STORMWATER MANAGEMENT CALCULATIONS

FOR

1820 N. MAIN STREET
CONDITIONAL USE PERMIT APPLICATION

MOUNT TABOR MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, VIRGINIA

September 1, 2020

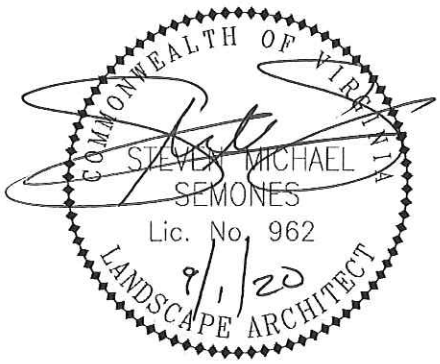

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TABLE OF CONTENTS

SECTION I: PROJECT NARRATIVE 3

SECTION II: STORMWATER MANAGEMENT SUMMARY 5

PRE-DEVELOPMENT SUMMARY 5

POST-DEVELOPMENT SUMMARY 8

SECTION III: STORMWATER QUALITY SUMMARY 13

SECTION IV: DOWNSTREAM ANALYSIS 14

SECTION V: STORMWATER MANAGEMENT MAINTENANCE/INSPECTION PLAN 15

APPENDIX A: SOILS MAPS & SOIL DESCRIPTIONS

APPENDIX B: DRAINAGE MAPS

APPENDIX C: STORMWATER QUANTITY CALCULATIONS

APPENDIX D: STORMWATER QUALITY CALCULATIONS

SECTION I: PROJECT NARRATIVE

Project Description

The purpose of this project is the redevelopment of 6.60 acres of land located at 1820 N. Main Street in Blacksburg. The site is zoned R-5 (Transitional Residential) and a conditional use permit is being applied for to allow a townhome use.

Existing Site Conditions

The project site[1] currently consists of three parcels totaling 6.60 acres. After a lot line readjustment and subdivision, the final project will consist of individual townhome parcels and common space lots. The site is bound by North Main Street to the west, Mountain Breeze Drive and the property of the Town of Blacksburg to the north, Maple Ridge common area to the east, and the properties of Charles & Sandra Smith and Xueqin Jiang & Guanghua Tang to the south. Currently, there is a convenience store (now vacant) and a single family home on the property, with the remainder of the property being vacant with trees. The existing impervious coverage totals approximately 0.42 acres (6.4% of the site). The surrounding area consists primarily of single-family residential and townhomes, with some vacant land and commercial area across Main Street. Existing soil conditions on-site include the types listed on the following page with slopes ranging from 2%-15%. There are currently no known environmental issues on site, however prior to construction, the site will be fully investigated to determine if there are any jurisdictional waters on the property or within any of the areas of disturbance. If evidence is found, the property will be delineated, confirmed by the US Army Corps of Engineers and all necessary permits will be filed. The majority of the site currently drains naturally to a low point on the western side next to Mountain Breeze Drive, where it enters a culvert and outfalls to an existing town-owned stormwater facility. A small portion of the site located at the southwestern corner of the site drains towards N. Main Street, bypassing the culvert under Mountain Breeze Drive and flowing directly to the existing stormwater facility.

[1] For the purposes of the Project Narrative, "site" shall be defined as the area within the subject property boundary, 6.60 acres, Tax Map #'s 167-A 8, 167-A 8A, 167-A 9

Existing soil conditions on-site include the following types:
(See attached soils map for specific locations.)

11B - Duffield-Ernest Complex, 2 to 7 Percent Slopes
K-Factor: 0.28
Texture: Silt Loam
HSG: B

13B - Frederick and Vertrees Gravelly Silt Loams, 2 to 7 Percent Slopes
K-Factor: 0.24
Texture: Gravelly Silt Loam
HSG: B

13C - Frederick and Vertrees Gravelly Silt Loams, 7 to 15 Percent Slopes
K-Factor: 0.24
Texture: Gravelly Silt Loam
HSG: B

Development Plans

The proposed development will consist of 43 townhomes, which will be located on individual subdivided lots. Parking will be provided in a common surface lot. A stormwater management facility, utilities, and pedestrian connections to N. Main Street and Mountain Breeze Drive will be provided. There is an existing Blacksburg Transit stop located on Givens Lane, approximately 600 feet from the main entrance to the project.

During Construction

Neighboring areas consist of single-family residential and townhomes, commercial developments, civic uses and some vacant land. Any runoff from the site shall be controlled with temporary measures such as a construction entrance, silt fence, sediment traps or basins, inlet protection, construction road stabilization, seeding and other measures per Virginia Erosion and Sediment Control Handbook standards.

SECTION II: STORMWATER MANAGEMENT SUMMARY

PRE-DEVELOPMENT SUMMARY

Please see Sheet SW3 for drainage area map.

In the pre-development condition, the site consists primarily of a vacant forested and grass area with a single-family residential home, convenience store, and associated parking. The majority of the site drains to a low point along Mountain Breeze Drive at the entrance to an existing culvert. This culvert conveys runoff from the project site, as well as some runoff from Maple Ridge, under Mountain Breeze Drive and into the existing pond. The entrance to this culvert has been set as the point of analysis. There is also a small area of direct runoff that flows towards Main Street.

All flows in the included HydroCAD model have been analyzed using the SCS/TR-55, weighted Q method. See the included drainage map and HydroCAD report for time of concentration calculations. Where a subwatershed is predominantly impervious, a minimum time of concentration of 6 minutes has been assumed.

PRE-DEVELOPMENT LAND COVER

Area (acres)	CN	Description (subcatchment numbers)
0.972	75	1/4 acre lots, 38% imp, HSG B (1S, 2S)
0.027	83	1/4 acre lots, 38% imp, HSG C (1S, 2S)
3.330	61	>75% Grass cover, Good, HSG B (1S, 2S)
1.228	74	>75% Grass cover, Good, HSG C (1S, 2S)
0.576	98	Impervious Area, HSG B (1S, 2S)
0.135	98	Impervious Area, HSG C (1S)
0.076	98	Right of Way, HSG B (1S, 2S)
0.634	98	Right of Way, HSG C (1S, 2S)
5.161	55	Woods, Good, HSG B (1S,)
12.139	**67**	**TOTAL AREA**

The CN value has been determined based upon soil type information obtained from the NRCS Web Soil Survey. All land covers are assumed to be in good condition and have been estimated from USGS mapping, aerial photography, and Town of Blacksburg GIS maps. All SCS land cover values were taken from Table 4-6a and Table 4-6b of the Virginia Stormwater Management Handbook. Rational "C" coefficients are derived from VSMH Table 4-3 "Rational Equation Runoff Coefficients".

All volume routing and peak flow calculations have been analyzed using the SCS/TR-20, weighted-Q method. All storm sewer conveyance systems have been analyzed using the Rational Method in accordance with VDOT standards, unless otherwise noted. Rainfall intensity values taken from NOAA Atlas 14 (Blacksburg 3 SE, Sta. 44-0766) for SCS/TR-55 calculations and VDOT Montgomery County BDE factors (Appendix 6C-2) for Rational Method calculations. Please see the attached "Hydrology Worksheet" and HydroCAD for time of concentration calculations.

Point of Analysis

Total Drainage Area= 11.39 acres

The peak pre-development runoff flows at the point of analysis are as follows:
(See HydroCAD report)

	Peak Flow	Runoff Volume
1-year	3.60 cfs	0.347 af
2-year	5.22 cfs	0.525 af
10-year	13.23 cfs	1.177 af
100-year	29.31 cfs	2.696 af

Direct Runoff

Total Drainage Area= 0.75 acres

The peak pre-development runoff flows at the point of analysis are as follows:
(See HydroCAD report)

	Peak Flow	Runoff Volume
1-year	0.91 cfs	0.062 af
2-year	1.15 cfs	0.080 af
10-year	1.89 cfs	0.137 af
100-year	3.08 cfs	0.255 af

POST-DEVELOPMENT SUMMARY

Please see Sheet SW4 for drainage area map.

The proposed site will be graded to capture runoff via curb and gutter and stormwater piping. An underground detention system will be installed to manage runoff. Outflow from the system will be managed by multiple flow control devices within the system's outlet structure. As shown in the attached HydroCAD calculations, the underground system has been designed to manage peak flows and meet water quantity requirements. The outlet manhole will be fitted with a DI-7 top in order to allow flows from the 100-year storm to exit the system. Outflow from the system will continue to the existing culvert under Mountain Breeze Drive, as in the pre-development condition, and be conveyed through this culvert, through the existing pond, and through a series of natural channels to the 1% point.

A small area adjacent to Main Street will continue to sheet flow towards the right of way as in the pre-development condition. As shown on the drainage maps and in the calculations, the direct runoff area will be reduced in size, providing a reduced amount of runoff that is draining to Main Street.

As shown in the enclosed HydroCAD calculations, the peak flow rates and runoff volume are reduced compared to the predevelopment calculations.

POST-DEVELOPMENT LAND COVER

Area (acres)	CN	Description (subcatchment numbers)
0.972	75	1/4 acre lots, 38% imp, HSG B (1SD)
0.027	83	1/4 acre lots, 38% imp, HSG C (1SD)
5.641	61	>75% Grass cover, Good, HSG B (1SA, 1SD, 2S)
1.228	74	>75% Grass cover, Good, HSG C (1SD)
3.033	98	Other Impervious Area, HSG B (1SA, 1SD, 2S)
0.135	98	Other Impervious Area, HSG C (1SD)
0.076	98	Right of Way, HSG B (1SD)
0.634	98	Right of Way, HSG C (1SD)
0.388	58	Woods/Grass Combination, Good, HSG B (1SA)
12.134	**75**	**TOTAL AREA**

The CN value has been determined based upon soil type information obtained from the NRCS Web Soil Survey. All land covers are assumed to be in good condition and have been estimated from USGS mapping, aerial photography, and Town of Blacksburg GIS maps. All SCS land cover values were taken from Table 4-6a and Table 4-6b of the Virginia Stormwater Management Handbook. Rational "C" coefficients are derived from VSMH Table 4-3 "Rational Equation Runoff Coefficients".

All volume routing and peak flow calculations have been analyzed using the SCS/TR-20, weighted-Q method. All storm sewer conveyance systems have been analyzed using the Rational Method in accordance with VDOT standards, unless otherwise noted. Rainfall intensity values taken from NOAA Atlas 14 (Blacksburg 3 SE, Sta. 44-0766) for SCS/TR-55 calculations and VDOT Montgomery County BDE factors (Appendix 6C-2) for Rational Method calculations. Please see the attached "Hydrology Worksheet" and HydroCAD for time of concentration calculations.

Point of Analysis

Total Drainage Area= 11.45 acres

The peak post-development runoff flows at the point of analysis are as follows:
(See HydroCAD report)

	Peak Flow	Runoff Volume
1-year	3.56 cfs	0.651 af
2-year	5.13 cfs	0.907 af
10-year	12.76 cfs	1.742 af
100-year	40.58 cfs	3.499 af

As shown above, the post-development flow at the point of analysis is less than the pre-development flow for the 1-year, 2-year, and 10-year storms, thus meeting or exceeding the Town of Blacksburg stormwater management requirements.

Direct Runoff

Total Drainage Area= 0.689 acres

The peak post-development runoff flows for the direct runoff area are as follows:
(See HydroCAD report)

	Peak Flow	Flow Reduction	Runoff Volume	Runoff Reduction
1-year	0.78 cfs	14.3%	0.053 af	14.5%
2-year	0.98 cfs	14.8%	0.069 af	13.8%
10-year	1.65 cfs	12.7%	0.120 af	12.4%
100-year	2.75 cfs	10.7%	0.227 af	11.0%

As shown above, the post-development runoff volumes and flows for the direct runoff area are less than the pre-development runoff volumes for the 1-year, 2-year, 10-year and 100-year storms, thus meeting the requirements of 9VAC25-870-66 subsection D.

Channel Protection

In accordance with 9VAC25-870-66 (B), concentrated stormwater flows will be discharged directly to a stormwater conveyance system. Runoff from this system will be discharged through a pipe into a natural channel and then through a culvert into the existing pond. From this pond, runoff will flow through a series of natural conveyance systems to the 1% analysis point of the site[2]. Per subdivision (3)(a), the maximum post-development peak flow rate from the 1-year 24-hour storm shall be calculated per the equations below to prevent erosion of the natural conveyance systems. Additionally, all analyzed storms will produce a post-development flow rate lower than the pre-development flow rate, therefore no erosion of any manmade systems should be expected.

R_v Calculation – DA #1

Pre-developed = 0.048 acre*ft – See HydroCAD "RV Calculation" Report
Developed = 0.460 acre*ft – See HydroCAD "RV Calculation" Report

$$Q_{Developed} \leq 0.8 \times (Q_{Forest} \times RV_{Forest})/RV_{Developed}$$
$$Q_{Developed} \leq 0.8 \times \left(Q_{Pre-developed} \times 0.048\right)/0.460$$
$$Q_{Developed} \leq 0.08 \times Q_{Pre-developed}$$

The resulting maximum allowable peak flow rate for the one-year 24-hour storm at the Point of Analysis 1 is 3.49 cfs.

The actual post-development peak flow rate achieved is 3.56 cfs. Due to the forested and grass areas present on the site in the existing condition, and due to the amount of offsite runoff that is flowing to the point of analysis, we do not feel that it is possible to reach a flow rate of 3.49 cfs. A 3" flow control valve is proposed to control the 1-year storm and allow the smallest flow possible to escape. We have included a variance request for this situation as part of this submittal.

R_v Calculation – DA #2 (Direct Runoff)

Pre-developed = 0.062 acre*ft – See HydroCAD "RV Calculation" Report
Developed = 0.053 acre*ft – See HydroCAD "RV Calculation" Report

As shown above, the runoff volume from the direct runoff area has been reduced, meeting channel protection requirements.

[2] In the context of channel and flood protection, "site" shall be defined as the land or water area where the land-disturbing activity will be physically conducted, including the limits of any off-site land disturbance (approximately 6.16 acres). See Sheets SW3-SW4.

Flood Protection

In accordance with 9VAC25-870-66 (C), concentrated stormwater flows have been discharged to a stormwater conveyance system. The downstream conveyance systems are made up of a series of natural and manmade conveyance systems. As shown on the attached HydroCAD calculations, the point of discharge releases a post-development peak flow rate for the 10-year 24-hour storm event that is less than the pre-development peak flow rate from the 10-year 24-hour storm event, satisfying subdivision 2(b). Per subdivision (3) of these regulations, no further analysis of the downstream stormwater conveyance system is required.

SECTION III: STORMWATER QUALITY SUMMARY

Water quality compliance has been achieved through use of the Virginia Runoff Reduction Method (VRRM) in accordance with the design criteria set forth in 9VAC25-870-65 and through the purchase of nutrient credits in accordance with the criteria set forth in the Code of Virginia. Per §62.1-44.15:35 (C)(2), the VSMP shall allow the use of nutrient credits when less than five acres of land will be disturbed, or the phosphorus water quality reduction requirement is less than 10 pounds per year. The proposed development is within the thresholds for the permitted use of credits, with a required phosphorus reduction load of 5.28 lbs/year.

The existing site[3] has a pre-development impervious land cover of 0.39 acres (6.3%). The post development site has an impervious land cover of 2.92 acres (47%) resulting in a composite runoff coefficient (R_v) of 0.56. The required pollutant removal rate is 5.28 pounds per year, which will be handled by purchasing credits.

[3] In the context of channel and flood protection, "site" shall be defined as the land or water area where the land-disturbing activity will be physically conducted, including the limits of any off-site land disturbance (approximately 6.16 acres). See Sheets SW3-SW4.

SECTION IV: DOWNSTREAM ANALYSIS

Runoff from the proposed development is discharged directly into to a series of natural and manmade conveyance systems. These conveyance systems carry flows from the site downstream to the 1% analysis point. The post-development peak runoff has been mitigated via underground detention facilities to prevent adverse impacts from this site to downstream properties in the form of channel erosion and flooding.

Per 9VAC25-870-66 subsection A, compliance with Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations has been satisfied by meeting the requirements of the for channel protection and flood protection as shown in the Post Development Summary. No adverse impacts to downstream properties are expected as a result of this development.

SECTION V: STORMWATER MANAGEMENT MAINTENANCE/INSPECTION PLAN

Generally:

1. The owner is responsible for providing or coordinating all facility inspections and any required maintenance that may result from such inspections.
2. Requirements listed here are to be taken as a minimum and do not represent the limit of responsibility.
3. Any standing water pumped during the maintenance operation must be disposed of per the VESCH, 1992 edition and any local requirements.

Required Action:

Underground Detention Facilities:

1. Every (6) months and after each major runoff producing storm event, a maintenance visit shall be performed and documented, and any repairs necessary to areas of failure/concern discovered during inspection shall be carried out. Typical maintenance tasks include:
   a. Cleanout of any debris or sediment accumulated in the structure that reduces the storage volume or otherwise hinders the performance of the facility.
   b. Visual inspection for structural deterioration, spalling, or cracking of the structural components.
2. The flow control manhole shall be inspected after each runoff producing storm event to check for debris and/or sediment accumulation that may compromise the performance of the structure. Such debris and sediments shall be removed immediately.

Per the Town of Blacksburg stormwater ordinance, a formal maintenance agreement shall be provided to the Town for review and ultimately recorded at the Montgomery County Courthouse legally binding the identified party to the maintenance/inspection responsibilities listed above.

SECTION VI: ALTERNATIVE STORMWATER MANAGEMENT PLANS

We have shown with the above calculations and enclosed HydroCAD reports that stormwater runoff can be managed through the use of an onsite underground detention system, and that all town and state requirements are able to be met, contingent on obtaining variance approval for the energy balance requirement. However, during the engineering design phase of the project, we may analyze alternative methods of managing stormwater runoff, such as an onsite detention pond, bioretention, bioswales, or utilizing the existing offsite town-owned pond. If we find another method that is preferable and meets all local and state requirements, we will present the calculations to the town for review and discussion during the site planning process.

APPENDIX A:
SOIL MAPS & SOIL DESCRIPTIONS

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Montgomery County, Virginia

July 2, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....11
Map Unit Descriptions.....11
Montgomery County, Virginia.....13
11B—Duffield-Ernest complex, 2 to 7 percent slopes.....13
13B—Frederick and Vertrees gravelly silt loams, 2 to 7 percent slopes.....14
13C—Frederick and Vertrees gravelly silt loams, 7 to 15 percent slopes...16
Soil Information for All Uses.....18
Soil Properties and Qualities.....18
Soil Erosion Factors.....18
K Factor, Whole Soil.....18
Soil Physical Properties.....21
Surface Texture.....21
Soil Qualities and Features.....24
Hydrologic Soil Group.....24
References.....29

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

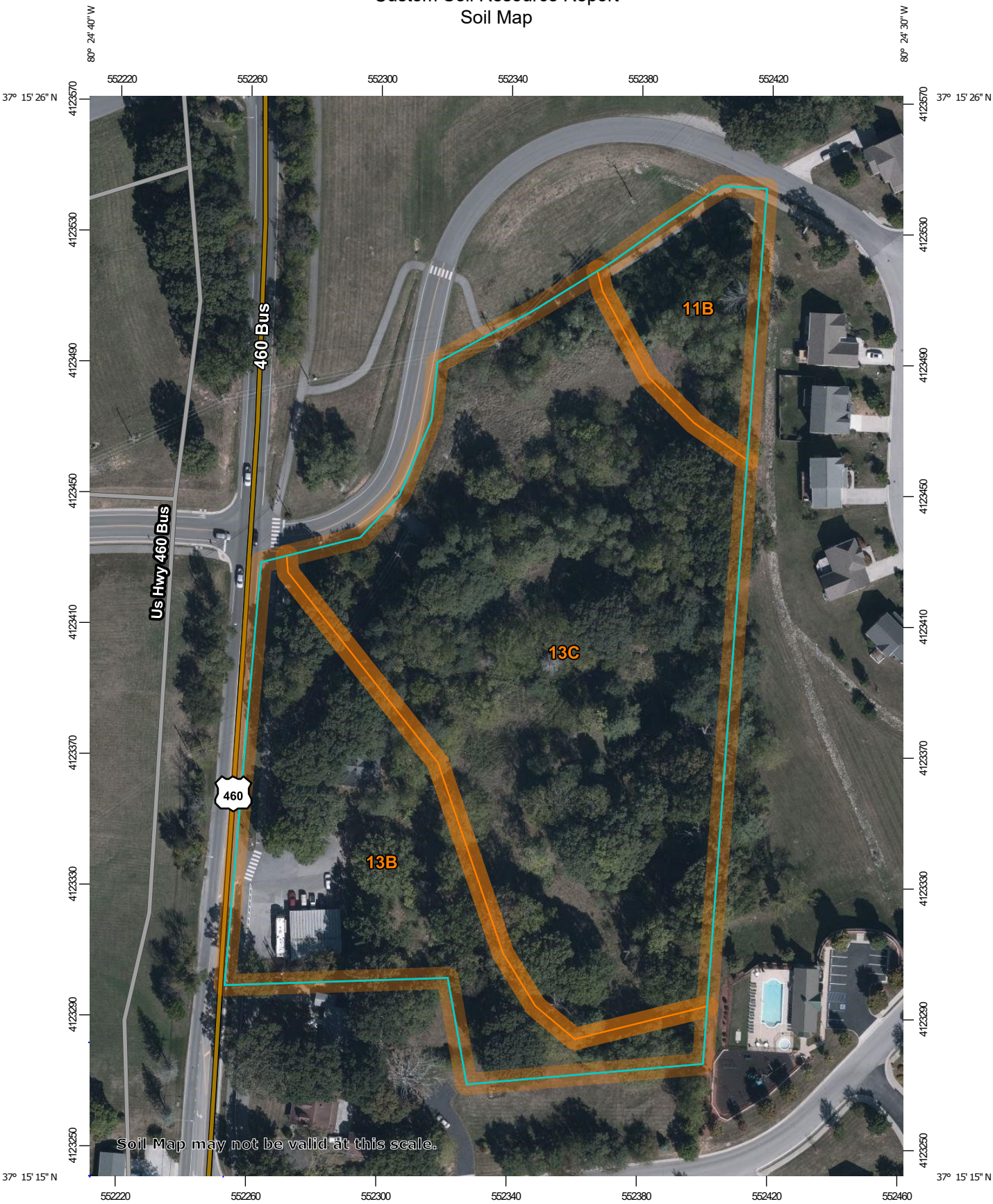
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,610 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
11B	Duffield-Ernest complex, 2 to 7 percent slopes	0.7	8.6%
13B	Frederick and Vertrees gravelly silt loams, 2 to 7 percent slopes	2.1	27.8%
13C	Frederick and Vertrees gravelly silt loams, 7 to 15 percent slopes	4.8	63.6%
Totals for Area of Interest		**7.6**	**100.0%**

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate

pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Montgomery County, Virginia

11B—Duffield-Ernest complex, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: kc1q
Elevation: 1,300 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Duffield and similar soils: 45 percent
Ernest and similar soils: 35 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Duffield

Setting

Landform: Drainageways
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvial, alluvial, eolian sediments underlain by loamy and clayey residuum of limestone and shale

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 37 inches: silty clay loam
H3 - 37 to 79 inches: clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 48 to 99 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Ernest

Setting

Landform: Drainageways

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Interbedded limestone and shale residuum

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 26 inches: silty clay loam
H3 - 26 to 50 inches: silty clay loam
H4 - 50 to 79 inches: silty clay loam

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 20 to 35 inches to fragipan
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Purdy

Percent of map unit: 3 percent
Landform: Stream terraces, depressions
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

13B—Frederick and Vertrees gravelly silt loams, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: kc1v
Elevation: 1,700 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Frederick and similar soils: 40 percent
Vertrees and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Frederick

Setting

Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone interbedded with siltstone and shale residuum

Typical profile

H1 - 0 to 10 inches: gravelly silt loam
H2 - 10 to 22 inches: clay
H3 - 22 to 79 inches: clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Forage suitability group: Moist, Fertile Soils (G128XB001VA)
Hydric soil rating: No

Description of Vertrees

Setting

Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone, siltstone, and shale residuum

Typical profile

H1 - 0 to 10 inches: gravelly silt loam
H2 - 10 to 25 inches: silty clay
H3 - 25 to 50 inches: clay
H4 - 50 to 79 inches: clay

Properties and qualities

Slope: 2 to 7 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Forage suitability group: Moist, Fertile Soils (G128XB001VA)
Hydric soil rating: No

13C—Frederick and Vertrees gravelly silt loams, 7 to 15 percent slopes

Map Unit Setting
National map unit symbol: kc1w
Elevation: 1,700 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Frederick and similar soils: 40 percent
Vertrees and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Frederick

Setting
Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone interbedded with siltstone and shale residuum

Typical profile
H1 - 0 to 10 inches: gravelly silt loam
H2 - 10 to 22 inches: clay
H3 - 22 to 79 inches: clay

Properties and qualities
Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Forage suitability group: Moist, Fertile Soils (G128XB001VA)
Hydric soil rating: No

Description of Vertrees

Setting
Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone, siltstone, and shale residuum

Typical profile
H1 - 0 to 10 inches: gravelly silt loam
H2 - 10 to 25 inches: silty clay
H3 - 25 to 50 inches: clay
H4 - 50 to 79 inches: clay

Properties and qualities
Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Forage suitability group: Moist, Fertile Soils (G128XB001VA)
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Erosion Factors

Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Map Scale: 1:1,610 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Lines

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Points

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
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.

Table—K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11B	Duffield-Ernest complex, 2 to 7 percent slopes	.28	0.7	8.6%
13B	Frederick and Vertrees gravelly silt loams, 2 to 7 percent slopes	.24	2.1	27.8%
13C	Frederick and Vertrees gravelly silt loams, 7 to 15 percent slopes	.24	4.8	63.6%
Totals for Area of Interest			**7.6**	**100.0%**

Rating Options—K Factor, Whole Soil

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Surface Texture

This displays the representative texture class and modifier of the surface horizon.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Map—Surface Texture

Map Scale: 1:1,610 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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

Gravelly silt loam

Silt loam

Not rated or not available

Soil Rating Lines

Gravelly silt loam

Silt loam

Not rated or not available

Soil Rating Points

Gravelly silt loam

Silt loam

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.

