FINAL STORM WATER DRAINAGE REPORT

ARISTOCRAT MOTORS

LOTS 2-3, OLDHAM EAST BUSINESS PARK

LEE'S SUMMIT, MISSOURI

704 SE OLDHAM COURT

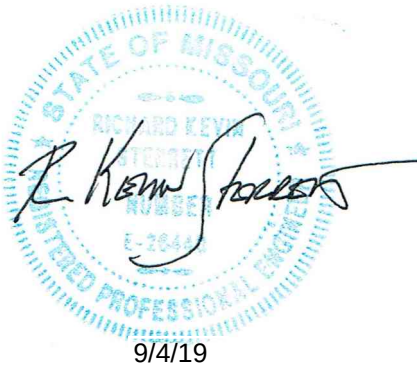
PREPARED FOR

ARISTOCRAT MOTORS

PREPARED BY

HG CONSULT, INC.

SEPTEMBER, 2019



9/4/19

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3. Project Overview

The proposed project is a new building and parking lot for Aristocrat Motors automotive sales. The new building addition will be contained in a 7400 square foot building footprint. This entire project is contained on 2.83 acre site. The site is construction ready, with all utilities on site.

The topography of the site is a gentle slope west to the east, with an existing drive to the site and the Skate Center to the south. Various concrete pads and parking areas are remnants from the previous use as a mobile home sales yard in the 1990's.

4. Drainage Assessment of the Project Site

Due to the slope of the site and the need for break in the drainage pattern to avoid excessive runoff down the existing street, two smaller watersheds are proposed, as it was when the project was proposed as KC Motors in 2017. Offsite drainage was originally designed to divert the storm water away from the site and influencing the detention volumes. This design is the same with this submittal except there now is a proposed development on Lot 1 for a climate controlled storage facility that will capture the same water as it was to be diverted,, keeping the detention system intact from the previous design. Minimal cut and fill grading will be required for the site and provide positive drainage away from the building, the 2 drainage areas will be directing storm water into new storm sewer system that forces storm water into the detention facilities. Design requirements call for a piping system with a minimum capacity for the 10 year event, with the 100 year storm event being routed overland in an above grade manner such as swales and gutters. To insure that higher frequency storms would not cause any ponding problems or inundation of parked vehicles, the structures and piping system have been designed to the 100 year event flows. With the relatively small drainage areas, these flows are low and pipe sizes are 18 inch and 24 inch.

5. Design and Methodology

The method for evaluating Aristocrat Motors was the use of a Hydrocad Model. Both Pre-Development and Post-Development conditions were considered:

- HydroCad 9.1
  - TR-55 Unit Hydrograph Method
    - 2-year, 10-year and 100-year Return Frequency storms
    - AMC II Soil Moisture conditions
    - 24-Hour SCS Type II Rainfall Distribution
    - SCS Runoff Curve Numbers per APWA 5600 (Table 5602-3)

Curve number calculations were calculated based on APWA 5600 for the Kansas City area. The pre-development curve number is 74. The calculations for the post-development curve number are located below.

Table 5.1 –Curve Number Calculations

Type	Area (ac)	CN
Undeveloped	0.77	74
Impervious	1.41	98
Total	**2.38**	**89**

Time of concentration was considered using TR-55; however, due to the small size of the drainage basin and the amount of impervious area on the site that will just be conveying sheet flow, a time of concentration of 5 minutes was assumed. This is the minimum time of concentration per APWA 5600.

Per APWA Section 5608.4 and City of Lee's Summit criteria, the post-development discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

The existing and proposed drainage area is 2.38 acres and flows to two points of interest where the proposed detention facility is located. Therefore, no off-site drainage will be bypassing the detention facility. The table below states the discharges for the allowable discharge rates per APWA 5600 and pre-development and post-development discharge rates.

Table 5.2 –Discharge Rates

	2-year **Area 1/2**	**10-year** **Area 1/2**	**100-year** **Area 1/2**
APWA Allowable Discharge Rates	1.19	4.76	7.14
Pre-Development Discharge Rates	3.85	5.21	9.19
Post-Development Discharge Rates	0.49/0.45	0.82/0.76	1.2/1.16

APWA 5608.4 also requires a 40-hour extended release of the water quality storm event (1.37”/24-hour rainfall) per Section 8.10 of the BMP Manual. The detention facility will release the water quality event over a 40-hour period. The baffle structures contain a 5” opening at the base elevation baffle of the structure to achieve the 40-hour extended detention.

6. Rip Rap Design

The riprap at the FES for discharge at the East system was calculated using the unpublished chart provided by City staff. The rip rap is sized based on the 18” pipe. Rip rap, as shown on the plans exceeds the minimum requirement per the chart.

7. Temporary Erosion and Sediment Control

During construction and prior to paving, it will be necessary to control erosion and sediment from the site during storms with in the construction timeframe. To insure that sediment does not enter the existing storm system or runs off to the existing street, perimeter containment is controlled by silt fence installation, inlet protection and an engineered detention release structure. To keep construction traffic from tracking mud onto the adjacent city street, a stabilized rock construction entrance will need to be installed. These erosion control devices, and their maintenance throughout the construction timeframe, are required by ordinance and the details for them are referenced by the City’s Design and Construction Manual and shown on Sheet 9.

Post development water quality will be addressed through the use of water quality detention release openings in the baffle wall of the structure downstream of the underground detention facilities. In addition, Flexstorm filters within the structures are proposed for pre and post development use. The owner will need to have a routine maintenance policy for the cleaning, repair and replacement of the detention release structure.

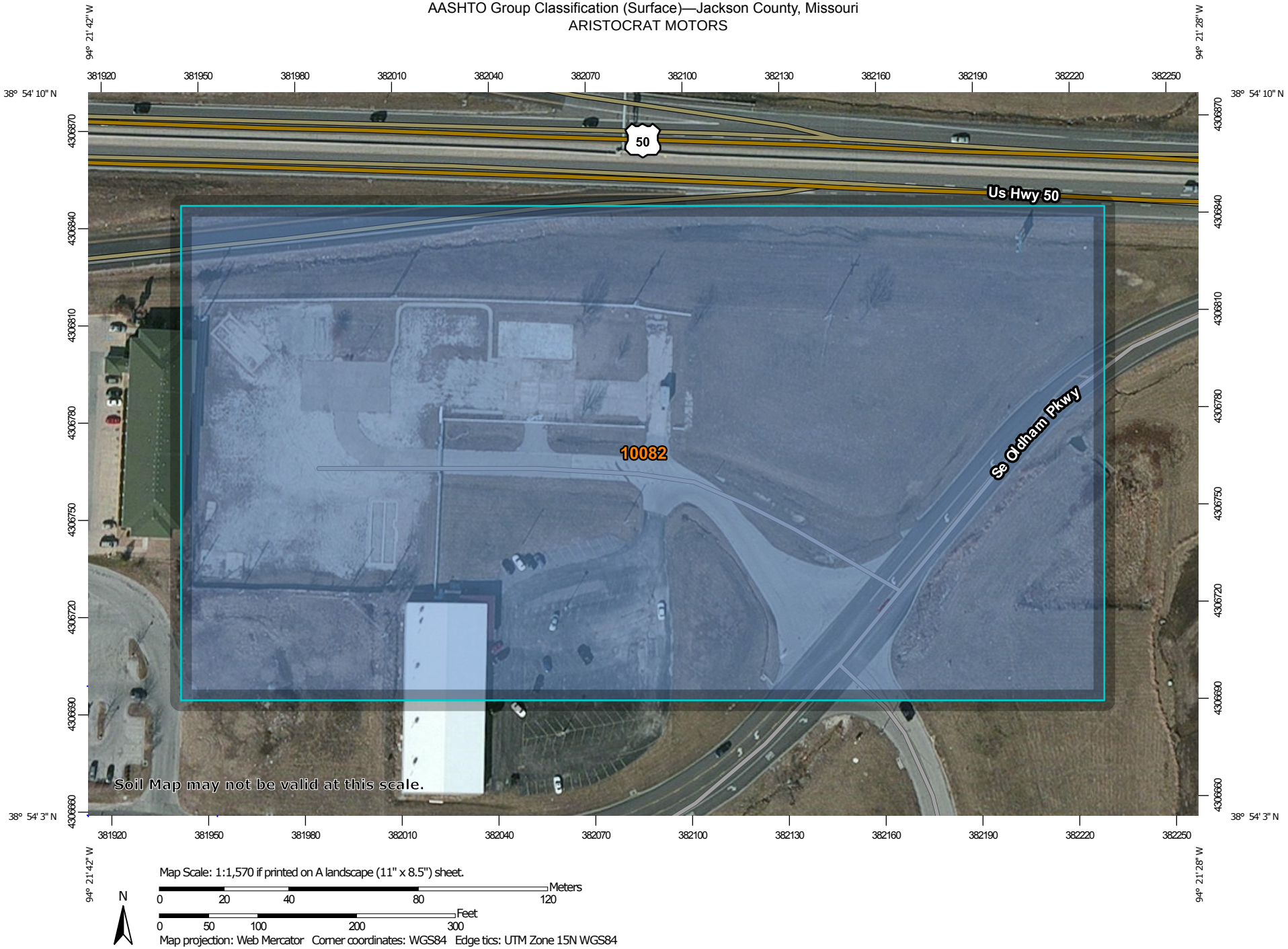
8. Conclusion

The proposed project is a new building addition and parking lot. The report has been prepared to evaluate the storm water discharge at the site to ensure the requirements of APWA 5600 are met. The detention facilities and release structure was designed to not increase peak discharges from existing conditions as well as meeting the maximum releases from APWA 5600. It is not anticipated that the Aristocrat Motors development will have any downstream impacts.

9. Design Calculations and Exhibits

See the attached for drainage area calculations, flows, pipe sizing, inlet sizing and water quality and detention calculations.

AASHTO Group Classification (Surface)—Jackson County, Missouri
ARISTOCRAT MOTORS



Map Scale: 1:1,570 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A-1
A-1-a
A-1-b
A-2
A-2-4
A-2-5
A-2-6
A-2-7
A-3
A-4
A-5
A-6
A-7
A-7-5
A-7-6
A-8
Not rated or not available

Soil Rating Lines

A-1
A-1-a
A-1-b
A-2
A-2-4
A-2-5
A-2-6
A-2-7
A-3
A-4
A-5
A-6
A-7
A-7-5
A-7-6
A-8
Not rated or not available

Soil Rating Points

A-1
A-1-a
A-1-b
A-2
A-2-4
A-2-5
A-2-6
A-2-7
A-3
A-4
A-5
A-6
A-7
A-7-5
A-7-6
A-8
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 17, Sep 28, 2016

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

Date(s) aerial images were photographed: Feb 19, 2012—Mar 25, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

AASHTO Group Classification (Surface)

AASHTO Group Classification (Surface)— Summary by Map Unit — Jackson County, Missouri (MO095)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	A-6	10.8	100.0%
Totals for Area of Interest			**10.8**	**100.0%**

Description

AASHTO group classification is a system that classifies soils specifically for geotechnical engineering purposes that are related to highway and airfield construction. It is based on particle-size distribution and Atterberg limits, such as liquid limit and plasticity index. This classification system is covered in AASHTO Standard No. M 145-82. The classification is based on that portion of the soil that is smaller than 3 inches in diameter.

The AASHTO classification system has two general classifications: (i) granular materials having 35 percent or less, by weight, particles smaller than 0.074 mm in diameter and (ii) silt-clay materials having more than 35 percent, by weight, particles smaller than 0.074 mm in diameter. These two divisions are further subdivided into seven main group classifications, plus eight subgroups, for a total of fifteen for mineral soils. Another class for organic soils is used.

