

**Glade Spring Crossing Subdivision Rezoning
Stormwater Management Concept Plan
Blacksburg, VA
November 28, 2022**



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Project Description

The purpose of this project is to construct a residential subdivision along Glade Road in Blacksburg, VA. The existing site is mostly undeveloped, except for one dwelling unit and an existing stormwater detention facility. Approximately 176 new dwelling units, 5,300 LF of roadway, 4,000 LF of trail, and four stormwater management facilities are proposed in the Glade Spring Crossing (herein called GSC) development. The exact makeup of the development and the landcover will be determined during the preliminary plat and site plan stages. This stormwater management concept plan provides the general approach to meeting the stormwater management regulations given the features proposed within the greater rezoning document. As such, the calculations and flow rates presented within are preliminary in nature and subject to change.

Conceptual Stormwater Management Approach

Two points of analysis, A and B, are considered for meeting the flood and channel protection regulatory requirements described in 9VAC25-870-66. The channel protection requirement of 9VAC25-870-66.B.3.a. is applied to Points of Analysis A and B to demonstrate regulatory compliance. The “energy balance” equation in this subsection is applied to the onsite runoff areas to determine the allowable peak flow rate during the 1-year, 24-hour design storm. The difference between the predevelopment peak and the allowable is the reduction required at the respective point of analysis. This “required reduction” is subtracted from the total predevelopment peak flow rate (which includes both onsite and offsite runoff) to determine the actual allowable total peak flow rate at the point of analysis post-development during the design storm.

Flood protection compliance is demonstrated by applying 9VAC25-870-66.C.2.b. to each point of analysis. This subsection requires that the post-development peak flow rate of the 10-year, 24-hour design storm is less than that the predevelopment peak flow rate at the point of analysis. Both the channel and flood protection requirements are met through the construction of four stormwater management facilities.

Of the four proposed stormwater management facilities, three are proposed in support of the goal of providing regional stormwater improvements in the Toms Creek watershed. An unnamed tributary to the Shadow Lakes Tributary, which is identified on FEMA FIRM Panel 0127C, conveys urban runoff through the center of the site. Further analysis of the regional flood reduction benefits to the unnamed tributary is available in a separate document entitled “Preliminary Analysis of Regional Stormwater Management Improvements as Part of the Glade Spring Crossing Subdivision.” The contributing drainage area exceeds 100 acres and thus is subject to the Town of Blacksburg Flood Hazard Overlay and Creek Valley Overlay. An analysis of the 100-year floodplain, Flood Hazard Overlay, and Creek Valley Overlay is provided in the document “Glade Spring Crossing Subdivision Rezoning Submission: Floodplain Calculations.”

These three regional stormwater management facilities also serve the proposed development and assist in meeting flood and channel protection regulatory requirements described in 9VAC25-870-66. at Point of Analysis A. The three ponds, identified as Ponds A, B, and C, discharge to the existing natural channel running through the site and exiting at the Point of Analysis. While Pond A is identified as a proposed facility, it shares the location of the existing detention facility located on the site. Upgrades to this facility are proposed as part of the GSC development. The proposed upgrades include

excavation to increase storage volume, modification of the embankment, a new outlet structure, and new discharge culvert. Pond A is proposed to remain a dry detention facility.

Pond B and Pond C act in series to reduce the peak discharge into the receiving channel. The contributing drainage area of Pond B is mostly made up of offsite upstream urban runoff. Pond B is proposed to perform as a dry detention facility, throttling offsite flow before discharging to Pond C. Pond C is proposed to perform as a wet pond, constructed to the Virginia Stormwater BMP Clearinghouse specification for Practice 14: Wet Ponds. Wet ponds built to this specification remove Total Phosphorus mass load from the contributing drainage area runoff. As such, Pond C is utilized to meet the GSC water quality obligations described in 9VAC25-870-63.

The final stormwater management facility is identified as SWM Area D. This facility serves to meet the water quantity requirements in the small drainage area discharging to the Shadow Lake Road roadside ditch, Point of Analysis B. The design and configuration of this facility is likely to change during the preliminary plat and site plan process, as it is in close proximity to existing and proposed utilities as well as a proposed trail and existing driveway. Point of Analysis B currently meets the channel and flood protection requirements without the construction of a BMP; however, during preliminary plat and site design, additional analysis may show the need for a BMP, such as a dry swale, check dams, level spreader, or underground detention.

Drainage Pattern Summary

A natural drainage way is present on the site in the existing condition. The drainage way receives offsite runoff from the University Boulevard, Glade Road, Village Way South, and Broce Drive areas. These areas are heavily developed, with land uses including commercial, 1/4-to-1/3-acre lot single family residential, and high density residential (apartments, townhomes). Most of the offsite runoff enters the site from one of two existing culverts under the US 460 Bypass: a “northern” culvert (48” CMP) and “southern” culvert (36” CMP). An existing detention pond maintained by the Town of Blacksburg is present on the parcel. This pond primarily receives runoff from the “northern” culvert and the adjacent Village at Toms Creek “common area” (tax map number 225-16-A). The runoff from the “southern” culvert is currently undetained and flows freely through the drainage way to the downstream property line. Additional runoff from “The Farm” (tax map number 225-A-5) and the Village at Toms Creek Phase 1, detention pond 1 contribute to the total flow rate at the property line. The combined flow at this point results in downstream flooding in the existing condition. This combined flow accounts for the predevelopment upstream stormwater improvements and ongoing land development projects. These include “The Union” and “The Farm” apartments and their associated underground detention facilities.

To address this flooding, stormwater management improvements are proposed on the 225-A-3 (Glade Spring Crossing) parcel. These include upgrades to the existing Town of Blacksburg detention pond (Pond A), construction of a new dry detention pond to detain flow from the “southern” culvert (Pond B), and construction of a new wet pond to the VA DEQ design specification 14 standard (Pond C). These measures combine to reduce the peak flow rate leaving in the natural drainage way during the 1-year and 10-year, 24-hour storm events. Furthermore, it is shown in a separate document that the water surface elevation of the 100-year floodplain is not increased in the post-development condition.

Methodology

Four designed existing detention facilities are present in the upstream offsite contributing drainage area. Two are located at “The Union” apartment development on University City Boulevard. The third is located at “The Farm” apartment development on Glade Road. The fourth located at the Village at Toms Creek. Engineering calculations for those developments were utilized in determining the peak flow rate during the existing condition. While not designed to serve as detention, both the “northern” and “southern” culverts under US 460 detain flows upstream of the site. Both culverts have been modeled as detention basins to determine accurate flow rates entering the site. The runoff discharged from the “northern” culvert is combined with other contributing areas to be routed through the existing Town of Blacksburg detention pond. Channel routing is performed on the Town of Blacksburg pond, the “southern” culvert discharge, “The Farm” development, and other contributing areas to the discharge point of the site, where it is combined with the Village pond discharge to determine the total peak flow rate in the existing condition.

