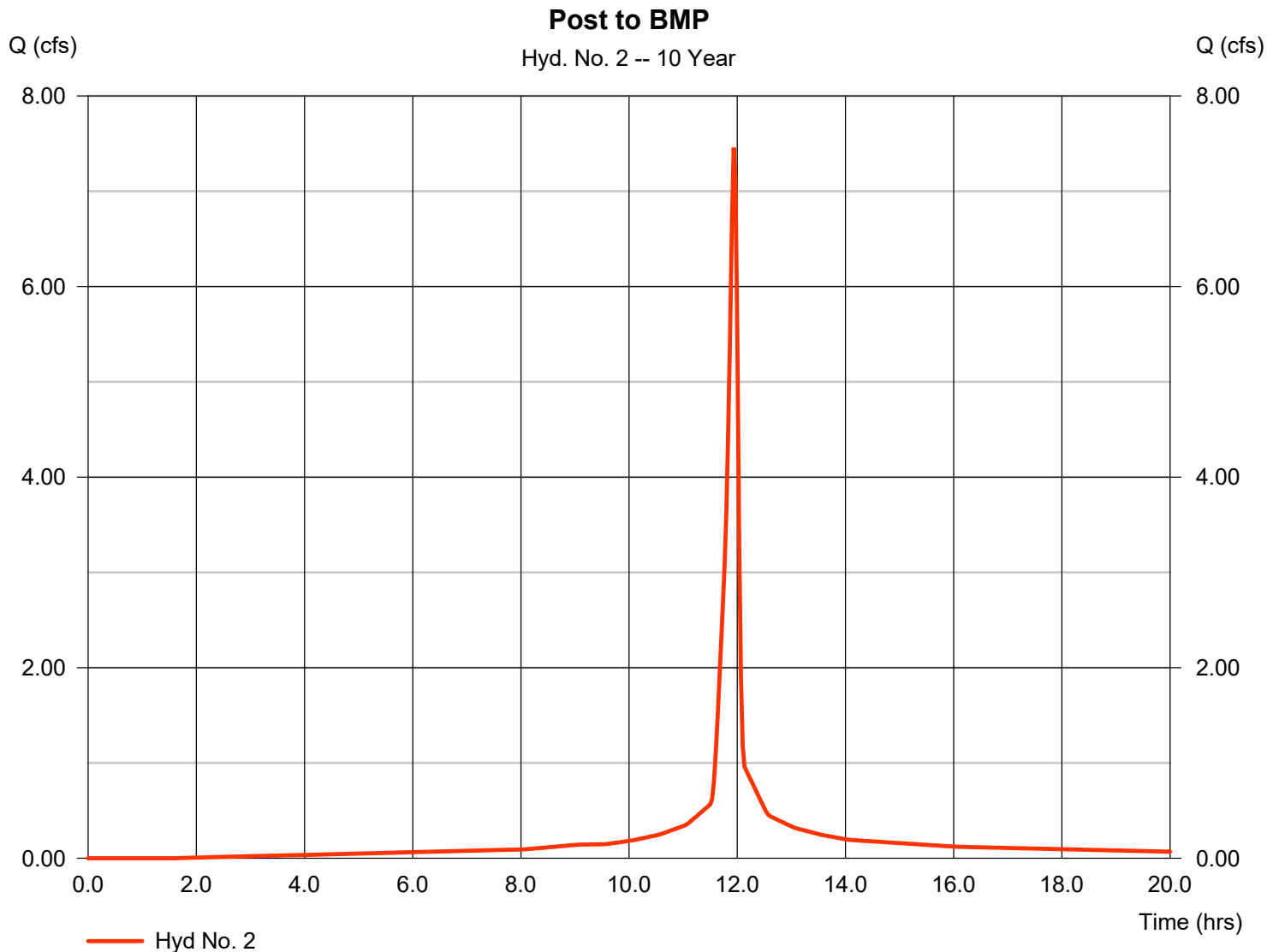


# Hydrograph Report

## 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

