STORMWATER REPORT

164 Essex Street
Melrose, Massachusetts

April 10, 2024

Applicant
Cedar Park Development, LLC
142 Hagget's Pond Road
Andover, MA 01841

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W&S Project Data
MELR-0047
SPessex#164.dwg
Existing.hcp
Proposed.hcp
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COMMONWEALTH OF MASSACHUSETTS
MATTHEW E MOORE
CIVIL
No. 45835
REGISTERED
PROFESSIONAL ENGINEER

4.1.2024

1 | *Mitigative Drainage Analysis*

1.1 Purpose

The purpose of this analysis is to compare the pre development watershed condition to the post development watershed condition for the project located at 164 Essex Street, Melrose, MA. This is accomplished by analyzing the surface stormwater runoff rates to the limit of watershed analysis as shown on the accompanying watershed maps. The result of this analysis is summarized in the Peak Rate of Runoff tables below, see Section 1.8.

1.2 Introduction

The subject property is located on the westerly side of Essex Street. The property is bounded by Essex Street to the east, railroad tracks to the west, an apartment building at 220 and 230 Essex Street to the north and a parking area associated with an assisted living facility to the south. Property access/egress is from Essex Street.

The subject property is 0.74 acres and is primarily a fenced paved parking area with an electronic gate for access from Essex Street. There is a vegetated area adjacent to Essex Street and no buildings are located on the property. The property does have drainage infrastructure (catch basins, particle separators and a leaching pipe/stone stormwater management area) and electric lines for the electronic gate and site lighting.

The proposal is to construct a 23,300± ft^2 76 unit residential building with underground parking, utilities and stormwater management devices for attenuation and treatment of stormwater runoff.

The property is located within the Extensive Business (BB-1) zoning district.

The property is generally flat with most of the grade change in the west-east direction.

1.3 Existing Condition Soils Analysis

To model the excess runoff for both the existing and proposed watershed condition, the parent soils on site were mapped using the Web Soil Survey (WSS) made available on the United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) website. The WSS provides vital soil data and information such as Hydrologic Soil Group (HSG), which is then input into a mathematical model to generate runoff curve numbers.

The user inputs the soil cover type and hydrologic soil group to generate a weighted curve number (CN) and also uses the topography of the land to generate a time of concentration (Tc) from which the stormwater runoff rate and volume can be calculated for a given watershed for comparison.

On-site soils are comprised of Urban Land (603) which does not have an assigned HSG. The existing subsurface pipe/stone stormwater management lies within a fill area of predominantly granular fill underlain by a natural sand and silt layer as determined from test borings.

A precipitation event occurred during March 28th through March 29th 2024 where the water level in the existing subsurface pipe/stone stormwater management was monitored. During a 4.5-hour time period the water level dropped 4.8 inches which translates to an exfiltration rate of 1.07 inches per hour. This rate is similar to a Rawls Rate for B soil (sandy loam 1.02 inches per hour), therefore, an HSG of B and an exfiltration rate of 1.02 inches per hour is used for the comparative purposes of this analysis.

1.4 Stormwater Modeling Methodology

The mathematical model used in this analysis for post development is computed using the stormwater modeling software HydroCAD, v10.20, developed by HydroCAD Software Solutions LLC. HydroCAD is a program used to model the hydrology and hydraulics of stormwater runoff and is based largely on programs and techniques developed by the NRCS, specifically TR-20 and TR-55 and other hydraulic calculation methods.

HydroCAD allows the user, for a given rainfall event, to generate runoff hydrographs for single or multiple watersheds and is used to determine if a given drainage system is adequate under the desired conditions and to predict flooding or other hydraulic impacts such as erosion at specified locations.

Five design storm events are analyzed and the result is summarized below in the Peak Rate of Runoff tables, see Section 1.8.

1.5 Pre-Development Watershed

The total pre-development watershed area is separated into six subcatchments resulting from existing topography and for comparison with the post-development condition.

The selected Comparison Edge 1L represents flow tributary towards Essex Street. The area tributary to this selected edge of comparison is 50,171 ft^2.

The total watershed area within the limit of watershed analysis is 50,171 ft^2.

Using the methods described in the stormwater modeling methodology above, runoff curve numbers and times of concentration are generated for each watershed for the pre-development condition to be used for comparison with the post-development condition described below. A schematic of the mathematical model and the result of the calculations for the 2-year, 10-year, 25-year, 50-year and 100-year storm events are included in this analysis. The 24-hour storm distribution curves used in these analyses are converted from NOAA Atlas 14 Point Precipitation Frequency Estimates based on the project location.

1.6 Post-Development Watershed

The post-development watershed is separated into eight subcatchments tributary to the selected edge of comparisons.

The selected Comparison Edge 1L represents flow tributary towards Essex Street. The area tributary to this selected edge of comparison is 50,171 ft^2.

The total watershed area within the limit of watershed analysis is 50,171 ft^2.

Post-development provides for the construction of deep sump hooded catch basins and subsurface infiltration galleys. These drainage devices will provide water quality, groundwater recharge and peak rate of runoff mitigation.

Building downspouts from the proposed building will discharge to the subsurface infiltration galleys.

Using the methods described in the stormwater modeling methodology above, runoff curve numbers and times of concentration are generated for the post-development condition. A schematic of the mathematical model and the result of the calculations for the 2-year, 10-year, 25-year, 50-year and 100-year storm events are included in this analysis. The 24-hour storm distribution curves used in these analyses are converted from NOAA Atlas 14 Point Precipitation Frequency Estimates based on the project location.

1.7 Compliance with DEP Stormwater Management Standards

Standard 1
No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

New stormwater runoff requiring treatment will be treated prior to discharge. A new pipe connection to an existing manhole is proposed as the sole project outfall, resulting in no erosion.

Standard 2
Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

Refer to Peak Rate of Runoff tables (Section 1.8) which demonstrate the post-development peak discharge rates are less than or equal to the pre-development peak discharge rates.

Standard 3
Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from the pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The project site is analyzed using Hydrologic Soil Group B and an exfiltration rate of 1.02 inches/hour is used as determined from field measurements of the existing subsurface pipe/stone stormwater management system. Groundwater recharge is provided by subsurface infiltration galleys.

Any unsuitable material encountered during construction will be removed and replaced with imported granular material. Should refusal/ledge be encountered during construction it shall be removed to a depth of four feet below infiltration system and backfilled with clean blasted rock fragments.

Standard 4
Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:
a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook

The project will utilize deep sump hooded catch basins and subsurface infiltration galleys to treat stormwater runoff.

Runoff from certain types of roof areas is considered "clean" by DEP and therefore do not require treatment. We assume the roof types for this project will satisfy this criterion.

Proposed permeable pavers are also not considered to require treatment.

Although there are some untreated impervious areas in the proposed condition (driveway entrance to garage and concrete sidewalk) there is a net reduction of 312± ft^2 of untreated impervious area between the proposed and existing condition.

The project site is not considered a LUHPPL, within a Zone II, Interim Wellhead Protection Area or Critical Area (Zone A) and therefore water quality volume/flowrate is based on a runoff of one-half inch.

Standard 5
For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow melt, and stormwater runoff, the proponent shall use specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated there under at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

This project is not being considered a LUHPPL.

Standard 6
Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2) (a) (1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of public water supply.

The project site is not within a Zone II, Interim Wellhead Protection Area or Critical Area.

Standard 7
A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

Although this project is not considered a redevelopment there is a net reduction of 2,031± ft^2 in impervious area (this includes permeable pavers and excludes pervious pavement)

Standard 8
A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

Refer to Section 5 Construction Period Pollution Prevention Plan and Erosion and Sediment Control.

Standard 9
A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

Refer to Appendix F Long Term Operation and Maintenance Plan (O&M).

Standard 10
All illicit discharges to the stormwater management system are prohibited.

Illicit Discharge Compliance Statement
No connection between the stormwater and wastewater management systems is proposed. Per requirements of Standard 10 it is herein stated that there are no proposed illicit discharges into the Stormwater Management System to be constructed as shown on the site plan.

Signed:________________________________ Date: 4/11/2024
Cedar Park Development, LLC
Sean Szekely

1.8 Conclusion

Examining the following Peak Rate of Runoff and Basin Performance tables the proposed stormwater management system is effective for mitigating the peak flow rate and volume from the limit of the watershed analysis for the 2-year, 10-year, 25-year, 50-year and 100-year storm events.

Table 1.8.1: Peak Rate of Runoff | Comparison Location 1L

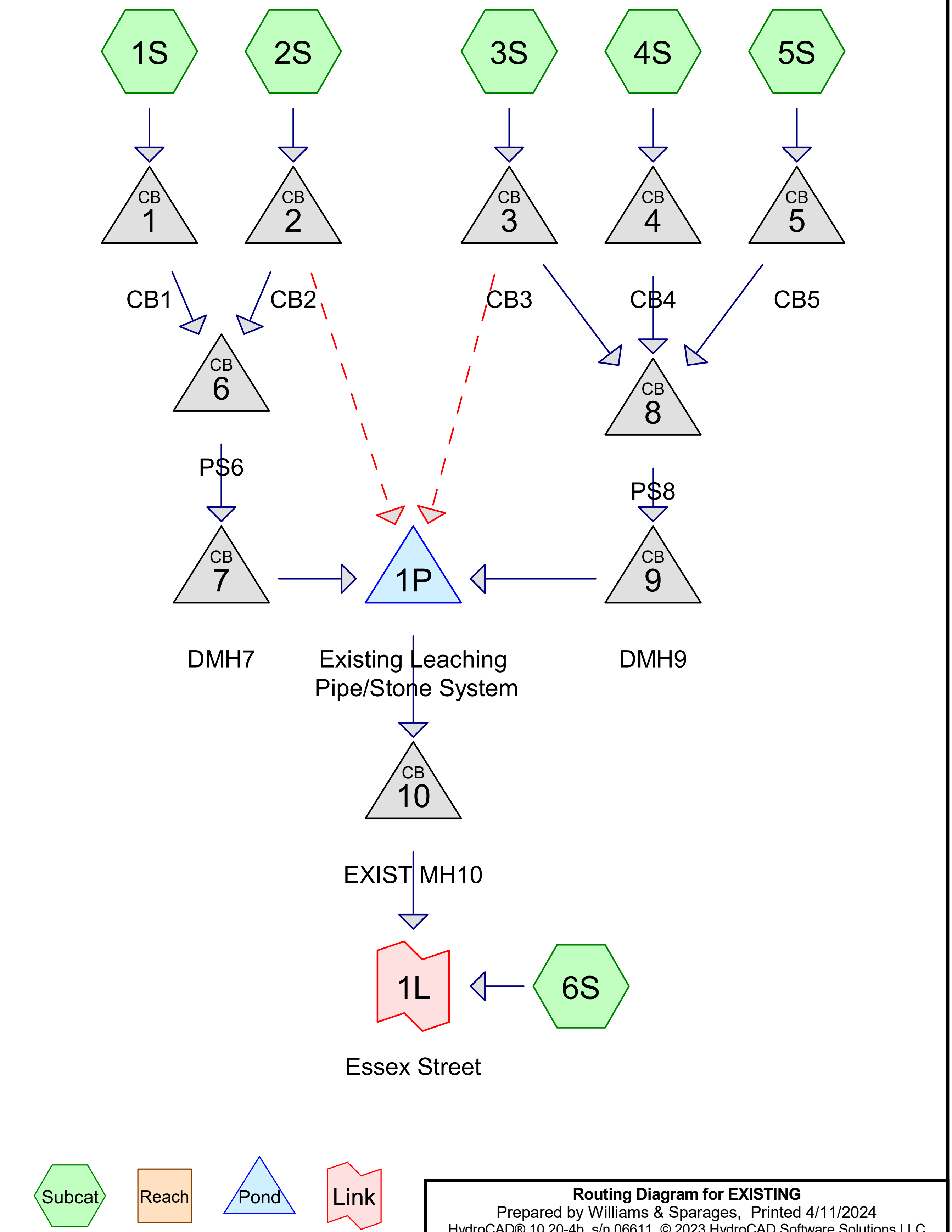
Description	**2 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
Existing Peak Rate of Runoff (cfs)	2.52	3.71	4.45	4.99	5.56
Proposed Peak Rate of Runoff (cfs)	0.57	0.95	1.19	1.37	1.55
Difference	**-1.95**	**-2.76**	**-3.26**	**-3.62**	**-4.01**

Table 1.8.2: Stormwater Management Area 1P | Subsurface Infiltration Galleys

24 Hour Local Storm event	Peak Rate of Runoff in (cfs)	Peak Rate of runoff out (cfs)				Peak Water Level (ft)
		Total (cfs)	Exfiltration (cfs)	8″ Culvert (cfs)		
2 year	1.93	0.07	0.07	0.00		50.56
10 year	3.10	0.20	0.07	0.13		51.93
25 year	3.84	0.62	0.07	0.55		52.24
50 year	4.38	0.94	0.07	0.87		52.69
100 year	4.98	1.25	0.07	1.18		53.57

1.9 HydroCAD Data

1.9.1 Existing Condition



Routing Diagram for EXISTING
Prepared by Williams & Sparages, Printed 4/11/2024
HydroCAD® 10.20-4b s/n 06611 © 2023 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	MA-164 Essex St Melrose 24-hr S1	2-yr	Default	24.00	1	3.29	2
2	10-yr	MA-164 Essex St Melrose 24-hr S1	10-yr	Default	24.00	1	5.17	2
3	25-yr	MA-164 Essex St Melrose 24-hr S1	25-yr	Default	24.00	1	6.34	2
4	50-yr	MA-164 Essex St Melrose 24-hr S1	50-yr	Default	24.00	1	7.21	2
5	100-yr	MA-164 Essex St Melrose 24-hr S1	100-yr	Default	24.00	1	8.16	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
7,919	69	50-75% Grass cover, Fair, HSG B (1S, 2S, 3S, 4S, 5S)
2,201	61	>75% Grass cover, Good, HSG B (6S)
6,924	96	Gravel surface, HSG B (1S, 2S, 3S, 4S)
33,127	98	Paved parking, HSG B (1S, 2S, 3S, 4S, 5S, 6S)
50,171	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
50,171	HSG B	1S, 2S, 3S, 4S, 5S, 6S
0	HSG C	
0	HSG D	
0	Other	
50,171		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	7,919	0	0	0	7,919	50-75% Grass cover, Fair	
0	2,201	0	0	0	2,201	>75% Grass cover, Good	
0	6,924	0	0	0	6,924	Gravel surface	
0	33,127	0	0	0	33,127	Paved parking	
0	**50,171**	**0**	**0**	**0**	**50,171**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1	53.18	52.69	94.0	0.0052	0.012	0.0	8.0	0.0	
2	1P	52.01	51.29	71.0	0.0101	0.012	0.0	8.0	0.0	
3	2	52.84	52.69	33.0	0.0045	0.012	0.0	8.0	0.0	
4	3	52.68	52.69	88.0	-0.0001	0.012	0.0	8.0	0.0	
5	4	52.81	52.69	8.0	0.0150	0.012	0.0	8.0	0.0	
6	5	53.21	52.69	72.0	0.0072	0.012	0.0	8.0	0.0	
7	6	52.14	52.26	28.0	-0.0043	0.012	0.0	12.0	0.0	
8	7	49.96	50.10	9.0	-0.0156	0.012	0.0	12.0	0.0	
9	7	50.26	50.10	8.0	0.0200	0.012	0.0	12.0	0.0	
10	8	52.39	51.82	31.0	0.0184	0.012	0.0	12.0	0.0	
11	9	50.12	50.10	10.0	0.0020	0.012	0.0	12.0	0.0	
12	9	50.32	50.10	11.0	0.0200	0.012	0.0	12.0	0.0	
13	10	51.29	50.75	14.0	0.0386	0.012	0.0	8.0	0.0	

Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,562 sf 55.71% Impervious Runoff Depth=2.44"
Flow Length=69' Slope=0.0320 '/' Tc=6.0 min CN=92 Runoff=0.56 cfs 1,738 cf

Subcatchment 2S: Runoff Area=14,873 sf 63.59% Impervious Runoff Depth=2.53"
Flow Length=141' Tc=6.0 min CN=93 Runoff=1.01 cfs 3,139 cf

Subcatchment 3S: Runoff Area=8,456 sf 68.87% Impervious Runoff Depth=2.53"
Flow Length=129' Tc=6.0 min CN=93 Runoff=0.57 cfs 1,784 cf

Subcatchment 4S: Runoff Area=11,171 sf 77.26% Impervious Runoff Depth=2.53"
Flow Length=142' Tc=6.0 min CN=93 Runoff=0.76 cfs 2,357 cf

Subcatchment 5S: Runoff Area=3,227 sf 85.65% Impervious Runoff Depth=2.63"
Flow Length=91' Slope=0.0290 '/' Tc=6.0 min CN=94 Runoff=0.22 cfs 708 cf

Subcatchment 6S: Runoff Area=3,882 sf 43.30% Impervious Runoff Depth=1.28"
Tc=6.0 min CN=77 Runoff=0.13 cfs 413 cf

Pond 1: CB1 Peak Elev=53.69' Inflow=0.56 cfs 1,738 cf
8.0" Round Culvert n=0.012 L=94.0' S=0.0052 '/' Outflow=0.56 cfs 1,738 cf

Pond 1P: Existing Leaching Pipe/Stone Peak Elev=55.01' Storage=2,518 cf Inflow=3.13 cfs 9,726 cf
Discarded=0.08 cfs 4,218 cf Primary=2.41 cfs 5,415 cf Outflow=2.49 cfs 9,633 cf

Pond 2: CB2 Peak Elev=53.70' Inflow=1.01 cfs 3,139 cf
Primary=1.01 cfs 3,139 cf Secondary=0.00 cfs 0 cf Outflow=1.01 cfs 3,139 cf

Pond 3: CB3 Peak Elev=53.52' Inflow=0.57 cfs 1,784 cf
Primary=0.57 cfs 1,784 cf Secondary=0.00 cfs 0 cf Outflow=0.57 cfs 1,784 cf

Pond 4: CB4 Peak Elev=53.40' Inflow=0.76 cfs 2,357 cf
8.0" Round Culvert n=0.012 L=8.0' S=0.0150 '/' Outflow=0.76 cfs 2,357 cf

Pond 5: CB5 Peak Elev=53.49' Inflow=0.22 cfs 708 cf
8.0" Round Culvert n=0.012 L=72.0' S=0.0072 '/' Outflow=0.22 cfs 708 cf

Pond 6: PS6 Peak Elev=53.07' Inflow=1.57 cfs 4,877 cf
12.0" Round Culvert n=0.012 L=28.0' S=-0.0043 '/' Outflow=1.57 cfs 4,877 cf

Pond 7: DMH7 Peak Elev=50.64' Inflow=1.57 cfs 4,877 cf
Outflow=1.57 cfs 4,877 cf

Pond 8: PS8 Peak Elev=53.06' Inflow=1.56 cfs 4,849 cf
12.0" Round Culvert n=0.012 L=31.0' S=0.0184 '/' Outflow=1.56 cfs 4,849 cf

Pond 9: DMH9 Peak Elev=50.73' Inflow=1.56 cfs 4,849 cf
Outflow=1.56 cfs 4,849 cf

Pond 10: EXIST MH10 Peak Elev=53.68' Inflow=2.41 cfs 5,415 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=2.41 cfs 5,415 cf

Link 1L: Essex Street Inflow=2.52 cfs 5,828 cf
Primary=2.52 cfs 5,828 cf

Total Runoff Area = 50,171 sf Runoff Volume = 10,139 cf Average Runoff Depth = 2.43"
33.97% Pervious = 17,044 sf 66.03% Impervious = 33,127 sf

Summary for Subcatchment 1S:

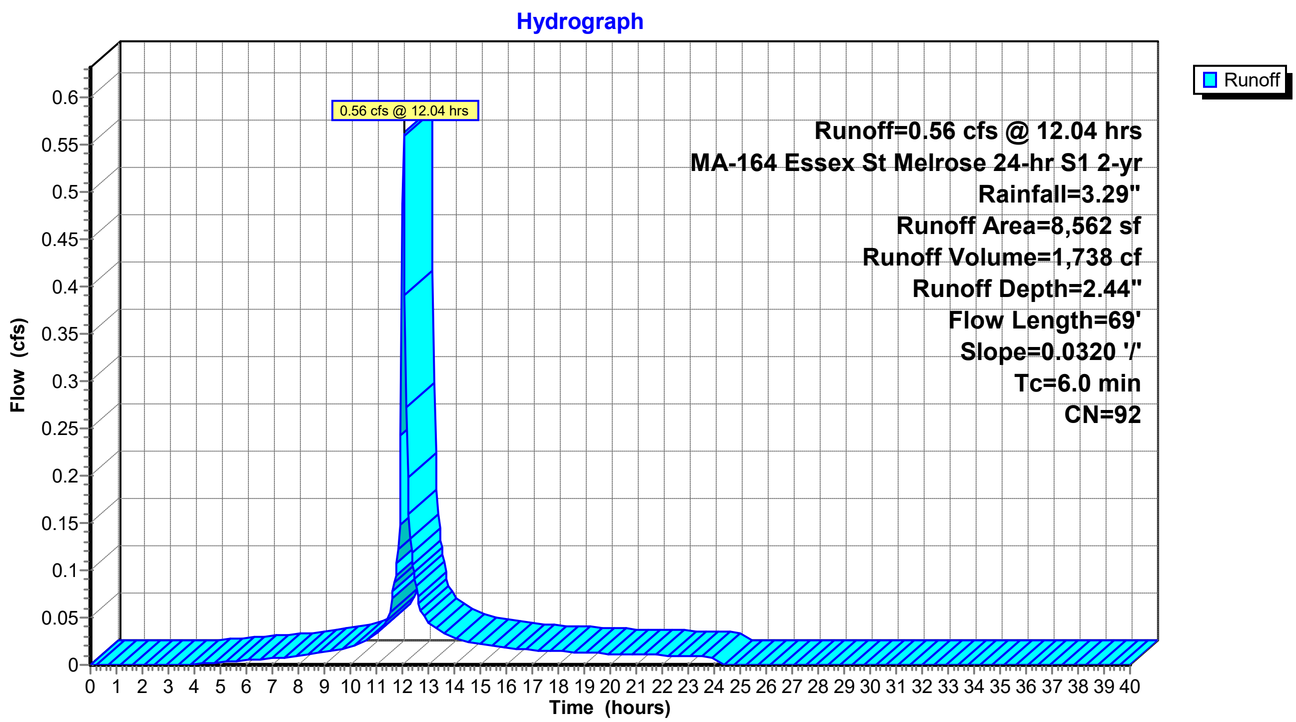
Runoff = 0.56 cfs @ 12.04 hrs, Volume= 1,738 cf, Depth= 2.44"
Routed to Pond 1 : CB1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
1,762	69	50-75% Grass cover, Fair, HSG B
4,770	98	Paved parking, HSG B
2,030	96	Gravel surface, HSG B
8,562	92	Weighted Average
3,792		44.29% Pervious Area
4,770		55.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	69	0.0320	1.56		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.7	69	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S:



Summary for Subcatchment 2S:

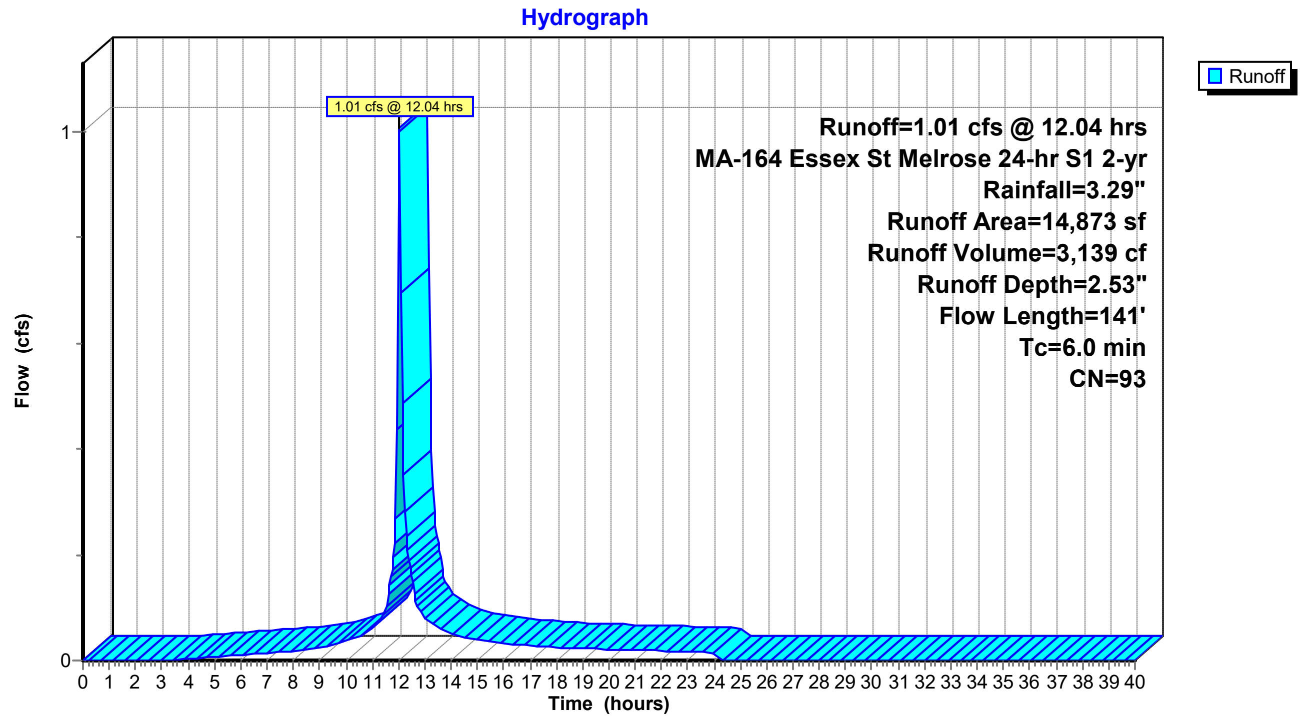
Runoff = 1.01 cfs @ 12.04 hrs, Volume= 3,139 cf, Depth= 2.53"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
2,420	69	50-75% Grass cover, Fair, HSG B
9,457	98	Paved parking, HSG B
2,996	96	Gravel surface, HSG B
14,873	93	Weighted Average
5,416		36.41% Pervious Area
9,457		63.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0195	1.38		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	41	0.0120	2.22		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	141	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S:



Summary for Subcatchment 3S:

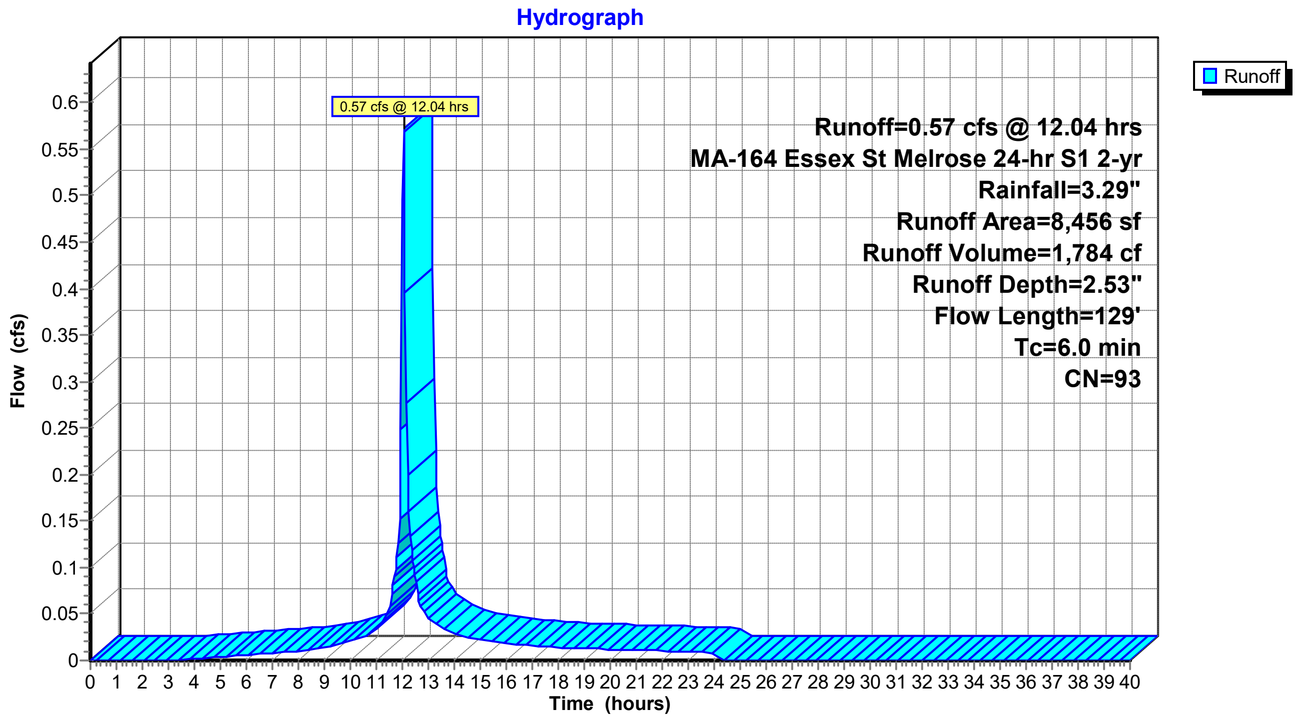
Runoff = 0.57 cfs @ 12.04 hrs, Volume= 1,784 cf, Depth= 2.53"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
1,406	69	50-75% Grass cover, Fair, HSG B
5,824	98	Paved parking, HSG B
1,226	96	Gravel surface, HSG B
8,456	93	Weighted Average
2,632		31.13% Pervious Area
5,824		68.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.2	29	0.0250	3.21		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.4	129	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S:



Summary for Subcatchment 4S:

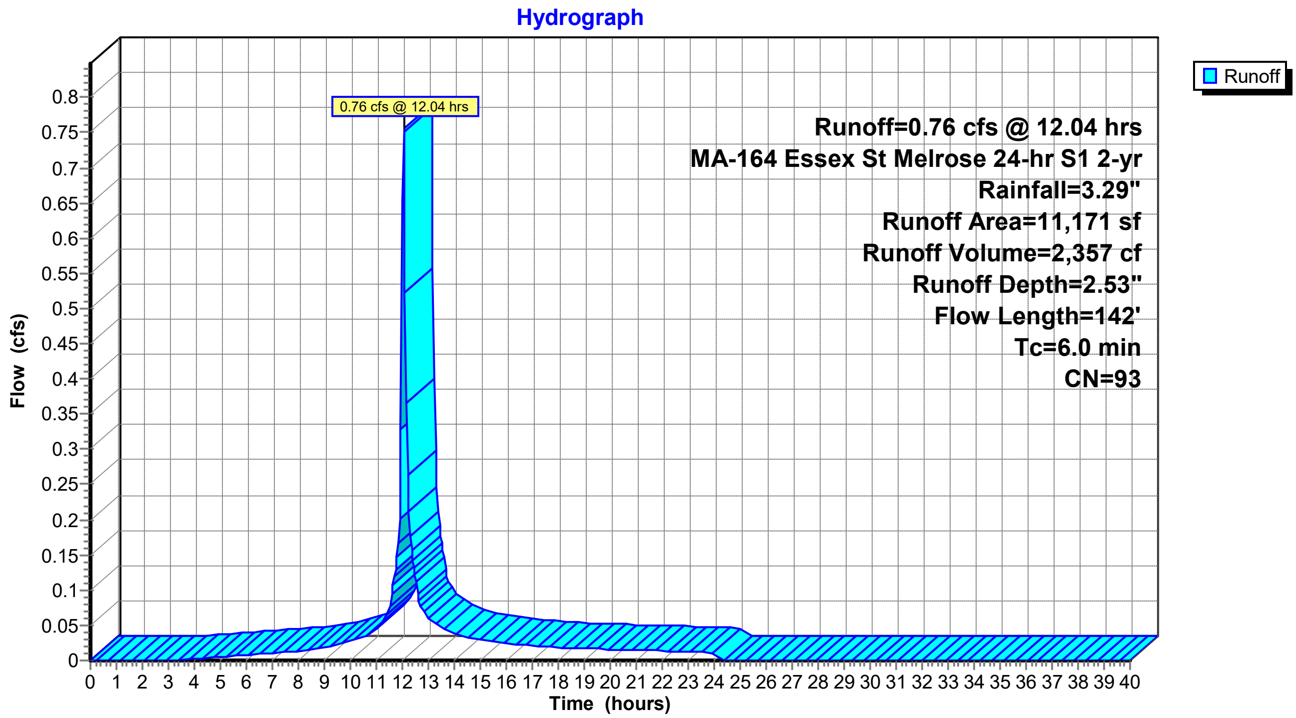
Runoff = 0.76 cfs @ 12.04 hrs, Volume= 2,357 cf, Depth= 2.53"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
1,868	69	50-75% Grass cover, Fair, HSG B
8,631	98	Paved parking, HSG B
672	96	Gravel surface, HSG B
11,171	93	Weighted Average
2,540		22.74% Pervious Area
8,631		77.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	42	0.0164	2.60		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	142	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S:



Summary for Subcatchment 5S:

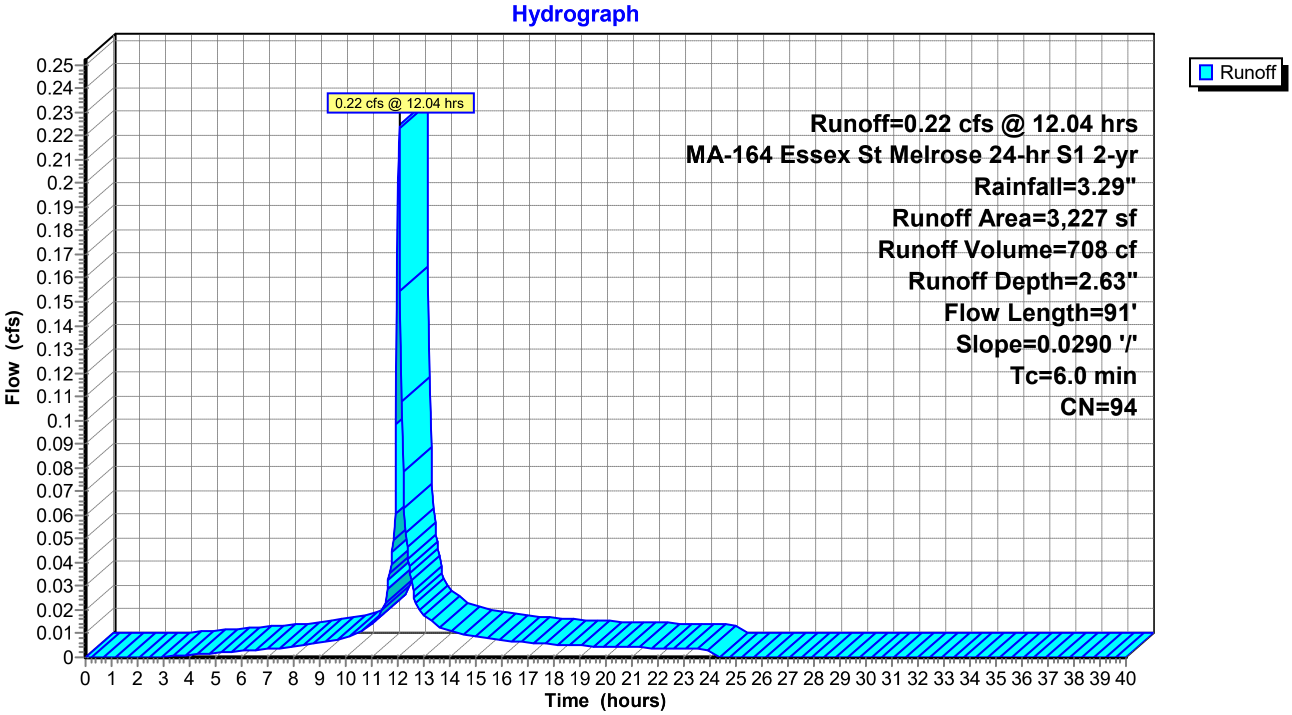
Runoff = 0.22 cfs @ 12.04 hrs, Volume= 708 cf, Depth= 2.63"
Routed to Pond 5 : CB5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
463	69	50-75% Grass cover, Fair, HSG B
2,764	98	Paved parking, HSG B
3,227	94	Weighted Average
463		14.35% Pervious Area
2,764		85.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	91	0.0290	1.59		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
1.0	91	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5S:



Summary for Subcatchment 6S:

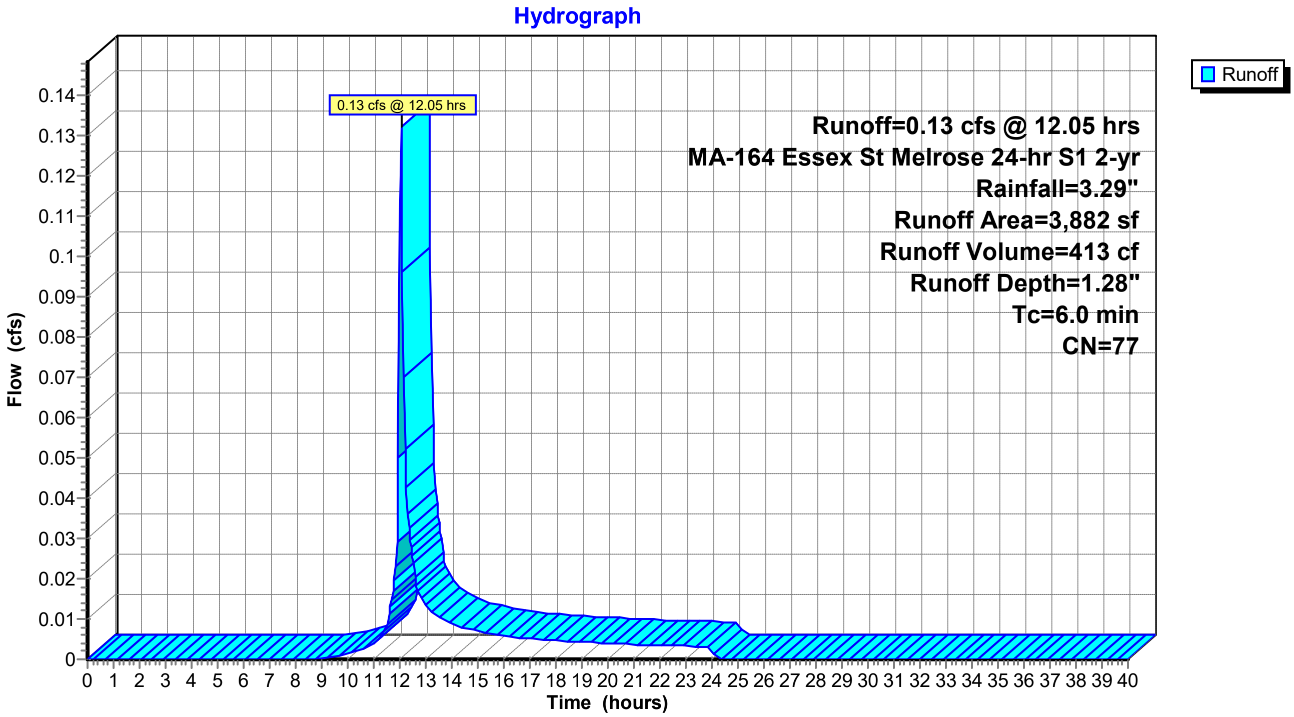
Runoff = 0.13 cfs @ 12.05 hrs, Volume= 413 cf, Depth= 1.28"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
2,201	61	>75% Grass cover, Good, HSG B
1,681	98	Paved parking, HSG B
3,882	77	Weighted Average
2,201		56.70% Pervious Area
1,681		43.30% Impervious Area

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

Subcatchment 6S:



Summary for Pond 1: CB1

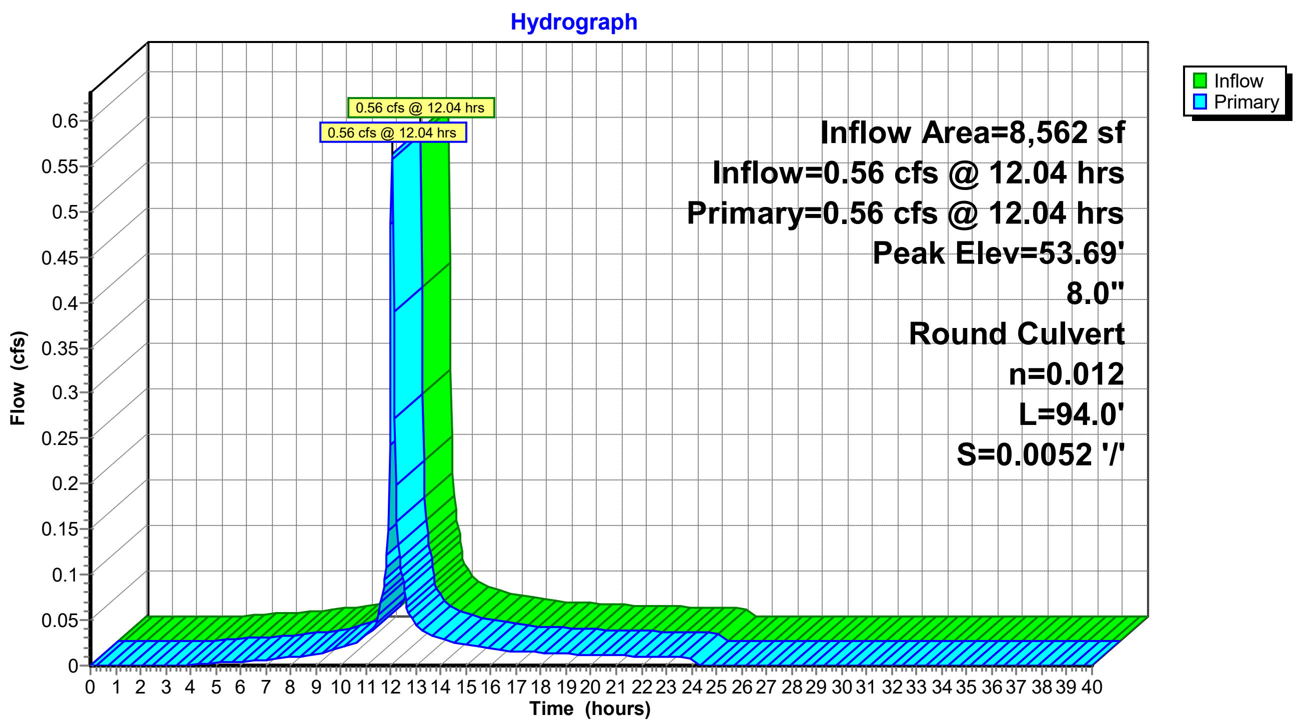
Inflow Area = 8,562 sf, 55.71% Impervious, Inflow Depth = 2.44" for 2-yr event
Inflow = 0.56 cfs @ 12.04 hrs, Volume= 1,738 cf
Outflow = 0.56 cfs @ 12.04 hrs, Volume= 1,738 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.56 cfs @ 12.04 hrs, Volume= 1,738 cf
Routed to Pond 6 : PS6

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.69' @ 12.04 hrs
Flood Elev= 55.08'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.18'	**8.0" Round Culvert** L= 94.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.18' / 52.69' S= 0.0052 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.54 cfs @ 12.04 hrs HW=53.68' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.54 cfs @ 2.70 fps)

Pond 1: CB1



Summary for Pond 1P: Existing Leaching Pipe/Stone System

Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 2.52" for 2-yr event
Inflow = 3.13 cfs @ 12.04 hrs, Volume= 9,726 cf
Outflow = 2.49 cfs @ 12.09 hrs, Volume= 9,633 cf, Atten= 20%, Lag= 3.1 min
Discarded = 0.08 cfs @ 12.09 hrs, Volume= 4,218 cf
Primary = 2.41 cfs @ 12.09 hrs, Volume= 5,415 cf
Routed to Pond 10 : EXIST MH10

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 55.01' @ 12.09 hrs Surf.Area= 3,302 sf Storage= 2,518 cf

Plug-Flow detention time= 265.1 min calculated for 9,633 cf (99% of inflow)
Center-of-Mass det. time= 259.1 min (1,064.7 - 805.6)

Volume	Invert	Avail.Storage	Storage Description
#1	48.90'	1,912 cf	**12.00'W x 120.00'L x 3.67'H Prismatoid** 5,285 cf Overall - 506 cf Embedded = 4,779 cf x 40.0% Voids
#2	50.10'	377 cf	**24.0" Round Pipe Storage** Inside #1 L= 120.0' 506 cf Overall - 1.9" Wall Thickness = 377 cf
#3	52.57'	3,586 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		5,875 cf	Total Available Storage

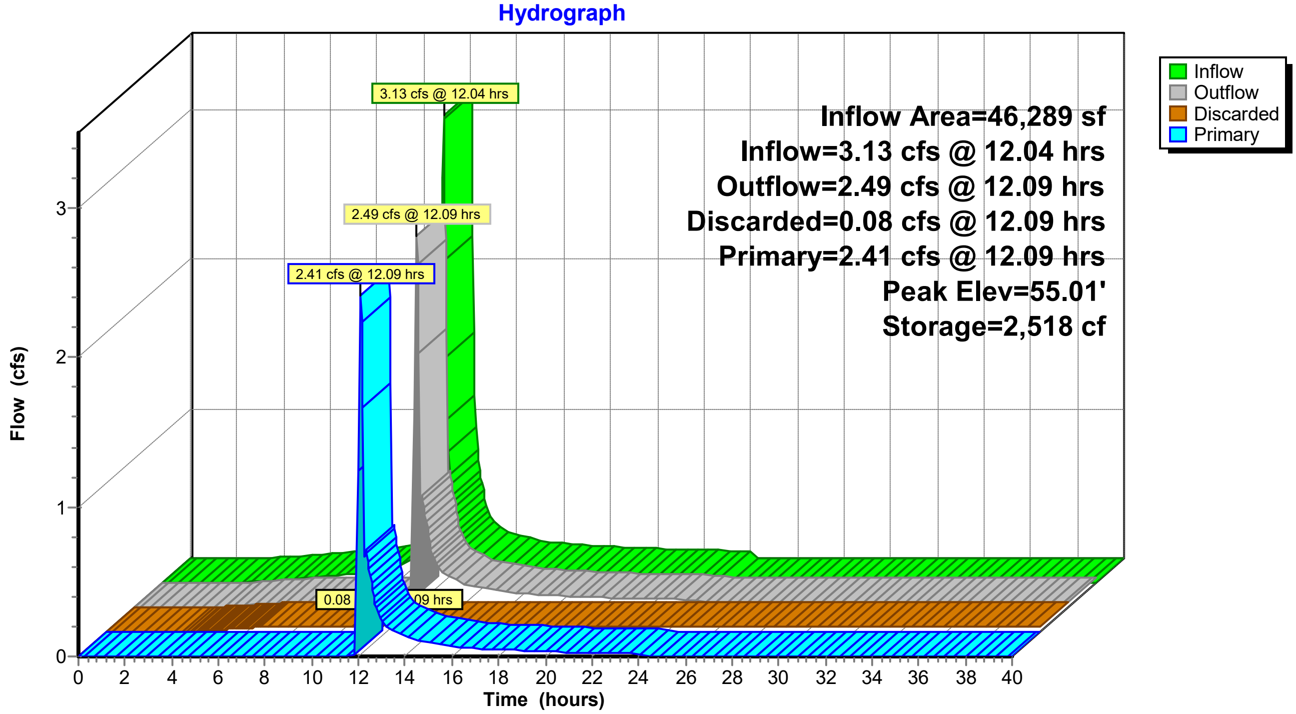
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.57	0	0	0
54.74	1	1	1
55.00	1,569	204	205
55.50	11,954	3,381	3,586

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.90'	**1.000 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	52.01'	**8.0" Round Culvert** L= 71.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.01' / 51.29' S= 0.0101 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#3	Primary	54.92'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 13.00 13.00 17.76 17.76 20.29 24.29 40.35 Elev. (feet) 55.46 55.42 55.02 54.92 55.32 55.31 55.35 55.46

Discarded OutFlow Max=0.07 cfs @ 12.09 hrs HW=55.01' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=2.38 cfs @ 12.09 hrs HW=55.01' (Free Discharge)
├─**2=Culvert** (Barrel Controls 2.24 cfs @ 6.42 fps)
└─**3=Asymmetrical Weir** (Weir Controls 0.14 cfs @ 0.39 fps)

Pond 1P: Existing Leaching Pipe/Stone System



Summary for Pond 2: CB2

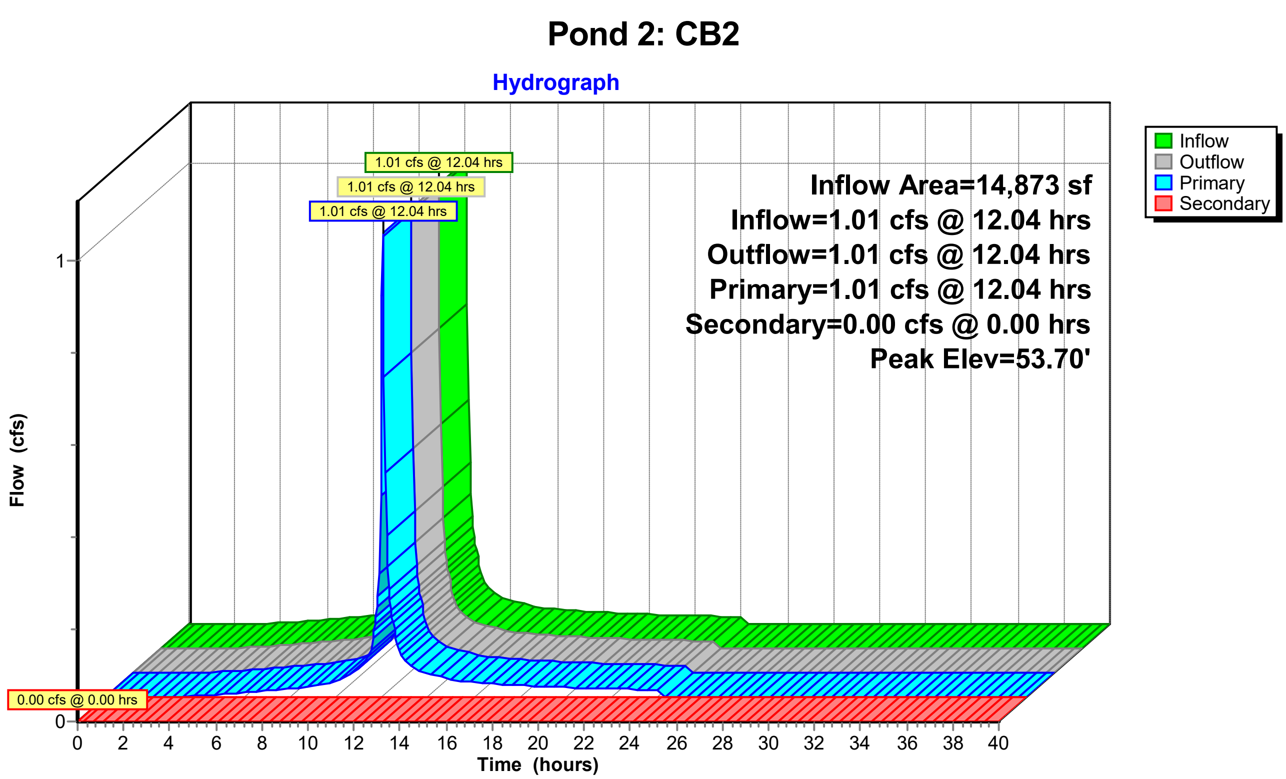
Inflow Area = 14,873 sf, 63.59% Impervious, Inflow Depth = 2.53" for 2-yr event
Inflow = 1.01 cfs @ 12.04 hrs, Volume= 3,139 cf
Outflow = 1.01 cfs @ 12.04 hrs, Volume= 3,139 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.01 cfs @ 12.04 hrs, Volume= 3,139 cf
Routed to Pond 6 : PS6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.70' @ 12.04 hrs
Flood Elev= 54.74'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.84'	**8.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.84' / 52.69' S= 0.0045 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.74'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.98 cfs @ 12.04 hrs HW=53.67' (Free Discharge)
1=Culvert (Barrel Controls 0.98 cfs @ 2.90 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=52.84' (Free Discharge)
2=Orifice/Grate (Controls 0.00 cfs)



Summary for Pond 3: CB3

Inflow Area = 8,456 sf, 68.87% Impervious, Inflow Depth = 2.53" for 2-yr event
Inflow = 0.57 cfs @ 12.04 hrs, Volume= 1,784 cf
Outflow = 0.57 cfs @ 12.04 hrs, Volume= 1,784 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.57 cfs @ 12.04 hrs, Volume= 1,784 cf
Routed to Pond 8 : PS8
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

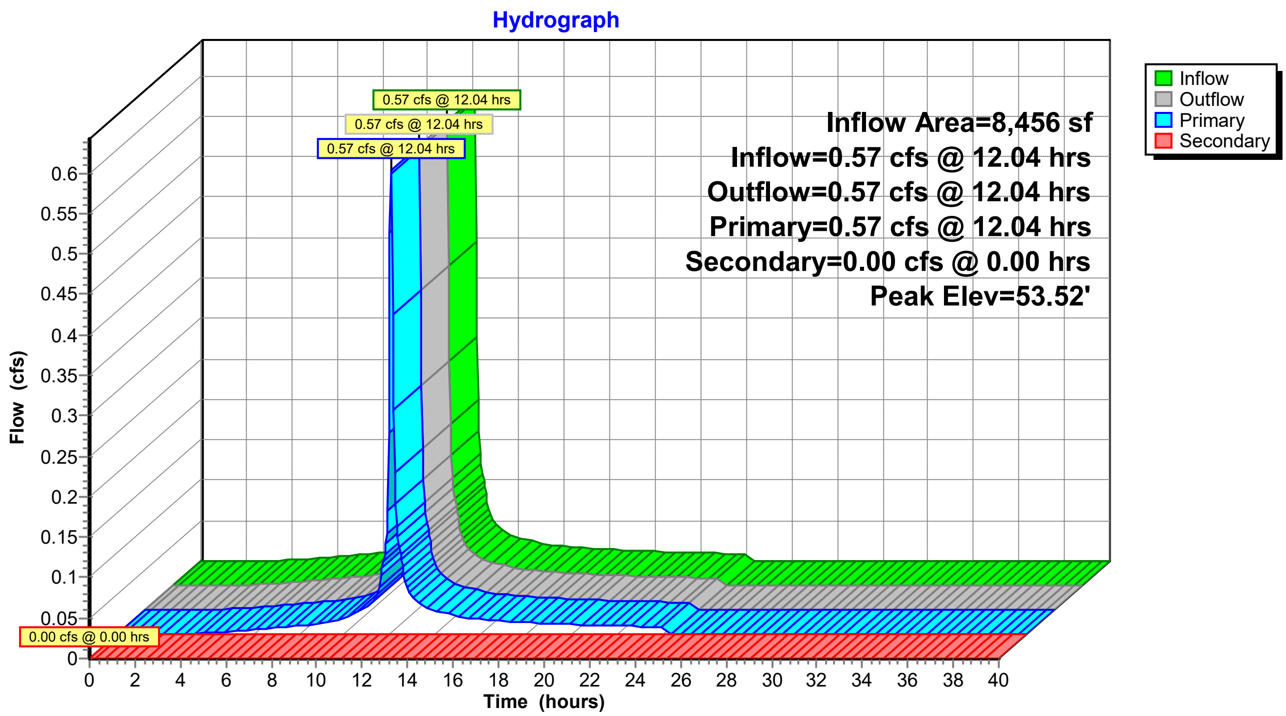
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.52' @ 12.04 hrs
Flood Elev= 54.78'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.69'	**8.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.68' / 52.69' S= -0.0001 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.78'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.56 cfs @ 12.04 hrs HW=53.50' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.56 cfs @ 1.66 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=52.69' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 3: CB3



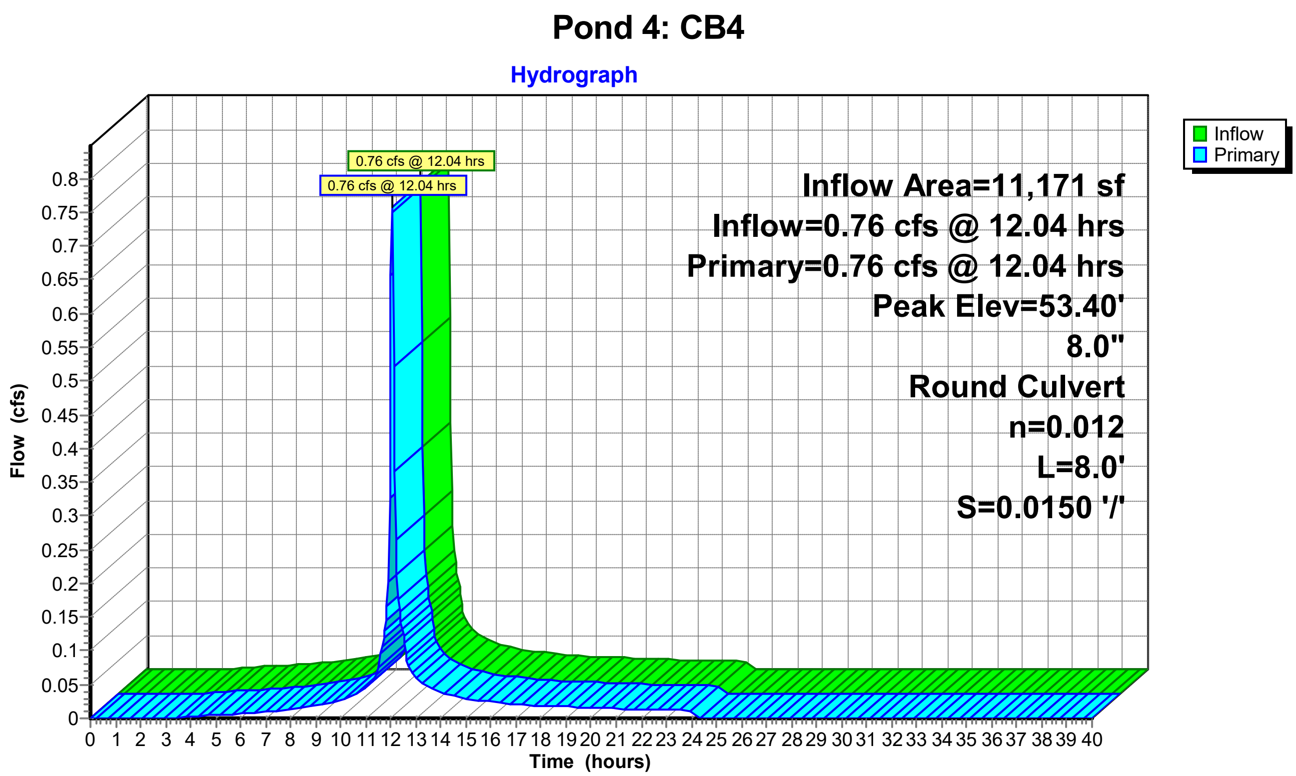
Summary for Pond 4: CB4

Inflow Area = 11,171 sf, 77.26% Impervious, Inflow Depth = 2.53" for 2-yr event
Inflow = 0.76 cfs @ 12.04 hrs, Volume= 2,357 cf
Outflow = 0.76 cfs @ 12.04 hrs, Volume= 2,357 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.76 cfs @ 12.04 hrs, Volume= 2,357 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.40' @ 12.04 hrs
Flood Elev= 54.81'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.81'	**8.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.81' / 52.69' S= 0.0150 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.73 cfs @ 12.04 hrs HW=53.38' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.73 cfs @ 3.07 fps)



Summary for Pond 5: CB5

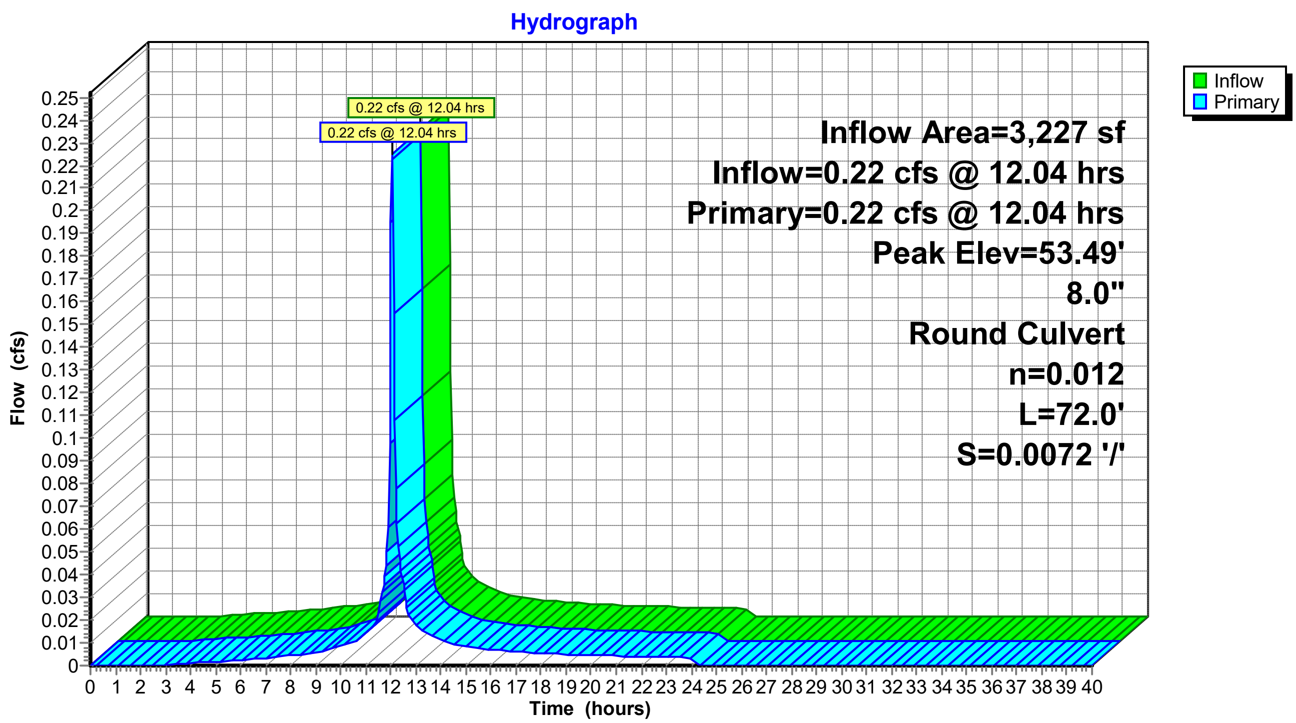
Inflow Area = 3,227 sf, 85.65% Impervious, Inflow Depth = 2.63" for 2-yr event
Inflow = 0.22 cfs @ 12.04 hrs, Volume= 708 cf
Outflow = 0.22 cfs @ 12.04 hrs, Volume= 708 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.22 cfs @ 12.04 hrs, Volume= 708 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.49' @ 12.04 hrs
Flood Elev= 55.11'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.21'	**8.0" Round Culvert** L= 72.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.21' / 52.69' S= 0.0072 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.22 cfs @ 12.04 hrs HW=53.48' (Free Discharge)
1=Culvert (Barrel Controls 0.22 cfs @ 2.36 fps)

Pond 5: CB5



Summary for Pond 6: PS6

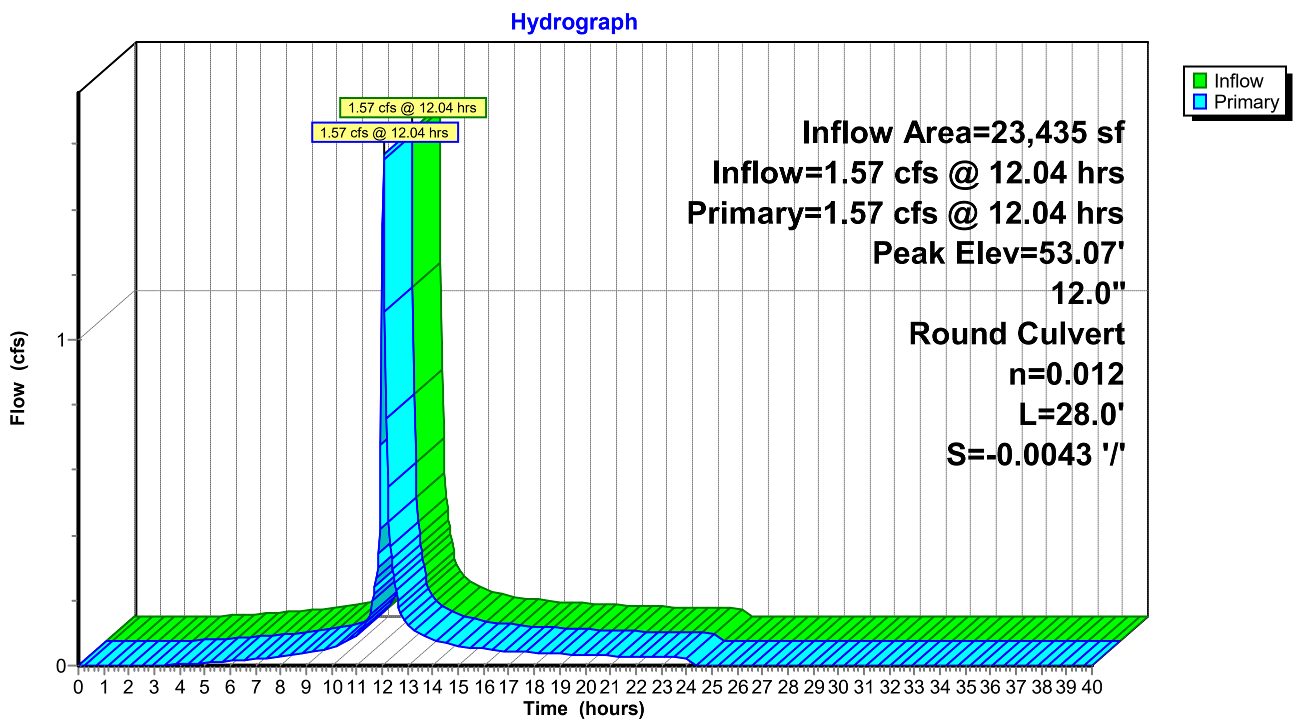
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 2.50" for 2-yr event
Inflow = 1.57 cfs @ 12.04 hrs, Volume= 4,877 cf
Outflow = 1.57 cfs @ 12.04 hrs, Volume= 4,877 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.57 cfs @ 12.04 hrs, Volume= 4,877 cf
Routed to Pond 7 : DMH7

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.07' @ 12.04 hrs
Flood Elev= 55.04'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.26'	**12.0" Round Culvert** L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.14' / 52.26' S= -0.0043 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.52 cfs @ 12.04 hrs HW=53.05' (Free Discharge)
↑**1=Culvert** (Barrel Controls 1.52 cfs @ 2.64 fps)

Pond 6: PS6



Summary for Pond 7: DMH7

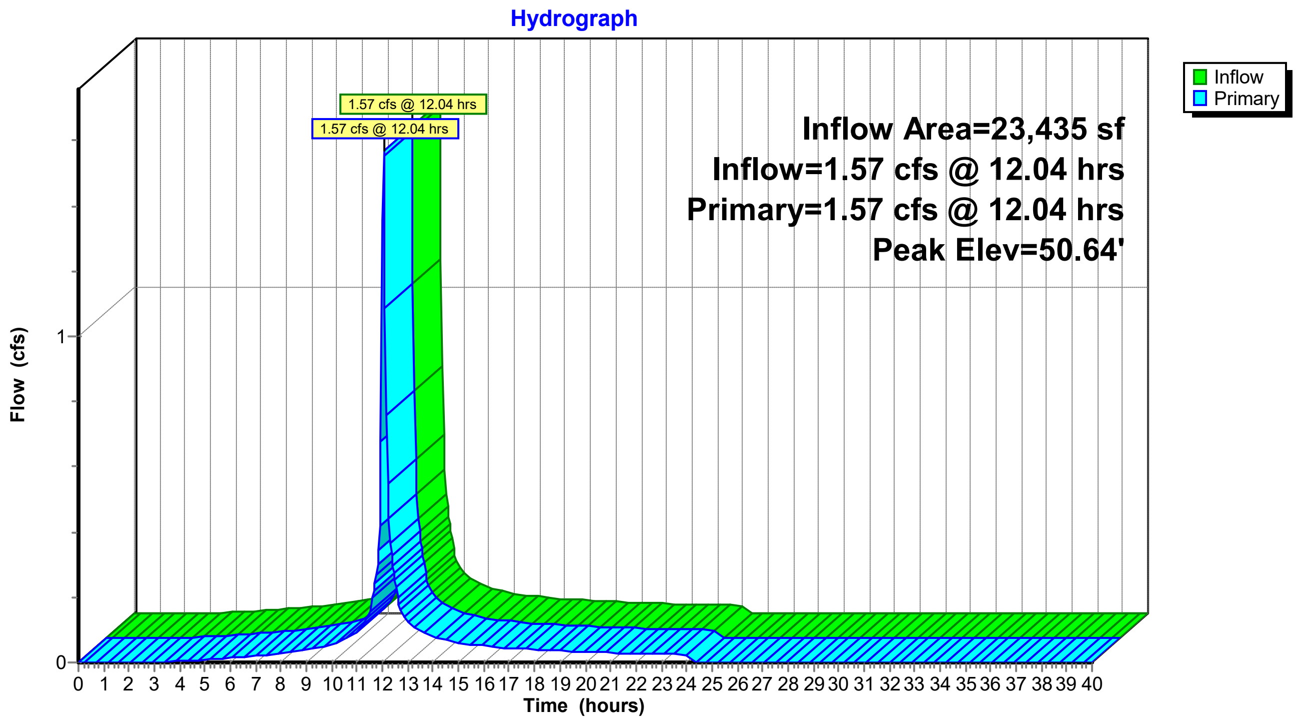
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 2.50" for 2-yr event
Inflow = 1.57 cfs @ 12.04 hrs, Volume= 4,877 cf
Outflow = 1.57 cfs @ 12.04 hrs, Volume= 4,877 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.57 cfs @ 12.04 hrs, Volume= 4,877 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 50.64' @ 12.04 hrs
Flood Elev= 55.36'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.10'	**12.0" Round Culvert** L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.96' / 50.10' S= -0.0156 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.26'	**12.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.26' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.51 cfs @ 12.04 hrs HW=50.63' (Free Discharge)
1=Culvert (Barrel Controls 0.99 cfs @ 2.49 fps)
2=Culvert (Barrel Controls 0.53 cfs @ 2.94 fps)

Pond 7: DMH7



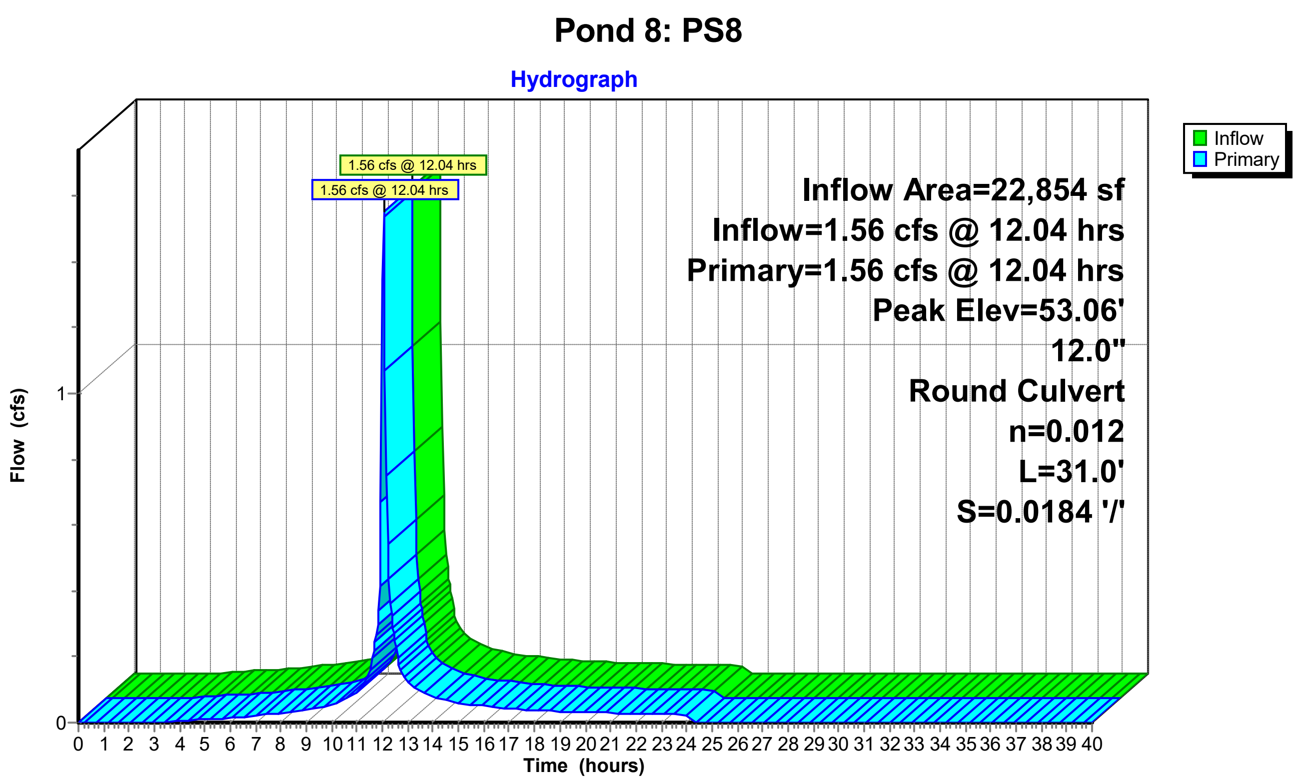
Summary for Pond 8: PS8

Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 2.55" for 2-yr event
Inflow = 1.56 cfs @ 12.04 hrs, Volume= 4,849 cf
Outflow = 1.56 cfs @ 12.04 hrs, Volume= 4,849 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.56 cfs @ 12.04 hrs, Volume= 4,849 cf
Routed to Pond 9 : DMH9

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.06' @ 12.04 hrs
Flood Elev= 54.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.39'	**12.0" Round Culvert** L= 31.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.39' / 51.82' S= 0.0184 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.50 cfs @ 12.04 hrs HW=53.04' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.50 cfs @ 2.75 fps)



Summary for Pond 9: DMH9

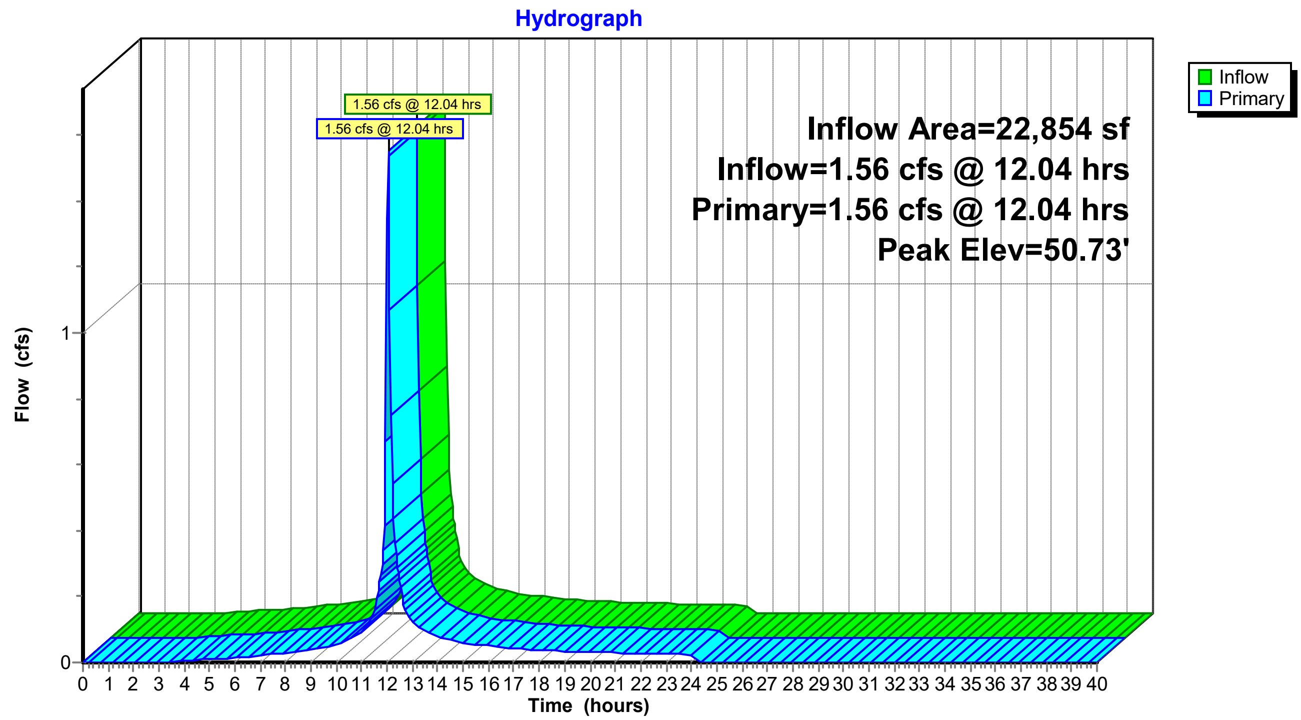
Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 2.55" for 2-yr event
Inflow = 1.56 cfs @ 12.04 hrs, Volume= 4,849 cf
Outflow = 1.56 cfs @ 12.04 hrs, Volume= 4,849 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.56 cfs @ 12.04 hrs, Volume= 4,849 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 50.73' @ 12.04 hrs
Flood Elev= 55.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.12'	**12.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.12' / 50.10' S= 0.0020 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.32'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.32' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.50 cfs @ 12.04 hrs HW=50.72' (Free Discharge)
1=Culvert (Barrel Controls 0.86 cfs @ 2.48 fps)
2=Culvert (Inlet Controls 0.64 cfs @ 2.16 fps)

Pond 9: DMH9



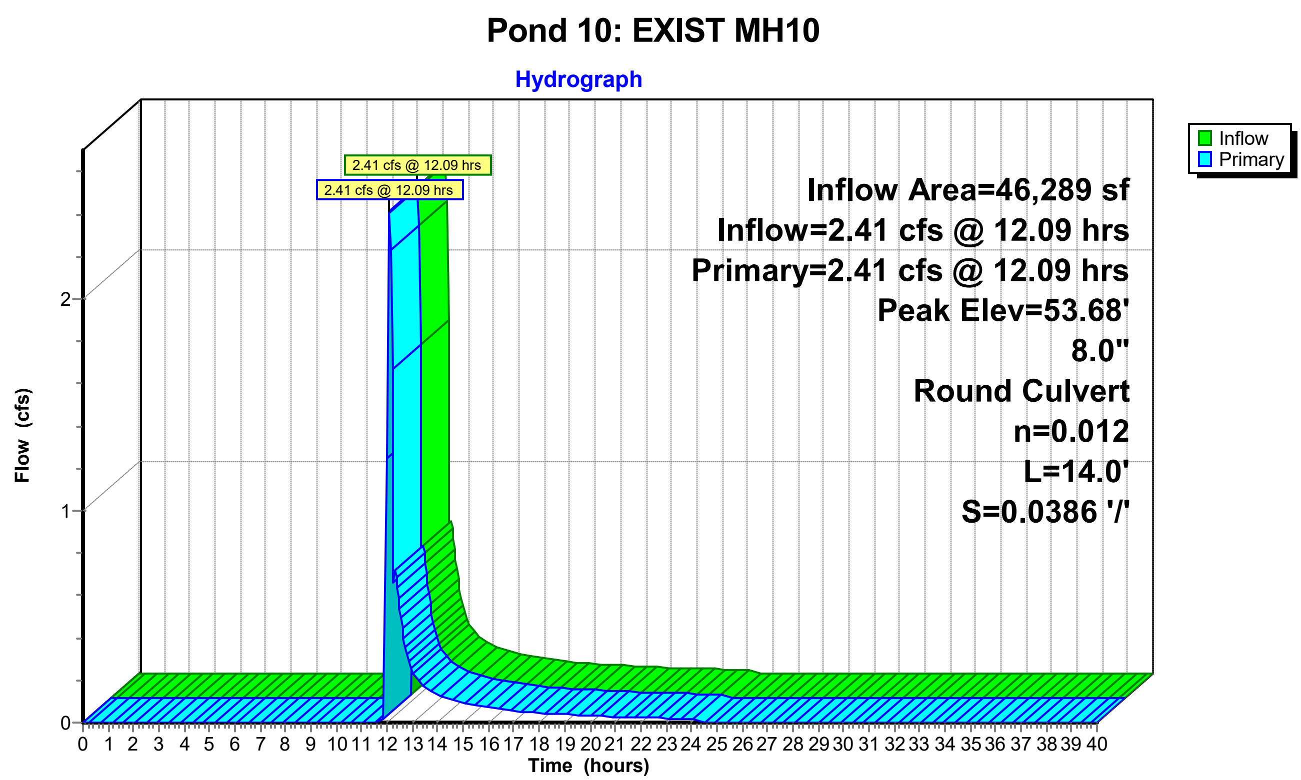
Summary for Pond 10: EXIST MH10

Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 1.40" for 2-yr event
Inflow = 2.41 cfs @ 12.09 hrs, Volume= 5,415 cf
Outflow = 2.41 cfs @ 12.09 hrs, Volume= 5,415 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.41 cfs @ 12.09 hrs, Volume= 5,415 cf
Routed to Link 1L : Essex Street

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.68' @ 12.09 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

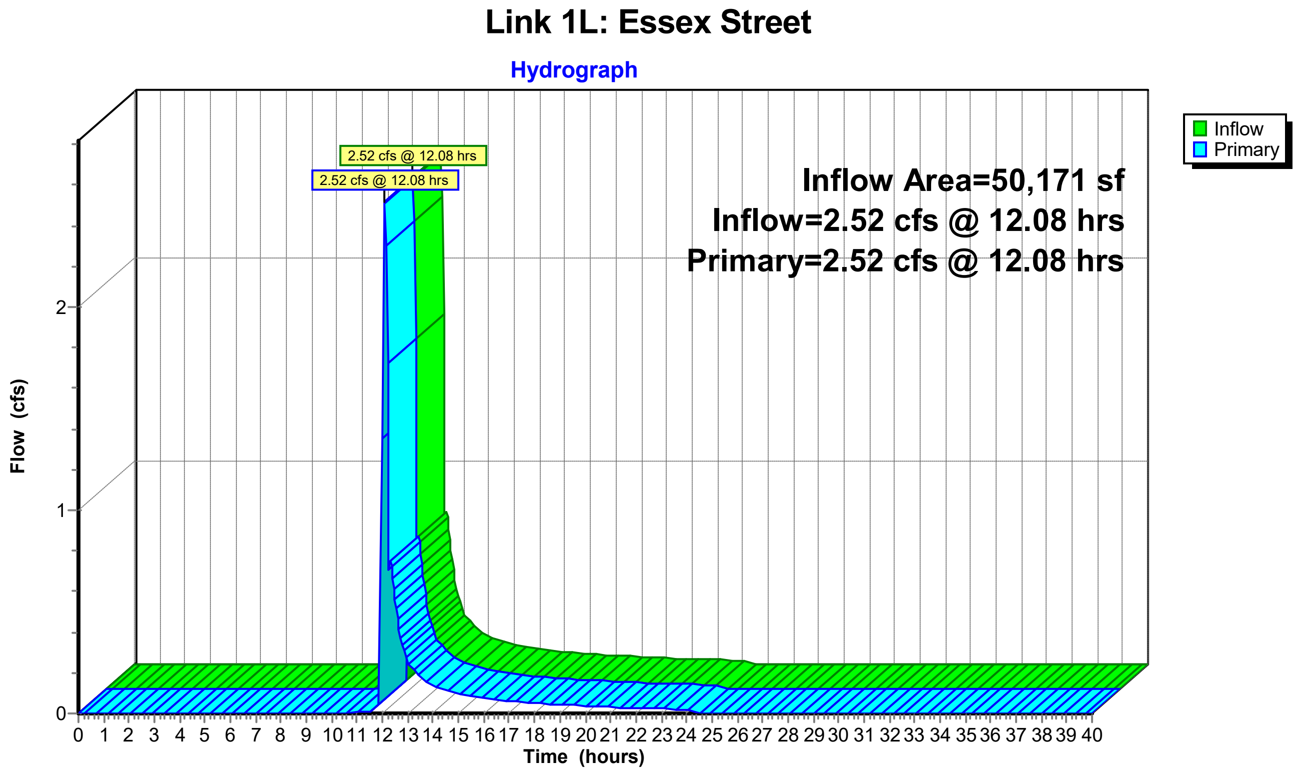
Primary OutFlow Max=2.39 cfs @ 12.09 hrs HW=53.65' (Free Discharge)
↑**1=Culvert** (Inlet Controls 2.39 cfs @ 6.86 fps)



Summary for Link 1L: Essex Street

Inflow Area =	50,171 sf,	66.03% Impervious,	Inflow Depth = 1.39"	for 2-yr event	
Inflow =	2.52 cfs @	12.08 hrs,	Volume=	5,828 cf	
Primary =	2.52 cfs @	12.08 hrs,	Volume=	5,828 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,562 sf 55.71% Impervious Runoff Depth=4.26"
Flow Length=69' Slope=0.0320 '/' Tc=6.0 min CN=92 Runoff=0.93 cfs 3,036 cf

Subcatchment 2S: Runoff Area=14,873 sf 63.59% Impervious Runoff Depth=4.36"
Flow Length=141' Tc=6.0 min CN=93 Runoff=1.64 cfs 5,410 cf

Subcatchment 3S: Runoff Area=8,456 sf 68.87% Impervious Runoff Depth=4.36"
Flow Length=129' Tc=6.0 min CN=93 Runoff=0.93 cfs 3,076 cf

Subcatchment 4S: Runoff Area=11,171 sf 77.26% Impervious Runoff Depth=4.36"
Flow Length=142' Tc=6.0 min CN=93 Runoff=1.23 cfs 4,063 cf

Subcatchment 5S: Runoff Area=3,227 sf 85.65% Impervious Runoff Depth=4.48"
Flow Length=91' Slope=0.0290 '/' Tc=6.0 min CN=94 Runoff=0.36 cfs 1,204 cf

Subcatchment 6S: Runoff Area=3,882 sf 43.30% Impervious Runoff Depth=2.77"
Tc=6.0 min CN=77 Runoff=0.29 cfs 895 cf

Pond 1: CB1 Peak Elev=53.92' Inflow=0.93 cfs 3,036 cf
8.0" Round Culvert n=0.012 L=94.0' S=0.0052 '/' Outflow=0.93 cfs 3,036 cf

Pond 1P: Existing Leaching Pipe/Stone Peak Elev=55.15' Storage=2,962 cf Inflow=5.11 cfs 16,789 cf
Discarded=0.14 cfs 4,511 cf Primary=3.51 cfs 12,171 cf Outflow=3.65 cfs 16,682 cf

Pond 2: CB2 Peak Elev=54.39' Inflow=1.64 cfs 5,410 cf
Primary=1.64 cfs 5,410 cf Secondary=0.00 cfs 0 cf Outflow=1.64 cfs 5,410 cf

Pond 3: CB3 Peak Elev=53.96' Inflow=0.93 cfs 3,076 cf
Primary=0.93 cfs 3,076 cf Secondary=0.00 cfs 0 cf Outflow=0.93 cfs 3,076 cf

Pond 4: CB4 Peak Elev=53.72' Inflow=1.23 cfs 4,063 cf
8.0" Round Culvert n=0.012 L=8.0' S=0.0150 '/' Outflow=1.23 cfs 4,063 cf

Pond 5: CB5 Peak Elev=53.57' Inflow=0.36 cfs 1,204 cf
8.0" Round Culvert n=0.012 L=72.0' S=0.0072 '/' Outflow=0.36 cfs 1,204 cf

Pond 6: PS6 Peak Elev=53.52' Inflow=2.58 cfs 8,446 cf
12.0" Round Culvert n=0.012 L=28.0' S=-0.0043 '/' Outflow=2.58 cfs 8,446 cf

Pond 7: DMH7 Peak Elev=50.82' Inflow=2.58 cfs 8,446 cf
Outflow=2.58 cfs 8,446 cf

Pond 8: PS8 Peak Elev=53.33' Inflow=2.53 cfs 8,343 cf
12.0" Round Culvert n=0.012 L=31.0' S=0.0184 '/' Outflow=2.53 cfs 8,343 cf

Pond 9: DMH9 Peak Elev=50.90' Inflow=2.53 cfs 8,343 cf
Outflow=2.53 cfs 8,343 cf

Pond 10: EXIST MH10 Peak Elev=55.97' Inflow=3.51 cfs 12,171 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=3.51 cfs 12,171 cf

Link 1L: Essex Street Inflow=3.71 cfs 13,065 cf
Primary=3.71 cfs 13,065 cf

Total Runoff Area = 50,171 sf Runoff Volume = 17,684 cf Average Runoff Depth = 4.23"
33.97% Pervious = 17,044 sf 66.03% Impervious = 33,127 sf

Summary for Subcatchment 1S:

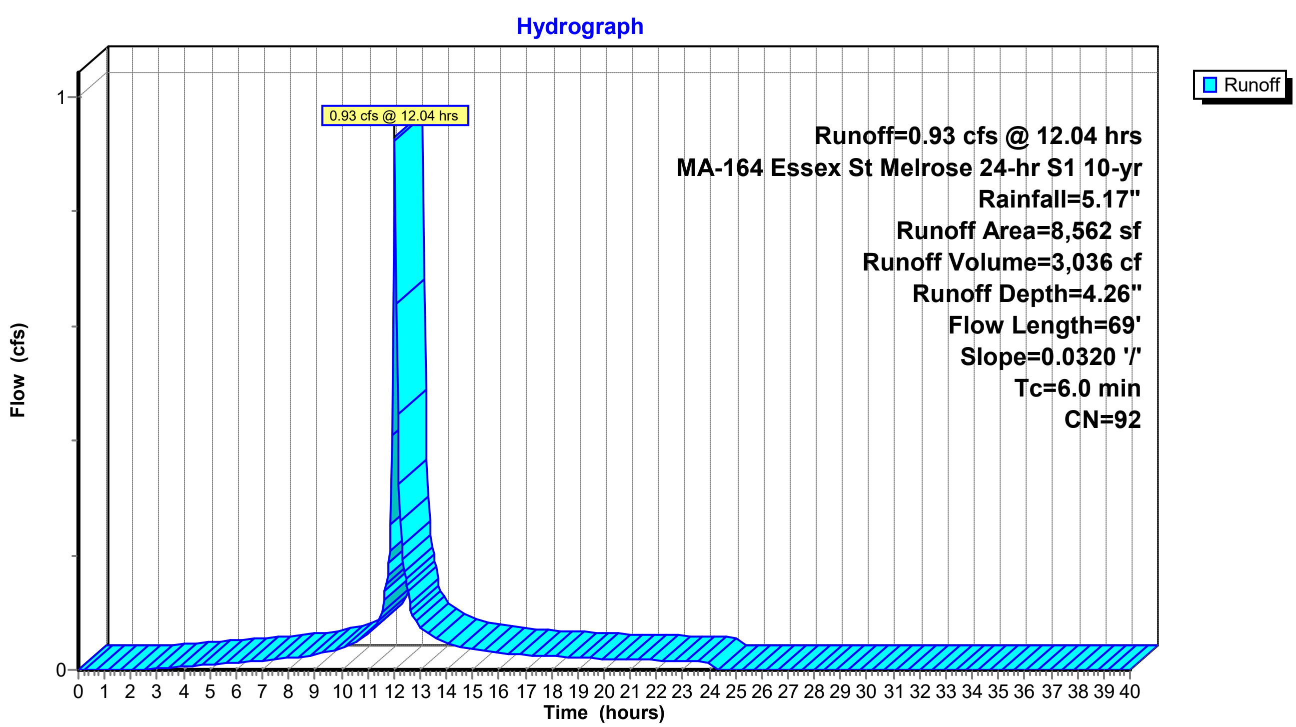
Runoff = 0.93 cfs @ 12.04 hrs, Volume= 3,036 cf, Depth= 4.26"
Routed to Pond 1 : CB1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
1,762	69	50-75% Grass cover, Fair, HSG B
4,770	98	Paved parking, HSG B
2,030	96	Gravel surface, HSG B
8,562	92	Weighted Average
3,792		44.29% Pervious Area
4,770		55.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	69	0.0320	1.56		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.7	69	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S:



Summary for Subcatchment 2S:

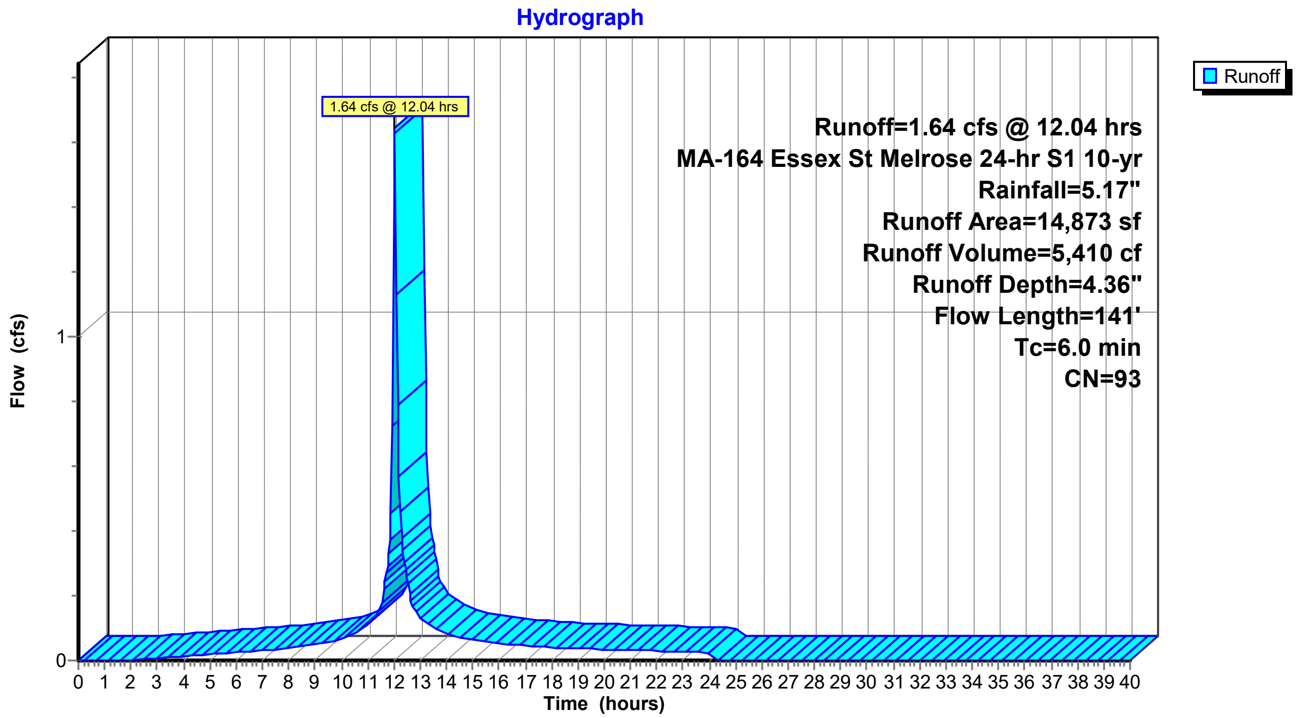
Runoff = 1.64 cfs @ 12.04 hrs, Volume= 5,410 cf, Depth= 4.36"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
2,420	69	50-75% Grass cover, Fair, HSG B
9,457	98	Paved parking, HSG B
2,996	96	Gravel surface, HSG B
14,873	93	Weighted Average
5,416		36.41% Pervious Area
9,457		63.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0195	1.38		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	41	0.0120	2.22		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	141	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S:



Summary for Subcatchment 3S:

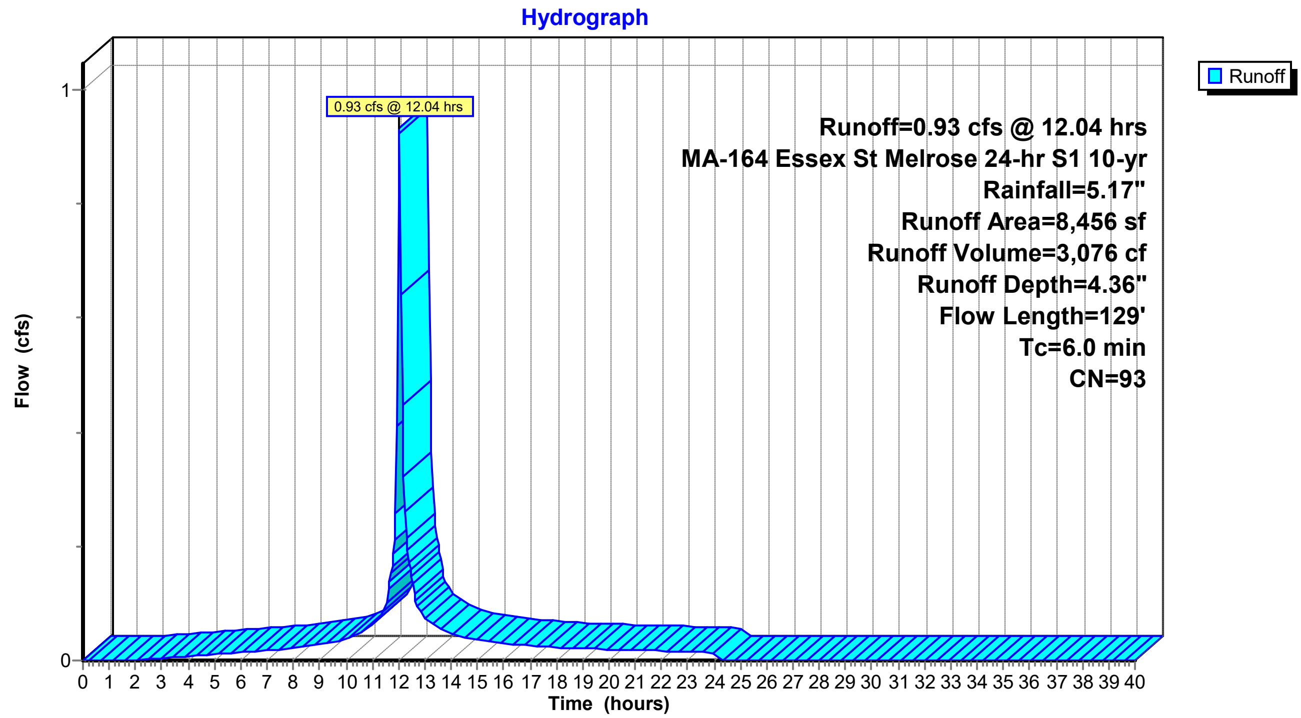
Runoff = 0.93 cfs @ 12.04 hrs, Volume= 3,076 cf, Depth= 4.36"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
1,406	69	50-75% Grass cover, Fair, HSG B
5,824	98	Paved parking, HSG B
1,226	96	Gravel surface, HSG B
8,456	93	Weighted Average
2,632		31.13% Pervious Area
5,824		68.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.2	29	0.0250	3.21		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.4	129	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S:



Summary for Subcatchment 4S:

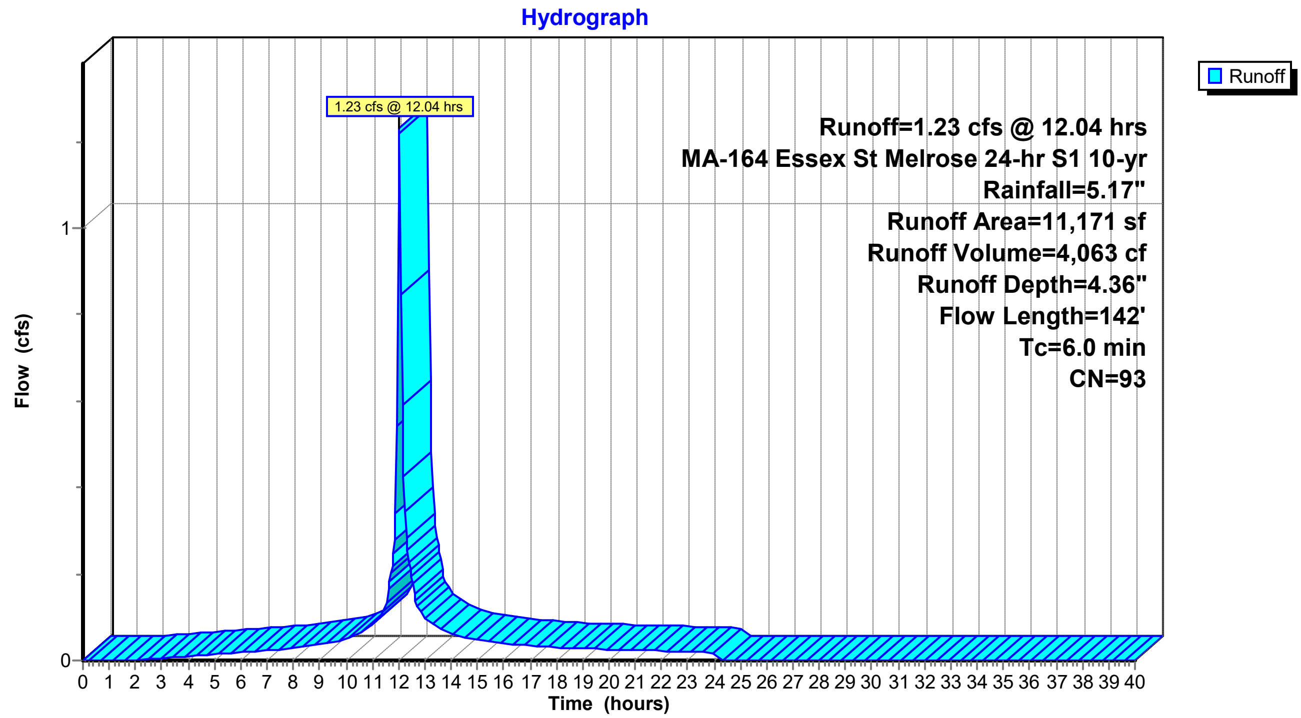
Runoff = 1.23 cfs @ 12.04 hrs, Volume= 4,063 cf, Depth= 4.36"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
1,868	69	50-75% Grass cover, Fair, HSG B
8,631	98	Paved parking, HSG B
672	96	Gravel surface, HSG B
11,171	93	Weighted Average
2,540		22.74% Pervious Area
8,631		77.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	42	0.0164	2.60		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	142	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S:



Summary for Subcatchment 5S:

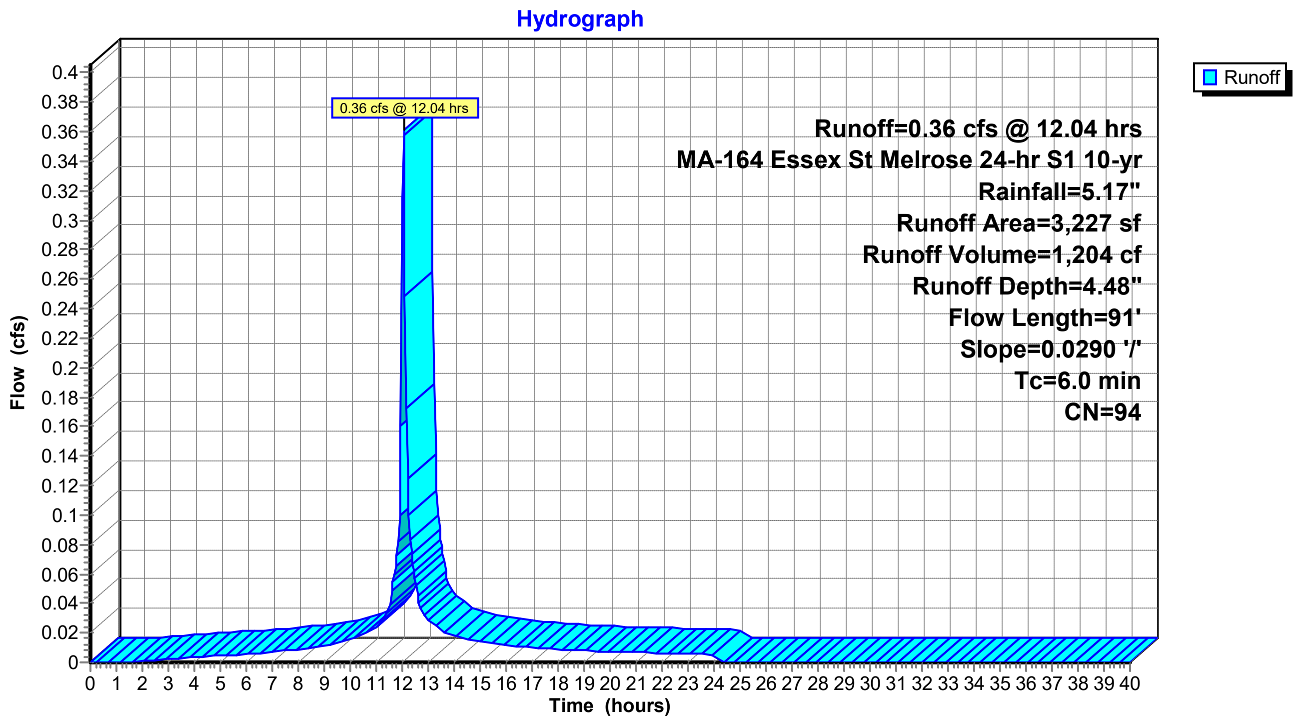
Runoff = 0.36 cfs @ 12.04 hrs, Volume= 1,204 cf, Depth= 4.48"
Routed to Pond 5 : CB5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
463	69	50-75% Grass cover, Fair, HSG B
2,764	98	Paved parking, HSG B
3,227	94	Weighted Average
463		14.35% Pervious Area
2,764		85.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	91	0.0290	1.59		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
1.0	91	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5S:



Summary for Subcatchment 6S:

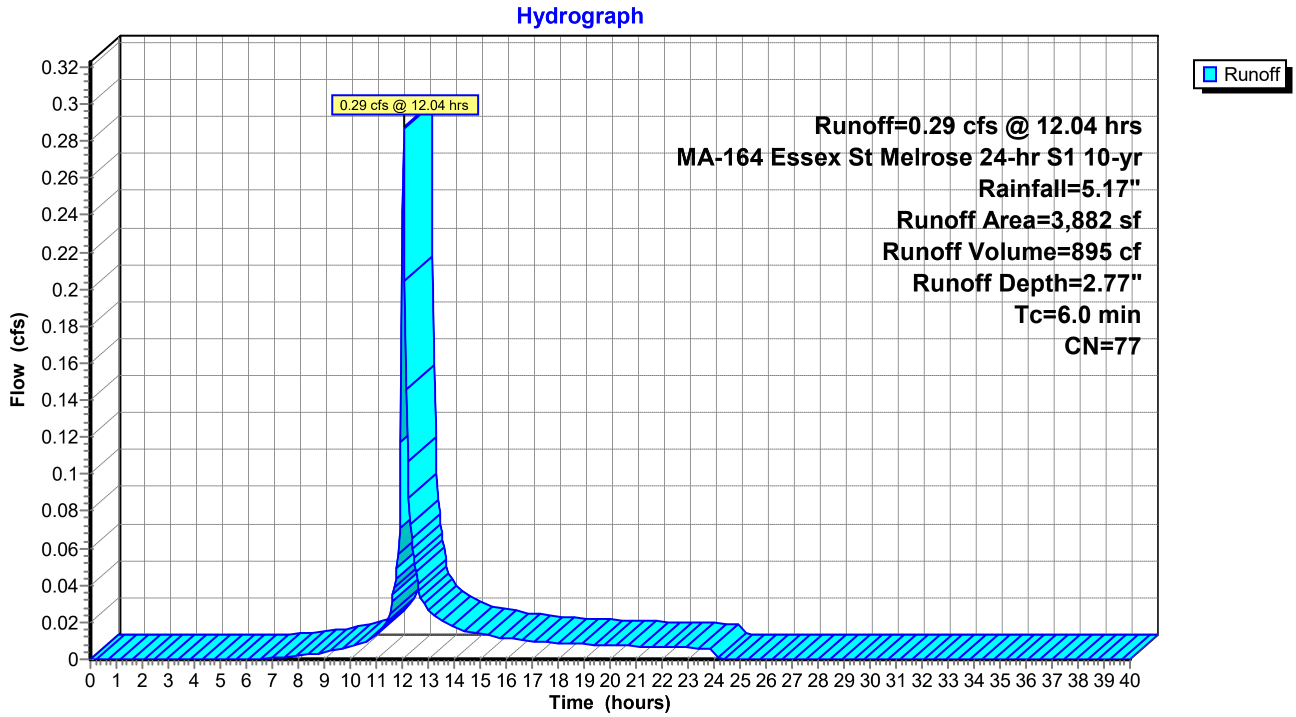
Runoff = 0.29 cfs @ 12.04 hrs, Volume= 895 cf, Depth= 2.77"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
2,201	61	>75% Grass cover, Good, HSG B
1,681	98	Paved parking, HSG B
3,882	77	Weighted Average
2,201		56.70% Pervious Area
1,681		43.30% Impervious Area

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

Subcatchment 6S:



Summary for Pond 1: CB1

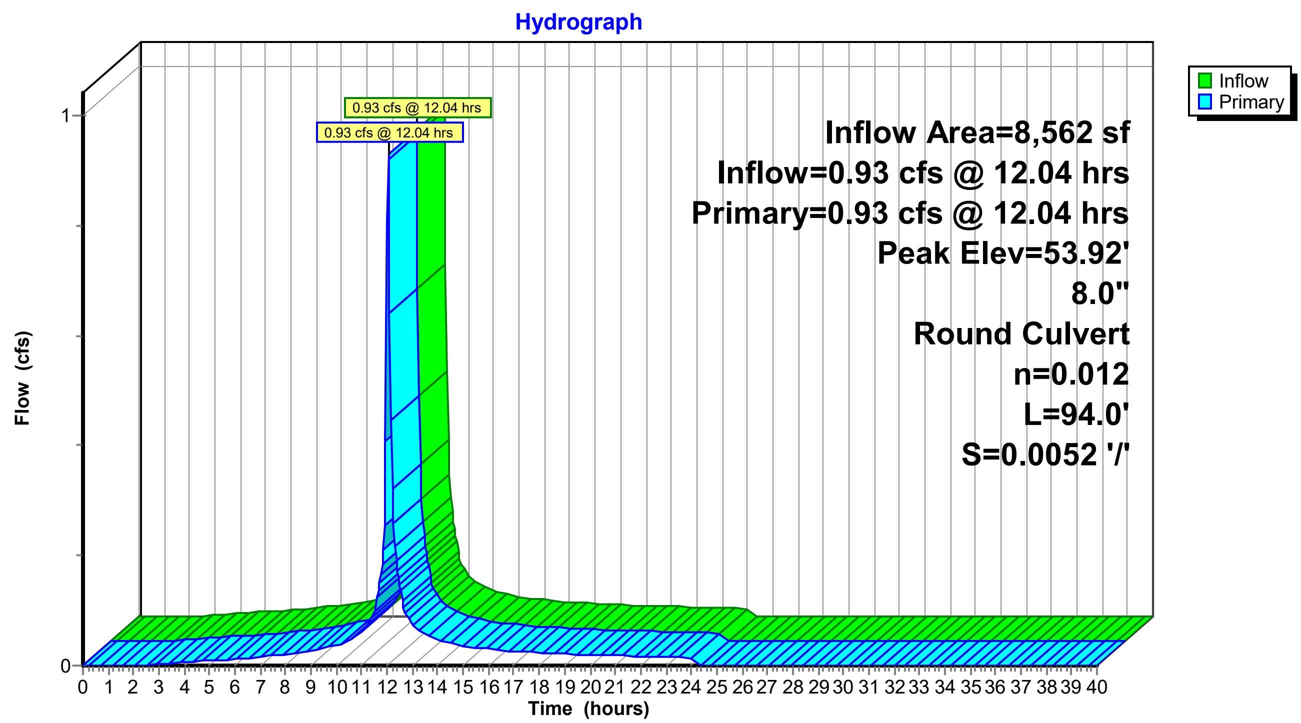
Inflow Area = 8,562 sf, 55.71% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.93 cfs @ 12.04 hrs, Volume= 3,036 cf
Outflow = 0.93 cfs @ 12.04 hrs, Volume= 3,036 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.93 cfs @ 12.04 hrs, Volume= 3,036 cf
Routed to Pond 6 : PS6

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.92' @ 12.04 hrs
Flood Elev= 55.08'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.18'	**8.0" Round Culvert** L= 94.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.18' / 52.69' S= 0.0052 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.90 cfs @ 12.04 hrs HW=53.90' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.90 cfs @ 2.99 fps)

Pond 1: CB1



Summary for Pond 1P: Existing Leaching Pipe/Stone System

Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 4.35" for 10-yr event
Inflow = 5.11 cfs @ 12.04 hrs, Volume= 16,789 cf
Outflow = 3.65 cfs @ 12.10 hrs, Volume= 16,682 cf, Atten= 29%, Lag= 3.9 min
Discarded = 0.14 cfs @ 12.10 hrs, Volume= 4,511 cf
Primary = 3.51 cfs @ 12.10 hrs, Volume= 12,171 cf
Routed to Pond 10 : EXIST MH10

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 55.15' @ 12.10 hrs Surf.Area= 6,120 sf Storage= 2,962 cf

Plug-Flow detention time= 171.5 min calculated for 16,682 cf (99% of inflow)
Center-of-Mass det. time= 167.4 min (954.4 - 787.1)

Volume	Invert	Avail.Storage	Storage Description
#1	48.90'	1,912 cf	**12.00'W x 120.00'L x 3.67'H Prismatoid** 5,285 cf Overall - 506 cf Embedded = 4,779 cf x 40.0% Voids
#2	50.10'	377 cf	**24.0" Round Pipe Storage** Inside #1 L= 120.0' 506 cf Overall - 1.9" Wall Thickness = 377 cf
#3	52.57'	3,586 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		5,875 cf	Total Available Storage

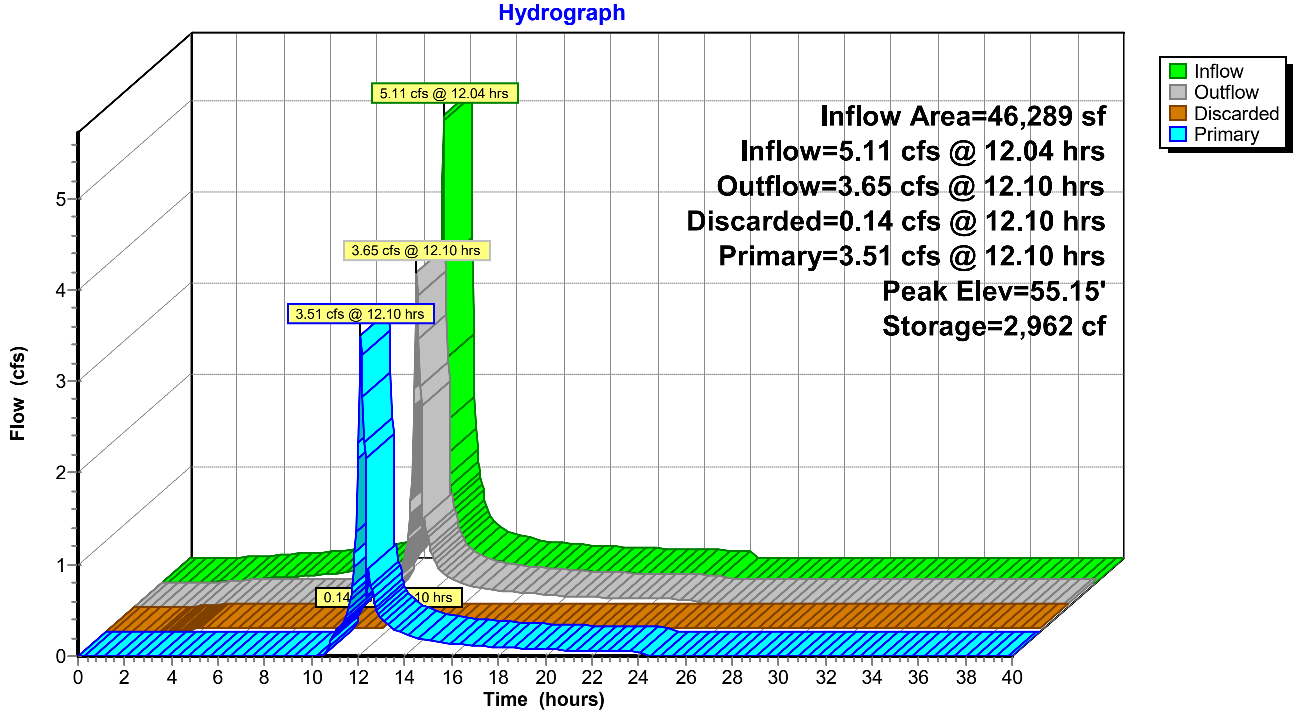
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.57	0	0	0
54.74	1	1	1
55.00	1,569	204	205
55.50	11,954	3,381	3,586

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.90'	**1.000 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	52.01'	**8.0" Round Culvert** L= 71.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.01' / 51.29' S= 0.0101 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#3	Primary	54.92'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 13.00 13.00 17.76 17.76 20.29 24.29 40.35 Elev. (feet) 55.46 55.42 55.02 54.92 55.32 55.31 55.35 55.46

Discarded OutFlow Max=0.14 cfs @ 12.10 hrs HW=55.15' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=3.47 cfs @ 12.10 hrs HW=55.15' (Free Discharge)
├─**2=Culvert** (Barrel Controls 2.29 cfs @ 6.57 fps)
└─**3=Asymmetrical Weir** (Weir Controls 1.17 cfs @ 1.09 fps)

Pond 1P: Existing Leaching Pipe/Stone System



Summary for Pond 2: CB2

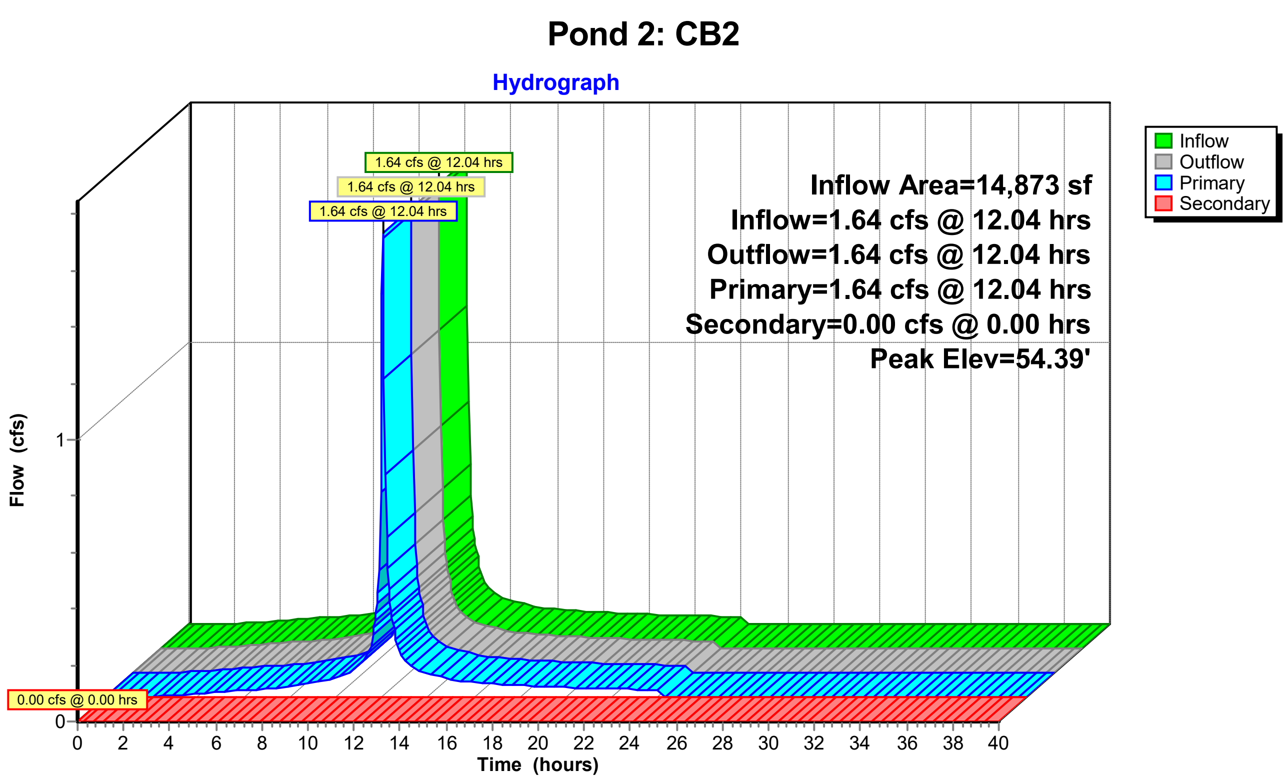
Inflow Area = 14,873 sf, 63.59% Impervious, Inflow Depth = 4.36" for 10-yr event
Inflow = 1.64 cfs @ 12.04 hrs, Volume= 5,410 cf
Outflow = 1.64 cfs @ 12.04 hrs, Volume= 5,410 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.64 cfs @ 12.04 hrs, Volume= 5,410 cf
Routed to Pond 6 : PS6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.39' @ 12.04 hrs
Flood Elev= 54.74'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.84'	**8.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.84' / 52.69' S= 0.0045 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.74'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.59 cfs @ 12.04 hrs HW=54.32' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.59 cfs @ 4.55 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=52.84' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.00 cfs)



Summary for Pond 3: CB3

Inflow Area = 8,456 sf, 68.87% Impervious, Inflow Depth = 4.36" for 10-yr event
Inflow = 0.93 cfs @ 12.04 hrs, Volume= 3,076 cf
Outflow = 0.93 cfs @ 12.04 hrs, Volume= 3,076 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.93 cfs @ 12.04 hrs, Volume= 3,076 cf
Routed to Pond 8 : PS8
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

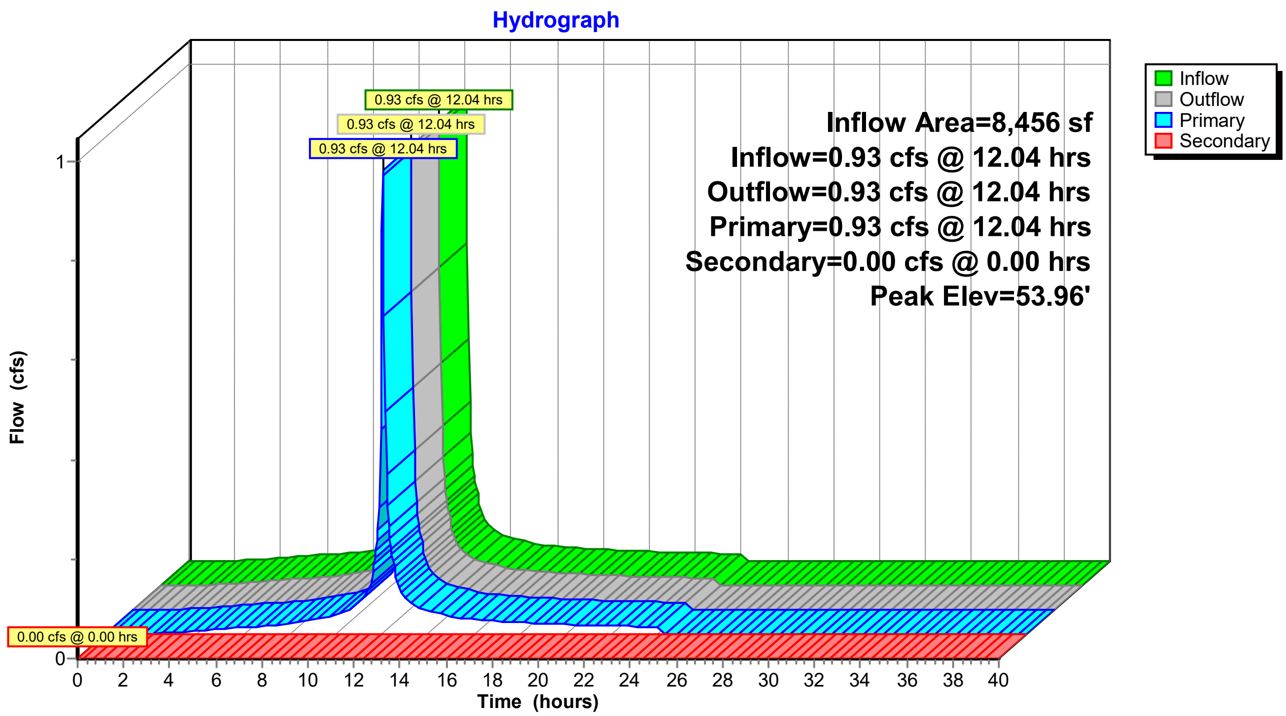
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.96' @ 12.04 hrs
Flood Elev= 54.78'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.69'	**8.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.68' / 52.69' S= -0.0001 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.78'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.90 cfs @ 12.04 hrs HW=53.92' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.90 cfs @ 2.58 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=52.69' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 3: CB3



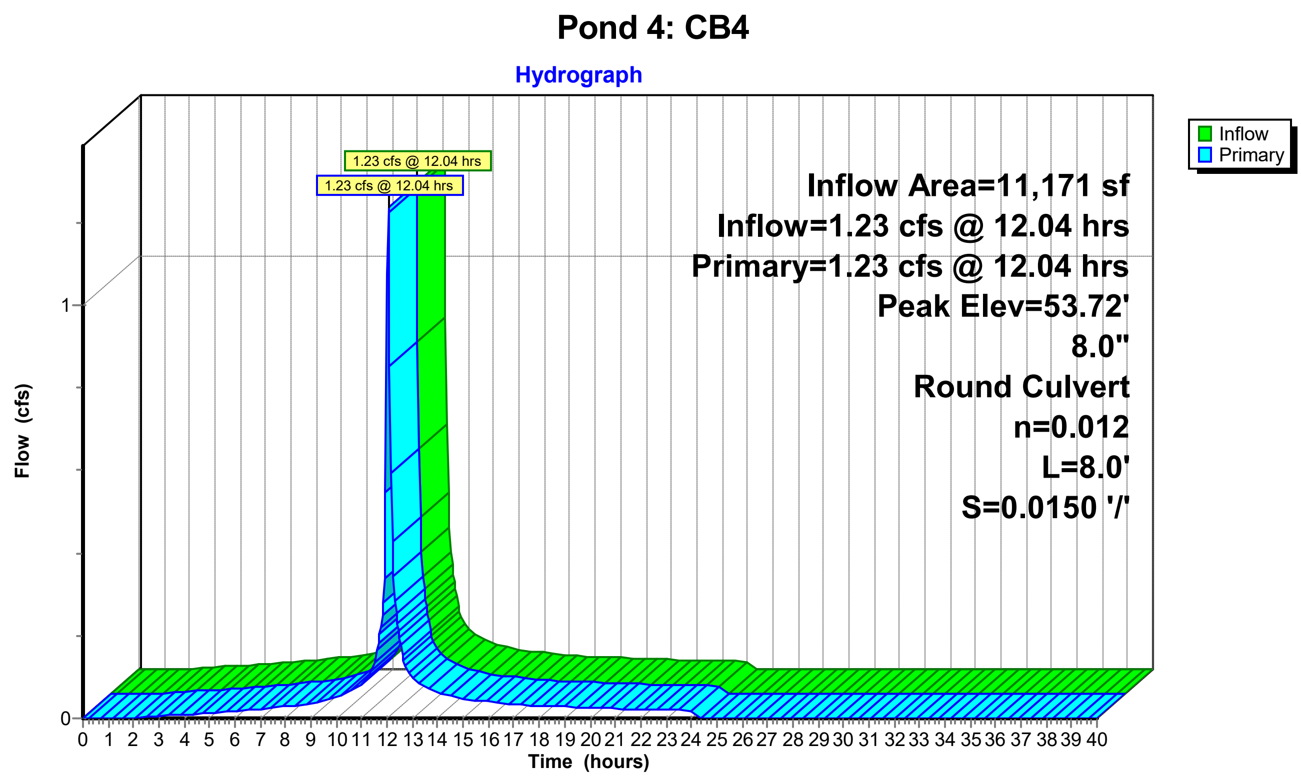
Summary for Pond 4: CB4

Inflow Area = 11,171 sf, 77.26% Impervious, Inflow Depth = 4.36" for 10-yr event
Inflow = 1.23 cfs @ 12.04 hrs, Volume= 4,063 cf
Outflow = 1.23 cfs @ 12.04 hrs, Volume= 4,063 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.23 cfs @ 12.04 hrs, Volume= 4,063 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.72' @ 12.04 hrs
Flood Elev= 54.81'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.81'	**8.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.81' / 52.69' S= 0.0150 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.20 cfs @ 12.04 hrs HW=53.68' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.20 cfs @ 3.45 fps)



Summary for Pond 5: CB5

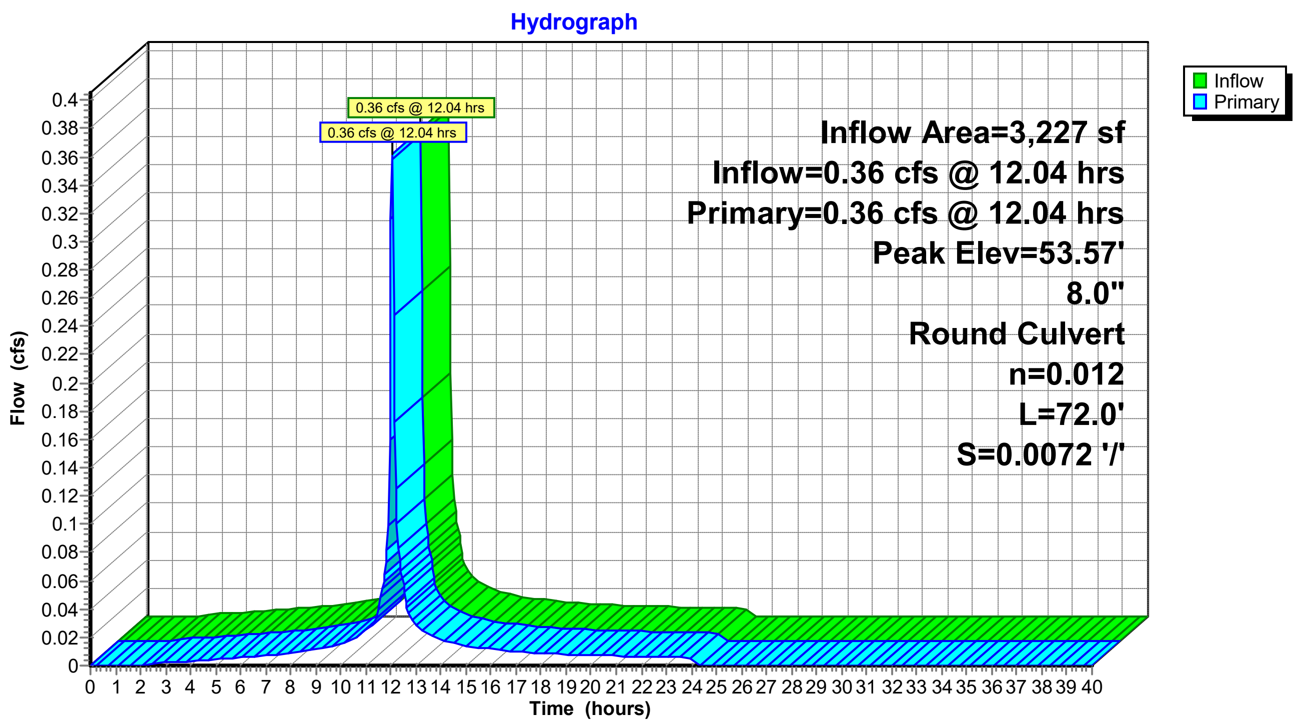
Inflow Area = 3,227 sf, 85.65% Impervious, Inflow Depth = 4.48" for 10-yr event
Inflow = 0.36 cfs @ 12.04 hrs, Volume= 1,204 cf
Outflow = 0.36 cfs @ 12.04 hrs, Volume= 1,204 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.36 cfs @ 12.04 hrs, Volume= 1,204 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.57' @ 12.04 hrs
Flood Elev= 55.11'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.21'	**8.0" Round Culvert** L= 72.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.21' / 52.69' S= 0.0072 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.35 cfs @ 12.04 hrs HW=53.57' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.35 cfs @ 2.66 fps)

Pond 5: CB5



Summary for Pond 6: PS6

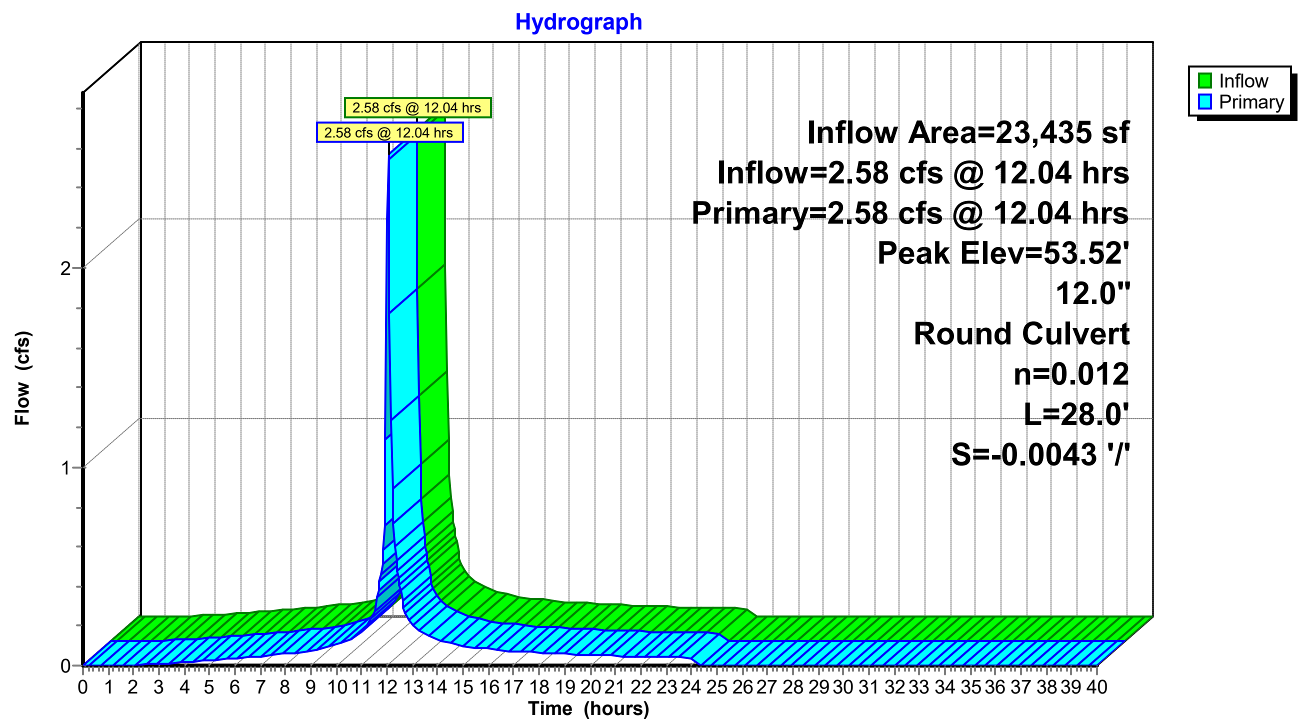
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 4.32" for 10-yr event
Inflow = 2.58 cfs @ 12.04 hrs, Volume= 8,446 cf
Outflow = 2.58 cfs @ 12.04 hrs, Volume= 8,446 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.58 cfs @ 12.04 hrs, Volume= 8,446 cf
Routed to Pond 7 : DMH7

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.52' @ 12.04 hrs
Flood Elev= 55.04'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.26'	**12.0" Round Culvert** L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.14' / 52.26' S= -0.0043 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.44 cfs @ 12.04 hrs HW=53.47' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.44 cfs @ 3.11 fps)

Pond 6: PS6



Summary for Pond 7: DMH7

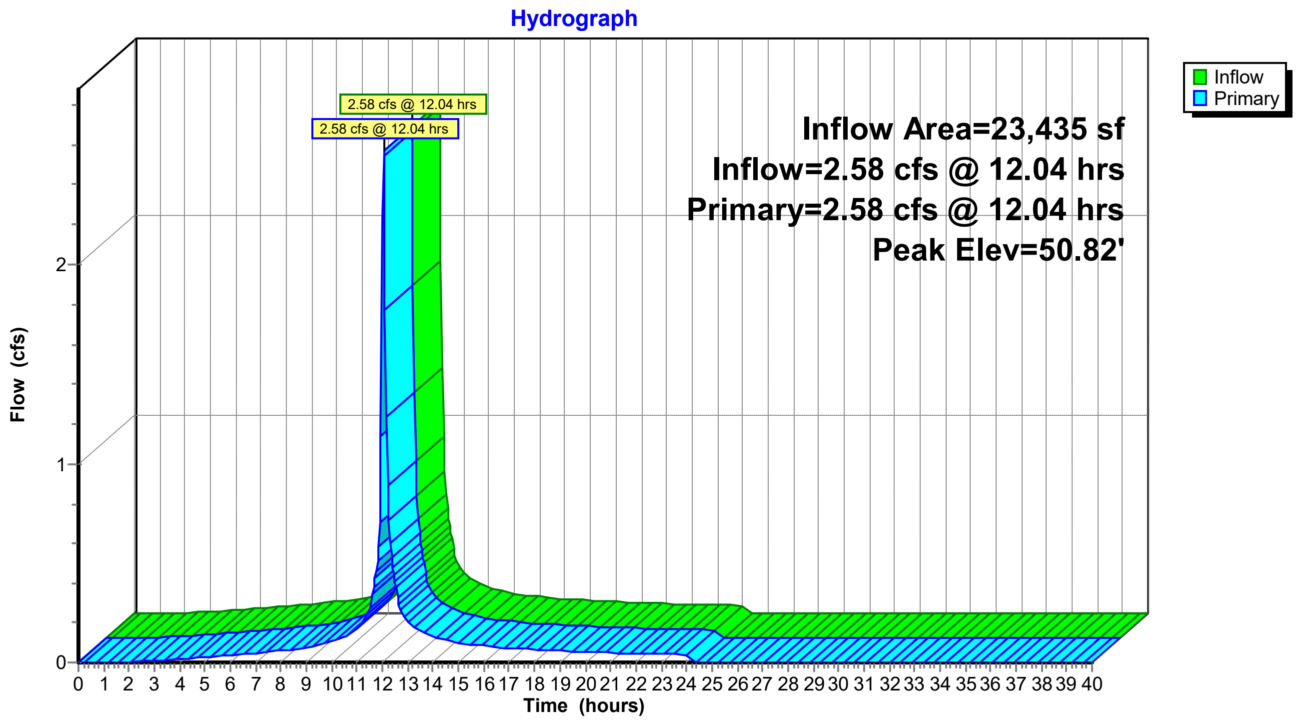
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 4.32" for 10-yr event
Inflow = 2.58 cfs @ 12.04 hrs, Volume= 8,446 cf
Outflow = 2.58 cfs @ 12.04 hrs, Volume= 8,446 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.58 cfs @ 12.04 hrs, Volume= 8,446 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 50.82' @ 12.04 hrs
Flood Elev= 55.36'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.10'	**12.0" Round Culvert** L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.96' / 50.10' S= -0.0156 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.26'	**12.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.26' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.48 cfs @ 12.04 hrs HW=50.81' (Free Discharge)
1=Culvert (Barrel Controls 1.48 cfs @ 2.83 fps)
2=Culvert (Barrel Controls 1.00 cfs @ 3.30 fps)

Pond 7: DMH7



Summary for Pond 8: PS8

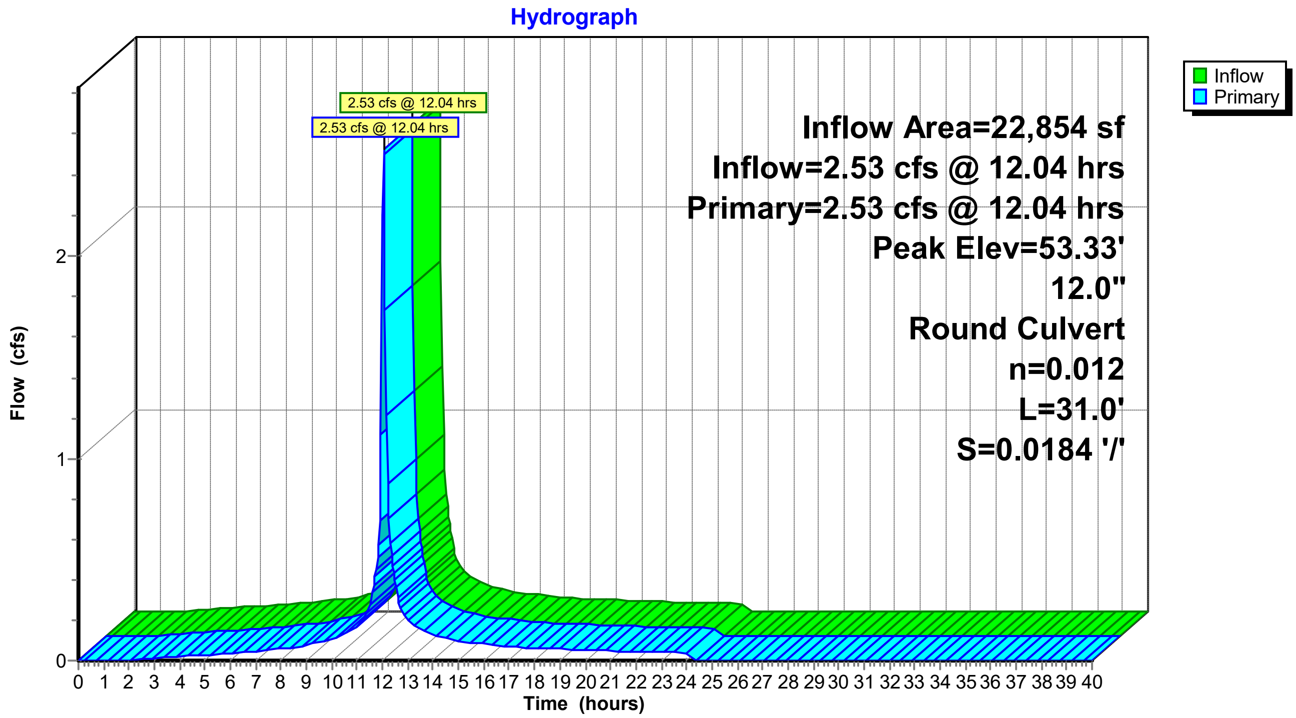
Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 4.38" for 10-yr event
Inflow = 2.53 cfs @ 12.04 hrs, Volume= 8,343 cf
Outflow = 2.53 cfs @ 12.04 hrs, Volume= 8,343 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.53 cfs @ 12.04 hrs, Volume= 8,343 cf
Routed to Pond 9 : DMH9

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.33' @ 12.04 hrs
Flood Elev= 54.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.39'	**12.0" Round Culvert** L= 31.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.39' / 51.82' S= 0.0184 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.45 cfs @ 12.04 hrs HW=53.30' (Free Discharge)
└**1=Culvert** (Inlet Controls 2.45 cfs @ 3.25 fps)

Pond 8: PS8



Summary for Pond 9: DMH9

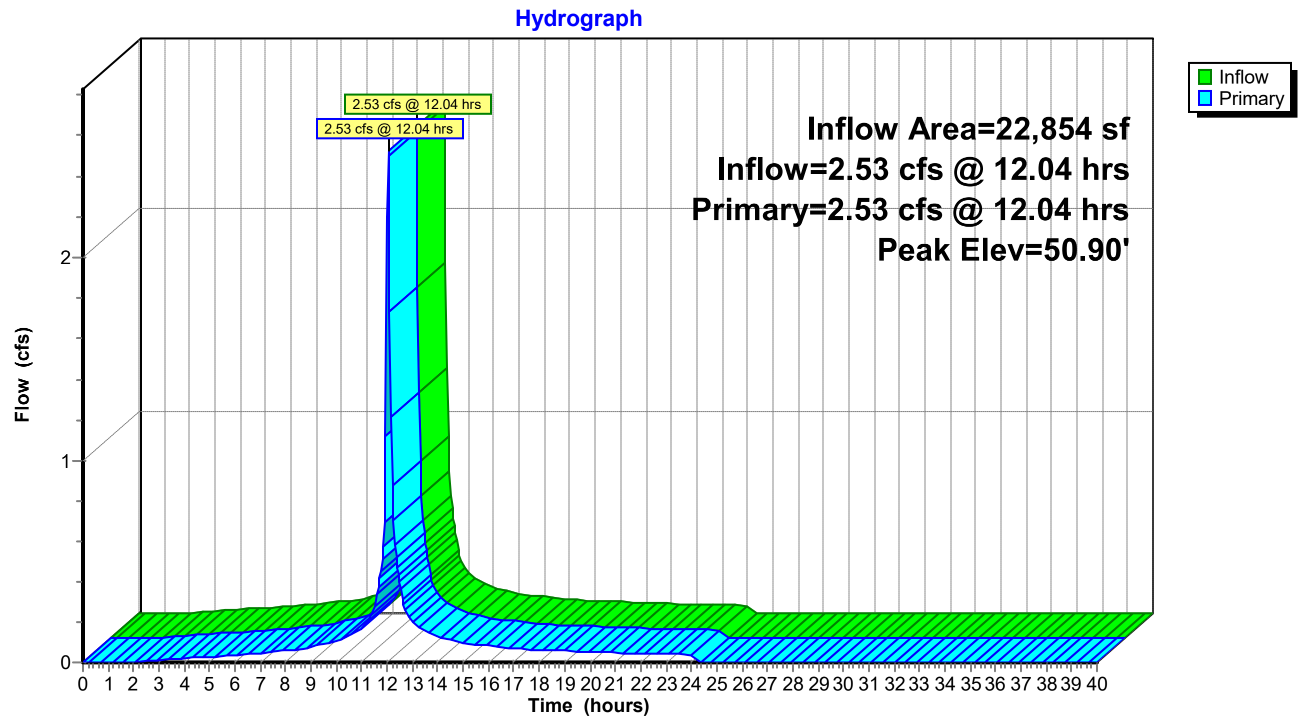
Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 4.38" for 10-yr event
Inflow = 2.53 cfs @ 12.04 hrs, Volume= 8,343 cf
Outflow = 2.53 cfs @ 12.04 hrs, Volume= 8,343 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.53 cfs @ 12.04 hrs, Volume= 8,343 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 50.90' @ 12.04 hrs
Flood Elev= 55.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.12'	**12.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.12' / 50.10' S= 0.0020 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.32'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.32' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.44 cfs @ 12.04 hrs HW=50.89' (Free Discharge)
1=Culvert (Barrel Controls 1.31 cfs @ 2.80 fps)
2=Culvert (Barrel Controls 1.13 cfs @ 3.56 fps)

Pond 9: DMH9



Summary for Pond 10: EXIST MH10

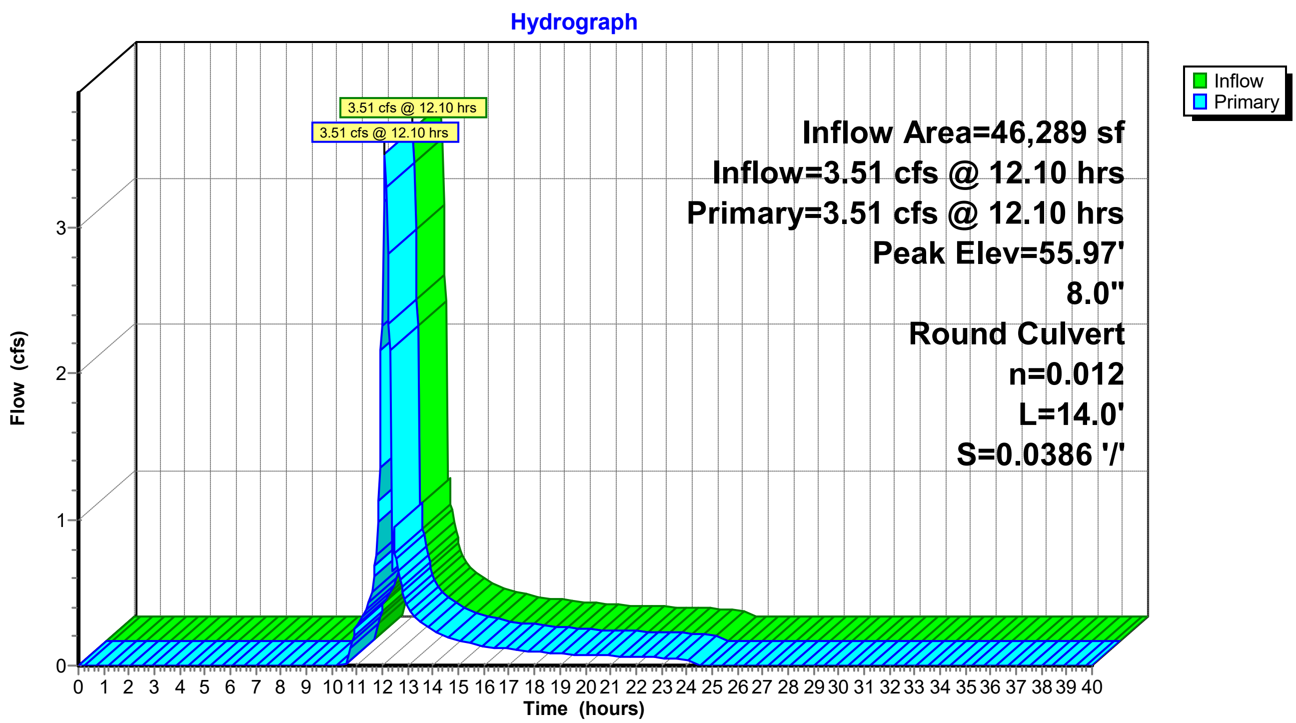
Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 3.16" for 10-yr event
Inflow = 3.51 cfs @ 12.10 hrs, Volume= 12,171 cf
Outflow = 3.51 cfs @ 12.10 hrs, Volume= 12,171 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.51 cfs @ 12.10 hrs, Volume= 12,171 cf
Routed to Link 1L : Essex Street

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 55.97' @ 12.10 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=3.48 cfs @ 12.10 hrs HW=55.92' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.48 cfs @ 9.98 fps)

Pond 10: EXIST MH10

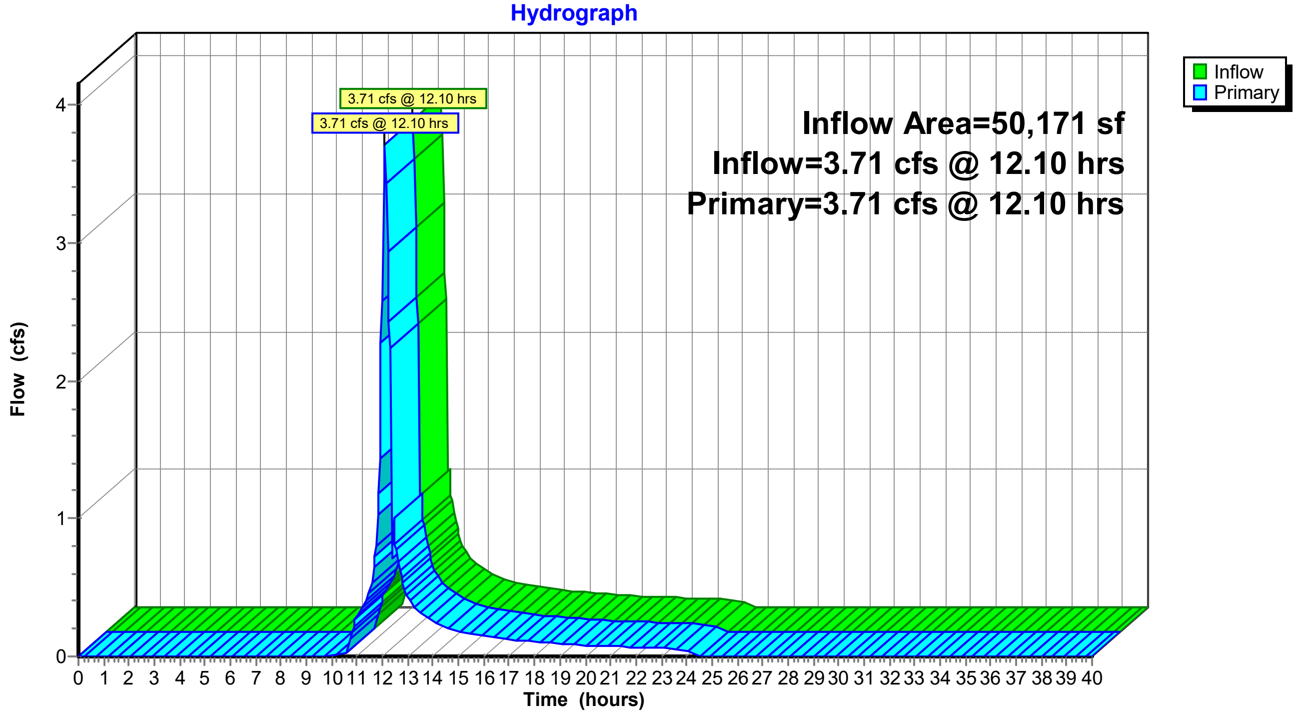


Summary for Link 1L: Essex Street

Inflow Area =	50,171 sf,	66.03% Impervious,	Inflow Depth = 3.13"	for 10-yr event	
Inflow =	3.71 cfs @	12.10 hrs,	Volume=	13,065 cf	
Primary =	3.71 cfs @	12.10 hrs,	Volume=	13,065 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 1L: Essex Street



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,562 sf 55.71% Impervious Runoff Depth=5.40"
Flow Length=69' Slope=0.0320 '/' Tc=6.0 min CN=92 Runoff=1.16 cfs 3,856 cf

Subcatchment 2S: Runoff Area=14,873 sf 63.59% Impervious Runoff Depth=5.52"
Flow Length=141' Tc=6.0 min CN=93 Runoff=2.04 cfs 6,840 cf

Subcatchment 3S: Runoff Area=8,456 sf 68.87% Impervious Runoff Depth=5.52"
Flow Length=129' Tc=6.0 min CN=93 Runoff=1.16 cfs 3,889 cf

Subcatchment 4S: Runoff Area=11,171 sf 77.26% Impervious Runoff Depth=5.52"
Flow Length=142' Tc=6.0 min CN=93 Runoff=1.53 cfs 5,137 cf

Subcatchment 5S: Runoff Area=3,227 sf 85.65% Impervious Runoff Depth=5.63"
Flow Length=91' Slope=0.0290 '/' Tc=6.0 min CN=94 Runoff=0.45 cfs 1,515 cf

Subcatchment 6S: Runoff Area=3,882 sf 43.30% Impervious Runoff Depth=3.78"
Tc=6.0 min CN=77 Runoff=0.39 cfs 1,222 cf

Pond 1: CB1 Peak Elev=54.34' Inflow=1.16 cfs 3,856 cf
8.0" Round Culvert n=0.012 L=94.0' S=0.0052 '/' Outflow=1.16 cfs 3,856 cf

Pond 1P: Existing Leaching Pipe/Stone Peak Elev=55.21' Storage=3,290 cf Inflow=6.33 cfs 21,236 cf
Discarded=0.17 cfs 4,631 cf Primary=4.19 cfs 16,493 cf Outflow=4.36 cfs 21,124 cf

Pond 2: CB2 Peak Elev=54.78' Inflow=2.04 cfs 6,840 cf
Primary=1.93 cfs 6,820 cf Secondary=0.11 cfs 20 cf Outflow=2.04 cfs 6,840 cf

Pond 3: CB3 Peak Elev=54.29' Inflow=1.16 cfs 3,889 cf
Primary=1.16 cfs 3,889 cf Secondary=0.00 cfs 0 cf Outflow=1.16 cfs 3,889 cf

Pond 4: CB4 Peak Elev=53.96' Inflow=1.53 cfs 5,137 cf
8.0" Round Culvert n=0.012 L=8.0' S=0.0150 '/' Outflow=1.53 cfs 5,137 cf

Pond 5: CB5 Peak Elev=53.62' Inflow=0.45 cfs 1,515 cf
8.0" Round Culvert n=0.012 L=72.0' S=0.0072 '/' Outflow=0.45 cfs 1,515 cf

Pond 6: PS6 Peak Elev=53.69' Inflow=3.09 cfs 10,676 cf
12.0" Round Culvert n=0.012 L=28.0' S=-0.0043 '/' Outflow=3.09 cfs 10,676 cf

Pond 7: DMH7 Peak Elev=50.91' Inflow=3.09 cfs 10,676 cf
Outflow=3.09 cfs 10,676 cf

Pond 8: PS8 Peak Elev=53.57' Inflow=3.13 cfs 10,541 cf
12.0" Round Culvert n=0.012 L=31.0' S=0.0184 '/' Outflow=3.13 cfs 10,541 cf

Pond 9: DMH9 Peak Elev=51.00' Inflow=3.13 cfs 10,541 cf
Outflow=3.13 cfs 10,541 cf

Pond 10: EXIST MH10 Peak Elev=57.82' Inflow=4.19 cfs 16,493 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=4.19 cfs 16,493 cf

Link 1L: Essex Street Inflow=4.45 cfs 17,715 cf
Primary=4.45 cfs 17,715 cf

Total Runoff Area = 50,171 sf Runoff Volume = 22,458 cf Average Runoff Depth = 5.37"
33.97% Pervious = 17,044 sf 66.03% Impervious = 33,127 sf

Summary for Subcatchment 1S:

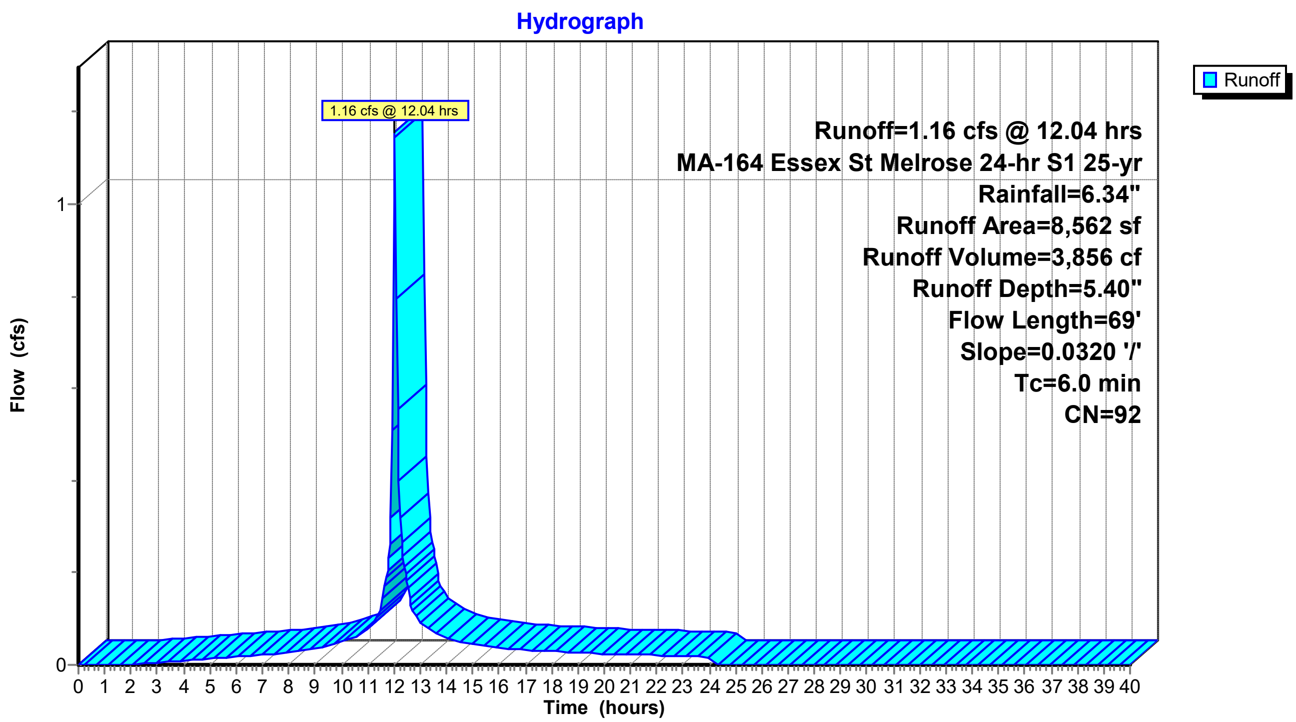
Runoff = 1.16 cfs @ 12.04 hrs, Volume= 3,856 cf, Depth= 5.40"
Routed to Pond 1 : CB1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
1,762	69	50-75% Grass cover, Fair, HSG B
4,770	98	Paved parking, HSG B
2,030	96	Gravel surface, HSG B
8,562	92	Weighted Average
3,792		44.29% Pervious Area
4,770		55.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	69	0.0320	1.56		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.7	69	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S:



Summary for Subcatchment 2S:

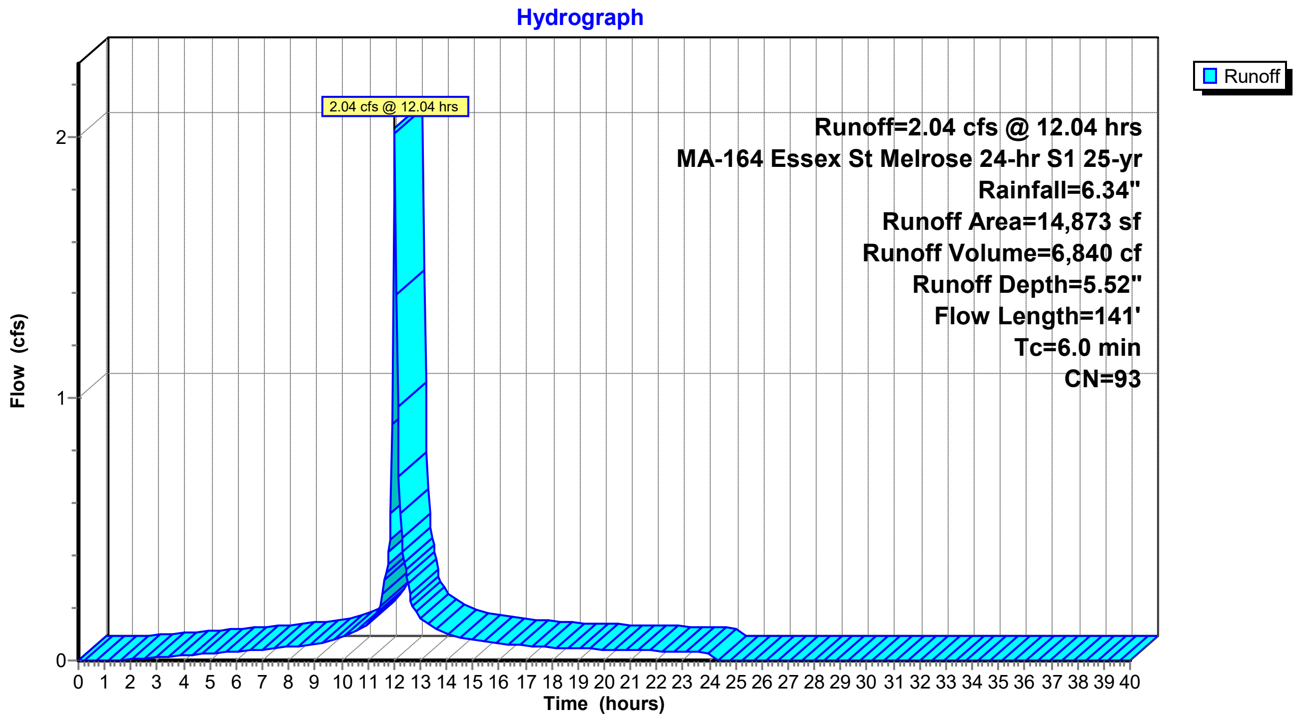
Runoff = 2.04 cfs @ 12.04 hrs, Volume= 6,840 cf, Depth= 5.52"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
2,420	69	50-75% Grass cover, Fair, HSG B
9,457	98	Paved parking, HSG B
2,996	96	Gravel surface, HSG B
14,873	93	Weighted Average
5,416		36.41% Pervious Area
9,457		63.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0195	1.38		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	41	0.0120	2.22		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	141	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S:



Summary for Subcatchment 3S:

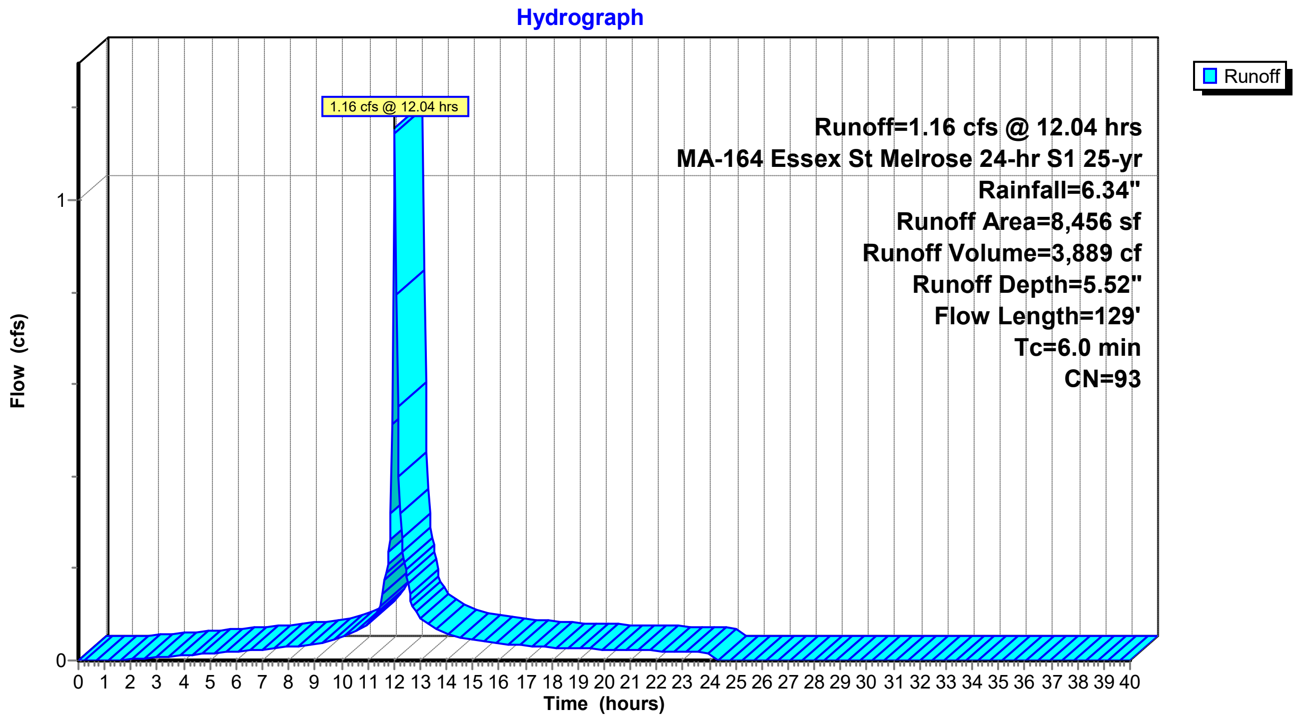
Runoff = 1.16 cfs @ 12.04 hrs, Volume= 3,889 cf, Depth= 5.52"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
1,406	69	50-75% Grass cover, Fair, HSG B
5,824	98	Paved parking, HSG B
1,226	96	Gravel surface, HSG B
8,456	93	Weighted Average
2,632		31.13% Pervious Area
5,824		68.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.2	29	0.0250	3.21		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.4	129	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S:



Summary for Subcatchment 4S:

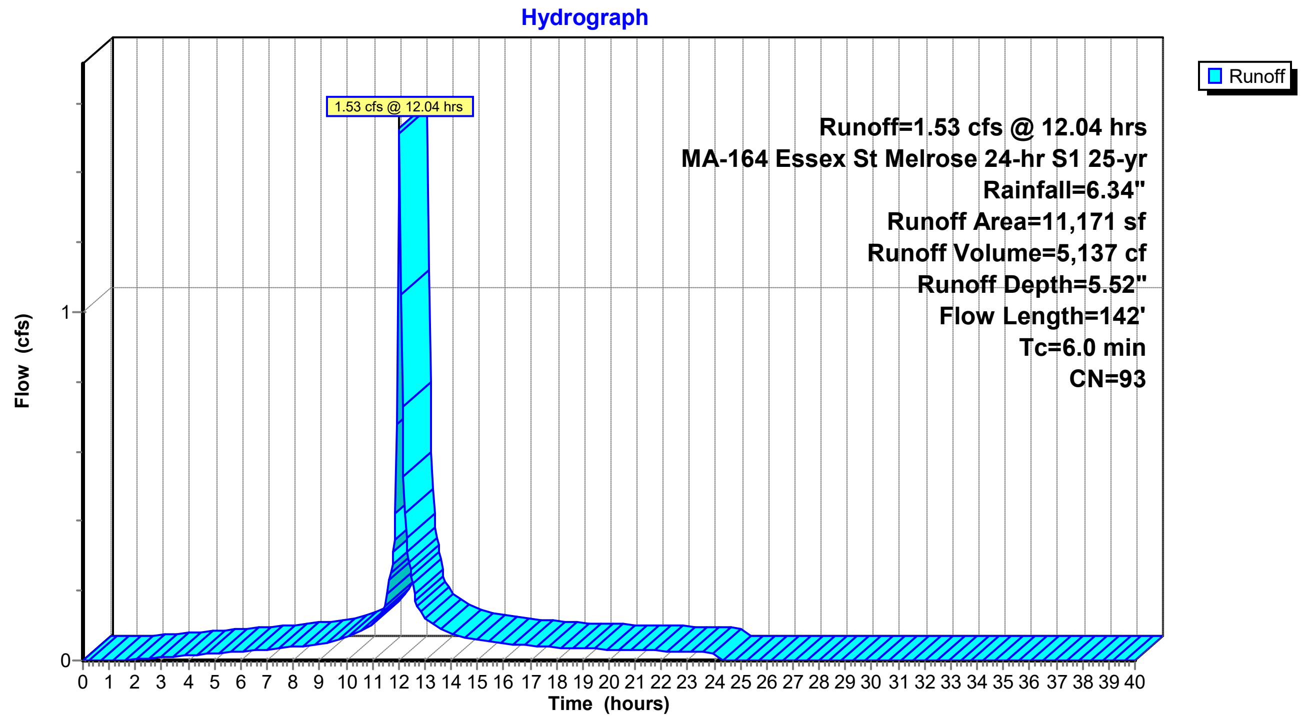
Runoff = 1.53 cfs @ 12.04 hrs, Volume= 5,137 cf, Depth= 5.52"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
1,868	69	50-75% Grass cover, Fair, HSG B
8,631	98	Paved parking, HSG B
672	96	Gravel surface, HSG B
11,171	93	Weighted Average
2,540		22.74% Pervious Area
8,631		77.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	42	0.0164	2.60		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	142	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S:



Summary for Subcatchment 5S:

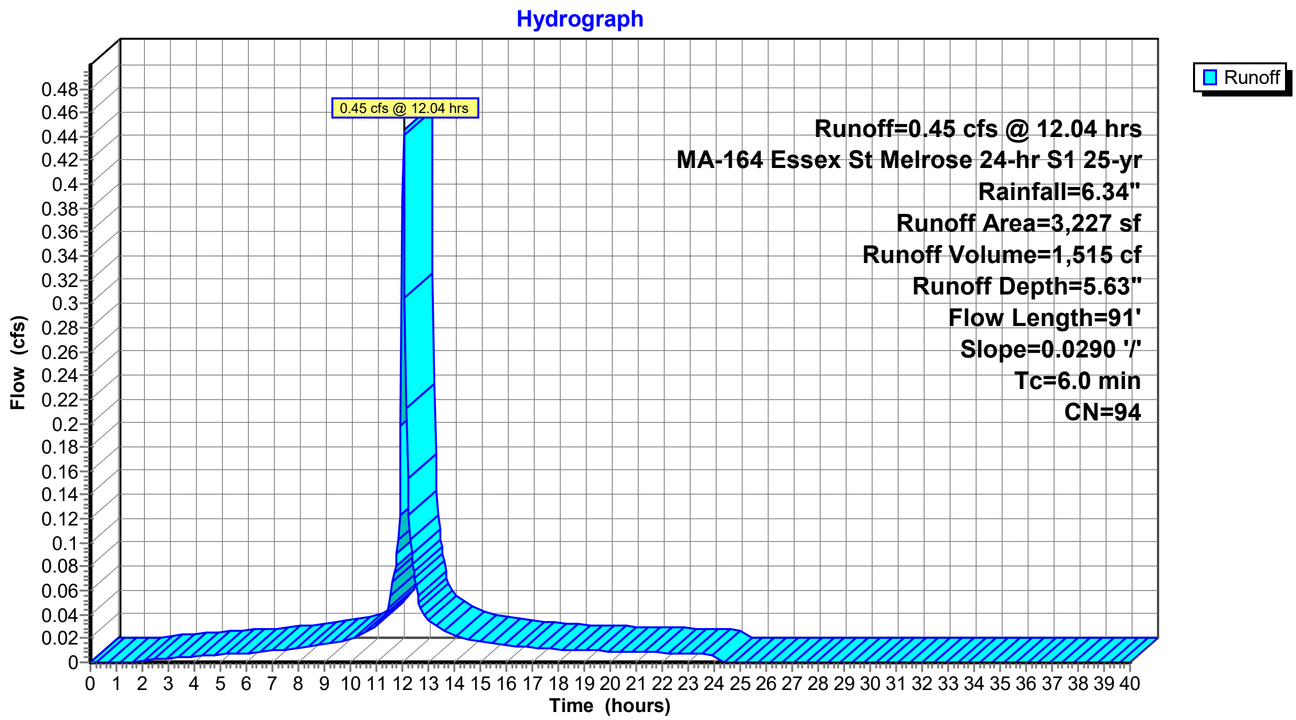
Runoff = 0.45 cfs @ 12.04 hrs, Volume= 1,515 cf, Depth= 5.63"
Routed to Pond 5 : CB5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
463	69	50-75% Grass cover, Fair, HSG B
2,764	98	Paved parking, HSG B
3,227	94	Weighted Average
463		14.35% Pervious Area
2,764		85.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	91	0.0290	1.59		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
1.0	91	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5S:



Summary for Subcatchment 6S:

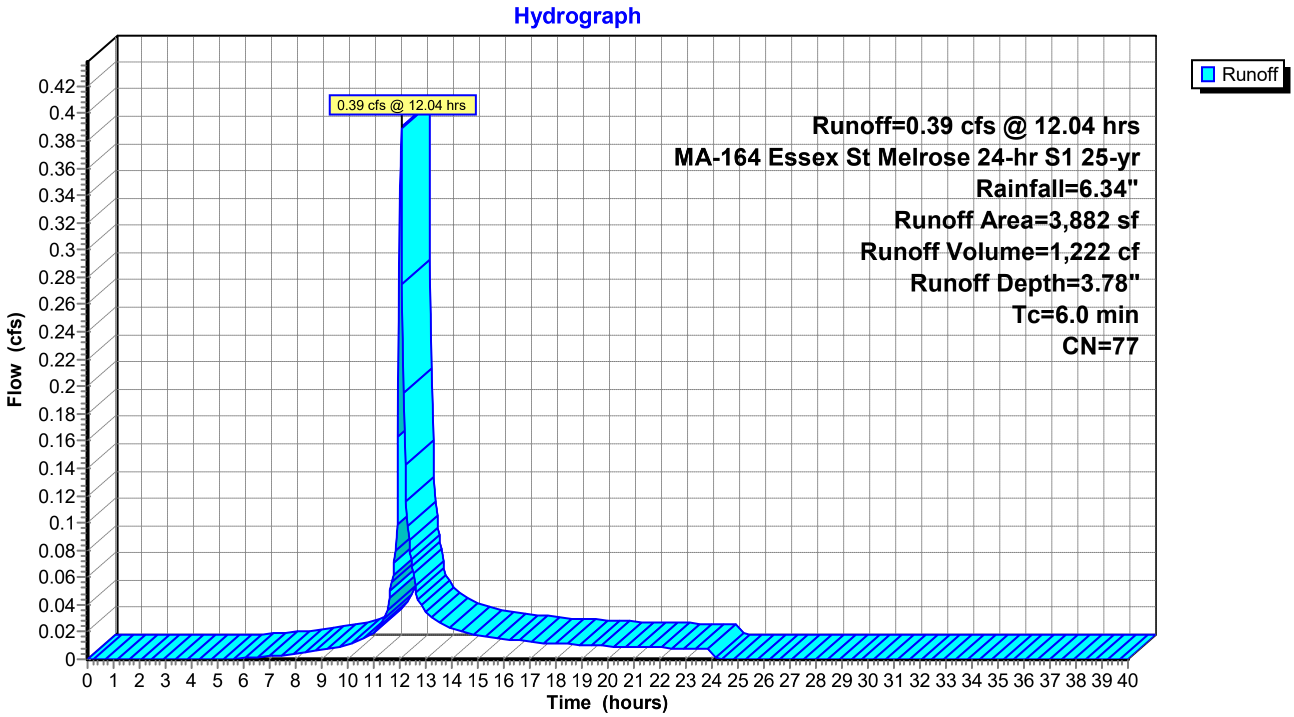
Runoff = 0.39 cfs @ 12.04 hrs, Volume= 1,222 cf, Depth= 3.78"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
2,201	61	>75% Grass cover, Good, HSG B
1,681	98	Paved parking, HSG B
3,882	77	Weighted Average
2,201		56.70% Pervious Area
1,681		43.30% Impervious Area

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

Subcatchment 6S:



Summary for Pond 1: CB1

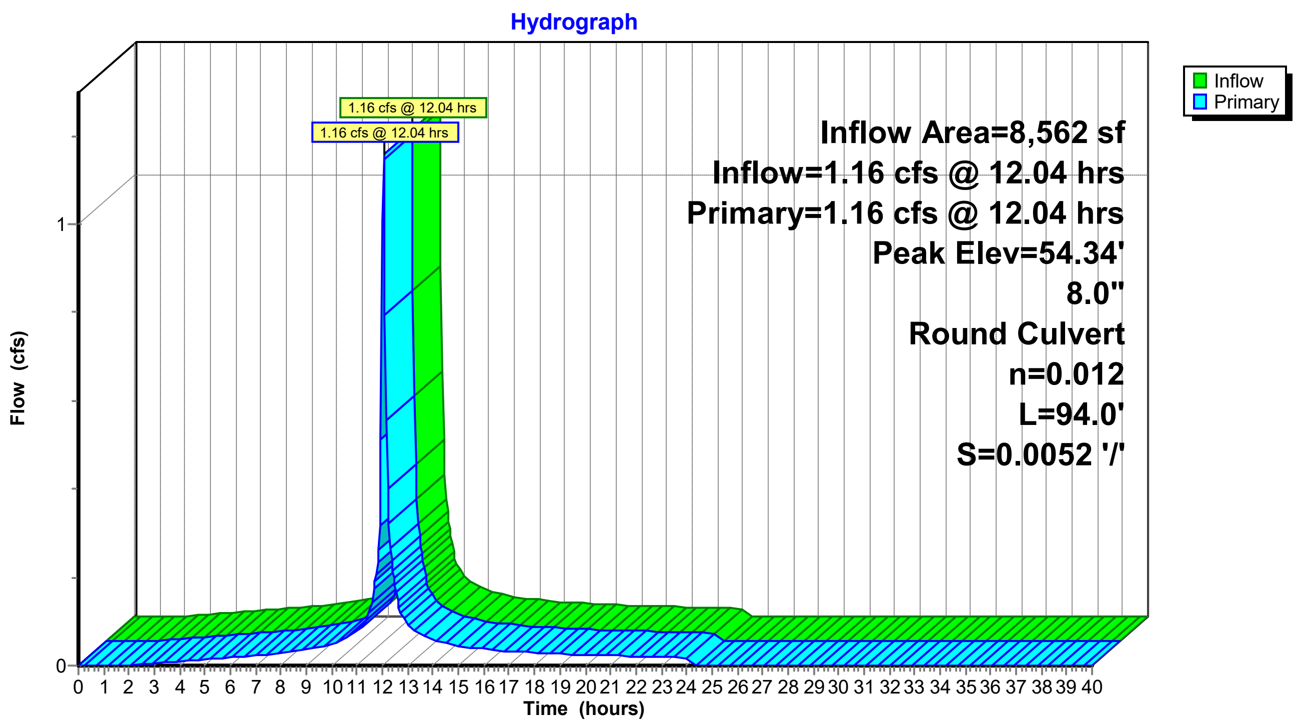
Inflow Area = 8,562 sf, 55.71% Impervious, Inflow Depth = 5.40" for 25-yr event
Inflow = 1.16 cfs @ 12.04 hrs, Volume= 3,856 cf
Outflow = 1.16 cfs @ 12.04 hrs, Volume= 3,856 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.16 cfs @ 12.04 hrs, Volume= 3,856 cf
Routed to Pond 6 : PS6

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.34' @ 12.04 hrs
Flood Elev= 55.08'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.18'	**8.0" Round Culvert** L= 94.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.18' / 52.69' S= 0.0052 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.10 cfs @ 12.04 hrs HW=54.26' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.10 cfs @ 3.16 fps)

Pond 1: CB1



Summary for Pond 1P: Existing Leaching Pipe/Stone System

Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 5.51" for 25-yr event
Inflow = 6.33 cfs @ 12.04 hrs, Volume= 21,236 cf
Outflow = 4.36 cfs @ 12.11 hrs, Volume= 21,124 cf, Atten= 31%, Lag= 4.2 min
Discarded = 0.17 cfs @ 12.11 hrs, Volume= 4,631 cf
Primary = 4.19 cfs @ 12.11 hrs, Volume= 16,493 cf
Routed to Pond 10 : EXIST MH10

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 55.21' @ 12.11 hrs Surf.Area= 7,403 sf Storage= 3,290 cf

Plug-Flow detention time= 142.5 min calculated for 21,098 cf (99% of inflow)
Center-of-Mass det. time= 140.1 min (919.6 - 779.6)

Volume	Invert	Avail.Storage	Storage Description
#1	48.90'	1,912 cf	**12.00'W x 120.00'L x 3.67'H Prismatoid**
			5,285 cf Overall - 506 cf Embedded = 4,779 cf x 40.0% Voids
#2	50.10'	377 cf	**24.0" Round Pipe Storage** Inside #1
			L= 120.0'
			506 cf Overall - 1.9" Wall Thickness = 377 cf
#3	52.57'	3,586 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		5,875 cf	Total Available Storage

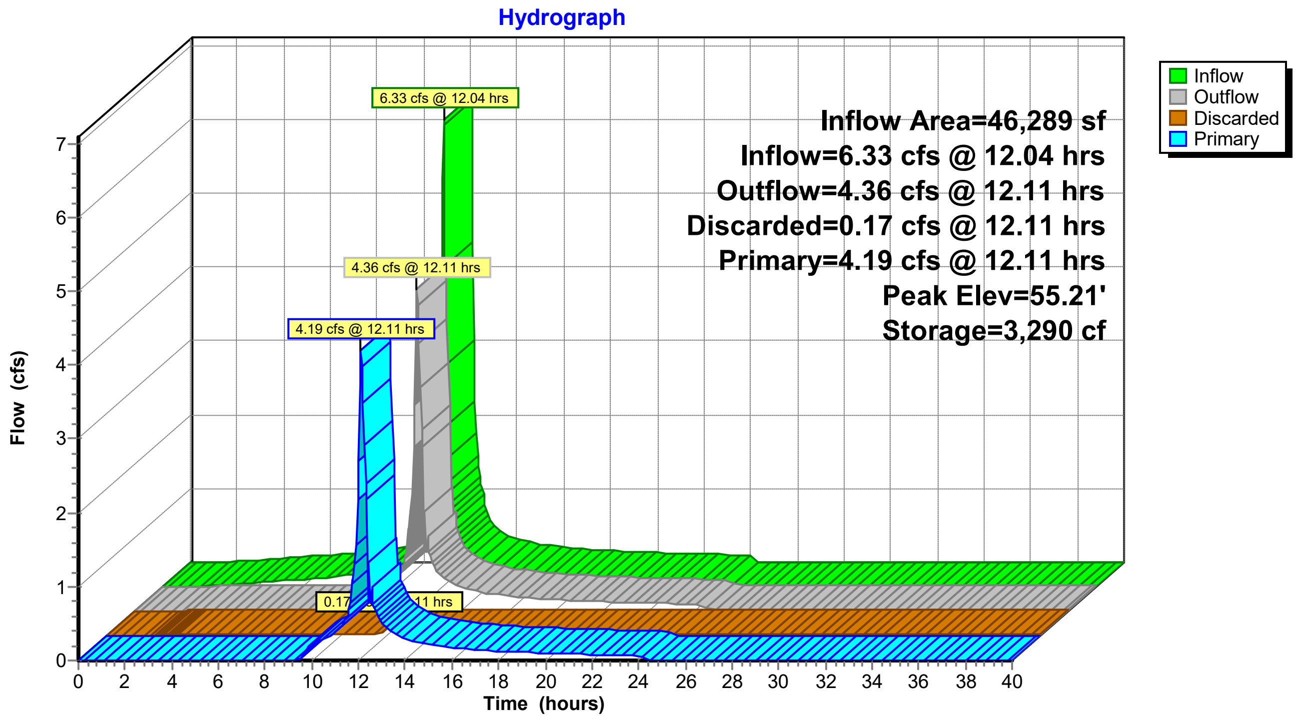
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.57	0	0	0
54.74	1	1	1
55.00	1,569	204	205
55.50	11,954	3,381	3,586

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.90'	**1.000 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	52.01'	**8.0" Round Culvert**
			L= 71.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 52.01' / 51.29' S= 0.0101 '/' Cc= 0.900
			n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#3	Primary	54.92'	**Asymmetrical Weir, C= 3.27**
			Offset (feet) 0.00 13.00 13.00 17.76 17.76 20.29 24.29 40.35
			Elev. (feet) 55.46 55.42 55.02 54.92 55.32 55.31 55.35 55.46

Discarded OutFlow Max=0.17 cfs @ 12.11 hrs HW=55.21' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=4.13 cfs @ 12.11 hrs HW=55.21' (Free Discharge)
├─**2=Culvert** (Barrel Controls 2.31 cfs @ 6.63 fps)
└─**3=Asymmetrical Weir** (Weir Controls 1.81 cfs @ 1.32 fps)

Pond 1P: Existing Leaching Pipe/Stone System



Summary for Pond 2: CB2

Inflow Area = 14,873 sf, 63.59% Impervious, Inflow Depth = 5.52" for 25-yr event
Inflow = 2.04 cfs @ 12.04 hrs, Volume= 6,840 cf
Outflow = 2.04 cfs @ 12.04 hrs, Volume= 6,840 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.93 cfs @ 12.04 hrs, Volume= 6,820 cf
Routed to Pond 6 : PS6
Secondary = 0.11 cfs @ 12.05 hrs, Volume= 20 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

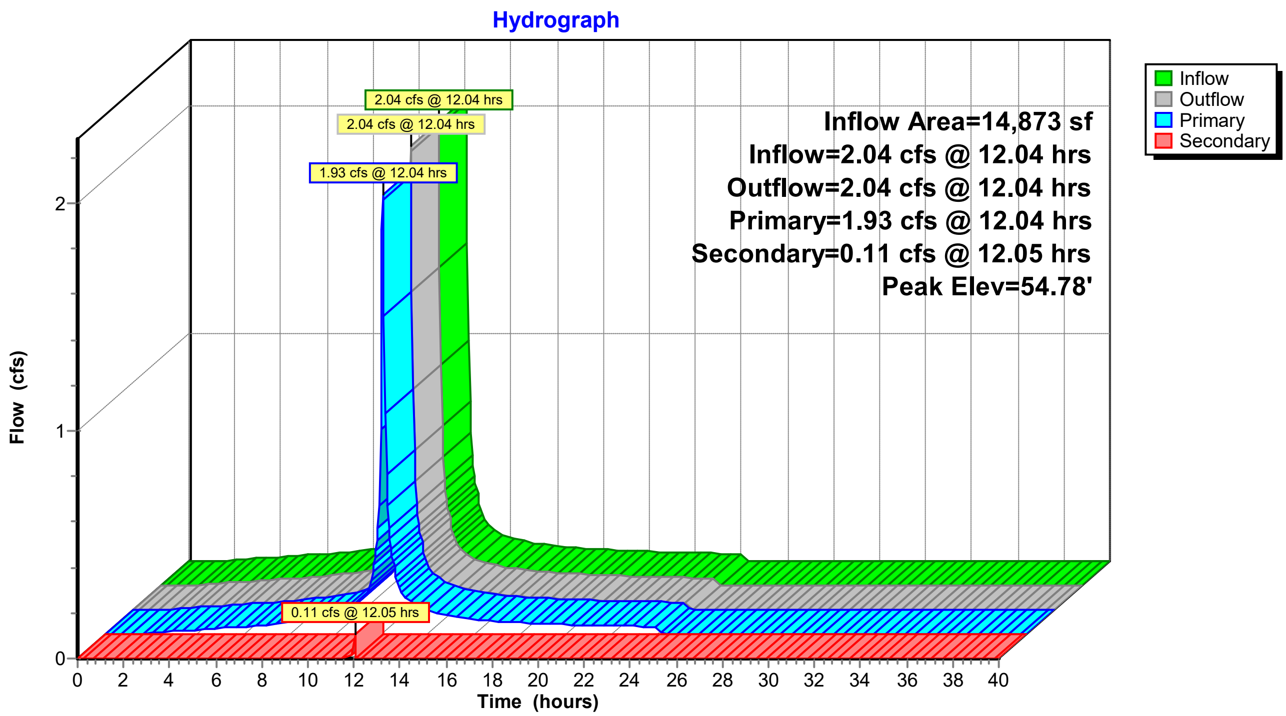
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.78' @ 12.04 hrs
Flood Elev= 54.74'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.84'	**8.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.84' / 52.69' S= 0.0045 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.74'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.87 cfs @ 12.04 hrs HW=54.70' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.87 cfs @ 5.35 fps)

Secondary OutFlow Max=0.08 cfs @ 12.05 hrs HW=54.75' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.08 cfs @ 0.33 fps)

Pond 2: CB2



Summary for Pond 3: CB3

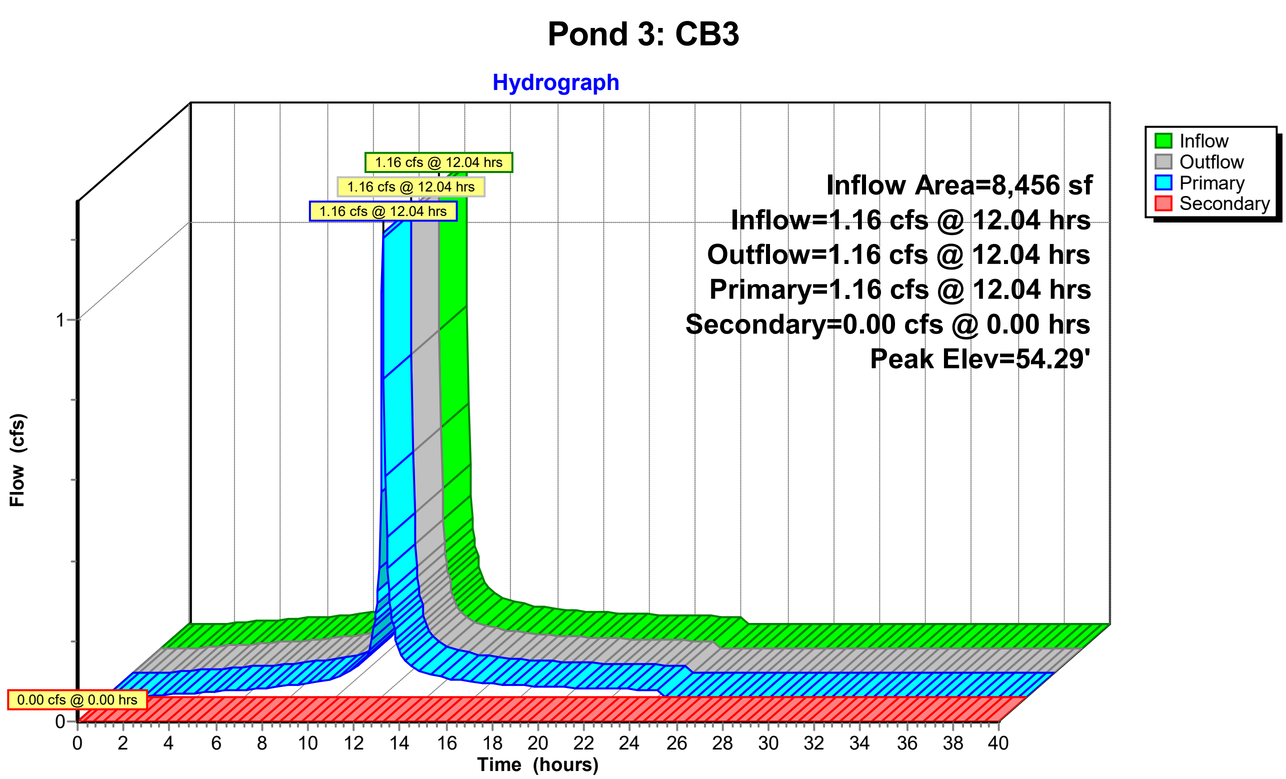
Inflow Area = 8,456 sf, 68.87% Impervious, Inflow Depth = 5.52" for 25-yr event
Inflow = 1.16 cfs @ 12.04 hrs, Volume= 3,889 cf
Outflow = 1.16 cfs @ 12.04 hrs, Volume= 3,889 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.16 cfs @ 12.04 hrs, Volume= 3,889 cf
Routed to Pond 8 : PS8
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.29' @ 12.04 hrs
Flood Elev= 54.78'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.69'	**8.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.68' / 52.69' S= -0.0001 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.78'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.12 cfs @ 12.04 hrs HW=54.23' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.12 cfs @ 3.20 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=52.69' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)



Summary for Pond 4: CB4

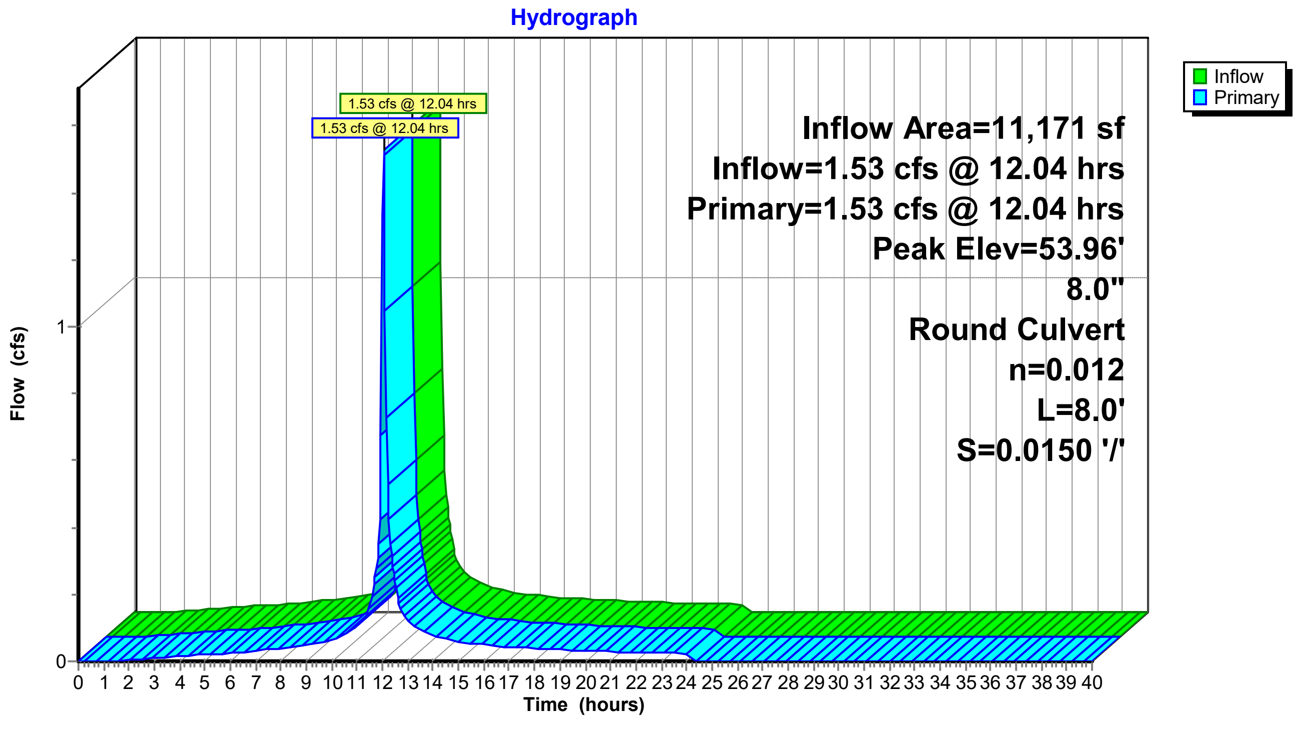
Inflow Area = 11,171 sf, 77.26% Impervious, Inflow Depth = 5.52" for 25-yr event
Inflow = 1.53 cfs @ 12.04 hrs, Volume= 5,137 cf
Outflow = 1.53 cfs @ 12.04 hrs, Volume= 5,137 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.53 cfs @ 12.04 hrs, Volume= 5,137 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.96' @ 12.04 hrs
Flood Elev= 54.81'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.81'	**8.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.81' / 52.69' S= 0.0150 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.48 cfs @ 12.04 hrs HW=53.92' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.48 cfs @ 4.23 fps)

Pond 4: CB4



Summary for Pond 5: CB5

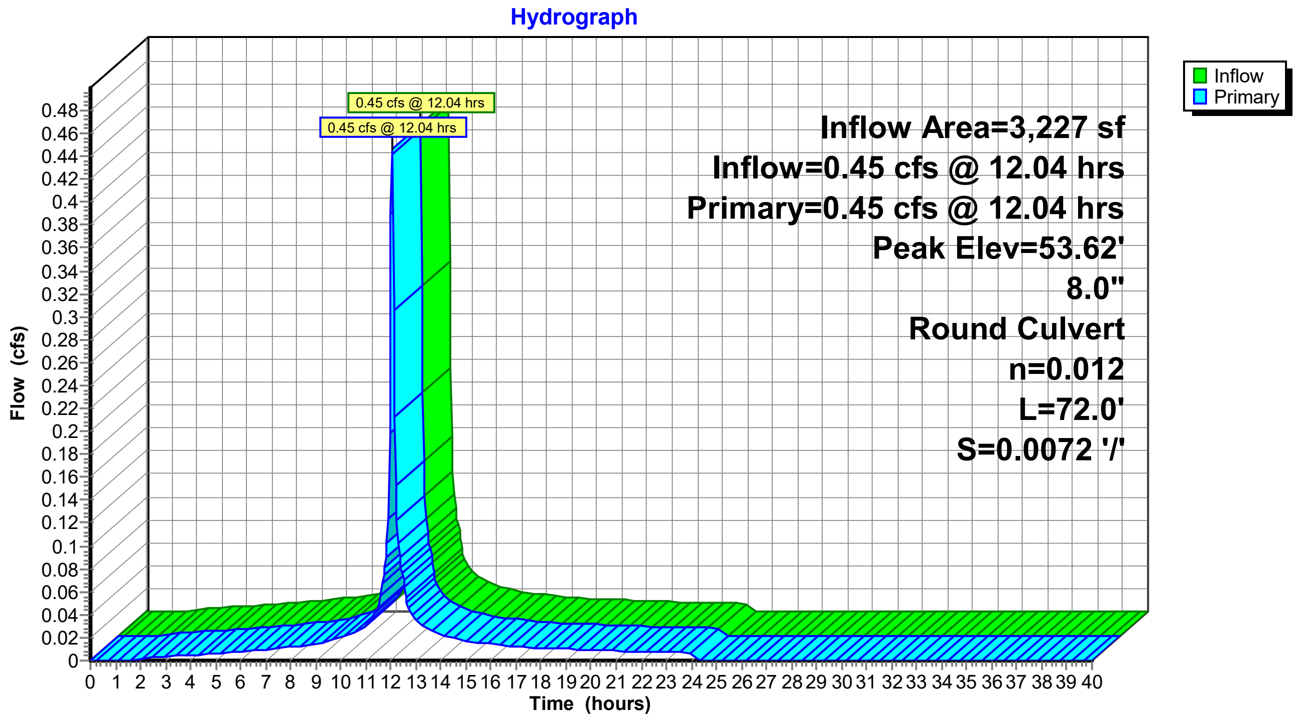
Inflow Area = 3,227 sf, 85.65% Impervious, Inflow Depth = 5.63" for 25-yr event
Inflow = 0.45 cfs @ 12.04 hrs, Volume= 1,515 cf
Outflow = 0.45 cfs @ 12.04 hrs, Volume= 1,515 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.45 cfs @ 12.04 hrs, Volume= 1,515 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.62' @ 12.04 hrs
Flood Elev= 55.11'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.21'	**8.0" Round Culvert** L= 72.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.21' / 52.69' S= 0.0072 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.43 cfs @ 12.04 hrs HW=53.61' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.43 cfs @ 2.80 fps)

Pond 5: CB5



Summary for Pond 6: PS6

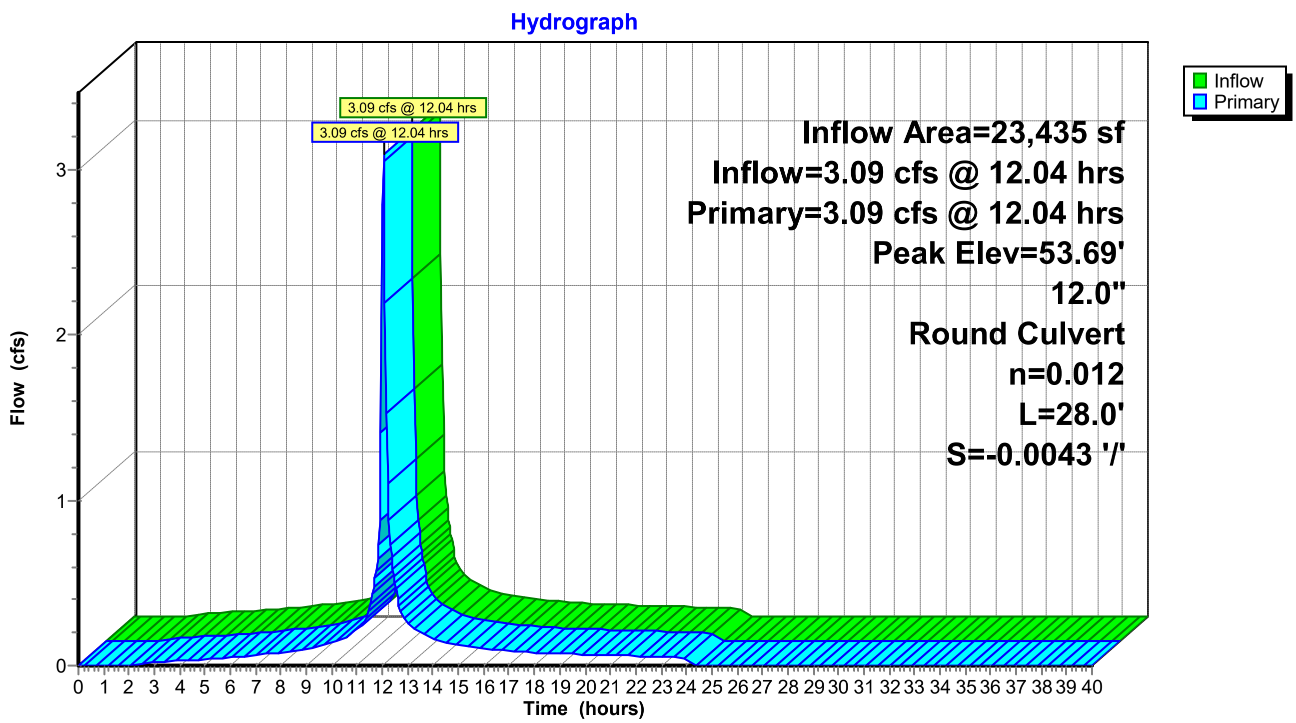
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 5.47" for 25-yr event
Inflow = 3.09 cfs @ 12.04 hrs, Volume= 10,676 cf
Outflow = 3.09 cfs @ 12.04 hrs, Volume= 10,676 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.09 cfs @ 12.04 hrs, Volume= 10,676 cf
Routed to Pond 7 : DMH7

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.69' @ 12.03 hrs
Flood Elev= 55.04'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.26'	**12.0" Round Culvert** L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.14' / 52.26' S= -0.0043 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.98 cfs @ 12.04 hrs HW=53.64' (Free Discharge)
└**1=Culvert** (Barrel Controls 2.98 cfs @ 3.80 fps)

Pond 6: PS6



Summary for Pond 7: DMH7

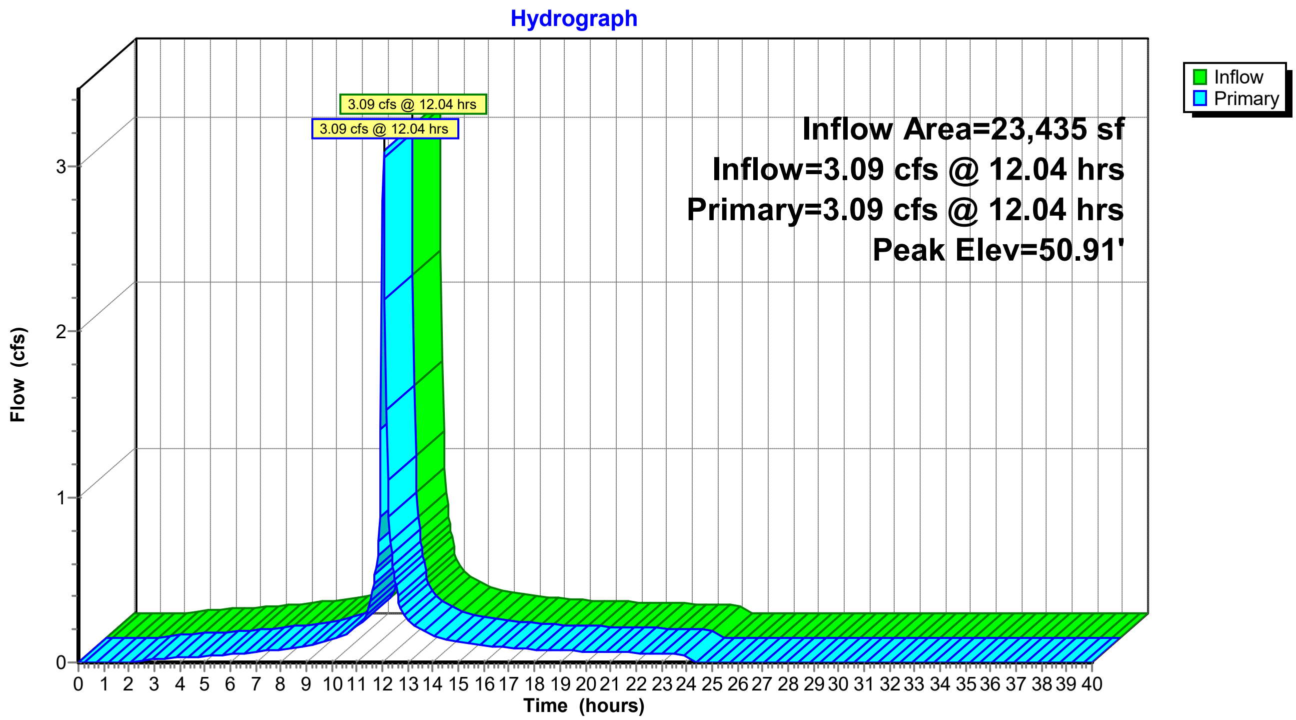
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 5.47" for 25-yr event
Inflow = 3.09 cfs @ 12.04 hrs, Volume= 10,676 cf
Outflow = 3.09 cfs @ 12.04 hrs, Volume= 10,676 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.09 cfs @ 12.04 hrs, Volume= 10,676 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 50.91' @ 12.04 hrs
Flood Elev= 55.36'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.10'	**12.0" Round Culvert** L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.96' / 50.10' S= -0.0156 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.26'	**12.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.26' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.98 cfs @ 12.04 hrs HW=50.89' (Free Discharge)
1=Culvert (Barrel Controls 1.73 cfs @ 2.97 fps)
2=Culvert (Barrel Controls 1.25 cfs @ 3.44 fps)

Pond 7: DMH7



Summary for Pond 8: PS8

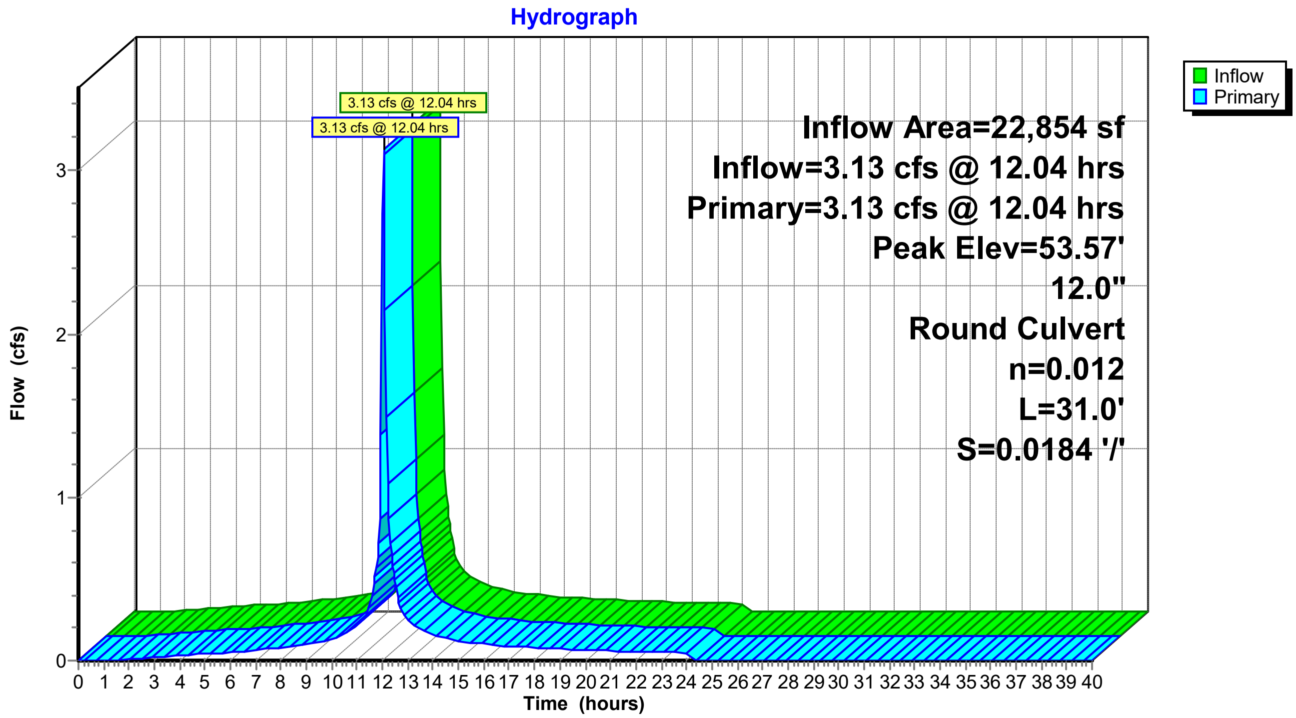
Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 5.53" for 25-yr event
Inflow = 3.13 cfs @ 12.04 hrs, Volume= 10,541 cf
Outflow = 3.13 cfs @ 12.04 hrs, Volume= 10,541 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.13 cfs @ 12.04 hrs, Volume= 10,541 cf
Routed to Pond 9 : DMH9

