NARRATIVE AND STORMWATER REPORT
FOR
NOTICE OF INTENT AND SPECIAL PERMIT
FOR A PROPOSED MULTI UNIT RESIDENTIAL DEVELOPMENT
HUTTLESTON AVENUE
FAIRHAVEN, MA

PREPARED FOR:

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SEPTEMBER 26, 2019
REVISED JANUARY 28, 2021

Table of Contents

1.0 INTRODUCTION

It is proposed to construct four three-unit residential buildings on the south side of Huttleston Avenue in Fairhaven, MA. This requires Special Permit/Site Plan Review by the Fairhaven Planning Board and an Order of Conditions from the Fairhaven Conservation Commission. This report has been prepared in support of those petitions.

2.0 EXISTING CONDITIONS

The Site is a 2.46-acre parcel referenced as Assessor's Map 31, Lots 115A and 117C. It is primarily wooded, with the exception of a 70 foot by 120-foot area adjacent to Huttleston Avenue that has bituminous concrete paving. The northern portion of the parcel is bordering vegetated wetlands that are jurisdictional under MA Wetland regulations. Test pits that were excavated in the upland areas indicate the presence of muck at a depth of 5 feet, indicating that the lot may have historically have been wetlands which were filled many decades ago. Drain lines run across the Site from Huttleston Avenue to a dilapidated drain manhole located in the wetlands and then southwest across a neighboring property toward the Brook Drive swale system. The site has been provided with gas service and municipal water and sewer stubs

3.0 PROPOSED IMPROVEMENTS

It is proposed to construct four, two-story wood framed three-unit residential buildings for a total of 12 residential 2-bedroom units with associated utilities, parking, and stormwater management infrastructure. A total of 26 standard parking spaces and 2 van accessible handicap spaces are proposed for a total of 28.

4.0 STORMWATER FACILITIES

The storm drainage system at the proposed development has been designed to create a reduction in the rate and volume of stormwater runoff from the existing site. The collection and treatment systems will be in the form of a sediment forebay, a constructed wetland detention basin, an infiltration area, and three underground infiltration chamber systems. Hydrologic computations were performed in order to model the volume and rate of flow of stormwater from the site, under both existing and proposed conditions, for a broad range of design storms.

4.1 STORMWATER COLLECTION SYSTEM

Throughout the development, stormwater will be collected from the impervious areas by a catch basin. The catch basin will be precast concrete with 4-foot-deep sump for sediment settlement and will be equipped with hoods on the outlets to prevent the discharge of floating debris and other substances.

The collected runoff will be conveyed to the water quality components through high density polyethylene (HDPE) piping with corrugated exterior walls and smooth interior walls. The corrugated exterior of the piping provides for exceptional strength and bearing capacity. The smooth interior walls of the piping provide a smoothness that exceeds that of concrete pipe, thus

providing increased hydraulic capacity. All of the piping is designed to provide self-cleansing velocities in large storm events to remain essentially maintenance free throughout its life. The last length of pipe at the outfalls where they are exposed to day light will be reinforced concrete.

All roof runoff will be directed to Cultec 330XLHD Chamber system. These units have been sized to handle the range of design storms and overflow through a wye connection and concrete splash pad during times of emergency.

4.2 STORMWATER MANAGEMENT FACILITIES

Current Department of Environmental Protection standards require that the peak runoff rate after development is not more than peak runoff rate prior to development for 2 and 10-year 24-hour storm events. Additionally, it is required that the stormwater management system be evaluated for 100-year storm projections.

Hydrologic modeling has been conducted for the design of the ponds to determine appropriate sizing and outflow characteristics. HydroCAD Version 7.10 was utilized to perform this hydrologic and hydraulic modeling. The 2, 10, 25, and 100-year design storms were evaluated. The hydrologic and hydraulic modeling established that the stormwater management system will effectively attenuate the full range of design storms. That is, the peak rate of flow after development will be less than or equal to existing conditions. The drainage summary provided with this document tabulates the projected decreases of peak runoff rates when the site is subjected to the design storm events. The complete hydrologic and hydraulic computational output is presented in Appendix A.

The pocket wetland system will be constructed with a sediment forebay, 18" to 24" deep marsh, 6" to 12", shallow marsh and 6-inch-high semi wet berms. The required size of the "basin/wetlands" based on the DEP Stormwater Manual is one hundredth of the water shed, which calculates to 512 square feet. The designed size is over four times the required size, please see plans.

4.3 WATER QUALITY CONSIDERATIONS AND STORMWATER STANDARDS

The Massachusetts Department of Environmental Protection (MassDEP) issued Stormwater Management standards. The goal is to improve water quality and address water quantity problems, which are sometimes caused by development projects, by the implementation of performance standards for stormwater management. The project was designed to meet and exceed all relevant standards established in the policy. The following sections describe how each of these standards will be achieved on this project by incorporating Best Management Practices (BMPs) into the design. Standards 1 through 10 are described below

4.3.1 UNTREATED STORMWATER (STANDARD 1)

Standard 1 of the DEP Stormwater Policy recommends that no new stormwater conveyance, such as storm drain outfalls, discharge untreated stormwater directly to wetlands or waterways of the Commonwealth. Flows from woods, fields, and other undeveloped areas are to be considered

uncontaminated, however, runoff from paved road and parking lot surfaces should receive treatment prior to discharge.

In designing this project, provisions have been made so that the runoff from drives and parking areas will receive proper treatment prior to discharge. All the proposed improvements will be located and graded such that runoff from the paved areas will be directed to a BMP. Runoff from these areas will be collected and conveyed to the water quality measures through a deep sump catch basin and subsurface piping. This collected runoff will receive a treatment utilizing Best Management Practices measures designed into the catch basin units, the sediment forebay and the detention basin which is designed as a constructed pocket wetland. These features are further described in the discussions for Standards 2 through 9. All clean roof runoff will be routed to an underground infiltration chamber. Through the collection and treatment of runoff from paved areas, DEP Standard 1 is satisfied.

4.3.2 POST DEVELOPMENT DISHCHARGE RATES (STANDARD 2)

Standard 2 of the DEP Stormwater Policy prescribes that stormwater management systems be implemented in order to ensure that post-development peak rates of discharge do not exceed existing rates of runoff for standard 2 year and 10-year 24-hour design storms. In addition, the pre- and post-peak rates for the 100-year storm must be evaluated to assure that there will not be increased off-site flooding. Hydrologic calculations have been conducted in designing the stormwater controls to ensure that this standard is satisfied.

For this project, roof runoff is designed to be directed into infiltration chambers (Cultec 330XLHD) on each building. It is important to note that no infiltration rate was modeled in hydroCAD in order to conservative. Please see appendix A. In evaluating the same areas under pre- and post-development conditions, a direct comparison can be made as to the net increase or decrease in runoff rates attributable to altered land uses. The Drainage Summary table below presents a summary of the hydrologic modeling conducted for this project. As presented in this table, the drainage system successfully moderates the flow for the full range of design storms and therefore this standard is met.

	FLOW							
	2 Year Flow (cfs)		10 Year Flow (cfs)		25 Year Flow (cfs)		100 Year Flow (cfs)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
DP-1 - Wetland Area	0.86	0.21	1.80	0.73	2.38	1.21	3.47	1.90
DP-2 - Offsite Drainage Network	0.00	0.02	0.00	0.14	0.00	0.40	0.00	1.47
DP-3-Street	0.24	0.00	0.40	0.00	0.50	0.00	0.66	0.00
Sum	1.10	0.23	2.20	0.87	2.88	1.61	4.13	3.37

In addition to runoff rate, the town of Fairhaven also requires that applicants control volume through the 10-year storm. The below table shows that this requirement has been fulfilled.

VOLUME

	2 Year Volume (af)		10 Year Vol. (af)		25 Year Vol. (af)		100 Year Vol. (af)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
DP-1 - Wetland Area	0.114	0.063	0.223	0.139	0.293	0.171	0.423	0.229
DP-2 - Offsite Drainage Network	0.000	0.031	0.000	0.090	0.000	0.139	0.000	0.237
Dp-3-Street	0.019	0.000	0.032	0.000	0.039	0.000	0.053	0.000
Sum	0.133	0.094	0.255	0.229	0.332	0.310	0.476	0.466

4.3.3 RECHARGE TO GROUNDWATER (STANDARD 3)

Standard 3 of the DEP Stormwater Policy prescribes that the stormwater runoff volume to be recharged to groundwater should be determined using existing soil characteristics.

The recharge volume must be infiltrated only to the maximum extent practical because the site is comprised solely of C and D soils. According to the USDA Soil Conservation Service mapping, the surficial soils under the proposed road, sidewalk and driveways are hydrologic soil group C. The DEP Stormwater Policy requires that a certain volume of runoff be infiltrated to groundwater based on the type of soil present and the amount of impervious area being generated by the proposed development. For Type C soils, the recharge rate has been established to be 0.25 inches of runoff. The soil under the proposed pavement is hydrologic soil group C. The 23,478 square feet of pavement with a 0.25-inch depth of precipitation will generate 490 cubic feet of water requiring infiltration. Thirty-six (36) infiltration units were designed to store and infiltrate a 0.25-inch depth of runoff generated by the proposed impervious area. They can store 1,978 (chamber storage only) cubic feet of runoff. Therefore standard 3 is met.

4.3.4 REMOVAL OF 80% OF TOTAL SUSPENDED SOLIDS (STANDARD 4)

Standard 4 of the DEP Stormwater Policy requires removal of 80% of total suspended solids before discharge of stormwater. A stormwater BMPs have been designed in order to meet the objectives of removing 80% of the average annual load of total suspended solids. These proposed measures include:

- Catch basins to be installed on this project will be equipped with Massachusetts Highway Department standard metal hoods mounted over the catch basin outlet pipe.
- Catch basin will be constructed with a four (4) foot deep sump.
- A detention basin has been designed with the primary objective of controlling peak discharges and volume. The basin is designed to act as a constructed pocket wetland as described in the MADEP Stormwater Management standards.

	Initial Suspended Solids	Removal Rate	Remaining Suspended Solids
Deep Sump catch basins with hoods	100%	25%	75%
Constructed Pocket Wetlands	75%	80%	15%

85% removal achieved - See TSS Worksheets in Appendix A
The combination of the above features will result in the removal of 85% of the total suspended solids as demonstrated above.

4.3.5 USES WITH HIGHER POTENTIAL POLLUNTANT LOADS (STANDARD 5)
Standard 5 of the DEP Stormwater Policy requires that stormwater discharges with higher potential pollutant loads, such as gas stations, be provided with specific BMPs. This standard does not apply to this project. The BMPs proposed in this project will provide excellent treatment of the roadway runoff.

4.3.6 STORMWATER DISCHARGES TO CRITICAL AREAS (STANDARD 6)
Standard 6 of the DEP Stormwater Policy seeks to protect critical areas. Critical areas are specifically designated Outstanding Resource Waters such as shell fish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies. This project is not located in a critical area and, therefore, the project is not subject to this standard.

4.3.7 REDEVELOPMENT OR PREVIOUSLY DEVELOPED SITES (STANDARD 7)
Standard 7 of the DEP Stormwater Policy applies to sites which have been previously developed and are being redeveloped. Diminished performance of BMPs is allowed in these areas. This site does not fall in that category.

4.3.8 EROSION AND SEDIMENT CONTROL (STANDARD 8)
Standard 8 of the DEP Stormwater Policy requires that erosion and sediment control measures be designed. Erosion and sediment control measures have been developed for this project and are included in the set of drawings. These plans show the proposed locations for erosion control devices. The following supplemental provisions are also a part of this plan.

Erosion and sedimentation control measures which are proposed to be implemented during construction include the installation of straw bales and silt fencing which has the bottom 6 inches buried in the ground. Any extra excavated soil which is not used to bury the base of the fence will be cast up gradient of the silt fence.

- Silt fence and straw bales, if installed, shall be inspected after every major rainfall runoff event (over ½" depth of precipitation). Damaged or misaligned fences shall be immediately repaired.
- Silt shall be immediately removed from all areas of the silt fence when depth of accumulation exceeds 6 inches.
- Sumps and out falls shall be inspected after every major rainfall runoff event (over ½" depth of precipitation). Silt shall be immediately removed from all sumps where the depth of accumulation exceeds 9 inches.
- All exposed construction areas will be stabilized upon completion, in order to minimize the time that these areas are unstabilized.

With the full impact of the measures presented on the Erosion and Sedimentation Control Plans and the procedures in Appendix B of this report, along with the provisions stipulated above, Standard 8 will be satisfied.

4.3.9 OPERATIONS AND MAINTENANCE PLANS (STANDARD 9)
Standard 9 of the DEP Stormwater Policy prescribes the adoption of a formal operation and maintenance plan to ensure that the stormwater management systems function properly as designed. Appendix D presents the Operation and Maintenance Plan, so Standard 9 is met.

4.3.10 PROHIBITION OF ILLICIT DISCHARGES (STANDARD 10)
Standard 10 prohibits illicit discharges. Appendix G addresses the non-existence of illicit discharges.

4.4 COMPLIANCE WITH FAIRHAVEN STORMWATER STANDARDS

The Town's stormwater regulations are presented in Section 198-31.1 of the Fairhaven zoning bylaw. They are administered by the Planning Board. This development has been designed in compliance with these standards except for the following for which waivers are being requested:

1. A 4:1 side slope to the forebay is being provided. It is requested to allow all other slopes to be 3:1 and 2:1 in order to save the large linden tree and to provide more separation from the wetlands (Section 198-31.1 (c)(2)(g)[6].

2. To allow the existing pipes in the detention basin and the proposed pipes that are not under paved areas to have less than 2 feet of cover since they will not be subjected to vehicle loads. Also, to allow HDPE pipe (c)(2)(n)[6].

5.0 SPECIAL PERMIT CRITERIA
Section 198-29 of the Fairhaven Zoning Bylaw requires that the proposed multi-unit residential development obtain a Special Permit from the Planning Board. The following subsections demonstrate how the proposed development meets the requisite criteria.

5.1 TRAFFIC
The parking areas have been designed to not require that any vehicle back into a public way. The western drive has been aligned with New Boston Road. At that drive, the minimum sight visibility to the east is 800 feet and to the west is 400 feet. The eastern drive has been located 225 feet from Gellette Road (on the same side of the street) and over 250 feet from New Boston Road (on the opposite side of the street). It has a minimum sight distance of 600 feet to the east and 600 feet to the west. In accordance with the Institute of Transportation Engineers' Traffic Generation Manual, the peak hourly a.m. (7 to 9 a.m.) trip ends are projected to be 11, with 2 entering and 9 leaving. It is projected that one vehicle would proceed north on New Boston Road, 5 vehicles would turn west and 4 would turn east. On average, a new vehicle trip would occur every twelve minutes westerly on Route 6 and every 20 minutes easterly on Route 6. This low volume would have no significant impact on level of service on Route 6.

The projected peak hourly p.m. (4 to 6 p.m.) trip ends is 12, with 8 vehicles entering and 4 leaving. It is projected that 5 inbound vehicles will be from the west and 3 inbound vehicles will be from the east. It is projected that 3 exiting vehicles will go west and 1 will go east. At most,

there will be an average of one vehicle every 12 minutes turning westbound. This low volume will not significantly impact the level of service on Route 6 in any direction.

5.2 SAFETY VEHCILE ACCESS

The driveways have been designed to allow emergency vehicles to maneuver to all developed areas of the site with either drive providing full access if the other drive were blocked.

5.3 UTILITIES

The site is serviced with municipal water, municipal sewer and natural gas. Underground cable and electric service will be provided. Section 4 of this report presents the stormwater design which complies with the subdivision regulations. Chapter 322 in all respects shall be met, except retaining the increased in volume of the 10-year storm on site, which requirement is impossible on almost every site in Fairhaven. A waiver is requested. The downgradient area consists of the Brook Drive swale system, which has the capacity to convey the full range of storms without deleterious flooding. Downgradient of Brook Drive, the stream flows 3,500 linear feet to the ocean without crossing a road.

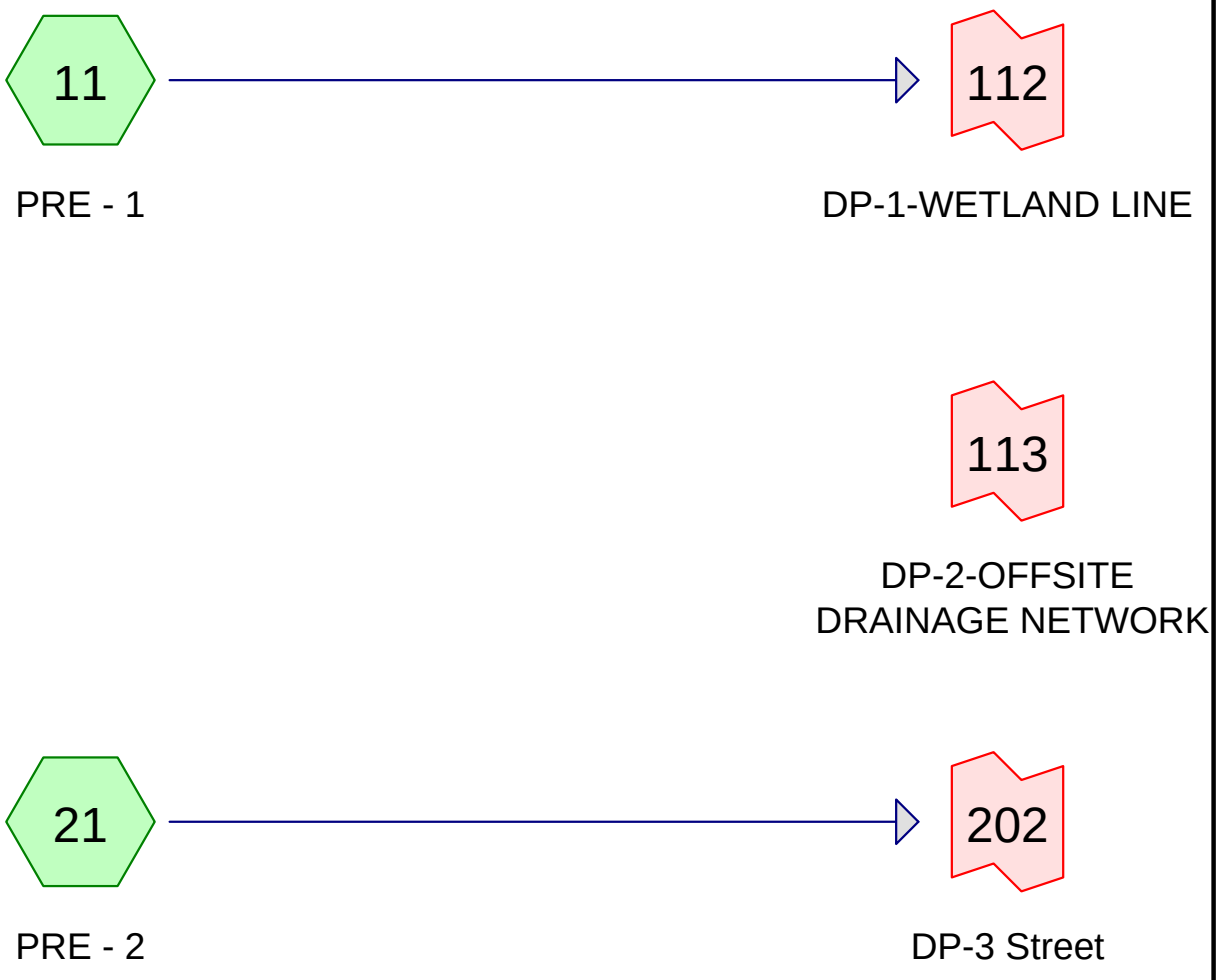
5.4 LANDSCAPING

The requisite trees and shrubs will be provided along Route 6, along other property lines, within the parking areas and to screen the parking as required by Section 198-27C of the Zoning Bylaw.

6.0 SPECIAL PERMIT CRITERIA

The proposed development will produce twelve 2-bedroom residential units which meet all of the Special Permit criteria and which will have minimal impact on the environment and little impact on town services.

Appendix A – Hydraulic & Hydrologic Computations



Subcat Reach Pond Link

Routing Diagram for LEWIS LANDING PRE-DEV-SEK-20201102
Prepared by Prime Engineering, Printed 1/28/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.125	98	Paved parking, HSG C (11, 21)
1.375	70	Woods, Good, HSG C (11, 21)
1.500	**72**	**TOTAL AREA**

Summary for Subcatchment 11: PRE - 1

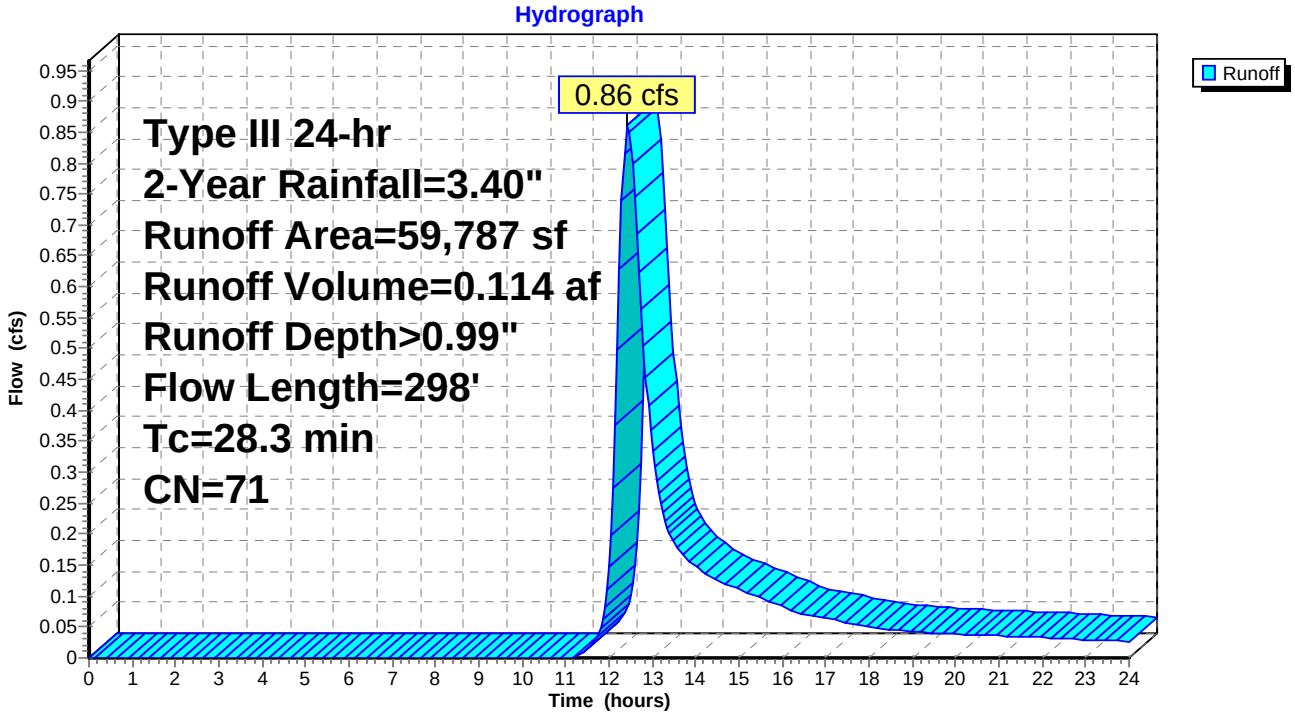
Runoff = 0.86 cfs @ 12.44 hrs, Volume= 0.114 af, Depth> 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (sf)	CN	Description
56,960	70	Woods, Good, HSG C
2,827	98	Paved parking, HSG C
59,787	71	Weighted Average
56,960		95.27% Pervious Area
2,827		4.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	50	0.0200	0.04		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.40"
7.5	248	0.0120	0.55		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.3	298	Total			

Subcatchment 11: PRE - 1



Summary for Subcatchment 21: PRE - 2

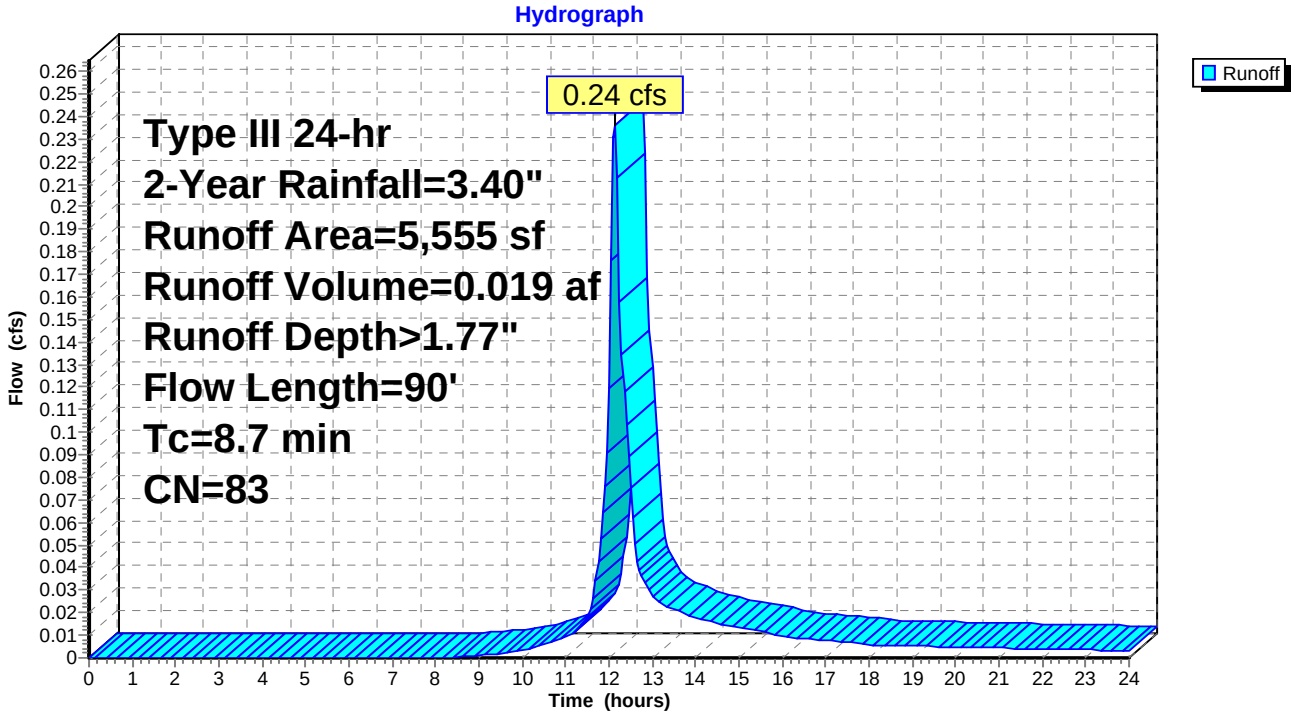
Runoff = 0.24 cfs @ 12.13 hrs, Volume= 0.019 af, Depth> 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (sf)	CN	Description
2,619	98	Paved parking, HSG C
2,936	70	Woods, Good, HSG C
5,555	83	Weighted Average
2,936		52.85% Pervious Area
2,619		47.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0260	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
1.5	40	0.0075	0.43		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.7	90	Total			

Subcatchment 21: PRE - 2

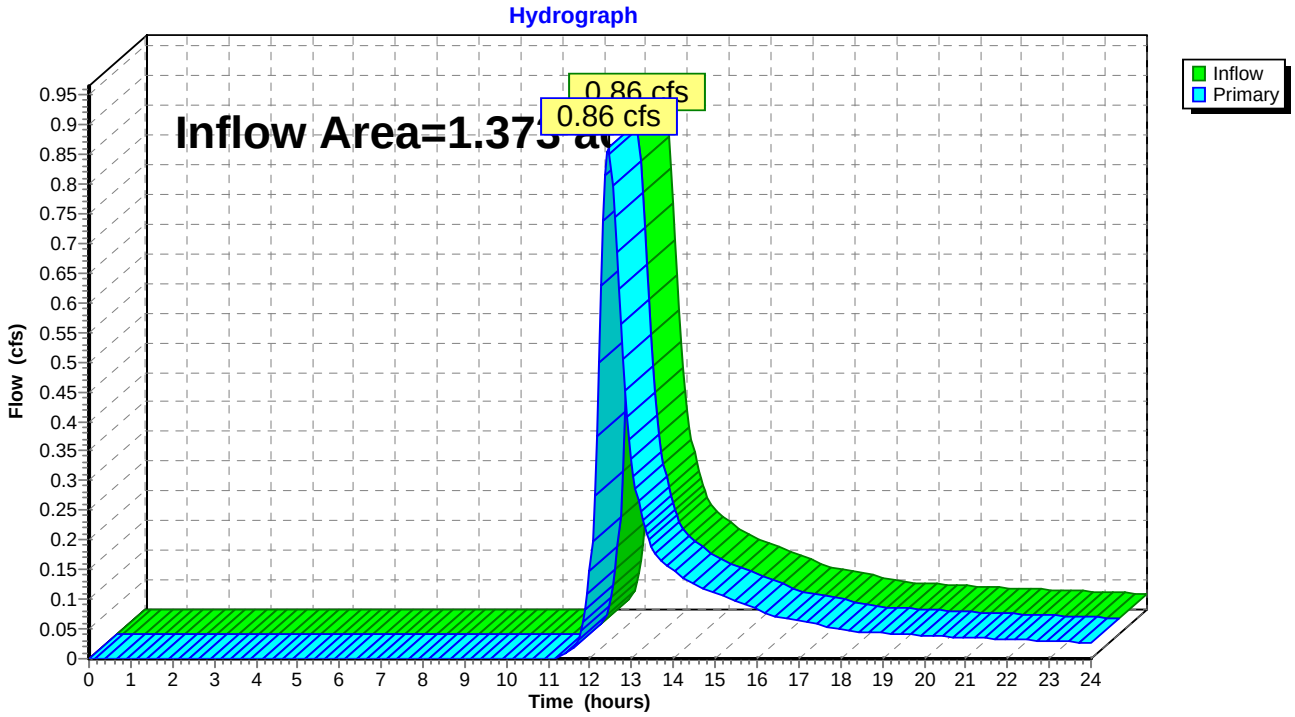


Summary for Link 112: DP-1-WETLAND LINE

Inflow Area = 1.373 ac, 4.73% Impervious, Inflow Depth > 0.99" for 2-Year event
Inflow = 0.86 cfs @ 12.44 hrs, Volume= 0.114 af
Primary = 0.86 cfs @ 12.44 hrs, Volume= 0.114 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 112: DP-1-WETLAND LINE

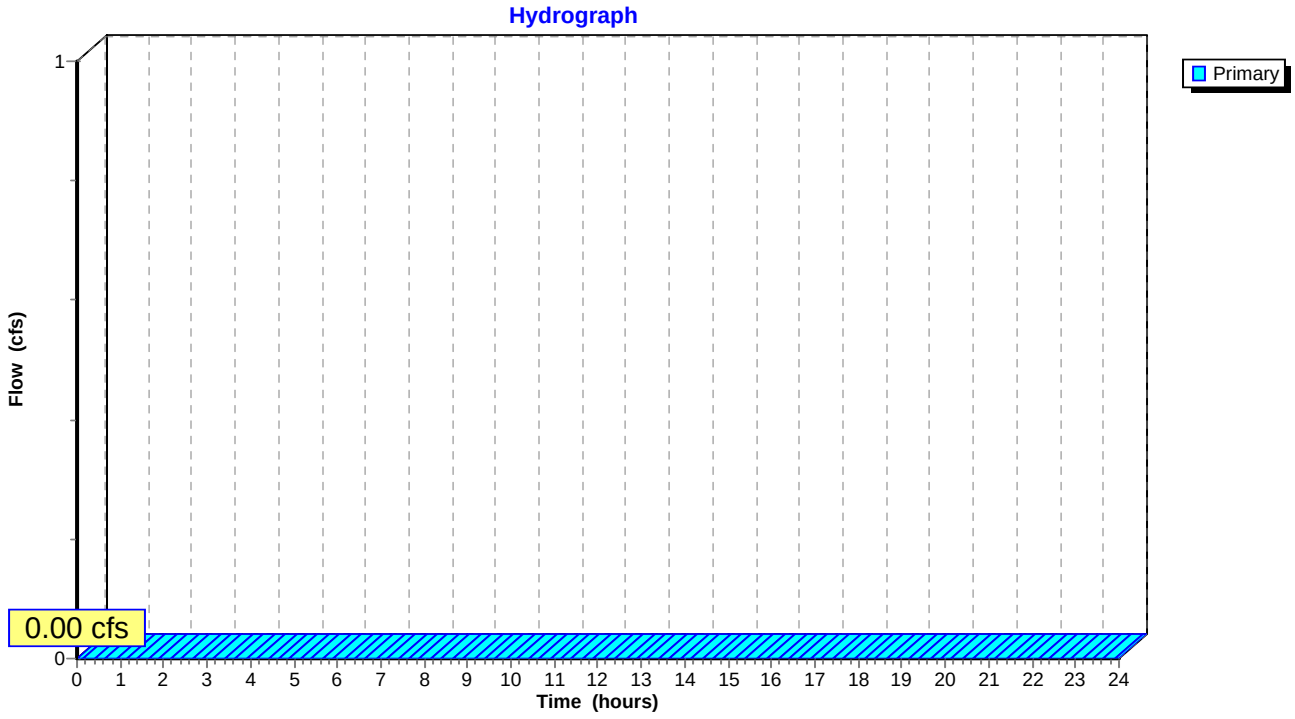


Summary for Link 113: DP-2-OFFSITE DRAINAGE NETWORK

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 113: DP-2-OFFSITE DRAINAGE NETWORK

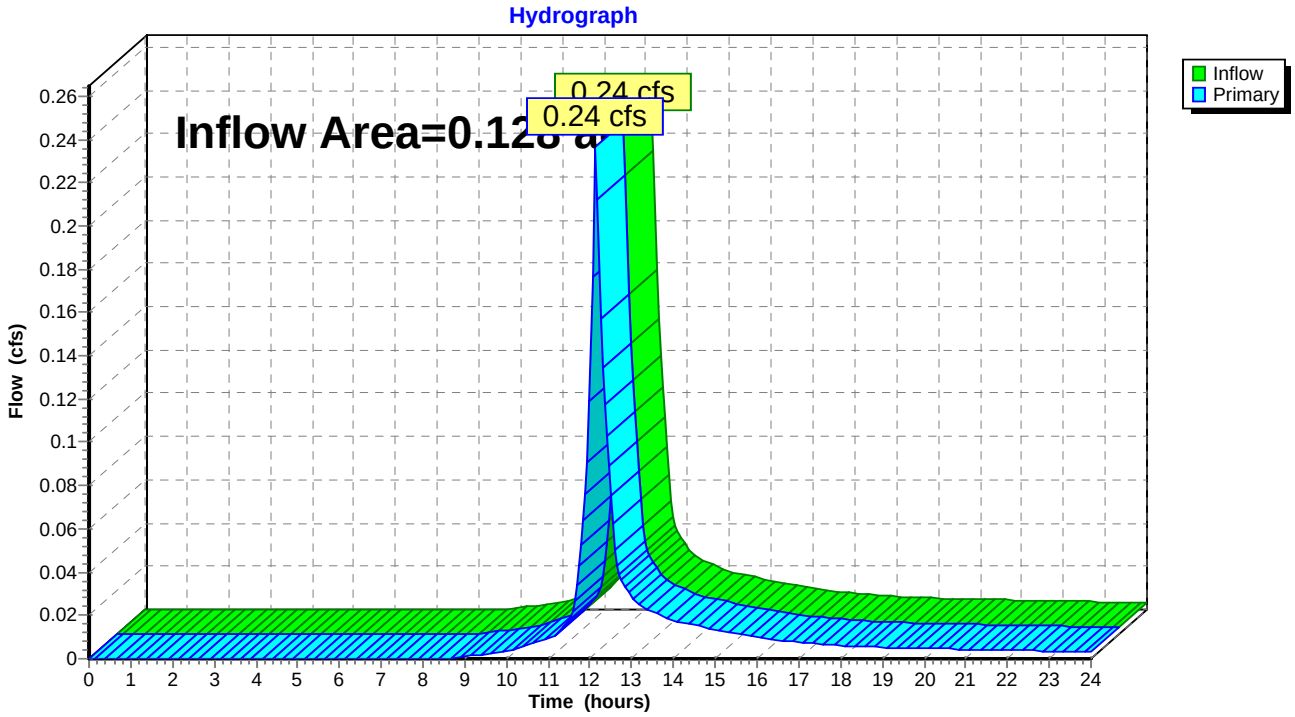


Summary for Link 202: DP-3 Street

Inflow Area = 0.128 ac, 47.15% Impervious, Inflow Depth > 1.77" for 2-Year event
Inflow = 0.24 cfs @ 12.13 hrs, Volume= 0.019 af
Primary = 0.24 cfs @ 12.13 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 202: DP-3 Street



Summary for Subcatchment 11: PRE - 1

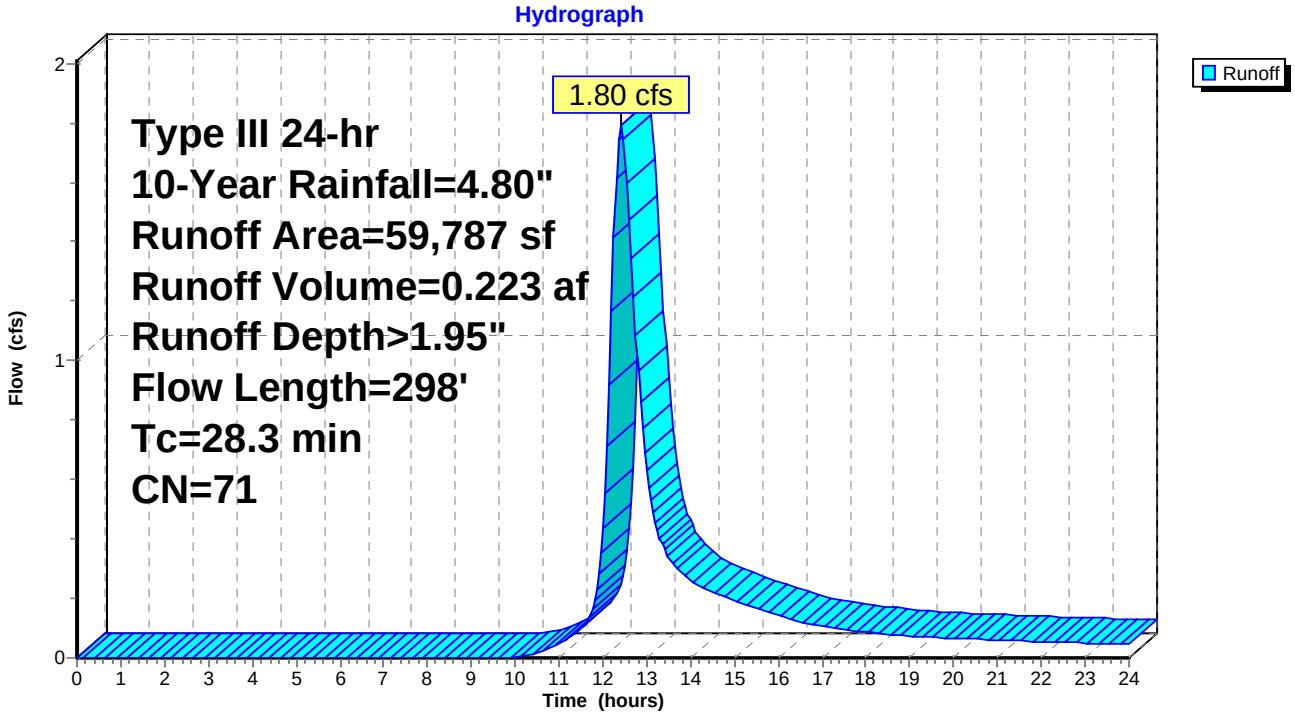
Runoff = 1.80 cfs @ 12.41 hrs, Volume= 0.223 af, Depth> 1.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
56,960	70	Woods, Good, HSG C
2,827	98	Paved parking, HSG C
59,787	71	Weighted Average
56,960		95.27% Pervious Area
2,827		4.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	50	0.0200	0.04		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.40"
7.5	248	0.0120	0.55		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.3	298	Total			

Subcatchment 11: PRE - 1



Summary for Subcatchment 21: PRE - 2

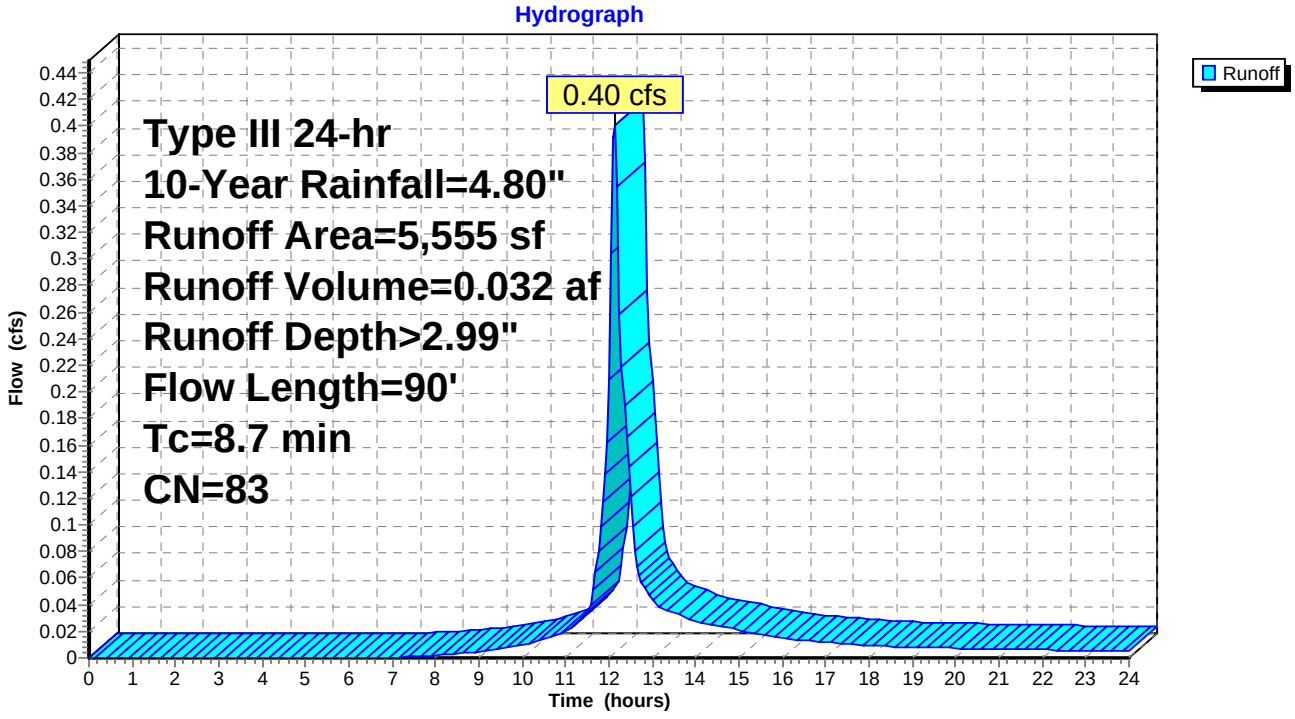
Runoff = 0.40 cfs @ 12.12 hrs, Volume= 0.032 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
2,619	98	Paved parking, HSG C
2,936	70	Woods, Good, HSG C
5,555	83	Weighted Average
2,936		52.85% Pervious Area
2,619		47.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0260	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
1.5	40	0.0075	0.43		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.7	90	Total			