Table—Surface Texture

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11B	Duffield-Ernest complex, 2 to 7 percent slopes	Silt loam	0.7	8.6%
13B	Frederick and Vertrees gravelly silt loams, 2 to 7 percent slopes	Gravelly silt loam	2.1	27.8%
13C	Frederick and Vertrees gravelly silt loams, 7 to 15 percent slopes	Gravelly silt loam	4.8	63.6%
Totals for Area of Interest			**7.6**	**100.0%**

Rating Options—Surface Texture

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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:

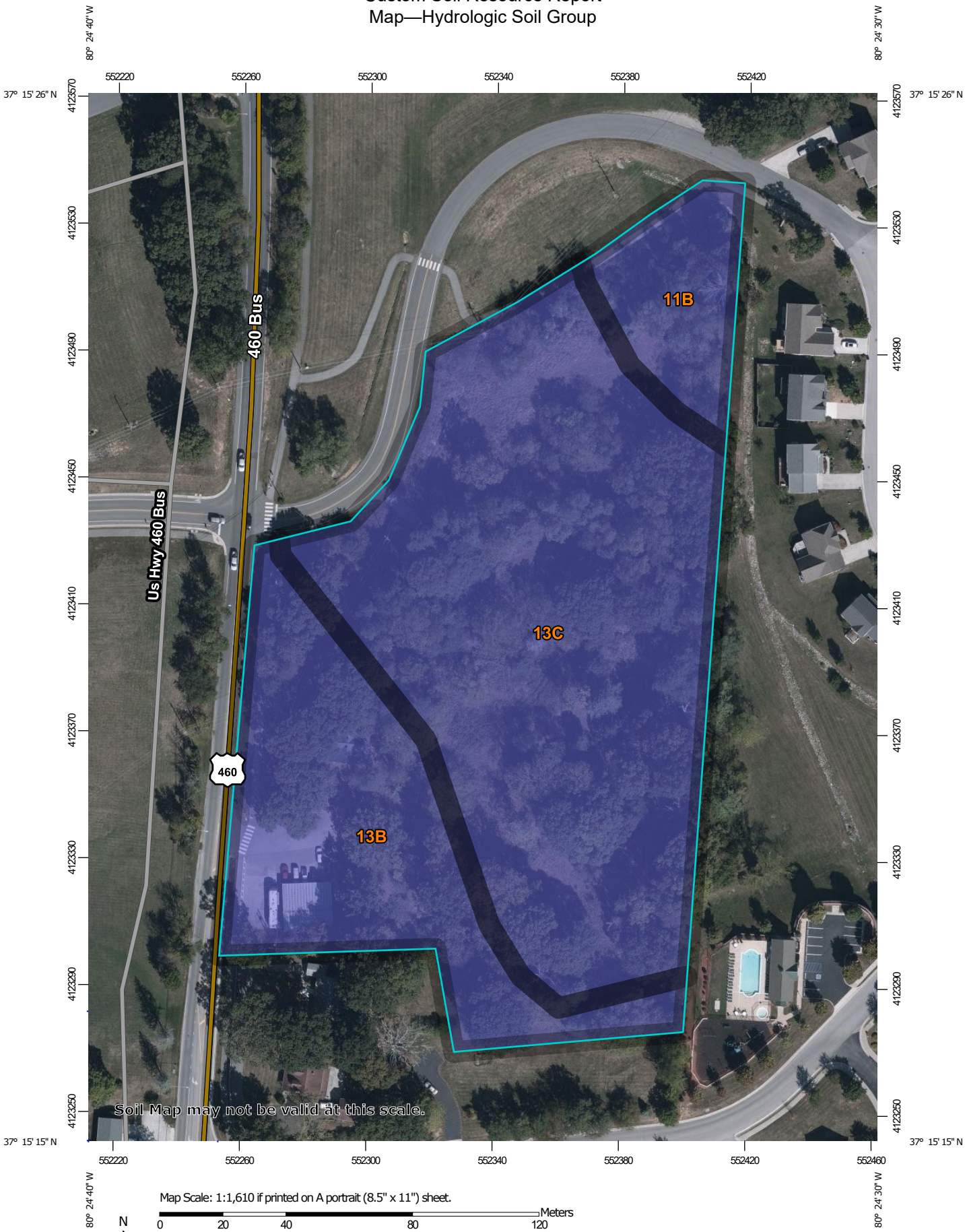
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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.



Map Scale: 1:1,610 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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.

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

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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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11B	Duffield-Ernest complex, 2 to 7 percent slopes	B	0.7	8.6%
13B	Frederick and Vertrees gravelly silt loams, 2 to 7 percent slopes	B	2.1	27.8%
13C	Frederick and Vertrees gravelly silt loams, 7 to 15 percent slopes	B	4.8	63.6%
Totals for Area of Interest			**7.6**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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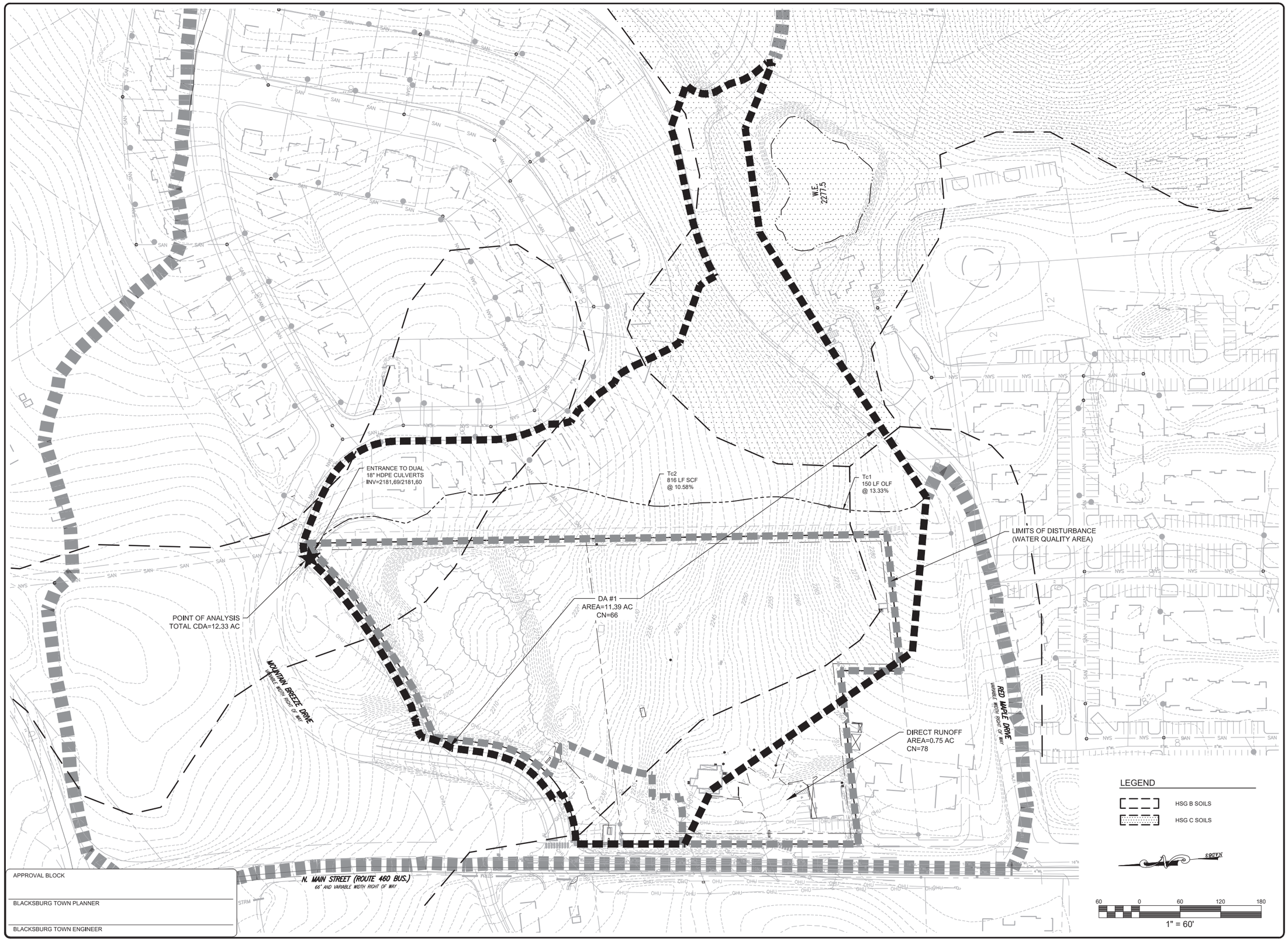
APPENDIX B:
DRAINAGE MAPS



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BLACKSBURG TOWN ENGINEER

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COMMONWEALTH OF VIRGINIA
STEVEN M. SEMONES
Lic. No. 962
9/1/20
LANDSCAPE ARCHITECT

1820 N. MAIN STREET

CONDITIONAL USE PERMIT

PRE-DEVELOPMENT DRAINAGE MAP

MOUNT TABOR MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, MONTGOMERY COUNTY, VIRGINIA

DRAWN BY	GLM
DESIGNED BY	GLM
CHECKED BY	SMS
DATE	9/1/20
SCALE	1" = 60'
REVISIONS	

SW3

PROJECT NO. 24200017.00

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STEVEN M. SEMONES
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9/1/20
LANDSCAPE ARCHITECT

1820 N. MAIN STREET

CONDITIONAL USE PERMIT

POST-DEVELOPMENT DRAINAGE MAP

MOUNT TABOR MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, MONTGOMERY COUNTY, VIRGINIA

DRAWN BY	GLM
DESIGNED BY	GLM
CHECKED BY	SMS
DATE	9/1/20
SCALE	1" = 80'
REVISIONS	

SW4

PROJECT NO. 24200017.00

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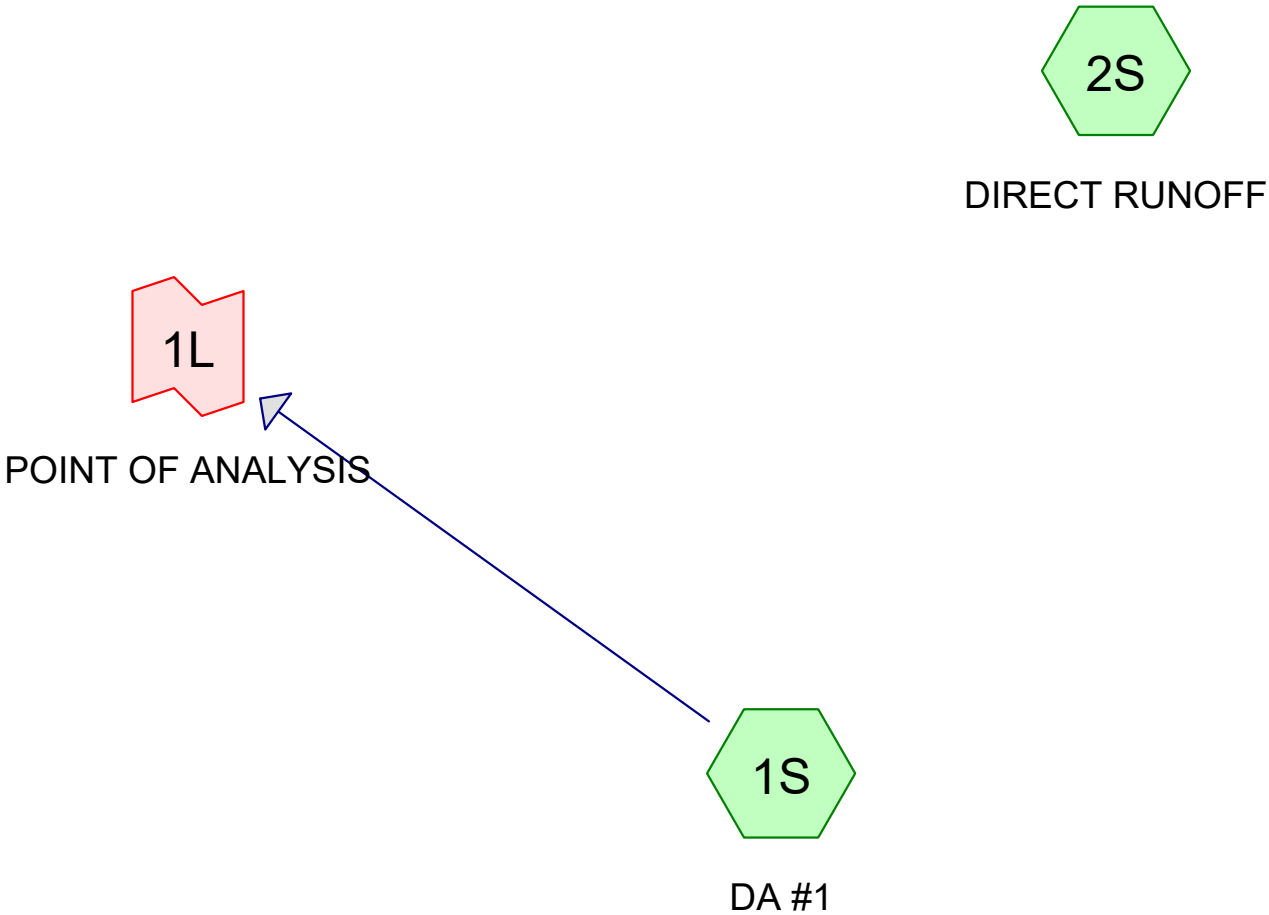
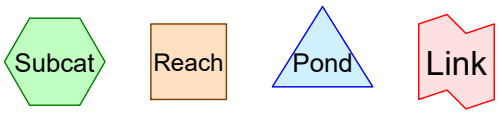
APPENDIX C:
STORMWATER QUANTITY CALCULATIONS





Routing Diagram for PRE DEV
Prepared by Balzer & Associates, Inc., Printed 8/31/2020
HydroCAD® 10.10-4a s/n 07713 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.972	75	1/4 acre lots, 38% imp, HSG B (1S)
0.027	83	1/4 acre lots, 38% imp, HSG C (1S)
3.330	61	>75% Grass cover, Good, HSG B (1S, 2S)
1.228	74	>75% Grass cover, Good, HSG C (1S)
0.576	98	Paved parking, HSG B (1S, 2S)
0.135	98	Paved parking, HSG C (1S)
0.076	98	Paved roads w/curbs & sewers, HSG B (1S)
0.634	98	Paved roads w/curbs & sewers, HSG C (1S)
5.161	58	Woods/grass comb., Good, HSG B (1S)
12.139	**67**	**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1 Runoff Area=11.390 ac Runoff Depth=0.37"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=3.60 cfs 0.347 af

Subcatchment 2S: DIRECT RUNOFF Runoff Area=0.749 ac Runoff Depth=0.99"
Tc=6.0 min CN=WQ Runoff=0.91 cfs 0.062 af

Link 1L: POINT OF ANALYSIS Inflow=3.60 cfs 0.347 af
Primary=3.60 cfs 0.347 af

Total Runoff Area = 12.139 ac Runoff Volume = 0.408 af Average Runoff Depth = 0.40"

Summary for Subcatchment 1S: DA #1

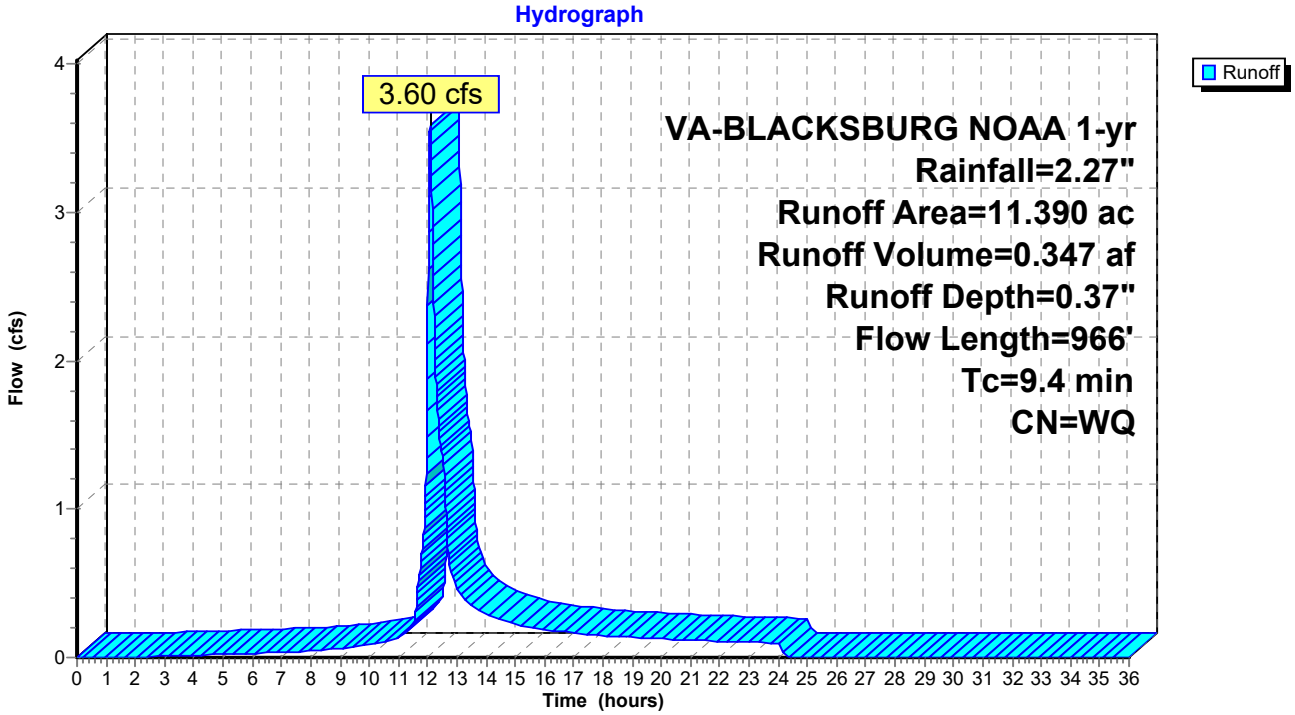
Runoff = 3.60 cfs @ 12.08 hrs, Volume= 0.347 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

	Area (ac)	CN	Description
*	5.161	58	Woods/grass comb., Good, HSG B
	2.916	61	>75% Grass cover, Good, HSG B
	1.228	74	>75% Grass cover, Good, HSG C
*	0.972	75	1/4 acre lots, 38% imp, HSG B
	0.027	83	1/4 acre lots, 38% imp, HSG C
	0.076	98	Paved roads w/curbs & sewers, HSG B
	0.634	98	Paved roads w/curbs & sewers, HSG C
	0.241	98	Paved parking, HSG B
	0.135	98	Paved parking, HSG C
	11.390		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1S: DA #1



Summary for Subcatchment 2S: DIRECT RUNOFF

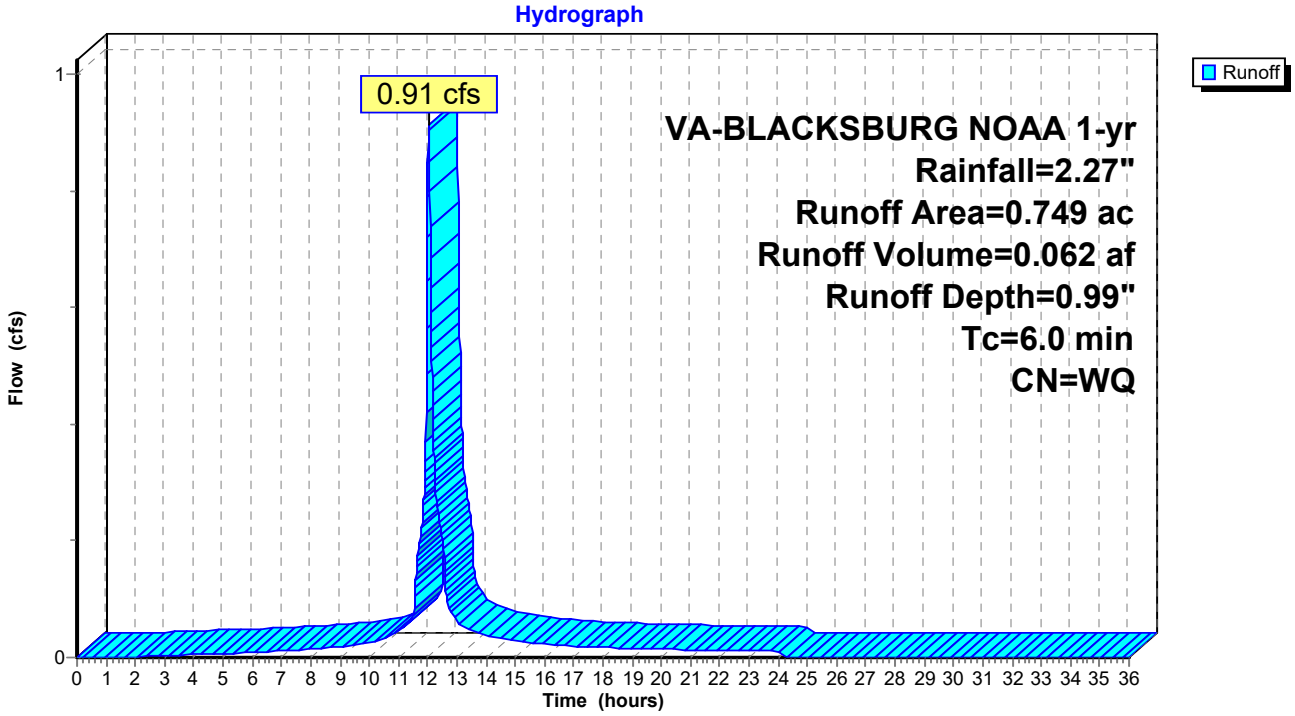
Runoff = 0.91 cfs @ 12.04 hrs, Volume= 0.062 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.414	61	>75% Grass cover, Good, HSG B
0.335	98	Paved parking, HSG B
0.749		Weighted Average

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

Subcatchment 2S: DIRECT RUNOFF

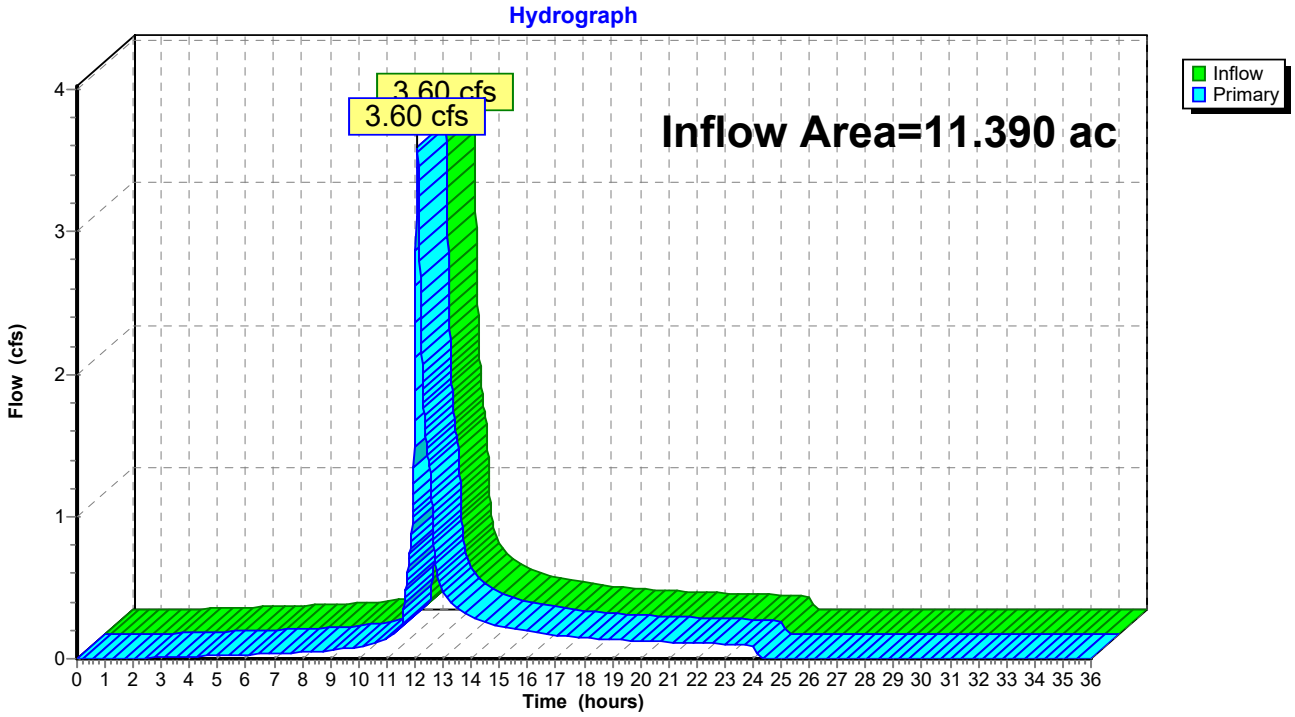


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.390 ac, Inflow Depth = 0.37" for 1-yr event
Inflow = 3.60 cfs @ 12.08 hrs, Volume= 0.347 af
Primary = 3.60 cfs @ 12.08 hrs, Volume= 0.347 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1 Runoff Area=11.390 ac Runoff Depth=0.55"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=5.22 cfs 0.525 af

Subcatchment 2S: DIRECT RUNOFF Runoff Area=0.749 ac Runoff Depth=1.28"
Tc=6.0 min CN=WQ Runoff=1.15 cfs 0.080 af

Link 1L: POINT OF ANALYSIS Inflow=5.22 cfs 0.525 af
Primary=5.22 cfs 0.525 af

Total Runoff Area = 12.139 ac Runoff Volume = 0.605 af Average Runoff Depth = 0.60"