The same offsite runoff from across the 460 culverts, the Village, and “The Farm” is utilized to determine the peak flow rate after the proposed stormwater management improvements. Contributing onsite future development is calculated and added to the new stormwater improvements. Runoff resulting from onsite development is determined by measuring the proposed impervious area of the proposed roads, sidewalks, and trails. Additional impervious area associated with the dwelling units is estimated by multiplying the average impervious area of a dwelling unit type with the number of units present in a particular drainage area.

Two different unit classifications are proposed on the development: North/Glade side and South/Village side units. The tables below detail the assumed dwelling unit impervious areas for each side. Note that driveways are included in the assumed impervious area. North units are assumed to be present on lots north of the drainageway through the site, whereas south units are assumed to be present south of the drainageway. The sum of the measured and estimated impervious areas is used to develop curve numbers (CNs) for each drainage area.

North/Village Side Units		South/Glade Side Units	
Typical Unit Impervious Footprint	Area (sf)	Typical Unit Impervious Footprint	Area (sf)
48'x48' (incl. variable porch)	2304	18'x35' (incl. 18'x5' porch)	630
45'x63' (incl. variable porch)	2835	28'x30' (incl. 28'x6' porch)	840
Average	2570	24'x34' (incl. 24'x6' porch)	816
		Average	770
Typical 20'x37' Driveway (total to EP)	740		
Typical 12'x12' Deck	144	Typical 18'x34' Driveway (total to back of curb)	612
Total Typical Impervious Area per Unit (average+driveway+deck)	3454	Total Typical Impervious Area per Unit (average+driveway)	1382

“Northern” runoff is routed through the upgraded Town of Blacksburg pond (Pond A). The proposed dry pond (Pond B) and wet pond (Pond C) are intended to operate in series in the southern drainage way through the site. Runoff from the “southern” culvert discharge, “The Farm,” and other onsite areas is routed through Pond B. The Pond B discharge is combined with other contributing drainage areas to Pond C. This combined flow is routed through the wet pond. The wet pond (Pond C) discharge, Town of Blacksburg upgraded pond (Pond A) discharge, and other contributing undetained areas are

channel routed to the point of discharge from the site where it is combined with the Village pond discharge to determine the peak flow rate after construction of the stormwater management improvements.

Given the location of the Creek Valley Overlay, the proposed improvements must be placed on the upstream side of the site and away from the point of discharge. As such, portions of the 225-A-3 (Glade Spring Crossing) parcel/site are not being detained by the stormwater management facilities. Developed undetained areas are shown to have minimal impact on the peak flow rate at the point of discharge from the property line.

Summary of Stormwater Compliance Results

The table below summarizes the allowable peak flow rates at each point of analysis and after the proposed GSC stormwater improvements. Both the allowable and postdevelopment flow rates are inclusive of the offsite runoff entering the site. New development is assumed to occur onsite at an average density of 4 units per acre and drain to the proposed stormwater management facilities. Other onsite areas that do not drain to the facilities are assumed to be developed at the same density as the adjacent areas draining to the BMPs. The table also describes the water quality benefits from the stormwater improvements in the form of total phosphorus (TP) reduction. Note that the flow rates and TP reductions below are preliminary in nature and subject to change pending complete engineering design.

Preliminary Stormwater Improvement Summary*				
Water Quantity				
Point of Analysis		Allowable peak flow rate (Q_{allow})	Postdev. Actual peak flow rate (Q_{post})	Regulations met?
A	1-year peak flow rate	75.45 cfs	24.83 cfs	$Q_{post} < Q_{allow} \therefore$ Yes
	10-year peak flow rate	175.77 cfs	90.38 cfs	$Q_{post} < Q_{allow} \therefore$ Yes
B	1-year peak flow rate	1.43 cfs	1.08 cfs	$Q_{post} < Q_{allow} \therefore$ Yes
	10-year peak flow rate	5.66 cfs	4.30 cfs	$Q_{post} < Q_{allow} \therefore$ Yes
Water Quality				
Target TP load reduction		TP load reduction achieved (after SWM improvements)		Excess TP load reduction relative to target
26.53 lb/yr		39.02 lb/yr		+12.49 lb/yr
*Note: All numbers are preliminary and subject to change during preliminary plat and site plan engineering design.				

Town of Blacksburg Flood Hazard Overlay and Creek Valley Overlay

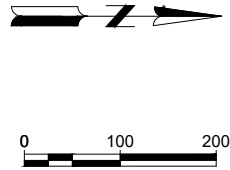
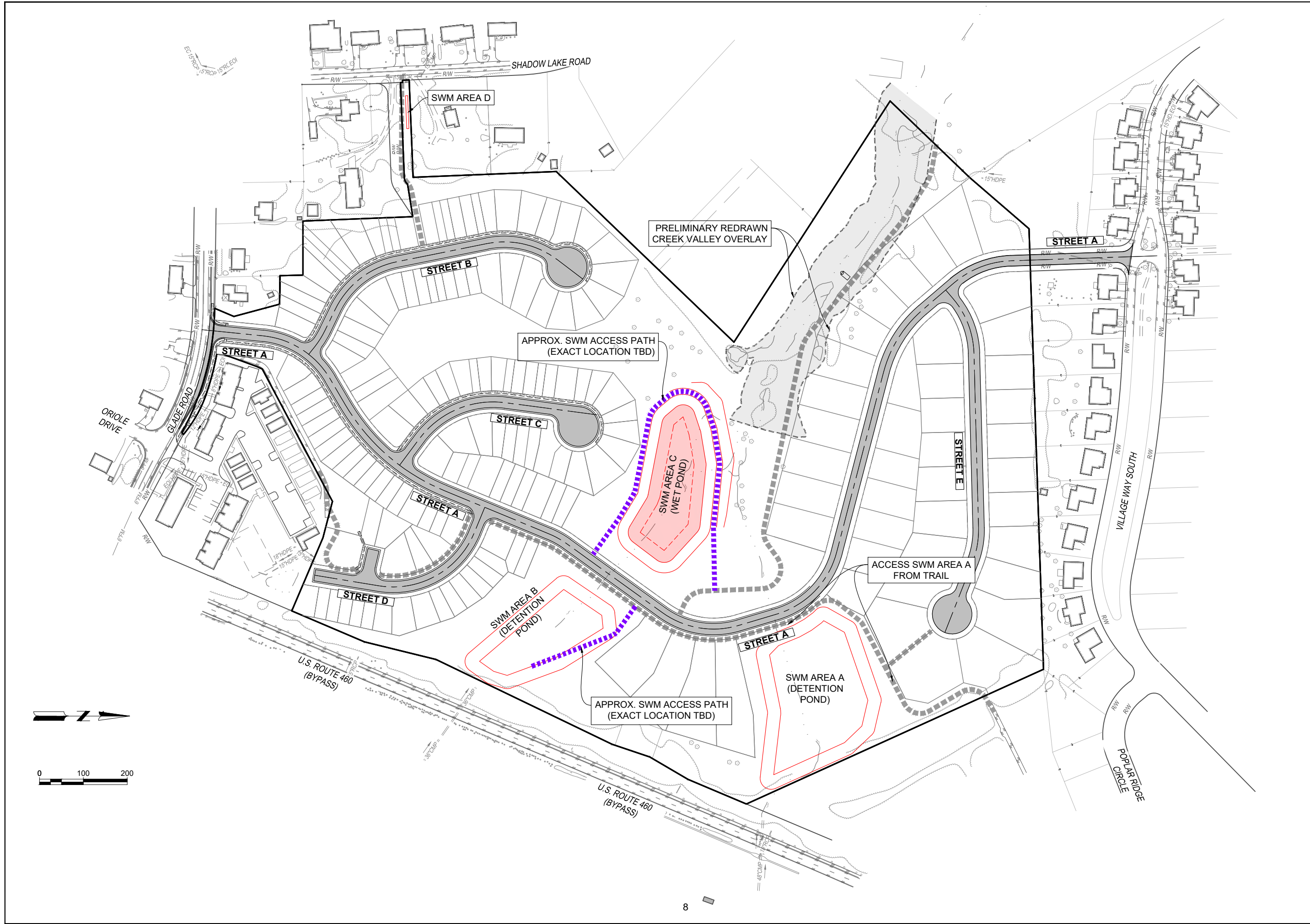
No flood study is on record establishing the 100-year base flood water surface elevation within the existing drainage way. As such, in pursuance of Section 3243(b) of the zoning ordinance, the engineer prepared a preliminary floodplain study to delineate the existing floodplain and the subsequent Flood Hazard Overlay (FHO) and Creek Valley Overlay (CVO). This flood study is provided in a separate document. The engineer proposes that the FHO be defined as the floodplain shown within the flood study. A final delineation study of the floodplain and CVO will be prepared during the preliminary plat process for Town approval.