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.57' @ 12.04 hrs
Flood Elev= 54.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.39'	**12.0" Round Culvert** L= 31.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.39' / 51.82' S= 0.0184 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.02 cfs @ 12.04 hrs HW=53.53' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.02 cfs @ 3.85 fps)

Pond 8: PS8



Summary for Pond 9: DMH9

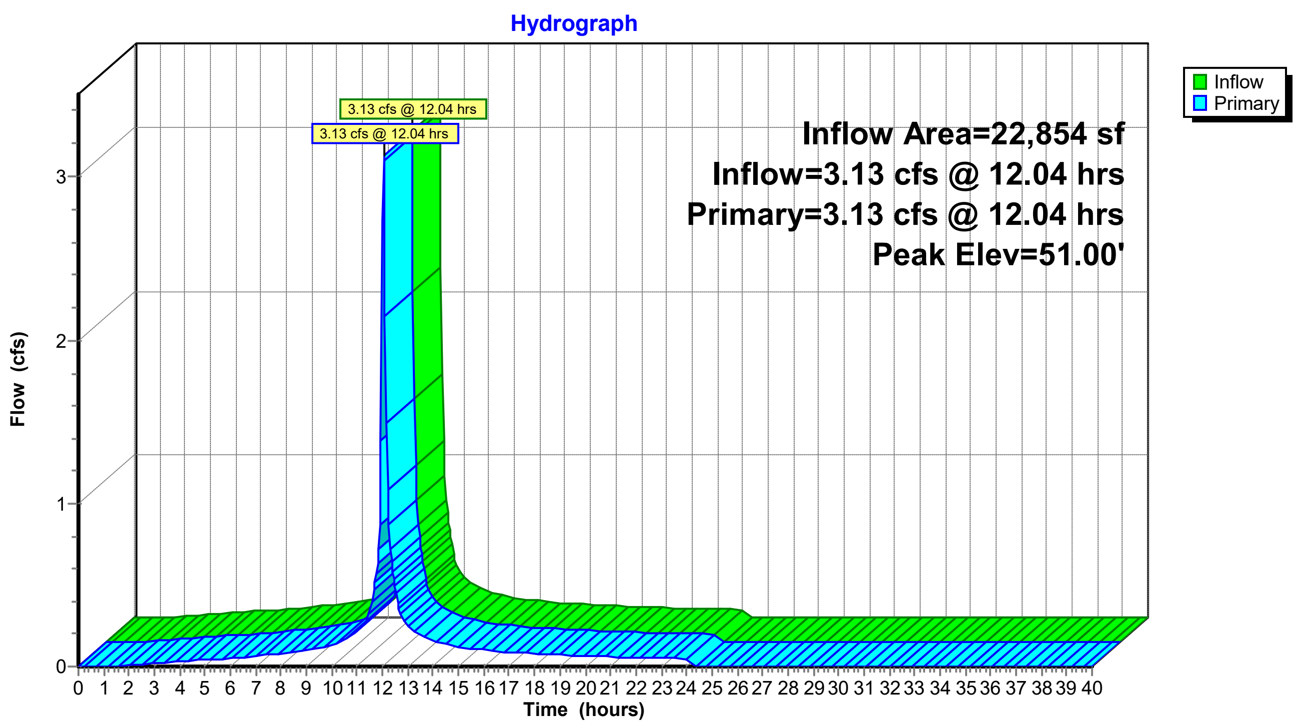
Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 5.53" for 25-yr event
Inflow = 3.13 cfs @ 12.04 hrs, Volume= 10,541 cf
Outflow = 3.13 cfs @ 12.04 hrs, Volume= 10,541 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.13 cfs @ 12.04 hrs, Volume= 10,541 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 51.00' @ 12.04 hrs
Flood Elev= 55.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.12'	**12.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.12' / 50.10' S= 0.0020 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.32'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.32' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.02 cfs @ 12.04 hrs HW=50.98' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.58 cfs @ 2.96 fps)
└—**2=Culvert** (Barrel Controls 1.43 cfs @ 3.71 fps)

Pond 9: DMH9



Summary for Pond 10: EXIST MH10

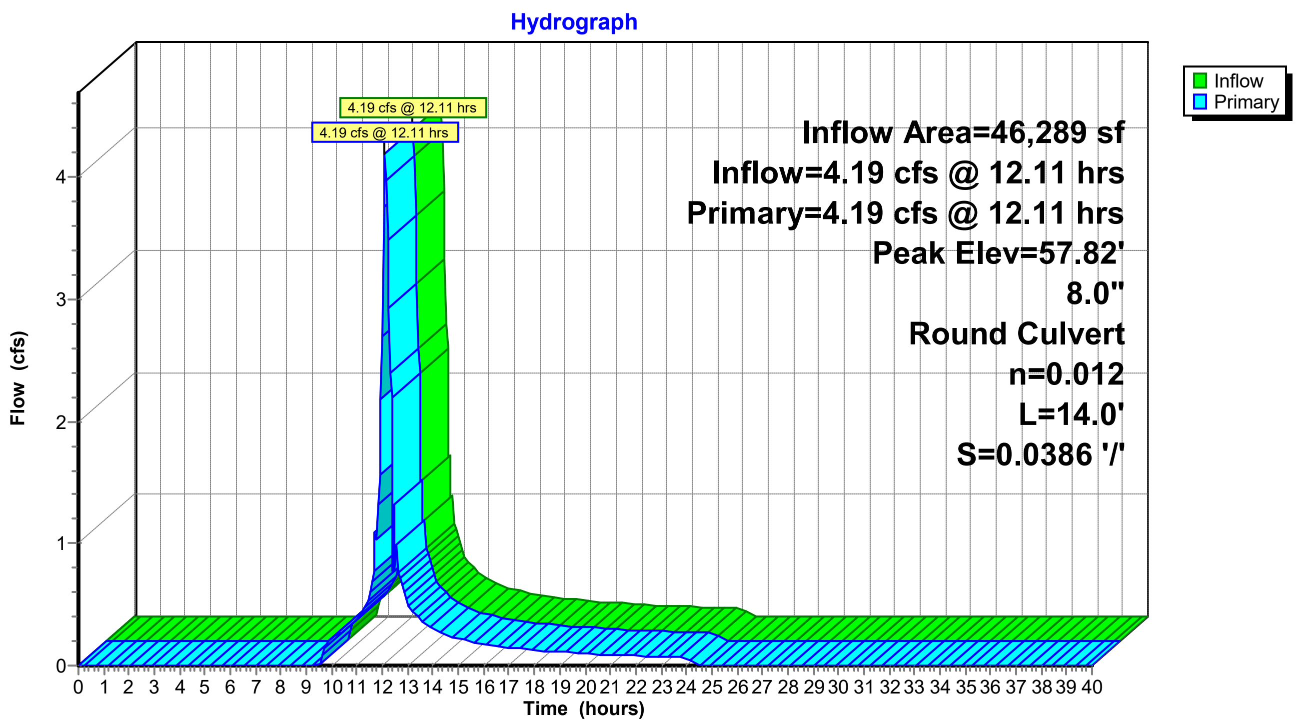
Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 4.28" for 25-yr event
Inflow = 4.19 cfs @ 12.11 hrs, Volume= 16,493 cf
Outflow = 4.19 cfs @ 12.11 hrs, Volume= 16,493 cf, Atten= 0%, Lag= 0.0 min
Primary = 4.19 cfs @ 12.11 hrs, Volume= 16,493 cf
Routed to Link 1L : Essex Street

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 57.82' @ 12.11 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=4.14 cfs @ 12.11 hrs HW=57.70' (Free Discharge)
↑**1=Culvert** (Inlet Controls 4.14 cfs @ 11.87 fps)

Pond 10: EXIST MH10

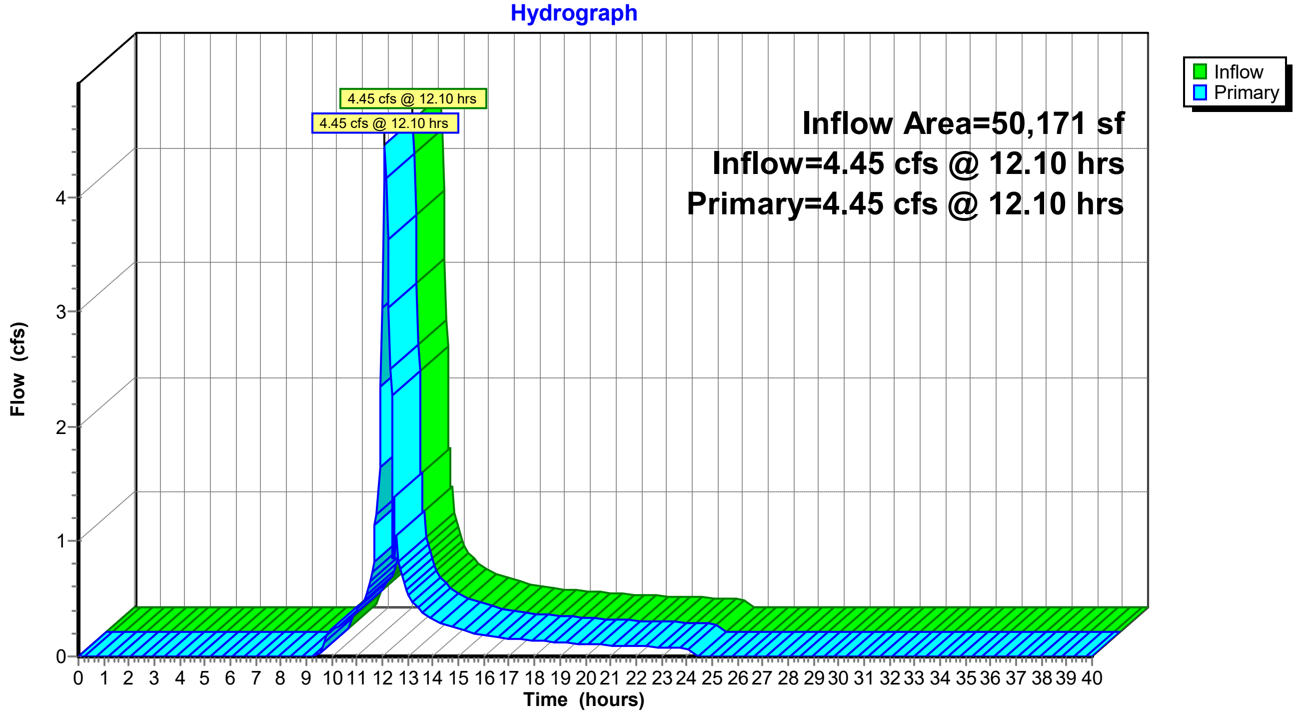


Summary for Link 1L: Essex Street

Inflow Area =	50,171 sf,	66.03% Impervious,	Inflow Depth = 4.24"	for 25-yr event
Inflow =	4.45 cfs @	12.10 hrs, Volume=	17,715 cf	
Primary =	4.45 cfs @	12.10 hrs, Volume=	17,715 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 1L: Essex Street



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,562 sf 55.71% Impervious Runoff Depth=6.26"
Flow Length=69' Slope=0.0320 '/' Tc=6.0 min CN=92 Runoff=1.32 cfs 4,468 cf

Subcatchment 2S: Runoff Area=14,873 sf 63.59% Impervious Runoff Depth=6.38"
Flow Length=141' Tc=6.0 min CN=93 Runoff=2.32 cfs 7,907 cf

Subcatchment 3S: Runoff Area=8,456 sf 68.87% Impervious Runoff Depth=6.38"
Flow Length=129' Tc=6.0 min CN=93 Runoff=1.32 cfs 4,495 cf

Subcatchment 4S: Runoff Area=11,171 sf 77.26% Impervious Runoff Depth=6.38"
Flow Length=142' Tc=6.0 min CN=93 Runoff=1.74 cfs 5,939 cf

Subcatchment 5S: Runoff Area=3,227 sf 85.65% Impervious Runoff Depth=6.50"
Flow Length=91' Slope=0.0290 '/' Tc=6.0 min CN=94 Runoff=0.51 cfs 1,747 cf

Subcatchment 6S: Runoff Area=3,882 sf 43.30% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=77 Runoff=0.47 cfs 1,474 cf

Pond 1: CB1 Peak Elev=54.65' Inflow=1.32 cfs 4,468 cf
8.0" Round Culvert n=0.012 L=94.0' S=0.0052 '/' Outflow=1.32 cfs 4,468 cf

Pond 1P: Existing Leaching Pipe/Stone Peak Elev=55.25' Storage=3,553 cf Inflow=7.21 cfs 24,556 cf
Discarded=0.19 cfs 4,703 cf Primary=4.68 cfs 19,738 cf Outflow=4.87 cfs 24,441 cf

Pond 2: CB2 Peak Elev=54.82' Inflow=2.32 cfs 7,907 cf
Primary=1.95 cfs 7,817 cf Secondary=0.38 cfs 90 cf Outflow=2.32 cfs 7,907 cf

Pond 3: CB3 Peak Elev=54.57' Inflow=1.32 cfs 4,495 cf
Primary=1.32 cfs 4,495 cf Secondary=0.00 cfs 0 cf Outflow=1.32 cfs 4,495 cf

Pond 4: CB4 Peak Elev=54.21' Inflow=1.74 cfs 5,939 cf
8.0" Round Culvert n=0.012 L=8.0' S=0.0150 '/' Outflow=1.74 cfs 5,939 cf

Pond 5: CB5 Peak Elev=53.65' Inflow=0.51 cfs 1,747 cf
8.0" Round Culvert n=0.012 L=72.0' S=0.0072 '/' Outflow=0.51 cfs 1,747 cf

Pond 6: PS6 Peak Elev=53.74' Inflow=3.27 cfs 12,285 cf
12.0" Round Culvert n=0.012 L=28.0' S=-0.0043 '/' Outflow=3.27 cfs 12,285 cf

Pond 7: DMH7 Peak Elev=50.93' Inflow=3.27 cfs 12,285 cf
Outflow=3.27 cfs 12,285 cf

Pond 8: PS8 Peak Elev=53.78' Inflow=3.57 cfs 12,181 cf
12.0" Round Culvert n=0.012 L=31.0' S=0.0184 '/' Outflow=3.57 cfs 12,181 cf

Pond 9: DMH9 Peak Elev=51.06' Inflow=3.57 cfs 12,181 cf
Outflow=3.57 cfs 12,181 cf

Pond 10: EXIST MH10 Peak Elev=59.38' Inflow=4.68 cfs 19,738 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=4.68 cfs 19,738 cf

Link 1L: Essex Street Inflow=4.99 cfs 21,212 cf
Primary=4.99 cfs 21,212 cf

Total Runoff Area = 50,171 sf Runoff Volume = 26,029 cf Average Runoff Depth = 6.23"
33.97% Pervious = 17,044 sf 66.03% Impervious = 33,127 sf

Summary for Subcatchment 1S:

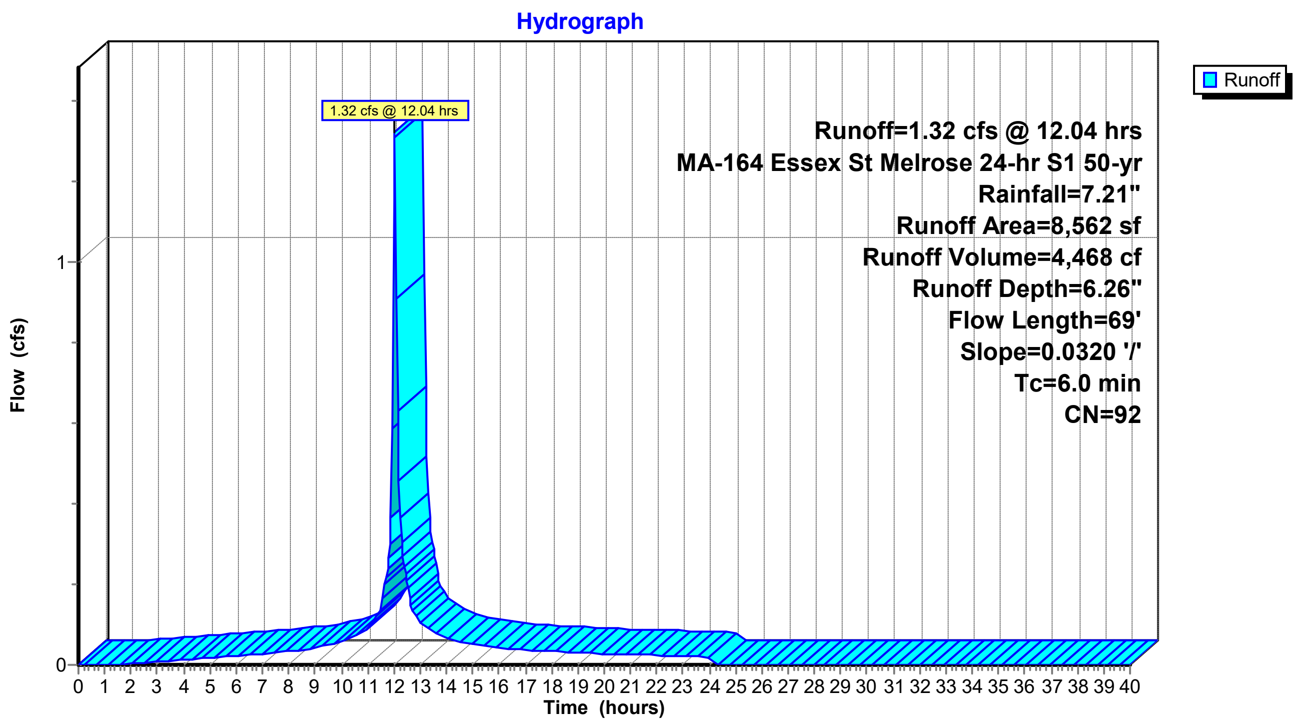
Runoff = 1.32 cfs @ 12.04 hrs, Volume= 4,468 cf, Depth= 6.26"
Routed to Pond 1 : CB1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
1,762	69	50-75% Grass cover, Fair, HSG B
4,770	98	Paved parking, HSG B
2,030	96	Gravel surface, HSG B
8,562	92	Weighted Average
3,792		44.29% Pervious Area
4,770		55.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	69	0.0320	1.56		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.7	69	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S:



Summary for Subcatchment 2S:

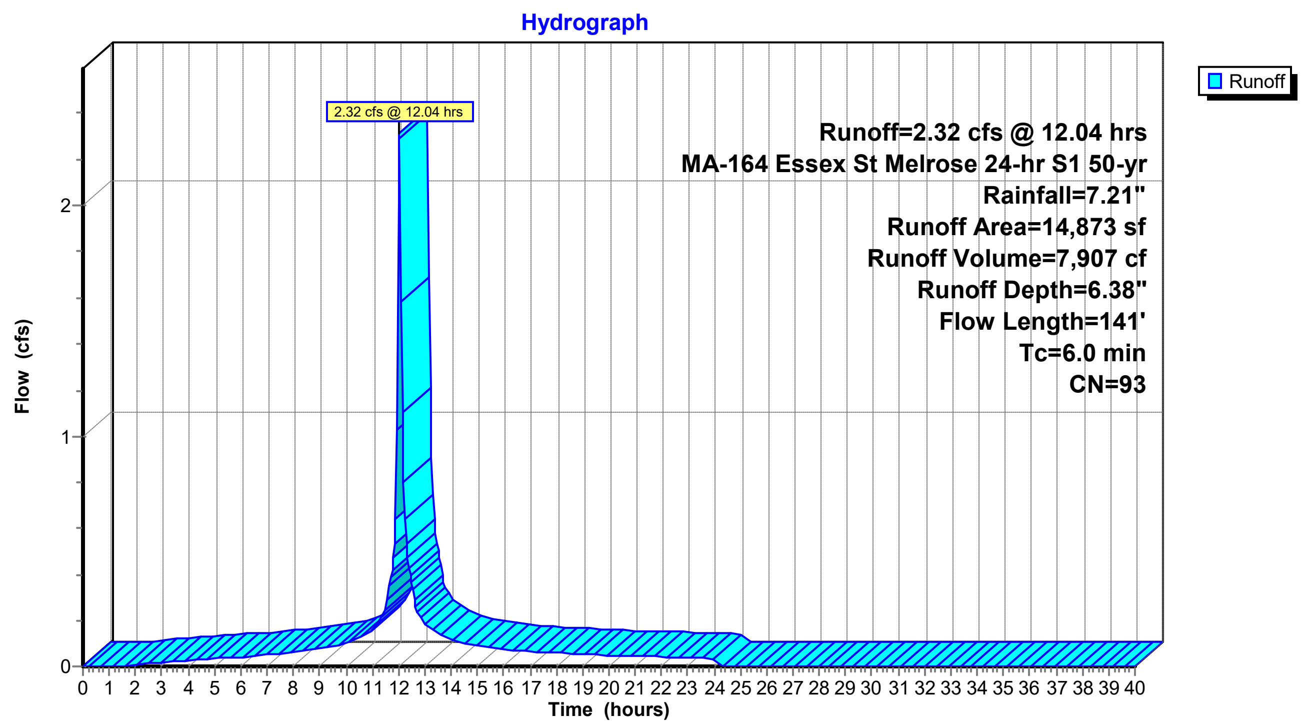
Runoff = 2.32 cfs @ 12.04 hrs, Volume= 7,907 cf, Depth= 6.38"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
2,420	69	50-75% Grass cover, Fair, HSG B
9,457	98	Paved parking, HSG B
2,996	96	Gravel surface, HSG B
14,873	93	Weighted Average
5,416		36.41% Pervious Area
9,457		63.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0195	1.38		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	41	0.0120	2.22		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	141	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S:



Summary for Subcatchment 3S:

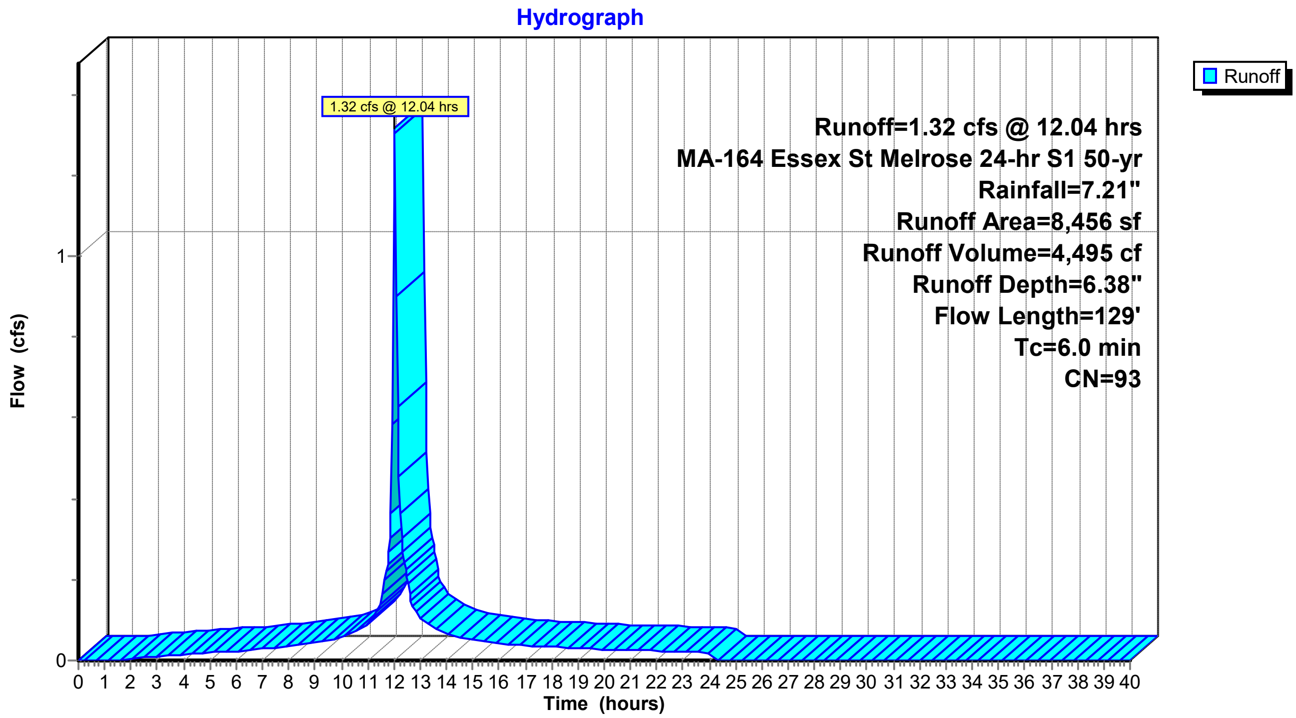
Runoff = 1.32 cfs @ 12.04 hrs, Volume= 4,495 cf, Depth= 6.38"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
1,406	69	50-75% Grass cover, Fair, HSG B
5,824	98	Paved parking, HSG B
1,226	96	Gravel surface, HSG B
8,456	93	Weighted Average
2,632		31.13% Pervious Area
5,824		68.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.2	29	0.0250	3.21		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.4	129	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S:



Summary for Subcatchment 4S:

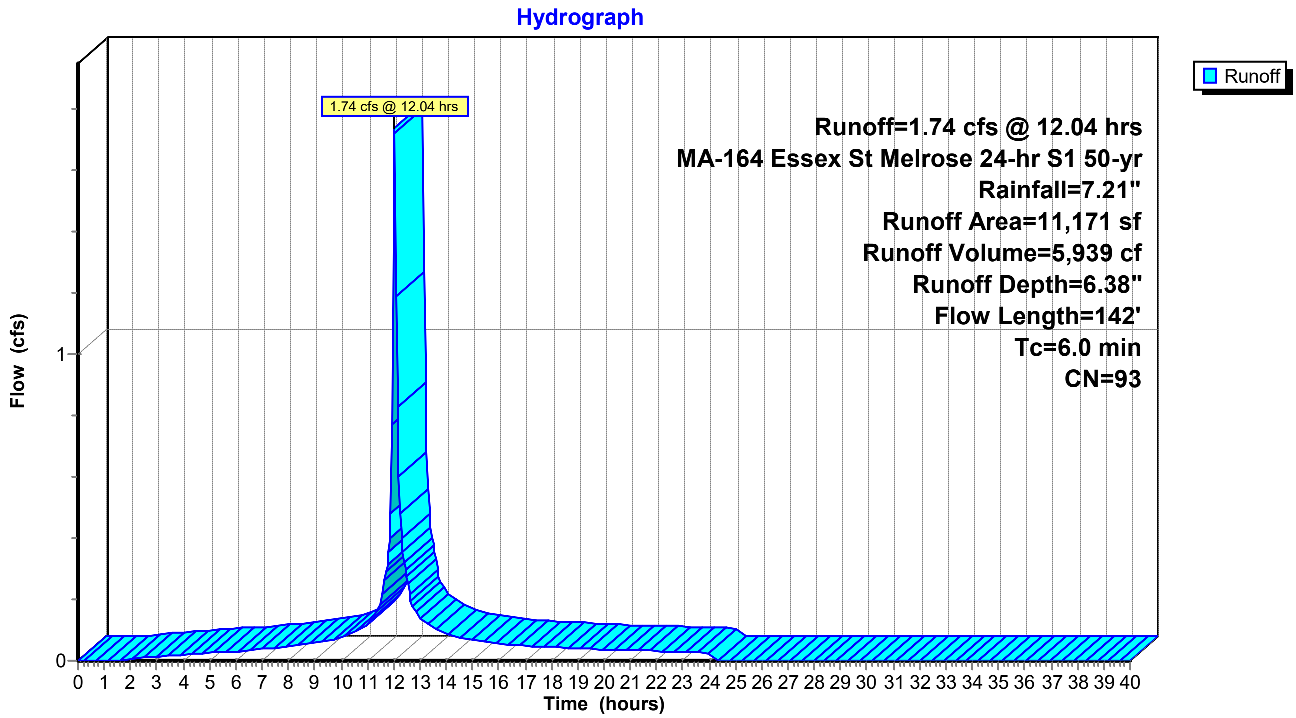
Runoff = 1.74 cfs @ 12.04 hrs, Volume= 5,939 cf, Depth= 6.38"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
1,868	69	50-75% Grass cover, Fair, HSG B
8,631	98	Paved parking, HSG B
672	96	Gravel surface, HSG B
11,171	93	Weighted Average
2,540		22.74% Pervious Area
8,631		77.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	42	0.0164	2.60		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	142	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S:



Summary for Subcatchment 5S:

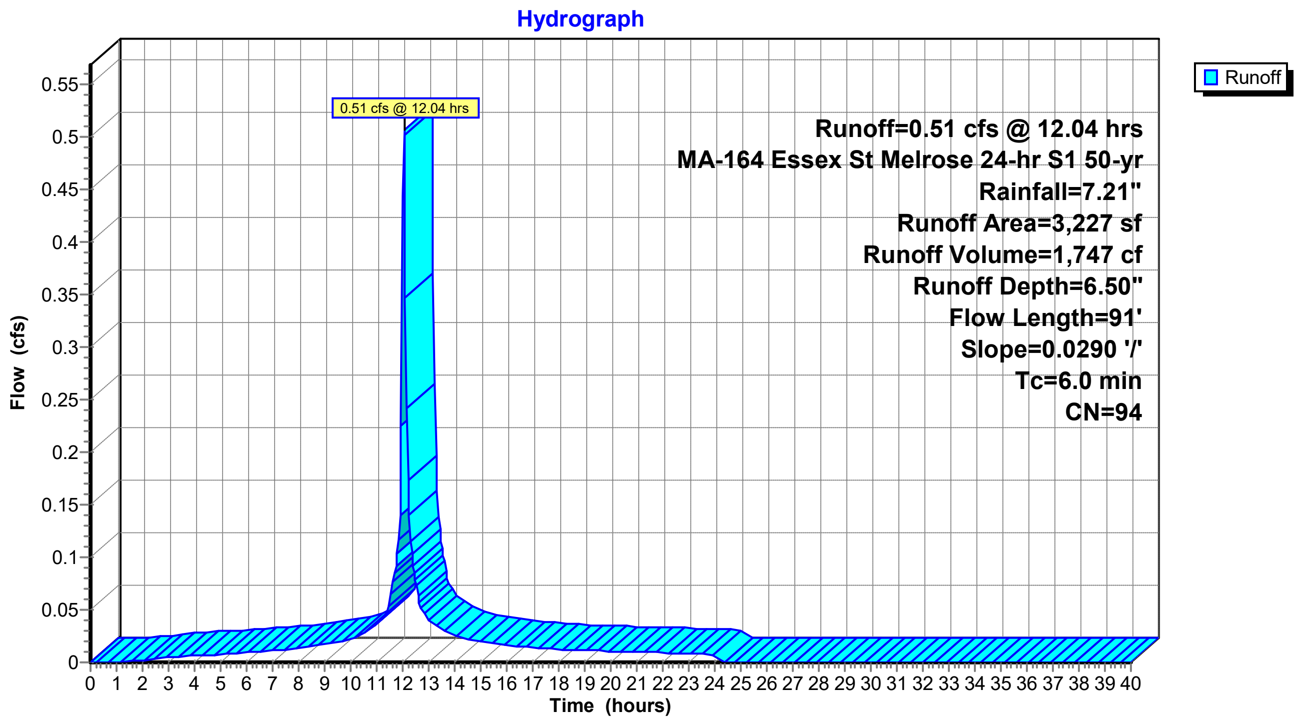
Runoff = 0.51 cfs @ 12.04 hrs, Volume= 1,747 cf, Depth= 6.50"
Routed to Pond 5 : CB5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
463	69	50-75% Grass cover, Fair, HSG B
2,764	98	Paved parking, HSG B
3,227	94	Weighted Average
463		14.35% Pervious Area
2,764		85.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	91	0.0290	1.59		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
1.0	91	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5S:



Summary for Subcatchment 6S:

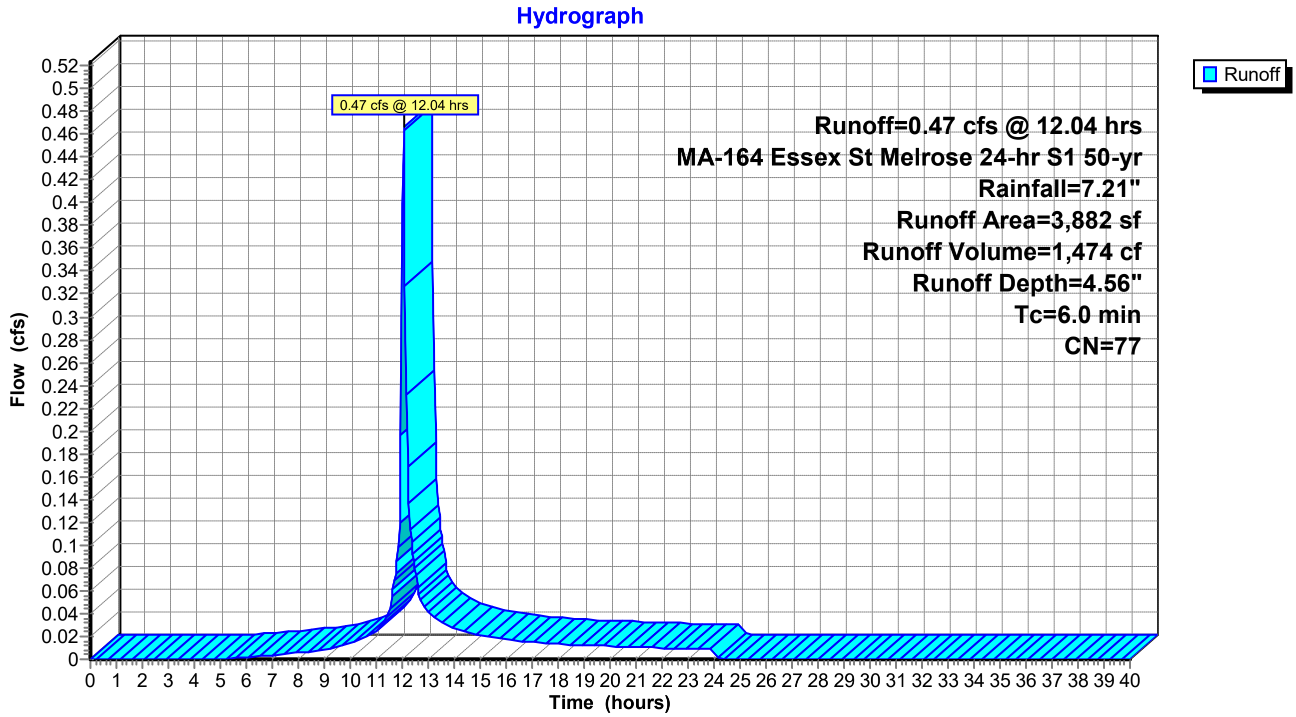
Runoff = 0.47 cfs @ 12.04 hrs, Volume= 1,474 cf, Depth= 4.56"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
2,201	61	>75% Grass cover, Good, HSG B
1,681	98	Paved parking, HSG B
3,882	77	Weighted Average
2,201		56.70% Pervious Area
1,681		43.30% Impervious Area

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

Subcatchment 6S:



Summary for Pond 1: CB1

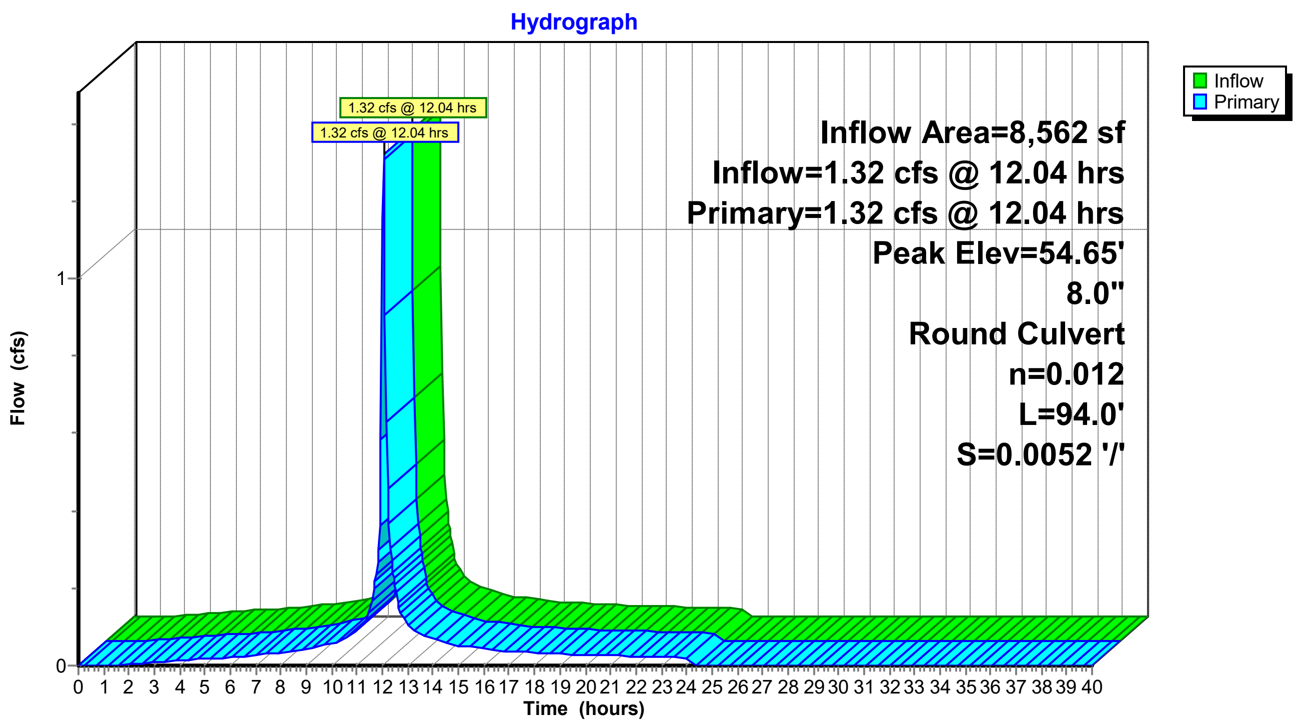
Inflow Area = 8,562 sf, 55.71% Impervious, Inflow Depth = 6.26" for 50-yr event
Inflow = 1.32 cfs @ 12.04 hrs, Volume= 4,468 cf
Outflow = 1.32 cfs @ 12.04 hrs, Volume= 4,468 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.32 cfs @ 12.04 hrs, Volume= 4,468 cf
Routed to Pond 6 : PS6

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.65' @ 12.04 hrs
Flood Elev= 55.08'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.18'	**8.0" Round Culvert** L= 94.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.18' / 52.69' S= 0.0052 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.28 cfs @ 12.04 hrs HW=54.56' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.28 cfs @ 3.66 fps)

Pond 1: CB1



Summary for Pond 1P: Existing Leaching Pipe/Stone System

Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 6.37" for 50-yr event
Inflow = 7.21 cfs @ 12.04 hrs, Volume= 24,556 cf
Outflow = 4.87 cfs @ 12.11 hrs, Volume= 24,441 cf, Atten= 32%, Lag= 4.3 min
Discarded = 0.19 cfs @ 12.11 hrs, Volume= 4,703 cf
Primary = 4.68 cfs @ 12.11 hrs, Volume= 19,738 cf
Routed to Pond 10 : EXIST MH10

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 55.25' @ 12.11 hrs Surf.Area= 8,255 sf Storage= 3,553 cf

Plug-Flow detention time= 128.6 min calculated for 24,441 cf (100% of inflow)
Center-of-Mass det. time= 125.5 min (900.7 - 775.2)

Volume	Invert	Avail.Storage	Storage Description
#1	48.90'	1,912 cf	**12.00'W x 120.00'L x 3.67'H Prismatoid** 5,285 cf Overall - 506 cf Embedded = 4,779 cf x 40.0% Voids
#2	50.10'	377 cf	**24.0" Round Pipe Storage** Inside #1 L= 120.0' 506 cf Overall - 1.9" Wall Thickness = 377 cf
#3	52.57'	3,586 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		5,875 cf	Total Available Storage

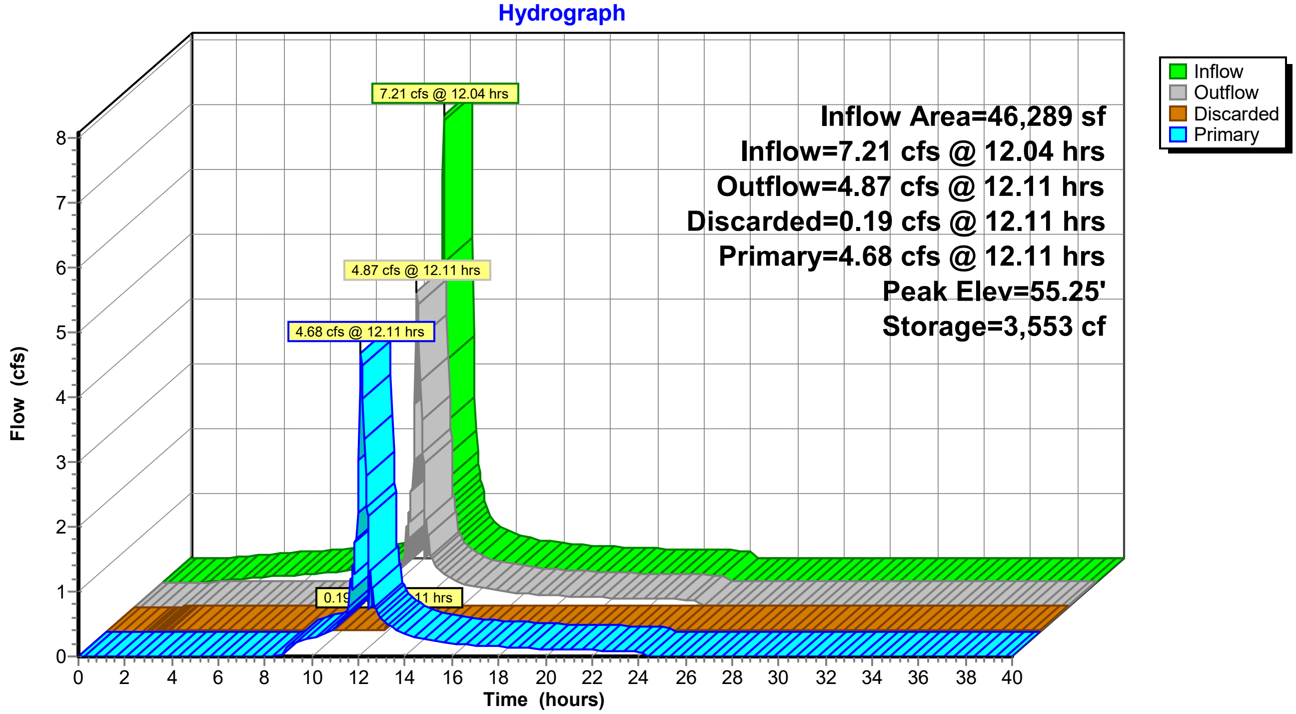
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.57	0	0	0
54.74	1	1	1
55.00	1,569	204	205
55.50	11,954	3,381	3,586

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.90'	**1.000 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	52.01'	**8.0" Round Culvert** L= 71.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.01' / 51.29' S= 0.0101 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#3	Primary	54.92'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 13.00 13.00 17.76 17.76 20.29 24.29 40.35 Elev. (feet) 55.46 55.42 55.02 54.92 55.32 55.31 55.35 55.46

Discarded OutFlow Max=0.19 cfs @ 12.11 hrs HW=55.25' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=4.62 cfs @ 12.11 hrs HW=55.25' (Free Discharge)
├─**2=Culvert** (Barrel Controls 2.33 cfs @ 6.67 fps)
└─**3=Asymmetrical Weir** (Weir Controls 2.29 cfs @ 1.47 fps)

Pond 1P: Existing Leaching Pipe/Stone System



Summary for Pond 2: CB2

Inflow Area = 14,873 sf, 63.59% Impervious, Inflow Depth = 6.38" for 50-yr event
Inflow = 2.32 cfs @ 12.04 hrs, Volume= 7,907 cf
Outflow = 2.32 cfs @ 12.04 hrs, Volume= 7,907 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.95 cfs @ 12.03 hrs, Volume= 7,817 cf
Routed to Pond 6 : PS6
Secondary = 0.38 cfs @ 12.05 hrs, Volume= 90 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

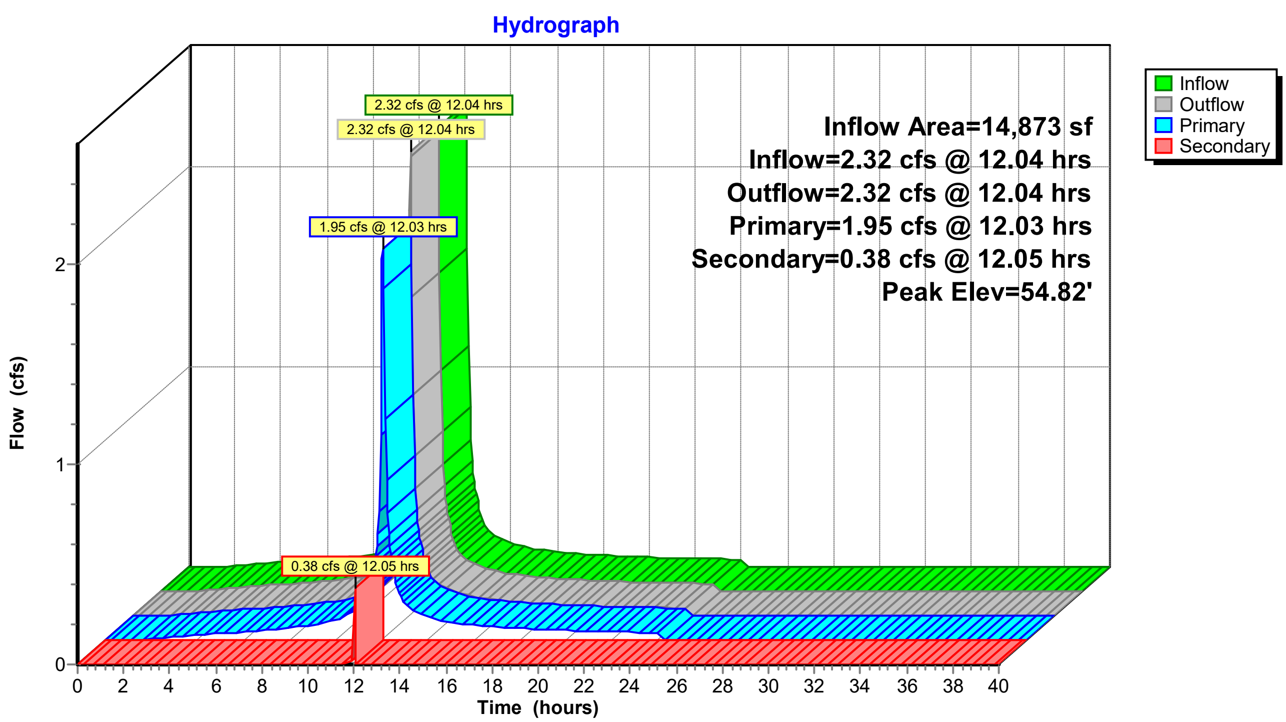
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.82' @ 12.03 hrs
Flood Elev= 54.74'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.84'	**8.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.84' / 52.69' S= 0.0045 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.74'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.91 cfs @ 12.03 hrs HW=54.76' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.91 cfs @ 5.47 fps)

Secondary OutFlow Max=0.33 cfs @ 12.05 hrs HW=54.77' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.33 cfs @ 0.53 fps)

Pond 2: CB2



Summary for Pond 3: CB3

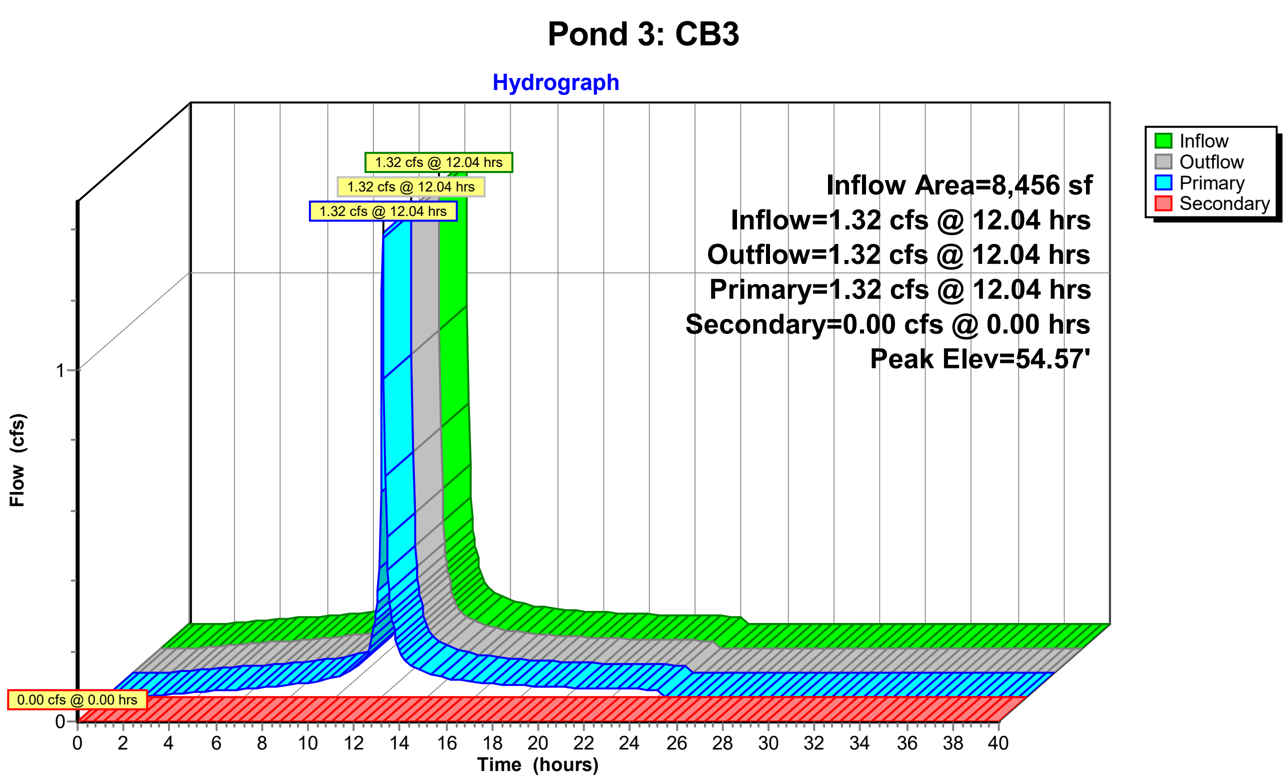
Inflow Area = 8,456 sf, 68.87% Impervious, Inflow Depth = 6.38" for 50-yr event
Inflow = 1.32 cfs @ 12.04 hrs, Volume= 4,495 cf
Outflow = 1.32 cfs @ 12.04 hrs, Volume= 4,495 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.32 cfs @ 12.04 hrs, Volume= 4,495 cf
Routed to Pond 8 : PS8
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.57' @ 12.04 hrs
Flood Elev= 54.78'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.69'	**8.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.68' / 52.69' S= -0.0001 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.78'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.27 cfs @ 12.04 hrs HW=54.49' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.27 cfs @ 3.64 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=52.69' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.00 cfs)



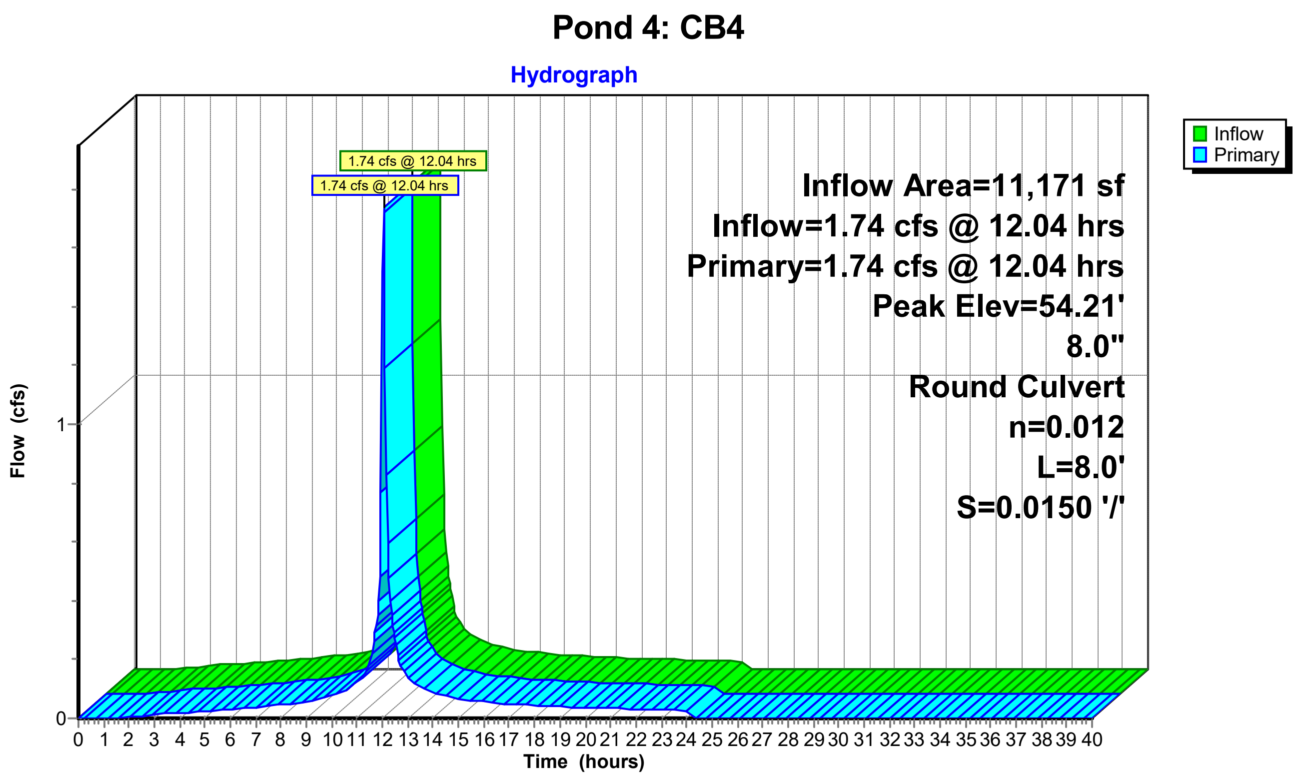
Summary for Pond 4: CB4

Inflow Area = 11,171 sf, 77.26% Impervious, Inflow Depth = 6.38" for 50-yr event
Inflow = 1.74 cfs @ 12.04 hrs, Volume= 5,939 cf
Outflow = 1.74 cfs @ 12.04 hrs, Volume= 5,939 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.74 cfs @ 12.04 hrs, Volume= 5,939 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.21' @ 12.04 hrs
Flood Elev= 54.81'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.81'	**8.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.81' / 52.69' S= 0.0150 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.68 cfs @ 12.04 hrs HW=54.14' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.68 cfs @ 4.81 fps)



Summary for Pond 5: CB5

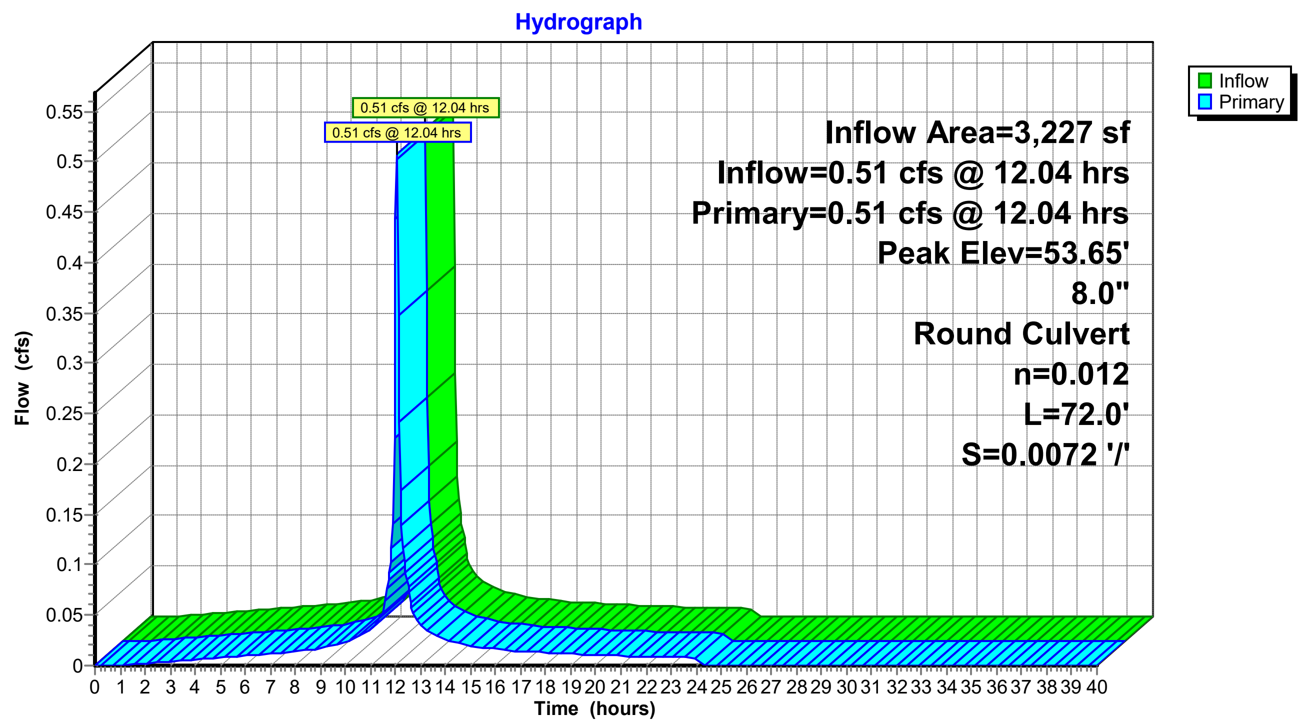
Inflow Area = 3,227 sf, 85.65% Impervious, Inflow Depth = 6.50" for 50-yr event
Inflow = 0.51 cfs @ 12.04 hrs, Volume= 1,747 cf
Outflow = 0.51 cfs @ 12.04 hrs, Volume= 1,747 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.51 cfs @ 12.04 hrs, Volume= 1,747 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.65' @ 12.04 hrs
Flood Elev= 55.11'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.21'	**8.0" Round Culvert** L= 72.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.21' / 52.69' S= 0.0072 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.49 cfs @ 12.04 hrs HW=53.64' (Free Discharge)
↑**1=Culvert** (Barrel Controls 0.49 cfs @ 2.88 fps)

Pond 5: CB5



Summary for Pond 6: PS6

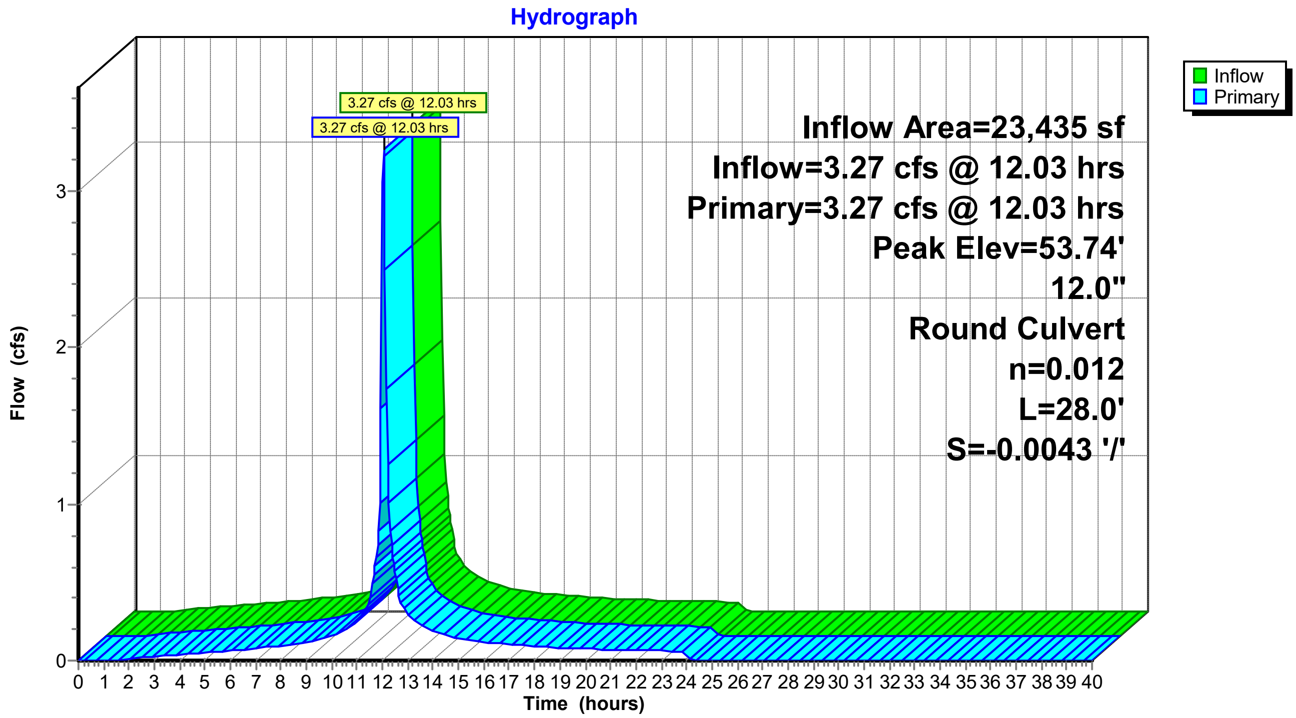
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 6.29" for 50-yr event
Inflow = 3.27 cfs @ 12.03 hrs, Volume= 12,285 cf
Outflow = 3.27 cfs @ 12.03 hrs, Volume= 12,285 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.27 cfs @ 12.03 hrs, Volume= 12,285 cf
Routed to Pond 7 : DMH7

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.74' @ 12.04 hrs
Flood Elev= 55.04'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.26'	**12.0" Round Culvert** L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.14' / 52.26' S= -0.0043 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.17 cfs @ 12.03 hrs HW=53.71' (Free Discharge)
└─**1=Culvert** (Barrel Controls 3.17 cfs @ 4.04 fps)

Pond 6: PS6



Summary for Pond 7: DMH7

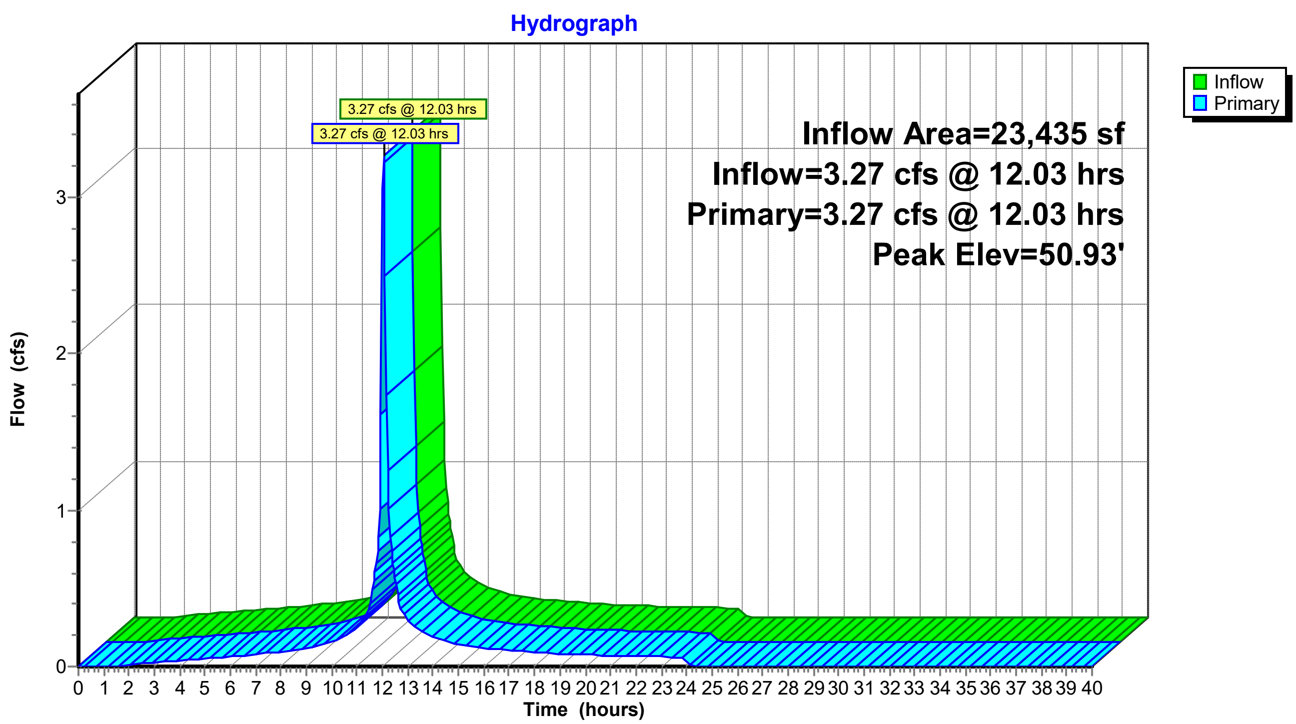
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 6.29" for 50-yr event
Inflow = 3.27 cfs @ 12.03 hrs, Volume= 12,285 cf
Outflow = 3.27 cfs @ 12.03 hrs, Volume= 12,285 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.27 cfs @ 12.03 hrs, Volume= 12,285 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 50.93' @ 12.03 hrs
Flood Elev= 55.36'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.10'	**12.0" Round Culvert** L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.96' / 50.10' S= -0.0156 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.26'	**12.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.26' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.17 cfs @ 12.03 hrs HW=50.92' (Free Discharge)
1=Culvert (Barrel Controls 1.82 cfs @ 3.02 fps)
2=Culvert (Barrel Controls 1.35 cfs @ 3.49 fps)

Pond 7: DMH7



Summary for Pond 8: PS8

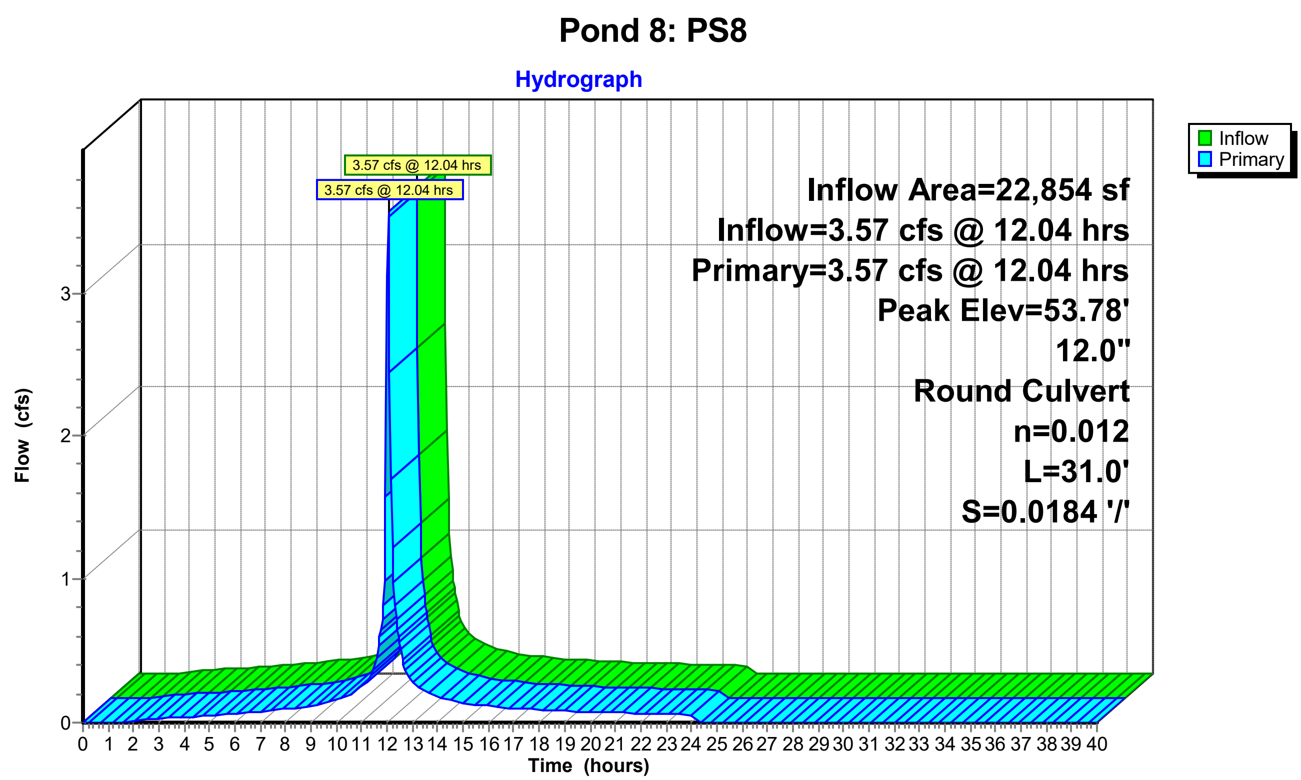
Inflow Area =	22,854 sf,	75.34% Impervious,	Inflow Depth = 6.40"	for 50-yr event	
Inflow =	3.57 cfs @	12.04 hrs,	Volume=	12,181 cf	
Outflow =	3.57 cfs @	12.04 hrs,	Volume=	12,181 cf,	Atten= 0%, Lag= 0.0 min
Primary =	3.57 cfs @	12.04 hrs,	Volume=	12,181 cf	

Routed to Pond 9 : DMH9

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.78' @ 12.04 hrs
Flood Elev= 54.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.39'	**12.0" Round Culvert** L= 31.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.39' / 51.82' S= 0.0184 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.44 cfs @ 12.04 hrs HW=53.72' (Free Discharge)
↑**1=Culvert** (Inlet Controls 3.44 cfs @ 4.38 fps)



Summary for Pond 9: DMH9

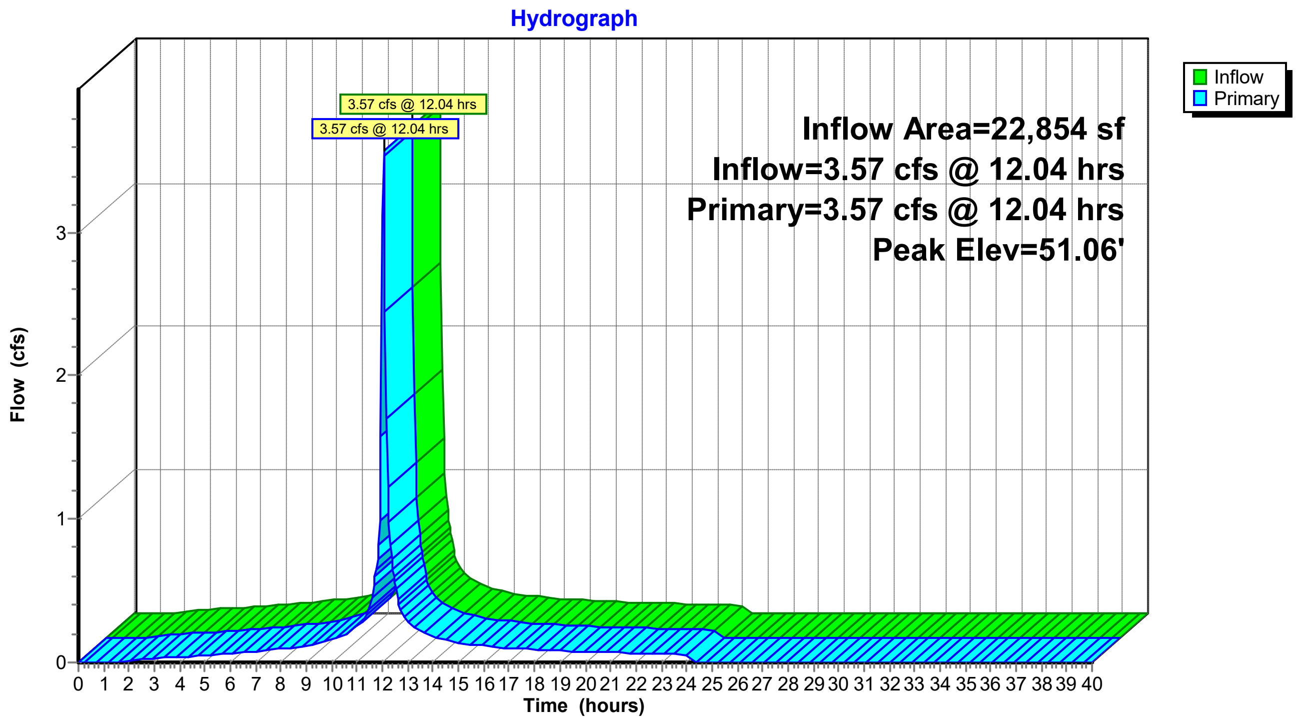
Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 6.40" for 50-yr event
Inflow = 3.57 cfs @ 12.04 hrs, Volume= 12,181 cf
Outflow = 3.57 cfs @ 12.04 hrs, Volume= 12,181 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.57 cfs @ 12.04 hrs, Volume= 12,181 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 51.06' @ 12.04 hrs
Flood Elev= 55.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.12'	**12.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.12' / 50.10' S= 0.0020 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.32'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.32' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.44 cfs @ 12.04 hrs HW=51.04' (Free Discharge)
1=Culvert (Barrel Controls 1.78 cfs @ 3.07 fps)
2=Culvert (Barrel Controls 1.66 cfs @ 3.81 fps)

Pond 9: DMH9



Summary for Pond 10: EXIST MH10

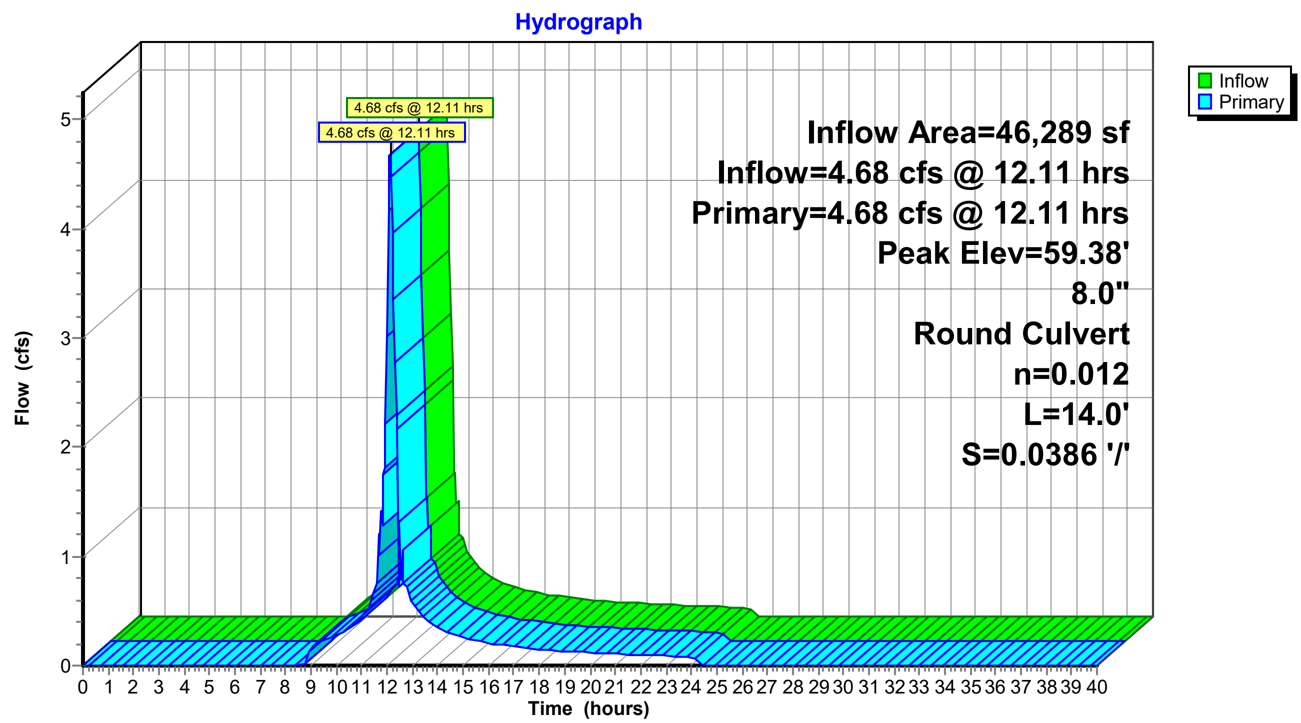
Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 5.12" for 50-yr event
Inflow = 4.68 cfs @ 12.11 hrs, Volume= 19,738 cf
Outflow = 4.68 cfs @ 12.11 hrs, Volume= 19,738 cf, Atten= 0%, Lag= 0.0 min
Primary = 4.68 cfs @ 12.11 hrs, Volume= 19,738 cf
Routed to Link 1L : Essex Street

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 59.38' @ 12.11 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=4.62 cfs @ 12.11 hrs HW=59.19' (Free Discharge)
↑**1=Culvert** (Inlet Controls 4.62 cfs @ 13.25 fps)

Pond 10: EXIST MH10

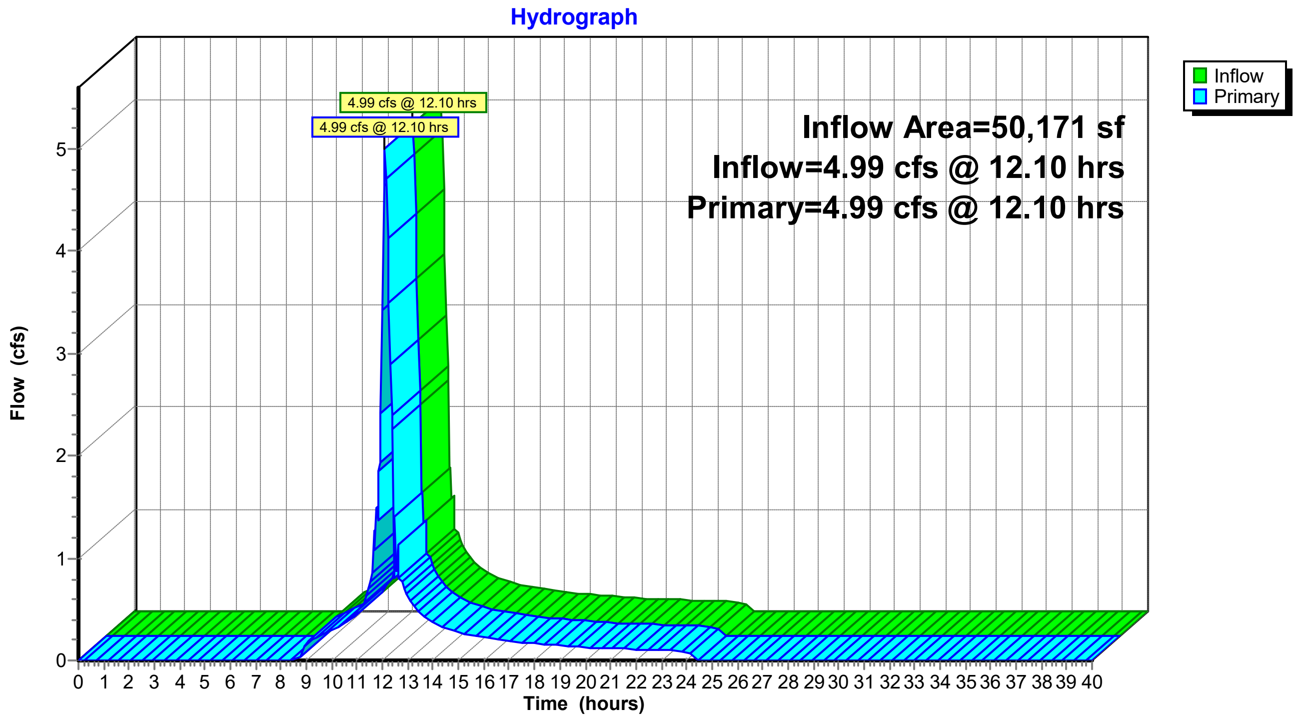


Summary for Link 1L: Essex Street

Inflow Area =	50,171 sf, 66.03% Impervious,	Inflow Depth = 5.07"	for 50-yr event	
Inflow =	4.99 cfs @ 12.10 hrs,	Volume=	21,212 cf	
Primary =	4.99 cfs @ 12.10 hrs,	Volume=	21,212 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 1L: Essex Street



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,562 sf 55.71% Impervious Runoff Depth=7.20"
Flow Length=69' Slope=0.0320 '/' Tc=6.0 min CN=92 Runoff=1.50 cfs 5,139 cf

Subcatchment 2S: Runoff Area=14,873 sf 63.59% Impervious Runoff Depth=7.32"
Flow Length=141' Tc=6.0 min CN=93 Runoff=2.63 cfs 9,074 cf

Subcatchment 3S: Runoff Area=8,456 sf 68.87% Impervious Runoff Depth=7.32"
Flow Length=129' Tc=6.0 min CN=93 Runoff=1.49 cfs 5,159 cf

Subcatchment 4S: Runoff Area=11,171 sf 77.26% Impervious Runoff Depth=7.32"
Flow Length=142' Tc=6.0 min CN=93 Runoff=1.97 cfs 6,816 cf

Subcatchment 5S: Runoff Area=3,227 sf 85.65% Impervious Runoff Depth=7.44"
Flow Length=91' Slope=0.0290 '/' Tc=6.0 min CN=94 Runoff=0.57 cfs 2,001 cf

Subcatchment 6S: Runoff Area=3,882 sf 43.30% Impervious Runoff Depth=5.42"
Tc=6.0 min CN=77 Runoff=0.55 cfs 1,754 cf

Pond 1: CB1 Peak Elev=55.02' Inflow=1.50 cfs 5,139 cf
8.0" Round Culvert n=0.012 L=94.0' S=0.0052 '/' Outflow=1.50 cfs 5,139 cf

Pond 1P: Existing Leaching Pipe/Stone Peak Elev=55.29' Storage=3,834 cf Inflow=8.17 cfs 28,189 cf
Discarded=0.21 cfs 4,770 cf Primary=5.20 cfs 23,302 cf Outflow=5.41 cfs 28,072 cf

Pond 2: CB2 Peak Elev=54.80' Inflow=2.63 cfs 9,074 cf
Primary=1.94 cfs 8,884 cf Secondary=0.69 cfs 190 cf Outflow=2.63 cfs 9,074 cf

Pond 3: CB3 Peak Elev=54.81' Inflow=1.49 cfs 5,159 cf
Primary=1.45 cfs 5,150 cf Secondary=0.05 cfs 9 cf Outflow=1.49 cfs 5,159 cf

Pond 4: CB4 Peak Elev=54.51' Inflow=1.97 cfs 6,816 cf
8.0" Round Culvert n=0.012 L=8.0' S=0.0150 '/' Outflow=1.97 cfs 6,816 cf

Pond 5: CB5 Peak Elev=53.69' Inflow=0.57 cfs 2,001 cf
8.0" Round Culvert n=0.012 L=72.0' S=0.0072 '/' Outflow=0.57 cfs 2,001 cf

Pond 6: PS6 Peak Elev=53.81' Inflow=3.44 cfs 14,023 cf
12.0" Round Culvert n=0.012 L=28.0' S=-0.0043 '/' Outflow=3.44 cfs 14,023 cf

Pond 7: DMH7 Peak Elev=50.96' Inflow=3.44 cfs 14,023 cf
Outflow=3.44 cfs 14,023 cf

Pond 8: PS8 Peak Elev=54.00' Inflow=3.99 cfs 13,966 cf
12.0" Round Culvert n=0.012 L=31.0' S=0.0184 '/' Outflow=3.99 cfs 13,966 cf

Pond 9: DMH9 Peak Elev=51.13' Inflow=3.99 cfs 13,966 cf
Outflow=3.99 cfs 13,966 cf

Pond 10: EXIST MH10 Peak Elev=61.17' Inflow=5.20 cfs 23,302 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=5.20 cfs 23,302 cf

Link 1L: Essex Street Inflow=5.56 cfs 25,056 cf
Primary=5.56 cfs 25,056 cf

Total Runoff Area = 50,171 sf Runoff Volume = 29,942 cf Average Runoff Depth = 7.16"
33.97% Pervious = 17,044 sf 66.03% Impervious = 33,127 sf

Summary for Subcatchment 1S:

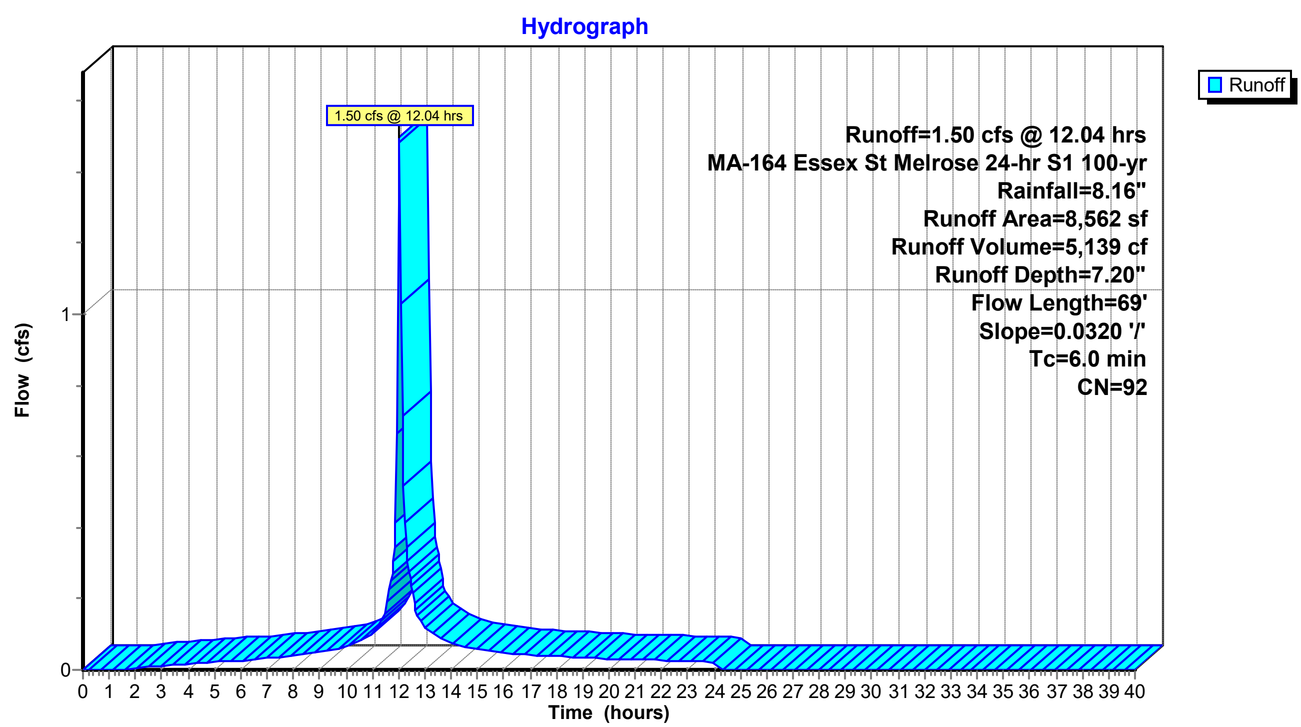
Runoff = 1.50 cfs @ 12.04 hrs, Volume= 5,139 cf, Depth= 7.20"
Routed to Pond 1 : CB1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
1,762	69	50-75% Grass cover, Fair, HSG B
4,770	98	Paved parking, HSG B
2,030	96	Gravel surface, HSG B
8,562	92	Weighted Average
3,792		44.29% Pervious Area
4,770		55.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	69	0.0320	1.56		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.7	69	Total,	Increased to minimum Tc = 6.0 min		

Subcatchment 1S:



Summary for Subcatchment 2S:

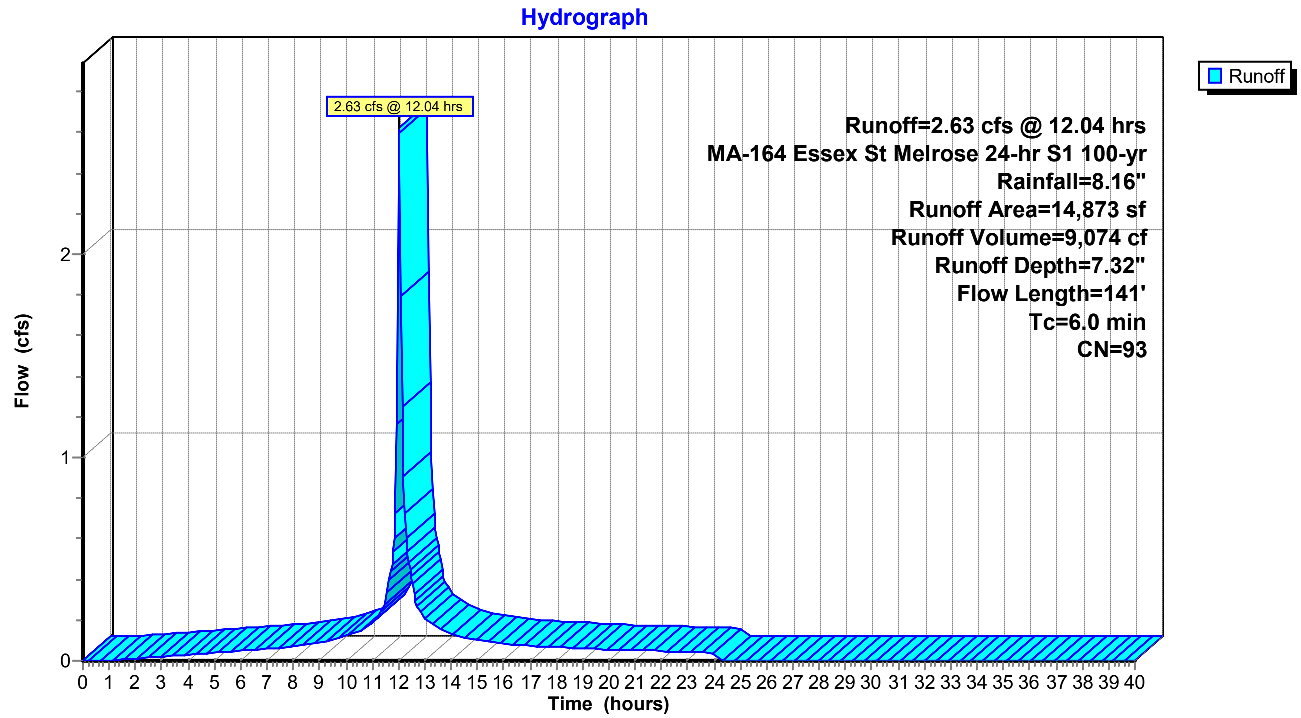
Runoff = 2.63 cfs @ 12.04 hrs, Volume= 9,074 cf, Depth= 7.32"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
2,420	69	50-75% Grass cover, Fair, HSG B
9,457	98	Paved parking, HSG B
2,996	96	Gravel surface, HSG B
14,873	93	Weighted Average
5,416		36.41% Pervious Area
9,457		63.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0195	1.38		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	41	0.0120	2.22		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	141	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S:



Summary for Subcatchment 3S:

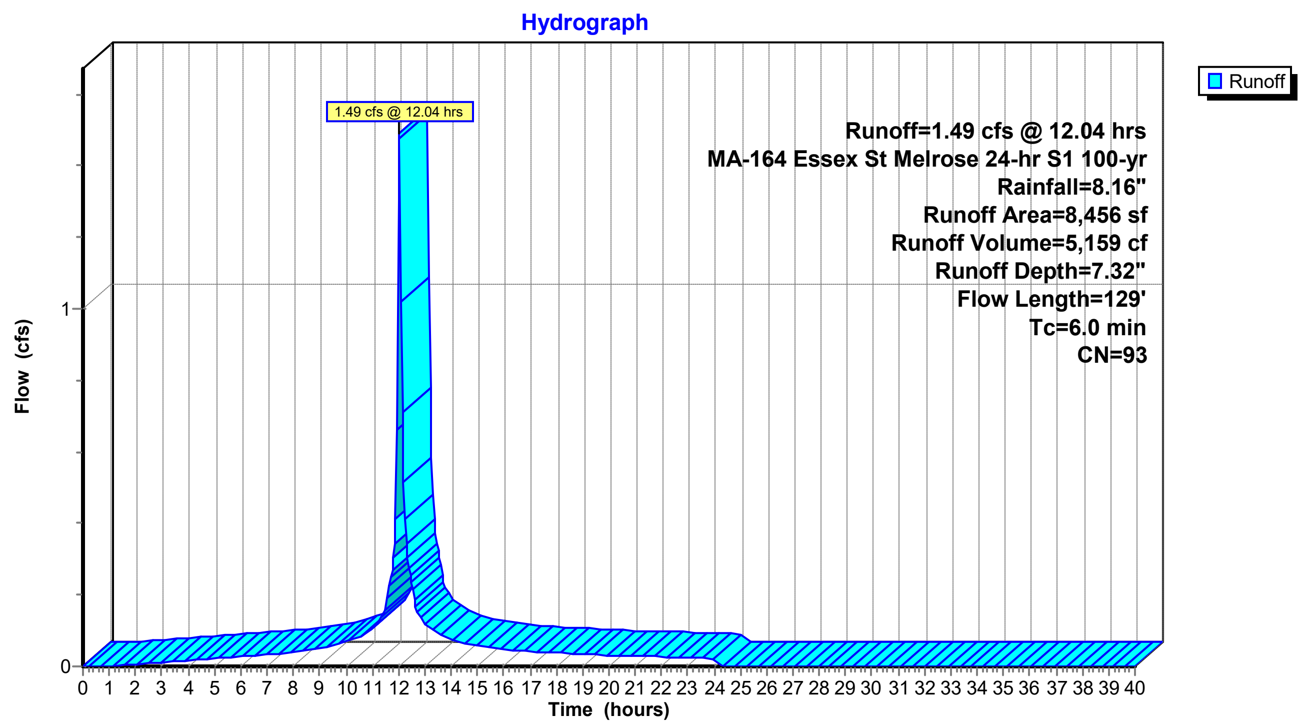
Runoff = 1.49 cfs @ 12.04 hrs, Volume= 5,159 cf, Depth= 7.32"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
1,406	69	50-75% Grass cover, Fair, HSG B
5,824	98	Paved parking, HSG B
1,226	96	Gravel surface, HSG B
8,456	93	Weighted Average
2,632		31.13% Pervious Area
5,824		68.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.2	29	0.0250	3.21		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.4	129	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S:



Summary for Subcatchment 4S:

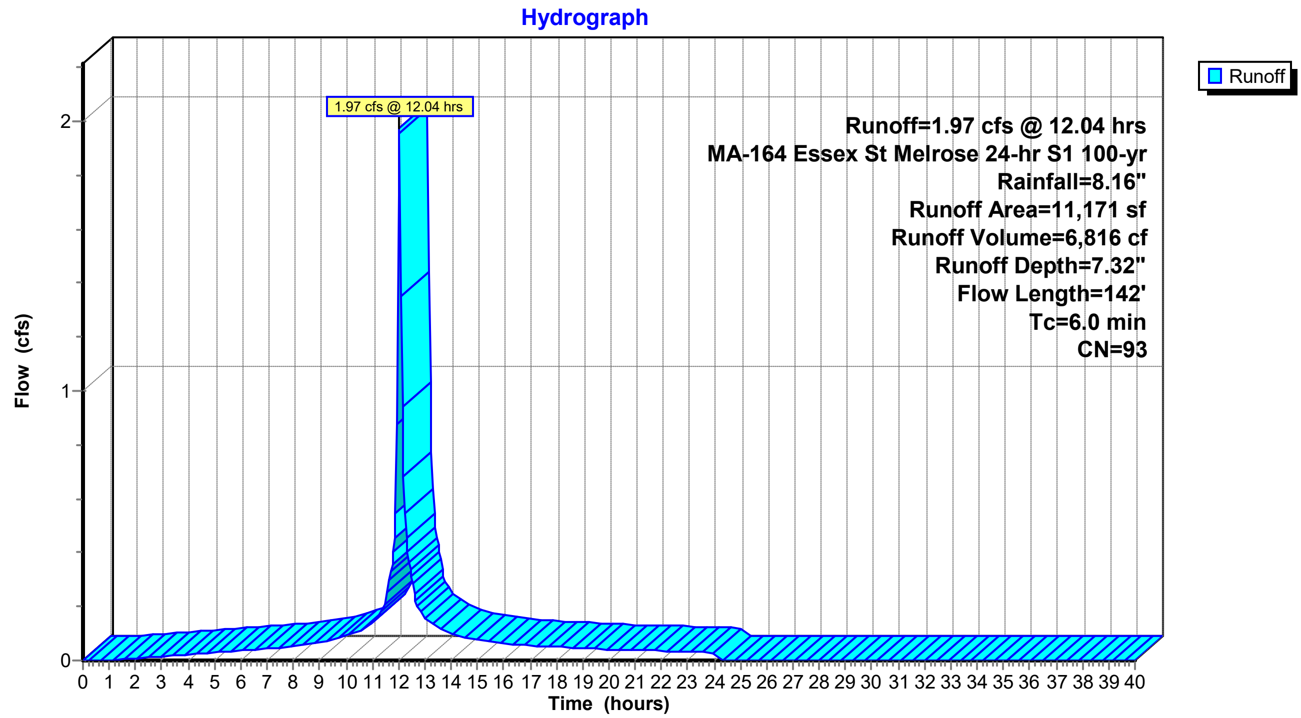
Runoff = 1.97 cfs @ 12.04 hrs, Volume= 6,816 cf, Depth= 7.32"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
1,868	69	50-75% Grass cover, Fair, HSG B
8,631	98	Paved parking, HSG B
672	96	Gravel surface, HSG B
11,171	93	Weighted Average
2,540		22.74% Pervious Area
8,631		77.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0190	1.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
0.3	42	0.0164	2.60		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	142	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S:



Summary for Subcatchment 5S:

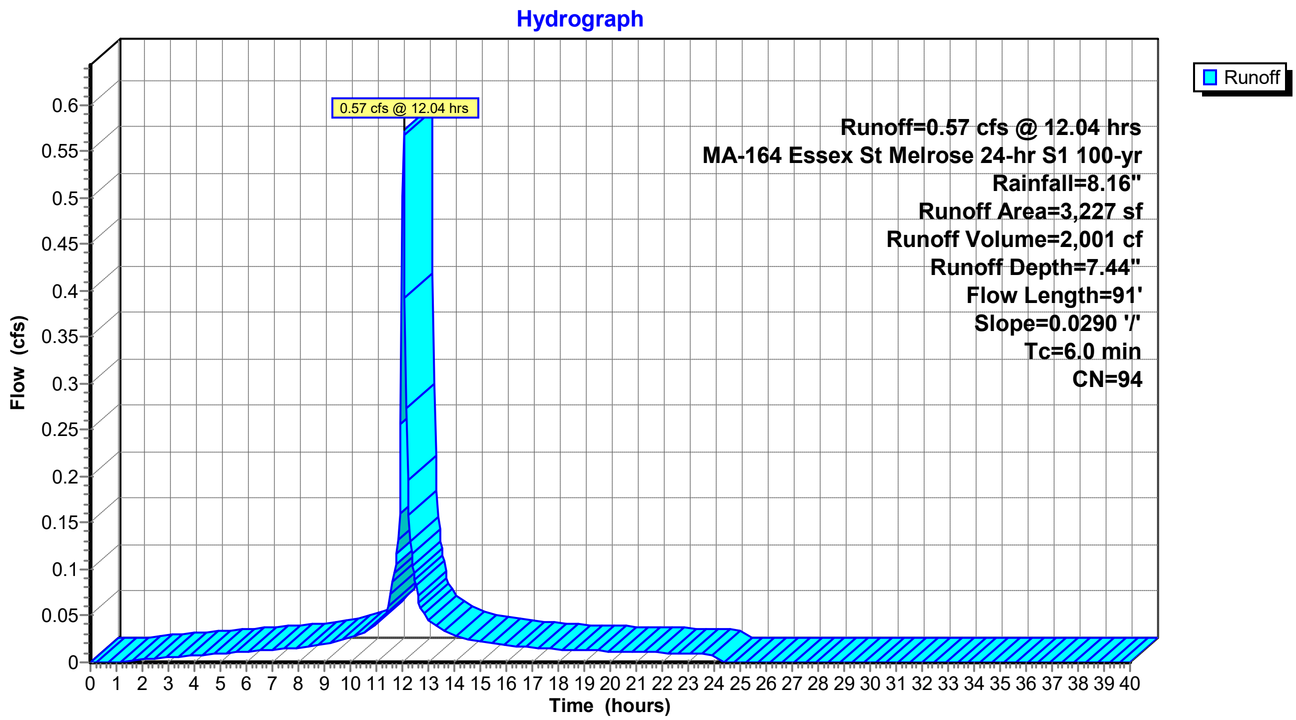
Runoff = 0.57 cfs @ 12.04 hrs, Volume= 2,001 cf, Depth= 7.44"
Routed to Pond 5 : CB5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
463	69	50-75% Grass cover, Fair, HSG B
2,764	98	Paved parking, HSG B
3,227	94	Weighted Average
463		14.35% Pervious Area
2,764		85.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	91	0.0290	1.59		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
1.0	91	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5S:



Summary for Subcatchment 6S:

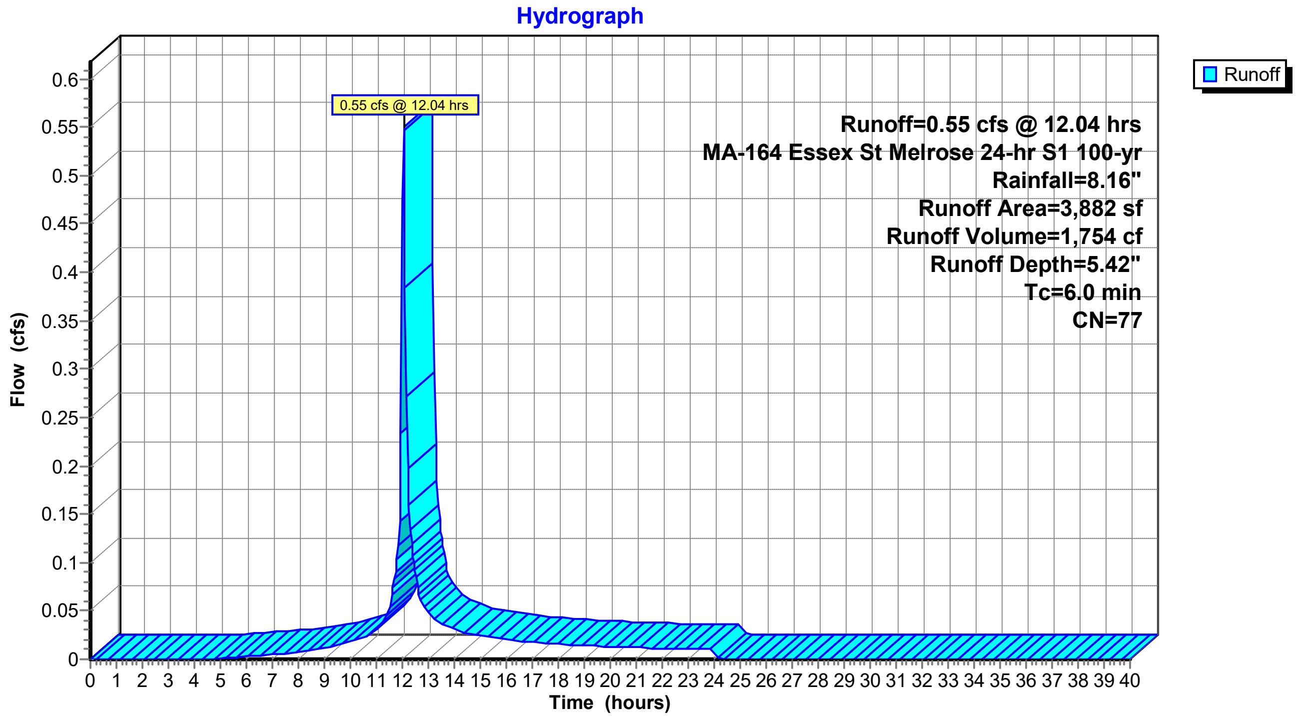
Runoff = 0.55 cfs @ 12.04 hrs, Volume= 1,754 cf, Depth= 5.42"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
2,201	61	>75% Grass cover, Good, HSG B
1,681	98	Paved parking, HSG B
3,882	77	Weighted Average
2,201		56.70% Pervious Area
1,681		43.30% Impervious Area

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

Subcatchment 6S:



Summary for Pond 1: CB1

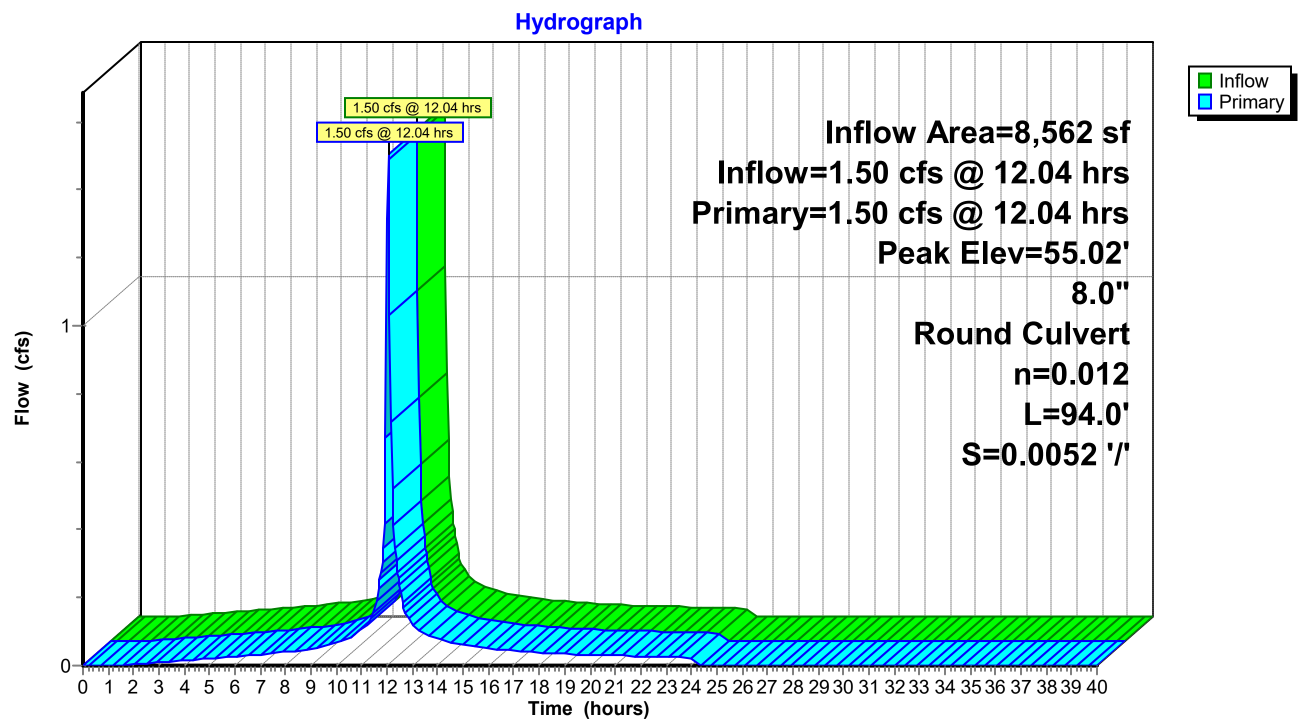
Inflow Area = 8,562 sf, 55.71% Impervious, Inflow Depth = 7.20" for 100-yr event
Inflow = 1.50 cfs @ 12.04 hrs, Volume= 5,139 cf
Outflow = 1.50 cfs @ 12.04 hrs, Volume= 5,139 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.50 cfs @ 12.04 hrs, Volume= 5,139 cf
Routed to Pond 6 : PS6

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 55.02' @ 12.04 hrs
Flood Elev= 55.08'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.18'	**8.0" Round Culvert** L= 94.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.18' / 52.69' S= 0.0052 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.45 cfs @ 12.04 hrs HW=54.91' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.45 cfs @ 4.15 fps)

Pond 1: CB1



Summary for Pond 1P: Existing Leaching Pipe/Stone System

Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 7.31" for 100-yr event
Inflow = 8.17 cfs @ 12.04 hrs, Volume= 28,189 cf
Outflow = 5.41 cfs @ 12.11 hrs, Volume= 28,072 cf, Atten= 34%, Lag= 4.5 min
Discarded = 0.21 cfs @ 12.11 hrs, Volume= 4,770 cf
Primary = 5.20 cfs @ 12.11 hrs, Volume= 23,302 cf
Routed to Pond 10 : EXIST MH10

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 55.29' @ 12.11 hrs Surf.Area= 9,064 sf Storage= 3,834 cf

Plug-Flow detention time= 115.7 min calculated for 28,072 cf (100% of inflow)
Center-of-Mass det. time= 112.9 min (884.1 - 771.2)

Volume	Invert	Avail.Storage	Storage Description
#1	48.90'	1,912 cf	**12.00'W x 120.00'L x 3.67'H Prismatoid** 5,285 cf Overall - 506 cf Embedded = 4,779 cf x 40.0% Voids
#2	50.10'	377 cf	**24.0" Round Pipe Storage** Inside #1 L= 120.0' 506 cf Overall - 1.9" Wall Thickness = 377 cf
#3	52.57'	3,586 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		5,875 cf	Total Available Storage

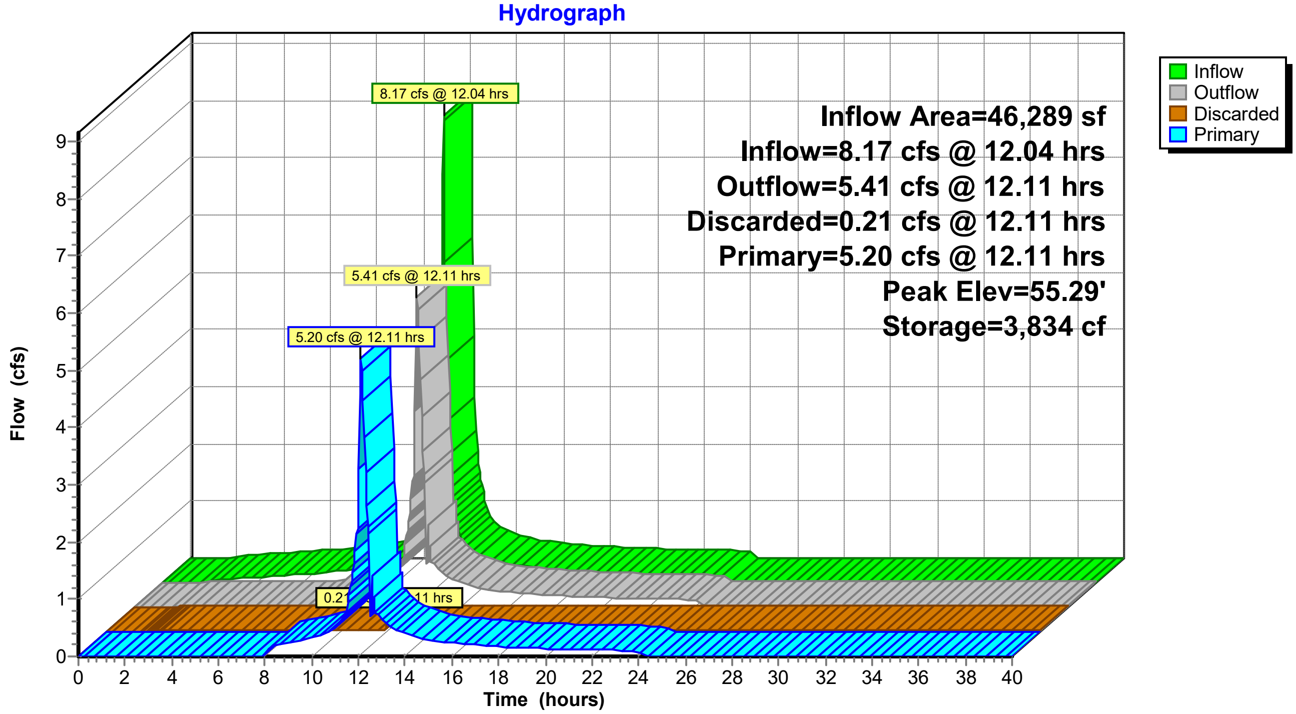
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.57	0	0	0
54.74	1	1	1
55.00	1,569	204	205
55.50	11,954	3,381	3,586

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.90'	**1.000 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	52.01'	**8.0" Round Culvert** L= 71.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.01' / 51.29' S= 0.0101 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#3	Primary	54.92'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 13.00 13.00 17.76 17.76 20.29 24.29 40.35 Elev. (feet) 55.46 55.42 55.02 54.92 55.32 55.31 55.35 55.46

Discarded OutFlow Max=0.21 cfs @ 12.11 hrs HW=55.29' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=5.11 cfs @ 12.11 hrs HW=55.29' (Free Discharge)
├─**2=Culvert** (Barrel Controls 2.34 cfs @ 6.71 fps)
└─**3=Asymmetrical Weir** (Weir Controls 2.77 cfs @ 1.59 fps)

Pond 1P: Existing Leaching Pipe/Stone System



Summary for Pond 2: CB2

Inflow Area = 14,873 sf, 63.59% Impervious, Inflow Depth = 7.32" for 100-yr event
Inflow = 2.63 cfs @ 12.04 hrs, Volume= 9,074 cf
Outflow = 2.63 cfs @ 12.04 hrs, Volume= 9,074 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.94 cfs @ 12.03 hrs, Volume= 8,884 cf
Routed to Pond 6 : PS6
Secondary = 0.69 cfs @ 12.04 hrs, Volume= 190 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

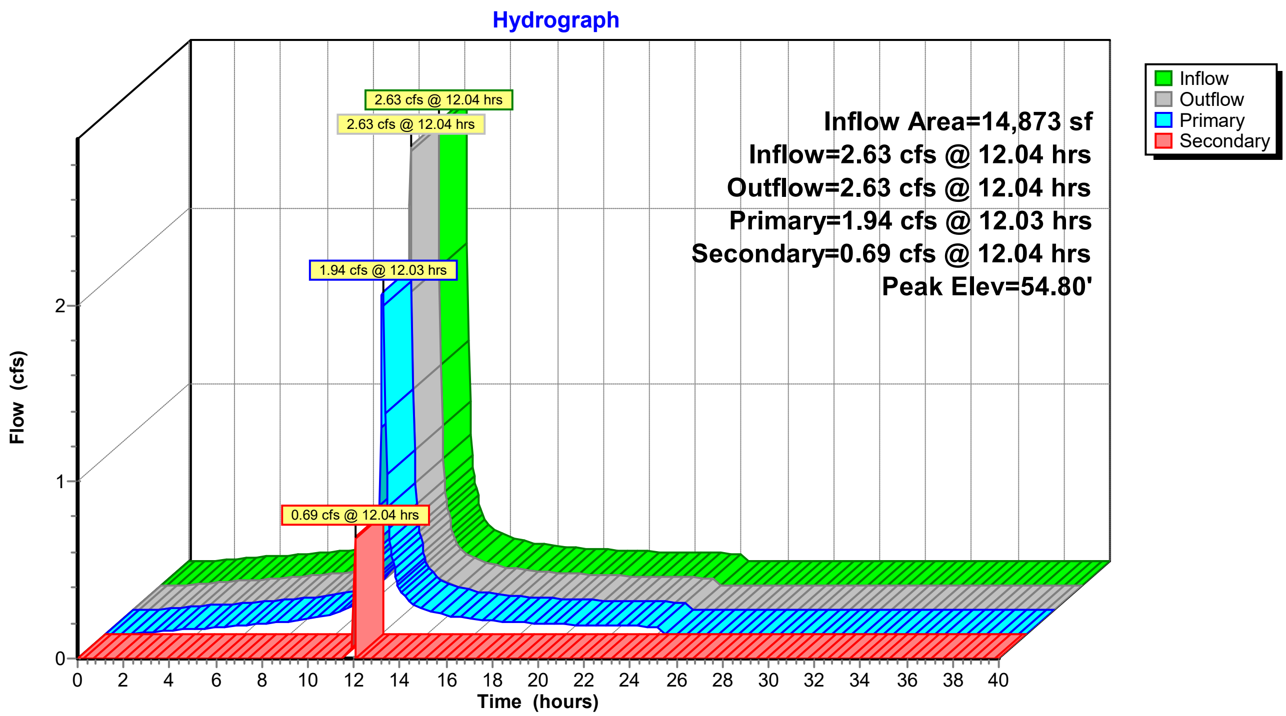
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.80' @ 12.03 hrs
Flood Elev= 54.74'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.84'	**8.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.84' / 52.69' S= 0.0045 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.74'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.92 cfs @ 12.03 hrs HW=54.78' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.92 cfs @ 5.50 fps)

Secondary OutFlow Max=0.60 cfs @ 12.04 hrs HW=54.78' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.60 cfs @ 0.65 fps)

Pond 2: CB2



Summary for Pond 3: CB3

Inflow Area = 8,456 sf, 68.87% Impervious, Inflow Depth = 7.32" for 100-yr event
Inflow = 1.49 cfs @ 12.04 hrs, Volume= 5,159 cf
Outflow = 1.49 cfs @ 12.04 hrs, Volume= 5,159 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.45 cfs @ 12.04 hrs, Volume= 5,150 cf
Routed to Pond 8 : PS8
Secondary = 0.05 cfs @ 12.05 hrs, Volume= 9 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

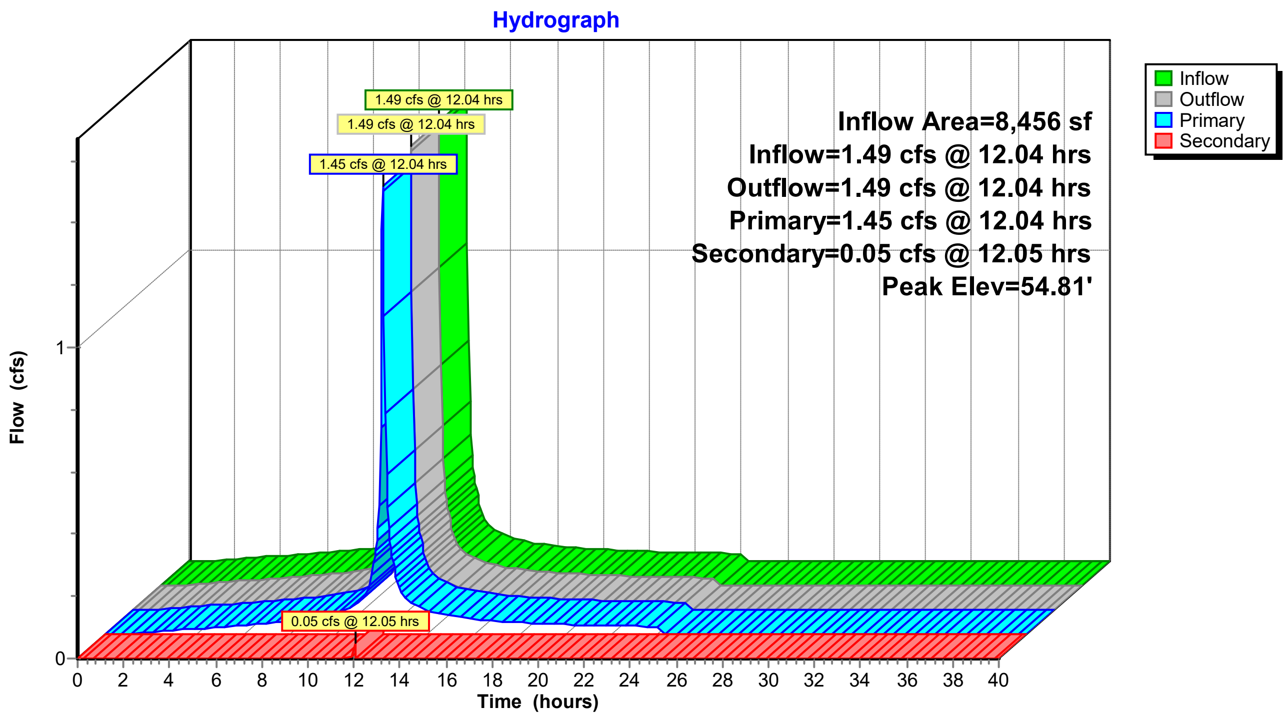
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.81' @ 12.04 hrs
Flood Elev= 54.78'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.69'	**8.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.68' / 52.69' S= -0.0001 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Secondary	54.78'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.40 cfs @ 12.04 hrs HW=54.72' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.40 cfs @ 4.00 fps)

Secondary OutFlow Max=0.02 cfs @ 12.05 hrs HW=54.78' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.02 cfs @ 0.22 fps)

Pond 3: CB3



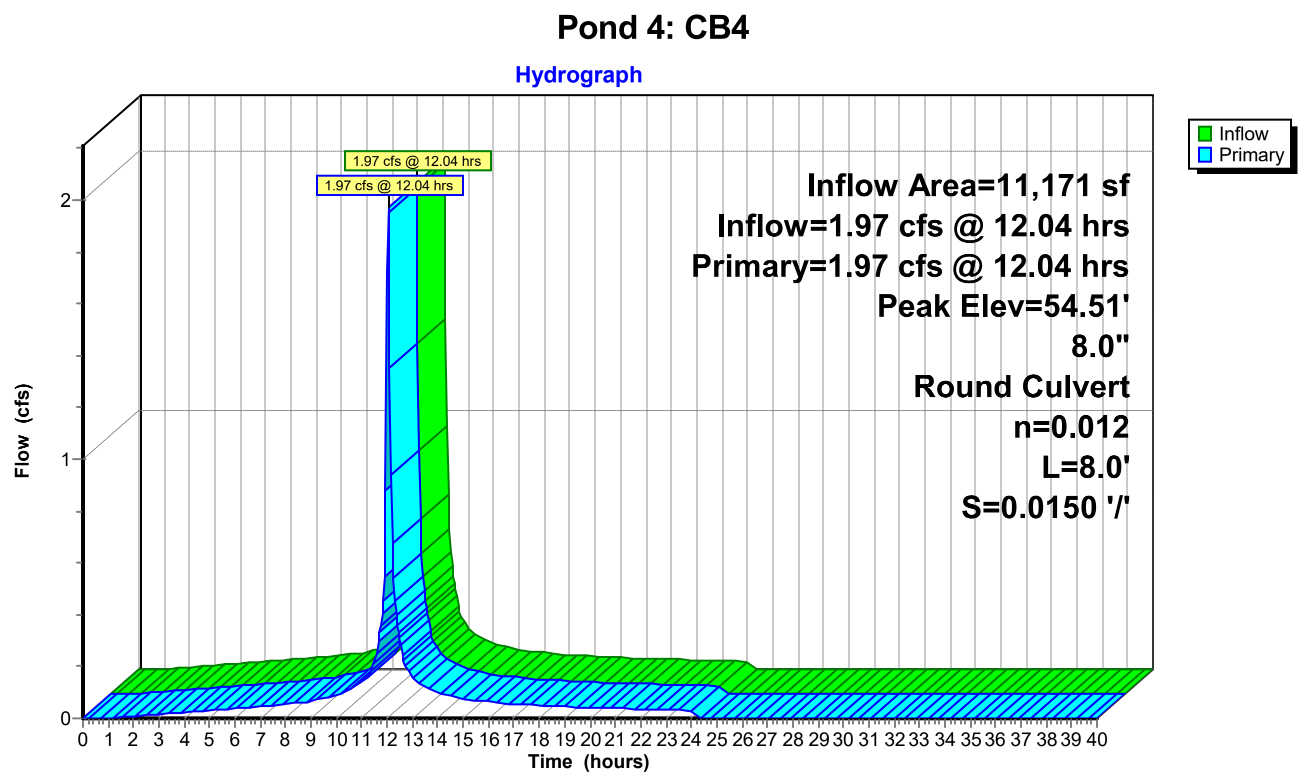
Summary for Pond 4: CB4

Inflow Area = 11,171 sf, 77.26% Impervious, Inflow Depth = 7.32" for 100-yr event
Inflow = 1.97 cfs @ 12.04 hrs, Volume= 6,816 cf
Outflow = 1.97 cfs @ 12.04 hrs, Volume= 6,816 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.97 cfs @ 12.04 hrs, Volume= 6,816 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.51' @ 12.04 hrs
Flood Elev= 54.81'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.81'	**8.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.81' / 52.69' S= 0.0150 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.90 cfs @ 12.04 hrs HW=54.43' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.90 cfs @ 5.46 fps)



Summary for Pond 5: CB5

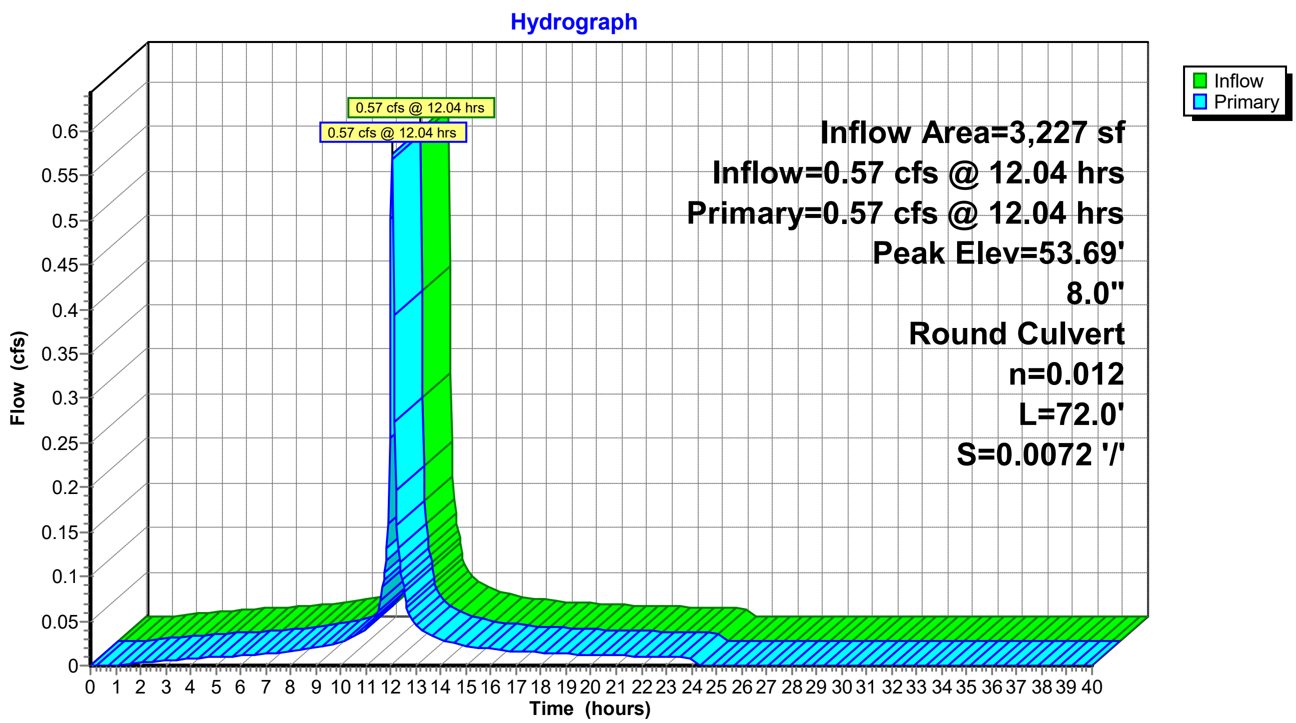
Inflow Area = 3,227 sf, 85.65% Impervious, Inflow Depth = 7.44" for 100-yr event
Inflow = 0.57 cfs @ 12.04 hrs, Volume= 2,001 cf
Outflow = 0.57 cfs @ 12.04 hrs, Volume= 2,001 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.57 cfs @ 12.04 hrs, Volume= 2,001 cf
Routed to Pond 8 : PS8

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.69' @ 12.04 hrs
Flood Elev= 55.11'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.21'	**8.0" Round Culvert** L= 72.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.21' / 52.69' S= 0.0072 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.55 cfs @ 12.04 hrs HW=53.68' (Free Discharge)
↑**1=Culvert** (Barrel Controls 0.55 cfs @ 2.97 fps)

Pond 5: CB5



Summary for Pond 6: PS6

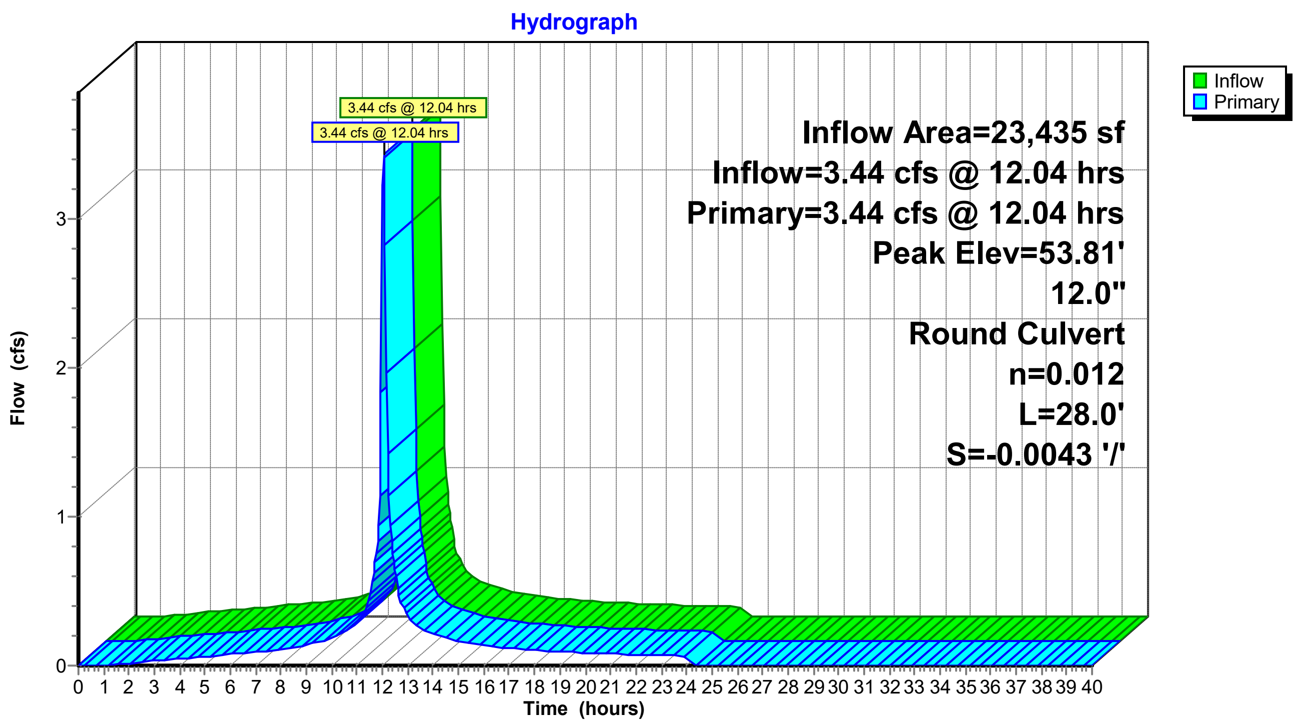
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 7.18" for 100-yr event
Inflow = 3.44 cfs @ 12.04 hrs, Volume= 14,023 cf
Outflow = 3.44 cfs @ 12.04 hrs, Volume= 14,023 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.44 cfs @ 12.04 hrs, Volume= 14,023 cf
Routed to Pond 7 : DMH7

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 53.81' @ 12.04 hrs
Flood Elev= 55.04'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.26'	**12.0" Round Culvert** L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.14' / 52.26' S= -0.0043 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.36 cfs @ 12.04 hrs HW=53.78' (Free Discharge)
↑**1=Culvert** (Barrel Controls 3.36 cfs @ 4.28 fps)

Pond 6: PS6



Summary for Pond 7: DMH7

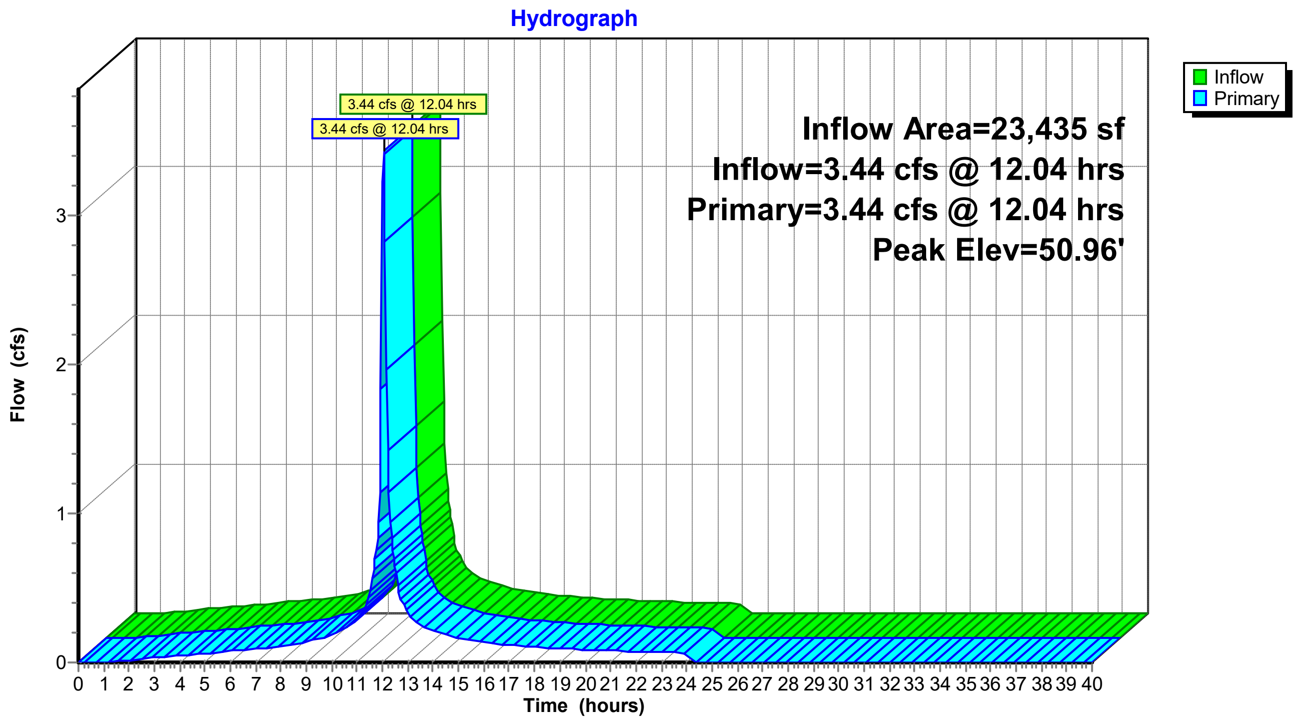
Inflow Area = 23,435 sf, 60.71% Impervious, Inflow Depth = 7.18" for 100-yr event
Inflow = 3.44 cfs @ 12.04 hrs, Volume= 14,023 cf
Outflow = 3.44 cfs @ 12.04 hrs, Volume= 14,023 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.44 cfs @ 12.04 hrs, Volume= 14,023 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 50.96' @ 12.04 hrs
Flood Elev= 55.36'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.10'	**12.0" Round Culvert** L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.96' / 50.10' S= -0.0156 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.26'	**12.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.26' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.36 cfs @ 12.04 hrs HW=50.95' (Free Discharge)
1=Culvert (Barrel Controls 1.92 cfs @ 3.07 fps)
2=Culvert (Barrel Controls 1.45 cfs @ 3.54 fps)

Pond 7: DMH7



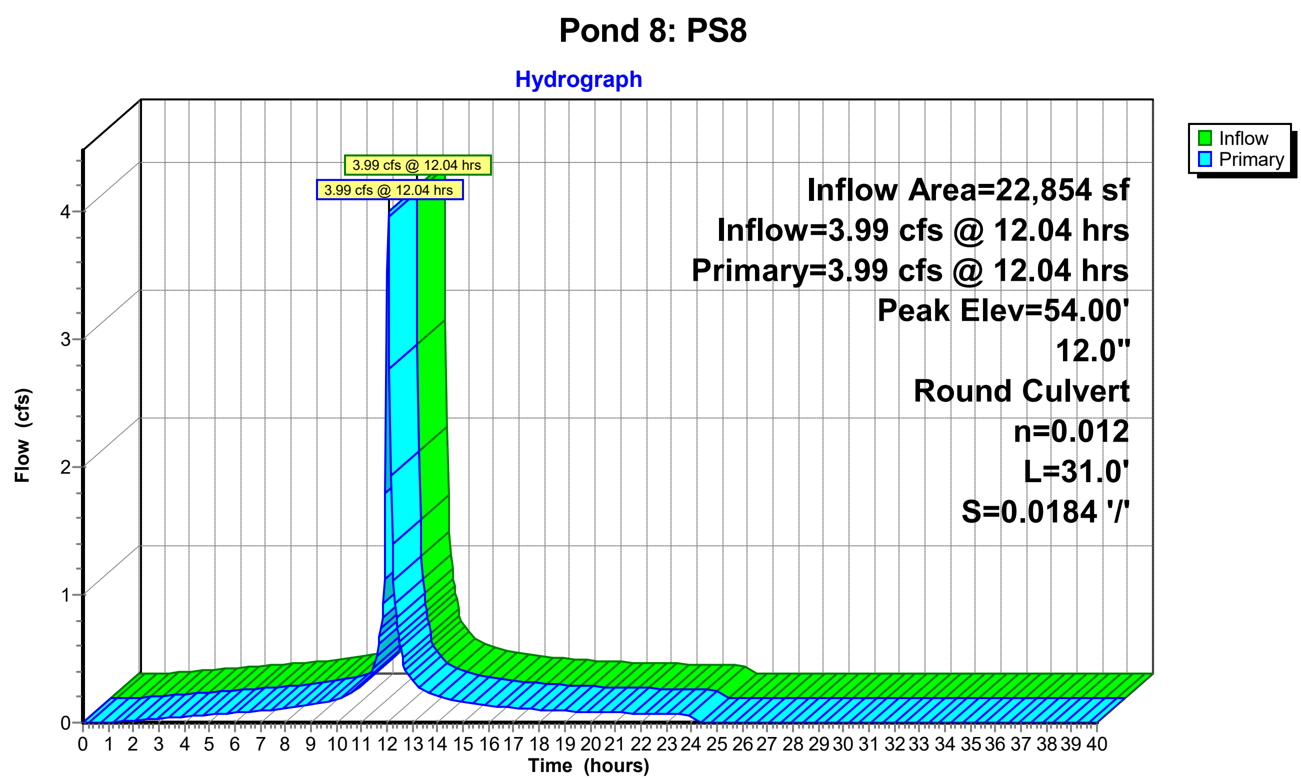
Summary for Pond 8: PS8

Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 7.33" for 100-yr event
Inflow = 3.99 cfs @ 12.04 hrs, Volume= 13,966 cf
Outflow = 3.99 cfs @ 12.04 hrs, Volume= 13,966 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.99 cfs @ 12.04 hrs, Volume= 13,966 cf
Routed to Pond 9 : DMH9

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 54.00' @ 12.04 hrs
Flood Elev= 54.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.39'	**12.0" Round Culvert** L= 31.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.39' / 51.82' S= 0.0184 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.85 cfs @ 12.04 hrs HW=53.93' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.85 cfs @ 4.91 fps)



Summary for Pond 9: DMH9

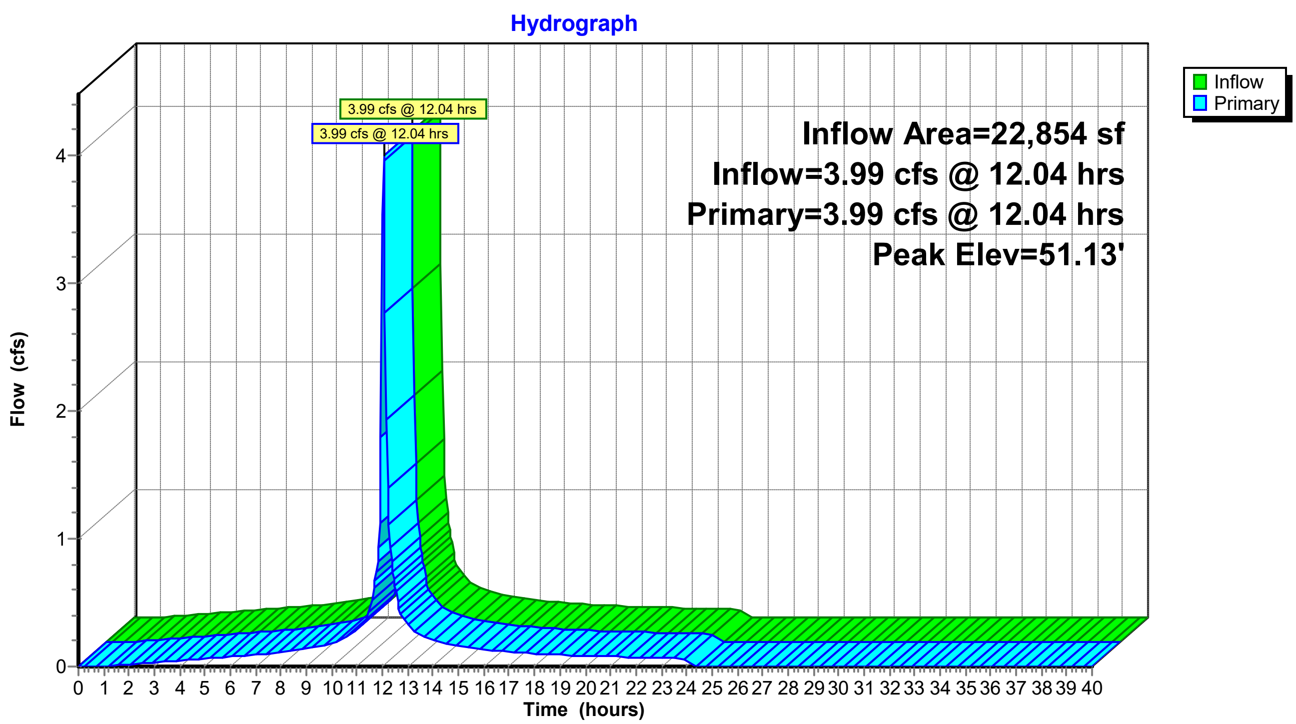
Inflow Area = 22,854 sf, 75.34% Impervious, Inflow Depth = 7.33" for 100-yr event
Inflow = 3.99 cfs @ 12.04 hrs, Volume= 13,966 cf
Outflow = 3.99 cfs @ 12.04 hrs, Volume= 13,966 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.99 cfs @ 12.04 hrs, Volume= 13,966 cf
Routed to Pond 1P : Existing Leaching Pipe/Stone System

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 51.13' @ 12.04 hrs
Flood Elev= 55.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.12'	**12.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.12' / 50.10' S= 0.0020 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Primary	50.32'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.32' / 50.10' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.85 cfs @ 12.04 hrs HW=51.11' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.97 cfs @ 3.17 fps)
└—**2=Culvert** (Barrel Controls 1.88 cfs @ 3.90 fps)

Pond 9: DMH9



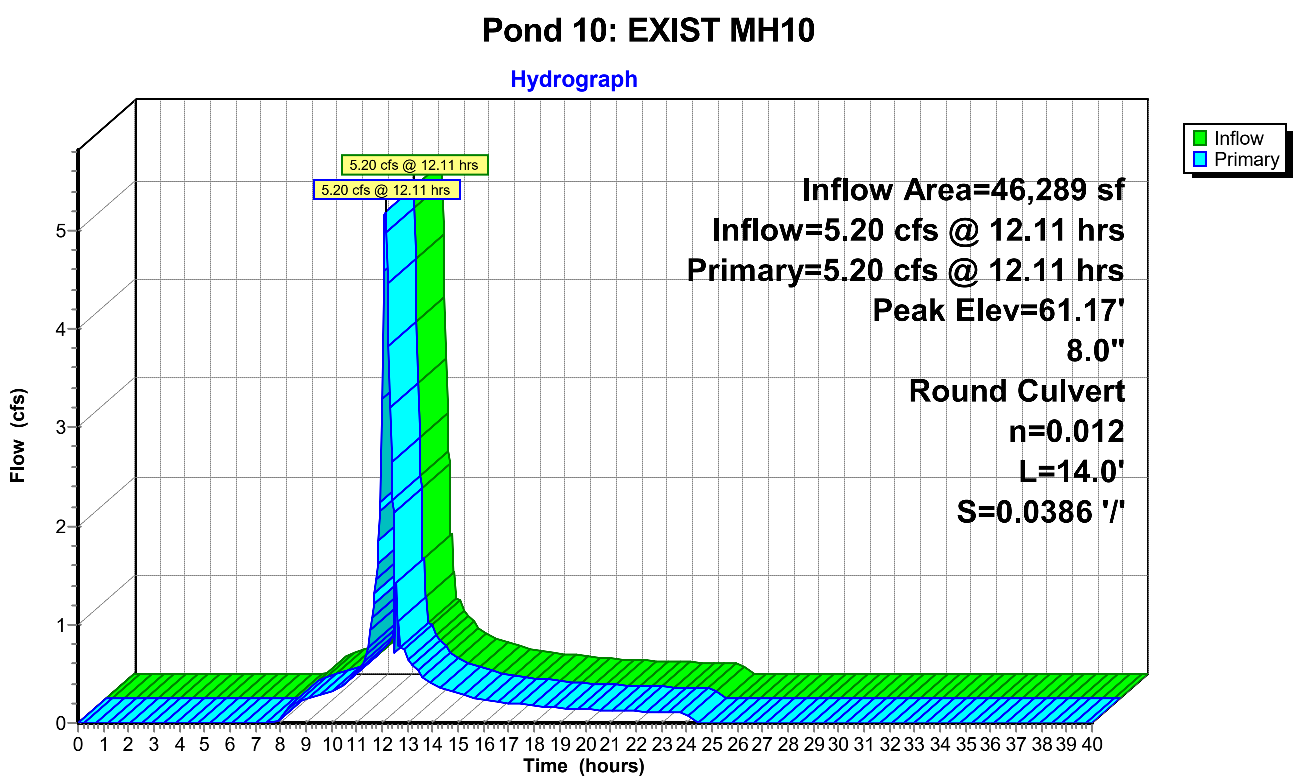
Summary for Pond 10: EXIST MH10

Inflow Area = 46,289 sf, 67.93% Impervious, Inflow Depth = 6.04" for 100-yr event
Inflow = 5.20 cfs @ 12.11 hrs, Volume= 23,302 cf
Outflow = 5.20 cfs @ 12.11 hrs, Volume= 23,302 cf, Atten= 0%, Lag= 0.0 min
Primary = 5.20 cfs @ 12.11 hrs, Volume= 23,302 cf
Routed to Link 1L : Essex Street

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Peak Elev= 61.17' @ 12.11 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

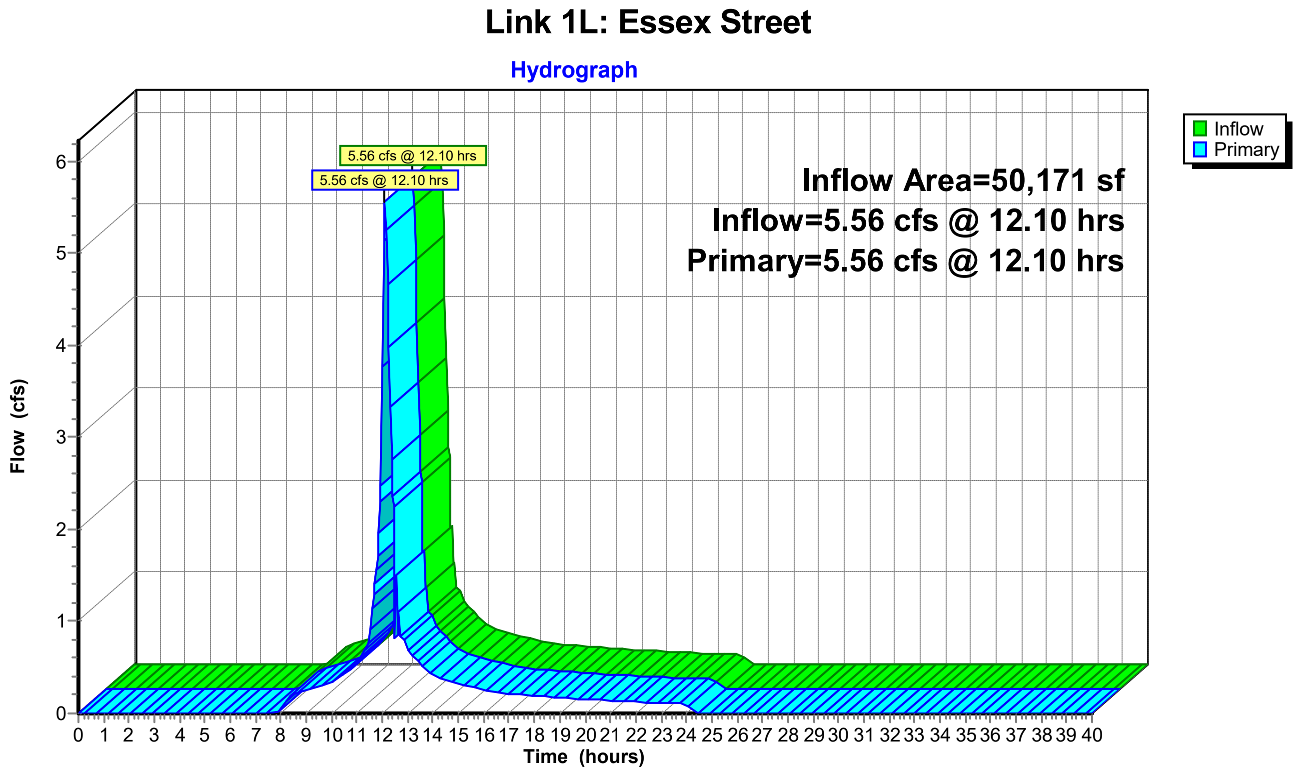
Primary OutFlow Max=5.12 cfs @ 12.11 hrs HW=60.92' (Free Discharge)
└─**1=Culvert** (Inlet Controls 5.12 cfs @ 14.68 fps)



Summary for Link 1L: Essex Street

Inflow Area =	50,171 sf,	66.03% Impervious,	Inflow Depth = 5.99"	for 100-yr event	
Inflow =	5.56 cfs @	12.10 hrs,	Volume=	25,056 cf	
Primary =	5.56 cfs @	12.10 hrs,	Volume=	25,056 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs



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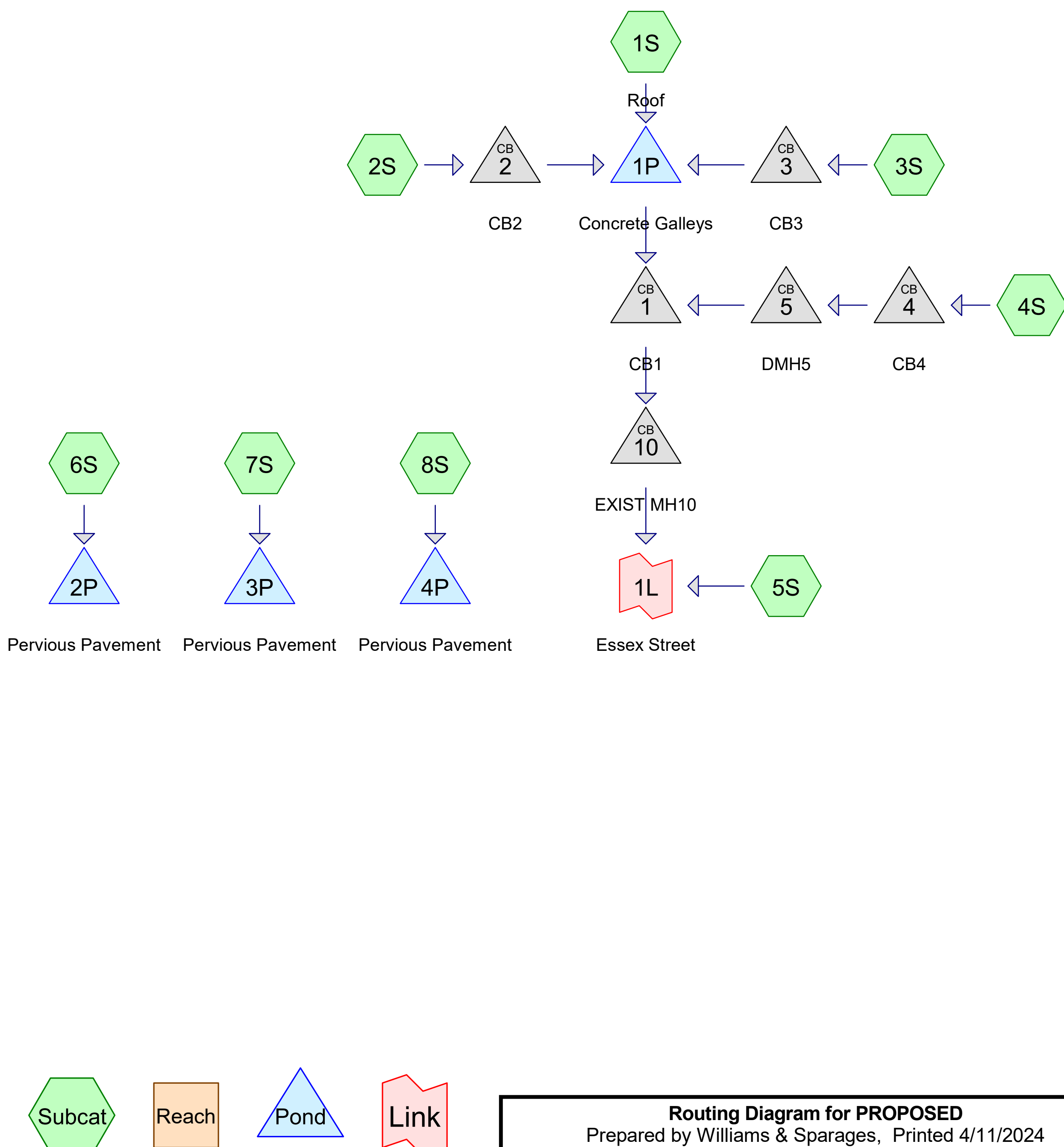
1.9.2 Proposed Condition



Routing Diagram for PROPOSED
Prepared by Williams & Sparages, Printed 4/11/2024
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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	MA-164 Essex St Melrose 24-hr S1	2-yr	Default	24.00	1	3.29	2
2	10-yr	MA-164 Essex St Melrose 24-hr S1	10-yr	Default	24.00	1	5.17	2
3	25-yr	MA-164 Essex St Melrose 24-hr S1	25-yr	Default	24.00	1	6.34	2
4	50-yr	MA-164 Essex St Melrose 24-hr S1	50-yr	Default	24.00	1	7.21	2
5	100-yr	MA-164 Essex St Melrose 24-hr S1	100-yr	Default	24.00	1	8.16	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
10,032	61	>75% Grass cover, Good, HSG B (2S, 3S, 4S, 5S, 6S, 7S)
6,924	96	Gravel surface, HSG B (2S)
9,904	98	Paved parking, HSG B (2S, 3S, 4S, 5S, 6S, 7S, 8S)
23,311	98	Roofs, HSG B (1S)
50,171	**90**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
50,171	HSG B	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S
0	HSG C	
0	HSG D	
0	Other	
50,171		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	10,032	0	0	0	10,032	>75% Grass cover, Good	
0	6,924	0	0	0	6,924	Gravel surface	
0	9,904	0	0	0	9,904	Paved parking	
0	23,311	0	0	0	23,311	Roofs	
0	**50,171**	**0**	**0**	**0**	**50,171**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1	51.33	51.29	4.0	0.0100	0.012	0.0	8.0	0.0	
2	1P	51.72	51.33	40.0	0.0098	0.012	0.0	8.0	0.0	
3	2	52.00	51.63	37.0	0.0100	0.012	0.0	8.0	0.0	
4	3	51.83	51.63	11.0	0.0182	0.012	0.0	8.0	0.0	
5	4	52.97	52.77	26.0	0.0077	0.012	0.0	8.0	0.0	
6	5	52.77	51.33	192.0	0.0075	0.012	0.0	8.0	0.0	
7	10	51.29	50.75	14.0	0.0386	0.012	0.0	8.0	0.0	

Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Runoff Area=23,311 sf 100.00% Impervious Runoff Depth=3.06"
Tc=6.0 min CN=98 Runoff=1.76 cfs 5,939 cf

Subcatchment 2S: Runoff Area=14,185 sf 1.50% Impervious Runoff Depth=1.40"
Flow Length=220' Tc=19.5 min CN=79 Runoff=0.32 cfs 1,660 cf

Subcatchment 3S: Runoff Area=1,017 sf 25.27% Impervious Runoff Depth=0.88"
Tc=6.0 min CN=70 Runoff=0.02 cfs 75 cf

Subcatchment 4S: Runoff Area=5,326 sf 95.04% Impervious Runoff Depth=2.84"
Tc=6.0 min CN=96 Runoff=0.39 cfs 1,260 cf

Subcatchment 5S: Runoff Area=3,827 sf 58.87% Impervious Runoff Depth=1.68"
Tc=6.0 min CN=83 Runoff=0.18 cfs 537 cf

Subcatchment 6S: Runoff Area=1,383 sf 74.19% Impervious Runoff Depth=2.08"
Tc=6.0 min CN=88 Runoff=0.08 cfs 240 cf

Subcatchment 7S: Runoff Area=1,043 sf 97.22% Impervious Runoff Depth=2.95"
Tc=6.0 min CN=97 Runoff=0.08 cfs 256 cf

Subcatchment 8S: Runoff Area=79 sf 100.00% Impervious Runoff Depth=3.06"
Tc=6.0 min CN=98 Runoff=0.01 cfs 20 cf

Pond 1: CB1 Peak Elev=51.78' Inflow=0.39 cfs 1,260 cf
8.0" Round Culvert n=0.012 L=4.0' S=0.0100 '/' Outflow=0.39 cfs 1,260 cf

Pond 1P: Concrete Galleys Peak Elev=50.56' Storage=3,517 cf Inflow=1.93 cfs 7,674 cf
Discarded=0.07 cfs 7,674 cf Primary=0.00 cfs 0 cf Outflow=0.07 cfs 7,674 cf

Pond 2: CB2 Peak Elev=52.33' Inflow=0.32 cfs 1,660 cf
8.0" Round Culvert n=0.012 L=37.0' S=0.0100 '/' Outflow=0.32 cfs 1,660 cf

Pond 2P: Pervious Pavement Peak Elev=53.09' Storage=31 cf Inflow=0.08 cfs 240 cf
Outflow=0.02 cfs 240 cf

Pond 3: CB3 Peak Elev=51.91' Inflow=0.02 cfs 75 cf
8.0" Round Culvert n=0.012 L=11.0' S=0.0182 '/' Outflow=0.02 cfs 75 cf

Pond 3P: Pervious Pavement Peak Elev=53.09' Storage=30 cf Inflow=0.08 cfs 256 cf
Outflow=0.02 cfs 256 cf

Pond 4: CB4 Peak Elev=53.39' Inflow=0.39 cfs 1,260 cf
8.0" Round Culvert n=0.012 L=26.0' S=0.0077 '/' Outflow=0.39 cfs 1,260 cf

Pond 4P: Pervious Pavement Peak Elev=53.05' Storage=2 cf Inflow=0.01 cfs 20 cf
Outflow=0.00 cfs 20 cf

Pond 5: DMH5 Peak Elev=53.15' Inflow=0.39 cfs 1,260 cf
8.0" Round Culvert n=0.012 L=192.0' S=0.0075 '/' Outflow=0.39 cfs 1,260 cf

Pond 10: EXIST MH10 Peak Elev=51.65' Inflow=0.39 cfs 1,260 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=0.39 cfs 1,260 cf

Link 1L: Essex Street Inflow=0.57 cfs 1,796 cf
Primary=0.57 cfs 1,796 cf

Total Runoff Area = 50,171 sf Runoff Volume = 9,986 cf Average Runoff Depth = 2.39"
33.80% Pervious = 16,956 sf 66.20% Impervious = 33,215 sf

Summary for Subcatchment 1S: Roof

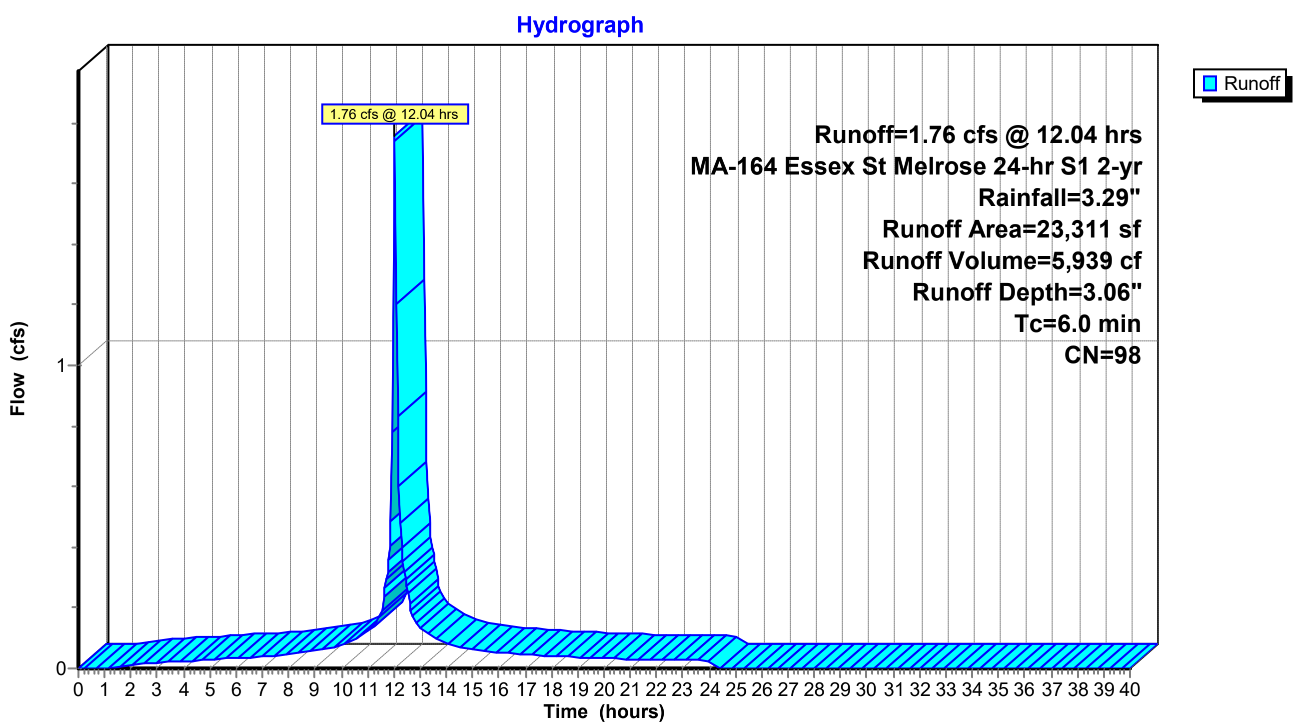
Runoff = 1.76 cfs @ 12.04 hrs, Volume= 5,939 cf, Depth= 3.06"
Routed to Pond 1P : Concrete Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
23,311	98	Roofs, HSG B
23,311		100.00% Impervious Area

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

Subcatchment 1S: Roof



Summary for Subcatchment 2S:

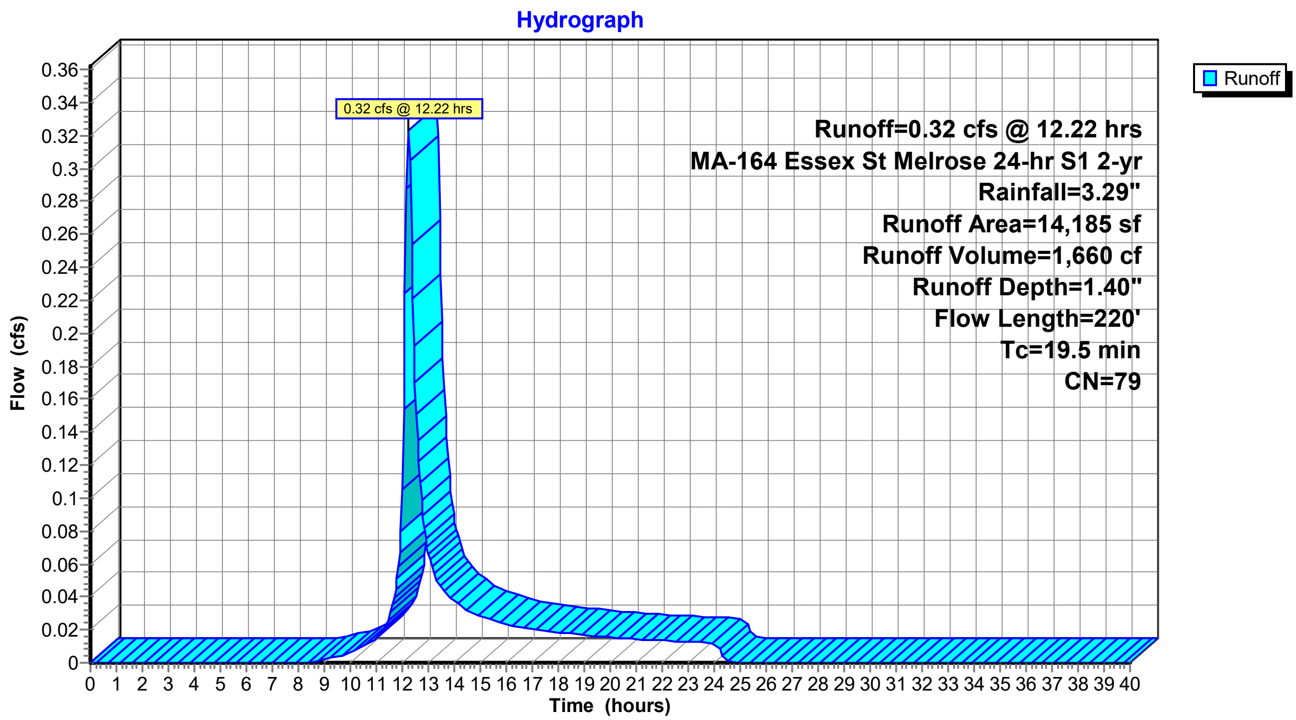
Runoff = 0.32 cfs @ 12.22 hrs, Volume= 1,660 cf, Depth= 1.40"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
6,924	96	Gravel surface, HSG B
7,048	61	>75% Grass cover, Good, HSG B
213	98	Paved parking, HSG B
14,185	79	Weighted Average
13,972		98.50% Pervious Area
213		1.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	35	0.0530	1.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
17.4	65	0.0050	0.06		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.29"
1.8	120	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
19.5	220	Total			

Subcatchment 2S:



Summary for Subcatchment 3S:

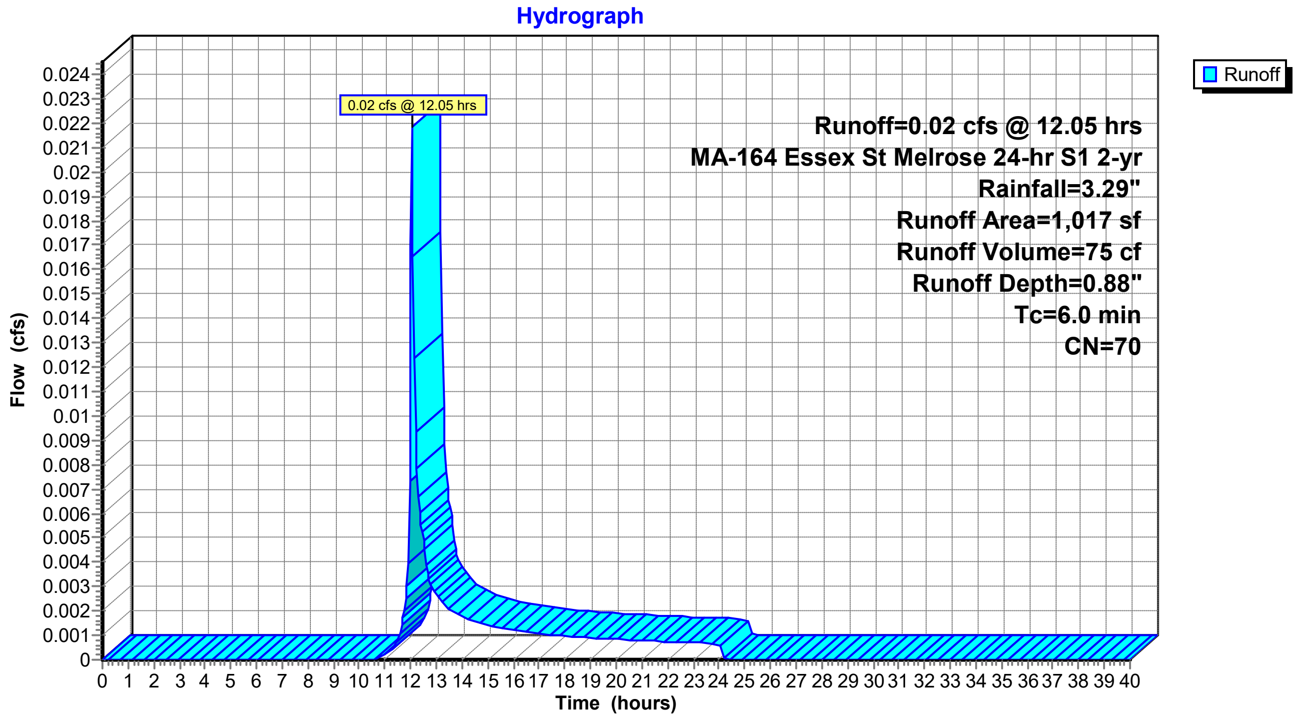
Runoff = 0.02 cfs @ 12.05 hrs, Volume= 75 cf, Depth= 0.88"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
760	61	>75% Grass cover, Good, HSG B
257	98	Paved parking, HSG B
1,017	70	Weighted Average
760		74.73% Pervious Area
257		25.27% Impervious Area

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

Subcatchment 3S:



Summary for Subcatchment 4S:

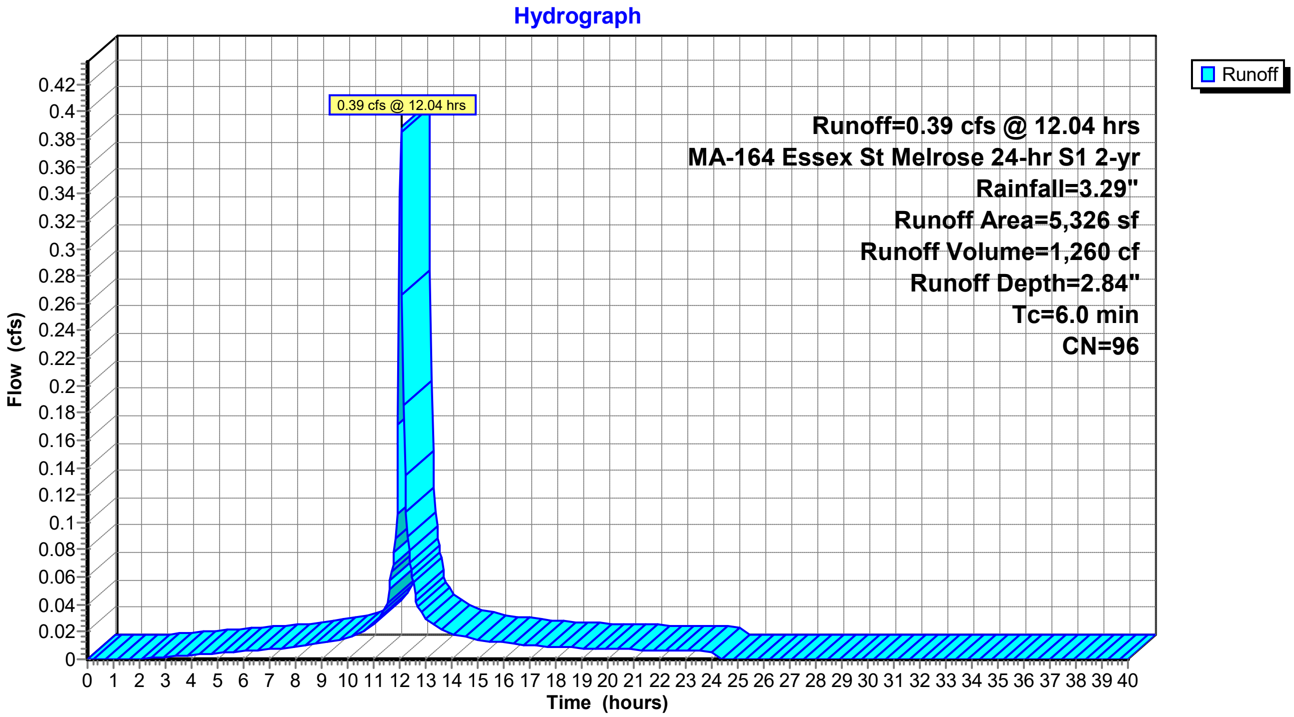
Runoff = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf, Depth= 2.84"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
264	61	>75% Grass cover, Good, HSG B
5,062	98	Paved parking, HSG B
5,326	96	Weighted Average
264		4.96% Pervious Area
5,062		95.04% Impervious Area

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

Subcatchment 4S:



Summary for Subcatchment 5S:

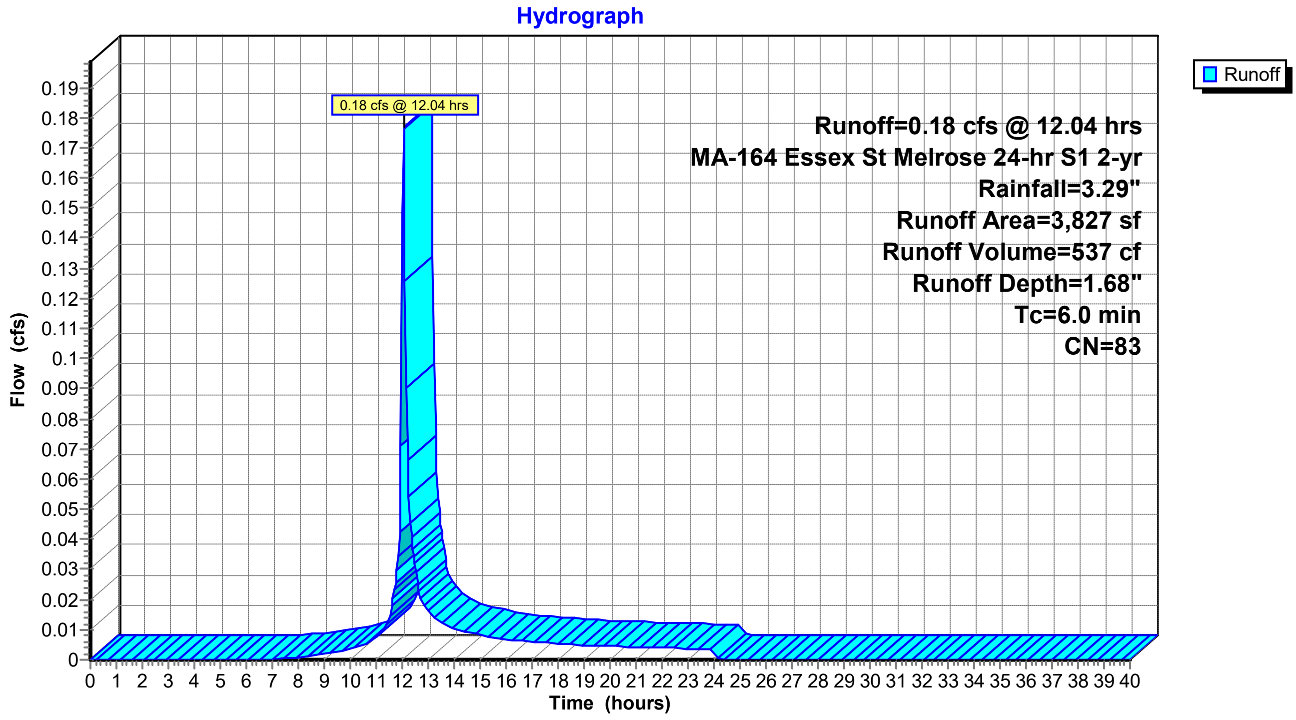
Runoff = 0.18 cfs @ 12.04 hrs, Volume= 537 cf, Depth= 1.68"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
1,574	61	>75% Grass cover, Good, HSG B
2,253	98	Paved parking, HSG B
3,827	83	Weighted Average
1,574		41.13% Pervious Area
2,253		58.87% Impervious Area

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

Subcatchment 5S:



Summary for Subcatchment 6S:

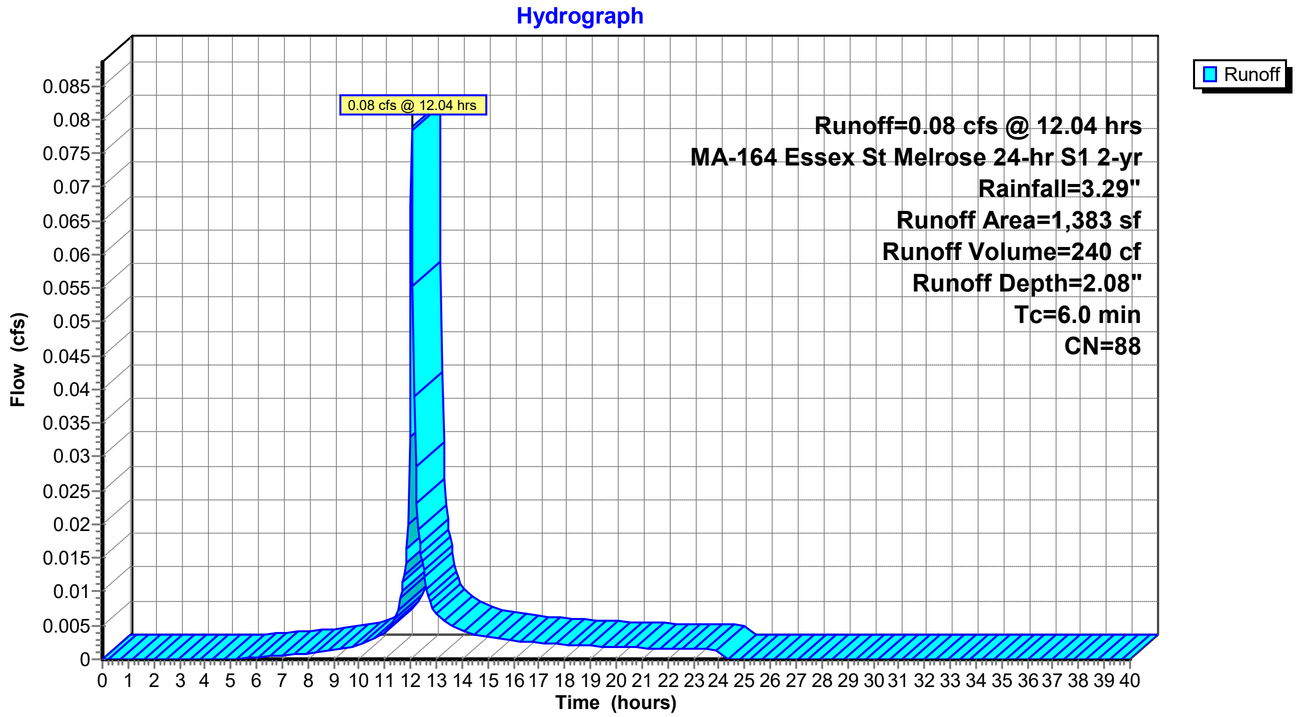
Runoff = 0.08 cfs @ 12.04 hrs, Volume= 240 cf, Depth= 2.08"
Routed to Pond 2P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
1,026	98	Paved parking, HSG B
357	61	>75% Grass cover, Good, HSG B
1,383	88	Weighted Average
357		25.81% Pervious Area
1,026		74.19% Impervious Area

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

Subcatchment 6S:



Summary for Subcatchment 7S:

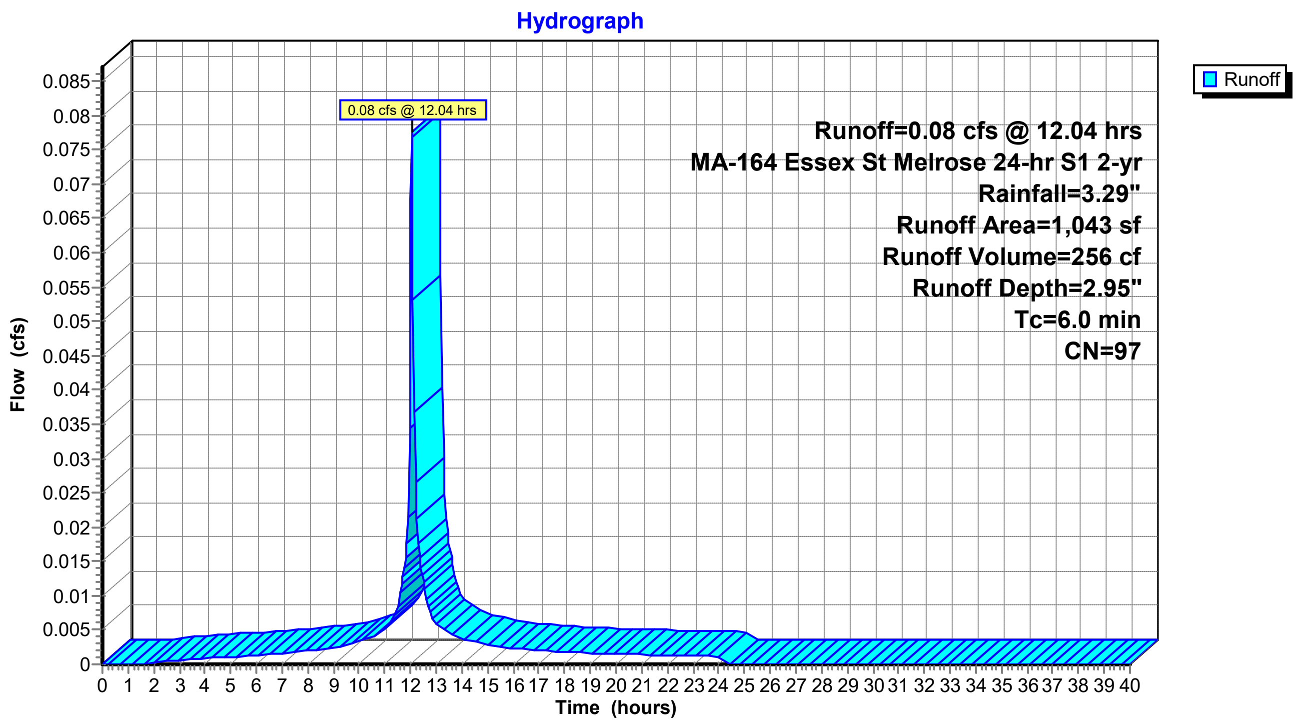
Runoff = 0.08 cfs @ 12.04 hrs, Volume= 256 cf, Depth= 2.95"
Routed to Pond 3P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
1,014	98	Paved parking, HSG B
29	61	>75% Grass cover, Good, HSG B
1,043	97	Weighted Average
29		2.78% Pervious Area
1,014		97.22% Impervious Area

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

Subcatchment 7S:



Summary for Subcatchment 8S:

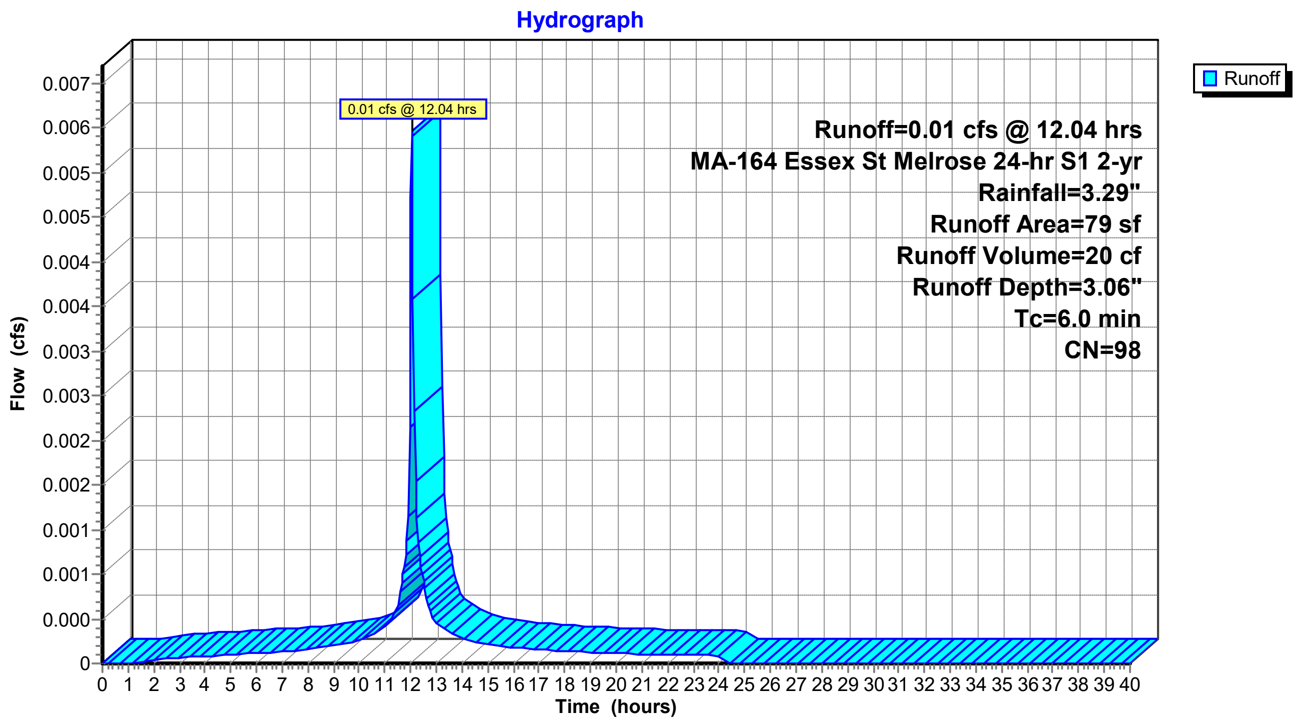
Runoff = 0.01 cfs @ 12.04 hrs, Volume= 20 cf, Depth= 3.06"
Routed to Pond 4P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 2-yr Rainfall=3.29"

Area (sf)	CN	Description
79	98	Paved parking, HSG B
79		100.00% Impervious Area

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

Subcatchment 8S:



Summary for Pond 1: CB1

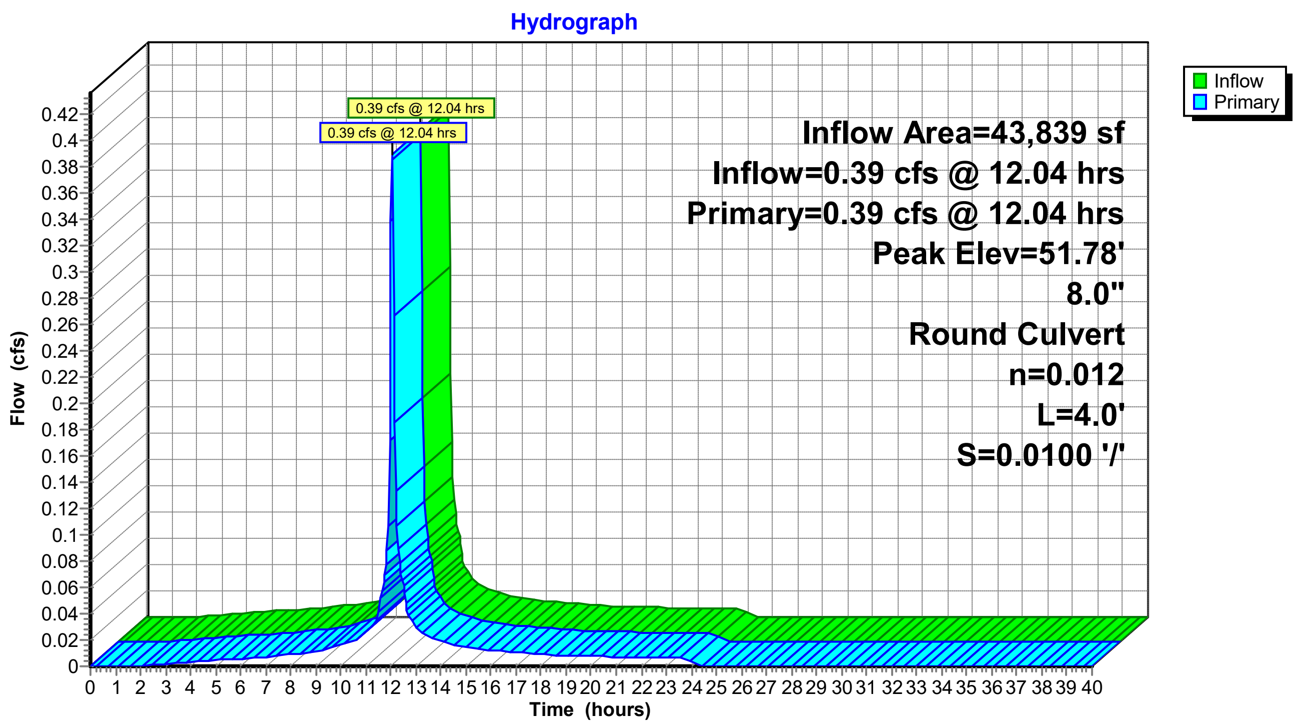
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 0.34" for 2-yr event
Inflow = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf
Outflow = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf
Routed to Pond 10 : EXIST MH10

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.78' @ 12.04 hrs
Flood Elev= 55.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.33'	**8.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.33' / 51.29' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.38 cfs @ 12.04 hrs HW=51.77' TW=51.64' (Dynamic Tailwater)
↑**1=Culvert** (Outlet Controls 0.38 cfs @ 2.20 fps)

Pond 1: CB1



Summary for Pond 1P: Concrete Galleys

Inflow Area = 38,513 sf, 61.75% Impervious, Inflow Depth = 2.39" for 2-yr event
Inflow = 1.93 cfs @ 12.04 hrs, Volume= 7,674 cf
Outflow = 0.07 cfs @ 10.60 hrs, Volume= 7,674 cf, Atten= 96%, Lag= 0.0 min
Discarded = 0.07 cfs @ 10.60 hrs, Volume= 7,674 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 50.56' @ 16.56 hrs Surf.Area= 3,040 sf Storage= 3,517 cf

Plug-Flow detention time= 444.1 min calculated for 7,664 cf (100% of inflow)
Center-of-Mass det. time= 444.4 min (1,232.9 - 788.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	48.50'	2,793 cf	**10.50'W x 289.50'L x 5.25'H Field A** 15,959 cf Overall - 8,976 cf Embedded = 6,983 cf x 40.0% Voids
#2A	49.50'	6,679 cf	**Concrete Galley 4x4x4.25** x 144 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 144 Chambers in 2 Rows
		9,472 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	51.72'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.72' / 51.33' S= 0.0098 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 10.60 hrs HW=48.56' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=48.50' TW=51.33' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 1P: Concrete Galleys - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

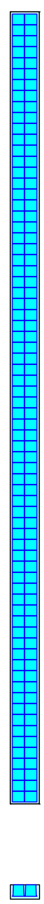
72 Chambers/Row x 4.00' Long = 288.00' Row Length +9.0" End Stone x 2 = 289.50' Base Length
2 Rows x 54.0" Wide + 9.0" Side Stone x 2 = 10.50' Base Width
12.0" Stone Base + 51.0" Chamber Height = 5.25' Field Height

144 Chambers x 46.4 cf = 6,678.8 cf Chamber Storage
144 Chambers x 62.3 cf = 8,975.7 cf Displacement

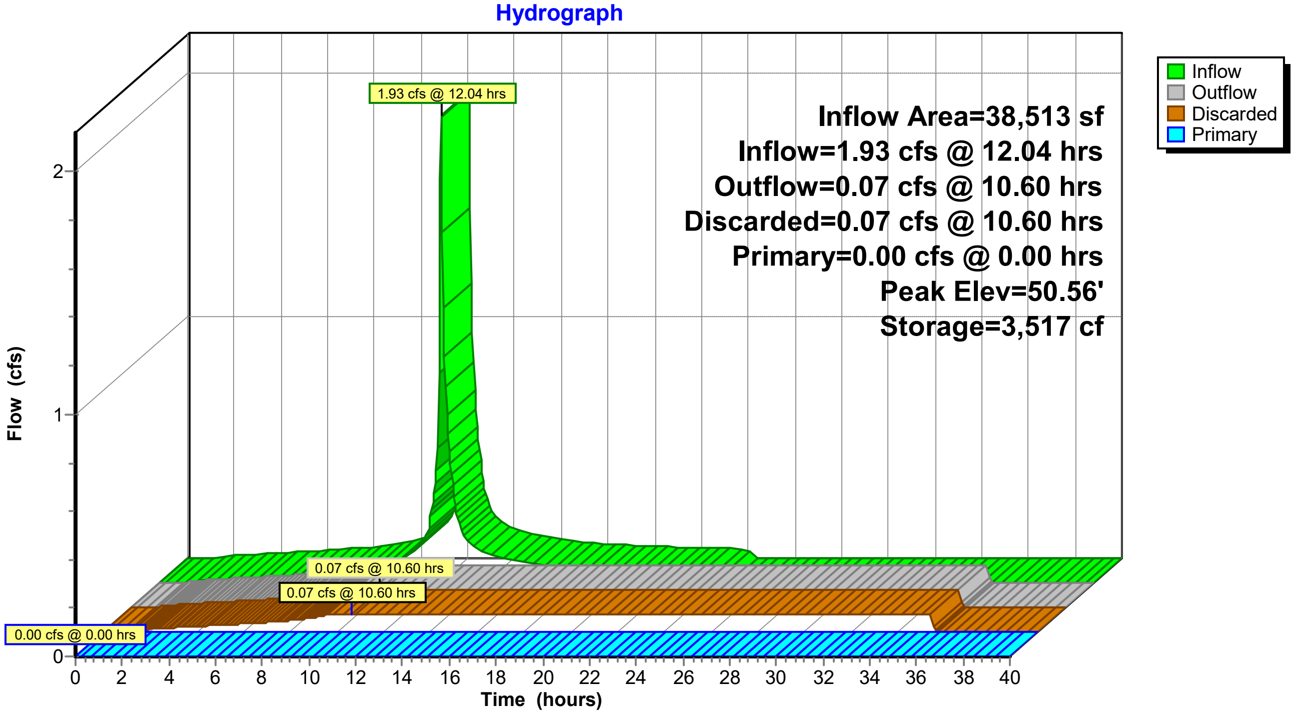
15,958.7 cf Field - 8,975.7 cf Chambers = 6,983.0 cf Stone x 40.0% Voids = 2,793.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,472.0 cf = 0.217 af
Overall Storage Efficiency = 59.4%
Overall System Size = 289.50' x 10.50' x 5.25'

144 Chambers
591.1 cy Field
258.6 cy Stone



Pond 1P: Concrete Galleys



Summary for Pond 2: CB2

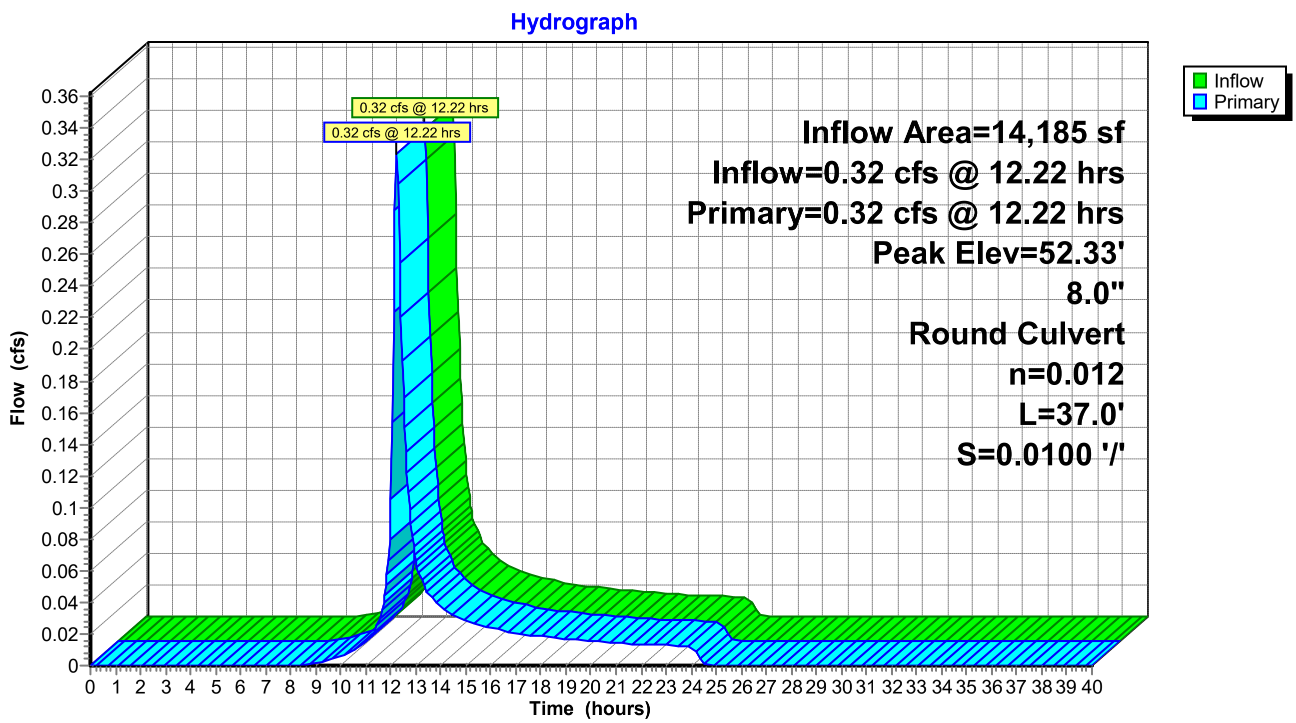
Inflow Area = 14,185 sf, 1.50% Impervious, Inflow Depth = 1.40" for 2-yr event
Inflow = 0.32 cfs @ 12.22 hrs, Volume= 1,660 cf
Outflow = 0.32 cfs @ 12.22 hrs, Volume= 1,660 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.32 cfs @ 12.22 hrs, Volume= 1,660 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.33' @ 12.22 hrs
Flood Elev= 54.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**8.0" Round Culvert** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 51.63' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.32 cfs @ 12.22 hrs HW=52.32' TW=49.91' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.32 cfs @ 2.77 fps)

Pond 2: CB2



Summary for Pond 2P: Pervious Pavement

Inflow Area = 1,383 sf, 74.19% Impervious, Inflow Depth = 2.08" for 2-yr event
Inflow = 0.08 cfs @ 12.04 hrs, Volume= 240 cf
Outflow = 0.02 cfs @ 12.00 hrs, Volume= 240 cf, Atten= 69%, Lag= 0.0 min
Discarded = 0.02 cfs @ 12.00 hrs, Volume= 240 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.09' @ 12.24 hrs Surf.Area= 1,026 sf Storage= 31 cf

Plug-Flow detention time= 6.4 min calculated for 239 cf (100% of inflow)
Center-of-Mass det. time= 6.4 min (841.3 - 834.8)

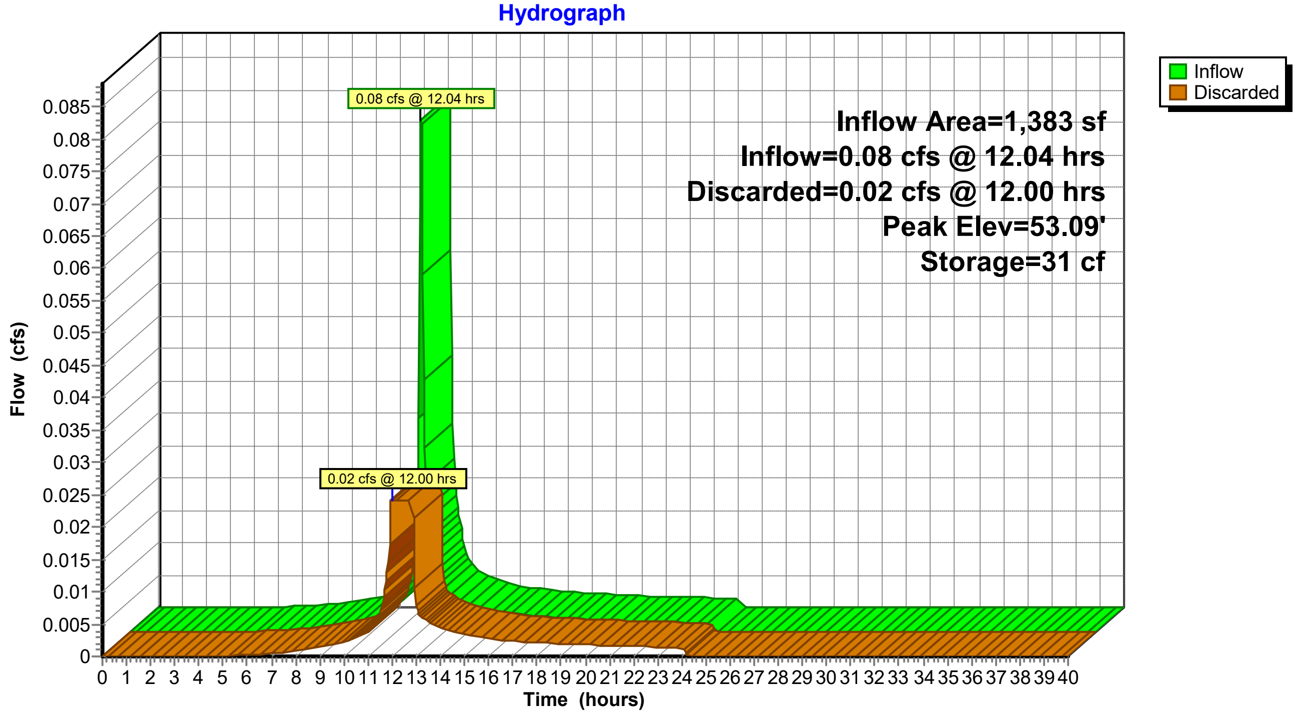
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	363 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,026	0.0	0	0
53.33	1,026	35.0	119	119
54.92	1,026	15.0	245	363

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 12.00 hrs HW=53.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 2P: Pervious Pavement



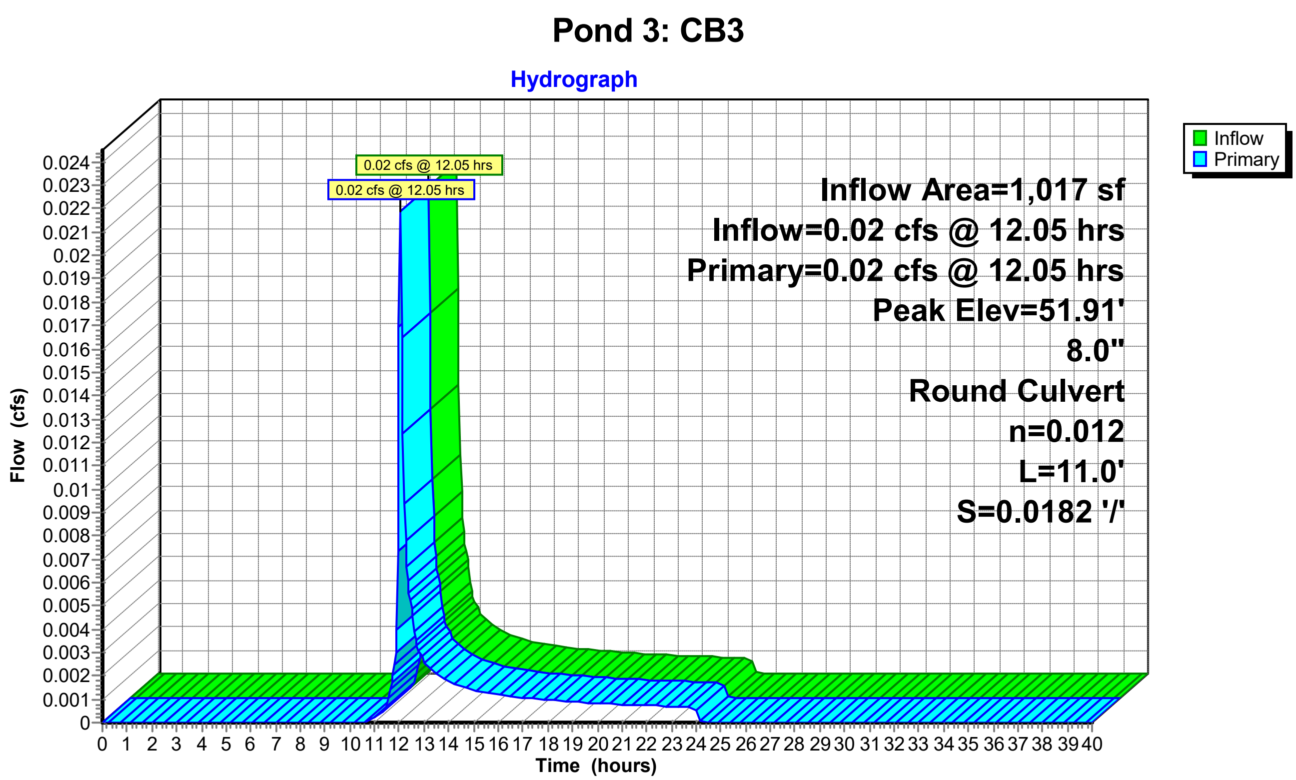
Summary for Pond 3: CB3

Inflow Area = 1,017 sf, 25.27% Impervious, Inflow Depth = 0.88" for 2-yr event
Inflow = 0.02 cfs @ 12.05 hrs, Volume= 75 cf
Outflow = 0.02 cfs @ 12.05 hrs, Volume= 75 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.02 cfs @ 12.05 hrs, Volume= 75 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.91' @ 12.05 hrs
Flood Elev= 54.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.83'	**8.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.83' / 51.63' S= 0.0182 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.02 cfs @ 12.05 hrs HW=51.91' TW=49.56' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.02 cfs @ 0.95 fps)



Summary for Pond 3P: Pervious Pavement

Inflow Area = 1,043 sf, 97.22% Impervious, Inflow Depth = 2.95" for 2-yr event
Inflow = 0.08 cfs @ 12.04 hrs, Volume= 256 cf
Outflow = 0.02 cfs @ 12.00 hrs, Volume= 256 cf, Atten= 69%, Lag= 0.0 min
Discarded = 0.02 cfs @ 12.00 hrs, Volume= 256 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.09' @ 12.22 hrs Surf.Area= 1,014 sf Storage= 30 cf

Plug-Flow detention time= 5.9 min calculated for 256 cf (100% of inflow)
Center-of-Mass det. time= 5.9 min (776.6 - 770.7)

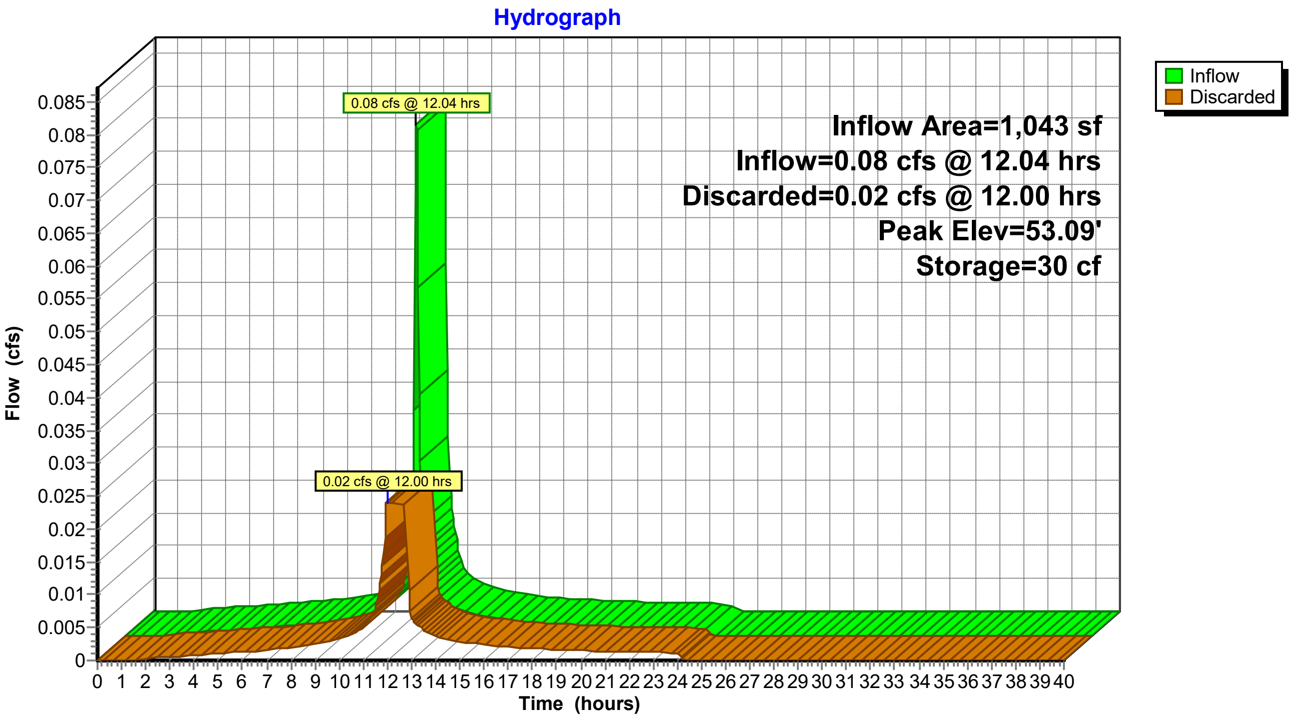
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	359 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,014	0.0	0	0
53.33	1,014	35.0	117	117
54.92	1,014	15.0	242	359

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 12.00 hrs HW=53.02' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 3P: Pervious Pavement