For each soil horizon in the database one or more AASHTO Group Classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

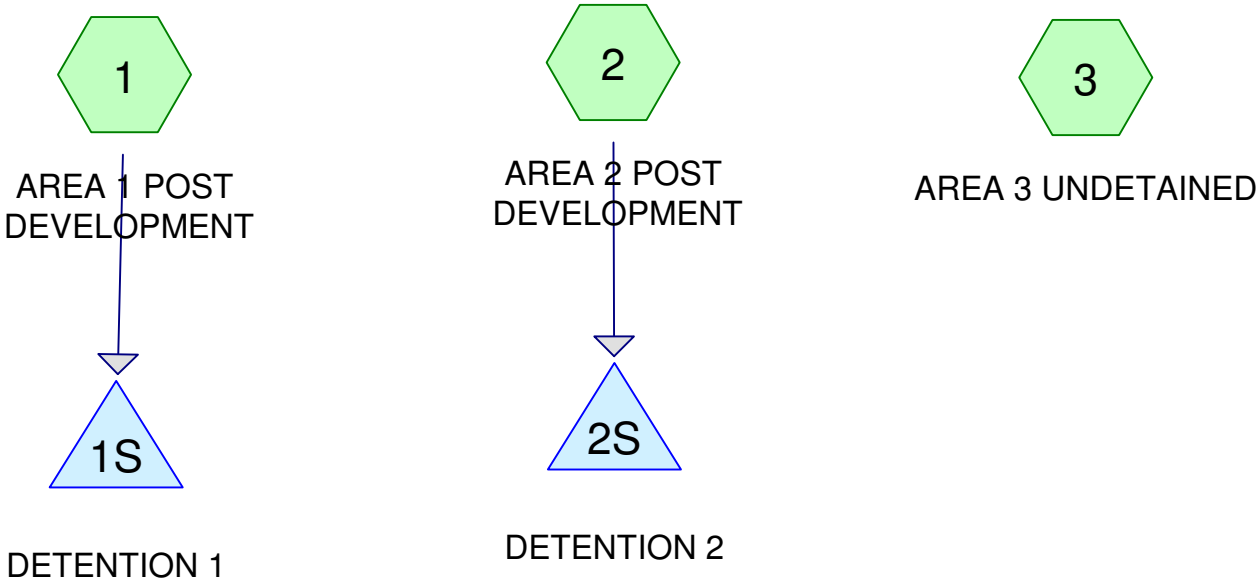
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

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



Subcat Reach Pond Link

Drainage Diagram for KC MOTORS POST
Prepared by HG Consult, Printed 4/17/2017

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.120	39	>75% Grass cover, Good, HSG A (1, 2, 3)
1.582	98	Paved parking, HSG A (1, 2)
0.126	98	Unconnected pavement, HSG A (3)
2.828		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.828	HSG A	1, 2, 3
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.828		**TOTAL AREA**

Time span=0.01-60.00 hrs, dt=0.01 hrs, 6000 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: AREA 1 POST Runoff Area=1.247 ac 66.16% Impervious Runoff Depth=1.50"
Tc=5.0 min CN=78 Runoff=3.48 cfs 0.156 af

Subcatchment 2: AREA 2 POST Runoff Area=1.129 ac 67.05% Impervious Runoff Depth=1.57"
Tc=5.0 min CN=79 Runoff=3.29 cfs 0.147 af

Subcatchment 3: AREA 3 UNDETAINED Runoff Area=0.452 ac 27.88% Impervious Runoff Depth=0.12"
Tc=5.0 min UI Adjusted CN=47 Runoff=0.01 cfs 0.005 af

Pond 1S: DETENTION 1 Peak Elev=1,013.17' Storage=0.062 af Inflow=3.48 cfs 0.156 af
Outflow=0.49 cfs 0.156 af

Pond 2S: DETENTION 2 Peak Elev=1,007.38' Storage=0.061 af Inflow=3.29 cfs 0.147 af
Outflow=0.45 cfs 0.147 af

Total Runoff Area = 2.828 ac Runoff Volume = 0.308 af Average Runoff Depth = 1.31"
39.60% Pervious = 1.120 ac 60.40% Impervious = 1.708 ac

Summary for Subcatchment 1: AREA 1 POST DEVELOPMENT

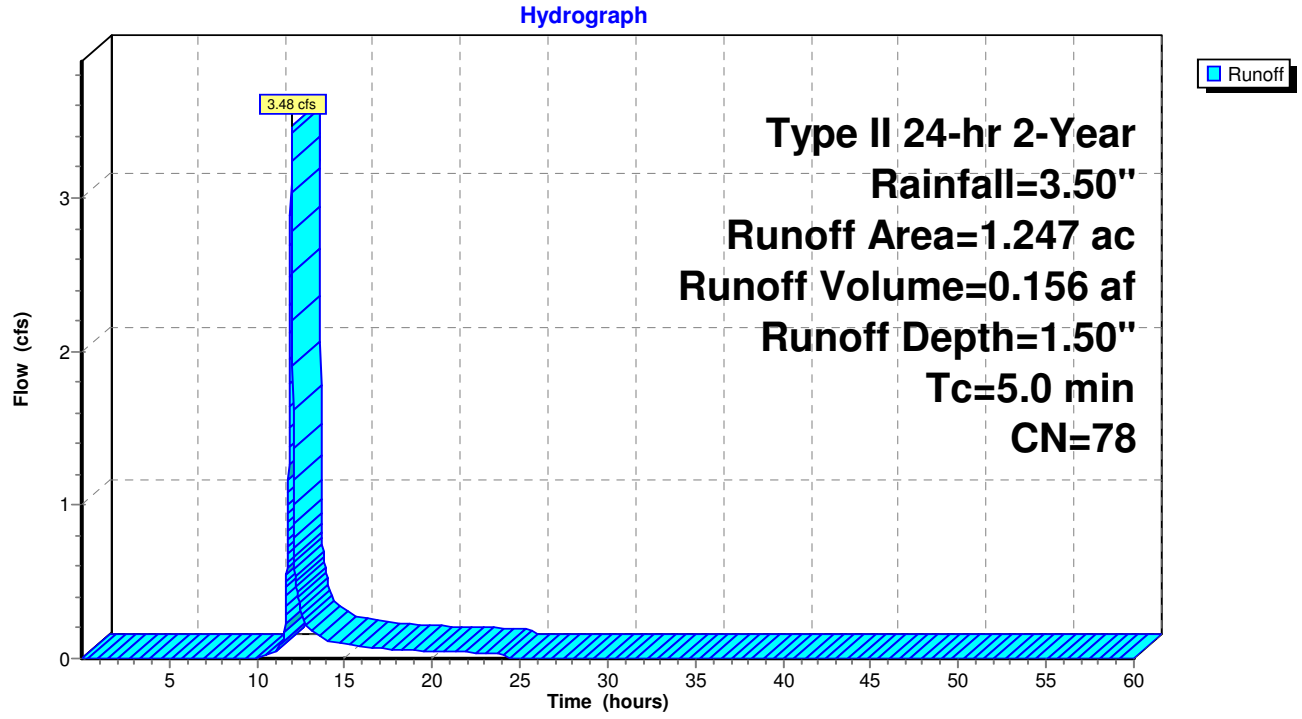
Runoff = 3.48 cfs @ 11.96 hrs, Volume= 0.156 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
0.825	98	Paved parking, HSG A
0.422	39	>75% Grass cover, Good, HSG A
1.247	78	Weighted Average
0.422		33.84% Pervious Area
0.825		66.16% Impervious Area

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

Subcatchment 1: AREA 1 POST DEVELOPMENT



Summary for Subcatchment 2: AREA 2 POST DEVELOPMENT

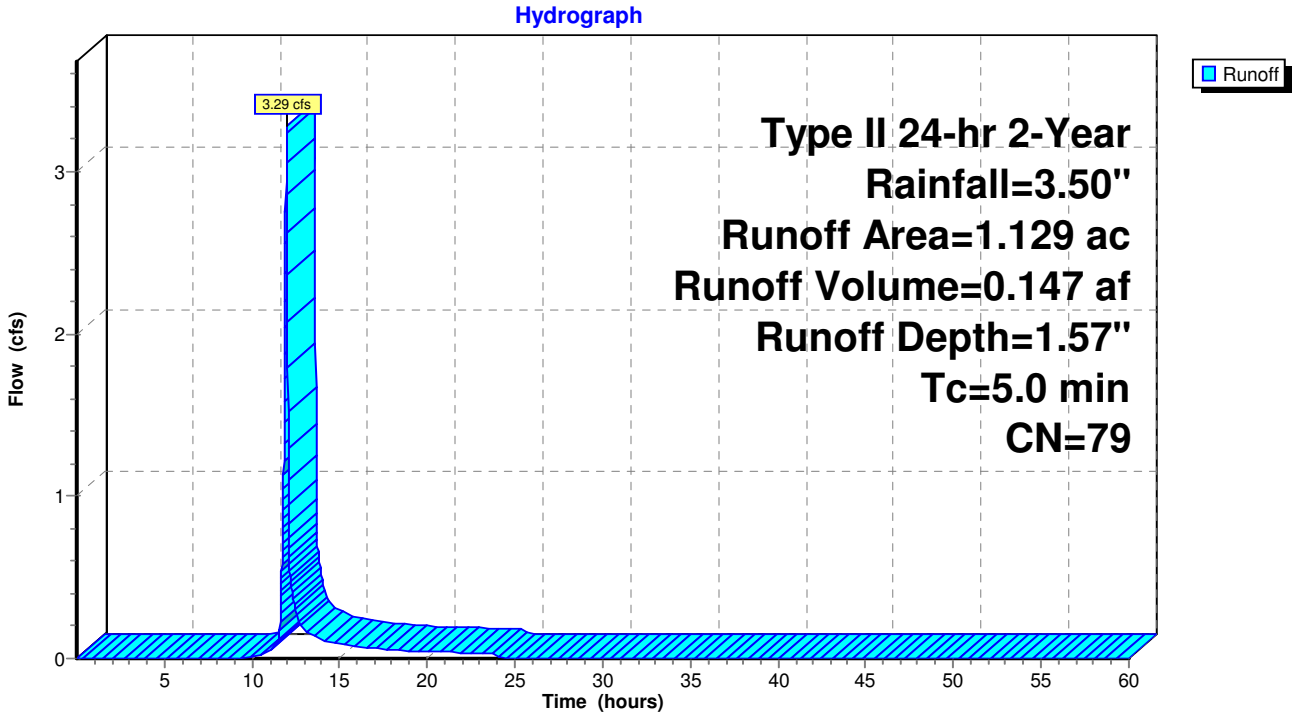
Runoff = 3.29 cfs @ 11.96 hrs, Volume= 0.147 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
0.372	39	>75% Grass cover, Good, HSG A
0.757	98	Paved parking, HSG A
1.129	79	Weighted Average
0.372		32.95% Pervious Area
0.757		67.05% Impervious Area

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

Subcatchment 2: AREA 2 POST DEVELOPMENT



Summary for Subcatchment 3: AREA 3 UNDETAINED

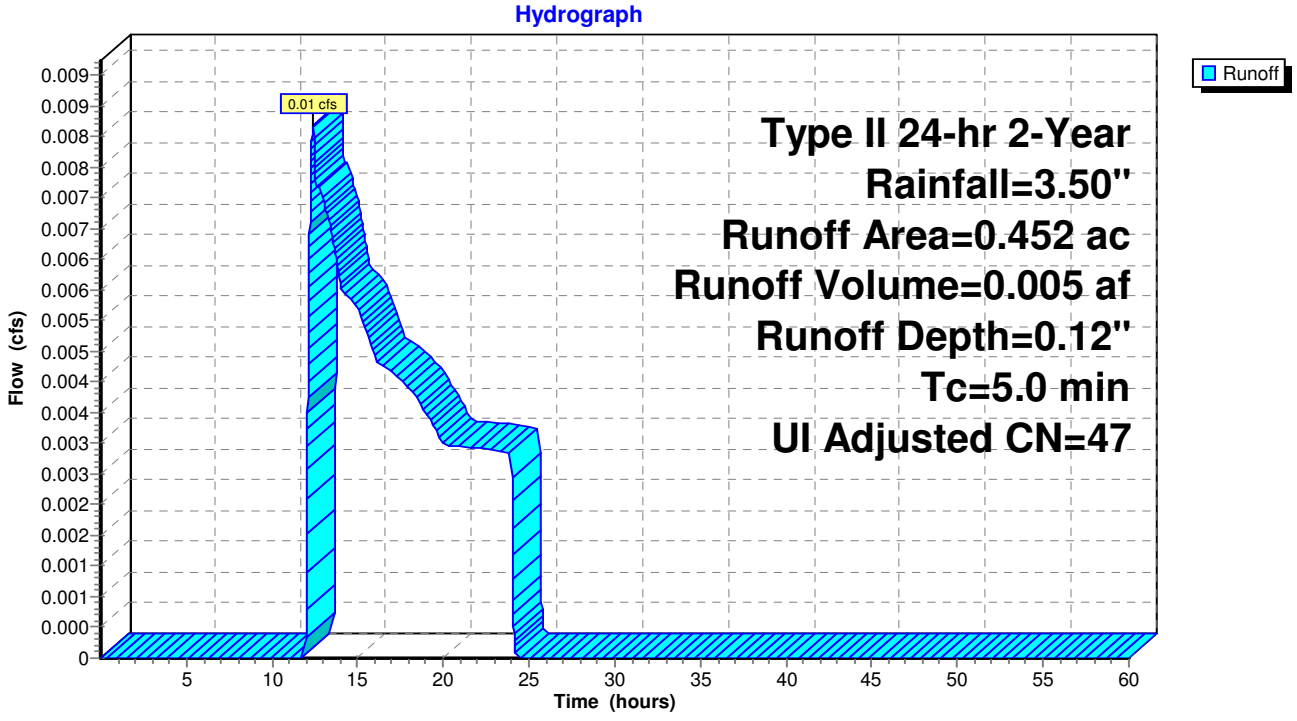
Runoff = 0.01 cfs @ 12.39 hrs, Volume= 0.005 af, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
0.326	39	>75% Grass cover, Good, HSG A
0.126	98	Unconnected pavement, HSG A
0.452	55	Weighted Average, UI Adjusted CN = 47
0.326		72.12% Pervious Area
0.126		27.88% Impervious Area
0.126		100.00% Unconnected

