

May 17, 2024

Project # RUS-2304

**STORMWATER MANAGEMENT REPORT
FOR
TRUCK MAINTENANCE FACILITY**

**BLOCK 50, LOT 15
ELK TOWNSHIP, GLOUCESTER COUNTY, NEW JERSEY**

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I. INTRODUCTION

A. Project Description & Location

The proposed project outlined in this report involves the construction of a new truck maintenance center of approximately 8,000 SF, proposed internal roadways, associated passenger car and truck parking, stormwater management measures and associated grading. The stormwater management basins proposed in this application are sized to accommodate flows from the developed area during the 2, 10 and 100-year storms. The property in question is a 2.56-acre parcel of land fronting Buck Road (C.R. 553) and Elk Road (C.R. 538) in the Elk Township, Gloucester County and is known as Block 50, Lot 15. The area of disturbance will be 2.50 acres.

B. Existing Site Conditions

The subject site to be developed is a 2.56-acre parcel of land designated on the Township's tax maps as Block 50, Lot 15. The project site fronts along Buck Road (C.R. 553) to the West and Elk Road (C.R. 538) to the North and is primarily surrounded by residential and farmlands use.

The site does not contain wetlands and does not have a significant body of water on or near site. On-site topography generally slopes from North-East to South-West through the site, from North to South along Buck Road site frontage. Soils onsite within the project area consist of Downer sandy loam, 0 to 2 percent slopes, Northern Coastal Plain (DoeA), which is categorized as Hydrologic Soil Group 'A'.

II. METHODOLOGY AND SOFTWARE

In accordance with the NJDEP rules regarding stormwater management, N.J.A.C. 7:8-1.6, the criteria to handle stormwater for major developments is to design acceptable systems that effectively manage the stormwater with respect to applicable regulations regarding water quality, runoff quantity and groundwater recharge. Each of these requirements was considered in a pre vs. post-development runoff analysis, conducted in conjunction with an evaluation of site conditions, local ordinance and proposed construction specifications. This was done to facilitate designing an appropriate stormwater management system for the proposed site, based on sound engineering principles to maximize water quality and to reduce peak flows offsite per the NJDEP stormwater regulations.

Accordingly, stormwater management analysis in this report consists of: (1) calculating runoff from the 2, 10 and 100-year storm events for the pre- and post-development conditions of each drainage area; (2) comparing the results of the pre-developed and post-developed conditions to ensure that an appropriate stormwater management plan has been implemented; and (3) providing a conclusion of the results of the analysis. The analysis demonstrates that the stormwater runoff will not adversely affect the area as a result of the proposed development of the property. Runoff is analyzed as a total flow at the point of analysis.

The existing pre- and proposed post-development flows were calculated using the USDA Natural Resources Conservation Service methodology, as described in Technical Release 55 - Urban Hydrology for Small Watersheds (TR-55), dated June 1986. These modeling techniques are incorporated in the HydroCAD 10.00 software package, which was used to analyze the pre- and post-development flows. All undisturbed areas of the site have been assumed to be in good hydrologic condition, with good cover for the pre-development analysis. Any significant land features and structures that could reduce pre-construction stormwater runoff rates and volumes, including depressions and culverts have been accounted for in the pre-development analysis.

The structural stormwater management measures have been designed to take into account the existing site conditions including environmentally critical areas, slopes, depth to seasonally high water table, soil types and permeability. They have also been designed to be strong, durable and corrosion resistant to minimize maintenance, facilitate maintenance and repairs and ensure proper functioning within the context of their operational requirements.

III. PRE-DEVELOPMENT CONDITIONS

To determine the peak runoff rate from the site for 2, 10 and 100-year storms before development, the project area was analyzed as one (1) existing drainage area (EDA-1). Drainage area EDA-1 consists of 2.503 acres of pervious surfaces. This area flows South-West towards POI #1 on Buck Road. Times of concentration were calculated using the McCuen-Speiss Equation to determine the appropriate sheet flow length; the remaining was modeled as shallow concentrated flows. Runoff rates and volumes were calculated for current and future rainfall using County-Specific New Jersey 24-Hour Rainfall Frequency Data and associated Current & Future Precipitation Adjustment Factors. Runoff for the pre-developed site was calculated using the HydroCAD 10.00 software package and is summarized in the table below:

Drainage Area	2-Year Storm (Current Rainfall Data) (cfs)	2-Year Storm (Future Rainfall Data) (cfs)	10-Year Storm (Current Rainfall Data) (cfs)	10-Year Storm (Future Rainfall Data) (cfs)	100-Year Storm (Current Rainfall Data) (cfs)	100-Year Storm (Future Rainfall Data) (cfs)
EDA-1	0.00	0.00	0.04	0.09	0.80	2.40

Table 1: Pre-Development Flow Summary

IV. POST-DEVELOPMENT STORMWATER MANAGEMENT SUMMARY

A. Water Quantity

To accomplish these tasks, 2.187 total acres of on-site runoff is routed to two (2) small-scale infiltration basins. The remaining 0.315 acres of on-site area is accounted for in the stormwater model as bypass. Managed runoff will be collected via overland flow, roof leaders, and a conventional piped stormwater collection system to direct the appropriate runoff to the corresponding basins. Both quality and quantity control are provided by the basins. The allowable peak runoff rates for the post-developed site were found by applying the required reductions to the pre-developed peak flows for the onsite disturbed areas. Runoff rates and volumes were calculated for current and future rainfall using County-Specific New Jersey 24-Hour Rainfall Frequency Data and associated Current & Future Precipitation Adjustment Factors. The calculations to determine allowable flows are as follows:

Point of Interest	Storm Event (yr)	Total Pre-Dev Runoff (cfs)	% Reduction	Total Allowable Runoff (cfs)	Total Post-Dev Runoff, Bypass Only (cfs)	Total Post-Dev Runoff, Entire LOD (cfs)	Total Post-Dev Runoff, Excluding Bypass (cfs)
POI #1 (Current)	2	0.00	50%	0.00	0.10	0.10	0.00
	10	0.04	75%	0.03	0.16	0.16	0.01
	100	0.80	80%	0.64	0.75	0.75	0.38
POI #1 (Future)	2	0.00	50%	0.00	0.12	0.12	0.00
	10	0.09	75%	0.07	0.21	0.21	0.07
	100	2.40	80%	1.92	1.58	1.58	1.32

Table 2: Allowable Runoff Summary

In review of the proposed analysis, it is important to note that individual Times of Concentration were calculated separately for the pervious and impervious areas. While it is the goal to manage the total volume of water leaving our site, some bypass area in the model unfortunately cannot be managed due to the grade difference from Buck Road (CR 553) to the project site. Due to this, and in conjunction with accounting for required reductions to flows in the 2- and 10-year storm events (0.00 CFS allowable for the 2-year and under 0.10 CFS allowable for the 10-year), the minimized bypass areas alone surpass the allowable rates. The design overmanages the runoff entering the proposed small-scale infiltration basins to the greatest extent possible in an attempt to counter these limitations. Unfortunately, given the limiting nature of the existing site as described above, approximately 0.12 CFS and 0.14 CFS exceeding the allowable rates for the 2- and 10-year storm events respectively leaves the site. Due to this, a waiver from section §86-4R(1)(c) is requested as eliminating all bypass in a post-development condition is not feasible in accordance with §86-4D(2). In the three (3) analyzed storms, the proposed post-development runoff rates for the bypass areas exceed the allowable limits and reach their peak outflow before the rest of the managed runoff (within required post-development allowable flows) reaches its peak outflow. Therefore, flows exiting the basins are less than the required reductions, thus meeting the requirements of the NJDEP Stormwater Management rules for stormwater quantity reductions.

B. Small Scale Infiltration Basin Discussion (Methodology)

There are two (2) proposed small-scale infiltration basins, Basin #1 is located at the North side and Basin #2 is located at the South side of the development area. Per NJDEP requirements, the basins were analyzed without exfiltration to comply with the stormwater quantity requirements. Stormwater will be conveyed to these basins via overland flow, swale, and a conventional gravity storm sewer system and per NJDEP requirements, the site is designed to convey a maximum of 2.5 acres of drainage area to each of the two small scale infiltration basins. Runoff discharging to the basins was analyzed with the HydroCAD 10.00 computer program utilizing the proposed basin volume characteristics. The summary of peak inflows, outflows, storage volumes, and basin elevations are outlined below:

Small scale infiltration basin (DA-1 Basin) accepts runoff from 1.16 acres of the disturbed area.

SMALL SCALE INFILTRATION BASIN #1 SUMMARY

	Storm (Yr.)	Basin Inflow (cfs)	Basin Outflow (cfs)	Maximum Pond Storage (cubic ft)	Peak Elevation (feet)
Current	2	2.74	0.00	8,103	130.00
	10	4.31	0.07	11,303	130.47
	100	7.84	0.30	18,873	131.43
Future	2	3.11	0.00	9,305	130.18
	10	5.02	0.10	12,782	130.67
	100	10.98	1.03	22,989	131.88

Table 3: Small Scale Basin 1 Summary

Flows from the basin are attenuated by an outlet control structure and by infiltration through the basins themselves (not accounted for in quantity reductions) which will have a 6" thick sand lined layer throughout. Above the basin bottom at 128.50, the first outlet being a 2.5" diameter vertical orifice set at the elevation of 130.20, above the peak water surface elevation during the 2-year storm event. This device retains the total volume of the 2-year storm at a depth below the maximum allowed of 2 feet and allows the collected runoff to infiltrate into the soil bed layer. The second outlet, a 10" W x 4" H vertical orifice at 131.30 and a third 24" x 48" horizontal grate at elevation 131.88 manage larger storms. In the cases of outlet structure failure and storms larger than the 100-year event, water will spill over the basin and flow West to Buck Road. The outflow from the outlet control structure will be conveyed via a 15" pipe to Basin 2 and will discharge to a riprap scour hole and dissipate the flow into the area.

Small scale infiltration basin (DA-2 Basin) accepts runoff from 0.88 acres of the disturbed area.

SMALL SCALE INFILTRATION BASIN #2 SUMMARY

	Storm (Yr.)	Basin Inflow (cfs)	Basin Outflow (cfs)	Maximum Pond Storage (cubic ft)	Peak Elevation
Current	2	1.77	0.00	5,435	128.86
	10	2.79	0.01	12,407	129.87
	100	5.17	0.38	16,685	130.44
Future	2	2.01	0.00	6,252	128.99
	10	3.24	0.07	14,029	130.09
	100	7.32	1.32	19,800	130.84

Table 4: Small Scale Basin 2 Summary

Flows from the basin are attenuated by an outlet control structure and by infiltration through the basins themselves (not accounted for in quantity reductions) which will have a 6" thick sand lined layer throughout. Above the basin bottom at 128.00, the first outlet being a 2.5" diameter vertical orifice set at the elevation of 129.78, above the peak water surface elevation during the 2-year storm event. This device retains the total volume of the 2-year storm at a depth below the maximum allowed of 2 feet and allows the collected runoff to infiltrate into the soil bed layer. The second outlet, a 18" W x 3" H vertical orifice at 130.30 and a third 24" x 48" horizontal grate at elevation 130.84 manage larger storms. In the cases of outlet structure failure and storms larger than the 100-year event, water will spill over the basin and flow West to Buck Road. The outflow from the outlet control structure will be conveyed via a 15" pipe and will discharge to an existing inlet on Buck Road.

The design infiltration rate for basin 1 is 0.72 in/hr and the design infiltration rate for basin 2 is 2.705 in/hr and both basins drain within 72 hours. Basin summary sheets detailing the outlet structures and orifices can be found in Appendix I of this report. Details of the outlet structures are included in the plan set.

C. Water Quality & Groundwater Recharge Discussion (Methodology)

The NJDEP Stormwater Management rules require that stormwater management measures be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from the developed site. In order to achieve 80% TSS removal, runoff from motor vehicle surfaces in the water quality event will be infiltrated in the green infrastructure small scale infiltration basins. Roof runoff will be infiltrated in our Southern small scale infiltration basin. The site incorporates two small-scale infiltration basins following the New Jersey Stormwater Best Management Practices. Each basin has maximum contributing drainage area of 2.50 acres not including the area of the basin themselves. All proposed small-scale infiltration basins have been sized to hold and infiltrate the entire water quality volume and the 2-year storm volume through the basin bottom surface area. Since the water quality storm runoff volume is completely infiltrated through the sand layer, a total suspended solids (TSS) removal rate of 80% is provided, meeting the water quality requirements in N.J.A.C. 7:8-5.5. The proposed basins, like all the stormwater management systems utilized in this design, incorporate the standards outlined in the NJDEP Best Management Practices.

The groundwater recharge requirements set forth in N.J.A.C. 7:8-5.4(a)2 are met by recharging the increase in runoff volume from pre to post development for the 2-year storm event. Extensive soil pits were dug, and percolation rates were tested on samples taken in April 2024. The NJDEP Stormwater rules require either: recharge of the increase in the post-development 2-year runoff volume; or recharge 100% of the sites average annual groundwater recharge volume in the post-developed condition. Groundwater recharge is accomplished by meeting the first of these options using two small surface infiltration basins located throughout the site.

	Runoff Volume	Basin 1 Infiltration	Basin 2 Infiltration
2YR PreDev	0.000 af	N/A	N/A
2YR PostDev	0.357 af (no bypass)	0.214 af	0.144 af
Increase	$0.357 - 0.000 = 0.357$ af (15,551 cf increase)	$0.214 - 0 = 0.214$ af (9,322 cf recharge)	$0.144 - 0 = .144$ af (6,273 cf recharge)
Difference	$(9,322 + 6,273) - 15,551 = 44$ cf (Recharge)		

Table 5: Groundwater Recharge Summary

D. Soil Erosion and Sediment Control

To minimize the effects of erosion, the proposed design and construction concepts and practices incorporate the standards for Soil Erosion and Sediment Control in New Jersey as provided by the New Jersey State Soil Conservation Committee. These erosion deterrents include but are not limited to the use of silt fence or other sediment barriers at downgrade slopes and inlet protection. In addition, dust control measures, stone tracking mats, and temporary and permanent vegetative cover will be utilized. Riprap aprons and scour holes will be constructed at all stormwater outfalls. General notes and guidelines are provided on the Soil Erosion and Sediment Control Plans for the contractor in order to ensure against soil erosion on the site while construction is in progress.

The soil erosion and sediment control plans will be reviewed by the Gloucester Soil Conservation District, which also monitors site activities during construction. The Soil Conservation District will inspect the site and may also recommend additional erosion and sediment control measures as appropriate.

E. Groundwater Mounding Analysis

The following data and supporting documentation demonstrate the limits and elevation of groundwater mounding occurring from the recharge of stormwater through mechanisms on-site. The intent of this analysis is to identify whether there are impacts to adjoining properties. The methodology used herein is based on the “Groundwater Table Hydraulic Impact Assessment Guide for Infiltration BMPs” in the New Jersey Stormwater Best Management Practices manual prepared by the NJDEP. The BMP manual provides a spreadsheet which has been developed to solve the Hantush analytical equation which calculates groundwater mounding. The results of the spreadsheets for the basin are included in Appendix J of this report.

Spreadsheet Input Criteria

Input data for the spreadsheets was determined both in accordance with information obtained by field investigations via continuous sampled borings and standardized data provided in the NJDEP BMP manual. Where applicable, MidAtlantic researched available soil survey data, regional well data, and other groundwater background data to support selection of input criteria. During the design of the proposed stormwater system, multiple field studies were performed to confirm the accuracy and efficiency of the proposed design. Each system was analyzed independently using different input variables depending on the soil and groundwater condition surrounding the system. The following are the specific data inputs for solving the Hantush equation for each infiltration basin:

Recharge Rate – Permeability rates may vary from soil testing results and may decrease over time, therefore, a factor of safety of 2 was applied to the average of the field-tested infiltration rates within each basin.

Duration of Infiltration Period – The maximum duration of infiltration period that may be used in the Hantush spreadsheet is 72 hours. The duration of the infiltration period is equal to the time required for the BMP to drain using the specified recharge rate. As stated in the NJ BMP Manual Chapter 13, the volume of runoff to be infiltrated is the total volume of runoff to be discarded through exfiltration. The duration of infiltration period for each basin was determined via the following calculation:

Duration of infiltration period, $t(hr)$

$$= \frac{\text{Discarded Volume via Exfiltration (CF)} \times 12 \text{ in/ft}}{\text{Infiltration Area (SF)} \times \text{Exfiltration Rate } (\frac{\text{in}}{\text{hr}})}$$

Additional calculation parameters are provided in Appendix J later in this report. Per the NJ BMP Manual Chapter 13, in the event the height of the groundwater mounding reaches or exceeds the elevation of the bottom of the BMP, the design must be adjusted, and a new model created. Adjustment of the recharge rate to a lower value allows slower infiltration of runoff and more time for the infiltrated runoff to dissipate into the saturated zone. A reduced recharge rate will have a smaller mounding height but result in a longer duration of infiltration period. The duration of infiltration period based on the reduced recharge rate may not exceed 72 hours. Input values for the horizontal hydraulic conductivity must not be altered, even in instances in which the input value for the recharge rate is adjusted. The duration of infiltration can be further extended, or stretched, up to the 72 hour maximum, measured from the end of the precipitation event, provided the recharge rate is proportionally reduced. Stretching the time frame requires the recharge rate to be proportionally reduced, assuming no change to any other parameters. If the adjusted model shows that the groundwater mounding height will not reach the bottom of the proposed BMP, then groundwater mounding will have no adverse impacts on the BMP.

The table below provides the following information:

- Initial duration of infiltration period, calculated via the equation above;
- Initial exfiltration rate, provided via geotechnical infiltration testing
- Adjusted duration of infiltration period, extended to the 72 hour maximum as stated above from the NJ BMP Manual Chapter 13
- Adjusted exfiltration rate, proportionally adjusted to the ratio of initial duration vs. adjusted duration

Basin	Initial Duration of Infiltration Period, t (hr)	Initial Exfiltration Rate (in/hr)	Adjusted Duration of Infiltration Period, t (hr)	Adjusted Exfiltration Rate (in/hr)
1	7.50	3.37	72.00	0.35
2	4.50	5.21	72.00	0.33

Specific Yield – The specific yield is the volume of water that will drain from a soil specimen due to gravity divided by the total volume of a specimen. This value is expressed as a ratio (or percentage) and coarse soils will generally have higher specific yields than fine-grained soil independent of each soil's respective porosity. For this analysis, the specific yield value utilized is 0.15 for all basins.

Horizontal Hydraulic Conductivity – The horizontal hydraulic conductivity is the rate at which water will move through the soil in a horizontal direction. The project is located within the coastal plain of New Jersey and per the BPM Manual the default value must be assumed to the five (5) times the recharge rate. As stated above, and in the NJ BMP Manual Chapter 13, input values for the horizontal hydraulic conductivity must not be altered, even in instances in which the input value for the recharge rate is adjusted.

Initial Thickness of Saturation Zone – The initial thickness of the saturated zone is the distance from the seasonal high water table (SHWT) to the first hydraulically restrictive layer. For this analysis, the initial thickness of saturated zone was assumed to be the default minimum of 10 feet immediately below the lowest elevation of the on-site test pits.

Groundwater Mounding Conclusion – Both the unadjusted and adjusted Hantush spreadsheets can be found in Appendix J later in this report. The results of the adjusted spreadsheets indicate that the depth of groundwater mounding for each of the small-scale infiltration basins are well below the footprint elevations, and therefore will have no adverse impacts on the BMPs.

Basin	Footprint Elevation	Assumed SHWT Elevation	Mounding Height (ft)	Mounding Elevation	Separation (ft)
1	128.50	126.00	2.437	128.437	0.063
2	128.00	125.50	1.860	127.360	0.640

F. Green Infrastructure

The green infrastructure requirements set forth in N.J.A.C. 7:8-5.3 are met by limiting the contributing drainage areas to the associated green infrastructure best management practice as listed in said section. Each small-scale infiltration basin has a contributing drainage area of less than 2.50 acres (does not include basin area per definition of Contributory Drainage Area listed in N.J.A.C. 7:8-1.2) are close to the source of runoff, are not concentrated on site and meets the rules of this section as described in N.J.A.C. 7:8-5.3(b). Therefore, the project meets the intent and rules of the green infrastructure rule.

G. Storm Drainage System Discussion (Methodology):

The stormwater conduits on site were designed according to the following criteria:

1. The Rational Method was used to determine the design flows.
2. NJ Rainfall Intensity Curves, with a minimum 25-year storm frequency was utilized to size all stormwater conduits.
3. All conduits are designed to convey the design storm by open channel flow.
4. Time of concentration (Tc) was calculated using the McCuen -Spiess Limitation.
5. All proposed stormwater conduits are reinforced concrete pipe, Class III or higher with an “n” value of 0.013, or high density polyethylene pipe with an “n” value of 0.011.
6. A minimum of 16” of cover is provided for all Class III Stormwater conduits and 12” for Class IV or V.

IV. CONCLUSION

The routing summaries provided for the stormwater management system demonstrate that the design of this project will store the increases in the post-development runoff volumes and attenuate the outflows to below the pre-developed peak runoff rates in accordance with the required

scale infiltration basins and underground infiltration basins that achieves an estimated 80% TSS removal. Groundwater recharge is maintained in the post development condition.

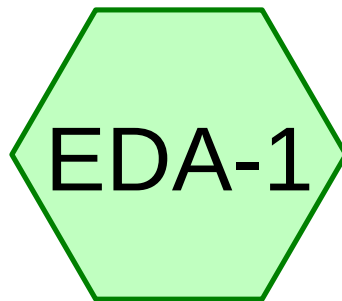
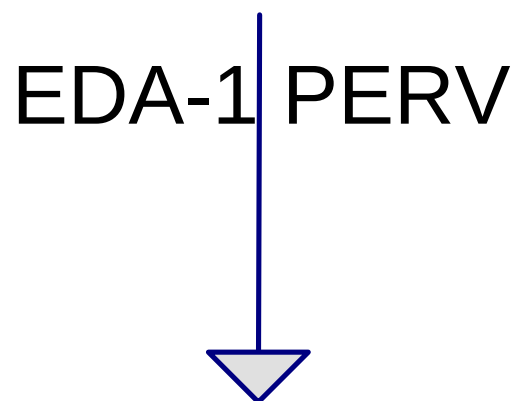
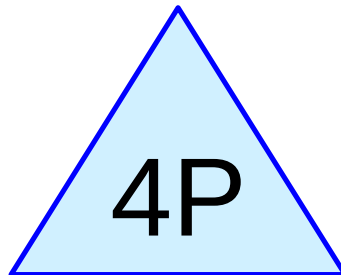
The stormwater management basins have been designed to meet the requirements of the “NJDEP Stormwater and Non-point Source Pollution – Best Management Practices Manual.” They are designed for minimum disturbance to the natural landscape. This stormwater management system meets the technical requirements as well as the overall intent of the NJDEP regulations in an aesthetically pleasing and technically compliant manner.

V. CERTIFICATION

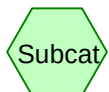
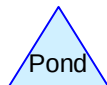
I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining and preparing the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for knowingly submitting false information, including the possibility of fine and imprisonment.

APPENDIX A

Pre-Development Drainage Analysis – Current Rainfall



PRE - POI #1 (SW Prop
Corner)



Pre&Post Development

Prepared by {enter your company name here}

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NOAA 24-hr C 2-Year C Rainfall=3.47"

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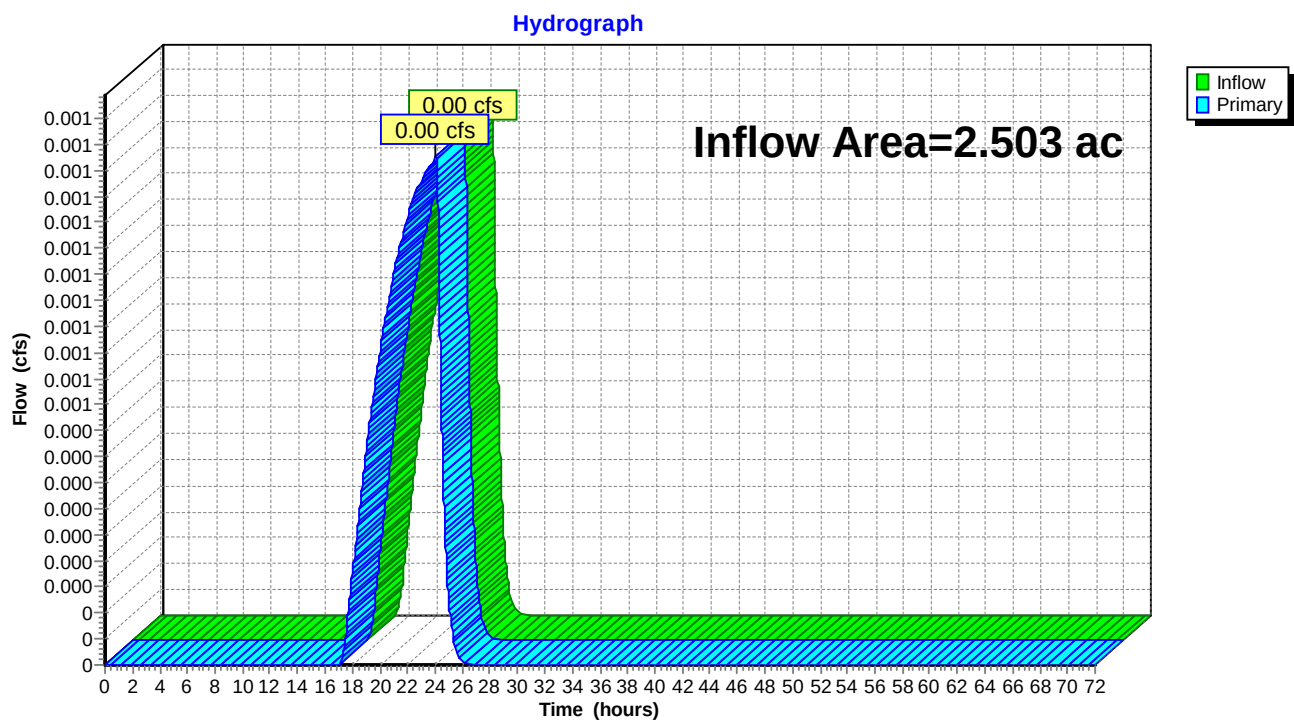
Summary for Pond 4P: PRE - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year C event
Inflow = 0.00 cfs @ 24.07 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 24.07 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 4P: PRE - POI #1 (SW Prop Corner)



Pre&Post Development

NOAA 24-hr C 2-Year C Rainfall=3.47"

Prepared by {enter your company name here}

Printed 4/24/2024

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Summary for Subcatchment EDA-1: EDA-1 PERV

Runoff = 0.00 cfs @ 24.07 hrs, Volume= 0.000 af, Depth= 0.00"

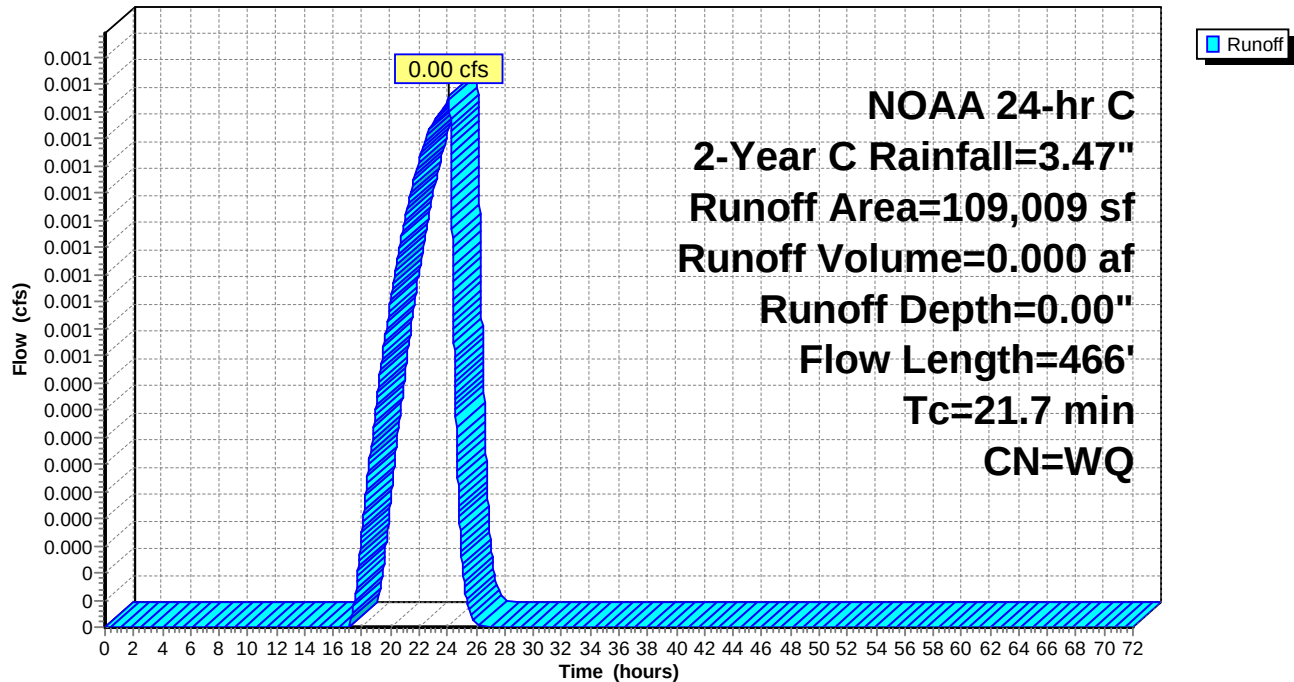
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
28,173	39	>75% Grass cover, Good, HSG A
80,836	30	Woods, Good, HSG A
109,009		Weighted Average
109,009	32	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	8	0.0100	0.02		Sheet Flow, 1-2
					Woods: Dense underbrush n= 0.800 P2= 3.38"
2.3	68	0.0100	0.50		Shallow Concentrated Flow, 1-2
					Woodland Kv= 5.0 fps
1.8	66	0.0150	0.61		Shallow Concentrated Flow, 3-4
					Woodland Kv= 5.0 fps
1.1	25	0.0060	0.39		Shallow Concentrated Flow, 4-5
					Woodland Kv= 5.0 fps
1.2	40	0.0060	0.54		Shallow Concentrated Flow, 5-6
					Short Grass Pasture Kv= 7.0 fps
3.2	74	0.0060	0.39		Shallow Concentrated Flow, 6-7
					Woodland Kv= 5.0 fps
1.8	67	0.0150	0.61		Shallow Concentrated Flow, 7-8
					Woodland Kv= 5.0 fps
3.9	118	0.0100	0.50		Shallow Concentrated Flow, 8-9
					Woodland Kv= 5.0 fps
21.7	466	Total			

Subcatchment EDA-1: EDA-1 PERV

Hydrograph



Pre&Post Development

Prepared by {enter your company name here}

HydroCAD® 10.00-26 s/n 07360 © 2020 HydroCAD Software Solutions LLC

NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Pond 4P: PRE - POI #1 (SW Prop Corner)

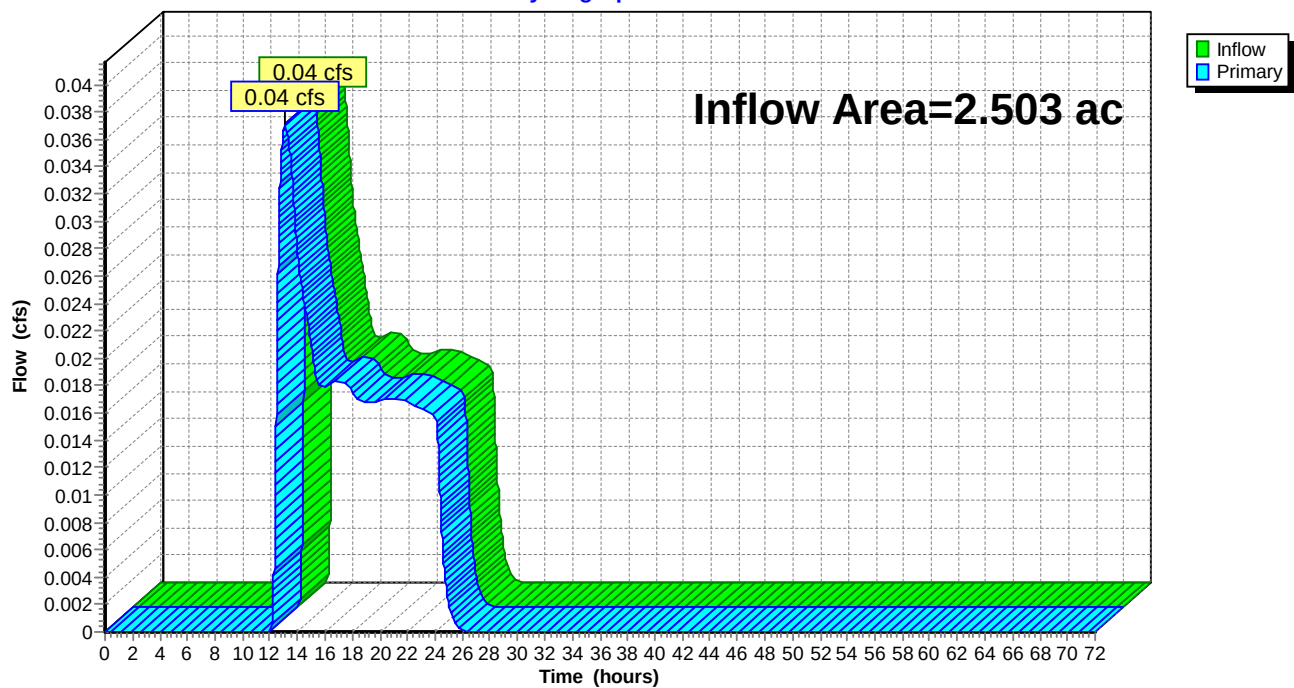
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 0.00% Impervious, Inflow Depth = 0.10" for 10-Year C event
Inflow = 0.04 cfs @ 13.11 hrs, Volume= 0.020 af
Primary = 0.04 cfs @ 13.11 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 4P: PRE - POI #1 (SW Prop Corner)

Hydrograph



Pre&Post Development

NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment EDA-1: EDA-1 PERV

Runoff = 0.04 cfs @ 13.11 hrs, Volume= 0.020 af, Depth= 0.10"

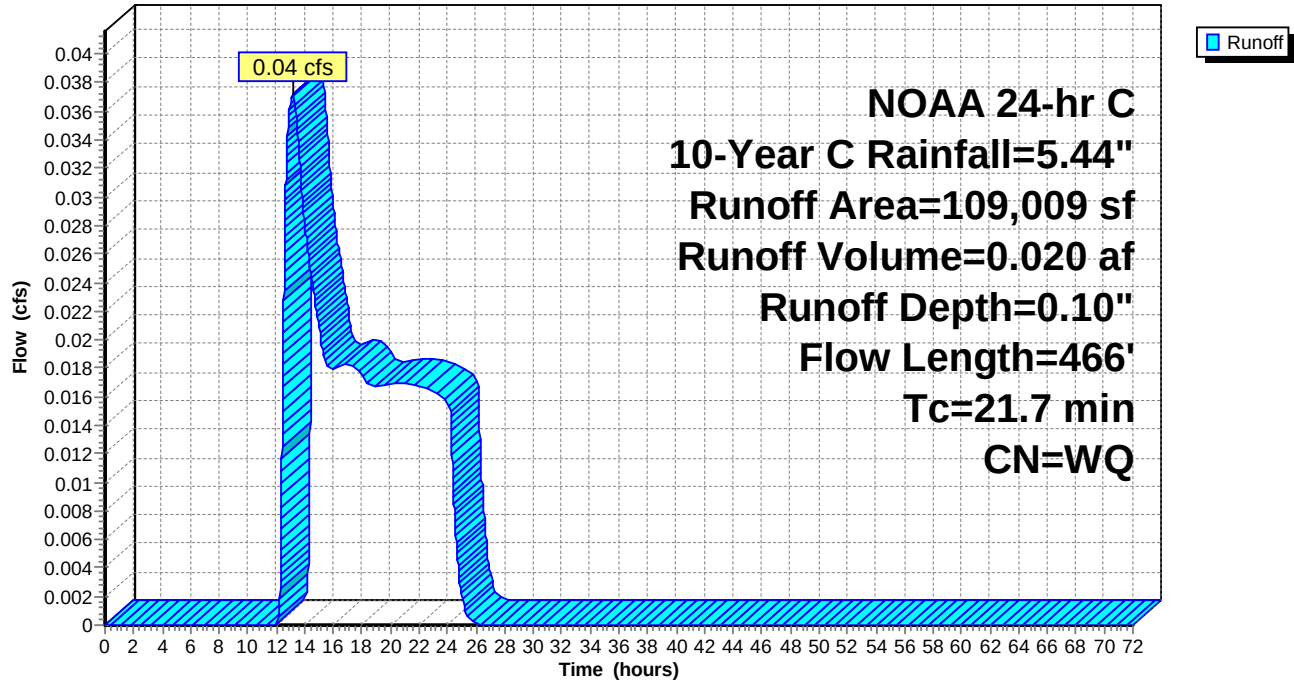
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
28,173	39	>75% Grass cover, Good, HSG A
80,836	30	Woods, Good, HSG A
109,009		Weighted Average
109,009	32	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	8	0.0100	0.02		Sheet Flow, 1-2
					Woods: Dense underbrush n= 0.800 P2= 3.38"
2.3	68	0.0100	0.50		Shallow Concentrated Flow, 1-2
					Woodland Kv= 5.0 fps
1.8	66	0.0150	0.61		Shallow Concentrated Flow, 3-4
					Woodland Kv= 5.0 fps
1.1	25	0.0060	0.39		Shallow Concentrated Flow, 4-5
					Woodland Kv= 5.0 fps
1.2	40	0.0060	0.54		Shallow Concentrated Flow, 5-6
					Short Grass Pasture Kv= 7.0 fps
3.2	74	0.0060	0.39		Shallow Concentrated Flow, 6-7
					Woodland Kv= 5.0 fps
1.8	67	0.0150	0.61		Shallow Concentrated Flow, 7-8
					Woodland Kv= 5.0 fps
3.9	118	0.0100	0.50		Shallow Concentrated Flow, 8-9
					Woodland Kv= 5.0 fps
21.7	466	Total			

Subcatchment EDA-1: EDA-1 PERV

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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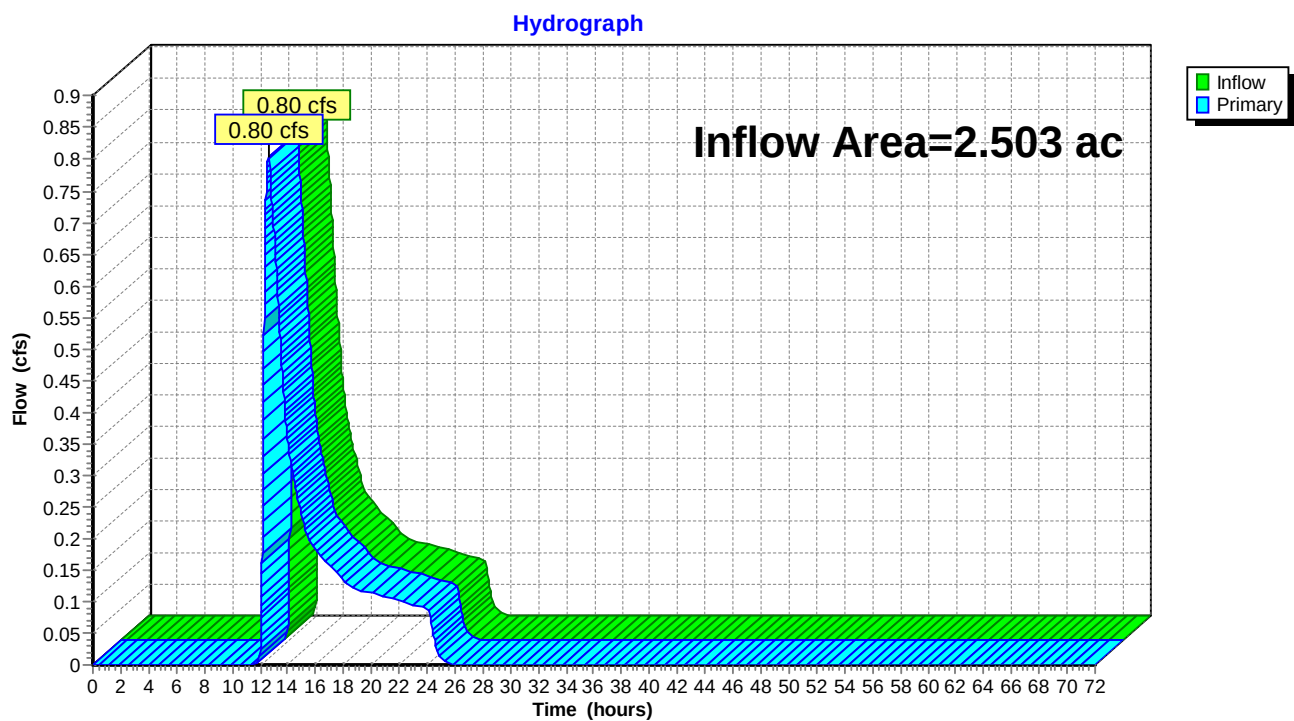
Summary for Pond 4P: PRE - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 0.00% Impervious, Inflow Depth = 1.03" for 100-Year C event
Inflow = 0.80 cfs @ 12.63 hrs, Volume= 0.215 af
Primary = 0.80 cfs @ 12.63 hrs, Volume= 0.215 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 4P: PRE - POI #1 (SW Prop Corner)



Pre&Post Development

NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment EDA-1: EDA-1 PERV

Runoff = 0.80 cfs @ 12.63 hrs, Volume= 0.215 af, Depth= 1.03"

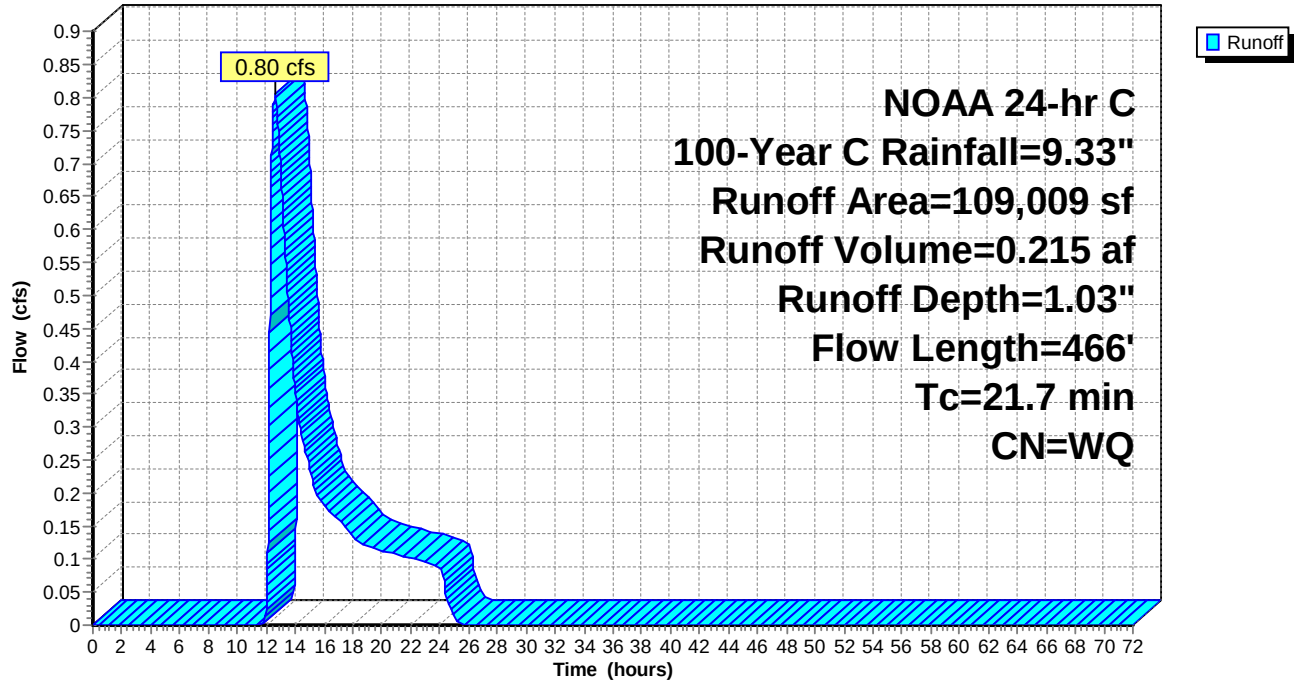
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
28,173	39	>75% Grass cover, Good, HSG A
80,836	30	Woods, Good, HSG A
109,009		Weighted Average
109,009	32	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	8	0.0100	0.02		Sheet Flow, 1-2
					Woods: Dense underbrush n= 0.800 P2= 3.38"
2.3	68	0.0100	0.50		Shallow Concentrated Flow, 1-2
					Woodland Kv= 5.0 fps
1.8	66	0.0150	0.61		Shallow Concentrated Flow, 3-4
					Woodland Kv= 5.0 fps
1.1	25	0.0060	0.39		Shallow Concentrated Flow, 4-5
					Woodland Kv= 5.0 fps
1.2	40	0.0060	0.54		Shallow Concentrated Flow, 5-6
					Short Grass Pasture Kv= 7.0 fps
3.2	74	0.0060	0.39		Shallow Concentrated Flow, 6-7
					Woodland Kv= 5.0 fps
1.8	67	0.0150	0.61		Shallow Concentrated Flow, 7-8
					Woodland Kv= 5.0 fps
3.9	118	0.0100	0.50		Shallow Concentrated Flow, 8-9
					Woodland Kv= 5.0 fps
21.7	466	Total			

Subcatchment EDA-1: EDA-1 PERV

Hydrograph



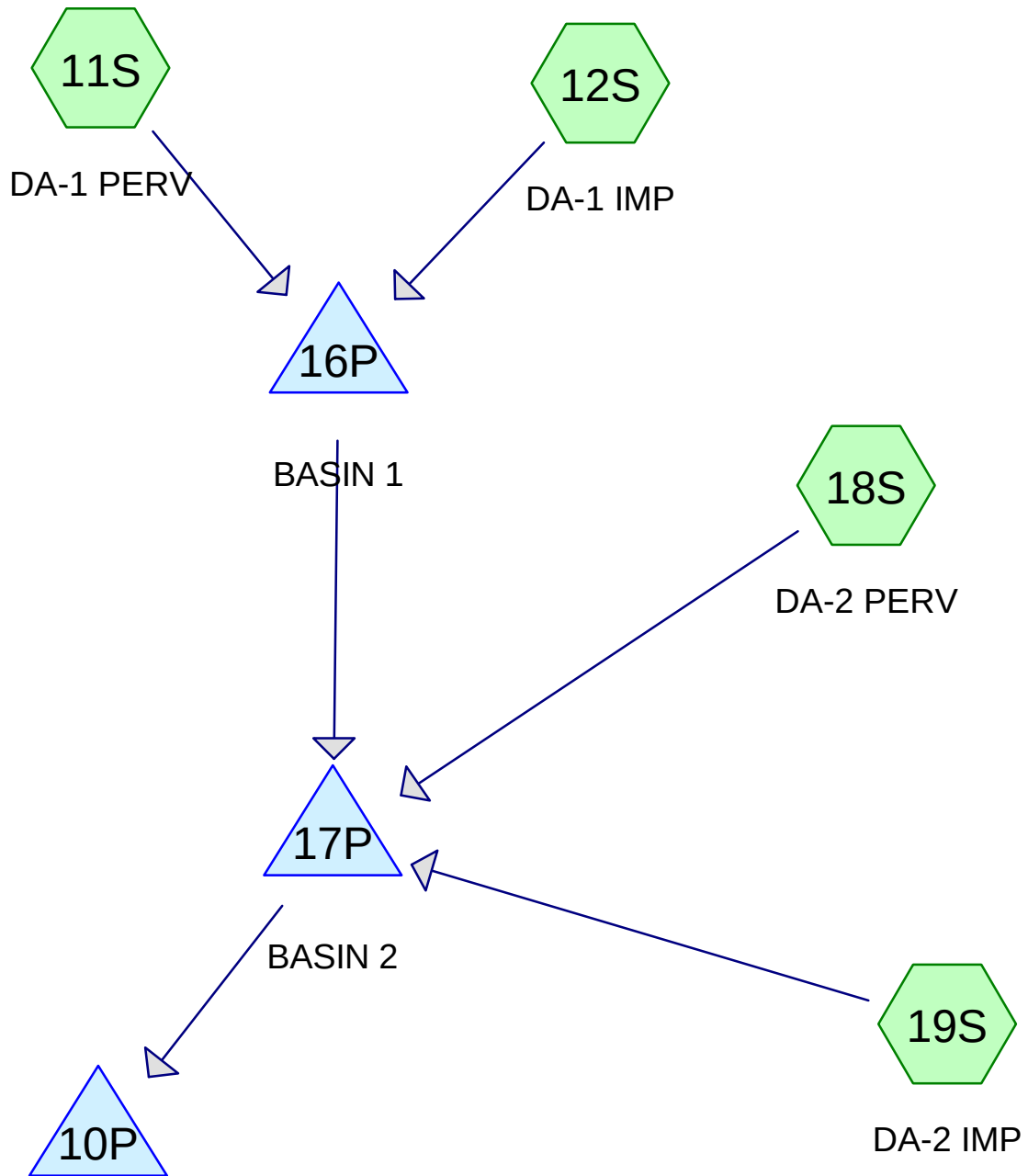
APPENDIX B

Post-Development Drainage Analysis – Current Rainfall (No Bypass)

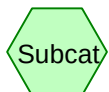
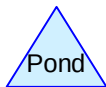
$$l = \frac{100\sqrt{S}}{n}$$

Post-Development Allowable Sheet Flow Length

DA	Surface	Slope	n	Calculated Sheet Flow Length (McCuen-Spiess)	Assumed Sheet Flow Length	Sheet Flow Used Length for Tc
DA-1P	Grass: Short	0.053	0.15	153	100	100
DA-1I	Smooth Surface	0.025	0.011	1437	100	100
DA-2P	Grass: Short	0.035	0.15	125	100	30
DA-2P	Grass: Short	0.017	0.15	87	87	87
DA-2I	Smooth Surface	0.016	0.011	1150	100	92
POI1-BYPASS P	Grass: Short	0.013	0.15	76	76	31
POI1-BYPASS I	Smooth Surface	0.074	0.011	2473	9	9



POST TEST - POI #1
(SW Prop Corner)



Routing Diagram for Pre&Post Development

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NOAA 24-hr C 2-Year C Rainfall=3.47"

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Page 2

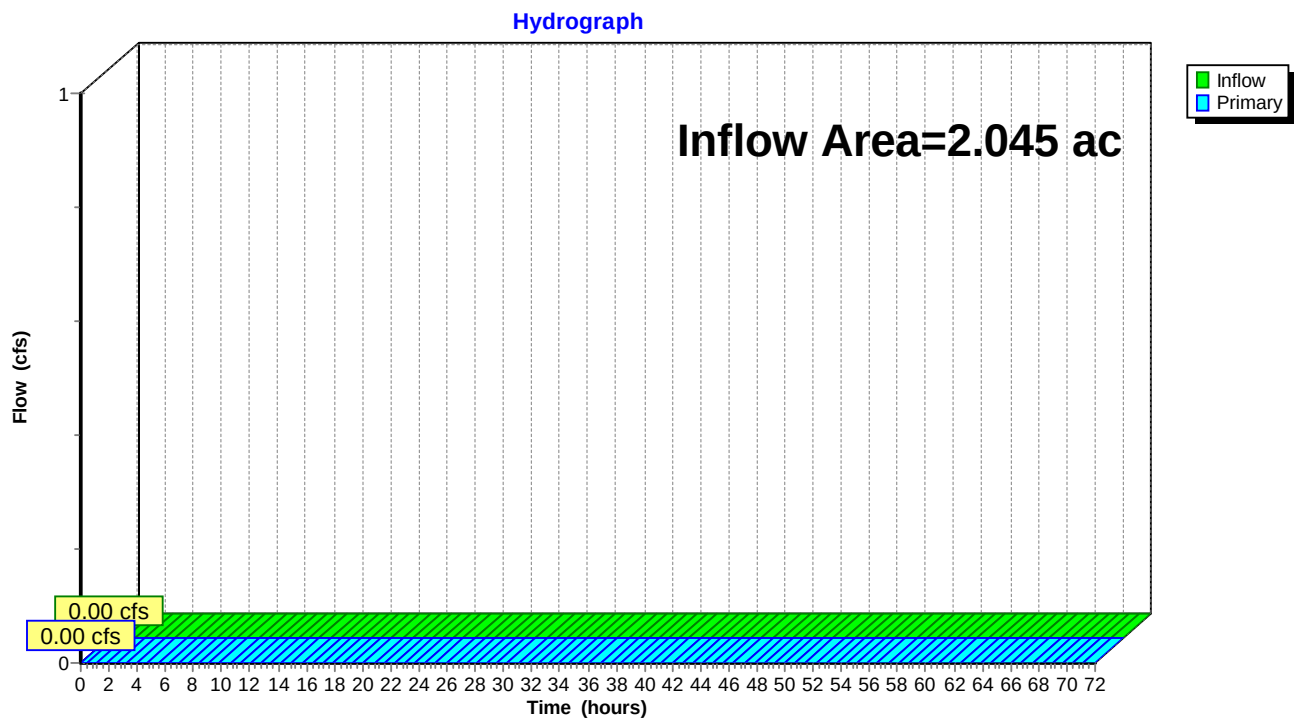
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth = 0.00" for 2-Year C event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.00 cfs @ 24.03 hrs, Volume= 0.000 af, Depth= 0.01"

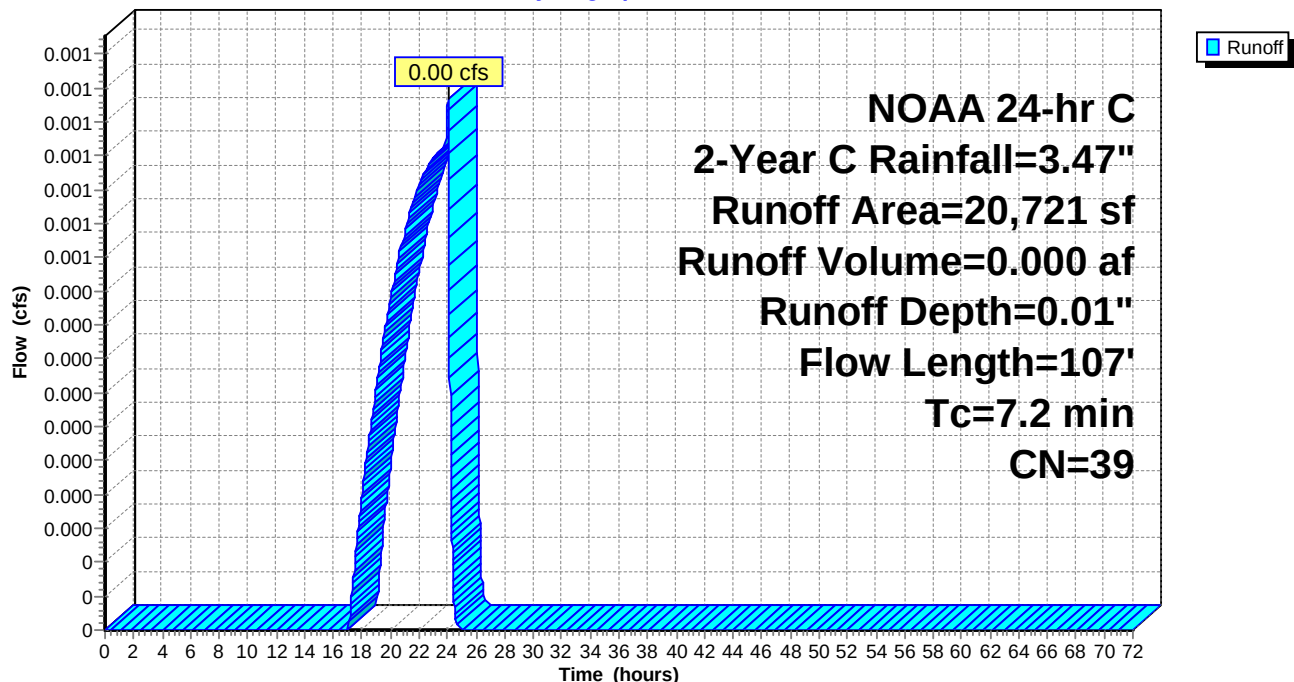
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 2.74 cfs @ 12.10 hrs, Volume= 0.186 af, Depth= 3.24"

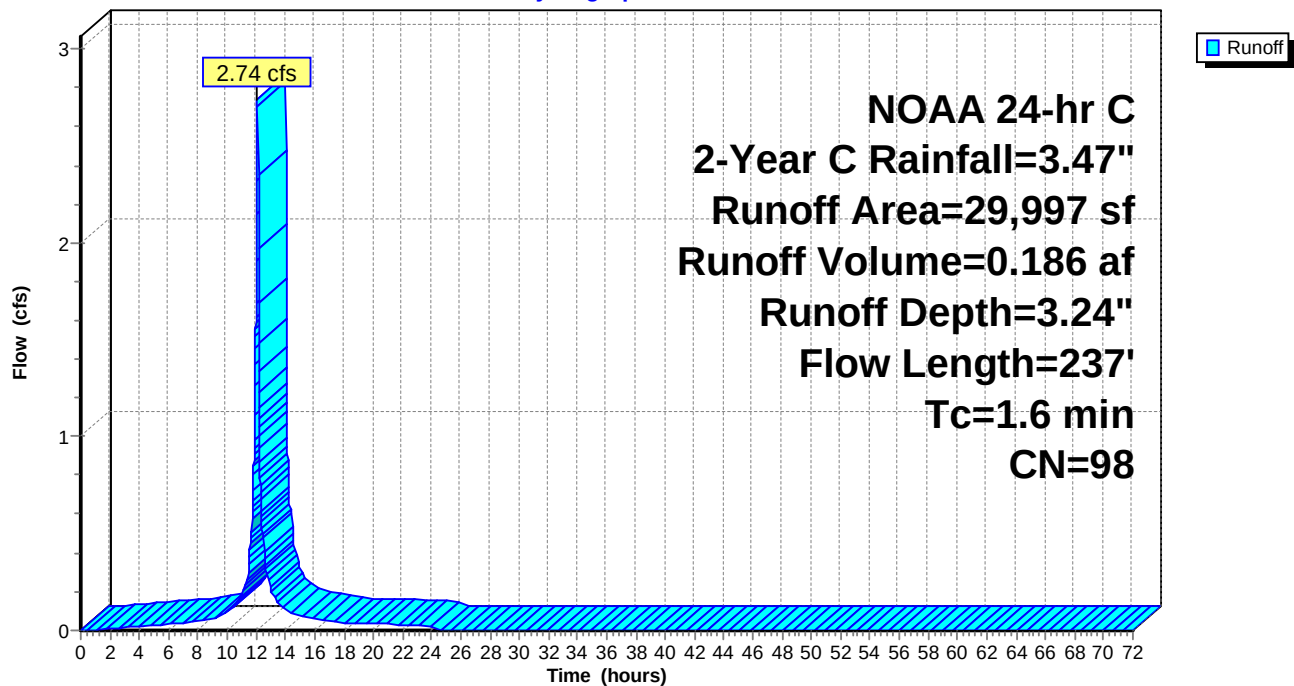
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 1.92" for 2-Year C event
 Inflow = 2.74 cfs @ 12.10 hrs, Volume= 0.186 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.00' @ 24.79 hrs Surf.Area= 6,406 sf Storage= 8,103 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

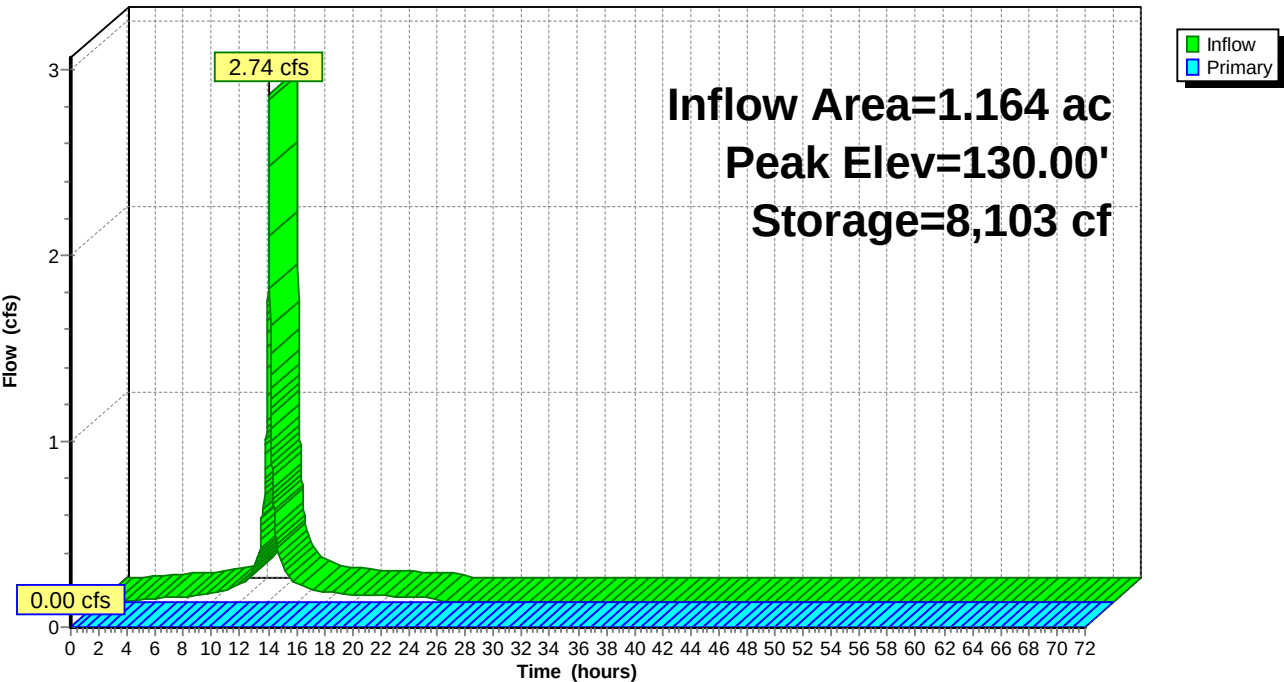
Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.50' TW=128.00' (Dynamic Tailwater)

↑ **1=Culvert** (Controls 0.00 cfs)
 ↑ **2=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1

Hydrograph



Pre&Post Development

NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth = 0.73" for 2-Year C event
 Inflow = 1.77 cfs @ 12.11 hrs, Volume= 0.125 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 128.86' @ 25.03 hrs Surf.Area= 6,582 sf Storage= 5,435 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

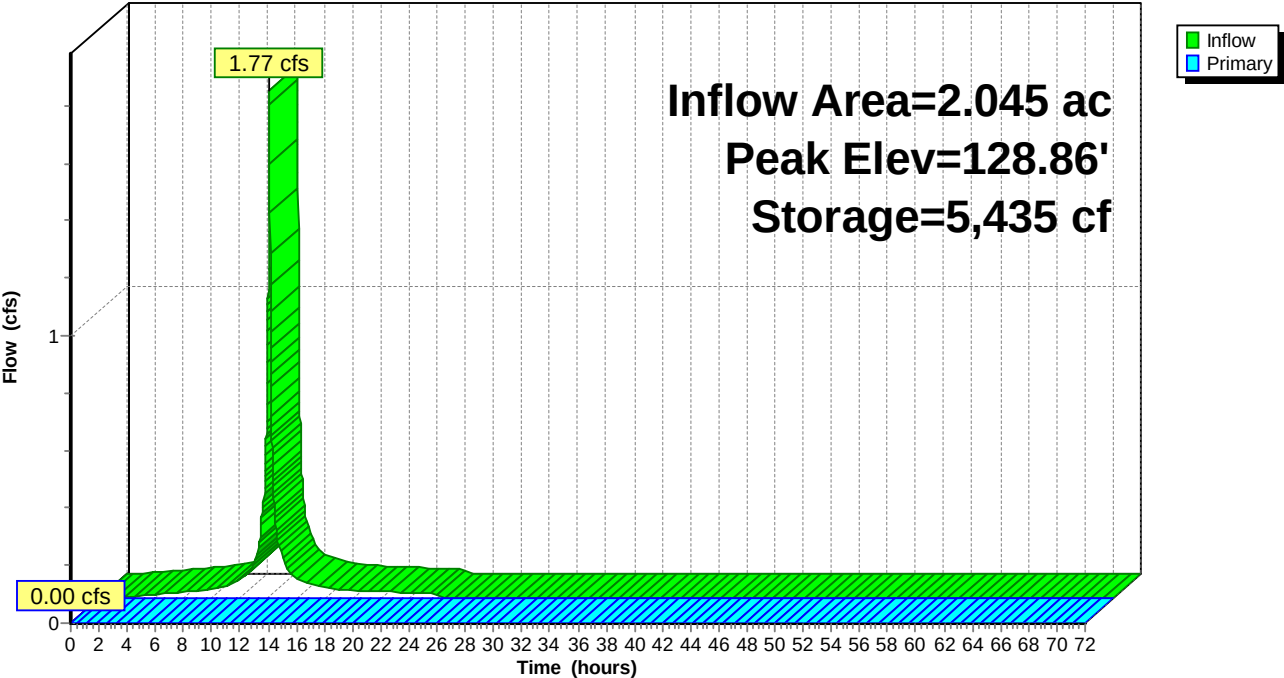
Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