Subcatchment 21: PRE - 2

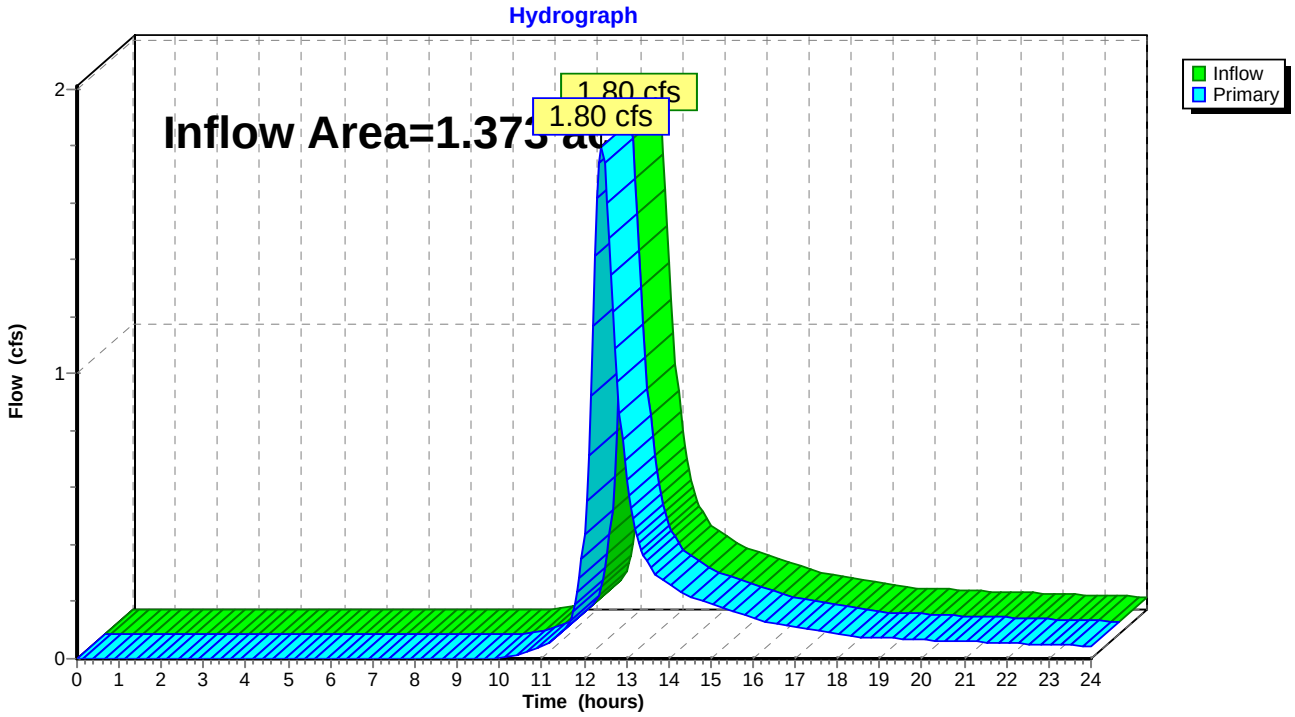


Summary for Link 112: DP-1-WETLAND LINE

Inflow Area = 1.373 ac, 4.73% Impervious, Inflow Depth > 1.95" for 10-Year event
Inflow = 1.80 cfs @ 12.41 hrs, Volume= 0.223 af
Primary = 1.80 cfs @ 12.41 hrs, Volume= 0.223 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 112: DP-1-WETLAND LINE

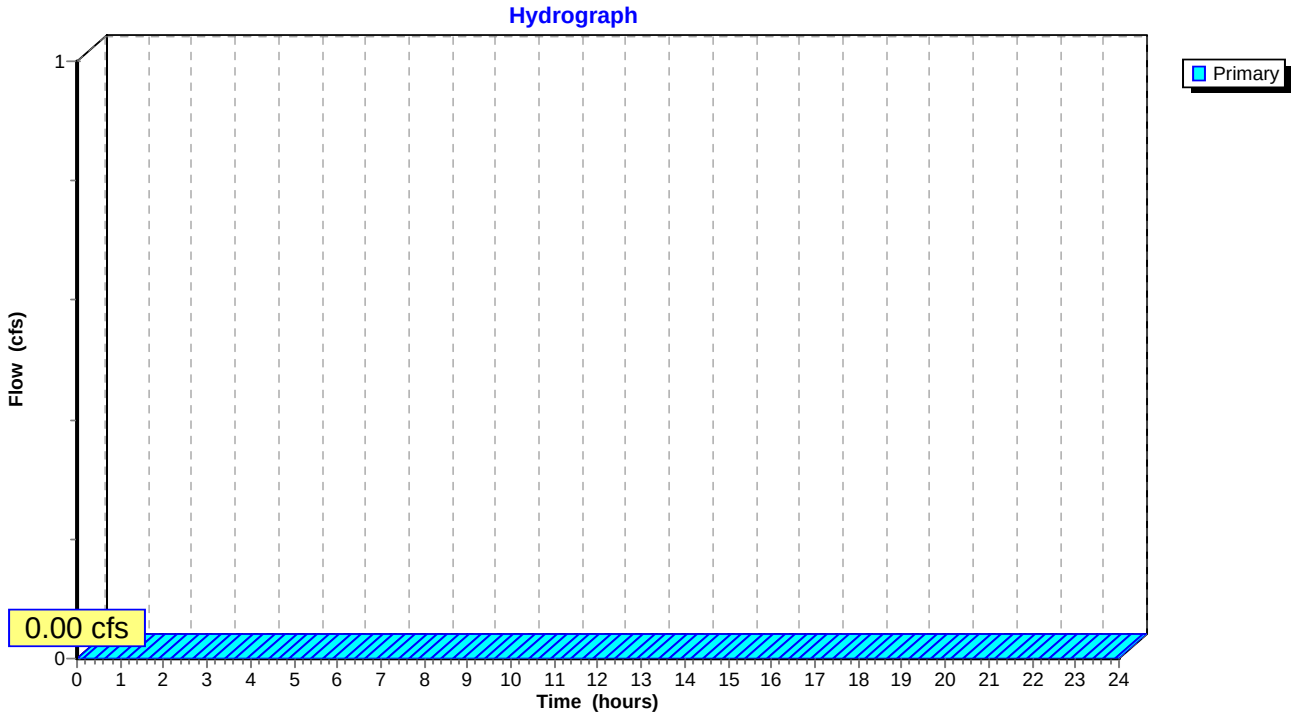


Summary for Link 113: DP-2-OFFSITE DRAINAGE NETWORK

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 113: DP-2-OFFSITE DRAINAGE NETWORK

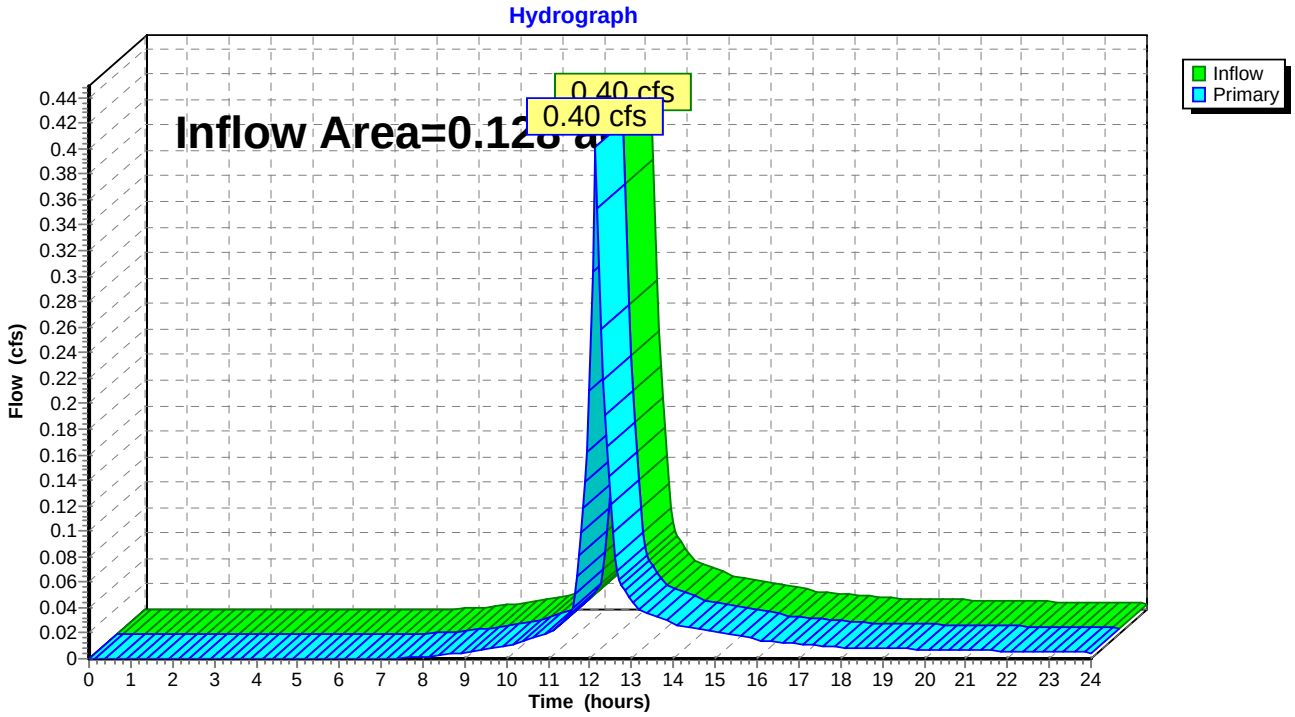


Summary for Link 202: DP-3 Street

Inflow Area = 0.128 ac, 47.15% Impervious, Inflow Depth > 2.99" for 10-Year event
Inflow = 0.40 cfs @ 12.12 hrs, Volume= 0.032 af
Primary = 0.40 cfs @ 12.12 hrs, Volume= 0.032 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 202: DP-3 Street



Summary for Subcatchment 11: PRE - 1

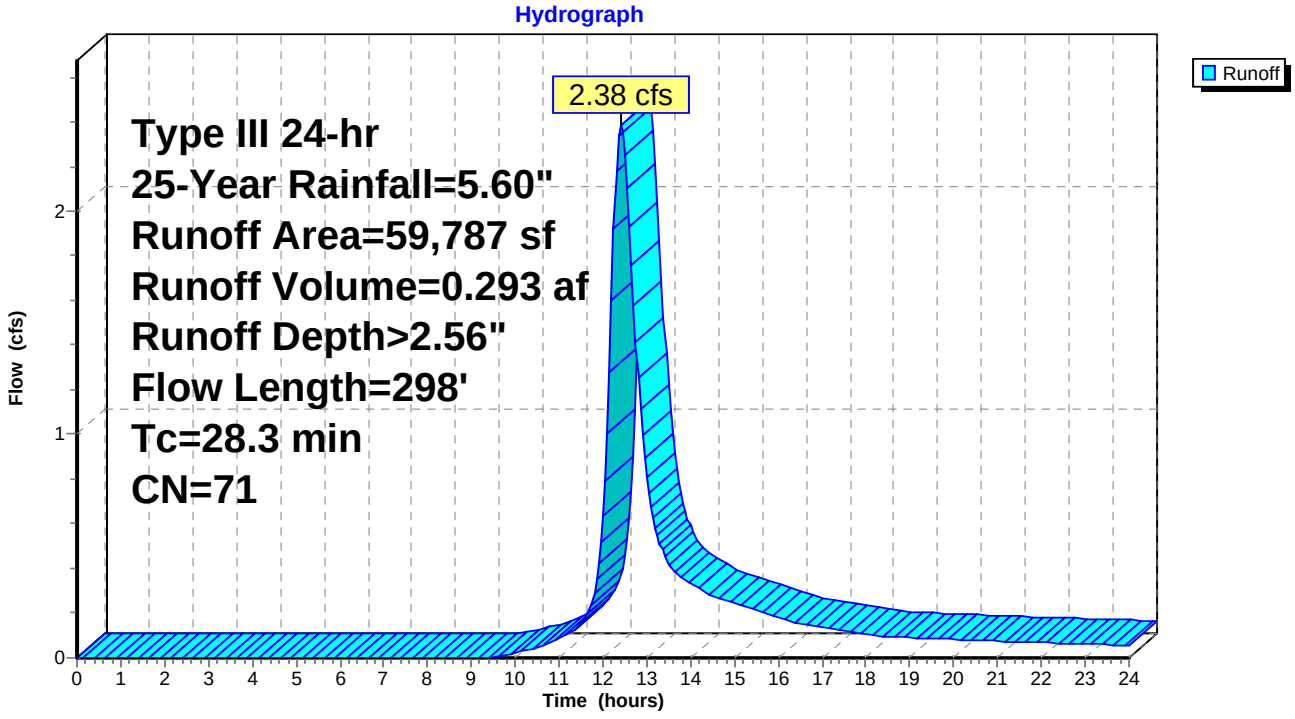
Runoff = 2.38 cfs @ 12.41 hrs, Volume= 0.293 af, Depth> 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (sf)	CN	Description
56,960	70	Woods, Good, HSG C
2,827	98	Paved parking, HSG C
59,787	71	Weighted Average
56,960		95.27% Pervious Area
2,827		4.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	50	0.0200	0.04		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.40"
7.5	248	0.0120	0.55		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.3	298	Total			

Subcatchment 11: PRE - 1



Summary for Subcatchment 21: PRE - 2

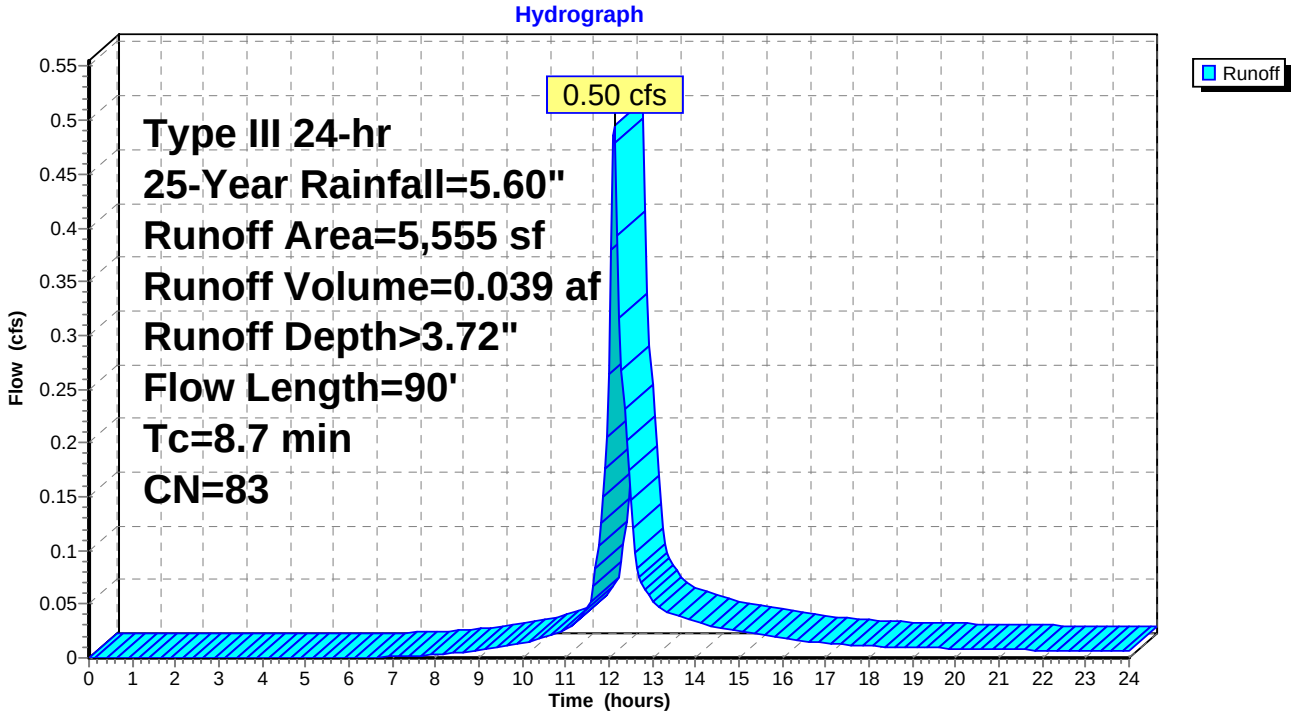
Runoff = 0.50 cfs @ 12.12 hrs, Volume= 0.039 af, Depth> 3.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (sf)	CN	Description
2,619	98	Paved parking, HSG C
2,936	70	Woods, Good, HSG C
5,555	83	Weighted Average
2,936		52.85% Pervious Area
2,619		47.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0260	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
1.5	40	0.0075	0.43		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.7	90	Total			

Subcatchment 21: PRE - 2

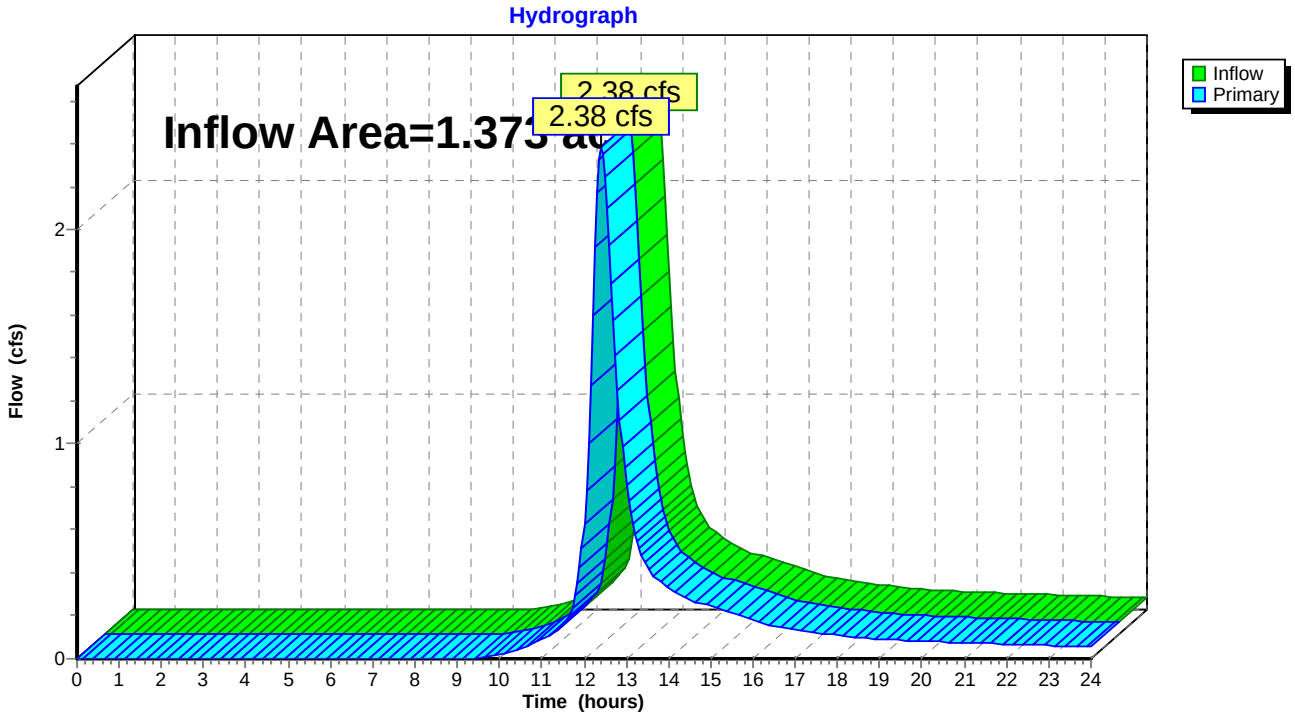


Summary for Link 112: DP-1-WETLAND LINE

Inflow Area = 1.373 ac, 4.73% Impervious, Inflow Depth > 2.56" for 25-Year event
Inflow = 2.38 cfs @ 12.41 hrs, Volume= 0.293 af
Primary = 2.38 cfs @ 12.41 hrs, Volume= 0.293 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 112: DP-1-WETLAND LINE

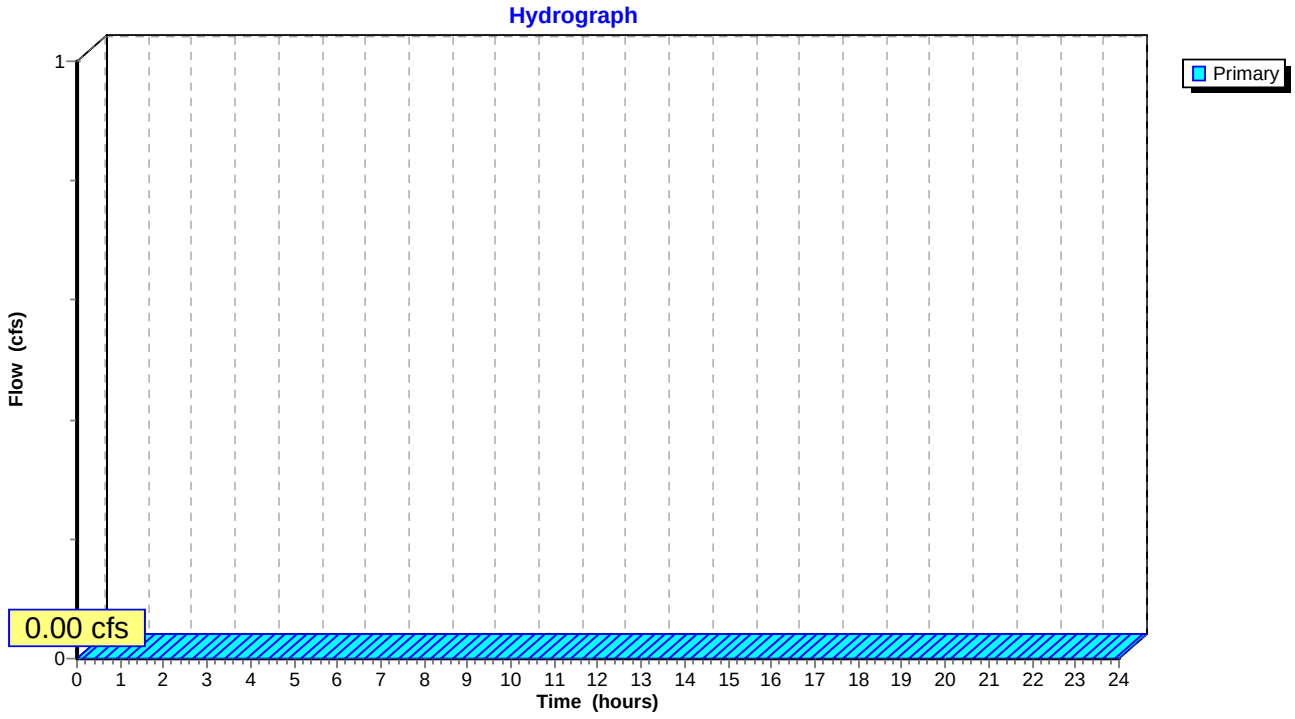


Summary for Link 113: DP-2-OFFSITE DRAINAGE NETWORK

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 113: DP-2-OFFSITE DRAINAGE NETWORK

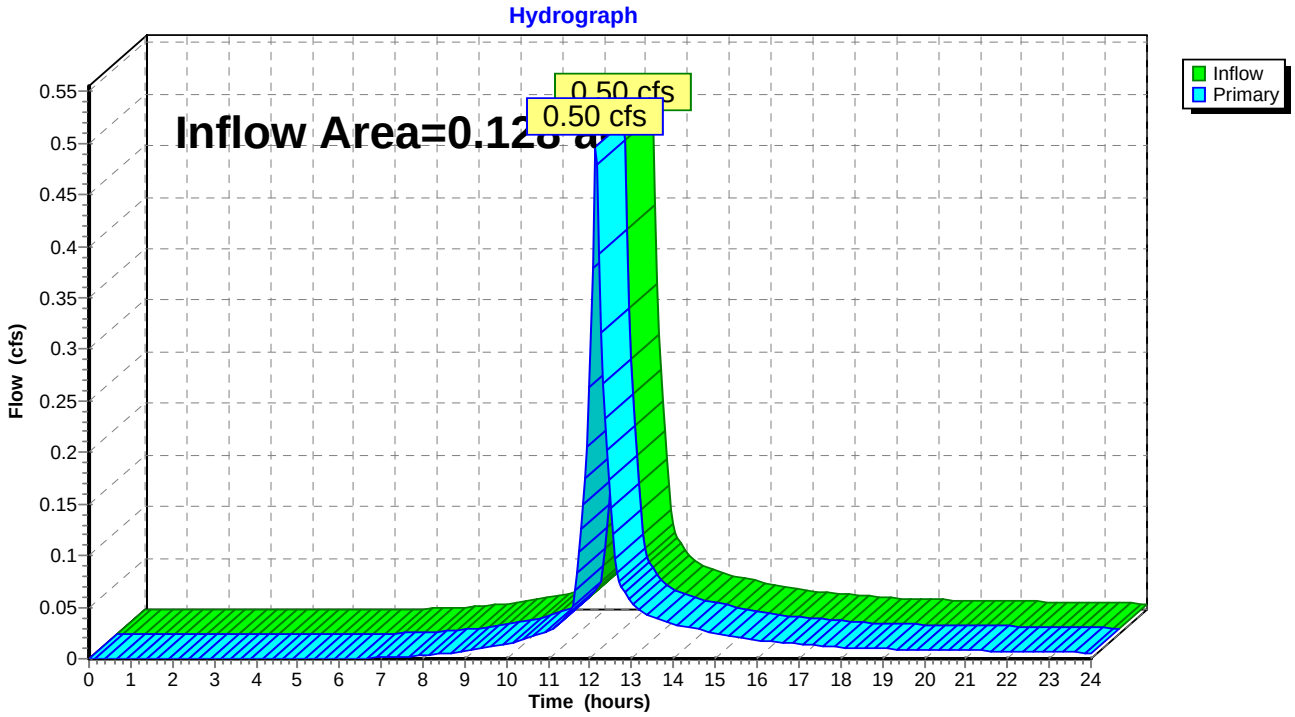


Summary for Link 202: DP-3 Street

Inflow Area = 0.128 ac, 47.15% Impervious, Inflow Depth > 3.72" for 25-Year event
Inflow = 0.50 cfs @ 12.12 hrs, Volume= 0.039 af
Primary = 0.50 cfs @ 12.12 hrs, Volume= 0.039 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 202: DP-3 Street



Summary for Subcatchment 11: PRE - 1

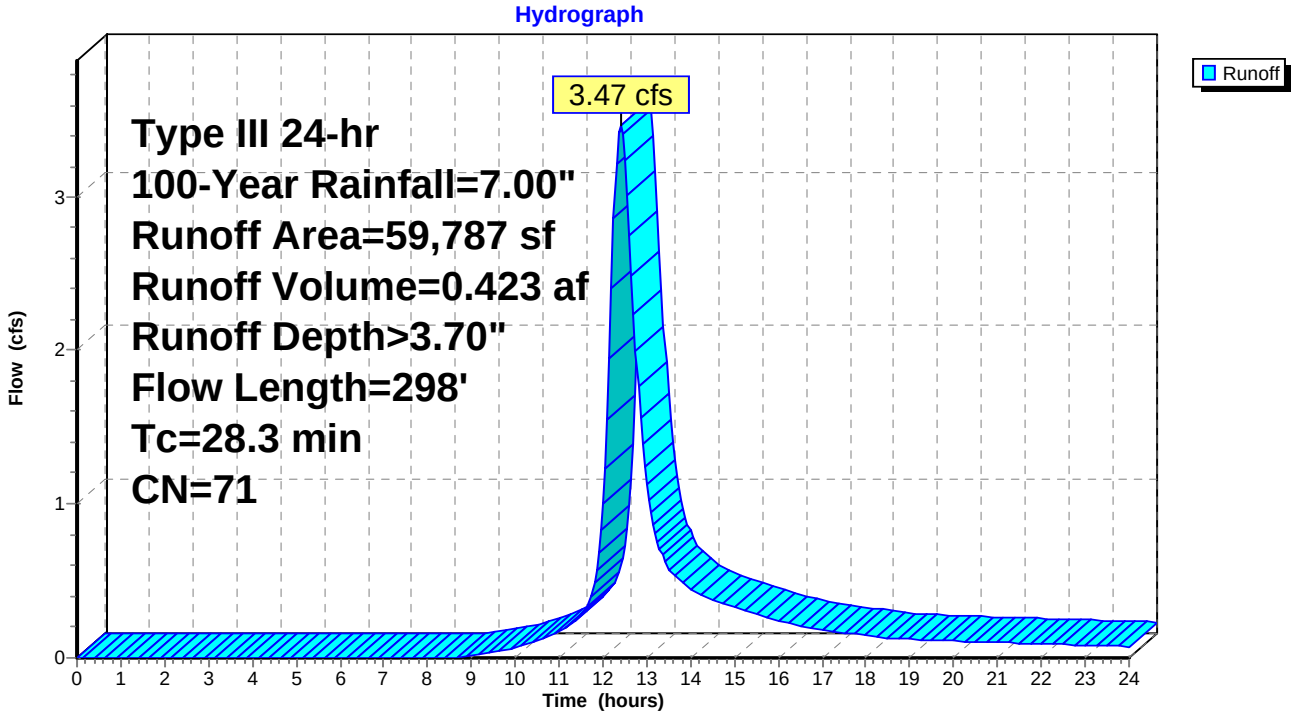
Runoff = 3.47 cfs @ 12.40 hrs, Volume= 0.423 af, Depth> 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (sf)	CN	Description
56,960	70	Woods, Good, HSG C
2,827	98	Paved parking, HSG C
59,787	71	Weighted Average
56,960		95.27% Pervious Area
2,827		4.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	50	0.0200	0.04		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.40"
7.5	248	0.0120	0.55		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.3	298	Total			

Subcatchment 11: PRE - 1



Summary for Subcatchment 21: PRE - 2

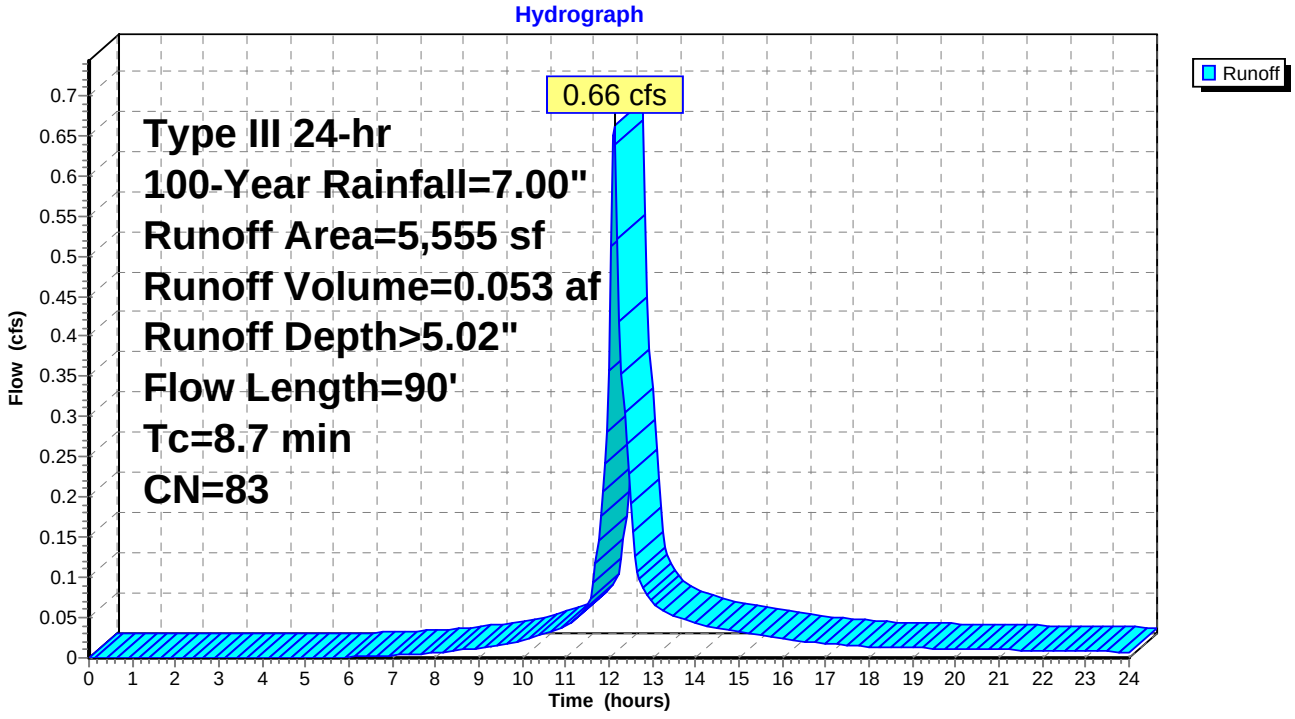
Runoff = 0.66 cfs @ 12.12 hrs, Volume= 0.053 af, Depth> 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (sf)	CN	Description
2,619	98	Paved parking, HSG C
2,936	70	Woods, Good, HSG C
5,555	83	Weighted Average
2,936		52.85% Pervious Area
2,619		47.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0260	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
1.5	40	0.0075	0.43		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.7	90	Total			

Subcatchment 21: PRE - 2

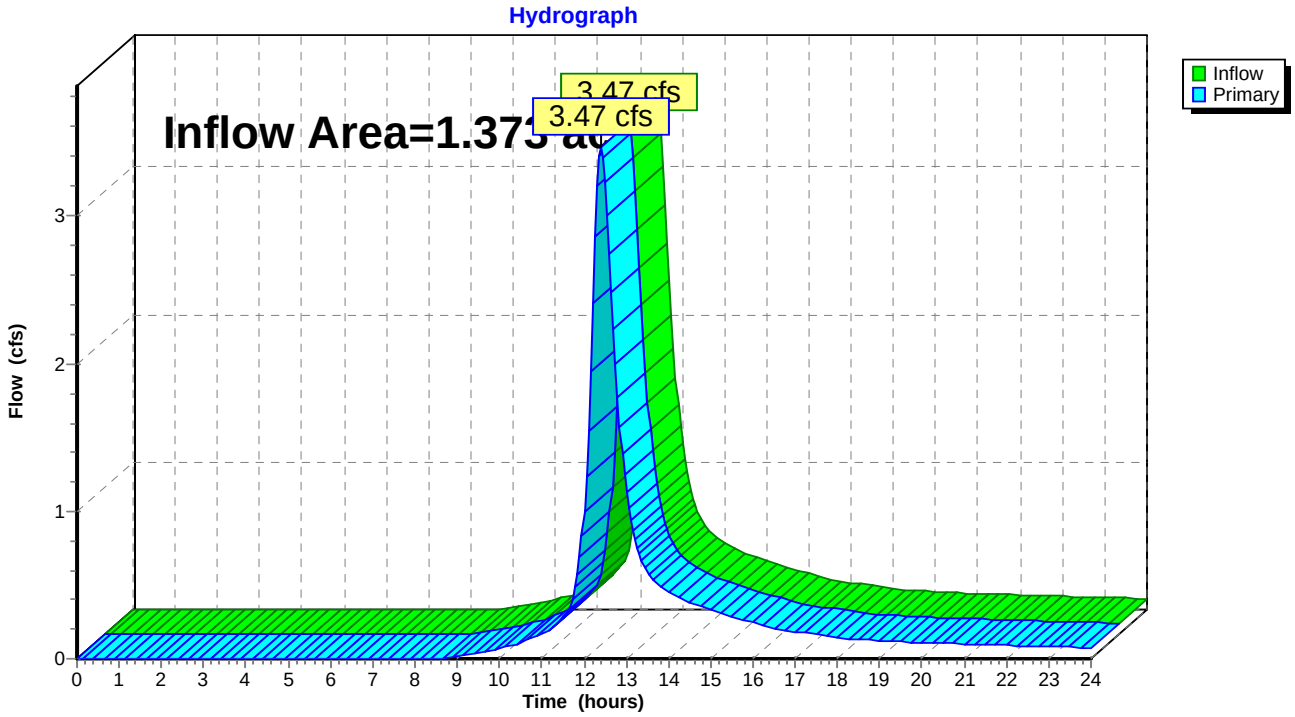


Summary for Link 112: DP-1-WETLAND LINE

Inflow Area = 1.373 ac, 4.73% Impervious, Inflow Depth > 3.70" for 100-Year event
Inflow = 3.47 cfs @ 12.40 hrs, Volume= 0.423 af
Primary = 3.47 cfs @ 12.40 hrs, Volume= 0.423 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 112: DP-1-WETLAND LINE

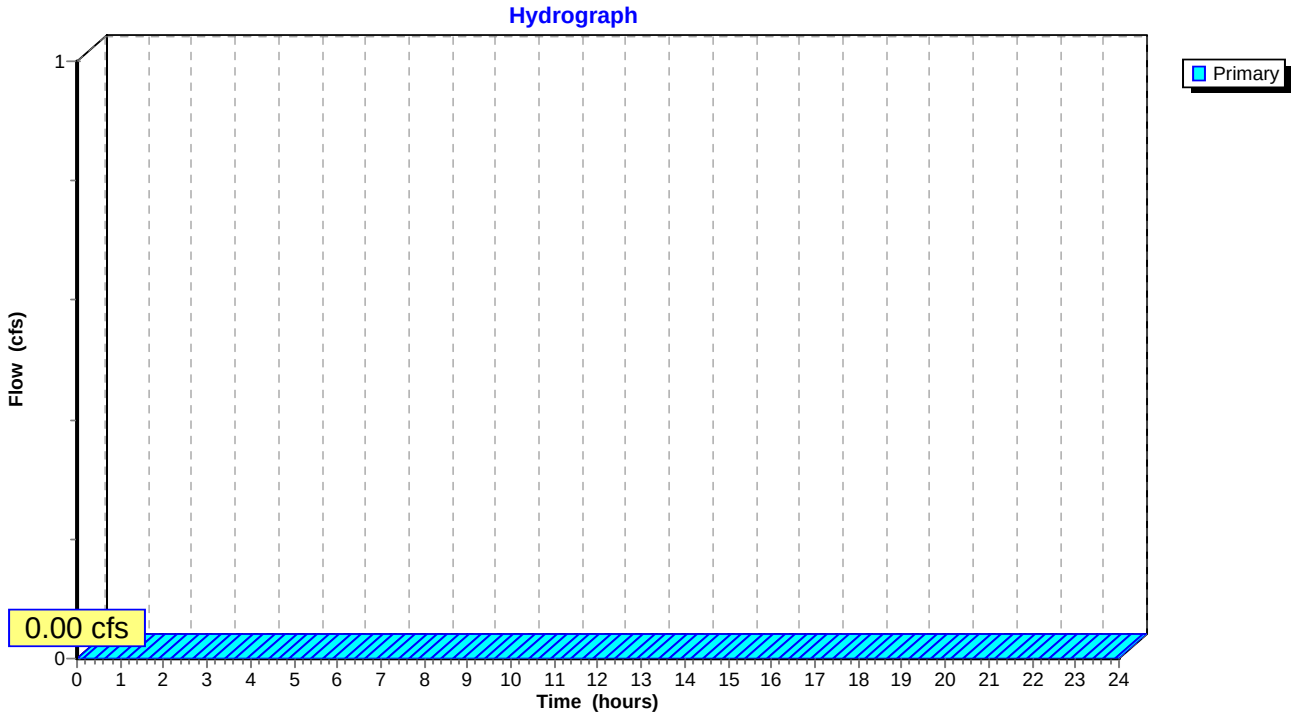


Summary for Link 113: DP-2-OFFSITE DRAINAGE NETWORK

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 113: DP-2-OFFSITE DRAINAGE NETWORK

