STORM WATER DRAINAGE ANALYSIS

KANSAS CITY MOTORS

LEES SUMMIT, MISSOURI

PREPARED BY

HG CONSULT, INC.

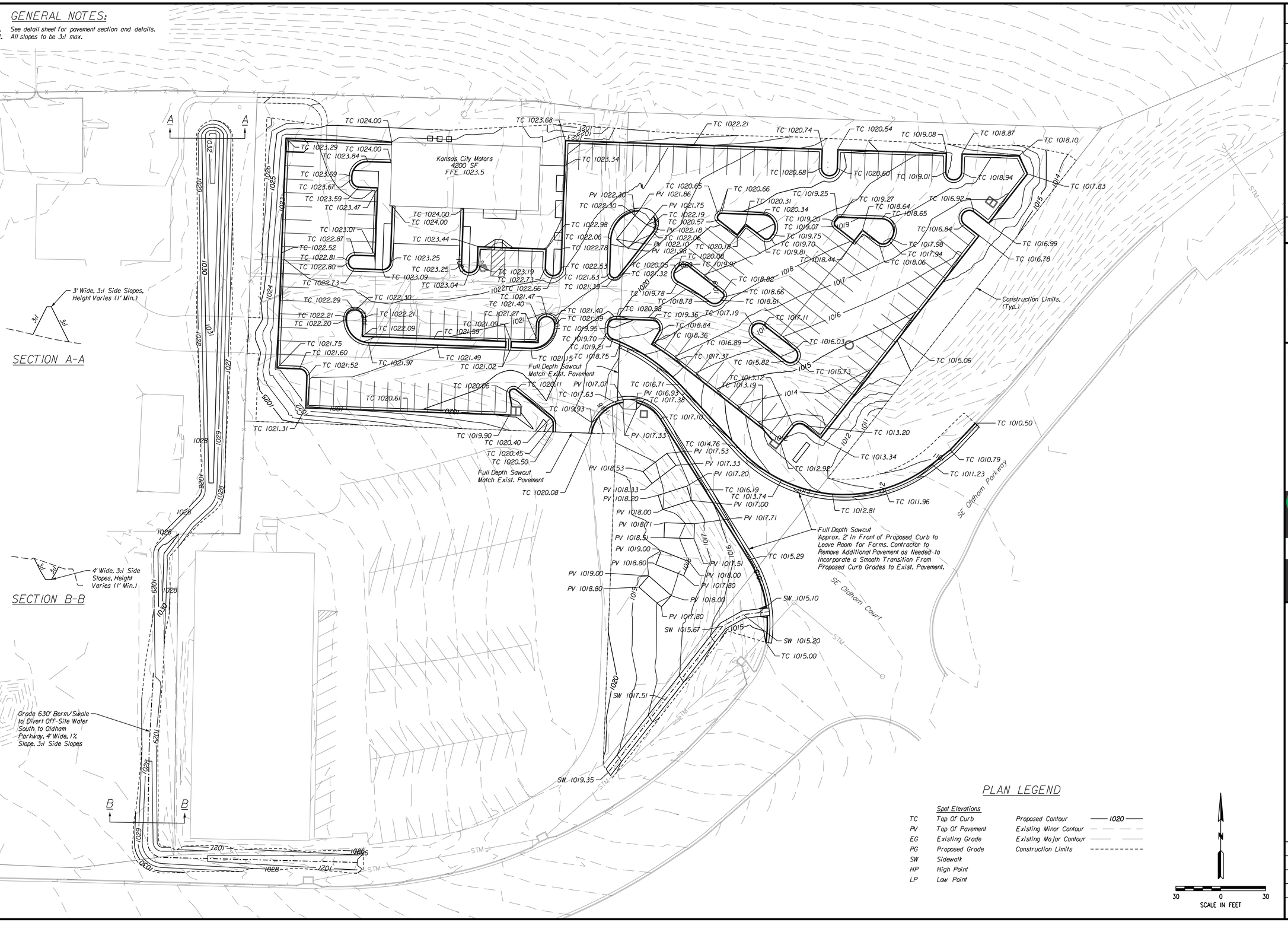
June 16, 2017

Included in this report is an analysis of the watershed draining to two proposed detention ponds. This analysis is an estimate taking into account the drainage area and time of concentration utilizing HydroCAD storm water modeling software. After analyzing the upstream drainage area (Area 1 – 0.976 acres, Area 2 – 0.903 acres), with an AASHTO soil rating (A rating) and the slope of the finish grade (3%), it is determined that by providing an orifice release size of five inches, the post developed rate of discharge for both areas (3.78 cfs) is less than the pre-developed drainage flow (4.08 cfs). The detention pond would be capable of detaining 0.541 acre-feet with a bottom elevation of 1006.78 in Area 1 detention and a bottom elevation of 1012.48 in Area 2 detention. The detention areas would have a maximum 100 year storm event elevation of 1012.20 in Area 1 detention and 1017.90 in Area 2 detention. This elevation would occur at maximum volume.

Grade berm/swale to divert off-site water South to Oldham Parkway. After anyalyzing the upstream drainage area (Area 4 - 2.569 Acres) it is determined that by providing a 4' wide swale with 3:1 side slopes at a maximum flow depth of 0.8', the swale can carry the 100 year flow of 11.6 cfs.

GENERAL NOTES:

1. See detail sheet for pavement section and details.
2. All slopes to be 3:1 max.



PLAN LEGEND

Spot Elevations

TC	Top Of Curb
PV	Top Of Pavement
EG	Existing Grade
PG	Proposed Grade
SW	Sidewalk
HP	High Point
LP	Low Point

Proposed Contour	1020
Existing Minor Contour	
Existing Major Contour	
Construction Limits	

30 0 30
SCALE IN FEET

NO.	BY	CK/APP	DATE	REVISION

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STATE OF MISSOURI
R. KEVIN STERRETT
NUMBER PE-2006440
PROFESSIONAL ENGINEER

R. KEVIN STERRETT, MO E-26440
6/16/17

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planners
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GRADING PLAN

KANSAS CITY MOTORS

LEE'S SUMMIT - JACKSON COUNTY - MISSOURI

X-REF NO.	XXX
DRAWING NO.	XXX
DATE	June 16, 2017
JOB NO.	16.045.01
SHEET OF	4 OF 17

REV.

GENERAL NOTES:

1. All storm sewer pipe to be HDPE w/ smooth interior.

Kansas City Motors
4200 SF
FFE 1023.5

Lot 1
OLDHAM EAST BUSINESS PARK
125,611 SQ. FT.
2.884 AC

Lot 2
OLDHAM EAST BUSINESS PARK
54,388 SQ. FT.
1.248 AC

Lot 3
OLDHAM EAST BUSINESS PARK
68,913 SQ. FT.
1.582 AC

Str. #2C (See Detail, This Sheet)
4'x6' Baffle Box
w/ Traffic Bearing Lid
Top El. 1016.85
N: 996034.22
E: 2828897.25
FL In (NW, SW) 1007.58 (15" HDPE)
5" Hole FL 1006.70 (Interior Wall)
Interior Wall Top El. 1011.70 (Emergency Overflow)
FL In (SW) 1006.70 (6" HDPE Underdrain)
FL Out (SE) 1006.50 (15" HDPE)

64.6 LF of 15" HDPE @ 0.77%

Str. #2D
End Section (15" HDPE)
w/ Concrete Toe Wall &
11.6 S.Y. of 24" Thick
Class III Riprap (D50=12")
N: 995993.68
E: 2828951.36
FL Out 1006.00

See ADS Storm Tech Detention Plans

126 LF of 6" HDPE Underdrain

78.9 LF of 15" HDPE @ 0.5%

See ADS Storm Tech Detention Plans

80.5 LF of 15" HDPE @ 0.66%

143 LF of 6" HDPE Underdrain

Str. #1A (See Detail, This Sheet)
5'x6' Baffle Box Curb Inlet
Top El. 1019.90
N: 995894.70
E: 2828579.70
FL Out (N) 1015.10 (15" HDPE)
FL Out (W) 1013.32 (24" HDPE)
5" Hole FL 1012.40 (Interior Wall)
Interior Wall Top El. 1017.40 (Emergency Overflow)
FL Out (E) 1012.20 (15" HDPE)
Install Flex Storm Filter for WQ BMP

Str. #2B
5' Dia. Concrete Manhole
w/ Traffic Bearing Lid
Top El. 1014.94
N: 995938.79
E: 2828802.30
FL In (SW) 1009.90 (15" HDPE)
FL Out (NW, SE) 1009.40 (15" HDPE)
FL Out (NE) 1007.62 (24" HDPE)

Str. #1B
4'x4' Field Inlet w/ 8" Throat (W,S)
Top El. 1017.35
N: 995892.72
E: 2828665.17
Throat El. 1016.18
FL In (W) 1011.67 (15" HDPE)
FL Out (SE) 1011.17 (15" HDPE)

Str. #2A
5'x3' Curb Inlet
Top El. 1012.92
N: 995872.61
E: 2828752.35
FL Out (NE) 1010.30 (15" HDPE)
Install Flex Storm Filter for WQ BMP

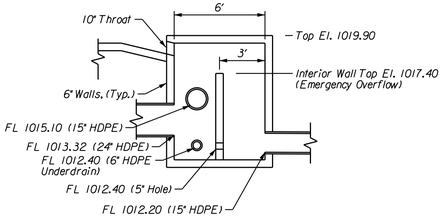
173.8 LF of 15" HDPE @ 0.66%

Str. #1C
Exist. Field Inlet
Top El. 1013.72
FL In (NW) 1010.02 (15" HDPE)
FL In (W) 1009.77 (Exist. 18" HDPE)
FL Out (NE) 1009.22 (Exist. 24" HDPE)

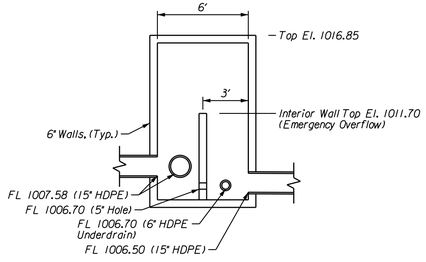
SE Oldham Court

SE Oldham Parkway

Note: For structural reinforcement, contractor shall mimmic that of the curb inlet and field inlet details located on sheets 14 & 15 in these construction plans.