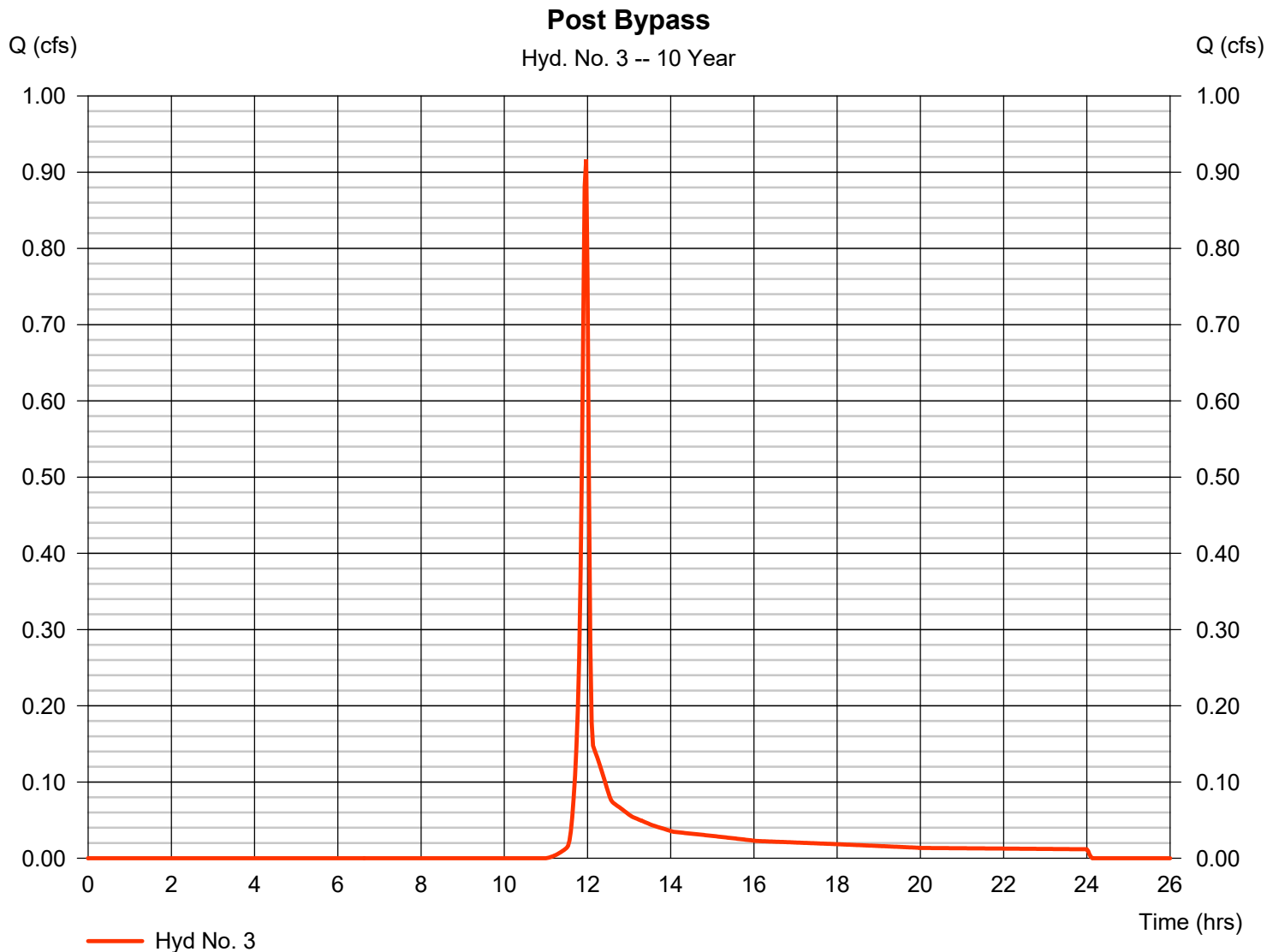


# Hydrograph Report

## 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



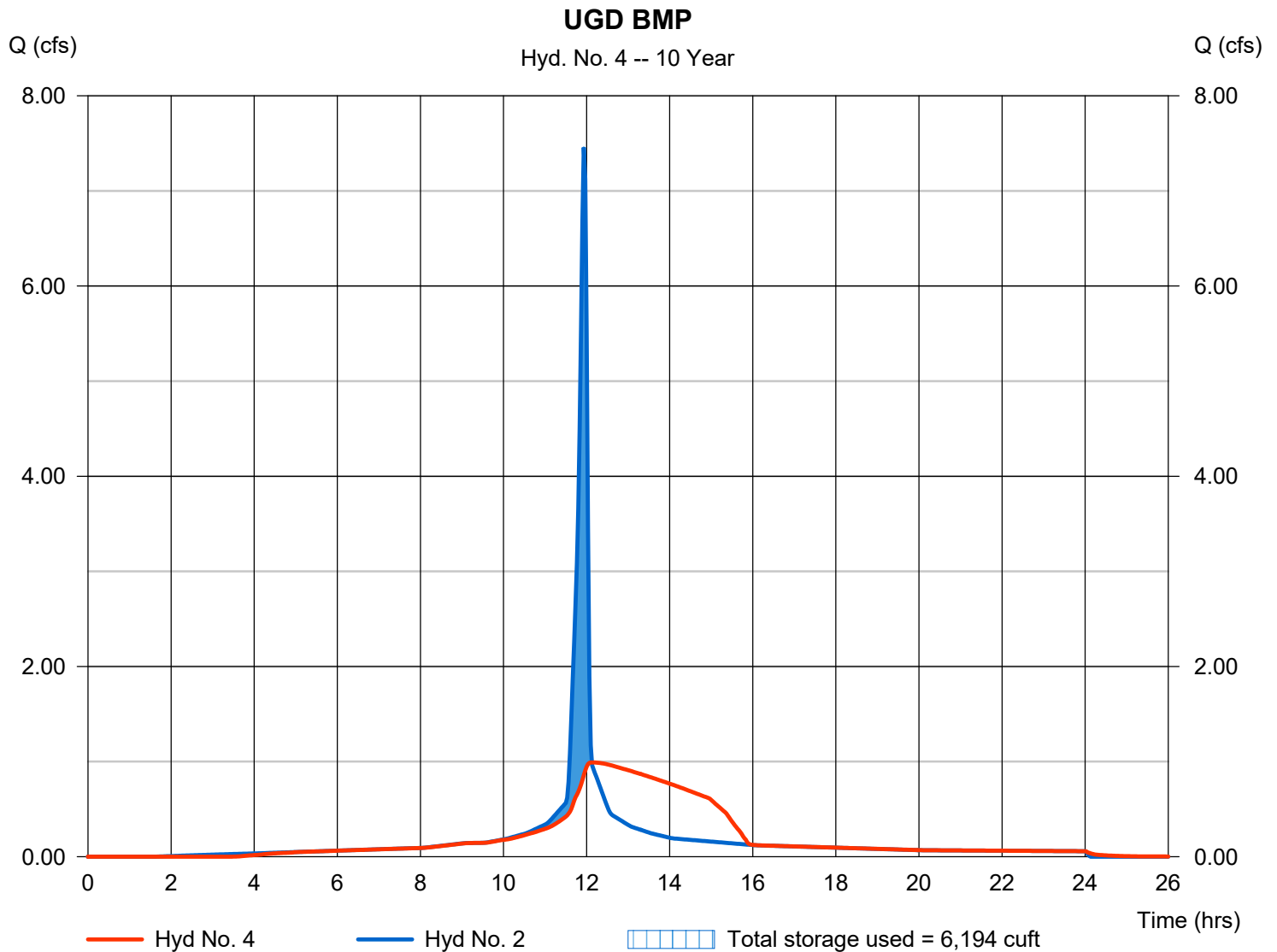