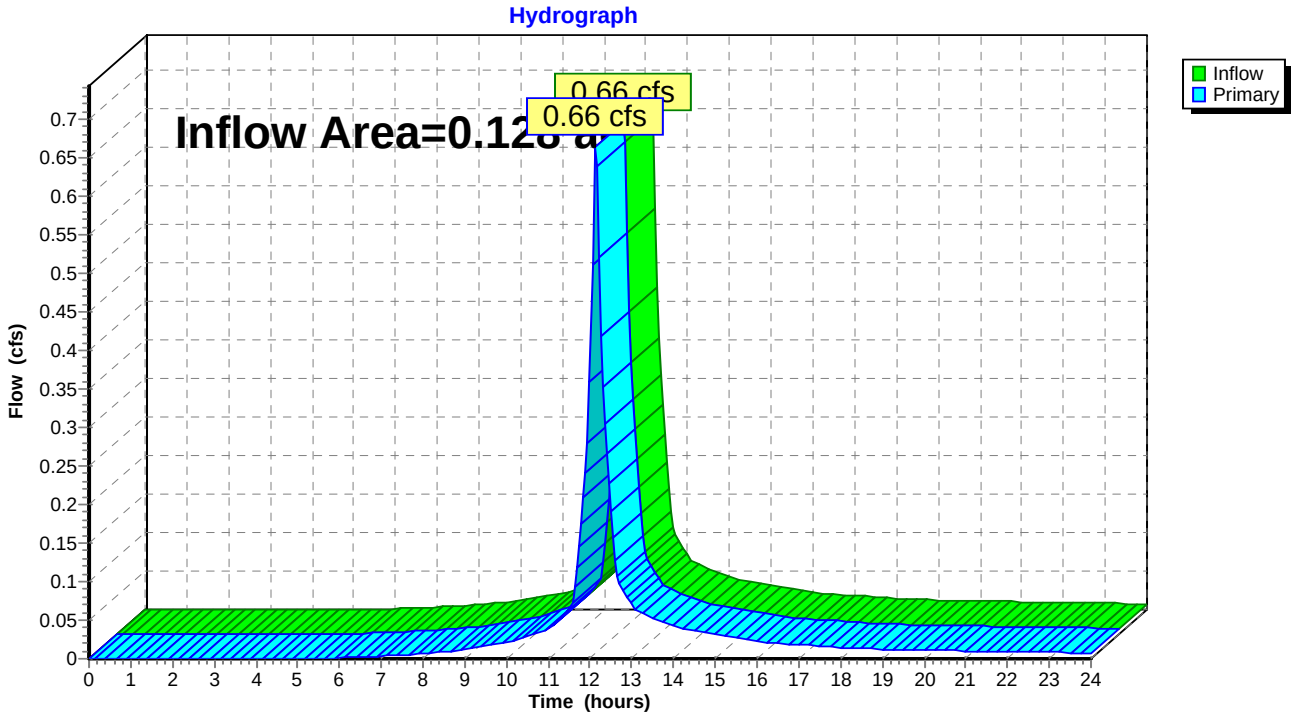


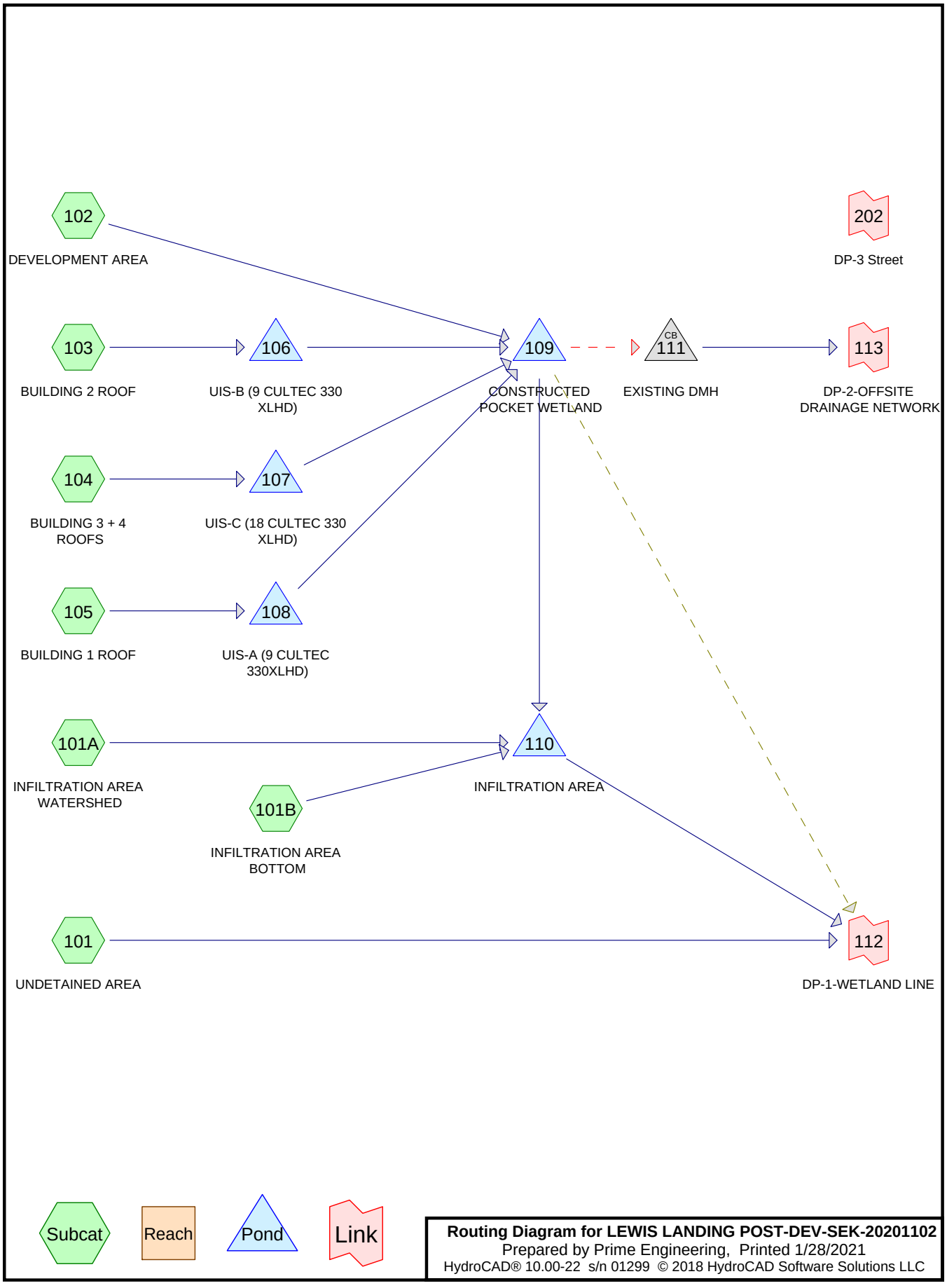
Summary for Link 202: DP-3 Street

Inflow Area = 0.128 ac, 47.15% Impervious, Inflow Depth > 5.02" for 100-Year event
Inflow = 0.66 cfs @ 12.12 hrs, Volume= 0.053 af
Primary = 0.66 cfs @ 12.12 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 202: DP-3 Street




102
DEVELOPMENT AREA
202
DP-3 Street
103
BUILDING 2 ROOF
106
UIS-B (9 CULTEC 330 XLHD)
109
CONSTRUCTED POCKET WETLAND
CB
111
EXISTING DMH
113
DP-2-OFFSITE DRAINAGE NETWORK
104
BUILDING 3 + 4 ROOFS
107
UIS-C (18 CULTEC 330 XLHD)
105
BUILDING 1 ROOF
108
UIS-A (9 CULTEC 330XLHD)
101A
INFILTRATION AREA WATERSHED
110
INFILTRATION AREA
101B
INFILTRATION AREA BOTTOM
101
UNDETAINED AREA
112
DP-1-WETLAND LINE
Subcat
Reach
Pond
Link
Routing Diagram for LEWIS LANDING POST-DEV-SEK-20201102
Prepared by Prime Engineering, Printed 1/28/2021
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.578	74	>75% Grass cover, Good, HSG C (101, 101A, 102)
0.039	98	BUILDING 2 ROOF (103)
0.121	98	DETENTION POND (102)
0.068	98	Infiltration area bottom (101B)
0.319	98	PAVEMENT (102)
0.039	98	ROOF 1 (105)
0.077	98	ROOF 3 AND 4 (104)
0.065	98	SIDEWALKS (102)
0.195	70	Woods, Good, HSG C (101A)
1.500	**85**	**TOTAL AREA**

Summary for Subcatchment 101: UNDETAINED AREA

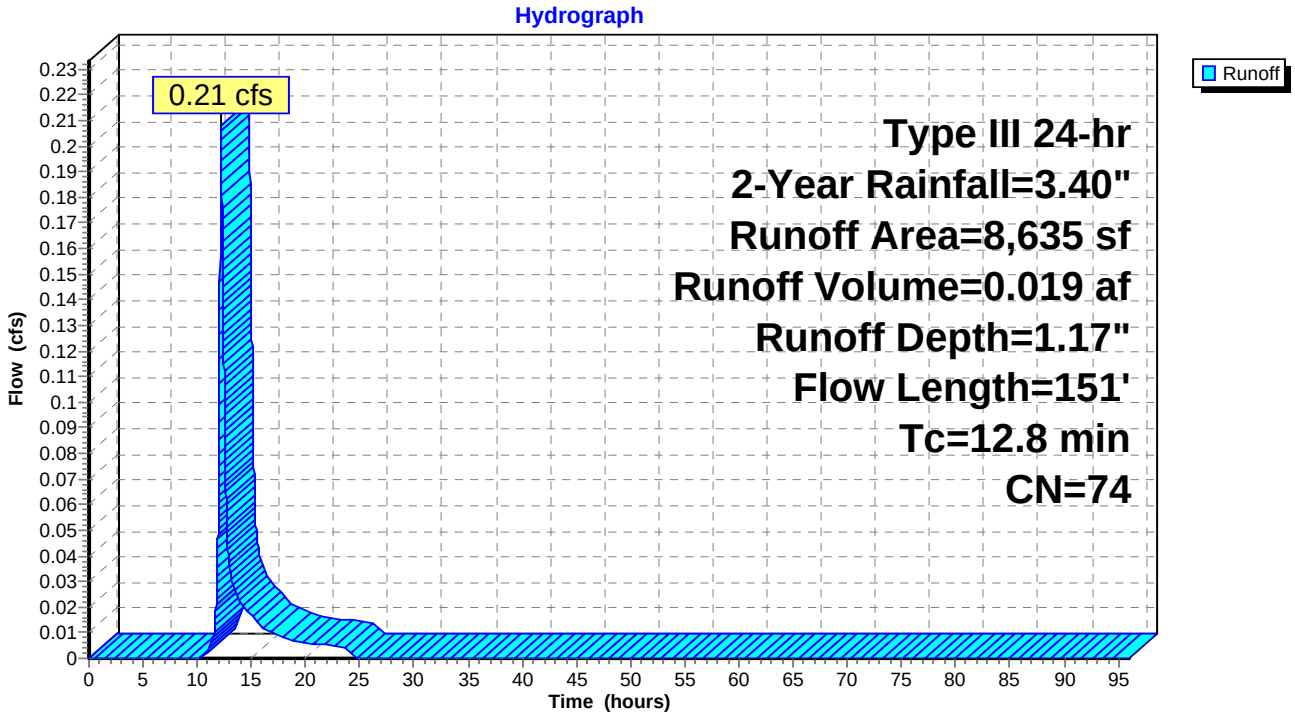
Runoff = 0.21 cfs @ 12.19 hrs, Volume= 0.019 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (sf)	CN	Description
8,635	74	>75% Grass cover, Good, HSG C
8,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0080	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
1.3	101	0.0070	1.25		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
12.8	151	Total			

Subcatchment 101: UNDETAINED AREA



Summary for Subcatchment 101A: INFILTRATION AREA WATERSHED

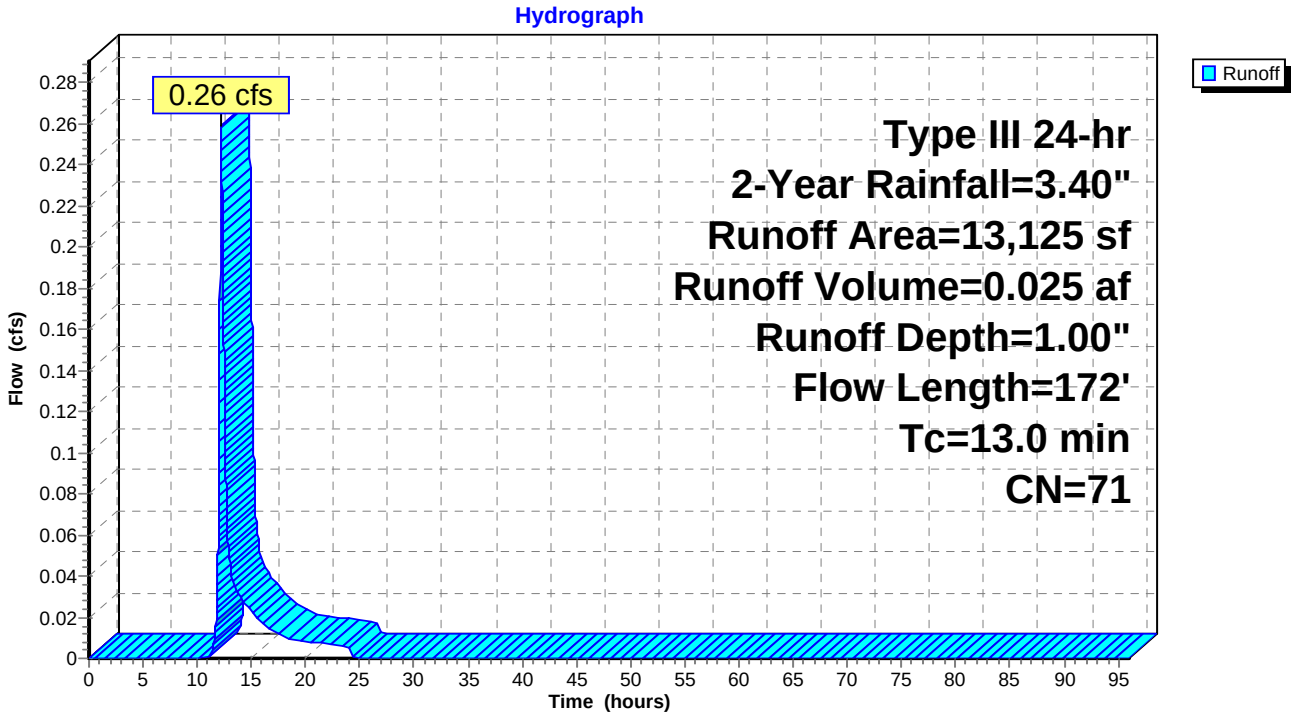
Runoff = 0.26 cfs @ 12.20 hrs, Volume= 0.025 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
	8,487	70	Woods, Good, HSG C
*	4,638	74	>75% Grass cover, Good, HSG C
	13,125	71	Weighted Average
	13,125		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.5	122	0.0275	0.83		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.0	172	Total			

Subcatchment 101A: INFILTRATION AREA WATERSHED



Summary for Subcatchment 101B: INFILTRATION AREA BOTTOM

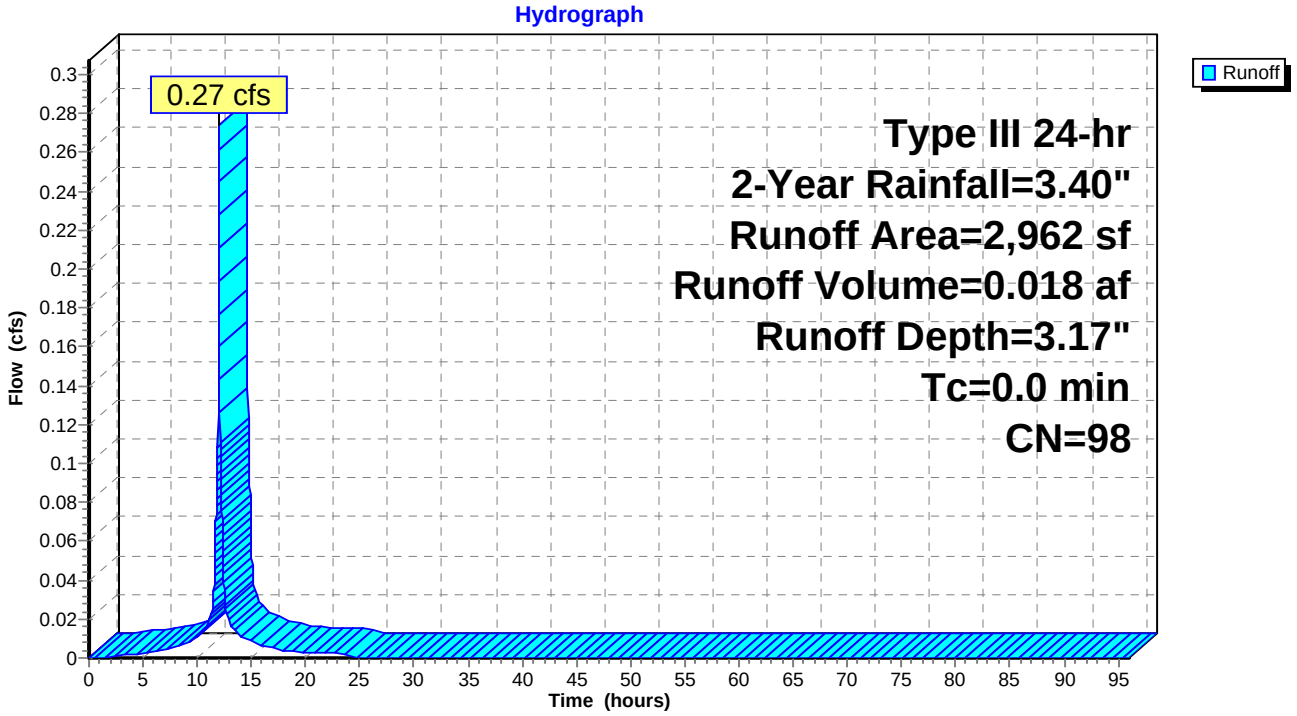
Runoff = 0.27 cfs @ 12.00 hrs, Volume= 0.018 af, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	2,962	98	Infiltration area bottom
	2,962		100.00% Impervious Area

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

Subcatchment 101B: INFILTRATION AREA BOTTOM



Summary for Subcatchment 102: DEVELOPMENT AREA

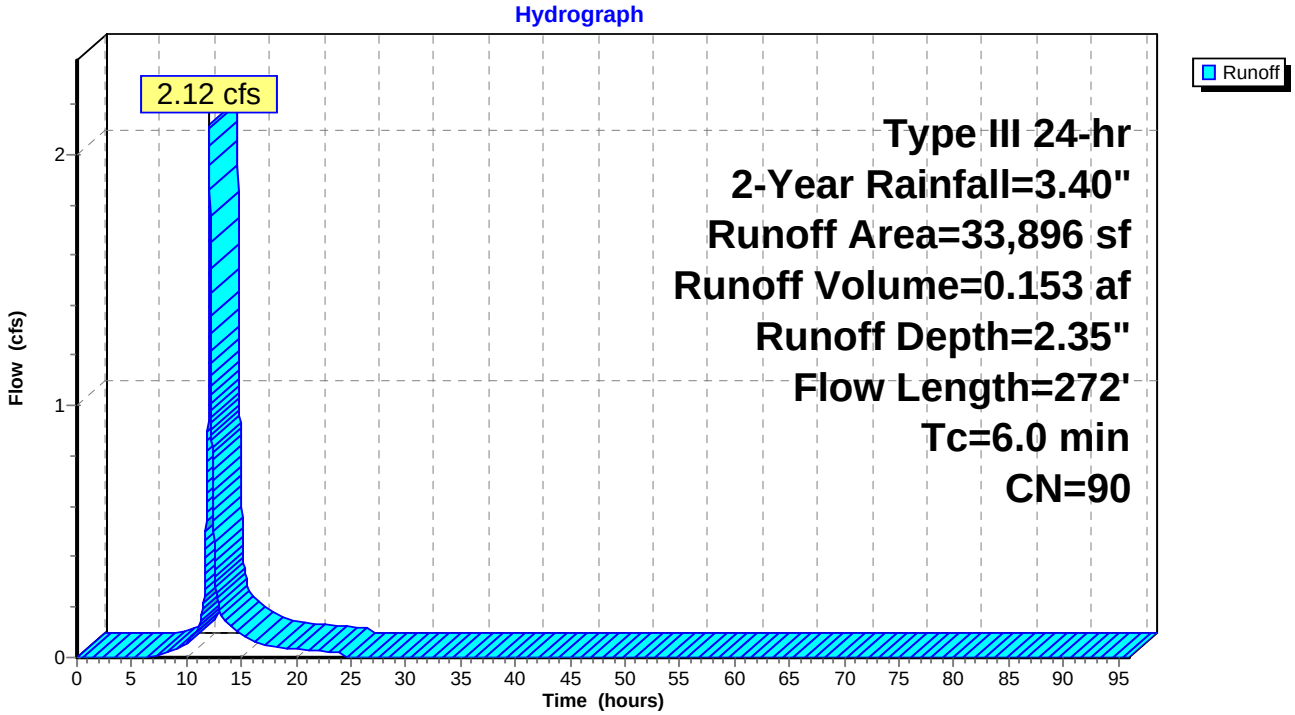
Runoff = 2.12 cfs @ 12.09 hrs, Volume= 0.153 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	13,875	98	PAVEMENT
*	2,842	98	SIDEWALKS
	11,922	74	>75% Grass cover, Good, HSG C
*	5,257	98	DETENTION POND
	33,896	90	Weighted Average
	11,922		35.17% Pervious Area
	21,974		64.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.94		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
1.2	172	0.0132	2.33		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.3	272	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 102: DEVELOPMENT AREA



Summary for Subcatchment 103: BUILDING 2 ROOF

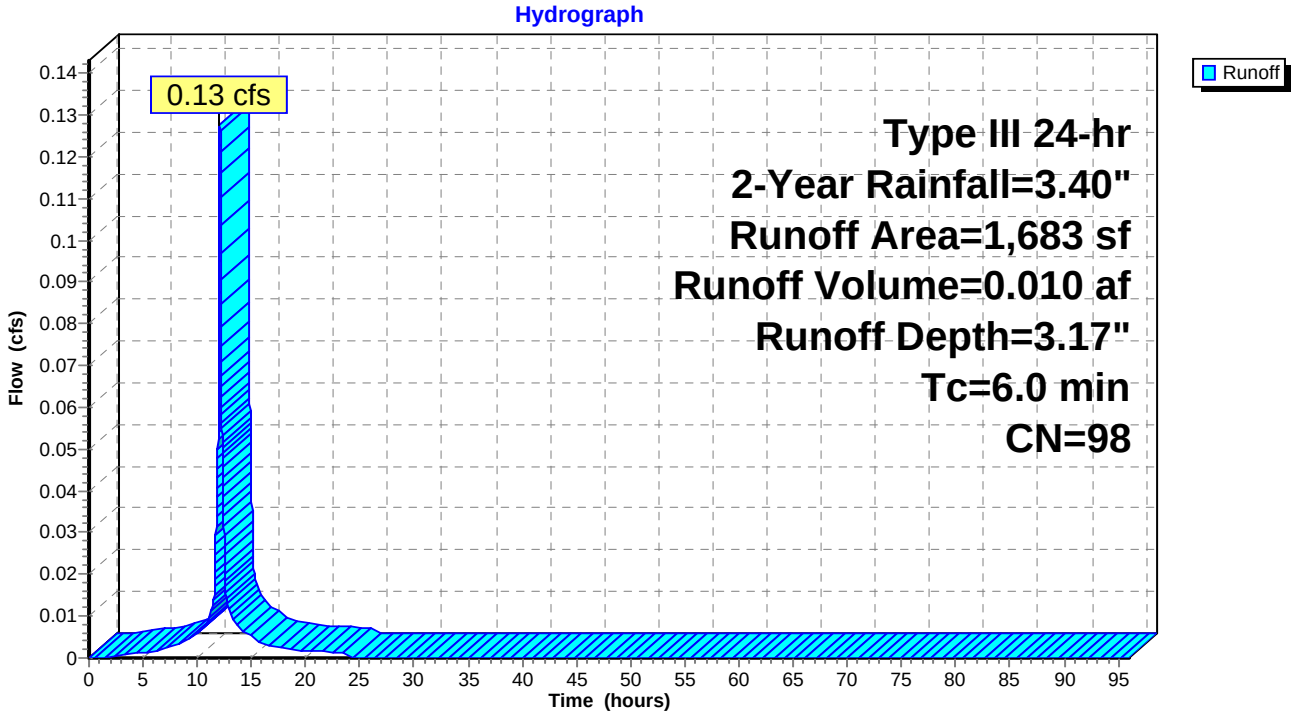
Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.010 af, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	1,683	98	BUILDING 2 ROOF
	1,683		100.00% Impervious Area

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

Subcatchment 103: BUILDING 2 ROOF



Summary for Subcatchment 104: BUILDING 3 + 4 ROOFS

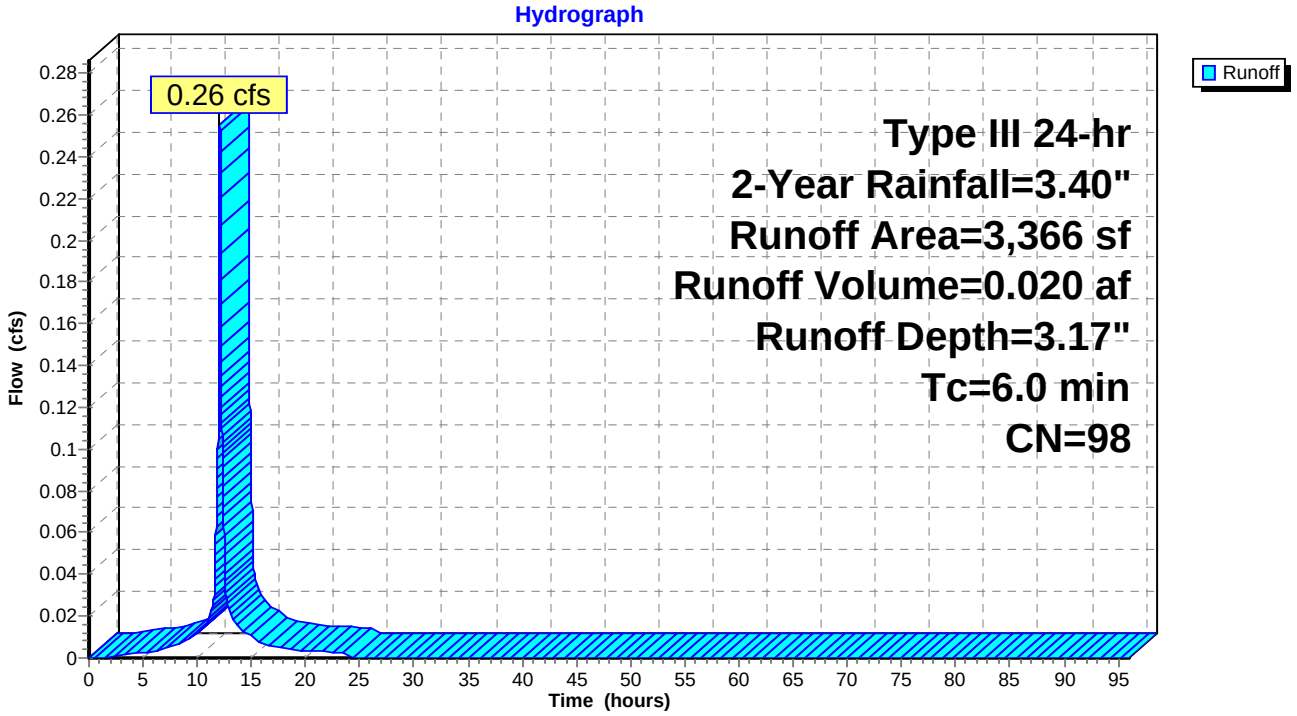
Runoff = 0.26 cfs @ 12.08 hrs, Volume= 0.020 af, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	3,366	98	ROOF 3 AND 4
	3,366		100.00% Impervious Area

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

Subcatchment 104: BUILDING 3 + 4 ROOFS



Summary for Subcatchment 105: BUILDING 1 ROOF

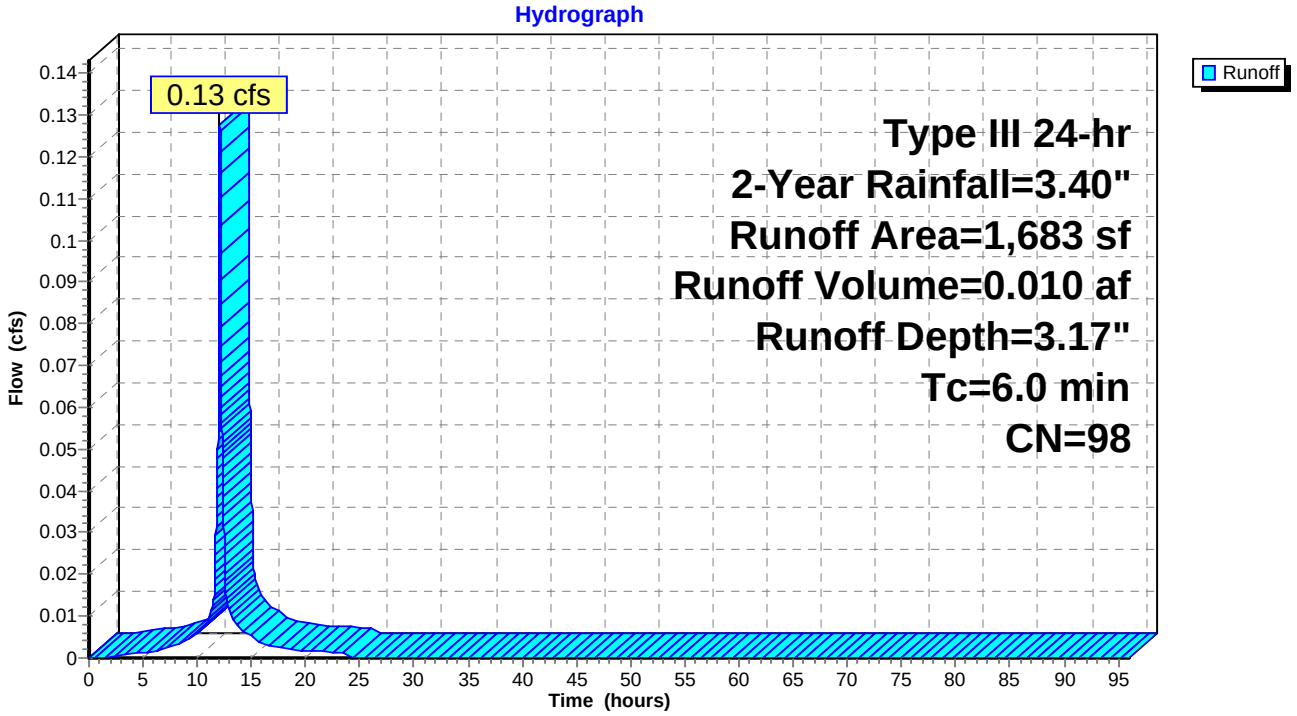
Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.010 af, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	1,683	98	ROOF 1
	1,683		100.00% Impervious Area

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

Subcatchment 105: BUILDING 1 ROOF



Summary for Pond 106: UIS-B (9 CULTEC 330 XLHD)

Inflow Area = 0.039 ac,100.00% Impervious, Inflow Depth = 3.17" for 2-Year event
Inflow = 0.13 cfs @ 12.08 hrs, Volume= 0.010 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 63.68' @ 24.34 hrs Surf.Area= 0.009 ac Storage= 0.010 af

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

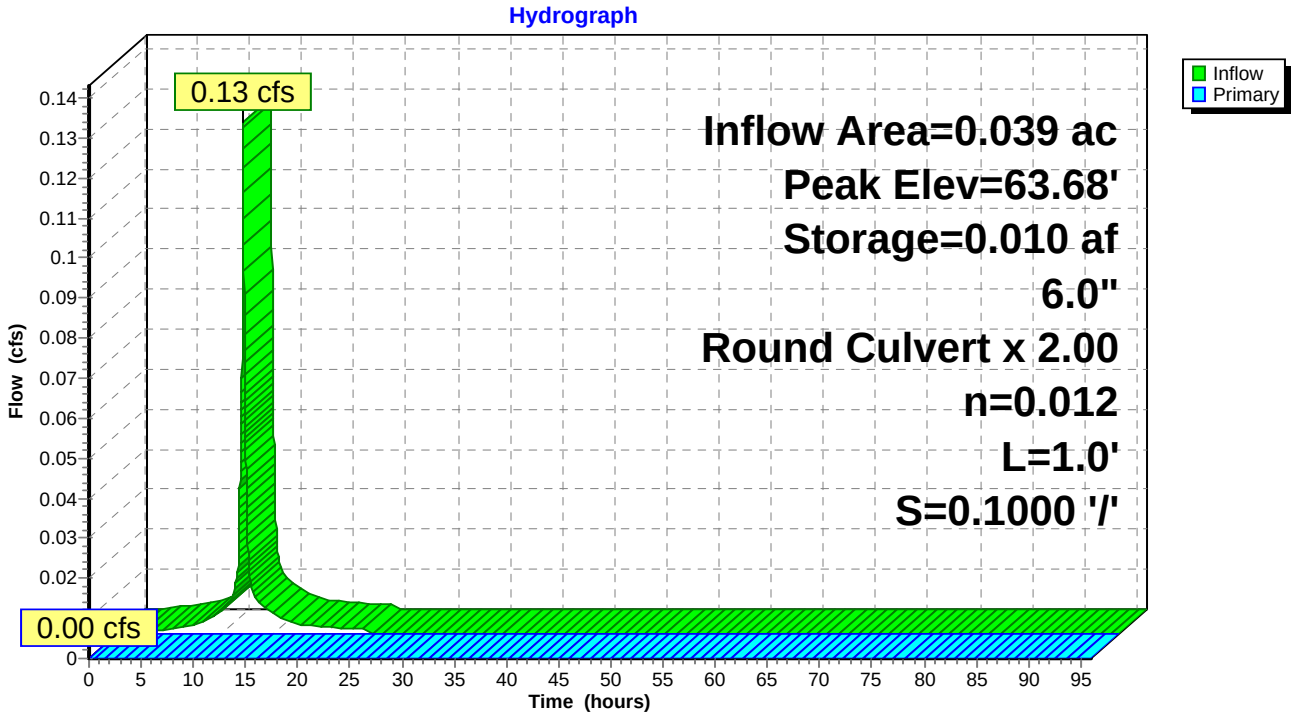
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.008 af	**16.00'W x 24.50'L x 3.54'H Field A** 0.032 af Overall - 0.012 af Embedded = 0.020 af x 40.0% Voids
#2A	62.50'	0.012 af	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE**
		0.020 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.60'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.60' / 66.50' S= 0.1000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 106: UIS-B (9 CULTEC 330 XLHD)



Summary for Pond 107: UIS-C (18 CULTEC 330 XLHD)

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 3.17" for 2-Year event
Inflow = 0.26 cfs @ 12.08 hrs, Volume= 0.020 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 63.77' @ 24.34 hrs Surf.Area= 0.017 ac Storage= 0.020 af

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

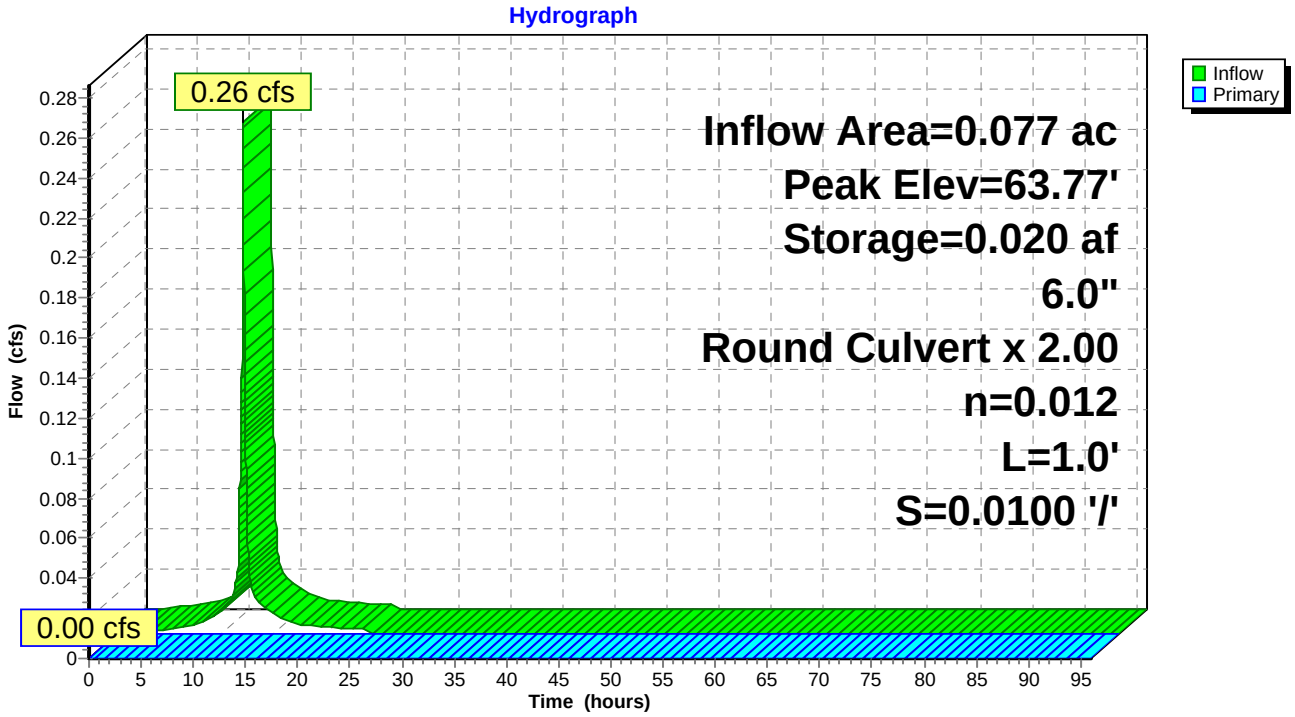
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.015 af	**16.00'W x 45.50'L x 3.54'H Field A** 0.059 af Overall - 0.022 af Embedded = 0.037 af x 40.0% Voids
#2A	62.50'	0.022 af	**Cultec R-330XLHD** x 18 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE OUTLET**
		0.037 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.70'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.70' / 66.69' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 107: UIS-C (18 CULTEC 330 XLHD)



Summary for Pond 108: UIS-A (9 CULTEC 330XLHD)

Inflow Area = 0.039 ac,100.00% Impervious, Inflow Depth = 3.17" for 2-Year event
Inflow = 0.13 cfs @ 12.08 hrs, Volume= 0.010 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 63.68' @ 24.34 hrs Surf.Area= 0.009 ac Storage= 0.010 af

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

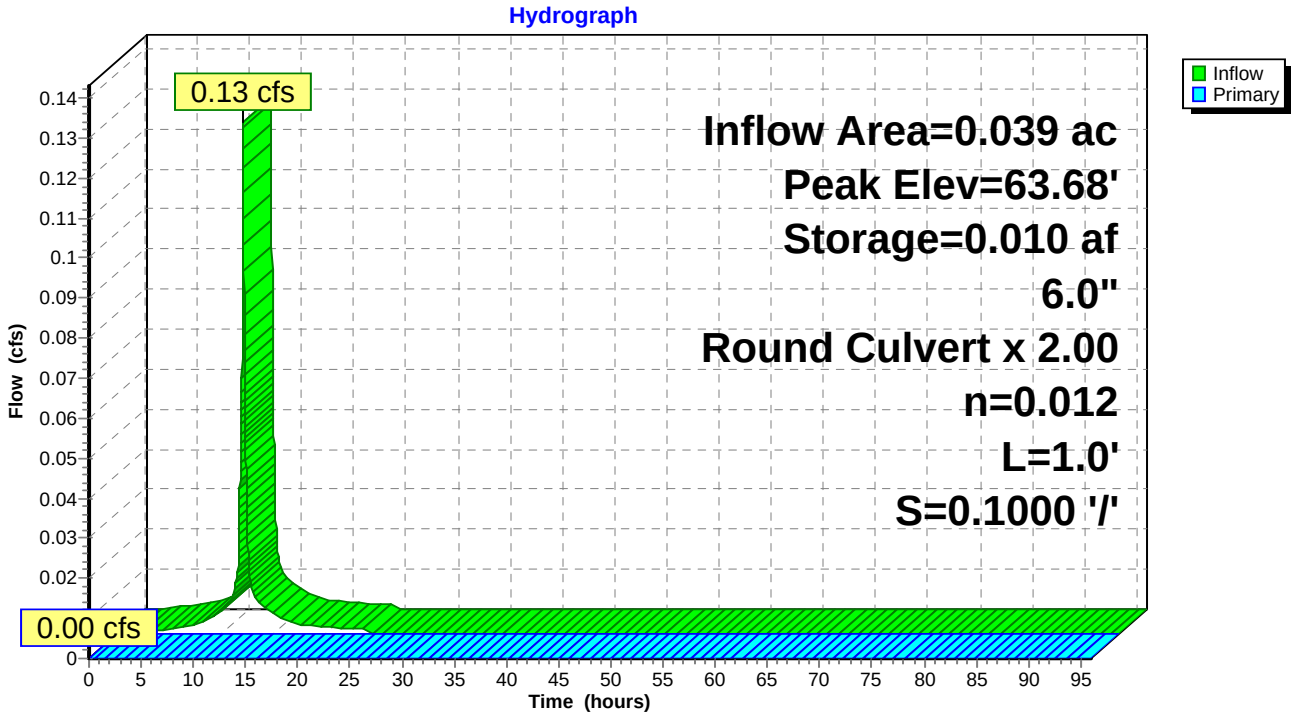
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.008 af	**16.00'W x 24.50'L x 3.54'H Field A** 0.032 af Overall - 0.012 af Embedded = 0.020 af x 40.0% Voids
#2A	62.50'	0.012 af	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE**
		0.020 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.30'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.30' / 66.20' S= 0.1000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 108: UIS-A (9 CULTEC 330XLHD)



Summary for Pond 109: CONSTRUCTED POCKET WETLAND

Inflow Area = 0.933 ac, 70.66% Impervious, Inflow Depth = 1.96" for 2-Year event
Inflow = 2.12 cfs @ 12.09 hrs, Volume= 0.153 af
Outflow = 0.03 cfs @ 20.56 hrs, Volume= 0.057 af, Atten= 99%, Lag= 508.6 min
Primary = 0.01 cfs @ 20.56 hrs, Volume= 0.026 af
Secondary = 0.02 cfs @ 20.56 hrs, Volume= 0.031 af
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 61.97' @ 20.56 hrs Surf.Area= 3,989 sf Storage= 5,572 cf

Plug-Flow detention time= 910.1 min calculated for 0.057 af (37% of inflow)
Center-of-Mass det. time= 784.6 min (1,589.2 - 804.6)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	15,527 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	1,260	0	0
61.00	3,063	2,162	2,162
62.00	4,020	3,542	5,703
63.00	4,931	4,476	10,179
64.00	5,766	5,349	15,527

