



To: City of Somerville Planning Board

Date: October 10, 2018

Memorandum

Project #: 13788.00

From: Conor Nagle, PE
Sarah Ebaugh, EIT

Re: Stormwater Memorandum
20 Inner Belt Road Development
Somerville, Massachusetts

Project Description & Introduction

The Applicants, Criterion Development Partners and Distinctive Hospitality Group, are proposing to redevelop the existing City Club parcel and adjacent parking lot located at 20 Inner Belt Road in Somerville, Massachusetts (the Site). The existing Site will be subdivided to create separate lots for the proposed apartment building and hotel uses and will be separated by an extension of Roland Street. The overall Site is bounded by Washington Street to the North, Inner Belt Road to the West, an existing MBTA rail yard to the South, and commercial developments to the East (Figure 1).

The lot to be created north of Roland St will include a 6-story hotel with outdoor patio space and parking area. The proposed development south of Roland St will include a 7-story residential building, with first floor space for a new City Club, event space, and a 7-story parking garage for use by residents, hotel guests, and City Club visitors.

This memo is an overview of the stormwater management proposed for the developments.

Existing Conditions

Under existing conditions, the Site is mostly impervious consisting of pavement and a 5,340-square foot building. There are landscape beds along the Inner Belt road sidewalk, and side yard abutting the Paradigm site. The Site's topography is relatively flat, with grades ranging from elevation 9' to elevation 12' (NAVD88). Stormwater is collected by catchbasins and piped via a closed pipe drainage system to the municipal system located within Inner Belt Road, with little to no water quality treatment.

According to the National Resources Conservation Service (NRCS), surface soils on the Site include Urban Land (Appendix A). Preliminary geotechnical investigations indicated that soils on site are primarily fill, consisting of very loose to compact, brown to black sand, with some to trace gravel, and trace silt. The fill transitioned to compact, gray, silty sand with trace gravel. Below the fill, organic deposit was encountered approximately 7 to 10 feet below ground surface. Groundwater was encountered approximately at elevation 2' to -1.5' (NAVD 88) across the site. Based on the boring logs throughout the site, an infiltration rate of 2.4 in/hr was used for calculations. A Preliminary Foundation Engineering Report was prepared by McPhail Associates, LLC, dated November 1, 2017, and is included in Appendix B.

Proposed Conditions

The development, which includes the construction of a 9,500-square foot hotel and a 205-unit residential building will be permitted as separate entities; therefore, separate stormwater systems have been designed to mitigate peak rates of runoff for each use.

The redevelopment project will maintain existing grading and drainage patterns to the maximum extent practicable. While the total area of landscape is being decreased, the development will provide for usable space for the residents by providing elevated courtyard areas and wide walking paths, while the hotel will provide outdoor patio space for its

guests. The Project is not subject to the Massachusetts Stormwater Management Standards as it is not located within a jurisdictional area as defined by the Wetlands Protection Act (WPA), however has been designed to meet the Stormwater Management Standards to the maximum extent practicable and the City of Somerville's Stormwater Policy.

Residential

The majority of the residential project site is occupied by building, therefore a 24-inch perforated pipe is proposed within the garage footprint as shown on Figure 3 (attached) to collect and infiltrate clean rooftop runoff. The perforated pipe is sized to provide approximately 3,140 cubic feet of infiltration, equating to 0.61-inches of the rooftop runoff.

Hotel

Under proposed conditions stormwater runoff from the hotel parking lot will be collected by a deep sump, hooded catch basin and piped to an underground infiltration system with an isolator row located beneath the parking lot. The system is designed to provide 80% TSS removal and 44% pretreatment prior to infiltration. The subsurface system consists of 12 Stormtech SC-740 chambers, providing approximately 1,040 cubic feet of infiltration, which equates to approximately 0.6-inches of water quality treatment. During larger storm events the system will overflow to the existing municipal system within Inner Belt Road.

Hydrologic Analysis & Results

The rainfall-runoff response of the Site under existing and proposed conditions were evaluated for the 1-year, 6-hour storm, the 1-year, 24-hour storm, the 2-year, 24-hour storm, the 5-year, 24-hour storm, the 10-year, 24-hour storm, the 25-year, 24-hour storm, and the 100-year, 24-hour storm as required by the City of Somerville Engineering's Department. Rainfall volumes used for this analysis were based on NOAA Atlas 14 and were 1.69", 2.63", 3.26", 4.29", 5.15", 6.33", 8.14", respectively.

Drainage areas for existing and proposed conditions are shown on Figures 2 and 3. The HydroCAD model is based on the NRCS Technical Release 20 (TR-20) Model for Project Formulation Hydrology. Detailed printouts of the HydroCAD analyses are included in Appendix C.

Table 1: Peak Discharge Rates (cfs) – Residential Development

Design Point 1: City of Somerville Drainage System

	1-year (6-hour)	1-year (24-hour)	2-year	5-year	10-year	25-year	100-year
<i>Existing</i>	3.4	4.0	5.0	6.6	8.0	9.8	12.7
<i>Proposed</i>	3.3	3.9	4.9	6.5	7.9	9.7	12.5

Table 2: Peak Discharge Rates (cfs) – Hotel Development

Design Point 1: City of Somerville Drainage System

	1-year (6-hour)	1-year (24-hour)	2-year	5-year	10-year	25-year	100-year
<i>Existing</i>	1.1	1.3	1.6	2.1	2.5	3.1	4.0
<i>Proposed</i>	0.8	1.3	1.6	2.1	2.5	3.1	4.0

Conclusion

The stormwater treatment for both development has been designed to treat the maximum extent practicable. As you can see in the tables above, the results indicate that peak discharge rates were reduced within the residential development for the storms listed, and rates were matched within the hotel development. With the limited area provided, infiltration has been provided on both site to treat approximately 0.6" of the roof runoff within the residential development, and 0.61" inches of impervious area within the hotel development.

Figures:

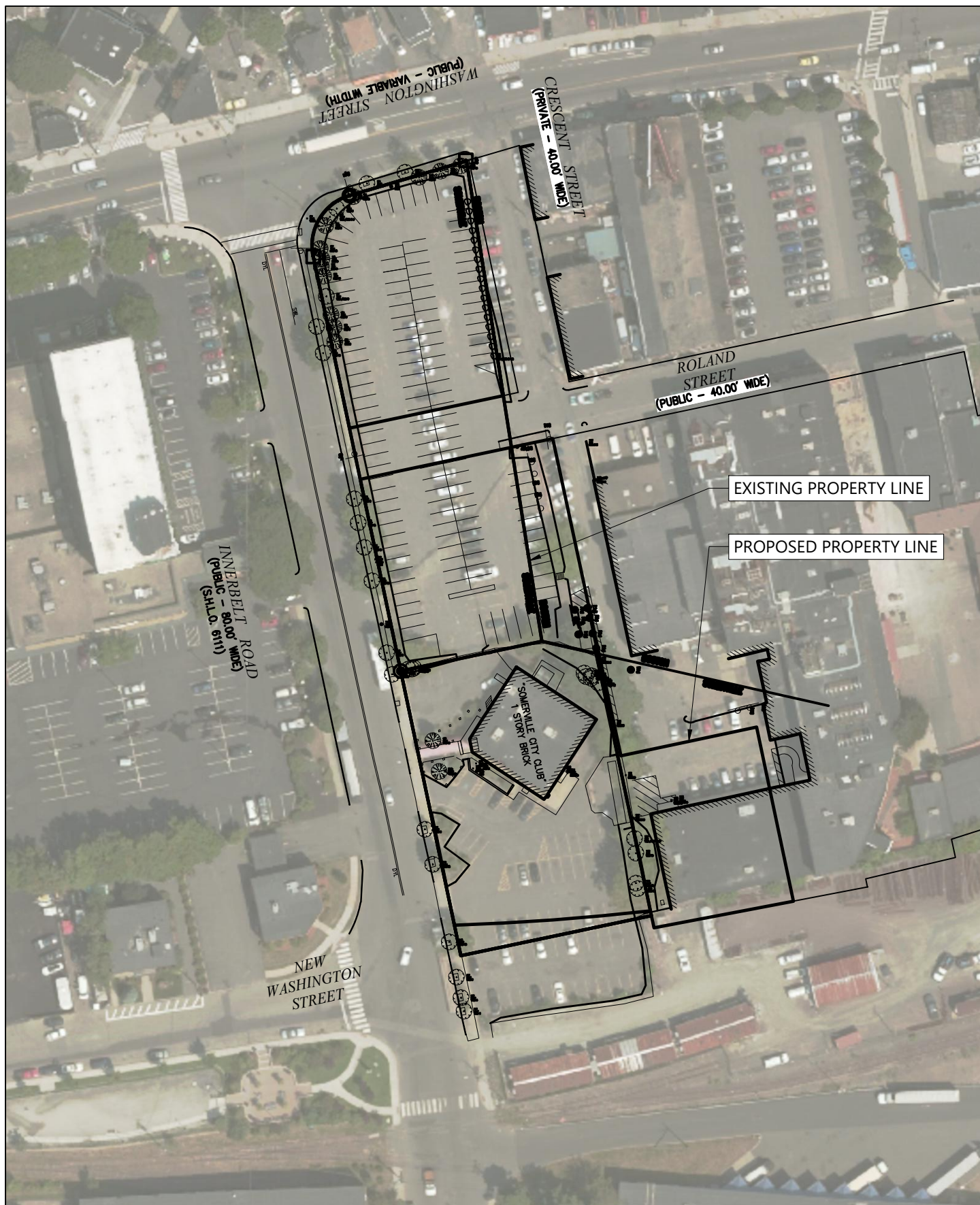
- Figure 1: Site Locus
- Figure 2: Existing Drainage Conditions
- Figure 3: Proposed Drainage Conditions

Appendices:

- Appendix A: NRCS Soil Survey
- Appendix B: Preliminary Foundation Engineering Report, prepared by McPhail Associates, LLC
- Appendix C: Existing & Proposed HydroCAD Reports

Figures

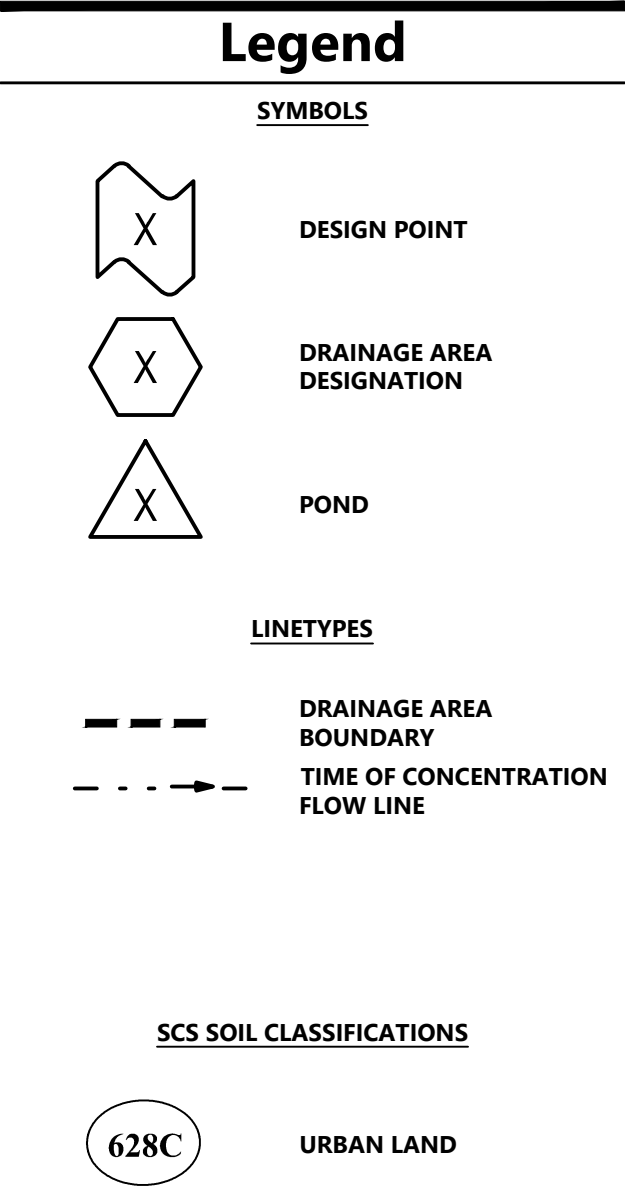
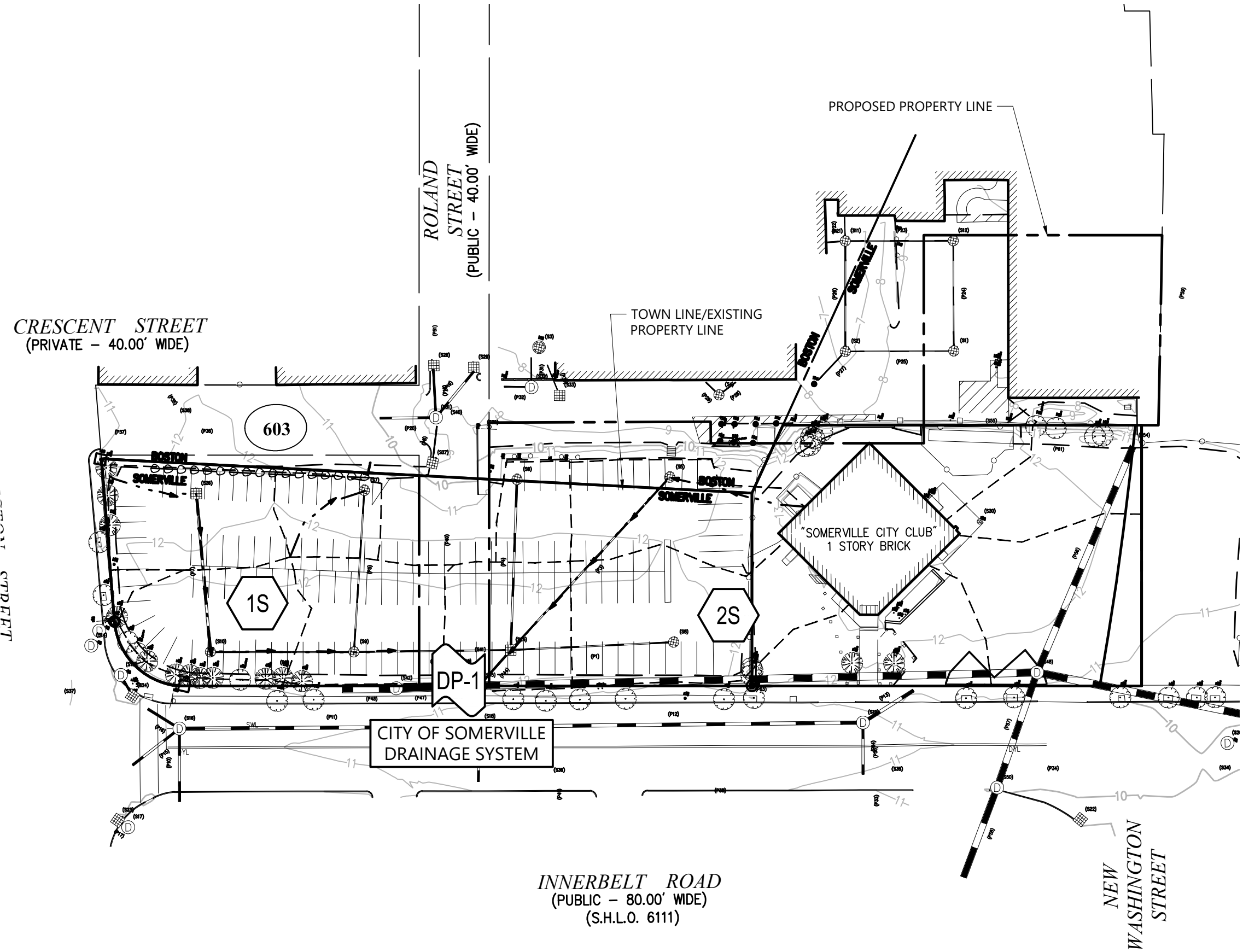
- Site Locus Plan
- Existing Drainage Conditions
- Proposed Drainage Conditions



Site Locus
Hotel & Residential Development
Somerville, MA

Figure 1

10/10/2018

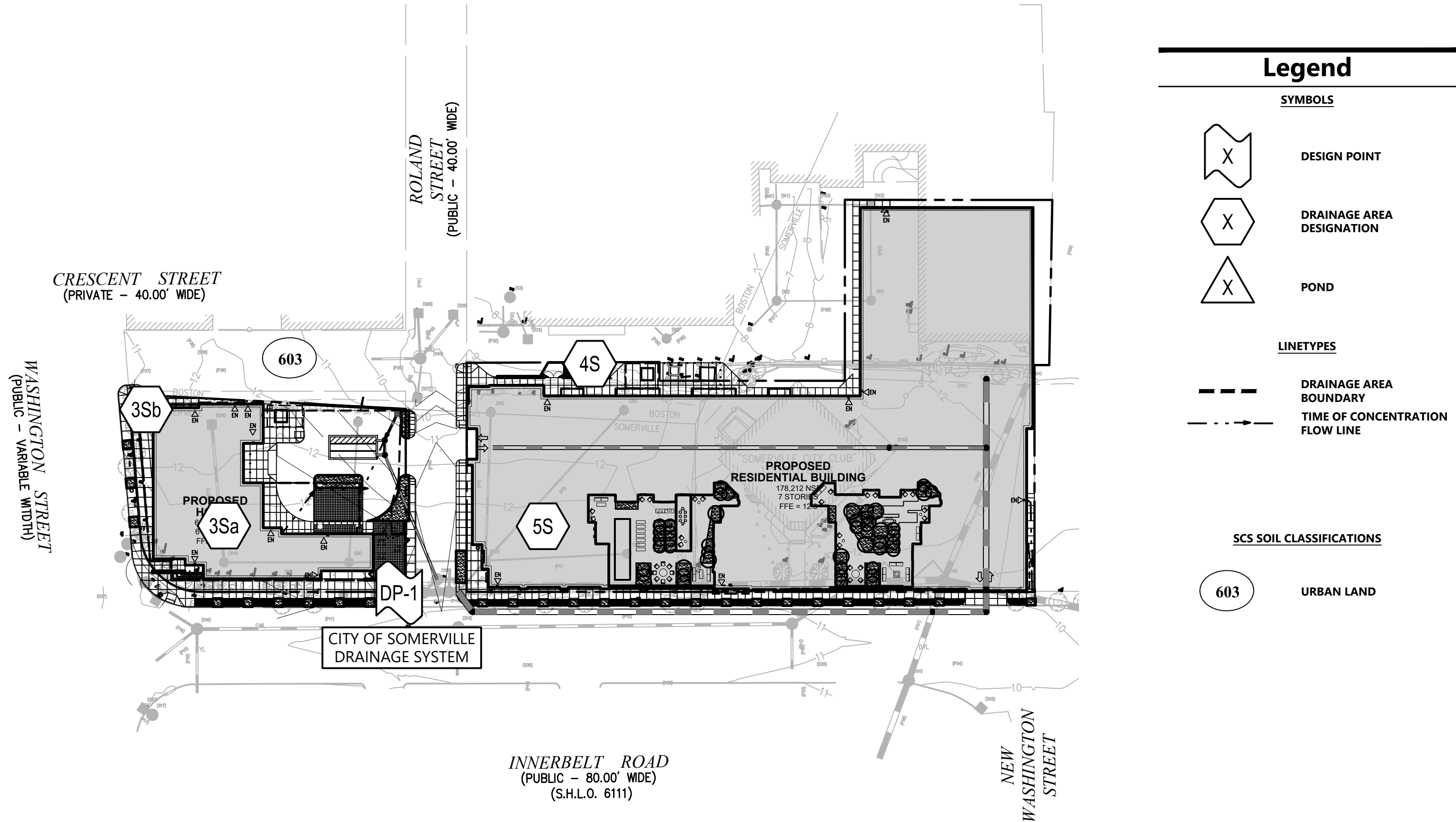


Existing Drainage Conditions

Hotel & Residential Development
Somerville, MA

Figure 2

10/10/2018



Proposed Drainage Conditions

Hotel & Residential Development
Somerville, MA

Figure 3

10/10/2018

Appendix A

- NRCS Soil Survey


Soil Map—Middlesex County, Massachusetts
(Criterion at 20 Inner Belt Road)




Soil Map—Middlesex County, Massachusetts
(Criterion at 20 Inner Belt Road)

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Middlesex County, Massachusetts

Survey Area Data: Version 16, Sep 14, 2016

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

Date(s) aerial images were photographed: Aug 10, 2014—Aug 11, 2014

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

Map Unit Legend

Middlesex County, Massachusetts (MA017)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
603	Urban land, wet substratum	1.7	100.0%
Totals for Area of Interest		1.7	100.0%

Appendix B

- Preliminary Foundation Engineering Report



November 1, 2017

CPC-T INNERBELT, LLC
1601 Trapelo Road, Suite 280
Waltham, MA 02451

Attention: Mr. Andrew Kaye

Reference: Inner Belt Road; Somerville, Massachusetts
Preliminary Foundation Engineering Report

Ladies and Gentlemen:

This report summarizes the results of our preliminary foundation design study for the Inner Belt project located at 1 Inner Belt Road in Somerville, Massachusetts. Refer to the Project Location Plan (**Figure 1**) for the general site location. This letter was prepared in accordance with our proposal dated June 1, 2017 and the subsequent authorization of Mr. Andrew Kaye.

Existing Conditions

The L-shaped subject site measures approximately 600 feet long from north to south, and is approximately 120 to 150 feet wide, measured east to west, within the northern three-quarters of the site, and is approximately 260 feet wide within the southern quarter of the site. Fronting onto Inner Belt Road to the east, the site is bounded by Washington Street to the north, and by Crescent Street and commercial property to the west and south. In general, the project site currently consists of an at-grade surface parking lot with the exception of the southwest corner of the property which is occupied by the Somerville City Club, and the southeast "L-portion" of the property which is occupied by a one (1) story building identified as 56 Roland Street. It is currently unknown if the two existing buildings on the property contain below-grade space.

The existing ground surface within the majority of the site (western portion) is relatively flat at Elevation +12. The ground surface surrounding the 56 Roland Street building is generally at Elevation +8. Elevations referenced herein are in feet and refer to the North American Vertical Datum of 1988 (NAVD88). Refer to **Figure 2** for existing site conditions.

Proposed Development

Based on the information provided, the proposed redevelopment of the project site is understood to consist of the construction of a hotel, which will be located within the northern third of the site, and an apartment building, which will be contained in the remainder of the property. The two proposed buildings are planned to be separated by a 20-foot wide sewer easement which will act as an access roadway.



The proposed hotel is planned to consist of a 120-room 5-story wood-framed structure with no below-grade space located the corner of Washington Street and Inner Belt Road. The proposed apartment building is planned to consist of a 250-unit 5-story structure which will also contain a management office, a community center and a 10,000 square-foot entertainment space, and 355 parking spaces of which 67 are located below grade at the apartment building and the balance in a 4-story above ground parking garage at the rear of the apartment building. The lowest-level slab within the garage footprint of the apartment building is planned to be stepped from Elevation +6 to Elevation +8 and to Elevation +13. In addition, portions of the apartment building extend beyond the footprint of the garage, and the lowest-level slabs will be located at Elevation +14 and Elevation +16. The proposed exterior grades of the building are Elevation +11 to the east and Elevation +14 to the west. The approximate building footprints of the apartment building and development area of the proposed hotel are indicated on **Figure 2**.

Subsurface Conditions

Roux Associates, Inc. (Roux) was retained by CPC-T Innerbelt, LLC to perform environmental assessment activities at the site that included a subsurface investigation consisting of thirteen (13) explorations. To provide subsurface information for preliminary geotechnical assessment of the site, three (3) of the explorations were performed as standard borings and soil samples were obtained from the borings for both environmental and geotechnical purposes. The remaining nine (9) explorations were performed as geoprobes including RX-1 through RX-6, RX-8, RX-10 and RX-11 completed during October 16 through 18, 2017 by Geosearch Inc. of Fitchburg, MA under contract to Roux. The three (3) borings: RX-7, RX-9 and RX-12 were completed on October 19, 2017 by Geosearch Inc. under contract to Roux and were also observed by McPhail. Approximate plan locations of the explorations are as indicated on the enclosed Subsurface Exploration Plan, **Figure 2**. The boring logs prepared by McPhail and the geoprobe logs prepared by Roux are included in **Appendix B** and **Appendix C**, respectively.

The borings and geoprobes performed at the site indicate that the ground surface is underlain by an approximate 2-inch thickness of asphalt pavement, overlying fill. The fill material was observed to generally consist of very loose to compact, brown to black, sand, with some to trace gravel, and trace silt, and was observed to transition to compact, gray, silty sand with trace gravel. Occasional cobbles, brick, glass, ash and cinders were also observed within the fill layer. Below the fill, a discontinuous, compressive organic deposit was encountered at depths varying from 7 to 10 feet below the ground surface, corresponding to approximate Elevation +4 to Elevation +1.7. Where encountered, the organic material was observed to generally be 2 to 3 feet thick and generally consist of very soft, dark brown, organic silt, with some organic fibers. Underlying the fill and organic deposit, where encountered, a natural marine sand deposit was observed. The surface of the natural marine sand deposit was encountered at depths varying from 9 to 14 feet below the existing ground surface, corresponding to approximate Elevation +3 to Elevation -2. The marine sand deposit was observed to generally consist of compact to dense, brown to gray, sand, with trace silt and occasional traces of gravel. The geoprobes were terminated



within the natural marine sand deposit, however the three (3) borings were advanced through the 7 to 8-foot thick marine sand deposit and into a marine clay deposit. The surface of the natural marine clay deposit was encountered at depths of 16.5 and 21 feet below the ground surface, corresponding to approximately Elevation -5 and Elevation -9. The marine clay deposit was observed to consist of soft to firm, gray, silty clay. The three (3) borings were terminated at depths of 21 and 25 feet below the existing ground surface within the marine clay deposit.

Observation wells were installed within nine (9) of the completed geoprobes at the site and the observation wells indicate that the groundwater level ranges from about Elevation +2 to Elevation -1.5. It is anticipated that future groundwater levels across the site may vary from those reported herein due to factors such as normal seasonal changes, runoff particularly during or following periods of heavy precipitation, and alterations of existing drainage patterns.

Preliminary Foundation Design Recommendations

Based on our understanding of the proposed development and the anticipated subsurface conditions, it is recommended that foundation support for the proposed building transfer the structural load through the existing fill and compressible organic deposit to the underlying undisturbed natural marine sand deposit. It is therefore recommended that foundation support for the proposed buildings be provided by spread footing foundations in conjunction with a soil supported slab-on-grade bearing on the existing soil that is improved by aggregate piers and rigid inclusions.

It is recommended that below footing subgrades, the existing soils be improved by rigid inclusions. Footings supported on rigid inclusion-improved soil should be proportioned utilizing a design bearing pressure of three (3) tsf. Recommended minimum footing widths for continuous and isolated spread footings are 24 and 30 inches, respectively.

Rigid inclusions are constructed by advancing a hollow mandrel to the design depth, densifying the surrounding soils by displacement. Once reaching the design depth, concrete is pumped through the mandrel, which opens as it is raised. If required, the mandrel can be raised and lowered several times, vertically ramming lifts of concrete to create an expanded base. The rigid inclusion elements are typically installed in a grid pattern and are used in conjunction with an engineered granular pad to produce an intermediate foundation system for support of foundation loads.

It is recommended that below the slab-on-grade, the existing soils be improved by aggregate piers. Aggregate piers are a ground improvement technique that involves ramming aggregate stone into a predrilled hole or by vertical displacement to reinforce unsuitable soils. The completed aggregate piers are typically about 20 inches in diameter.



General Foundation Recommendations

The lowest level slabs should be designed as conventional slabs-on-grade underlain by a polyethylene vapor barrier. The vapor barrier should be underlain by a minimum 9-inch thickness of $\frac{3}{4}$ -inch crushed stone underlain by a layer of filter fabric, such as Mirafi 140N.

For the areas of the apartment building and the proposed hotel where the lowest-level slab is planned to be at or above the exterior finished grades, perimeter and underslab drainage systems are not considered necessary. For the proposed apartment building, both perimeter and underslab drainage systems are recommended wherever the lowest level slab is proposed to be below grade to protect the below grade level against groundwater intrusion.

All localized depressions in the lowest level slab-on-grade extending below the underslab drainage system (such as elevator pits) should be provided with properly tied continuous waterstops in all construction joints and crystalline waterproofing on their interior surfaces to protect against groundwater intrusion. Depressions in the lowest level slab should be designed to resist a hydrostatic uplift pressure resulting from the groundwater being present at the invert elevation of the adjacent underslab drain line.

Foundation Construction Considerations

The primary foundation construction considerations include preparation of the foundation bearing surfaces and the slabs-on-grade, installation of the aggregate piers and rigid inclusions, installation of the temporary earth support system, vibrations associated with installation of the aggregate piers, rigid inclusions and temporary earth support system, construction dewatering, and off-site disposal of excess excavated soil. These construction considerations are considered by McPhail to be critical to proper foundation performance of the completed structures and to mitigate potential adverse foundation construction impacts on the surrounding area.

Based on the existing grades at the site and the proposed lowest level slabs elevations, it is anticipated that excavation of up to 8 feet below the ground surface will be required to reach the bottom of footing elevation. It is recommended that a trench box and/or open cutting and sloping the sides of the excavation be utilized as much as possible. However, it is understood that due to the constraints of the property line and adjacent utility easements, temporary excavation support may be required.

If required, temporary earth support is recommended to consist of a cantilevered steel soldier pile and timber lagging system. It is anticipated that conventional driving of the soldier piles will be sufficient to advance through the soils present at the site.



CPC-T INNERBELT, LLC
November 1, 2017
Page 5

Closing Remarks

It is recommended that a supplemental subsurface exploration program consisting of additional borings be performed at the subject site prior to the preparation of a final foundation engineering report. The borings would be performed within the footprint of the proposed structures to further delineate the subsurface conditions across the site for both foundation and temporary excavation support design purposes.

We trust that the above is sufficient for your present requirements. Should you have any questions concerning the above, please call us.

Very truly yours,

McPHAIL ASSOCIATES, LLC

A handwritten signature in blue ink, appearing to read 'Olivia C. Deterling'.

Olivia C. Deterling

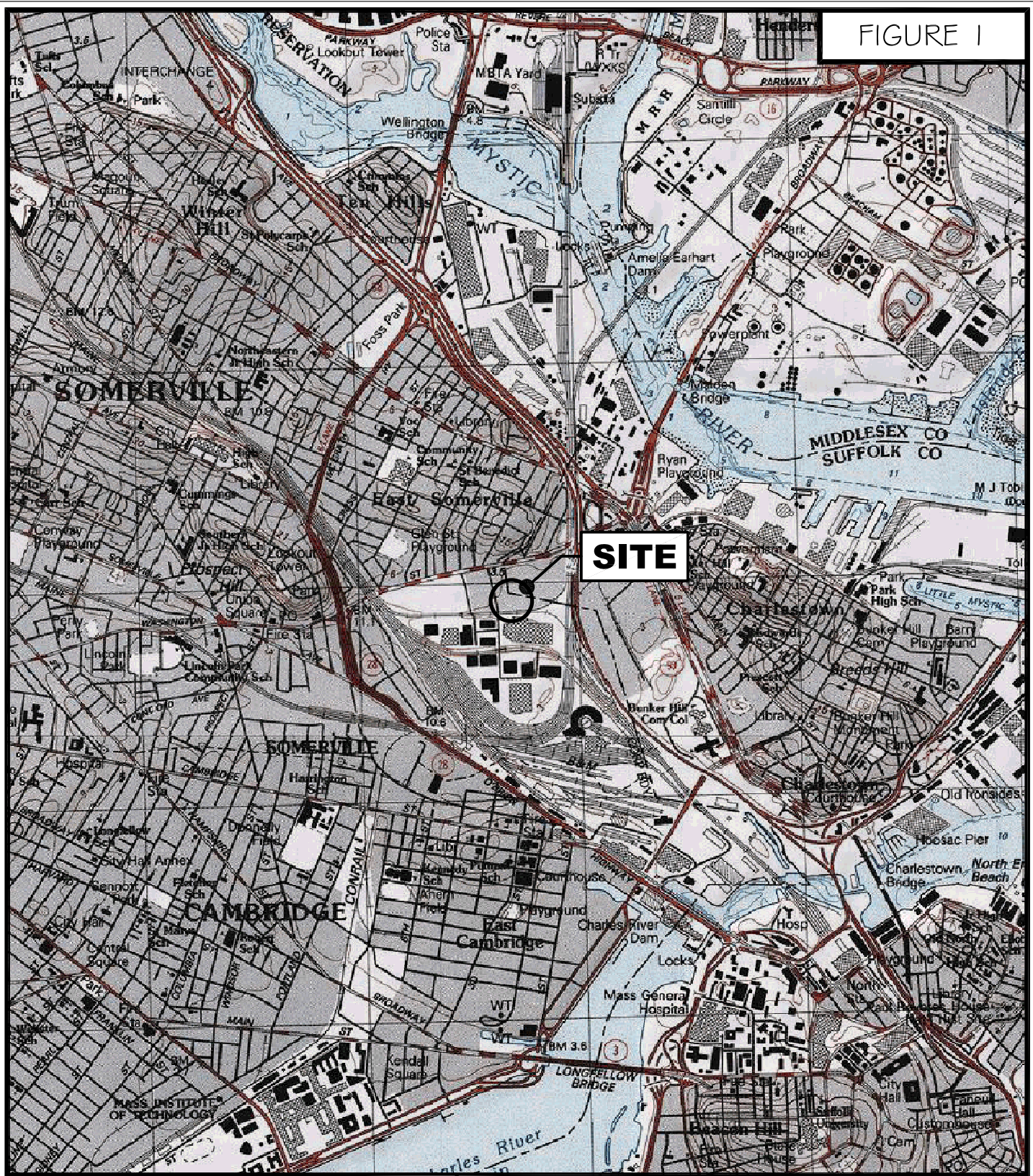
A handwritten signature in blue ink, appearing to read 'Ambrose J. Donovan'.

Ambrose J. Donovan, P.E., L.S.P.

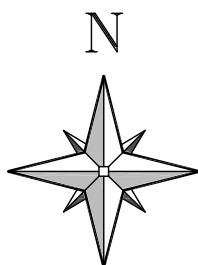
N:\Working Documents\Reports\6469 PFER 110117.docx

OCD/ajd

FIGURE I



Geotechnical and
Geoenvironmental Engineers
2269 Massachusetts Avenue
Cambridge, MA 02140
617/868-1420
617/868-1423 (Fax)
www.mcphailgeo.com



SCALE 1:25,000

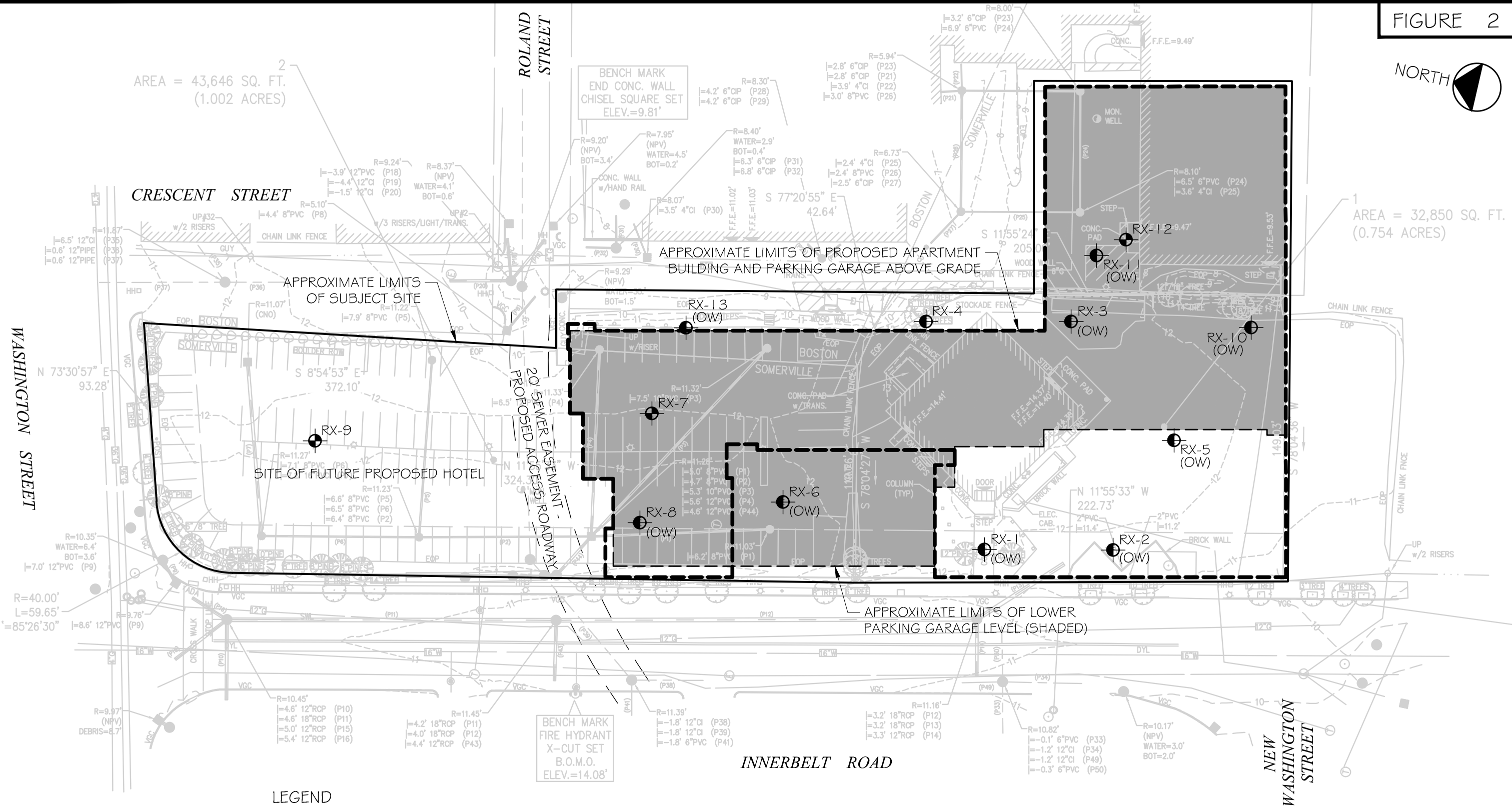
PROJECT LOCATION PLAN

INNER BELT ROAD

SOMERVILLE

MASSACHUSETTS

FIGURE 2



- APPROXIMATE LOCATION OF BORING PERFORMED BY GEOSearch INC. FOR ROUX ASSOCIATES, INC. AND OBSERVED BY McPHAIL ASSOCIATES, LLC ON OCTOBER 19, 2017
- APPROXIMATE LOCATION OF GEOPROBE PERFORMED BY GEOSearch INC. FOR ROUX ASSOCIATES, INC. ON OCTOBER 19, 2017
- (OW) — INDICATES OBSERVATION WELL INSTALLED WITHIN COMPLETED GEOPROBE

REFERENCE: THIS PLAN WAS PREPARED FROM A 40-SCALE DRAWING ENTITLED, "EXISTING CONDITIONS PLAN OF LAND" DATED JANUARY 27, 2017 PROVIDED BY VHB



INNER BELT ROAD			
SOMERVILLE		MASSACHUSETTS	
SUBSURFACE EXPLORATION PLAN			
FOR			
CPC-T INNERBELT, LLC			
BY			
McPHAIL ASSOCIATES, LLC			
Date: NOVEMBER 2017	Dwn: M.B.S.	Chkd: O.C.D.	Scale: 1" = 50'
Project No: 6469			



APPENDIX A:

LIMITATIONS



LIMITATIONS

This report has been prepared on behalf of and for the exclusive use of CPC-T INNERBELT, LLC for specific application to the 1 Inner Belt Road development to be located in Somerville, Massachusetts in accordance with generally accepted soil and geotechnical engineering practices. No other warranty, expressed or implied, is made.

In the event that any changes in nature or design of the proposed construction are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by McPhail Associates.

The analyses and recommendations presented in this report are based upon the data obtained from the subsurface explorations performed at the approximate locations indicated on the enclosed plan. If variations in the nature and extent of subsurface conditions between the widely spaced explorations become evident during the course of construction, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.



