1722 PARKING LOT IMPROVEMENTS
CITY OF MASSILLON
STARK COUNTY, OHIO

STORMWATER MANAGEMENT REPORT

December 2020

PREPARED BY:

CIVPRO ENGINEERING, LLC
4450 Belden Village St. NW, Suite 800
Canton, Ohio 44718
(234) 310-3913

PROPERTY INFORMATION

Owner/Developer: 1722 First Street Northeast, LLC
1722 First Street NE
Massillon, OH 44646

Site Location: Located in part of the NE quarter of Section 6, Township 10N, Range 9W
Massillon, OH 44646
LAT: 40.817791; LONG: -81.524915

DRAINAGE NARRATIVE

This following report is a summary regarding the differences in runoff volumes as a result of the construction of the gravel parking lot, as shown on the associated site plan. The intent is that stormwater will flow to a proposed detention ponding area by over land flow and into a proposed storm sewer system which will tie into an existing manhole. Storm events for the 1 year through 100 year storm events were analyzed with those events routed through the proposed detention basin. This basin is being designed to detain water to account for the additional runoff caused by the new parking lot. The watershed of the basin was the analyzed drainage area and includes the entire area that is being affected by the development of the parking lot (see drainage maps).

EXISTING CONDITIONS

The site is located on the east side of 1st St. NE in the City of Massillon, Stark County, Ohio. The existing topography of the site consists mostly of grass. The soil makeup of the site is made up of predominantly chili-urban land complex as shown on the enclosed Hydrologic Soil Group report. Hydraulic Soil Group A was used for calculations. Because the parking lot has already been built, county contours were used for the drainage analysis before it was built.

PROPOSED CONDITIONS

Although the gravel parking lot has already been built, it was treated as proposed development for detention design purposes. Actual proposed development includes only the detention basin, outlet structure, and proposed storm sewer as shown on the Construction Plans prepared by CIVPRO Engineering, LLC. A topographical survey was done of the site and was used to create the contours of the site with the parking lot.

The goals of the stormwater management system design were to maintain previous drainage patterns and to mitigate peak post development flows. The drainage improvements rout the stormwater runoff from the parking lot on the subject site into a proposed detention basin via overland flow before discharging into the storm sewer.

METHOD OF ANALYSIS

Hydrologic computations and storm routing for the proposed project were determined from the Soil Conservation Service Method (TR-20) using the computer generated HydroCAD Stormwater Computer Modeling System.

STORMWATER DETENTION BASIN ROUTED DISCHARGE - WEST

STORM EVENT (YEAR)	PRE-DEVELOPED PEAK RUNOFF RATE (CFS)	PEAK DETENTION BASIN ROUTED DISCHARGE (CFS)	PEAK WATER ELEVAION (FT)	PEAK STORAGE (CF)
1	0.00	0.00	949.83	6,134
2	0.00	0.00	950.39	8,119
5	0.00	0.00	951.12	11,174
10	0.01	0.01	951.68	13,817
25	0.11	0.11	951.93	15,090
50	0.33	0.18	952.29	17,043
100	0.85	0.85	952.45	17,987

The discharge from the proposed Dry Extended Detention Basin is through a concrete outlet Structure. A 3" orifice at with an invert elevation of 951.60 and a top grate at elevation 952.37 regulate the flow into the structure. A 12" primary discharge pipe with an invert elevation of 947.00 regulates the flow out of the structure. If the structure were to fail, an emergency spillway is in place to direct stormwater towards the west with an invert elevation of 935.00.

Map Scale: 1:751 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 35 70 140 210

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Stark County, Ohio
Survey Area Data: Version 17, Jun 11, 2020

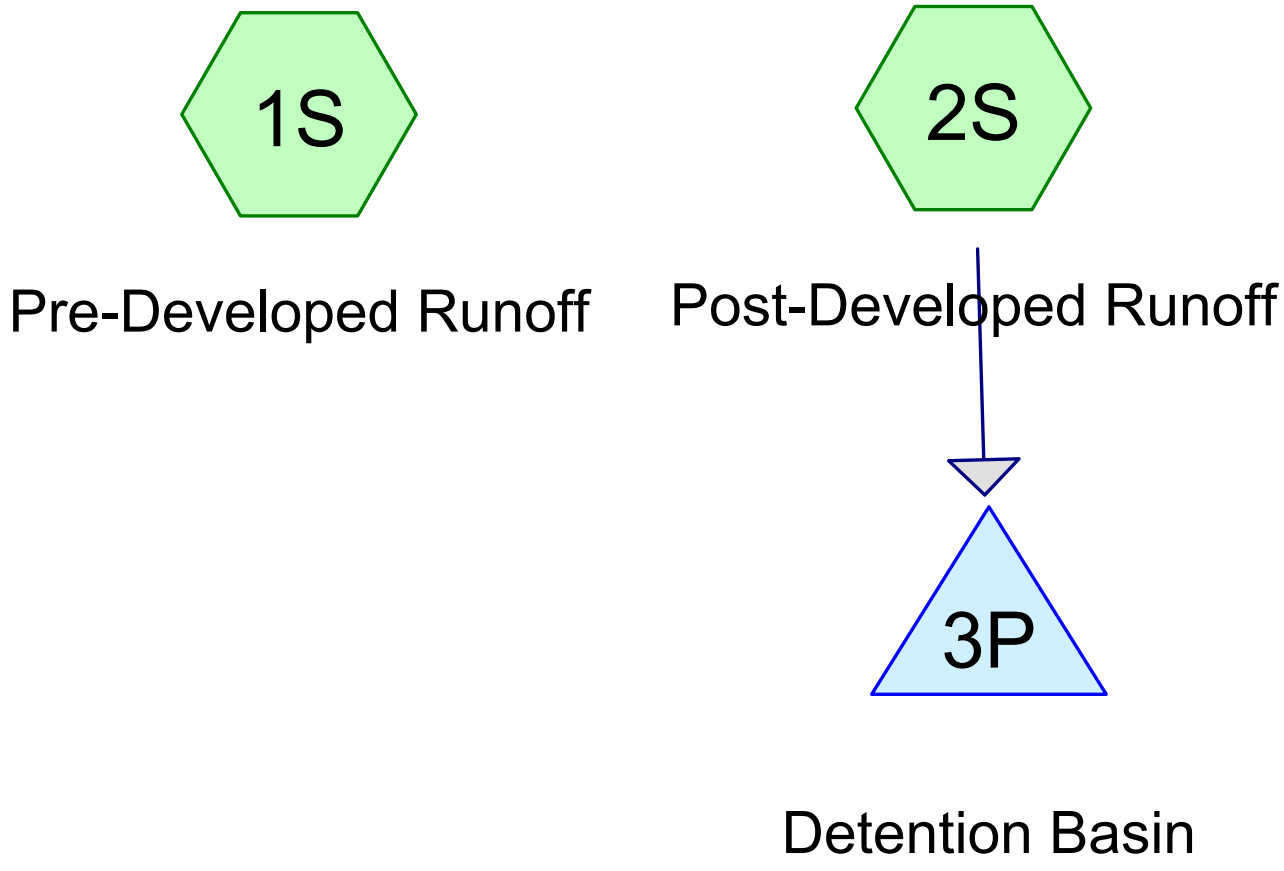
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 25, 2014—Mar 21, 2017

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CuB	Chili-Urban land complex, undulating	0.9	53.8%
Up	Udorthents-Pits complex	0.8	46.2%
Totals for Area of Interest		**1.6**	**100.0%**



Subcat Reach Pond Link

Routing Diagram for Detention Calcs
Prepared by CIVPRO Engineering, LLC, Printed 12/23/2020

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	NOAA 24-hr	A	Default	24.00	1	2.03	2
2	2-Year	NOAA 24-hr	A	Default	24.00	1	2.43	2
3	5-Year	NOAA 24-hr	A	Default	24.00	1	3.02	2
4	10-Year	NOAA 24-hr	A	Default	24.00	1	3.53	2
5	25-Year	NOAA 24-hr	A	Default	24.00	1	4.26	2
6	50-Year	NOAA 24-hr	A	Default	24.00	1	4.89	2
7	100-Year	NOAA 24-hr	A	Default	24.00	1	5.58	2

Summary for Subcatchment 1S: Pre-Developed Runoff

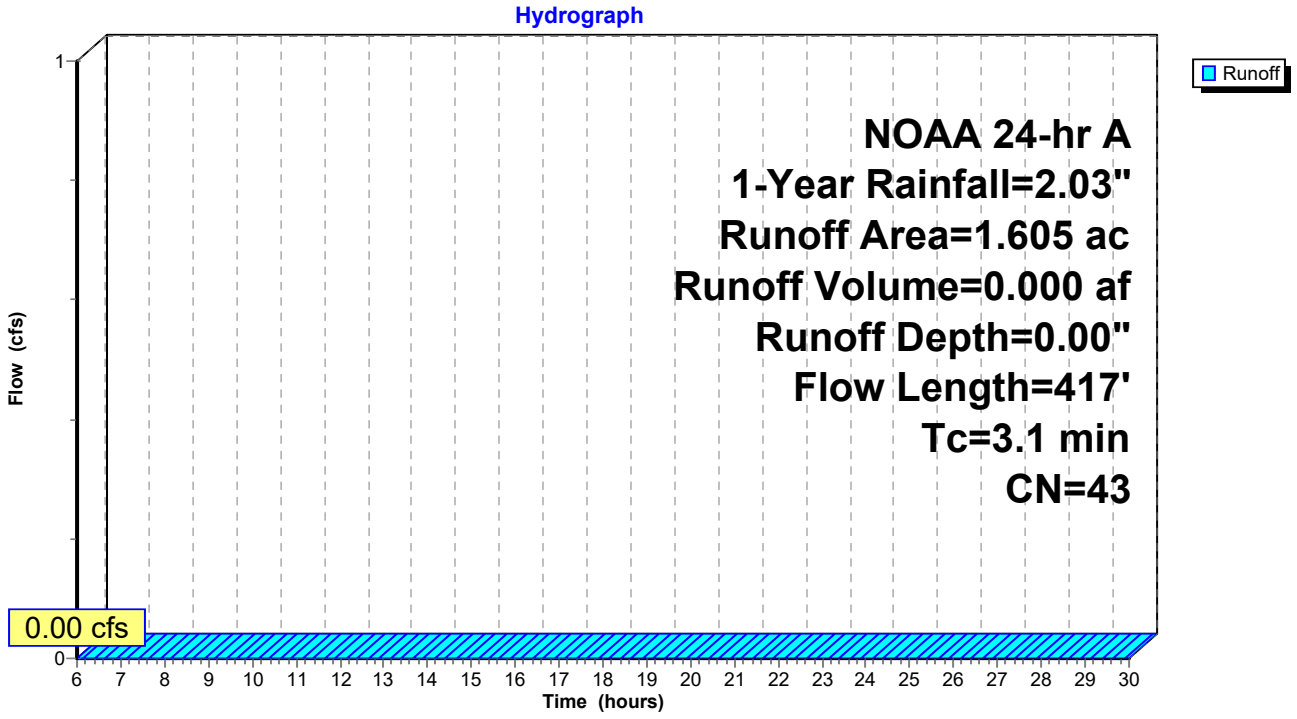
Runoff = 0.00 cfs @ 6.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 1-Year Rainfall=2.03"

Area (ac)	CN	Description
1.496	39	>75% Grass cover, Good, HSG A
0.109	96	Gravel surface, HSG A
1.605	43	Weighted Average
1.605		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.9	317	0.0330	2.72		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	417	Total			