# Hydrograph Report

## 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.



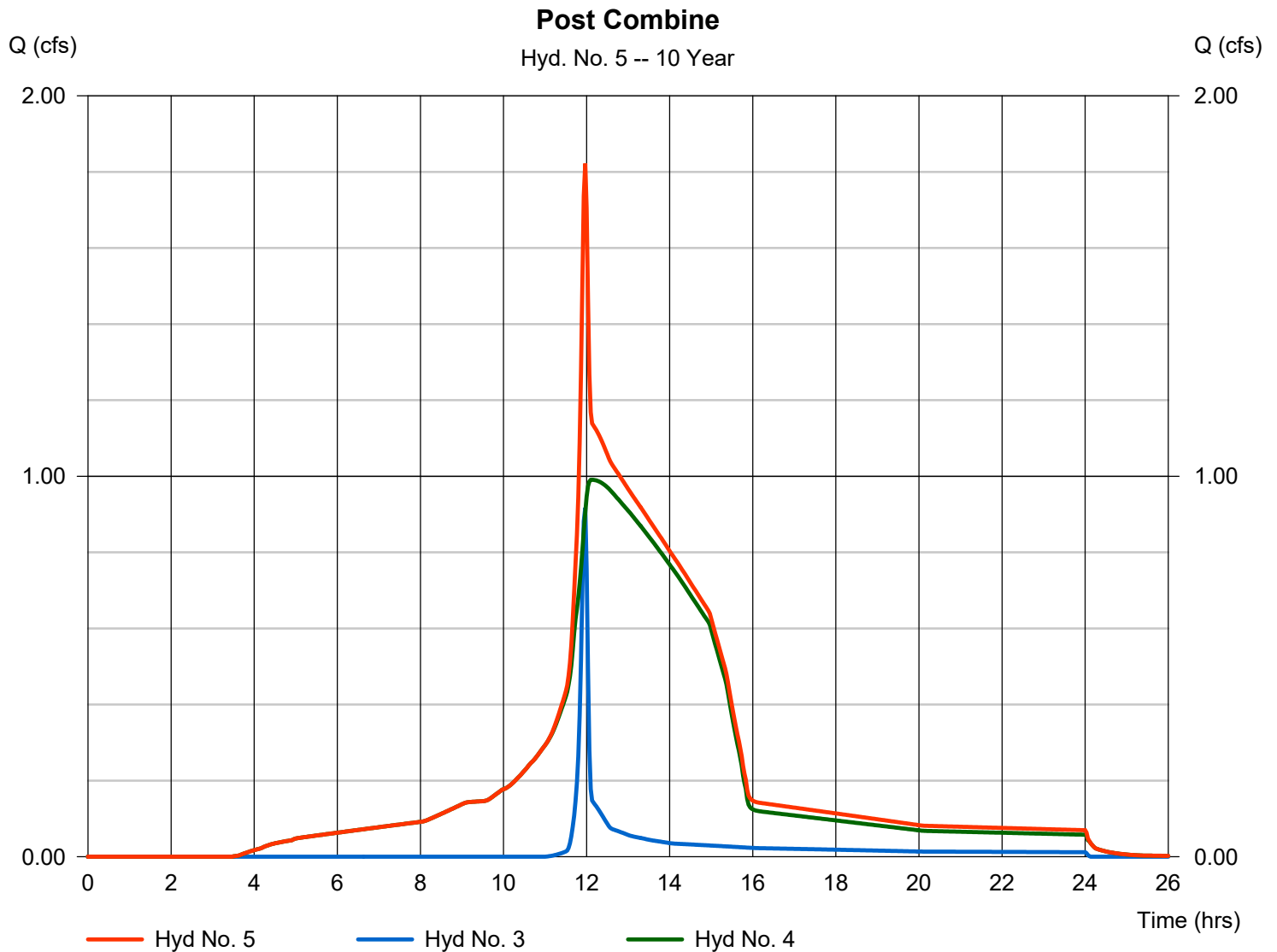
# Hydrograph Report

## Hyd. No. 5

Post Combine

Hydrograph type = Combine  
Storm frequency = 10 yrs  
Time interval = 2 min  
Inflow hyds. = 3, 4

