MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

CONCEPT APPROVAL
FOR STORMWATER AND SEDIMENT CONTROL

PRD No:	24-PR-0054	Contract No:	MO9985188
Description:	SPRING STREET TO SECOND AVENUE	Road:	MD 390
Design Firm:	IN-HOUSE	Date Submitted:	12/20/2024

Concept Approval for stormwater management and sediment and erosion control is hereby granted to the Maryland Department of Transportation State Highway Administration (MDOT SHA) in compliance with Environment Article, Section 4-106 and 4-205 Annotated Code of Maryland. This Concept Approval shall expire two years from the date of this letter unless renewed. Significant changes to the project design may require a new Concept Approval.

No earth disturbance is permitted prior to final approval. Final design of all stormwater management practices shall meet Maryland Department of the Environment and MDOT SHA design requirements.

Approved By: Kuang zhihua
for Jeffrey Knaub, P.E., Chief
Plan Review Division

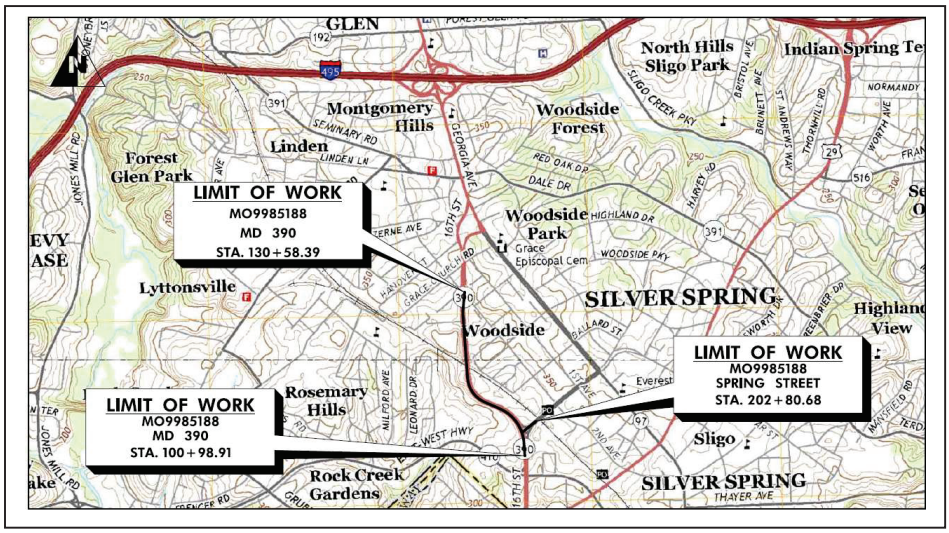
Date: 12/20/2024

Project Data Summary

Points of Investigation (POI/LOI)	POI/LOI 1, 3, 5, 6, 8, 10-13, 16, 17
IART/IAT	0.50Acre/1.17Acre
Limit of Disturbance (LOD)	2.83 Acres
Water Quality (WQv)	WQv for the project is met using 2 bioswales located in POI 16 and POI 17
Washington Metropolitan (021402)	0.57-Acre Credit
Channel Protection Volume (CPv)	CPv is required in POIs 1, 3, and 10. A CPv variance is requested for these POIs. The remaining study points do not require CPv.
Water Quantity Control (Qp/Qf)	Peak flow increases exist for the 10-year storm in POIs 5, 10, and 13. County concurrence has been requested for waivers for the increases. Verification that Q100 management would not be required by the County was also requested. The remaining study points do not require peak management.
Pond Code 378 / Dam Safety	Not Applicable

STORMWATER MANAGEMENT REPORT
MD 390 (16th STREET) PROTECTED BICYCLE LANES
FROM SPRING STREET TO 2ND AVENUE
MONTGOMERY COUNTY

SHA Contract No. MO9985188
SHA FMIS No. MO998B21
SHA PRD No 24-PR-0054



PREPARED BY:
Maryland State Highway Administration
Office of Highway Development
Highway Design Division
707 North Calvert St.
Baltimore, MD, 21202

PREPARED FOR:
Maryland State Highway Administration
Office of Highway Development
Highway Design Division
707 North Calvert St.
Baltimore, MD, 21202

Date: November 2024

Table of Contents

List of Appendices

EXECUTIVE SUMMARY/TABLES

The project is located within the Washington Metropolitan Watershed (#021402) and has 9 points of interest (POIs) and 2 lines of interest (LOI) with a total Impervious Area Requiring Treatment (IART) of 0.50 acres. The two proposed SWM facilities (located offsite) will provide 1.17 acres of impervious area treatment (IAT) thus providing the MDOT SHA water quality bank with 0.57 acres of impervious area treatment credit after a 0.10-acre banking fee.

Refer to appendices for supporting documentation.

Site Description and Natural Resources

Predominant Hydrologic Soil Group/s (HSG)	B, C & D are present
Limit of Disturbance (acre)	2.83 acres
Highly Erodible Soils (K Value > 0.48) or (K Value > 0.35 where Slope >15%)	Present
SWM Exempt?	No
Downstream Waterbody Name (6-Digit Watershed)	Washington Metropolitan (#021402)
8-Digit Watershed	Rock Creek (#02140206)
Tier II Watershed?	No
Stream Use Classification	Fenwick Branch, Class I
Impairments	Bacteria (4a Enterococcus) Nutrients (Nitrogen, 4a phosphorus) Sediments (4a TSS)
Wetland/Waterway Impacts?	No
Floodplain Impacts?	No
Hotspot Description	No
Chesapeake Bay Critical Area Impacts?	No
Severn River Watershed?	No
Interjurisdictional Waterway? (Jones Falls, Gwynn's Falls or Herring Run Watershed)	No
Karst Topography?	No

Table 1: POI/LOI Data

POI/ LOI	Development Class (New Dev./ Redev.)	Ex. Drg Area (Acre)	Pr. Drg Area (Acre)	Ex. I_A in SSA (Acre)	Pr. I_A in SSA (Acre)	I_{ART} (Acre)	I_{AT} (Acre)
1	New Dev.	1.43	1.43	0.01	0.01	0.01	0.00
3	Redev.	26.42	26.42	0.49	0.50	0.22	0.00
5	Redev.	1.04	1.05	0.20	0.18	0.06	0.00
6	Redev.	1.96	1.89	0.46	0.27	0.03	0.00
8	Redev.	1.10	1.06	0.31	0.20	0.05	0.00
10	Redev.	0.21	0.25	0.09	0.11	0.07	0.00
11	Redev.	0.61	0.58	0.14	0.13	0.06	0.00
12	New Dev.	0.14	0.14	0.00	0.00	0.00	0.00
13	New Dev.	1.01	1.09	0.00	0.00	0.00	0.00
16	OFFSITE	0.97	0.97	0.00	0.00	0.00	0.43
17	OFFSITE	1.24	1.24	0.00	0.00	0.00	0.74
TOTAL						0.50	1.17

Table 2: BMP Data

POI/LOI	BMP #	BMP Type	Drainage Area to BMP (Acre)	Ex. Treated Impervious (Acre)	Pr. Treated Impervious (Acre)	378 Review Required?	MDE Review Required?
16	42	Bio-Swale	0.97	0.00	0.43	No	No
17	24	Bio-Swale	1.24	0.00	0.74	No	No

Table 3: Treatment Summary

6-Digit Watershed	I_{ART} (Acre)	I_{AT} (Acre)	Treatment Method/s
021402	0.67	1.17	Two (2) proposed bioswales

Table 4: Treatment by POI/LOI

POI/LOI	ESDv Req'd (Y/N)	ESDv Pro'd (Y/N)	ESDv Method	Qp/Qf Peak Increase (storm)	Qp/Qf Peak Managed (Y/N)	Qp/Qf Method
1	Y	N	Variance	None	N/A	N/A
3	Y	N	Variance	None	N/A	N/A
5	N	N	N/A	Yes (Q1, Q10)	N	None; no increase at downstream POI.
6	N	N	N/A	None	N/A	N/A
8	N	N	N/A	None	N/A	N/A
10	Y	N	Variance	Yes (Q1, Q10)	N	None; no increase at downstream POI.
11	N	N	N/A	None	N/A	N/A
12	N	N	N/A	None	N/A	N/A
13	N	N	N/A	Yes (Q1, Q10)	N	None; no increase at downstream POI.

INTRODUCTION

This report presents the concept SWM analysis and design for the MD 390 Protected Bicycle Lanes from Spring Street to 2nd Avenue project located in Montgomery County, Maryland. The purpose of the project is to improve bicycle and pedestrian connectivity, accessibility, and safety along 16th Street. The project consists of constructing an 8-foot-wide, two-way protected bicycle facility (cycle track), a concrete/grass median ranging from 2 to 5-foot-wide separating the cycle track and roadway, a 6-foot-wide American with Disabilities Act (ADA) compliant sidewalk with a grass buffer, and the reconstruction of the 16th Street and Spring Street intersection into a protected intersection for two legs. The existing roadway is closed section throughout the entire project limits that directs runoff to the Fenwick Branch of Rock Creek.

REGULATORY REQUIREMENTS

☒ **Stormwater Management** - Stormwater management approval is required for projects that disturb more than 5,000 square feet.

☒ **Erosion and Sediment Control** - Erosion and sediment control review and approval is required for projects that disturb more than 5,000 square feet or 100 cubic yards of earth.

☐ **Anne Arundel Soil Conservation District Review** - Projects located within the Severn River watershed require submittal to and approval from the Anne Arundel Soil Conservation District, in accordance with MD Code, Environment, 4-308.

☒ **NPDES permit/NOI** - An NPDES permit is required for projects that disturb more than 1 acre of land.

☐ **TIER II Review** - Projects located within a TIER II watershed with an LOD greater than one acre require completion of the NPDES anti-degradation checklist which should be included as part of the SWM narrative. Enhanced ESC measures should be provided for work proposed in the TIER 2 buffer.

☐ **Critical Area Review** – Projects that lie within the Chesapeake Bay Critical Area require review by the Critical Area Commission.

☐ **DNR Review** – Projects located in a Use III watershed must consider thermal impacts and shall not include wet pools as part of the Stormwater Management and Erosion Sediment Control design. Coordination with DNR may be required.

☐ **Dam Safety/Small Pond Review** – SHA PRD Small Pond Review is required for projects meeting the criteria for a small pond based on the MDE flowchart located here***: LINK***. Ponds requiring dam safety review will be reviewed by MDE Dam Safety. Every small pond facility is required to have a standalone report after concept level evaluation. For Dam Safety reviews, provide a standalone report to SHA PRD for screening before submittal to MDE.

STORMWATER MANAGEMENT ANALYSIS

The 2000 Maryland Stormwater Design Manual, Volumes I and II including revisions based on the Stormwater Management Act of 2007 and subsequent updates by MDE and the MDOT SHA Sediment and Stormwater Guidelines and Procedures (latest version) must be used to determine qualitative and quantitative needs. The Environmental Site Design (ESD) requirements have been implemented to the Maximum Extent Practicable (MEP) within the project limits to manage runoff as close to its source as possible.

The stormwater study area (SSA) represents the area draining to each POI in existing conditions within the project limits of disturbance. If the existing imperviousness for the drainage area within the stormwater study area is greater than 40% then the area is classified as 'redevelopment'. Conversely, if the imperviousness for the drainage area within the stormwater study area is 40% or less than the area is classified as 'new development'.

Computational Analysis

A HydroCAD analysis was performed for each study location for both existing and proposed conditions to calculate peak discharges. There is ongoing work being done by the Maryland Transit Administration (MTA) Purple Line Project within the project limits – as such, the existing conditions of the MD 390 Cycle Track project's analysis have assumed completion of the proposed Purple Line improvements, including proposed drainage improvements. The HydroCAD computations include the 1-year and 10-year storm events. It is the assumption of the project team that Montgomery County will not require 100-year storm peak discharge management as they are not requiring it for the adjacent MO2245171 (MD 97 from MD 390 to MD 192 Widen & Resurface) project; see the approved county concurrence from that contract in Appendix B.

Description of POIs/LOIs

The drainage areas (DAs) to POIs 2, 4, 7 were delineated prior to the finalization of the roadway design; it was determined that there is no work included in these DAs, so they were removed from the analysis. Previously identified POI 9 was determined not to be located on the ROW line and actually drains to POI 10. Due to the lack of available space within the project limits, SWM treatment will be provided offsite, via proposed bioswales in POIs 16 & 17. Variances are being requested for all POIs/LOIs with ESDv requirements (POIs 1, 3, and 10).

POI 1:

This POI is located where a 24" reinforced concrete pipe (RCP) running underneath MD 390 leaves state right-of-way (ROW), approximately 34' east of the edge of roadway at STA 121+84 LT. In both existing and proposed conditions, runoff going to this POI flows down Noyes Lane and 3rd Avenue into a headwall that feeds into the 24" RCP. The land uses consist of a mix of impervious and open area.

POI 3:

This POI is located at the downstream end of a 36" asphalt coated corrugated metal pipe (ACCMP) that runs underneath MD 390, approximately 77' east of the edge of roadway, at STA 124+83 LT. The DA to this POI includes most of MD 390 northbound from the bridge over CSX to 2nd Avenue as well as much of the residential area east of MD 390 between Noyes Lane and 1st Avenue. The land use consists of a mix of impervious and open area. Drainage from POIs 1, 2, and 3 join in the drainage system that runs underneath the CSX & purple line tracks at **Outfall A**, which ultimately drains to the Fenwick Branch of Rock Creek.

POI-5:

This drainage area consists of runoff from northbound MD 390 between the bridge of CSX and the entrance to the Woodside Purple Line Station. The POI is located where a 24" RCP leaves state ROW. While there is an increase in the 10-year storm peak discharge at this POI in proposed conditions, the POI exits the ROW at the proposed MTA Purple Line Station property line and flows via closed channel pipe to POI 6 where there is an ultimate decrease in the 10-year storm peak discharge The land use in this drainage area is a mix of impervious and open area.

POI 6:

This drainage area consists of both directions of MD 390 in front of the Woodside Purple Line Station. The POI is located along where a 60" RCP leaves state ROW, just south of the edge of roadway, at STA 111+51 LT. The land use is a mix of impervious and open area. POI 6 receives all the runoff from POIs 4, 5, 8, 9, 10, 12, & 13, as well as other offsite areas, and ultimately outfalls at **Outfall B** which leads to the Fenwick Branch of Rock Creek.

POI 8:

This drainage area consists of parts of MD 390 southbound and Spring Street. Runoff from the Spring Street bridge flows north along MD 390 to the POI, which is located along a 24" RCP at STA 106+48 RT. Runoff then flows through the drainage system underneath the Woodside Station, which drains to POI 6. The drainage area is a mix of impervious and open area.

POI 10:

This drainage area consists of impervious and open space along Spring St from the intersection with MD 390 to the Spring Street bridge over CSX. Runoff drains to the inlet at STA 201+38 RT which drains to the POI located in an existing 24" pipe. While there is an increase in the 10-year storm peak discharge at this POI in proposed conditions, the POI exits the ROW at the proposed MTA Purple Line Station property line and flows via closed channel pipe to POI 6 where there is an ultimate decrease in the 10-year storm peak discharge

POI 11:

This drainage includes the median along Spring Street and MD 390 southbound south of the intersection with Spring Street. Runoff drains to the POI at the inlet approximately 130' south of

STA 100+00. This inlet then drains to **Outfall-C**, an endwall south of MD 410 that outlets into a stream draining to the Fenwick Branch of Rock Creek.

LOI 12:

This drainage area includes the area behind the sidewalk along northbound Spring Street. Water leaves state ROW as a line of interest and ultimately drains into the purple line drainage system that leads to POI 6.

LOI 13:

This drainage area includes the area behind the sidewalk along MD 390 between the roadway and the Woodside Station. While there is an increase in the 10-year storm peak discharge at this POI in proposed conditions, the POI exits the ROW at the proposed MTA Purple Line Station property line and flows to POI 6 where there is an ultimate decrease in the 10-year storm peak discharge

Offsite POIs & Treatment

The offsite facilities proposed to meet the water quality requirements for this project were originally designed under Contract No. AZ1505174 and received PRD Concept Approval under PR # 24-PR-0019.

POI #16:

This POI is located adjacent to northbound MD 201, Kenilworth Avenue. The flow is collected in a natural ditch along the roadway. The discharge leaves SHA ROW and continues into an unnamed creek. Bioswale Site #42 is proposed in this POI with treatment values shown in Table 3. There is no anticipated discharge increase at this POI after the construction of the ESD facility as there is no change in land use between existing and proposed conditions.

POI #17:

This POI is located adjacent to northbound MD 201, Kenilworth Avenue. The flow from the state highway is collected in the median and flows under northbound MD 201 via a 24-inch RCP. The pipe is in good condition. The outfall consists of a length of concrete ditch. Some minor cracking of the concrete is present, but overall, the outfall is in stable condition. Bioswale Site #24 is proposed in this POI with treatment values shown in Table 3. There is no anticipated discharge increase at this POI after the construction of the ESD facility as there is no change in land use between existing and proposed conditions.

Table 5: Treatment Provided by Proposed Offsite Facilities

POI#	Facility Name and Type		Drainage Area (ac.)	ESD_v provided (cf)	Provided Imp. Area treated (ac.)	Treated Pe
16	Site #42	Bioswale	0.97	1,503	0.43	0.62
17	Site #24	Bioswale	1.24	3,100	0.74	1.17
Total				**4,603**	**1.17**	

Small Pond/Dam Safety Concept Assessment

There are no existing small ponds or proposed facilities located within the project limits that present a potential Small Pond and / or Dam Safety permitting concern.

EROSION AND SEDIMENT CONTROL NARRATIVE

All Erosion and Sediment Control (ESC) practices will be designed according to the latest applicable standards and specifications. Erosion and Sediment Control will be accomplished through various approved controls including silt fence at the toe of fill slopes and inlet protection. It is anticipated that a majority of the work onsite will be within the footprint of the existing roadway and will be stabilized at the end of each work day.

Appendix A

Data and Computation Tables

MDE Sediment & Stormwater Plan Review

Attachment E: Stormwater Concept Approval for State & Federal Projects

SWM Calculator Condensed Format

Project Description: MD 390 PROTECTED BICYCLE LANES
FROM SPRING STREET TO 2ND AVENUE

County: Montgomery

MDE Tracking Number:

Job # 24-PR-0054
Contract # MO9985188
Date: 11/19/2024
Designed by: HMS
Reviewed by:

Clear Input Cells

Determine Development Classification for the Reconstruction Activities:

STEP 1 Site / Drainage Area Data

STEP 2 Impervious Area Requiring Treatment (IART)

STEP 3 Required ESD Volume for Treating Redevelopment ($ESD_{V\ RE\text{-}DEV'L}$)

STEP 4 ESD Volume Reduction from Decreasing Impervious Area ($ESD_{V\ reduced\Delta i}$) (for Redevelopment Classification when ΔAi<0)

STEP 5 Required ESD Volume for treating New Development ($ESD_{V\ NEW}$) for POI

STEP 6 ESD Volume for the Shifted Impervious Area ($ESD_{V\ SHIFT}$) In/out of POI

STEP 7 Req'd ESDv from Loss of Existing SWM ($ESD_{V\ Loss}$)

STEP 8 Required ESD Volume for the POI ($ESD_{V\ POI}$)

STEP 9 Required Recharge Volume (Re_V)

	Report to ESD Summary Sheet														Col. 1	Col. 2		Col. 3			Col. 4a		Col. 4b		Col. 5a			Col. 5b			Col. 6		Col. 7	Col. 8		Col. 9												Col. 10
	Report to WQSS»		Col. D				Col. B	Col. C	Col. E	Col. F			Col. G		should match Col. I	should match Col. J	should match Col. K																																
POI	SWM Study Area	Existing Impervious Surface Area	Percent Existing Impervious-ness	Development Classification for Re-construc-tion	Existing Condition Drainage Area	Proposed Condition Drainage Area	Existing Imp. Area within LOD	Proposed Imp. Area within LOD	Area for which WQ is Not Req'd (i.e. 3.3.A Waiver)	Loss of Existing Water Quality (Area)	Loss of Existing ESD_V / WQ_v (Volume)	Loss of Existing Recharge (Volume)	Re-constructed Imp. Area Already Treated (Area)	Ex. Imp. Area outside of LOD Shifted in/out of POI	qualify for a Cp_V Waiver under Section 3.3.B of the Guide-lines?	IART from **Redevelopment:** For Re-dev'l Classification, $IART_{RE\text{-}DEV'L} = 50\%$ of $(A_{IU} - A_{MI} - A_{REC})$ For New Dev'l Classification, $IART_{RE\text{-}DEV'L} = 0$	IART from **New Development:** For Re-dev'l Classification, $IART_{NEW} = \Delta Ai = A_{IU} - A_{IE}$ For New Dev'l Classification, $IART_{NEW} = A_{IU} - A_{MI} - A_{REC}$	**Total IART:** $IART = IART_{RE\text{-}DEV'L} + IART_{NEW} + A_{LI}$	P_E	R_V	$ESD_{V\ RE\text{-}DEV'L}$	Applied to Project: P_E	Applied to Project: R_V	Applied to Project: $ESD_{V\ reduced\Delta i}$	Applied to POI: P_E	Applied to POI: R_V	Applied to POI: $ESD_{V\ reduced\Delta i}$	$ESD_{V\ NEW}$ for 3.3.B Waiver: P_E	$ESD_{V\ NEW}$ for 3.3.B Waiver: R_V	$ESD_{V\ NEW}$ for 3.3.B Waiver: $ESD_{V\ NEW}$	$ESD_{V\ NEW}$ for No Waiver or No Impervious Reduction (i.e. ΔAi >=0): Soil Group A P_E	Soil Group B P_E	Soil Group C P_E	Soil Group D P_E	Weighted P_E	R_V	$ESD_{V\ NEW}$	P_E	R_V	$ESD_{V\ SHIFT}$	$ESDV$ Loss	$ESD_{V\ POI}$	1-Year Management Requirement	Soil Specific Recharge Factor (S): Soil Group A	Soil Group B	Soil Group C	Soil Group D	Weighted S	Recharge Volume ($Re_{V\ NEW}$) for New Development	Loss of Existing Recharge Volume (Rev Loss)	Total Required Recharge Volume (Rev)
	A_S	A_{IE}	%I		A_E	A_P	A_{EI}	A_{PI}	A_{MI}	A_{LI}	$ESD_{V\ Loss}$	$Re_{V\ Loss}$	A_{RECI}	A_{SHIFT}	Cp_{VW}	$IART_{RE\text{-}DEV'L}$	$IART_{NEW}$	IART																																
	acres	acres	$\%I = A_{IX} / A_S$		acres	acres	acres	acres	acres	acres	cubic feet	cubic feet	acres	acres		acres	acres	acres	in.		cubic feet	in.		cubic	in.		cubic	in.		cubic feet	ac.	ac.	ac.	ac.		in.			cubic feet	cubic feet	cubic feet	ac.	ac.	ac.	ac.	in.	cubic feet	cubic feet	cubic feet
1	0.04	0.01	25.0%	New Dev'l	1.43	1.43	0.01	0.01								0.00	0.01	0.01	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0				0.01		2.20	0.95	76	N/A	N/A	0	0	76	NO	0.00	0.00	0.01	0.00	0.13	4	0	4
3	0.93	0.49	52.7%	Re-dev'l	26.42	26.42	0.49	0.50	0.07							0.21	0.01	0.22	1.00	0.95	724	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0				0.01		2.20	0.95	76	N/A	N/A	0	0	76	NO	0.00	0.00	0.01	0.00	0.13	4	0	4
5	0.21	0.20	95.2%	Re-dev'l	1.04	1.05	0.20	0.18	0.04							0.08	-0.02	0.06	1.00	0.95	276	1.00	1.00	69	2.6	1.00	-179	N/A	N/A	0						N/A	N/A	0	N/A	N/A	0	0	-179	YES	0.00	0.00	0.00	0.00	0.00	0	0	0
6	0.54	0.46	85.2%	Re-dev'l	1.96	1.89	0.46	0.27	0.02							0.22	-0.19	0.03	1.00	0.95	759	1.00	1.00	655	2.6	1.00	-1704	N/A	N/A	0						N/A	N/A	0	N/A	N/A	0	0	-1,704	NO	0.00	0.00	0.00	0.00	0.00	0	0	0
8	0.34	0.31	91.2%	Re-dev'l	1.10	1.06	0.31	0.20								0.16	-0.11	0.05	1.00	0.95	532	1.00	1.00	379	2.6	1.00	-986	N/A	N/A	0						N/A	N/A	0	N/A	N/A	0	0	-986	NO	0.00	0.00	0.00	0.00	0.00	0	0	0
10	0.09	0.09	100.0%	Re-dev'l	0.21	0.25	0.09	0.11								0.05	0.02	0.07	1.00	0.95	172	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0					0.02	2.00	0.95	138	N/A	N/A	0	0	138	YES	0.00	0.00	0.00	0.02	0.07	5	0	5
11	0.23	0.14	60.9%	Re-dev'l	0.61	0.58	0.14	0.13								0.07	-0.01	0.06	1.00	0.95	241	1.00	1.00	34	2.6	1.00	-90	N/A	N/A	0						N/A	N/A	0	N/A	N/A	0	0	-90	NO	0.00	0.00	0.00	0.00	0.00	0	0	0
12	0.11	0.00	0.0%	New Dev'l	0.14	0.14	0.00	0.00								0.00	0.00	0.00	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0						N/A	N/A	0	N/A	N/A	0	0	0	NO	0.00	0.00	0.00	0.00	0.00	0	0	0
13	0.33	0.00	0.0%	New Dev'l	1.01	1.09	0.00	0.00								0.00	0.00	0.00	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0						N/A	N/A	0	N/A	N/A	0	0	0	YES	0.00	0.00	0.00	0.00	0.00	0	0	0
16	0.22	0.00	0.0%	New Dev'l	0.97	0.97	0.00	0.00								0.00	0.00	0.00	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0						N/A	N/A	0	N/A	N/A	0	0	0	NO	0.00	0.00	0.00	0.00	0.00	0	0	0
17	0.65	0.00	0.0%	New Dev'l	1.24	1.24	0.00	0.00								0.00	0.00	0.00	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0						N/A	N/A	0	N/A	N/A	0	0	0	NO	0.00	0.00	0.00	0.00	0.00	0	0	0

Attachment E: Stormwater Concept Approval

MDE Sediment & Stormwater Plan Review
for State & Federal Projects

Project Description: MD 390 PROTECTED BICYCLE LANES FROM SPRING STREET TO 2ND AVENUE

Contract Number: MO9985188

MDE Tracking Number:

Job # 24-PR-0054

Date: 11/19/2024

Designed by: HMS

Checked by:

ESD SUMMARY SHEET

Point of Investigation	Required ESD Management												Provided ESD Management						ESDV and ReV Requirements		Is the POI Requirement met?
	Col. 1	Col. 2	Col. 3	Col. 4a	Col. 4b	Col. 5a	Col. 5b	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 14	Col. 15	Col. 16			
	$IART_{RE-DEV'L}$	$IART_{NEW}$	$ESD_{V\ RE-DEV'L}$ (P_E=1.0 in)	$ESD_{V\ reducedAi}$ Reduction Applied to Project (P_E= 1.0 in)	$ESD_{V\ reducedAi}$ Reduction Applied to POI (P_E= 2.6 in)	$ESD_{V\ NEW}$ For 3.3.B Waivers (P_E= 1 in)	$ESD_{V\ NEW}$ (P_E = 2 to 2.6 in)	$ESD_{V\ SHIFT}$ (P_E = 2.6 in)	$ESD_{V\ Loss}$	Required ESD_V for POI =4b +5b+6 +7	Required ESD_V for PROJECT =Σ3+Σ4a +Σ5a+Σ5b +Σ6+Σ7	Required Re_V	Type of Practice	BMP Number	P_E Treated by Practice	Provided ESD_V	ESD_V from WQ Bank Debit	Provided Re_V	ESDv Project Requirement: Provided ESDv 4603 cf >= 1877 cf	Rev Project Requirement: Provided Rev 0 cf < 13 cf	
Total >>>	0.80	-0.29	2,724	-1,137		0	290	0	0		1,877	13				4,603		0	CHECK: OK	CHECK: FAIL	
Units >>>	acres	acres	cubic feet	cubic feet	cubic feet	cubic feet	cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet			inches	Cubic feet	Cubic feet	Cubic feet			
1	0.00	0.01	0	0	0	0	76	0	0	**76**		**4**							Provided ESDv at POI 0 cf < 76 cf		NO
3	0.21	0.01	724	0	0	0	76	0	0	**76**		**4**							Provided ESDv at POI 0 cf < 76 cf		NO
5	0.08	-0.02	276	-69	-179	0	0	0	0	**0**		**0**							Provided ESDv at POI 0 cf >= 0 cf		YES
6	0.23	-0.19	759	-655	-1,704	0	0	0	0	**0**		**0**							Provided ESDv at POI 0 cf >= 0 cf		YES
8	0.16	-0.11	552	-379	-986	0	0	0	0	**0**		**0**							Provided ESDv at POI 0 cf >= 0 cf		YES
10	0.05	0.02	172	0	0	0	138	0	0	**138**		**5**							Provided ESDv at POI 0 cf < 138 cf		NO
11	0.07	-0.01	241	-34	-90	0	0	0	0	**0**		**0**							Provided ESDv at POI 0 cf >= 0 cf		YES
12	0.00	0.00	0	0	0	0	0	0	0	**0**		**0**							Provided ESDv at POI 0 cf >= 0 cf		YES
13	0.00	0.00	0	0	0	0	0	0	0	**0**		**0**							Provided ESDv at POI 0 cf >= 0 cf		YES
16	0.00	0.00	0	0	0	0	0	0	0	**0**		**0**	M-8 Bio- Swales	42	0.62	1,503.0		0.0	Provided ESDv at POI 1503 cf >= 0 cf		YES
17	0.00	0.00	0	0	0	0	0	0	0	**0**		**0**	M-8 Bio- Swales	24	1.17	3,100.0		0.0	Provided ESDv at POI 3100 cf >= 0 cf		YES

Attachment E: Stormwater Concept Approval

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

Contract Number: MO9985188 PRD Number:
Contract Description: MD 390 PROTECTED BICYCLE LANES FROM SPRING STREET TO 2ND AVENUE Date: 11/25/24

IMPERVIOUS AREA SHIFT MATRIX

From POI (Giving)		In/Out of LOD	To POI (Receiving) 1	3	5	6	8	10	11	12	13	16	17						Total From	Net Shift
	1	In																	0.00	0.00
		Out																	0.00	
	3	In																	0.00	0.00
		Out																	0.00	
	5	In																	0.00	0.00
		Out																	0.00	
	6	In									0.01								0.01	-0.01
		Out																	0.00	
	8	In						0.02											0.02	-0.01
		Out																	0.00	
	10	In					0.01												0.01	0.02
		Out																	0.00	
	11	In						0.01											0.01	-0.01
		Out																	0.00	
	12	In																	0.00	0.00
		Out																	0.00	
	13	In																	0.00	0.01
		Out																	0.00	
	16	In																	0.00	0.00
		Out																	0.00	
	17	In																	0.00	0.00
		Out																	0.00	
		In																		
		Out																		
		In																		
		Out																		
		In																		
		Out																		
		In																		
		Out																		
		In																		
		Out																		
Total To		In	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.01	0.00	0.00							*0.00*
		Out	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							

Attachment E: Stormwater Concept Approval

MDOT SHA Water Quality Summary Sheet - Version 1.0

PRD Number: 24-PR-0054 | Contract No.: MO9985188 | Project Description: MD 390 PROTECED BICYCLE LANES FROM SPRING S | 6-Digit Watershed: 021402 - Washington Metropolitan Area

Approved by Chief, Highway Hydraulics Division — Date

Approved by Chief, Plan Review Division — Date

Printed Name

(●) Concept ( ) Site Development ( ) Final

0.10	Banking Fee (acres)
0.57	Net Debit/Credit to WQ Bank (acres)
Net Reduction in Impervious Area (ac) =	0.3
Reconstructed Impervious Area Treated (ac) =	1.17

POI Data							Water Quality Required				Water Quality Provided							RESULT
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
POI	Existing Impervious within LOD (acres)	Proposed Impervious within LOD (acres)	Existing % Impervious within SSA (0 to 100)	Maintenance Area within LOD (acres)	Loss of Water Quality (acres)	Impervious Area Already Treated (acres)	Net Change in Impervious (acres)	IART from Redevelopment (acres)	IART from New Development (acres)	TOTAL IART (acres)	Type of Treatment	SWM Facility Number	Treatment Provided by Existing BMP (acres)	Treated MDOT SHA Impervious (acres)	Treated Non MDOT SHA Impervious (acres)	P_E Treated (inches)	Effective Impervious Treated (acres)	WQ Summary excess/deficit (acres)
	A_{EI}	A_{PI}	%I	A_{MI}	A_{LI}	A_{RECI}	ΔA_I	$IART_{RE\text{-}DEV'L}$	$IART_{NEW}$	IART			Not included in IAT				IAT	$\Sigma S=\Sigma R-\Sigma K$
							H = C-B	I=0.5(B-E-G) or 0	J = H or C-E-G	K = I+J+F								
TOTALS	**1.70**	**1.40**		**0.13**	**0.00**	**0.00**	**-0.30**	**0.79**	**-0.29**	**0.50**			**0.00**	**1.43**	**0.00**		**1.17**	**0.67**
1	0.01	0.01	25.0	0.00	0.00	0.00	0.00	0.00	0.01	0.01						0.00	0.00	**-0.01**
3	0.49	0.50	52.7	0.07	0.00	0.00	0.01	0.21	0.01	0.22						0.00	0.00	**-0.22**
5	0.20	0.18	95.2	0.04	0.00	0.00	-0.02	0.08	-0.02	0.06						0.00	0.00	**-0.06**
6	0.46	0.27	85.2	0.02	0.00	0.00	-0.19	0.22	-0.19	0.03						0.00	0.00	**-0.03**
8	0.31	0.20	91.2	0.00	0.00	0.00	-0.11	0.16	-0.11	0.05						0.00	0.00	**-0.05**
10	0.09	0.11	100.0	0.00	0.00	0.00	0.02	0.05	0.02	0.07						0.00	0.00	**-0.07**
11	0.14	0.13	60.9	0.00	0.00	0.00	-0.01	0.07	-0.01	0.06						0.00	0.00	**-0.06**
12	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00	0.00	0.00
13	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00	0.00	0.00
16	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**M-8 Bio-Swales**	**42**	0.00	0.69	0.00	0.62	0.43	**0.43**
17	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**M-8 Bio-Swales**	**24**	0.00	0.74	0.00	1.17	0.74	**0.74**

Peak Flow Summary Sheet

County: Montgomery **Qp/Qf Req'd:** Q10 (2), Q100 (2) (Notes listed below)

POI DRAINAGE AREA DATA							PEAK FLOWS - ONLY LIST THOSE REQUIRED BY COUNTY			
Study Point (POI/LOI)	Condition	Drainage Area (acres)	Impervious Area (Acres)	RCN	Tc (hours)	Q1 (cfs)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)	Increase?
1	Existing	1.43	0.58	76	0.12	1.2		4.2		NO
	Proposed	1.43	0.58	76	0.12	1.2		4.2		
3A	Existing	5.19	2.44	80	0.10	6.2		17.8		NO
	Proposed	5.19	2.45	80	0.10	6.2		17.8		
3B	Existing	21.23	8.08	76	0.16	16.5		55.6		NO
	Proposed	21.23	8.08	76	0.16	16.5		55.6		
3	Existing	26.42	10.52	77	0.16	22.0		71.8		NO
	Proposed	26.42	10.53	77	0.16	22.0		71.8		
OUT-A	Existing	27.85	11.10			23.2		75.9		NO
	Proposed	27.85	11.10			23.2		75.9		
5	Existing	1.04	1.00	97	0.10	2.7		5.1		YES (Q1, Q10)
	Proposed	1.05	0.98	97	0.10	2.7		5.2		
6	Existing	1.96	1.79	96	0.10	4.9		9.5		NO
	Proposed	1.88	1.59	95	0.10	4.6		9.0		
6L*	Existing	5.45	4.07			11.5		23.6		
	Proposed	5.48	3.78			11.2		23.5		
8	Existing	1.10	1.06	97	0.10	2.8		5.4		NO
	Proposed	1.07	0.94	95	0.10	2.6		5.1		
10	Existing	0.21	0.21	98	0.10	0.6		1.0		Yes (Q1, Q10)
	Proposed	0.26	0.25	97	0.10	0.7		1.3		
12	Existing	0.14	0.01	82	0.10	0.2		0.5		NO
	Proposed	0.14	0.01	81	0.10	0.2		0.5		
13	Existing	1.01	0.01	68	0.10	0.4		2.2		Yes (Q1, Q10)
	Proposed	1.09	0.01	69	0.10	0.5		2.5		
OUT B	Existing	33.30	15.17			33.1		96.9		NO
	Proposed	33.33	14.88			32.9		96.7		
11/OUT-C	Existing	0.61	0.46	94	0.10	1.4		2.9		NO
	Proposed	0.58	0.44	94	0.10	1.4		2.7		

Notes:

1a	Peak Management Required for Projects South of the Chesapeak & Delaware Canal
1b	Peak Management Required for Projects North of the Chesapeak & Delaware Canal
2	Peak Increases Require County Concurrence
3	Post-development peak must be w/in 10% of pre-development peak
4	Peak Management Required for Projects in Jones Falls, Gwynns Falls, Herring Run
5	Peak Management Required for Projects in Carroll Creek
*	Study Point 6L corresponds to the hydrocad analysis which includes other upstream Project POIs to that point

Appendix B

Variance Requests/County Concurrence Requests

MDOT STATE HIGHWAY ADMINISTRATION – PLAN REVIEW DIVISION

STORMWATER MANAGEMENT WAIVER APPLICATION

PRD No: 24-PR-0054 Contract No: MO9985188 Road: MD 390 (16th Street)

Project Description: Protected Bicycle Lanes from Spring Street to 2nd Avenue

List all POI/LOI where this waiver applies: POIs 3, 5, & 6

MDOT State Highway Administration hereby requests a stormwater management waiver be granted for the above referenced POI/LOI in accordance with the following section of the Stormwater Management Guidelines for State Highway Projects:

X	3.3.A.	Contract plans and provisions, stormwater management report.*
	3.3.B.1.a.	Contract plans and provisions, stormwater management report.
	3.3.B.1.b.	Contract plans and provisions, stormwater management report.*
	3.3.B.1.c.i	Contract plans and provisions, stormwater management report.*
	3.3.B.1.c.ii	Contract plans and provisions, stormwater management report.*
	3.3.B.2.a.	Contract plans and provisions, stormwater management report.
	3.3.B.2.b.	Contract plans and provisions, stormwater management report.*
	3.3.B.2.c.i	Contract plans and provisions, stormwater management report.*
	3.3.B.2.c.ii	Contract plans and provisions, stormwater management report.*
	3.3.B.3	Contract plans and provisions, stormwater management report.**

*Submit evidence of stable outfall with adequate capacity (e.g., video, photos, statement)

**Submit evidence of stable outfall and concurrence from local jurisdiction as needed

Waiver Requested By:

Mariefrance Guiteau _____ _____ 11/25/24

Printed Name (MDOT SHA PM or HHD Liaison) Signature Date

_____ Approved _____ Denied/Reason _____

By: _____ _____

Division Chief, Plan Review Division Date

MDOT STATE HIGHWAY ADMINISTRATION – PLAN REVIEW DIVISION

STORMWATER MANAGEMENT WAIVER APPLICATION

PRD No: 24-PR-0054 Contract No: MO9985188 Road: MD 390 (16th Street)

Project Description: Protected Bicycle Lanes from Spring Street to 2nd Avenue

List all POI/LOI where this waiver applies: POIs 5 & 10, LOI 13

MDOT State Highway Administration hereby requests a stormwater management waiver be granted for the above referenced POI/LOI in accordance with the following section of the Stormwater Management Guidelines for State Highway Projects:

	3.3.A.	Contract plans and provisions, stormwater management report.*
	3.3.B.1.a.	Contract plans and provisions, stormwater management report.
	3.3.B.1.b.	Contract plans and provisions, stormwater management report.*
	3.3.B.1.c.i	Contract plans and provisions, stormwater management report.*
	3.3.B.1.c.ii	Contract plans and provisions, stormwater management report.*
	3.3.B.2.a.	Contract plans and provisions, stormwater management report.
	3.3.B.2.b.	Contract plans and provisions, stormwater management report.*
	3.3.B.2.c.i	Contract plans and provisions, stormwater management report.*
	3.3.B.2.c.ii	Contract plans and provisions, stormwater management report.*
X	3.3.B.3	Contract plans and provisions, stormwater management report.**

*Submit evidence of stable outfall with adequate capacity (e.g., video, photos, statement)

**Submit evidence of stable outfall and concurrence from local jurisdiction as needed

Waiver Requested By:

Mariefrance Guiteau _____ _____ 11/25/24

Printed Name (MDOT SHA PM or HHD Liaison) Signature Date

_____ Approved _____ Denied/Reason _____

By: _____ _____

Division Chief, Plan Review Division Date

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

CONCURRENCE TO WAIVE STORMWATER MANAGEMENT QUANTITY REQUIREMENTS

To be completed by Maryland SHA

Date: 11/25/2024
Contract Number: MO9985188
Project Description: MD 390 Protected Bicycle Lanes from Spring Street to 2nd Avenue
County: Montgomery
Concurring Authority Organization/Agency/Office: Montgomery County Department of Permitting Services, Water Resources Section
Plan Review Division (PRD) Number: 24-PR-0054
Highway Hydraulics Division (HHD) Liaison: Tyler Bazan
Project Manager: Mariefrance Guiteau

Type of Request

- ☐ Overbank Flood Protection Volume (Q_{p2})
- ☒ Overbank Flood Protection Volume (Q_{p10})
- ☐ Extreme Flood Protection Volume (Q_f)

Justification of Request

The Maryland Department of Transportation State Highway Administration (MDOT SHA) is currently submitting documentation for the approval of storm water management (SWM) and erosion and sediment control (ESC) for a project within Montgomery County, specifically where MDOT SHA is improving accessibility for cyclists and pedestrians per MDOT SHA Contract No. MO9985188. The MDOT SHA *Sediment and Stormwater Guidelines and Procedures* (October 2017) Part A – Guidelines, Section 12, Table 2 (revised 2/22/2016) indicates that management of the peak discharge rate (Qp) for the Q10 and Q100 storm events may be required in Montgomery County per footnote (2):

> *(2) Quantity control may be required by the county due to historical flooding problems, downstream floodplain development, inadequate conveyance system, or other county specific criteria. Review the applicable county ordinance for further information.*

For this project, we are seeking a waiver of stormwater management quantity control requirements under Section 3.3.B.3 of those same Guidelines, which states the conditions of:

> *3.3.B.3 Historical downstream flooding problems do not exist and management of the overbank flood protection (QP) volume within the watershed (see Table 2) is not required by the local jurisdiction and is stated as such in a letter provided by the local jurisdiction to MDOT SHA. CpV shall be provided as required by the Design Manual.*

Per Montgomery County Ordinance 19.00.01.04, 10-year management may be required if the County determines that the receiving conveyance(s) cannot handle an increase, and 100-year management is required only when the County determines it is necessary to protect existing buildings. SHA is requesting that Montgomery County waive 100-year management on this contract as they have for the adjacent project along MD 97 (Georgia Avenue) under contract MO2245171.

The roadway improvement project extends along MD 390 from Spring Street to 2nd Avenue. A project location map, drainage area mapping, and ultimate outfall mapping can be found in the attached Stormwater Management Report. The project improvements consist of converting an existing vehicular travel lane into a two-way protected cycle track to increase bicycle Level of Service (LOS) and connectivity and widening sidewalks behind the proposed cycle track to improve pedestrian accessibility. Runoff from the project area flows through a combination of State and County storm drains as well as

open channel flow before ultimately outfalling into the Fenwick Branch of Rock Creek (Use I). The entire project limits are located outside of the FEMA floodplain.

MDOT SHA's in-house designers have analyzed the existing and proposed condition hydrology along the project limits and determined that, of the 9 project POIs and 2 LOIs which ultimately discharge to the Fenwick Branch of Rock Creek, two POIs and one LOI have minor increases in peak discharge for the subject storms. POI 5 has a 0.07 cubic-foot per second (cfs) increase in peak discharge for Q10, POI 3 has an 0.25 cfs increase in peak discharge for Q10, and LOI 13 has a 0.29 cfs increase in peak discharge for Q10. POIs 5 and 10 are in SHA storm drains that leave state right-of-way (ROW) along MD 390 and flow towards the proposed Purple Line Woodside station via closed channel pipe that then flows back towards MD 390 at POI 6; LOI 13 is located along state ROW where flow enters the Woodside Station and towards inlets that flow back to MD 390 to POI 6. POI 6 flows south via MC DOT storm drains underneath Summit Hills apartments, ultimately outfalling at Outfall B, a box culvert that outlets into Fenwick Branch of Rock Creek (SHA Office of Structures #1506000). Table 1 below lists the existing and proposed 10-year storm event peak discharge for each POI/LOI as well as the numerical and percent increase from existing conditions.

Table 1: Increases in Peak Discharge

POI/LOI	Q10 Existing (c.f.s)	Q10 Proposed (c.f.s)	Discharge Increase (c.f.s)	Discharge Increase (%)
5	5.08	5.15	0.07	1.38%
10	1.03	1.25	0.22	21.36%
13	2.18	2.47	0.29	13.30%

Table 2: Existing and Proposed Peak Discharges

POI/LOI #	Q10 (c.f.s.)		Delta Q10 (c.f.s)
	Ex.	Prop.	
5	5.08	5.15	+ 0.07
6	9.47	8.98	- 0.49
8	5.38	5.13	- 0.25
10	1.03	1.25	+ 0.22
12	0.52	0.50	- 0.02
13	2.18	2.47	+ 0.29
OUT-B	96.87	96.72	- 0.18

As noted above, all POIs within the project limits discharge to Fenwick Branch, and flow from there to Rock Creek. As shown by Table 2, while there is an increase in peak discharge for POIs 5 and 10 and LOI 13, the discharges at the remainder of the POIs that drain to Outfall-B decrease due to minor drainage area changes and removal of existing pavement in proposed conditions. Consequentially, the peak discharge to Outfall B decreases in the 10-year storm event. The three POI/LOI that do have a minor increase in discharge will not significantly impact the stability of the outfalls. Photos will be provided demonstrating that the downstream outfall for each POI is stable.

If you have any questions or require additional information, please contact MDOT SHA's project manager Mariefrance Guiteau at 410-545-8885 or by email at MGuiteau@mdot.maryland.gov.

MDOT SHA asks that you review the County's records regarding drainage concerns or flooding within the project limits so that the Q10 and Q100 management may be waived. Please indicate the results of your review under the signature line. We request that your concurrence be sent by email to Ms. Guiteau at MGuiteau@mdot.maryland.gov.

To be completed by the concurring authority

☐ We are not aware of downstream flooding or stability issues at the identified Point(s) of Interest (POI) for the specified project and concur with waiving the stormwater management quantity requirements.

☐ We are aware of known flooding or stability issues at one or more of the Point(s) of Interest (POI) for the specified project and do not concur with waiving stormwater management quantity requirements.

Printed Name: _____ Job Title: _____

Signature: _____ Date: _____

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

CONCURRENCE TO WAIVE STORMWATER MANAGEMENT QUANTITY REQUIREMENTS

To be completed by MDOT SHA
Date: 02/20/2024
Contract Number: MO2245171
Project Description: MD 97 from MD 390 to MD 192 Widen and Resurface Project
County: Montgomery
Concurring Authority Organization/Agency/Office: Montgomery County Department of Permitting Services, Water Resources Section
Plan Review Division (PRD) Number: 19-PR-0063
Highway Hydraulics Division (HHD) Liaison: Tyler Bazan
Project Manager: MarieFrance Guiteau

Justification/Merit of Request
Dear Mr. Etheridge:

The Maryland Department of Transportation State Highway Administration (MDOT SHA) is in the permit acquisition process for stormwater management (SWM) and erosion & sediment control (ESC) for the subject project located within Montgomery County. Table 2 of the MDOT SHA Sediment and Stormwater Guidelines and Procedures manual indicates that for projects in Montgomery County, 2-year management is not required, but 10-year management and/or 100-year management may be required by the County. Per Montgomery County Ordinance 19.00.01.04, 10-year management may be required if the County determines that the receiving conveyance(s) cannot handle an increase, and 100-year management is required only when the County determines it is necessary to protect existing buildings.

This roadway improvement project extends along MD 97 (Georgia Avenue) from Grace Church Road to just north of Forest Glen Road, with additional improvements along MD 390 (16th Street) from 2nd Avenue to MD 97. A project location map, drainage area mapping, and ultimate outfall mapping can be found in the attached Stormwater Management Report. Runoff from the project area flows through a combination of State and County storm drains as well as open channel flow before ultimately outfalling into Sligo Creek (02-14-02-5) or Rock Creek (02-14-02-06). Both receiving waters are Use I. The entire project limits are located outside of the FEMA floodplain (Zone X) for both waterways.

A meeting was held on February 15, 2024 between MarieFrance Guiteau (SHA Project Manager), Tyler Bazan (SHA Highway Hydraulics Division Liaison), Anna Wagner (SWM Design Consultant, Century Engineering), and Mark Etheridge (Montgomery County DPS Water Resources Section Manager), to discuss the 10- and 100-year management requirements. At this meeting, it was discussed that the County will not require management of the 100-year frequency storm event for this project.

Our design consultant has analyzed the existing and proposed condition hydrology for the project. Based on this analysis, the improvements at two of the project's Points of Investigation (POI), specifically POI 4 and POI 5, will result in minor net increases in the 10-year peak discharge rates from existing to proposed conditions. Table 1 and the POI descriptions below summarize the peak discharge increases at each of these POIs. Peak discharge computations can be found in the attached Stormwater Management Report.

<u>POI 4</u>

POI 4 is located at MD 97 Sta. 123+70 Right where runoff leaves the project area via surface runoff in the form of gutter flow down Flora Lane as well as sheet flow on the adjacent property. Downstream of POI 4, runoff continues as surface runoff for approximately 160 ft before being picked up in a Montgomery County storm drain system at the intersection of Flora Lane with Woodland Drive. The total drainage area

to POI 4 increases from 0.39 acres in existing conditions to 0.42 acres in proposed conditions, and the total impervious area draining to POI 4 increases by 0.03 acres from existing to proposed conditions. Consequently, the 10-year peak discharge rate at POI 4 increases by approximately 0.2 cfs from existing to proposed conditions.

POI 5

POI 5 is located at MD 97 Sta. 120+50 Right where runoff leaves the project area via gutter flow down White Oak Drive. Downstream of POI 5, runoff continues as gutter flow down White Oak Drive and then Woodland Drive for approximately 430 ft, before being picked up in the same Montgomery County storm drain system as POI 4 at the intersection of Flora Lane with Woodland Drive. The total drainage area to POI 5 increases from 0.64 acres in existing conditions to 0.69 acres in proposed conditions; although, there is no net change in the total impervious area draining to POI 5 from existing to proposed conditions. Consequently, the 10-year peak discharge rate at POI 5 increases by approximately 0.2 cfs from existing to proposed conditions.

Table 1. 10-Year Peak Discharge Summary

POI	Existing Conditions 10-Yr Peak Discharge (cfs)	Proposed Conditions 10-Yr Peak Discharge (cfs)	10-Yr Peak Discharge Increase (cfs)
4	1.6	1.8	+0.2
5	3.2	3.4	+0.2

Due to the small drainage areas, lack of storm drain present within the project limits, dense urban development, and limited ROW, there is no opportunity to provide quantity management within POI 4 or POI 5. These minor increases in peak discharge rates will have de minimis impact on downstream conditions. The existing Montgomery County storm drain system downstream of POIs 4 and 5 continues down Flora Lane approximately 1,900 ft until ultimately outfalling into an unnamed tributary to Sligo Creek near the intersection of Flora Lane with Columbia Boulevard. During a field visit for the project, both POIs 4 and 5, along with the ultimate 54" RCP outfall were investigated and found to be in stable condition. We are not aware of any downstream flooding issues at these POIs.

We are requesting concurrence from the County for accepting the minor increases of 10-year peak discharge rates at POI 4 and POI 5. To confirm that there are no known flooding issues at these POIs and that 10-year management can be waived, we are requesting that you review the County's records regarding any drainage concerns in the project limits. Please indicate the results of your review under your respective signature line at the end of this document.

We are also requesting documentation (via your response below) that the County does not require management of the 100-year frequency storm event for this project, as per our discussion on February 15, 2024.

If you have any questions or require additional information, please contact Tyler Bazan at 410-545-5592 or by email at tbazan@mdot.maryland.gov. For expediency, your response may also be e-mailed to Mr. Bazan. We look forward to hearing from you.

To be completed by the concurring authority. Check all that are applicable.

Mark Etheridge

Mark Etheridge
Manager, Water Resources Section
Department of Permitting Services
Montgomery County. Maryland

20 Feb 2024
Date

10-Year Management:

☒ Our office is not aware of flooding issues within or downstream of the project limits and is in concurrence with the proposed waiver for management of the Q_{10} at POI 4 and POI 5.

☐ Flooding/conveyance concerns have been identified at the following location(s) in the project limits and management of the Q_{10} is required at these locations:

_____

100-Year Management:

☒ Our office does not require management of the Q_{100} as part of this project.

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

Wes Moore
Governor
Aruna Miller
Lieutenant Governor
Paul J. Wiedefeld
Secretary
William Pines, P.E.
Administrator

VARIANCE REQUEST FOR CHANNEL PROTECTION VOLUME

TO:	JEFFREY KNAUB, P.E. DIVISION CHIEF, PLAN REVIEW DIVISION
FROM:	NICOLAS SAAVEDRA, P.E. DIVISION CHIEF, HIGHWAY HESIGN DIVISION
SUBJECT:	**SHA CONTRACT NO.:** MO9985188 **SHA FMIS NO.:** MO988B21 **PRD NO.:** 24-PR-0054 **PROJECT:** MD 390 (16TH STREET) PROTECTED BICYCLE LANES FROM SPRING STREET TO 2ND AVENUE **CPV VARIANCE REQUEST FOR POI 1 & 3**
DATE:	NOVEMBER 25, 2024
DATE REQUESTED BY:	N/A

PURPOSE OF REQUEST

To request a channel protection volume (CPv) variance for point-of-interest (POI).

SUMMARY

We request a variance from Section 4.0 Stormwater Management Criteria of the MDOT SHA *Sediment and Stormwater Guidelines and Procedures* as there are exceptional circumstances that restricts adherence to the guidelines.

In accordance with Section 3.4 of the MDOT SHA *Sediment and Stormwater Guidelines and Procedures*, we request a variance of the CPv requirement for POIs 1 and 3 since there is both new and reconstructed impervious area within the drainage area.

The proposed cycle track construction will add 0.01 ac of new impervious area to the site in both drainage areas 1 and 3. The resulting IART to provide CPv treatment is 0.01 ac and the resulting ESDv required to provide CPv management is 76 cf in each POI. Both have an ESDv shortfall of 76 cf due to BMPs being determined not to be practicable within the contributing drainage area to the POI. There is no change in the 1-yr discharge from existing to proposed conditions (1.24 cfs at POI 1 and 21.97 cfs at POI 3). Drainage leaves state right-of-way (ROW) at POI 1 via storm drain at approximately STA 121+85 LT and at POI 3 via storm drain at approximately STA 125+00 LT. Flow from both POIs flows via a closed storm-drain system to the southwest, underneath CSX tracks and discharges to the surface at Outfall A, just south of CSX tracks to the west of MD 390. The locations of POI 1 and 3 as well as Outfall A can be seen in the map shown in Figure 1.

Figure 1: Map of POI & Outfall locations

The water resources designers visited the project site on July 29, 2024 and were able to photograph and assess the outfall condition. Figure 2 shows the area immediately downstream of the headwall at Outfall A. The concrete apron of the outfall and the receiving channel can be seen to be in stable condition. This photograph was taken from the parking lot of an existing apartment complex – closer photos were not possible due to the presence of a perimeter chain link fence and steep slopes that precluded closer access to the stream. Figure 3 shows the receiving channel approximately 300 feet south of Outfall A, also in stable condition.

Therefore, we are requesting a variance for CPv management at POI-1 and POI 3. The POIs were determined to be stable upon field inspection. Please see the Concept SWM Report for supporting computation.

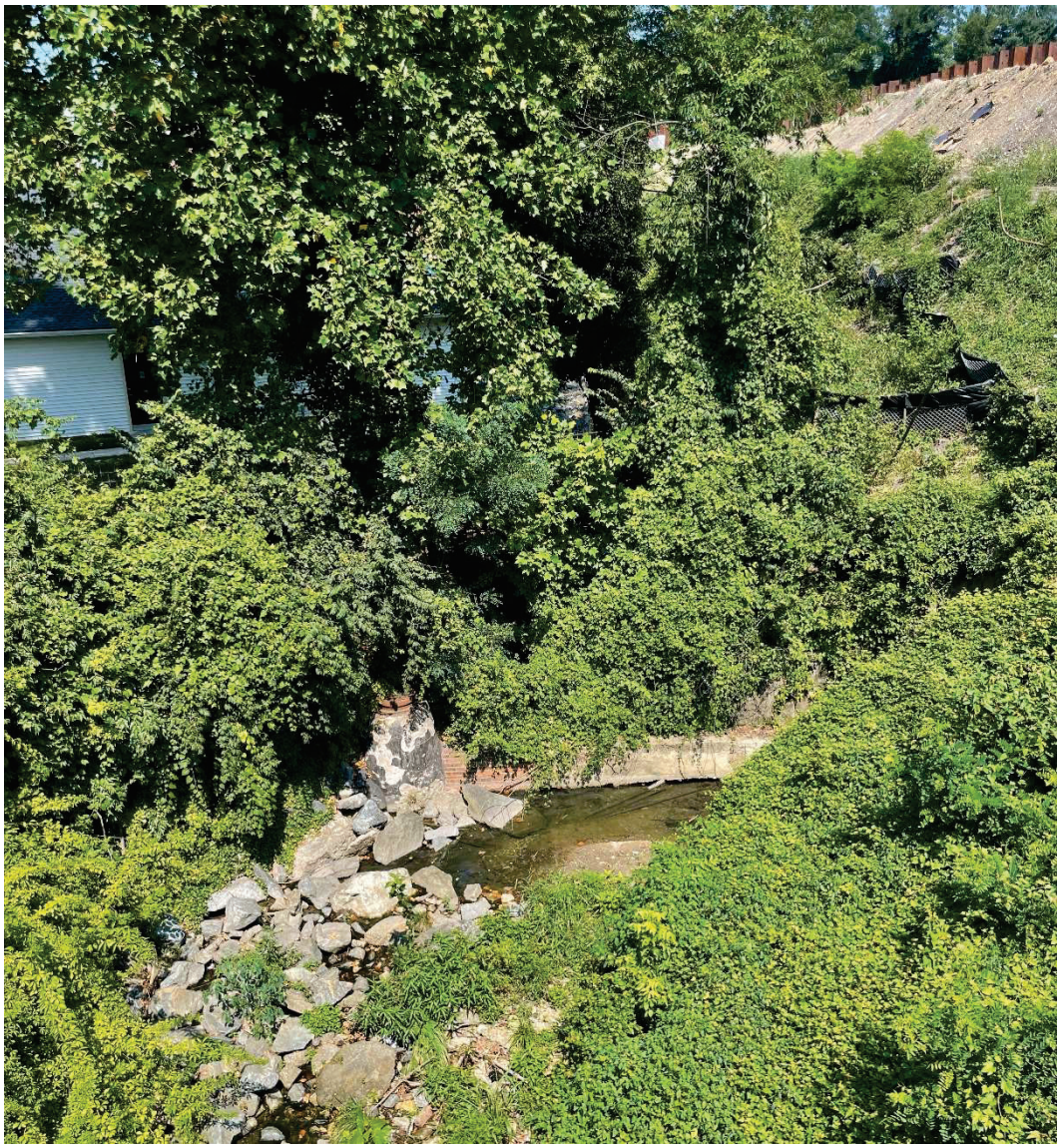


Figure 2: Channel immediately downstream of Outfall A.

Figure 3: Channel downstream of Outfall A

RECOMMENDATIONS

We recommend that the variance request be granted on the merit of the request.

If you have any questions or need additional information, please contact Mr. Tyler Bazan at 410-545-5592 or tbazan@mdot.maryland.gov. You may also reach me at 410-545-8908 or at nsaavedra@mdot.maryland.gov.

VO/bs

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

Wes Moore
Governor
Aruna Miller
Lieutenant Governor
Paul J. Wiedefeld
Secretary
William Pines, P.E.
Administrator

VARIANCE REQUEST FOR CHANNEL PROTECTION VOLUME

TO: JEFFREY KNAUB, P.E.
DIVISION CHIEF, PLAN REVIEW DIVISION

FROM: NICOLAS SAAVEDRA, P.E.
DIVISION CHIEF, HIGHWAY HESIGN DIVISION

SUBJECT: **SHA CONTRACT NO.:** MO9985188
SHA FMIS NO.: MO988B21
PRD NO.: 24-PR-0054
PROJECT: MD 390 (16TH STREET) PROTECTED BICYCLE LANES FROM SPRING STREET TO 2ND AVENUE
CPV VARIANCE REQUEST FOR POI 10

DATE: NOVEMBER 25, 2024

DATE REQUESTED BY:

PURPOSE OF REQUEST

To request a channel protection volume (CPv) variance for point-of-interest (POI).

SUMMARY

We request a variance from Section 4.0 Stormwater Management Criteria of the MDOT SHA *Sediment and Stormwater Guidelines and Procedures* as there are exceptional circumstances that restricts adherence to the guidelines.

In accordance with Section 3.4 of the MDOT SHA *Sediment and Stormwater Guidelines and Procedures*, we request a variance of the CPv requirement for POI 10 since there is both new and reconstructed impervious area within the drainage area.

The proposed cycle track construction will add 0.02 ac of new impervious to the site within the drainage area to POI 10. The resulting IART to provide CPv treatment is 0.02 ac and the resulting ESDv required to provide CPv management is 138 cf. The POI has an ESDv shortfall of 138 cf due to BMPs being determined not to be practicable within the contributing drainage area to the POI. Drainage leaves state right-of-way (ROW) at POI 10 via a closed pipe network that routes through POI 6, and discharges to the surface just south of MD 410 via a box culvert (OOS Structure #1506000) at Outfall B, discharging directly to the Fenwick Branch of Rock Creek. The locations of POIs 6 and 10 and Outfall B can be seen in the map shown in Figure 1. There is a decrease in the 1-yr discharge from existing to proposed conditions at Outfall B (33.13 cfs to 32.85 cfs).

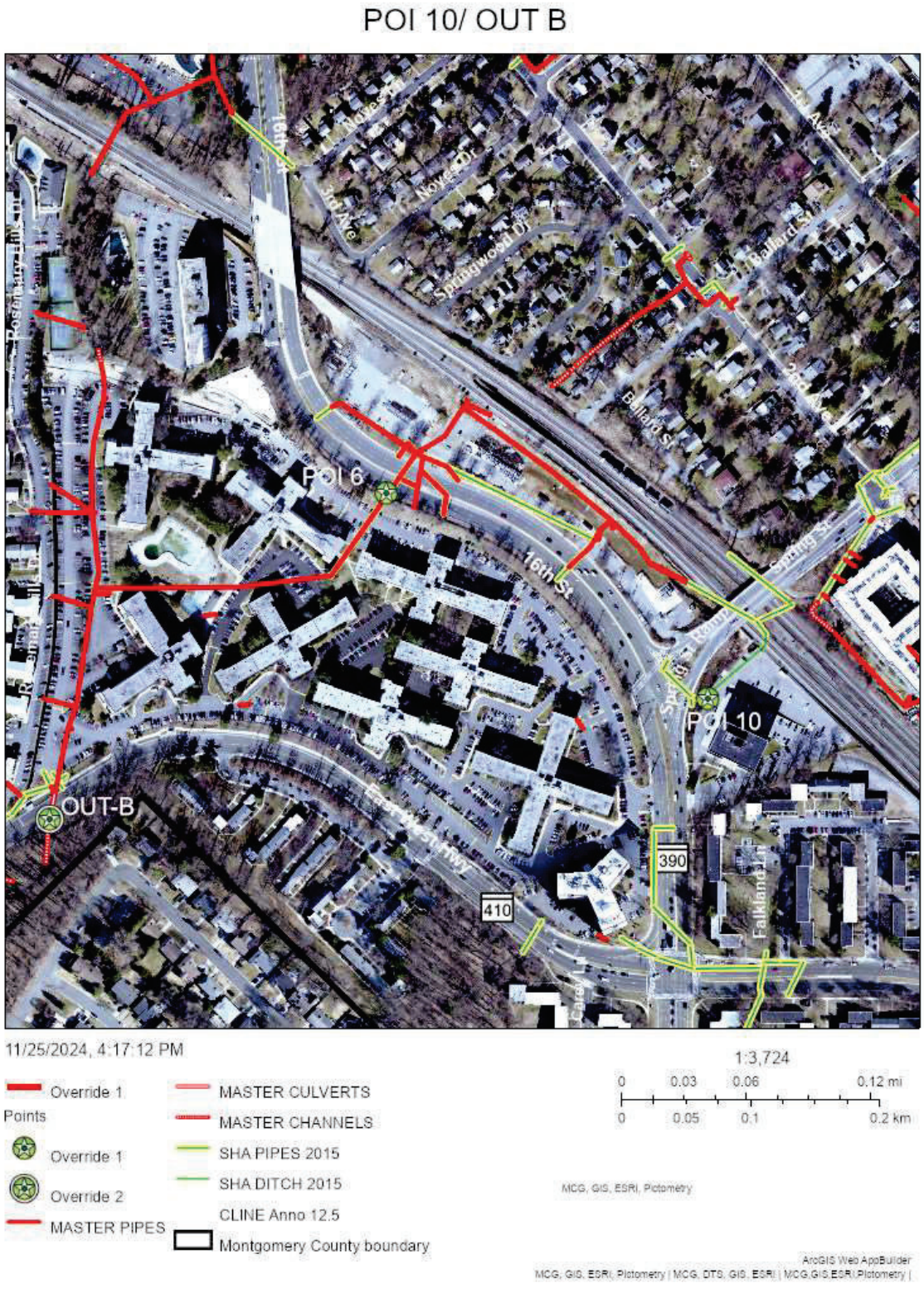


Figure 1: Map of POI and Outfall locations.

Upon a July 29, 2024, site visit, the area immediately downstream of Outfall B was inspected and assessed to be in stable condition as shown in Figure 2. Figure 3 shows the channel downstream of Outfall B. Therefore, we are requesting a variance for CPv management at POI-10. The outfall was determined to be stable upon field inspection. Please see the Concept SWM Report for supporting computation.

Figure 2: Receiving channel immediately downstream of Outfall B

Figure 3: View of channel downstream of Outfall B; Fenwick Branch, Rock Creek

RECOMMENDATIONS

We recommend that the variance request be granted on the merit of the request.

If you have any questions or need additional information, please contact Mr. Tyler Bazan at 410-545-5592 or tbazan@mdot.maryland.gov. You may also reach me at 410-545-8908 or at nsaavedra@mdot.maryland.gov.