STR. #1A
(FACING NORTH)



STR. #2C
(FACING NORTHEAST)

SCALE IN FEET
30 0 30

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STATE OF MISSOURI
R. KEVIN STERRETT
NUMBER 2006440
PROFESSIONAL ENGINEER

6/16/17

R. KEVIN STERRETT, MO E-26440

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

STORM SEWER PLAN

KANSAS CITY MOTORS
LEE'S SUMMIT - JACKSON COUNTY - MISSOURI

X-REF NO.
XXX
DRAWING NO.
XXX
DATE
June 16, 2017
JOB NO.
16.045.01

6 SHEET OF 17

REV.

DRAINAGE SUMMARY:

After analyzing the upstream drainage area (Area 1 - 0.976 acres, Area 2 - 0.903 acres, with an AASHTO soil rating (A rating) and the slope of the finish grade (3%), it is determined that by providing an orifice release size of five inches, the post developed rate of discharge for both areas (3.78 cfs) is less than the pre-developed drainage flow (4.08 cfs). The detention ponds would be capable of detaining 0.541 acre-feet with a bottom elevation of 1012.48 in Area 1 detention and a bottom elevation of 1006.78 in Area 2 detention. The detention areas would have a maximum 100 year storm even elevation of 1017.90 in Area 1 detention and 1012.20 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.

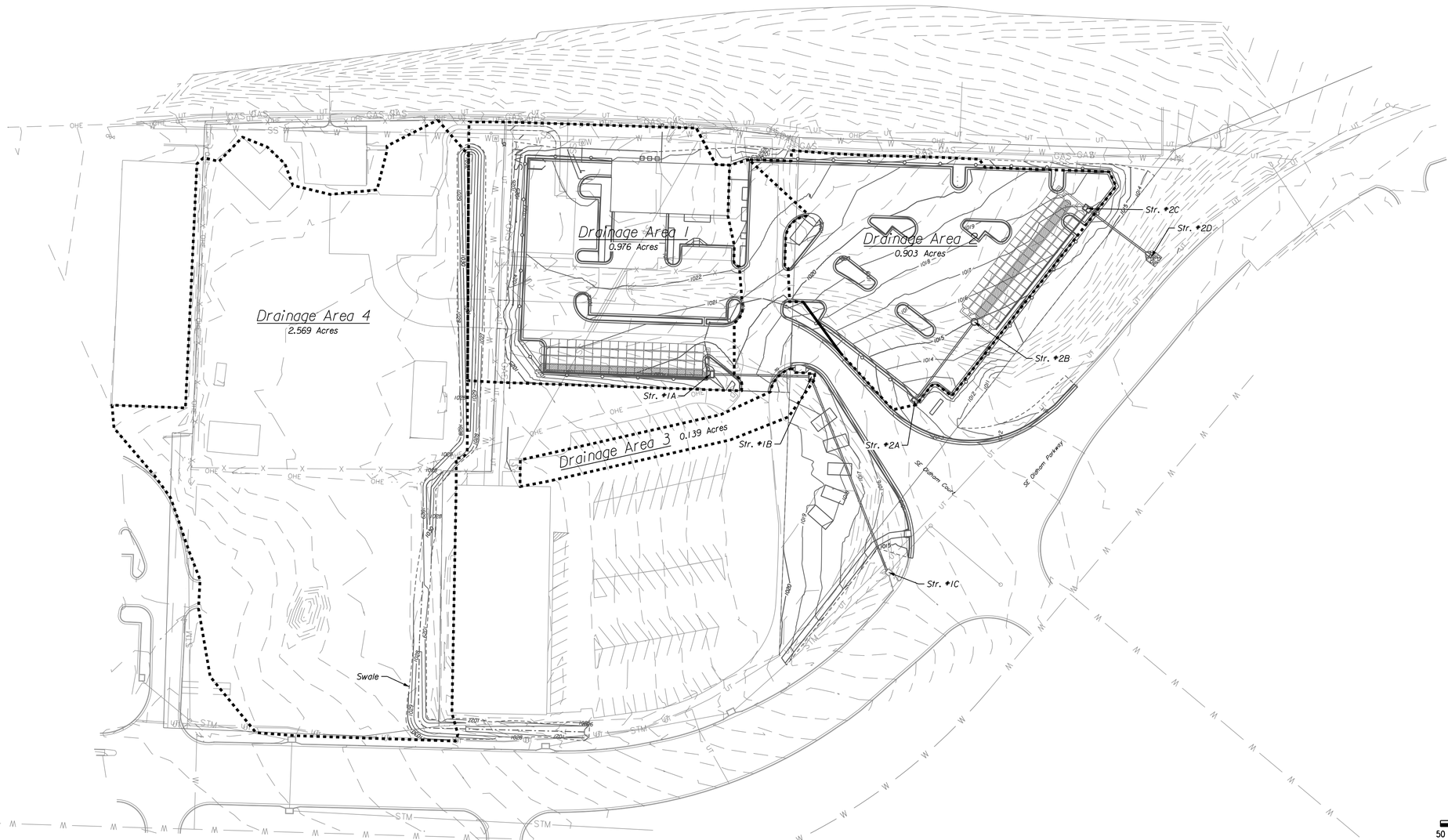
Grade berm/swale to divert off-site water South to Oldham Parkway. After anyalyzing the upstream drainage area (Area 4 - 2.569 Acres) it is determined that by providing a 4' wide swale with 3:1 side slopes at a maximum flow depth of 0.8', the swale can carry the 100 year flow of 11.6 cfs.

STORM SEWER CALCULATIONS

Storm Line	Sewer Location		Tributary Area (AC.)			Composite Runoff Coefficient	100-Year Design (k=1.25)		Pipe Design					
								Runoff (cfs)						
	From Structure No.	To Structure No.	Area Designation	Acres	Total		Intensity (in/hr) i(100)	Q(100)	Pipe Size (in)	Pipe Slope (%)	Pipe Type	Rough. Coeff. (Mannings)	Full Velocity (fps)	Full Flow (cfs)
Line 1	1A	1B	1	0.976	0.976	0.30	10.32	3.78	15	0.66	HDPE	0.012	4.63	5.68
	1B	1C	3	0.139	1.115	0.30	10.32	4.32	15	0.66	HDPE	0.012	4.63	5.68
Line 2	2A	2B	2	0.903	0.903	0.30	10.32	3.49	15	0.50	HDPE	0.012	4.03	4.95
	2C	2D	2	0.000	0.903	0.30	10.32	3.49	15	0.77	HDPE	0.012	5.00	6.14

SWALE CALCULATIONS

Swale Width	100-Year Flow (cfs)	Avg. Slope	Depth (ft)	Velocity (fps)	Area (S.F.)	Hyd. Radius (ft)	Shear Stress (psf)
4	11.6	1.0%	0.8	3.5	3.4	0.6	0.5



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STATE OF MISSOURI
R. KEVIN STERRETT
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PROFESSIONAL ENGINEER

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DRAINAGE AREA MAP

KANSAS CITY MOTORS
LEE'S SUMMIT - JACKSON COUNTY - MISSOURI

X-REF. NO.
XXX
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16.045.01
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7 17

REV.

AASHTO Group Classification (Surface)—Jackson County, Missouri
(KC 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.