Subcatchment 1S: Pre-Developed Runoff



Summary for Subcatchment 2S: Post-Developed Runoff

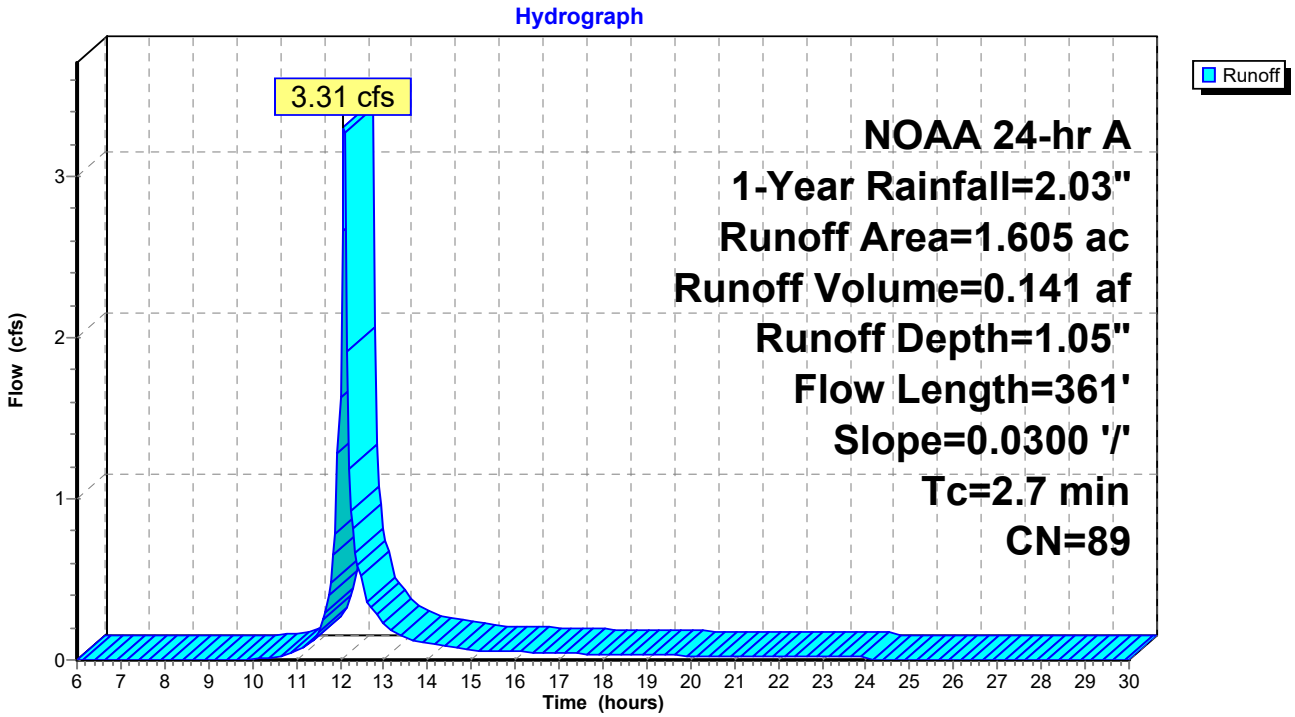
Runoff = 3.31 cfs @ 12.09 hrs, Volume= 0.141 af, Depth= 1.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 1-Year Rainfall=2.03"

Area (ac)	CN	Description
0.023	98	Paved parking, HSG A
1.231	96	Gravel surface, HSG A
0.206	39	>75% Grass cover, Good, HSG A
0.145	98	Water Surface, HSG A
1.605	89	Weighted Average
1.437		89.53% Pervious Area
0.168		10.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.5	261	0.0300	2.94		**Shallow Concentrated Flow,** Kv= 17.0 fps
2.7	361	Total			

Subcatchment 2S: Post-Developed Runoff



Summary for Pond 3P: Detention Basin

Inflow Area = 1.605 ac, 10.47% Impervious, Inflow Depth = 1.05" for 1-Year event
Inflow = 3.31 cfs @ 12.09 hrs, Volume= 0.141 af
Outflow = 0.00 cfs @ 6.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 6.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 949.83' @ 24.20 hrs Surf.Area= 3,315 sf Storage= 6,134 cf

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

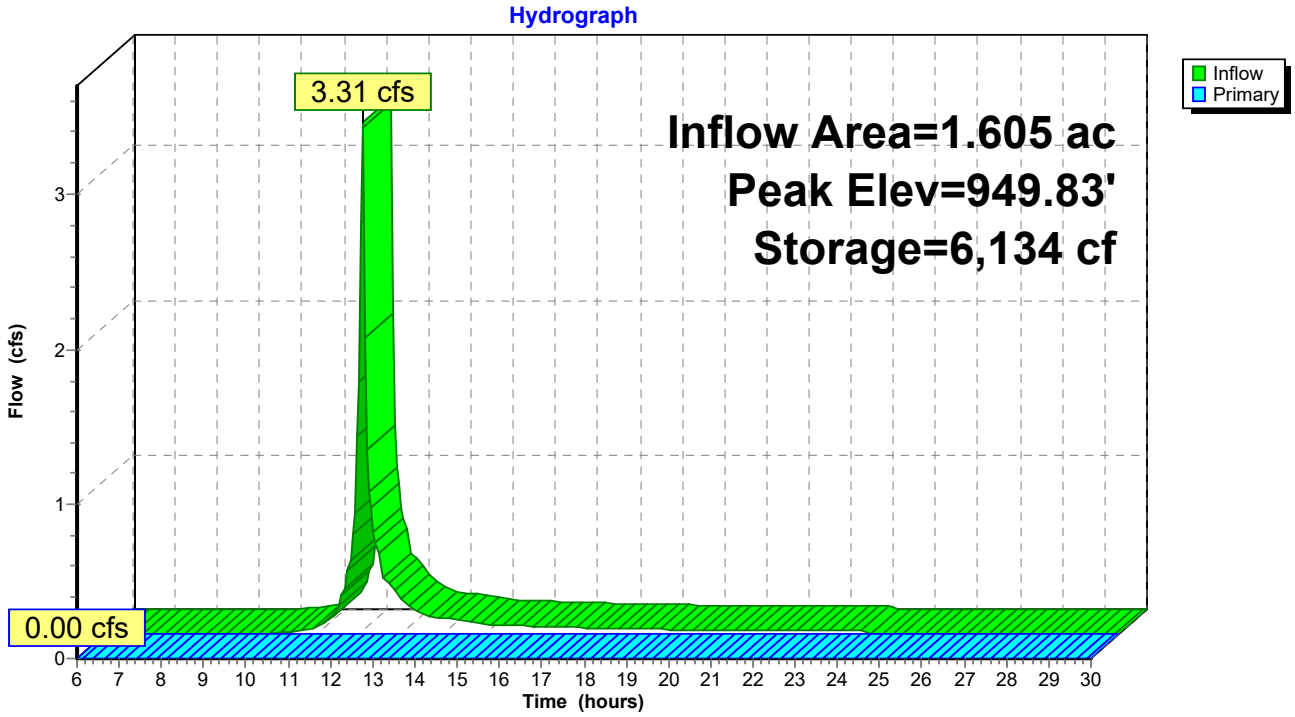
Volume	Invert	Avail.Storage	Storage Description
#1	947.00'	21,299 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
947.00	1,092	0	0
948.00	1,825	1,459	1,459
949.00	2,614	2,220	3,678
950.00	3,460	3,037	6,715
951.00	4,363	3,912	10,627
952.00	5,322	4,843	15,469
953.00	6,337	5,830	21,299

Device	Routing	Invert	Outlet Devices
#1	Primary	947.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 947.00' / 946.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	951.60'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	952.37'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 6.00 hrs HW=947.00' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Basin



Summary for Subcatchment 1S: Pre-Developed Runoff

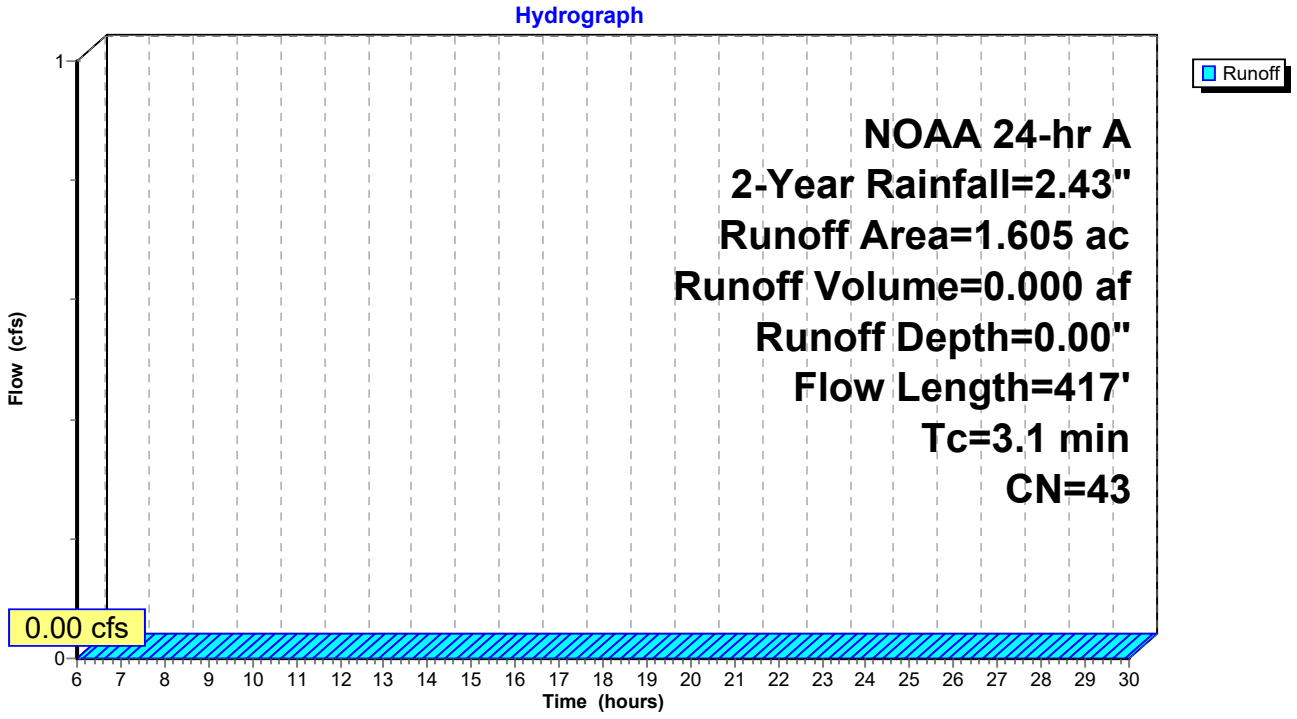
Runoff = 0.00 cfs @ 6.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 2-Year Rainfall=2.43"

Area (ac)	CN	Description
1.496	39	>75% Grass cover, Good, HSG A
0.109	96	Gravel surface, HSG A
1.605	43	Weighted Average
1.605		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.9	317	0.0330	2.72		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	417	Total			