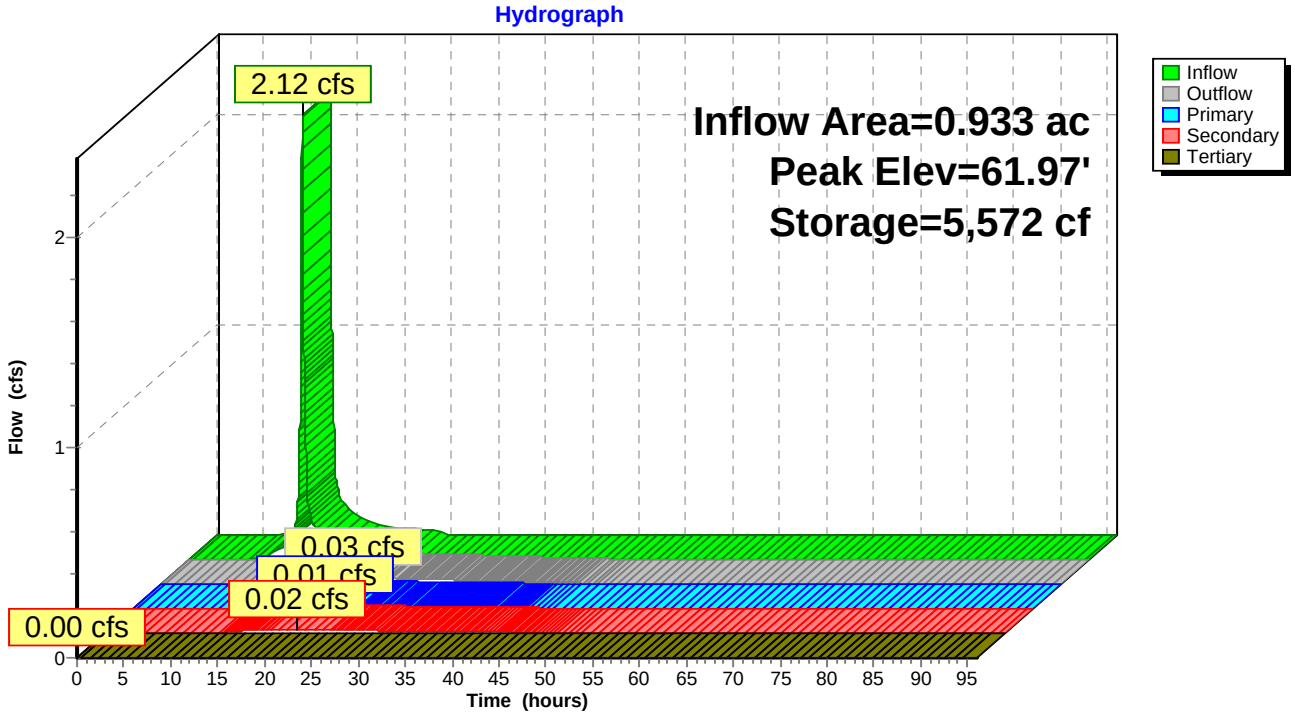
Device	Routing	Invert	Outlet Devices
#1	Primary	61.43'	**4.0" Round Culvert** L= 40.5' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 61.43' / 61.20' S= 0.0057 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Device 1	61.60'	**1.0" Vert. Orifice/Grate** C= 0.600
#3	Tertiary	63.60'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	59.35'	**12.0" Round Culvert** L= 70.6' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 59.35' / 58.35' S= 0.0142 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#5	Device 4	61.60'	**1.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 4	62.35'	**24.0" W x 9.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.01 cfs @ 20.56 hrs HW=61.97' (Free Discharge)
└─**1=Culvert** (Passes 0.01 cfs of 0.19 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 2.75 fps)

Secondary OutFlow Max=0.02 cfs @ 20.56 hrs HW=61.97' (Free Discharge)
└─**4=Culvert** (Passes 0.02 cfs of 5.50 cfs potential flow)
└─**5=Orifice/Grate** (Orifice Controls 0.02 cfs @ 2.92 fps)
└─**6=Orifice/Grate** (Controls 0.00 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 109: CONSTRUCTED POCKET WETLAND



Summary for Pond 110: INFILTRATION AREA

Inflow Area = 1.302 ac, 55.84% Impervious, Inflow Depth = 0.63" for 2-Year event
Inflow = 0.36 cfs @ 12.00 hrs, Volume= 0.069 af
Outflow = 0.05 cfs @ 13.72 hrs, Volume= 0.043 af, Atten= 85%, Lag= 102.9 min
Primary = 0.05 cfs @ 13.72 hrs, Volume= 0.043 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 60.72' @ 13.72 hrs Surf.Area= 3,278 sf Storage= 1,163 cf

Plug-Flow detention time= 549.7 min calculated for 0.043 af (63% of inflow)
Center-of-Mass det. time= 249.9 min (1,338.1 - 1,088.2)

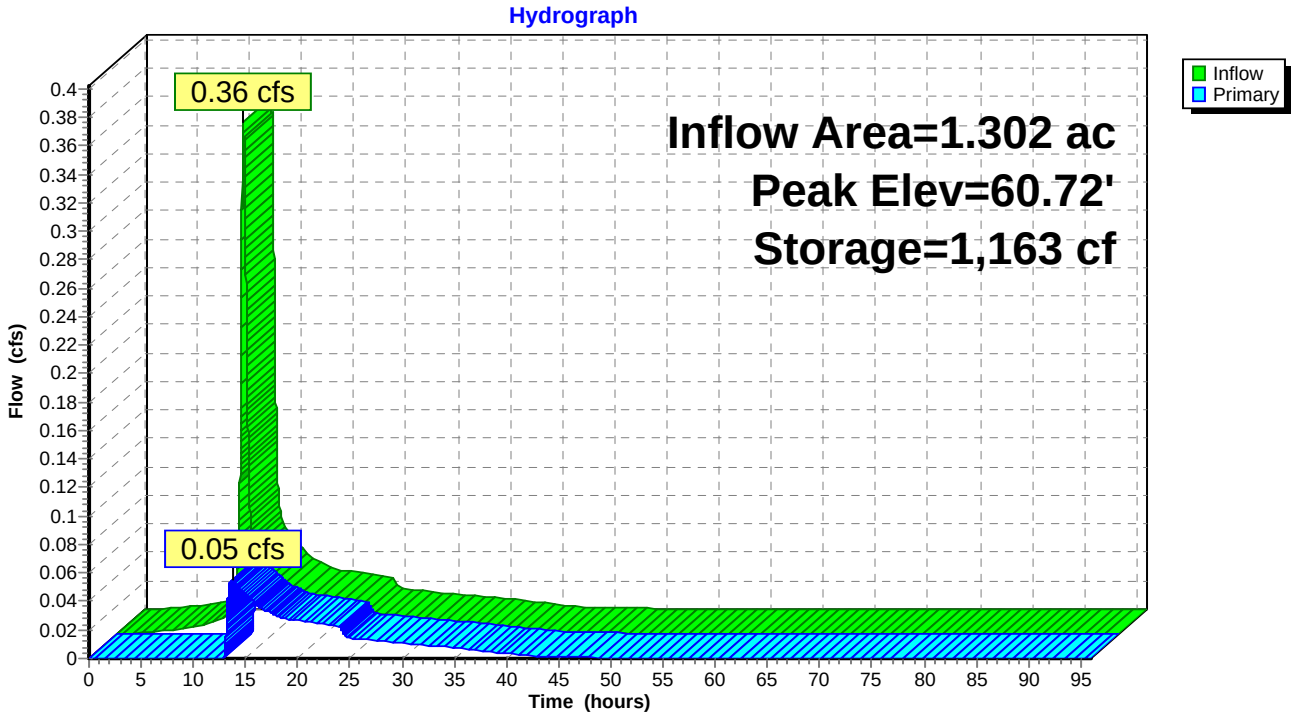
Volume	Invert	Avail.Storage	Storage Description
#1	60.33'	2,190 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.33	2,962	0	0
60.58	2,962	741	741
61.00	3,942	1,450	2,190

Device	Routing	Invert	Outlet Devices
#1	Primary	60.70'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.05 cfs @ 13.72 hrs HW=60.72' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.05 cfs @ 0.35 fps)

Pond 110: INFILTRATION AREA



Summary for Pond 111: EXISTING DMH

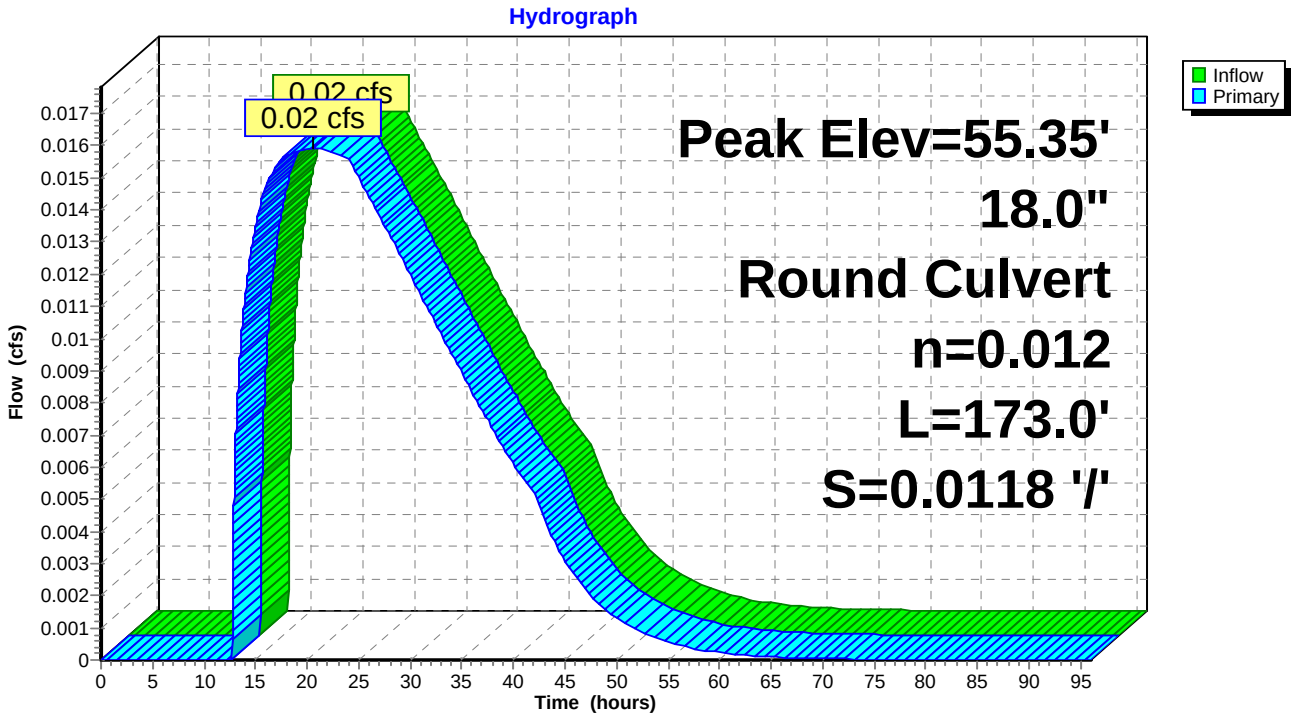
Inflow	=	0.02 cfs @	20.56 hrs, Volume=	0.031 af
Outflow	=	0.02 cfs @	20.56 hrs, Volume=	0.031 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.02 cfs @	20.56 hrs, Volume=	0.031 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 55.35' @ 20.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	55.30'	**18.0" Round Culvert** L= 173.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 55.30' / 53.26' S= 0.0118 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.02 cfs @ 20.56 hrs HW=55.35' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.02 cfs @ 1.19 fps)

Pond 111: EXISTING DMH

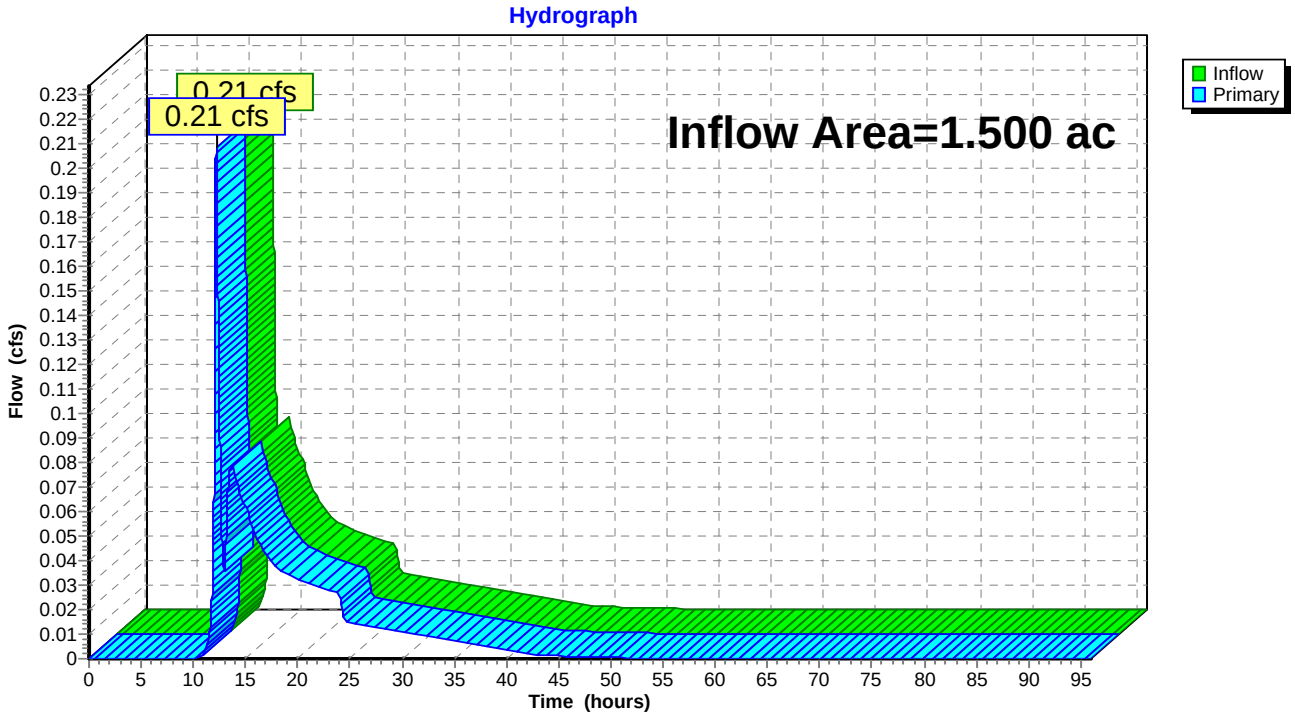


Summary for Link 112: DP-1-WETLAND LINE

Inflow Area = 1.500 ac, 48.46% Impervious, Inflow Depth = 0.50" for 2-Year event
Inflow = 0.21 cfs @ 12.19 hrs, Volume= 0.063 af
Primary = 0.21 cfs @ 12.19 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 112: DP-1-WETLAND LINE

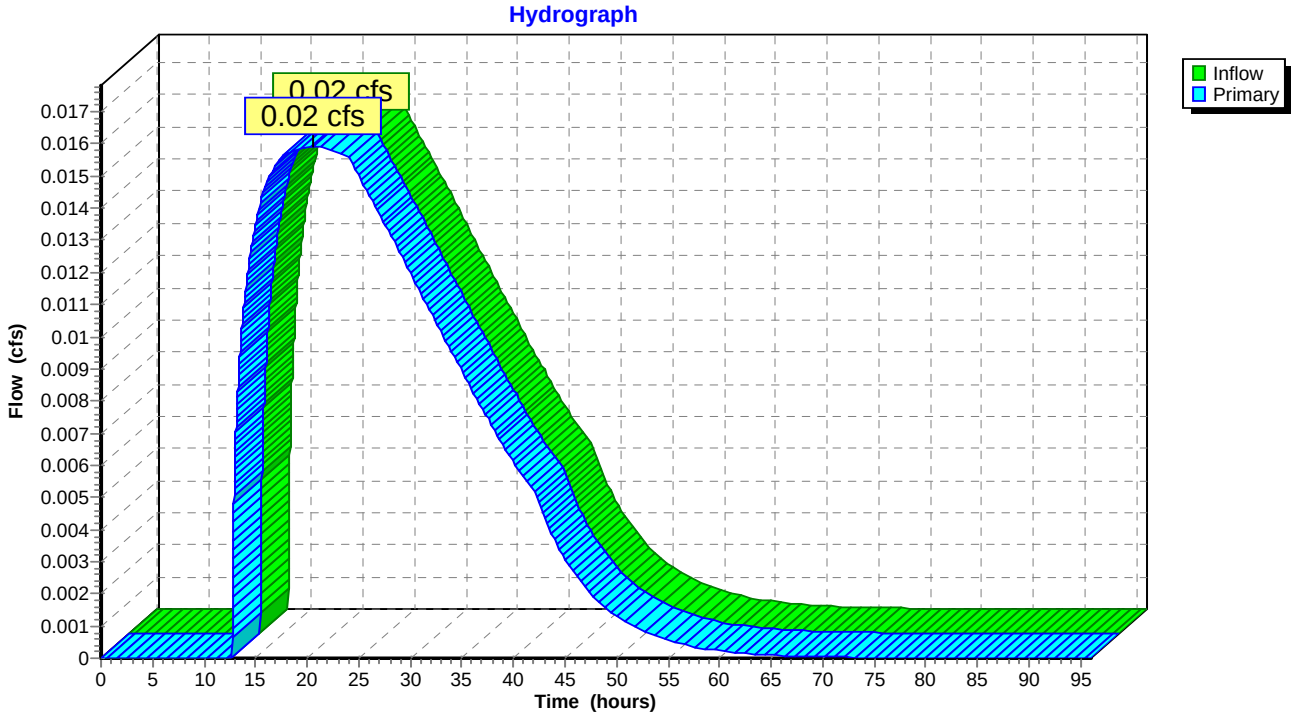


Summary for Link 113: DP-2-OFFSITE DRAINAGE NETWORK

Inflow = 0.02 cfs @ 20.56 hrs, Volume= 0.031 af
Primary = 0.02 cfs @ 20.56 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 113: DP-2-OFFSITE DRAINAGE NETWORK

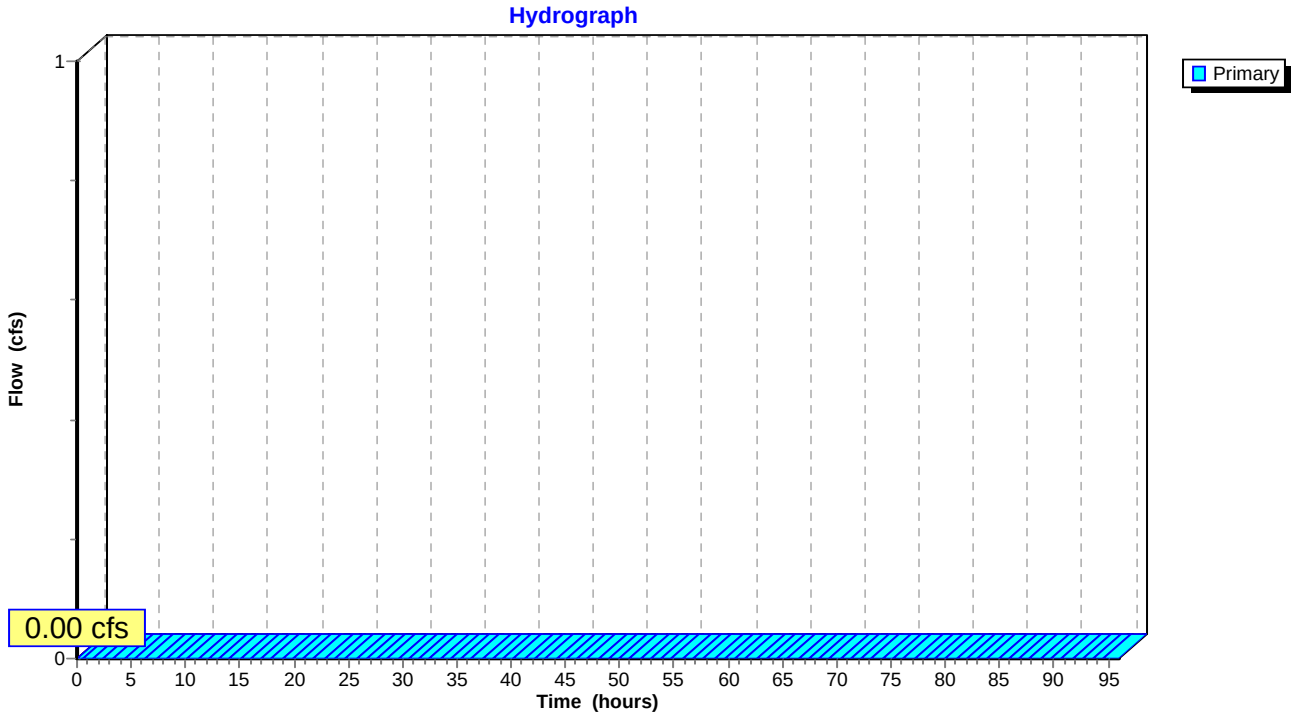


Summary for Link 202: DP-3 Street

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 202: DP-3 Street



Summary for Subcatchment 101: UNDETAINED AREA

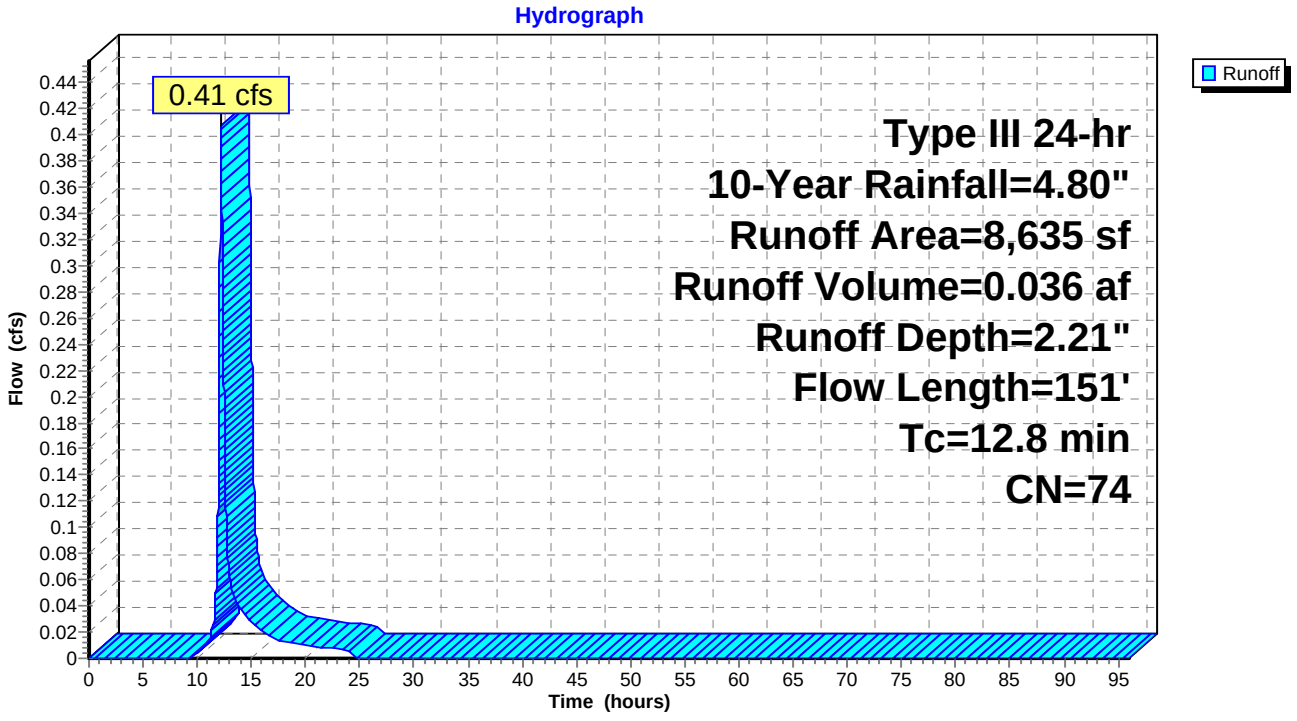
Runoff = 0.41 cfs @ 12.18 hrs, Volume= 0.036 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
8,635	74	>75% Grass cover, Good, HSG C
8,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0080	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
1.3	101	0.0070	1.25		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
12.8	151	Total			

Subcatchment 101: UNDETAINED AREA



Summary for Subcatchment 101A: INFILTRATION AREA WATERSHED

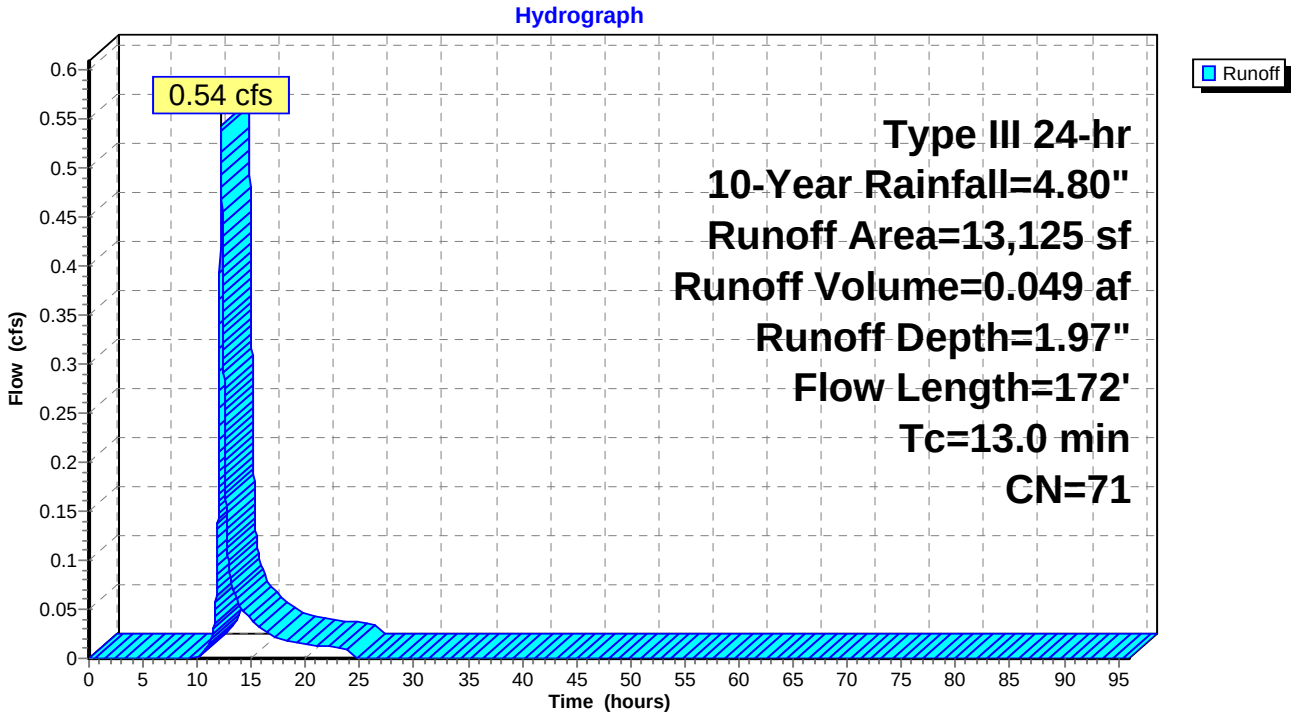
Runoff = 0.54 cfs @ 12.18 hrs, Volume= 0.049 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	8,487	70	Woods, Good, HSG C
*	4,638	74	>75% Grass cover, Good, HSG C
	13,125	71	Weighted Average
	13,125		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.5	122	0.0275	0.83		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.0	172	Total			

Subcatchment 101A: INFILTRATION AREA WATERSHED



Summary for Subcatchment 101B: INFILTRATION AREA BOTTOM

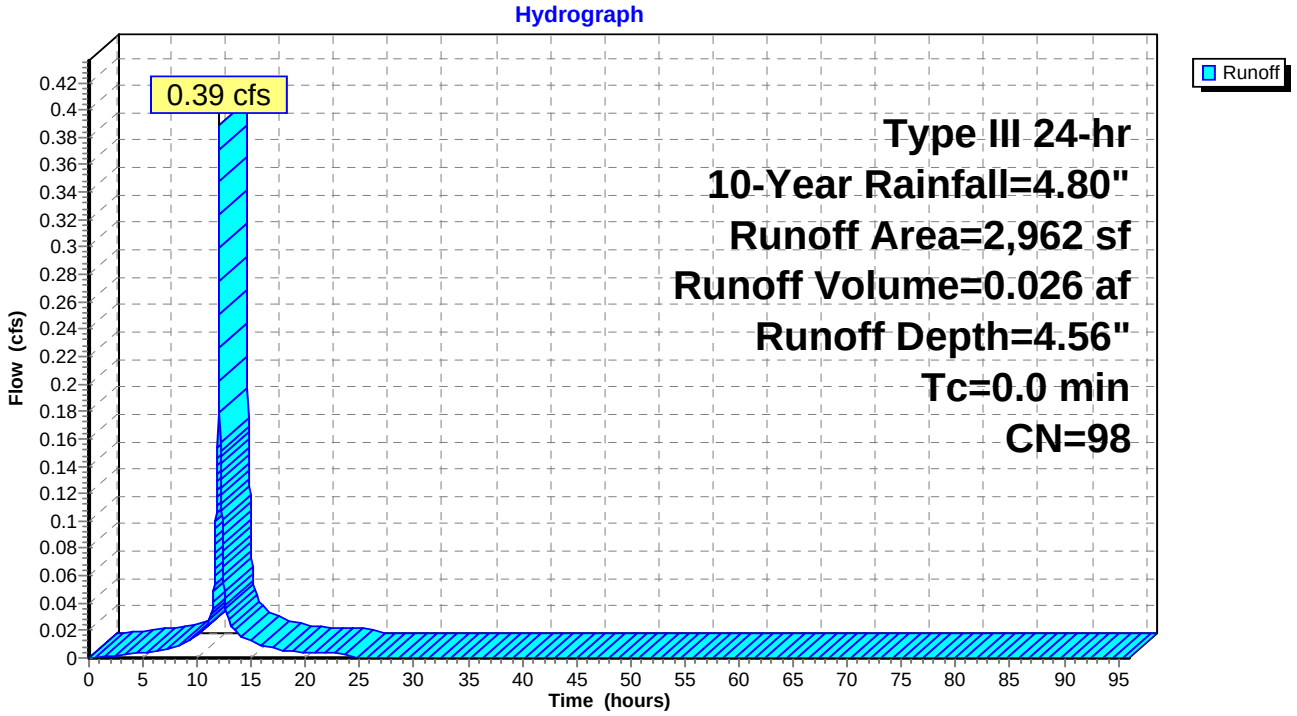
Runoff = 0.39 cfs @ 12.00 hrs, Volume= 0.026 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	2,962	98	Infiltration area bottom
	2,962		100.00% Impervious Area

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

Subcatchment 101B: INFILTRATION AREA BOTTOM



Summary for Subcatchment 102: DEVELOPMENT AREA

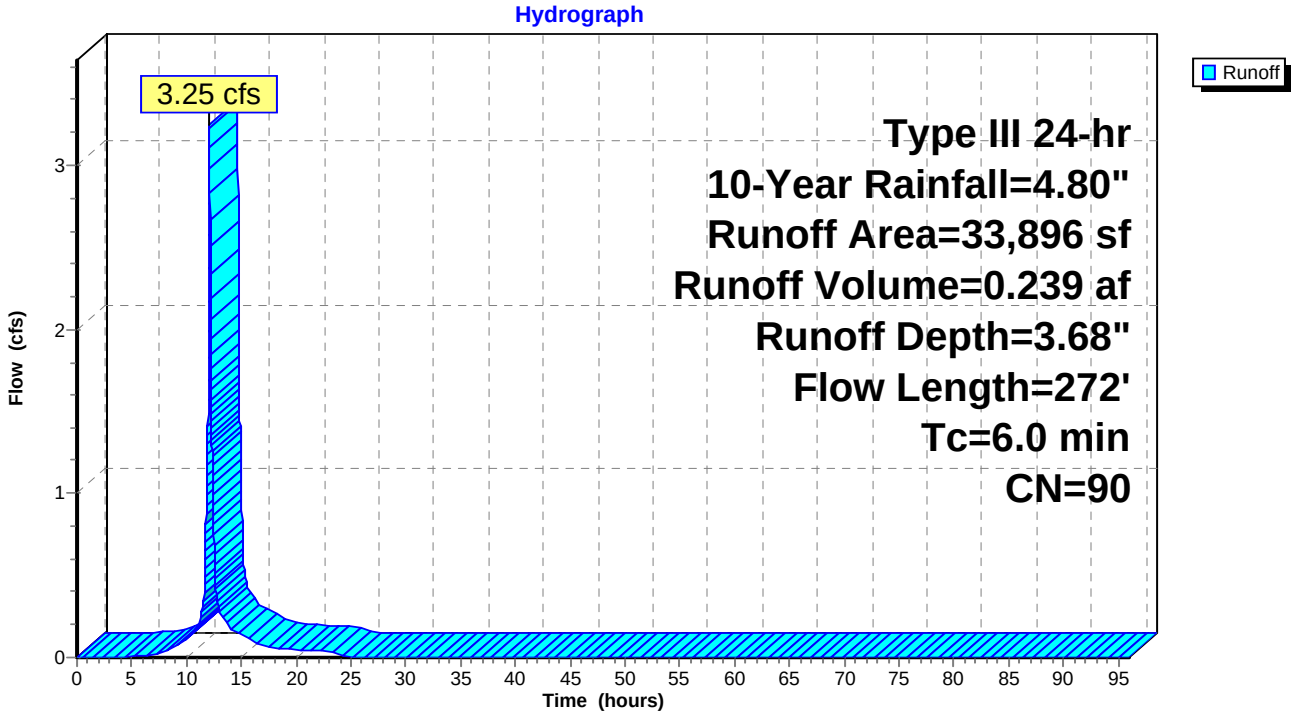
Runoff = 3.25 cfs @ 12.09 hrs, Volume= 0.239 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	13,875	98	PAVEMENT
*	2,842	98	SIDEWALKS
	11,922	74	>75% Grass cover, Good, HSG C
*	5,257	98	DETENTION POND
	33,896	90	Weighted Average
	11,922		35.17% Pervious Area
	21,974		64.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.94		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
1.2	172	0.0132	2.33		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.3	272	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 102: DEVELOPMENT AREA



Summary for Subcatchment 103: BUILDING 2 ROOF

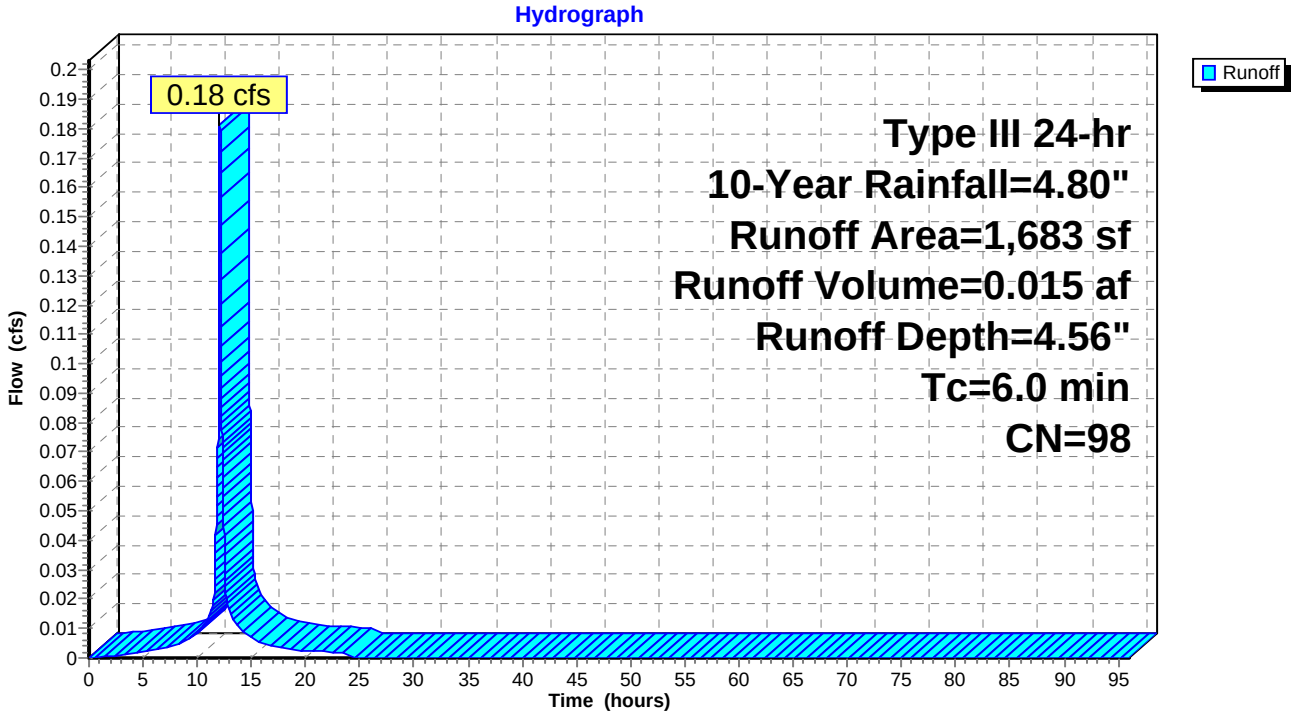
Runoff = 0.18 cfs @ 12.08 hrs, Volume= 0.015 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	1,683	98	BUILDING 2 ROOF
	1,683		100.00% Impervious Area

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

Subcatchment 103: BUILDING 2 ROOF



Summary for Subcatchment 104: BUILDING 3 + 4 ROOFS

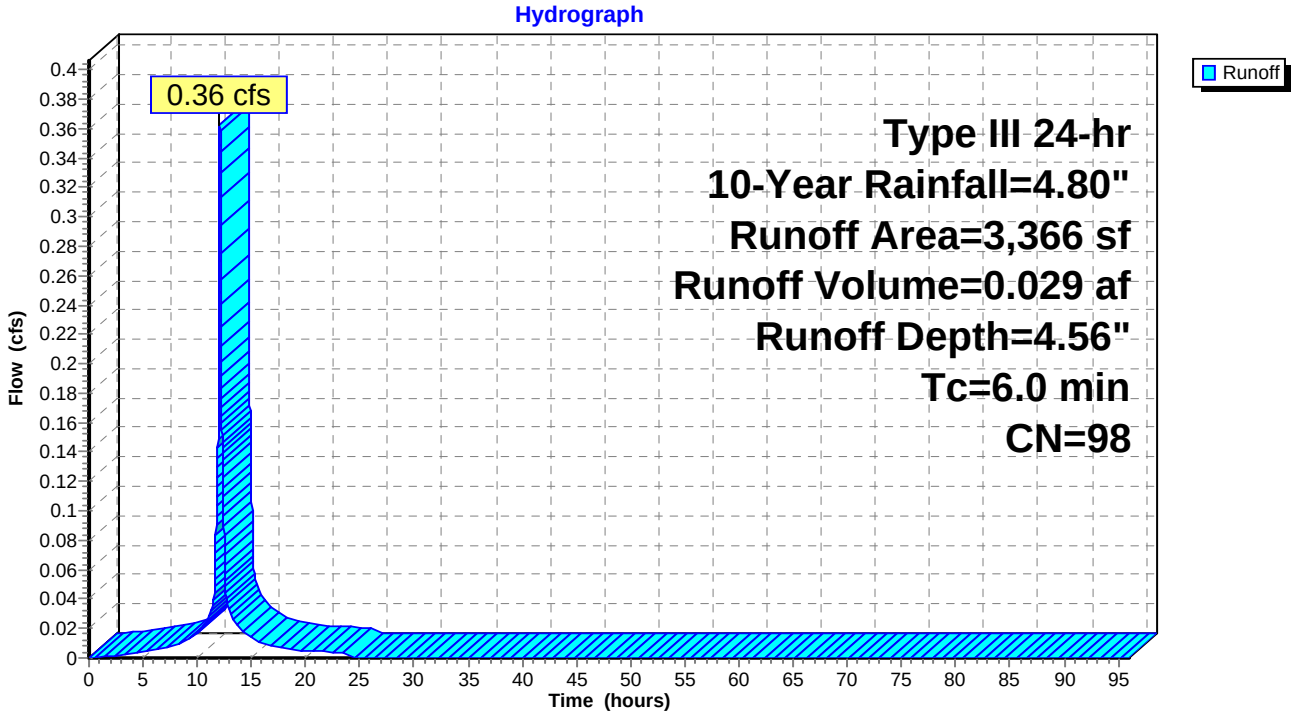
Runoff = 0.36 cfs @ 12.08 hrs, Volume= 0.029 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	3,366	98	ROOF 3 AND 4
	3,366		100.00% Impervious Area

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

Subcatchment 104: BUILDING 3 + 4 ROOFS



Summary for Subcatchment 105: BUILDING 1 ROOF

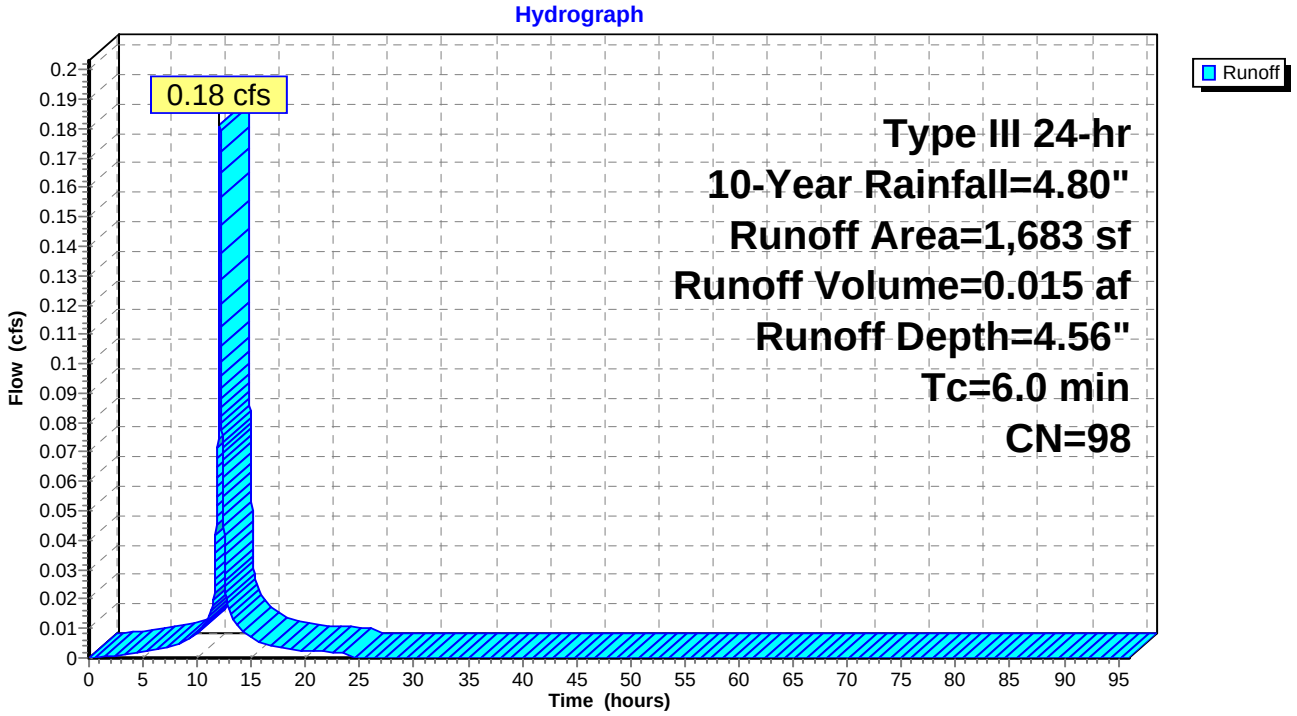
Runoff = 0.18 cfs @ 12.08 hrs, Volume= 0.015 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	1,683	98	ROOF 1
	1,683		100.00% Impervious Area

