STORMWATER MANAGEMENT CALCULATIONS

FOR

OLD BLACKSBURG HIGH SCHOOL PLANNED RESIDENTIAL DEVELOPMENT

AMENDED REZONING APPLICATION

MOUNT TABOR MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, VIRGINIA

APRIL 1, 2024

PREPARED BY:

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SECTION I: PROJECT NARRATIVE

Project Description

The purpose of this project is the redevelopment of approximately 36.50 acres of land formerly held by the Montgomery County School Board as the Old Blacksburg High School. The project was previously rezoned in 2019 to a Planned Residential Development to permit construction of 100 townhomes units on a 12.9 acre portion of the property with the remainder sold to the Town of Blacksburg. This application proposes to amend the previously approved rezoning to revise the layout and reduce the density of the townhome development to 73 units.

Existing Site Conditions

The project site[1] is located off of Patrick Henry Drive within a natural valley between the Blacksburg Heights subdivision and the Apperson Park subdivision. The site is bound by Patrick Henry Drive to the west, Grove Avenue (constructed and paper street portions) to the north, and multiple private properties to the south and east. The easternmost 2.6 acre portion of the site is located in Montgomery County. Surrounding properties consist of single-family residential and civic uses. The site was previously mass graded after demolition of the existing school building and surrounding infrastructure in 2020.

Existing soil conditions on-site include the types listed below with slopes generally ranging from 2%-33%. 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.

Existing soil conditions on-site include the following types:

(See attached soils map for specific locations.)

7D - Berks and Weikert very stony soils, 15 to 35 percent slopes
11B - Duffield-Ernest complex, 2 to 7 percent slopes
16B - Groseclose and Poplimento soils, 2 to 7 percent slopes
16C - Groseclose and Poplimento soils, 7 to 15 percent slopes
16D - Groseclose and Poplimento soils, 15 to 25 percent slopes
29 - Udorthents and Urban land

Development Plans

The proposed development will consist of 73 new townhomes, streets, sidewalks, parking, walking trails and multi-use paths. Water main and sanitary sewer main extensions are proposed to serve the development. Stormwater quantity requirements are met through a reduction in impervious area and directing all concentrated site runoff to existing storm drains. Water quality requirements will be met by purchasing nutrient credits. Some of the proposed rights of way may be dedicated as public streets to the Town of Blacksburg. Water quantity and

[1] For the purposes of the Project Narrative, "site" shall be defined as the area within the original subject property boundary, 36.50 acres, Tax Map #227-A-4D, #227-A-4, #227-A-4C, and #041-A-2.

water quality requirements for these streets has been provided for in the design calculations herein.

During Construction

Neighboring areas are primarily developed urban land consisting of single-family residential and civic uses. Any runoff from the site shall be controlled with temporary measures such as a construction entrance, silt fence, 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 SW1 for drainage area map.

NOTE: As this application is an amendment to a previously approved rezoning ordinance, this analysis has been performed in a manner to closely mimic the previous assumptions and conclusions for consistency. Pre- and post-development analysis has been updated to reflect the revised limits of disturbance and revised post-development impervious area only. Reference Town Council approved Ordinance #1895 for Old Blacksburg High School Planned Residential Development – Rezoning Application & Preliminary Masterplan dated April 30, 2019 and revised August 23, 2019 prepared by Parker Design Group and Communita Atelier.

In the pre-development condition prior to initial redevelopment, the site contained a high school building with parking lots and other impervious areas. There were no existing stormwater management BMPs serving the high school site. Runoff from the site was collected by various storm sewer inlets which converged into storm drains running along the Patrick Henry Drive entrance to the site and ultimately was discharged through manmade and natural conveyance systems on the southwest side of Patrick Henry Drive. The Limit of Analysis has been set at the storm drain crossing to the southwest side of Patrick Henry Drive, encompassing a drainage area of approximately 62 acres to include the entire rezoned area.

See the following pages and the enclosed HydroCAD report for the peak flow rates and runoff volumes in the pre-development condition. All flows in the HydroCAD model have been analyzed using the SCS/TR-55, weighted CN 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-ReDevelopment Land Cover

Area (acres)	CN	Description (subcatchment-numbers)
5.600	77	Forest/Open (A, B)
10.840	98	Impervious (A, B)
18.030	83	Per TOB GIS Data (C1)
13.350	77	Per TOB GIS Data (C2)
13.830	80	Turf (A, B)
61.650	**83**	**TOTAL AREA**

Limit of Analysis

Total Drainage Area= 61.65 acres

	Peak Flow	**Runoff Volume**
1-year	79.49 cfs	4.815 af
2-year	110.59 cfs	6.684 af
10-year	204.10 cfs	12.457 af

POST-DEVELOPMENT SUMMARY

Please see Sheet SW2 for drainage area map.

In the post-development condition, the site will be graded to capture site runoff via sheet flow, roof drains, curb inlets, and stormwater piping. Runoff will be collected in a storm drain system that will discharge to the same existing storm drains near the Patrick Henry Drive entrance. Since the proposed development accomplishes a significant reduction in impervious area, no stormwater management BMPs are required to achieve the minimum channel and flood protection requirements. The following pages and the HydroCAD report demonstrate that the site will be contributing less flow to the Limit of Analysis point than in the pre-development condition.

See the following pages and the enclosed HydroCAD report for the peak flow rates and runoff volumes in the post-development condition. All flows in this model have been analyzed using the SCS/TR-55, weighted CN 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.

Post-Development Land Cover

Area (acres)	CN	Description (subcatchment-numbers)
4.200	77	Forest/Open (B)
8.600	98	Impervious (A, B)
18.030	83	Per TOB GIS Data (C1)
13.350	77	Per TOB GIS Data (C2)
17.470	80	Turf (A, B)
61.650	**83**	**TOTAL AREA**

Limit of Analysis

Total Drainage Area= 61.65 acres

	Peak Flow	**Runoff Volume**
1-year	74.54 cfs	4.534 af
2-year	105.42 cfs	6.369 af
10-year	198.87 cfs	12.078 af

As shown above, the post-development peak flow rates are less than the pre-development peak flow rates for the 1-year, 2-year, and 10-year, thus meeting Town of Blacksburg base requirements for stormwater quantity.

Channel Protection

In accordance with Town Code §18-613(b), concentrated stormwater flows will be discharged directly to a stormwater conveyance system. Runoff is discharged into existing storm sewer which crosses Patrick Henry Drive and flows through a series of manmade and natural conveyance systems downstream. Since there are sections of natural channel downstream of the site[2], the applicable design criteria is §18-613(b)(3) (the energy balance) and 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. The energy balance has been applied to site runoff (Area "A") according to the following equation for the 1-year storm in order to demonstrate compliance with Channel Protection.

$$Q_{POST} \leq I.F. \times \left(\frac{Q_{PRE-DEVELOPED} \times RV_{PRE-DEVELOPED}}{RV_{DEVELOPED}}\right)$$; where

I.F. = 0.9 for *Sites* less than 1.0 acre and 0.8 for *Sites* greater than 1.0 acre
$Q_{Developed}$ = the allowable peak flow rate of runoff from POD #1 post-development
$RV_{Developed}$ = the volume of runoff from POD #1 in the developed condition
$Q_{Pre-developed}$ = the peak flow rate of runoff from POD #1 in the pre-developed condition
$RV_{Pre-developed}$ = the volume of runoff from POD #1 in the pre-developed condition

R_v Calculation
Pre-developed = 1.834 acre*ft – See HydroCAD "Pre-Development" Report for "DA A"
Developed = 1.553 acre*ft – See HydroCAD "Post-Development" Report for "DA A"

$$Q_{Developed} \leq I.F. \times \left(Q_{Pre-Developed} \times RV_{Pre-Developed}\right)/RV_{Developed}$$
$$Q_{Developed} \leq 0.8 \times (38.31 \times 1.834)/1.553$$
$$Q_{Developed} \leq 36.19\ cfs$$

TABLE 1: CHANNEL PROTECTION COMPLIANCE SUMMARY

	Pre-development Peak Flow	Energy Balance Max $Q_{Developed}$	Post-development Peak Flow	% Change (from Pre-Dev)
DA "A"	38.31 cfs	36.19 cfs	**32.98 cfs**	**-13.9%**

[2] In the context of channel and flood protection, "site" is 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 15.59 acres). See Sheets SW1-SW2.

Flood Protection

In accordance with Town Code §18-613(c), concentrated stormwater flows have been discharged to a stormwater conveyance system. The downstream conveyance system is a manmade storm sewer. 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 subsection 2(ii) of the Code. Per subsection (3) of the Code, when subdivision 2(ii) is utilized, the discharge point constitutes the Limits of Analysis and no further analysis of the downstream stormwater conveyance system is required.

TABLE 2: FLOOD PROTECTION COMPLIANCE SUMMARY

	Pre-development Peak Flow	**Post-development Peak Flow**	**% Change**
Limit of Analysis	204.10 cfs	198.87 cfs	**-2.6%**

SECTION III: STORMWATER QUALITY SUMMARY

Water quality compliance will be achieved 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 the area of disturbance is less than 5 acres or the water quality reduction requirement is less than 10 pounds per year. This site qualifies for nutrient credit purchase with a phosphorus reduction requirement of 1.69 pounds per year.

The existing site[3] has an impervious land cover of 9.34 acres (60%). The post-development site will have an impervious land cover of 7.10 acres (46%) resulting in a runoff coefficient (R_v) of 0.57. The required pollutant removal rate is 1.69 lb/year, all of which will be handled with nutrient credits.

[3] In the context of channel and flood protection, "site" is 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 15.59 acres). See Sheets SW1-SW2.

SECTION IV: DOWNSTREAM ANALYSIS

Runoff from the proposed development is discharged directly into to a series of manmade and natural conveyance systems. These conveyance systems carry flows from the site downstream to the required limits of analysis. The post-development peak runoff rate and total runoff volume has been reduced through this redevelopment by removal of impervious area which can be expected to reduce adverse impacts from this site to downstream properties such as channel erosion and flooding.

Per Town Code §18-613 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 should be expected as a result of this development.

APPENDIX A:
SOIL MAPS & SOIL DESCRIPTIONS

Map Scale: 1:3,260 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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 11, Aug 28, 2018

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

Date(s) aerial images were photographed: Oct 22, 2012—Feb 5, 2017

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
7D	Berks and Weikert very stony soils, 15 to 35 percent slopes	1.2	3.8%
11B	Duffield-Ernest complex, 2 to 7 percent slopes	3.4	11.2%
16B	Groseclose and Poplimento soils, 2 to 7 percent slopes	1.2	4.0%
16C	Groseclose and Poplimento soils, 7 to 15 percent slopes	6.7	21.8%
16D	Groseclose and Poplimento soils, 15 to 25 percent slopes	0.9	2.8%
29	Udorthents and Urban land	17.3	56.4%
Totals for Area of Interest		**30.6**	**100.0%**

Montgomery County, Virginia

7D—Berks and Weikert very stony soils, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: kc39
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: Not prime farmland

Map Unit Composition

Berks and similar soils: 50 percent
Weikert and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Berks

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 7 inches: channery silt loam
H2 - 7 to 23 inches: very channery silt loam
H3 - 23 to 33 inches: extremely channery silt loam
H4 - 33 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B

Forage suitability group: Droughty Soils (G128XB012VA)
Hydric soil rating: No

Description of Weikert

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 4 inches: very channery silt loam
H2 - 4 to 13 inches: very channery silt loam
H3 - 13 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

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

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

16B—Groseclose and Poplimento soils, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: kc22
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

Groseclose and similar soils: 45 percent
Poplimento and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Groseclose

Setting

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

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 28 inches: clay
H3 - 28 to 39 inches: clay
H4 - 39 to 51 inches: clay
H5 - 51 to 79 inches: clay loam

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 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: C
Hydric soil rating: No

Description of Poplimento

Setting

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

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 35 inches: clay
H3 - 35 to 55 inches: clay
H4 - 55 to 79 inches: channery silty clay loam

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 7.7 inches)

Interpretive groups

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

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

16C—Groseclose and Poplimento soils, 7 to 15 percent slopes

Map Unit Setting

National map unit symbol: kc23
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

Groseclose and similar soils: 45 percent
Poplimento and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Groseclose

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, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 28 inches: clay
H3 - 28 to 39 inches: clay
H4 - 39 to 51 inches: clay
H5 - 51 to 79 inches: clay loam

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 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: C
Hydric soil rating: No

Description of Poplimento

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, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 35 inches: clay
H3 - 35 to 55 inches: clay
H4 - 55 to 79 inches: channery silty clay loam

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 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

16D—Groseclose and Poplimento soils, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: kc24
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

Groseclose and similar soils: 45 percent
Poplimento and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Groseclose

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 28 inches: clay
H3 - 28 to 39 inches: clay
H4 - 39 to 51 inches: clay
H5 - 51 to 79 inches: clay loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 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): 4e

Hydrologic Soil Group: C
Hydric soil rating: No

Description of Poplimento

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 35 inches: clay
H3 - 35 to 55 inches: clay
H4 - 55 to 79 inches: channery silty clay loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
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 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

29—Udorthents and Urban land

Map Unit Setting

National map unit symbol: kc2r
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: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 45 percent
Urban land: 30 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform: Hills
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Limestone, shale, sandstone, or granite residuum

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Limestone, shale, sandstone, or granite residuum

Minor Components

Purdy

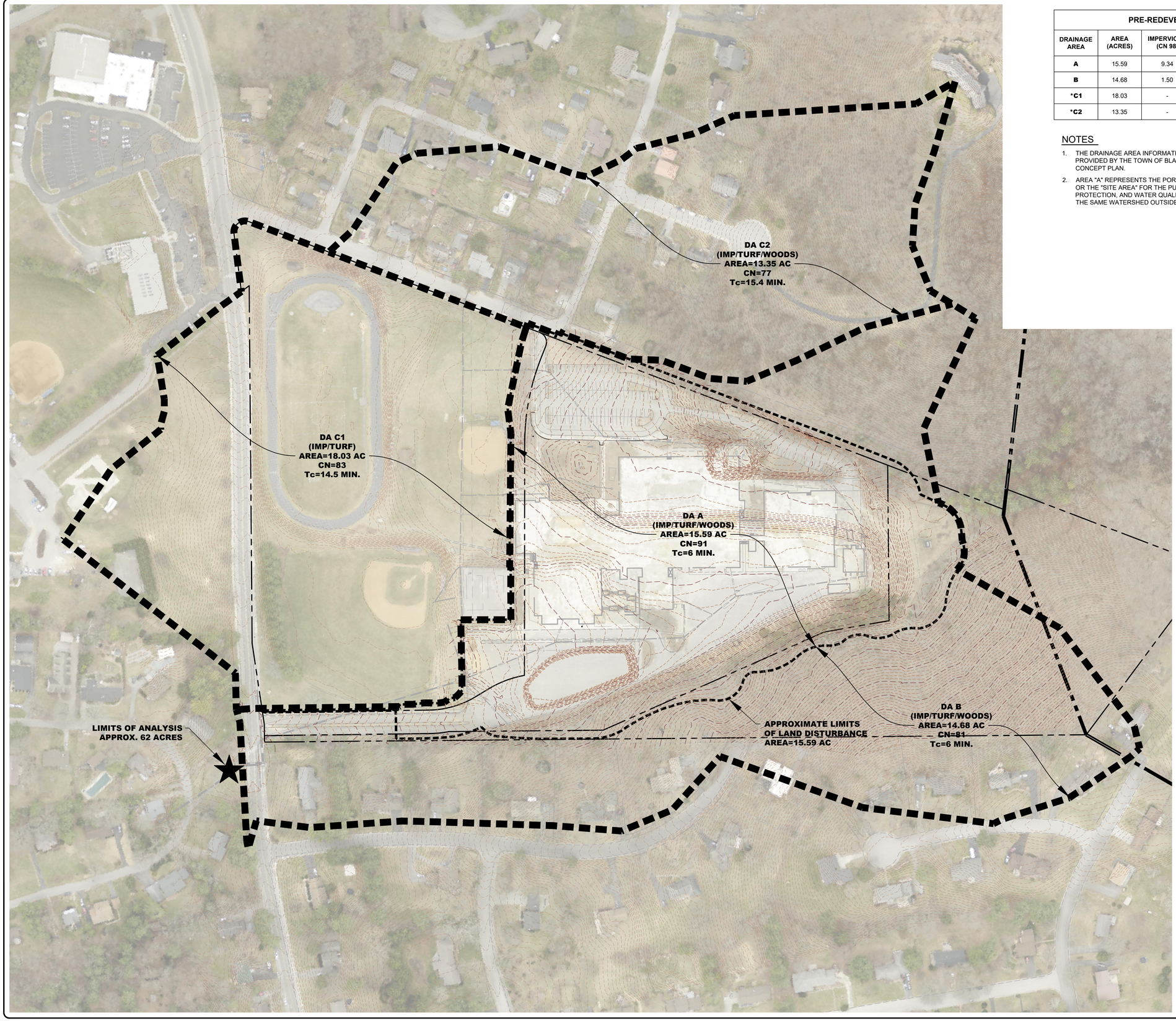
Percent of map unit: 3 percent
Landform: Stream terraces, depressions
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

APPENDIX B:
DRAINAGE MAPS



PRE-REDEVELOPMENT LAND COVER SUMMARY

DRAINAGE AREA	AREA (ACRES)	IMPERVIOUS (CN 98)	TURF (CN 80)	FOREST/OPEN (CN 77)	WEIGHTED CN
A	15.59	9.34	4.85	1.40	91
B	14.68	1.50	8.98	4.20	81
***C1**	18.03	-	-	-	83
***C2**	13.35	-	-	-	77

NOTES

1. THE DRAINAGE AREA INFORMATION FOR AREAS C1 AND C2 ARE BASED ON WATERSHED DATA PROVIDED BY THE TOWN OF BLACKSBURG CONSISTENT WITH THE 2019 REZONING STORMWATER CONCEPT PLAN.
2. AREA "A" REPRESENTS THE PORTION OF THE WATERSHED WITHIN THE LIMITS OF DISTURBANCE, OR THE "SITE AREA" FOR THE PURPOSES OF DETERMINING CHANNEL PROTECTION, FLOOD PROTECTION, AND WATER QUALITY REQUIREMENTS. AREA "B" REPRESENTS THE PORTION OF THE SAME WATERSHED OUTSIDE OF THE LIMITS OF DISTURBANCE.