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

Subcatchment 3: AREA 3 UNDETAINED



Summary for Pond 1S: DETENTION 1

Inflow Area = 1.247 ac, 66.16% Impervious, Inflow Depth = 1.50" for 2-Year event
Inflow = 3.48 cfs @ 11.96 hrs, Volume= 0.156 af
Outflow = 0.49 cfs @ 12.20 hrs, Volume= 0.156 af, Atten= 86%, Lag= 14.1 min
Primary = 0.49 cfs @ 12.20 hrs, Volume= 0.156 af

Routing by Stor-Ind method, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,013.17' @ 12.20 hrs Surf.Area= 0.078 ac Storage= 0.062 af

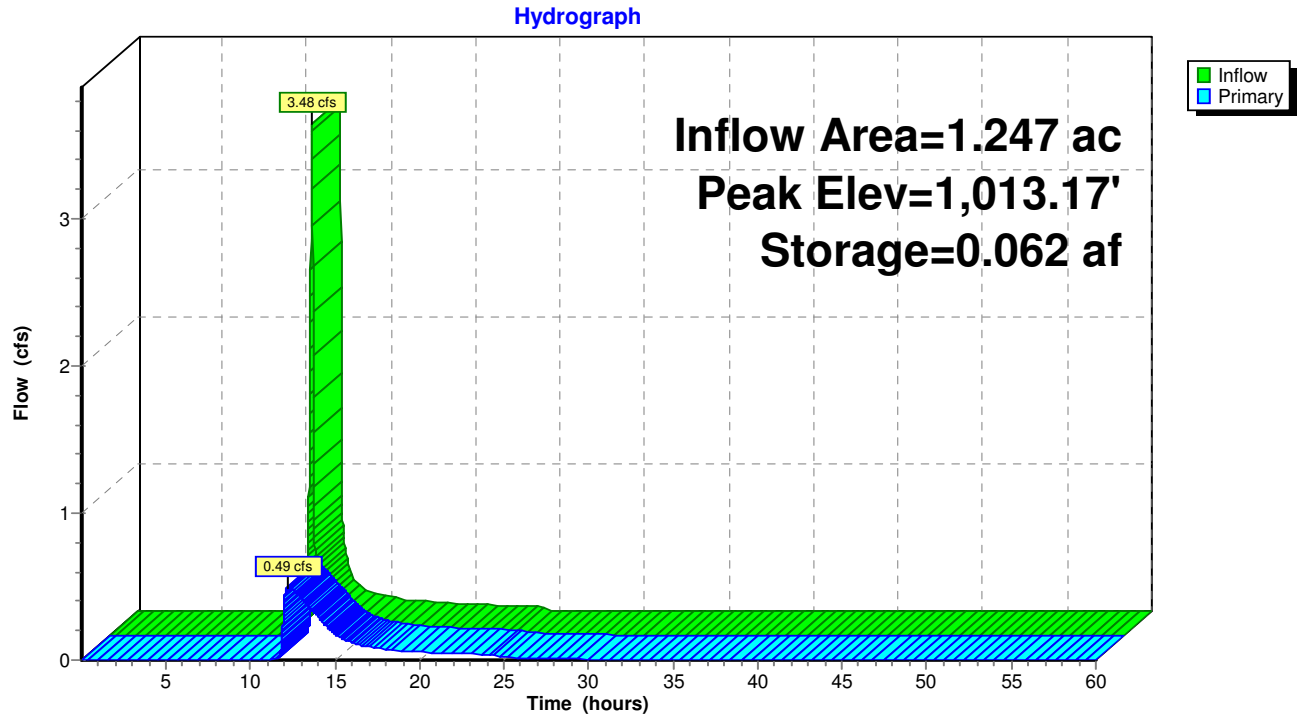
Plug-Flow detention time= 120.6 min calculated for 0.156 af (100% of inflow)
Center-of-Mass det. time= 120.5 min (960.6 - 840.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,012.40'	0.308 af	**77.0"W x 66.0"H x 570.00'L Parabolic Arch**

Device	Routing	Invert	Outlet Devices
#1	Primary	1,012.40'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.49 cfs @ 12.20 hrs HW=1,013.17' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.49 cfs @ 3.61 fps)

Pond 1S: DETENTION 1



Summary for Pond 2S: DETENTION 2

Inflow Area = 1.129 ac, 67.05% Impervious, Inflow Depth = 1.57" for 2-Year event
Inflow = 3.29 cfs @ 11.96 hrs, Volume= 0.147 af
Outflow = 0.45 cfs @ 12.21 hrs, Volume= 0.147 af, Atten= 86%, Lag= 14.9 min
Primary = 0.45 cfs @ 12.21 hrs, Volume= 0.147 af

Routing by Stor-Ind method, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,007.38' @ 12.21 hrs Surf.Area= 0.085 ac Storage= 0.061 af

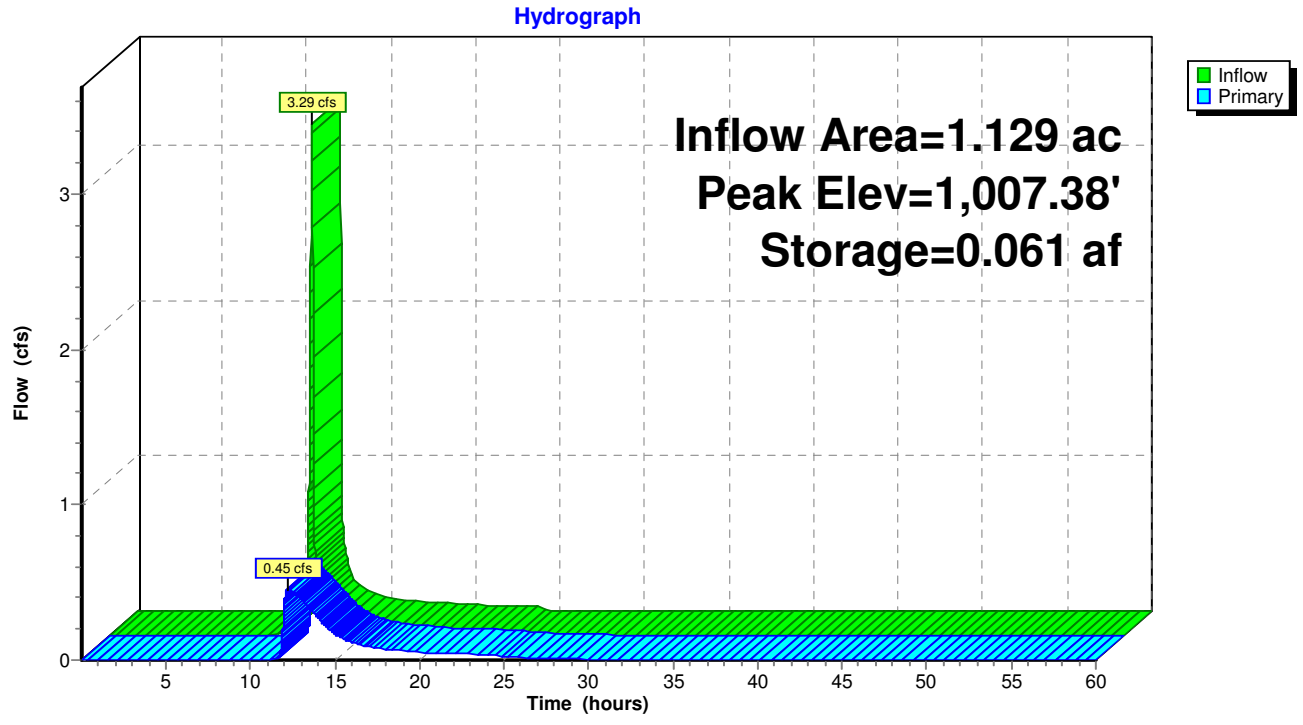
Plug-Flow detention time= 139.5 min calculated for 0.147 af (100% of inflow)
Center-of-Mass det. time= 138.8 min (976.0 - 837.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,006.70'	0.235 af	**77.0"W x 45.0"H x 637.50'L Parabolic Arch**

Device	Routing	Invert	Outlet Devices
#1	Primary	1,006.70'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.45 cfs @ 12.21 hrs HW=1,007.38' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.45 cfs @ 3.31 fps)

Pond 2S: DETENTION 2



Time span=0.01-60.00 hrs, dt=0.01 hrs, 6000 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: AREA 1 POST Runoff Area=1.247 ac 66.16% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=78 Runoff=6.80 cfs 0.308 af

Subcatchment 2: AREA 2 POST Runoff Area=1.129 ac 67.05% Impervious Runoff Depth=3.06"
Tc=5.0 min CN=79 Runoff=6.33 cfs 0.288 af

Subcatchment 3: AREA 3 UNDETAINED Runoff Area=0.452 ac 27.88% Impervious Runoff Depth=0.65"
Tc=5.0 min UI Adjusted CN=47 Runoff=0.41 cfs 0.024 af

Pond 1S: DETENTION 1 Peak Elev=1,014.16' Storage=0.135 af Inflow=6.80 cfs 0.308 af
Outflow=0.82 cfs 0.308 af

Pond 2S: DETENTION 2 Peak Elev=1,008.24' Storage=0.129 af Inflow=6.33 cfs 0.288 af
Outflow=0.76 cfs 0.288 af

Total Runoff Area = 2.828 ac Runoff Volume = 0.621 af Average Runoff Depth = 2.63"
39.60% Pervious = 1.120 ac 60.40% Impervious = 1.708 ac

Summary for Subcatchment 1: AREA 1 POST DEVELOPMENT

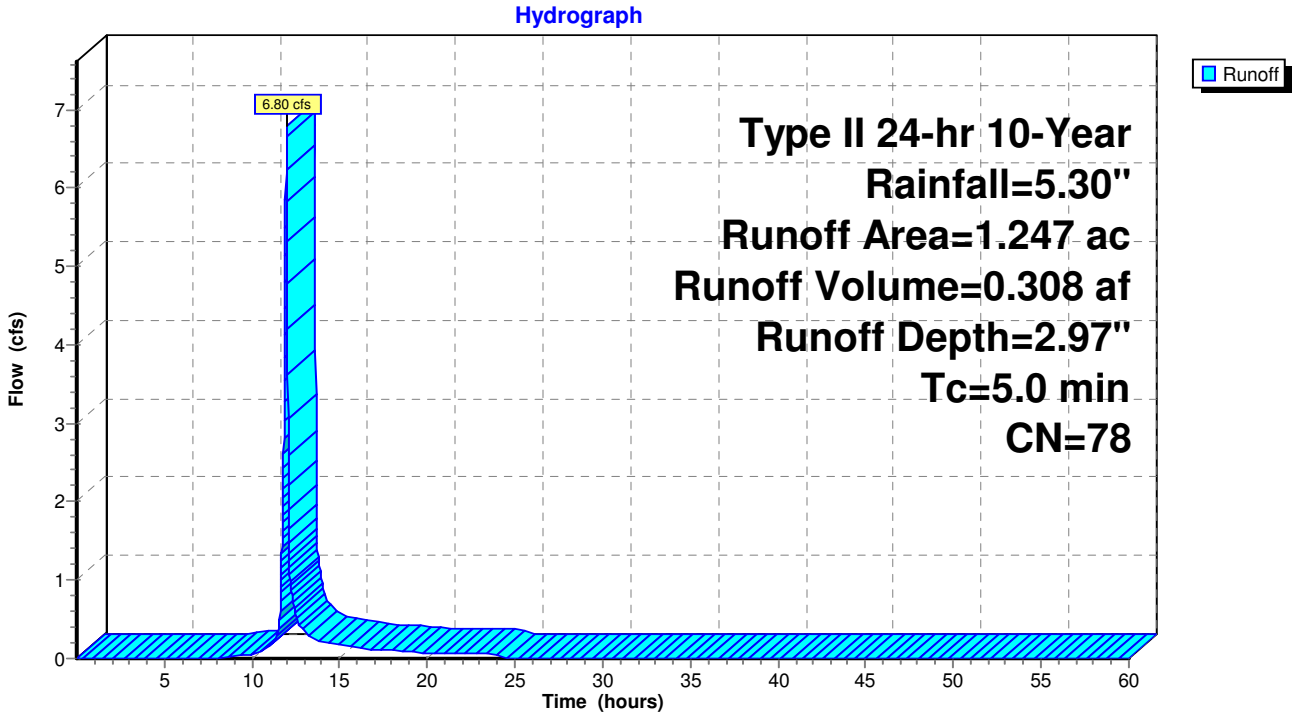
Runoff = 6.80 cfs @ 11.96 hrs, Volume= 0.308 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
0.825	98	Paved parking, HSG A
0.422	39	>75% Grass cover, Good, HSG A
1.247	78	Weighted Average
0.422		33.84% Pervious Area
0.825		66.16% Impervious Area