Peak discharge = 1.822 cfs  
Time to peak = 11.97 hrs  
Hyd. volume = 18,932 cuft  
Contrib. drain. area = 0.350 ac









## 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:	<a href="mailto:Kpgettle@gmail.com">Kpgettle@gmail.com</a>
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	
<b>Commercial</b>	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																
Roof											0.67					
Open/Landscaped											0.42					
											0.19					
<b>Industrial</b>	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																
Roof																
Open/Landscaped																
<b>Transportation</b>	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																
<b>Misc. Pervious</b>	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)																
<b>Residential</b>	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)																
<b>Land Taken up by BMP</b>																
<b>JURISDICTIONAL LANDS</b>	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 $T_c$
<b>Sheet Flow</b>		
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
$T_1$ (hrs)=	0.01	0.03
<b>Shallow Flow</b>		
Length (ft)=	297.00	
Slope (ft/ft)=	7.00	
Surface Cover:	Unpaved	
Average Velocity (ft/sec)=	42.69	0.00
$T_1$ (hrs)=	0.00	0.00
<b>Channel Flow 1</b>		
Length (ft)=		315.00
Slope (ft/ft)=		0.01
Cross Sectional Flow Area (ft <sup>2</sup> )=		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
$T_1$ (hrs)=	0.00	0.01
$T_c$ (hrs)=		
<b>RESULTS</b>		
	<b>PRE-DEVELOPMENT</b>	<b>POST-DEVELOPMENT</b>
Site Impervious Surface Area (Ac) =	0.00	1.09
Lot Impervious Surface Area (Ac) =	0.00	0.00
<b>1-year, 24-hour storm (Peak Flow)</b>		
Volume of runoff (ft <sup>3</sup> ) =	1,922	11,430
Volume change (ft <sup>3</sup> ) =		9,509
Runoff (inches) = $Q^2$ =	0.3651	2.1716
Peak Discharge (cfs) = $Q$ =		
Composite Curve Number (DA) =	61	89
Composite Curve Number (Site only) =	61	89
<b>DISCONNECTED IMPERVIOUS - Credit given only to residential development with drainage area with less than 30% impervious</b>		
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 (ft <sup>3</sup> )=			
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)	
	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
<b>Commercial</b>										
Parking lot	0.67									
Roof	0.42									
Open/Landscaped	0.01									
<b>Industrial</b>										
Parking lot										
Roof										
Open/Landscaped										
<b>Transportation</b>										
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										
<b>Misc. Pervious</b>										
Managed pervious										
Unmanaged (pasture)										
Woods (not on lots)										
<b>Residential</b>										
Roadway										
Grassed Right-of-ways										
Driveway										
Parking lot										
Roof										
Sidewalk										
Lawn										
Managed pervious										
Woods (on lots)										
<b>Land Taken up by BMP</b>										
<b>JURISDICTIONAL LANDS</b>										
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	Total	Inflow P	Total	Outflow N	Total	Outflow P	Total	Provided Volume Managed (c.f.)
			EMC (mg/L)	Inflow N (lb/ac/yr)	EMC (mg/L)	Inflow P (lb/ac/yr)	N EMC (mg/L)	Outflow N (lb/ac/yr)	P EMC (mg/L)	Outflow P (lb/ac/yr)	
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		