Subcatchment 1S: Pre-Developed Runoff



Summary for Subcatchment 2S: Post-Developed Runoff

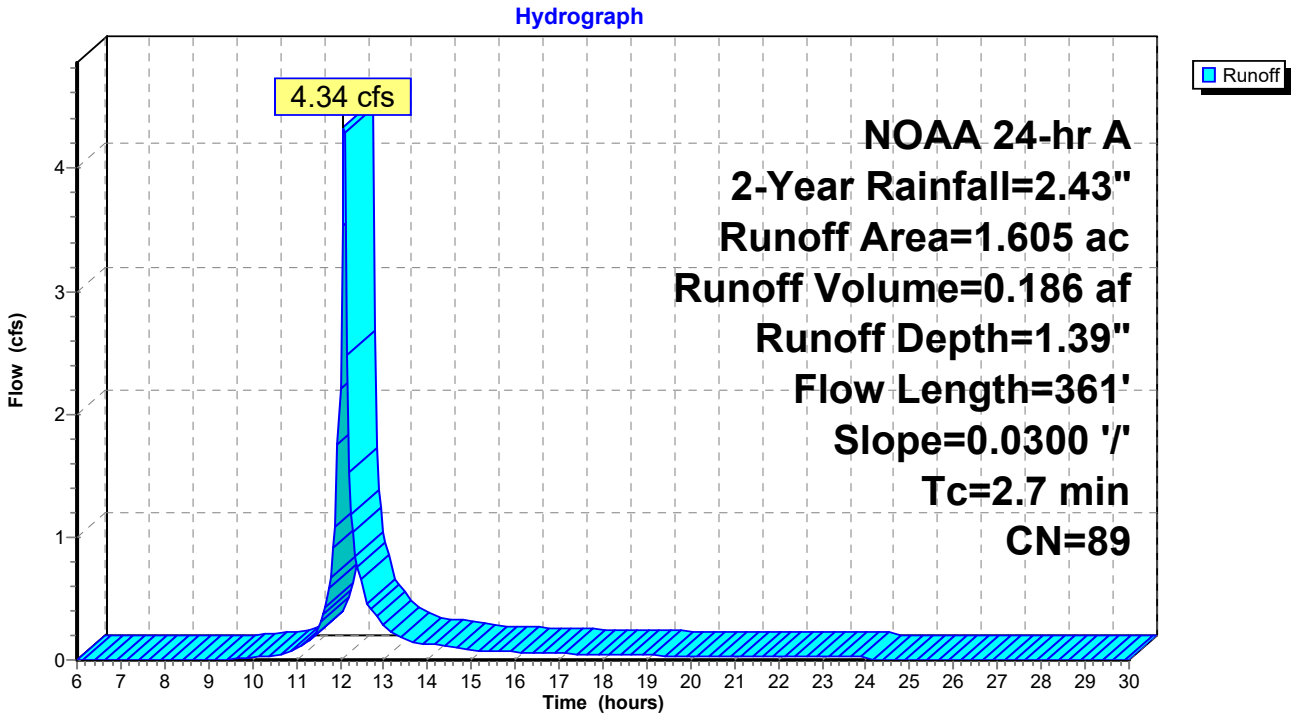
Runoff = 4.34 cfs @ 12.09 hrs, Volume= 0.186 af, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 2-Year Rainfall=2.43"

Area (ac)	CN	Description
0.023	98	Paved parking, HSG A
1.231	96	Gravel surface, HSG A
0.206	39	>75% Grass cover, Good, HSG A
0.145	98	Water Surface, HSG A
1.605	89	Weighted Average
1.437		89.53% Pervious Area
0.168		10.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.5	261	0.0300	2.94		**Shallow Concentrated Flow,** Kv= 17.0 fps
2.7	361	Total			

Subcatchment 2S: Post-Developed Runoff



Summary for Pond 3P: Detention Basin

Inflow Area = 1.605 ac, 10.47% Impervious, Inflow Depth = 1.39" for 2-Year event
Inflow = 4.34 cfs @ 12.09 hrs, Volume= 0.186 af
Outflow = 0.00 cfs @ 6.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 6.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 950.39' @ 24.20 hrs Surf.Area= 3,809 sf Storage= 8,119 cf

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

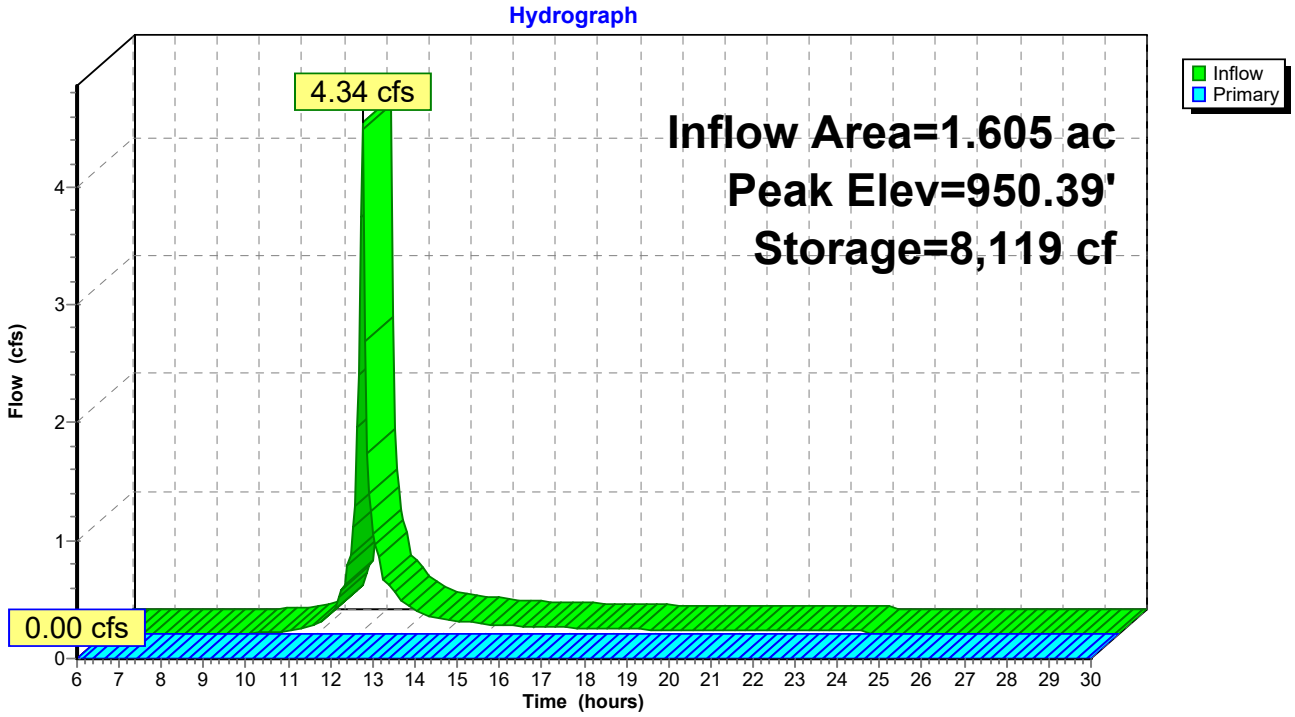
Volume	Invert	Avail.Storage	Storage Description
#1	947.00'	21,299 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
947.00	1,092	0	0
948.00	1,825	1,459	1,459
949.00	2,614	2,220	3,678
950.00	3,460	3,037	6,715
951.00	4,363	3,912	10,627
952.00	5,322	4,843	15,469
953.00	6,337	5,830	21,299

Device	Routing	Invert	Outlet Devices
#1	Primary	947.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 947.00' / 946.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	951.60'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	952.37'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 6.00 hrs HW=947.00' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Basin



Summary for Subcatchment 1S: Pre-Developed Runoff

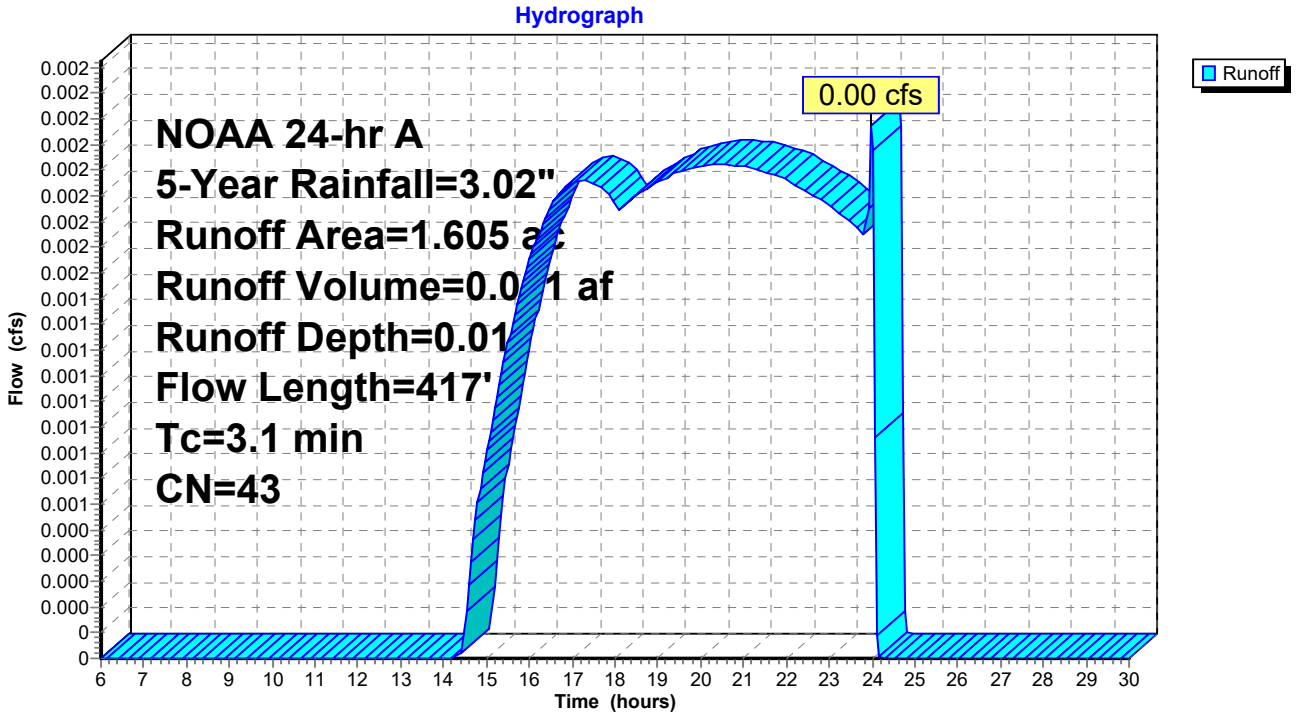
Runoff = 0.00 cfs @ 23.98 hrs, Volume= 0.001 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 5-Year Rainfall=3.02"

Area (ac)	CN	Description
1.496	39	>75% Grass cover, Good, HSG A
0.109	96	Gravel surface, HSG A
1.605	43	Weighted Average
1.605		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.9	317	0.0330	2.72		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	417	Total			