100 0 100 200 300

1" = 100'

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JAMES RICHARD TAYLOR
Lic. No. 55142
3/1/24
PROFESSIONAL ENGINEER

OLD BLACKSBURG HIGH SCHOOL

STORMWATER CONCEPT PLAN

PRE-DEVELOPMENT DRAINAGE MAP

MOUNT TABOR MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, VIRGINIA

DRAWN BY	JJH
DESIGNED BY	JRT
CHECKED BY	SMS
DATE	3/1/2024
SCALE	1" = 100'
REVISIONS	

SW1

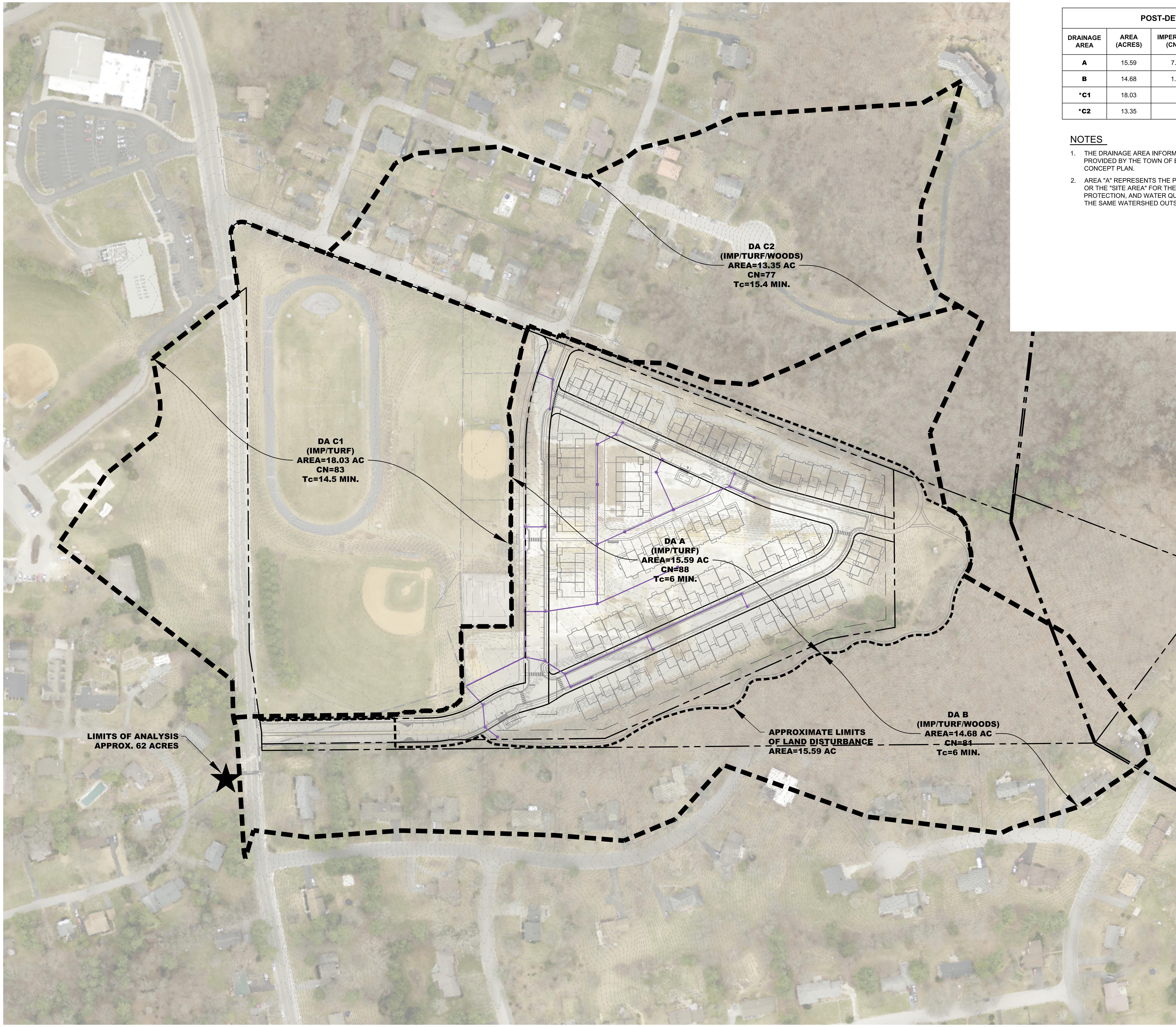
PROJECT NO. 24220132.00

J:\2023\24220132.00 HS DEVELOPMENT - OBH TOWNHOMES\CIVIL\dwg\DA MAPS.dwg Pc3 PLOTTED: 3/5/2024 11:13:17 AM

POST-DEVELOPMENT LAND COVER SUMMARY					
DRAINAGE AREA	AREA (ACRES)	IMPERVIOUS (CN 98)	TURF (CN 80)	FOREST/OPEN (CN 77)	WEIGHTED CN
A	15.59	7.10	8.49	-	88
B	14.68	1.50	8.98	4.20	81
*C1	18.03	-	-	-	83
*C2	13.35	-	-	-	77

NOTES

1. THE DRAINAGE AREA INFORMATION FOR AREAS C1 AND C2 ARE BASED ON WATERSHED DATA PROVIDED BY THE TOWN OF BLACKSBURG CONSISTENT WITH THE 2019 REZONING STORMWATER CONCEPT PLAN.
2. AREA "A" REPRESENTS THE PORTION OF THE WATERSHED WITHIN THE LIMITS OF DISTURBANCE, OR THE "SITE AREA" FOR THE PURPOSES OF DETERMINING CHANNEL PROTECTION, FLOOD PROTECTION, AND WATER QUALITY REQUIREMENTS. AREA "B" REPRESENTS THE PORTION OF THE SAME WATERSHED OUTSIDE OF THE LIMITS OF DISTURBANCE.



100 0 100 200 300

1" = 100'

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3/1/24
PROFESSIONAL ENGINEER

OLD BLACKSBURG HIGH SCHOOL

STORMWATER CONCEPT PLAN

POST-DEVELOPMENT DRAINAGE MAP

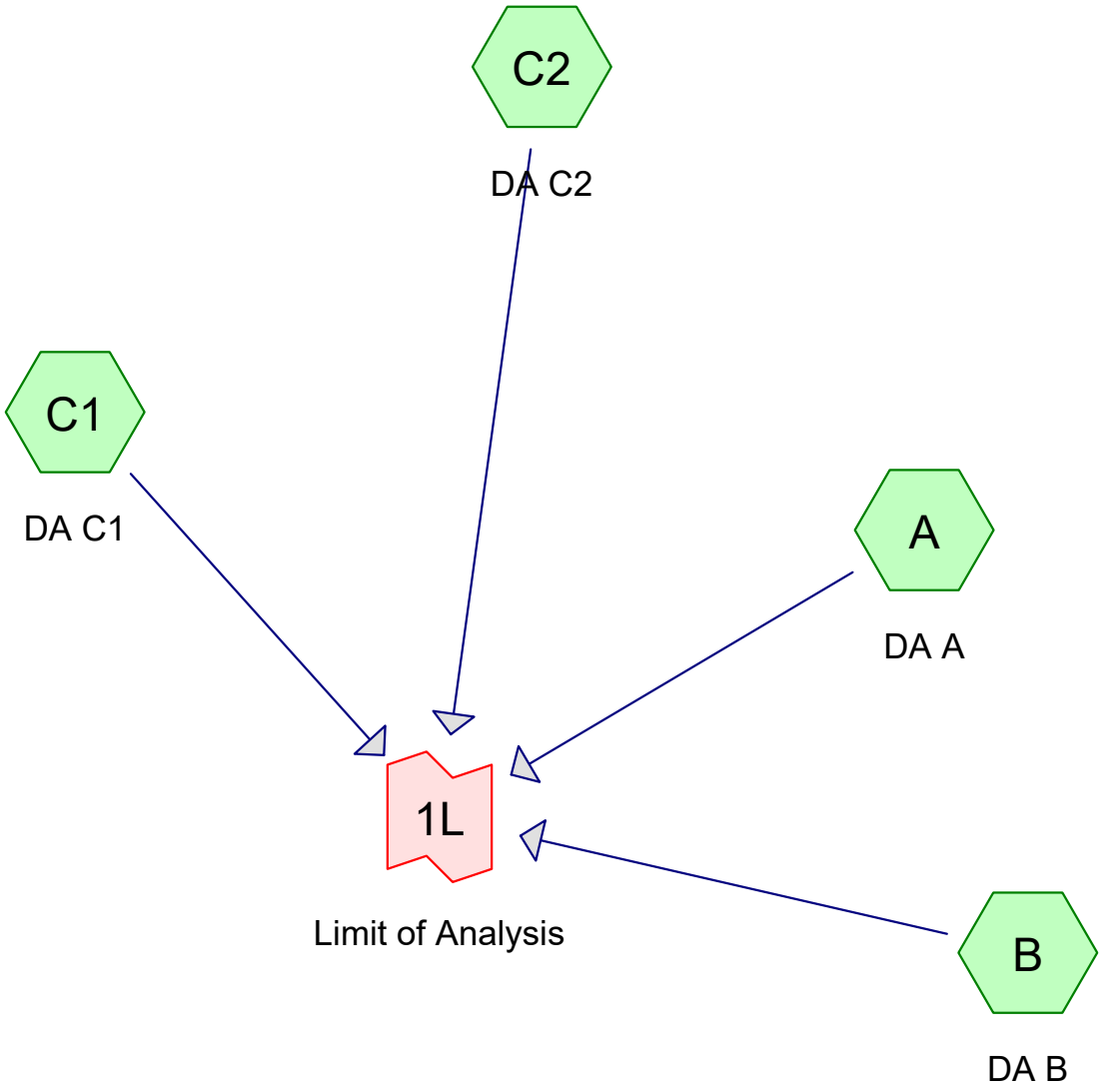
MOUNT TABOR MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, VIRGINIA

DRAWN BY	JJH
DESIGNED BY	JRT
CHECKED BY	SMS
DATE	3/1/2024
SCALE	1" = 100'
REVISIONS	

SW2

PROJECT NO. 24220132.00

APPENDIX C:
STORMWATER QUANTITY CALCULATIONS



Subcat Reach Pond Link

Routing Diagram for PRE-DEVELOPMENT
Prepared by Balzer & Associates, Inc, Printed 3/5/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC	P2 (inches)
1	1-yr	Type II 24-hr		Default	24.00	1	2.28	2	2.76
2	2-yr	Type II 24-hr		Default	24.00	1	2.76	2	2.76
3	10-yr	Type II 24-hr		Default	24.00	1	4.11	2	2.76

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5.600	77	Forest/Open (A, B)
10.840	98	Impervious (A, B)
18.030	83	Per TOB GIS Data (C1)
13.350	77	Per TOB GIS Data (C2)
13.830	80	Turf (A, B)
61.650	**83**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.03 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment A: DA A Runoff Area=15.590 ac Runoff Depth=1.41"
Tc=6.0 min CN=91 Runoff=38.31 cfs 1.834 af

Subcatchment B: DA B Runoff Area=14.680 ac Runoff Depth=0.79"
Tc=6.0 min CN=81 Runoff=20.47 cfs 0.965 af

Subcatchment C1: DA C1 Runoff Area=18.030 ac Runoff Depth=0.89"
Tc=14.5 min CN=83 Runoff=20.87 cfs 1.341 af

Subcatchment C2: DA C2 Runoff Area=13.350 ac Runoff Depth=0.61"
Tc=15.4 min CN=77 Runoff=9.52 cfs 0.674 af

Link 1L: Limit of Analysis Inflow=79.49 cfs 4.815 af
Primary=79.49 cfs 4.815 af

Total Runoff Area = 61.650 ac Runoff Volume = 4.815 af Average Runoff Depth = 0.94"

Summary for Subcatchment A: DA A

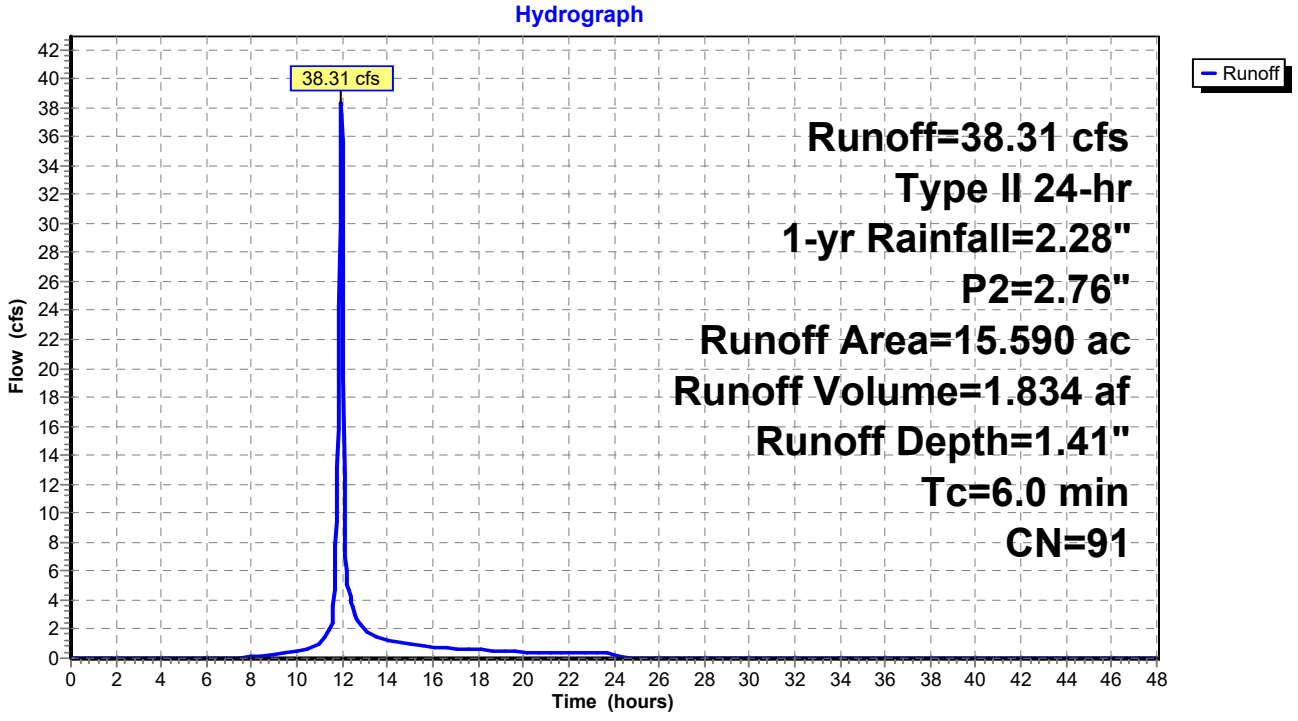
Runoff = 38.31 cfs @ 11.97 hrs, Volume= 1.834 af, Depth= 1.41"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-yr Rainfall=2.28", P2=2.76"

	Area (ac)	CN	Description
*	9.340	98	Impervious
*	4.850	80	Turf
*	1.400	77	Forest/Open
	15.590	91	Weighted Average

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

Subcatchment A: DA A



Summary for Subcatchment B: DA B

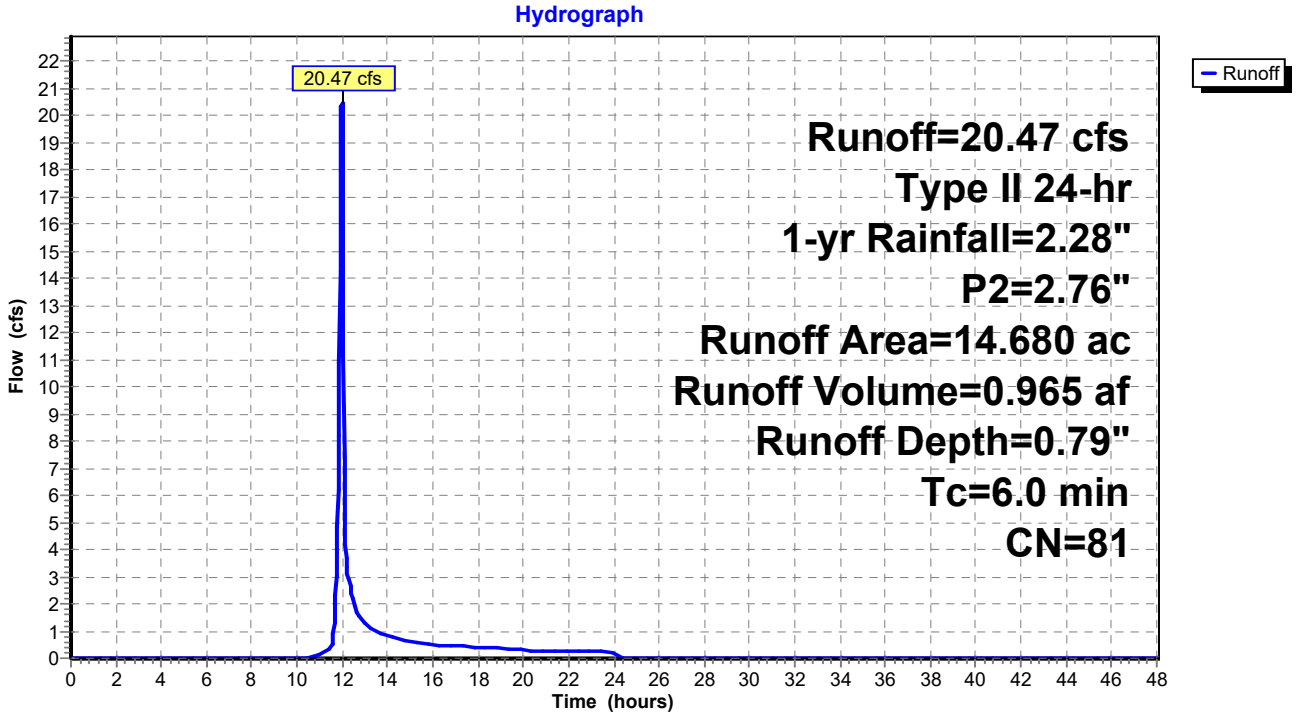
Runoff = 20.47 cfs @ 11.98 hrs, Volume= 0.965 af, Depth= 0.79"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-yr Rainfall=2.28", P2=2.76"