The CVO limits are proposed to be modified as part of this project, pursuant to Section 3231. The calculated 100-year floodplain is utilized as the basis for the redefined CVO. The new CVO includes areas within the floodplain, areas within 50 feet of the channel centerline, and adjacent slopes 25% or steeper. Slopes were confirmed by the topographic survey dated 4/28/2022 sealed by a licensed land surveyor. The resulting CVO is depicted in this stormwater management analysis and in the rezoning documents.

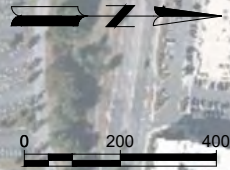
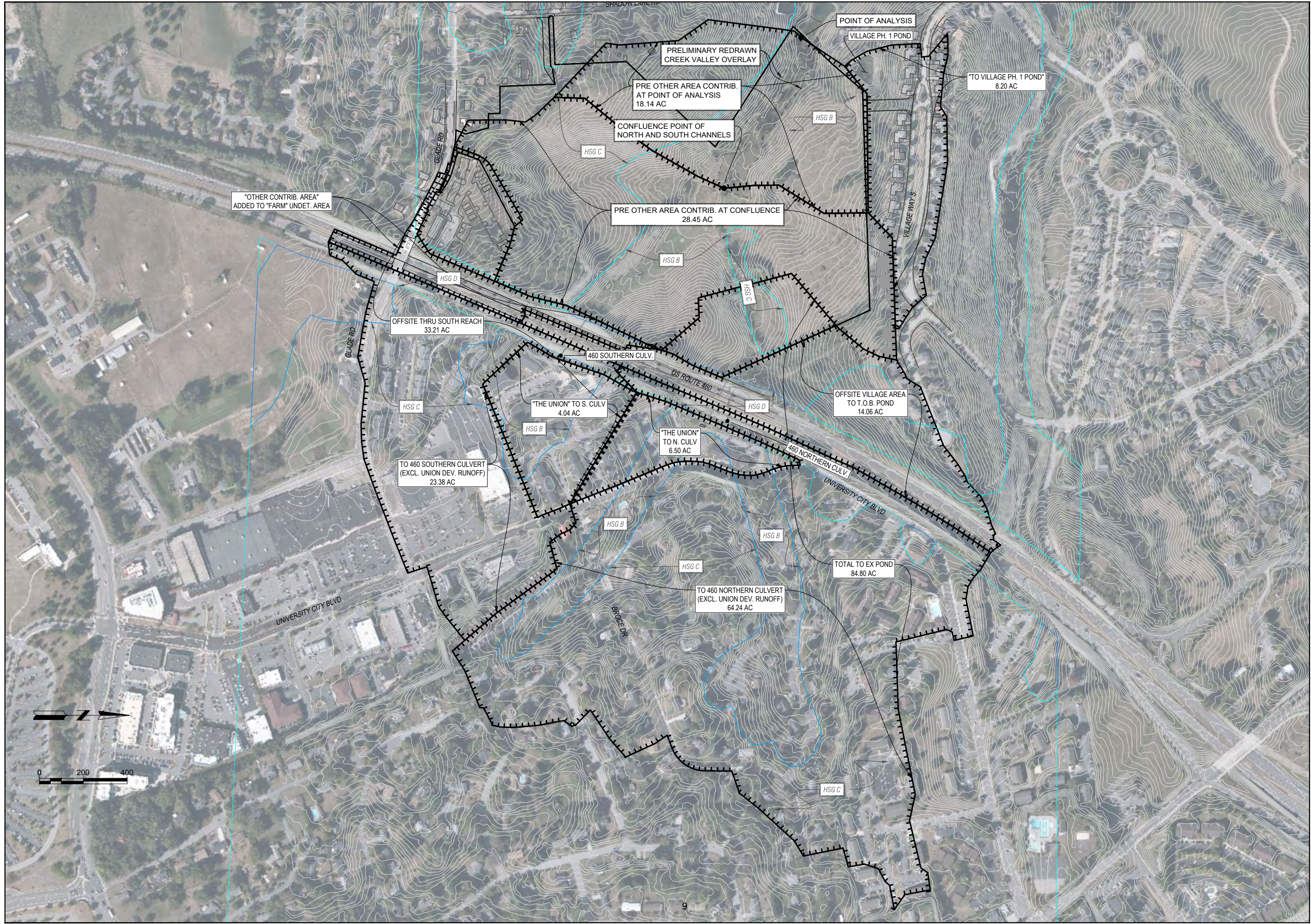
The study further documents that the proposed Glade Spring Crossing development and stormwater management improvements do not result in an increase in the water surface elevation at any point along the analyzed floodplain. The preliminary redrawn Creek Valley Overlay is compared to the existing CVO in Appendix A.