VO/bs

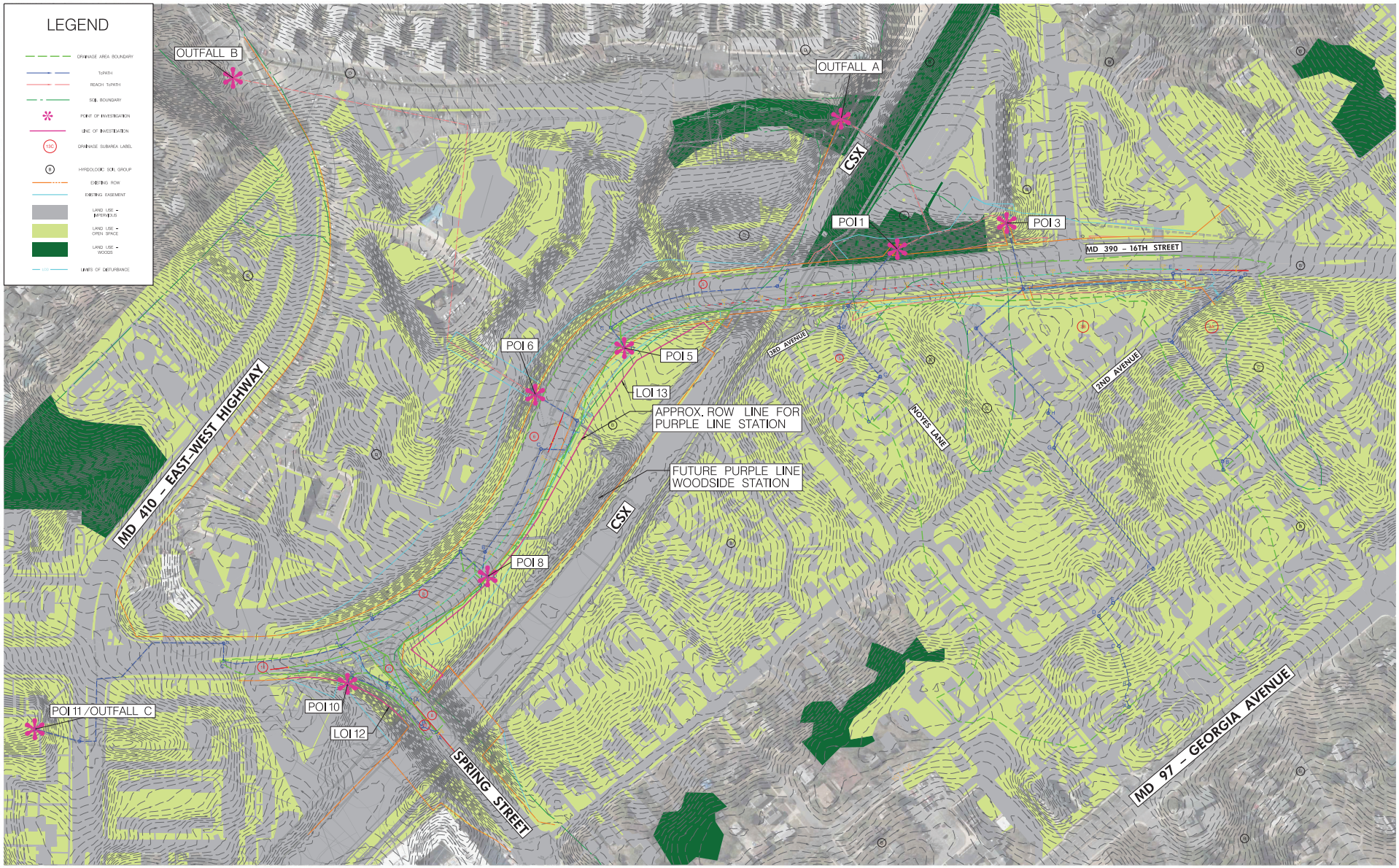
Appendix C

Drainage Area Mapping for Project Site

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

Montgomery County
Aerial Photography 2017
1":70' Scale

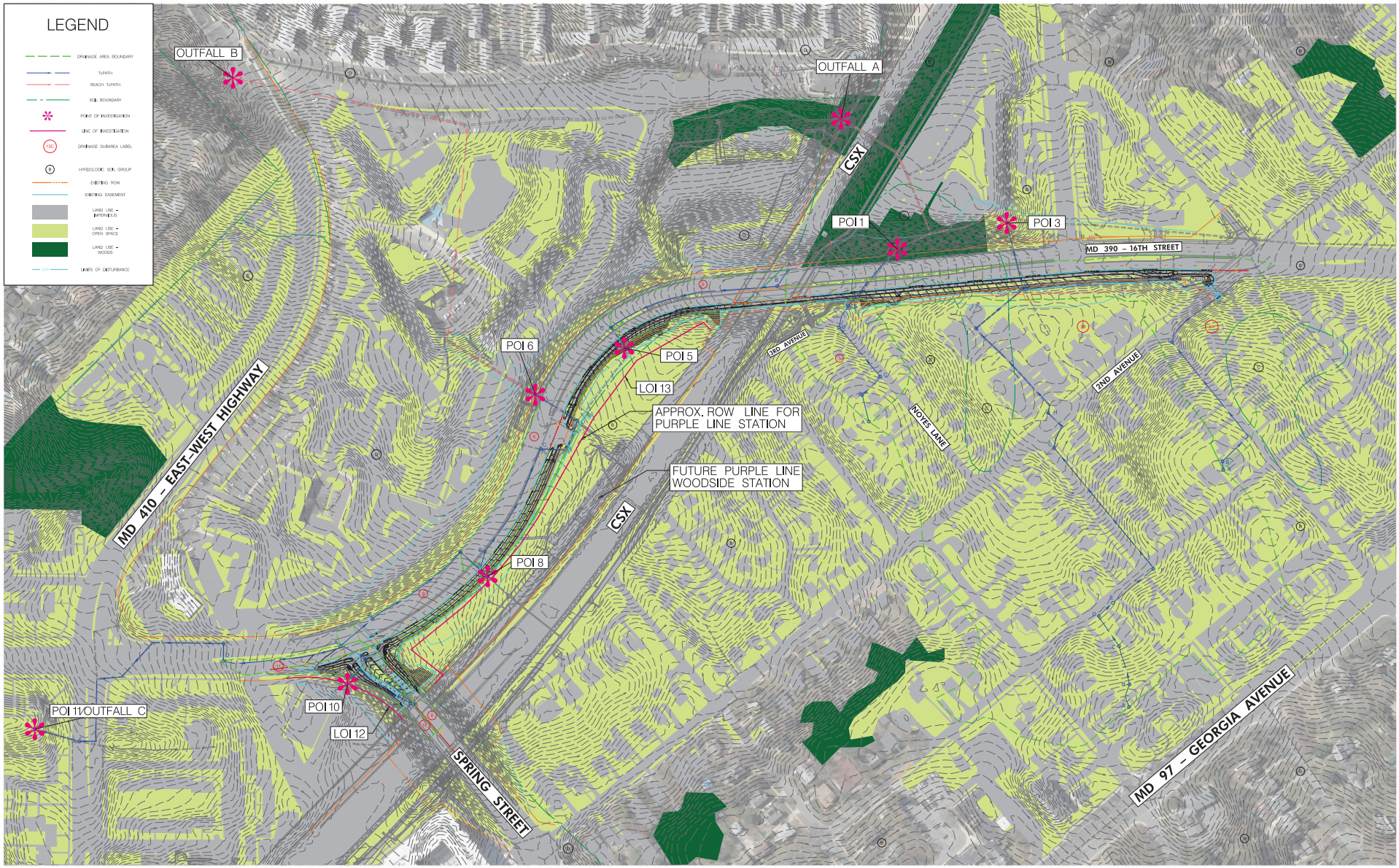
MD 390 (FROM SPRING STREET TO 2ND AVENUE)
DRAINAGE AREA MAP - EXISTING



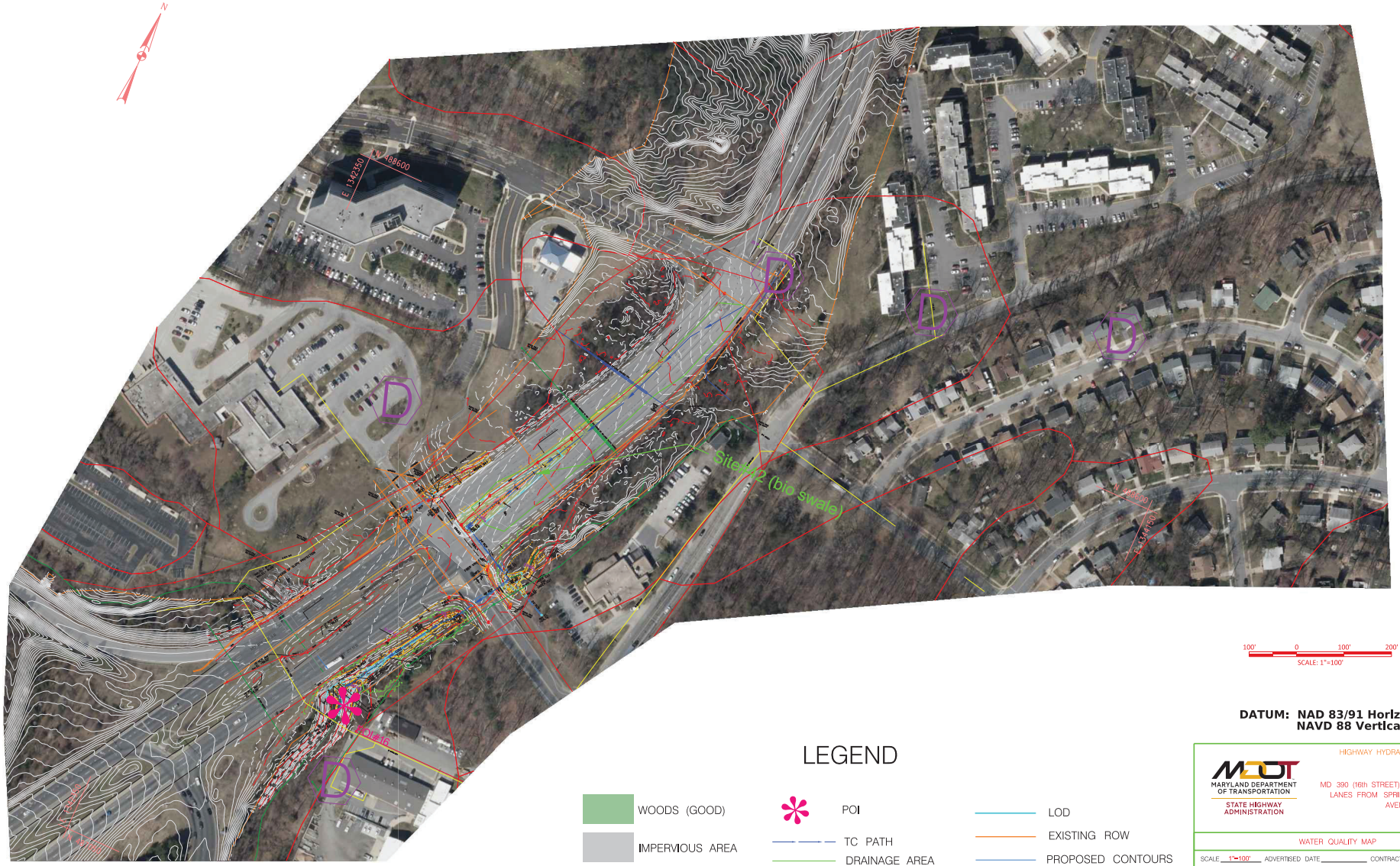
MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

Montgomery County
Aerial Photography 2017
1":70' Scale

MD 390 (FROM SPRING STREET TO 2ND AVENUE)
DRAINAGE AREA MAP - PROPOSED



Attachment E: Stormwater Concept Approval



100' 0 100' 200'
SCALE: 1"=100'

DATUM: NAD 83/91 Horizontal
NAVD 88 Vertical

LEGEND

- WOODS (GOOD)
- IMPERVIOUS AREA
- OPEN SPACE (GOOD)
- 100-yr FLOODPLAIN
- POI
- TC PATH
- DRAINAGE AREA
- EXISTING CONTOUR
- WETLAND
- STREAMS /CHANNELS
- LOD
- EXISTING ROW
- PROPOSED CONTOURS
- B — SOIL TYPE IDENTIFIER
- SOIL BOUNDRY
- DRAINAGE PIPE

HIGHWAY HYDRAULICS DIVISION

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

MD 390 (16th STREET) PROTECTED BICYCLE LANES FROM SPRING STREET TO 2ND AVENUE

WATER QUALITY MAP

SCALE 1"=100' ADVERTISED DATE _____ CONTRACT NO. MO998S188

DESIGNED BY	HHD	COUNTY	Montgomery
DRAWN BY	HHD	LOGMILE	
CHECKED BY	HHD	HORIZONTAL SCALE	
MDE/PRD	TBD	VERTICAL SCALE	

DRAWING NO. - 2 OF 2 SHEET NO. OF #

BY: yilin – Highway Hydraulics Division

PLOTTED: 07/19/2024
FILE: pw:\SHA\MPWK.shacaddad.mdot.mdstate:SHAEDMS02\Documents\Projects\Montgomery\MO998 - MD 390 - Protected Two-Way Cycle Track\Drainage\SWMp\D4-P001_MO998-105.dgn

Attachment E: Stormwater Concept Approval

DATUM: NAD 83/91 Horizontal
NAVD 88 Vertical

LEGEND

- WOODS (GOOD)
- IMPERVIOUS AREA
- OPEN SPACE (GOOD)
- 100-yr FLOODPLAIN
- POI
- TC PATH
- DRAINAGE AREA
- EXISTING CONTOUR
- WETLAND
- STREAMS /CHANNELS
- LOD
- EXISTING ROW
- PROPOSED CONTOURS
- SOIL TYPE IDENTIFIER
- SOIL BOUNDRY
- DRAINAGE PIPE

HIGHWAY HYDRAULICS DIVISION

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

MD 390 (16th STREET) PROTECTED BICYCLE LANES FROM SPRING STREET TO 2ND AVENUE

WATER QUALITY MAP

SCALE 1"=100' ADVERTISED DATE _____ CONTRACT NO. MO998S188

DESIGNED BY	HHD	COUNTY	Montgomery
DRAWN BY	HHD	LOGMILE	
CHECKED BY	HHD	HORIZONTAL SCALE	
MDE/PRD	TBD	VERTICAL SCALE	

DRAWING NO. – 1 OF 2 SHEET NO. OF #

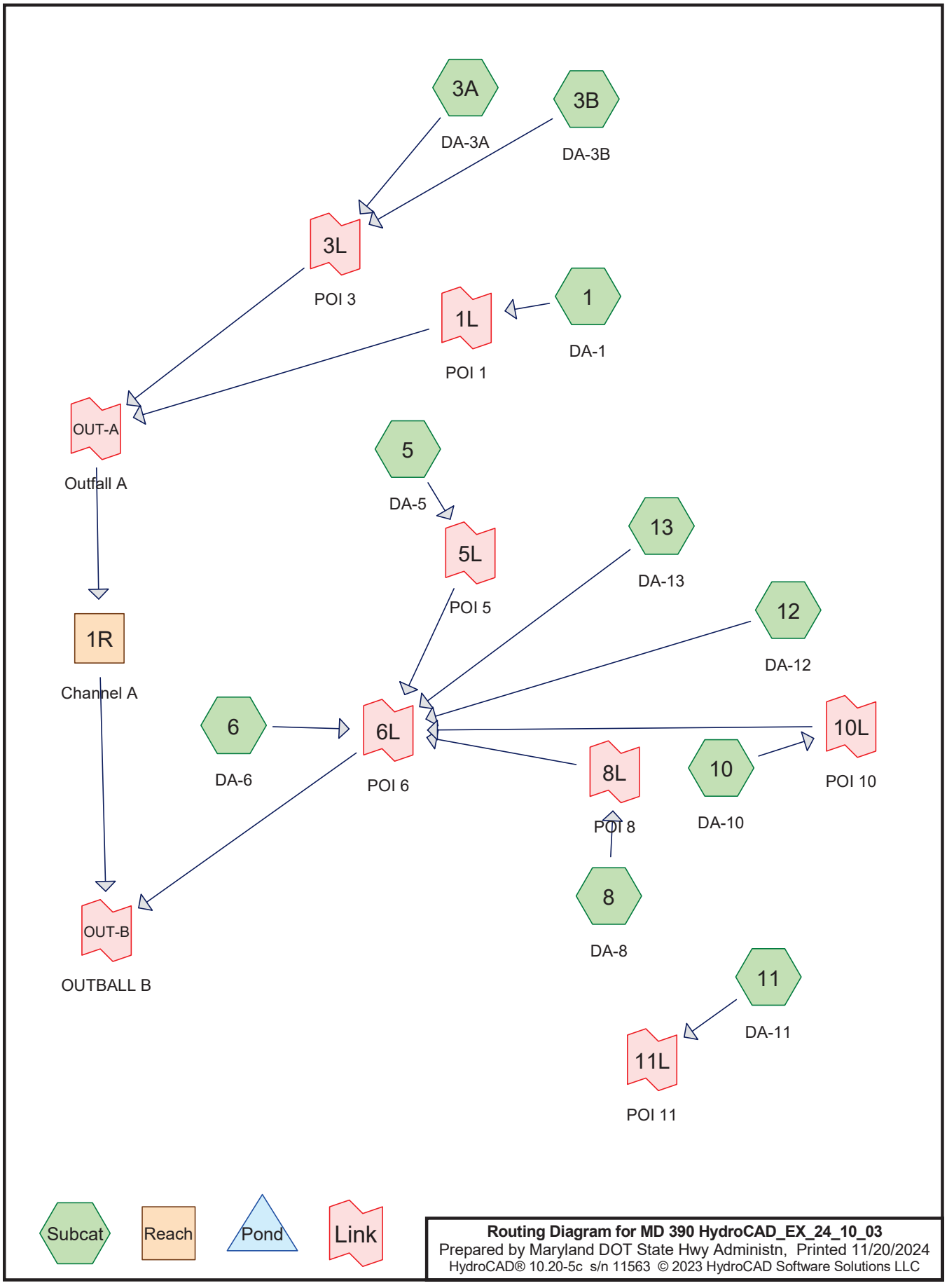
BY: yilin – Highway Hydraulics Division

PLOTTED: 07/19/2024
FILE: pw:\SHA\MPWK.shacaddad.mdot.mdstate:SHAEDMS02\Documents\Projects\Montgomery\MO998 - MD 390 - Protected Two-Way Cycle Track\Drainage\SWMp\D4-P001_MO998-107.dgn

Appendix D

HydroCAD Computations and Stormwater Management Computations

Existing HydroCAD Computations



Routing Diagram for MD 390 HydroCAD_EX_24_10_03
Prepared by Maryland DOT State Hwy Administn, Printed 11/20/2024

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery
Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery
Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery
Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery
Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	NOAA 24-hr	C	Default	24.00	1	2.57	2
2	10-Year	NOAA 24-hr	C	Default	24.00	1	4.77	2
3	100-Year	NOAA 24-hr	C	Default	24.00	1	8.23	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
15.779	61	>75% Grass cover, Good, HSG B (1, 3A, 3B, 5, 6, 8, 13)
1.644	74	>75% Grass cover, Good, HSG C (1, 3A, 3B)
0.862	80	>75% Grass cover, Good, HSG D (5, 6, 8, 10, 11, 12, 13)
15.628	98	Paved parking, HSG A (1, 3A, 3B, 5, 6, 8, 10, 11, 12, 13)
33.914	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
15.628	HSG A	1, 3A, 3B, 5, 6, 8, 10, 11, 12, 13
15.779	HSG B	1, 3A, 3B, 5, 6, 8, 13
1.644	HSG C	1, 3A, 3B
0.862	HSG D	5, 6, 8, 10, 11, 12, 13
0.000	Other	
33.914		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	15.779	1.644	0.862	0.000	18.286	>75% Grass cover, Good	1, 3A, 3B, 5, 6, 8, 10, 11, 12, 13
15.628	0.000	0.000	0.000	0.000	15.628	Paved parking	1, 3A, 3B, 5, 6, 8, 10, 11, 12, 13
15.628	**15.779**	**1.644**	**0.862**	**0.000**	**33.914**	**TOTAL AREA**	

MD 390 HydroCAD_EX_24_10_03
Prepared by Maryland DOT State Hwy Administn
Printed 11/20/2024

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	3A	0.00	0.00	425.0	0.0185	0.013	0.0	42.0	0.0	
2	3A	0.00	0.00	186.0	0.1070	0.024	0.0	36.0	0.0	
3	3B	0.00	0.00	144.0	0.0070	0.013	0.0	15.0	0.0	
4	3B	0.00	0.00	443.0	0.0590	0.013	0.0	15.0	0.0	
5	3B	0.00	0.00	106.0	0.0090	0.013	0.0	24.0	0.0	
6	3B	0.00	0.00	309.0	0.0030	0.024	0.0	36.0	0.0	
7	3B	0.00	0.00	176.0	0.0060	0.024	0.0	36.0	0.0	
8	3B	0.00	0.00	186.0	0.1070	0.024	0.0	36.0	0.0	
9	5	0.00	0.00	56.0	0.0200	0.013	0.0	24.0	0.0	
10	6	0.00	0.00	155.0	0.0050	0.011	0.0	24.0	0.0	
11	6	0.00	0.00	134.0	0.0430	0.011	0.0	60.0	0.0	
12	8	0.00	0.00	100.0	0.0139	0.013	0.0	24.0	0.0	
13	10	0.00	0.00	24.0	0.4170	0.024	0.0	24.0	0.0	
14	11	0.00	0.00	48.0	0.0108	0.013	0.0	18.0	0.0	
15	11	0.00	0.00	603.0	0.0311	0.013	0.0	24.0	0.0	
16	11	0.00	0.00	126.0	0.0963	0.013	0.0	36.0	0.0	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Muskingum-Cunge method - Pond routing by Stor-Ind method

Subcatchment 1: DA-1 Runoff Area=62,414 sf 40.34% Impervious Runoff Depth>0.66"
Flow Length=383' Tc=7.3 min CN=76 Runoff=1.24 cfs 0.079 af

Subcatchment 3A: DA-3A Runoff Area=226,077 sf 46.92% Impervious Runoff Depth>0.85"
Flow Length=1,510' Tc=6.0 min CN=80 Runoff=6.16 cfs 0.367 af

Subcatchment 3B: DA-3B Runoff Area=924,625 sf 38.06% Impervious Runoff Depth>0.66"
Flow Length=1,690' Tc=9.8 min CN=76 Runoff=16.45 cfs 1.164 af

Subcatchment 5: DA-5 Runoff Area=45,261 sf 95.98% Impervious Runoff Depth>2.08"
Flow Length=583' Tc=6.0 min CN=97 Runoff=2.67 cfs 0.180 af

Subcatchment 6: DA-6 Runoff Area=85,224 sf 91.31% Impervious Runoff Depth>1.99"
Flow Length=703' Tc=6.0 min CN=96 Runoff=4.90 cfs 0.325 af

Subcatchment 8: DA-8 Runoff Area=47,939 sf 96.35% Impervious Runoff Depth>2.08"
Flow Length=503' Tc=6.0 min CN=97 Runoff=2.82 cfs 0.191 af

Subcatchment 10: DA-10 Runoff Area=9,093 sf 99.75% Impervious Runoff Depth>2.17"
Flow Length=321' Tc=6.0 min CN=98 Runoff=0.55 cfs 0.038 af

Subcatchment 11: DA-11 Runoff Area=26,663 sf 75.85% Impervious Runoff Depth>1.81"
Flow Length=1,351' Tc=6.0 min CN=94 Runoff=1.44 cfs 0.092 af

Subcatchment 12: DA-12 Runoff Area=6,182 sf 9.51% Impervious Runoff Depth>0.96"
Flow Length=377' Tc=6.0 min CN=82 Runoff=0.19 cfs 0.011 af

Subcatchment 13: DA-13 Runoff Area=43,805 sf 0.70% Impervious Runoff Depth>0.36"
Tc=6.0 min CN=68 Runoff=0.43 cfs 0.030 af

Reach 1R: Channel A Avg. Flow Depth=0.66' Max Vel=9.80 fps Inflow=23.20 cfs 1.610 af
n=0.017 L=500.0' S=0.0120 '/' Capacity=105.42 cfs Outflow=23.05 cfs 1.609 af

Link 1L: POI 1 Inflow=1.24 cfs 0.079 af
Primary=1.24 cfs 0.079 af

Link 3L: POI 3 Inflow=21.97 cfs 1.532 af
Primary=21.97 cfs 1.532 af

Link 5L: POI 5 Inflow=2.67 cfs 0.180 af
Primary=2.67 cfs 0.180 af

Link 6L: POI 6 Inflow=11.53 cfs 0.776 af
Primary=11.53 cfs 0.776 af

Link 8L: POI 8 Inflow=2.82 cfs 0.191 af
Primary=2.82 cfs 0.191 af

Link 10L: POI 10 Inflow=0.55 cfs 0.038 af
Primary=0.55 cfs 0.038 af

Link 11L: POI 11 Inflow=1.44 cfs 0.092 af
Primary=1.44 cfs 0.092 af

Link OUT-A: Outfall A Inflow=23.20 cfs 1.610 af
Primary=23.20 cfs 1.610 af

Link OUT-B: OUTBALL B Inflow=33.13 cfs 2.385 af
Primary=33.13 cfs 2.385 af

Total Runoff Area = 33.914 ac Runoff Volume = 2.478 af Average Runoff Depth = 0.88"
53.92% Pervious = 18.286 ac 46.08% Impervious = 15.628 ac

Summary for Subcatchment 1: DA-1

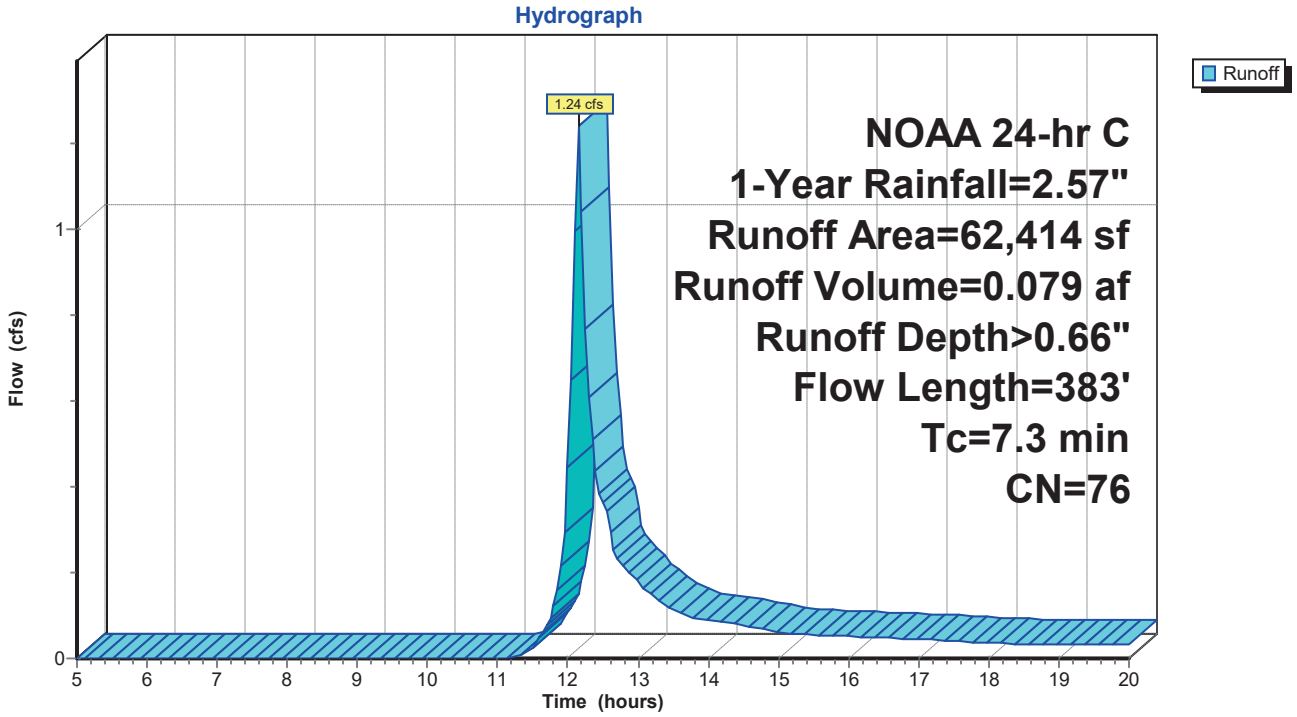
Runoff = 1.24 cfs @ 12.15 hrs, Volume= 0.079 af, Depth> 0.66"
Routed to Link 1L : POI 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
25,177	98	Paved parking, HSG A
34,812	61	>75% Grass cover, Good, HSG B
2,425	74	>75% Grass cover, Good, HSG C
62,414	76	Weighted Average
37,237		59.66% Pervious Area
25,177		40.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	75	0.0350	0.20		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.3	71	0.0460	4.35		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	171	0.0760	5.60		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.2	66	0.0610	5.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
7.3	383	Total			

Subcatchment 1: DA-1



Summary for Subcatchment 3A: DA-3A

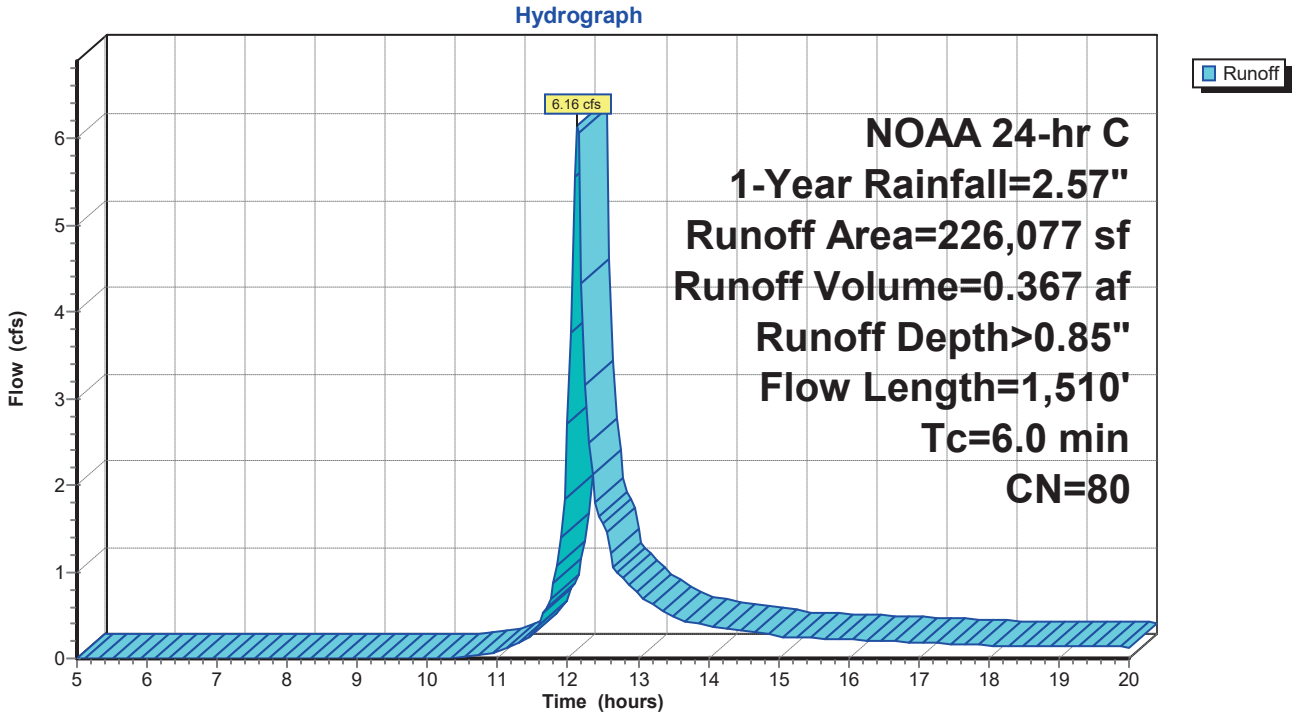
Runoff = 6.16 cfs @ 12.14 hrs, Volume= 0.367 af, Depth> 0.85"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
106,069	98	Paved parking, HSG A
86,815	61	>75% Grass cover, Good, HSG B
33,193	74	>75% Grass cover, Good, HSG C
226,077	80	Weighted Average
120,008		53.08% Pervious Area
106,069		46.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	22	0.0227	1.05		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	428	0.0771	5.64		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.9	263	0.0532	4.68		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.0	186	0.0220	3.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	425	0.0185	14.22	136.84	**Pipe Channel, E-F** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.2	186	0.1070	16.72	118.18	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
4.2	1,510	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3A: DA-3A



Summary for Subcatchment 3B: DA-3B

[47] Hint: Peak is 304% of capacity of segment #5
[47] Hint: Peak is 105% of capacity of segment #6

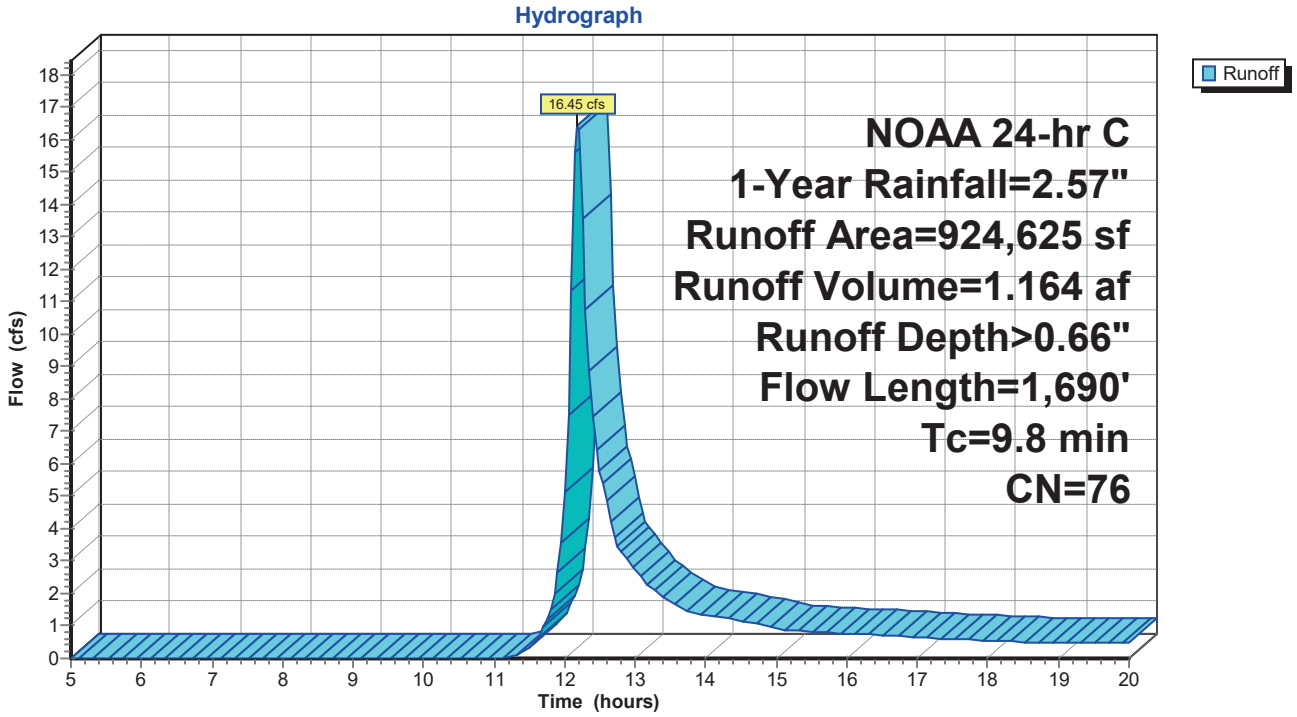
Runoff = 16.45 cfs @ 12.19 hrs, Volume= 1.164 af, Depth> 0.66"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
351,876	98	Paved parking, HSG A
536,743	61	>75% Grass cover, Good, HSG B
36,006	74	>75% Grass cover, Good, HSG C
924,625	76	Weighted Average
572,749		61.94% Pervious Area
351,876		38.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0620	0.24		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.4	108	0.1020	5.14		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.5	99	0.0400	3.22		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	54	0.0190	2.80		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	144	0.0070	4.40	5.40	**Pipe Channel, E-F** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.6	443	0.0590	12.79	15.69	**Pipe Channel, F-G** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.3	106	0.0090	6.83	21.46	**Pipe Channel, G-H** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
1.8	309	0.0030	2.80	19.79	**Pipe Channel, H-I** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.7	176	0.0060	3.96	27.98	**Pipe Channel, I-J** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.2	186	0.1070	16.72	118.18	**Pipe Channel, J-K** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
9.8	1,690	Total			

Subcatchment 3B: DA-3B



Summary for Subcatchment 5: DA-5

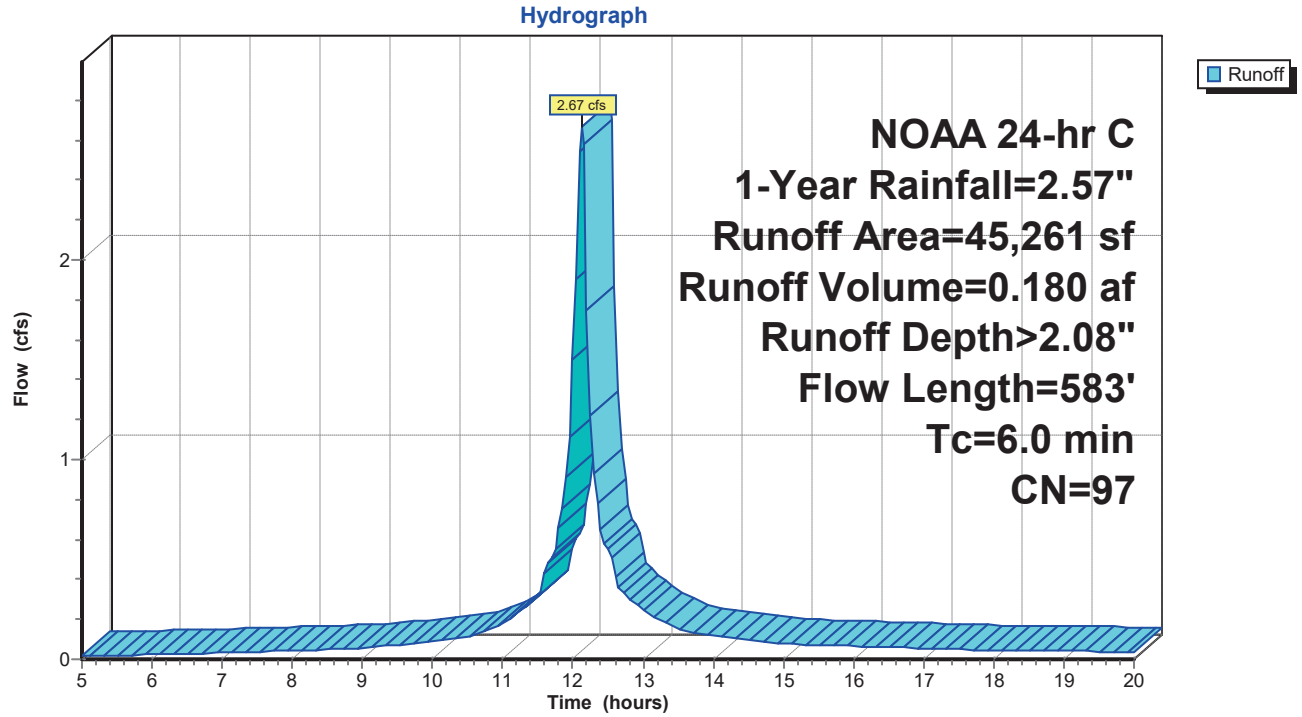
Runoff = 2.67 cfs @ 12.13 hrs, Volume= 0.180 af, Depth> 2.08"
Routed to Link 5L : POI 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
43,440	98	Paved parking, HSG A
23	61	>75% Grass cover, Good, HSG B
1,798	80	>75% Grass cover, Good, HSG D
45,261	97	Weighted Average
1,821		4.02% Pervious Area
43,440		95.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	51	0.0200	1.18		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.9	476	0.0441	4.26		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.1	56	0.0200	10.18	31.99	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
2.7	583	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5: DA-5



Summary for Subcatchment 6: DA-6

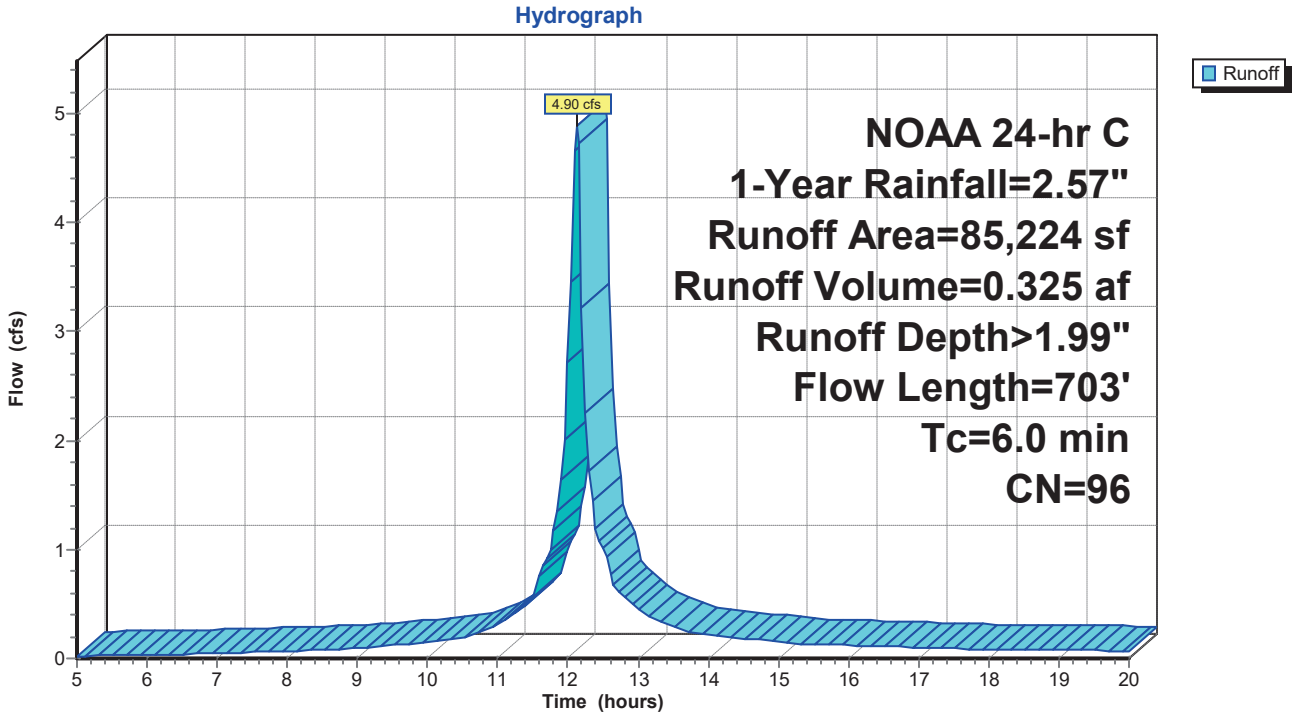
Runoff = 4.90 cfs @ 12.13 hrs, Volume= 0.325 af, Depth> 1.99"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
77,819	98	Paved parking, HSG A
165	61	>75% Grass cover, Good, HSG B
7,240	80	>75% Grass cover, Good, HSG D
85,224	96	Weighted Average
7,405		8.69% Pervious Area
77,819		91.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	93	0.0540	1.99		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	321	0.0311	3.58		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.4	155	0.0050	6.02	18.90	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	134	0.0430	32.51	638.26	**Pipe Channel, D-E** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.011 Concrete pipe, straight & clean
2.8	703	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 6: DA-6



Summary for Subcatchment 8: DA-8

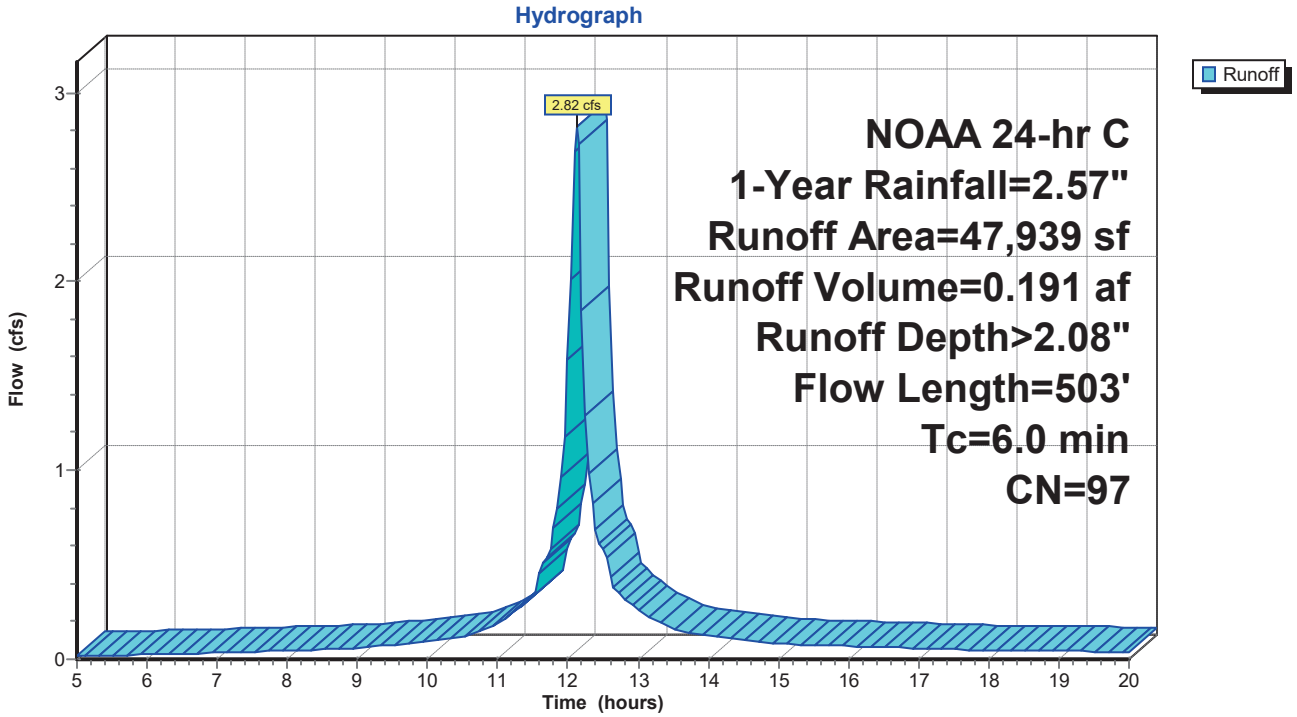
Runoff = 2.82 cfs @ 12.13 hrs, Volume= 0.191 af, Depth> 2.08"
Routed to Link 8L : POI 8

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
46,190	98	Paved parking, HSG A
1,120	61	>75% Grass cover, Good, HSG B
629	80	>75% Grass cover, Good, HSG D
47,939	97	Weighted Average
1,749		3.65% Pervious Area
46,190		96.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	303	0.0396	4.04		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.2	100	0.0139	8.49	26.67	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
2.7	503	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 8: DA-8



Summary for Subcatchment 10: DA-10

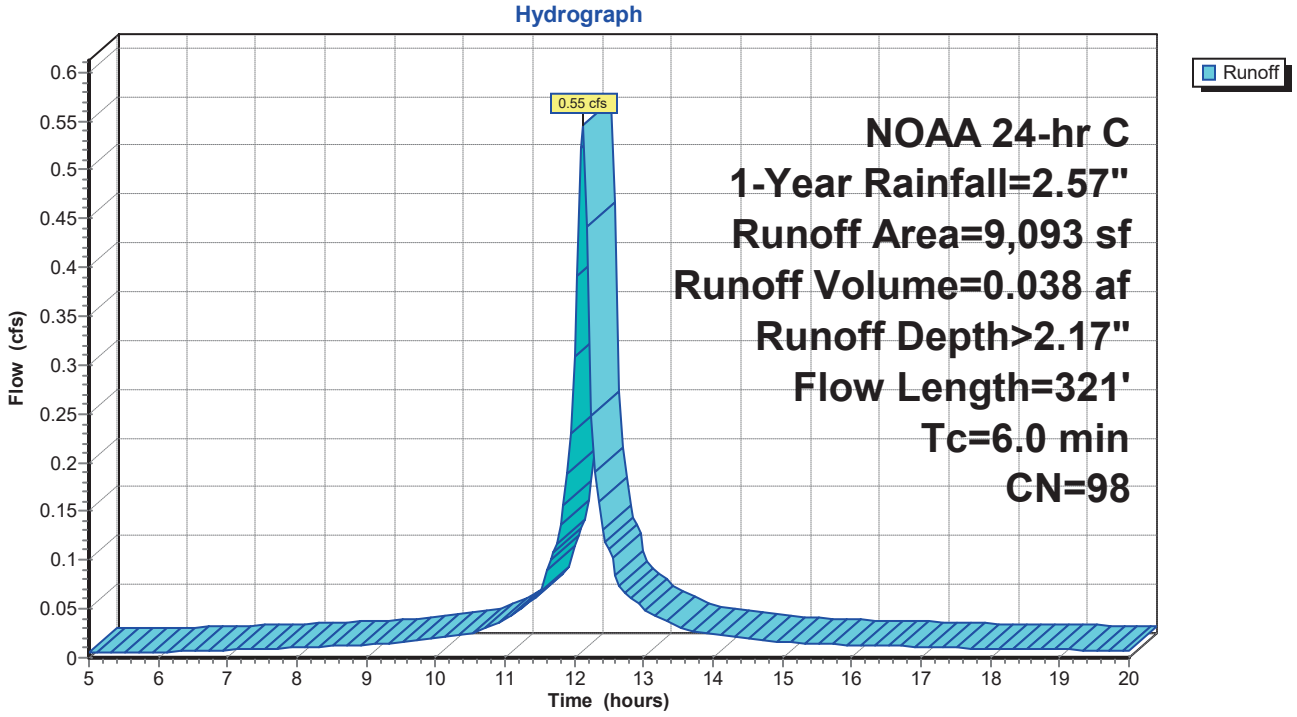
Runoff = 0.55 cfs @ 12.13 hrs, Volume= 0.038 af, Depth> 2.17"
Routed to Link 10L : POI 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
9,070	98	Paved parking, HSG A
23	80	>75% Grass cover, Good, HSG D
9,093	98	Weighted Average
23		0.25% Pervious Area
9,070		99.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	43	0.0470	1.61		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.0	254	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	24	0.4170	25.19	79.13	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.024
1.4	321	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 10: DA-10



Summary for Subcatchment 11: DA-11

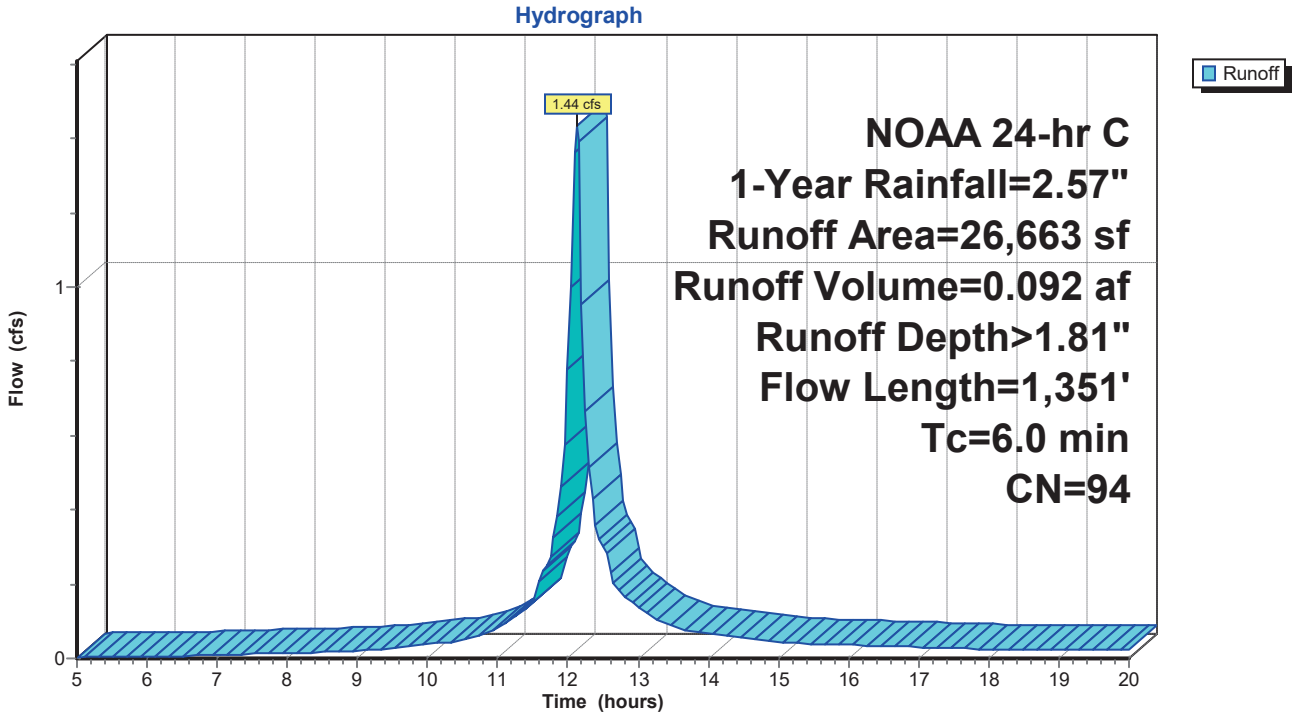
Runoff = 1.44 cfs @ 12.13 hrs, Volume= 0.092 af, Depth> 1.81"
Routed to Link 11L : POI 11

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
20,223	98	Paved parking, HSG A
6,440	80	>75% Grass cover, Good, HSG D
26,663	94	Weighted Average
6,440		24.15% Pervious Area
20,223		75.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	81	0.0340	1.60		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.9	493	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.1	48	0.0108	6.18	10.92	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
0.8	603	0.0311	12.70	39.90	**Pipe Channel, D-E** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
0.1	126	0.0963	29.28	206.98	**Pipe Channel, E-F** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Concrete pipe, bends & connections
3.7	1,351	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 11: DA-11



Summary for Subcatchment 12: DA-12

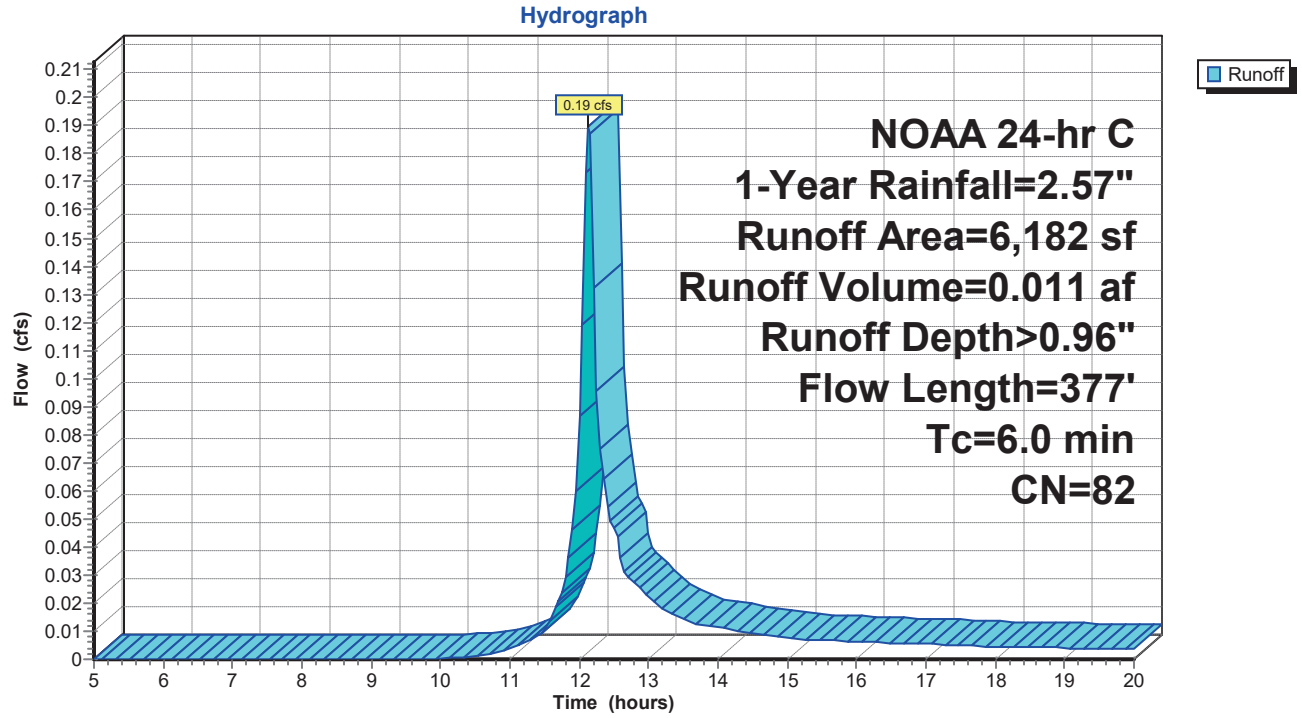
Runoff = 0.19 cfs @ 12.13 hrs, Volume= 0.011 af, Depth> 0.96"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
588	98	Paved parking, HSG A
5,594	80	>75% Grass cover, Good, HSG D
6,182	82	Weighted Average
5,594		90.49% Pervious Area
588		9.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.03		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.7	156	0.0060	1.57		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	21	0.2860	10.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.3	100	0.0600	4.97		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
3.6	377	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 12: DA-12



Summary for Subcatchment 13: DA-13

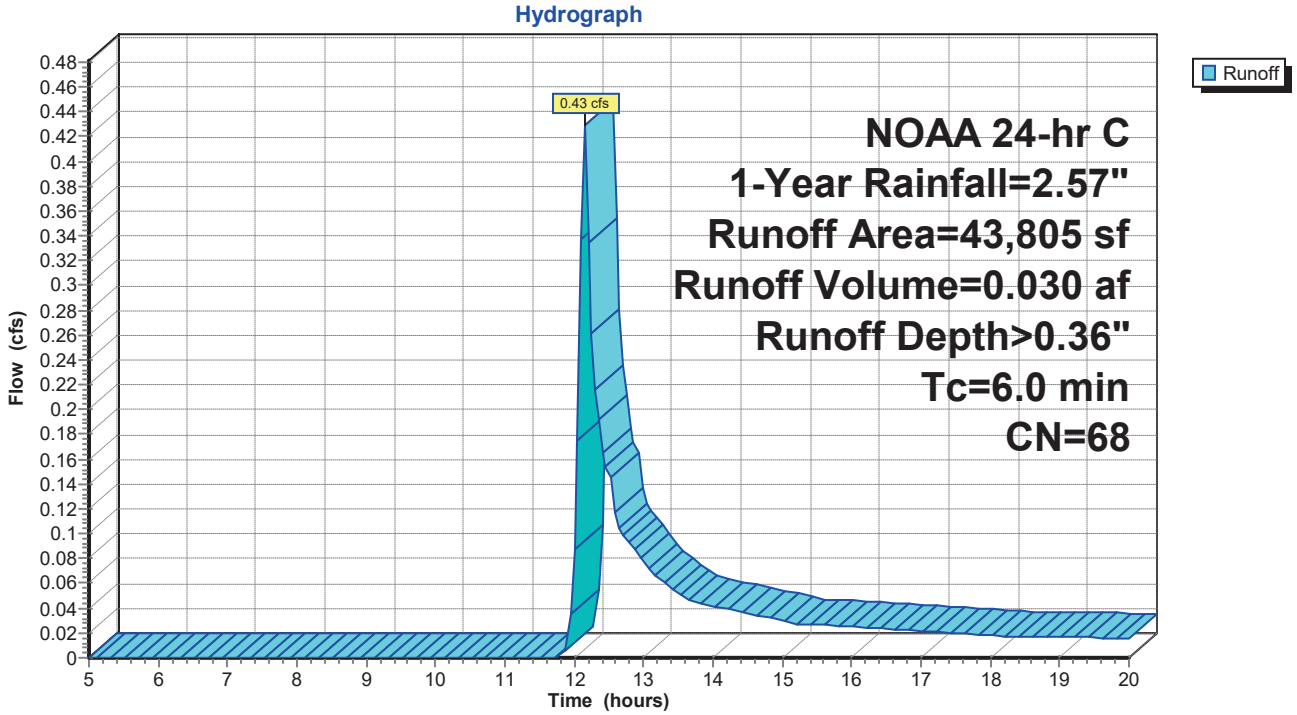
Runoff = 0.43 cfs @ 12.15 hrs, Volume= 0.030 af, Depth> 0.36"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
308	98	Paved parking, HSG A
27,660	61	>75% Grass cover, Good, HSG B
15,837	80	>75% Grass cover, Good, HSG D
43,805	68	Weighted Average
43,497		99.30% Pervious Area
308		0.70% Impervious Area

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

Subcatchment 13: DA-13



Summary for Reach 1R: Channel A

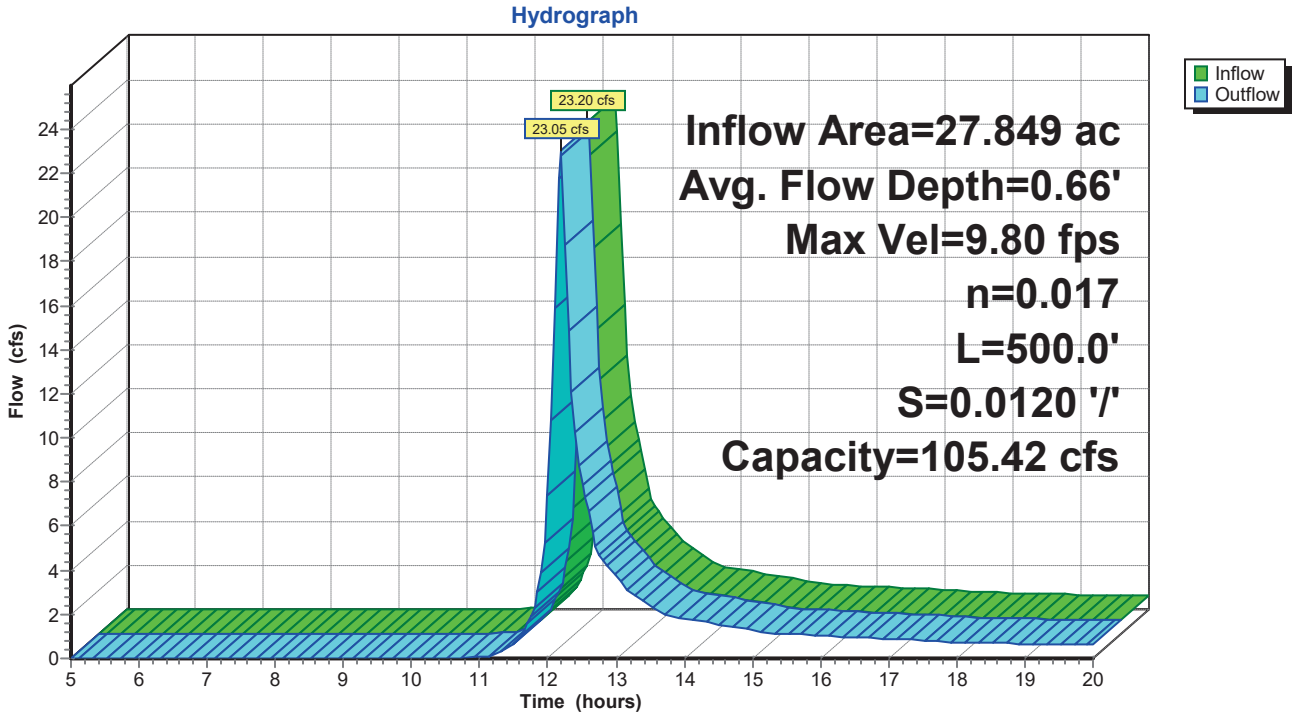
Inflow Area = 27.849 ac, 39.82% Impervious, Inflow Depth > 0.69" for 1-Year event
Inflow = 23.20 cfs @ 12.17 hrs, Volume= 1.610 af
Outflow = 23.05 cfs @ 12.19 hrs, Volume= 1.609 af, Atten= 1%, Lag= 1.2 min
Routed to Link OUT-B : OUTBALL B

Routing by Muskingum-Cunge method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Reference Flow= 17.40 cfs Estimated Depth= 0.73' Velocity= 6.35 fps
m= 1.497, c= 9.50 fps, dt= 3.0 min, dx= 500.0' / 1 = 500.0', K= 0.9 min, X= 0.459
Max. Velocity= 9.80 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 9.46 fps, Avg. Travel Time= 0.9 min

Peak Storage= 1,200 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.66' , Surface Width= 4.31'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 105.42 cfs

3.00' x 2.00' deep channel, n= 0.017 Concrete, unfinished
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 500.0' Slope= 0.0120 '/'
Inlet Invert= 274.00', Outlet Invert= 268.00'

Reach 1R: Channel A

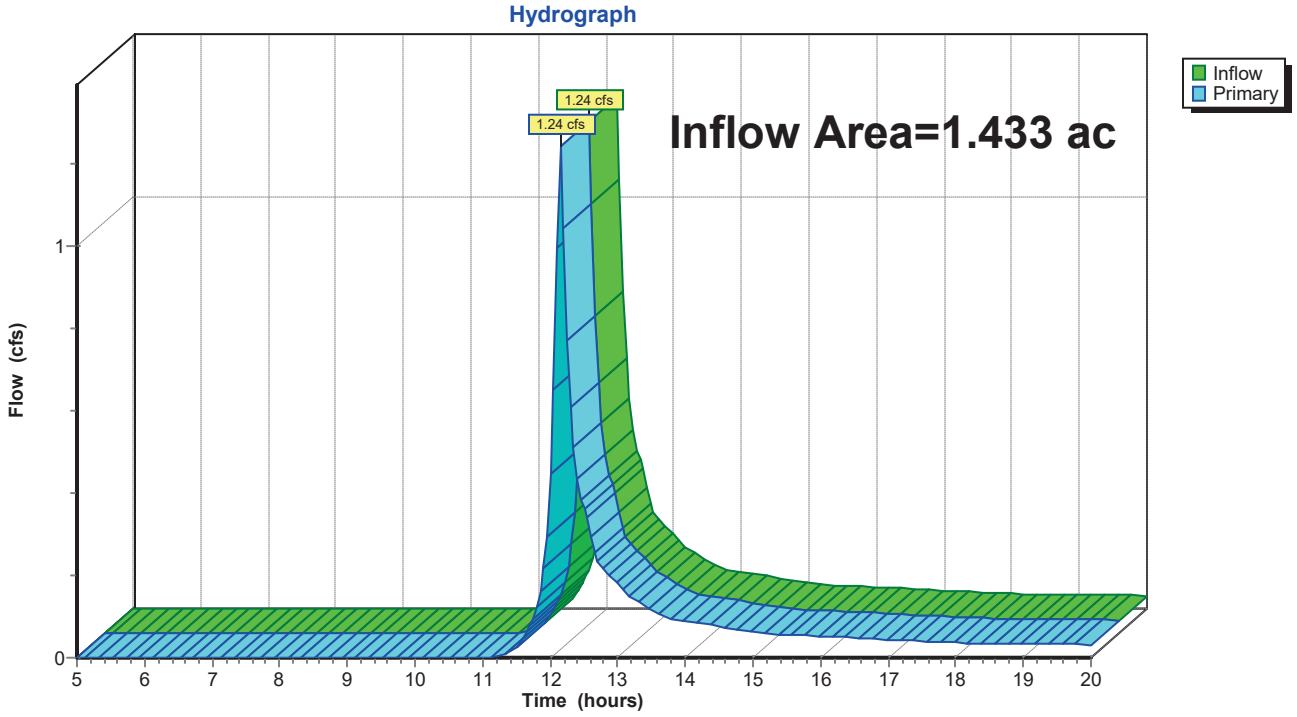


Summary for Link 1L: POI 1

Inflow Area = 1.433 ac, 40.34% Impervious, Inflow Depth > 0.66" for 1-Year event
Inflow = 1.24 cfs @ 12.15 hrs, Volume= 0.079 af
Primary = 1.24 cfs @ 12.15 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

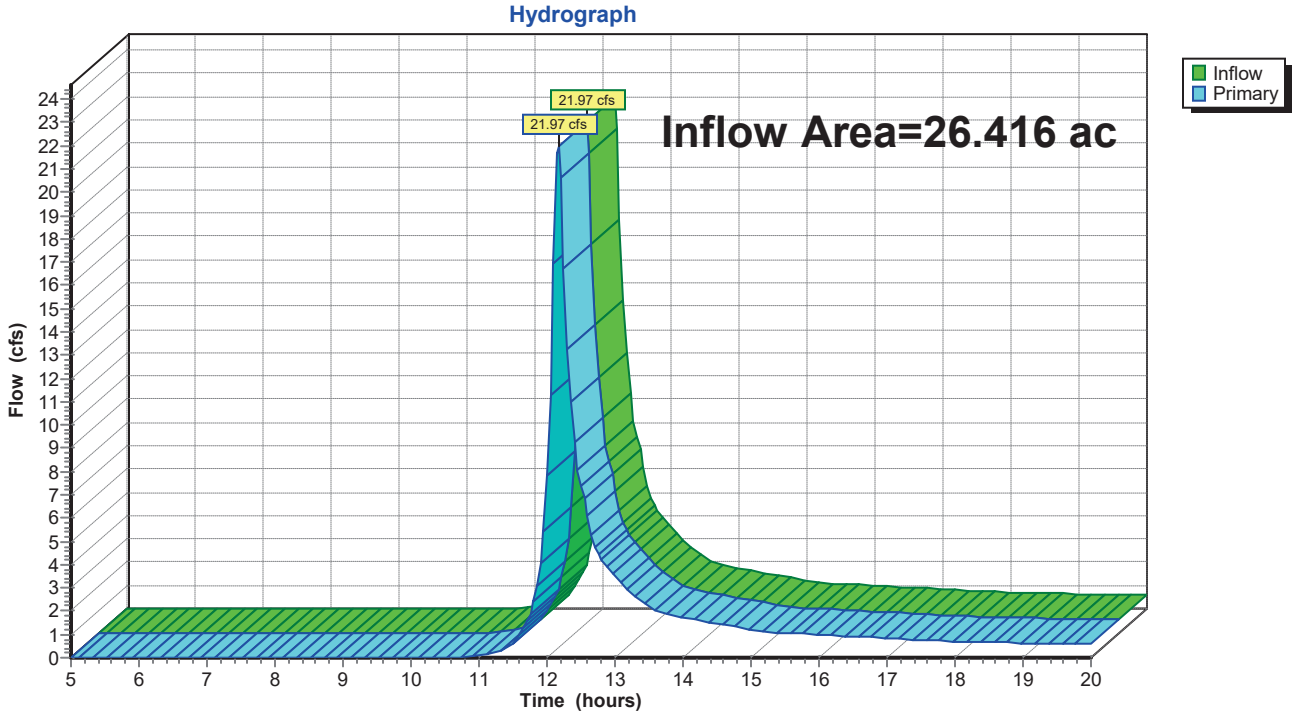


Summary for Link 3L: POI 3

Inflow Area = 26.416 ac, 39.80% Impervious, Inflow Depth > 0.70" for 1-Year event
Inflow = 21.97 cfs @ 12.17 hrs, Volume= 1.532 af
Primary = 21.97 cfs @ 12.17 hrs, Volume= 1.532 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: POI 3

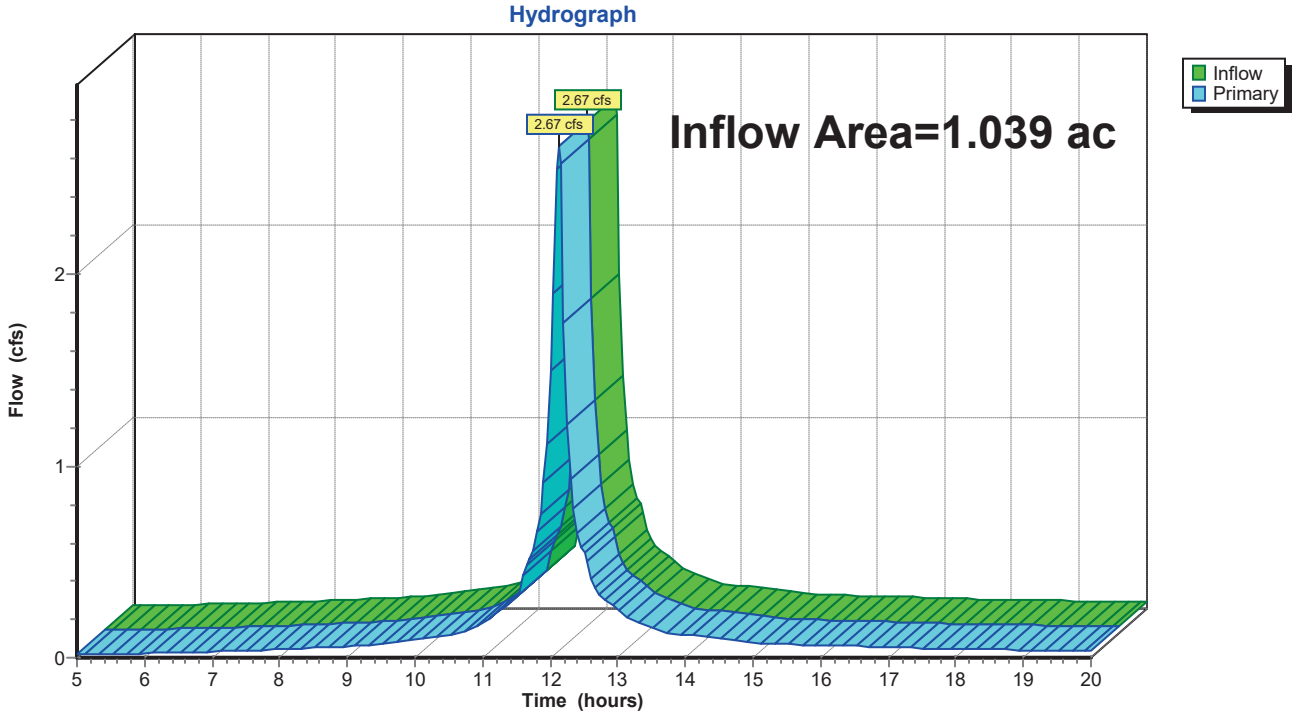


Summary for Link 5L: POI 5

Inflow Area = 1.039 ac, 95.98% Impervious, Inflow Depth > 2.08" for 1-Year event
Inflow = 2.67 cfs @ 12.13 hrs, Volume= 0.180 af
Primary = 2.67 cfs @ 12.13 hrs, Volume= 0.180 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: POI 5

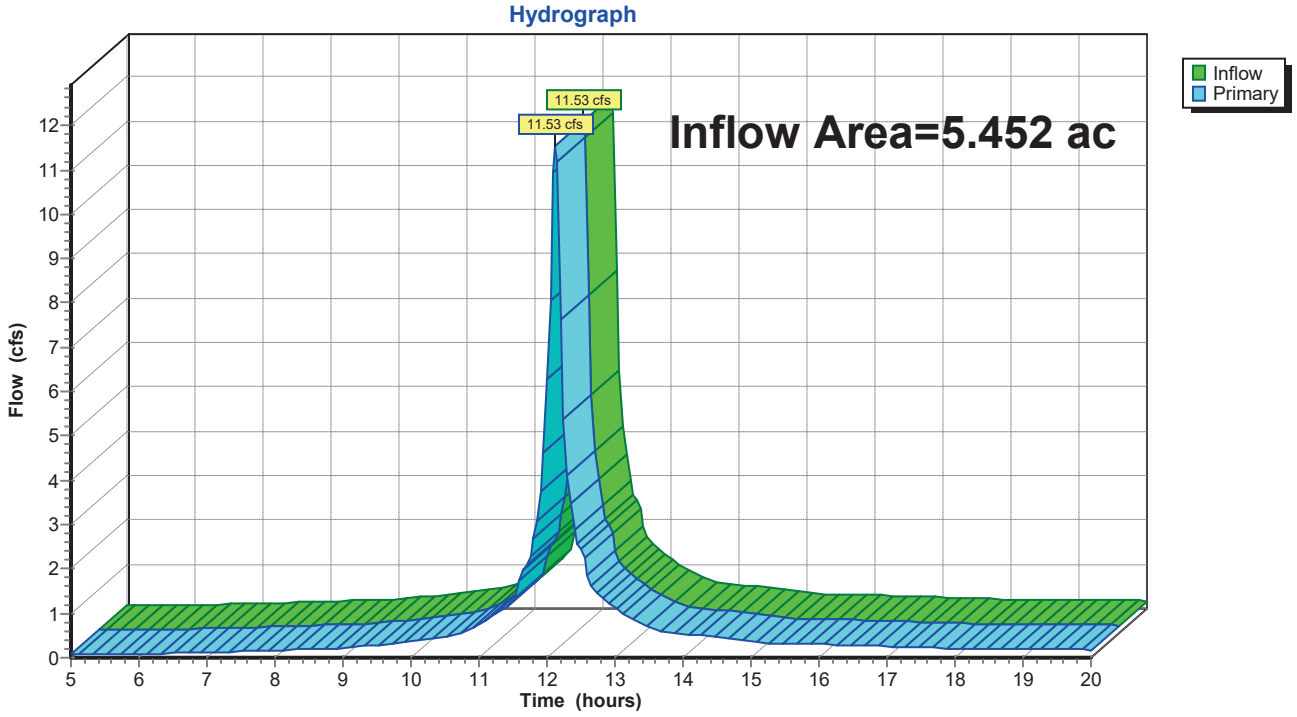


Summary for Link 6L: POI 6

Inflow Area = 5.452 ac, 74.70% Impervious, Inflow Depth > 1.71" for 1-Year event
Inflow = 11.53 cfs @ 12.13 hrs, Volume= 0.776 af
Primary = 11.53 cfs @ 12.13 hrs, Volume= 0.776 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-B : OUTBALL B

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 6L: POI 6

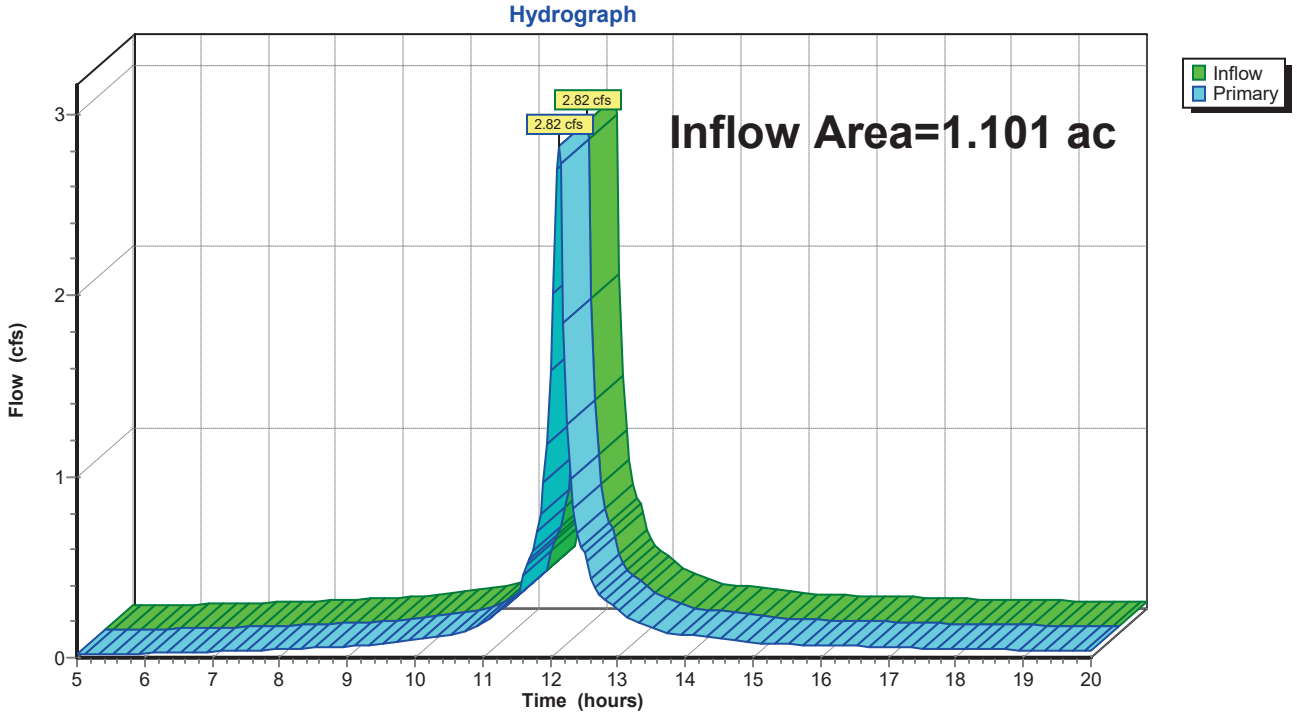


Summary for Link 8L: POI 8

Inflow Area = 1.101 ac, 96.35% Impervious, Inflow Depth > 2.08" for 1-Year event
Inflow = 2.82 cfs @ 12.13 hrs, Volume= 0.191 af
Primary = 2.82 cfs @ 12.13 hrs, Volume= 0.191 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 8L: POI 8