Summary for Pond 4: CB4

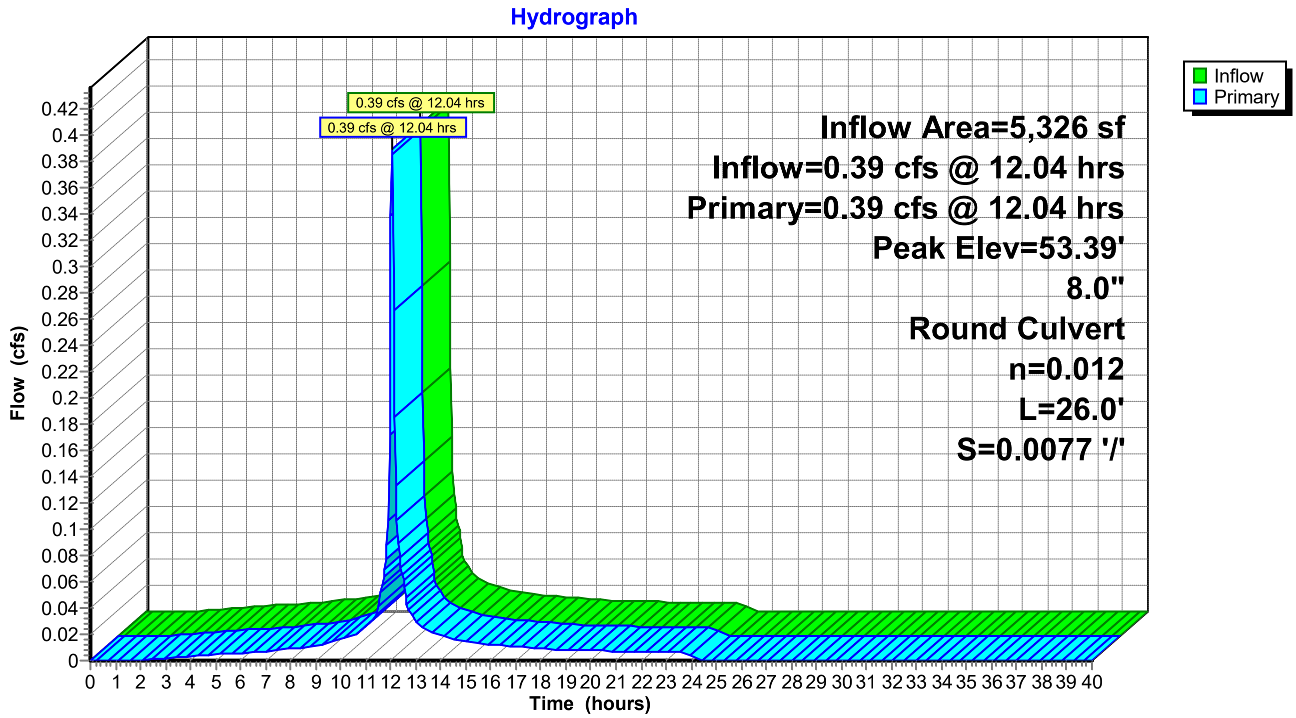
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 2.84" for 2-yr event
Inflow = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf
Outflow = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf
Routed to Pond 5 : DMH5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.39' @ 12.04 hrs
Flood Elev= 55.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.97'	**8.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.97' / 52.77' S= 0.0077 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.37 cfs @ 12.04 hrs HW=53.38' TW=53.14' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.37 cfs @ 2.37 fps)

Pond 4: CB4



Summary for Pond 4P: Pervious Pavement

Inflow Area = 79 sf,100.00% Impervious, Inflow Depth = 3.06" for 2-yr event
Inflow = 0.01 cfs @ 12.04 hrs, Volume= 20 cf
Outflow = 0.00 cfs @ 12.05 hrs, Volume= 20 cf, Atten= 60%, Lag= 0.7 min
Discarded = 0.00 cfs @ 12.05 hrs, Volume= 20 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.05' @ 12.18 hrs Surf.Area= 102 sf Storage= 2 cf

Plug-Flow detention time= 4.1 min calculated for 20 cf (100% of inflow)
Center-of-Mass det. time= 4.0 min (762.9 - 758.9)

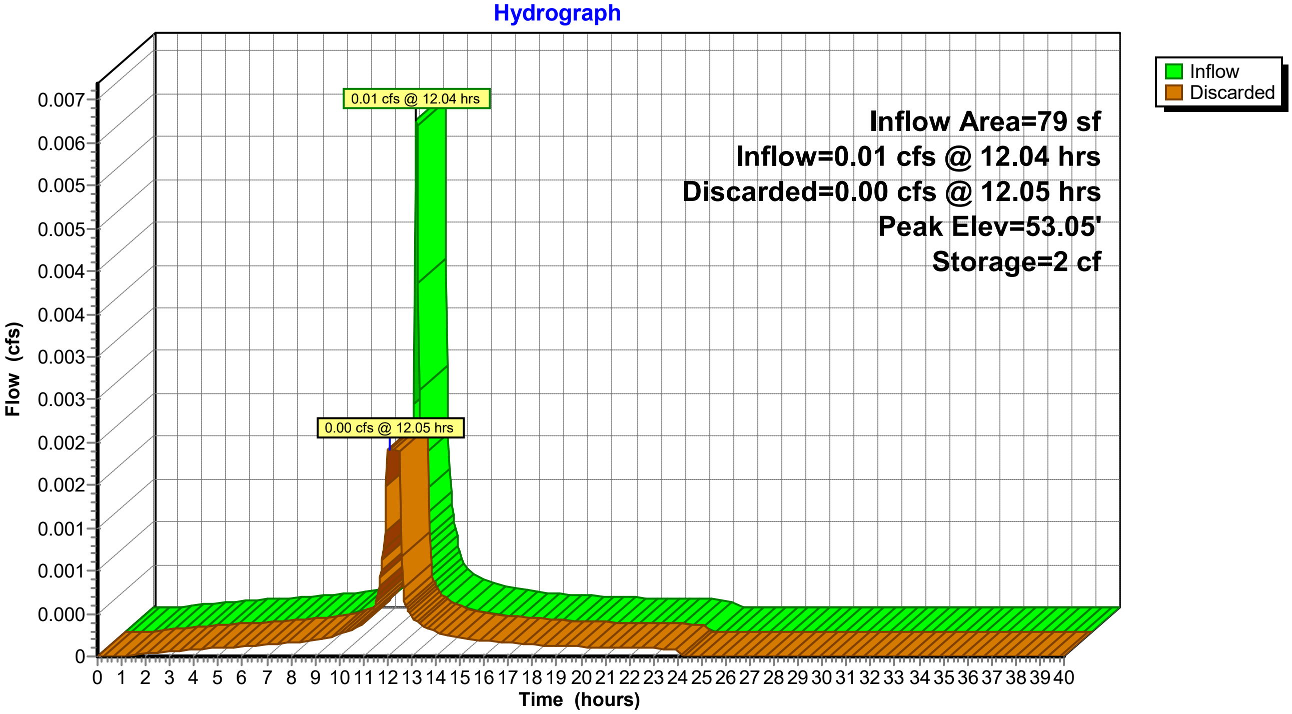
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	36 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	102	0.0	0	0
53.33	102	35.0	12	12
54.92	102	15.0	24	36

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 12.05 hrs HW=53.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Pond 4P: Pervious Pavement



Summary for Pond 5: DMH5

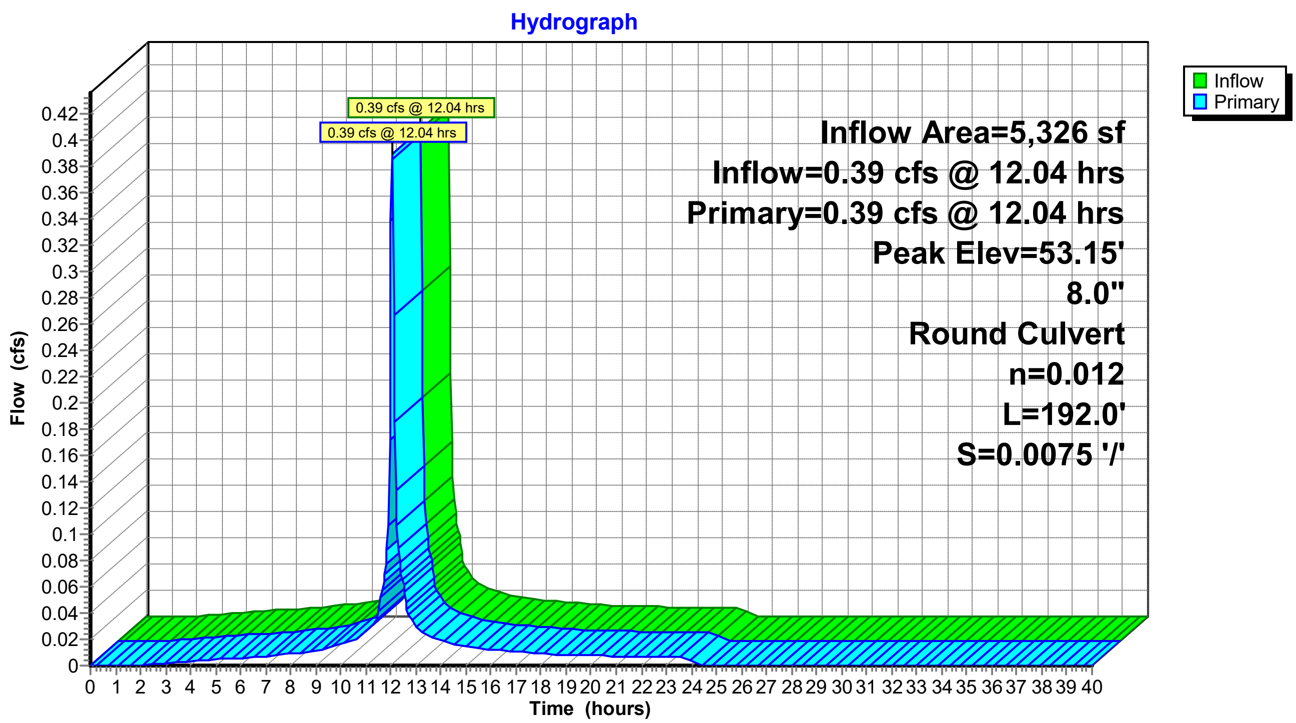
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 2.84" for 2-yr event
Inflow = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf
Outflow = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.15' @ 12.04 hrs
Flood Elev= 55.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.77'	**8.0" Round Culvert** L= 192.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.77' / 51.33' S= 0.0075 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.38 cfs @ 12.04 hrs HW=53.14' TW=51.77' (Dynamic Tailwater)
1=Culvert (Outlet Controls 0.38 cfs @ 2.73 fps)

Pond 5: DMH5



Summary for Pond 10: EXIST MH10

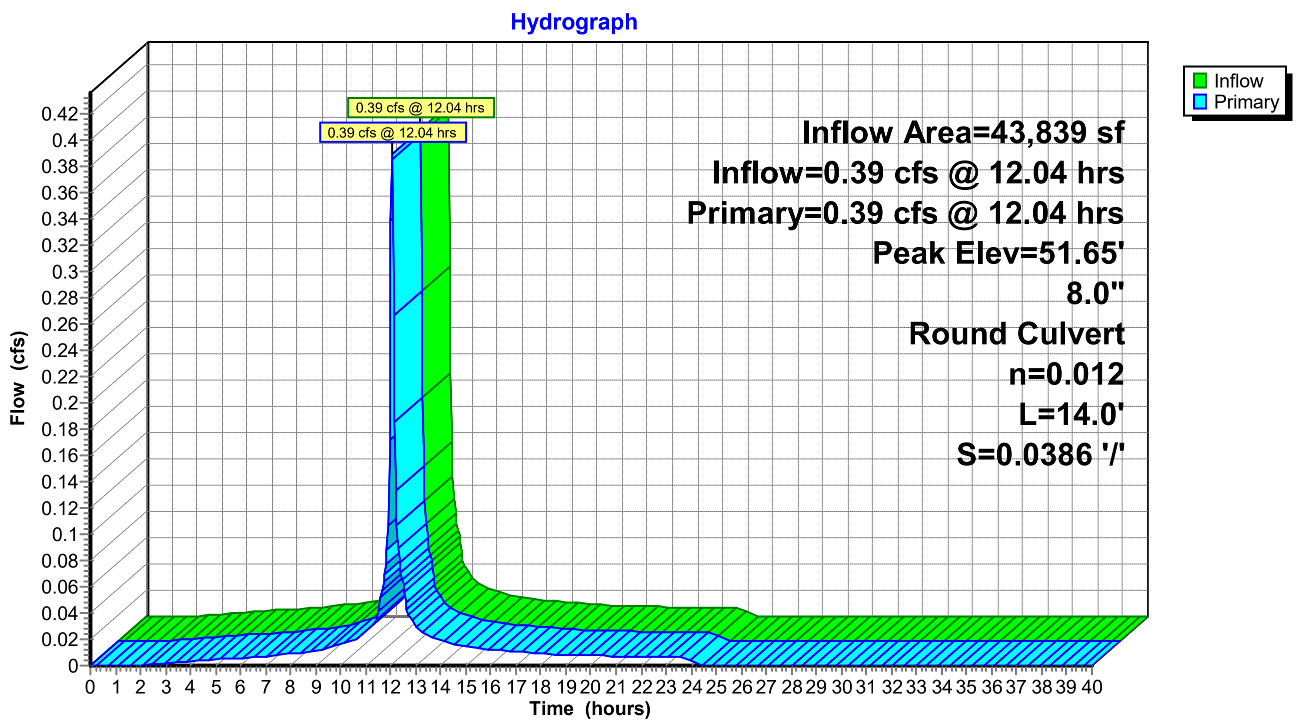
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 0.34" for 2-yr event
Inflow = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf
Outflow = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.39 cfs @ 12.04 hrs, Volume= 1,260 cf
Routed to Link 1L : Essex Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.65' @ 12.04 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.38 cfs @ 12.04 hrs HW=51.64' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 0.38 cfs @ 2.02 fps)

Pond 10: EXIST MH10

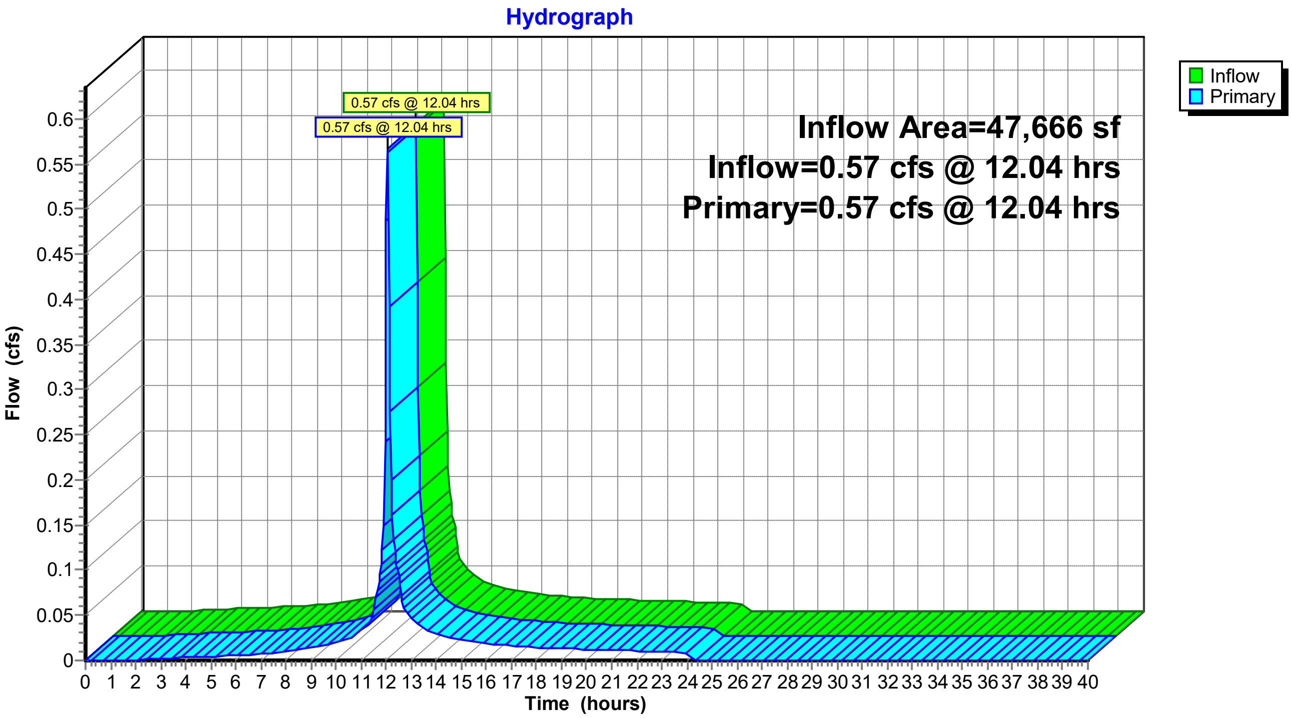


Summary for Link 1L: Essex Street

Inflow Area =	47,666 sf,	65.24% Impervious,	Inflow Depth = 0.45"	for 2-yr event
Inflow =	0.57 cfs @	12.04 hrs, Volume=	1,796 cf	
Primary =	0.57 cfs @	12.04 hrs, Volume=	1,796 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 1L: Essex Street



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Runoff Area=23,311 sf 100.00% Impervious Runoff Depth=4.93"
Tc=6.0 min CN=98 Runoff=2.72 cfs 9,583 cf

Subcatchment 2S: Runoff Area=14,185 sf 1.50% Impervious Runoff Depth=2.95"
Flow Length=220' Tc=19.5 min CN=79 Runoff=0.68 cfs 3,485 cf

Subcatchment 3S: Runoff Area=1,017 sf 25.27% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=70 Runoff=0.06 cfs 183 cf

Subcatchment 4S: Runoff Area=5,326 sf 95.04% Impervious Runoff Depth=4.70"
Tc=6.0 min CN=96 Runoff=0.61 cfs 2,087 cf

Subcatchment 5S: Runoff Area=3,827 sf 58.87% Impervious Runoff Depth=3.33"
Tc=6.0 min CN=83 Runoff=0.34 cfs 1,061 cf

Subcatchment 6S: Runoff Area=1,383 sf 74.19% Impervious Runoff Depth=3.83"
Tc=6.0 min CN=88 Runoff=0.14 cfs 441 cf

Subcatchment 7S: Runoff Area=1,043 sf 97.22% Impervious Runoff Depth=4.82"
Tc=6.0 min CN=97 Runoff=0.12 cfs 419 cf

Subcatchment 8S: Runoff Area=79 sf 100.00% Impervious Runoff Depth=4.93"
Tc=6.0 min CN=98 Runoff=0.01 cfs 32 cf

Pond 1: CB1 Peak Elev=51.92' Inflow=0.61 cfs 3,894 cf
8.0" Round Culvert n=0.012 L=4.0' S=0.0100 '/' Outflow=0.61 cfs 3,894 cf

Pond 1P: Concrete Galleys Peak Elev=51.93' Storage=6,466 cf Inflow=3.10 cfs 13,251 cf
Discarded=0.07 cfs 9,475 cf Primary=0.13 cfs 1,807 cf Outflow=0.20 cfs 11,283 cf

Pond 2: CB2 Peak Elev=52.51' Inflow=0.68 cfs 3,485 cf
8.0" Round Culvert n=0.012 L=37.0' S=0.0100 '/' Outflow=0.68 cfs 3,485 cf

Pond 2P: Pervious Pavement Peak Elev=53.23' Storage=83 cf Inflow=0.14 cfs 441 cf
Outflow=0.02 cfs 441 cf

Pond 3: CB3 Peak Elev=51.96' Inflow=0.06 cfs 183 cf
8.0" Round Culvert n=0.012 L=11.0' S=0.0182 '/' Outflow=0.06 cfs 183 cf

Pond 3P: Pervious Pavement Peak Elev=53.18' Storage=65 cf Inflow=0.12 cfs 419 cf
Outflow=0.02 cfs 419 cf

Pond 4: CB4 Peak Elev=53.53' Inflow=0.61 cfs 2,087 cf
8.0" Round Culvert n=0.012 L=26.0' S=0.0077 '/' Outflow=0.61 cfs 2,087 cf

Pond 4P: Pervious Pavement Peak Elev=53.11' Storage=4 cf Inflow=0.01 cfs 32 cf
Outflow=0.00 cfs 32 cf

Pond 5: DMH5 Peak Elev=53.27' Inflow=0.61 cfs 2,087 cf
8.0" Round Culvert n=0.012 L=192.0' S=0.0075 '/' Outflow=0.61 cfs 2,087 cf

Pond 10: EXIST MH10 Peak Elev=51.76' Inflow=0.61 cfs 3,894 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=0.61 cfs 3,894 cf

Link 1L: Essex Street Inflow=0.95 cfs 4,956 cf
Primary=0.95 cfs 4,956 cf

Total Runoff Area = 50,171 sf Runoff Volume = 17,292 cf Average Runoff Depth = 4.14"
33.80% Pervious = 16,956 sf 66.20% Impervious = 33,215 sf

Summary for Subcatchment 1S: Roof

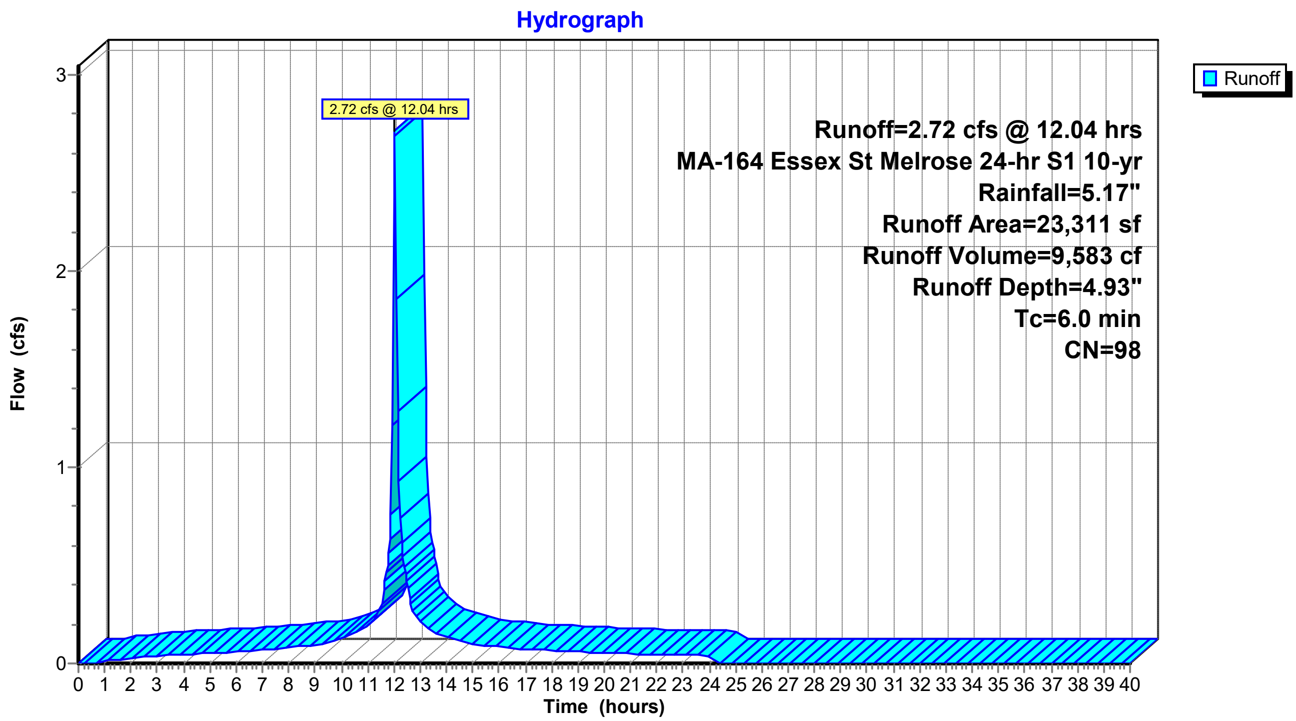
Runoff = 2.72 cfs @ 12.04 hrs, Volume= 9,583 cf, Depth= 4.93"
Routed to Pond 1P : Concrete Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
23,311	98	Roofs, HSG B
23,311		100.00% Impervious Area

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

Subcatchment 1S: Roof



Summary for Subcatchment 2S:

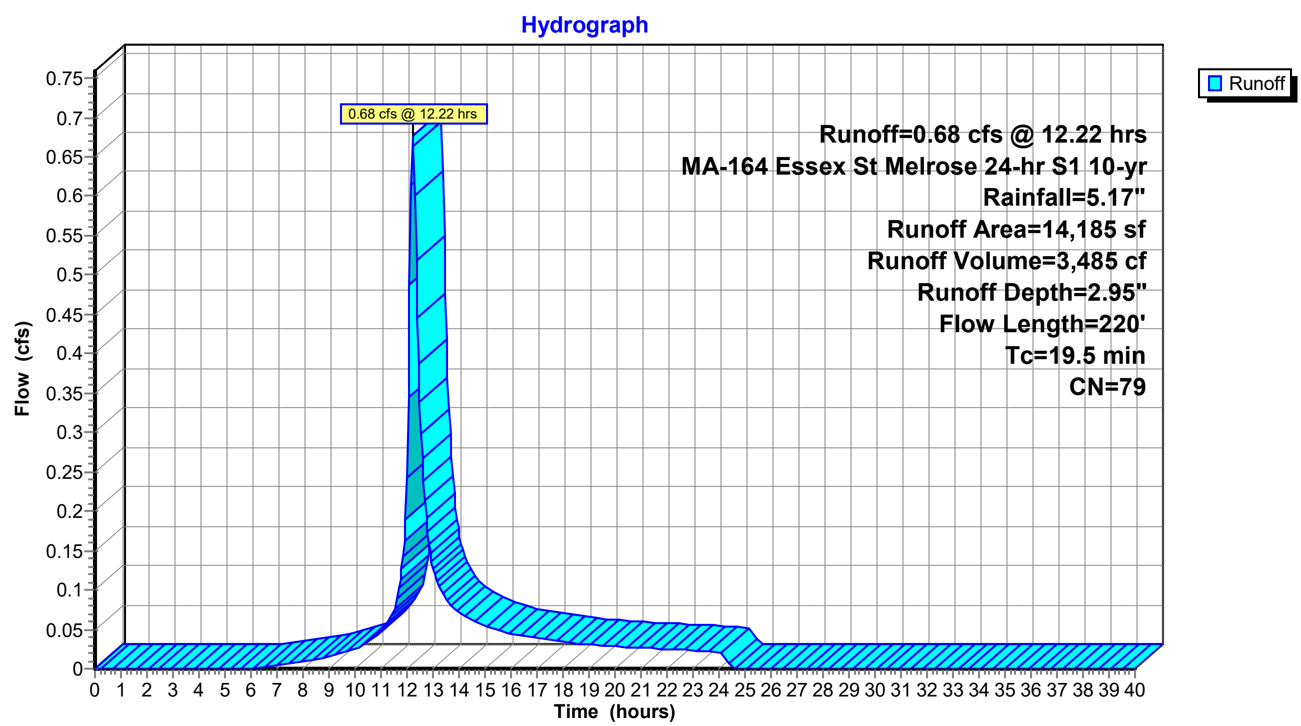
Runoff = 0.68 cfs @ 12.22 hrs, Volume= 3,485 cf, Depth= 2.95"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
6,924	96	Gravel surface, HSG B
7,048	61	>75% Grass cover, Good, HSG B
213	98	Paved parking, HSG B
14,185	79	Weighted Average
13,972		98.50% Pervious Area
213		1.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	35	0.0530	1.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
17.4	65	0.0050	0.06		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.29"
1.8	120	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
19.5	220	Total			

Subcatchment 2S:



Summary for Subcatchment 3S:

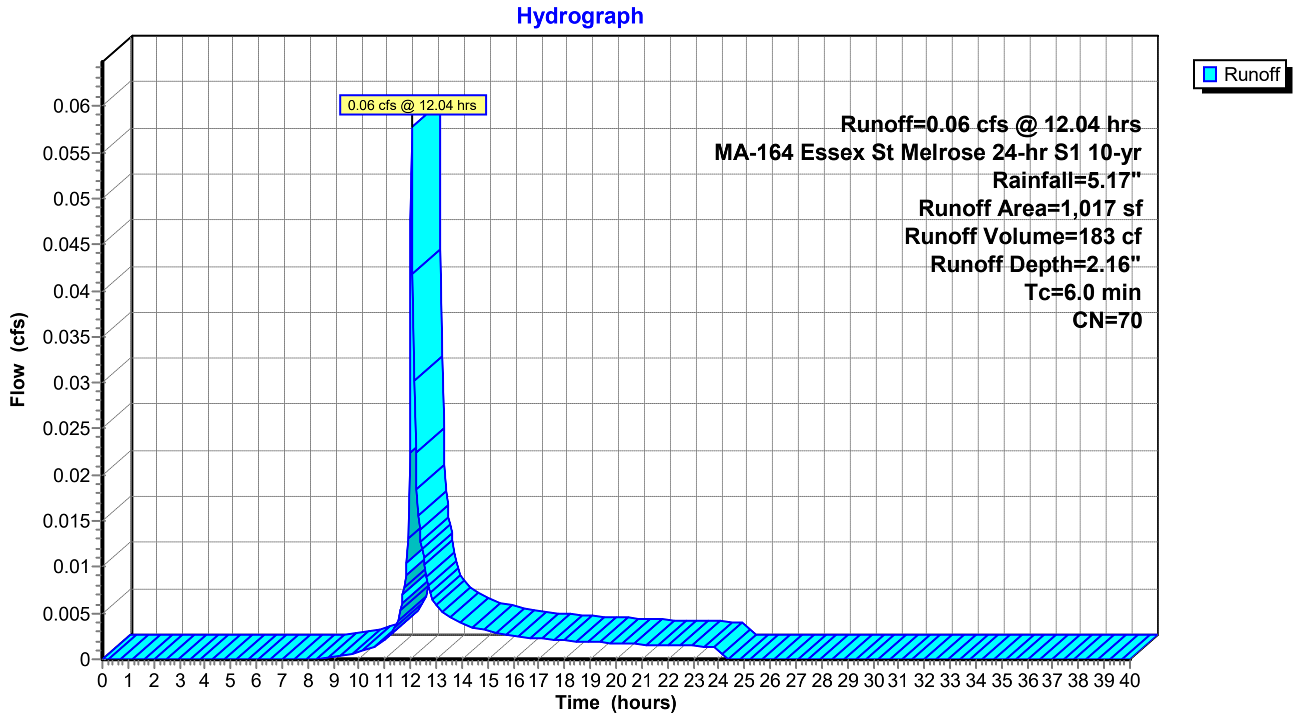
Runoff = 0.06 cfs @ 12.04 hrs, Volume= 183 cf, Depth= 2.16"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
760	61	>75% Grass cover, Good, HSG B
257	98	Paved parking, HSG B
1,017	70	Weighted Average
760		74.73% Pervious Area
257		25.27% Impervious Area

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

Subcatchment 3S:



Summary for Subcatchment 4S:

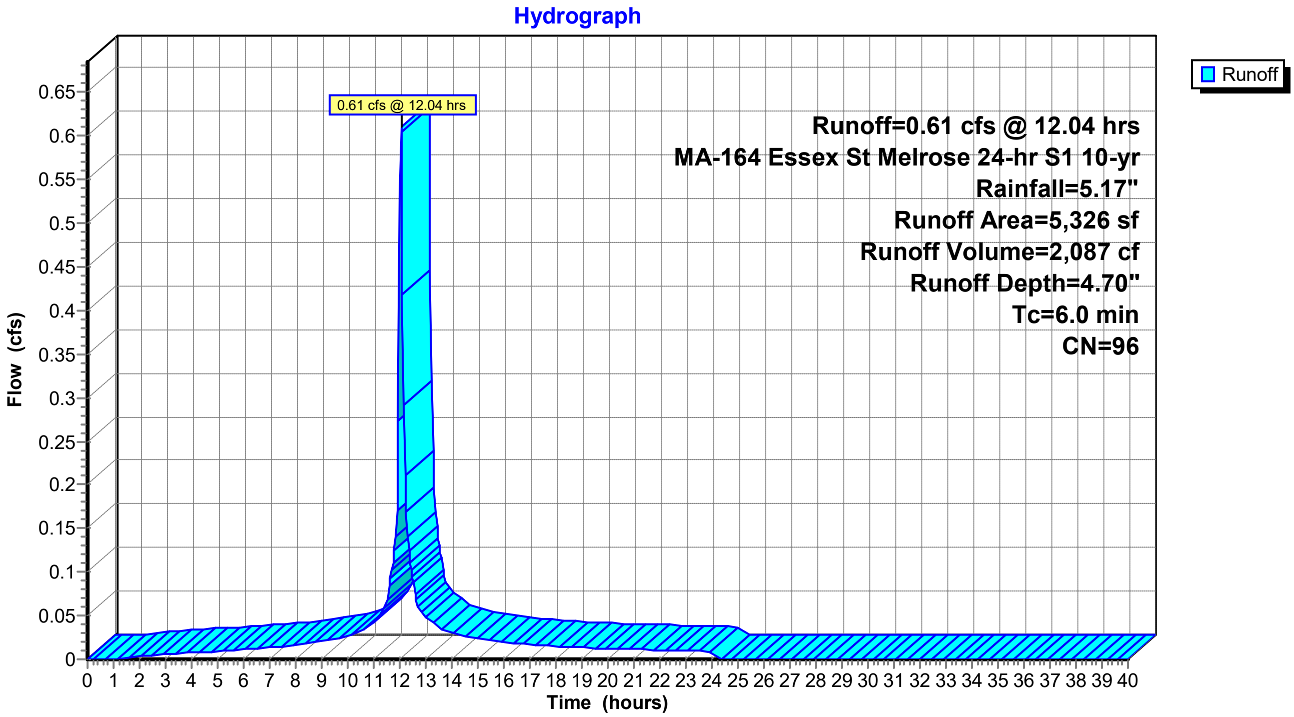
Runoff = 0.61 cfs @ 12.04 hrs, Volume= 2,087 cf, Depth= 4.70"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
264	61	>75% Grass cover, Good, HSG B
5,062	98	Paved parking, HSG B
5,326	96	Weighted Average
264		4.96% Pervious Area
5,062		95.04% Impervious Area

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

Subcatchment 4S:



Summary for Subcatchment 5S:

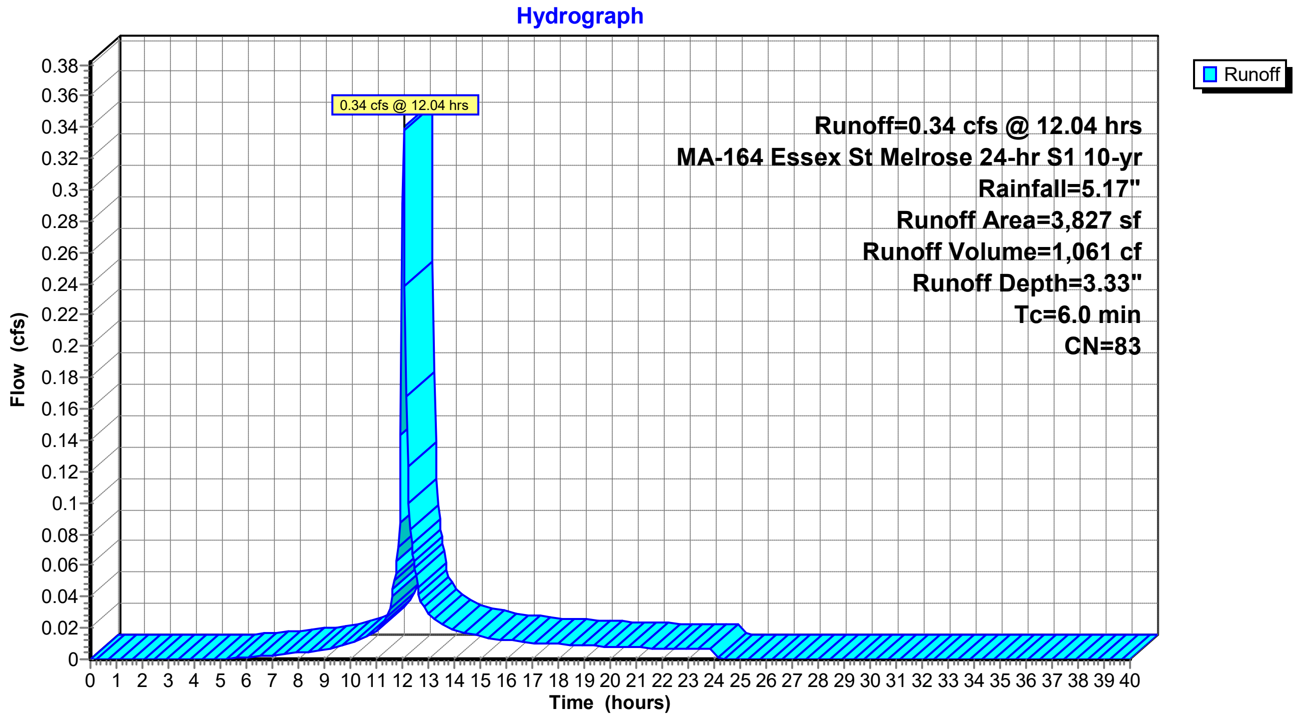
Runoff = 0.34 cfs @ 12.04 hrs, Volume= 1,061 cf, Depth= 3.33"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
1,574	61	>75% Grass cover, Good, HSG B
2,253	98	Paved parking, HSG B
3,827	83	Weighted Average
1,574		41.13% Pervious Area
2,253		58.87% Impervious Area

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

Subcatchment 5S:



Summary for Subcatchment 6S:

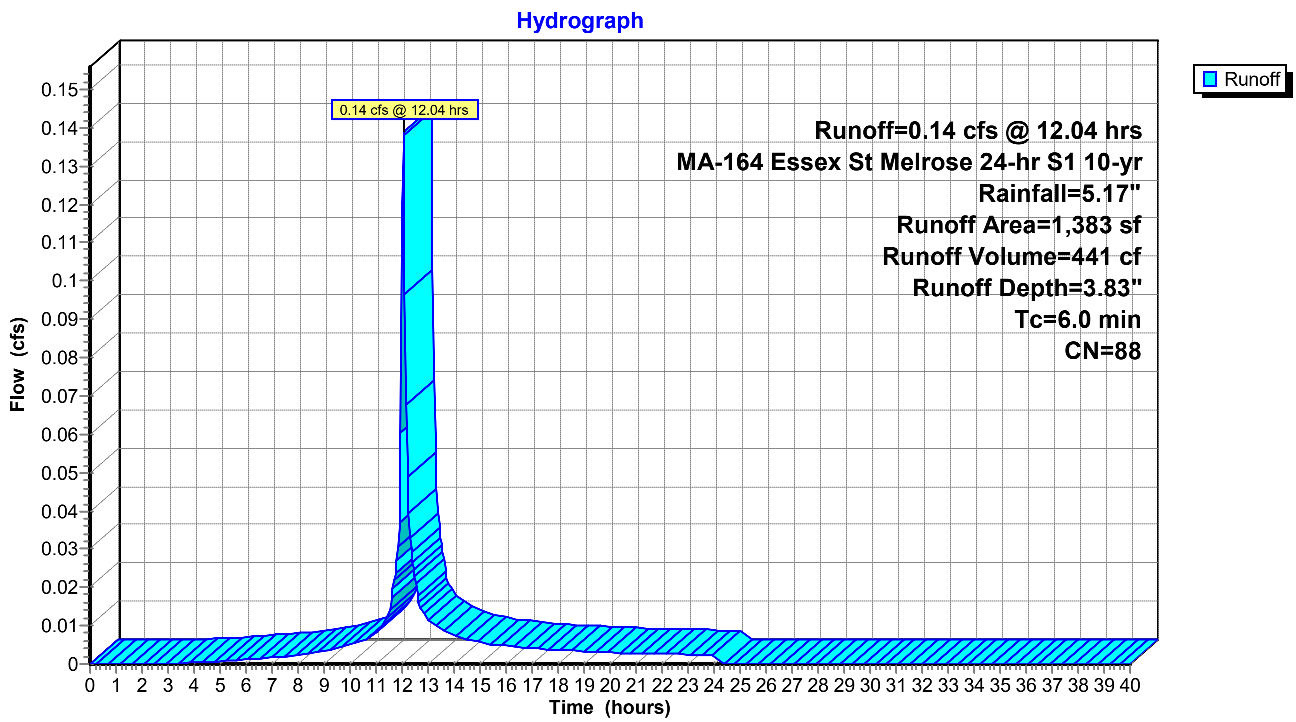
Runoff = 0.14 cfs @ 12.04 hrs, Volume= 441 cf, Depth= 3.83"
Routed to Pond 2P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
1,026	98	Paved parking, HSG B
357	61	>75% Grass cover, Good, HSG B
1,383	88	Weighted Average
357		25.81% Pervious Area
1,026		74.19% Impervious Area

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

Subcatchment 6S:



Summary for Subcatchment 7S:

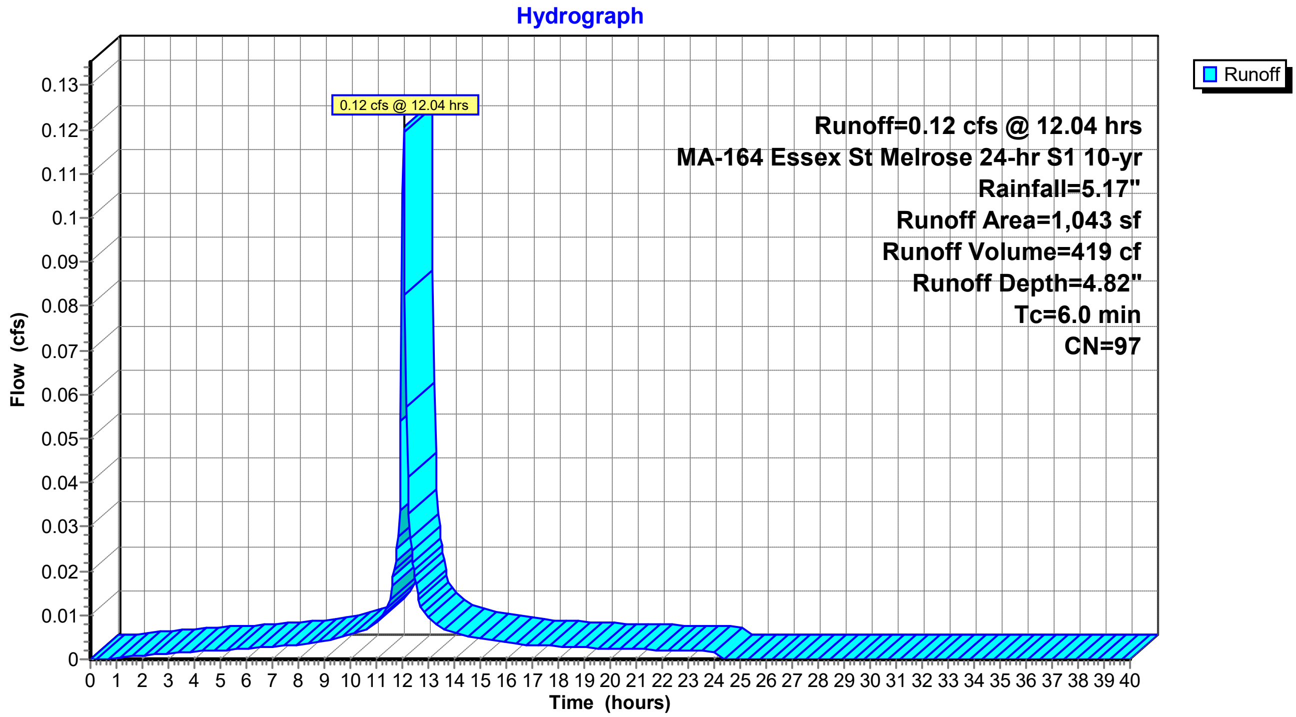
Runoff = 0.12 cfs @ 12.04 hrs, Volume= 419 cf, Depth= 4.82"
Routed to Pond 3P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
1,014	98	Paved parking, HSG B
29	61	>75% Grass cover, Good, HSG B
1,043	97	Weighted Average
29		2.78% Pervious Area
1,014		97.22% Impervious Area

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

Subcatchment 7S:



Summary for Subcatchment 8S:

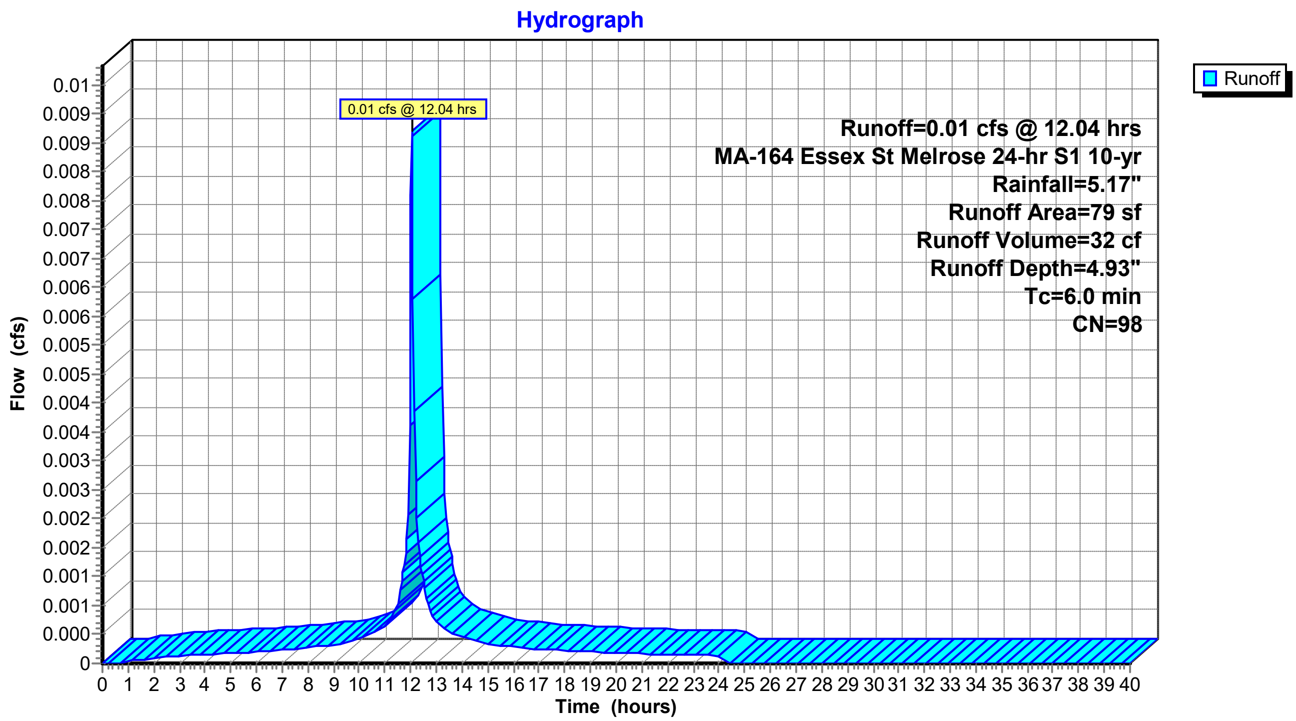
Runoff = 0.01 cfs @ 12.04 hrs, Volume= 32 cf, Depth= 4.93"
Routed to Pond 4P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 10-yr Rainfall=5.17"

Area (sf)	CN	Description
79	98	Paved parking, HSG B
79		100.00% Impervious Area

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

Subcatchment 8S:



Summary for Pond 1: CB1

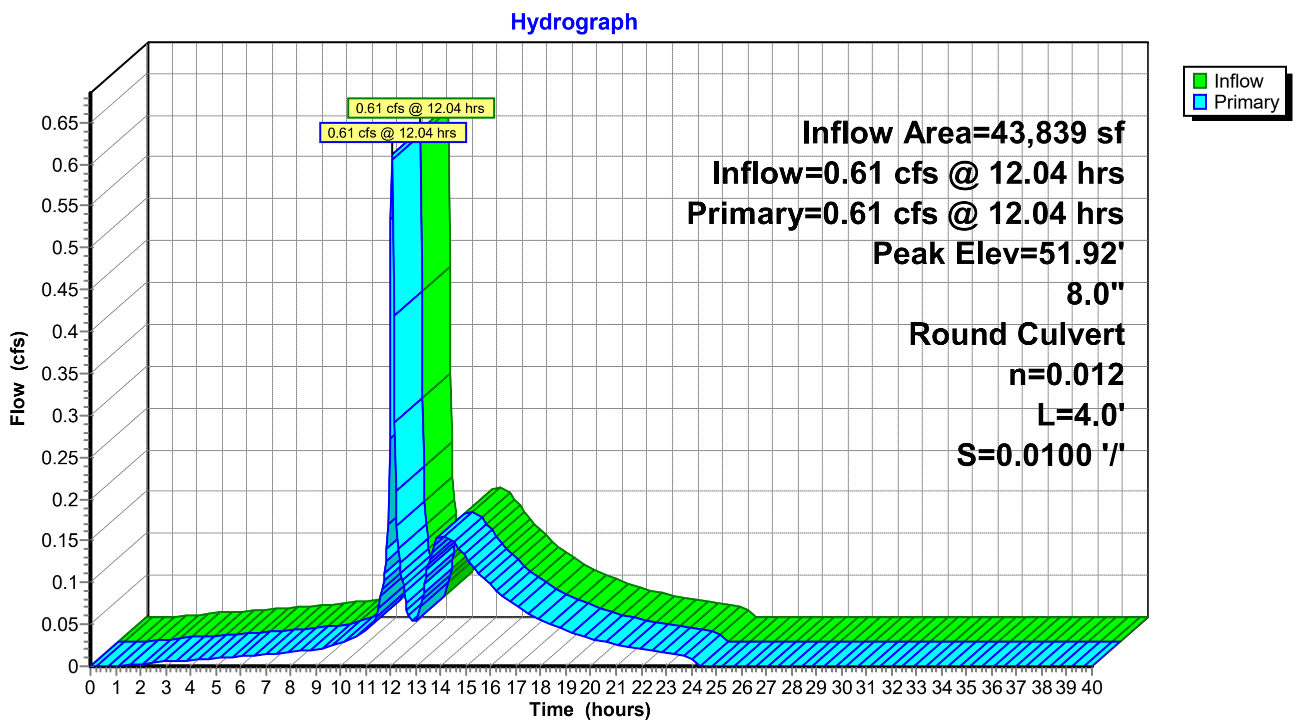
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 1.07" for 10-yr event
Inflow = 0.61 cfs @ 12.04 hrs, Volume= 3,894 cf
Outflow = 0.61 cfs @ 12.04 hrs, Volume= 3,894 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.61 cfs @ 12.04 hrs, Volume= 3,894 cf
Routed to Pond 10 : EXIST MH10

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.92' @ 12.04 hrs
Flood Elev= 55.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.33'	**8.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.33' / 51.29' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.59 cfs @ 12.04 hrs HW=51.90' TW=51.75' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.59 cfs @ 2.47 fps)

Pond 1: CB1



Summary for Pond 1P: Concrete Galleys

Inflow Area = 38,513 sf, 61.75% Impervious, Inflow Depth = 4.13" for 10-yr event
Inflow = 3.10 cfs @ 12.04 hrs, Volume= 13,251 cf
Outflow = 0.20 cfs @ 14.16 hrs, Volume= 11,283 cf, Atten= 94%, Lag= 126.8 min
Discarded = 0.07 cfs @ 8.35 hrs, Volume= 9,475 cf
Primary = 0.13 cfs @ 14.16 hrs, Volume= 1,807 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.93' @ 14.14 hrs Surf.Area= 3,040 sf Storage= 6,466 cf

Plug-Flow detention time= 542.9 min calculated for 11,269 cf (85% of inflow)
Center-of-Mass det. time= 465.1 min (1,245.4 - 780.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	48.50'	2,793 cf	**10.50'W x 289.50'L x 5.25'H Field A** 15,959 cf Overall - 8,976 cf Embedded = 6,983 cf x 40.0% Voids
#2A	49.50'	6,679 cf	**Concrete Galley 4x4x4.25** x 144 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 144 Chambers in 2 Rows
		9,472 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	51.72'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.72' / 51.33' S= 0.0098 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 8.35 hrs HW=48.55' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.13 cfs @ 14.16 hrs HW=51.93' TW=51.60' (Dynamic Tailwater)
└─**2=Culvert** (Outlet Controls 0.13 cfs @ 1.99 fps)

Pond 1P: Concrete Galleys - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

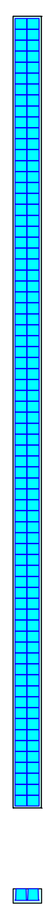
72 Chambers/Row x 4.00' Long = 288.00' Row Length +9.0" End Stone x 2 = 289.50' Base Length
2 Rows x 54.0" Wide + 9.0" Side Stone x 2 = 10.50' Base Width
12.0" Stone Base + 51.0" Chamber Height = 5.25' Field Height

144 Chambers x 46.4 cf = 6,678.8 cf Chamber Storage
144 Chambers x 62.3 cf = 8,975.7 cf Displacement

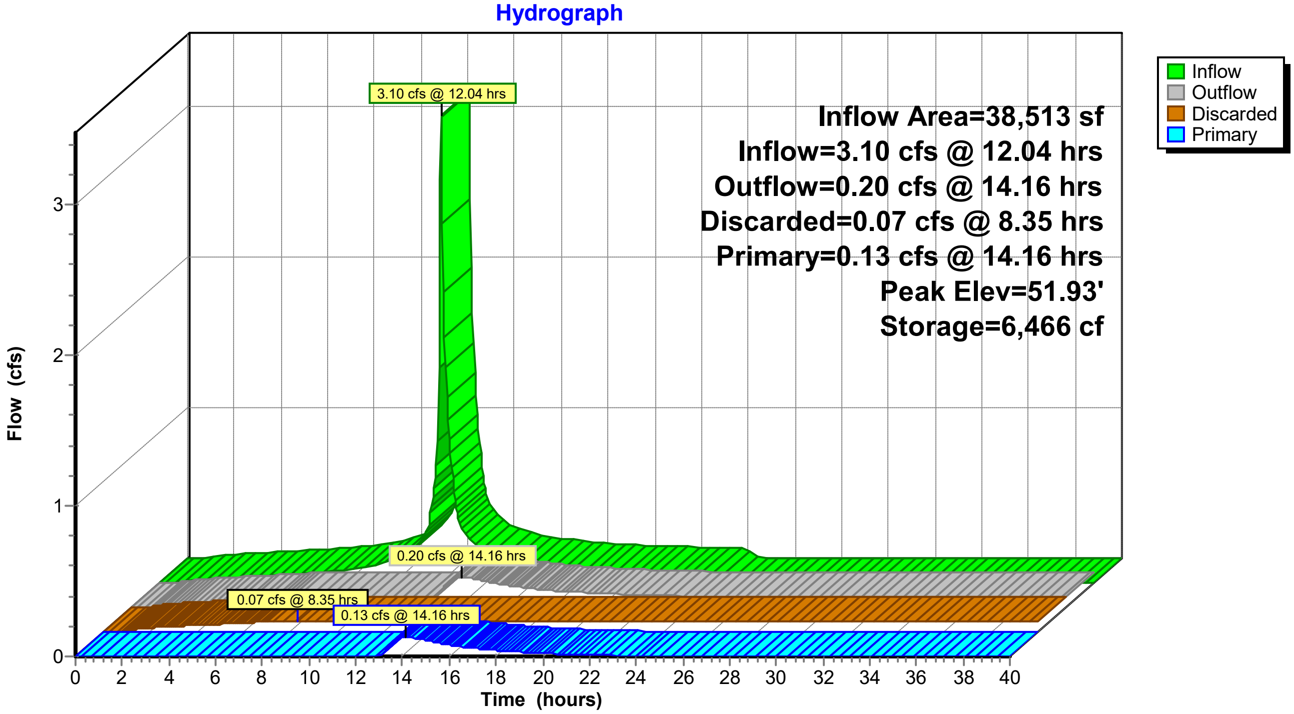
15,958.7 cf Field - 8,975.7 cf Chambers = 6,983.0 cf Stone x 40.0% Voids = 2,793.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,472.0 cf = 0.217 af
Overall Storage Efficiency = 59.4%
Overall System Size = 289.50' x 10.50' x 5.25'

144 Chambers
591.1 cy Field
258.6 cy Stone



Pond 1P: Concrete Galleys



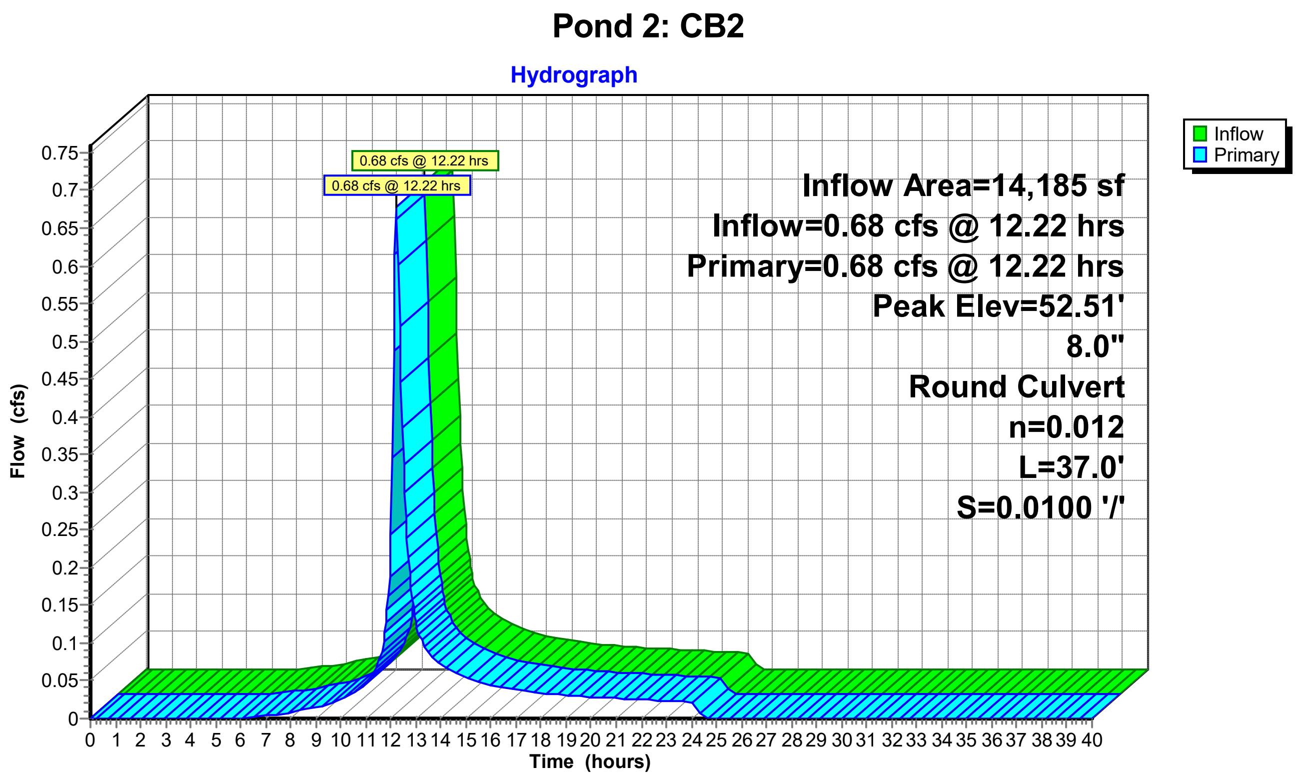
Summary for Pond 2: CB2

Inflow Area = 14,185 sf, 1.50% Impervious, Inflow Depth = 2.95" for 10-yr event
Inflow = 0.68 cfs @ 12.22 hrs, Volume= 3,485 cf
Outflow = 0.68 cfs @ 12.22 hrs, Volume= 3,485 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.68 cfs @ 12.22 hrs, Volume= 3,485 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.51' @ 12.22 hrs
Flood Elev= 54.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**8.0" Round Culvert** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 51.63' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.67 cfs @ 12.22 hrs HW=52.51' TW=50.90' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.67 cfs @ 3.25 fps)



Summary for Pond 2P: Pervious Pavement

Inflow Area = 1,383 sf, 74.19% Impervious, Inflow Depth = 3.83" for 10-yr event
Inflow = 0.14 cfs @ 12.04 hrs, Volume= 441 cf
Outflow = 0.02 cfs @ 11.95 hrs, Volume= 441 cf, Atten= 83%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.95 hrs, Volume= 441 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.23' @ 12.46 hrs Surf.Area= 1,026 sf Storage= 83 cf

Plug-Flow detention time= 17.1 min calculated for 441 cf (100% of inflow)
Center-of-Mass det. time= 17.1 min (829.6 - 812.4)

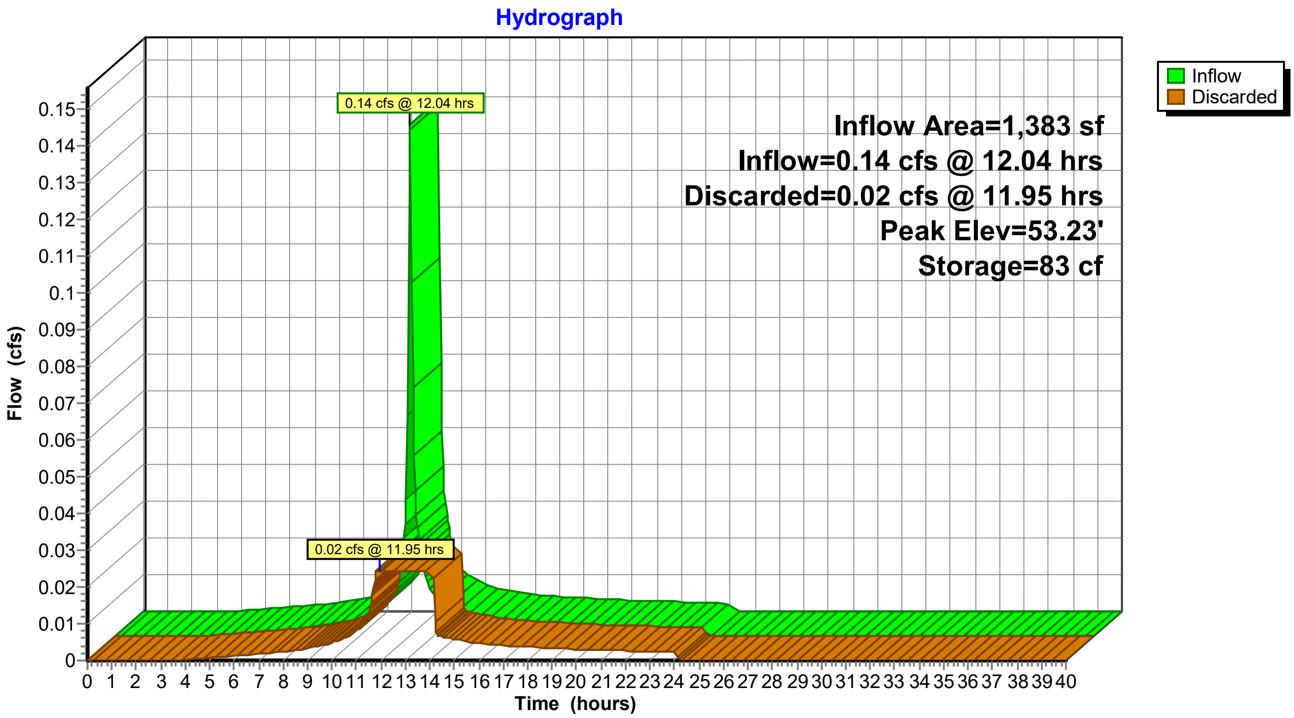
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	363 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,026	0.0	0	0
53.33	1,026	35.0	119	119
54.92	1,026	15.0	245	363

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 11.95 hrs HW=53.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 2P: Pervious Pavement



Summary for Pond 3: CB3

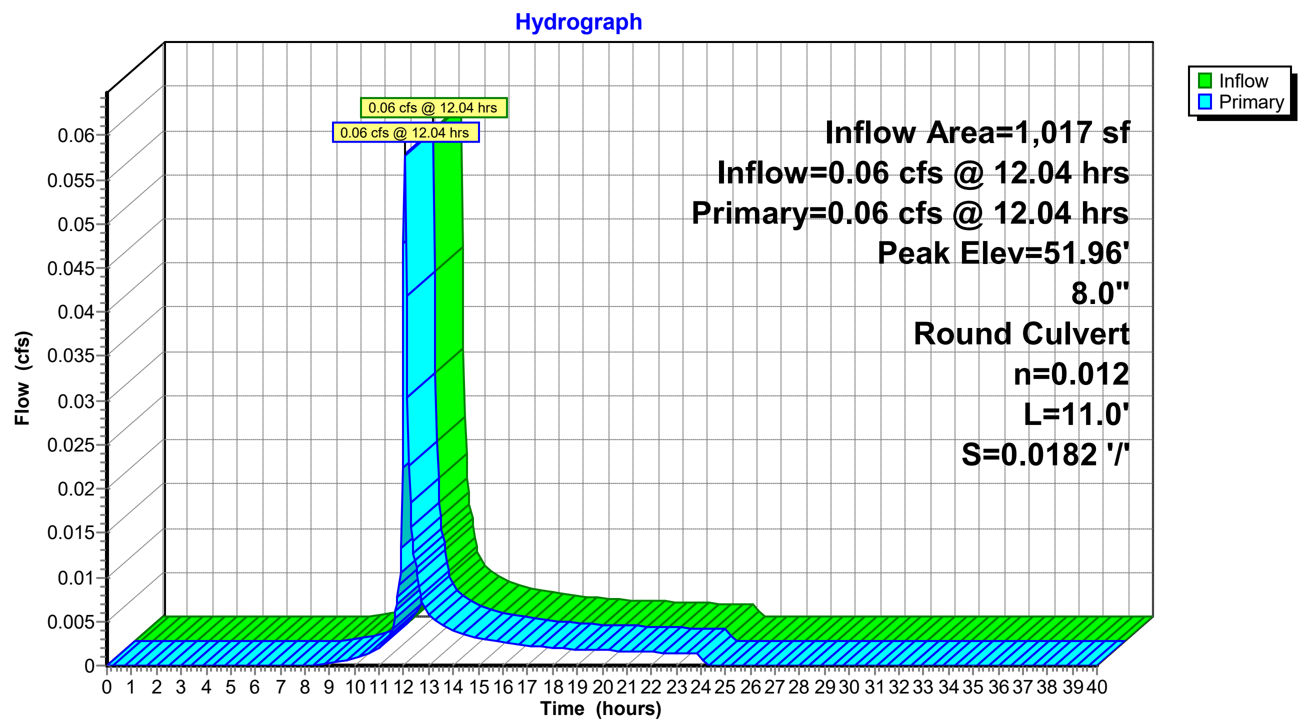
Inflow Area = 1,017 sf, 25.27% Impervious, Inflow Depth = 2.16" for 10-yr event
Inflow = 0.06 cfs @ 12.04 hrs, Volume= 183 cf
Outflow = 0.06 cfs @ 12.04 hrs, Volume= 183 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.06 cfs @ 12.04 hrs, Volume= 183 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.96' @ 12.04 hrs
Flood Elev= 54.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.83'	**8.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.83' / 51.63' S= 0.0182 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.06 cfs @ 12.04 hrs HW=51.96' TW=50.29' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 0.06 cfs @ 1.21 fps)

Pond 3: CB3



Summary for Pond 3P: Pervious Pavement

Inflow Area = 1,043 sf, 97.22% Impervious, Inflow Depth = 4.82" for 10-yr event
Inflow = 0.12 cfs @ 12.04 hrs, Volume= 419 cf
Outflow = 0.02 cfs @ 11.95 hrs, Volume= 419 cf, Atten= 80%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.95 hrs, Volume= 419 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.18' @ 12.36 hrs Surf.Area= 1,014 sf Storage= 65 cf

Plug-Flow detention time= 12.1 min calculated for 418 cf (100% of inflow)
Center-of-Mass det. time= 12.1 min (770.3 - 758.2)

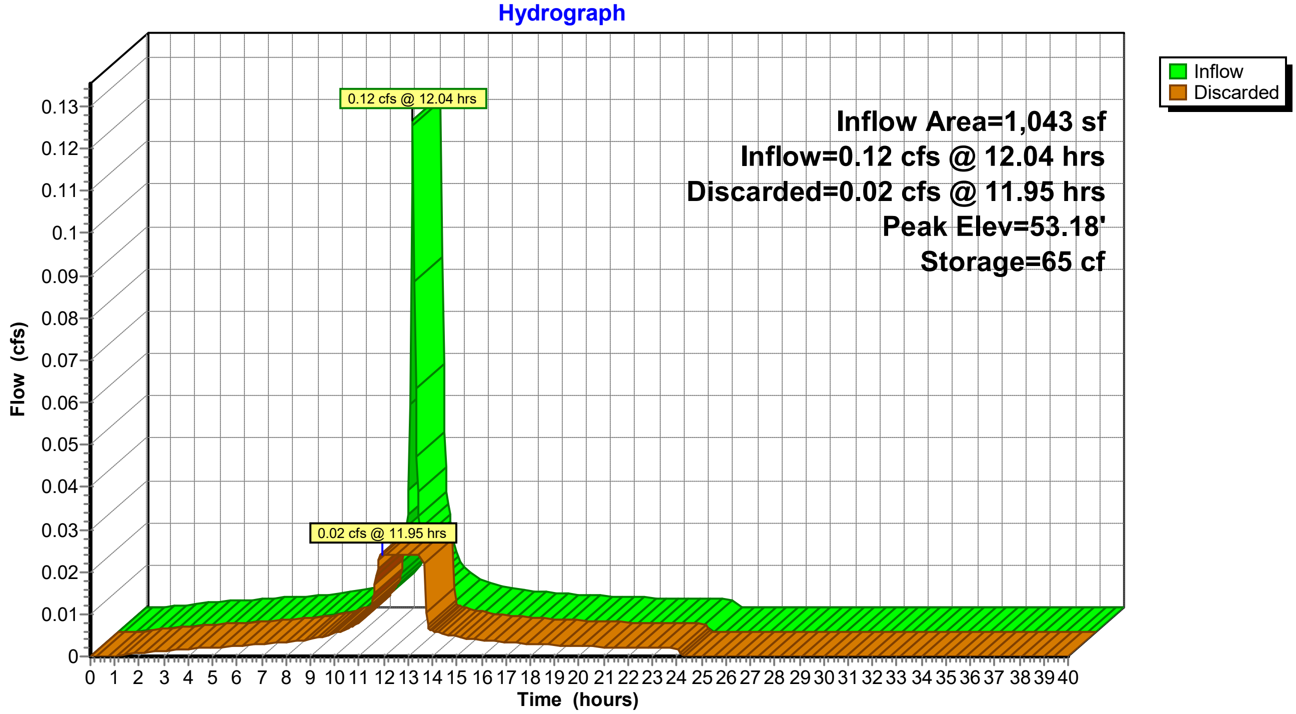
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	359 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,014	0.0	0	0
53.33	1,014	35.0	117	117
54.92	1,014	15.0	242	359

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 11.95 hrs HW=53.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 3P: Pervious Pavement



Summary for Pond 4: CB4

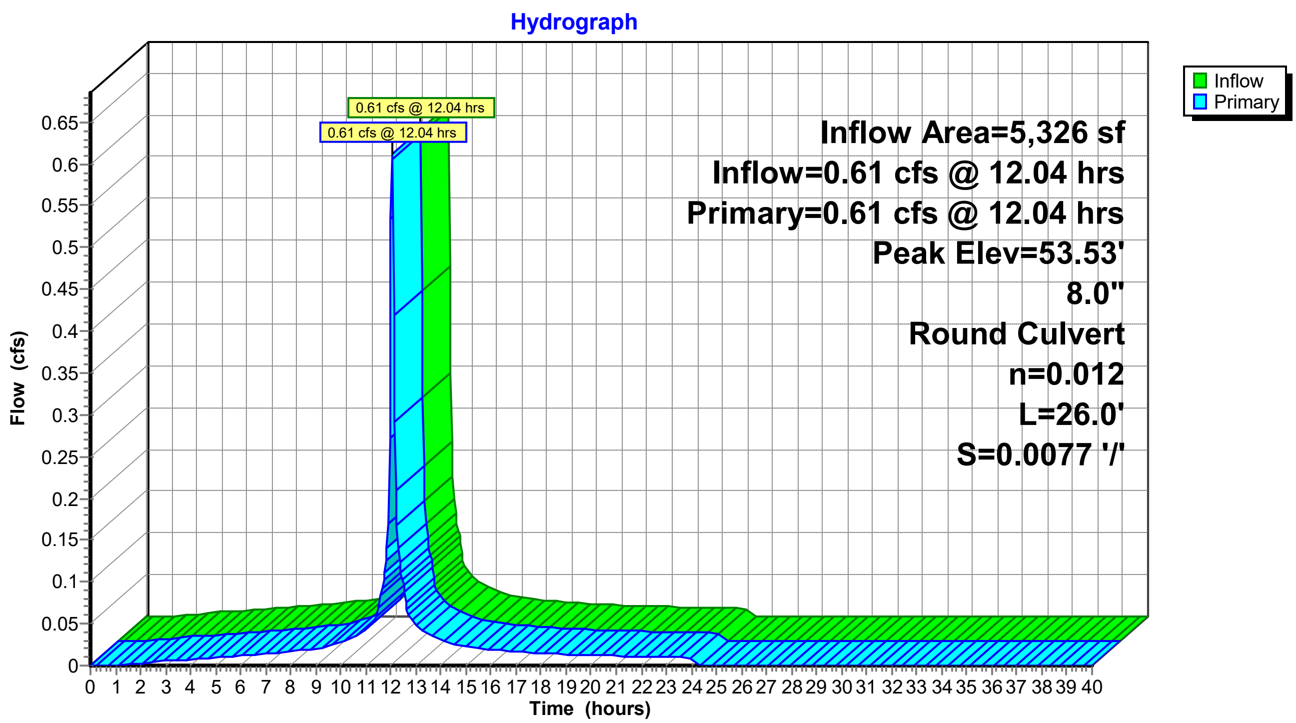
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 4.70" for 10-yr event
Inflow = 0.61 cfs @ 12.04 hrs, Volume= 2,087 cf
Outflow = 0.61 cfs @ 12.04 hrs, Volume= 2,087 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.61 cfs @ 12.04 hrs, Volume= 2,087 cf
Routed to Pond 5 : DMH5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.53' @ 12.04 hrs
Flood Elev= 55.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.97'	**8.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.97' / 52.77' S= 0.0077 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.59 cfs @ 12.04 hrs HW=53.52' TW=53.26' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.59 cfs @ 2.59 fps)

Pond 4: CB4



Summary for Pond 4P: Pervious Pavement

Inflow Area = 79 sf,100.00% Impervious, Inflow Depth = 4.93" for 10-yr event
Inflow = 0.01 cfs @ 12.04 hrs, Volume= 32 cf
Outflow = 0.00 cfs @ 12.00 hrs, Volume= 32 cf, Atten= 74%, Lag= 0.0 min
Discarded = 0.00 cfs @ 12.00 hrs, Volume= 32 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.11' @ 12.27 hrs Surf.Area= 102 sf Storage= 4 cf

Plug-Flow detention time= 7.4 min calculated for 32 cf (100% of inflow)
Center-of-Mass det. time= 7.4 min (756.4 - 749.0)

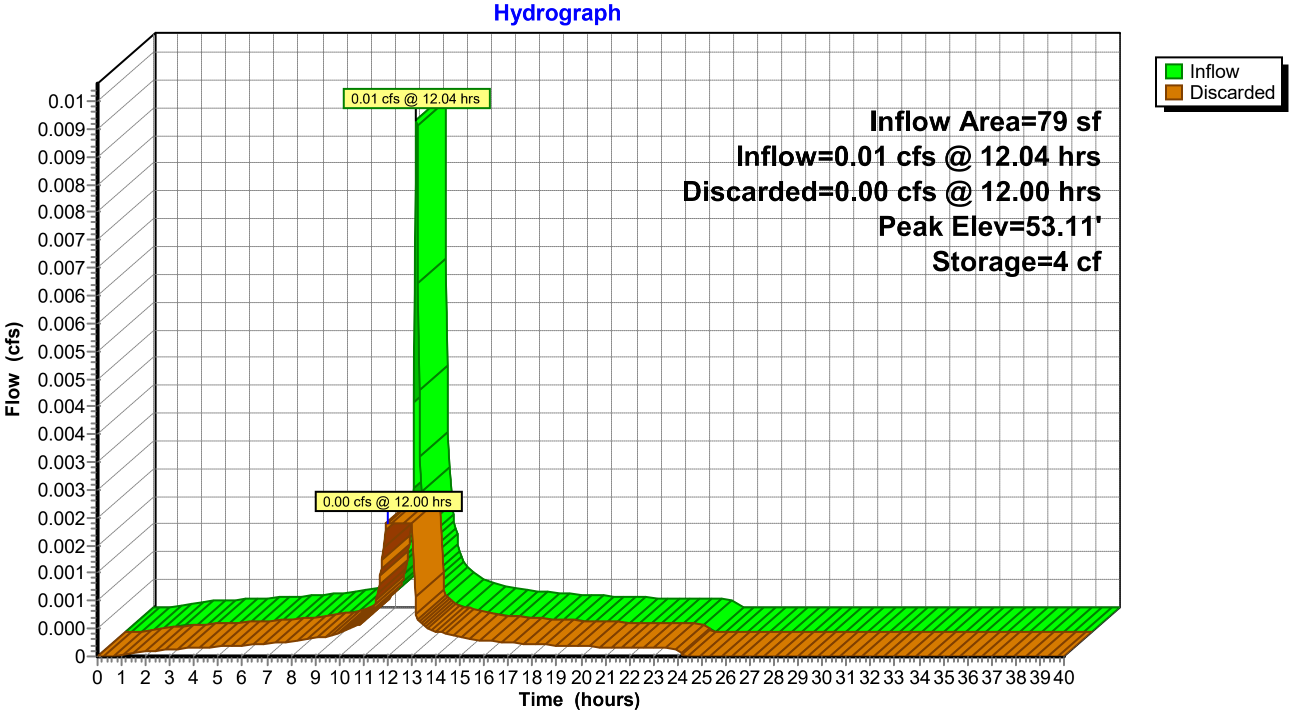
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	36 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	102	0.0	0	0
53.33	102	35.0	12	12
54.92	102	15.0	24	36

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 12.00 hrs HW=53.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Pond 4P: Pervious Pavement



Summary for Pond 5: DMH5

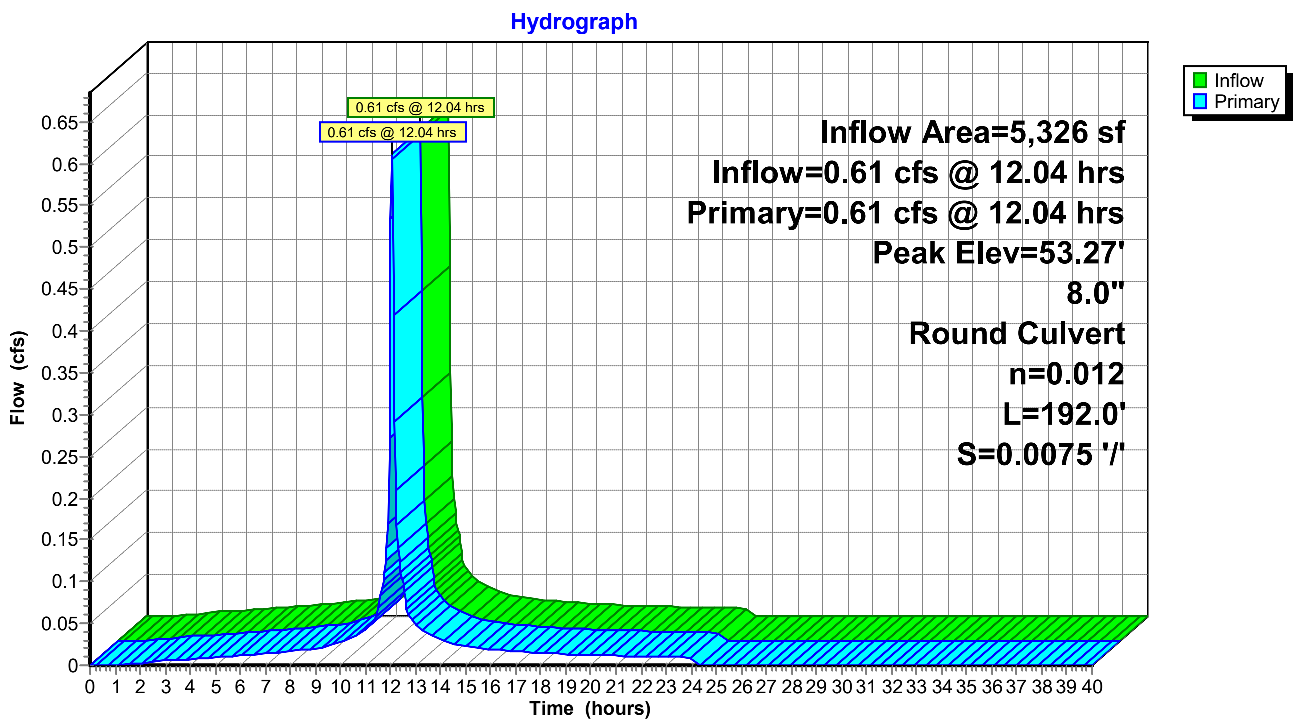
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 4.70" for 10-yr event
Inflow = 0.61 cfs @ 12.04 hrs, Volume= 2,087 cf
Outflow = 0.61 cfs @ 12.04 hrs, Volume= 2,087 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.61 cfs @ 12.04 hrs, Volume= 2,087 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.27' @ 12.04 hrs
Flood Elev= 55.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.77'	**8.0" Round Culvert** L= 192.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.77' / 51.33' S= 0.0075 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.59 cfs @ 12.04 hrs HW=53.26' TW=51.90' (Dynamic Tailwater)
1=Culvert (Outlet Controls 0.59 cfs @ 3.00 fps)

Pond 5: DMH5



Summary for Pond 10: EXIST MH10

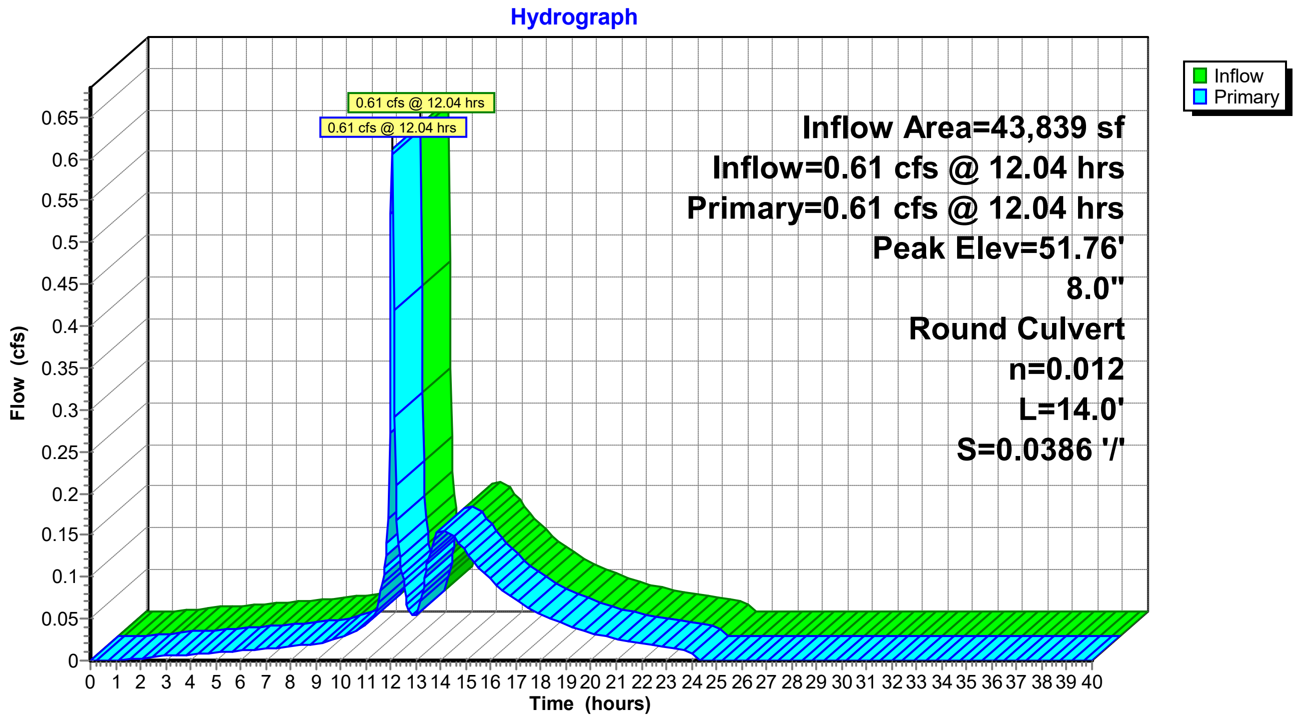
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 1.07" for 10-yr event
Inflow = 0.61 cfs @ 12.04 hrs, Volume= 3,894 cf
Outflow = 0.61 cfs @ 12.04 hrs, Volume= 3,894 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.61 cfs @ 12.04 hrs, Volume= 3,894 cf
Routed to Link 1L : Essex Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.76' @ 12.04 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.59 cfs @ 12.04 hrs HW=51.75' TW=0.00' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.59 cfs @ 2.30 fps)

Pond 10: EXIST MH10

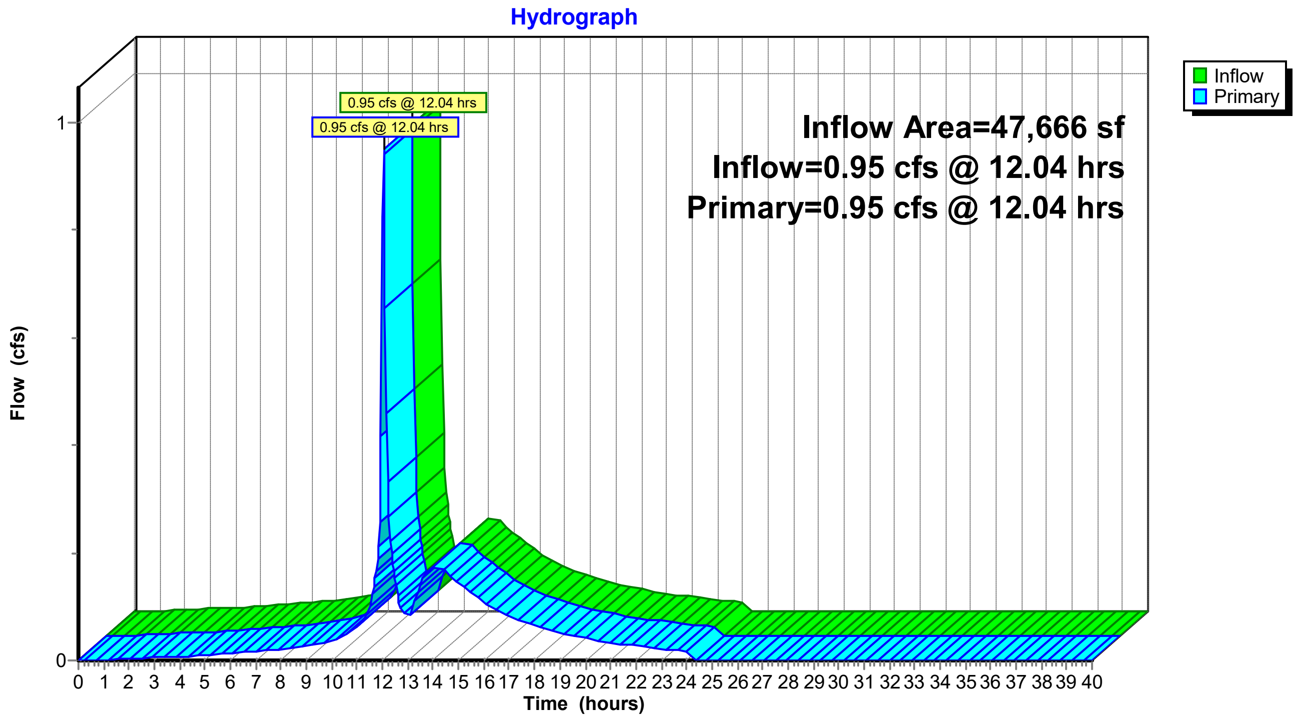


Summary for Link 1L: Essex Street

Inflow Area =	47,666 sf,	65.24% Impervious,	Inflow Depth = 1.25"	for 10-yr event
Inflow =	0.95 cfs @	12.04 hrs, Volume=	4,956 cf	
Primary =	0.95 cfs @	12.04 hrs, Volume=	4,956 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 1L: Essex Street



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Runoff Area=23,311 sf 100.00% Impervious Runoff Depth=6.10"
Tc=6.0 min CN=98 Runoff=3.31 cfs 11,853 cf

Subcatchment 2S: Runoff Area=14,185 sf 1.50% Impervious Runoff Depth=3.98"
Flow Length=220' Tc=19.5 min CN=79 Runoff=0.91 cfs 4,710 cf

Subcatchment 3S: Runoff Area=1,017 sf 25.27% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=70 Runoff=0.08 cfs 261 cf

Subcatchment 4S: Runoff Area=5,326 sf 95.04% Impervious Runoff Depth=5.87"
Tc=6.0 min CN=96 Runoff=0.75 cfs 2,604 cf

Subcatchment 5S: Runoff Area=3,827 sf 58.87% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=83 Runoff=0.44 cfs 1,406 cf

Subcatchment 6S: Runoff Area=1,383 sf 74.19% Impervious Runoff Depth=4.95"
Tc=6.0 min CN=88 Runoff=0.18 cfs 571 cf

Subcatchment 7S: Runoff Area=1,043 sf 97.22% Impervious Runoff Depth=5.98"
Tc=6.0 min CN=97 Runoff=0.15 cfs 520 cf

Subcatchment 8S: Runoff Area=79 sf 100.00% Impervious Runoff Depth=6.10"
Tc=6.0 min CN=98 Runoff=0.01 cfs 40 cf

Pond 1: CB1 Peak Elev=52.02' Inflow=0.75 cfs 7,636 cf
8.0" Round Culvert n=0.012 L=4.0' S=0.0100 '/' Outflow=0.75 cfs 7,636 cf

Pond 1P: Concrete Galleys Peak Elev=52.24' Storage=7,131 cf Inflow=3.84 cfs 16,824 cf
Discarded=0.07 cfs 9,734 cf Primary=0.55 cfs 5,033 cf Outflow=0.62 cfs 14,767 cf

Pond 2: CB2 Peak Elev=52.63' Inflow=0.91 cfs 4,710 cf
8.0" Round Culvert n=0.012 L=37.0' S=0.0100 '/' Outflow=0.91 cfs 4,710 cf

Pond 2P: Pervious Pavement Peak Elev=53.36' Storage=123 cf Inflow=0.18 cfs 571 cf
Outflow=0.02 cfs 571 cf

Pond 3: CB3 Peak Elev=52.24' Inflow=0.08 cfs 261 cf
8.0" Round Culvert n=0.012 L=11.0' S=0.0182 '/' Outflow=0.08 cfs 261 cf

Pond 3P: Pervious Pavement Peak Elev=53.26' Storage=92 cf Inflow=0.15 cfs 520 cf
Outflow=0.02 cfs 520 cf

Pond 4: CB4 Peak Elev=53.62' Inflow=0.75 cfs 2,604 cf
8.0" Round Culvert n=0.012 L=26.0' S=0.0077 '/' Outflow=0.75 cfs 2,604 cf

Pond 4P: Pervious Pavement Peak Elev=53.16' Storage=6 cf Inflow=0.01 cfs 40 cf
Outflow=0.00 cfs 40 cf

Pond 5: DMH5 Peak Elev=53.35' Inflow=0.75 cfs 2,604 cf
8.0" Round Culvert n=0.012 L=192.0' S=0.0075 '/' Outflow=0.75 cfs 2,604 cf

Pond 10: EXIST MH10 Peak Elev=51.83' Inflow=0.75 cfs 7,636 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=0.75 cfs 7,636 cf

Link 1L: Essex Street Inflow=1.19 cfs 9,042 cf
Primary=1.19 cfs 9,042 cf

Total Runoff Area = 50,171 sf Runoff Volume = 21,964 cf Average Runoff Depth = 5.25"
33.80% Pervious = 16,956 sf 66.20% Impervious = 33,215 sf

Summary for Subcatchment 1S: Roof

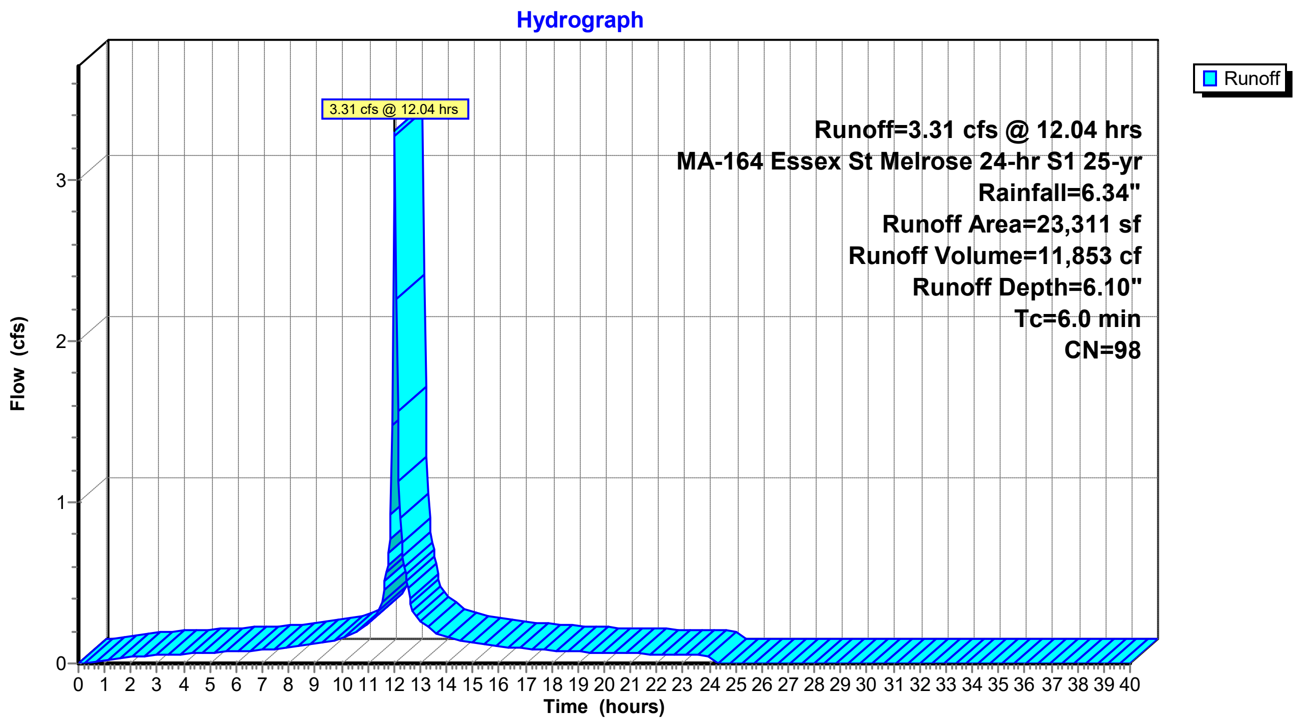
Runoff = 3.31 cfs @ 12.04 hrs, Volume= 11,853 cf, Depth= 6.10"
Routed to Pond 1P : Concrete Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
23,311	98	Roofs, HSG B
23,311		100.00% Impervious Area

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

Subcatchment 1S: Roof



Summary for Subcatchment 2S:

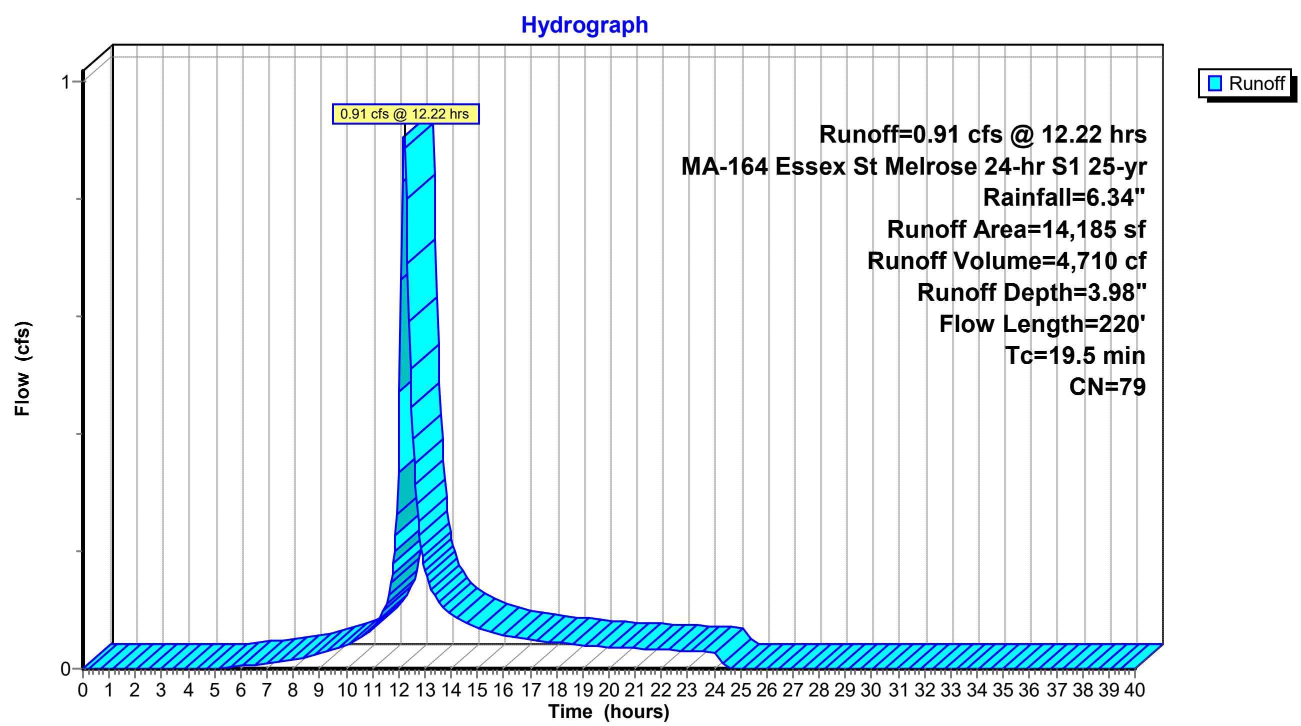
Runoff = 0.91 cfs @ 12.22 hrs, Volume= 4,710 cf, Depth= 3.98"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
6,924	96	Gravel surface, HSG B
7,048	61	>75% Grass cover, Good, HSG B
213	98	Paved parking, HSG B
14,185	79	Weighted Average
13,972		98.50% Pervious Area
213		1.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	35	0.0530	1.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
17.4	65	0.0050	0.06		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.29"
1.8	120	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
19.5	220	Total			

Subcatchment 2S:



Summary for Subcatchment 3S:

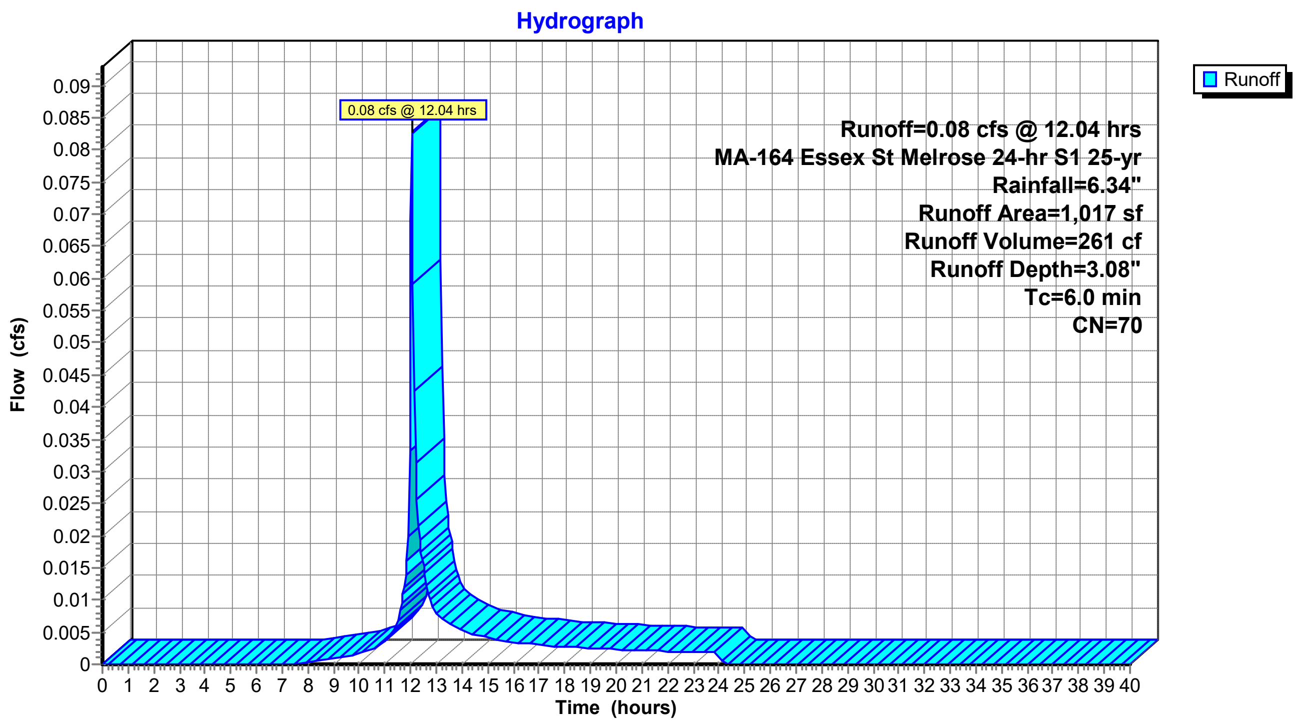
Runoff = 0.08 cfs @ 12.04 hrs, Volume= 261 cf, Depth= 3.08"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
760	61	>75% Grass cover, Good, HSG B
257	98	Paved parking, HSG B
1,017	70	Weighted Average
760		74.73% Pervious Area
257		25.27% Impervious Area

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

Subcatchment 3S:



Summary for Subcatchment 4S:

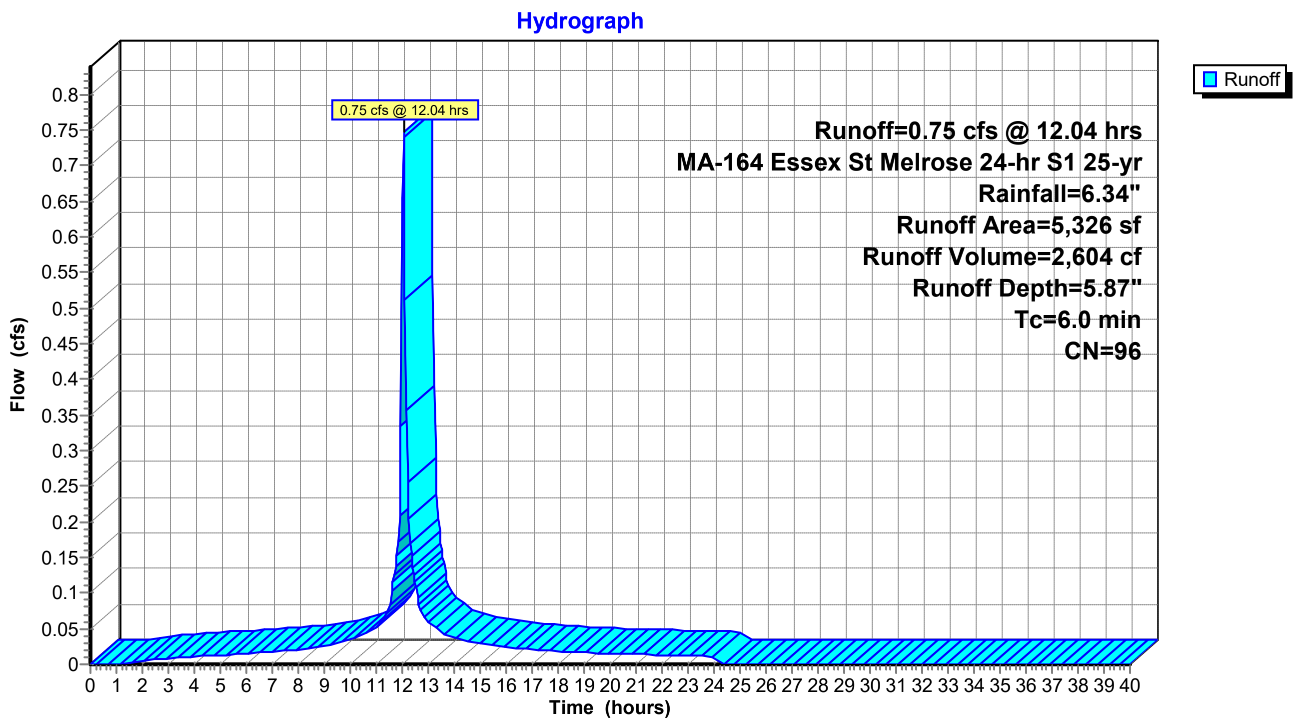
Runoff = 0.75 cfs @ 12.04 hrs, Volume= 2,604 cf, Depth= 5.87"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
264	61	>75% Grass cover, Good, HSG B
5,062	98	Paved parking, HSG B
5,326	96	Weighted Average
264		4.96% Pervious Area
5,062		95.04% Impervious Area

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

Subcatchment 4S:



Summary for Subcatchment 5S:

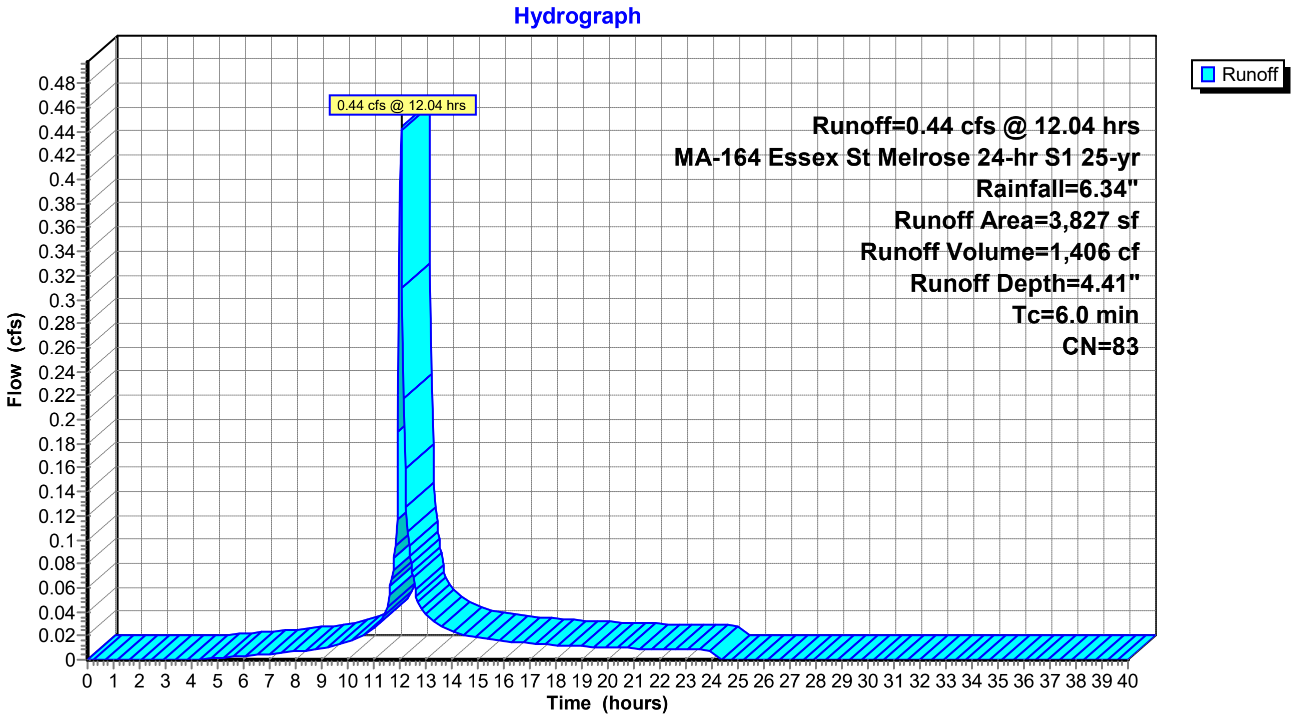
Runoff = 0.44 cfs @ 12.04 hrs, Volume= 1,406 cf, Depth= 4.41"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
1,574	61	>75% Grass cover, Good, HSG B
2,253	98	Paved parking, HSG B
3,827	83	Weighted Average
1,574		41.13% Pervious Area
2,253		58.87% Impervious Area

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

Subcatchment 5S:



Summary for Subcatchment 6S:

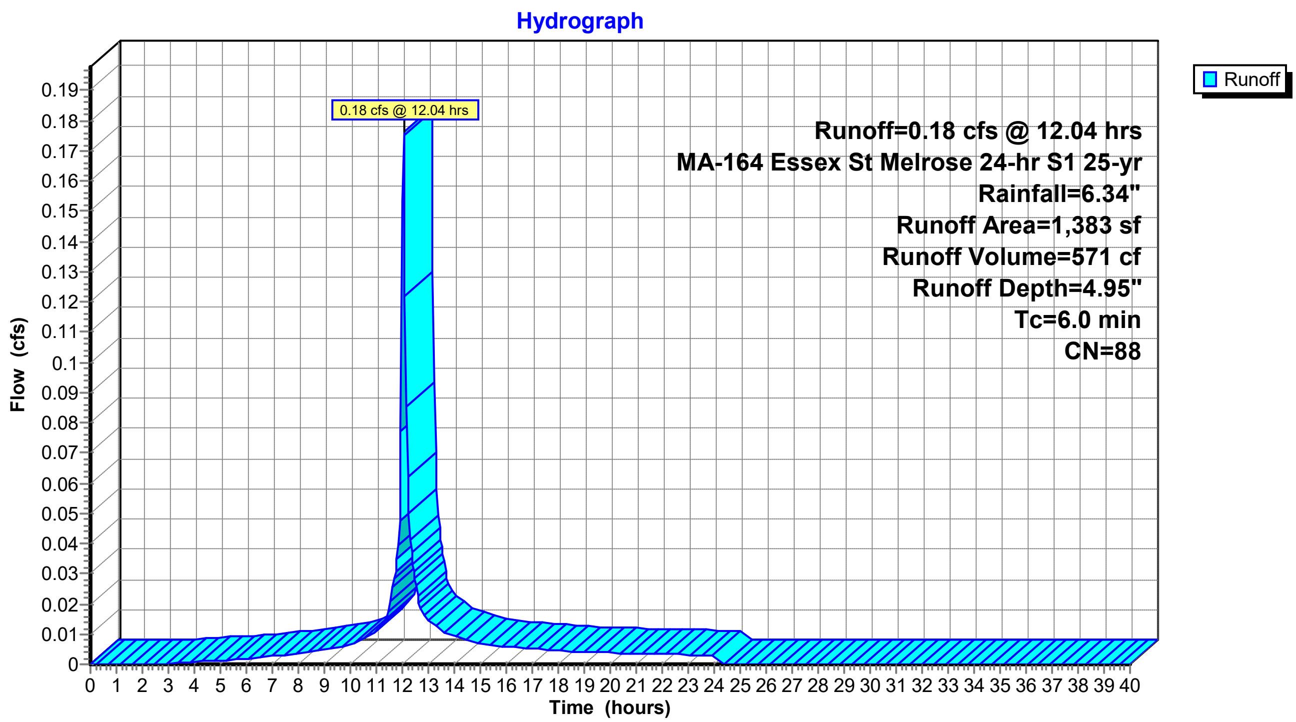
Runoff = 0.18 cfs @ 12.04 hrs, Volume= 571 cf, Depth= 4.95"
Routed to Pond 2P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
1,026	98	Paved parking, HSG B
357	61	>75% Grass cover, Good, HSG B
1,383	88	Weighted Average
357		25.81% Pervious Area
1,026		74.19% Impervious Area

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

Subcatchment 6S:



Summary for Subcatchment 7S:

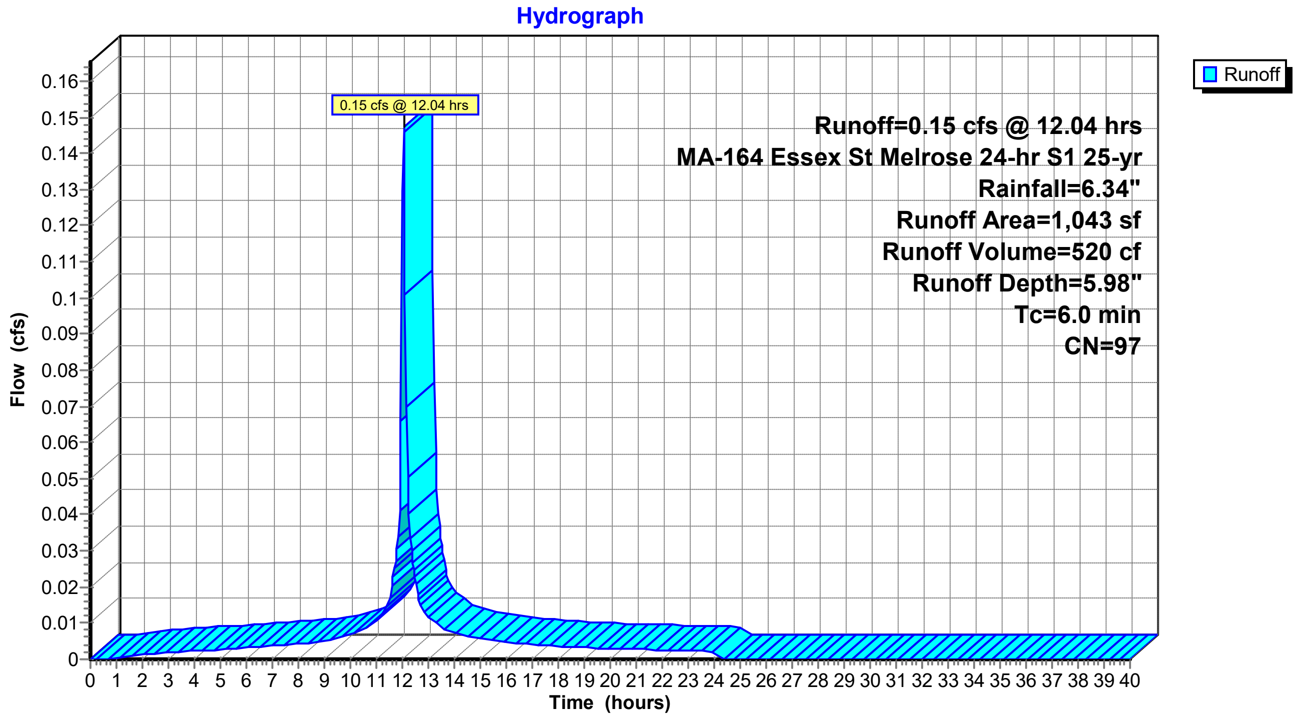
Runoff = 0.15 cfs @ 12.04 hrs, Volume= 520 cf, Depth= 5.98"
Routed to Pond 3P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
1,014	98	Paved parking, HSG B
29	61	>75% Grass cover, Good, HSG B
1,043	97	Weighted Average
29		2.78% Pervious Area
1,014		97.22% Impervious Area

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

Subcatchment 7S:



Summary for Subcatchment 8S:

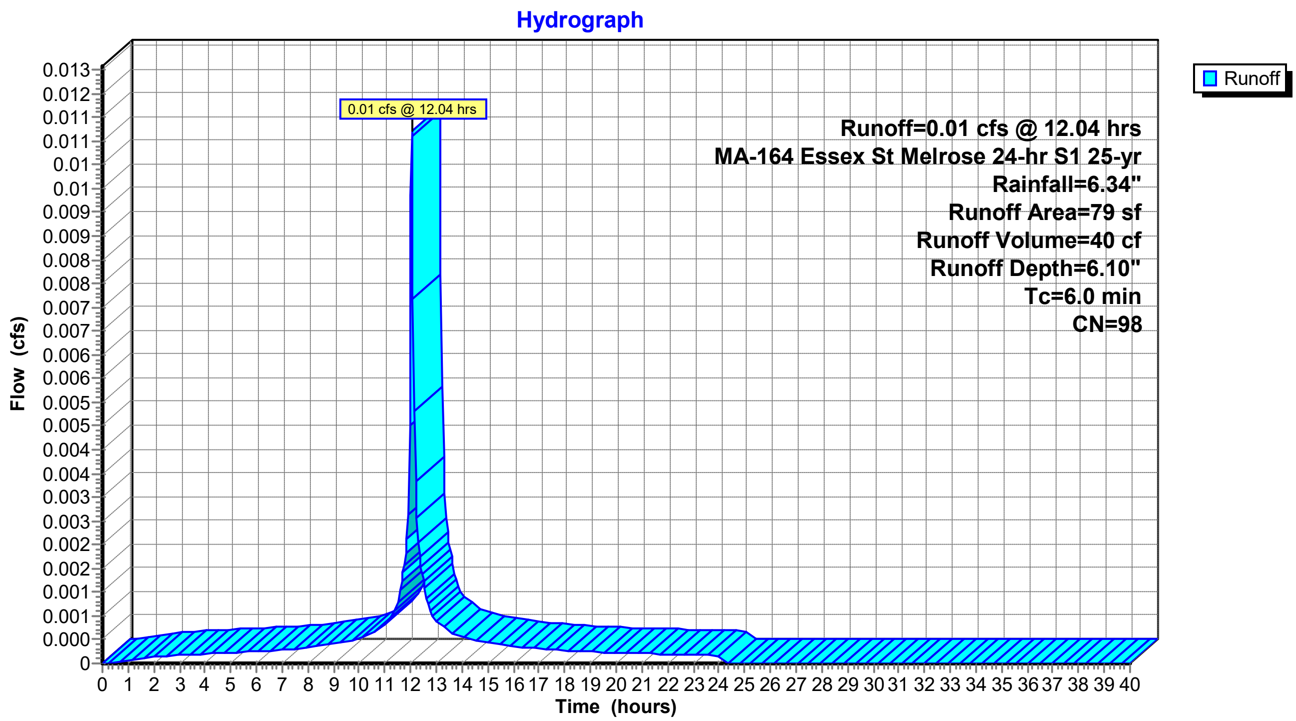
Runoff = 0.01 cfs @ 12.04 hrs, Volume= 40 cf, Depth= 6.10"
Routed to Pond 4P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 25-yr Rainfall=6.34"

Area (sf)	CN	Description
79	98	Paved parking, HSG B
79		100.00% Impervious Area

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

Subcatchment 8S:



Summary for Pond 1: CB1

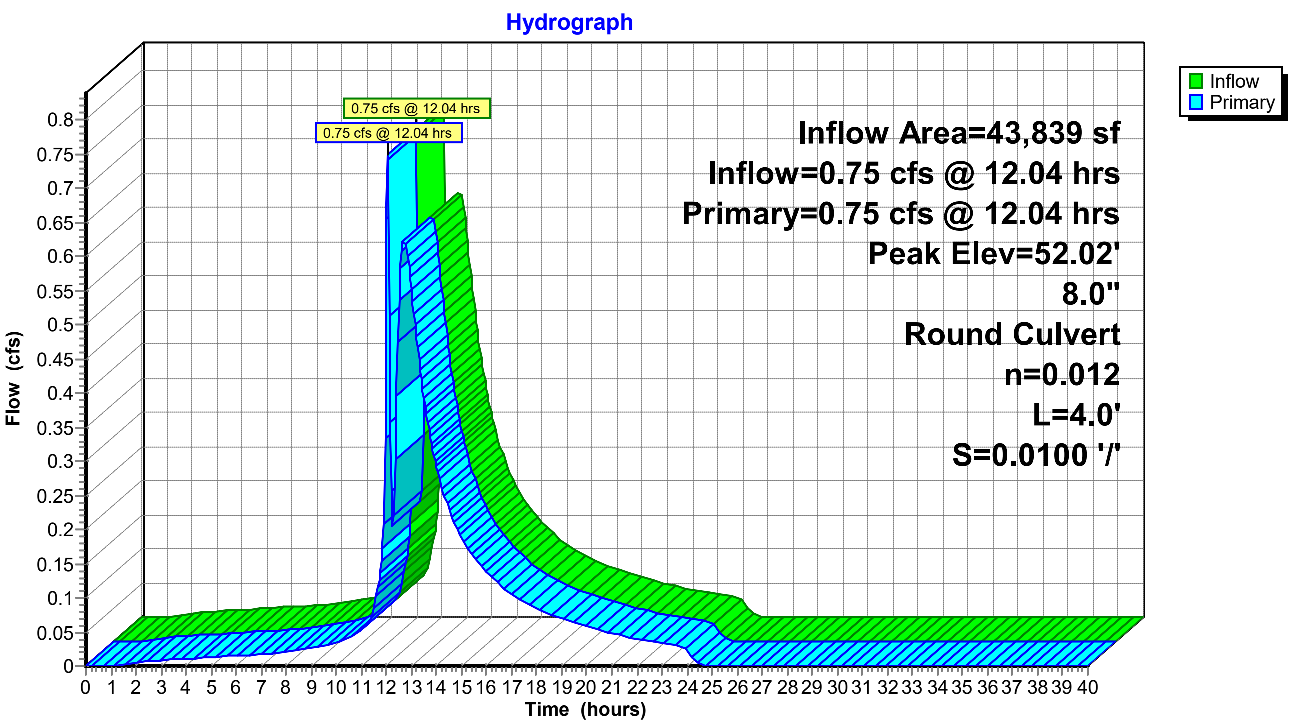
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 2.09" for 25-yr event
Inflow = 0.75 cfs @ 12.04 hrs, Volume= 7,636 cf
Outflow = 0.75 cfs @ 12.04 hrs, Volume= 7,636 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.75 cfs @ 12.04 hrs, Volume= 7,636 cf
Routed to Pond 10 : EXIST MH10

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.02' @ 12.04 hrs
Flood Elev= 55.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.33'	**8.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.33' / 51.29' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.73 cfs @ 12.04 hrs HW=52.00' TW=51.81' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.73 cfs @ 2.09 fps)

Pond 1: CB1



Summary for Pond 1P: Concrete Galleys

Inflow Area = 38,513 sf, 61.75% Impervious, Inflow Depth = 5.24" for 25-yr event
Inflow = 3.84 cfs @ 12.04 hrs, Volume= 16,824 cf
Outflow = 0.62 cfs @ 12.73 hrs, Volume= 14,767 cf, Atten= 84%, Lag= 41.3 min
Discarded = 0.07 cfs @ 6.90 hrs, Volume= 9,734 cf
Primary = 0.55 cfs @ 12.73 hrs, Volume= 5,033 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.24' @ 12.72 hrs Surf.Area= 3,040 sf Storage= 7,131 cf

Plug-Flow detention time= 438.2 min calculated for 14,767 cf (88% of inflow)
Center-of-Mass det. time= 370.3 min (1,146.7 - 776.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	48.50'	2,793 cf	**10.50'W x 289.50'L x 5.25'H Field A** 15,959 cf Overall - 8,976 cf Embedded = 6,983 cf x 40.0% Voids
#2A	49.50'	6,679 cf	**Concrete Galley 4x4x4.25** x 144 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 144 Chambers in 2 Rows
		9,472 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	51.72'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.72' / 51.33' S= 0.0098 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 6.90 hrs HW=48.55' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.55 cfs @ 12.73 hrs HW=52.24' TW=51.92' (Dynamic Tailwater)
└─**2=Culvert** (Outlet Controls 0.55 cfs @ 2.56 fps)

Pond 1P: Concrete Galleys - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

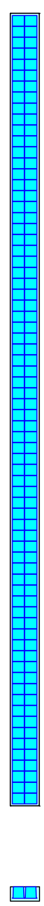
72 Chambers/Row x 4.00' Long = 288.00' Row Length +9.0" End Stone x 2 = 289.50' Base Length
2 Rows x 54.0" Wide + 9.0" Side Stone x 2 = 10.50' Base Width
12.0" Stone Base + 51.0" Chamber Height = 5.25' Field Height

144 Chambers x 46.4 cf = 6,678.8 cf Chamber Storage
144 Chambers x 62.3 cf = 8,975.7 cf Displacement

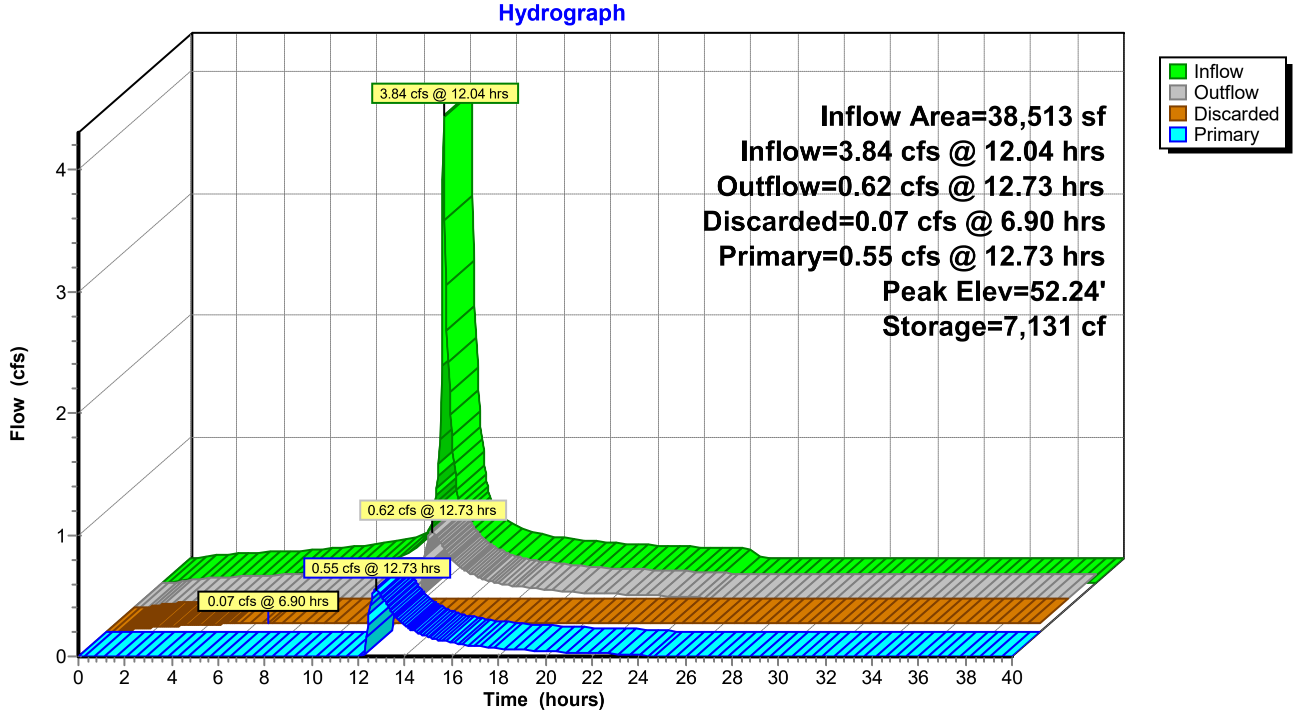
15,958.7 cf Field - 8,975.7 cf Chambers = 6,983.0 cf Stone x 40.0% Voids = 2,793.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,472.0 cf = 0.217 af
Overall Storage Efficiency = 59.4%
Overall System Size = 289.50' x 10.50' x 5.25'

144 Chambers
591.1 cy Field
258.6 cy Stone



Pond 1P: Concrete Galleys



Summary for Pond 2: CB2

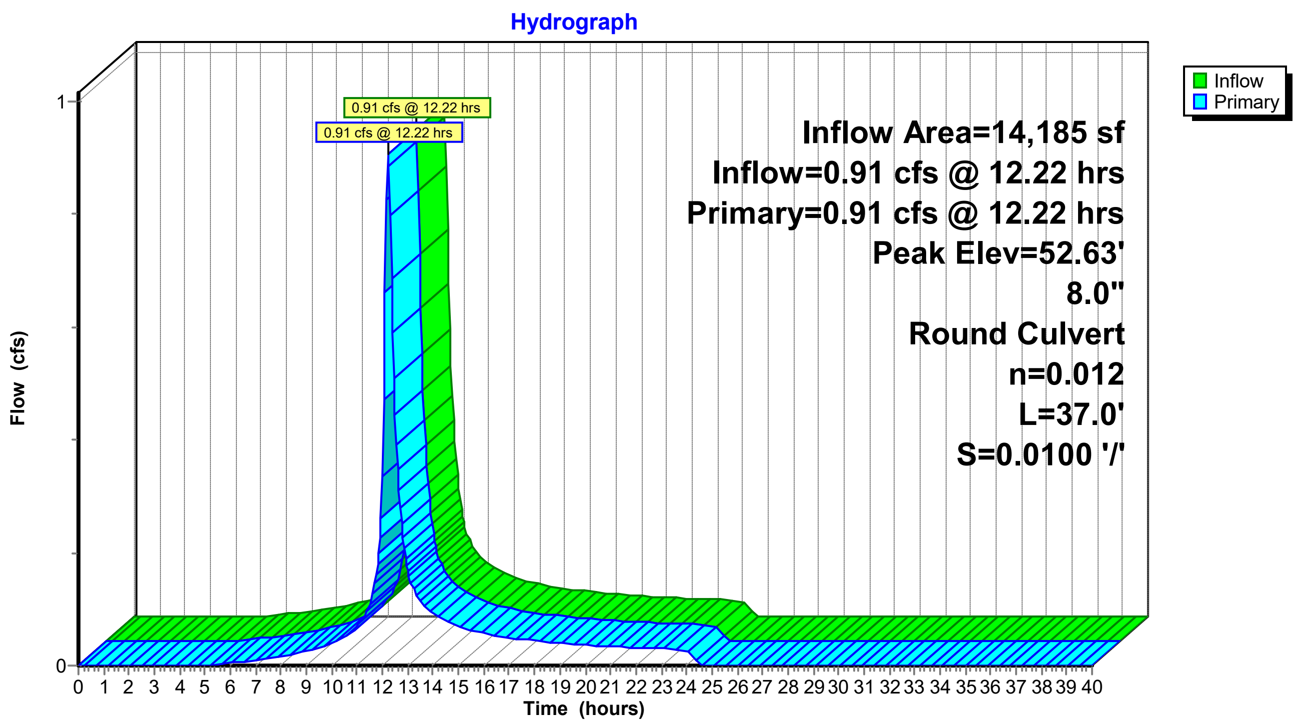
Inflow Area = 14,185 sf, 1.50% Impervious, Inflow Depth = 3.98" for 25-yr event
Inflow = 0.91 cfs @ 12.22 hrs, Volume= 4,710 cf
Outflow = 0.91 cfs @ 12.22 hrs, Volume= 4,710 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.91 cfs @ 12.22 hrs, Volume= 4,710 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.63' @ 12.22 hrs
Flood Elev= 54.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**8.0" Round Culvert** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 51.63' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.90 cfs @ 12.22 hrs HW=52.62' TW=51.62' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.90 cfs @ 3.44 fps)

Pond 2: CB2



Summary for Pond 2P: Pervious Pavement

Inflow Area = 1,383 sf, 74.19% Impervious, Inflow Depth = 4.95" for 25-yr event
Inflow = 0.18 cfs @ 12.04 hrs, Volume= 571 cf
Outflow = 0.02 cfs @ 11.85 hrs, Volume= 571 cf, Atten= 86%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.85 hrs, Volume= 571 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.36' @ 12.58 hrs Surf.Area= 1,026 sf Storage= 123 cf

Plug-Flow detention time= 27.1 min calculated for 570 cf (100% of inflow)
Center-of-Mass det. time= 27.0 min (830.1 - 803.1)

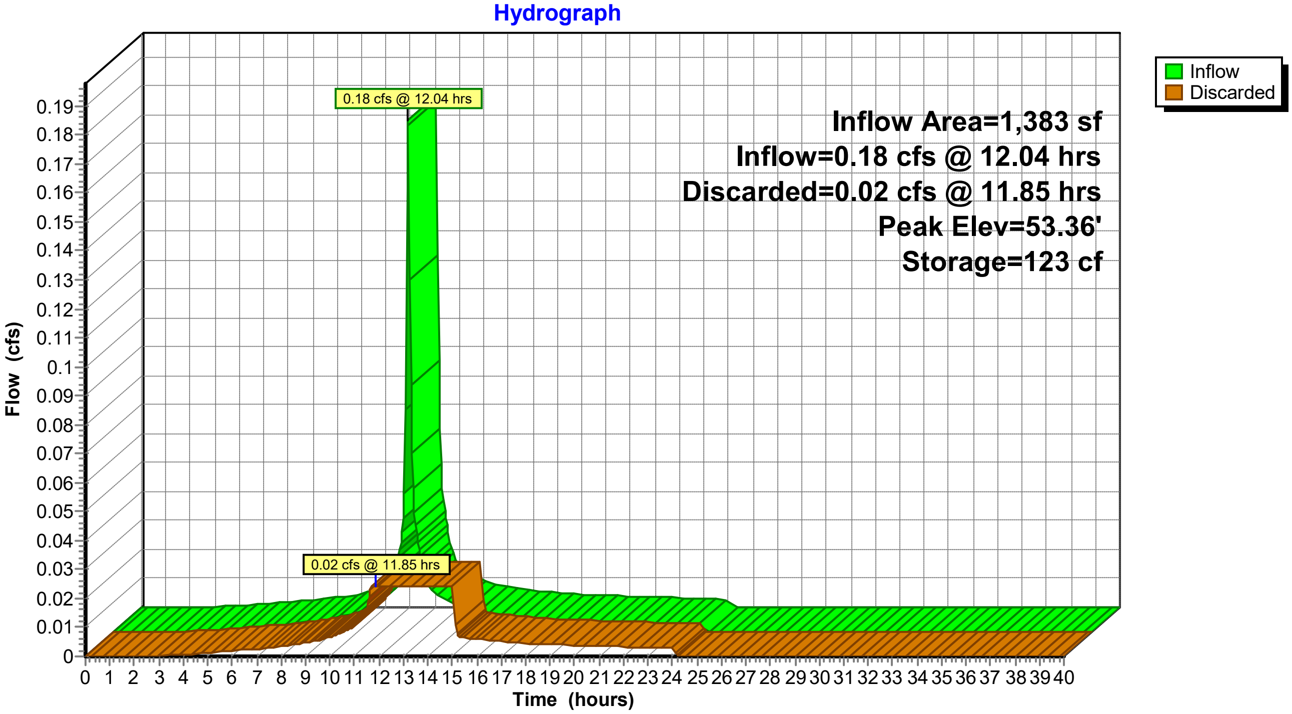
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	363 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,026	0.0	0	0
53.33	1,026	35.0	119	119
54.92	1,026	15.0	245	363

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 11.85 hrs HW=53.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 2P: Pervious Pavement



Summary for Pond 3: CB3

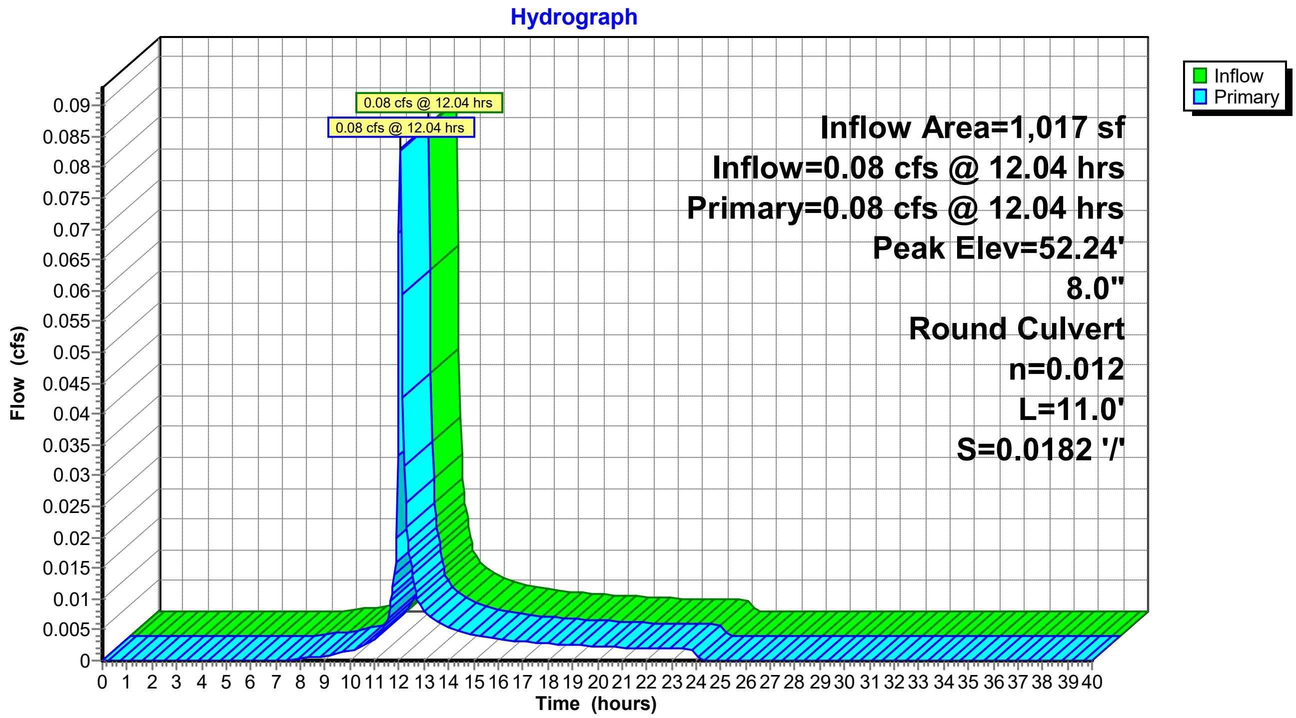
Inflow Area = 1,017 sf, 25.27% Impervious, Inflow Depth = 3.08" for 25-yr event
Inflow = 0.08 cfs @ 12.04 hrs, Volume= 261 cf
Outflow = 0.08 cfs @ 12.04 hrs, Volume= 261 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.08 cfs @ 12.04 hrs, Volume= 261 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.24' @ 12.72 hrs
Flood Elev= 54.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.83'	**8.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.83' / 51.63' S= 0.0182 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.08 cfs @ 12.04 hrs HW=51.98' TW=50.85' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.08 cfs @ 1.33 fps)

Pond 3: CB3



Summary for Pond 3P: Pervious Pavement

Inflow Area = 1,043 sf, 97.22% Impervious, Inflow Depth = 5.98" for 25-yr event
Inflow = 0.15 cfs @ 12.04 hrs, Volume= 520 cf
Outflow = 0.02 cfs @ 11.90 hrs, Volume= 520 cf, Atten= 84%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.90 hrs, Volume= 520 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.26' @ 12.47 hrs Surf.Area= 1,014 sf Storage= 92 cf

Plug-Flow detention time= 17.6 min calculated for 519 cf (100% of inflow)
Center-of-Mass det. time= 17.6 min (771.0 - 753.4)

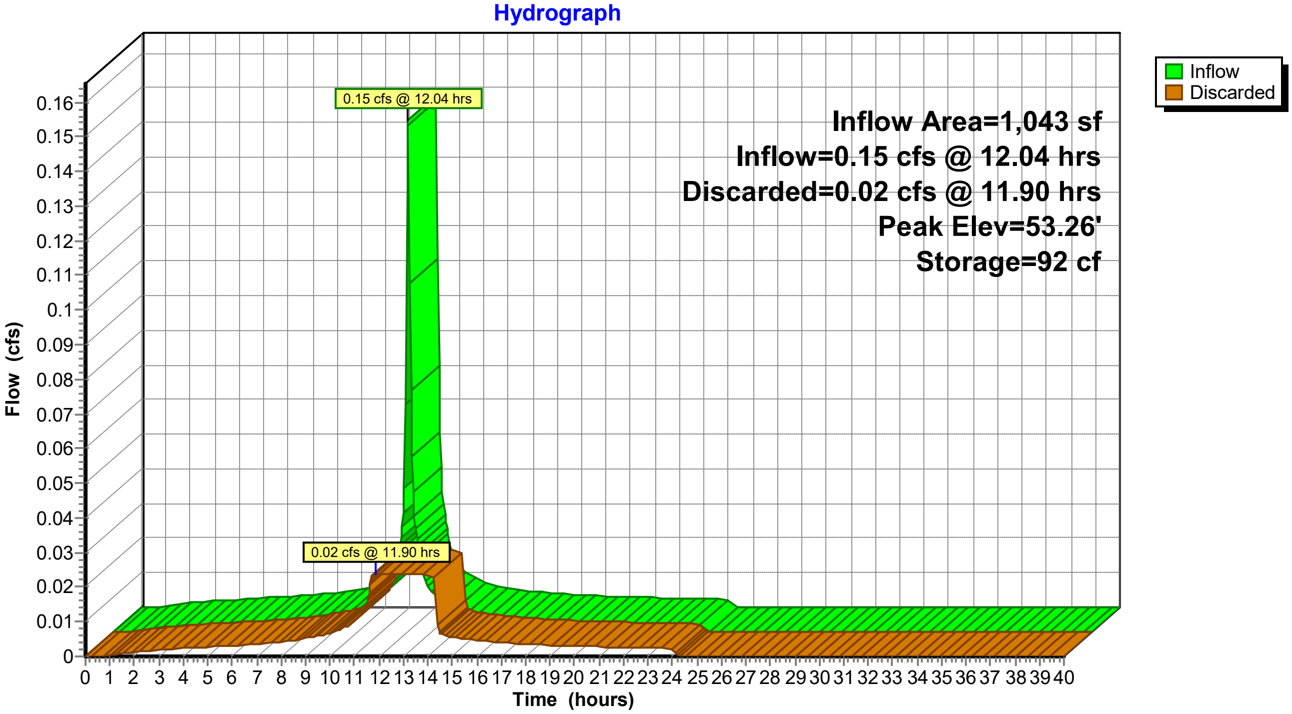
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	359 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,014	0.0	0	0
53.33	1,014	35.0	117	117
54.92	1,014	15.0	242	359

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 11.90 hrs HW=53.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 3P: Pervious Pavement



Summary for Pond 4: CB4

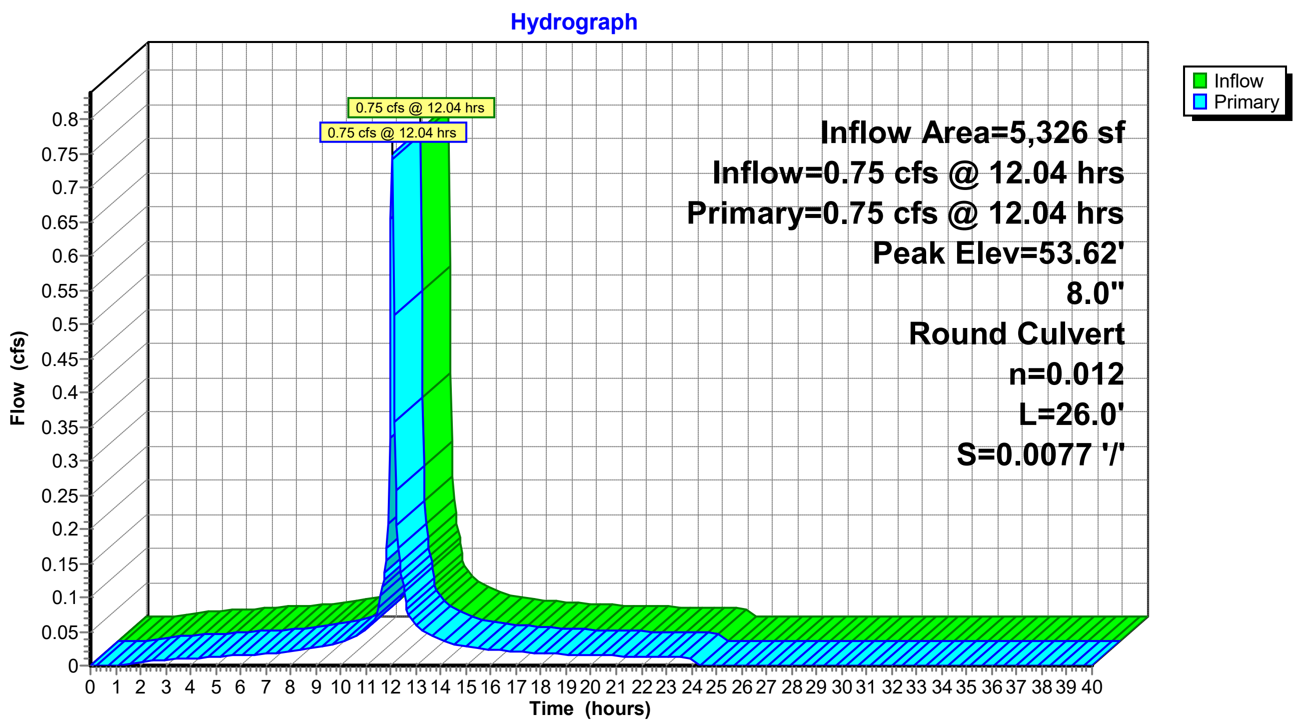
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 5.87" for 25-yr event
Inflow = 0.75 cfs @ 12.04 hrs, Volume= 2,604 cf
Outflow = 0.75 cfs @ 12.04 hrs, Volume= 2,604 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.75 cfs @ 12.04 hrs, Volume= 2,604 cf
Routed to Pond 5 : DMH5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.62' @ 12.04 hrs
Flood Elev= 55.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.97'	**8.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.97' / 52.77' S= 0.0077 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.72 cfs @ 12.04 hrs HW=53.61' TW=53.33' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.72 cfs @ 2.68 fps)

Pond 4: CB4



Summary for Pond 4P: Pervious Pavement

Inflow Area = 79 sf,100.00% Impervious, Inflow Depth = 6.10" for 25-yr event
Inflow = 0.01 cfs @ 12.04 hrs, Volume= 40 cf
Outflow = 0.00 cfs @ 11.95 hrs, Volume= 40 cf, Atten= 79%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.95 hrs, Volume= 40 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.16' @ 12.33 hrs Surf.Area= 102 sf Storage= 6 cf

Plug-Flow detention time= 10.2 min calculated for 40 cf (100% of inflow)
Center-of-Mass det. time= 10.2 min (755.6 - 745.3)

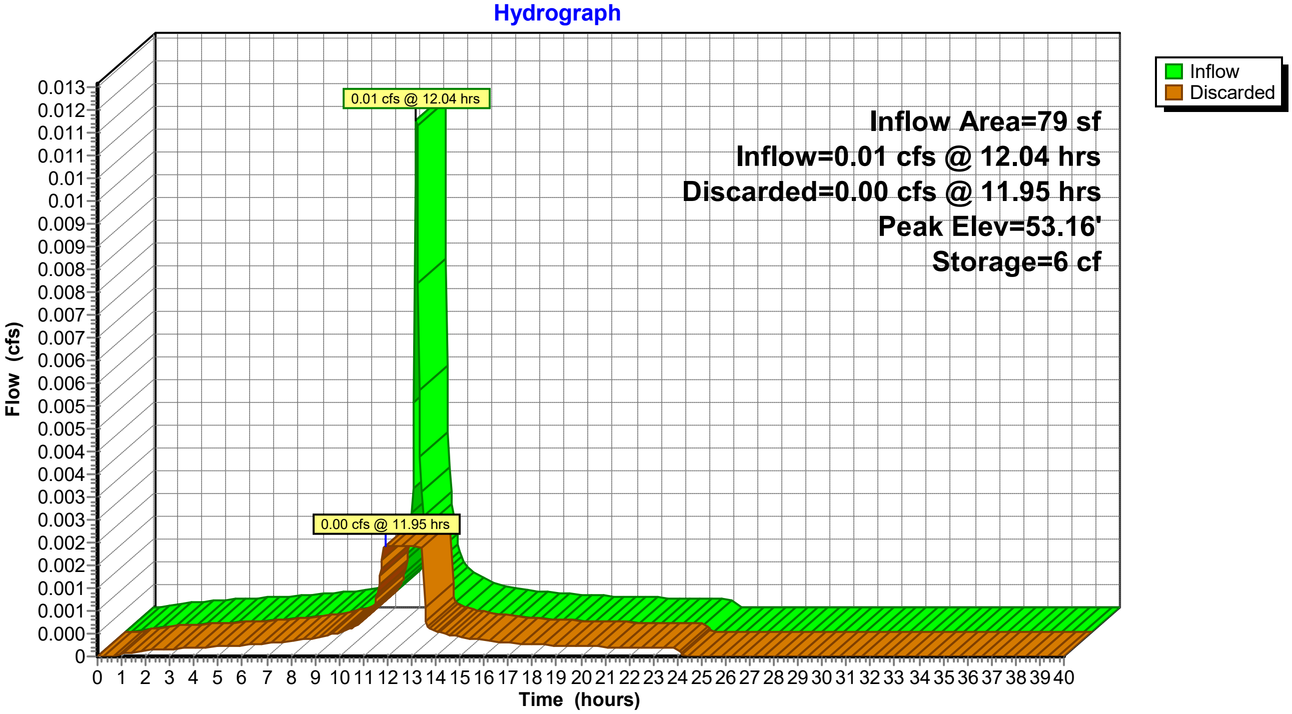
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	36 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	102	0.0	0	0
53.33	102	35.0	12	12
54.92	102	15.0	24	36

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 11.95 hrs HW=53.02' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Pond 4P: Pervious Pavement



Summary for Pond 5: DMH5

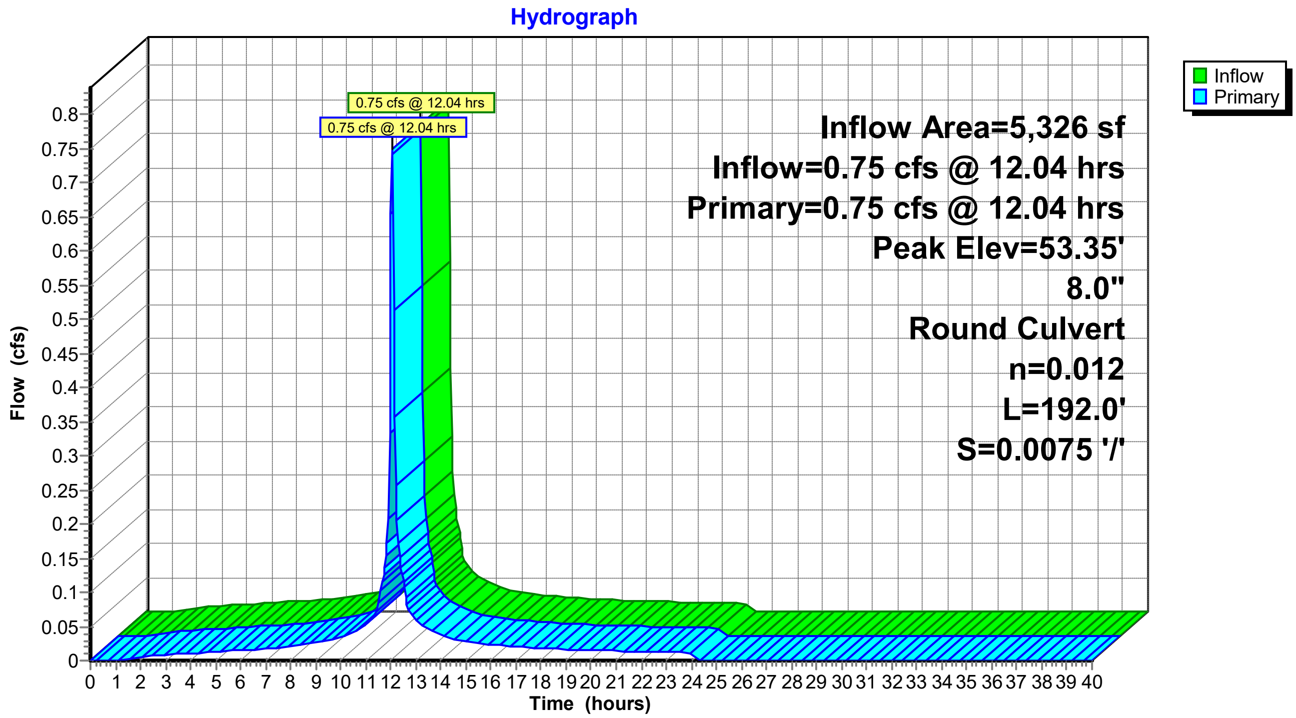
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 5.87" for 25-yr event
Inflow = 0.75 cfs @ 12.04 hrs, Volume= 2,604 cf
Outflow = 0.75 cfs @ 12.04 hrs, Volume= 2,604 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.75 cfs @ 12.04 hrs, Volume= 2,604 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.35' @ 12.04 hrs
Flood Elev= 55.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.77'	**8.0" Round Culvert** L= 192.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.77' / 51.33' S= 0.0075 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.72 cfs @ 12.04 hrs HW=53.33' TW=52.00' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.72 cfs @ 3.10 fps)

Pond 5: DMH5



Summary for Pond 10: EXIST MH10

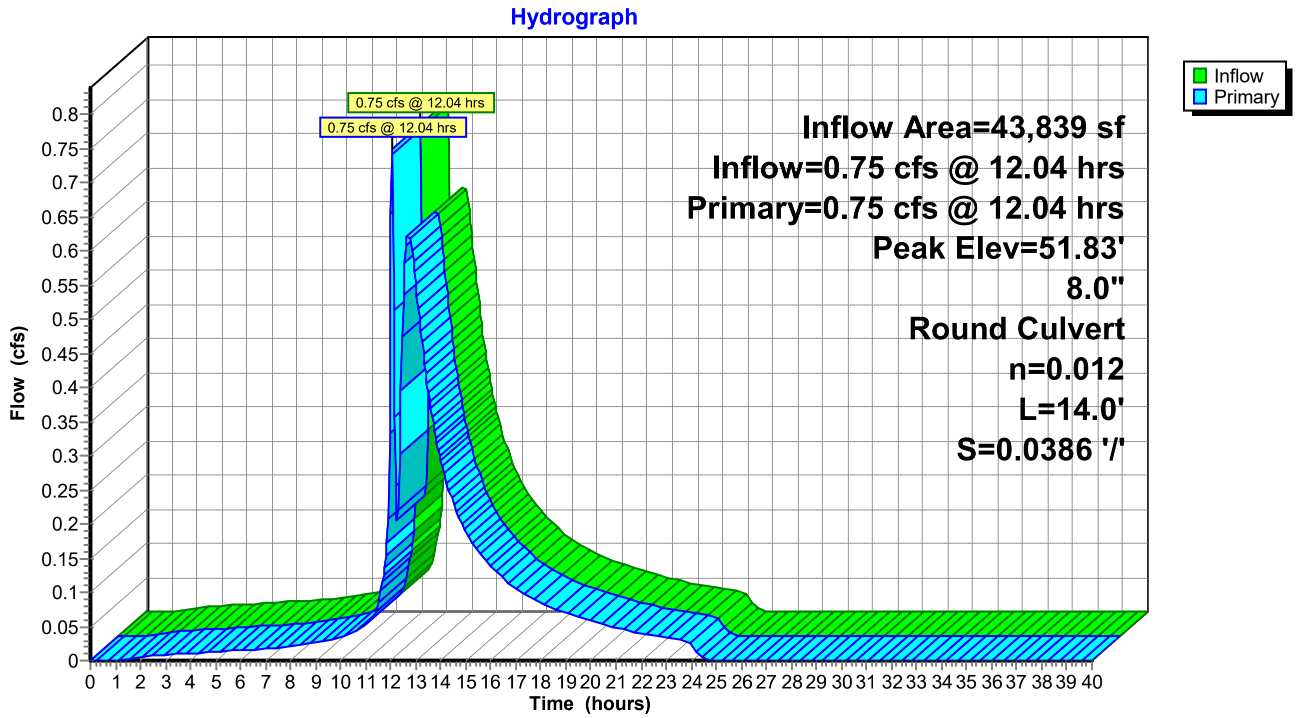
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 2.09" for 25-yr event
Inflow = 0.75 cfs @ 12.04 hrs, Volume= 7,636 cf
Outflow = 0.75 cfs @ 12.04 hrs, Volume= 7,636 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.75 cfs @ 12.04 hrs, Volume= 7,636 cf
Routed to Link 1L : Essex Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.83' @ 12.04 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.72 cfs @ 12.04 hrs HW=51.81' TW=0.00' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.72 cfs @ 2.46 fps)

Pond 10: EXIST MH10

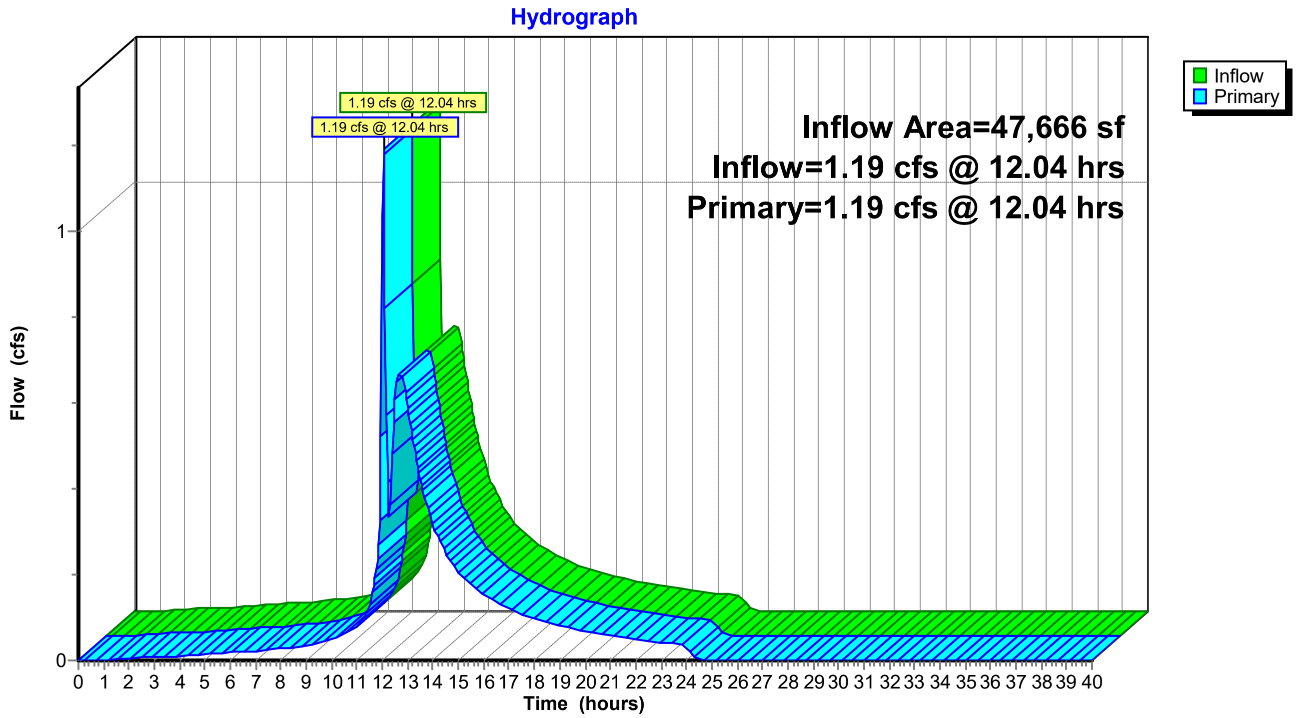


Summary for Link 1L: Essex Street

Inflow Area =	47,666 sf,	65.24% Impervious,	Inflow Depth = 2.28"	for 25-yr event	
Inflow =	1.19 cfs @	12.04 hrs,	Volume=	9,042 cf	
Primary =	1.19 cfs @	12.04 hrs,	Volume=	9,042 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 1L: Essex Street



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Runoff Area=23,311 sf 100.00% Impervious Runoff Depth=6.97"
Tc=6.0 min CN=98 Runoff=3.75 cfs 13,541 cf

Subcatchment 2S: Runoff Area=14,185 sf 1.50% Impervious Runoff Depth=4.78"
Flow Length=220' Tc=19.5 min CN=79 Runoff=1.08 cfs 5,647 cf

Subcatchment 3S: Runoff Area=1,017 sf 25.27% Impervious Runoff Depth=3.79"
Tc=6.0 min CN=70 Runoff=0.10 cfs 322 cf

Subcatchment 4S: Runoff Area=5,326 sf 95.04% Impervious Runoff Depth=6.73"
Tc=6.0 min CN=96 Runoff=0.85 cfs 2,988 cf

Subcatchment 5S: Runoff Area=3,827 sf 58.87% Impervious Runoff Depth=5.23"
Tc=6.0 min CN=83 Runoff=0.52 cfs 1,667 cf

Subcatchment 6S: Runoff Area=1,383 sf 74.19% Impervious Runoff Depth=5.80"
Tc=6.0 min CN=88 Runoff=0.20 cfs 668 cf

Subcatchment 7S: Runoff Area=1,043 sf 97.22% Impervious Runoff Depth=6.85"
Tc=6.0 min CN=97 Runoff=0.17 cfs 596 cf

Subcatchment 8S: Runoff Area=79 sf 100.00% Impervious Runoff Depth=6.97"
Tc=6.0 min CN=98 Runoff=0.01 cfs 46 cf

Pond 1: CB1 Peak Elev=52.30' Inflow=0.94 cfs 10,526 cf
8.0" Round Culvert n=0.012 L=4.0' S=0.0100 '/' Outflow=0.94 cfs 10,526 cf

Pond 1P: Concrete Galleys Peak Elev=52.69' Storage=8,085 cf Inflow=4.38 cfs 19,510 cf
Discarded=0.07 cfs 9,876 cf Primary=0.87 cfs 7,538 cf Outflow=0.94 cfs 17,414 cf

Pond 2: CB2 Peak Elev=52.77' Inflow=1.08 cfs 5,647 cf
8.0" Round Culvert n=0.012 L=37.0' S=0.0100 '/' Outflow=1.08 cfs 5,647 cf

Pond 2P: Pervious Pavement Peak Elev=53.57' Storage=155 cf Inflow=0.20 cfs 668 cf
Outflow=0.02 cfs 668 cf

Pond 3: CB3 Peak Elev=52.68' Inflow=0.10 cfs 322 cf
8.0" Round Culvert n=0.012 L=11.0' S=0.0182 '/' Outflow=0.10 cfs 322 cf

Pond 3P: Pervious Pavement Peak Elev=53.32' Storage=113 cf Inflow=0.17 cfs 596 cf
Outflow=0.02 cfs 596 cf

Pond 4: CB4 Peak Elev=53.69' Inflow=0.85 cfs 2,988 cf
8.0" Round Culvert n=0.012 L=26.0' S=0.0077 '/' Outflow=0.85 cfs 2,988 cf

Pond 4P: Pervious Pavement Peak Elev=53.20' Storage=7 cf Inflow=0.01 cfs 46 cf
Outflow=0.00 cfs 46 cf

Pond 5: DMH5 Peak Elev=53.41' Inflow=0.85 cfs 2,988 cf
8.0" Round Culvert n=0.012 L=192.0' S=0.0075 '/' Outflow=0.85 cfs 2,988 cf

Pond 10: EXIST MH10 Peak Elev=51.93' Inflow=0.94 cfs 10,526 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=0.94 cfs 10,526 cf

Link 1L: Essex Street Inflow=1.37 cfs 12,193 cf
Primary=1.37 cfs 12,193 cf

Total Runoff Area = 50,171 sf Runoff Volume = 25,474 cf Average Runoff Depth = 6.09"
33.80% Pervious = 16,956 sf 66.20% Impervious = 33,215 sf

Summary for Subcatchment 1S: Roof

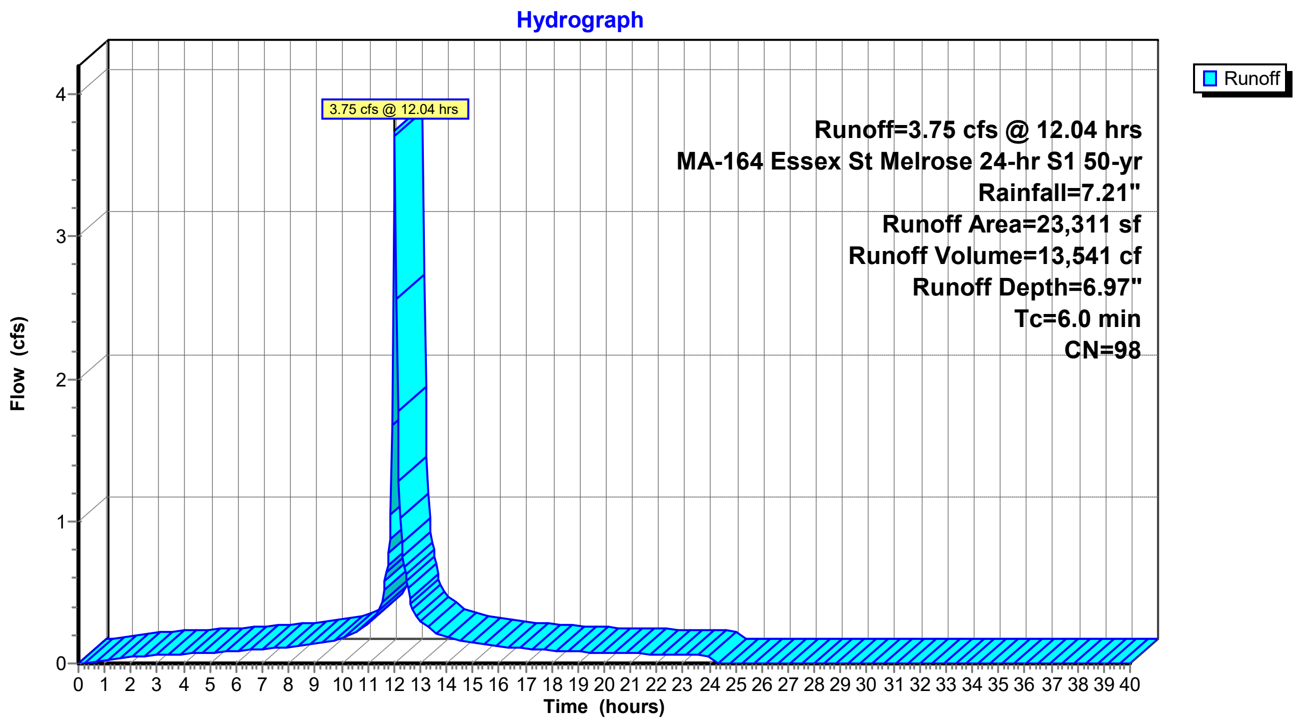
Runoff = 3.75 cfs @ 12.04 hrs, Volume= 13,541 cf, Depth= 6.97"
Routed to Pond 1P : Concrete Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
23,311	98	Roofs, HSG B
23,311		100.00% Impervious Area

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

Subcatchment 1S: Roof



Summary for Subcatchment 2S:

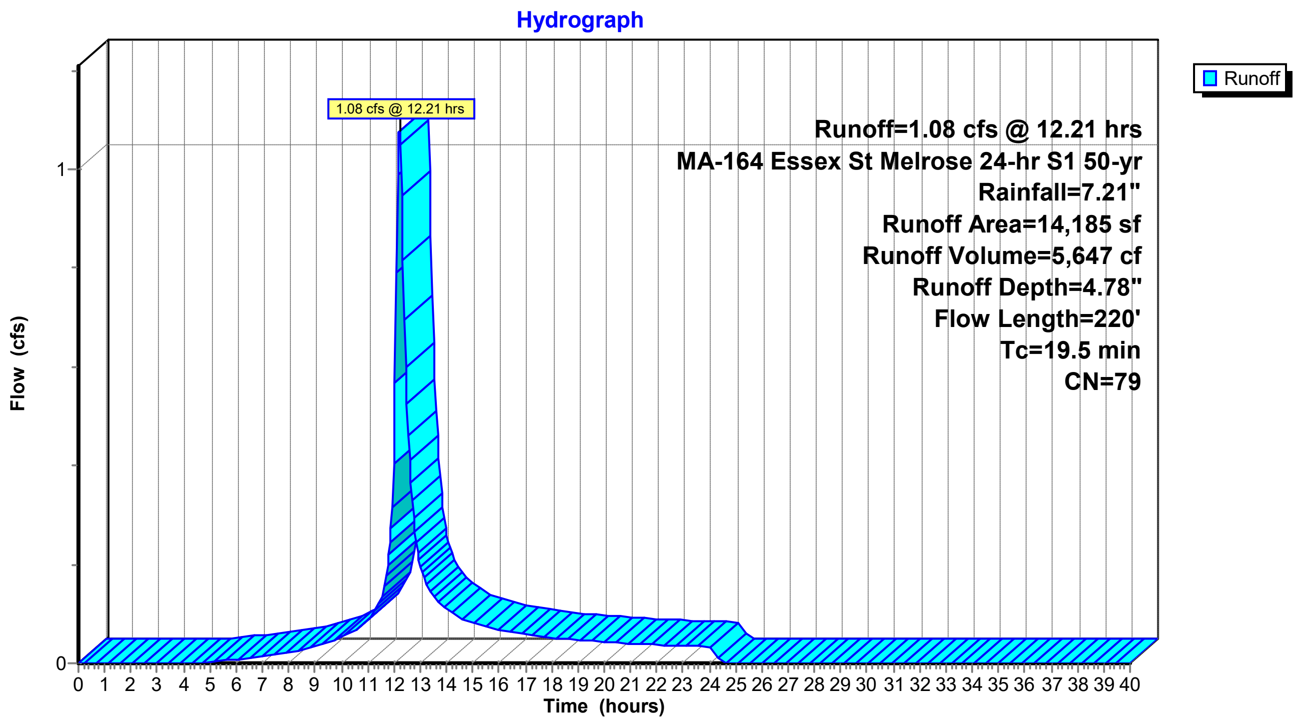
Runoff = 1.08 cfs @ 12.21 hrs, Volume= 5,647 cf, Depth= 4.78"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
6,924	96	Gravel surface, HSG B
7,048	61	>75% Grass cover, Good, HSG B
213	98	Paved parking, HSG B
14,185	79	Weighted Average
13,972		98.50% Pervious Area
213		1.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	35	0.0530	1.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
17.4	65	0.0050	0.06		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.29"
1.8	120	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
19.5	220	Total			

Subcatchment 2S:



Summary for Subcatchment 3S:

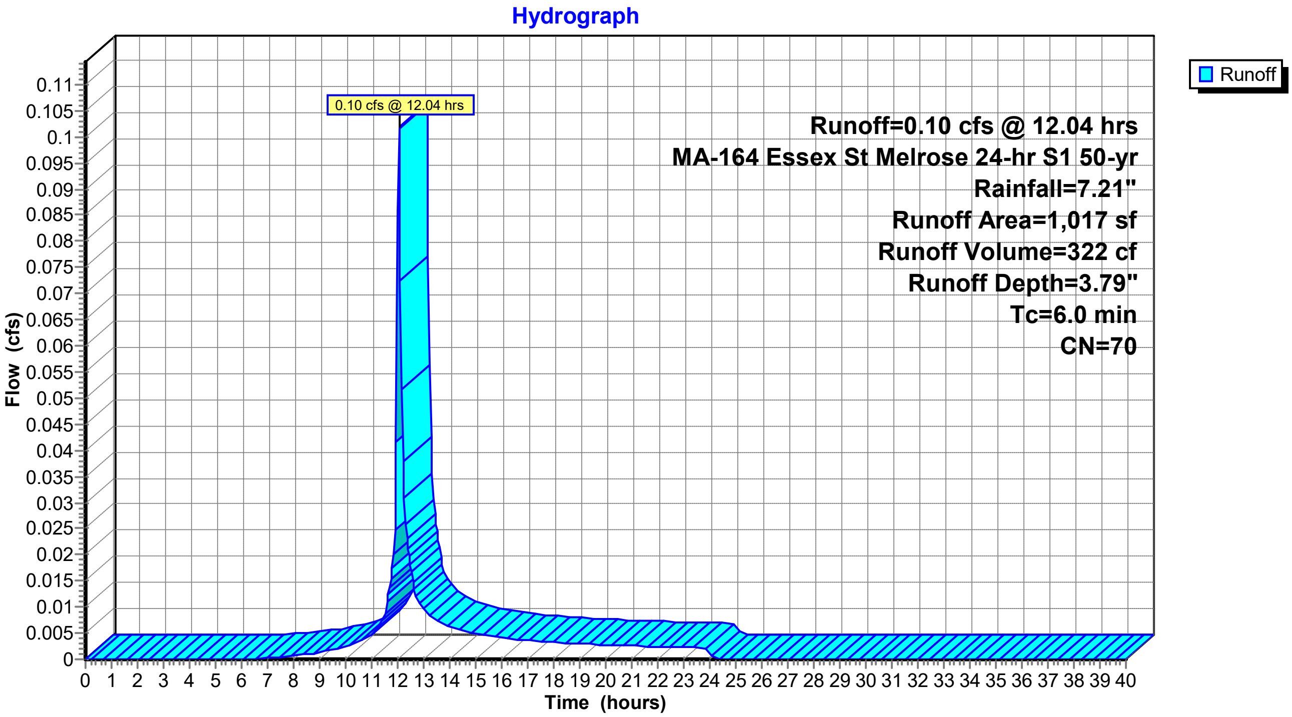
Runoff = 0.10 cfs @ 12.04 hrs, Volume= 322 cf, Depth= 3.79"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
760	61	>75% Grass cover, Good, HSG B
257	98	Paved parking, HSG B
1,017	70	Weighted Average
760		74.73% Pervious Area
257		25.27% Impervious Area

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

Subcatchment 3S:



Summary for Subcatchment 4S:

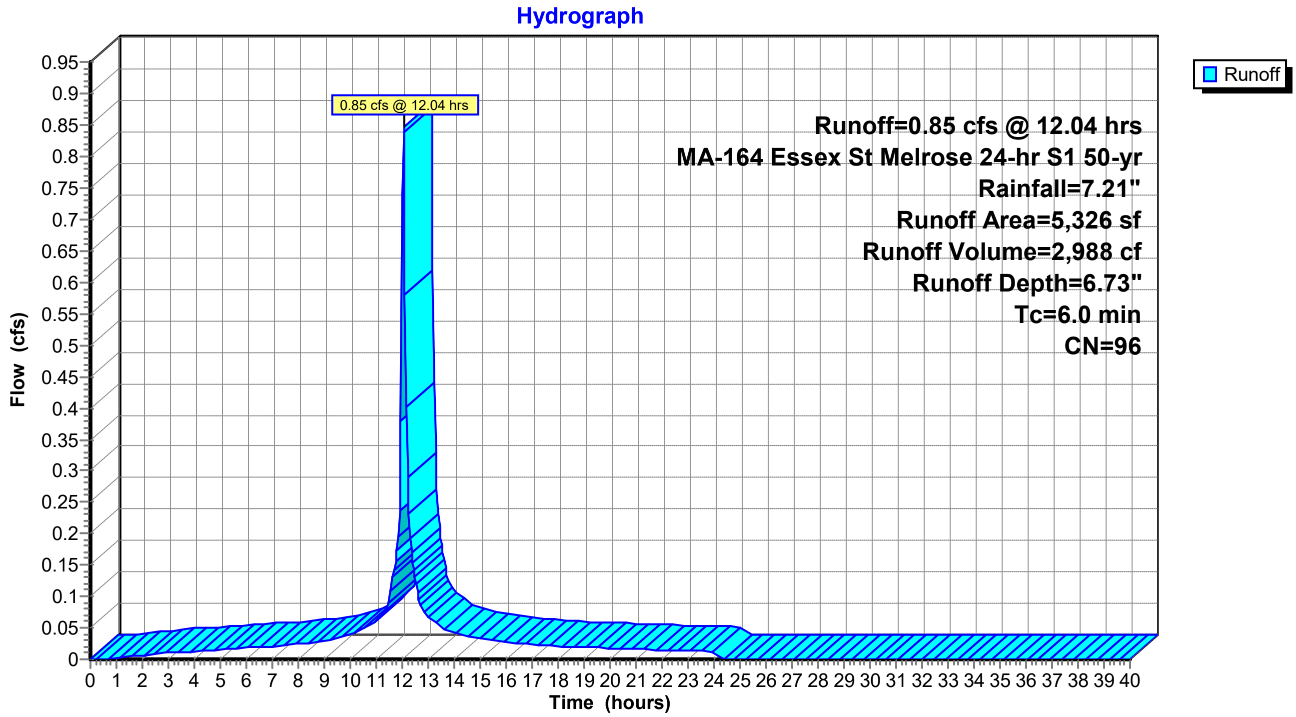
Runoff = 0.85 cfs @ 12.04 hrs, Volume= 2,988 cf, Depth= 6.73"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
264	61	>75% Grass cover, Good, HSG B
5,062	98	Paved parking, HSG B
5,326	96	Weighted Average
264		4.96% Pervious Area
5,062		95.04% Impervious Area

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

Subcatchment 4S:



Summary for Subcatchment 5S:

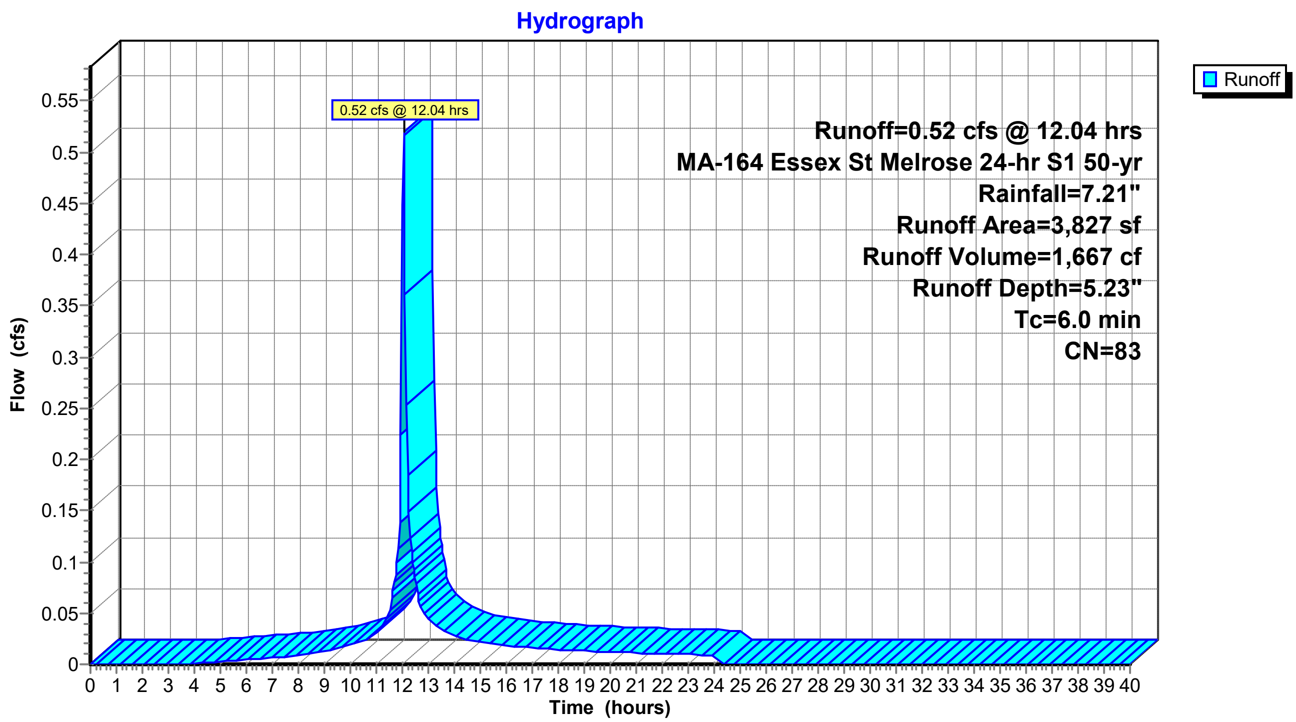
Runoff = 0.52 cfs @ 12.04 hrs, Volume= 1,667 cf, Depth= 5.23"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
1,574	61	>75% Grass cover, Good, HSG B
2,253	98	Paved parking, HSG B
3,827	83	Weighted Average
1,574		41.13% Pervious Area
2,253		58.87% Impervious Area

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

Subcatchment 5S:



Summary for Subcatchment 6S:

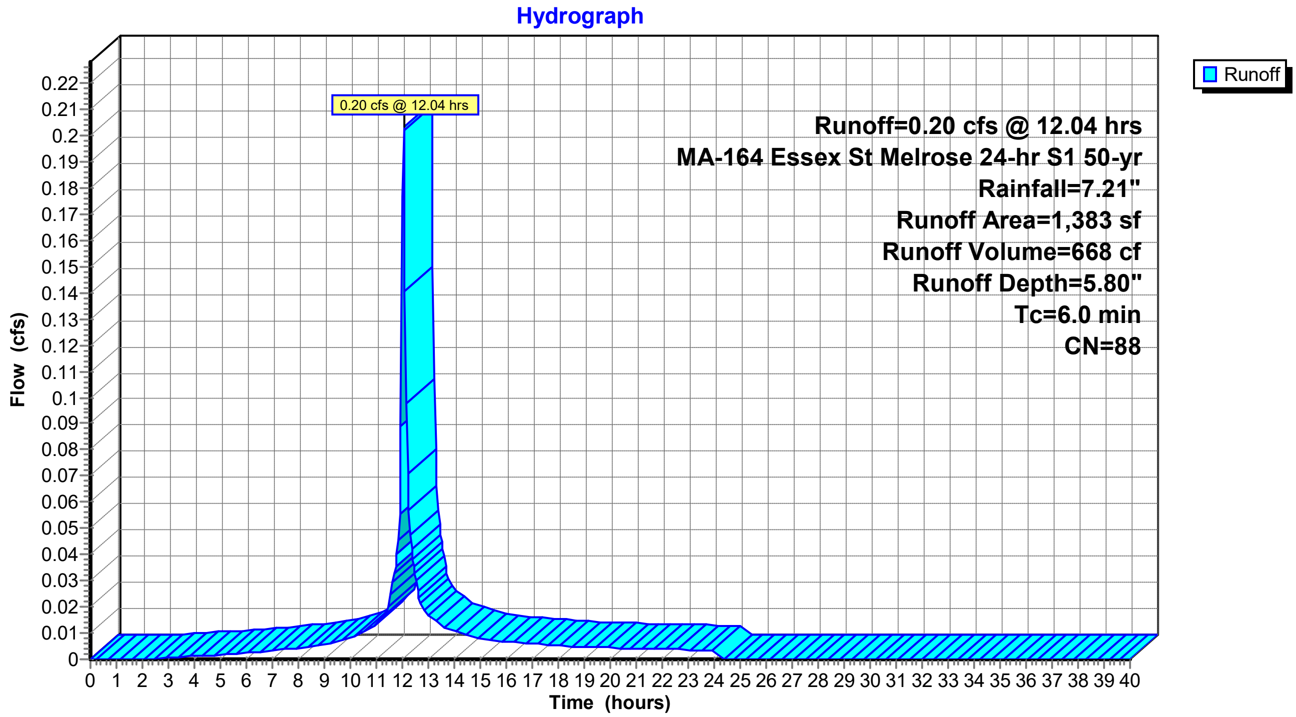
Runoff = 0.20 cfs @ 12.04 hrs, Volume= 668 cf, Depth= 5.80"
Routed to Pond 2P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
1,026	98	Paved parking, HSG B
357	61	>75% Grass cover, Good, HSG B
1,383	88	Weighted Average
357		25.81% Pervious Area
1,026		74.19% Impervious Area

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

Subcatchment 6S:



Summary for Subcatchment 7S:

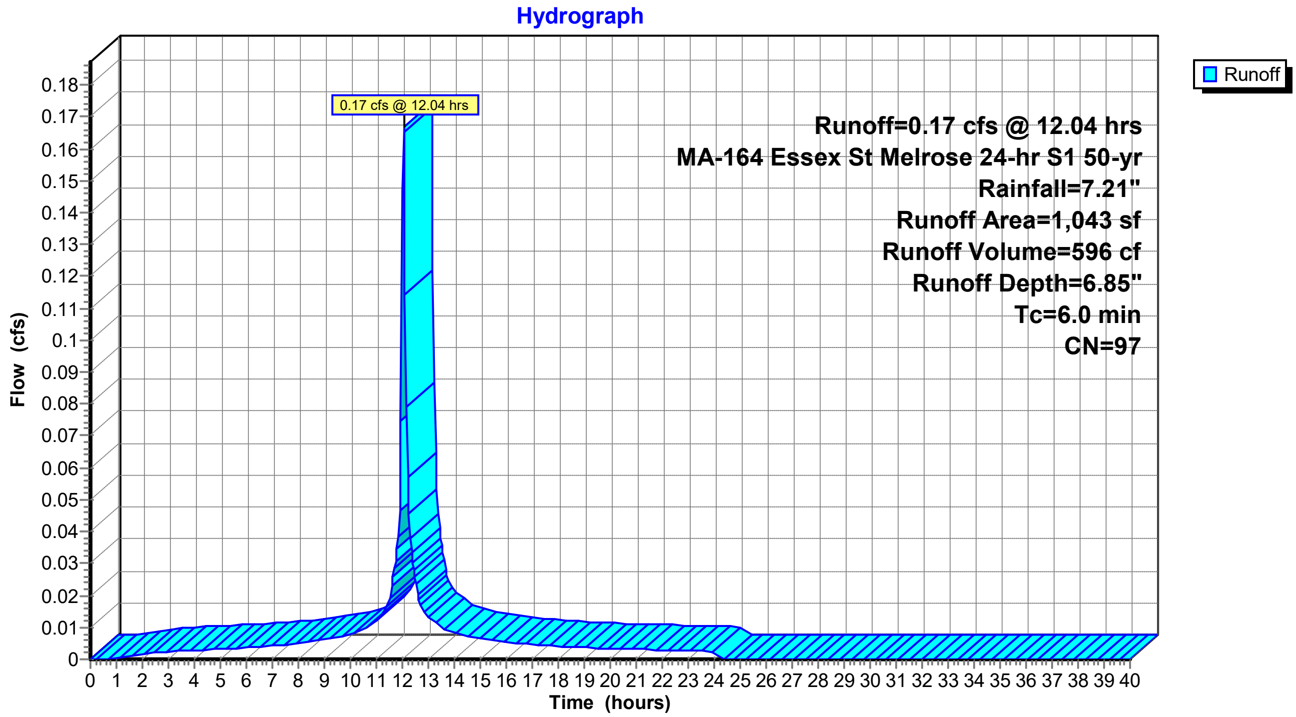
Runoff = 0.17 cfs @ 12.04 hrs, Volume= 596 cf, Depth= 6.85"
Routed to Pond 3P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
1,014	98	Paved parking, HSG B
29	61	>75% Grass cover, Good, HSG B
1,043	97	Weighted Average
29		2.78% Pervious Area
1,014		97.22% Impervious Area

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

Subcatchment 7S:



Summary for Subcatchment 8S:

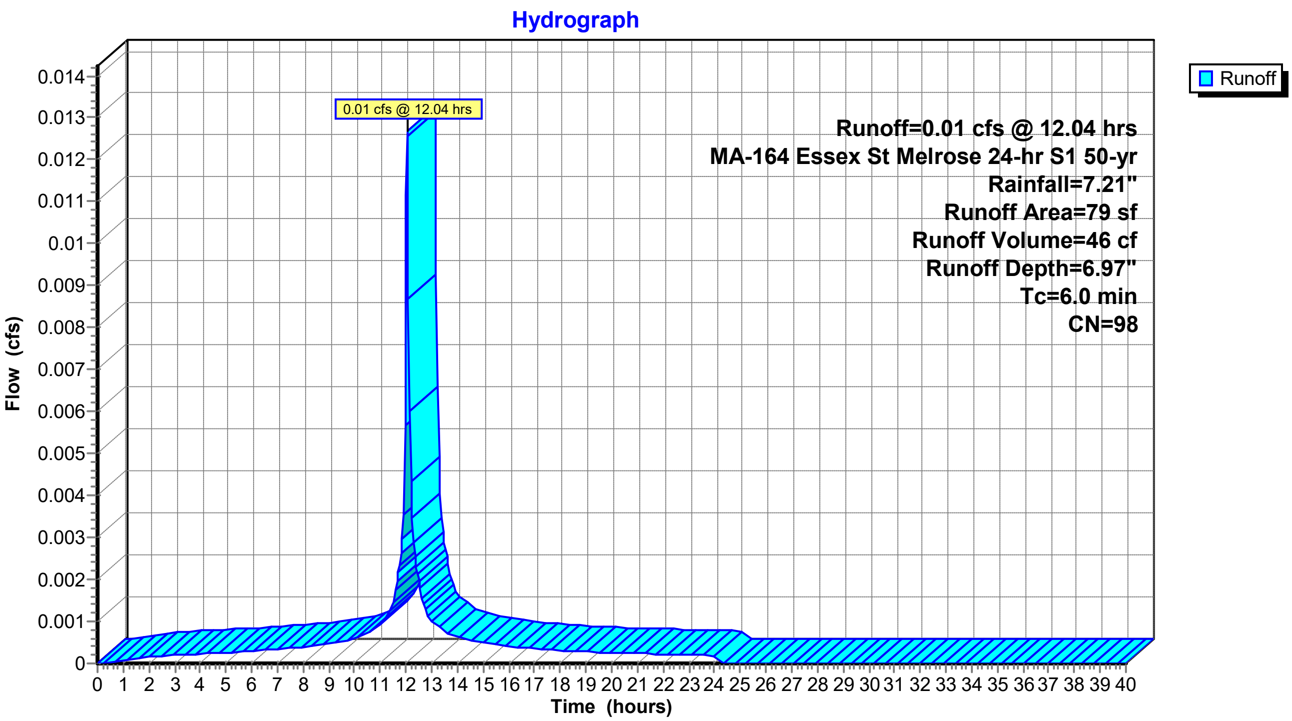
Runoff = 0.01 cfs @ 12.04 hrs, Volume= 46 cf, Depth= 6.97"
Routed to Pond 4P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 50-yr Rainfall=7.21"

Area (sf)	CN	Description
79	98	Paved parking, HSG B
79		100.00% Impervious Area

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

Subcatchment 8S:



Summary for Pond 1: CB1

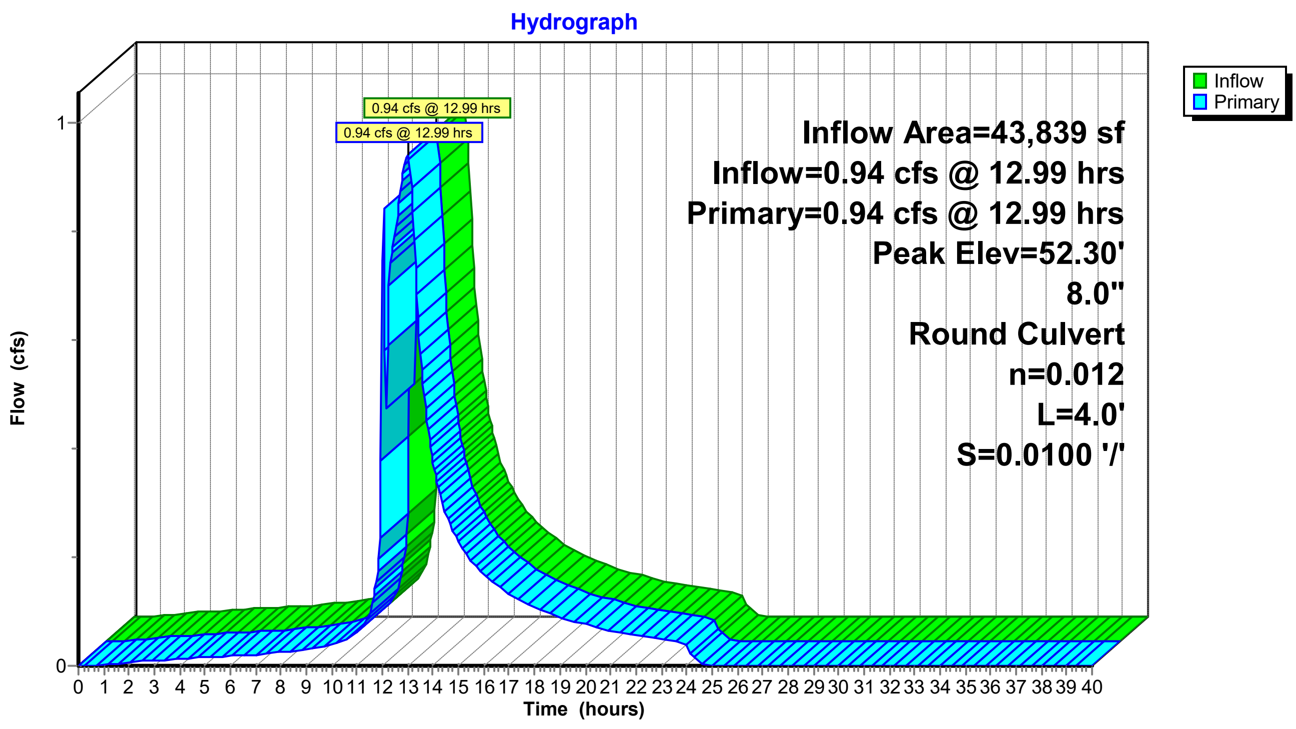
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 2.88" for 50-yr event
Inflow = 0.94 cfs @ 12.99 hrs, Volume= 10,526 cf
Outflow = 0.94 cfs @ 12.99 hrs, Volume= 10,526 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.94 cfs @ 12.99 hrs, Volume= 10,526 cf
Routed to Pond 10 : EXIST MH10

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.30' @ 12.92 hrs
Flood Elev= 55.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.33'	**8.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.33' / 51.29' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.00 cfs @ 12.99 hrs HW=52.29' TW=51.93' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 1.00 cfs @ 2.88 fps)

Pond 1: CB1



Summary for Pond 1P: Concrete Galleys

Inflow Area = 38,513 sf, 61.75% Impervious, Inflow Depth = 6.08" for 50-yr event
Inflow = 4.38 cfs @ 12.04 hrs, Volume= 19,510 cf
Outflow = 0.94 cfs @ 13.00 hrs, Volume= 17,414 cf, Atten= 78%, Lag= 57.4 min
Discarded = 0.07 cfs @ 5.90 hrs, Volume= 9,876 cf
Primary = 0.87 cfs @ 13.00 hrs, Volume= 7,538 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.69' @ 12.64 hrs Surf.Area= 3,040 sf Storage= 8,085 cf

Plug-Flow detention time= 386.5 min calculated for 17,414 cf (89% of inflow)
Center-of-Mass det. time= 325.2 min (1,099.2 - 774.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	48.50'	2,793 cf	**10.50'W x 289.50'L x 5.25'H Field A** 15,959 cf Overall - 8,976 cf Embedded = 6,983 cf x 40.0% Voids
#2A	49.50'	6,679 cf	**Concrete Galley 4x4x4.25** x 144 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 144 Chambers in 2 Rows
		9,472 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	51.72'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.72' / 51.33' S= 0.0098 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 5.90 hrs HW=48.55' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.76 cfs @ 13.00 hrs HW=52.52' TW=52.28' (Dynamic Tailwater)
└**2=Culvert** (Outlet Controls 0.76 cfs @ 2.28 fps)

Pond 1P: Concrete Galleys - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

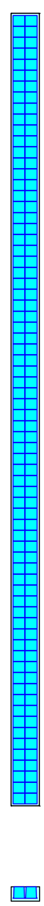
72 Chambers/Row x 4.00' Long = 288.00' Row Length +9.0" End Stone x 2 = 289.50' Base Length
2 Rows x 54.0" Wide + 9.0" Side Stone x 2 = 10.50' Base Width
12.0" Stone Base + 51.0" Chamber Height = 5.25' Field Height

144 Chambers x 46.4 cf = 6,678.8 cf Chamber Storage
144 Chambers x 62.3 cf = 8,975.7 cf Displacement

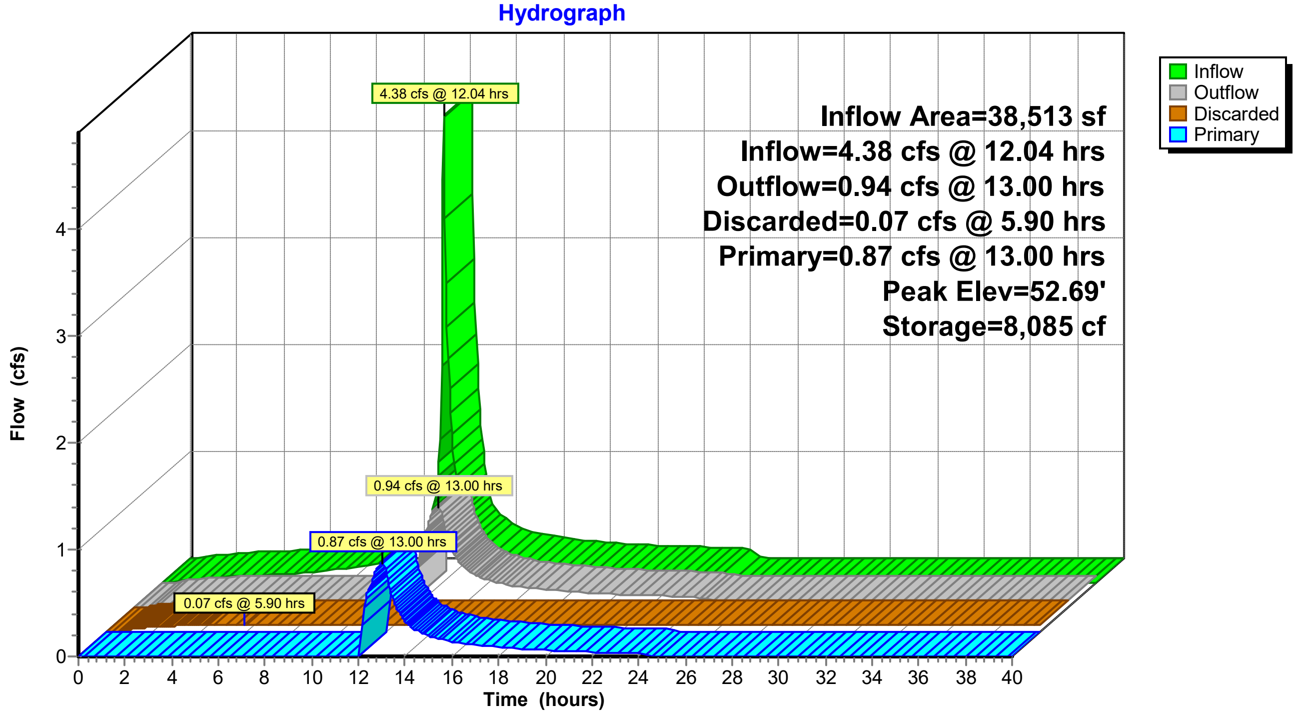
15,958.7 cf Field - 8,975.7 cf Chambers = 6,983.0 cf Stone x 40.0% Voids = 2,793.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,472.0 cf = 0.217 af
Overall Storage Efficiency = 59.4%
Overall System Size = 289.50' x 10.50' x 5.25'

144 Chambers
591.1 cy Field
258.6 cy Stone



Pond 1P: Concrete Galleys



Summary for Pond 2: CB2

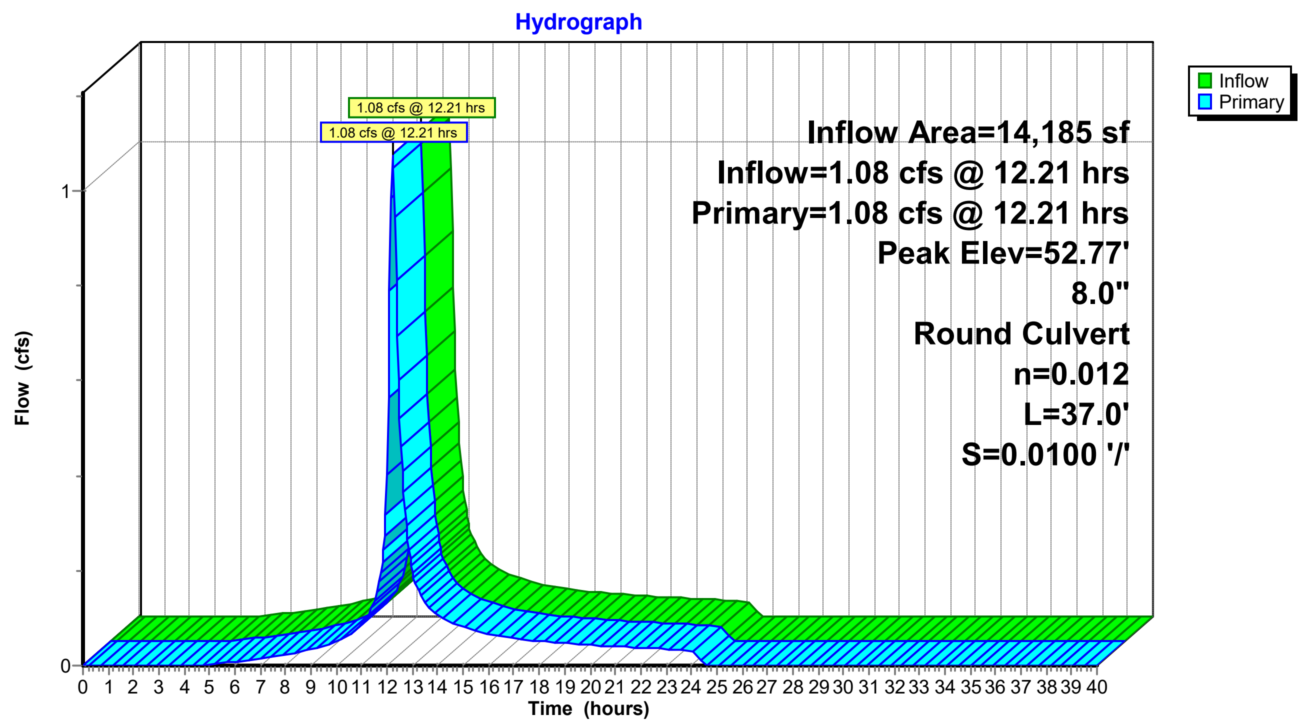
Inflow Area = 14,185 sf, 1.50% Impervious, Inflow Depth = 4.78" for 50-yr event
Inflow = 1.08 cfs @ 12.21 hrs, Volume= 5,647 cf
Outflow = 1.08 cfs @ 12.21 hrs, Volume= 5,647 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.08 cfs @ 12.21 hrs, Volume= 5,647 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.77' @ 12.31 hrs
Flood Elev= 54.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**8.0" Round Culvert** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 51.63' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.08 cfs @ 12.21 hrs HW=52.75' TW=52.17' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.08 cfs @ 3.09 fps)

Pond 2: CB2



Summary for Pond 2P: Pervious Pavement

Inflow Area = 1,383 sf, 74.19% Impervious, Inflow Depth = 5.80" for 50-yr event
Inflow = 0.20 cfs @ 12.04 hrs, Volume= 668 cf
Outflow = 0.02 cfs @ 11.75 hrs, Volume= 668 cf, Atten= 88%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.75 hrs, Volume= 668 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.57' @ 12.64 hrs Surf.Area= 1,026 sf Storage= 155 cf

Plug-Flow detention time= 35.6 min calculated for 667 cf (100% of inflow)
Center-of-Mass det. time= 35.6 min (833.2 - 797.6)

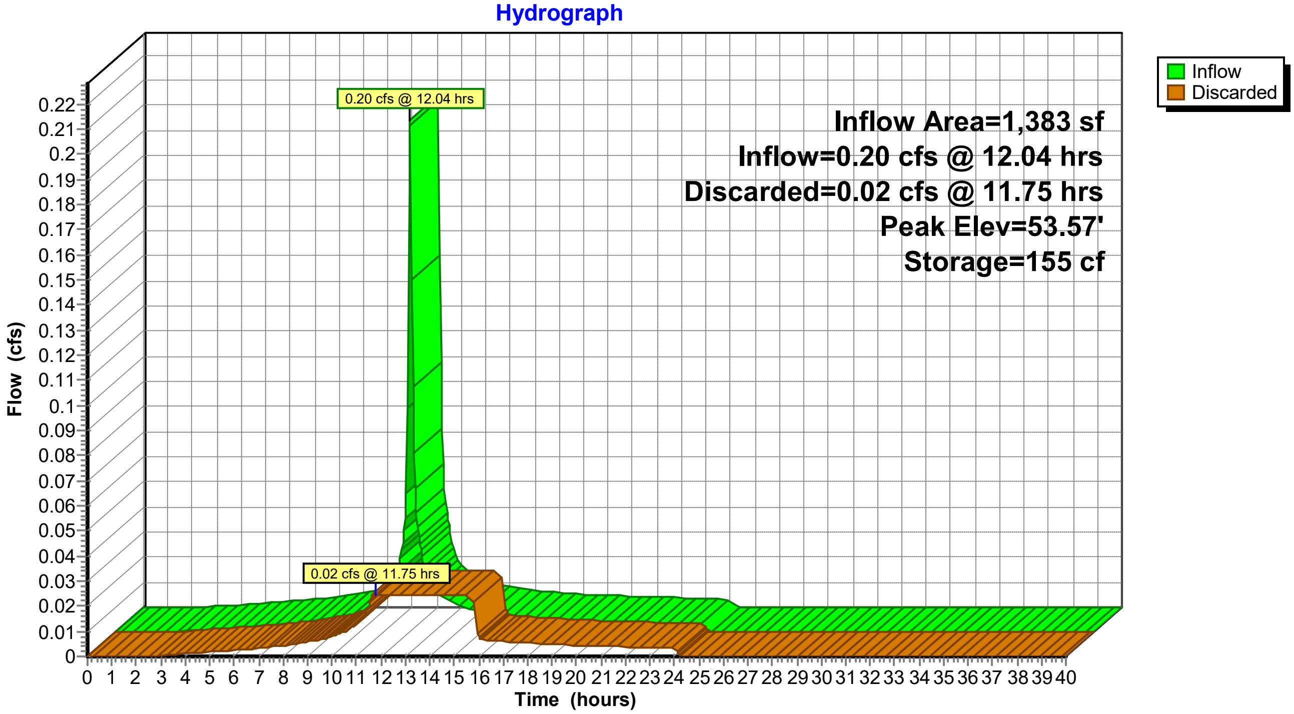
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	363 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,026	0.0	0	0
53.33	1,026	35.0	119	119
54.92	1,026	15.0	245	363

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 11.75 hrs HW=53.02' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 2P: Pervious Pavement



Summary for Pond 3: CB3

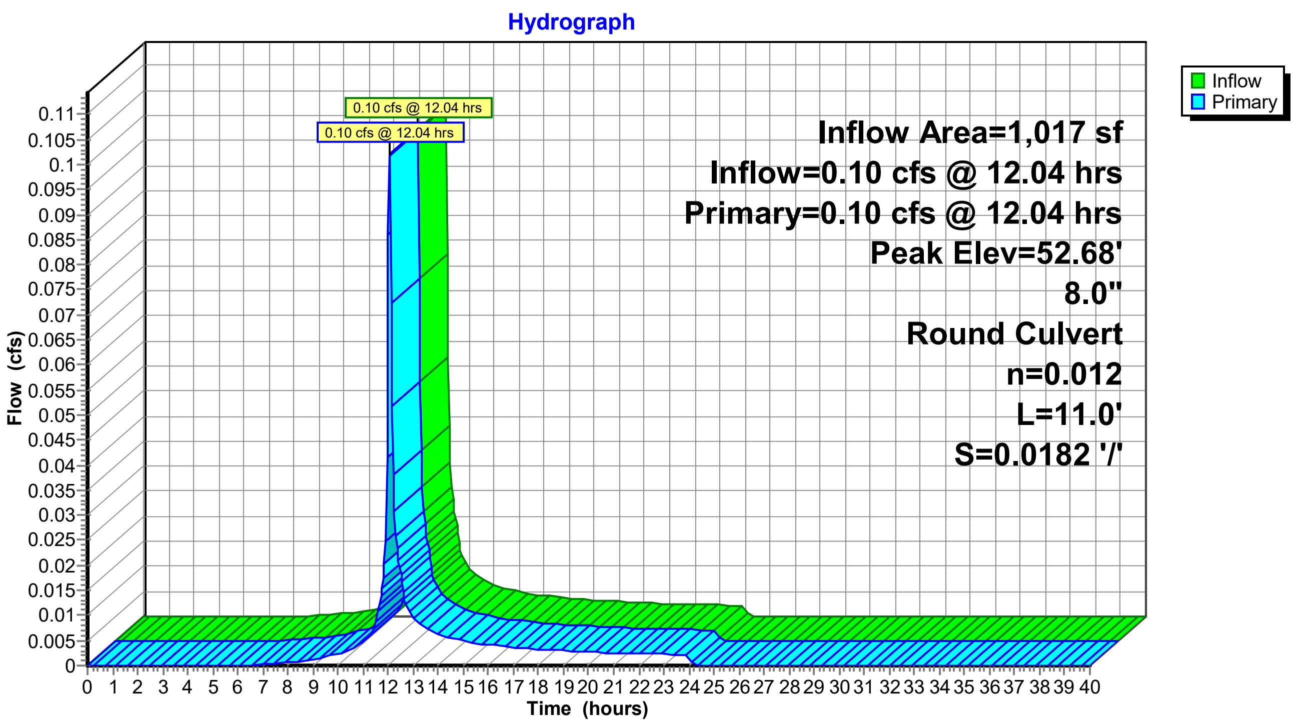
Inflow Area = 1,017 sf, 25.27% Impervious, Inflow Depth = 3.79" for 50-yr event
Inflow = 0.10 cfs @ 12.04 hrs, Volume= 322 cf
Outflow = 0.10 cfs @ 12.04 hrs, Volume= 322 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.10 cfs @ 12.04 hrs, Volume= 322 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.68' @ 12.64 hrs
Flood Elev= 54.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.83'	**8.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.83' / 51.63' S= 0.0182 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.10 cfs @ 12.04 hrs HW=52.00' TW=51.31' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.10 cfs @ 1.41 fps)

Pond 3: CB3



Summary for Pond 3P: Pervious Pavement

Inflow Area = 1,043 sf, 97.22% Impervious, Inflow Depth = 6.85" for 50-yr event
Inflow = 0.17 cfs @ 12.04 hrs, Volume= 596 cf
Outflow = 0.02 cfs @ 11.85 hrs, Volume= 596 cf, Atten= 86%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.85 hrs, Volume= 596 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.32' @ 12.54 hrs Surf.Area= 1,014 sf Storage= 113 cf

Plug-Flow detention time= 22.3 min calculated for 596 cf (100% of inflow)
Center-of-Mass det. time= 22.3 min (773.0 - 750.7)

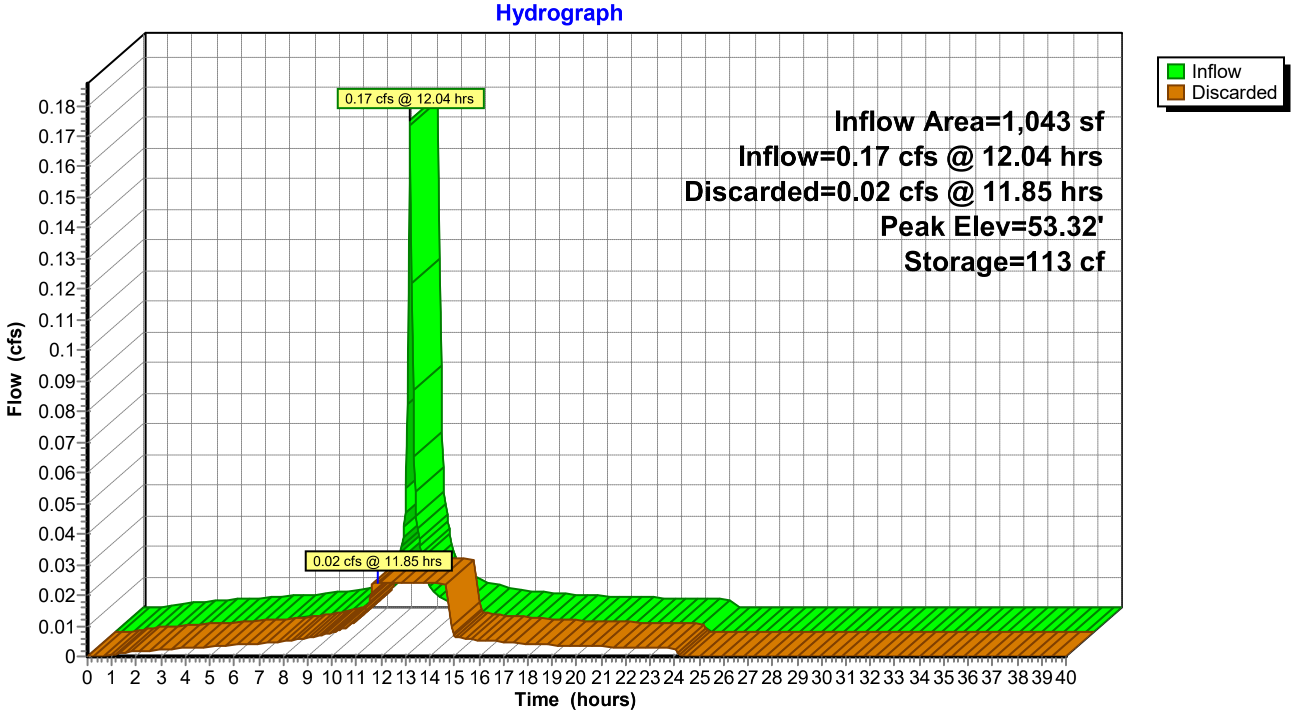
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	359 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,014	0.0	0	0
53.33	1,014	35.0	117	117
54.92	1,014	15.0	242	359