APPENDIX B:

BORING LOGS PREPARED BY MCPHAIL


Project: 1 Inner Belt Road		Job #: 6469.2.00		Boring No. RX-7																									
Location: 1 Inner Belt Road		Date Started: 10-19-17																											
City/State: Somerville, MA		Date Finished: 10-19-17																											
Contractor: GeoSearch		Casing Type/Depth (ft): 3"		<table border="1"> <tr><th colspan="4">Groundwater Observations</th></tr> <tr> <th>Date</th><th>Depth</th><th>Elev.</th><th>Notes</th></tr> <tr> <td>10-19-17</td><td>9</td><td>3.1</td><td></td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table>		Groundwater Observations				Date	Depth	Elev.	Notes	10-19-17	9	3.1													
Groundwater Observations																													
Date	Depth	Elev.	Notes																										
10-19-17	9	3.1																											
Driller/Helper: Rodney/Kenny		Casing Hammer (lbs)/Drop (in): 140/30																											
Logged By/Reviewed By: K. Hanrahan		Sampler Size/Type: Split Spoon																											
Surface Elevation (ft): 12.1		Sampler Hammer (lbs)/Drop (in): 140/30																											

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample					Sample Description and Boring Notes	
					N-Value	No.	Pen. /Rec. (in)	Depth (ft)	Blows Per 6"		
			0.2 / 11.9	ASPHALT	n/a	VAC1	10/	0.2-1.0		Light brown, SAND, trace gravel/cobbles. (Fill)	
1	11			FILL						Dark brown, SAND, some gravel, trace fines. (Fill)	
2	10										Geosearch vacuum excavated 0-5' on previous date. Soil description from Roux Associates.
3	9				n/a	VAC2	48/	1.0-5.0			
4	8										
5	7								16		Loose, dark brown, SAND, trace silt, w/ trace ash & cinders. (Fill)
6	6				8	S1	24/8	5.0-7.0	5		
7	5								3		
8	4				3	S2	24/1	7.0-9.0	2		Very loose, dark brown, SAND, some silt, w/ trace ash & cinders and brick. (Fill)
9	3								1		
10	2				3	S3	24/8	9.0-11.0	2		Very loose, dark brown, SAND, trace silt, w/ trace ash & cinders. (Fill)
11	1					8					
12	0				14	S4	12/6	11.0-12.0	6		Compact, brown, SAND, trace silt, w/ trace ash & cinders, glass, bricks. (Fill)
13	-1		13.0 / -0.9	MARINE SAND	19	S4A	12/10	12.0-13.0	9		Compact, dark brown, SILTY SAND, trace gravel. (Fill)
14	-2				16	S5	24/1	13.0-15.0	7		Compact, brown, SILTY SAND. (Marine Sand)
15	-3								10		
16	-4				19	S6	24/10	15.0-17.0	9		Compact, gray, SAND, trace gravel. (Marine Sand)
17	-5								9		Compact, gray, SAND, trace silt. (Marine Sand)
18	-6				18	S7	24/12	17.0-19.0	8		Compact, gray, SAND, trace silt. (Marine Sand)
19	-7								10		
20	-8				15	S8	24/12	19.0-21.0	6		Compact, gray, SAND, trace silt. (Marine Sand)
21	-9		21.0 / -8.9	MARINE CLAY					11		
22	-10				8	S9	24/12	21.0-23.0	4		Stiff, gray, SILTY CLAY. (Marine Clay)

GRANULAR SOILS		SOIL COMPONENT	
BLOWS/FT.	DENSITY	DESCRIPTIVE TERM	PROPORTION OF TOTAL
0-4	V.LOOSE	"TRACE"	0-10%
4-10	LOOSE	"SOME"	10-20%
10-30	COMPACT	"ADJECTIVE" (eg SANDY, SILTY)	20-35%
30-50	DENSE	"AND"	35-50%
>50	V.DENSE		

COHESIVE SOILS		Notes:
BLOWS/FT.	CONSISTENCY	
<2	V.SOFT	Casing advanced to a depth of 19 feet bgs. Weather: Sunny
2-4	SOFT	
4-8	FIRM	
8-15	STIFF	
15-30	V.STIFF	
>30	HARD	

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"



McPHAIL ASSOCIATES, LLC
 2269 MASSACHUSETTS AVENUE
 CAMBRIDGE, MA 02140
 TEL: 617-868-1420
 FAX: 617-868-1423

Page 1 of 2

Project: 1 Inner Belt Road Location: 1 Inner Belt Road City/State: Somerville, MA				Job #: 6469.2.00 Date Started: 10-19-17 Date Finished: 10-19-17				Boring No. <div style="font-size: 24pt; font-weight: bold;">RX-7</div>																											
Contractor: GeoSearch Driller/Helper: Rodney/Kenny Logged By/Reviewed By: K. Hanrahan Surface Elevation (ft): 12.1				Casing Type/Depth (ft): 3" Casing Hammer (lbs)/Drop (in): 140/30 Sampler Size/Type: Split Spoon Sampler Hammer (lbs)/Drop (in): 140/30				<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="4">Groundwater Observations</th> </tr> <tr> <th>Date</th> <th>Depth</th> <th>Elev.</th> <th>Notes</th> </tr> <tr> <td>10-19-17</td> <td>9</td> <td>3.1</td> <td></td> </tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table>				Groundwater Observations				Date	Depth	Elev.	Notes	10-19-17	9	3.1													
Groundwater Observations																																			
Date	Depth	Elev.	Notes																																
10-19-17	9	3.1																																	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample					Sample Description and Boring Notes
					N-Value	No.	Pen. /Rec. (in)	Depth (ft)	Blows Per 6"	
24	-12		25.0 / -12.9	MARINE CLAY	3	S10	24/4	23.0-25.0	1 1 2 2	Soft, gray, SILTY CLAY. (Marine Clay)
25	-13									
26	-14			Bottom of borehole 25 feet below ground surface.						
27	-15									
28	-16									
29	-17									
30	-18									
31	-19									
32	-20									
33	-21									
34	-22									
35	-23									
36	-24									
37	-25									
38	-26									
39	-27									
40	-28									
41	-29									
42	-30									
43	-31									
44	-32									
45	-33									

GRANULAR SOILS		SOIL COMPONENT			 McPHAIL ASSOCIATES, LLC 2269 MASSACHUSETTS AVENUE CAMBRIDGE, MA 02140 TEL: 617-868-1420 FAX: 617-868-1423
BLOWS/FT.	DENSITY	<u>DESCRIPTIVE TERM</u>	<u>PROPORTION OF TOTAL</u>		
0-4	V.LOOSE	"TRACE"	0-10%	SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"	
4-10	LOOSE	"SOME"	10-20%		
10-30	COMPACT	"ADJECTIVE" (eg SANDY, SILTY)	20-35%		
30-50	DENSE	"AND"	35-50%		
>50	V.DENSE				
COHESIVE SOILS					
BLOWS/FT.	CONSISTENCY	Notes: Casing advanced to a depth of 19 feet bgs. Weather: Sunny			
<2	V.SOFT				
2-4	SOFT				
4-8	FIRM				
8-15	STIFF				
15-30	V.STIFF				
>30	HARD				

Project: 1 Inner Belt Road Location: 1 Inner Belt Road City/State: Somerville, MA		Job #: 6469.2.00 Date Started: 10-19-17 Date Finished: 10-19-17		Boring No. <div style="font-size: 24pt; font-weight: bold;">RX-9</div>																									
Contractor: GeoSearch Driller/Helper: Rodney/Kenny Logged By/Reviewed By: K. Hanrahan Surface Elevation (ft): 12.1				Casing Type/Depth (ft): 3" Casing Hammer (lbs)/Drop (in): 140/30 Sampler Size/Type: Split Spoon Sampler Hammer (lbs)/Drop (in): 140/30																									
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="4">Groundwater Observations</th> </tr> <tr> <th>Date</th> <th>Depth</th> <th>Elev.</th> <th>Notes</th> </tr> <tr> <td>10-19-17</td> <td>9</td> <td>3.1</td> <td></td> </tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table>						Groundwater Observations				Date	Depth	Elev.	Notes	10-19-17	9	3.1													
Groundwater Observations																													
Date	Depth	Elev.	Notes																										
10-19-17	9	3.1																											

Depth (ft)	Elev. (ft)	Symbol	Depth/Elev. to Strata Change (ft)	Stratum	Sample					Sample Description and Boring Notes
					N-Value	No.	Pen. /Rec. (in)	Depth (ft)	Blows Per 6"	
1	11		0.2 / 11.9	ASPHALT						Light brown, SAND, trace fine gravel and cobble. (Fill) Geosearch vacuum excavated 0-5' on previous date. Soil description from Roux Associates.
2	10									
3	9									
4	8									
5	7									
6	6									
7	5									
8	4									
9	3									
10	2		9.0 / 3.1	MARINE SAND	8	S1	24/10	5.0-7.0	1 5 3 6	Loose, brown, SAND, trace silt, w/ trace ash & cinders. (Fill) Loose, dark brown, SAND, some silt, w/ trace ash & cinders and wood. (Fill)
11	1									
12	0									
13	-1									
14	-2									
15	-3									
16	-4									
17	-5									
18	-6									
19	-7		17.0 / -4.9	MARINE CLAY	15	S3	24/12	9.0-11.0	6 5 10 20	Compact, light brown, SAND, trace silt. (Marine Sand) Dense, light brown, SAND, trace silt. (Marine Sand) Compact, brown, SAND, trace silt. (Marine Sand) Compact, brown, SAND, trace silt, trace gravel. (Marine Sand)
20	-8									
21	-9									
22	-10									
22	-10		21.0 / -8.9		6	S7	24/18	17.0-19.0	1 2 4 5	Firm, gray, SILTY CLAY. (Marine Clay) Firm, gray, SILTY CLAY. (Marine Clay)
					7	S8	24/12	19.0-21.0	3 4 3 4	
				Bottom of borehole 21 feet below ground surface.						

GRANULAR SOILS		SOIL COMPONENT	
BLOWS/FT.	DENSITY	DESCRIPTIVE TERM	PROPORTION OF TOTAL
0-4	V.LOOSE	"TRACE"	0-10%
4-10	LOOSE	"SOME"	10-20%
10-30	COMPACT	"ADJECTIVE" (eg SANDY, SILTY)	20-35%
30-50	DENSE	"AND"	35-50%
>50	V.DENSE		
COHESIVE SOILS		SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"	
BLOWS/FT.	CONSISTENCY	Notes:	
<2	V.SOFT	Casing advanced to a depth of 17 feet bgs. Weather: Sunny	
2-4	SOFT		
4-8	FIRM		
8-15	STIFF		
15-30	V.STIFF		
>30	HARD		

McPHAIL ASSOCIATES, LLC
 2269 MASSACHUSETTS AVENUE
 CAMBRIDGE, MA 02140
 TEL: 617-868-1420
 FAX: 617-868-1423

Page 1 of 1

Project: 1 Inner Belt Road Location: 1 Inner Belt Road City/State: Somerville, MA		Job #: 6469.2.00 Date Started: 10-19-17 Date Finished: 10-19-17		Boring No. <div style="font-size: 24pt; font-weight: bold;">RX-12</div>																									
Contractor: GeoSearch Driller/Helper: Rodney/Kenny Logged By/Reviewed By: K. Hanrahan Surface Elevation (ft): 8.7		Casing Type/Depth (ft): 3" Casing Hammer (lbs)/Drop (in): 140/30 Sampler Size/Type: Split Spoon Sampler Hammer (lbs)/Drop (in): 140/30		<table border="1"> <thead> <tr> <th colspan="4">Groundwater Observations</th> </tr> <tr> <th>Date</th> <th>Depth</th> <th>Elev.</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td>10-19-17</td> <td>9</td> <td>-0.3</td> <td></td> </tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>		Groundwater Observations				Date	Depth	Elev.	Notes	10-19-17	9	-0.3													
Groundwater Observations																													
Date	Depth	Elev.	Notes																										
10-19-17	9	-0.3																											

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample					Sample Description and Boring Notes
					N-Value	No.	Pen. /Rec. (in)	Depth (ft)	Blows Per 6"	
1	8		0.2 / 8.5	ASPHALT						Brown, SAND, some gravel, trace silt. (Fill) Geosearch vacuum excavated 0-5' on previous date. Soil description from Roux Associates.
2	7			n/a	VAC1	38/	0.2-3.4			
3	6									
4	5									
5	4									
6	3		7.0 / 1.7	ORGANIC SILT					3 2 1 WOH	Very loose, black, SAND and SILT, w/ trace ash & cinders, wood. (Fill) Very soft, dark brown, organic SILT with some organic fibers. (Organic Silt)
7	2		3		S1	24/14	5.0-7.0			
8	1		1		WOH	24/12	7.0-9.0			
9	0		1		WOH					
10	-1		2							
11	-2		9.0 / -0.3	MARINE SAND	14	S3	24/14	9.0-11.0	1 13 20	Compact, gray, SAND, trace silt. (Marine Sand) Dense, gray, SAND, trace silt, trace organics. (Marine Sand) Compact, gray, SAND, trace silt. (Marine Sand) Compact, gray, SAND, some gravel, trace silt, trace clay. (Marine Sand)
12	-3		40		S4	24/16	11.0-13.0	21 20 20 13		
13	-4									
14	-5		12		S5	24/14	13.0-15.0	4 6 6 8		
15	-6									
16	-7		16.5 / -7.8	MARINE CLAY	8	S6A	6/5	16.5-17.0	4 3 7	Firm, gray, SILTY CLAY. (Marine Clay) Firm, gray, SILTY CLAY. (Marine Clay) Firm, gray, SILTY CLAY. (Marine Clay)
17	-8									
18	-9		4		S7	24/8	17.0-19.0	2 1 3 5		
19	-10									
20	-11		5		S8	24/14	19.0-21.0	3 2 3 5		
21	-12		21.0 / -12.3							
22	-13			Bottom of borehole 21 feet below ground surface.						
	-14									

GRANULAR SOILS		SOIL COMPONENT	
BLOWS/FT.	DENSITY	DESCRIPTIVE TERM	PROPORTION OF TOTAL
0-4	V.LOOSE	"TRACE"	0-10%
4-10	LOOSE	"SOME"	10-20%
10-30	COMPACT	"ADJECTIVE" (eg SANDY, SILTY)	20-35%
30-50	DENSE	"AND"	35-50%
>50	V.DENSE		

COHESIVE SOILS		Notes:
BLOWS/FT.	CONSISTENCY	
<2	V.SOFT	Casing advanced to a depth of 21 feet bgs. Weather: Sunny
2-4	SOFT	
4-8	FIRM	
8-15	STIFF	
15-30	V.STIFF	
>30	HARD	

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

McPHAIL ASSOCIATES, LLC
 2269 MASSACHUSETTS AVENUE
 CAMBRIDGE, MA 02140
 TEL: 617-868-1420
 FAX: 617-868-1423

Page 1 of 1



APPENDIX C:
GEOPROBE LOGS PREPARED BY OTHERS



ROUX ASSOCIATES, INC.
Environmental Consulting
& Management

12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

WELL NO. RX-1	NORTHING Not Measured	EASTING Not Measured
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners		LOCATION Innerbelt Road
APPROVED BY E. Runstrom	LOGGED BY A. Hoffmann	Somerville, MA
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan		GEOGRAPHIC AREA NA
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler	BOREHOLE DIAMETER 2-inches	DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe
CASING MAT./DIA. PVC / 1-inch	SCREEN: TYPE Slotted	SAMPLING METHOD 2" Macro-Core
ELEVATION OF: (Feet)	GROUND SURFACE	START-FINISH DATE 10/16/17-10/17/17
TOP OF WELL CASING		SAND PACK SIZES #2
TOP & BOTTOM SCREEN /		
TOTAL LENGTH 10.0ft		
DIA. 1-inch		
SLOT SIZE 10-Slot		

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
9.5		ASPHALT.				
51.2		Dark brown fine to coarse SAND, some Silt, trace fine Gravel; brick fragments; moist (fill).				Pre-cleared to 5 feet bgs with vac truck and hand tools.
139		Dark brown fine to coarse SAND, little Silt, trace fine Gravel; moist (fill).				RX1 (2-3) sample collected during pre-clearing for laboratory analysis.
275		Dark brown fine to coarse SAND, little Silt, trace fine Gravel; ash; moist (fill).				
44.6		Dark brown fine to coarse SAND, little Silt and fine to medium Gravel; staining, petroleum odor; moist (fill).				
260		Dark brown coarse SAND and fine Gravel, some fine to medium Sand; moist.				3 feet of recovery.
						RX1 (7-9) sample collected for laboratory analysis.
10		Dark brown PEAT; moist.				
64.4						3 feet of recovery.
15		Grey fine to coarse SAND, trace Silt; moist.				
3.3						3 feet of recovery.
20						End of boring 20 feet bgs.



GROUND WATER LEVEL
10/18/2017



ROUX ASSOCIATES, INC.
Environmental Consulting
& Management

12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

WELL NO. RX-2	NORTHING Not Measured	EASTING Not Measured
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners		LOCATION Innerbelt Road
APPROVED BY E. Runstrom	LOGGED BY A. Hoffmann	Somerville, MA
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan		GEOGRAPHIC AREA NA
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler	BOREHOLE DIAMETER 2-inches	DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe
CASING MAT./DIA. PVC / 1-inch	SCREEN: TYPE Slotted	SAMPLING METHOD 2" Macro-Core
ELEVATION OF: (Feet)		START-FINISH DATE 10/16/17-10/17/17
GROUND SURFACE		SAND PACK SIZES #2
TOP OF WELL CASING		
TOP & BOTTOM SCREEN		
TOTAL LENGTH 10.0ft		
DIA. 1-inch		
SLOT SIZE 10-Slot		

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
		ASPHALT.				
		Dark brown fine to coarse SAND, some Silt, trace Gravel; moist (fill).			0.6	Pre-cleared to 5 feet bgs with vac truck and hand tools.
		Dark brown fine to coarse SAND, some Silt, trace Gravel; brick fragments; moist (fill).			16.4	
		Grey fine to medium SAND; staining, petroleum odor; moist.			240	
		Dark grey fine to medium SAND, trace fine Gravel; staining, petroleum odor; moist.			911	
5		Dark brown coarse SAND and fine to medium GRAVEL, little fine to medium Sand; very moist.			945	RX2 (4-5) sample collected during pre-clearing for laboratory analysis.
		Dark brown PEAT; moist.			567	3 feet recovery.
10		Gray medium to coarse SAND, little fine Sand; wet.			631	3 feet recovery.
					14.1	
15						End of boring 15 feet bgs.



ROUX ASSOCIATES, INC.
Environmental Consulting
& Management

12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

WELL NO. RX-3	NORTHING Not Measured	EASTING Not Measured
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners		LOCATION Innerbelt Road
APPROVED BY E. Runstrom	LOGGED BY A. Hoffmann	Somerville, MA
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan		GEOGRAPHIC AREA NA
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler	BOREHOLE DIAMETER 2-inches	DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe
CASING MAT./DIA. PVC / 1-inch	SCREEN: TYPE Slotted	SAMPLING METHOD 2" Macro-Core
ELEVATION OF: (Feet)	GROUND SURFACE	START-FINISH DATE 10/16/17-10/17/17
TOP OF WELL CASING		SAND PACK SIZES #2
TOP & BOTTOM SCREEN /		
TOTAL LENGTH 10.0ft		
DIA. 1-inch		
SLOT SIZE 10-Slot		

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
		ASPHALT.				
	Temporary well set to 20 feet bgs.	Dark brown fine to coarse SAND, some fine to medium Gravel, trace Silt; moist (fill).				Pre-cleared to 5 feet bgs with vac truck and hand tools.
		Dark brown fine to coarse SAND, some fine to medium Gravel, trace Silt; moist (fill).		G	0.4	RX3 (2-3) sample collected during pre-clearing for laboratory analysis.
		Dark brown fine to coarse (+) SAND, some fine Gravel, trace Silt; moist (fill).			0.4	
5		Brown fine to coarse SAND, some fine Gravel, trace Cobble; brick fragments; dry (fill).			2.2	
		Dark brown fine to coarse SAND, some fine to medium Gravel, trace Silt; very moist.			0.6	4 feet recovery.
		Dark brown PEAT; petroleum staining and odor; moist.			2.9	
10		Dark brown fine SAND and SILT, trace Clay and Peat; petroleum staining and odor; very moist to wet.			2.4	4 feet recovery.
		Gray medium SAND, some fine and coarse Sand; wet.			45.7	RX3 (12-15) sample collected for laboratory analysis.
15					5.3	4 feet recovery.
20						End of boring 20 feet bgs.



ROUX ASSOCIATES, INC.
Environmental Consulting
& Management

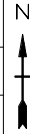
12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

SOIL BORING LOG



WELL NO. RX-4	NORTHING Not Measured	EASTING Not Measured
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners	LOCATION Innerbelt Road	
APPROVED BY E. Runstrom	LOGGED BY A. Hoffmann	Somerville, MA
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan	GEOGRAPHIC AREA NA	
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler	BOREHOLE DIAMETER 2-inches	DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe
LAND SURFACE ELEVATION Not Measured	DEPTH TO WATER Not Measured	BACKFILL Native
		SAMPLING METHOD 2" Macro-Core
		START-FINISH DATE 10/17/17-10/17/17

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
		ASPHALT.				
1		Brown fine SAND and Cobble; dry (fill).			0.2	Pre-cleared to 5 feet bgs with vac truck and hand tools.
2		Brown fine SAND and Cobble; brick fragments; dry (fill).			0.4	
3					0.4	RX4 (2-3) sample collected during pre-clearing for laboratory analysis.
4					0.4	
5					0.4	
6					0.4	
7					0.4	
8					0.4	

Refusal at 8 feet bgs.




12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

WELL NO. RX-5		NORTHING Not Measured		EASTING Not Measured		
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners				LOCATION Innerbelt Road		
APPROVED BY E. Runstrom		LOGGED BY A. Hoffmann		Somerville, MA		
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan				GEOGRAPHIC AREA NA		
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler		BOREHOLE DIAMETER 2-inches		DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe		
CASING MAT./DIA. PVC / 1-inch		SCREEN: TYPE Slotted		SAMPLING METHOD 2" Macro-Core		START-FINISH DATE 10/16/17-10/17/17
ELEVATION OF: (Feet)		GROUND SURFACE		TOP OF WELL CASING		TOTAL LENGTH 10.0ft
				TOP & BOTTOM SCREEN /		SAND PACK SIZES #2

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
0		ASPHALT. Dark brown fine to coarse SAND, little Silt; moist (fill).			0.4	Pre-cleared to 5 feet bgs with vac truck and hand tools.
5		Dark brown fine to coarse SAND, some Silt, trace Gravel, trace Cobble and wood fragments, trace brick fragments; moist (fill). Dark brown fine to coarse SAND, some Silt, trace Gravel; moist. Dark brown fine to coarse SAND, some Silt and fine to coarse Gravel; moist.		G	10.1 0.7 1.3 2.7	RX5 (2-3) sample collected during pre-clearing for laboratory analysis.
10		Dark brown SAND, some fine Gravel, trace fine to medium Sand; dry.			8.2	4 feet recovery.
15		Brown PEAT; moist.			5.6	5 feet recovery.
20		Gray fine to coarse SAND; wet.			10.1 10.4	5 feet recovery.
25		Gray fine SAND and SILT, little medium to coarse Sand; wet.				

GROUND WATER LEVEL
10/18/2017

Temporary well set to 20 feet bgs.

End of boring 20 feet bas.

End of boring 20 feet bgs.




12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

WELL NO. RX-6		NORTHING Not Measured		EASTING Not Measured		
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners				LOCATION Innerbelt Road		
APPROVED BY E. Runstrom		LOGGED BY A. Hoffmann		Somerville, MA		
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan				GEOGRAPHIC AREA NA		
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler		BOREHOLE DIAMETER 2-inches		DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe		
CASING MAT./DIA. PVC / 1-inch		SCREEN: TYPE Slotted		SAMPLING METHOD 2" Macro-Core		START-FINISH DATE 10/16/17-10/17/17
ELEVATION OF: (Feet)		GROUND SURFACE		TOP OF WELL CASING		TOTAL LENGTH 10.0ft
				TOP & BOTTOM SCREEN /		SAND PACK SIZES #2

[illegible]



ROUX ASSOCIATES, INC.
Environmental Consulting
& Management

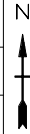
12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

SOIL BORING LOG



WELL NO. RX-7	NORTHING Not Measured	EASTING Not Measured
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners	LOCATION Innerbelt Road	
APPROVED BY E. Runstrom	LOGGED BY E. Runstrom	Somerville, MA
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan	GEOGRAPHIC AREA NA	
DRILL BIT DIAMETER/TYPE 2-in. / Auger	BOREHOLE DIAMETER 4-inches	DRILLING EQUIPMENT/METHOD CME- D27 / Drive and Wash
LAND SURFACE ELEVATION Not Measured	DEPTH TO WATER Not Measured	SAMPLING METHOD 2" Split Spoon
	BACKFILL Native	START-FINISH DATE 10/17/18-10/19/17

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
		ASPHALT.				
		Light brown fine to coarse SAND, trace fine Gravel and Cobble; dry (fill).				Pre-cleared to 5 feet bgs with vac truck and hand tools.
		Dark brown fine to coarse SAND, some fine to medium Gravel, trace Silt; dry (fill).			0.6	
		Dark brown coarse SAND, some fine Gravel, little fine to medium Sand; dry (fill).			1.6	RX7 (2-3) sample collected during pre-clearing for laboratory analysis.
					1.5	
					2.3	
5		Dark brown SAND, some fine Gravel; broken shells; dry (fill).	16		0.9	8 inches recovery.
			5			
			3			
			2			
		Dark brown SAND, little coarse Gravel; dry (fill).	3		2.2	1 inch recovery.
			2			
			1			
			1			
		Dark brown SAND, little coarse Gravel; glass fragments; wet (fill).	3		0.1	8 inches recovery.
10			1			
			2			
			8			
			11		0.1	10 inches recovery.
			12			
		Dark brown medium (+) to coarse SAND, trace fine Gravel; wet.	6			
			8			
		Brown fine to medium SAND, trace Gravel; wet.	6		ND	1 inch recovery.
			7			
			9			
15			10			
		Brown to gray fine to medium SAND, trace fine to medium Gravel; odor; dry.	13		2.1	10 inches recovery.
			10			
			9			
			9			
			9		0.1	1 foot recovery.
			10			
			8			
			10			
			4		0.1	1 foot recovery.
20			6			
			9			
			11			
			6		ND	1 foot recovery.
			4			
			4			
			5			
			1		ND	4 inches recovery.
			1			
			2			
25			2			

End of boring 25 feet bgs.




12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

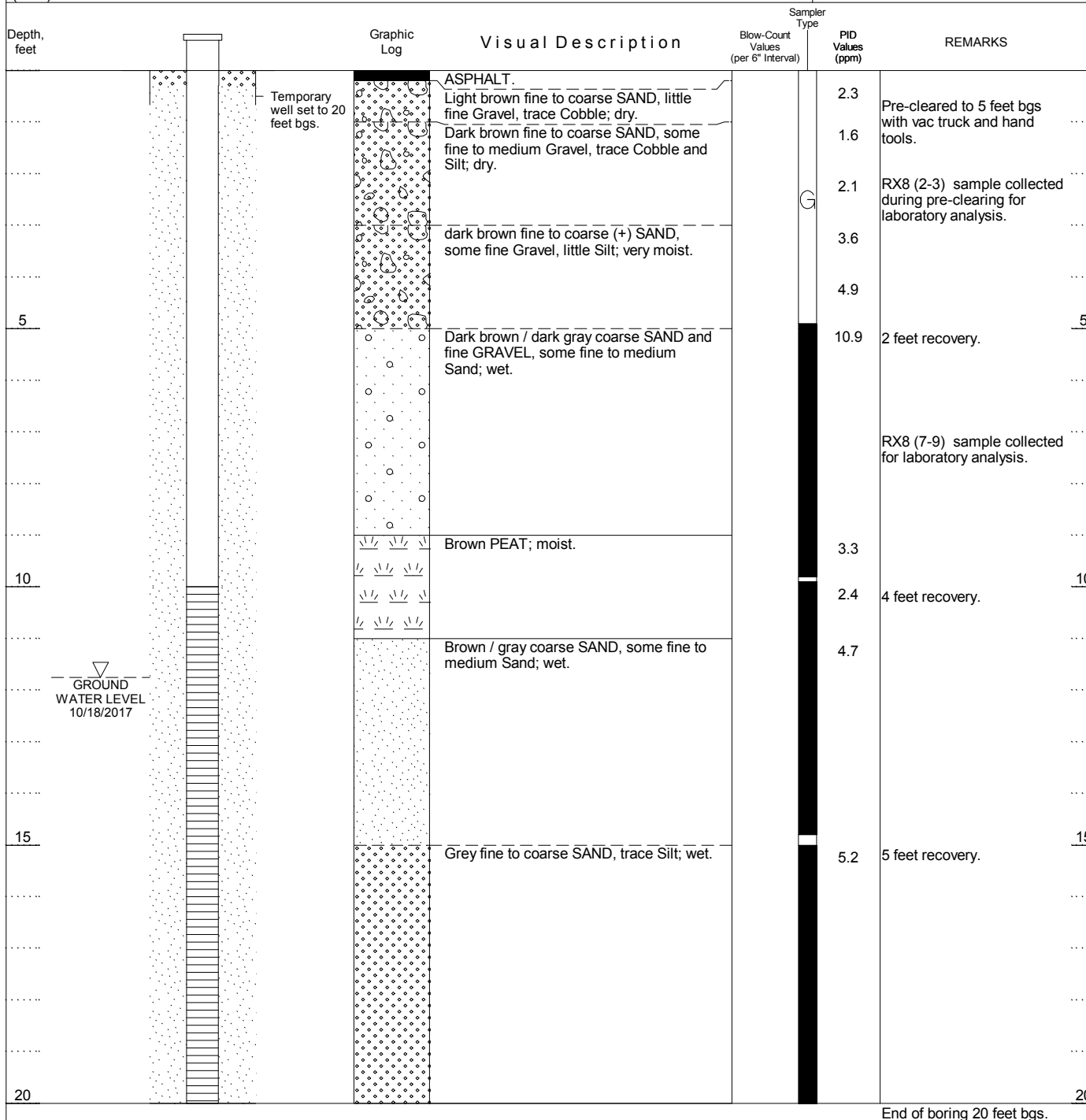
DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

WELL NO. RX-8		NORTHING Not Measured		EASTING Not Measured		
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners				LOCATION Innerbelt Road		
APPROVED BY E. Runstrom		LOGGED BY A. Hoffmann		Somerville, MA		
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan				GEOGRAPHIC AREA NA		
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler		BOREHOLE DIAMETER 2-inches		DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe		
CASING MAT./DIA. PVC / 1-inch		SCREEN: TYPE Slotted		SAMPLING METHOD 2" Macro-Core		START-FINISH DATE 10/17/18-10/17/17
ELEVATION OF: (Feet)		GROUND SURFACE		TOP OF WELL CASING		SAND PACK SIZES #2
				TOTAL LENGTH 10.0ft TOP & BOTTOM SCREEN /		



End of boring 20 feet bgs.



ROUX ASSOCIATES, INC.
Environmental Consulting
& Management

12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

SOIL BORING LOG



WELL NO. RX-9	NORTHING Not Measured	EASTING Not Measured
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners	LOCATION Innerbelt Road	
APPROVED BY E. Runstrom	LOGGED BY E. Runstrom	Somerville, MA
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan	GEOGRAPHIC AREA NA	
DRILL BIT DIAMETER/TYPE 2-in. / Auger	BOREHOLE DIAMETER 4-inches	DRILLING EQUIPMENT/METHOD CME- D27 / Drive and Wash
LAND SURFACE ELEVATION Not Measured	DEPTH TO WATER Not Measured	SAMPLING METHOD 2" Split Spoon
		START-FINISH DATE 10/16/17-10/19/17
		BACKFILL Native

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
		ASPHALT.				
		Light brown fine to coarse SAND, trace fine Gravel and Cobble; moist (fill).			1.1	Pre-cleared to 5 feet bgs with vac truck and hand tools.
		Dark brown fine to coarse SAND, trace fine Gravel, trace Cobble and brick fragments; moist (fill).			1.6	
		Dark brown fine to coarse SAND, trace fine Gravel, trace Cobble, trace Silt, brick fragments; moist (fill).			1.1	RX9 (2-3) sample collected during pre-clearing for laboratory analysis.
		Dark brown fine to coarse SAND, little fine Gravel and Silt; moist.			1.1	
		Dark brown fine to coarse SAND, little fine Gravel and Silt; very moist.			0.8	
5		Dark gray fine to coarse SAND, some fine Gravel; 4 inch seam of gray Silty Clay and wood fragments; dry.	1		0.4	10 inch recovery.
			5			
			3			
		Dark gray fine to coarse SAND, some fine Gravel; moist.	6		0.5	3 feet recovery.
			6			
			3			
			4			
		Brown medium (+) to coarse SAND; wet.	6		0.1	1 foot recovery.
10			5			
			10			
			20			
			18		ND	1.2 feet recovery.
			19			
			21			
			21			
			8		ND	1 foot recovery.
			10			
			10			
15			12			
			11		0.3	1.2 feet recovery.
			10			
			13			
			8			
		Gray Silty CLAY; wet.	1		ND	1.5 feet recovery.
			2			
			4			
			5			
			3		ND	2 feet recovery.
			4			
20			3			
			4			

End of boring 21 feet bgs.




12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

WELL NO. RX-10		NORTHING Not Measured		EASTING Not Measured		
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners				LOCATION Innerbelt Road		
APPROVED BY E. Runstrom		LOGGED BY A. Hoffmann		Somerville, MA		
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan				GEOGRAPHIC AREA NA		
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler		BOREHOLE DIAMETER 2-inches		DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe		
CASING MAT./DIA. PVC / 1-inch		SCREEN: TYPE Slotted		SAMPLING METHOD 2" Macro-Core		START-FINISH DATE 10/16/17-10/17/17
ELEVATION OF: (Feet)		GROUND SURFACE		TOP OF WELL CASING		SAND PACK SIZES #2
				TOTAL LENGTH 10.0ft TOP & BOTTOM SCREEN /		

[illegible]

End of boring 20 feet bgs.




12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

WELL NO. RX-11		NORTHING Not Measured		EASTING Not Measured		
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners				LOCATION Innerbelt Road		
APPROVED BY E. Runstrom		LOGGED BY A. Hoffmann		Somerville, MA		
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan				GEOGRAPHIC AREA NA		
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler		BOREHOLE DIAMETER 2-inches		DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe		SAMPLING METHOD 2" Macro-Core
CASING MAT./DIA. PVC / 1-inch		SCREEN: TYPE Slotted		MAT. PVC		START-FINISH DATE 10/17/17-10/17/17
ELEVATION OF: (Feet)		GROUND SURFACE		TOP OF WELL CASING		TOTAL LENGTH 10.0ft
				TOP & BOTTOM SCREEN		DIA. 1-inch
						SLOT SIZE 10-Slot
						SAND PACK SIZES #2

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
0		ASPHALT.				
1.0		Brown fine to coarse SAND, some fine Gravel, trace Silt; dry.			1.0	Pre-cleared to 5 feet bgs with vac truck and hand tools.
2.7					2.7	
4.6		Brown fine to coarse (+) SAND, some fine Gravel, trace fine; moist.		G	4.6	RX11 (2-3) sample collected during pre-clearing for laboratory analysis.
3.2					3.2	
3.3					3.3	
3.9		Dark brown fine to coarse SAND, some fine Gravel, trace Silt; moist.			3.9	3 feet recovery. RX11 (5-7) sample collected for laboratory analysis.
5.4		Brown PEAT; shells; moist.			5.4	
10		Gray fine to coarse SAND; wet.			2.3	5 feet recovery.
15		Gray fine to coarse SAND, some Silt; wet.			4.9	




12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

WELL LOCATION SKETCH MAP

Page 1 of 1

SOIL BORING LOG



WELL NO. RX-12		NORTHING Not Measured		EASTING Not Measured		
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners				LOCATION Innerbelt Road		
APPROVED BY E. Runstrom		LOGGED BY E. Runstrom		Somerville, MA		
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan				GEOGRAPHIC AREA NA		
DRILL BIT DIAMETER/TYPE 2-in. / Auger		BOREHOLE DIAMETER 4-inches		DRILLING EQUIPMENT/METHOD CME- D27 / Drive and Wash		
LAND SURFACE ELEVATION Not Measured		DEPTH TO WATER Not Measured		SAMPLING METHOD 2" Split Spoon		START-FINISH DATE 10/17/17-10/19/17
		BACKFILL Native				

Depth, feet	Graphic Log	Visual Description	Sampler		REMARKS
			Blow-Count Values (per 6" Interval)	Type PID Values (ppm)	
5		Brown fine to coarse SAND, some fine Gravel, trace Silt; dry (fill).		G	Pre-cleared to 5 feet bgs with vac truck and hand tools.
		Dark brown fine to coarse SAND, trace Silt; wood fragments; dry (fill).	3 2 1 WH	2.1	14 inches recovery.
		Clayey SILT, trace Peat; wood fragments; dry.	1 WH WH WH	1.7	1 foot recovery.
10		Gray fine to medium SAND, trace fine Gravel; wet.	2 1 13 20 12 20 20 13 12 6 6 8 4 3 7 4 2 1 3 5 3 2 3 5	4.2 2.7 5.7 0.2 ND ND	14 inches recovery. 16 inches recovery. 14 inches recovery. 2 feet recovery. 8 inches recovery. 14 feet recovery.
15		Clayey SILT; dry.			
		2 inch seam gray fine to medium SAND with trace fine Gravel.			
		Clayey SILT; dry.			
		Gray Clayey SILT; dry.			
20		Clayey SILT; dry.			

End of boring 21 feet bgs.



ROUX ASSOCIATES, INC.
Environmental Consulting
& Management

12 Gill Street
Suite 4700
Woburn, MA 01801
Telephone: (781) 569-4000
Fax: (781) 569-4001

DRAFT

WELL LOCATION SKETCH MAP

Page 1 of 1

WELL CONSTRUCTION LOG

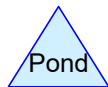
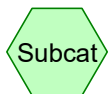
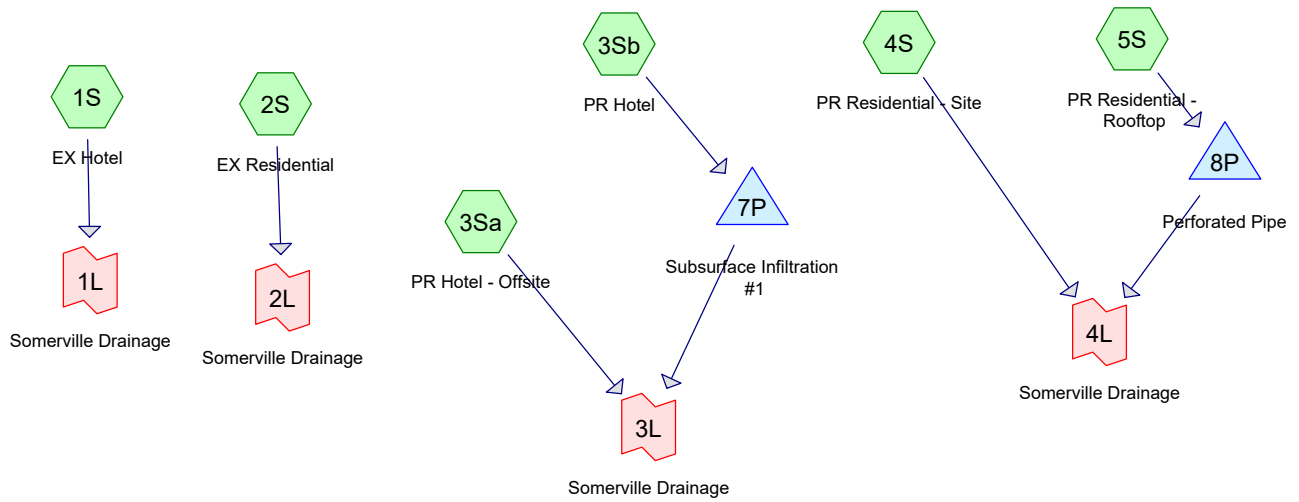
WELL NO. RX-13	NORTHING Not Measured	EASTING Not Measured
PROJECT NO./NAME 2761.0003M000 / Criterion Dev. Partners		LOCATION Innerbelt Road
APPROVED BY E. Runstrom	LOGGED BY A. Hoffmann	Somerville, MA
DRILLING CONTRACTOR/DRILLER Geosearch / Pat McClenahan		GEOGRAPHIC AREA NA
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler	BOREHOLE DIAMETER 2-inches	DRILLING EQUIPMENT/METHOD 6712 DT / Geoprobe
CASING MAT./DIA. PVC / 1-inch	SCREEN: TYPE Slotted	SAMPLING METHOD 2" Macro-Core
ELEVATION OF: (Feet)	GROUND SURFACE	START-FINISH DATE 10/17/17-10/17/17
TOP OF WELL CASING		SAND PACK SIZES #2
TOTAL LENGTH 10.0ft		
DIA. 1-inch		
SLOT SIZE 10-Slot		
TOP & BOTTOM SCREEN /		

Depth, feet	Graphic Log	Visual Description	Blow-Count Values (per 6" Interval)	Sampler Type	PID Values (ppm)	REMARKS
		ASPHALT.				
		Light brown fine to medium SAND, trace fine Gravel and Cobble; dry.			0.1	Pre-cleared to 5 feet bgs with vac truck and hand tools.
					0.2	
		Dark brown fine to coarse SAND, little Gravel, trace Cobble; moist.			0.1	RX13 (2-3) sample collected during pre-clearing for laboratory analysis.
		Dark brown fine to coarse SAND and fine to medium GRAVEL; moist.			0.3	
		Dark brown coarse SAND, little fine to medium Sand and fine Gravel; moist.				
5		Dark brown coarse SAND, some fine Gravel, trace fine to medium Sand; dry.			0.6	3 feet recovery.
						RX13 (6-8) sample collected for laboratory analysis.
		Brown PEAT; moist.				
10					1.6	5 feet recovery.
		Gray fine to coarse SAND, trace Silt; wet.				
15						
		Advanced boring 15 - 20 feet bgs for well screen installation and subsequent sampling. No sample collected.				
20						

End of boring 20 feet bgs.