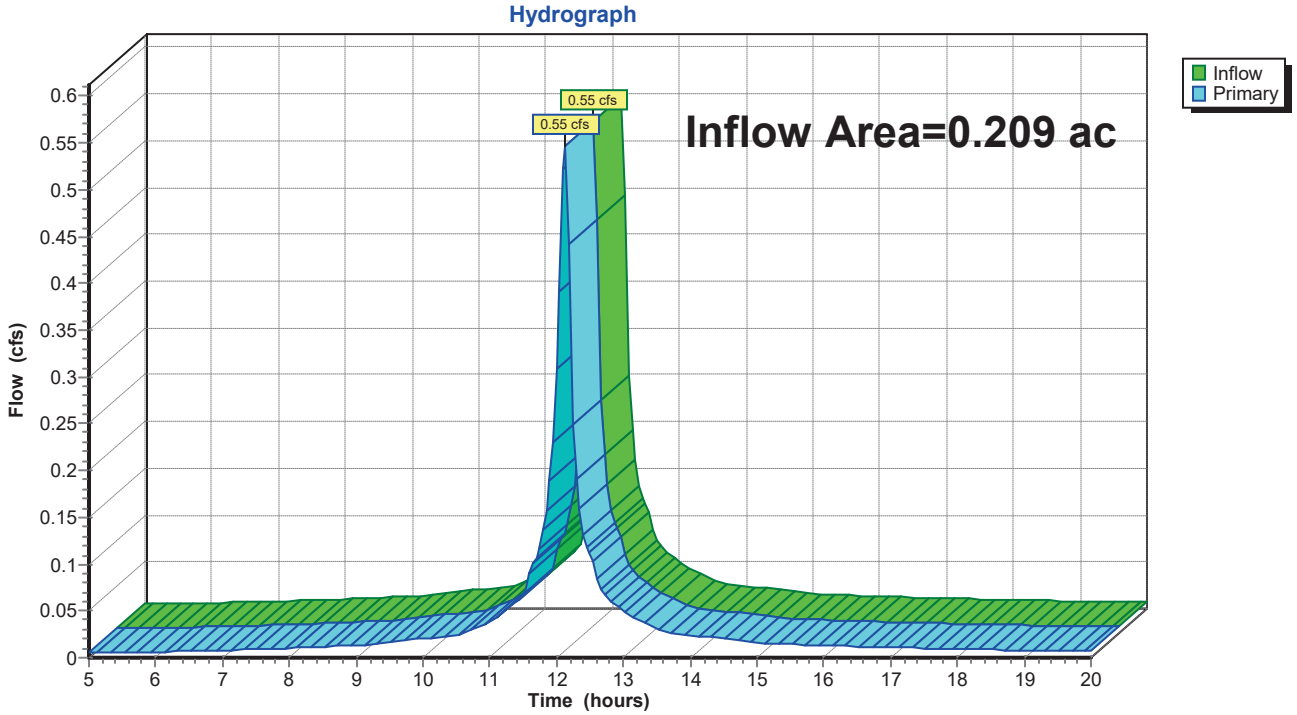


Summary for Link 10L: POI 10

Inflow Area = 0.209 ac, 99.75% Impervious, Inflow Depth > 2.17" for 1-Year event
Inflow = 0.55 cfs @ 12.13 hrs, Volume= 0.038 af
Primary = 0.55 cfs @ 12.13 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: POI 10

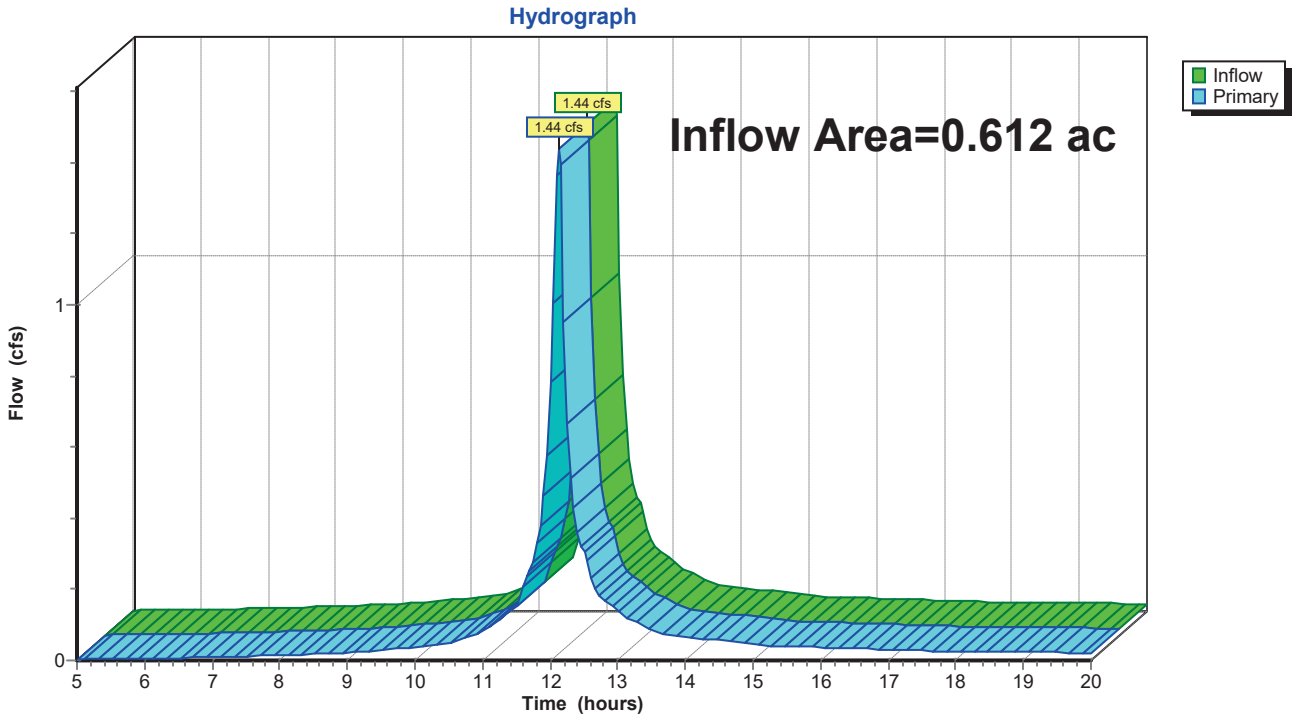


Summary for Link 11L: POI 11

Inflow Area = 0.612 ac, 75.85% Impervious, Inflow Depth > 1.81" for 1-Year event
Inflow = 1.44 cfs @ 12.13 hrs, Volume= 0.092 af
Primary = 1.44 cfs @ 12.13 hrs, Volume= 0.092 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 11L: POI 11

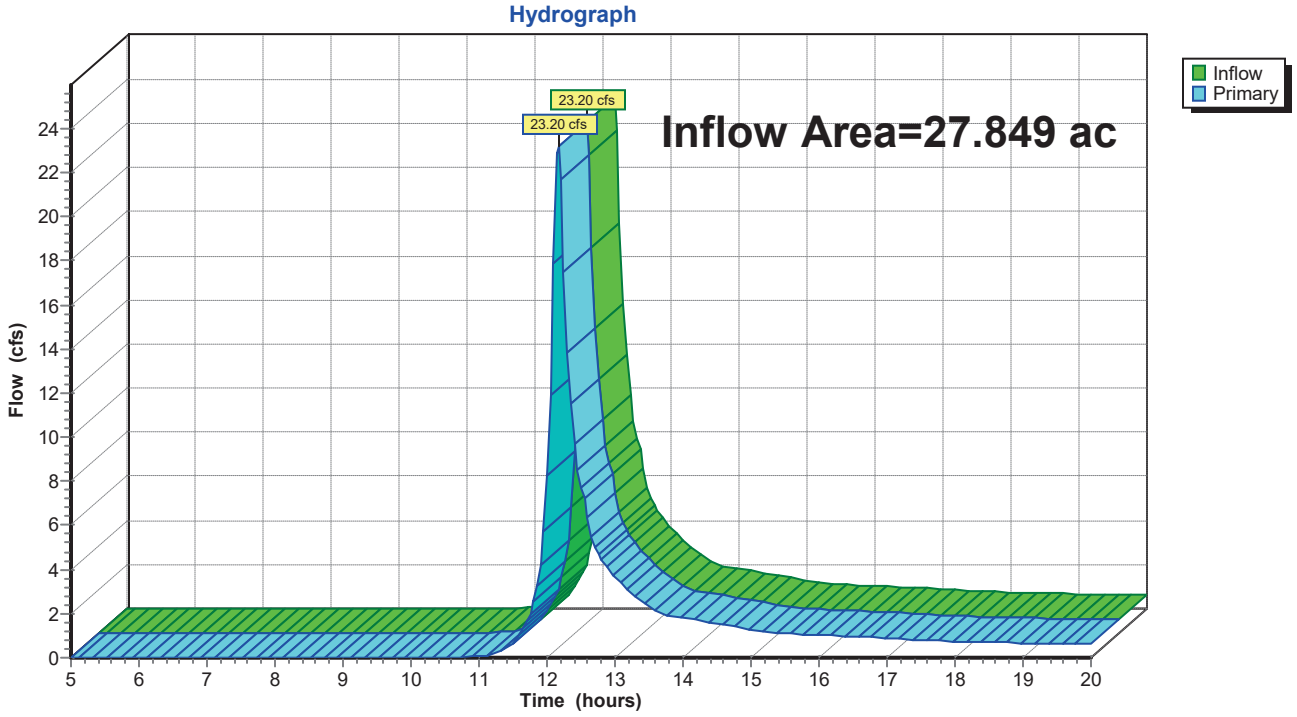


Summary for Link OUT-A: Outfall A

Inflow Area = 27.849 ac, 39.82% Impervious, Inflow Depth > 0.69" for 1-Year event
Inflow = 23.20 cfs @ 12.17 hrs, Volume= 1.610 af
Primary = 23.20 cfs @ 12.17 hrs, Volume= 1.610 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 1R : Channel A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-A: Outfall A

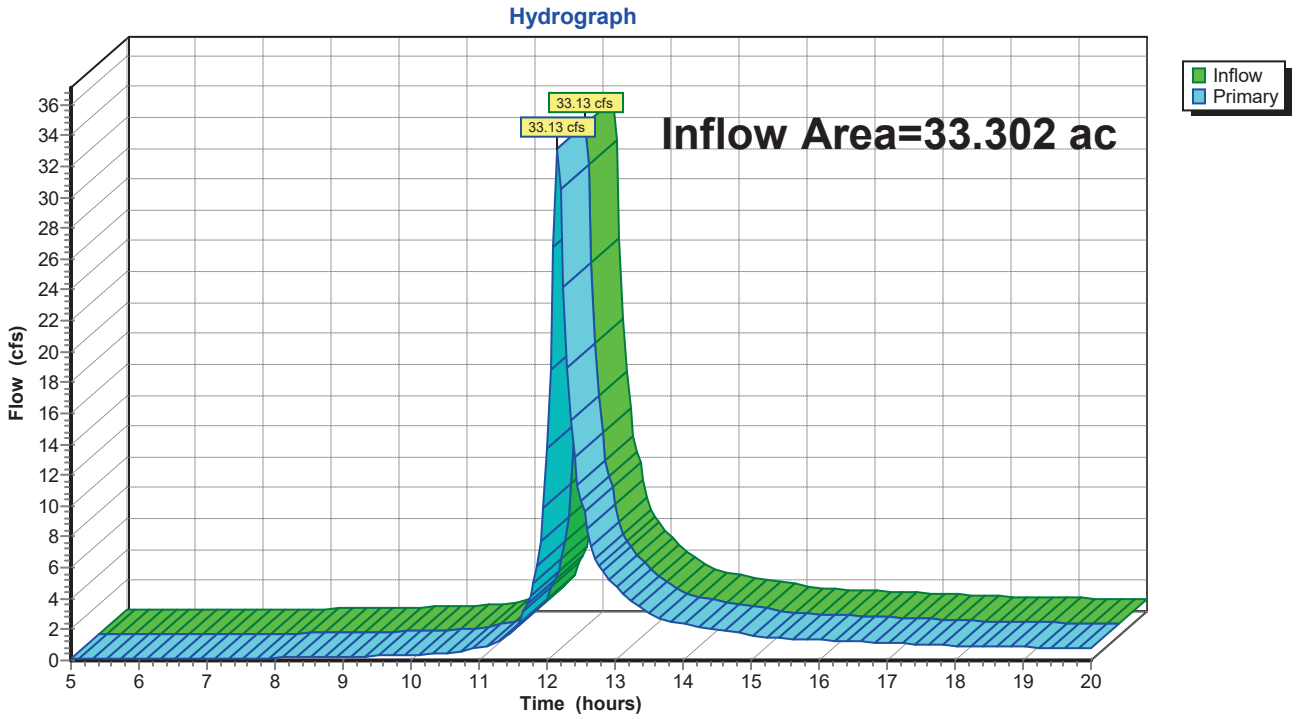


Summary for Link OUT-B: OUTBALL B

Inflow Area = 33.302 ac, 45.53% Impervious, Inflow Depth > 0.86" for 1-Year event
Inflow = 33.13 cfs @ 12.16 hrs, Volume= 2.385 af
Primary = 33.13 cfs @ 12.16 hrs, Volume= 2.385 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-B: OUTBALL B



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Muskingum-Cunge method - Pond routing by Stor-Ind method

Subcatchment 1: DA-1 Runoff Area=62,414 sf 40.34% Impervious Runoff Depth>2.15"
Flow Length=383' Tc=7.3 min CN=76 Runoff=4.15 cfs 0.257 af

Subcatchment 3A: DA-3A Runoff Area=226,077 sf 46.92% Impervious Runoff Depth>2.49"
Flow Length=1,510' Tc=6.0 min CN=80 Runoff=17.77 cfs 1.076 af

Subcatchment 3B: DA-3B Runoff Area=924,625 sf 38.06% Impervious Runoff Depth>2.15"
Flow Length=1,690' Tc=9.8 min CN=76 Runoff=55.58 cfs 3.807 af

Subcatchment 5: DA-5 Runoff Area=45,261 sf 95.98% Impervious Runoff Depth>4.08"
Flow Length=583' Tc=6.0 min CN=97 Runoff=5.08 cfs 0.353 af

Subcatchment 6: DA-6 Runoff Area=85,224 sf 91.31% Impervious Runoff Depth>4.00"
Flow Length=703' Tc=6.0 min CN=96 Runoff=9.47 cfs 0.652 af

Subcatchment 8: DA-8 Runoff Area=47,939 sf 96.35% Impervious Runoff Depth>4.08"
Flow Length=503' Tc=6.0 min CN=97 Runoff=5.38 cfs 0.374 af

Subcatchment 10: DA-10 Runoff Area=9,093 sf 99.75% Impervious Runoff Depth>4.16"
Flow Length=321' Tc=6.0 min CN=98 Runoff=1.03 cfs 0.072 af

Subcatchment 11: DA-11 Runoff Area=26,663 sf 75.85% Impervious Runoff Depth>3.81"
Flow Length=1,351' Tc=6.0 min CN=94 Runoff=2.89 cfs 0.194 af

Subcatchment 12: DA-12 Runoff Area=6,182 sf 9.51% Impervious Runoff Depth>2.66"
Flow Length=377' Tc=6.0 min CN=82 Runoff=0.52 cfs 0.032 af

Subcatchment 13: DA-13 Runoff Area=43,805 sf 0.70% Impervious Runoff Depth>1.55"
Tc=6.0 min CN=68 Runoff=2.18 cfs 0.130 af

Reach 1R: Channel A Avg. Flow Depth=1.36' Max Vel=13.08 fps Inflow=75.93 cfs 5.140 af
n=0.017 L=500.0' S=0.0120 '/' Capacity=105.42 cfs Outflow=75.33 cfs 5.139 af

Link 1L: POI 1 Inflow=4.15 cfs 0.257 af
Primary=4.15 cfs 0.257 af

Link 3L: POI 3 Inflow=71.83 cfs 4.883 af
Primary=71.83 cfs 4.883 af

Link 5L: POI 5 Inflow=5.08 cfs 0.353 af
Primary=5.08 cfs 0.353 af

Link 6L: POI 6 Inflow=23.64 cfs 1.613 af
Primary=23.64 cfs 1.613 af

Link 8L: POI 8 Inflow=5.38 cfs 0.374 af
Primary=5.38 cfs 0.374 af

Link 10L: POI 10 Inflow=1.03 cfs 0.072 af
Primary=1.03 cfs 0.072 af

Link 11L: POI 11 Inflow=2.89 cfs 0.194 af
Primary=2.89 cfs 0.194 af

Link OUT-A: Outfall A Inflow=75.93 cfs 5.140 af
Primary=75.93 cfs 5.140 af

Link OUT-B: OUTBALL B Inflow=96.87 cfs 6.752 af
Primary=96.87 cfs 6.752 af

Total Runoff Area = 33.914 ac Runoff Volume = 6.948 af Average Runoff Depth = 2.46"
53.92% Pervious = 18.286 ac 46.08% Impervious = 15.628 ac

Summary for Subcatchment 1: DA-1

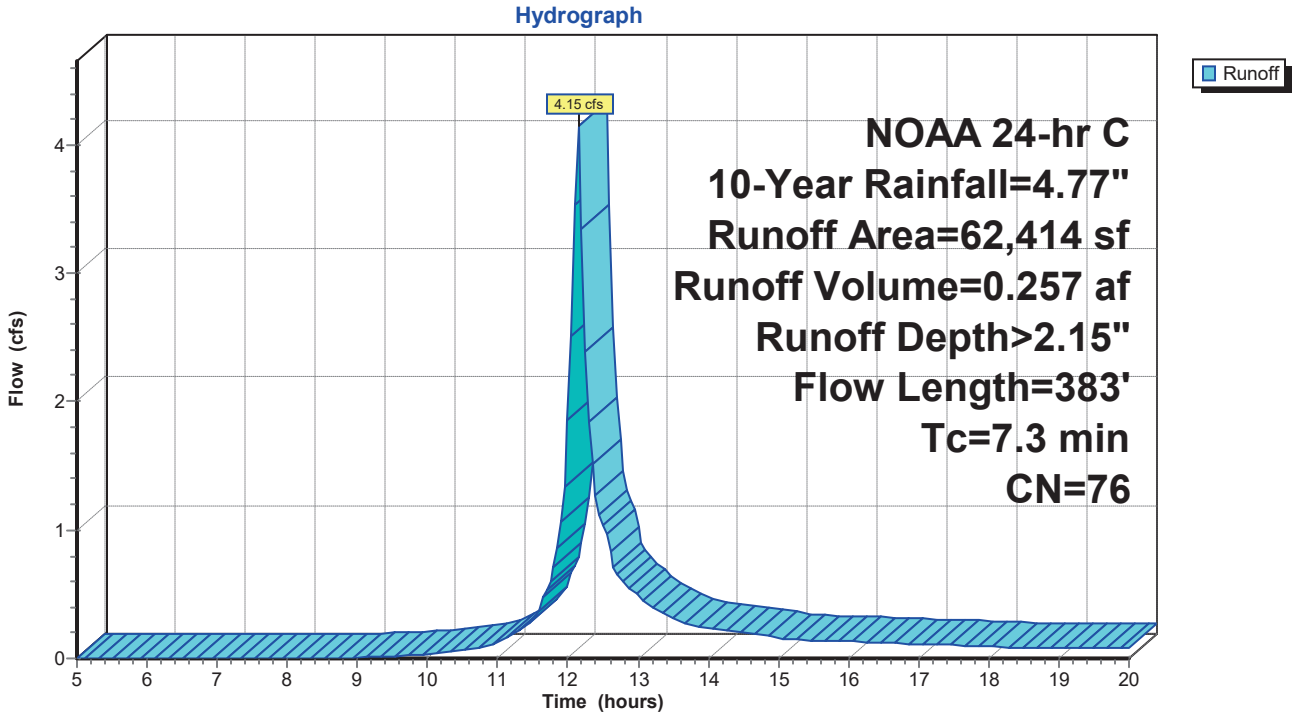
Runoff = 4.15 cfs @ 12.15 hrs, Volume= 0.257 af, Depth> 2.15"
Routed to Link 1L : POI 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
25,177	98	Paved parking, HSG A
34,812	61	>75% Grass cover, Good, HSG B
2,425	74	>75% Grass cover, Good, HSG C
62,414	76	Weighted Average
37,237		59.66% Pervious Area
25,177		40.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	75	0.0350	0.20		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.3	71	0.0460	4.35		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	171	0.0760	5.60		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.2	66	0.0610	5.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
7.3	383	Total			

Subcatchment 1: DA-1



Summary for Subcatchment 3A: DA-3A

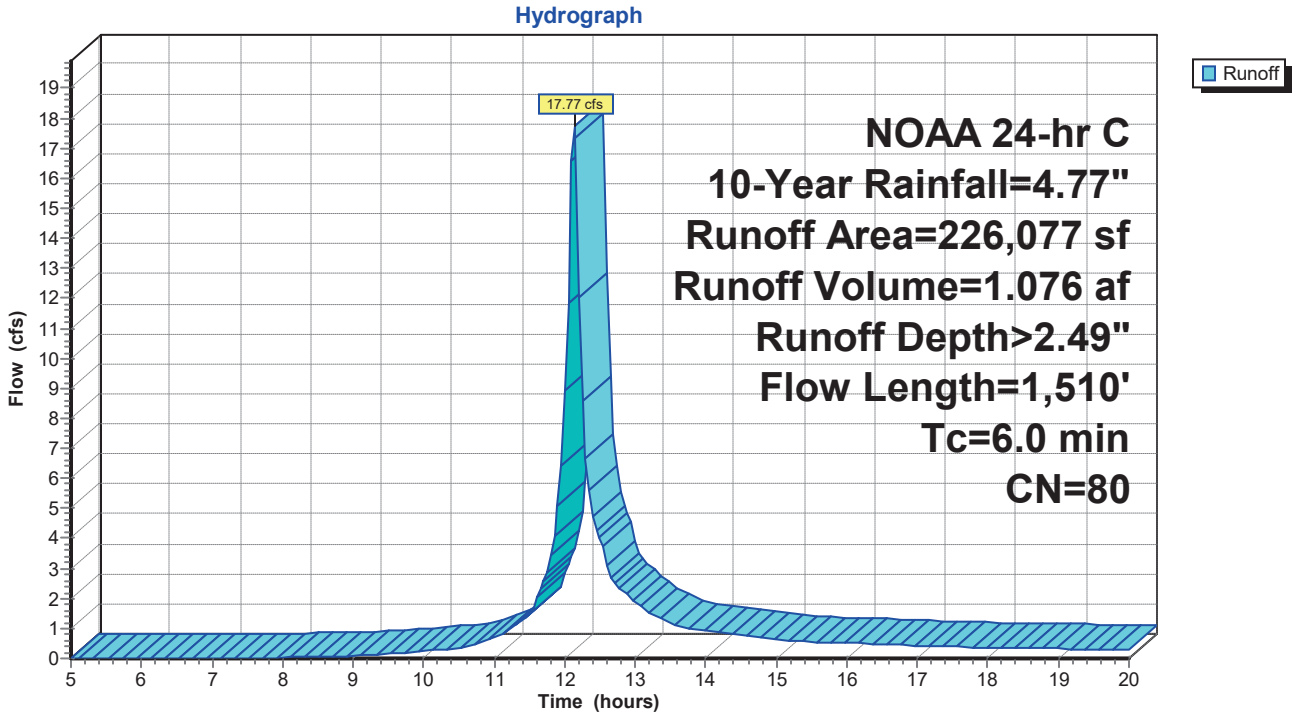
Runoff = 17.77 cfs @ 12.13 hrs, Volume= 1.076 af, Depth> 2.49"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
106,069	98	Paved parking, HSG A
86,815	61	>75% Grass cover, Good, HSG B
33,193	74	>75% Grass cover, Good, HSG C
226,077	80	Weighted Average
120,008		53.08% Pervious Area
106,069		46.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	22	0.0227	1.05		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	428	0.0771	5.64		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.9	263	0.0532	4.68		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.0	186	0.0220	3.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	425	0.0185	14.22	136.84	**Pipe Channel, E-F** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.2	186	0.1070	16.72	118.18	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
4.2	1,510	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3A: DA-3A



Summary for Subcatchment 3B: DA-3B

[47] Hint: Peak is 1028% of capacity of segment #5
[47] Hint: Peak is 354% of capacity of segment #6
[47] Hint: Peak is 259% of capacity of segment #7
[47] Hint: Peak is 281% of capacity of segment #8
[47] Hint: Peak is 199% of capacity of segment #9

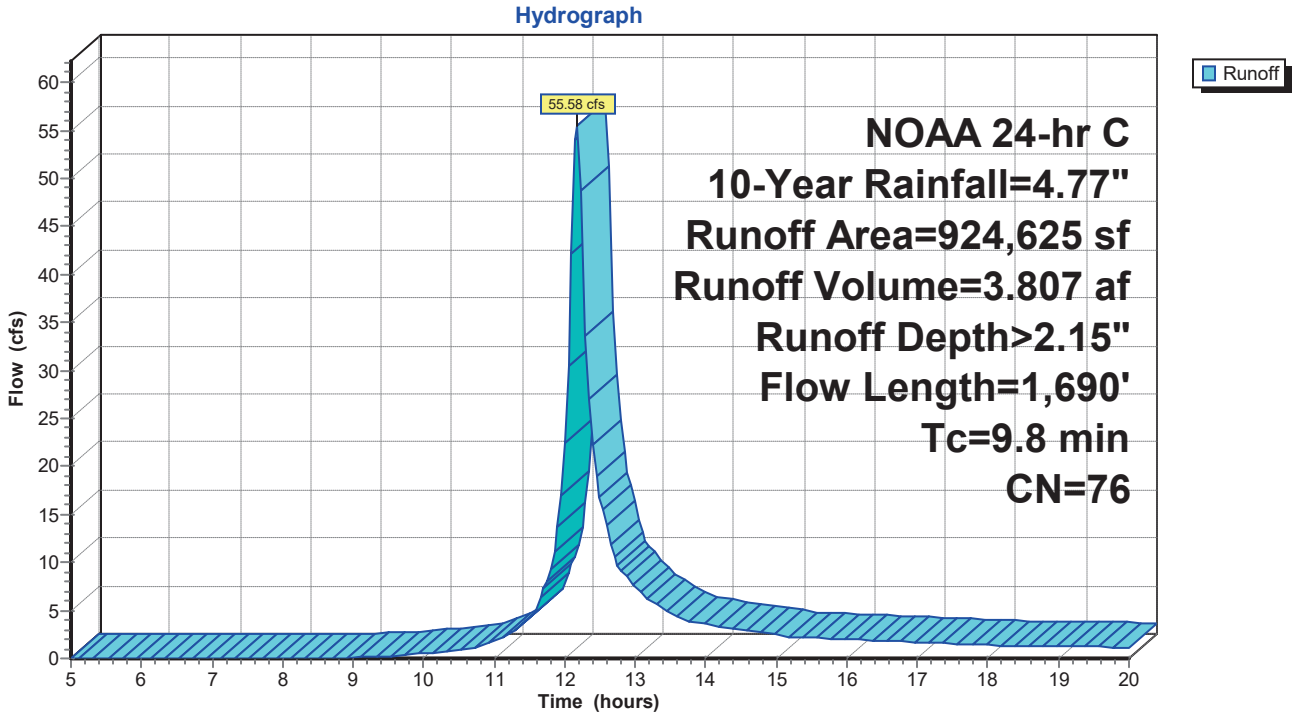
Runoff = 55.58 cfs @ 12.17 hrs, Volume= 3.807 af, Depth> 2.15"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
351,876	98	Paved parking, HSG A
536,743	61	>75% Grass cover, Good, HSG B
36,006	74	>75% Grass cover, Good, HSG C
924,625	76	Weighted Average
572,749		61.94% Pervious Area
351,876		38.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0620	0.24		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.4	108	0.1020	5.14		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.5	99	0.0400	3.22		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	54	0.0190	2.80		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	144	0.0070	4.40	5.40	**Pipe Channel, E-F** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.6	443	0.0590	12.79	15.69	**Pipe Channel, F-G** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.3	106	0.0090	6.83	21.46	**Pipe Channel, G-H** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
1.8	309	0.0030	2.80	19.79	**Pipe Channel, H-I** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.7	176	0.0060	3.96	27.98	**Pipe Channel, I-J** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.2	186	0.1070	16.72	118.18	**Pipe Channel, J-K** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
9.8	1,690	Total			

Subcatchment 3B: DA-3B



Summary for Subcatchment 5: DA-5

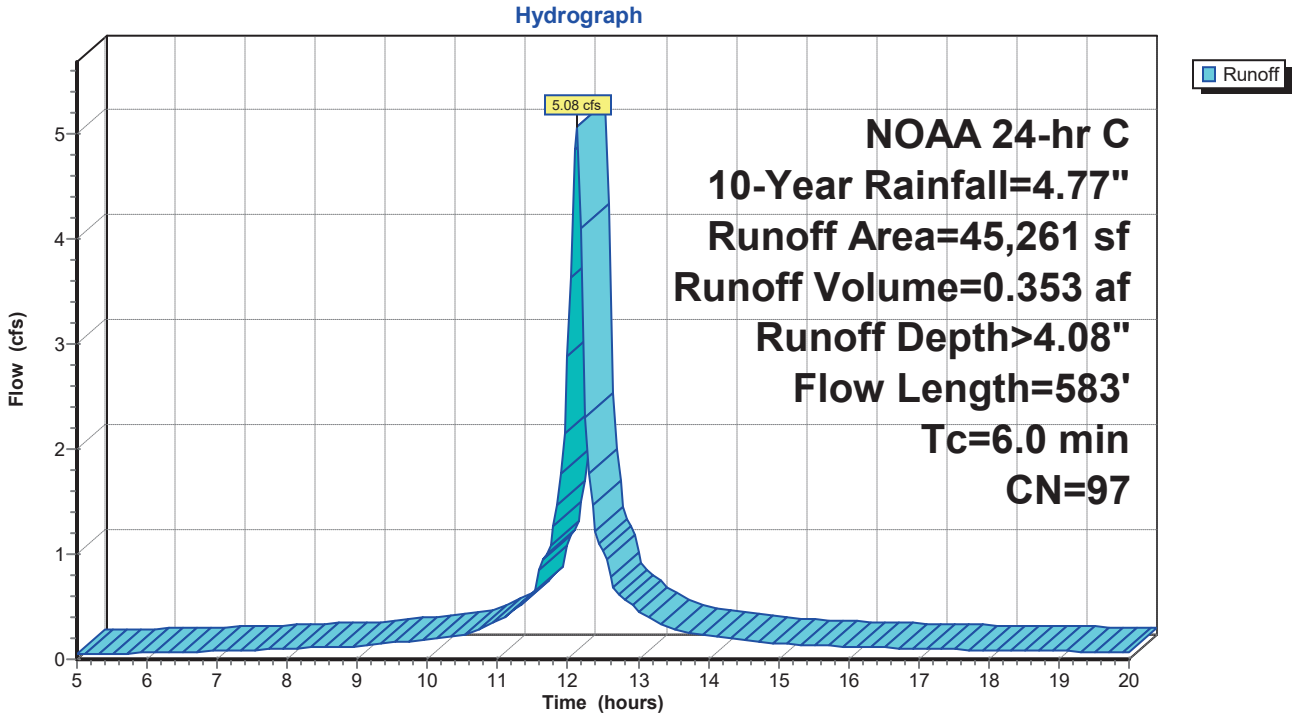
Runoff = 5.08 cfs @ 12.13 hrs, Volume= 0.353 af, Depth> 4.08"
Routed to Link 5L : POI 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
43,440	98	Paved parking, HSG A
23	61	>75% Grass cover, Good, HSG B
1,798	80	>75% Grass cover, Good, HSG D
45,261	97	Weighted Average
1,821		4.02% Pervious Area
43,440		95.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	51	0.0200	1.18		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.9	476	0.0441	4.26		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.1	56	0.0200	10.18	31.99	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
2.7	583	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5: DA-5



Summary for Subcatchment 6: DA-6

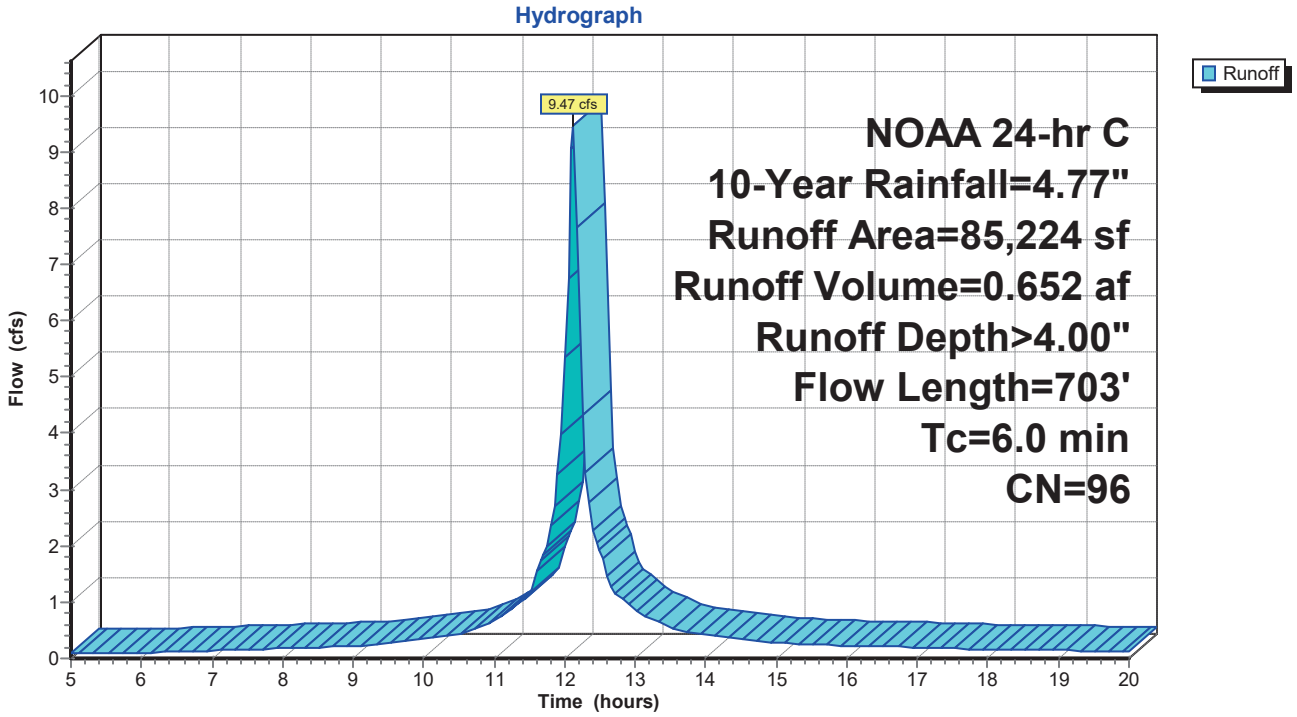
Runoff = 9.47 cfs @ 12.13 hrs, Volume= 0.652 af, Depth> 4.00"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
77,819	98	Paved parking, HSG A
165	61	>75% Grass cover, Good, HSG B
7,240	80	>75% Grass cover, Good, HSG D
85,224	96	Weighted Average
7,405		8.69% Pervious Area
77,819		91.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	93	0.0540	1.99		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	321	0.0311	3.58		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.4	155	0.0050	6.02	18.90	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	134	0.0430	32.51	638.26	**Pipe Channel, D-E** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.011 Concrete pipe, straight & clean
2.8	703	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 6: DA-6



Summary for Subcatchment 8: DA-8

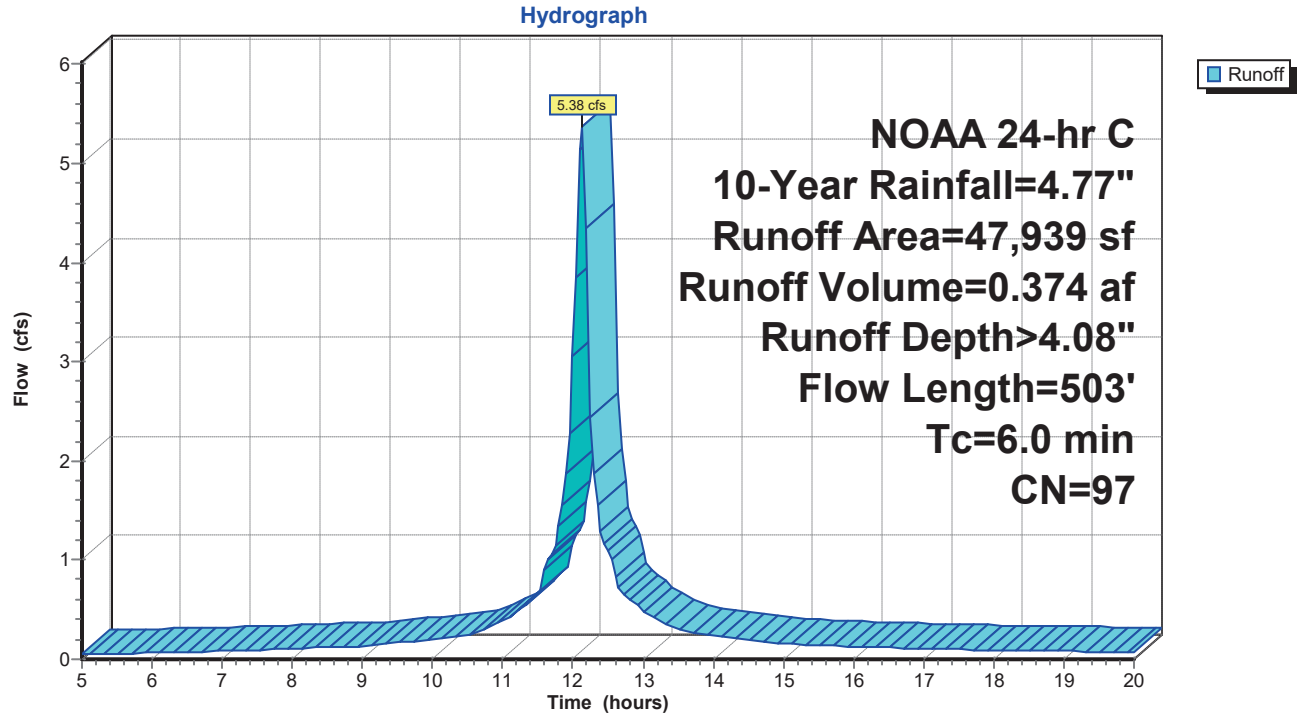
Runoff = 5.38 cfs @ 12.13 hrs, Volume= 0.374 af, Depth> 4.08"
Routed to Link 8L : POI 8

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
46,190	98	Paved parking, HSG A
1,120	61	>75% Grass cover, Good, HSG B
629	80	>75% Grass cover, Good, HSG D
47,939	97	Weighted Average
1,749		3.65% Pervious Area
46,190		96.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	303	0.0396	4.04		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.2	100	0.0139	8.49	26.67	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
2.7	503	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 8: DA-8



Summary for Subcatchment 10: DA-10

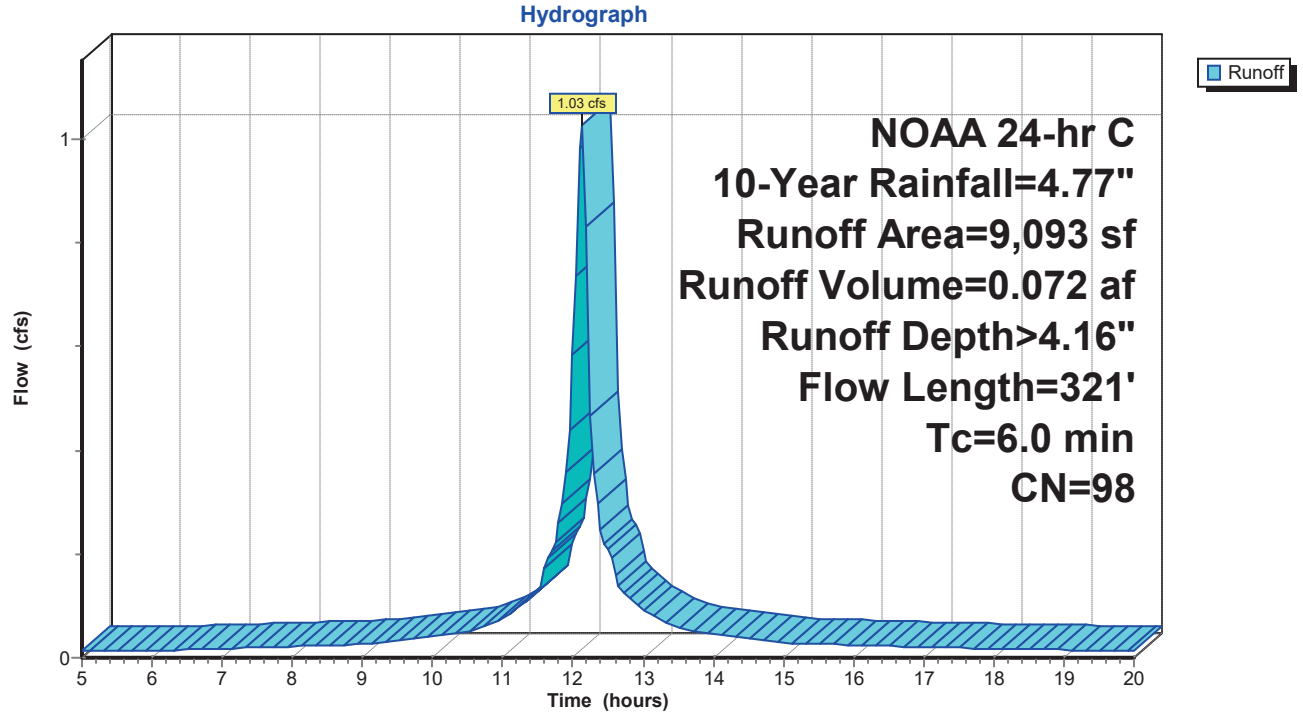
Runoff = 1.03 cfs @ 12.13 hrs, Volume= 0.072 af, Depth> 4.16"
Routed to Link 10L : POI 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
9,070	98	Paved parking, HSG A
23	80	>75% Grass cover, Good, HSG D
9,093	98	Weighted Average
23		0.25% Pervious Area
9,070		99.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	43	0.0470	1.61		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.0	254	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	24	0.4170	25.19	79.13	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.024
1.4	321	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 10: DA-10



Summary for Subcatchment 11: DA-11

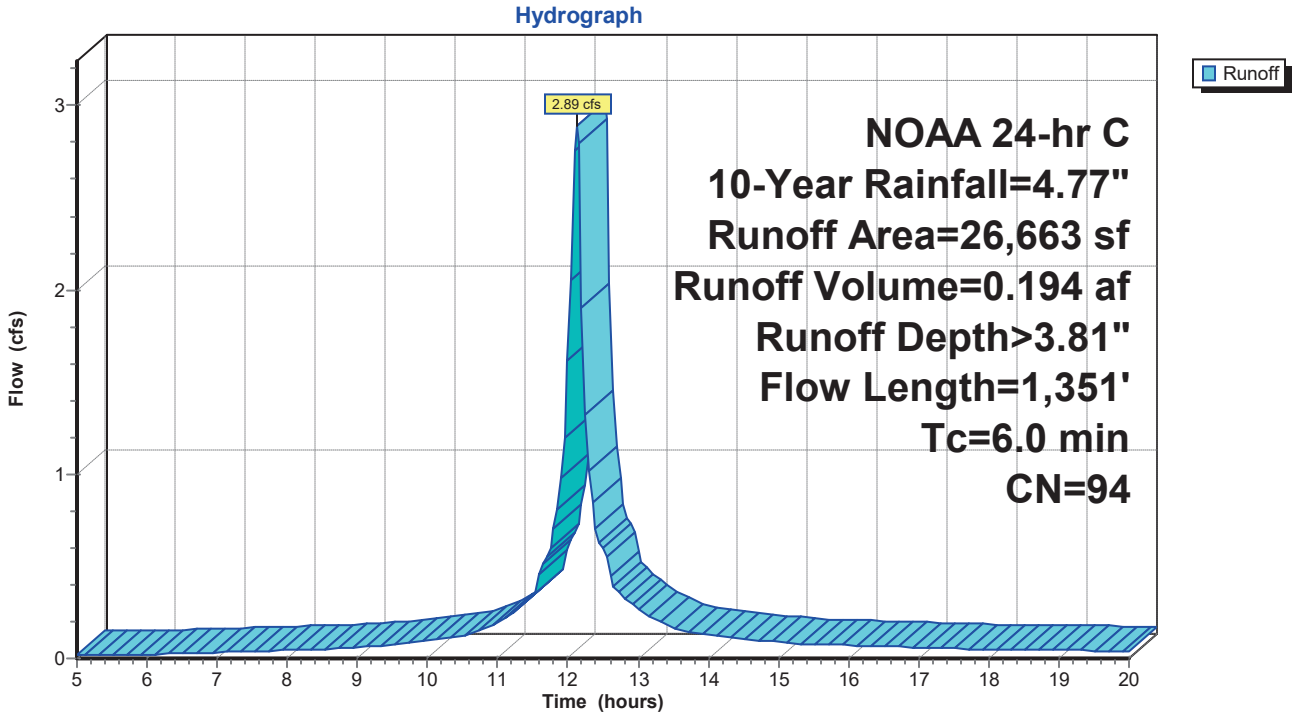
Runoff = 2.89 cfs @ 12.13 hrs, Volume= 0.194 af, Depth> 3.81"
Routed to Link 11L : POI 11

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
20,223	98	Paved parking, HSG A
6,440	80	>75% Grass cover, Good, HSG D
26,663	94	Weighted Average
6,440		24.15% Pervious Area
20,223		75.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	81	0.0340	1.60		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.9	493	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.1	48	0.0108	6.18	10.92	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
0.8	603	0.0311	12.70	39.90	**Pipe Channel, D-E** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
0.1	126	0.0963	29.28	206.98	**Pipe Channel, E-F** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Concrete pipe, bends & connections
3.7	1,351	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 11: DA-11



Summary for Subcatchment 12: DA-12

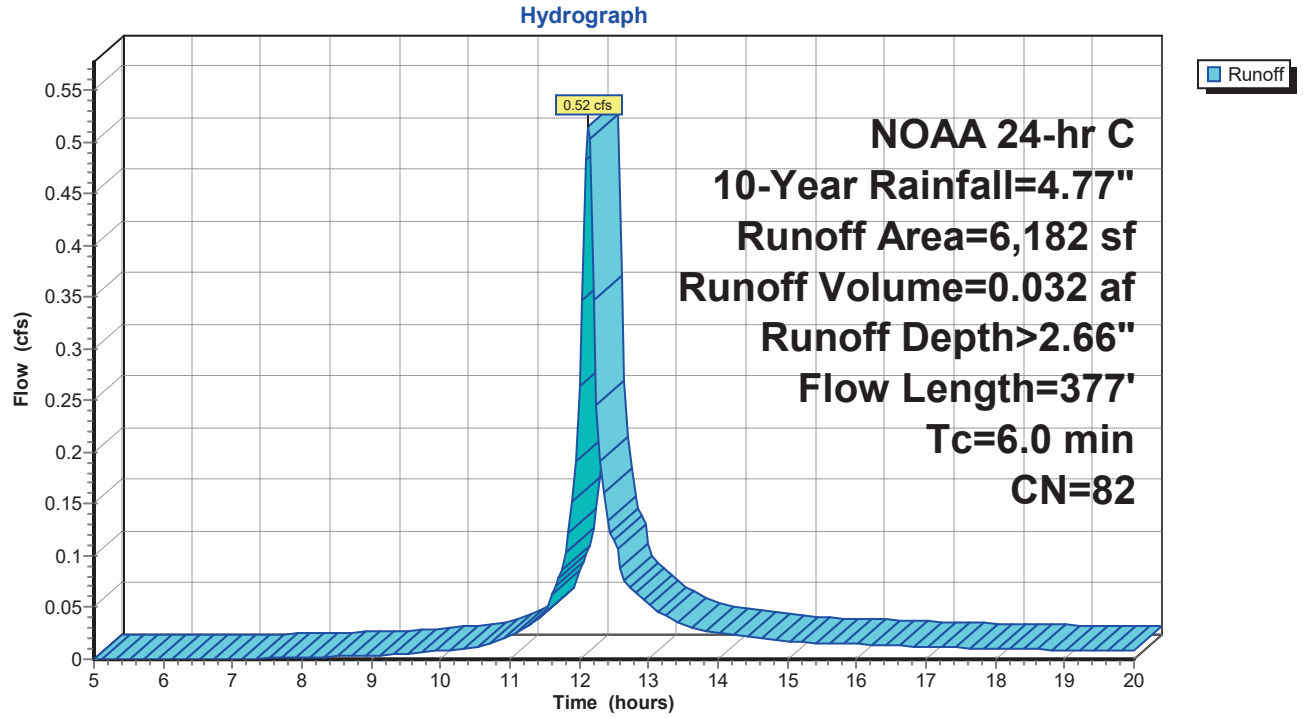
Runoff = 0.52 cfs @ 12.13 hrs, Volume= 0.032 af, Depth> 2.66"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
588	98	Paved parking, HSG A
5,594	80	>75% Grass cover, Good, HSG D
6,182	82	Weighted Average
5,594		90.49% Pervious Area
588		9.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.03		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.7	156	0.0060	1.57		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	21	0.2860	10.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.3	100	0.0600	4.97		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
3.6	377	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 12: DA-12



Summary for Subcatchment 13: DA-13

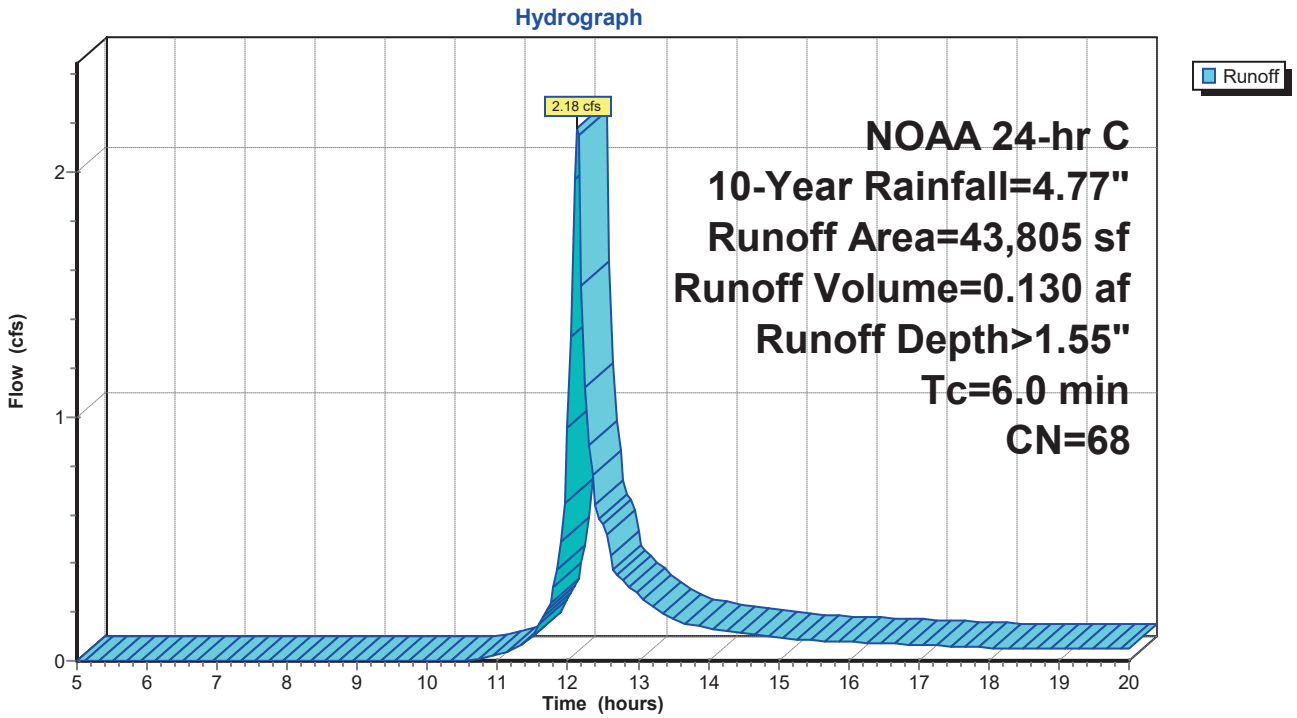
Runoff = 2.18 cfs @ 12.14 hrs, Volume= 0.130 af, Depth> 1.55"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
308	98	Paved parking, HSG A
27,660	61	>75% Grass cover, Good, HSG B
15,837	80	>75% Grass cover, Good, HSG D
43,805	68	Weighted Average
43,497		99.30% Pervious Area
308		0.70% Impervious Area

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

Subcatchment 13: DA-13



Summary for Reach 1R: Channel A

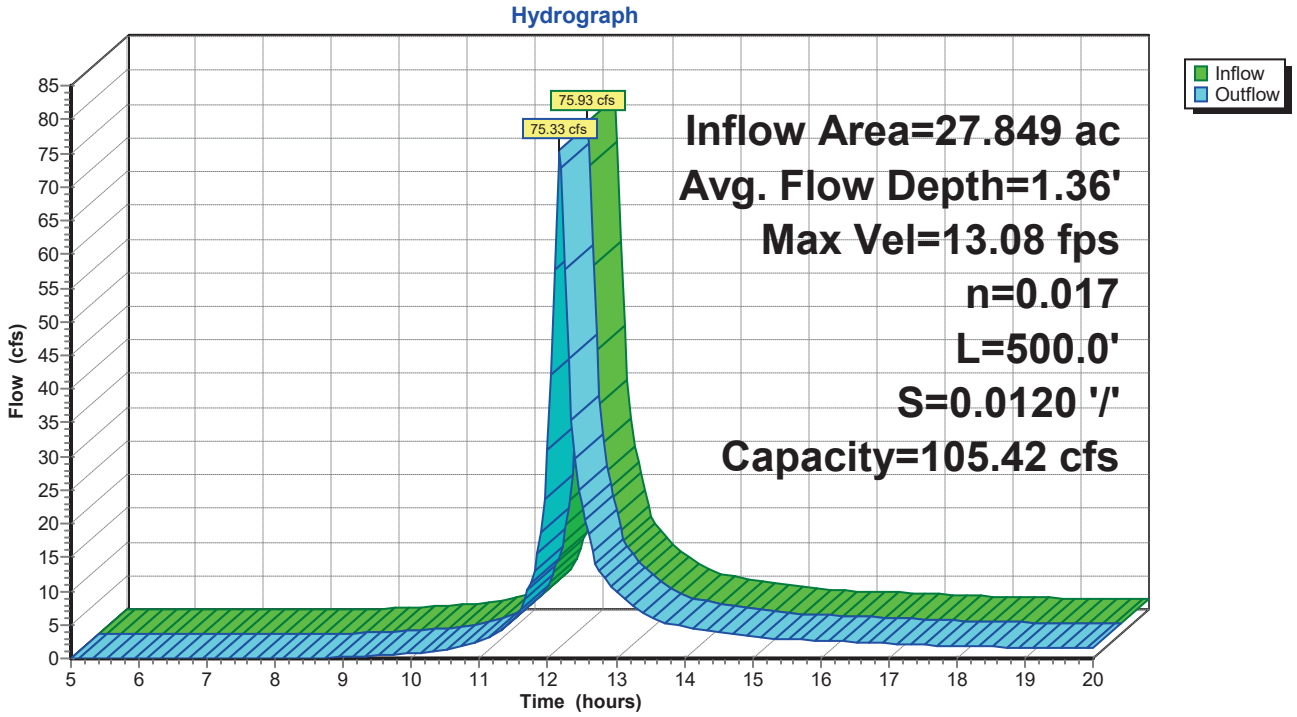
Inflow Area = 27.849 ac, 39.82% Impervious, Inflow Depth > 2.21" for 10-Year event
Inflow = 75.93 cfs @ 12.16 hrs, Volume= 5.140 af
Outflow = 75.33 cfs @ 12.17 hrs, Volume= 5.139 af, Atten= 1%, Lag= 0.8 min
Routed to Link OUT-B : OUTBALL B

Routing by Muskingum-Cunge method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Reference Flow= 56.95 cfs Estimated Depth= 1.44' Velocity= 8.94 fps
m= 1.430, c= 12.78 fps, dt= 3.0 min, dx= 500.0' / 1 = 500.0', K= 0.7 min, X= 0.416
Max. Velocity= 13.08 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 12.75 fps, Avg. Travel Time= 0.7 min

Peak Storage= 2,951 cf @ 12.17 hrs
Average Depth at Peak Storage= 1.36' , Surface Width= 5.71'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 105.42 cfs

3.00' x 2.00' deep channel, n= 0.017 Concrete, unfinished
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 500.0' Slope= 0.0120 '/'
Inlet Invert= 274.00', Outlet Invert= 268.00'

Reach 1R: Channel A

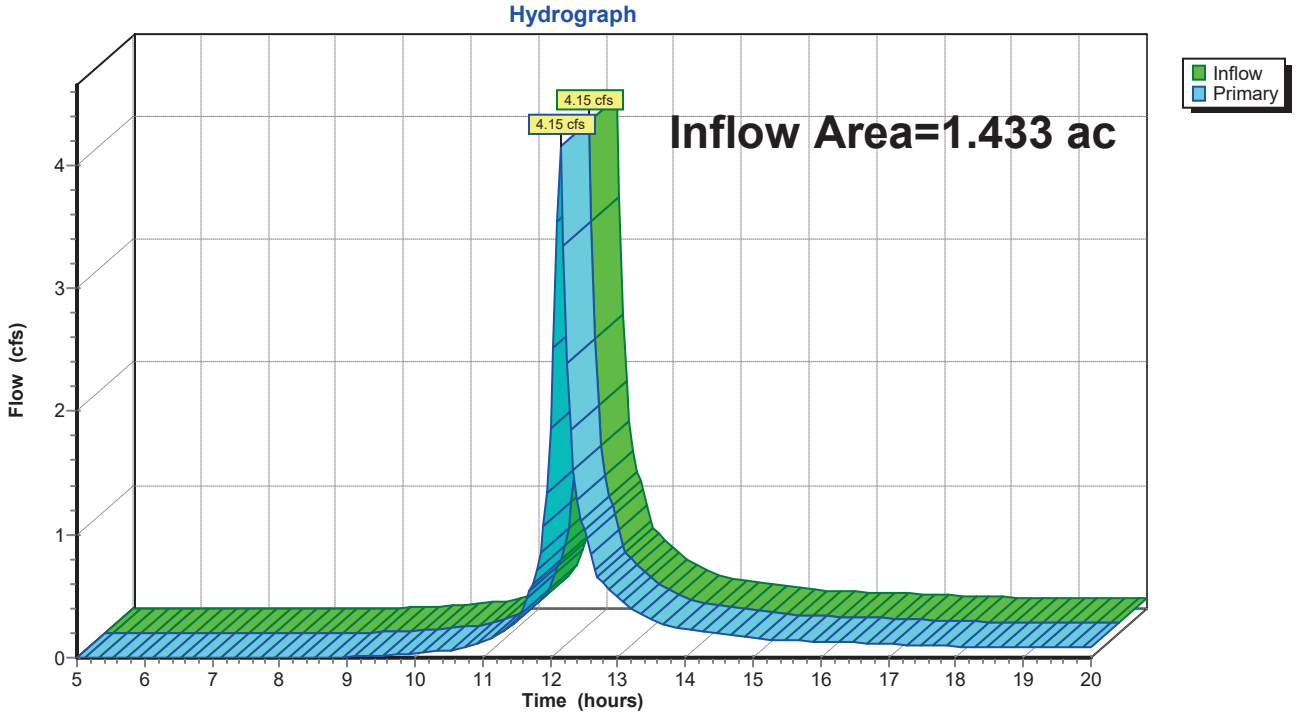


Summary for Link 1L: POI 1

Inflow Area = 1.433 ac, 40.34% Impervious, Inflow Depth > 2.15" for 10-Year event
Inflow = 4.15 cfs @ 12.15 hrs, Volume= 0.257 af
Primary = 4.15 cfs @ 12.15 hrs, Volume= 0.257 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

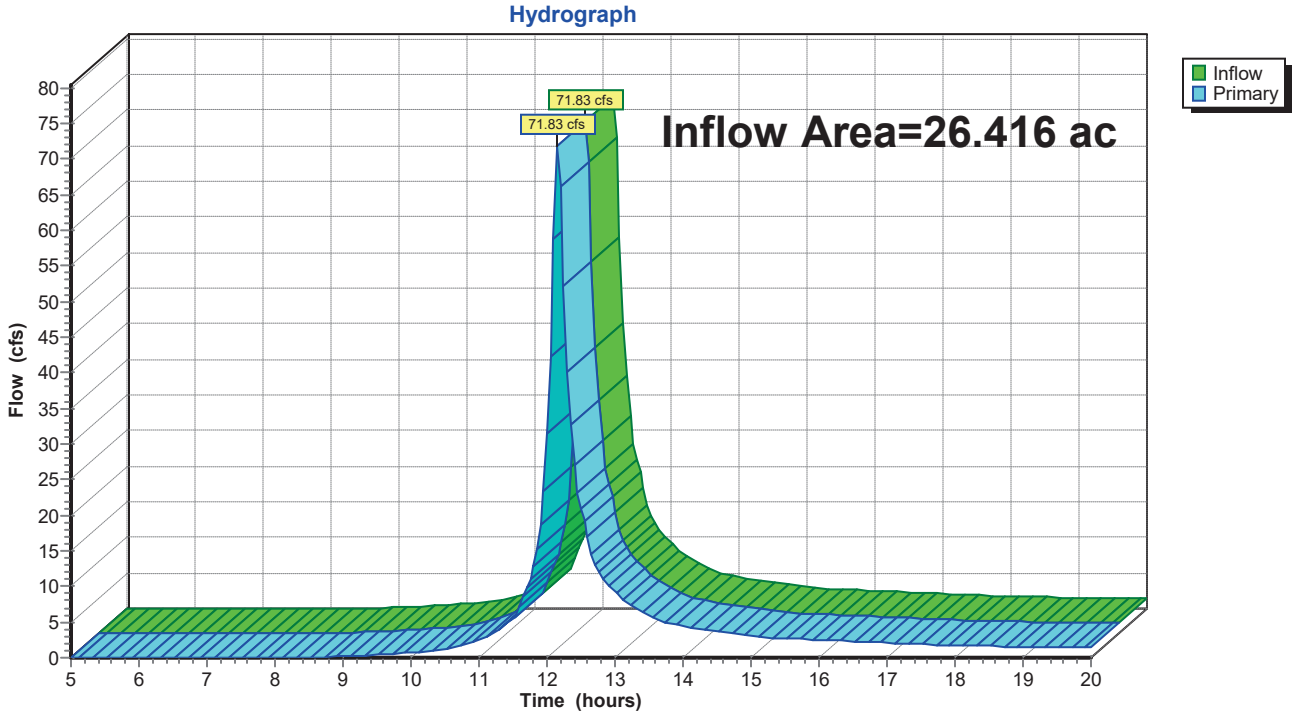


Summary for Link 3L: POI 3

Inflow Area = 26.416 ac, 39.80% Impervious, Inflow Depth > 2.22" for 10-Year event
Inflow = 71.83 cfs @ 12.16 hrs, Volume= 4.883 af
Primary = 71.83 cfs @ 12.16 hrs, Volume= 4.883 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: POI 3

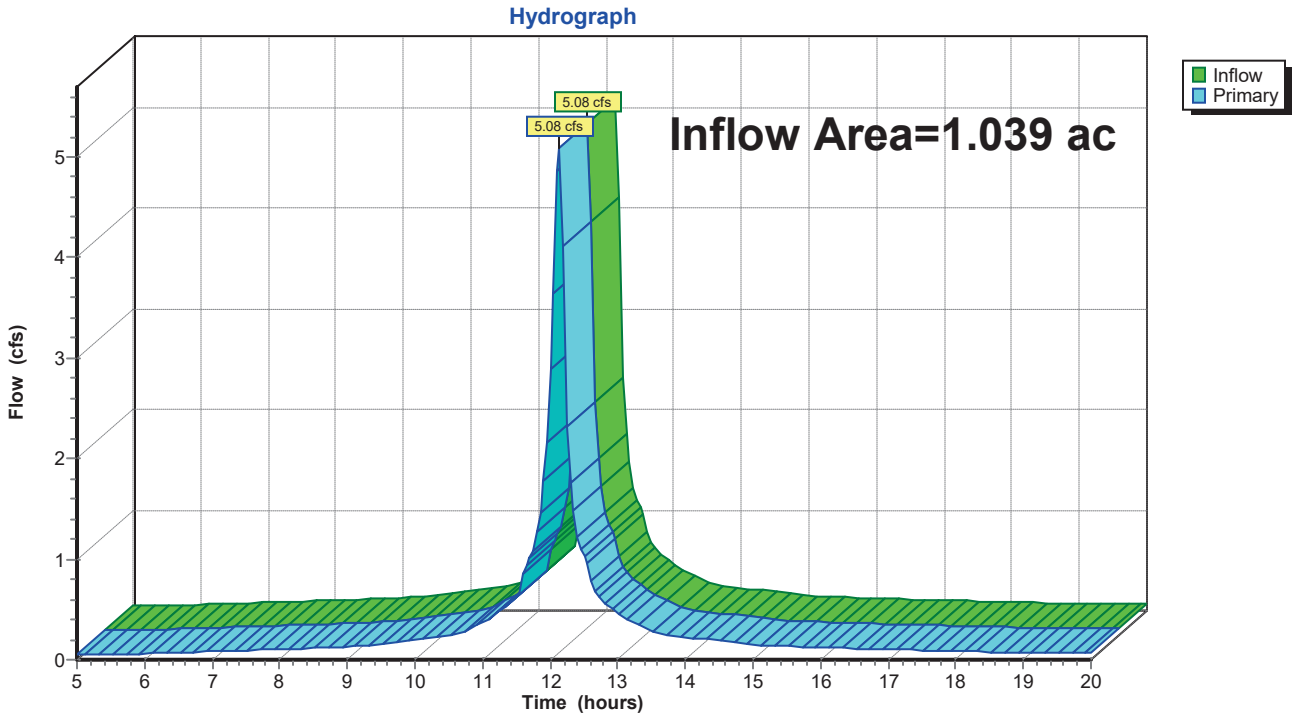


Summary for Link 5L: POI 5

Inflow Area = 1.039 ac, 95.98% Impervious, Inflow Depth > 4.08" for 10-Year event
Inflow = 5.08 cfs @ 12.13 hrs, Volume= 0.353 af
Primary = 5.08 cfs @ 12.13 hrs, Volume= 0.353 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: POI 5

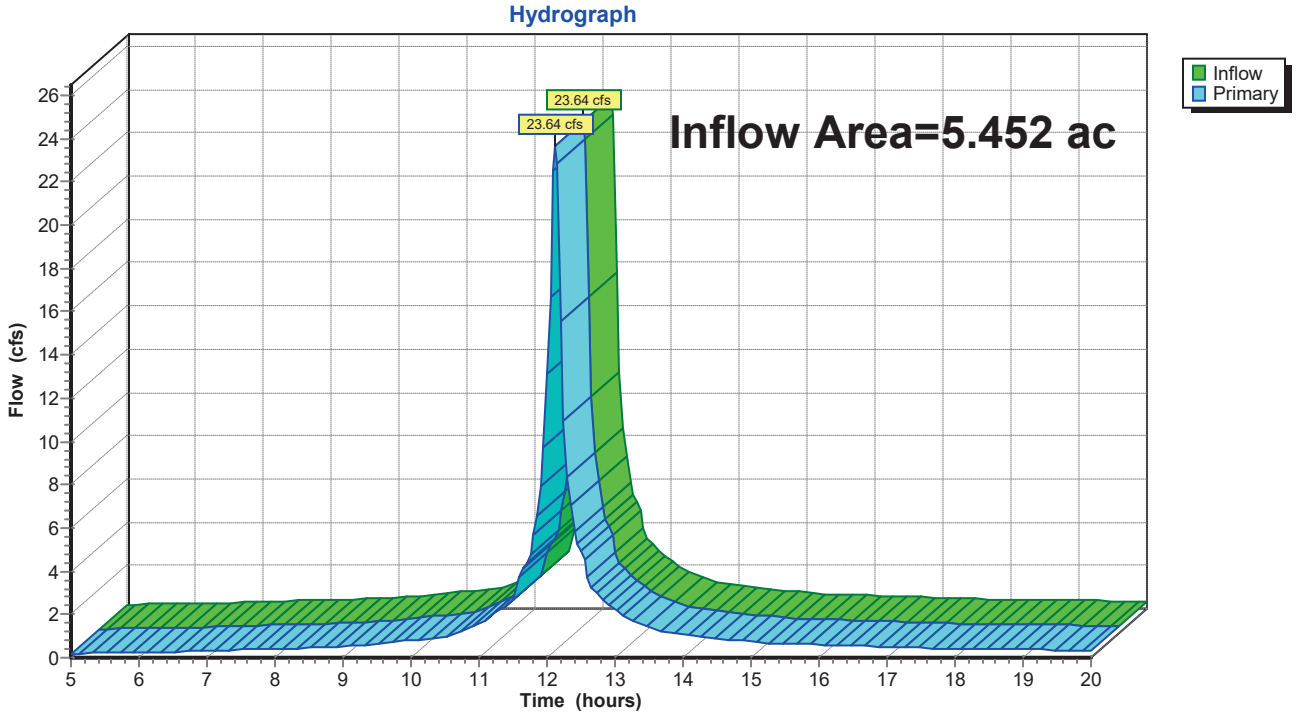


Summary for Link 6L: POI 6

Inflow Area = 5.452 ac, 74.70% Impervious, Inflow Depth > 3.55" for 10-Year event
Inflow = 23.64 cfs @ 12.13 hrs, Volume= 1.613 af
Primary = 23.64 cfs @ 12.13 hrs, Volume= 1.613 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-B : OUTBALL B

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 6L: POI 6

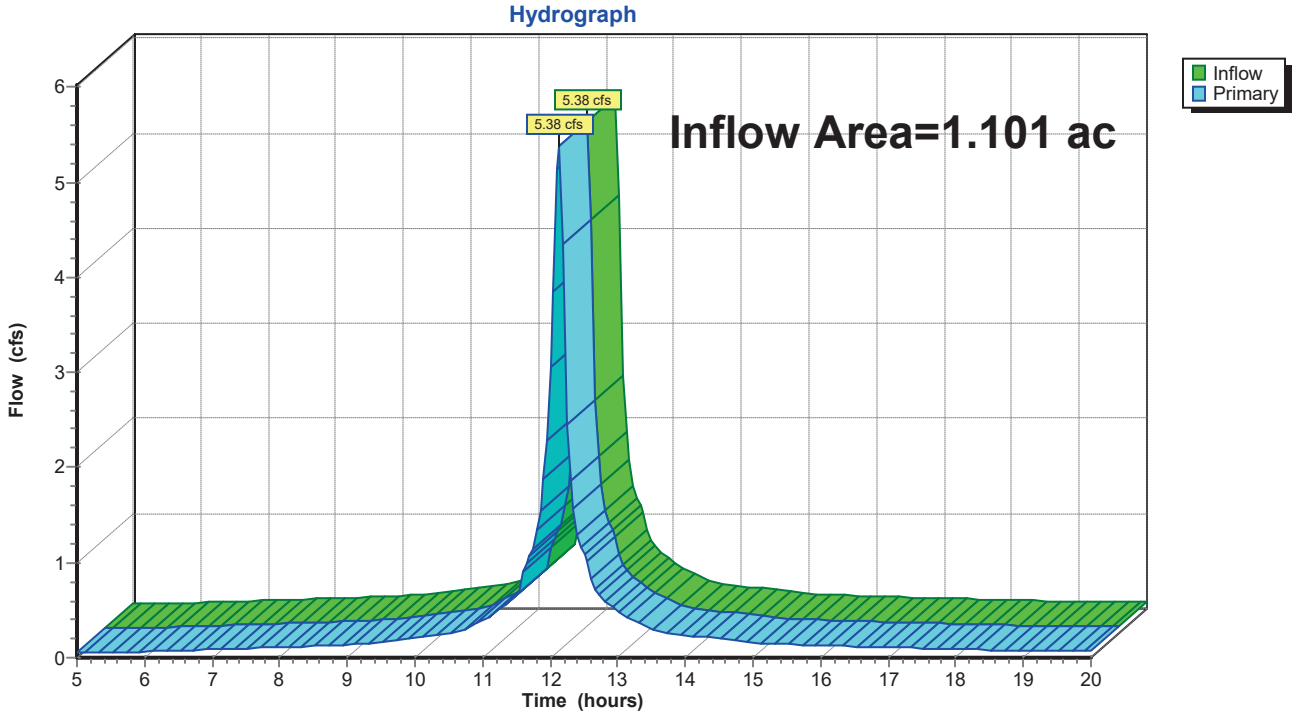


Summary for Link 8L: POI 8

Inflow Area = 1.101 ac, 96.35% Impervious, Inflow Depth > 4.08" for 10-Year event
Inflow = 5.38 cfs @ 12.13 hrs, Volume= 0.374 af
Primary = 5.38 cfs @ 12.13 hrs, Volume= 0.374 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 8L: POI 8

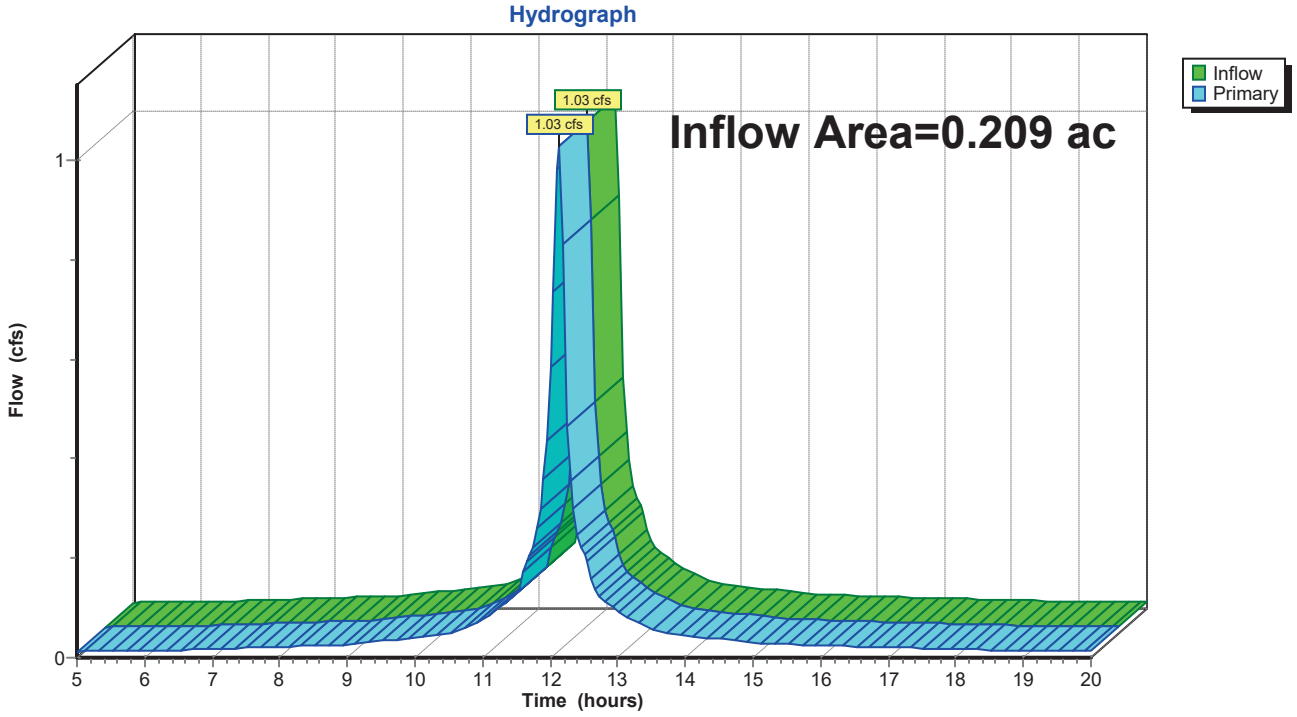


Summary for Link 10L: POI 10

Inflow Area = 0.209 ac, 99.75% Impervious, Inflow Depth > 4.16" for 10-Year event
Inflow = 1.03 cfs @ 12.13 hrs, Volume= 0.072 af
Primary = 1.03 cfs @ 12.13 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: POI 10