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

Subcatchment 1: AREA 1 POST DEVELOPMENT



Summary for Subcatchment 2: AREA 2 POST DEVELOPMENT

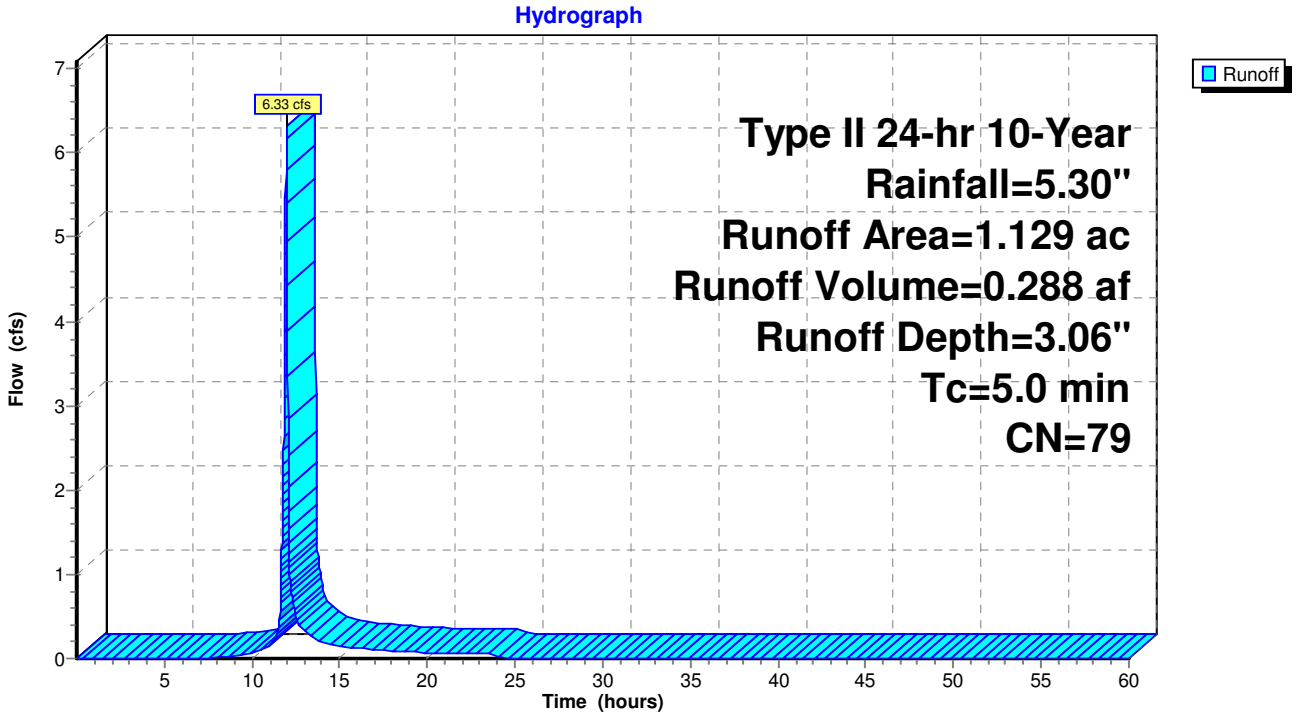
Runoff = 6.33 cfs @ 11.96 hrs, Volume= 0.288 af, Depth= 3.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
0.372	39	>75% Grass cover, Good, HSG A
0.757	98	Paved parking, HSG A
1.129	79	Weighted Average
0.372		32.95% Pervious Area
0.757		67.05% Impervious Area

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

Subcatchment 2: AREA 2 POST DEVELOPMENT



Summary for Subcatchment 3: AREA 3 UNDETAINED

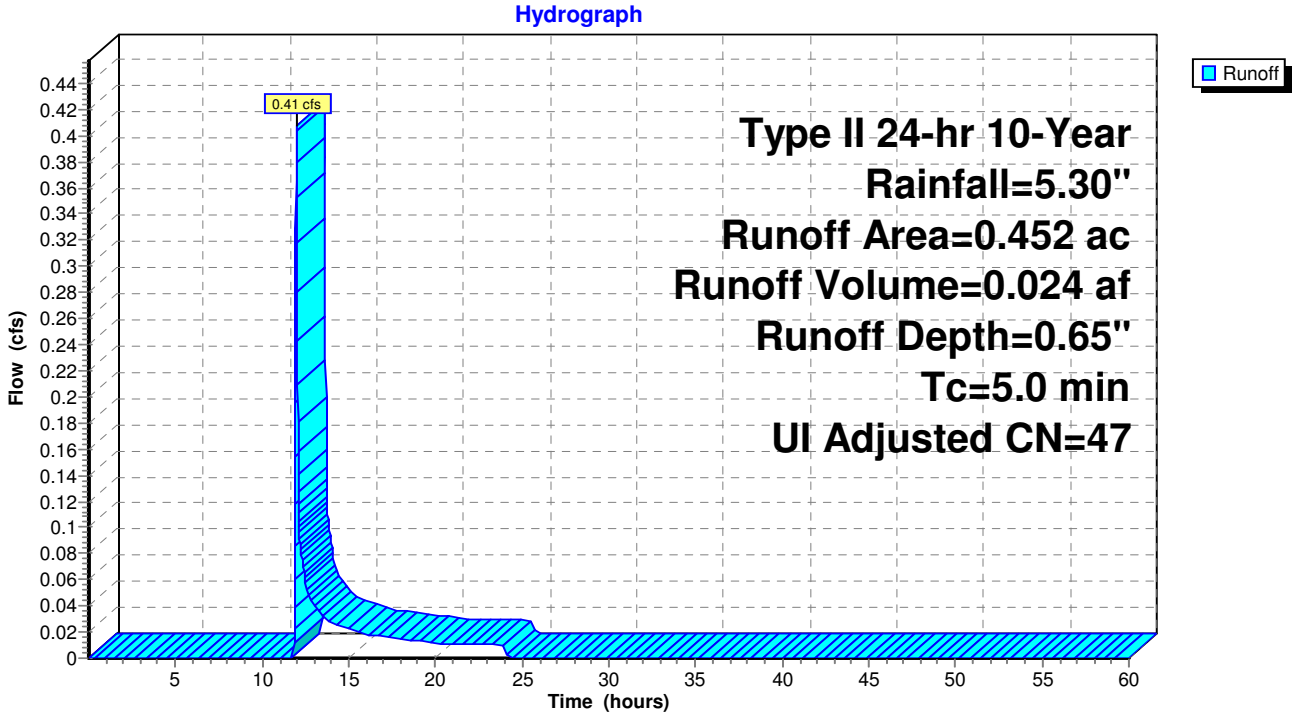
Runoff = 0.41 cfs @ 11.99 hrs, Volume= 0.024 af, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
0.326	39	>75% Grass cover, Good, HSG A
0.126	98	Unconnected pavement, HSG A
0.452	55	Weighted Average, UI Adjusted CN = 47
0.326		72.12% Pervious Area
0.126		27.88% Impervious Area
0.126		100.00% Unconnected

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

Subcatchment 3: AREA 3 UNDETAINED



Summary for Pond 1S: DETENTION 1

Inflow Area = 1.247 ac, 66.16% Impervious, Inflow Depth = 2.97" for 10-Year event
Inflow = 6.80 cfs @ 11.96 hrs, Volume= 0.308 af
Outflow = 0.82 cfs @ 12.26 hrs, Volume= 0.308 af, Atten= 88%, Lag= 18.2 min
Primary = 0.82 cfs @ 12.26 hrs, Volume= 0.308 af

Routing by Stor-Ind method, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,014.16' @ 12.26 hrs Surf.Area= 0.069 ac Storage= 0.135 af

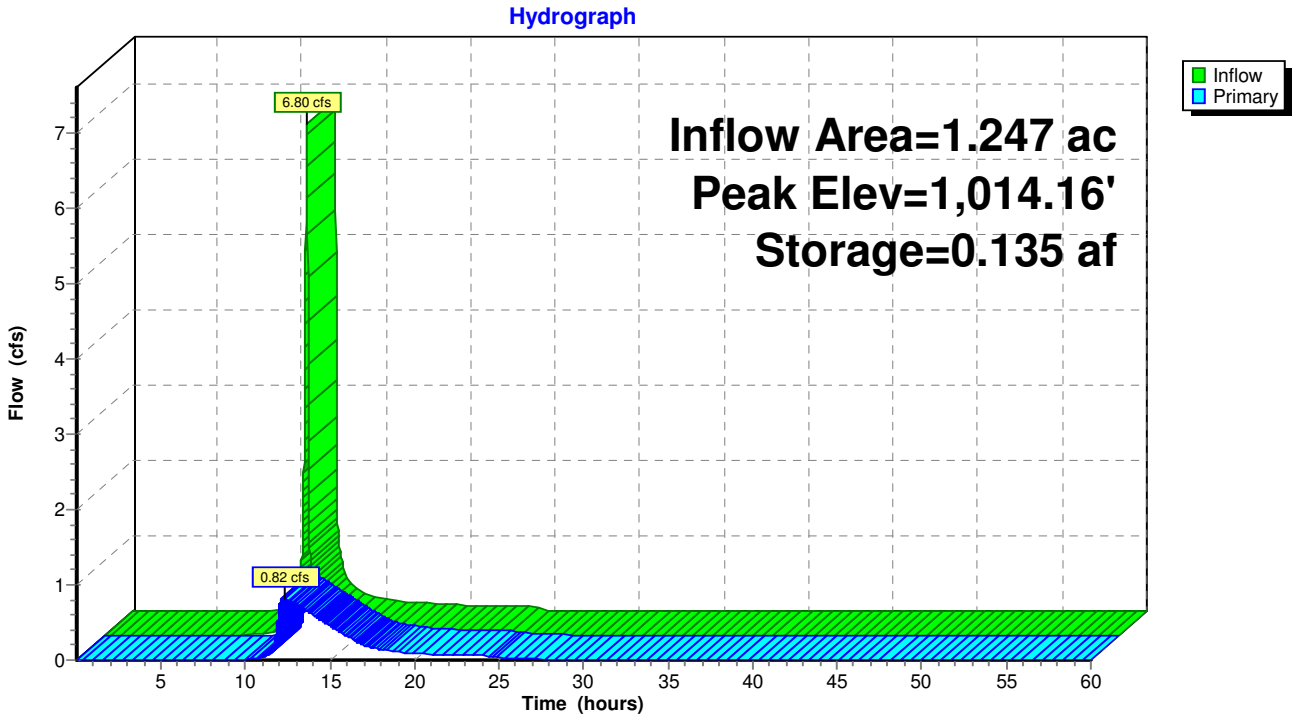
Plug-Flow detention time= 114.5 min calculated for 0.308 af (100% of inflow)
Center-of-Mass det. time= 114.8 min (935.2 - 820.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,012.40'	0.308 af	**77.0"W x 66.0"H x 570.00'L Parabolic Arch**

Device	Routing	Invert	Outlet Devices
#1	Primary	1,012.40'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.82 cfs @ 12.26 hrs HW=1,014.16' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.82 cfs @ 6.00 fps)

Pond 1S: DETENTION 1



Summary for Pond 2S: DETENTION 2

Inflow Area = 1.129 ac, 67.05% Impervious, Inflow Depth = 3.06" for 10-Year event
Inflow = 6.33 cfs @ 11.96 hrs, Volume= 0.288 af
Outflow = 0.76 cfs @ 12.26 hrs, Volume= 0.288 af, Atten= 88%, Lag= 18.1 min
Primary = 0.76 cfs @ 12.26 hrs, Volume= 0.288 af