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 11.85 hrs HW=53.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 3P: Pervious Pavement



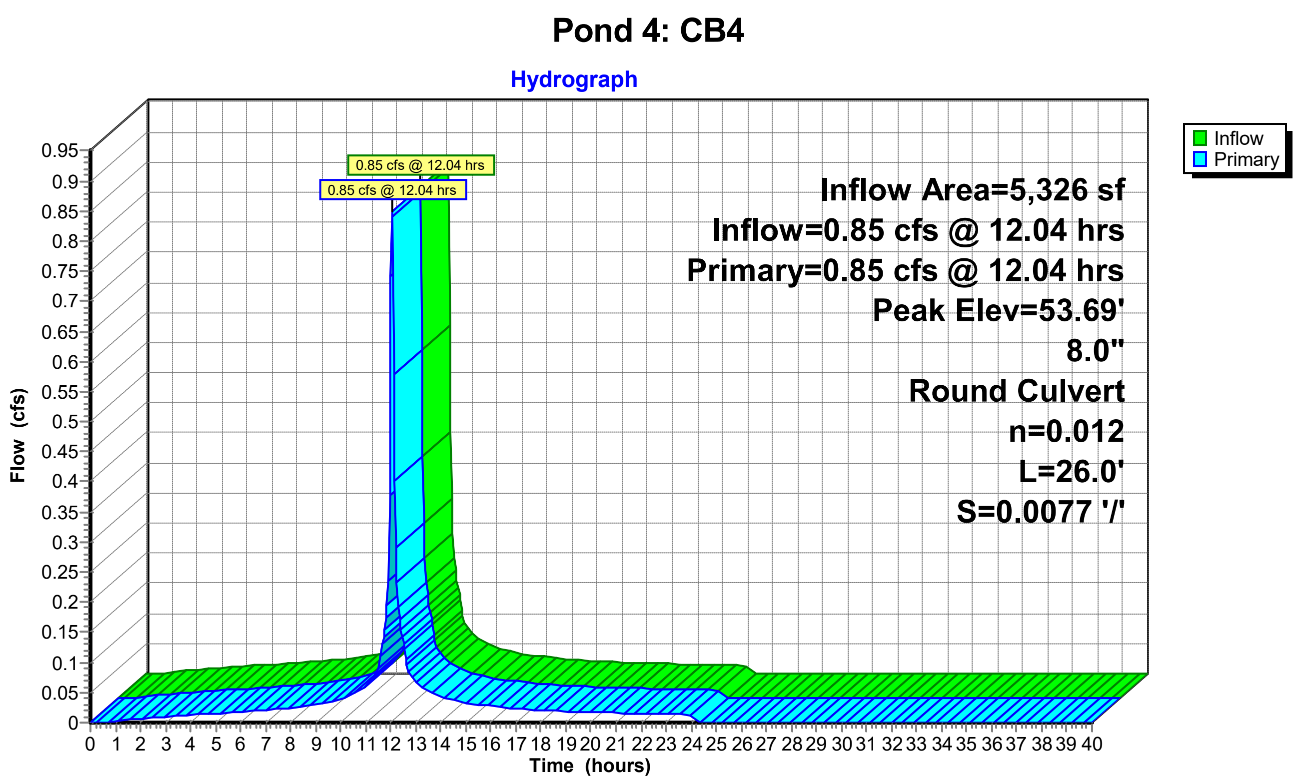
Summary for Pond 4: CB4

Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 6.73" for 50-yr event
Inflow = 0.85 cfs @ 12.04 hrs, Volume= 2,988 cf
Outflow = 0.85 cfs @ 12.04 hrs, Volume= 2,988 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.85 cfs @ 12.04 hrs, Volume= 2,988 cf
Routed to Pond 5 : DMH5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.69' @ 12.04 hrs
Flood Elev= 55.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.97'	**8.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.97' / 52.77' S= 0.0077 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.81 cfs @ 12.04 hrs HW=53.67' TW=53.39' (Dynamic Tailwater)
1=Culvert (Outlet Controls 0.81 cfs @ 2.73 fps)



Summary for Pond 4P: Pervious Pavement

Inflow Area = 79 sf,100.00% Impervious, Inflow Depth = 6.97" for 50-yr event
Inflow = 0.01 cfs @ 12.04 hrs, Volume= 46 cf
Outflow = 0.00 cfs @ 11.95 hrs, Volume= 46 cf, Atten= 81%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.95 hrs, Volume= 46 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.20' @ 12.38 hrs Surf.Area= 102 sf Storage= 7 cf

Plug-Flow detention time= 12.7 min calculated for 46 cf (100% of inflow)
Center-of-Mass det. time= 12.7 min (756.0 - 743.3)

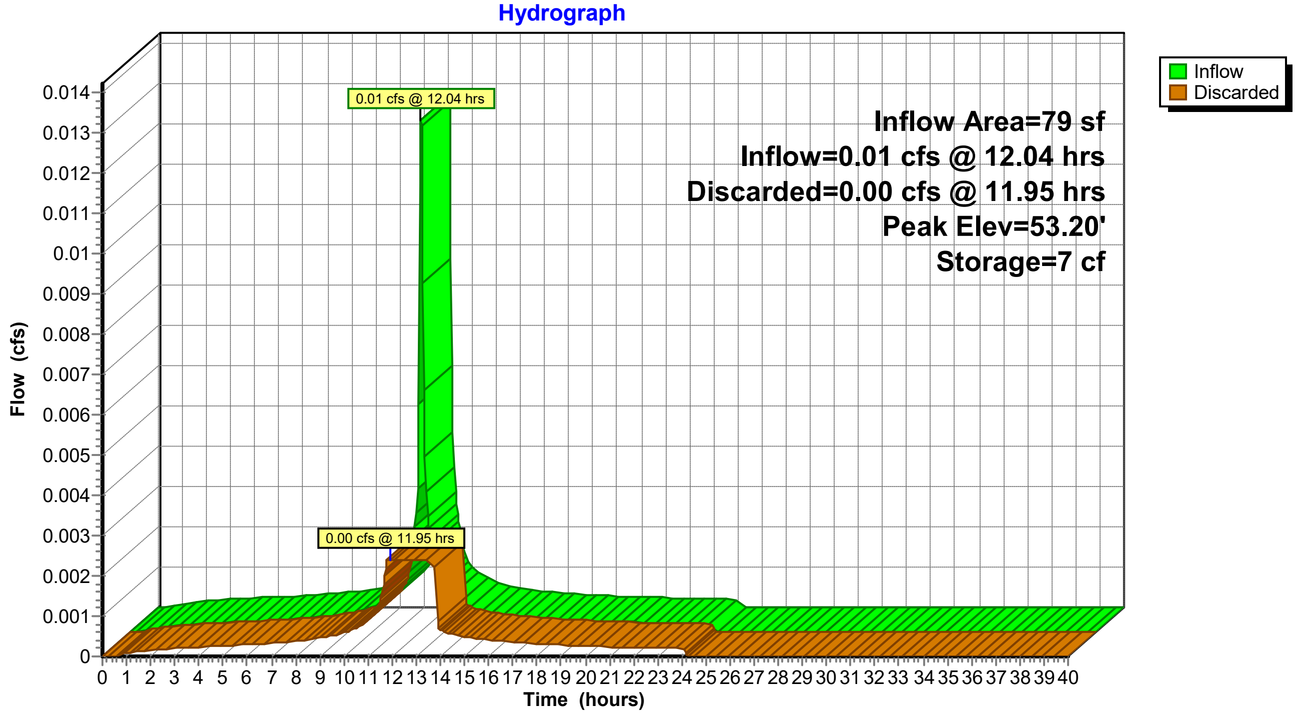
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	36 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	102	0.0	0	0
53.33	102	35.0	12	12
54.92	102	15.0	24	36

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 11.95 hrs HW=53.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Pond 4P: Pervious Pavement



Summary for Pond 5: DMH5

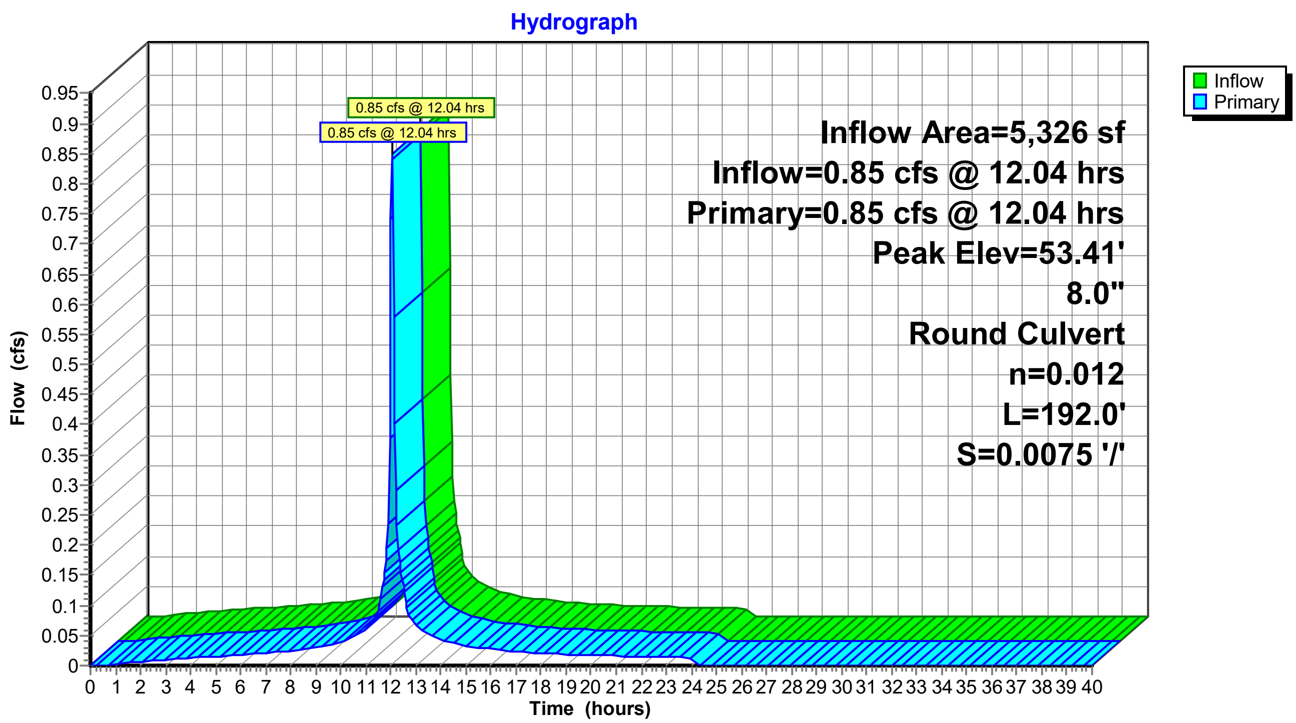
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 6.73" for 50-yr event
Inflow = 0.85 cfs @ 12.04 hrs, Volume= 2,988 cf
Outflow = 0.85 cfs @ 12.04 hrs, Volume= 2,988 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.85 cfs @ 12.04 hrs, Volume= 2,988 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.41' @ 12.04 hrs
Flood Elev= 55.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.77'	**8.0" Round Culvert** L= 192.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.77' / 51.33' S= 0.0075 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.82 cfs @ 12.04 hrs HW=53.39' TW=52.10' (Dynamic Tailwater)
1=Culvert (Outlet Controls 0.82 cfs @ 3.13 fps)

Pond 5: DMH5



Summary for Pond 10: EXIST MH10

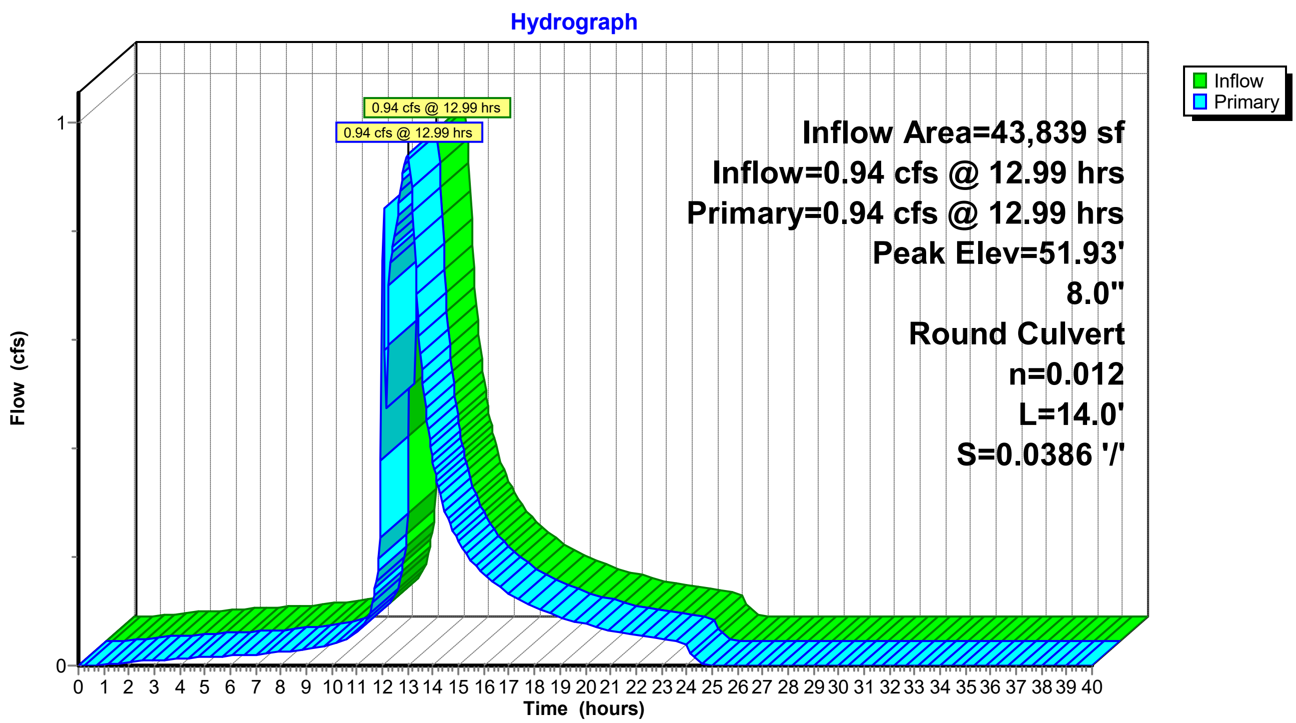
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 2.88" for 50-yr event
Inflow = 0.94 cfs @ 12.99 hrs, Volume= 10,526 cf
Outflow = 0.94 cfs @ 12.99 hrs, Volume= 10,526 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.94 cfs @ 12.99 hrs, Volume= 10,526 cf
Routed to Link 1L : Essex Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 51.93' @ 12.99 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.94 cfs @ 12.99 hrs HW=51.93' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.94 cfs @ 2.73 fps)

Pond 10: EXIST MH10

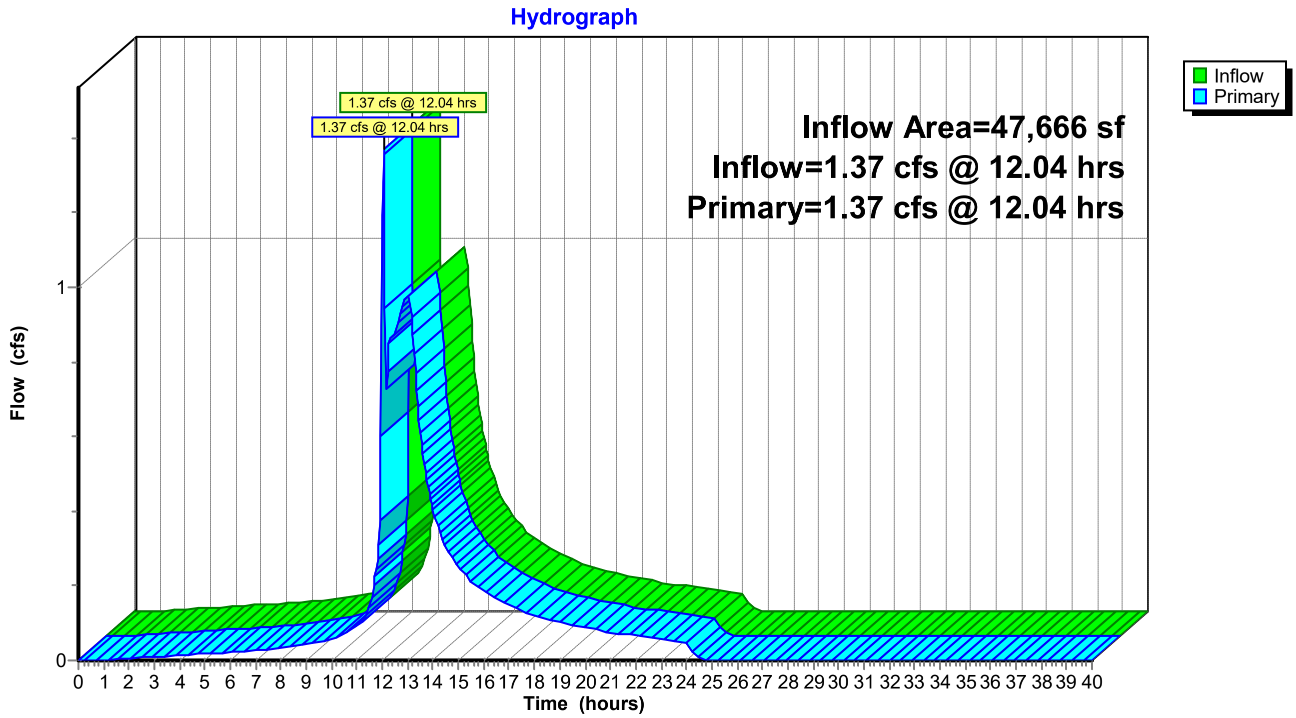


Summary for Link 1L: Essex Street

Inflow Area = 47,666 sf, 65.24% Impervious, Inflow Depth = 3.07" for 50-yr event
Inflow = 1.37 cfs @ 12.04 hrs, Volume= 12,193 cf
Primary = 1.37 cfs @ 12.04 hrs, Volume= 12,193 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 1L: Essex Street



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Runoff Area=23,311 sf 100.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=98 Runoff=4.22 cfs 15,385 cf

Subcatchment 2S: Runoff Area=14,185 sf 1.50% Impervious Runoff Depth=5.66"
Flow Length=220' Tc=19.5 min CN=79 Runoff=1.27 cfs 6,687 cf

Subcatchment 3S: Runoff Area=1,017 sf 25.27% Impervious Runoff Depth=4.60"
Tc=6.0 min CN=70 Runoff=0.12 cfs 390 cf

Subcatchment 4S: Runoff Area=5,326 sf 95.04% Impervious Runoff Depth=7.68"
Tc=6.0 min CN=96 Runoff=0.96 cfs 3,409 cf

Subcatchment 5S: Runoff Area=3,827 sf 58.87% Impervious Runoff Depth=6.13"
Tc=6.0 min CN=83 Runoff=0.60 cfs 1,955 cf

Subcatchment 6S: Runoff Area=1,383 sf 74.19% Impervious Runoff Depth=6.72"
Tc=6.0 min CN=88 Runoff=0.23 cfs 775 cf

Subcatchment 7S: Runoff Area=1,043 sf 97.22% Impervious Runoff Depth=7.80"
Tc=6.0 min CN=97 Runoff=0.19 cfs 678 cf

Subcatchment 8S: Runoff Area=79 sf 100.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=98 Runoff=0.01 cfs 52 cf

Pond 1: CB1 Peak Elev=52.83' Inflow=1.27 cfs 13,760 cf
8.0" Round Culvert n=0.012 L=4.0' S=0.0100 '/' Outflow=1.27 cfs 13,760 cf

Pond 1P: Concrete Galleys Peak Elev=53.57' Storage=9,401 cf Inflow=4.98 cfs 22,463 cf
Discarded=0.07 cfs 9,985 cf Primary=1.18 cfs 10,352 cf Outflow=1.25 cfs 20,336 cf

Pond 2: CB2 Peak Elev=53.63' Inflow=1.27 cfs 6,687 cf
8.0" Round Culvert n=0.012 L=37.0' S=0.0100 '/' Outflow=1.27 cfs 6,687 cf

Pond 2P: Pervious Pavement Peak Elev=53.80' Storage=191 cf Inflow=0.23 cfs 775 cf
Outflow=0.02 cfs 775 cf

Pond 3: CB3 Peak Elev=53.52' Inflow=0.12 cfs 390 cf
8.0" Round Culvert n=0.012 L=11.0' S=0.0182 '/' Outflow=0.12 cfs 390 cf

Pond 3P: Pervious Pavement Peak Elev=53.47' Storage=138 cf Inflow=0.19 cfs 678 cf
Outflow=0.02 cfs 678 cf

Pond 4: CB4 Peak Elev=53.80' Inflow=0.96 cfs 3,409 cf
8.0" Round Culvert n=0.012 L=26.0' S=0.0077 '/' Outflow=0.96 cfs 3,409 cf

Pond 4P: Pervious Pavement Peak Elev=53.24' Storage=9 cf Inflow=0.01 cfs 52 cf
Outflow=0.00 cfs 52 cf

Pond 5: DMH5 Peak Elev=53.50' Inflow=0.96 cfs 3,409 cf
8.0" Round Culvert n=0.012 L=192.0' S=0.0075 '/' Outflow=0.96 cfs 3,409 cf

Pond 10: EXIST MH10 Peak Elev=52.19' Inflow=1.27 cfs 13,760 cf
8.0" Round Culvert n=0.012 L=14.0' S=0.0386 '/' Outflow=1.27 cfs 13,760 cf

Link 1L: Essex Street Inflow=1.55 cfs 15,715 cf
Primary=1.55 cfs 15,715 cf

Total Runoff Area = 50,171 sf Runoff Volume = 29,332 cf Average Runoff Depth = 7.02"
33.80% Pervious = 16,956 sf 66.20% Impervious = 33,215 sf

Summary for Subcatchment 1S: Roof

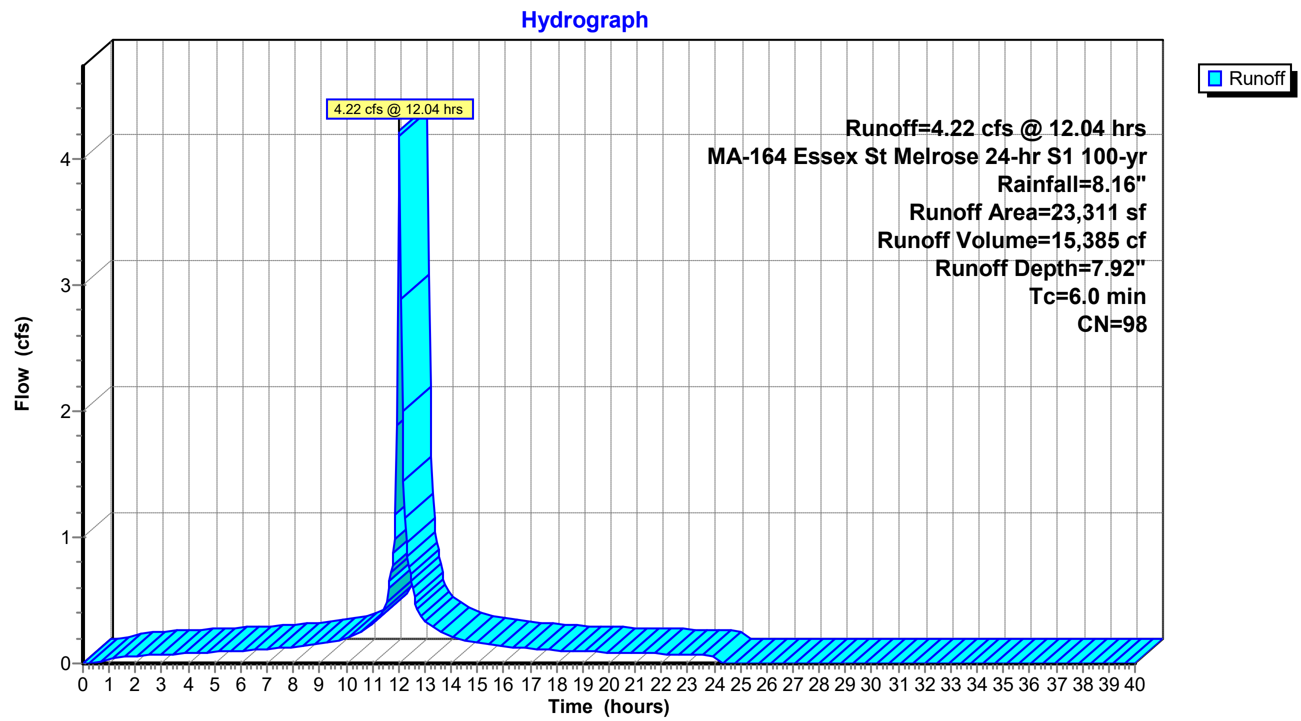
Runoff = 4.22 cfs @ 12.04 hrs, Volume= 15,385 cf, Depth= 7.92"
Routed to Pond 1P : Concrete Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
23,311	98	Roofs, HSG B
23,311		100.00% Impervious Area

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

Subcatchment 1S: Roof



Summary for Subcatchment 2S:

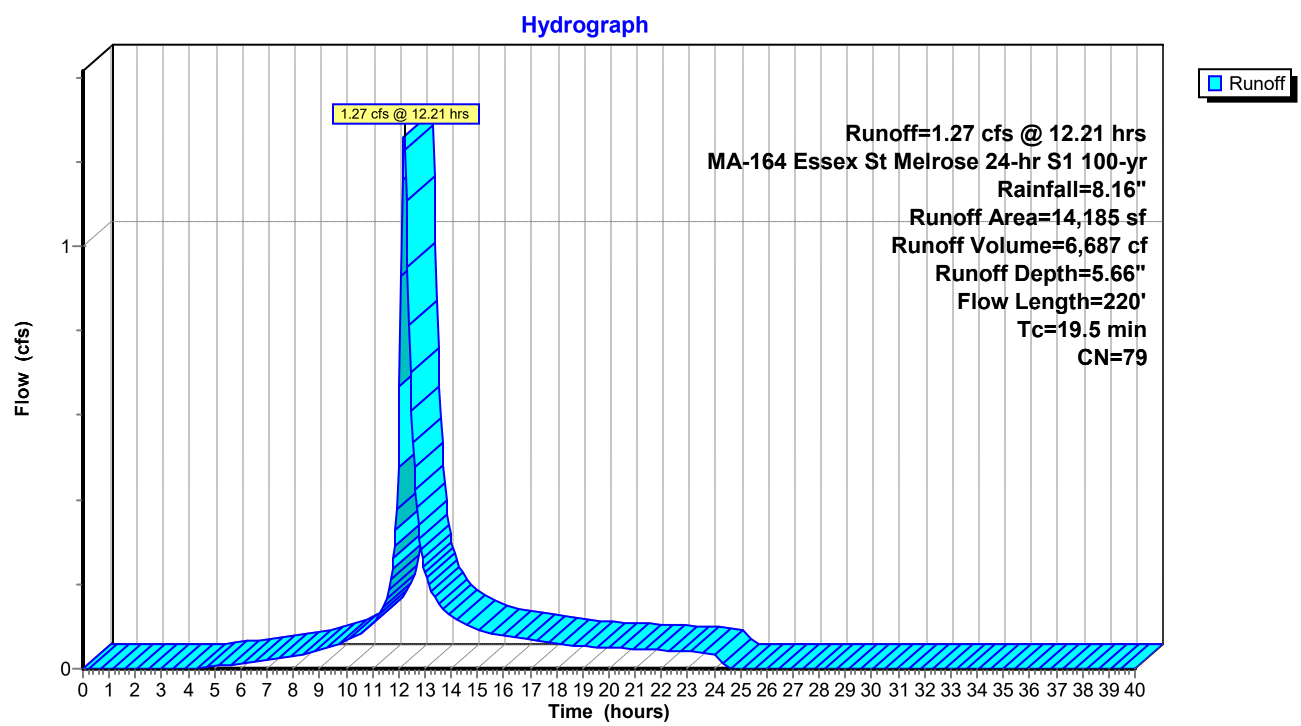
Runoff = 1.27 cfs @ 12.21 hrs, Volume= 6,687 cf, Depth= 5.66"
Routed to Pond 2 : CB2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
6,924	96	Gravel surface, HSG B
7,048	61	>75% Grass cover, Good, HSG B
213	98	Paved parking, HSG B
14,185	79	Weighted Average
13,972		98.50% Pervious Area
213		1.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	35	0.0530	1.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.29"
17.4	65	0.0050	0.06		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.29"
1.8	120	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
19.5	220	Total			

Subcatchment 2S:



Summary for Subcatchment 3S:

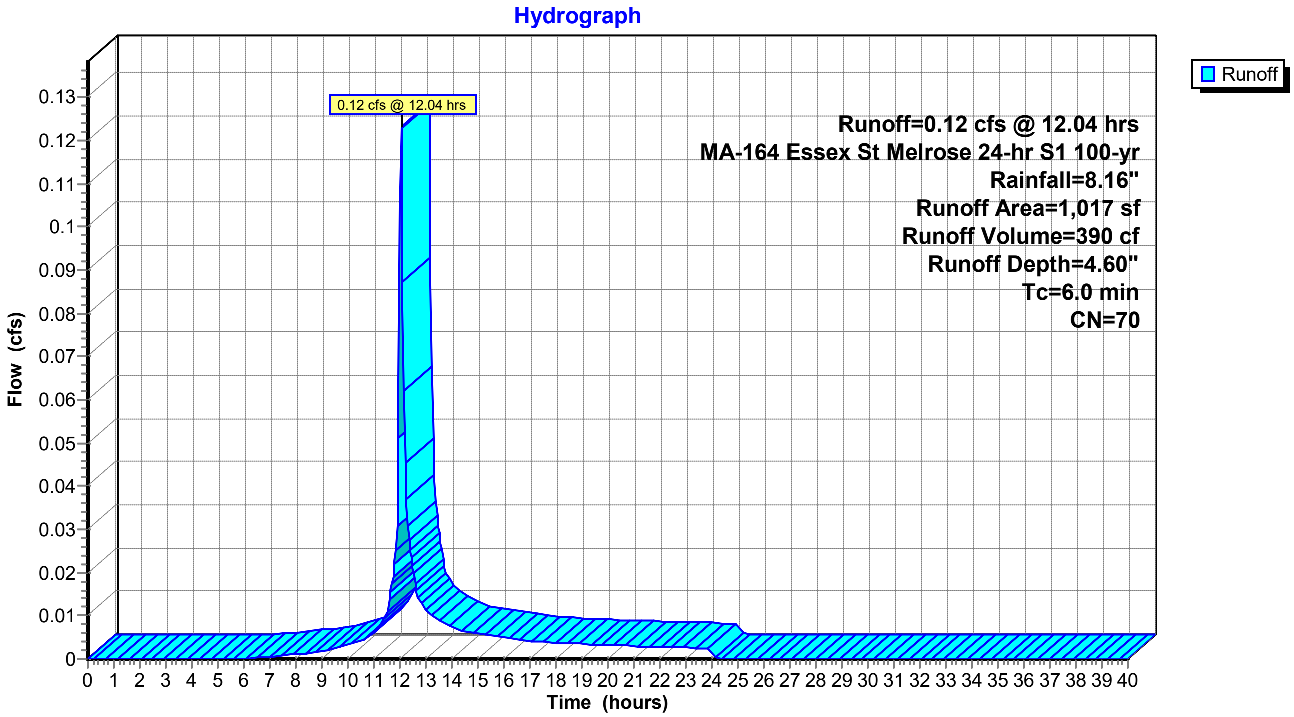
Runoff = 0.12 cfs @ 12.04 hrs, Volume= 390 cf, Depth= 4.60"
Routed to Pond 3 : CB3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
760	61	>75% Grass cover, Good, HSG B
257	98	Paved parking, HSG B
1,017	70	Weighted Average
760		74.73% Pervious Area
257		25.27% Impervious Area

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

Subcatchment 3S:



Summary for Subcatchment 4S:

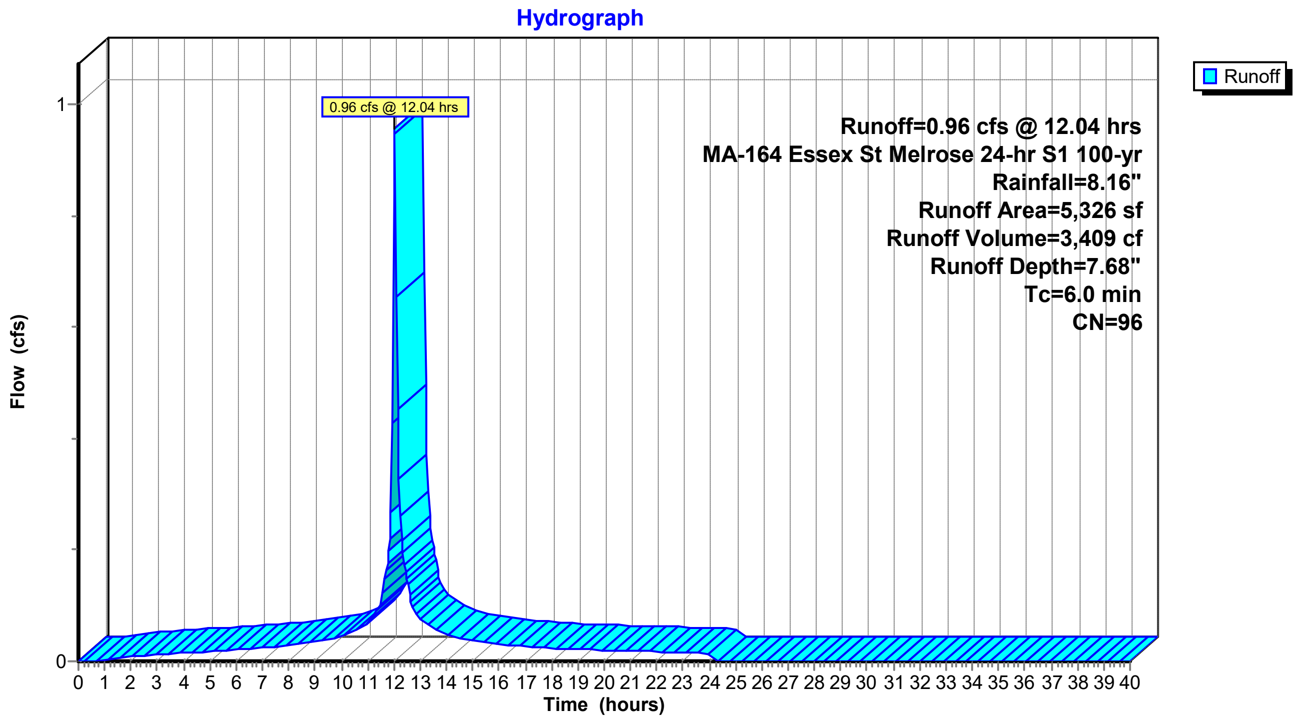
Runoff = 0.96 cfs @ 12.04 hrs, Volume= 3,409 cf, Depth= 7.68"
Routed to Pond 4 : CB4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
264	61	>75% Grass cover, Good, HSG B
5,062	98	Paved parking, HSG B
5,326	96	Weighted Average
264		4.96% Pervious Area
5,062		95.04% Impervious Area

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

Subcatchment 4S:



Summary for Subcatchment 5S:

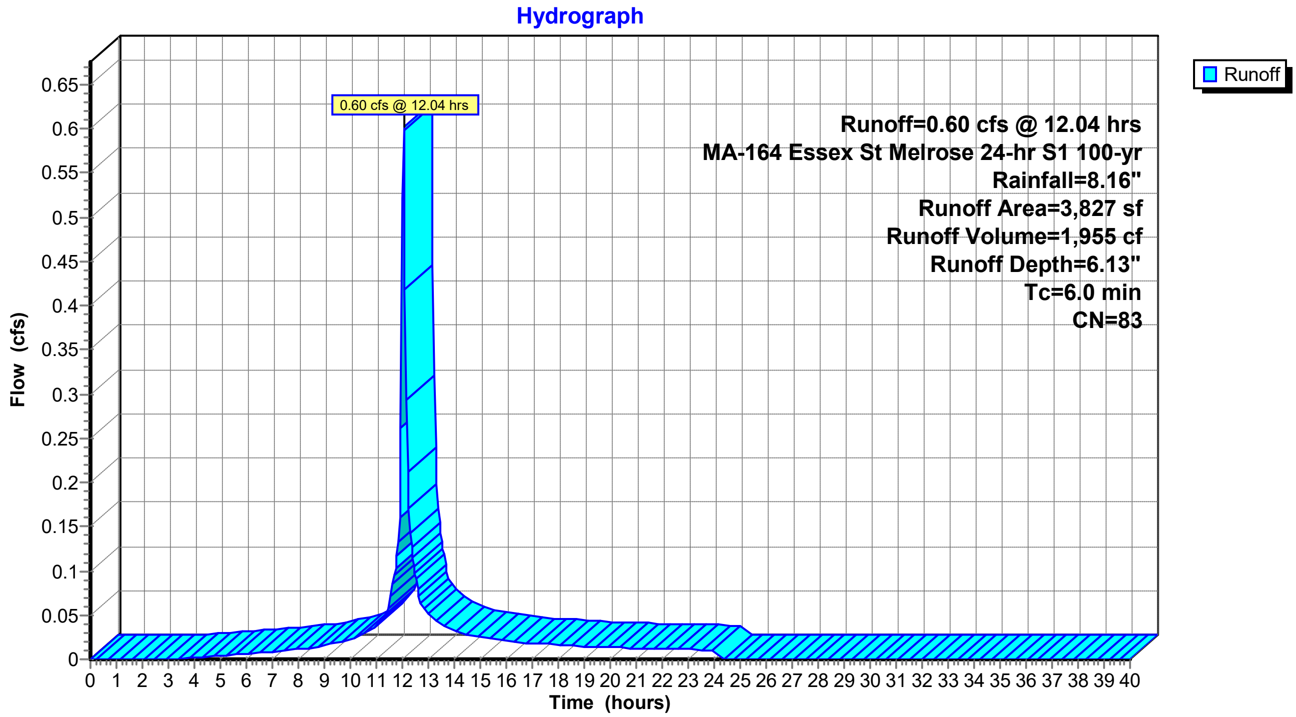
Runoff = 0.60 cfs @ 12.04 hrs, Volume= 1,955 cf, Depth= 6.13"
Routed to Link 1L : Essex Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
1,574	61	>75% Grass cover, Good, HSG B
2,253	98	Paved parking, HSG B
3,827	83	Weighted Average
1,574		41.13% Pervious Area
2,253		58.87% Impervious Area

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

Subcatchment 5S:



Summary for Subcatchment 6S:

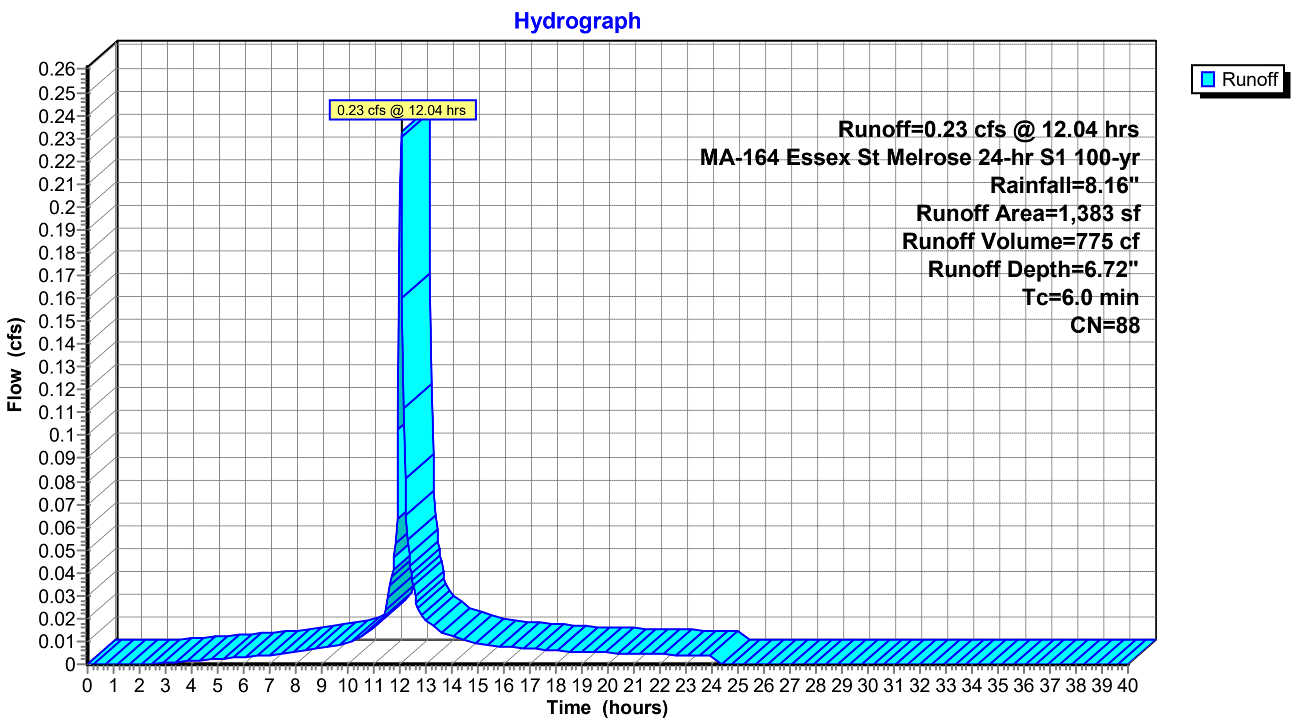
Runoff = 0.23 cfs @ 12.04 hrs, Volume= 775 cf, Depth= 6.72"
Routed to Pond 2P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
1,026	98	Paved parking, HSG B
357	61	>75% Grass cover, Good, HSG B
1,383	88	Weighted Average
357		25.81% Pervious Area
1,026		74.19% Impervious Area

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

Subcatchment 6S:



Summary for Subcatchment 7S:

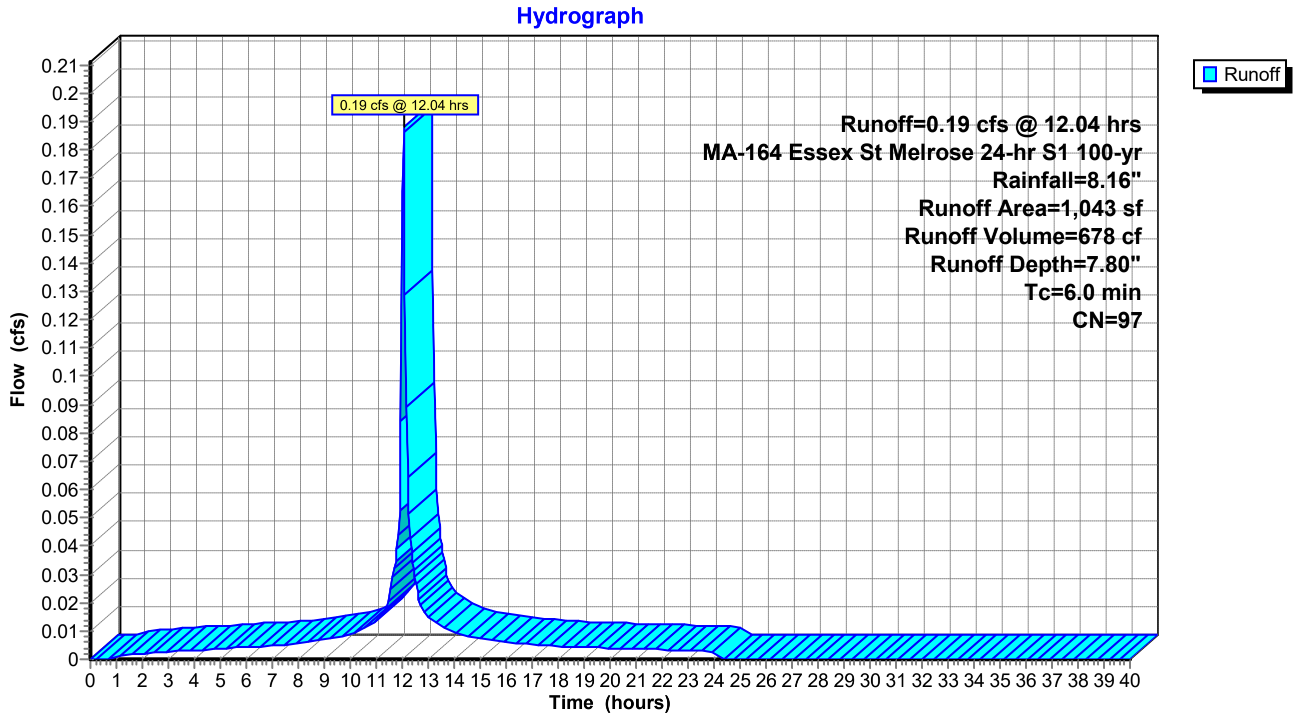
Runoff = 0.19 cfs @ 12.04 hrs, Volume= 678 cf, Depth= 7.80"
Routed to Pond 3P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
1,014	98	Paved parking, HSG B
29	61	>75% Grass cover, Good, HSG B
1,043	97	Weighted Average
29		2.78% Pervious Area
1,014		97.22% Impervious Area

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

Subcatchment 7S:



Summary for Subcatchment 8S:

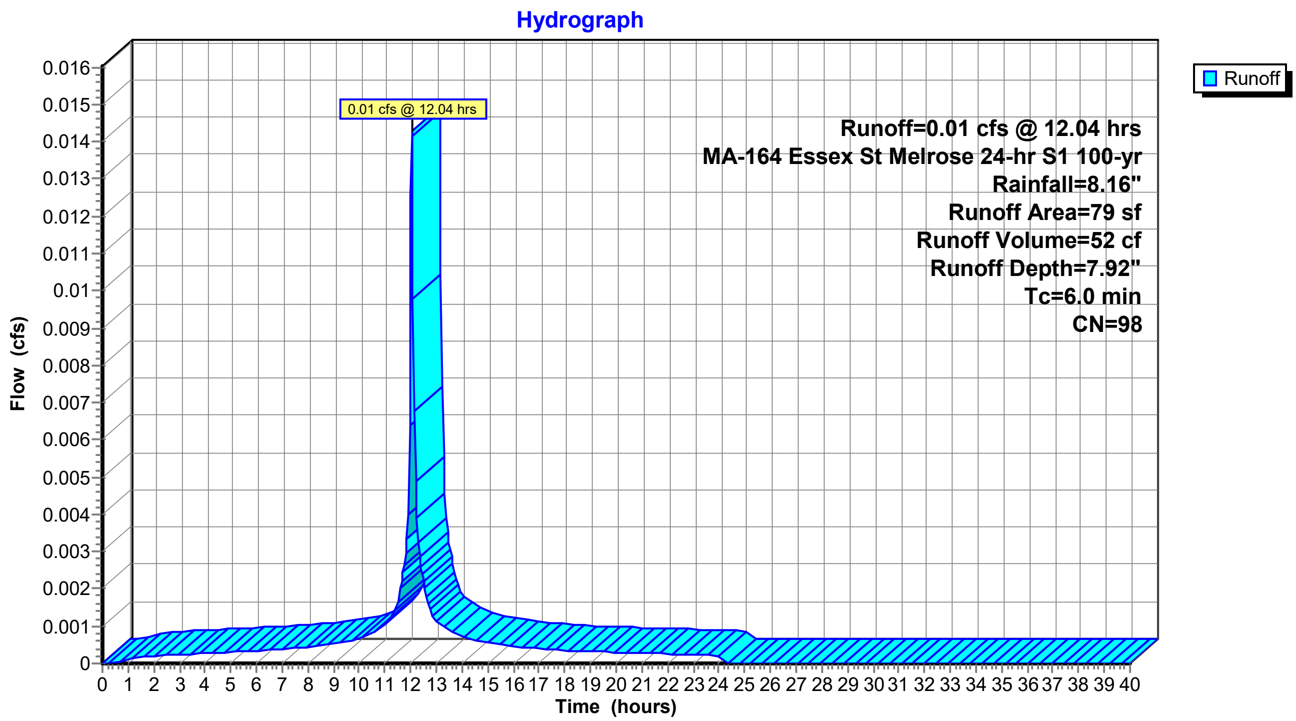
Runoff = 0.01 cfs @ 12.04 hrs, Volume= 52 cf, Depth= 7.92"
Routed to Pond 4P : Pervious Pavement

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
MA-164 Essex St Melrose 24-hr S1 100-yr Rainfall=8.16"

Area (sf)	CN	Description
79	98	Paved parking, HSG B
79		100.00% Impervious Area

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

Subcatchment 8S:



Summary for Pond 1: CB1

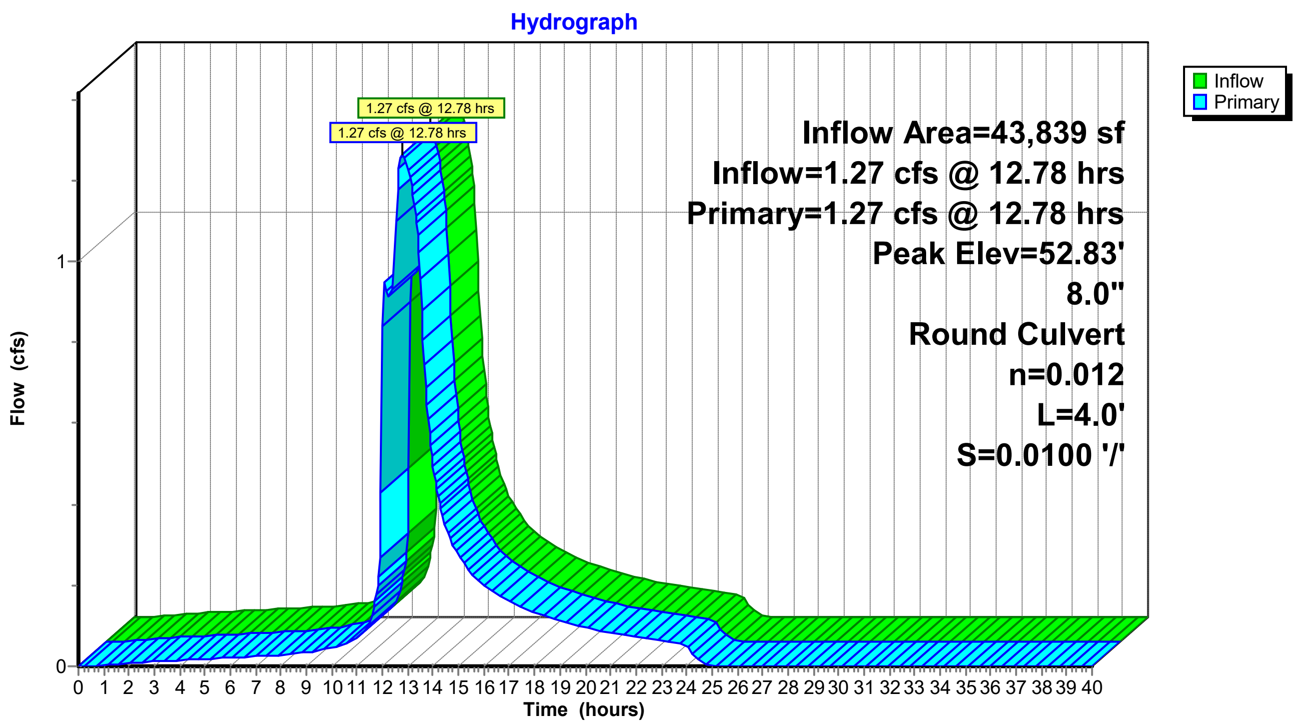
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 3.77" for 100-yr event
Inflow = 1.27 cfs @ 12.78 hrs, Volume= 13,760 cf
Outflow = 1.27 cfs @ 12.78 hrs, Volume= 13,760 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.27 cfs @ 12.78 hrs, Volume= 13,760 cf
Routed to Pond 10 : EXIST MH10

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.83' @ 12.66 hrs
Flood Elev= 55.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.33'	**8.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.33' / 51.29' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.28 cfs @ 12.78 hrs HW=52.77' TW=52.19' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.28 cfs @ 3.66 fps)

Pond 1: CB1



Summary for Pond 1P: Concrete Galleys

Inflow Area = 38,513 sf, 61.75% Impervious, Inflow Depth = 7.00" for 100-yr event
Inflow = 4.98 cfs @ 12.04 hrs, Volume= 22,463 cf
Outflow = 1.25 cfs @ 12.82 hrs, Volume= 20,336 cf, Atten= 75%, Lag= 46.8 min
Discarded = 0.07 cfs @ 4.90 hrs, Volume= 9,985 cf
Primary = 1.18 cfs @ 12.82 hrs, Volume= 10,352 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.57' @ 12.58 hrs Surf.Area= 3,040 sf Storage= 9,401 cf

Plug-Flow detention time= 346.6 min calculated for 20,336 cf (91% of inflow)
Center-of-Mass det. time= 291.4 min (1,063.0 - 771.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	48.50'	2,793 cf	**10.50'W x 289.50'L x 5.25'H Field A** 15,959 cf Overall - 8,976 cf Embedded = 6,983 cf x 40.0% Voids
#2A	49.50'	6,679 cf	**Concrete Galley 4x4x4.25** x 144 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 144 Chambers in 2 Rows
		9,472 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	48.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	51.72'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.72' / 51.33' S= 0.0098 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 4.90 hrs HW=48.55' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.99 cfs @ 12.82 hrs HW=53.16' TW=52.75' (Dynamic Tailwater)
└─**2=Culvert** (Outlet Controls 0.99 cfs @ 2.83 fps)

Pond 1P: Concrete Galleys - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

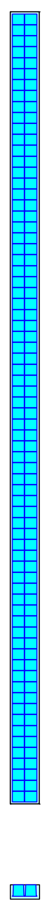
72 Chambers/Row x 4.00' Long = 288.00' Row Length +9.0" End Stone x 2 = 289.50' Base Length
2 Rows x 54.0" Wide + 9.0" Side Stone x 2 = 10.50' Base Width
12.0" Stone Base + 51.0" Chamber Height = 5.25' Field Height

144 Chambers x 46.4 cf = 6,678.8 cf Chamber Storage
144 Chambers x 62.3 cf = 8,975.7 cf Displacement

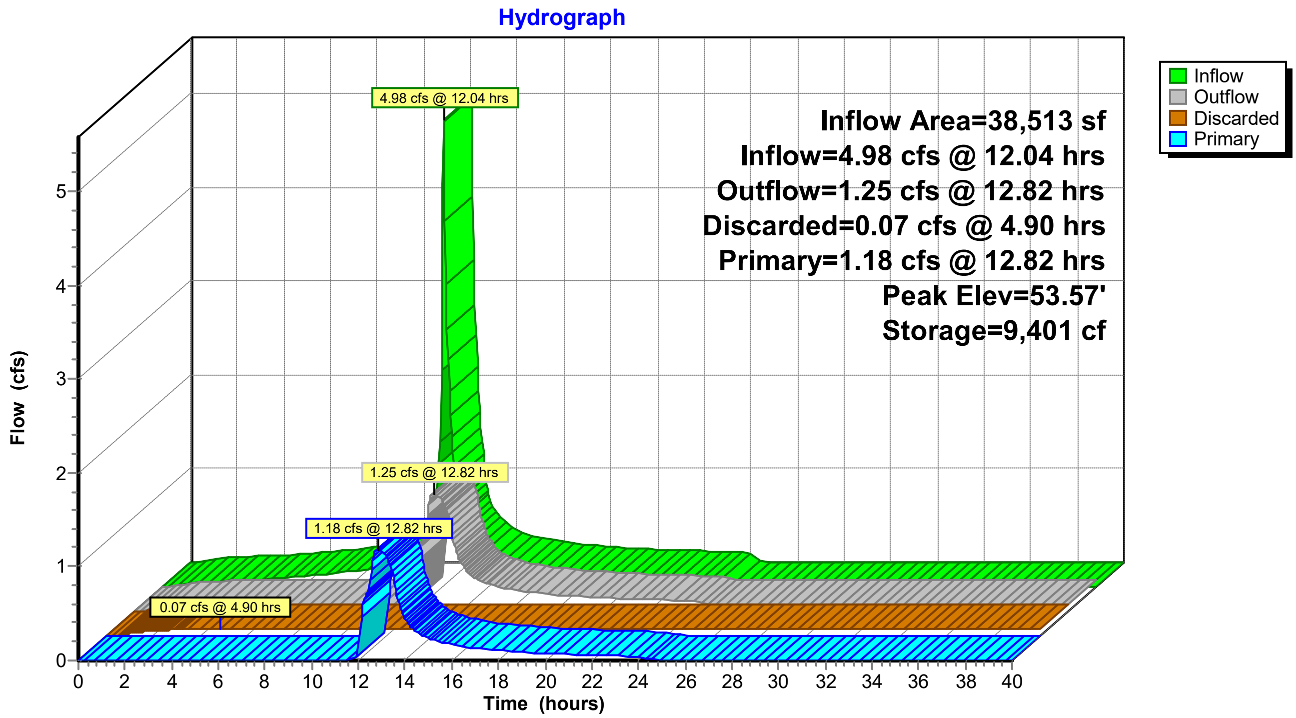
15,958.7 cf Field - 8,975.7 cf Chambers = 6,983.0 cf Stone x 40.0% Voids = 2,793.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,472.0 cf = 0.217 af
Overall Storage Efficiency = 59.4%
Overall System Size = 289.50' x 10.50' x 5.25'

144 Chambers
591.1 cy Field
258.6 cy Stone



Pond 1P: Concrete Galleys



Summary for Pond 2: CB2

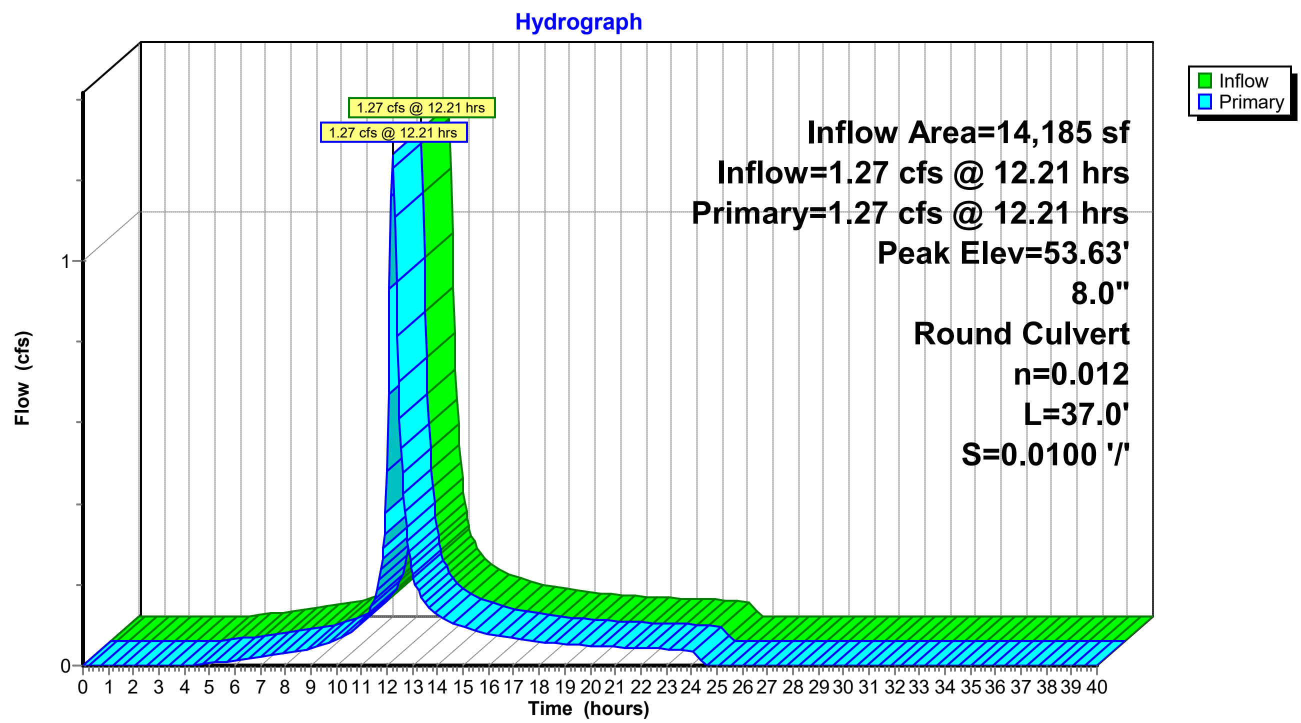
Inflow Area = 14,185 sf, 1.50% Impervious, Inflow Depth = 5.66" for 100-yr event
Inflow = 1.27 cfs @ 12.21 hrs, Volume= 6,687 cf
Outflow = 1.27 cfs @ 12.21 hrs, Volume= 6,687 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.27 cfs @ 12.21 hrs, Volume= 6,687 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.63' @ 12.57 hrs
Flood Elev= 54.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**8.0" Round Culvert** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 51.63' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.25 cfs @ 12.21 hrs HW=53.40' TW=52.76' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.25 cfs @ 3.59 fps)

Pond 2: CB2



Summary for Pond 2P: Pervious Pavement

Inflow Area = 1,383 sf, 74.19% Impervious, Inflow Depth = 6.72" for 100-yr event
Inflow = 0.23 cfs @ 12.04 hrs, Volume= 775 cf
Outflow = 0.02 cfs @ 11.70 hrs, Volume= 775 cf, Atten= 90%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.70 hrs, Volume= 775 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.80' @ 12.73 hrs Surf.Area= 1,026 sf Storage= 191 cf

Plug-Flow detention time= 46.5 min calculated for 774 cf (100% of inflow)
Center-of-Mass det. time= 46.4 min (838.9 - 792.4)

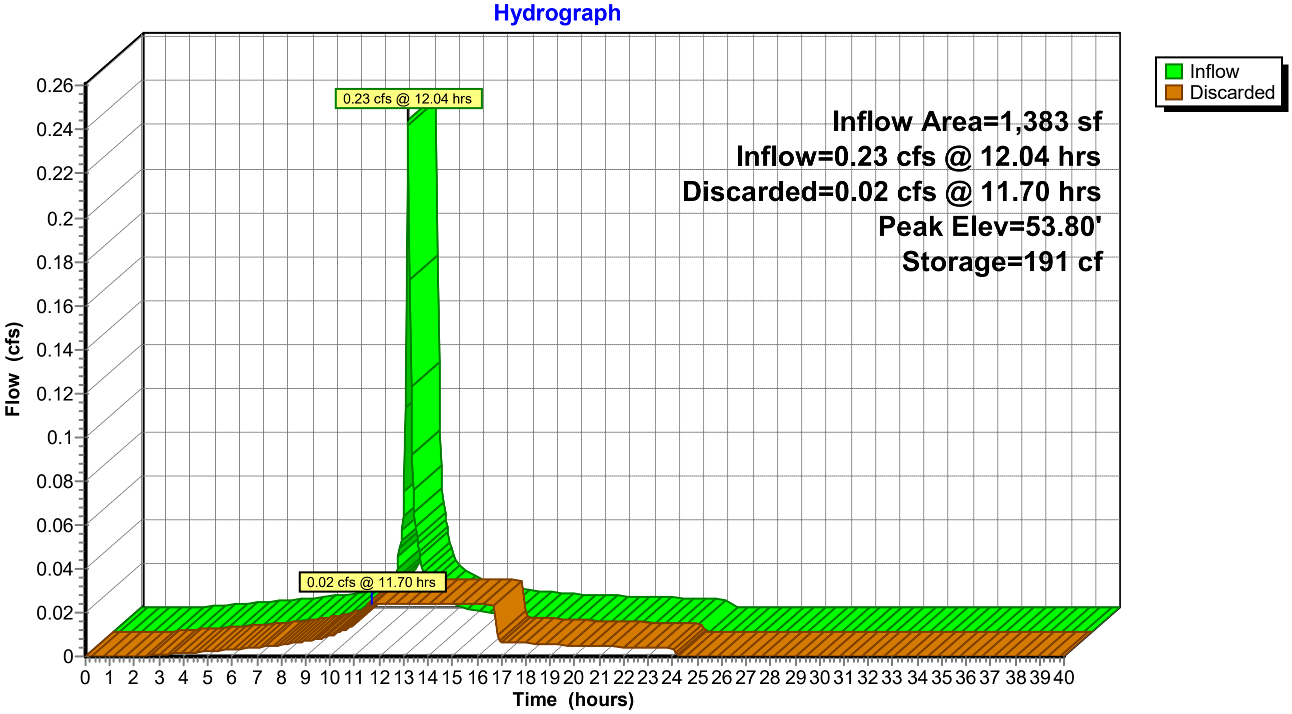
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	363 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,026	0.0	0	0
53.33	1,026	35.0	119	119
54.92	1,026	15.0	245	363

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 11.70 hrs HW=53.02' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 2P: Pervious Pavement



Summary for Pond 3: CB3

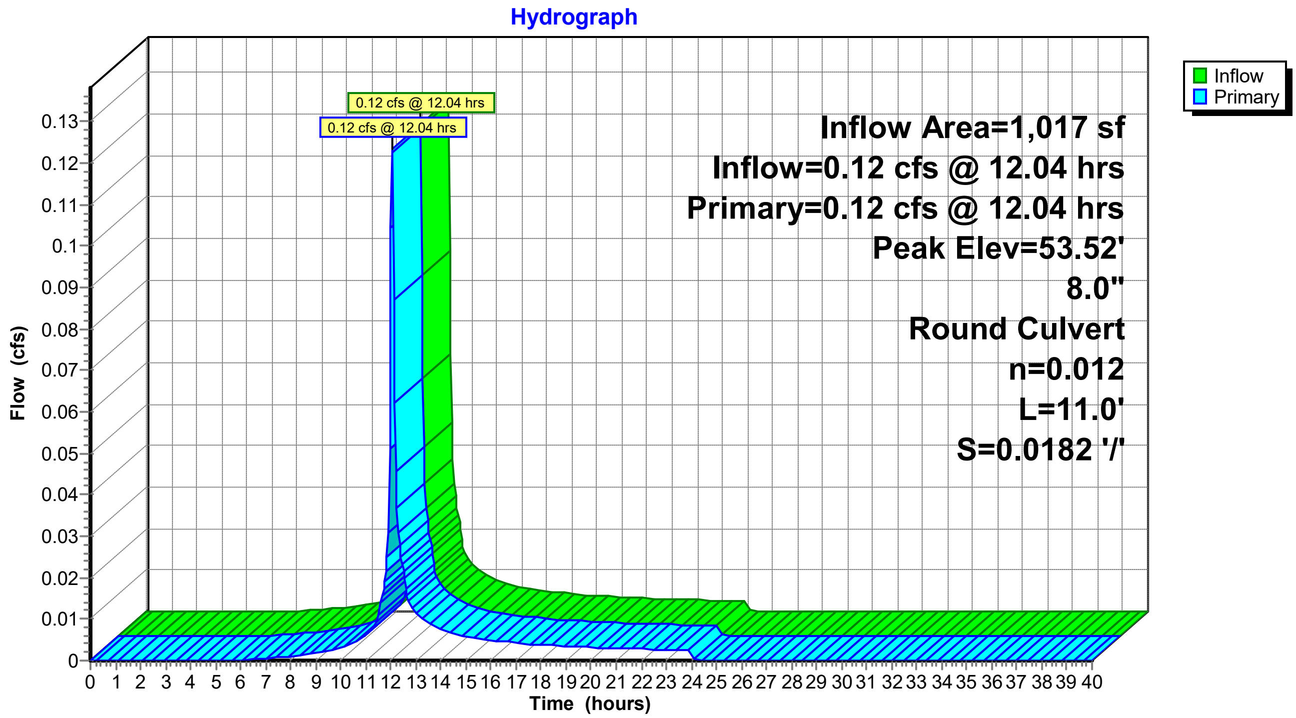
Inflow Area = 1,017 sf, 25.27% Impervious, Inflow Depth = 4.60" for 100-yr event
Inflow = 0.12 cfs @ 12.04 hrs, Volume= 390 cf
Outflow = 0.12 cfs @ 12.04 hrs, Volume= 390 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.12 cfs @ 12.04 hrs, Volume= 390 cf
Routed to Pond 1P : Concrete Galleys

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.52' @ 12.58 hrs
Flood Elev= 54.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.83'	**8.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.83' / 51.63' S= 0.0182 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.14 cfs @ 12.04 hrs HW=52.04' TW=51.84' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.14 cfs @ 2.22 fps)

Pond 3: CB3



Summary for Pond 3P: Pervious Pavement

Inflow Area = 1,043 sf, 97.22% Impervious, Inflow Depth = 7.80" for 100-yr event
Inflow = 0.19 cfs @ 12.04 hrs, Volume= 678 cf
Outflow = 0.02 cfs @ 11.75 hrs, Volume= 678 cf, Atten= 87%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.75 hrs, Volume= 678 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.47' @ 12.59 hrs Surf.Area= 1,014 sf Storage= 138 cf

Plug-Flow detention time= 28.4 min calculated for 678 cf (100% of inflow)
Center-of-Mass det. time= 28.3 min (776.6 - 748.3)

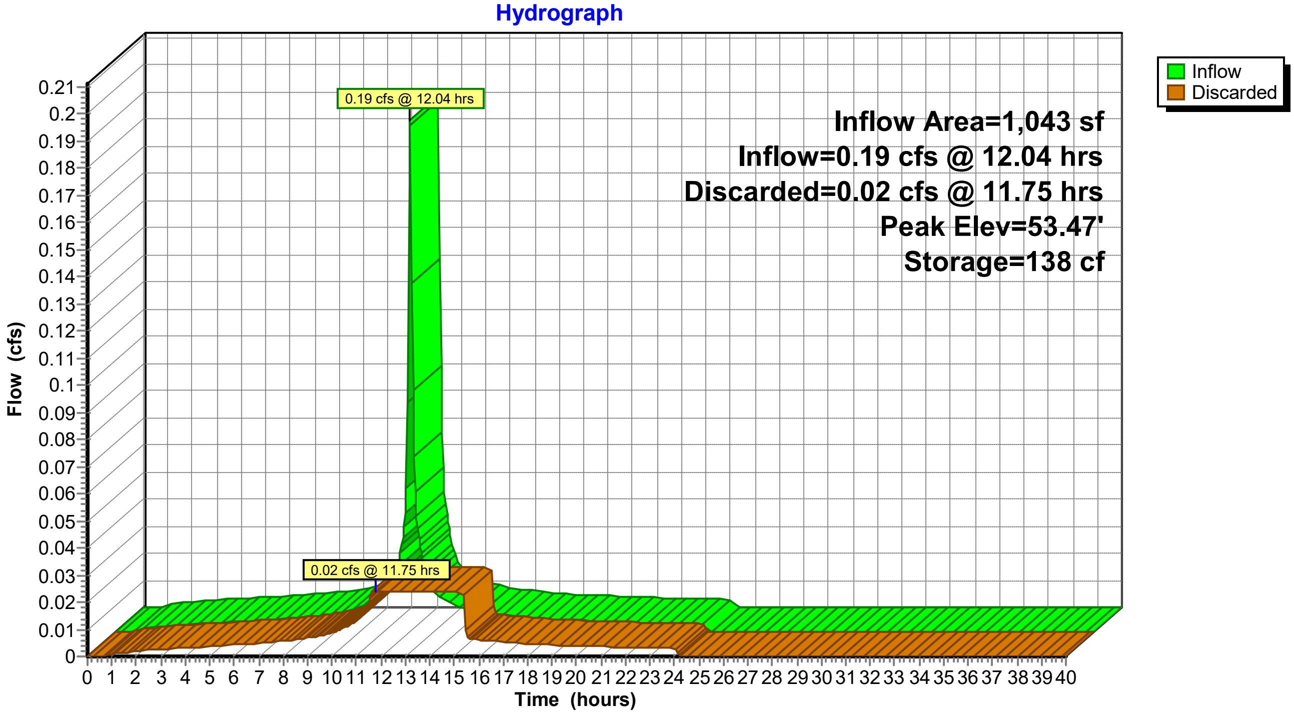
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	359 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	1,014	0.0	0	0
53.33	1,014	35.0	117	117
54.92	1,014	15.0	242	359

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.02 cfs @ 11.75 hrs HW=53.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 3P: Pervious Pavement



Summary for Pond 4: CB4

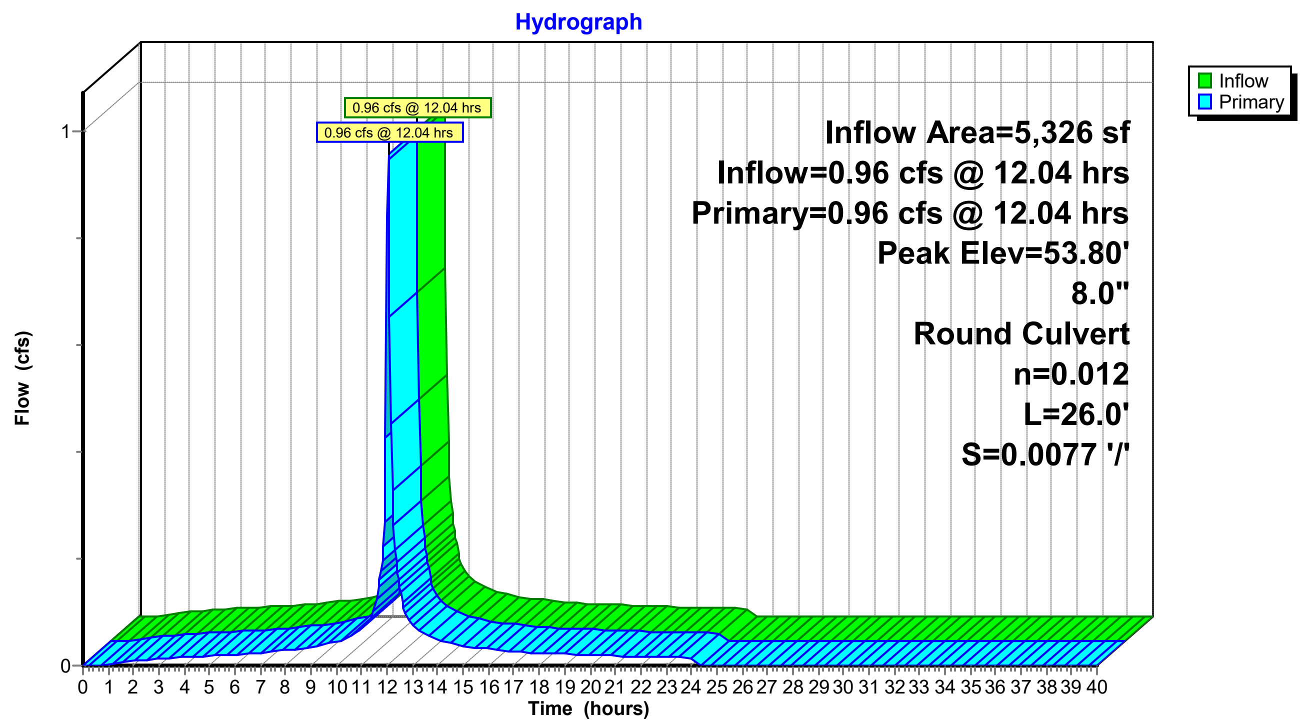
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 7.68" for 100-yr event
Inflow = 0.96 cfs @ 12.04 hrs, Volume= 3,409 cf
Outflow = 0.96 cfs @ 12.04 hrs, Volume= 3,409 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.96 cfs @ 12.04 hrs, Volume= 3,409 cf
Routed to Pond 5 : DMH5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.80' @ 12.04 hrs
Flood Elev= 55.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.97'	**8.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.97' / 52.77' S= 0.0077 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.92 cfs @ 12.04 hrs HW=53.77' TW=53.48' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 0.92 cfs @ 2.62 fps)

Pond 4: CB4



Summary for Pond 4P: Pervious Pavement

Inflow Area = 79 sf,100.00% Impervious, Inflow Depth = 7.92" for 100-yr event
Inflow = 0.01 cfs @ 12.04 hrs, Volume= 52 cf
Outflow = 0.00 cfs @ 11.90 hrs, Volume= 52 cf, Atten= 83%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.90 hrs, Volume= 52 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.24' @ 12.45 hrs Surf.Area= 102 sf Storage= 9 cf

Plug-Flow detention time= 16.0 min calculated for 52 cf (100% of inflow)
Center-of-Mass det. time= 16.0 min (757.4 - 741.4)

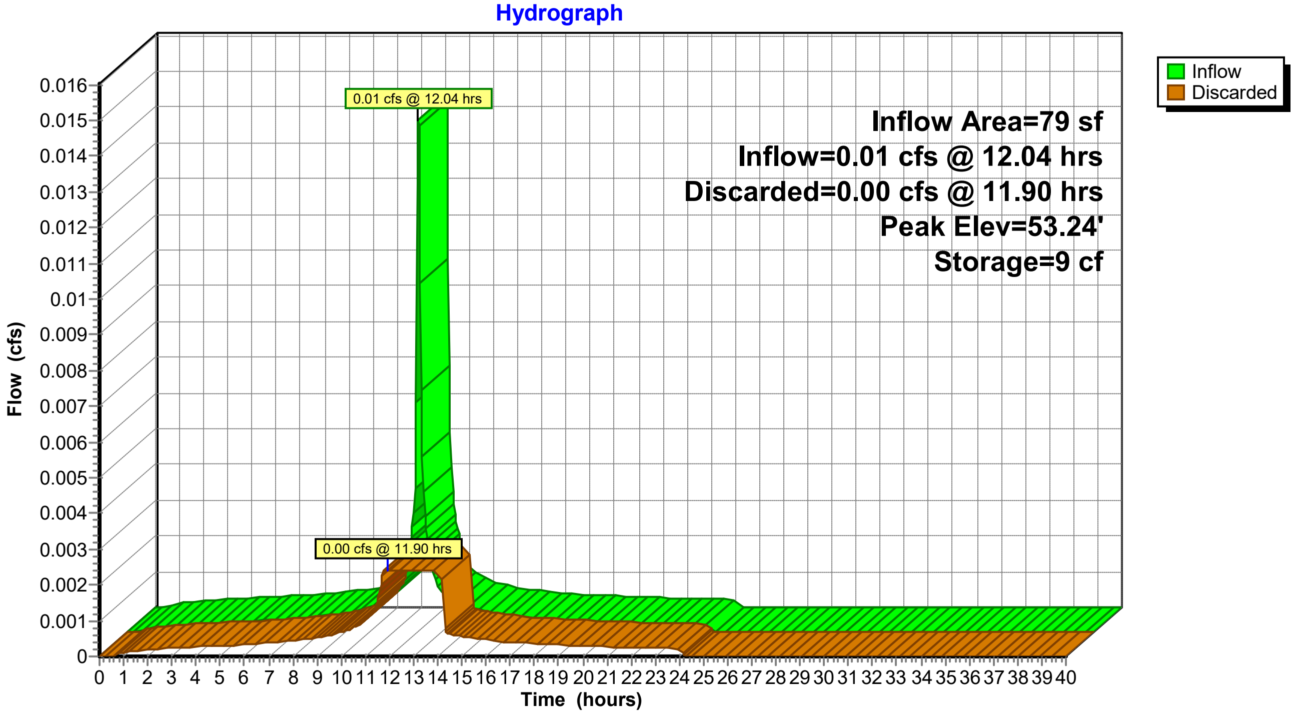
Volume	Invert	Avail.Storage	Storage Description
#1	53.00'	36 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.00	102	0.0	0	0
53.33	102	35.0	12	12
54.92	102	15.0	24	36

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 11.90 hrs HW=53.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Pond 4P: Pervious Pavement



Summary for Pond 5: DMH5

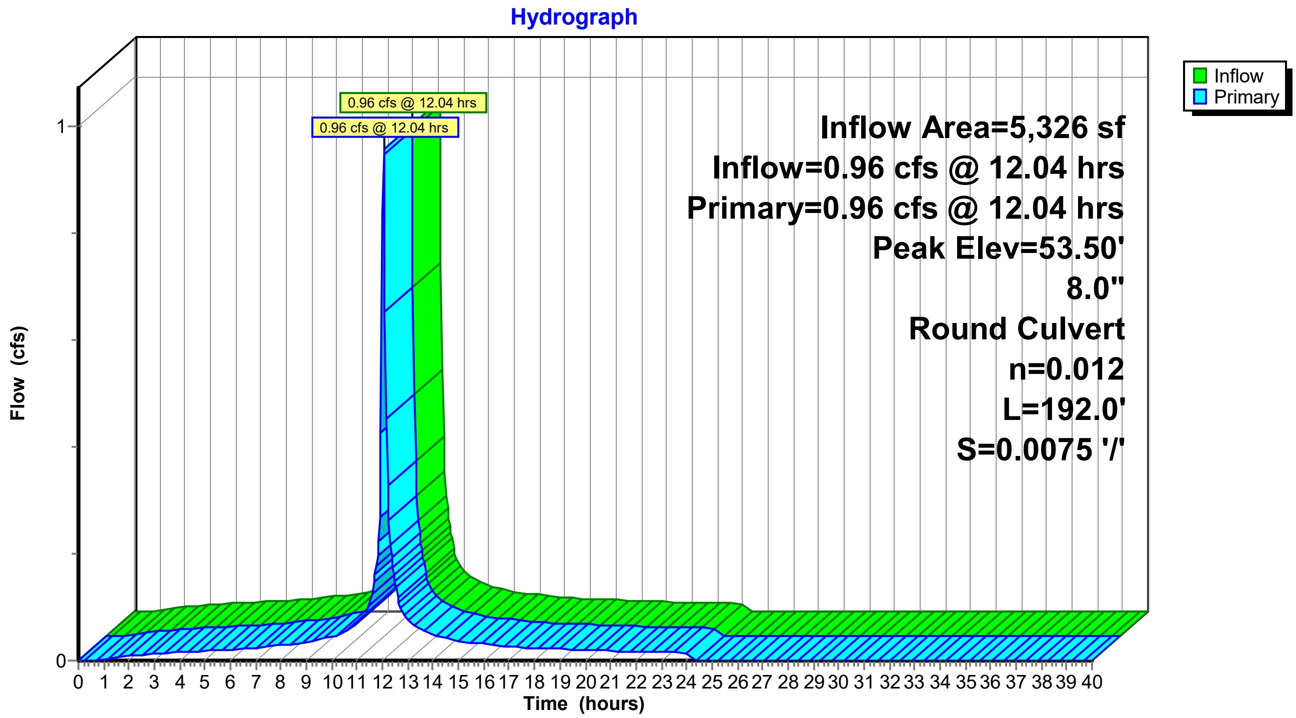
Inflow Area = 5,326 sf, 95.04% Impervious, Inflow Depth = 7.68" for 100-yr event
Inflow = 0.96 cfs @ 12.04 hrs, Volume= 3,409 cf
Outflow = 0.96 cfs @ 12.04 hrs, Volume= 3,409 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.96 cfs @ 12.04 hrs, Volume= 3,409 cf
Routed to Pond 1 : CB1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 53.50' @ 12.04 hrs
Flood Elev= 55.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.77'	**8.0" Round Culvert** L= 192.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.77' / 51.33' S= 0.0075 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.93 cfs @ 12.04 hrs HW=53.48' TW=52.22' (Dynamic Tailwater)
↑**1=Culvert** (Outlet Controls 0.93 cfs @ 3.12 fps)

Pond 5: DMH5



Summary for Pond 10: EXIST MH10

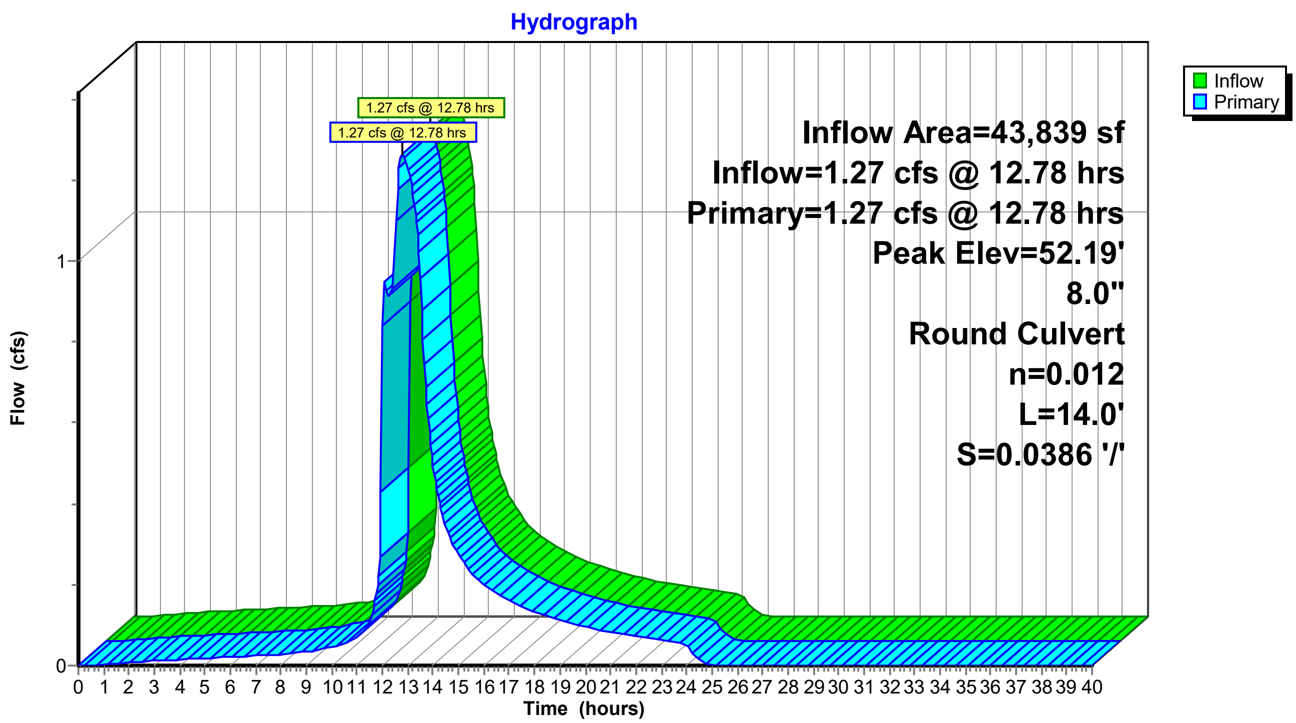
Inflow Area = 43,839 sf, 65.79% Impervious, Inflow Depth = 3.77" for 100-yr event
Inflow = 1.27 cfs @ 12.78 hrs, Volume= 13,760 cf
Outflow = 1.27 cfs @ 12.78 hrs, Volume= 13,760 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.27 cfs @ 12.78 hrs, Volume= 13,760 cf
Routed to Link 1L : Essex Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 52.19' @ 12.78 hrs
Flood Elev= 55.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.29'	**8.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.29' / 50.75' S= 0.0386 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.26 cfs @ 12.78 hrs HW=52.19' TW=0.00' (Dynamic Tailwater)
1=Culvert (Inlet Controls 1.26 cfs @ 3.62 fps)

Pond 10: EXIST MH10

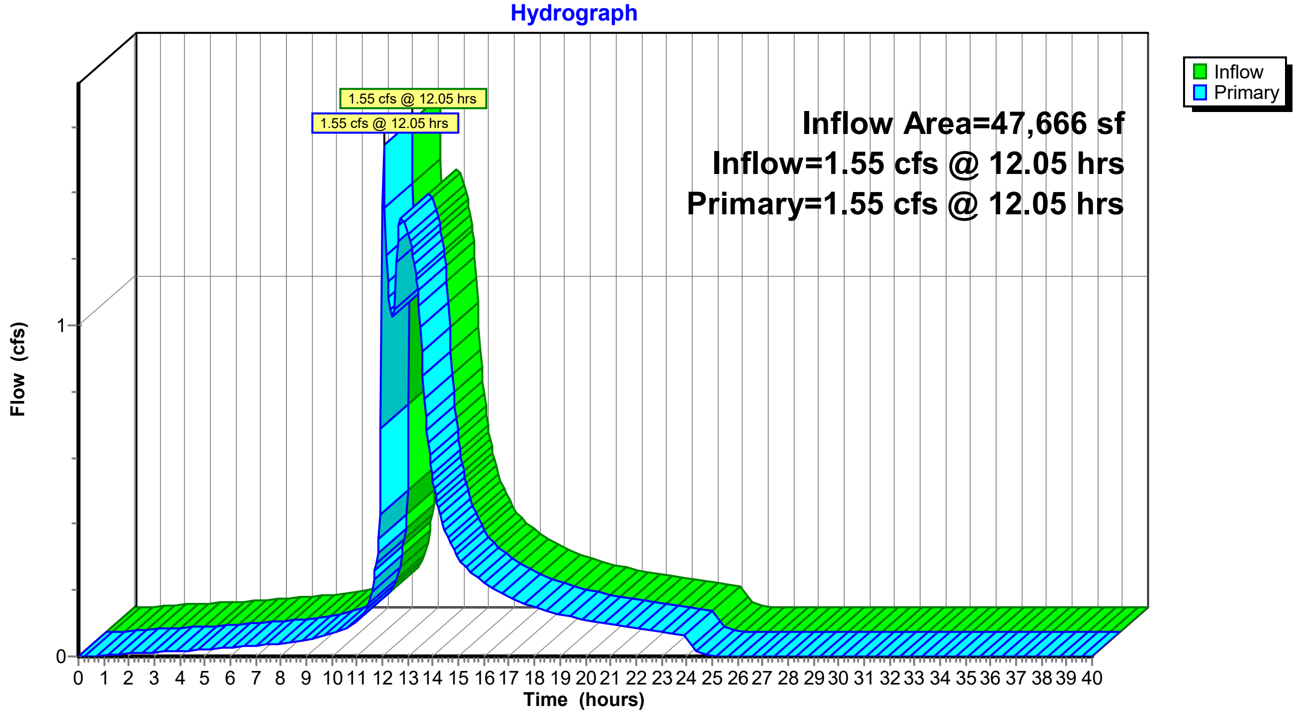


Summary for Link 1L: Essex Street

Inflow Area = 47,666 sf, 65.24% Impervious, Inflow Depth = 3.96" for 100-yr event
Inflow = 1.55 cfs @ 12.05 hrs, Volume= 15,715 cf
Primary = 1.55 cfs @ 12.05 hrs, Volume= 15,715 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 1L: Essex Street



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25-yr Event

50-yr Event

100-yr Event

2 | *Stormwater Report Compliance Calculations*

2.1 Standard 1 | No Untreated Discharges Or Erosion To Wetlands

Untreated Discharges
To document compliance that new discharges are adequately treated refer to calculations for Standards 4 through 6.

Erosion To Wetlands
There are no on-site wetland resource areas.

2.2 Standard 2 | Peak Rate Attenuation

Refer to Peak Rate of Runoff tables below (see Mitigative Drainage Analysis)

Table 2.2.1: Peak Rate of Runoff | Comparison Location 1L

Description	**2 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
Existing Peak Rate of Runoff (cfs)	2.52	3.71	4.45	4.99	5.56
Proposed Peak Rate of Runoff (cfs)	0.57	0.95	1.19	1.37	1.55
Difference	**-1.95**	**-2.76**	**-3.26**	**-3.62**	**-4.01**

Table 2.2.2: Stormwater Management Area 1P | Subsurface Infiltration Galleys

24 Hour Local Storm event	Peak Rate of Runoff in (cfs)	Peak Rate of runoff out (cfs)				Peak Water Level (ft)
		Total (cfs)	Exfiltration (cfs)	8″ Culvert (cfs)		
2 year	1.93	0.07	0.07	0.00		50.56
10 year	3.10	0.20	0.07	0.13		51.93
25 year	3.84	0.62	0.07	0.55		52.24
50 year	4.38	0.94	0.07	0.87		52.69
100 year	4.98	1.25	0.07	1.18		53.57

2.3 Standard 3 | Stormwater Recharge

Recharge Volume:
$R_{v\ required}$ = (Impervious Area)(F)

Site is analyzed using Hydrologic Soil Groups:
F_B = 0.35 in.

***Site Impervious Area Draining to Recharge Facilities*:**

Stormwater Management Area 1P
$A_{imp\ B\ soils} = 23781\ ft^2$
$R_{v\ required} = [(23781)(0.35)/12] = 694\ ft^3$
$R_{v\ provided} = 6011\ ft^3$ (storage volume below outlet)

Capture Area Adjustment
Total impervious area: 26130 ft^2 (proposed on-site impervious only, excludes pervious pavement)
Site impervious areas draining to recharge facilities: 23781 ft^2
Ratio of total impervious area to site impervious areas draining to recharge facilities:
(26130/23781) = 1.10

Total Recharge Volume Required
$A_{imp\ B\ soils\ total}$ = 26130 ft^2
$R_{v\ required}$ = (26130)(0.35)/12 = 762 ft^3
Adjusted minimum required recharge volume = (762)(1.10) = 838 ft^3

Total Recharge Volume Provided
$R_{v\ provided}$ = 6011 ft^3

Capture Area Percentage:
Site impervious areas draining to recharge facilities: 23781 ft^2
Total impervious area: 26130 ft^2
Percent Captured: (23781/26130) = 91.0% > 65%

Drawdown Within 72 Hours:
$T_{drawdown}$ = [$R_{v\ total}$ / (K)(Bottom Area)]

Stormwater Management Area 1P
$R_{v\ 1P}$ = 9401 ft^3 (100 year storage volume)
K = 1.02 in/hr (Rawls Rate)
Bottom Area = 3173 ft^2 (see site plan)
$T_{drawdown}$ = 9401 / [(1.02)(3173)/12] = 35 hours < 72 hours

2.4 Standard 4 | Water Quality

Water Quality:
Water quality is provided through the following stormwater best management practices.

1) Deep Sump Catch Basins w/hood
2) Subsurface Infiltration Galleys

Stormwater Management Area 1P
$V_{wq\ required}$ = [(23781)(0.50)/12] = 991 ft^3
$V_{wq\ provided}$ = 6011 ft^3 (storage volume below outlet)

TSS Removal:

Pretreatment Chain for SWMA1P = 25%

- Deep Sump Hooded Catch Basin = 25%

Treatment Chain for SWMA1P = 80%

- Infiltration Galleys = 80%

TSS Removal Calculation Worksheet

Location: Pretreatment Chain SWMA1P

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75

Total TSS Removal = 25%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: MELR-0047
Prepared By: MEM
Date: 4/10/2024

*Equals remaining load from previous BMP (E) which enters the BMP

TSS Removal Calculation Worksheet

Location: Treatment Chain SWMA1P

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Subsurface Infiltration Structure	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

Total TSS Removal = 80%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: MELR-0047
Prepared By: MEM
Date: 4/10/2024

*Equals remaining load from previous BMP (E) which enters the BMP

EPA Phosphorus Load Reduction for Structural Stormwater Best Management Practices:

Stormwater Management Area 1P			
IA - Impervious Area Characteristics			
Subcatchment	Land Use	Area ft^2	HSG
1S	HDR	23311	B
2S	HDR	213	B
3S	HDR	257	B
Total		23781	

Stormwater Management Area 1P			
PA - Pervious Area Characteristics			
Subcatchment	Land Use	Area ft^2	HSG
1S	HDR	0	B
2S	HDR	13972	B
3S	HDR	460	B
Total		14432	

BMP Volume = 6011 ft^3 (volume below outlet)
BMP $Volume_{(IA-in)1}$ = [(6011 ft^3)(12 in/ft)]/(23781 ft^2) = 3.03 in
Interpolated runoff depth for B Soils = 0.22 in
BMP $Volume_{(PA-ft^3)1}$ = [(14432 ft^2)(0.22 in)]/(12 in/ft) = 265 ft^3
BMP $Volume_{(IA-ft^3)1}$ = (6011 ft^3 - 265 ft^3) = 5746 ft^3
BMP $Volume_{(IA-in)2}$ = [(5746 ft^3)(12 in/ft)]/(23781 ft^2) = 2.90 in
% Difference = [(3.03 in – 2.90 in)/(3.03 in + 2.90 in)/2)] = 4.4% ∴ OK
Given the depth of runoff is greater than 2 inches it is assumed 100% reduction is achieved.
BMP $Reduction_{(\%-P)}$ = 100% (from Table 3-9, Appendix F of the MA MS4 General Permit)
BMP Load = [(23781 ft^2)/(43560 ft^2/acre)](2.32 lbs/acre/year) + [(14432 ft^2)/(43560 ft^2/acre)](0.12 lbs/acre/year) = 1.31 lbs/year
BMP $Reduction_{(lbs-P)}$ = (1.31 lbs/year)(1.0) = 1.31 lbs/year

2.5 Standard 5 | Land Uses With Higher Potential Pollutant Loading

This project is not considered a LUHPPL.

2.6 Standard 6 | Critical Areas

Stormwater discharge from this property is not within a Zone II, Interim Wellhead Protection Area of a public water supply or a Critical Area.

2.7 Standard 7 | Redevelopment

This project is not considered a redevelopment.

2.8 Standard 8 | Construction Period Controls

Refer to Section 5 Construction Period Pollution Prevention Plan and Erosion and Sediment Control.

2.9 Standard 9 | Long Term Operation And Maintenance Plan

Refer to Appendix F Long Term Operation and Maintenance Plan.

2.10 Standard 10 |Illicit Discharges To Drainage System

There are no proposed illicit discharges into the Stormwater Management Systems to be constructed as shown on the site/definitive plan.

3 | MassDEP Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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

The Stormwater Report must include:

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

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

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

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

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

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

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

4.11.2024

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of “country drainage” versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe): Pervious pavement

3.3 Standard 1: No New Untreated Discharges

☒ No new untreated discharges (Less 885 ft^2 of driveway and sidewalk)

☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

3.4 Standard 2: Peak Rate Attenuation

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

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

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

3.5 Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

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

3.6 Standard 4: Water Quality

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

List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

3.8 Standard 6: Critical Areas

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.11 Standard 9: Operation and Maintenance Plan

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

  ☒ Name of the stormwater management system owners;

  ☒ Party responsible for operation and maintenance;

  ☒ Schedule for implementation of routine and non-routine maintenance tasks;

- ☒ Plan showing the location of all stormwater BMPs maintenance access areas; (See O&M site plan)
- ☐ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

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

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

3.12 Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached; (See Standard 10 Section 1.7 of the Mitigative Drainage Analysis)

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

4 | *Long Term Pollution Prevention Plan*

This Long Term Pollution Prevention Plan is prepared to comply with the provisions set forth in the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards. Structural Best Management Practices (BMPs) require periodic maintenance to ensure proper function and efficiency in pollutant removal from stormwater discharges that would otherwise reach wetland resource areas untreated.

Maintenance schedules found below are as recommended in Department of Environmental Protection's Massachusetts Stormwater Handbook and as recommended in manufacturer's specifications.

4.1 Driveway/Parking Lot Sweeping

Driveway and parking lot shall be swept on a monthly average with special attention given to spring (March/April) and late fall (November/December).

4.2 Trash and Litter Cleanup

Property owner(s) shall perform trash and litter cleanup once per month in and around the site. Trash and litter shall be disposed of in on-site dumpsters.

4.3 Ownership and Maintenance Responsibilities

After completion Cedar Park Development, LLC will assume full responsibility of continuing the operation and maintenance of the stormwater management system. The exception would be if a legal agreement is made with another party to perform such duties for the owner(s).

4.4 DEP Standard 4 Water Quality

The Long Term Pollution Prevention Plan includes the following:

Good housekeeping practices
Prevent or reduce pollutant runoff from reaching the wetland resource areas through street sweeping, stabilizing all disturbed areas with vegetative cover and catch basin cleaning.

Provisions for storing materials and waste products inside or under cover
All materials on site are to be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure. All waste products are to be placed in secure receptacles until they are emptied by a solid waste management company licensed in the Commonwealth of Massachusetts.

Vehicle washing controls
Vehicle owners shall wash their vehicles at commercial car washes which recycle water and use approximately 60% on average of the amount of water used in a home wash. All contaminants/hazardous waste shall be disposed of in a manner specified by local or State regulation or by the manufacturer. Site personnel shall be instructed in these practices.

Requirements for routine inspections and maintenance of Stormwater BMP's
Follow the procedures outlined in Appendix F Long Term Operation and Maintenance Plan and the provided Inspection and Maintenance Forms.

Spill prevention and response plans
Spill Prevention: As mentioned previously, all materials on site are to be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure. Products shall be kept in their original containers with the original manufacturer's label. Products should not be mixed unless recommended by the manufacturer. The manufacturer's recommendations for proper use, storage and disposal shall be followed at all times and, if possible, all of the product should be used up before proper disposal.

Response: The manufacturer's recommended methods for cleanup must be followed and spills cleaned up immediately after discovery. Spills shall be kept well ventilated and personnel must wear appropriate protective gear to prevent injury from contact with hazardous substances. Spills of toxic or hazardous material must be reported to the appropriate local and/or State agencies in accordance with the local and/or Commonwealth of Massachusetts regulations.

Requirements for storage and use of fertilizers, herbicides and pesticides
Consult the City of Melrose, MA Conservation Commission for any questions regarding these materials.

Fertilizers: Fertilizers are to be applied at the minimum amounts recommended by the manufacturer and once applied shall be worked into the soil to limit the possibility of entering the storm drains. Storage procedures are to be followed as previously stated and the contents of any partially used bags should be transferred to a sealable container, either bag or bin to avoid spilling.

Herbicides and Pesticides: Storage of these materials are to be as outlined previously and especially out of the reach of pets and children, away from damp areas where their containers may succumb to moisture or rust and should not be stored near food. These materials must not be placed in the trash or washed down the drain. Handle using rubber gloves and use an appropriate mask when using these products for extensive periods of time.

Provisions for maintenance of lawns, gardens, and other landscaped areas
These activities are left to the owner(s) to schedule and perform.

Pet waste management provisions
These activities are left to the pet owner(s) to schedule and perform.

Provisions for solid waste management
All waste products are to be placed in secure receptacles until they are emptied by a solid waste management company licensed in the Commonwealth of Massachusetts.

Snow disposal and plowing plans relative to Wetland Resource Areas
Snow disposal/removal shall be in compliance with MassDEP's Bureau of Water Resources guidelines, effective December 11, 2020. See Section 7 Snow Disposal Guidelines.

Winter Road Salt and/or Sand Use and Storage restrictions
Road Salt use must be in compliance with the Guidelines on Deicing Chemical (Road Salt) Storage effective date December 19, 1997, Guideline No. DWSG97-1 found in the BRP's Drinking Water Program. Sand Use: Encourage the use of environmentally friendly alternatives such as calcium chloride and/or sand instead of road salt for melting ice whenever possible.

Street Sweeping schedules
Street sweeping should be performed on a monthly average; however, at the very least sweeping must occur once a year in the spring and fall in order to minimize the amount of Total Suspended Solids load on the deep-sump catch basins and the other Best Management Practices tributary thereto.

Provisions for prevention of illicit discharges to the stormwater management systems
According to Standard 10 in the Massachusetts Stormwater Handbook, Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

Documentation that Stormwater BMP's are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from land uses with higher potential pollutant loads (LUHPPL)
Not applicable as this project does not meet the criteria for a LUHPPL.

Training for staff or personnel involved with implementing LTPPP
This responsibility lies with the owner(s) unless a legally-binding agreement is made with another party to perform such duties for the owner(s).

List of Emergency contacts for implementing Long-Term Pollution Prevention Plan
This responsibility lies with the owner(s) unless a legally-binding agreement is made with another party to perform such duties for the owner(s).

5 | Construction Period Pollution Prevention Plan & Erosion & Sediment Control

This Construction Period Pollution Prevention Plan and Erosion and Sediment Control Plan is prepared to comply with the provisions set forth in the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards.

5.1 Site Description

Project name and location
164 Essex Street
Melrose, Massachusetts 01949

Applicant Name and Address
Cedar Park Development LLC
Sean Szekely
142 Hagget's Pond Road
Andover, Massachusetts 01841

Description (Purpose and Types of Soil Disturbing Activities)

The proposal is to construct a 23,300± ft^2 76 unit residential building with underground parking, utilities and stormwater management devices for attenuation and treatment of stormwater runoff.

Soil disturbing activities include: Installation of erosion and sediment control devices, stormwater management devices, utilities, pavement, landscape and preparation for final loaming and seeding.

Site Runoff Coefficient
The final composite runoff coefficient for the area of construction is approximately 0.8.

Site Area
The site is 0.74 acres, 0.8 acres will be disturbed by construction activities.

Sequence of Major Activities
1. Install construction entrance
2. Install erosion control devices
3. Demolition
4. Earthwork
5. Utility Installation
6. Parking garage slab and pavement base course installation
7. Building construction
8. Curbing and sidewalk construction
9. Finished grading and slope stabilization
10. Finished Paving
11. Loam and seed all disturbed areas
12. Final cleanup including inspection and cleanout of all stormwater structures

Name of Receiving Waters
Boston Harbor

5.2 Erosion and Sediment Controls

In order to limit the amount of erosion and sedimentation that takes place during and after construction, it is important to implement a management plan, which will protect and limit the amount of land area that is devoid of vegetation at any given time.

Prior to Construction
Prior to start of construction activities, the owner, builder, and site contractor shall clearly identify areas that may be affected by the proposed clearing and earth moving activities by reviewing the approved grading plan as part of an initial site visit. During the site visit, the limit of work line shall be reviewed to confirm the type of erosion control measure to be used to protect downstream wetland resources and abutting property. Limits of tree clearing shall be verified during the initial site visit with emphasis on identifying "save areas" for existing trees and vegetation where practicable.