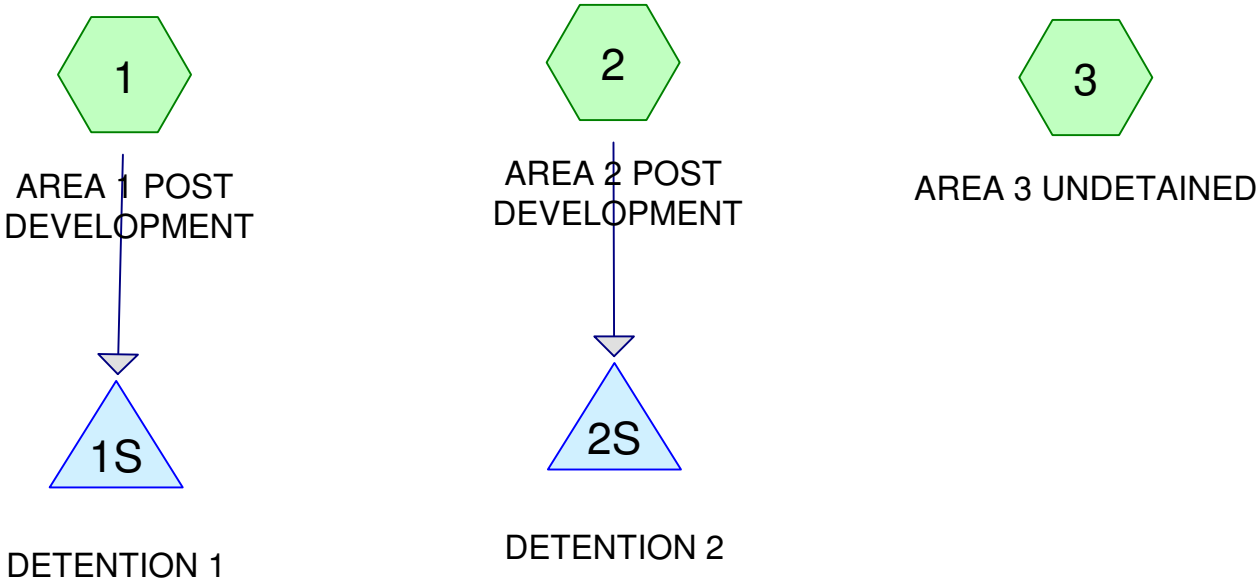
Rating Options

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

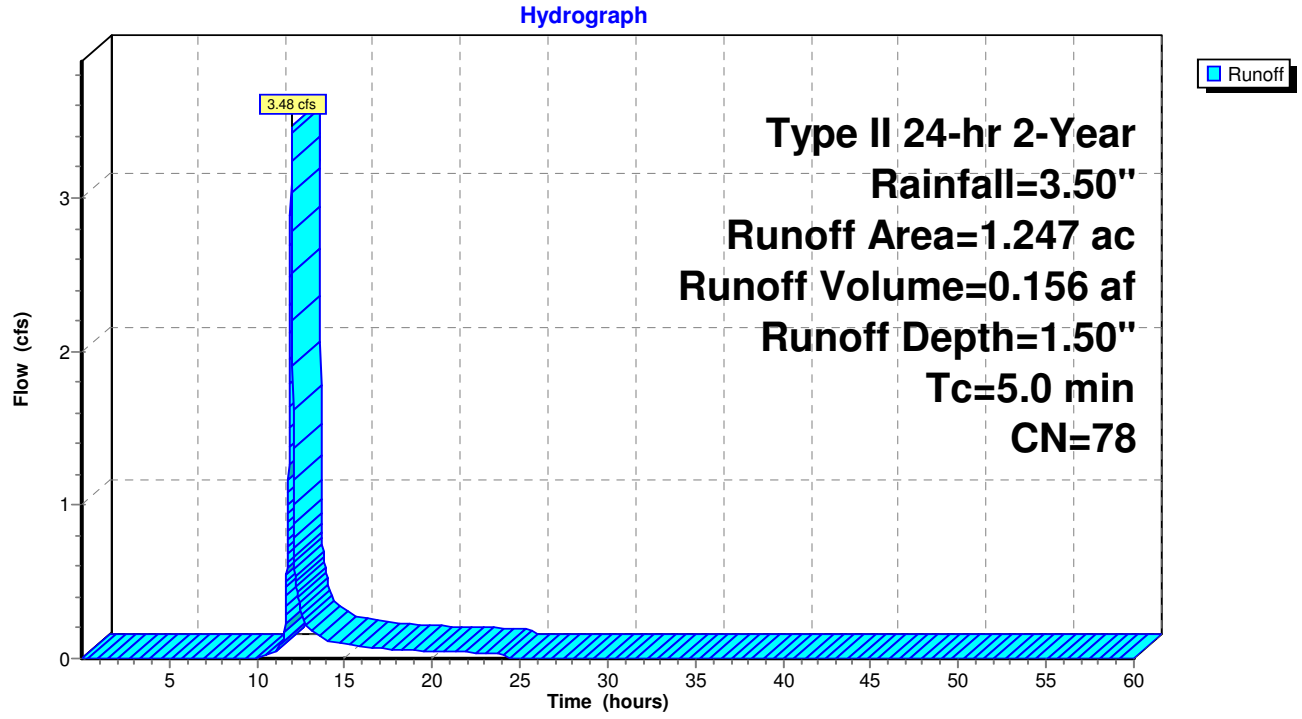
Runoff = 3.48 cfs @ 11.96 hrs, Volume= 0.156 af, Depth= 1.50"

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

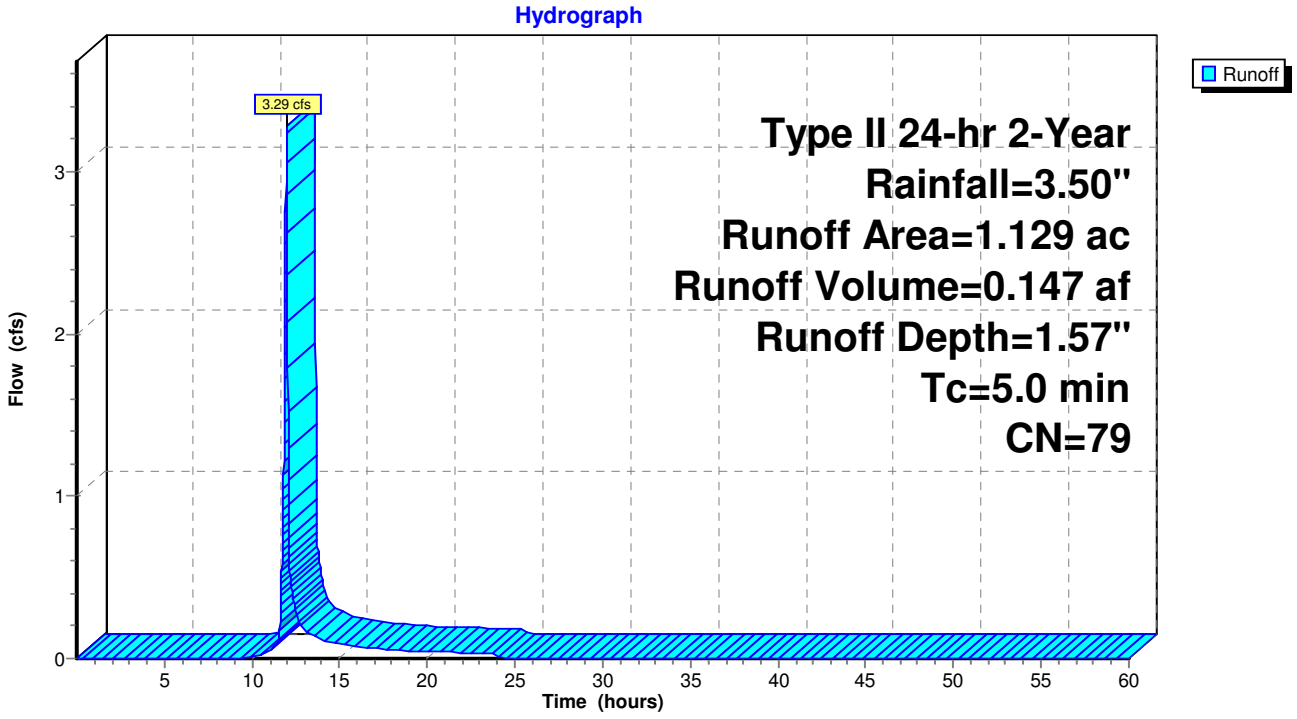
Runoff = 3.29 cfs @ 11.96 hrs, Volume= 0.147 af, Depth= 1.57"

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

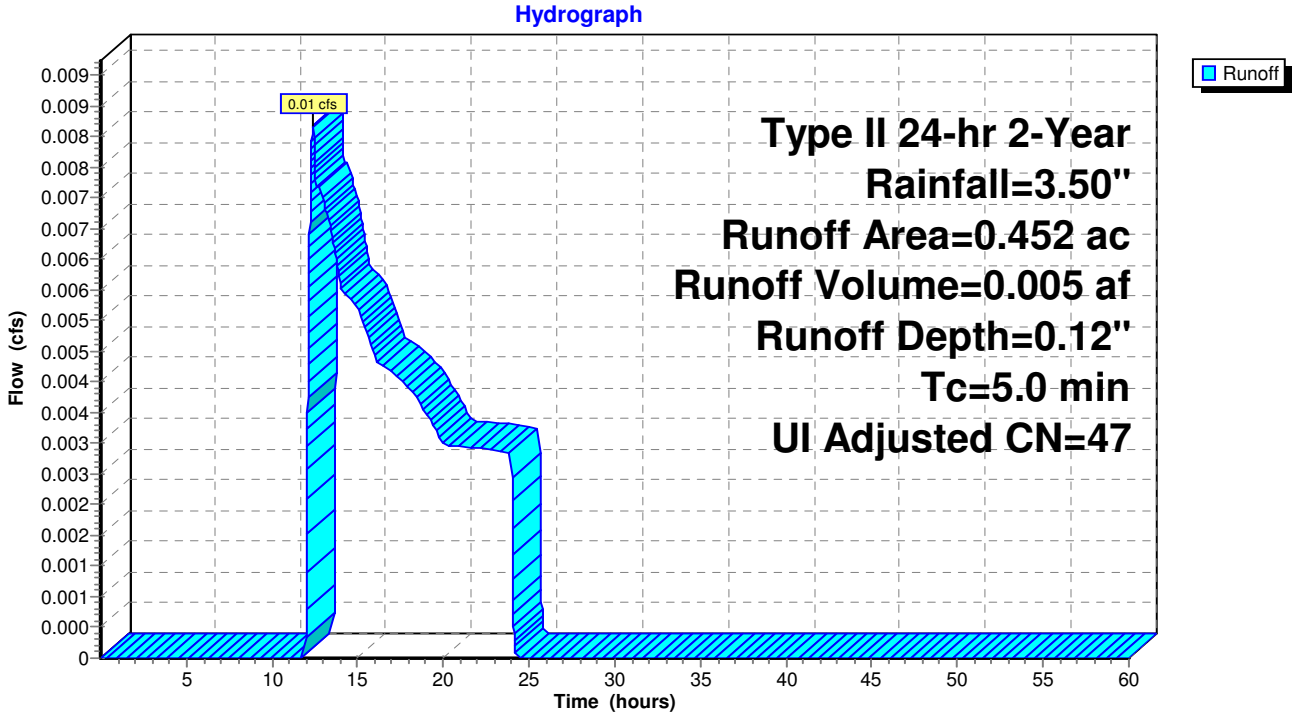
Runoff = 0.01 cfs @ 12.39 hrs, Volume= 0.005 af, Depth= 0.12"