Summary for Subcatchment 1S: DA #1

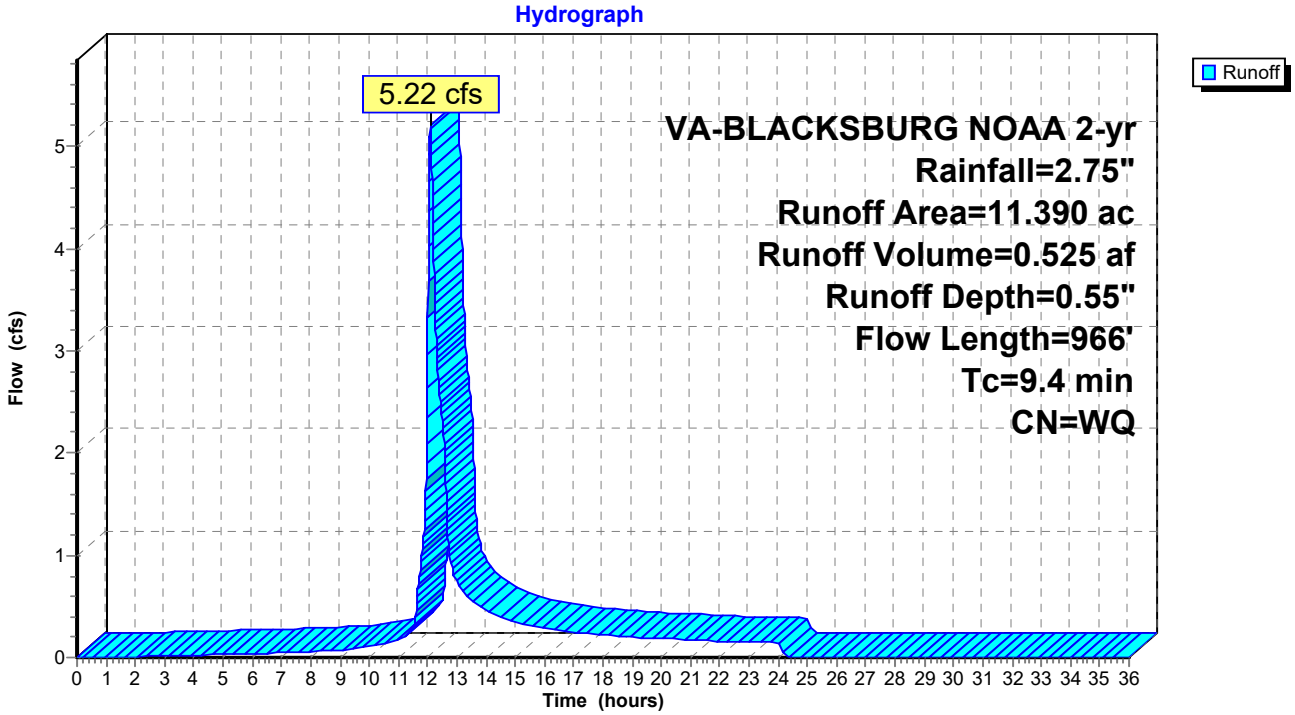
Runoff = 5.22 cfs @ 12.09 hrs, Volume= 0.525 af, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

	Area (ac)	CN	Description
*	5.161	58	Woods/grass comb., Good, HSG B
	2.916	61	>75% Grass cover, Good, HSG B
	1.228	74	>75% Grass cover, Good, HSG C
*	0.972	75	1/4 acre lots, 38% imp, HSG B
	0.027	83	1/4 acre lots, 38% imp, HSG C
	0.076	98	Paved roads w/curbs & sewers, HSG B
	0.634	98	Paved roads w/curbs & sewers, HSG C
	0.241	98	Paved parking, HSG B
	0.135	98	Paved parking, HSG C
	11.390		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1S: DA #1



Summary for Subcatchment 2S: DIRECT RUNOFF

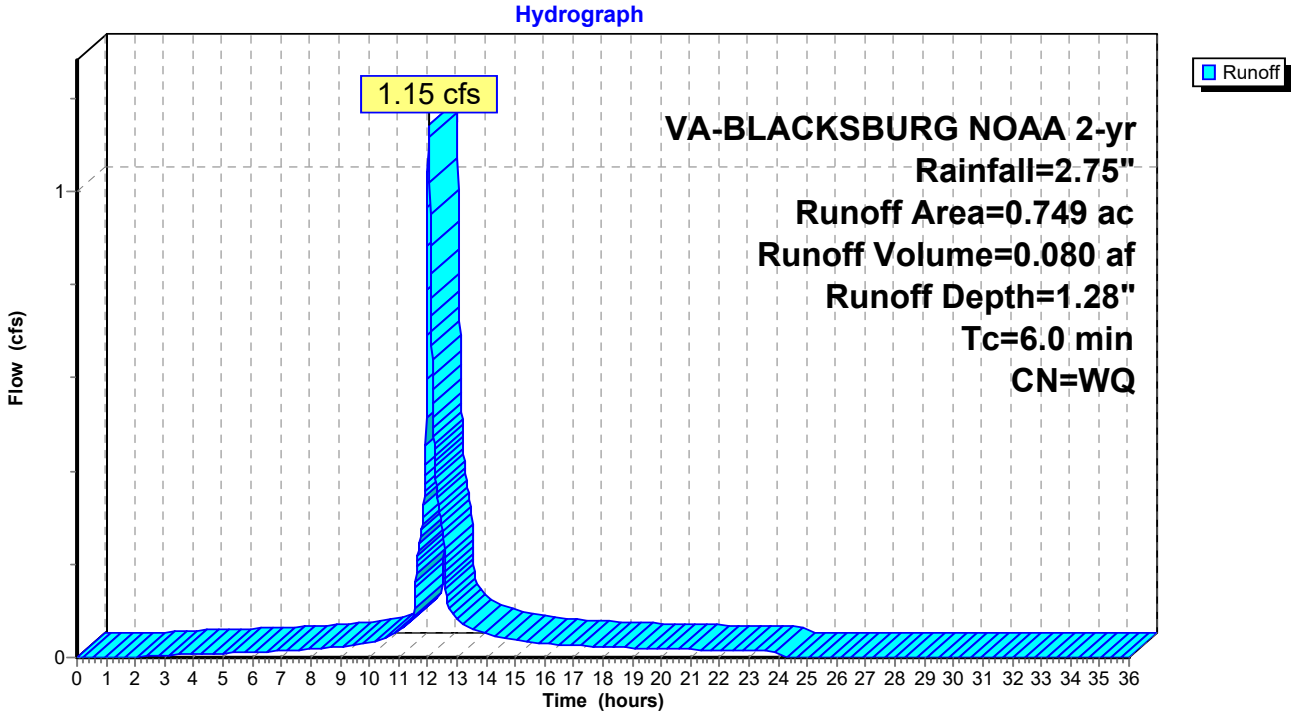
Runoff = 1.15 cfs @ 12.04 hrs, Volume= 0.080 af, Depth= 1.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.414	61	>75% Grass cover, Good, HSG B
0.335	98	Paved parking, HSG B
0.749		Weighted Average

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

Subcatchment 2S: DIRECT RUNOFF

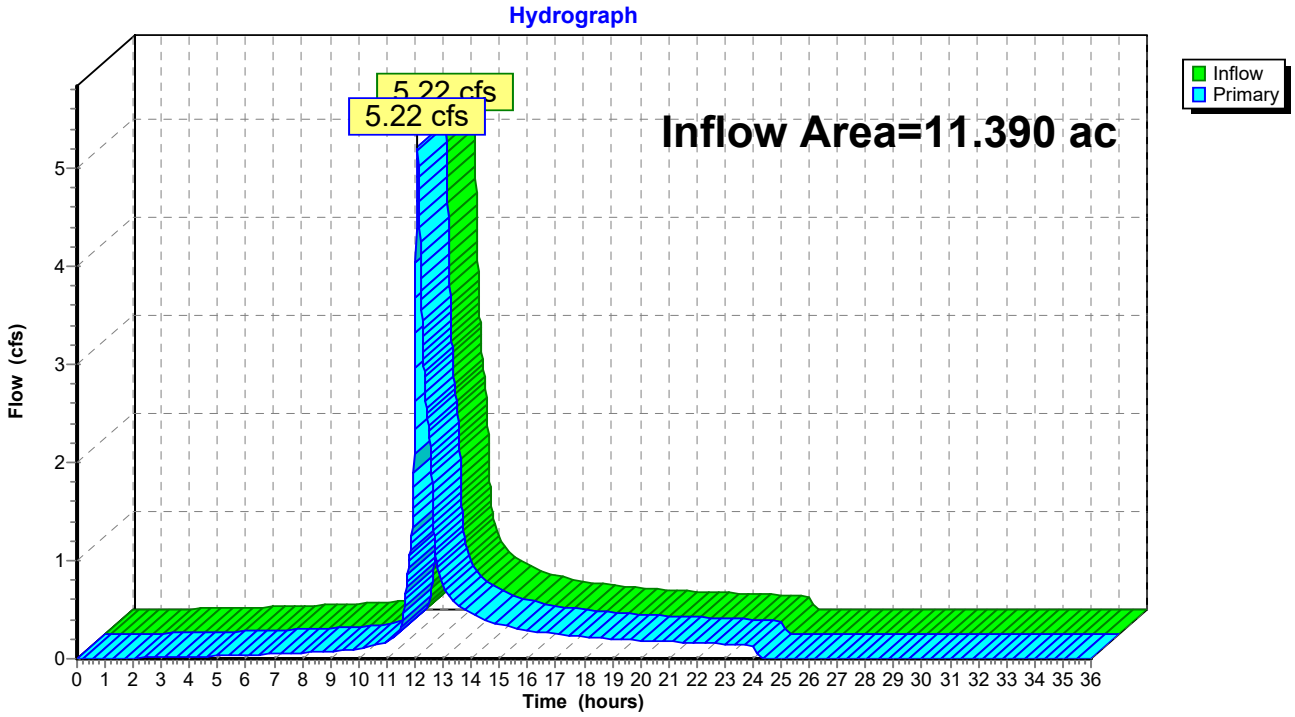


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.390 ac, Inflow Depth = 0.55" for 2-yr event
Inflow = 5.22 cfs @ 12.09 hrs, Volume= 0.525 af
Primary = 5.22 cfs @ 12.09 hrs, Volume= 0.525 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1 Runoff Area=11.390 ac Runoff Depth=1.24"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=13.23 cfs 1.177 af

Subcatchment 2S: DIRECT RUNOFF Runoff Area=0.749 ac Runoff Depth=2.20"
Tc=6.0 min CN=WQ Runoff=1.89 cfs 0.137 af

Link 1L: POINT OF ANALYSIS Inflow=13.23 cfs 1.177 af
Primary=13.23 cfs 1.177 af

Total Runoff Area = 12.139 ac Runoff Volume = 1.314 af Average Runoff Depth = 1.30"

Summary for Subcatchment 1S: DA #1

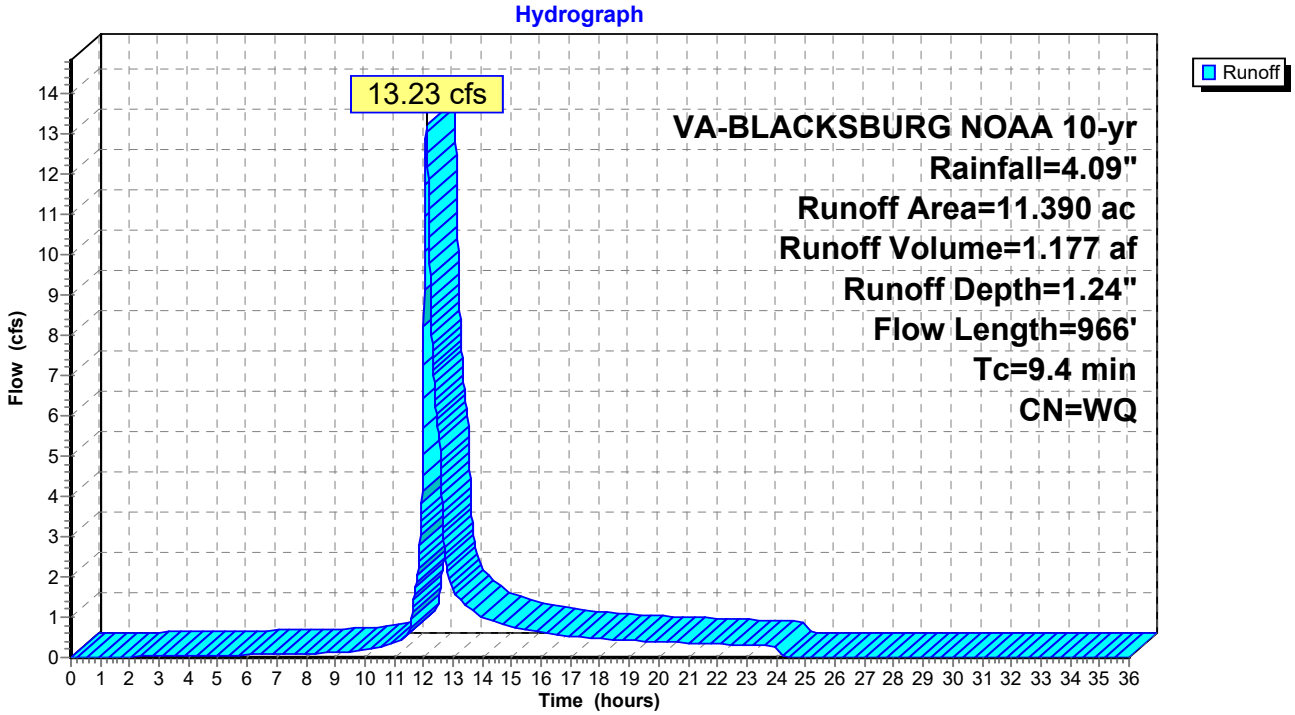
Runoff = 13.23 cfs @ 12.09 hrs, Volume= 1.177 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

	Area (ac)	CN	Description
*	5.161	58	Woods/grass comb., Good, HSG B
	2.916	61	>75% Grass cover, Good, HSG B
	1.228	74	>75% Grass cover, Good, HSG C
*	0.972	75	1/4 acre lots, 38% imp, HSG B
	0.027	83	1/4 acre lots, 38% imp, HSG C
	0.076	98	Paved roads w/curbs & sewers, HSG B
	0.634	98	Paved roads w/curbs & sewers, HSG C
	0.241	98	Paved parking, HSG B
	0.135	98	Paved parking, HSG C
	11.390		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1S: DA #1



Summary for Subcatchment 2S: DIRECT RUNOFF

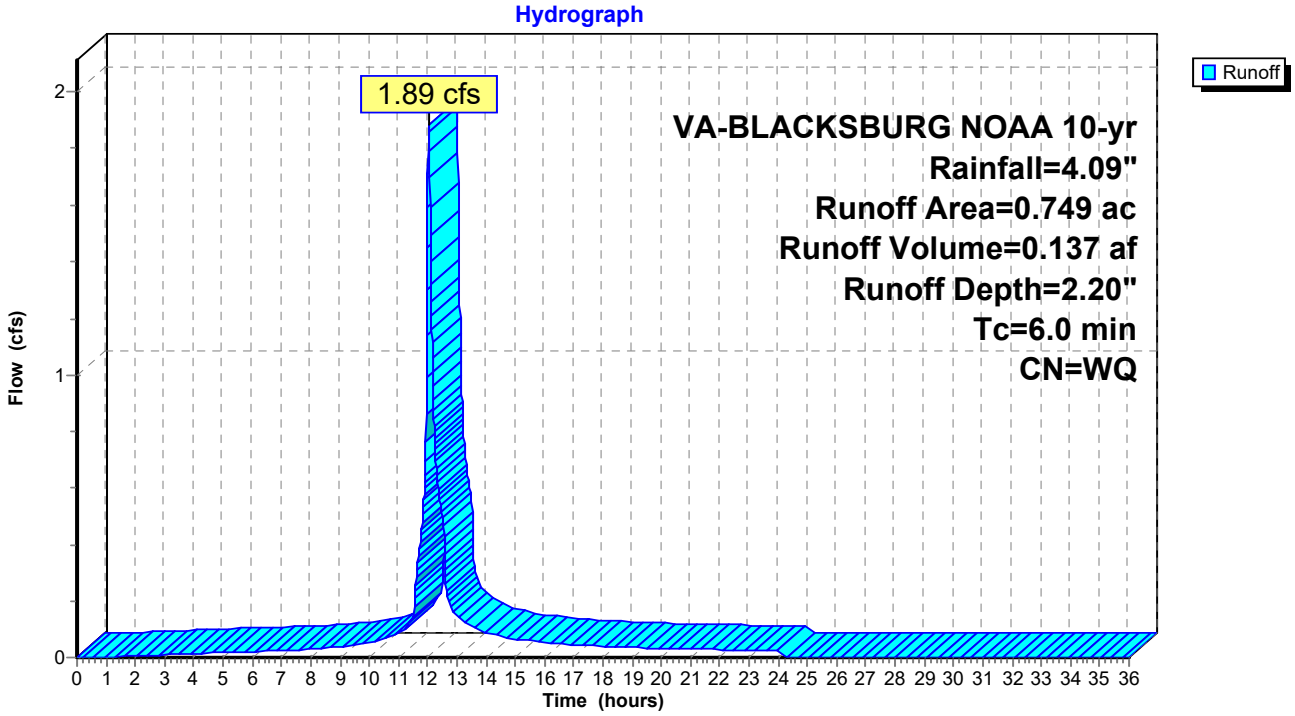
Runoff = 1.89 cfs @ 12.04 hrs, Volume= 0.137 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.414	61	>75% Grass cover, Good, HSG B
0.335	98	Paved parking, HSG B
0.749		Weighted Average

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

Subcatchment 2S: DIRECT RUNOFF

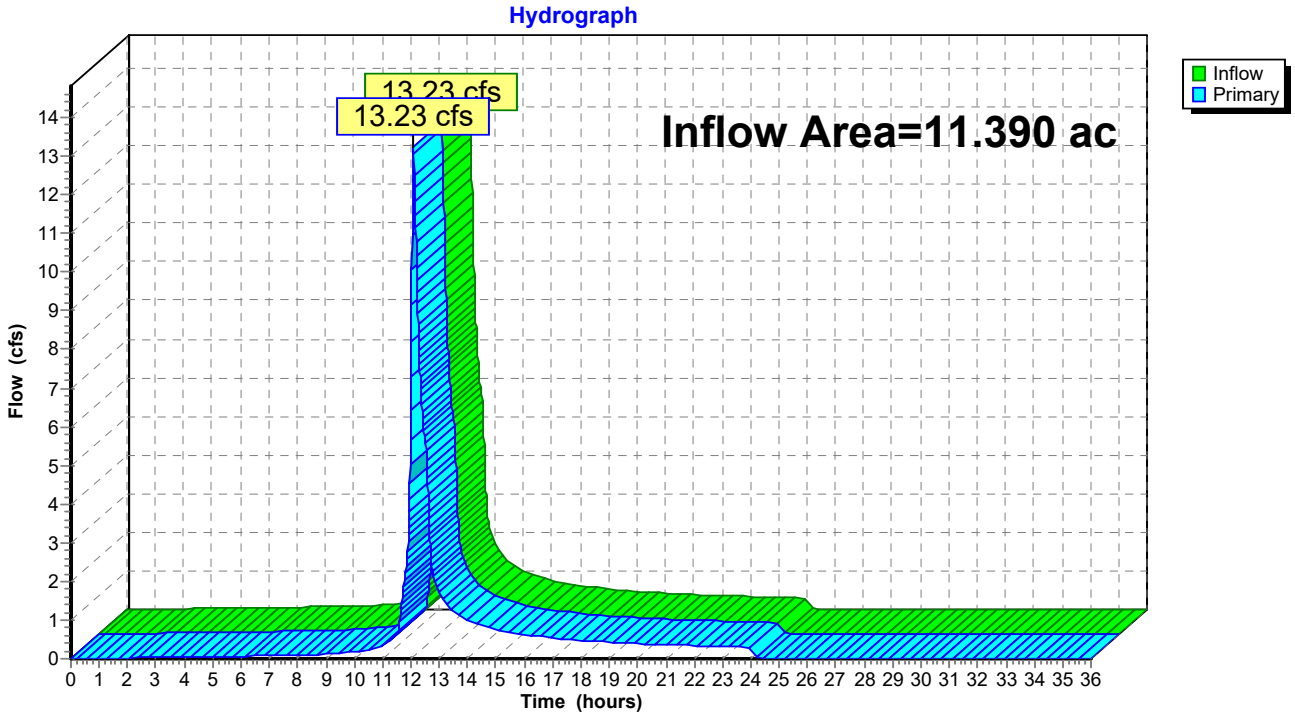


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.390 ac, Inflow Depth = 1.24" for 10-yr event
Inflow = 13.23 cfs @ 12.09 hrs, Volume= 1.177 af
Primary = 13.23 cfs @ 12.09 hrs, Volume= 1.177 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1 Runoff Area=11.390 ac Runoff Depth=2.84"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=29.31 cfs 2.696 af

Subcatchment 2S: DIRECT RUNOFF Runoff Area=0.749 ac Runoff Depth=4.08"
Tc=6.0 min CN=WQ Runoff=3.08 cfs 0.255 af

Link 1L: POINT OF ANALYSIS Inflow=29.31 cfs 2.696 af
Primary=29.31 cfs 2.696 af

Total Runoff Area = 12.139 ac Runoff Volume = 2.951 af Average Runoff Depth = 2.92"

Summary for Subcatchment 1S: DA #1

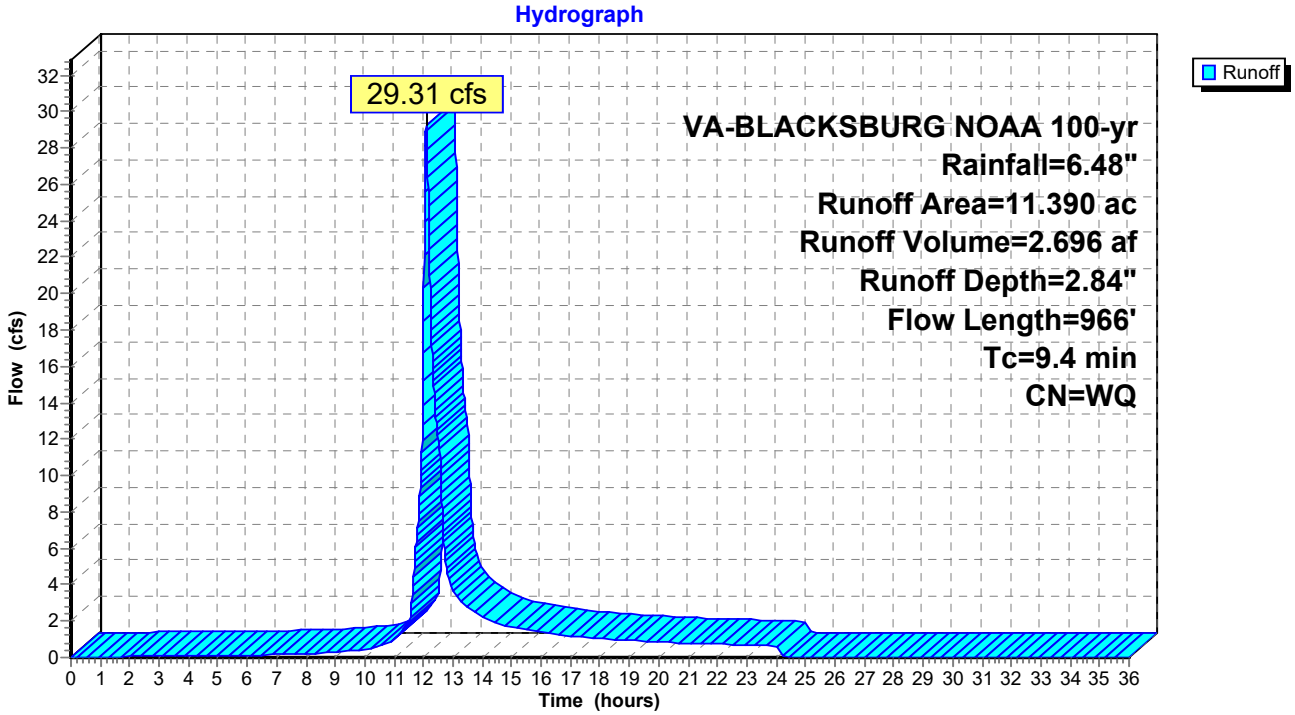
Runoff = 29.31 cfs @ 12.09 hrs, Volume= 2.696 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

	Area (ac)	CN	Description
*	5.161	58	Woods/grass comb., Good, HSG B
	2.916	61	>75% Grass cover, Good, HSG B
	1.228	74	>75% Grass cover, Good, HSG C
*	0.972	75	1/4 acre lots, 38% imp, HSG B
	0.027	83	1/4 acre lots, 38% imp, HSG C
	0.076	98	Paved roads w/curbs & sewers, HSG B
	0.634	98	Paved roads w/curbs & sewers, HSG C
	0.241	98	Paved parking, HSG B
	0.135	98	Paved parking, HSG C
	11.390		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1S: DA #1