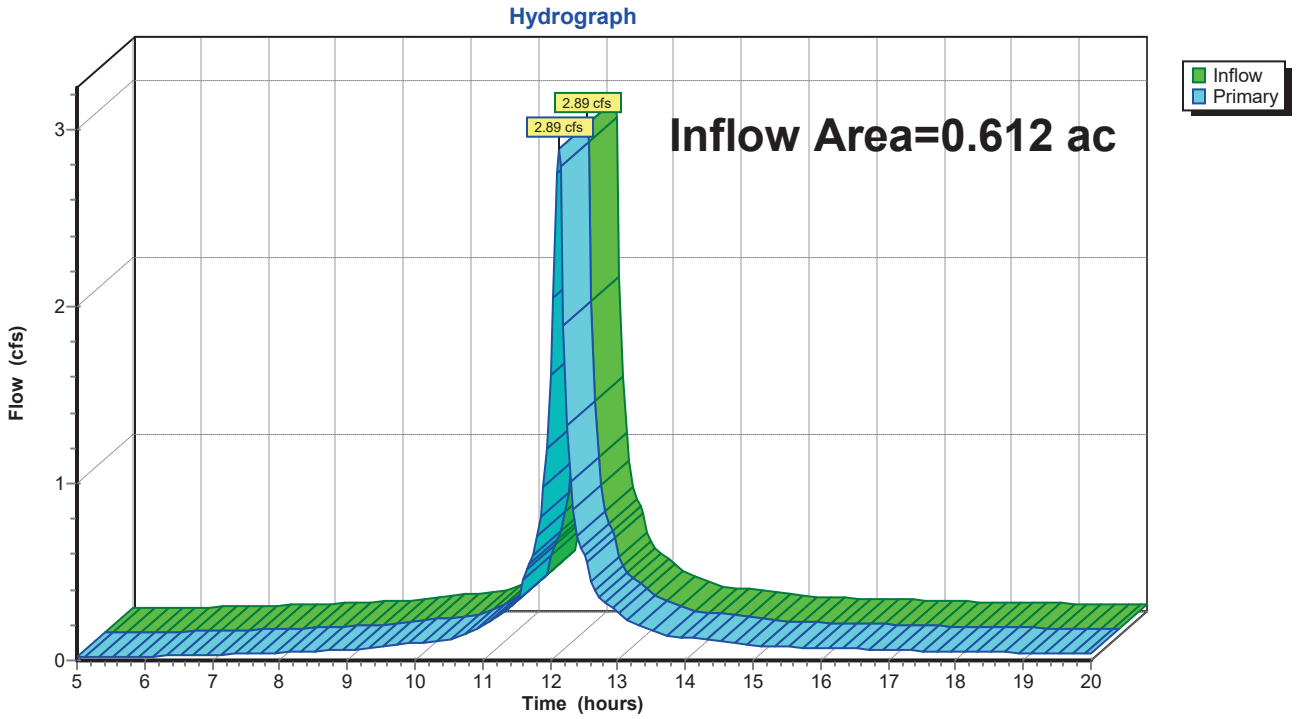


Summary for Link 11L: POI 11

Inflow Area = 0.612 ac, 75.85% Impervious, Inflow Depth > 3.81" for 10-Year event
Inflow = 2.89 cfs @ 12.13 hrs, Volume= 0.194 af
Primary = 2.89 cfs @ 12.13 hrs, Volume= 0.194 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 11L: POI 11

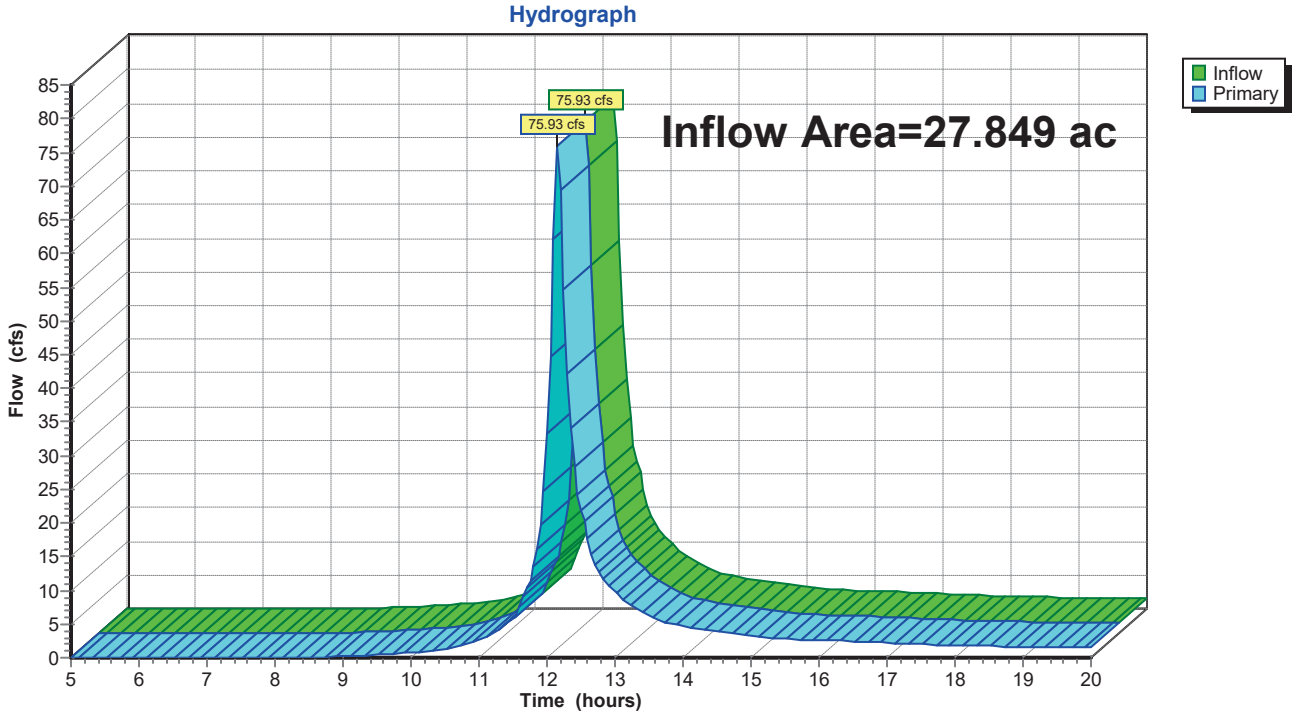


Summary for Link OUT-A: Outfall A

Inflow Area = 27.849 ac, 39.82% Impervious, Inflow Depth > 2.21" for 10-Year event
Inflow = 75.93 cfs @ 12.16 hrs, Volume= 5.140 af
Primary = 75.93 cfs @ 12.16 hrs, Volume= 5.140 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 1R : Channel A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-A: Outfall A

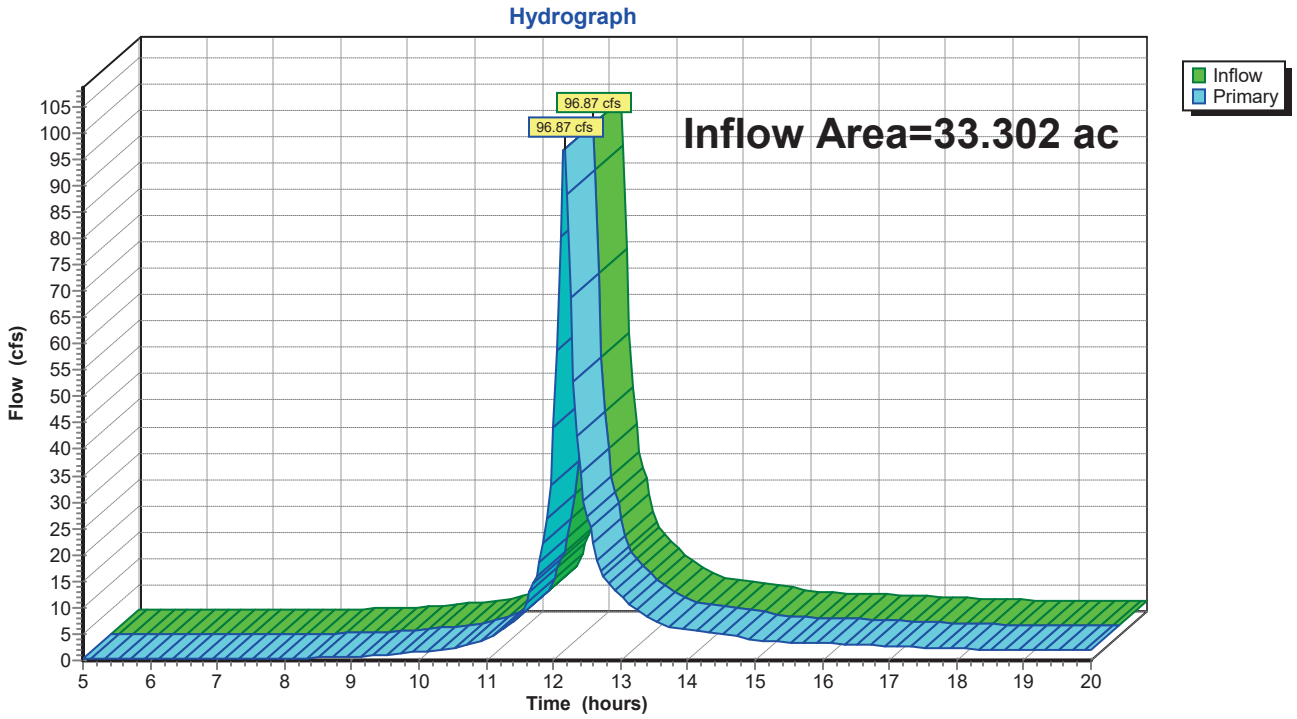


Summary for Link OUT-B: OUTBALL B

Inflow Area = 33.302 ac, 45.53% Impervious, Inflow Depth > 2.43" for 10-Year event
Inflow = 96.87 cfs @ 12.16 hrs, Volume= 6.752 af
Primary = 96.87 cfs @ 12.16 hrs, Volume= 6.752 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-B: OUTBALL B



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Muskingum-Cunge method - Pond routing by Stor-Ind method

Subcatchment 1: DA-1 Runoff Area=62,414 sf 40.34% Impervious Runoff Depth>4.99"
Flow Length=383' Tc=7.3 min CN=76 Runoff=9.32 cfs 0.596 af

Subcatchment 3A: DA-3A Runoff Area=226,077 sf 46.92% Impervious Runoff Depth>5.46"
Flow Length=1,510' Tc=6.0 min CN=80 Runoff=37.36 cfs 2.360 af

Subcatchment 3B: DA-3B Runoff Area=924,625 sf 38.06% Impervious Runoff Depth>4.99"
Flow Length=1,690' Tc=9.8 min CN=76 Runoff=125.45 cfs 8.822 af

Subcatchment 5: DA-5 Runoff Area=45,261 sf 95.98% Impervious Runoff Depth>7.20"
Flow Length=583' Tc=6.0 min CN=97 Runoff=8.83 cfs 0.623 af

Subcatchment 6: DA-6 Runoff Area=85,224 sf 91.31% Impervious Runoff Depth>7.13"
Flow Length=703' Tc=6.0 min CN=96 Runoff=16.58 cfs 1.162 af

Subcatchment 8: DA-8 Runoff Area=47,939 sf 96.35% Impervious Runoff Depth>7.20"
Flow Length=503' Tc=6.0 min CN=97 Runoff=9.36 cfs 0.660 af

Subcatchment 10: DA-10 Runoff Area=9,093 sf 99.75% Impervious Runoff Depth>7.25"
Flow Length=321' Tc=6.0 min CN=98 Runoff=1.78 cfs 0.126 af

Subcatchment 11: DA-11 Runoff Area=26,663 sf 75.85% Impervious Runoff Depth>6.96"
Flow Length=1,351' Tc=6.0 min CN=94 Runoff=5.14 cfs 0.355 af

Subcatchment 12: DA-12 Runoff Area=6,182 sf 9.51% Impervious Runoff Depth>5.69"
Flow Length=377' Tc=6.0 min CN=82 Runoff=1.05 cfs 0.067 af

Subcatchment 13: DA-13 Runoff Area=43,805 sf 0.70% Impervious Runoff Depth>4.08"
Tc=6.0 min CN=68 Runoff=5.68 cfs 0.342 af

Reach 1R: Channel A Avg. Flow Depth=2.20' Max Vel=15.05 fps Inflow=169.09 cfs 11.778 af
n=0.017 L=500.0' S=0.0120 '/' Capacity=105.42 cfs Outflow=167.94 cfs 11.776 af

Link 1L: POI 1 Inflow=9.32 cfs 0.596 af
Primary=9.32 cfs 0.596 af

Link 3L: POI 3 Inflow=159.87 cfs 11.182 af
Primary=159.87 cfs 11.182 af

Link 5L: POI 5 Inflow=8.83 cfs 0.623 af
Primary=8.83 cfs 0.623 af

Link 6L: POI 6 Inflow=43.27 cfs 2.980 af
Primary=43.27 cfs 2.980 af

Link 8L: POI 8 Inflow=9.36 cfs 0.660 af
Primary=9.36 cfs 0.660 af

Link 10L: POI 10 Inflow=1.78 cfs 0.126 af
Primary=1.78 cfs 0.126 af

Link 11L: POI 11 Inflow=5.14 cfs 0.355 af
Primary=5.14 cfs 0.355 af

Link OUT-A: Outfall A Inflow=169.09 cfs 11.778 af
Primary=169.09 cfs 11.778 af

Link OUT-B: OUTBALL B Inflow=207.94 cfs 14.756 af
Primary=207.94 cfs 14.756 af

Total Runoff Area = 33.914 ac Runoff Volume = 15.113 af Average Runoff Depth = 5.35"
53.92% Pervious = 18.286 ac 46.08% Impervious = 15.628 ac

Summary for Subcatchment 1: DA-1

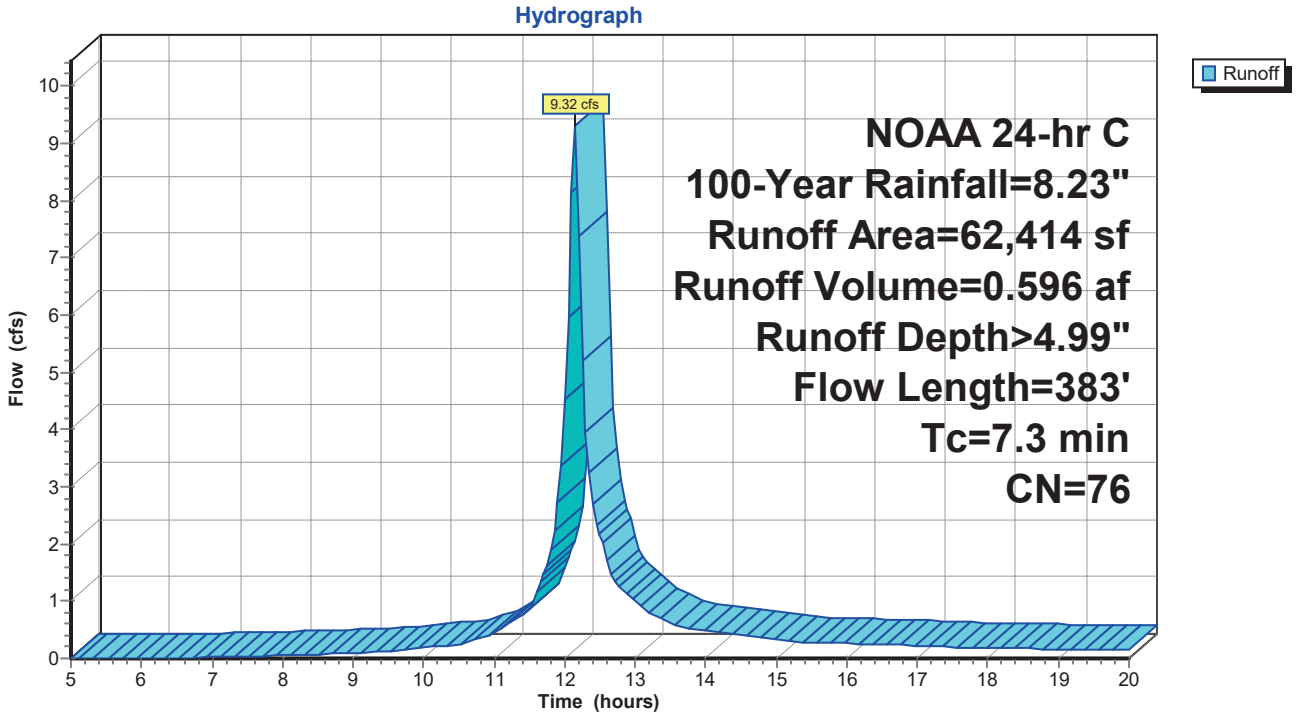
Runoff = 9.32 cfs @ 12.14 hrs, Volume= 0.596 af, Depth> 4.99"
Routed to Link 1L : POI 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
25,177	98	Paved parking, HSG A
34,812	61	>75% Grass cover, Good, HSG B
2,425	74	>75% Grass cover, Good, HSG C
62,414	76	Weighted Average
37,237		59.66% Pervious Area
25,177		40.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	75	0.0350	0.20		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.3	71	0.0460	4.35		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	171	0.0760	5.60		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.2	66	0.0610	5.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
7.3	383	Total			

Subcatchment 1: DA-1



Summary for Subcatchment 3A: DA-3A

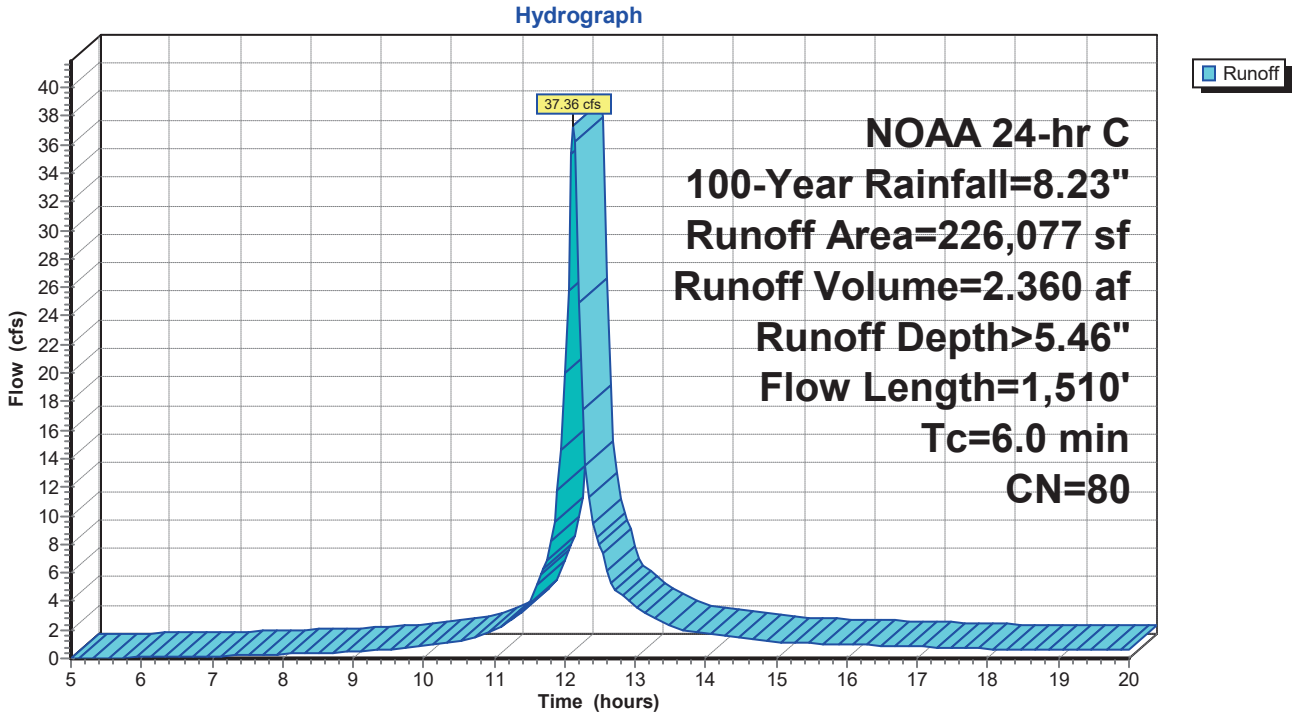
Runoff = 37.36 cfs @ 12.13 hrs, Volume= 2.360 af, Depth> 5.46"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
106,069	98	Paved parking, HSG A
86,815	61	>75% Grass cover, Good, HSG B
33,193	74	>75% Grass cover, Good, HSG C
226,077	80	Weighted Average
120,008		53.08% Pervious Area
106,069		46.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	22	0.0227	1.05		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	428	0.0771	5.64		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.9	263	0.0532	4.68		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.0	186	0.0220	3.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	425	0.0185	14.22	136.84	**Pipe Channel, E-F** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.2	186	0.1070	16.72	118.18	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
4.2	1,510	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3A: DA-3A



Summary for Subcatchment 3B: DA-3B

[47] Hint: Peak is 2321% of capacity of segment #5
[47] Hint: Peak is 800% of capacity of segment #6
[47] Hint: Peak is 585% of capacity of segment #7
[47] Hint: Peak is 634% of capacity of segment #8
[47] Hint: Peak is 448% of capacity of segment #9
[47] Hint: Peak is 106% of capacity of segment #10

Runoff = 125.45 cfs @ 12.17 hrs, Volume= 8.822 af, Depth> 4.99"
Routed to Link 3L : POI 3

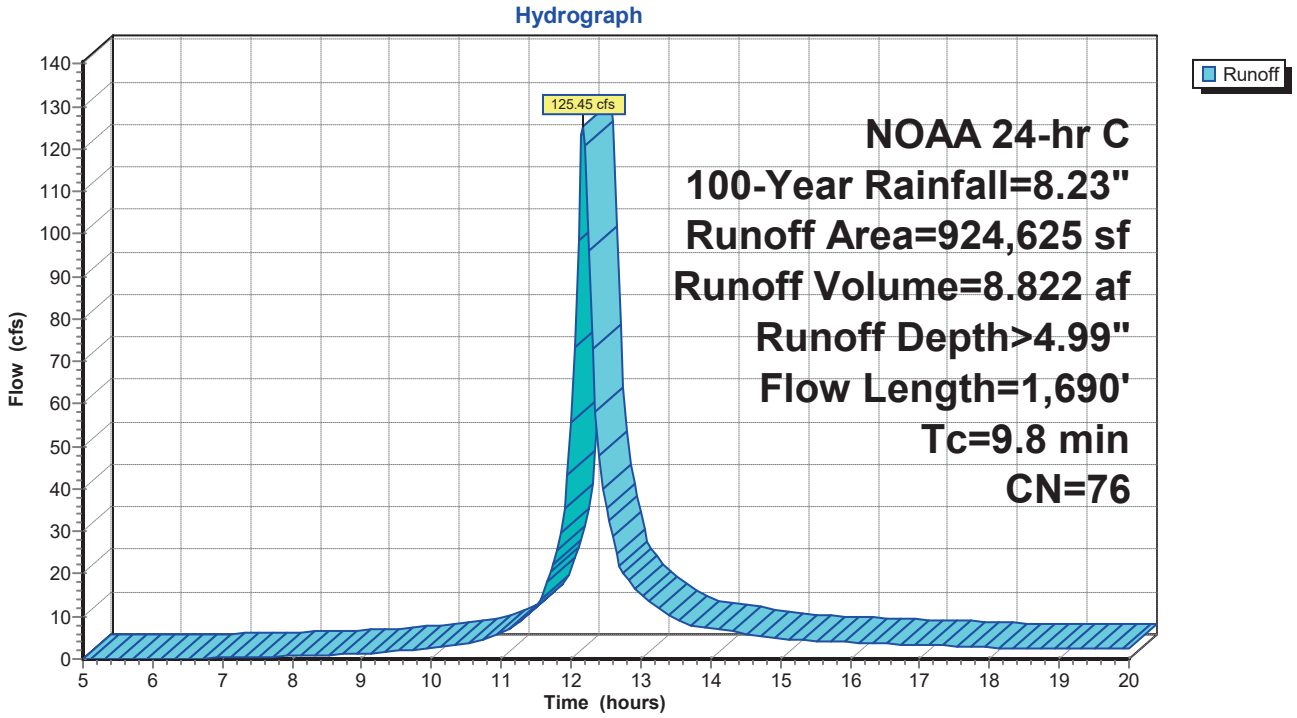
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
351,876	98	Paved parking, HSG A
536,743	61	>75% Grass cover, Good, HSG B
36,006	74	>75% Grass cover, Good, HSG C
924,625	76	Weighted Average
572,749		61.94% Pervious Area
351,876		38.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0620	0.24		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.4	108	0.1020	5.14		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.5	99	0.0400	3.22		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	54	0.0190	2.80		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	144	0.0070	4.40	5.40	**Pipe Channel, E-F** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.6	443	0.0590	12.79	15.69	**Pipe Channel, F-G** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.3	106	0.0090	6.83	21.46	**Pipe Channel, G-H** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
1.8	309	0.0030	2.80	19.79	**Pipe Channel, H-I** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.7	176	0.0060	3.96	27.98	**Pipe Channel, I-J** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.2	186	0.1070	16.72	118.18	**Pipe Channel, J-K** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024

9.8 1,690 Total

Subcatchment 3B: DA-3B



Summary for Subcatchment 5: DA-5

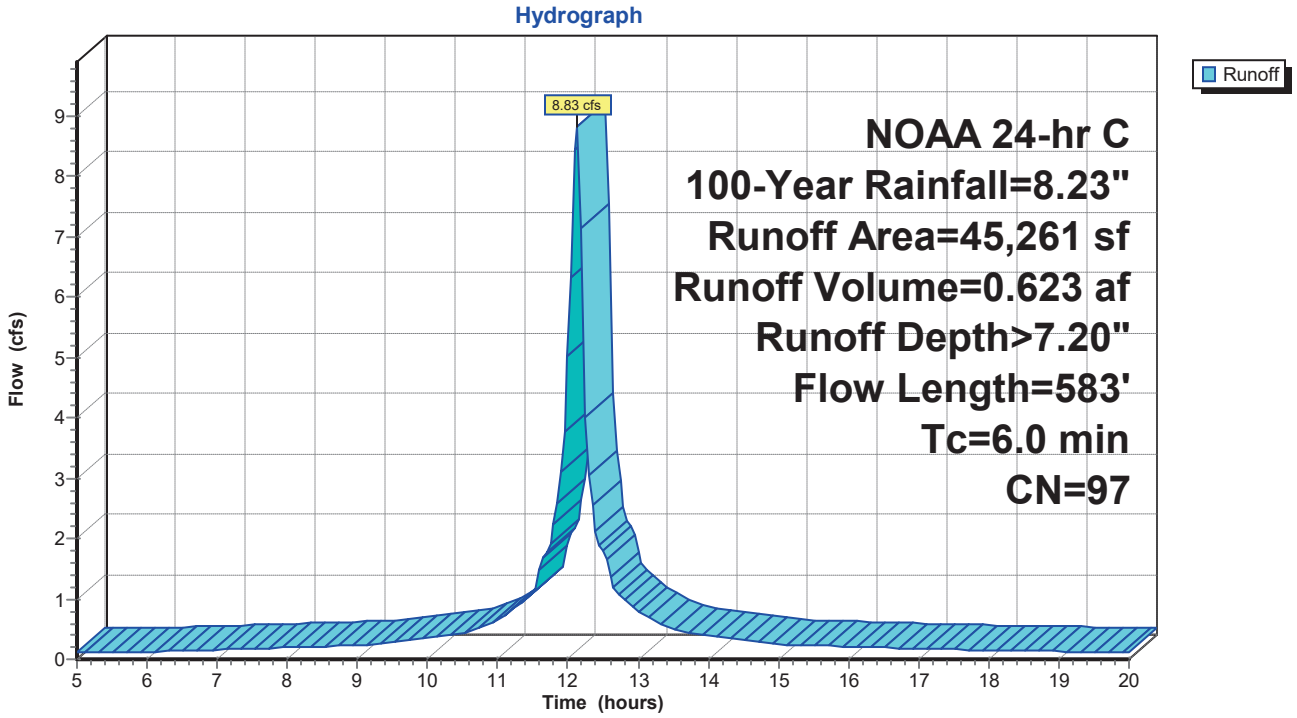
Runoff = 8.83 cfs @ 12.13 hrs, Volume= 0.623 af, Depth> 7.20"
Routed to Link 5L : POI 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
43,440	98	Paved parking, HSG A
23	61	>75% Grass cover, Good, HSG B
1,798	80	>75% Grass cover, Good, HSG D
45,261	97	Weighted Average
1,821		4.02% Pervious Area
43,440		95.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	51	0.0200	1.18		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.9	476	0.0441	4.26		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.1	56	0.0200	10.18	31.99	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
2.7	583	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5: DA-5



Summary for Subcatchment 6: DA-6

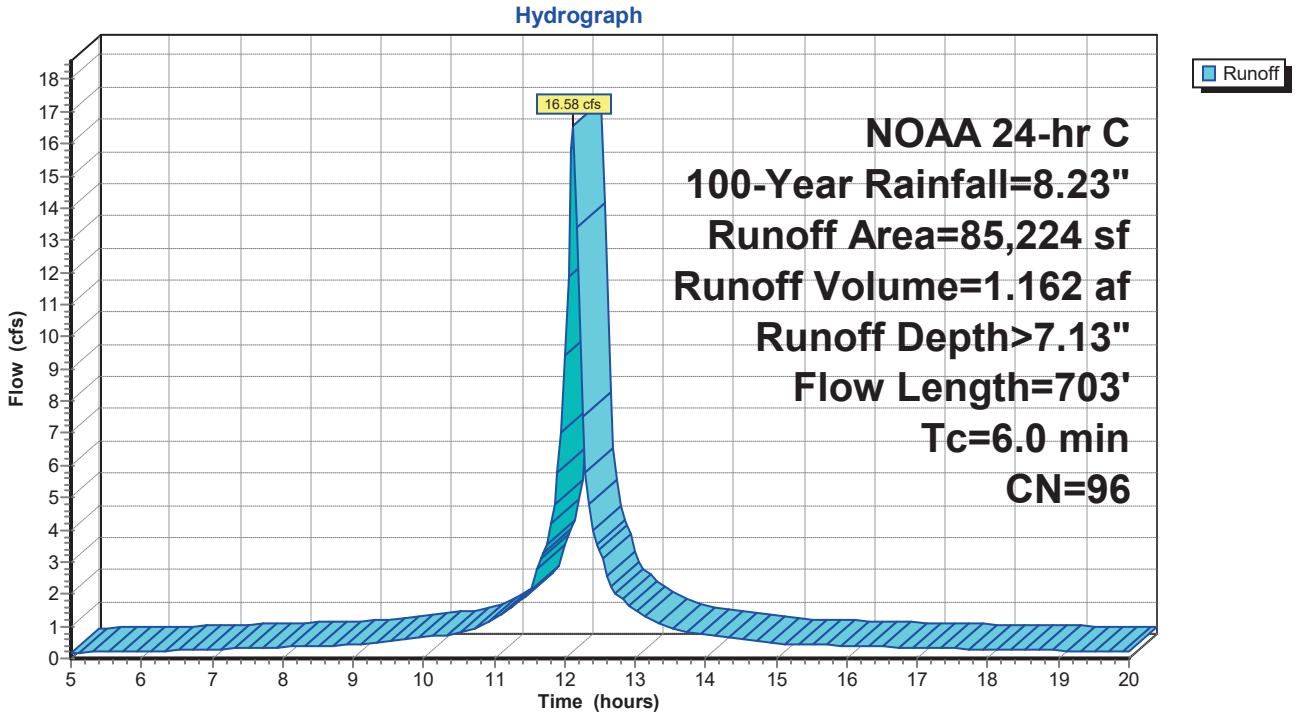
Runoff = 16.58 cfs @ 12.13 hrs, Volume= 1.162 af, Depth> 7.13"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
77,819	98	Paved parking, HSG A
165	61	>75% Grass cover, Good, HSG B
7,240	80	>75% Grass cover, Good, HSG D
85,224	96	Weighted Average
7,405		8.69% Pervious Area
77,819		91.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	93	0.0540	1.99		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	321	0.0311	3.58		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.4	155	0.0050	6.02	18.90	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	134	0.0430	32.51	638.26	**Pipe Channel, D-E** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.011 Concrete pipe, straight & clean
2.8	703	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 6: DA-6



Summary for Subcatchment 8: DA-8

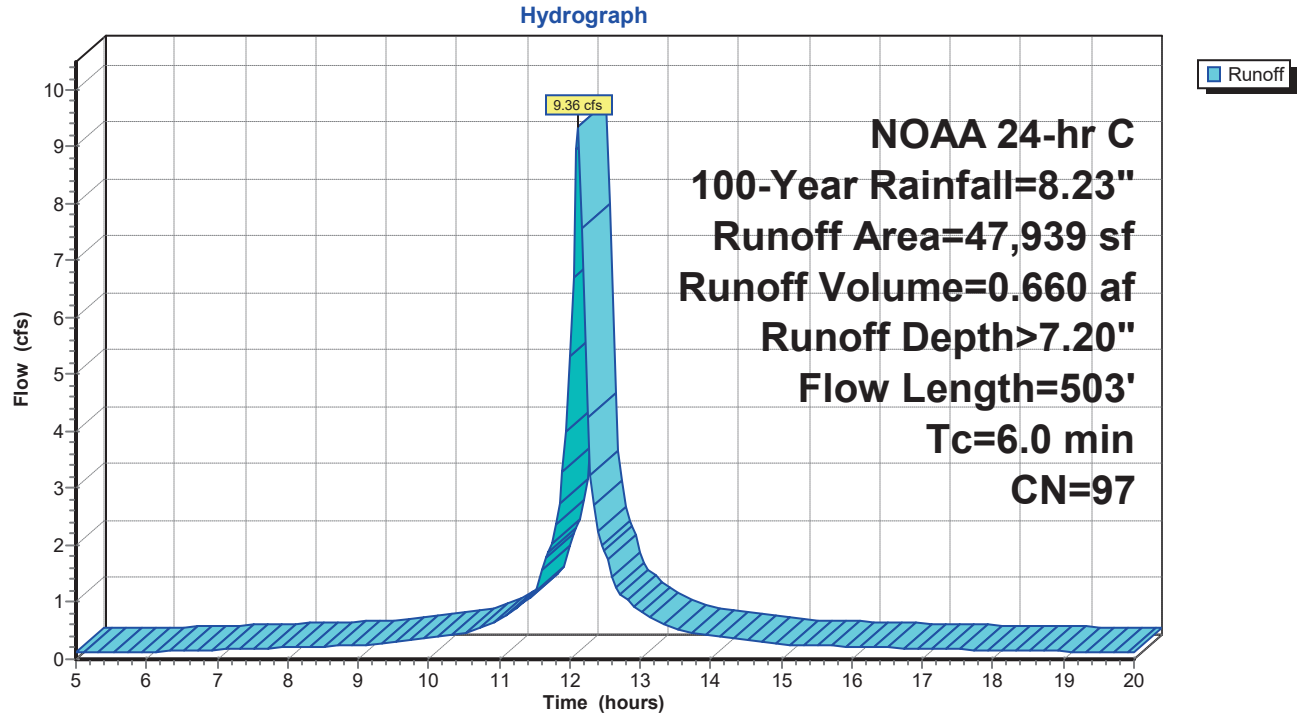
Runoff = 9.36 cfs @ 12.13 hrs, Volume= 0.660 af, Depth> 7.20"
Routed to Link 8L : POI 8

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
46,190	98	Paved parking, HSG A
1,120	61	>75% Grass cover, Good, HSG B
629	80	>75% Grass cover, Good, HSG D
47,939	97	Weighted Average
1,749		3.65% Pervious Area
46,190		96.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	303	0.0396	4.04		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.2	100	0.0139	8.49	26.67	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
2.7	503	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 8: DA-8



Summary for Subcatchment 10: DA-10

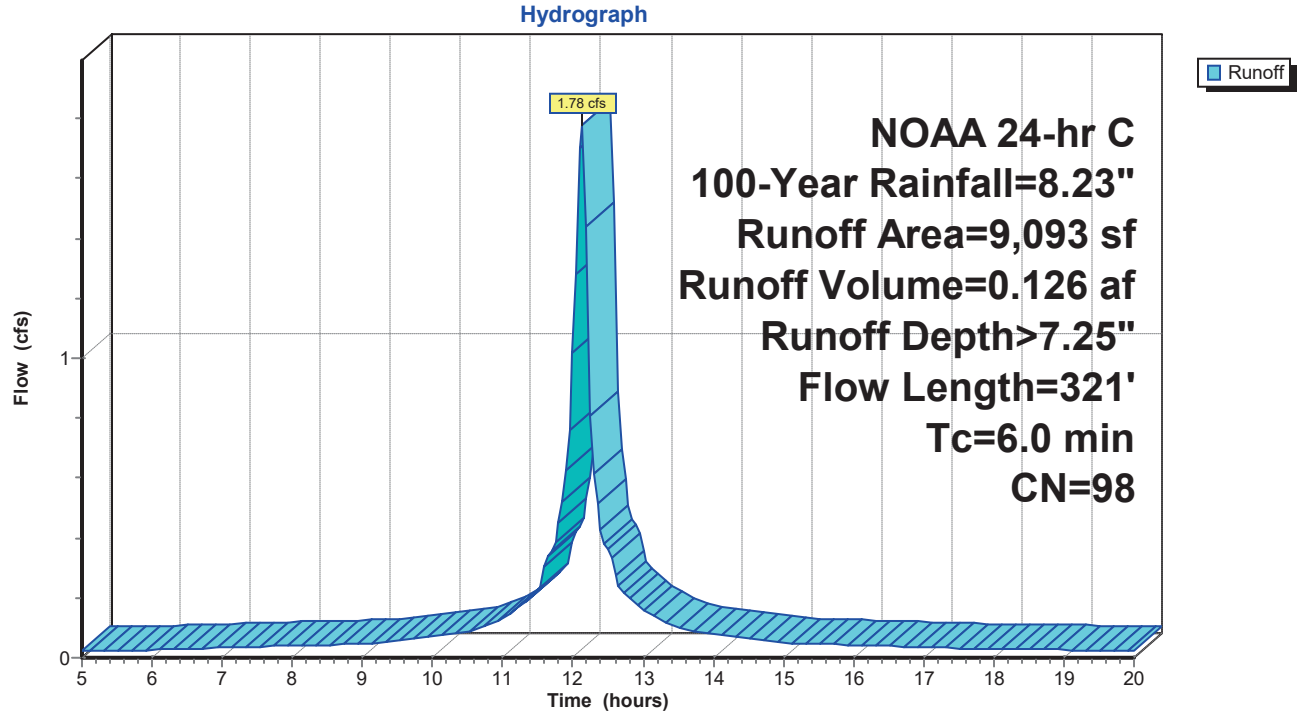
Runoff = 1.78 cfs @ 12.13 hrs, Volume= 0.126 af, Depth> 7.25"
Routed to Link 10L : POI 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
9,070	98	Paved parking, HSG A
23	80	>75% Grass cover, Good, HSG D
9,093	98	Weighted Average
23		0.25% Pervious Area
9,070		99.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	43	0.0470	1.61		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.0	254	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	24	0.4170	25.19	79.13	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.024
1.4	321	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 10: DA-10



Summary for Subcatchment 11: DA-11

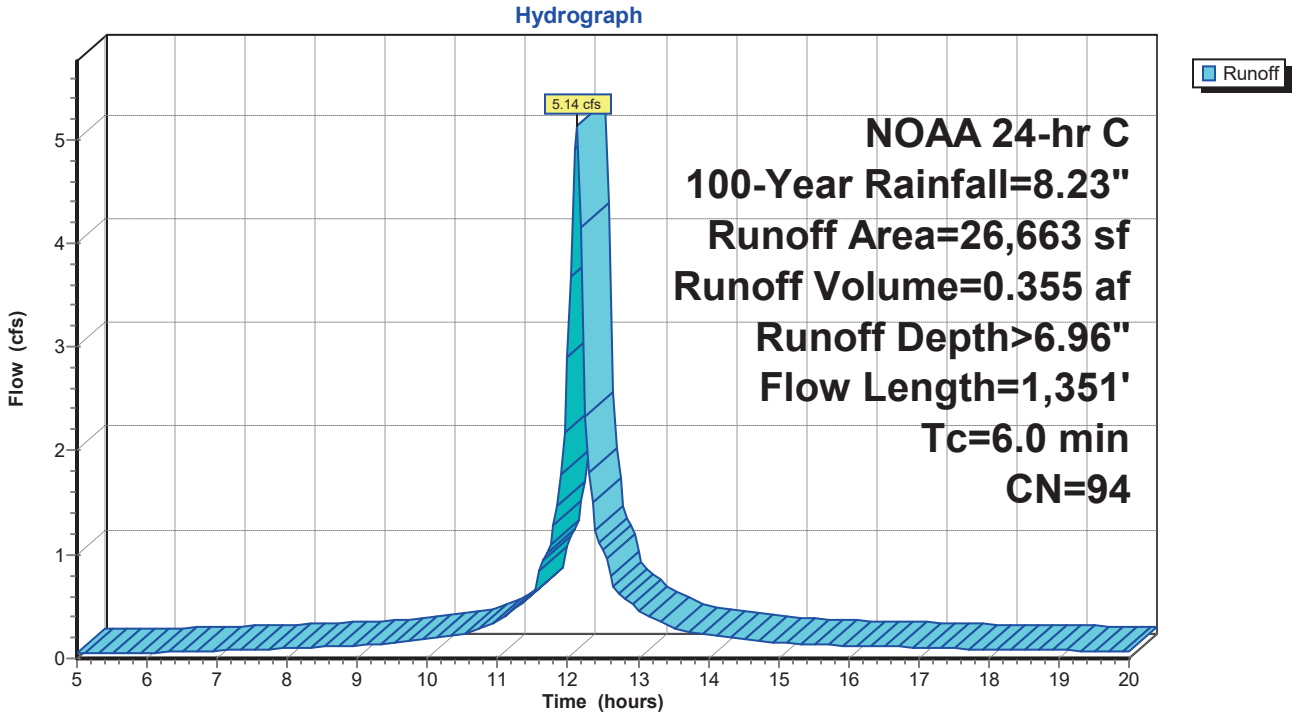
Runoff = 5.14 cfs @ 12.13 hrs, Volume= 0.355 af, Depth> 6.96"
Routed to Link 11L : POI 11

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
20,223	98	Paved parking, HSG A
6,440	80	>75% Grass cover, Good, HSG D
26,663	94	Weighted Average
6,440		24.15% Pervious Area
20,223		75.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	81	0.0340	1.60		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.9	493	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.1	48	0.0108	6.18	10.92	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
0.8	603	0.0311	12.70	39.90	**Pipe Channel, D-E** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
0.1	126	0.0963	29.28	206.98	**Pipe Channel, E-F** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Concrete pipe, bends & connections
3.7	1,351	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 11: DA-11



Summary for Subcatchment 12: DA-12

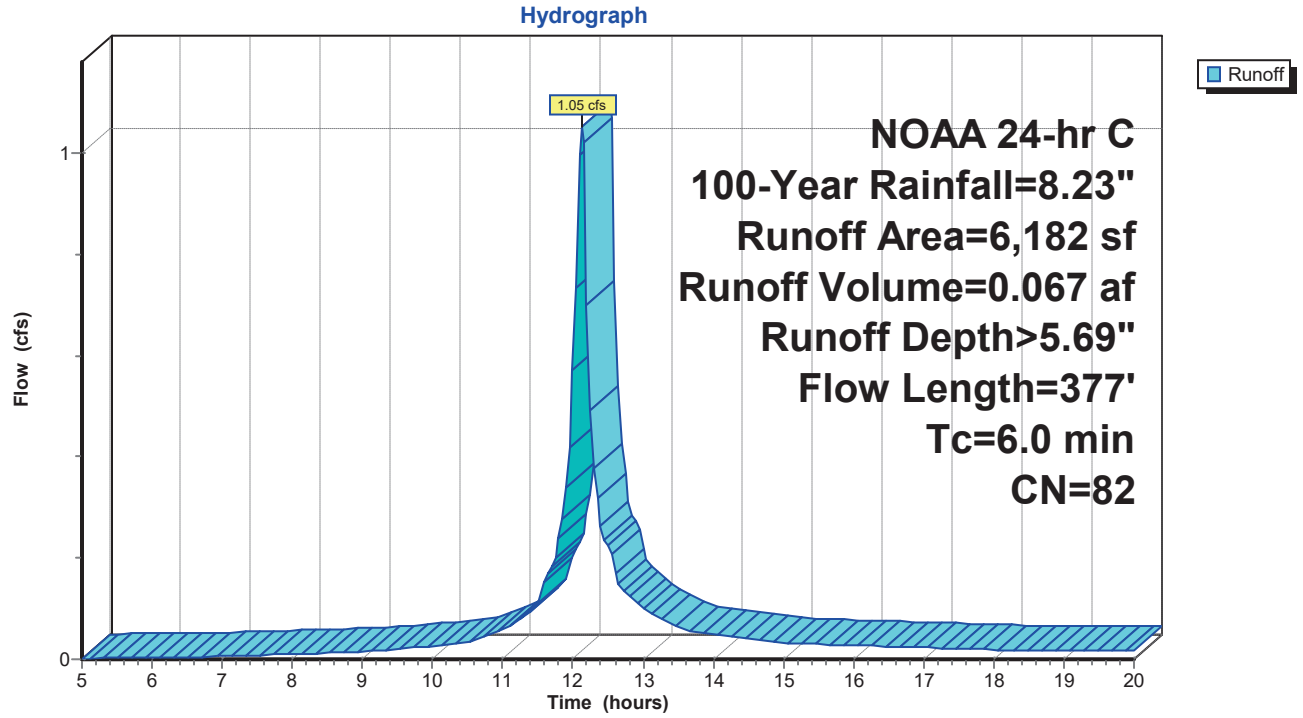
Runoff = 1.05 cfs @ 12.13 hrs, Volume= 0.067 af, Depth> 5.69"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
588	98	Paved parking, HSG A
5,594	80	>75% Grass cover, Good, HSG D
6,182	82	Weighted Average
5,594		90.49% Pervious Area
588		9.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.03		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.7	156	0.0060	1.57		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	21	0.2860	10.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.3	100	0.0600	4.97		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
3.6	377	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 12: DA-12



Summary for Subcatchment 13: DA-13

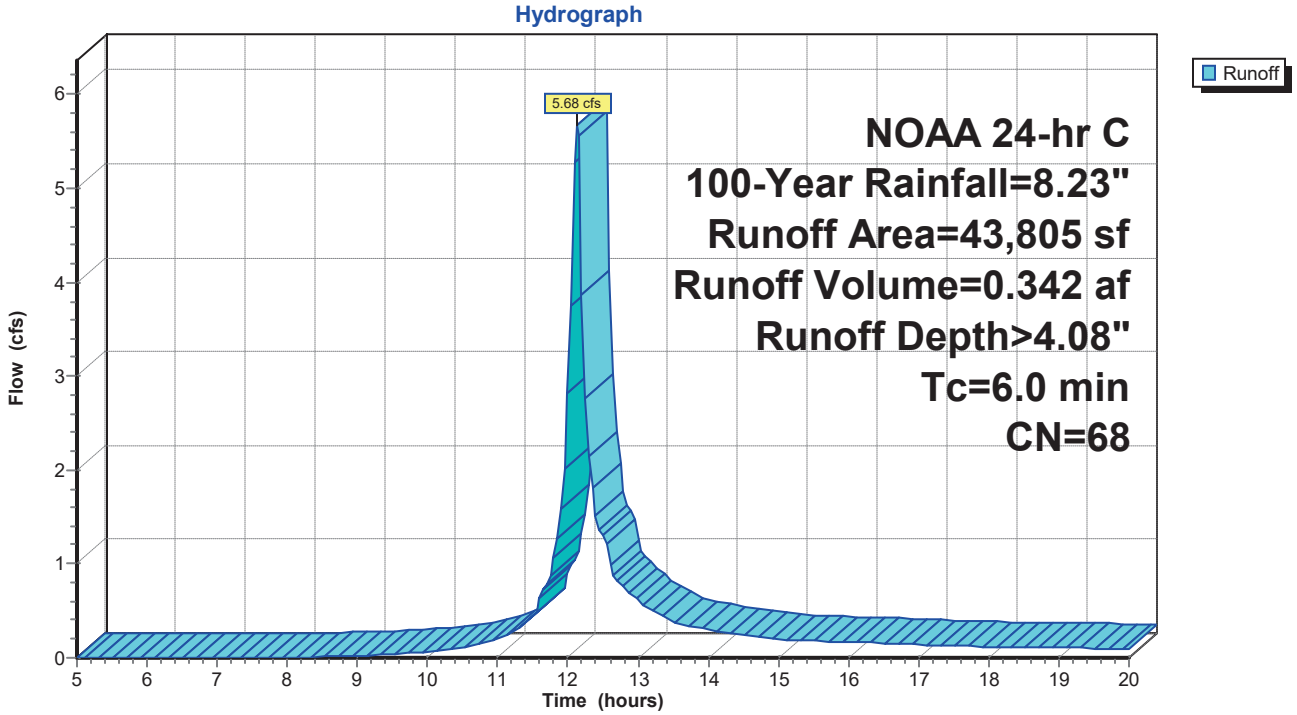
Runoff = 5.68 cfs @ 12.13 hrs, Volume= 0.342 af, Depth> 4.08"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
308	98	Paved parking, HSG A
27,660	61	>75% Grass cover, Good, HSG B
15,837	80	>75% Grass cover, Good, HSG D
43,805	68	Weighted Average
43,497		99.30% Pervious Area
308		0.70% Impervious Area

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

Subcatchment 13: DA-13



Summary for Reach 1R: Channel A

[91] Warning: Storage range exceeded by 0.20'
[55] Hint: Peak inflow is 160% of Manning's capacity

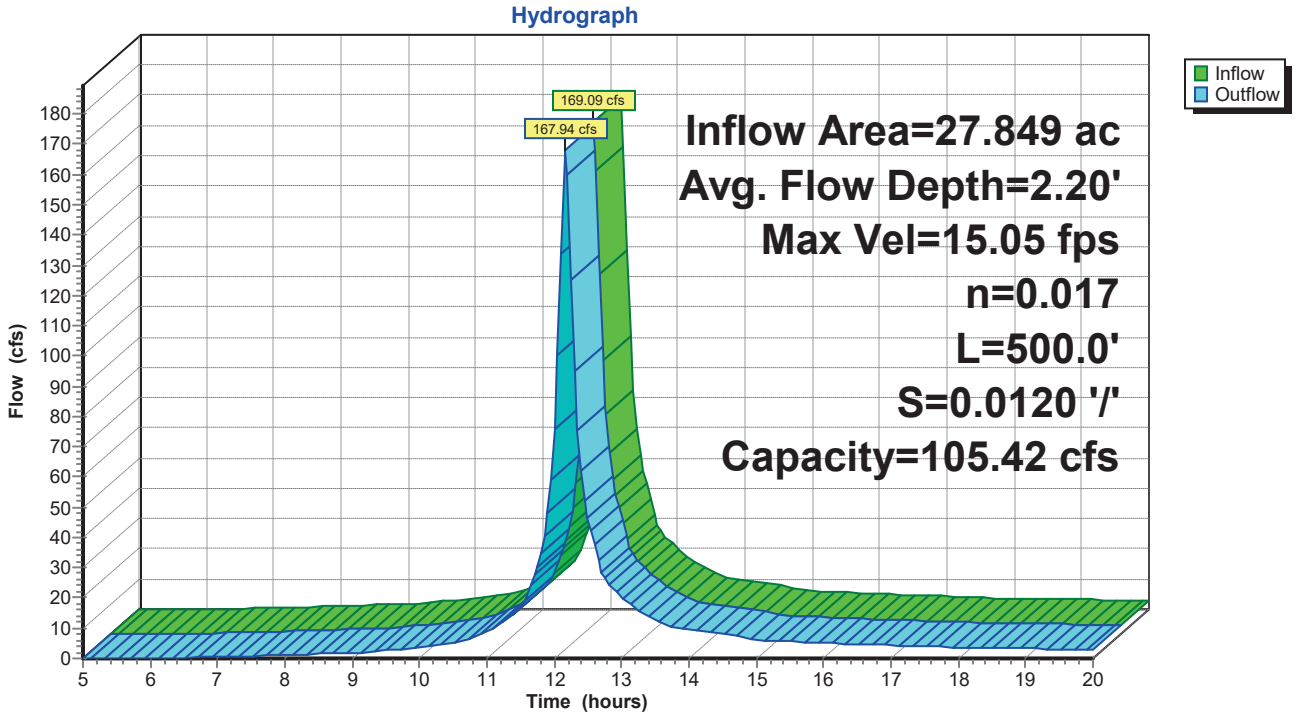
Inflow Area = 27.849 ac, 39.82% Impervious, Inflow Depth > 5.07" for 100-Year event
Inflow = 169.09 cfs @ 12.16 hrs, Volume= 11.778 af
Outflow = 167.94 cfs @ 12.17 hrs, Volume= 11.776 af, Atten= 1%, Lag= 0.6 min
Routed to Link OUT-B : OUTBALL B

Routing by Muskingum-Cunge method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Reference Flow= 105.42 cfs Estimated Depth= 2.00' Velocity= 10.54 fps
m= 1.400, c= 14.75 fps, dt= 3.0 min, dx= 500.0' / 1 = 500.0', K= 0.6 min, X= 0.381
Max. Velocity= 15.05 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 14.73 fps, Avg. Travel Time= 0.6 min

Peak Storage= 5,699 cf @ 12.16 hrs
Average Depth at Peak Storage= 2.20' , Surface Width= 7.40'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 105.42 cfs

3.00' x 2.00' deep channel, n= 0.017 Concrete, unfinished
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 500.0' Slope= 0.0120 '/'
Inlet Invert= 274.00', Outlet Invert= 268.00'

Reach 1R: Channel A

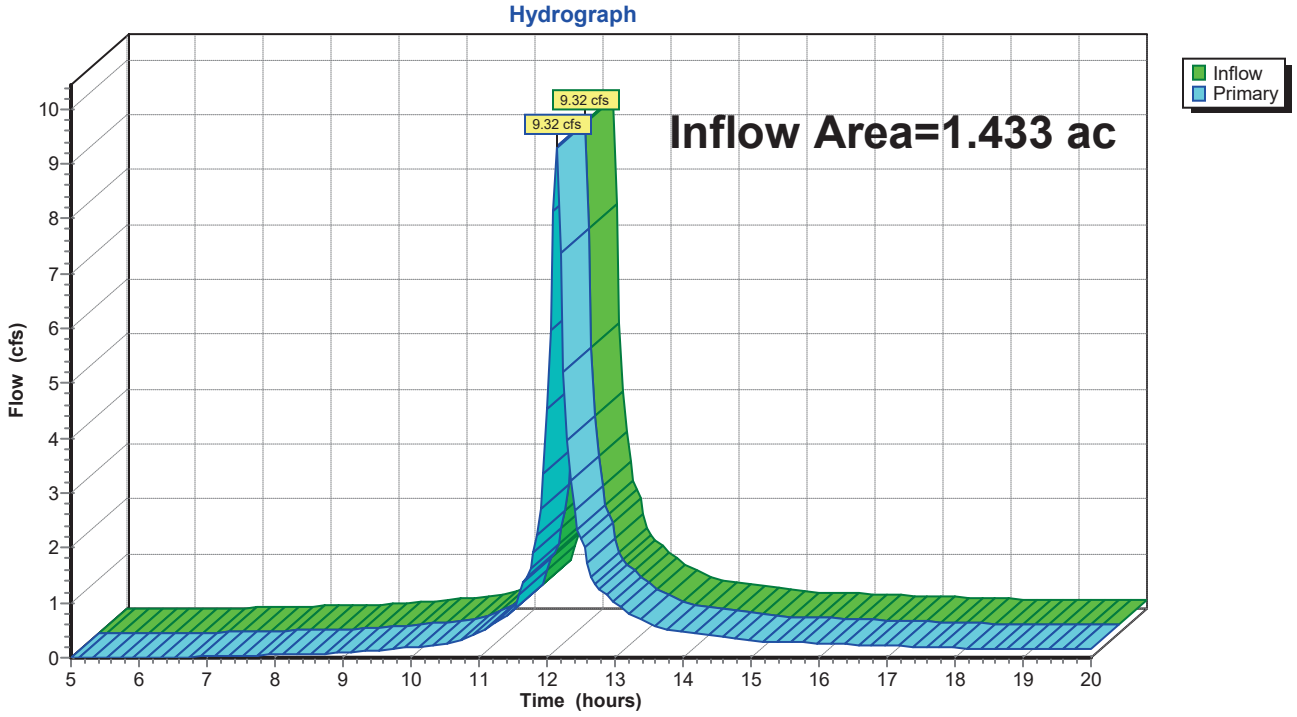


Summary for Link 1L: POI 1

Inflow Area = 1.433 ac, 40.34% Impervious, Inflow Depth > 4.99" for 100-Year event
Inflow = 9.32 cfs @ 12.14 hrs, Volume= 0.596 af
Primary = 9.32 cfs @ 12.14 hrs, Volume= 0.596 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

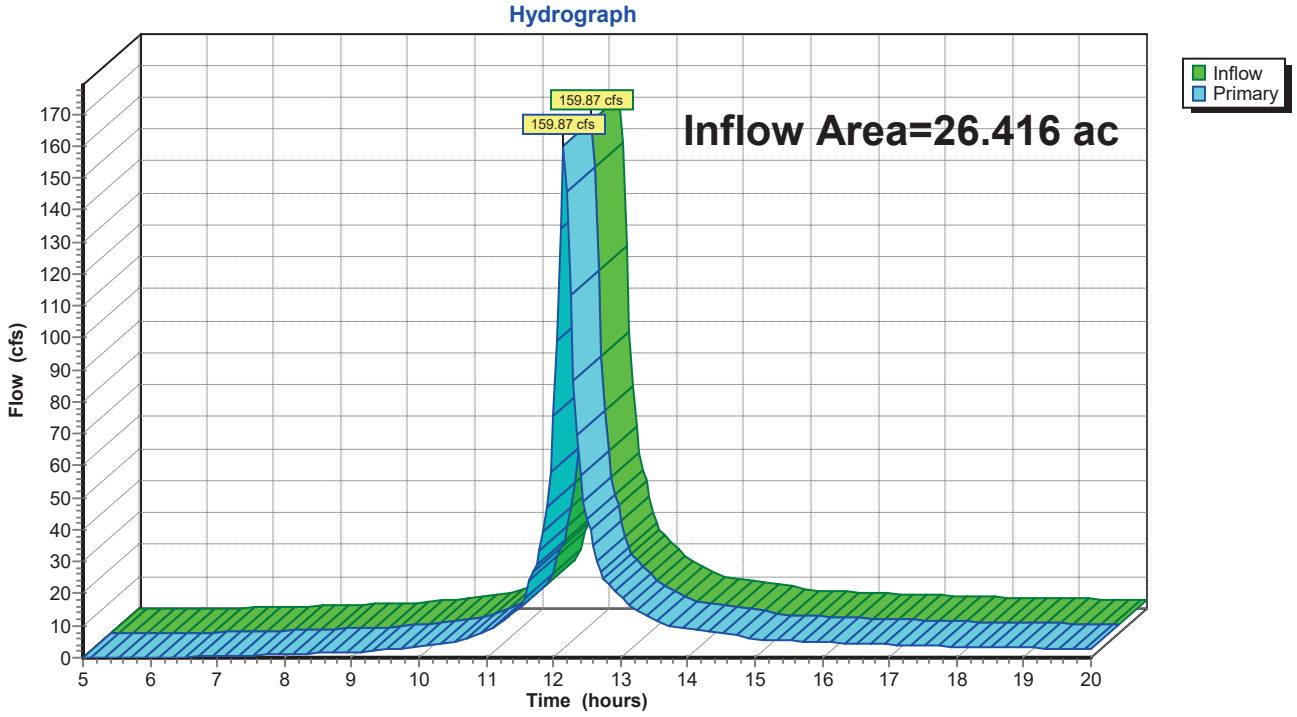


Summary for Link 3L: POI 3

Inflow Area = 26.416 ac, 39.80% Impervious, Inflow Depth > 5.08" for 100-Year event
Inflow = 159.87 cfs @ 12.16 hrs, Volume= 11.182 af
Primary = 159.87 cfs @ 12.16 hrs, Volume= 11.182 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: POI 3

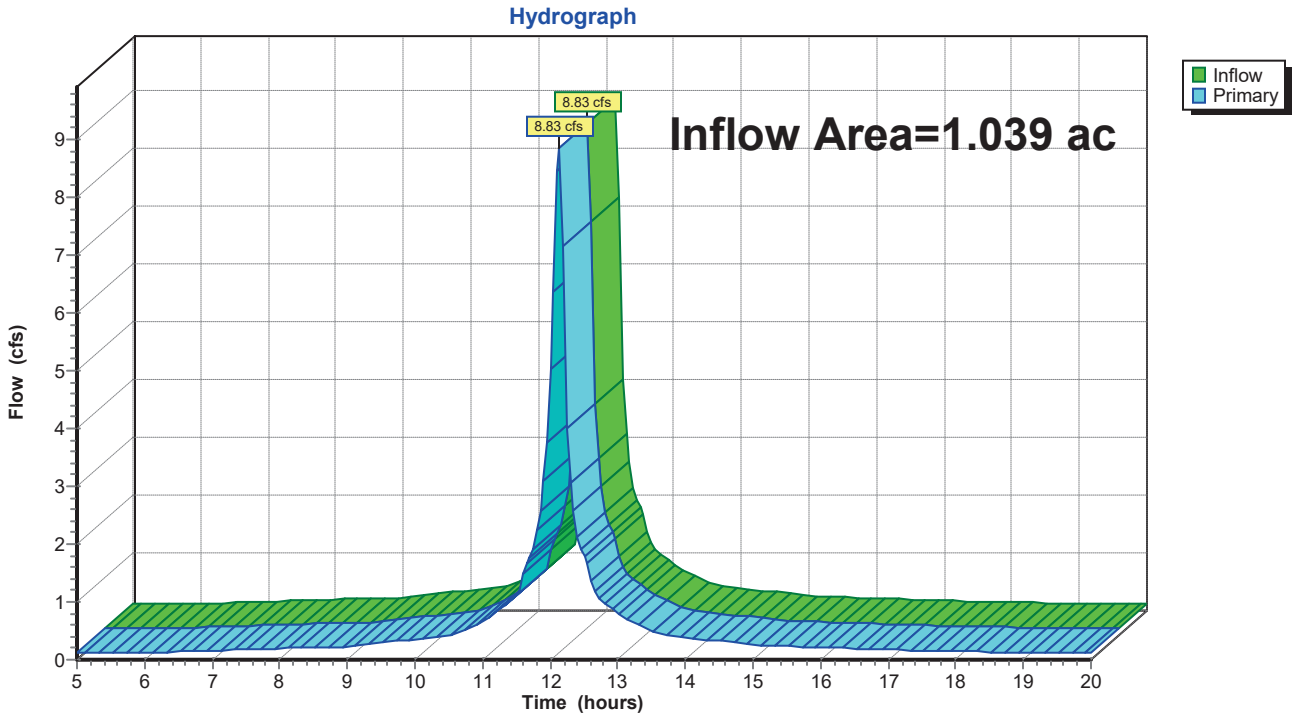


Summary for Link 5L: POI 5

Inflow Area = 1.039 ac, 95.98% Impervious, Inflow Depth > 7.20" for 100-Year event
Inflow = 8.83 cfs @ 12.13 hrs, Volume= 0.623 af
Primary = 8.83 cfs @ 12.13 hrs, Volume= 0.623 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: POI 5

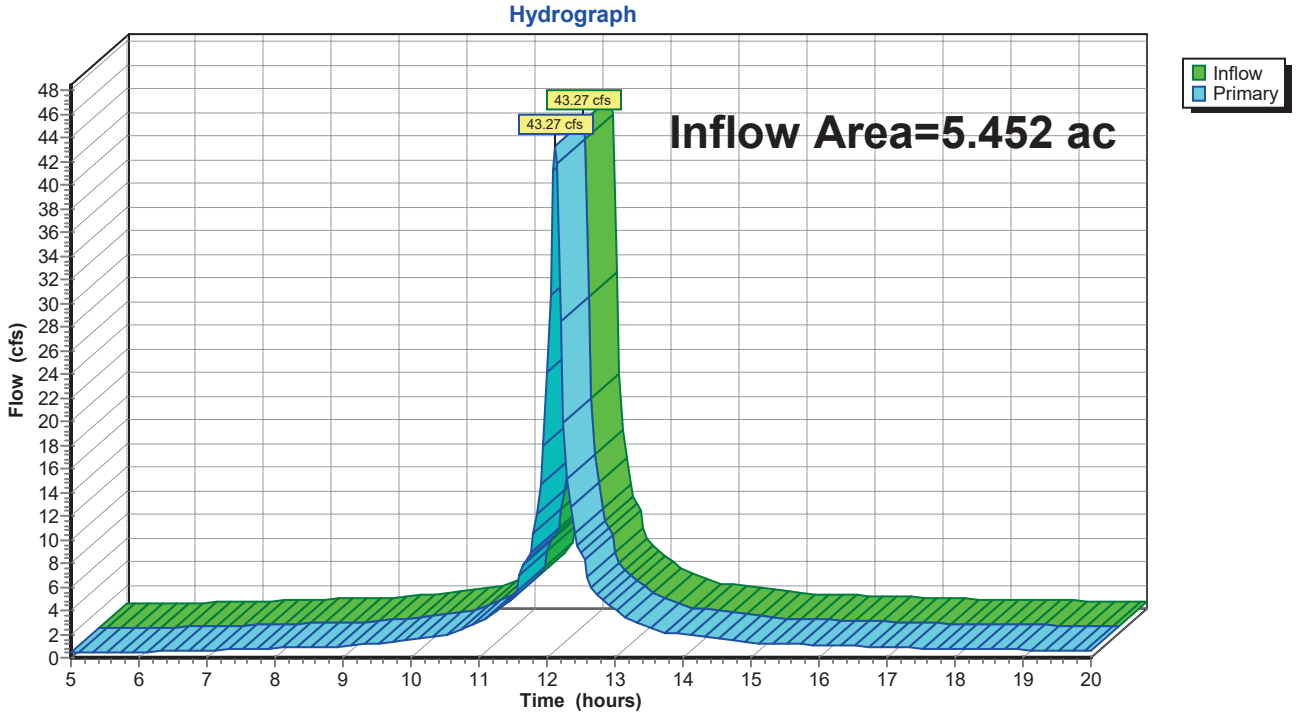


Summary for Link 6L: POI 6

Inflow Area = 5.452 ac, 74.70% Impervious, Inflow Depth > 6.56" for 100-Year event
Inflow = 43.27 cfs @ 12.13 hrs, Volume= 2.980 af
Primary = 43.27 cfs @ 12.13 hrs, Volume= 2.980 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-B : OUTBALL B

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 6L: POI 6

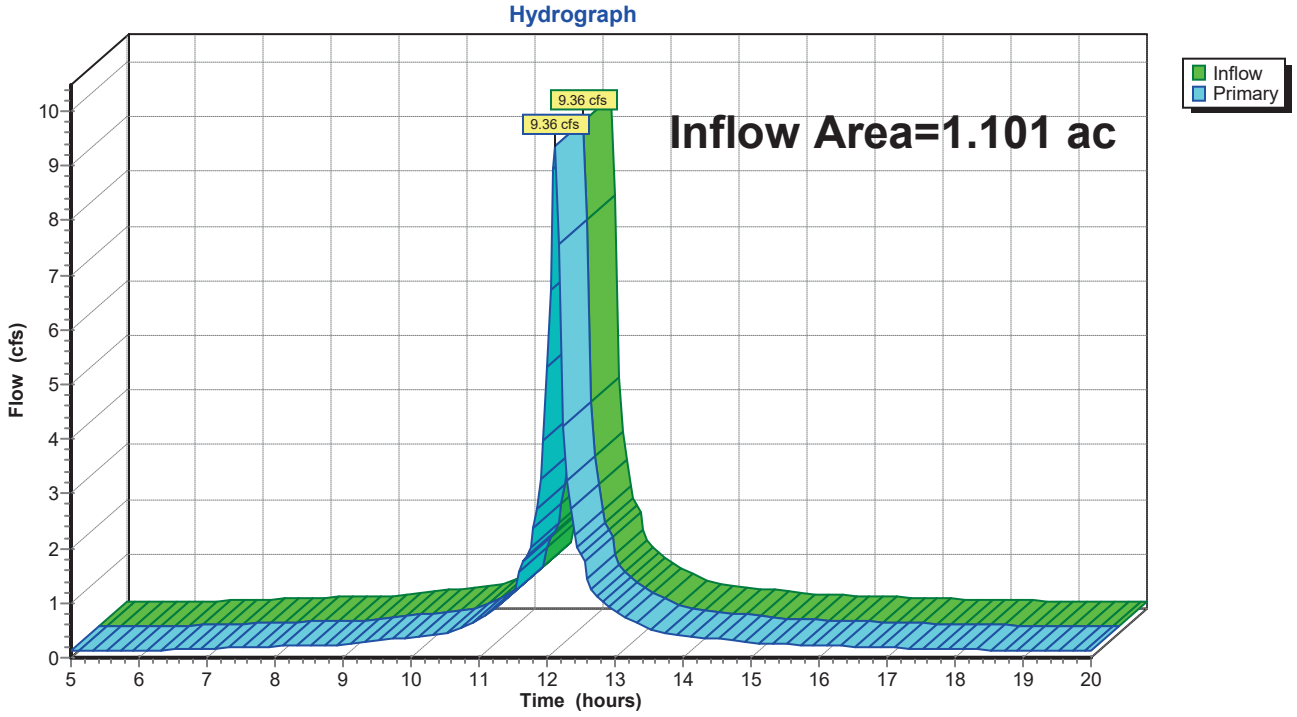


Summary for Link 8L: POI 8

Inflow Area = 1.101 ac, 96.35% Impervious, Inflow Depth > 7.20" for 100-Year event
Inflow = 9.36 cfs @ 12.13 hrs, Volume= 0.660 af
Primary = 9.36 cfs @ 12.13 hrs, Volume= 0.660 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 8L: POI 8

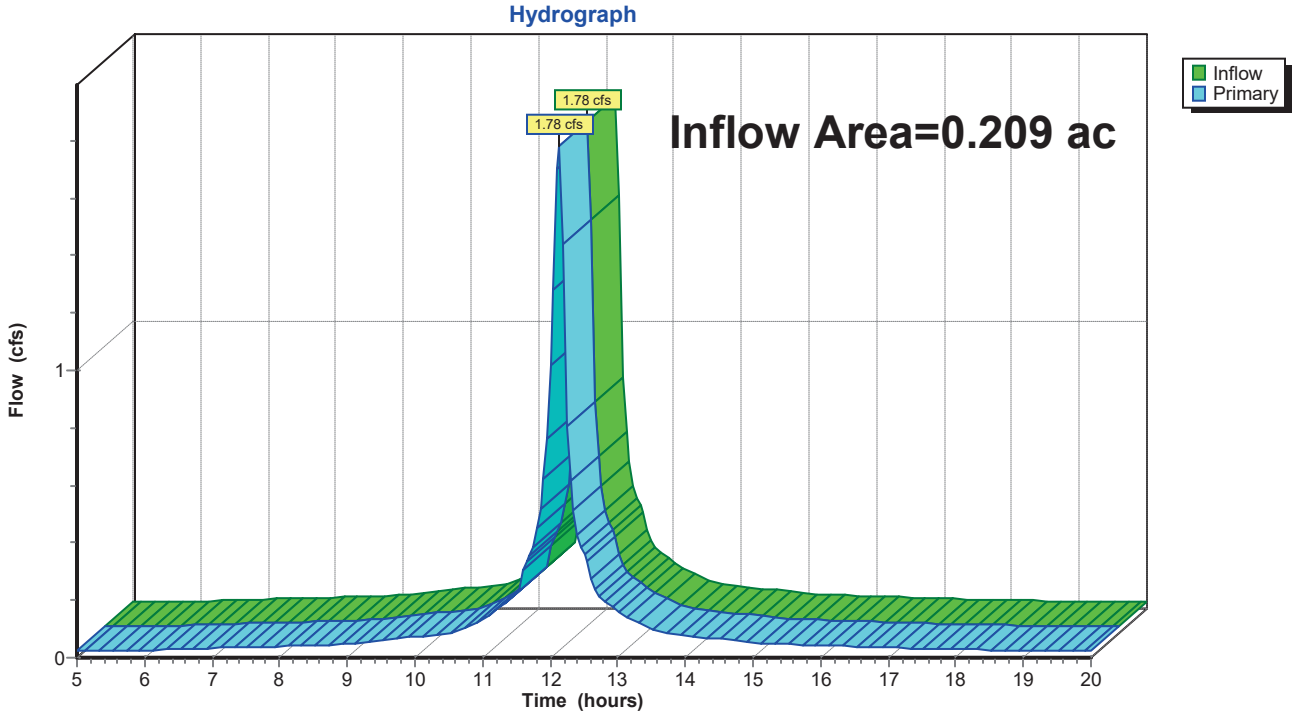


Summary for Link 10L: POI 10

Inflow Area = 0.209 ac, 99.75% Impervious, Inflow Depth > 7.25" for 100-Year event
Inflow = 1.78 cfs @ 12.13 hrs, Volume= 0.126 af
Primary = 1.78 cfs @ 12.13 hrs, Volume= 0.126 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: POI 10

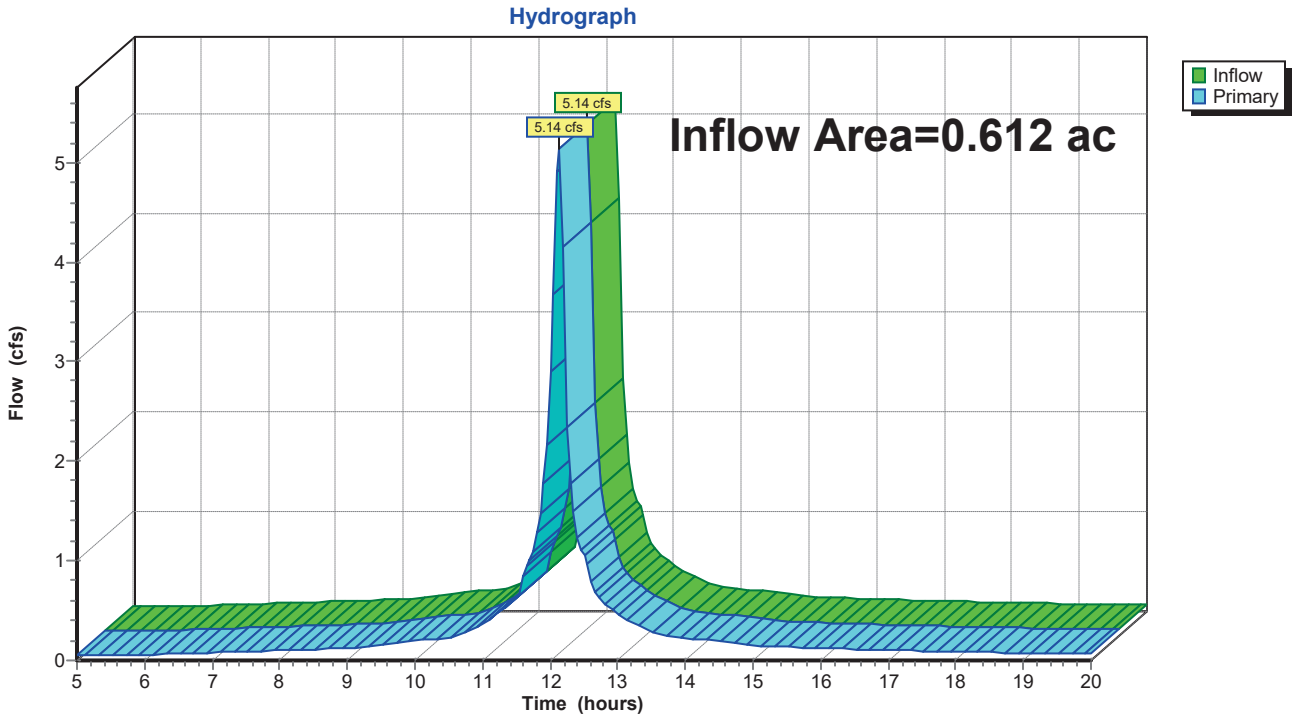


Summary for Link 11L: POI 11

Inflow Area = 0.612 ac, 75.85% Impervious, Inflow Depth > 6.96" for 100-Year event
Inflow = 5.14 cfs @ 12.13 hrs, Volume= 0.355 af
Primary = 5.14 cfs @ 12.13 hrs, Volume= 0.355 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 11L: POI 11