Wetlands and Jurisdictional Waters

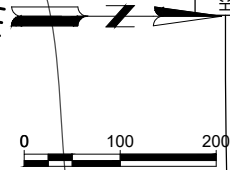
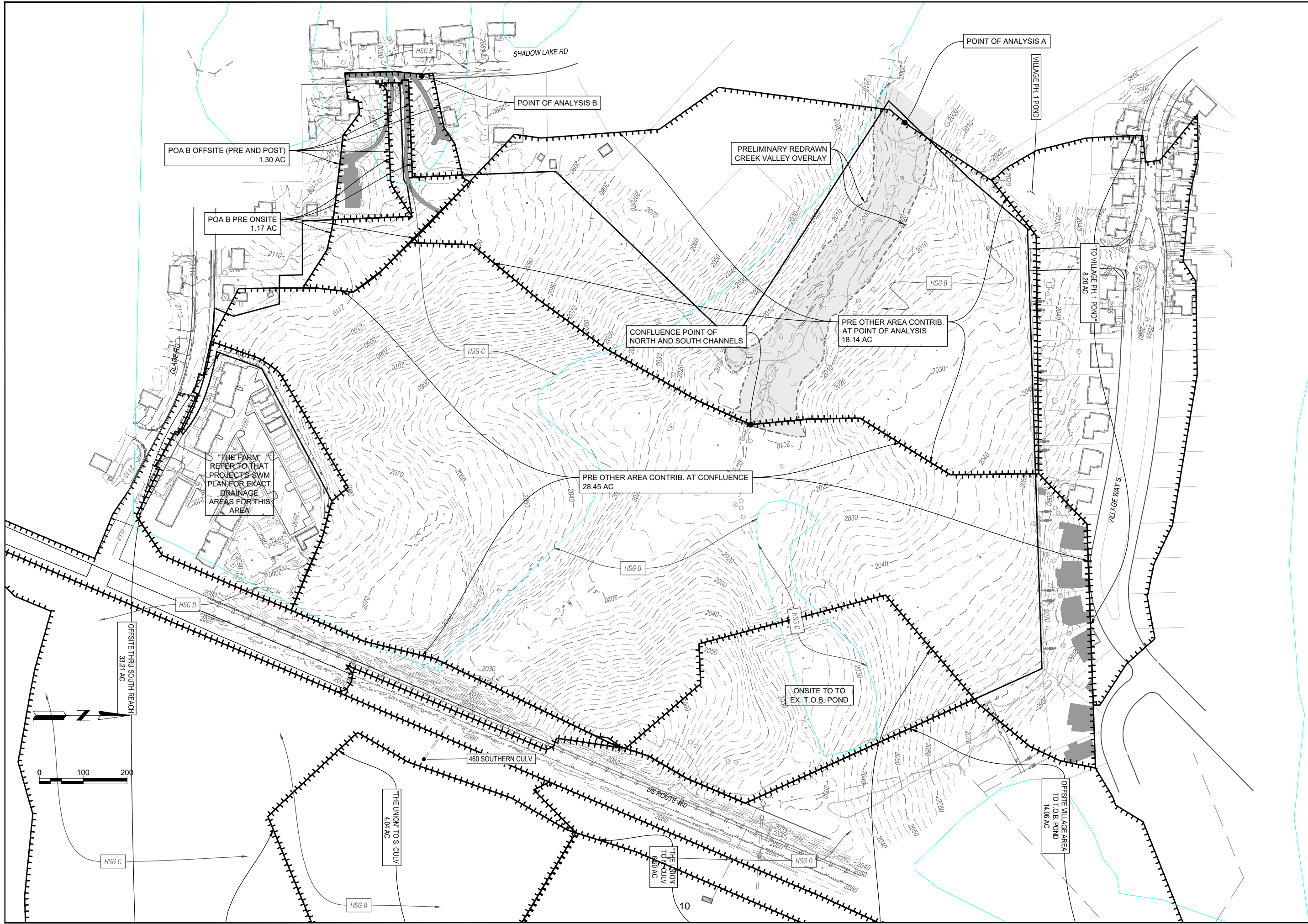
A preliminary wetland delineation and jurisdictional water evaluation performed has been performed prior to the proposed project. Five areas have been identified as possible wetlands on the site. Pond C on this plan will impact one of the identified wetlands. A map depicting the preliminary wetlands and jurisdictional waters is included in Appendix B. Note that these areas are preliminary and have not yet been confirmed by the US Army Corps of Engineers.



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<p>PRELIMINARY</p>	
<p>STORMWATER MANAGEMENT AREAS EXHIBIT</p>	
<p>PROPOSED DEVELOPMENT OF GLADE SPRING CROSSING PROPERTY OF GLADE HGTS, LLC - TAX PARCELS 225-(A)-3, 225-(A)-4, & 224-(A)-57, 45.0976 AC. TOWN OF BLACKSBURG - PRICES FORK DISTRICT MONTGOMERY COUNTY, VIRGINIA</p>	
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Sheet No. 1 of 1	SWM

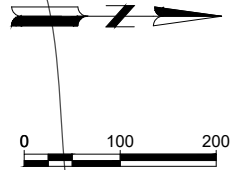
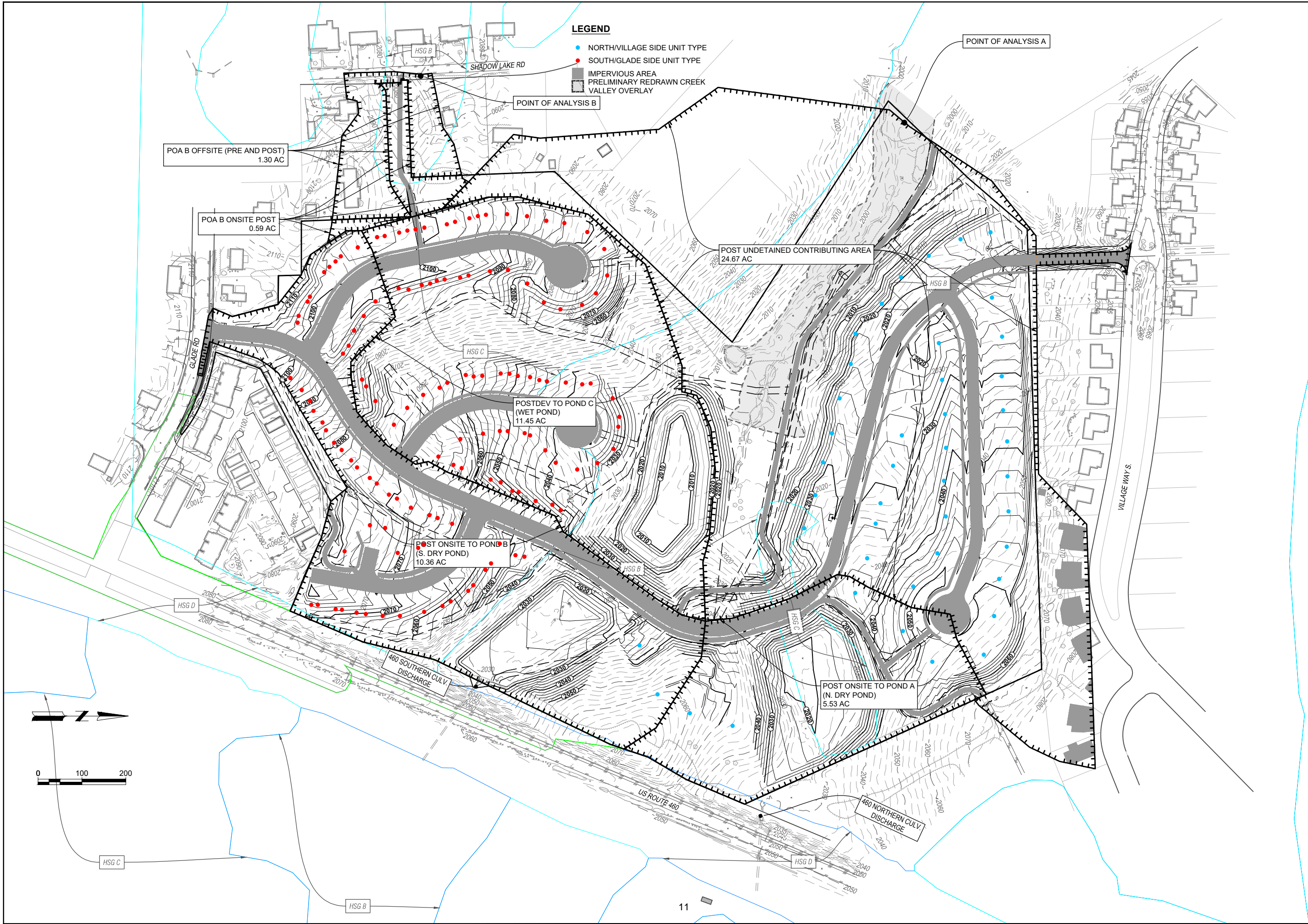