Appendix C

- Existing & Proposed HydroCAD Report



Routing Diagram for 13788.00_EX vs PR

Prepared by VHB, Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Printed 10/10/2018

Page 2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.189	89	<50% Grass cover, Poor, HSG D (1S, 2S)
0.011	74	>75% Grass cover, Good, HSG C (3Sb)
0.124	98	Parking, sidewalks, pavers, walls, etc (3Sb)
0.498	98	Paved parking (1S, 3Sa)
1.147	98	Paved parking, conc (2S)
0.122	98	Roof - City Club (2S)
0.310	98	Roof - Hotel (3Sb)
0.186	98	Roof - Paradigm (2S)
1.405	98	Roofs (5S)
0.184	98	Unconnected pavement (4S)
4.175	98	TOTAL AREA

13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Printed 10/10/2018

Page 3

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.011	HSG C	3Sb
0.189	HSG D	1S, 2S
3.975	Other	1S, 2S, 3Sa, 3Sb, 4S, 5S
4.175		TOTAL AREA

13788.00_EX vs PR

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 4

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.189	0.000	0.189	<50% Grass cover, Poor	
0.000	0.000	0.011	0.000	0.000	0.011	>75% Grass cover, Good	
0.000	0.000	0.000	0.000	0.124	0.124	Parking, sidewalks, pavers, walls, etc	
0.000	0.000	0.000	0.000	0.498	0.498	Paved parking	
0.000	0.000	0.000	0.000	1.147	1.147	Paved parking, conc	
0.000	0.000	0.000	0.000	0.122	0.122	Roof - City Club	
0.000	0.000	0.000	0.000	0.310	0.310	Roof - Hotel	
0.000	0.000	0.000	0.000	0.186	0.186	Roof - Paradigm	
0.000	0.000	0.000	0.000	1.405	1.405	Roofs	
0.000	0.000	0.000	0.000	0.184	0.184	Unconnected pavement	
0.000	0.000	0.011	0.189	3.975	4.175	TOTAL AREA	

13788.00_EX vs PR

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 5

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1S	0.00	0.00	91.0	0.0789	0.011	8.0	0.0	0.0
2	1S	0.00	0.00	82.0	0.0066	0.011	8.0	0.0	0.0
3	1S	0.00	0.00	37.0	0.0195	0.011	8.0	0.0	0.0
4	2S	0.00	0.00	134.0	0.0167	0.011	8.0	0.0	0.0
5	2S	0.00	0.00	20.0	0.0366	0.011	8.0	0.0	0.0
6	3Sb	0.00	0.00	18.0	0.0150	0.015	12.0	0.0	0.0
7	8P	2.00	1.97	2.0	0.0150	0.013	24.0	0.0	0.0

13788.00_EX vs PR*Type III 24-hr 1-YR(24HR) Rainfall=2.63"*

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 6

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Hotel	Runoff Area=21,734 sf 88.71% Impervious Runoff Depth=2.29" Flow Length=261' Tc=6.0 min CN=97 Runoff=1.24 cfs 0.095 af
Subcatchment2S: EX Residential	Runoff Area=69,198 sf 91.63% Impervious Runoff Depth=2.29" Flow Length=233' Tc=6.0 min CN=97 Runoff=3.95 cfs 0.303 af
Subcatchment3Sa: PR Hotel - Offsite	Runoff Area=2,394 sf 100.00% Impervious Runoff Depth=2.40" Tc=6.0 min CN=98 Runoff=0.14 cfs 0.011 af
Subcatchment3Sb: PR Hotel	Runoff Area=19,340 sf 97.63% Impervious Runoff Depth=2.29" Flow Length=140' Tc=6.0 min CN=97 Runoff=1.10 cfs 0.085 af
Subcatchment4S: PR Residential - Site	Runoff Area=8,001 sf 100.00% Impervious Runoff Depth=2.40" Flow Length=60' Slope=0.0210 '/' Tc=6.0 min CN=98 Runoff=0.47 cfs 0.037 af
Subcatchment5S: PR Residential -	Runoff Area=61,197 sf 100.00% Impervious Runoff Depth=2.40" Tc=6.0 min CN=98 Runoff=3.57 cfs 0.281 af
Pond 7P: Subsurface Infiltration #1	Peak Elev=8.63' Storage=0.024 af Inflow=1.10 cfs 0.085 af Outflow=1.11 cfs 0.063 af
Pond 8P: Perforated Pipe	Peak Elev=8.41' Storage=2,512 cf Inflow=3.57 cfs 0.281 af Discarded=0.08 cfs 0.155 af Primary=3.44 cfs 0.126 af Outflow=3.52 cfs 0.281 af
Link 1L: Somerville Drainage	Inflow=1.24 cfs 0.095 af Primary=1.24 cfs 0.095 af
Link 2L: Somerville Drainage	Inflow=3.95 cfs 0.303 af Primary=3.95 cfs 0.303 af
Link 3L: Somerville Drainage	Inflow=1.25 cfs 0.074 af Primary=1.25 cfs 0.074 af
Link 4L: Somerville Drainage	Inflow=3.90 cfs 0.163 af Primary=3.90 cfs 0.163 af

Total Runoff Area = 4.175 ac Runoff Volume = 0.812 af Average Runoff Depth = 2.33"
4.79% Pervious = 0.200 ac 95.21% Impervious = 3.975 ac

13788.00_EX vs PR

Type III 24-hr 1-YR(24HR) Rainfall=2.63"

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 7

Summary for Subcatchment 1S: EX Hotel

Runoff = 1.24 cfs @ 12.08 hrs, Volume= 0.095 af, Depth= 2.29"

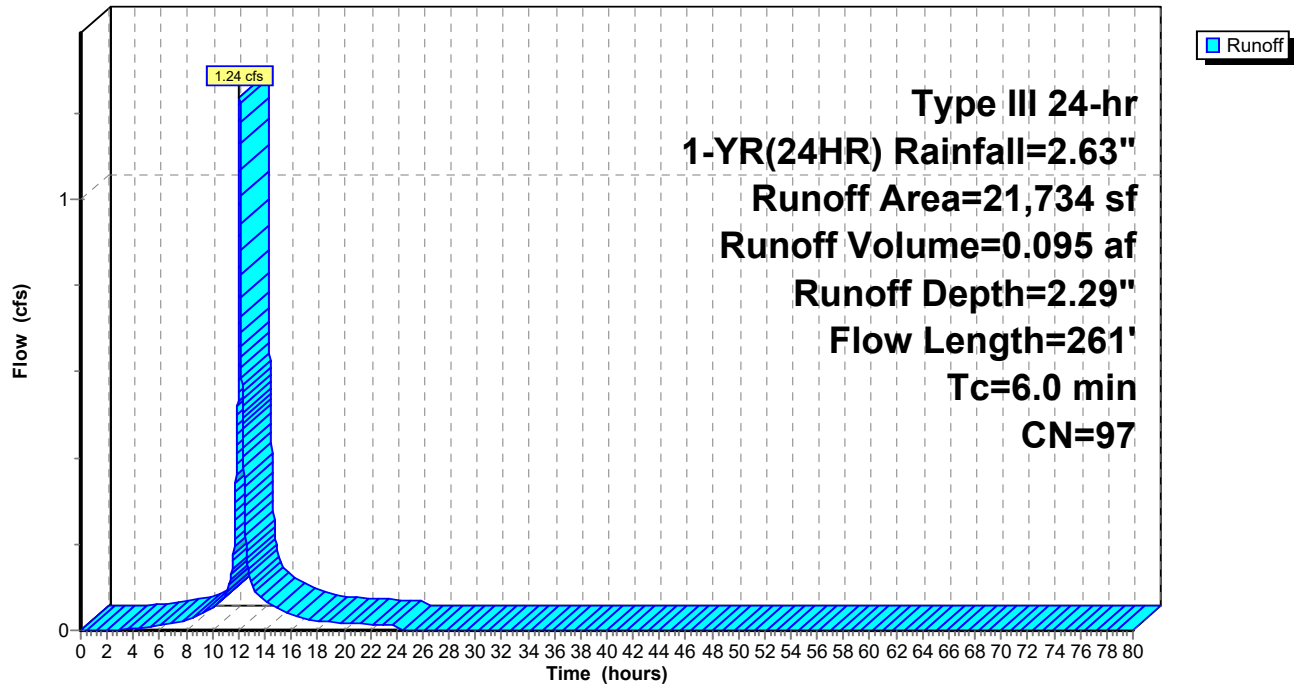
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR(24HR) Rainfall=2.63"

	Area (sf)	CN	Description
*	19,281	98	Paved parking
	2,453	89	<50% Grass cover, Poor, HSG D
	21,734	97	Weighted Average
	2,453		11.29% Pervious Area
	19,281		88.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	4	0.1262	0.45		Sheet Flow, Fallow n= 0.050 P2= 3.19"
0.8	46	0.0120	0.96		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.0	1	0.0125	2.27		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	91	0.0789	11.49	4.01	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.4	82	0.0066	3.32	1.16	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.1	37	0.0195	5.71	1.99	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
1.5	261	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: EX Hotel

Hydrograph



13788.00_EX vs PR

Type III 24-hr 1-YR(24HR) Rainfall=2.63"

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 9

Summary for Subcatchment 2S: EX Residential

Runoff = 3.95 cfs @ 12.08 hrs, Volume= 0.303 af, Depth= 2.29"

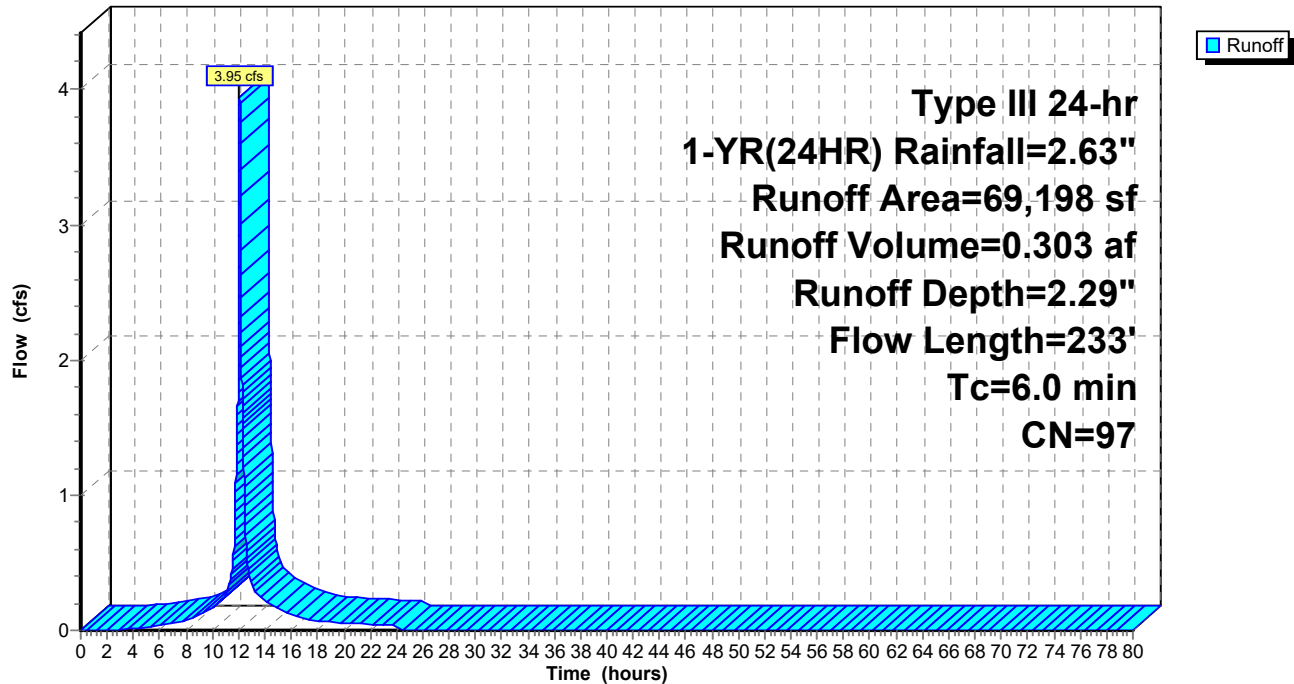
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR(24HR) Rainfall=2.63"

	Area (sf)	CN	Description
*	5,325	98	Roof - City Club
*	8,096	98	Roof - Paradigm
	5,794	89	<50% Grass cover, Poor, HSG D
*	49,983	98	Paved parking, conc
	69,198	97	Weighted Average
	5,794		8.37% Pervious Area
	63,404		91.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0044	0.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
1.6	20	0.0800	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.19"
0.6	20	0.0040	0.52		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.2	30	0.0234	3.11		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	134	0.0167	5.29	1.85	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
0.0	20	0.0366	7.83	2.73	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
3.1	233	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: EX Residential

Hydrograph



Summary for Subcatchment 3Sa: PR Hotel - Offsite

Runoff = 0.14 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 2.40"

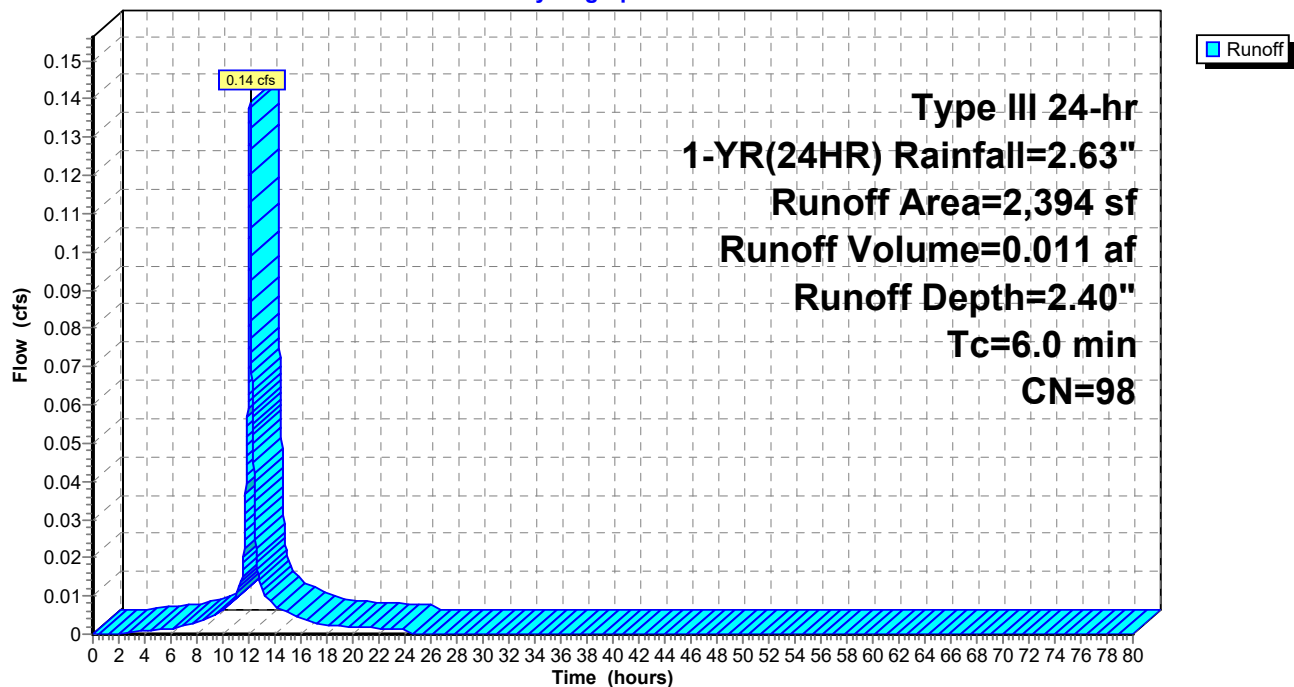
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR(24HR) Rainfall=2.63"

	Area (sf)	CN	Description
*	2,394	98	Paved parking
	2,394		100.00% Impervious Area

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

Subcatchment 3Sa: PR Hotel - Offsite

Hydrograph



Summary for Subcatchment 3Sb: PR Hotel

Runoff = 1.10 cfs @ 12.08 hrs, Volume= 0.085 af, Depth= 2.29"

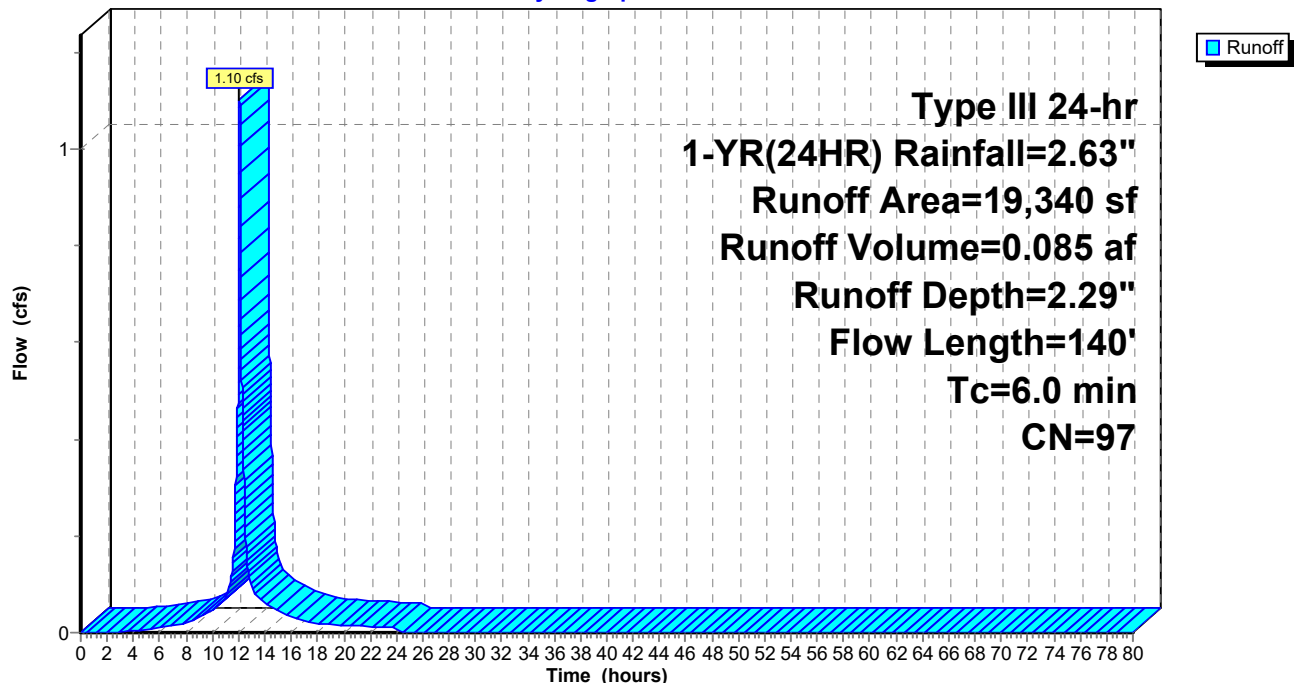
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR(24HR) Rainfall=2.63"

	Area (sf)	CN	Description
*	13,484	98	Roof - Hotel
*	5,398	98	Parking, sidewalks, pavers, walls, etc
	458	74	>75% Grass cover, Good, HSG C
	19,340	97	Weighted Average
	458		2.37% Pervious Area
	18,882		97.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0150	1.07		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.4	72	0.0233	3.10		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	18	0.0150	4.82	3.78	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Corrugated PE, smooth interior
1.3	140	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3Sb: PR Hotel

Hydrograph



Summary for Subcatchment 4S: PR Residential - Site

Runoff = 0.47 cfs @ 12.08 hrs, Volume= 0.037 af, Depth= 2.40"

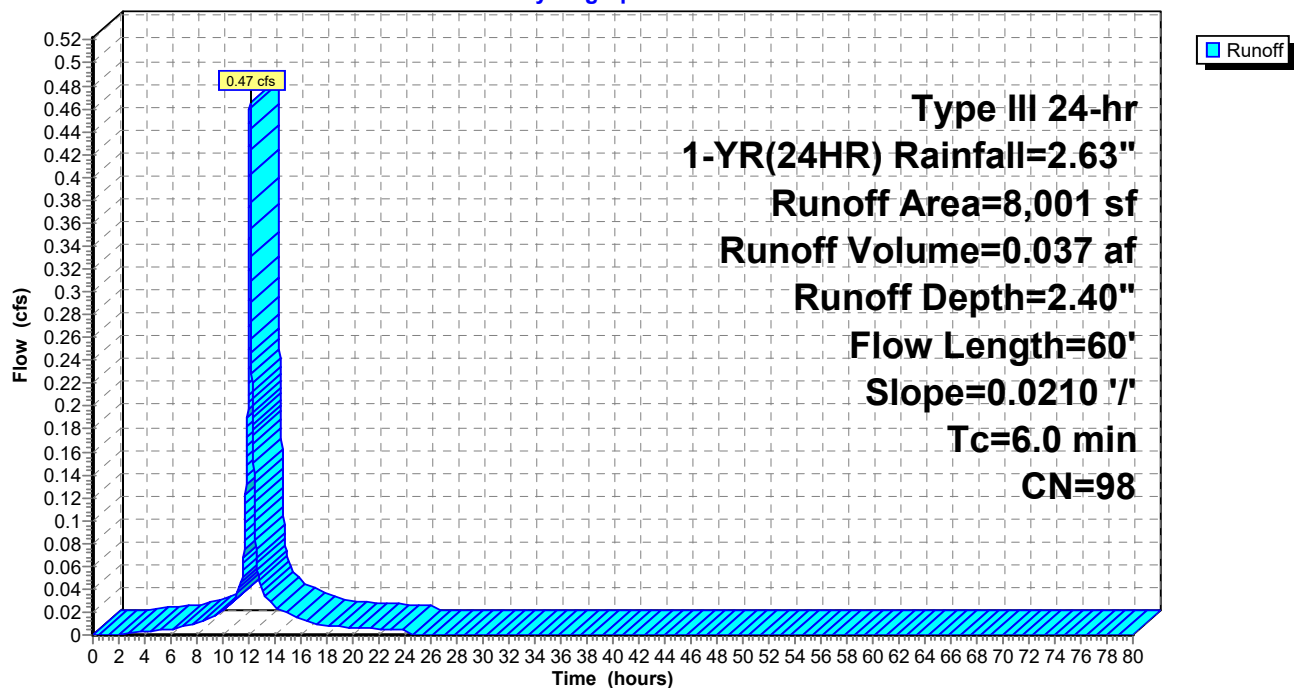
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR(24HR) Rainfall=2.63"

Area (sf)	CN	Description
* 8,001	98	Unconnected pavement
8,001		100.00% Impervious Area
8,001		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0210	1.22		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.1	10	0.0210	2.94		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.8	60	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: PR Residential - Site

Hydrograph



Summary for Subcatchment 5S: PR Residential - Rooftop

Runoff = 3.57 cfs @ 12.08 hrs, Volume= 0.281 af, Depth= 2.40"

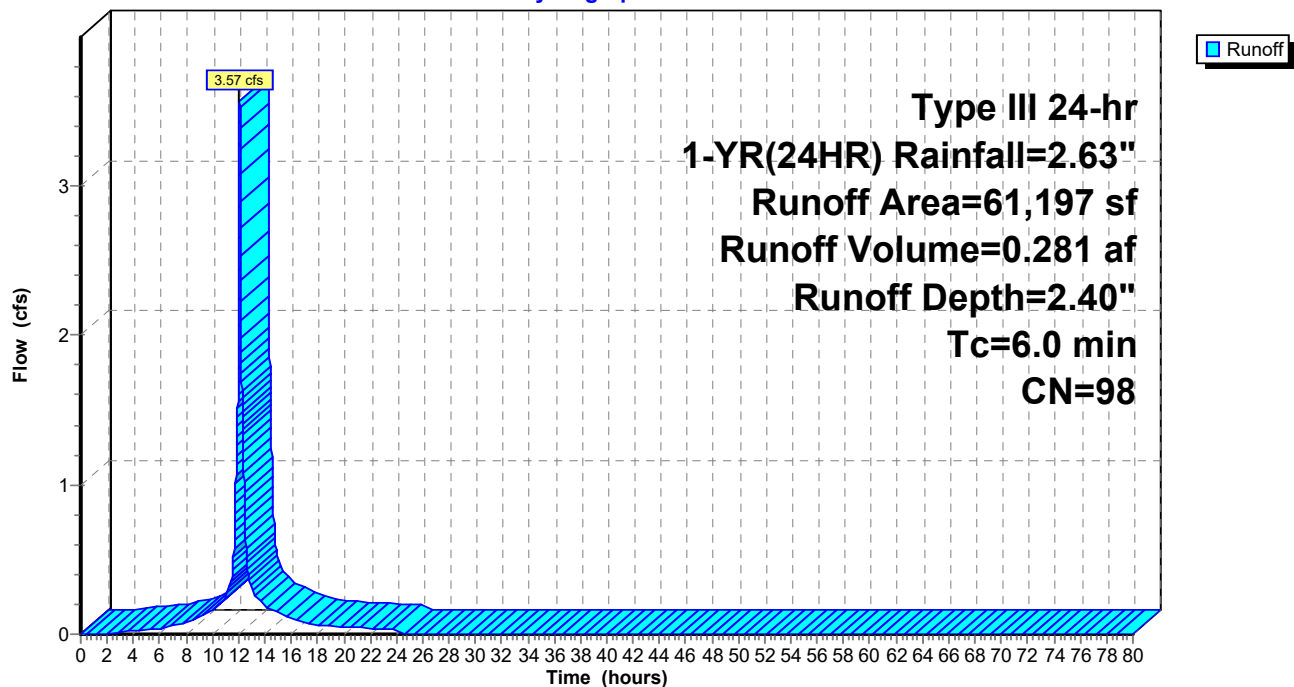
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-YR(24HR) Rainfall=2.63"

Area (sf)	CN	Description
* 61,197	98	Roofs
61,197		100.00% Impervious Area

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

Subcatchment 5S: PR Residential - Rooftop

Hydrograph



Summary for Pond 7P: Subsurface Infiltration #1

[93] Warning: Storage range exceeded by 0.03'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.444 ac, 97.63% Impervious, Inflow Depth = 2.29" for 1-YR(24HR) event
 Inflow = 1.10 cfs @ 12.08 hrs, Volume= 0.085 af
 Outflow = 1.11 cfs @ 12.09 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.3 min
 Primary = 1.11 cfs @ 12.09 hrs, Volume= 0.063 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.63' @ 12.09 hrs Surf.Area= 0.012 ac Storage= 0.024 af

Plug-Flow detention time= 153.9 min calculated for 0.063 af (74% of inflow)
 Center-of-Mass det. time= 67.5 min (838.7 - 771.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.10'	0.011 af	15.75'W x 32.10'L x 3.50'H Field A 0.041 af Overall - 0.013 af Embedded = 0.028 af x 40.0% Voids
#2A	5.60'	0.013 af	ADS_StormTech SC-740 +Cap x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 4 Chambers
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.20'	24.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.10 cfs @ 12.09 hrs HW=8.63' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 1.10 cfs @ 2.23 fps)

Pond 7P: Subsurface Infiltration #1 - Chamber Wizard Field A**Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

4 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 30.10' Row Length +12.0" End Stone x 2 = 32.10' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

12 Chambers x 45.9 cf = 551.3 cf Chamber Storage

1,769.3 cf Field - 551.3 cf Chambers = 1,218.0 cf Stone x 40.0% Voids = 487.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,038.5 cf = 0.024 af

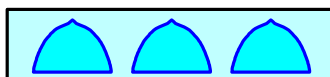
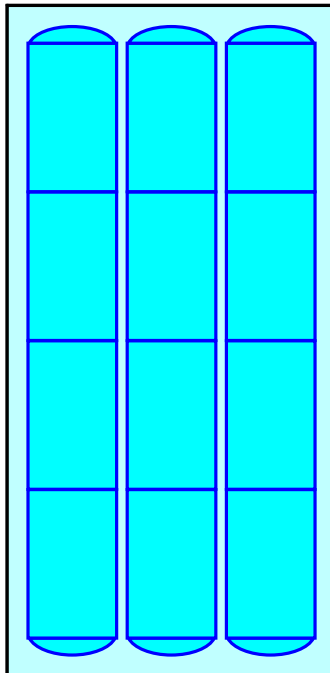
Overall Storage Efficiency = 58.7%

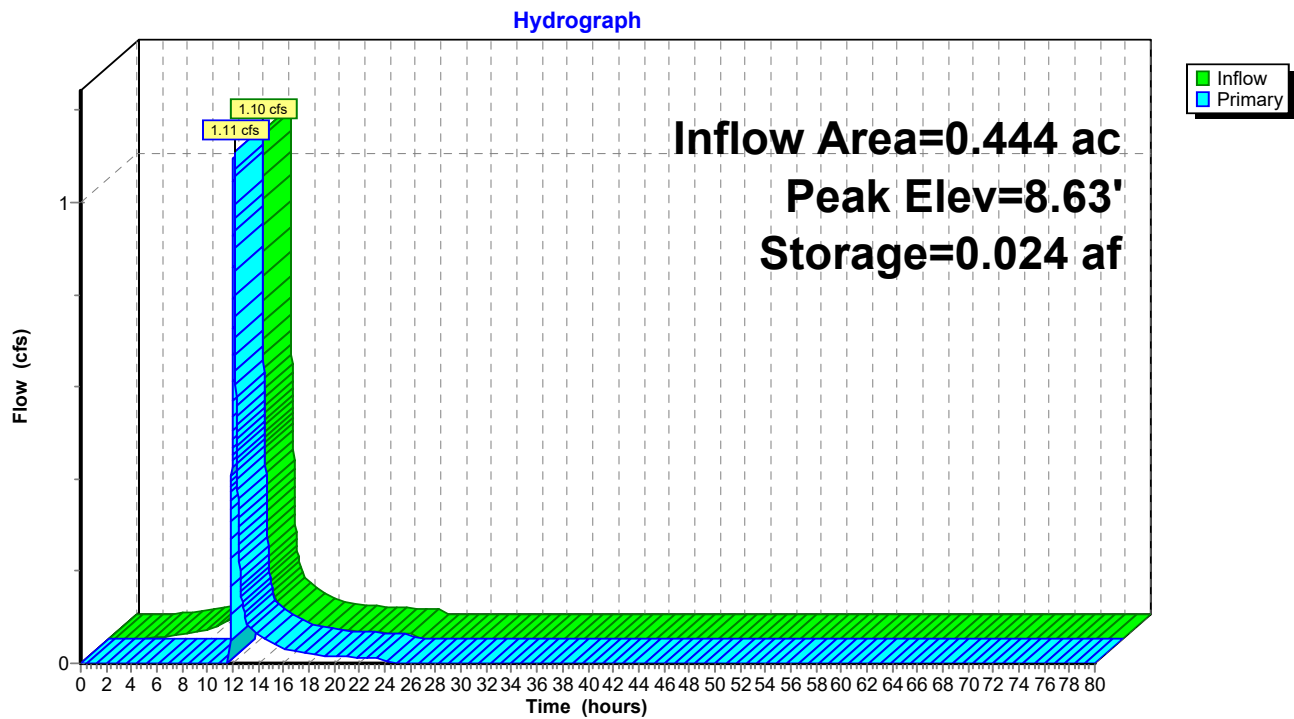
Overall System Size = 32.10' x 15.75' x 3.50'

12 Chambers

65.5 cy Field

45.1 cy Stone



Pond 7P: Subsurface Infiltration #1

Summary for Pond 8P: Perforated Pipe

Inflow Area = 1.405 ac, 100.00% Impervious, Inflow Depth = 2.40" for 1-YR(24HR) event
 Inflow = 3.57 cfs @ 12.08 hrs, Volume= 0.281 af
 Outflow = 3.52 cfs @ 12.10 hrs, Volume= 0.281 af, Atten= 1%, Lag= 0.8 min
 Discarded = 0.08 cfs @ 8.29 hrs, Volume= 0.155 af
 Primary = 3.44 cfs @ 12.10 hrs, Volume= 0.126 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.41' @ 12.10 hrs Surf.Area= 1,440 sf Storage= 2,512 cf

Plug-Flow detention time= 152.5 min calculated for 0.281 af (100% of inflow)
 Center-of-Mass det. time= 152.6 min (913.3 - 760.7)

Volume	Invert	Avail.Storage	Storage Description
#1	6.10'	1,005 cf	24.0" Round Pipe Storage Inside #2 L= 320.0'
#2	5.10'	2,190 cf	4.50'W x 320.00'L x 4.50'H Stone 6,480 cf Overall - 1,005 cf Embedded = 5,475 cf x 40.0% Voids
		3,195 cf	Total Available Storage

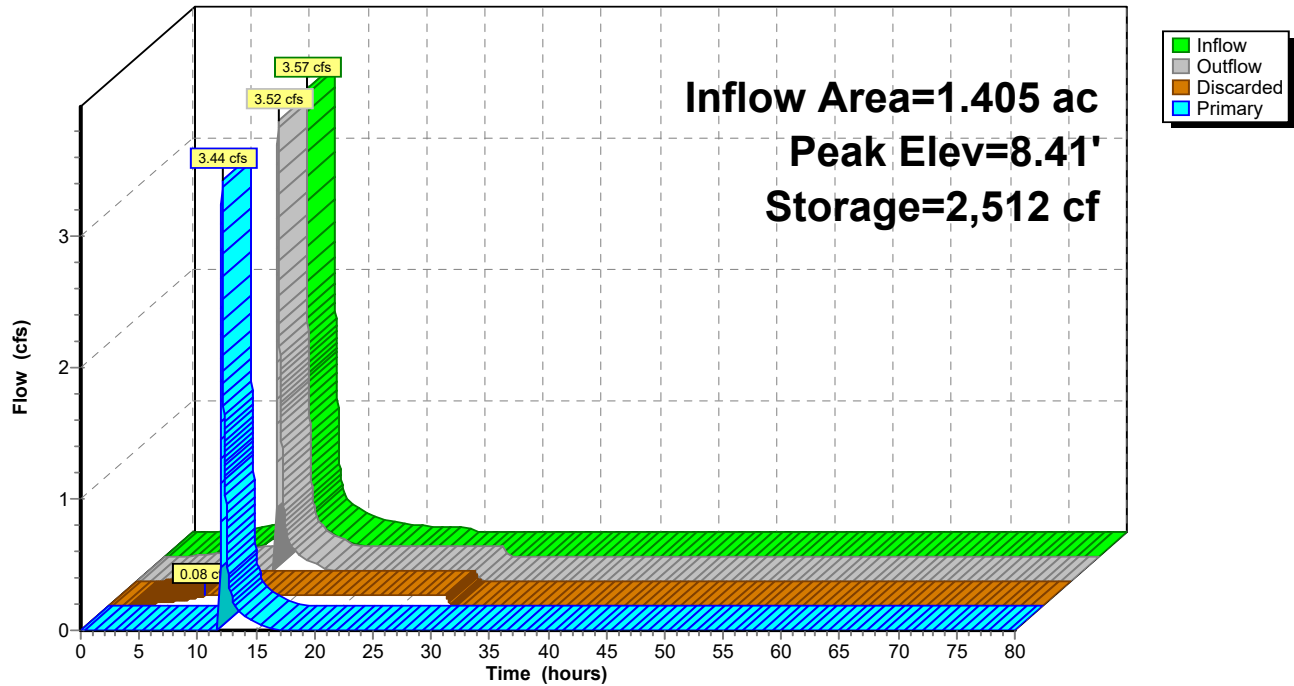
Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	24.0" Round Culvert L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.97' S= 0.0150 ' / Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	8.00'	4.0' long x 5.60' rise Sharp-Crested Rectangular Weir 2 End Contraction(s) 6.0' Crest Height
#3	Discarded	5.10'	2.400 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 8.29 hrs HW=5.19' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=3.43 cfs @ 12.10 hrs HW=8.41' (Free Discharge)
 ↑ **1=Culvert** (Passes 3.43 cfs of 35.19 cfs potential flow)
 ↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 3.43 cfs @ 2.12 fps)

Pond 8P: Perforated Pipe

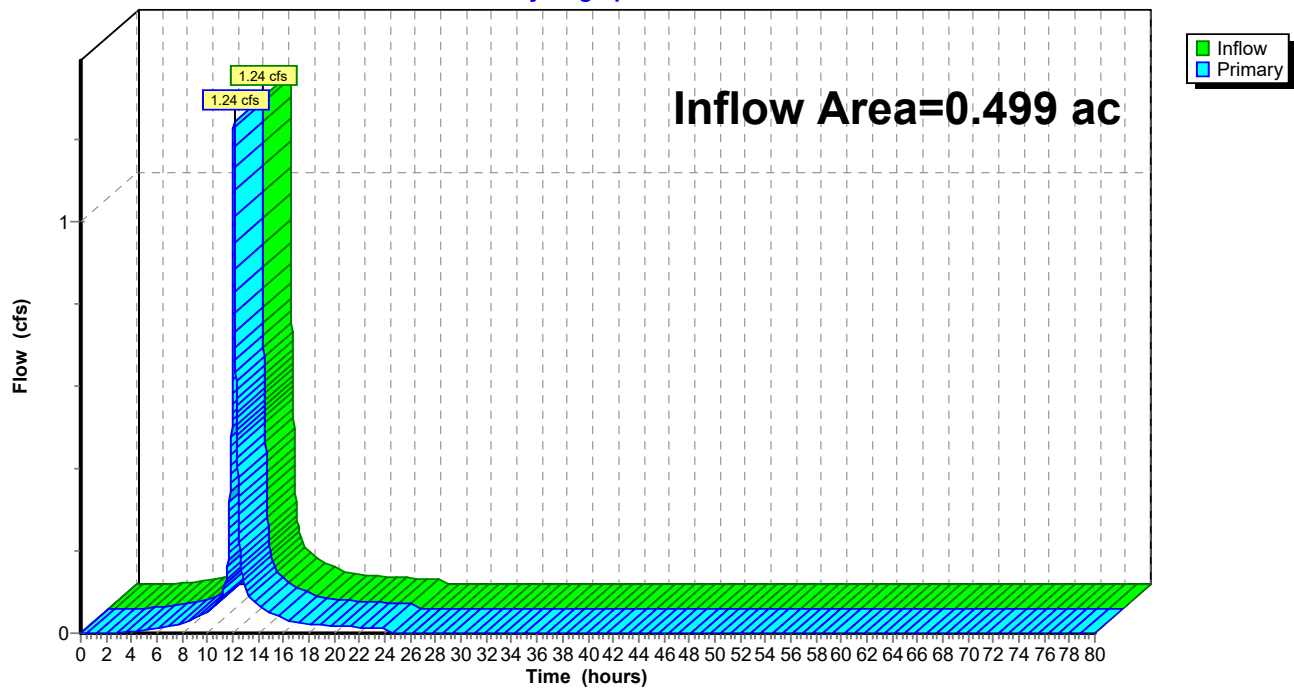
Hydrograph



Summary for Link 1L: Somerville Drainage

Inflow Area = 0.499 ac, 88.71% Impervious, Inflow Depth = 2.29" for 1-YR(24HR) event
Inflow = 1.24 cfs @ 12.08 hrs, Volume= 0.095 af
Primary = 1.24 cfs @ 12.08 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min

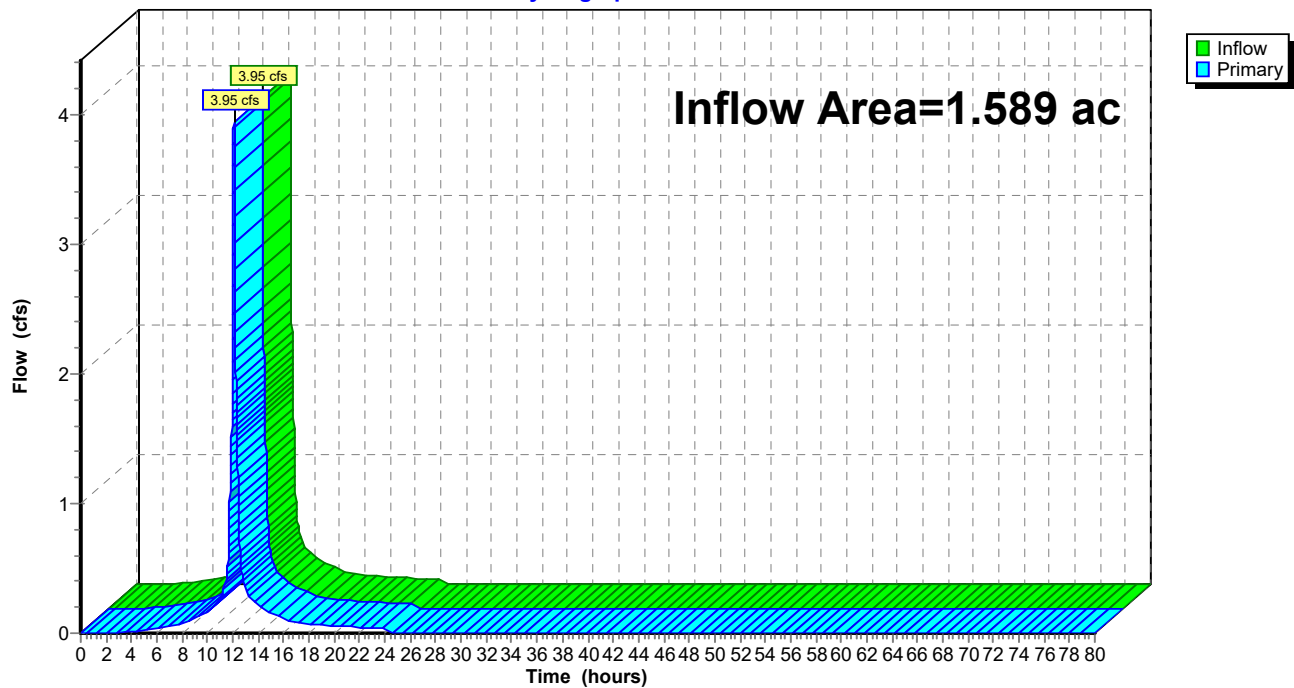
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 1L: Somerville Drainage**Hydrograph**

Summary for Link 2L: Somerville Drainage

Inflow Area = 1.589 ac, 91.63% Impervious, Inflow Depth = 2.29" for 1-YR(24HR) event
Inflow = 3.95 cfs @ 12.08 hrs, Volume= 0.303 af
Primary = 3.95 cfs @ 12.08 hrs, Volume= 0.303 af, Atten= 0%, Lag= 0.0 min

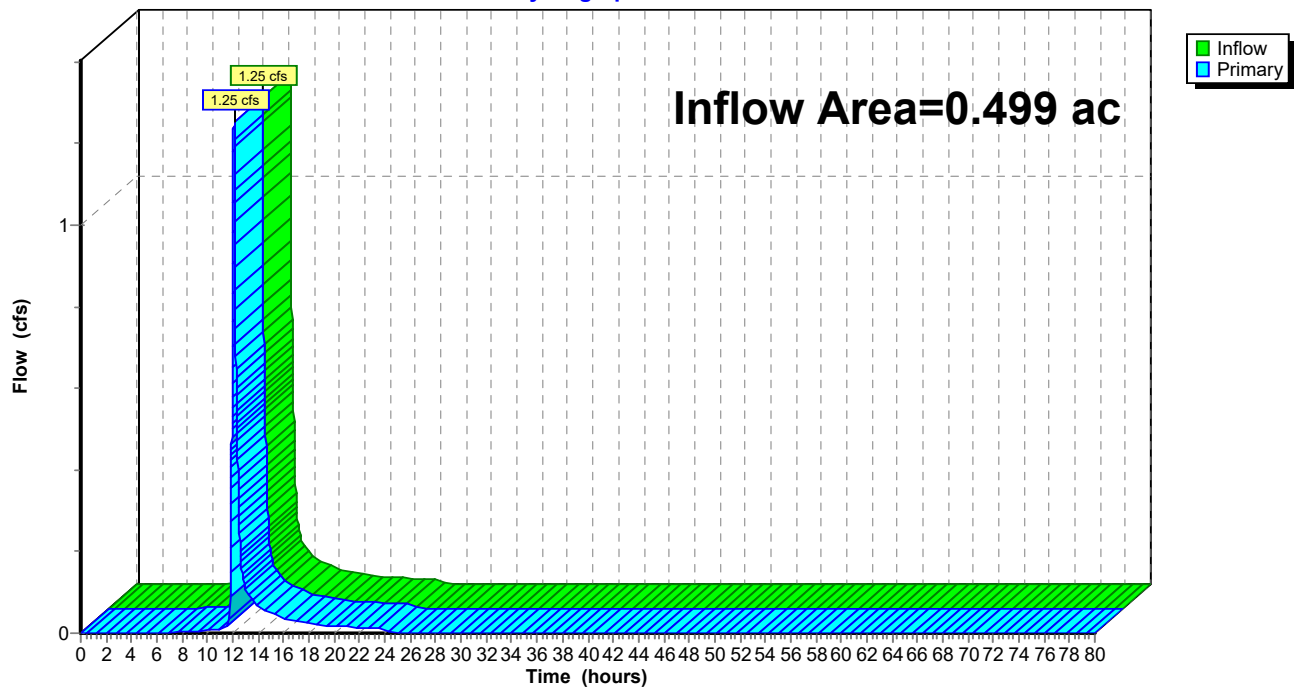
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 2L: Somerville Drainage**Hydrograph**

Summary for Link 3L: Somerville Drainage

Inflow Area = 0.499 ac, 97.89% Impervious, Inflow Depth = 1.78" for 1-YR(24HR) event
Inflow = 1.25 cfs @ 12.09 hrs, Volume= 0.074 af
Primary = 1.25 cfs @ 12.09 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.0 min

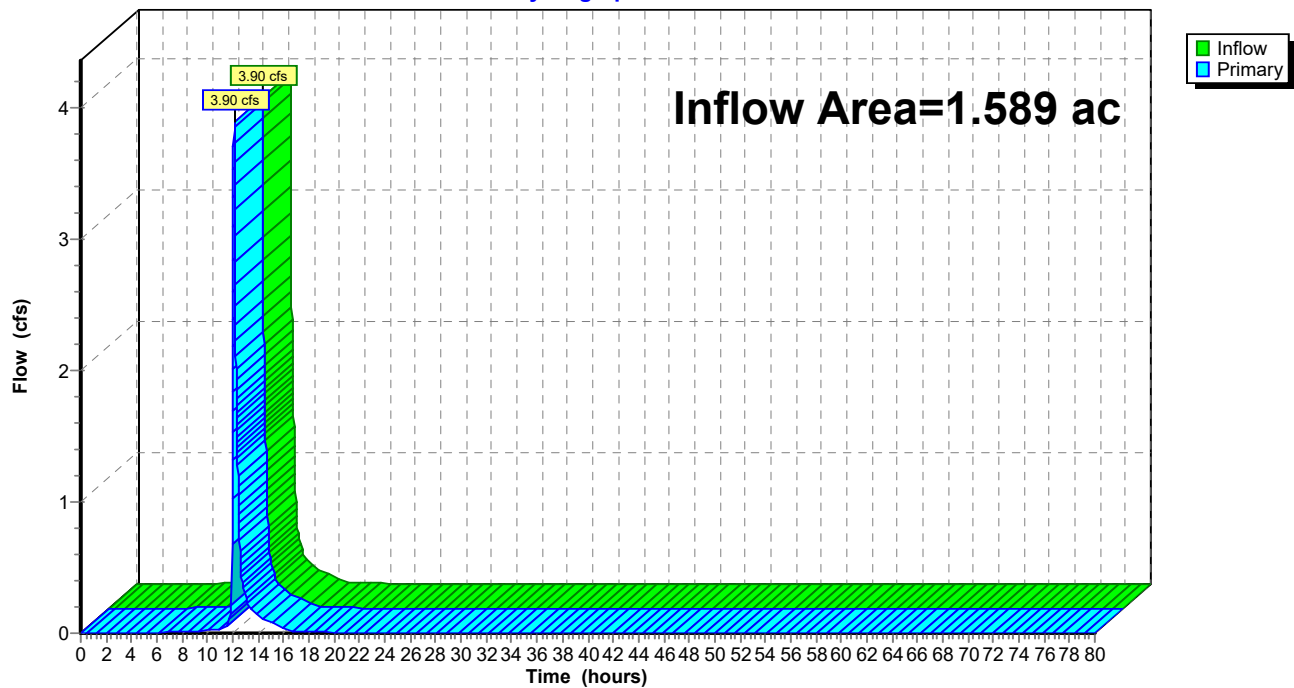
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 3L: Somerville Drainage**Hydrograph**