	Area (ac)	CN	Description
*	1.500	98	Impervious
*	8.980	80	Turf
*	4.200	77	Forest/Open
	14.680	81	Weighted Average

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

Subcatchment B: DA B



Summary for Subcatchment C1: DA C1

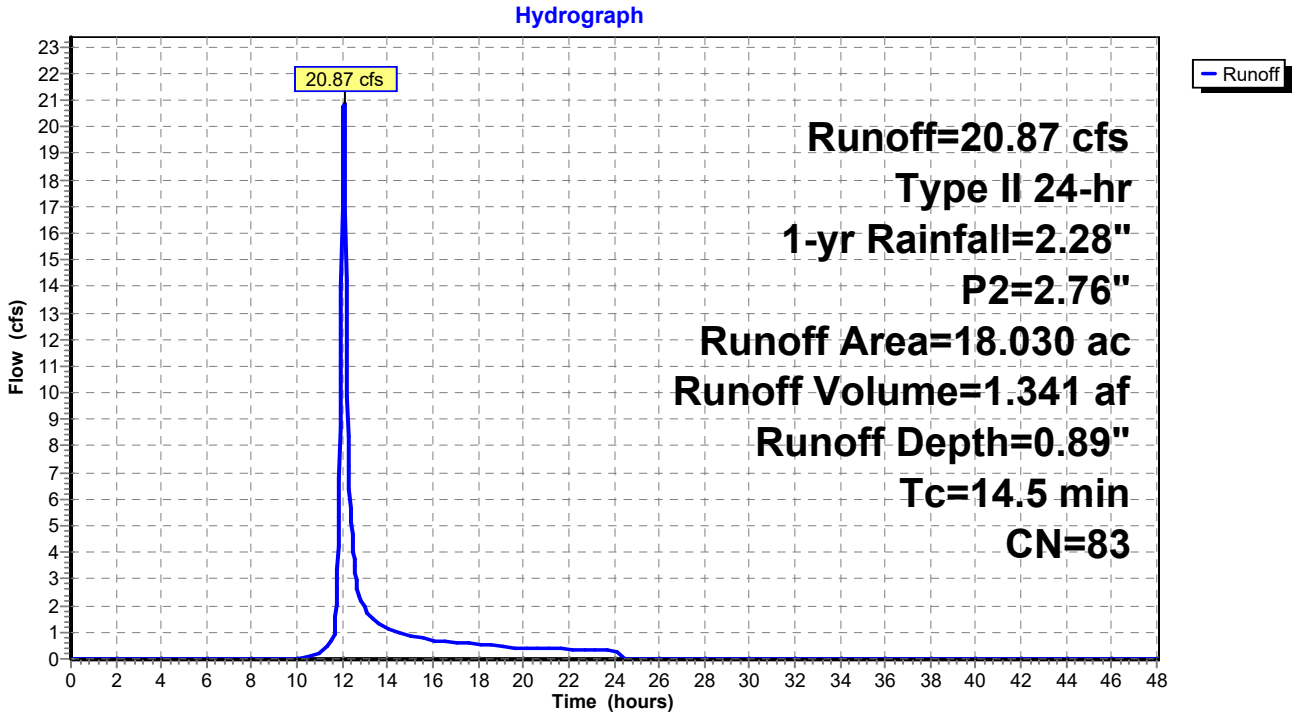
Runoff = 20.87 cfs @ 12.07 hrs, Volume= 1.341 af, Depth= 0.89"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-yr Rainfall=2.28", P2=2.76"

	Area (ac)	CN	Description
*	18.030	83	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5					**Direct Entry, Per TOB GIS Data**

Subcatchment C1: DA C1



Summary for Subcatchment C2: DA C2

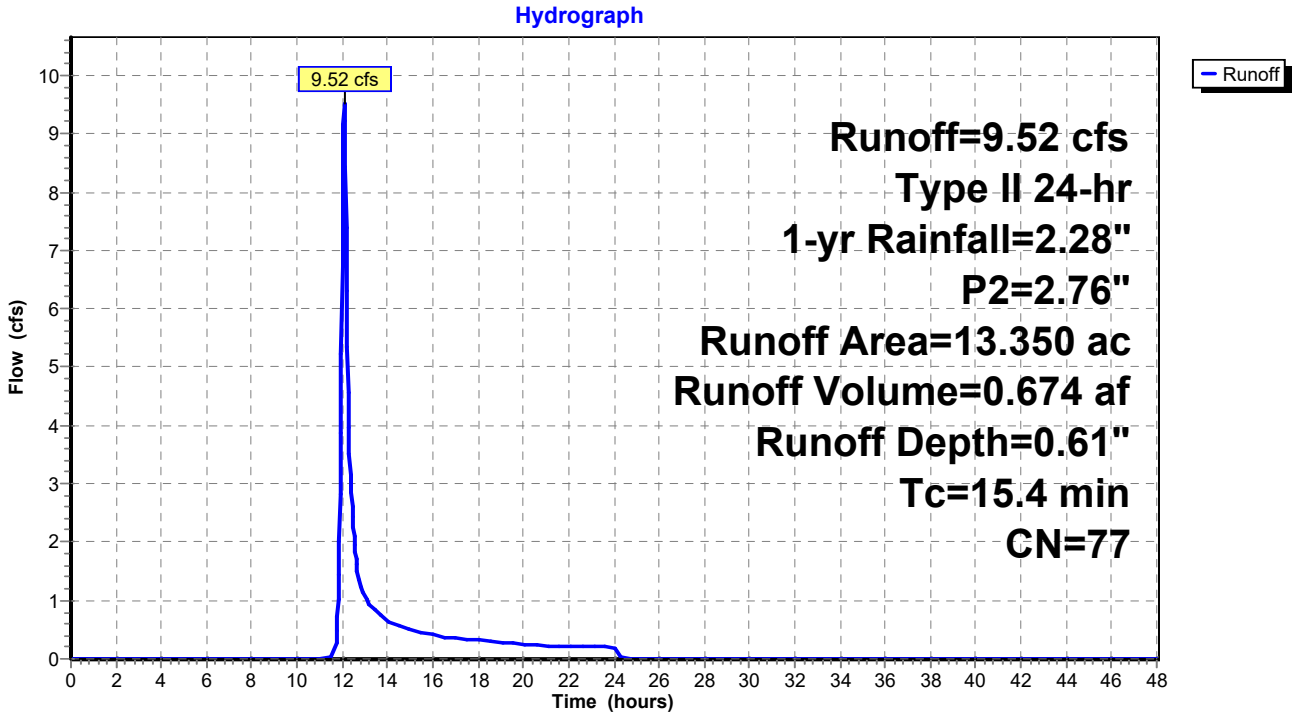
Runoff = 9.52 cfs @ 12.09 hrs, Volume= 0.674 af, Depth= 0.61"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-yr Rainfall=2.28", P2=2.76"

	Area (ac)	CN	Description
*	13.350	77	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4					**Direct Entry, Per TOB GIS Data**

Subcatchment C2: DA C2

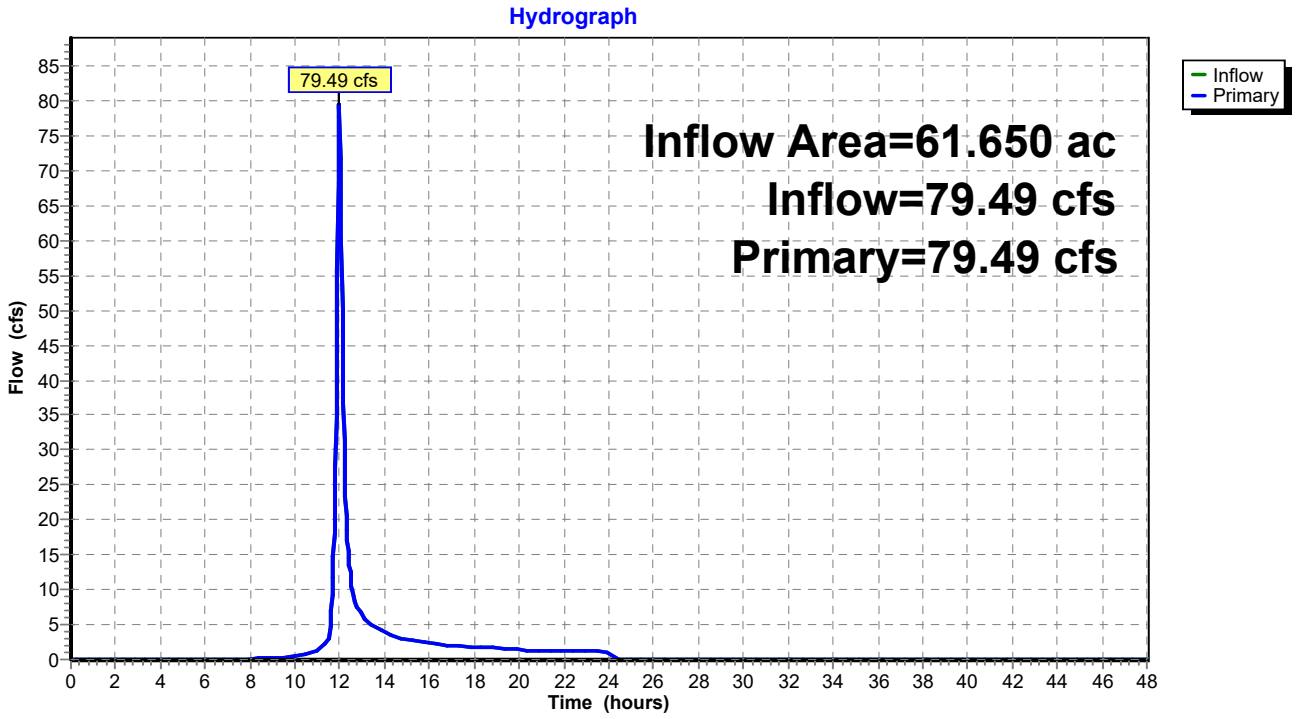


Summary for Link 1L: Limit of Analysis

Inflow Area = 61.650 ac, Inflow Depth = 0.94" for 1-yr event
Inflow = 79.49 cfs @ 11.99 hrs, Volume= 4.815 af
Primary = 79.49 cfs @ 11.99 hrs, Volume= 4.815 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1L: Limit of Analysis



Time span=0.00-48.00 hrs, dt=0.03 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment A: DA A Runoff Area=15.590 ac Runoff Depth=1.85"
Tc=6.0 min CN=91 Runoff=49.53 cfs 2.402 af

Subcatchment B: DA B Runoff Area=14.680 ac Runoff Depth=1.13"
Tc=6.0 min CN=81 Runoff=29.57 cfs 1.385 af

Subcatchment C1: DA C1 Runoff Area=18.030 ac Runoff Depth=1.26"
Tc=14.5 min CN=83 Runoff=29.68 cfs 1.887 af

Subcatchment C2: DA C2 Runoff Area=13.350 ac Runoff Depth=0.91"
Tc=15.4 min CN=77 Runoff=14.89 cfs 1.010 af

Link 1L: Limit of Analysis Inflow=110.59 cfs 6.684 af
Primary=110.59 cfs 6.684 af

Total Runoff Area = 61.650 ac Runoff Volume = 6.684 af Average Runoff Depth = 1.30"

Summary for Subcatchment A: DA A

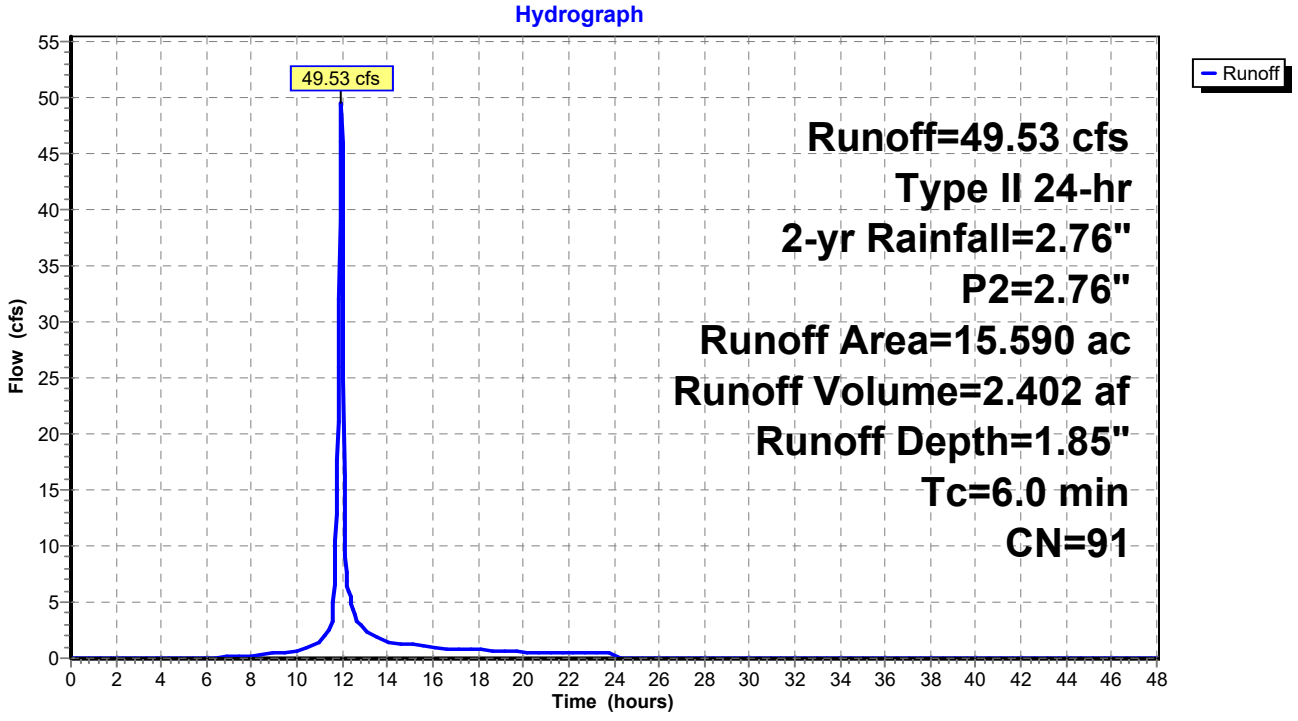
Runoff = 49.53 cfs @ 11.97 hrs, Volume= 2.402 af, Depth= 1.85"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-yr Rainfall=2.76", P2=2.76"

	Area (ac)	CN	Description
*	9.340	98	Impervious
*	4.850	80	Turf
*	1.400	77	Forest/Open
	15.590	91	Weighted Average

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

Subcatchment A: DA A



Summary for Subcatchment B: DA B

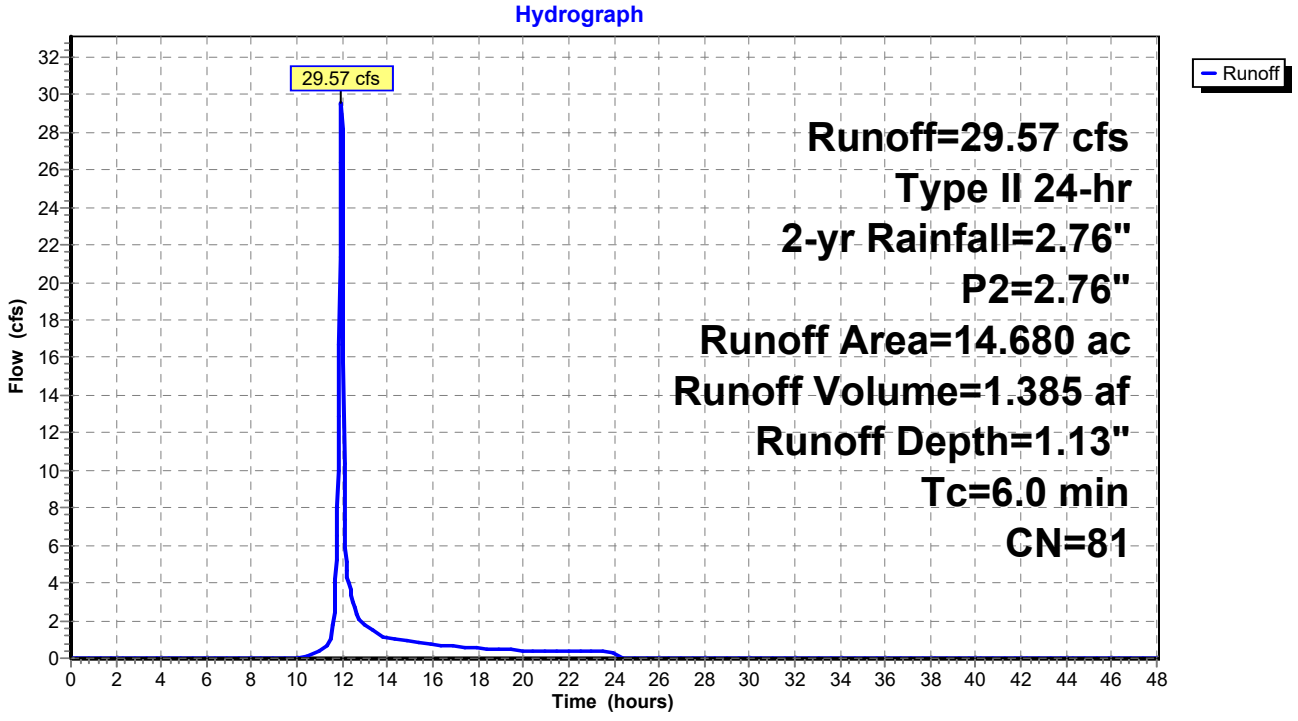
Runoff = 29.57 cfs @ 11.98 hrs, Volume= 1.385 af, Depth= 1.13"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-yr Rainfall=2.76", P2=2.76"