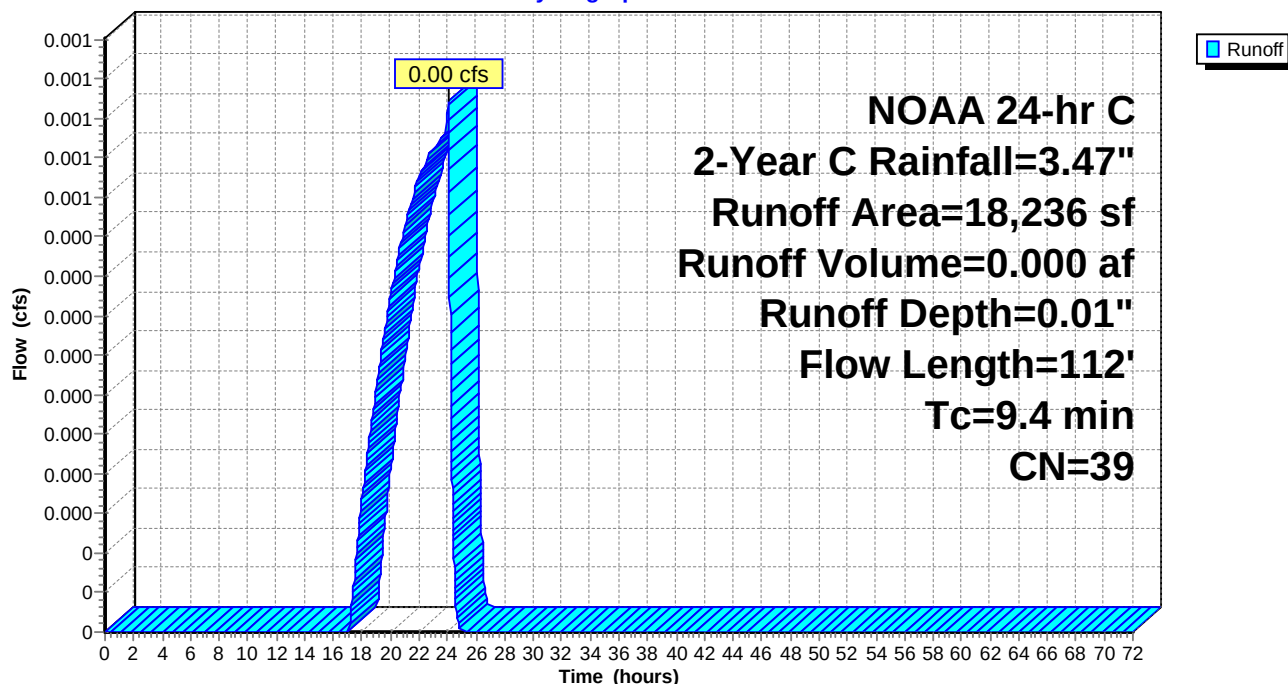
Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.00' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.00 cfs of 7.45 cfs potential flow)
 ↑ **2=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

Hydrograph





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NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 1.77 cfs @ 12.11 hrs, Volume= 0.125 af, Depth= 3.24"

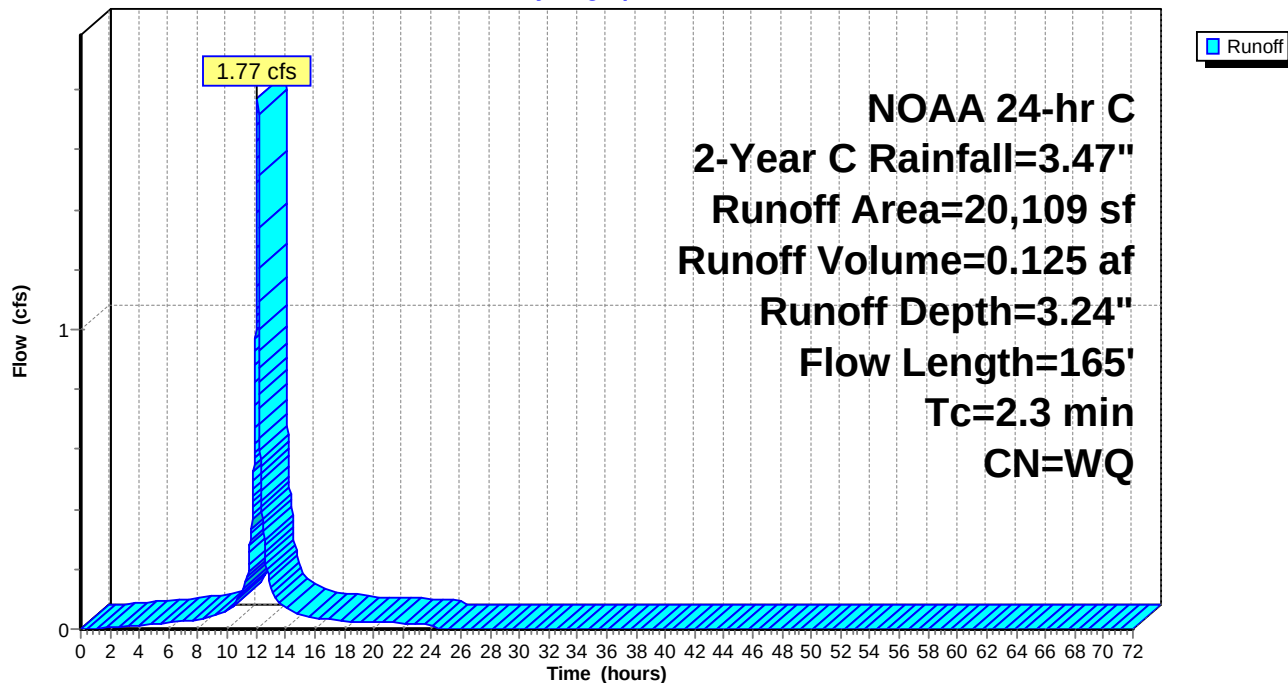
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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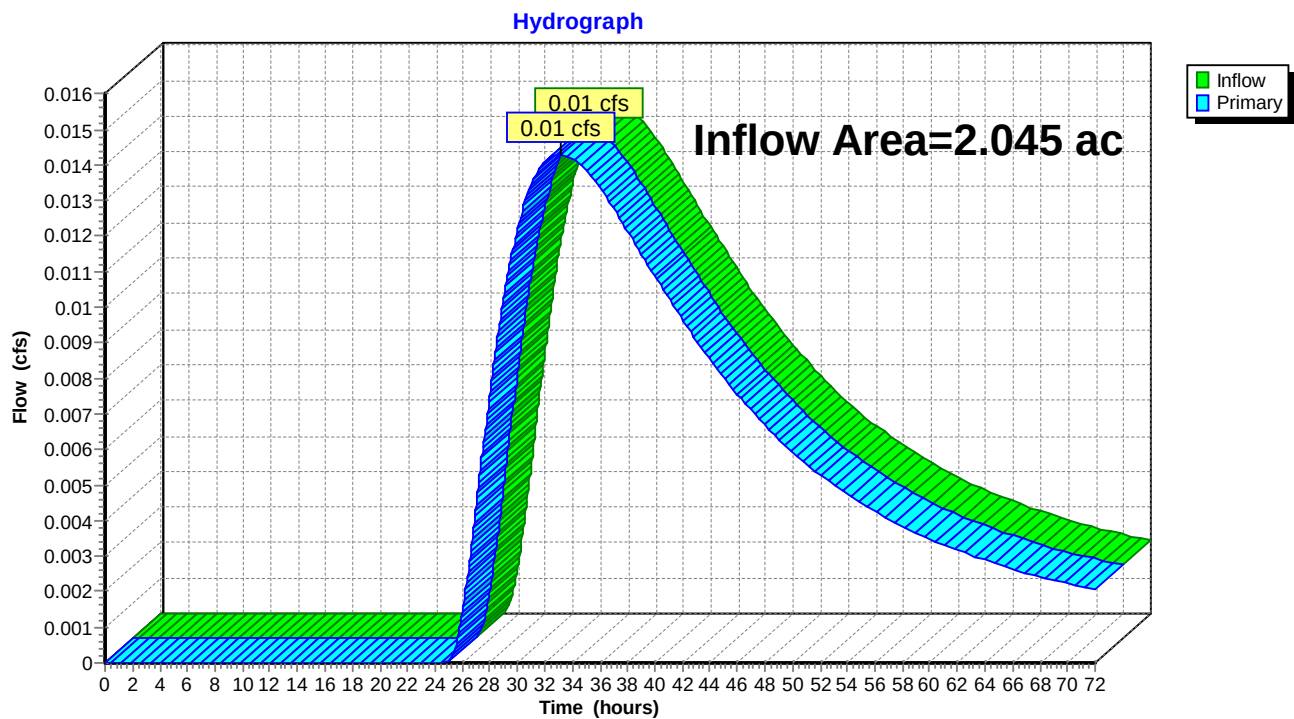
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 0.16" for 10-Year C event
Inflow = 0.01 cfs @ 33.09 hrs, Volume= 0.026 af
Primary = 0.01 cfs @ 33.09 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.04 cfs @ 12.55 hrs, Volume= 0.012 af, Depth= 0.30"

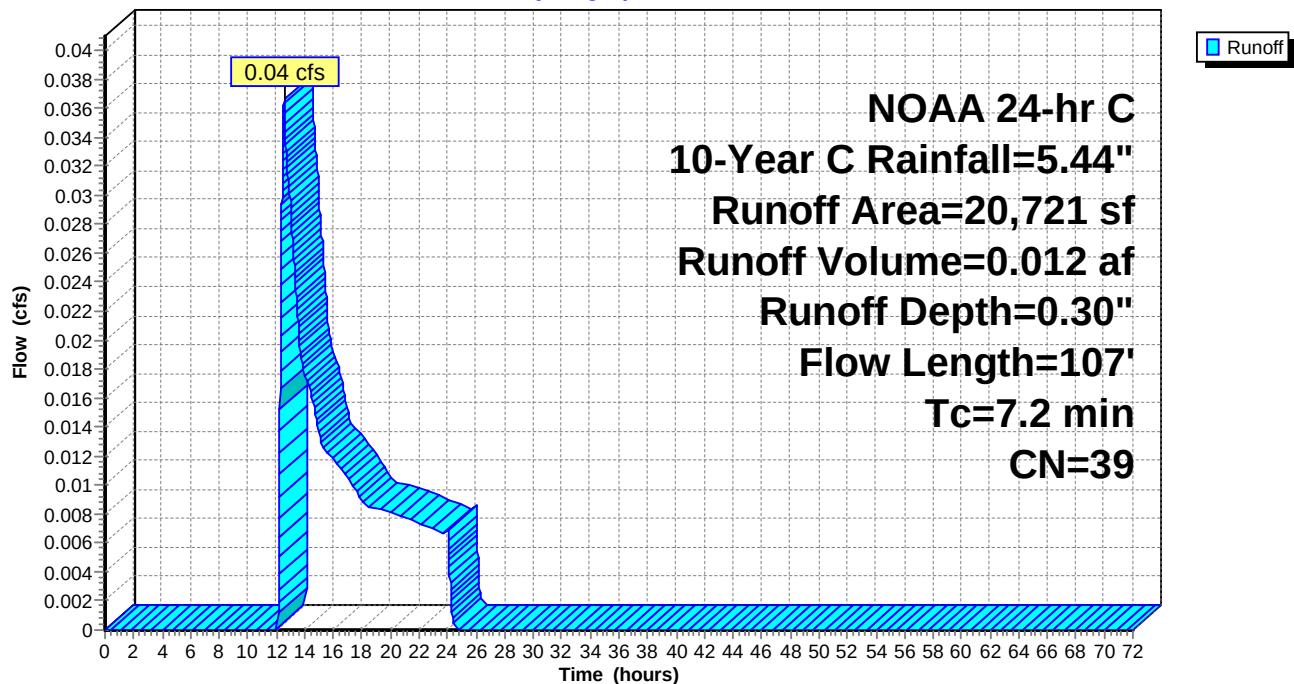
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 4.31 cfs @ 12.10 hrs, Volume= 0.299 af, Depth= 5.20"

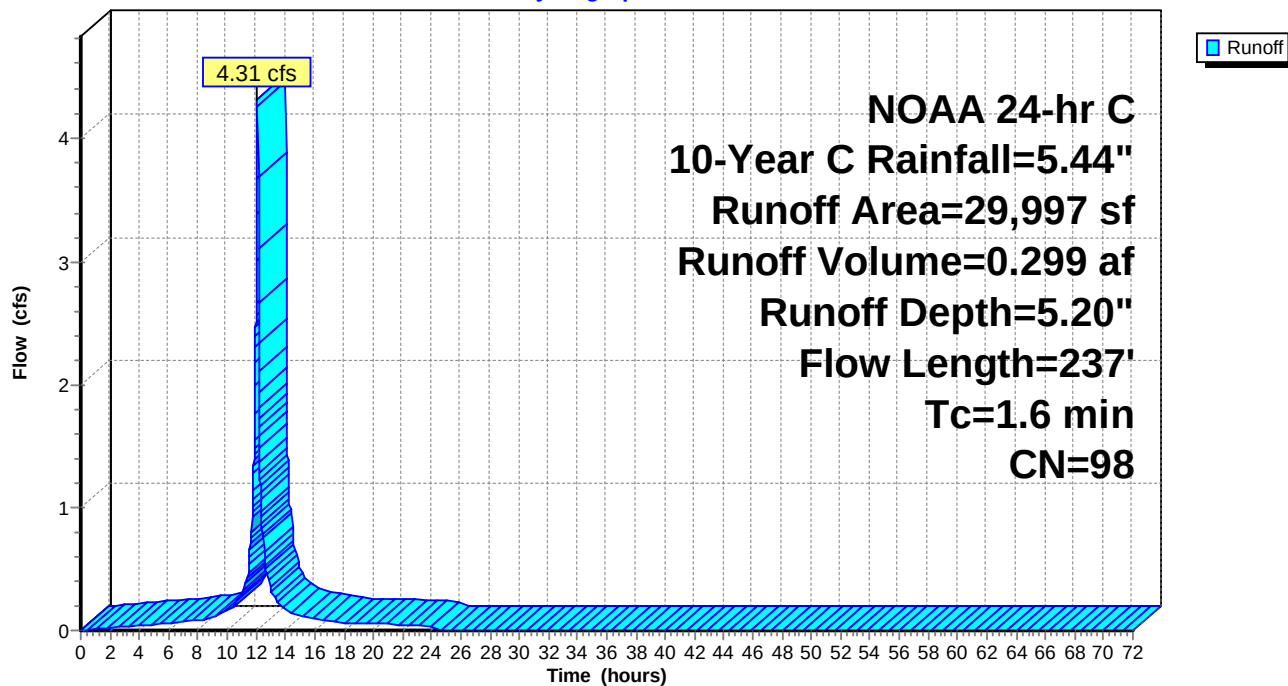
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 3.20" for 10-Year C event
 Inflow = 4.31 cfs @ 12.10 hrs, Volume= 0.310 af
 Outflow = 0.07 cfs @ 18.61 hrs, Volume= 0.091 af, Atten= 98%, Lag= 390.9 min
 Primary = 0.07 cfs @ 18.61 hrs, Volume= 0.091 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.47' @ 18.61 hrs Surf.Area= 7,149 sf Storage= 11,303 cf

Plug-Flow detention time= 911.7 min calculated for 0.091 af (29% of inflow)
 Center-of-Mass det. time= 702.3 min (1,456.2 - 753.9)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

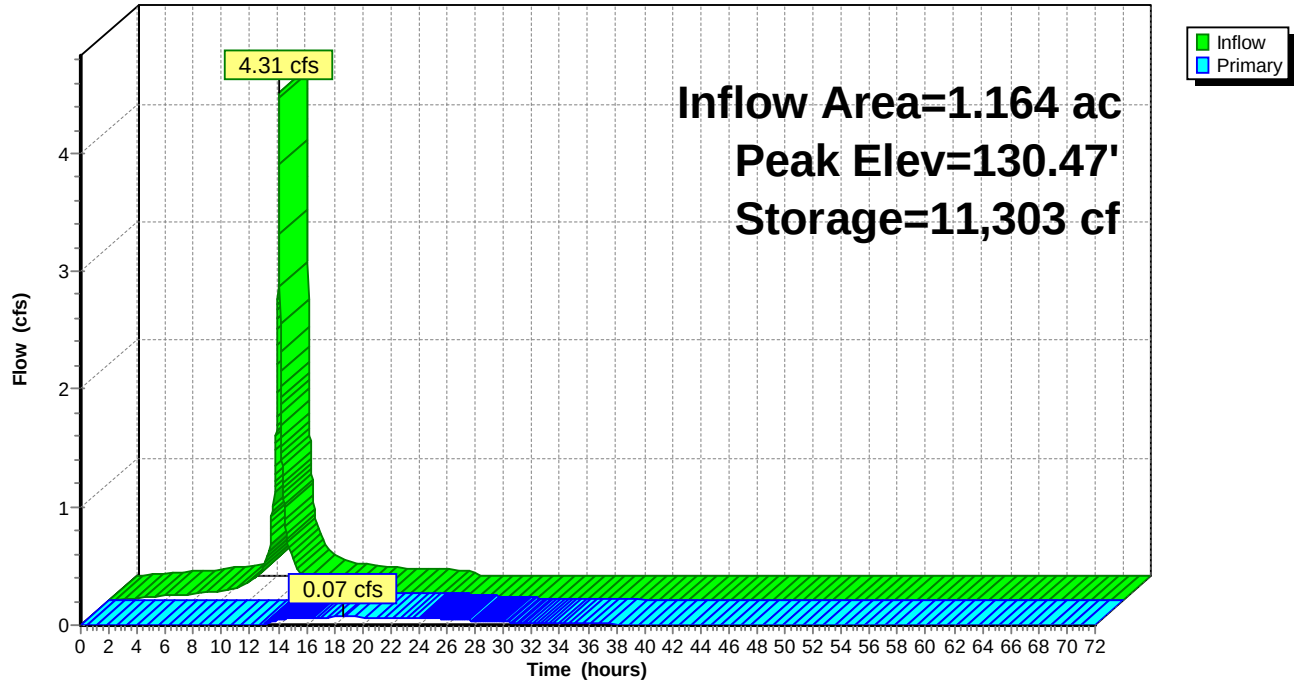
Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 ' / S= 0.0064 ' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.07 cfs @ 18.61 hrs HW=130.47' TW=129.46' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.07 cfs of 2.38 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.07 cfs @ 1.97 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1

Hydrograph



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 1.77" for 10-Year C event
 Inflow = 2.79 cfs @ 12.11 hrs, Volume= 0.302 af
 Outflow = 0.01 cfs @ 33.09 hrs, Volume= 0.026 af, Atten= 99%, Lag= 1,259.2 min
 Primary = 0.01 cfs @ 33.09 hrs, Volume= 0.026 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 129.87' @ 33.09 hrs Surf.Area= 7,286 sf Storage= 12,407 cf

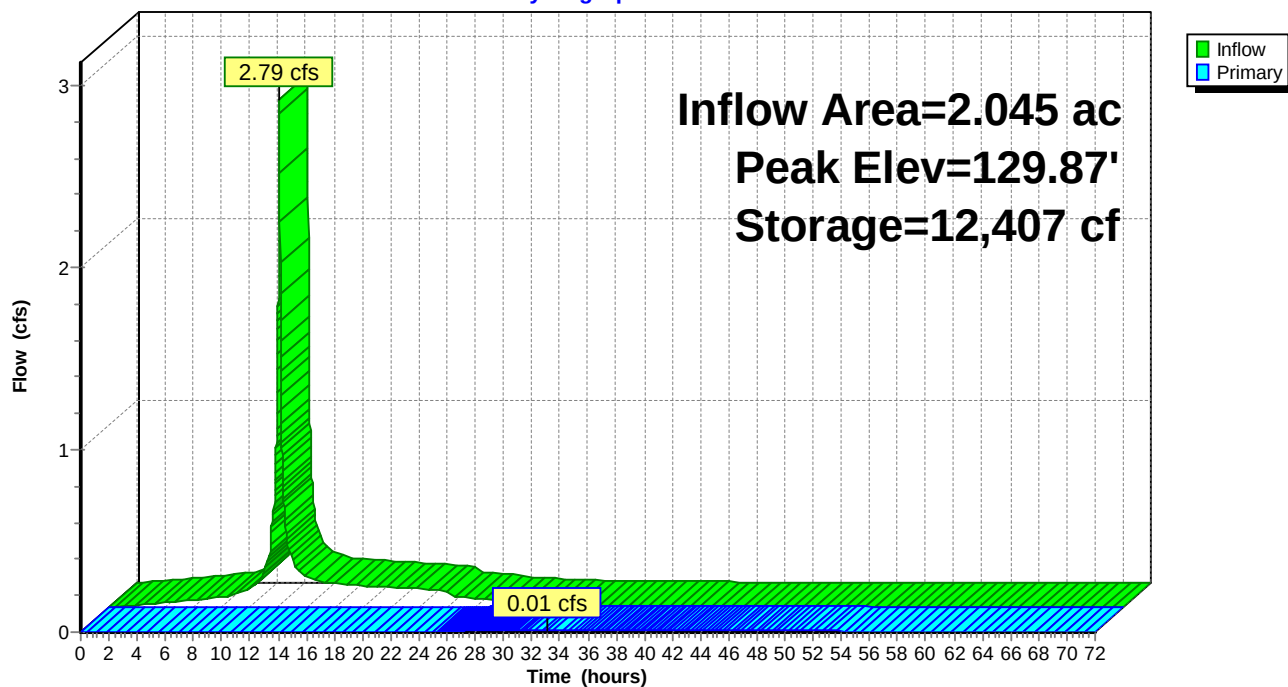
Plug-Flow detention time= 2,161.0 min calculated for 0.026 af (9% of inflow)
 Center-of-Mass det. time= 1,586.6 min (2,555.6 - 969.0)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 33.09 hrs HW=129.87' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 0.01 cfs of 10.14 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 1.02 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2**Hydrograph**

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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.03 cfs @ 12.59 hrs, Volume= 0.010 af, Depth= 0.30"

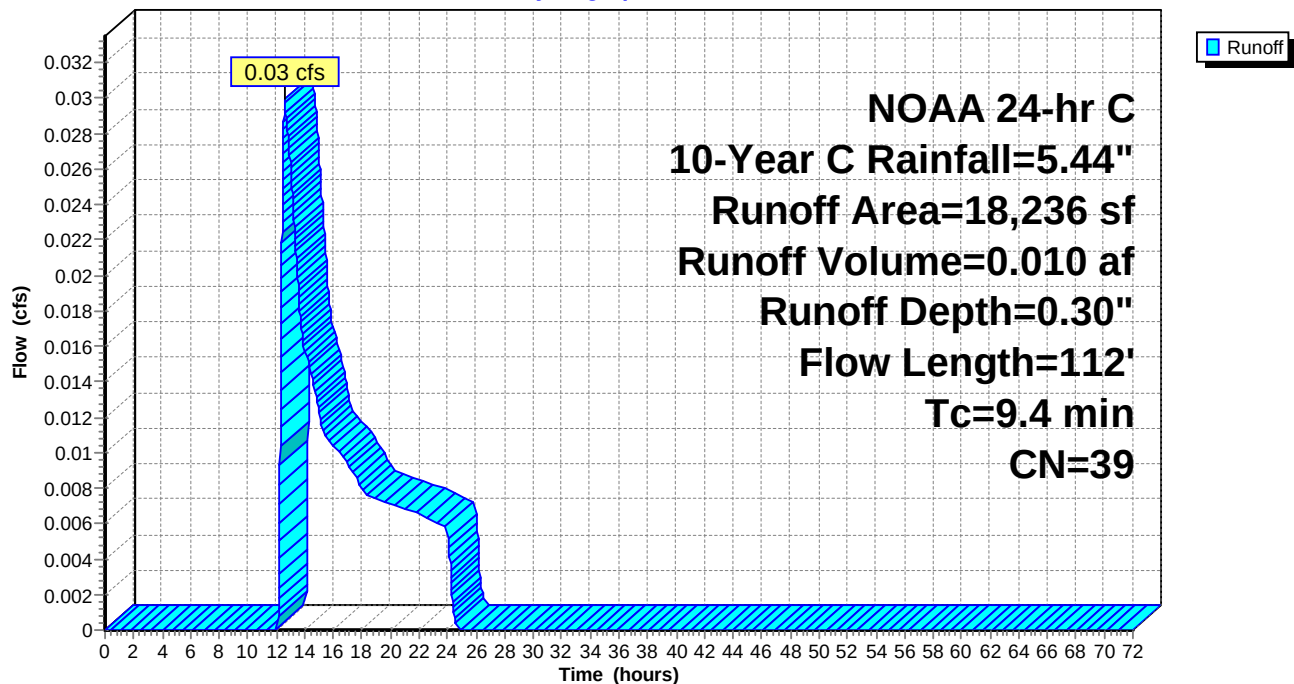
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 2.79 cfs @ 12.11 hrs, Volume= 0.200 af, Depth= 5.20"

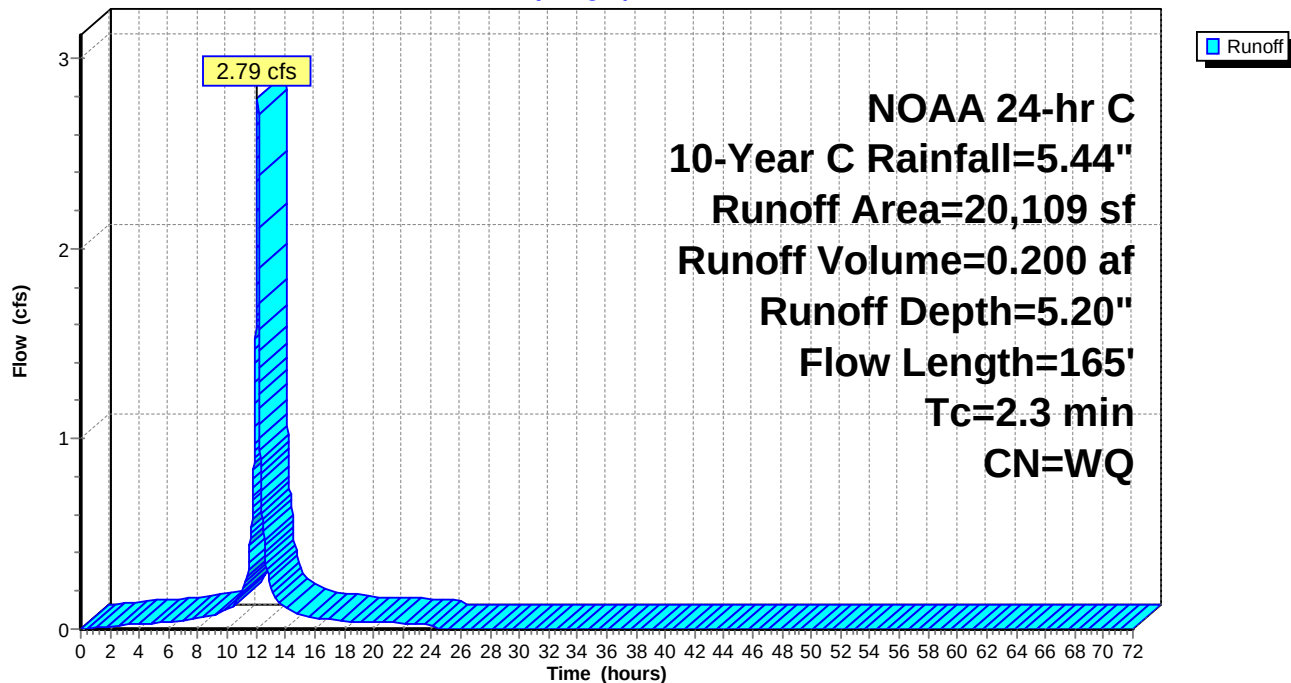
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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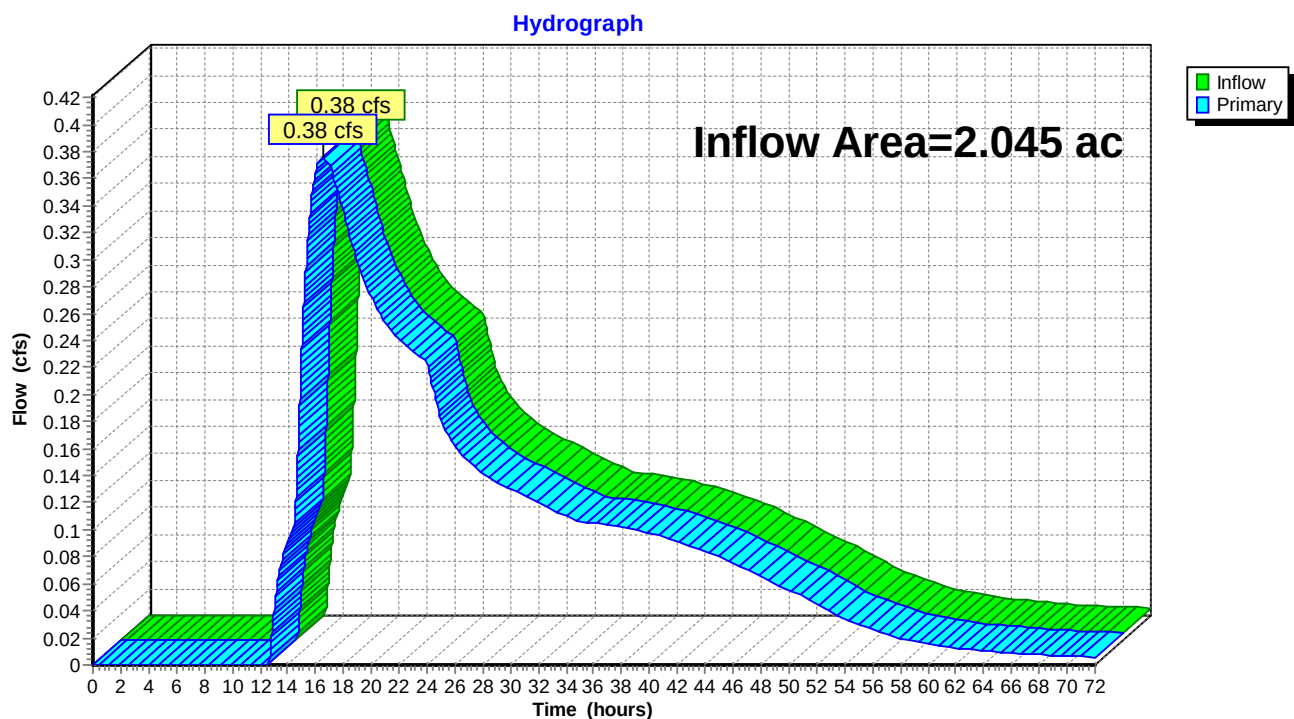
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 2.95" for 100-Year C event
Inflow = 0.38 cfs @ 16.51 hrs, Volume= 0.503 af
Primary = 0.38 cfs @ 16.51 hrs, Volume= 0.503 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.63 cfs @ 12.17 hrs, Volume= 0.070 af, Depth= 1.76"

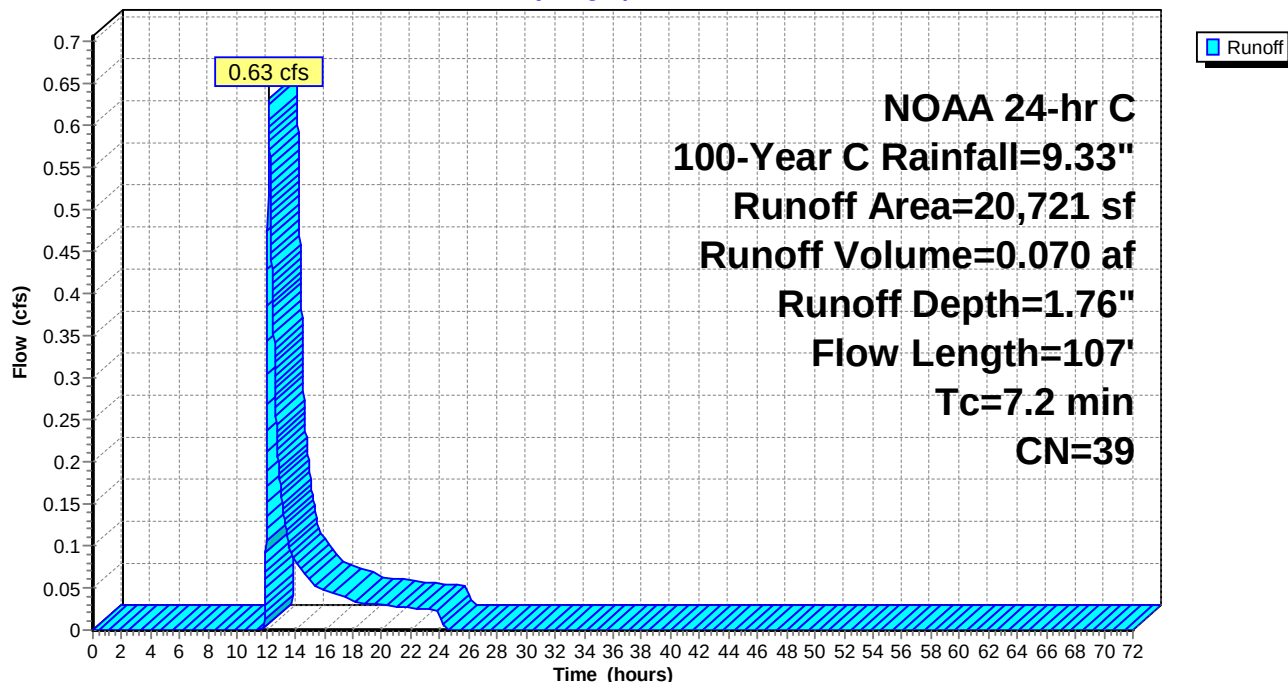
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 7.42 cfs @ 12.10 hrs, Volume= 0.522 af, Depth= 9.09"

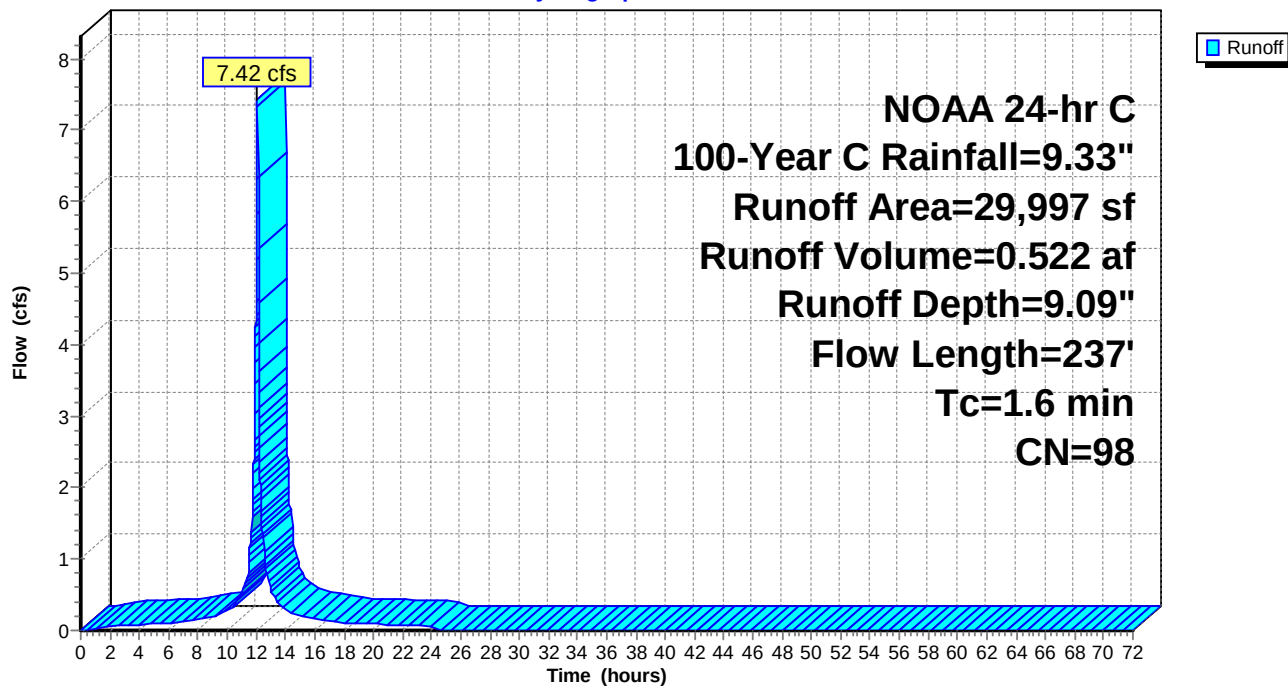
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2
					Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3
					Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4
					18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'
					n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 6.10" for 100-Year C event
 Inflow = 7.84 cfs @ 12.10 hrs, Volume= 0.591 af
 Outflow = 0.30 cfs @ 14.51 hrs, Volume= 0.371 af, Atten= 96%, Lag= 144.6 min
 Primary = 0.30 cfs @ 14.51 hrs, Volume= 0.371 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 131.43' @ 14.62 hrs Surf.Area= 8,744 sf Storage= 18,873 cf

Plug-Flow detention time= 874.9 min calculated for 0.371 af (63% of inflow)
 Center-of-Mass det. time= 756.8 min (1,513.4 - 756.7)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.30 cfs @ 14.51 hrs HW=131.43' TW=130.31' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.30 cfs of 3.95 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 5.10 fps)
 ↑ **3=Orifice/Grate** (Orifice Controls 0.12 cfs @ 1.15 fps)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

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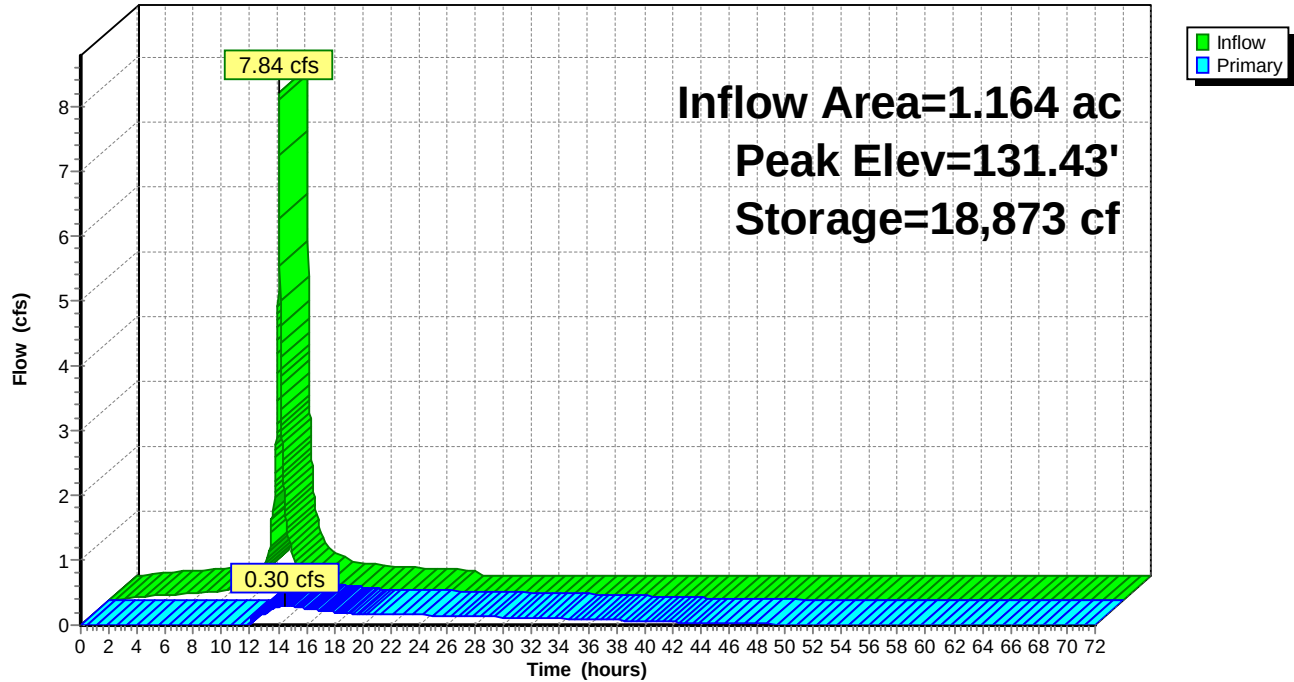
NOAA 24-hr C 100-Year C Rainfall=9.33"

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Pond 16P: BASIN 1

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 4.59" for 100-Year C event
 Inflow = 5.17 cfs @ 12.11 hrs, Volume= 0.782 af
 Outflow = 0.38 cfs @ 16.51 hrs, Volume= 0.503 af, Atten= 93%, Lag= 264.1 min
 Primary = 0.38 cfs @ 16.51 hrs, Volume= 0.503 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.44' @ 16.51 hrs Surf.Area= 7,701 sf Storage= 16,685 cf

Plug-Flow detention time= 964.3 min calculated for 0.503 af (64% of inflow)
 Center-of-Mass det. time= 614.9 min (1,734.0 - 1,119.1)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

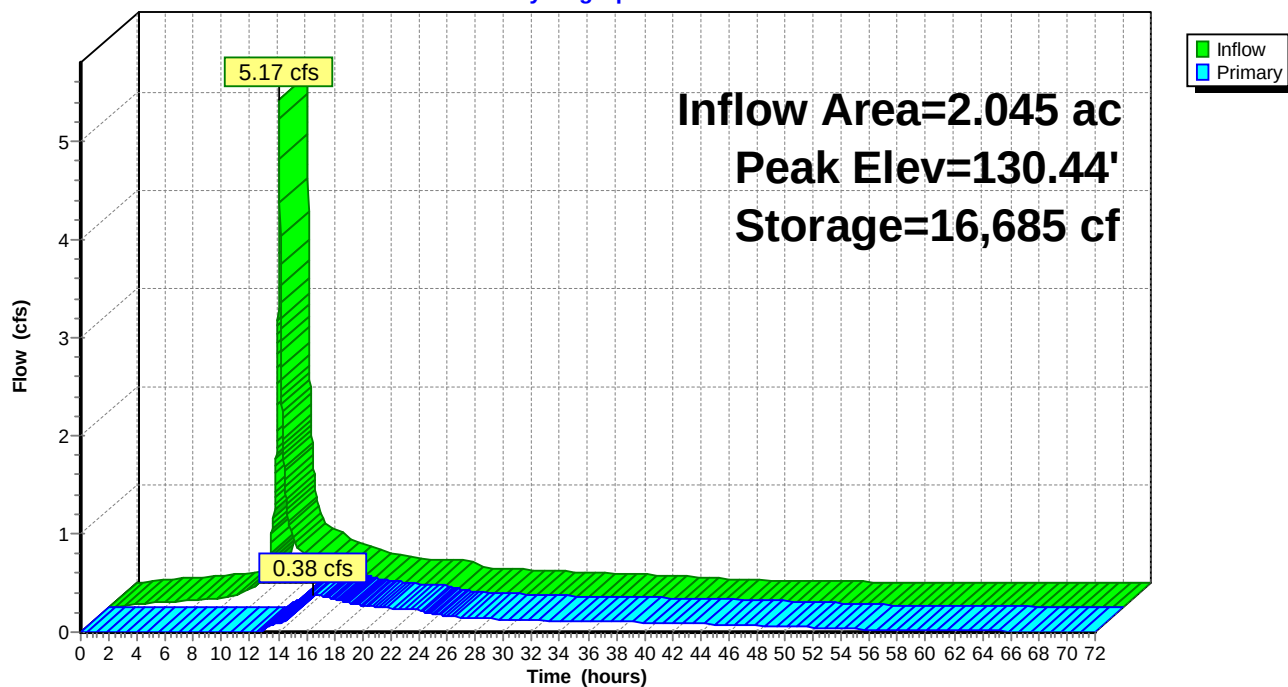
Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.38 cfs @ 16.51 hrs HW=130.44' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.38 cfs of 10.83 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 3.59 fps)
 ↑ **3=Orifice/Grate** (Orifice Controls 0.25 cfs @ 1.20 fps)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.48 cfs @ 12.21 hrs, Volume= 0.061 af, Depth= 1.76"

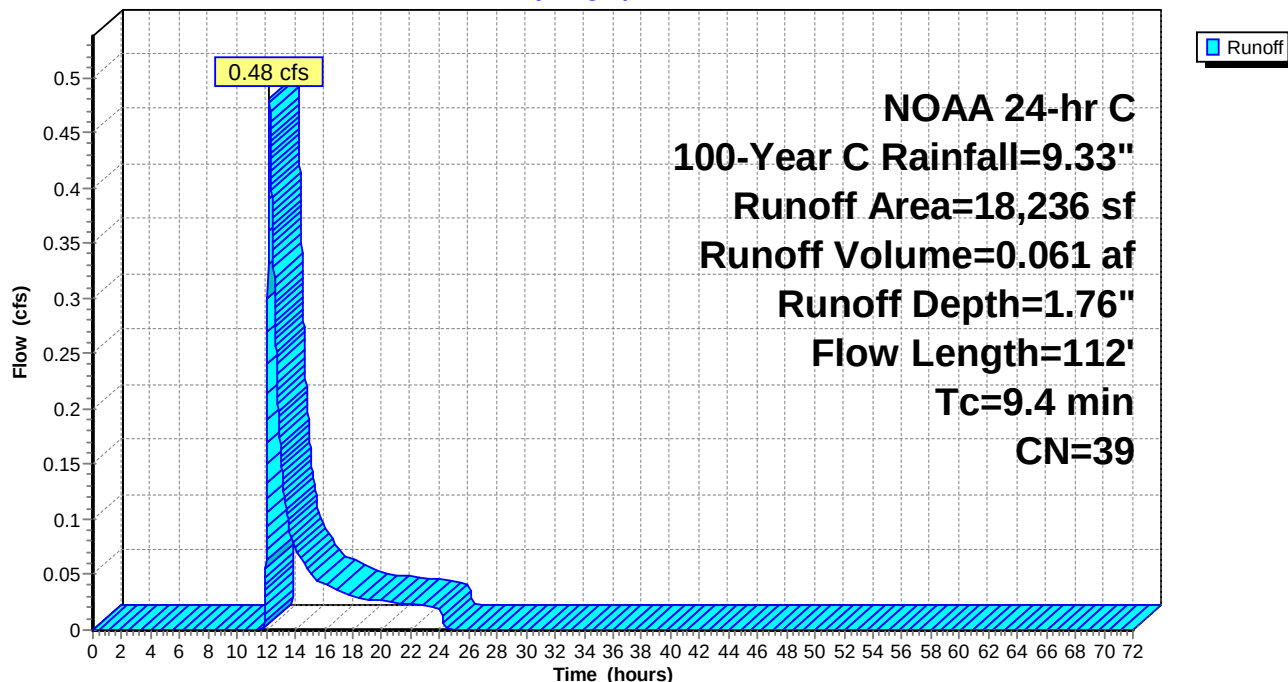
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3
					Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4
					Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 4.79 cfs @ 12.11 hrs, Volume= 0.350 af, Depth= 9.09"

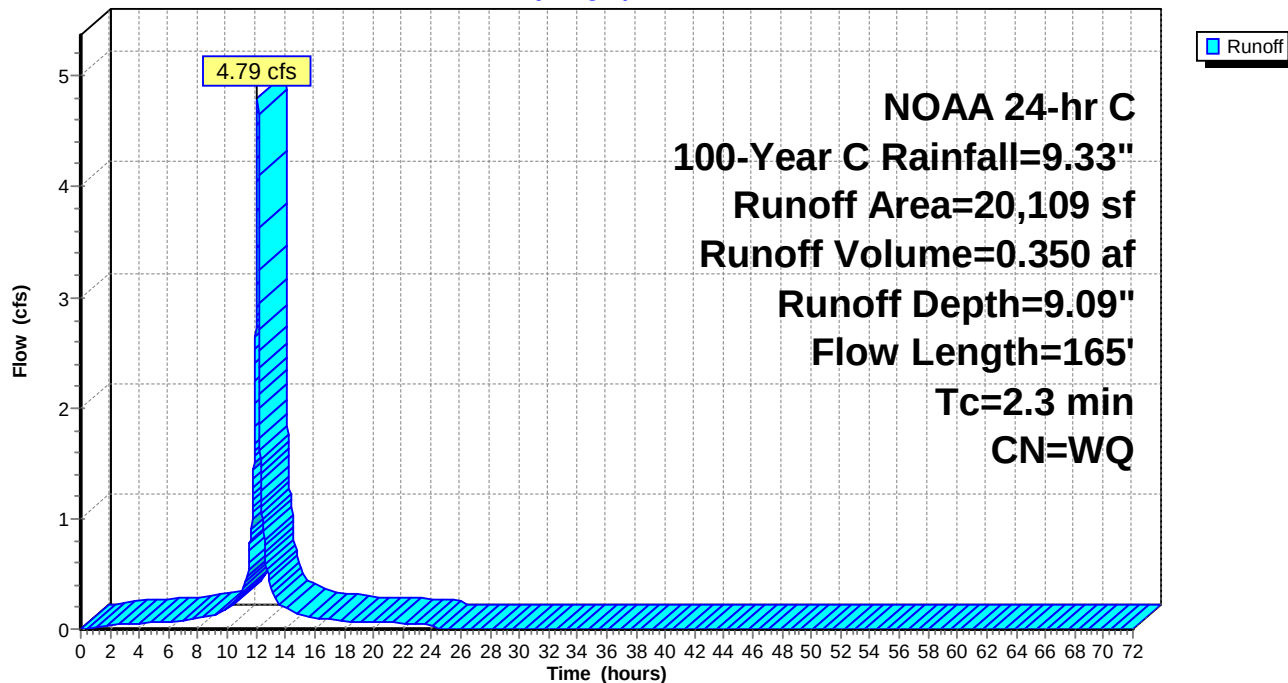
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

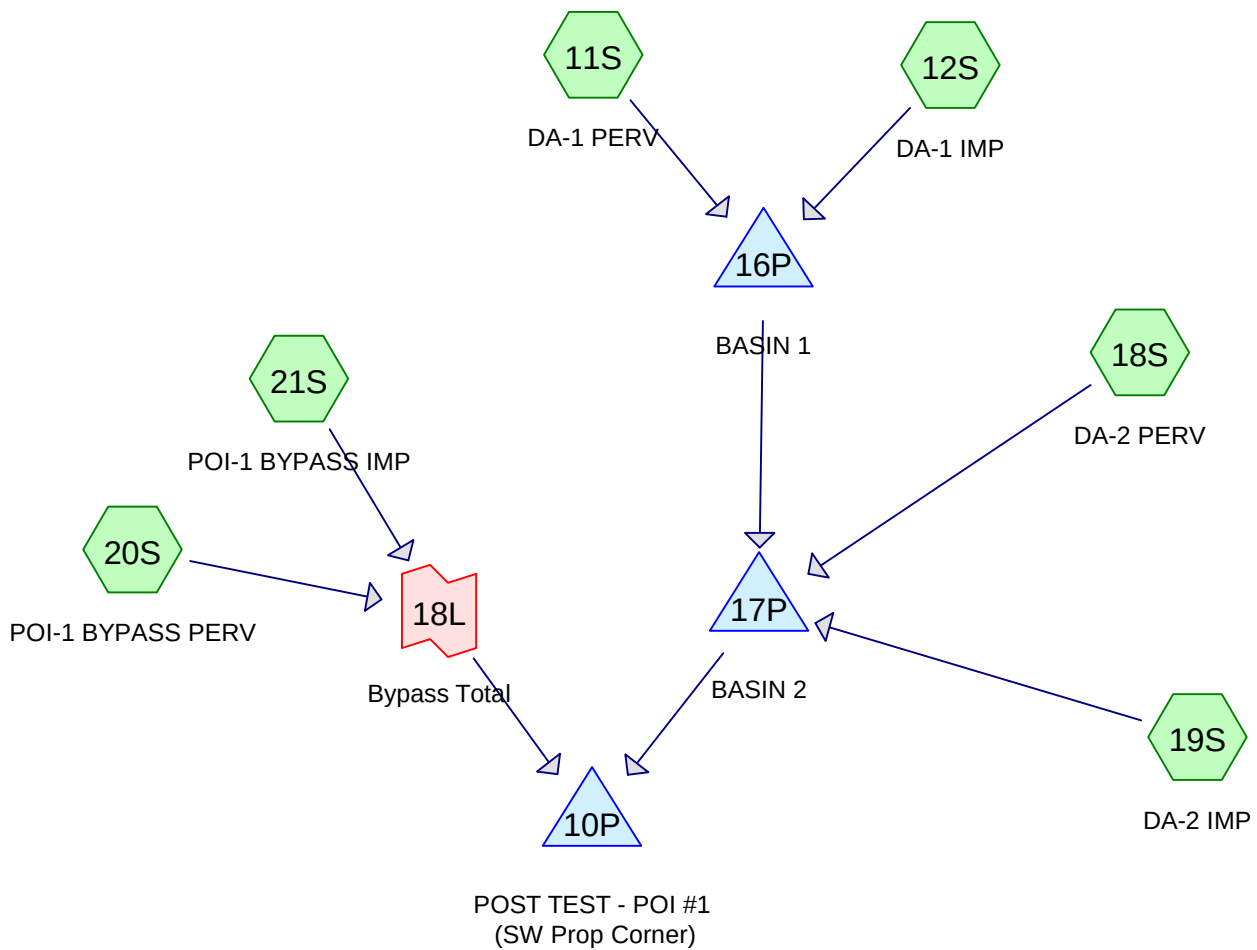
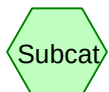
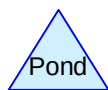
Subcatchment 19S: DA-2 IMP

Hydrograph



APPENDIX C

Post-Development Drainage Analysis – Current Rainfall (With Bypass)



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NOAA 24-hr C 2-Year C Rainfall=3.47"

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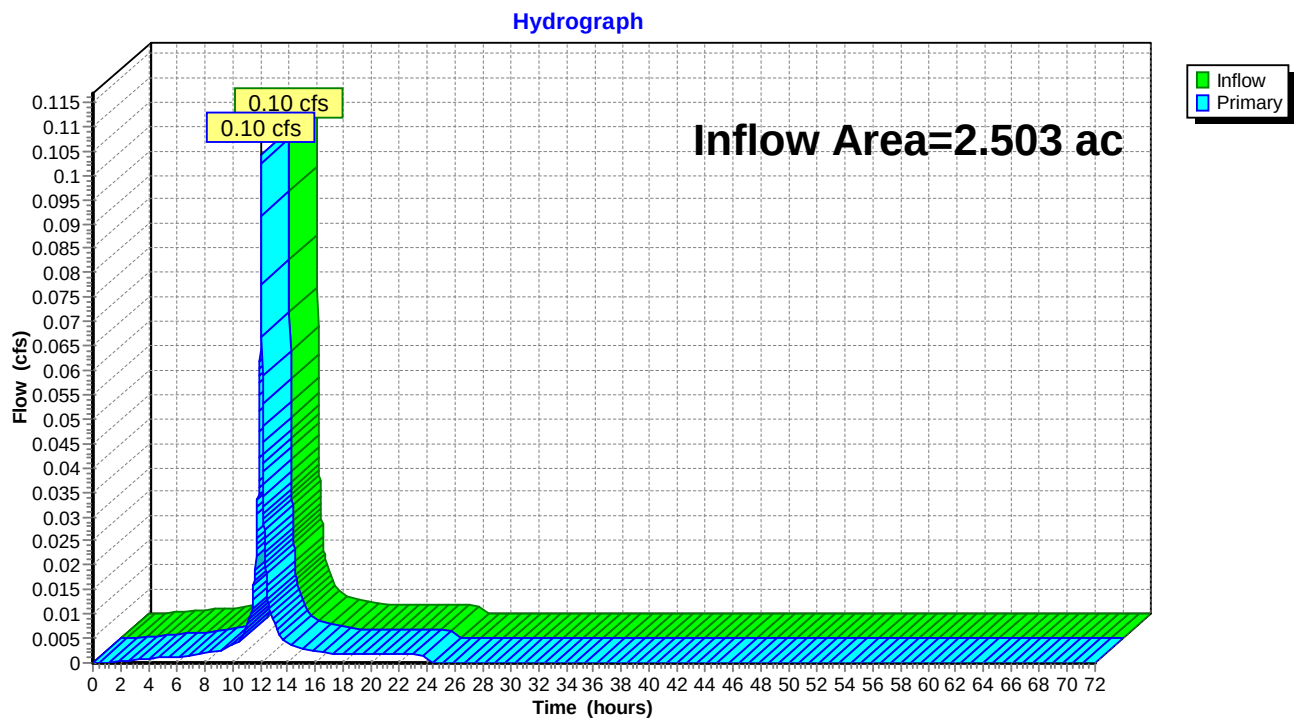
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 47.02% Impervious, Inflow Depth = 0.04" for 2-Year C event
Inflow = 0.10 cfs @ 12.10 hrs, Volume= 0.007 af
Primary = 0.10 cfs @ 12.10 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



Summary for Subcatchment 11S: DA-1 PERV

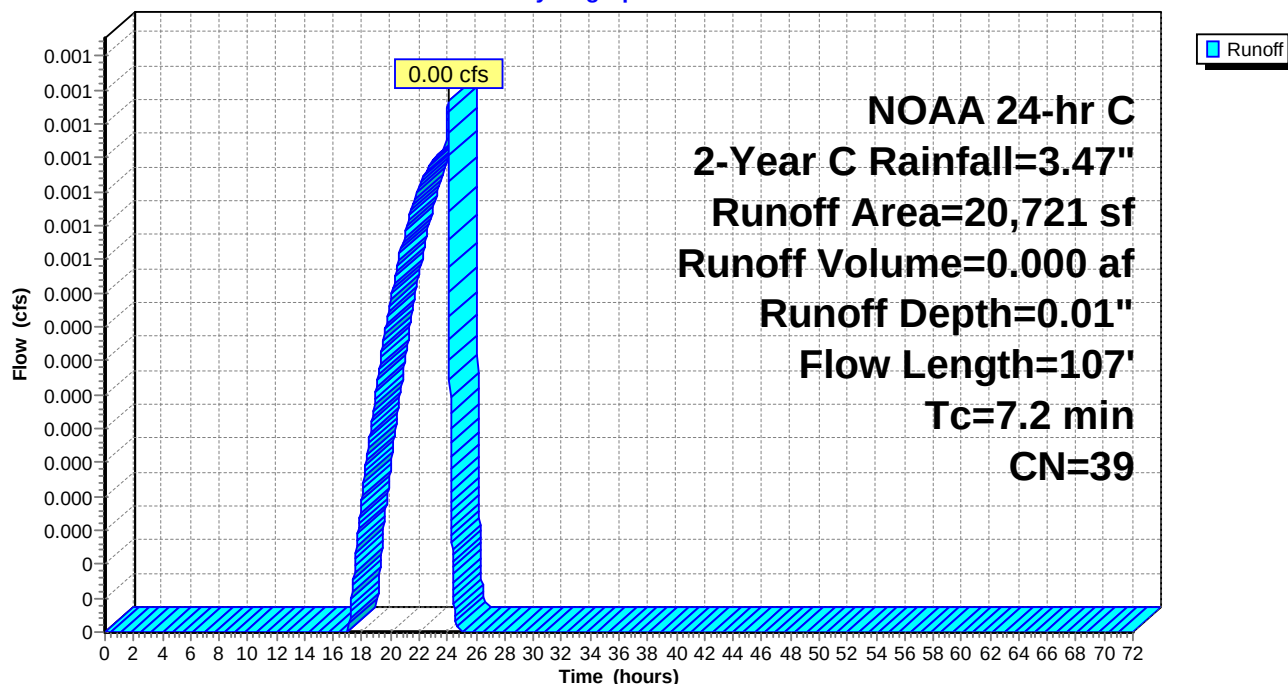
Runoff = 0.00 cfs @ 24.03 hrs, Volume= 0.000 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)		CN	Description		
20,721		39	>75% Grass cover, Good, HSG A		
20,721		39	100.00% Pervious Area		
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 2.74 cfs @ 12.10 hrs, Volume= 0.186 af, Depth= 3.24"

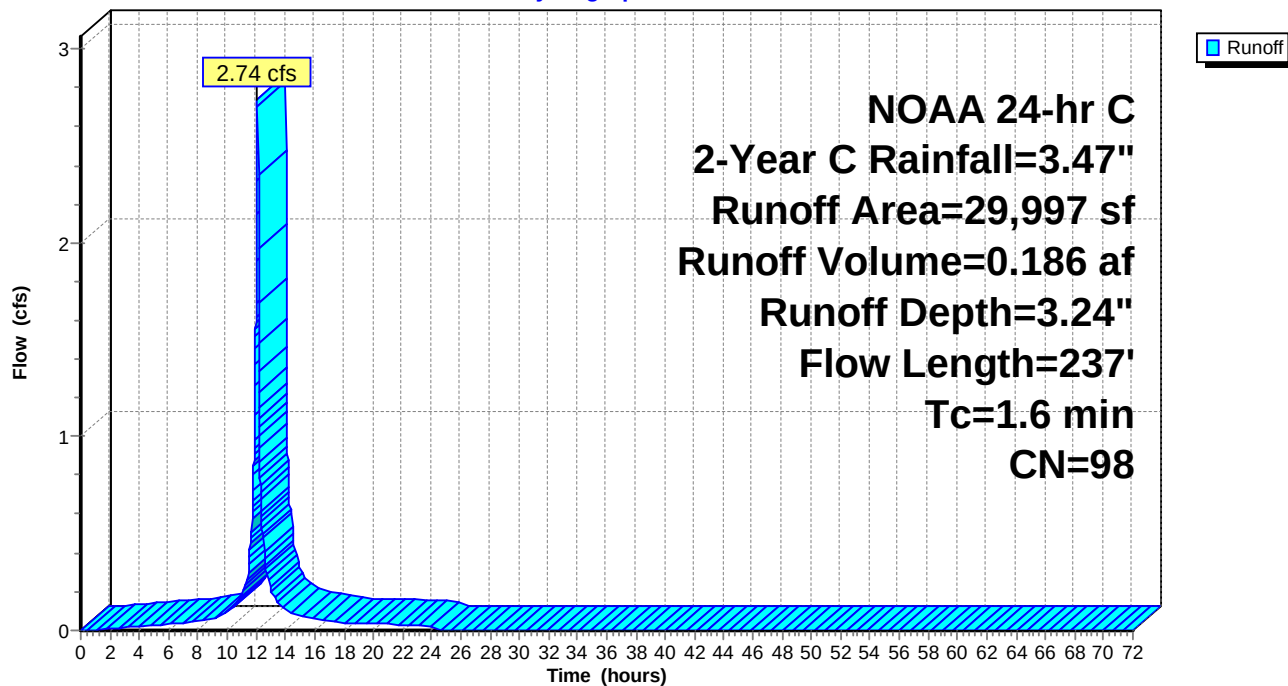
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 1.92" for 2-Year C event
 Inflow = 2.74 cfs @ 12.10 hrs, Volume= 0.186 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.00' @ 24.79 hrs Surf.Area= 6,406 sf Storage= 8,103 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

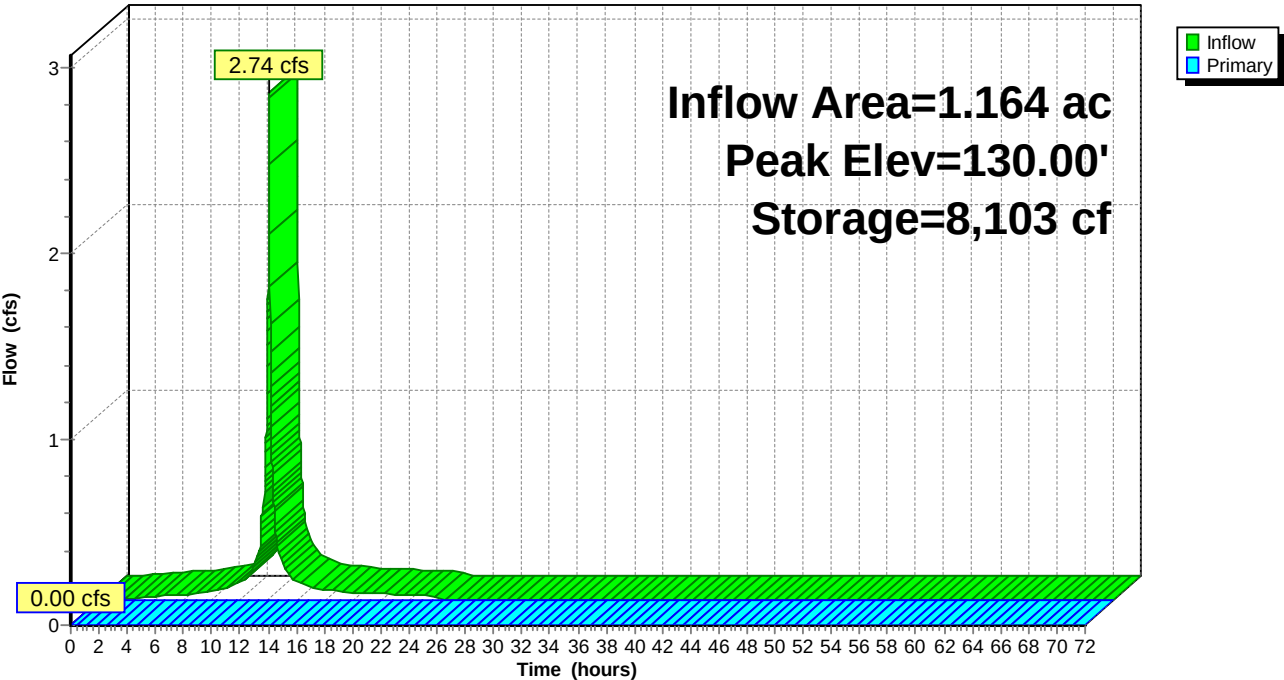
Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.50' TW=128.00' (Dynamic Tailwater)

↑ **1=Culvert** (Controls 0.00 cfs)
 ↑ **2=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1