Summary for Link 4L: Somerville Drainage

Inflow Area = 1.589 ac, 100.00% Impervious, Inflow Depth = 1.23" for 1-YR(24HR) event
Inflow = 3.90 cfs @ 12.10 hrs, Volume= 0.163 af
Primary = 3.90 cfs @ 12.10 hrs, Volume= 0.163 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 4L: Somerville Drainage**Hydrograph**

13788.00_EX vs PR*Type III 6-hr 1-YR(6HR) Rainfall=1.69"*

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 24

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Hotel	Runoff Area=21,734 sf 88.71% Impervious Runoff Depth=1.37" Flow Length=261' Tc=6.0 min CN=97 Runoff=1.07 cfs 0.057 af
Subcatchment2S: EX Residential	Runoff Area=69,198 sf 91.63% Impervious Runoff Depth=1.37" Flow Length=233' Tc=6.0 min CN=97 Runoff=3.42 cfs 0.181 af
Subcatchment3Sa: PR Hotel - Offsite	Runoff Area=2,394 sf 100.00% Impervious Runoff Depth=1.47" Tc=6.0 min CN=98 Runoff=0.12 cfs 0.007 af
Subcatchment3Sb: PR Hotel	Runoff Area=19,340 sf 97.63% Impervious Runoff Depth=1.37" Flow Length=140' Tc=6.0 min CN=97 Runoff=0.96 cfs 0.051 af
Subcatchment4S: PR Residential - Site	Runoff Area=8,001 sf 100.00% Impervious Runoff Depth=1.47" Flow Length=60' Slope=0.0210 '/' Tc=6.0 min CN=98 Runoff=0.41 cfs 0.022 af
Subcatchment5S: PR Residential -	Runoff Area=61,197 sf 100.00% Impervious Runoff Depth=1.47" Tc=6.0 min CN=98 Runoff=3.16 cfs 0.172 af
Pond 7P: Subsurface Infiltration #1	Peak Elev=8.54' Storage=0.024 af Inflow=0.96 cfs 0.051 af Outflow=0.71 cfs 0.029 af
Pond 8P: Perforated Pipe	Peak Elev=8.37' Storage=2,486 cf Inflow=3.16 cfs 0.172 af Discarded=0.08 cfs 0.086 af Primary=2.92 cfs 0.086 af Outflow=3.00 cfs 0.172 af
Link 1L: Somerville Drainage	Inflow=1.07 cfs 0.057 af Primary=1.07 cfs 0.057 af
Link 2L: Somerville Drainage	Inflow=3.42 cfs 0.181 af Primary=3.42 cfs 0.181 af
Link 3L: Somerville Drainage	Inflow=0.81 cfs 0.035 af Primary=0.81 cfs 0.035 af
Link 4L: Somerville Drainage	Inflow=3.31 cfs 0.108 af Primary=3.31 cfs 0.108 af

Total Runoff Area = 4.175 ac Runoff Volume = 0.490 af Average Runoff Depth = 1.41"
4.79% Pervious = 0.200 ac 95.21% Impervious = 3.975 ac

13788.00_EX vs PR

Type III 6-hr 1-YR(6HR) Rainfall=1.69"

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 25

Summary for Subcatchment 1S: EX Hotel

Runoff = 1.07 cfs @ 3.09 hrs, Volume= 0.057 af, Depth= 1.37"

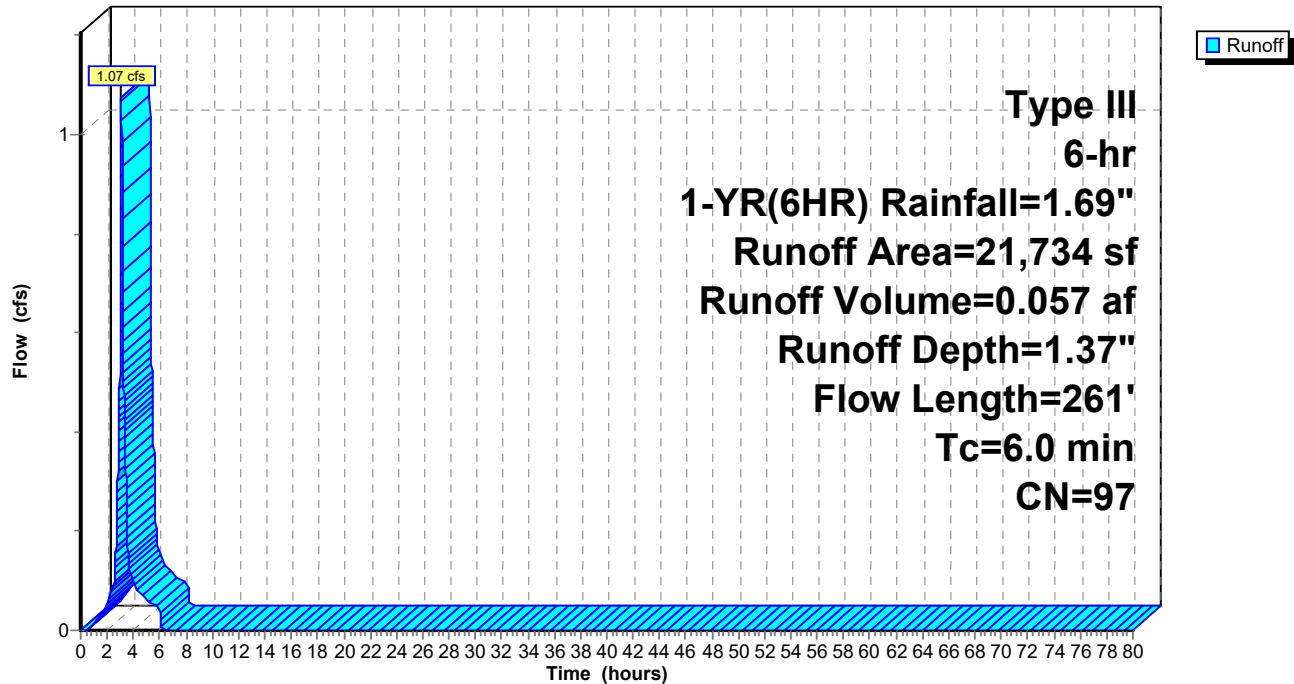
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-YR(6HR) Rainfall=1.69"

	Area (sf)	CN	Description
*	19,281	98	Paved parking
	2,453	89	<50% Grass cover, Poor, HSG D
	21,734	97	Weighted Average
	2,453		11.29% Pervious Area
	19,281		88.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	4	0.1262	0.45		Sheet Flow, Fallow n= 0.050 P2= 3.19"
0.8	46	0.0120	0.96		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.0	1	0.0125	2.27		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	91	0.0789	11.49	4.01	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.4	82	0.0066	3.32	1.16	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.1	37	0.0195	5.71	1.99	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
1.5	261	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: EX Hotel

Hydrograph



13788.00_EX vs PR

Type III 6-hr 1-YR(6HR) Rainfall=1.69"

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 27

Summary for Subcatchment 2S: EX Residential

Runoff = 3.42 cfs @ 3.09 hrs, Volume= 0.181 af, Depth= 1.37"

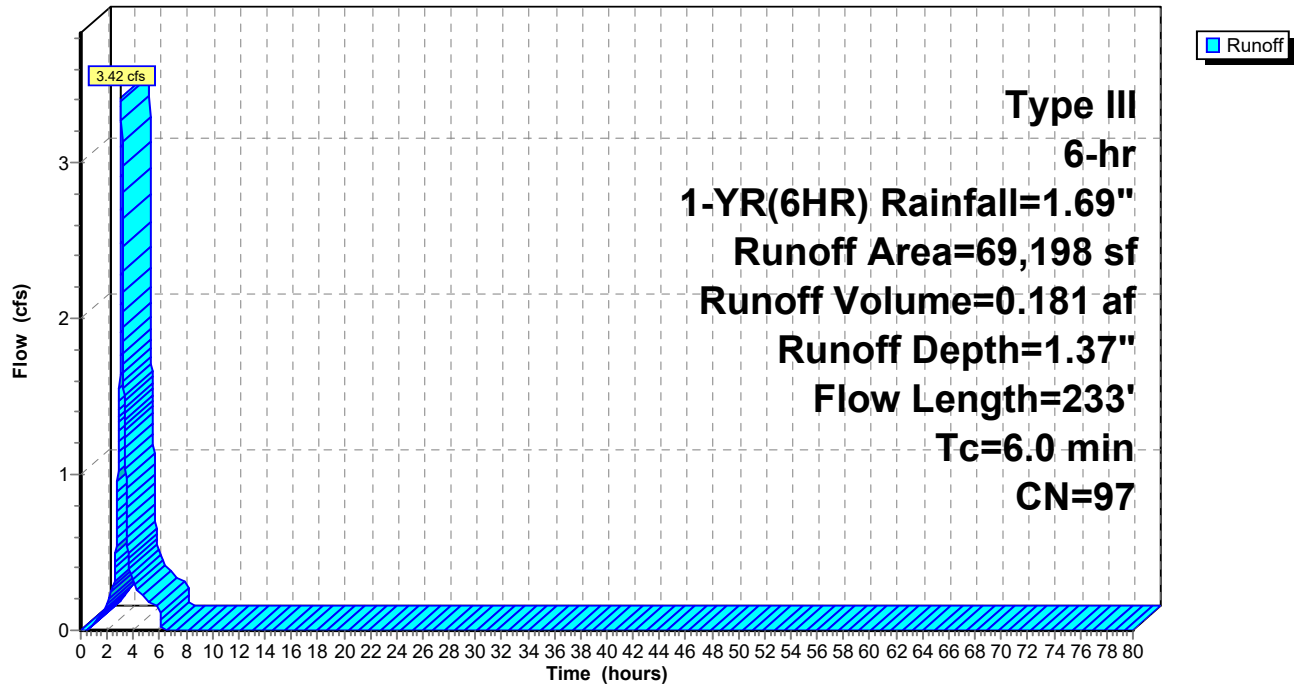
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-YR(6HR) Rainfall=1.69"

	Area (sf)	CN	Description
*	5,325	98	Roof - City Club
*	8,096	98	Roof - Paradigm
	5,794	89	<50% Grass cover, Poor, HSG D
*	49,983	98	Paved parking, conc
	69,198	97	Weighted Average
	5,794		8.37% Pervious Area
	63,404		91.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0044	0.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
1.6	20	0.0800	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.19"
0.6	20	0.0040	0.52		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.2	30	0.0234	3.11		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	134	0.0167	5.29	1.85	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
0.0	20	0.0366	7.83	2.73	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
3.1	233	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: EX Residential

Hydrograph



Summary for Subcatchment 3Sa: PR Hotel - Offsite

Runoff = 0.12 cfs @ 3.08 hrs, Volume= 0.007 af, Depth= 1.47"

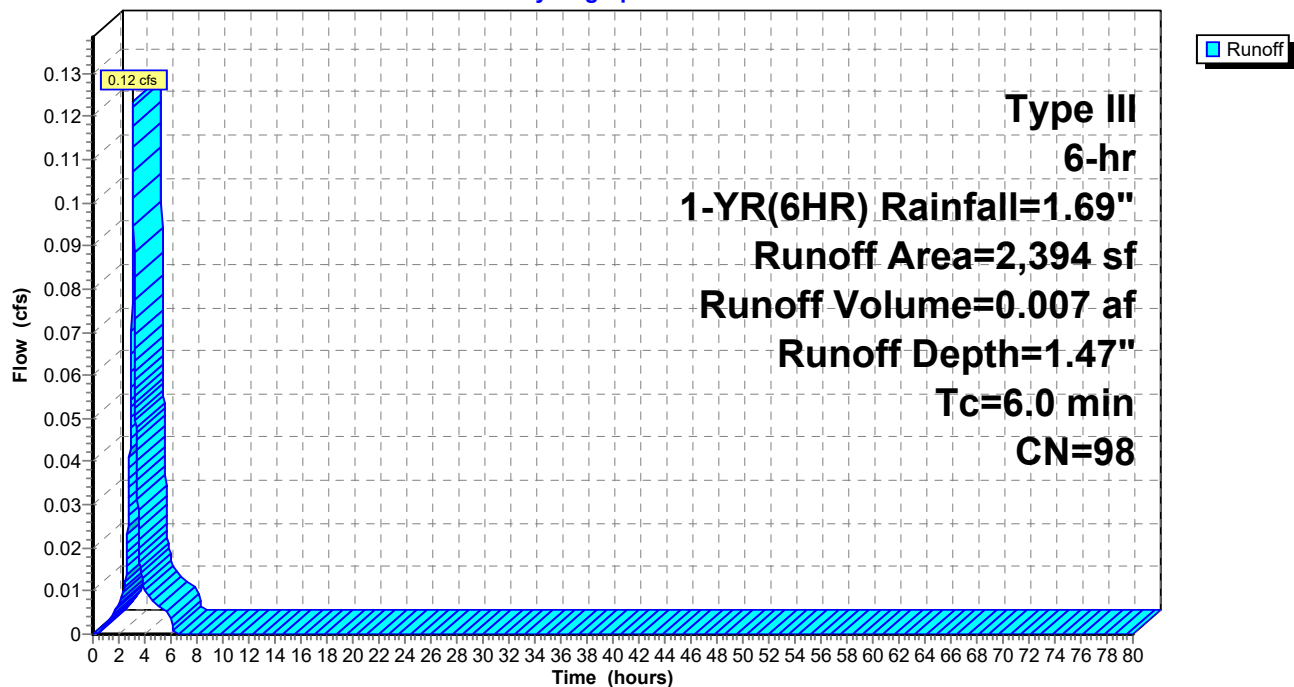
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-YR(6HR) Rainfall=1.69"

	Area (sf)	CN	Description
*	2,394	98	Paved parking
	2,394		100.00% Impervious Area

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

Subcatchment 3Sa: PR Hotel - Offsite

Hydrograph



Summary for Subcatchment 3Sb: PR Hotel

Runoff = 0.96 cfs @ 3.09 hrs, Volume= 0.051 af, Depth= 1.37"

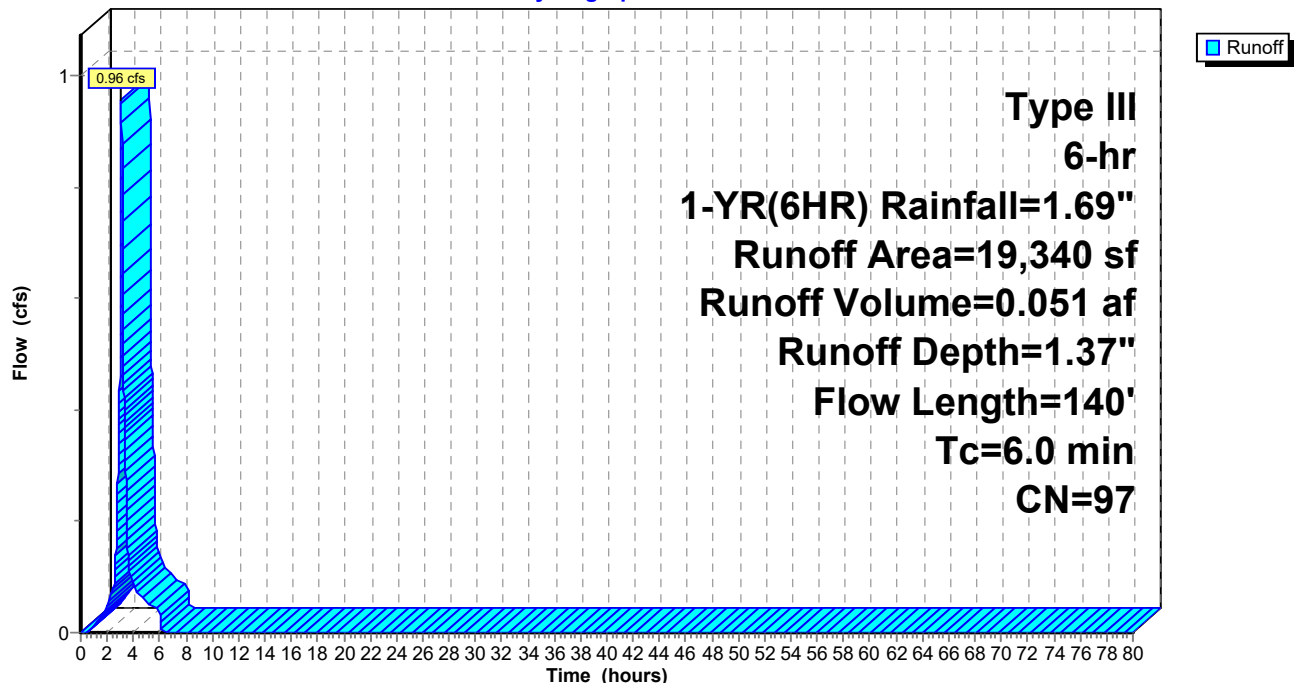
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-YR(6HR) Rainfall=1.69"

	Area (sf)	CN	Description
*	13,484	98	Roof - Hotel
*	5,398	98	Parking, sidewalks, pavers, walls, etc
	458	74	>75% Grass cover, Good, HSG C
	19,340	97	Weighted Average
	458		2.37% Pervious Area
	18,882		97.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0150	1.07		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.4	72	0.0233	3.10		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	18	0.0150	4.82	3.78	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Corrugated PE, smooth interior
1.3	140	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3Sb: PR Hotel

Hydrograph



Summary for Subcatchment 4S: PR Residential - Site

Runoff = 0.41 cfs @ 3.08 hrs, Volume= 0.022 af, Depth= 1.47"

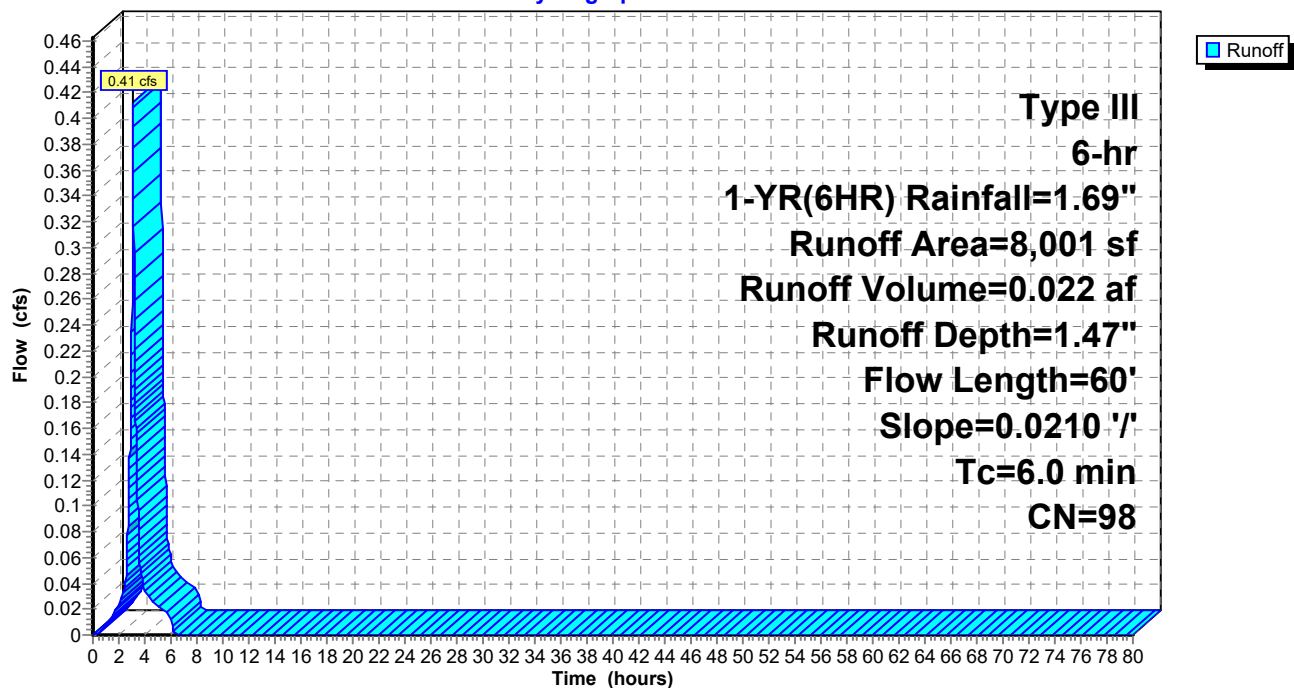
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-YR(6HR) Rainfall=1.69"

Area (sf)	CN	Description
* 8,001	98	Unconnected pavement
8,001		100.00% Impervious Area
8,001		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0210	1.22		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.1	10	0.0210	2.94		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.8	60	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: PR Residential - Site

Hydrograph



Summary for Subcatchment 5S: PR Residential - Rooftop

Runoff = 3.16 cfs @ 3.08 hrs, Volume= 0.172 af, Depth= 1.47"

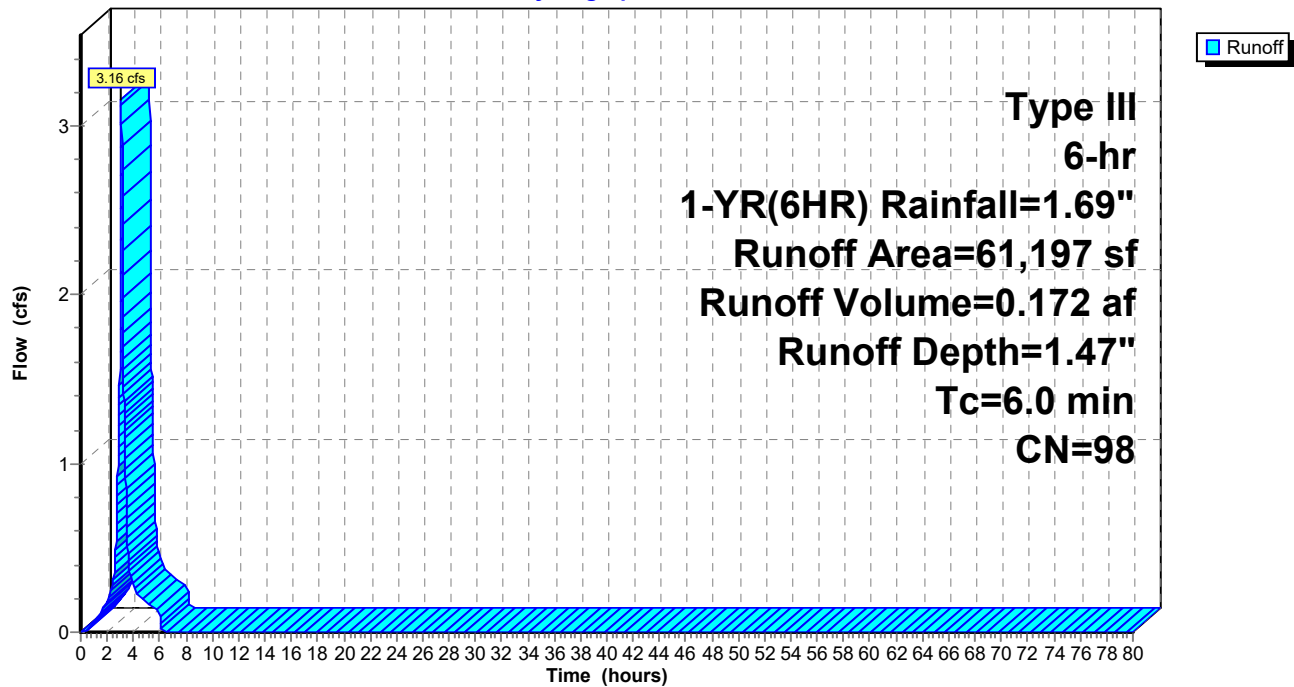
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 6-hr 1-YR(6HR) Rainfall=1.69"

Area (sf)	CN	Description
* 61,197	98	Roofs
61,197		100.00% Impervious Area

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

Subcatchment 5S: PR Residential - Rooftop

Hydrograph



Summary for Pond 7P: Subsurface Infiltration #1

Inflow Area = 0.444 ac, 97.63% Impervious, Inflow Depth = 1.37" for 1-YR(6HR) event
 Inflow = 0.96 cfs @ 3.09 hrs, Volume= 0.051 af
 Outflow = 0.71 cfs @ 3.16 hrs, Volume= 0.029 af, Atten= 25%, Lag= 4.2 min
 Primary = 0.71 cfs @ 3.16 hrs, Volume= 0.029 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.54' @ 3.16 hrs Surf.Area= 0.012 ac Storage= 0.024 af

Plug-Flow detention time= 68.3 min calculated for 0.029 af (57% of inflow)
 Center-of-Mass det. time= 34.4 min (237.0 - 202.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.10'	0.011 af	15.75'W x 32.10'L x 3.50'H Field A 0.041 af Overall - 0.013 af Embedded = 0.028 af x 40.0% Voids
#2A	5.60'	0.013 af	ADS_StormTech SC-740 +Cap x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 4 Chambers
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.20'	24.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=0.71 cfs @ 3.16 hrs HW=8.54' (Free Discharge)
 ↑ **1=Orifice/Grate** (Orifice Controls 0.71 cfs @ 1.99 fps)

Pond 7P: Subsurface Infiltration #1 - Chamber Wizard Field A**Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

4 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 30.10' Row Length +12.0" End Stone x 2 = 32.10' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

12 Chambers x 45.9 cf = 551.3 cf Chamber Storage

1,769.3 cf Field - 551.3 cf Chambers = 1,218.0 cf Stone x 40.0% Voids = 487.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,038.5 cf = 0.024 af

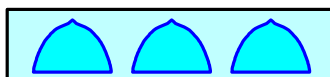
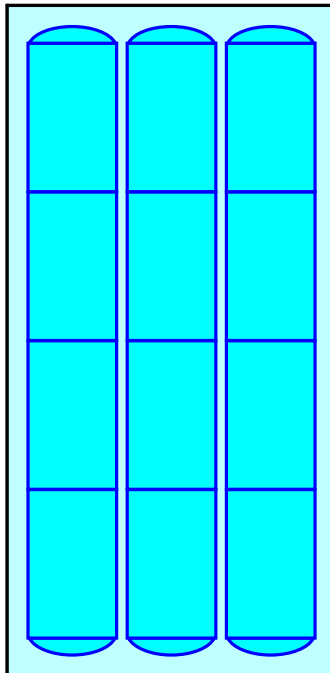
Overall Storage Efficiency = 58.7%

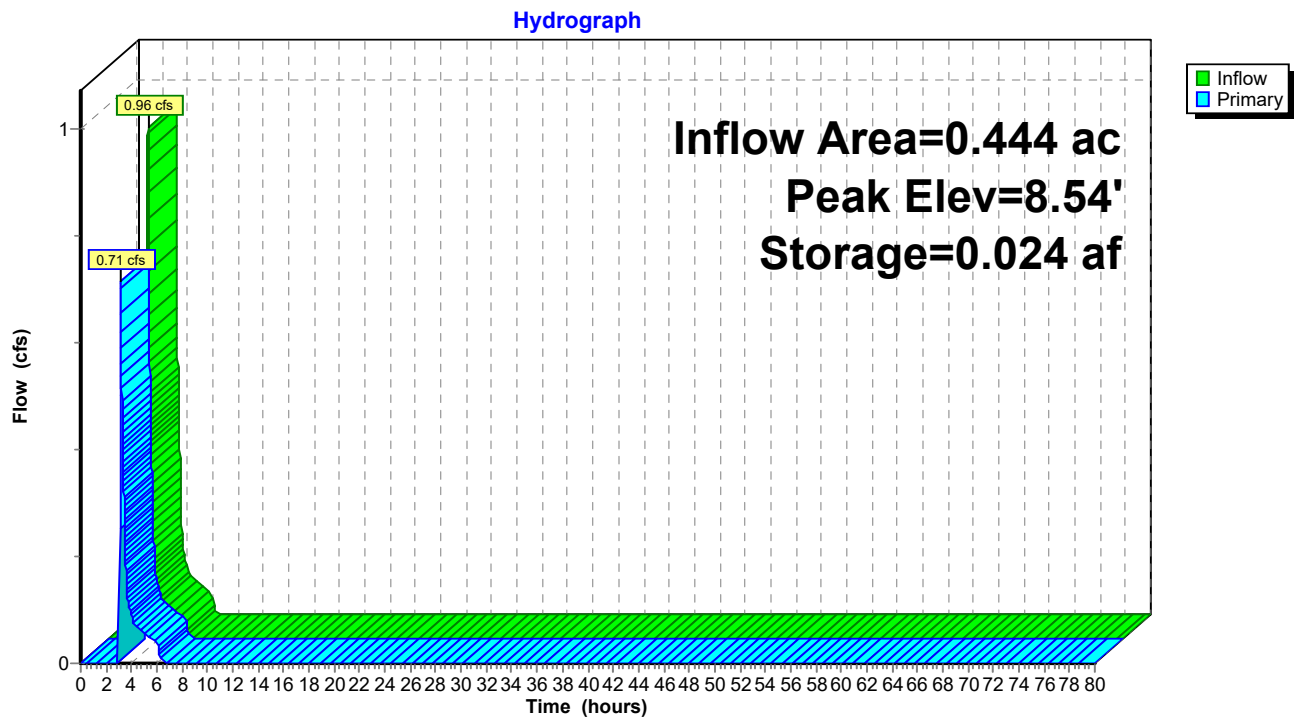
Overall System Size = 32.10' x 15.75' x 3.50'

12 Chambers

65.5 cy Field

45.1 cy Stone



Pond 7P: Subsurface Infiltration #1

Summary for Pond 8P: Perforated Pipe

Inflow Area = 1.405 ac, 100.00% Impervious, Inflow Depth = 1.47" for 1-YR(6HR) event
 Inflow = 3.16 cfs @ 3.08 hrs, Volume= 0.172 af
 Outflow = 3.00 cfs @ 3.11 hrs, Volume= 0.172 af, Atten= 5%, Lag= 1.7 min
 Discarded = 0.08 cfs @ 1.36 hrs, Volume= 0.086 af
 Primary = 2.92 cfs @ 3.11 hrs, Volume= 0.086 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.37' @ 3.11 hrs Surf.Area= 1,440 sf Storage= 2,486 cf

Plug-Flow detention time= 134.6 min calculated for 0.172 af (100% of inflow)
 Center-of-Mass det. time= 134.6 min (333.4 - 198.8)

Volume	Invert	Avail.Storage	Storage Description
#1	6.10'	1,005 cf	24.0" Round Pipe Storage Inside #2 L= 320.0'
#2	5.10'	2,190 cf	4.50'W x 320.00'L x 4.50'H Stone 6,480 cf Overall - 1,005 cf Embedded = 5,475 cf x 40.0% Voids
		3,195 cf	Total Available Storage

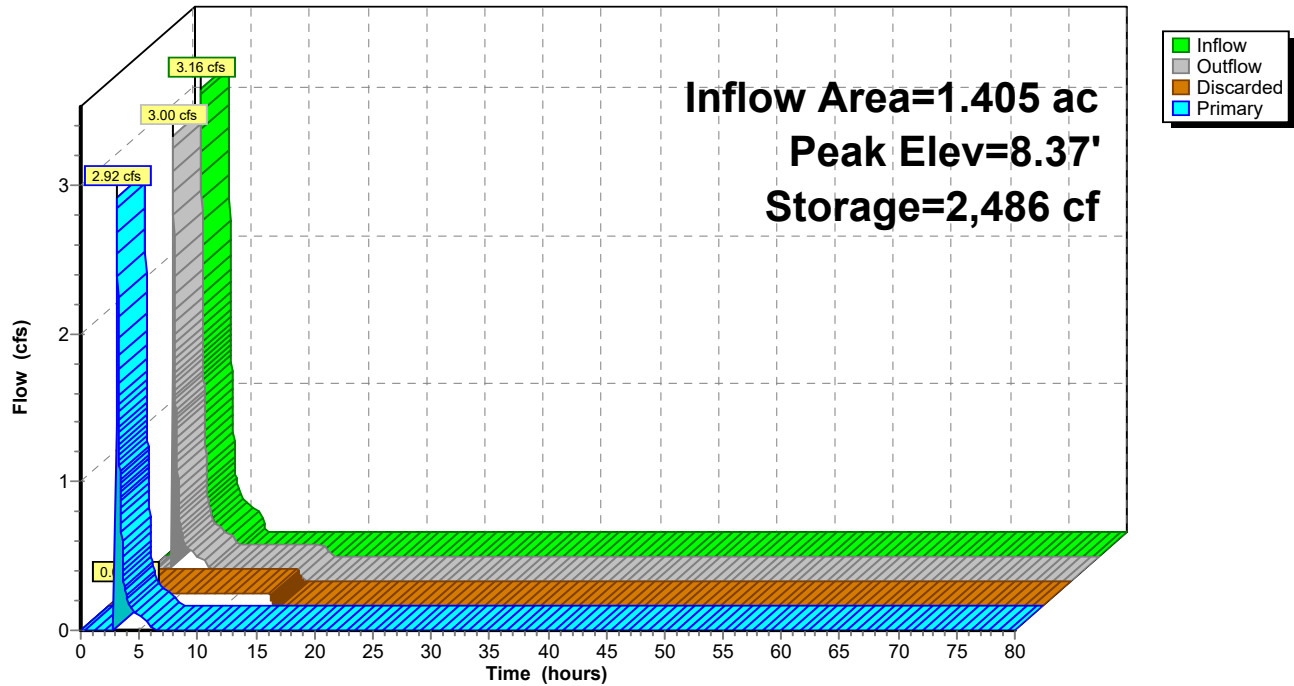
Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	24.0" Round Culvert L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.97' S= 0.0150 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	8.00'	4.0' long x 5.60' rise Sharp-Crested Rectangular Weir 2 End Contraction(s) 6.0' Crest Height
#3	Discarded	5.10'	2.400 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 1.36 hrs HW=5.19' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=2.90 cfs @ 3.11 hrs HW=8.37' (Free Discharge)
 ↑ **1=Culvert** (Passes 2.90 cfs of 35.05 cfs potential flow)
 ↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 2.90 cfs @ 2.00 fps)

Pond 8P: Perforated Pipe

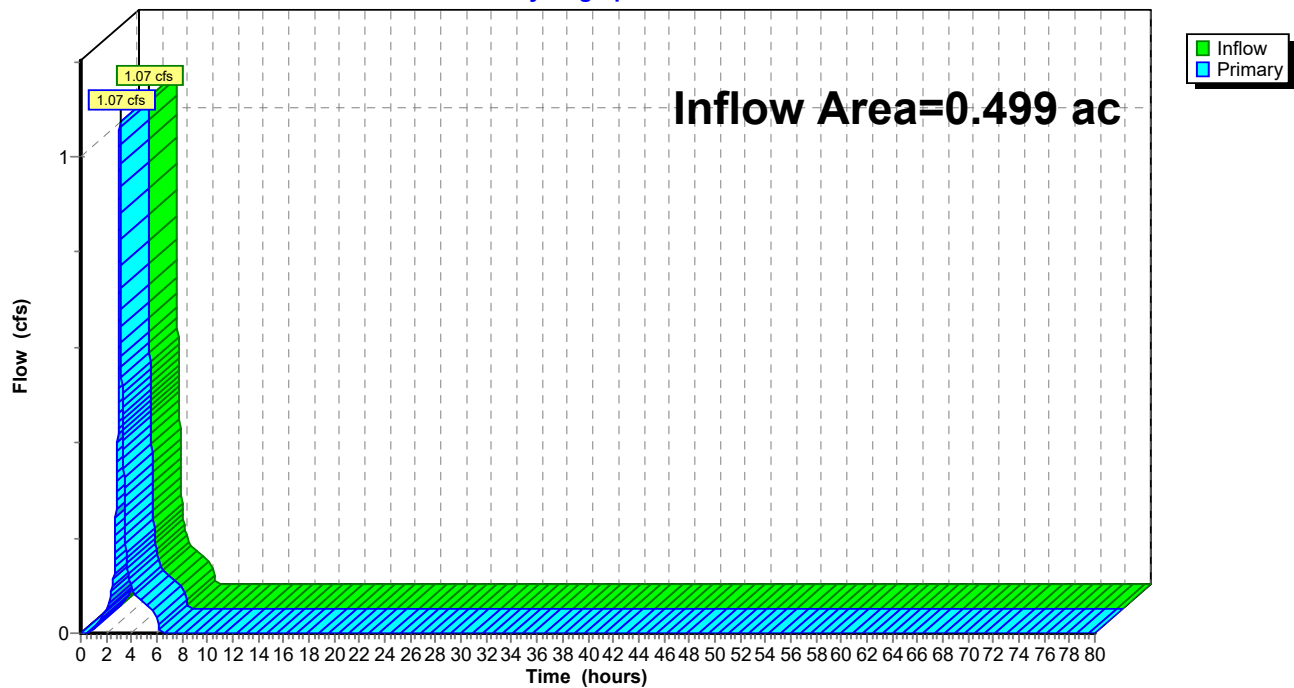
Hydrograph



Summary for Link 1L: Somerville Drainage

Inflow Area = 0.499 ac, 88.71% Impervious, Inflow Depth = 1.37" for 1-YR(6HR) event
Inflow = 1.07 cfs @ 3.09 hrs, Volume= 0.057 af
Primary = 1.07 cfs @ 3.09 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min

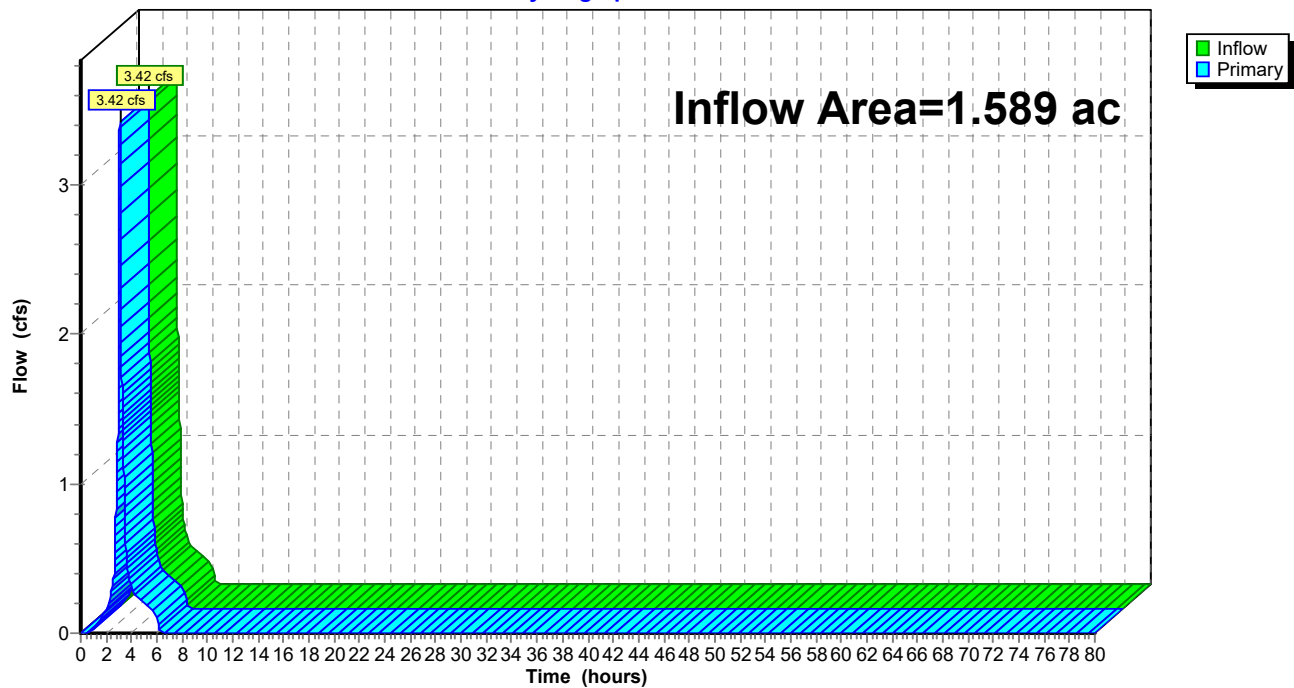
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 1L: Somerville Drainage**Hydrograph**

Summary for Link 2L: Somerville Drainage

Inflow Area = 1.589 ac, 91.63% Impervious, Inflow Depth = 1.37" for 1-YR(6HR) event
Inflow = 3.42 cfs @ 3.09 hrs, Volume= 0.181 af
Primary = 3.42 cfs @ 3.09 hrs, Volume= 0.181 af, Atten= 0%, Lag= 0.0 min

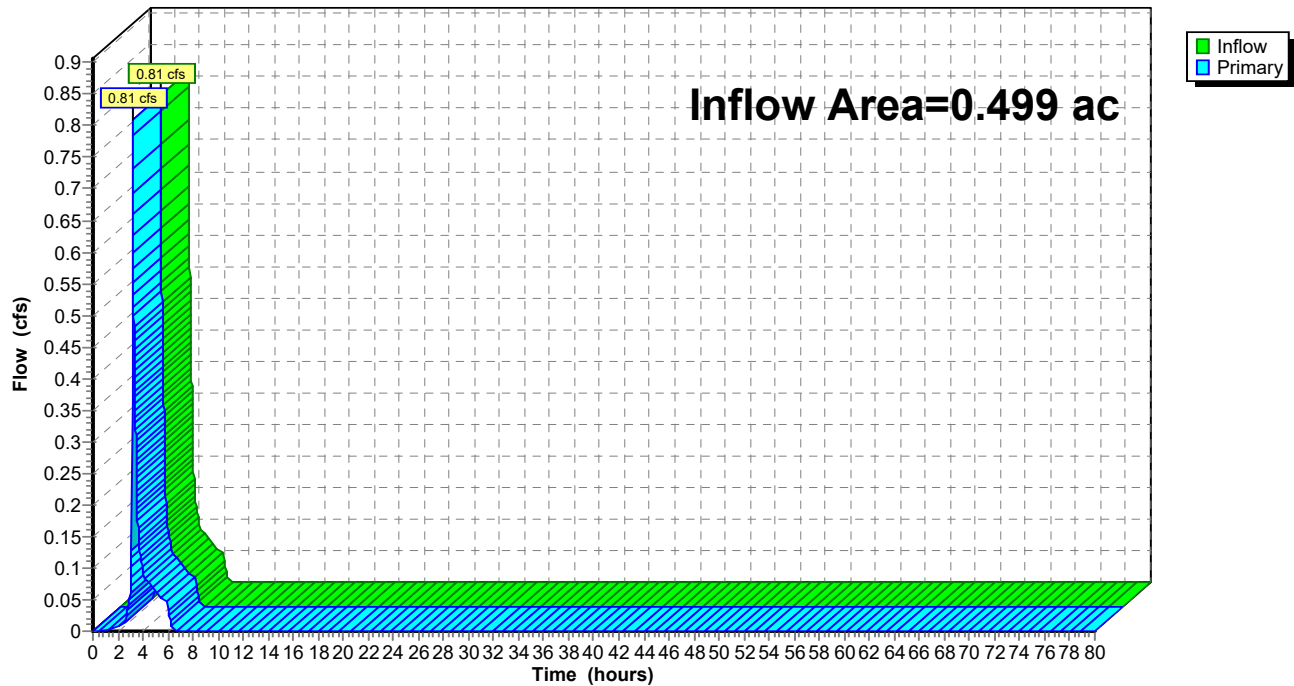
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 2L: Somerville Drainage**Hydrograph**

Summary for Link 3L: Somerville Drainage

Inflow Area = 0.499 ac, 97.89% Impervious, Inflow Depth = 0.85" for 1-YR(6HR) event
Inflow = 0.81 cfs @ 3.15 hrs, Volume= 0.035 af
Primary = 0.81 cfs @ 3.15 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 3L: Somerville Drainage**Hydrograph**