	Area (ac)	CN	Description
*	1.500	98	Impervious
*	8.980	80	Turf
*	4.200	77	Forest/Open
	14.680	81	Weighted Average

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

Subcatchment B: DA B



Summary for Subcatchment C1: DA C1

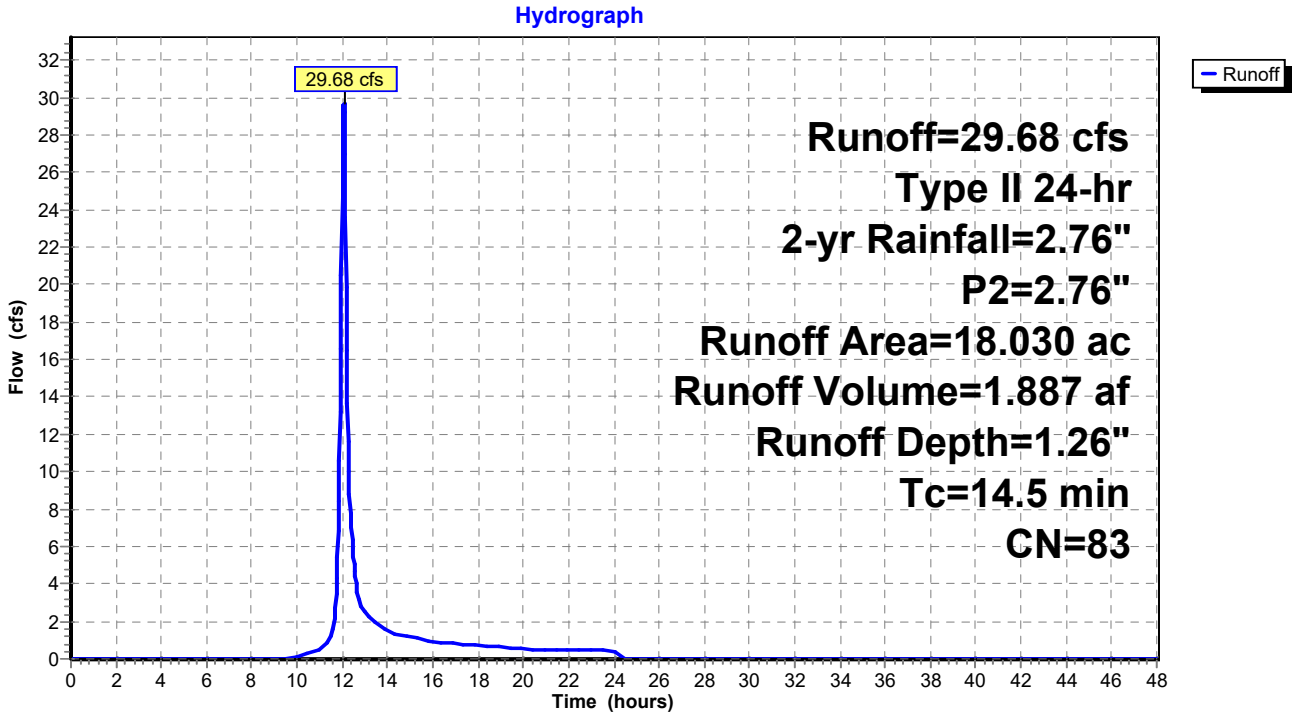
Runoff = 29.68 cfs @ 12.07 hrs, Volume= 1.887 af, Depth= 1.26"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-yr Rainfall=2.76", P2=2.76"

	Area (ac)	CN	Description
*	18.030	83	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5					**Direct Entry, Per TOB GIS Data**

Subcatchment C1: DA C1



Summary for Subcatchment C2: DA C2

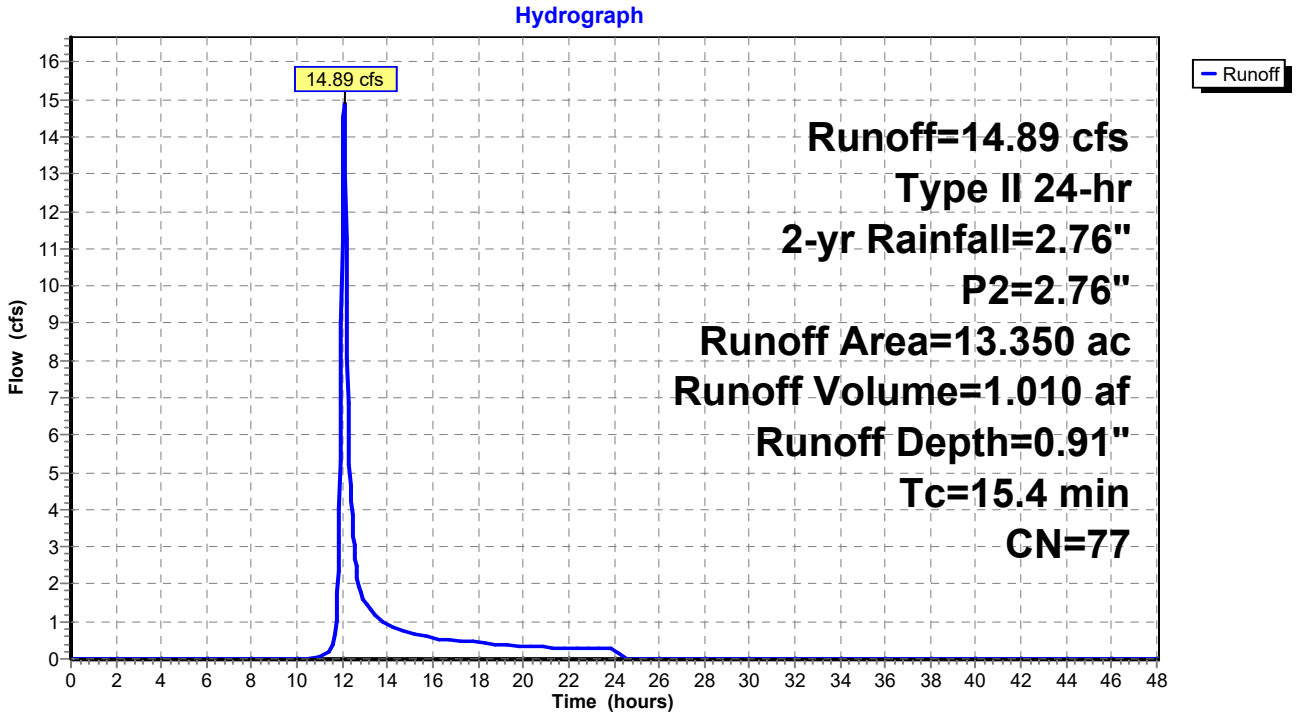
Runoff = 14.89 cfs @ 12.09 hrs, Volume= 1.010 af, Depth= 0.91"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-yr Rainfall=2.76", P2=2.76"

	Area (ac)	CN	Description
*	13.350	77	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4					**Direct Entry, Per TOB GIS Data**

Subcatchment C2: DA C2

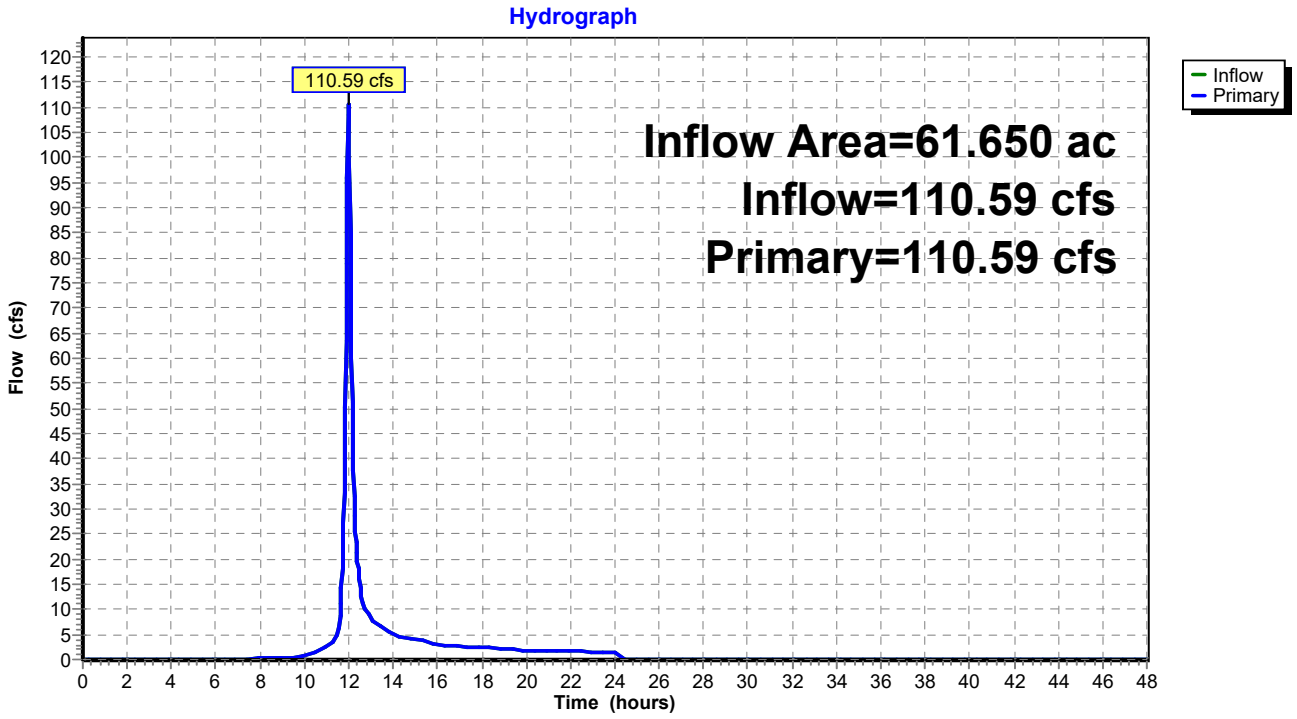


Summary for Link 1L: Limit of Analysis

Inflow Area = 61.650 ac, Inflow Depth = 1.30" for 2-yr event
Inflow = 110.59 cfs @ 11.99 hrs, Volume= 6.684 af
Primary = 110.59 cfs @ 11.99 hrs, Volume= 6.684 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1L: Limit of Analysis



Time span=0.00-48.00 hrs, dt=0.03 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment A: DA A Runoff Area=15.590 ac Runoff Depth=3.12"
Tc=6.0 min CN=91 Runoff=81.12 cfs 4.057 af

Subcatchment B: DA B Runoff Area=14.680 ac Runoff Depth=2.21"
Tc=6.0 min CN=81 Runoff=57.42 cfs 2.709 af

Subcatchment C1: DA C1 Runoff Area=18.030 ac Runoff Depth=2.38"
Tc=14.5 min CN=83 Runoff=56.35 cfs 3.579 af

Subcatchment C2: DA C2 Runoff Area=13.350 ac Runoff Depth=1.90"
Tc=15.4 min CN=77 Runoff=32.24 cfs 2.112 af

Link 1L: Limit of Analysis Inflow=204.10 cfs 12.457 af
Primary=204.10 cfs 12.457 af

Total Runoff Area = 61.650 ac Runoff Volume = 12.457 af Average Runoff Depth = 2.42"

Summary for Subcatchment A: DA A

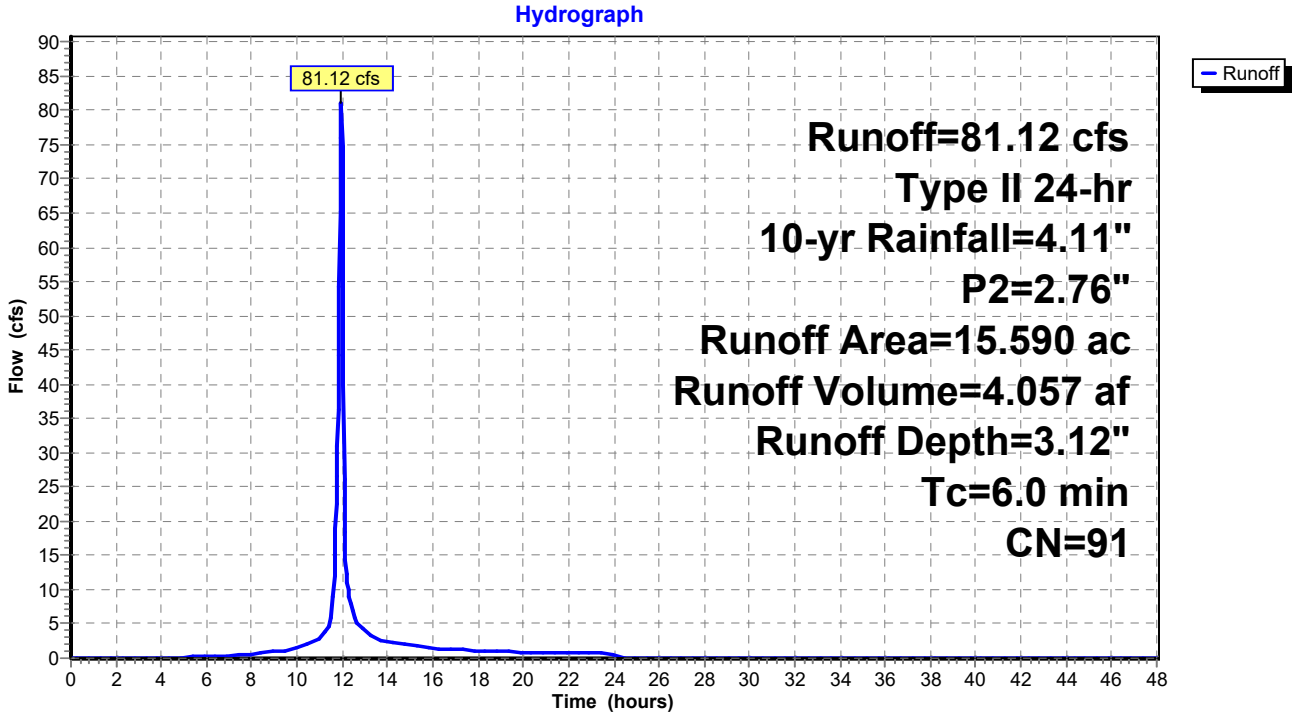
Runoff = 81.12 cfs @ 11.97 hrs, Volume= 4.057 af, Depth= 3.12"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-yr Rainfall=4.11", P2=2.76"

	Area (ac)	CN	Description
*	9.340	98	Impervious
*	4.850	80	Turf
*	1.400	77	Forest/Open
	15.590	91	Weighted Average

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

Subcatchment A: DA A



Summary for Subcatchment B: DA B

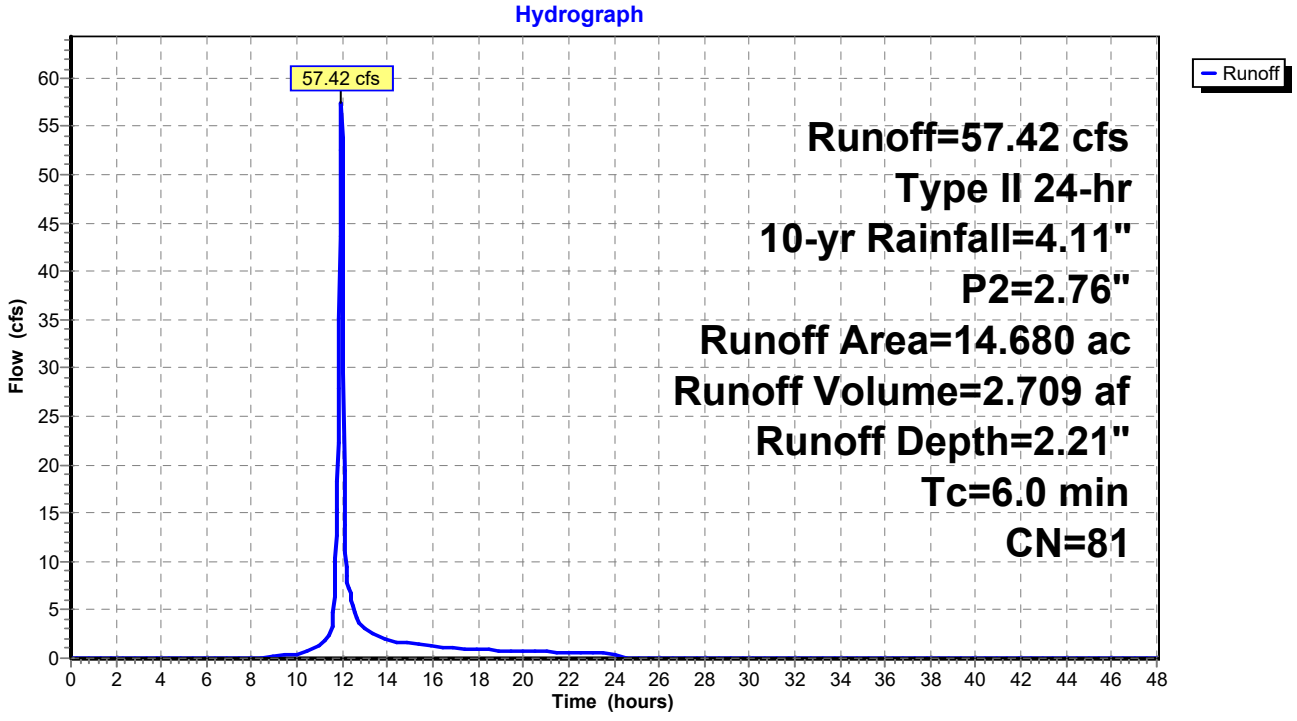
Runoff = 57.42 cfs @ 11.97 hrs, Volume= 2.709 af, Depth= 2.21"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-yr Rainfall=4.11", P2=2.76"