Hydrograph



Pre&Post Development

NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth = 0.73" for 2-Year C event
 Inflow = 1.77 cfs @ 12.11 hrs, Volume= 0.125 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 128.86' @ 25.03 hrs Surf.Area= 6,582 sf Storage= 5,435 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.00' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.00 cfs of 7.45 cfs potential flow)

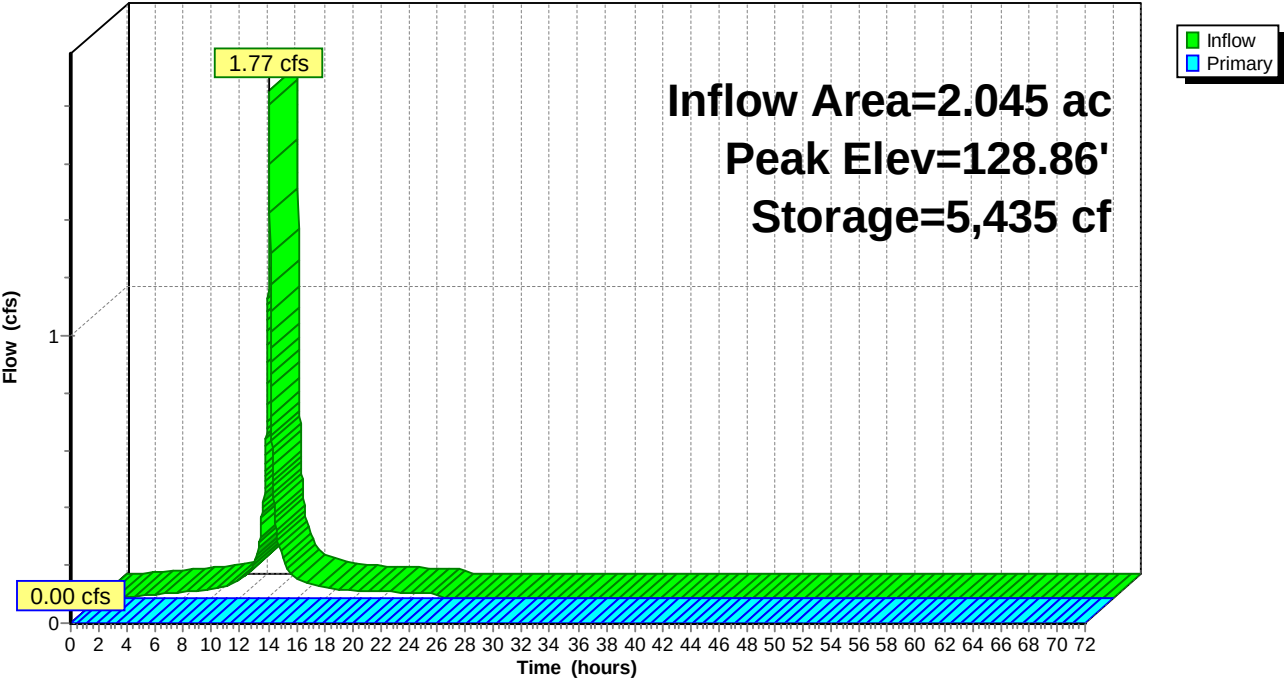
↑ **2=Orifice/Grate** (Controls 0.00 cfs)

↑ **3=Orifice/Grate** (Controls 0.00 cfs)

↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

Hydrograph



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NOAA 24-hr C 2-Year C Rainfall=3.47"

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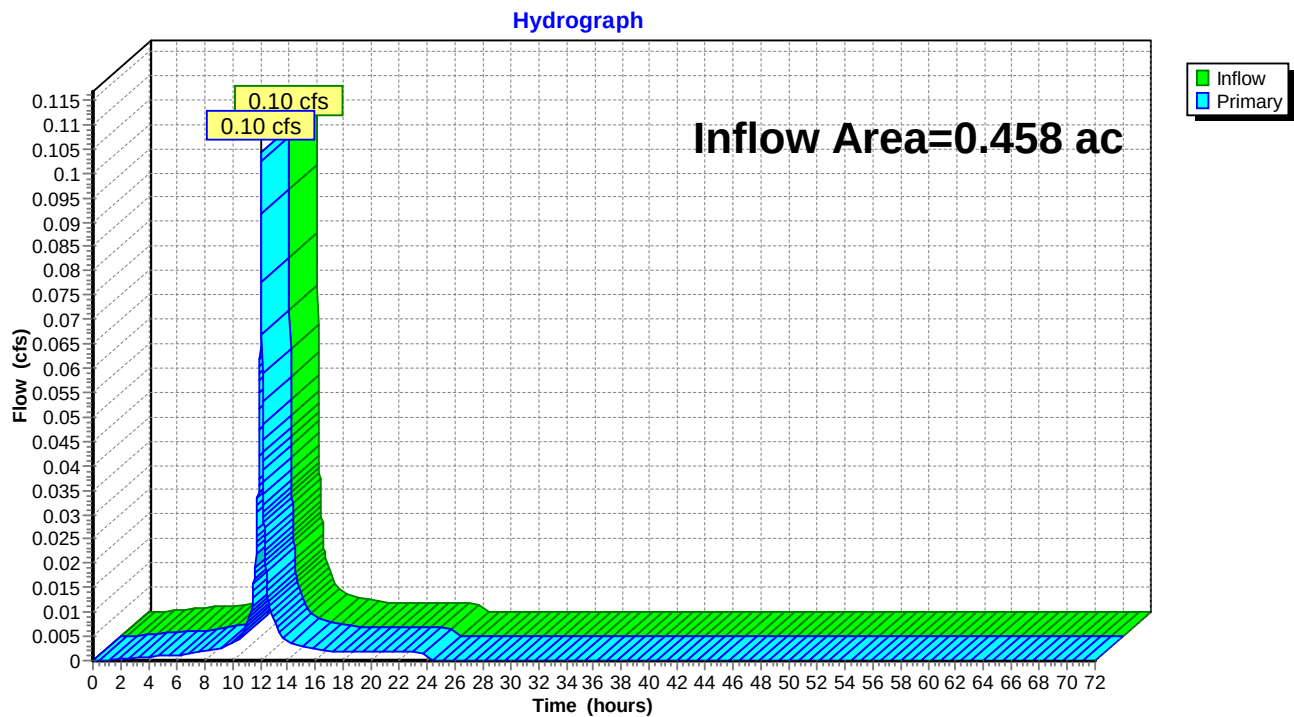
Page 9

Summary for Link 18L: Bypass Total

Inflow Area = 0.458 ac, 5.77% Impervious, Inflow Depth = 0.19" for 2-Year C event
Inflow = 0.10 cfs @ 12.10 hrs, Volume= 0.007 af
Primary = 0.10 cfs @ 12.10 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 18L: Bypass Total



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NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.00 cfs @ 24.04 hrs, Volume= 0.000 af, Depth= 0.01"

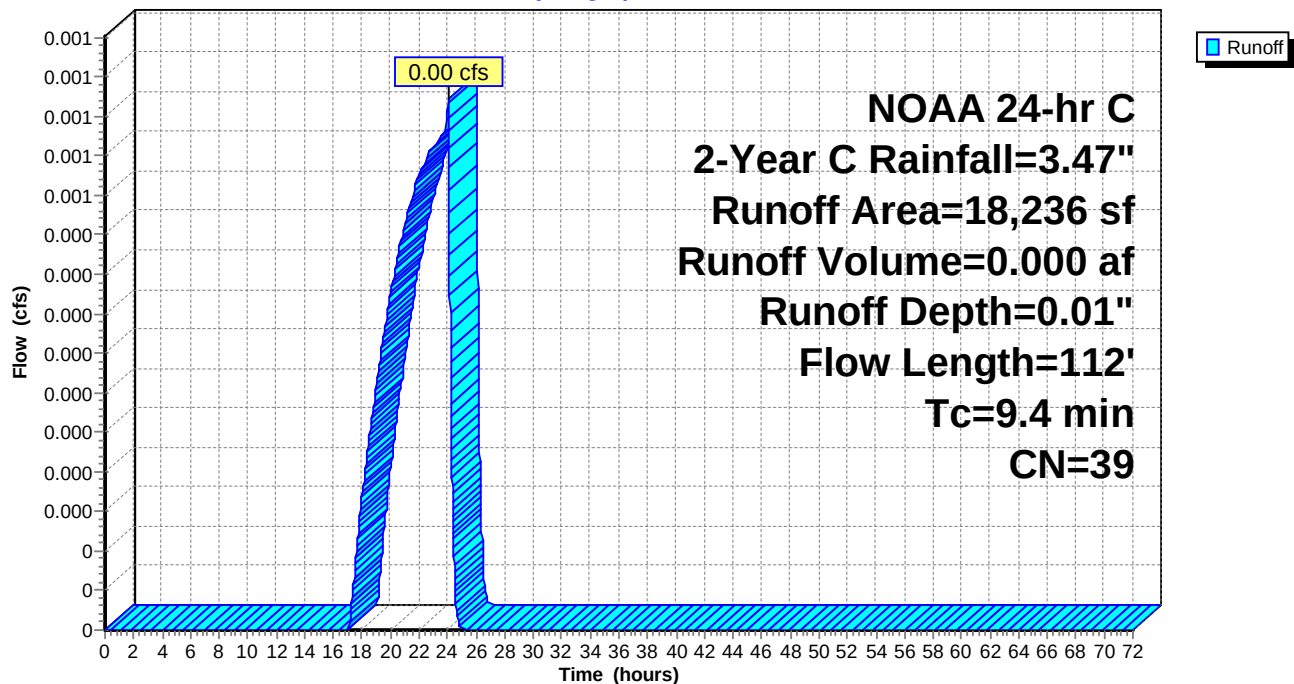
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 2-Year C Rainfall=3.47"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 1.77 cfs @ 12.11 hrs, Volume= 0.125 af, Depth= 3.24"

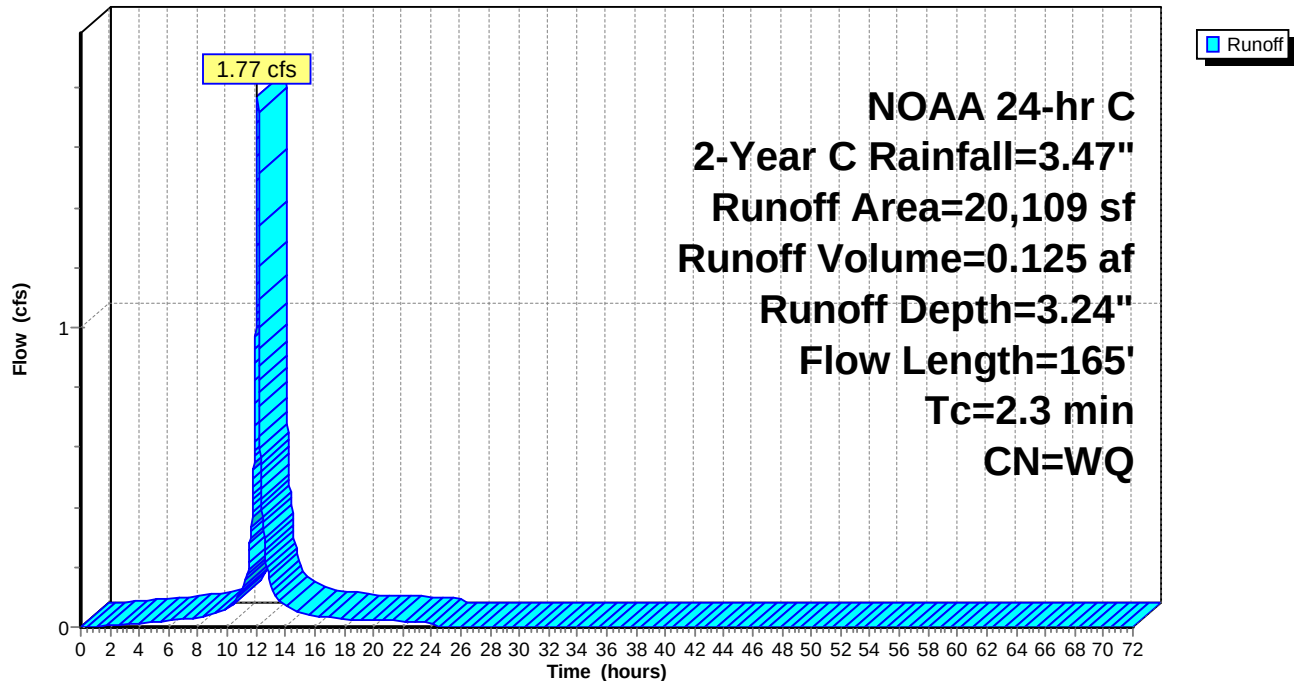
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



Summary for Subcatchment 20S: POI-1 BYPASS PERV

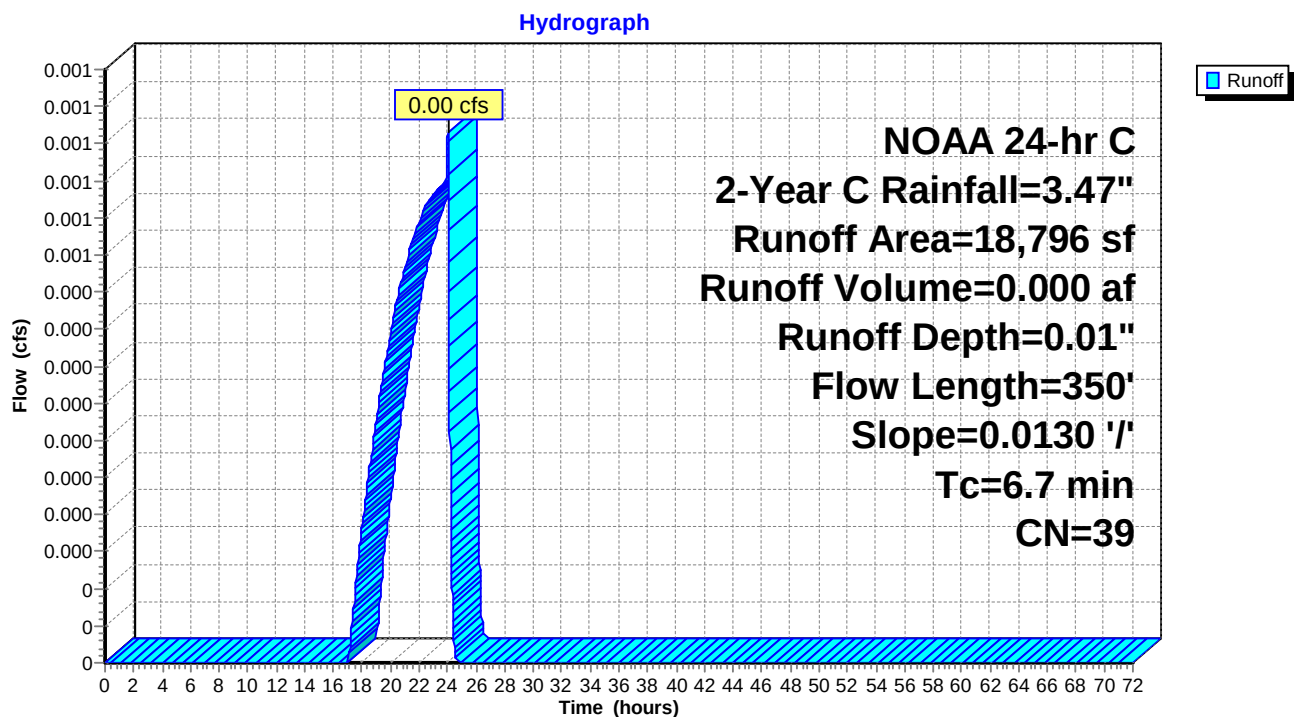
Runoff = 0.00 cfs @ 24.03 hrs, Volume= 0.000 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
18,796	39	>75% Grass cover, Good, HSG A
18,796	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	31	0.0130	0.12		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
2.3	319	0.0130	2.31		Shallow Concentrated Flow, P2-P3
					Paved Kv= 20.3 fps
6.7	350	Total			

Subcatchment 20S: POI-1 BYPASS PERV



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Summary for Subcatchment 21S: POI-1 BYPASS IMP

Runoff = 0.10 cfs @ 12.10 hrs, Volume= 0.007 af, Depth= 3.24"

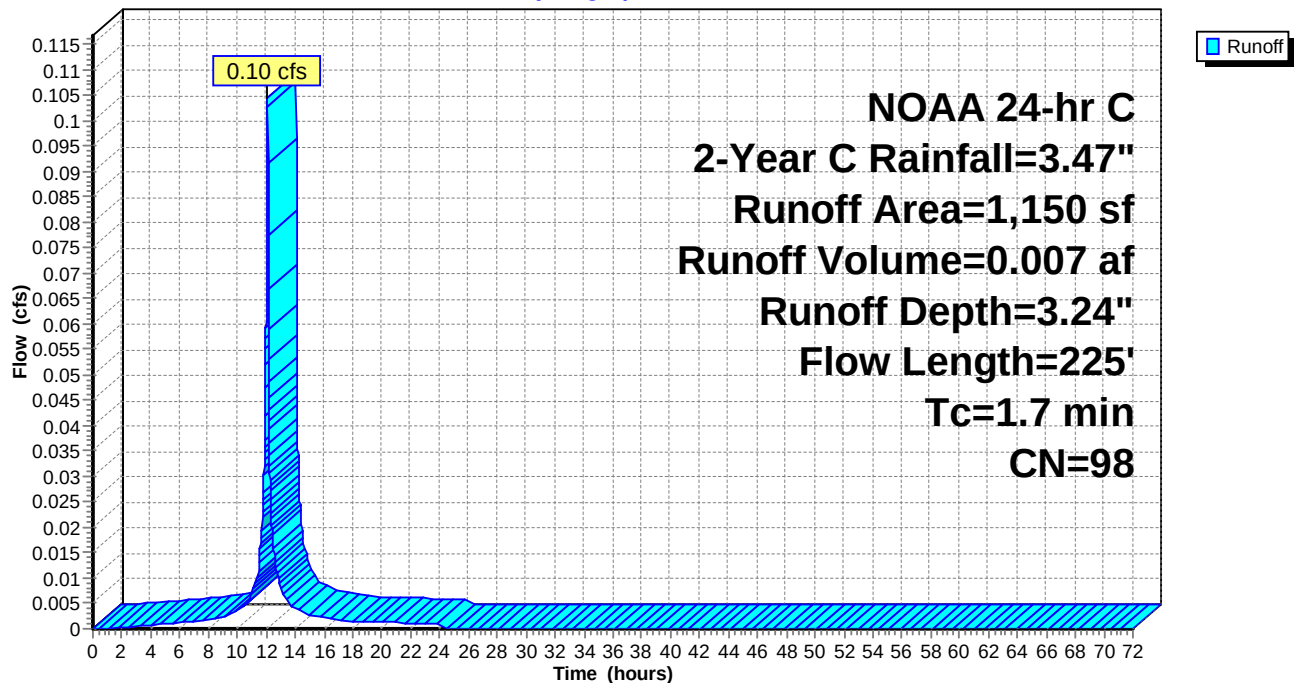
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year C Rainfall=3.47"

Area (sf)	CN	Description
1,150	98	Paved parking, HSG A
1,150	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	9	0.0740	1.47		Sheet Flow, I1-I2
					Smooth surfaces n= 0.011 P2= 3.38"
1.6	216	0.0130	2.31		Shallow Concentrated Flow, I2-I3
					Paved Kv= 20.3 fps
1.7	225	Total			

Subcatchment 21S: POI-1 BYPASS IMP

Hydrograph



Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

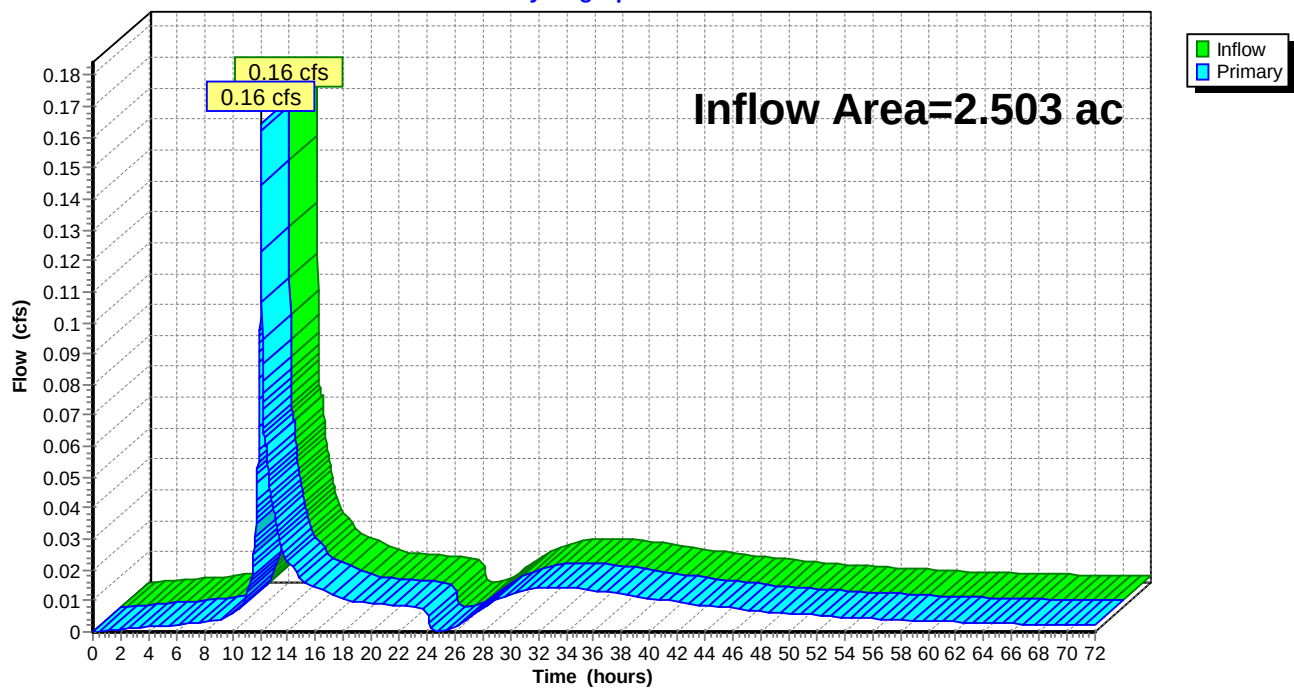
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 47.02% Impervious, Inflow Depth > 0.23" for 10-Year C event
Inflow = 0.16 cfs @ 12.10 hrs, Volume= 0.049 af
Primary = 0.16 cfs @ 12.10 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)

Hydrograph



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.04 cfs @ 12.55 hrs, Volume= 0.012 af, Depth= 0.30"

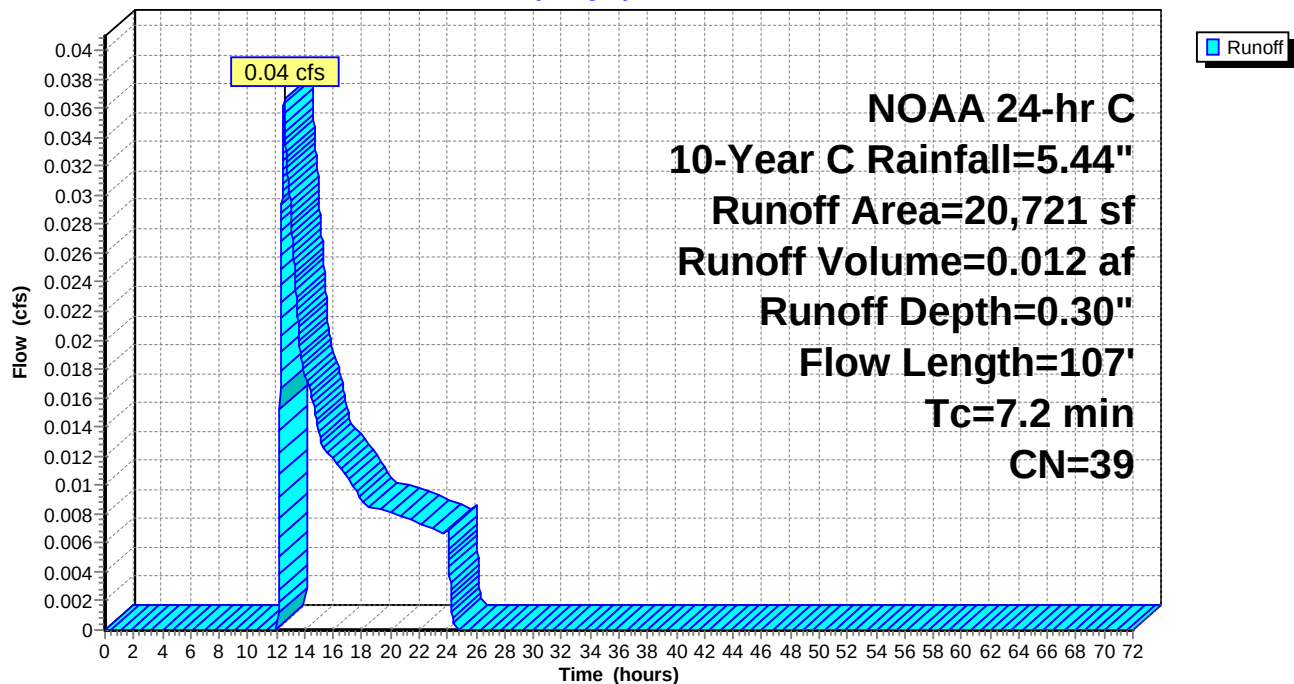
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 4.31 cfs @ 12.10 hrs, Volume= 0.299 af, Depth= 5.20"

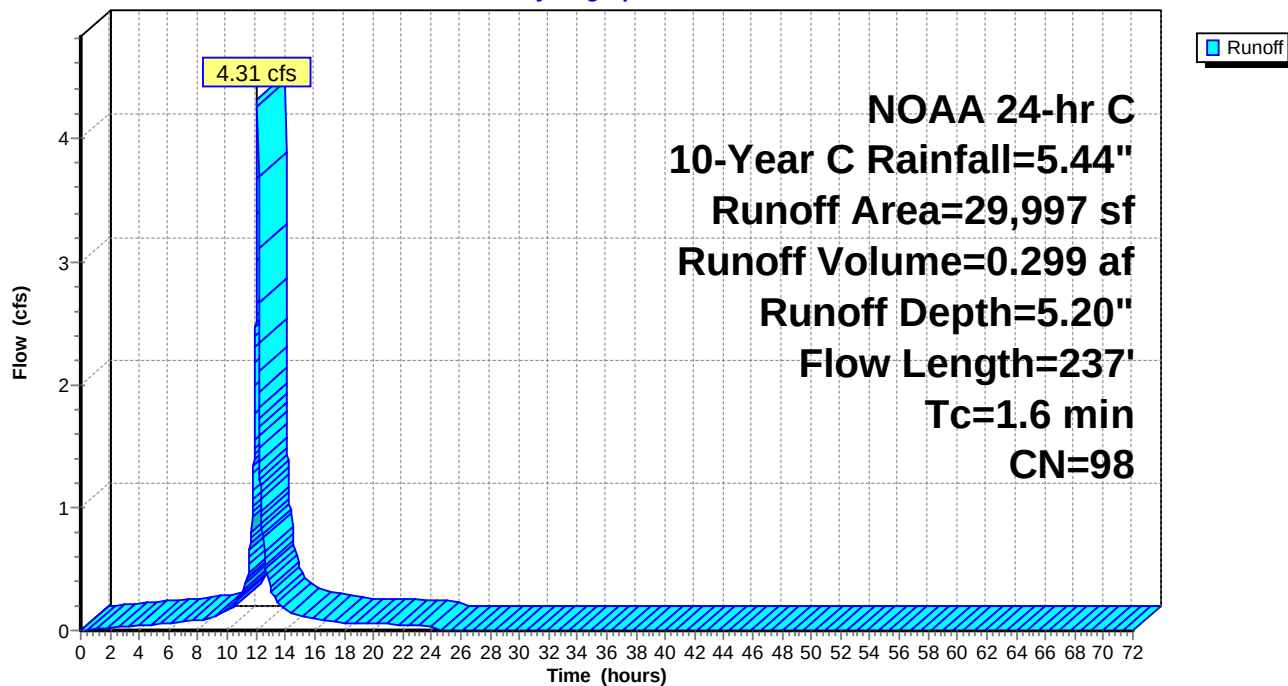
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 3.20" for 10-Year C event
 Inflow = 4.31 cfs @ 12.10 hrs, Volume= 0.310 af
 Outflow = 0.07 cfs @ 18.61 hrs, Volume= 0.091 af, Atten= 98%, Lag= 390.9 min
 Primary = 0.07 cfs @ 18.61 hrs, Volume= 0.091 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.47' @ 18.61 hrs Surf.Area= 7,149 sf Storage= 11,303 cf

Plug-Flow detention time= 911.7 min calculated for 0.091 af (29% of inflow)
 Center-of-Mass det. time= 702.3 min (1,456.2 - 753.9)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

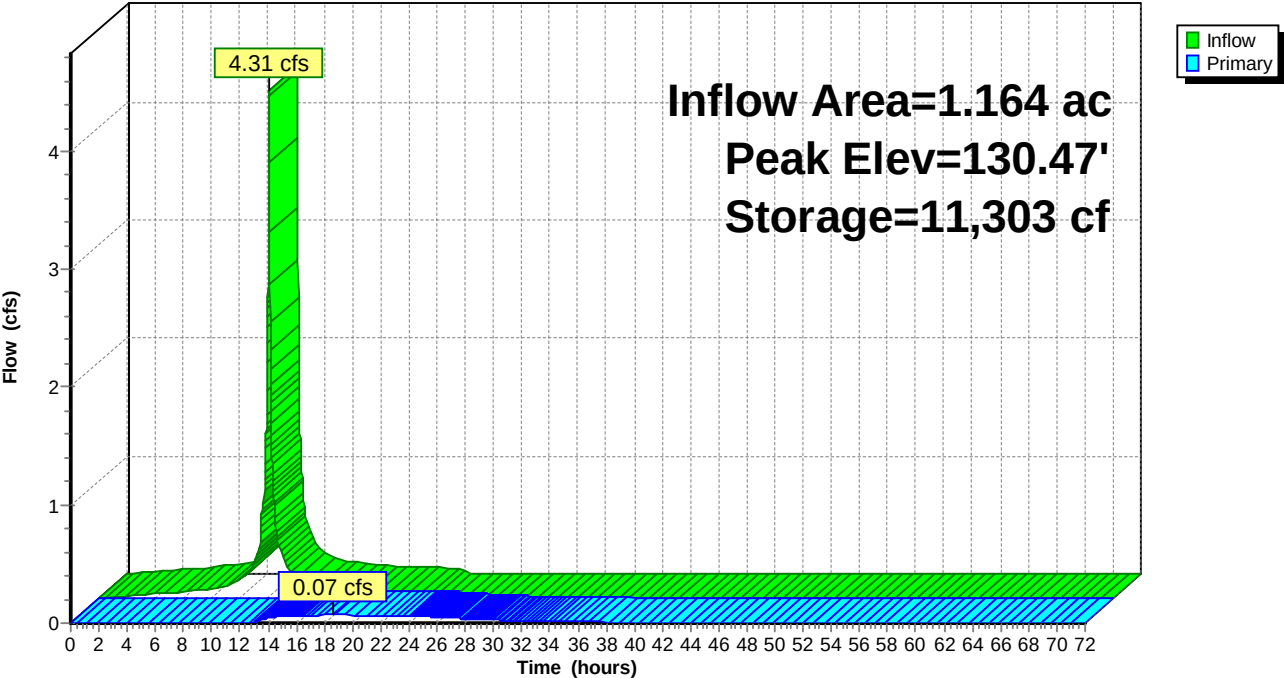
Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 ' /' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.07 cfs @ 18.61 hrs HW=130.47' TW=129.46' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.07 cfs of 2.38 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.07 cfs @ 1.97 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1

Hydrograph



Pre&Post Development

NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 1.77" for 10-Year C event
 Inflow = 2.79 cfs @ 12.11 hrs, Volume= 0.302 af
 Outflow = 0.01 cfs @ 33.09 hrs, Volume= 0.026 af, Atten= 99%, Lag= 1,259.2 min
 Primary = 0.01 cfs @ 33.09 hrs, Volume= 0.026 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 129.87' @ 33.09 hrs Surf.Area= 7,286 sf Storage= 12,407 cf

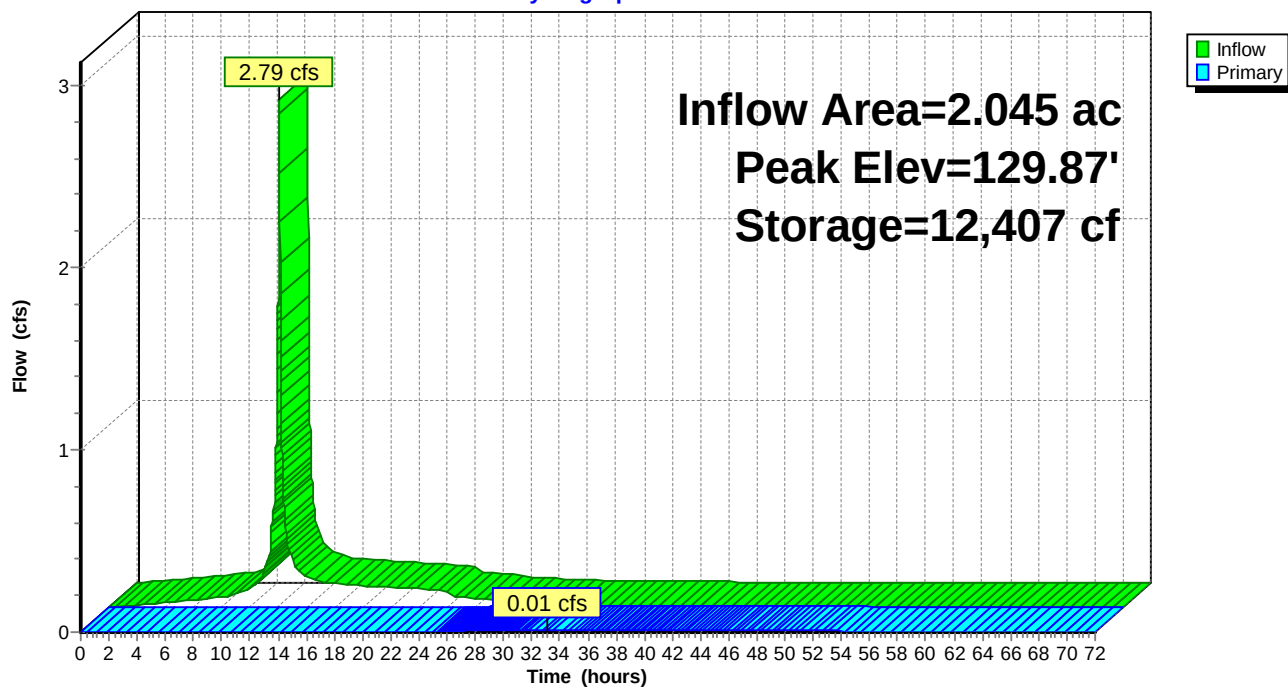
Plug-Flow detention time= 2,161.0 min calculated for 0.026 af (9% of inflow)
 Center-of-Mass det. time= 1,586.6 min (2,555.6 - 969.0)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 33.09 hrs HW=129.87' TW=0.00' (Dynamic Tailwater)

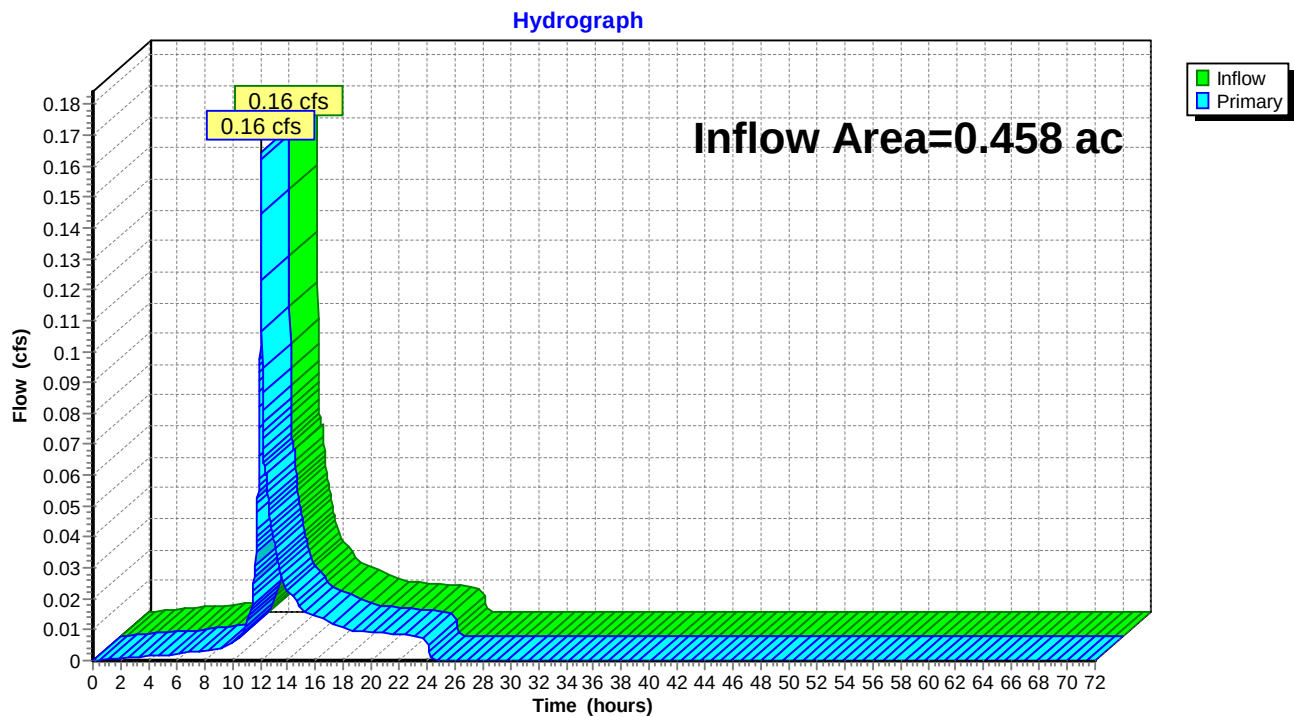
↑ **1=Culvert** (Passes 0.01 cfs of 10.14 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 1.02 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2**Hydrograph**

Summary for Link 18L: Bypass Total

Inflow Area = 0.458 ac, 5.77% Impervious, Inflow Depth = 0.58" for 10-Year C event
Inflow = 0.16 cfs @ 12.10 hrs, Volume= 0.022 af
Primary = 0.16 cfs @ 12.10 hrs, Volume= 0.022 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 18L: Bypass Total

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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.03 cfs @ 12.59 hrs, Volume= 0.010 af, Depth= 0.30"

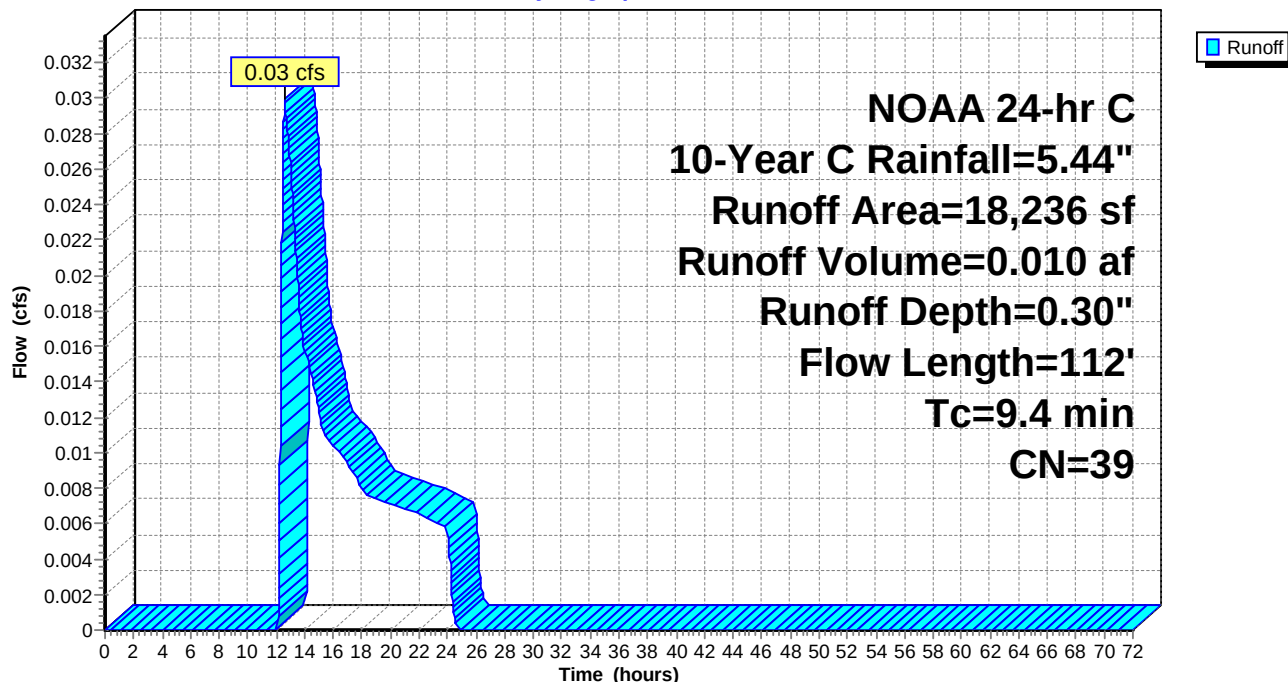
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 2.79 cfs @ 12.11 hrs, Volume= 0.200 af, Depth= 5.20"

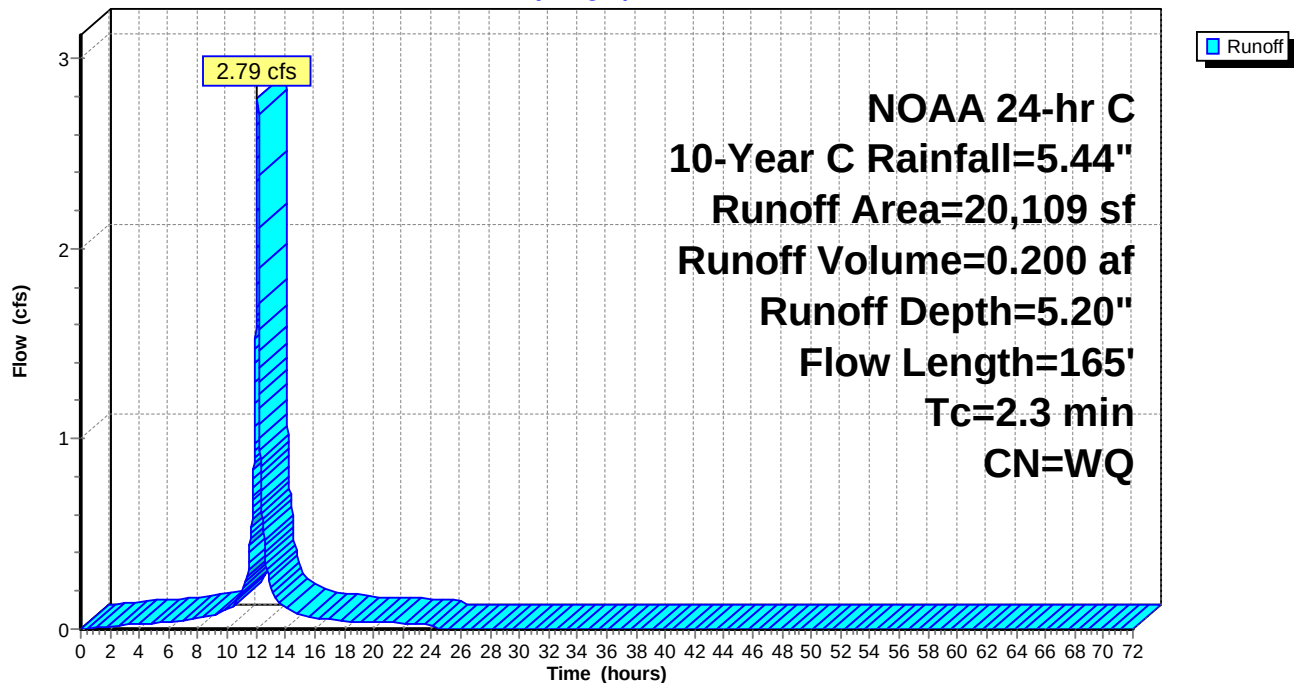
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 20S: POI-1 BYPASS PERV

Runoff = 0.03 cfs @ 12.55 hrs, Volume= 0.011 af, Depth= 0.30"

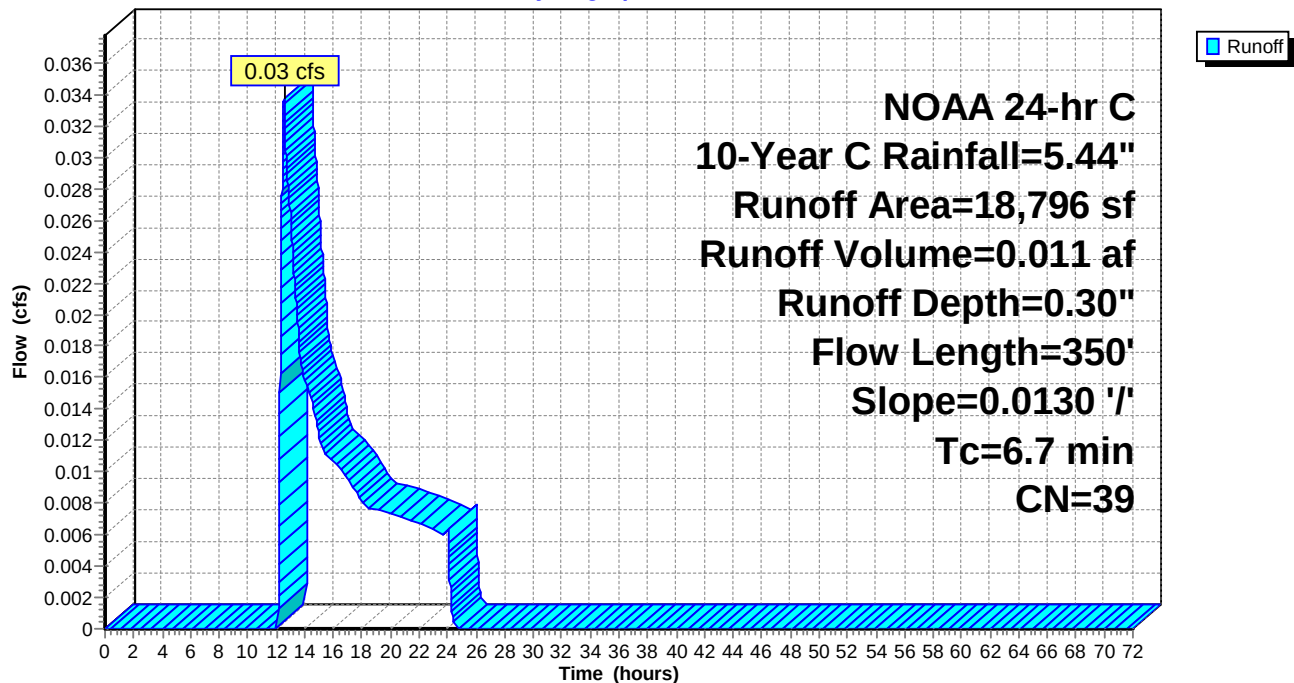
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
18,796	39	>75% Grass cover, Good, HSG A
18,796	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	31	0.0130	0.12		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
2.3	319	0.0130	2.31		Shallow Concentrated Flow, P2-P3
					Paved Kv= 20.3 fps
6.7	350	Total			

Subcatchment 20S: POI-1 BYPASS PERV

Hydrograph



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NOAA 24-hr C 10-Year C Rainfall=5.44"

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Summary for Subcatchment 21S: POI-1 BYPASS IMP

Runoff = 0.16 cfs @ 12.10 hrs, Volume= 0.011 af, Depth= 5.20"

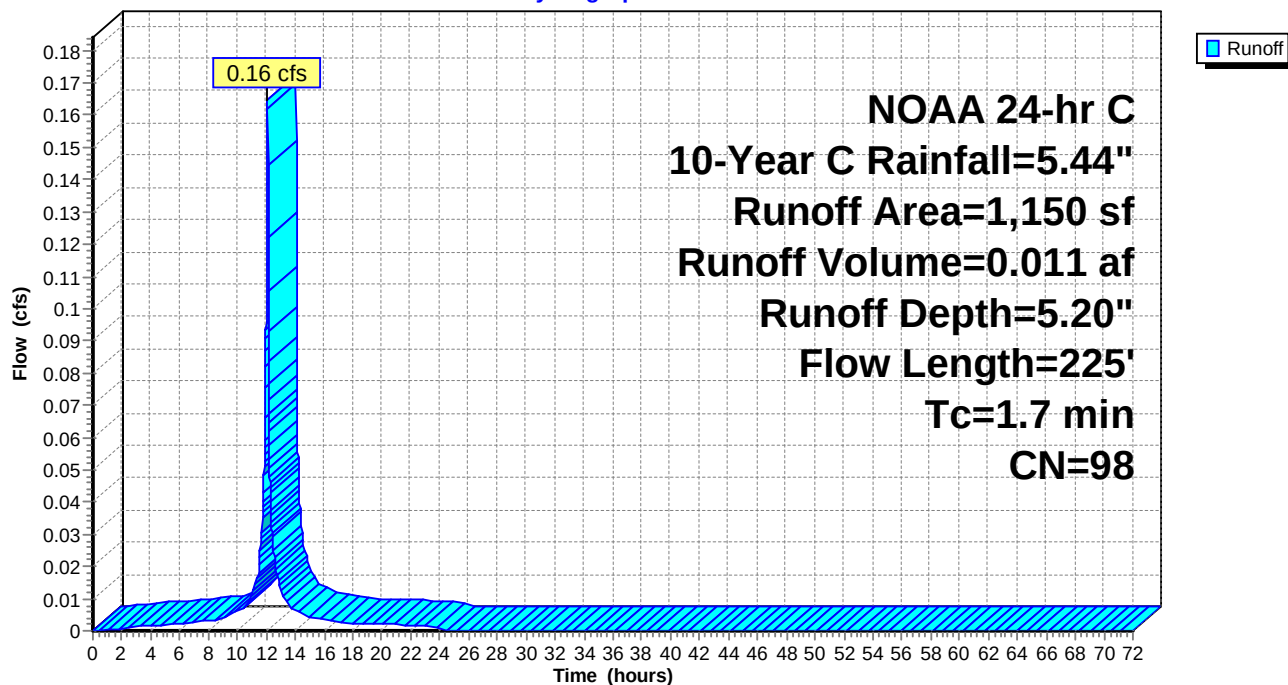
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year C Rainfall=5.44"

Area (sf)	CN	Description
1,150	98	Paved parking, HSG A
1,150	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	9	0.0740	1.47		Sheet Flow, I1-I2
					Smooth surfaces n= 0.011 P2= 3.38"
1.6	216	0.0130	2.31		Shallow Concentrated Flow, I2-I3
					Paved Kv= 20.3 fps
1.7	225	Total			

Subcatchment 21S: POI-1 BYPASS IMP

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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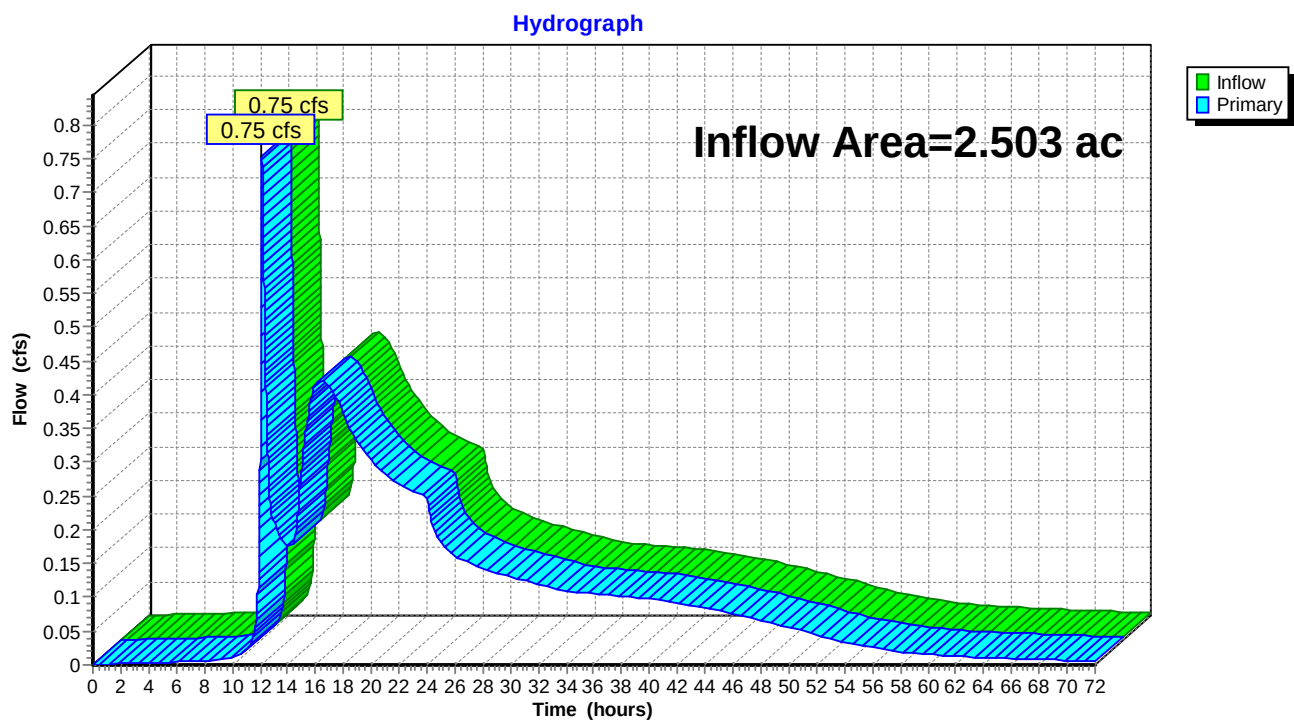
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 47.02% Impervious, Inflow Depth > 2.81" for 100-Year C event
Inflow = 0.75 cfs @ 12.12 hrs, Volume= 0.586 af
Primary = 0.75 cfs @ 12.12 hrs, Volume= 0.586 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.63 cfs @ 12.17 hrs, Volume= 0.070 af, Depth= 1.76"

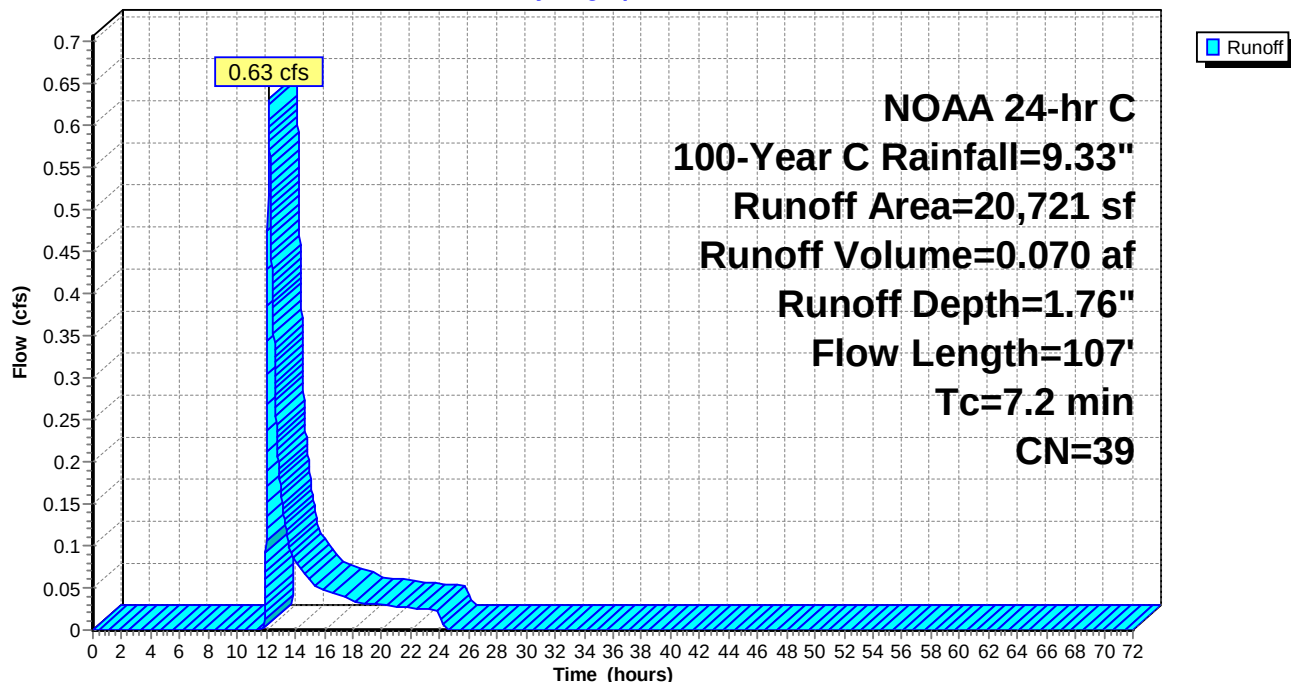
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 7.42 cfs @ 12.10 hrs, Volume= 0.522 af, Depth= 9.09"

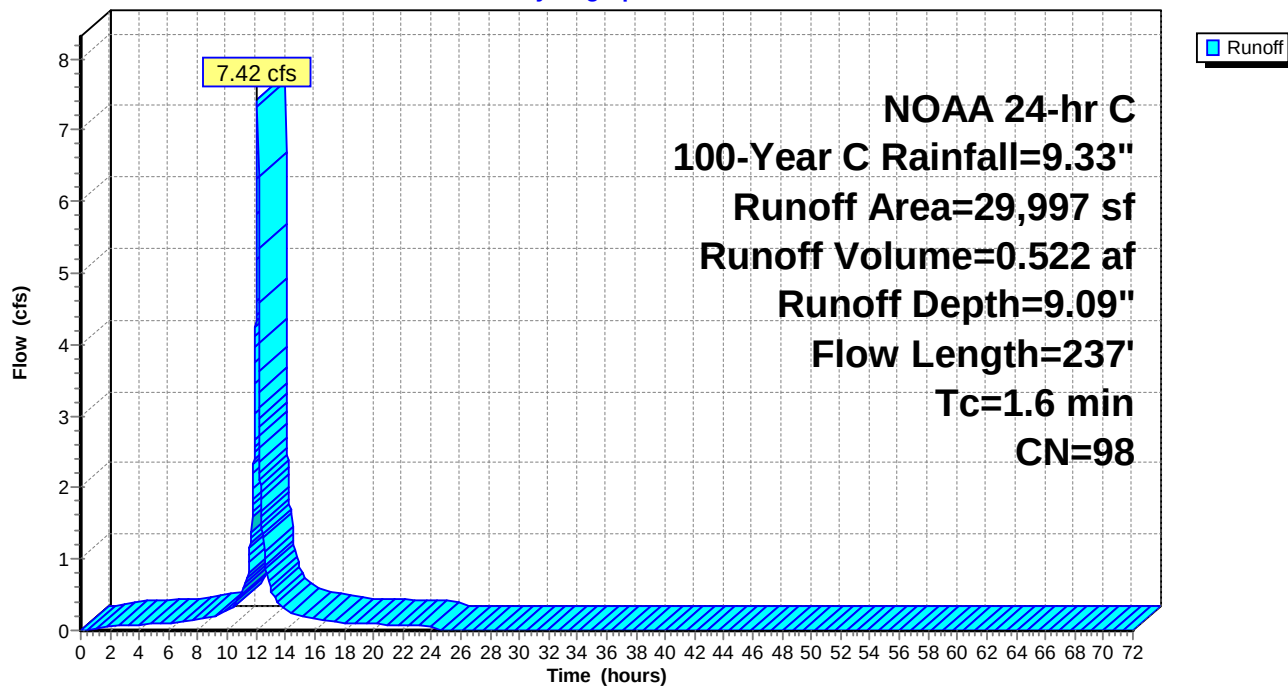
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 6.10" for 100-Year C event
 Inflow = 7.84 cfs @ 12.10 hrs, Volume= 0.591 af
 Outflow = 0.30 cfs @ 14.51 hrs, Volume= 0.371 af, Atten= 96%, Lag= 144.6 min
 Primary = 0.30 cfs @ 14.51 hrs, Volume= 0.371 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 131.43' @ 14.62 hrs Surf.Area= 8,744 sf Storage= 18,873 cf

Plug-Flow detention time= 874.9 min calculated for 0.371 af (63% of inflow)
 Center-of-Mass det. time= 756.8 min (1,513.4 - 756.7)

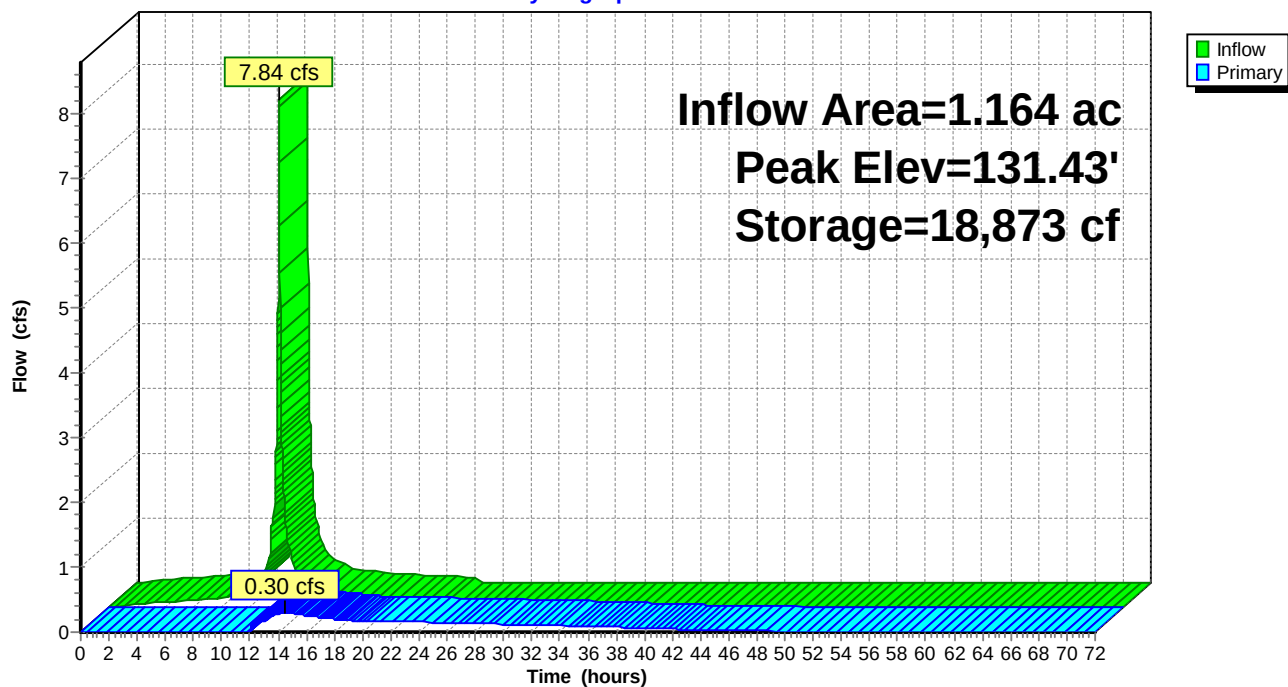
Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.30 cfs @ 14.51 hrs HW=131.43' TW=130.31' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.30 cfs of 3.95 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 5.10 fps)
 ↑ **3=Orifice/Grate** (Orifice Controls 0.12 cfs @ 1.15 fps)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1**Hydrograph**

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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 4.59" for 100-Year C event
 Inflow = 5.17 cfs @ 12.11 hrs, Volume= 0.782 af
 Outflow = 0.38 cfs @ 16.51 hrs, Volume= 0.503 af, Atten= 93%, Lag= 264.1 min
 Primary = 0.38 cfs @ 16.51 hrs, Volume= 0.503 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.44' @ 16.51 hrs Surf.Area= 7,701 sf Storage= 16,685 cf

Plug-Flow detention time= 964.3 min calculated for 0.503 af (64% of inflow)
 Center-of-Mass det. time= 614.9 min (1,734.0 - 1,119.1)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