Summary for Subcatchment 2S: DIRECT RUNOFF

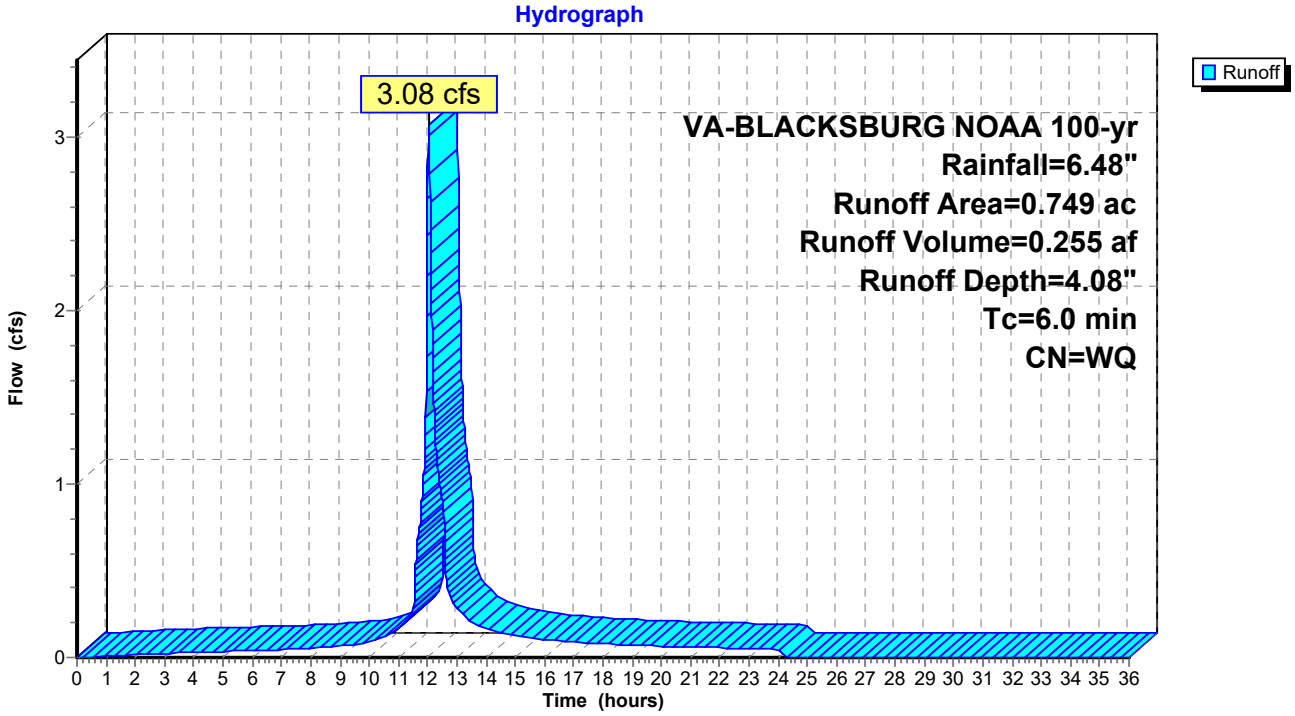
Runoff = 3.08 cfs @ 12.04 hrs, Volume= 0.255 af, Depth= 4.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.414	61	>75% Grass cover, Good, HSG B
0.335	98	Paved parking, HSG B
0.749		Weighted Average

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

Subcatchment 2S: DIRECT RUNOFF

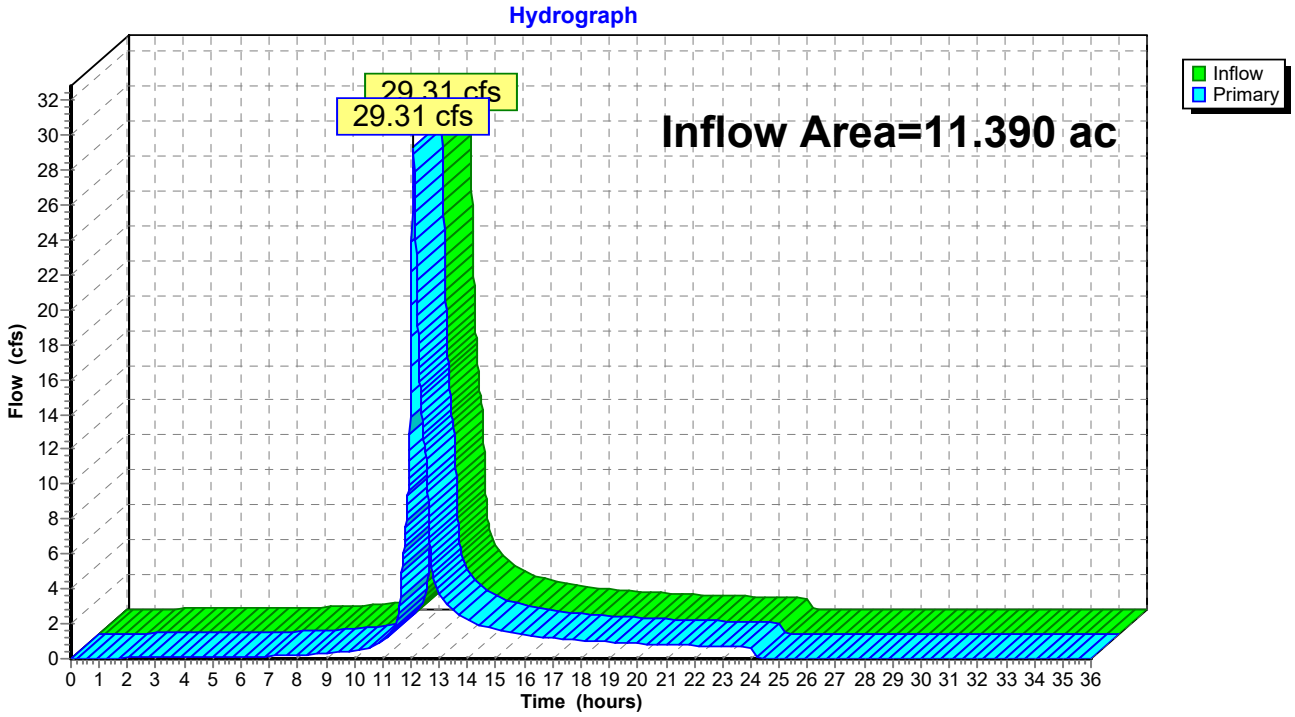


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.390 ac, Inflow Depth = 2.84" for 100-yr event
Inflow = 29.31 cfs @ 12.09 hrs, Volume= 2.696 af
Primary = 29.31 cfs @ 12.09 hrs, Volume= 2.696 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS



Routing Diagram for RV CALCULATION
Prepared by Balzer & Associates, Inc., Printed 8/31/2020
HydroCAD® 10.10-4a s/n 07713 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.352	61	>75% Grass cover, Good, HSG B (1SA, 1SB, 2SA, 2SB)
3.181	98	Paved parking, HSG B (1SA, 1SB, 2SA, 2SB)
4.773	58	Woods/grass comb., Good, HSG B (1SA)
12.306	**69**	**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1SA: DA #1 - PRE DEV Runoff Area=5.406 ac Runoff Depth=0.11"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=0.16 cfs 0.048 af

Subcatchment 1SB: DA #1 - POST-DEV Runoff Area=5.462 ac Runoff Depth=1.01"
Tc=6.0 min CN=WQ Runoff=6.85 cfs 0.460 af

Subcatchment 2SA: DA #2 - PRE DEV Runoff Area=0.749 ac Runoff Depth=0.99"
Tc=6.0 min CN=WQ Runoff=0.91 cfs 0.062 af

Subcatchment 2SB: DA #2 - POST DEV Runoff Area=0.689 ac Runoff Depth=0.92"
Tc=6.0 min CN=WQ Runoff=0.78 cfs 0.053 af

Total Runoff Area = 12.306 ac Runoff Volume = 0.623 af Average Runoff Depth = 0.61"

Summary for Subcatchment 1SA: DA #1 - PRE DEV

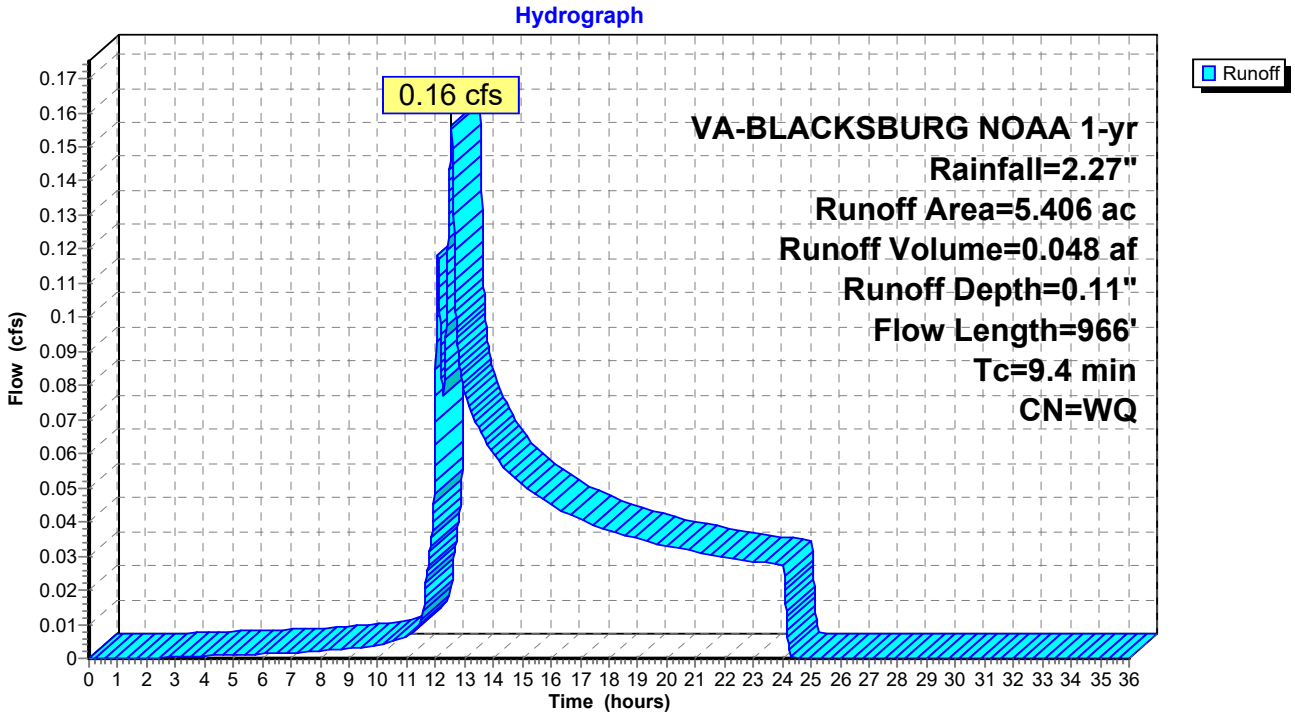
Runoff = 0.16 cfs @ 12.56 hrs, Volume= 0.048 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
4.773	58	Woods/grass comb., Good, HSG B
0.582	61	>75% Grass cover, Good, HSG B
0.051	98	Paved parking, HSG B
5.406		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1SA: DA #1 - PRE DEV



Summary for Subcatchment 1SB: DA #1 - POST-DEV

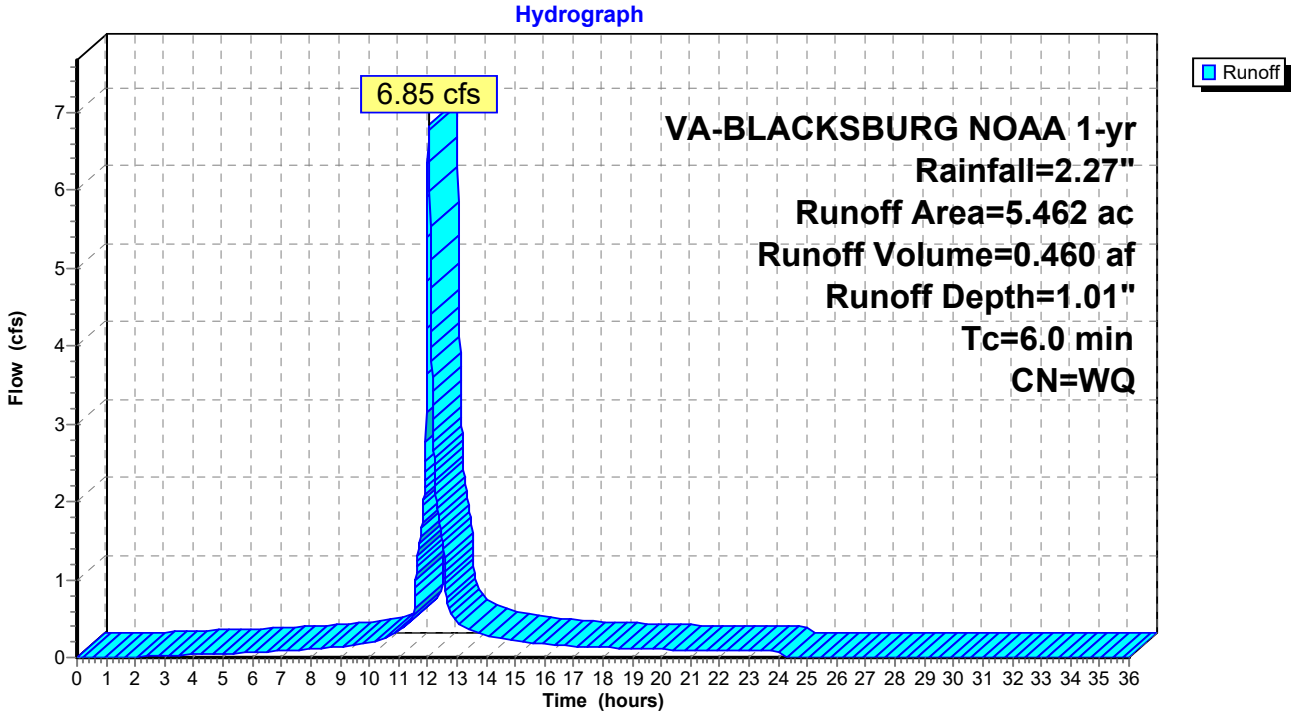
Runoff = 6.85 cfs @ 12.04 hrs, Volume= 0.460 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
2.952	61	>75% Grass cover, Good, HSG B
2.510	98	Paved parking, HSG B
5.462		Weighted Average

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

Subcatchment 1SB: DA #1 - POST-DEV



Summary for Subcatchment 2SA: DA #2 - PRE DEV

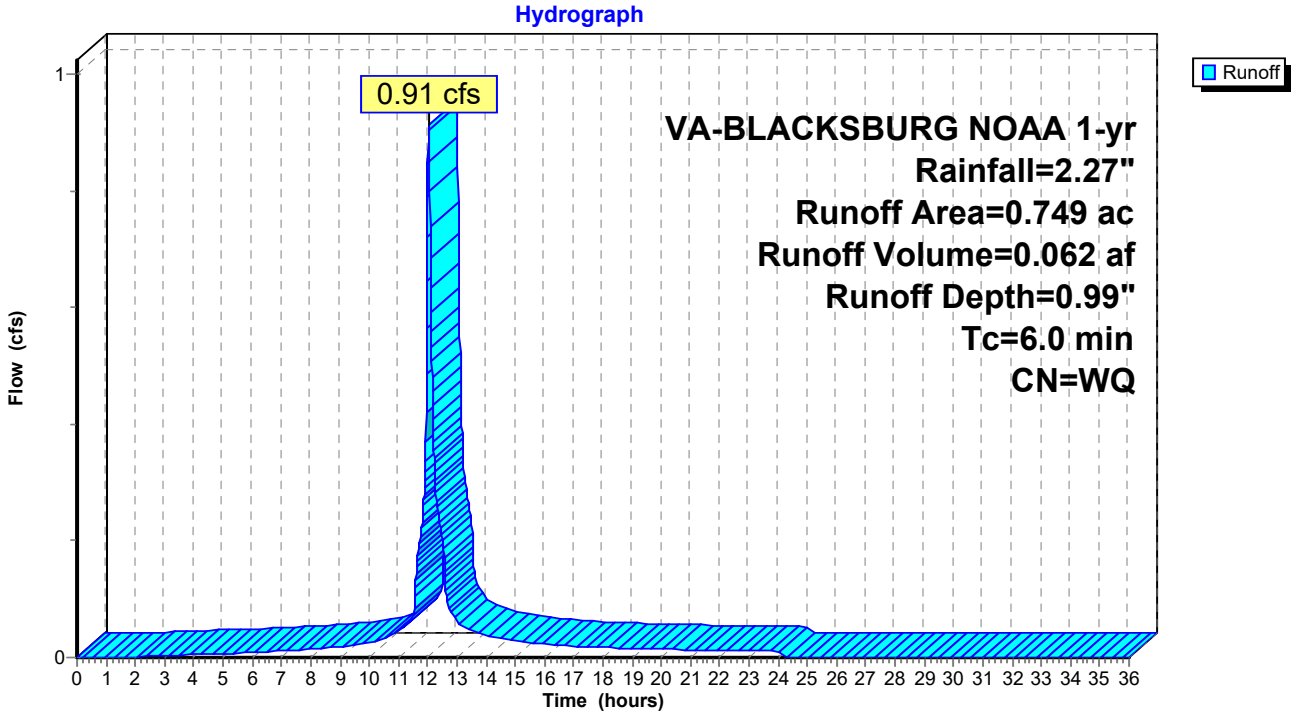
Runoff = 0.91 cfs @ 12.04 hrs, Volume= 0.062 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.414	61	>75% Grass cover, Good, HSG B
0.335	98	Paved parking, HSG B
0.749		Weighted Average

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

Subcatchment 2SA: DA #2 - PRE DEV



Summary for Subcatchment 2SB: DA #2 - POST DEV

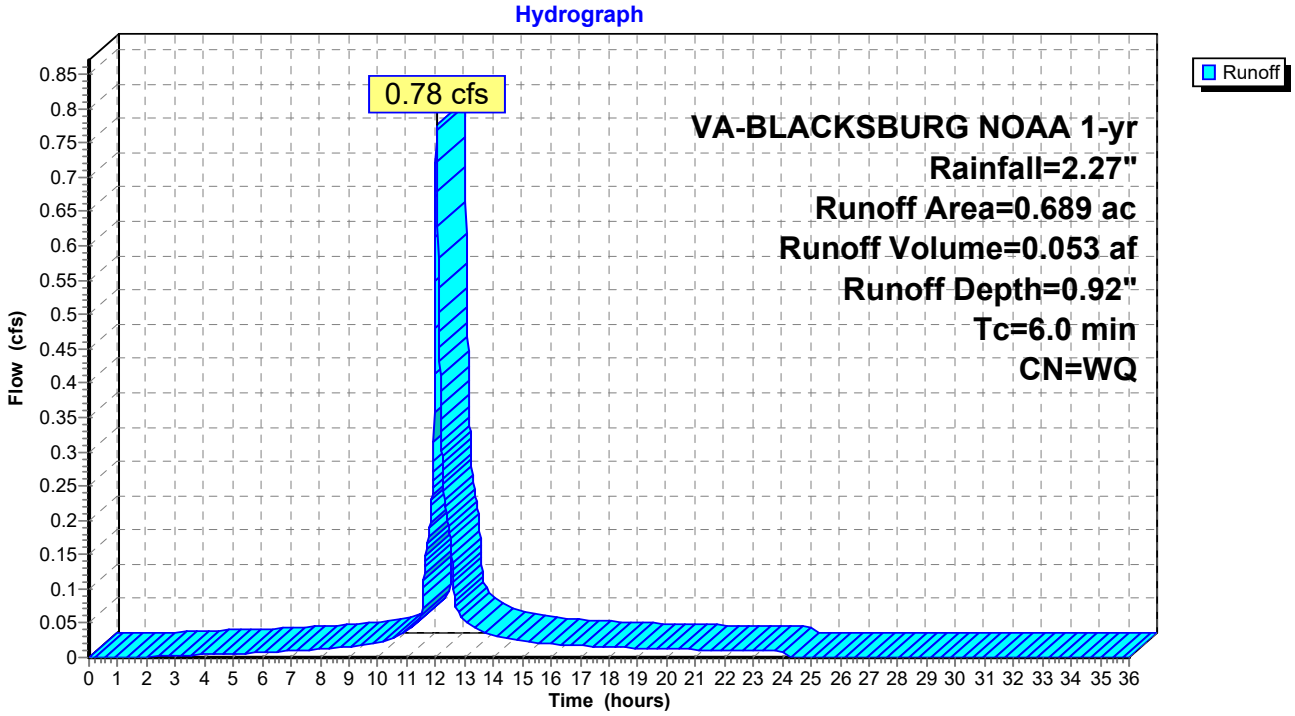
Runoff = 0.78 cfs @ 12.04 hrs, Volume= 0.053 af, Depth= 0.92"

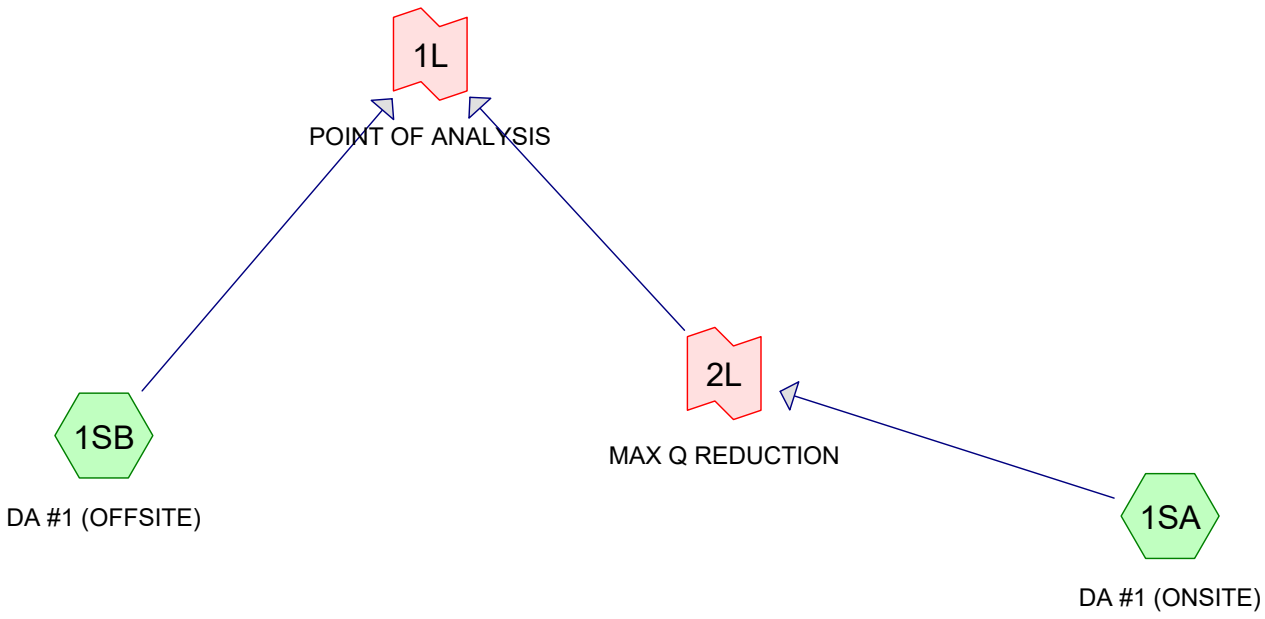
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

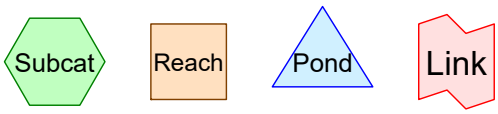
Area (ac)	CN	Description
0.404	61	>75% Grass cover, Good, HSG B
0.285	98	Paved parking, HSG B
0.689		Weighted Average

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

Subcatchment 2SB: DA #2 - POST DEV







Routing Diagram for CHANNEL PROTECTION
Prepared by Balzer & Associates, Inc., Printed 8/31/2020
HydroCAD® 10.10-4a s/n 07713 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.972	75	1/4 acre lots, 38% imp, HSG B (1SB)
0.027	83	1/4 acre lots, 38% imp, HSG C (1SB)
2.916	61	>75% Grass cover, Good, HSG B (1SA, 1SB)
1.228	74	>75% Grass cover, Good, HSG C (1SB)
0.241	98	Paved parking, HSG B (1SA, 1SB)
0.135	98	Paved parking, HSG C (1SB)
0.076	98	Paved roads w/curbs & sewers, HSG B (1SB)
0.634	98	Paved roads w/curbs & sewers, HSG C (1SB)
5.161	58	Woods/grass comb., Good, HSG B (1SA, 1SB)
11.390	**66**	**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1SA: DA #1 (ONSITE) Runoff Area=5.406 ac Runoff Depth=0.11"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=0.16 cfs 0.048 af

Subcatchment 1SB: DA #1 (OFFSITE) Runoff Area=5.984 ac Runoff Depth=0.60"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=3.48 cfs 0.298 af

Link 1L: POINT OF ANALYSIS Inflow=3.49 cfs 0.302 af
Primary=3.49 cfs 0.302 af

Link 2L: MAX Q REDUCTION x 0.08 Inflow=0.16 cfs 0.048 af
Primary=0.01 cfs 0.004 af Secondary=0.14 cfs 0.045 af

Total Runoff Area = 11.390 ac Runoff Volume = 0.347 af Average Runoff Depth = 0.37"

Summary for Subcatchment 1SA: DA #1 (ONSITE)

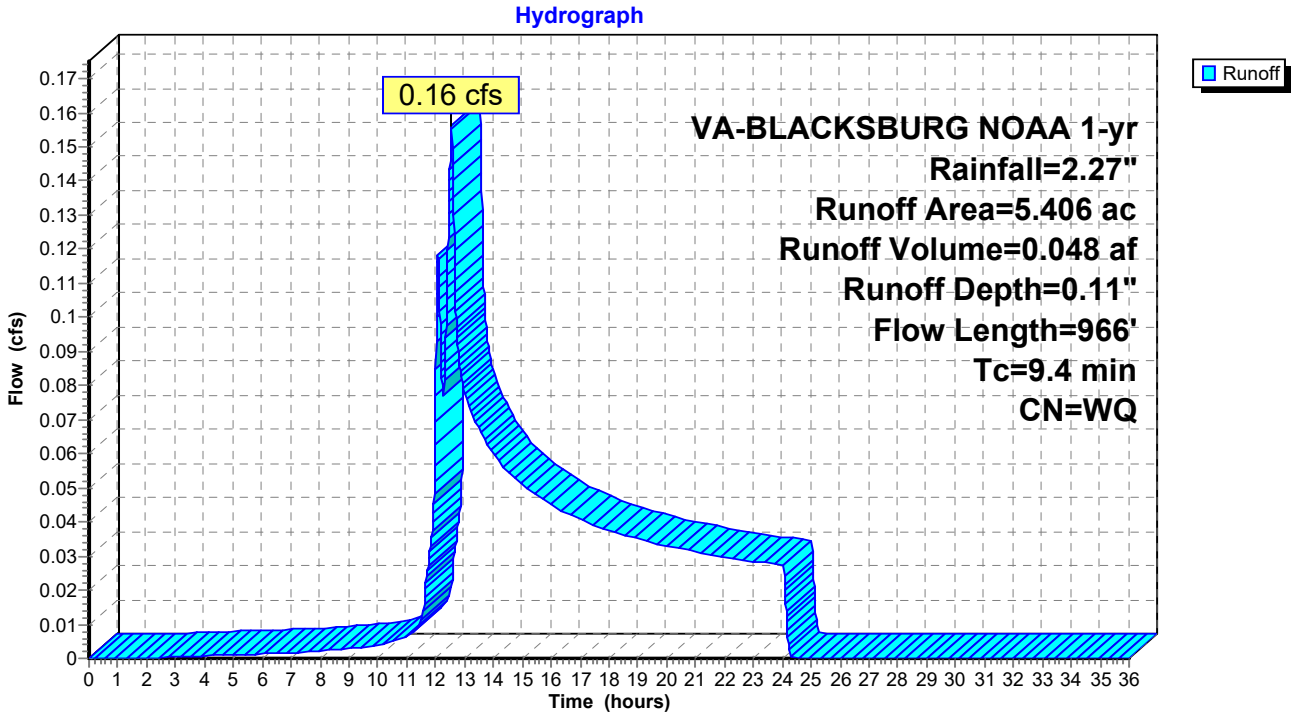
Runoff = 0.16 cfs @ 12.56 hrs, Volume= 0.048 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