	Area (ac)	CN	Description
*	1.500	98	Impervious
*	8.980	80	Turf
*	4.200	77	Forest/Open
	14.680	81	Weighted Average

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

Subcatchment B: DA B



Summary for Subcatchment C1: DA C1

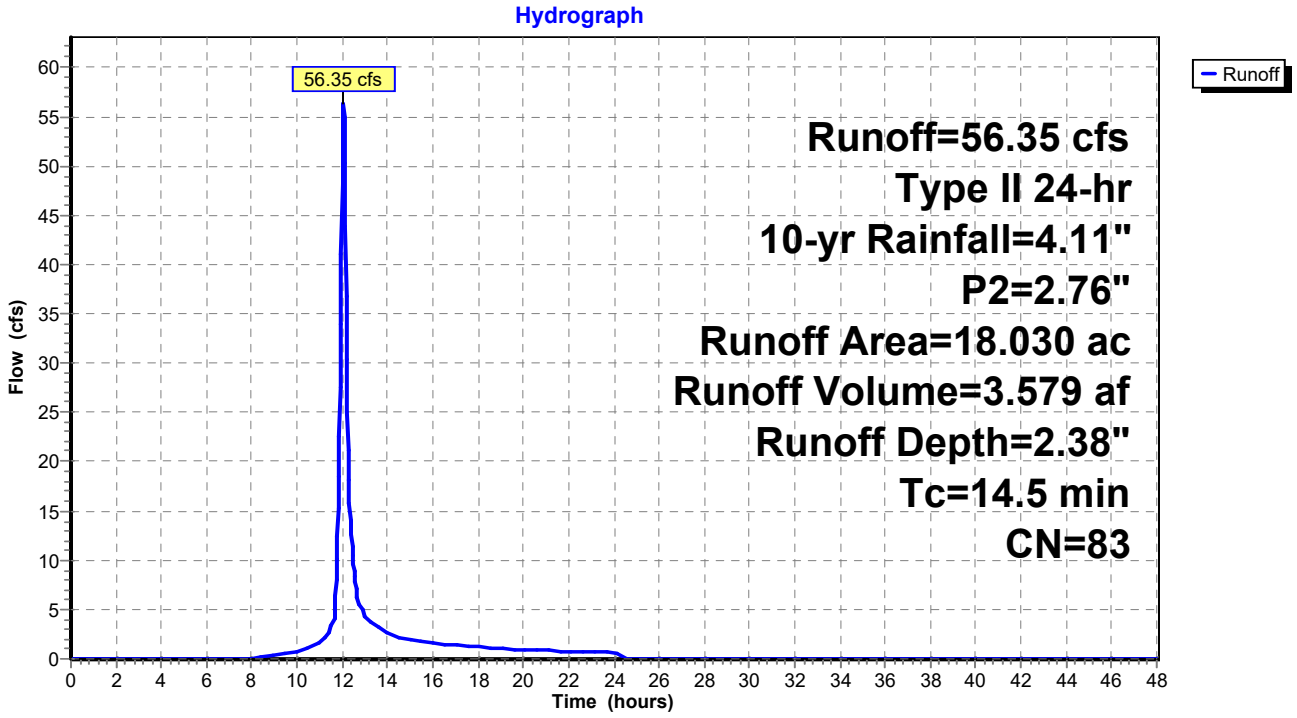
Runoff = 56.35 cfs @ 12.06 hrs, Volume= 3.579 af, Depth= 2.38"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-yr Rainfall=4.11", P2=2.76"

	Area (ac)	CN	Description
*	18.030	83	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5					**Direct Entry, Per TOB GIS Data**

Subcatchment C1: DA C1



Summary for Subcatchment C2: DA C2

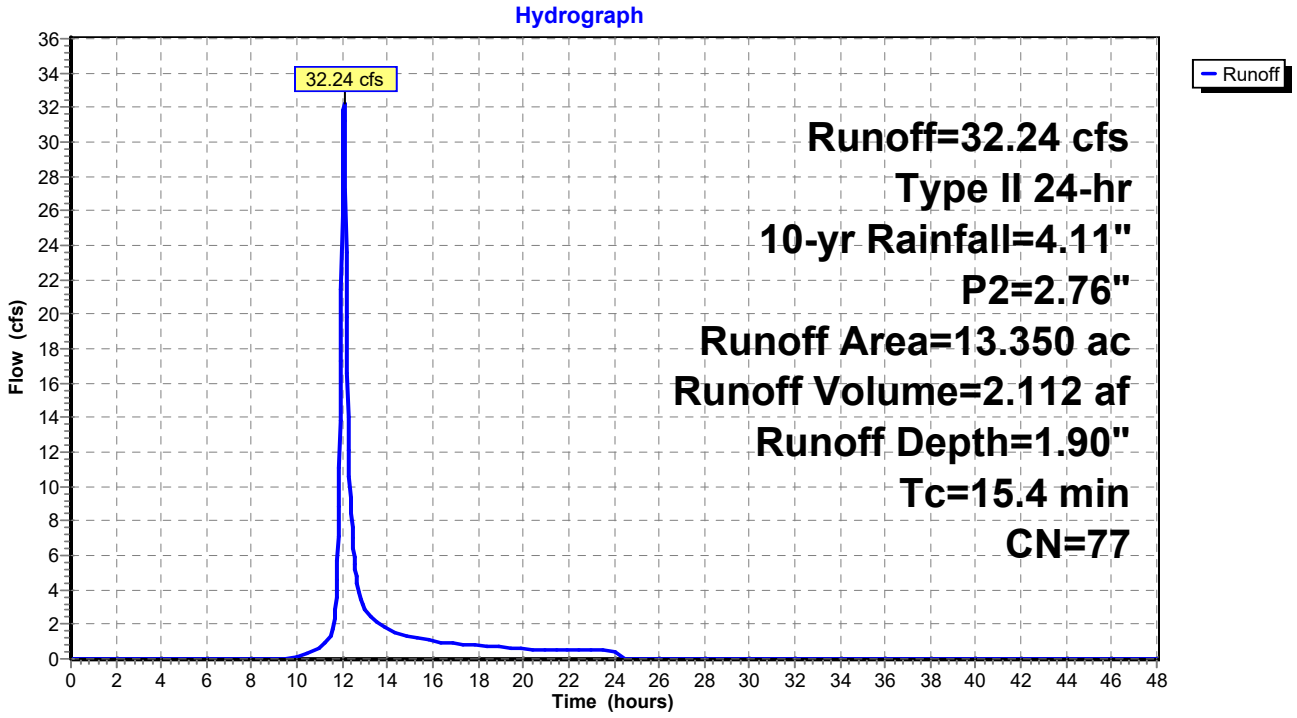
Runoff = 32.24 cfs @ 12.08 hrs, Volume= 2.112 af, Depth= 1.90"
Routed to Link 1L : Limit of Analysis

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-yr Rainfall=4.11", P2=2.76"

	Area (ac)	CN	Description
*	13.350	77	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4					**Direct Entry, Per TOB GIS Data**

Subcatchment C2: DA C2

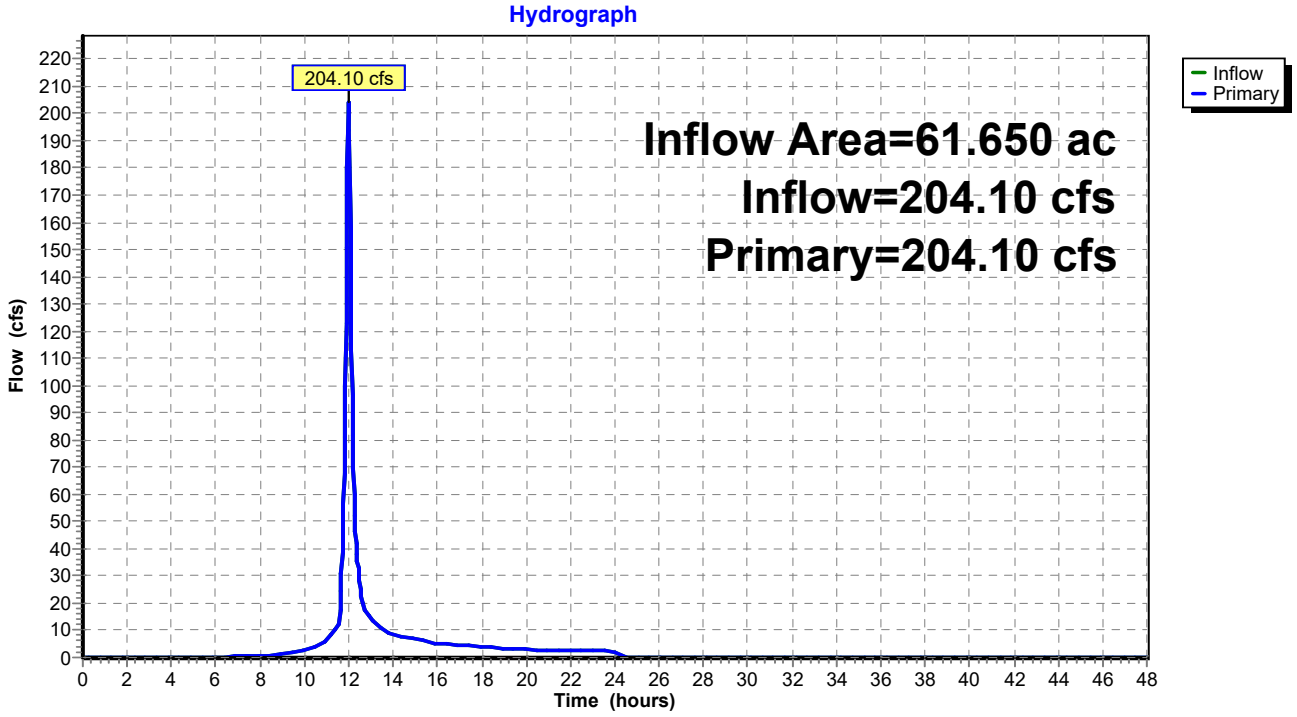


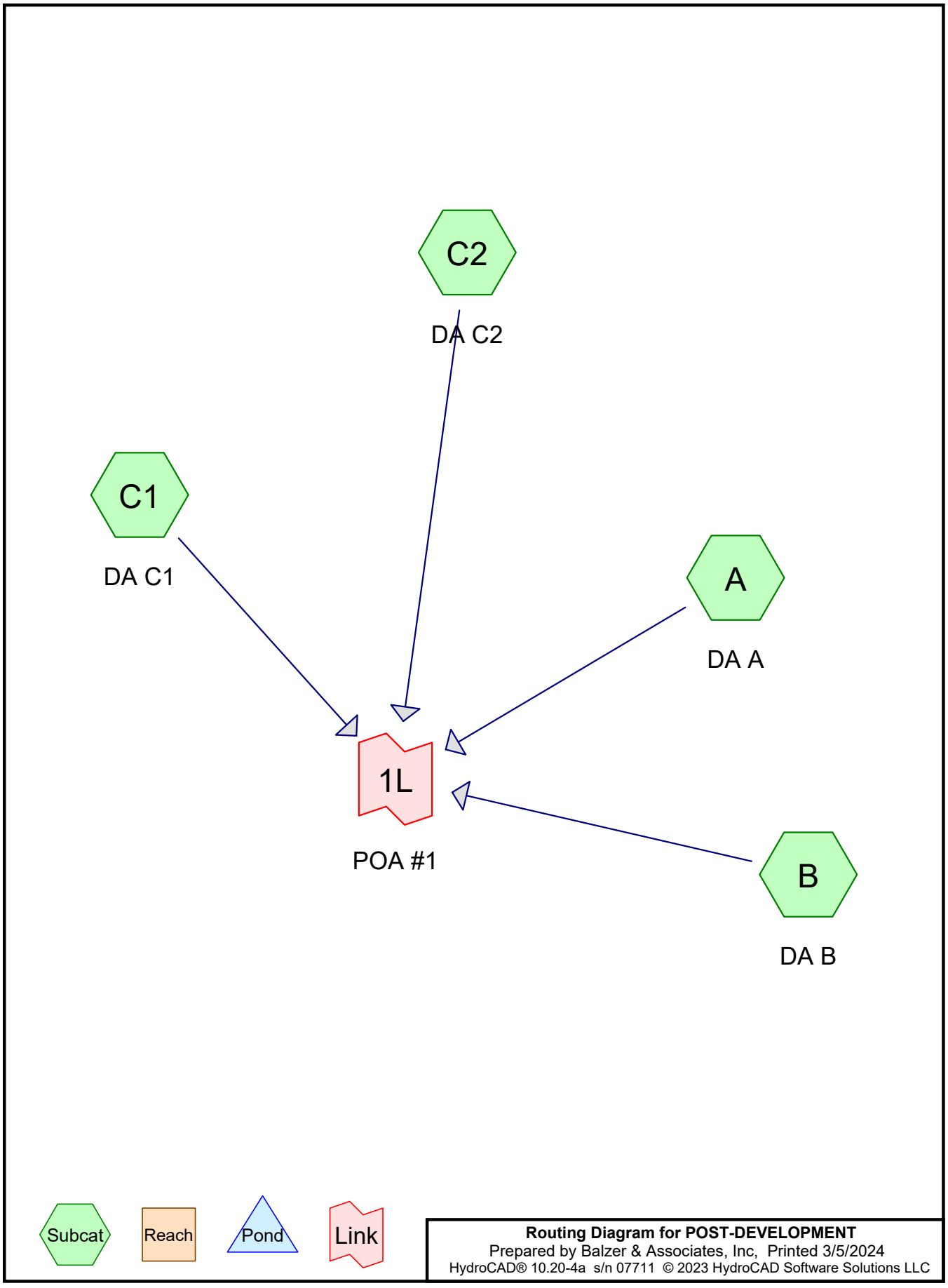
Summary for Link 1L: Limit of Analysis

Inflow Area = 61.650 ac, Inflow Depth = 2.42" for 10-yr event
Inflow = 204.10 cfs @ 11.99 hrs, Volume= 12.457 af
Primary = 204.10 cfs @ 11.99 hrs, Volume= 12.457 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1L: Limit of Analysis





Routing Diagram for POST-DEVELOPMENT
Prepared by Balzer & Associates, Inc, Printed 3/5/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-yr	Type II 24-hr		Default	24.00	1	2.28	2
2	2-yr	Type II 24-hr		Default	24.00	1	2.76	2
3	10-yr	Type II 24-hr		Default	24.00	1	4.11	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.200	77	Forest/Open (B)
8.600	98	Impervious (A, B)
18.030	83	Per TOB GIS Data (C1)
13.350	77	Per TOB GIS Data (C2)
17.470	80	Turf (A, B)
61.650	**83**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.03 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment A: DA A Runoff Area=15.590 ac Runoff Depth=1.20"
Tc=6.0 min CN=88 Runoff=32.98 cfs 1.553 af

Subcatchment B: DA B Runoff Area=14.680 ac Runoff Depth=0.79"
Tc=6.0 min CN=81 Runoff=20.47 cfs 0.965 af

Subcatchment C1: DA C1 Runoff Area=18.030 ac Runoff Depth=0.89"
Tc=14.5 min CN=83 Runoff=20.87 cfs 1.341 af

Subcatchment C2: DA C2 Runoff Area=13.350 ac Runoff Depth=0.61"
Tc=15.4 min CN=77 Runoff=9.52 cfs 0.674 af

Link 1L: POA #1 Inflow=74.54 cfs 4.534 af
Primary=74.54 cfs 4.534 af

Total Runoff Area = 61.650 ac Runoff Volume = 4.534 af Average Runoff Depth = 0.88"