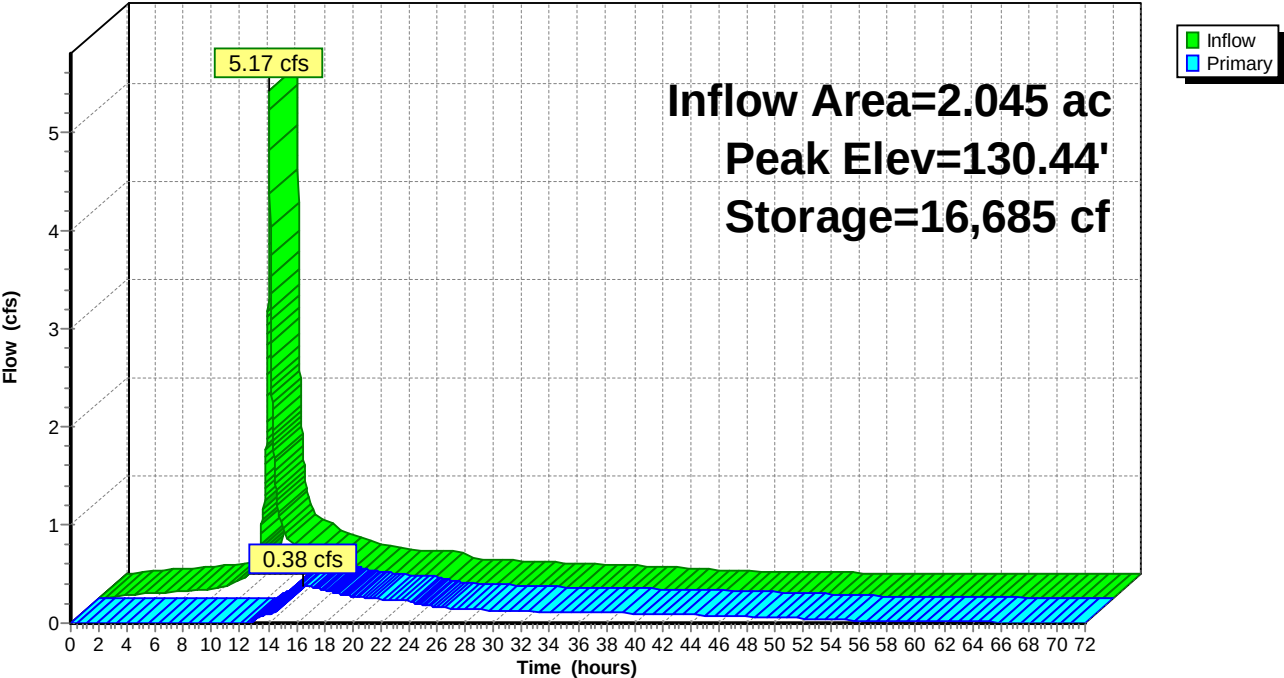
Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 ' /' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.38 cfs @ 16.51 hrs HW=130.44' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 0.38 cfs of 10.83 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 3.59 fps)
 ↑ **3=Orifice/Grate** (Orifice Controls 0.25 cfs @ 1.20 fps)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

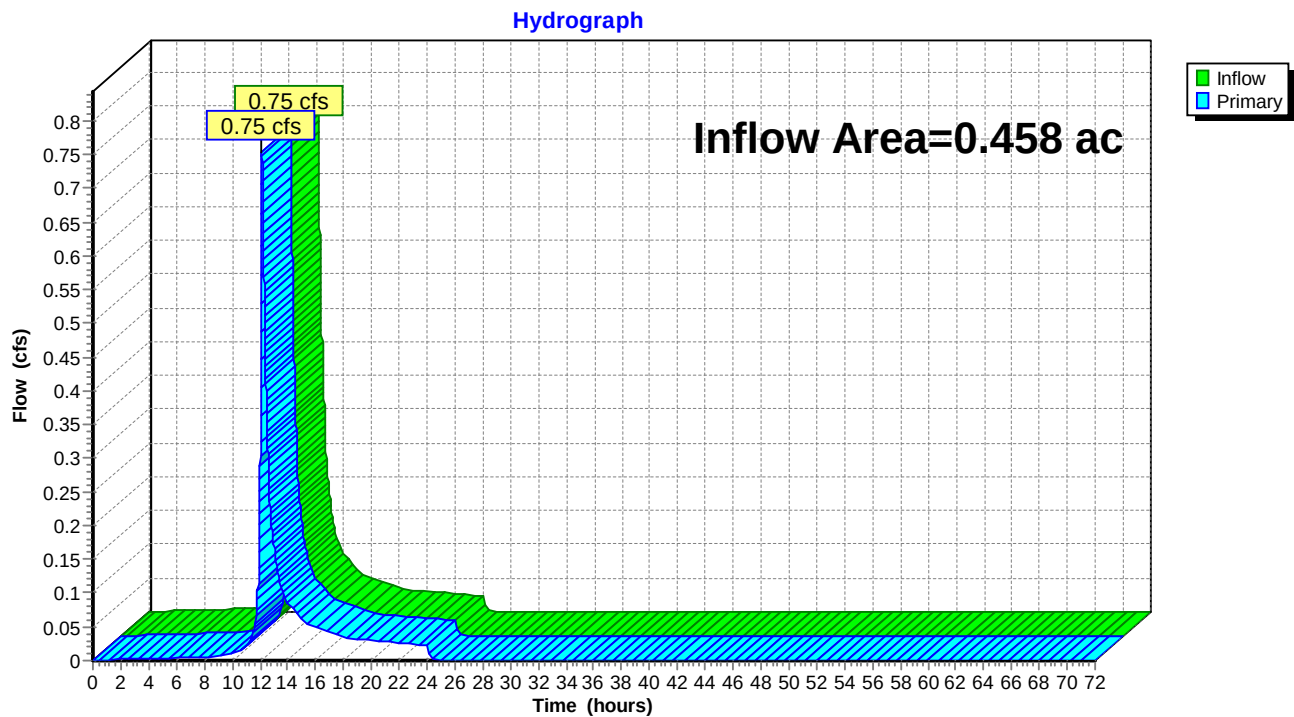
Hydrograph



Summary for Link 18L: Bypass Total

Inflow Area = 0.458 ac, 5.77% Impervious, Inflow Depth = 2.18" for 100-Year C event
Inflow = 0.75 cfs @ 12.12 hrs, Volume= 0.083 af
Primary = 0.75 cfs @ 12.12 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 18L: Bypass Total

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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.48 cfs @ 12.21 hrs, Volume= 0.061 af, Depth= 1.76"

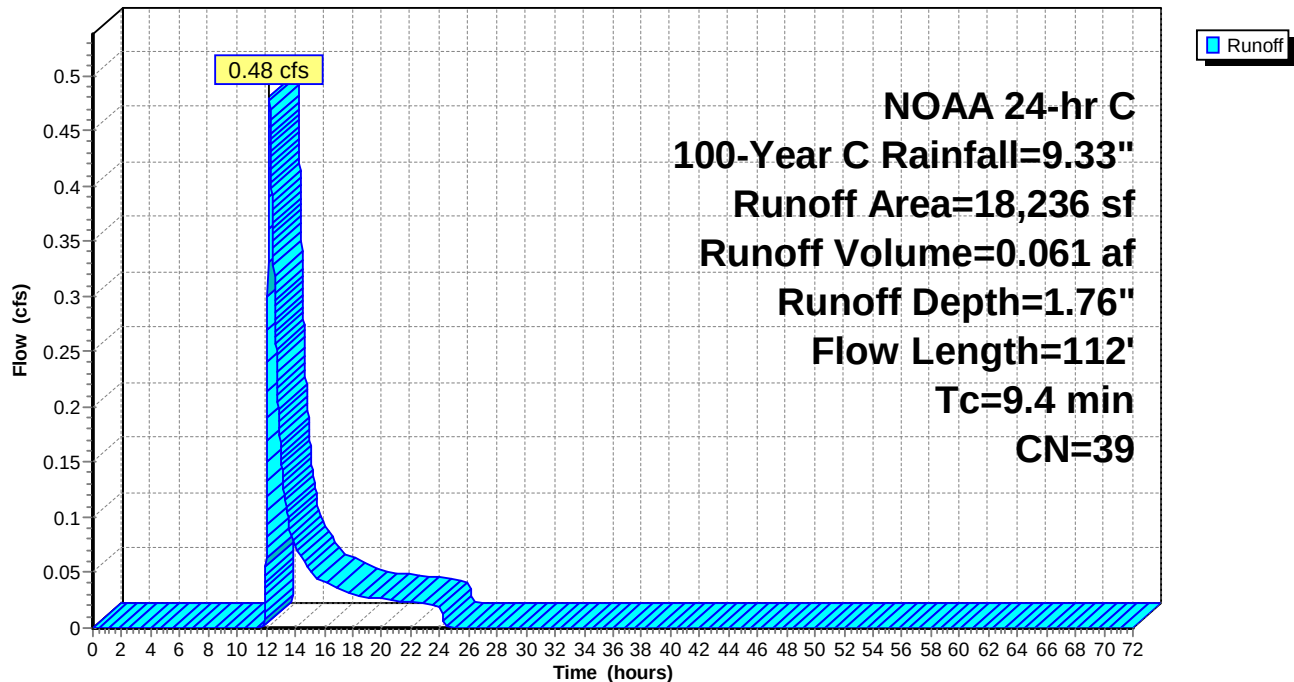
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 4.79 cfs @ 12.11 hrs, Volume= 0.350 af, Depth= 9.09"

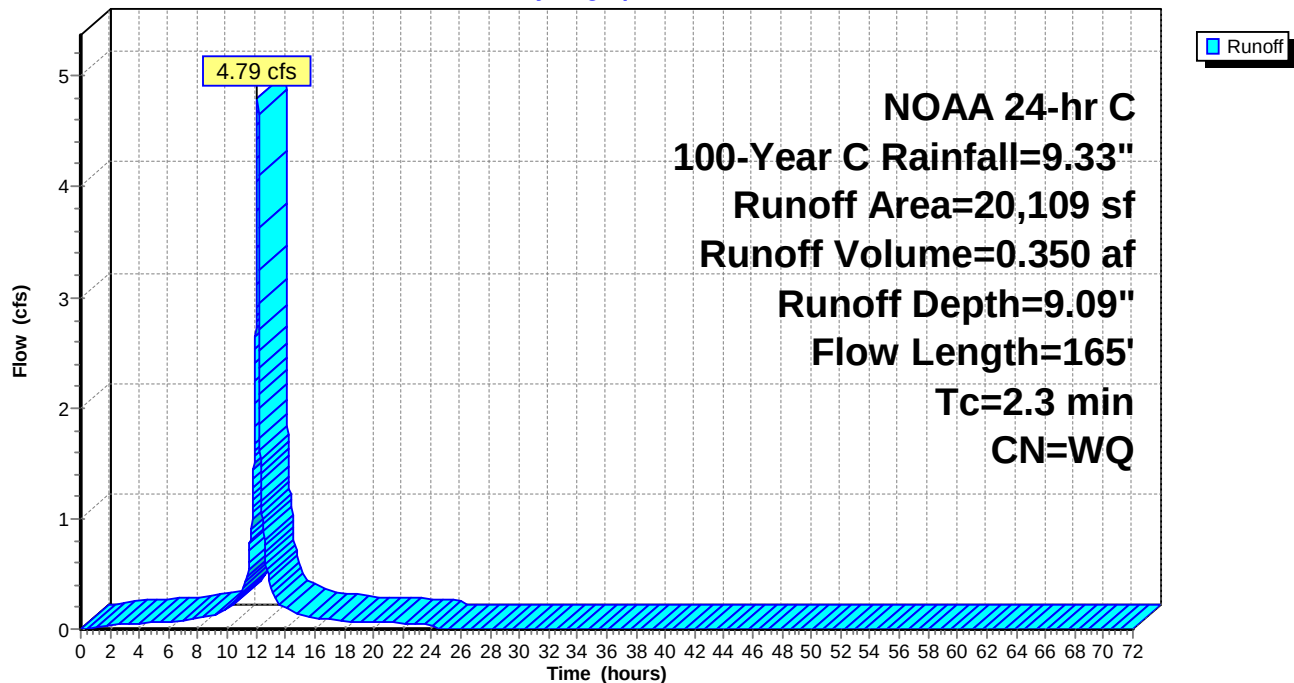
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment 20S: POI-1 BYPASS PERV

Runoff = 0.59 cfs @ 12.17 hrs, Volume= 0.063 af, Depth= 1.76"

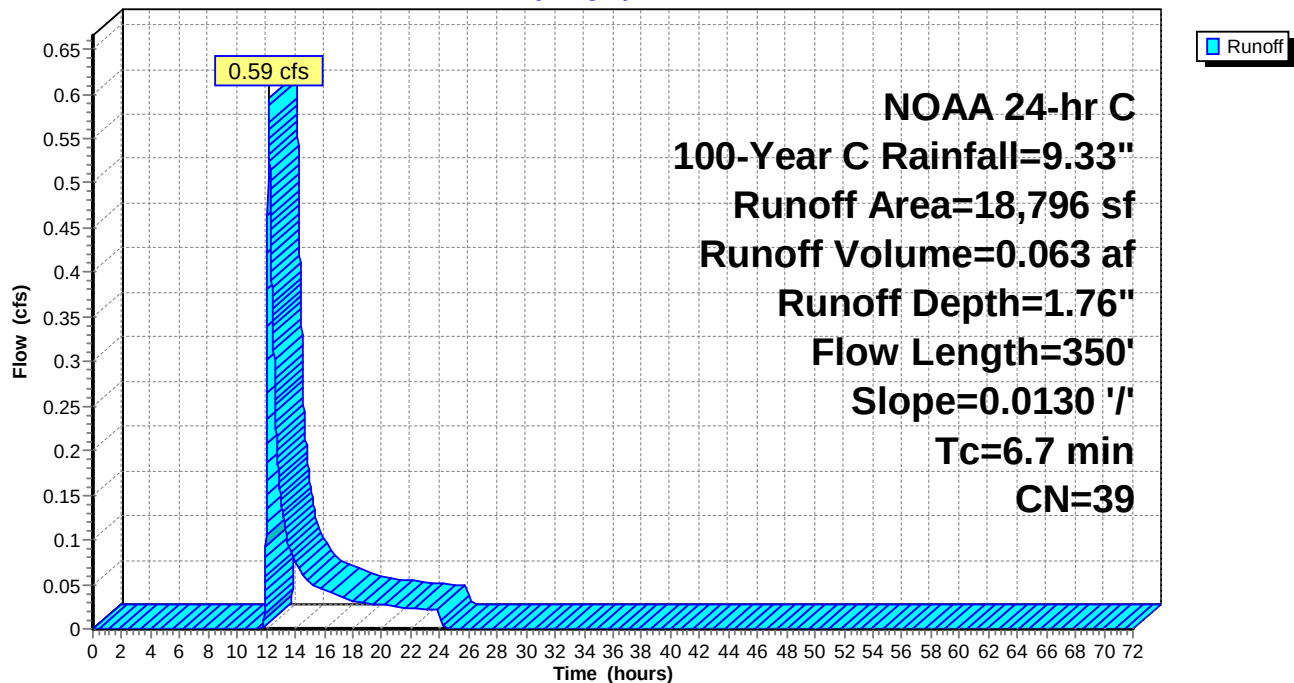
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
18,796	39	>75% Grass cover, Good, HSG A
18,796	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	31	0.0130	0.12		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
2.3	319	0.0130	2.31		Shallow Concentrated Flow, P2-P3
					Paved Kv= 20.3 fps
6.7	350	Total			

Subcatchment 20S: POI-1 BYPASS PERV

Hydrograph



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NOAA 24-hr C 100-Year C Rainfall=9.33"

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Summary for Subcatchment 21S: POI-1 BYPASS IMP

Runoff = 0.28 cfs @ 12.10 hrs, Volume= 0.020 af, Depth= 9.09"

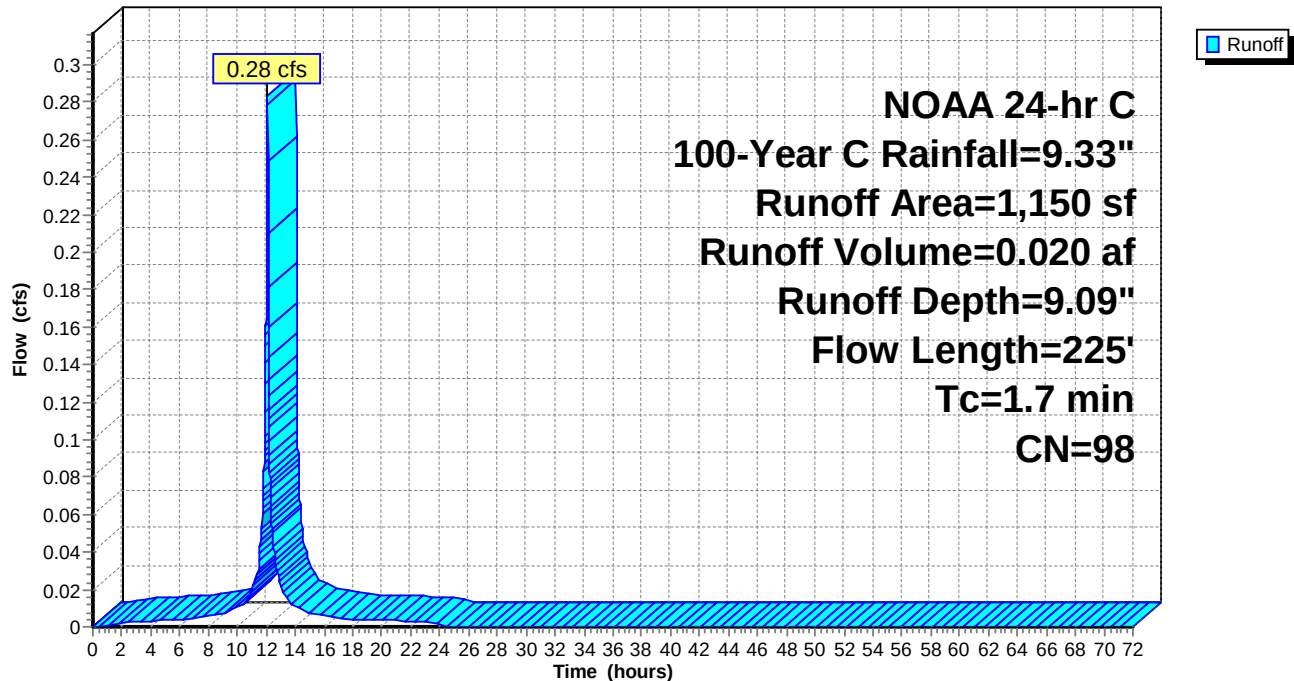
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year C Rainfall=9.33"

Area (sf)	CN	Description
1,150	98	Paved parking, HSG A
1,150	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	9	0.0740	1.47		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.6	216	0.0130	2.31		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
1.7	225	Total			

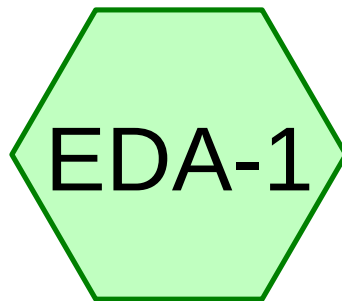
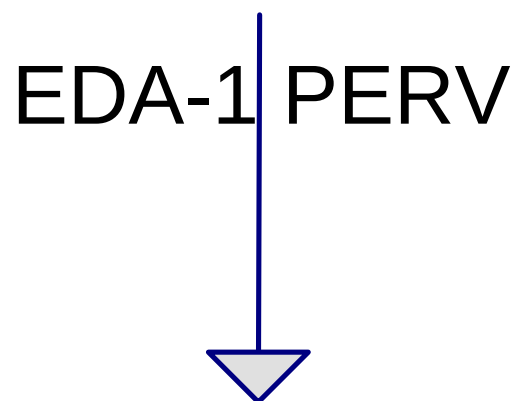
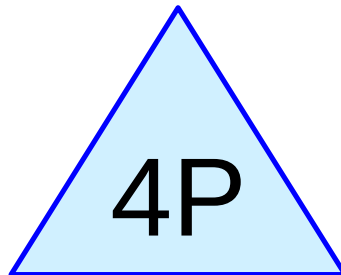
Subcatchment 21S: POI-1 BYPASS IMP

Hydrograph

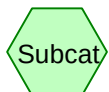
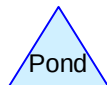


APPENDIX D

Pre-Development Drainage Analysis – Future Rainfall



PRE - POI #1 (SW Prop
Corner)



Pre&Post Development

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NOAA 24-hr C 2-Year F Rainfall=3.93"

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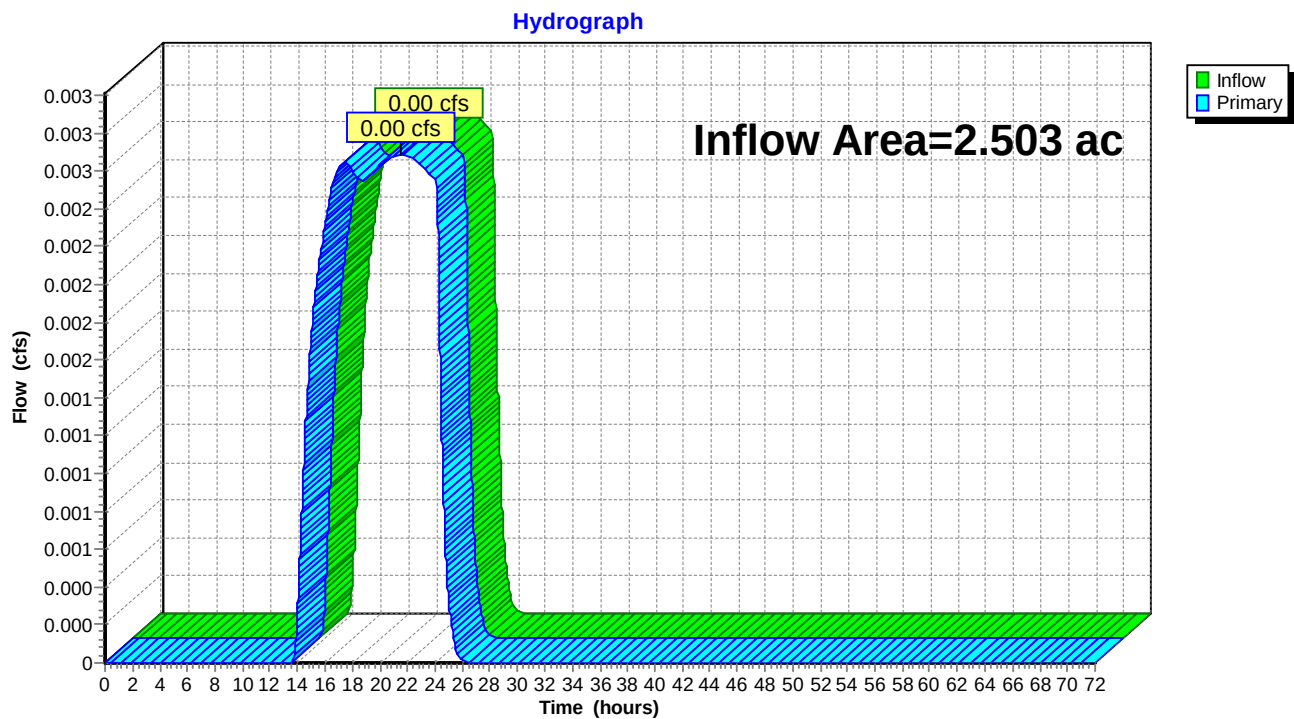
Summary for Pond 4P: PRE - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 0.00% Impervious, Inflow Depth = 0.01" for 2-Year F event
Inflow = 0.00 cfs @ 21.50 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 21.50 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 4P: PRE - POI #1 (SW Prop Corner)



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NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Subcatchment EDA-1: EDA-1 PERV

Runoff = 0.00 cfs @ 21.50 hrs, Volume= 0.002 af, Depth= 0.01"

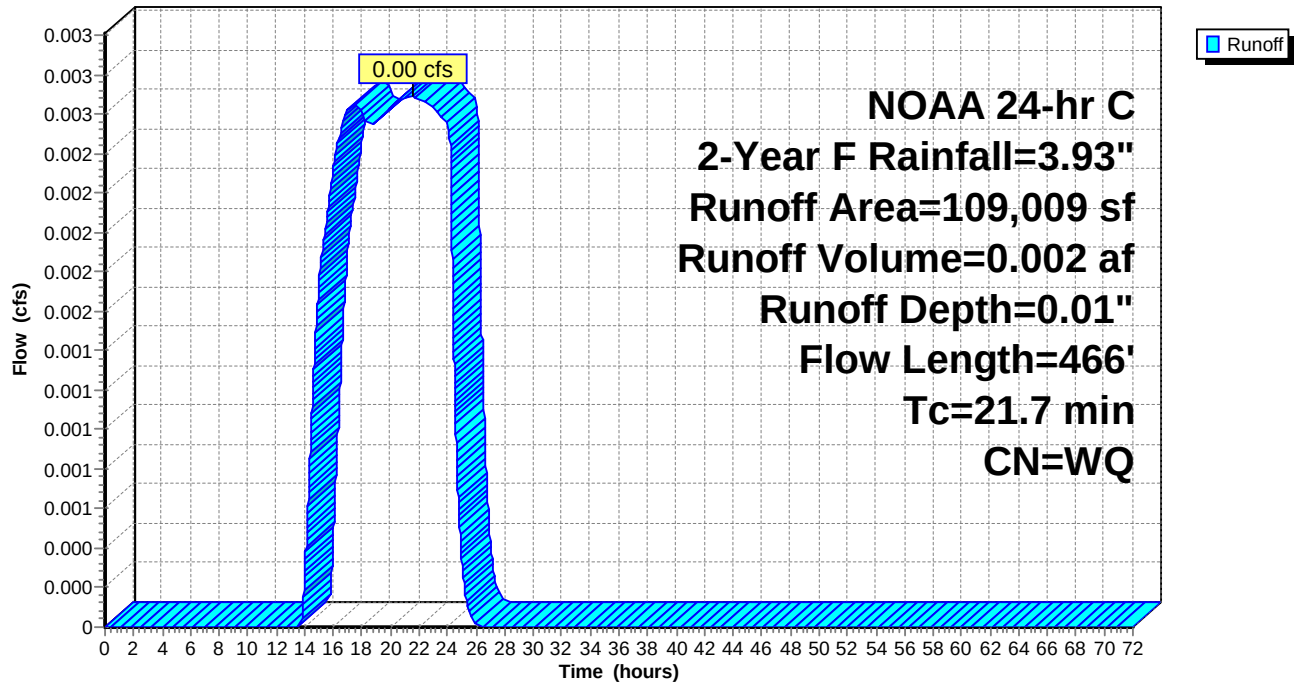
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
28,173	39	>75% Grass cover, Good, HSG A
80,836	30	Woods, Good, HSG A
109,009		Weighted Average
109,009	32	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	8	0.0100	0.02		Sheet Flow, 1-2
					Woods: Dense underbrush n= 0.800 P2= 3.38"
2.3	68	0.0100	0.50		Shallow Concentrated Flow, 1-2
					Woodland Kv= 5.0 fps
1.8	66	0.0150	0.61		Shallow Concentrated Flow, 3-4
					Woodland Kv= 5.0 fps
1.1	25	0.0060	0.39		Shallow Concentrated Flow, 4-5
					Woodland Kv= 5.0 fps
1.2	40	0.0060	0.54		Shallow Concentrated Flow, 5-6
					Short Grass Pasture Kv= 7.0 fps
3.2	74	0.0060	0.39		Shallow Concentrated Flow, 6-7
					Woodland Kv= 5.0 fps
1.8	67	0.0150	0.61		Shallow Concentrated Flow, 7-8
					Woodland Kv= 5.0 fps
3.9	118	0.0100	0.50		Shallow Concentrated Flow, 8-9
					Woodland Kv= 5.0 fps
21.7	466	Total			

Subcatchment EDA-1: EDA-1 PERV

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Pond 4P: PRE - POI #1 (SW Prop Corner)

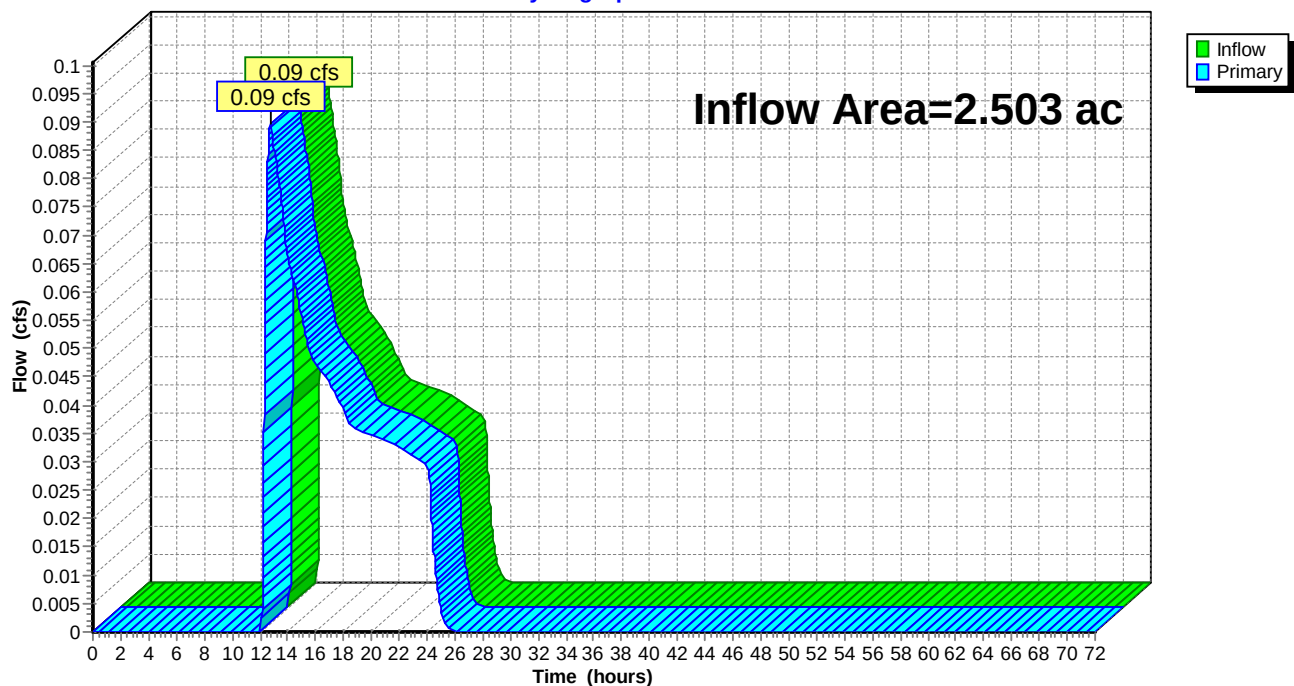
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 0.00% Impervious, Inflow Depth = 0.22" for 10-Year F event
Inflow = 0.09 cfs @ 12.73 hrs, Volume= 0.046 af
Primary = 0.09 cfs @ 12.73 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 4P: PRE - POI #1 (SW Prop Corner)

Hydrograph



Pre&Post Development

NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Subcatchment EDA-1: EDA-1 PERV

Runoff = 0.09 cfs @ 12.73 hrs, Volume= 0.046 af, Depth= 0.22"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
28,173	39	>75% Grass cover, Good, HSG A
80,836	30	Woods, Good, HSG A
109,009		Weighted Average
109,009	32	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	8	0.0100	0.02		Sheet Flow, 1-2
					Woods: Dense underbrush n= 0.800 P2= 3.38"
2.3	68	0.0100	0.50		Shallow Concentrated Flow, 1-2
					Woodland Kv= 5.0 fps
1.8	66	0.0150	0.61		Shallow Concentrated Flow, 3-4
					Woodland Kv= 5.0 fps
1.1	25	0.0060	0.39		Shallow Concentrated Flow, 4-5
					Woodland Kv= 5.0 fps
1.2	40	0.0060	0.54		Shallow Concentrated Flow, 5-6
					Short Grass Pasture Kv= 7.0 fps
3.2	74	0.0060	0.39		Shallow Concentrated Flow, 6-7
					Woodland Kv= 5.0 fps
1.8	67	0.0150	0.61		Shallow Concentrated Flow, 7-8
					Woodland Kv= 5.0 fps
3.9	118	0.0100	0.50		Shallow Concentrated Flow, 8-9
					Woodland Kv= 5.0 fps
21.7	466	Total			

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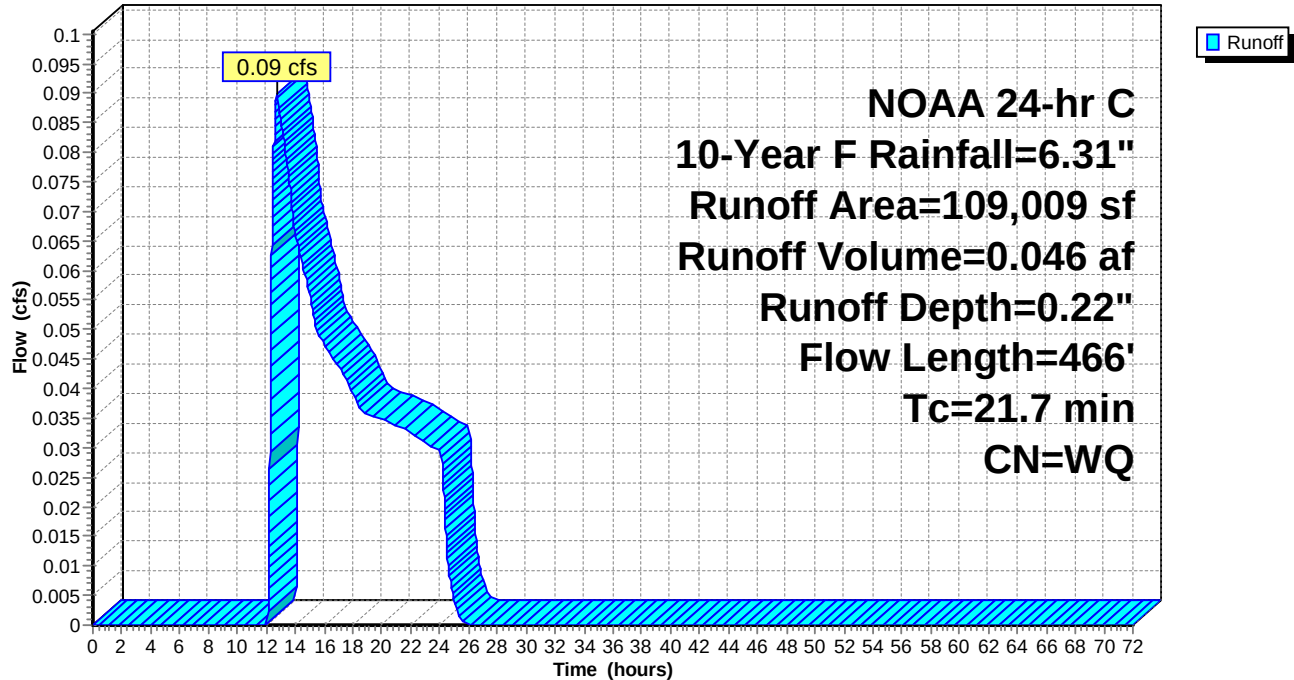
NOAA 24-hr C 10-Year F Rainfall=6.31"

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Subcatchment EDA-1: EDA-1 PERV

Hydrograph



Summary for Pond 4P: PRE - POI #1 (SW Prop Corner)

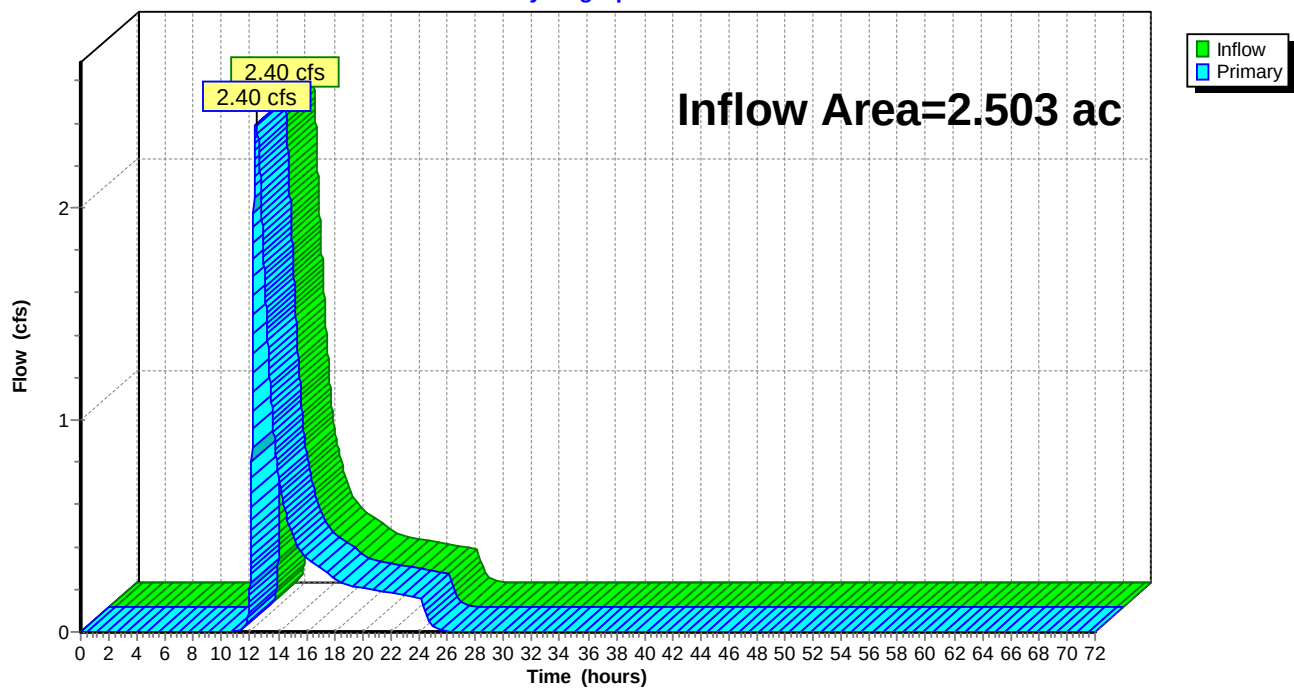
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 0.00% Impervious, Inflow Depth = 2.32" for 100-Year F event
Inflow = 2.40 cfs @ 12.44 hrs, Volume= 0.485 af
Primary = 2.40 cfs @ 12.44 hrs, Volume= 0.485 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 4P: PRE - POI #1 (SW Prop Corner)

Hydrograph



Pre&Post Development

NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Subcatchment EDA-1: EDA-1 PERV

Runoff = 2.40 cfs @ 12.44 hrs, Volume= 0.485 af, Depth= 2.32"

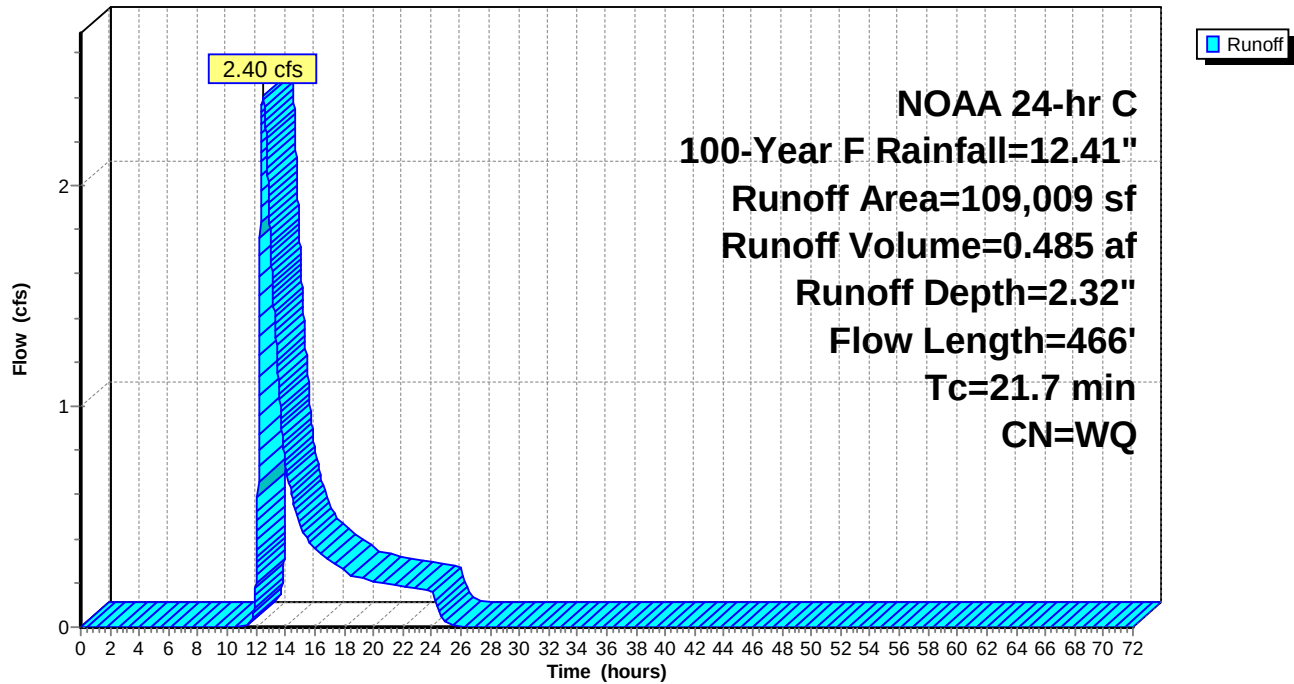
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
28,173	39	>75% Grass cover, Good, HSG A
80,836	30	Woods, Good, HSG A
109,009		Weighted Average
109,009	32	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	8	0.0100	0.02		Sheet Flow, 1-2
					Woods: Dense underbrush n= 0.800 P2= 3.38"
2.3	68	0.0100	0.50		Shallow Concentrated Flow, 1-2
					Woodland Kv= 5.0 fps
1.8	66	0.0150	0.61		Shallow Concentrated Flow, 3-4
					Woodland Kv= 5.0 fps
1.1	25	0.0060	0.39		Shallow Concentrated Flow, 4-5
					Woodland Kv= 5.0 fps
1.2	40	0.0060	0.54		Shallow Concentrated Flow, 5-6
					Short Grass Pasture Kv= 7.0 fps
3.2	74	0.0060	0.39		Shallow Concentrated Flow, 6-7
					Woodland Kv= 5.0 fps
1.8	67	0.0150	0.61		Shallow Concentrated Flow, 7-8
					Woodland Kv= 5.0 fps
3.9	118	0.0100	0.50		Shallow Concentrated Flow, 8-9
					Woodland Kv= 5.0 fps
21.7	466	Total			

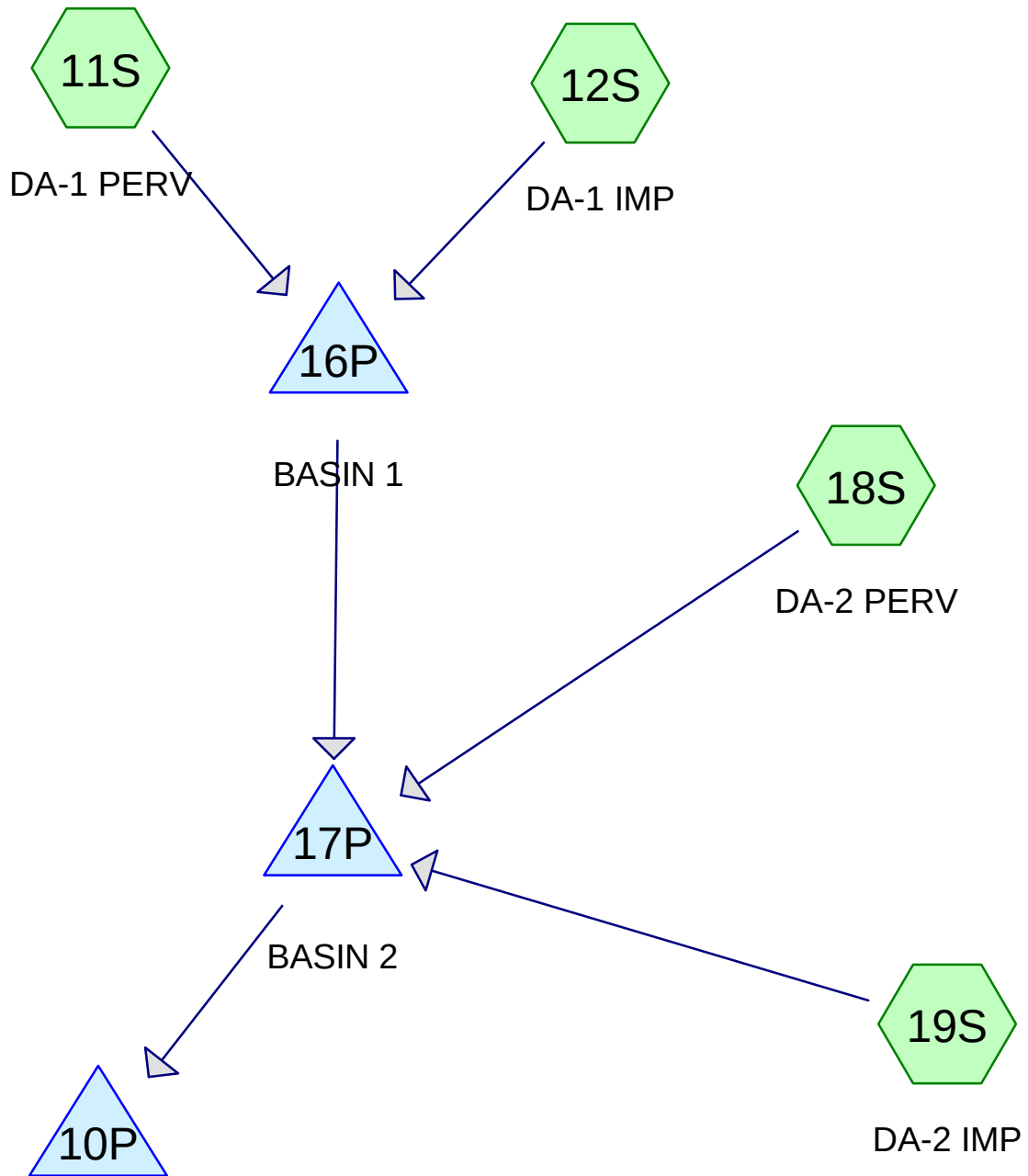
Subcatchment EDA-1: EDA-1 PERV

Hydrograph

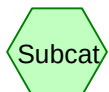
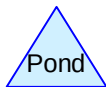


APPENDIX E

Post-Development Drainage Analysis – Future Rainfall (No Bypass)



POST TEST - POI #1
(SW Prop Corner)



Pre&Post Development

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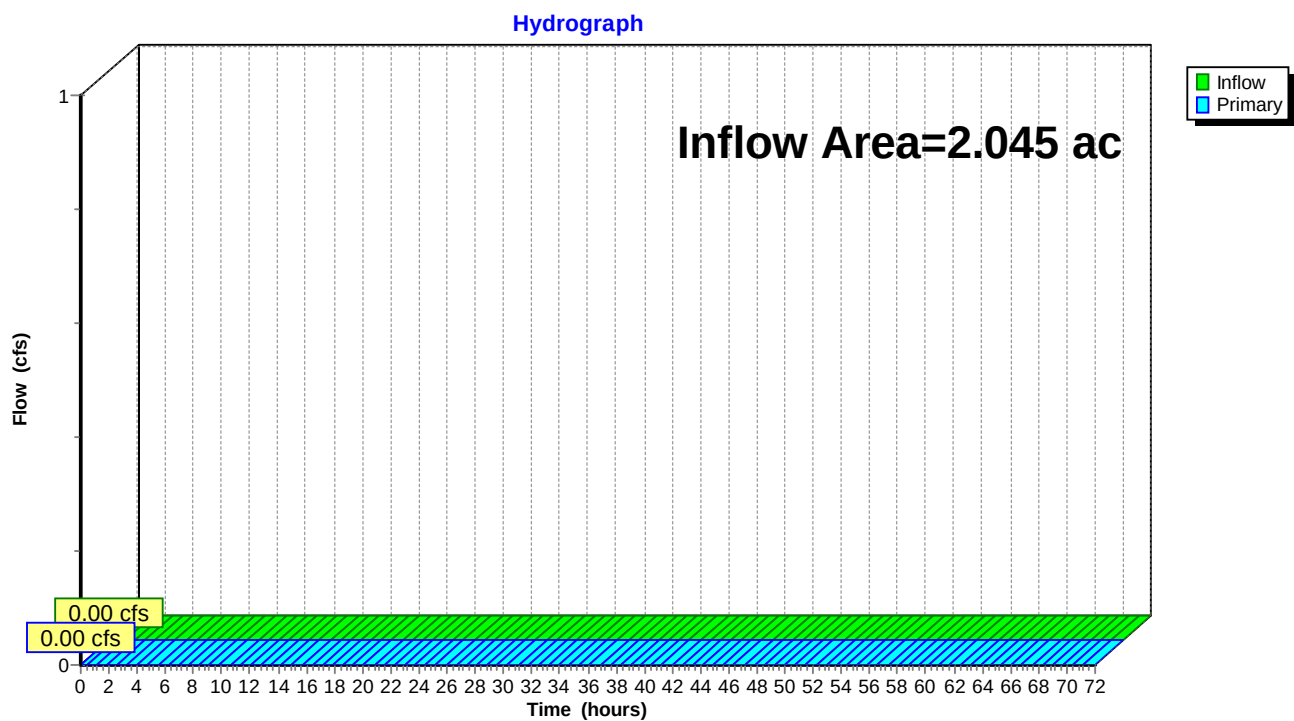
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth = 0.00" for 2-Year F event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.00 cfs @ 24.03 hrs, Volume= 0.002 af, Depth= 0.04"

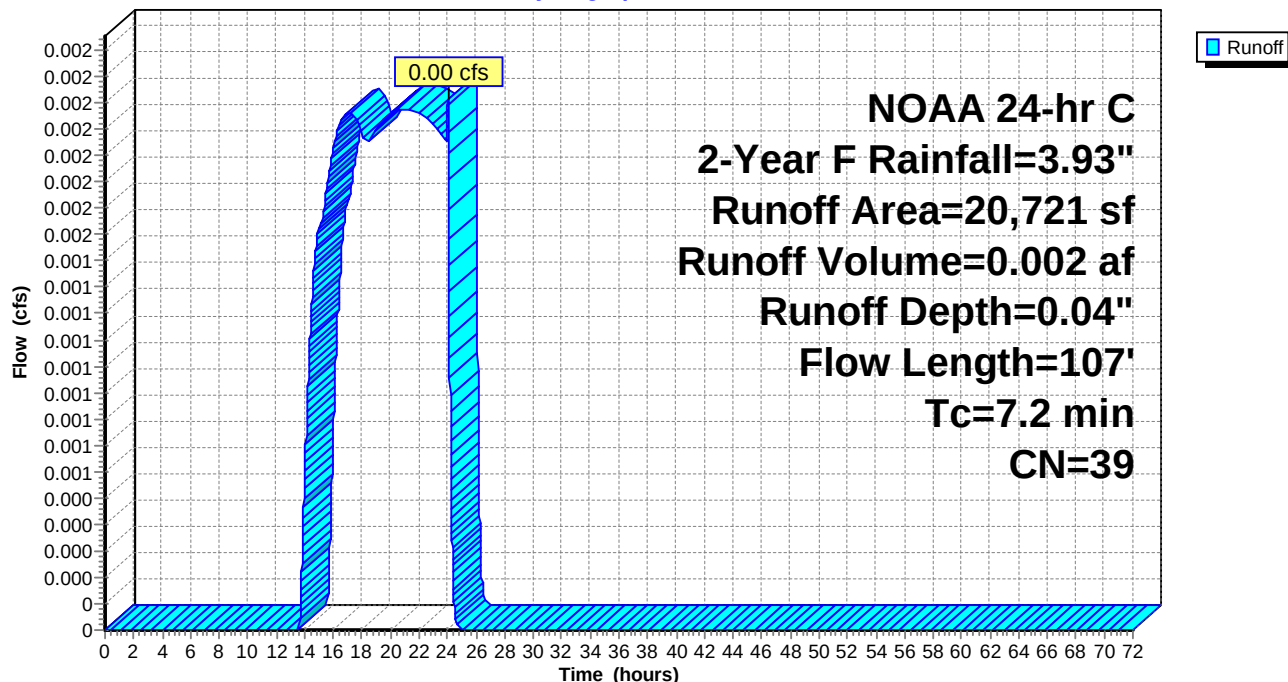
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 3.11 cfs @ 12.10 hrs, Volume= 0.212 af, Depth= 3.70"

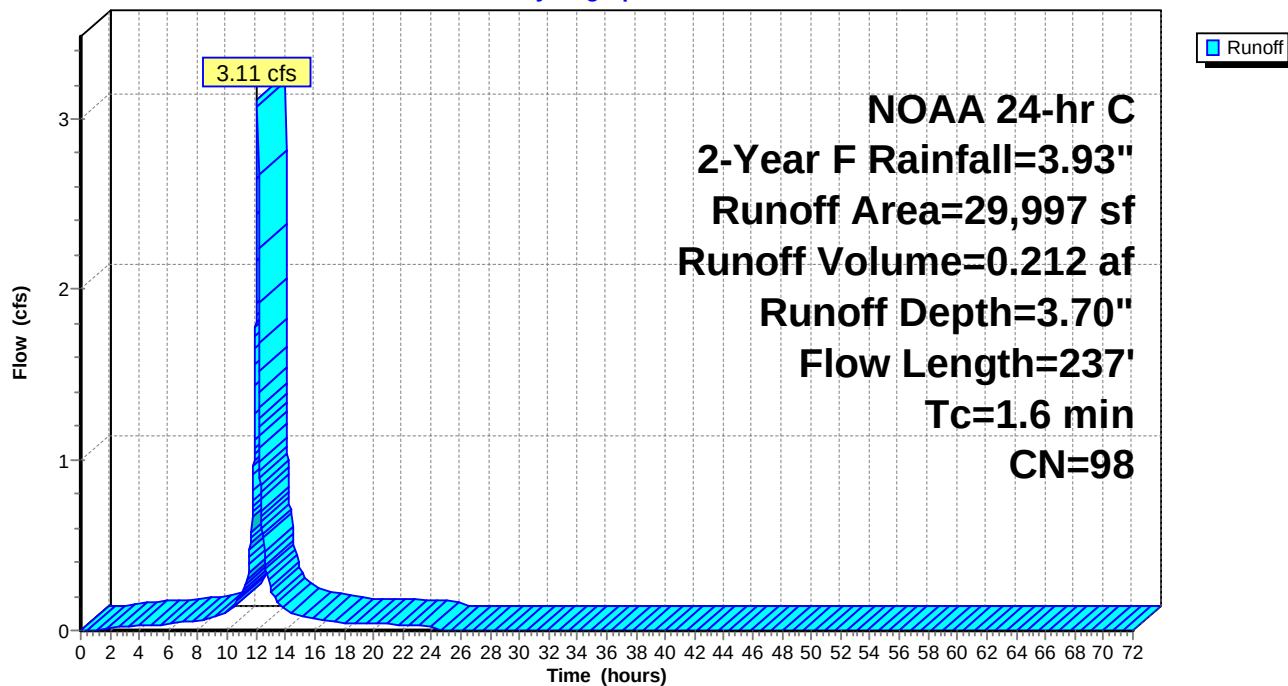
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2
					Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3
					Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4
					18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'
					n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



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NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 2.20" for 2-Year F event
 Inflow = 3.11 cfs @ 12.10 hrs, Volume= 0.214 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.18' @ 24.79 hrs Surf.Area= 6,695 sf Storage= 9,305 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

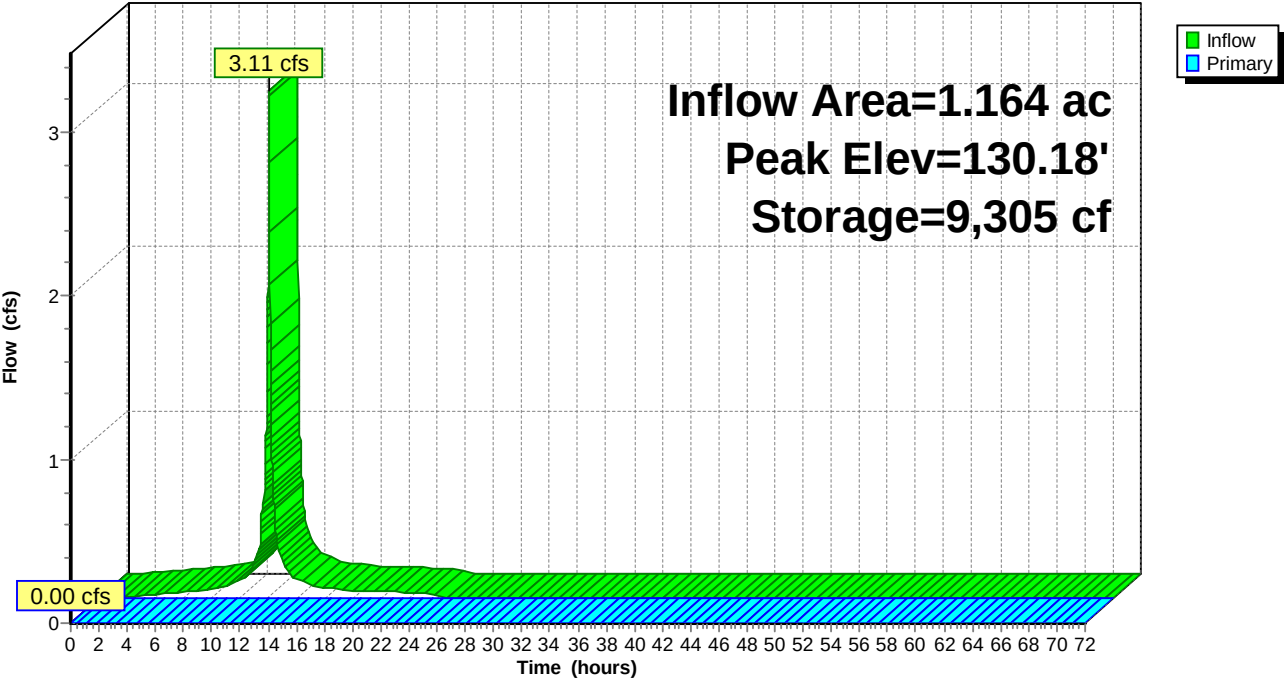
Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 ' /' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.50' TW=128.00' (Dynamic Tailwater)

↑ **1=Culvert** (Controls 0.00 cfs)
 ↑ **2=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1

Hydrograph



Pre&Post Development

NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth = 0.84" for 2-Year F event
 Inflow = 2.01 cfs @ 12.11 hrs, Volume= 0.144 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 128.99' @ 25.03 hrs Surf.Area= 6,665 sf Storage= 6,252 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.00' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.00 cfs of 7.45 cfs potential flow)

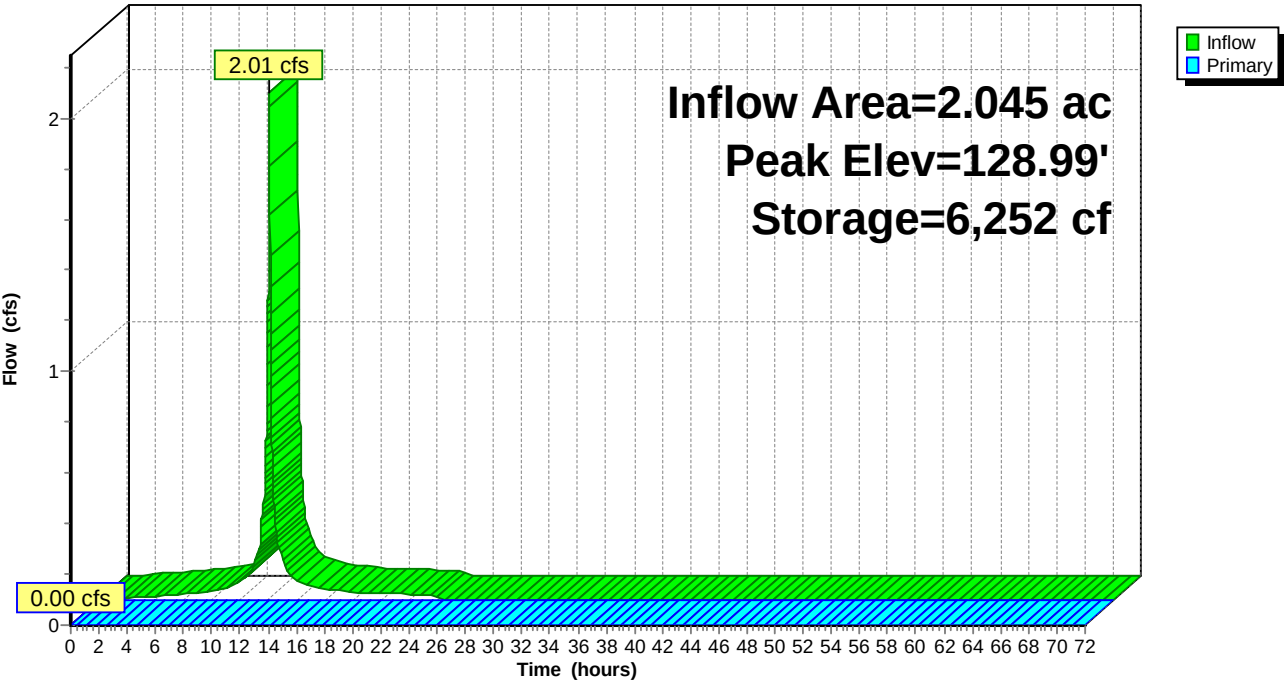
↑ **2=Orifice/Grate** (Controls 0.00 cfs)

↑ **3=Orifice/Grate** (Controls 0.00 cfs)

↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

Hydrograph



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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.00 cfs @ 21.37 hrs, Volume= 0.001 af, Depth= 0.04"

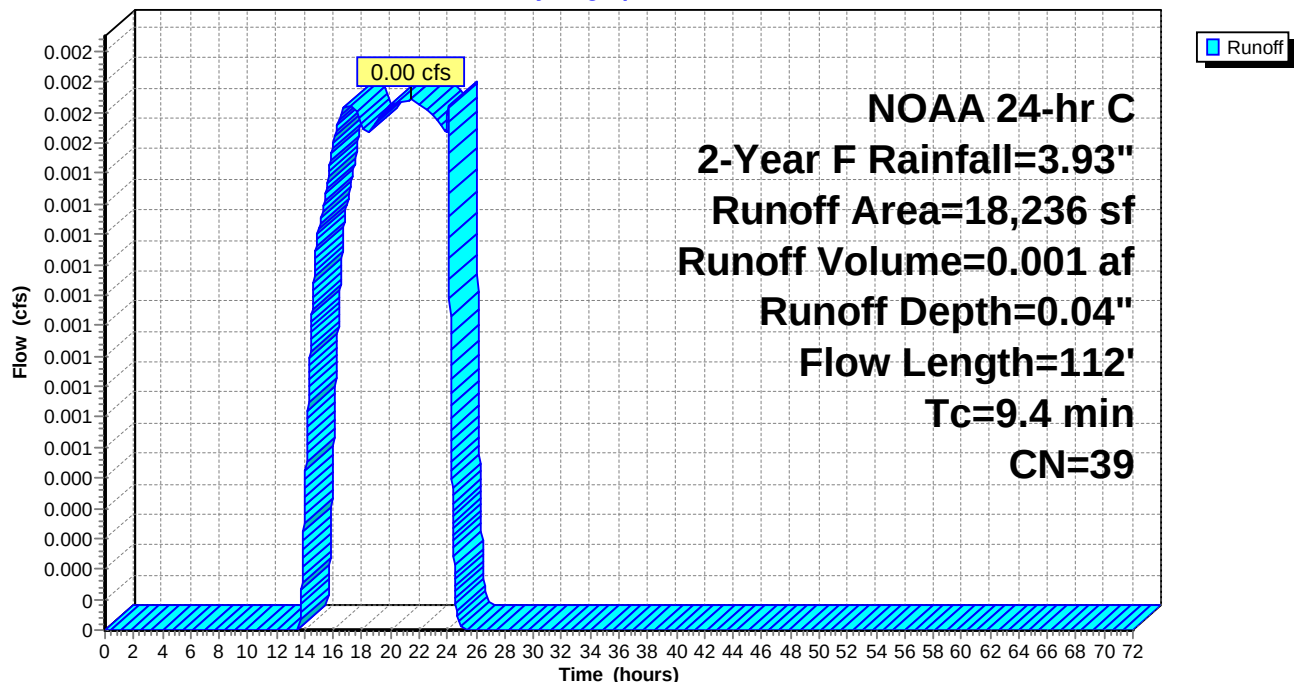
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 2.01 cfs @ 12.11 hrs, Volume= 0.142 af, Depth= 3.70"