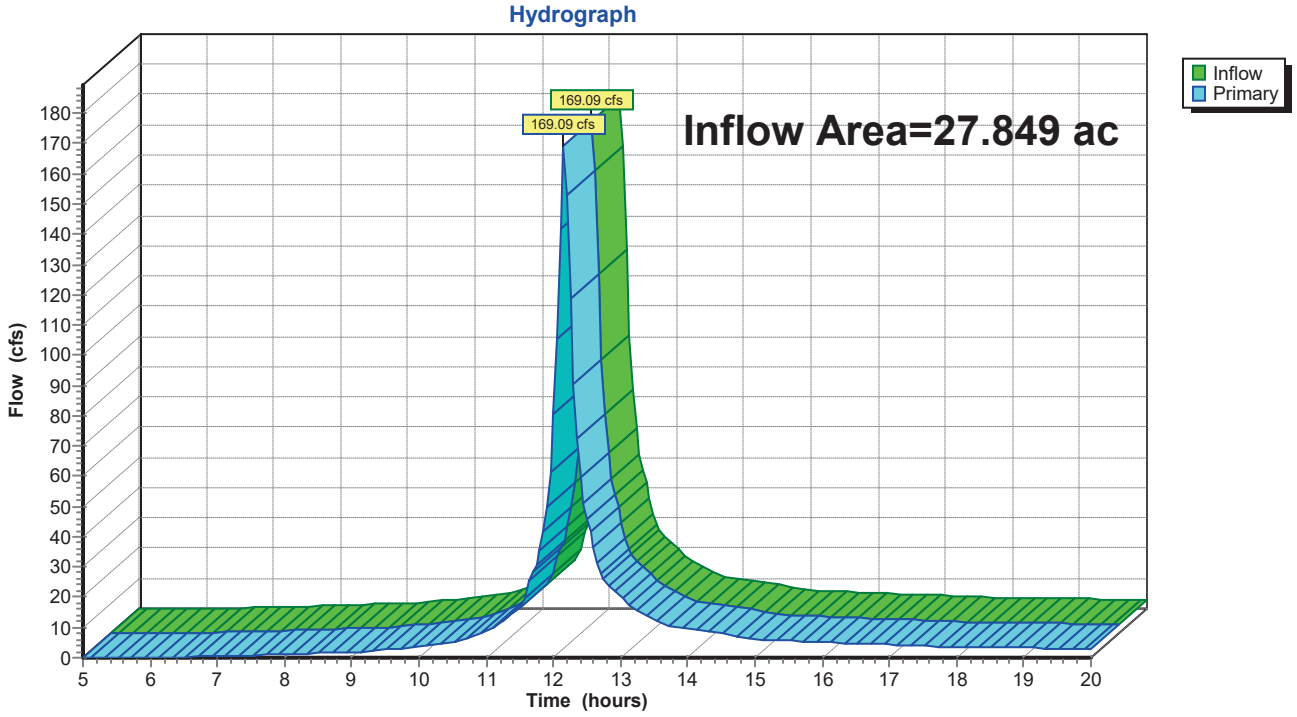


Summary for Link OUT-A: Outfall A

Inflow Area = 27.849 ac, 39.82% Impervious, Inflow Depth > 5.07" for 100-Year event
Inflow = 169.09 cfs @ 12.16 hrs, Volume= 11.778 af
Primary = 169.09 cfs @ 12.16 hrs, Volume= 11.778 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 1R : Channel A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-A: Outfall A

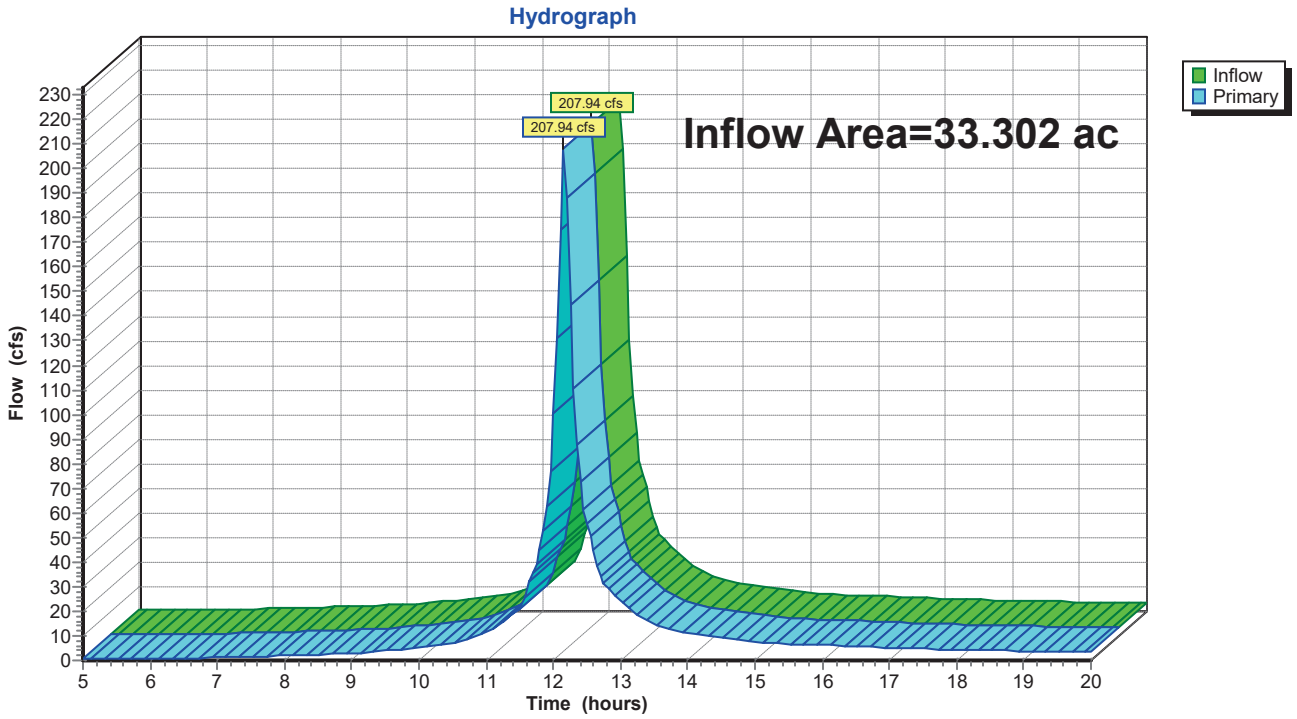


Summary for Link OUT-B: OUTBALL B

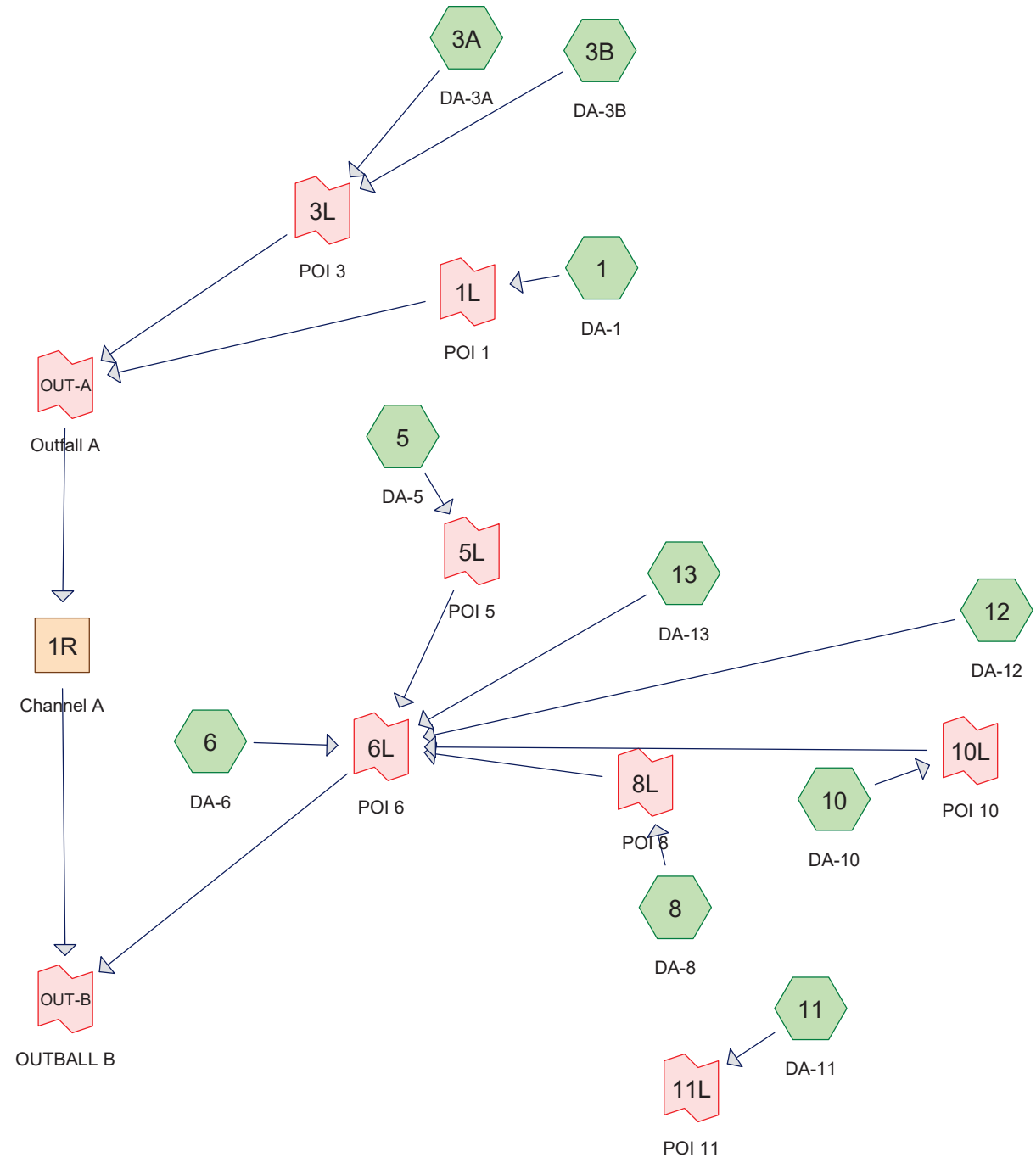
Inflow Area = 33.302 ac, 45.53% Impervious, Inflow Depth > 5.32" for 100-Year event
Inflow = 207.94 cfs @ 12.16 hrs, Volume= 14.756 af
Primary = 207.94 cfs @ 12.16 hrs, Volume= 14.756 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-B: OUTBALL B



Proposed HydroCAD Computations



Routing Diagram for MD 390 HydroCAD_PROP_24_11_12
Prepared by Maryland DOT State Hwy Administn, Printed 11/20/2024
HydroCAD® 10.20-5c s/n 11563 © 2023 HydroCAD Software Solutions LLC

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery
Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery
Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery
Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery
Rainfall events imported from "NRCS-Rain.txt" for 5015 MD Montgomery

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	NOAA 24-hr	C	Default	24.00	1	2.57	2
2	10-Year	NOAA 24-hr	C	Default	24.00	1	4.77	2
3	100-Year	NOAA 24-hr	C	Default	24.00	1	8.23	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
15.784	61	>75% Grass cover, Good, HSG B (1, 3A, 3B, 5, 6, 8, 13)
1.647	74	>75% Grass cover, Good, HSG C (1, 3A, 3B)
1.156	80	>75% Grass cover, Good, HSG D (5, 6, 8, 10, 11, 12, 13)
15.326	98	Paved parking, HSG A (1, 3A, 3B, 5, 6, 8, 10, 11, 12, 13)
33.913	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
15.326	HSG A	1, 3A, 3B, 5, 6, 8, 10, 11, 12, 13
15.784	HSG B	1, 3A, 3B, 5, 6, 8, 13
1.647	HSG C	1, 3A, 3B
1.156	HSG D	5, 6, 8, 10, 11, 12, 13
0.000	Other	
33.913		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	15.784	1.647	1.156	0.000	18.587	>75% Grass cover, Good	1, 3A, 3B, 5, 6, 8, 10, 11, 12, 13
15.326	0.000	0.000	0.000	0.000	15.326	Paved parking	1, 3A, 3B, 5, 6, 8, 10, 11, 12, 13
15.326	**15.784**	**1.647**	**1.156**	**0.000**	**33.913**	**TOTAL AREA**	

MD 390 HydroCAD_PROP_24_11_12
Prepared by Maryland DOT State Hwy Administn
Printed 11/20/2024

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	3A	0.00	0.00	152.0	0.0050	0.013	0.0	18.0	0.0	
2	3A	0.00	0.00	402.0	0.0056	0.011	0.0	42.0	0.0	
3	3A	0.00	0.00	186.0	0.1070	0.024	0.0	36.0	0.0	
4	3B	0.00	0.00	144.0	0.0070	0.013	0.0	15.0	0.0	
5	3B	0.00	0.00	443.0	0.0590	0.013	0.0	15.0	0.0	
6	3B	0.00	0.00	106.0	0.0090	0.013	0.0	24.0	0.0	
7	3B	0.00	0.00	309.0	0.0030	0.024	0.0	36.0	0.0	
8	3B	0.00	0.00	176.0	0.0060	0.024	0.0	36.0	0.0	
9	3B	0.00	0.00	186.0	0.1070	0.024	0.0	36.0	0.0	
10	6	0.00	0.00	155.0	0.0050	0.011	0.0	24.0	0.0	
11	6	0.00	0.00	134.0	0.0430	0.011	0.0	60.0	0.0	
12	10	0.00	0.00	24.0	0.4170	0.024	0.0	24.0	0.0	
13	11	0.00	0.00	48.0	0.0108	0.013	0.0	18.0	0.0	
14	11	0.00	0.00	603.0	0.0311	0.013	0.0	24.0	0.0	
15	11	0.00	0.00	126.0	0.0963	0.013	0.0	36.0	0.0	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Muskingum-Cunge method - Pond routing by Stor-Ind method

Subcatchment 1: DA-1 Runoff Area=62,414 sf 40.42% Impervious Runoff Depth>0.66"
Flow Length=383' Tc=7.3 min CN=76 Runoff=1.24 cfs 0.079 af

Subcatchment 3A: DA-3A Runoff Area=226,089 sf 47.14% Impervious Runoff Depth>0.85"
Flow Length=1,375' Tc=6.0 min CN=80 Runoff=6.16 cfs 0.367 af

Subcatchment 3B: DA-3B Runoff Area=924,625 sf 38.06% Impervious Runoff Depth>0.66"
Flow Length=1,690' Tc=9.8 min CN=76 Runoff=16.45 cfs 1.164 af

Subcatchment 5: DA-5 Runoff Area=45,927 sf 92.87% Impervious Runoff Depth>2.08"
Flow Length=523' Slope=0.0670 '/' Tc=6.0 min CN=97 Runoff=2.71 cfs 0.183 af

Subcatchment 6: DA-6 Runoff Area=81,706 sf 84.87% Impervious Runoff Depth>1.90"
Flow Length=657' Tc=6.0 min CN=95 Runoff=4.56 cfs 0.297 af

Subcatchment 8: DA-8 Runoff Area=46,644 sf 88.24% Impervious Runoff Depth>1.90"
Flow Length=359' Tc=6.0 min CN=95 Runoff=2.60 cfs 0.170 af

Subcatchment 10: DA-10 Runoff Area=11,113 sf 97.13% Impervious Runoff Depth>2.08"
Flow Length=321' Tc=6.0 min CN=97 Runoff=0.65 cfs 0.044 af

Subcatchment 11: DA-11 Runoff Area=25,207 sf 76.84% Impervious Runoff Depth>1.81"
Flow Length=1,358' Tc=6.0 min CN=94 Runoff=1.36 cfs 0.087 af

Subcatchment 12: DA-12 Runoff Area=6,184 sf 3.86% Impervious Runoff Depth>0.90"
Flow Length=377' Tc=6.0 min CN=81 Runoff=0.18 cfs 0.011 af

Subcatchment 13: DA-13 Runoff Area=47,336 sf 0.77% Impervious Runoff Depth>0.39"
Tc=6.0 min CN=69 Runoff=0.52 cfs 0.036 af

Reach 1R: Channel A Avg. Flow Depth=0.66' Max Vel=9.80 fps Inflow=23.20 cfs 1.610 af
n=0.017 L=500.0' S=0.0120 '/' Capacity=105.42 cfs Outflow=23.05 cfs 1.609 af

Link 1L: POI 1 Inflow=1.24 cfs 0.079 af
Primary=1.24 cfs 0.079 af

Link 3L: POI 3 Inflow=21.97 cfs 1.532 af
Primary=21.97 cfs 1.532 af

Link 5L: POI 5 Inflow=2.71 cfs 0.183 af
Primary=2.71 cfs 0.183 af

Link 6L: POI 6 Inflow=11.20 cfs 0.741 af
Primary=11.20 cfs 0.741 af

Link 8L: POI 8 Inflow=2.60 cfs 0.170 af
Primary=2.60 cfs 0.170 af

Link 10L: POI 10 Inflow=0.65 cfs 0.044 af
Primary=0.65 cfs 0.044 af

Link 11L: POI 11 Inflow=1.36 cfs 0.087 af
Primary=1.36 cfs 0.087 af

Link OUT-A: Outfall A Inflow=23.20 cfs 1.610 af
Primary=23.20 cfs 1.610 af

Link OUT-B: OUTBALL B Inflow=32.84 cfs 2.350 af
Primary=32.84 cfs 2.350 af

Total Runoff Area = 33.913 ac Runoff Volume = 2.438 af Average Runoff Depth = 0.86"
54.81% Pervious = 18.587 ac 45.19% Impervious = 15.326 ac

Summary for Subcatchment 1: DA-1

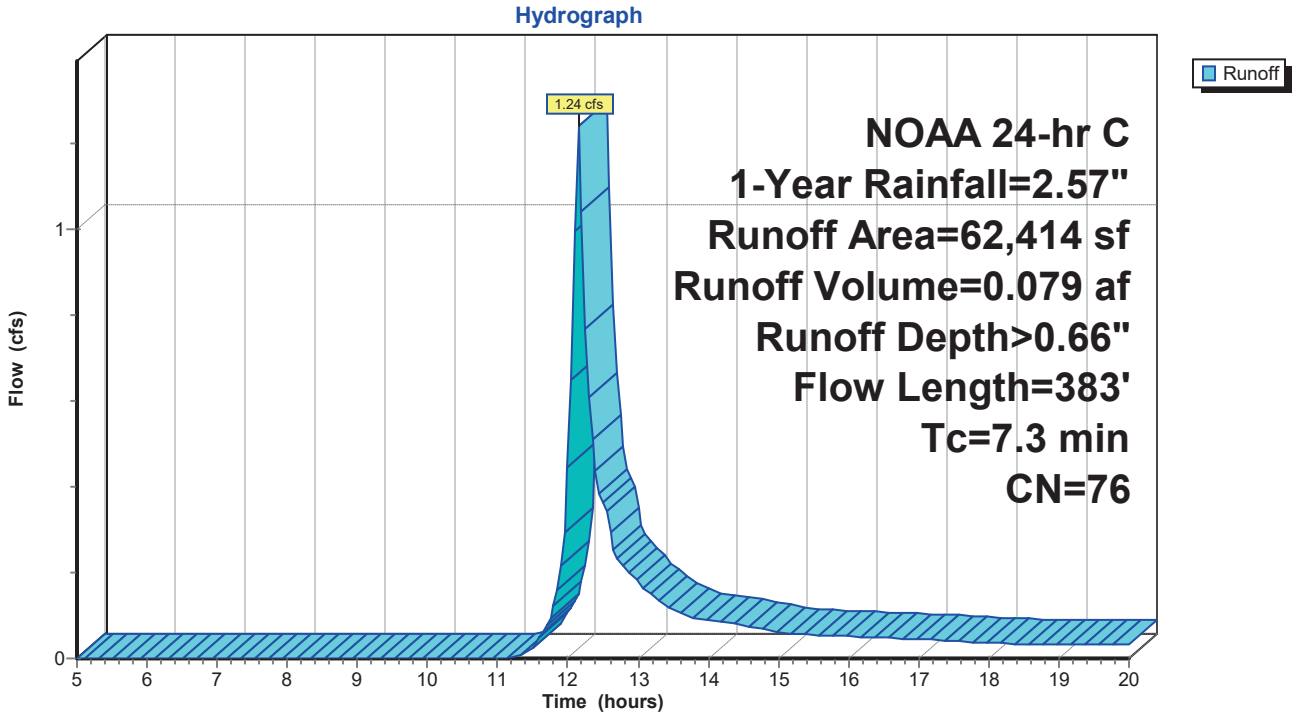
Runoff = 1.24 cfs @ 12.15 hrs, Volume= 0.079 af, Depth> 0.66"
Routed to Link 1L : POI 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
25,229	98	Paved parking, HSG A
34,812	61	>75% Grass cover, Good, HSG B
2,373	74	>75% Grass cover, Good, HSG C
62,414	76	Weighted Average
37,185		59.58% Pervious Area
25,229		40.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	75	0.0350	0.20		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.3	71	0.0460	4.35		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	171	0.0760	5.60		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.2	66	0.0610	5.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
7.3	383	Total			

Subcatchment 1: DA-1



Summary for Subcatchment 3A: DA-3A

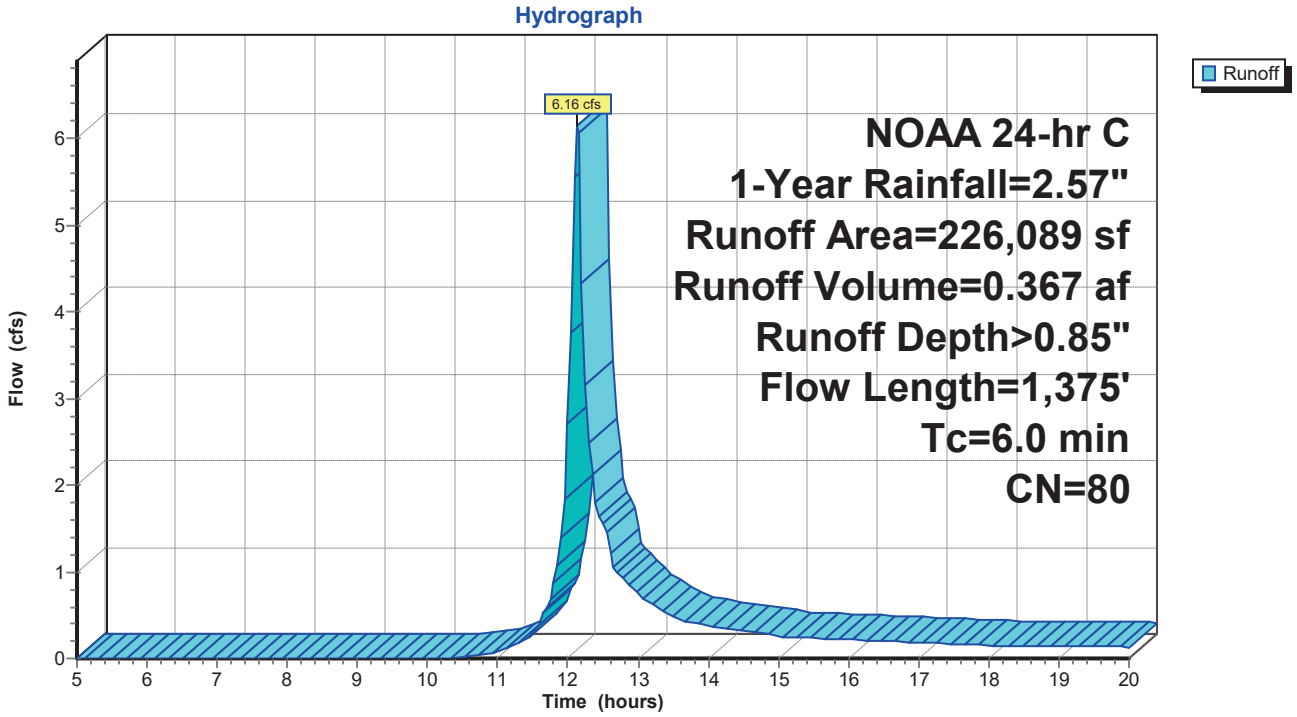
Runoff = 6.16 cfs @ 12.14 hrs, Volume= 0.367 af, Depth> 0.85"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
106,574	98	Paved parking, HSG A
86,146	61	>75% Grass cover, Good, HSG B
33,369	74	>75% Grass cover, Good, HSG C
226,089	80	Weighted Average
119,515		52.86% Pervious Area
106,574		47.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	22	0.0227	1.05		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	428	0.0771	5.64		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.8	185	0.0378	3.95		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.6	152	0.0050	4.20	7.43	**Pipe Channel, D-E** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.7	402	0.0056	9.25	88.98	**Pipe Channel, E-F** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.011 Concrete pipe, straight & clean
0.2	186	0.1070	16.72	118.18	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
3.9	1,375	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3A: DA-3A



Summary for Subcatchment 3B: DA-3B

[47] Hint: Peak is 304% of capacity of segment #5
[47] Hint: Peak is 105% of capacity of segment #6

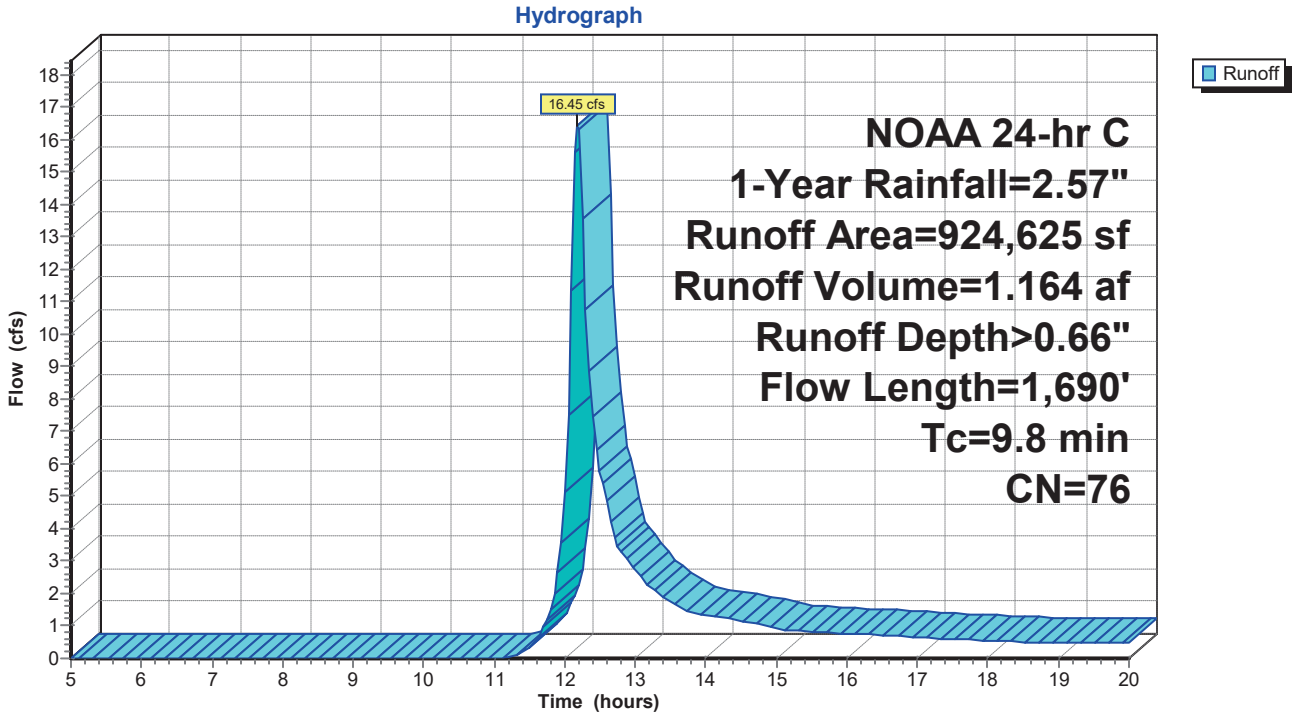
Runoff = 16.45 cfs @ 12.19 hrs, Volume= 1.164 af, Depth> 0.66"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
351,876	98	Paved parking, HSG A
536,743	61	>75% Grass cover, Good, HSG B
36,006	74	>75% Grass cover, Good, HSG C
924,625	76	Weighted Average
572,749		61.94% Pervious Area
351,876		38.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0620	0.24		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.4	108	0.1020	5.14		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.5	99	0.0400	3.22		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	54	0.0190	2.80		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	144	0.0070	4.40	5.40	**Pipe Channel, E-F** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.6	443	0.0590	12.79	15.69	**Pipe Channel, F-G** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.3	106	0.0090	6.83	21.46	**Pipe Channel, G-H** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
1.8	309	0.0030	2.80	19.79	**Pipe Channel, H-I** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.7	176	0.0060	3.96	27.98	**Pipe Channel, I-J** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.2	186	0.1070	16.72	118.18	**Pipe Channel, J-K** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
9.8	1,690	Total			

Subcatchment 3B: DA-3B



Summary for Subcatchment 5: DA-5

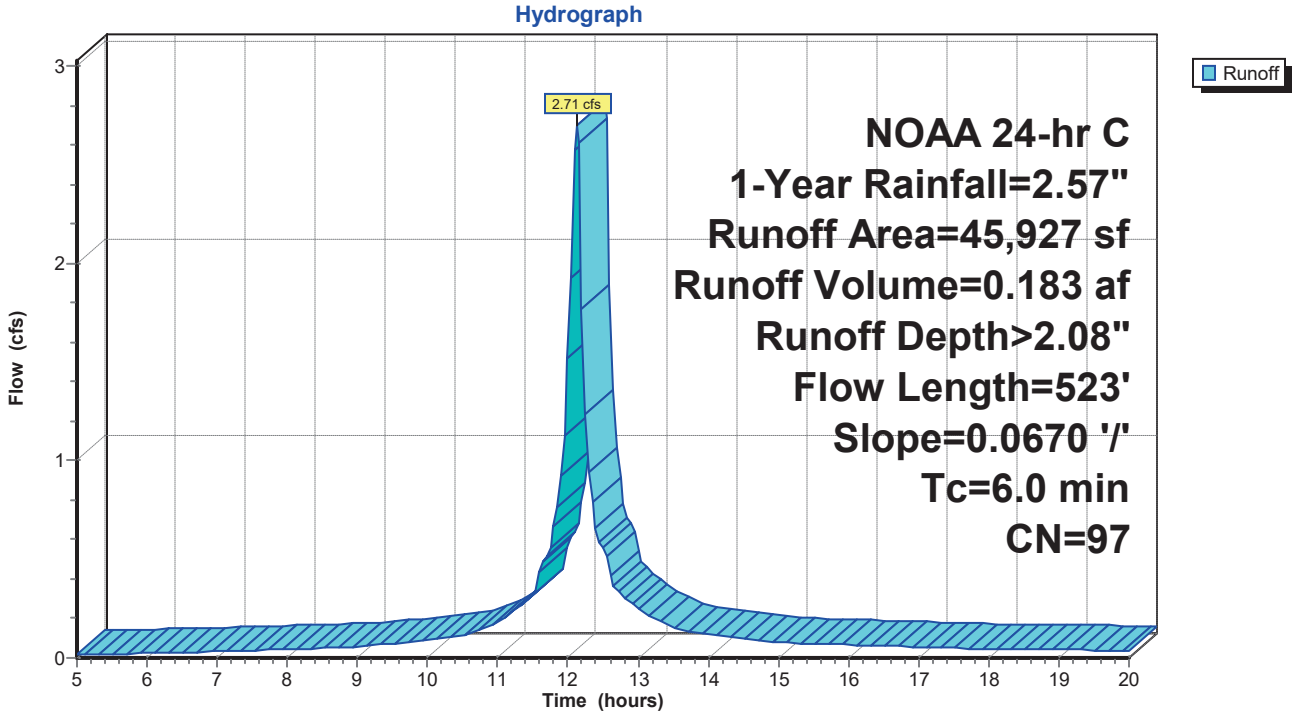
Runoff = 2.71 cfs @ 12.13 hrs, Volume= 0.183 af, Depth> 2.08"
Routed to Link 5L : POI 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
42,651	98	Paved parking, HSG A
20	61	>75% Grass cover, Good, HSG B
3,256	80	>75% Grass cover, Good, HSG D
45,927	97	Weighted Average
3,276		7.13% Pervious Area
42,651		92.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	53	0.0670	1.93		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	470	0.0670	5.25		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	523	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5: DA-5



Summary for Subcatchment 6: DA-6

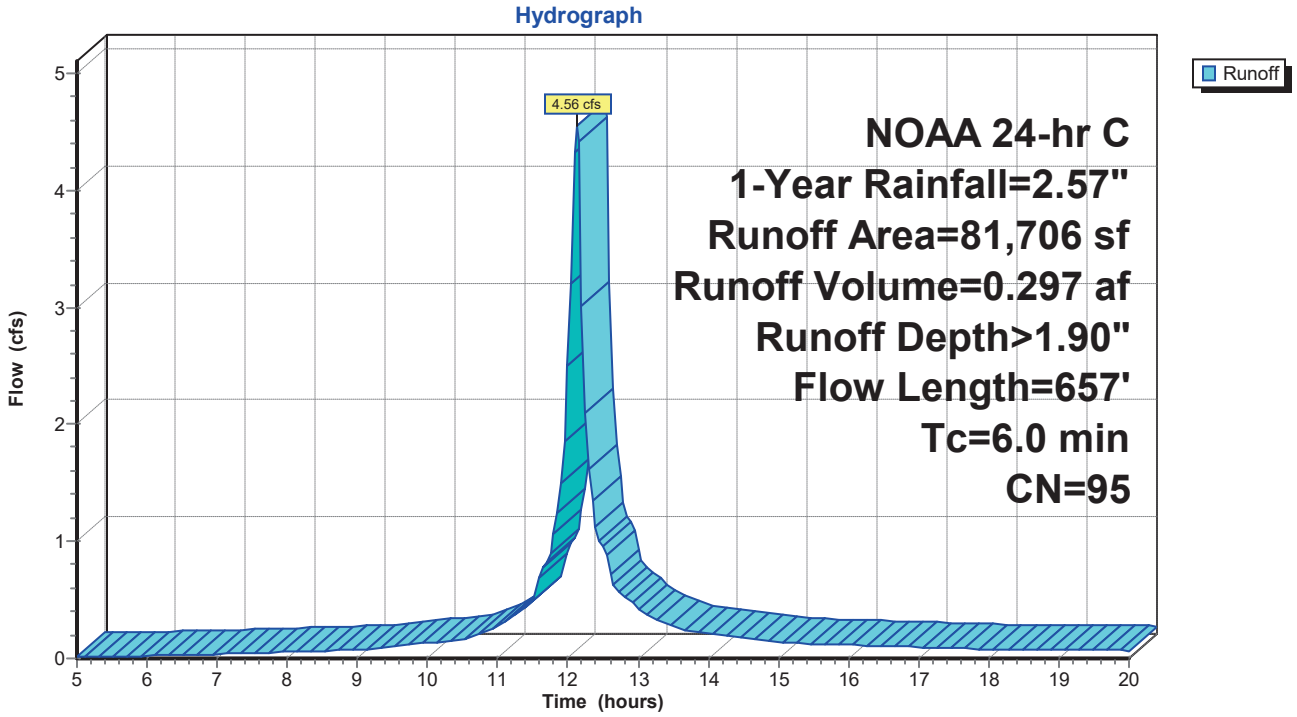
Runoff = 4.56 cfs @ 12.13 hrs, Volume= 0.297 af, Depth> 1.90"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
69,345	98	Paved parking, HSG A
164	61	>75% Grass cover, Good, HSG B
12,197	80	>75% Grass cover, Good, HSG D
81,706	95	Weighted Average
12,361		15.13% Pervious Area
69,345		84.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	47	0.0540	1.73		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	321	0.0311	3.58		**Shallow Concentrated Flow, b-c** Paved Kv= 20.3 fps
0.4	155	0.0050	6.02	18.90	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	134	0.0430	32.51	638.26	**Pipe Channel, D-E** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.011 Concrete pipe, straight & clean
2.5	657	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 6: DA-6



Summary for Subcatchment 8: DA-8

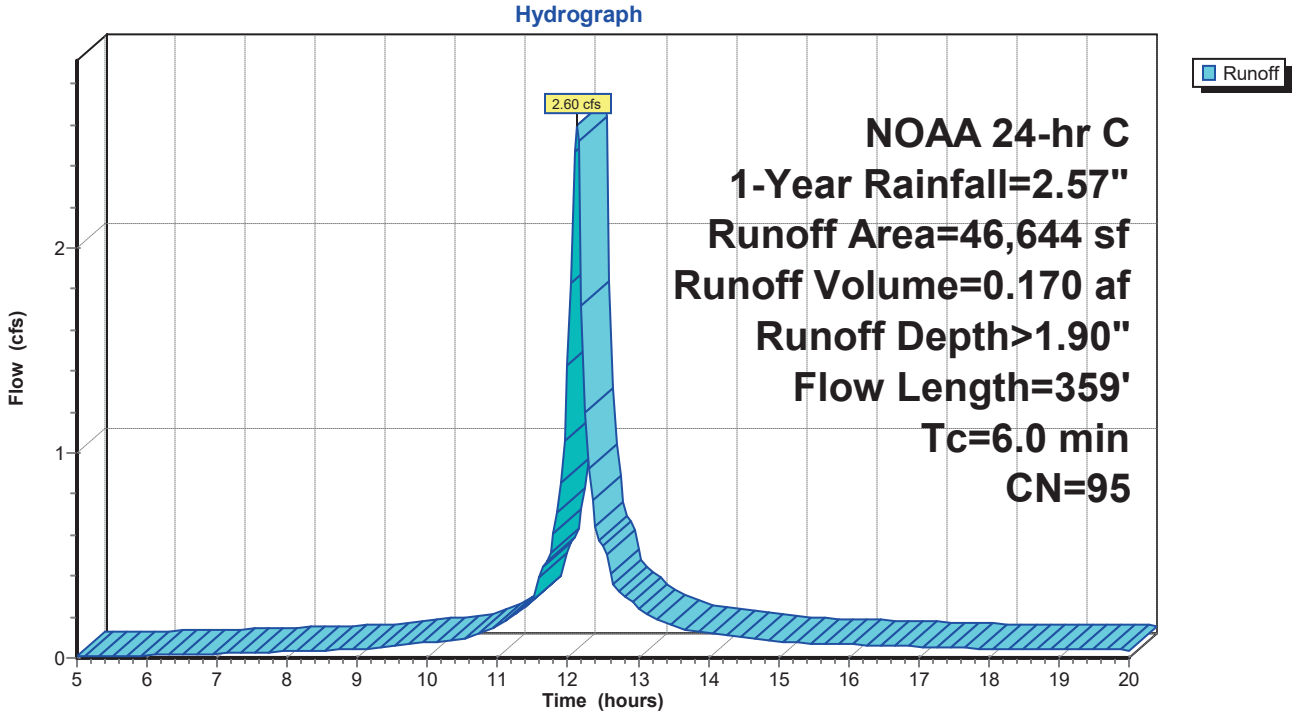
Runoff = 2.60 cfs @ 12.13 hrs, Volume= 0.170 af, Depth> 1.90"
Routed to Link 8L : POI 8

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
41,159	98	Paved parking, HSG A
1,093	61	>75% Grass cover, Good, HSG B
4,392	80	>75% Grass cover, Good, HSG D
46,644	95	Weighted Average
5,485		11.76% Pervious Area
41,159		88.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	309	0.0390	4.01		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	359	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 8: DA-8



Summary for Subcatchment 10: DA-10

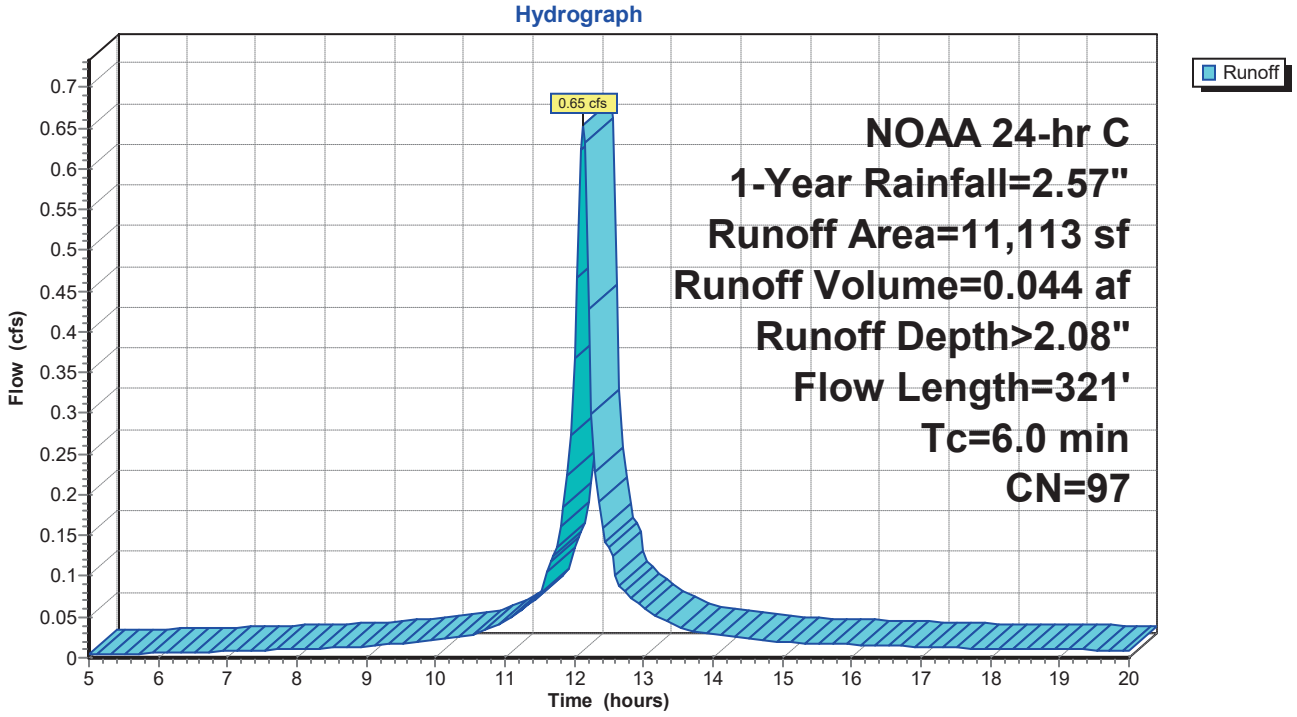
Runoff = 0.65 cfs @ 12.13 hrs, Volume= 0.044 af, Depth> 2.08"
Routed to Link 10L : POI 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
10,794	98	Paved parking, HSG A
319	80	>75% Grass cover, Good, HSG D
11,113	97	Weighted Average
319		2.87% Pervious Area
10,794		97.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	43	0.0470	1.61		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.0	254	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	24	0.4170	25.19	79.13	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.024
1.4	321	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 10: DA-10



Summary for Subcatchment 11: DA-11

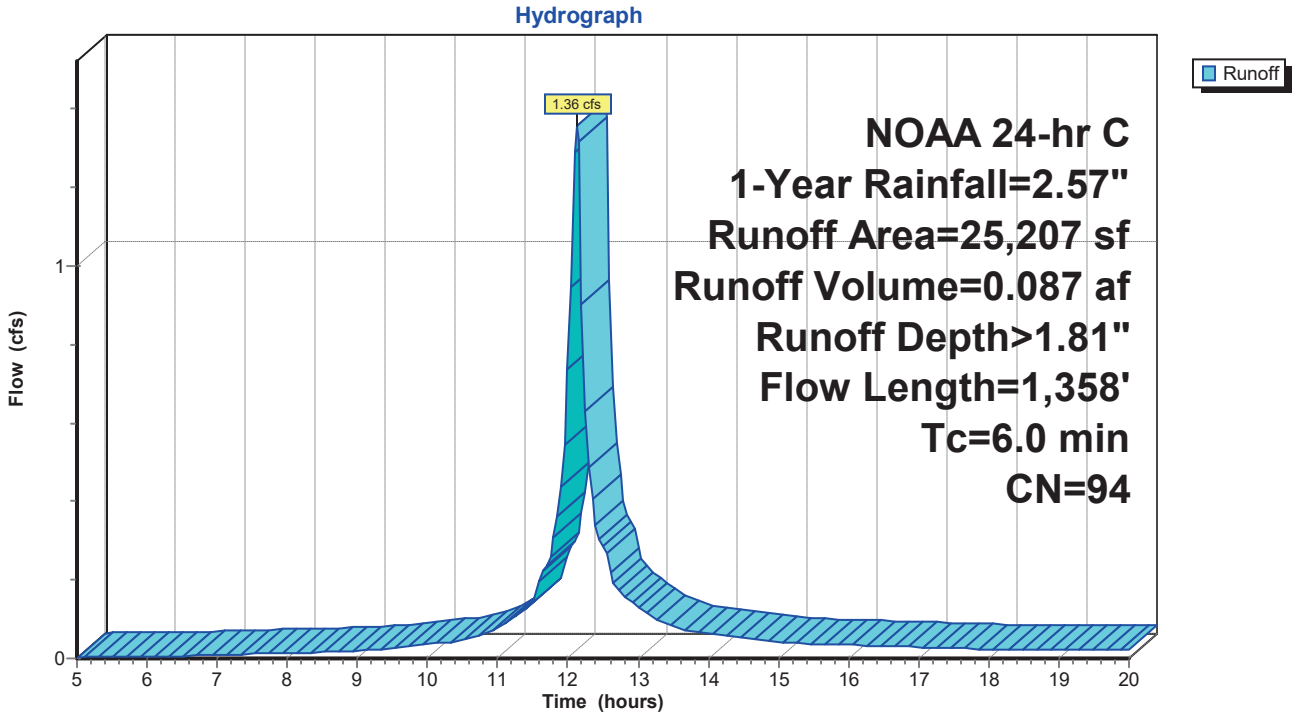
Runoff = 1.36 cfs @ 12.13 hrs, Volume= 0.087 af, Depth> 1.81"
Routed to Link 11L : POI 11

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
19,368	98	Paved parking, HSG A
5,839	80	>75% Grass cover, Good, HSG D
25,207	94	Weighted Average
5,839		23.16% Pervious Area
19,368		76.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	53	0.0340	1.47		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
0.4	125	0.0600	4.97		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.8	403	0.0347	3.78		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.1	48	0.0108	6.18	10.92	**Pipe Channel, D-E** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.8	603	0.0311	12.70	39.90	**Pipe Channel, E-F** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.1	126	0.0963	29.28	206.98	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
3.8	1,358	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 11: DA-11



Summary for Subcatchment 12: DA-12

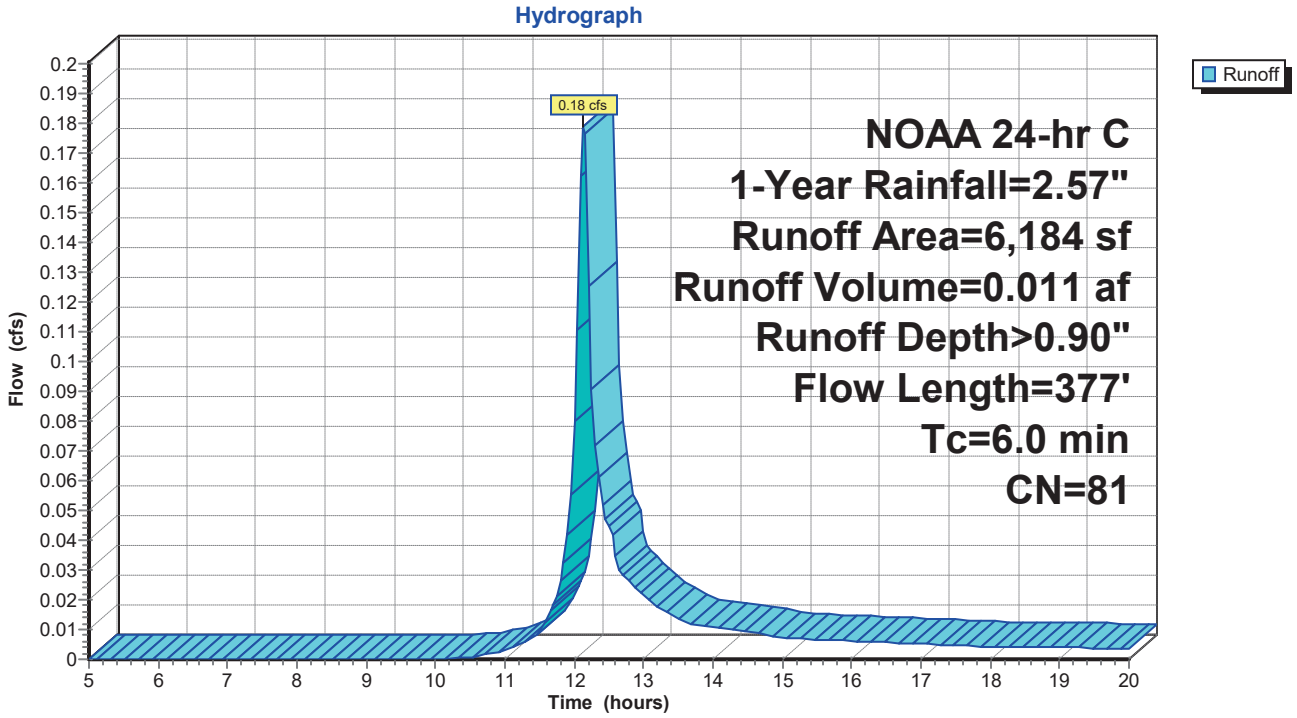
Runoff = 0.18 cfs @ 12.14 hrs, Volume= 0.011 af, Depth> 0.90"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
239	98	Paved parking, HSG A
5,945	80	>75% Grass cover, Good, HSG D
6,184	81	Weighted Average
5,945		96.14% Pervious Area
239		3.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.03		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.7	156	0.0060	1.57		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	21	0.2860	10.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.3	100	0.0600	4.97		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
3.6	377	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 12: DA-12



Summary for Subcatchment 13: DA-13

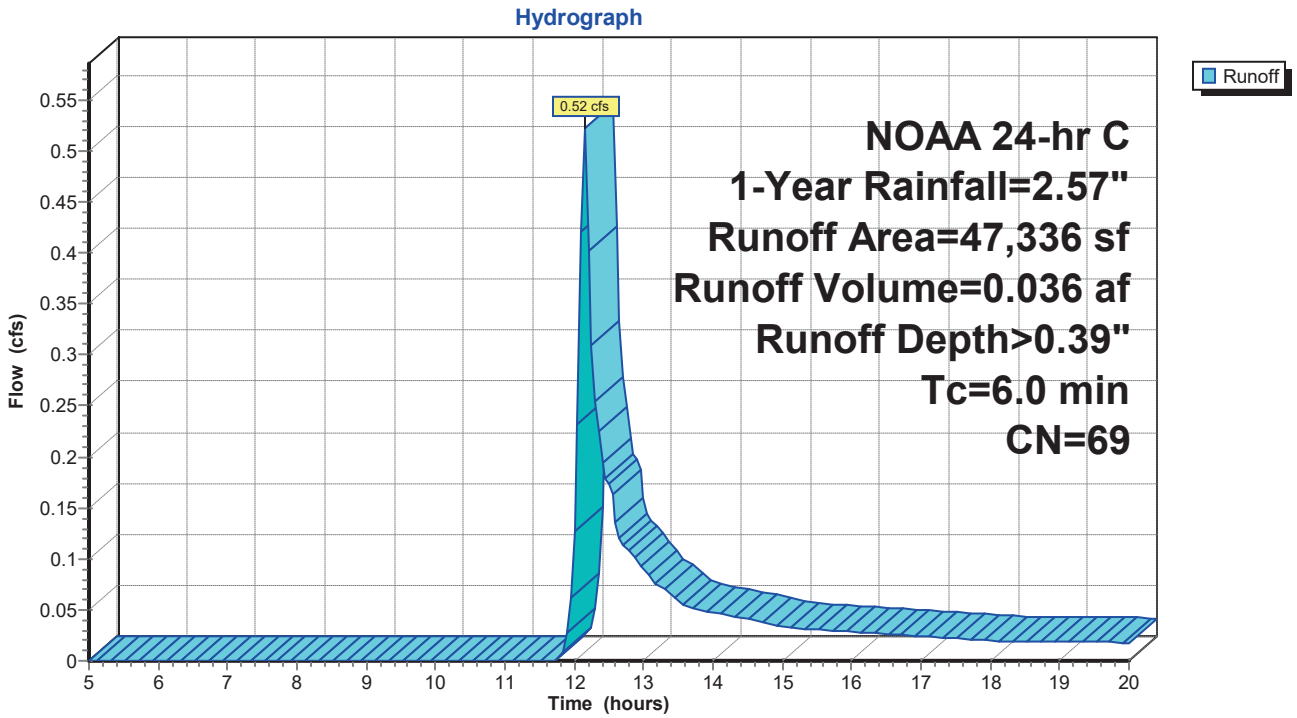
Runoff = 0.52 cfs @ 12.15 hrs, Volume= 0.036 af, Depth> 0.39"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.57"

Area (sf)	CN	Description
366	98	Paved parking, HSG A
28,571	61	>75% Grass cover, Good, HSG B
18,399	80	>75% Grass cover, Good, HSG D
47,336	69	Weighted Average
46,970		99.23% Pervious Area
366		0.77% Impervious Area

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

Subcatchment 13: DA-13



Summary for Reach 1R: Channel A

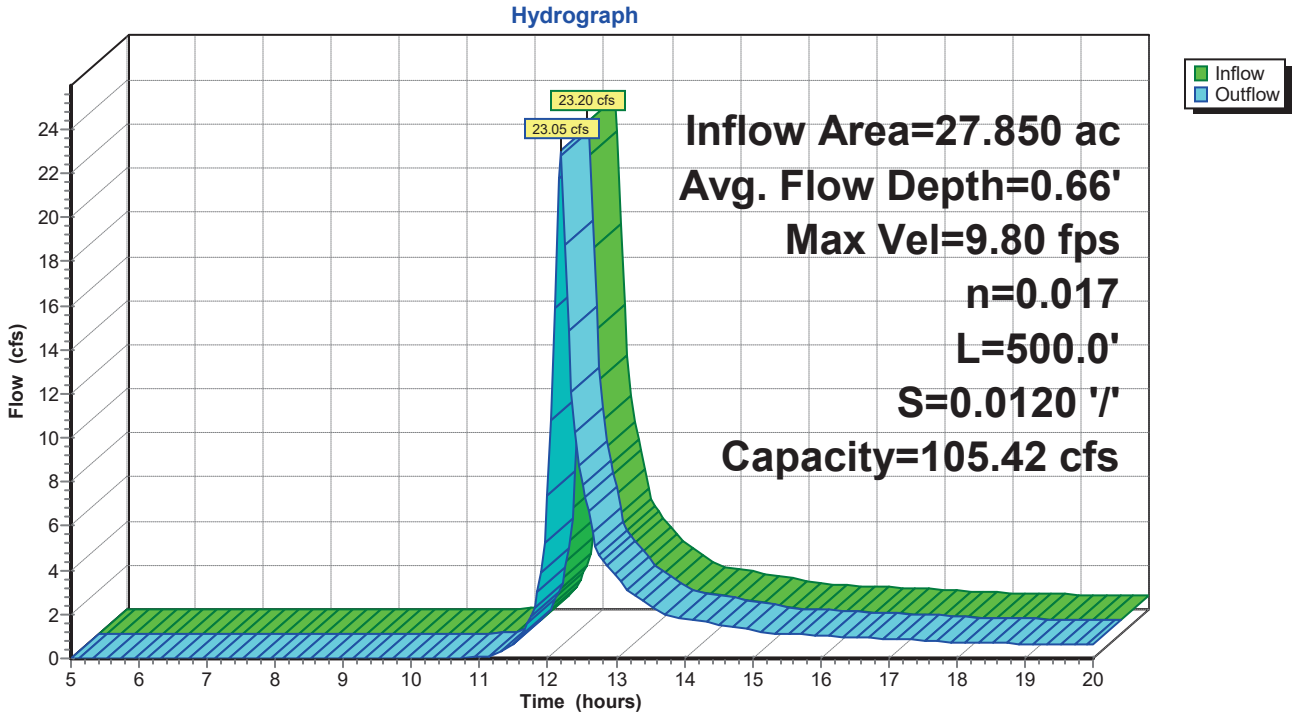
Inflow Area = 27.850 ac, 39.87% Impervious, Inflow Depth > 0.69" for 1-Year event
Inflow = 23.20 cfs @ 12.17 hrs, Volume= 1.610 af
Outflow = 23.05 cfs @ 12.19 hrs, Volume= 1.609 af, Atten= 1%, Lag= 1.2 min
Routed to Link OUT-B : OUTBALL B

Routing by Muskingum-Cunge method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Reference Flow= 17.40 cfs Estimated Depth= 0.73' Velocity= 6.35 fps
m= 1.497, c= 9.50 fps, dt= 3.0 min, dx= 500.0' / 1 = 500.0', K= 0.9 min, X= 0.459
Max. Velocity= 9.80 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 9.46 fps, Avg. Travel Time= 0.9 min

Peak Storage= 1,200 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.66' , Surface Width= 4.31'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 105.42 cfs

3.00' x 2.00' deep channel, n= 0.017 Concrete, unfinished
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 500.0' Slope= 0.0120 '/'
Inlet Invert= 274.00', Outlet Invert= 268.00'

Reach 1R: Channel A

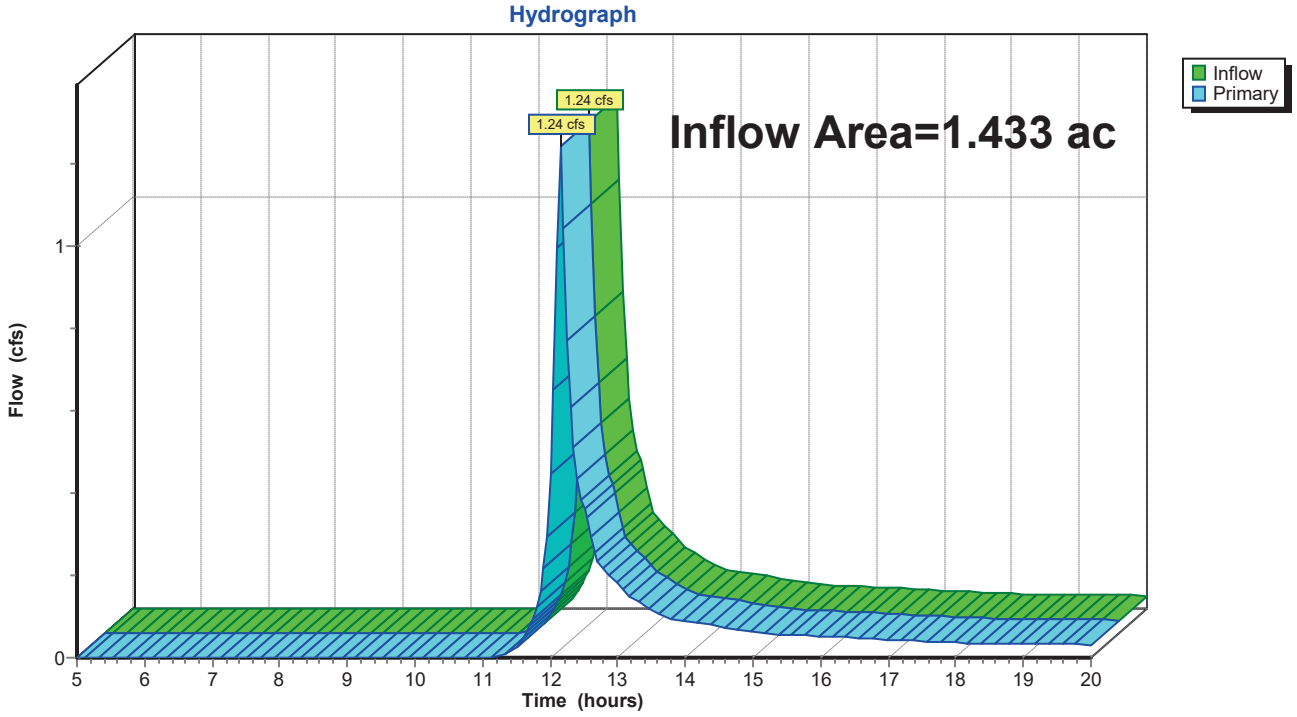


Summary for Link 1L: POI 1

Inflow Area = 1.433 ac, 40.42% Impervious, Inflow Depth > 0.66" for 1-Year event
Inflow = 1.24 cfs @ 12.15 hrs, Volume= 0.079 af
Primary = 1.24 cfs @ 12.15 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

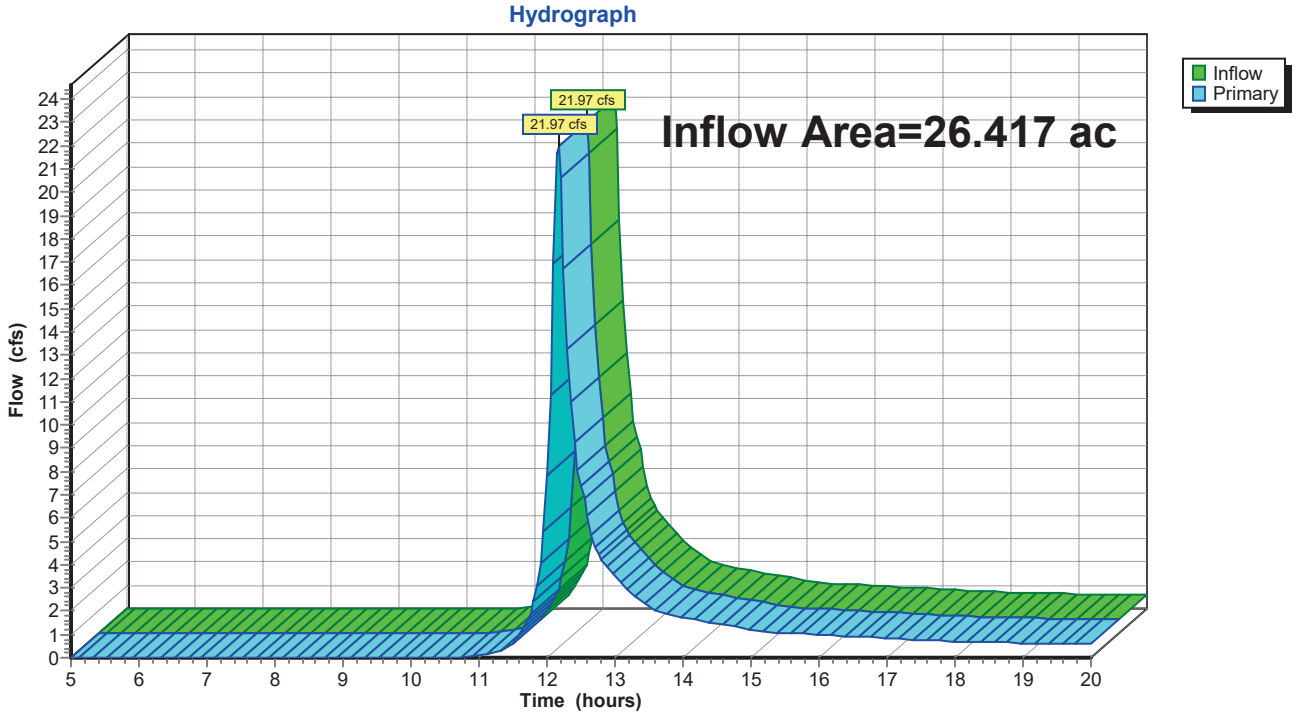


Summary for Link 3L: POI 3

Inflow Area = 26.417 ac, 39.84% Impervious, Inflow Depth > 0.70" for 1-Year event
Inflow = 21.97 cfs @ 12.17 hrs, Volume= 1.532 af
Primary = 21.97 cfs @ 12.17 hrs, Volume= 1.532 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: POI 3

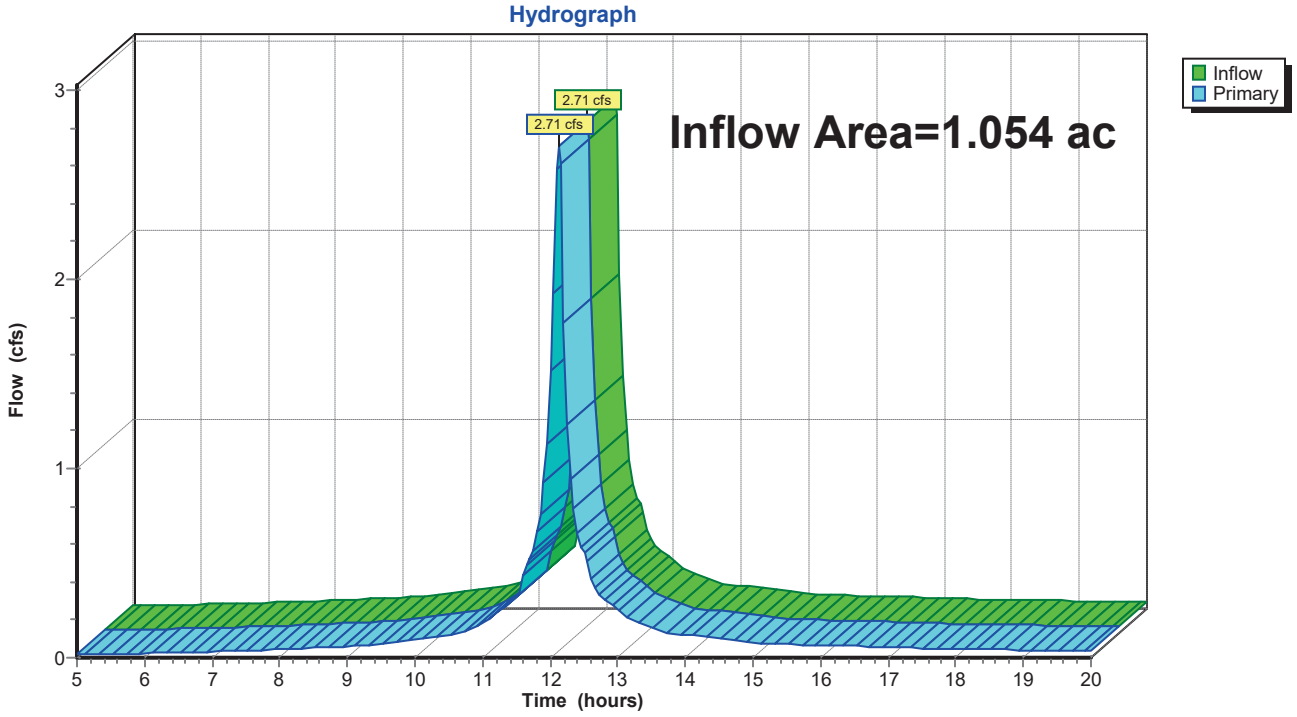


Summary for Link 5L: POI 5

Inflow Area = 1.054 ac, 92.87% Impervious, Inflow Depth > 2.08" for 1-Year event
Inflow = 2.71 cfs @ 12.13 hrs, Volume= 0.183 af
Primary = 2.71 cfs @ 12.13 hrs, Volume= 0.183 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: POI 5

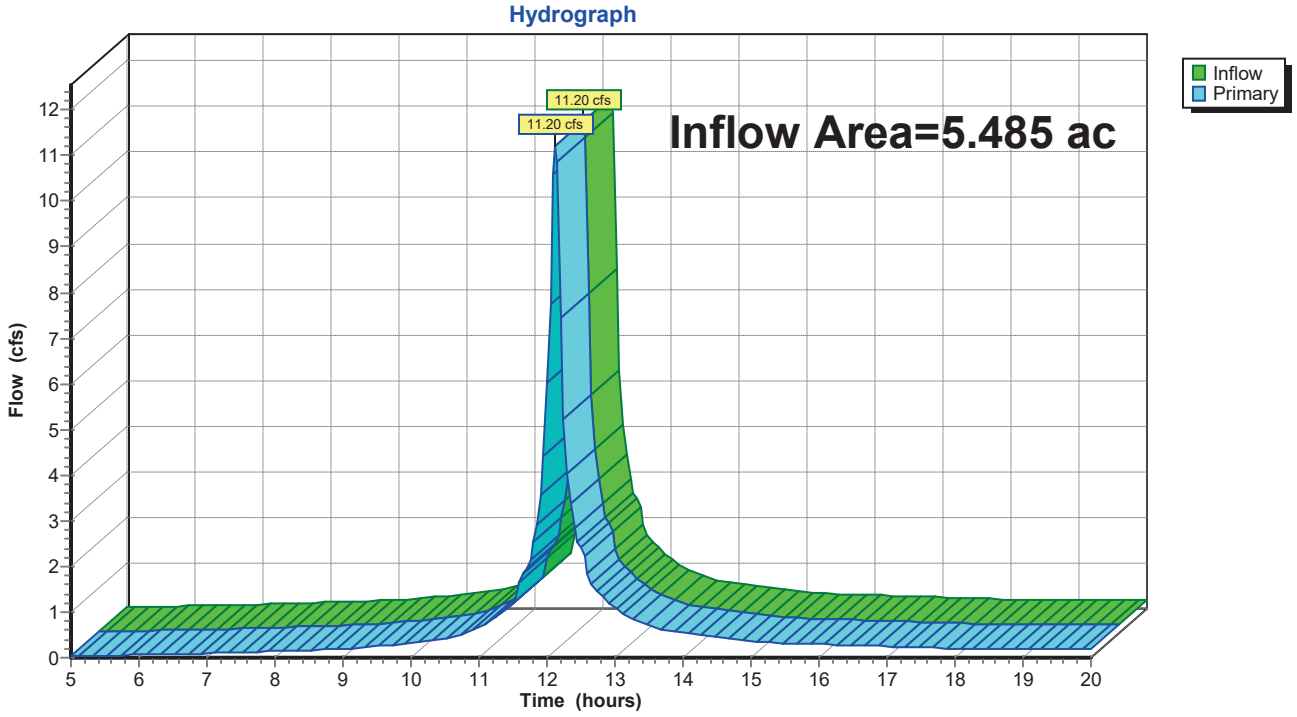


Summary for Link 6L: POI 6

Inflow Area = 5.485 ac, 68.88% Impervious, Inflow Depth > 1.62" for 1-Year event
Inflow = 11.20 cfs @ 12.13 hrs, Volume= 0.741 af
Primary = 11.20 cfs @ 12.13 hrs, Volume= 0.741 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-B : OUTBALL B

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 6L: POI 6

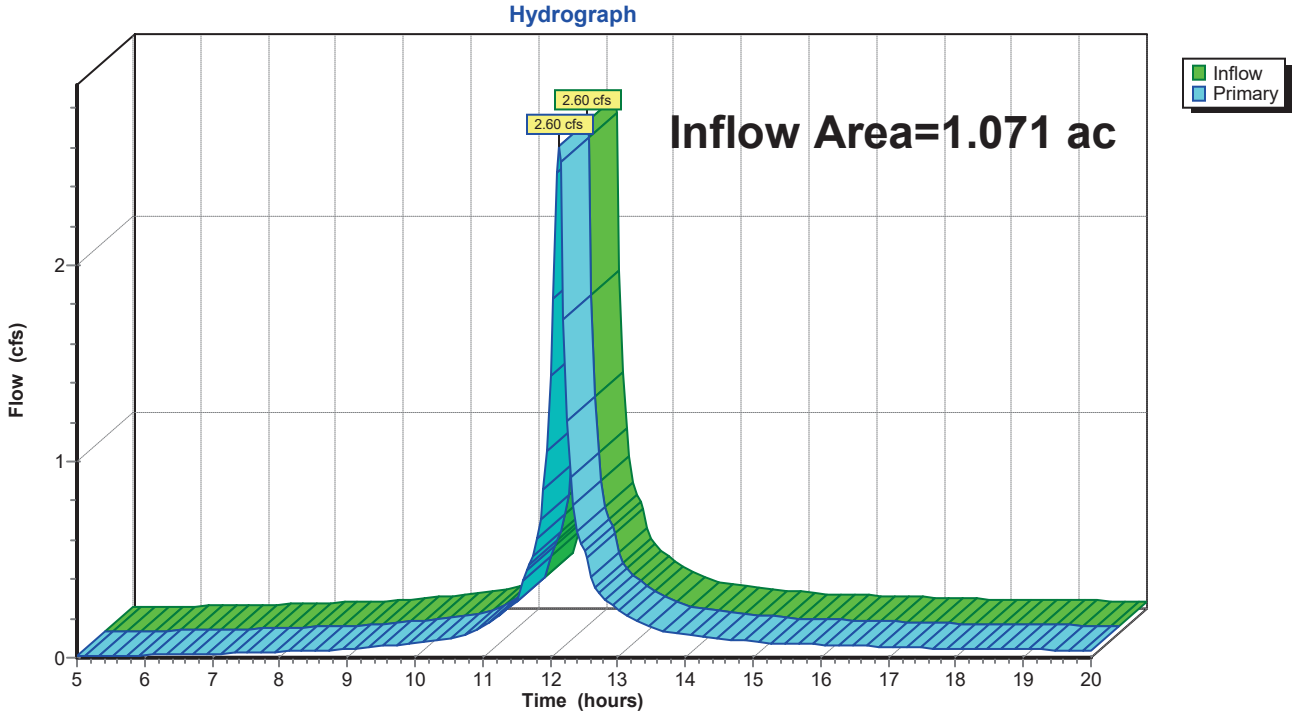


Summary for Link 8L: POI 8

Inflow Area = 1.071 ac, 88.24% Impervious, Inflow Depth > 1.90" for 1-Year event
Inflow = 2.60 cfs @ 12.13 hrs, Volume= 0.170 af
Primary = 2.60 cfs @ 12.13 hrs, Volume= 0.170 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 8L: POI 8