Summary for Subcatchment A: DA A

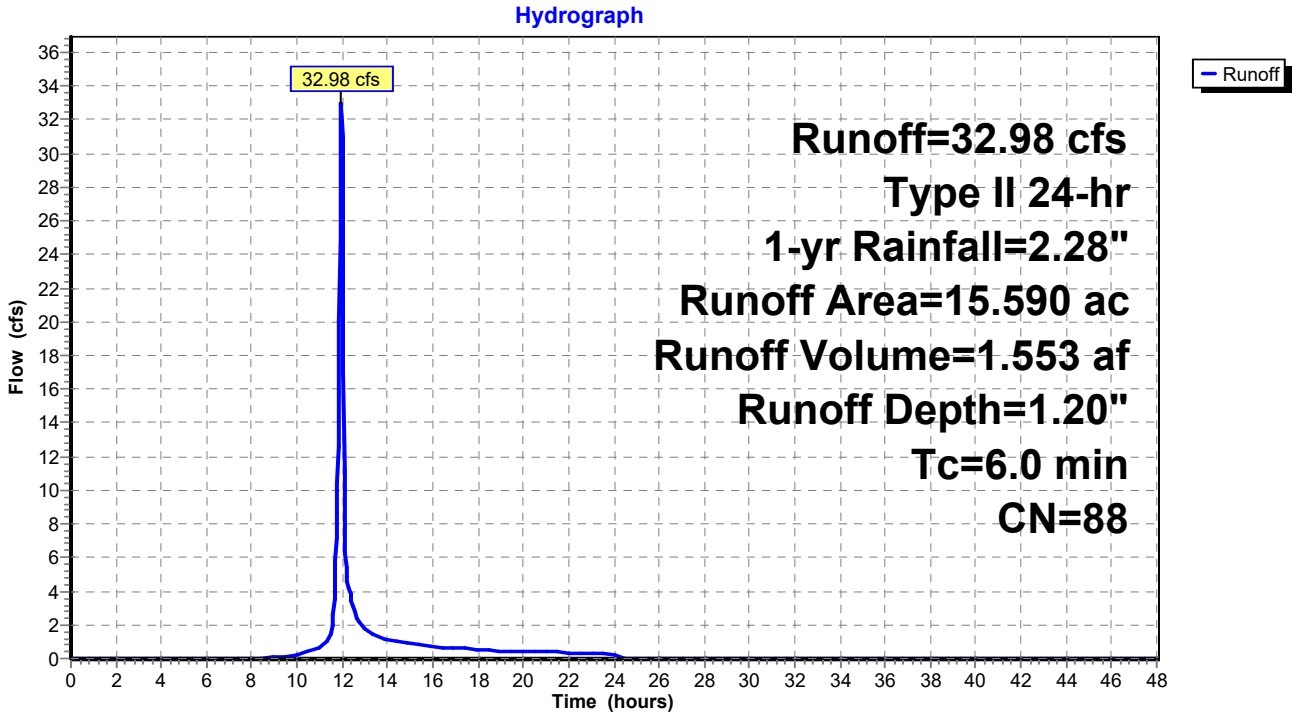
Runoff = 32.98 cfs @ 11.97 hrs, Volume= 1.553 af, Depth= 1.20"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-yr Rainfall=2.28"

	Area (ac)	CN	Description
*	7.100	98	Impervious
*	8.490	80	Turf
	15.590	88	Weighted Average

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

Subcatchment A: DA A



Summary for Subcatchment B: DA B

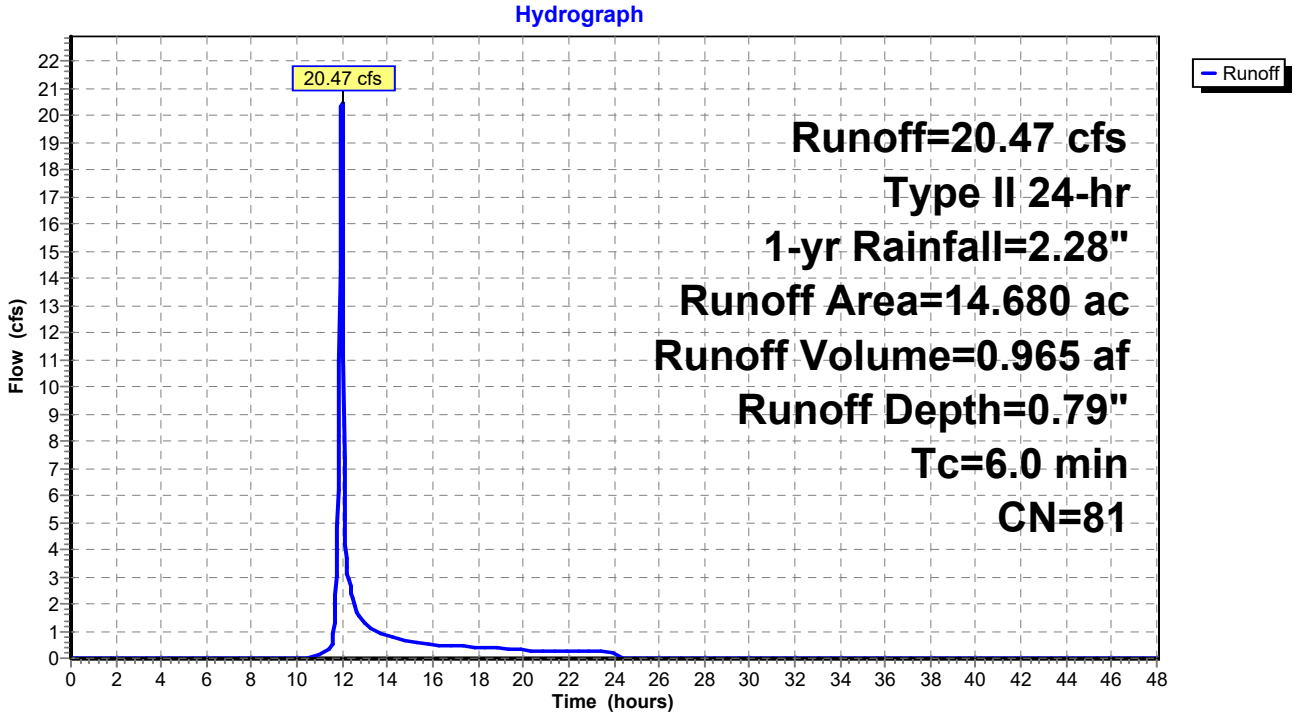
Runoff = 20.47 cfs @ 11.98 hrs, Volume= 0.965 af, Depth= 0.79"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-yr Rainfall=2.28"

	Area (ac)	CN	Description
*	1.500	98	Impervious
*	8.980	80	Turf
*	4.200	77	Forest/Open
	14.680	81	Weighted Average

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

Subcatchment B: DA B



Summary for Subcatchment C1: DA C1

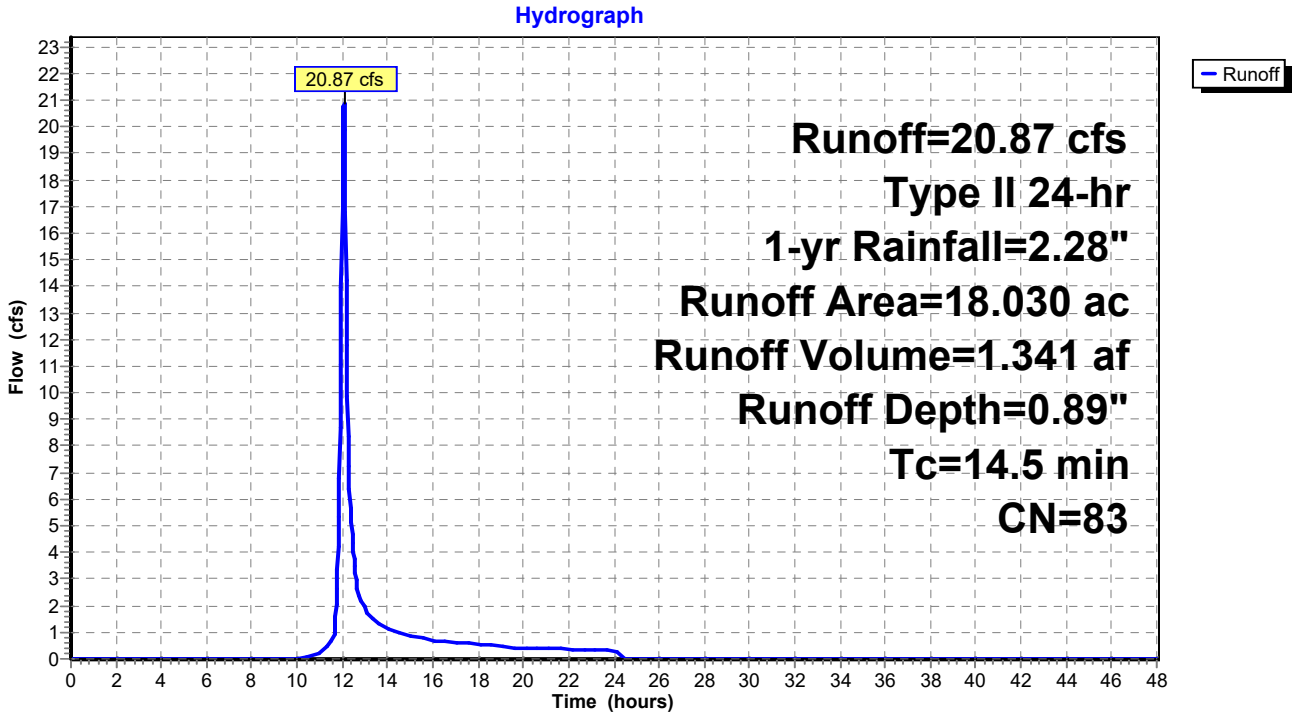
Runoff = 20.87 cfs @ 12.07 hrs, Volume= 1.341 af, Depth= 0.89"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-yr Rainfall=2.28"

	Area (ac)	CN	Description
*	18.030	83	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5					**Direct Entry, Per TOB GIS Data**

Subcatchment C1: DA C1



Summary for Subcatchment C2: DA C2

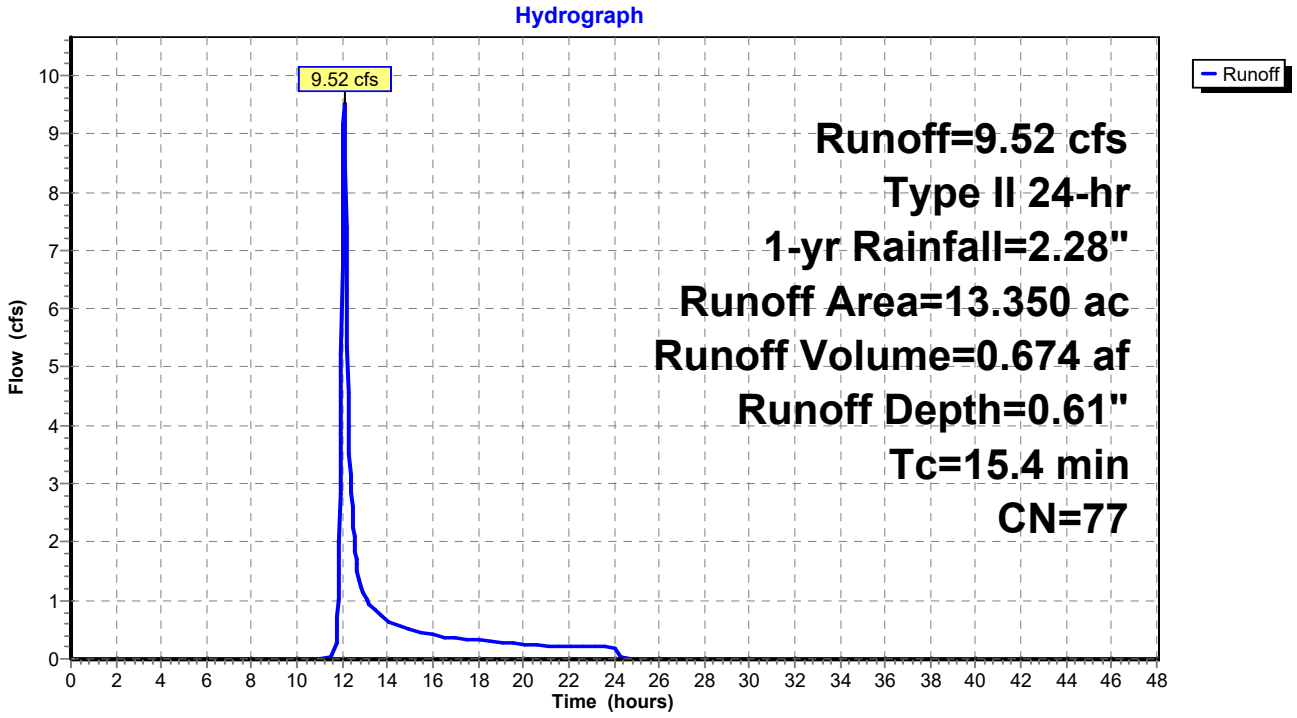
Runoff = 9.52 cfs @ 12.09 hrs, Volume= 0.674 af, Depth= 0.61"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-yr Rainfall=2.28"

	Area (ac)	CN	Description
*	13.350	77	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4					**Direct Entry, Per TOB GIS Data**

Subcatchment C2: DA C2

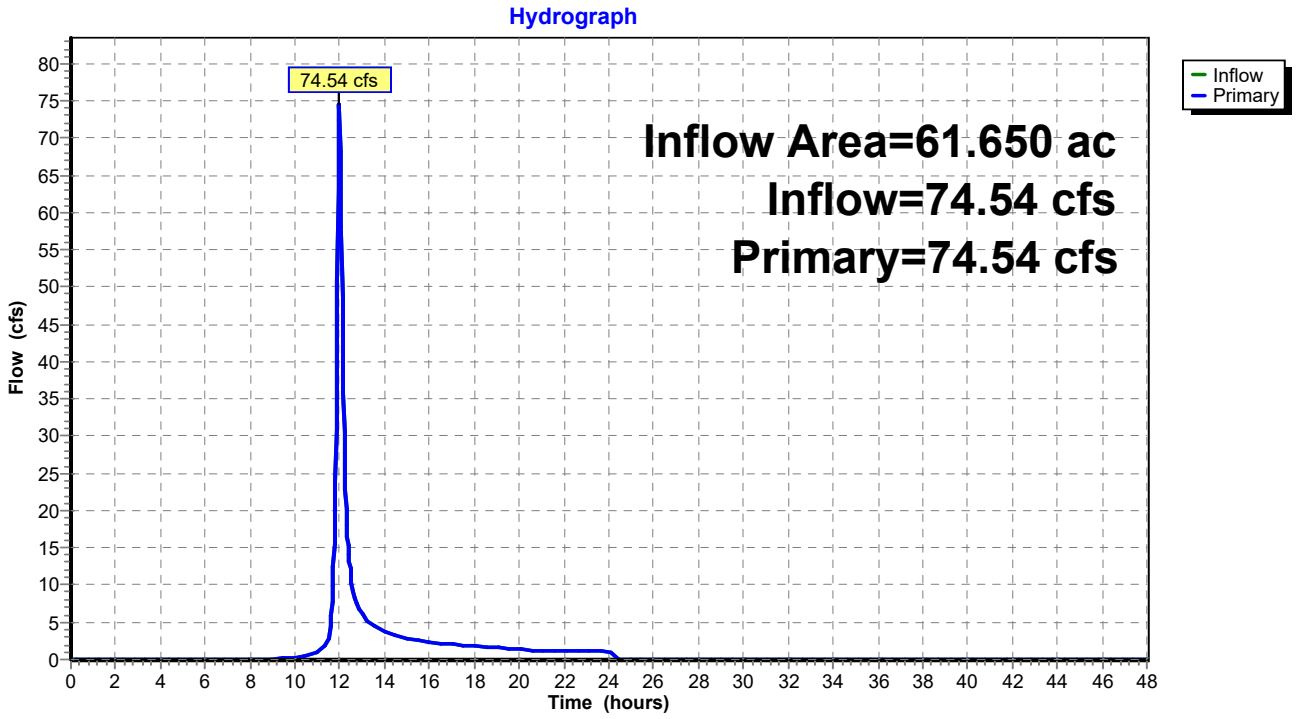


Summary for Link 1L: POA #1

Inflow Area = 61.650 ac, Inflow Depth = 0.88" for 1-yr event
Inflow = 74.54 cfs @ 11.99 hrs, Volume= 4.534 af
Primary = 74.54 cfs @ 11.99 hrs, Volume= 4.534 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1L: POA #1



Time span=0.00-48.00 hrs, dt=0.03 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment A: DA A Runoff Area=15.590 ac Runoff Depth=1.61"
Tc=6.0 min CN=88 Runoff=43.93 cfs 2.087 af

Subcatchment B: DA B Runoff Area=14.680 ac Runoff Depth=1.13"
Tc=6.0 min CN=81 Runoff=29.57 cfs 1.385 af

Subcatchment C1: DA C1 Runoff Area=18.030 ac Runoff Depth=1.26"
Tc=14.5 min CN=83 Runoff=29.68 cfs 1.887 af

Subcatchment C2: DA C2 Runoff Area=13.350 ac Runoff Depth=0.91"
Tc=15.4 min CN=77 Runoff=14.89 cfs 1.010 af

Link 1L: POA #1 Inflow=105.42 cfs 6.369 af
Primary=105.42 cfs 6.369 af

Total Runoff Area = 61.650 ac Runoff Volume = 6.369 af Average Runoff Depth = 1.24"