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

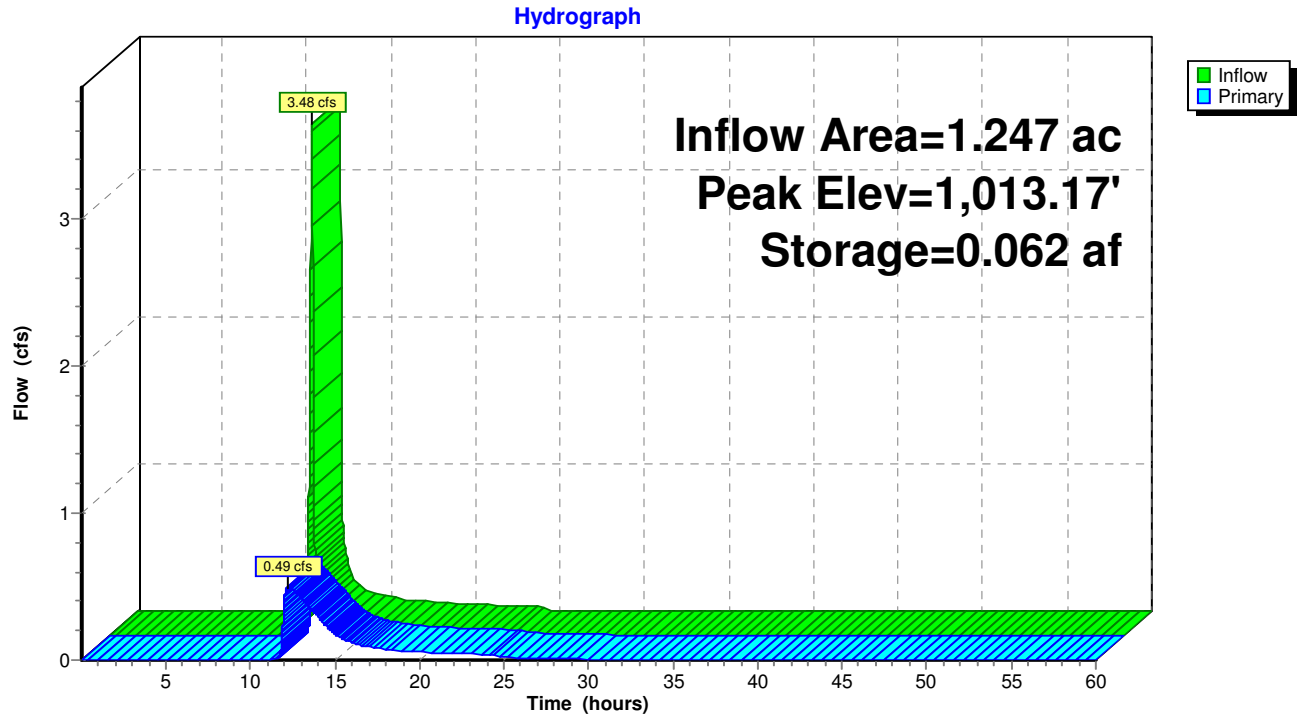
Plug-Flow detention time= 120.6 min calculated for 0.156 af (100% of inflow)
Center-of-Mass det. time= 120.5 min (960.6 - 840.1)

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

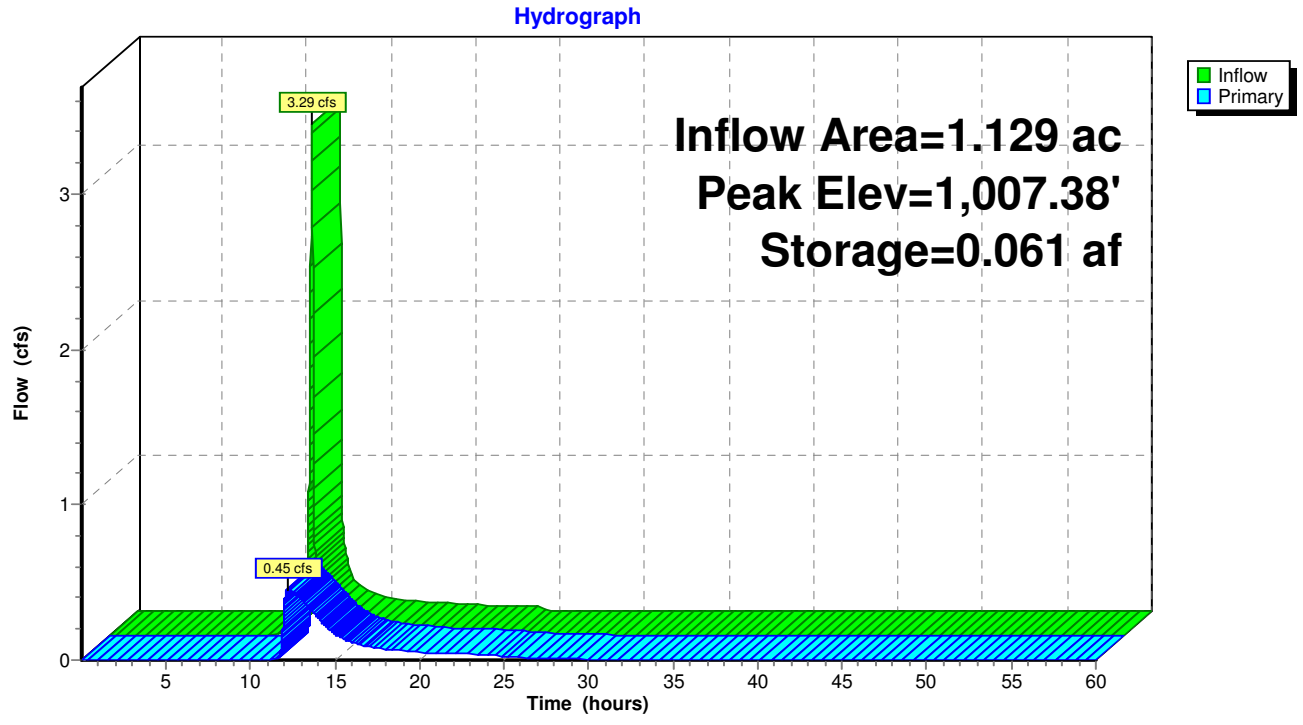
Plug-Flow detention time= 139.5 min calculated for 0.147 af (100% of inflow)
Center-of-Mass det. time= 138.8 min (976.0 - 837.1)

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

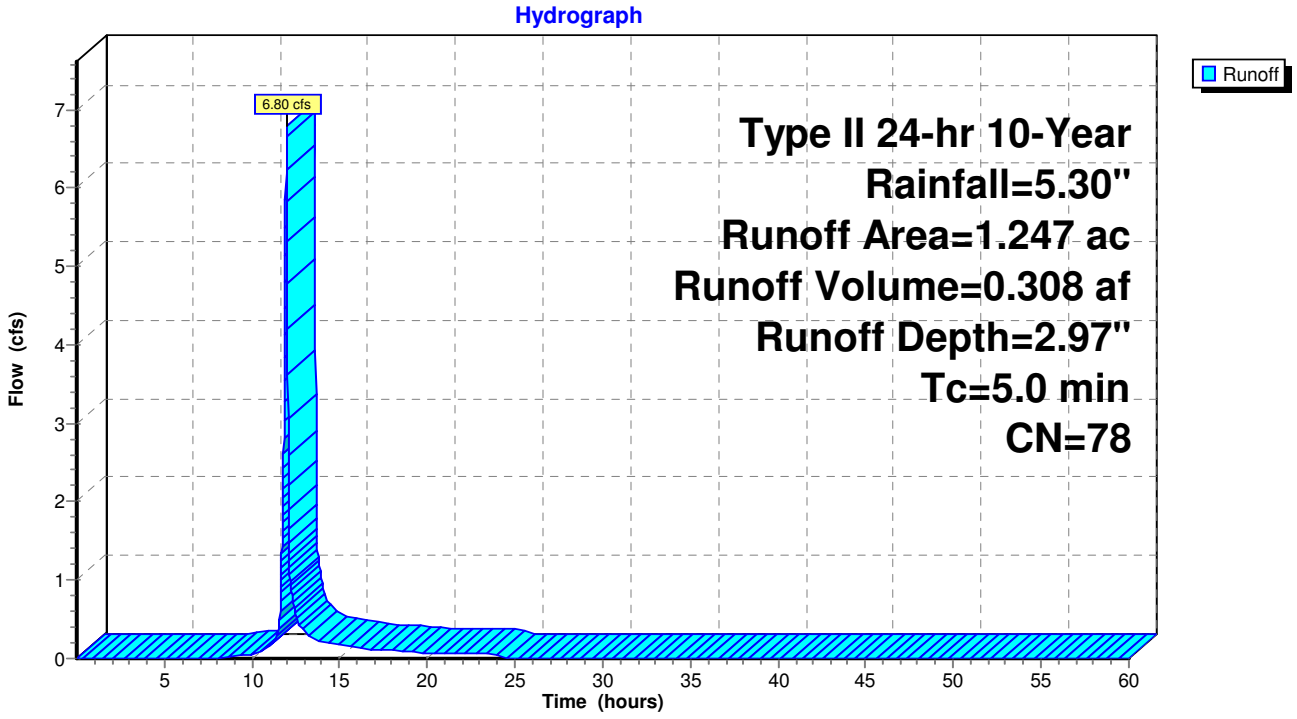
Runoff = 6.80 cfs @ 11.96 hrs, Volume= 0.308 af, Depth= 2.97"