	Area (ac)	CN	Description
*	4.773	58	Woods/grass comb., Good, HSG B
	0.582	61	>75% Grass cover, Good, HSG B
	0.051	98	Paved parking, HSG B
	5.406		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1SA: DA #1 (ONSITE)



Summary for Subcatchment 1SB: DA #1 (OFFSITE)

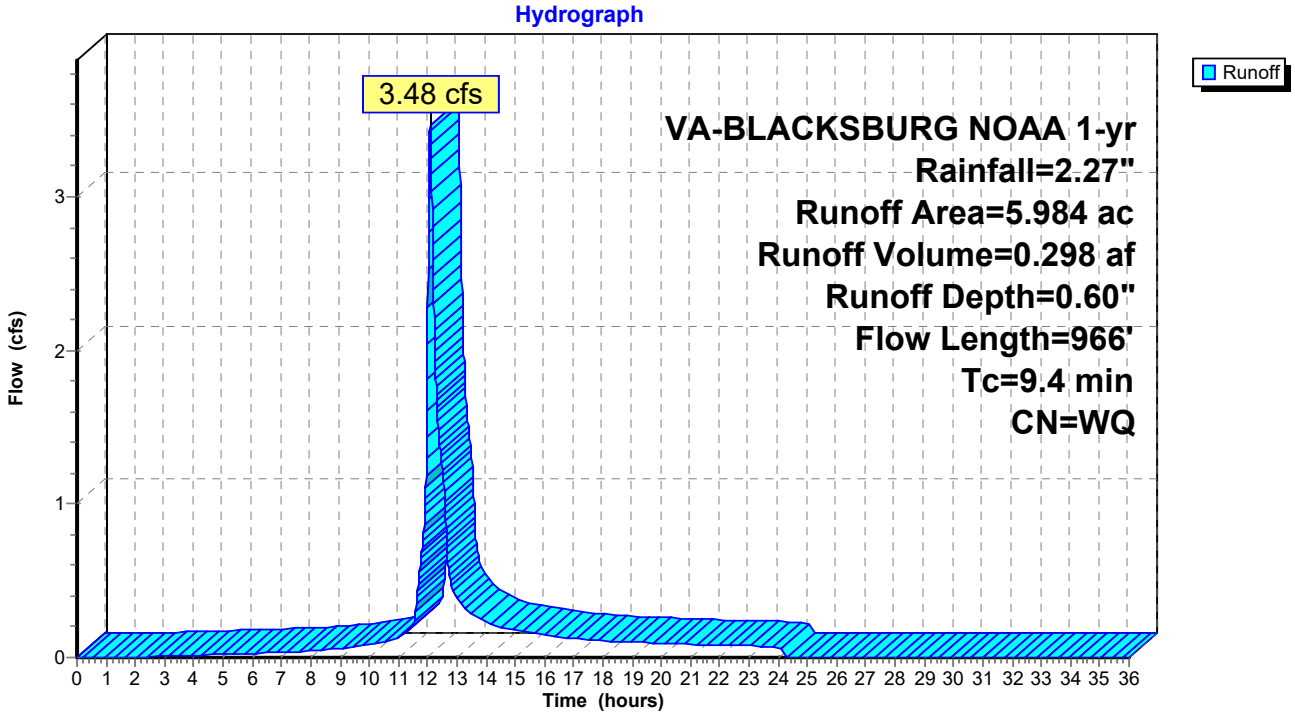
Runoff = 3.48 cfs @ 12.08 hrs, Volume= 0.298 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.388	58	Woods/grass comb., Good, HSG B
2.334	61	>75% Grass cover, Good, HSG B
1.228	74	>75% Grass cover, Good, HSG C
0.972	75	1/4 acre lots, 38% imp, HSG B
0.027	83	1/4 acre lots, 38% imp, HSG C
0.076	98	Paved roads w/curbs & sewers, HSG B
0.634	98	Paved roads w/curbs & sewers, HSG C
0.190	98	Paved parking, HSG B
0.135	98	Paved parking, HSG C
5.984		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1SB: DA #1 (OFFSITE)

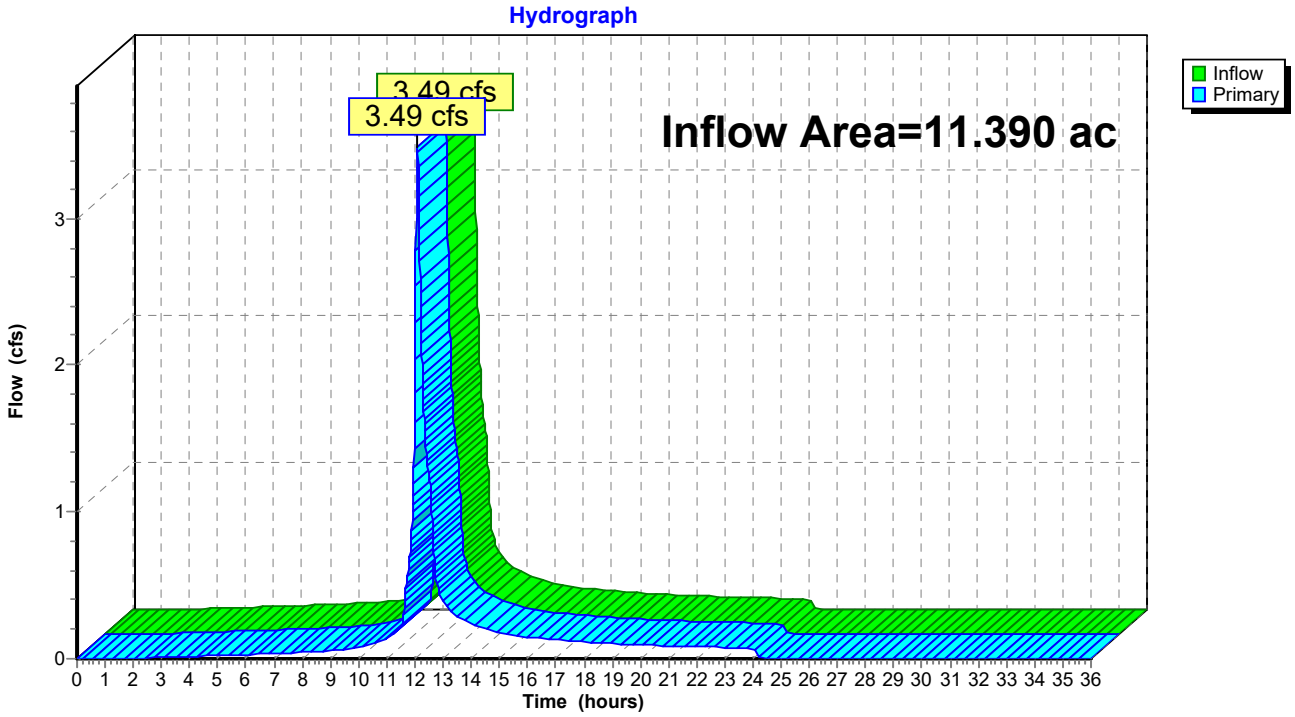


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.390 ac, Inflow Depth = 0.32" for 1-yr event
Inflow = 3.49 cfs @ 12.08 hrs, Volume= 0.302 af
Primary = 3.49 cfs @ 12.08 hrs, Volume= 0.302 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS

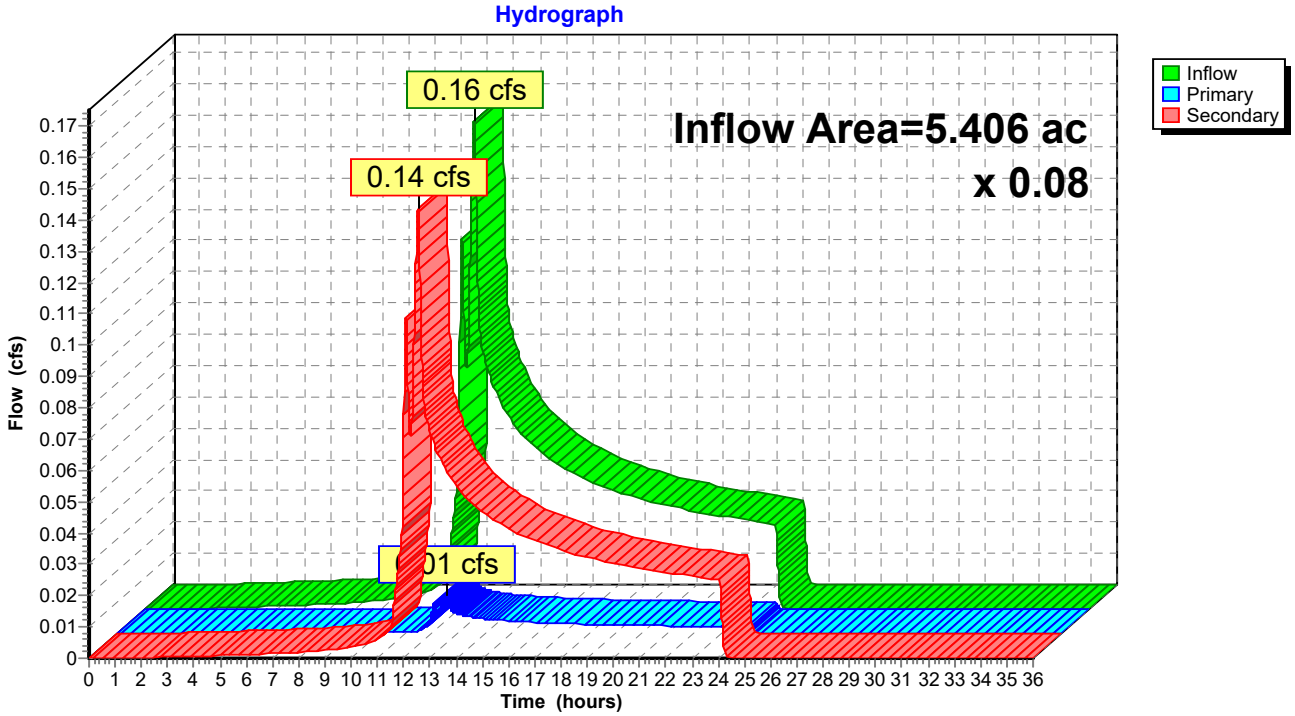


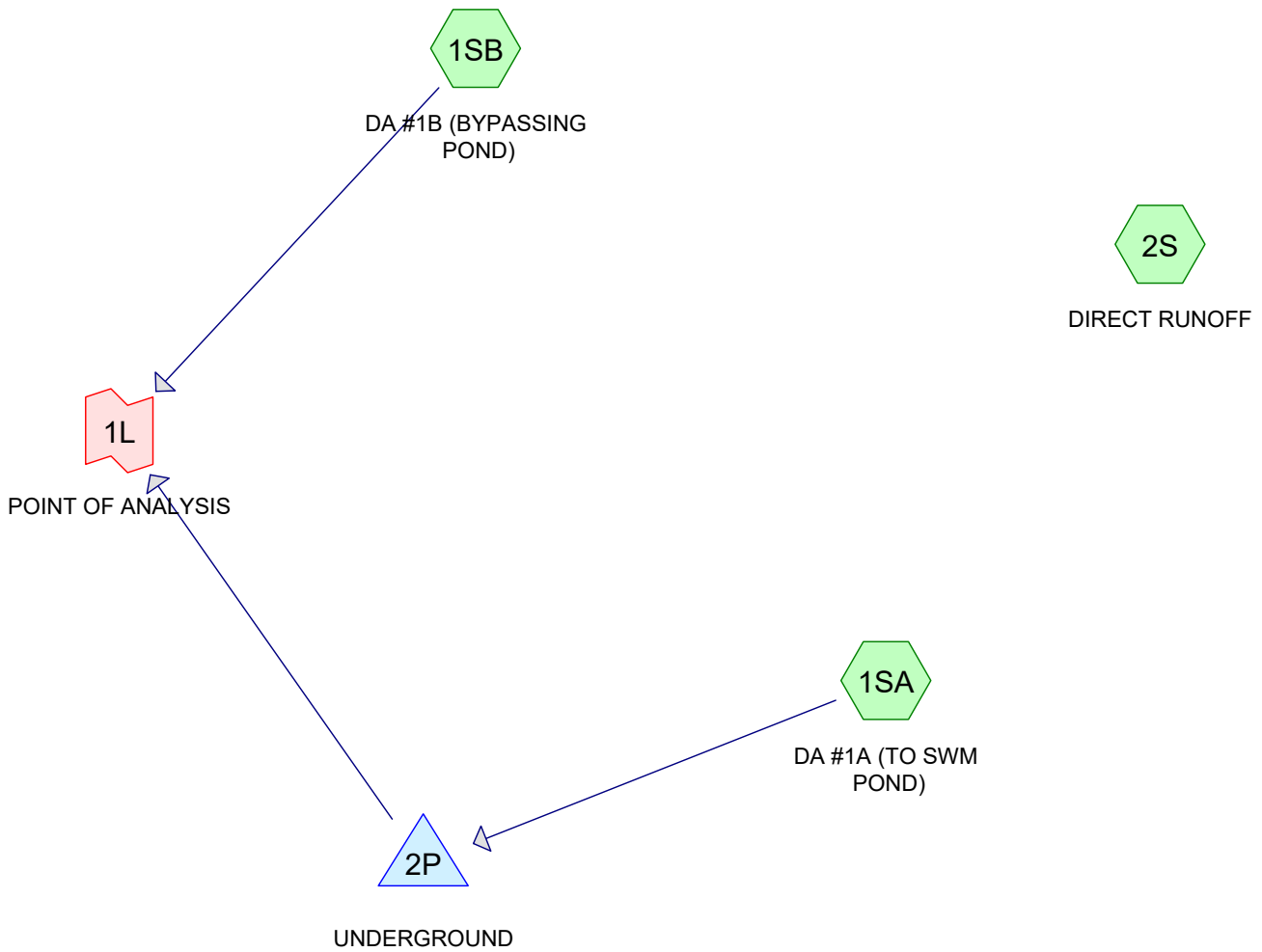
Summary for Link 2L: MAX Q REDUCTION

Inflow Area =	5.406 ac,	Inflow Depth =	0.11"	for	1-yr event
Inflow =	0.16 cfs @	12.56 hrs,	Volume=	0.048 af	
Primary =	0.01 cfs @	12.56 hrs,	Volume=	0.004 af,	Atten= 92%, Lag= 0.0 min
Secondary =	0.14 cfs @	12.56 hrs,	Volume=	0.045 af	

Primary outflow = Inflow x 0.08, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 2L: MAX Q REDUCTION





Subcat Reach Pond Link

Routing Diagram for POST DEV
Prepared by Balzer & Associates, Inc., Printed 8/31/2020
HydroCAD® 10.10-4a s/n 07713 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.972	75	1/4 acre lots, 38% imp, HSG B (1SB)
0.027	83	1/4 acre lots, 38% imp, HSG C (1SB)
5.641	61	>75% Grass cover, Good, HSG B (1SA, 1SB, 2S)
1.228	74	>75% Grass cover, Good, HSG C (1SB)
3.033	98	Paved parking, HSG B (1SA, 1SB, 2S)
0.135	98	Paved parking, HSG C (1SB)
0.076	98	Paved roads w/curbs & sewers, HSG B (1SB)
0.634	98	Paved roads w/curbs & sewers, HSG C (1SB)
0.388	58	Woods/grass comb., Good, HSG B (1SA)
12.134	**75**	**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1SA: DA #1A (TO SWM POND) Runoff Area=5.844 ac Runoff Depth=0.97"
Tc=6.0 min CN=WQ Runoff=7.00 cfs 0.471 af

Subcatchment 1SB: DA #1B (BYPASSING POND) Runoff Area=5.601 ac Runoff Depth=0.63"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=3.46 cfs 0.295 af

Subcatchment 2S: DIRECT RUNOFF Runoff Area=0.689 ac Runoff Depth=0.92"
Tc=6.0 min CN=WQ Runoff=0.78 cfs 0.053 af

Pond 2P: UNDERGROUND Peak Elev=2,196.11' Storage=0.259 af Inflow=7.00 cfs 0.471 af
Outflow=0.53 cfs 0.357 af

Link 1L: POINT OF ANALYSIS Inflow=3.56 cfs 0.651 af
Primary=3.56 cfs 0.651 af

Total Runoff Area = 12.134 ac Runoff Volume = 0.819 af Average Runoff Depth = 0.81"

Summary for Subcatchment 1SA: DA #1A (TO SWM POND)

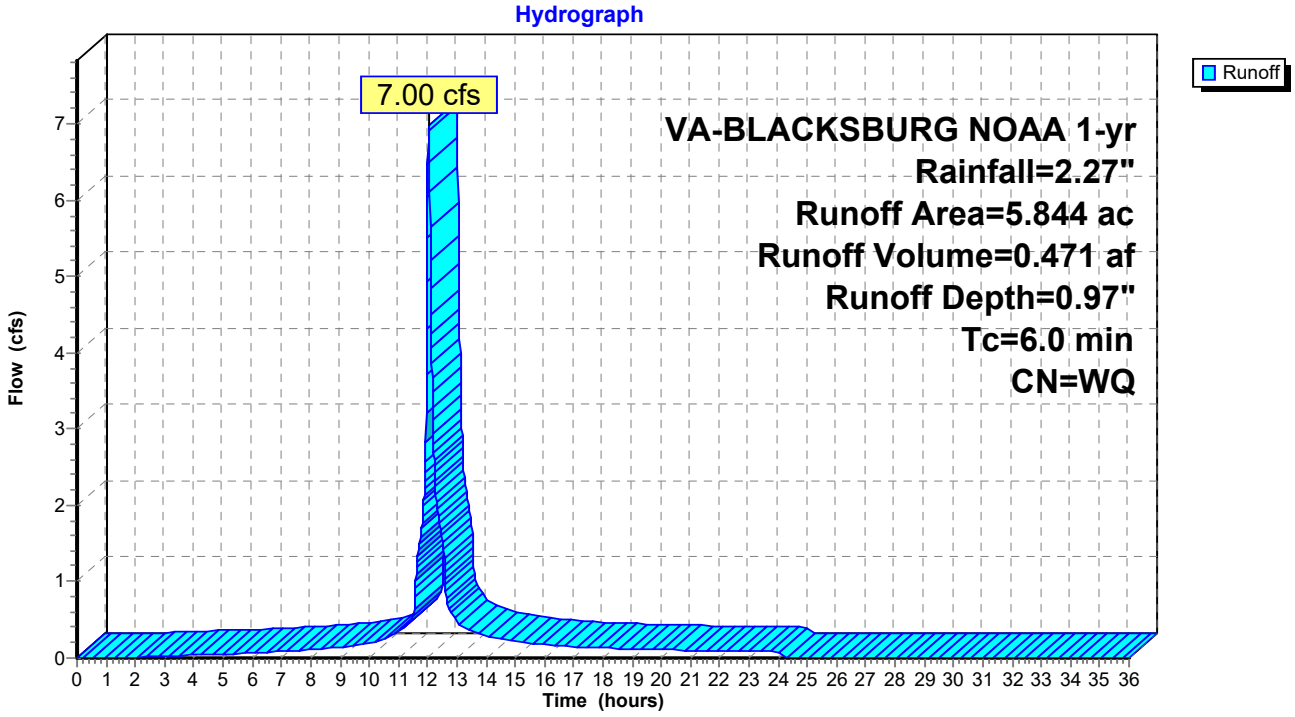
Runoff = 7.00 cfs @ 12.04 hrs, Volume= 0.471 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.388	58	Woods/grass comb., Good, HSG B
2.891	61	>75% Grass cover, Good, HSG B
2.565	98	Paved parking, HSG B
5.844		Weighted Average

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

Subcatchment 1SA: DA #1A (TO SWM POND)



Summary for Subcatchment 1SB: DA #1B (BYPASSING POND)

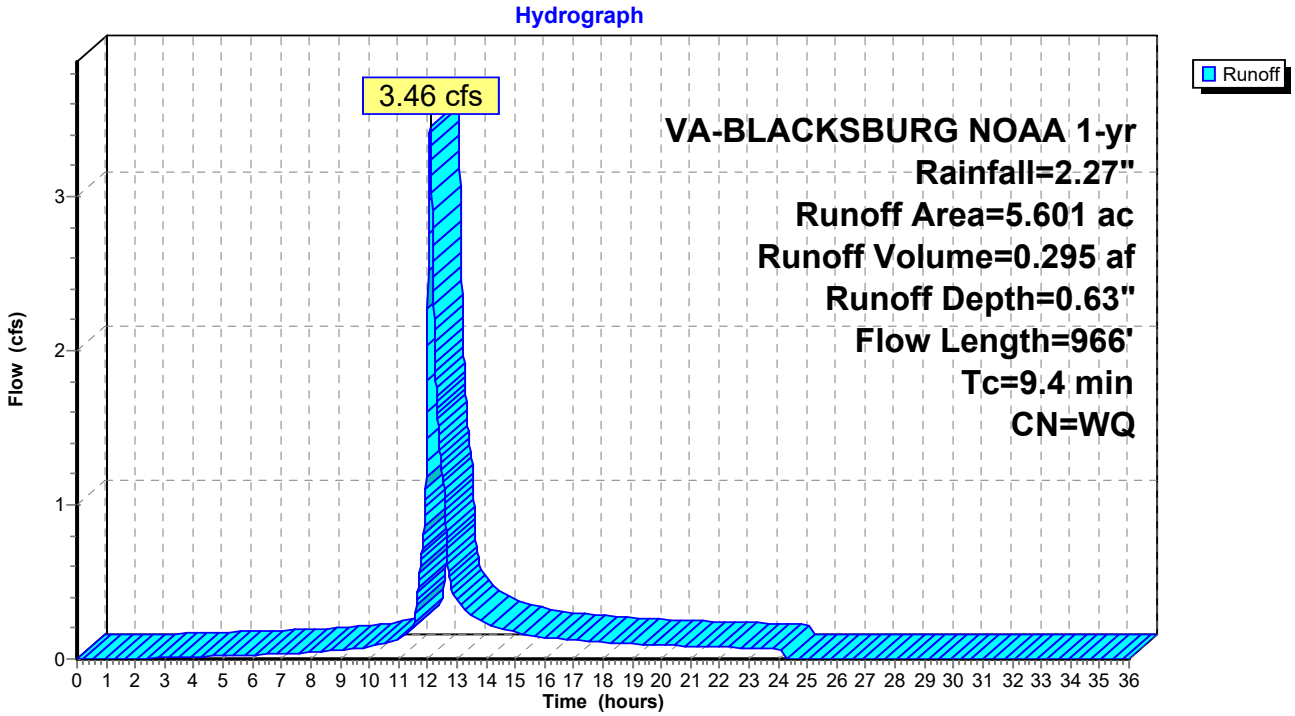
Runoff = 3.46 cfs @ 12.08 hrs, Volume= 0.295 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
2.346	61	>75% Grass cover, Good, HSG B
1.228	74	>75% Grass cover, Good, HSG C
0.972	75	1/4 acre lots, 38% imp, HSG B
0.027	83	1/4 acre lots, 38% imp, HSG C
0.076	98	Paved roads w/curbs & sewers, HSG B
0.634	98	Paved roads w/curbs & sewers, HSG C
0.183	98	Paved parking, HSG B
0.135	98	Paved parking, HSG C
5.601		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1SB: DA #1B (BYPASSING POND)



Summary for Subcatchment 2S: DIRECT RUNOFF

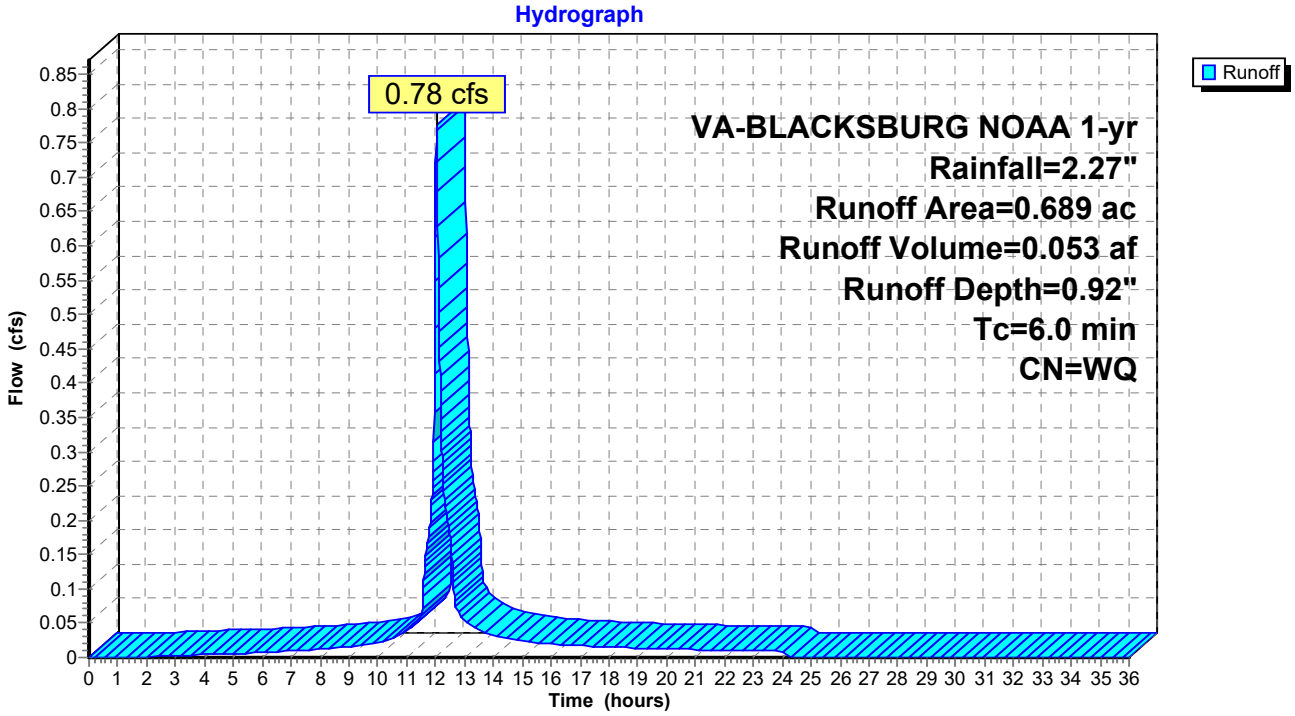
Runoff = 0.78 cfs @ 12.04 hrs, Volume= 0.053 af, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.404	61	>75% Grass cover, Good, HSG B
0.285	98	Paved parking, HSG B
0.689		Weighted Average