Routing by Stor-Ind method, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,008.24' @ 12.26 hrs Surf.Area= 0.072 ac Storage= 0.129 af

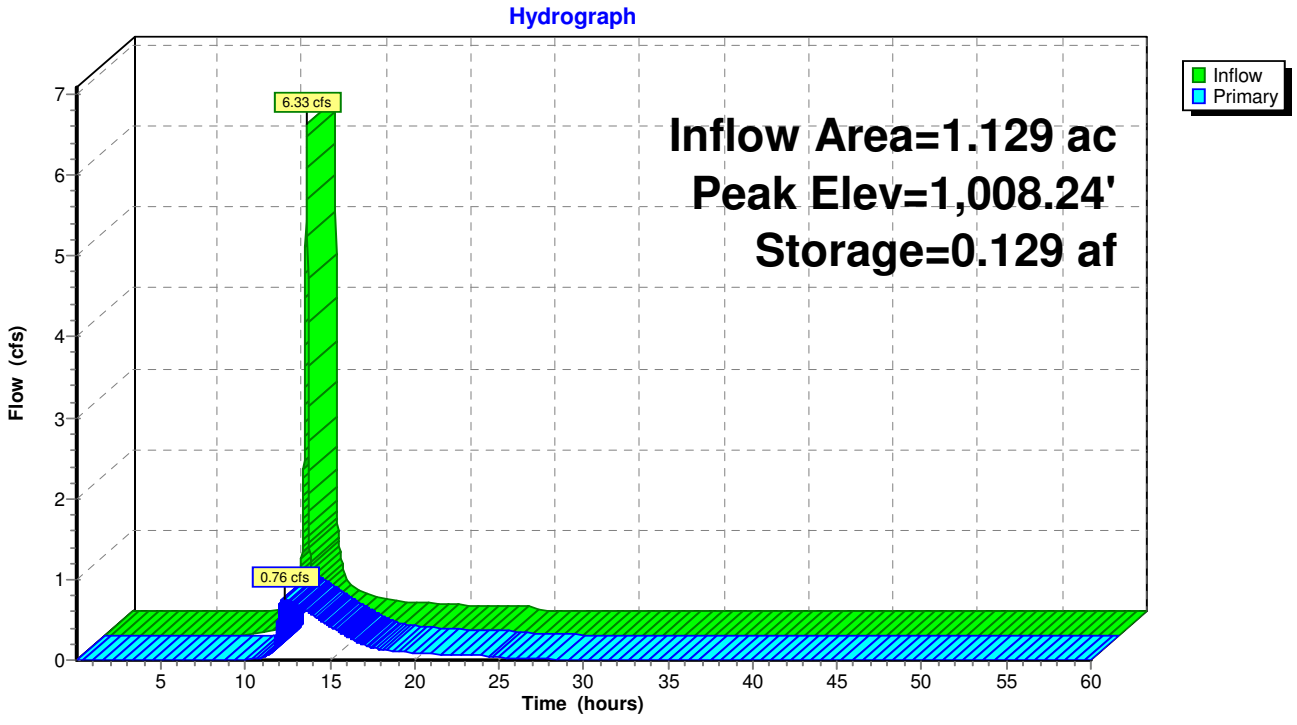
Plug-Flow detention time= 126.6 min calculated for 0.288 af (100% of inflow)
Center-of-Mass det. time= 126.4 min (944.3 - 817.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,006.70'	0.235 af	**77.0"W x 45.0"H x 637.50'L Parabolic Arch**

Device	Routing	Invert	Outlet Devices
#1	Primary	1,006.70'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.76 cfs @ 12.26 hrs HW=1,008.24' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.76 cfs @ 5.56 fps)

Pond 2S: DETENTION 2



Time span=0.01-60.00 hrs, dt=0.01 hrs, 6000 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: AREA 1 POST Runoff Area=1.247 ac 66.16% Impervious Runoff Depth=3.76"
Tc=5.0 min CN=78 Runoff=8.52 cfs 0.390 af

Subcatchment 2: AREA 2 POST Runoff Area=1.129 ac 67.05% Impervious Runoff Depth=3.86"
Tc=5.0 min CN=79 Runoff=7.90 cfs 0.363 af

Subcatchment 3: AREA 3 UNDETAINED Runoff Area=0.452 ac 27.88% Impervious Runoff Depth=1.02"
Tc=5.0 min UI Adjusted CN=47 Runoff=0.75 cfs 0.039 af

Pond 1S: DETENTION 1 Peak Elev=1,014.75' Storage=0.175 af Inflow=8.52 cfs 0.390 af
Outflow=0.96 cfs 0.390 af

Pond 2S: DETENTION 2 Peak Elev=1,008.78' Storage=0.165 af Inflow=7.90 cfs 0.363 af
Outflow=0.90 cfs 0.363 af

Total Runoff Area = 2.828 ac Runoff Volume = 0.792 af Average Runoff Depth = 3.36"
39.60% Pervious = 1.120 ac 60.40% Impervious = 1.708 ac

Summary for Subcatchment 1: AREA 1 POST DEVELOPMENT

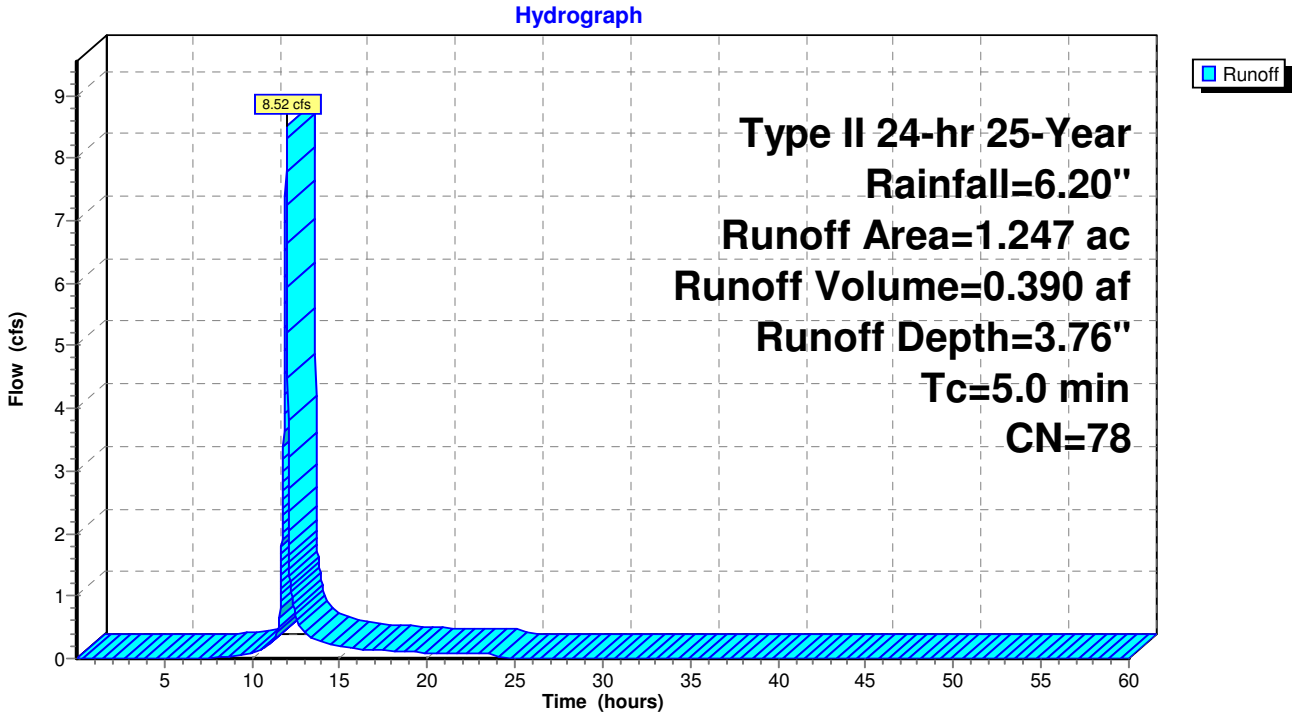
Runoff = 8.52 cfs @ 11.96 hrs, Volume= 0.390 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=6.20"

Area (ac)	CN	Description
0.825	98	Paved parking, HSG A
0.422	39	>75% Grass cover, Good, HSG A
1.247	78	Weighted Average
0.422		33.84% Pervious Area
0.825		66.16% Impervious Area

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

Subcatchment 1: AREA 1 POST DEVELOPMENT



Summary for Subcatchment 2: AREA 2 POST DEVELOPMENT

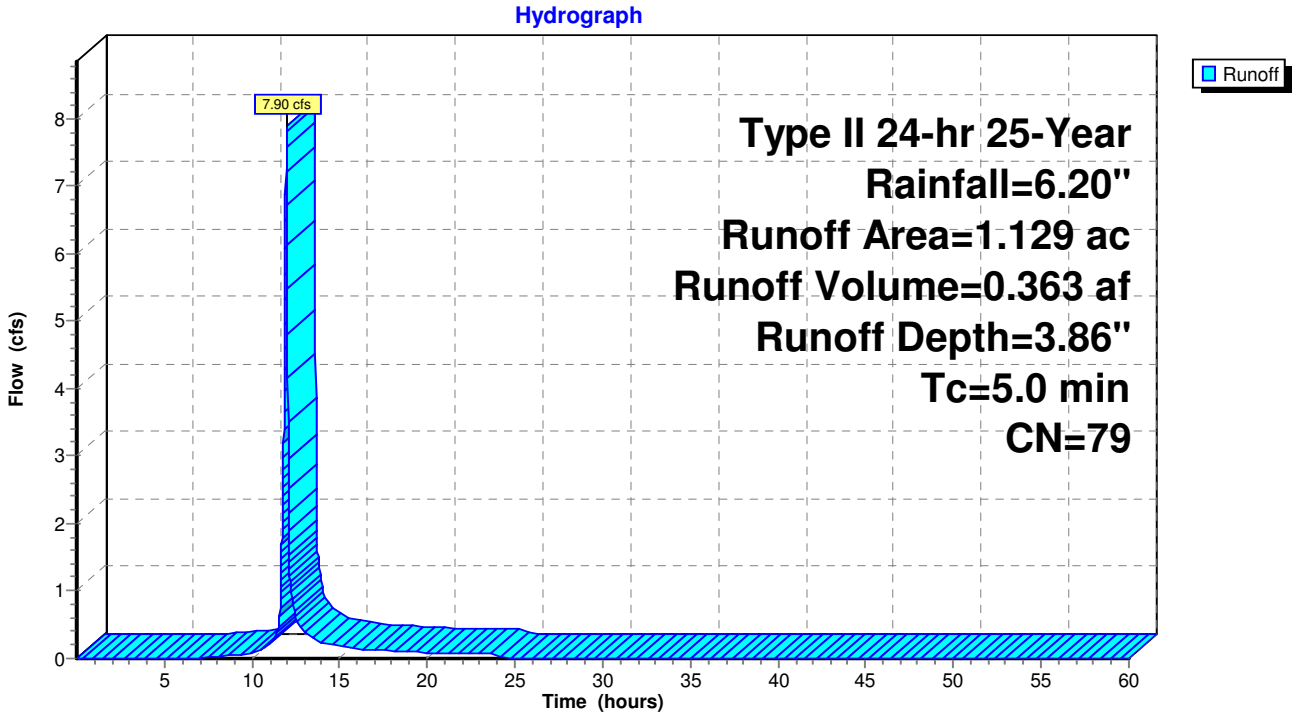
Runoff = 7.90 cfs @ 11.96 hrs, Volume= 0.363 af, Depth= 3.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=6.20"

Area (ac)	CN	Description
0.372	39	>75% Grass cover, Good, HSG A
0.757	98	Paved parking, HSG A
1.129	79	Weighted Average
0.372		32.95% Pervious Area
0.757		67.05% Impervious Area