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

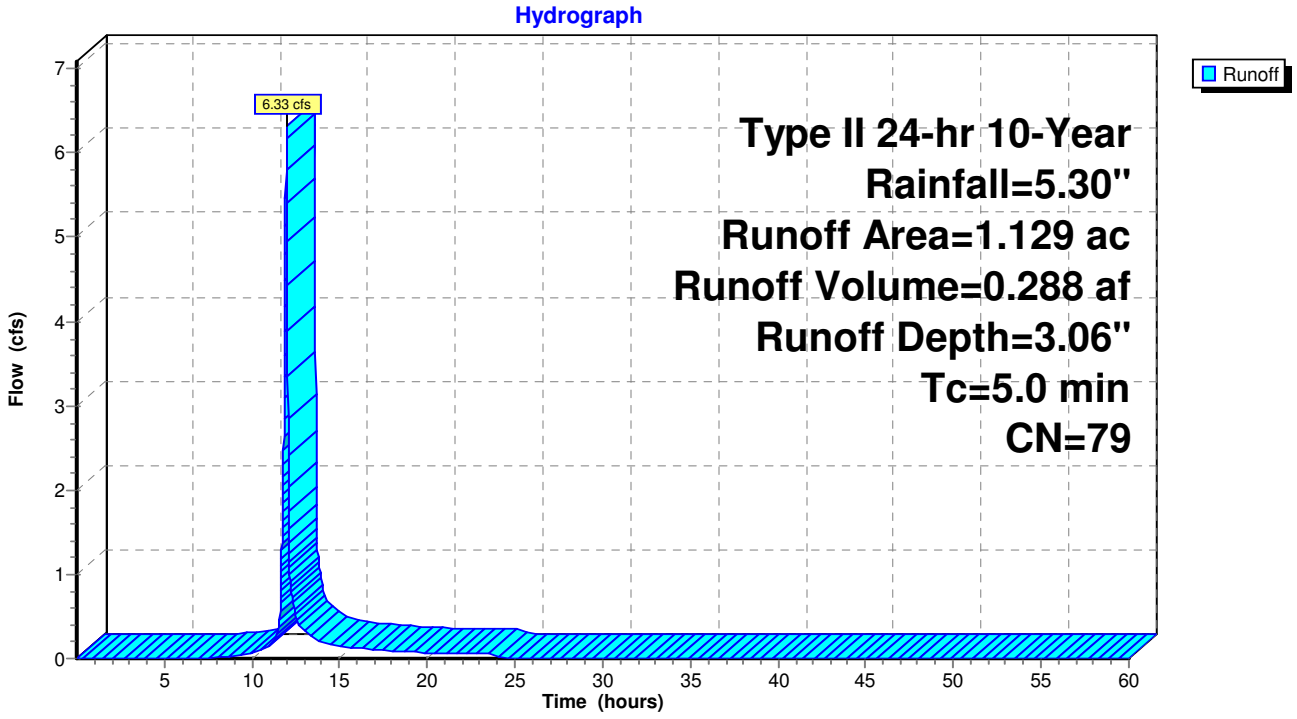
Runoff = 6.33 cfs @ 11.96 hrs, Volume= 0.288 af, Depth= 3.06"

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

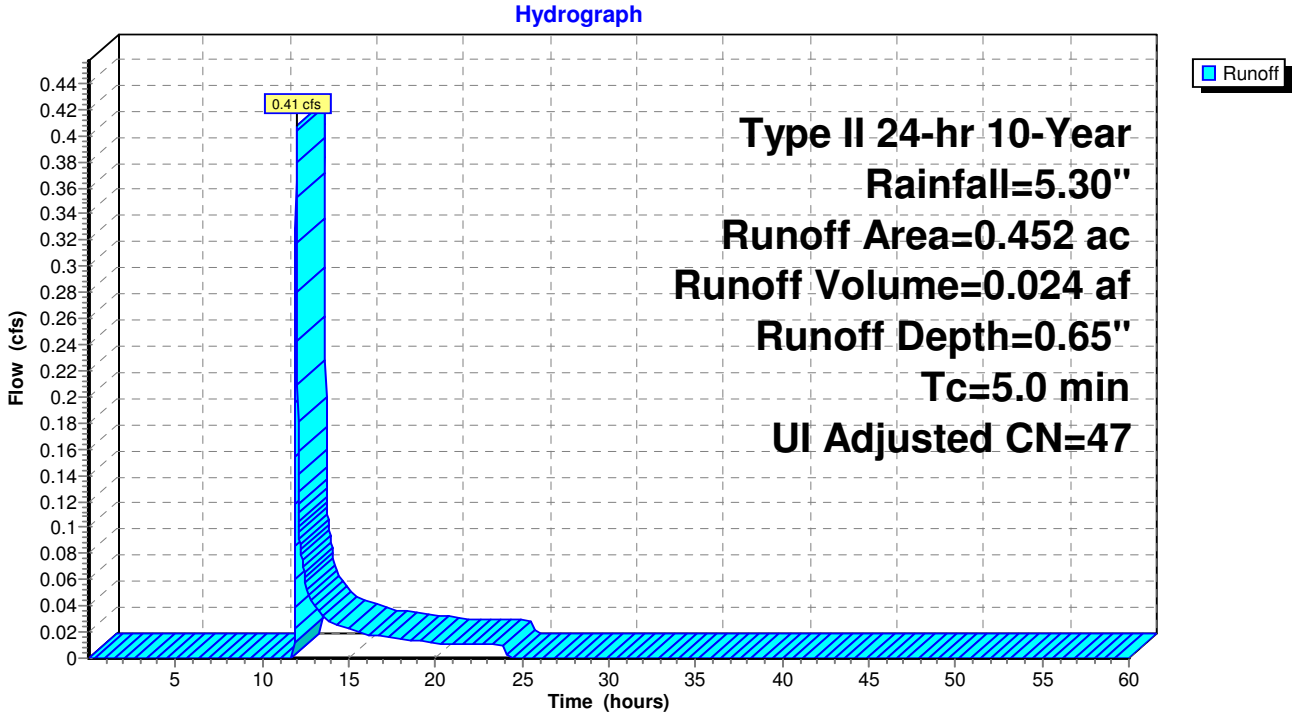
Runoff = 0.41 cfs @ 11.99 hrs, Volume= 0.024 af, Depth= 0.65"

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

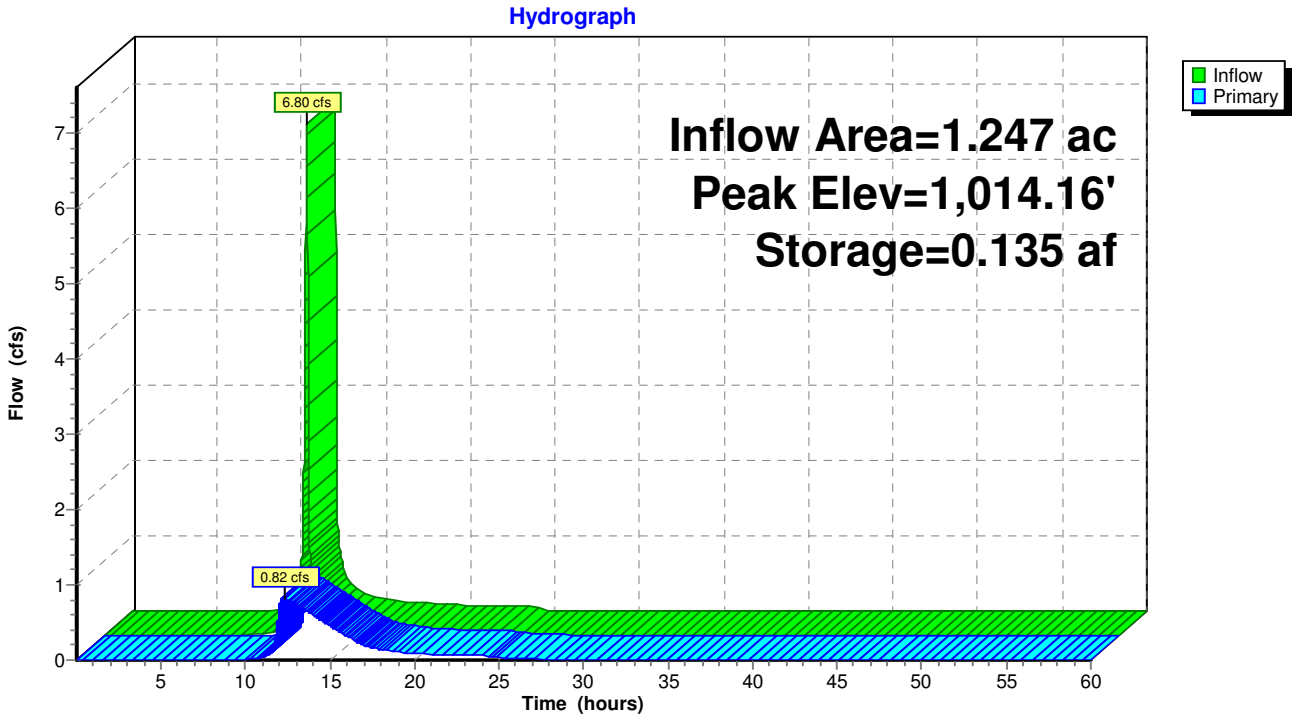
Plug-Flow detention time= 114.5 min calculated for 0.308 af (100% of inflow)
Center-of-Mass det. time= 114.8 min (935.2 - 820.5)

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

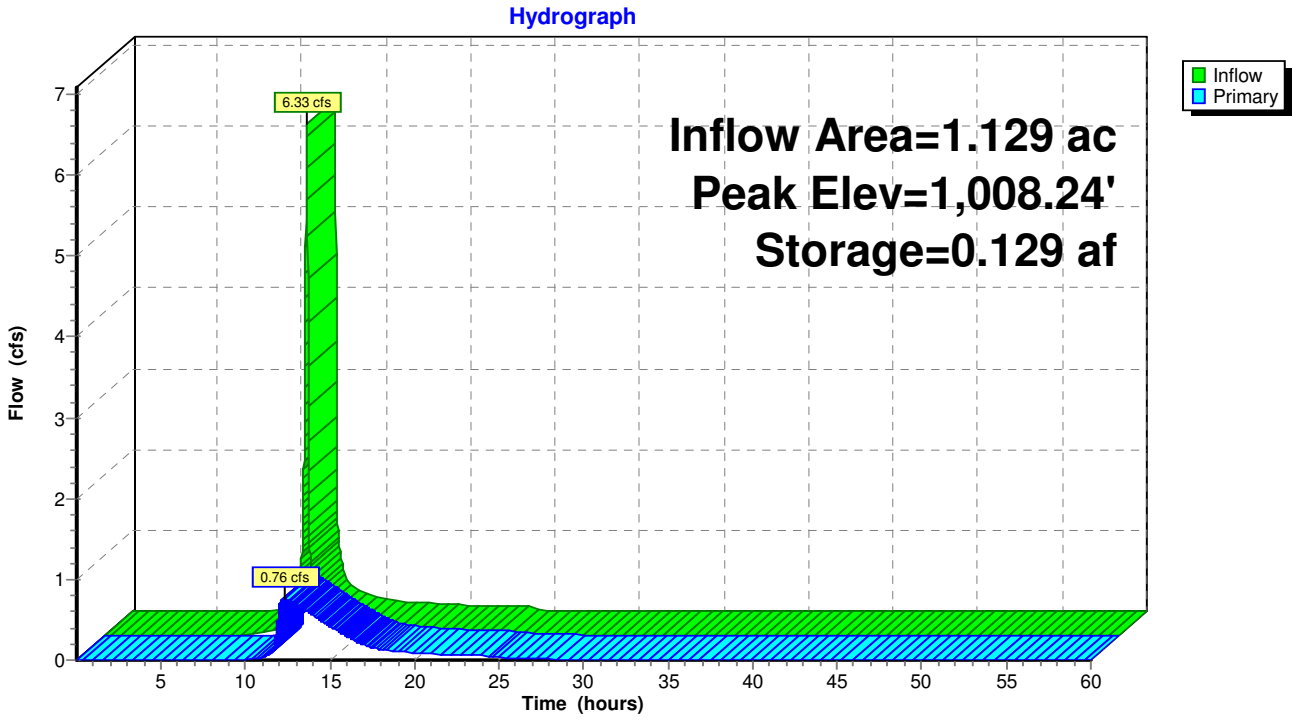
Plug-Flow detention time= 126.6 min calculated for 0.288 af (100% of inflow)
Center-of-Mass det. time= 126.4 min (944.3 - 817.9)