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

Subcatchment 2S: DIRECT RUNOFF



Summary for Pond 2P: UNDERGROUND

[44] Hint: Outlet device #2 is below defined storage

Inflow Area =	5.844 ac,	Inflow Depth =	0.97"	for	1-yr event
Inflow =	7.00 cfs @	12.04 hrs,	Volume=	0.471 af	
Outflow =	0.53 cfs @	12.87 hrs,	Volume=	0.357 af,	Atten= 92%, Lag= 49.9 min
Primary =	0.53 cfs @	12.87 hrs,	Volume=	0.357 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 2,196.11' @ 12.87 hrs Surf.Area= 0.125 ac Storage= 0.259 af

Plug-Flow detention time= 457.2 min calculated for 0.357 af (76% of inflow)
Center-of-Mass det. time= 361.7 min (1,142.9 - 781.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,193.00'	0.167 af	**44.50'W x 122.00'L x 6.00'H Field A** 0.748 af Overall - 0.330 af Embedded = 0.418 af x 40.0% Voids
#2A	2,193.50'	0.330 af	**CMP Round 60** x 36 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= -5.00' x 19.63 sf x 6 rows 42.50' Header x 19.63 sf x 1 = 834.5 cf Inside
		0.497 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,192.90'	**24.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2,192.90' / 2,192.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	2,192.95'	**Reg-U-Flo SXH 3.0-in**
#3	Device 1	2,195.60'	**5.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	2,195.90'	**0.5' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=0.53 cfs @ 12.87 hrs HW=2,196.11' (Free Discharge)
└─**1=Culvert** (Passes 0.53 cfs of 22.47 cfs potential flow)
  ├─**2=Reg-U-Flo SXH 3.0-in** (Custom Controls 0.11 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.31 cfs @ 2.96 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 0.11 cfs @ 1.08 fps)

Pond 2P: UNDERGROUND - Chamber Wizard Field A

Chamber Model = CMP Round 60 (Round Corrugated Metal Pipe)
Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf
Overall Size= 60.0"W x 60.0"H x 20.00'L
Row Length Adjustment= -5.00' x 19.63 sf x 6 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

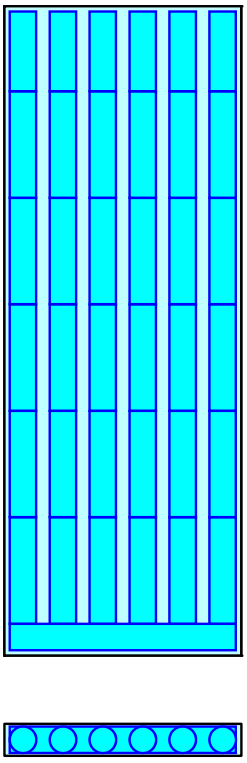
6 Chambers/Row x 20.00' Long -5.00' Row Adjustment +5.00' Header x 1 = 120.00' Row Length +12.0" End Stone x 2 = 122.00' Base Length
6 Rows x 60.0" Wide + 30.0" Spacing x 5 + 12.0" Side Stone x 2 = 44.50' Base Width
6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

36 Chambers x 392.7 cf -5.00' Row Adjustment x 19.63 sf x 6 Rows + 42.50' Header x 19.63 sf = 14,382.6 cf Chamber Storage

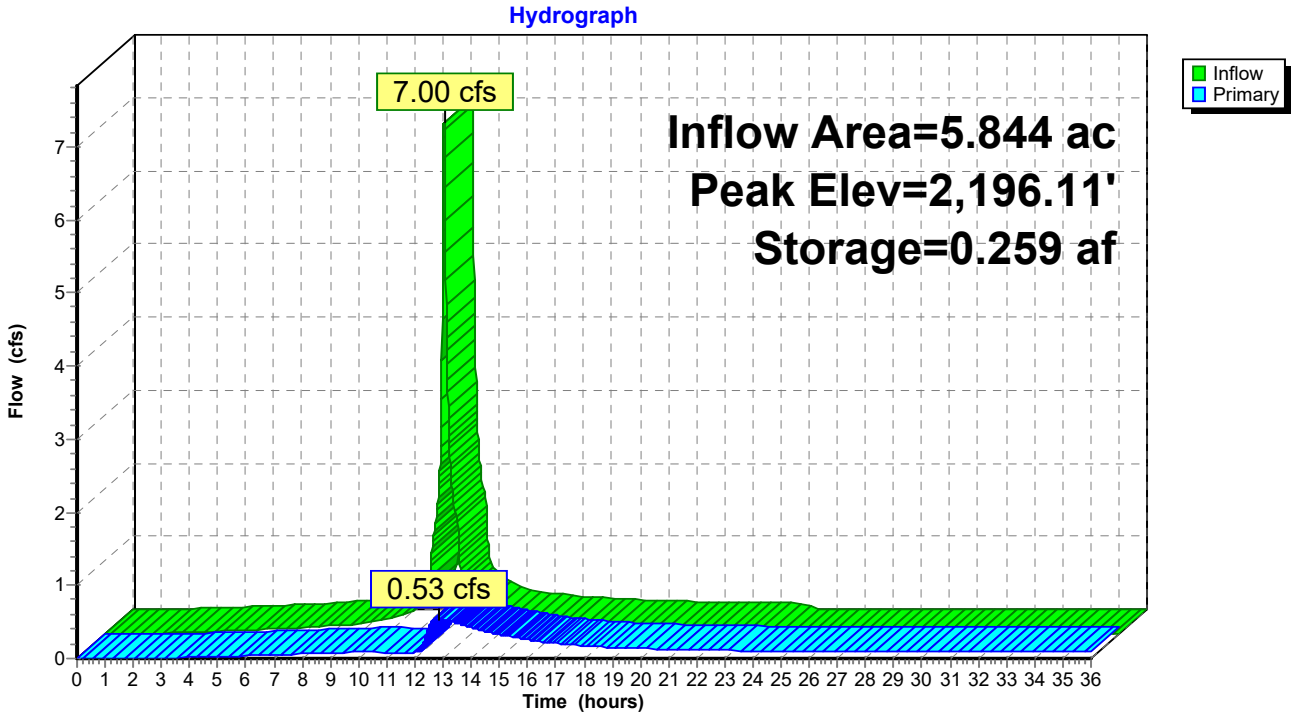
32,574.0 cf Field - 14,382.6 cf Chambers = 18,191.4 cf Stone x 40.0% Voids = 7,276.6 cf Stone Storage

Chamber Storage + Stone Storage = 21,659.2 cf = 0.497 af
Overall Storage Efficiency = 66.5%
Overall System Size = 122.00' x 44.50' x 6.00'

36 Chambers
1,206.4 cy Field
673.8 cy Stone



Pond 2P: UNDERGROUND

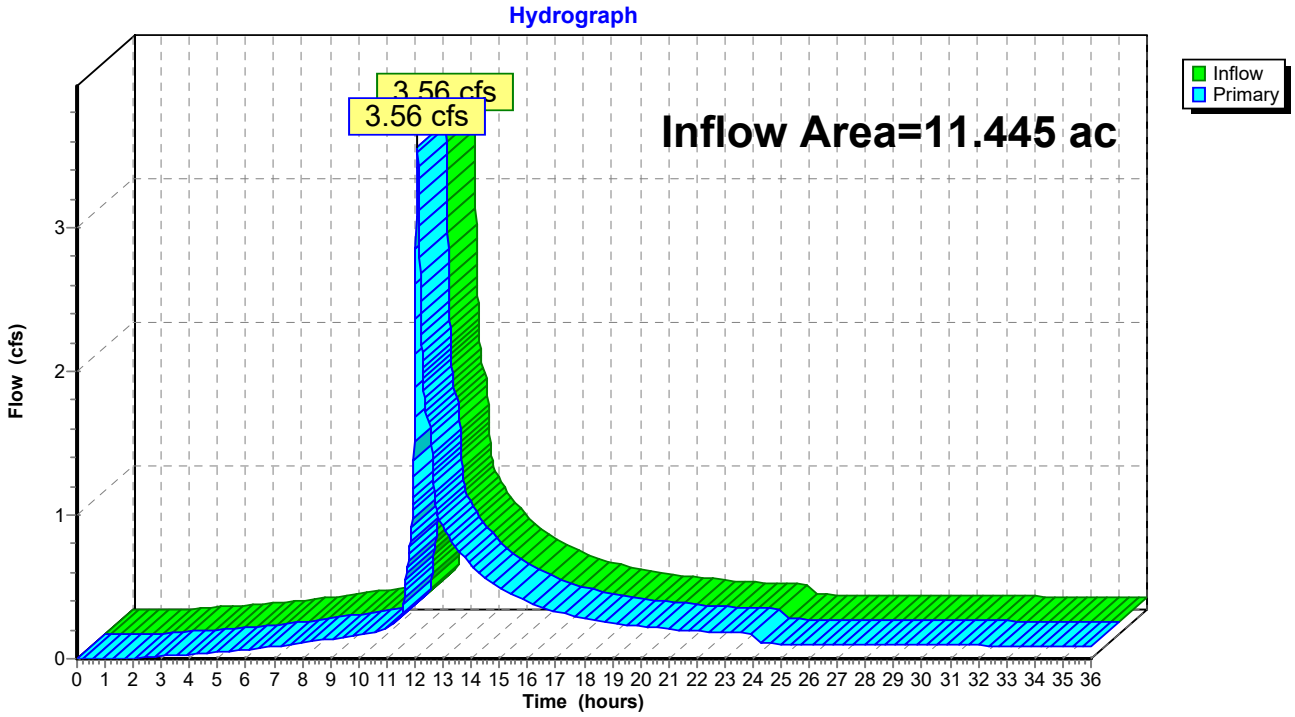


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.445 ac, Inflow Depth > 0.68" for 1-yr event
Inflow = 3.56 cfs @ 12.08 hrs, Volume= 0.651 af
Primary = 3.56 cfs @ 12.08 hrs, Volume= 0.651 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1SA: DA #1A (TO SWM POND) Runoff Area=5.844 ac Runoff Depth=1.26"
Tc=6.0 min CN=WQ Runoff=8.76 cfs 0.611 af

Subcatchment 1SB: DA #1B (BYPASSING POND) Runoff Area=5.601 ac Runoff Depth=0.89"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=4.95 cfs 0.414 af

Subcatchment 2S: DIRECT RUNOFF Runoff Area=0.689 ac Runoff Depth=1.20"
Tc=6.0 min CN=WQ Runoff=0.98 cfs 0.069 af

Pond 2P: UNDERGROUND Peak Elev=2,196.61' Storage=0.309 af Inflow=8.76 cfs 0.611 af
Outflow=1.39 cfs 0.492 af

Link 1L: POINT OF ANALYSIS Inflow=5.13 cfs 0.907 af
Primary=5.13 cfs 0.907 af

Total Runoff Area = 12.134 ac Runoff Volume = 1.095 af Average Runoff Depth = 1.08"

Summary for Subcatchment 1SA: DA #1A (TO SWM POND)

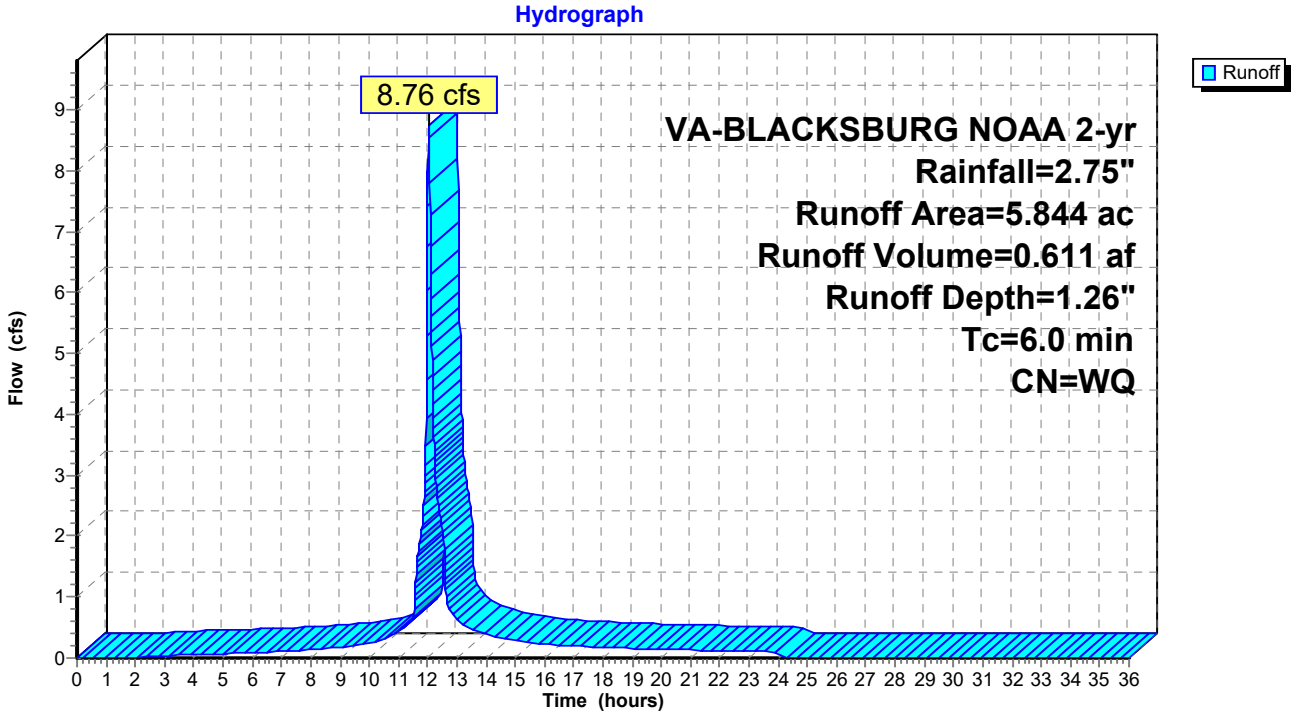
Runoff = 8.76 cfs @ 12.04 hrs, Volume= 0.611 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.388	58	Woods/grass comb., Good, HSG B
2.891	61	>75% Grass cover, Good, HSG B
2.565	98	Paved parking, HSG B
5.844		Weighted Average

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

Subcatchment 1SA: DA #1A (TO SWM POND)



Summary for Subcatchment 1SB: DA #1B (BYPASSING POND)

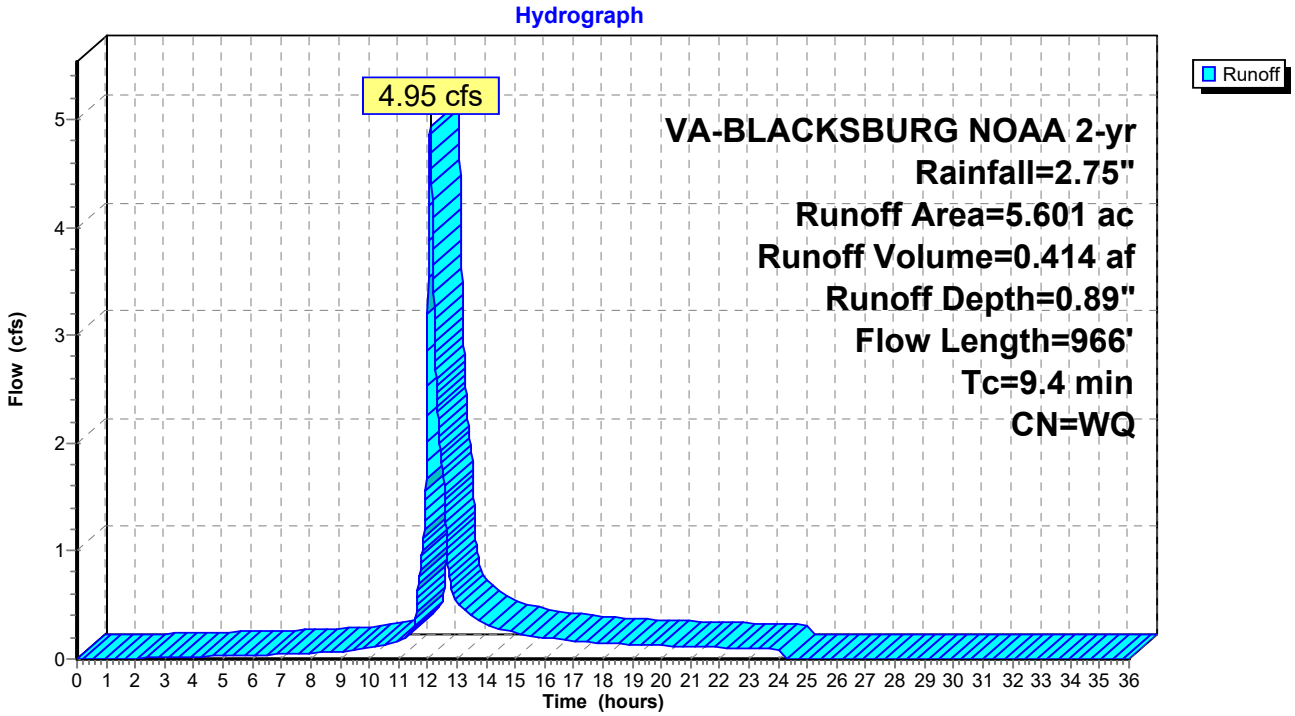
Runoff = 4.95 cfs @ 12.09 hrs, Volume= 0.414 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
2.346	61	>75% Grass cover, Good, HSG B
1.228	74	>75% Grass cover, Good, HSG C
0.972	75	1/4 acre lots, 38% imp, HSG B
0.027	83	1/4 acre lots, 38% imp, HSG C
0.076	98	Paved roads w/curbs & sewers, HSG B
0.634	98	Paved roads w/curbs & sewers, HSG C
0.183	98	Paved parking, HSG B
0.135	98	Paved parking, HSG C
5.601		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1SB: DA #1B (BYPASSING POND)



Summary for Subcatchment 2S: DIRECT RUNOFF

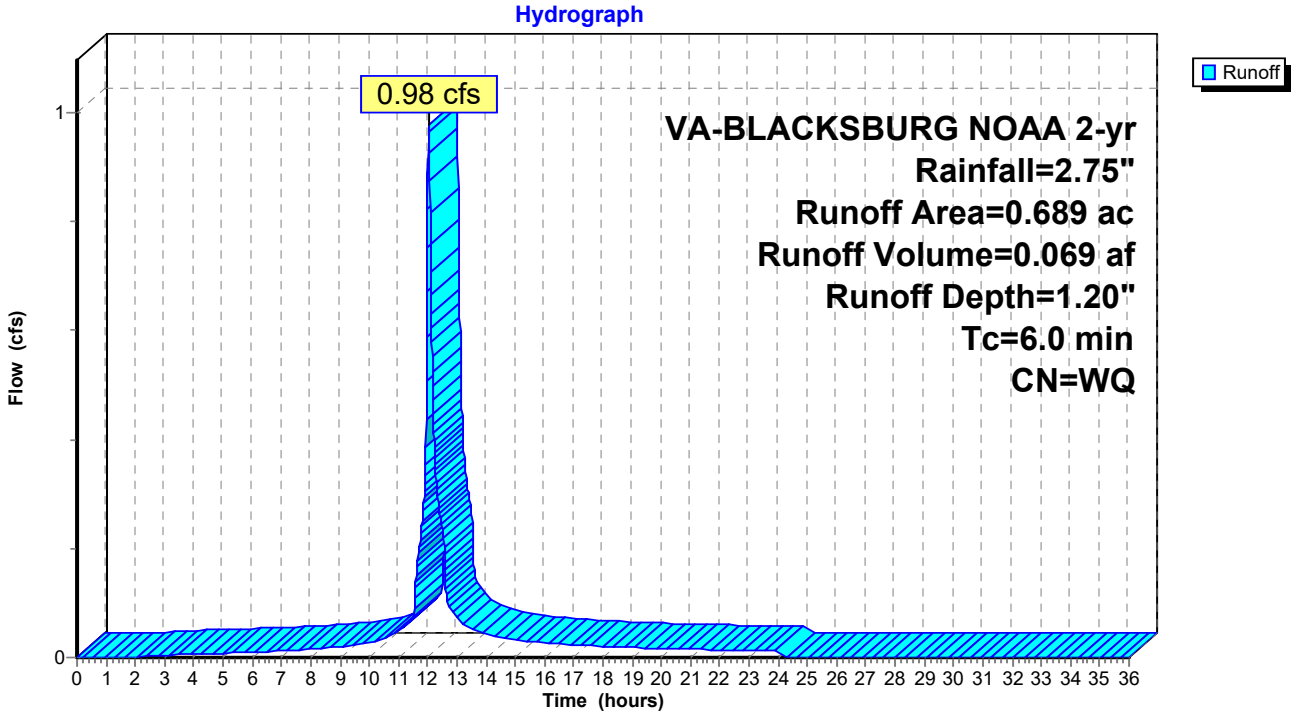
Runoff = 0.98 cfs @ 12.04 hrs, Volume= 0.069 af, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.404	61	>75% Grass cover, Good, HSG B
0.285	98	Paved parking, HSG B
0.689		Weighted Average

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

Subcatchment 2S: DIRECT RUNOFF



Summary for Pond 2P: UNDERGROUND

[44] Hint: Outlet device #2 is below defined storage

Inflow Area =	5.844 ac,	Inflow Depth =	1.26"	for 2-yr event	
Inflow =	8.76 cfs @	12.04 hrs,	Volume=	0.611 af	
Outflow =	1.39 cfs @	12.59 hrs,	Volume=	0.492 af,	Atten= 84%, Lag= 33.2 min
Primary =	1.39 cfs @	12.59 hrs,	Volume=	0.492 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 2,196.61' @ 12.59 hrs Surf.Area= 0.125 ac Storage= 0.309 af

Plug-Flow detention time= 367.3 min calculated for 0.492 af (81% of inflow)
Center-of-Mass det. time= 282.0 min (1,063.8 - 781.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,193.00'	0.167 af	**44.50'W x 122.00'L x 6.00'H Field A** 0.748 af Overall - 0.330 af Embedded = 0.418 af x 40.0% Voids
#2A	2,193.50'	0.330 af	**CMP Round 60** x 36 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= -5.00' x 19.63 sf x 6 rows 42.50' Header x 19.63 sf x 1 = 834.5 cf Inside
		0.497 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,192.90'	**24.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2,192.90' / 2,192.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	2,192.95'	**Reg-U-Flo SXH 3.0-in**
#3	Device 1	2,195.60'	**5.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	2,195.90'	**0.5' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=1.39 cfs @ 12.59 hrs HW=2,196.61' (Free Discharge)
└─**1=Culvert** (Passes 1.39 cfs of 24.88 cfs potential flow)
  ├─**2=Reg-U-Flo SXH 3.0-in** (Custom Controls 0.12 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.47 cfs @ 4.52 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 0.80 cfs @ 2.26 fps)

Pond 2P: UNDERGROUND - Chamber Wizard Field A

Chamber Model = CMP Round 60 (Round Corrugated Metal Pipe)
Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf
Overall Size= 60.0"W x 60.0"H x 20.00'L
Row Length Adjustment= -5.00' x 19.63 sf x 6 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

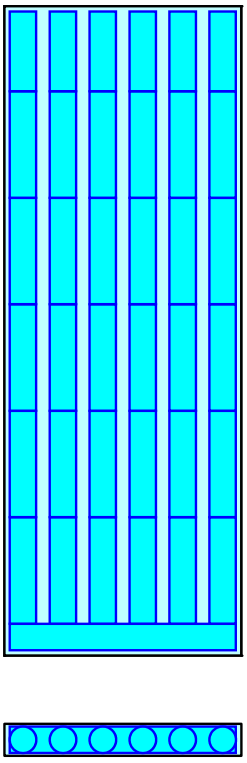
6 Chambers/Row x 20.00' Long -5.00' Row Adjustment +5.00' Header x 1 = 120.00' Row Length +12.0" End Stone x 2 = 122.00' Base Length
6 Rows x 60.0" Wide + 30.0" Spacing x 5 + 12.0" Side Stone x 2 = 44.50' Base Width
6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

36 Chambers x 392.7 cf -5.00' Row Adjustment x 19.63 sf x 6 Rows + 42.50' Header x 19.63 sf = 14,382.6 cf Chamber Storage