Summary for Subcatchment A: DA A

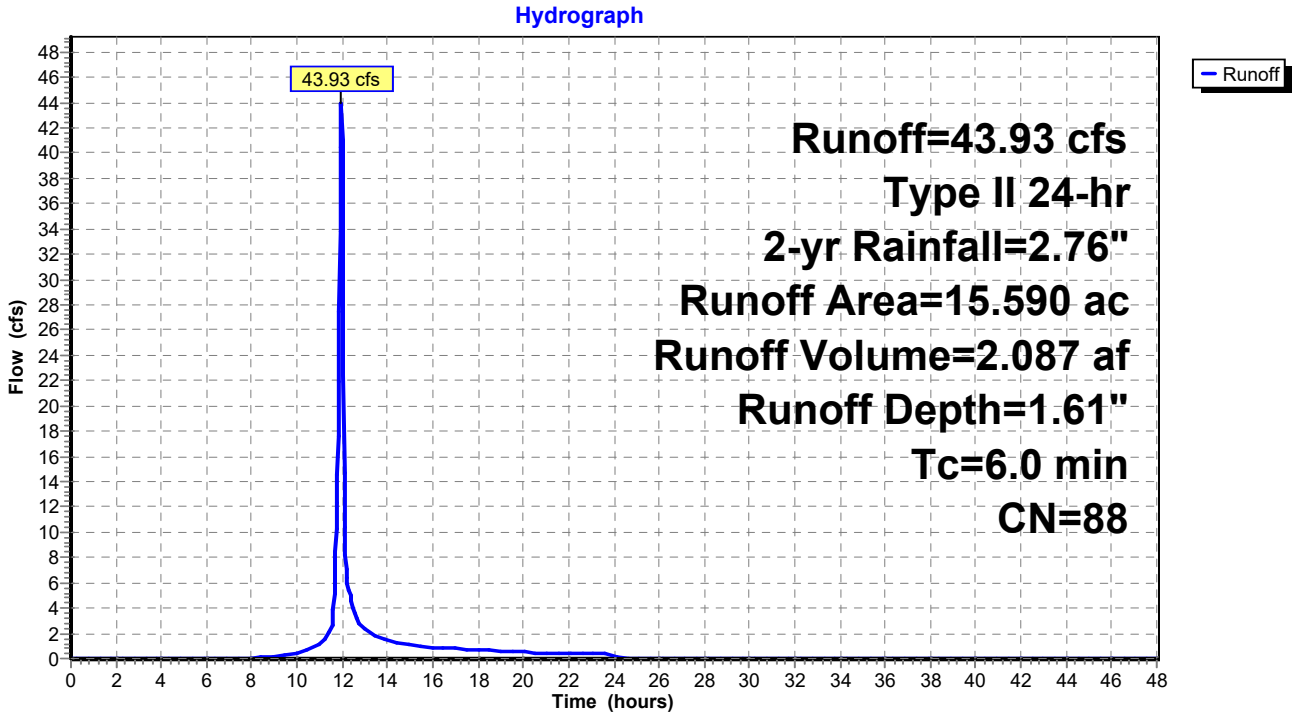
Runoff = 43.93 cfs @ 11.97 hrs, Volume= 2.087 af, Depth= 1.61"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-yr Rainfall=2.76"

	Area (ac)	CN	Description
*	7.100	98	Impervious
*	8.490	80	Turf
	15.590	88	Weighted Average

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

Subcatchment A: DA A



Summary for Subcatchment B: DA B

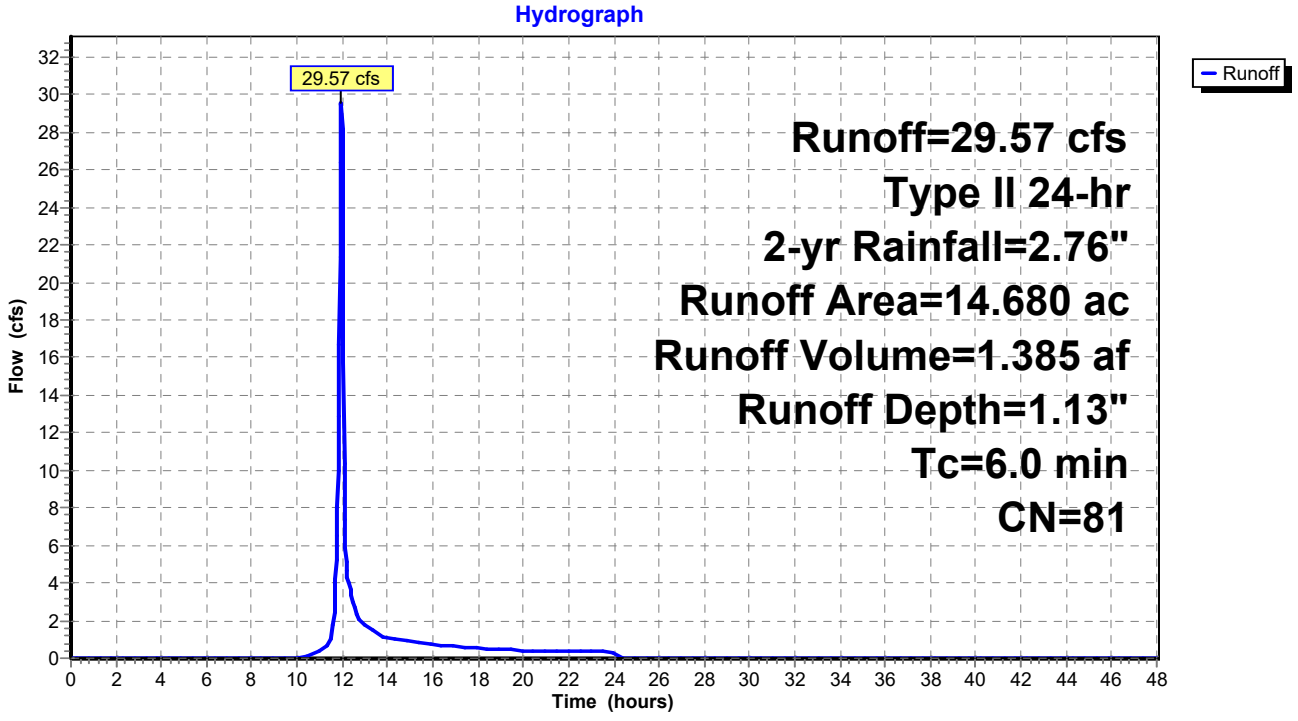
Runoff = 29.57 cfs @ 11.98 hrs, Volume= 1.385 af, Depth= 1.13"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-yr Rainfall=2.76"

	Area (ac)	CN	Description
*	1.500	98	Impervious
*	8.980	80	Turf
*	4.200	77	Forest/Open
	14.680	81	Weighted Average

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

Subcatchment B: DA B



Summary for Subcatchment C1: DA C1

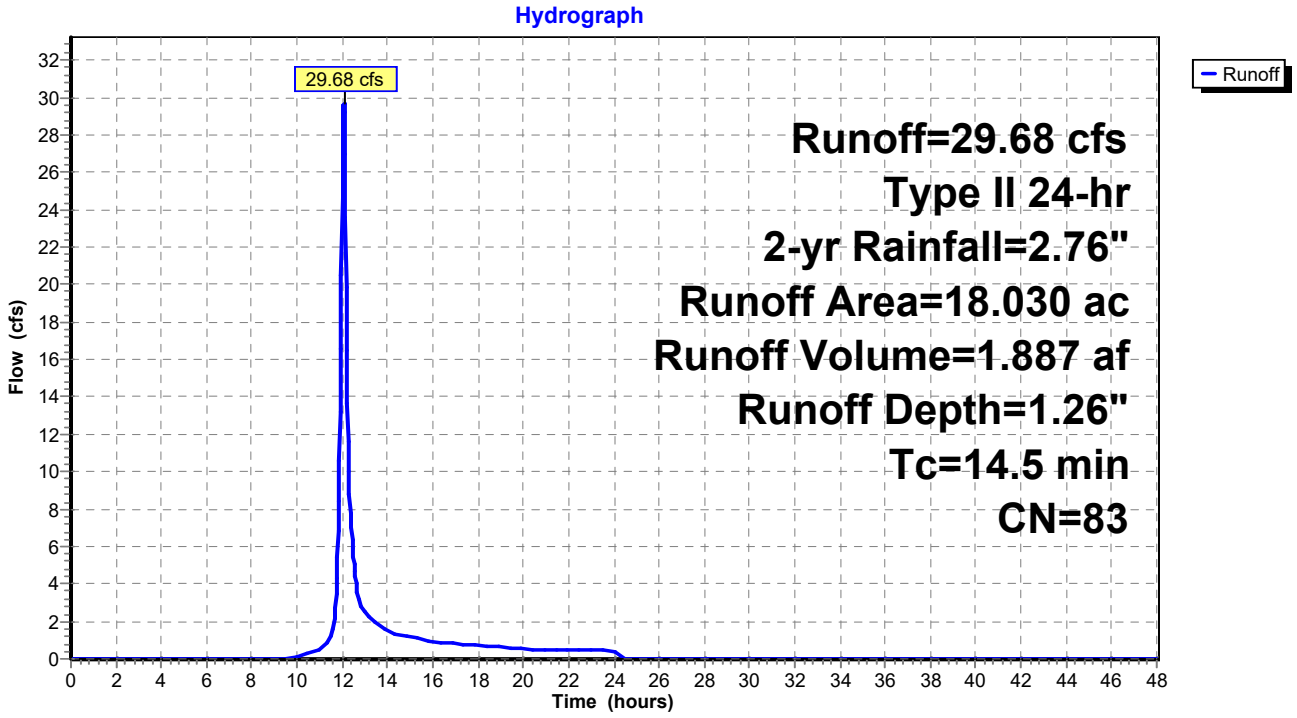
Runoff = 29.68 cfs @ 12.07 hrs, Volume= 1.887 af, Depth= 1.26"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-yr Rainfall=2.76"

	Area (ac)	CN	Description
*	18.030	83	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5					**Direct Entry, Per TOB GIS Data**

Subcatchment C1: DA C1



Summary for Subcatchment C2: DA C2

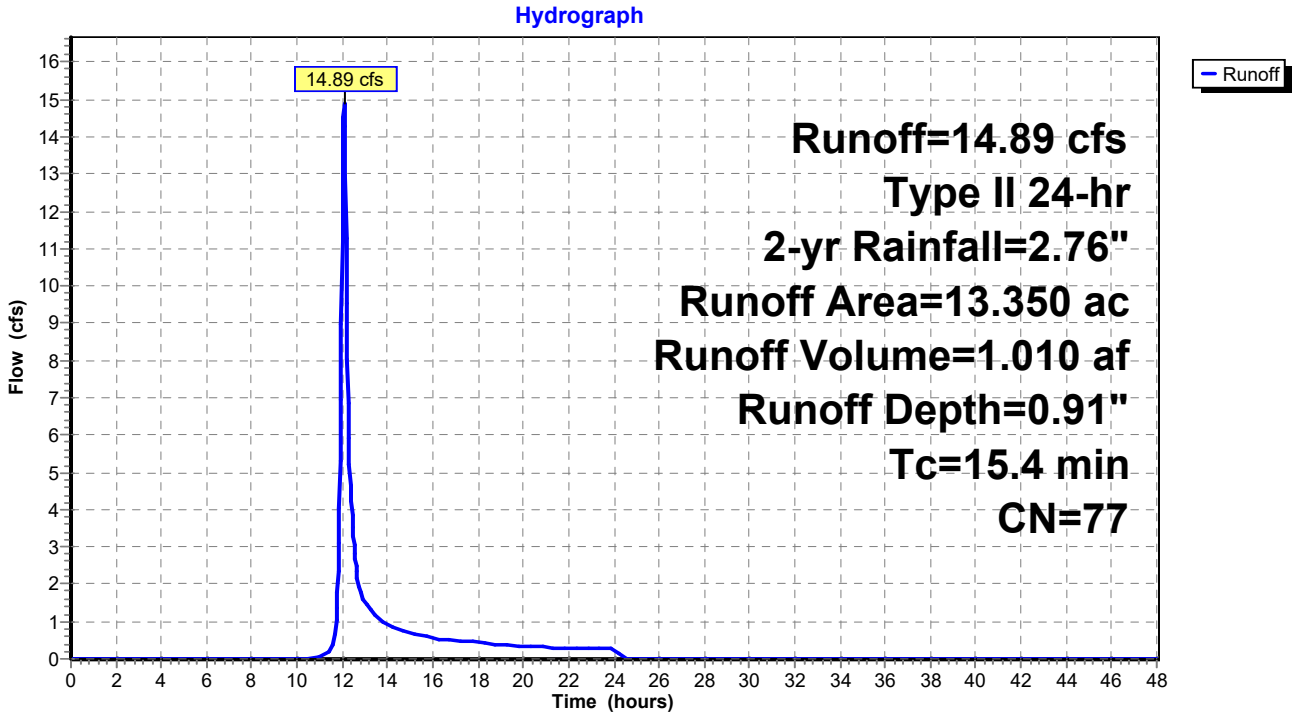
Runoff = 14.89 cfs @ 12.09 hrs, Volume= 1.010 af, Depth= 0.91"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-yr Rainfall=2.76"

	Area (ac)	CN	Description
*	13.350	77	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4					**Direct Entry, Per TOB GIS Data**

Subcatchment C2: DA C2

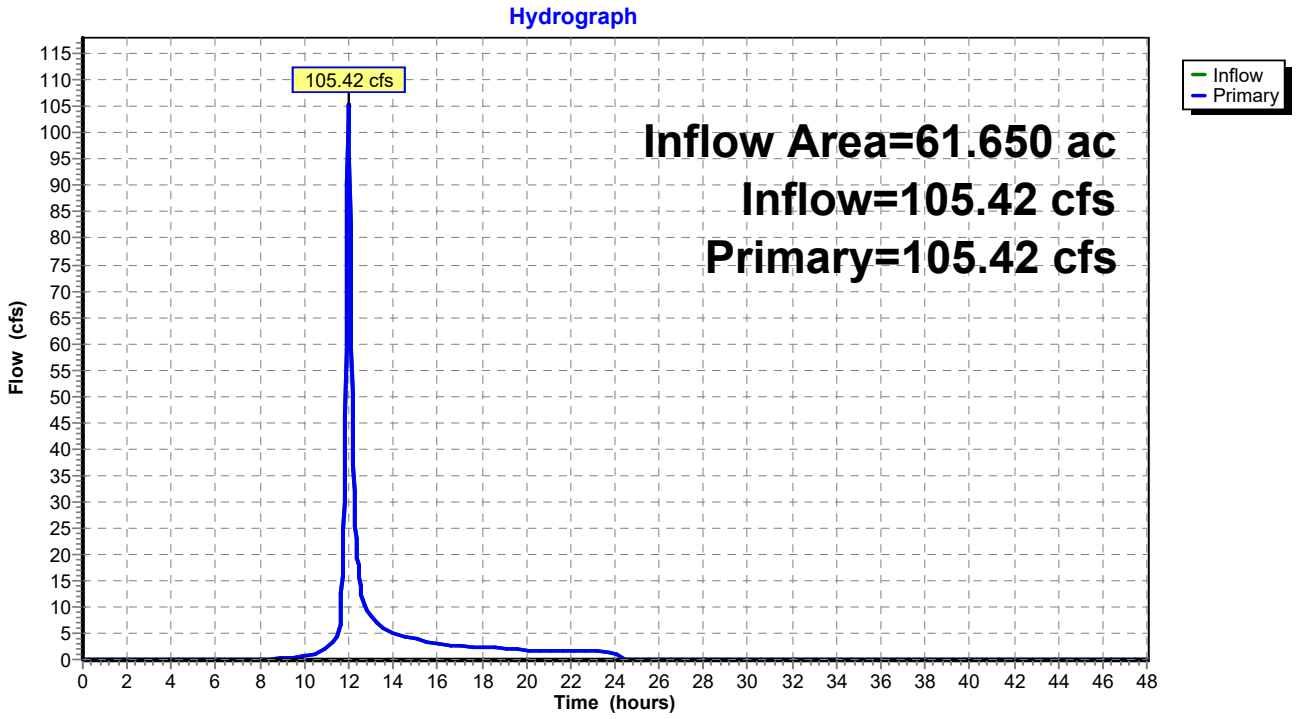


Summary for Link 1L: POA #1

Inflow Area = 61.650 ac, Inflow Depth = 1.24" for 2-yr event
Inflow = 105.42 cfs @ 11.99 hrs, Volume= 6.369 af
Primary = 105.42 cfs @ 11.99 hrs, Volume= 6.369 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1L: POA #1



Time span=0.00-48.00 hrs, dt=0.03 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment A: DA A Runoff Area=15.590 ac Runoff Depth=2.83"
Tc=6.0 min CN=88 Runoff=75.42 cfs 3.678 af

Subcatchment B: DA B Runoff Area=14.680 ac Runoff Depth=2.21"
Tc=6.0 min CN=81 Runoff=57.42 cfs 2.709 af

Subcatchment C1: DA C1 Runoff Area=18.030 ac Runoff Depth=2.38"
Tc=14.5 min CN=83 Runoff=56.35 cfs 3.579 af

Subcatchment C2: DA C2 Runoff Area=13.350 ac Runoff Depth=1.90"
Tc=15.4 min CN=77 Runoff=32.24 cfs 2.112 af

Link 1L: POA #1 Inflow=198.87 cfs 12.078 af
Primary=198.87 cfs 12.078 af

Total Runoff Area = 61.650 ac Runoff Volume = 12.078 af Average Runoff Depth = 2.35"