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

Subcatchment 2: AREA 2 POST DEVELOPMENT



Summary for Subcatchment 3: AREA 3 UNDETAINED

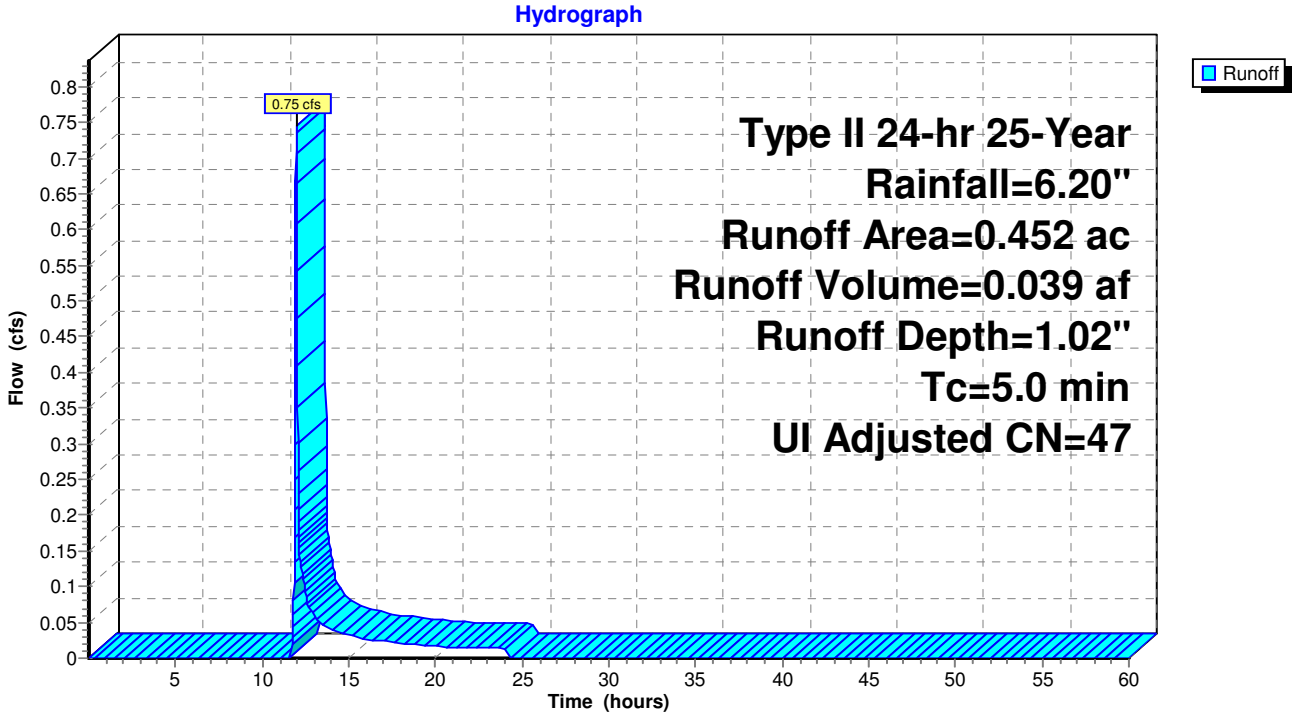
Runoff = 0.75 cfs @ 11.98 hrs, Volume= 0.039 af, Depth= 1.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=6.20"

Area (ac)	CN	Description
0.326	39	>75% Grass cover, Good, HSG A
0.126	98	Unconnected pavement, HSG A
0.452	55	Weighted Average, UI Adjusted CN = 47
0.326		72.12% Pervious Area
0.126		27.88% Impervious Area
0.126		100.00% Unconnected

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

Subcatchment 3: AREA 3 UNDETAINED



Summary for Pond 1S: DETENTION 1

Inflow Area = 1.247 ac, 66.16% Impervious, Inflow Depth = 3.76" for 25-Year event
Inflow = 8.52 cfs @ 11.96 hrs, Volume= 0.390 af
Outflow = 0.96 cfs @ 12.30 hrs, Volume= 0.390 af, Atten= 89%, Lag= 20.2 min
Primary = 0.96 cfs @ 12.30 hrs, Volume= 0.390 af

Routing by Stor-Ind method, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,014.75' @ 12.30 hrs Surf.Area= 0.063 ac Storage= 0.175 af

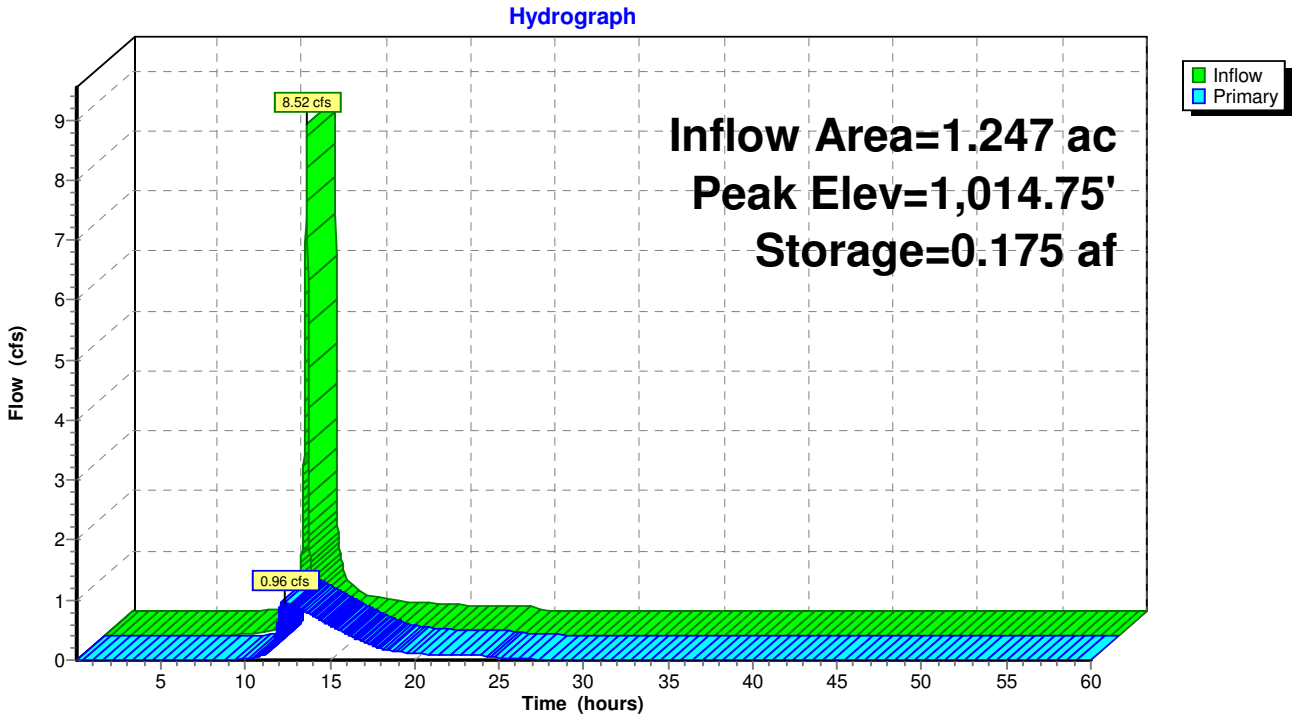
Plug-Flow detention time= 117.1 min calculated for 0.390 af (100% of inflow)
Center-of-Mass det. time= 117.3 min (931.1 - 813.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,012.40'	0.308 af	**77.0"W x 66.0"H x 570.00'L Parabolic Arch**

Device	Routing	Invert	Outlet Devices
#1	Primary	1,012.40'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.96 cfs @ 12.30 hrs HW=1,014.75' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.96 cfs @ 7.05 fps)

Pond 1S: DETENTION 1



Summary for Pond 2S: DETENTION 2

Inflow Area = 1.129 ac, 67.05% Impervious, Inflow Depth = 3.86" for 25-Year event
Inflow = 7.90 cfs @ 11.96 hrs, Volume= 0.363 af
Outflow = 0.90 cfs @ 12.29 hrs, Volume= 0.363 af, Atten= 89%, Lag= 19.6 min
Primary = 0.90 cfs @ 12.29 hrs, Volume= 0.363 af

Routing by Stor-Ind method, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,008.78' @ 12.29 hrs Surf.Area= 0.063 ac Storage= 0.165 af

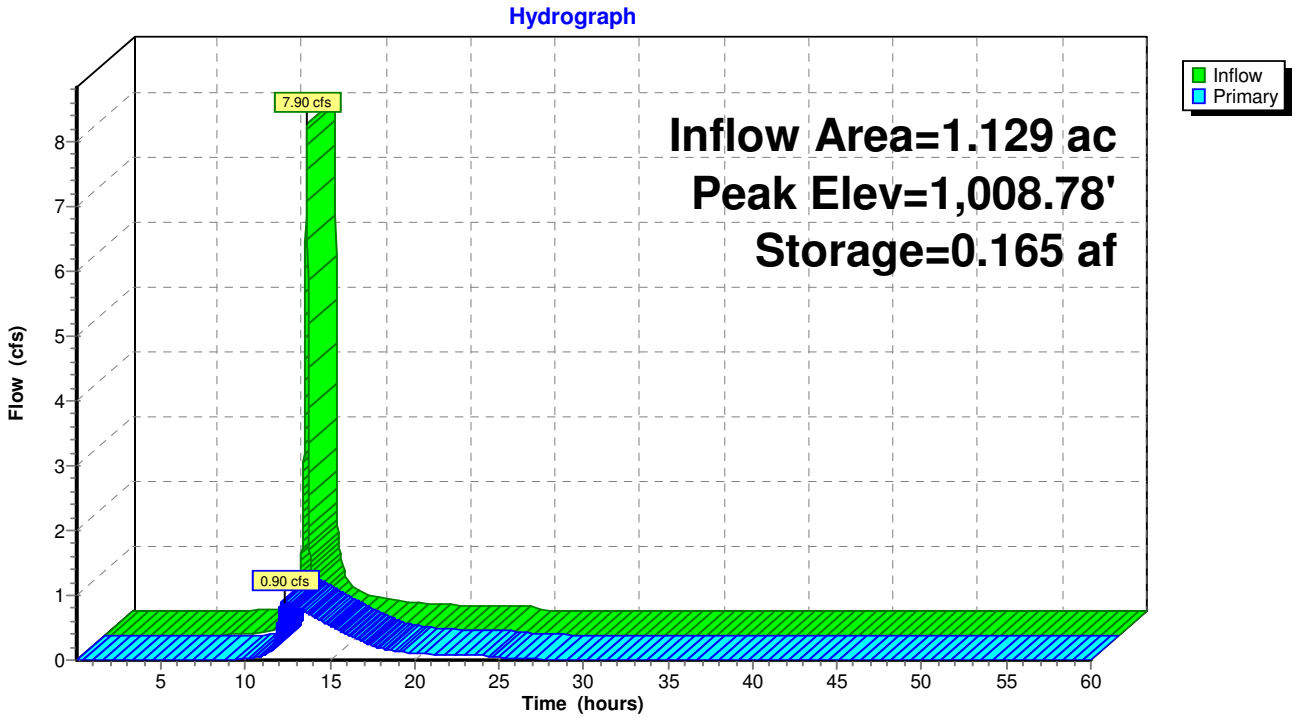
Plug-Flow detention time= 127.1 min calculated for 0.363 af (100% of inflow)
Center-of-Mass det. time= 127.0 min (938.3 - 811.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,006.70'	0.235 af	**77.0"W x 45.0"H x 637.50'L Parabolic Arch**

Device	Routing	Invert	Outlet Devices
#1	Primary	1,006.70'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.90 cfs @ 12.29 hrs HW=1,008.78' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.90 cfs @ 6.59 fps)

Pond 2S: DETENTION 2



Time span=0.01-60.00 hrs, dt=0.01 hrs, 6000 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: AREA 1 POST Runoff Area=1.247 ac 66.16% Impervious Runoff Depth=5.11"
Tc=5.0 min CN=78 Runoff=11.43 cfs 0.531 af

Subcatchment 2: AREA 2 POST Runoff Area=1.129 ac 67.05% Impervious Runoff Depth=5.23"
Tc=5.0 min CN=79 Runoff=10.53 cfs 0.492 af

Subcatchment 3: AREA 3 UNDETAINED Runoff Area=0.452 ac 27.88% Impervious Runoff Depth=1.77"
Tc=5.0 min UI Adjusted CN=47 Runoff=1.42 cfs 0.067 af

Pond 1S: DETENTION 1 Peak Elev=1,015.95' Storage=0.243 af Inflow=11.43 cfs 0.531 af
Outflow=1.20 cfs 0.531 af

Pond 2S: DETENTION 2 Peak Elev=1,010.05' Storage=0.227 af Inflow=10.53 cfs 0.492 af
Outflow=1.16 cfs 0.492 af

Total Runoff Area = 2.828 ac Runoff Volume = 1.090 af Average Runoff Depth = 4.63"
39.60% Pervious = 1.120 ac 60.40% Impervious = 1.708 ac