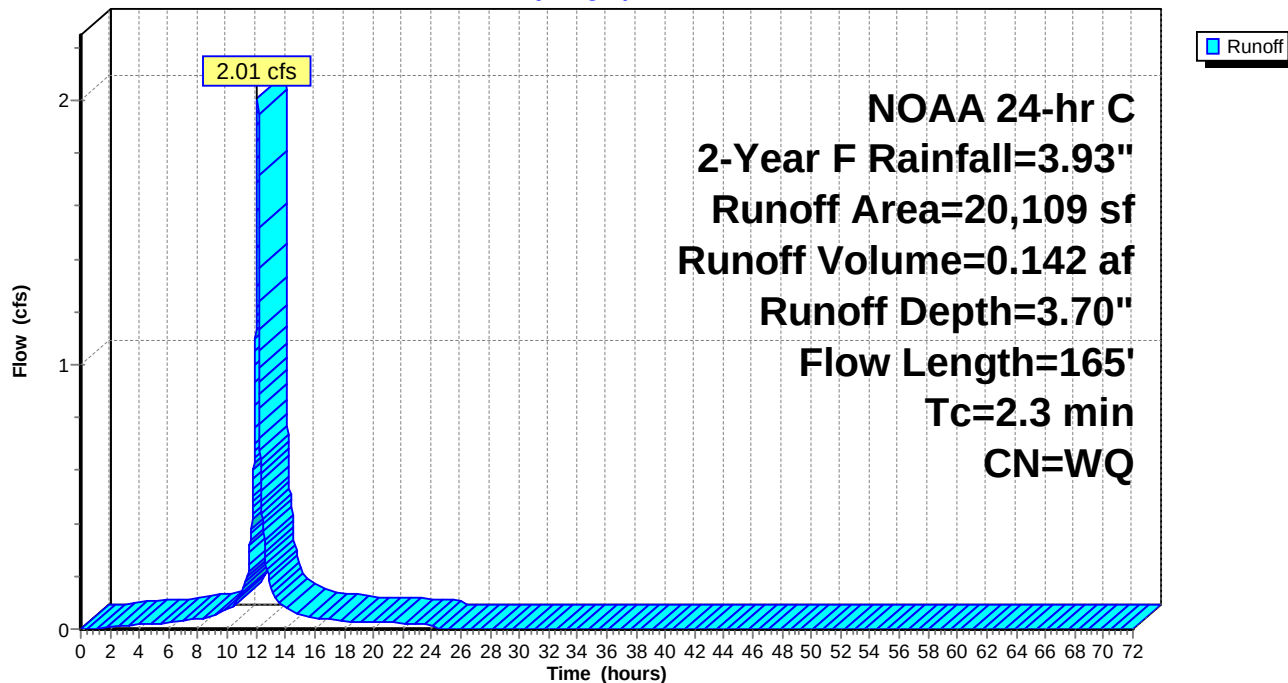
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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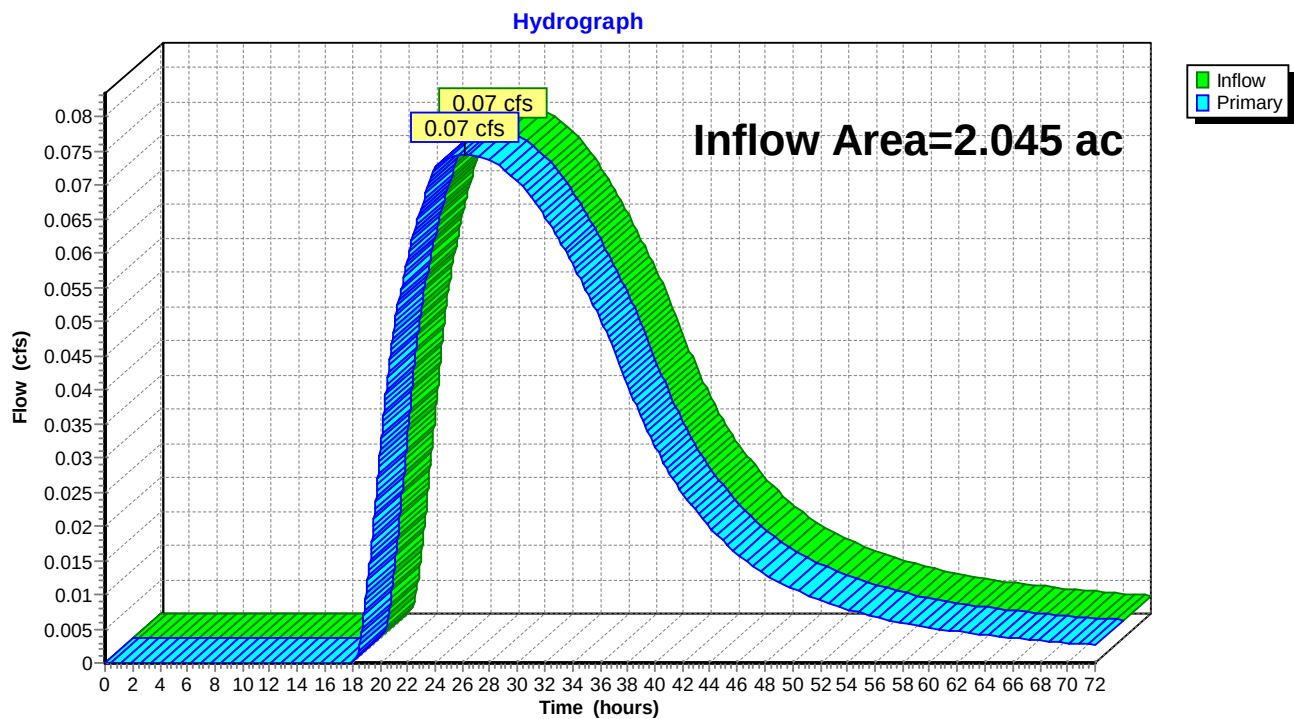
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 0.74" for 10-Year F event
Inflow = 0.07 cfs @ 26.23 hrs, Volume= 0.127 af
Primary = 0.07 cfs @ 26.23 hrs, Volume= 0.127 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.09 cfs @ 12.35 hrs, Volume= 0.021 af, Depth= 0.54"

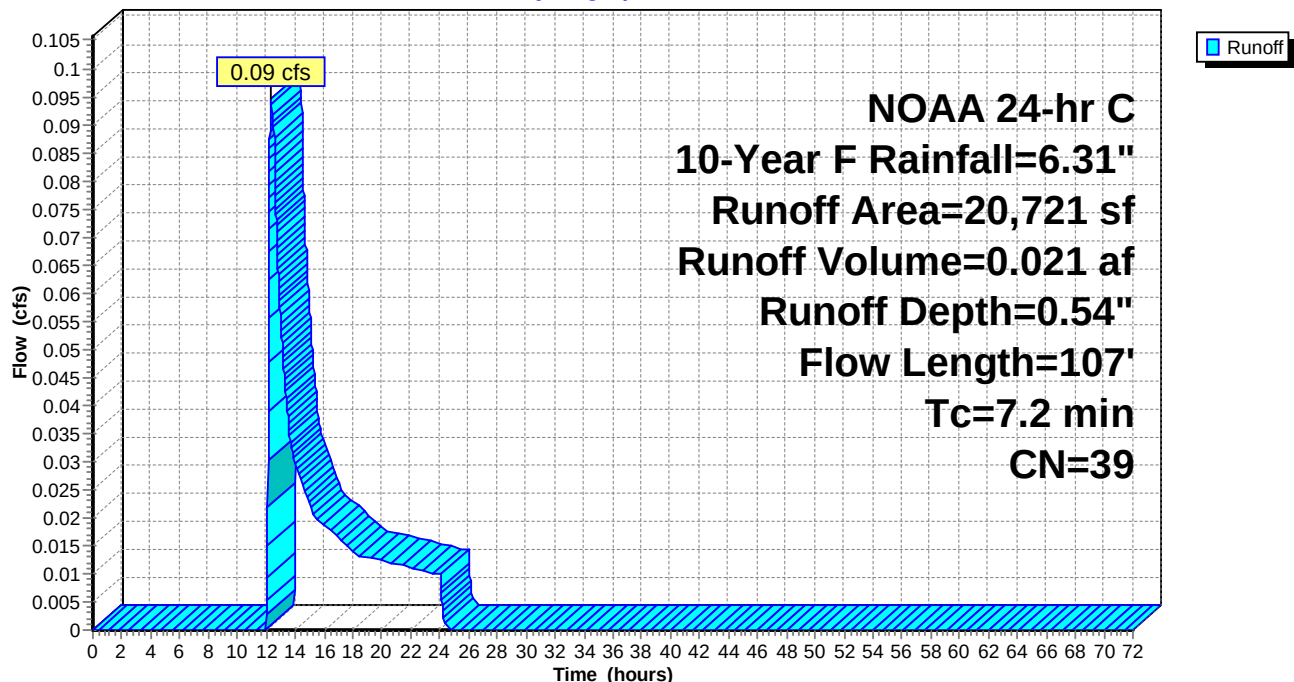
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 5.01 cfs @ 12.10 hrs, Volume= 0.348 af, Depth= 6.07"

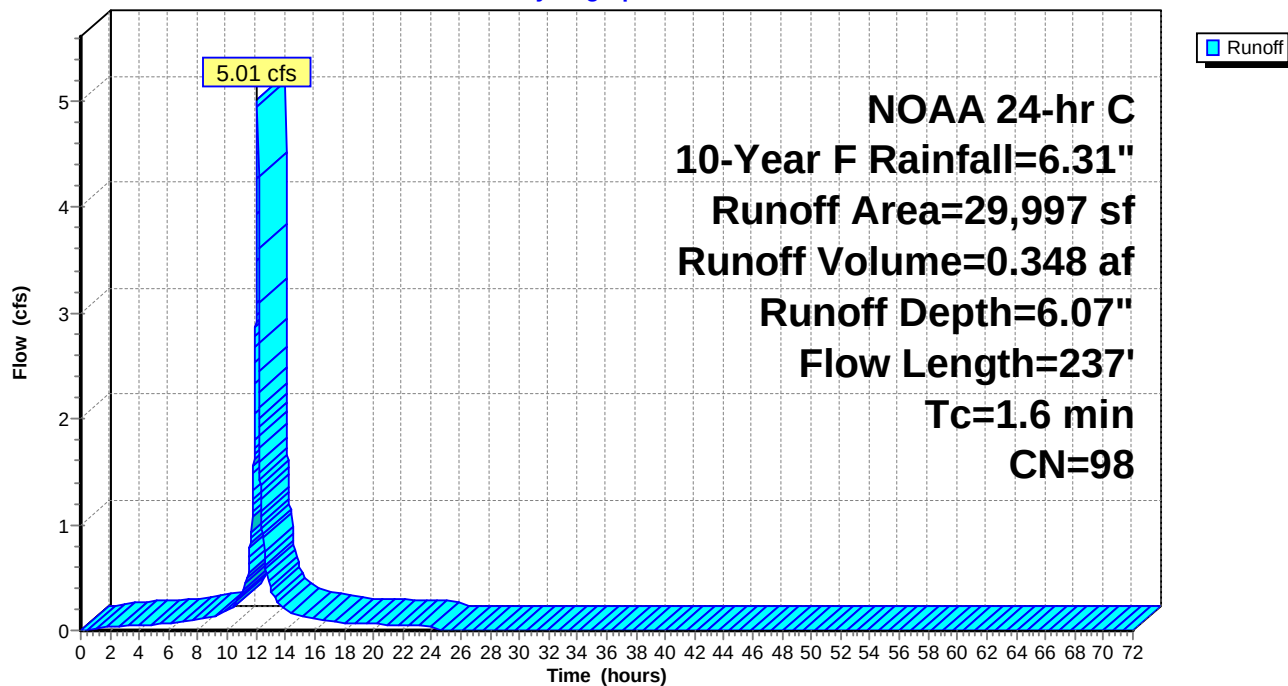
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 3.81" for 10-Year F event
 Inflow = 5.02 cfs @ 12.10 hrs, Volume= 0.370 af
 Outflow = 0.10 cfs @ 17.30 hrs, Volume= 0.150 af, Atten= 98%, Lag= 312.1 min
 Primary = 0.10 cfs @ 17.30 hrs, Volume= 0.150 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.67' @ 17.30 hrs Surf.Area= 7,467 sf Storage= 12,782 cf

Plug-Flow detention time= 842.0 min calculated for 0.150 af (41% of inflow)
 Center-of-Mass det. time= 677.0 min (1,431.6 - 754.6)

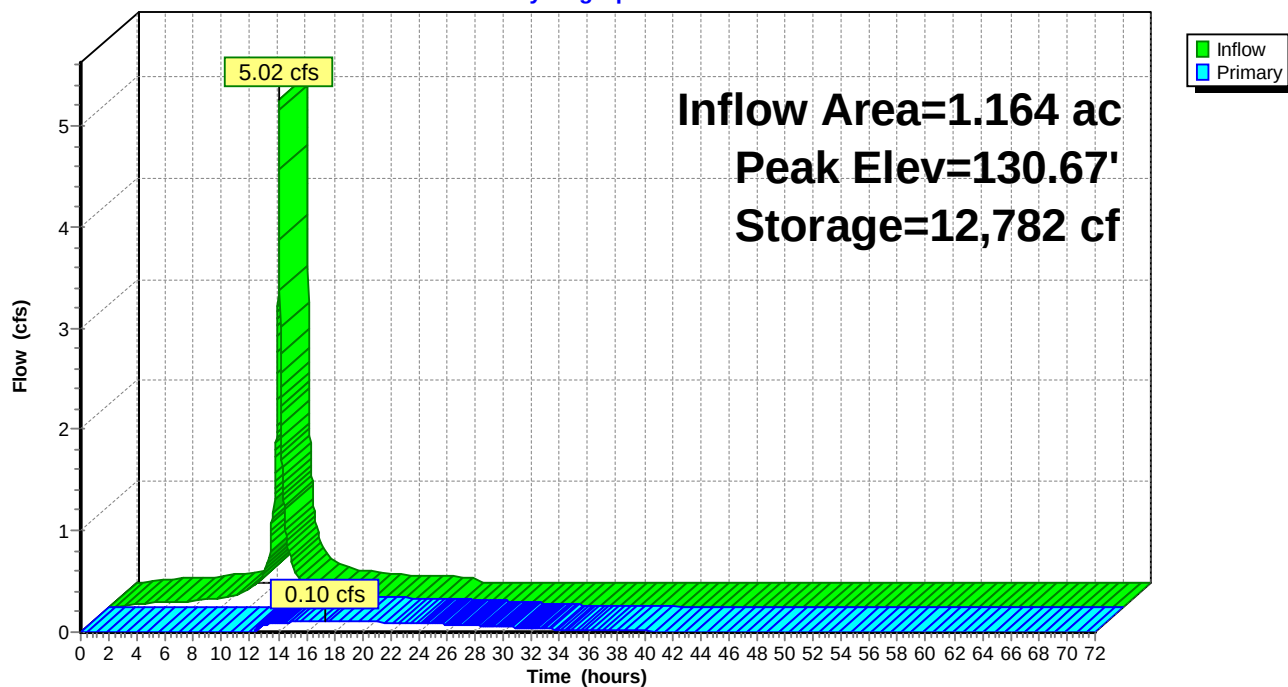
Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 ' / Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.10 cfs @ 17.30 hrs HW=130.67' TW=129.72' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.10 cfs of 3.00 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.10 cfs @ 2.93 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1**Hydrograph**

Pre&Post Development

NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 2.36" for 10-Year F event
 Inflow = 3.24 cfs @ 12.11 hrs, Volume= 0.403 af
 Outflow = 0.07 cfs @ 26.23 hrs, Volume= 0.127 af, Atten= 98%, Lag= 847.4 min
 Primary = 0.07 cfs @ 26.23 hrs, Volume= 0.127 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.09' @ 26.23 hrs Surf.Area= 7,444 sf Storage= 14,029 cf

Plug-Flow detention time= 1,379.8 min calculated for 0.127 af (31% of inflow)
 Center-of-Mass det. time= 987.4 min (1,997.8 - 1,010.4)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

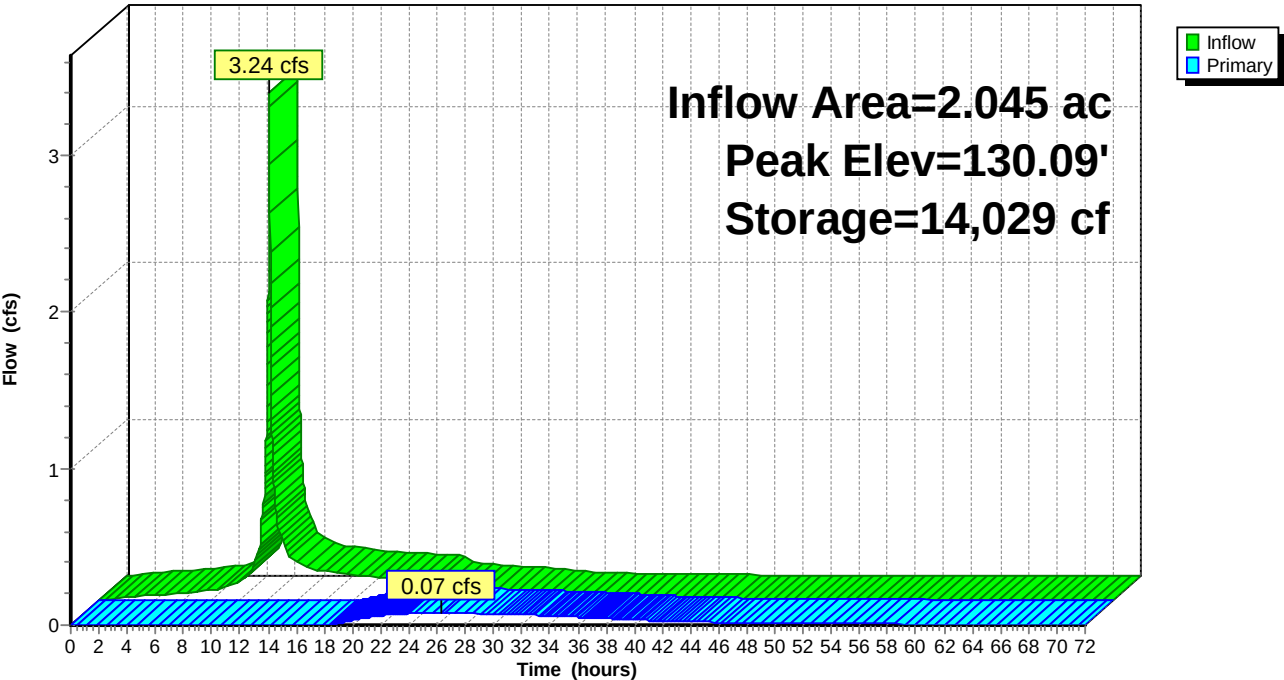
Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.07 cfs @ 26.23 hrs HW=130.09' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.07 cfs of 10.41 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.07 cfs @ 2.18 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.08 cfs @ 12.53 hrs, Volume= 0.019 af, Depth= 0.54"

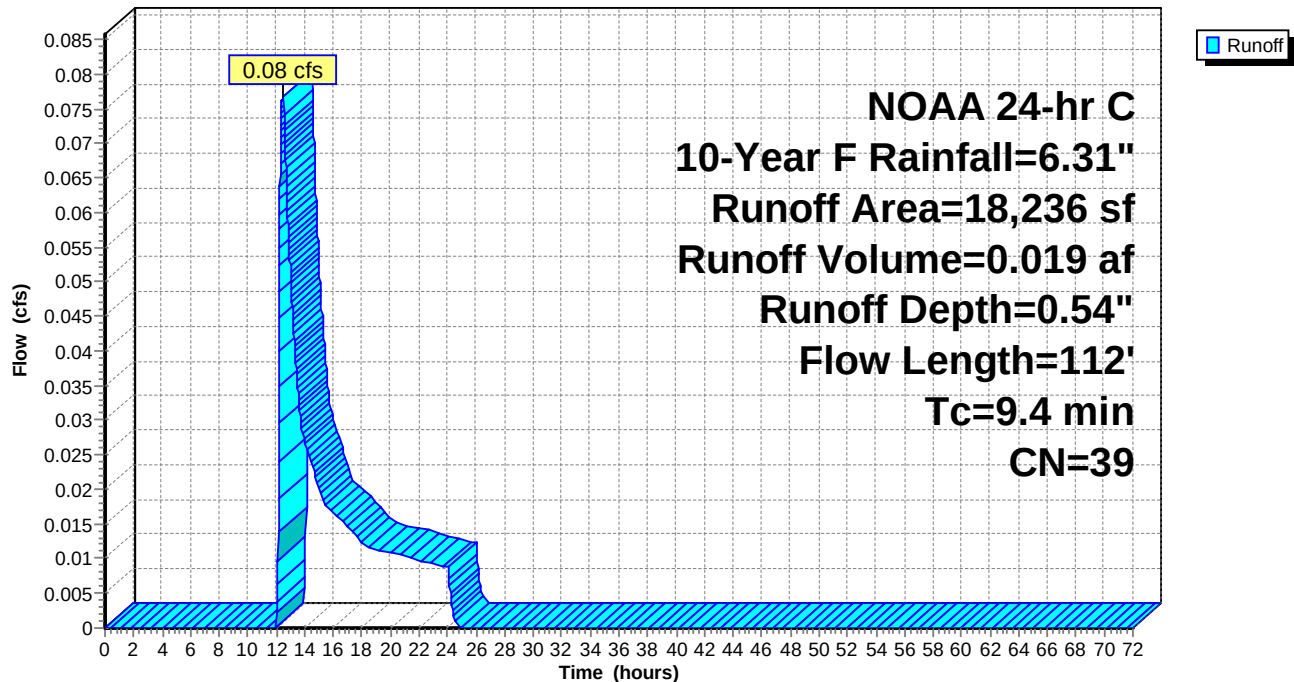
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 3.24 cfs @ 12.11 hrs, Volume= 0.234 af, Depth= 6.07"

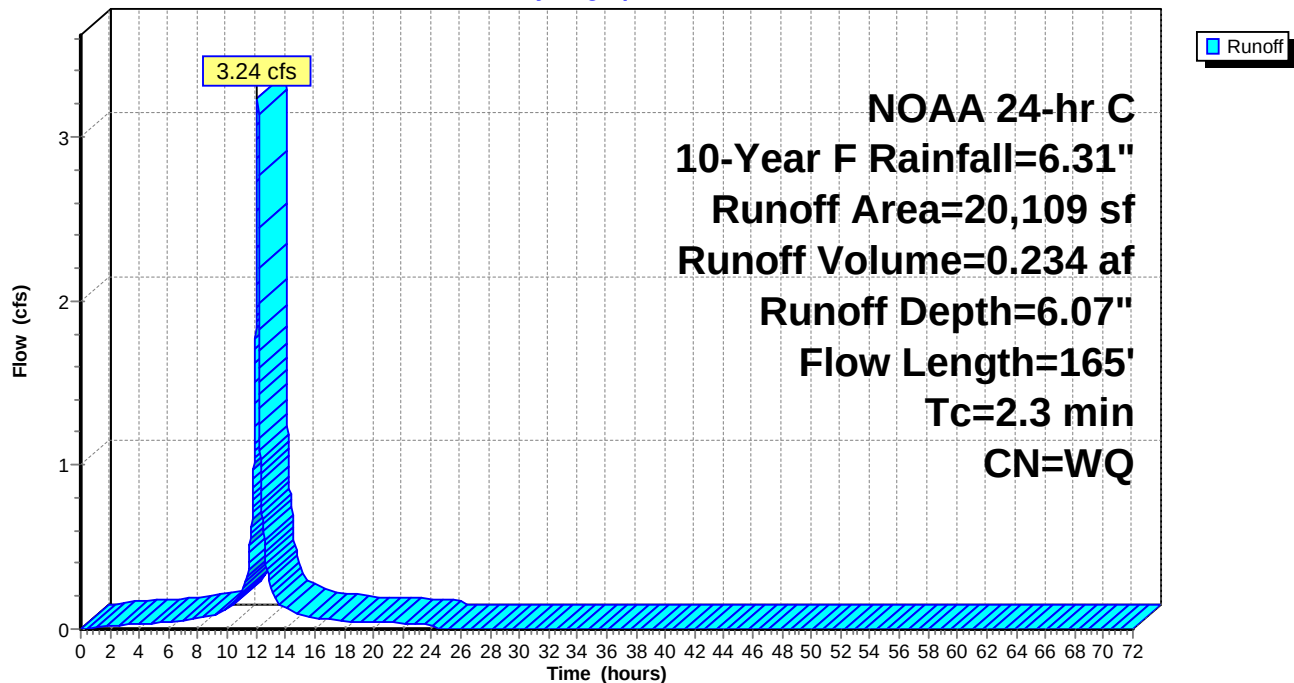
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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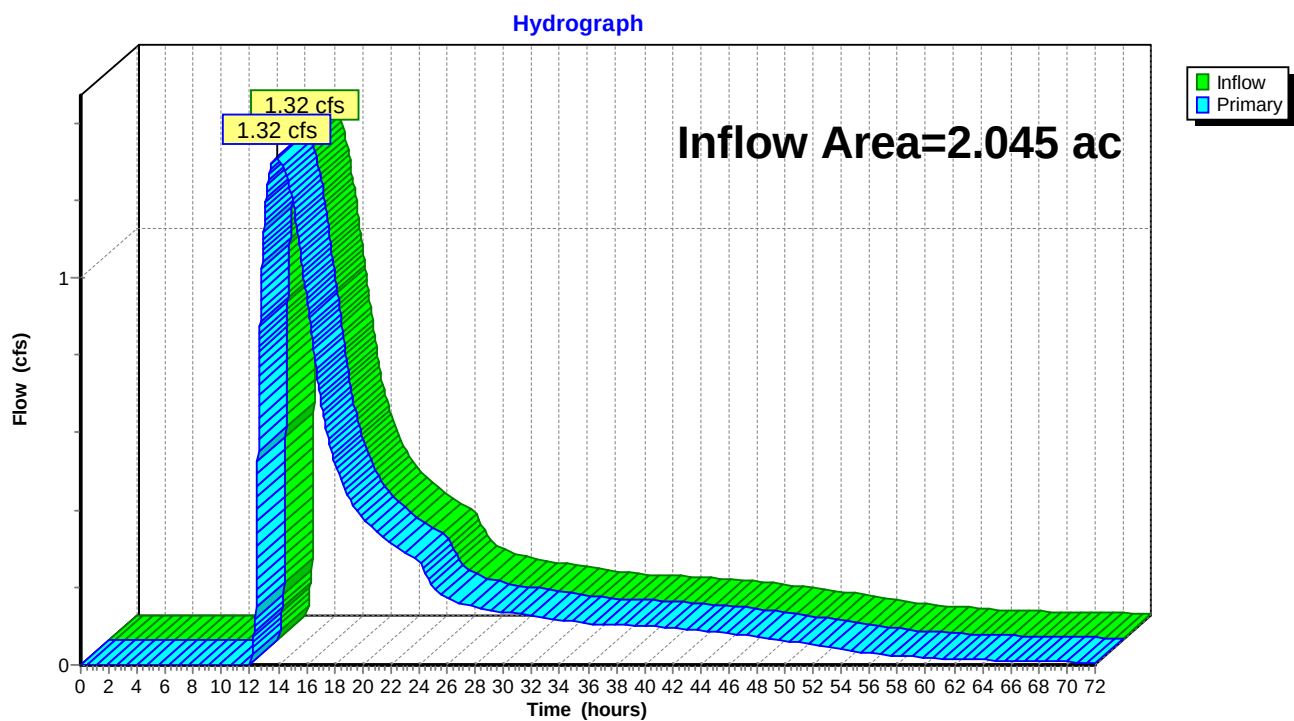
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 5.42" for 100-Year F event
Inflow = 1.32 cfs @ 13.90 hrs, Volume= 0.924 af
Primary = 1.32 cfs @ 13.90 hrs, Volume= 0.924 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 1.46 cfs @ 12.16 hrs, Volume= 0.137 af, Depth= 3.46"

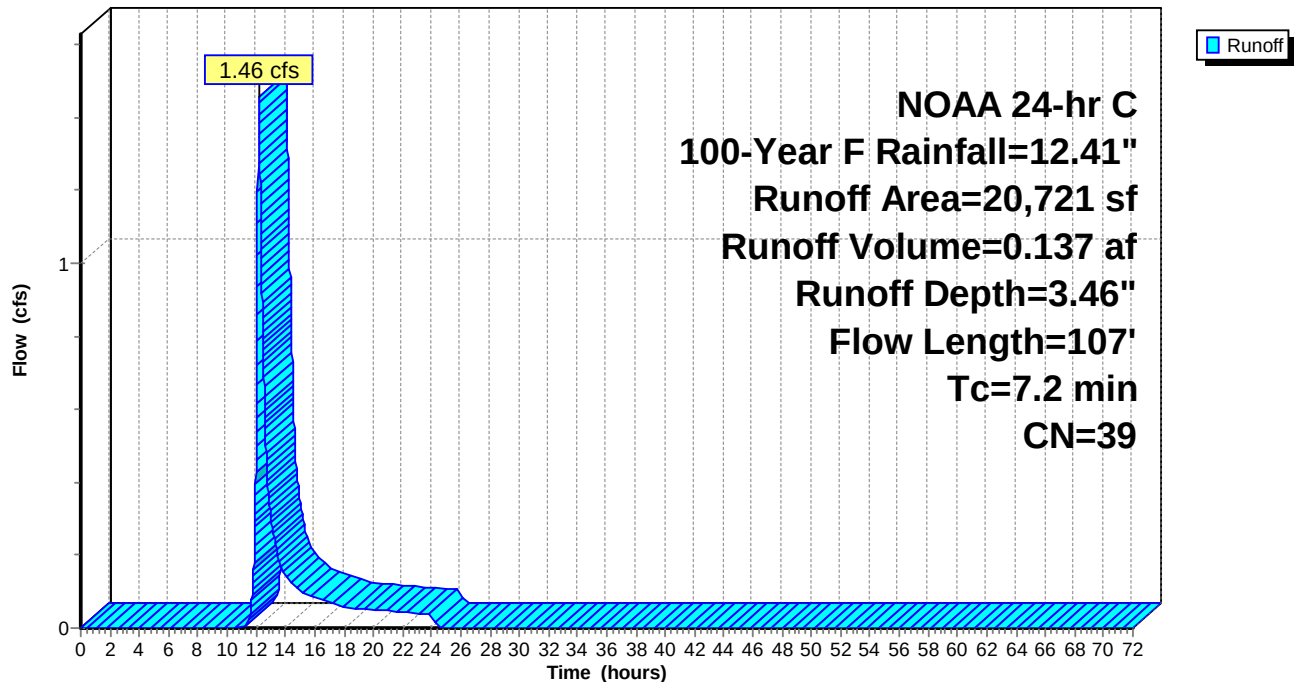
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 9.87 cfs @ 12.10 hrs, Volume= 0.698 af, Depth=12.17"

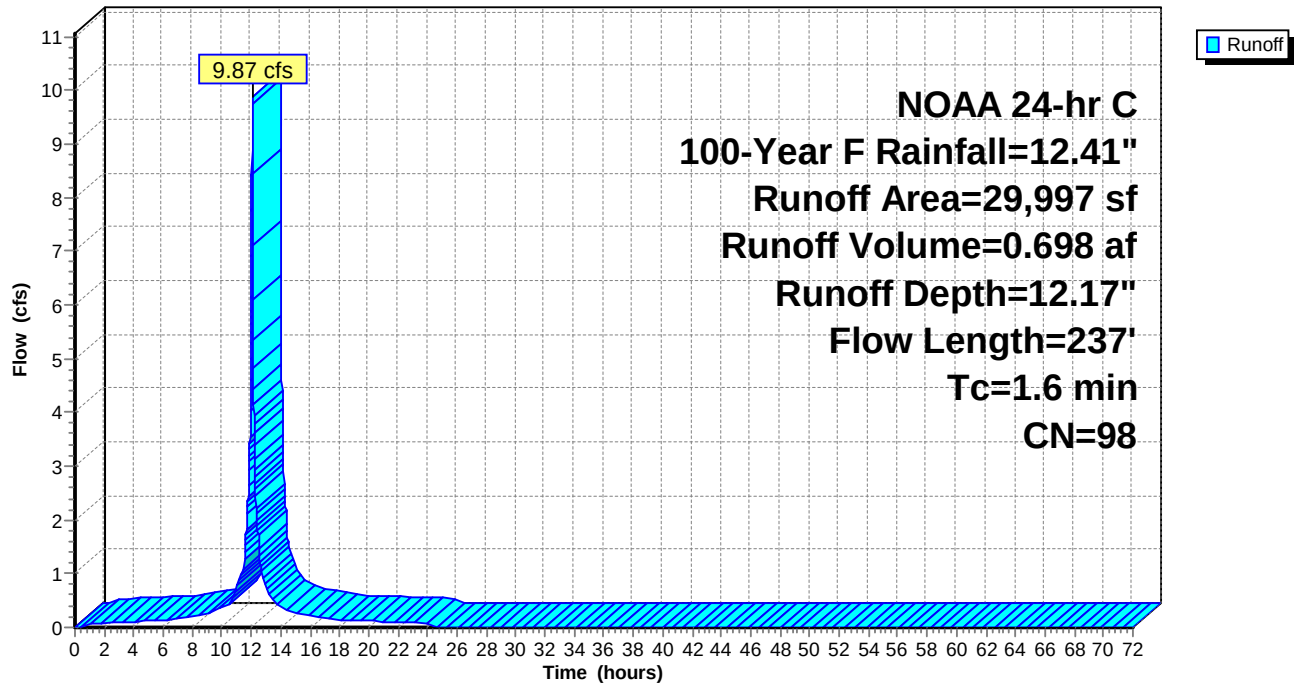
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 8.61" for 100-Year F event
 Inflow = 10.98 cfs @ 12.10 hrs, Volume= 0.835 af
 Outflow = 1.03 cfs @ 12.99 hrs, Volume= 0.615 af, Atten= 91%, Lag= 53.4 min
 Primary = 1.03 cfs @ 12.99 hrs, Volume= 0.615 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 131.88' @ 13.03 hrs Surf.Area= 9,549 sf Storage= 22,989 cf

Plug-Flow detention time= 639.9 min calculated for 0.615 af (74% of inflow)
 Center-of-Mass det. time= 541.2 min (1,299.1 - 757.9)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

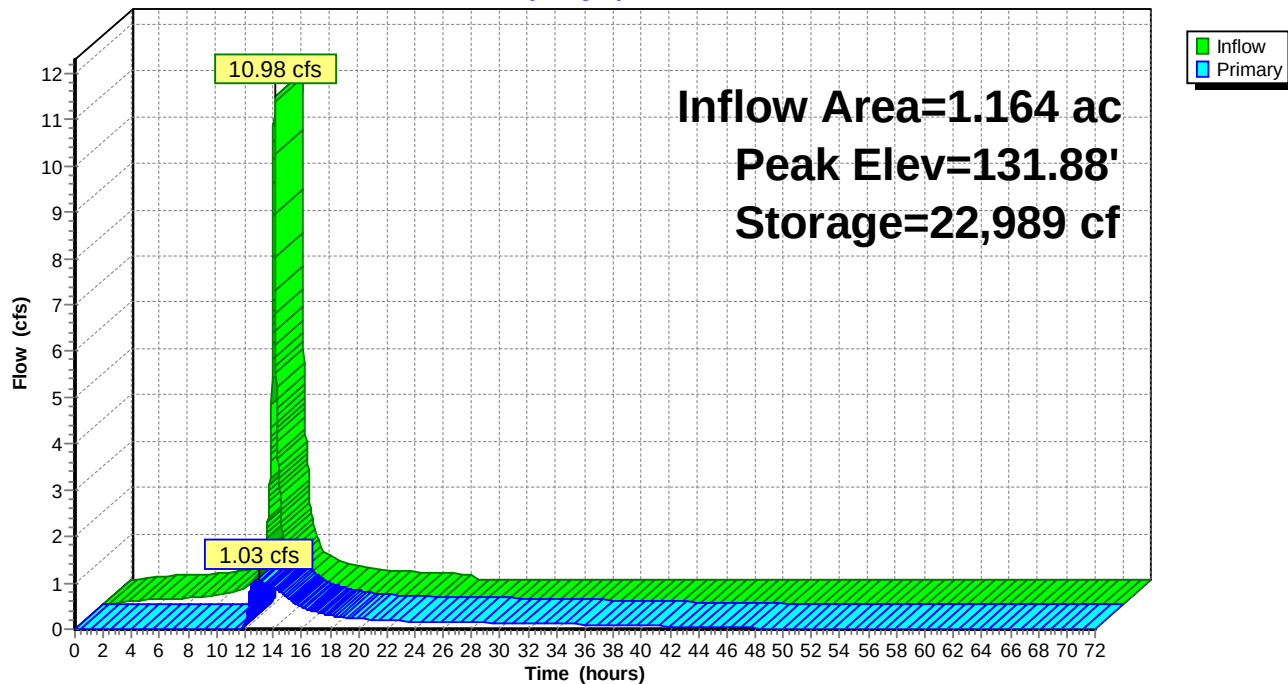
Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.03 cfs @ 12.99 hrs HW=131.88' TW=130.72' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 1.03 cfs of 4.01 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 5.17 fps)
 ↑ **3=Orifice/Grate** (Orifice Controls 0.85 cfs @ 3.06 fps)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1

Hydrograph



Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 7.06" for 100-Year F event
 Inflow = 7.32 cfs @ 12.11 hrs, Volume= 1.203 af
 Outflow = 1.32 cfs @ 13.90 hrs, Volume= 0.924 af, Atten= 82%, Lag= 107.8 min
 Primary = 1.32 cfs @ 13.90 hrs, Volume= 0.924 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.84' @ 13.90 hrs Surf.Area= 7,991 sf Storage= 19,800 cf

Plug-Flow detention time= 592.2 min calculated for 0.924 af (77% of inflow)
 Center-of-Mass det. time= 355.2 min (1,393.2 - 1,038.0)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

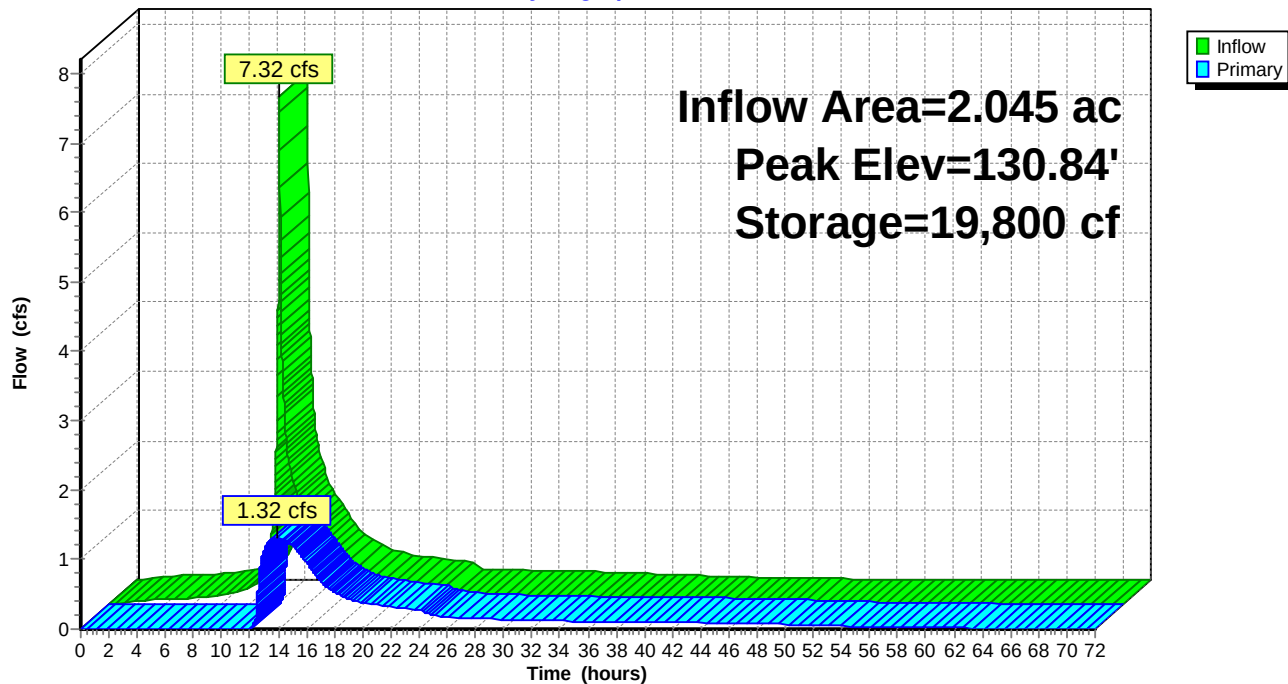
Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.32 cfs @ 13.90 hrs HW=130.84' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 1.32 cfs of 11.28 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.16 cfs @ 4.70 fps)
 ↑ **3=Orifice/Grate** (Orifice Controls 1.16 cfs @ 3.08 fps)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

Hydrograph



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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 1.12 cfs @ 12.20 hrs, Volume= 0.121 af, Depth= 3.46"

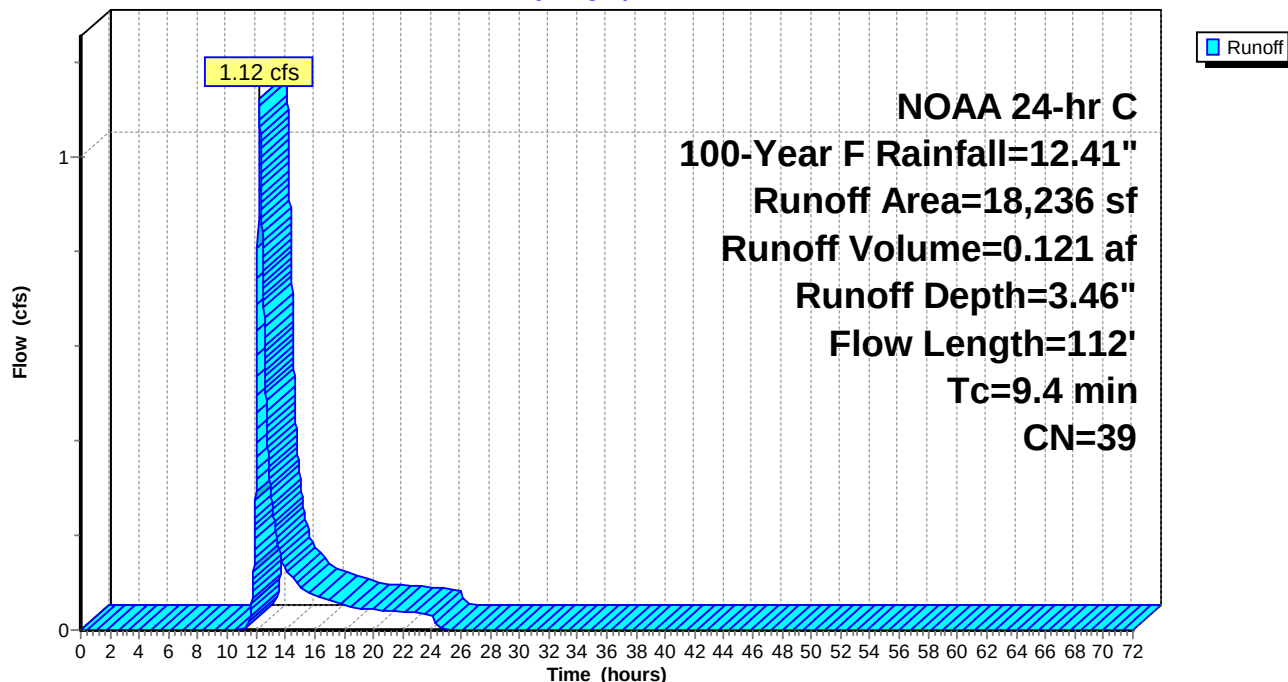
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3
					Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4
					Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 6.38 cfs @ 12.11 hrs, Volume= 0.468 af, Depth=12.17"

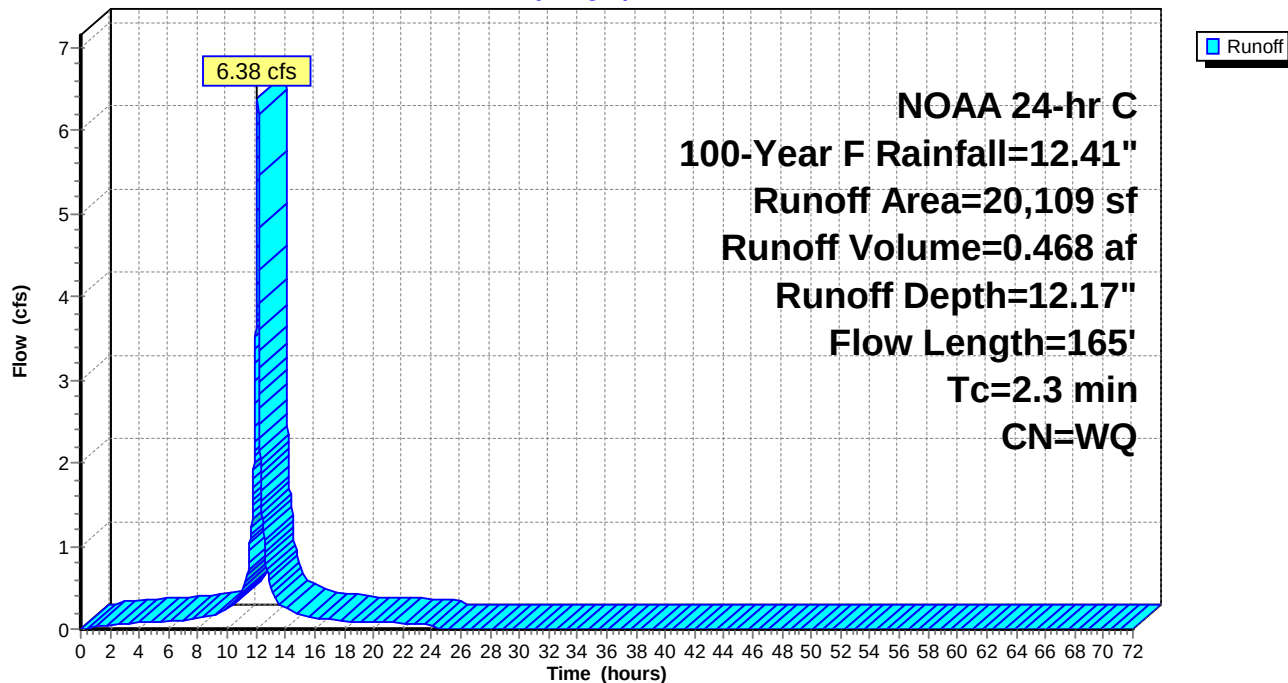
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

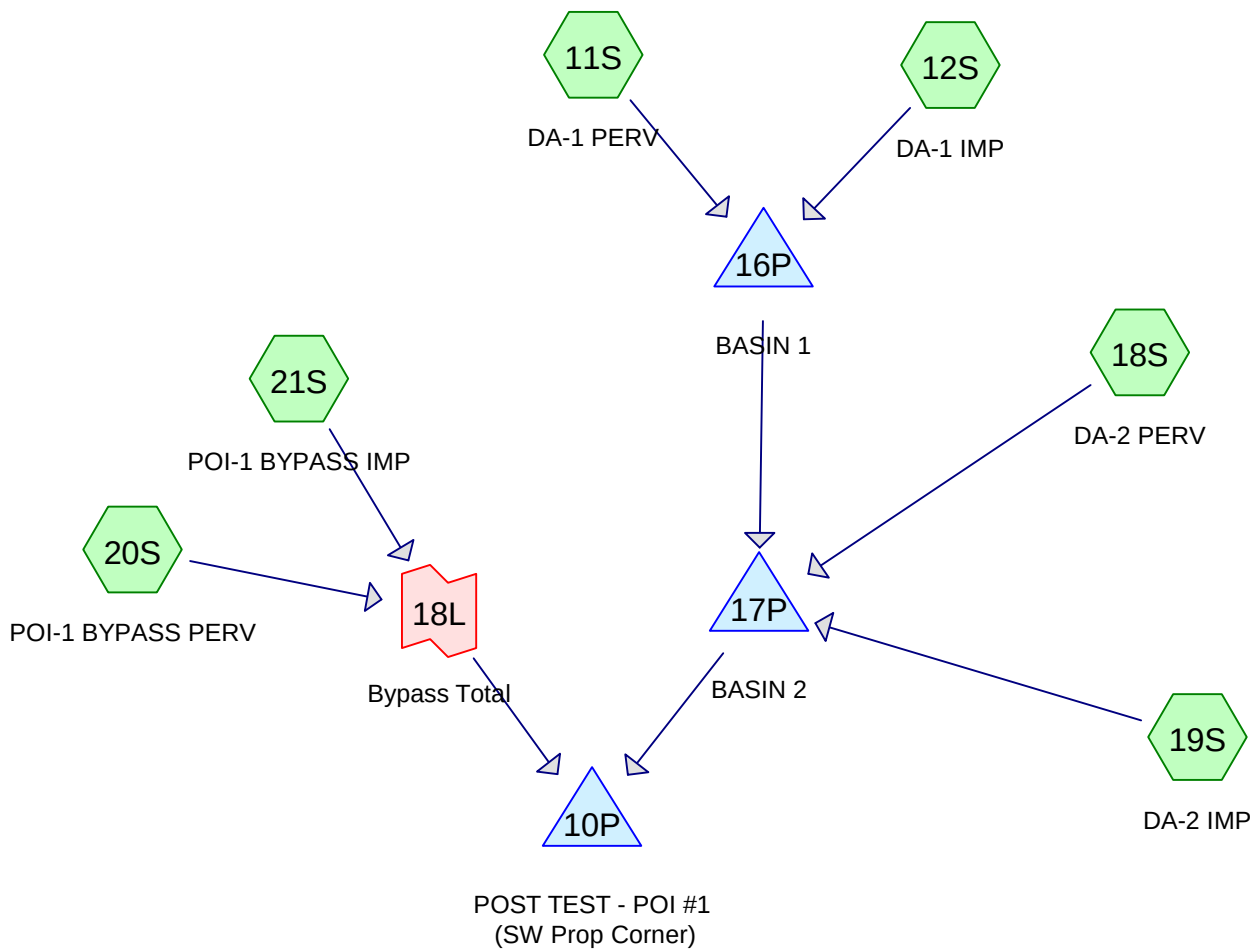
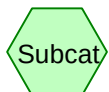
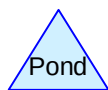
Subcatchment 19S: DA-2 IMP

Hydrograph



APPENDIX F

Post-Development Drainage Analysis – Future Rainfall (With Bypass)



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NOAA 24-hr C 2-Year F Rainfall=3.93"

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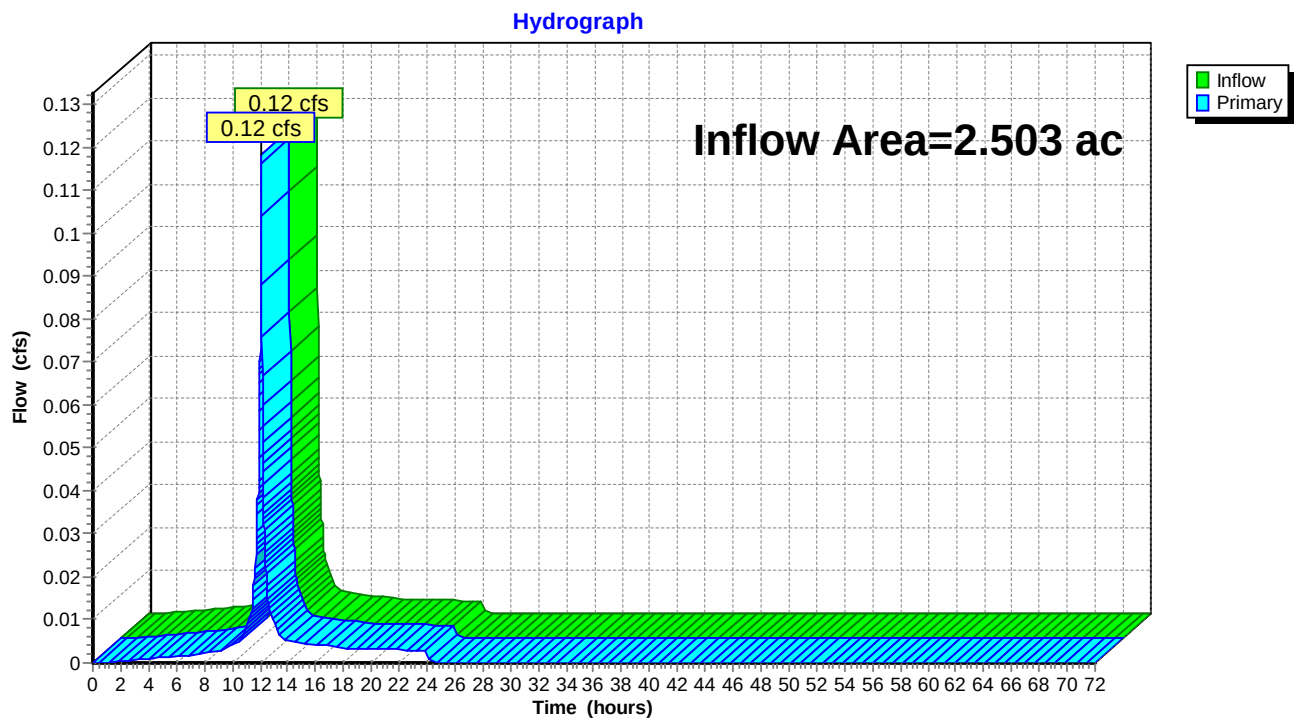
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 47.02% Impervious, Inflow Depth = 0.05" for 2-Year F event
Inflow = 0.12 cfs @ 12.10 hrs, Volume= 0.010 af
Primary = 0.12 cfs @ 12.10 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.00 cfs @ 24.03 hrs, Volume= 0.002 af, Depth= 0.04"

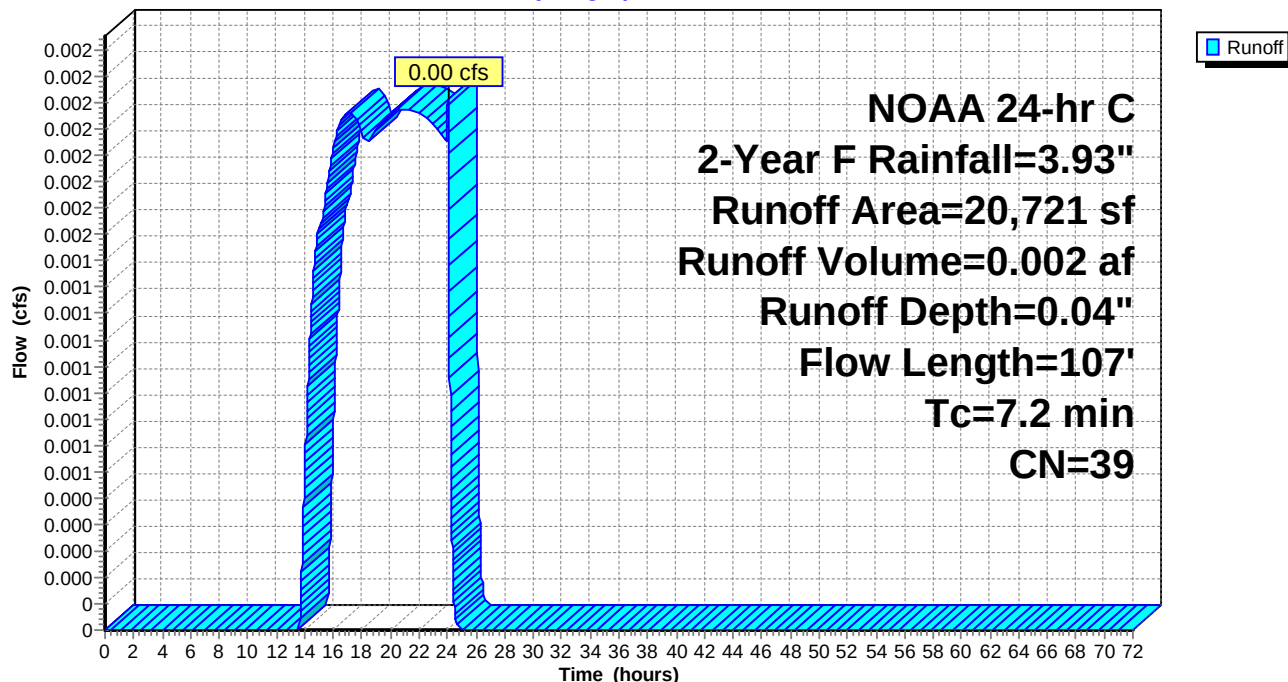
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



Pre&Post Development

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NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 3.11 cfs @ 12.10 hrs, Volume= 0.212 af, Depth= 3.70"

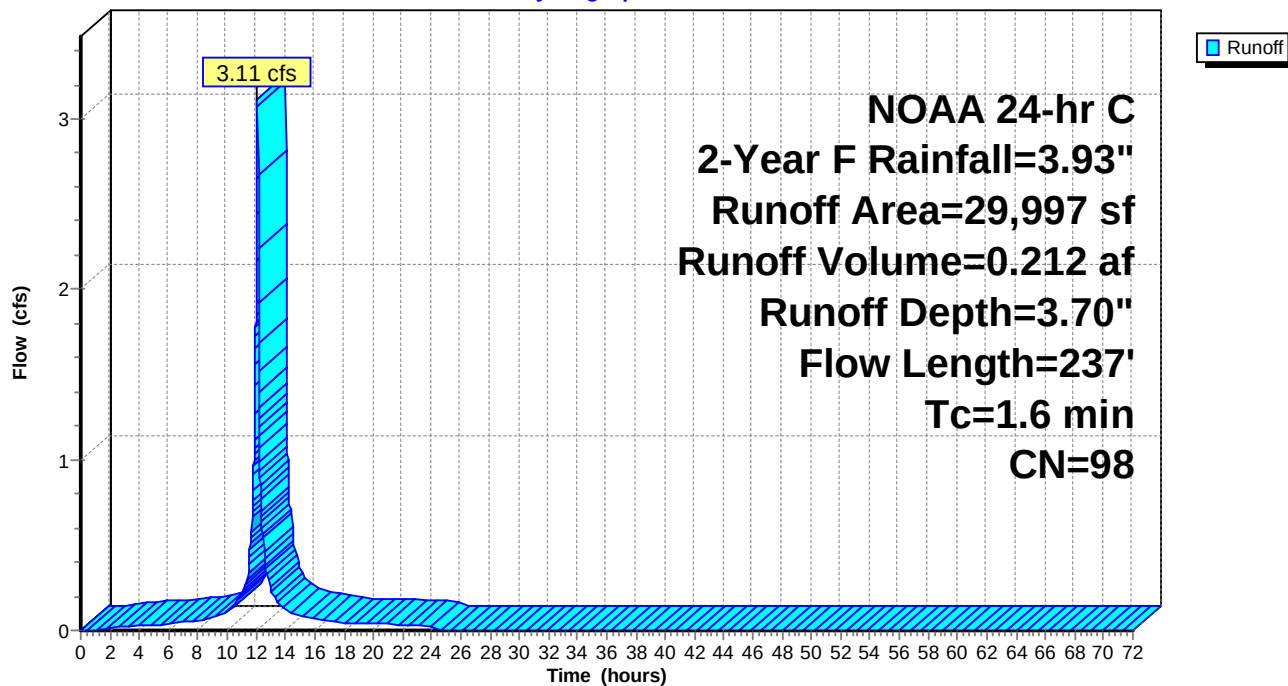
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 2.20" for 2-Year F event
 Inflow = 3.11 cfs @ 12.10 hrs, Volume= 0.214 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.18' @ 24.79 hrs Surf.Area= 6,695 sf Storage= 9,305 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

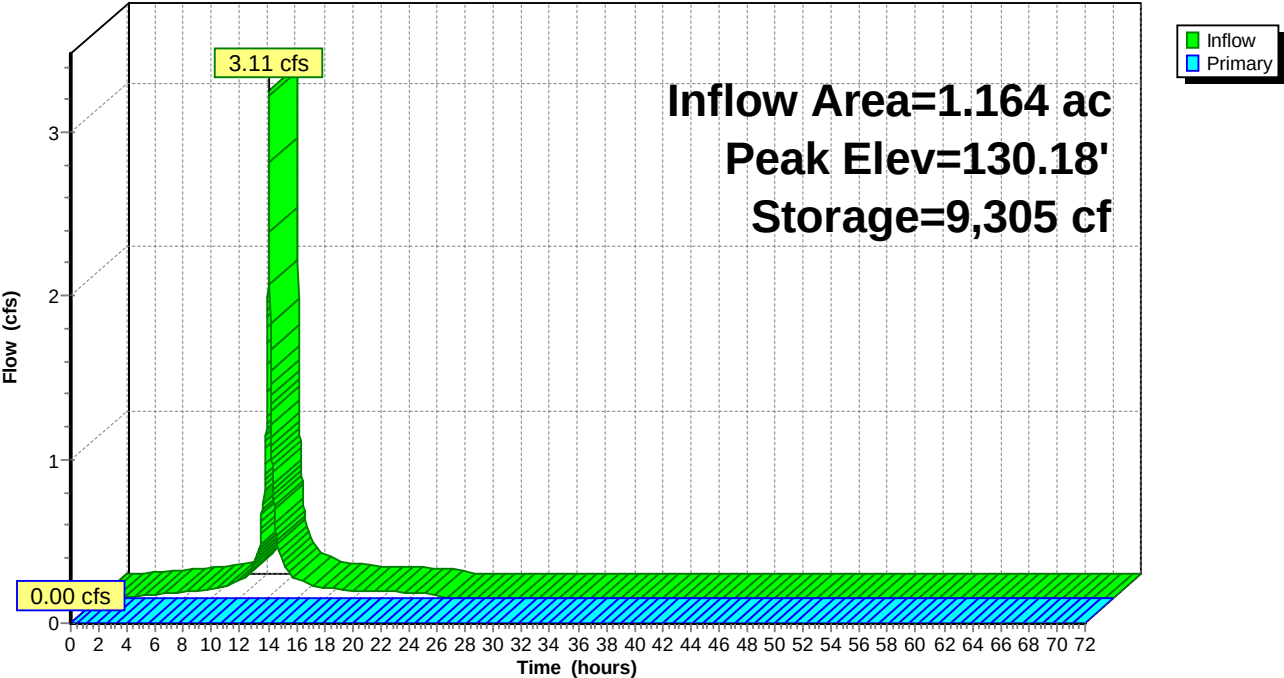
Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.50' TW=128.00' (Dynamic Tailwater)

↑ **1=Culvert** (Controls 0.00 cfs)
 ↑ **2=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1

Hydrograph



Pre&Post Development

NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth = 0.84" for 2-Year F event
 Inflow = 2.01 cfs @ 12.11 hrs, Volume= 0.144 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 128.99' @ 25.03 hrs Surf.Area= 6,665 sf Storage= 6,252 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.00' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.00 cfs of 7.45 cfs potential flow)

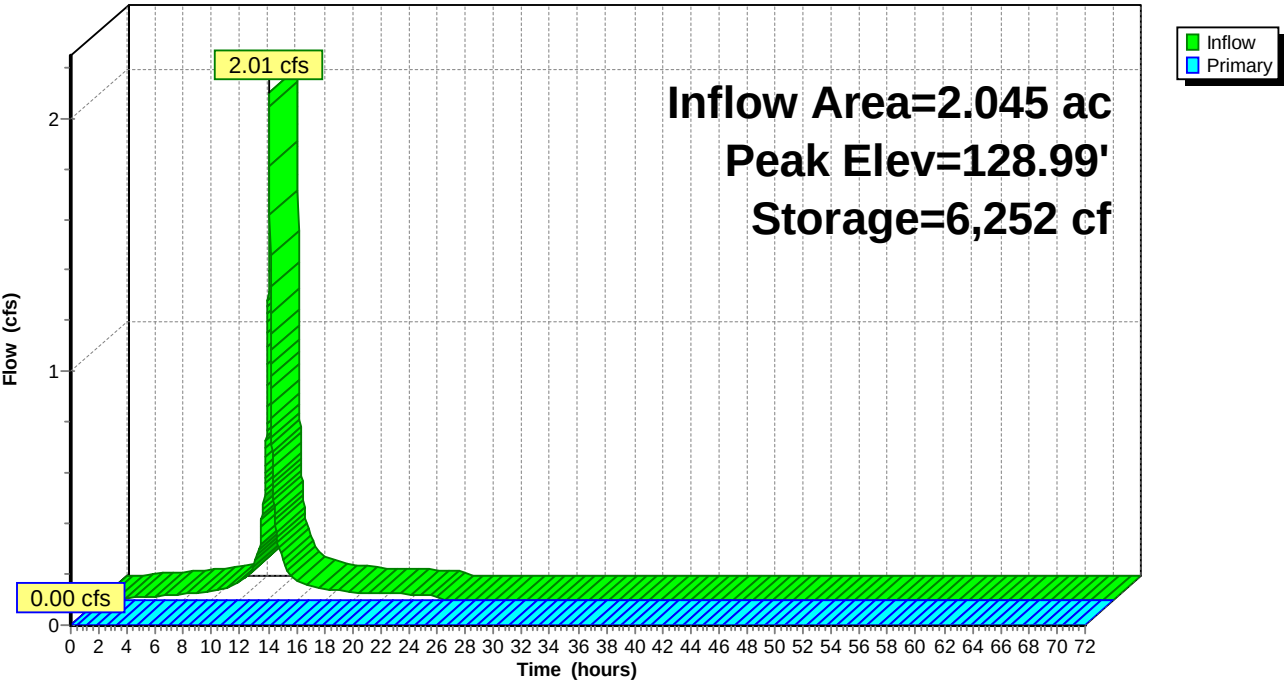
↑ **2=Orifice/Grate** (Controls 0.00 cfs)

↑ **3=Orifice/Grate** (Controls 0.00 cfs)

↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

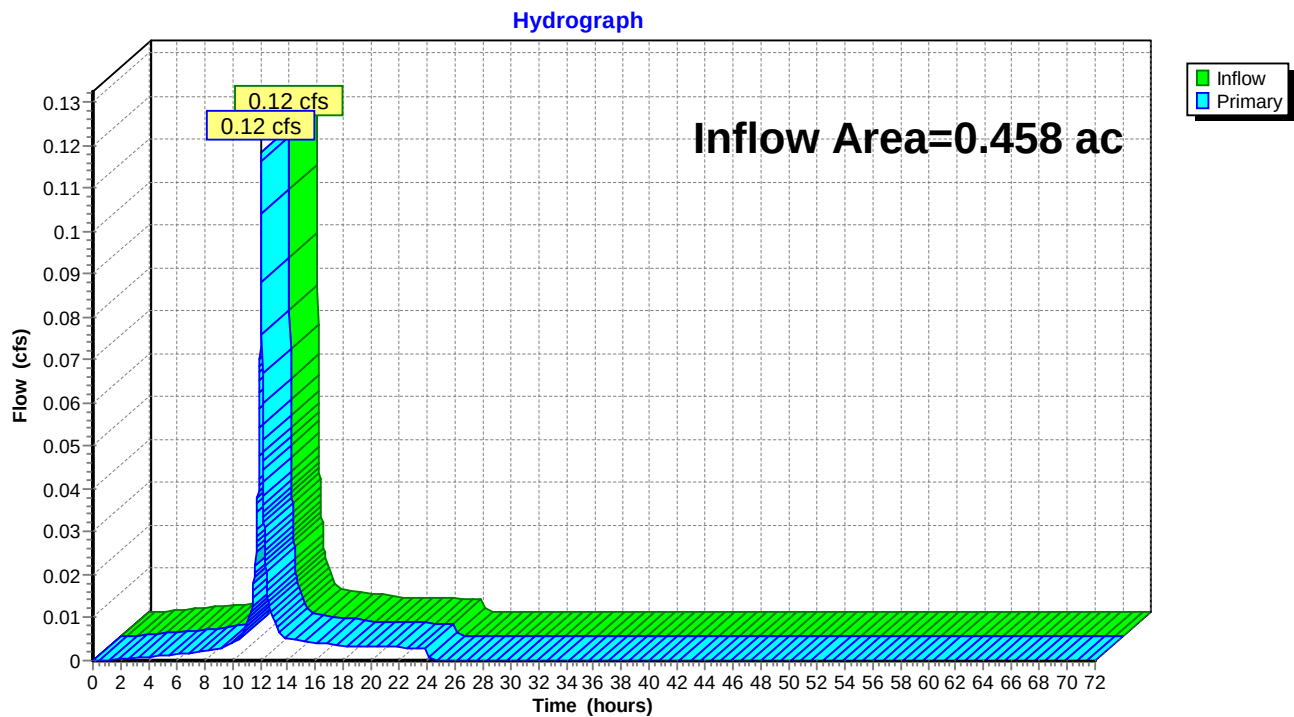
Hydrograph



Summary for Link 18L: Bypass Total

Inflow Area = 0.458 ac, 5.77% Impervious, Inflow Depth = 0.25" for 2-Year F event
Inflow = 0.12 cfs @ 12.10 hrs, Volume= 0.010 af
Primary = 0.12 cfs @ 12.10 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 18L: Bypass Total