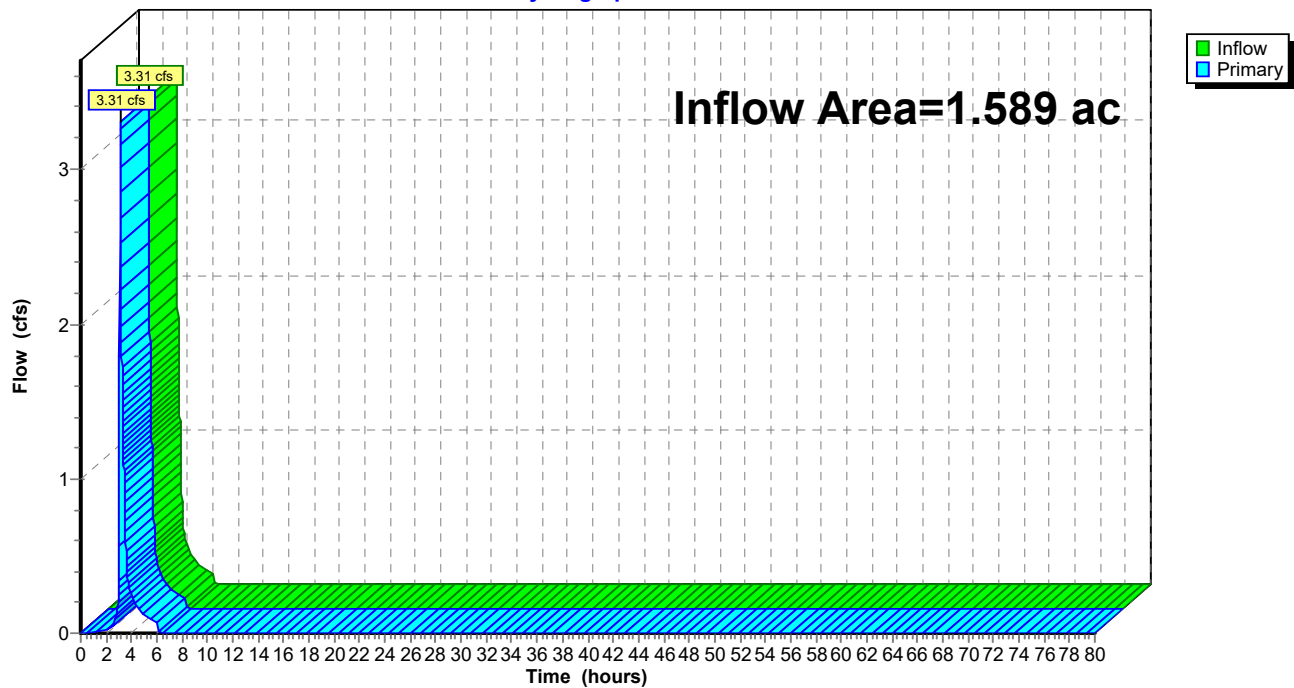
Summary for Link 4L: Somerville Drainage

Inflow Area = 1.589 ac, 100.00% Impervious, Inflow Depth = 0.82" for 1-YR(6HR) event
Inflow = 3.31 cfs @ 3.11 hrs, Volume= 0.108 af
Primary = 3.31 cfs @ 3.11 hrs, Volume= 0.108 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 4L: Somerville Drainage

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.26"

Printed 10/10/2018

Page 42

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Hotel	Runoff Area=21,734 sf 88.71% Impervious Runoff Depth=2.92" Flow Length=261' Tc=6.0 min CN=97 Runoff=1.56 cfs 0.121 af
Subcatchment2S: EX Residential	Runoff Area=69,198 sf 91.63% Impervious Runoff Depth=2.92" Flow Length=233' Tc=6.0 min CN=97 Runoff=4.96 cfs 0.386 af
Subcatchment3Sa: PR Hotel - Offsite	Runoff Area=2,394 sf 100.00% Impervious Runoff Depth=3.03" Tc=6.0 min CN=98 Runoff=0.17 cfs 0.014 af
Subcatchment3Sb: PR Hotel	Runoff Area=19,340 sf 97.63% Impervious Runoff Depth=2.92" Flow Length=140' Tc=6.0 min CN=97 Runoff=1.39 cfs 0.108 af
Subcatchment4S: PR Residential - Site	Runoff Area=8,001 sf 100.00% Impervious Runoff Depth=3.03" Flow Length=60' Slope=0.0210 '/' Tc=6.0 min CN=98 Runoff=0.58 cfs 0.046 af
Subcatchment5S: PR Residential -	Runoff Area=61,197 sf 100.00% Impervious Runoff Depth=3.03" Tc=6.0 min CN=98 Runoff=4.45 cfs 0.354 af
Pond 7P: Subsurface Infiltration #1	Peak Elev=8.68' Storage=0.024 af Inflow=1.39 cfs 0.108 af Outflow=1.39 cfs 0.086 af
Pond 8P: Perforated Pipe	Peak Elev=8.48' Storage=2,551 cf Inflow=4.45 cfs 0.354 af Discarded=0.08 cfs 0.167 af Primary=4.32 cfs 0.187 af Outflow=4.40 cfs 0.354 af
Link 1L: Somerville Drainage	Inflow=1.56 cfs 0.121 af Primary=1.56 cfs 0.121 af
Link 2L: Somerville Drainage	Inflow=4.96 cfs 0.386 af Primary=4.96 cfs 0.386 af
Link 3L: Somerville Drainage	Inflow=1.56 cfs 0.100 af Primary=1.56 cfs 0.100 af
Link 4L: Somerville Drainage	Inflow=4.89 cfs 0.233 af Primary=4.89 cfs 0.233 af

Total Runoff Area = 4.175 ac Runoff Volume = 1.030 af Average Runoff Depth = 2.96"
4.79% Pervious = 0.200 ac 95.21% Impervious = 3.975 ac

13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.26"

Printed 10/10/2018

Page 43

Summary for Subcatchment 1S: EX Hotel

Runoff = 1.56 cfs @ 12.08 hrs, Volume= 0.121 af, Depth= 2.92"

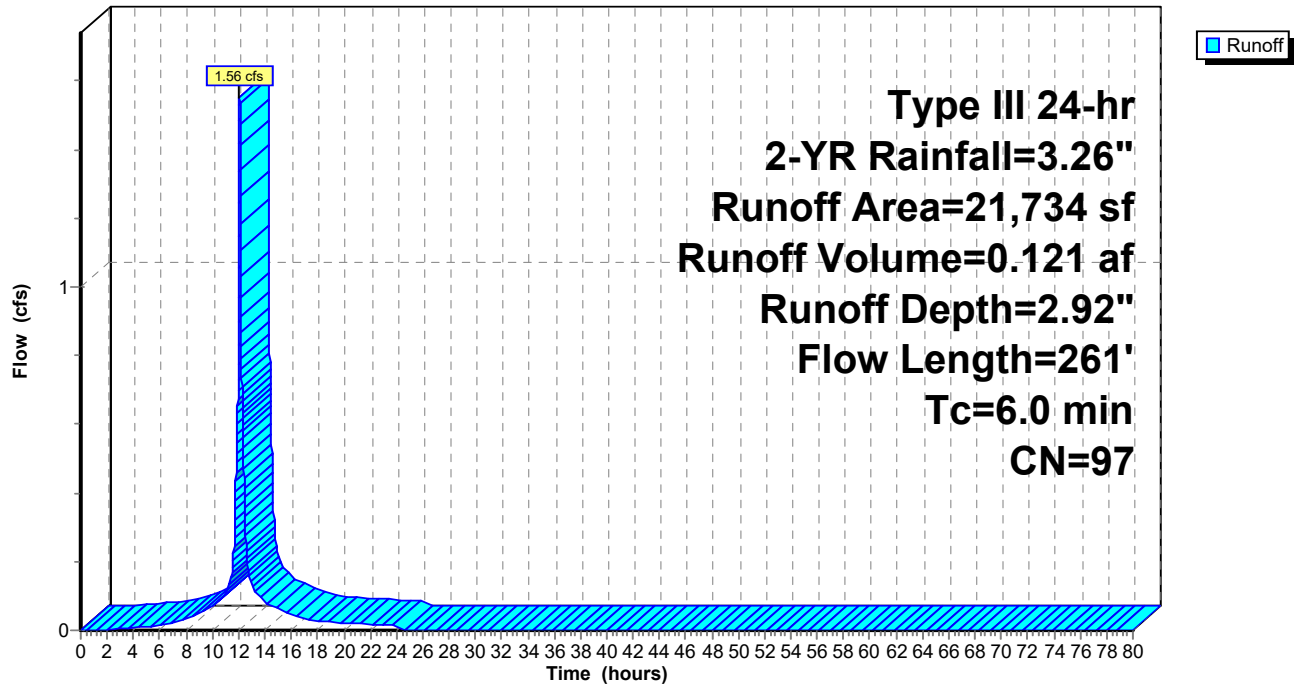
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.26"

	Area (sf)	CN	Description
*	19,281	98	Paved parking
	2,453	89	<50% Grass cover, Poor, HSG D
	21,734	97	Weighted Average
	2,453		11.29% Pervious Area
	19,281		88.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	4	0.1262	0.45		Sheet Flow, Fallow n= 0.050 P2= 3.19"
0.8	46	0.0120	0.96		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.0	1	0.0125	2.27		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	91	0.0789	11.49	4.01	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.4	82	0.0066	3.32	1.16	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.1	37	0.0195	5.71	1.99	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
1.5	261	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: EX Hotel

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.26"

Printed 10/10/2018

Page 45

Summary for Subcatchment 2S: EX Residential

Runoff = 4.96 cfs @ 12.08 hrs, Volume= 0.386 af, Depth= 2.92"

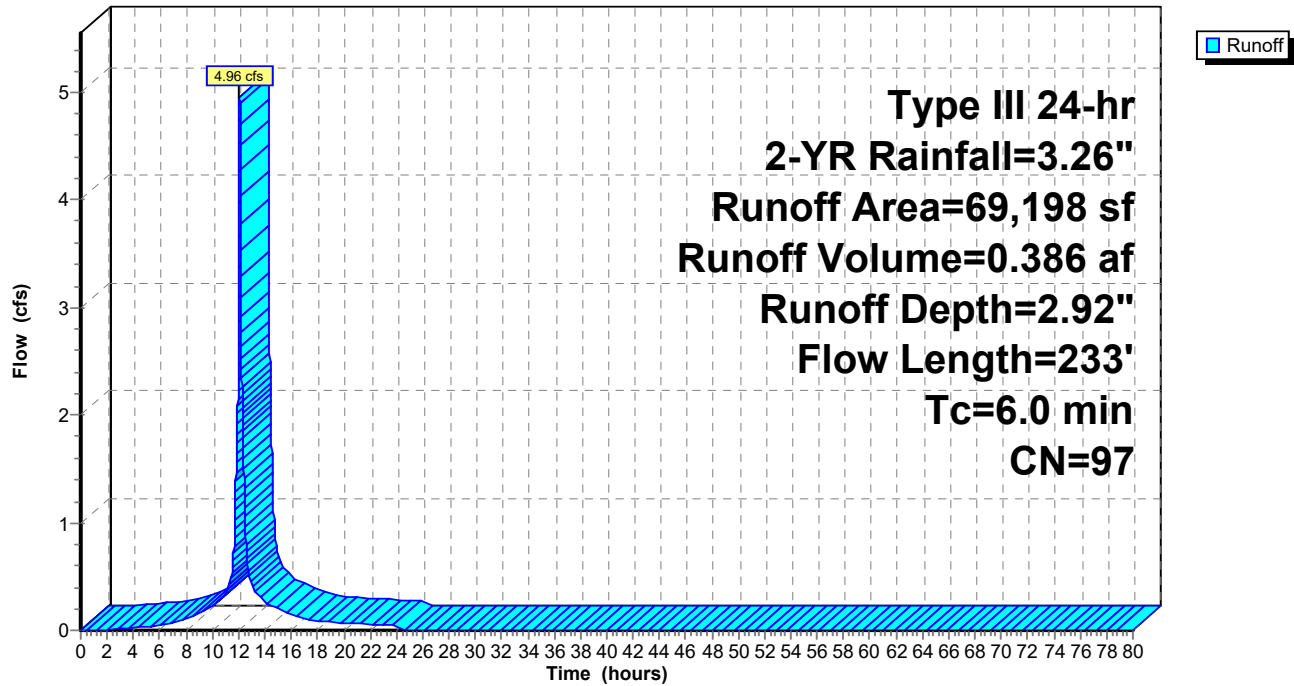
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.26"

	Area (sf)	CN	Description
*	5,325	98	Roof - City Club
*	8,096	98	Roof - Paradigm
	5,794	89	<50% Grass cover, Poor, HSG D
*	49,983	98	Paved parking, conc
	69,198	97	Weighted Average
	5,794		8.37% Pervious Area
	63,404		91.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0044	0.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
1.6	20	0.0800	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.19"
0.6	20	0.0040	0.52		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.2	30	0.0234	3.11		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	134	0.0167	5.29	1.85	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
0.0	20	0.0366	7.83	2.73	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
3.1	233	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: EX Residential

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.26"

Printed 10/10/2018

Page 47

Summary for Subcatchment 3Sa: PR Hotel - Offsite

Runoff = 0.17 cfs @ 12.08 hrs, Volume= 0.014 af, Depth= 3.03"

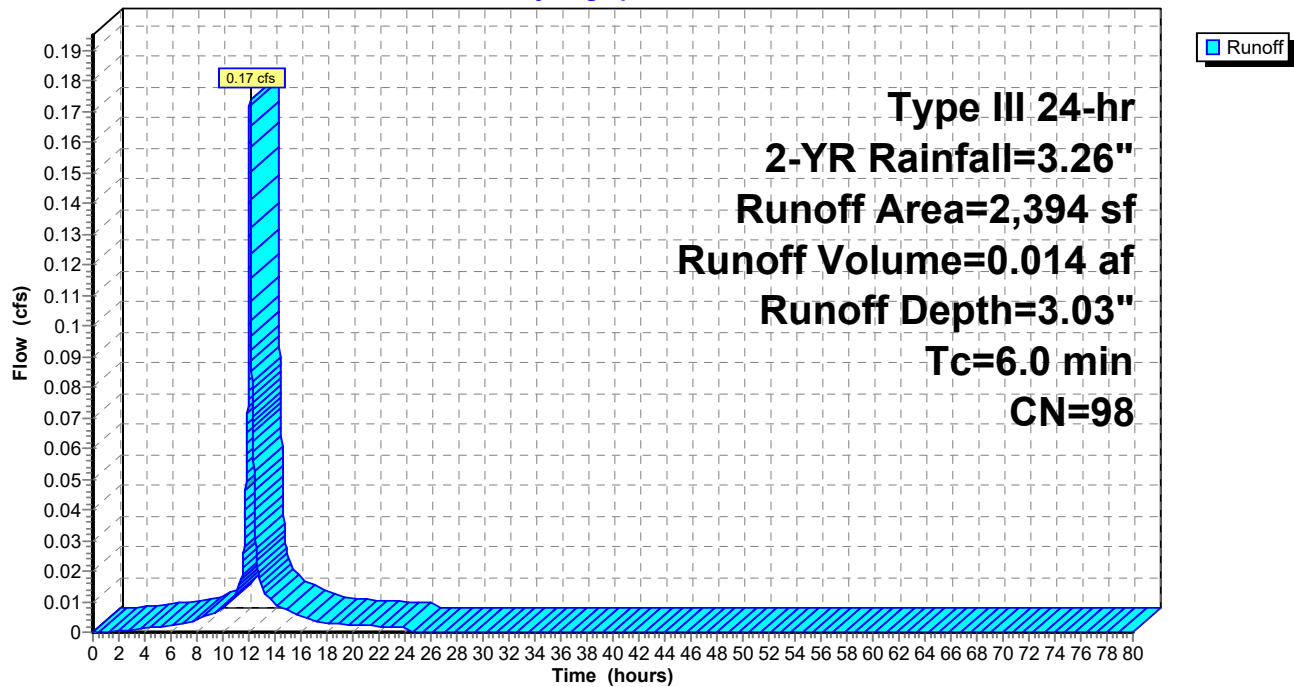
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.26"

	Area (sf)	CN	Description
*	2,394	98	Paved parking
	2,394		100.00% Impervious Area

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

Subcatchment 3Sa: PR Hotel - Offsite

Hydrograph



Summary for Subcatchment 3Sb: PR Hotel

Runoff = 1.39 cfs @ 12.08 hrs, Volume= 0.108 af, Depth= 2.92"

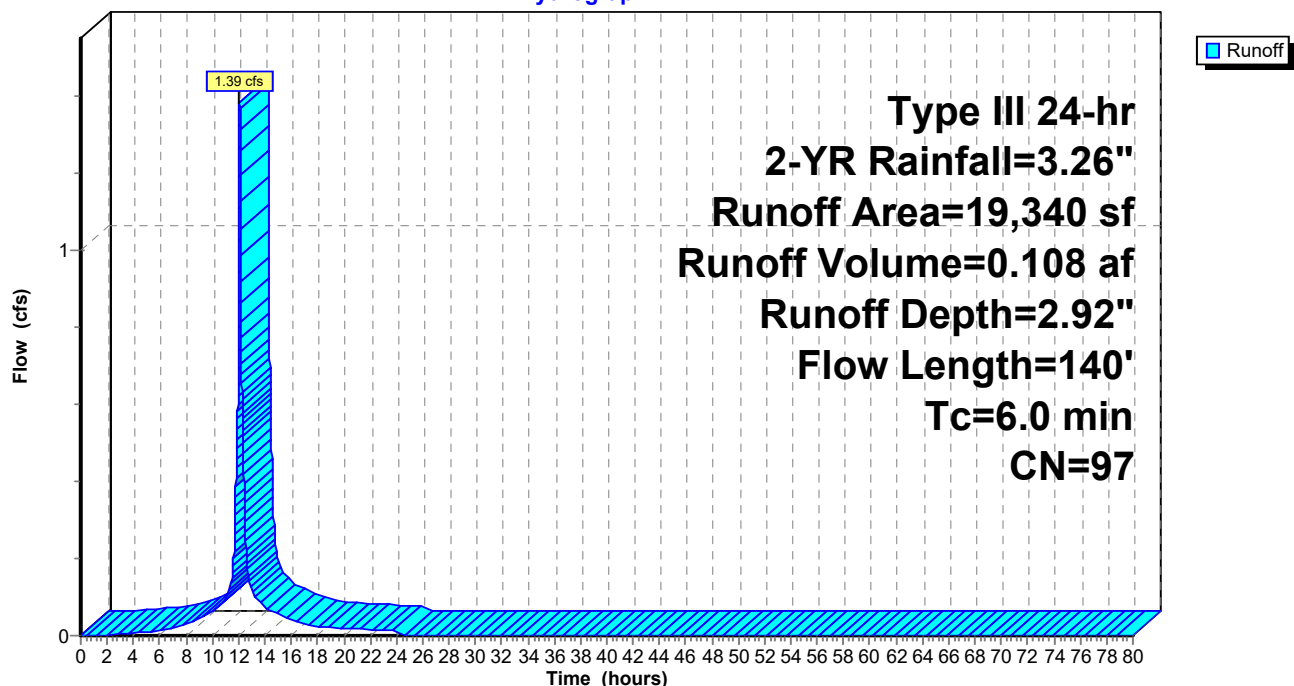
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.26"

	Area (sf)	CN	Description
*	13,484	98	Roof - Hotel
*	5,398	98	Parking, sidewalks, pavers, walls, etc
	458	74	>75% Grass cover, Good, HSG C
	19,340	97	Weighted Average
	458		2.37% Pervious Area
	18,882		97.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0150	1.07		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.4	72	0.0233	3.10		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	18	0.0150	4.82	3.78	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Corrugated PE, smooth interior
1.3	140	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3Sb: PR Hotel

Hydrograph



Summary for Subcatchment 4S: PR Residential - Site

Runoff = 0.58 cfs @ 12.08 hrs, Volume= 0.046 af, Depth= 3.03"

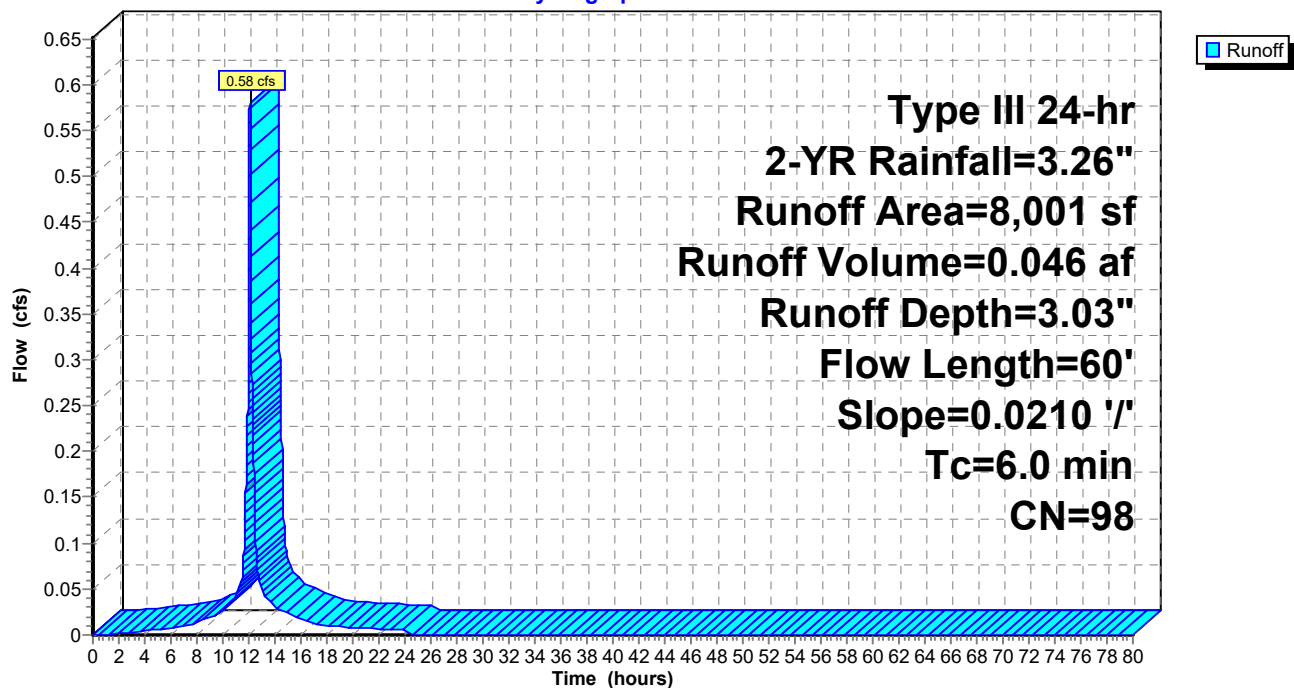
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.26"

Area (sf)	CN	Description
* 8,001	98	Unconnected pavement
8,001		100.00% Impervious Area
8,001		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0210	1.22		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.1	10	0.0210	2.94		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.8	60	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: PR Residential - Site

Hydrograph



Summary for Subcatchment 5S: PR Residential - Rooftop

Runoff = 4.45 cfs @ 12.08 hrs, Volume= 0.354 af, Depth= 3.03"

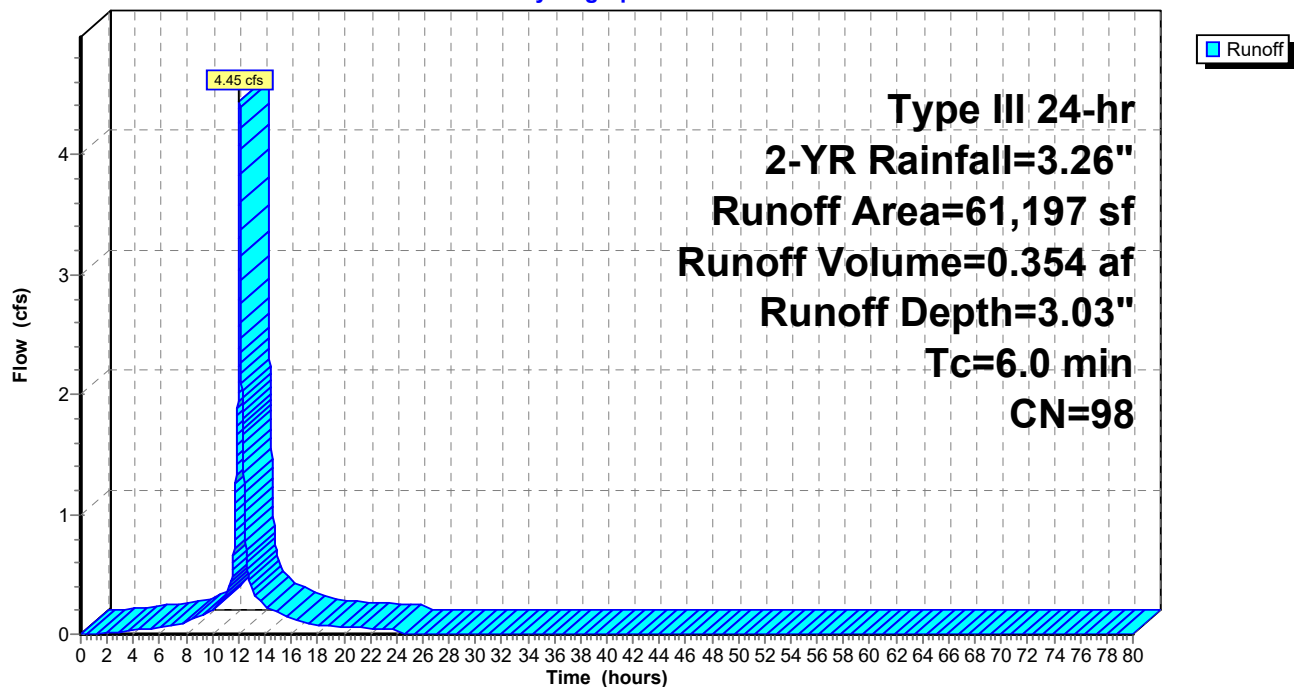
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.26"

Area (sf)	CN	Description
* 61,197	98	Roofs
61,197		100.00% Impervious Area

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

Subcatchment 5S: PR Residential - Rooftop

Hydrograph



Summary for Pond 7P: Subsurface Infiltration #1

[93] Warning: Storage range exceeded by 0.08'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.444 ac, 97.63% Impervious, Inflow Depth = 2.92" for 2-YR event
 Inflow = 1.39 cfs @ 12.08 hrs, Volume= 0.108 af
 Outflow = 1.39 cfs @ 12.09 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.2 min
 Primary = 1.39 cfs @ 12.09 hrs, Volume= 0.086 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.68' @ 12.09 hrs Surf.Area= 0.012 ac Storage= 0.024 af

Plug-Flow detention time= 137.0 min calculated for 0.086 af (80% of inflow)
 Center-of-Mass det. time= 60.4 min (826.0 - 765.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.10'	0.011 af	15.75'W x 32.10'L x 3.50'H Field A 0.041 af Overall - 0.013 af Embedded = 0.028 af x 40.0% Voids
#2A	5.60'	0.013 af	ADS_StormTech SC-740 +Cap x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 4 Chambers
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.20'	24.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.38 cfs @ 12.09 hrs HW=8.68' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 1.38 cfs @ 2.37 fps)

Pond 7P: Subsurface Infiltration #1 - Chamber Wizard Field A**Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

4 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 30.10' Row Length +12.0" End Stone x 2 = 32.10' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

12 Chambers x 45.9 cf = 551.3 cf Chamber Storage

1,769.3 cf Field - 551.3 cf Chambers = 1,218.0 cf Stone x 40.0% Voids = 487.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,038.5 cf = 0.024 af

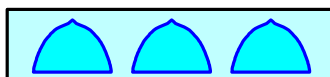
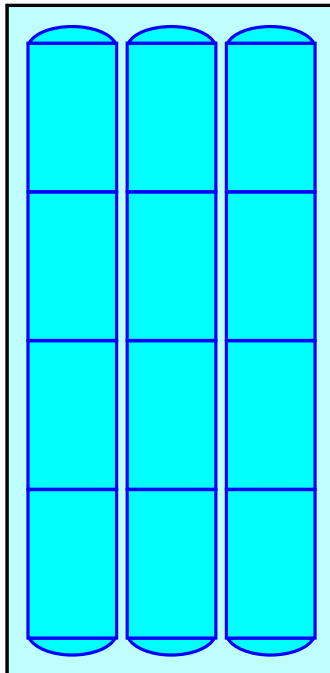
Overall Storage Efficiency = 58.7%

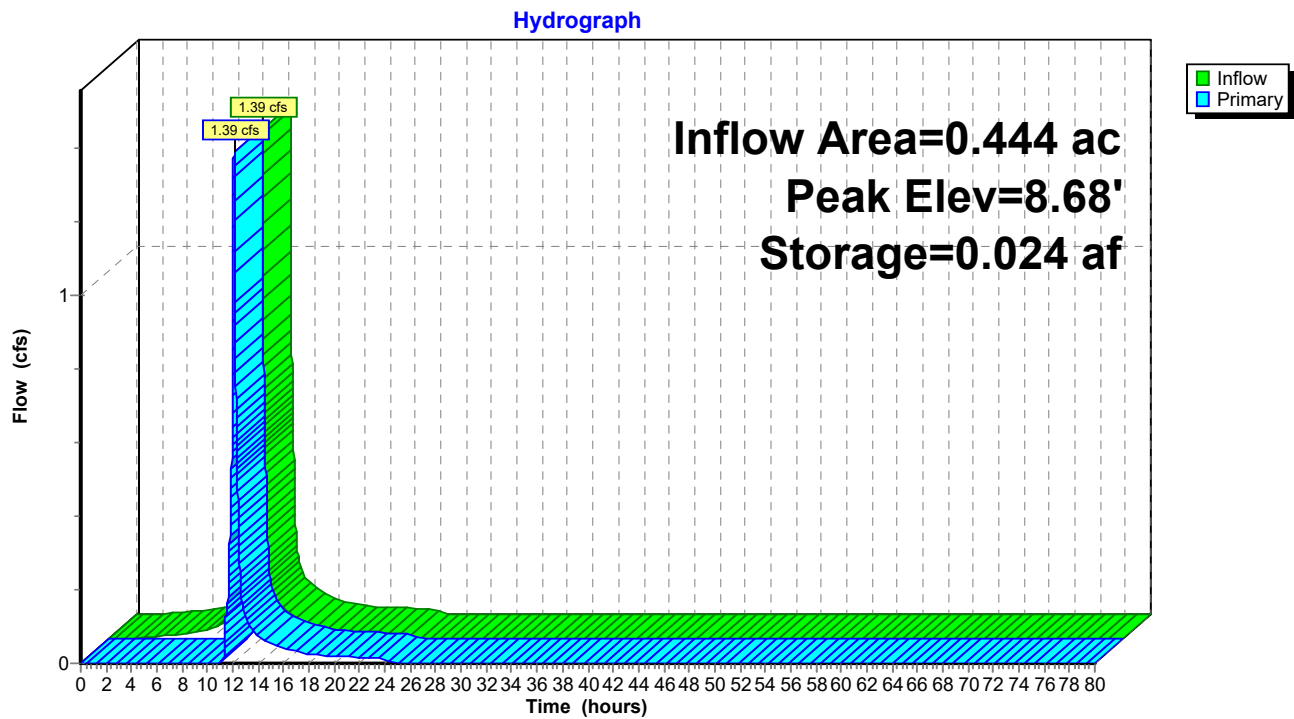
Overall System Size = 32.10' x 15.75' x 3.50'

12 Chambers

65.5 cy Field

45.1 cy Stone



Pond 7P: Subsurface Infiltration #1

Summary for Pond 8P: Perforated Pipe

Inflow Area = 1.405 ac, 100.00% Impervious, Inflow Depth = 3.03" for 2-YR event
 Inflow = 4.45 cfs @ 12.08 hrs, Volume= 0.354 af
 Outflow = 4.40 cfs @ 12.10 hrs, Volume= 0.354 af, Atten= 1%, Lag= 0.7 min
 Discarded = 0.08 cfs @ 7.36 hrs, Volume= 0.167 af
 Primary = 4.32 cfs @ 12.10 hrs, Volume= 0.187 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.48' @ 12.10 hrs Surf.Area= 1,440 sf Storage= 2,551 cf

Plug-Flow detention time= 135.7 min calculated for 0.354 af (100% of inflow)
 Center-of-Mass det. time= 135.6 min (891.7 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1	6.10'	1,005 cf	24.0" Round Pipe Storage Inside #2 L= 320.0'
#2	5.10'	2,190 cf	4.50'W x 320.00'L x 4.50'H Stone 6,480 cf Overall - 1,005 cf Embedded = 5,475 cf x 40.0% Voids
		3,195 cf	Total Available Storage

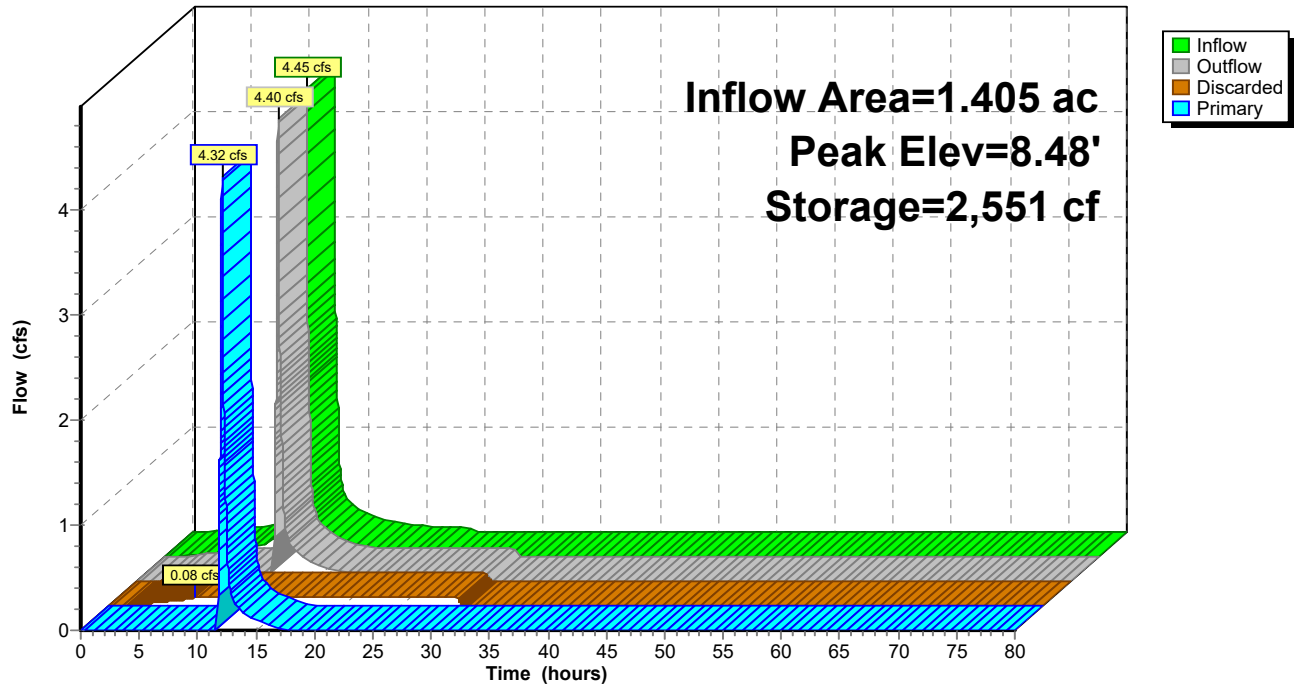
Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	24.0" Round Culvert L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.97' S= 0.0150 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	8.00'	4.0' long x 5.60' rise Sharp-Crested Rectangular Weir 2 End Contraction(s) 6.0' Crest Height
#3	Discarded	5.10'	2.400 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 7.36 hrs HW=5.19' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=4.30 cfs @ 12.10 hrs HW=8.48' (Free Discharge)
 ↑ **1=Culvert** (Passes 4.30 cfs of 35.41 cfs potential flow)
 ↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 4.30 cfs @ 2.29 fps)

Pond 8P: Perforated Pipe

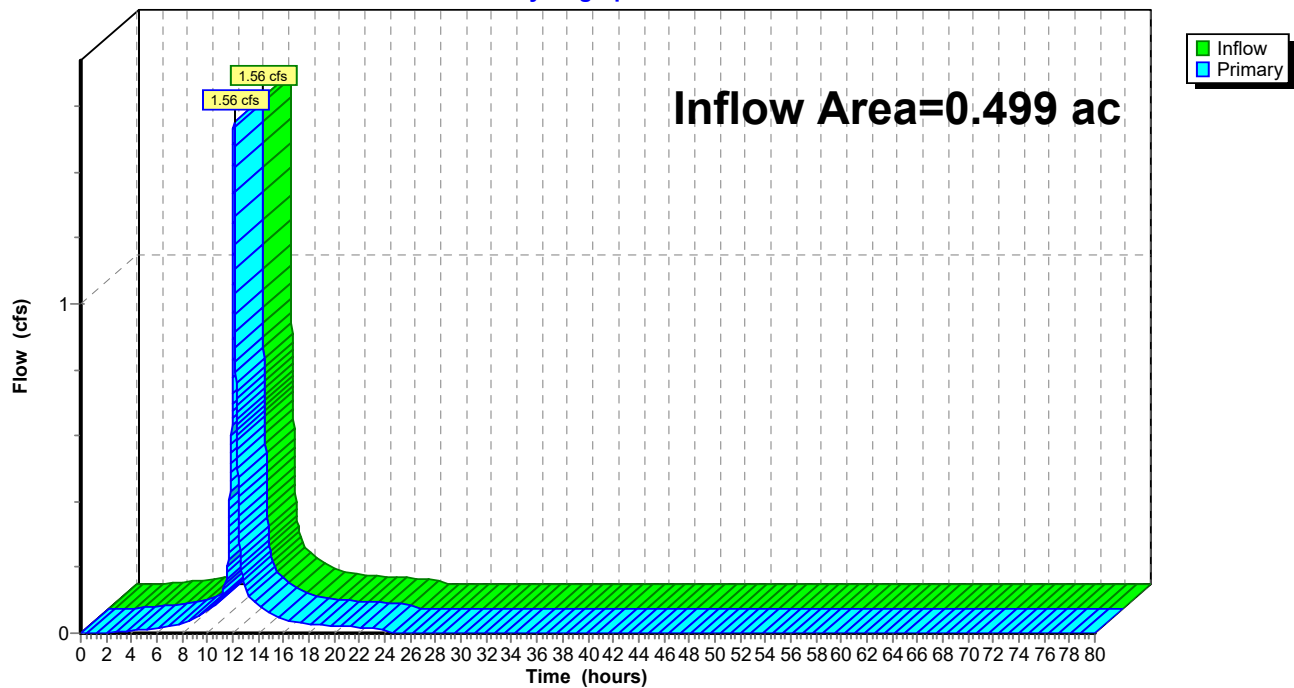
Hydrograph



Summary for Link 1L: Somerville Drainage

Inflow Area = 0.499 ac, 88.71% Impervious, Inflow Depth = 2.92" for 2-YR event
Inflow = 1.56 cfs @ 12.08 hrs, Volume= 0.121 af
Primary = 1.56 cfs @ 12.08 hrs, Volume= 0.121 af, Atten= 0%, Lag= 0.0 min

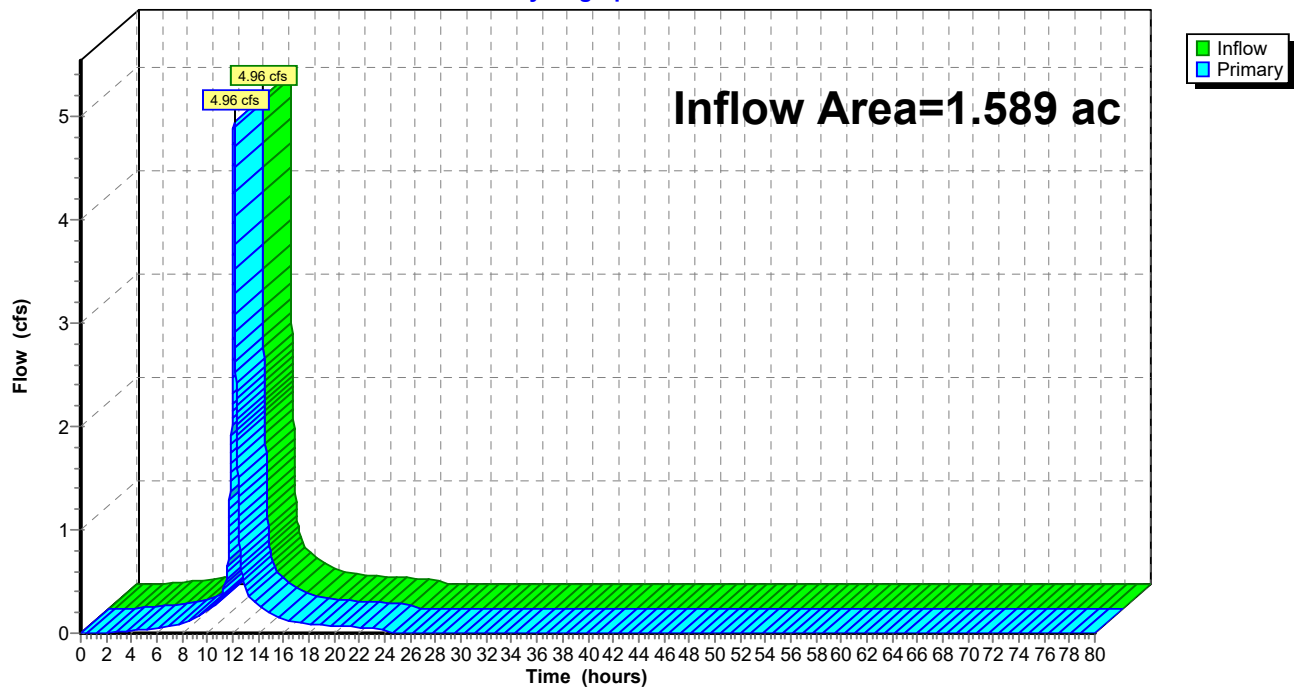
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 1L: Somerville Drainage**Hydrograph**

Summary for Link 2L: Somerville Drainage

Inflow Area = 1.589 ac, 91.63% Impervious, Inflow Depth = 2.92" for 2-YR event
Inflow = 4.96 cfs @ 12.08 hrs, Volume= 0.386 af
Primary = 4.96 cfs @ 12.08 hrs, Volume= 0.386 af, Atten= 0%, Lag= 0.0 min