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

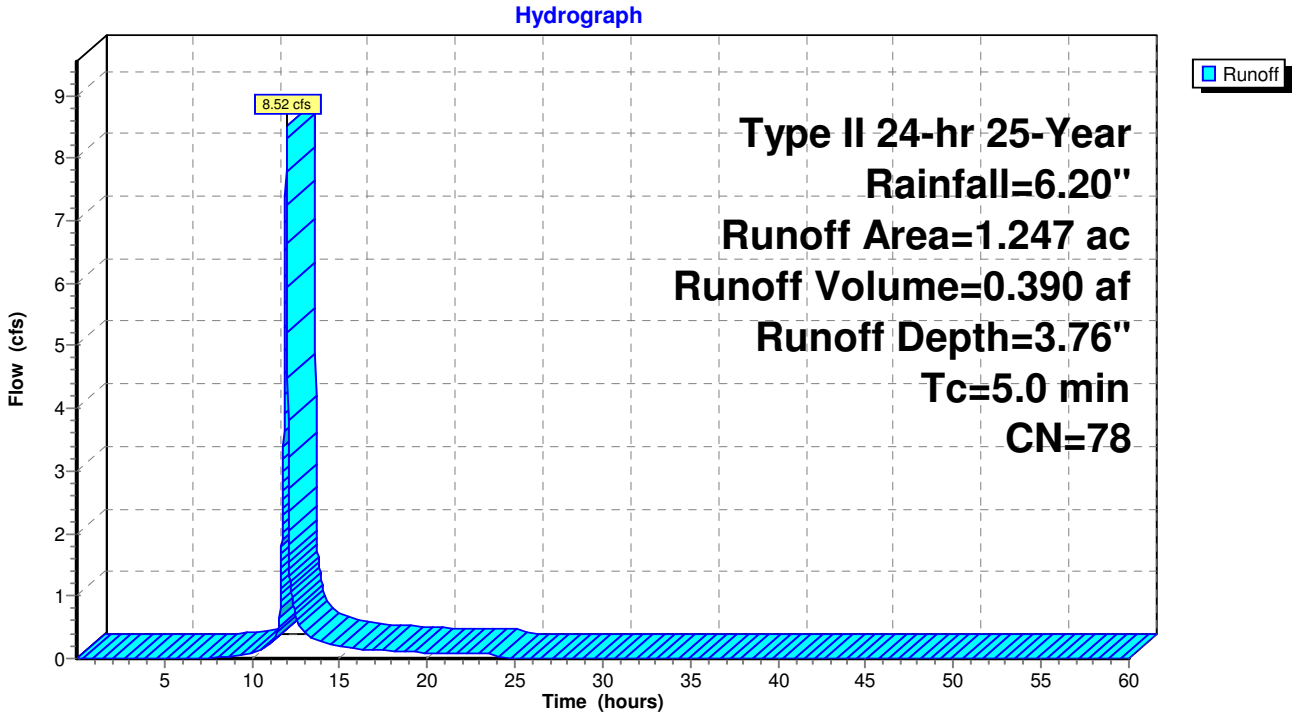
Runoff = 8.52 cfs @ 11.96 hrs, Volume= 0.390 af, Depth= 3.76"

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

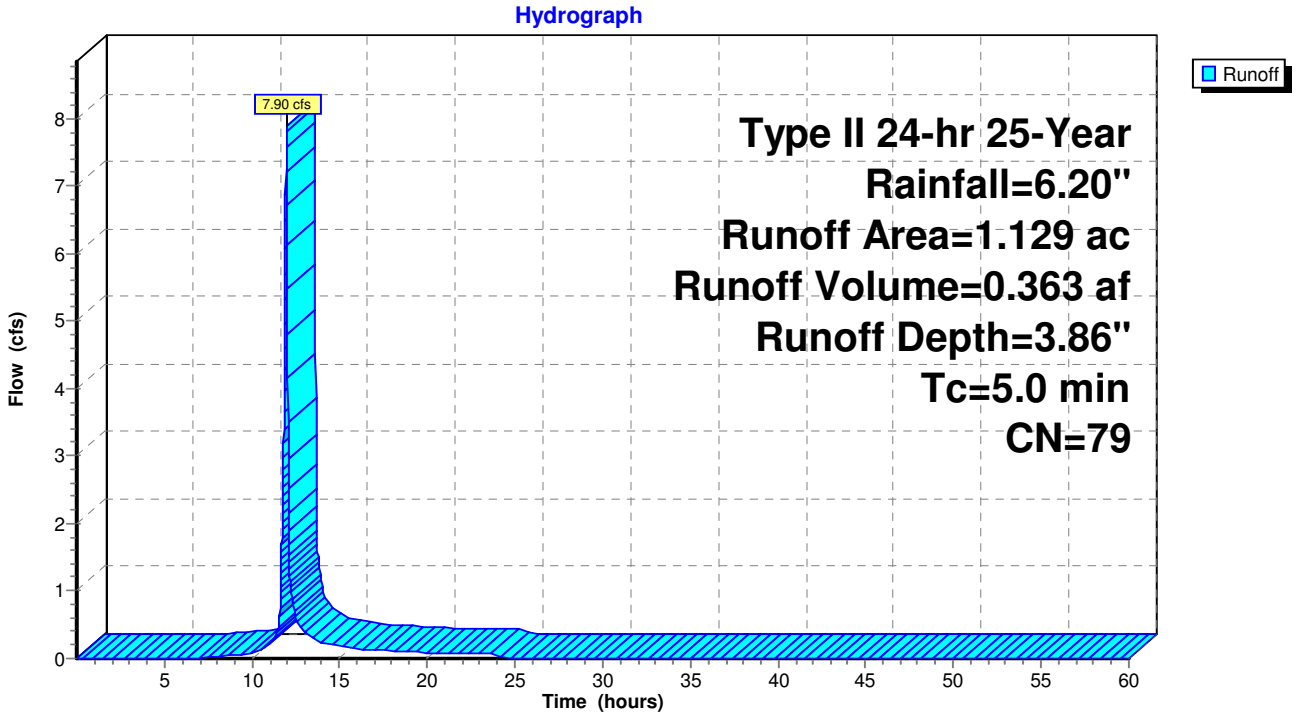
Runoff = 7.90 cfs @ 11.96 hrs, Volume= 0.363 af, Depth= 3.86"

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

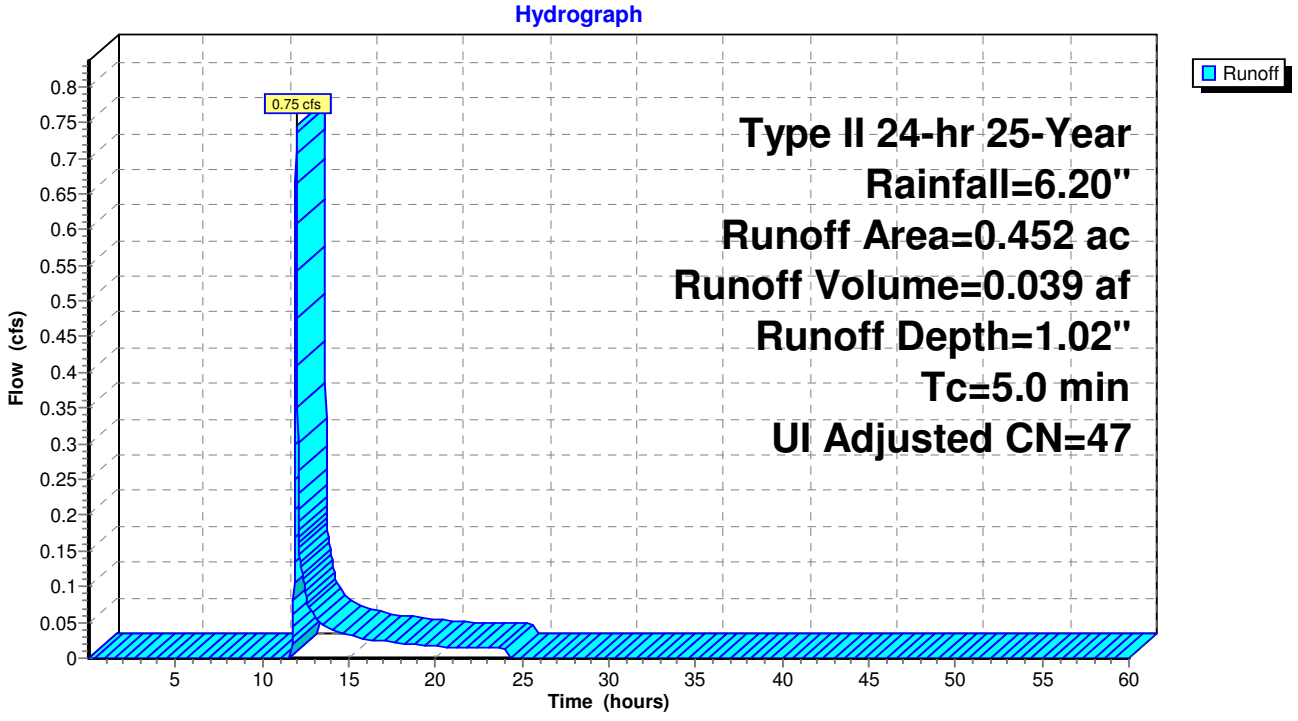
Runoff = 0.75 cfs @ 11.98 hrs, Volume= 0.039 af, Depth= 1.02"