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<p>PRELIMINARY</p>		
<p>PREDEVELOPMENT OFFSITE CONTRIBUTING DRAINAGE AREAS</p>		
<p>PROPOSED DEVELOPMENT OF GLADE SPRING CROSSING PROPERTY OF GLADE HGTS, LLC - TAX PARCELS 225-(A)-3, 225-(A)-4, & 224-(A)-57 - 45,0976 AC. TOWN OF BLACKSBURG - PRICES FORK DISTRICT MONTGOMERY COUNTY, VIRGINIA</p>		
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No.	Revision / Issue	Date
PRELIMINARY		
PROPOSED DEVELOPMENT OF GLADE SPRING CROSSING PREDEVELOPMENT ONSITE DRAINAGE AREAS		
PROPOSED DEVELOPMENT OF GLADE SPRING CROSSING PROPERTY OF GLADE HGTS, LLC - TAX PARCELS 225-(A)-3, 225-(A)-4, & 224-(A)-57 - 45,0976 AC. TOWN OF BLACKSBURG - PRICES FORK DISTRICT MONTGOMERY COUNTY, VIRGINIA		
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PRELIMINARY	
POSTDEVELOPMENT ONSITE DRAINAGE AREAS	
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Sheet No. 1 of 1	D3



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

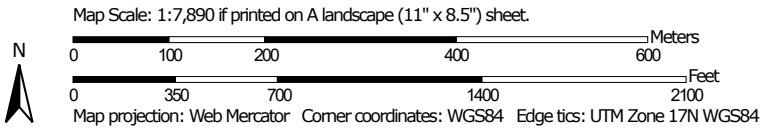
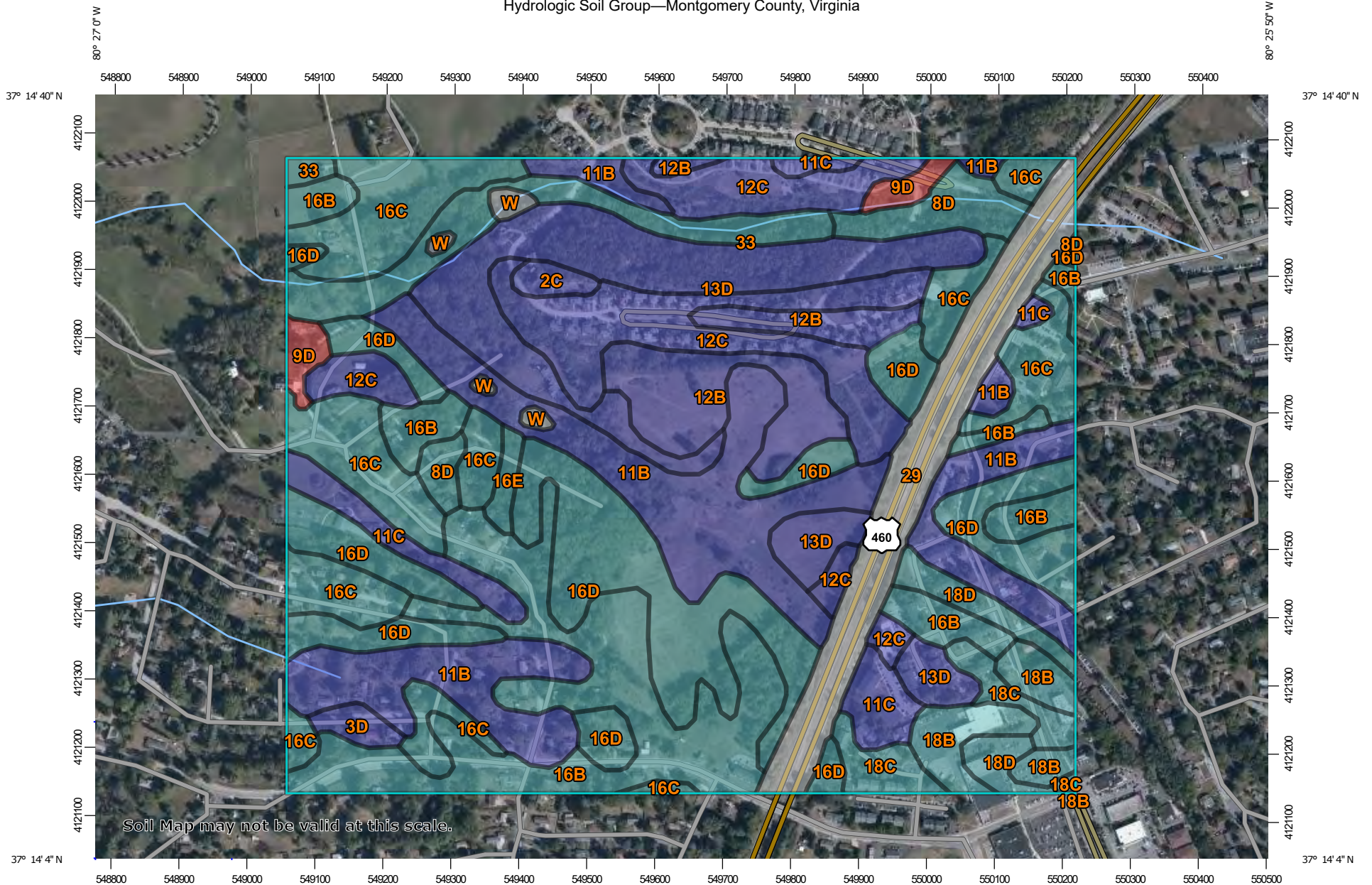
[PF_tabular](#) | [PF_graphical](#) | [Maps & aerials](#)