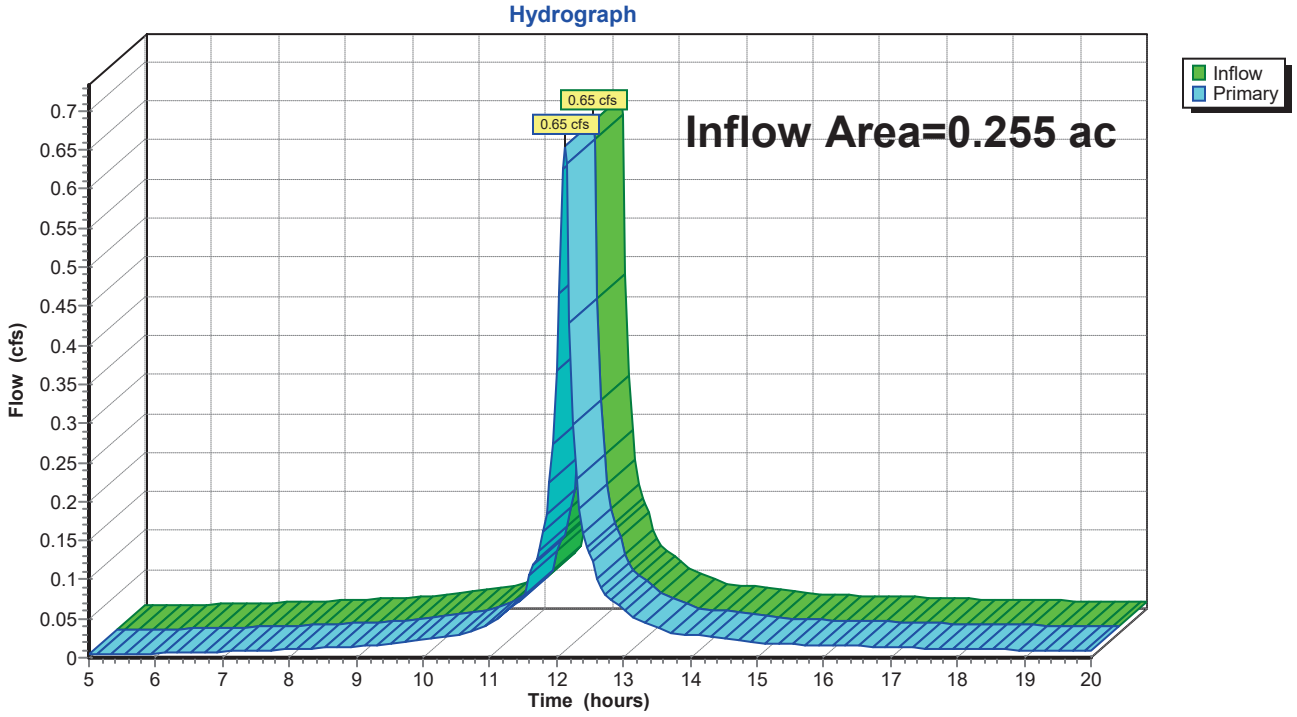


Summary for Link 10L: POI 10

Inflow Area = 0.255 ac, 97.13% Impervious, Inflow Depth > 2.08" for 1-Year event
Inflow = 0.65 cfs @ 12.13 hrs, Volume= 0.044 af
Primary = 0.65 cfs @ 12.13 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: POI 10

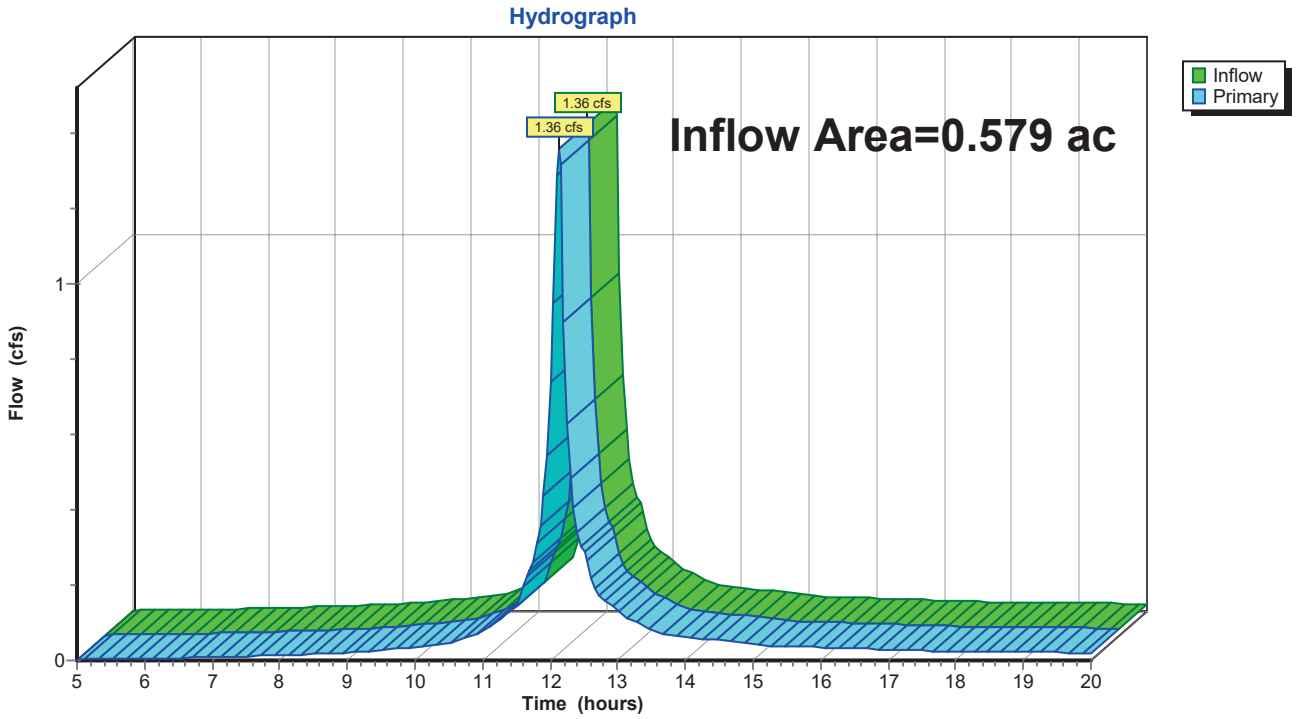


Summary for Link 11L: POI 11

Inflow Area = 0.579 ac, 76.84% Impervious, Inflow Depth > 1.81" for 1-Year event
Inflow = 1.36 cfs @ 12.13 hrs, Volume= 0.087 af
Primary = 1.36 cfs @ 12.13 hrs, Volume= 0.087 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 11L: POI 11

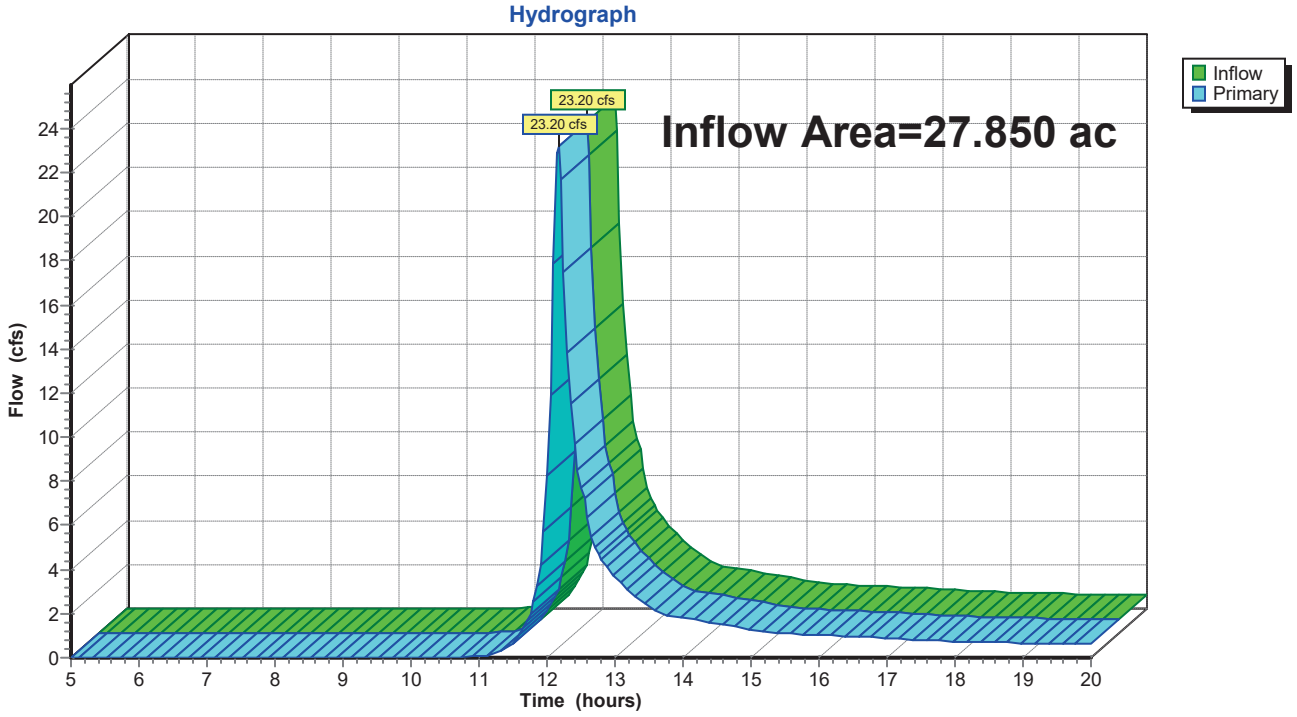


Summary for Link OUT-A: Outfall A

Inflow Area = 27.850 ac, 39.87% Impervious, Inflow Depth > 0.69" for 1-Year event
Inflow = 23.20 cfs @ 12.17 hrs, Volume= 1.610 af
Primary = 23.20 cfs @ 12.17 hrs, Volume= 1.610 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 1R : Channel A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-A: Outfall A

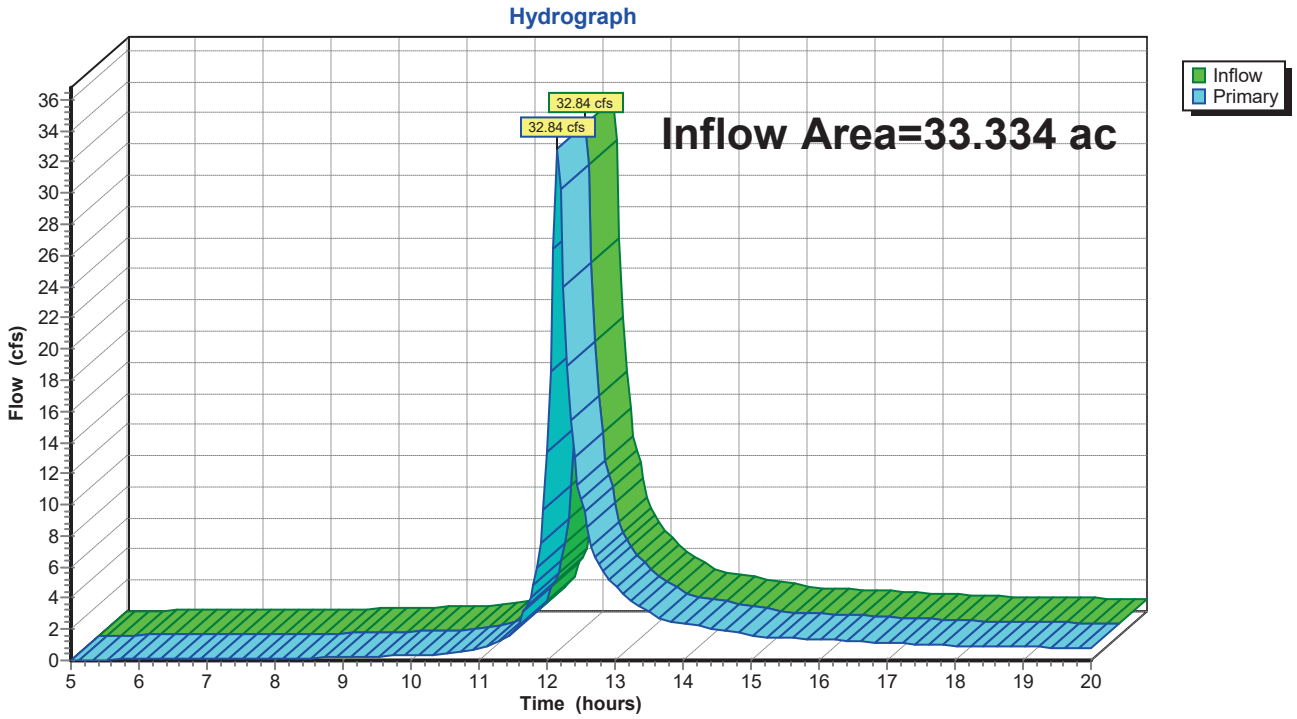


Summary for Link OUT-B: OUTBALL B

Inflow Area = 33.334 ac, 44.64% Impervious, Inflow Depth > 0.85" for 1-Year event
Inflow = 32.84 cfs @ 12.16 hrs, Volume= 2.350 af
Primary = 32.84 cfs @ 12.16 hrs, Volume= 2.350 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-B: OUTBALL B



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Muskingum-Cunge method - Pond routing by Stor-Ind method

Subcatchment 1: DA-1 Runoff Area=62,414 sf 40.42% Impervious Runoff Depth>2.15"
Flow Length=383' Tc=7.3 min CN=76 Runoff=4.15 cfs 0.257 af

Subcatchment 3A: DA-3A Runoff Area=226,089 sf 47.14% Impervious Runoff Depth>2.49"
Flow Length=1,375' Tc=6.0 min CN=80 Runoff=17.77 cfs 1.076 af

Subcatchment 3B: DA-3B Runoff Area=924,625 sf 38.06% Impervious Runoff Depth>2.15"
Flow Length=1,690' Tc=9.8 min CN=76 Runoff=55.58 cfs 3.807 af

Subcatchment 5: DA-5 Runoff Area=45,927 sf 92.87% Impervious Runoff Depth>4.08"
Flow Length=523' Slope=0.0670 '/' Tc=6.0 min CN=97 Runoff=5.15 cfs 0.359 af

Subcatchment 6: DA-6 Runoff Area=81,706 sf 84.87% Impervious Runoff Depth>3.91"
Flow Length=657' Tc=6.0 min CN=95 Runoff=8.98 cfs 0.611 af

Subcatchment 8: DA-8 Runoff Area=46,644 sf 88.24% Impervious Runoff Depth>3.91"
Flow Length=359' Tc=6.0 min CN=95 Runoff=5.13 cfs 0.349 af

Subcatchment 10: DA-10 Runoff Area=11,113 sf 97.13% Impervious Runoff Depth>4.08"
Flow Length=321' Tc=6.0 min CN=97 Runoff=1.25 cfs 0.087 af

Subcatchment 11: DA-11 Runoff Area=25,207 sf 76.84% Impervious Runoff Depth>3.81"
Flow Length=1,358' Tc=6.0 min CN=94 Runoff=2.74 cfs 0.184 af

Subcatchment 12: DA-12 Runoff Area=6,184 sf 3.86% Impervious Runoff Depth>2.58"
Flow Length=377' Tc=6.0 min CN=81 Runoff=0.50 cfs 0.030 af

Subcatchment 13: DA-13 Runoff Area=47,336 sf 0.77% Impervious Runoff Depth>1.62"
Tc=6.0 min CN=69 Runoff=2.47 cfs 0.147 af

Reach 1R: Channel A Avg. Flow Depth=1.36' Max Vel=13.08 fps Inflow=75.93 cfs 5.141 af
n=0.017 L=500.0' S=0.0120 '/' Capacity=105.42 cfs Outflow=75.34 cfs 5.139 af

Link 1L: POI 1 Inflow=4.15 cfs 0.257 af
Primary=4.15 cfs 0.257 af

Link 3L: POI 3 Inflow=71.83 cfs 4.883 af
Primary=71.83 cfs 4.883 af

Link 5L: POI 5 Inflow=5.15 cfs 0.359 af
Primary=5.15 cfs 0.359 af

Link 6L: POI 6 Inflow=23.47 cfs 1.582 af
Primary=23.47 cfs 1.582 af

Link 8L: POI 8 Inflow=5.13 cfs 0.349 af
Primary=5.13 cfs 0.349 af

Link 10L: POI 10 Inflow=1.25 cfs 0.087 af
Primary=1.25 cfs 0.087 af

Link 11L: POI 11 Inflow=2.74 cfs 0.184 af
Primary=2.74 cfs 0.184 af

Link OUT-A: Outfall A Inflow=75.93 cfs 5.141 af
Primary=75.93 cfs 5.141 af

Link OUT-B: OUTBALL B Inflow=96.72 cfs 6.721 af
Primary=96.72 cfs 6.721 af

Total Runoff Area = 33.913 ac Runoff Volume = 6.906 af Average Runoff Depth = 2.44"
54.81% Pervious = 18.587 ac 45.19% Impervious = 15.326 ac

Summary for Subcatchment 1: DA-1

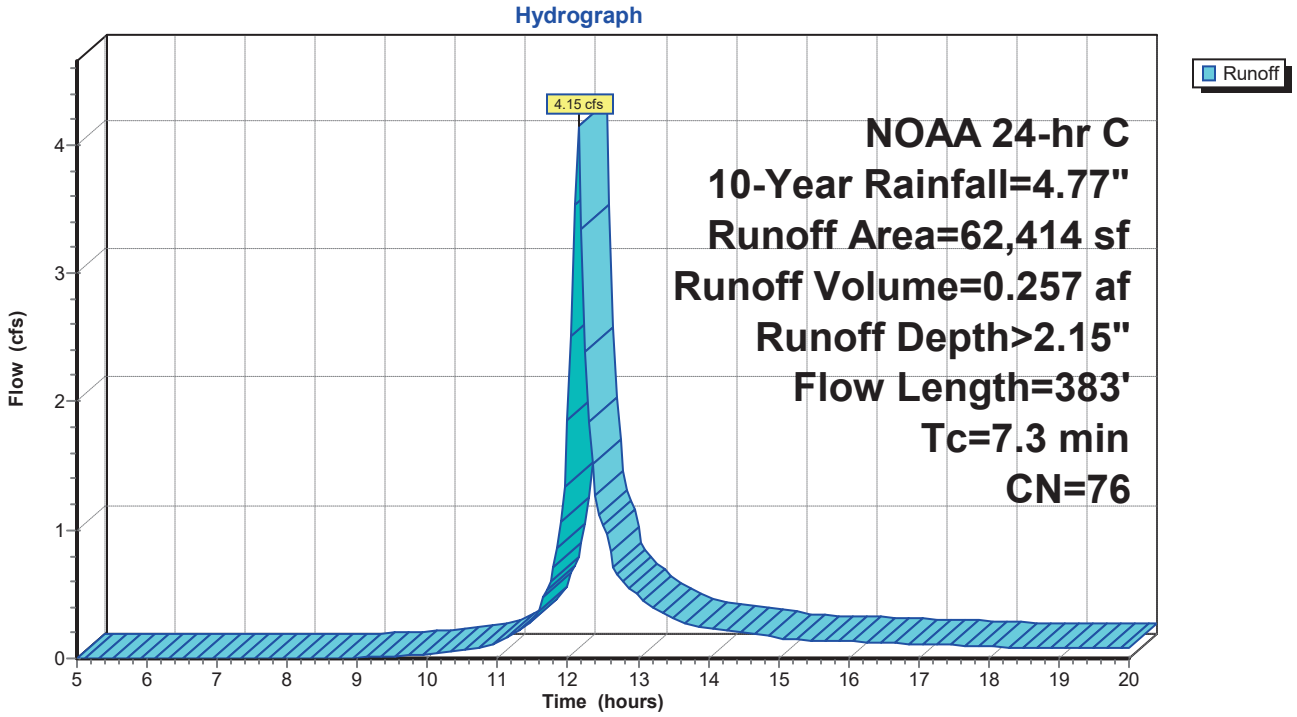
Runoff = 4.15 cfs @ 12.15 hrs, Volume= 0.257 af, Depth> 2.15"
Routed to Link 1L : POI 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
25,229	98	Paved parking, HSG A
34,812	61	>75% Grass cover, Good, HSG B
2,373	74	>75% Grass cover, Good, HSG C
62,414	76	Weighted Average
37,185		59.58% Pervious Area
25,229		40.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	75	0.0350	0.20		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.3	71	0.0460	4.35		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	171	0.0760	5.60		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.2	66	0.0610	5.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
7.3	383	Total			

Subcatchment 1: DA-1



Summary for Subcatchment 3A: DA-3A

[47] Hint: Peak is 239% of capacity of segment #4

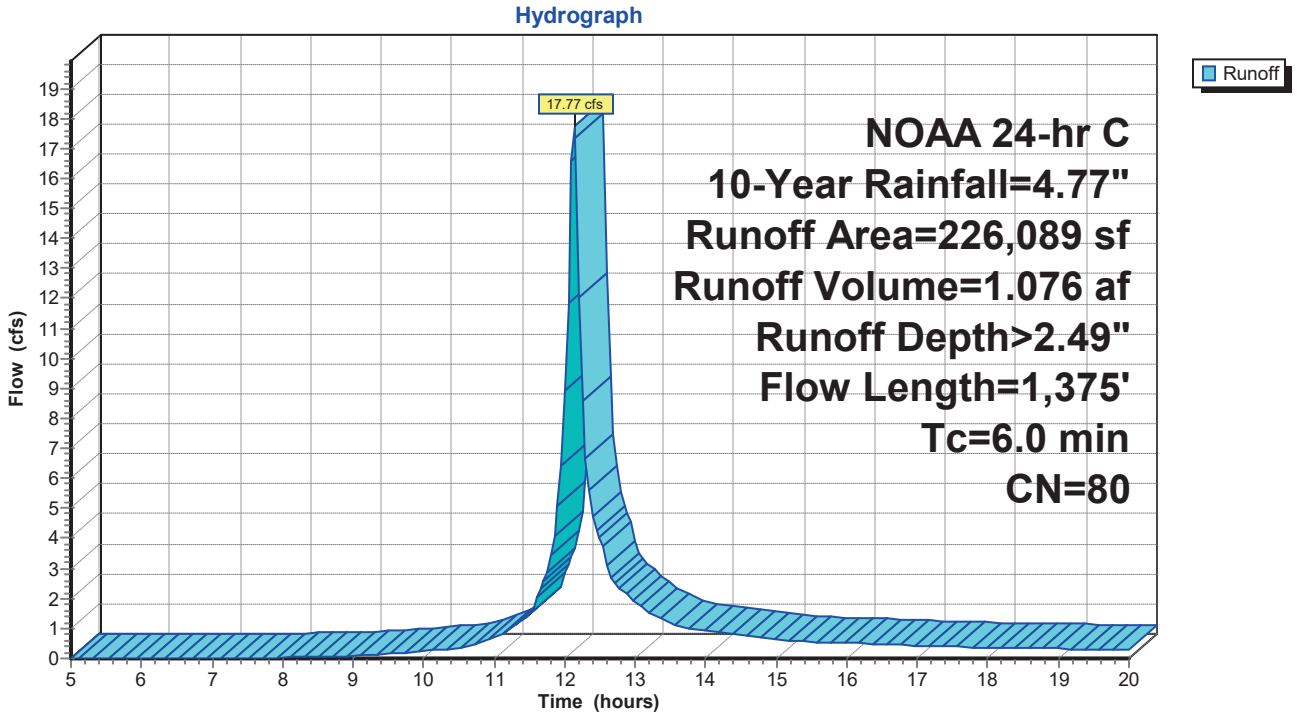
Runoff = 17.77 cfs @ 12.13 hrs, Volume= 1.076 af, Depth> 2.49"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
106,574	98	Paved parking, HSG A
86,146	61	>75% Grass cover, Good, HSG B
33,369	74	>75% Grass cover, Good, HSG C
226,089	80	Weighted Average
119,515		52.86% Pervious Area
106,574		47.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	22	0.0227	1.05		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	428	0.0771	5.64		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.8	185	0.0378	3.95		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.6	152	0.0050	4.20	7.43	**Pipe Channel, D-E** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.7	402	0.0056	9.25	88.98	**Pipe Channel, E-F** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.011 Concrete pipe, straight & clean
0.2	186	0.1070	16.72	118.18	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
3.9	1,375	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3A: DA-3A



Summary for Subcatchment 3B: DA-3B

[47] Hint: Peak is 1028% of capacity of segment #5
[47] Hint: Peak is 354% of capacity of segment #6
[47] Hint: Peak is 259% of capacity of segment #7
[47] Hint: Peak is 281% of capacity of segment #8
[47] Hint: Peak is 199% of capacity of segment #9

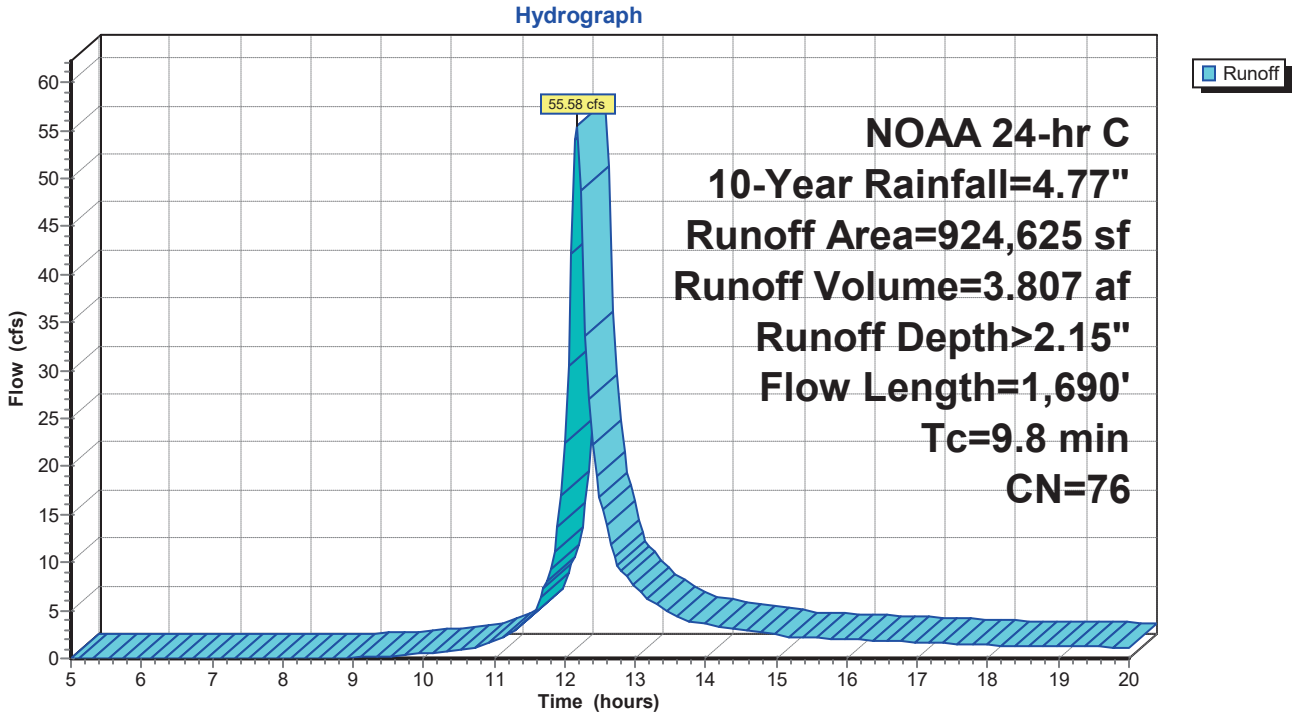
Runoff = 55.58 cfs @ 12.17 hrs, Volume= 3.807 af, Depth> 2.15"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
351,876	98	Paved parking, HSG A
536,743	61	>75% Grass cover, Good, HSG B
36,006	74	>75% Grass cover, Good, HSG C
924,625	76	Weighted Average
572,749		61.94% Pervious Area
351,876		38.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0620	0.24		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.4	108	0.1020	5.14		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.5	99	0.0400	3.22		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	54	0.0190	2.80		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	144	0.0070	4.40	5.40	**Pipe Channel, E-F** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.6	443	0.0590	12.79	15.69	**Pipe Channel, F-G** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.3	106	0.0090	6.83	21.46	**Pipe Channel, G-H** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
1.8	309	0.0030	2.80	19.79	**Pipe Channel, H-I** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.7	176	0.0060	3.96	27.98	**Pipe Channel, I-J** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.2	186	0.1070	16.72	118.18	**Pipe Channel, J-K** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
9.8	1,690	Total			

Subcatchment 3B: DA-3B



Summary for Subcatchment 5: DA-5

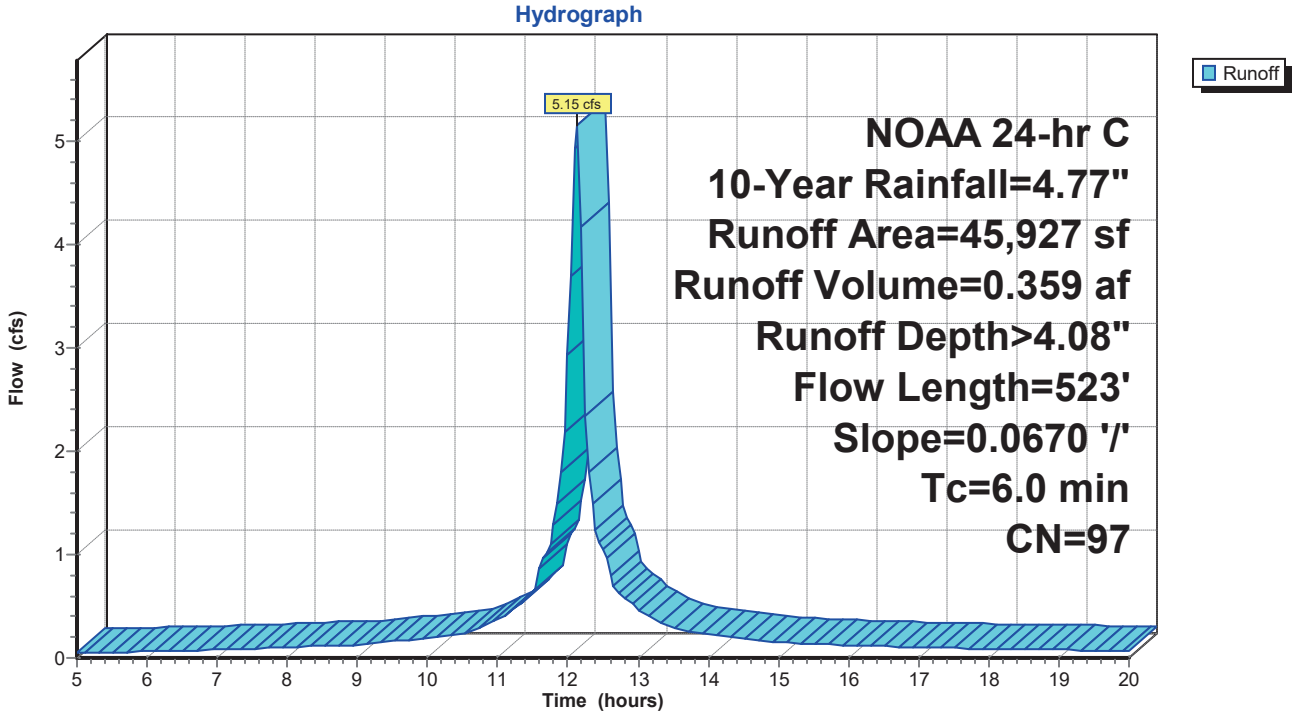
Runoff = 5.15 cfs @ 12.13 hrs, Volume= 0.359 af, Depth> 4.08"
Routed to Link 5L : POI 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
42,651	98	Paved parking, HSG A
20	61	>75% Grass cover, Good, HSG B
3,256	80	>75% Grass cover, Good, HSG D
45,927	97	Weighted Average
3,276		7.13% Pervious Area
42,651		92.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	53	0.0670	1.93		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	470	0.0670	5.25		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	523	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5: DA-5



Summary for Subcatchment 6: DA-6

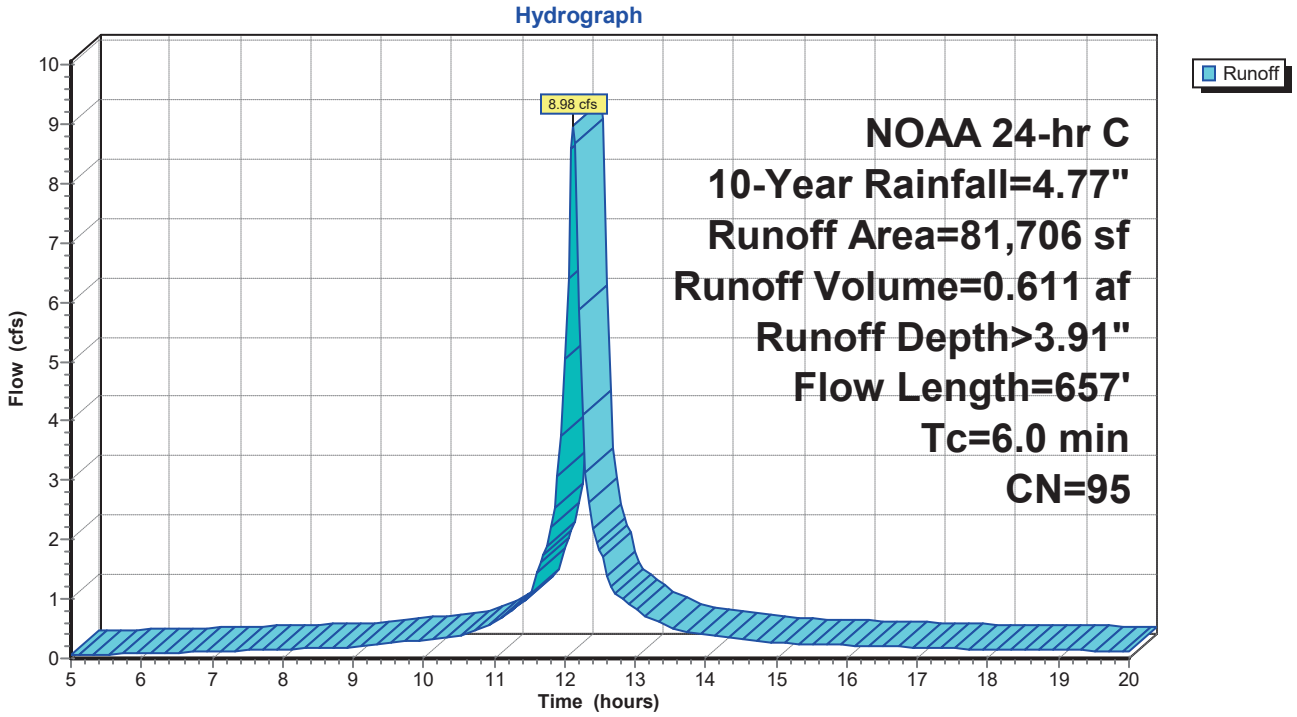
Runoff = 8.98 cfs @ 12.13 hrs, Volume= 0.611 af, Depth> 3.91"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
69,345	98	Paved parking, HSG A
164	61	>75% Grass cover, Good, HSG B
12,197	80	>75% Grass cover, Good, HSG D
81,706	95	Weighted Average
12,361		15.13% Pervious Area
69,345		84.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	47	0.0540	1.73		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	321	0.0311	3.58		**Shallow Concentrated Flow, b-c** Paved Kv= 20.3 fps
0.4	155	0.0050	6.02	18.90	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	134	0.0430	32.51	638.26	**Pipe Channel, D-E** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.011 Concrete pipe, straight & clean
2.5	657	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 6: DA-6



Summary for Subcatchment 8: DA-8

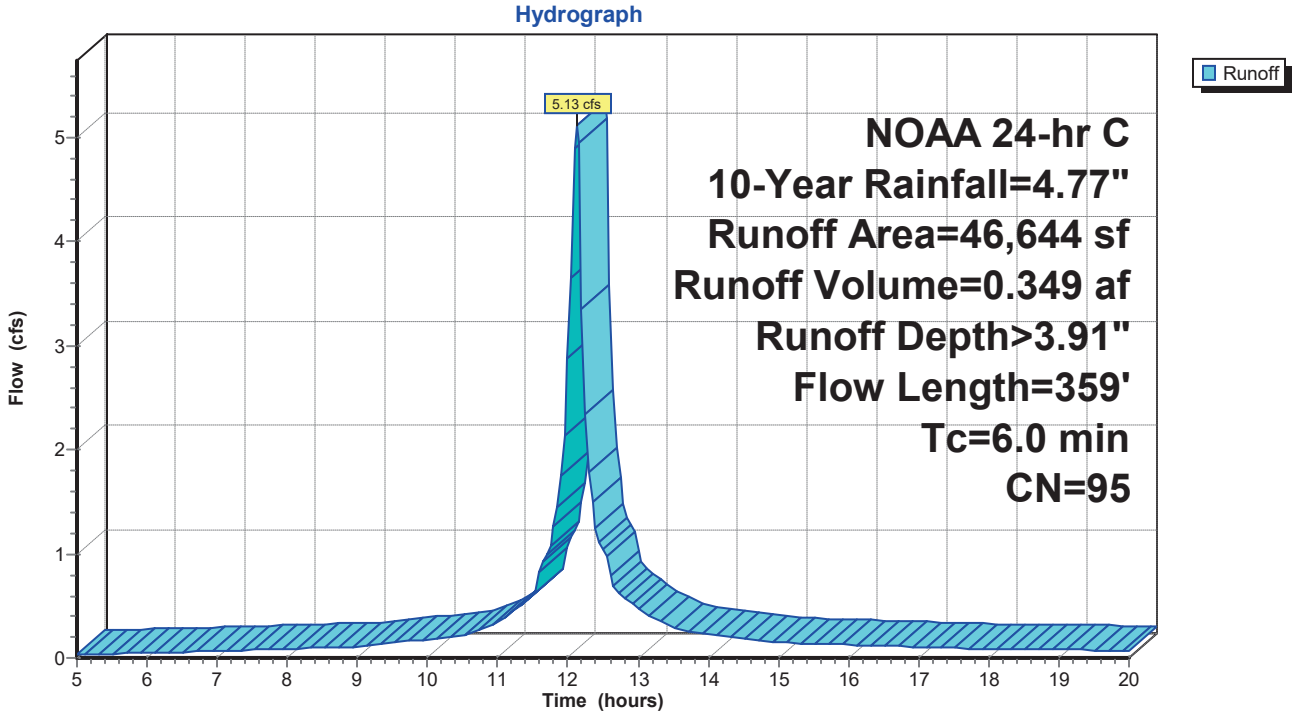
Runoff = 5.13 cfs @ 12.13 hrs, Volume= 0.349 af, Depth> 3.91"
Routed to Link 8L : POI 8

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
41,159	98	Paved parking, HSG A
1,093	61	>75% Grass cover, Good, HSG B
4,392	80	>75% Grass cover, Good, HSG D
46,644	95	Weighted Average
5,485		11.76% Pervious Area
41,159		88.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	309	0.0390	4.01		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	359	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 8: DA-8



Summary for Subcatchment 10: DA-10

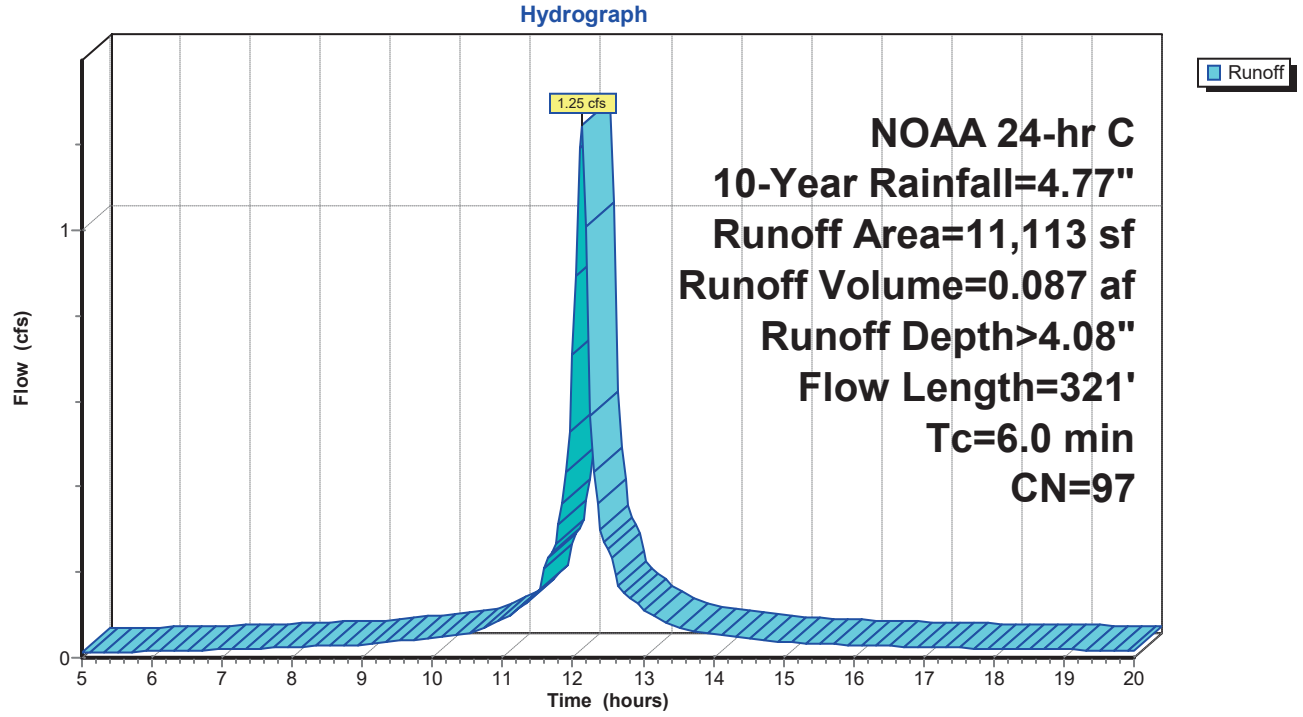
Runoff = 1.25 cfs @ 12.13 hrs, Volume= 0.087 af, Depth> 4.08"
Routed to Link 10L : POI 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
10,794	98	Paved parking, HSG A
319	80	>75% Grass cover, Good, HSG D
11,113	97	Weighted Average
319		2.87% Pervious Area
10,794		97.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	43	0.0470	1.61		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.0	254	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	24	0.4170	25.19	79.13	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.024
1.4	321	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 10: DA-10



Summary for Subcatchment 11: DA-11

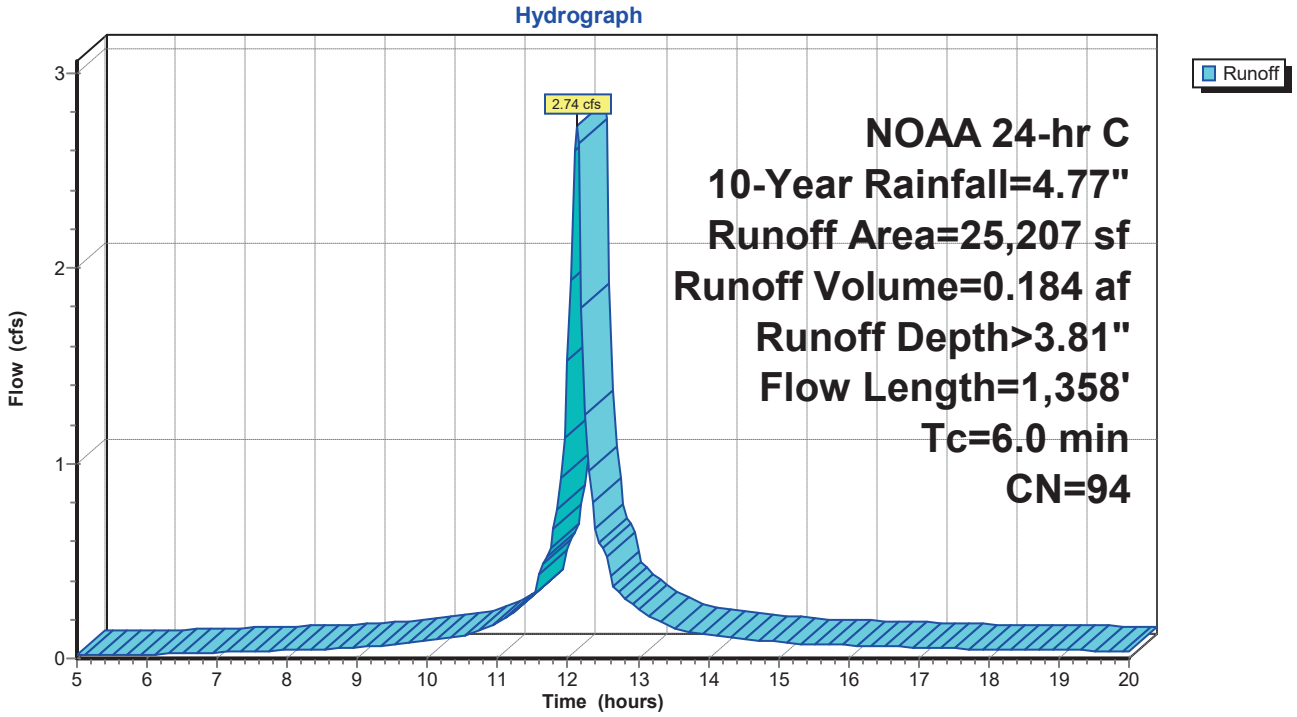
Runoff = 2.74 cfs @ 12.13 hrs, Volume= 0.184 af, Depth> 3.81"
Routed to Link 11L : POI 11

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
19,368	98	Paved parking, HSG A
5,839	80	>75% Grass cover, Good, HSG D
25,207	94	Weighted Average
5,839		23.16% Pervious Area
19,368		76.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	53	0.0340	1.47		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
0.4	125	0.0600	4.97		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.8	403	0.0347	3.78		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.1	48	0.0108	6.18	10.92	**Pipe Channel, D-E** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.8	603	0.0311	12.70	39.90	**Pipe Channel, E-F** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.1	126	0.0963	29.28	206.98	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
3.8	1,358	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 11: DA-11



Summary for Subcatchment 12: DA-12

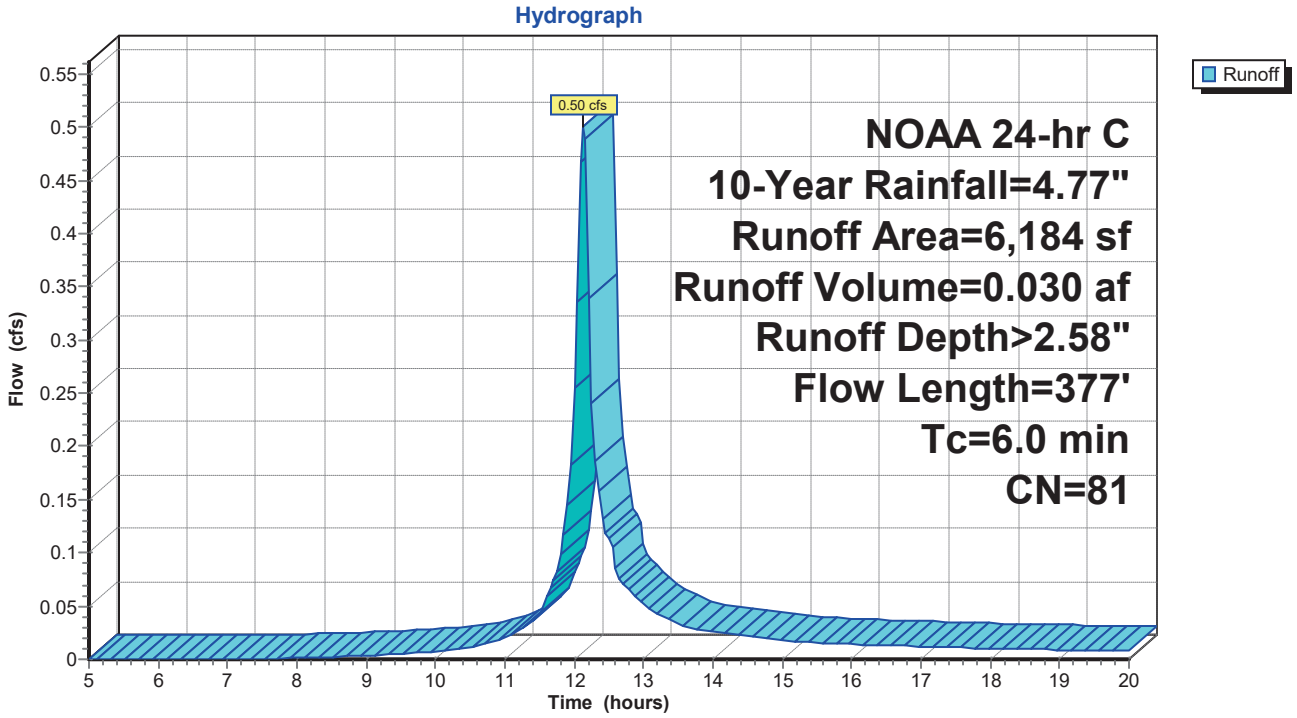
Runoff = 0.50 cfs @ 12.13 hrs, Volume= 0.030 af, Depth> 2.58"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
239	98	Paved parking, HSG A
5,945	80	>75% Grass cover, Good, HSG D
6,184	81	Weighted Average
5,945		96.14% Pervious Area
239		3.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.03		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.7	156	0.0060	1.57		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	21	0.2860	10.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.3	100	0.0600	4.97		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
3.6	377	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 12: DA-12



Summary for Subcatchment 13: DA-13

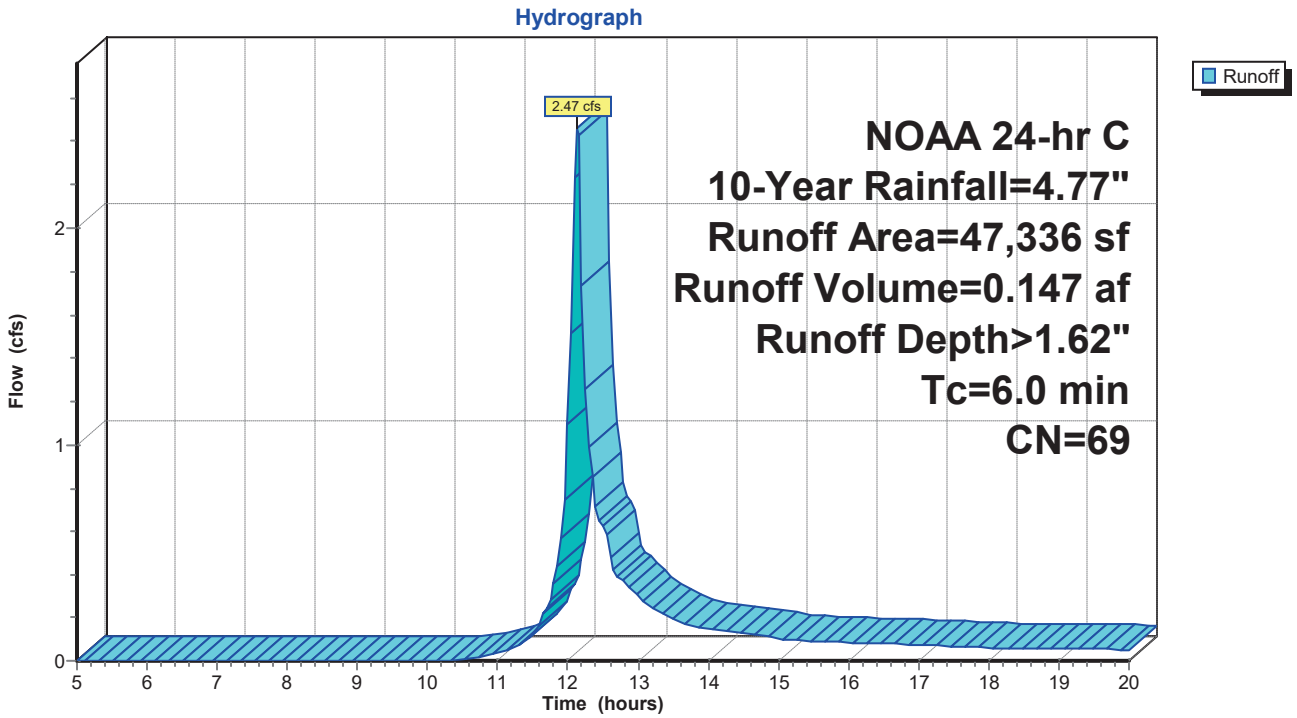
Runoff = 2.47 cfs @ 12.14 hrs, Volume= 0.147 af, Depth> 1.62"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.77"

Area (sf)	CN	Description
366	98	Paved parking, HSG A
28,571	61	>75% Grass cover, Good, HSG B
18,399	80	>75% Grass cover, Good, HSG D
47,336	69	Weighted Average
46,970		99.23% Pervious Area
366		0.77% Impervious Area

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

Subcatchment 13: DA-13



Summary for Reach 1R: Channel A

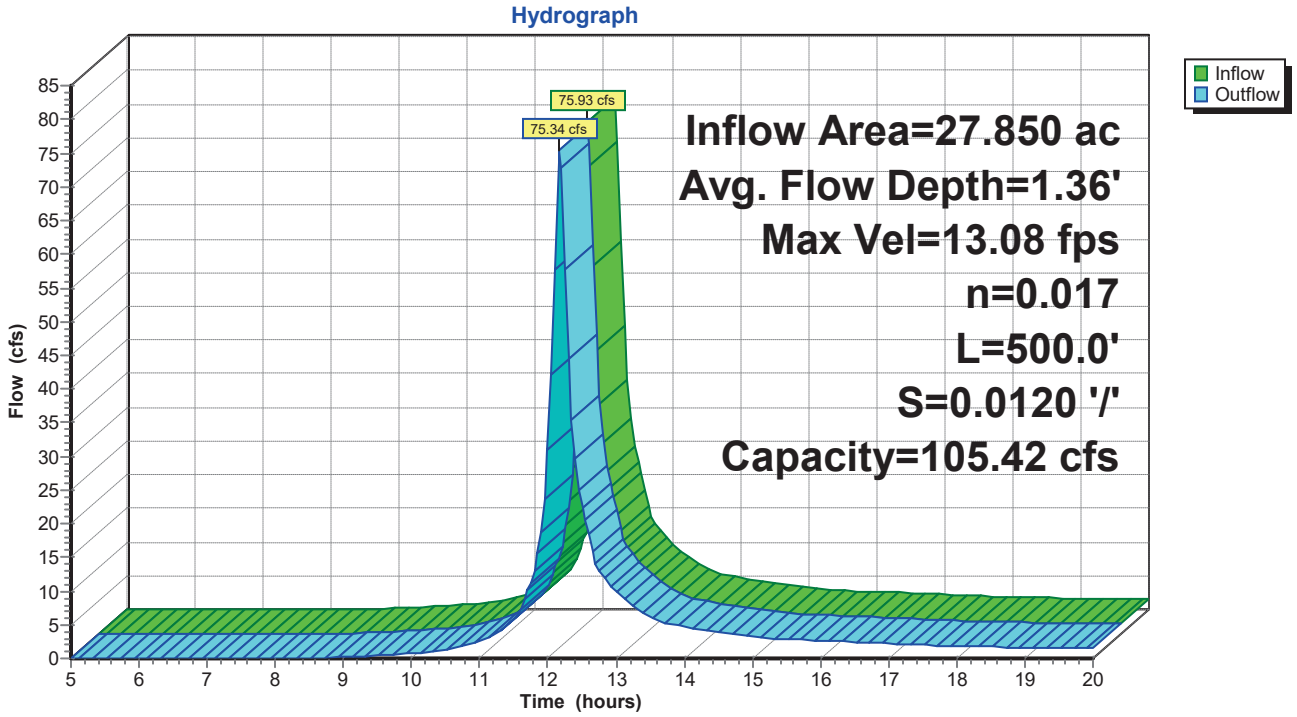
Inflow Area = 27.850 ac, 39.87% Impervious, Inflow Depth > 2.21" for 10-Year event
Inflow = 75.93 cfs @ 12.16 hrs, Volume= 5.141 af
Outflow = 75.34 cfs @ 12.17 hrs, Volume= 5.139 af, Atten= 1%, Lag= 0.8 min
Routed to Link OUT-B : OUTBALL B

Routing by Muskingum-Cunge method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Reference Flow= 56.95 cfs Estimated Depth= 1.44' Velocity= 8.94 fps
m= 1.430, c= 12.78 fps, dt= 3.0 min, dx= 500.0' / 1 = 500.0', K= 0.7 min, X= 0.416
Max. Velocity= 13.08 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 12.75 fps, Avg. Travel Time= 0.7 min

Peak Storage= 2,951 cf @ 12.17 hrs
Average Depth at Peak Storage= 1.36' , Surface Width= 5.71'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 105.42 cfs

3.00' x 2.00' deep channel, n= 0.017 Concrete, unfinished
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 500.0' Slope= 0.0120 '/'
Inlet Invert= 274.00', Outlet Invert= 268.00'

Reach 1R: Channel A

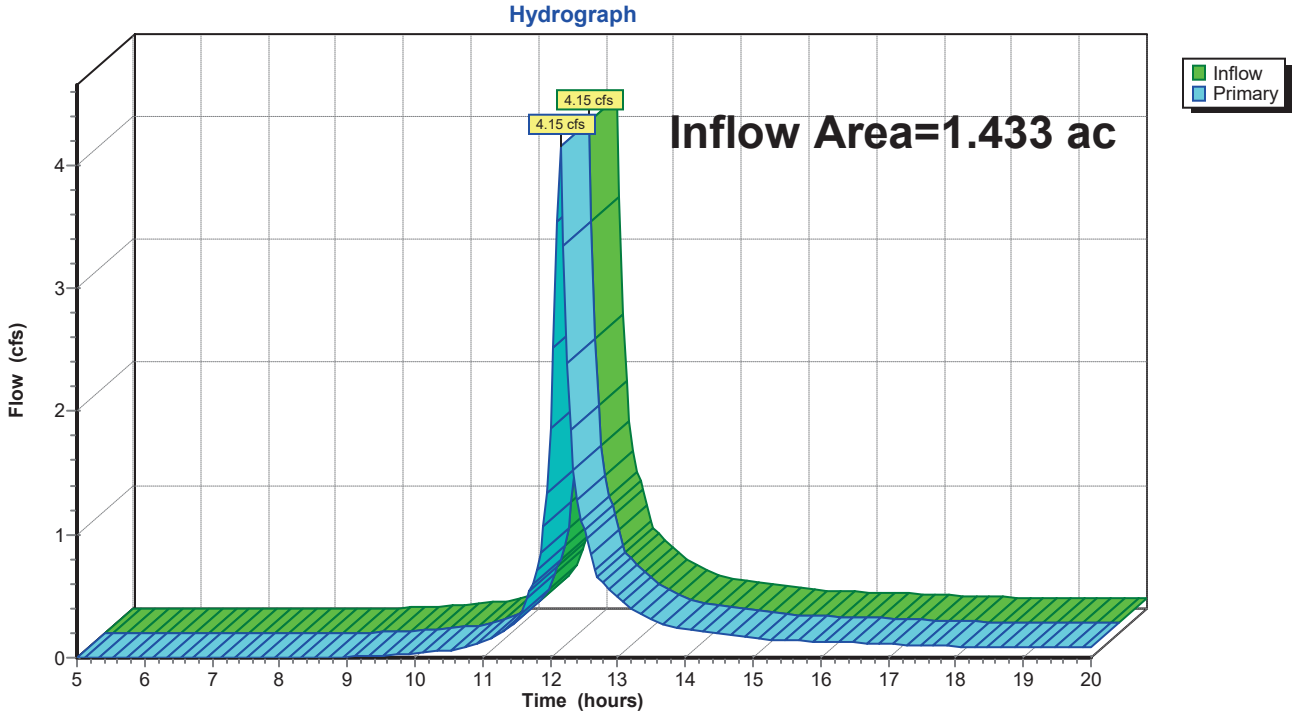


Summary for Link 1L: POI 1

Inflow Area = 1.433 ac, 40.42% Impervious, Inflow Depth > 2.15" for 10-Year event
Inflow = 4.15 cfs @ 12.15 hrs, Volume= 0.257 af
Primary = 4.15 cfs @ 12.15 hrs, Volume= 0.257 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

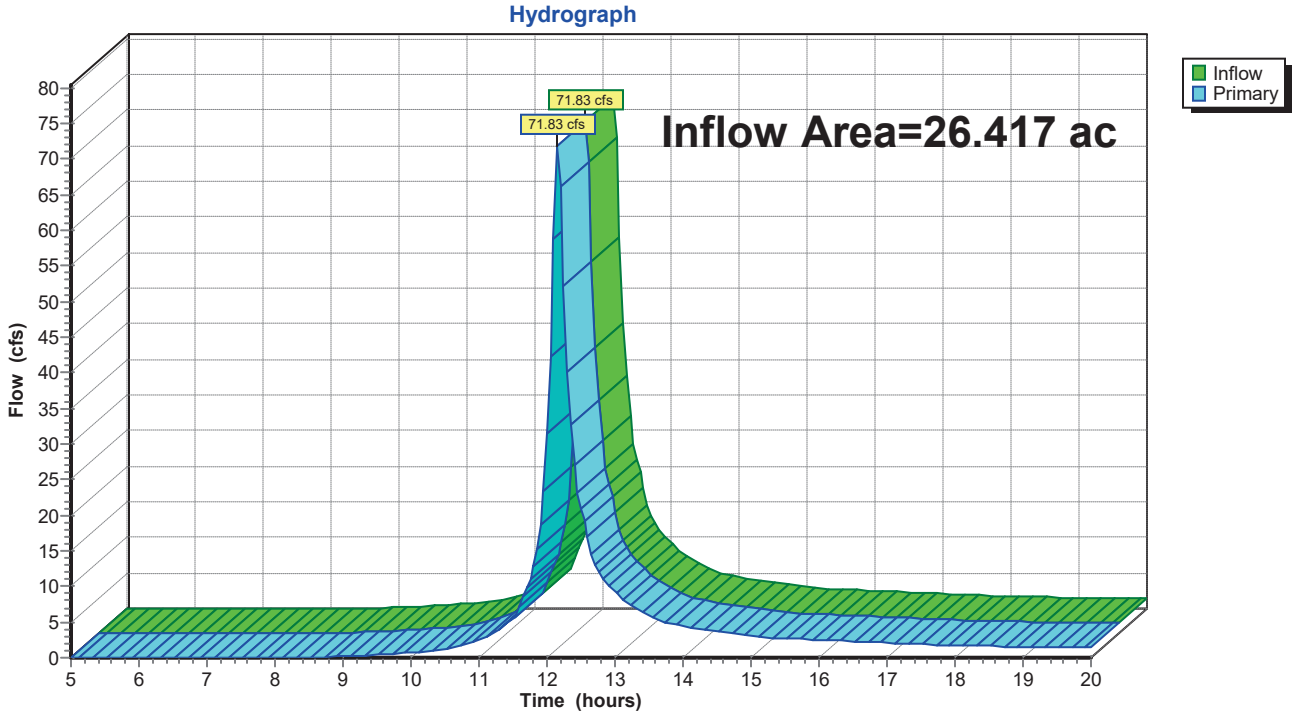


Summary for Link 3L: POI 3

Inflow Area = 26.417 ac, 39.84% Impervious, Inflow Depth > 2.22" for 10-Year event
Inflow = 71.83 cfs @ 12.16 hrs, Volume= 4.883 af
Primary = 71.83 cfs @ 12.16 hrs, Volume= 4.883 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: POI 3

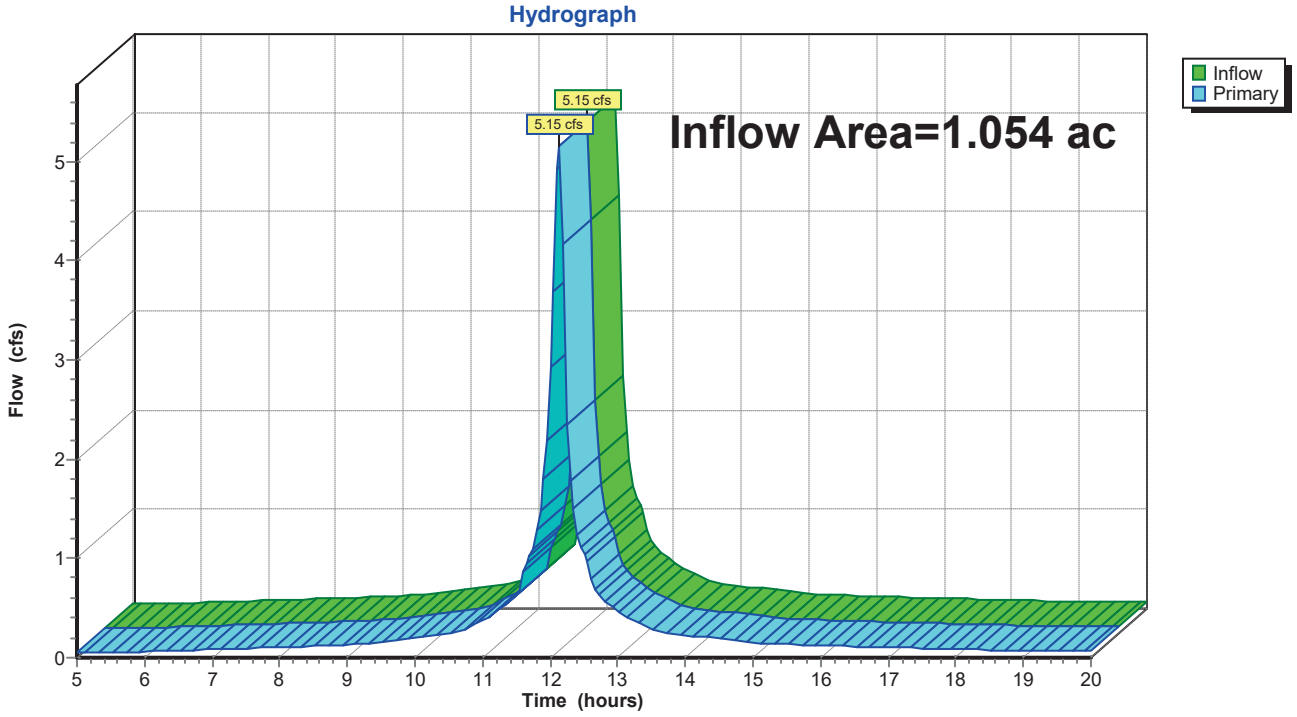


Summary for Link 5L: POI 5

Inflow Area = 1.054 ac, 92.87% Impervious, Inflow Depth > 4.08" for 10-Year event
Inflow = 5.15 cfs @ 12.13 hrs, Volume= 0.359 af
Primary = 5.15 cfs @ 12.13 hrs, Volume= 0.359 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: POI 5

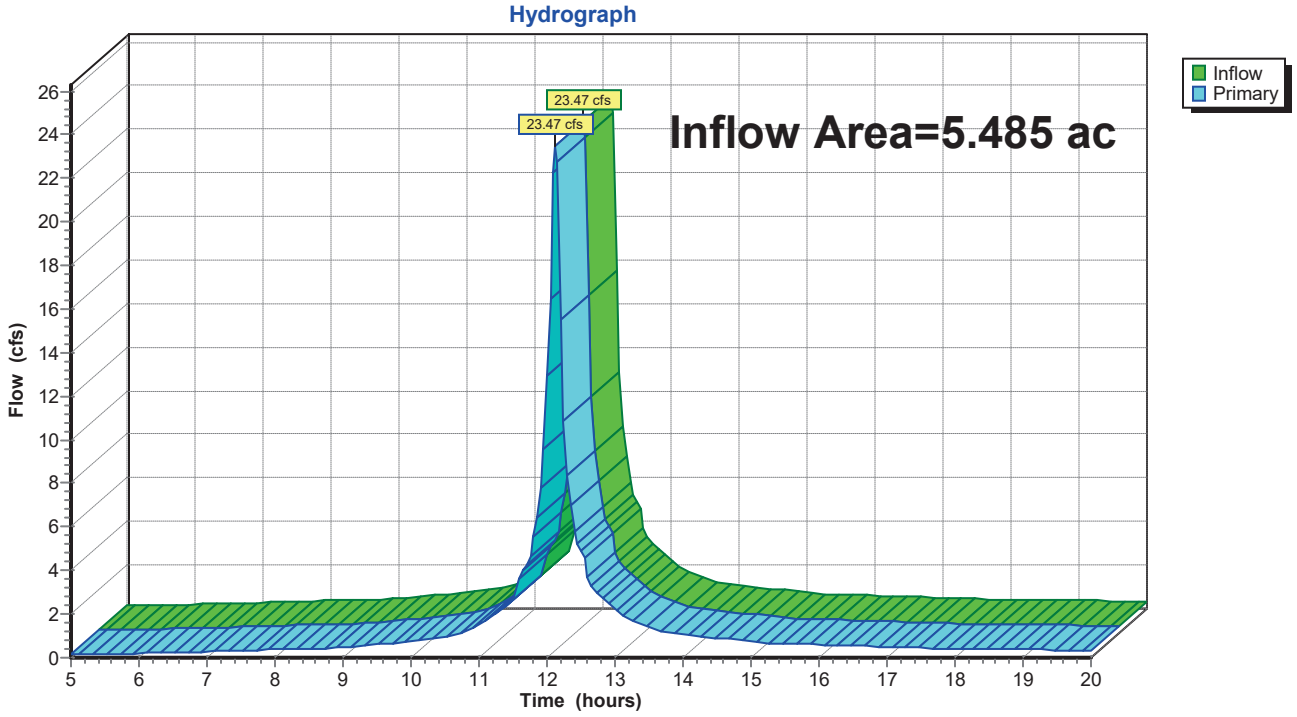


Summary for Link 6L: POI 6

Inflow Area = 5.485 ac, 68.88% Impervious, Inflow Depth > 3.46" for 10-Year event
Inflow = 23.47 cfs @ 12.13 hrs, Volume= 1.582 af
Primary = 23.47 cfs @ 12.13 hrs, Volume= 1.582 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-B : OUTBALL B

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 6L: POI 6

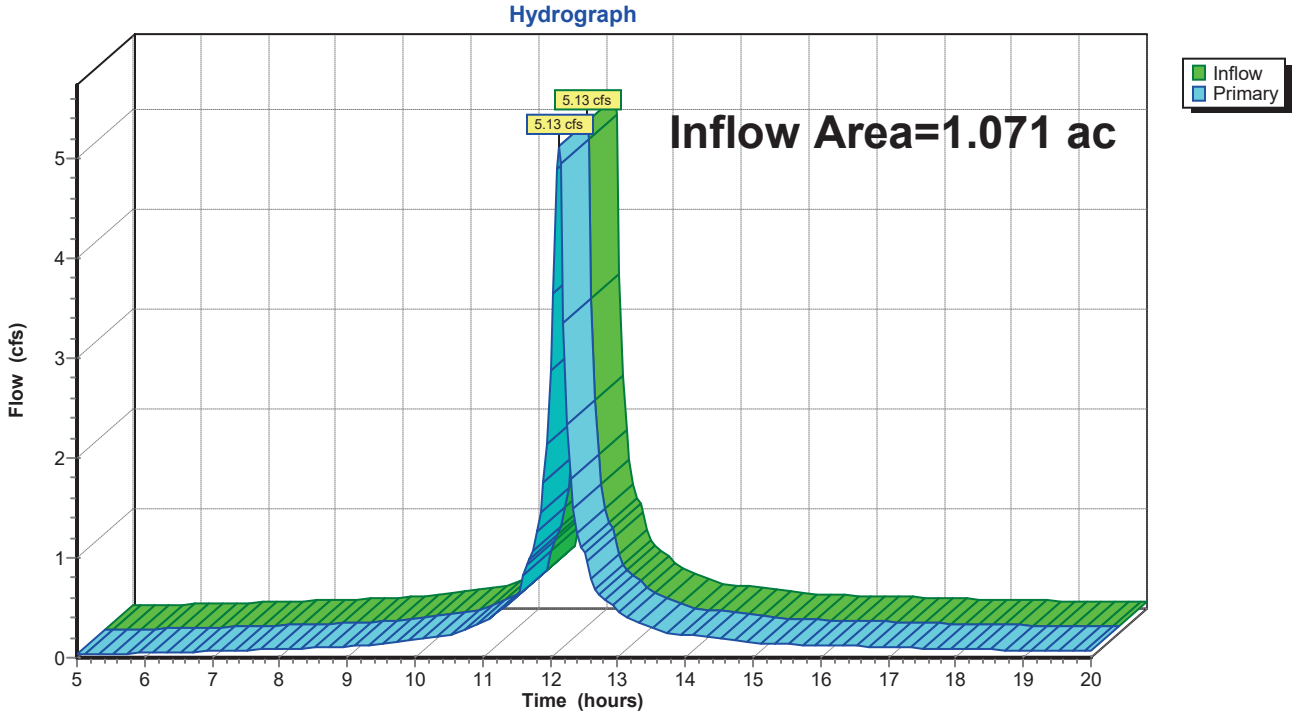


Summary for Link 8L: POI 8

Inflow Area = 1.071 ac, 88.24% Impervious, Inflow Depth > 3.91" for 10-Year event
Inflow = 5.13 cfs @ 12.13 hrs, Volume= 0.349 af
Primary = 5.13 cfs @ 12.13 hrs, Volume= 0.349 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 8L: POI 8