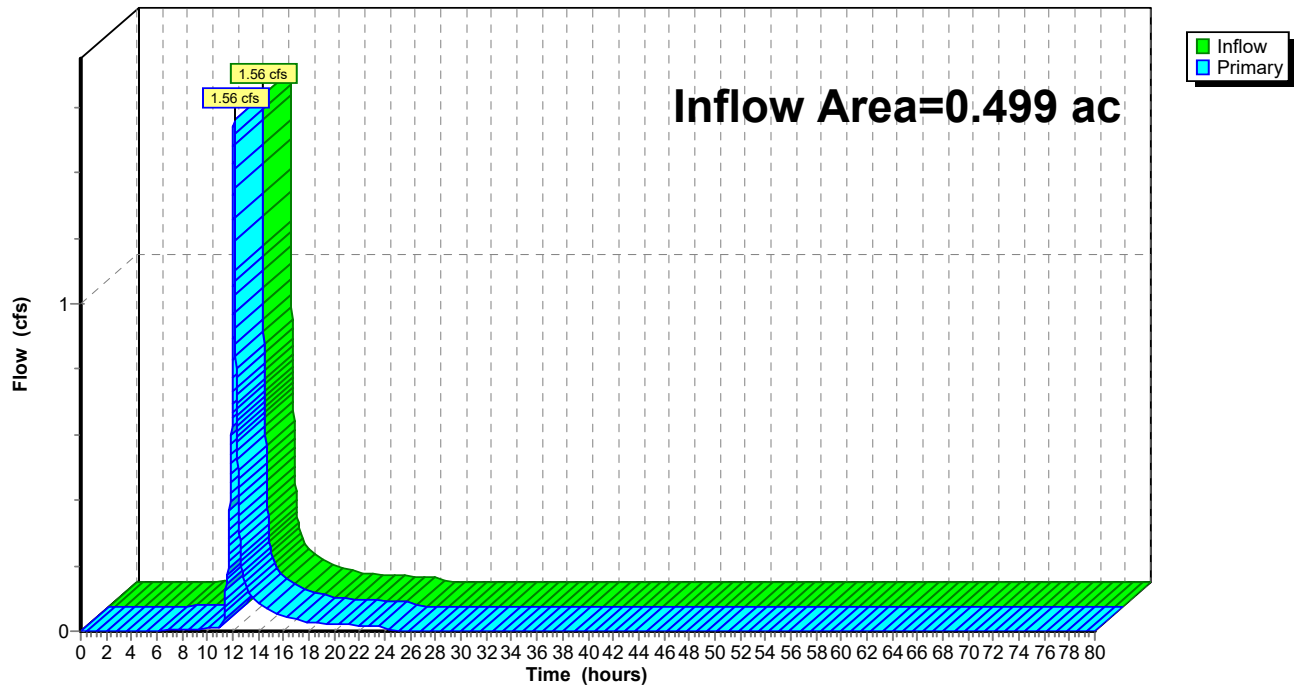
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 2L: Somerville Drainage**Hydrograph**

Summary for Link 3L: Somerville Drainage

Inflow Area = 0.499 ac, 97.89% Impervious, Inflow Depth = 2.40" for 2-YR event
Inflow = 1.56 cfs @ 12.09 hrs, Volume= 0.100 af
Primary = 1.56 cfs @ 12.09 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min

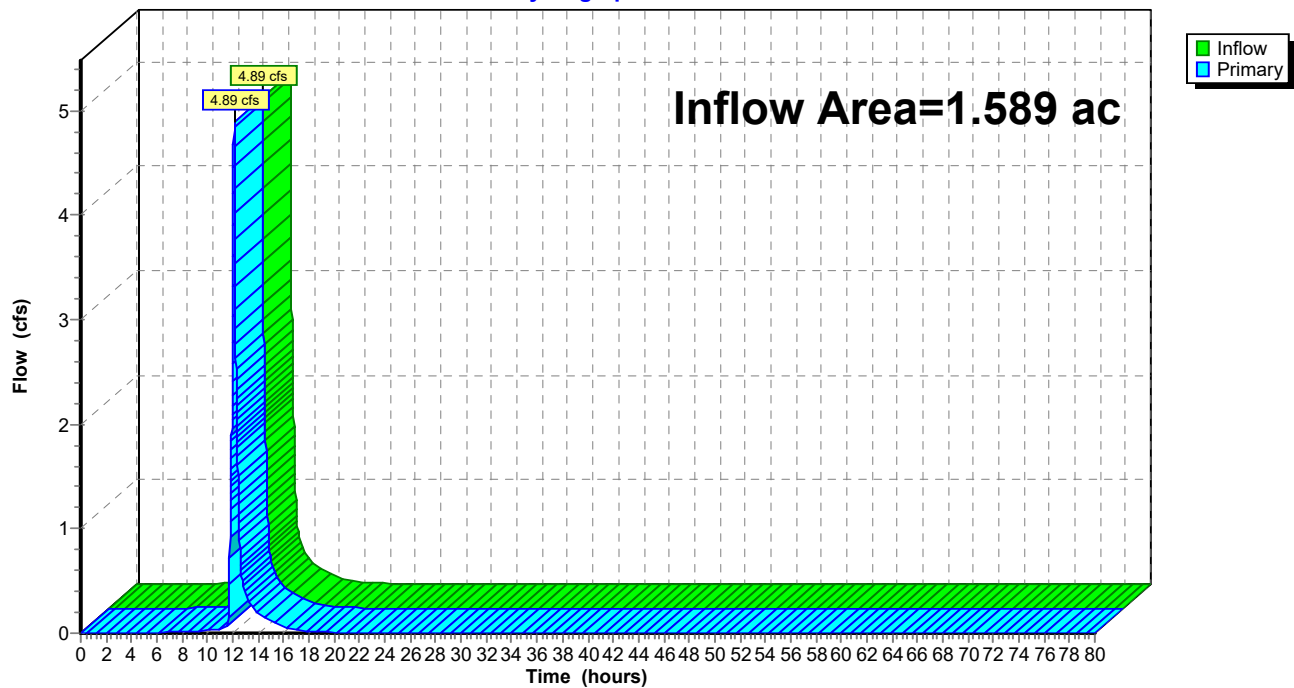
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 3L: Somerville Drainage**Hydrograph**

Summary for Link 4L: Somerville Drainage

Inflow Area = 1.589 ac, 100.00% Impervious, Inflow Depth = 1.76" for 2-YR event
Inflow = 4.89 cfs @ 12.09 hrs, Volume= 0.233 af
Primary = 4.89 cfs @ 12.09 hrs, Volume= 0.233 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 4L: Somerville Drainage**Hydrograph**

13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 5-YR Rainfall=4.29"

Printed 10/10/2018

Page 60

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Hotel Runoff Area=21,734 sf 88.71% Impervious Runoff Depth=3.94"
 Flow Length=261' Tc=6.0 min CN=97 Runoff=2.07 cfs 0.164 af

Subcatchment2S: EX Residential Runoff Area=69,198 sf 91.63% Impervious Runoff Depth=3.94"
 Flow Length=233' Tc=6.0 min CN=97 Runoff=6.59 cfs 0.522 af

Subcatchment3Sa: PR Hotel - Offsite Runoff Area=2,394 sf 100.00% Impervious Runoff Depth=4.05"
 Tc=6.0 min CN=98 Runoff=0.23 cfs 0.019 af

Subcatchment3Sb: PR Hotel Runoff Area=19,340 sf 97.63% Impervious Runoff Depth=3.94"
 Flow Length=140' Tc=6.0 min CN=97 Runoff=1.84 cfs 0.146 af

Subcatchment4S: PR Residential - Site Runoff Area=8,001 sf 100.00% Impervious Runoff Depth=4.05"
 Flow Length=60' Slope=0.0210 '/' Tc=6.0 min CN=98 Runoff=0.77 cfs 0.062 af

Subcatchment5S: PR Residential - Runoff Area=61,197 sf 100.00% Impervious Runoff Depth=4.05"
 Tc=6.0 min CN=98 Runoff=5.88 cfs 0.475 af

Pond 7P: Subsurface Infiltration #1 Peak Elev=8.77' Storage=0.024 af Inflow=1.84 cfs 0.146 af
 Outflow=1.89 cfs 0.124 af

Pond 8P: Perforated Pipe Peak Elev=8.58' Storage=2,611 cf Inflow=5.88 cfs 0.475 af
 Discarded=0.08 cfs 0.183 af Primary=5.75 cfs 0.292 af Outflow=5.83 cfs 0.475 af

Link 1L: Somerville Drainage Inflow=2.07 cfs 0.164 af
 Primary=2.07 cfs 0.164 af

Link 2L: Somerville Drainage Inflow=6.59 cfs 0.522 af
 Primary=6.59 cfs 0.522 af

Link 3L: Somerville Drainage Inflow=2.12 cfs 0.142 af
 Primary=2.12 cfs 0.142 af

Link 4L: Somerville Drainage Inflow=6.51 cfs 0.354 af
 Primary=6.51 cfs 0.354 af

Total Runoff Area = 4.175 ac Runoff Volume = 1.386 af Average Runoff Depth = 3.99"
4.79% Pervious = 0.200 ac 95.21% Impervious = 3.975 ac

13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 5-YR Rainfall=4.29"

Printed 10/10/2018

Page 61

Summary for Subcatchment 1S: EX Hotel

Runoff = 2.07 cfs @ 12.08 hrs, Volume= 0.164 af, Depth= 3.94"

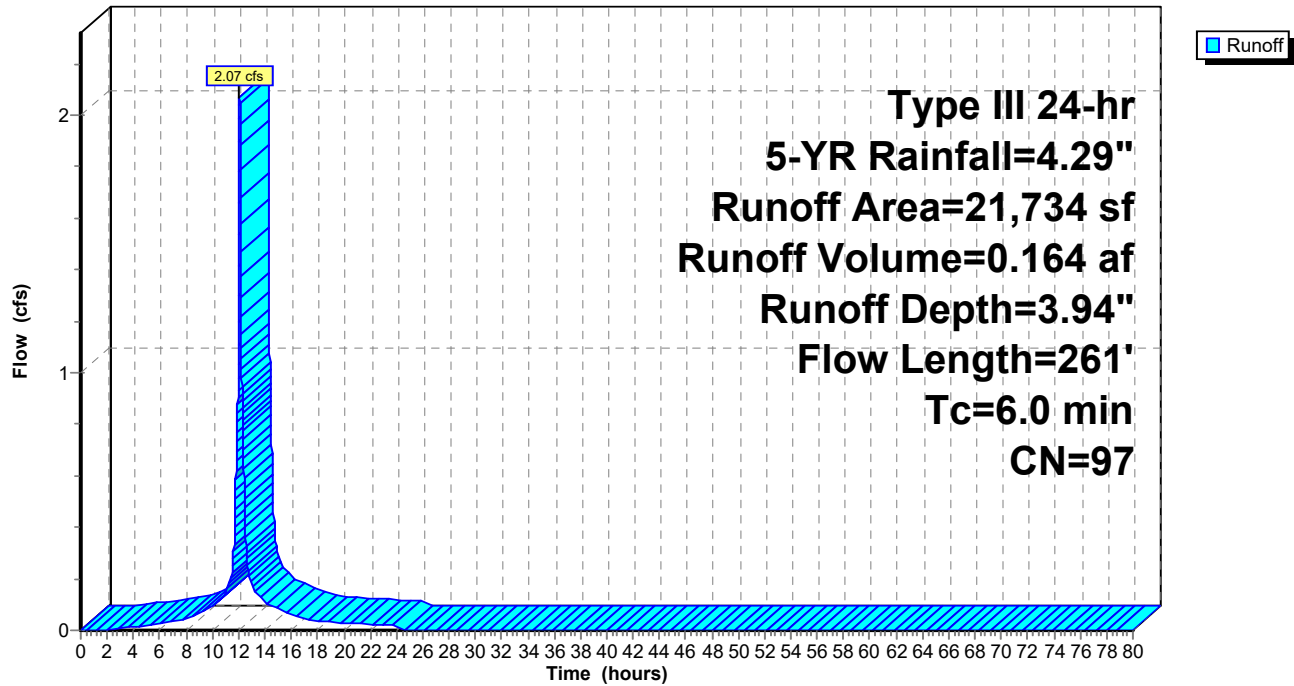
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 5-YR Rainfall=4.29"

	Area (sf)	CN	Description
*	19,281	98	Paved parking
	2,453	89	<50% Grass cover, Poor, HSG D
	21,734	97	Weighted Average
	2,453		11.29% Pervious Area
	19,281		88.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	4	0.1262	0.45		Sheet Flow, Fallow n= 0.050 P2= 3.19"
0.8	46	0.0120	0.96		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.0	1	0.0125	2.27		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	91	0.0789	11.49	4.01	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.4	82	0.0066	3.32	1.16	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.1	37	0.0195	5.71	1.99	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
1.5	261	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: EX Hotel

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 5-YR Rainfall=4.29"

Printed 10/10/2018

Page 63

Summary for Subcatchment 2S: EX Residential

Runoff = 6.59 cfs @ 12.08 hrs, Volume= 0.522 af, Depth= 3.94"

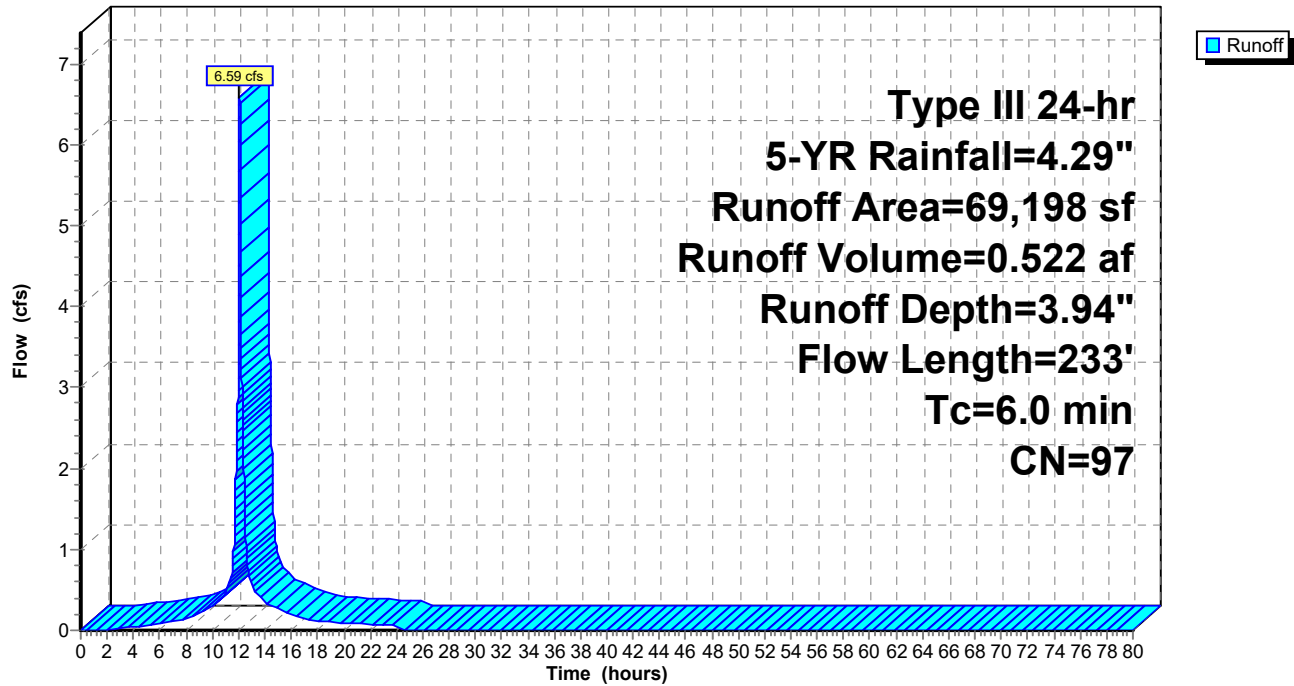
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 5-YR Rainfall=4.29"

	Area (sf)	CN	Description
*	5,325	98	Roof - City Club
*	8,096	98	Roof - Paradigm
	5,794	89	<50% Grass cover, Poor, HSG D
*	49,983	98	Paved parking, conc
	69,198	97	Weighted Average
	5,794		8.37% Pervious Area
	63,404		91.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0044	0.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
1.6	20	0.0800	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.19"
0.6	20	0.0040	0.52		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.2	30	0.0234	3.11		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	134	0.0167	5.29	1.85	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
0.0	20	0.0366	7.83	2.73	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
3.1	233	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: EX Residential

Hydrograph



Summary for Subcatchment 3Sa: PR Hotel - Offsite

Runoff = 0.23 cfs @ 12.08 hrs, Volume= 0.019 af, Depth= 4.05"

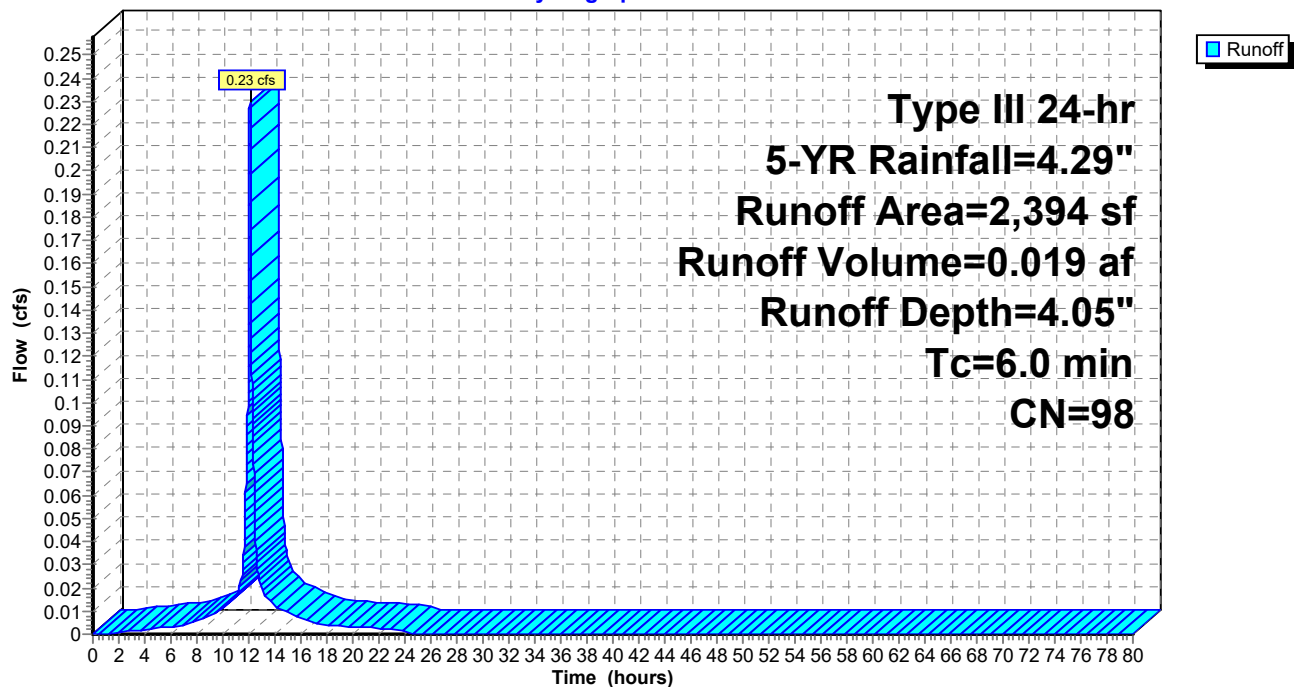
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 5-YR Rainfall=4.29"

Area (sf)	CN	Description
* 2,394	98	Paved parking
2,394		100.00% Impervious Area

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

Subcatchment 3Sa: PR Hotel - Offsite

Hydrograph



Summary for Subcatchment 3Sb: PR Hotel

Runoff = 1.84 cfs @ 12.08 hrs, Volume= 0.146 af, Depth= 3.94"

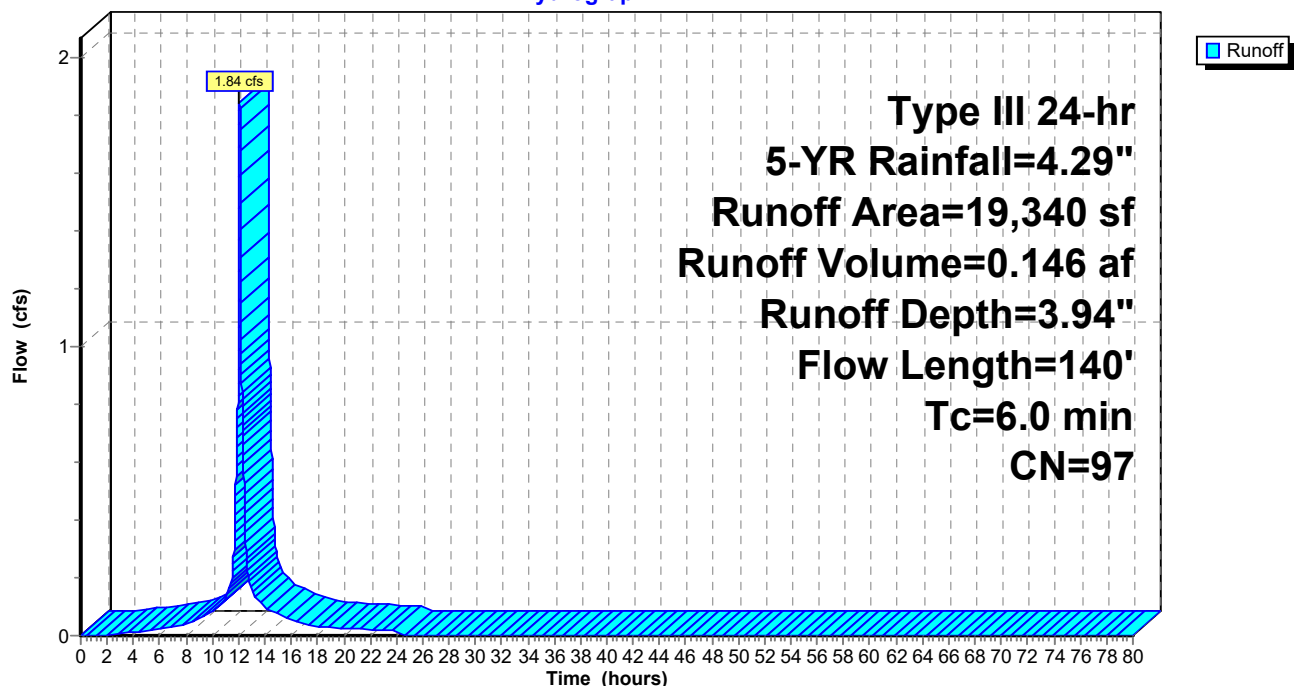
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 5-YR Rainfall=4.29"

Area (sf)	CN	Description
* 13,484	98	Roof - Hotel
* 5,398	98	Parking, sidewalks, pavers, walls, etc
458	74	>75% Grass cover, Good, HSG C
19,340	97	Weighted Average
458		2.37% Pervious Area
18,882		97.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0150	1.07		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.4	72	0.0233	3.10		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	18	0.0150	4.82	3.78	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Corrugated PE, smooth interior
1.3	140	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3Sb: PR Hotel

Hydrograph



Summary for Subcatchment 4S: PR Residential - Site

Runoff = 0.77 cfs @ 12.08 hrs, Volume= 0.062 af, Depth= 4.05"

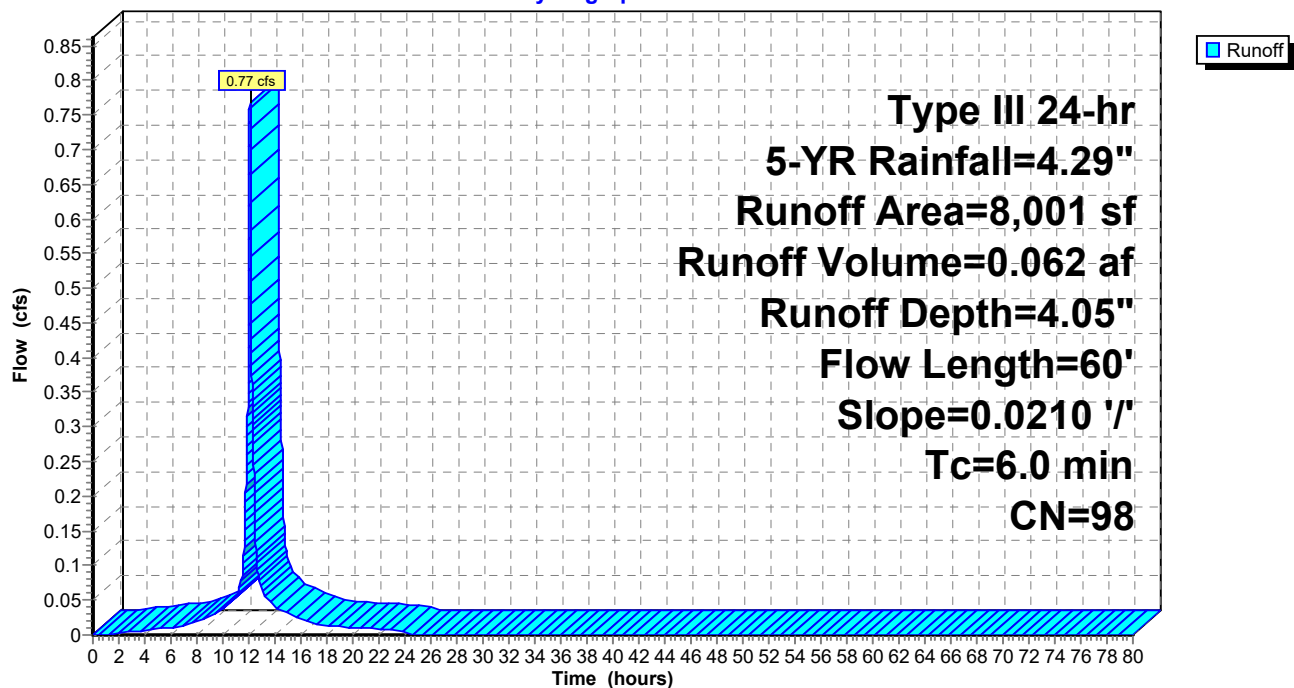
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 5-YR Rainfall=4.29"

Area (sf)	CN	Description
* 8,001	98	Unconnected pavement
8,001		100.00% Impervious Area
8,001		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0210	1.22		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.1	10	0.0210	2.94		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.8	60	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: PR Residential - Site

Hydrograph



Summary for Subcatchment 5S: PR Residential - Rooftop

Runoff = 5.88 cfs @ 12.08 hrs, Volume= 0.475 af, Depth= 4.05"

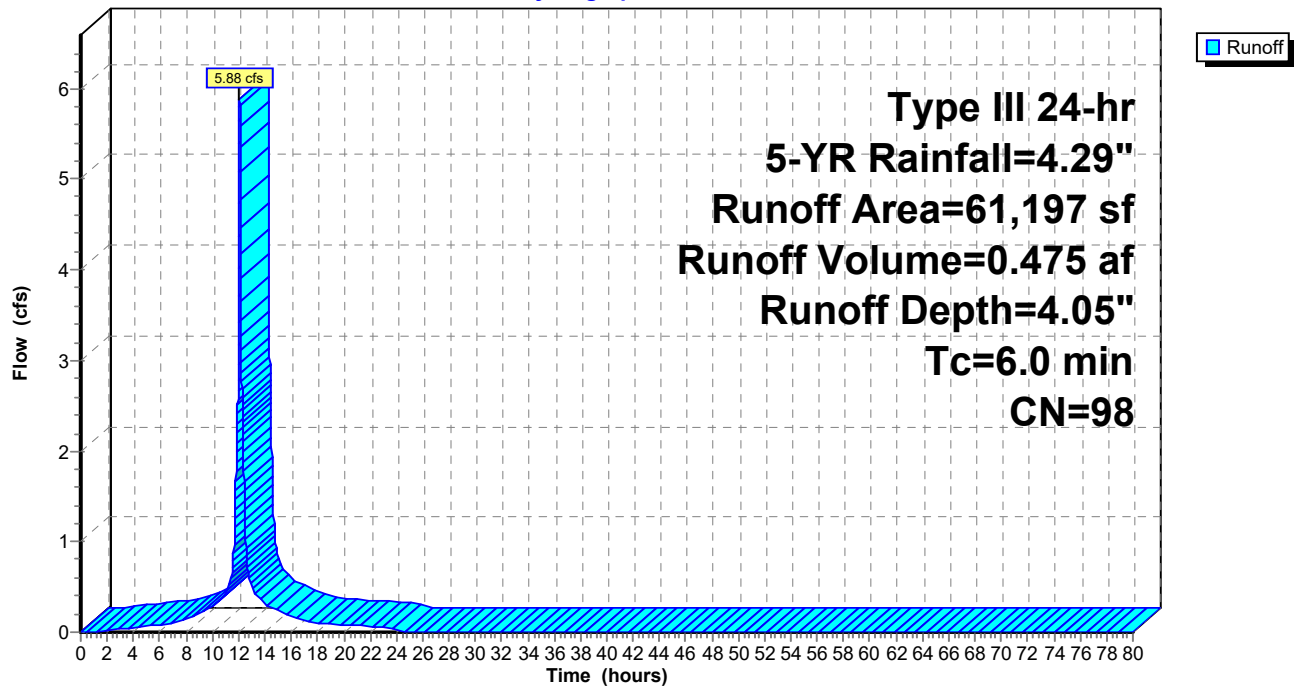
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 5-YR Rainfall=4.29"

Area (sf)	CN	Description
* 61,197	98	Roofs
61,197		100.00% Impervious Area

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

Subcatchment 5S: PR Residential - Rooftop

Hydrograph



Summary for Pond 7P: Subsurface Infiltration #1

[93] Warning: Storage range exceeded by 0.17'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=3)

Inflow Area = 0.444 ac, 97.63% Impervious, Inflow Depth = 3.94" for 5-YR event
 Inflow = 1.84 cfs @ 12.08 hrs, Volume= 0.146 af
 Outflow = 1.89 cfs @ 12.08 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.0 min
 Primary = 1.89 cfs @ 12.08 hrs, Volume= 0.124 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.77' @ 12.08 hrs Surf.Area= 0.012 ac Storage= 0.024 af

Plug-Flow detention time= 117.5 min calculated for 0.124 af (85% of inflow)
 Center-of-Mass det. time= 52.8 min (811.9 - 759.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.10'	0.011 af	15.75"W x 32.10'L x 3.50'H Field A 0.041 af Overall - 0.013 af Embedded = 0.028 af x 40.0% Voids
#2A	5.60'	0.013 af	ADS_StormTech SC-740 +Cap x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 4 Chambers
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.20'	24.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.88 cfs @ 12.08 hrs HW=8.77' (Free Discharge)
 ↑ **1=Orifice/Grate** (Orifice Controls 1.88 cfs @ 2.56 fps)

Pond 7P: Subsurface Infiltration #1 - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

4 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 30.10' Row Length +12.0" End Stone x 2 = 32.10' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

12 Chambers x 45.9 cf = 551.3 cf Chamber Storage

1,769.3 cf Field - 551.3 cf Chambers = 1,218.0 cf Stone x 40.0% Voids = 487.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,038.5 cf = 0.024 af

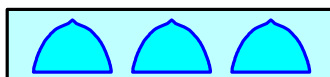
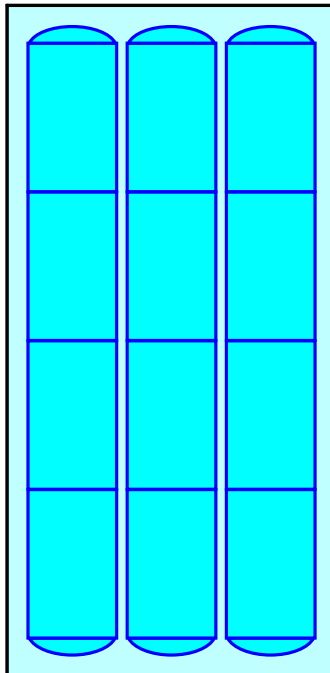
Overall Storage Efficiency = 58.7%

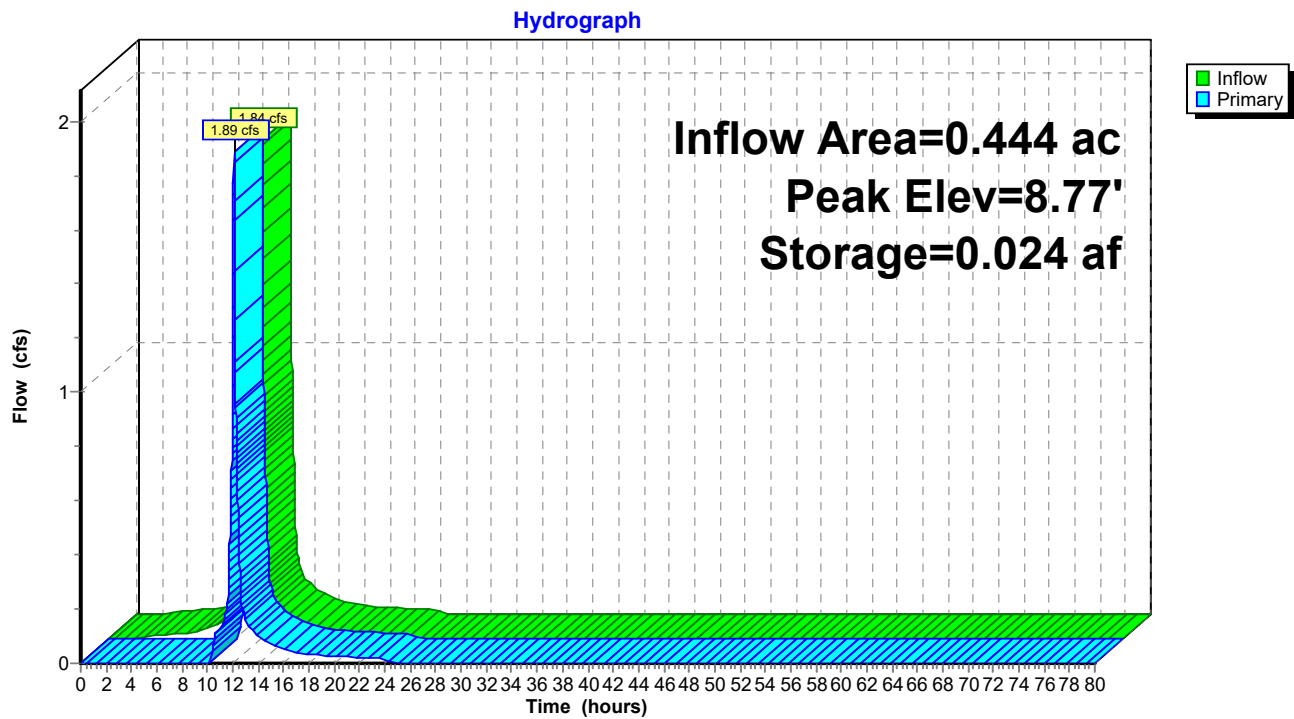
Overall System Size = 32.10' x 15.75' x 3.50'

12 Chambers

65.5 cy Field

45.1 cy Stone



Pond 7P: Subsurface Infiltration #1

Summary for Pond 8P: Perforated Pipe

Inflow Area = 1.405 ac, 100.00% Impervious, Inflow Depth = 4.05" for 5-YR event
 Inflow = 5.88 cfs @ 12.08 hrs, Volume= 0.475 af
 Outflow = 5.83 cfs @ 12.09 hrs, Volume= 0.475 af, Atten= 1%, Lag= 0.7 min
 Discarded = 0.08 cfs @ 6.26 hrs, Volume= 0.183 af
 Primary = 5.75 cfs @ 12.09 hrs, Volume= 0.292 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.58' @ 12.09 hrs Surf.Area= 1,440 sf Storage= 2,611 cf

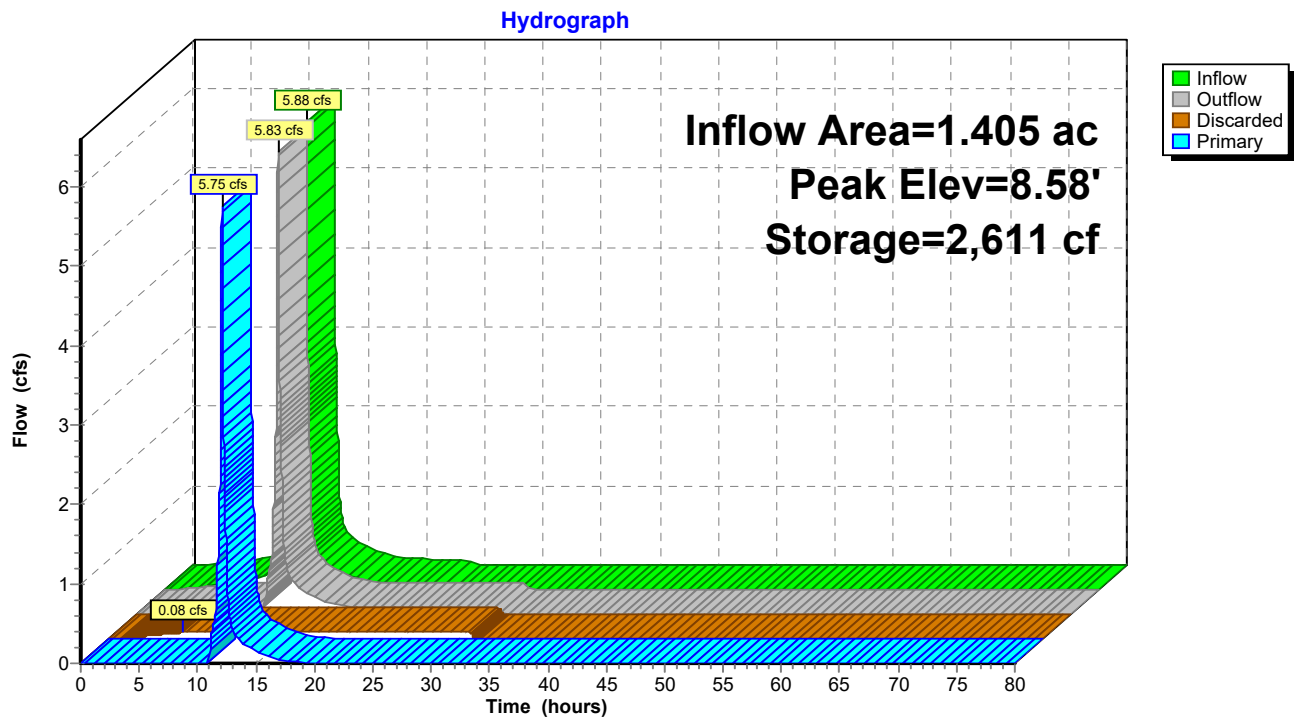
Plug-Flow detention time= 116.5 min calculated for 0.475 af (100% of inflow)
 Center-of-Mass det. time= 116.6 min (867.2 - 750.7)

Volume	Invert	Avail.Storage	Storage Description
#1	6.10'	1,005 cf	24.0" Round Pipe Storage Inside #2 L= 320.0'
#2	5.10'	2,190 cf	4.50'W x 320.00'L x 4.50'H Stone 6,480 cf Overall - 1,005 cf Embedded = 5,475 cf x 40.0% Voids
		3,195 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	24.0" Round Culvert L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.97' S= 0.0150 ' / Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	8.00'	4.0' long x 5.60' rise Sharp-Crested Rectangular Weir 2 End Contraction(s) 6.0' Crest Height
#3	Discarded	5.10'	2.400 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 6.26 hrs HW=5.19' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.08 cfs)

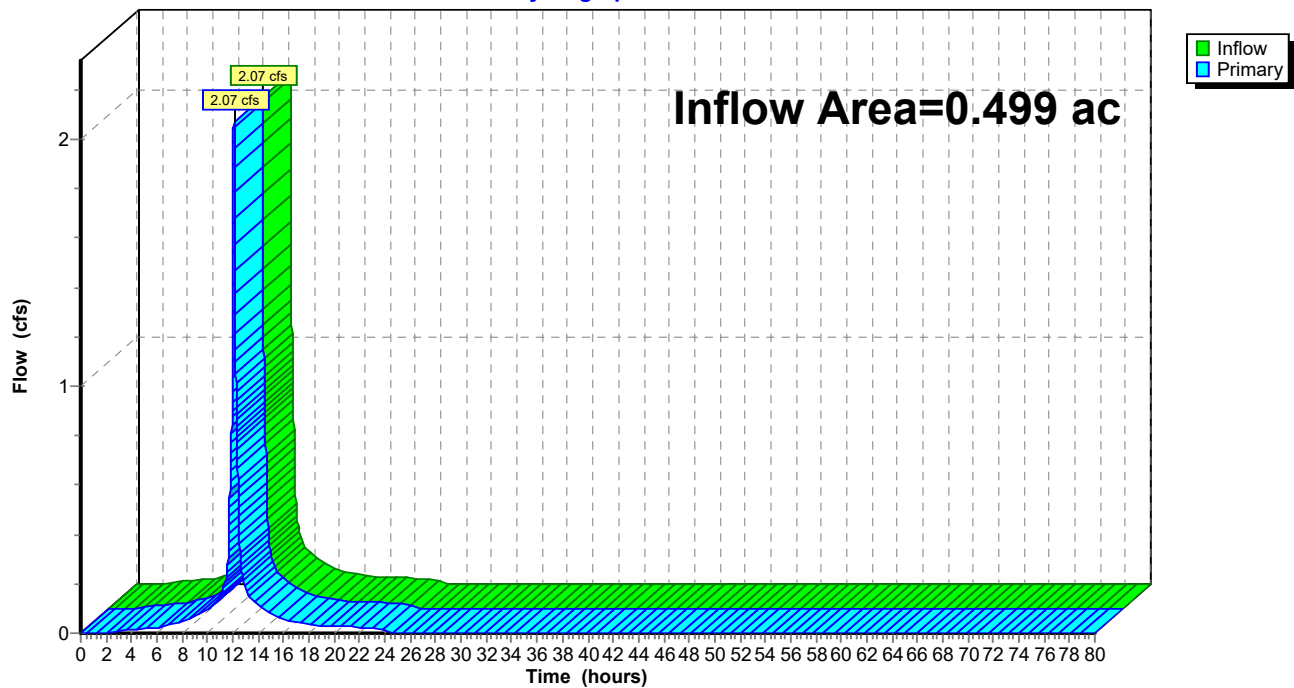
Primary OutFlow Max=5.74 cfs @ 12.09 hrs HW=8.58' (Free Discharge)
 ↑ **1=Culvert** (Passes 5.74 cfs of 35.75 cfs potential flow)
 ↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 5.74 cfs @ 2.53 fps)

Pond 8P: Perforated Pipe

Summary for Link 1L: Somerville Drainage

Inflow Area = 0.499 ac, 88.71% Impervious, Inflow Depth = 3.94" for 5-YR event
Inflow = 2.07 cfs @ 12.08 hrs, Volume= 0.164 af
Primary = 2.07 cfs @ 12.08 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.0 min

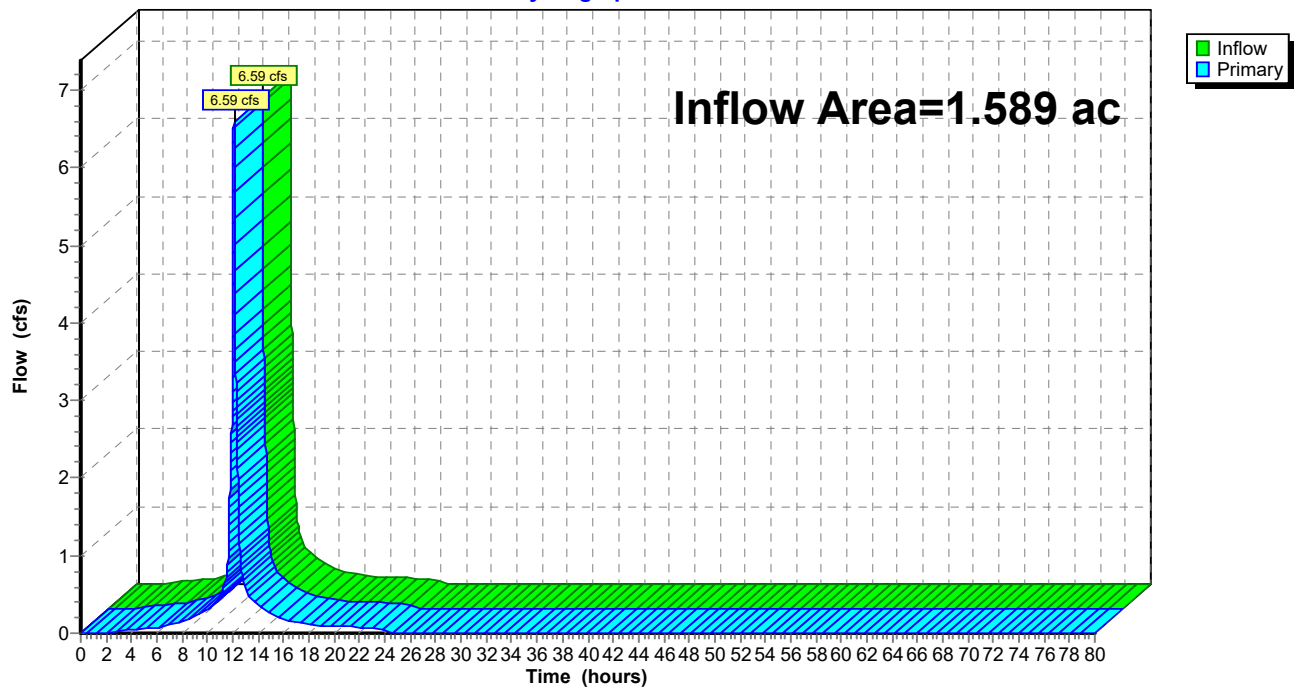
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 1L: Somerville Drainage**Hydrograph**