PF tabular

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	0.294 (0.267-0.326)	0.351 (0.318-0.389)	0.421 (0.380-0.466)	0.471 (0.424-0.521)	0.533 (0.476-0.589)	0.575 (0.510-0.636)	0.616 (0.542-0.684)	0.653 (0.569-0.729)	0.697 (0.599-0.785)	0.729 (0.618-0.827)
10-min	0.470 (0.426-0.520)	0.561 (0.508-0.622)	0.674 (0.609-0.746)	0.754 (0.679-0.833)	0.849 (0.759-0.938)	0.915 (0.812-1.01)	0.979 (0.861-1.09)	1.03 (0.902-1.16)	1.10 (0.947-1.24)	1.15 (0.973-1.30)
15-min	0.588 (0.533-0.651)	0.706 (0.639-0.782)	0.853 (0.771-0.944)	0.953 (0.859-1.05)	1.08 (0.962-1.19)	1.16 (1.03-1.28)	1.24 (1.09-1.37)	1.31 (1.14-1.46)	1.39 (1.19-1.56)	1.44 (1.22-1.63)
30-min	0.806 (0.731-0.892)	0.975 (0.882-1.08)	1.21 (1.10-1.34)	1.38 (1.24-1.53)	1.59 (1.43-1.76)	1.75 (1.55-1.93)	1.90 (1.67-2.11)	2.03 (1.77-2.27)	2.21 (1.90-2.49)	2.33 (1.98-2.65)
60-min	1.00 (0.911-1.11)	1.22 (1.11-1.36)	1.55 (1.40-1.72)	1.80 (1.62-1.99)	2.12 (1.90-2.35)	2.37 (2.10-2.62)	2.61 (2.30-2.90)	2.85 (2.48-3.18)	3.17 (2.72-3.57)	3.41 (2.89-3.86)
2-hr	1.17 (1.06-1.29)	1.42 (1.29-1.57)	1.81 (1.64-1.99)	2.10 (1.90-2.32)	2.49 (2.23-2.75)	2.79 (2.49-3.09)	3.10 (2.73-3.44)	3.40 (2.97-3.80)	3.81 (3.27-4.29)	4.11 (3.48-4.67)
3-hr	1.25 (1.14-1.38)	1.52 (1.38-1.67)	1.92 (1.75-2.11)	2.23 (2.02-2.46)	2.65 (2.38-2.91)	2.97 (2.65-3.28)	3.30 (2.92-3.65)	3.64 (3.18-4.05)	4.08 (3.50-4.59)	4.42 (3.74-5.02)
6-hr	1.53 (1.42-1.68)	1.85 (1.71-2.02)	2.31 (2.13-2.53)	2.69 (2.46-2.94)	3.20 (2.91-3.51)	3.62 (3.26-3.97)	4.06 (3.60-4.47)	4.52 (3.95-5.00)	5.16 (4.41-5.76)	5.66 (4.75-6.39)
12-hr	1.86 (1.72-2.03)	2.23 (2.06-2.44)	2.78 (2.57-3.04)	3.25 (2.98-3.54)	3.91 (3.54-4.26)	4.46 (3.99-4.87)	5.05 (4.46-5.54)	5.69 (4.94-6.28)	6.62 (5.59-7.40)	7.39 (6.11-8.34)
24-hr	2.26 (2.10-2.44)	2.73 (2.54-2.94)	3.47 (3.22-3.73)	4.06 (3.77-4.37)	4.93 (4.54-5.29)	5.65 (5.18-6.07)	6.44 (5.85-6.90)	7.28 (6.56-7.82)	8.51 (7.56-9.16)	9.54 (8.39-10.3)
2-day	2.68 (2.51-2.89)	3.25 (3.03-3.50)	4.09 (3.80-4.40)	4.78 (4.43-5.13)	5.75 (5.30-6.17)	6.55 (6.01-7.03)	7.41 (6.75-7.95)	8.32 (7.52-8.94)	9.63 (8.60-10.4)	10.7 (9.46-11.6)
3-day	2.85 (2.67-3.07)	3.45 (3.22-3.71)	4.33 (4.04-4.65)	5.05 (4.69-5.41)	6.06 (5.60-6.49)	6.89 (6.34-7.38)	7.77 (7.11-8.33)	8.71 (7.90-9.35)	10.0 (9.00-10.8)	11.1 (9.87-12.0)
4-day	3.02 (2.83-3.24)	3.65 (3.41-3.91)	4.58 (4.28-4.90)	5.32 (4.96-5.70)	6.37 (5.90-6.81)	7.23 (6.67-7.73)	8.14 (7.46-8.71)	9.10 (8.27-9.75)	10.5 (9.40-11.3)	11.6 (10.3-12.5)
7-day	3.52 (3.29-3.78)	4.24 (3.96-4.55)	5.25 (4.90-5.63)	6.05 (5.64-6.50)	7.17 (6.65-7.69)	8.07 (7.45-8.64)	8.99 (8.27-9.66)	9.96 (9.10-10.7)	11.3 (10.2-12.2)	12.4 (11.1-13.4)
10-day	4.05 (3.79-4.33)	4.86 (4.56-5.19)	5.94 (5.56-6.34)	6.76 (6.32-7.21)	7.88 (7.33-8.40)	8.75 (8.11-9.32)	9.63 (8.89-10.3)	10.5 (9.66-11.2)	11.7 (10.7-12.6)	12.7 (11.5-13.6)
20-day	5.51 (5.21-5.84)	6.56 (6.19-6.94)	7.85 (7.40-8.30)	8.85 (8.33-9.36)	10.2 (9.57-10.8)	11.2 (10.5-11.9)	12.3 (11.4-13.0)	13.3 (12.4-14.2)	14.7 (13.6-15.7)	15.8 (14.5-16.9)
30-day	6.85 (6.48-7.24)	8.10 (7.66-8.56)	9.51 (8.99-10.0)	10.6 (9.98-11.2)	12.0 (11.2-12.6)	13.0 (12.2-13.7)	14.0 (13.1-14.8)	15.0 (14.0-15.9)	16.3 (15.1-17.3)	17.2 (15.9-18.4)
45-day	8.67 (8.23-9.13)	10.2 (9.68-10.7)	11.8 (11.2-12.4)	13.0 (12.3-13.7)	14.5 (13.7-15.2)	15.6 (14.7-16.4)	16.7 (15.7-17.5)	17.7 (16.6-18.6)	18.9 (17.7-20.0)	19.8 (18.5-21.0)
60-day	10.4 (9.93-11.0)	12.2 (11.6-12.8)	13.9 (13.3-14.6)	15.2 (14.5-16.0)	16.8 (15.9-17.6)	17.9 (17.0-18.8)	18.9 (17.9-19.9)	19.9 (18.8-21.0)	21.1 (19.8-22.3)	21.9 (20.6-23.2)

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.

Hydrologic Soil Group—Montgomery County, Virginia



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 1:15,800.