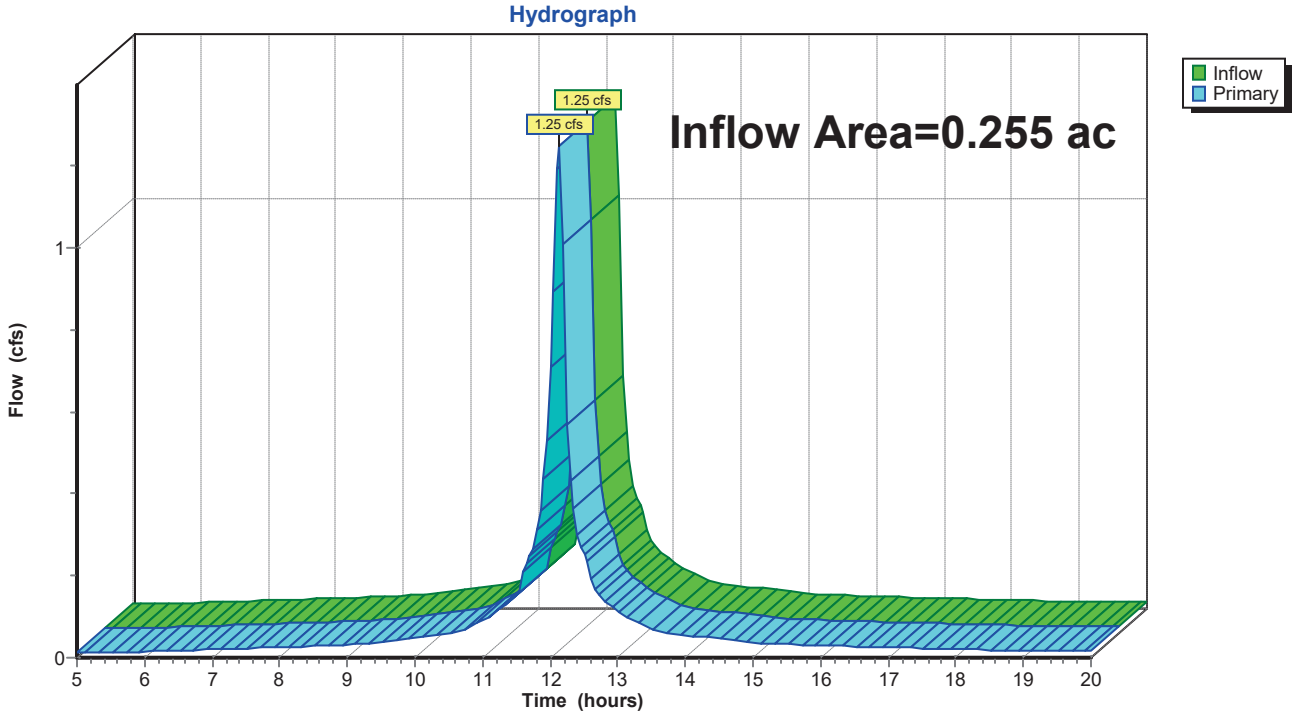


Summary for Link 10L: POI 10

Inflow Area = 0.255 ac, 97.13% Impervious, Inflow Depth > 4.08" for 10-Year event
Inflow = 1.25 cfs @ 12.13 hrs, Volume= 0.087 af
Primary = 1.25 cfs @ 12.13 hrs, Volume= 0.087 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: POI 10

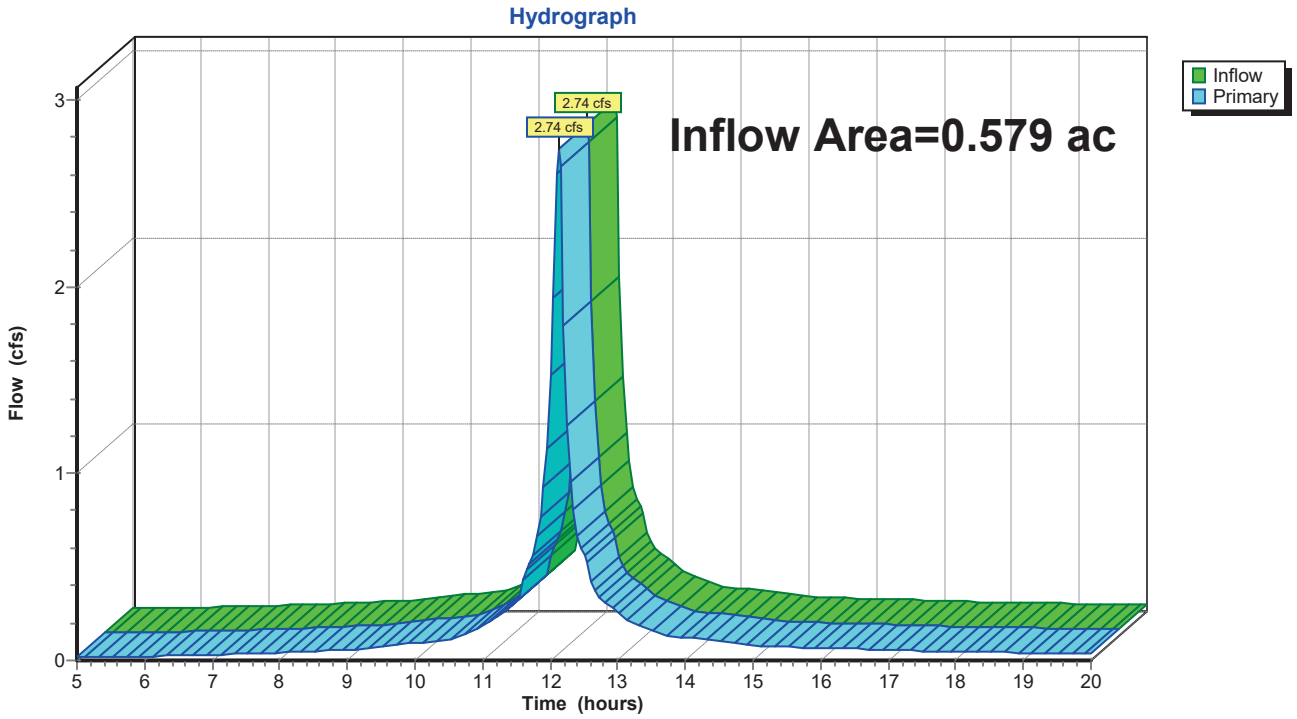


Summary for Link 11L: POI 11

Inflow Area = 0.579 ac, 76.84% Impervious, Inflow Depth > 3.81" for 10-Year event
Inflow = 2.74 cfs @ 12.13 hrs, Volume= 0.184 af
Primary = 2.74 cfs @ 12.13 hrs, Volume= 0.184 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 11L: POI 11

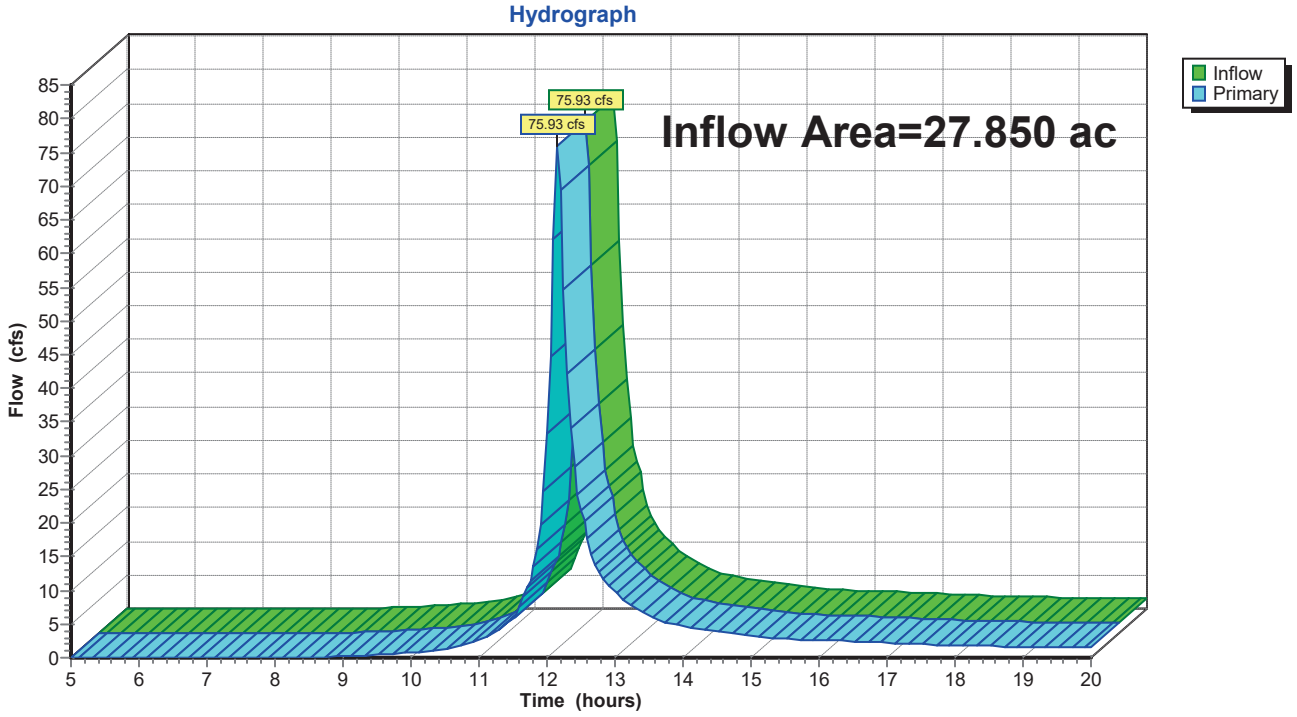


Summary for Link OUT-A: Outfall A

Inflow Area = 27.850 ac, 39.87% Impervious, Inflow Depth > 2.21" for 10-Year event
Inflow = 75.93 cfs @ 12.16 hrs, Volume= 5.141 af
Primary = 75.93 cfs @ 12.16 hrs, Volume= 5.141 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 1R : Channel A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-A: Outfall A

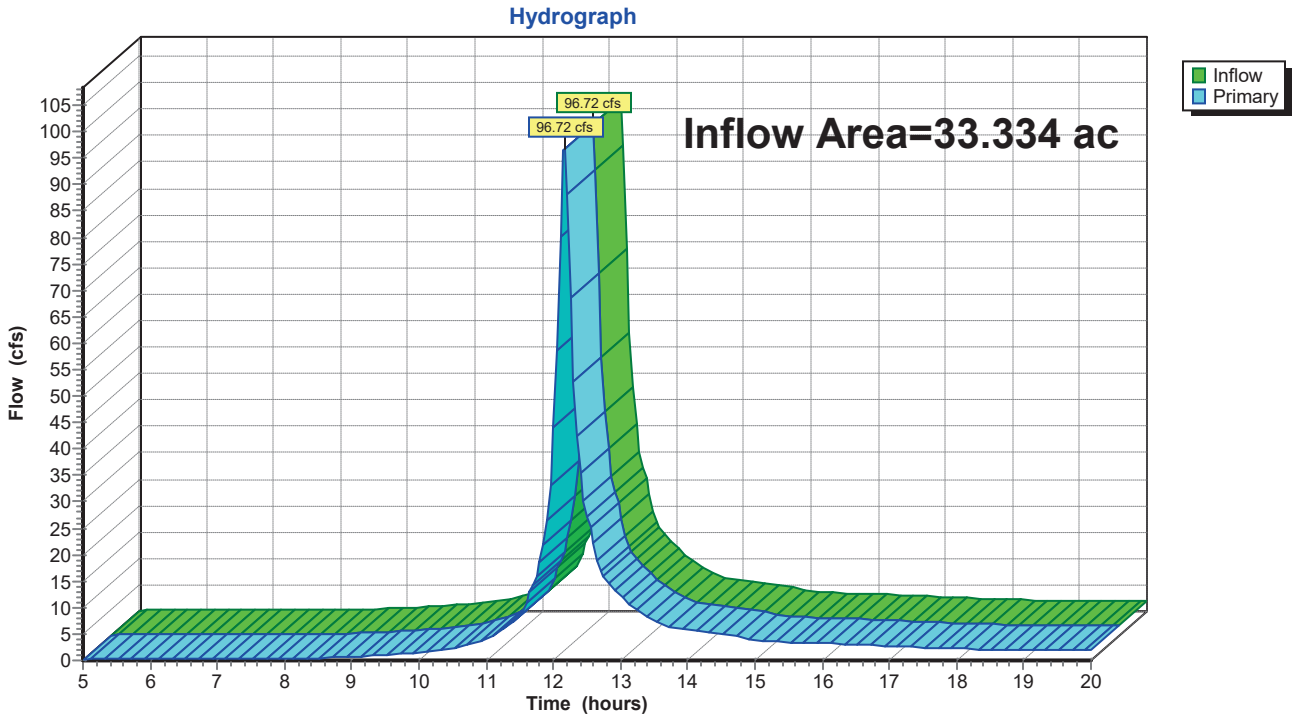


Summary for Link OUT-B: OUTBALL B

Inflow Area = 33.334 ac, 44.64% Impervious, Inflow Depth > 2.42" for 10-Year event
Inflow = 96.72 cfs @ 12.16 hrs, Volume= 6.721 af
Primary = 96.72 cfs @ 12.16 hrs, Volume= 6.721 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-B: OUTBALL B



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Muskingum-Cunge method - Pond routing by Stor-Ind method

Subcatchment 1: DA-1 Runoff Area=62,414 sf 40.42% Impervious Runoff Depth>4.99"
Flow Length=383' Tc=7.3 min CN=76 Runoff=9.32 cfs 0.596 af

Subcatchment 3A: DA-3A Runoff Area=226,089 sf 47.14% Impervious Runoff Depth>5.46"
Flow Length=1,375' Tc=6.0 min CN=80 Runoff=37.36 cfs 2.360 af

Subcatchment 3B: DA-3B Runoff Area=924,625 sf 38.06% Impervious Runoff Depth>4.99"
Flow Length=1,690' Tc=9.8 min CN=76 Runoff=125.45 cfs 8.822 af

Subcatchment 5: DA-5 Runoff Area=45,927 sf 92.87% Impervious Runoff Depth>7.20"
Flow Length=523' Slope=0.0670 '/' Tc=6.0 min CN=97 Runoff=8.96 cfs 0.632 af

Subcatchment 6: DA-6 Runoff Area=81,706 sf 84.87% Impervious Runoff Depth>7.05"
Flow Length=657' Tc=6.0 min CN=95 Runoff=15.82 cfs 1.101 af

Subcatchment 8: DA-8 Runoff Area=46,644 sf 88.24% Impervious Runoff Depth>7.05"
Flow Length=359' Tc=6.0 min CN=95 Runoff=9.03 cfs 0.629 af

Subcatchment 10: DA-10 Runoff Area=11,113 sf 97.13% Impervious Runoff Depth>7.20"
Flow Length=321' Tc=6.0 min CN=97 Runoff=2.17 cfs 0.153 af

Subcatchment 11: DA-11 Runoff Area=25,207 sf 76.84% Impervious Runoff Depth>6.96"
Flow Length=1,358' Tc=6.0 min CN=94 Runoff=4.86 cfs 0.336 af

Subcatchment 12: DA-12 Runoff Area=6,184 sf 3.86% Impervious Runoff Depth>5.57"
Flow Length=377' Tc=6.0 min CN=81 Runoff=1.04 cfs 0.066 af

Subcatchment 13: DA-13 Runoff Area=47,336 sf 0.77% Impervious Runoff Depth>4.20"
Tc=6.0 min CN=69 Runoff=6.29 cfs 0.380 af

Reach 1R: Channel A Avg. Flow Depth=2.20' Max Vel=15.05 fps Inflow=169.09 cfs 11.778 af
n=0.017 L=500.0' S=0.0120 '/' Capacity=105.42 cfs Outflow=167.94 cfs 11.776 af

Link 1L: POI 1 Inflow=9.32 cfs 0.596 af
Primary=9.32 cfs 0.596 af

Link 3L: POI 3 Inflow=159.87 cfs 11.182 af
Primary=159.87 cfs 11.182 af

Link 5L: POI 5 Inflow=8.96 cfs 0.632 af
Primary=8.96 cfs 0.632 af

Link 6L: POI 6 Inflow=43.31 cfs 2.961 af
Primary=43.31 cfs 2.961 af

Link 8L: POI 8 Inflow=9.03 cfs 0.629 af
Primary=9.03 cfs 0.629 af

Link 10L: POI 10 Inflow=2.17 cfs 0.153 af
Primary=2.17 cfs 0.153 af

Link 11L: POI 11 Inflow=4.86 cfs 0.336 af
Primary=4.86 cfs 0.336 af

Link OUT-A: Outfall A Inflow=169.09 cfs 11.778 af
Primary=169.09 cfs 11.778 af

Link OUT-B: OUTBALL B Inflow=207.99 cfs 14.737 af
Primary=207.99 cfs 14.737 af

Total Runoff Area = 33.913 ac Runoff Volume = 15.075 af Average Runoff Depth = 5.33"
54.81% Pervious = 18.587 ac 45.19% Impervious = 15.326 ac

Summary for Subcatchment 1: DA-1

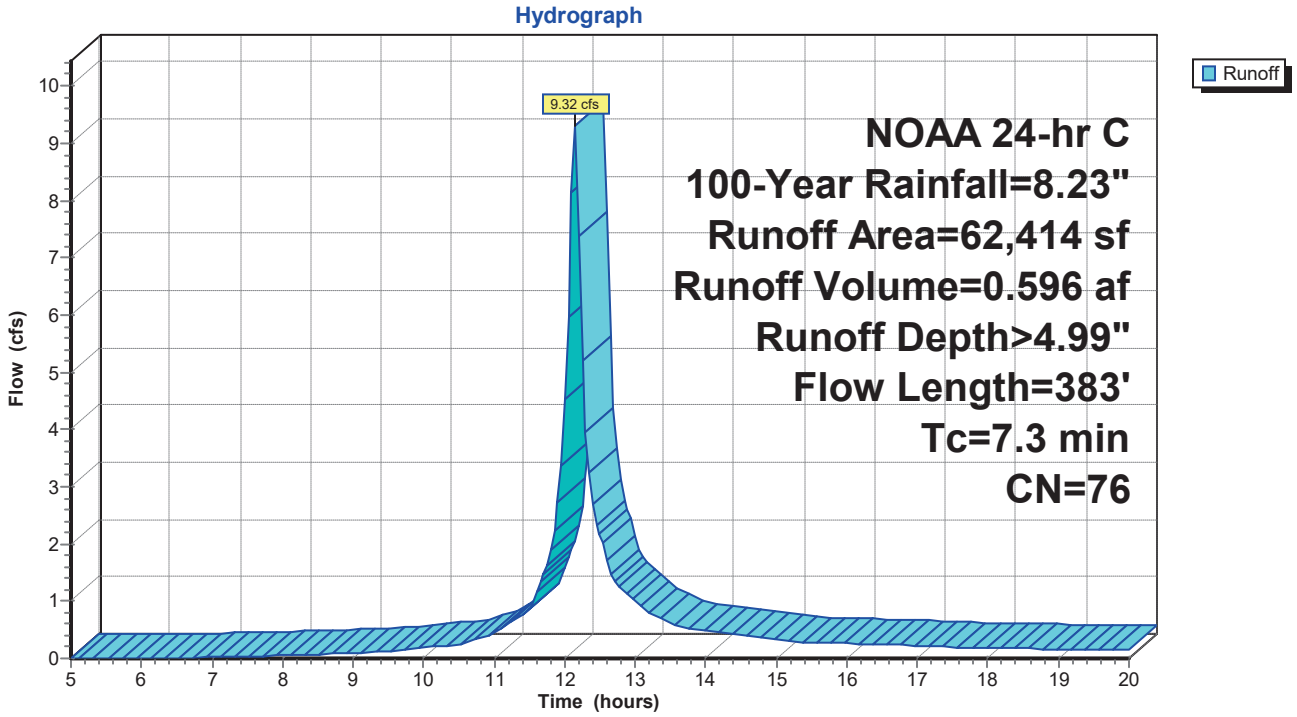
Runoff = 9.32 cfs @ 12.14 hrs, Volume= 0.596 af, Depth> 4.99"
Routed to Link 1L : POI 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
25,229	98	Paved parking, HSG A
34,812	61	>75% Grass cover, Good, HSG B
2,373	74	>75% Grass cover, Good, HSG C
62,414	76	Weighted Average
37,185		59.58% Pervious Area
25,229		40.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	75	0.0350	0.20		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.3	71	0.0460	4.35		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	171	0.0760	5.60		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.2	66	0.0610	5.01		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
7.3	383	Total			

Subcatchment 1: DA-1



Summary for Subcatchment 3A: DA-3A

[47] Hint: Peak is 503% of capacity of segment #4

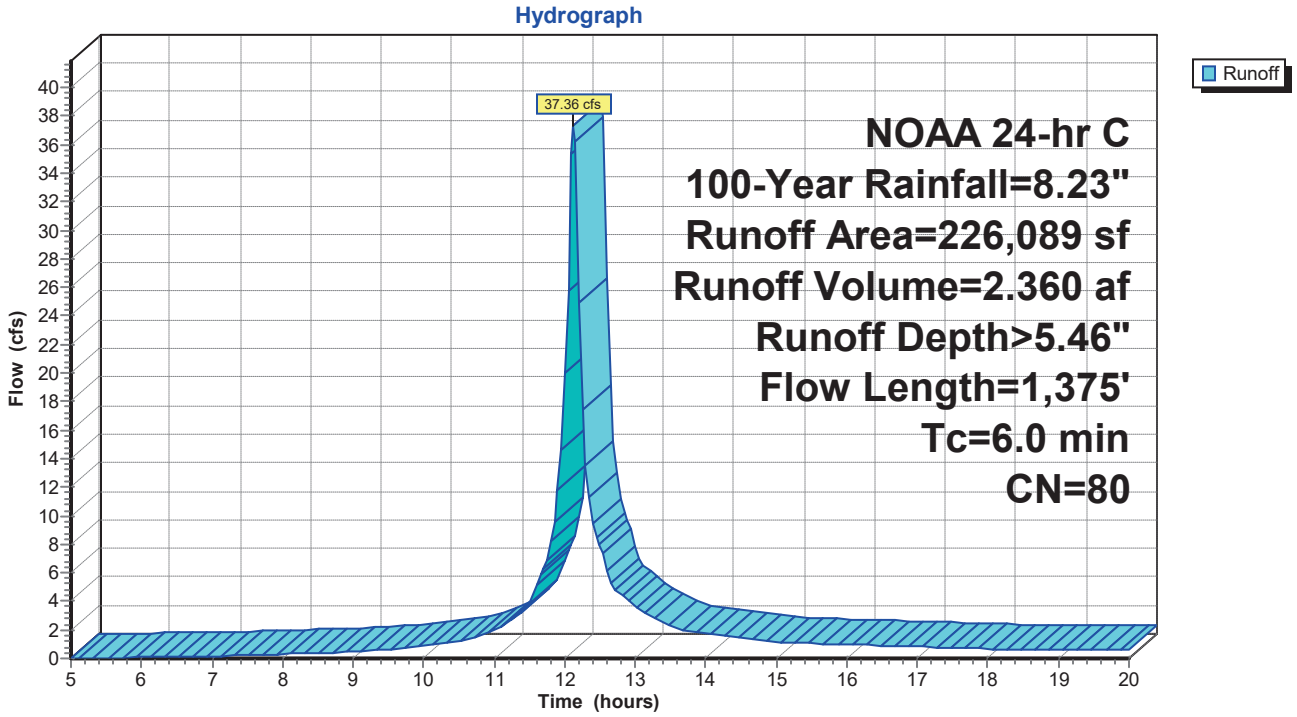
Runoff = 37.36 cfs @ 12.13 hrs, Volume= 2.360 af, Depth> 5.46"
Routed to Link 3L : POI 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
106,574	98	Paved parking, HSG A
86,146	61	>75% Grass cover, Good, HSG B
33,369	74	>75% Grass cover, Good, HSG C
226,089	80	Weighted Average
119,515		52.86% Pervious Area
106,574		47.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	22	0.0227	1.05		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	428	0.0771	5.64		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.8	185	0.0378	3.95		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.6	152	0.0050	4.20	7.43	**Pipe Channel, D-E** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.7	402	0.0056	9.25	88.98	**Pipe Channel, E-F** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.011 Concrete pipe, straight & clean
0.2	186	0.1070	16.72	118.18	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
3.9	1,375	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3A: DA-3A



Summary for Subcatchment 3B: DA-3B

[47] Hint: Peak is 2321% of capacity of segment #5
[47] Hint: Peak is 800% of capacity of segment #6
[47] Hint: Peak is 585% of capacity of segment #7
[47] Hint: Peak is 634% of capacity of segment #8
[47] Hint: Peak is 448% of capacity of segment #9
[47] Hint: Peak is 106% of capacity of segment #10

Runoff = 125.45 cfs @ 12.17 hrs, Volume= 8.822 af, Depth> 4.99"
Routed to Link 3L : POI 3

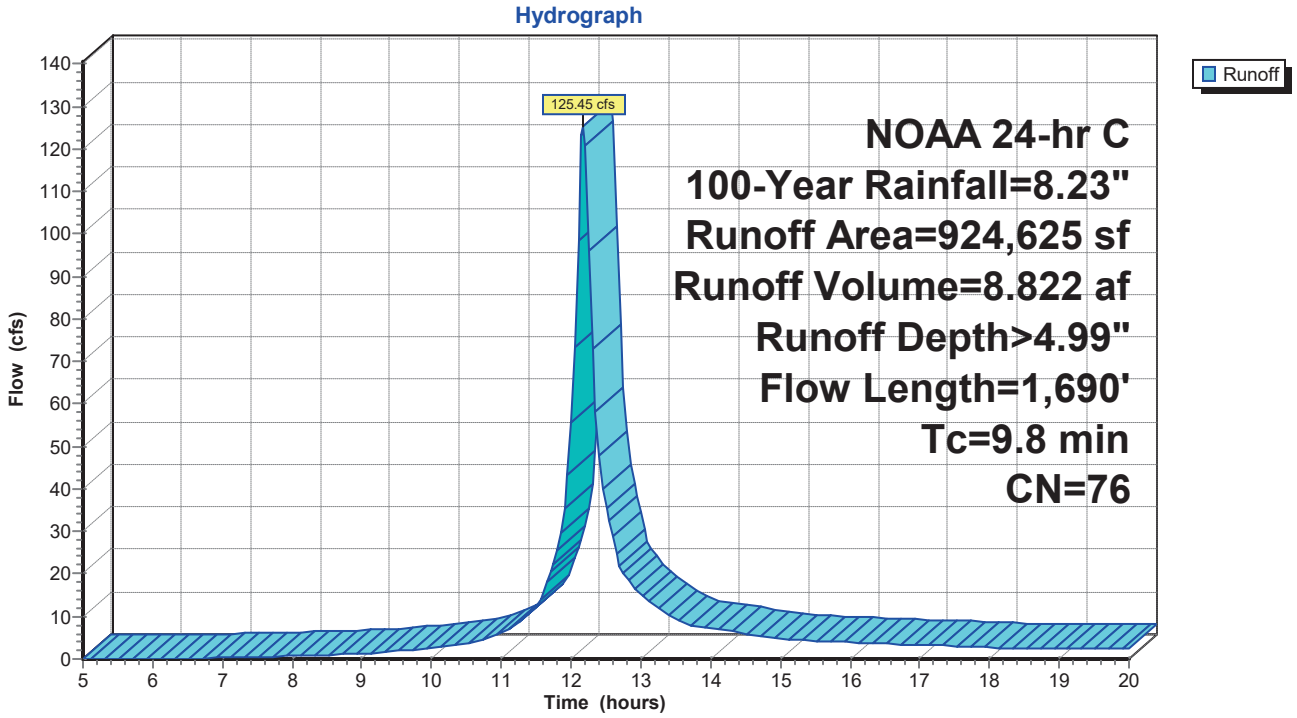
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
351,876	98	Paved parking, HSG A
536,743	61	>75% Grass cover, Good, HSG B
36,006	74	>75% Grass cover, Good, HSG C
924,625	76	Weighted Average
572,749		61.94% Pervious Area
351,876		38.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	65	0.0620	0.24		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.10"
0.4	108	0.1020	5.14		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.5	99	0.0400	3.22		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.3	54	0.0190	2.80		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.5	144	0.0070	4.40	5.40	**Pipe Channel, E-F** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.6	443	0.0590	12.79	15.69	**Pipe Channel, F-G** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.3	106	0.0090	6.83	21.46	**Pipe Channel, G-H** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
1.8	309	0.0030	2.80	19.79	**Pipe Channel, H-I** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.7	176	0.0060	3.96	27.98	**Pipe Channel, I-J** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024
0.2	186	0.1070	16.72	118.18	**Pipe Channel, J-K** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.024

9.8 1,690 Total

Subcatchment 3B: DA-3B



Summary for Subcatchment 5: DA-5

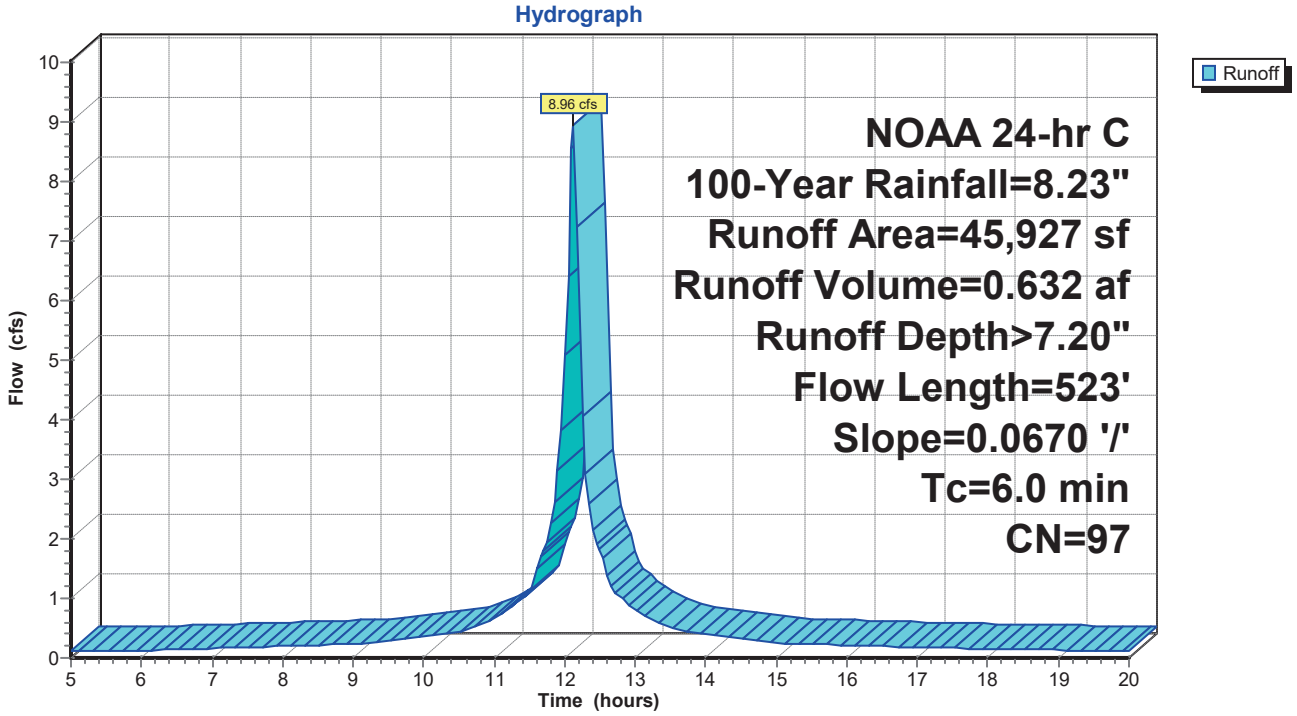
Runoff = 8.96 cfs @ 12.13 hrs, Volume= 0.632 af, Depth> 7.20"
Routed to Link 5L : POI 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
42,651	98	Paved parking, HSG A
20	61	>75% Grass cover, Good, HSG B
3,256	80	>75% Grass cover, Good, HSG D
45,927	97	Weighted Average
3,276		7.13% Pervious Area
42,651		92.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	53	0.0670	1.93		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	470	0.0670	5.25		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	523	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5: DA-5



Summary for Subcatchment 6: DA-6

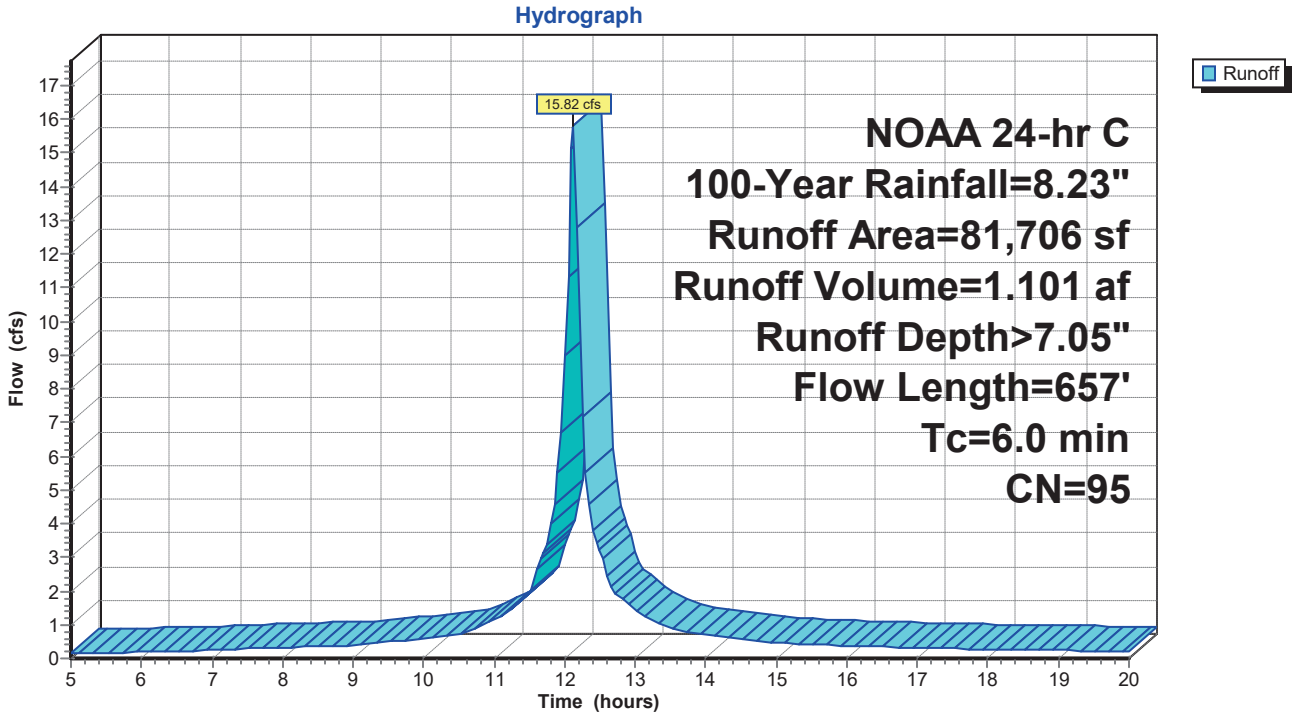
Runoff = 15.82 cfs @ 12.13 hrs, Volume= 1.101 af, Depth> 7.05"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
69,345	98	Paved parking, HSG A
164	61	>75% Grass cover, Good, HSG B
12,197	80	>75% Grass cover, Good, HSG D
81,706	95	Weighted Average
12,361		15.13% Pervious Area
69,345		84.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	47	0.0540	1.73		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.5	321	0.0311	3.58		**Shallow Concentrated Flow, b-c** Paved Kv= 20.3 fps
0.4	155	0.0050	6.02	18.90	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	134	0.0430	32.51	638.26	**Pipe Channel, D-E** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.011 Concrete pipe, straight & clean
2.5	657	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 6: DA-6



Summary for Subcatchment 8: DA-8

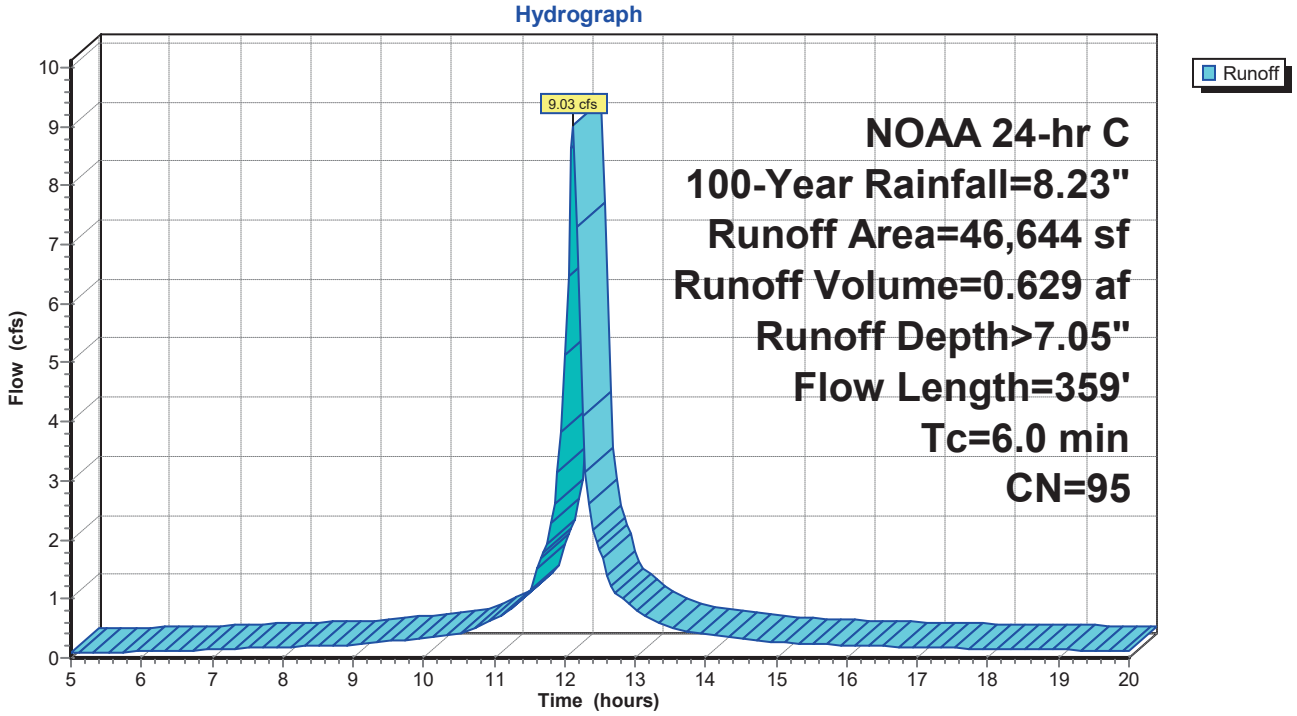
Runoff = 9.03 cfs @ 12.13 hrs, Volume= 0.629 af, Depth> 7.05"
Routed to Link 8L : POI 8

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
41,159	98	Paved parking, HSG A
1,093	61	>75% Grass cover, Good, HSG B
4,392	80	>75% Grass cover, Good, HSG D
46,644	95	Weighted Average
5,485		11.76% Pervious Area
41,159		88.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.3	309	0.0390	4.01		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	359	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 8: DA-8



Summary for Subcatchment 10: DA-10

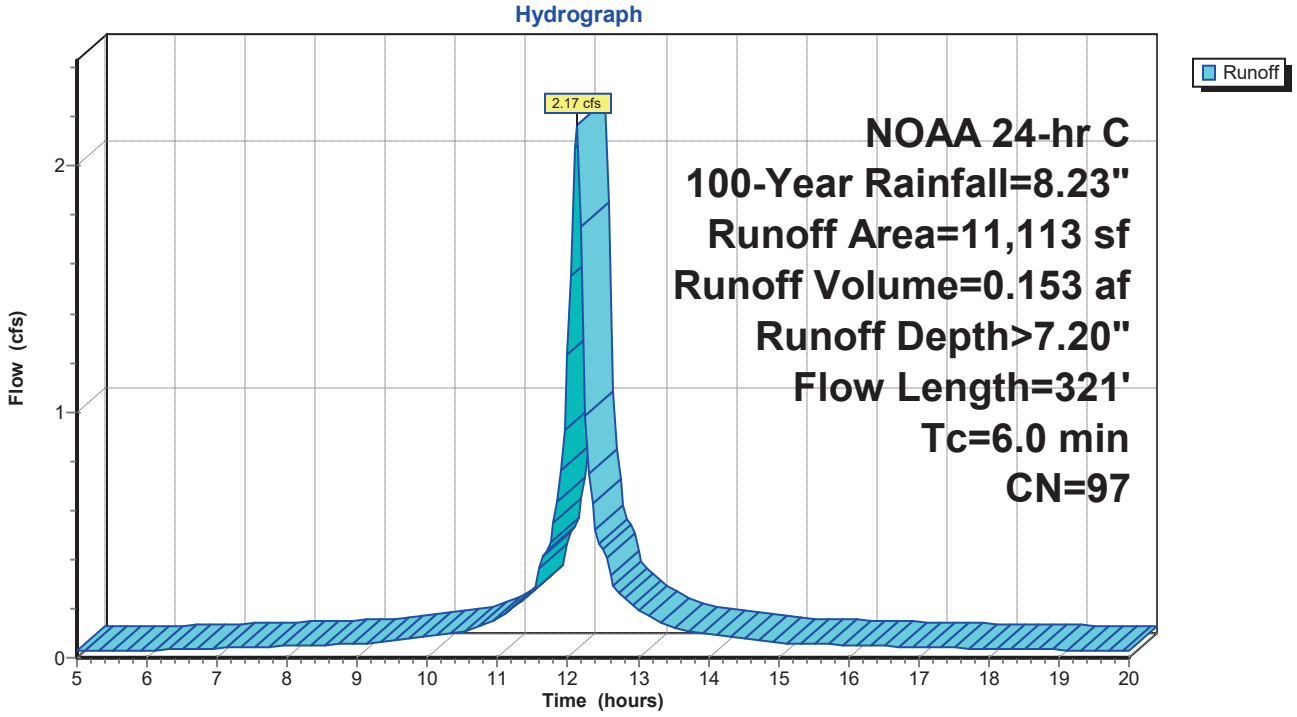
Runoff = 2.17 cfs @ 12.13 hrs, Volume= 0.153 af, Depth> 7.20"
Routed to Link 10L : POI 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
10,794	98	Paved parking, HSG A
319	80	>75% Grass cover, Good, HSG D
11,113	97	Weighted Average
319		2.87% Pervious Area
10,794		97.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	43	0.0470	1.61		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.0	254	0.0470	4.40		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	24	0.4170	25.19	79.13	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.024
1.4	321	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 10: DA-10



Summary for Subcatchment 11: DA-11

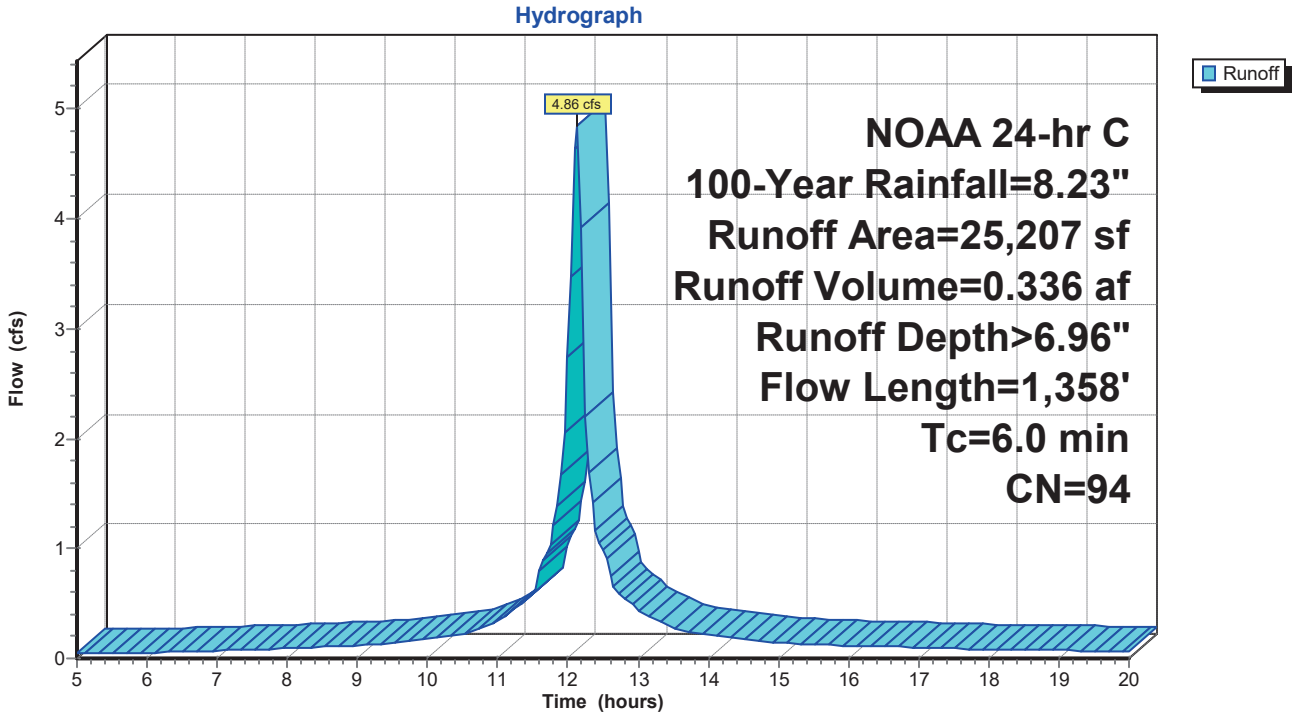
Runoff = 4.86 cfs @ 12.13 hrs, Volume= 0.336 af, Depth> 6.96"
Routed to Link 11L : POI 11

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
19,368	98	Paved parking, HSG A
5,839	80	>75% Grass cover, Good, HSG D
25,207	94	Weighted Average
5,839		23.16% Pervious Area
19,368		76.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	53	0.0340	1.47		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
0.4	125	0.0600	4.97		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.8	403	0.0347	3.78		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.1	48	0.0108	6.18	10.92	**Pipe Channel, D-E** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.8	603	0.0311	12.70	39.90	**Pipe Channel, E-F** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.1	126	0.0963	29.28	206.98	**Pipe Channel, F-G** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
3.8	1,358	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 11: DA-11



Summary for Subcatchment 12: DA-12

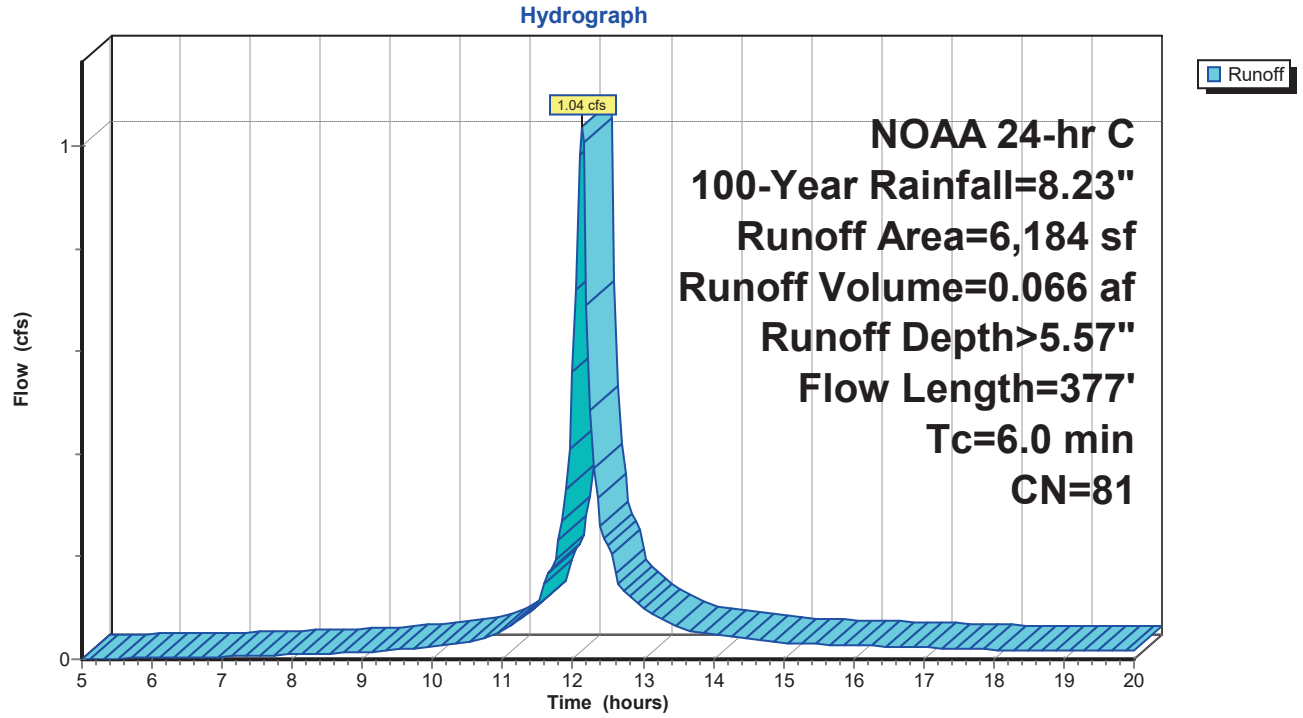
Runoff = 1.04 cfs @ 12.13 hrs, Volume= 0.066 af, Depth> 5.57"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
239	98	Paved parking, HSG A
5,945	80	>75% Grass cover, Good, HSG D
6,184	81	Weighted Average
5,945		96.14% Pervious Area
239		3.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.03		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.10"
1.7	156	0.0060	1.57		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.0	21	0.2860	10.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.3	100	0.0600	4.97		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
3.6	377	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 12: DA-12



Summary for Subcatchment 13: DA-13

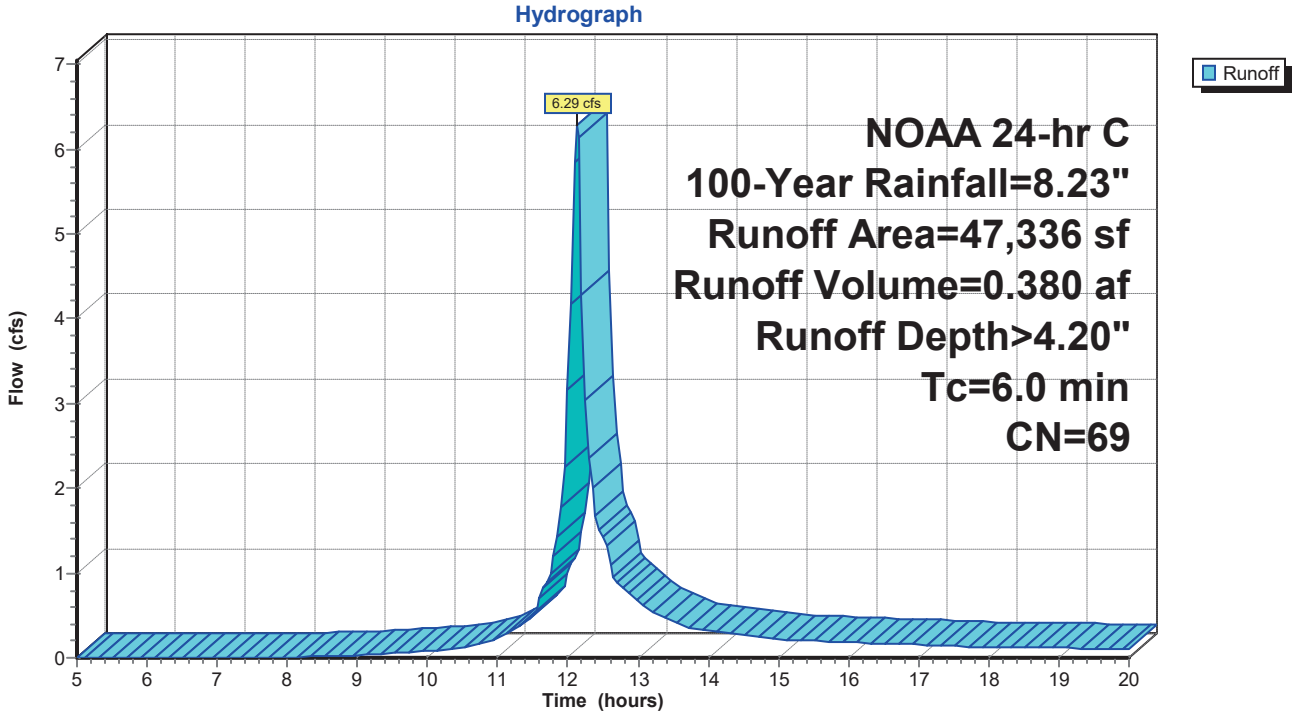
Runoff = 6.29 cfs @ 12.13 hrs, Volume= 0.380 af, Depth> 4.20"
Routed to Link 6L : POI 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.23"

Area (sf)	CN	Description
366	98	Paved parking, HSG A
28,571	61	>75% Grass cover, Good, HSG B
18,399	80	>75% Grass cover, Good, HSG D
47,336	69	Weighted Average
46,970		99.23% Pervious Area
366		0.77% Impervious Area

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

Subcatchment 13: DA-13



Summary for Reach 1R: Channel A

[91] Warning: Storage range exceeded by 0.20'
[55] Hint: Peak inflow is 160% of Manning's capacity

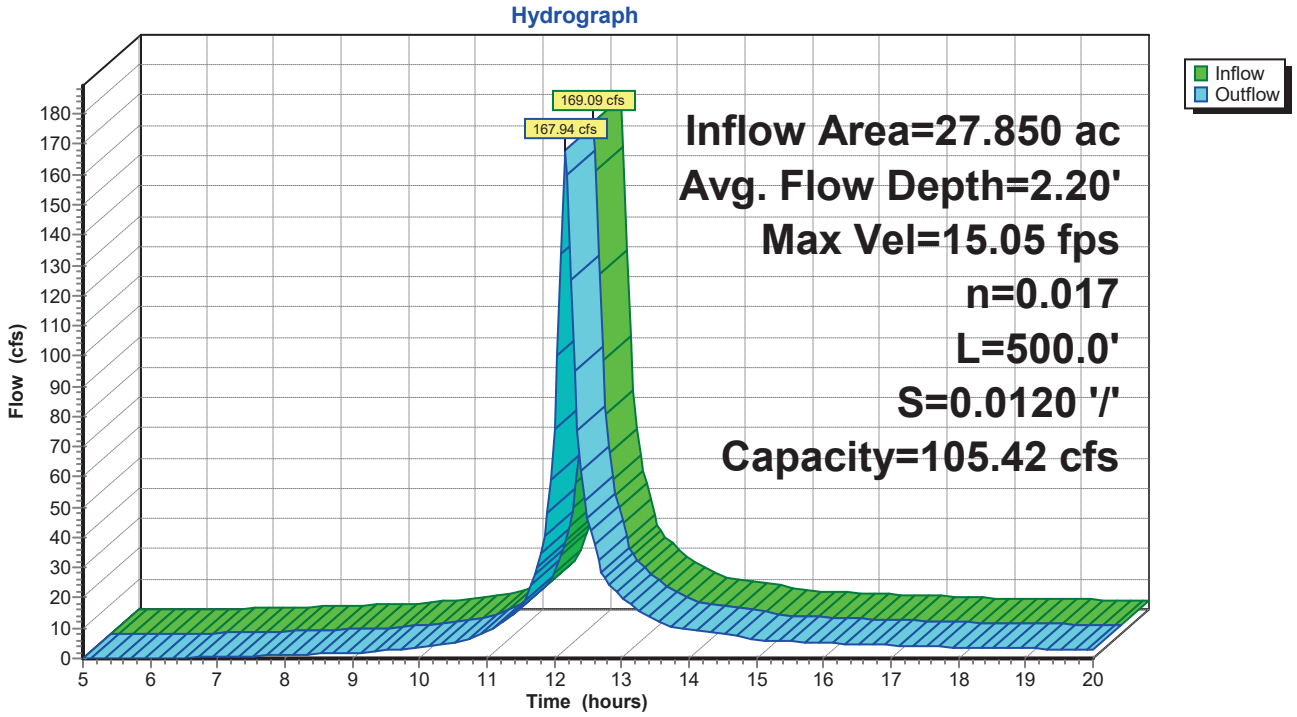
Inflow Area = 27.850 ac, 39.87% Impervious, Inflow Depth > 5.07" for 100-Year event
Inflow = 169.09 cfs @ 12.16 hrs, Volume= 11.778 af
Outflow = 167.94 cfs @ 12.17 hrs, Volume= 11.776 af, Atten= 1%, Lag= 0.6 min
Routed to Link OUT-B : OUTBALL B

Routing by Muskingum-Cunge method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Reference Flow= 105.42 cfs Estimated Depth= 2.00' Velocity= 10.54 fps
m= 1.400, c= 14.75 fps, dt= 3.0 min, dx= 500.0' / 1 = 500.0', K= 0.6 min, X= 0.381
Max. Velocity= 15.05 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 14.73 fps, Avg. Travel Time= 0.6 min

Peak Storage= 5,699 cf @ 12.16 hrs
Average Depth at Peak Storage= 2.20' , Surface Width= 7.40'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 105.42 cfs

3.00' x 2.00' deep channel, n= 0.017 Concrete, unfinished
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 500.0' Slope= 0.0120 '/'
Inlet Invert= 274.00', Outlet Invert= 268.00'

Reach 1R: Channel A

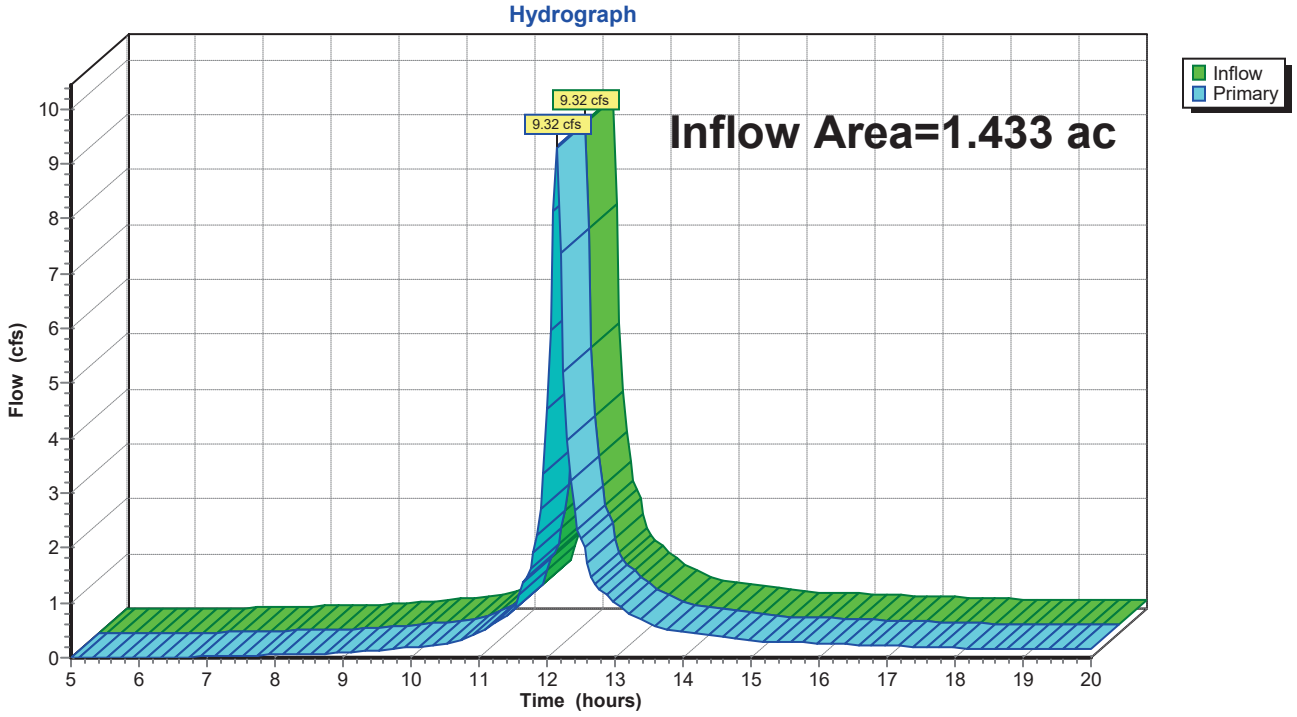


Summary for Link 1L: POI 1

Inflow Area = 1.433 ac, 40.42% Impervious, Inflow Depth > 4.99" for 100-Year event
Inflow = 9.32 cfs @ 12.14 hrs, Volume= 0.596 af
Primary = 9.32 cfs @ 12.14 hrs, Volume= 0.596 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

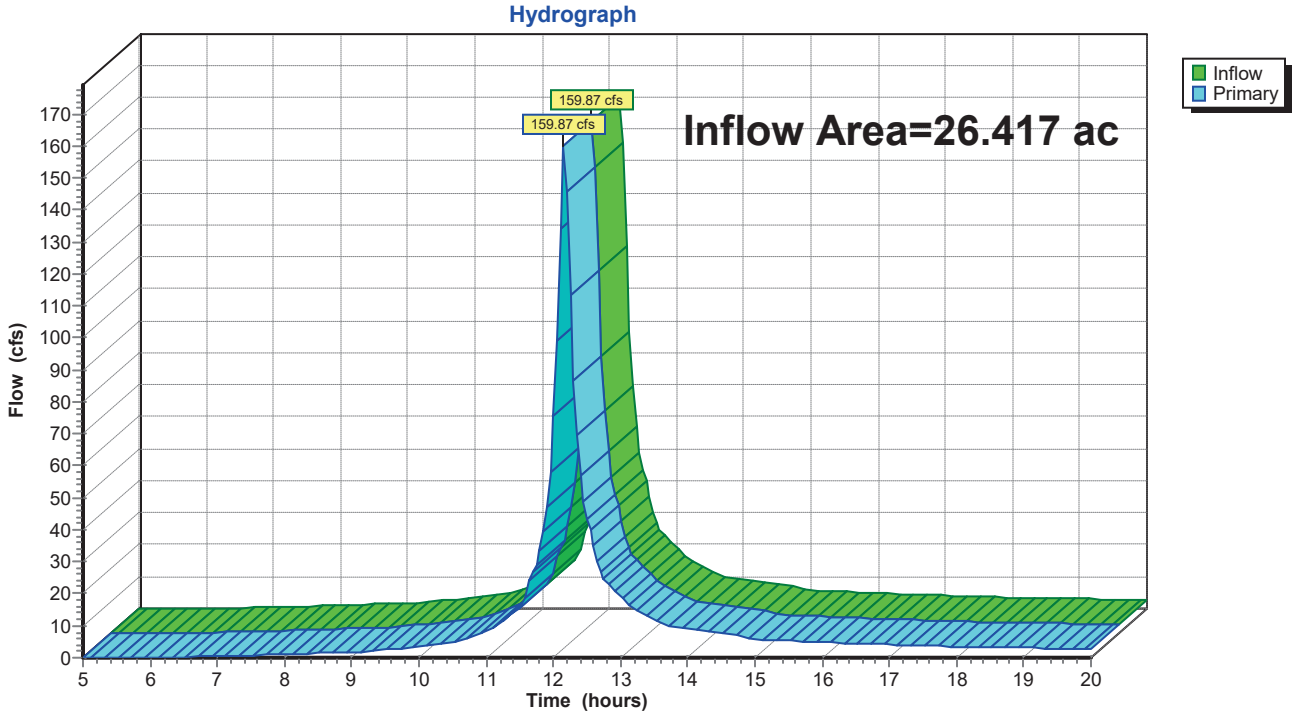


Summary for Link 3L: POI 3

Inflow Area = 26.417 ac, 39.84% Impervious, Inflow Depth > 5.08" for 100-Year event
Inflow = 159.87 cfs @ 12.16 hrs, Volume= 11.182 af
Primary = 159.87 cfs @ 12.16 hrs, Volume= 11.182 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-A : Outfall A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: POI 3

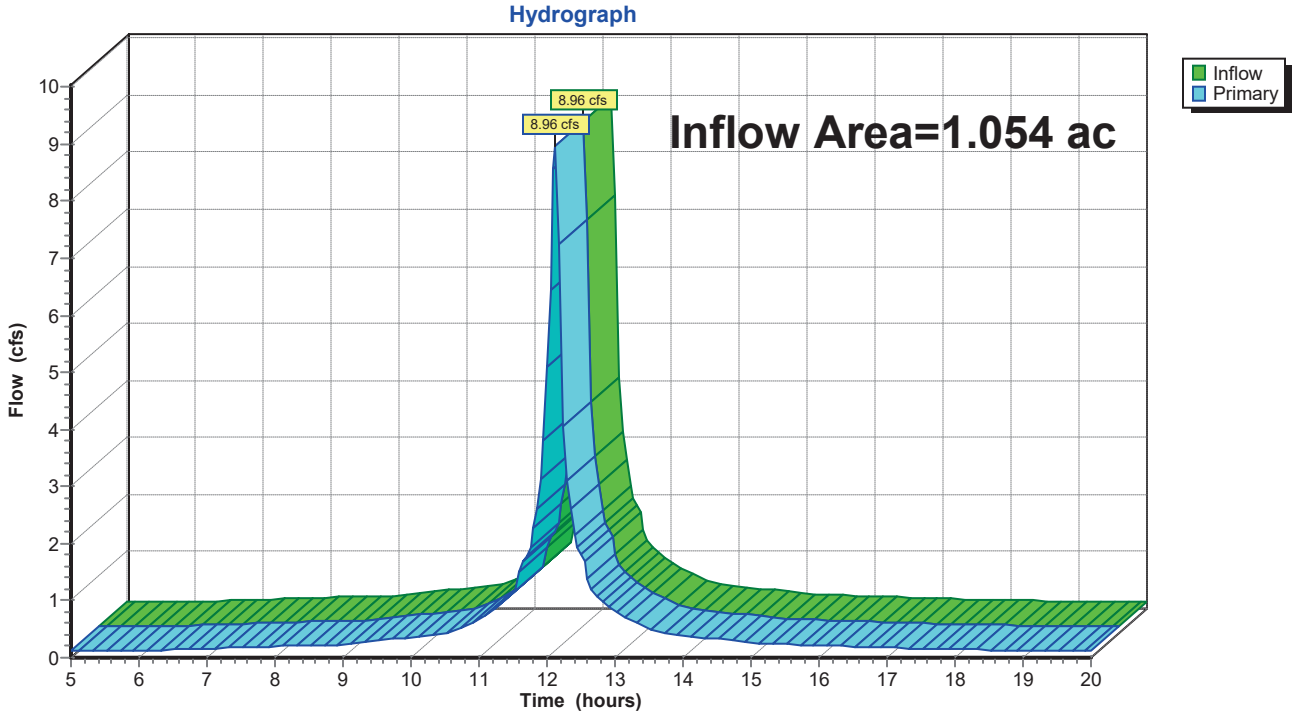


Summary for Link 5L: POI 5

Inflow Area = 1.054 ac, 92.87% Impervious, Inflow Depth > 7.20" for 100-Year event
Inflow = 8.96 cfs @ 12.13 hrs, Volume= 0.632 af
Primary = 8.96 cfs @ 12.13 hrs, Volume= 0.632 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: POI 5

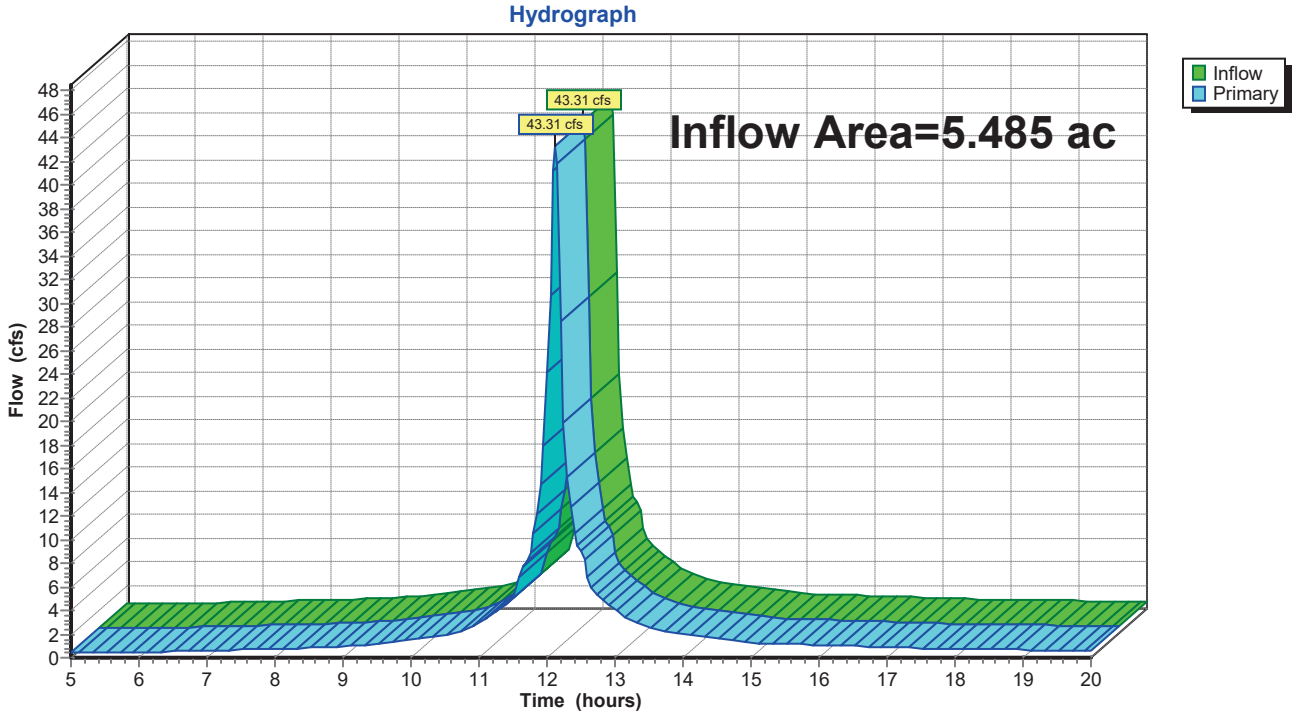


Summary for Link 6L: POI 6

Inflow Area = 5.485 ac, 68.88% Impervious, Inflow Depth > 6.48" for 100-Year event
Inflow = 43.31 cfs @ 12.13 hrs, Volume= 2.961 af
Primary = 43.31 cfs @ 12.13 hrs, Volume= 2.961 af, Atten= 0%, Lag= 0.0 min
Routed to Link OUT-B : OUTBALL B

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 6L: POI 6

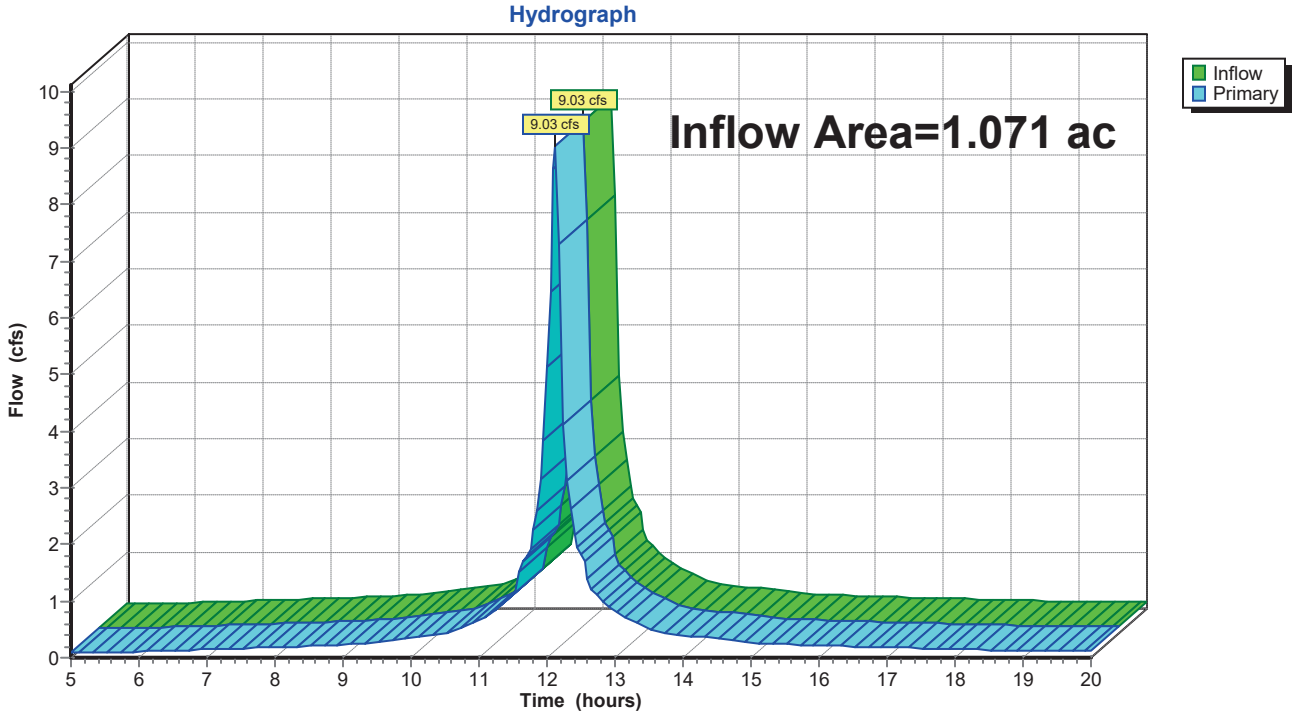


Summary for Link 8L: POI 8

Inflow Area = 1.071 ac, 88.24% Impervious, Inflow Depth > 7.05" for 100-Year event
Inflow = 9.03 cfs @ 12.13 hrs, Volume= 0.629 af
Primary = 9.03 cfs @ 12.13 hrs, Volume= 0.629 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 8L: POI 8

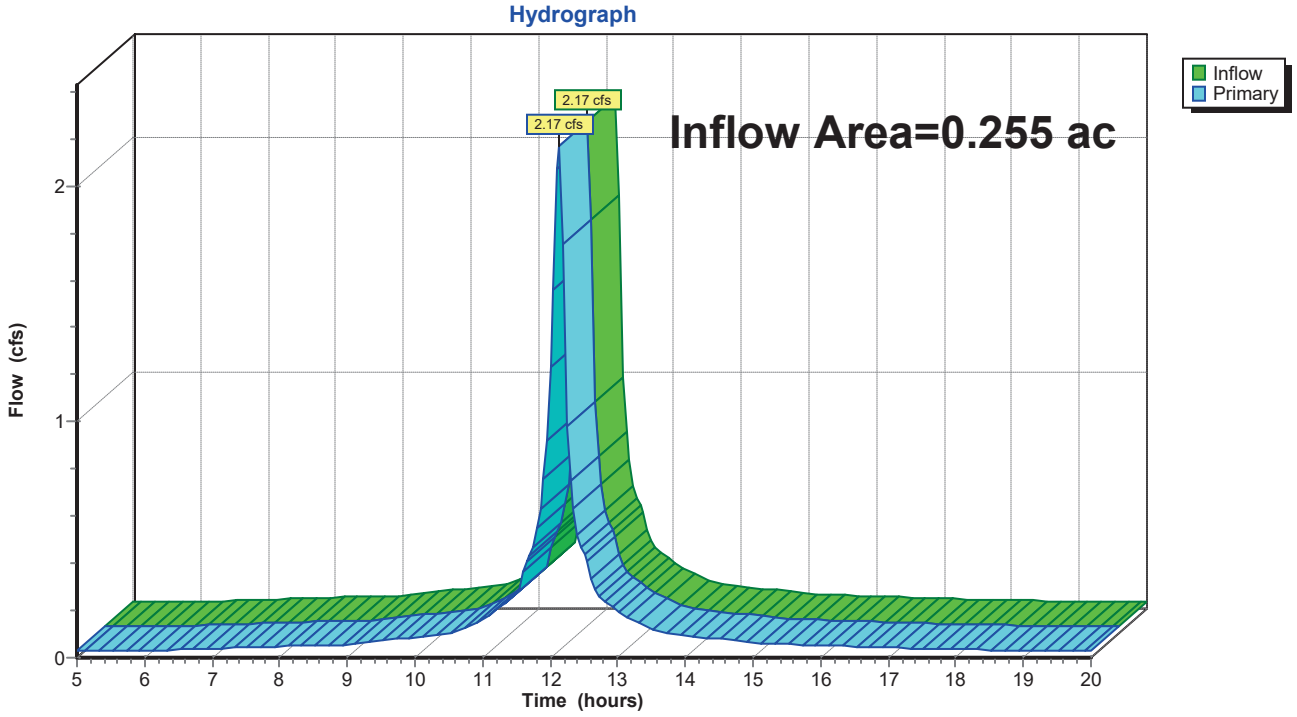


Summary for Link 10L: POI 10

Inflow Area = 0.255 ac, 97.13% Impervious, Inflow Depth > 7.20" for 100-Year event
Inflow = 2.17 cfs @ 12.13 hrs, Volume= 0.153 af
Primary = 2.17 cfs @ 12.13 hrs, Volume= 0.153 af, Atten= 0%, Lag= 0.0 min
Routed to Link 6L : POI 6