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NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.00 cfs @ 21.37 hrs, Volume= 0.001 af, Depth= 0.04"

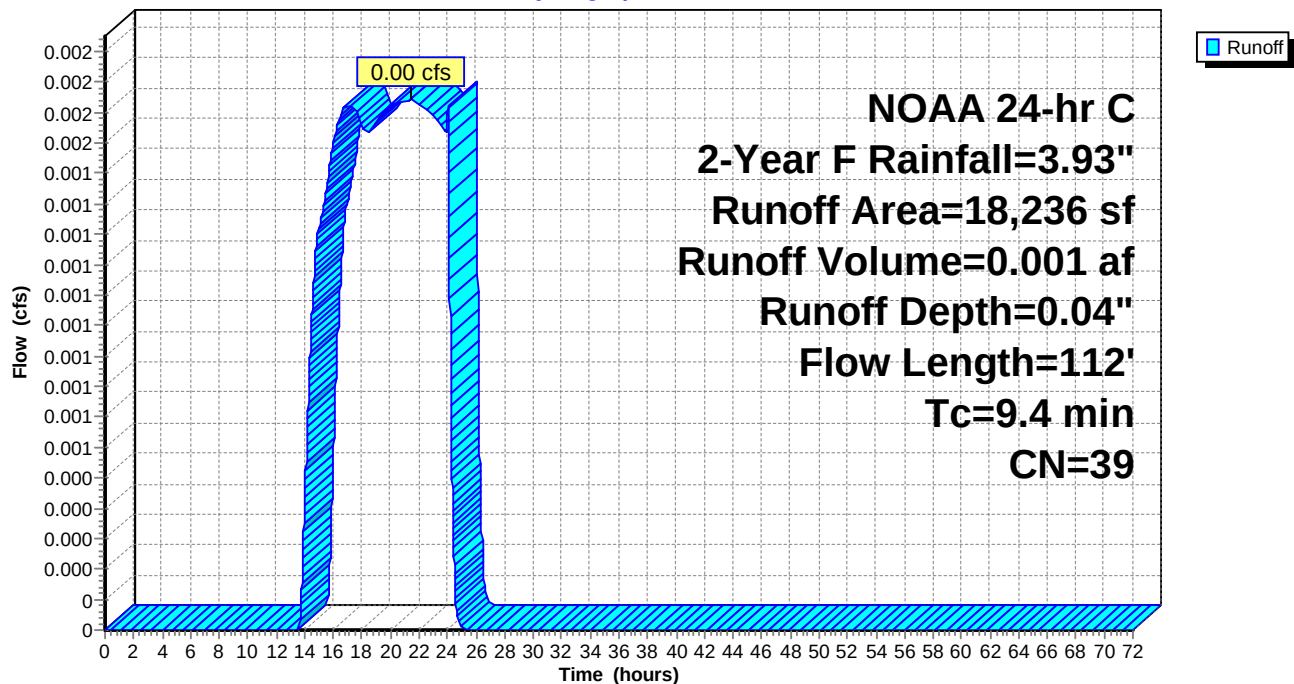
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 2-Year F Rainfall=3.93"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 2.01 cfs @ 12.11 hrs, Volume= 0.142 af, Depth= 3.70"

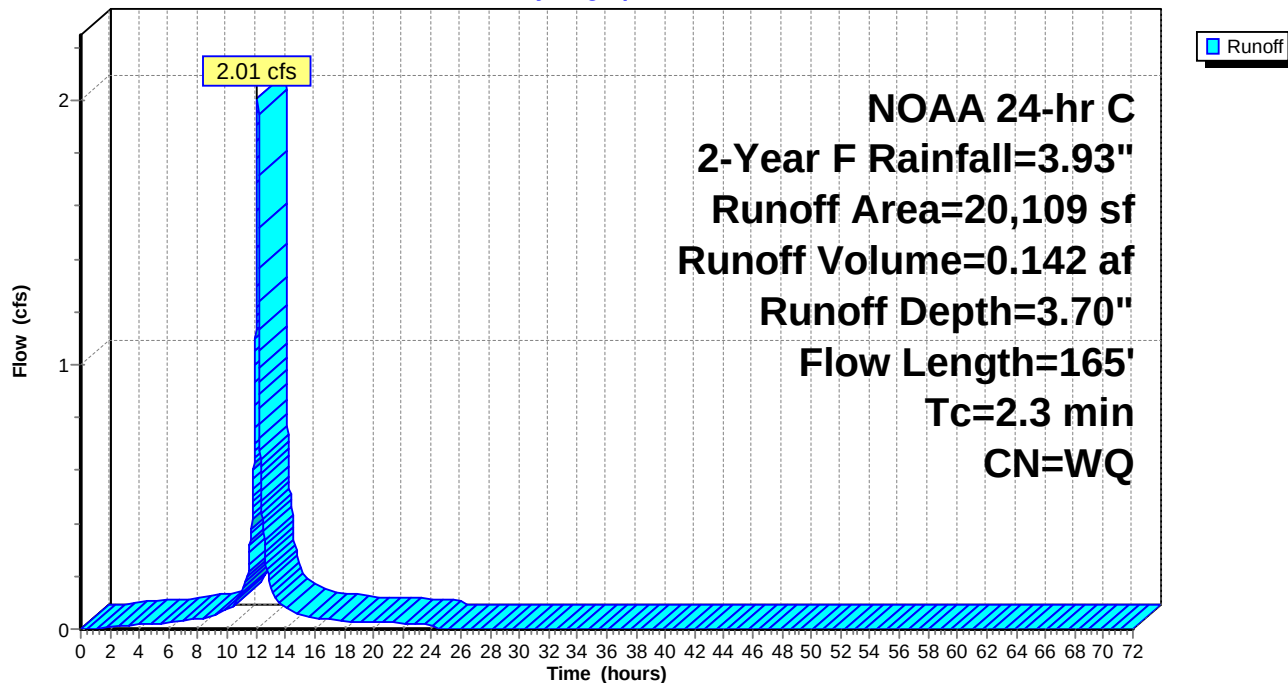
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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Summary for Subcatchment 20S: POI-1 BYPASS PERV

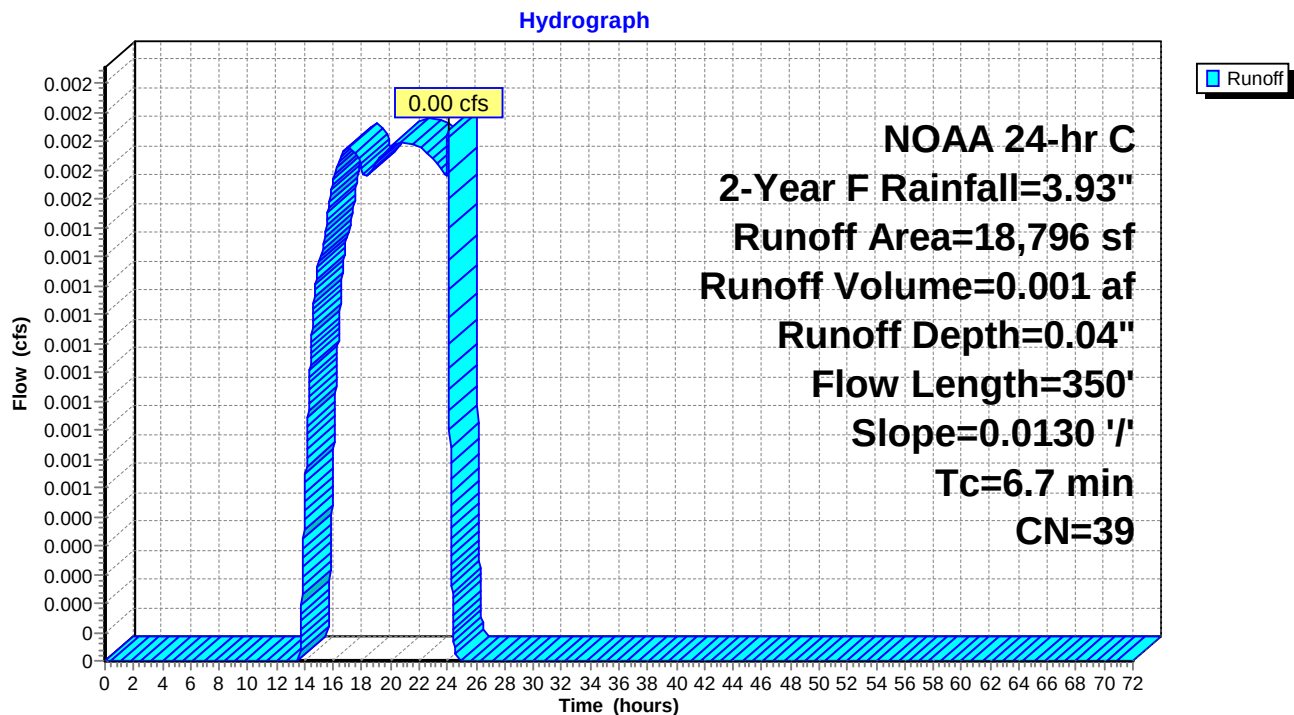
Runoff = 0.00 cfs @ 24.02 hrs, Volume= 0.001 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
18,796	39	>75% Grass cover, Good, HSG A
18,796	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	31	0.0130	0.12		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
2.3	319	0.0130	2.31		Shallow Concentrated Flow, P2-P3
					Paved Kv= 20.3 fps
6.7	350	Total			

Subcatchment 20S: POI-1 BYPASS PERV



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Summary for Subcatchment 21S: POI-1 BYPASS IMP

Runoff = 0.12 cfs @ 12.10 hrs, Volume= 0.008 af, Depth= 3.70"

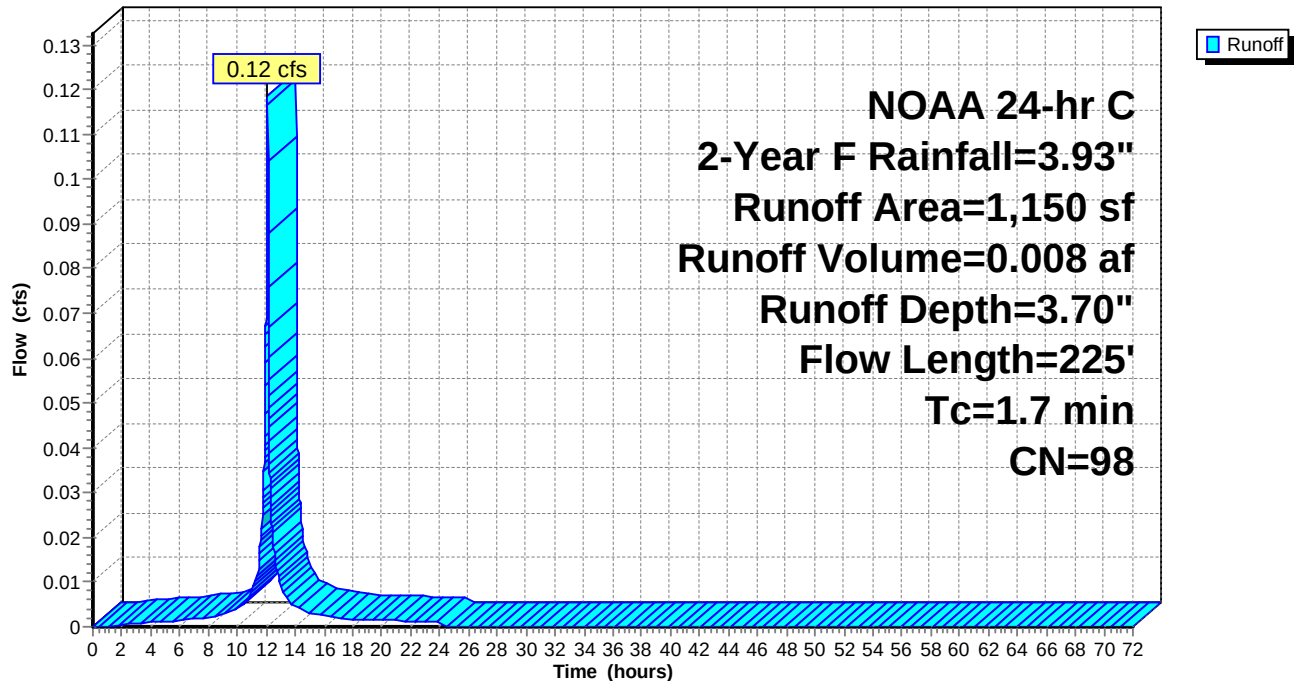
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 2-Year F Rainfall=3.93"

Area (sf)	CN	Description
1,150	98	Paved parking, HSG A
1,150	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	9	0.0740	1.47		Sheet Flow, I1-I2
					Smooth surfaces n= 0.011 P2= 3.38"
1.6	216	0.0130	2.31		Shallow Concentrated Flow, I2-I3
					Paved Kv= 20.3 fps
1.7	225	Total			

Subcatchment 21S: POI-1 BYPASS IMP

Hydrograph

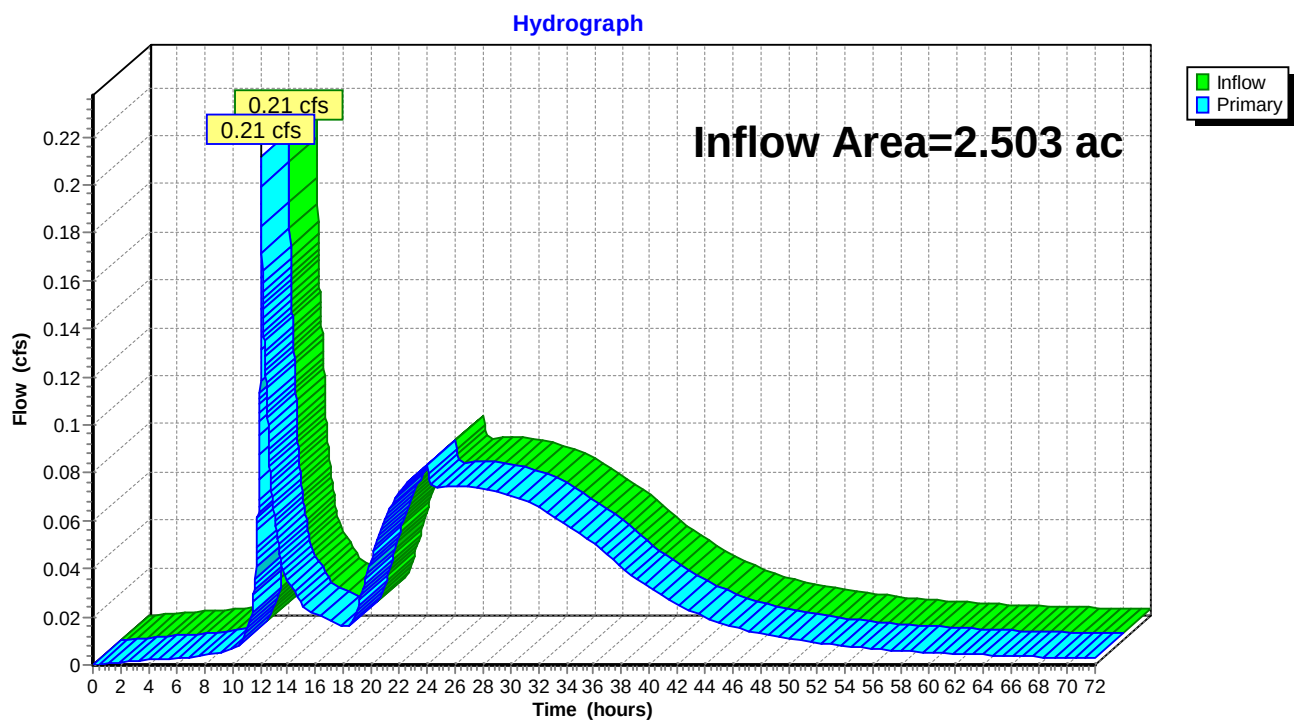


Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 47.02% Impervious, Inflow Depth > 0.76" for 10-Year F event
Inflow = 0.21 cfs @ 12.11 hrs, Volume= 0.159 af
Primary = 0.21 cfs @ 12.11 hrs, Volume= 0.159 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 0.09 cfs @ 12.35 hrs, Volume= 0.021 af, Depth= 0.54"

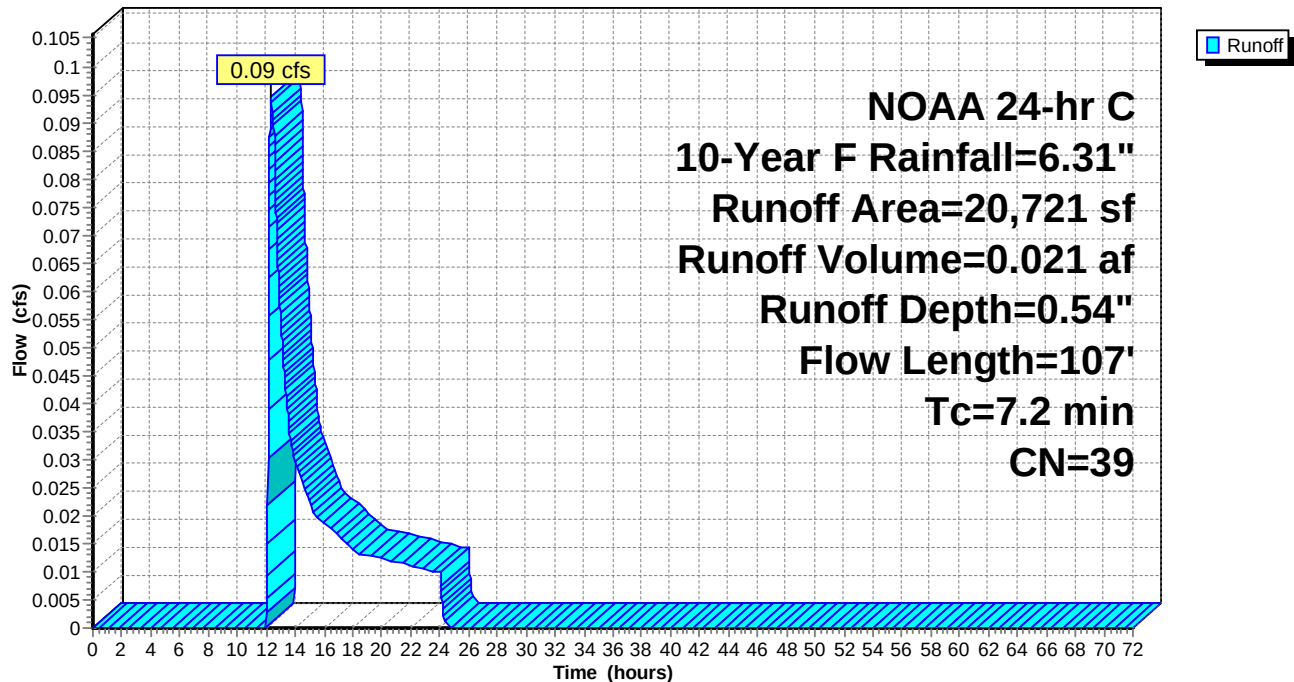
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 5.01 cfs @ 12.10 hrs, Volume= 0.348 af, Depth= 6.07"

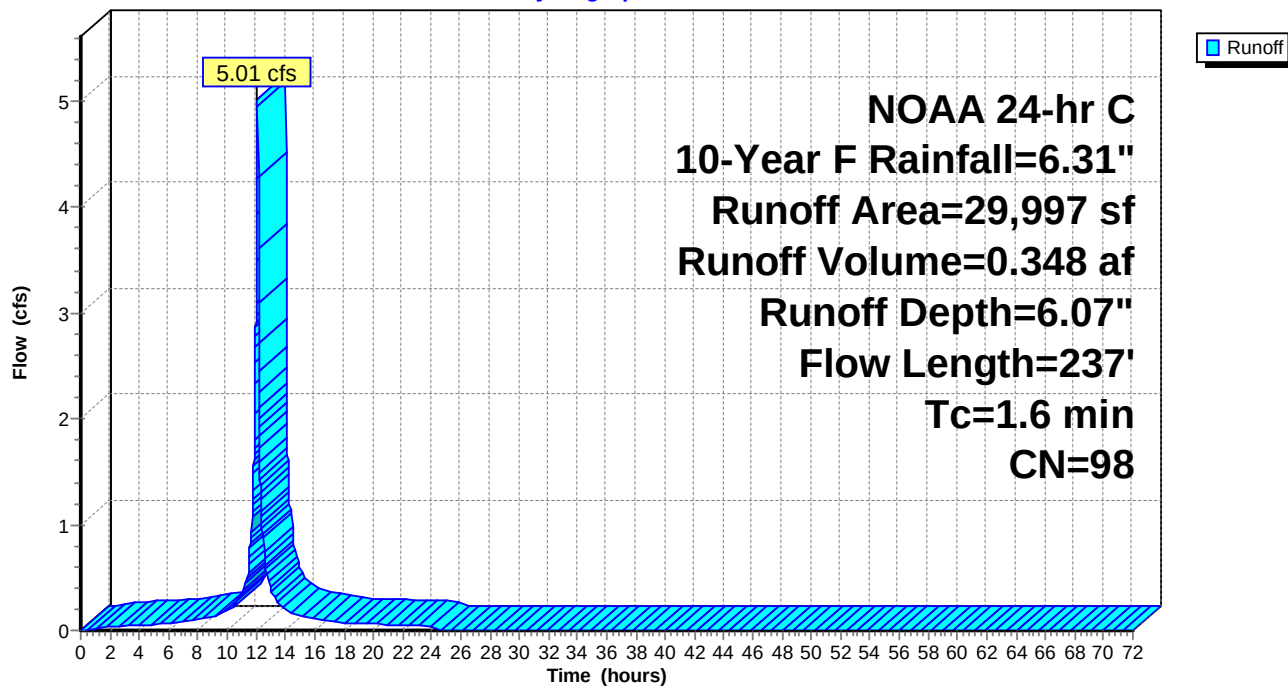
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 3.81" for 10-Year F event
 Inflow = 5.02 cfs @ 12.10 hrs, Volume= 0.370 af
 Outflow = 0.10 cfs @ 17.30 hrs, Volume= 0.150 af, Atten= 98%, Lag= 312.1 min
 Primary = 0.10 cfs @ 17.30 hrs, Volume= 0.150 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.67' @ 17.30 hrs Surf.Area= 7,467 sf Storage= 12,782 cf

Plug-Flow detention time= 842.0 min calculated for 0.150 af (41% of inflow)
 Center-of-Mass det. time= 677.0 min (1,431.6 - 754.6)

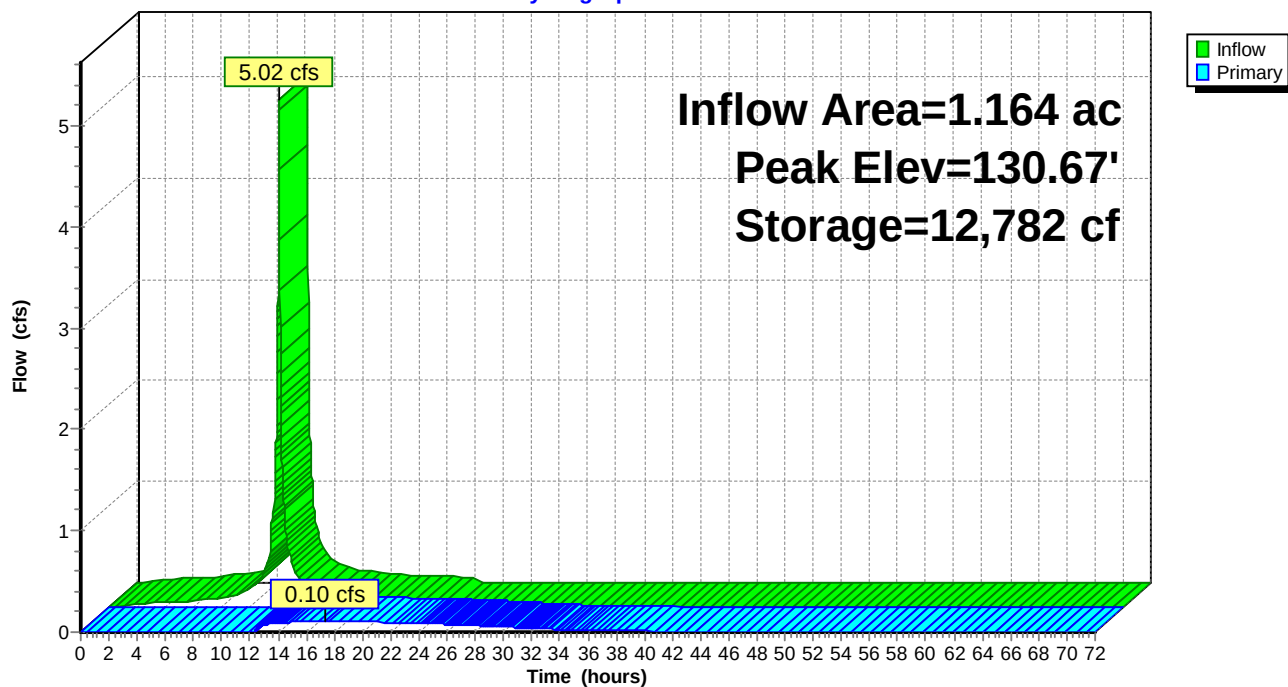
Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 ' / Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.10 cfs @ 17.30 hrs HW=130.67' TW=129.72' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.10 cfs of 3.00 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.10 cfs @ 2.93 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1**Hydrograph**

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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 2.36" for 10-Year F event
 Inflow = 3.24 cfs @ 12.11 hrs, Volume= 0.403 af
 Outflow = 0.07 cfs @ 26.23 hrs, Volume= 0.127 af, Atten= 98%, Lag= 847.4 min
 Primary = 0.07 cfs @ 26.23 hrs, Volume= 0.127 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.09' @ 26.23 hrs Surf.Area= 7,444 sf Storage= 14,029 cf

Plug-Flow detention time= 1,379.8 min calculated for 0.127 af (31% of inflow)
 Center-of-Mass det. time= 987.4 min (1,997.8 - 1,010.4)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.07 cfs @ 26.23 hrs HW=130.09' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.07 cfs of 10.41 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.07 cfs @ 2.18 fps)
 ↑ **3=Orifice/Grate** (Controls 0.00 cfs)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

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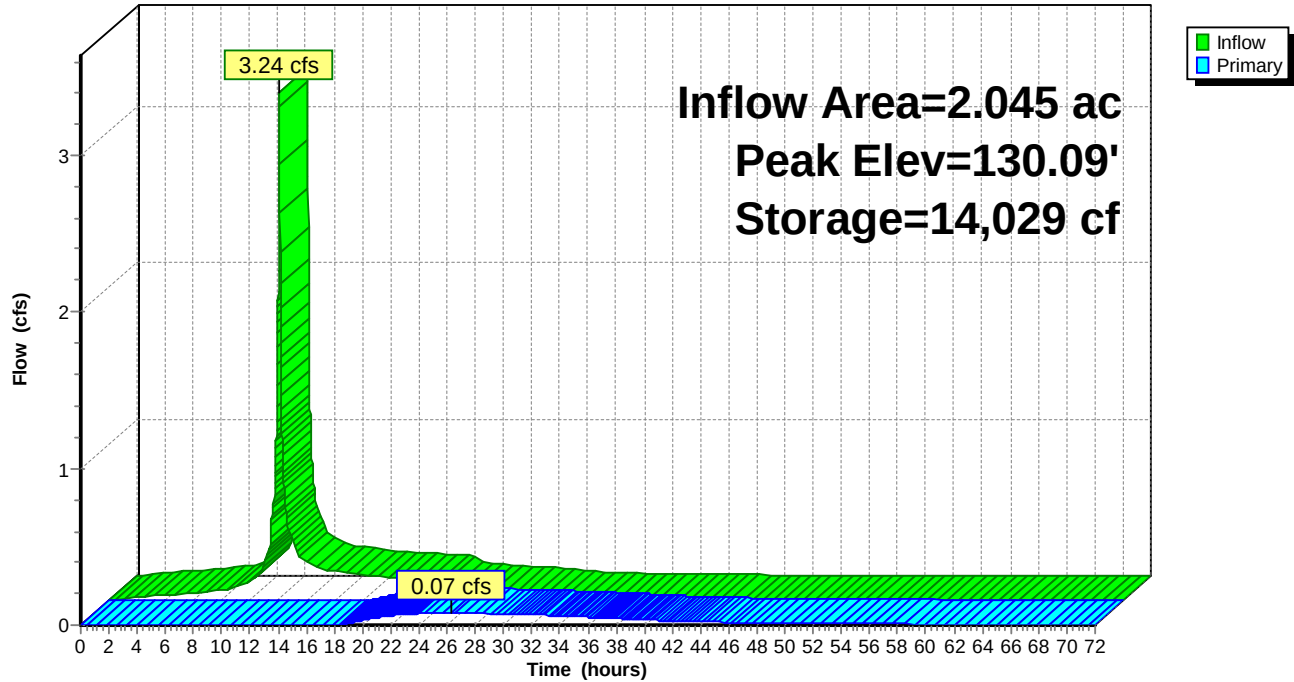
NOAA 24-hr C 10-Year F Rainfall=6.31"

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Pond 17P: BASIN 2

Hydrograph



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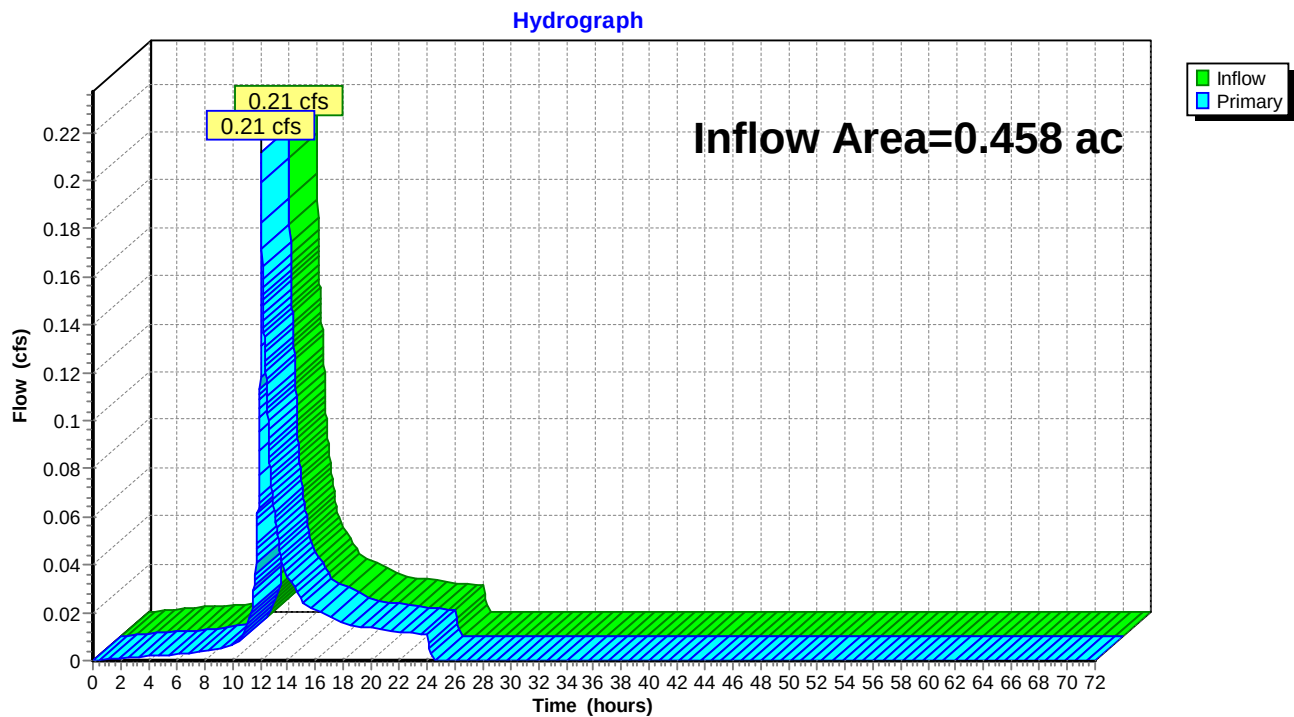
Page 21

Summary for Link 18L: Bypass Total

Inflow Area = 0.458 ac, 5.77% Impervious, Inflow Depth = 0.86" for 10-Year F event
Inflow = 0.21 cfs @ 12.11 hrs, Volume= 0.033 af
Primary = 0.21 cfs @ 12.11 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 18L: Bypass Total



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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 0.08 cfs @ 12.53 hrs, Volume= 0.019 af, Depth= 0.54"

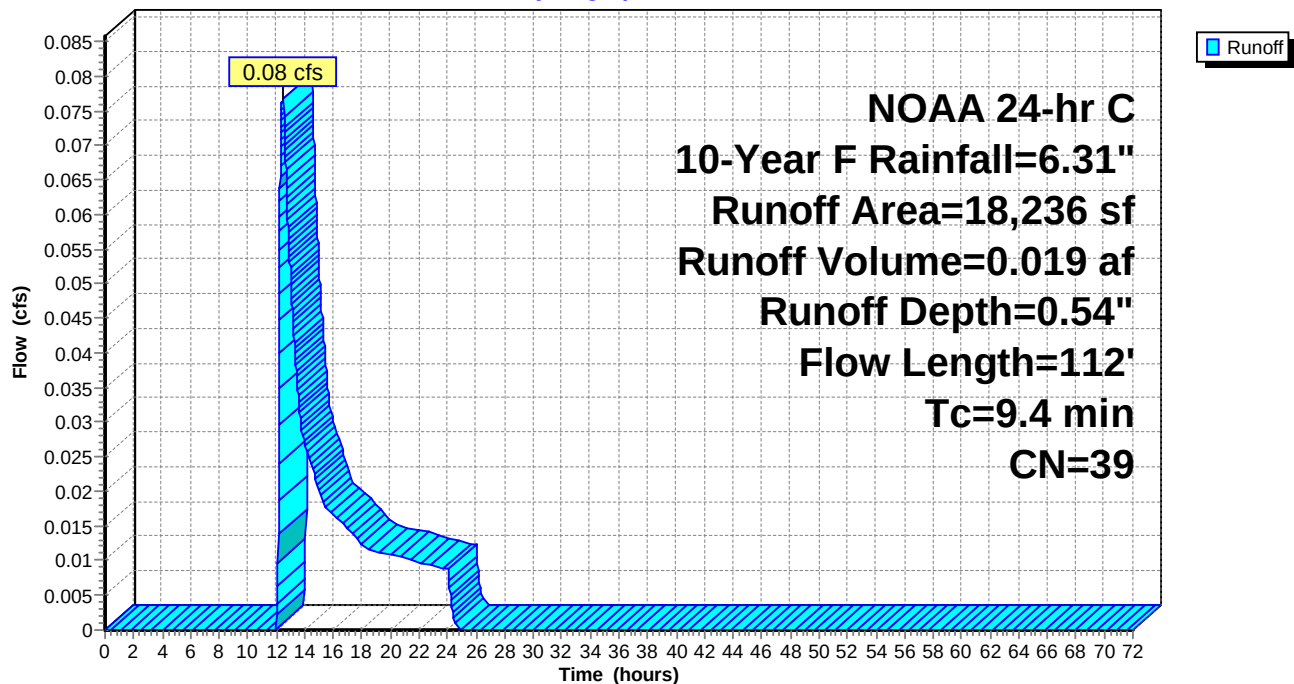
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 3.24 cfs @ 12.11 hrs, Volume= 0.234 af, Depth= 6.07"

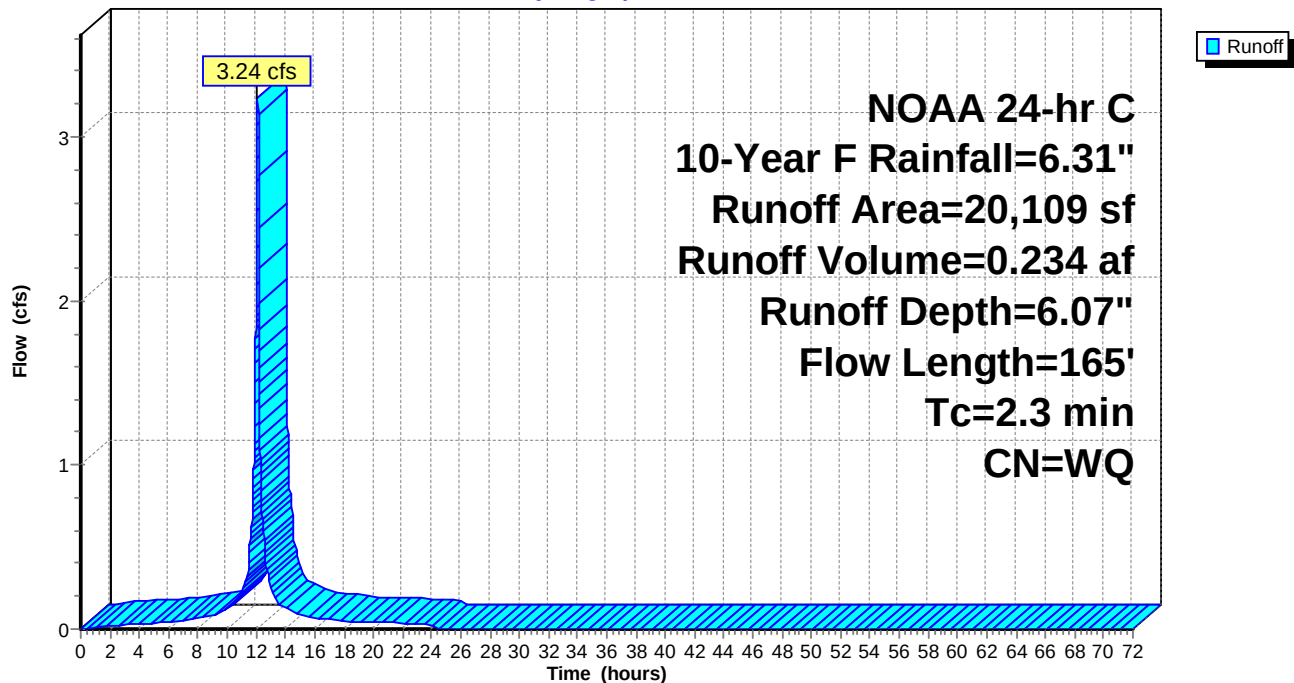
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Subcatchment 20S: POI-1 BYPASS PERV

Runoff = 0.09 cfs @ 12.34 hrs, Volume= 0.019 af, Depth= 0.54"

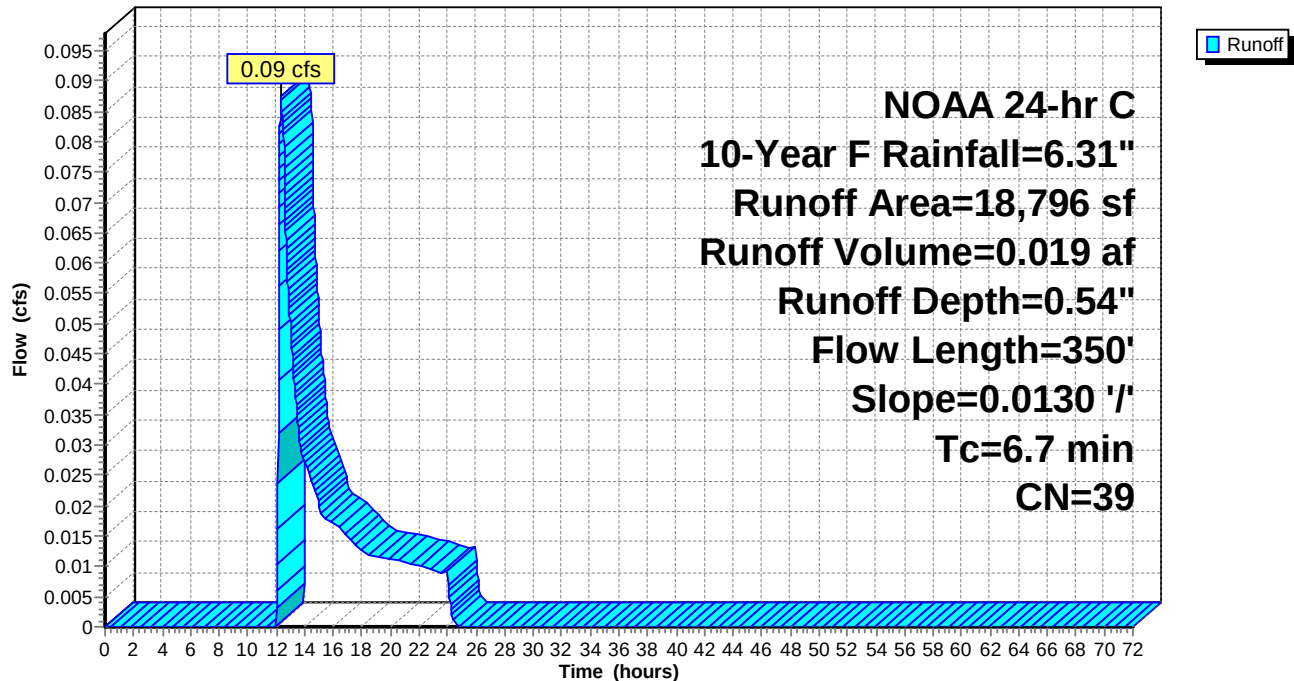
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
18,796	39	>75% Grass cover, Good, HSG A
18,796	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	31	0.0130	0.12		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
2.3	319	0.0130	2.31		Shallow Concentrated Flow, P2-P3
					Paved Kv= 20.3 fps
6.7	350	Total			

Subcatchment 20S: POI-1 BYPASS PERV

Hydrograph



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NOAA 24-hr C 10-Year F Rainfall=6.31"

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Summary for Subcatchment 21S: POI-1 BYPASS IMP

Runoff = 0.19 cfs @ 12.10 hrs, Volume= 0.013 af, Depth= 6.07"

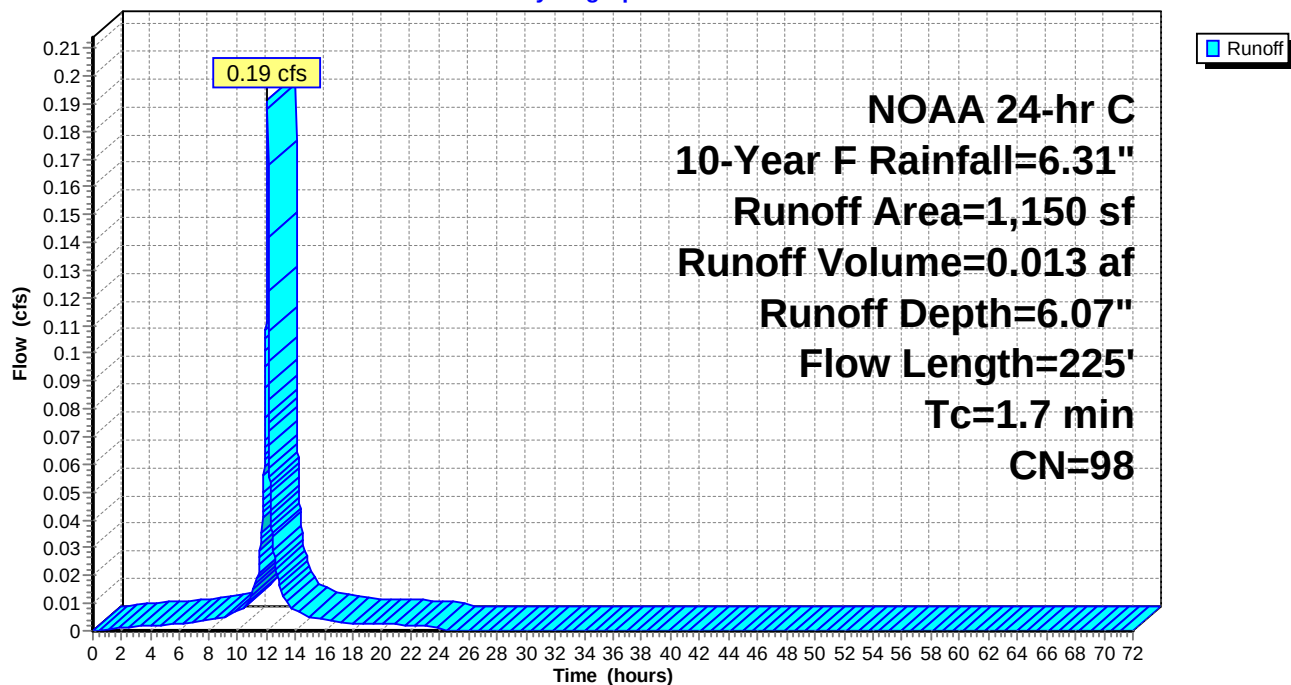
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-Year F Rainfall=6.31"

Area (sf)	CN	Description
1,150	98	Paved parking, HSG A
1,150	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	9	0.0740	1.47		Sheet Flow, I1-I2
					Smooth surfaces n= 0.011 P2= 3.38"
1.6	216	0.0130	2.31		Shallow Concentrated Flow, I2-I3
					Paved Kv= 20.3 fps
1.7	225	Total			

Subcatchment 21S: POI-1 BYPASS IMP

Hydrograph



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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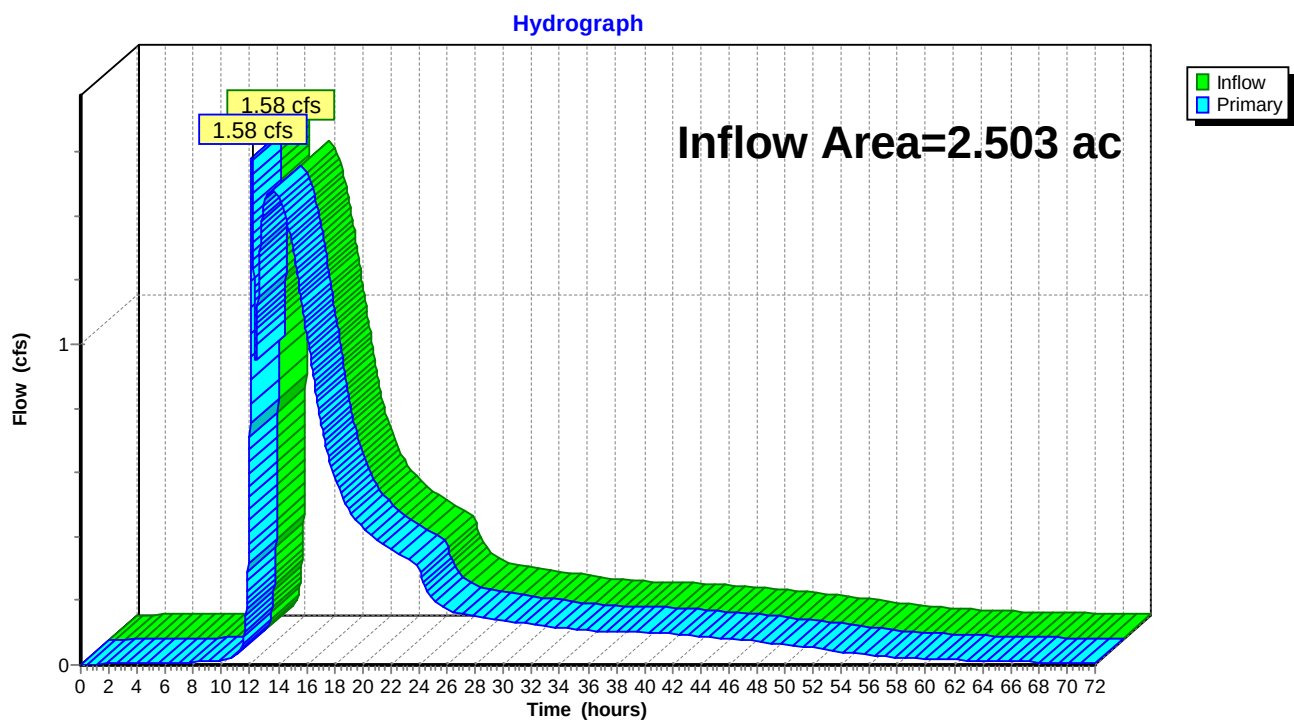
Summary for Pond 10P: POST TEST - POI #1 (SW Prop Corner)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.503 ac, 47.02% Impervious, Inflow Depth > 5.16" for 100-Year F event
Inflow = 1.58 cfs @ 12.15 hrs, Volume= 1.075 af
Primary = 1.58 cfs @ 12.15 hrs, Volume= 1.075 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 10P: POST TEST - POI #1 (SW Prop Corner)



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Subcatchment 11S: DA-1 PERV

Runoff = 1.46 cfs @ 12.16 hrs, Volume= 0.137 af, Depth= 3.46"

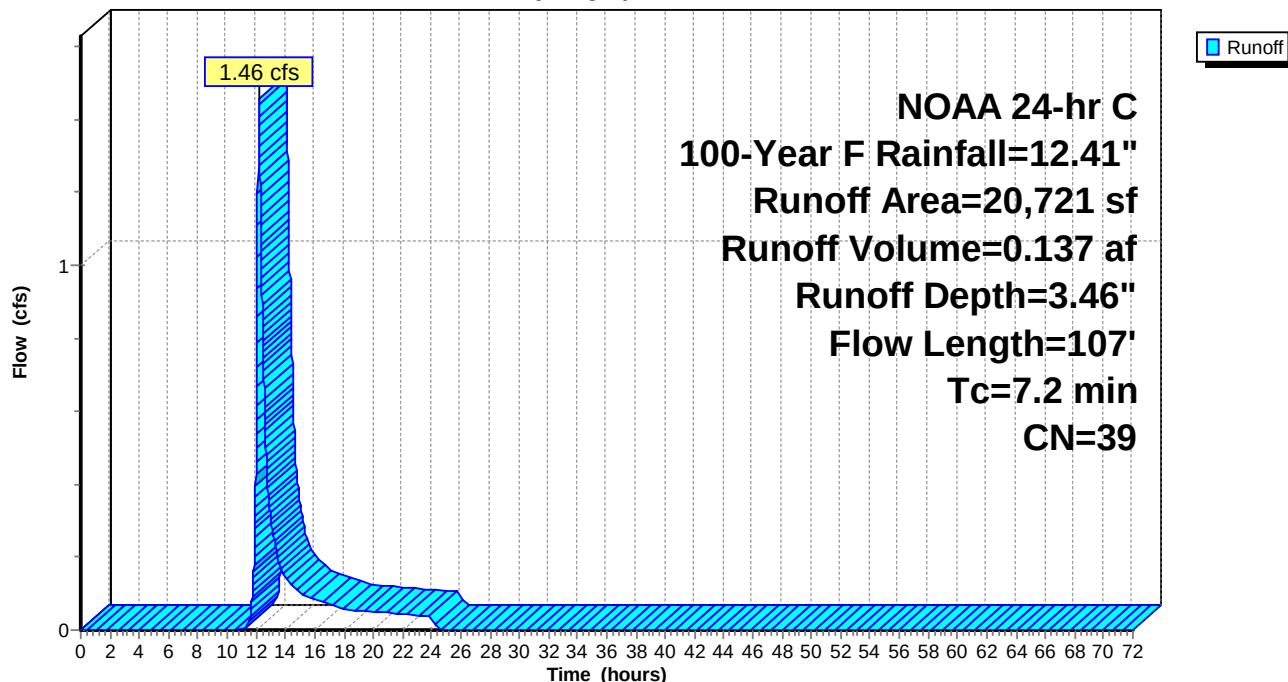
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV

Hydrograph



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 9.87 cfs @ 12.10 hrs, Volume= 0.698 af, Depth=12.17"

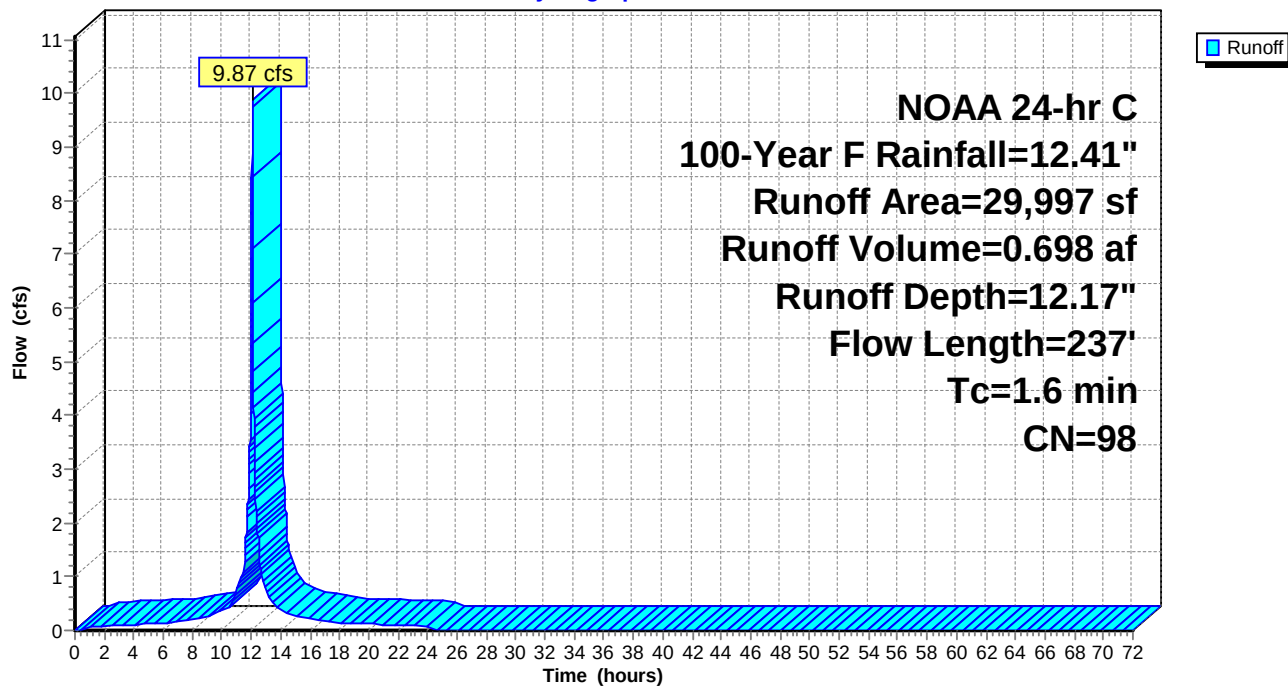
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



Pre&Post Development

NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 8.61" for 100-Year F event
 Inflow = 10.98 cfs @ 12.10 hrs, Volume= 0.835 af
 Outflow = 1.03 cfs @ 12.99 hrs, Volume= 0.615 af, Atten= 91%, Lag= 53.4 min
 Primary = 1.03 cfs @ 12.99 hrs, Volume= 0.615 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 131.88' @ 13.03 hrs Surf.Area= 9,549 sf Storage= 22,989 cf

Plug-Flow detention time= 639.9 min calculated for 0.615 af (74% of inflow)
 Center-of-Mass det. time= 541.2 min (1,299.1 - 757.9)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

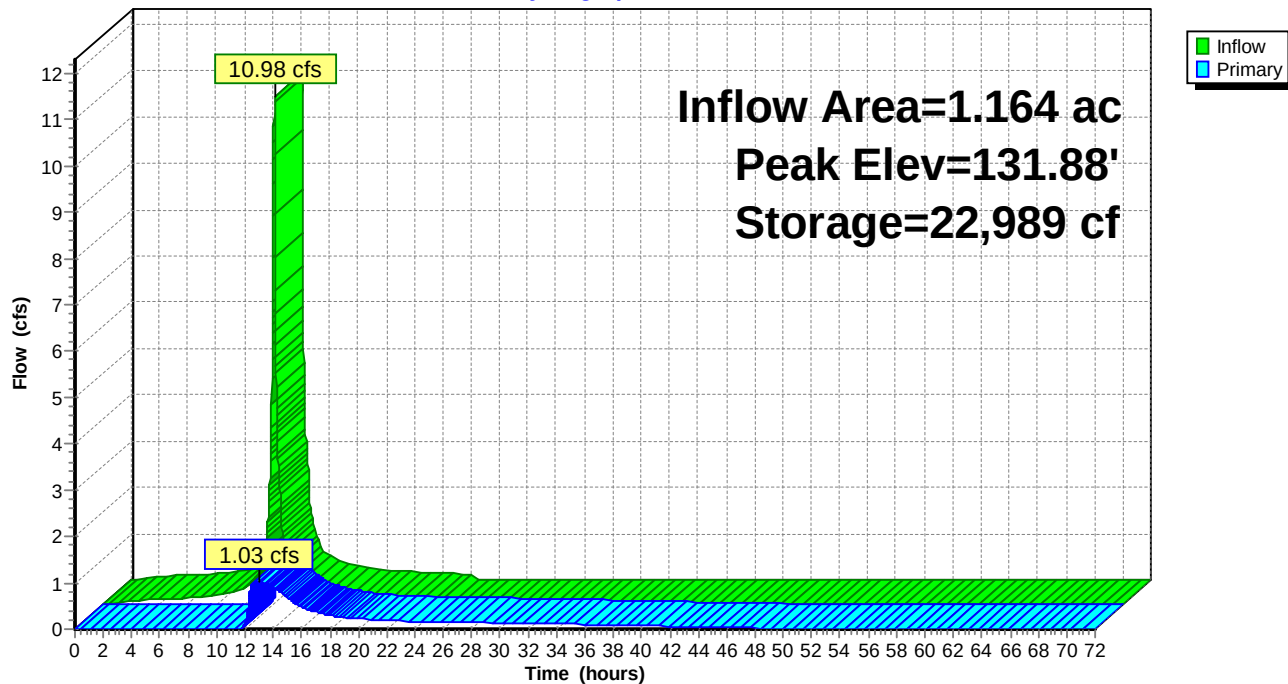
Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.03 cfs @ 12.99 hrs HW=131.88' TW=130.72' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 1.03 cfs of 4.01 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 5.17 fps)
 ↑ **3=Orifice/Grate** (Orifice Controls 0.85 cfs @ 3.06 fps)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 16P: BASIN 1

Hydrograph



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth > 7.06" for 100-Year F event
 Inflow = 7.32 cfs @ 12.11 hrs, Volume= 1.203 af
 Outflow = 1.32 cfs @ 13.90 hrs, Volume= 0.924 af, Atten= 82%, Lag= 107.8 min
 Primary = 1.32 cfs @ 13.90 hrs, Volume= 0.924 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 130.84' @ 13.90 hrs Surf.Area= 7,991 sf Storage= 19,800 cf

Plug-Flow detention time= 592.2 min calculated for 0.924 af (77% of inflow)
 Center-of-Mass det. time= 355.2 min (1,393.2 - 1,038.0)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

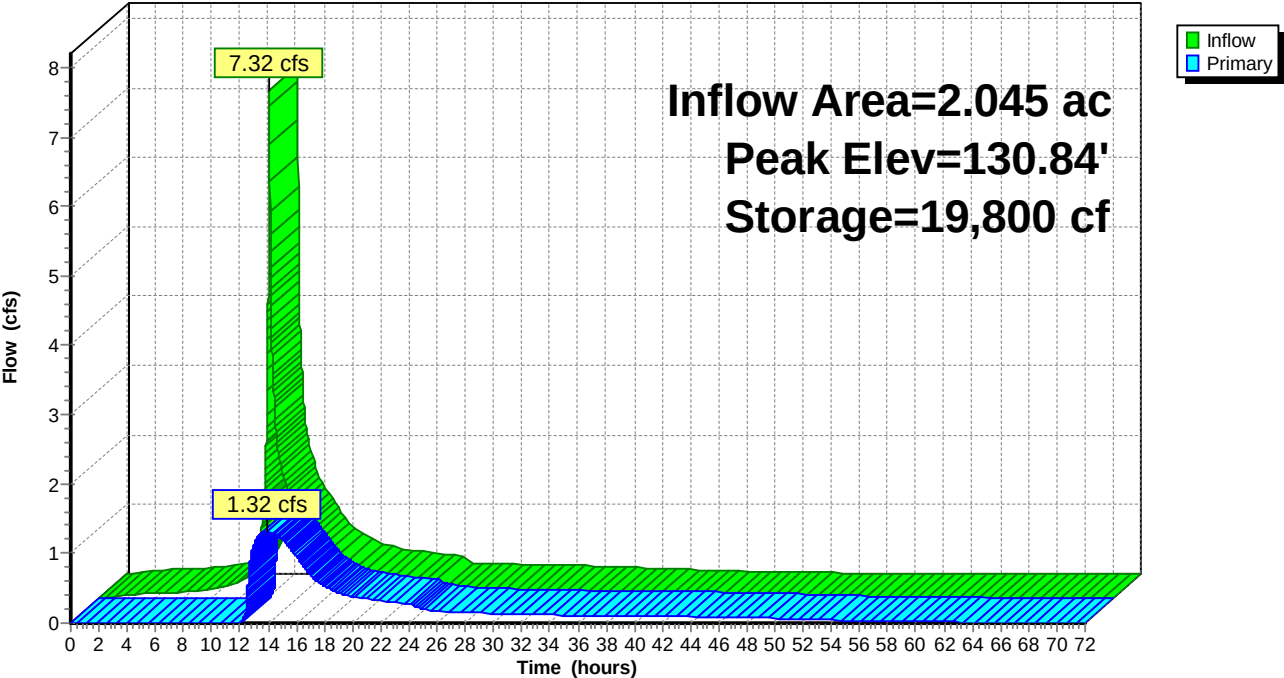
Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.32 cfs @ 13.90 hrs HW=130.84' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 1.32 cfs of 11.28 cfs potential flow)
 ↑ **2=Orifice/Grate** (Orifice Controls 0.16 cfs @ 4.70 fps)
 ↑ **3=Orifice/Grate** (Orifice Controls 1.16 cfs @ 3.08 fps)
 ↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Pond 17P: BASIN 2

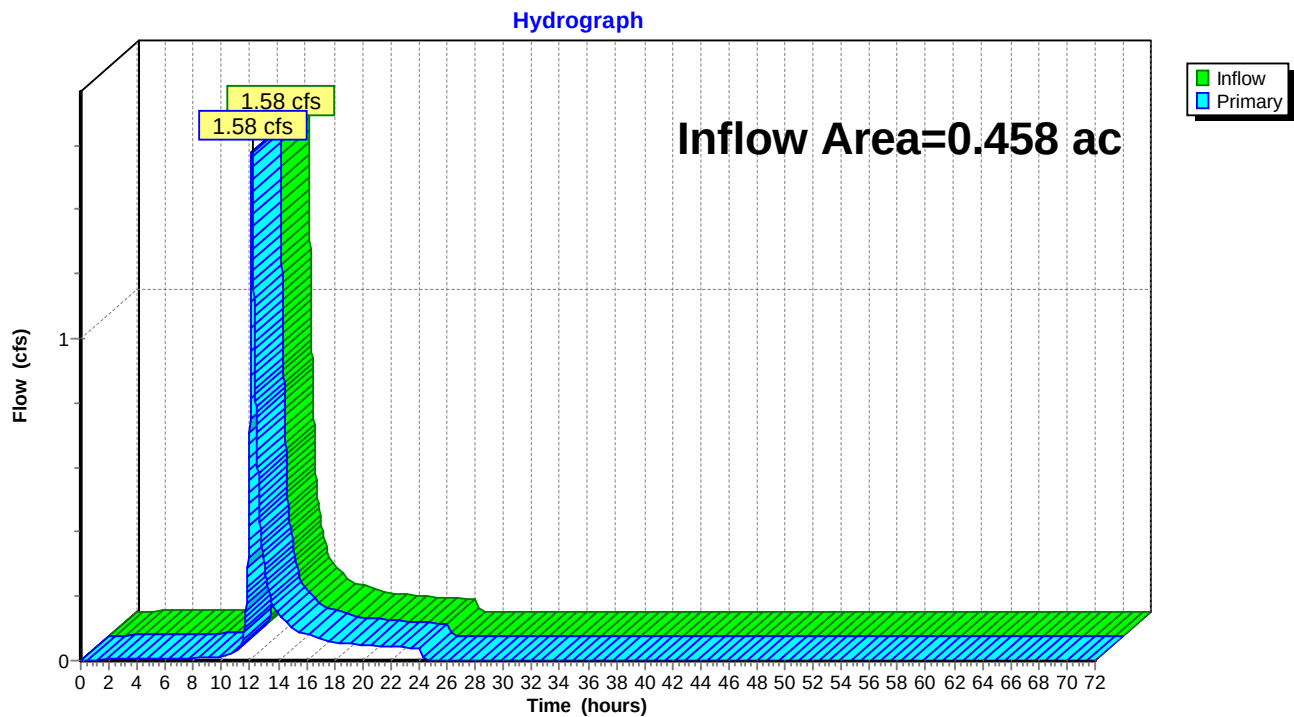
Hydrograph



Summary for Link 18L: Bypass Total

Inflow Area = 0.458 ac, 5.77% Impervious, Inflow Depth = 3.96" for 100-Year F event
Inflow = 1.58 cfs @ 12.14 hrs, Volume= 0.151 af
Primary = 1.58 cfs @ 12.14 hrs, Volume= 0.151 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 18L: Bypass Total