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

Subcatchment 105: BUILDING 1 ROOF



Summary for Pond 106: UIS-B (9 CULTEC 330 XLHD)

Inflow Area = 0.039 ac,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 0.18 cfs @ 12.08 hrs, Volume= 0.015 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 64.38' @ 24.34 hrs Surf.Area= 0.009 ac Storage= 0.015 af

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

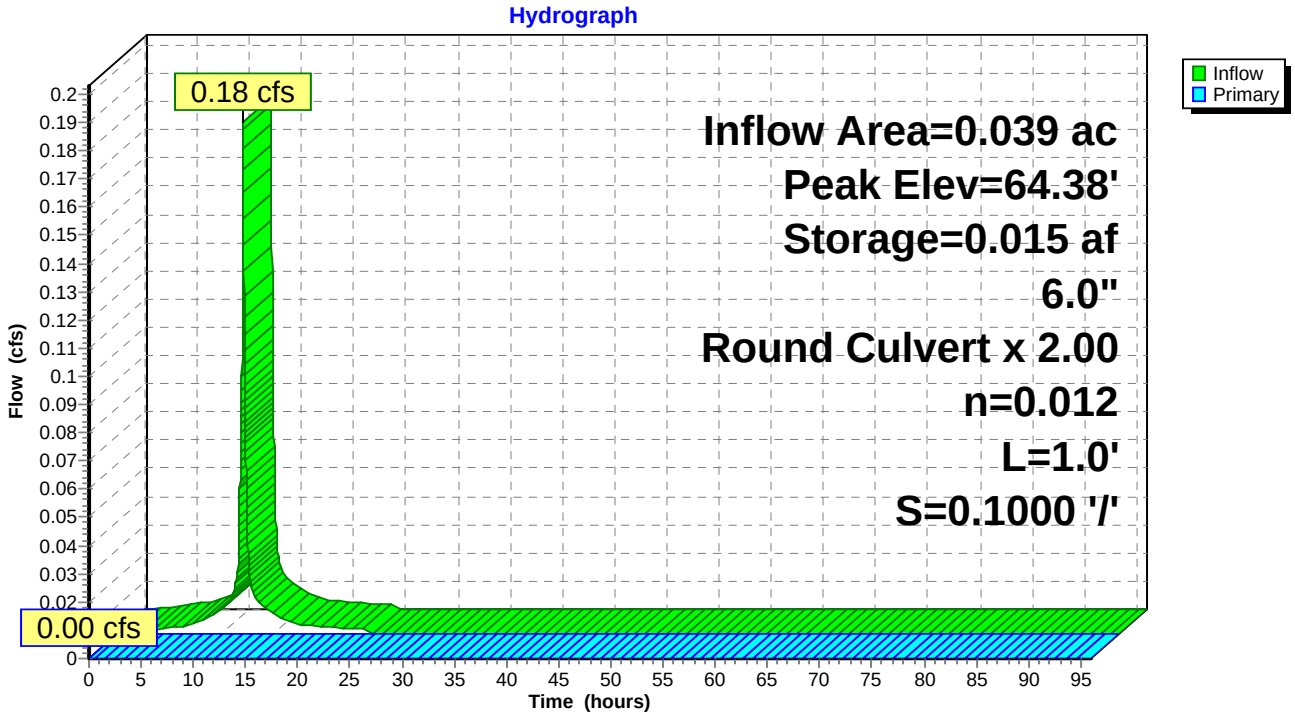
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.008 af	**16.00'W x 24.50'L x 3.54'H Field A** 0.032 af Overall - 0.012 af Embedded = 0.020 af x 40.0% Voids
#2A	62.50'	0.012 af	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE**
		0.020 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.60'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.60' / 66.50' S= 0.1000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 106: UIS-B (9 CULTEC 330 XLHD)



Summary for Pond 107: UIS-C (18 CULTEC 330 XLHD)

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 0.36 cfs @ 12.08 hrs, Volume= 0.029 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 64.53' @ 24.34 hrs Surf.Area= 0.017 ac Storage= 0.029 af

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

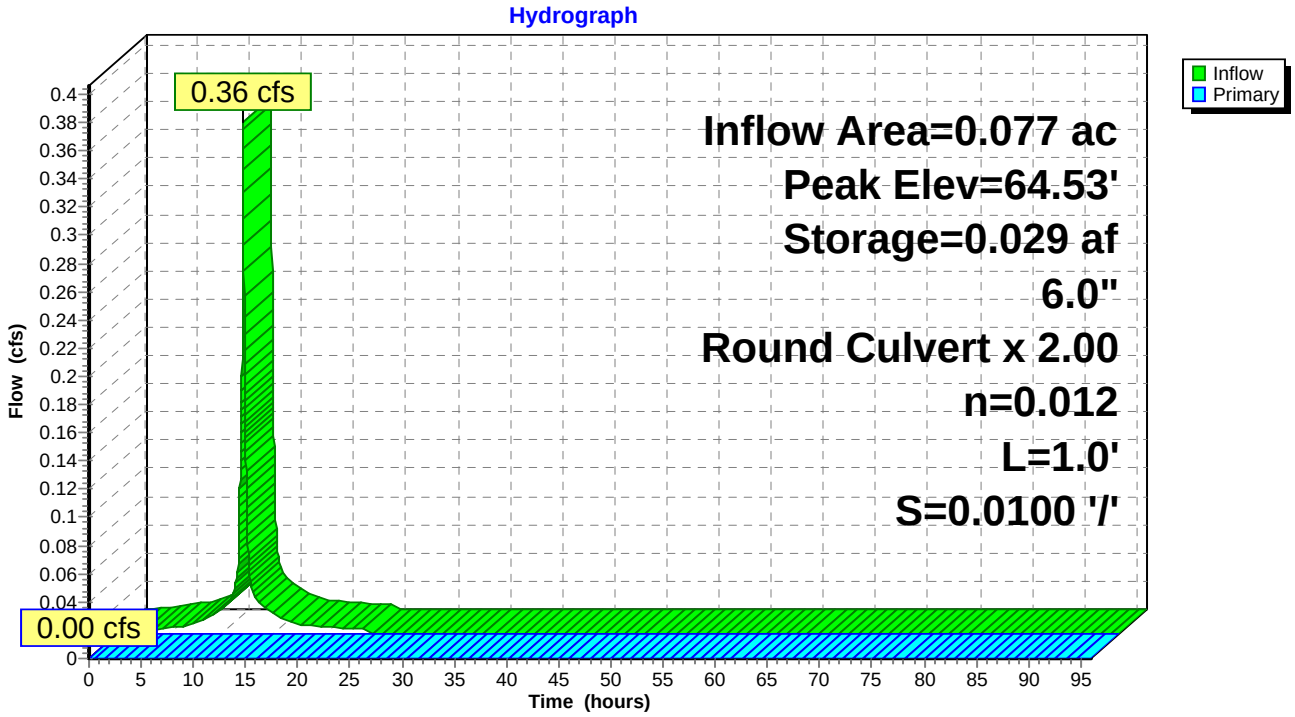
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.015 af	**16.00'W x 45.50'L x 3.54'H Field A** 0.059 af Overall - 0.022 af Embedded = 0.037 af x 40.0% Voids
#2A	62.50'	0.022 af	**Cultec R-330XLHD** x 18 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE OUTLET**
		0.037 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.70'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.70' / 66.69' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 107: UIS-C (18 CULTEC 330 XLHD)



Summary for Pond 108: UIS-A (9 CULTEC 330XLHD)

Inflow Area = 0.039 ac,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 0.18 cfs @ 12.08 hrs, Volume= 0.015 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 64.38' @ 24.34 hrs Surf.Area= 0.009 ac Storage= 0.015 af

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

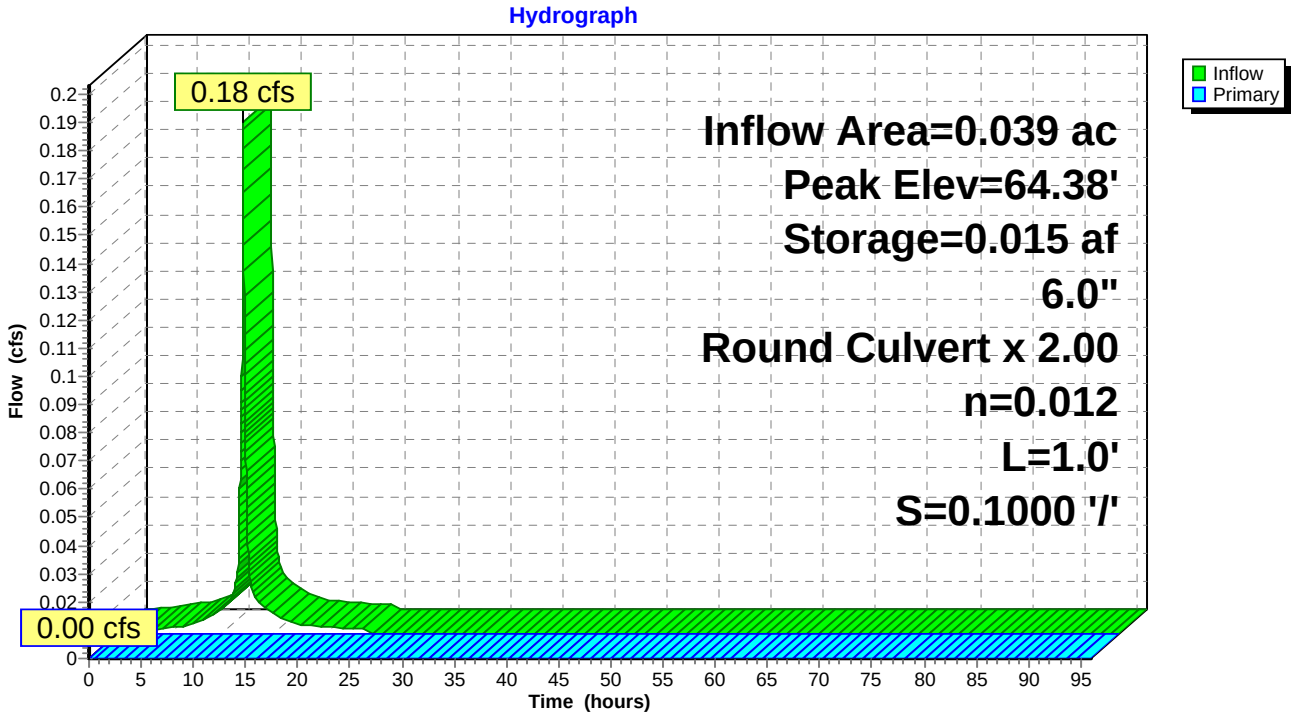
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.008 af	**16.00'W x 24.50'L x 3.54'H Field A** 0.032 af Overall - 0.012 af Embedded = 0.020 af x 40.0% Voids
#2A	62.50'	0.012 af	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE**
		0.020 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.30'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.30' / 66.20' S= 0.1000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 108: UIS-A (9 CULTEC 330XLHD)



Summary for Pond 109: CONSTRUCTED POCKET WETLAND

Inflow Area = 0.933 ac, 70.66% Impervious, Inflow Depth = 3.07" for 10-Year event
Inflow = 3.25 cfs @ 12.09 hrs, Volume= 0.239 af
Outflow = 0.16 cfs @ 14.35 hrs, Volume= 0.143 af, Atten= 95%, Lag= 136.1 min
Primary = 0.02 cfs @ 14.35 hrs, Volume= 0.053 af
Secondary = 0.14 cfs @ 14.35 hrs, Volume= 0.090 af
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 62.42' @ 14.35 hrs Surf.Area= 4,401 sf Storage= 7,462 cf

Plug-Flow detention time= 884.7 min calculated for 0.143 af (60% of inflow)
Center-of-Mass det. time= 781.8 min (1,574.0 - 792.1)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	15,527 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	1,260	0	0
61.00	3,063	2,162	2,162
62.00	4,020	3,542	5,703
63.00	4,931	4,476	10,179
64.00	5,766	5,349	15,527

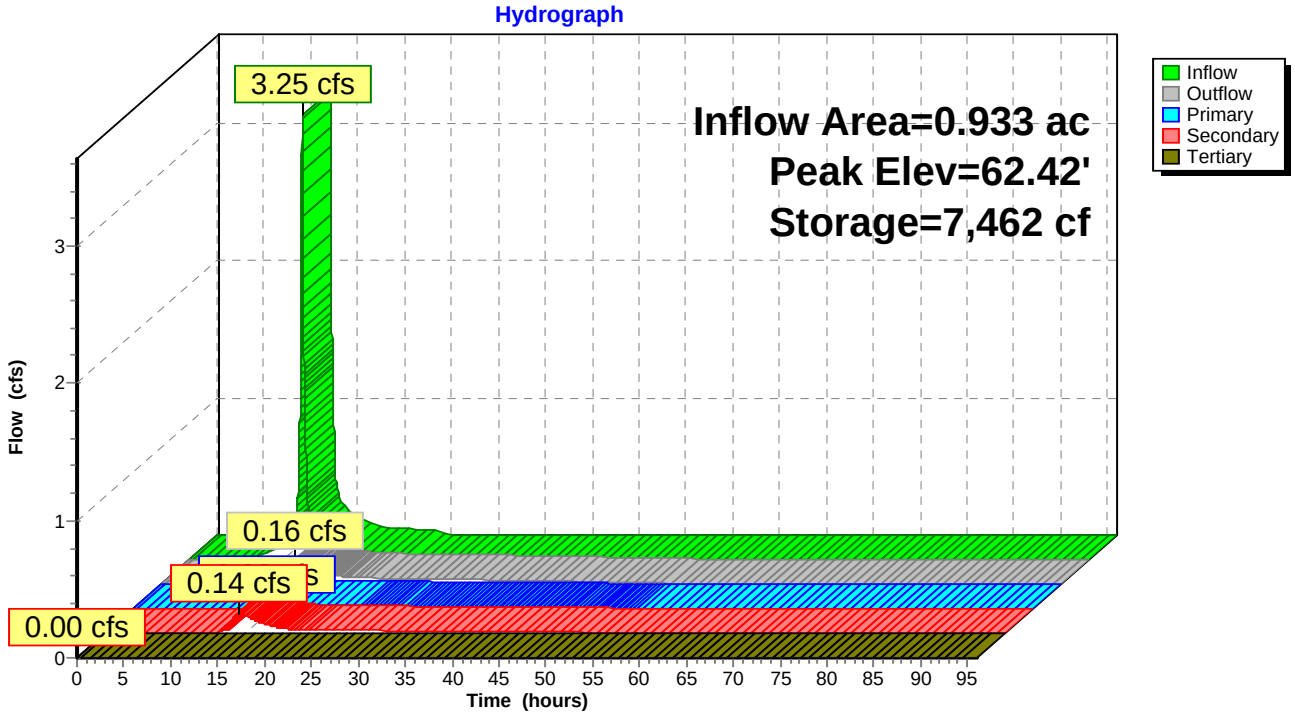
Device	Routing	Invert	Outlet Devices
#1	Primary	61.43'	**4.0" Round Culvert** L= 40.5' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 61.43' / 61.20' S= 0.0057 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Device 1	61.60'	**1.0" Vert. Orifice/Grate** C= 0.600
#3	Tertiary	63.60'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	59.35'	**12.0" Round Culvert** L= 70.6' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 59.35' / 58.35' S= 0.0142 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#5	Device 4	61.60'	**1.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 4	62.35'	**24.0" W x 9.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.02 cfs @ 14.35 hrs HW=62.42' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.26 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 4.24 fps)

Secondary OutFlow Max=0.14 cfs @ 14.35 hrs HW=62.42' (Free Discharge)
└─**4=Culvert** (Passes 0.14 cfs of 6.00 cfs potential flow)
└─**5=Orifice/Grate** (Orifice Controls 0.02 cfs @ 4.35 fps)
└─**6=Orifice/Grate** (Orifice Controls 0.11 cfs @ 0.84 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 109: CONSTRUCTED POCKET WETLAND



Summary for Pond 110: INFILTRATION AREA

Inflow Area = 1.302 ac, 55.84% Impervious, Inflow Depth = 1.18" for 10-Year event
Inflow = 0.68 cfs @ 12.18 hrs, Volume= 0.128 af
Outflow = 0.45 cfs @ 12.37 hrs, Volume= 0.103 af, Atten= 34%, Lag= 11.6 min
Primary = 0.45 cfs @ 12.37 hrs, Volume= 0.103 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 60.76' @ 12.37 hrs Surf.Area= 3,391 sf Storage= 1,325 cf

Plug-Flow detention time= 414.1 min calculated for 0.103 af (80% of inflow)
Center-of-Mass det. time= 145.4 min (1,327.0 - 1,181.6)

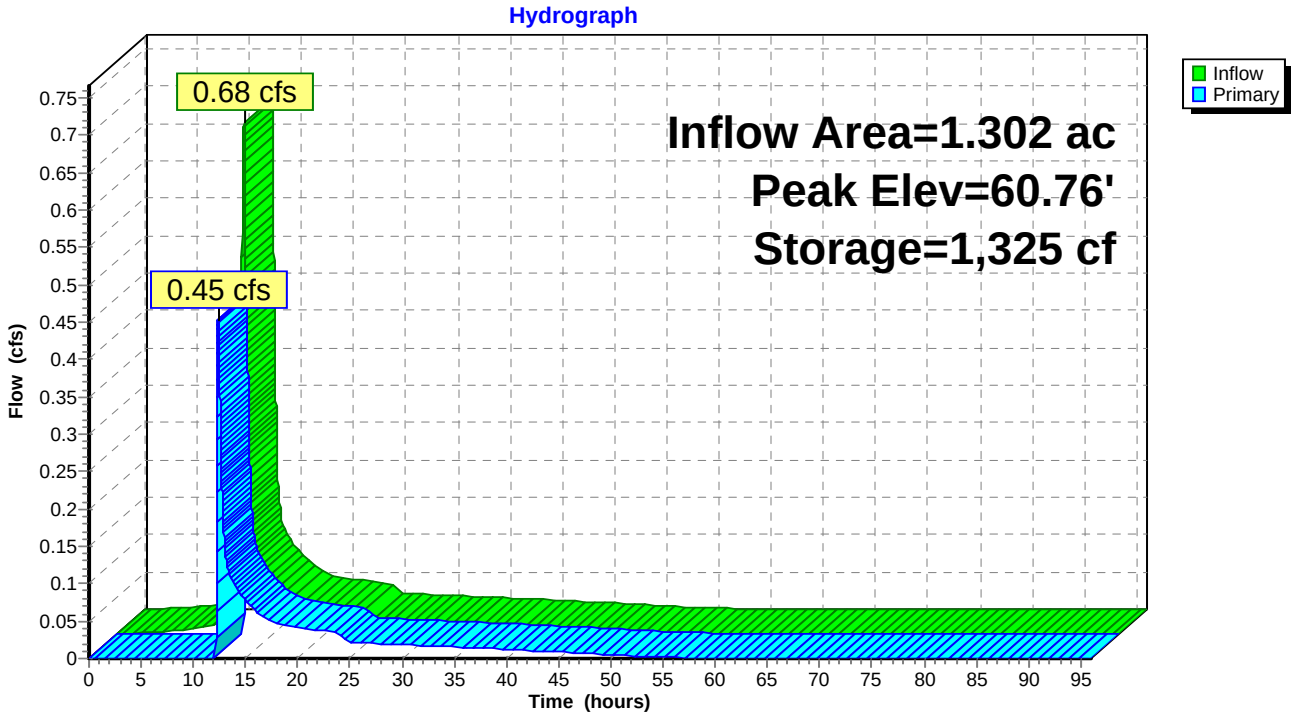
Volume	Invert	Avail.Storage	Storage Description
#1	60.33'	2,190 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.33	2,962	0	0
60.58	2,962	741	741
61.00	3,942	1,450	2,190

Device	Routing	Invert	Outlet Devices
#1	Primary	60.70'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.45 cfs @ 12.37 hrs HW=60.76' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.45 cfs @ 0.71 fps)

Pond 110: INFILTRATION AREA



Summary for Pond 111: EXISTING DMH

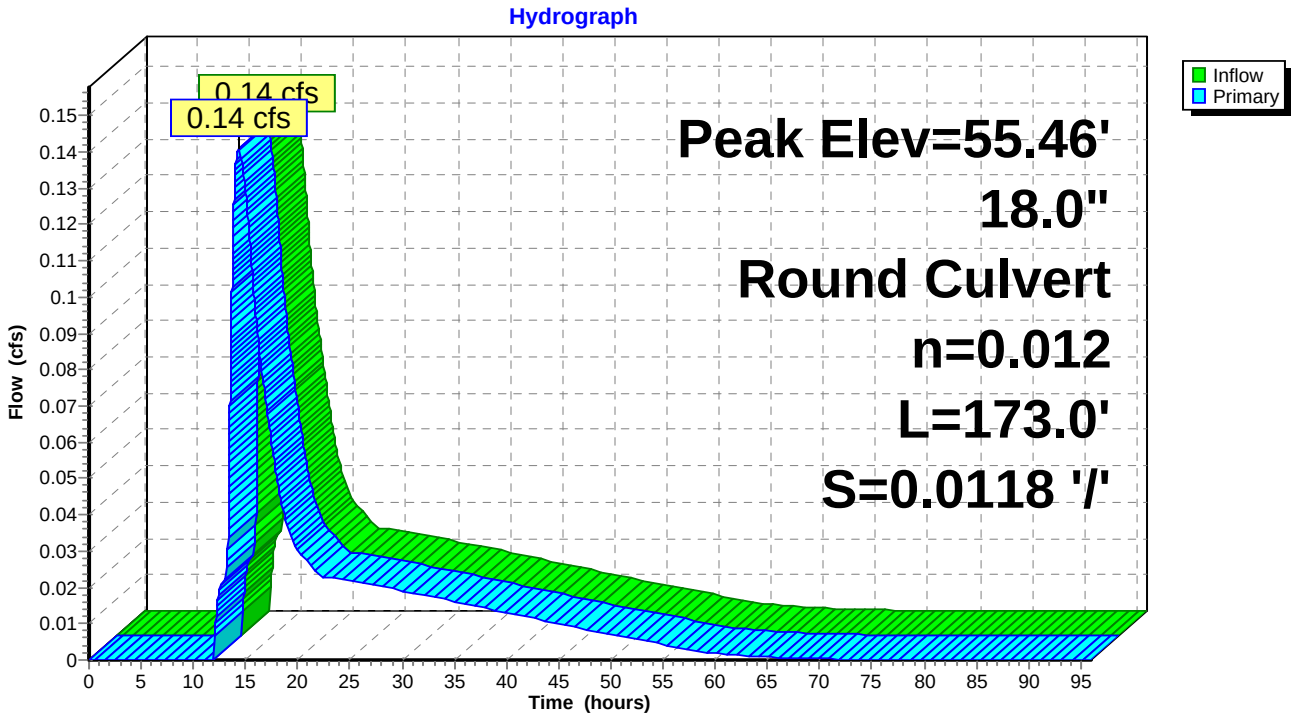
Inflow	=	0.14 cfs @	14.35 hrs, Volume=	0.090 af
Outflow	=	0.14 cfs @	14.35 hrs, Volume=	0.090 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.14 cfs @	14.35 hrs, Volume=	0.090 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 55.46' @ 14.35 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	55.30'	**18.0" Round Culvert** L= 173.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 55.30' / 53.26' S= 0.0118 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.14 cfs @ 14.35 hrs HW=55.46' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.14 cfs @ 1.37 fps)

Pond 111: EXISTING DMH

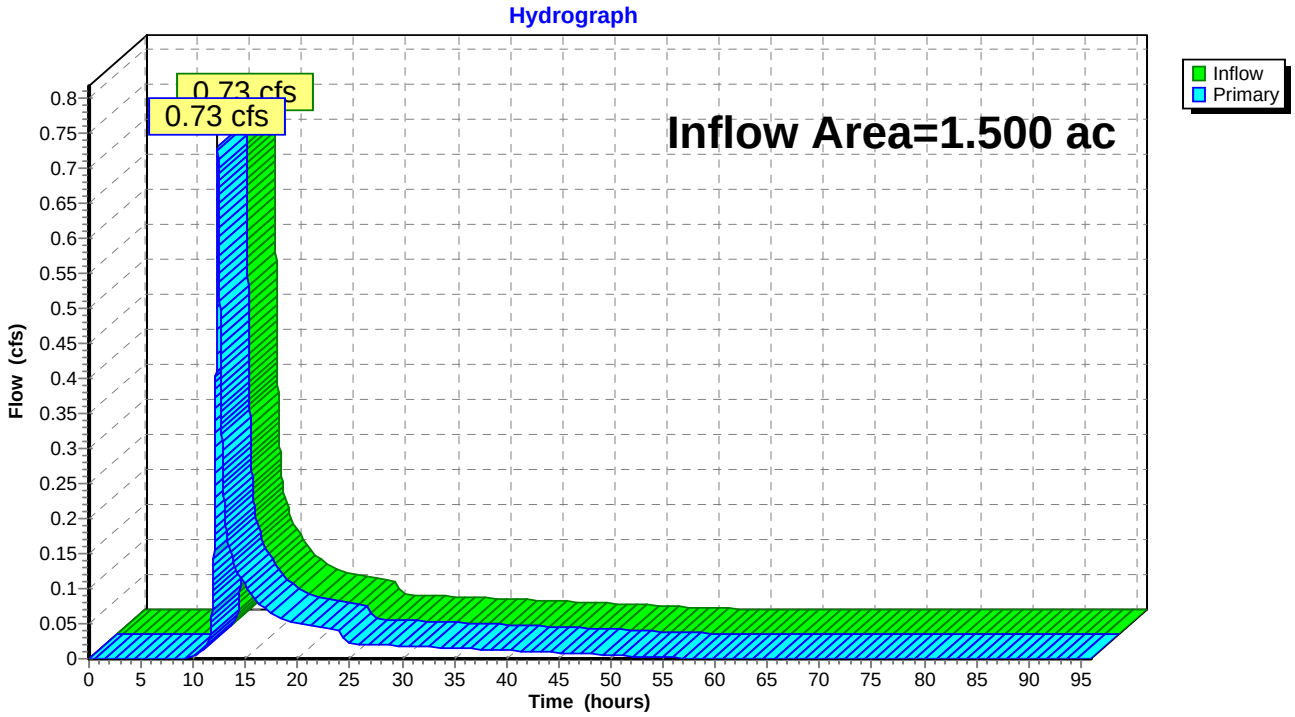


Summary for Link 112: DP-1-WETLAND LINE

Inflow Area = 1.500 ac, 48.46% Impervious, Inflow Depth = 1.11" for 10-Year event
Inflow = 0.73 cfs @ 12.33 hrs, Volume= 0.139 af
Primary = 0.73 cfs @ 12.33 hrs, Volume= 0.139 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 112: DP-1-WETLAND LINE

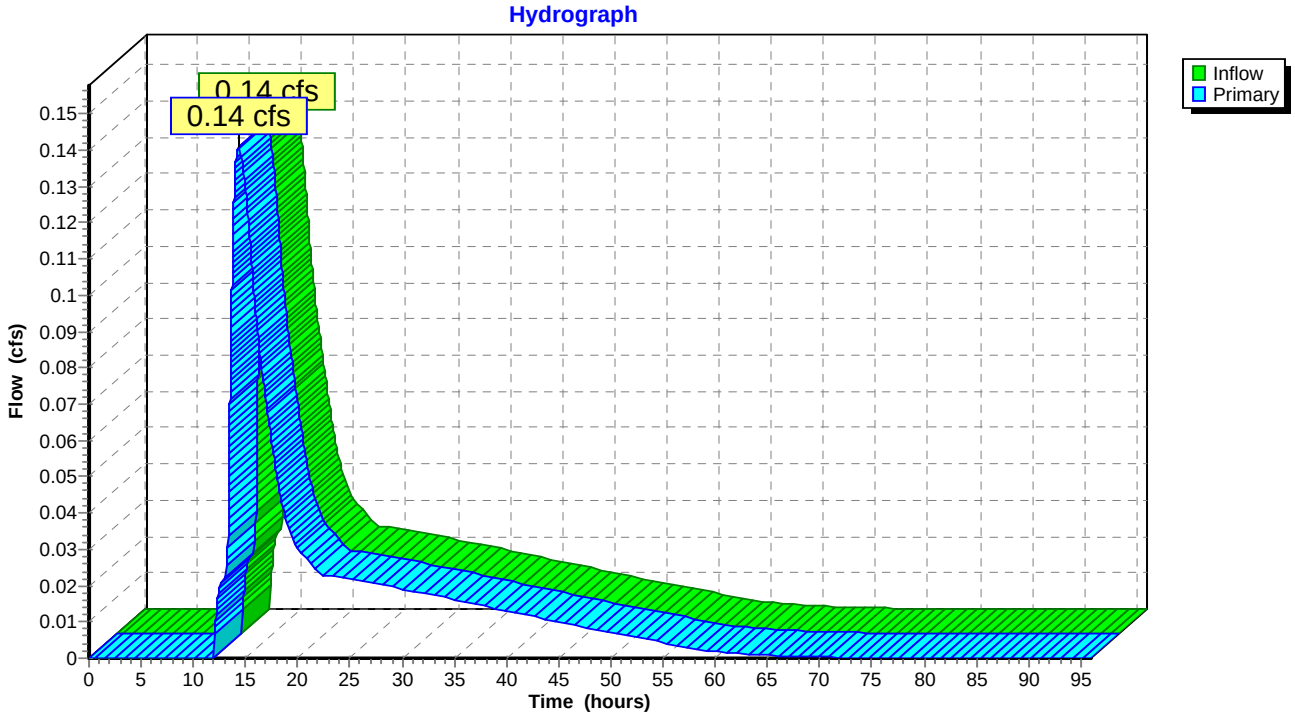


Summary for Link 113: DP-2-OFFSITE DRAINAGE NETWORK

Inflow = 0.14 cfs @ 14.35 hrs, Volume= 0.090 af
Primary = 0.14 cfs @ 14.35 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 113: DP-2-OFFSITE DRAINAGE NETWORK

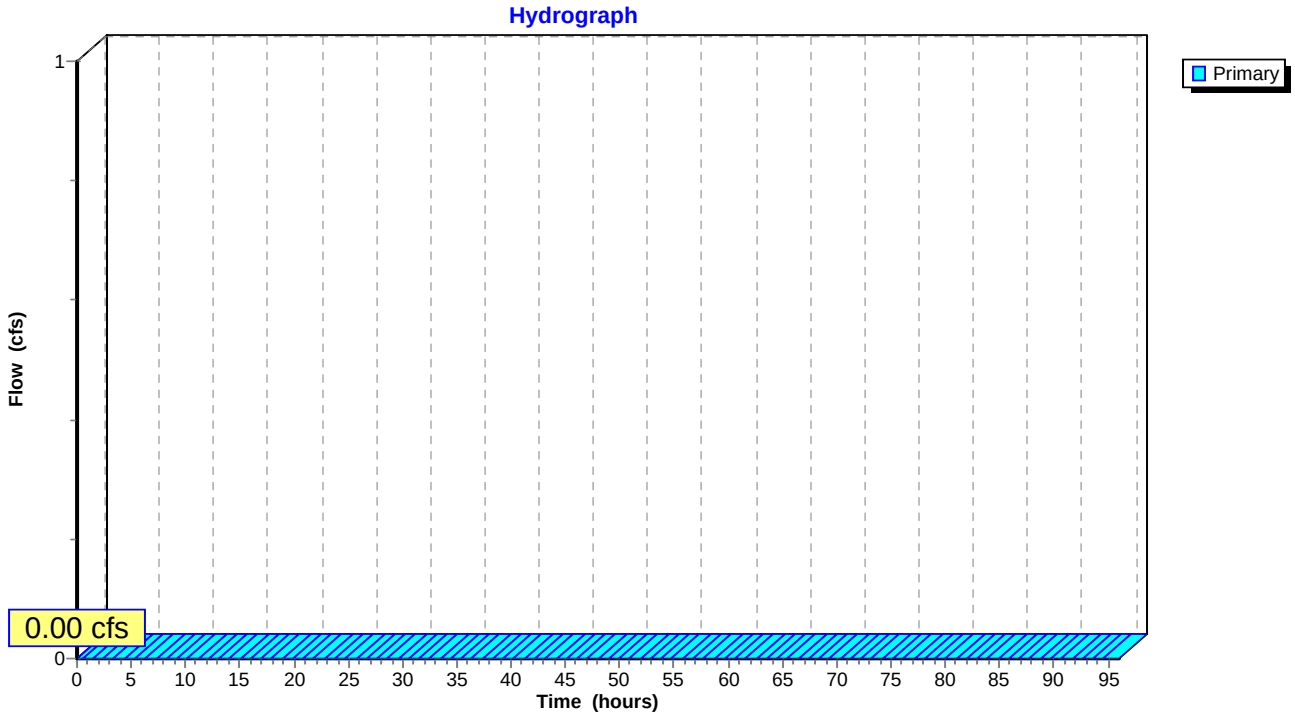


Summary for Link 202: DP-3 Street

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 202: DP-3 Street



Summary for Subcatchment 101: UNDETAINED AREA

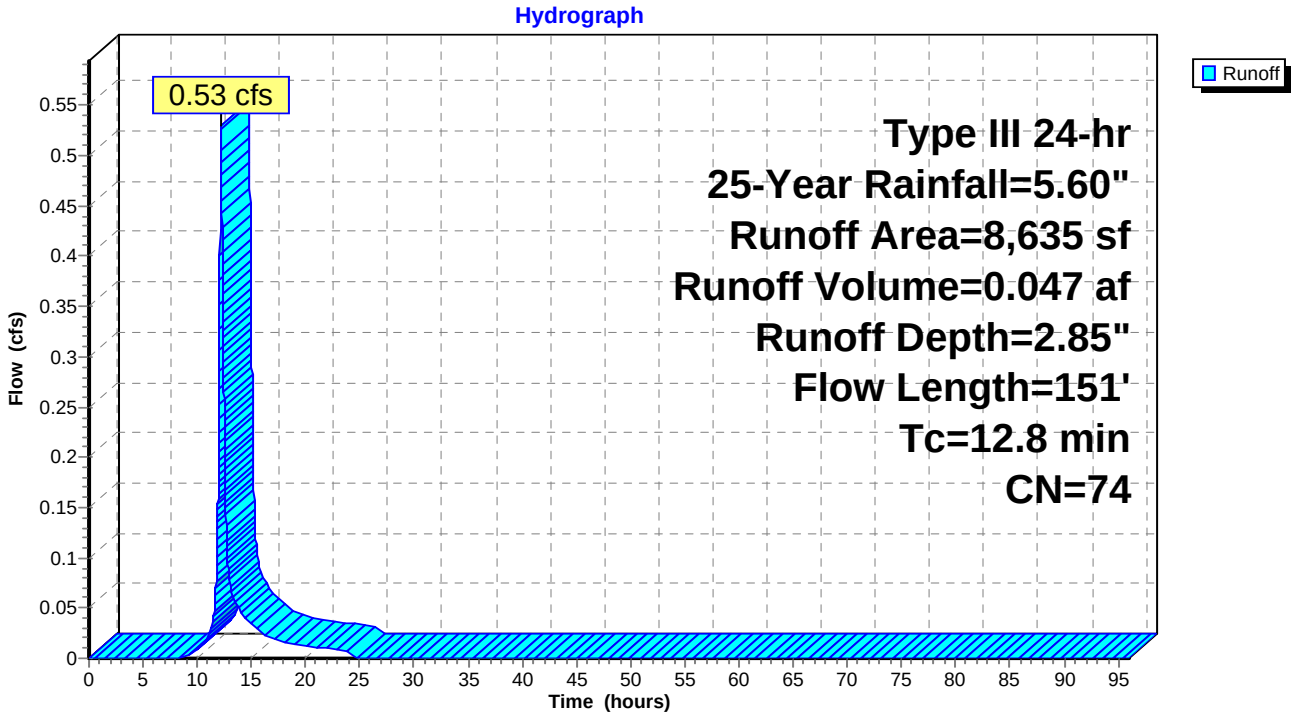
Runoff = 0.53 cfs @ 12.18 hrs, Volume= 0.047 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (sf)	CN	Description
8,635	74	>75% Grass cover, Good, HSG C
8,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0080	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
1.3	101	0.0070	1.25		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
12.8	151	Total			

Subcatchment 101: UNDETAINED AREA



Summary for Subcatchment 101A: INFILTRATION AREA WATERSHED

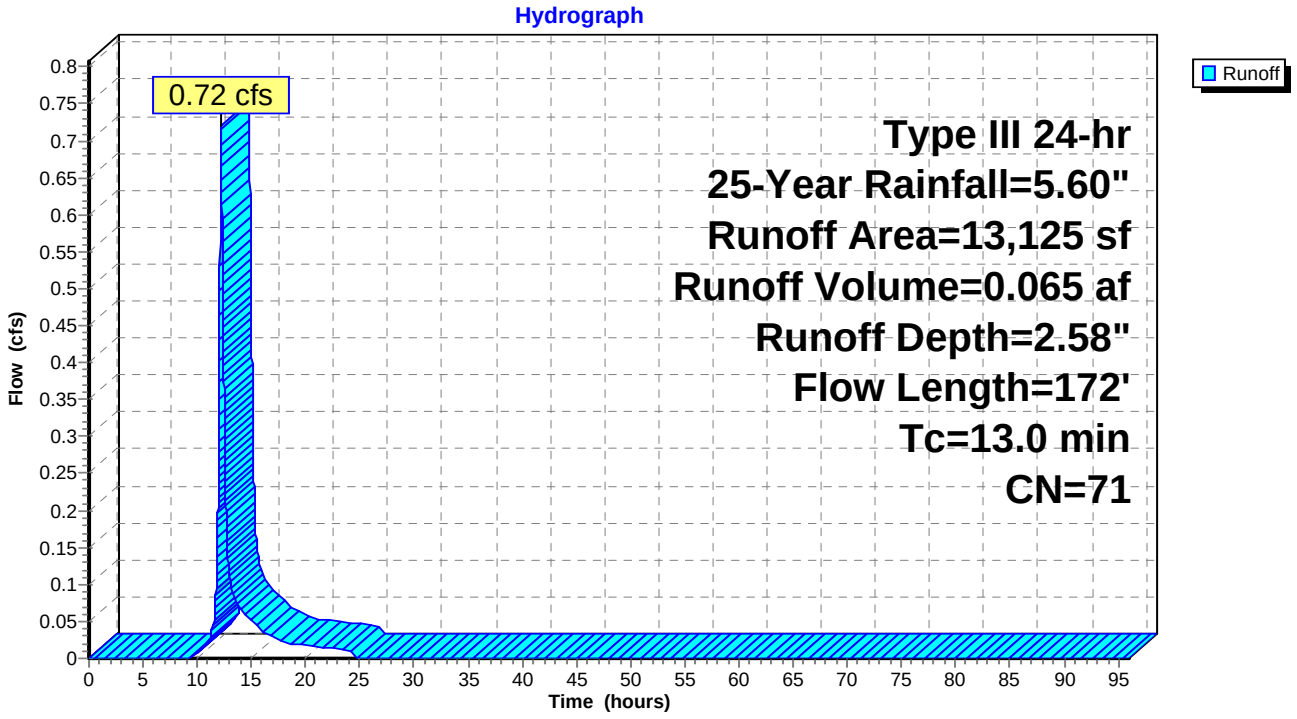
Runoff = 0.72 cfs @ 12.18 hrs, Volume= 0.065 af, Depth= 2.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
	8,487	70	Woods, Good, HSG C
*	4,638	74	>75% Grass cover, Good, HSG C
	13,125	71	Weighted Average
	13,125		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.5	122	0.0275	0.83		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.0	172	Total			

Subcatchment 101A: INFILTRATION AREA WATERSHED



Summary for Subcatchment 101B: INFILTRATION AREA BOTTOM

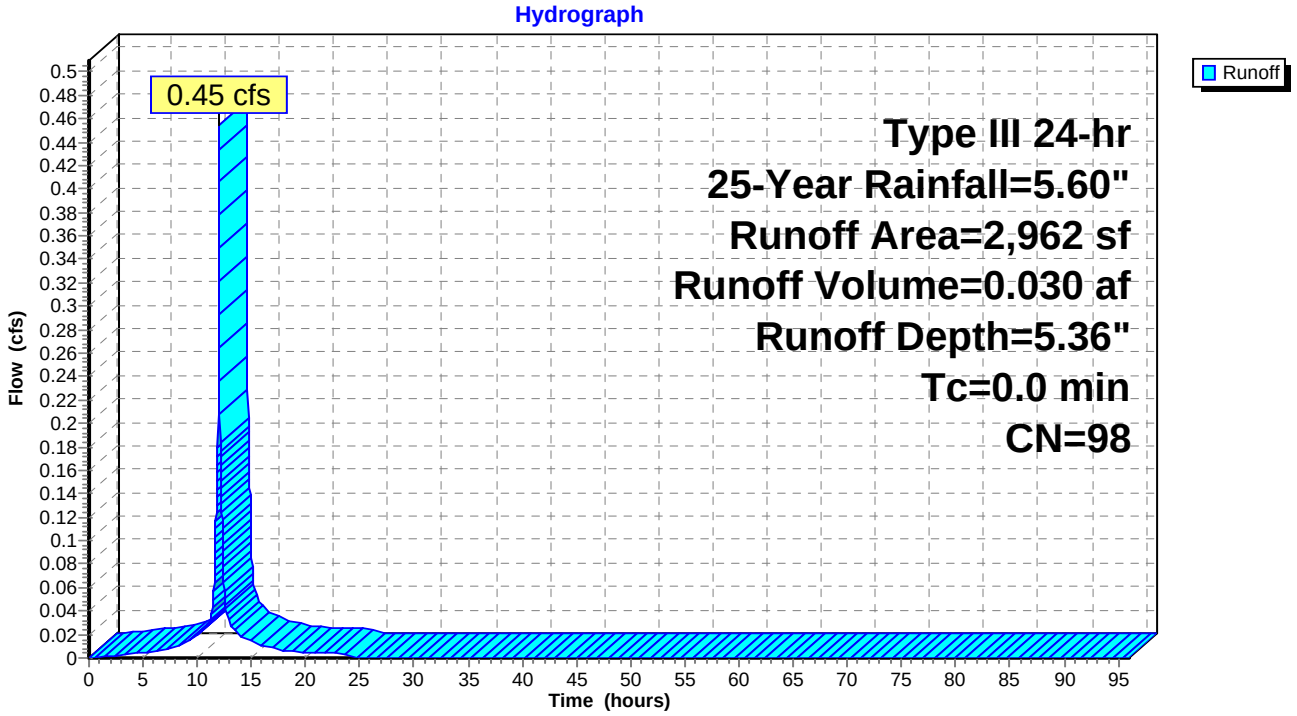
Runoff = 0.45 cfs @ 12.00 hrs, Volume= 0.030 af, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	2,962	98	Infiltration area bottom
	2,962		100.00% Impervious Area