Summary for Link 2L: Somerville Drainage

Inflow Area = 1.589 ac, 91.63% Impervious, Inflow Depth = 3.94" for 5-YR event
Inflow = 6.59 cfs @ 12.08 hrs, Volume= 0.522 af
Primary = 6.59 cfs @ 12.08 hrs, Volume= 0.522 af, Atten= 0%, Lag= 0.0 min

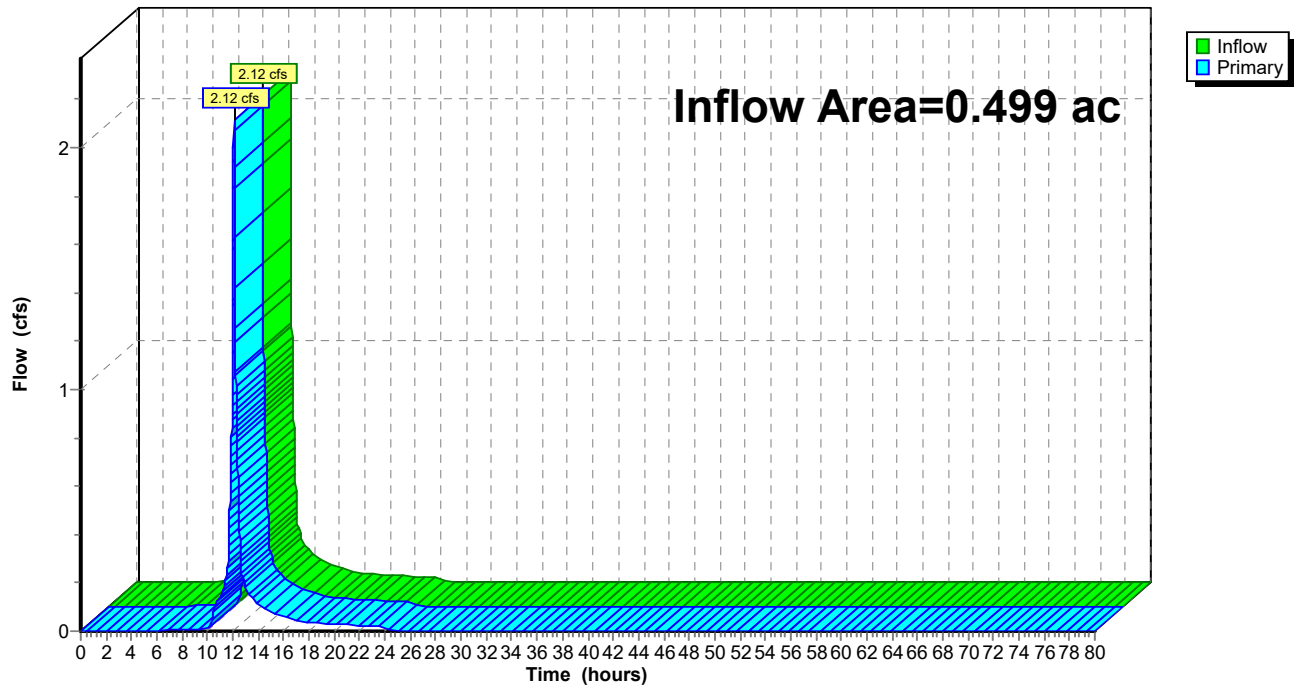
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 2L: Somerville Drainage**Hydrograph**

Summary for Link 3L: Somerville Drainage

Inflow Area = 0.499 ac, 97.89% Impervious, Inflow Depth = 3.42" for 5-YR event
Inflow = 2.12 cfs @ 12.08 hrs, Volume= 0.142 af
Primary = 2.12 cfs @ 12.08 hrs, Volume= 0.142 af, Atten= 0%, Lag= 0.0 min

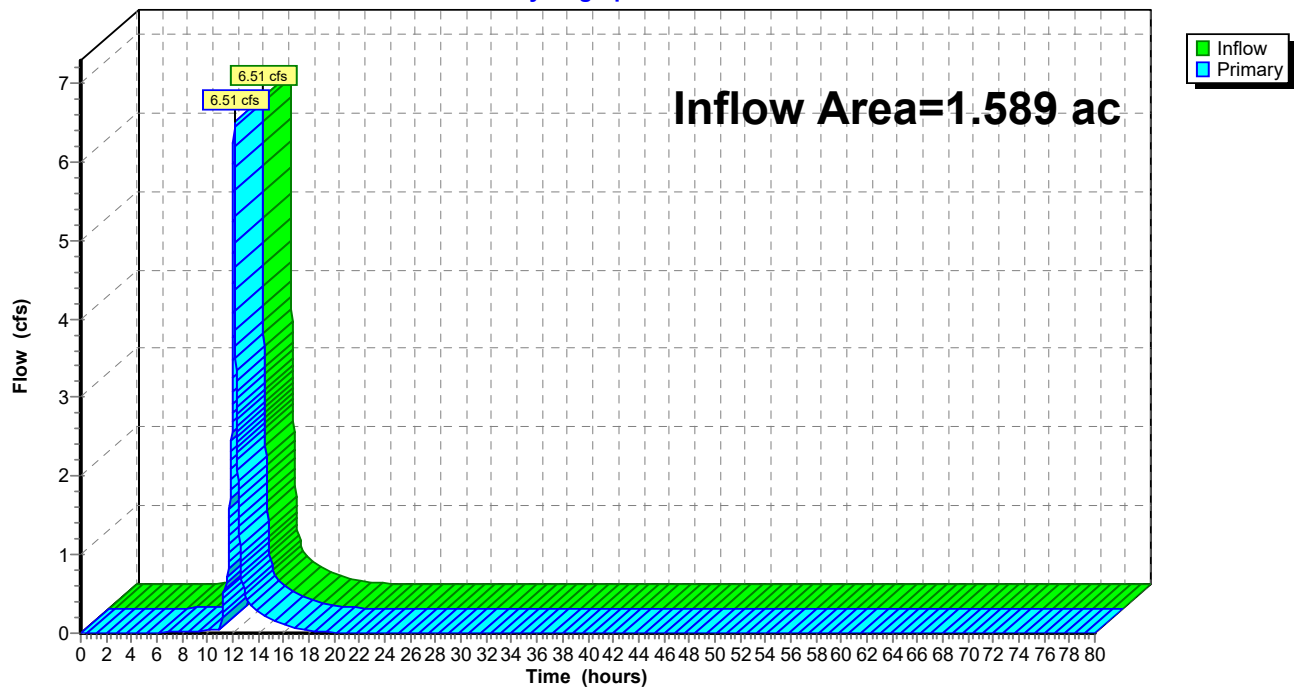
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 3L: Somerville Drainage**Hydrograph**

Summary for Link 4L: Somerville Drainage

Inflow Area = 1.589 ac, 100.00% Impervious, Inflow Depth = 2.67" for 5-YR event
Inflow = 6.51 cfs @ 12.09 hrs, Volume= 0.354 af
Primary = 6.51 cfs @ 12.09 hrs, Volume= 0.354 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 4L: Somerville Drainage**Hydrograph**

13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=5.15"

Printed 10/10/2018

Page 78

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Hotel	Runoff Area=21,734 sf 88.71% Impervious Runoff Depth=4.80" Flow Length=261' Tc=6.0 min CN=97 Runoff=2.50 cfs 0.199 af
Subcatchment2S: EX Residential	Runoff Area=69,198 sf 91.63% Impervious Runoff Depth=4.80" Flow Length=233' Tc=6.0 min CN=97 Runoff=7.95 cfs 0.635 af
Subcatchment3Sa: PR Hotel - Offsite	Runoff Area=2,394 sf 100.00% Impervious Runoff Depth=4.91" Tc=6.0 min CN=98 Runoff=0.28 cfs 0.023 af
Subcatchment3Sb: PR Hotel	Runoff Area=19,340 sf 97.63% Impervious Runoff Depth=4.80" Flow Length=140' Tc=6.0 min CN=97 Runoff=2.22 cfs 0.177 af
Subcatchment4S: PR Residential - Site	Runoff Area=8,001 sf 100.00% Impervious Runoff Depth=4.91" Flow Length=60' Slope=0.0210 '/' Tc=6.0 min CN=98 Runoff=0.93 cfs 0.075 af
Subcatchment5S: PR Residential -	Runoff Area=61,197 sf 100.00% Impervious Runoff Depth=4.91" Tc=6.0 min CN=98 Runoff=7.08 cfs 0.575 af
Pond 7P: Subsurface Infiltration #1	Peak Elev=8.82' Storage=0.024 af Inflow=2.22 cfs 0.177 af Outflow=2.25 cfs 0.155 af
Pond 8P: Perforated Pipe	Peak Elev=8.66' Storage=2,656 cf Inflow=7.08 cfs 0.575 af Discarded=0.08 cfs 0.191 af Primary=6.94 cfs 0.384 af Outflow=7.02 cfs 0.575 af
Link 1L: Somerville Drainage	Inflow=2.50 cfs 0.199 af Primary=2.50 cfs 0.199 af
Link 2L: Somerville Drainage	Inflow=7.95 cfs 0.635 af Primary=7.95 cfs 0.635 af
Link 3L: Somerville Drainage	Inflow=2.53 cfs 0.178 af Primary=2.53 cfs 0.178 af
Link 4L: Somerville Drainage	Inflow=7.86 cfs 0.459 af Primary=7.86 cfs 0.459 af

Total Runoff Area = 4.175 ac Runoff Volume = 1.685 af Average Runoff Depth = 4.84"
4.79% Pervious = 0.200 ac 95.21% Impervious = 3.975 ac

13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=5.15"

Printed 10/10/2018

Page 79

Summary for Subcatchment 1S: EX Hotel

Runoff = 2.50 cfs @ 12.08 hrs, Volume= 0.199 af, Depth= 4.80"

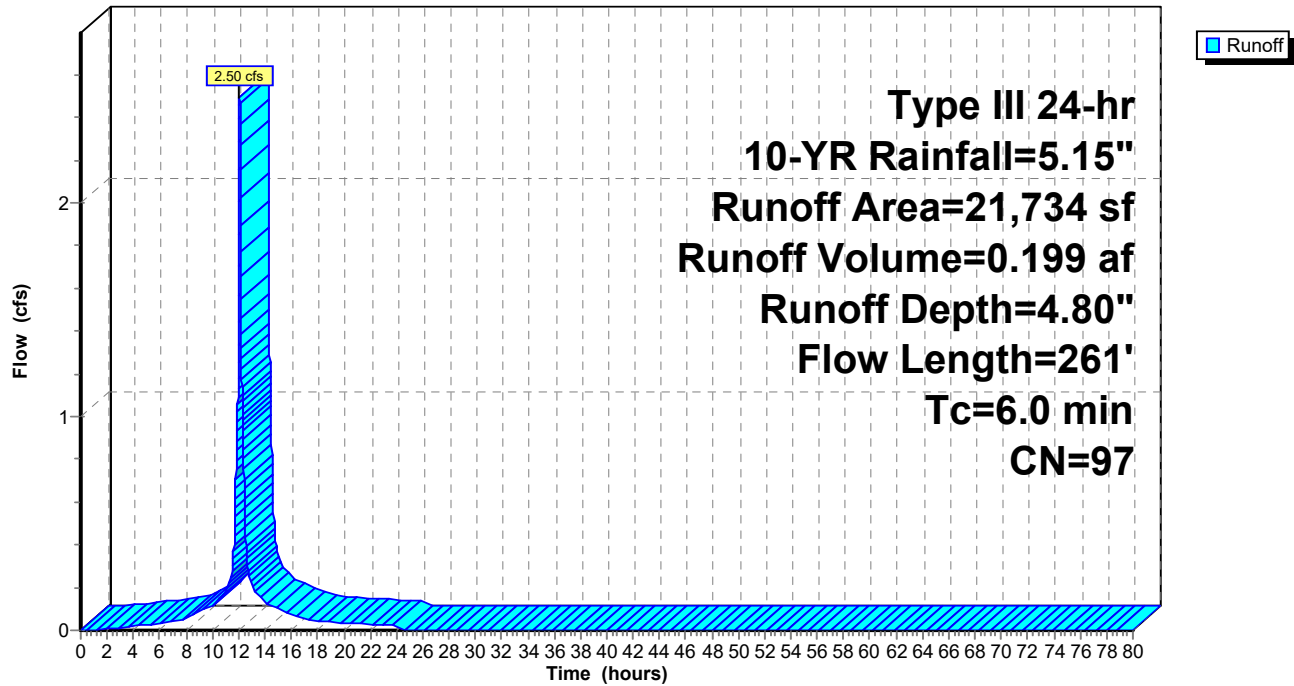
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.15"

	Area (sf)	CN	Description
*	19,281	98	Paved parking
	2,453	89	<50% Grass cover, Poor, HSG D
	21,734	97	Weighted Average
	2,453		11.29% Pervious Area
	19,281		88.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	4	0.1262	0.45		Sheet Flow, Fallow n= 0.050 P2= 3.19"
0.8	46	0.0120	0.96		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.0	1	0.0125	2.27		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	91	0.0789	11.49	4.01	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.4	82	0.0066	3.32	1.16	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.1	37	0.0195	5.71	1.99	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
1.5	261	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: EX Hotel

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=5.15"

Printed 10/10/2018

Page 81

Summary for Subcatchment 2S: EX Residential

Runoff = 7.95 cfs @ 12.08 hrs, Volume= 0.635 af, Depth= 4.80"

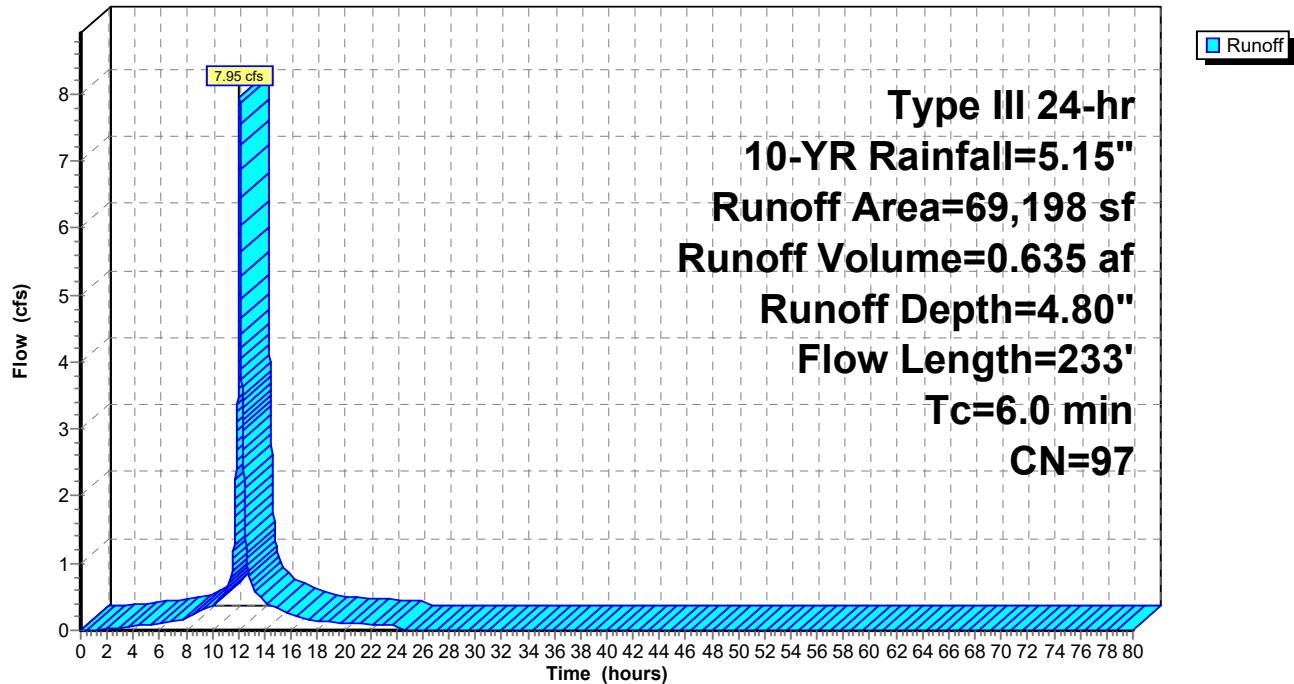
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.15"

	Area (sf)	CN	Description
*	5,325	98	Roof - City Club
*	8,096	98	Roof - Paradigm
	5,794	89	<50% Grass cover, Poor, HSG D
*	49,983	98	Paved parking, conc
	69,198	97	Weighted Average
	5,794		8.37% Pervious Area
	63,404		91.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0044	0.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
1.6	20	0.0800	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.19"
0.6	20	0.0040	0.52		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.2	30	0.0234	3.11		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	134	0.0167	5.29	1.85	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
0.0	20	0.0366	7.83	2.73	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
3.1	233	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: EX Residential

Hydrograph



Summary for Subcatchment 3Sa: PR Hotel - Offsite

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af, Depth= 4.91"

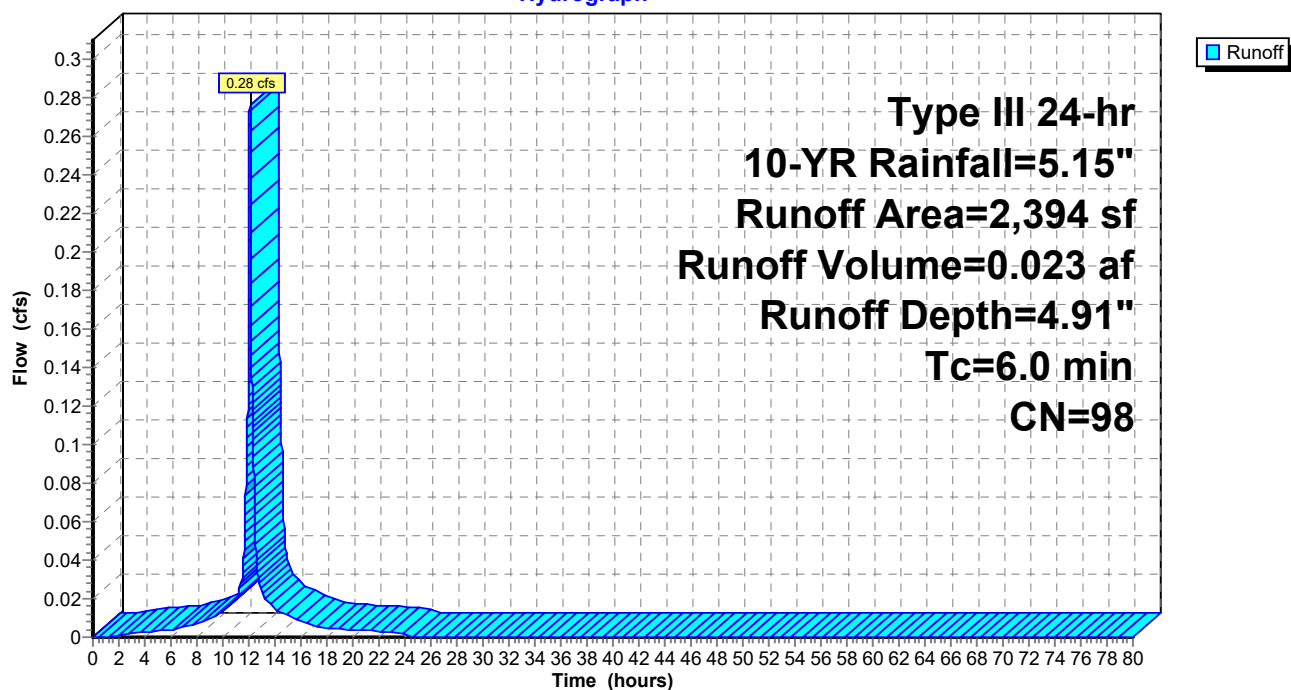
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.15"

Area (sf)	CN	Description
* 2,394	98	Paved parking
2,394		100.00% Impervious Area

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

Subcatchment 3Sa: PR Hotel - Offsite

Hydrograph



Summary for Subcatchment 3Sb: PR Hotel

Runoff = 2.22 cfs @ 12.08 hrs, Volume= 0.177 af, Depth= 4.80"

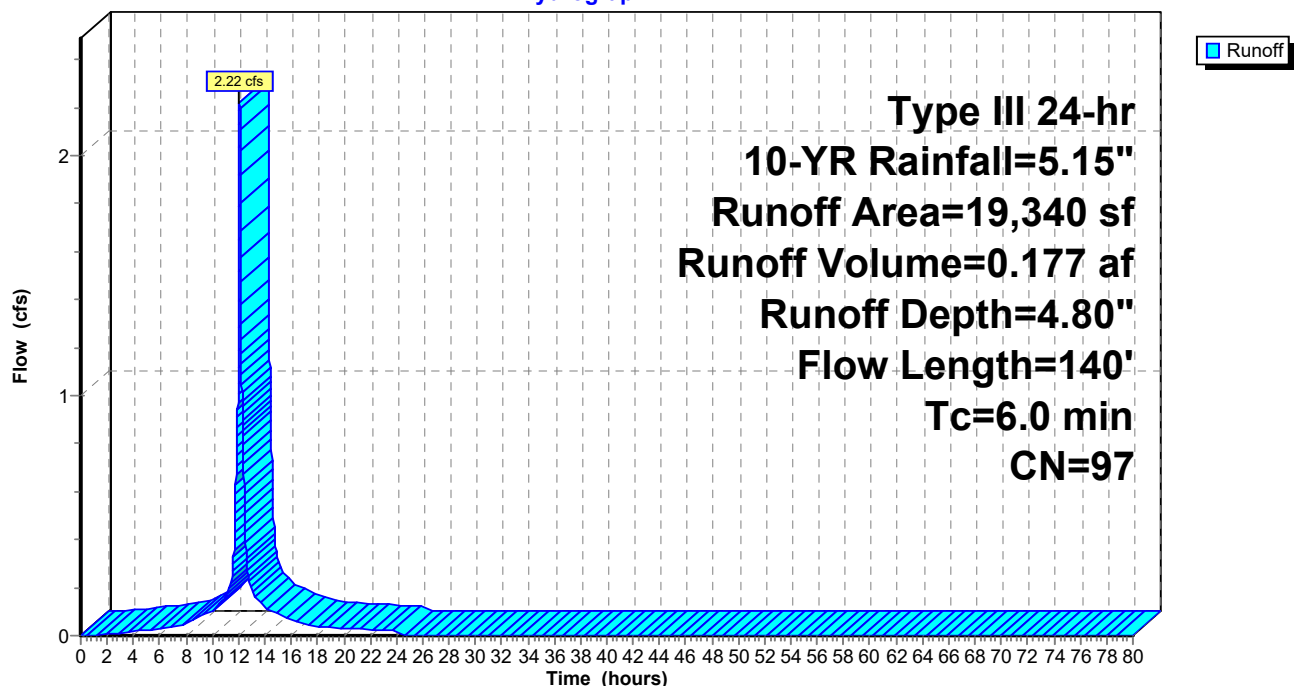
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.15"

	Area (sf)	CN	Description
*	13,484	98	Roof - Hotel
*	5,398	98	Parking, sidewalks, pavers, walls, etc
	458	74	>75% Grass cover, Good, HSG C
	19,340	97	Weighted Average
	458		2.37% Pervious Area
	18,882		97.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0150	1.07		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.4	72	0.0233	3.10		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	18	0.0150	4.82	3.78	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Corrugated PE, smooth interior
1.3	140	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3Sb: PR Hotel

Hydrograph



Summary for Subcatchment 4S: PR Residential - Site

Runoff = 0.93 cfs @ 12.08 hrs, Volume= 0.075 af, Depth= 4.91"

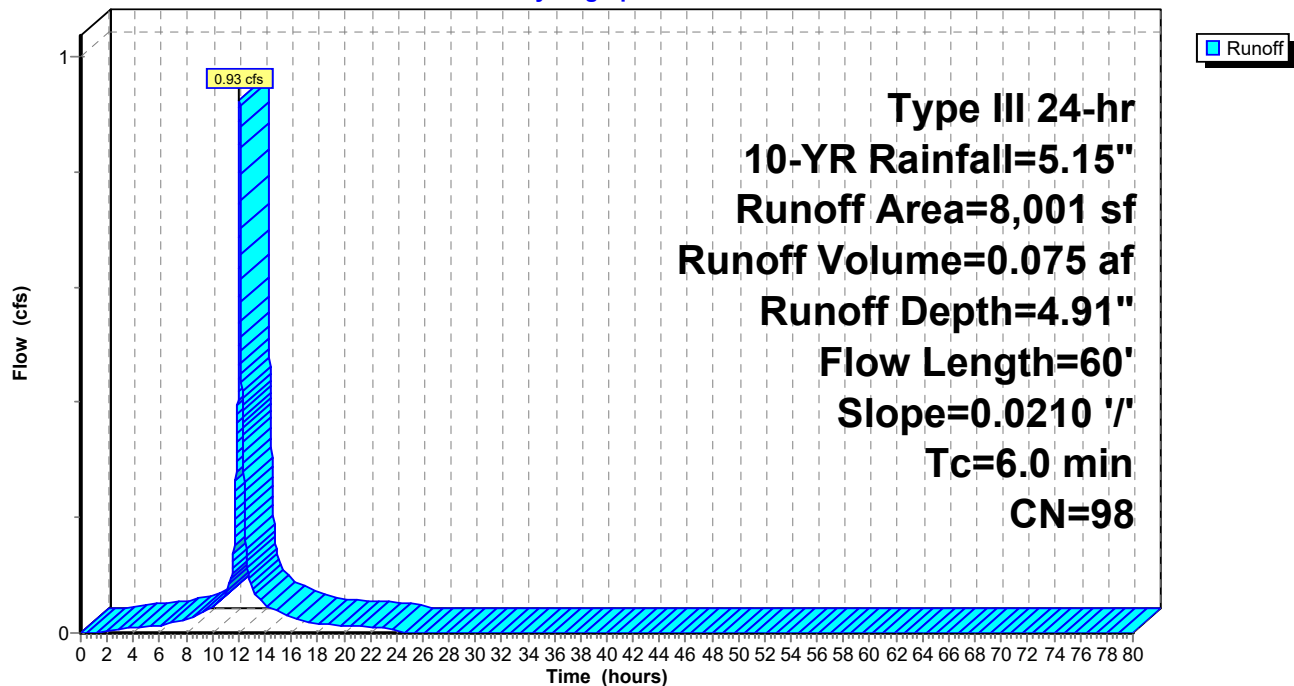
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.15"

Area (sf)	CN	Description
* 8,001	98	Unconnected pavement
8,001		100.00% Impervious Area
8,001		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0210	1.22		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.1	10	0.0210	2.94		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.8	60	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: PR Residential - Site

Hydrograph



Summary for Subcatchment 5S: PR Residential - Rooftop

Runoff = 7.08 cfs @ 12.08 hrs, Volume= 0.575 af, Depth= 4.91"

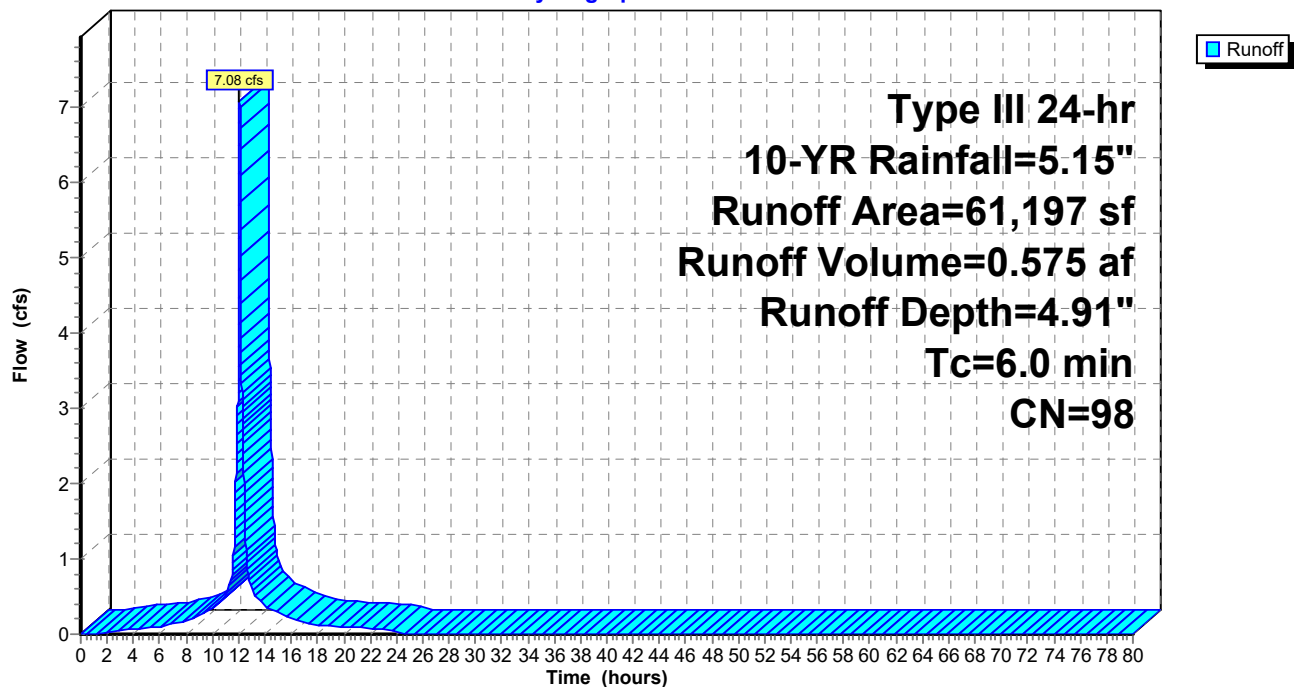
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.15"

Area (sf)	CN	Description
* 61,197	98	Roofs
61,197		100.00% Impervious Area

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

Subcatchment 5S: PR Residential - Rooftop

Hydrograph



Summary for Pond 7P: Subsurface Infiltration #1

[93] Warning: Storage range exceeded by 0.22'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.444 ac, 97.63% Impervious, Inflow Depth = 4.80" for 10-YR event
 Inflow = 2.22 cfs @ 12.08 hrs, Volume= 0.177 af
 Outflow = 2.25 cfs @ 12.08 hrs, Volume= 0.155 af, Atten= 0%, Lag= 0.0 min
 Primary = 2.25 cfs @ 12.08 hrs, Volume= 0.155 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.82' @ 12.08 hrs Surf.Area= 0.012 ac Storage= 0.024 af

Plug-Flow detention time= 105.4 min calculated for 0.155 af (88% of inflow)
 Center-of-Mass det. time= 48.0 min (803.2 - 755.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.10'	0.011 af	15.75'W x 32.10'L x 3.50'H Field A 0.041 af Overall - 0.013 af Embedded = 0.028 af x 40.0% Voids
#2A	5.60'	0.013 af	ADS_StormTech SC-740 +Cap x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 4 Chambers
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.20'	24.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=2.24 cfs @ 12.08 hrs HW=8.82' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 2.24 cfs @ 2.69 fps)

Pond 7P: Subsurface Infiltration #1 - Chamber Wizard Field A**Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

4 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 30.10' Row Length +12.0" End Stone x 2 = 32.10' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

12 Chambers x 45.9 cf = 551.3 cf Chamber Storage

1,769.3 cf Field - 551.3 cf Chambers = 1,218.0 cf Stone x 40.0% Voids = 487.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,038.5 cf = 0.024 af

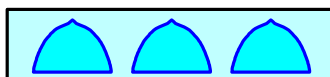
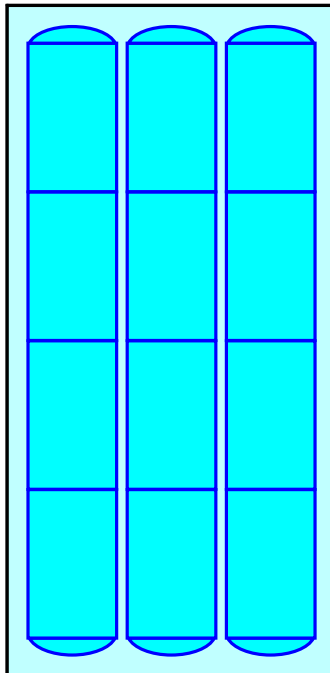
Overall Storage Efficiency = 58.7%

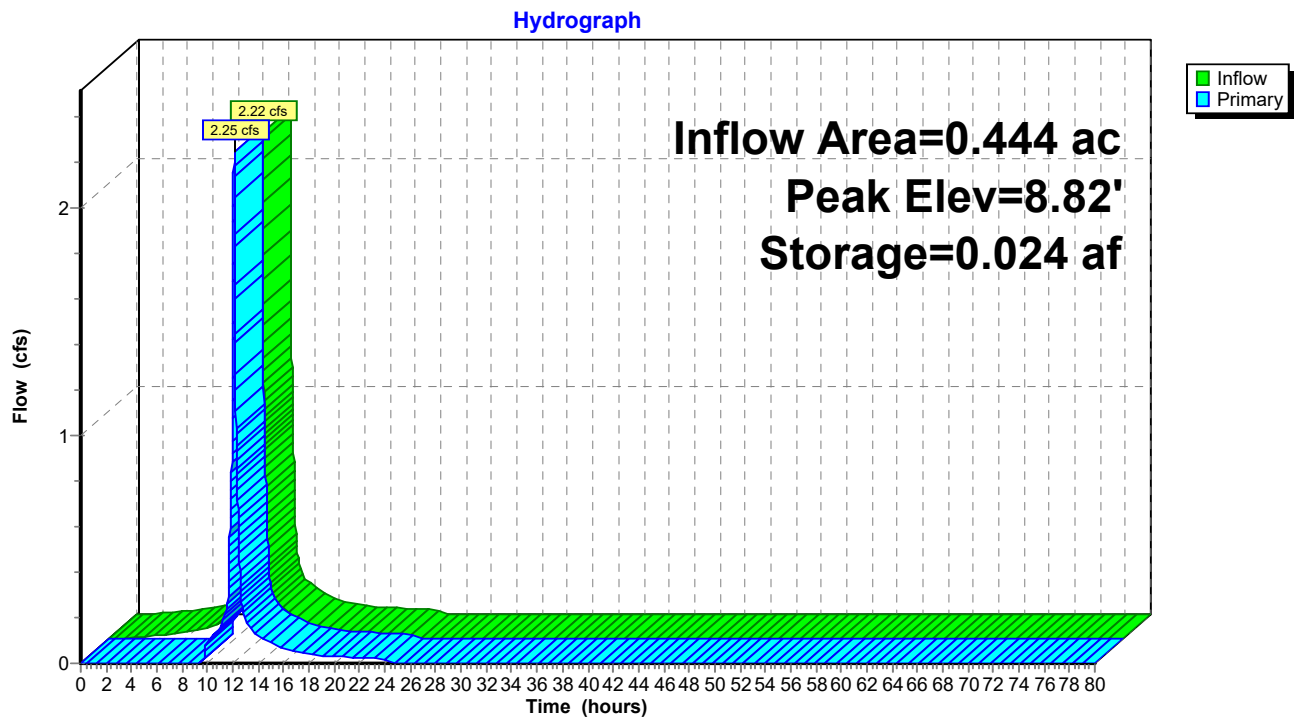
Overall System Size = 32.10' x 15.75' x 3.50'

12 Chambers

65.5 cy Field

45.1 cy Stone



Pond 7P: Subsurface Infiltration #1

Summary for Pond 8P: Perforated Pipe

Inflow Area = 1.405 ac, 100.00% Impervious, Inflow Depth = 4.91" for 10-YR event
 Inflow = 7.08 cfs @ 12.08 hrs, Volume= 0.575 af
 Outflow = 7.02 cfs @ 12.09 hrs, Volume= 0.575 af, Atten= 1%, Lag= 0.6 min
 Discarded = 0.08 cfs @ 4.98 hrs, Volume= 0.191 af
 Primary = 6.94 cfs @ 12.09 hrs, Volume= 0.384 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.66' @ 12.09 hrs Surf.Area= 1,440 sf Storage= 2,656 cf

Plug-Flow detention time= 103.3 min calculated for 0.575 af (100% of inflow)
 Center-of-Mass det. time= 103.4 min (850.9 - 747.5)

Volume	Invert	Avail.Storage	Storage Description
#1	6.10'	1,005 cf	24.0" Round Pipe Storage Inside #2 L= 320.0'
#2	5.10'	2,190 cf	4.50'W x 320.00'L x 4.50'H Stone 6,480 cf Overall - 1,005 cf Embedded = 5,475 cf x 40.0% Voids
		3,195 cf	Total Available Storage

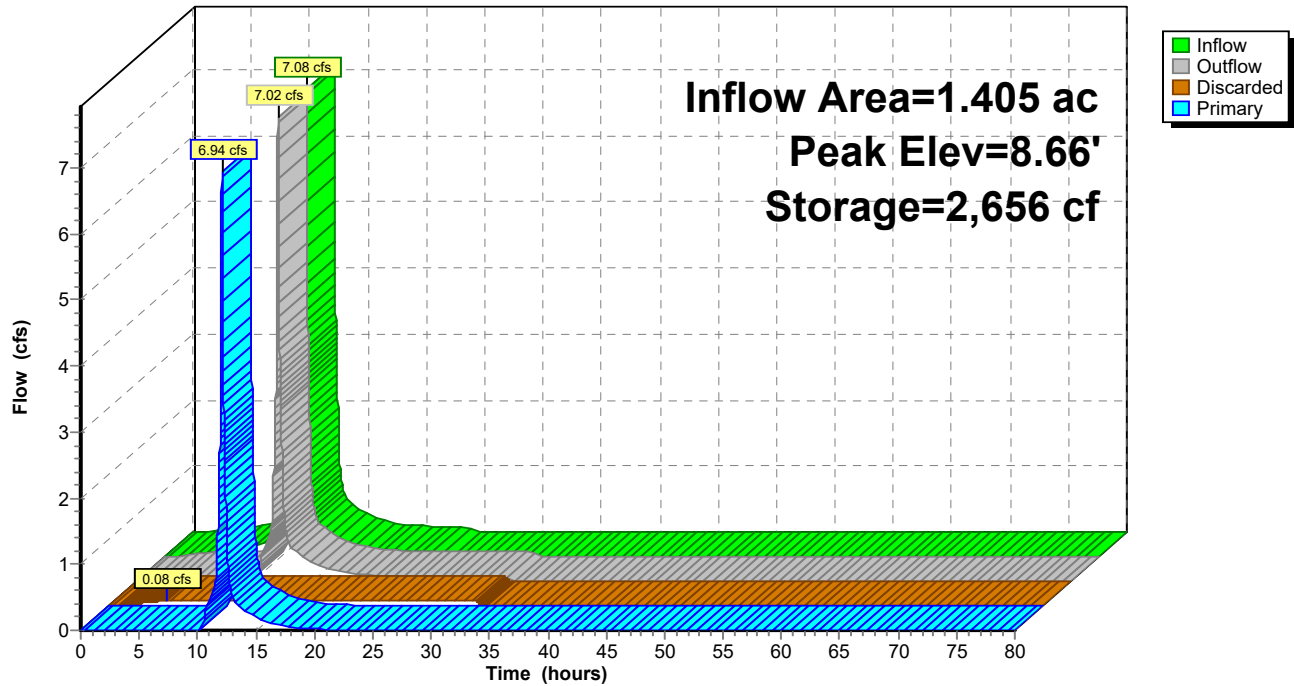
Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	24.0" Round Culvert L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.97' S= 0.0150 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	8.00'	4.0' long x 5.60' rise Sharp-Crested Rectangular Weir 2 End Contraction(s) 6.0' Crest Height
#3	Discarded	5.10'	2.400 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 4.98 hrs HW=5.19' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=6.93 cfs @ 12.09 hrs HW=8.66' (Free Discharge)
 ↑ **1=Culvert** (Passes 6.93 cfs of 36.00 cfs potential flow)
 ↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 6.93 cfs @ 2.70 fps)

Pond 8P: Perforated Pipe

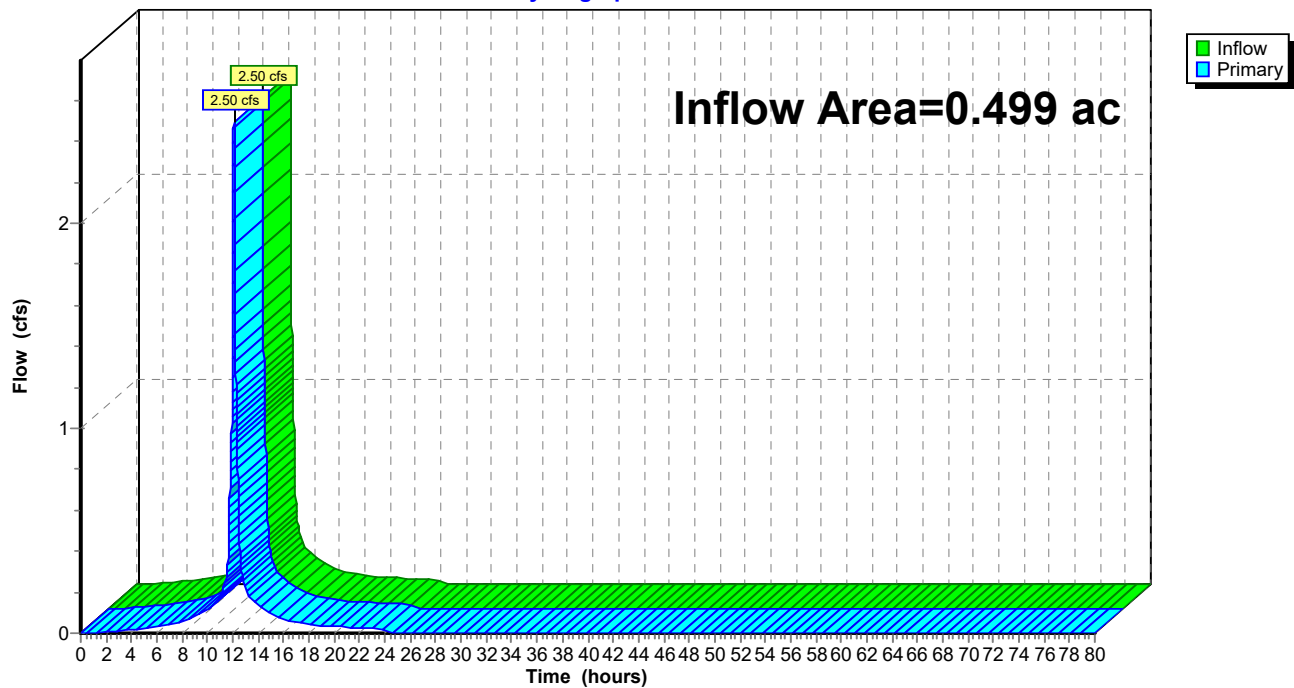
Hydrograph



Summary for Link 1L: Somerville Drainage

Inflow Area = 0.499 ac, 88.71% Impervious, Inflow Depth = 4.80" for 10-YR event
Inflow = 2.50 cfs @ 12.08 hrs, Volume= 0.199 af
Primary = 2.50 cfs @ 12.08 hrs, Volume= 0.199 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 1L: Somerville Drainage**Hydrograph**