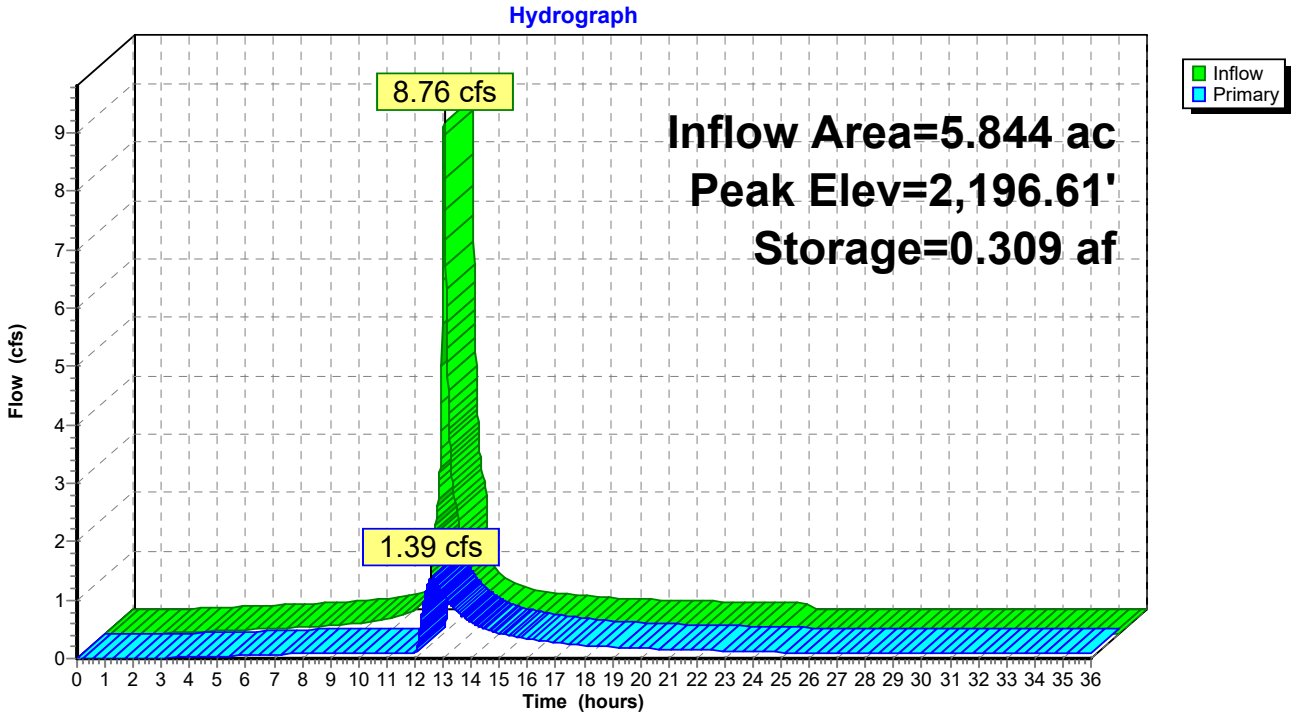
32,574.0 cf Field - 14,382.6 cf Chambers = 18,191.4 cf Stone x 40.0% Voids = 7,276.6 cf Stone Storage

Chamber Storage + Stone Storage = 21,659.2 cf = 0.497 af
Overall Storage Efficiency = 66.5%
Overall System Size = 122.00' x 44.50' x 6.00'

36 Chambers
1,206.4 cy Field
673.8 cy Stone



Pond 2P: UNDERGROUND

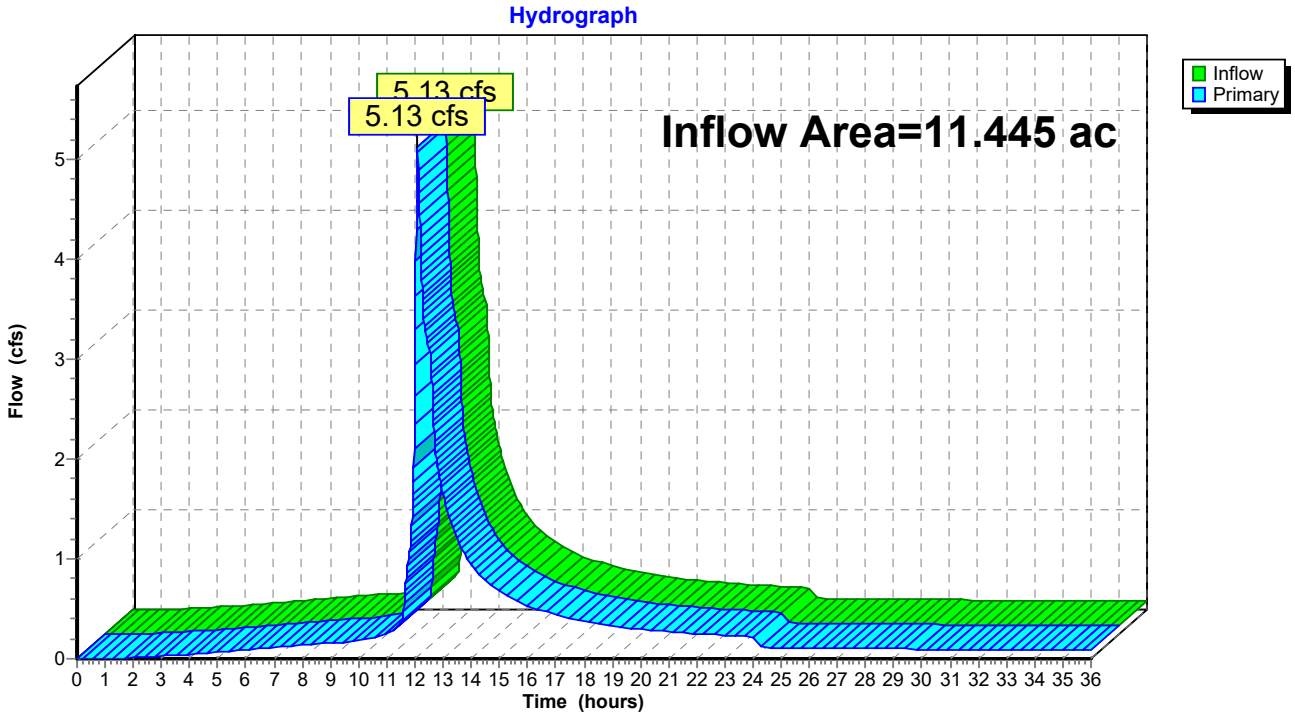


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.445 ac, Inflow Depth > 0.95" for 2-yr event
Inflow = 5.13 cfs @ 12.09 hrs, Volume= 0.907 af
Primary = 5.13 cfs @ 12.09 hrs, Volume= 0.907 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1SA: DA #1A (TO SWM POND) Runoff Area=5.844 ac Runoff Depth=2.16"
Tc=6.0 min CN=WQ Runoff=14.43 cfs 1.054 af

Subcatchment 1SB: DA #1B (BYPASSING POND) Runoff Area=5.601 ac Runoff Depth=1.74"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=9.91 cfs 0.814 af

Subcatchment 2S: DIRECT RUNOFF Runoff Area=0.689 ac Runoff Depth=2.10"
Tc=6.0 min CN=WQ Runoff=1.65 cfs 0.120 af

Pond 2P: UNDERGROUND Peak Elev=2,197.90' Storage=0.429 af Inflow=14.43 cfs 1.054 af
Outflow=4.64 cfs 0.928 af

Link 1L: POINT OF ANALYSIS Inflow=12.76 cfs 1.742 af
Primary=12.76 cfs 1.742 af

Total Runoff Area = 12.134 ac Runoff Volume = 1.988 af Average Runoff Depth = 1.97"

Summary for Subcatchment 1SA: DA #1A (TO SWM POND)

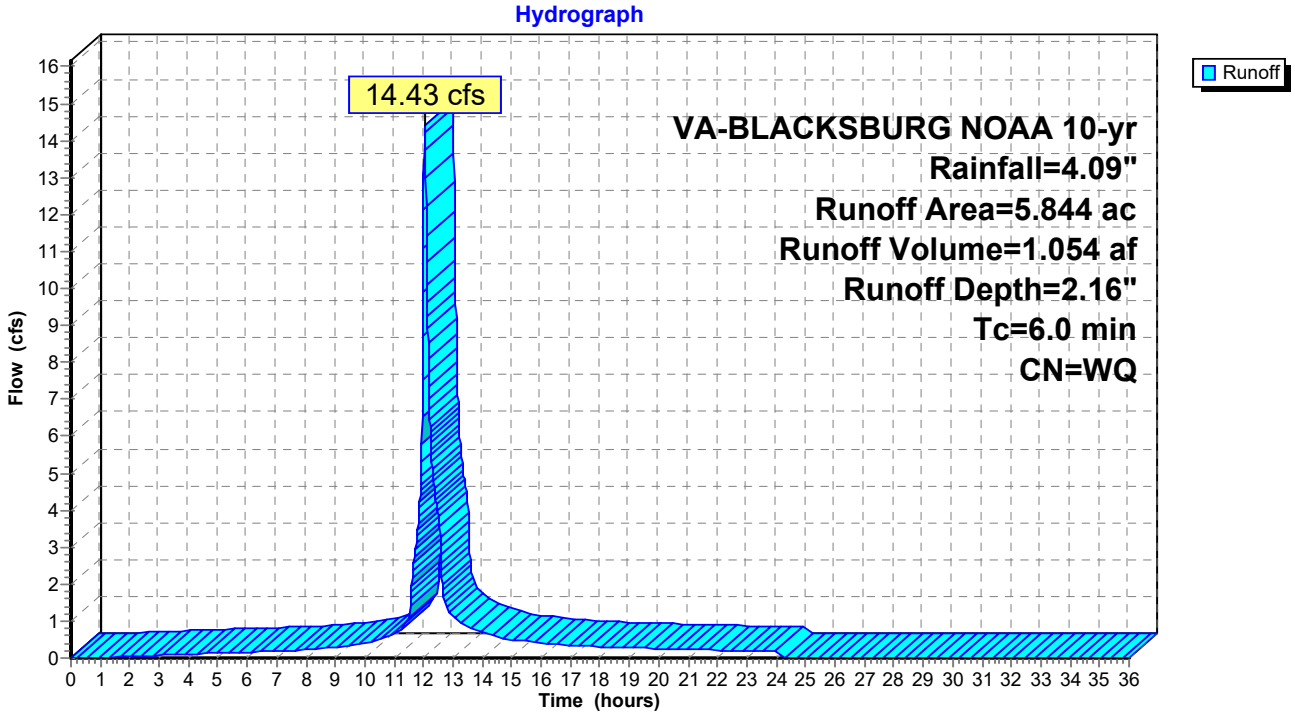
Runoff = 14.43 cfs @ 12.04 hrs, Volume= 1.054 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.388	58	Woods/grass comb., Good, HSG B
2.891	61	>75% Grass cover, Good, HSG B
2.565	98	Paved parking, HSG B
5.844		Weighted Average

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

Subcatchment 1SA: DA #1A (TO SWM POND)



Summary for Subcatchment 1SB: DA #1B (BYPASSING POND)

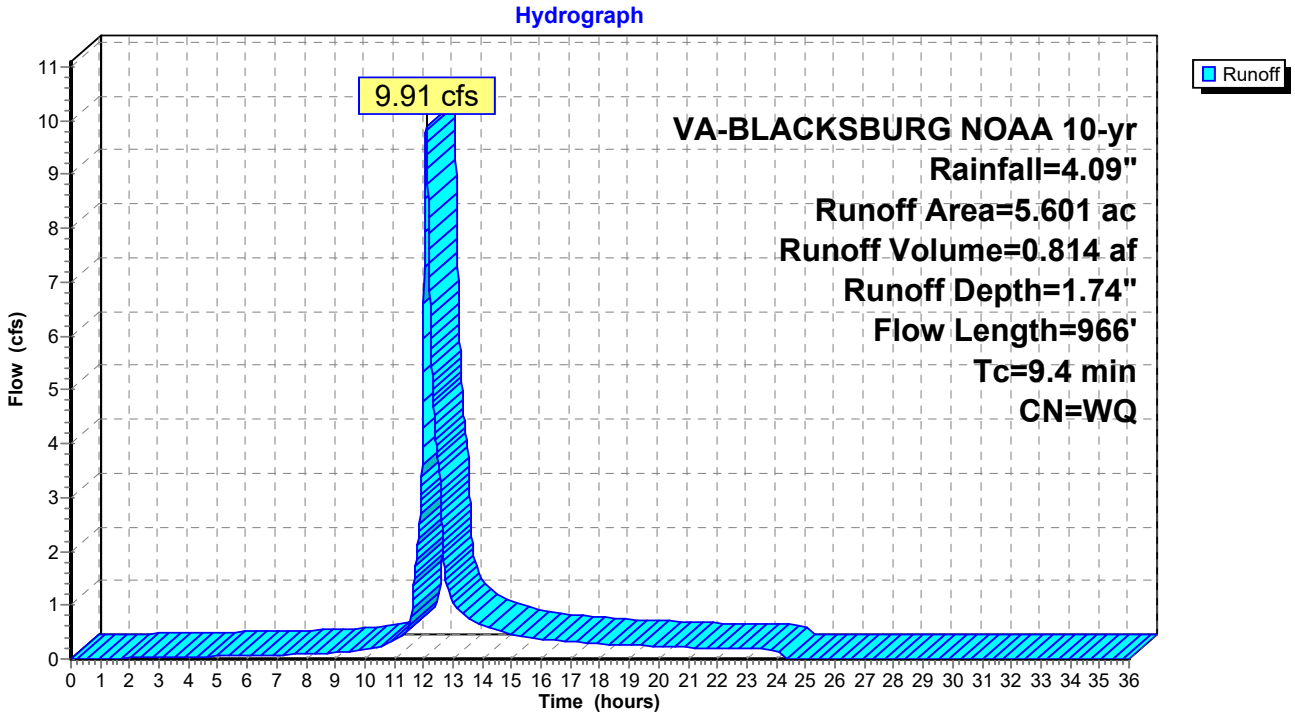
Runoff = 9.91 cfs @ 12.08 hrs, Volume= 0.814 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
2.346	61	>75% Grass cover, Good, HSG B
1.228	74	>75% Grass cover, Good, HSG C
0.972	75	1/4 acre lots, 38% imp, HSG B
0.027	83	1/4 acre lots, 38% imp, HSG C
0.076	98	Paved roads w/curbs & sewers, HSG B
0.634	98	Paved roads w/curbs & sewers, HSG C
0.183	98	Paved parking, HSG B
0.135	98	Paved parking, HSG C
5.601		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1SB: DA #1B (BYPASSING POND)



Summary for Subcatchment 2S: DIRECT RUNOFF

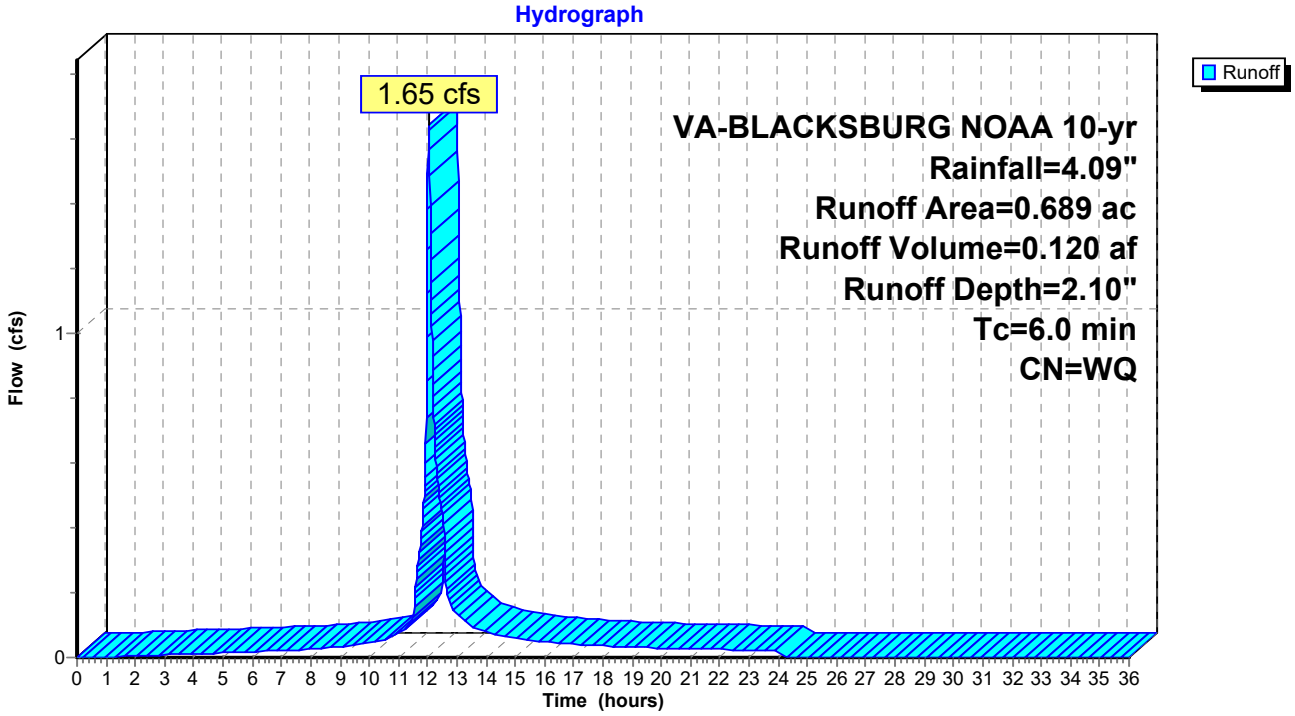
Runoff = 1.65 cfs @ 12.04 hrs, Volume= 0.120 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.404	61	>75% Grass cover, Good, HSG B
0.285	98	Paved parking, HSG B
0.689		Weighted Average

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

Subcatchment 2S: DIRECT RUNOFF



Summary for Pond 2P: UNDERGROUND

[44] Hint: Outlet device #2 is below defined storage

Inflow Area =	5.844 ac,	Inflow Depth =	2.16"	for	10-yr event
Inflow =	14.43 cfs @	12.04 hrs,	Volume=	1.054 af	
Outflow =	4.64 cfs @	12.36 hrs,	Volume=	0.928 af,	Atten= 68%, Lag= 19.1 min
Primary =	4.64 cfs @	12.36 hrs,	Volume=	0.928 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 2,197.90' @ 12.36 hrs Surf.Area= 0.125 ac Storage= 0.429 af

Plug-Flow detention time= 242.3 min calculated for 0.928 af (88% of inflow)
Center-of-Mass det. time= 180.6 min (963.4 - 782.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,193.00'	0.167 af	**44.50'W x 122.00'L x 6.00'H Field A** 0.748 af Overall - 0.330 af Embedded = 0.418 af x 40.0% Voids
#2A	2,193.50'	0.330 af	**CMP Round 60** x 36 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= -5.00' x 19.63 sf x 6 rows 42.50' Header x 19.63 sf x 1 = 834.5 cf Inside
		0.497 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,192.90'	**24.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2,192.90' / 2,192.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	2,192.95'	**Reg-U-Flo SXH 3.0-in**
#3	Device 1	2,195.60'	**5.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	2,195.90'	**0.5' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=4.64 cfs @ 12.36 hrs HW=2,197.90' (Free Discharge)
└─**1=Culvert** (Passes 4.64 cfs of 30.26 cfs potential flow)
  ├─**2=Reg-U-Flo SXH 3.0-in** (Custom Controls 0.14 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.74 cfs @ 7.10 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 3.75 cfs @ 3.75 fps)

Pond 2P: UNDERGROUND - Chamber Wizard Field A

Chamber Model = CMP Round 60 (Round Corrugated Metal Pipe)
Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf
Overall Size= 60.0"W x 60.0"H x 20.00'L
Row Length Adjustment= -5.00' x 19.63 sf x 6 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

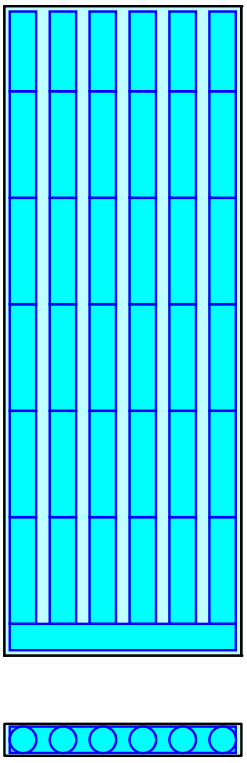
6 Chambers/Row x 20.00' Long -5.00' Row Adjustment +5.00' Header x 1 = 120.00' Row Length +12.0" End Stone x 2 = 122.00' Base Length
6 Rows x 60.0" Wide + 30.0" Spacing x 5 + 12.0" Side Stone x 2 = 44.50' Base Width
6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

36 Chambers x 392.7 cf -5.00' Row Adjustment x 19.63 sf x 6 Rows + 42.50' Header x 19.63 sf = 14,382.6 cf Chamber Storage

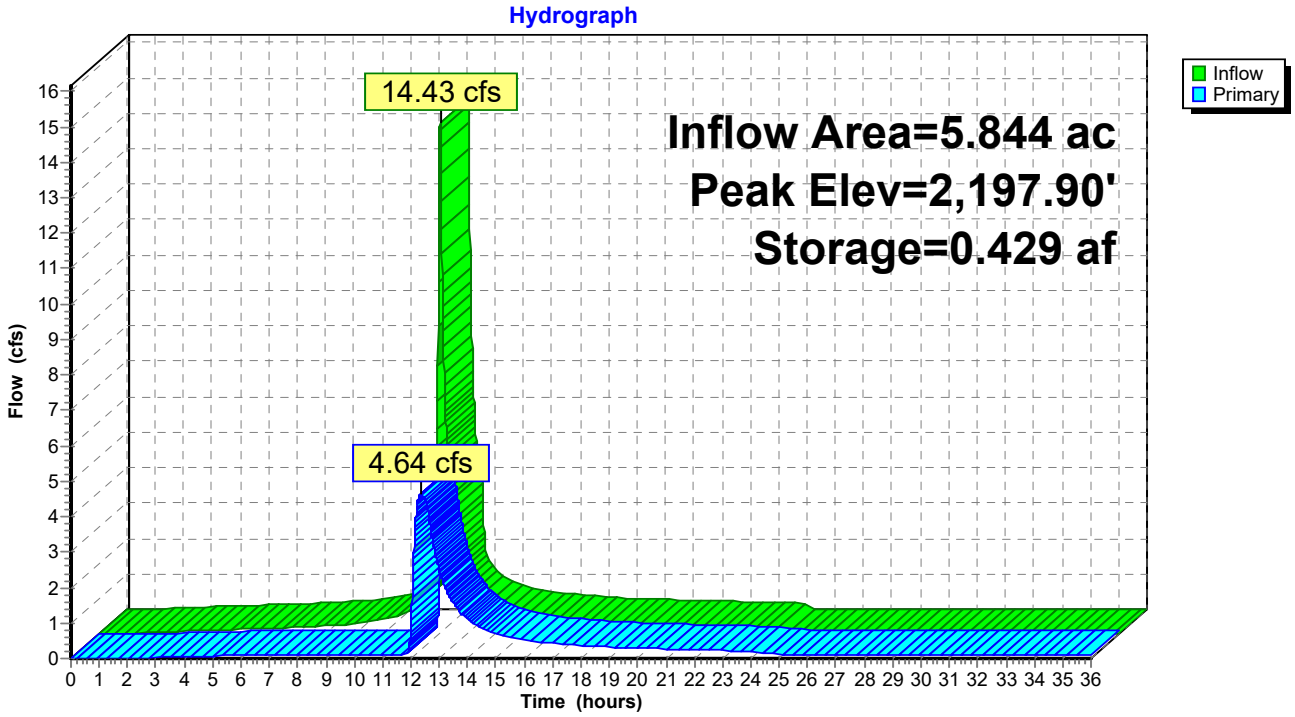
32,574.0 cf Field - 14,382.6 cf Chambers = 18,191.4 cf Stone x 40.0% Voids = 7,276.6 cf Stone Storage

Chamber Storage + Stone Storage = 21,659.2 cf = 0.497 af
Overall Storage Efficiency = 66.5%
Overall System Size = 122.00' x 44.50' x 6.00'

36 Chambers
1,206.4 cy Field
673.8 cy Stone



Pond 2P: UNDERGROUND

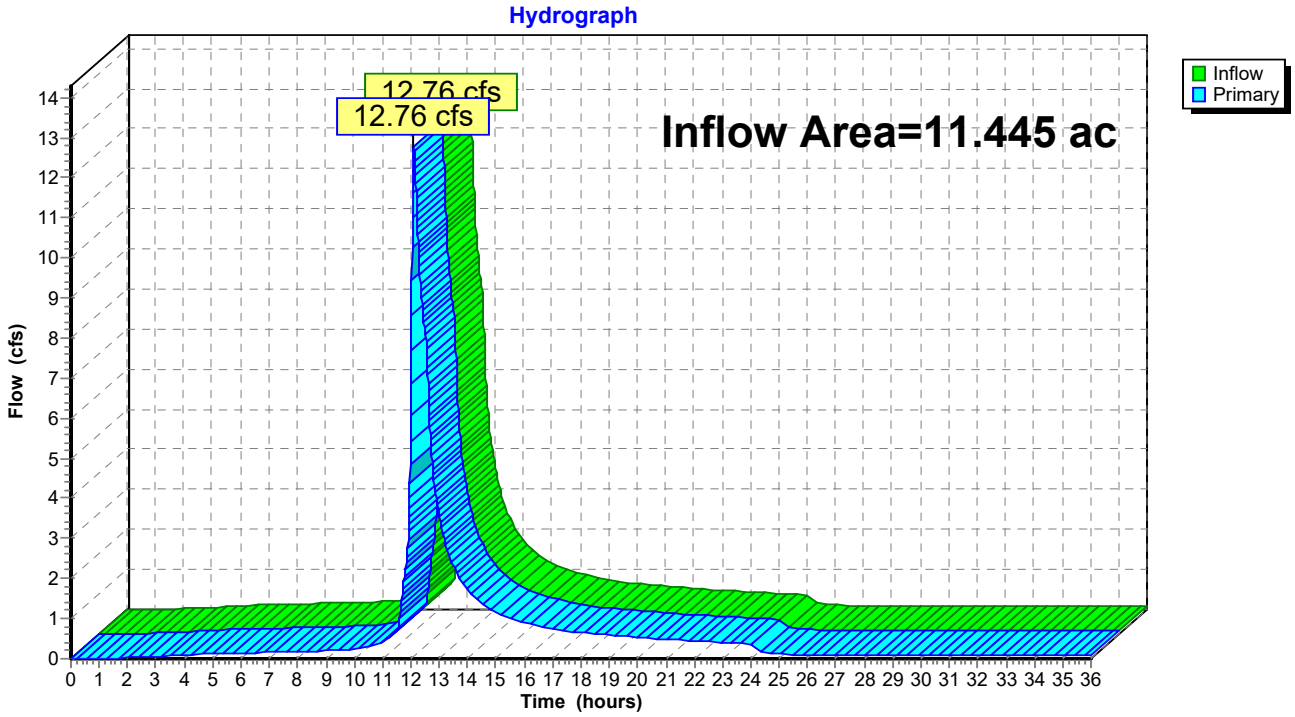


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.445 ac, Inflow Depth > 1.83" for 10-yr event
Inflow = 12.76 cfs @ 12.10 hrs, Volume= 1.742 af
Primary = 12.76 cfs @ 12.10 hrs, Volume= 1.742 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1SA: DA #1A (TO SWM POND) Runoff Area=5.844 ac Runoff Depth=4.03"
Tc=6.0 min CN=WQ Runoff=23.71 cfs 1.963 af