Subcatchment 1S: Pre-Developed Runoff



Summary for Subcatchment 2S: Post-Developed Runoff

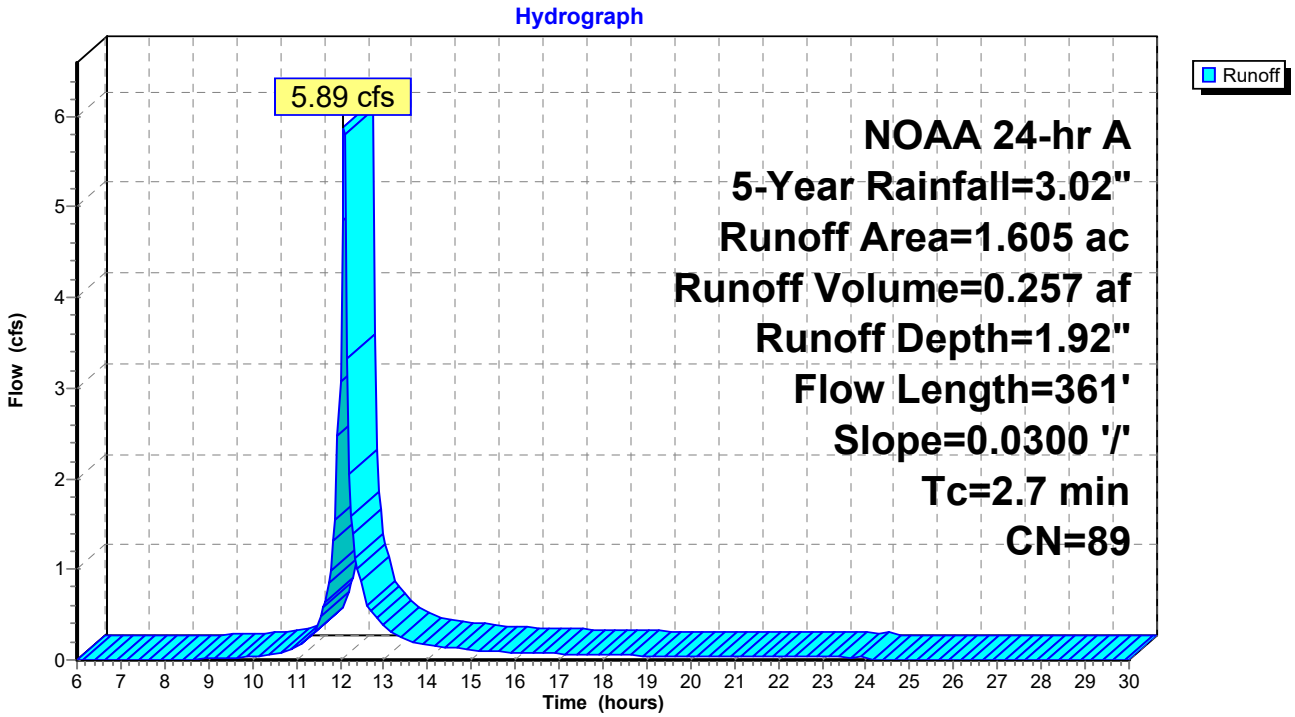
Runoff = 5.89 cfs @ 12.09 hrs, Volume= 0.257 af, Depth= 1.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 5-Year Rainfall=3.02"

Area (ac)	CN	Description
0.023	98	Paved parking, HSG A
1.231	96	Gravel surface, HSG A
0.206	39	>75% Grass cover, Good, HSG A
0.145	98	Water Surface, HSG A
1.605	89	Weighted Average
1.437		89.53% Pervious Area
0.168		10.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.5	261	0.0300	2.94		**Shallow Concentrated Flow,** Kv= 17.0 fps
2.7	361	Total			

Subcatchment 2S: Post-Developed Runoff



Summary for Pond 3P: Detention Basin

Inflow Area = 1.605 ac, 10.47% Impervious, Inflow Depth = 1.92" for 5-Year event
Inflow = 5.89 cfs @ 12.09 hrs, Volume= 0.257 af
Outflow = 0.00 cfs @ 6.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 6.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 951.12' @ 24.20 hrs Surf.Area= 4,482 sf Storage= 11,174 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	947.00'	21,299 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
947.00	1,092	0	0
948.00	1,825	1,459	1,459
949.00	2,614	2,220	3,678
950.00	3,460	3,037	6,715
951.00	4,363	3,912	10,627
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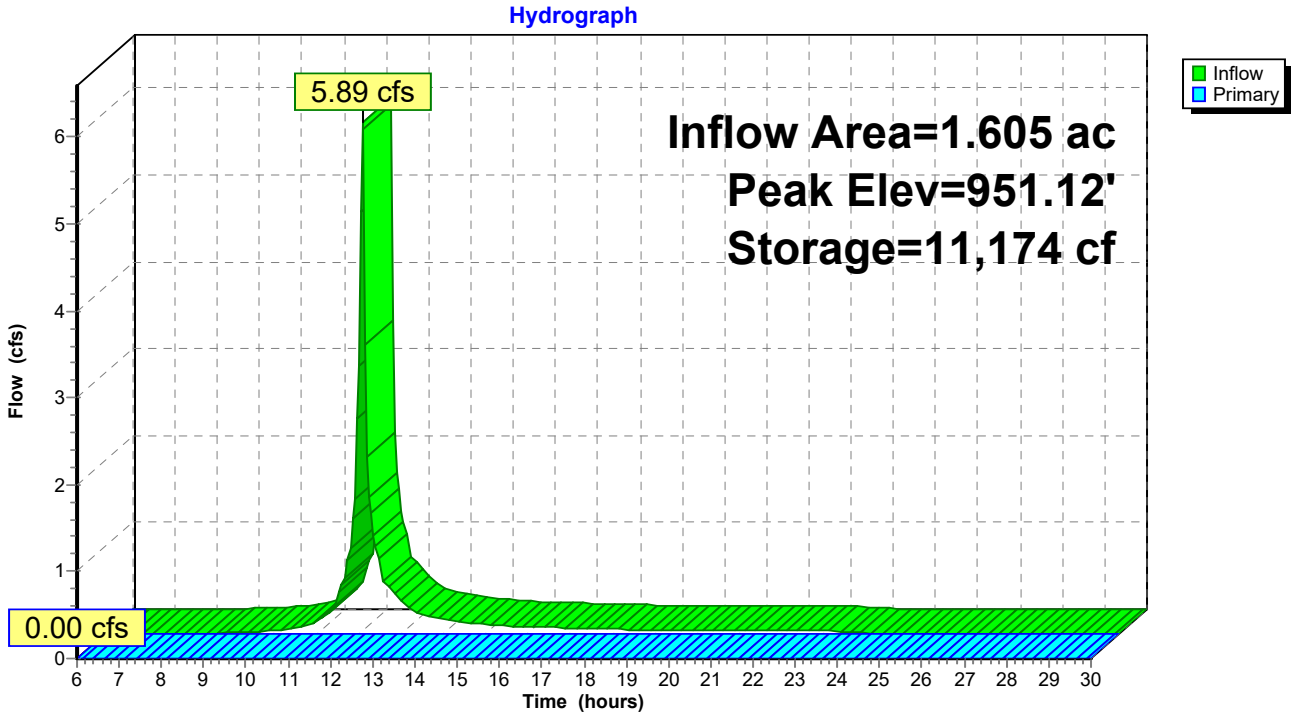
953.00	6,337	5,830	21,299

Device	Routing	Invert	Outlet Devices
#1	Primary	947.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 947.00' / 946.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	951.60'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	952.37'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 6.00 hrs HW=947.00' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Basin



Summary for Subcatchment 1S: Pre-Developed Runoff

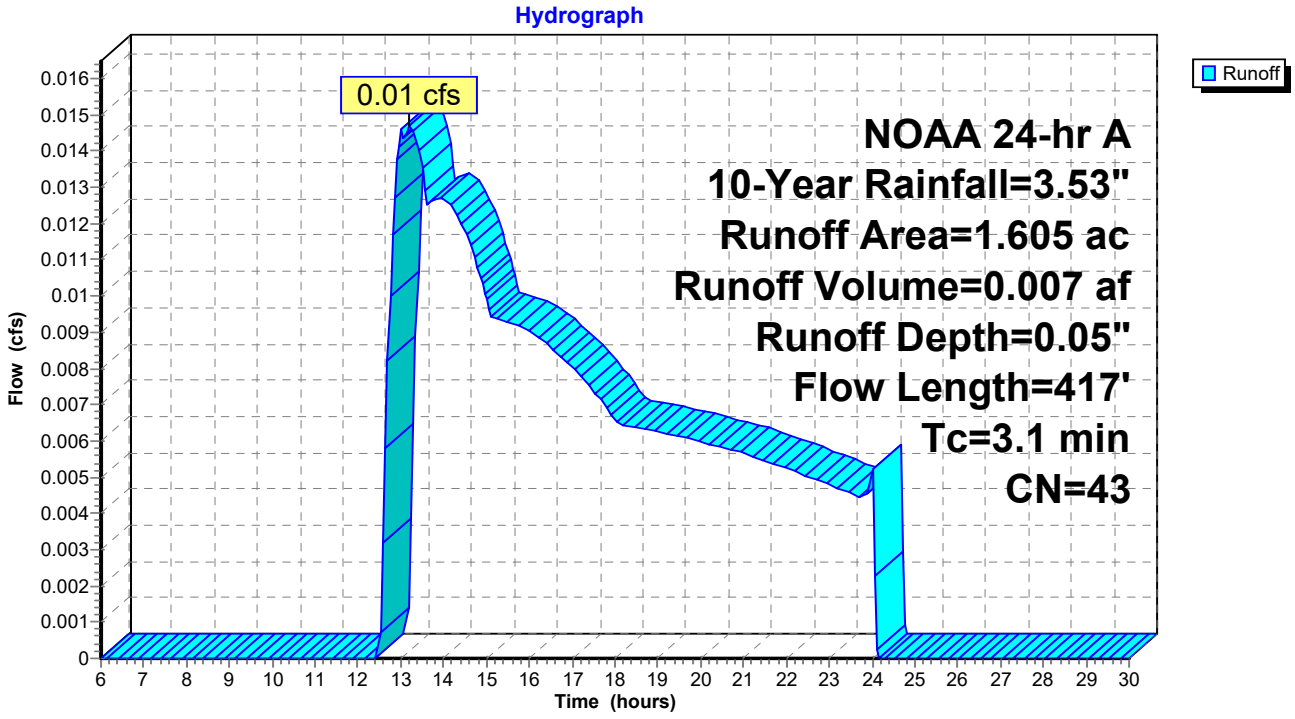
Runoff = 0.01 cfs @ 13.21 hrs, Volume= 0.007 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 10-Year Rainfall=3.53"

Area (ac)	CN	Description
1.496	39	>75% Grass cover, Good, HSG A
0.109	96	Gravel surface, HSG A
1.605	43	Weighted Average
1.605		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.9	317	0.0330	2.72		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	417	Total			

Subcatchment 1S: Pre-Developed Runoff



Summary for Subcatchment 2S: Post-Developed Runoff

Runoff = 7.24 cfs @ 12.09 hrs, Volume= 0.319 af, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 10-Year Rainfall=3.53"

Area (ac)	CN	Description
0.023	98	Paved parking, HSG A
1.231	96	Gravel surface, HSG A
0.206	39	>75% Grass cover, Good, HSG A
0.145	98	Water Surface, HSG A
1.605	89	Weighted Average
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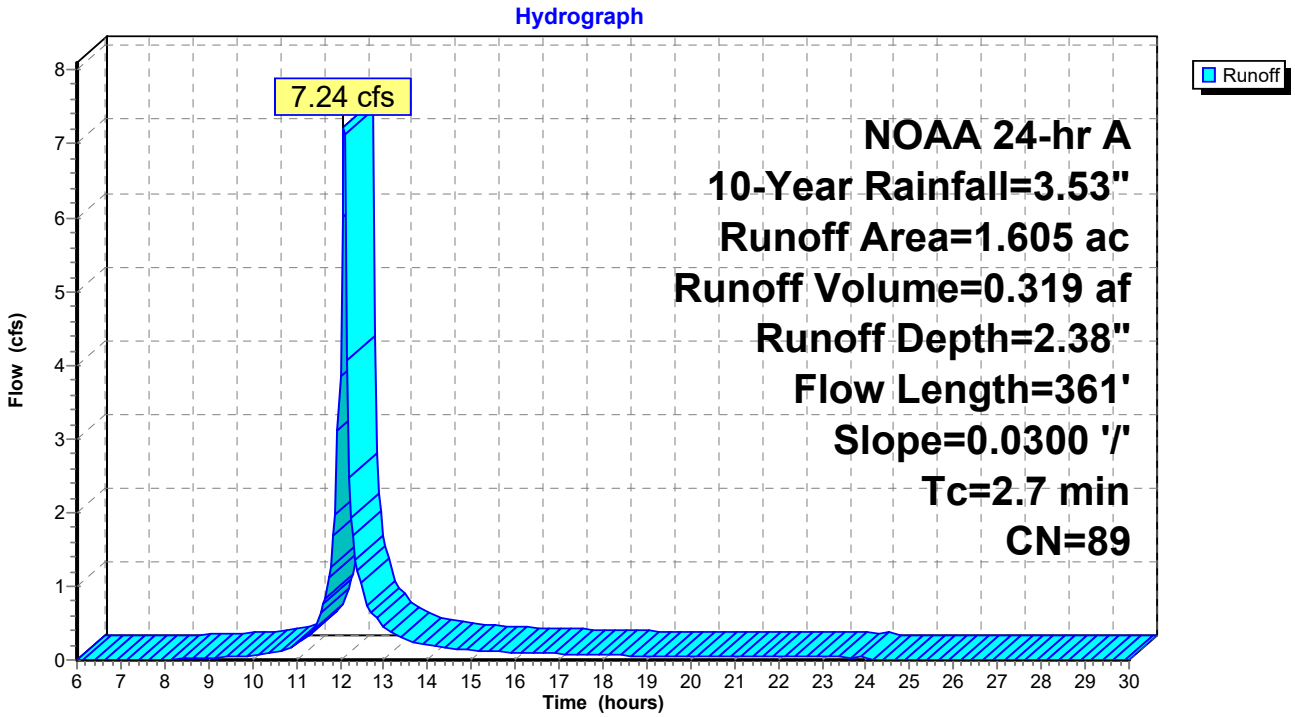
0.168		10.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.5	261	0.0300	2.94		**Shallow Concentrated Flow,** Kv= 17.0 fps
2.7	361	Total			