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: Montgomery County, Virginia
 Survey Area Data: Version 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 29, 2019—Oct 4, 2019

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
2C	Berks-Groseclose complex, 7 to 15 percent slopes	B	1.3	0.5%
3D	Berks-Lowell-Rayne complex, 15 to 25 percent slopes	B	1.4	0.5%
8D	Caneyville-Opequon-Rock outcrop complex, 7 to 25 percent slopes	C	5.6	2.1%
9D	Carbo and Chilhowie soils, 15 to 25 percent slopes	D	2.6	1.0%
11B	Duffield-Ernest complex, 2 to 7 percent slopes	B	39.6	14.8%
11C	Duffield-Ernest complex, 7 to 15 percent slopes	B	7.4	2.8%
12B	Frederick and Vertrees silt loams, 2 to 7 percent slopes	B	13.1	4.9%
12C	Frederick and Vertrees silt loams, 7 to 15 percent slopes	B	25.3	9.4%
13D	Frederick and Vertrees gravelly silt loams, 15 to 25 percent slopes	B	25.0	9.3%
16B	Groseclose and Poplimento soils, 2 to 7 percent slopes	C	35.5	13.2%
16C	Groseclose and Poplimento soils, 7 to 15 percent slopes	C	30.3	11.3%
16D	Groseclose and Poplimento soils, 15 to 25 percent slopes	C	37.2	13.9%
16E	Groseclose and Poplimento soils, 25 to 60 percent slopes	C	1.2	0.4%
18B	Groseclose-Urban land complex, 2 to 7 percent slopes	C	6.3	2.4%
18C	Groseclose-Urban land complex, 7 to 15 percent slopes	C	4.8	1.8%
18D	Groseclose-Urban land complex, 15 to 25 percent slopes	C	4.3	1.6%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
29	Udorthents and Urban land		16.2	6.1%
33	Weaver soils	C	9.6	3.6%
W	Water		1.3	0.5%
Totals for Area of Interest			268.1	100.0%

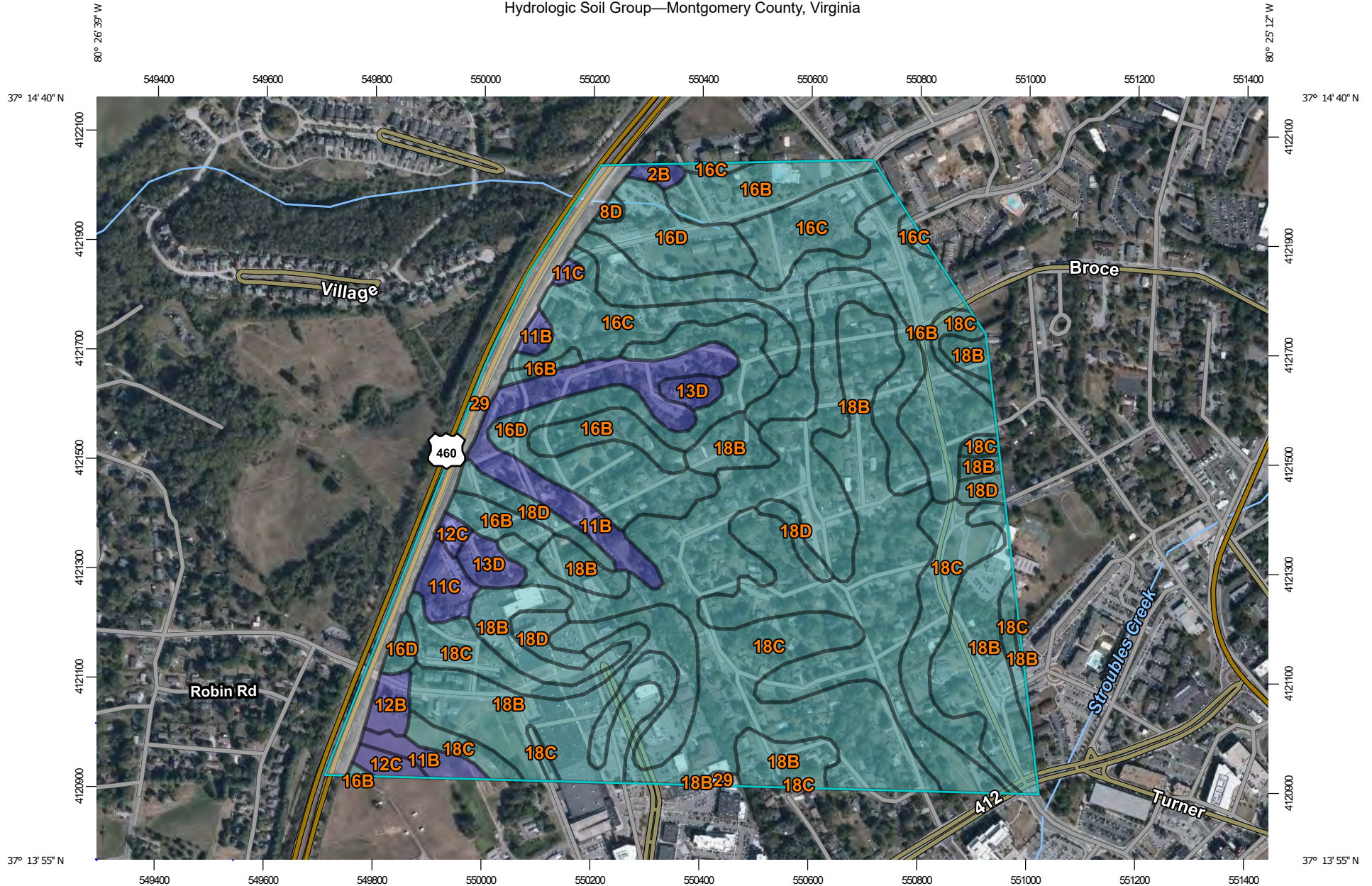
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Montgomery County, Virginia



Map Scale: 1:9,840 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N 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 1:15,800.

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: Montgomery County, Virginia
 Survey Area Data: Version 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 29, 2019—Oct 4, 2019

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
2B	Berks-Groseclose complex, 2 to 7 percent slopes	B	0.8	0.3%
8D	Caneyville-Opequon-Rock outcrop complex, 7 to 25 percent slopes	C	0.4	0.1%
11B	Duffield-Ernest complex, 2 to 7 percent slopes	B	15.1	5.4%
11C	Duffield-Ernest complex, 7 to 15 percent slopes	B	3.2	1.1%
12B	Frederick and Vertrees silt loams, 2 to 7 percent slopes	B	1.9	0.7%
12C	Frederick and Vertrees silt loams, 7 to 15 percent slopes	B	2.0	0.7%
13D	Frederick and Vertrees gravelly silt loams, 15 to 25 percent slopes	B	3.4	1.2%
16B	Groseclose and Poplimento soils, 2 to 7 percent slopes	C	36.4	13.0%
16C	Groseclose and Poplimento soils, 7 to 15 percent slopes	C	18.1	6.4%
16D	Groseclose and Poplimento soils, 15 to 25 percent slopes	C	25.9	9.2%
18B	Groseclose-Urban land complex, 2 to 7 percent slopes	C	79.7	28.4%
18C	Groseclose-Urban land complex, 7 to 15 percent slopes	C	75.6	26.9%
18D	Groseclose-Urban land complex, 15 to 25 percent slopes	C	7.1	2.5%
29	Udorthents and Urban land		11.1	3.9%
Totals for Area of Interest			280.8	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

WATER QUALITY

SITE ONLY ANALYSIS TO
DETERMINE REQUIRED
TP LOAD
REDUCTION

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: 2013 Draft Stds & Specs

Site Summary

Project Title: Glade Heights Preliminary Analysis for Site

Date: 44861

Total Rainfall (in):	43
Total Disturbed Acreage:	47.31

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	29.94	17.33	0.00	47.27	100
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0
Impervious Cover (acres)	0.00	0.00	0.04	0.00	0.04	0
					47.31	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	22.61	10.75	0.00	33.36	71
Impervious Cover (acres)	0.00	7.33	6.62	0.00	13.95	29
					47.31	100