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

Subcatchment 101B: INFILTRATION AREA BOTTOM



Summary for Subcatchment 102: DEVELOPMENT AREA

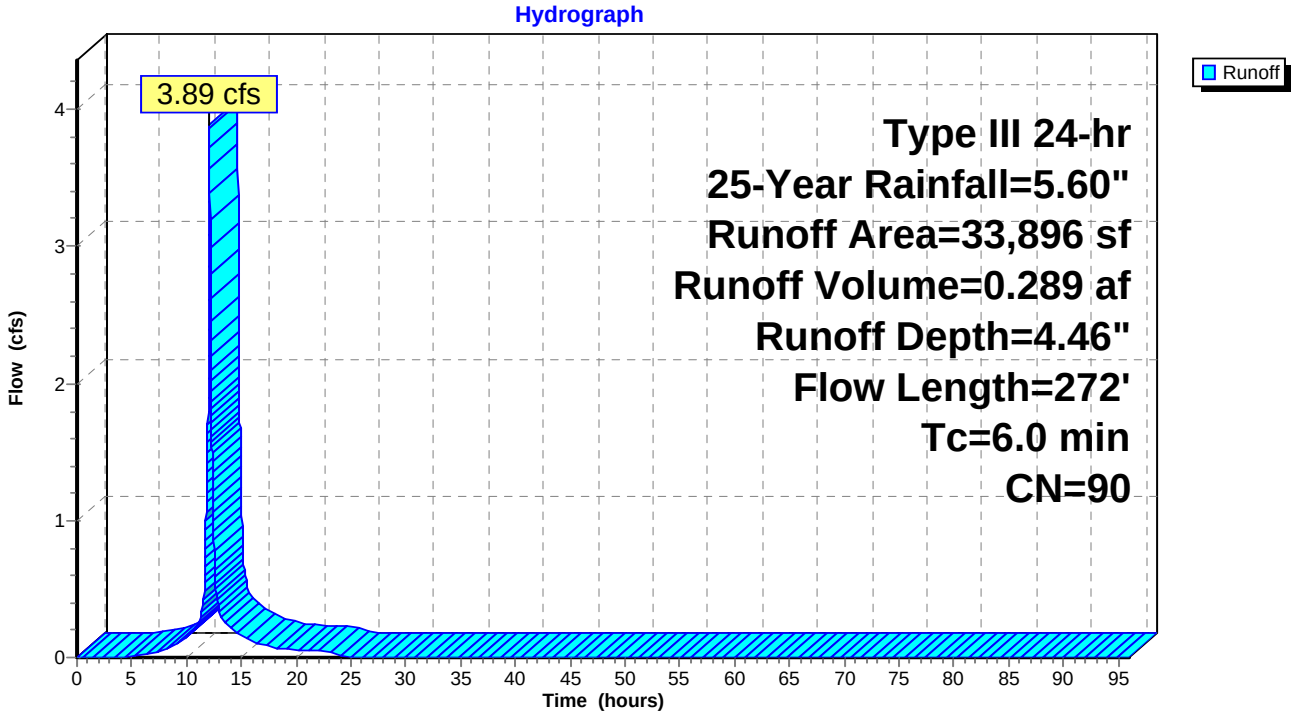
Runoff = 3.89 cfs @ 12.08 hrs, Volume= 0.289 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	13,875	98	PAVEMENT
*	2,842	98	SIDEWALKS
	11,922	74	>75% Grass cover, Good, HSG C
*	5,257	98	DETENTION POND
	33,896	90	Weighted Average
	11,922		35.17% Pervious Area
	21,974		64.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.94		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
1.2	172	0.0132	2.33		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.3	272	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 102: DEVELOPMENT AREA



Summary for Subcatchment 103: BUILDING 2 ROOF

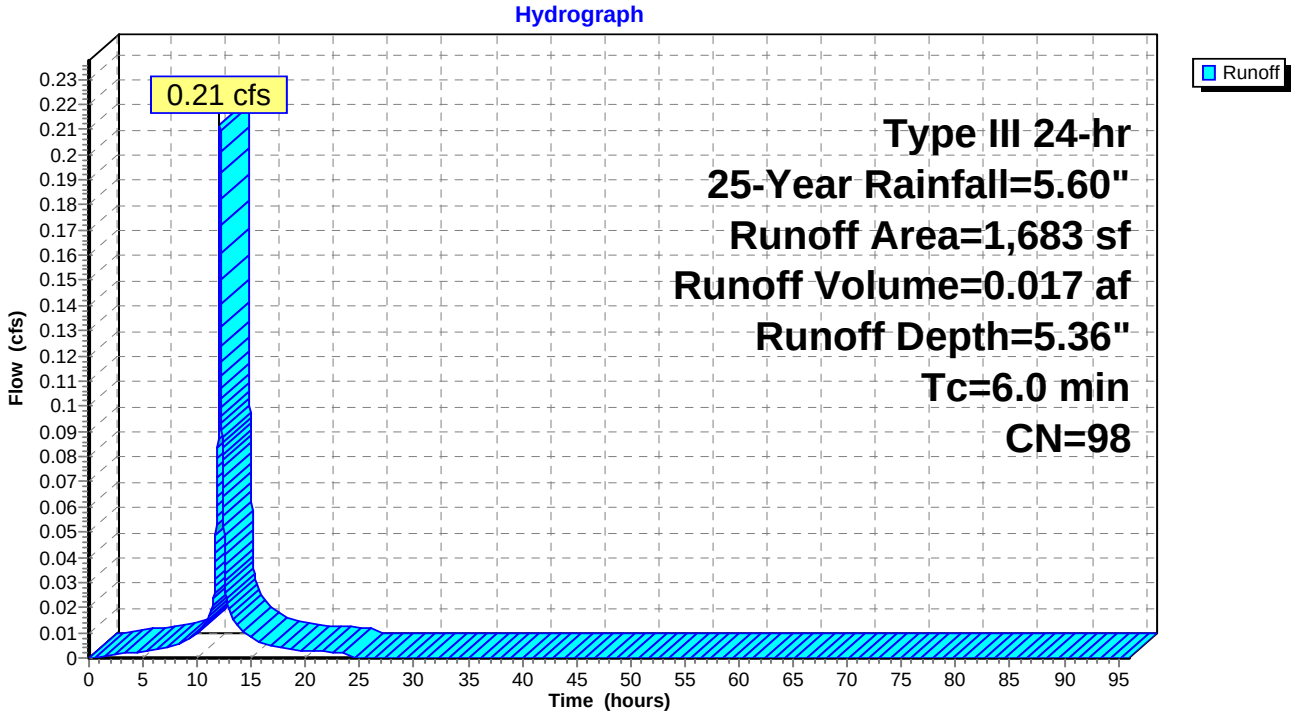
Runoff = 0.21 cfs @ 12.08 hrs, Volume= 0.017 af, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	1,683	98	BUILDING 2 ROOF
	1,683		100.00% Impervious Area

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

Subcatchment 103: BUILDING 2 ROOF



Summary for Subcatchment 104: BUILDING 3 + 4 ROOFS

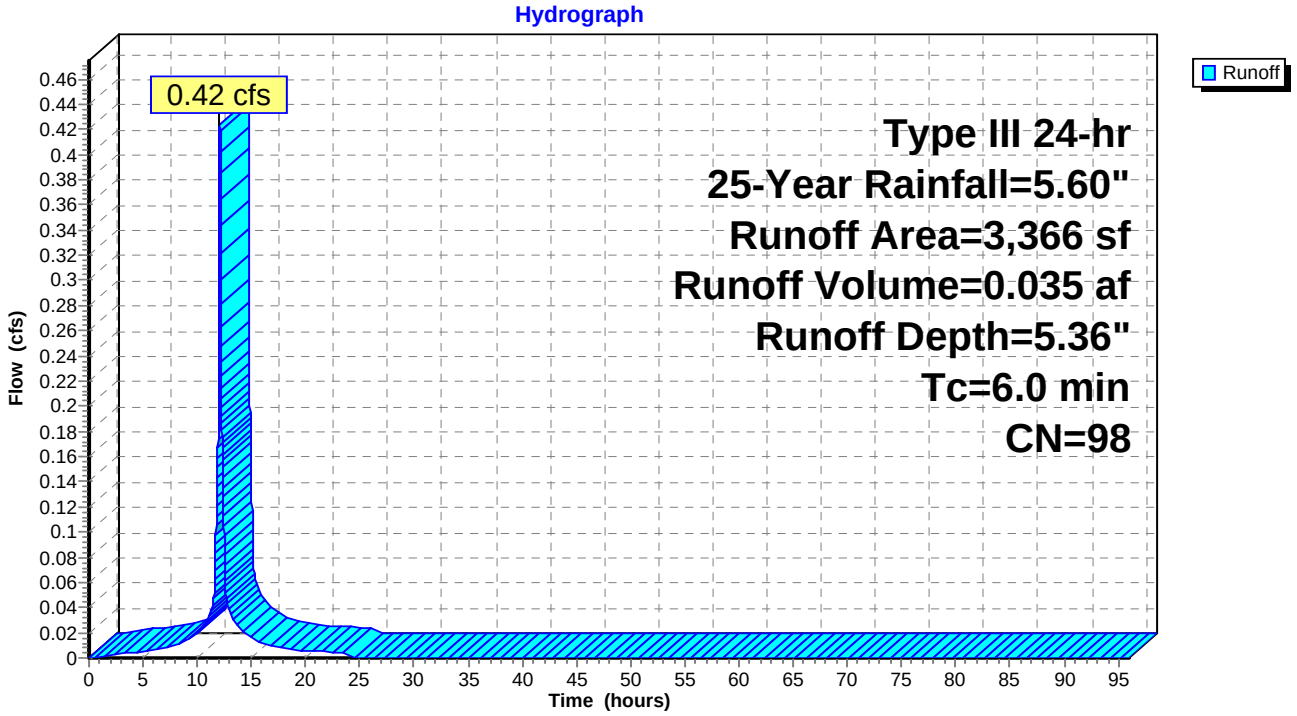
Runoff = 0.42 cfs @ 12.08 hrs, Volume= 0.035 af, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	3,366	98	ROOF 3 AND 4
	3,366		100.00% Impervious Area

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

Subcatchment 104: BUILDING 3 + 4 ROOFS



Summary for Subcatchment 105: BUILDING 1 ROOF

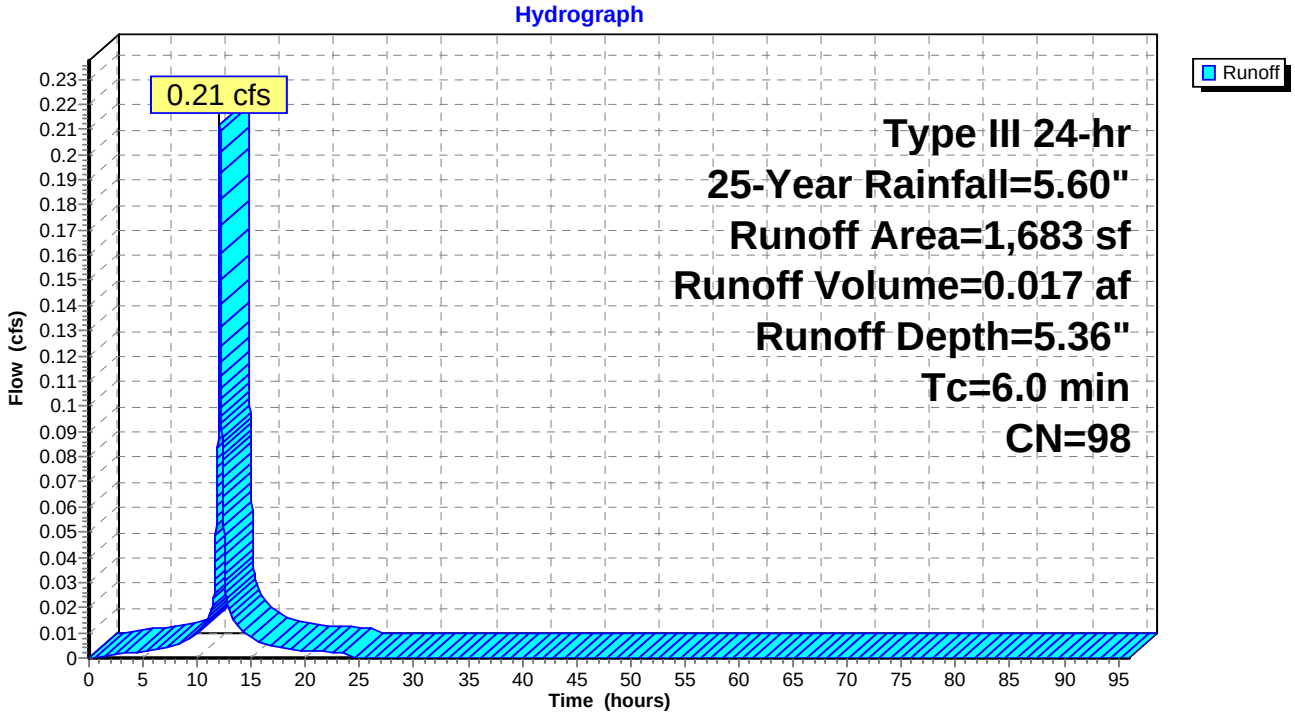
Runoff = 0.21 cfs @ 12.08 hrs, Volume= 0.017 af, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	1,683	98	ROOF 1
	1,683		100.00% Impervious Area

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

Subcatchment 105: BUILDING 1 ROOF



Summary for Pond 106: UIS-B (9 CULTEC 330 XLHD)

Inflow Area = 0.039 ac,100.00% Impervious, Inflow Depth = 5.36" for 25-Year event
Inflow = 0.21 cfs @ 12.08 hrs, Volume= 0.017 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 64.88' @ 24.34 hrs Surf.Area= 0.009 ac Storage= 0.017 af

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

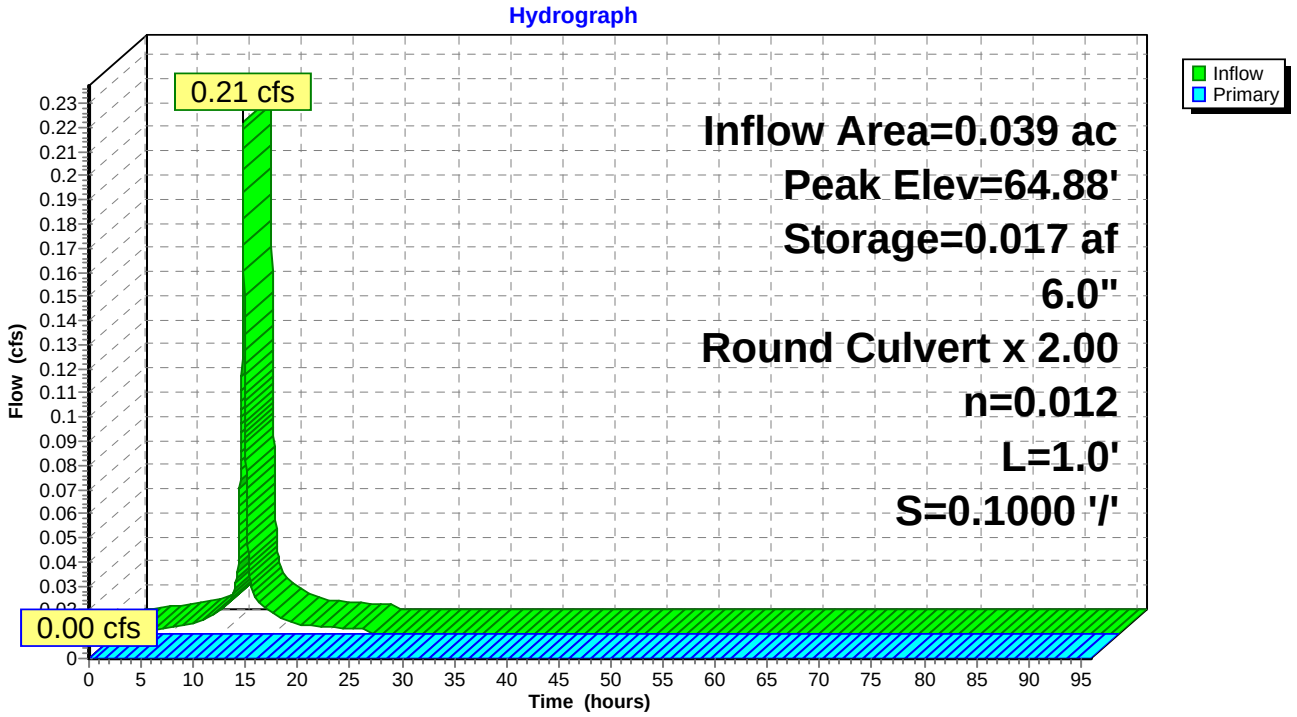
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.008 af	**16.00'W x 24.50'L x 3.54'H Field A** 0.032 af Overall - 0.012 af Embedded = 0.020 af x 40.0% Voids
#2A	62.50'	0.012 af	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE**
		0.020 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.60'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.60' / 66.50' S= 0.1000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 106: UIS-B (9 CULTEC 330 XLHD)



Summary for Pond 107: UIS-C (18 CULTEC 330 XLHD)

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 5.36" for 25-Year event
Inflow = 0.42 cfs @ 12.08 hrs, Volume= 0.035 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 65.16' @ 24.34 hrs Surf.Area= 0.017 ac Storage= 0.035 af

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

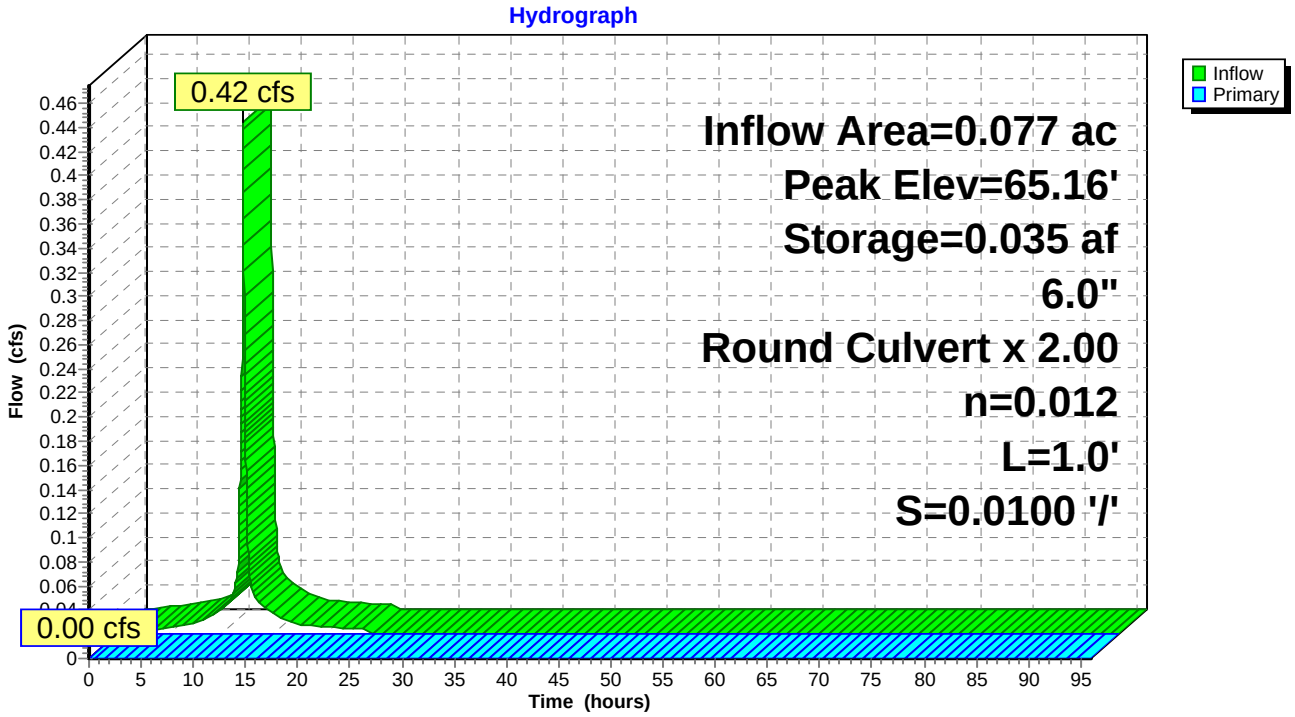
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.015 af	**16.00'W x 45.50'L x 3.54'H Field A** 0.059 af Overall - 0.022 af Embedded = 0.037 af x 40.0% Voids
#2A	62.50'	0.022 af	**Cultec R-330XLHD** x 18 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE OUTLET**
		0.037 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.70'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.70' / 66.69' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 107: UIS-C (18 CULTEC 330 XLHD)



Summary for Pond 108: UIS-A (9 CULTEC 330XLHD)

Inflow Area = 0.039 ac,100.00% Impervious, Inflow Depth = 5.36" for 25-Year event
Inflow = 0.21 cfs @ 12.08 hrs, Volume= 0.017 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 Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 64.88' @ 24.34 hrs Surf.Area= 0.009 ac Storage= 0.017 af

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

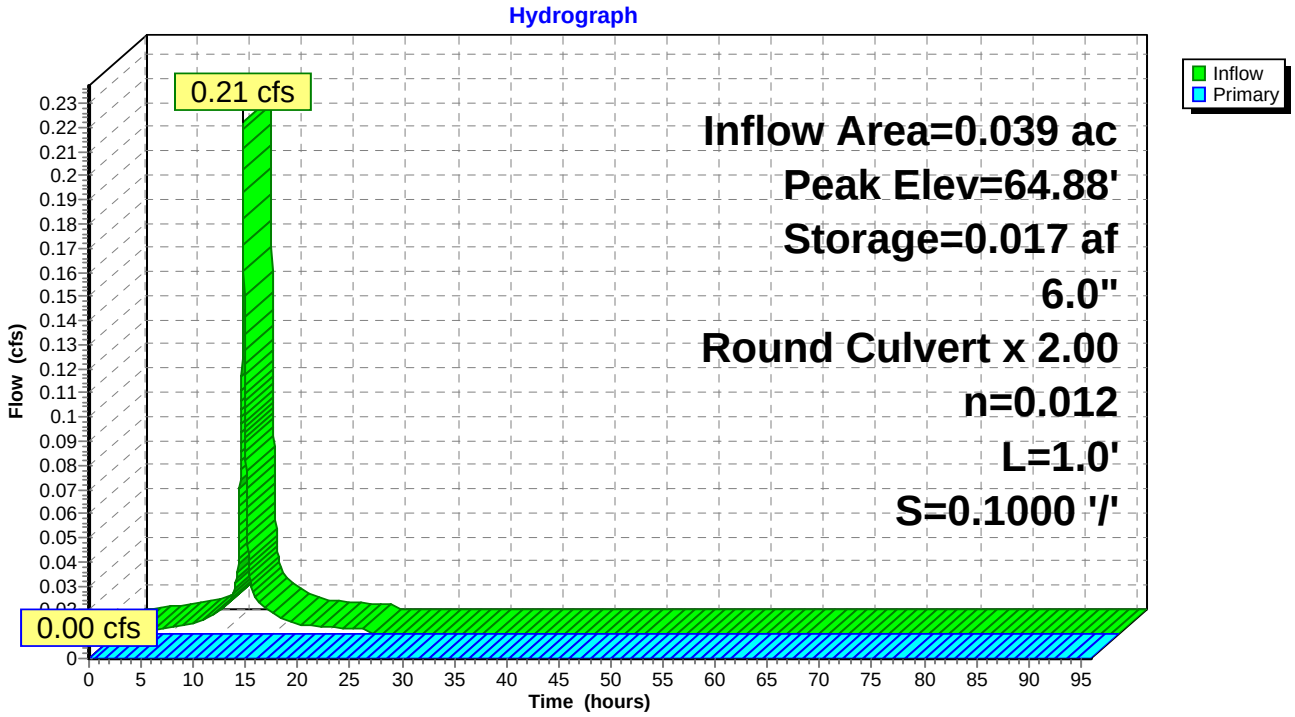
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.008 af	**16.00'W x 24.50'L x 3.54'H Field A** 0.032 af Overall - 0.012 af Embedded = 0.020 af x 40.0% Voids
#2A	62.50'	0.012 af	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE**
		0.020 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.30'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.30' / 66.20' S= 0.1000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Controls 0.00 cfs)

Pond 108: UIS-A (9 CULTEC 330XLHD)



Summary for Pond 109: CONSTRUCTED POCKET WETLAND

Inflow Area = 0.933 ac, 70.66% Impervious, Inflow Depth = 3.72" for 25-Year event
Inflow = 3.89 cfs @ 12.08 hrs, Volume= 0.289 af
Outflow = 0.43 cfs @ 12.77 hrs, Volume= 0.193 af, Atten= 89%, Lag= 41.4 min
Primary = 0.02 cfs @ 12.77 hrs, Volume= 0.054 af
Secondary = 0.40 cfs @ 12.77 hrs, Volume= 0.139 af
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 62.50' @ 12.77 hrs Surf.Area= 4,476 sf Storage= 7,829 cf

Plug-Flow detention time= 703.7 min calculated for 0.193 af (67% of inflow)
Center-of-Mass det. time= 608.2 min (1,395.1 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	15,527 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	1,260	0	0
61.00	3,063	2,162	2,162
62.00	4,020	3,542	5,703
63.00	4,931	4,476	10,179
64.00	5,766	5,349	15,527

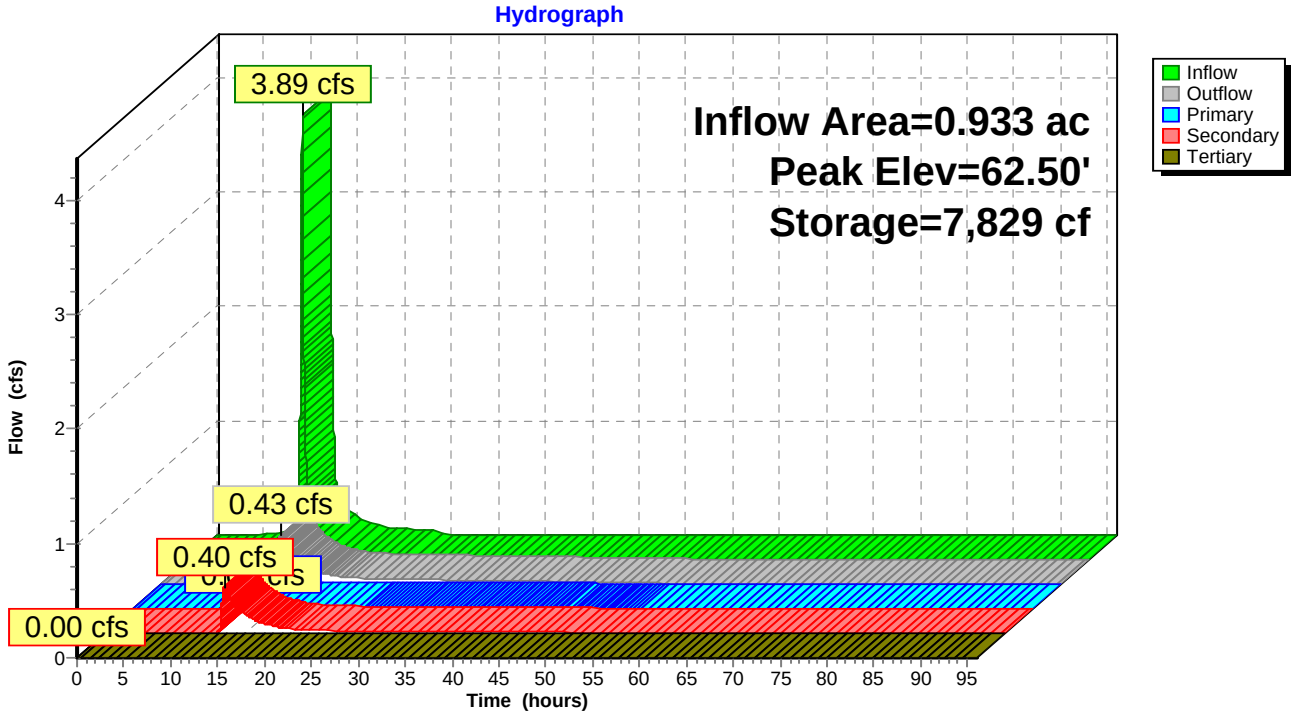
Device	Routing	Invert	Outlet Devices
#1	Primary	61.43'	**4.0" Round Culvert** L= 40.5' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 61.43' / 61.20' S= 0.0057 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Device 1	61.60'	**1.0" Vert. Orifice/Grate** C= 0.600
#3	Tertiary	63.60'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	59.35'	**12.0" Round Culvert** L= 70.6' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 59.35' / 58.35' S= 0.0142 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#5	Device 4	61.60'	**1.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 4	62.35'	**24.0" W x 9.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.02 cfs @ 12.77 hrs HW=62.50' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.28 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 4.46 fps)

Secondary OutFlow Max=0.40 cfs @ 12.77 hrs HW=62.50' (Free Discharge)
└─**4=Culvert** (Passes 0.40 cfs of 6.08 cfs potential flow)
└─**5=Orifice/Grate** (Orifice Controls 0.02 cfs @ 4.57 fps)
└─**6=Orifice/Grate** (Orifice Controls 0.38 cfs @ 1.25 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 109: CONSTRUCTED POCKET WETLAND



Summary for Pond 110: INFILTRATION AREA

Inflow Area = 1.302 ac, 55.84% Impervious, Inflow Depth = 1.38" for 25-Year event
Inflow = 0.89 cfs @ 12.18 hrs, Volume= 0.149 af
Outflow = 0.75 cfs @ 12.28 hrs, Volume= 0.124 af, Atten= 16%, Lag= 5.9 min
Primary = 0.75 cfs @ 12.28 hrs, Volume= 0.124 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 60.79' @ 12.28 hrs Surf.Area= 3,450 sf Storage= 1,411 cf

Plug-Flow detention time= 352.6 min calculated for 0.124 af (83% of inflow)
Center-of-Mass det. time= 115.8 min (1,250.6 - 1,134.8)

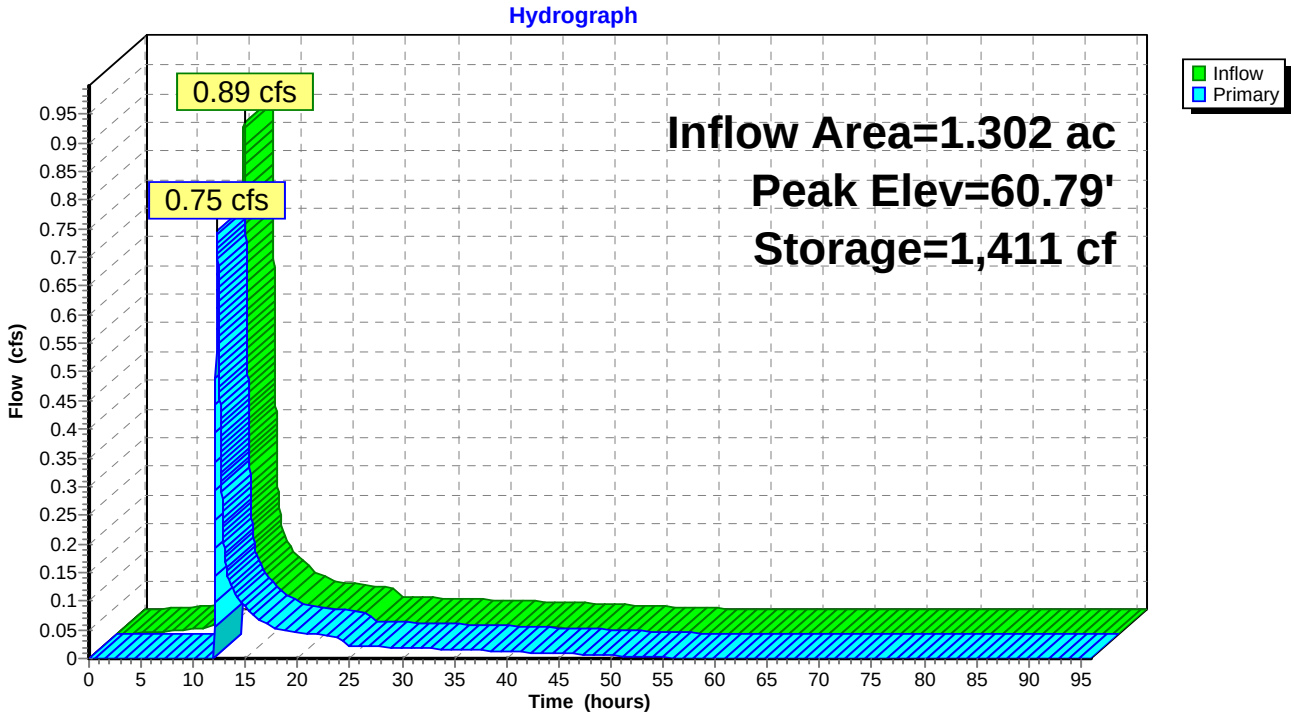
Volume	Invert	Avail.Storage	Storage Description
#1	60.33'	2,190 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.33	2,962	0	0
60.58	2,962	741	741
61.00	3,942	1,450	2,190

Device	Routing	Invert	Outlet Devices
#1	Primary	60.70'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.75 cfs @ 12.28 hrs HW=60.79' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.75 cfs @ 0.84 fps)

Pond 110: INFILTRATION AREA



Summary for Pond 111: EXISTING DMH

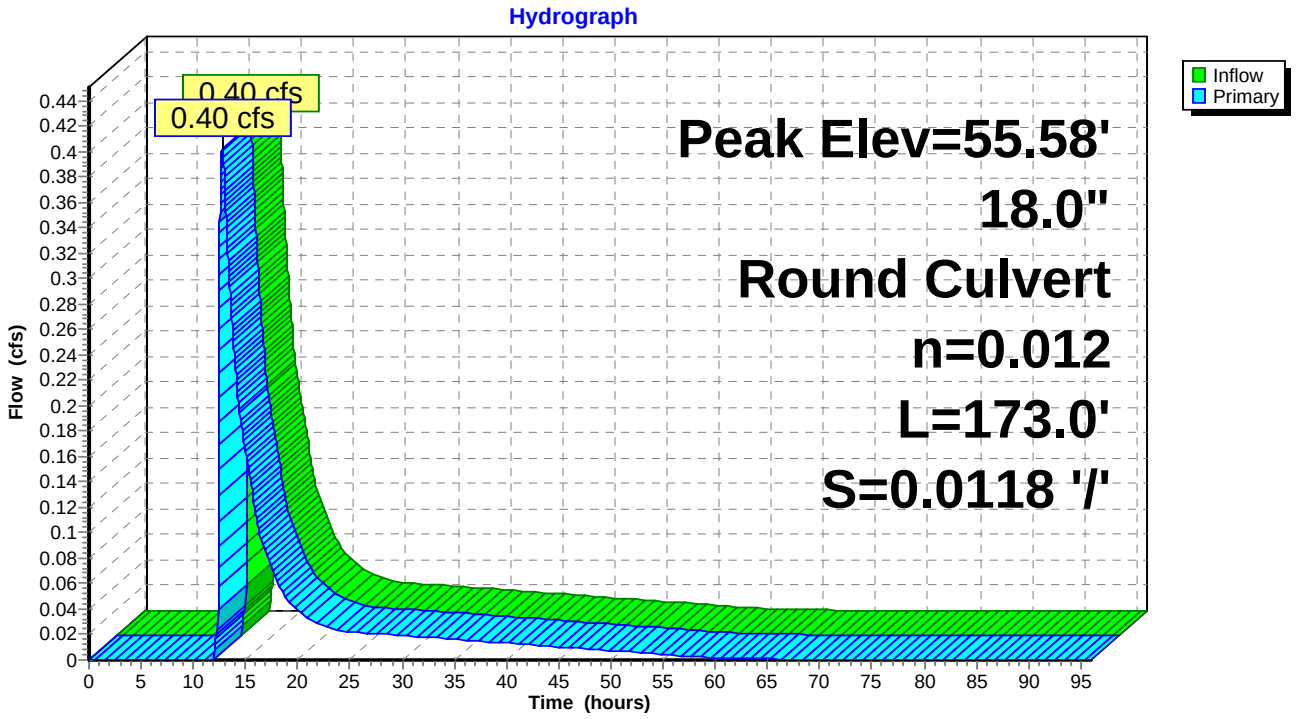
Inflow	=	0.40 cfs @	12.77 hrs, Volume=	0.139 af
Outflow	=	0.40 cfs @	12.77 hrs, Volume=	0.139 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.40 cfs @	12.77 hrs, Volume=	0.139 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 55.58' @ 12.77 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	55.30'	**18.0" Round Culvert** L= 173.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 55.30' / 53.26' S= 0.0118 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.40 cfs @ 12.77 hrs HW=55.58' (Free Discharge)
1=Culvert (Inlet Controls 0.40 cfs @ 1.79 fps)

Pond 111: EXISTING DMH

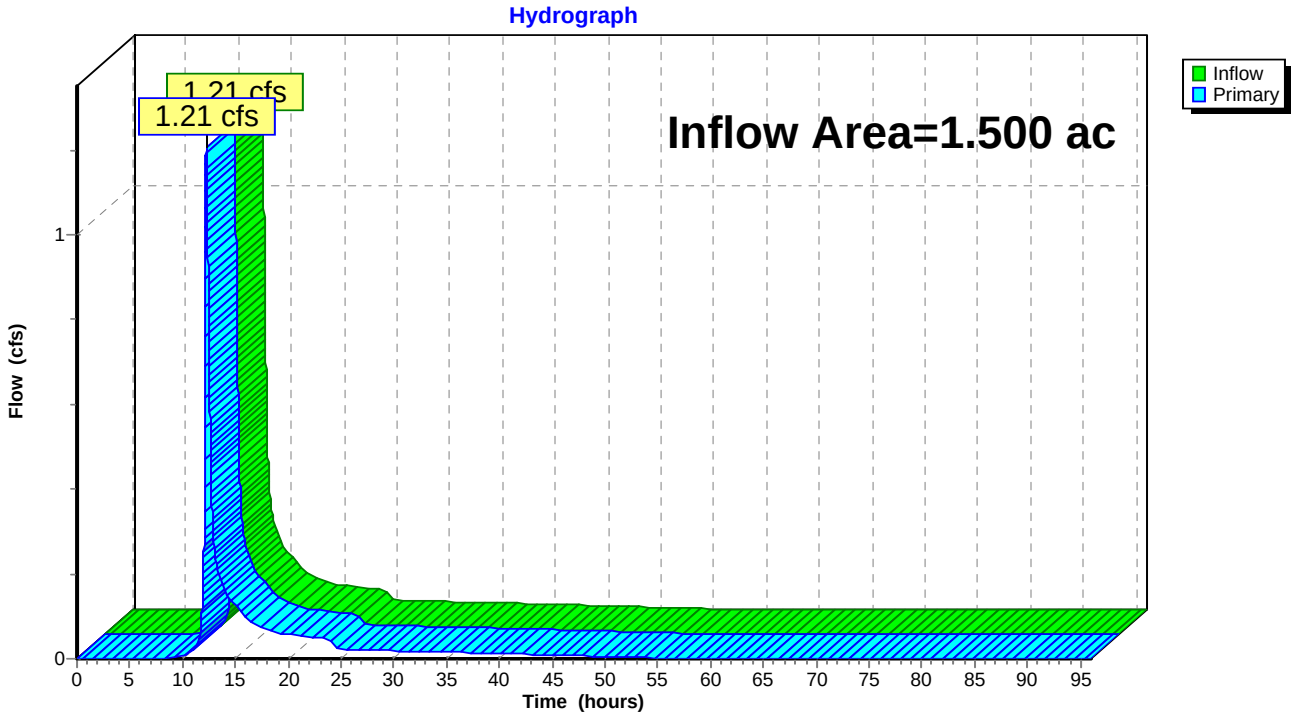


Summary for Link 112: DP-1-WETLAND LINE

Inflow Area = 1.500 ac, 48.46% Impervious, Inflow Depth = 1.37" for 25-Year event
Inflow = 1.21 cfs @ 12.24 hrs, Volume= 0.171 af
Primary = 1.21 cfs @ 12.24 hrs, Volume= 0.171 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 112: DP-1-WETLAND LINE

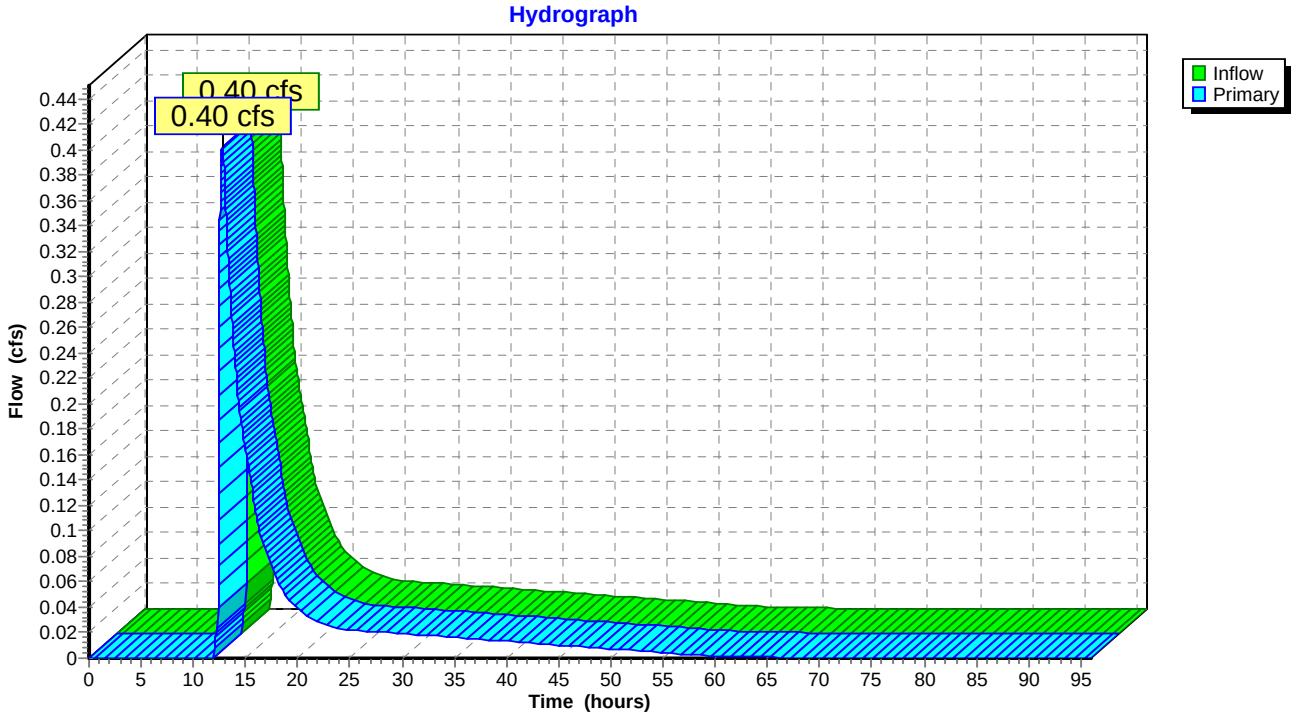


Summary for Link 113: DP-2-OFFSITE DRAINAGE NETWORK

Inflow = 0.40 cfs @ 12.77 hrs, Volume= 0.139 af
Primary = 0.40 cfs @ 12.77 hrs, Volume= 0.139 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 113: DP-2-OFFSITE DRAINAGE NETWORK