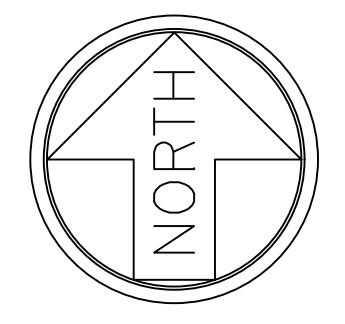
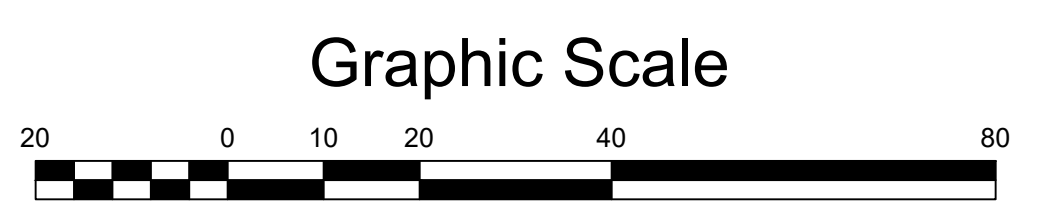
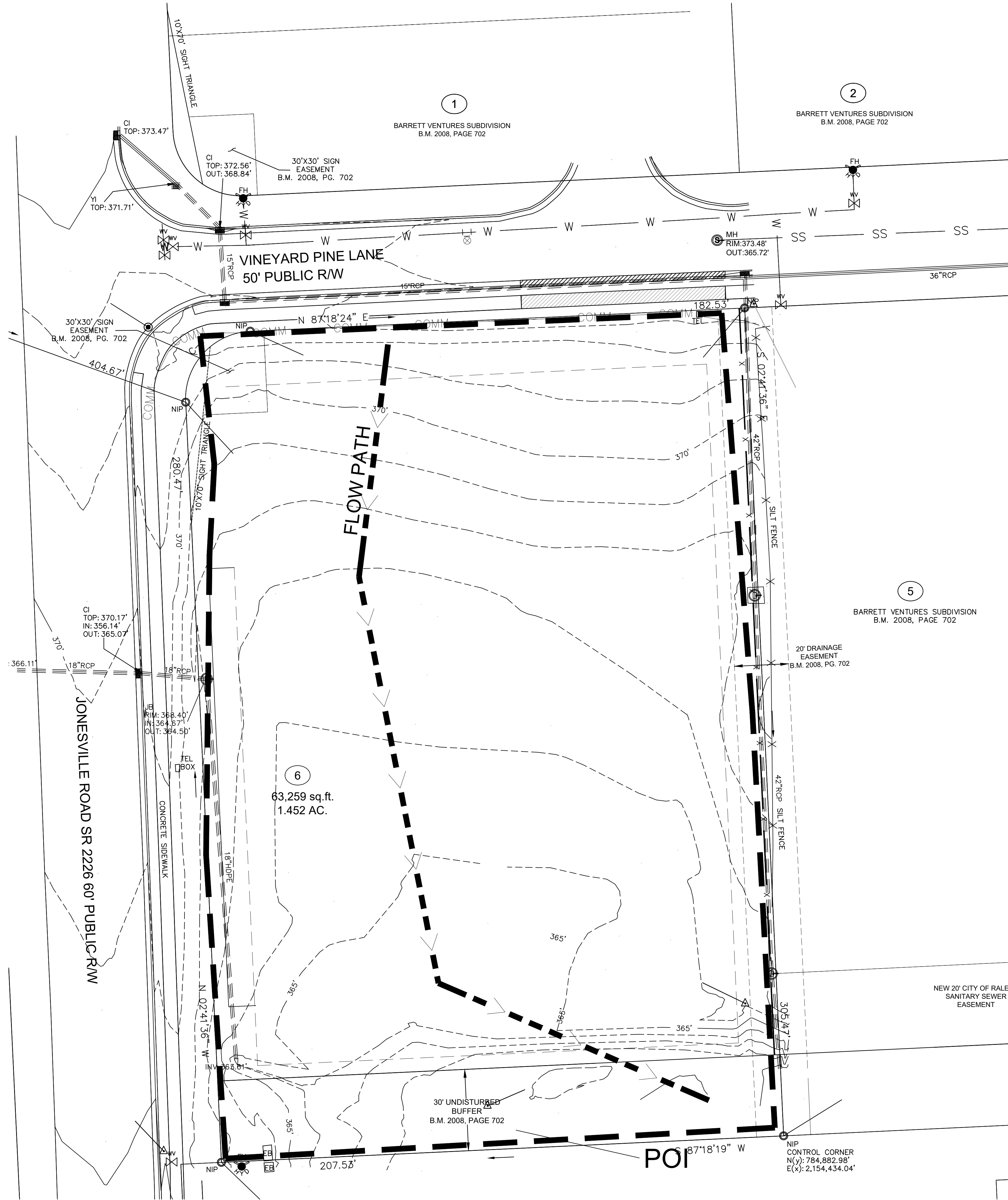
**Sub-DA1(b) BMP(s)**