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post- ReDevelopment	Post- Development (New Impervious)	Adjusted Pre- ReDevelopment
Site Rv	0.43	0.21	0.95	0.03
Treatment Volume (ft ³)	73,094	25,125	47,969	4,149
TP Load (lb/yr)	45.92	15.79	30.14	2.61

Baseline TP Load (lb/yr): 13.692524* **Reduction below new development load limitation not required*

Pre- ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
0.08	0.97	0.47

Total TP Load Reduction Required (lb/yr)	26.53	2.09	24.44
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	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre- ReDevelopment
TN Load (lb/yr)	328.54	26.53

**SITE ONLY ANALYSIS TO
DETERMINE REQUIRED
TP LOAD
REDUCTION**

Site Compliance Summary

Maximum % Reduction Required Below Pre-ReDevelopment Load	20%
---	-----

** Note: % Reduction will reduce post-development TP load to less than or equal to baseline load of 13.69 lb/yr (0.41 lb/ac/yr)
[Required reduction for Post-ReDev. = Post-ReDev TP load - baseline load of 13.692524 lb/yr], baseline load = site area x 0.41 lb/ac/yr*

Total Runoff Volume Reduction (ft ³)	0
Total TP Load Reduction Achieved (lb/yr)	0.00
Total TN Load Reduction Achieved (lb/yr)	0.00
Remaining Post Development TP Load (lb/yr)	45.92
Remaining TP Load Reduction Required	26.53

**Reduction below new development load limitation not required*

TOTAL AREA TO WET POND TO DETERMINE TP REMOVED BY BMP

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: 2013 Draft Stds & Specs

Site Summary

Project Title: Glade Heights Preliminary Analysis to Wet Pond

Date: 44512

Total Rainfall (in):	43
Total Disturbed Acreage:	58.33

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.72	1.66	1.53	3.91	7
Managed Turf (acres)	0.00	9.25	22.11	0.72	32.08	55
Impervious Cover (acres)	0.00	2.55	18.54	1.25	22.34	38
					58.33	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.72	1.66	1.53	3.91	7
Managed Turf (acres)	0.00	7.33	15.67	0.72	23.72	41
Impervious Cover (acres)	0.00	4.47	24.98	1.25	30.70	53
					58.33	100

* Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post-ReDevelopment	Post-Development (New Impervious)	Adjusted Pre-ReDevelopment
Site Rv	0.59	0.53	0.95	0.53
Treatment Volume (ft ³)	124,955	96,126	28,829	96,126
TP Load (lb/yr)	78.51	60.40	18.11	60.40

Pre-ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
1.21	1.35	1.21

Total TP Load Reduction Required (lb/yr)	26.76	12.08	14.69
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	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre-ReDevelopment
TN Load (lb/yr)	561.64	461.44

Wet pond contributing drainage area
 5.83 ac (Union runoff to south culvert)
 23.38 ac ("To 460 South Culvert (excl. Union)")
 4.00 ac (Runoff from "The Farm")
 9.20 ac ("Post to south dry pond")
 10.24 ac ("Postdev to wet pond only")
52.64 ac total

TOTAL AREA TO WET POND
TO DETERMINE TP REMOVED BY BMP

Site Compliance Summary

Maximum % Reduction Required Below Pre-ReDevelopment Load	20%
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Total Runoff Volume Reduction (ft ³)	0
Total TP Load Reduction Achieved (lb/yr)	39.02
Total TN Load Reduction Achieved (lb/yr)	167.50
Remaining Post Development TP Load (lb/yr)	39.49
Remaining TP Load Reduction (lb/yr) Required	0.00

** TARGET TP REDUCTION EXCEEDED BY █████ LB/YEAR **

SEE SITE ONLY VRRM ANALYSIS FOR TARGET TP
REDUCTION (26.53 LB/YR)
TP LOAD REDUCTION ACHIEVED: 39.02 LB/YR
TARGET TP REDUCTION EXCEED BY:
39.02 - 26.53 = **12.49 LB/YR**

**TOTAL AREA TO WET POND
TO DETERMINE TP REMOVED BY BMP**

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest/Open (acres)	3.91	0.00	0.00	0.00	0.00	3.91
Managed Turf (acres)	23.72	0.00	0.00	0.00	0.00	23.72
Impervious Cover (acres)	30.70	0.00	0.00	0.00	0.00	30.70
Total Area (acres)	58.33	0.00	0.00	0.00	0.00	58.33

Drainage Area Compliance Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Reduced (lb/yr)	39.02	0.00	0.00	0.00	0.00	39.02
TN Load Reduced (lb/yr)	167.50	0.00	0.00	0.00	0.00	167.50

**TOTAL AREA TO WET POND
TO DETERMINE TP REMOVED BY BMP**

Drainage Area A Summary**Land Cover Summary**

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.72	1.66	1.53	3.91	7
Managed Turf (acres)	0.00	7.33	15.67	0.72	23.72	41
Impervious Cover (acres)	0.00	4.47	24.98	1.25	30.70	53
					58.33	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft ³)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed
13.a. Wet Pond #1 (Spec #14)	23.72	30.7	124,357.99	0.00	78.05	39.02	39.02	

Total Impervious Cover Treated (acres)	30.70
Total Turf Area Treated (acres)	23.72
Total TP Load Reduction Achieved in D.A. (lb/yr)	39.02
Total TN Load Reduction Achieved in D.A. (lb/yr)	167.50

WATER QUANTITY

Table 2-2a Runoff curve numbers for urban areas ^{1/}

Cover description	Average percent impervious area ^{2/}	Curve numbers for hydrologic soil group			
		A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) ^{3/}:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)					
		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ^{4/}		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82

Developing urban areas

Newly graded areas
(pervious areas only, no vegetation) ^{5/}

		77	86	91	94
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Idle lands (CN's are determined using cover types
similar to those in table 2-2c).

¹ Average runoff condition, and $I_a = 0.2S$.

² The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

³ CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

⁴ Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

⁵ Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands ^{1/}

Cover description	Hydrologic condition	Curve numbers for hydrologic soil group			
		A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. ^{2/}	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. ^{3/}	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 ^{4/}	48	65	73
Woods—grass combination (orchard or tree farm). ^{5/}	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. ^{6/}	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 ^{4/}	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

¹ Average runoff condition, and $I_a = 0.2S$.

² **Poor:** <50% ground cover or heavily grazed with no mulch.

Fair: 50 to 75% ground cover and not heavily grazed.

Good: > 75% ground cover and lightly or only occasionally grazed.

³ **Poor:** <50% ground cover.

Fair: 50 to 75% ground cover.

Good: >75% ground cover.

⁴ Actual curve number is less than 30; use CN = 30 for runoff computations.

⁵ CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

⁶ **Poor:** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.

Fair: Woods are grazed but not burned, and some forest litter covers the soil.

Good: Woods are protected from grazing, and litter and brush adequately cover the soil.