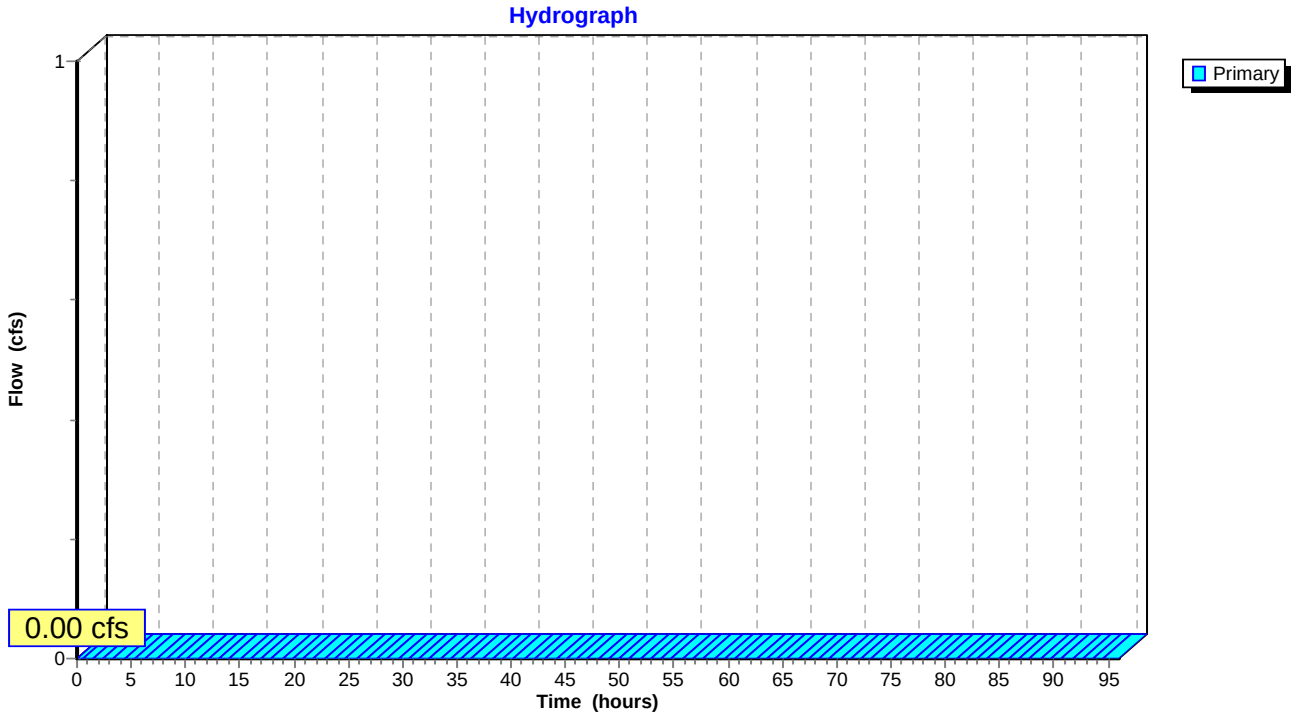


Summary for Link 202: DP-3 Street

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 202: DP-3 Street



Summary for Subcatchment 101: UNDETAINED AREA

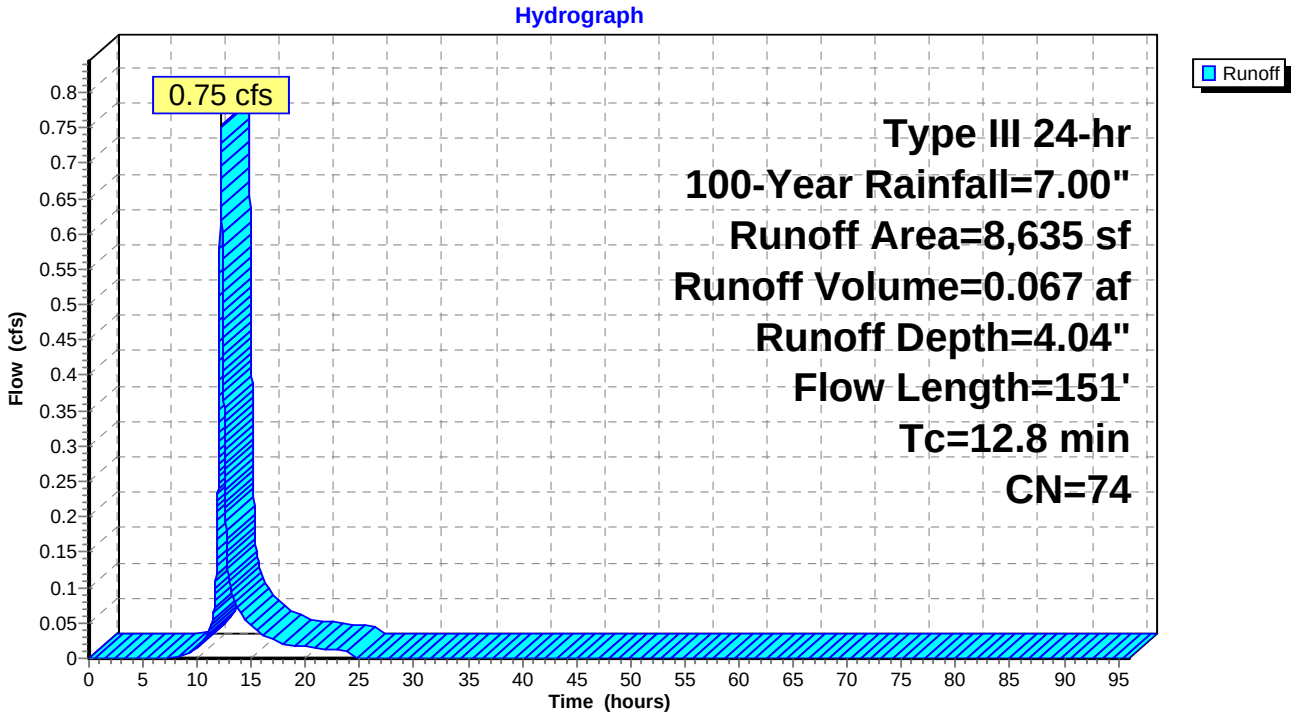
Runoff = 0.75 cfs @ 12.18 hrs, Volume= 0.067 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (sf)	CN	Description
8,635	74	>75% Grass cover, Good, HSG C
8,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0080	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
1.3	101	0.0070	1.25		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
12.8	151	Total			

Subcatchment 101: UNDETAINED AREA



Summary for Subcatchment 101A: INFILTRATION AREA WATERSHED

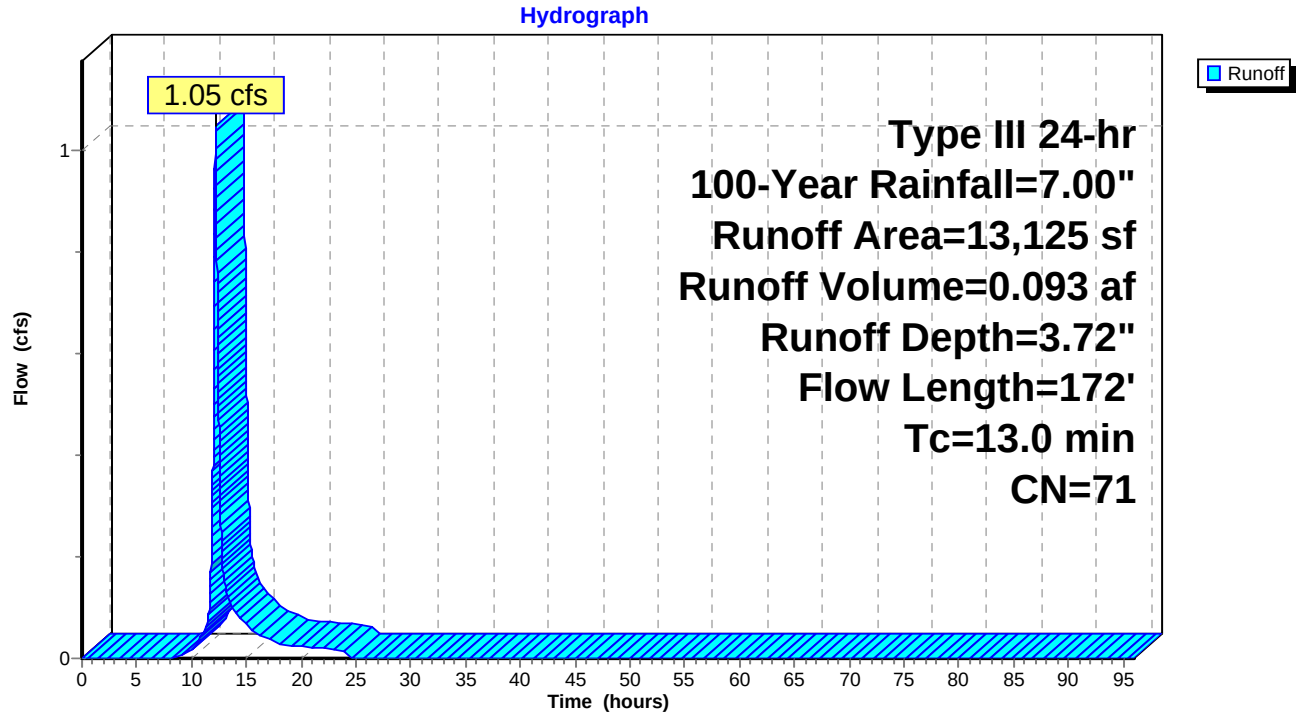
Runoff = 1.05 cfs @ 12.18 hrs, Volume= 0.093 af, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
	8,487	70	Woods, Good, HSG C
*	4,638	74	>75% Grass cover, Good, HSG C
	13,125	71	Weighted Average
	13,125		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.5	122	0.0275	0.83		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.0	172	Total			

Subcatchment 101A: INFILTRATION AREA WATERSHED



Summary for Subcatchment 101B: INFILTRATION AREA BOTTOM

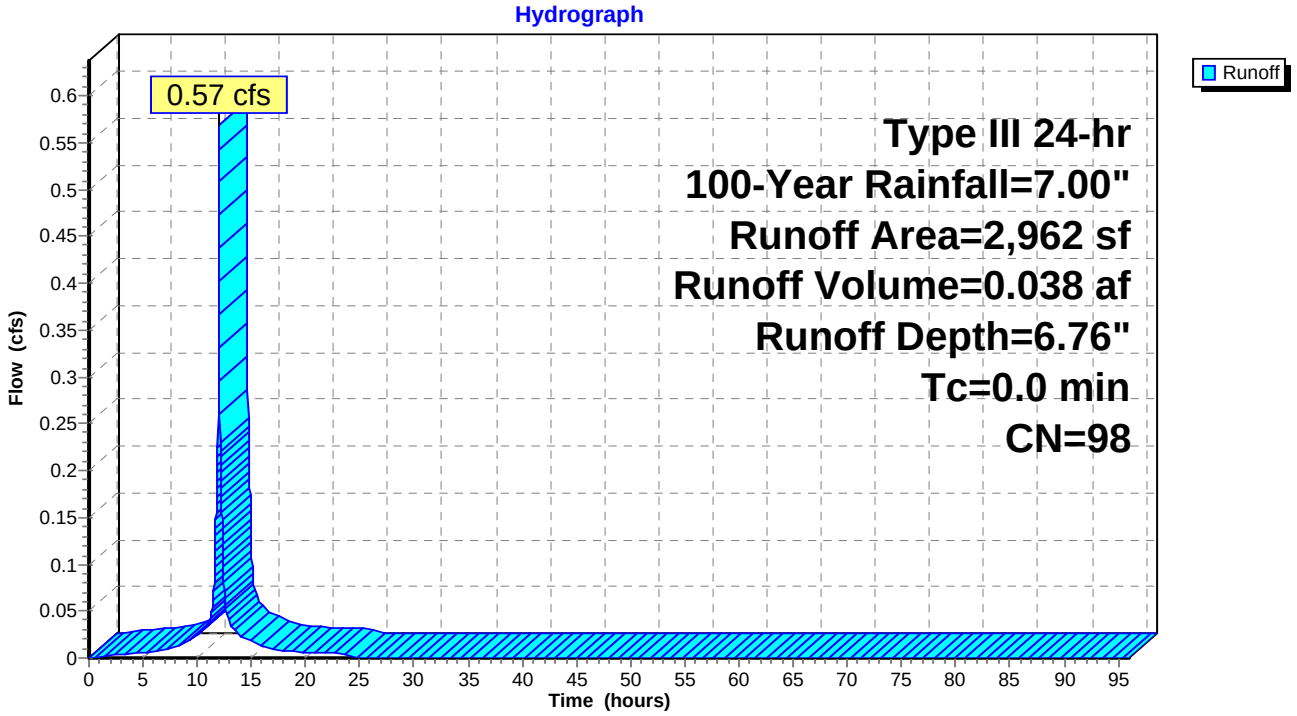
Runoff = 0.57 cfs @ 12.00 hrs, Volume= 0.038 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	2,962	98	Infiltration area bottom
	2,962		100.00% Impervious Area

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

Subcatchment 101B: INFILTRATION AREA BOTTOM



Summary for Subcatchment 102: DEVELOPMENT AREA

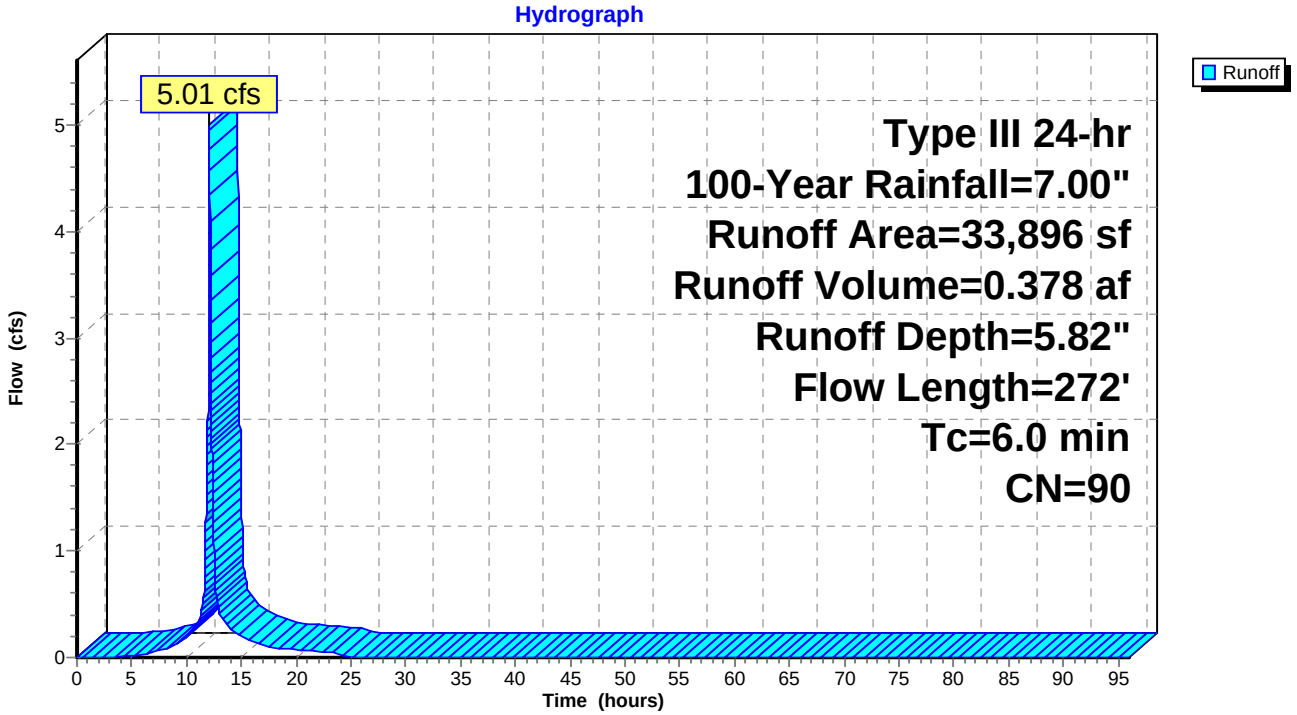
Runoff = 5.01 cfs @ 12.08 hrs, Volume= 0.378 af, Depth= 5.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	13,875	98	PAVEMENT
*	2,842	98	SIDEWALKS
	11,922	74	>75% Grass cover, Good, HSG C
*	5,257	98	DETENTION POND
	33,896	90	Weighted Average
	11,922		35.17% Pervious Area
	21,974		64.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.94		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.40"
1.2	172	0.0132	2.33		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.3	272	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 102: DEVELOPMENT AREA



Summary for Subcatchment 103: BUILDING 2 ROOF

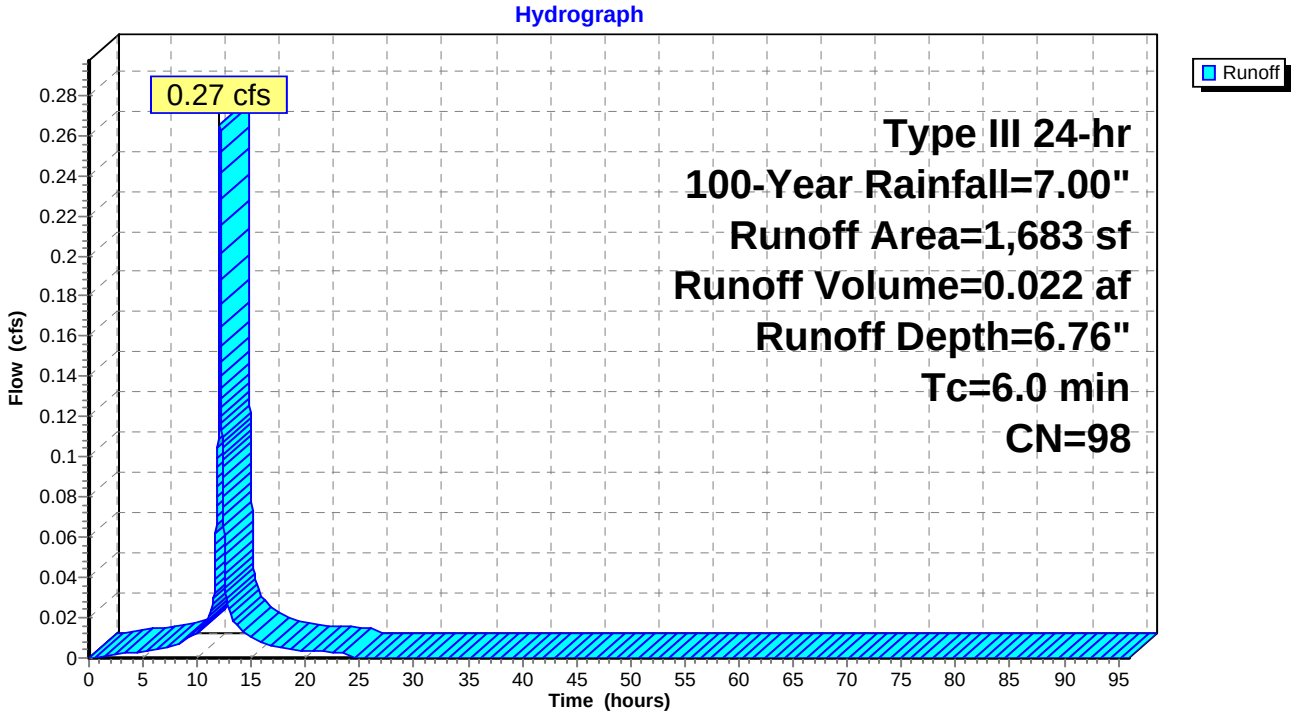
Runoff = 0.27 cfs @ 12.08 hrs, Volume= 0.022 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	1,683	98	BUILDING 2 ROOF
	1,683		100.00% Impervious Area

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

Subcatchment 103: BUILDING 2 ROOF



Summary for Subcatchment 104: BUILDING 3 + 4 ROOFS

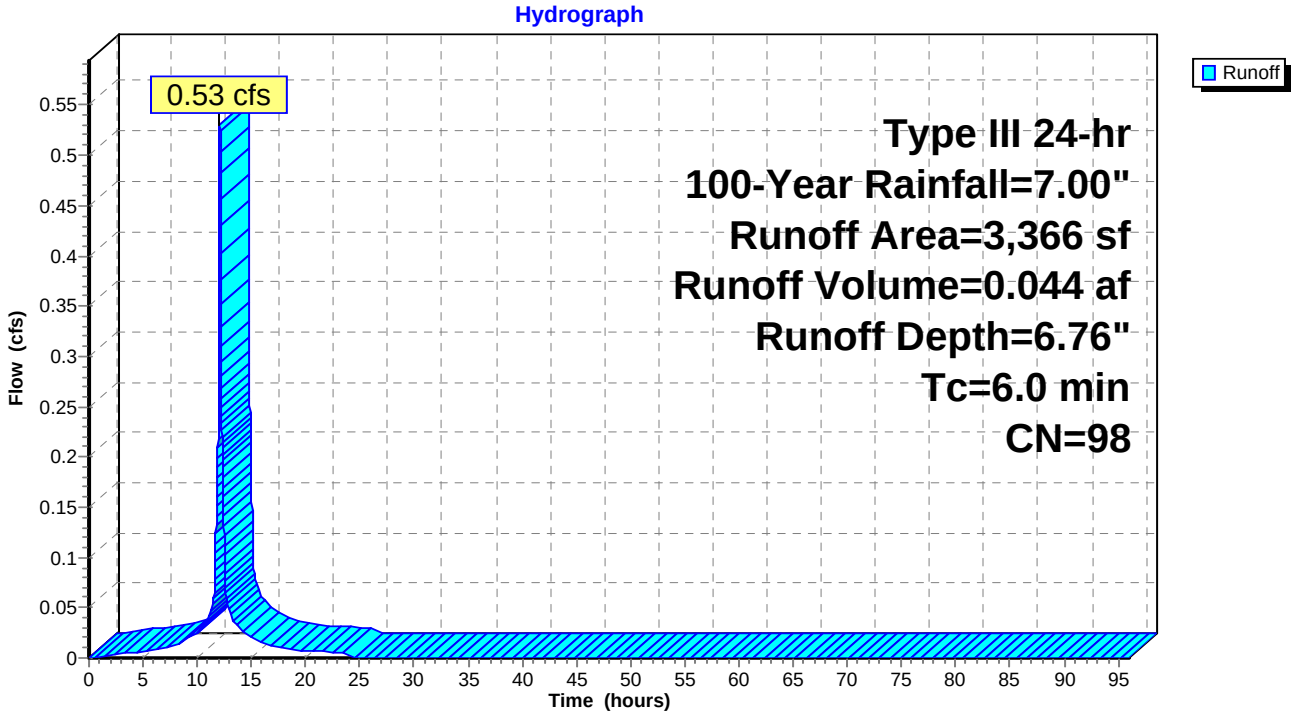
Runoff = 0.53 cfs @ 12.08 hrs, Volume= 0.044 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	3,366	98	ROOF 3 AND 4
	3,366		100.00% Impervious Area

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

Subcatchment 104: BUILDING 3 + 4 ROOFS



Summary for Subcatchment 105: BUILDING 1 ROOF

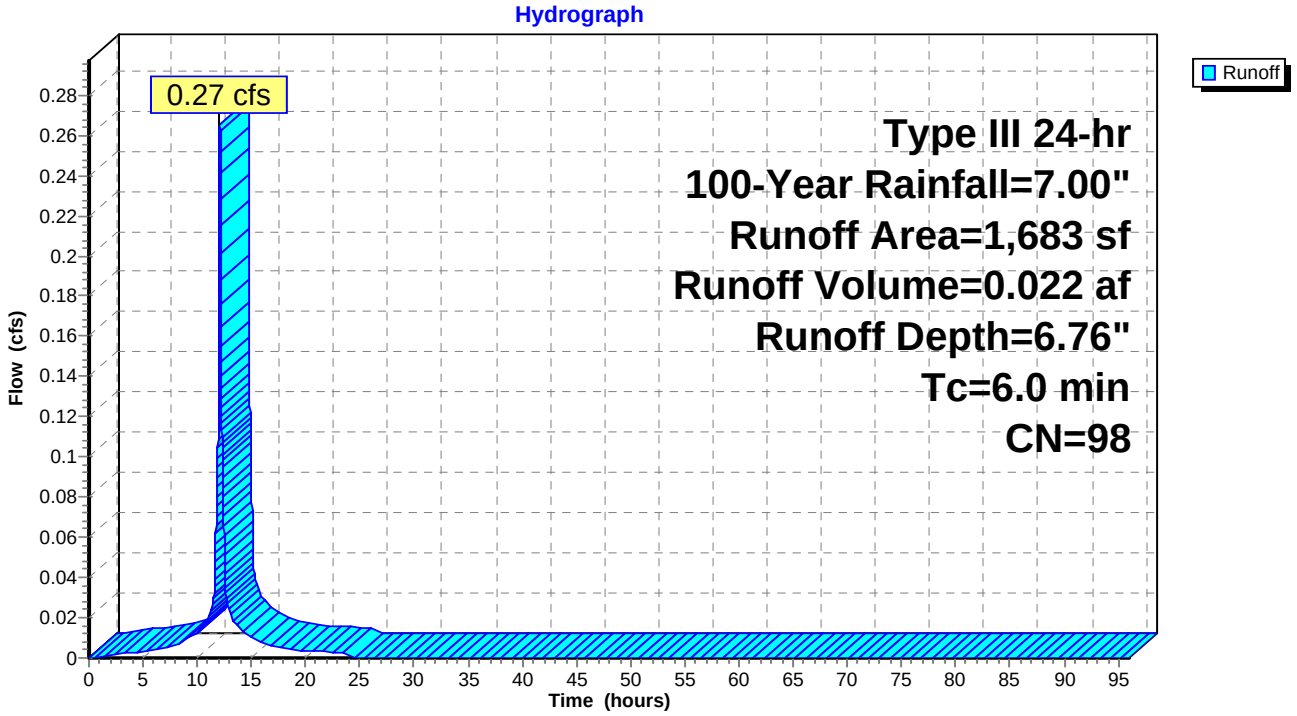
Runoff = 0.27 cfs @ 12.08 hrs, Volume= 0.022 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	1,683	98	ROOF 1
	1,683		100.00% Impervious Area

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

Subcatchment 105: BUILDING 1 ROOF



Summary for Pond 106: UIS-B (9 CULTEC 330 XLHD)

Inflow Area = 0.039 ac,100.00% Impervious, Inflow Depth = 6.76" for 100-Year event
Inflow = 0.27 cfs @ 12.08 hrs, Volume= 0.022 af
Outflow = 0.01 cfs @ 17.03 hrs, Volume= 0.002 af, Atten= 98%, Lag= 296.8 min
Primary = 0.01 cfs @ 17.03 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 66.62' @ 17.03 hrs Surf.Area= 0.009 ac Storage= 0.020 af

Plug-Flow detention time= 861.9 min calculated for 0.002 af (10% of inflow)
Center-of-Mass det. time= 461.9 min (1,204.9 - 743.0)

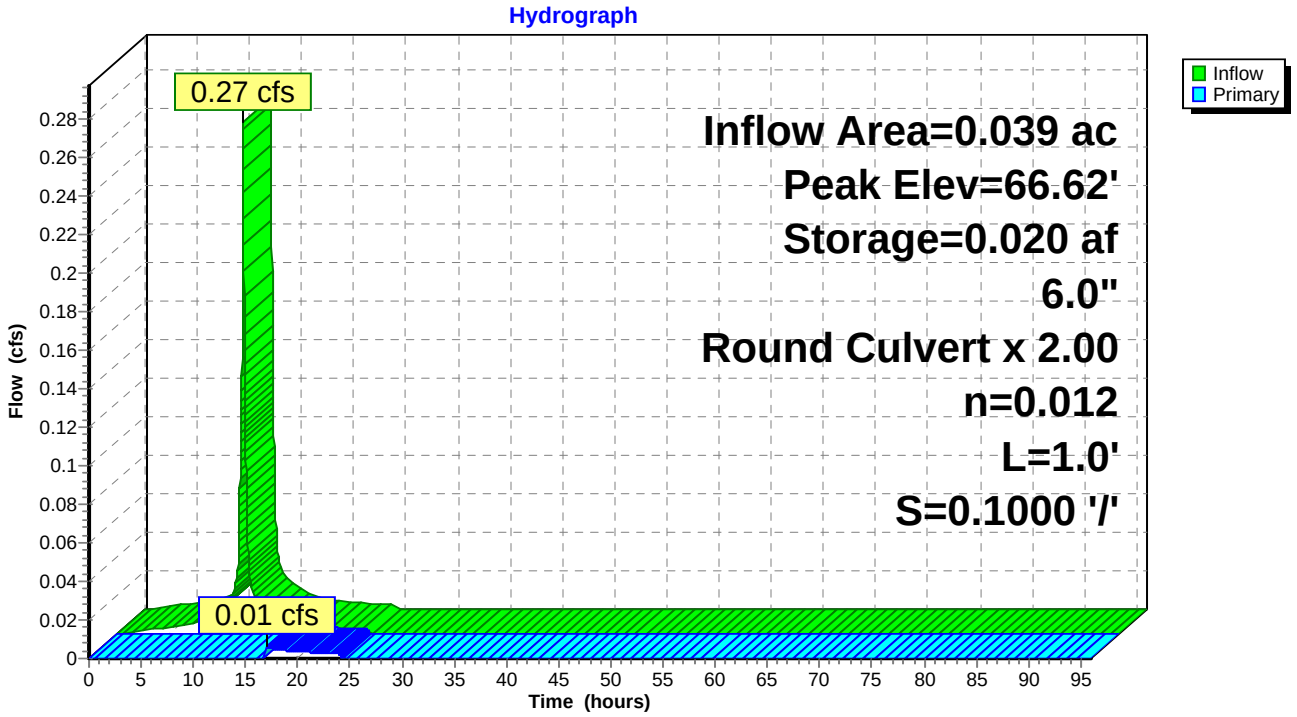
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.008 af	**16.00'W x 24.50'L x 3.54'H Field A** 0.032 af Overall - 0.012 af Embedded = 0.020 af x 40.0% Voids
#2A	62.50'	0.012 af	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE**
		0.020 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.60'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.60' / 66.50' S= 0.1000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 17.03 hrs HW=66.62' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Inlet Controls 0.00 cfs @ 0.52 fps)

Pond 106: UIS-B (9 CULTEC 330 XLHD)



Summary for Pond 107: UIS-C (18 CULTEC 330 XLHD)

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 6.76" for 100-Year event
Inflow = 0.53 cfs @ 12.08 hrs, Volume= 0.044 af
Outflow = 0.02 cfs @ 15.18 hrs, Volume= 0.006 af, Atten= 96%, Lag= 185.8 min
Primary = 0.02 cfs @ 15.18 hrs, Volume= 0.006 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 66.76' @ 15.18 hrs Surf.Area= 0.017 ac Storage= 0.037 af

Plug-Flow detention time= 702.0 min calculated for 0.006 af (15% of inflow)
Center-of-Mass det. time= 374.7 min (1,117.7 - 743.0)

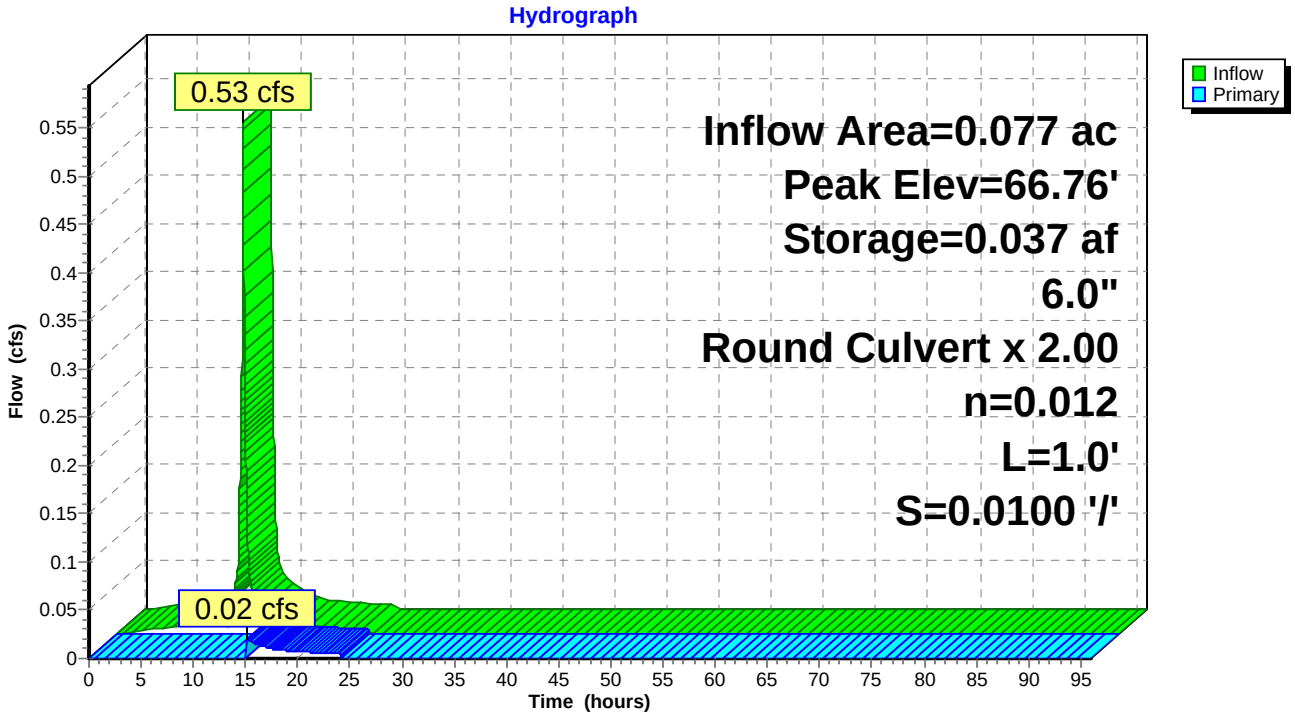
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.015 af	**16.00'W x 45.50'L x 3.54'H Field A** 0.059 af Overall - 0.022 af Embedded = 0.037 af x 40.0% Voids
#2A	62.50'	0.022 af	**Cultec R-330XLHD** x 18 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE OUTLET**
		0.037 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.70'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.70' / 66.69' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.02 cfs @ 15.18 hrs HW=66.76' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Barrel Controls 0.02 cfs @ 0.93 fps)

Pond 107: UIS-C (18 CULTEC 330 XLHD)



Summary for Pond 108: UIS-A (9 CULTEC 330XLHD)

Inflow Area = 0.039 ac,100.00% Impervious, Inflow Depth = 6.76" for 100-Year event
Inflow = 0.27 cfs @ 12.08 hrs, Volume= 0.022 af
Outflow = 0.01 cfs @ 17.02 hrs, Volume= 0.002 af, Atten= 98%, Lag= 296.2 min
Primary = 0.01 cfs @ 17.02 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 66.33' @ 17.02 hrs Surf.Area= 0.009 ac Storage= 0.020 af

Plug-Flow detention time= 860.8 min calculated for 0.002 af (10% of inflow)
Center-of-Mass det. time= 461.3 min (1,204.3 - 743.0)

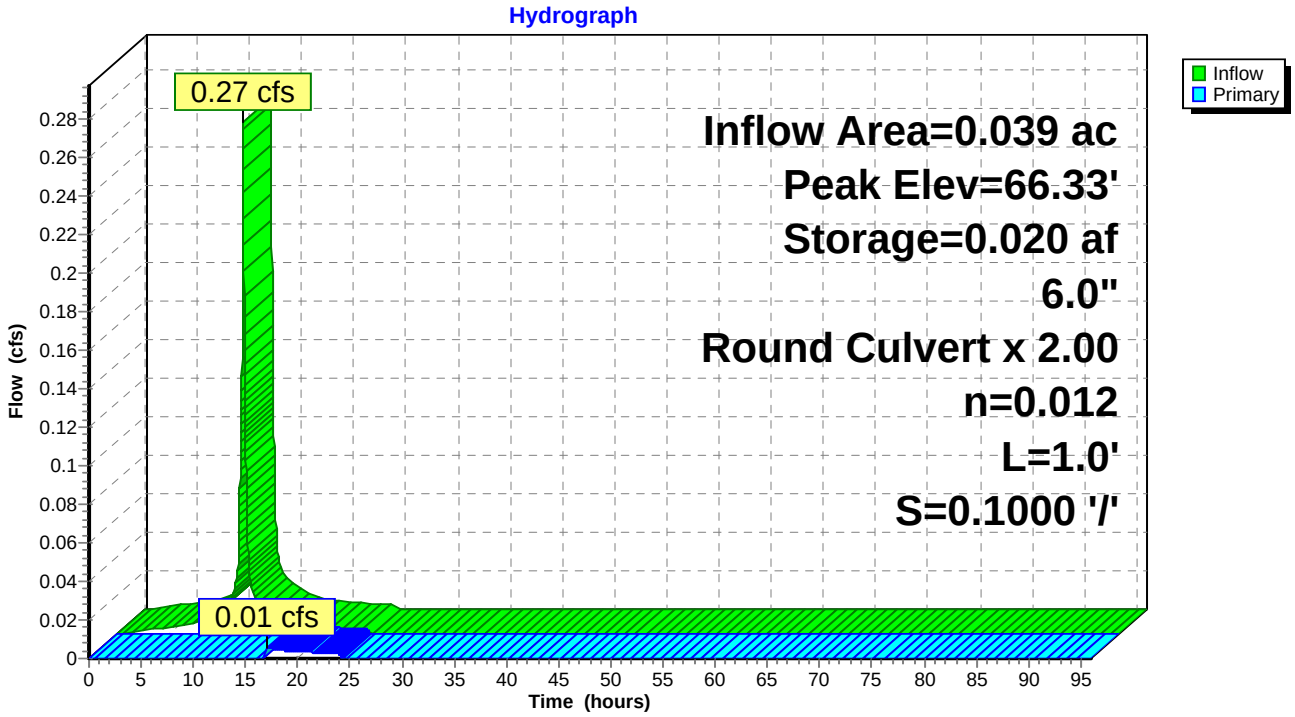
Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	0.008 af	**16.00'W x 24.50'L x 3.54'H Field A** 0.032 af Overall - 0.012 af Embedded = 0.020 af x 40.0% Voids
#2A	62.50'	0.012 af	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
#3	65.54'	0.000 af	**1.00'D x 1.50'H WYE**
		0.020 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	66.30'	**6.0" Round ROOF LEADER WYE OUTLET AT BLDG X 2.00** L= 1.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 66.30' / 66.20' S= 0.1000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 17.02 hrs HW=66.33' (Free Discharge)
1=ROOF LEADER WYE OUTLET AT BLDG (Inlet Controls 0.00 cfs @ 0.56 fps)

Pond 108: UIS-A (9 CULTEC 330XLHD)



Summary for Pond 109: CONSTRUCTED POCKET WETLAND

Inflow Area = 0.933 ac, 70.66% Impervious, Inflow Depth = 4.99" for 100-Year event
Inflow = 5.01 cfs @ 12.08 hrs, Volume= 0.388 af
Outflow = 1.50 cfs @ 12.40 hrs, Volume= 0.292 af, Atten= 70%, Lag= 19.2 min
Primary = 0.03 cfs @ 12.40 hrs, Volume= 0.056 af
Secondary = 1.47 cfs @ 12.40 hrs, Volume= 0.237 af
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 62.72' @ 12.40 hrs Surf.Area= 4,676 sf Storage= 8,834 cf

Plug-Flow detention time= 522.0 min calculated for 0.292 af (75% of inflow)
Center-of-Mass det. time= 431.5 min (1,221.5 - 790.0)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	15,527 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	1,260	0	0
61.00	3,063	2,162	2,162
62.00	4,020	3,542	5,703
63.00	4,931	4,476	10,179
64.00	5,766	5,349	15,527

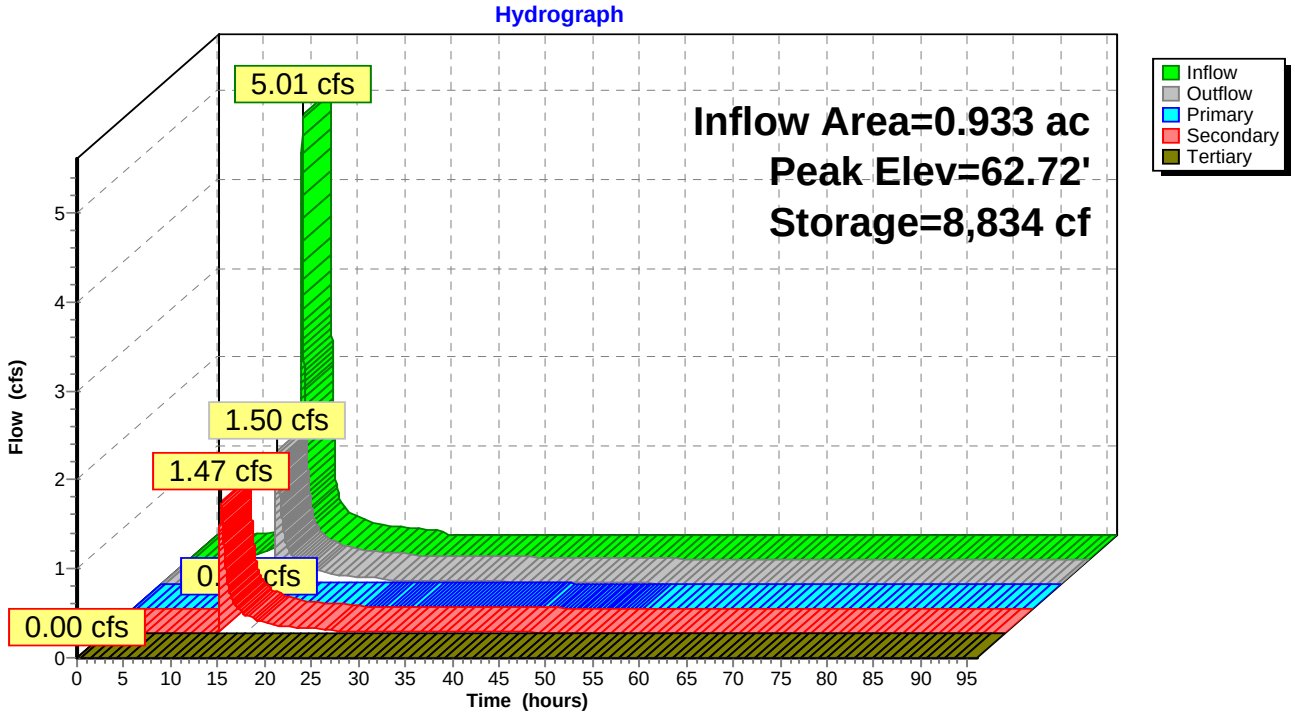
Device	Routing	Invert	Outlet Devices
#1	Primary	61.43'	**4.0" Round Culvert** L= 40.5' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 61.43' / 61.20' S= 0.0057 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Device 1	61.60'	**1.0" Vert. Orifice/Grate** C= 0.600
#3	Tertiary	63.60'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	59.35'	**12.0" Round Culvert** L= 70.6' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 59.35' / 58.35' S= 0.0142 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#5	Device 4	61.60'	**1.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 4	62.35'	**24.0" W x 9.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.03 cfs @ 12.40 hrs HW=62.72' (Free Discharge)
└─**1=Culvert** (Passes 0.03 cfs of 0.31 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.03 cfs @ 5.00 fps)