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)=								
<b>Sub-DA1 (c) BMP(s)</b>											
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)=								
<b>Sub-DA1 (d) BMP(s)</b>											
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)=								
<b>Sub-DA1 (e) BMP(s)</b>											
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)=								
<b>DA1 BMP SUMMARY</b>											
Total Volume Treated (c.f.)=		0									
DA1 Outflow Total Nitrogen (lb/ac/yr)=		8.82									
DA1 Outflow Total Phosphorus (lb/ac/yr)=		1.30									
<b>1-year, 24-hour storm</b>											
Pre Development Peak Discharge (cfs)= Q <sub>1-year</sub> =											
Post BMP Peak Discharge (cfs)= Q <sub>1-year</sub> =											

Project Name: **Vineyard Pine Commercial**

**DA SITE SUMMARY**  
**BMP CALCULATIONS**

<b>BMP SUMMARY</b>						
<b>DRAINAGE AREA SUMMARIES</b>						
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6
<b>Post-Development (1-year, 24-hour storm)</b>						
Peak Flow (cfs)= $Q_{1-year}$ =						
<b>Post-Development with BMPs (1-year, 24-hour storm)</b>						
% Impervious =	75%					
Volume Managed (CF)=	0					
Post BMP Peak Discharge (cfs)= $Q_{1-year}$ =						
Have Target Curve Number Requirements been met?	N/A					
<b>Pre Development Nitrogen and Phosphorus Load</b>						
Total Nitrogen (lb/ac/yr)=	1.57					
Total Phosphorus (lb/ac/yr)=	N/A					
<b>Post Development Nitrogen and Phosphorus Load</b>						
Total Nitrogen (lb/ac/yr)=	9.90					
Total Phosphorus (lb/ac/yr)=	N/A					
<b>Post-BMP Nitrogen Loading</b>						
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

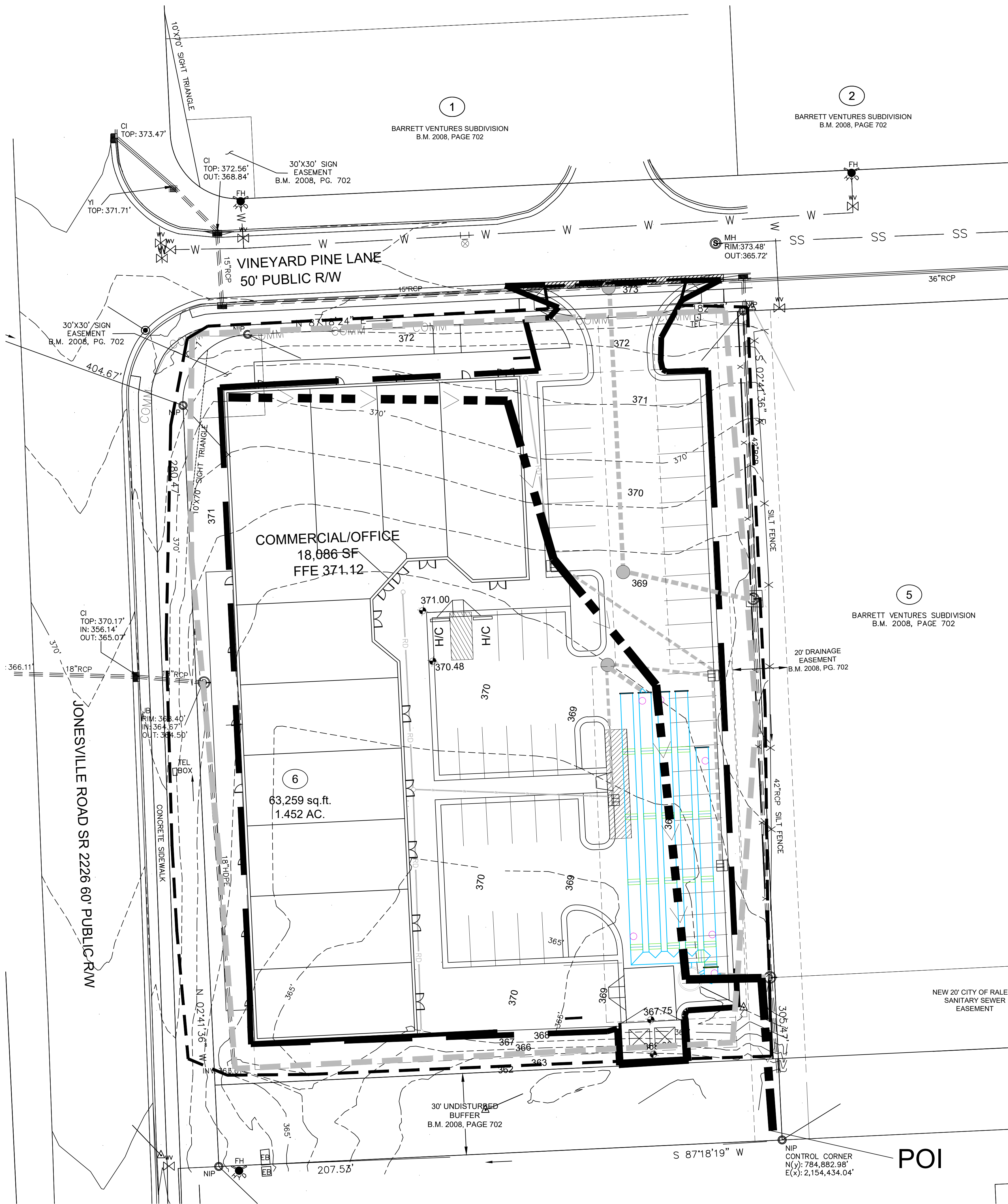
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1			
2			
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		REVISION DESCRIPTION	BY