Subcatchment 2S: Post-Developed Runoff



Summary for Pond 3P: Detention Basin

Inflow Area = 1.605 ac, 10.47% Impervious, Inflow Depth = 2.38" for 10-Year event
Inflow = 7.24 cfs @ 12.09 hrs, Volume= 0.319 af
Outflow = 0.01 cfs @ 24.06 hrs, Volume= 0.006 af, Atten= 100%, Lag= 718.3 min
Primary = 0.01 cfs @ 24.06 hrs, Volume= 0.006 af

Routing by Stor-Ind method, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 951.68' @ 24.06 hrs Surf.Area= 5,016 sf Storage= 13,817 cf

Plug-Flow detention time= 969.5 min calculated for 0.006 af (2% of inflow)
Center-of-Mass det. time= 746.1 min (1,535.0 - 788.9)

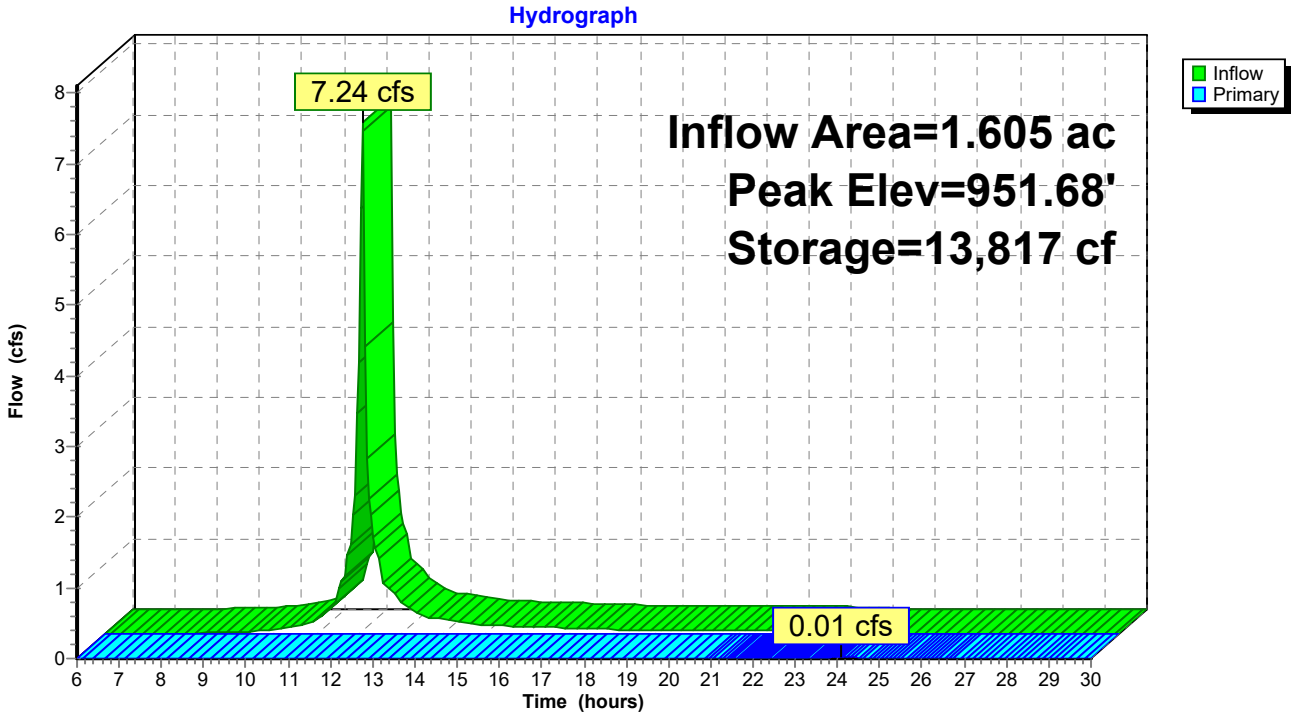
Volume	Invert	Avail.Storage	Storage Description
#1	947.00'	21,299 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
947.00	1,092	0	0
948.00	1,825	1,459	1,459
949.00	2,614	2,220	3,678
950.00	3,460	3,037	6,715
951.00	4,363	3,912	10,627
952.00	5,322	4,843	15,469
953.00	6,337	5,830	21,299

Device	Routing	Invert	Outlet Devices
#1	Primary	947.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 947.00' / 946.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	951.60'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	952.37'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 24.06 hrs HW=951.68' (Free Discharge)
└**1=Culvert** (Passes 0.01 cfs of 6.10 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.97 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Basin



Summary for Subcatchment 1S: Pre-Developed Runoff

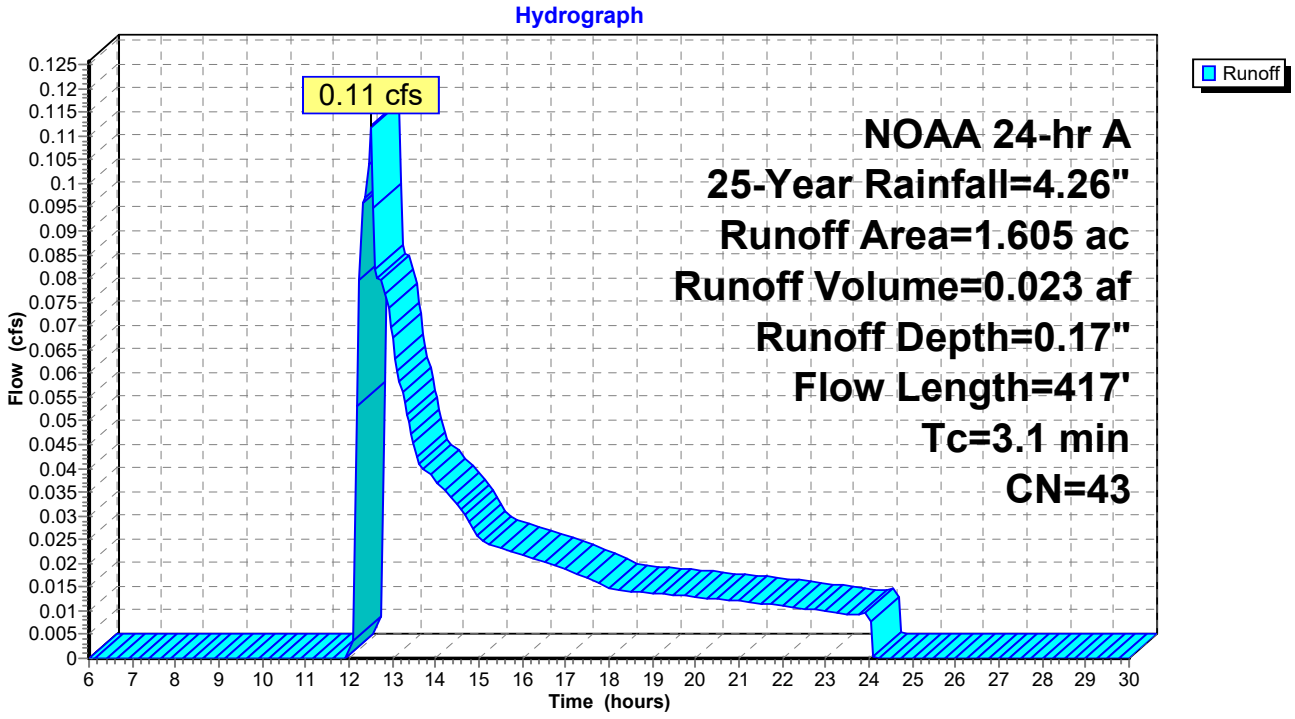
Runoff = 0.11 cfs @ 12.49 hrs, Volume= 0.023 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 25-Year Rainfall=4.26"

Area (ac)	CN	Description
1.496	39	>75% Grass cover, Good, HSG A
0.109	96	Gravel surface, HSG A
1.605	43	Weighted Average
1.605		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.9	317	0.0330	2.72		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	417	Total			

Subcatchment 1S: Pre-Developed Runoff



Summary for Subcatchment 2S: Post-Developed Runoff

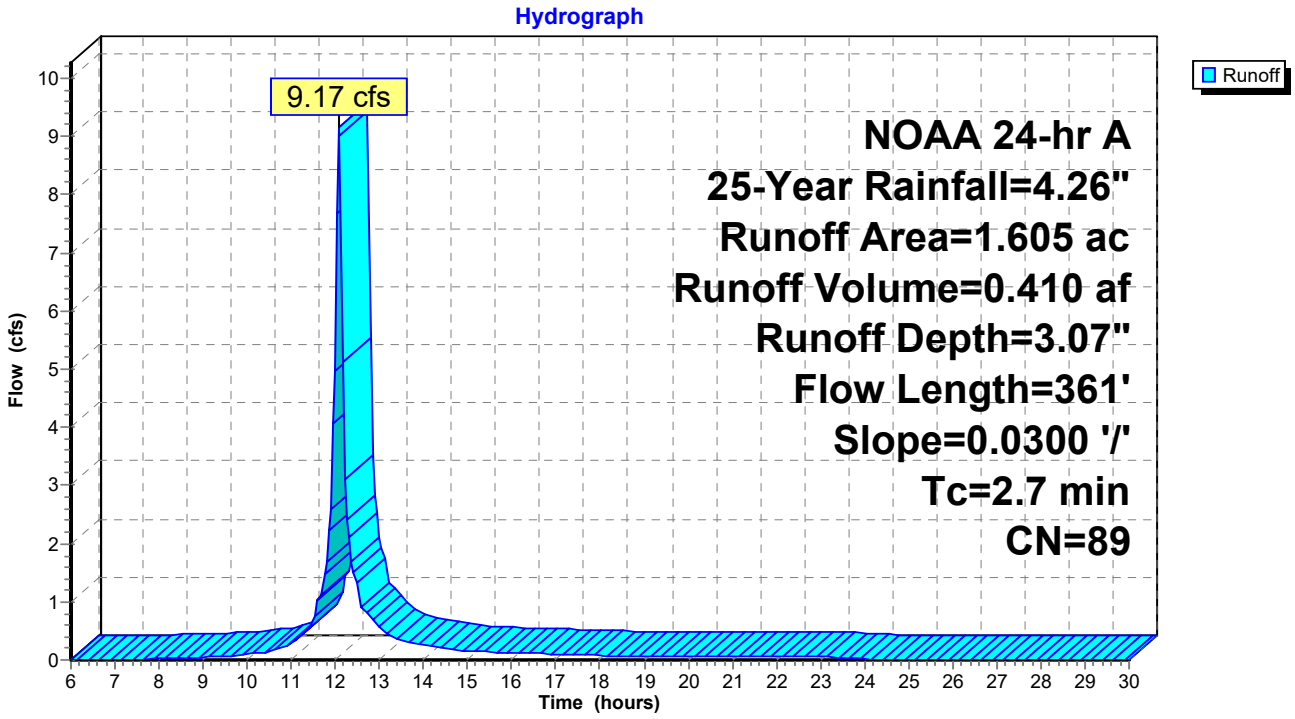
Runoff = 9.17 cfs @ 12.09 hrs, Volume= 0.410 af, Depth= 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 25-Year Rainfall=4.26"