Secondary OutFlow Max=1.47 cfs @ 12.40 hrs HW=62.72' (Free Discharge)
└─**4=Culvert** (Passes 1.47 cfs of 6.29 cfs potential flow)
└─**5=Orifice/Grate** (Orifice Controls 0.03 cfs @ 5.10 fps)
└─**6=Orifice/Grate** (Orifice Controls 1.44 cfs @ 1.95 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 109: CONSTRUCTED POCKET WETLAND



Summary for Pond 110: INFILTRATION AREA

Inflow Area = 1.302 ac, 55.84% Impervious, Inflow Depth = 1.73" for 100-Year event
Inflow = 1.27 cfs @ 12.18 hrs, Volume= 0.188 af
Outflow = 1.18 cfs @ 12.23 hrs, Volume= 0.162 af, Atten= 7%, Lag= 3.3 min
Primary = 1.18 cfs @ 12.23 hrs, Volume= 0.162 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 60.82' @ 12.23 hrs Surf.Area= 3,524 sf Storage= 1,522 cf

Plug-Flow detention time= 280.1 min calculated for 0.162 af (86% of inflow)
Center-of-Mass det. time= 85.6 min (1,158.0 - 1,072.4)

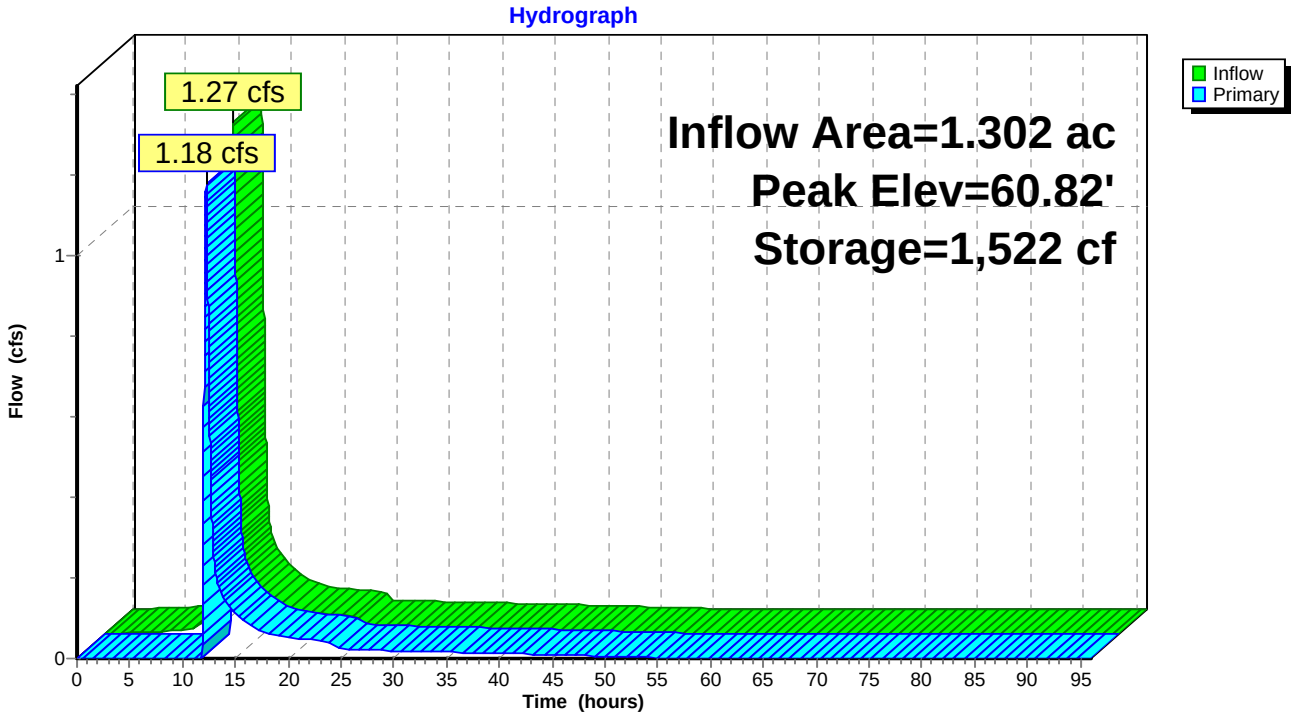
Volume	Invert	Avail.Storage	Storage Description
#1	60.33'	2,190 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.33	2,962	0	0
60.58	2,962	741	741
61.00	3,942	1,450	2,190

Device	Routing	Invert	Outlet Devices
#1	Primary	60.70'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=1.18 cfs @ 12.23 hrs HW=60.82' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 1.18 cfs @ 0.97 fps)

Pond 110: INFILTRATION AREA



Summary for Pond 111: EXISTING DMH

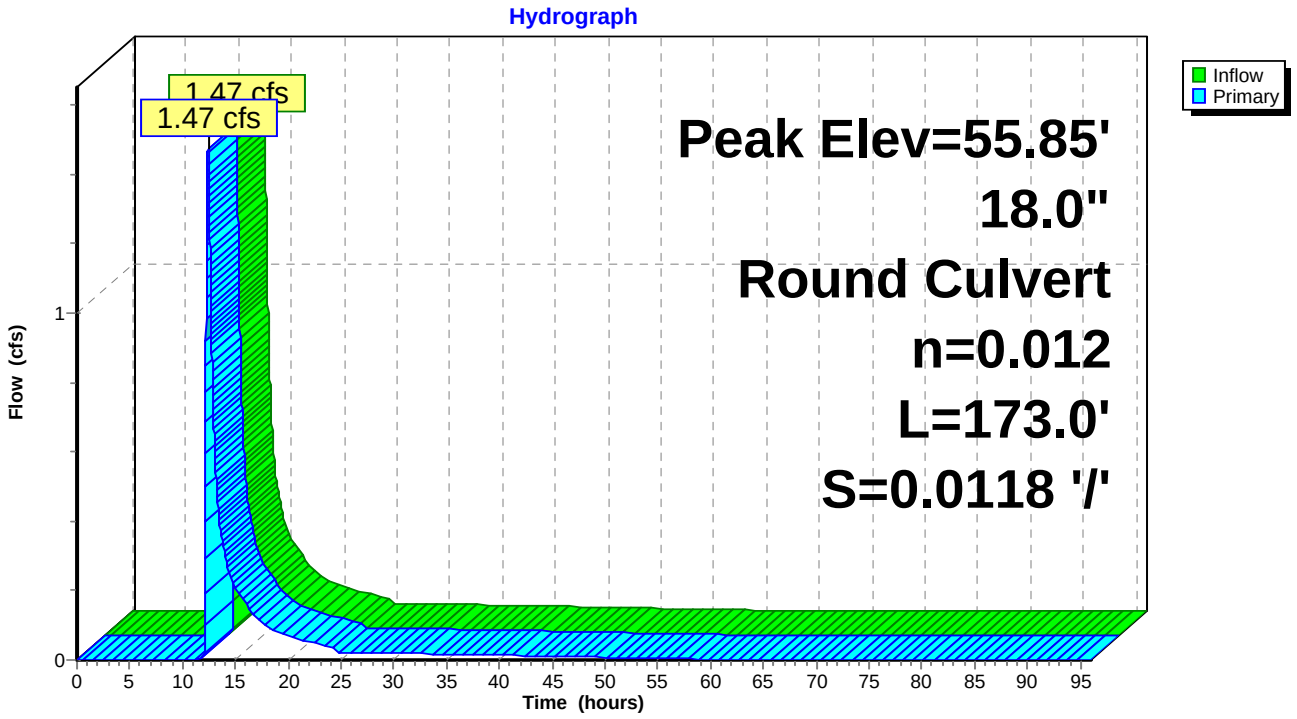
Inflow	=	1.47 cfs @	12.40 hrs, Volume=	0.237 af
Outflow	=	1.47 cfs @	12.40 hrs, Volume=	0.237 af, Atten= 0%, Lag= 0.0 min
Primary	=	1.47 cfs @	12.40 hrs, Volume=	0.237 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 55.85' @ 12.40 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	55.30'	**18.0" Round Culvert** L= 173.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 55.30' / 53.26' S= 0.0118 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=1.47 cfs @ 12.40 hrs HW=55.85' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.47 cfs @ 2.52 fps)

Pond 111: EXISTING DMH

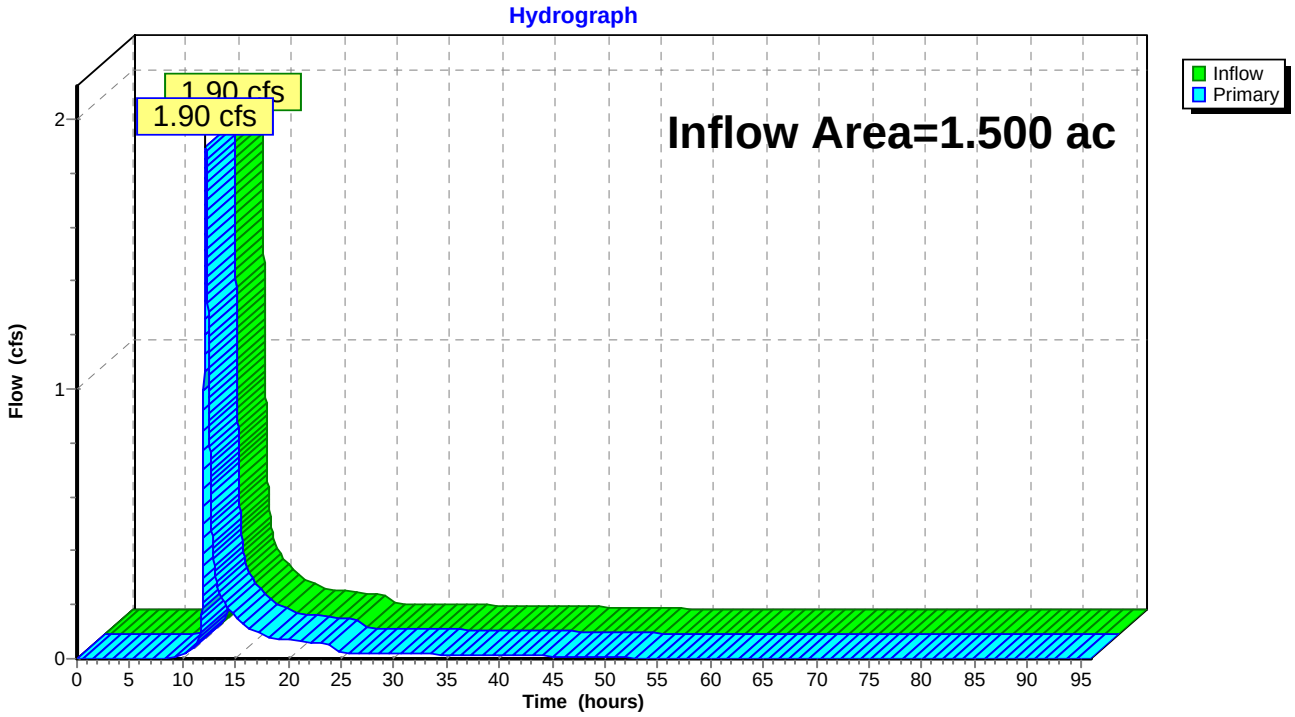


Summary for Link 112: DP-1-WETLAND LINE

Inflow Area = 1.500 ac, 48.46% Impervious, Inflow Depth = 1.83" for 100-Year event
Inflow = 1.90 cfs @ 12.20 hrs, Volume= 0.229 af
Primary = 1.90 cfs @ 12.20 hrs, Volume= 0.229 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 112: DP-1-WETLAND LINE

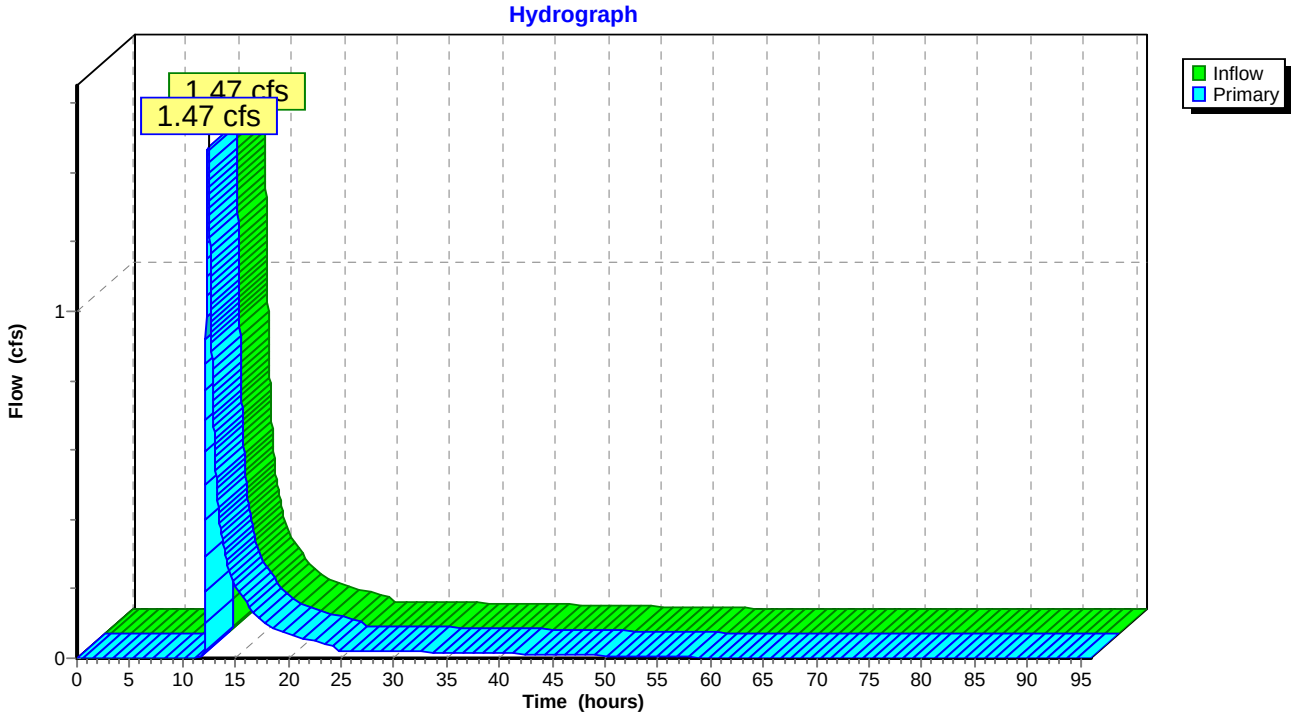


Summary for Link 113: DP-2-OFFSITE DRAINAGE NETWORK

Inflow = 1.47 cfs @ 12.40 hrs, Volume= 0.237 af
Primary = 1.47 cfs @ 12.40 hrs, Volume= 0.237 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 113: DP-2-OFFSITE DRAINAGE NETWORK

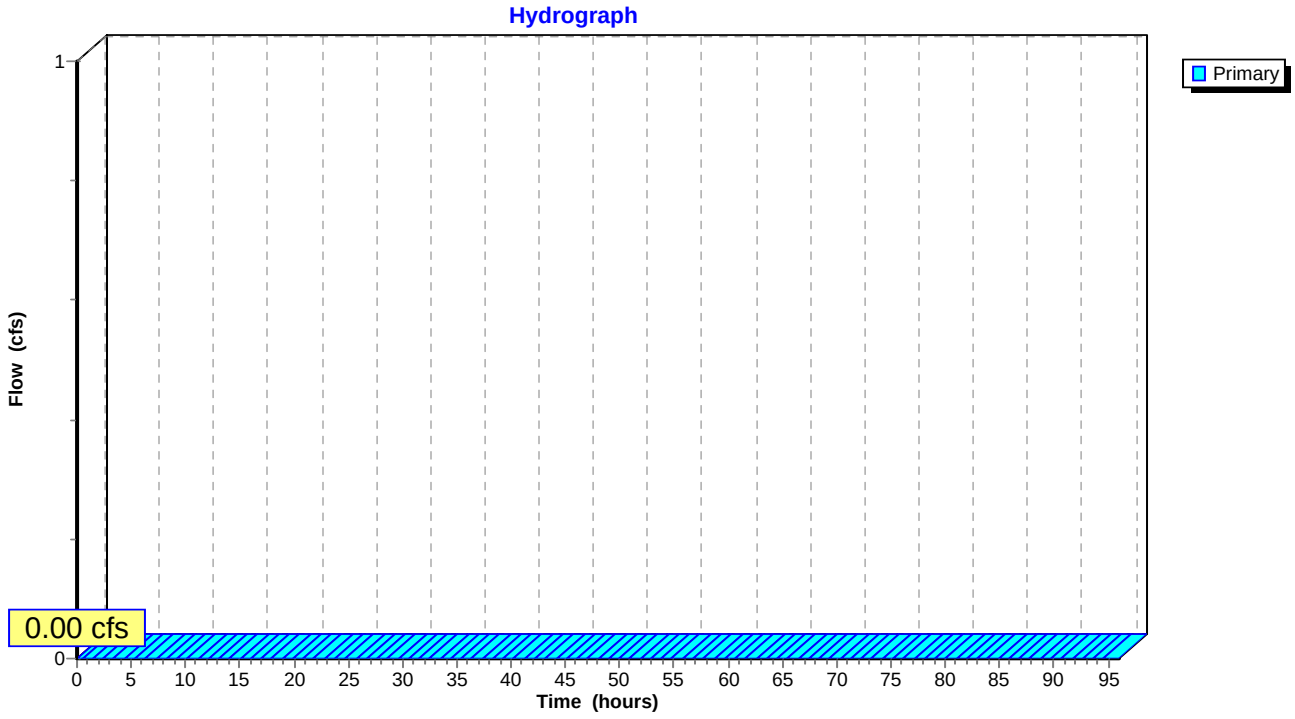


Summary for Link 202: DP-3 Street

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 202: DP-3 Street



Appendix B – Erosion and Sediment Control Program

Erosion and Sediment Controls

Soil erosion is the process by which the surface of the land is worn away by the action of wind, water, ice, and gravity. Natural or geologic erosion is a factor in creating the topographic features of the earth as we know it today. Except for some cases of shoreline and stream channel erosion, natural erosion occurs at a very slow and uniform rate. Accelerated erosion occurs when the surface of the land is disturbed and vegetation is removed by either natural forces or man's activities. Exposed, unprotected soil is then subject to rapid erosion by the action of wind or water. The erosive action of water can be separated into two categories: raindrop erosion which is the result of the vertical force of falling water; and sheet, rill, and gully erosion which are the result of the horizontal force of flowing water. Both forces detach and move soil particles.

During construction, the contractor is directed to comply with the precautionary measures provided in the contract documents, and to conduct his construction activities in such a manner as to prevent damage or impairment to the environment. It shall be the contractor's responsibility not to undertake at any time, in any particular area, more than that magnitude of work which can be safely and adequately controlled by the forces at his disposal. Failure on the part of the contractor to cooperate with the responsible person to regulate the works set forth in the contract documents to successful completion, shall constitute grounds for suspension of construction activities of the contract. An emphasis shall be made to control erosion before it occurs. Upon completion of the project, no soil shall be left exposed (bare) in any of the construction areas of the site.

Erosion and Sediment Control Plan

To address the above issues, an Erosion and Sedimentation Control Plan has been developed which describes the potential for erosion and sedimentation problems on the project and explains and illustrates the measures which are to be taken to control those issues. The plan is implemented by the project contractor(s) based on requirements shown on the construction drawings and technical specification, as well as requirements detailed in permits which become part of the contract between the owner and contractor.

Erosion and Sediment Control Techniques

Erosion and sedimentation controls shall be employed to minimize erosion and transport of sediment into on-site and adjacent resource areas during the earthwork and construction phases of the project. The major erosion control techniques proposed include hay bale barriers, silt fence barriers, inlet sediment traps, a stabilized construction entrance, and erosion control matting. A detailed description of each technique is discussed below.

Temporary Erosion Control Measures

During construction activities, the following measures shall be employed to minimize the potential impacts to wetland and water resources within the project area from siltation and sedimentation. The erosion control measures are shown on the site plans.

Preservation of Natural Vegetation

Natural vegetation shall be preserved on site where possible. This measure will prevent erosion by providing continuous anchoring of the soil.

Drainage Swale Hay Bale Check Dams
Hay bales shall also be placed across construction ditches during construction to limit the transport of sediment into drainage systems and waterways.

Silt Fences
Silt fences shall be placed at the limits of work where the slope is less than two percent. Typically, they shall be installed adjacent to resource areas, where soil will be exposed due to construction related activities, as depicted on the plans. The fence shall be placed in a sturdy, upright position and supported/anchored to withstand the forces of the elements and the circumstances of construction activities. The fence shall be installed in a manner that shall prevent runoff from passing over, under or around the fence (i.e. all of the runoff will pass through the fence). They shall be attached to posts (either steel or wood) in sufficient number to support the fence. The posts shall typically be placed 4 to 8 feet apart. It shall be the construction contractor's responsibility to maintain the fence in a functional condition throughout the duration of construction activities. The contractor shall also remove any large accumulations of sediment in a timely manner and dispose the material appropriately.

Hay Bales
Hay bales shall be placed, in conjunction with silt fences, at the limit of work on steep slopes only. Steep slopes for this project are those which are greater than two percent. The hay bales shall be staked with metal or wood stakes to anchor them to the ground. The contractor shall be responsible for maintaining the hay bales in good condition and replacing them as necessary. Bales that deteriorate and are no longer intact or that become plugged with sediment shall be removed and disposed. They shall be replaced with new hay bales installed as described above.

Erosion and Sediment Control - Maintenance
The general contractor shall have primary responsibility for implementing temporary and permanent controls described in the plan and shall be responsible for assuring contractor compliance with contract documents including all erosion and sediment control measures.

1. The on-site contractor shall inspect sediment and erosion control structures weekly and after each rainfall event greater than ½ inch. Records of the inspections shall be prepared and maintained on site by the contractor (Attachment B-1).

2. Silt shall be removed from behind barriers if greater than 6 inches deep or as needed to ensure the stability of the control device.

3. Damaged or deteriorated items shall be repaired or replaced immediately after identification.

4. The underside of hay bales shall be kept in close contact with the earth and reset as necessary.

Once construction in a particular area has been completed and the areas have been stabilized, these temporary devices shall be removed.

Appendix C – Inspection and Maintenance Report Form

STORMWATER POLLUTION PREVENTION PLAN
WEEKLY INSPECTION AND MAINTENANCE REPORT FORM

Inspector:_____ **Title**_____ **Date:**_____

Specific Site Location:_____

STABILIZATION MEASURES

AREA	INSTALLED? (Yes/No)	CONDITION OF STABILIZATION MEASURE
Silt Fences		
Sediment Filter Mitt Berm		
Stabilization for Stockpiles		
Seeding and Planting		
Geotextile Fabrics		

STABILIZATION REQUIRED:

_____

_____

_____

_____

TO BE PERFORMED BY: _____ **ON OR**

BEFORE:_____

Make note of the date and location of the following:

•The start of grading activities

•Temporary or permanent cease of grading activities

•Implementation of temporary stabilization

•Implementation of final stabilization

_____

_____

_____

STORMWATER POLLUTION PREVENTION PLAN
WEEKLY INSPECTION AND MAINTENANCE REPORT FORM
Continued

Weather information for the period since the last inspection (or since commencement of construction activity if the first inspection) including a best estimate of the beginning of each storm event, duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred;

_____

_____

_____

Weather information and a description of any discharges occurring at the time of the inspection;

_____

_____

_____

Form A-III

STORMWATER POLLUTION PREVENTION PLAN (SWPPP)
INSPECTION CHECKLIST - TO BE COMPLETED BY CONTRACTOR

Inspected By:_____, **Title** _____ **Date:**_____

YES	NO	DOES NOT APPLY	ITEM
			Are the BMPs called for on the SWPPP installed in the proper location and according to the specification of the SWPPP?
			Are all operational stormwater inlets protected from sediment flow?
			Do any erosion/siltation control measure require repair or clean-out to maintain adequate function? If yes, indicate which ones.
			Are on-site construction traffic routes, parking, and storage of equipment and supplies restricted to areas specifically designated for those uses?
			Are the locations of temporary soil stockpiles or construction materials in approved areas?
			Do any seeded or landscaped areas require maintenance irrigation, fertilization, seeding or mulching?
			Is there any evidence that sediment is leaving the site?
			Is there any evidence of erosion on cut or fill slopes?
			Is there any evidence of sediment, debris, or mud on public roads at intersections with site access roads?
			Notes:
Action to be Taken:			

Note: See Page 13, Part 4 (Inspections) of the General Permit (Attachment "L") for additional inspection report requirements.

Appendix D – Permanent Stormwater System and Operation and Maintenance Program

PERMANENT STORMWATER SYSTEM
OPERATION AND MAINTENANCE PROGRAM
FOR
HUTTLESTON AVENUE APARTMENTS
HUTTLESTON AVENUE, FAIRHAVEN, MA

PREPARED FOR:
DANA LEWIS
18 TANNER LANE
FAIRHAVEN, MA

PREPARED BY:

PRIME ENGINEERING, INC.
P.O. BOX 1088
LAKEVILLE, MA

SEPTEMBER 26, 2019
REVISED JANUARY 28, 2021

LONG TERM POLLUTION PREVENTION PLAN

(PERMANENT STORMWATER SYSTEM OPERATION AND MAINTENANCE PROGRAM)

1.0 INTRODUCTION

The plans for the installation of a twelve-unit residential facility on Huttleston Avenue in Fairhaven have been designed to protect stormwater quality. In order for this to continue in the long term, it is necessary to implement the following long-term Operation and Maintenance Program.

2.0 RESPONSIBLE PARTY

Responsible Party: Dana Lewis
18 Tanner Lane
Fairhaven, MA 02719

Attention: Dana Lewis - (508) 326-5783

_____
Dana Lewis
I agree to implement the provisions of this plan

3.0 SOURCE CONTROL MEASURES

The most effective means of providing clean runoff is to prevent pollutants from coming into contact with the stormwater in the first place. This involves the following:

- Keeping fertilizers, stockpiles, etc. covered at all times. All such products shall be stored off-site.
- All landscaping, fertilization, and other grounds maintenance, if necessary, shall be performed by personnel who are trained at how to maintain the grounds.
- Periodic removal of windblown debris and litter from the site.

4.0 MAINTENANCE OF STORM SYSTEM

This section presents the periodic maintenance that must be completed:

- Catch basin – inspect and clean grate and sump 4 times per year as required by MSH
- Wetland sediment forebay must be cleaned once a year.
- Constructed Pocket Wetland should be inspected twice a year during both the growing and non-growing seasons for the first three years of construction, record observation per MSH Vol. 2, Ch. 2 Pg. 46. Cleaning out sediment in basin/wetland system once every 10 year. If vegetation is stressed or missing, it must be re-planted.
- Inspect roof drain inlet (roof gutter system) at least twice a year, remove any debris that might clog the system.

- Infiltration basin should be inspected twice per year per MSH Vol.2, Ch.2, Pg. 92, At least twice a year, mow the buffer area, side slopes, and basin bottom. Remove grass clippings and accumulated organic matter to prevent an impervious organic mat from forming.
- The infiltration units shall be inspected annually. The inspections shall be performed during or immediately following a measured rainfall event of ½ inch depth or greater so that the depth of water in the infiltrator can be compared with the depth of rainfall.
- The parking areas and drives shall be swept twice a year.
- An annual report, signed by a MA licensed professional engineer, shall be provided to the Fairhaven Conservation Commission (refer to attached Inspection Log).

5.0 SPILL PREVENTION AND RESPONSE PLAN

The project consists of five houses that will not emit any significant pollutants. The only potential source of pollution is the grass cutting equipment and automobiles.

The responsible party shall train maintenance personnel in the proper handling and cleanup of spilled hazardous substances or oil. No spilled hazardous substances or oil shall be allowed to come in contact with stormwater discharges. If such contact occurs, the stormwater discharge shall be contained on site until appropriate measures, in compliance with state and federal regulations, are taken to dispose such contaminated stormwater. The responsible party shall train all personnel in spill prevention and cleanup procedures.

In order to prevent or minimize the potential for a spill of hazardous substances or oil to come into contact with stormwater, the following steps shall be implemented:

- A spill control and containment kit (containing, for example, absorbent materials, rags, gloves, plastic and metal trash containers, etc.) shall be readily available.
- Manufacturer's recommended methods for spill cleanup shall be known and maintenance personnel shall be trained regarding these procedures and the location of the information and cleanup supplies.
- The responsible party shall ensure that all hazardous waste discovered or generated at the site is disposed properly by a licensed hazardous material disposal company. The responsible party shall not exceed hazardous waste storage requirements mandated by the EPA or state and local authority.

In the event of a spill of hazardous substances or oil, the following procedures must be followed:

- All measures must be taken to contain and abate the spill and to prevent the discharge of the hazardous substance or oil to stormwater or off-site.
- For spills of less than a quarter gallon of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.
- For spills greater than a quarter gallon of material, immediately contact Richard J. Rheaume, LSP, Prime Engineering, Inc., P.O. Box 1088, Lakeville, MA 02347 at (508) 947-0050. Provide information on the type of material spilled, the location

of the spill, the quantity spilled, and the time of the spill and proceed with prevention, containment and/or clean-up.

- Spills of amounts that exceed reportable quantities of certain substances specifically mentioned in federal regulations 40 CFR 110, 40 CFR 117, and 40 CFR 302 must be immediately reported to the EPA National Response Center at (800) 242-8802.
- The department head shall be the spill prevention and response coordinator. He/she shall designate the individuals who shall receive spill prevention and response training. These individuals shall each become responsible for a particular phase of prevention and response. The names of these personnel should be posted in the material storage area and in the property office.

Any spill that occurs shall be documented on a Blank Spill Report that is enclosed as Attachment E.

6.0 SNOW AND ICE REMOVAL

Snow and ice shall be removed by mechanical equipment. Sand and salt shall only be applied when the safety of the public is at stake.

MAINTENANCE BUDGET
Street Sweeping $1,000
Catch Basin Cleaning $ 800
Forebay Cleaning $ 800
Inspections and Reports $1,200
Total $3,800

LEWIS LANDING STORMWATER SYSTEM
INSPECTION LOG

Inspector: _____

Date of Inspection: _____

General condition of overall site:

Condition of paved surfaces:

Condition of catch basins:

Condition of forebay:

Condition of detention basin side slopes:

Condition of wetland vegetation:

Condition of micro pools:

Condition of roof leaders and underground chamber systems:

Additional comments:

Appendix E – Spill Report Template

SPILL REPORT

SITE ADDRESS: _____

NAME OF PERSON COMPLETING THIS FORM: _____

DATE: _____

TYPE OF MATERIAL: _____ QUANTITY: _____

DESCRIPTION OF RELEASE: _____

_____

_____

CIRCUMSTANCES LEADING TO RELEASE: _____

_____

_____

_____

LOCATION OF SPILL: _____

_____

_____

RESPONSE ACTIONS: _____

_____

PERSONNEL: _____

ATTACHDOCUMENTATION OF NOTIFICATION AND CORRECTIVE MEASURES AS IMPLEMENTED TO PREVENT REOCCURRENCE

(COPY AS NEEDED)

_____

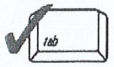
Appendix F – Checklist for Stormwater Report

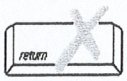
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.





A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

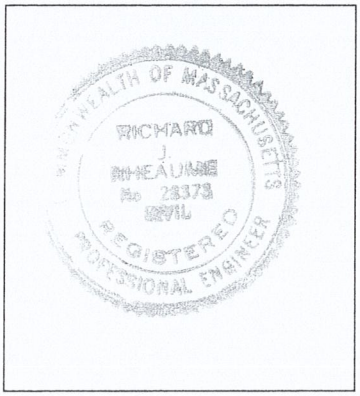
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

- [x] New development
- [ ] Redevelopment
- [ ] Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- [x] No disturbance to any Wetland Resource Areas
- [ ] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [ ] Reduced Impervious Area (Redevelopment Only)
- [ ] Minimizing disturbance to existing trees and shrubs
- [ ] LID Site Design Credit Requested:
  - [ ] Credit 1
  - [ ] Credit 2
  - [ ] Credit 3
- [ ] Use of "country drainage" versus curb and gutter conveyance and pipe
- [ ] Bioretention Cells (includes Rain Gardens)
- [x] Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- [ ] Treebox Filter
- [ ] Water Quality Swale
- [x] Grass Channel
- [ ] Green Roof
- [ ] Other (describe): _____

Standard 1: No New Untreated Discharges

- [x] No new untreated discharges
- [x] Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- [x] Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☑ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☑ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☑ Soil Analysis provided.

☑ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☑ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☑ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☑ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☑ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☑ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☑ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☑ The BMP is sized (and calculations provided) based on:

- ☑ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☑ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☑ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☑ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☑ Name of the stormwater management system owners;
- ☑ Party responsible for operation and maintenance;
- ☑ Schedule for implementation of routine and non-routine maintenance tasks;
- ☑ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☑ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☑ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Appendix G – Interim Discharge Statement

INTERIM ILLICIT DISCHARGE STATEMENT

1.0 INTRODUCTION

The following is an Interim Illicit Discharge statement based on existing conditions and design conditions. Once construction is complete, a final illicit discharge statement shall be issued to the Fairhaven Conservation Commission based on as-built conditions.

2.0 EXISTING CONDITIONS

The existing site is undeveloped woodland. There are no known illicit connections in this area. No sources of illicit discharges were uncovered when this system was recently surveyed. Based on this investigation, to the best of my knowledge, there are no current illicit discharges to the storm drainage system. If during construction, an illicit discharge is discovered, it shall be removed immediately

3.0 PROPOSED DESIGN

The proposed design calls for piped storm flow. There are no points in the proposed storm drainage system where illicit discharges are likely to occur.

Certain types of discharges are allowable under the U.S. Environmental Protection Agency Construction General Permit, and it is the intent of the site's Long Term Pollution Prevention Plan to allow such discharges. These types of discharges shall be allowed under the conditions that no pollutants shall be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined in the Long Term Pollution Prevention Plan shall be strictly followed to ensure that no contamination of these non-stormwater discharges takes place.

I hereby certify that the preceding is accurate.

Richard J. Rheaume, P.E., LSP
Prime Engineering, Inc.

Appendix H – Soils Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Bristol County, Massachusetts, Southern Part

July 11, 2019

Preface

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

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

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

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

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

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

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

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

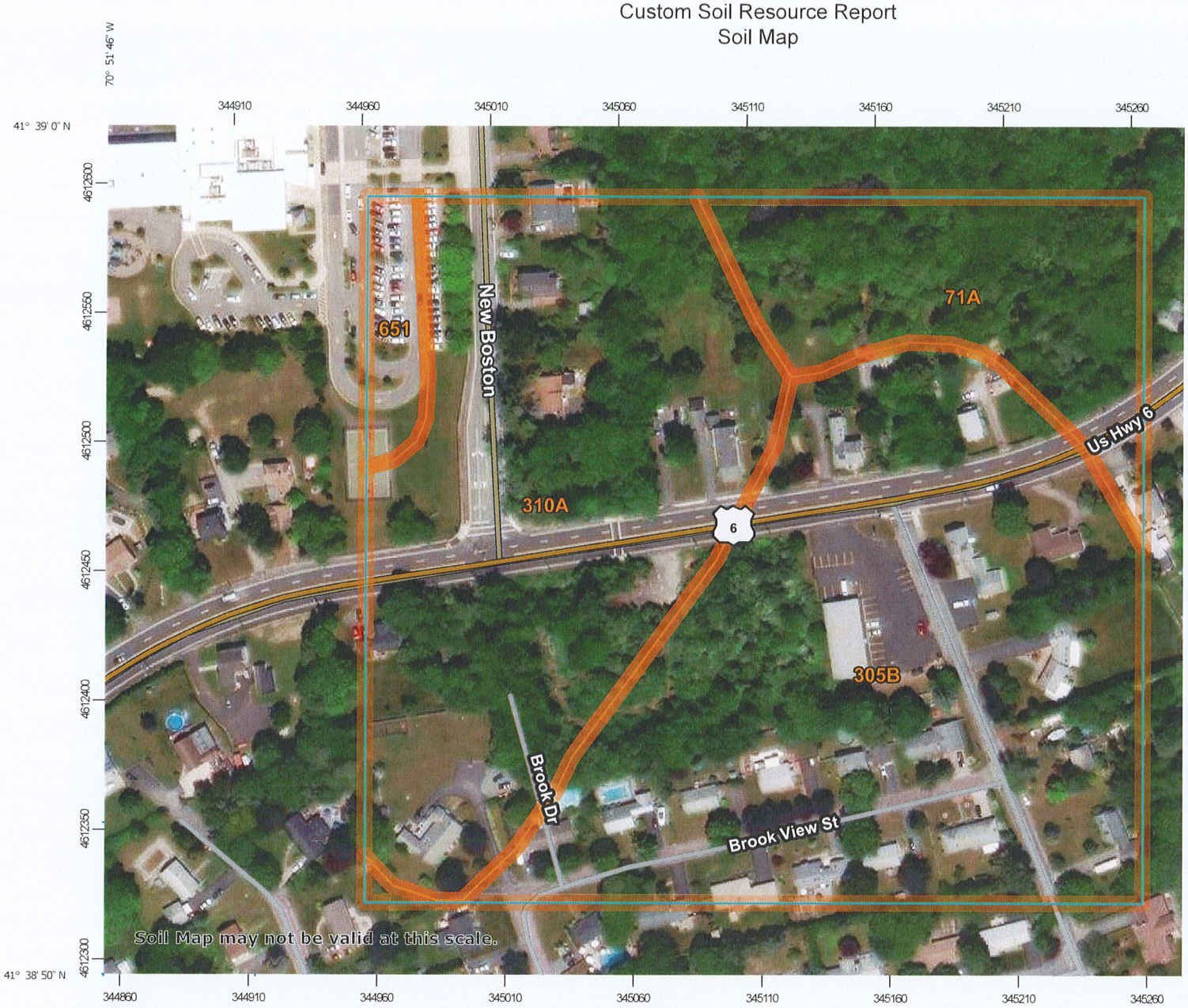
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree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

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

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

Soil Map

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


70° 51' 46" W
344910
344960
345010
345060
345110
345160
345210
345260
41° 39' 0" N
4612600
4612550
4612500
4612450
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4612350
4612300
651
New Boston
71A
Us Hwy 6
6
310A
305B
Brook Dr
Brook View St
Soil Map may not be valid at this scale.
41° 38' 50" N
344860
344910
344960
345010
345060
345110
345160
345210
345260
70° 51' 46" W
N
Map Scale: 1:2,310 if printed on A landscape (11" x 8.5") sheet.
Meters
0 30 60 120 180
Feet
0 100 200 400 600
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORM

The soil surveys that comprise your A
1:20,000.

Warning: Soil Map may not be valid at

Enlargement of maps beyond the scal
misunderstanding of the detail of map
line placement. The maps do not show
contrasting soils that could have been
scale.

Please rely on the bar scale on each r
measurements.

Source of Map: Natural Resources (
Web Soil Survey URL:
Coordinate System: Web Mercator (

Maps from the Web Soil Survey are b
projection, which preserves direction a
distance and area. A projection that p
Albers equal-area conic projection, sh
accurate calculations of distance or ar

This product is generated from the US
of the version date(s) listed below.

Soil Survey Area: Bristol County, Ma
Survey Area Data: Version 12, Sep

Soil map units are labeled (as space a
1:50,000 or larger.

Date(s) aerial images were photograp
2017

The orthophoto or other base map on
compiled and digitized probably differs
imagery displayed on these maps. As
shifting of map unit boundaries may b

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	2.9	14.1%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	9.5	46.5%
310A	Woodbridge fine sandy loam, 0 to 3 percent slopes	7.5	36.7%
651	Udorthents, smoothed	0.6	2.7%
Totals for Area of Interest		**20.5**	**100.0%**

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Bristol County, Massachusetts, Southern Part

71A—Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69b
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, extremely stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury, Extremely Stony

Setting

Landform: Ground moraines, depressions, drumlins, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Whitman, extremely stony

Percent of map unit: 7 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Woodbridge, extremely stony

Percent of map unit: 7 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Crest, base slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 1 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Crest
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

305B—Paxton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2qp
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Paxton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex

Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

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

Minor Components

Woodbridge

Percent of map unit: 9 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 6 percent
Landform: Ground moraines, depressions, drainageways, hills
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Charlton

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

310A—Woodbridge fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2w686
Elevation: 0 to 1,420 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodbridge and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam
Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

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

Minor Components

Paxton

Percent of map unit: 7 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 6 percent
Landform: Hills, drumlins, drainageways, ground moraines, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman, extremely stony

Percent of map unit: 1 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sutton

Percent of map unit: 1 percent
Landform: Hills, ground moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

651—Udorthents, smoothed

Map Unit Setting

National map unit symbol: v5rw
Elevation: 0 to 3,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, smoothed, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Smoothed

Setting

Parent material: Made land over loose sandy and gravelly glaciofluvial deposits and/or firm coarse-loamy basal till derived from granite and gneiss

Typical profile

H1 - 0 to 6 inches: variable
H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: Unranked

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