**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
<b>Overall Site</b>	63,162.00	1.45
<b>Impervious Summary</b>		
Pre		
Parking Lot	0.00	0.00
Managed Pervious	63,162.00	1.45
<b>Total</b>		<b>1.45</b>
Post		
Parking Lot	29,394.00	0.67
Roof	18,086.00	0.42
Open Landscape	8,436.00	0.19
Managed Pervious	7,245.00	0.17
<b>Total</b>		<b>1.45</b>

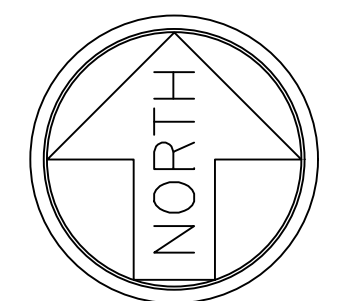
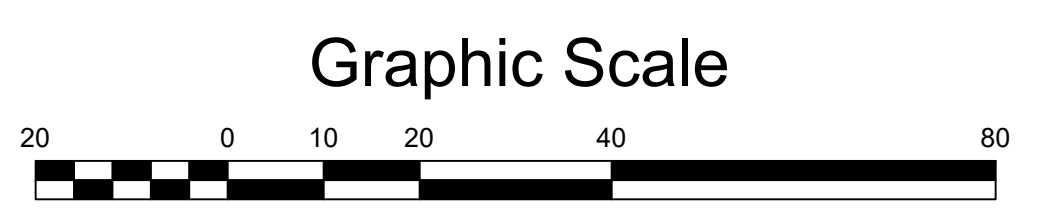
**Gettle Engineering and Design, PLLC**  
 3616 Waxwing Court,  
 Wake Forest, North Carolina 27587  
 (919) 210-3934 Firm License P-2538

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

**PRELIMINARY  
DO NOT USE FOR  
CONSTRUCTION**

**Post Drainage Map**  
 Jonesville Road Commercial  
 MRR Development, LLC  
 Rolesville, Wake County, North Carolina

Project No.  
 Dwg No.  
**EX2**



POI