Area (ac)	CN	Description
0.023	98	Paved parking, HSG A
1.231	96	Gravel surface, HSG A
0.206	39	>75% Grass cover, Good, HSG A
0.145	98	Water Surface, HSG A
1.605	89	Weighted Average
1.437		89.53% Pervious Area
0.168		10.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.5	261	0.0300	2.94		**Shallow Concentrated Flow,** Kv= 17.0 fps
2.7	361	Total			

Subcatchment 2S: Post-Developed Runoff



Summary for Pond 3P: Detention Basin

Inflow Area = 1.605 ac, 10.47% Impervious, Inflow Depth = 3.07" for 25-Year event
Inflow = 9.17 cfs @ 12.09 hrs, Volume= 0.410 af
Outflow = 0.11 cfs @ 16.77 hrs, Volume= 0.094 af, Atten= 99%, Lag= 281.2 min
Primary = 0.11 cfs @ 16.77 hrs, Volume= 0.094 af

Routing by Stor-Ind method, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 951.93' @ 16.77 hrs Surf.Area= 5,253 sf Storage= 15,090 cf

Plug-Flow detention time= 510.2 min calculated for 0.093 af (23% of inflow)
Center-of-Mass det. time= 401.9 min (1,185.6 - 783.7)

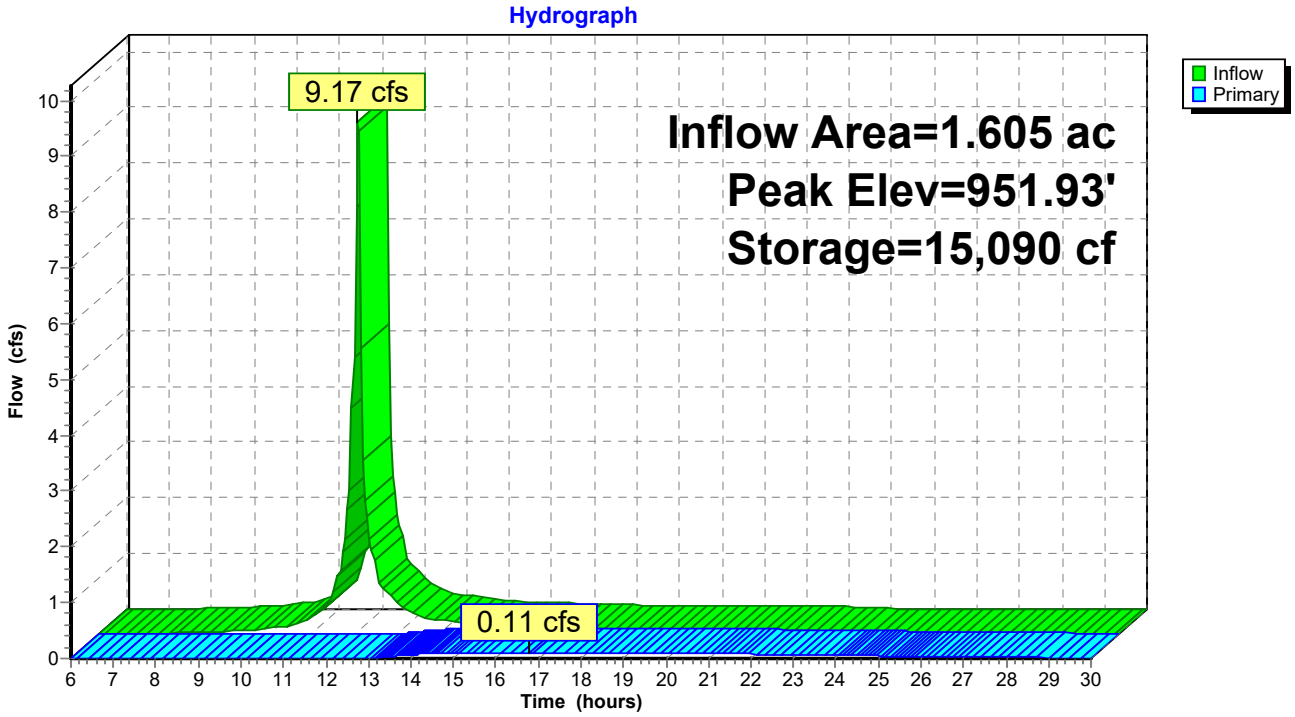
Volume	Invert	Avail.Storage	Storage Description
#1	947.00'	21,299 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
947.00	1,092	0	0
948.00	1,825	1,459	1,459
949.00	2,614	2,220	3,678
950.00	3,460	3,037	6,715
951.00	4,363	3,912	10,627
952.00	5,322	4,843	15,469
953.00	6,337	5,830	21,299

Device	Routing	Invert	Outlet Devices
#1	Primary	947.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 947.00' / 946.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	951.60'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	952.37'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.11 cfs @ 16.77 hrs HW=951.93' (Free Discharge)
└**1=Culvert** (Passes 0.11 cfs of 6.28 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.11 cfs @ 2.17 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Basin



Summary for Subcatchment 1S: Pre-Developed Runoff

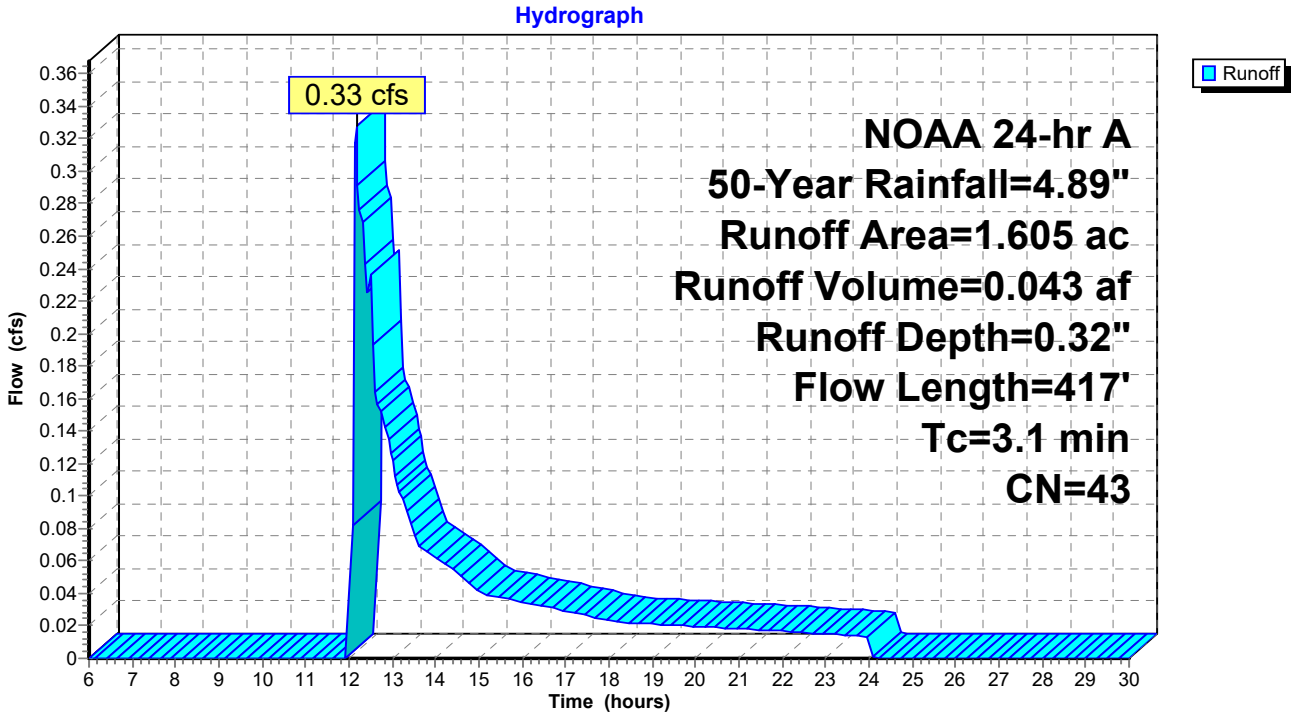
Runoff = 0.33 cfs @ 12.17 hrs, Volume= 0.043 af, Depth= 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 50-Year Rainfall=4.89"

Area (ac)	CN	Description
1.496	39	>75% Grass cover, Good, HSG A
0.109	96	Gravel surface, HSG A
1.605	43	Weighted Average
1.605		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.9	317	0.0330	2.72		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	417	Total			

Subcatchment 1S: Pre-Developed Runoff



Summary for Subcatchment 2S: Post-Developed Runoff

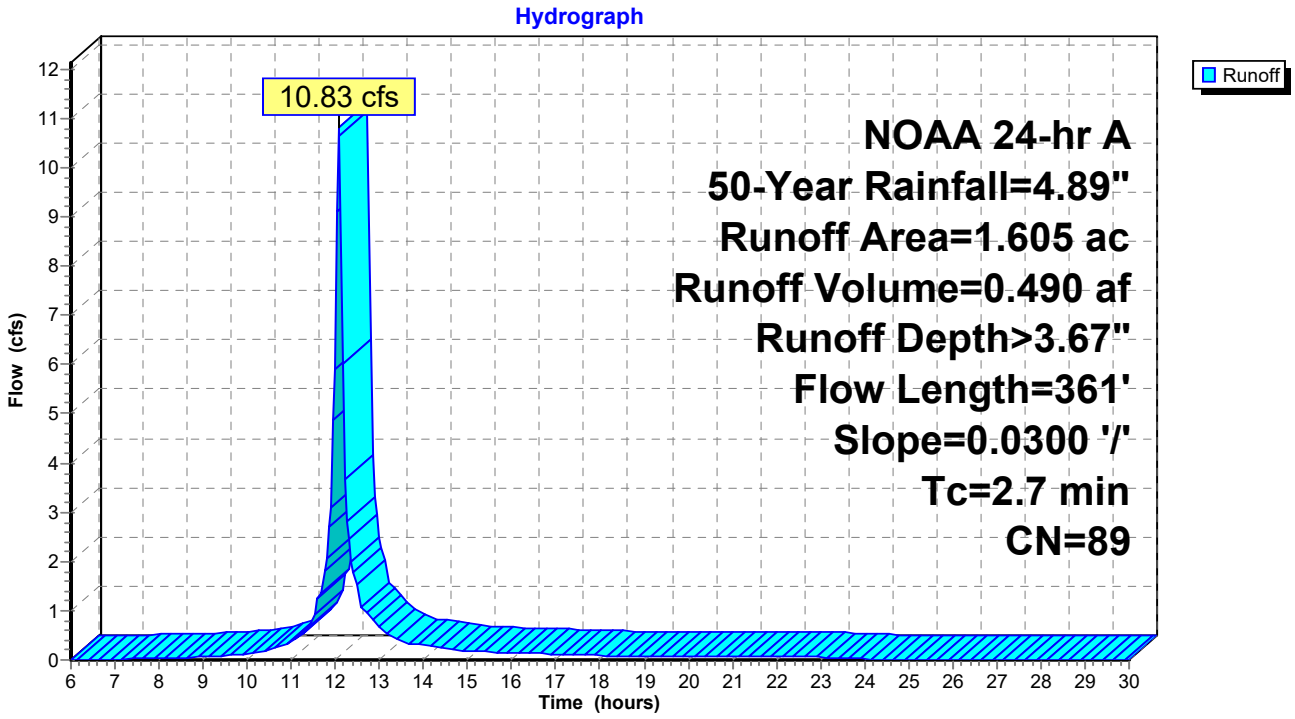
Runoff = 10.83 cfs @ 12.09 hrs, Volume= 0.490 af, Depth> 3.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 50-Year Rainfall=4.89"