Summary for Subcatchment A: DA A

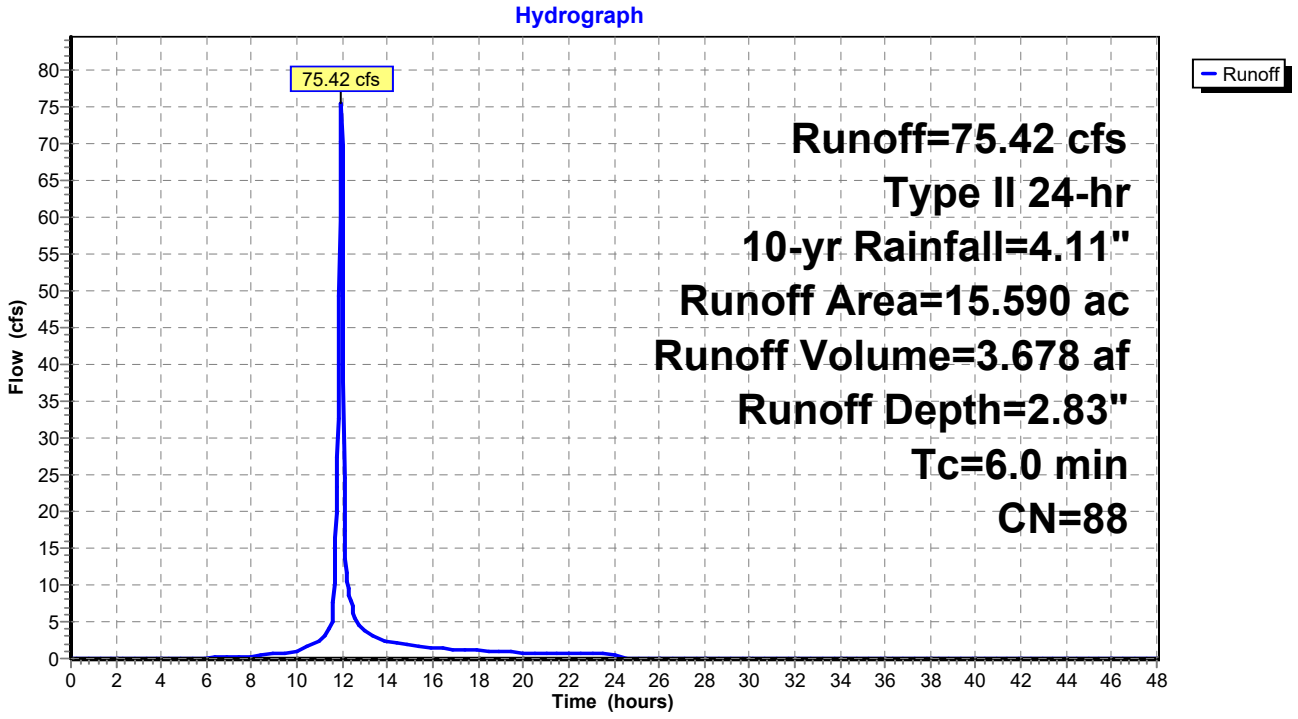
Runoff = 75.42 cfs @ 11.97 hrs, Volume= 3.678 af, Depth= 2.83"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-yr Rainfall=4.11"

	Area (ac)	CN	Description
*	7.100	98	Impervious
*	8.490	80	Turf
	15.590	88	Weighted Average

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

Subcatchment A: DA A



Summary for Subcatchment B: DA B

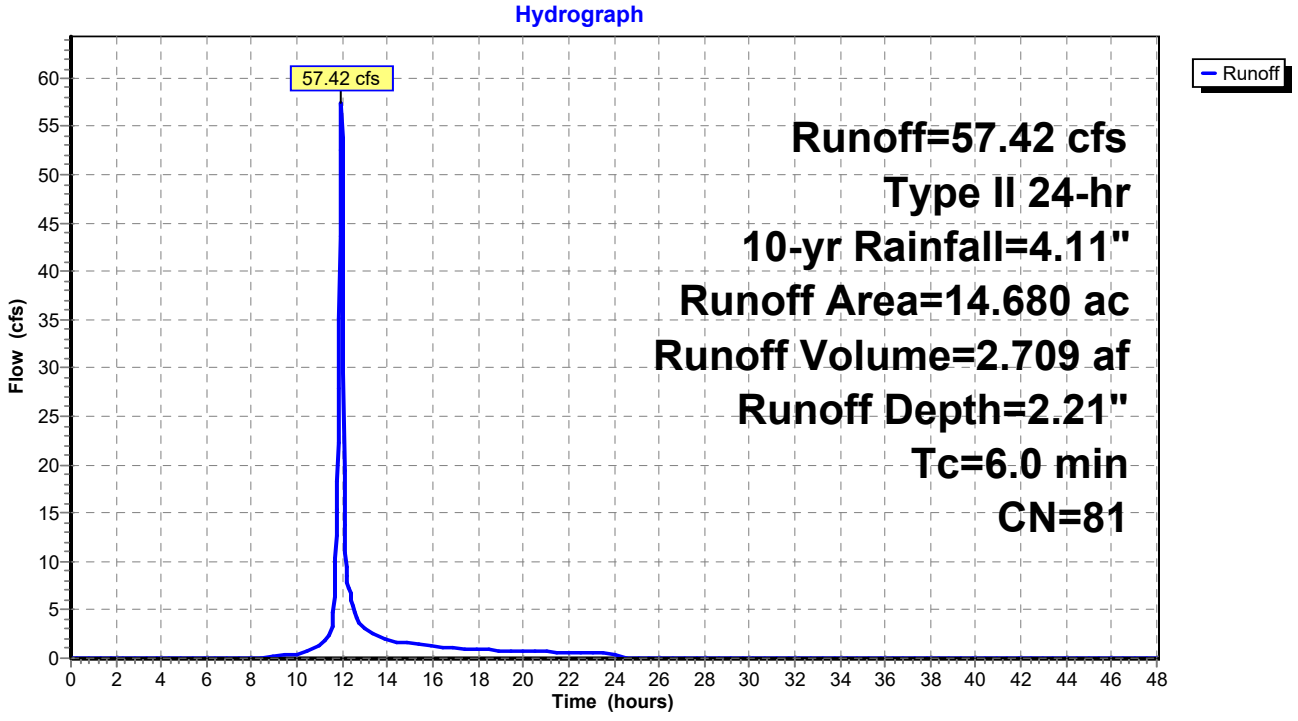
Runoff = 57.42 cfs @ 11.97 hrs, Volume= 2.709 af, Depth= 2.21"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-yr Rainfall=4.11"

	Area (ac)	CN	Description
*	1.500	98	Impervious
*	8.980	80	Turf
*	4.200	77	Forest/Open
	14.680	81	Weighted Average

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

Subcatchment B: DA B



Summary for Subcatchment C1: DA C1

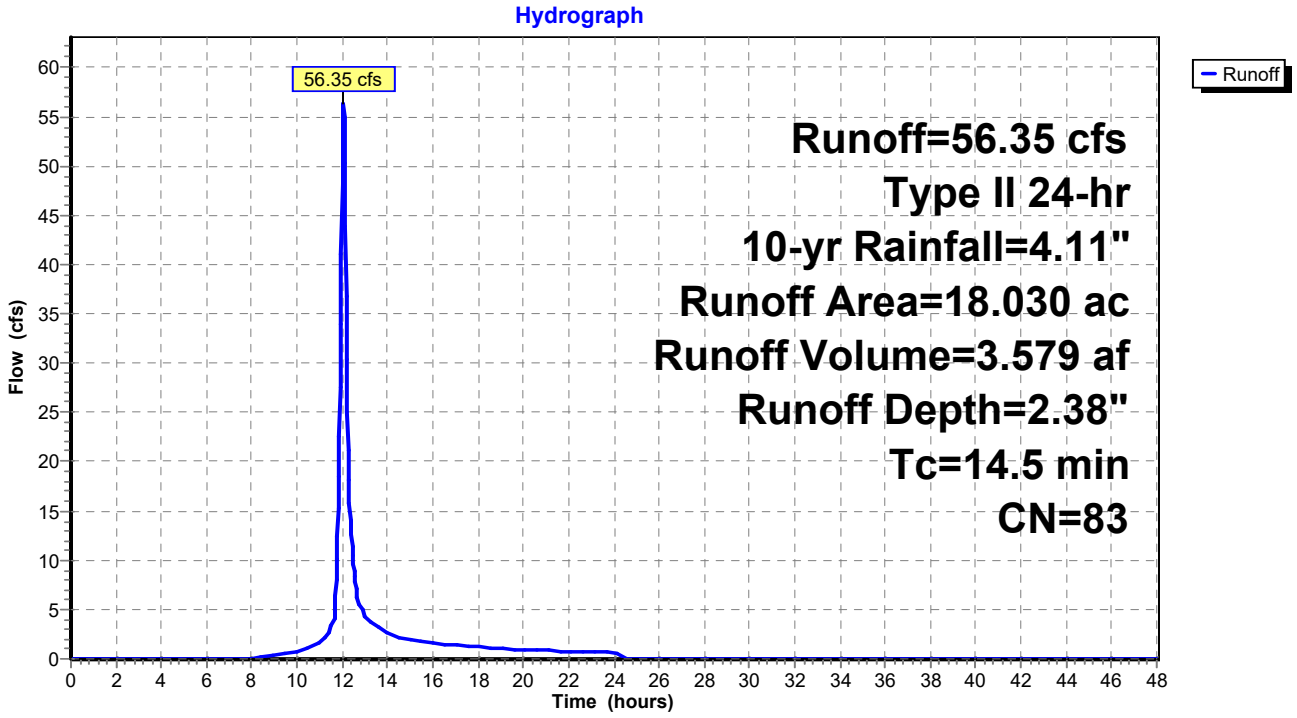
Runoff = 56.35 cfs @ 12.06 hrs, Volume= 3.579 af, Depth= 2.38"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-yr Rainfall=4.11"

	Area (ac)	CN	Description
*	18.030	83	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5					**Direct Entry, Per TOB GIS Data**

Subcatchment C1: DA C1



Summary for Subcatchment C2: DA C2

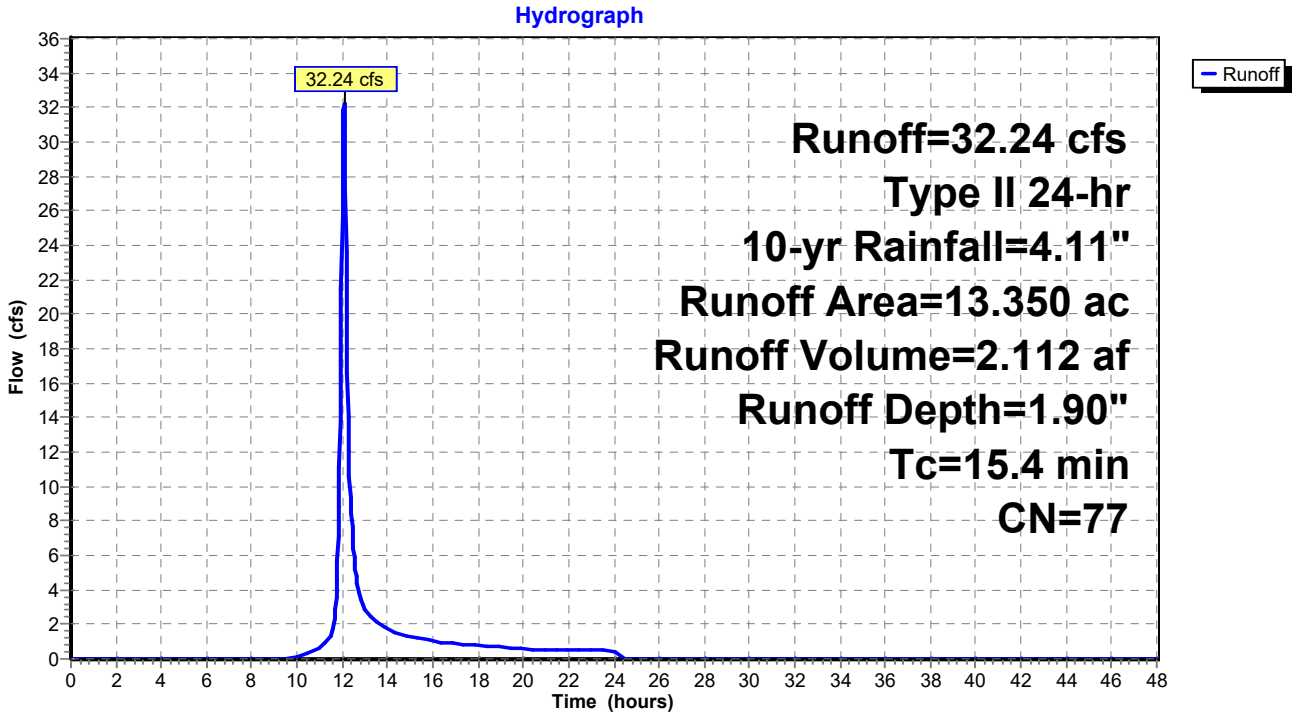
Runoff = 32.24 cfs @ 12.08 hrs, Volume= 2.112 af, Depth= 1.90"
Routed to Link 1L : POA #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-yr Rainfall=4.11"

	Area (ac)	CN	Description
*	13.350	77	Per TOB GIS Data

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4					**Direct Entry, Per TOB GIS Data**

Subcatchment C2: DA C2

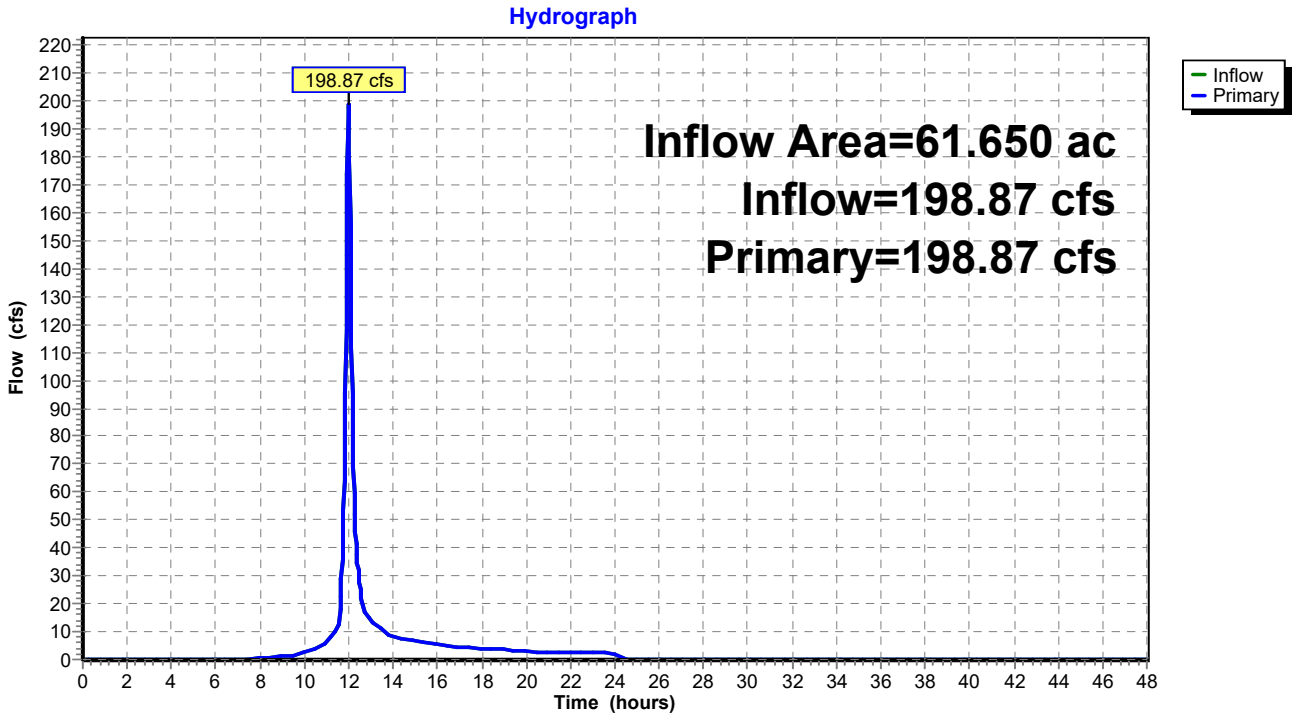


Summary for Link 1L: POA #1

Inflow Area = 61.650 ac, Inflow Depth = 2.35" for 10-yr event
Inflow = 198.87 cfs @ 11.99 hrs, Volume= 12.078 af
Primary = 198.87 cfs @ 11.99 hrs, Volume= 12.078 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1L: POA #1



APPENDIX D:
STORMWATER QUALITY CALCULATIONS

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

BMP Design Specifications List: **2011 Stds & Specs**

Site Summary

Project Title: OBHS TOWNHOMES
Date: 45352

Total Rainfall (in):	**43**
Total Disturbed Acreage:	**15.59**

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	0.00	1.40	1.40	9
Managed Turf (acres)	0.00	0.00	0.00	4.85	4.85	31
Impervious Cover (acres)	0.00	0.00	0.00	9.34	9.34	60
					15.59	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	0.00	0.00	8.49	8.49	54
Impervious Cover (acres)	0.00	0.00	0.00	7.10	7.10	46
					15.59	100

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post-ReDevelopment	Post-Development (New Impervious)	Adjusted Pre-ReDevelopment
Site Rv	0.57	0.57	--	0.65
Treatment Volume (ft^3)	32,189	32,189	--	36,864
TP Load (lb/yr)	20.22	20.22	--	23.16

Total TP Load Reduction Required (lb/yr)	**1.69**	1.69	0

	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre-ReDevelopment
TN Load (lb/yr)	144.68	165.70

Pre-ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
1.49	**1.30**	**1.30**

Site Compliance Summary

Maximum % Reduction Required Below Pre-ReDevelopment Load	20%

Total Runoff Volume Reduction (ft^3)	0
Total TP Load Reduction Achieved (lb/yr)	0.00
Total TN Load Reduction Achieved (lb/yr)	0.00
Remaining Post Development TP Load (lb/yr)	20.22
Remaining TP Load Reduction (lb/yr) Required	**1.69**

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Total Area (acres)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Drainage Area Compliance Summary

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

Runoff Volume and CN Calculations

	1-year storm	2-year storm	10-year storm
Target Rainfall Event (in)	2.28	2.76	4.11

Drainage Areas	RV & CN	Drainage Area A	Drainage Area B	Drainage Area C	Drainage Area D	Drainage Area E
CN		0	0	0	0	0
RR (ft^3)		0	0	0	0	0
1-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	0	0	0	0	0
2-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	0	0	0	0	0
10-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	0	0	0	0	0