Subcatchment 1SB: DA #1B (BYPASSING POND) Runoff Area=5.601 ac Runoff Depth=3.57"
Flow Length=966' Tc=9.4 min CN=WQ Runoff=18.38 cfs 1.668 af

Subcatchment 2S: DIRECT RUNOFF Runoff Area=0.689 ac Runoff Depth=3.95"
Tc=6.0 min CN=WQ Runoff=2.75 cfs 0.227 af

Pond 2P: UNDERGROUND Peak Elev=2,202.17' Storage=0.497 af Inflow=23.71 cfs 1.963 af
Outflow=23.66 cfs 1.831 af

Link 1L: POINT OF ANALYSIS Inflow=40.58 cfs 3.499 af
Primary=40.58 cfs 3.499 af

Total Runoff Area = 12.134 ac Runoff Volume = 3.858 af Average Runoff Depth = 3.82"

Summary for Subcatchment 1SA: DA #1A (TO SWM POND)

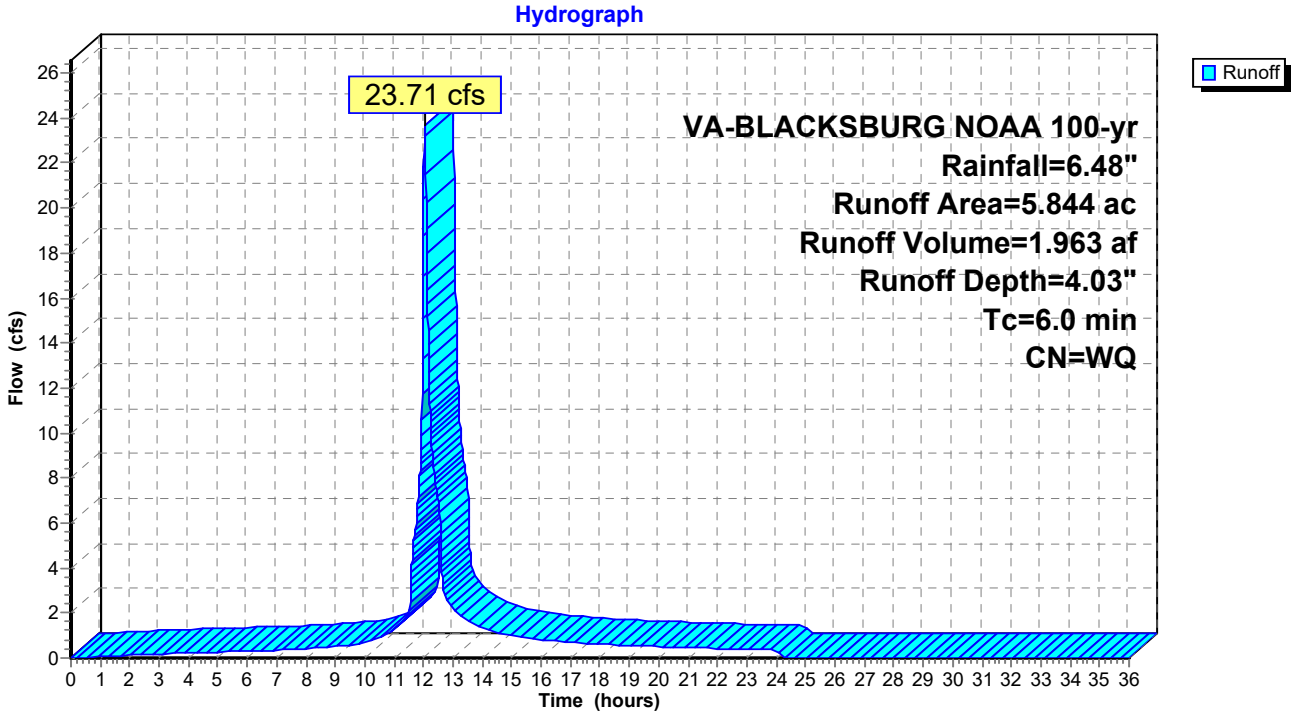
Runoff = 23.71 cfs @ 12.04 hrs, Volume= 1.963 af, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.388	58	Woods/grass comb., Good, HSG B
2.891	61	>75% Grass cover, Good, HSG B
2.565	98	Paved parking, HSG B
5.844		Weighted Average

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

Subcatchment 1SA: DA #1A (TO SWM POND)



Summary for Subcatchment 1SB: DA #1B (BYPASSING POND)

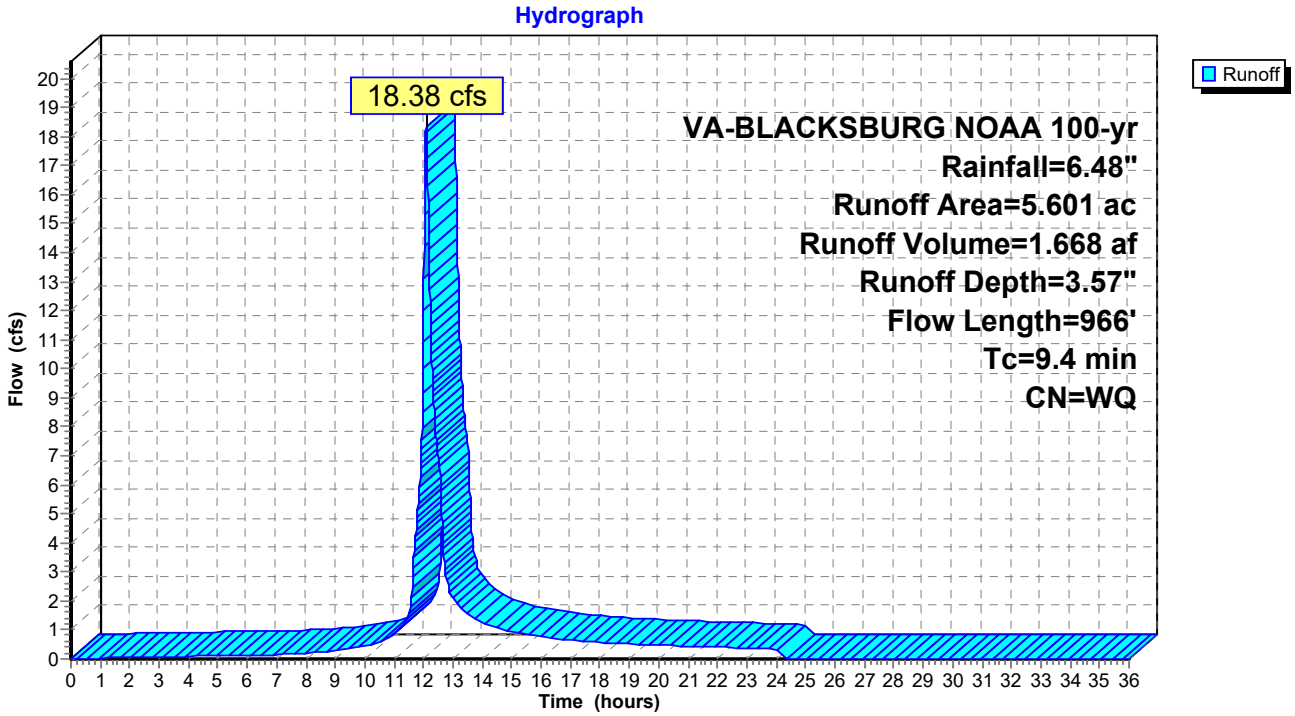
Runoff = 18.38 cfs @ 12.08 hrs, Volume= 1.668 af, Depth= 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
2.346	61	>75% Grass cover, Good, HSG B
1.228	74	>75% Grass cover, Good, HSG C
0.972	75	1/4 acre lots, 38% imp, HSG B
0.027	83	1/4 acre lots, 38% imp, HSG C
0.076	98	Paved roads w/curbs & sewers, HSG B
0.634	98	Paved roads w/curbs & sewers, HSG C
0.183	98	Paved parking, HSG B
0.135	98	Paved parking, HSG C
5.601		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	150	0.1333	0.37		**Sheet Flow, Tc1** Grass: Short n= 0.150 P2= 2.76"
2.6	816	0.1058	5.24		**Shallow Concentrated Flow, Tc2** Unpaved Kv= 16.1 fps
9.4	966	Total			

Subcatchment 1SB: DA #1B (BYPASSING POND)



Summary for Subcatchment 2S: DIRECT RUNOFF

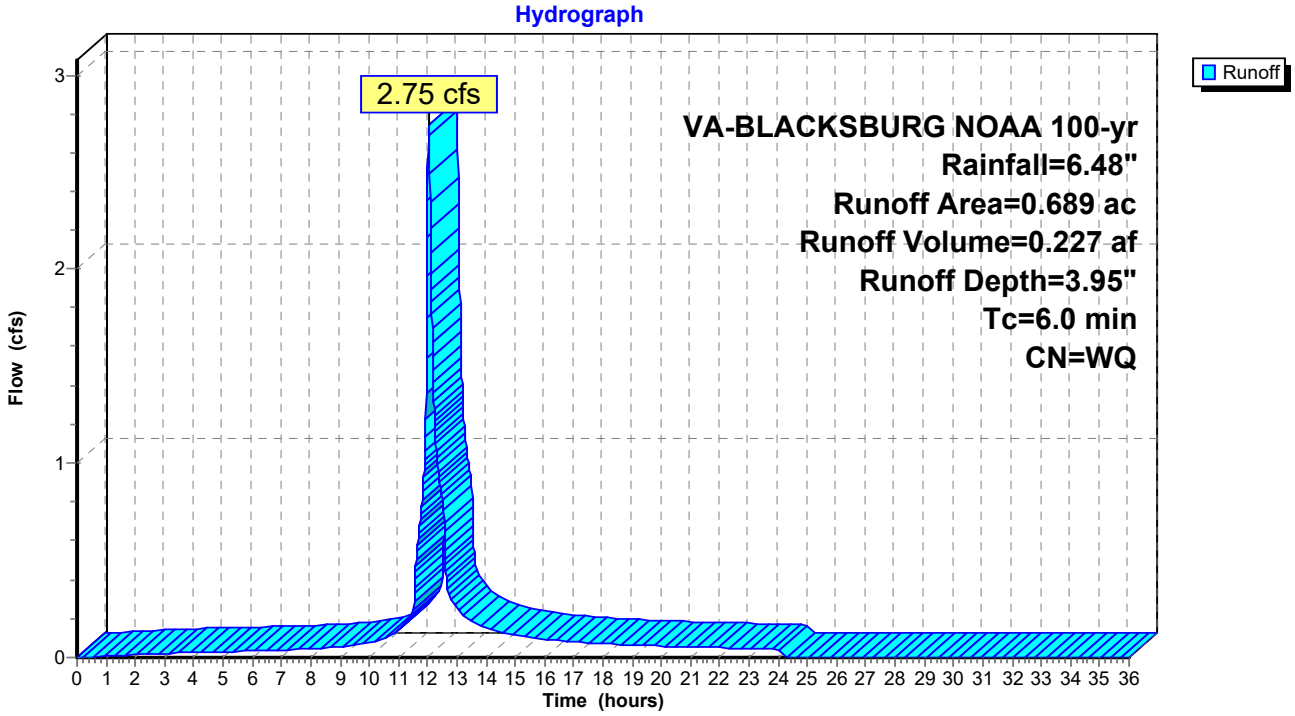
Runoff = 2.75 cfs @ 12.04 hrs, Volume= 0.227 af, Depth= 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.404	61	>75% Grass cover, Good, HSG B
0.285	98	Paved parking, HSG B
0.689		Weighted Average

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

Subcatchment 2S: DIRECT RUNOFF



Summary for Pond 2P: UNDERGROUND

[44] Hint: Outlet device #2 is below defined storage
[93] Warning: Storage range exceeded by 3.17'
[95] Warning: Outlet Device #2 rise exceeded

Inflow Area =	5.844 ac,	Inflow Depth =	4.03"	for	100-yr event
Inflow =	23.71 cfs @	12.04 hrs,	Volume=	1.963 af	
Outflow =	23.66 cfs @	12.04 hrs,	Volume=	1.831 af,	Atten= 0%, Lag= 0.0 min
Primary =	23.66 cfs @	12.04 hrs,	Volume=	1.831 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 2,202.17' @ 12.04 hrs Surf.Area= 0.125 ac Storage= 0.497 af

Plug-Flow detention time= 160.5 min calculated for 1.830 af (93% of inflow)
Center-of-Mass det. time= 121.4 min (906.1 - 784.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,193.00'	0.167 af	**44.50'W x 122.00'L x 6.00'H Field A** 0.748 af Overall - 0.330 af Embedded = 0.418 af x 40.0% Voids
#2A	2,193.50'	0.330 af	**CMP Round 60** x 36 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= -5.00' x 19.63 sf x 6 rows 42.50' Header x 19.63 sf x 1 = 834.5 cf Inside
		0.497 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,192.90'	**24.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2,192.90' / 2,192.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	2,192.95'	**Reg-U-Flo SXH 3.0-in**
#3	Device 1	2,195.60'	**5.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	2,195.90'	**0.5' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=23.63 cfs @ 12.04 hrs HW=2,202.17' (Free Discharge)
- **1=Culvert** (Passes 23.63 cfs of 43.49 cfs potential flow)
  - **2=Reg-U-Flo SXH 3.0-in** (Custom Controls 0.16 cfs)
  - **3=Orifice/Grate** (Orifice Controls 1.27 cfs @ 12.22 fps)
  - **4=Broad-Crested Rectangular Weir** (Weir Controls 22.20 cfs @ 7.08 fps)

Pond 2P: UNDERGROUND - Chamber Wizard Field A

Chamber Model = CMP Round 60 (Round Corrugated Metal Pipe)
Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf
Overall Size= 60.0"W x 60.0"H x 20.00'L
Row Length Adjustment= -5.00' x 19.63 sf x 6 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

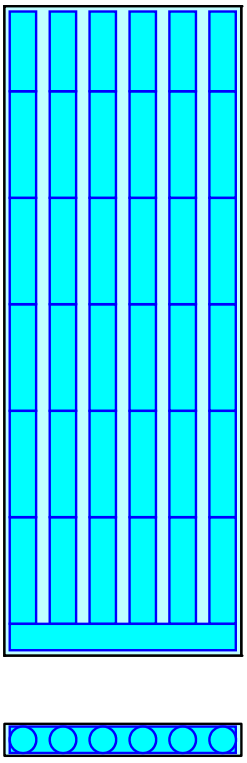
6 Chambers/Row x 20.00' Long -5.00' Row Adjustment +5.00' Header x 1 = 120.00' Row Length +12.0" End Stone x 2 = 122.00' Base Length
6 Rows x 60.0" Wide + 30.0" Spacing x 5 + 12.0" Side Stone x 2 = 44.50' Base Width
6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

36 Chambers x 392.7 cf -5.00' Row Adjustment x 19.63 sf x 6 Rows + 42.50' Header x 19.63 sf = 14,382.6 cf Chamber Storage

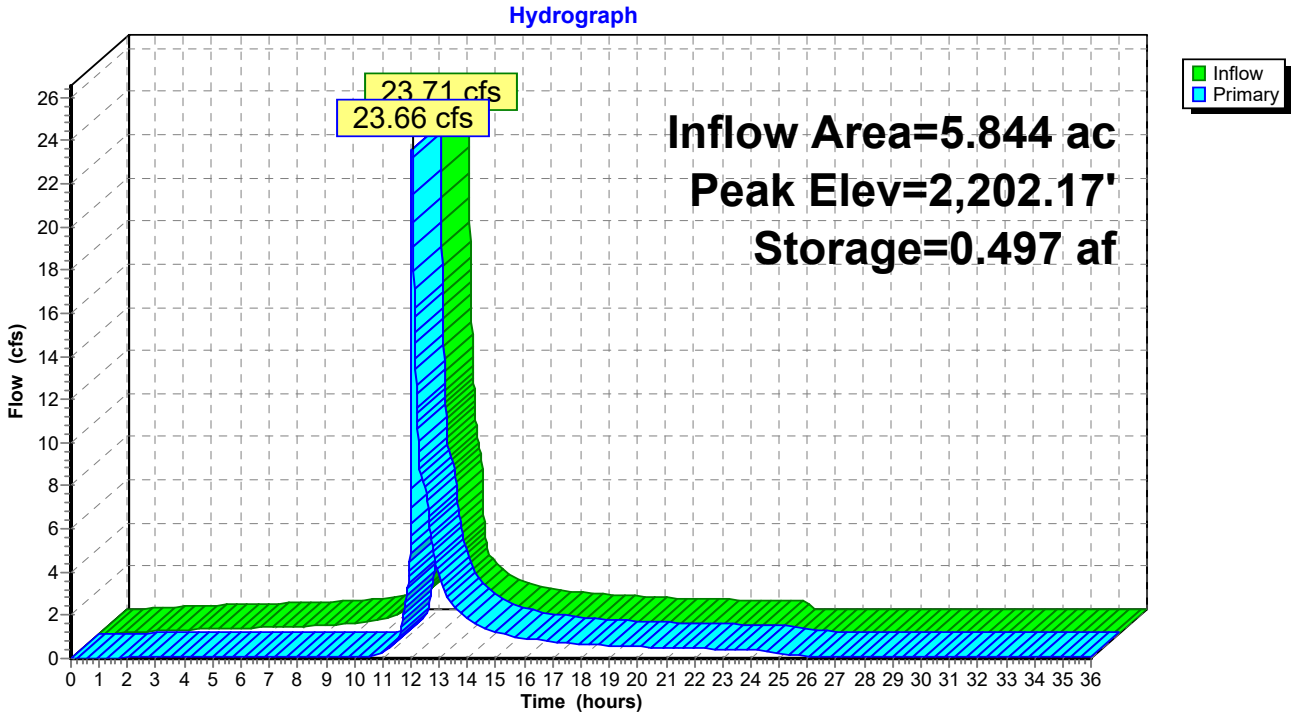
32,574.0 cf Field - 14,382.6 cf Chambers = 18,191.4 cf Stone x 40.0% Voids = 7,276.6 cf Stone Storage

Chamber Storage + Stone Storage = 21,659.2 cf = 0.497 af
Overall Storage Efficiency = 66.5%
Overall System Size = 122.00' x 44.50' x 6.00'

36 Chambers
1,206.4 cy Field
673.8 cy Stone



Pond 2P: UNDERGROUND

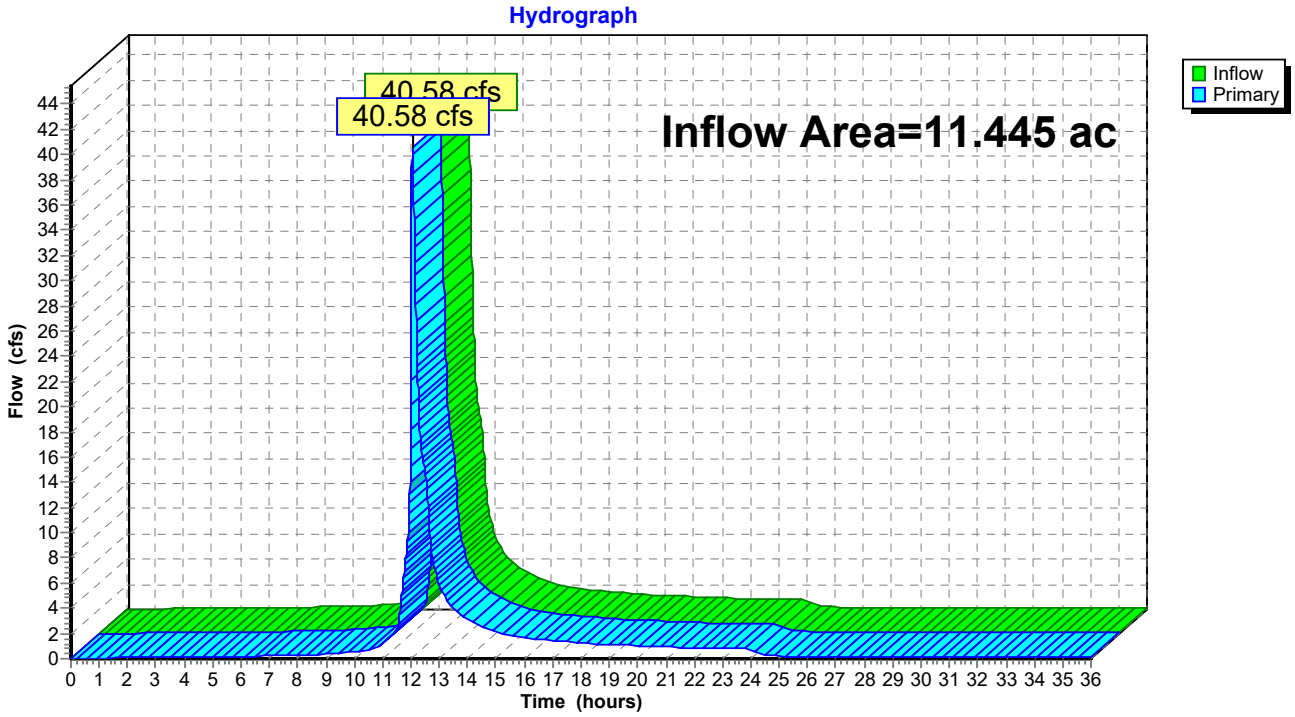


Summary for Link 1L: POINT OF ANALYSIS

Inflow Area = 11.445 ac, Inflow Depth > 3.67" for 100-yr event
Inflow = 40.58 cfs @ 12.05 hrs, Volume= 3.499 af
Primary = 40.58 cfs @ 12.05 hrs, Volume= 3.499 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 1L: POINT OF ANALYSIS



APPENDIX D:
STORMWATER QUALITY CALCULATIONS

Project Name:	Noonkester Property	CLEAR ALL	data input cells
Date:	9/1/2020		constant values
	Linear Development Project? No		calculation cells
Site Information			final results

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* →	6.16	*Check:*	
Maximum reduction required:	*20%*	*BMP Design Specifications List:*	2013 Draft Stds & Specs
The site's net increase in impervious cover (acres) is:	*2.53*	*Linear project?*	No
Post-Development TP Load Reduction for Site (lb/yr):	*5.28*	*Land cover areas entered correctly?*	✔
		Total disturbed area entered?	✔

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed forest/open space		4.77			4.77
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed		1.00			1.00
Impervious Cover (acres)		0.39			0.39
					6.16

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed		3.24			3.24
Impervious Cover (acres)		2.92			2.92
Area Check	OK.	OK.	OK.	OK.	6.16

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre		
Pre-ReDevelopment	**Listed**	**Adjusted[1]**
Forest/Open Space Cover (acres)	4.77	2.24
Weighted Rv(forest)	0.03	0.03
% Forest	77%	62%
Managed Turf Cover (acres)	1.00	1.00
Weighted Rv(turf)	0.20	0.20
% Managed Turf	16%	28%
Impervious Cover (acres)	0.39	0.39
Rv(impervious)	0.95	0.95
% Impervious	6%	11%
Total Site Area (acres)	**6.16**	**3.63**
Site Rv	**0.12**	**0.18**

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0595	0.0531	
Pre-ReDevelopment Treatment Volume (cubic feet)	2,590	2,315	
Pre-ReDevelopment TP Load (lb/yr)	**1.63**	**1.45**	*
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	0.26	0.40	*
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*1.49*	

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)	
Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	3.24
Weighted Rv (turf)	0.20
% Managed Turf	53%
Impervious Cover (acres)	2.92
Rv(impervious)	0.95
% Impervious	47%
Final Site Area (acres)	**6.16**
Final Post Dev Site Rv	**0.56**

Land Cover Summary-Post	
Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	3.24
Weighted Rv (turf)	0.20
% Managed Turf	89%
ReDev. Impervious Cover (acres)	0.39
Rv(impervious)	0.95
% Impervious	11%
Total ReDev. Site Area (acres)	**3.63**
ReDev Site Rv	**0.28**

Land Cover Summary-Post	
Post-Development New Impervious	
New Impervious Cover (acres)	2.53
Rv(impervious)	0.95

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume (acre-ft)	0.2852	**Post-ReDevelopment Treatment Volume (acre-ft)**	0.0849	**Post-Development Treatment Volume (acre-ft)**	0.2003
Final Post-Development Treatment Volume (cubic feet)	12,422	**Post-ReDevelopment Treatment Volume (cubic feet)**	3,697	**Post-Development Treatment Volume (cubic feet)**	8,725
Final Post-Development TP Load (lb/yr)	**7.80**	* **Post-ReDevelopment Load (TP) (lb/yr)***	**2.32**	**Post-Development TP Load (lb/yr)**	**5.48**
Final Post-Development TP Load per acre (lb/acre/yr)	1.27	Post-ReDevelopment TP Load per acre (lb/acre/yr)	0.64		
		Max. Reduction Required (Below Pre-ReDevelopment Load)	**20%**		
		* **TP Load Reduction Required for Redeveloped Area (lb/yr)**	**0.83**	**TP Load Reduction Required for New Impervious Area (lb/yr)**	**4.44**

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

* *Reduction below new development load limitation not required*

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**5.28**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	11.64	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	55.83