Area (ac)	CN	Description
0.023	98	Paved parking, HSG A
1.231	96	Gravel surface, HSG A
0.206	39	>75% Grass cover, Good, HSG A
0.145	98	Water Surface, HSG A
1.605	89	Weighted Average
1.437		89.53% Pervious Area
0.168		10.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.5	261	0.0300	2.94		**Shallow Concentrated Flow,** Kv= 17.0 fps
2.7	361	Total			

Subcatchment 2S: Post-Developed Runoff



Summary for Pond 3P: Detention Basin

Inflow Area = 1.605 ac, 10.47% Impervious, Inflow Depth > 3.67" for 50-Year event
Inflow = 10.83 cfs @ 12.09 hrs, Volume= 0.490 af
Outflow = 0.18 cfs @ 15.03 hrs, Volume= 0.171 af, Atten= 98%, Lag= 176.4 min
Primary = 0.18 cfs @ 15.03 hrs, Volume= 0.171 af

Routing by Stor-Ind method, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 952.29' @ 15.03 hrs Surf.Area= 5,614 sf Storage= 17,043 cf

Plug-Flow detention time= 469.3 min calculated for 0.171 af (35% of inflow)
Center-of-Mass det. time= 375.2 min (1,155.3 - 780.1)

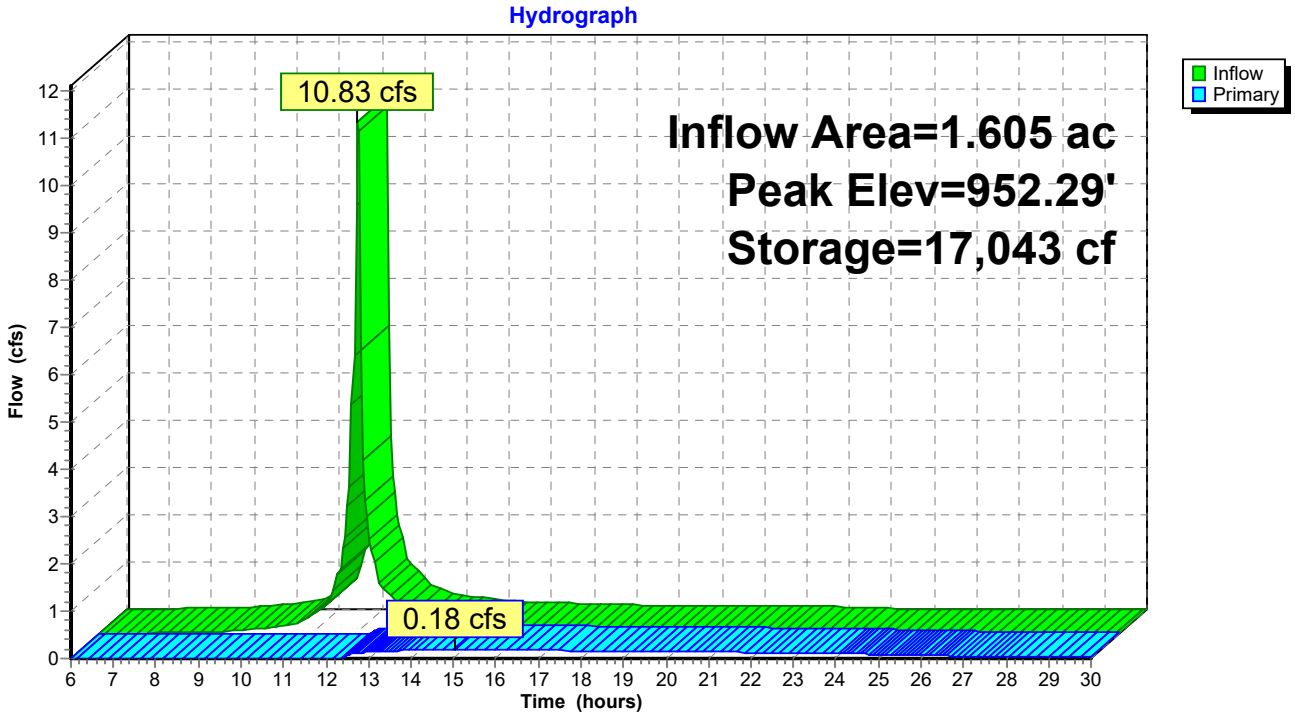
Volume	Invert	Avail.Storage	Storage Description
#1	947.00'	21,299 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
947.00	1,092	0	0
948.00	1,825	1,459	1,459
949.00	2,614	2,220	3,678
950.00	3,460	3,037	6,715
951.00	4,363	3,912	10,627
952.00	5,322	4,843	15,469
953.00	6,337	5,830	21,299

Device	Routing	Invert	Outlet Devices
#1	Primary	947.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 947.00' / 946.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	951.60'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	952.37'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.18 cfs @ 15.03 hrs HW=952.29' (Free Discharge)
└**1=Culvert** (Passes 0.18 cfs of 6.53 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 3.61 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Basin



Summary for Subcatchment 1S: Pre-Developed Runoff

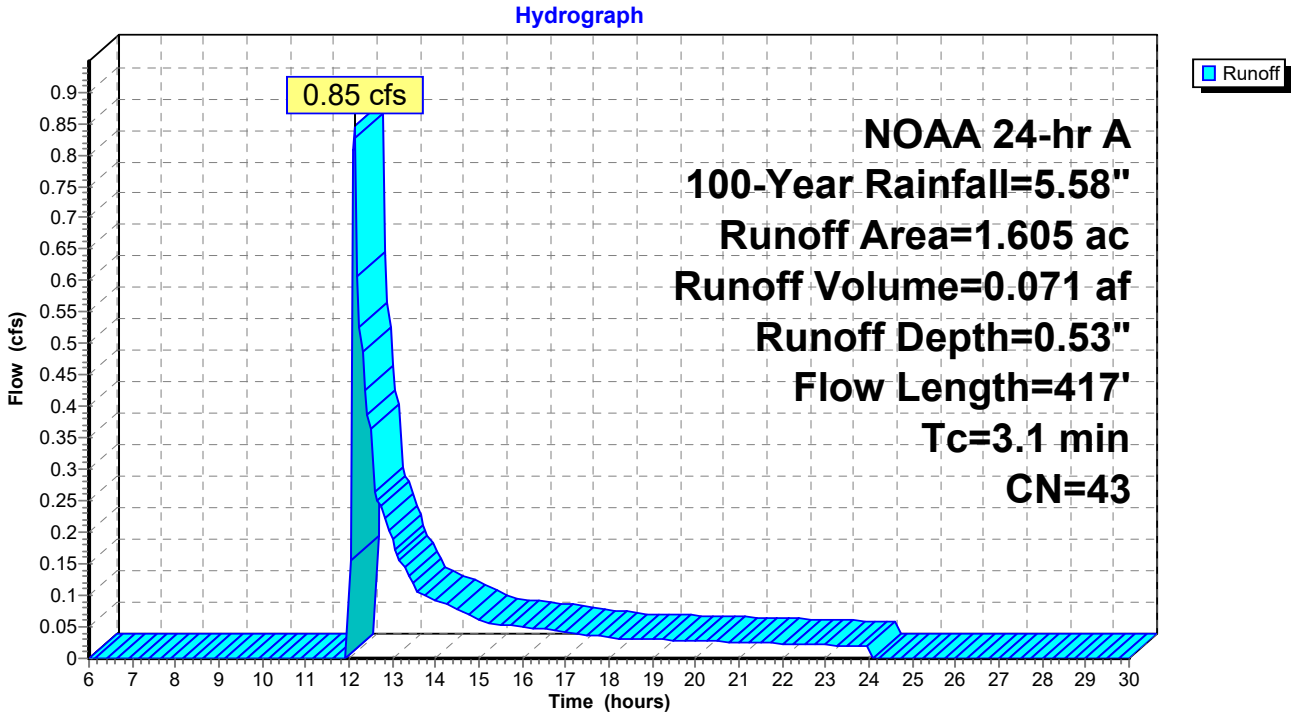
Runoff = 0.85 cfs @ 12.13 hrs, Volume= 0.071 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 100-Year Rainfall=5.58"

Area (ac)	CN	Description
1.496	39	>75% Grass cover, Good, HSG A
0.109	96	Gravel surface, HSG A
1.605	43	Weighted Average
1.605		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.9	317	0.0330	2.72		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	417	Total			

Subcatchment 1S: Pre-Developed Runoff



Summary for Subcatchment 2S: Post-Developed Runoff

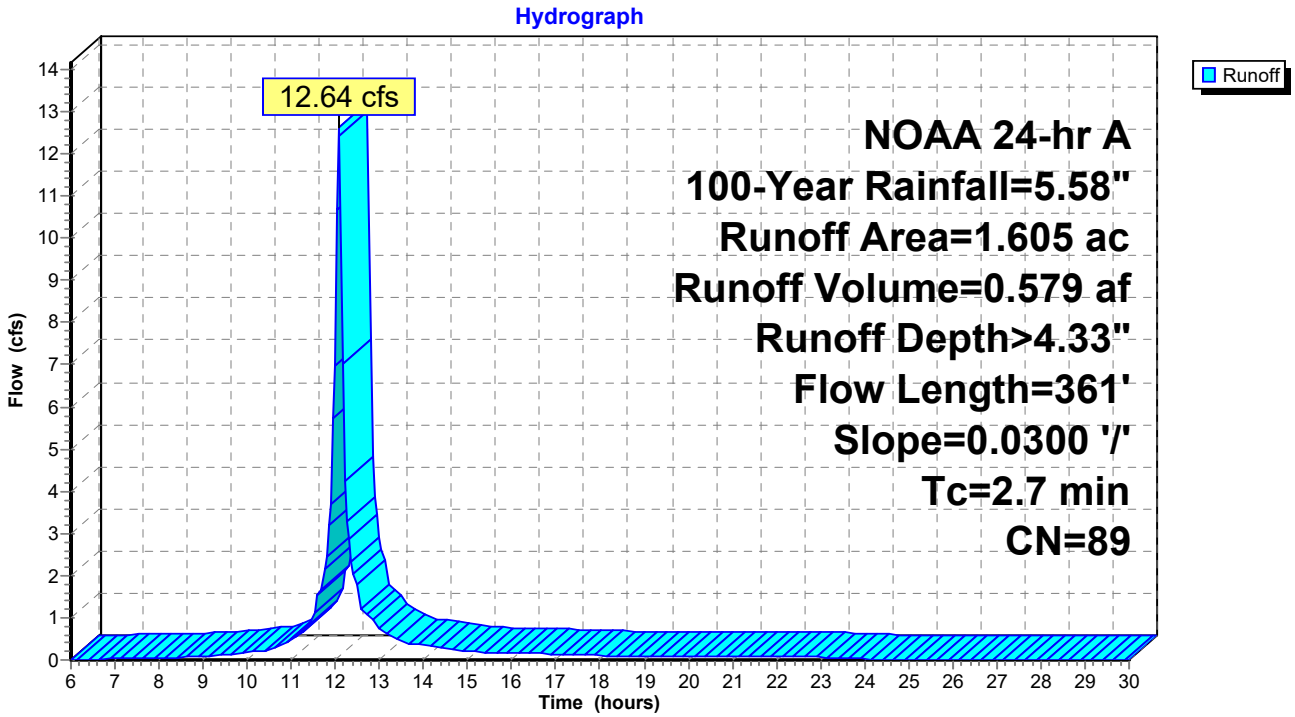
Runoff = 12.64 cfs @ 12.09 hrs, Volume= 0.579 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr A 100-Year Rainfall=5.58"