Summary for Subcatchment 1: AREA 1 POST DEVELOPMENT

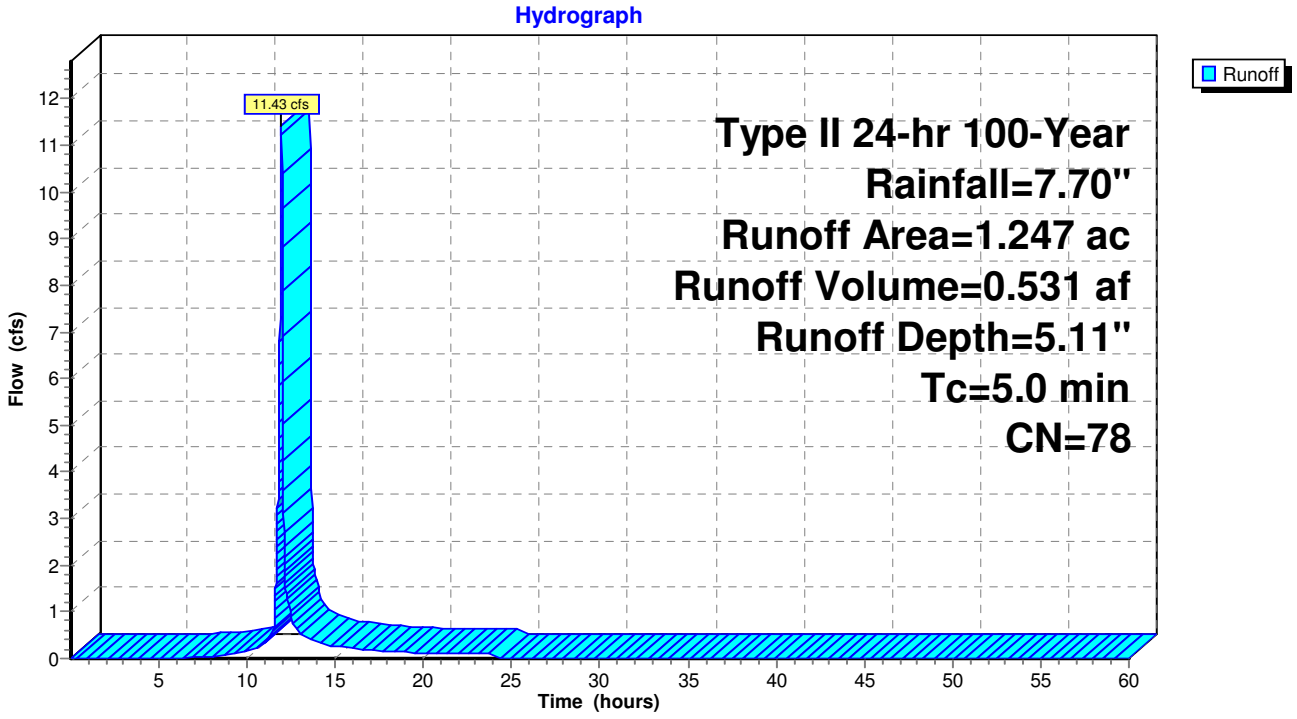
Runoff = 11.43 cfs @ 11.96 hrs, Volume= 0.531 af, Depth= 5.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
0.825	98	Paved parking, HSG A
0.422	39	>75% Grass cover, Good, HSG A
1.247	78	Weighted Average
0.422		33.84% Pervious Area
0.825		66.16% Impervious Area

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

Subcatchment 1: AREA 1 POST DEVELOPMENT



Summary for Subcatchment 2: AREA 2 POST DEVELOPMENT

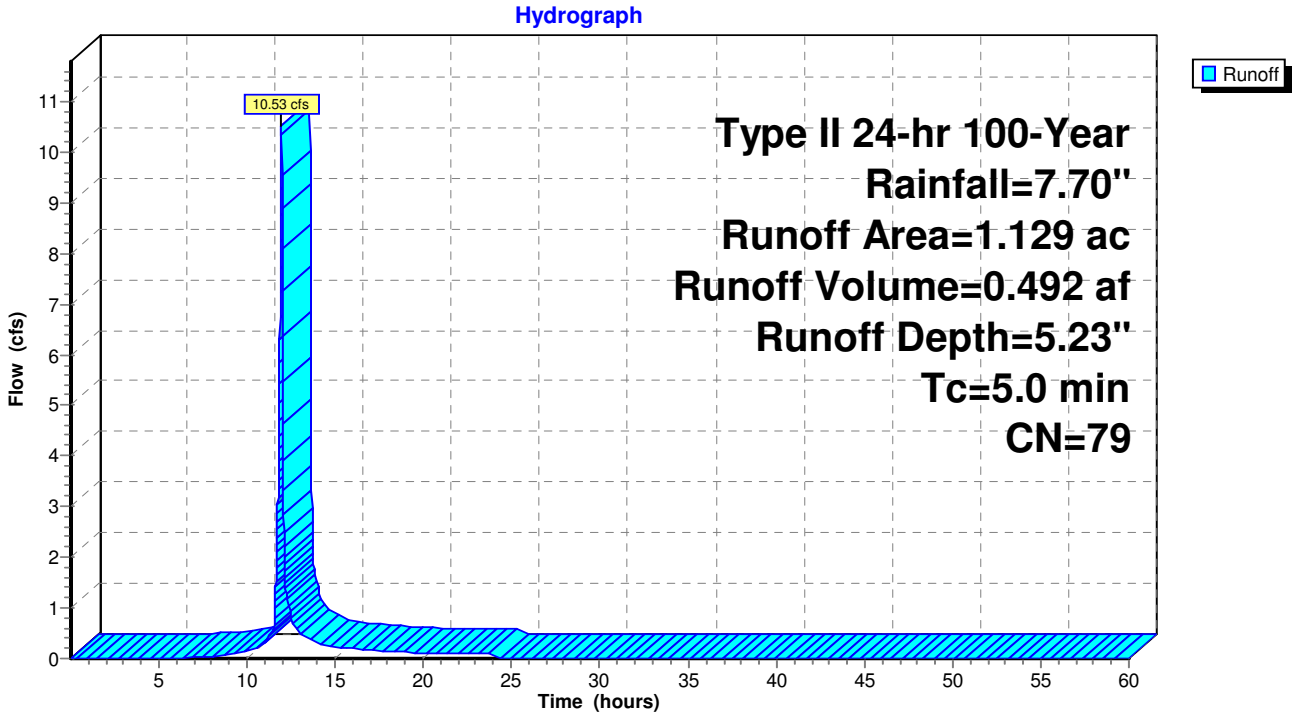
Runoff = 10.53 cfs @ 11.96 hrs, Volume= 0.492 af, Depth= 5.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
0.372	39	>75% Grass cover, Good, HSG A
0.757	98	Paved parking, HSG A
1.129	79	Weighted Average
0.372		32.95% Pervious Area
0.757		67.05% Impervious Area

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

Subcatchment 2: AREA 2 POST DEVELOPMENT



Summary for Subcatchment 3: AREA 3 UNDETAINED

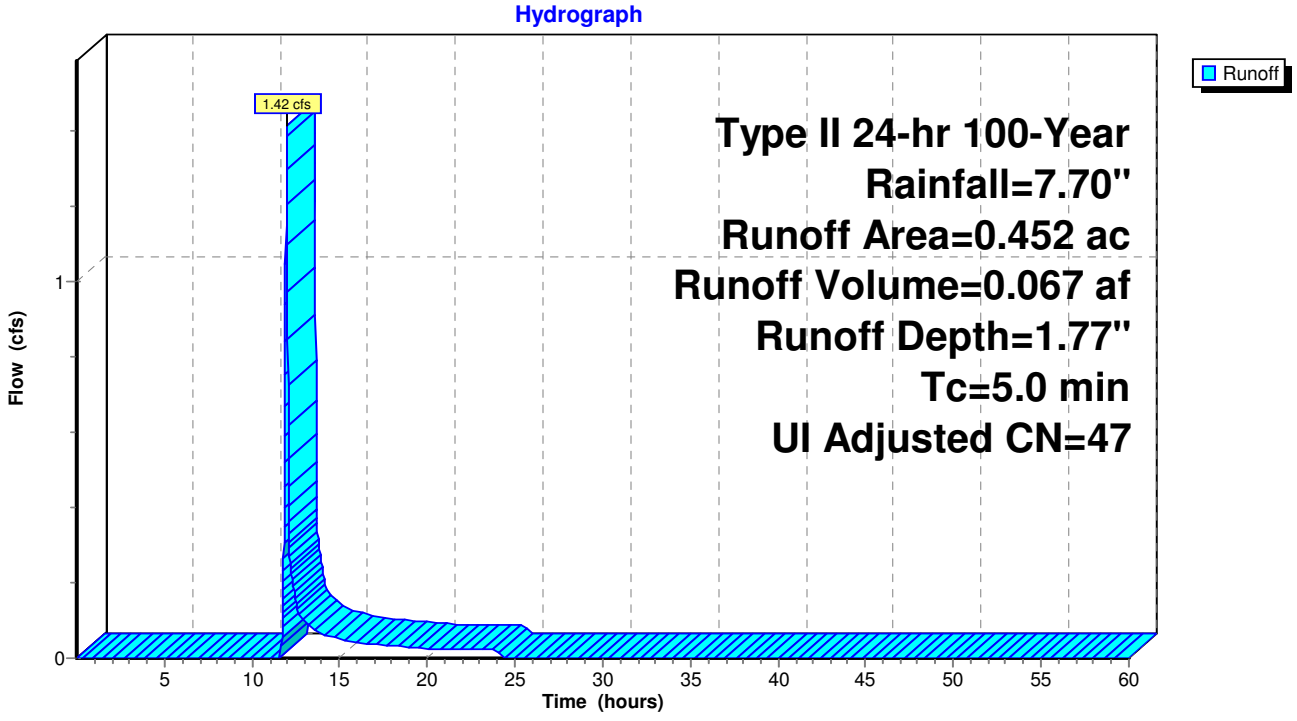
Runoff = 1.42 cfs @ 11.97 hrs, Volume= 0.067 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
0.326	39	>75% Grass cover, Good, HSG A
0.126	98	Unconnected pavement, HSG A
0.452	55	Weighted Average, UI Adjusted CN = 47
0.326		72.12% Pervious Area
0.126		27.88% Impervious Area
0.126		100.00% Unconnected

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

Subcatchment 3: AREA 3 UNDETAINED



Summary for Pond 1S: DETENTION 1

Inflow Area = 1.247 ac, 66.16% Impervious, Inflow Depth = 5.11" for 100-Year event
Inflow = 11.43 cfs @ 11.96 hrs, Volume= 0.531 af
Outflow = 1.20 cfs @ 12.33 hrs, Volume= 0.531 af, Atten= 90%, Lag= 22.3 min
Primary = 1.20 cfs @ 12.33 hrs, Volume= 0.531 af

Routing by Stor-Ind method, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,015.95' @ 12.33 hrs Surf.Area= 0.050 ac Storage= 0.243 af

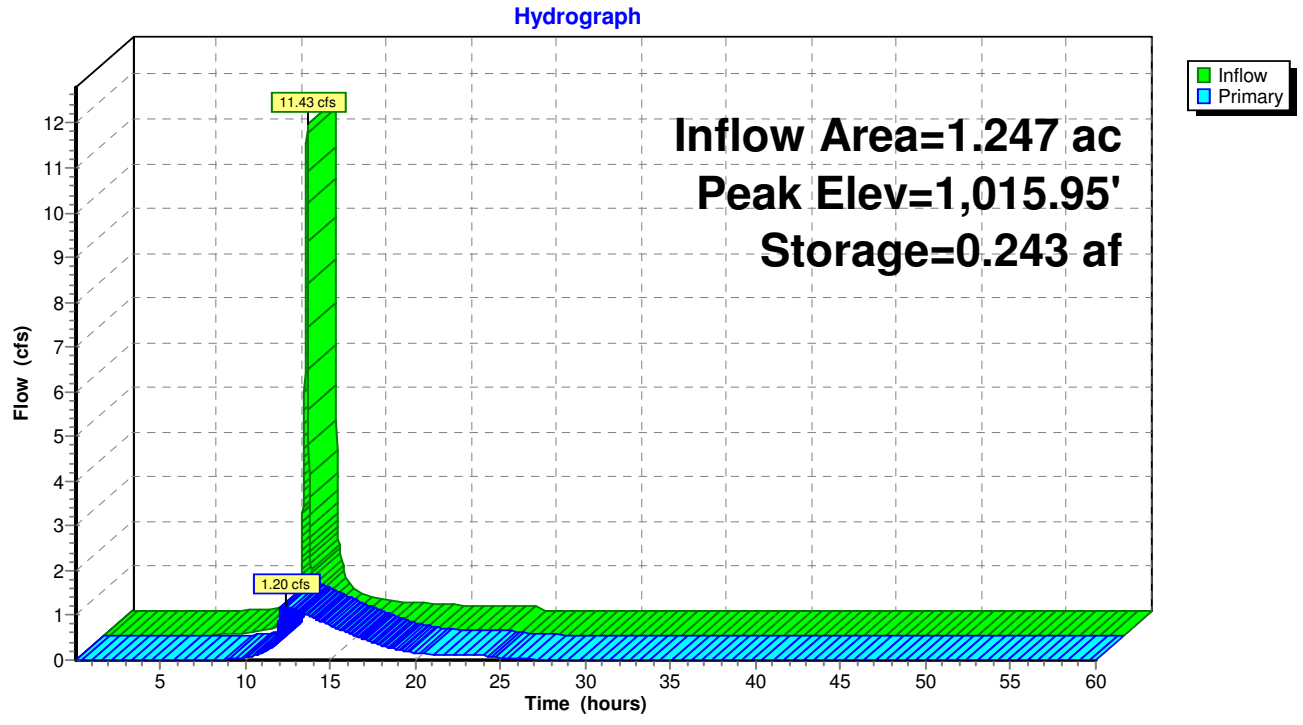
Plug-Flow detention time= 123.1 min calculated for 0.531 af (100% of inflow)
Center-of-Mass det. time= 123.0 min (928.0 - 805.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,012.40'	0.308 af	**77.0"W x 66.0"H x 570.00'L Parabolic Arch**