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Summary for Subcatchment 18S: DA-2 PERV

Runoff = 1.12 cfs @ 12.20 hrs, Volume= 0.121 af, Depth= 3.46"

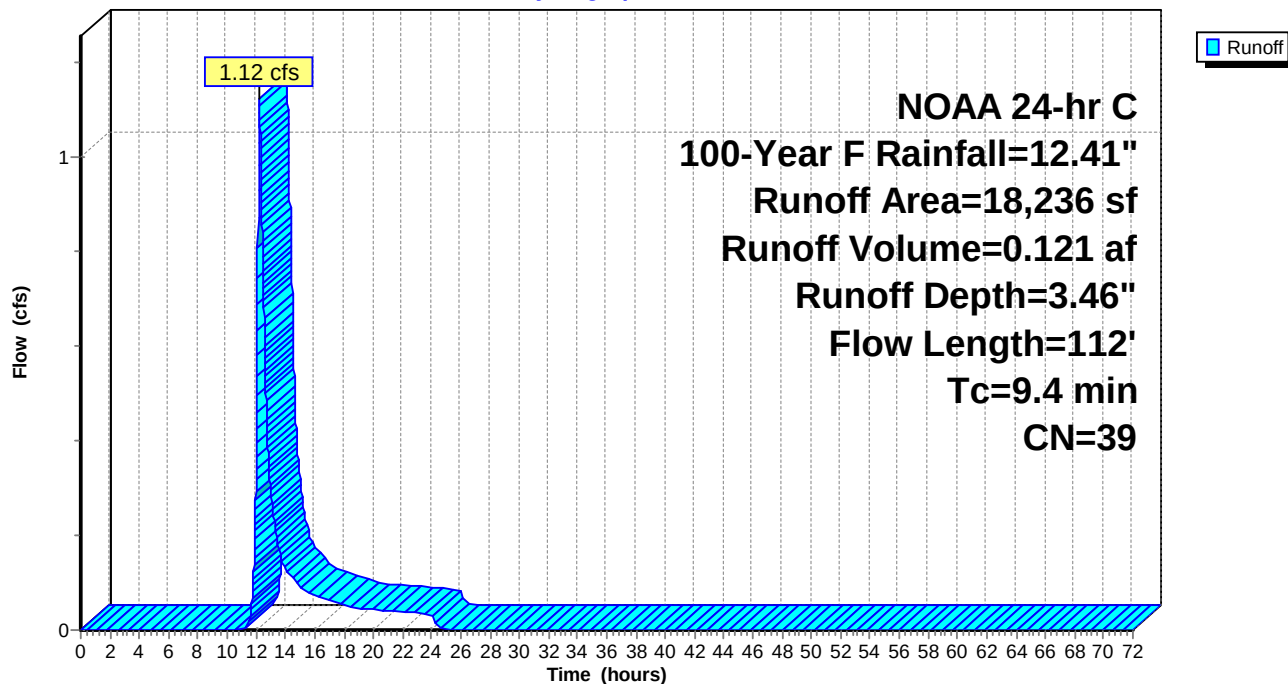
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3
					Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4
					Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV

Hydrograph



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Subcatchment 19S: DA-2 IMP

Runoff = 6.38 cfs @ 12.11 hrs, Volume= 0.468 af, Depth=12.17"

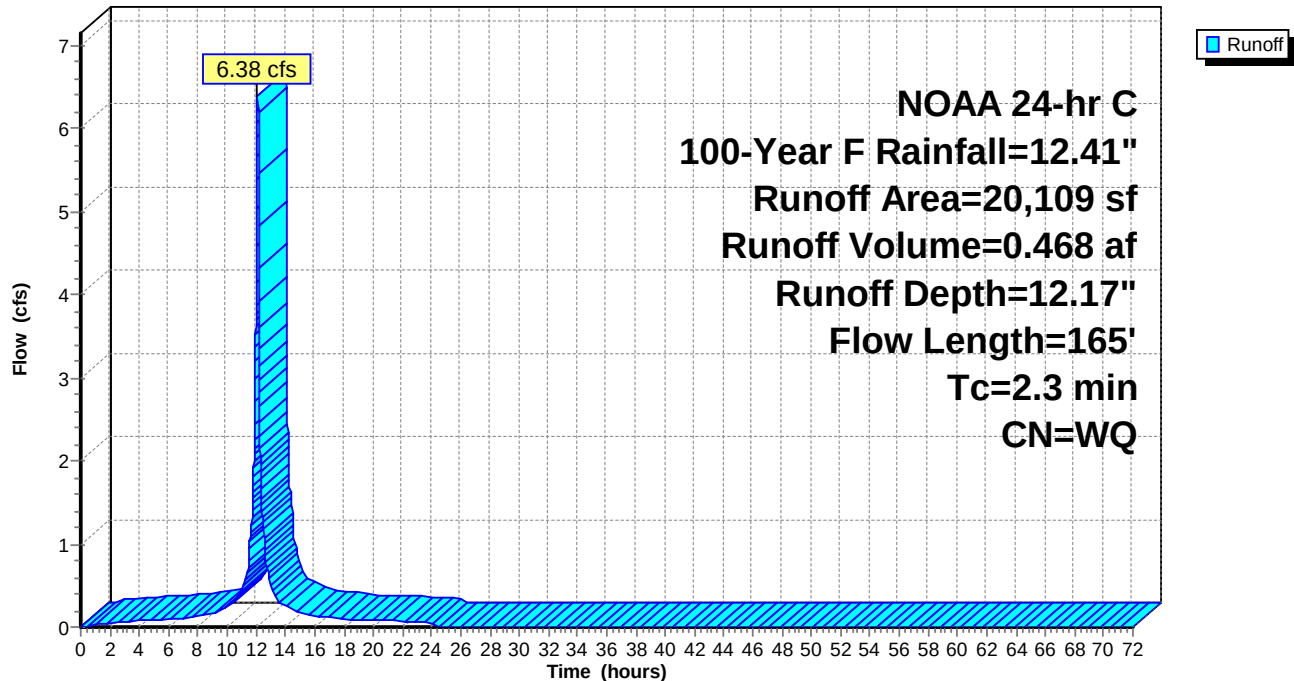
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

Hydrograph



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Summary for Subcatchment 20S: POI-1 BYPASS PERV

Runoff = 1.37 cfs @ 12.16 hrs, Volume= 0.124 af, Depth= 3.46"

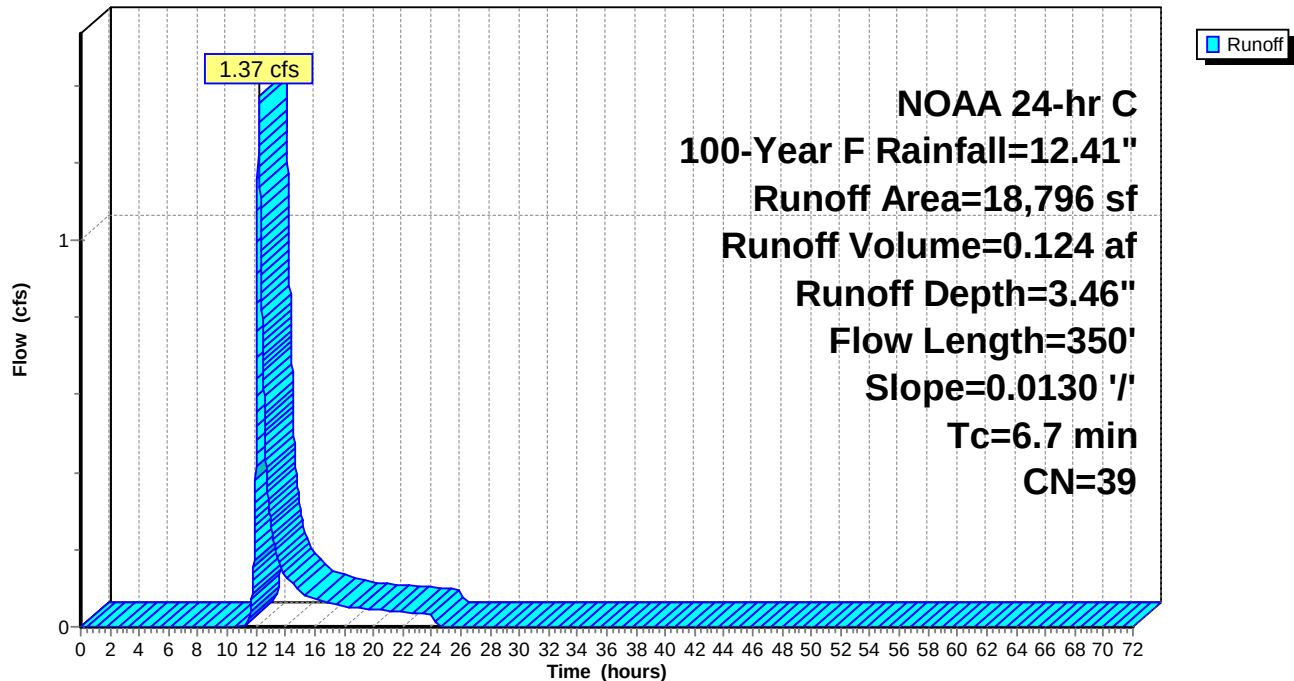
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
18,796	39	>75% Grass cover, Good, HSG A
18,796	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	31	0.0130	0.12		Sheet Flow, P1-P2
					Grass: Short n= 0.150 P2= 3.38"
2.3	319	0.0130	2.31		Shallow Concentrated Flow, P2-P3
					Paved Kv= 20.3 fps
6.7	350	Total			

Subcatchment 20S: POI-1 BYPASS PERV

Hydrograph



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NOAA 24-hr C 100-Year F Rainfall=12.41"

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Summary for Subcatchment 21S: POI-1 BYPASS IMP

Runoff = 0.38 cfs @ 12.10 hrs, Volume= 0.027 af, Depth=12.17"

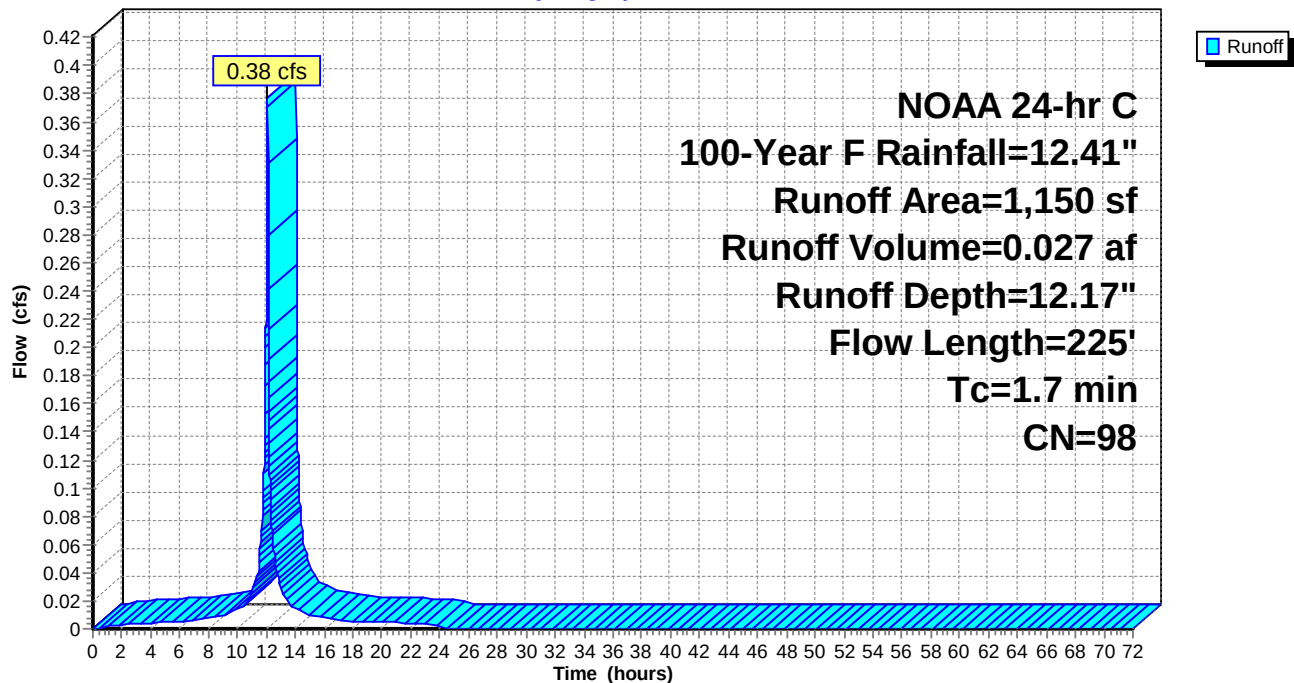
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-Year F Rainfall=12.41"

Area (sf)	CN	Description
1,150	98	Paved parking, HSG A
1,150	98	100.00% Impervious Area

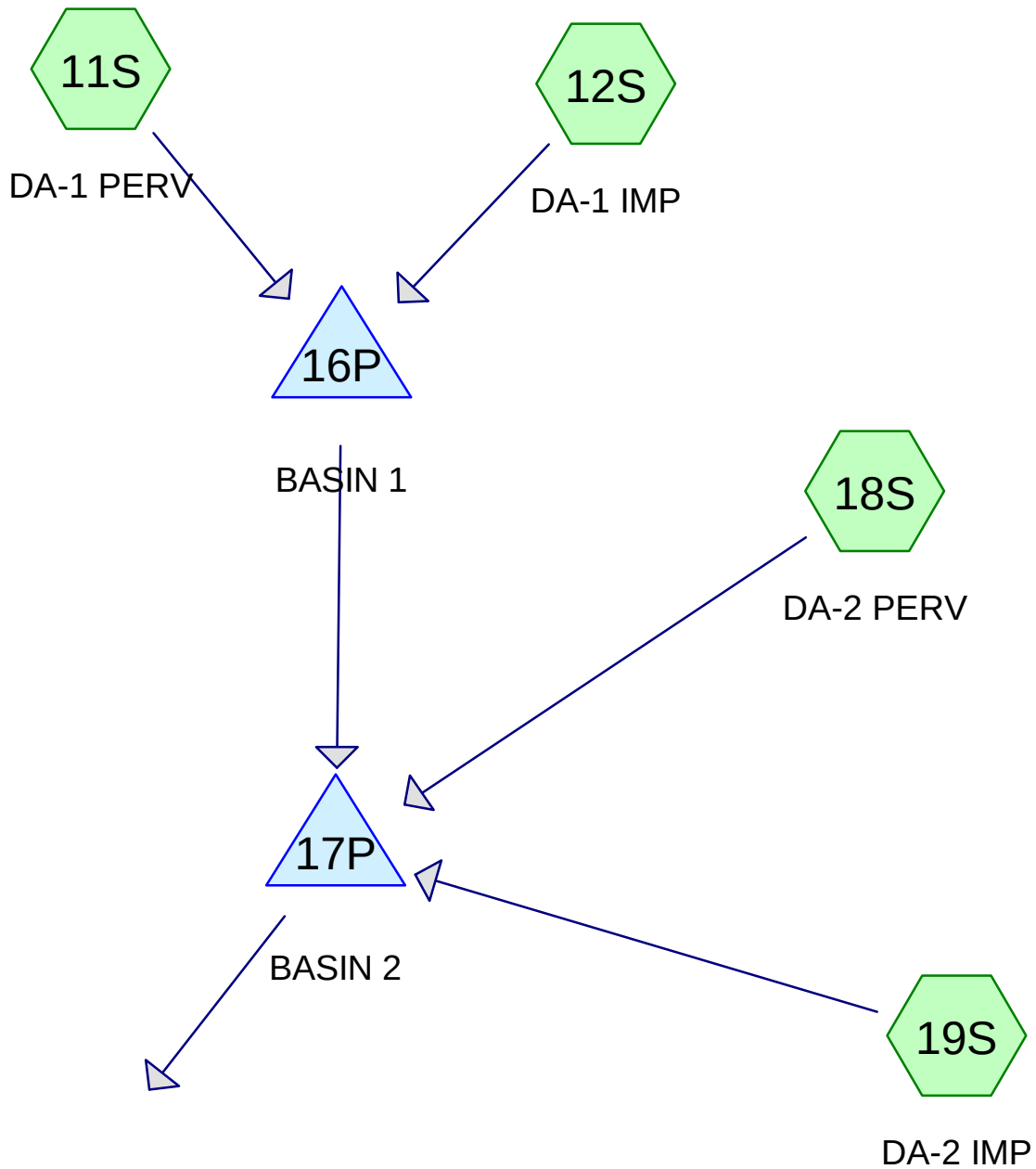
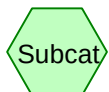
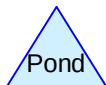
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	9	0.0740	1.47		Sheet Flow, I1-I2
					Smooth surfaces n= 0.011 P2= 3.38"
1.6	216	0.0130	2.31		Shallow Concentrated Flow, I2-I3
					Paved Kv= 20.3 fps
1.7	225	Total			

Subcatchment 21S: POI-1 BYPASS IMP

Hydrograph



Water Quality Storm



Routing Diagram for Pre&Post Development

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NJ DEP 2-hr WQ Rainfall=1.25"

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Summary for Subcatchment 11S: DA-1 PERV

[45] Hint: Runoff=Zero

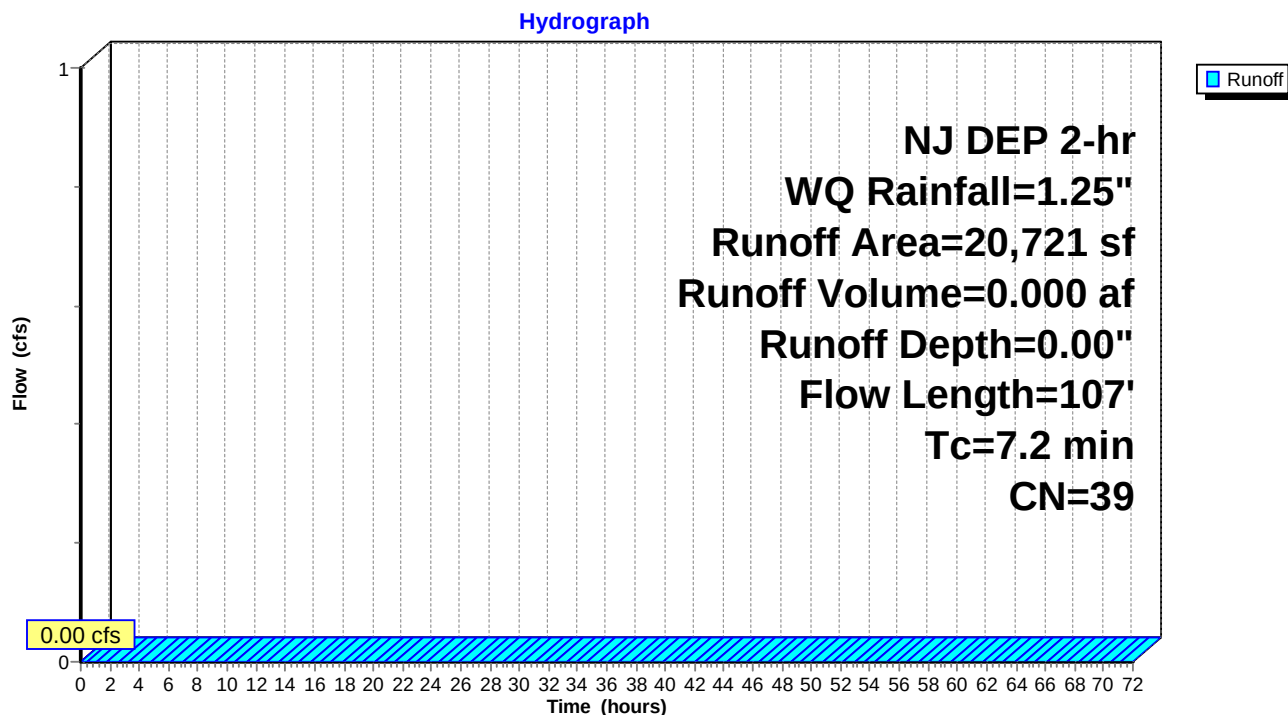
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

Area (sf)	CN	Description
20,721	39	>75% Grass cover, Good, HSG A
20,721	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	51	0.0530	0.23		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
3.3	49	0.0660	0.24		Sheet Flow, P2-P3 Grass: Short n= 0.150 P2= 3.38"
0.1	7	0.0660	1.80		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
7.2	107	Total			

Subcatchment 11S: DA-1 PERV



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NJ DEP 2-hr WQ Rainfall=1.25"

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Summary for Subcatchment 12S: DA-1 IMP

Runoff = 2.11 cfs @ 1.08 hrs, Volume= 0.059 af, Depth= 1.03"

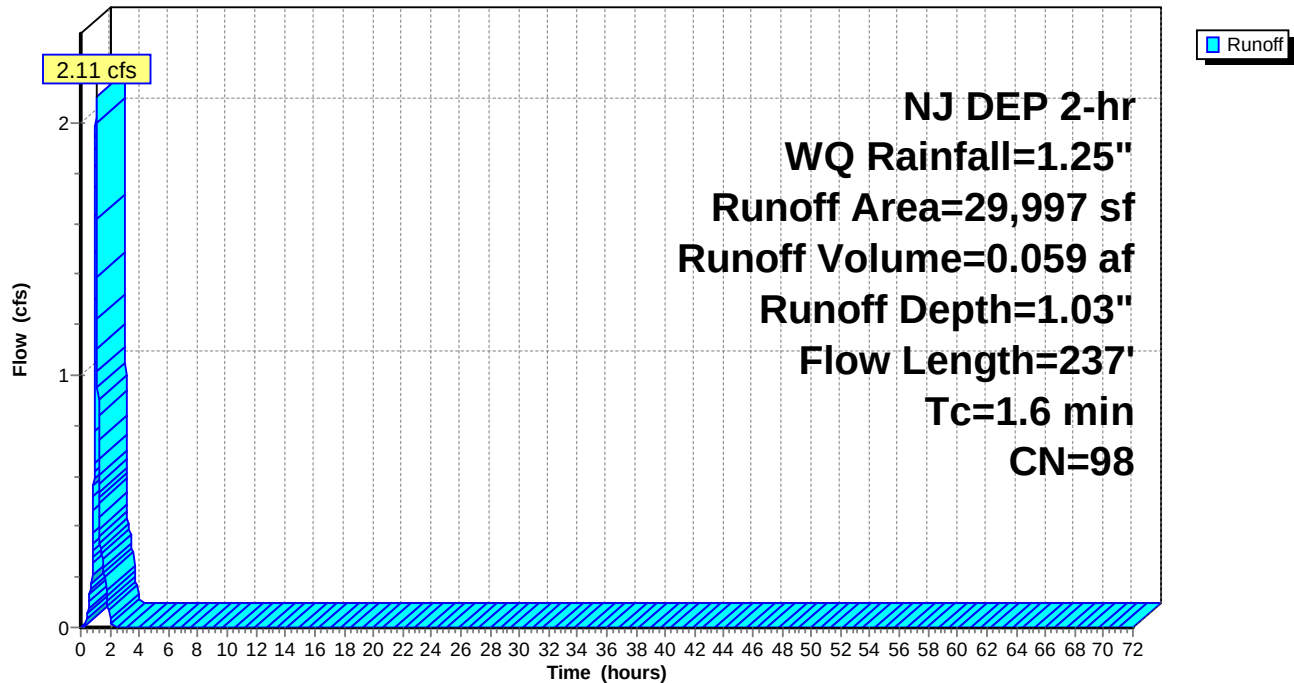
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

Area (sf)	CN	Description
29,997	98	Paved parking, HSG A
29,997	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, I2-I3 Paved Kv= 20.3 fps
0.4	123	0.0081	5.35	9.45	Pipe Channel, I3-I4 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
1.6	237	Total			

Subcatchment 12S: DA-1 IMP

Hydrograph



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NJ DEP 2-hr WQ Rainfall=1.25"

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Summary for Pond 16P: BASIN 1

Inflow Area = 1.164 ac, 59.14% Impervious, Inflow Depth = 0.61" for WQ event
Inflow = 2.11 cfs @ 1.08 hrs, Volume= 0.059 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 129.04' @ 2.19 hrs Surf.Area= 5,107 sf Storage= 2,586 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.50'	24,169 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.50	4,447	0	0
129.00	5,051	2,375	2,375
130.00	6,406	5,729	8,103
131.00	7,979	7,193	15,296
132.00	9,768	8,874	24,169

Device	Routing	Invert	Outlet Devices
#1	Primary	129.50'	15.0" Round Culvert L= 234.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 129.50' / 128.00' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	130.20'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	131.30'	10.0" W x 4.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	131.88'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.50' TW=128.00' (Dynamic Tailwater)

↑ **1=Culvert** (Controls 0.00 cfs)
↑ **2=Orifice/Grate** (Controls 0.00 cfs)
↑ **3=Orifice/Grate** (Controls 0.00 cfs)
↑ **4=Orifice/Grate** (Controls 0.00 cfs)

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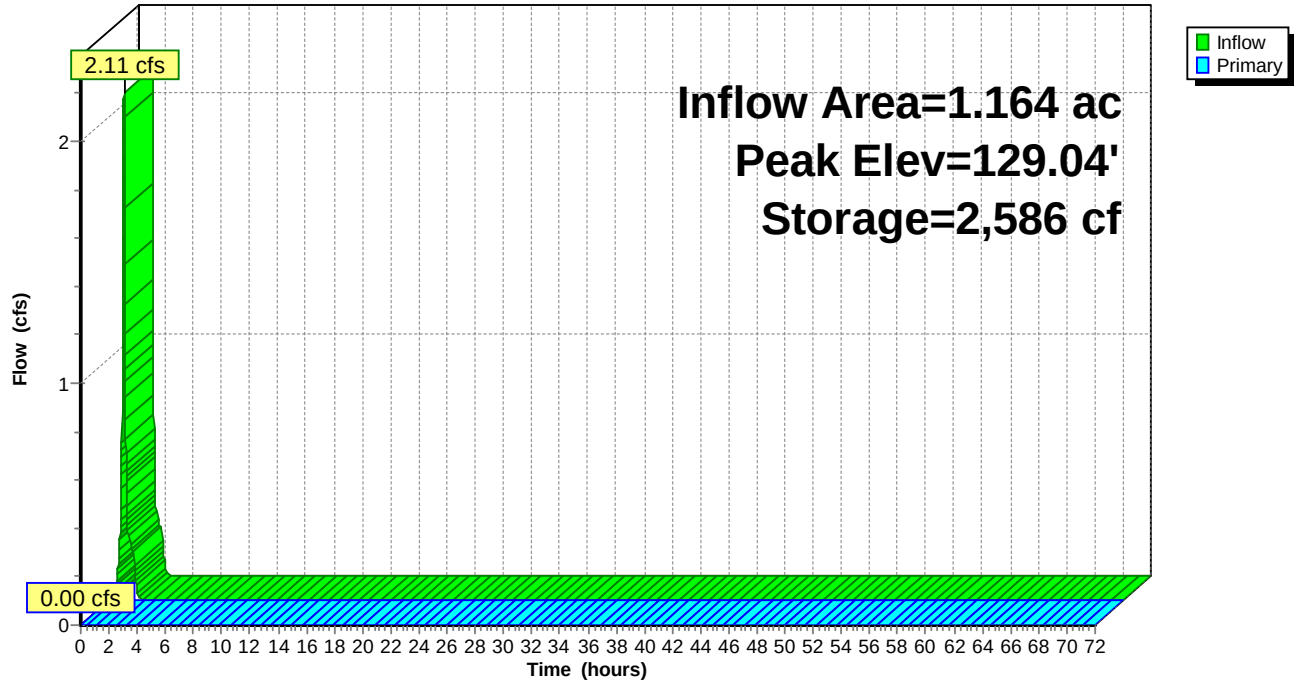
NJ DEP 2-hr WQ Rainfall=1.25"

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Page 5

Pond 16P: BASIN 1

Hydrograph



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NJ DEP 2-hr WQ Rainfall=1.25"

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Summary for Pond 17P: BASIN 2

Inflow Area = 2.045 ac, 56.26% Impervious, Inflow Depth = 0.23" for WQ event
Inflow = 1.39 cfs @ 1.09 hrs, Volume= 0.040 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 128.28' @ 2.26 hrs Surf.Area= 6,191 sf Storage= 1,734 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	128.00'	21,107 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
128.00	5,999	0	0
129.00	6,674	6,337	6,337
130.00	7,378	7,026	13,363
131.00	8,110	7,744	21,107

Device	Routing	Invert	Outlet Devices
#1	Primary	125.20'	15.0" Round Culvert L= 100.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 125.20' / 124.56' S= 0.0064 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	129.78'	2.5" Vert. Orifice/Grate C= 0.600
#3	Device 1	130.30'	18.0" W x 3.0" H Vert. Orifice/Grate C= 0.600
#4	Device 1	130.84'	24.0" x 48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=128.00' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.00 cfs of 7.45 cfs potential flow)

↑ **2=Orifice/Grate** (Controls 0.00 cfs)

↑ **3=Orifice/Grate** (Controls 0.00 cfs)

↑ **4=Orifice/Grate** (Controls 0.00 cfs)

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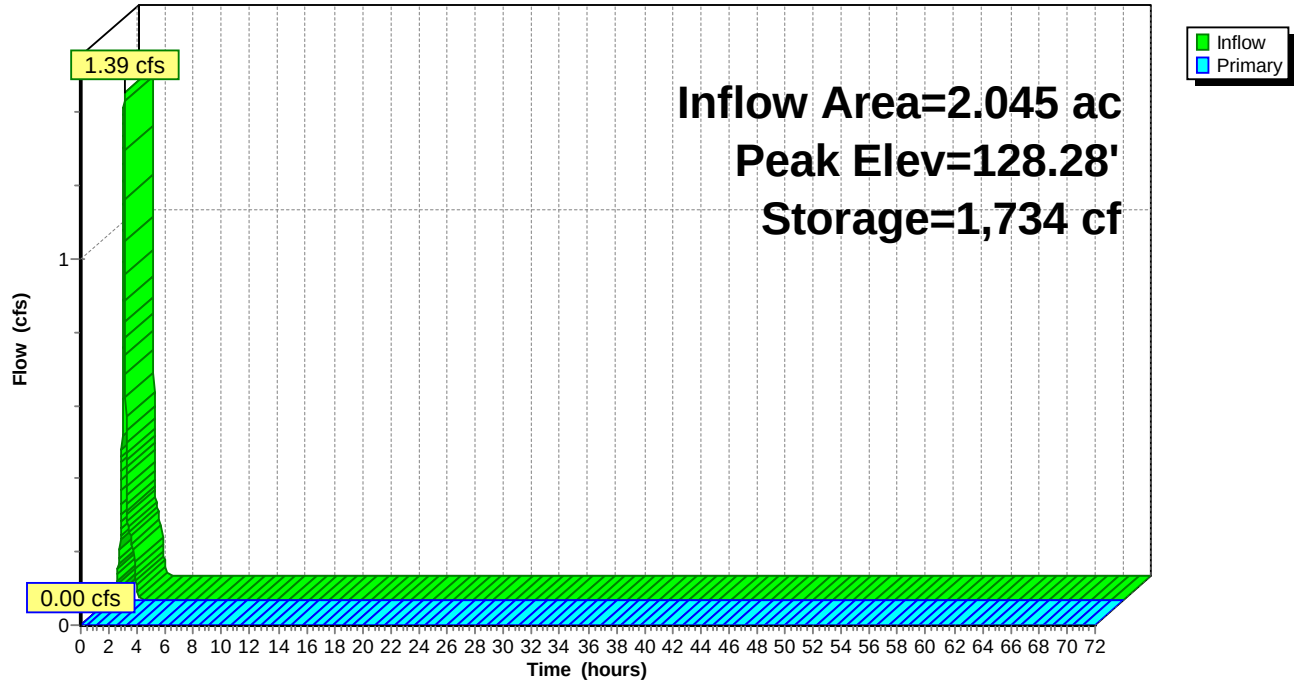
NJ DEP 2-hr WQ Rainfall=1.25"

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Pond 17P: BASIN 2

Hydrograph



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NJ DEP 2-hr WQ Rainfall=1.25"

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Summary for Subcatchment 18S: DA-2 PERV

[45] Hint: Runoff=Zero

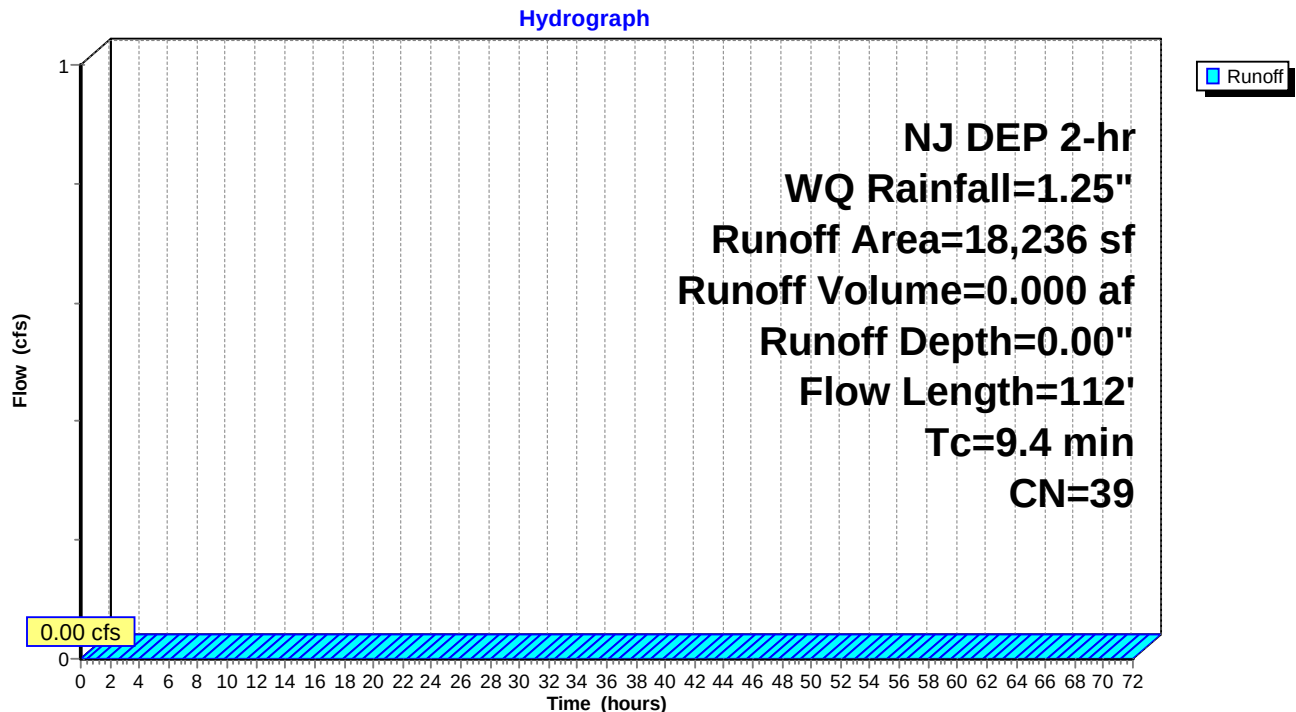
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

Area (sf)	CN	Description
18,236	39	>75% Grass cover, Good, HSG A
18,236	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	87	0.0170	0.16		Sheet Flow, P1-P2 Grass: Short n= 0.150 P2= 3.38"
0.3	16	0.0170	0.91		Shallow Concentrated Flow, P2-P3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, P3-P4 Short Grass Pasture Kv= 7.0 fps
9.4	112	Total			

Subcatchment 18S: DA-2 PERV



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NJ DEP 2-hr WQ Rainfall=1.25"

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Summary for Subcatchment 19S: DA-2 IMP

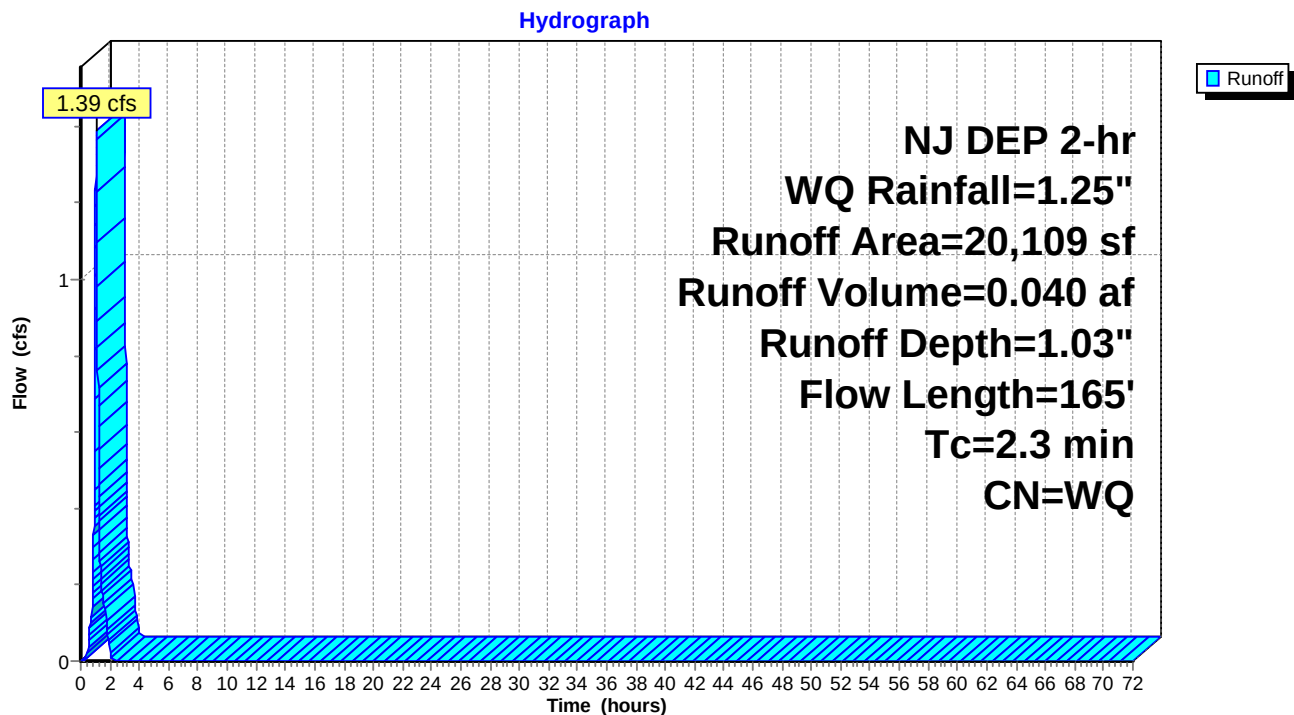
Runoff = 1.39 cfs @ 1.09 hrs, Volume= 0.040 af, Depth= 1.03"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

Area (sf)	CN	Description
12,109	98	Paved parking, HSG A
8,000	98	Unconnected roofs, HSG A
20,109		Weighted Average
20,109	98	100.00% Impervious Area
8,000		39.78% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	92	0.0160	1.27		Sheet Flow, I1-I2 Smooth surfaces n= 0.011 P2= 3.38"
1.1	64	0.0184	0.95		Shallow Concentrated Flow, I2-I3 Short Grass Pasture Kv= 7.0 fps
0.0	9	0.3300	4.02		Shallow Concentrated Flow, I3-I4 Short Grass Pasture Kv= 7.0 fps
2.3	165	Total			

Subcatchment 19S: DA-2 IMP

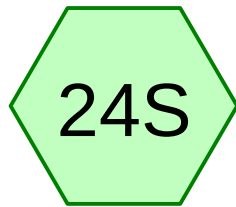


APPENDIX G
StormSewer Chart & TC Calculations

$$l = \frac{100\sqrt{S}}{n}$$

Inlet Area - Allowable Sheet Flow Lengths

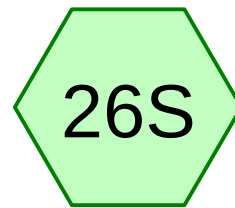
Inlet Area (IA)	Slope	Cover Type	n	Calculated Sheet Flow Length (McCuen-Spiess)	Assumed Sheet Flow Length	Used Sheet Flow Length for Tc
CB-1A2 "E"	0.025	Pavement	0.011	1437	100	100
CB-1A3 "B"	0.014	Pavement	0.011	1076	100	100
CB-1B2 "B"	0.009	Pavement	0.011	862	65	65
CB-2B2 "B"	0.040	Pavement	0.011	1818	65	65
CB-2C1 "B"	0.029	Pavement	0.011	1548	100	100



CB-1A2 "E"



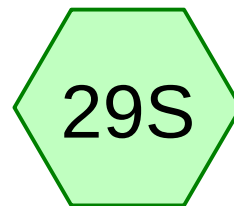
CB-1A3 "B"



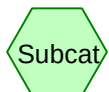
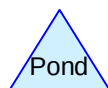
CB-1B2 "B"



CB-2B2 "B"



CB-1B2 "B"



Routing Diagram for Pre&Post Development

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NOAA 24-hr D 25-Year F Rainfall=8.00"

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Page 2

Summary for Subcatchment 24S: CB-1A2 "E"

Runoff = 3.53 cfs @ 12.10 hrs, Volume= 0.273 af, Depth= 7.76"

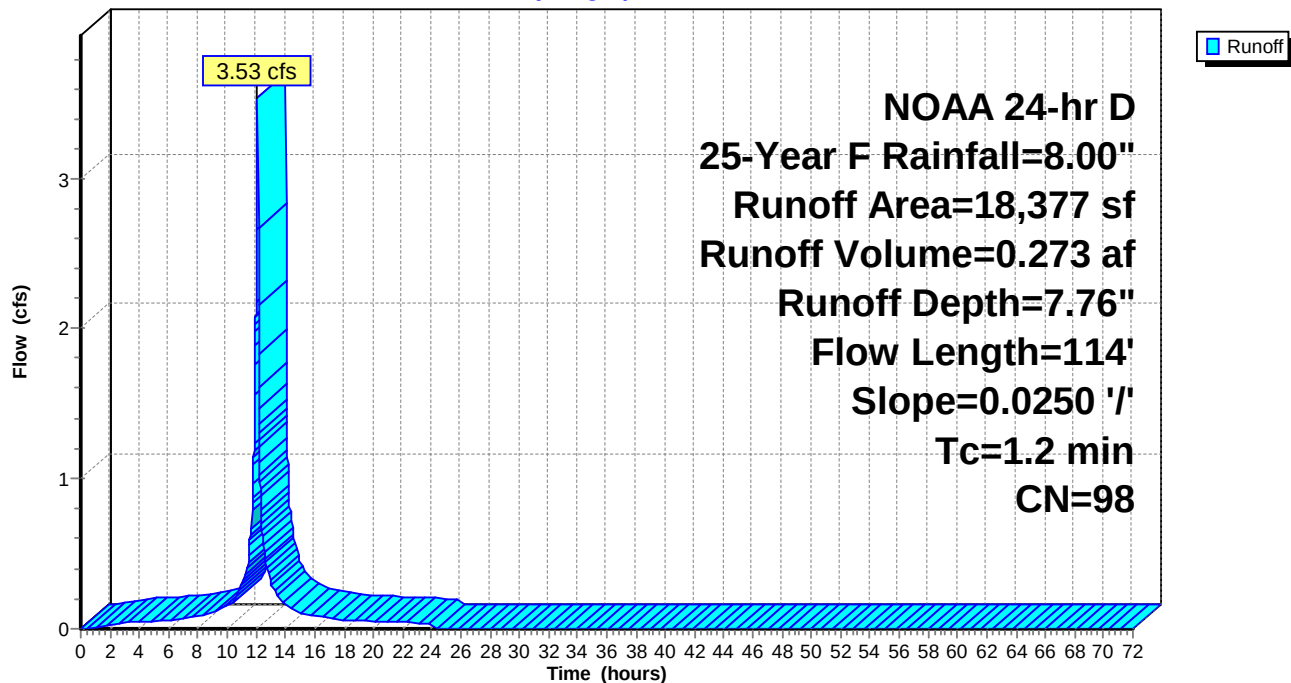
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr D 25-Year F Rainfall=8.00"

Area (sf)	CN	Description
18,377	98	Paved parking, HSG A
18,377	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0250	1.55		Sheet Flow, 1-2
					Smooth surfaces n= 0.011 P2= 3.38"
0.1	14	0.0250	3.21		Shallow Concentrated Flow, 2-3
					Paved Kv= 20.3 fps
1.2	114	Total			

Subcatchment 24S: CB-1A2 "E"

Hydrograph



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NOAA 24-hr D 25-Year F Rainfall=8.00"

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Summary for Subcatchment 25S: CB-1A3 "B"[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 1.10 cfs @ 12.10 hrs, Volume= 0.085 af, Depth= 7.76"

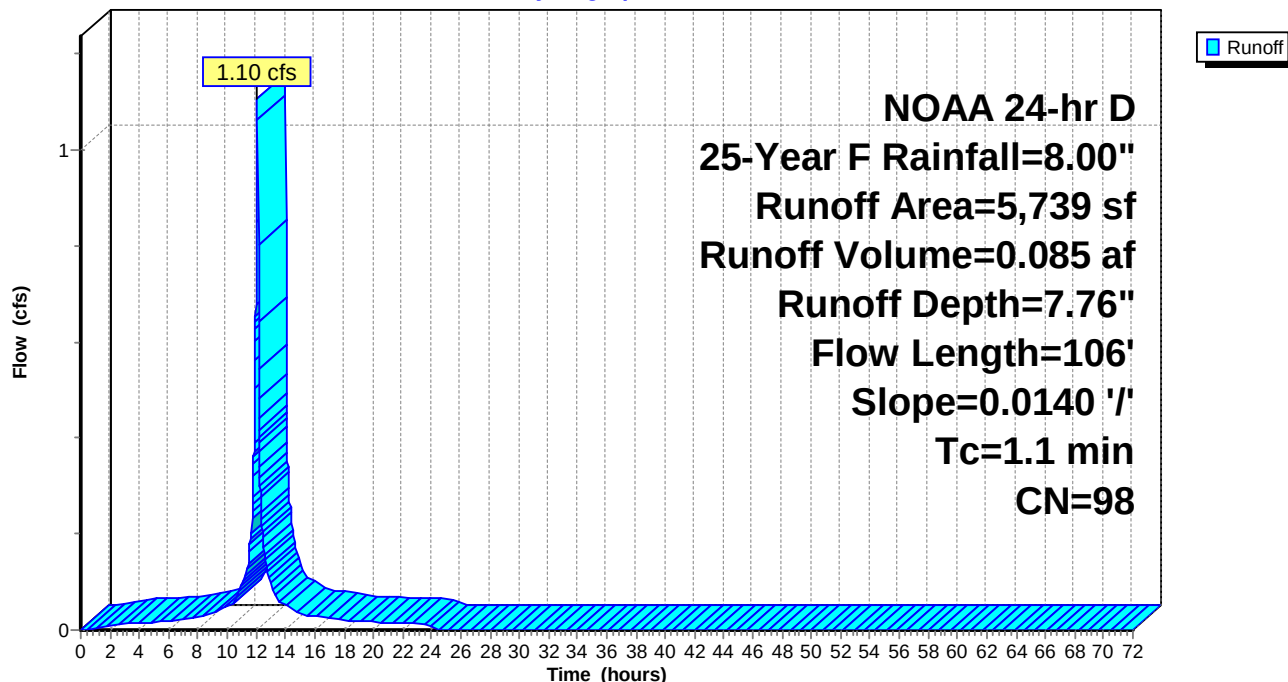
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, $dt=0.01$ hrs
NOAA 24-hr D 25-Year F Rainfall=8.00"

Area (sf)	CN	Description
5,739	98	Paved parking, HSG A
5,739	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	46	0.0140	1.05		Sheet Flow, 1-2
					Smooth surfaces n= 0.011 P2= 3.38"
0.4	60	0.0140	2.40		Shallow Concentrated Flow, 2-3
					Paved Kv= 20.3 fps
1.1	106	Total			

Subcatchment 25S: CB-1A3 "B"

Hydrograph



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NOAA 24-hr D 25-Year F Rainfall=8.00"

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Page 6

Summary for Subcatchment 26S: CB-1B2 "B"

Runoff = 1.11 cfs @ 12.10 hrs, Volume= 0.087 af, Depth= 7.76"

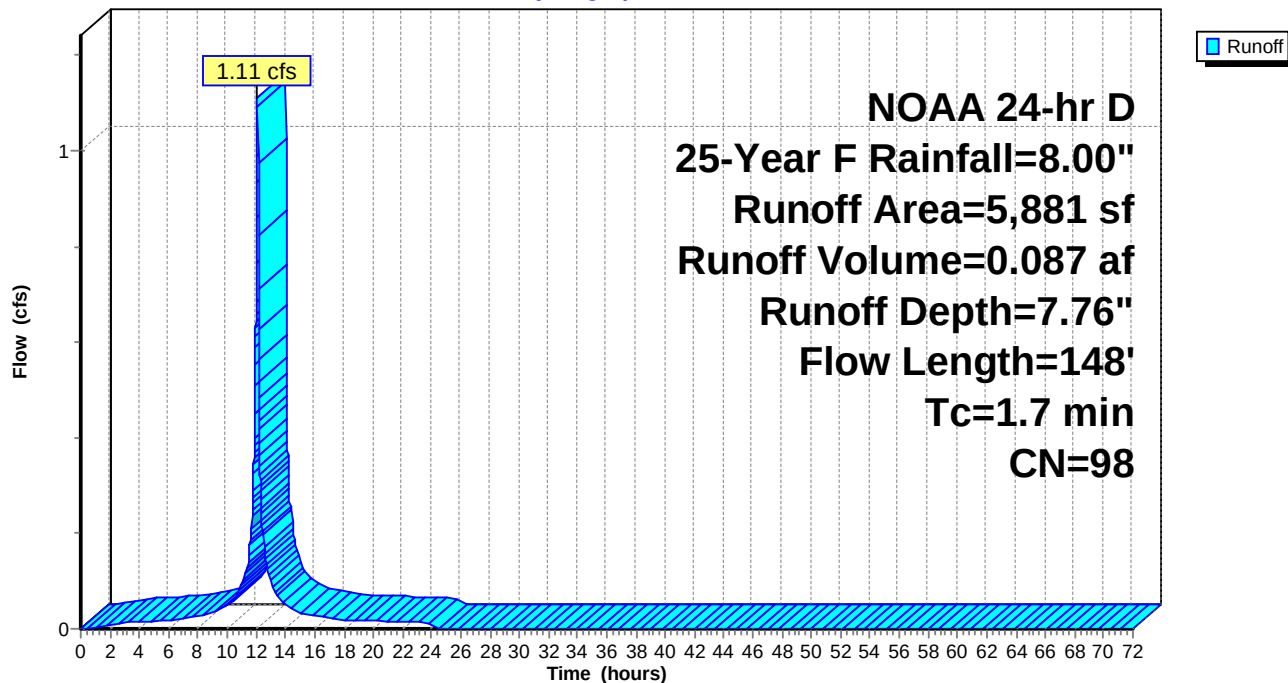
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr D 25-Year F Rainfall=8.00"

Area (sf)	CN	Description
5,881	98	Paved parking, HSG A
5,881	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	65	0.0090	0.94		Sheet Flow, 1-2
					Smooth surfaces n= 0.011 P2= 3.38"
0.6	83	0.0120	2.22		Shallow Concentrated Flow, 2-3
					Paved Kv= 20.3 fps
1.7	148	Total			

Subcatchment 26S: CB-1B2 "B"

Hydrograph



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NOAA 24-hr D 25-Year F Rainfall=8.00"

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Summary for Subcatchment 28S: CB-2B2 "B"

Runoff = 0.99 cfs @ 12.10 hrs, Volume= 0.077 af, Depth= 7.14"

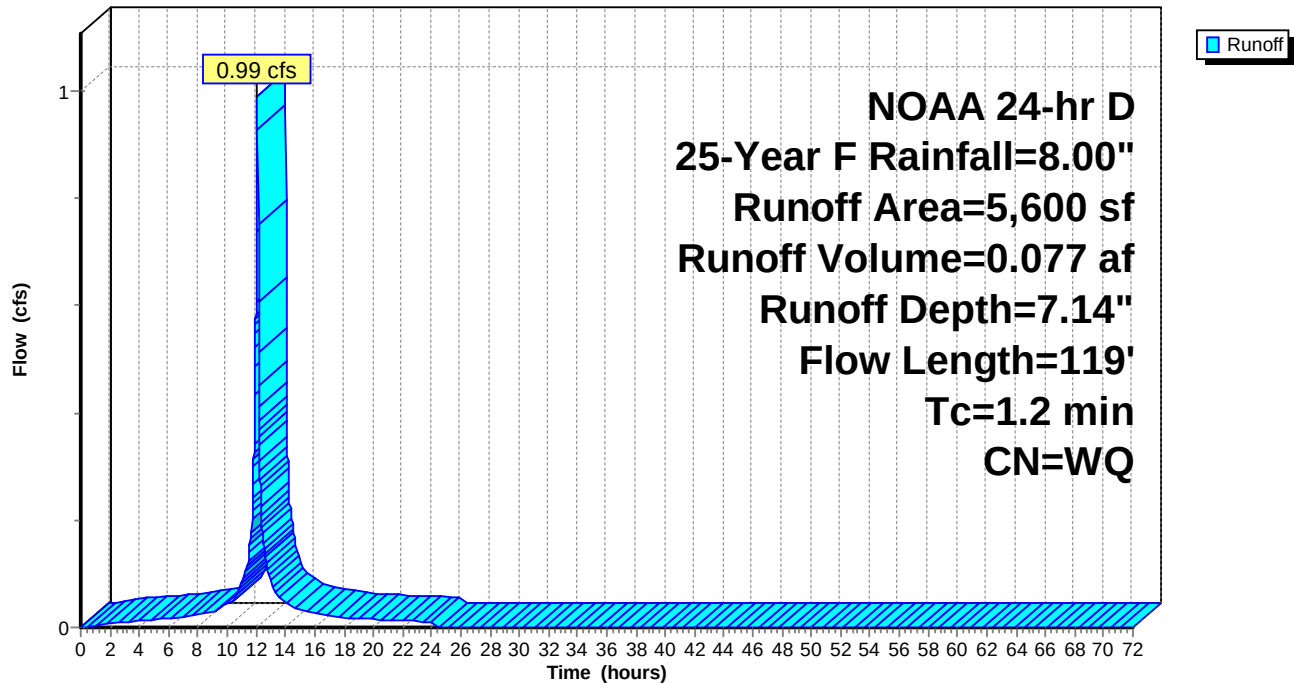
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr D 25-Year F Rainfall=8.00"

Area (sf)	CN	Description
5,076	98	Paved parking, HSG A
524	39	>75% Grass cover, Good, HSG A
5,600		Weighted Average
524	39	9.36% Pervious Area
5,076	98	90.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	65	0.0230	1.37		Sheet Flow, 1-2
					Smooth surfaces n= 0.011 P2= 3.38"
0.4	54	0.0120	2.22		Shallow Concentrated Flow, 2-3
					Paved Kv= 20.3 fps
1.2	119	Total			

Subcatchment 28S: CB-2B2 "B"

Hydrograph



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NOAA 24-hr D 25-Year F Rainfall=8.00"

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Summary for Subcatchment 29S: CB-1B2 "B"

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 0.77 cfs @ 12.10 hrs, Volume= 0.059 af, Depth= 6.11"

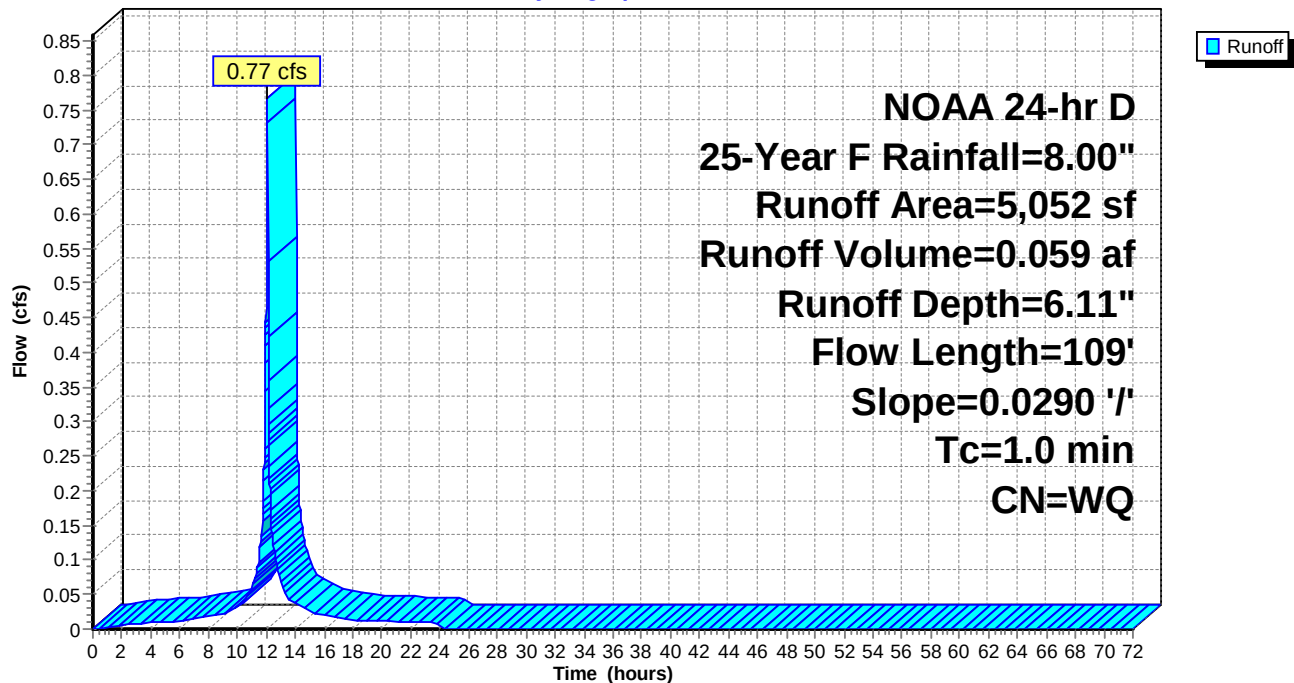
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-72.00 hrs, $dt=0.01$ hrs
NOAA 24-hr D 25-Year F Rainfall=8.00"

Area (sf)	CN	Description
3,788	98	Paved parking, HSG A
1,264	39	>75% Grass cover, Good, HSG A
5,052		Weighted Average
1,264	39	25.02% Pervious Area
3,788	98	74.98% Impervious Area

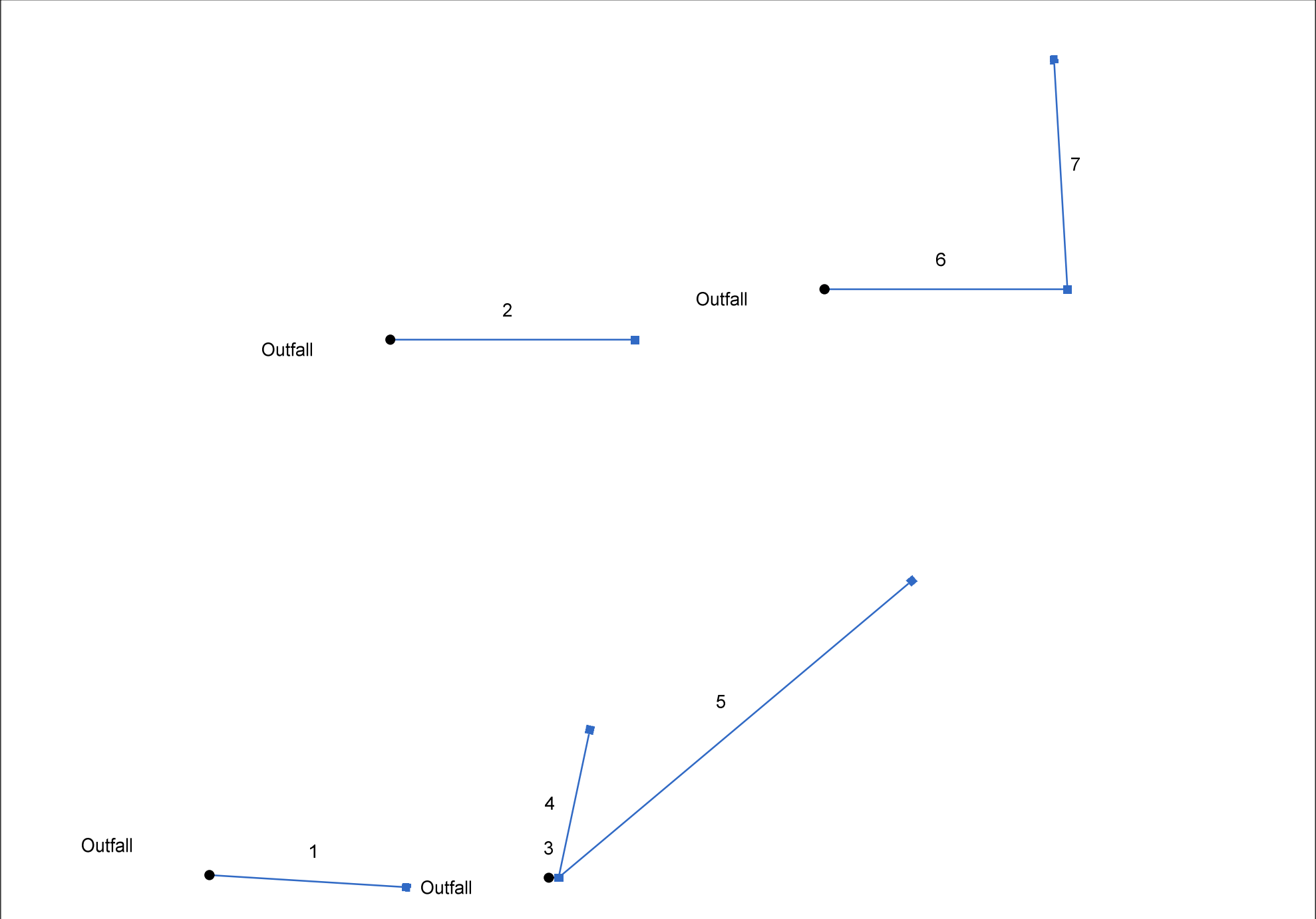
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	100	0.0290	1.64		Sheet Flow, 1-2
					Smooth surfaces $n=0.011$ $P2=3.38"$
0.0	9	0.0290	3.46		Shallow Concentrated Flow, 2-3
					Paved $K_v=20.3$ fps
1.0	109	Total			

Subcatchment 29S: CB-1B2 "B"

Hydrograph



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 2024-04-26 Working.stm	Number of lines: 7	Date: 5/17/2024
--------------------------------------	--------------------	-----------------

Line No.	Inlet ID	Line ID	Drng Area	Runoff Coeff	Line Size	Line Length	Line Slope	n-val Pipe	Tc	Invert Up	Invert Dn	Gnd/Rim El Up	Gnd/Rim El Dn	HGL Up	HGL Dn	Vel Ave	Flow Rate
			(ac)	(C)	(in)	(ft)	(%)		(min)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(cfs)
1	New	OCS-2 TO DOGHOUSE MH-2A1	0.00	0.00	15	100.000	0.64	0.013	10.0	125.20	124.56	129.44	130.33	125.37	124.73	1.99	0.20
2		CB-1B2 TO FES-1B1	0.14	0.98	15	124.000	0.50	0.013	1.7	129.12	128.50	132.20	133.00	129.49	128.95	2.56	0.88
3		CB-2B2 TO HW-2B1	0.13	0.92	15	5.000	0.60	0.013	41.9	128.03	128.00	131.27	133.00	128.38	128.63	2.09	0.82
4		CB-2C1 TO CB-2B2	0.12	0.83	12	77.000	0.49	0.013	1.0	128.41	128.03	130.11	131.27	128.75	128.38	2.65	0.64
5		OCS-1 TO CB-2B2	0.00	0.00	15	234.000	0.63	0.013	10.0	129.50	128.03	131.27	131.27	129.65 j	128.38	1.17	0.15
6		CB-1A2 TO FES-1A1	0.42	0.98	15	123.000	0.50	0.013	4.0	129.12	128.50	132.12	133.00	129.93	129.30	4.11	3.44
7		CB-1A3 TO CB-1A2	0.13	0.98	15	117.000	0.50	0.013	1.1	129.70	129.12	132.70	132.12	130.34	130.32	0.97	0.81
Project File: 2024-04-26 Working.stm										Number of lines: 7				Date: 5/17/2024			
NOTES: ** Critical depth																	

Capac Full	
(cfs)	
5.17	
4.57	
5.00	
2.50	
5.12	
4.58	
4.55	
Project File: 2024-04-26 Working.stm	
Number of lines: 7	
Date: 5/17/2024	
NOTES: ** Critical depth	

APPENDIX H
Outlet Protection

25-Year Storm Basin Outflow

Q (cfs) =	3.44
W (in) =	15
H (in) =	15
TW (ft) =	1.68

	WSE
Invert	128.5
2YR	130.18

JOB NAME: ELK TOWNSHIP - TRUCK MAINTENACE FACILITY
JOB NUMBER: RUS-2304
CALCULATED: JRN
DATE: 04/26/2024
OUTLET ID: FES-1A1

Rip-Rap Design

Scour Hole

Q (cfs)	W (in)	H (in)	TW	W _o (ft)	H (ft)	D _o Multiplier	W (Total)	L	D ₅₀ (in)	
3.44	15	15	1.68	1.25	1.25	1	10.0	11.3	0.2	-----
3.44	15	15	1.68	1.25	1.25	0.5	6.3	7.5	0.3	THIS ONE

25-Year Storm Basin Outflow

Q (cfs) =	0.88
W (in) =	15
H (in) =	15
TW (ft) =	1.68

	WSE
Invert	128.5
2YR	130.18

JOB NAME: ELK TOWNSHIP - TRUCK MAINTENACE FACILITY
JOB NUMBER: RUS-2304
CALCULATED: JRN
DATE: 04/26/2024
OUTLET ID: FES-1B1

Rip-Rap Design

Scour Hole

Q (cfs)	W (in)	H (in)	TW	W _o (ft)	H (ft)	D _o Multiplier	W (Total)	L	D ₅₀ (in)	
0.88	15	15	1.68	1.25	1.25	1	10.0	11.3	0.0	-----
0.88	15	15	1.68	1.25	1.25	0.5	6.3	7.5	0.1	THIS ONE

25-Year Storm Basin Outflow

Q (cfs) =	0.82
W (in) =	15
H (in) =	15
TW (ft) =	0.99

	WSE
Invert	128
2YR	128.99

JOB NAME: ELK TOWNSHIP - TRUCK MAINTENACE FACILITY
JOB NUMBER: RUS-2304
CALCULATED: JRN
DATE: 04/26/2024
OUTLET ID: FES-2B1

Rip-Rap Design

Scour Hole

Q (cfs)	W (in)	H (in)	TW	W _o (ft)	H (ft)	D _o Multiplier	W (Total)	L	D ₅₀ (in)	
0.82	15	15	0.99	1.25	1.25	1	10.0	11.3	0.1	-----
0.82	15	15	0.99	1.25	1.25	0.5	6.3	7.5	0.1	THIS ONE

APPENDIX I

Basin Summary Sheets

New Jersey Department of Agriculture
Hydrologic Modeling Database – Data Entry Form

Project Site Details

Chpt. 251 Application Number: _____

Start Date (if known): _____

County: Gloucester

Street Address: SE Corner Buck Road (CR 553) & Elk Road (CR 538)

Municipality: Elk Township

Block: 50

Lot: 15

NJDEP Anderson Landuse Code (4 digits):

Landuse description: 1700 & 4420

Site Centroid Location (NJ State Plane Feet): ¹

Northing: 295,782 Easting: 316,637

Project Contact Details

Applicant: Russo Corporation

Address: PO Box 188, 403 Helms Avenue, Swedesboro, NJ 08085

Phone: (856) 467-7006

Email: nrosso@russocorporation.com

Post Construction Operation & Maintenance:²

Party Name: Jags united corporation

Address: 143 Nathan Hale Drive, Woodbury NJ, 08096

Phone: 8565031782

Email: jags8182@gmail.com

Party type: Applicant/Owner

New Jersey Department of Agriculture
Hydrologic Modeling Database – Data Entry Form

Basin Details:³

Basin Centroid (NJ State Plane Feet):⁴

Northing: _____ Easting: _____

Basin Type: Small-Scale Infiltration Basin #1

Construction: ☒ excavated ☐ embankment ☐ sub-surface (check one)

Status phase:⁵ Design ☒ As-built ☐

Dam Height: (ft) _____ top width: (ft) _____

Dam Classification: _____

Drainage Area(s) to Basin [note- include any bypass areas]⁶

Drainage Area Name	Drainage Area (acres)	Post-Development CN#	Percent Impervious	Time of Concentration (min)
DA-1 PERV	0.476	39	0%	7.2
DA-1 IMP	0.689	98	100%	1.6

Basin Outlet Structure(s)⁷

ID: OCS-1

End of Pipe Location:⁸ Northing: _____ Easting: _____

Discharge Type ⁹ (weir, orifice, etc)	Dimensions (diameter, length)	Elevation (USGS)	Discharge Coefficient ¹⁰	Equation Used ¹¹
Orifice	2.5"	130.20	0.6	$Q=1.71CL(H^{(3/2)})$
Orifice	10" x 4"	131.30	0.6	$Q=1.71CL(H^{(3/2)})$
Grate	24" x 48"	131.88	0.6	$Q=1.71CL(H^{(3/2)})$

New Jersey Department of Agriculture
Hydrologic Modeling Database – Data Entry Form

Basin Outlet Structure(s)

ID: Emergency Spillway

End of Pipe Location: Northing:

Easting:

Discharge Type (weir, orifice, etc)	Dimensions (diameter, length)	Elevation (USGS)	Discharge Coefficient	Equation Used

Basin Stage-Discharge Rating Table¹²

Elevation (USGS Feet)	Storage (Acre-Ft)	Total Outlet Structure Discharge (cfs)
128.50	0	0.00
129.00	0.05	0.00
129.50	0.12	0.00
130.00	0.19	0.00
130.50	0.26	0.07
131.00	0.35	0.14
131.50	0.45	0.42
131.88	0.53	1.03

NJDEP BMP Water Quality Structures¹³

Type (rain garden, green roof, seepage pit etc)	Size	Size Units (cu ft, sq ft etc)	Northing (SPF)	Easting (SPF)

New Jersey Department of Agriculture
Hydrologic Modeling Database – Data Entry Form

Explanatory Notes-

¹ Approximate location of center of site, coordinates in state plane feet

² Indicate who will be responsible for permanent operation and maintenance

³ Additional Basin Detail Pages can be used for more than one basin in a project.