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

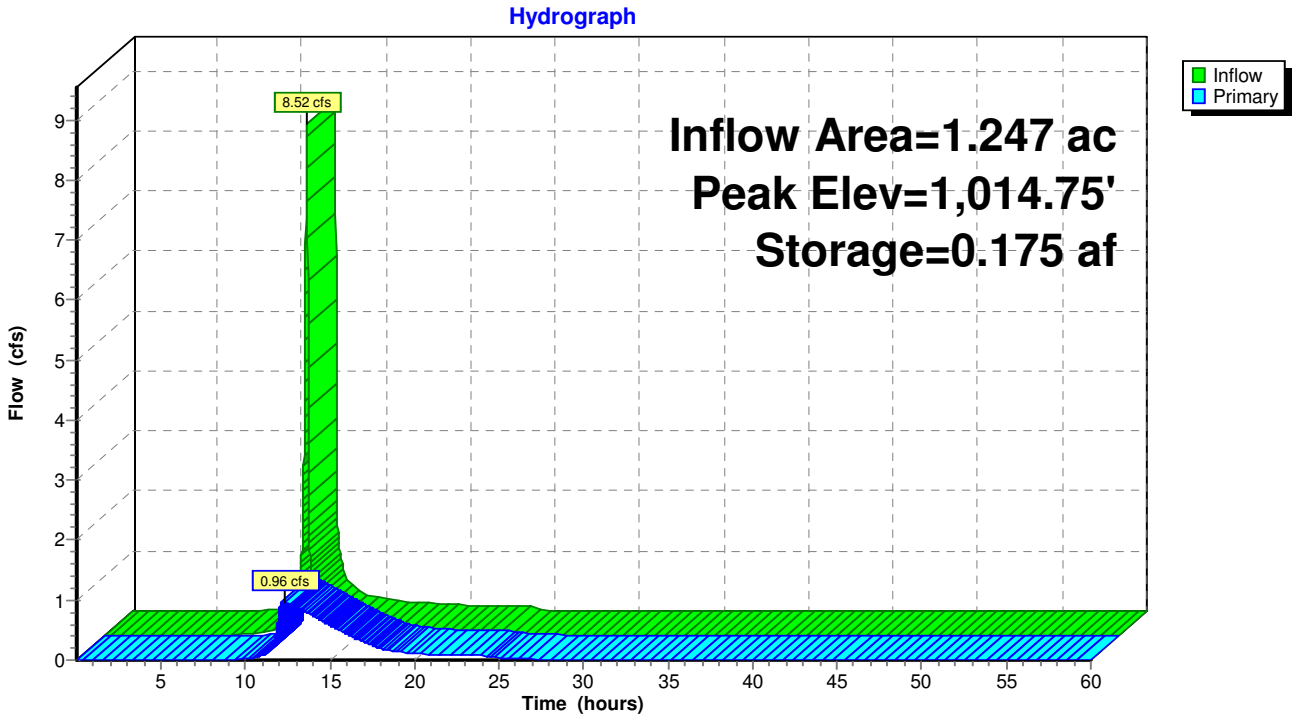
Plug-Flow detention time= 117.1 min calculated for 0.390 af (100% of inflow)
Center-of-Mass det. time= 117.3 min (931.1 - 813.8)

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

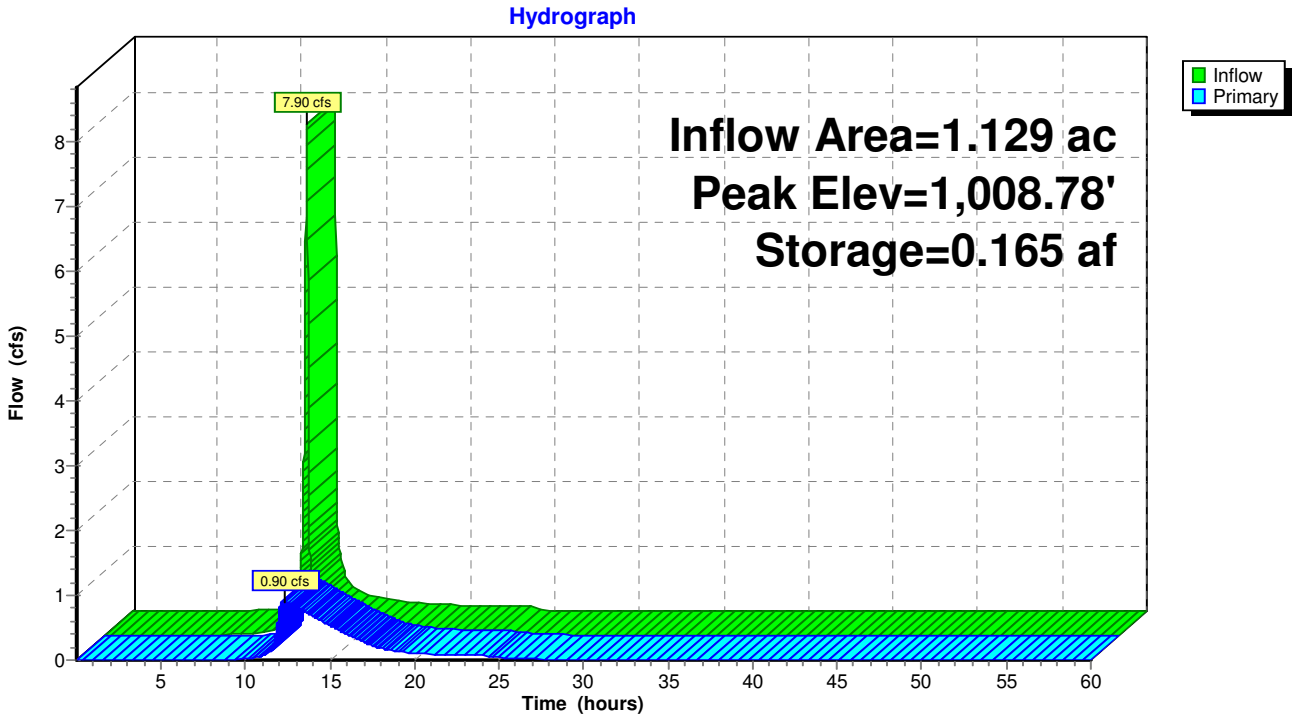
Plug-Flow detention time= 127.1 min calculated for 0.363 af (100% of inflow)
Center-of-Mass det. time= 127.0 min (938.3 - 811.3)

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

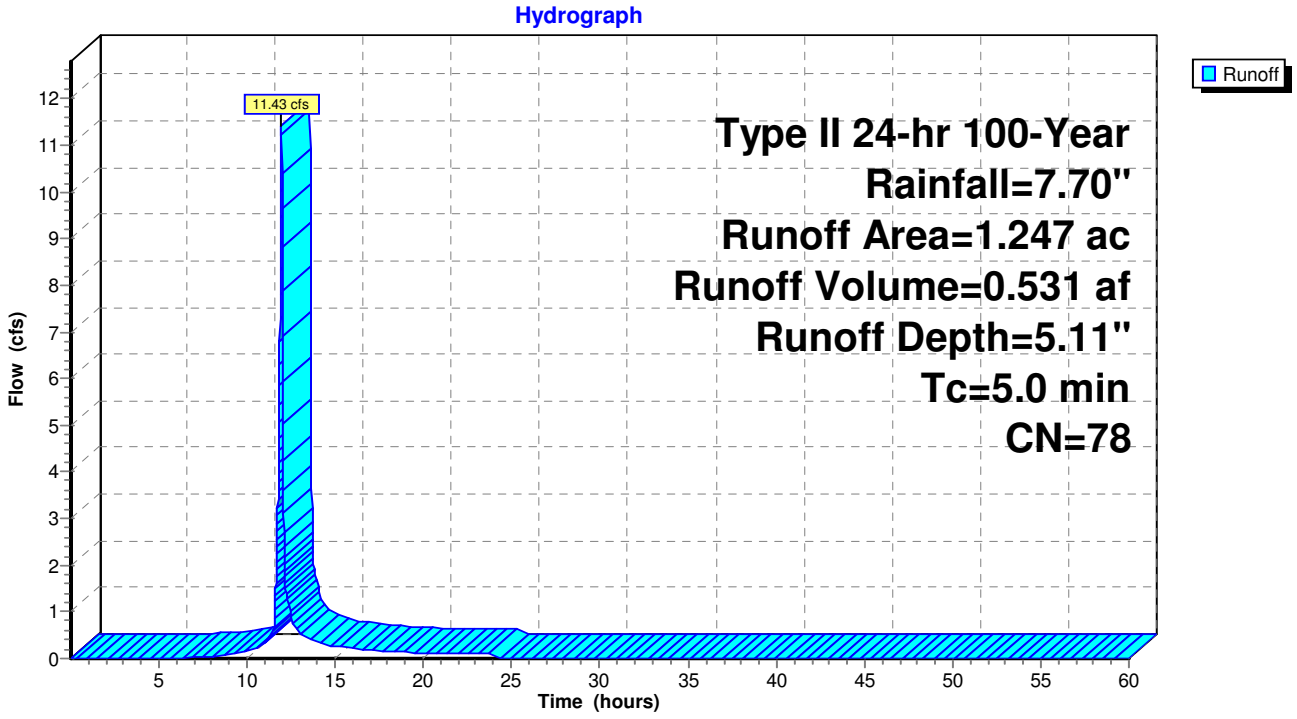
Runoff = 11.43 cfs @ 11.96 hrs, Volume= 0.531 af, Depth= 5.11"