Erosion and Sediment Control Device
Siltfence is proposed as the primary erosion control device for this project (see detail provided on site/definitive plan). It is important for the owner, builder, and/or site contractor to have access to a supply of compost BMPs should the need arise for additional erosion and sediment control measures. A compost filter sock or approved equal may be used along a slope and/or together with siltfence to protect against concentrated stormwater runoff over exposed surfaces. Erosion and sediment control devices shall be inspected every 7 days or within 24-hours of a 1/4-inch (or greater) rainfall event to ensure that they are operating properly. Should sediment levels begin to build up on the erosion control devices, it may be necessary to remove the accumulated sediment to ensure that the erosion control devices continue to operate as designed. Sediment shall be removed when it reaches one third the height of the fence.

Earth-moving Activities
After trees and other vegetation are cleared, earth-moving (or grading) activities can begin. The approved grading plan shall be used to help guide the site contractor during regrading activities. Often times it is helpful to have a land surveyor establish benchmark elevations and/or lines of grade to aid the site contractor during regrading activities. This is the time during which the site is most vulnerable to erosion. Therefore, it is important for the site contractor to finalize grading activities as soon as practicable following land clearing. Areas than remain exposed longer than 30 working days in an interim condition shall be stabilized in a temporary fashion. Once final grades have been established, permanent vegetation can be established.

Temporary Seeding
During construction it may be necessary to temporarily stabilize areas that will not be brought to final grade for a period longer than 30 working days. Temporary seeding is accomplished using fast-growing grass seed species such as ryegrass. Seeding shall be performed in accordance with the guidelines set forth in the attached **Temporary Seeding Guidance**, which is an excerpt from the publication entitled, "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, May 2003, prepared by Franklin, Hampden, and Hampshire Conservation Districts."

Permanent Seeding & Plantings
Once final grades have been established and the weather permits, every effort shall be made to establish permanent vegetation on disturbed and exposed areas. In addition to grass seed, tree and shrub plantings shall be an integral part of the permanent stabilization plan. Care shall be taken by the owner, builder, and/or site contractor to select trees, shrubs, and seed mixes that are best suited to the soil conditions on the site. Soil moisture, depth to seasonal groundwater, and exposure to sunlight shall be carefully

considered when selecting species. In recent years, the emphasis on using plant species native to Massachusetts has grown. Information on the use of non-native and native species can be found on the web and in many local nursery catalogs.

Permanent seeding shall be performed in accordance with the guidelines set forth in the attached **Permanent Seeding Guidance**, which is an excerpt from a publication entitled, "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, May 2003, prepared by Franklin, Hampden, and Hampshire Conservation Districts."

Seeding, Permanent

The establishment of perennial vegetative cover on disturbed areas.

Purpose

Permanent seeding of grass and planting trees and shrubs provides stabilization to the soil by holding soil particles in place.

Vegetation reduces sediments and runoff to downstream areas by slowing the velocity of runoff and permitting greater infiltration of the runoff.

Vegetation also filters sediments, helps the soil absorb water, improves wildlife habitats, and enhances the aesthetics of a site.

Where Practice Applies

- Permanent seeding and planting is appropriate for any graded or cleared area where long-lived plant cover is needed to stabilize the soil.
- Areas which will not be brought to final grade for a year or more.
- Some areas where permanent seeding is especially important are filter strips, buffer areas, vegetated swales, steep slopes, and stream banks.
- This practice is effective on areas where soils are unstable because of their texture or structure, high water table, winds, or steep slope.

Advantages

Advantages of seeding over other means of establishing plants include the small initial establishment cost, the wide variety of grasses and legumes available, low labor requirement, and ease of establishment in difficult areas.

Seeding is usually the most economical way to stabilize large areas.

Well established grass and ground covers can give an aesthetically pleasing, finished look to a development.

Once established, the vegetation will serve to prevent erosion and retard the velocity of runoff.

Disadvantages/Problems

Disadvantages which must be dealt with are the potential for erosion during the establishment stage, a need to reseed areas that fail to establish, limited periods during the year suitable for seeding, and a need for water and appropriate climatic conditions during germination. Vegetation and mulch cannot prevent soil slippage and erosion if soil is not inherently stable.

Coarse, high grasses that are not mowed can create a fire hazard in some locales. Very short mowed grass, however, provides less stability and sediment filtering capacity.

Grass planted to the edge of a watercourse may encourage fertilizing and mowing near the water's edge and increase nutrient and pesticide contamination.

Depends initially on climate and weather for success.

May require regular irrigation to establish and maintain.

Planning considerations

Selection of the right plant materials for the site, good seedbed preparation, timing, and conscientious maintenance are important. Whenever possible, native species of plants should be used for landscaping. These plants are already adapted to the locale and survivability should be higher than with "introduced" species.

Native species are also less likely to require irrigation, which can be a large maintenance burden and is neither cost-effective nor ecologically sound.

If non-native plant species are used, they should be tolerant of a large range of growing conditions, as low-maintenance as possible, and not invasive.

Consider the microclimate within the development area. Low areas may be frost pockets and require hardier vegetation since cold air tends to sink and flow towards low spots. South-facing slopes may be more difficult to re-vegetate because they tend to be sunnier and drier.

Divert as much surface water as possible from the area to be planted.

Remove seepage water that would continue to have adverse effects on soil stability or the protecting vegetation. Subsurface drainage or other engineering practices may be needed. In this situation, a permit may be needed from the local Conservation Commission: check ahead of time to avoid construction delays.

Provide protection from equipment, trampling and other destructive agents.

Vegetation cannot be expected to supply an erosion control cover and prevent slippage on a soil that is not stable due to its texture, structure, water movement, or excessive slope.

Seeding Grasses and Legumes

Install needed surface runoff control measures such as gradient terraces, berms, dikes, level spreaders, waterways, and sediment basins prior to seeding or planting.

Seedbed Preparation

If infertile or coarse-textured subsoil will be exposed during land shaping, it is best to stockpile topsoil and respread it over the finished slope at a minimum 2- to 6-inch depth and roll it to provide a firm seedbed. If construction fill operations have left soil exposed with a loose, rough, or irregular surface, smooth with blade and roll.
Loosen the soil to a depth of 3-5 inches with suitable agricultural or construction equipment.
Areas not to receive top soil shall be treated to firm the seedbed after incorporation of the lime and fertilizer so that it is depressed no more than ½ - 1 inch when stepped on with a shoe. Areas to receive topsoil shall not be firmed until after topsoiling and lime and fertilizer is applied and incorporated, at which time it shall be treated to firm the seedbed as described above. This can be done by rolling or cultipacking.

Cool Season Grasses

Cool Season Grasses grow rapidly in the cool weather of spring and fall, and set seed in June and July. Cool season grasses become dormant when summer temperatures persist above 85 degrees and moisture is scarce.

Lime and Fertilizer

Apply lime and fertilizer according to soil test and current Extension Service recommendations. In absence of a soil test, apply lime (a pH of 5.5 - 6.0 is desired) at a rate of 2.5 tons per acre and 10-20-20 analysis fertilizer at a rate of 500 pounds per acre (40 % of N to be in an organic or slow release form). Incorporate lime and fertilizer into the top 2-3 inches of soil.

Seeding Dates

Seeding operations should be performed within one of the following periods:

- April 1 - May 31,
- August 1 - September 10,
- November 1 - December 15 as a dormant seeding (seeding rates shall be increased by 50% for dormant seedings).

Seeding Methods

Seeding should be performed by one of the following methods. Seed should be planted to a depth of ¼ to ½ inches.

- Drill seedings,
- Broadcast and rolled, cultipacked or tracked with a small track piece of construction equipment,
- Hydroseeding, with subsequent tracking.

Mulch

Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas.

Warm Season Grasses

Warm Season Grasses begin growth slowly in the spring, grow rapidly in the hot summer months and set seed in the fall. Many warm season grasses are sensitive to frost in the fall, and the top growth may die back. Growth begins from the plant base the following spring.

Lime and Fertilizer

Lime to attain a pH of at least 5.5. Apply a 0-10-10 analysis fertilizer at the rate of 600 lbs./acre.

Incorporate both into the top 2-3 inches of soil. (30 lbs. of slow release nitrogen should be applied after emergence of grass in the late spring.)

Seeding Dates

Seeding operations should be performed as an early spring seeding (April 1-May 15) with the use of cold treated seed. A late fall early winter dormant seeding (November 1 - December 15) can also be made, however the seeding rate will need to be increased by 50%.

Seeding Methods

Seeding should be performed by one of the following methods:

- Drill seedings (de-awned or de-bearded seed should be used unless the drill is equipped with special features to accept awned seed).
- Broadcast seeding with subsequent rolling, cultipacking or tracking the seeding with small track construction equipment. Tracking should be oriented up and down the slope.
- Hydroseeding with subsequent tracking. If wood fiber mulch is used, it should be applied as a separate operation after seeding and tracking to assure good seed to soil contact.

Mulch

Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas.

Seed Mixtures for Permanent Cover

Recommended mixtures for permanent seeding are provided on the following pages. Select plant species which are suited to the site conditions and planned use. Soil moisture conditions, often the major limiting site factor, are usually classified as follows:

Dry - Sands and gravels to sandy loams. No effective moisture supply from seepage or a high water table.

Moist - Well drained to moderately well drained sandy loams, loams, and finer; or coarser textured material with moderate influence on root zone from seepage or a high water table.

Wet - All textures with a water table at or very near the soil surface, or with enduring seepage.

When other factors strongly influence site conditions, the plants selected must also be tolerant of these conditions.

Permanent Seeding Mixtures

Mix	Site	Seed Mixture	Seed, Pounds per: Acre	Seed, Pounds per: 1,000 sf	Remarks
1	Dry	Little Bluestem			* Use Warm Season planting procedure.
		or Broomsedge	10	0.25	* Roadsides
		Tumble Lovegrass*	1	0.10	* Sand and Gravel Stabilization
		Switchgrass	10	0.25	* Clover requires inoculation with nitrogen-fixing bacteria
		Bush Clover*	2	0.10	
		Red Top	1	0.10	* Rates for this mix are for PLS.
2	Dry	Deertongue	15	0.35	* Use Warm Season planting procedures.
		Broomsedge	10	0.25	* Acid sites/Mine spoil
		Bush Clover*	2	0.10	* Clover requires inoculation with nitrogen-fixing bacteria.
		Red Top	1	0.10	
					*Rates for this mix are for PLS.
3	Dry	Big Bluestem	10	0.25	* Use Warm Season planting procedures.
		Indian Grass	10	0.25	* Eastern Prairie appearance
		Switchgrass	10	0.25	* Sand and Gravel pits.
		Little Bluestem	10	0.25	* Golf Course Wild Areas
		Red Top or	1	0.10	* Sanitary Landfill Cover seeding
		Perennial Ryegrass	10	0.25	* Wildlife Areas
					*OK to substitute Poverty Dropseed in place of Red Top/Ryegrass.
					*Rates for this mix are for PLS.
4	Dry	Flat Pea	25	0.60	* Use Cool Season planting procedures
		Red Top or	2	0.10	* Utility Rights-of-Ways (tends to suppress woody growth)
		Perennial Ryegrass	15	0.35	
5	Dry	Little Bluestem	5	0.10	* Use Warm Season planting procedures.
		Switchgrass	10	0.25	* Coastal sites
		Beach Pea*	20	0.45	* Rates for Bluestein and Switchgrass are for PLS.
		Perennial Ryegrass	10	0.25	
6	Dry - Moist	Red Fescue	10	0.25	* Use Cool Season planting procedure.
		Canada Bluegrass	10	0.25	* Provides quick cover but is non-aggressive; will tend to allow indigenous plant colonization.
		Perennial Ryegrass	10	0.25	
		Red Top	1	0.10	* General erosion control on variety of sites, including forest roads, skid trails and landings.
7	Moist-Wet	Switchgrass	10	0.25	* Use Warm Season planting procedure.
		Virginia Wild Rye	5	0.10	* Coastal plain/flood plain
		Big Bluestem	15	0.35	* Rates for Bluestem and Switchgrass are for PLS.
		Red Top	1	0.10	

Permanent Seeding Mixtures

Mix	Site	Seed Mixture	Seed, Pounds per: Acre	Seed, Pounds per: 1,000 sf	Remarks
8	Moist	Creeping Bentgrass	5	0.10	* Use Cool Season planting procedures.
	Wet	Fringed Bromegrass	5	0.10	* Pond Banks
		Fowl Meadowgrass	5	0.10	* Waterways/ditch banks
		Bluejoint Reedgrass or Rice Cutgrass	2	0.10	
		Perennial Ryegrass	10	0.25	
9	Moist	Red Fescue	5	0.10	*Salt Tolerant
	Wet	Creeping Bentgrass	2	0.10	* Fescue and Bentgrass provide low growing appearance, while Switchgrass provides tall cover for wildlife.
		Switchgrass	8	0.20	
		Perennial Ryegrass	10	0.25	
10	Moist	Red Fescue	5	0.10	* Use Cool Season planting procedure.
	Wet	Creeping Bentgrass	5	0.10	* Trefoil requires inoculation with nitrogen fixing bacteria.
		Virginia Wild Rye	8	0.20	
		Wood Reed Grass*	1	0.10	* Suitable for forest access roads, skid trails and other partial shade situations.
		Showy Tick Trefoil*	1	0.10	
11	Moist	Creeping Bentgrass	5	0.10	* Use Cool Season planting procedure.
	Wet	Bluejoint Reed Grass	1	0.10	* Suitable for waterways, pond or ditch banks.
		Virginia Wild Rye	3	0.10	* Trefoil requires inoculation with nitrogen fixing bacteria.
		Fowl Meadow Grass	10	0.25	
		Showy Tick Trefoil*	1	0.10	
		Red Top	1	0.10	
12	Wet	Blue Joint Reed Grass	1	0.10	* Use Cool Season planting procedure.
		Canada Manna Grass	1	0.10	* OK to seed in saturated soil conditions, but not in standing water.
		Rice Cut Grass	1	0.10	
		Creeping Bent Grass	5	0.10	* Suitable as stabilization seeding for created wetland.
		Fowl Meadow Grass	5	0.10	* All species in this mix are native to Massachusetts.
13	Dry - Moist	American Beachgrass	18" centers	18' centers	*Vegetative planting with dormant culms, 3-5 culms per planting
14	Inter-Tidal	Smooth Cordgrass Saltmeadow Cordgrass	12-18" centers	12-18" centers	* Vegetative planting with transplants.

Notes:
* Species such as Tumble Lovegrass, Fringed Bromegrass, Wood Reedgrass, Bush Clover and Beach Pea, while known to be commercially available from specific seed suppliers, may not always be available from your particular seed suppliers. The local Natural Resources Conservation Service office may be able to help with a source of supply. In the event a particular species listed in a mix can not be obtained, however, it may be possible to substitute another species.

Seed mixtures by courtesy of Natural Resources Conservation Service, Amherst, MA.

(PLS) Pure Live Seed

Warm Season grass seed is sold and planted on the basis of pure live seed. An adjustment is made to the bulk rate of the seed to compensate for inert material and non-viable seed. Percent of pure live seed is calculated by multiplying the percent purity by the percent germination; **(% purity) x (% germination) = percent PLS.**

For example, if the seeding rate calls for 10 lbs./acre PLS and the seed lot has a purity of 70% and germination of 75%, the PLS factor is:

(.70 x .75) =.53

10 lbs. divided by .53 = approx. 19 lbs.

Therefore, 19 lbs of seed from the particular lot will need to be applied to obtain 10 lbs. of pure live seed.

Special Note

Tall Fescue, Reed Canary Grass, Crownvetch and Birdsfoot Trefoil are no longer recommended for general erosion control use in Massachusetts due to the invasive characteristics of each. If these species are used, it is recommended that the ecosystem of the site be analyzed for the effects species invasiveness may impose. The mixes listed in the above mixtures include either species native to Massachusetts or non-native species that are not perceived to be invasive, as per the Massachusetts Native Plant Advisory Committee.

Wetlands Seed Mixtures

For newly created wetlands, a wetlands specialist should design plantings to provide the best chance of success. Do not use introduced, invasive plants like reed canarygrass (Phalaris arundinacea) or purple loosestrife (Lythrum salicaria). Using plants such as these will cause many more problems than they will solve.

The following grasses all thrive in wetland situations:

- Fresh Water Cordgrass (*Spartina pectinata*)
- Marsh/Creeping Bentgrass (*Agrostis stolonifera, var. Palustric*)
- Broomsedge (*Andropogon virginicus*)
- Fringed Bromegrass (*Bromus ciliatus*)
- Blue Joint Reed Grass (*Calamagrostis cavedensis*)
- Fowl Meadow Grass (*Glyceria striata*)
- Riverbank Wild Rye (*Elymus riparius*)
- Rice Cutgrass (*Leersia oryzoides*)
- Stout Wood Reed (*Cinna arundinacea*)
- Canada Manna Grass (*Glyceria canadensis*)

A sample wetlands seed mix developed by The New England Environmental Wetland Plant Nursery is shown on the following page.

Wetland Seed Mixture

The New England Environmental Wetland Plant Nursery has developed a seed mixture which is specifically designed to be used in wetland replication projects and stormwater detention basins. It is composed of seeds from a variety of indigenous wetland species. Establishing a native wetland plant understory in these areas provides quick erosion control, wildlife food and cover, and helps to reduce the establishment of undesirable invasive species such as Phragmites and purple loosestrife (Lythrum salicaria). The species have been selected to represent varying degrees of drought tolerance, and will establish themselves based upon microtopography and the resulting variation in soil moisture.

Common Name (*Scientific Name*)	**% in Mix**	**Comments**
Lurid Sedge (*Carex lurida*)	30	A low ground cover that tolerates mesic sites in addition to saturated areas; prolific seeder in second growing season.
Fowl Meadow Grass (*Glyceria Canadensis*)	25	Prolific seed producer that is a valuable wildlife food source.
Fringed Sedge (*Carex crinita*)	10	A medium to large sedge that tolerates saturated areas; good seed producer.
Joe-Pye Weed (*Eupatoriadelphus maculatus*)	10	Flowering plant that is valuable for wildlife cover. Grows to 4 feet.
Brook Sedge (*Carex spp., Ovales group*)	10	Tolerates a wide range of hydrologic conditions.
Woolgrass (*Scirpus cyperinus*)	5	Tolerates fluctuating hydrology.
Boneset (*Eupatorium perfoliatum*)	5	Flowering Plant that is valuable for wildlife cover. Grows to 3 feet.
Tussock Sedge (*Carex stricta*)	<5	Grows in elevated hummocks on wet sites, may grow rhizomonously on drier sites.
Blue Vervain (*Verbena hastata*)	<5	A native plant that bears attractive, blue flowers.

The recommended application rate is one pound per 5,000 square feet when used as an understory cover. This rate should be increased to one pound per 2,500 square feet for detention basins and other sites which require a very dense cover. For best results, a late fall application is recommended. This mix is not recommended for standing water.

Maintenance

Inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.

If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents resowing, mulch or jute netting is an effective temporary cover.

Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed.

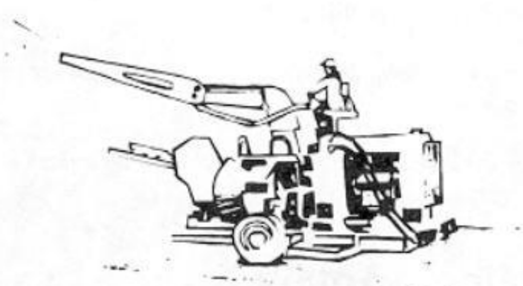
References

North Carolina Department of Environment, Health, and Natural Resources, ***Erosion and Sediment Control Field Manual***, Raleigh, NC, February 1991.

Personal communication, Richard J. DeVergilio, USDA, Natural Resources Conservation Service, Amherst, MA.

U.S. Environmental Protection Agency, ***Storm Water Management For Construction Activities***, EPA-832-R- 92-005, Washington, DC, September, 1992.

Washington State Department of Ecology, ***Stormwater Management Manual for the Puget Sound Basin***, Olympia, WA, February, 1992.

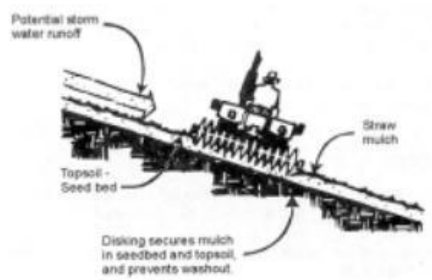


HYDRO-SEEDING

Seeding, Temporary

Planting rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas.

Purpose



To temporarily stabilize areas that will not be brought to final grade for a period of more than 30 working days.
To stabilize disturbed areas before final grading or in a season not suitable for permanent seeding.
Temporary seeding controls runoff and erosion until permanent vegetation or other erosion control measures can be established.
Root systems hold down the soils so that they are less apt to be carried offsite by storm water runoff or wind.
Temporary seeding also reduces the problems associated with mud and dust from bare soil surfaces during construction.

Where Practice Applies

On any cleared, unvegetated, or sparsely vegetated soil surface where vegetative cover is needed for less than one year. Applications of this practice include diversions, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles.

Where permanent structures are to be installed or extensive re-grading of the area will occur prior to the establishment of permanent vegetation.

Areas which will not be subjected to heavy wear by construction traffic.

Areas sloping up to 10% for 100 feet or less, where temporary seeding is the only practice used.

Advantages

This is a relatively inexpensive form of erosion control but should only be used on sites awaiting permanent planting or grading. Those sites should have permanent measures used.

Vegetation will not only prevent erosion from occurring, but will also trap sediment in runoff from other parts of the site.

Temporary seeding offers fairly rapid protection to exposed areas.

Disadvantages/Problems

Temporary seeding is only viable when there is a sufficient window in time for plants to grow and establish cover. It depends heavily on the season and rainfall rate for success.

If sown on subsoil, growth will be poor unless heavily fertilized and limed. Because overfertilization can cause pollution of stormwater runoff, other practices such as mulching alone may be more appropriate. The potential for over-fertilization is an even worse problem in or near aquatic systems.

Once seeded, areas should not be travelled over.

Irrigation may be needed for successful growth. Regular irrigation is not encouraged because of the expense and the potential for erosion in areas that are not regularly inspected.

Planning Considerations

Temporary seedings provide protective cover for less than one year. Areas must be reseeded annual or planted with perennial vegetation.

Temporary seeding is used to protect earthen sediment control practices and to stabilize denuded areas that will not be brought into final grade for several weeks or months. Temporary seeding can provide a nurse crop for permanent vegetation, provide residue for soil protection and seedbed preparation, and help prevent dust production during construction.

Use low-maintenance native species wherever possible.

Planting should be timed to minimize the need for irrigation.

Sheet erosion, caused by the impact of rain on bare soil, is the source of most fine particles in sediment. To reduce this sediment load in runoff, the soil surface itself should be protected. The most efficient and economical means of controlling sheet and rill erosion is to establish vegetative cover. Annual plants which sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover. Temporary seeding is effective when combined with construction phasing so bare areas of the site are minimized at all times.

Temporary seeding may prevent costly maintenance operations on other erosion control systems. For example, sediment basin clean-outs will be reduced if the drainage area of the basin is seeded where grading and construction are not taking place. Perimeter dikes will be more effective if not choked with sediment.

Proper seedbed preparation and the use of quality seed are important in this practice just as in permanent seeding. Failure to carefully follow sound agronomic recommendations will often result in an inadequate stand of vegetation that provides little or no erosion control.

Soil that has been compacted by heavy traffic or machinery may need to be loosened. Successful growth usually requires that the soil be tilled before the seed is applied. Topsoiling is not necessary for temporary seeding; however, it may improve the chances of establishing temporary vegetation in an area.

Planting Procedures

Time of Planting

Planting should preferably be done between April 1 and June 30, and September 1 through September 30. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1 and March 31, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.

Site Preparation

Before seeding, install needed surface runoff control measures such as gradient terraces, interceptor dike/swales, level spreaders, and sediment basins.

Seedbed Preparation

The seedbed should be firm with a fairly fine surface.

Perform all cultural operations across or at right angles to the slope. See **Topsoiling** and **Surface Roughening** for more information on seedbed preparation. A minimum of 2 to 4 inches of tilled topsoil is required.

Liming and Fertilization

Apply uniformly 2 tons of ground limestone per acre (100 lbs. per 1,000 Sq. Ft.) or according to soil test.

Apply uniformly 10-10-10 analysis fertilizer at the rate of 400 lbs. per acre (14 lbs. per 1,000 Sq. Ft.) or as indicated by soil test. Forty percent of the nitrogen should be in organic form.

Work in lime and fertilizer to a depth of 4 inches using any suitable equipment.

Seedings for Temporary Cover

Species	**Seeding Rates lbs/sq.ft.** 1,000 Sq.Ft.	Acre	**Recommended Seeding Dates**
Annual Ryegrass	1	40	April 1 to June 1 Aug. 15 to Sept. 15
Foxtail Millet	0.7	30	May 1 to June 30
Oats	2	80	April 1 to July 1 August 15 to Sept. 15
Winter Rye	3	120	Aug. 15 to Oct. 15

"Hydro-seeding" applications with appropriate seed-mulch-fertilizer mixtures may also be used.

Seeding

Select adapted species from the accompanying table.
Apply seed uniformly according to the rate indicated in the table by broadcasting, drilling or hydraulic application.
Cover seeds with suitable equipment as follows:

Rye grass	¼ inch
Millet	½ to ¾ inch
Oats	1 to 1-1/2 inches
Winter rye	1 to 1-1/2 inches.

Mulch

Use an effective mulch, such as clean grain straw; tacked and/or tied down with netting to protect seedbed and encourage plant growth.

Common Trouble Points

Lime and fertilizer not incorporated to at least 4 inches
May be lost to runoff or remain concentrated near the surface where they may inhibit germination.

Mulch rate inadequate or straw mulch not tacked down
Results in poor germination or failure, and erosion damage. Repair damaged areas, reseed and mulch.

Annual ryegrass used for temporary seeding
Ryegrass reseeds itself and makes it difficult to establish a good cover of permanent vegetation.

Seed not broadcast evenly or rate too low
Results in patchy growth and erosion.

Maintenance

Inspect within 6 weeks of planting to see if stands are adequate. Check for damage after heavy rains. Stands should be uniform and dense. Fertilize, reseed, and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.

Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather or on adverse sites. Water application rates should be controlled to prevent runoff.

Structural Practices
Silt fence or approved equal shall be installed as shown on the approved site/definitive plan to help prevent erosion and sedimentation of the downstream wetland resources identified on the project.

Catch basins appropriately identified on the site/definitive plan shall be fitted with a siltsack or approved equal during construction to prevent the accumulation of sediments in the catch basin sump. Catch basins shall be cleaned as specified in the Long Term Pollution Prevention Plan or the Long Term Operation and Maintenance Plan.

Stormwater Management
The stormwater runoff shall be managed through the use of several best management practices:

1) Deep Sump Catch Basins w/hood
2) Subsurface Infiltration Galleys

5.3 Other Controls

Waste Materials
All waste materials shall be collected and stored in secure metal dumpsters rented from a licensed solid waste management company in Massachusetts. The dumpsters shall meet all local and state solid waste management regulations as outlined in 310 CMR 19.00. All trash and construction debris generated on site shall be disposed of in the dumpsters. The dumpsters shall be emptied as often as necessary during construction and transferred to an approved solid waste facility licensed to accept municipal solid waste and/or construction and demolition debris. No construction waste shall be buried on site. All personnel shall be instructed regarding the correct procedure for waste disposal.

Hazardous Waste
All hazardous waste materials shall be disposed of in a manner specified by local or State regulation or by the manufacturer. Site personnel shall be instructed in these practices.

Sanitary Waste
All sanitary shall be collected from portable units, as needed, by a licensed septage hauler in Massachusetts, in accordance with the requirements of the local Board of Health.

Offsite Vehicle Tracking
Construction entrance and exit shall be via Essex Street.

5.4 Timing of Controls/Measures

As indicated in the Sequence of Major Activities, the installation of erosion and sediment control devices shall be in place prior to earth excavating activities.

5.5 Certification of Compliance with Federal, State, and Local Regulations

The Construction Period Pollution Prevention Plan reflects the requirements of the Massachusetts Wetlands Protection Act (310 CMR 10.00). There is no wetland filling associated with this project, it is strictly a buffer zone project. Note that there are no other applicable State or Federal requirements for sediment and erosion control plans (or permits), or stormwater management plans (or permits) required for this project to the best of our knowledge.

5.6 Maintenance and Inspection Procedures

Erosion and Sediment Control Inspection and Maintenance Practices
The following items represent the inspection and maintenance practices that will be used to maintain sediment and erosion control.

1. All control measures shall be inspected at least once every fourteen (14) days and following any storm event of 1/4 inches or greater.
2. All measures shall be maintained in good working order; if a repair is necessary, it shall be initiated within 24 hours of the report.
3. Built up sediment shall be removed from silt fencing when it has reached one-third the height of the fence.
4. Silt fence shall be inspected for depth of sediment, tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly set in the ground.
5. The catch basin grates shall be inspected for grate elevation relative to current surface condition; condition of silt sack, and degree to which sediment has accumulated on the grate and in the sump of the catch basin.
6. Temporary and permanent seeding and any plantings shall be inspected for bare spots, washouts, and healthy growth.
7. A maintenance inspection report shall be prepared following each inspection. A copy of the form to be completed by the inspector is attached to this document.
8. Cedar Park Development, LLC shall select three individuals who will be responsible for inspections, maintenance and repair activities as well as who shall be responsible for filling out the inspection and maintenance report.
9. Personnel selected for inspection and maintenance responsibilities shall receive training from Cedar Park Development, LLC or their designated representative. They will be trained in all the inspection and maintenance practices necessary for keeping the erosion and sediment control devices used on site in good working order.

5.7 Non Stormwater Discharges

It is expected that the following non-stormwater discharges will occur from the site during the construction period

1. Water from water line flushing.
2. Pavement wash waters.

All non-stormwater discharges shall be directed to the proposed site BMPs prior to discharge.

5.8 Inventory for Pollution Prevention Plan

The materials or substances listed below are expected to be present on site during construction

1. Concrete
2. Wood
3. Structural Steel
4. Masonry Block
5. Office Building Materials
6. Fiber Glass Insulation
7. Fertilizers
8. Petroleum Based Products
9. Cleaning Solvents
10. Paints (enamel and latex)

11. Tar
12. Waterproofing Materials

5.9 Spill Prevention

Material Management Practices
The following are the material management practices that shall be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

Good Housekeeping
The following good housekeeping practices will be followed on site during the construction project.
1. A concerted effort shall be made to store only enough product required to complete a particular task.
2. All materials stored on site shall be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure.
3. Products shall be kept in their original containers with the original manufacturer's label.
4. Substances shall not be mixed with one another unless recommended by the manufacturer.
5. Whenever possible, all of a product shall be used up before disposing of the container.
6. Manufacturer's recommendations for proper use and disposal shall be followed.
7. The site superintendent shall perform a daily site inspection to ensure proper use and disposal of materials on site.

Hazardous Products
The following practices are intended to reduce the risks associated with hazardous materials.
1. Products shall be kept in original containers unless they are not resealable.
2. Where feasible, the original labels and material safety data shall be retained, whereas they contain important product information.
3. If surplus product must be disposed, follow manufacturer's or local and state recommended methods for proper disposal.

Product Specific Practices
The following product specific practices shall be followed on site:

Petroleum Products
All on site vehicles shall be monitored for leaks and receive regular preventative maintenance to reduce the risk of leakage. Petroleum products shall be stored in tightly sealed containers which are clearly labeled. Any bituminous concrete or asphalt substances used on site shall be applied according to the manufacturer's recommendations.

Fertilizers
Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be in a covered shed or trailer. The contents of any partially used bags of fertilizers shall be transferred to a sealable plastic bag or bin to avoid spills. Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be in a covered shed or trailer. The contents of any partially used bags of fertilizers shall be transferred to a sealable plastic bag or bin to avoid spills.

Paints
All containers shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged into any catch basin, drain manhole, or any portion of the stormwater management system.

Excess paint shall be properly disposed of according to manufacturer's recommendations or State and local regulations.

Concrete Trucks

Concrete trucks shall not be allowed to wash out or discharge surplus concrete or drum wash water on site.

Spill Control Practices

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices shall be followed for spill prevention and cleanup:

1. Manufacturer's recommended methods for cleanup shall be readily available at the on site trailer and site personnel shall be made aware of the procedures and the location of the information.
2. Materials and equipment necessary for spill cleanup shall be kept in the material storage area on site. Equipment and materials shall include, but not be limited to
3. brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.
4. All spills shall be cleaned up immediately after discovery.
5. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
6. Spills of toxic or hazardous material shall be reported to the appropriate State and/or local authority in accordance with local and/or State regulations.
7. The spill prevention plan shall be adjusted to include measures to prevent a particular type of spill from reoccurring and how to clean up the spill if there is another occurrence. A description of the spill, what caused it, and the clean up measures shall also be included.
8. Cedar Park Development, LLC or their assigned designee shall be the spill prevention and cleanup coordinator. Cedar Park Development, LLC shall designate at least three other site personnel who will be trained in the spill control practices identified above.

Pollution Prevention Plan Certificate

I certify under penalty of law that this document and all its attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signed:____Date: 4/11/2024

Cedar Park Development, LLC
Sean Szekely

Inspection and Maintenance Form

To be completed every 14 days and within 24 hours of a rainfall event of 1/4 inches or greater

Inspector: Date:

Inspector Title:

Days since last rainfall: Amount of last rainfall:

Structural Controls: Silt Fence/Compost Filter Sock

From	To	Avg. depth of sediment (in.)	Tear	Posts secure	Overall condition
			Yes ☐ No ☐	Yes ☐ No ☐	Poor ☐ Fair ☐ Good ☐
			Yes ☐ No ☐	Yes ☐ No ☐	Poor ☐ Fair ☐ Good ☐
			Yes ☐ No ☐	Yes ☐ No ☐	Poor ☐ Fair ☐ Good ☐
			Yes ☐ No ☐	Yes ☐ No ☐	Poor ☐ Fair ☐ Good ☐
			Yes ☐ No ☐	Yes ☐ No ☐	Poor ☐ Fair ☐ Good ☐
			Yes ☐ No ☐	Yes ☐ No ☐	Poor ☐ Fair ☐ Good ☐

Maintenance required

To be performed by: On or before:

Inspection and Maintenance Form

To be completed every 14 days and within 24 hours of a rainfall event of 1/4 inches or greater

Inspector: Date:

Inspector Title:

Days since last rainfall: Amount of last rainfall:

Structural Controls: Catch Basins / Grates

Structure Identification	Location	Catch basin at grade	Hood/trap installed	Sediment buildup (in.)	Overall condition
CB1	Front building	Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
CB2	Rear building	Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
CB3	Front building south end	Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
CB4	North end building	Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
		Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
		Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐

Maintenance required

To be performed by: On or before:

Inspection and Maintenance Form

To be completed every 14 days and within 24 hours of a rainfall event of 1/4 inches or greater

Inspector: Date:

Inspector Title:

Days since last rainfall: Amount of last rainfall:

Structural Controls: Silt Sack / Filter Fabric

Structure Identification	Location	Catch basin at grade	Hood/trap installed	Sediment buildup (in.)	Silt Sack Full
CB1	Front building	Yes ☐ No ☐	Yes ☐ No ☐		Yes ☐ No ☐
CB2	Rear building	Yes ☐ No ☐	Yes ☐ No ☐		Yes ☐ No ☐
CB3	Front building south end	Yes ☐ No ☐	Yes ☐ No ☐		Yes ☐ No ☐
CB4	North end building	Yes ☐ No ☐	Yes ☐ No ☐		Yes ☐ No ☐
EXCB1	Essex Street	Yes ☐ No ☐	Yes ☐ No ☐		Yes ☐ No ☐
EXCB2	Essex Street	Yes ☐ No ☐	Yes ☐ No ☐		Yes ☐ No ☐

Maintenance required

To be performed by: On or before:

Inspection and Maintenance Form

To be completed every 14 days and within 24 hours of a rainfall event of 1/4 inches or greater

Inspector: ______________________ Date: __________

Inspector Title: ______________________

Days since last rainfall: __________ Amount of last rainfall: __________

Structural Controls: Subsurface Infiltration Galleys

Structure Identification	Location	Condition of stone bed	Filter fabric installed	Sediment buildup at inlet (in.)	Sediment buildup at outlet (in.)
SWMA1P	Parking garage		Yes ☐ No ☐		
			Yes ☐ No ☐		
			Yes ☐ No ☐		
			Yes ☐ No ☐		
			Yes ☐ No ☐		
			Yes ☐ No ☐		

Maintenance required

____

To be performed by: ______________________ On or before: __________

6 | NRCS Web Soil Survey

7 | *Snow Disposal Guidelines*

The following Snow Disposal Guidance is reproduced from the Mass.gov website:
https://www.mass.gov/guides/snow-disposal-guidance

The Massachusetts Department of Environmental Protection's Snow Disposal Guidance offers information on the proper steps to take when locating sites for the disposal of snow. Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. Public safety is of the utmost importance. However, care must be taken to ensure that collected snow, which may be contaminated with road salt, sand, litter, and automotive pollutants such as oil, is disposed of in a manner that will minimize threats to nearby sensitive resource areas.

In order to avoid potential contamination to wetlands, water supplies, and waterbodies, MassDEP recommends that municipalities and businesses identify and map appropriate upland snow disposal locations. To assist municipalities and businesses in this planning effort, and to avoid use of snow disposal at sites which compromise wetlands resources or public water supplies, MassDEP has developed this snow disposal mapping tool:

https://maps.env.state.ma.us/dep/arcgis/js/templates/PSF/

If a community or business demonstrates that there is no remaining capacity at upland snow disposal locations, local conservation commissions are authorized to issue Emergency Certifications under the Massachusetts Wetlands Protection Act for snow disposal in certain wetland resource areas. In such cases, Emergency Certifications can only be issued at the request of a public agency or by order of a public agency for the protection of the health or safety of citizens, and are limited to those activities necessary to abate the emergency.

In the event of a regional or statewide severe weather event, MassDEP may also issue a broader Emergency Declaration under the Wetlands Protect Act which allows greater flexibility in snow disposal practices. Details of this approval process are found below.

Massachusetts Department of Environmental Protection
Bureau of Water Resources Snow Disposal Guidance

Effective Date: December 11, 2020

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: Bureau of Resource Protection (BRP) Snow Disposal Guideline No. BRPG97-1 issued December 12, 1997 and BRPG01-01 issued March 8, 2001; Bureau of Water Resources (BWR) snow disposal guidance issued December 21, 2015 and December 12, 2018.

Approved by: Kathleen Baskin, Assistant Commissioner, Bureau of Water Resources

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are protective of wetlands, drinking water, and water bodies, and are acceptable to the Massachusetts Department of Environmental Protection (MassDEP), Bureau of Water Resources.

APPLICABILITY: These Guidelines are issued by MassDEP's Bureau of Water Resources on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to all federal agencies, state agencies, state authorities, municipal agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While MassDEP is aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything that occurs on the land has the potential to impact the Commonwealth's water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help federal agencies, state agencies, state authorities, municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter. Following these guidelines and obtaining the necessary approvals may also help municipalities in cases when seeking reimbursement for snow disposal costs from the Federal Emergency Management Agency is possible.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas or upland locations on impervious surfaces away from water resources and drinking water wells. At these locations, the snow meltwater can filter into the soil, leaving behind sand and debris which can be removed in the spring. The following conditions should be followed:

- Within water supply Zone A and Zone II, avoid storage or disposal of snow and ice containing deicing chemicals that has been collected from streets located outside these zones. Municipalities may have a water supply protection land use control that prohibits the disposal of snow and ice containing deicing chemicals from outside the Zone A and Zone II, subject to the Massachusetts Drinking Water Regulations at 310 CMR 22.20C and 310 CMR 22.21(2).

- Avoid storage or disposal of snow or ice in Interim Wellhead Protection Areas (IWPA) of public water supply wells, and within 75 feet of a private well, where road salt may contaminate water supplies.

- Avoid dumping snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.

- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater.

- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage systems including detention basins, swales or ditches. Snow combined with sand and debris may block a stormwater drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Recommended Site Selection Procedures

It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

- Estimate how much snow disposal capacity may be needed for the season so that an adequate number of disposal sites can be selected and prepared.

- Identify sites that could potentially be used for snow disposal, such as municipal open space (e.g., parking lots or parks).

- Select sites located in upland locations that are not likely to impact sensitive environmental resources first.

- If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

Snow Disposal Mapping Assistance

MassDEP has an online mapping tool to assist in identifying possible locations to potentially dispose of snow. MassDEP encourages municipalities to use this tool to identify possible snow disposal options. The tool identifies wetland resource areas, public drinking water supplies and other sensitive locations where snow should not be disposed. The tool may be accessed through the Internet at the following web address: https://maps.env.state.ma.us/dep/arcgis/js/templates/PSF/.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.

- Wherever possible maintain a 50-foot vegetated buffer between the disposal site and adjacent waterbodies to filter pollutants from the meltwater.

- Clear debris from the site prior to using the site for snow disposal.

- Clear debris from the site and properly dispose of it at the end of the snow season, and no later than May 15.

3. SNOW DISPOSAL APPROVALS

Proper snow disposal may be undertaken through one of the following approval procedures:

- Routine snow disposal – Minimal, if any, administrative review is required in these cases when upland and pervious snow disposal locations or upland locations on impervious surfaces that have functioning and maintained stormwater management systems have been identified, mapped, and used for snow disposal following ordinary snowfalls. Use of upland and pervious snow disposal sites avoids wetland resource areas and allows snow meltwater to recharge groundwater and will help filter pollutants, sand, and other debris. This process will address the majority of snow removal efforts until an entity exhausts all available upland snow disposal sites. The location and mapping of snow disposal sites will help facilitate each entity's routine snow management efforts.

- Emergency Certifications – If an entity demonstrates that there is no remaining capacity at upland snow disposal locations, local conservation commissions may issue an Emergency Certification under the Massachusetts Wetlands Protection regulations to authorize snow disposal in buffer zones to wetlands, certain open water areas, and certain wetland resource areas (i.e. within flood plains). Emergency Certifications can only be issued at the request of a public agency or by order of a public agency for the protection of the health or safety of citizens, and are limited to those activities necessary to abate the emergency. See 310 CMR 10.06(1)-(4). Use the following guidelines in these emergency situations:

    - Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.

    - Do not dispose of snow in salt marshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.

    - Do not dispose of snow where trucks may cause shoreline damage or erosion.

• Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.

• Severe Weather Emergency Declarations – In the event of a large-scale severe weather event, MassDEP may issue a broader Emergency Declaration under the Wetlands Protection Act which allows federal agencies, state agencies, state authorities, municipalities, and businesses greater flexibility in snow disposal practices. Emergency Declarations typically authorize greater snow disposal options while protecting especially sensitive resources such as public drinking water supplies, vernal pools, land containing shellfish, FEMA designated floodways, coastal dunes, and salt marsh. In the event of severe winter storm emergencies, the snow disposal site maps created by municipalities will enable MassDEP and the Massachusetts Emergency Management Agency (MEMA) in helping communities identify appropriate snow disposal locations.

If upland disposal sites have been exhausted, the Emergency Declaration issued by MassDEP allows for snow disposal near water bodies. In these situations, a buffer of at least 50 feet, preferably vegetated, should still be maintained between the site and the waterbody. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, the Emergency Declaration issued by MassDEP may allow disposal of snow in certain waterbodies under certain conditions. ***A federal agency, state agency, state authority, municipality or business seeking to dispose of snow in a waterbody should take the following steps:***

• Call the emergency contact phone number [(888) 304-1133)] and notify the MEMA of the municipality's intent.

• MEMA will ask for some information about where the requested disposal will take place.

• MEMA will confirm that the disposal is consistent with MassDEP's Severe Weather Emergency Declaration and these guidelines and is therefore approved. During declared statewide snow emergency events, MassDEP's website will also highlight the emergency contact phone number [(888) 304-1133)] for authorizations and inquiries. For further non-emergency information about this Guidance you may contact your MassDEP Regional Office Service Center:

Northeast Regional Office, Wilmington, 978-694-3246
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7650
Western Regional Office, Springfield, 413-755-2114

8 | Deicing Chemical (Road Salt) Storage

The following Snow Disposal Guidance is reproduced from the Mass.gov website:
https://www.mass.gov/guides/guidelines-on-road-salt-storage

Effective Date: December 19, 1997
Guideline No. DWSG97-1

Applicability: Applies to all parties storing road salt or other chemical deicing agents.

Supersedes: Fact Sheet: DEICING CHEMICAL (ROAD SALT) STORAGE (January 1996)

Approved by: Arleen O'Donnell, Asst. Commissioner for Resource Protection

PURPOSE: To summarize salt storage prohibition standards around drinking water supplies and current salt storage practices.

APPLICABILITY: These guidelines are issued on behalf of the Bureau of Resource Protection's Drinking Water Program. They apply to all parties storing road salt or other chemical deicing agents.

The Road Salt Problem

Historically, there have been incidents in Massachusetts where improperly stored road salt has polluted public and private drinking water supplies. Recognizing the problem, state and local governments have taken steps in recent years to remediate impacted water supplies and to protect water supplies from future contamination. As a result of properly designing storage sheds, new incidents are uncommon. These guidelines summarize salt storage prohibition standards around drinking water supplies and current salt storage practices.

Salt Pile Restrictions in Water Supply Protection Areas

Uncovered storage of salt is forbidden by Massachusetts General Law Chapter 85, section 7A in areas that would threaten water supplies. The Drinking Water Regulations, 310 CMR 22.21(2)(b), also restrict deicing chemical storage within wellhead protection areas (Zone I and Zone II) for public water supply wells, as follows: "storage of sodium chloride, chemically treated abrasives or other chemicals used for the removal of ice and snow on roads [are prohibited], unless such storage is within a structure designed to prevent the generation and escape of contaminated runoff or leachate." For drinking water reservoirs, 310 CMR 22.20C prohibits, through local bylaw, uncovered or uncontained storage of road or parking lot de-icing and sanding materials within Zone A at new reservoirs and at those reservoirs increasing their withdrawals under MGL Chapter 21G, the Water Management Act.

For people on a low-sodium diet, 20 mg/L of sodium in drinking water is consistent with the bottled water regulations' meaning of "sodium free." At 20 mg/L, sodium contributes 10% or less to the sodium level in people on a sodium-restricted diet.

Salt Storage Best Management Practices

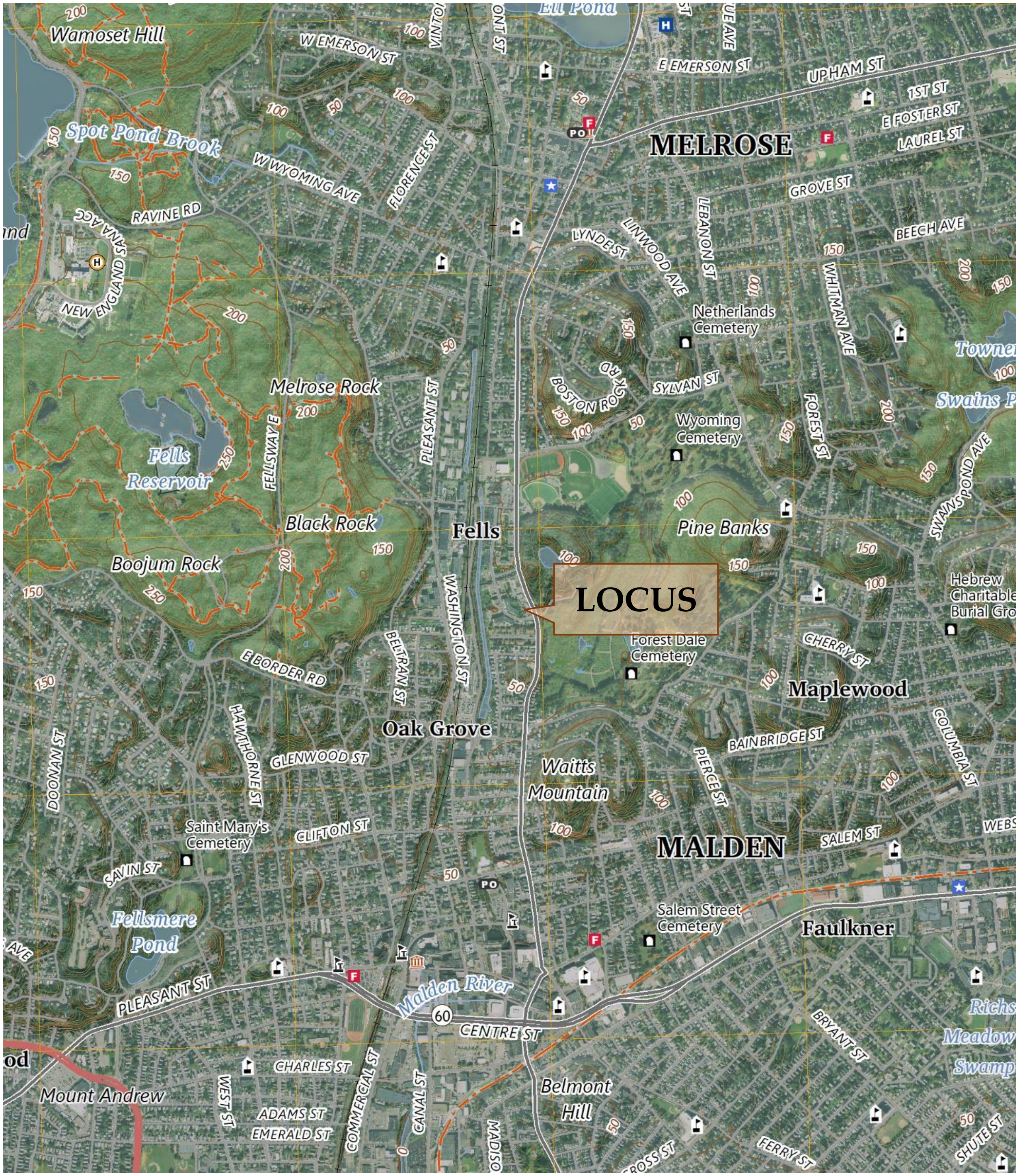
Components of an "environment-friendly" roadway deicing salt storage facility include:
the right site = a flat site;
adequate space for salt piles;

storage on a pad (impervious/paved area);
storage under a roof; and
runoff collection/containment.
For more information, see The Salt Storage Handbook, 6th ed. Virginia: Salt Institute, 2006.

Salt Storage Practices of the Massachusetts Highway Department

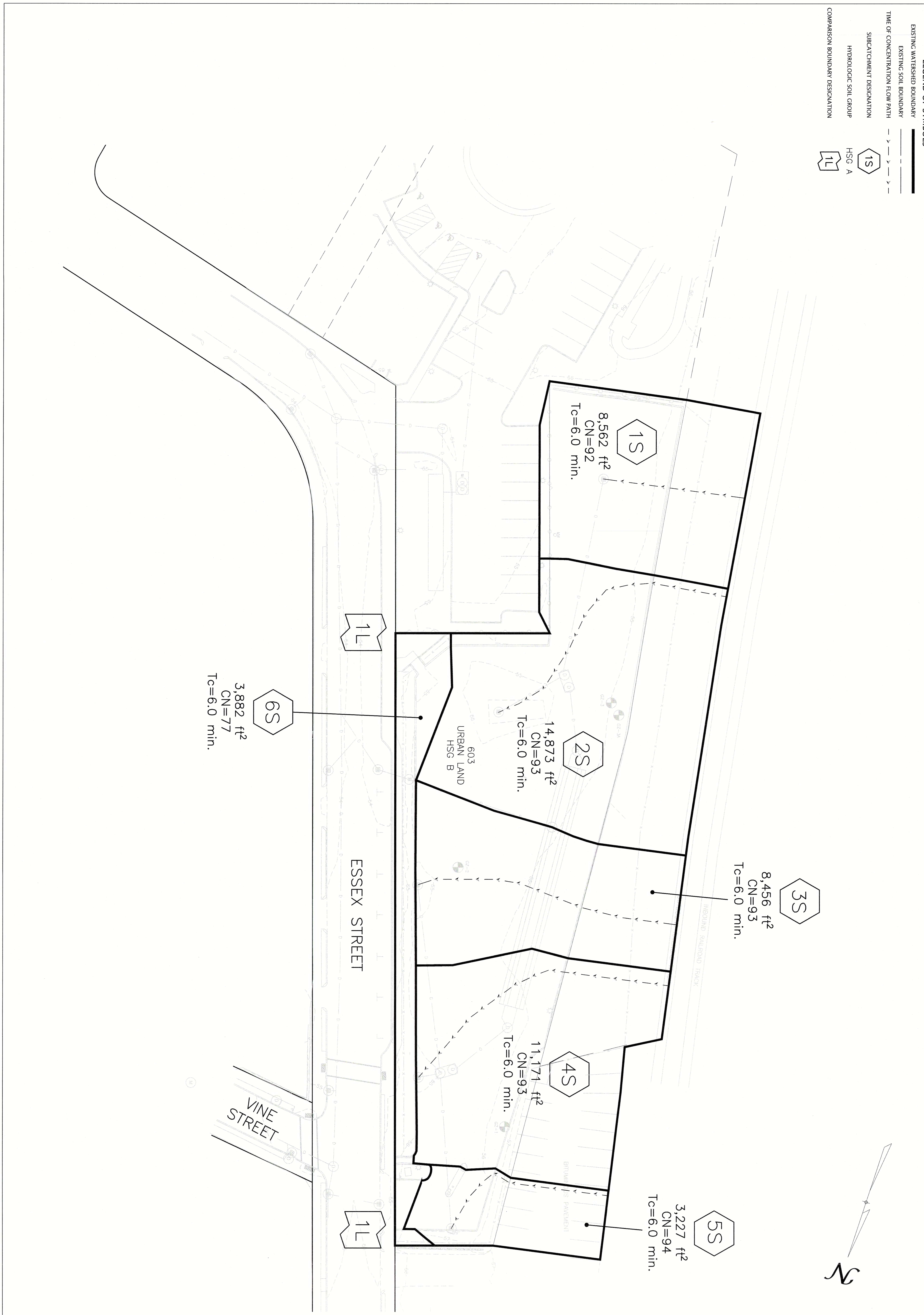
The Massachusetts Highway Department (MHD) has 216 permanent salt storage sheds at 109 locations in the state. On leased land and state land under arteries and ramps, where the MHD cannot build sheds, salt piles are stored under impermeable material. This accounts for an additional 15 sites. The MHD also administers a program to assist municipalities with the construction of salt storage sheds. Of 351 communities, 201 municipalities have used state funds for salt storage facilities.

Appendix A – General Location Map



USGS Locus Map
1100 Main Street, Malden, MA
NAVD88

Appendix B – Site Maps



EXISTING CONDITION WATERSHED MAP

164 ESSEX STREET, MELROSE, MA

DRAWING: W1.1

SHEET 1 OF 1

0' 10' 20' 40'

SCALE: 1"=20'

APRIL 10, 2024

6			12		
5			11		
4			10		
3			9		
2			8		
1			7		

SEAL

COMMONWEALTH OF MASSACHUSETTS
MATTHEW E MOORE
CIVIL
No. 45885
REGISTERED PROFESSIONAL ENGINEER
4.11.2024

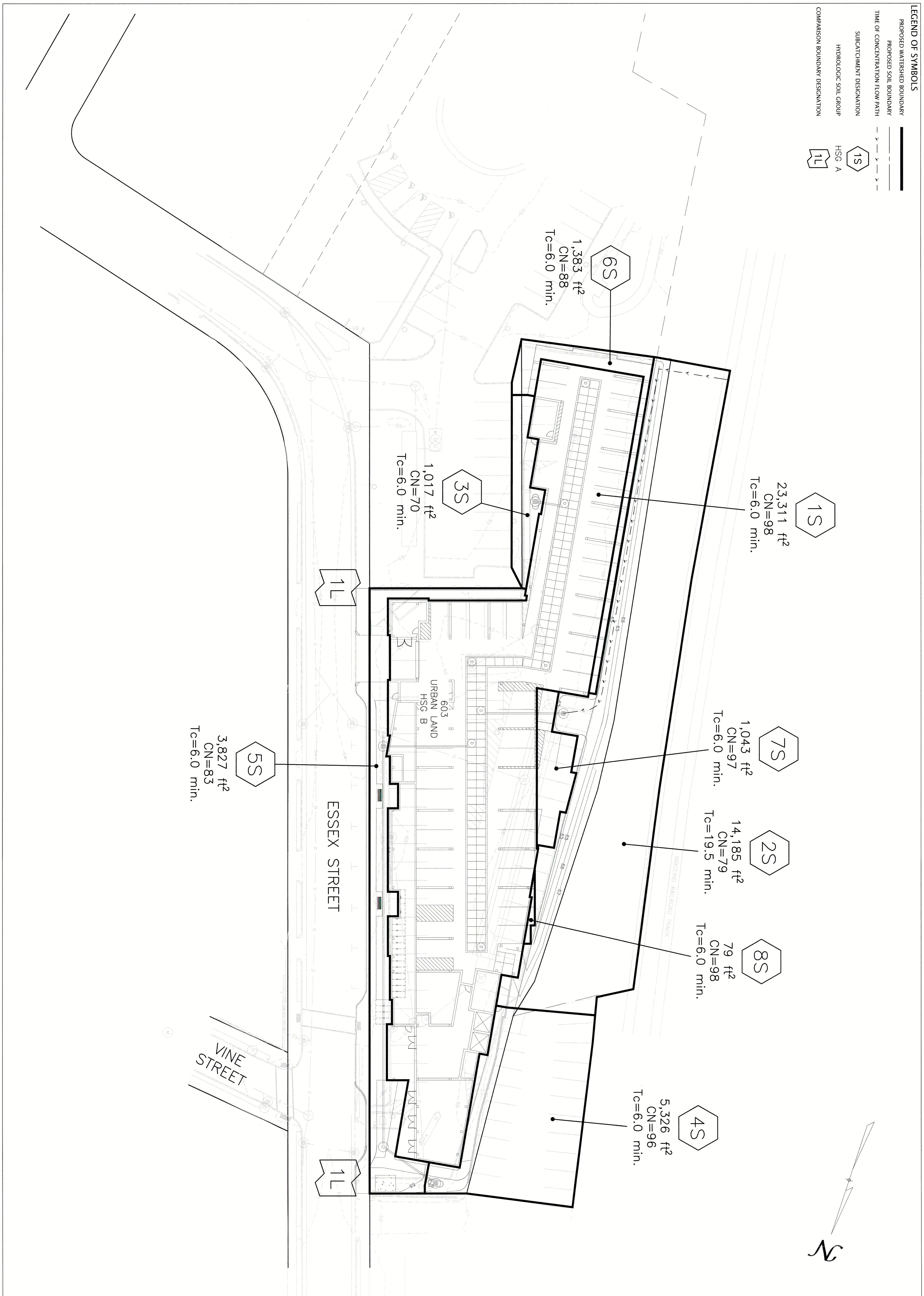
Designed By: MEM
Drawn By: MEM
Reviewed By: RLW
Project Manager: RLW
Job File Number: MELR-0047
Drawing File Folder: MELR47

- [x] Drawing Issued for Review
- [ ] Drawing Issued for Permit
- [ ] Drawing Issued for Construction

Owner:
LG Realty, LLC
100 Cottage Street
Melrose, MA 02176

Applicant:
Cedar Park Development, LLC
142 Hagget's Pond Road
Andover, MA 01841

WILLIAMS & SPARAGES
ENGINEERS | SCIENTISTS | SURVEYORS
189 NORTH MAIN STREET
SUITE 101
MIDDLETON, MA 01949
PHONE: (978) 539-8088
FAX: (978) 539-8200
WSENGINEERS.COM



PROPOSED CONDITION WATERSHED MAP

164 ESSEX STREET, MELROSE, MA

DRAWING: W1.2

SHEET 1 OF 1

0' 10' 20' 40'

SCALE: 1"=20'

APRIL 10, 2024

6		12	
5		11	
4		10	
3		9	
2		8	
1		7	

SEAL

COMMONWEALTH OF MASSACHUSETTS MATTHEW E. MOORE CIVIL No. 45885 REGISTERED PROFESSIONAL ENGINEER

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Appendix C – Soil Logs

Appendix D – Groundwater Mounding Analysis

MOUNDSOLV
GROUNDWATER MOUNDING ANALYSIS FOR A SLOPING WATER-TABLE AQUIFER ZLOTNIK ET AL. (2017) SOLUTION

Solution Method

Zlotnik et al. (2017) transient solution for a rectangular source (linearization method 1)

Site Description

Aquifer Data

Property	Value
Horizontal hydraulic conductivity, *K* (ft/d)	2.04
Specific yield, *Sy*	0.1
Initial saturated thickness, h_0 (ft)	20
Maximum allowable water-table rise, *σ* (ft)	2
Dip, *i* (ft/ft)	0
Slope rotation from x axis, *γ* (°)	0

Recharge Sources

Property	Source 1
X coordinate at center, *X* (ft)	0
Y coordinate at center, *Y* (ft)	0
Dimension along x* axis, *L* (ft)	291
Dimension along y* axis, *W* (ft)	10.5
Rotation from slope direction, *ϕ* (°)	0
Recharge rate, *Q* (ft^3/d)	838
Infiltration rate, *q* (ft/d)	0.274259532
Recharge duration, t_0 (d)	1

Monitoring Points

Elapsed Time, t = 4 d

Name	x (ft)	y (ft)	s (ft)	h (ft)	z (ft)
Source 1	0	0	0.2138	20.21	0

Time Series Data

Time	Source 1	
(d)	s (ft)	h (ft)
0	0	20
0.002327	0.006383	20.01
0.005236	0.01433	20.01
0.008873	0.02401	20.02
0.01342	0.03546	20.04
0.0191	0.04872	20.05
0.0262	0.06389	20.06
0.03508	0.0811	20.08
0.04618	0.1005	20.1
0.06005	0.1224	20.12
0.07739	0.1471	20.15
0.09906	0.1747	20.17
0.1262	0.2056	20.21
0.16	0.2403	20.24
0.2024	0.2792	20.28
0.2553	0.3227	20.32
0.3214	0.3713	20.37
0.4041	0.4258	20.43
0.5075	0.4867	20.49
0.6366	0.5548	20.55
0.7981	0.631	20.63
1	0.7162	20.72
1.007	0.7	20.7
1.016	0.6816	20.68
1.027	0.6621	20.66
1.04	0.6418	20.64
1.057	0.6205	20.62
1.079	0.5984	20.6
1.105	0.5752	20.58
1.139	0.5511	20.55
1.18	0.526	20.53
1.232	0.5	20.5

1.297	0.4733	20.47
1.378	0.4461	20.45
1.48	0.4185	20.42
1.607	0.3907	20.39
1.766	0.3632	20.36
1.964	0.3361	20.34
2.212	0.3096	20.31
2.522	0.2841	20.28
2.91	0.2596	20.26
3.394	0.2361	20.24
4	0.2138	20.21

Profile Data

Profile Along X* Axis for Source 1 at Elapsed Time, t = 4 d

x* (ft)	s (ft)	h (ft)	z (ft)
-250	0.005413	20.01	0
-240	0.008235	20.01	0
-230	0.01217	20.01	0
-220	0.01745	20.02	0
-210	0.02432	20.02	0
-200	0.03294	20.03	0
-190	0.04339	20.04	0
-180	0.05561	20.06	0
-170	0.06942	20.07	0
-160	0.08448	20.08	0
-150	0.1003	20.1	0
-140	0.1164	20.12	0
-130	0.1322	20.13	0
-120	0.1472	20.15	0
-110	0.1609	20.16	0
-100	0.1729	20.17	0
-90	0.1832	20.18	0
-80	0.1916	20.19	0
-70	0.1983	20.2	0

-60	0.2034	20.2	0
-50	0.2072	20.21	0
-40	0.2099	20.21	0
-30	0.2118	20.21	0
-20	0.2129	20.21	0
-10	0.2136	20.21	0
0	0.2138	20.21	0
10	0.2136	20.21	0
20	0.2129	20.21	0
30	0.2118	20.21	0
40	0.2099	20.21	0
50	0.2072	20.21	0
60	0.2034	20.2	0
70	0.1983	20.2	0
80	0.1916	20.19	0
90	0.1832	20.18	0
100	0.1729	20.17	0
110	0.1609	20.16	0
120	0.1472	20.15	0
130	0.1322	20.13	0
140	0.1164	20.12	0
150	0.1003	20.1	0
160	0.08448	20.08	0
170	0.06942	20.07	0
180	0.05561	20.06	0
190	0.04339	20.04	0
200	0.03294	20.03	0
210	0.02432	20.02	0
220	0.01745	20.02	0
230	0.01217	20.01	0
240	0.008235	20.01	0
250	0.005413	20.01	0

The axes of Source 1 (x, y*) are rotated 0°*
from the axes of mapping coordinate system (x, y)

Profile Along Y* Axis for Source 1 at Elapsed Time, t = 4 d

y* (ft)	s (ft)	h (ft)	z (ft)
-200	0.000217	20	0
-192	0.0003686	20	0
-184	0.0006136	20	0
-176	0.001001	20	0
-168	0.0016	20	0
-160	0.002505	20	0
-152	0.003843	20	0
-144	0.005772	20.01	0
-136	0.008491	20.01	0
-128	0.01223	20.01	0
-120	0.01724	20.02	0
-112	0.02379	20.02	0
-104	0.03213	20.03	0
-96	0.04247	20.04	0
-88	0.05491	20.05	0
-80	0.06945	20.07	0
-72	0.08593	20.09	0
-64	0.104	20.1	0
-56	0.1231	20.12	0
-48	0.1425	20.14	0
-40	0.1613	20.16	0
-32	0.1785	20.18	0
-24	0.1931	20.19	0
-16	0.2043	20.2	0
-8	0.2114	20.21	0
0	0.2138	20.21	0
8	0.2114	20.21	0
16	0.2043	20.2	0
24	0.1931	20.19	0
32	0.1785	20.18	0
40	0.1613	20.16	0
48	0.1425	20.14	0

56	0.1231	20.12	0
64	0.104	20.1	0
72	0.08593	20.09	0
80	0.06945	20.07	0
88	0.05491	20.05	0
96	0.04247	20.04	0
104	0.03213	20.03	0
112	0.02379	20.02	0
120	0.01724	20.02	0
128	0.01223	20.01	0
136	0.008491	20.01	0
144	0.005772	20.01	0
152	0.003843	20	0
160	0.002505	20	0
168	0.0016	20	0
176	0.001001	20	0
184	0.0006136	20	0
192	0.0003686	20	0
200	0.000217	20	0

The axes of Source 1 (x, y*) are rotated 0°*
from the axes of mapping coordinate system (x, y)

Sensitivity Data

Source 1, x=0 ft, y=0 ft

Parameter	Water-Table Rise (ft)		
Multiplier	K	Sy	h_0
0.5	0.3038	0.2881	0.3038
0.575	0.2833	0.2729	0.2833
0.65	0.2665	0.2595	0.2665
0.725	0.2522	0.2476	0.2522
0.8	0.2399	0.2371	0.2399
0.875	0.2291	0.2276	0.2291
0.95	0.2196	0.219	0.2196
1.025	0.211	0.2113	0.211
1.1	0.2032	0.2042	0.2032
1.175	0.1961	0.1978	0.1961

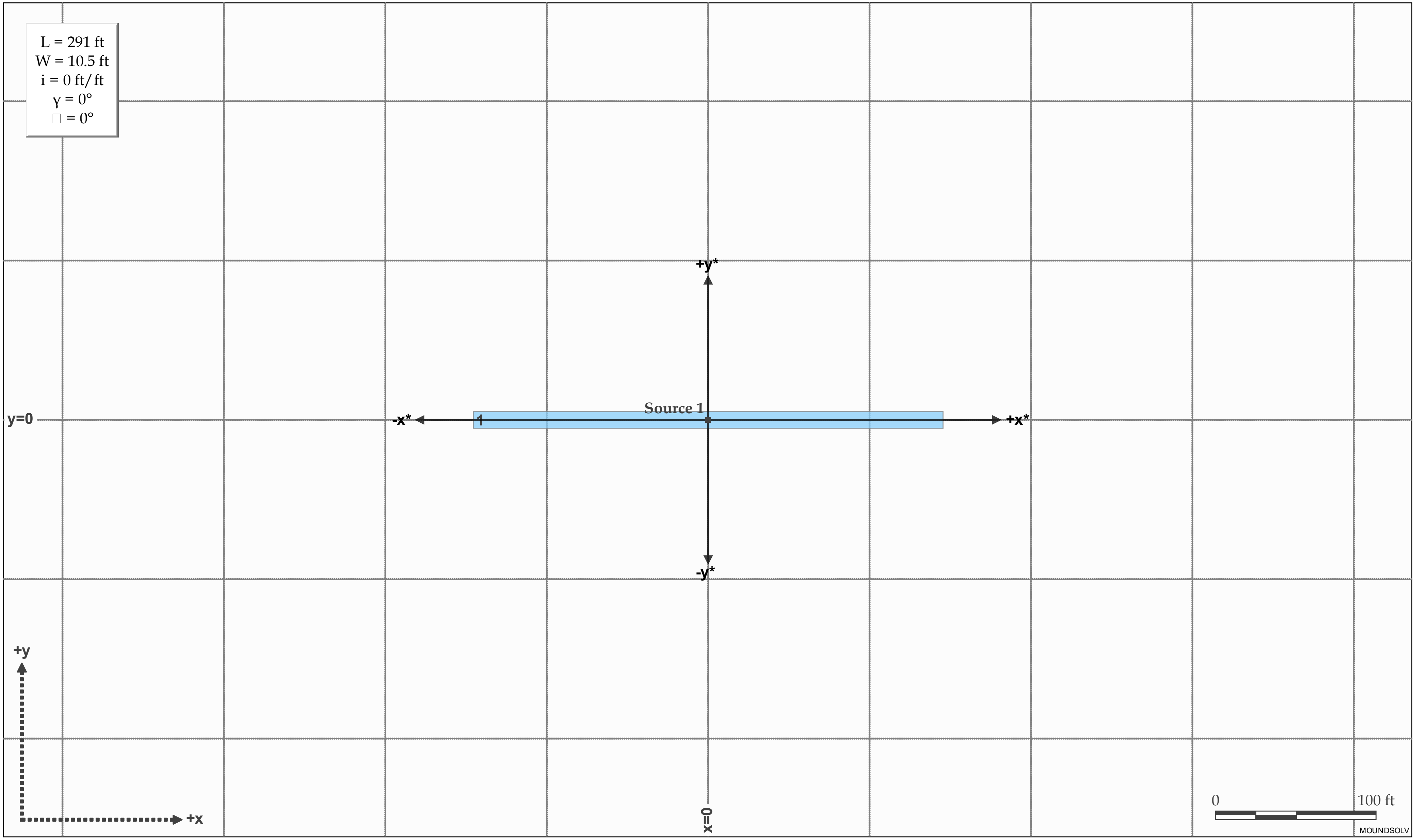
1.25	0.1896	0.1919	0.1896
1.325	0.1836	0.1865	0.1836
1.4	0.178	0.1815	0.178
1.475	0.1728	0.1769	0.1728
1.55	0.168	0.1725	0.168
1.625	0.1634	0.1685	0.1634
1.7	0.1591	0.1648	0.1591
1.775	0.155	0.1613	0.155
1.85	0.1512	0.1579	0.1512
1.925	0.1475	0.1548	0.1475
2	0.1441	0.1519	0.1441

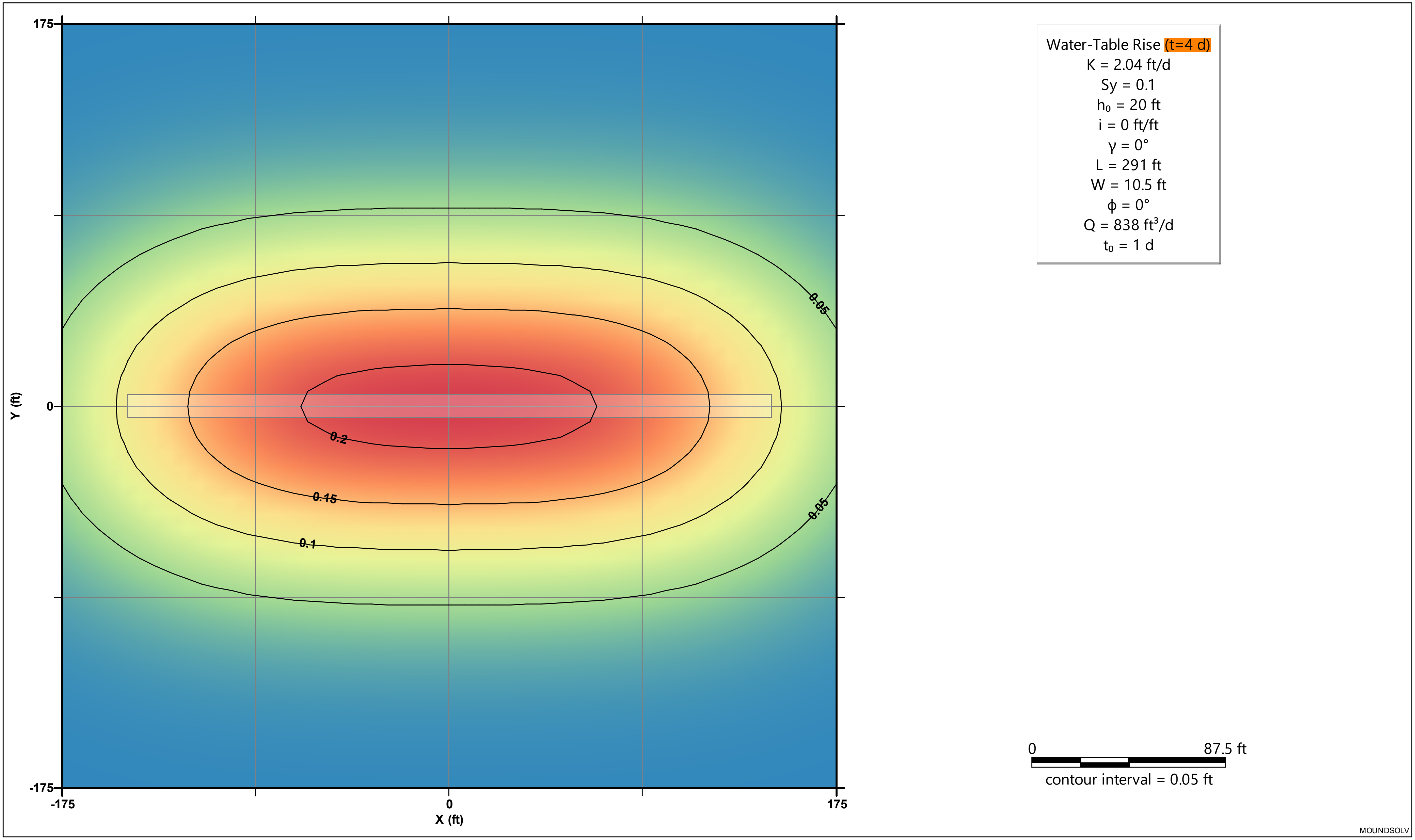
Notation

h is water-table elevation above datum[1]
h_0 is aquifer saturated thickness prior to mounding
i is dip of aquifer
K is horizontal hydraulic conductivity
L is dimension of recharge source parallel to *x** axis
q is infiltration rate (= *Q* / *L*·*W*)
Q is recharge rate
s is water-table rise above static water table
Sy is specific yield
t is time since start of recharge
t_0 is time when recharge stops
W is dimension of recharge source parallel to *y** axis
x, *y* are mapping Cartesian coordinate axes
*x**, *y** are recharge source Cartesian coordinate axes
z is elevation above datum[1]
γ is angle between *x* axis and dip direction
ϕ is angle between dip direction and *x** axis of recharge source
σ is maximum acceptable water-table rise

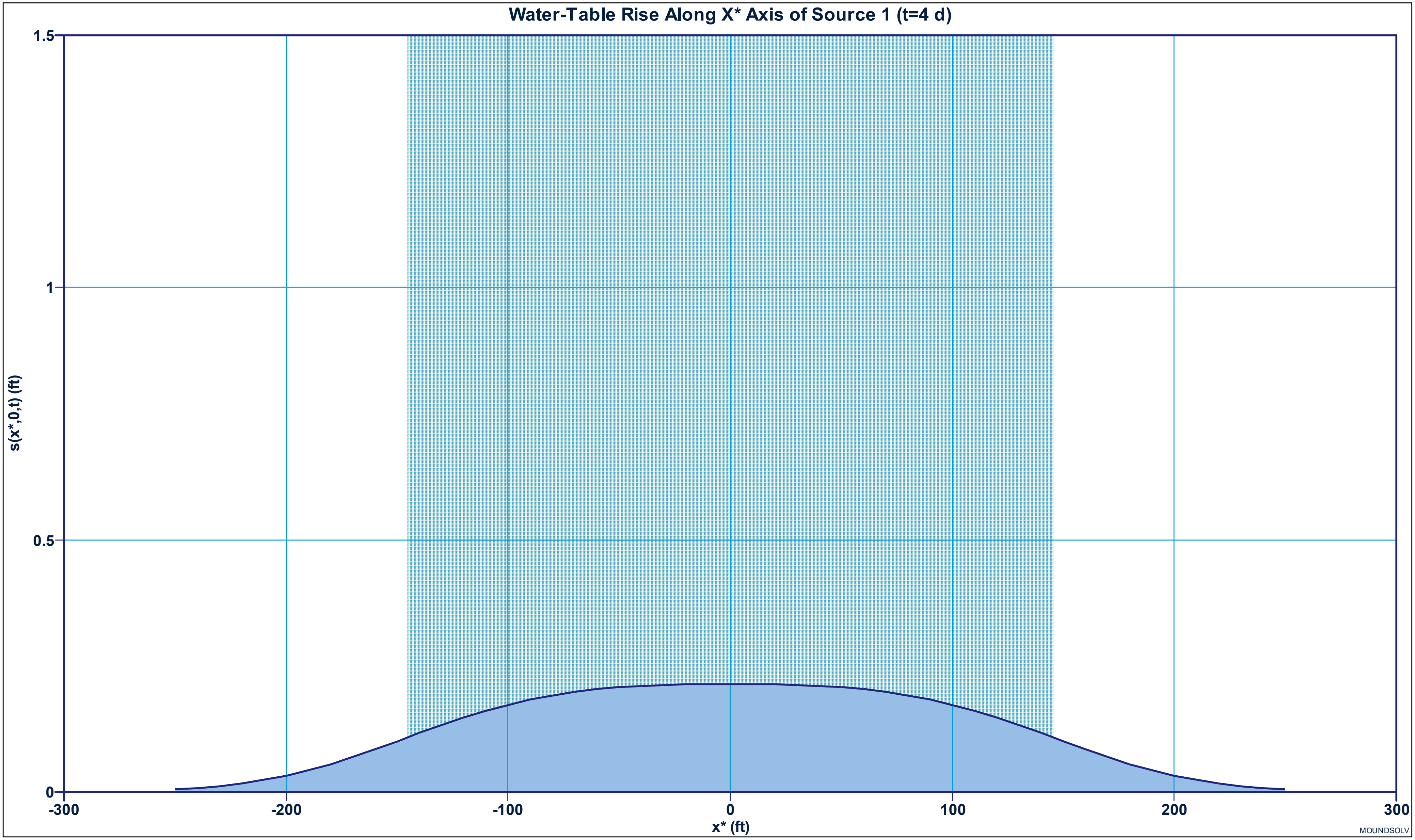
[1]*Elevation datum is the base of aquifer beneath the center of primary recharge source*

Report generated by MOUNDSOLV v4.0 on 11 Apr 2024 at 06:45:17
MOUNDSOLV (www.aqtesolv.com)

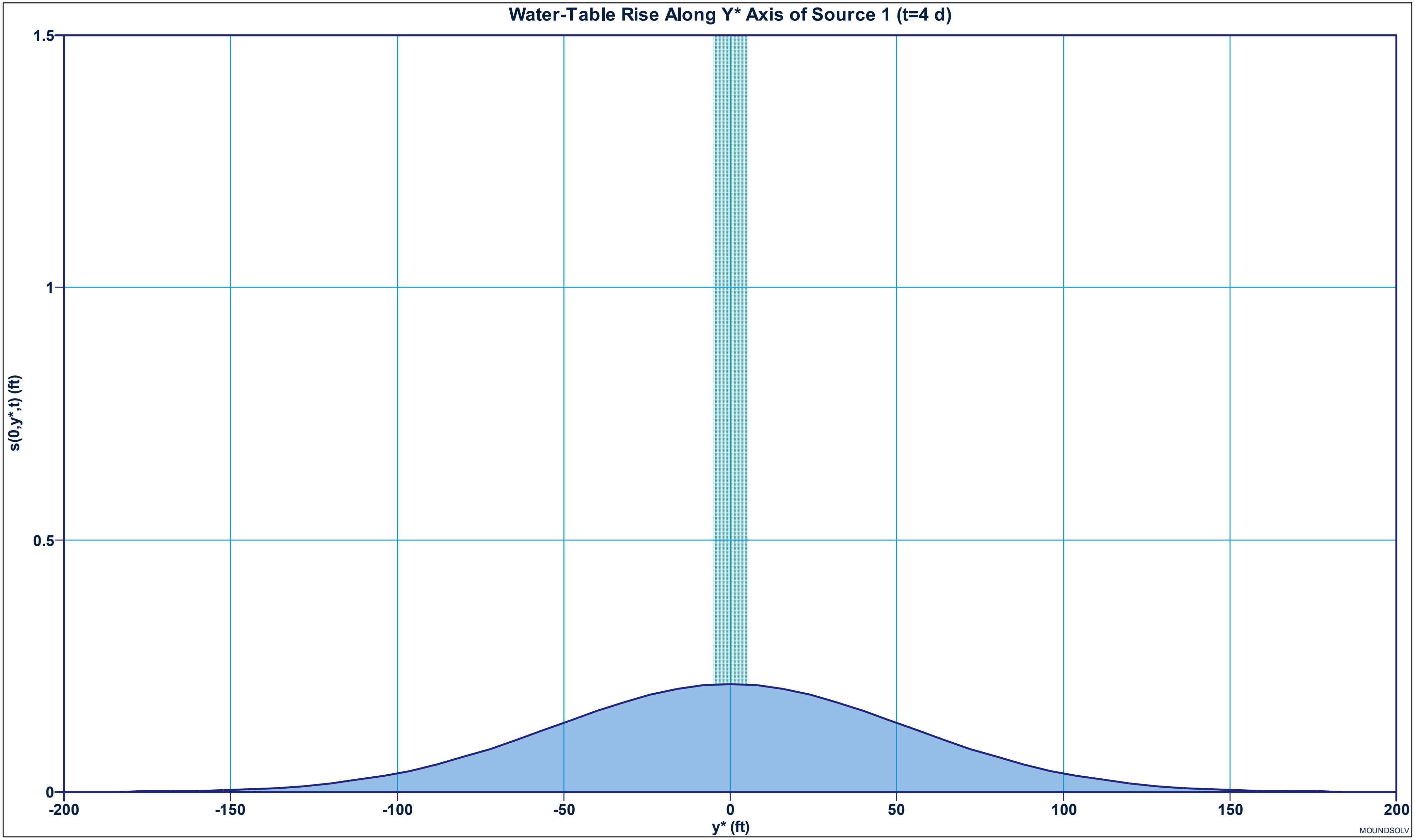

L = 291 ft
W = 10.5 ft
i = 0 ft/ft
γ = 0°
= 0°
+y*
Source 1
y=0
-x*
1
+x*
-y*
+y
+x
x=0
0
100 ft
MOUNDSOLV



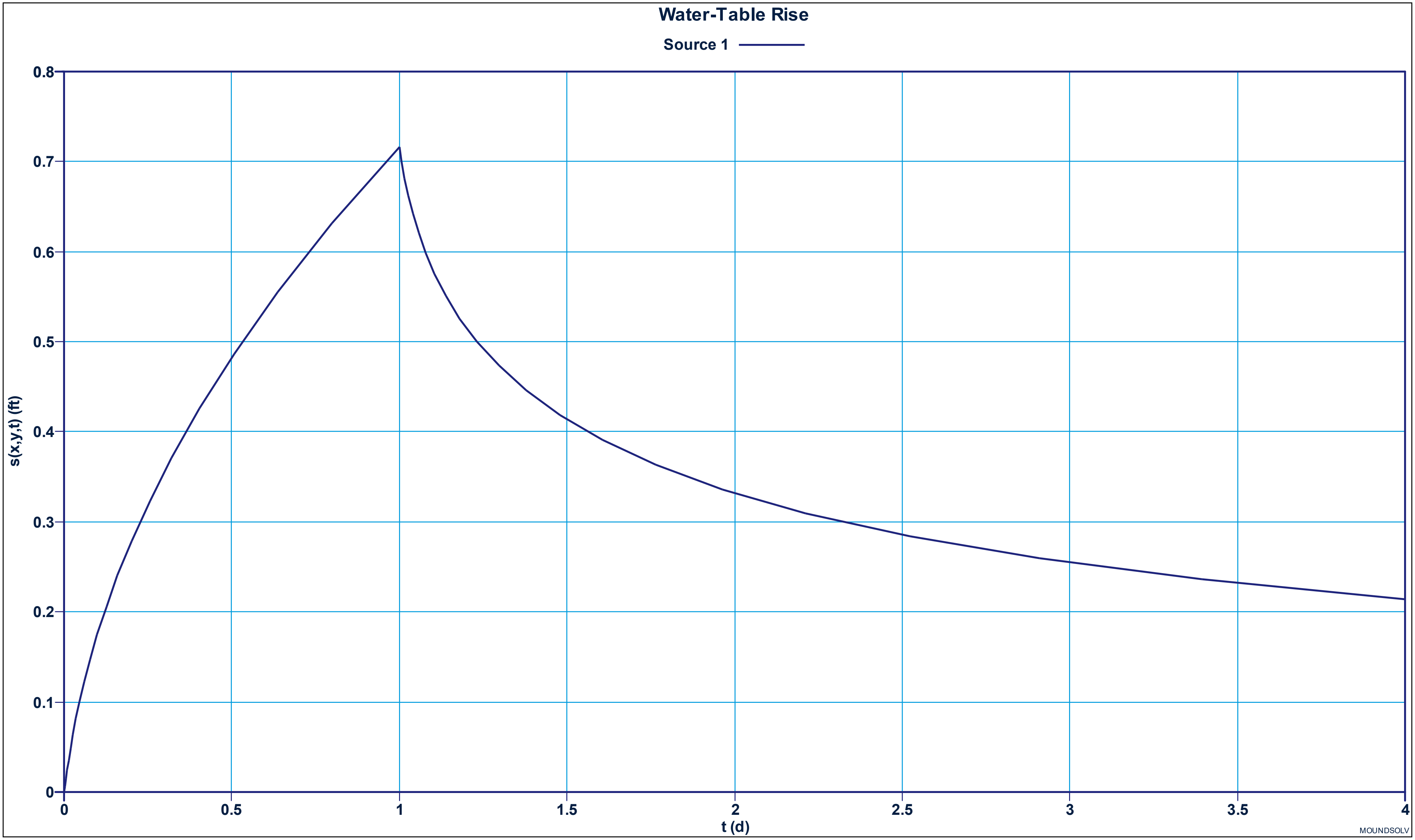
Water-Table Rise (t=4 d)
K = 2.04 ft/d
Sy = 0.1
h0 = 20 ft
i = 0 ft/ft
γ = 0°
L = 291 ft
W = 10.5 ft
ϕ = 0°
Q = 838 ft³/d
t0 = 1 d
175
0
-175
Y (ft)
-175
0
175
X (ft)
0.05
0.05
0.1
0.15
0.2
0
87.5 ft
contour interval = 0.05 ft
MOUNDSOLV



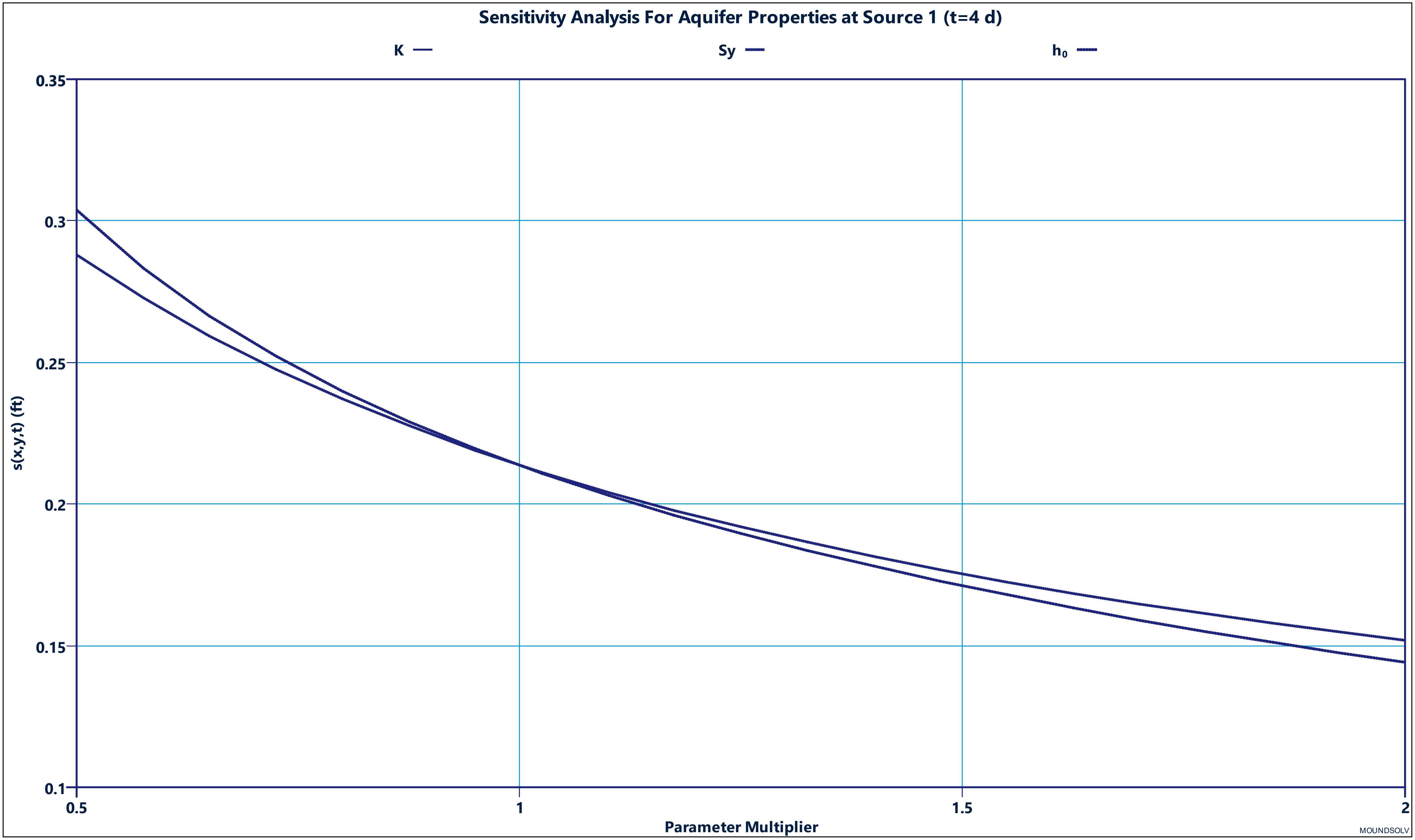
Water-Table Rise Along X* Axis of Source 1 (t=4 d)
s(x*,0,t) (ft)
1.5
1
0.5
0
-300
-200
-100
0
100
200
300
x* (ft)
MOUNDSOLV



Water-Table Rise Along Y* Axis of Source 1 (t=4 d)
1.5
1
0.5
0
s(0,y*,t) (ft)
-200
-150
-100
-50
0
50
100
150
200
y* (ft)
MOUNDSOLV



Water-Table Rise
Source 1
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
s(x,y,t) (ft)
0
0.5
1
1.5
2
2.5
3
3.5
4
t (d)
MOUNDSOLV



Sensitivity Analysis For Aquifer Properties at Source 1 (t=4 d)
K
Sy
h_0
0.35
0.3
0.25
0.2
0.15
0.1
s(x,y,t) (ft)
0.5
1
1.5
2
Parameter Multiplier
MOUNDSOLV

Appendix E – Open Channel Pipe Flow Calculations

Open Channel Pipe Flow Calculations

Pipe Segment	Pipe Slope (ft./ft.)	Pipe Size (in.)	Manning's n	$Q_{full\ flow}$ (ft^3/s)	$Q_{2\ yr}$ (ft^3/s)	$Q_{10\ yr}$ (ft^3/s)	$Q_{25\ yr}$ (ft^3/s)	$Q_{50\ yr}$ (ft^3/s)	$Q_{100\ yr}$ (ft^3/s)
SWMA1P-->CB1	0.0098	8	0.012	**1.30**	0.00	0.13	0.55	0.87	**1.18**
CB1-->MH10	0.0100	8	0.012	**1.31**	0.39	0.61	0.75	0.94	**1.27**
CB2-->SWMA1P	0.0100	8	0.012	**1.31**	0.32	0.68	0.91	1.08	**1.27**
CB3-->SWMA1P	0.0182	8	0.012	**1.77**	0.02	0.06	0.08	0.10	**0.12**
CB4-->DMH5	0.0077	8	0.012	**1.15**	0.39	0.61	0.75	0.85	**0.96**
DMH5-->CB1	0.0075	8	0.012	**1.13**	0.39	0.61	0.75	0.85	**0.96**

Appendix F – Long Term Operation & Maintenance Plan

Long Term Operation & Maintenance Plan

164 Essex Street
Melrose, Massachusetts

April 10, 2024

Applicant
Szecon Development
142 Hagget's Pond Road
Andover, MA 01841

Prepared By
Williams & Sparages, LLC
189 North Main Street, Suite 101
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W&S Project Data
MELR-0047
SPessex#164.dwg
Existing.hcp
Proposed.hcp
p:\melr-0047(164 essex street)\drainage\stormwater_report.docx

W& WILLIAMS SPARAGES
ENGINEERS | SCIENTISTS | SURVEYORS
S

1 | Long Term Operation & Maintenance Plan

This Operation & Maintenance Plan is prepared to comply with provisions set forth in the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards.

Structural Best Management Practices (BMPs) require periodic maintenance to ensure proper function and efficiency in pollutant removal from stormwater discharges that would otherwise reach wetland resource areas untreated. Maintenance schedules found below are as recommended in MassDEP's Massachusetts Stormwater Handbook and as recommended in the manufacturer's specifications.

The person(s) having legal interest in the property:

Sean Szekely, Manager
Cell number: 978 423 3193
Email: sean@szecon.com

Property tax reference number(s):

Melrose Assessors: C8 0 4

The stormwater management system owner and the party responsible for maintenance and finance of the stormwater management system shall be Cedar Park Development LLC and its designated employees given below.

Sean Szekely, Manager
Cell number: 978 423 3193
Email: sean@szecon.com

Signed:____Date: 4/11/2024____________________________
Cedar Park Development LLC
Sean Szekely

1.1 The following BMPs provide pollutant removal, groundwater recharge and storage

1) Deep Sump Catch Basins w/hood
2) Subsurface Infiltration Galleys

Deep-Sump Catch Basin with Hood/Trap
Inspect and/or clean at least four times per year with special consideration given to the end of foliage and snow removal seasons.

Sediments must also be removed four times per year or whenever the depth of deposits is equal to one half the depth from the bottom of the sump to the invert of the lowest outlet pipe. A minimum sump storage capacity of 50% shall be maintained throughout the year.

Clamshell buckets and/or vacuum trucks are typically used to remove sediment in Massachusetts.

Cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste without any prior approval by MassDEP. However, some landfills require catch basin cleanings to be tested before they are accepted. For information on all of the MassDEP requirements pertaining to the disposal of catch basin cleanings go to
http://www.mass.gov/eea/agencies/massdep/recycle/regulations/management-of-catch-basin-cleanings.html

Subsurface Infiltration Galleys
Galley maintenance is not generally required. However, recharge systems are prone to failure due to clogging. Regulating the sediment and petroleum product input into the proposed recharge system is the priority maintenance activity. Sediments and any oil spillage should be trapped and removed before they reach the galleys. Any upstream devices connected to the infiltration system (catch basins, deep sump manholes, proprietary devices) shall be inspected and cleaned at least twice per year to prevent sediments and debris from entering and clogging the recharge system.

Sediments must also be removed whenever the depth of deposits is greater than or equal to 3".

The contractor shall verify that the required washed crushed stone and geotechnical fabric materials are clean and free of sediments and petroleum residue prior to, during and after galley system installation. Inspections of the galley system shall be made by after every major storm for the first few months after construction to verify that proper functioning has been achieved. During the initial inspection the water level should be measured and recorded in a permanent log over several days to check the drainage duration and verify that sediments are not accumulating. If ponded water is present after 24 hours or an accumulation of sediment or debris is noted within the galleys the owner or designated property manager and engineer shall determine the cause for this condition and devise an action plan to improve system functionality.

Once the galley system has been verified to perform as designed, interior galley conditions shall be inspected at least twice per year. Post construction inspections (to be conducted through inspection ports) shall consist of documenting interior and stone bed conditions, measured water depth and presence of sediment. Should inspection indicate that the system is clogged (ponding water present after 24 hours and/or sediment accumulations) replacement or major repair actions may be required. Should the system require replacement or major repair actions the owner or designated property manager and engineer shall determine the cause for this condition and devise an action plan

The inspection and maintenance of the subsurface infiltration system shall belong to the owner or designated property manager.

1.2 The following BMPs are utilized to minimize impacts to wetland resource areas

Driveway/Parking Lot Sweeping
Driveway and parking lot sweeping will be conducted on a monthly average. Special attention will be given to the spring (March or April) and late fall (November or December).

Snow Removal
Snow will be removed from parking areas and sidewalks during snow events. Snow will be stockpiled in various areas in and around the site. Snow disposal/removal shall be in compliance with MassDEP's Bureau of Water Resources guidelines, effective December 11, 2020. See Section 8 Snow Disposal Guidelines. Provisions will be made to remove snow from the site when the designated areas have reached their capacity.

Rip Rap Apron/Spillway/Level Spreader (Not applicable)
The rip rap apron, spillway and level spreader will be inspected during and after several storms (e.g. 0.5-inch or greater) and if necessary, maintenance performed during the first year of operation. Thereafter, inspections and preventative maintenance shall be performed at least twice a year, and after every time drainage discharges through the high outlet orifice or a major storm event which is defined as a storm that is equal to or greater than the 2-year, 24-hour storm (3.29 inches in a 24 hour storm). Any detrimental sediment accumulation shall be removed.
If rilling is present downgradient or adjacent to the rip rap apron, spillway and level spreader the cause shall be identified and corrected and damage shall be repaired.

Leaf litter shall be removed from the rip rap apron, spillway and level spreader.

Vegetation in the vicinity of the rip rap apron, spillway and level spreader shall be inspected periodically and if needed, fertilized to maintain healthy, dense growth.

1.3 Permanent Seeding

Permanent Seeding & Plantings
Once final grades have been established and the weather permits, every effort shall be made to establish permanent vegetation on disturbed and exposed areas no later than September of that year, otherwise temporary seeding practices shall be used until permanent seeding practices can resume the following spring, April 1st through May 31st.

In addition to grass seed, tree and shrub plantings shall be an integral part of the permanent stabilization plan. Care shall be taken by the owner, builder, and/or site contractor to select trees, shrubs, and seed mixes that are best suited to the soil conditions on the site. Soil moisture, depth to seasonal groundwater, and exposure to sunlight shall be carefully considered when selecting species. In recent years, the emphasis on using plant species native to Massachusetts has grown. Information on the use of non-native and native species can be found on the web and in many local nursery catalogs.

Permanent seeding shall be performed in accordance with the guidelines set forth in the "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, May 2003, prepared by Franklin, Hampden, and Hampshire Conservation Districts."

1.4 Estimated Annual Operation and Maintenance Budget

The estimated annual operation and maintenance budget for the project site is $2,000.

1.5 Stormwater Management Easements

No stormwater management easements are provided. Stormwater management system will be maintained by the property owner.

1.6 Changes to Long Term Operation and Maintenance Plan

The owner(s) of the stormwater management system must notify the Department of Public Works of changes in ownership or assignment of financial responsibility.

Inspection and Maintenance Form

Refer to Section 1.1 above for frequency of inspection

Inspector: Date:

Inspector Title:

Days since last rainfall: Amount of last rainfall:

Structural Controls: Catch Basins / Grates

Structure Identification	Location	Catch basin at grade	Hood/trap installed	Sediment buildup (in.)	Overall condition
CB1	Front building	Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
CB2	Rear building	Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
CB3	Front building south end	Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
CB4	North end building	Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
		Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐
		Yes ☐ No ☐	Yes ☐ No ☐		Poor ☐ Fair ☐ Good ☐

Maintenance required

To be performed by: On or before:

Inspection and Maintenance Form

Refer to Section 1.1 above for frequency of inspection

Inspector: Date:

Inspector Title:

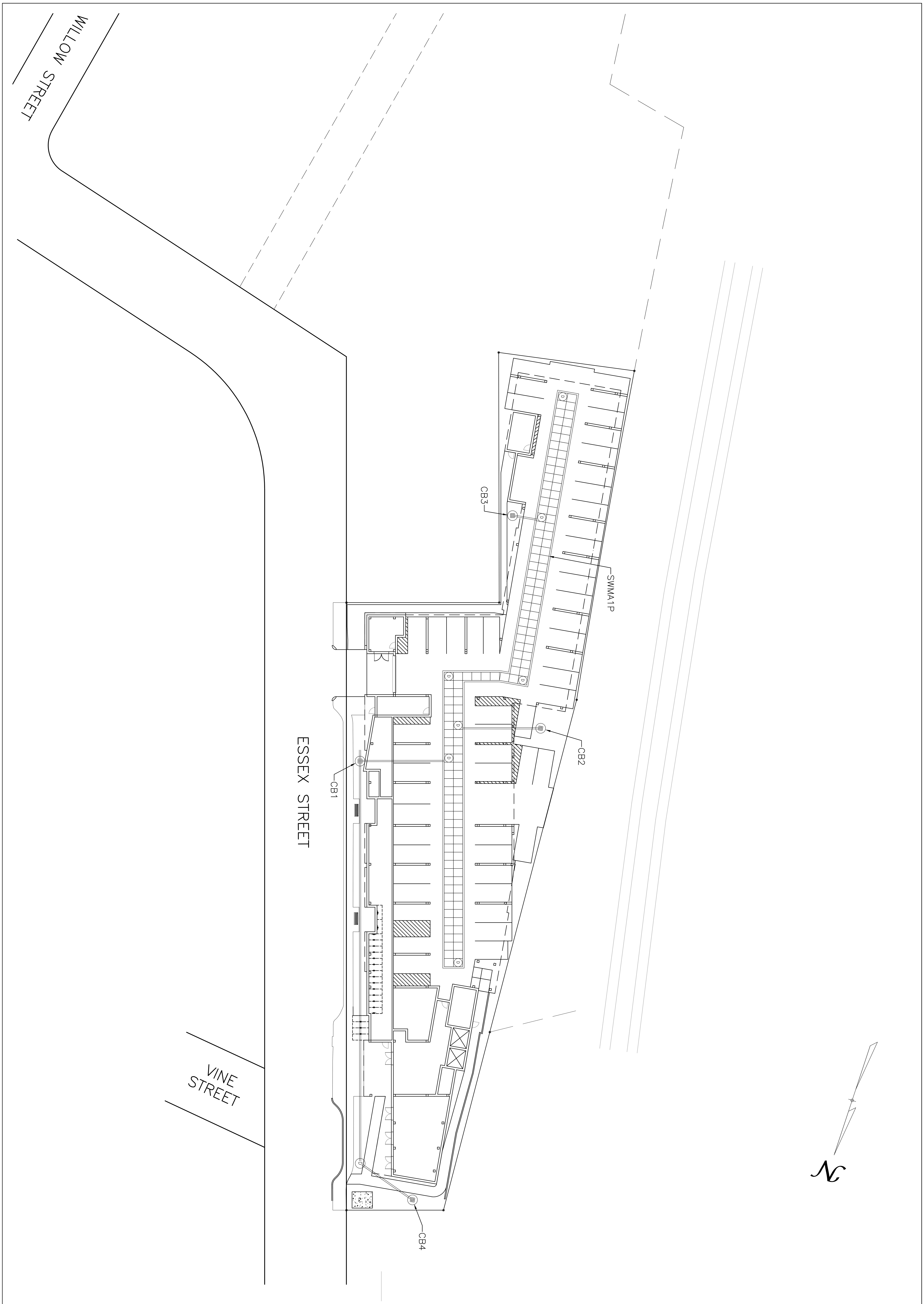
Days since last rainfall: Amount of last rainfall:

Structural Controls: Subsurface Infiltration Galleys

Structure Identification	Location	Condition of stone bed	Filter fabric installed	Sediment buildup at inlet (in.)	Sediment buildup at outlet (in.)
SWMA1P	Parking garage		Yes ☐ No ☐		
			Yes ☐ No ☐		
			Yes ☐ No ☐		
			Yes ☐ No ☐		
			Yes ☐ No ☐		
			Yes ☐ No ☐		

Maintenance required

To be performed by: On or before:



LONG TERM OPERATION & MAINTENANCE PLAN

164 ESSEX STREET, MELROSE, MA

DRAWING: C1

SHEET 1 OF 1

0' 10' 20' 40'

SCALE: 1"=20'

APRIL 10, 2024

6				12			
5				11			
4				10			
3				9			
2				8			
1				7			

SEAL

Designed By: MEM
Drawn By: MEM
Reviewed By: RLW
Project Manager: RLW
Job File Number: MELR-0047
Drawing File Folder: MELR47

☒ Drawing Issued for Review
☐ Drawing Issued for Permit
☐ Drawing Issued for Construction

Owner:
LG Realty, LLC
100 Cottage Street
Melrose, MA 02176

Applicant:
Cedar Park Development, LLC
142 Hagget's Pond Road
Andover, MA 01841

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