Device	Routing	Invert	Outlet Devices
#1	Primary	1,012.40'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.20 cfs @ 12.33 hrs HW=1,015.95' (Free Discharge)
1=Orifice/Grate (Orifice Controls 1.20 cfs @ 8.80 fps)

Pond 1S: DETENTION 1



Summary for Pond 2S: DETENTION 2

Inflow Area = 1.129 ac, 67.05% Impervious, Inflow Depth = 5.23" for 100-Year event
Inflow = 10.53 cfs @ 11.96 hrs, Volume= 0.492 af
Outflow = 1.16 cfs @ 12.29 hrs, Volume= 0.492 af, Atten= 89%, Lag= 20.1 min
Primary = 1.16 cfs @ 12.29 hrs, Volume= 0.492 af

Routing by Stor-Ind method, Time Span= 0.01-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,010.05' @ 12.29 hrs Surf.Area= 0.031 ac Storage= 0.227 af

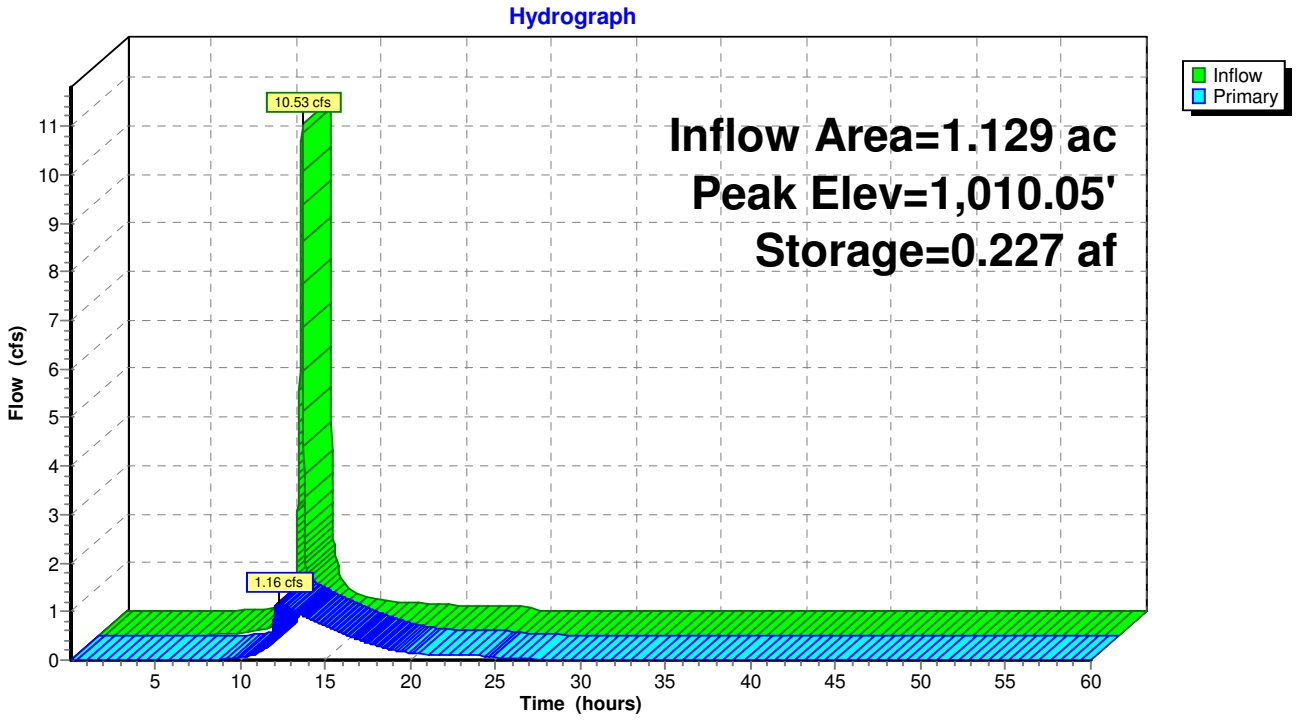
Plug-Flow detention time= 129.6 min calculated for 0.492 af (100% of inflow)
Center-of-Mass det. time= 129.3 min (931.9 - 802.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,006.70'	0.235 af	**77.0"W x 45.0"H x 637.50'L Parabolic Arch**

Device	Routing	Invert	Outlet Devices
#1	Primary	1,006.70'	**5.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.16 cfs @ 12.29 hrs HW=1,010.05' (Free Discharge)
1=Orifice/Grate (Orifice Controls 1.16 cfs @ 8.53 fps)

Pond 2S: DETENTION 2

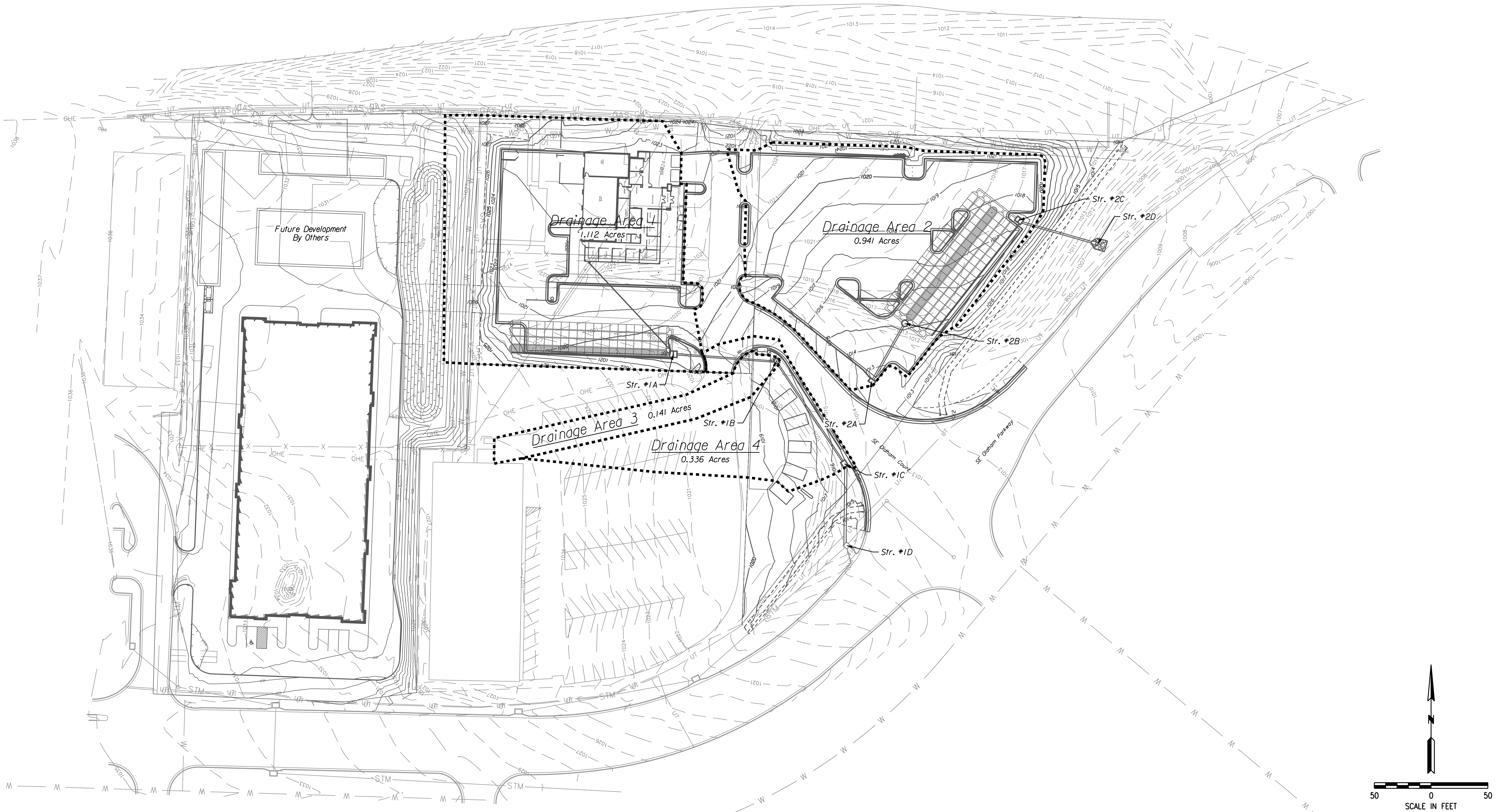


DRAINAGE SUMMARY:

After analyzing the upstream drainage area (Area 1 1.112 acres, Area 2 0.941 acres), with an AASHTO soil rating (C rating) and the slope of the finish grade (3%), it is determined that the outlet structures detailed in the plan sheets, the post developed rate of discharge for both areas (4.29 cfs) is less than the pre-developed drainage flow (14.99 cfs). The detention ponds would be capable of detaining 0.466 acre-feet with a bottom elevation of 1014.4 in Area 1 detention and a bottom elevation of 1006.7 in Area 2 detention. The detention areas would have a maximum 100 year storm event elevation of 1018.9 in Area 1 detention and 1011.4 in Area 2 detention. This elevation would occur at maximum volume. For more information, see Storm Water Drainage Analysis that was submitted along with these construction plans.

STORM SEWER CALCULATIONS

Storm Line	Sewer Location		Tributary Area (AC.)			Composite Runoff Coefficient	100-Year Design (k=1.25)		Pipe Design					
	From Structure No.	To Structure No.	Area Designation Acres		Total		Intensity (in/hr) i(100)	Runoff (cfs) Q(100)	Pipe Size (in)	Pipe Slope (%)	Pipe Type	Rough. Coeff. (Mannings)	Full Velocity (fps)	Full Flow (cfs)
Line 1	1A	1B	1	1.112	1.112	0.57	10.32	8.18	24	0.61	HDPE	0.01	7.31	22.97
	1B	1C	3	0.141	1.253	0.80	10.32	9.63	24	5.48	HDPE	0.01	21.90	68.84
	1C	1D	4	0.336	1.589	0.80	10.32	13.10	24	5.52	HDPE	0.01	21.99	69.09
Line 2	2A	2B	2	0.941	0.941	0.76	10.32	9.23	18	0.73	HDPE	0.01	6.60	11.67
	2C	2D	2	0.000	0.941	0.30	10.32	9.23	18	0.72	HDPE	0.01	6.56	11.59



DATE	REVISION	NO.	BY	CK/APP
9/3/19	Addressed bid questions in regards to ME-201	3	RAM	RKS
7/16/19	Addressed City Comment Letter dated 6/28/19	2	RAM	RKS
6/14/19	PDP Submittal	1	RAM	RKS

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9/3/19

R. KEVIN STERRETT, MO E-26440

Consult Inc engineers planners
11010 Haskell St. Ste 210 Kansas City, KS 66109 816-759-2285 CORPORATE LICENSE No. E2010005873

DRAINAGE AREA MAP

ARISTOCRAT MOTORS

LEE'S SUMMIT - JACKSON COUNTY - MISSOURI

X-REF NO. XXX

DRAWING NO. XXX

DATE September 2019

JOB NO. 19.006.01

7 SHEET OF 14

REV.

9/3/2019
FDP-DrainageAreaMap.dgn