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

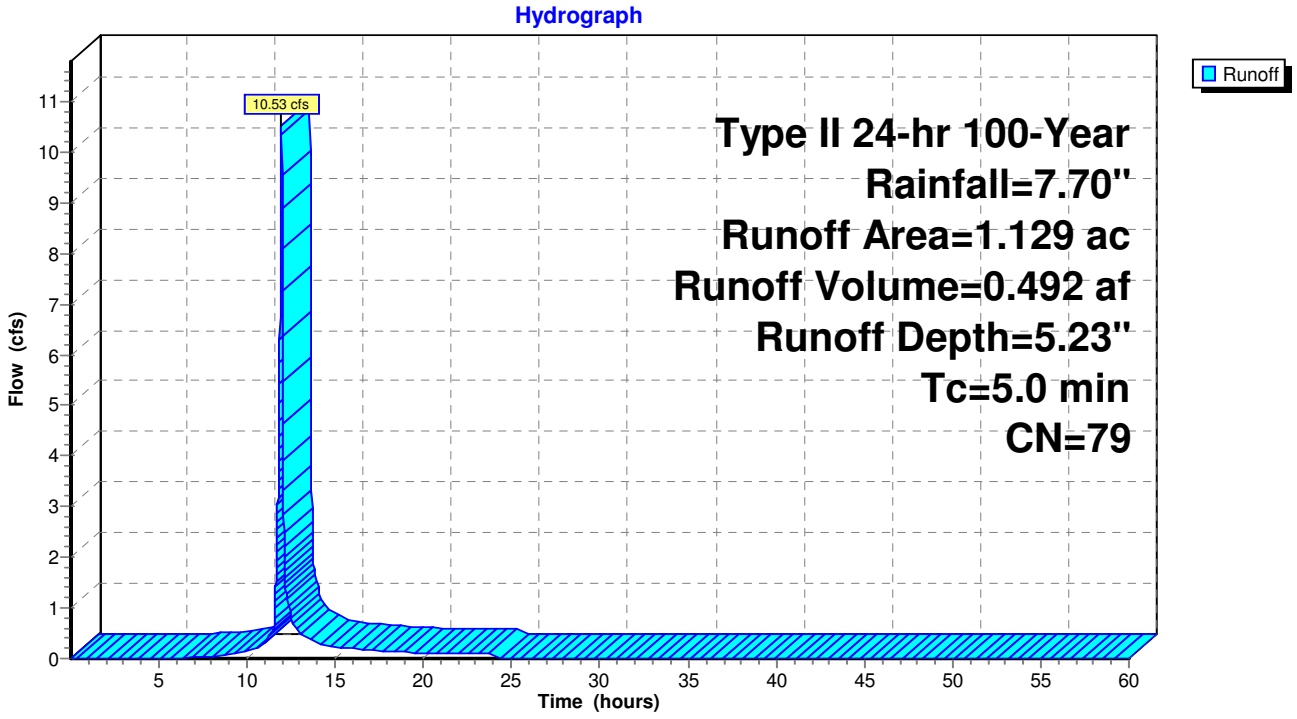
Runoff = 10.53 cfs @ 11.96 hrs, Volume= 0.492 af, Depth= 5.23"

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

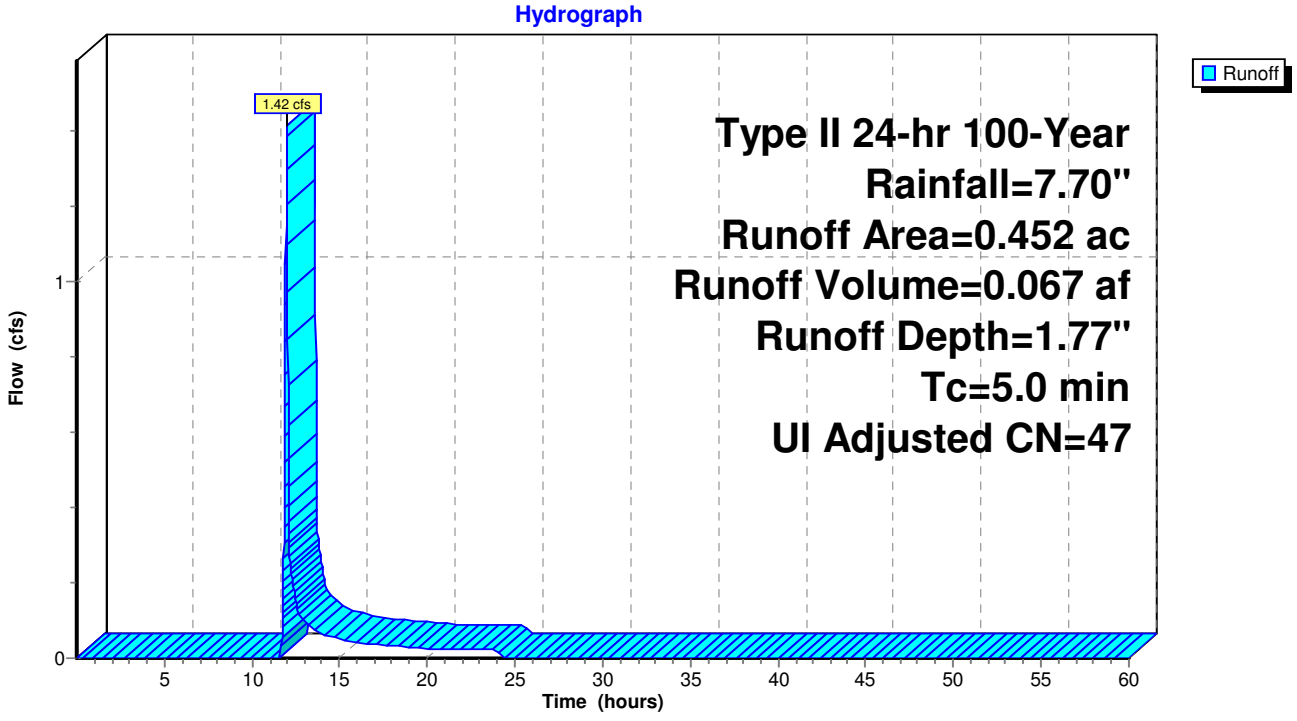
Runoff = 1.42 cfs @ 11.97 hrs, Volume= 0.067 af, Depth= 1.77"

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

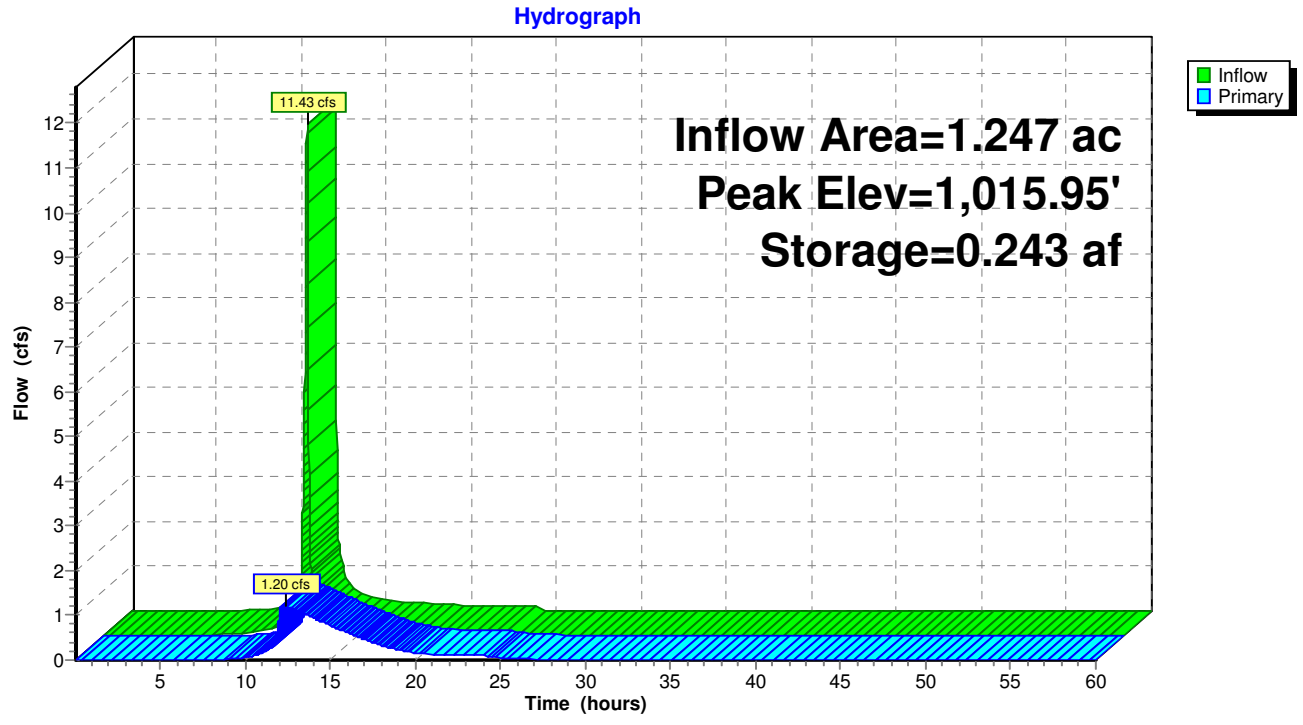
Plug-Flow detention time= 123.1 min calculated for 0.531 af (100% of inflow)
Center-of-Mass det. time= 123.0 min (928.0 - 805.0)

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