⁴ Approximate location of center of basin, coordinates in state plane feet

⁵ Indicate “design” for basins not yet constructed

⁶ Drainage areas which are modified by construction, but not directed to the basin should still be listed and described

⁷ “Outlet structure” means the control box, outlet headwall, FES etc. This does not refer to an individual control on the structure such as a weir or orifice. There are two tables for more than one outlet structure

⁸ Approximate location of terminal discharge end of basin outfall, coordinates in state plane feet

⁹ Indicate the type of outlet – weir, orifice, hydro brake, etc.

¹⁰ Discharge Coefficient specific to the type of outlet control i.e., 0.6 for circular orifice

¹¹ List the discharge equation for each outlet (weir, orifice etc) used

¹² For basins with dead storage below the primary outlet, indicate 0 cfs discharge until the lowest outlet is reached. Routing table should begin at the lowest basin elevation.

¹³ Describe NJDEP BMP Manual water quality devices such as seepage pits, rain gardens etc. Size is appropriate for device – cubic feet, square feet or linear feet. Location of device using state plane feet coordinates.

New Jersey Department of Agriculture
Hydrologic Modeling Database – Data Entry Form

Project Site Details

Chpt. 251 Application Number: _____

Start Date (if known): _____

County: Gloucester

Street Address: SE Corner Buck Road (CR 553) & Elk Road (CR 538)

Municipality: Elk Township

Block: 50

Lot: 15

NJDEP Anderson Landuse Code (4 digits):

Landuse description: 1700 & 4420

Site Centroid Location (NJ State Plane Feet): ¹

Northing: 295,782 Easting: 316,637

Project Contact Details

Applicant: Russo Corperation

Address: PO Box 188, 403 Helms Avenue, Swedesboro, NJ 08085

Phone: (856) 467-7006

Email: nrosso@russocorperation.com

Post Construction Operation & Maintenance:²

Party Name: Jags united corporation

Address: 143 Nathan Hale Drive, Woodbury NJ, 08096

Phone: 8565031782

Email: jags8182@gmail.com

Party type: Applicant/Owner

New Jersey Department of Agriculture
Hydrologic Modeling Database – Data Entry Form

Basin Details:³

Basin Centroid (NJ State Plane Feet):⁴

Northing: _____ Easting: _____

Basin Type: Small-Scale Infiltration Basin #2

Construction: ☒ excavated ☐ embankment ☐ sub-surface (check one)

Status phase:⁵ Design ☒ As-built ☐

Dam Height: (ft) _____ top width: (ft) _____

Dam Classification: _____

Drainage Area(s) to Basin [note- include any bypass areas]⁶

Drainage Area Name	Drainage Area (acres)	Post-Development CN#	Percent Impervious	Time of Concentration (min)
DA-2 PERV	0.419	39	0%	9.4
DA-2 IMP	0.462	98	100%	2.3

Basin Outlet Structure(s)⁷

ID: OCS-2

End of Pipe Location:⁸ Northing: _____ Easting: _____

Discharge Type ⁹ (weir, orifice, etc)	Dimensions (diameter, length)	Elevation (USGS)	Discharge ¹⁰ Coefficient	Equation Used ¹¹
Orifice	2.5"	129.78	0.6	$Q=1.71CL(H^{(3/2)})$
Orifice	18" x 3"	130.30	0.6	$Q=1.71CL(H^{(3/2)})$
Grate	24" x 48"	130.84	0.6	$Q=1.71CL(H^{(3/2)})$

New Jersey Department of Agriculture
Hydrologic Modeling Database – Data Entry Form

Basin Outlet Structure(s)

ID: Emergency Spillway

End of Pipe Location: Northing:

Easting:

Discharge Type (weir, orifice, etc)	Dimensions (diameter, length)	Elevation (USGS)	Discharge Coefficient	Equation Used

Basin Stage-Discharge Rating Table¹²

Elevation (USGS Feet)	Storage (Acre-Ft)	Total Outlet Structure Discharge (cfs)
128.00	0	0.00
128.50	0.07	0.00
129.00	0.15	0.00
129.50	0.22	0.00
130.00	0.31	0.06
130.50	0.39	0.56
130.84	0.45	1.32

NJDEP BMP Water Quality Structures¹³

Type (rain garden, green roof, seepage pit etc)	Size	Size Units (cu ft, sq ft etc)	Northing (SPF)	Easting (SPF)

New Jersey Department of Agriculture
Hydrologic Modeling Database – Data Entry Form

Explanatory Notes-

¹ Approximate location of center of site, coordinates in state plane feet

² Indicate who will be responsible for permanent operation and maintenance

³ Additional Basin Detail Pages can be used for more than one basin in a project.

⁴ Approximate location of center of basin, coordinates in state plane feet

⁵ Indicate “design” for basins not yet constructed

⁶ Drainage areas which are modified by construction, but not directed to the basin should still be listed and described

⁷ “Outlet structure” means the control box, outlet headwall, FES etc. This does not refer to an individual control on the structure such as a weir or orifice. There are two tables for more than one outlet structure

⁸ Approximate location of terminal discharge end of basin outfall, coordinates in state plane feet

⁹ Indicate the type of outlet – weir, orifice, hydro brake, etc.

¹⁰ Discharge Coefficient specific to the type of outlet control i.e., 0.6 for circular orifice

¹¹ List the discharge equation for each outlet (weir, orifice etc) used

¹² For basins with dead storage below the primary outlet, indicate 0 cfs discharge until the lowest outlet is reached. Routing table should begin at the lowest basin elevation.

¹³ Describe NJDEP BMP Manual water quality devices such as seepage pits, rain gardens etc. Size is appropriate for device – cubic feet, square feet or linear feet. Location of device using state plane feet coordinates.

APPENDIX J
Groundwater Mounding

Input Values

3.37
0.150
16.85
20.000
74.000
7.50
10.00

R Recharge rate (permeability rate) (in/hr)
Sy Specific yield, Sy (dimensionless)
 default value is 0.15; max value is 0.2 provided that a lab test data is submitted
Kh Horizontal hydraulic conductivity (in/hr)
 Kh = 5xRecharge Rate (R) in the coastal plain; Kh=R outside the coastal plain
x 1/2 length of basin (x direction, in feet)
y 1/2 width of basin (y direction, in feet)
t Duration of infiltration period (hours)
hi(0) Initial thickness of saturated zone (feet)

17.483
7.483

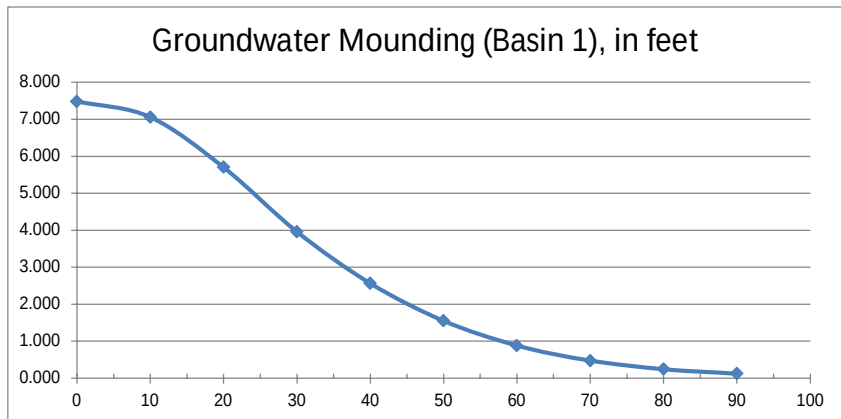
h(max) Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
Δh(max) Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water center of basin in x
 Mounding, in feet direction, in feet

7.483	0
7.056	10
5.700	20
3.957	30
2.562	40
1.548	50
0.878	60
0.471	70
0.241	80
0.118	90



Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Input Values

0.35
0.150
16.85
20.000
74.000
72.00
10.00

R	Recharge rate (permeability rate) (in/hr)
Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the coastal plain; Kh=R outside the coastal plain
x	1/2 length of basin (x direction, in feet)
y	1/2 width of basin (y direction, in feet)
t	Duration of infiltration period (hours)
hi(0)	Initial thickness of saturated zone (feet)

12.437
2.437

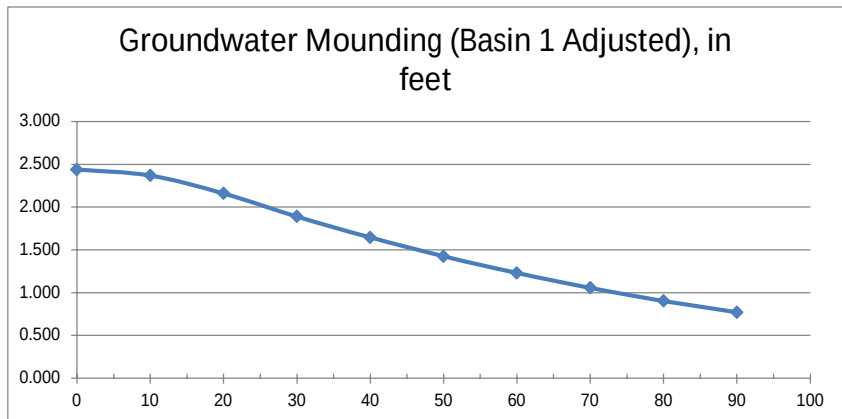
h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
Ground-water center of basin in x
Mounding, in feet direction, in feet

2.437	0
2.368	10
2.159	20
1.889	30
1.644	40
1.424	50
1.228	60
1.055	70
0.902	80
0.768	90



Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Input Values

5.21
0.150
26.05
23.000
68.000
4.50
10.00

R	Recharge rate (permeability rate) (in/hr) Specific yield, Sy (dimensionless)
Sy	default value is 0.15; max value is 0.2 provided that a lab test data is submitted
Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the coastal plain; Kh=R outside the coastal plain
x	1/2 length of basin (x direction, in feet)
y	1/2 width of basin (y direction, in feet)
t	Duration of infiltration period (hours)
hi(0)	Initial thickness of saturated zone (feet)

17.758
7.758

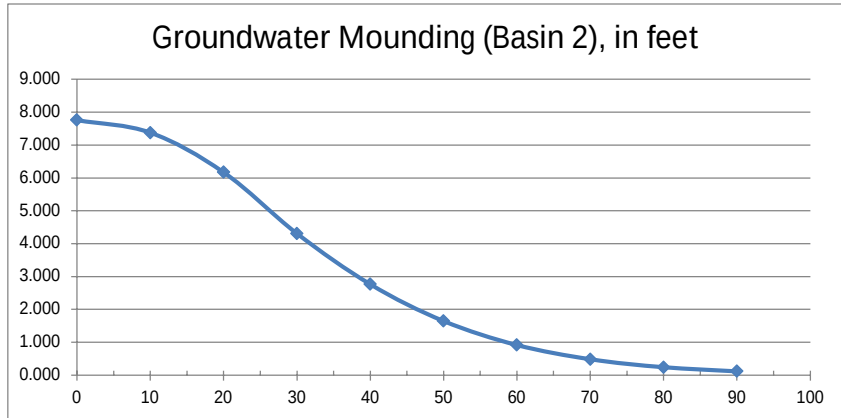
h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water center of basin in x
Mounding, in feet direction, in feet

7.758	0
7.377	10
6.171	20
4.306	30
2.762	40
1.645	50
0.916	60
0.480	70
0.239	80
0.114	90



Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Input Values

0.33
0.150
26.05
23.000
68.000
72.00
10.00

R Recharge rate (permeability rate) (in/hr)
Sy Specific yield, Sy (dimensionless)
 default value is 0.15; max value is 0.2 provided that a lab test data is submitted
Kh Horizontal hydraulic conductivity (in/hr)
 Kh = 5xRecharge Rate (R) in the coastal plain; Kh=R outside the coastal plain
x 1/2 length of basin (x direction, in feet)
y 1/2 width of basin (y direction, in feet)
t Duration of infiltration period (hours)
hi(0) Initial thickness of saturated zone (feet)

11.860
1.860

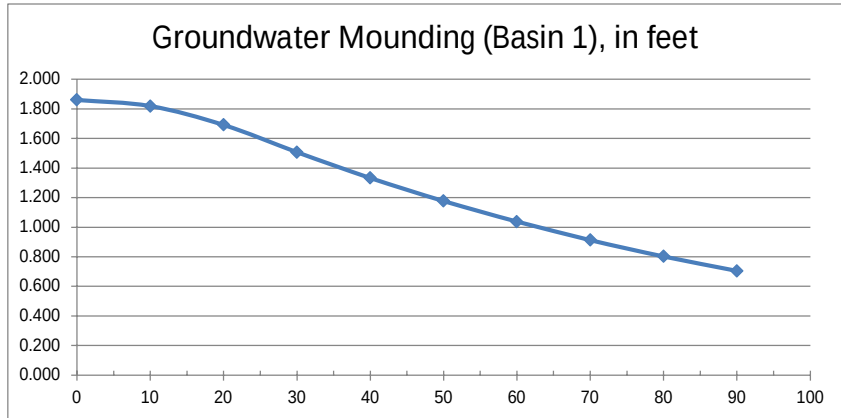
h(max) Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
Δh(max) Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
 Ground-water center of basin in x
 Mounding, in feet direction, in feet

1.860	0
1.819	10
1.692	20
1.507	30
1.333	40
1.177	50
1.037	60
0.913	70
0.803	80
0.704	90



Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

APPENDIX K
Soil Testing Logs

Report of Subsurface Exploration, Permeability Testing & Geotechnical Engineering Assessment

Truck Service Center

Elk Township, Gloucester County, New Jersey



Mr. Nate Russo
Russo Corporation
403 Helms Avenue
Swedesboro, New Jersey 08085



1800 Route 34, Suite 101
Wall Township, New Jersey 07719
T: 732.312.9800
F: 732.312.9801
fpaengineers.com

May 16, 2024

Mr. Nate Russo
Russo Corporation
403 Helms Avenue
Swedesboro, New Jersey 08085

Re: Report of Subsurface Exploration, Permeability Testing &
Geotechnical Engineering Assessment
Truck Service Center
Elk Township, Gloucester County, New Jersey
FPA No. 21743.001R1

Dear Mr. Russo:

INTRODUCTION

This report presents the results of our Subsurface Exploration, Permeability Testing and Geotechnical Engineering Assessment performed in connection with the proposed improvements to the property located at 705 Buck Road in Elk Township, Gloucester County, New Jersey. The property is designated as Block 15, Lot 15 on the Elk Township Tax Map and occupies approximately 2.56 acres. The property is currently wooded. The regional location of the project site is presented on Drawing No. 1, "Regional Location Plan."

It is our understanding that the site will be developed into a tractor trailer service center. The increase in impervious coverage from the proposed improvements will necessitate stormwater management to be incorporated into the site design. Based upon our review of the Preliminary/Final Site Plans prepared by MidAtlantic Engineering Partners, it is our understanding that the proposed stormwater management structures may include two stormwater infiltration basins. The property is relatively flat with site grades varying from approximate elevation +129 feet within the southwest portion of the site along Buck Road and gradually slope up to approximately elevation +133 feet in the north along Elk Road. As provided by Mid Atlantic Engineering Partners, the proposed bottom of the stormwater infiltration basins are situated at elevations +128 feet and +128.5 feet, which is approximately 0 to 4.5 feet below the existing site grades.

The purpose for our involvement on the project at this time was to perform a subsurface exploration and permeability testing of the soils specifically at the planned stormwater management systems to facilitate the design and construction of the subject structures at the project site. Our scope of work included the technical observation of 4 test pits, laboratory permeability testing of select samples recovered from the test pits and the preparation of this report.



SUBSURFACE EXPLORATION

French and Parrello Associates (FPA) provided technical oversight of 4 test pits performed on April 4, 2024 at the locations identified on the above referenced plan provided by MidAtlantic Engineering Partners. The field work was performed by an excavator provided by the Client while under the full-time technical observation by a representative of FPA. The test pit locations were located by a representative of FPA utilizing handheld GPS equipment as well as based on correlation with existing site features presented on the site plan. The approximate test pit locations are presented on Drawing No. 2, "Test Pit Location Plan."

The test pits, designated as TP-1 through TP-4, were excavated to determine soil and groundwater conditions as well as soil permeability rates for stormwater infiltration design. The test pits were advanced to depths ranging from approximately 8 feet to 12 feet below the existing ground surface. The exposed soil profiles were classified in accordance with the Burmister Soil Classification System. Indications of seasonal high groundwater (e.g., soil mottling) were also evaluated within the test pits and noted on the logs where observed. The depth to groundwater was measured upon the completion of the test pits. Soil classifications, soil mottling observations and recorded groundwater depths are presented on the test pit logs in Appendix A.

PERMEABILITY TESTING

Selected soil samples were returned to our in-house soils laboratory and subjected to laboratory permeability testing. Specifically, 4 Rigid Wall Permeability Tests were performed in accordance with ASTM D-2434. The tests were performed below the bottom of the proposed stormwater management systems in soils representative of the subgrade conditions below the bottom of the basin. A summary of permeability testing is summarized below and is included in Appendix B.

SITE CONDITIONS

Regional Geology

Based on our review of the published geologic literature, the native soils at the project site are comprised of stratified alluvial soils referred to on the Geologic Map of New Jersey as the Bridgeton formation underlain by stratified marine deposits. The alluvial soils typically consist of sand, silty and clayey sand and sandy silt. Some gravel is always intermixed within the major soil fraction and this gravel, together with coarser sand, becomes increasingly abundant with depth. The material is poorly sorted with "fines" distributed throughout the profile. The alluvial soils are underlain by marine deposits referred to on the Geologic Map of New Jersey as the Cohansey Sand formation. The marine soils typically consist of uniform narrowly-graded sand with silty sand layers commonly interbedded. Bedrock is encountered at depths greater than 100 feet throughout Gloucester County.

Subsurface Conditions

The soils encountered within the test pits were consistent with those reported in published geologic literature and typically consisted of a surficial layer of alluvial clayey sand underlain by predominately granular marine deposits to their terminating depths. The surficial clayey sand layer was generally encountered from the existing ground surface to depths ranging from approximately 2 feet to 7 feet and was comprised of coarse to fine sand intermixed with moderate to significant amounts of silt and clay as well as minor to moderate amounts of coarse to fine gravel.



Granular marine deposits of the Cohansey sand formation were encountered below the surficial clayey sand layer to their terminating depths and consisted of coarse to fine sand intermixed with minor to moderate amounts of silt and coarse to fine gravel. Based upon the observed excavation effort during the advancement of the test pits, the relative density of granular marine soils was medium-dense.

Groundwater was encountered within the test pits at depths ranging from approximately 2.5 feet to 7 feet below the existing grade at the time the explorations were performed, corresponding to approximate elevations +125 feet to +126 feet. In accordance with the guidelines presented in the New Jersey Stormwater Best Management Practices (BMP) manual, during the months of January through April, inclusive, water levels may be measured directly within soil profile pits when soil mottling is not observed at a higher elevation. Therefore, the encountered groundwater level should be taken as the seasonal high water at elevations +125 feet to +126 feet.

Seasonal and storm-related fluctuations in the groundwater level, as well as the potential presence of perched groundwater in the surficial clayey sand layer should be anticipated. For a more detailed description of the subsurface soil and groundwater conditions encountered, please refer to the test pit logs presented in Appendix A.

DISCUSSION & RECOMMENDATIONS

FPA performed four laboratory Rigid Wall Permeability Tests to determine permeability rates of the soils specifically at the planned stormwater management systems. The test pits performed at the proposed stormwater structure locations encountered surficial clayey sands underlain by coarse to fine sands with minor to moderate amounts of silt and coarse to fine gravel. The surficial clayey sands encountered from the existing grade to depths ranging from approximately 2 feet to 7 feet are intermixed with moderate to significant amounts of silt and clay and are not suitable for stormwater infiltration. The tested infiltration rate of the underlying granular soils ranged from approximately 1.44 inches per hour to 15.41 inches per hour as summarized below and is suitable for stormwater infiltration.

Test Pit	Test Depth (Elevation)	Soil Classification	Soil Permeability
TP-1	80-132" (+121 to +125.3 feet)	Ligh Tan m+f SAND , little Silt.	1.44 in/hr
TP-2	84-144" (+121 to +126 feet)	Tan c+mf SAND , little mf Gravel, little Silt.	12.05 in/hr
TP-3	24-96" (+120 to +126 feet)	Orange-Brown cmf SAND , some cmf Gravel, little+ Silt.	15.41 in/hr
TP-4	30-84" (+123 to +127.5 feet)	Brown c+mf SAND , some+ cmf Gravel, little+ Clayey Silt.	5.41 in/hr

The guidelines presented in the New Jersey Stormwater Best Management Practices manual indicate that a minimum design permeability rate of 0.5 inches per hour is required for infiltration basins. Design rates consider a factor of safety of 2 applied to laboratory permeability testing results. Additionally, the bottom of subsurface stormwater basins shall be situated a minimum of 2 feet above the estimated seasonal high water level which should be taken as elevations +125 feet to +126 feet since the indications of the seasonal high water elevation were not observed above the encountered groundwater level.



Based upon the encountered granular soils as well as laboratory permeability test results, it is our opinion stormwater infiltration is feasible for the proposed stormwater management structures at the project site within the predominantly granular marine soils encountered at or below depths ranging from approximately 2 feet to 7 feet from the existing grade. The surficial sandy clay must be completely removed from below the proposed bottom of the stormwater management system. We anticipate this layer will be removed during excavations for the southern stormwater basin in the vicinity of test pit TP-4. We anticipate over-excavation on the order of 2 to 3 feet may be required to reach the suitable soil stratum for infiltration in the vicinity of test pits TP-1 through TP-3. In-situ single ring infiltrometer testing may be performed at the proposed bottom of the northern basin elevation at the time of construction to limit the required depth of over-excavation.

We recommend a representative of FPA be on-site during excavations to delineate the depth of removal and replacement below the proposed stormwater structures as well as to perform in-situ permeability testing at the time of basin construction. It is our opinion that the on-site free-draining granular soils encountered below the surface clayey sand layer encountered at depths ranging from 2 to 7 feet may be used to backfill the over-excavations to the proposed bottom of the stormwater structures. Alternatively, imported granular fill conforming to ASTM C-33 sand may be utilized.

CLOSING & LIMITATIONS

The recommendations contained herein are contingent upon subsurface conditions remaining consistent with those encountered during our subsurface exploration. They are also contingent upon the basis that all stormwater management structure related aspects of construction, including stripping, excavation and removal of unsuitable soil, be observed by a representative of FPA. This is to observe compliance with the design concepts and specifications and to allow design changes in the event that subsurface conditions differ from those anticipated prior to construction.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands, chemically hazardous, or biologically toxic materials in the soil, surface water, groundwater or air, on or below or around the site. Services performed by FPA during this project have been conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended in the services provided.

Should you have any questions or if we can be of service to you in the future, please feel free to contact us.

Sincerely,

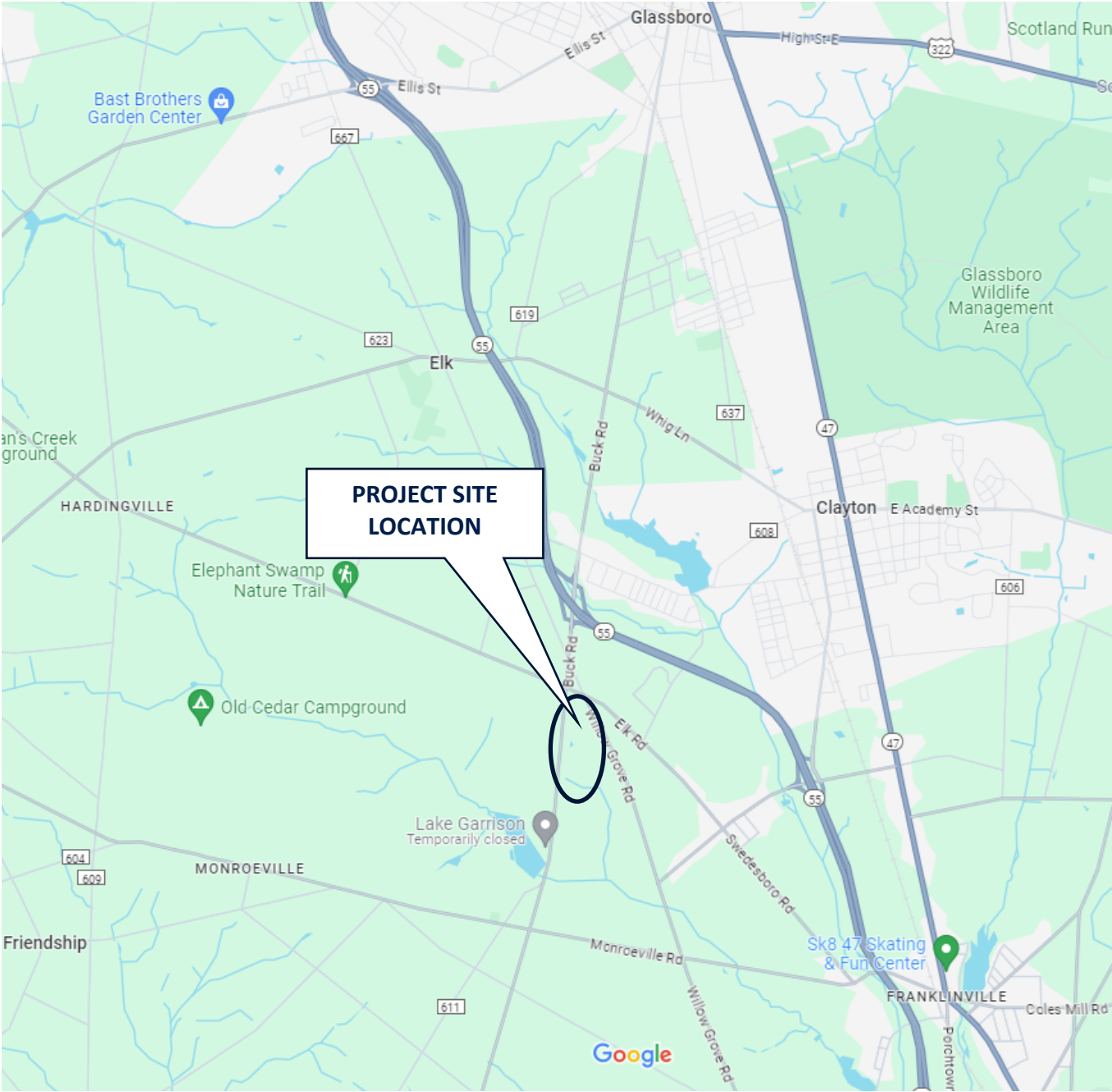
FRENCH & PARRELLO ASSOCIATES

A handwritten signature in blue ink that reads 'David M. Rohmeyer'.

David M. Rohmeyer, PE
Project Manager

A handwritten signature in blue ink that reads 'Joseph M. Tierney'.

Joseph M. Tierney, PE
Project Consultant, Manager of Geotechnical Services



REGIONAL LOCATION PLAN

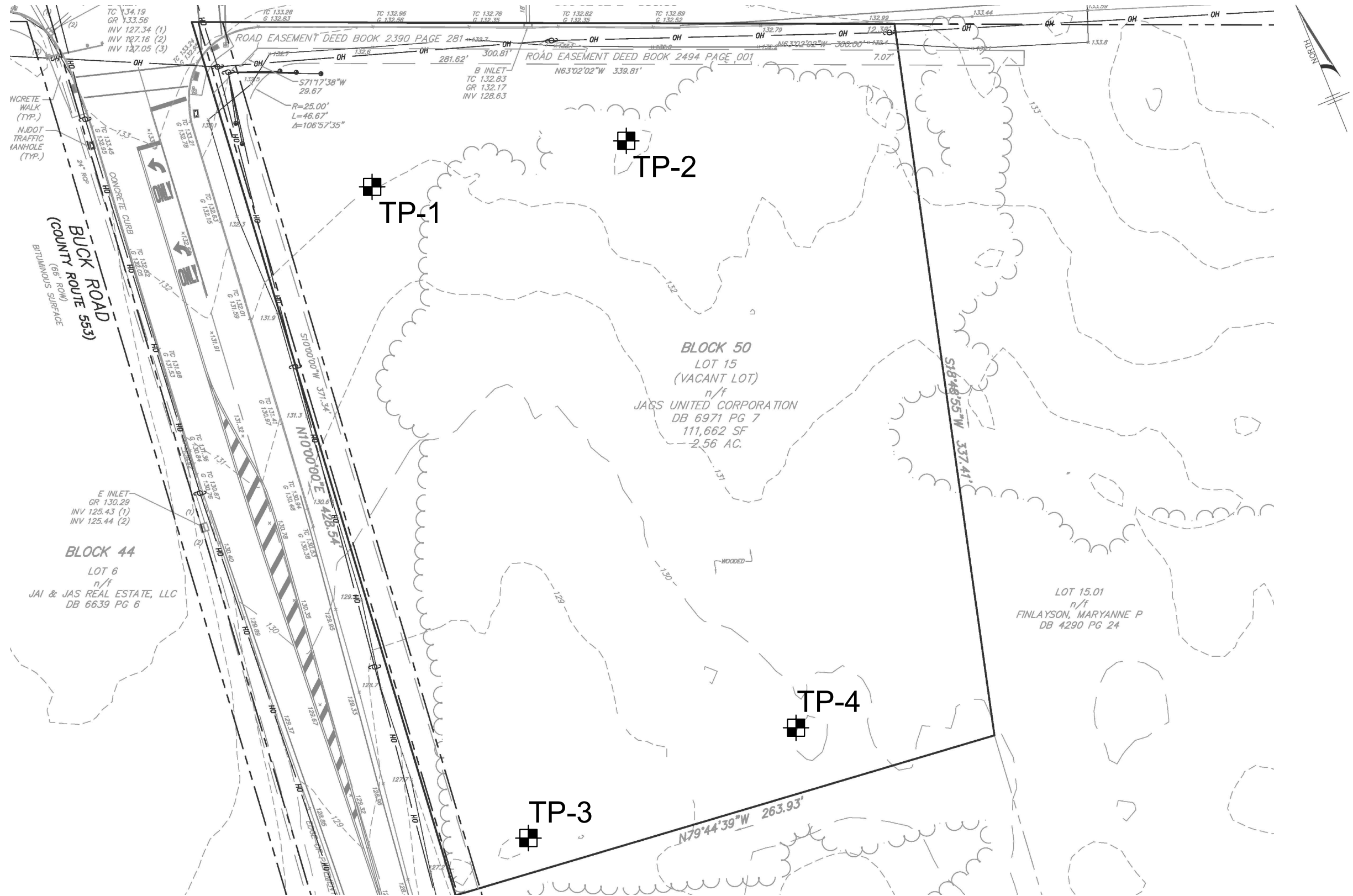
Copyright Google Maps, 2024

TRUCK SERVICE CENTER

ELK TOWNSHIP, GLOUCESTER COUNTY, NEW JERSEY

SCALE:	DATE:	JOB NO.:	DRAWING NO.:
NTS	MAY 2024	21743.001	1

O:\21K\21700\21743 - Elk Tractor Trailer Service Center\CADD\21743.001 - TPLP 11x17.dwg tlp
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LEGEND:

 TEST PIT LOCATION

FPA
FRENCH & PARRELLO
ASSOCIATES

Corporate Office:
1800 Rt 34, Suite 101
Wall, New Jersey 07719
732.312.8000

FPAengineers.com

New Jersey ▲ New York ▲ Pennsylvania ▲ Georgia

TEST PIT LOCATION PLAN
FOR
TRUCK SERVICE CENTER

TOWNSHIP OF ELK
GLOUCESTER COUNTY, NEW JERSEY

DATE: MAY 2024	SCALE: APPROX. 1"=50'	DRAWING # 2
DRAWN BY: MTM	PROJECT NUMBER: 21743.001	



Appendix A **Test Pit Logs**

BURMISTER SOIL CLASSIFICATION SYSTEM

A. Cohesionless Soils: Particle Size Definitions

Soil	Fraction	U.S. Standard Sieve	Actual Sizes
Gravel	coarse	3 in. to 1 in.	76 mm to 25 mm
	medium	1 in. to 3/8 in.	25 mm to 9.5 mm
	fine	3/8 in. to No. 10	9.5 mm to 2.0 mm
Sand	coarse	No. 10 to No. 30	2.0 mm to 0.6 mm
	medium	No. 30 to No. 60	0.6 mm to 0.25 mm
	fine	No. 60 to No. 200	0.25 mm to 0.075 mm
Silt		< No. 200	< 0.075 mm

B. Terms Describing Gradation of Cohesionless Soils

Written Description	Symbol/Designation	Defining Proportions
coarse, medium to fine	cmf	all fractions > 10%
coarse to medium	cm	< 10% fine
medium to fine	mf	< 10% coarse
coarse	c	< 10% medium and fine
medium	m	< 10% coarse and fine
fine	f	< 10% coarse and medium

Note: Use (+) for upper limit and (-) for lower limit.

C. Cohesive Soils: Terms Describing Plasticity

Soil	Plasticity Index	Workability	Plasticity Description
Clayey SILT	1 to 5	1/4 in. thread	Slightly Plastic
SILT & CLAY	5 to 10	1/8 in. thread	Low Plasticity
CLAY & SILT	10 to 20	1/16 in. thread	Medium Plasticity
Silty CLAY	20 to 40	1/32 in. thread	High Plasticity
CLAY	>40	1/64 in. thread	Very High Plasticity

D. Terms Describing Overall Composition of Soil

Written Proportion	Proportion Symbol	Proportion Percent by Weight
and	a	35 to 50
some	s	20 to 35
little	l	10 to 20
trace	t	1 to 10

Note: Use (+) for upper limit and (-) for lower limit.



TEST PIT NO.: TP-1
DATE: 4/4/2024

DESCRIPTION

Brown mf **SAND**, some Silt.

Orange-Brown cmf **SAND**, little+ cmf Gravel, little Clayey Silt. (*Sample 1*)

Prop. Basin Bot: 128.5'

Light Tan m⁺f **SAND**, little Silt. (Sample 2, k=1.44 in./hr)

END OF TEST PIT AT @ 11' (Sidewall Collapse)

CONTRACTOR: Russo Corp.

EXCAVATOR: Caterpillar 430E

The information shown hereon indicates the subsurface conditions encountered at the specified test pit location on the date(s) of excavation. Subsurface conditions are likely to vary across the project site. Interpretation of the subsurface data shall be at the discretion of the user.



TEST PIT LOG

TRUCK SERVICE CENTER
ELK TOWNSHIP, GLOUCESTER COUNTY, NJ (FPA JOB NO. 21743.001)

TEST PIT NO.: TP-2
DATE: 4/4/2024

GROUND ELEV.: +133'±
DEPTH OF WATER: 7'±
GROUNDWATER ELEV.: 126'±
DEPTH TO EST. SEASONAL HIGH WATER: 7'±

DEPTH	DESCRIPTION
0 – 19"	Brown mf+ SAND , and Clayey Silt.
19 – 84"	Orange-Brown cmf SAND , some+ cmf Gravel, little Clayey Silt. (<i>Sample 1</i>) <div>Prop. Basin Bot: 128.5'</div>
84 – 144"	Tan c+mf SAND , little mf Gravel, little Silt. (<i>Sample 2, k=12.05 in./hr</i>)

END OF TEST PIT AT @ 12' (*Sidewall Collapse*)

NOTES:

SOILS ENGINEER: J. Tierney, PE

CONTRACTOR: Russo Corp.

TEST PIT OBSERVER: M. Milgrom

EXCAVATOR: Caterpillar 430E

The information shown hereon indicates the subsurface conditions encountered at the specified test pit location on the date(s) of excavation. Subsurface conditions are likely to vary across the project site. Interpretation of the subsurface data shall be at the discretion of the user.



TEST PIT LOG

TRUCK SERVICE CENTER
ELK TOWNSHIP, GLOUCESTER COUNTY, NJ (FPA JOB NO. 21743.001)

TEST PIT NO.: TP-3
DATE: 4/4/2024

GROUND ELEV.: +128'±
DEPTH OF WATER: 2.5'±
GROUNDWATER ELEV.: 125.5'±
DEPTH TO EST. SEASONAL HIGH WATER: 2.5'±

DEPTH	DESCRIPTION
0 – 24"	Dark Brown mf SAND , and Clayey Silt. <i>Prop. Basin Bot: 128'</i>
24 – 96"	Orange-Brown cmf SAND , some cmf Gravel, little* Silt. (<i>Sample 1, k=15.41 in./hr</i>)

END OF TEST PIT AT @ 8' (*Sidewall Collapse*)

NOTES:

SOILS ENGINEER: J. Tierney, PE

CONTRACTOR: Russo Corp.

TEST PIT OBSERVER: M. Milgrom

EXCAVATOR: Caterpillar 430E

The information shown hereon indicates the subsurface conditions encountered at the specified test pit location on the date(s) of excavation. Subsurface conditions are likely to vary across the project site. Interpretation of the subsurface data shall be at the discretion of the user.



TEST PIT LOG

TRUCK SERVICE CENTER
ELK TOWNSHIP, GLOUCESTER COUNTY, NJ (FPA JOB NO. 21743.001)

TEST PIT NO.: TP-4
DATE: 4/4/2024

GROUND ELEV.: +130'±
DEPTH OF WATER: 5'±
GROUNDWATER ELEV.: +125'±
DEPTH TO EST. SEASONAL HIGH WATER: 5'±

DEPTH	DESCRIPTION
0 – 30"	Brown mf SAND , some Clayey Silt. <i>Prop. Basin Bot: 128'</i>
30 – 84"	Brown c+mf SAND , some+ cmf Gravel, little+ Clayey Silt. (<i>Sample 1, k=5.41 in./hr</i>)
84 – 120"	Tan c+mf SAND , some cmf Gravel, little- Silt. (<i>Sample 2</i>)

END OF TEST PIT AT @ 10' (*Sidewall Collapse*)

NOTES:

SOILS ENGINEER: J. Tierney, PE

CONTRACTOR: Russo Corp.

TEST PIT OBSERVER: M. Milgrom

EXCAVATOR: Caterpillar 430E

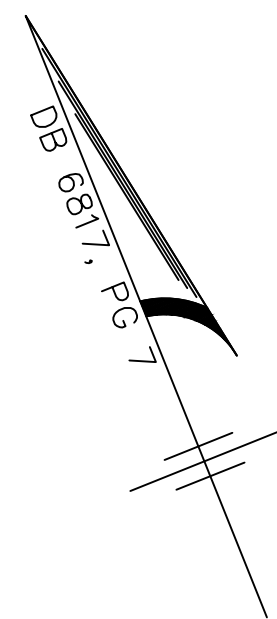
The information shown hereon indicates the subsurface conditions encountered at the specified test pit location on the date(s) of excavation. Subsurface conditions are likely to vary across the project site. Interpretation of the subsurface data shall be at the discretion of the user.



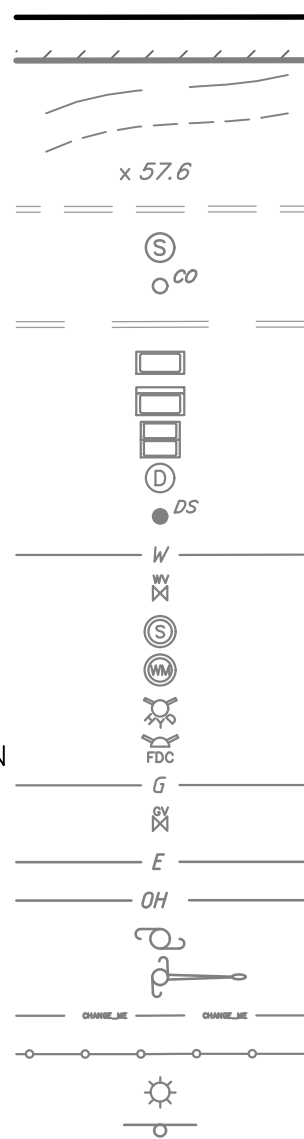
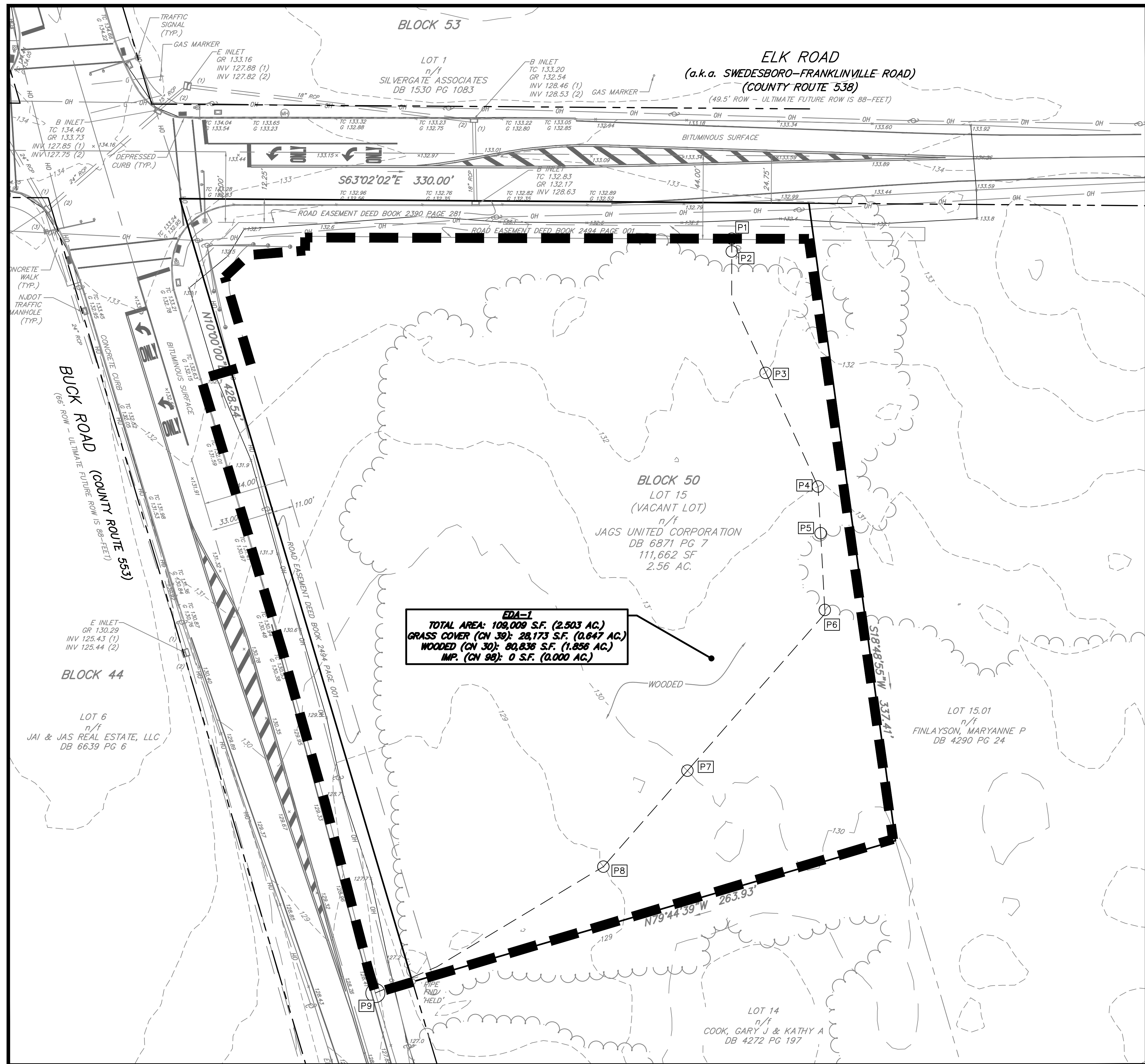
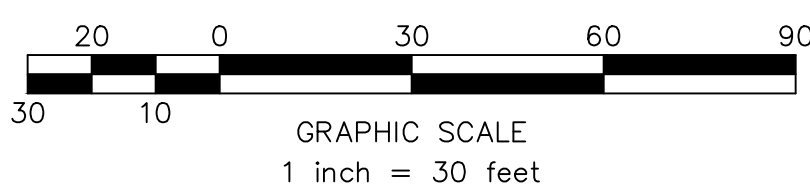
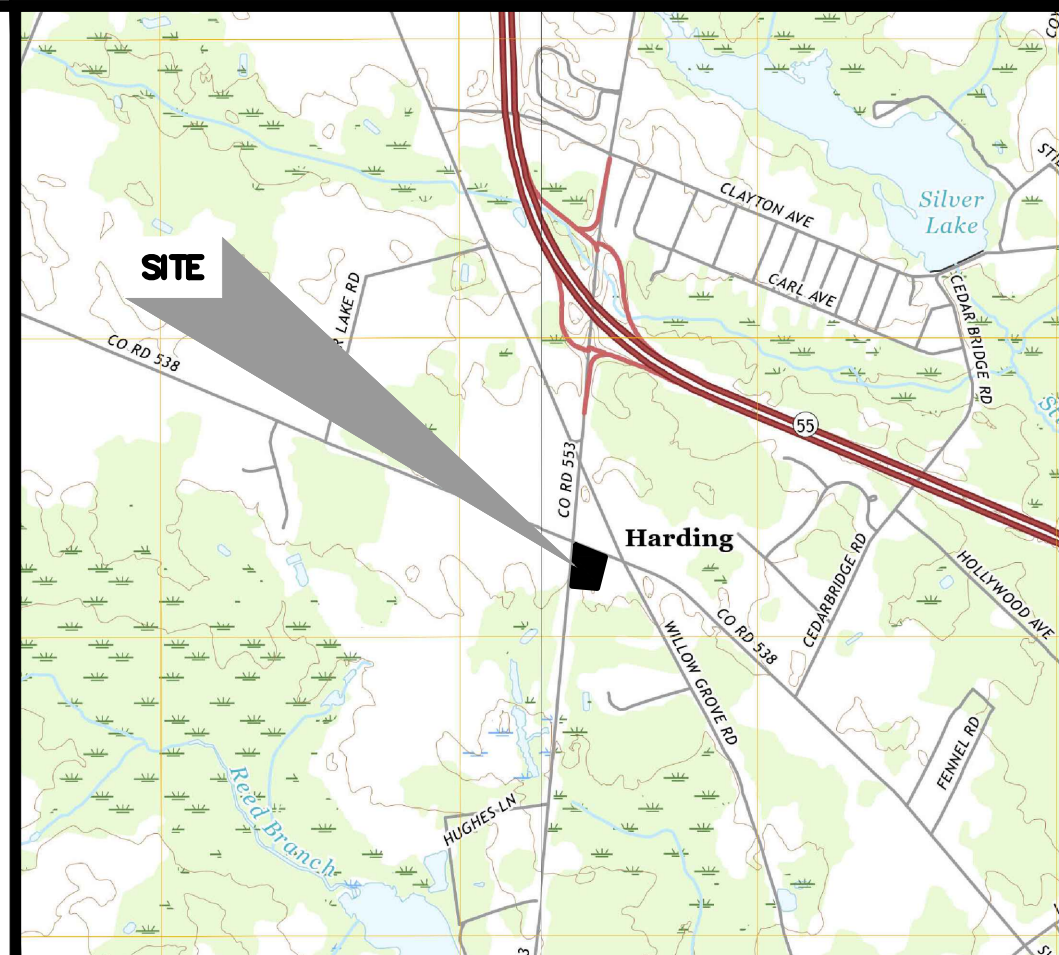
Appendix B

Laboratory Testing

APPENDIX L
Drainage Area Maps

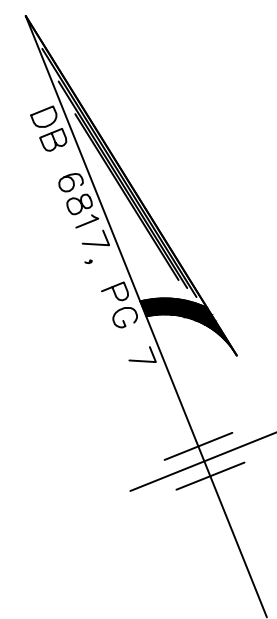


- PROJECT BOUNDARY
EXISTING BUILDING
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
EXISTING SPOT ELEVATION
EXISTING SANITARY SEWER LINE
EXISTING SANITARY SEWER MANHOLE
EXISTING SANITARY SEWER CLEANOUT
EXISTING STORM SEWER LINE
EXISTING TYPE 'A' INLET
EXISTING TYPE 'B' INLET
EXISTING TYPE 'E' INLET
EXISTING MANHOLE/STORM GRATE
EXISTING DOWNSPOUT
EXISTING WATER LINE
EXISTING WATER VALVE
EXISTING SPRINKLER BOX
EXISTING WATER METER PIT
EXISTING FIRE HYDRANT
EXISTING FIRE DEPARTMENT CONNECTION
EXISTING GAS LINE
EXISTING GAS VALVE
EXISTING UNDERGROUND ELECTRIC LINE
EXISTING OVERHEAD ELECTRIC LINE
EXISTING UTILITY POLE
EXISTING UTILITY POLE W/ LIGHT
EXISTING FENCELINE
EXISTING GUIDERAIL
EXISTING LIGHT POLE
EXISTING SIGNAGE

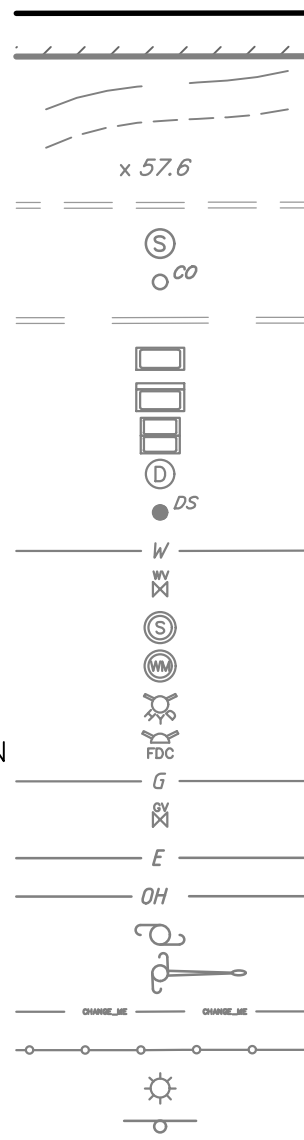
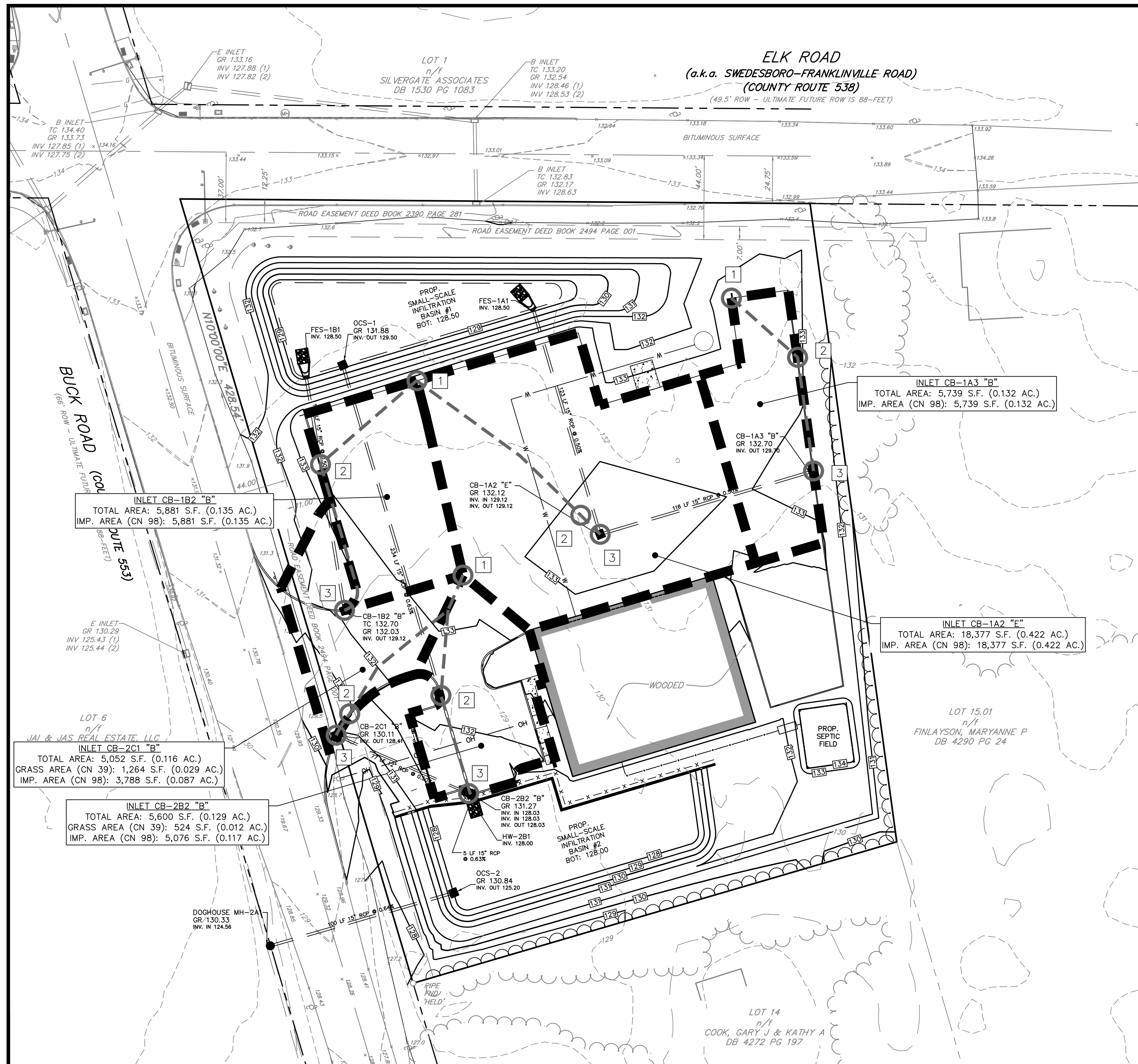
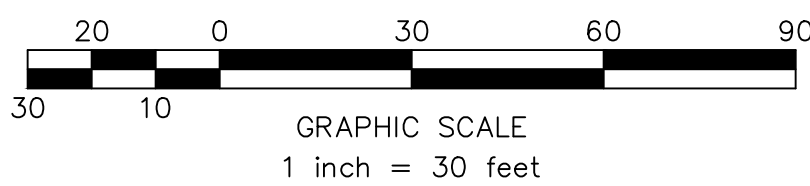
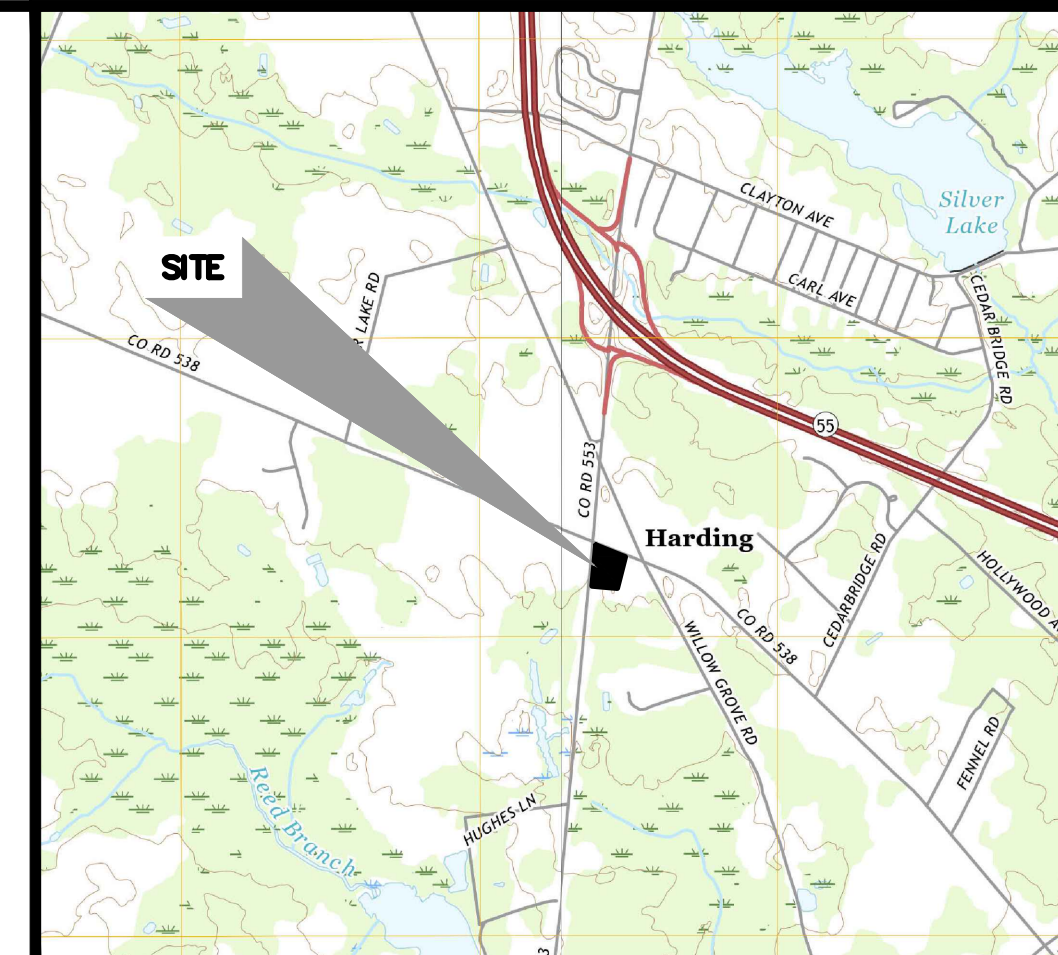


LOCATION MAP
PITMAN EAST, NJ USGS QUAD MAP
SCALE: 1"=2000'

	<p>PRELIMINARY SITE PLANS BLOCK 50, LOT 15 705 BUCK ROAD PRE-DEVELOPMENT DRAINAGE AREA MAP</p>			<p>SITUATED IN TOWNSHIP OF ELK, GLOUCESTER COUNTY, NEW JERSEY</p>			<p>2024B Briggs Road, Suite 300 Mount Laurel, NJ 08054 609-910-4450</p>			<p>Certificate of Authorization No. 24G42814000</p>			<p>Louis L. Ziegenfuss I/P.E. PE No. GED42381500 William J. Franklin II P.E. PE No. GED4238550</p>			<p>Sheet Number 1 OF 3</p>		
	DRAWN BY:			CHECKED BY:			RELEASED BY:											
	DATE:			HORIZONTAL SCALE:			VERTICAL SCALE:											
	05/17/24			1" = 30'			N/A											
	PROJECT NO.:			RUS-2304														
DRAWING NAME:			99-DA Maps.dwg															
DATE			REVISIONS			DRAWN BY			CHECKED BY									



- PROJECT BOUNDARY
EXISTING BUILDING
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
EXISTING SPOT ELEVATION
EXISTING SANITARY SEWER LINE
EXISTING SANITARY SEWER MANHOLE
EXISTING SANITARY SEWER CLEANOUT
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EXISTING FENCELINE
EXISTING GUIDERAIL
EXISTING LIGHT POLE
EXISTING SIGNAGE



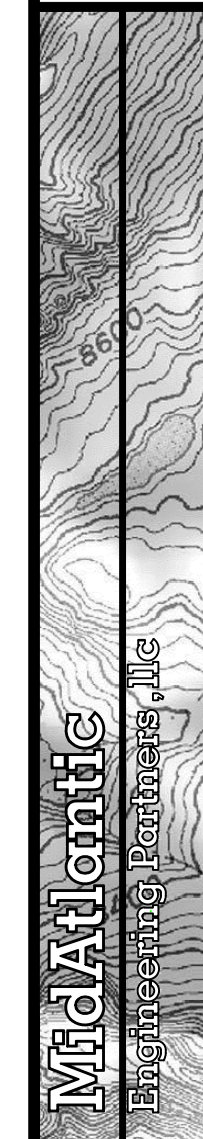
LOCATION MAP
PITMAN EAST, NJ USGS QUAD MAP
SCALE: 1"=2000'

[illegible]

DRAWN BY: JKK	CHECKED BY: SMD	RELEASED BY:
DATE: 05/17/24	HORIZONTAL SCALE: 1" = 30'	VERTICAL SCALE: N/A
PROJECT No.: RUS-2304		
DRAWING NAME: 99-DA Maps.dwg		

PRELIMINARY SITE PLANS
BLOCK 50, LOT 15
705 BUCK ROAD
INLET DRAINAGE AREA MAP

SITUATED IN
TOWNSHIP OF ELK, GLOUCESTER COUNTY, NEW JERSEY



Certificate of Authorization No. 24G-28184000

Louis L. Zueggner IV P.E.	PE No. GE04226500	2026B Briggs Road, Suite 300
William J. Parkhill III P.E.	PE No. GE04733800	Mount Laurel, NJ 08054
		609-910-4450

Sheet Number
3 OF **3**