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: POI 10

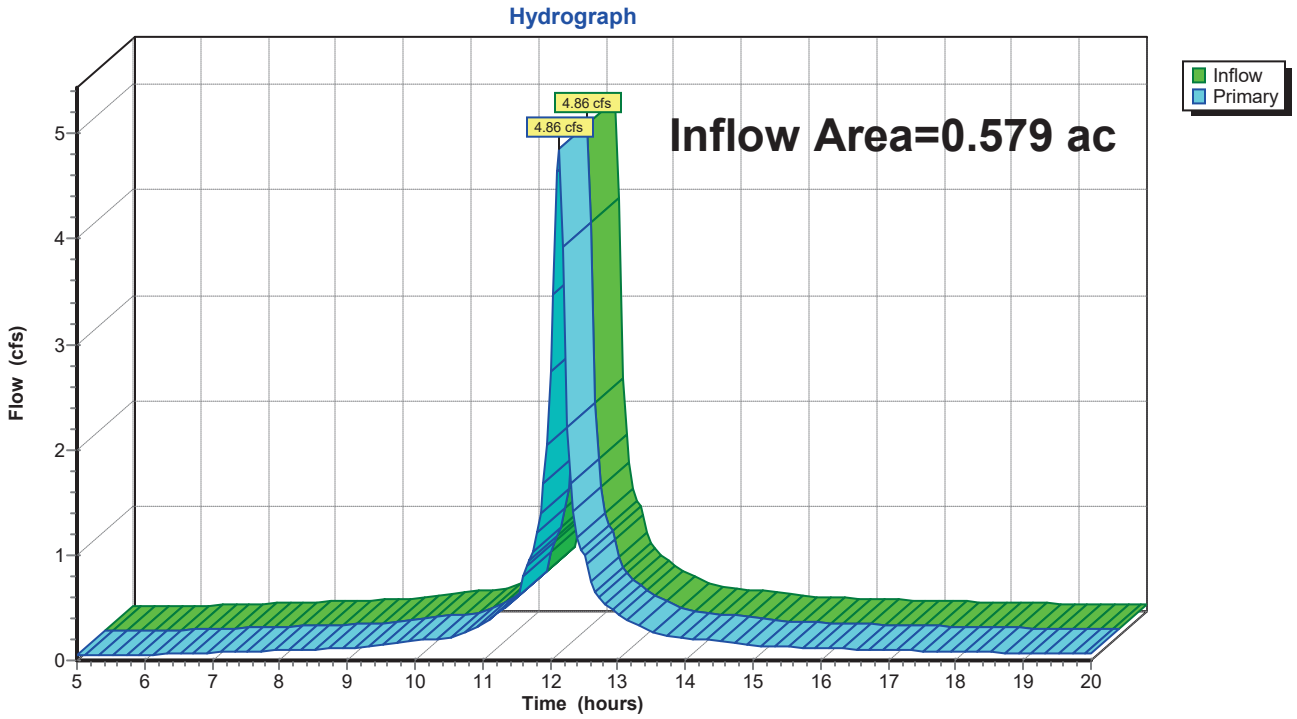


Summary for Link 11L: POI 11

Inflow Area = 0.579 ac, 76.84% Impervious, Inflow Depth > 6.96" for 100-Year event
Inflow = 4.86 cfs @ 12.13 hrs, Volume= 0.336 af
Primary = 4.86 cfs @ 12.13 hrs, Volume= 0.336 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 11L: POI 11

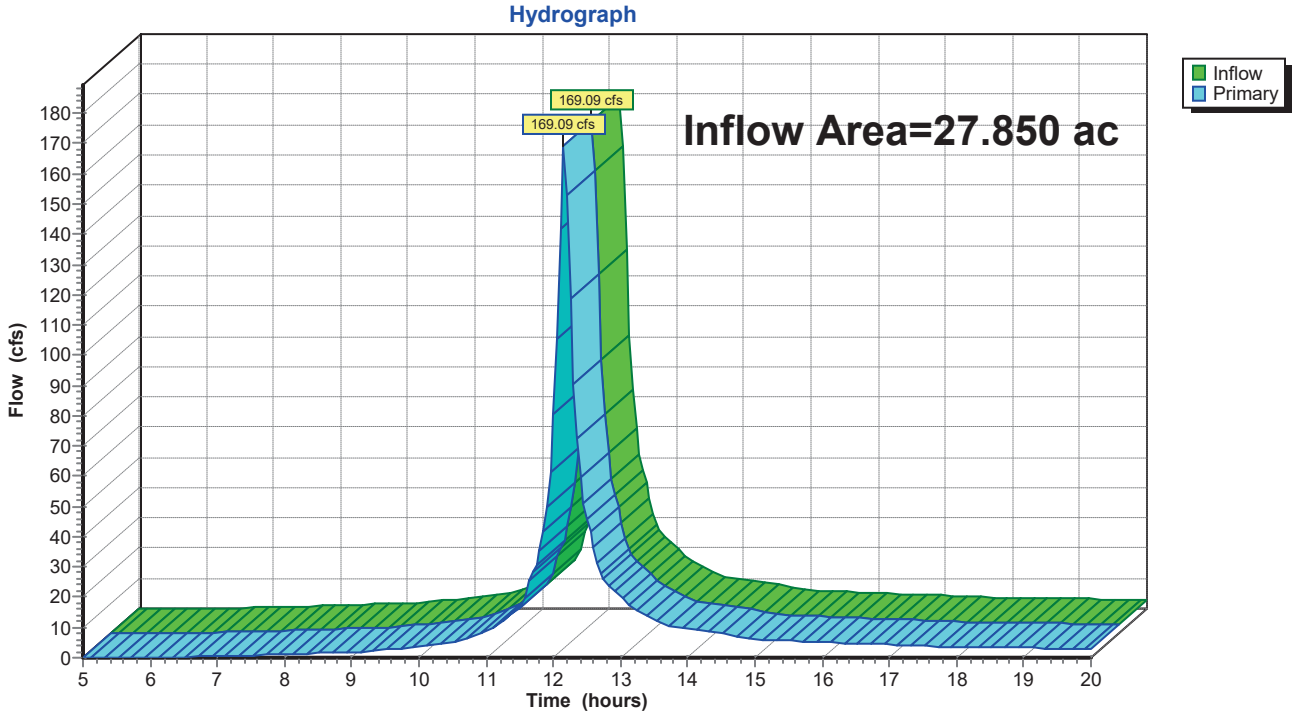


Summary for Link OUT-A: Outfall A

Inflow Area = 27.850 ac, 39.87% Impervious, Inflow Depth > 5.07" for 100-Year event
Inflow = 169.09 cfs @ 12.16 hrs, Volume= 11.778 af
Primary = 169.09 cfs @ 12.16 hrs, Volume= 11.778 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 1R : Channel A

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-A: Outfall A

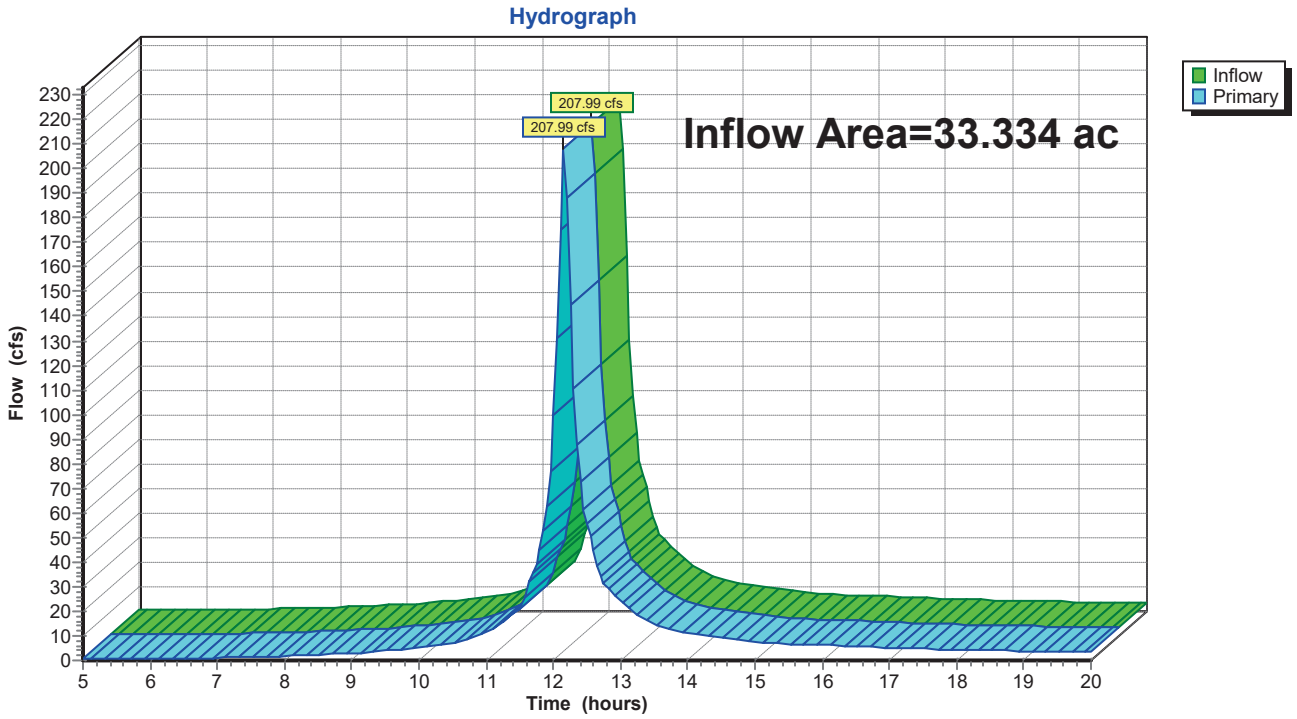


Summary for Link OUT-B: OUTBALL B

Inflow Area = 33.334 ac, 44.64% Impervious, Inflow Depth > 5.31" for 100-Year event
Inflow = 207.99 cfs @ 12.16 hrs, Volume= 14.737 af
Primary = 207.99 cfs @ 12.16 hrs, Volume= 14.737 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link OUT-B: OUTBALL B



Bioswale Design Calculations - Site # 24

Attachment E: Stormwater Concept Approval

Project:	Washington Metro water quality improvement	Designed By:	YJ
County:	Prince George's County	Checked By:	
Watershed:	Washington Metro	Date:	
Contract #:	AZ1505174		
PRD #:			
Design Phase:	Concept	**POI:**	
		Facility No:	24

Bioswale Design Calculations

Step 1: Determine Contributing Drainage Area Data: Input Cell

Contributing Area (A) =	54,203	sf.	= Maximum Contributing Drainage Area: 1 ac.
HSG A =		sf.	= HSG A within Contributing Area
HSG B =		sf.	= HSG B within Contributing Area
HSG C =		sf.	= HSG C within Contributing Area
HSG D =	54,203	sf.	= HSG D within Contributing Area
Contributing Impervious Area (A_i) =	32,312	sf.	
Percent Impervious Area ($\%_{IMP}$) =	59.6	% → use	60%
Volumetric Runoff Coefficient (R_v) =	0.587		= 0.5 + 0.009 * ($\%_{IMP}$)
Contributing Rainfall Target (P_E) =	1.8	in.	= Target Pe for the Contributing Area
Contributing ESD_v Target ($ESDV_T$) =	4769	cf.	= (P_E * A * R_v) / 12

Step 2: Determine Bioswale Design Dimensions:

Bioswale Surface Area (A_f) =	2,400	sf.	= Surface Area must be ≥ 2% of the contributing Area ----> 0.0443
Bioswale Length (L) =	300	ft.	
Bioswale Bottom Width (W) =	8	ft.	= Must be between 2 to 8 ft.
Side Slope (S_S) =	0.25	ft/ft	= 1:4 min side slopes
Bioswale Slope (S_L) =	0.01	ft/ft	= 4% maximum longitudinal slope
Number of Check Dams (C_d) =	3		= Number of Full Cells + 1 if Partial Cell is present

Step 3: Determine ESDv and Pe Provided in Bioswale:

A_f/A_i =	7.4	% → use	5%
Percent Surface Storage Required ($V_{\%-R}$) =	55%	of ESD_v	= Surface Storage tables based on P_E, $\%_{IMP}$, and A_f/A_i
Required Surface Storage (V_R) =	2623	cf.	= Surface storage required for full Contributing Pe Credit.
Check Dam Height (CD_H) =	1.00	ft.	
Check Dam Spacing (CD_S) =	100.00	ft.	= CD_H / S_L, If less than 50 ft. a minimum of 50 ft is used.
Number of Full Cells (C_F) =	3.00		= L / CD_S
Partial Cells (C_P) =	No		
Surface Storage Per Facility (V_C) =	533.33	cf.	= (2 * (CD_H^3 / S_S * S_L) + 3 * (CD_H^2 * W / S_L)) / 6
Total Surface Storage Provided (V_T) =	1600.00	cf.	= V_C * C_F + ((L - CD_S * C_F) * V_C / CD_S)
Percent Volume Provided Above Surface ($V_{\%-P}$) =	34%	of ESD_v	= V_T / V_{TBC}

The facility does not provide enough surface storage to treat the target Pe, iterations are required to determine the reduced Pe

			Percent Storage	
From	P_E	ESD_v	Required	Actual
	in.	*cf.*	*%*	*%*
Table	1.10	2,914	51	55
Iteration	1.17	3,100	51.7	51.7
Table	1.20	3,179	52	50

The PE treated is based on providing a surface storage volume that is a certain percent of the ESDv, but the ESDv changes depending on the PE. Therefore, determing the PE treated is an iterative process. The table shown demonstrates this process.

Through iterations the achieved Pe for this Bioswale is 1.17 in. and the ESDv attained by the facility is 3100 cf.

Step 4: Determine Effective Impervious Area Treated:

Contrib. Imp. Area	P_E treated	Imp. Area Treated
ac.	*in.*	*ac.*
0.74	1.17	0.74

The facility is providing a Pe greater than 1 in. 100% of the contributing impervious area, 0.74 ac., is considered treated.

Step 5: Facility Summary Table:

Facility ID	Contrib. Area	Contrib. Imp. Area	Length	Width	Slope	Check Dams	Rainfall Treated	ESDv Provided	Imp. Area Treated
	sf.	*sf.*	*ft.*	*ft.*	*ft./ft.*	#	*in.*	*cf.*	*ac.*
24	54,203	32,312	300	8	0.01	3	1.17	3,100	0.74

Note: The tables used for determining the amount of surface storage above the media have been provided by MDE to be used with State Highway Administration (SHA) Bioretention Soil Mix (BSM). The tables can only be used with SHA BSM with an infiltration rate of 1 in/hr. The tables are not valid for media with an infiltration rate different than 1 in/hr.

Attachment E: Stormwater Concept Approval

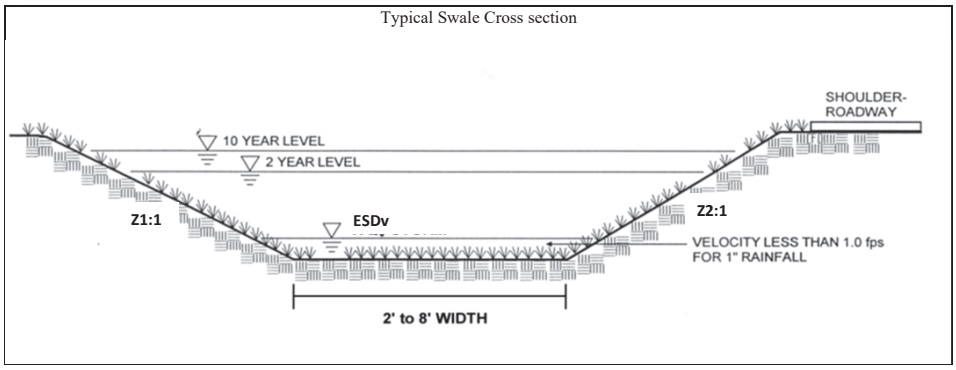
Project:	Washington Metro water quality improvement	Designed By:	YJ
County:	Prince George's County	Checked By:	
Watershed:	Washington Metro	Date:	
Contract #:	AZ1505174		
PRD #:			
Design Phase:	Concept	**POI:**	
		Facility No:	24

Swale Check: Method for Computing Peak Discharge for ESDv and 10-yr check

Drainage Area Data

ESDv Rainfall Depth (Pe) =	1.8	in.	= Use Required Contributing Pe
Drainage Area (A) =	1.244	ac.	
Total Impervious Area (I) =	0.742	ac.	
Time-of-Concentration (Tc) =	0.100	hr.	= Tc value from TR-55 Computations
Percent Impervious =	59.6	%	= I/A
Runoff Coefficient (Rv) =	0.587		= 0.05+0.009*(I)
Runoff Volume (Qe) =	1.0566	in.	= Pe * Rv (Eq. Ref. Vol. II, Appendix D.10)
Adjusted RCN =	92		= 1000 / [10+5Pe+10Qa-10√(Qa2+1.25QaPe)] (Eq. Ref. Vol. II, Appendix D.10)
Initial Abstract (Ia) =	0.17		= (200/CN)-2
Ia/Pe =	0.10		= If Ia/Pe is less than 0.1 then 0.1 will be used.
Unit Peak Discharge (qu) =	1010.0	csm/in.	= Log (q_u) = C_0 + C_i * Log (Tc) + C_2 * [Log (Tc)]^2 (Figure D.11.1)
ESDv Peak Flow (Qw) =	2.07	cfs.	= (qu csm/in) * (A mi2) * (Qe in)

Swale Dimensions



Side Slope (Z1) =	4	:1
Side Slope (Z2) =	4	:1
Bottom Width (B) =	8	ft.
Slope of Channel (S) =	0.01	ft/ft

Criteria for the Swale velocity *Ref. Vol. I, ch 5, pg 5.109*

1. The maximum flow velocity for runoff from the ESDv rainfall shall be less than or equal to 1.0 fps (see Appendix D.10 for methodology to compute flowrate).
2. The maximum flow velocity for runoff from the ten-year design event shall be non erosive.

Solve Mannings Equation

$$V = (1.49 * A * R^{2/3} * S^{1/2}) / n$$

Flow Depth	Mann Coeff. (n)	Flow Area (A)	Hydraulic Radius (R)	R^(2/3)	A*R^(2/3)	Capacity (Qw)	Qp	Velocity (V)	Wetted Perimeter (WP)
(in.)		(sf.)	(ft.)			cfs	Cfs	fps	ft.
4.3	0.144	3.42	0.31	0.459	1.569	1.62	2.07	0.47	10.98
4.8	0.137	3.88	0.34	0.489	1.897	2.07	2.07	0.53	11.33
5.3	0.130	4.35	0.37	0.518	2.255	2.59	2.07	0.60	11.67

**The "n" values from Fig. 7.5 of CWP "Design of SW Filtering Systems"; if d<4in than n=0.15; if d>12in than n=0.03; if 4in<d>12in than n=0.207-0.0145*d*

Depth of Flow = d =	4.84	in.	= from table above
Computed Velocity = V =	0.53	fps	= Qw/A velocity must be less than or equal to 1 fps

10-year Storm Event Design Check

Present Soil Types =	D		
RCN Post-Development =	92		= RCN values from TR-55 Computations
Time-of-Concentration (Tc) =	0.100	hr.	= Tc values from TR-55 Computations
10-year Discharge (Q10) =	6.09	cfs	= See TR-55 output

Attachment E: Stormwater Concept Approval

Project:	*Washington Metro water quality improvement*	*Designed By:*	*YJ*
County:	*Prince George's County*	*Checked By:*	
Watershed:	*Washington Metro*	*Date:*	
Contract #:	*AZ1505174*		
PRD #:			
Design Phase:	*Concept*	***POI:***	
		Facility No:	*24*

Swale Check: Method for Computing Peak Discharge for ESDv and 10-yr check

Table D.12.1 Permissible Velocities for Channels Lined with Vegetation

Channel Slope	Lining	Permissible Velocity[1] (ft/sec)
0-5%	Reed canarygrass Tall fescue Kentucky bluegrass	5
	Grass-legume mixture	4
	Red fescue Redtop Sericea lespedeza Annual lespedeza Small grains	2.5
5-10%	Reed canarygrass Tall fescue Kentucky bluegrass	4
	Grass-legume mixture	3
Greater than 10%	Reed canarygrass Tall fescue Kentucky bluegrass	3

[1] For highly erodible soils, permissible velocities should be decreased 25%. An erodibility factor (K) greater than 0.35 would indicate a highly erodible soil. Erodibility factors (K-factors) for Maryland soils are listed either in the Soil Survey or on the Soils-5 forms available in each Soil Conservation District or local NRCS office.

Source: Soil and Water Conservation Engineering, Schwab, *et al.*

The permissible velocity = *5.000* *fps*

Maximum permissible velocities are given in Table D.12.1 (Appendix D.12 of MDE Manual). If you are providing soil stabilization you may use Limiting Velocities from P.I-3-A-3 of SHA Highway Drainage Manual.

Solve Mannings Equation

$$V = (1.49 * A * R^{2/3} * S^{1/2}) / n$$

Flow Depth	Mann Coeff. (n)	Flow Area (A)	Hydraulic Radius (R)	R^(2/3)	A*R^(2/3)	Capacity (Q)	Q_{10}	Velocity (V)	Wetted Perimeter (WP)
(in.)		(sf.)	(ft.)			cfs	Cfs	fps	ft.
6.9	0.107	5.95	0.47	0.602	3.582	5.01	6.09	0.84	12.76
7.4	0.099	6.49	0.49	0.626	4.059	6.09	6.09	0.94	13.11
7.9	0.092	7.03	0.52	0.649	4.565	7.39	6.09	1.05	13.45

**The "n" values from Fig. 7.5 of CWP "Design of SW Filtering Systems"; if d<4in than n=0.15; if d>12in than n=0.03; if 4in<d>12in than n=0.207-0.0145*d*

Depth of Flow (d) =	7.43	*in.*	*= from table above*
Computed Velocity (V) =	0.94	*fps*	*= Q/A velocity must be less than permissible velocity*
Depth of Swale from Edge of Pavement =	2.50	*ft.*	
Freeboard Provided =	10.57	*in.*	*= 9 inch minimum freeboard for 10-yr Storm event (check dam=12inch depth)*

Bioswale Design Calculations - Site # 42

Attachment E: Stormwater Concept Approval

Project:	Washington Metro water quality improvement	Designed By:	YJ
County:	Prince George's County	Checked By:	
Watershed:	Washington Metro	Date:	
Contract #:	AZ1505174		
PRD #:			
Design Phase:	Concept	**POI:**	
		Facility No:	42

Bioswale Design Calculations

Step 1: Determine Contributing Drainage Area Data: Input Cell

Contributing Area (A) =	42,258	sf.	= Maximum Contributing Drainage Area: 1 ac.
HSG A =		sf.	= HSG A within Contributing Area
HSG B =		sf.	= HSG B within Contributing Area
HSG C =		sf.	= HSG C within Contributing Area
HSG D =	42,258	sf.	= HSG D within Contributing Area
Contributing Impervious Area (A_I) =	29,966	sf.	
Percent Impervious Area ($\%_{IMP}$) =	70.9	% → use	75%
Volumetric Runoff Coefficient (R_v) =	0.688		= 0.5 + 0.009 * ($\%_{IMP}$)
Contributing Rainfall Target (P_E) =	1.8	in.	= Target Pe for the Contributing Area
Contributing ESD$_v$ Target ($ESDV_T$) =	4362	cf.	= (P_E * A * R_v) / 12

Step 2: Determine Bioswale Design Dimensions:

Bioswale Surface Area (A_f) =	1,200	sf.	= Surface Area must be ≥ 2% of the contributing Area ---->	0.0284
Bioswale Length (L) =	150	ft.		
Bioswale Bottom Width (W) =	8	ft.	= Must be between 2 to 8 ft.	
Side Slope (S_S) =	0.25	ft/ft	= 1:4 min side slopes	
Bioswale Slope (S_L) =	0.02	ft/ft	= 4% maximum longitudinal slope	
Number of Check Dams (C_d) =	3		= Number of Full Cells + 1 if Partial Cell is present	

Step 3: Determine ESDv and Pe Provided in Bioswale:

A_f/A_i =	4.0	% → use	2%
Percent Surface Storage Required ($V_{\%-R}$) =	59%	of ESD$_v$	= Surface Storage tables based on P_E, $\%_{IMP}$, and A_f/A_i
Required Surface Storage (V_R) =	2574	cf.	= Surface storage required for full Contributing Pe Credit.
Check Dam Height (CD_H) =	1.00	ft.	
Check Dam Spacing (CD_S) =	50.00	ft.	= CD_H / S_L, If less than 50 ft. a minimum of 50 ft is used.
Number of Full Cells (C_F) =	3.00		= L / CD_S
Partial Cells (C_P) =	No		
Surface Storage Per Facility (V_C) =	266.67	cf.	= (2 * (CD_H^3 / S_S * S_L) + 3 * (CD_H^2 * W / S_L)) / 6
Total Surface Storage Provided (V_T) =	800.00	cf.	= V_C * C_F + ((L - CD_S * C_F) * V_C / CD_S)
Percent Volume Provided Above Surface ($V_{\%-P}$) =	18%	of ESD$_v$	= V_T / V_{TBC}

The facility does not provide enough surface storage to treat the target Pe, iterations are required to determine the reduced Pe

			Percent Storage	
From	P_E	ESD_v	Required	Actual
	in.	cf.	%	%
Table	0.60	1,454	53	55
Iteration	0.62	1,503	53.4	53.4
Table	0.70	1,696	55	47

The PE treated is based on providing a surface storage volume that is a certain percent of the ESDv, but the ESDv changes depending on the PE. Therefore, determing the PE treated is an iterative process. The table shown demonstrates this process.

Through iterations the achieved Pe for this Bioswale is 0.62 in. and the ESDv attained by the facility is 1503 cf.

Step 4: Determine Effective Impervious Area Treated:

Contrib. Imp. Area	P_E treated	Imp. Area Treated
ac.	in.	ac.
0.69	0.62	0.43

The facility is providing a Pe less than 1 in. only partial credit of, 0.43 ac., is considered treated.

Step 5: Facility Summary Table:

Facility ID	Contrib. Area	Contrib. Imp. Area	Length	Width	Slope	Check Dams	Rainfall Treated	ESDv Provided	Imp. Area Treated
	sf.	sf.	ft.	ft.	ft./ft.	#	in.	cf.	ac.
42	42,258	29,966	150	8	0.02	3	0.62	1,503	0.43

Note: The tables used for determining the amount of surface storage above the media have been provided by MDE to be used with State Highway Administration (SHA) Bioretention Soil Mix (BSM). The tables can only be used with SHA BSM with an infiltration rate of 1 in/hr. The tables are not valid for media with an infiltration rate different than 1 in/hr.

Attachment E: Stormwater Concept Approval

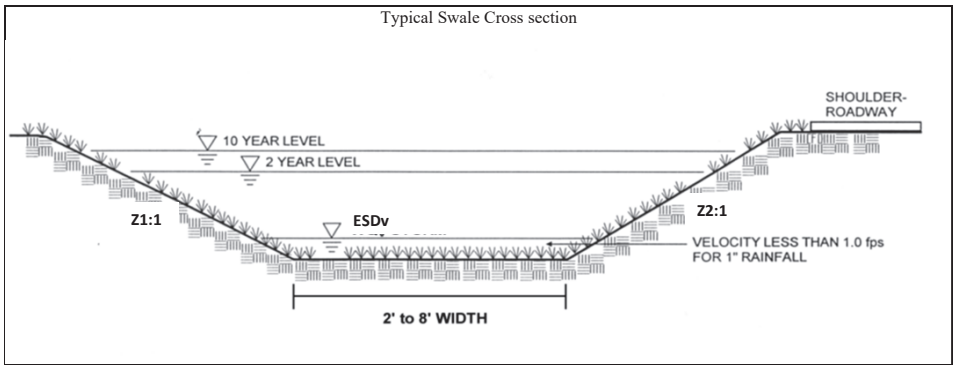
Project:	Washington Metro water quality improvement	Designed By:	YJ
County:	Prince George's County	Checked By:	
Watershed:	Washington Metro	Date:	
Contract #:	AZ1505174		
PRD #:			
Design Phase:	Concept	**POI:**	
		Facility No:	42

Swale Check: Method for Computing Peak Discharge for ESDv and 10-yr check

Drainage Area Data

ESDv Rainfall Depth (Pe) =	1.8	in.	= Use Required Contributing Pe
Drainage Area (A) =	0.970	ac.	
Total Impervious Area (I) =	0.688	ac.	
Time-of-Concentration (Tc) =	0.100	hr.	= Tc value from TR-55 Computations
Percent Impervious =	70.9	%	= I/A
Runoff Coefficient (Rv) =	0.688		= 0.05+0.009*(I)
Runoff Volume (Qe) =	1.2384	in.	= Pe * Rv (Eq. Ref. Vol. II, Appendix D.10)
Adjusted RCN =	94		= 1000 / [10+5Pe+10Qa-10√(Qa2+1.25QaPe)] (Eq. Ref. Vol. II, Appendix D.10)
Initial Abstract (Ia) =	0.13		= (200/CN)-2
Ia/Pe =	0.10		= If Ia/Pe is less than 0.1 then 0.1 will be used.
Unit Peak Discharge (qu) =	1010.0	csm/in.	= Log (q_u) = C_0 + C_i * Log (Tc) + C_2 * [Log (Tc)]^2 (Figure D.11.1)
ESDv Peak Flow (Qw) =	1.90	cfs.	= (qu csm/in) * (A mi2) * (Qe in)

Swale Dimensions



Side Slope (Z1) =	4	:1
Side Slope (Z2) =	4	:1
Bottom Width (B) =	8	ft.
Slope of Channel (S) =	0.02	ft/ft

Criteria for the Swale velocity *Ref. Vol. I, ch 5, pg 5.109*

1. The maximum flow velocity for runoff from the ESDv rainfall shall be less than or equal to 1.0 fps (see Appendix D.10 for methodology to compute flowrate).
2. The maximum flow velocity for runoff from the ten-year design event shall be non erosive.

Solve Mannings Equation

$$V = (1.49 * A * R^{2/3} * S^{1/2}) / n$$

Flow Depth	Mann Coeff. (n)	Flow Area (A)	Hydraulic Radius (R)	R^(2/3)	A*R^(2/3)	Capacity (Qw)	Qp	Velocity (V)	Wetted Perimeter (WP)
(in.)		(sf.)	(ft.)			cfs	Cfs	fps	ft.
3.5	0.150	2.66	0.26	0.403	1.070	1.50	1.90	0.57	10.39
4.0	0.150	3.09	0.29	0.436	1.350	1.90	1.90	0.61	10.74
4.5	0.142	3.54	0.32	0.468	1.658	2.46	1.90	0.69	11.08

**The "n" values from Fig. 7.5 of CWP "Design of SW Filtering Systems"; if d<4in than n=0.15; if d>12in than n=0.03; if 4in<d>12in than n=0.207-0.0145*d*

Depth of Flow = d =	3.98	in.	= from table above
Computed Velocity = V =	0.61	fps	= Qw/A velocity must be less than or equal to 1 fps

10-year Storm Event Design Check

Present Soil Types =	D		
RCN Post-Development =	92		= RCN values from TR-55 Computations
Time-of-Concentration (Tc) =	0.100	hr.	= Tc values from TR-55 Computations
10-year Discharge (Q10) =	4.92	cfs	= See TR-55 output

Attachment E: Stormwater Concept Approval

Project:	*Washington Metro water quality improvement*	*Designed By:*	*YJ*
County:	*Prince George's County*	*Checked By:*	
Watershed:	*Washington Metro*	*Date:*	
Contract #:	*AZ1505174*		
PRD #:			
Design Phase:	*Concept*	***POI:***	
		Facility No:	*42*

Swale Check: Method for Computing Peak Discharge for ESDv and 10-yr check

Table D.12.1 Permissible Velocities for Channels Lined with Vegetation

Channel Slope	Lining	Permissible Velocity[1] (ft/sec)
0-5%	Reed canarygrass Tall fescue Kentucky bluegrass	5
	Grass-legume mixture	4
	Red fescue Redtop Sericea lespedeza Annual lespedeza Small grains	2.5
5-10%	Reed canarygrass Tall fescue Kentucky bluegrass	4
	Grass-legume mixture	3
Greater than 10%	Reed canarygrass Tall fescue Kentucky bluegrass	3

[1] For highly erodible soils, permissible velocities should be decreased 25%. An erodibility factor (K) greater than 0.35 would indicate a highly erodible soil. Erodibility factors (K-factors) for Maryland soils are listed either in the Soil Survey or on the Soils-5 forms available in each Soil Conservation District or local NRCS office.

Source: Soil and Water Conservation Engineering, Schwab, *et al.*

The permissible velocity = *5.000* *fps*

Maximum permissible velocities are given in Table D.12.1 (Appendix D.12 of MDE Manual). If you are providing soil stabilization you may use Limiting Velocities from P.I-3-A-3 of SHA Highway Drainage Manual.

Solve Mannings Equation

$$V = (1.49 * A * R^{2/3} * S^{1/2}) / n$$

Flow Depth	Mann Coeff. (n)	Flow Area (A)	Hydraulic Radius (R)	R^(2/3)	A*R^(2/3)	Capacity (Q)	Q_{10}	Velocity (V)	Wetted Perimeter (WP)
(in.)		(sf.)	(ft.)			cfs	Cfs	fps	ft.
5.5	0.127	4.53	0.38	0.529	2.396	3.98	4.92	0.88	11.80
6.0	0.120	5.03	0.41	0.556	2.793	4.92	4.92	0.98	12.14
6.5	0.112	5.53	0.44	0.581	3.218	6.04	4.92	1.09	12.49

**The "n" values from Fig. 7.5 of CWP "Design of SW Filtering Systems"; if d<4in than n=0.15; if d>12in than n=0.03; if 4in<d>12in than n=0.207-0.0145*d*

Depth of Flow (d) =	6.03	*in.*	*= from table above*
Computed Velocity (V) =	0.98	*fps*	*= Q/A velocity must be less than permissible velocity*
Depth of Swale from Edge of Pavement =	2.50	*ft.*	
Freeboard Provided =	11.97	*in.*	*= 9 inch minimum freeboard for 10-yr Storm event (check dam=12inch depth)*

TR-55 Computations - Sites #24 & 42

WinTR-55 Current Data Description

--- Identification Data ---

User: JJ
Project:
SubTitle:
State: Maryland
County: Prince Georges NOAA-C
Filename: C:\TR55 comp\Sites for MO998.w55

Date: 07/10/2024
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
site#42		Outlet	0.97	93	0.100
site#24		Outlet	1.24	91	0.100

--- Storm Data --

Rainfall Depth by Rainfall Return Period

1-Yr (in)	2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)
2.63	3.19	4.12	4.93	6.17	7.26	8.5

Storm Data Source: Prince Georges NOAA-C County, Maryland (NRCS)
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

JJ

Prince Georges NOAA-C County, Maryland

Storm Data

Rainfall Depth by Rainfall Return Period

1-Yr (in)	2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)
2.63	3.19	4.12	4.93	6.17	7.26	8.5

Storm Data Source: Prince Georges NOAA-C County, Maryland (NRCS)
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

JJ

Prince Georges NOAA-C County, Maryland

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 1-Yr (cfs)	2-Yr (cfs)	10-Yr (cfs)	100-Yr (cfs)
SUBAREAS				
site#42	2.38	3.01	4.92	8.79
site#24	2.82	3.62	6.09	11.06
REACHES				

JJ

Prince Georges NOAA-C County, Maryland

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 1-Yr (cfs)	(hr)	2-Yr (cfs)	(hr)	10-Yr (cfs)	(hr)	100-Yr (cfs)	(hr)
SUBAREAS								
site#42	2.38	12.12	3.01	12.12	4.92	12.11	8.79	12.12
site#24	2.82	12.12	3.62	12.12	6.09	12.12	11.06	12.12
REACHES								
OUTLET								

JJ

Prince Georges NOAA-C County, Maryland

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
site#42	.97	0.100	93	Outlet	
site#24	1.24	0.100	91	Outlet	

JJ

Prince Georges NOAA-C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
site#42							
User-provided							0.100
					Time of Concentration		0.100
site#24							
User-provided							0.100
					Time of Concentration		0.100

JJ

Prince Georges NOAA-C County, Maryland

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
site#42	CN directly entered by user	-	.97	93
	Total Area / Weighted Curve Number		.97	93
site#24	CN directly entered by user	-	1.24	91
	Total Area / Weighted Curve Number		1.24	91

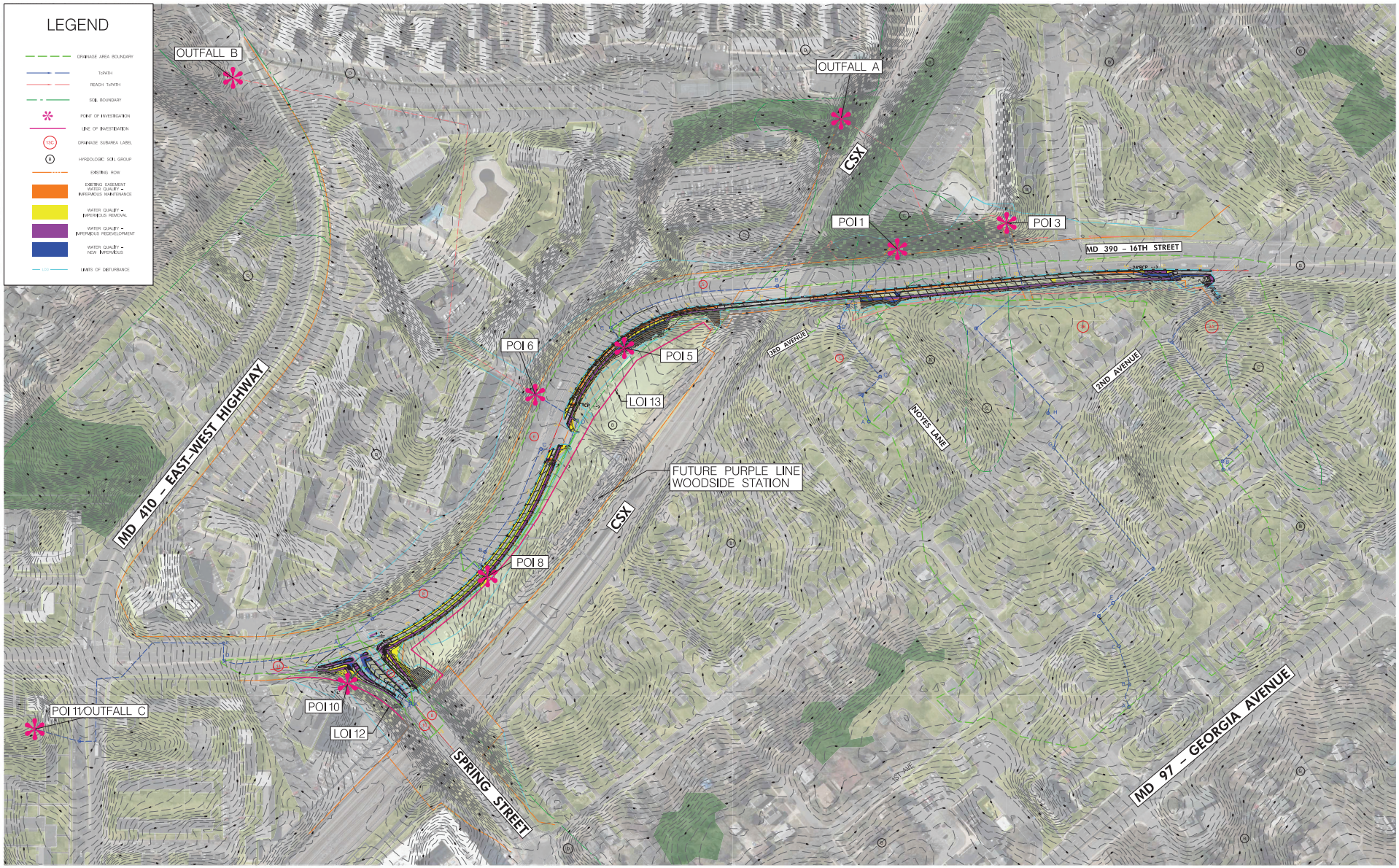
Appendix E

Water Quality Mapping

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

Montgomery County
Aerial Photography 2017
1":70' Scale

MD 390 (FROM SPRING STREET TO 2ND AVENUE)
WATER QUALITY MAP



Appendix F

Erosion and Sediment Control Mapping & Computations

(Not included as part of the Concept Submittal to PRD and will be included in future submittals)

Appendix G

Natural Resources

- Soil Survey (HSG and K Factor)
- Stream Designation Information
- Impairment Information
- FEMA Mapping

* *Environmental Features not present in project area*

Soil Survey (HSG and K Factor)

United States Department of Agriculture

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 District of Columbia, and Montgomery County, Maryland

MD 390 - SOIL SURVEY

July 15, 2024

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

Contents

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: 1:12,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 scales ranging from 1:12,000 to 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: District of Columbia
Survey Area Data: Version 17, Sep 12, 2023

Soil Survey Area: Montgomery County, Maryland
Survey Area Data: Version 19, Sep 12, 2023

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jun 30, 2022—Sep 1, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

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
Ck	Codorus silt loam	2.2	0.3%
GmB	Glenelg variant-Urban land complex, 0 to 8 percent slopes	1.5	0.2%
MbD	Manor loam, 15 to 40 percent slopes	2.0	0.3%
McC	Manor channery loam, 8 to 15 percent slopes	8.1	1.2%
MdB	Manor-Urban land complex, 0 to 8 percent slopes	55.8	8.0%
MdC	Manor-Urban land complex, 8 to 15 percent slopes	5.1	0.7%
MdD	Manor-Urban land complex, 15 to 40 percent slopes	21.1	3.0%
Ub	Urban land	8.5	1.2%
Subtotals for Soil Survey Area		**104.3**	**14.9%**
Totals for Area of Interest		**697.4**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1C	Gaila silt loam, 8 to 15 percent slopes	9.3	1.3%
2B	Glenelg silt loam, 3 to 8 percent slopes	62.4	9.0%
2C	Glenelg silt loam, 8 to 15 percent slopes	71.4	10.2%
2UB	Glenelg-Urban land complex, 0 to 8 percent slopes	103.5	14.8%
2UC	Glenelg-Urban land complex, 8 to 15 percent slopes	129.9	18.6%
16D	Brinklow-Blocktown channery silt loams, 15 to 25 percent slopes	6.5	0.9%
67UB	Urban land-Wheaton complex, 0 to 8 percent slopes	37.6	5.4%
400	Urban land	172.6	24.7%
Subtotals for Soil Survey Area		**593.2**	**85.1%**
Totals for Area of Interest		**697.4**	**100.0%**

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.

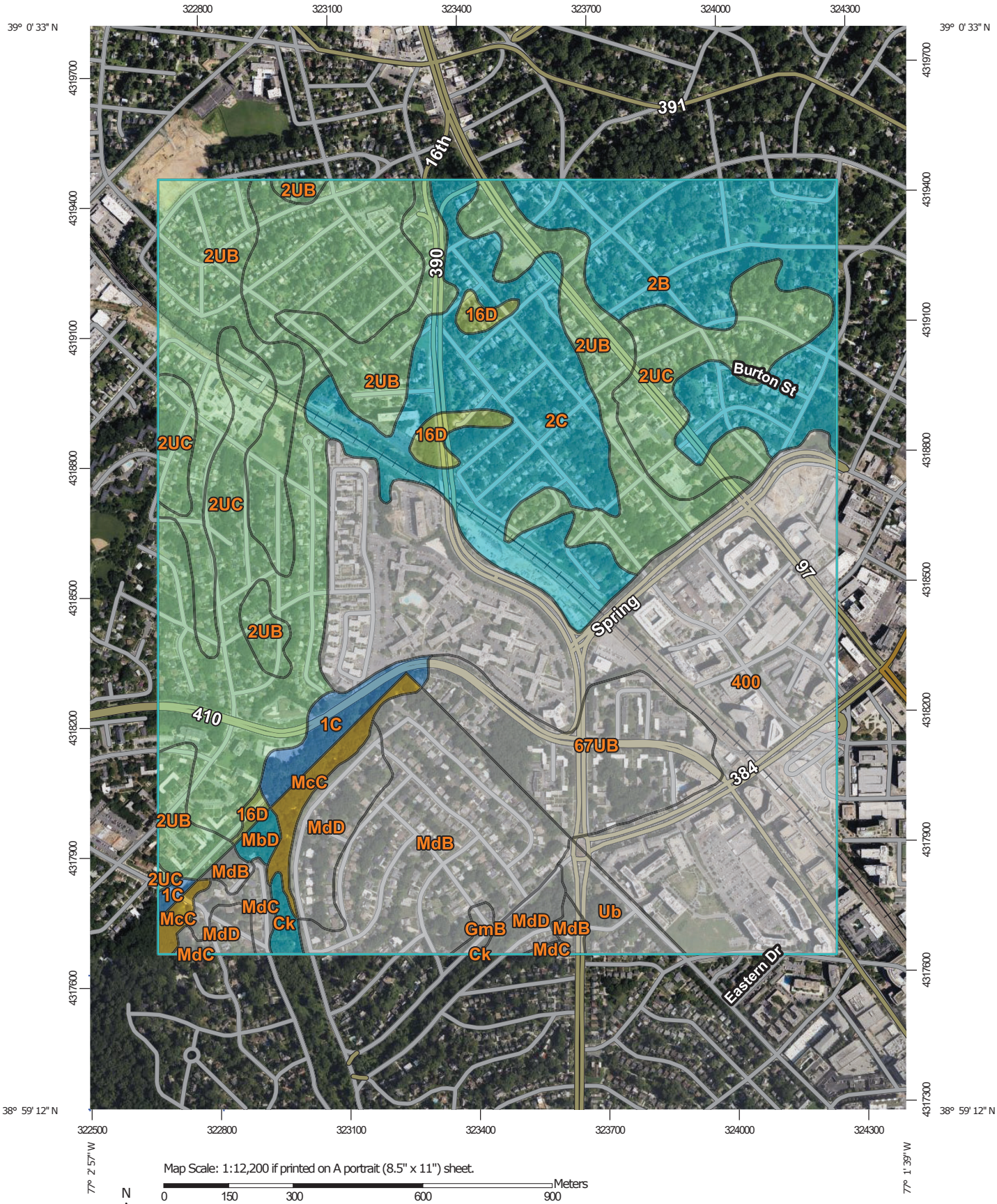
K Factor, Whole Soil

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.

Factor K does not apply to organic horizons and is not reported for those layers.

Custom Soil Resource Report
Map—K Factor, Whole Soil



Custom Soil Resource Report

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 scales ranging from 1:12,000 to 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: District of Columbia
Survey Area Data: Version 17, Sep 12, 2023

Soil Survey Area: Montgomery County, Maryland
Survey Area Data: Version 19, Sep 12, 2023

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jun 30, 2022—Sep 1, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

Custom Soil Resource Report

MAP LEGEND

MAP INFORMATION

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
Ck	Codorus silt loam	.37	2.2	0.3%
GmB	Glenelg variant-Urban land complex, 0 to 8 percent slopes		1.5	0.2%
MbD	Manor loam, 15 to 40 percent slopes	.37	2.0	0.3%
McC	Manor channery loam, 8 to 15 percent slopes	.15	8.1	1.2%
MdB	Manor-Urban land complex, 0 to 8 percent slopes		55.8	8.0%
MdC	Manor-Urban land complex, 8 to 15 percent slopes		5.1	0.7%
MdD	Manor-Urban land complex, 15 to 40 percent slopes		21.1	3.0%
Ub	Urban land		8.5	1.2%
Subtotals for Soil Survey Area			**104.3**	**14.9%**
Totals for Area of Interest			**697.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1C	Gaila silt loam, 8 to 15 percent slopes	.43	9.3	1.3%
2B	Glenelg silt loam, 3 to 8 percent slopes	.37	62.4	9.0%
2C	Glenelg silt loam, 8 to 15 percent slopes	.37	71.4	10.2%
2UB	Glenelg-Urban land complex, 0 to 8 percent slopes	.28	103.5	14.8%
2UC	Glenelg-Urban land complex, 8 to 15 percent slopes	.28	129.9	18.6%
16D	Brinklow-Blocktown channery silt loams, 15 to 25 percent slopes	.24	6.5	0.9%
67UB	Urban land-Wheaton complex, 0 to 8 percent slopes		37.6	5.4%
400	Urban land		172.6	24.7%
Subtotals for Soil Survey Area			**593.2**	**85.1%**
Totals for Area of Interest			**697.4**	**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)

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

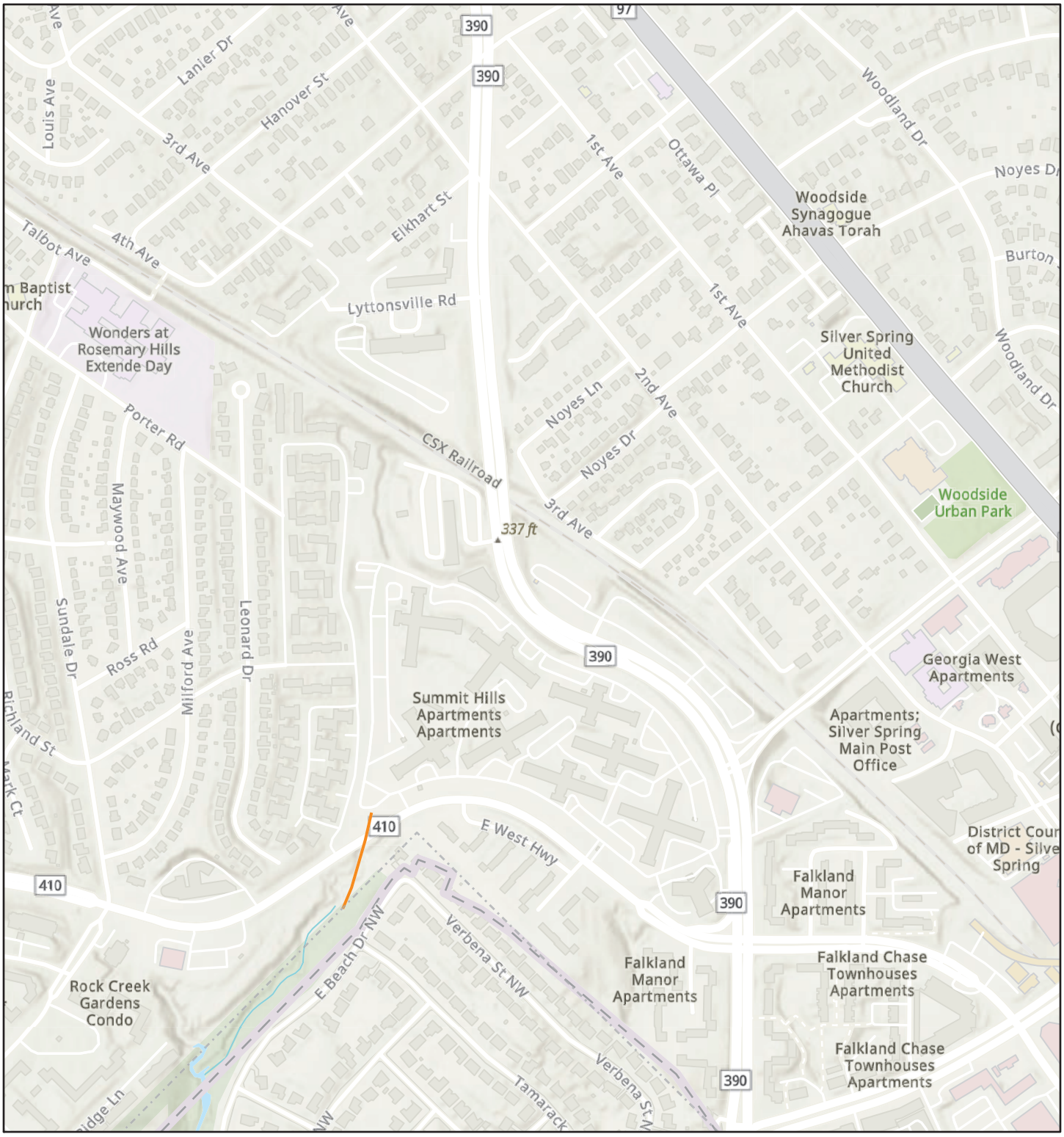
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Stream Designation Information

MD 390 - STREAM DESIGNATION



7/12/2024, 4:29:24 PM

1:9,028

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

County Boundaries

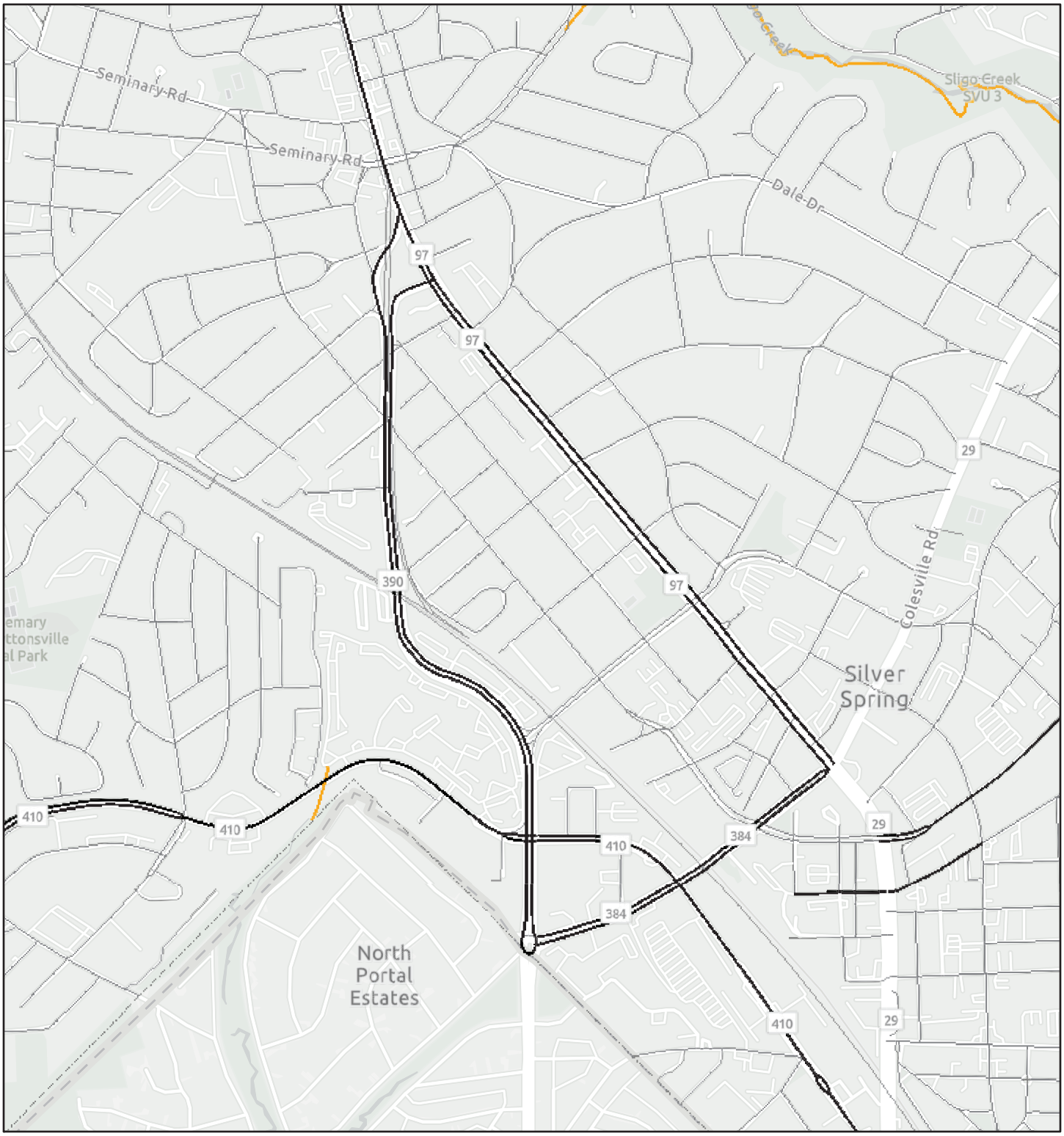
Streams Use Classes 2014

I

Impairment Information

Attachment E: Stormwater Concept Approval

MD 390 - BACTERIA



7/11/2024, 2:05:53 PM

1:16,614

0 0.1 0.2 0.4 mi

0 0.17 0.35 0.7 km

Maryland Routes

Maryland Route

Maryland Route Ramp

Local and Other Roads

Other Roads

Local Roads

Local Ramps

IR - Bacteria- Streams

2-Meets Water Quality Criterion

3-Insufficient Information

4a-Impaired, TMDL Complete

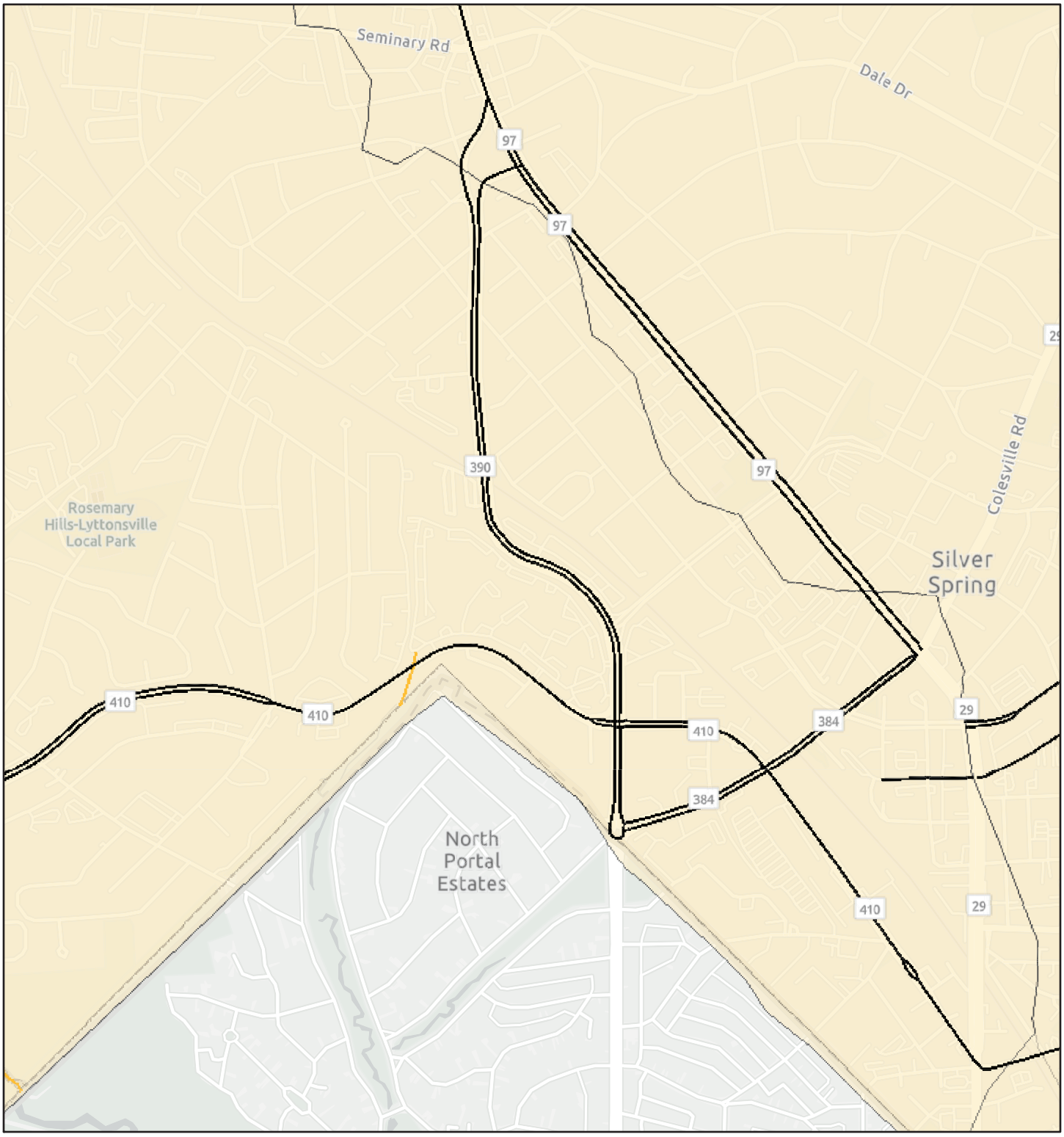
5-Impaired, TMDL Needed

Maryland Department of Transportation (MDOT), Maryland Department of Transportation State Highway Administration (MDOT SHA), Office of Planning and Preliminary Engineering (OPPE), Data Services Division (DSD), MDOT SHA Geospatial Technologies Team (GIS@mdot.state.md.us), Maryland iMap (MDiMAP) , Maryland Department of the Environment, MDE, WSA, Sources:

HSEECH
MDE

Attachment E: Stormwater Concept Approval

MD 390 - Nutrients



7/11/2024, 2:16:45 PM

1:16,614

0 0.1 0.2 0.4 mi

0 0.17 0.35 0.7 km

Maryland Routes

Maryland Route

Maryland Route Ramp

IR - Phosphorus - Streams

2-Meets Water Quality Criterion

3-Insufficient Information

4a-Impaired, TMDL Complete

5-Impaired, TMDL Needed

TMDL - Nitrogen - Tidal Water

TMDL - Phosphorus - Tidal Water

TMDL - Phosphorus - Streams

County Boundaries

Maryland Department of Transportation (MDOT), Maryland Department of Transportation State Highway Administration (MDOT SHA), Office of Planning and Preliminary Engineering (OPPE), Data Services Division (DSD), MDOT SHA Geospatial Technologies Team (GIS@mdot.state.md.us), Maryland iMap (MDiMAP) , Maryland Department of the Environment, MDE, WSA, Sources:

HSEECH
MDE

MD 390 - Water Quality Assessments (IR) and TMDL's

7/11/2024, 1:56:57 PM

1:16,614

0 0.1 0.2 0.4 mi

0 0.17 0.35 0.7 km

Maryland Routes

Maryland Route

Maryland Route Ramp

Local and Other Roads

Other Roads

Local Roads

Local Ramps

TMDL - Sediments - Streams

TMDL - Sediments - Tidal Water

IR - Sediments - Streams

2-Meets Water Quality Criterion

4a-Impaired, TMDL Complete

Maryland Department of Transportation (MDOT), Maryland Department of Transportation State Highway Administration (MDOT SHA), Office of Planning and Preliminary Engineering (OPPE), Data Services Division (DSD), MDOT SHA Geospatial Technologies Team (GIS@mdot.state.md.us), Maryland iMap (MDiMAP) , Maryland Department of the Environment, MDE, WSA, Sources:

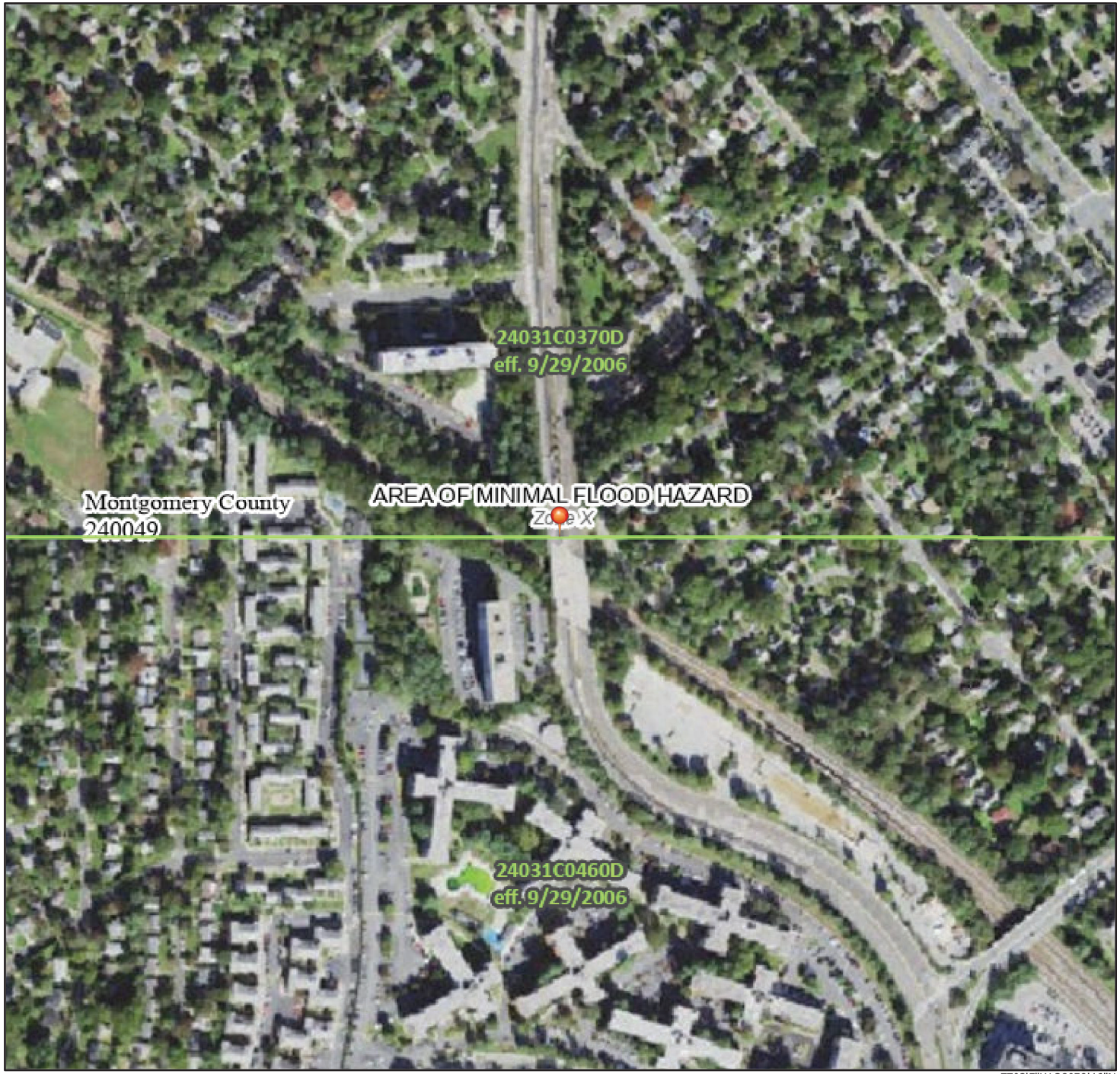
HSEECH
MDE

FEMA Mapping

National Flood Hazard Layer FIRMette

FEMA

77°2'43"W 39°0'14"N



77°2'5"W 38°59'46"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/12/2024 at 4:36 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Appendix H

Outfall Photographs and Stability Analysis

OUTFALL A

Outfall A is the downstream end of a 72" reinforced concrete pipe (RCP) that flows north to south underneath CSX tracks approximately 400 feet northwest of MD 390 (16th Street). Outfall A receives drainage from project points of interest (POIs) 1 and 3 as well as offsite drainage from local roads and residential communities. The channel downstream of Outfall A appeared to be in a stable condition during a site visit conducted on July 29, 2024. Flow from this channel reinters a 54" RCP that flows south and outlets at Outfall B. There is no change in the modeled 1-year and 10-year storm peak discharges at Outfall A between the existing and proposed conditions of the MD 390 cycle-track project.

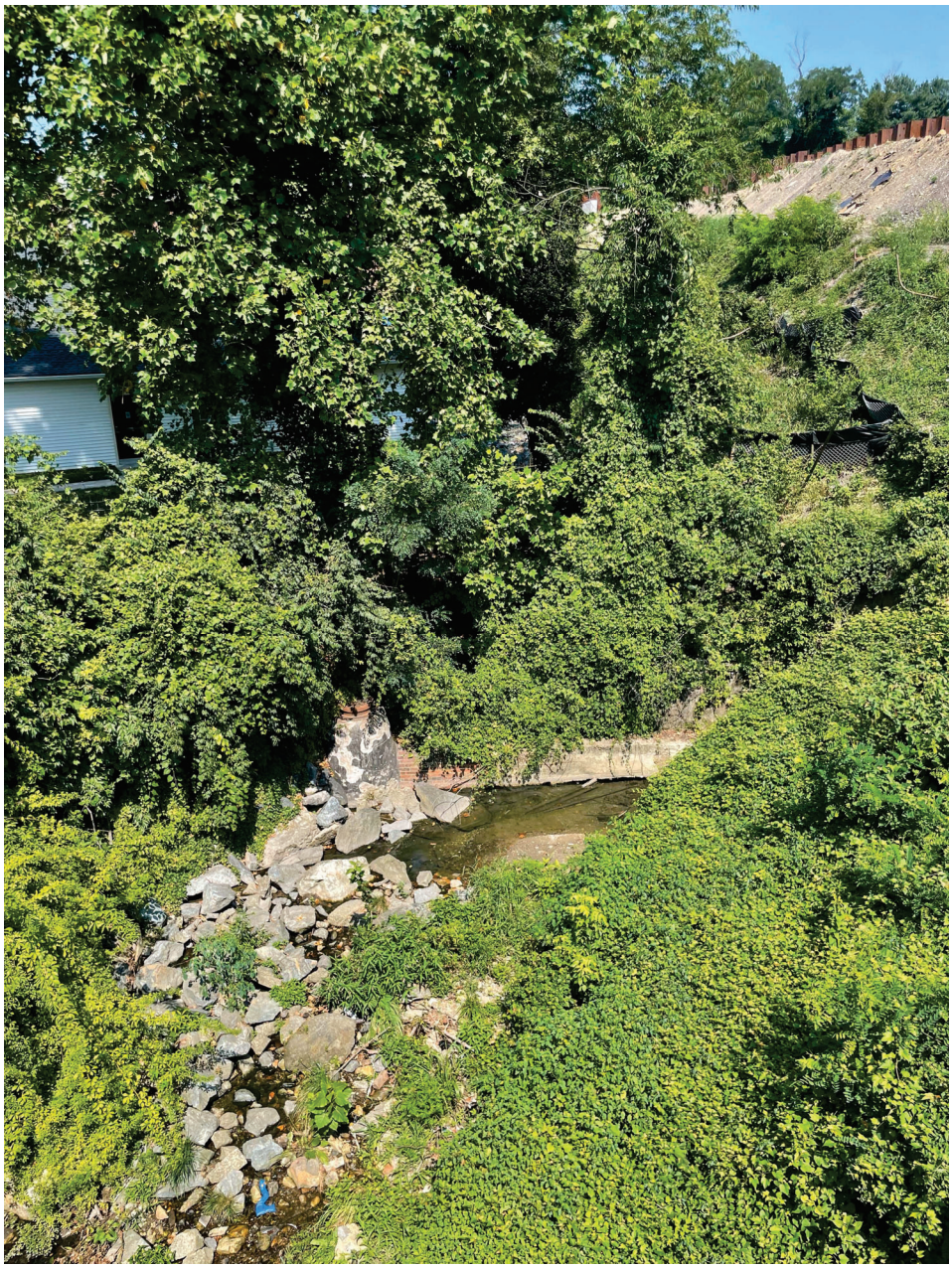


Figure 1: Looking west at Outfall A

Figure 2: Looking southwest at channel downstream of Outfall A

Figure 3: Looking northwest at channel downstream of Outfall A

Figure 4: Looking at receiving pipe downstream of Outfall A

OUTFALL B

Outfall B is the downstream end of a box culvert (OOS Structure #1506000) that runs underneath MD 410 (East-West Highway) approximately 90 feet northeast of the intersection of MD 410 and Rosemary Hills Drive. Outfall B receives drainage from project POIs 5, 6, 8, & 10 and project lines of interest (LOIs) 12 & 13, drainage from the Purple Line Woodside Station, and drainage from local roads and residential development between MD 410 and MD 390. Outfall B drains directly to the Fenwick Branch of Rock Creek; the downstream channel appeared to be in a stable condition during the July site visit. There is a modeled decrease in the 1-year and 10-year storm peak discharges at Outfall B between the existing and proposed conditions of the MD 390 cycle-track project.

Figure 5: Looking at Outfall B

Figure 6: Channel downstream of Outfall B

Figure 7: Structure number for box culvert

OUTFALL C

Outfall C is an endwall at the downstream end of a 36" RCP that runs underneath MD 410, approximately 150 feet east of the intersection of MD 410 and MD 390. Outfall C receives drainage from project POI 11, as well as drainage along MD 410 and from some private residential development. The downstream channel is a channel with a steep longitudinal slope and steep side slopes. During the July site visit, it was noted that large portions of the channel side slopes showed signs of significant erosion; additionally, there were several areas where gabion was installed along the side slopes (assumed to be a local or private effort). This channel drains back into a local drainage system that appears to outfall to a collector stream of the Fenwick Branch just across the Washington, D.C. border. There is a modeled decrease in the 1-year and 10-year storm peak discharges at Outfall C between the existing and proposed conditions of the MD 390 cycle-track project.

Figure 8: Looking at Outfall C headwall

Figure 9: Looking downstream (south) of Outfall C

Figure 10: Looking upstream (north)

Figure 11: View of receiving pipe at downstream end of channel

MD 390 - Outfall Map

7/31/2024, 9:41:12 AM

1:7,391

0 0.05 0.1 0ut

0 0.1 0.2 0.4 km

- OUTFALLS
- MASTER PIPES
- MASTER CULVERTS
- MASTER CHANNELS
- SHA PIPES 2015
- SHA DITCH 2015
- CLINE Level 12
- Place_Name Level 11+

MCG, GIS, ESRI, Pictometry

ArcGIS Web AppBuilder

MCG, GIS, ESRI, Pictometry | MCG, DTS, GIS, ESRI |

Appendix I

Culvert/Dam Evaluation and Summary

(Not included as part of the Concept Submittal to PRD and will be included in future submissions)

Appendix J

References

- Maryland Department of the Environment, 2000 Maryland Stormwater Design Manual, (October 2000, Revised May 2009)
- Maryland Department of the Environment, 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control
- Maryland Department of the Environment, Dam Safety Policy Memorandum #2 (October 2019)
- Maryland Department of the Environment, Dam Safety Policy Memorandum #5 (February 2022)
- Maryland Department of the Environment, Maryland Stormwater Management and Erosion & Sediment Control Guidelines for State and Federal Projects, (February 2015)
- Maryland Department of Transportation State Highway Administration, Highway Drainage Manual, (September 2023)
- Maryland Department of Transportation State Highway Administration, Sediment and Stormwater Guidelines and Procedures, (October 2017)
- Web Soil Survey for Montgomery County, Maryland