Area (ac)	CN	Description
0.023	98	Paved parking, HSG A
1.231	96	Gravel surface, HSG A
0.206	39	>75% Grass cover, Good, HSG A
0.145	98	Water Surface, HSG A
1.605	89	Weighted Average
1.437		89.53% Pervious Area
0.168		10.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.43"
1.5	261	0.0300	2.94		**Shallow Concentrated Flow,** Kv= 17.0 fps
2.7	361	Total			

Subcatchment 2S: Post-Developed Runoff



Summary for Pond 3P: Detention Basin

Inflow Area = 1.605 ac, 10.47% Impervious, Inflow Depth > 4.33" for 100-Year event
Inflow = 12.64 cfs @ 12.09 hrs, Volume= 0.579 af
Outflow = 0.85 cfs @ 12.93 hrs, Volume= 0.258 af, Atten= 93%, Lag= 50.7 min
Primary = 0.85 cfs @ 12.93 hrs, Volume= 0.258 af

Routing by Stor-Ind method, Time Span= 6.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 952.45' @ 12.93 hrs Surf.Area= 5,782 sf Storage= 17,987 cf

Plug-Flow detention time= 387.1 min calculated for 0.258 af (44% of inflow)
Center-of-Mass det. time= 299.8 min (1,076.7 - 776.9)

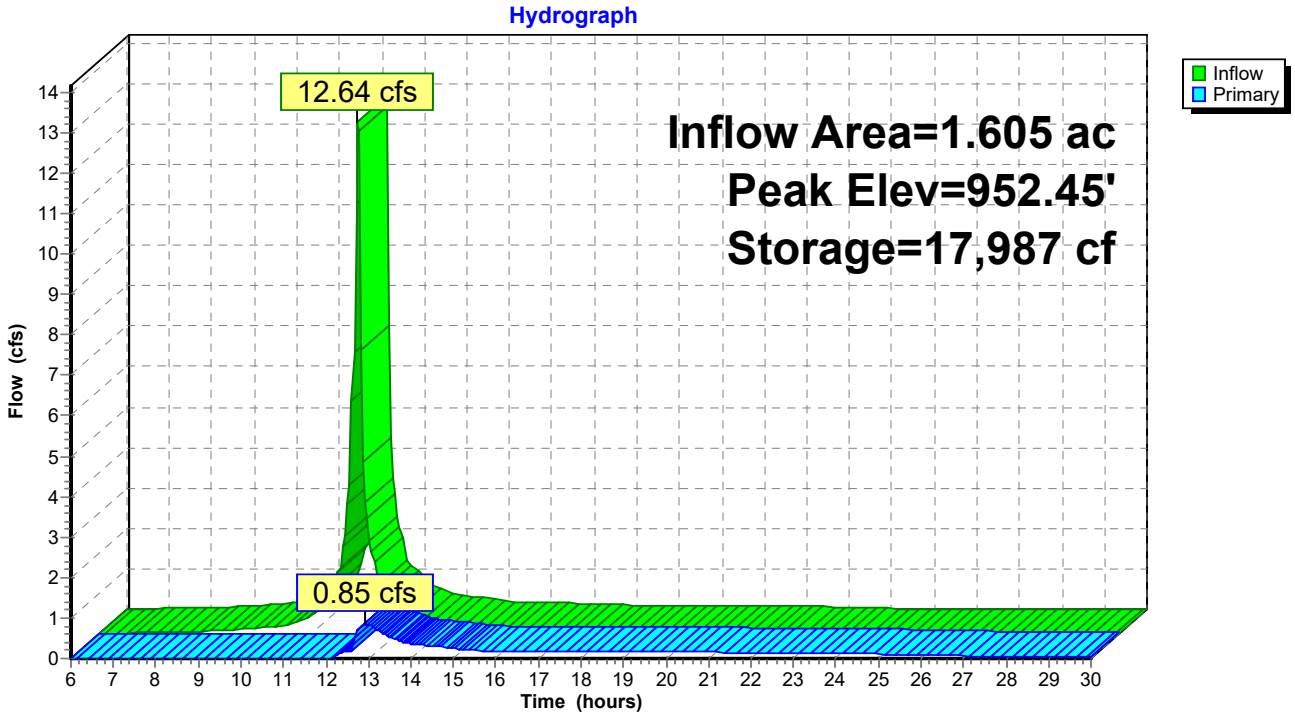
Volume	Invert	Avail.Storage	Storage Description
#1	947.00'	21,299 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

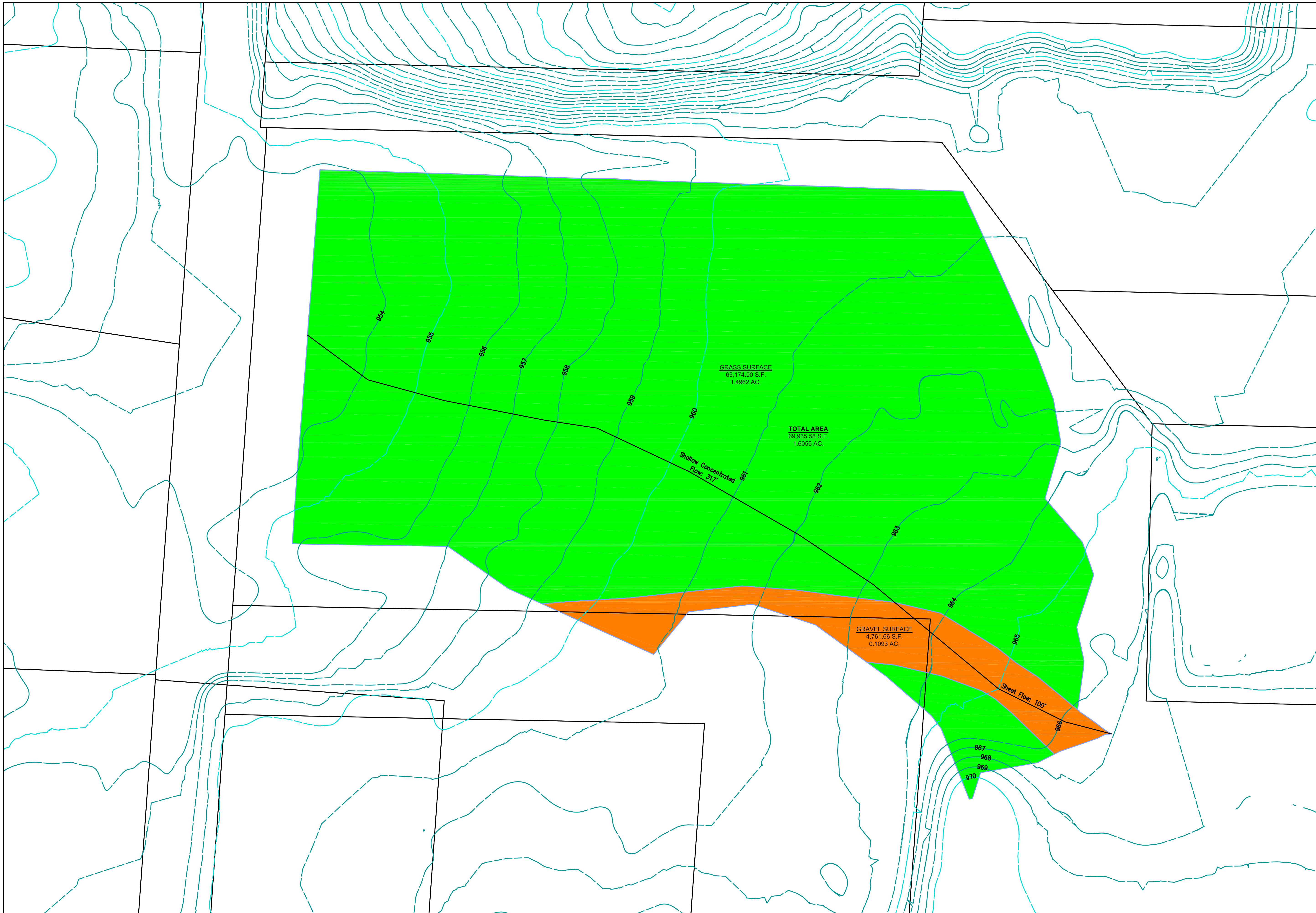
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
947.00	1,092	0	0
948.00	1,825	1,459	1,459
949.00	2,614	2,220	3,678
950.00	3,460	3,037	6,715
951.00	4,363	3,912	10,627
952.00	5,322	4,843	15,469
953.00	6,337	5,830	21,299

Device	Routing	Invert	Outlet Devices
#1	Primary	947.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 947.00' / 946.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	951.60'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	952.37'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.83 cfs @ 12.93 hrs HW=952.45' (Free Discharge)
└**1=Culvert** (Passes 0.83 cfs of 6.64 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 4.11 fps)
  └**3=Orifice/Grate** (Weir Controls 0.63 cfs @ 0.94 fps)

Pond 3P: Detention Basin





NW NE SW SE N

VERTICAL IN FEET 0 25 50

0 10 20 HORIZONTAL SCALE IN FEET

CHECKED BY: KAD

DATE: Dec. 2020

DRAWN BY: BMH

DATE: Dec. 2020

REVISIONS: DATE DESCRIPTION

1722 ERIE AVE. NW MASSILLON, OH, 44646

Pre-Developed Drainage Map

City of Massillon

Stark County, Ohio

CIVPRO ENGINEERING
ENGINEERS–SURVEYORS–CONSTRUCTION MANAGERS
4450 BELDEN VILLAGE STREET NW, SUITE 800 CANTON, OH 44718
PHONE: (234) 410-3913 EMAIL: KAD@CIVPROENGINEERING.COM
WWW.CIVPROENGINEERING.COM

DRAWING NAME:

REF NUMBER:

1 / 2

WATER SURFACE
6,337.44 S.F.
.1455 AC.

CONCRETE SURFACE
1,010.37 S.F.
0.0232 AC.

GRAVEL SURFACE
53,604.85 S.F.
1.2306 AC.

GRASS SURFACE
8,983.44 S.F.
.2062 AC.

TOTAL AREA
69,935.58 S.F.
1.6055 AC.

Shallow Concentrated Flow: 261'

Sheet Flow: 100'

951 953 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971

NW NE SW SE

VERTICAL IN FEET 50 25 0

0 10 20
HORIZONTAL SCALE IN FEET

CHECKED BY: KAD
DATE: Dec. 2020
DRAWN BY: BMH
DATE: Dec. 2020

REVISIONS:

DATE	DESCRIPTION

1722 ERIE AVE. NW MASSILLON, OH. 44646
Post-Developed Drainage Map
City of Massillon
Stark County, Ohio

CIVPRO ENGINEERING
ENGINEERS-SURVEYORS-CONSTRUCTION MANAGERS
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DRAWING NAME:

REF NUMBER:

2 / 2