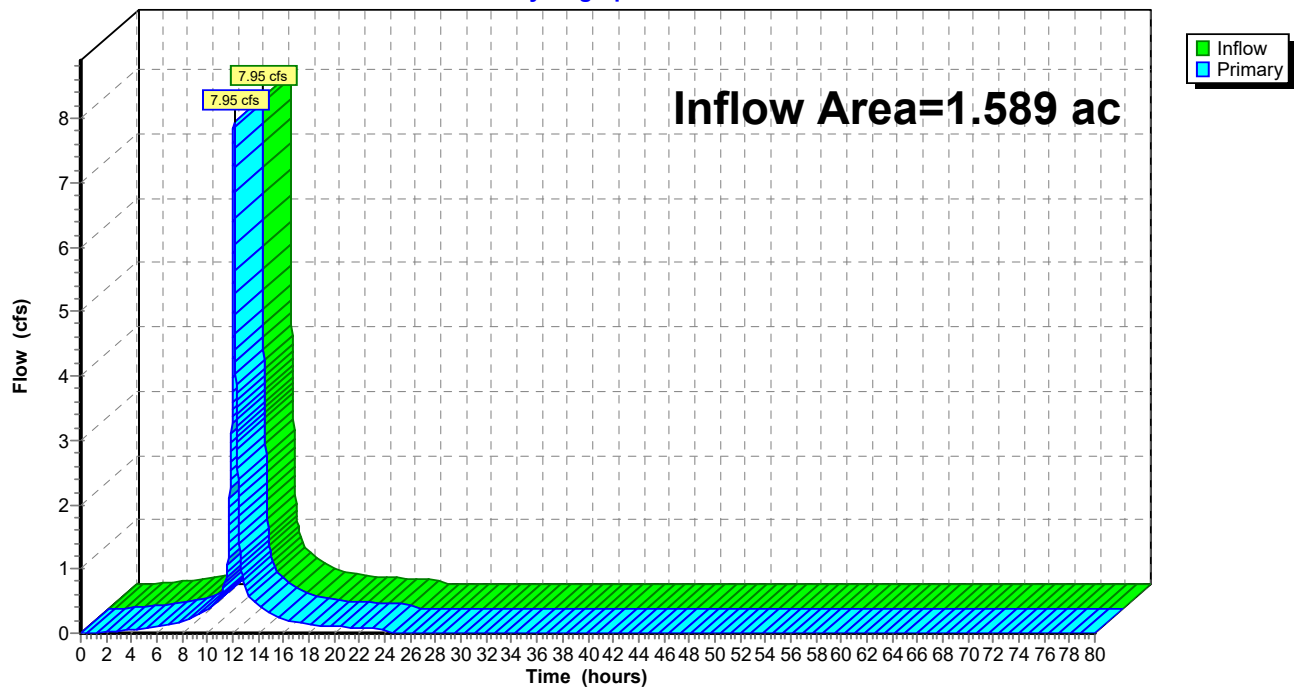
Summary for Link 2L: Somerville Drainage

Inflow Area = 1.589 ac, 91.63% Impervious, Inflow Depth = 4.80" for 10-YR event
Inflow = 7.95 cfs @ 12.08 hrs, Volume= 0.635 af
Primary = 7.95 cfs @ 12.08 hrs, Volume= 0.635 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 2L: Somerville Drainage

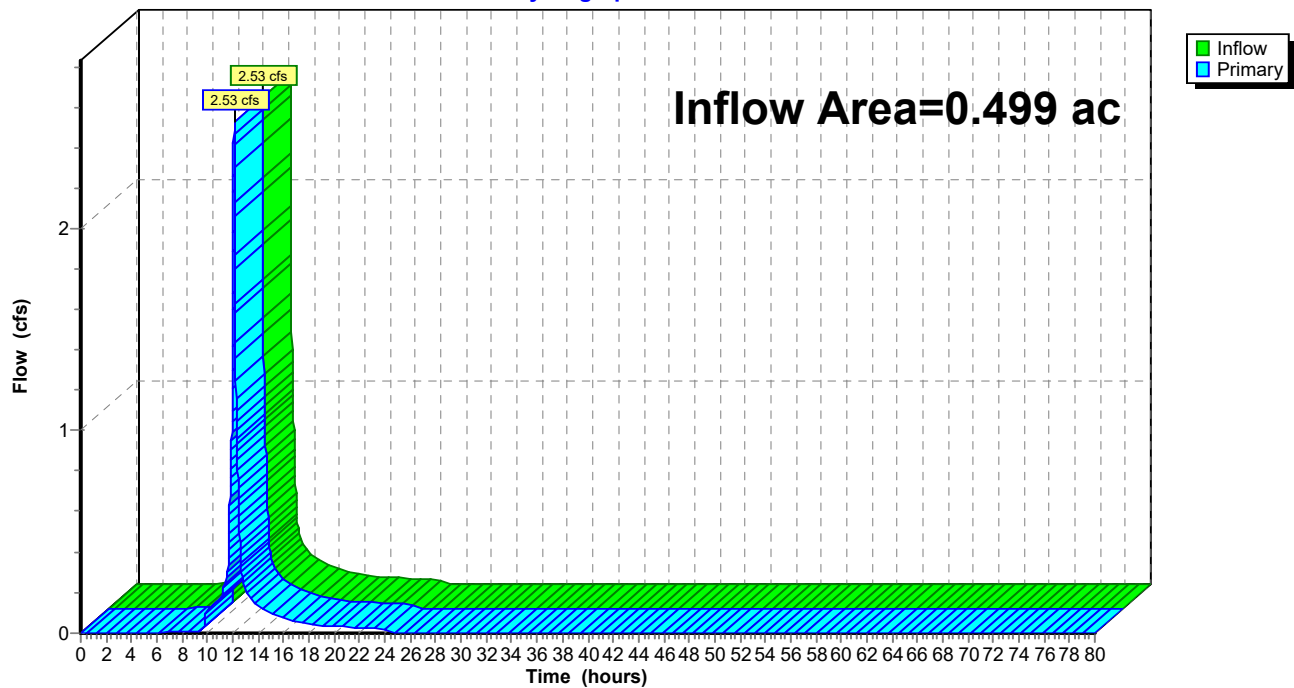
Hydrograph



Summary for Link 3L: Somerville Drainage

Inflow Area = 0.499 ac, 97.89% Impervious, Inflow Depth = 4.28" for 10-YR event
Inflow = 2.53 cfs @ 12.08 hrs, Volume= 0.178 af
Primary = 2.53 cfs @ 12.08 hrs, Volume= 0.178 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 3L: Somerville Drainage**Hydrograph**

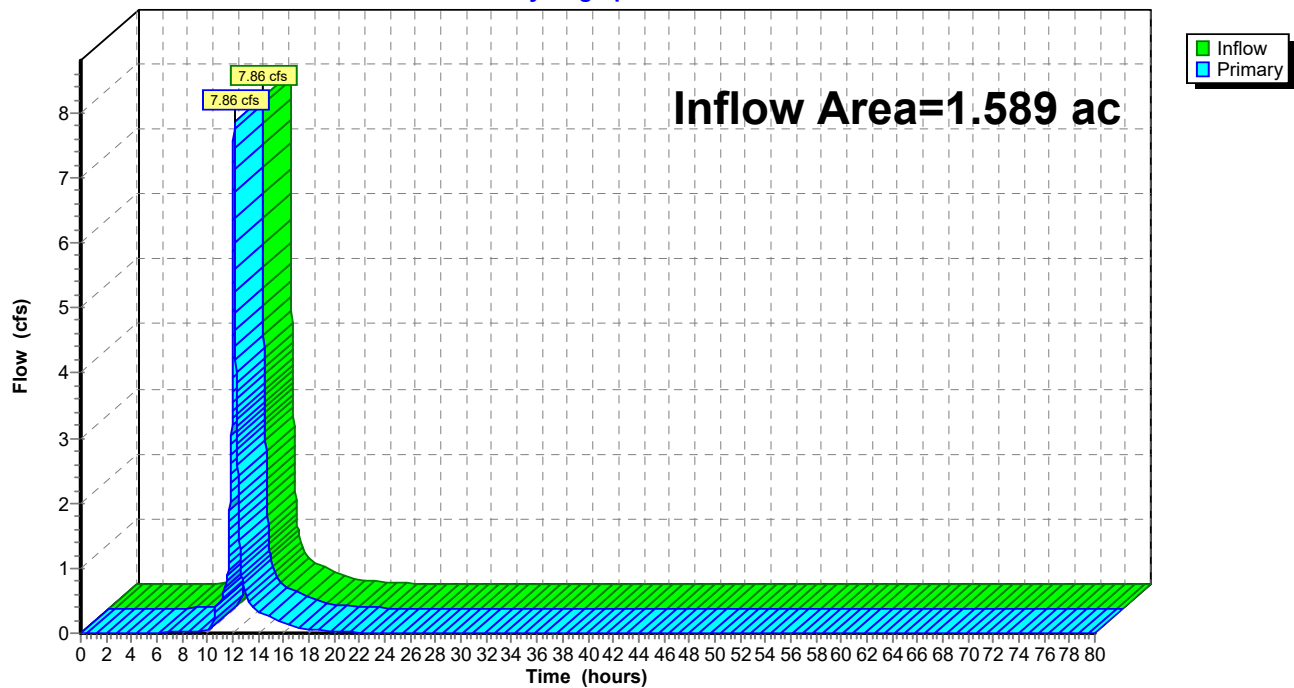
Summary for Link 4L: Somerville Drainage

Inflow Area = 1.589 ac, 100.00% Impervious, Inflow Depth = 3.47" for 10-YR event
Inflow = 7.86 cfs @ 12.09 hrs, Volume= 0.459 af
Primary = 7.86 cfs @ 12.09 hrs, Volume= 0.459 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 4L: Somerville Drainage

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25-YR Rainfall=6.33"

Printed 10/10/2018

Page 96

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Hotel Runoff Area=21,734 sf 88.71% Impervious Runoff Depth=5.97"
 Flow Length=261' Tc=6.0 min CN=97 Runoff=3.08 cfs 0.248 af

Subcatchment2S: EX Residential Runoff Area=69,198 sf 91.63% Impervious Runoff Depth=5.97"
 Flow Length=233' Tc=6.0 min CN=97 Runoff=9.81 cfs 0.791 af

Subcatchment3Sa: PR Hotel - Offsite Runoff Area=2,394 sf 100.00% Impervious Runoff Depth=6.09"
 Tc=6.0 min CN=98 Runoff=0.34 cfs 0.028 af

Subcatchment3Sb: PR Hotel Runoff Area=19,340 sf 97.63% Impervious Runoff Depth=5.97"
 Flow Length=140' Tc=6.0 min CN=97 Runoff=2.74 cfs 0.221 af

Subcatchment4S: PR Residential - Site Runoff Area=8,001 sf 100.00% Impervious Runoff Depth=6.09"
 Flow Length=60' Slope=0.0210 '/' Tc=6.0 min CN=98 Runoff=1.14 cfs 0.093 af

Subcatchment5S: PR Residential - Runoff Area=61,197 sf 100.00% Impervious Runoff Depth=6.09"
 Tc=6.0 min CN=98 Runoff=8.72 cfs 0.713 af

Pond 7P: Subsurface Infiltration #1 Peak Elev=8.89' Storage=0.024 af Inflow=2.74 cfs 0.221 af
 Outflow=2.75 cfs 0.199 af

Pond 8P: Perforated Pipe Peak Elev=8.77' Storage=2,715 cf Inflow=8.72 cfs 0.713 af
 Discarded=0.08 cfs 0.197 af Primary=8.58 cfs 0.516 af Outflow=8.66 cfs 0.713 af

Link 1L: Somerville Drainage Inflow=3.08 cfs 0.248 af
 Primary=3.08 cfs 0.248 af

Link 2L: Somerville Drainage Inflow=9.81 cfs 0.791 af
 Primary=9.81 cfs 0.791 af

Link 3L: Somerville Drainage Inflow=3.10 cfs 0.227 af
 Primary=3.10 cfs 0.227 af

Link 4L: Somerville Drainage Inflow=9.71 cfs 0.609 af
 Primary=9.71 cfs 0.609 af

Total Runoff Area = 4.175 ac Runoff Volume = 2.094 af Average Runoff Depth = 6.02"
4.79% Pervious = 0.200 ac 95.21% Impervious = 3.975 ac

13788.00_EX vs PR

Type III 24-hr 25-YR Rainfall=6.33"

Prepared by VHB

Printed 10/10/2018

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Page 97

Summary for Subcatchment 1S: EX Hotel

Runoff = 3.08 cfs @ 12.08 hrs, Volume= 0.248 af, Depth= 5.97"

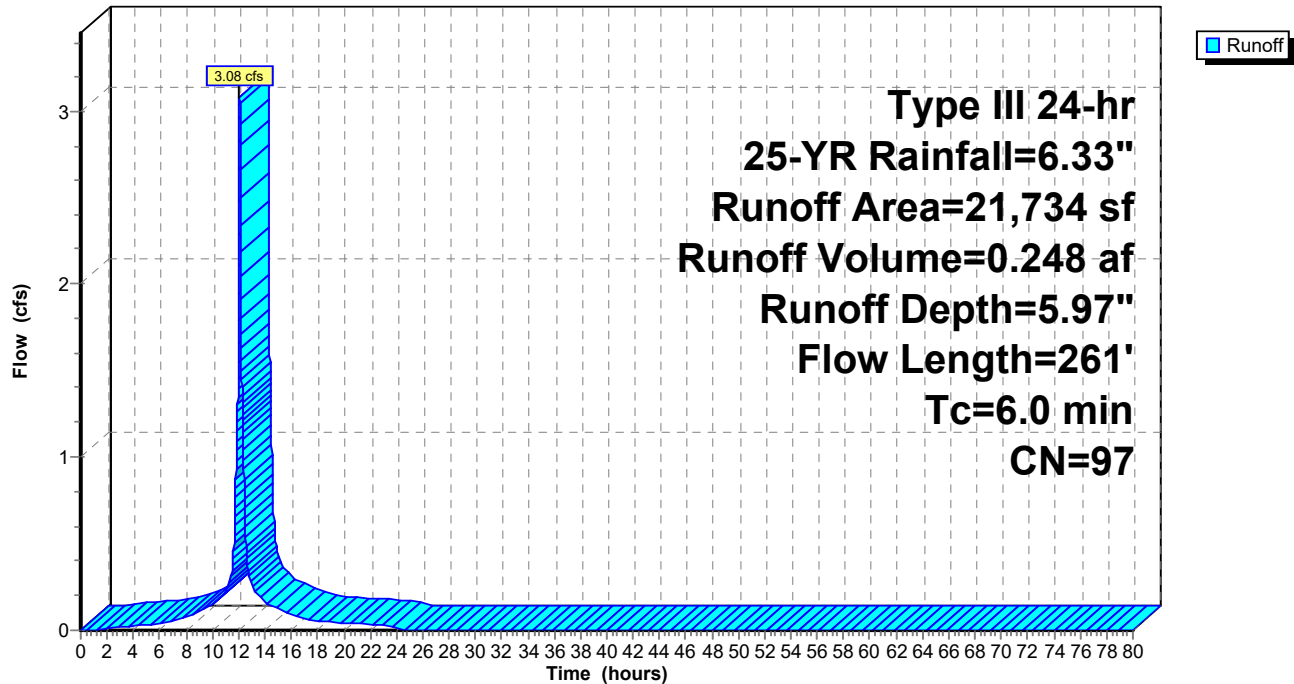
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.33"

	Area (sf)	CN	Description
*	19,281	98	Paved parking
	2,453	89	<50% Grass cover, Poor, HSG D
	21,734	97	Weighted Average
	2,453		11.29% Pervious Area
	19,281		88.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	4	0.1262	0.45		Sheet Flow, Fallow n= 0.050 P2= 3.19"
0.8	46	0.0120	0.96		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.0	1	0.0125	2.27		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	91	0.0789	11.49	4.01	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.4	82	0.0066	3.32	1.16	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.1	37	0.0195	5.71	1.99	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
1.5	261	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: EX Hotel

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25-YR Rainfall=6.33"

Printed 10/10/2018

Page 99

Summary for Subcatchment 2S: EX Residential

Runoff = 9.81 cfs @ 12.08 hrs, Volume= 0.791 af, Depth= 5.97"

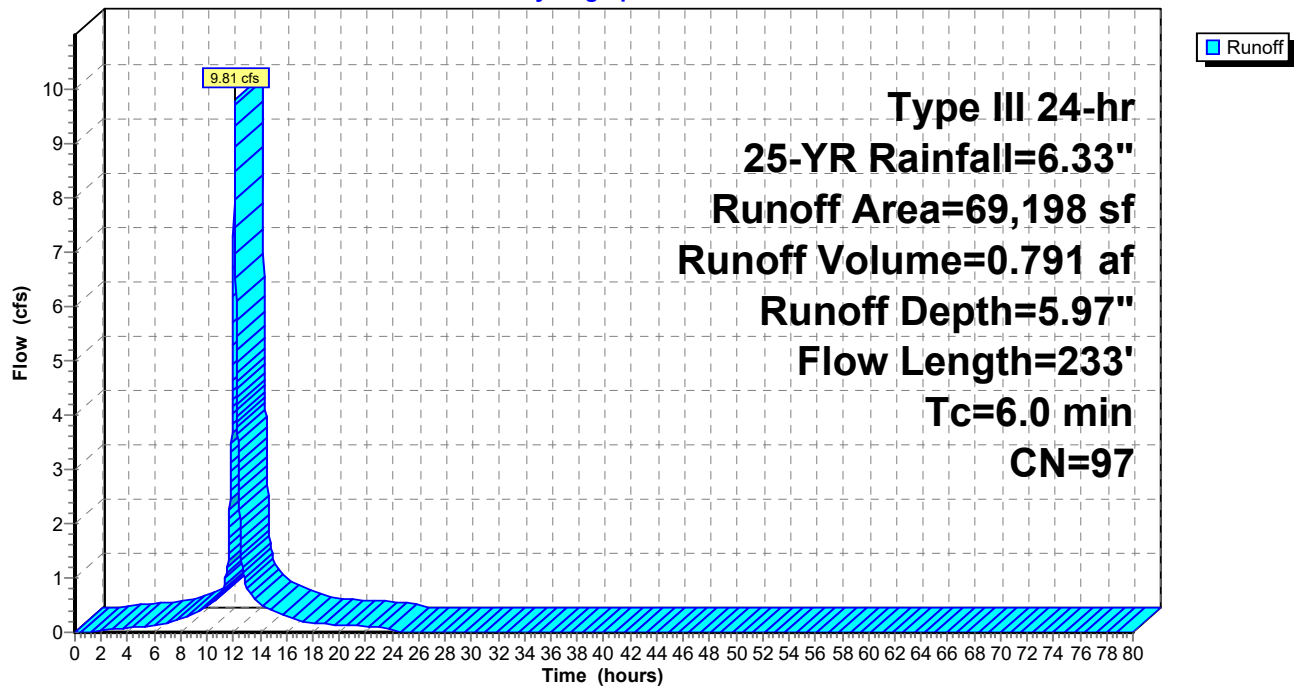
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.33"

	Area (sf)	CN	Description
*	5,325	98	Roof - City Club
*	8,096	98	Roof - Paradigm
	5,794	89	<50% Grass cover, Poor, HSG D
*	49,983	98	Paved parking, conc
	69,198	97	Weighted Average
	5,794		8.37% Pervious Area
	63,404		91.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0044	0.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
1.6	20	0.0800	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.19"
0.6	20	0.0040	0.52		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.2	30	0.0234	3.11		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	134	0.0167	5.29	1.85	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
0.0	20	0.0366	7.83	2.73	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
3.1	233	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: EX Residential

Hydrograph



Summary for Subcatchment 3Sa: PR Hotel - Offsite

Runoff = 0.34 cfs @ 12.08 hrs, Volume= 0.028 af, Depth= 6.09"

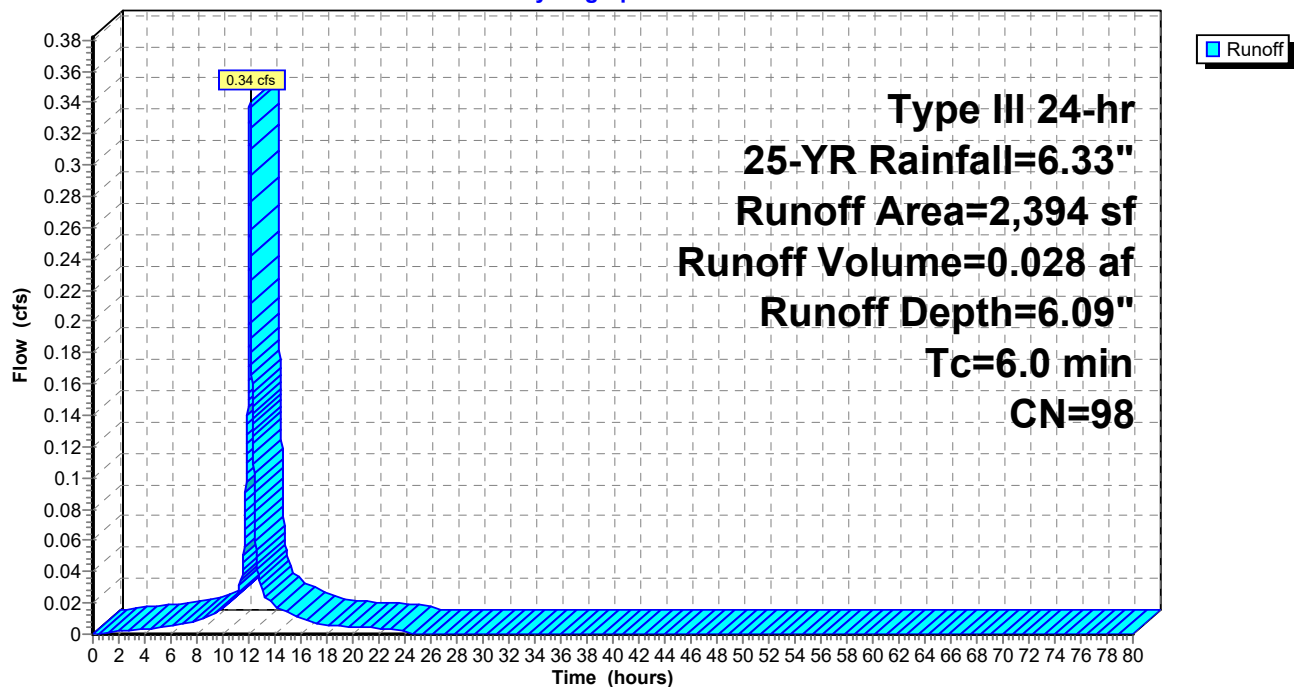
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.33"

	Area (sf)	CN	Description
*	2,394	98	Paved parking
	2,394		100.00% Impervious Area

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

Subcatchment 3Sa: PR Hotel - Offsite

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25-YR Rainfall=6.33"

Printed 10/10/2018

Page 102

Summary for Subcatchment 3Sb: PR Hotel

Runoff = 2.74 cfs @ 12.08 hrs, Volume= 0.221 af, Depth= 5.97"

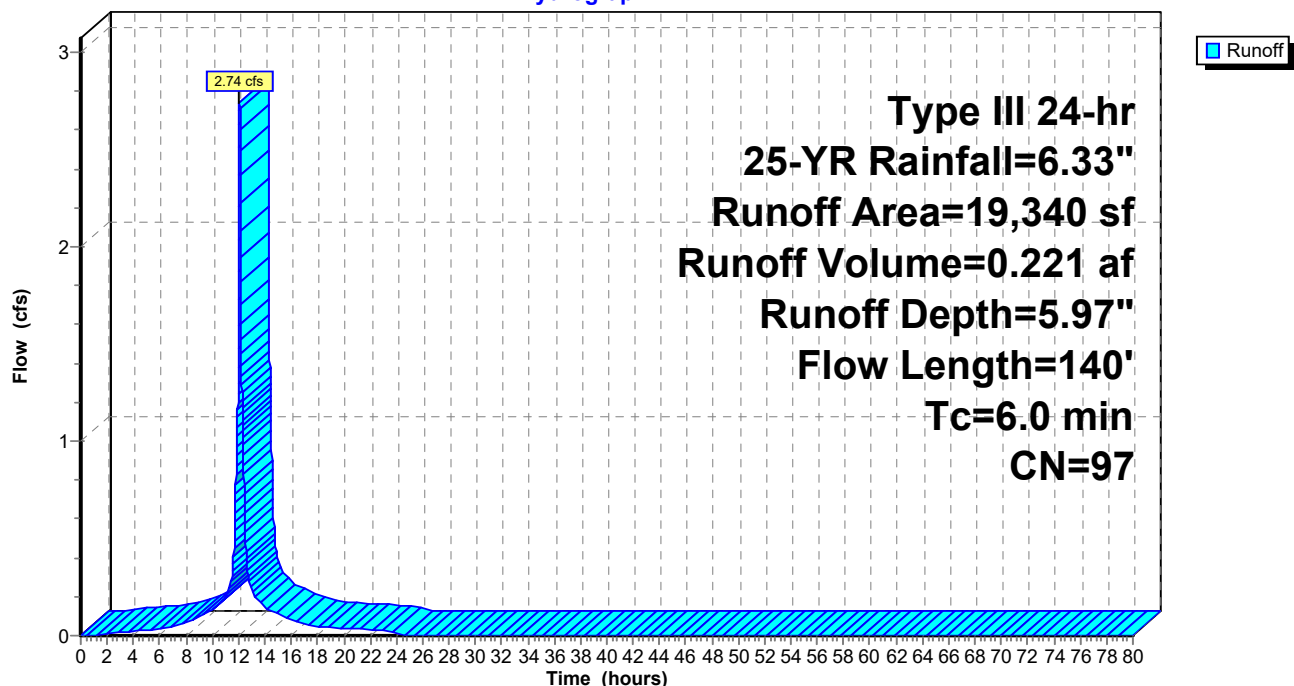
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.33"

	Area (sf)	CN	Description
*	13,484	98	Roof - Hotel
*	5,398	98	Parking, sidewalks, pavers, walls, etc
	458	74	>75% Grass cover, Good, HSG C
	19,340	97	Weighted Average
	458		2.37% Pervious Area
	18,882		97.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0150	1.07		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.4	72	0.0233	3.10		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	18	0.0150	4.82	3.78	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Corrugated PE, smooth interior
1.3	140	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3Sb: PR Hotel

Hydrograph



Summary for Subcatchment 4S: PR Residential - Site

Runoff = 1.14 cfs @ 12.08 hrs, Volume= 0.093 af, Depth= 6.09"

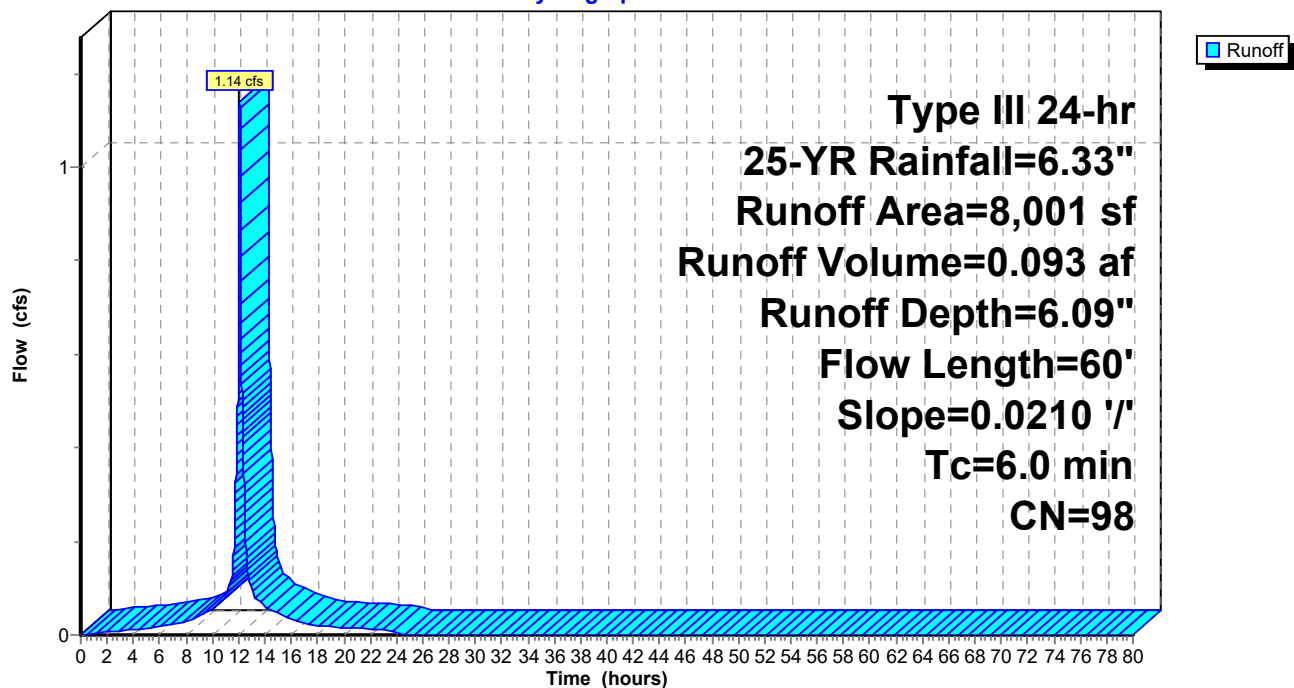
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.33"

Area (sf)	CN	Description
* 8,001	98	Unconnected pavement
8,001		100.00% Impervious Area
8,001		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0210	1.22		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.1	10	0.0210	2.94		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.8	60	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: PR Residential - Site

Hydrograph



Summary for Subcatchment 5S: PR Residential - Rooftop

Runoff = 8.72 cfs @ 12.08 hrs, Volume= 0.713 af, Depth= 6.09"

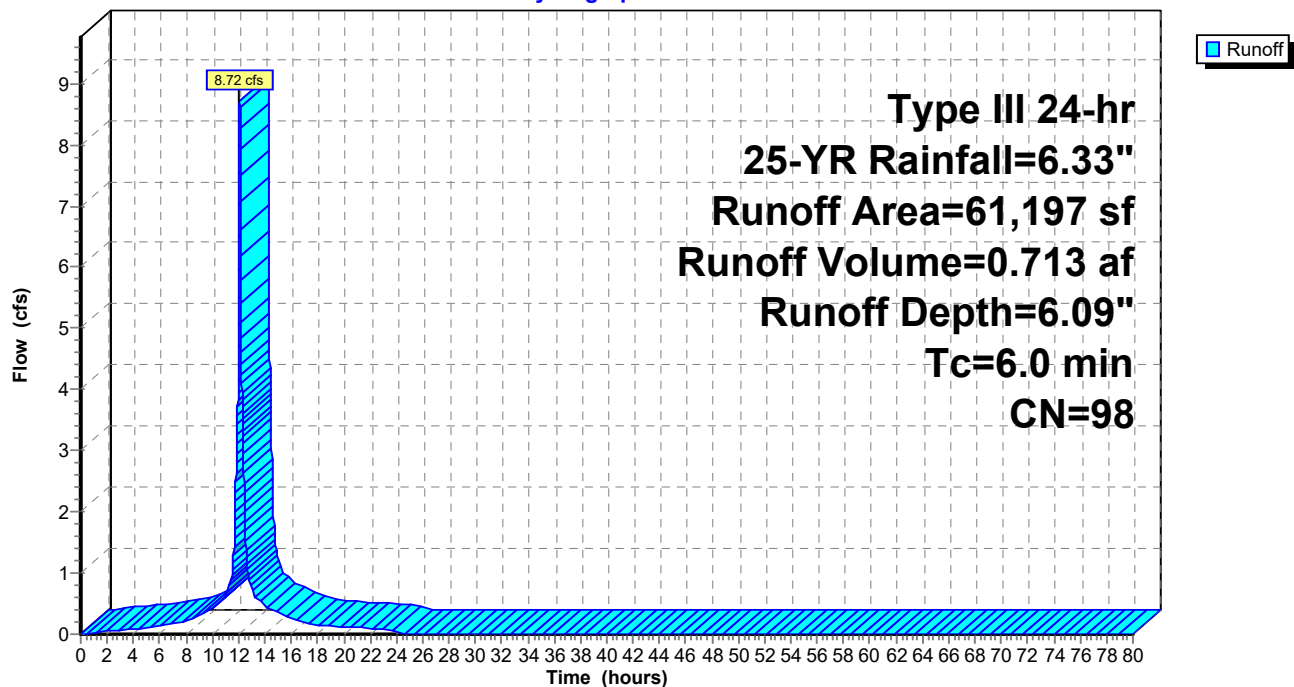
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.33"

Area (sf)	CN	Description
* 61,197	98	Roofs
61,197		100.00% Impervious Area

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

Subcatchment 5S: PR Residential - Rooftop

Hydrograph



Summary for Pond 7P: Subsurface Infiltration #1

[93] Warning: Storage range exceeded by 0.29'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.444 ac, 97.63% Impervious, Inflow Depth = 5.97" for 25-YR event
 Inflow = 2.74 cfs @ 12.08 hrs, Volume= 0.221 af
 Outflow = 2.75 cfs @ 12.09 hrs, Volume= 0.199 af, Atten= 0%, Lag= 0.3 min
 Primary = 2.75 cfs @ 12.09 hrs, Volume= 0.199 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.89' @ 12.09 hrs Surf.Area= 0.012 ac Storage= 0.024 af

Plug-Flow detention time= 92.5 min calculated for 0.199 af (90% of inflow)
 Center-of-Mass det. time= 42.9 min (794.0 - 751.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.10'	0.011 af	15.75'W x 32.10'L x 3.50'H Field A 0.041 af Overall - 0.013 af Embedded = 0.028 af x 40.0% Voids
#2A	5.60'	0.013 af	ADS_StormTech SC-740 +Cap x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 4 Chambers
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.20'	24.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=2.74 cfs @ 12.09 hrs HW=8.89' (Free Discharge)

↑1=Orifice/Grate (Orifice Controls 2.74 cfs @ 2.83 fps)

Pond 7P: Subsurface Infiltration #1 - Chamber Wizard Field A**Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

4 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 30.10' Row Length +12.0" End Stone x 2 = 32.10' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

12 Chambers x 45.9 cf = 551.3 cf Chamber Storage

1,769.3 cf Field - 551.3 cf Chambers = 1,218.0 cf Stone x 40.0% Voids = 487.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,038.5 cf = 0.024 af

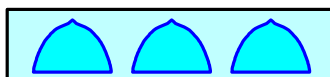
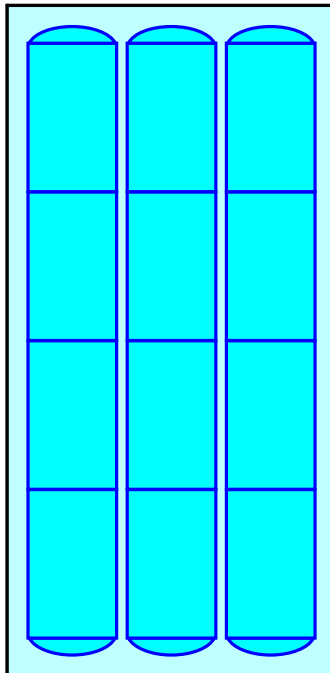
Overall Storage Efficiency = 58.7%

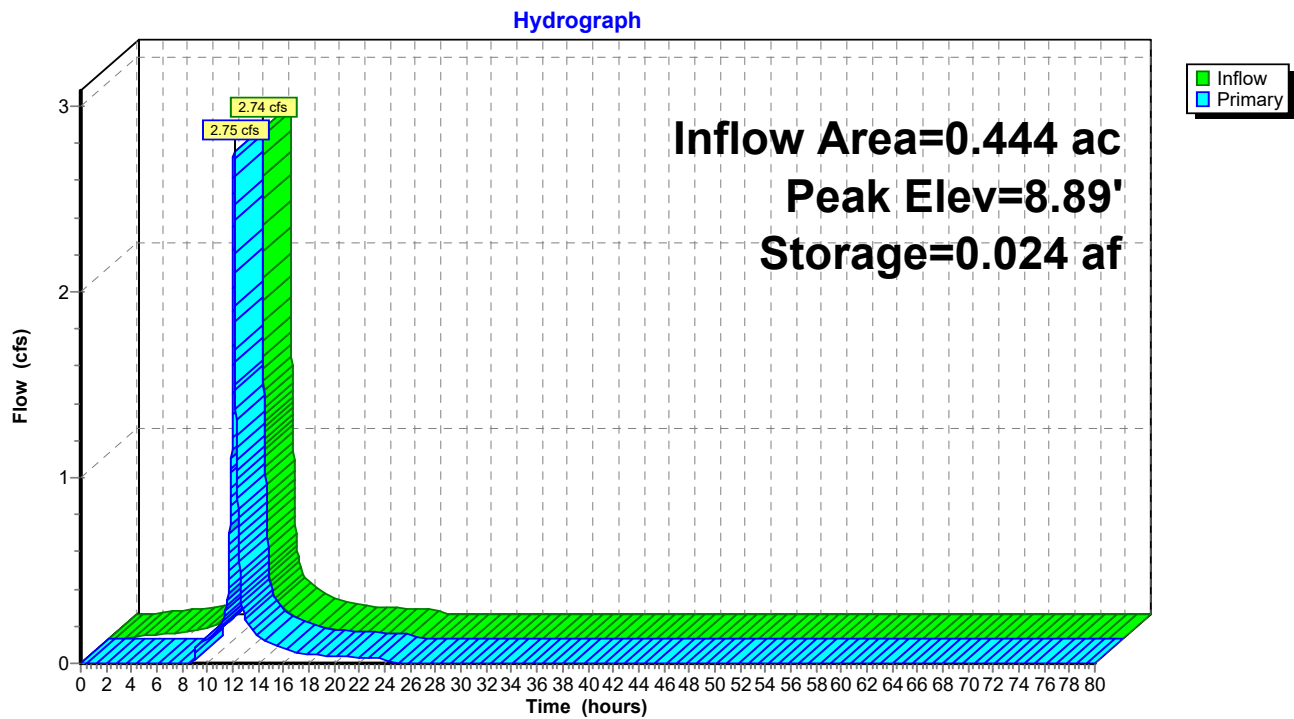
Overall System Size = 32.10' x 15.75' x 3.50'

12 Chambers

65.5 cy Field

45.1 cy Stone



Pond 7P: Subsurface Infiltration #1

Summary for Pond 8P: Perforated Pipe

Inflow Area = 1.405 ac, 100.00% Impervious, Inflow Depth = 6.09" for 25-YR event
 Inflow = 8.72 cfs @ 12.08 hrs, Volume= 0.713 af
 Outflow = 8.66 cfs @ 12.09 hrs, Volume= 0.713 af, Atten= 1%, Lag= 0.6 min
 Discarded = 0.08 cfs @ 3.74 hrs, Volume= 0.197 af
 Primary = 8.58 cfs @ 12.09 hrs, Volume= 0.516 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.77' @ 12.09 hrs Surf.Area= 1,440 sf Storage= 2,715 cf

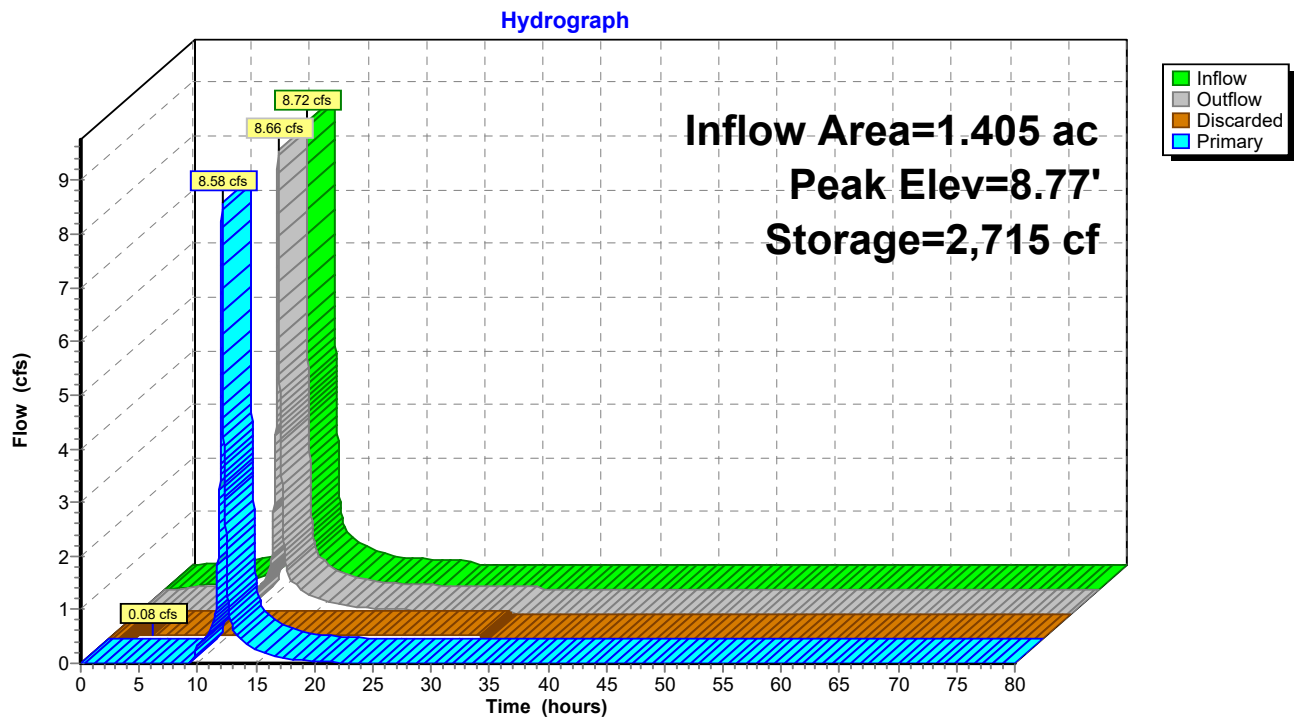
Plug-Flow detention time= 88.9 min calculated for 0.713 af (100% of inflow)
 Center-of-Mass det. time= 89.0 min (833.3 - 744.4)

Volume	Invert	Avail.Storage	Storage Description
#1	6.10'	1,005 cf	24.0" Round Pipe Storage Inside #2 L= 320.0'
#2	5.10'	2,190 cf	4.50'W x 320.00'L x 4.50'H Stone 6,480 cf Overall - 1,005 cf Embedded = 5,475 cf x 40.0% Voids
		3,195 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	24.0" Round Culvert L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.97' S= 0.0150 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	8.00'	4.0' long x 5.60' rise Sharp-Crested Rectangular Weir 2 End Contraction(s) 6.0' Crest Height
#3	Discarded	5.10'	2.400 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 3.74 hrs HW=5.19' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=8.56 cfs @ 12.09 hrs HW=8.77' (Free Discharge)
 ↑ **1=Culvert** (Passes 8.56 cfs of 36.32 cfs potential flow)
 ↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 8.56 cfs @ 2.91 fps)

Pond 8P: Perforated Pipe

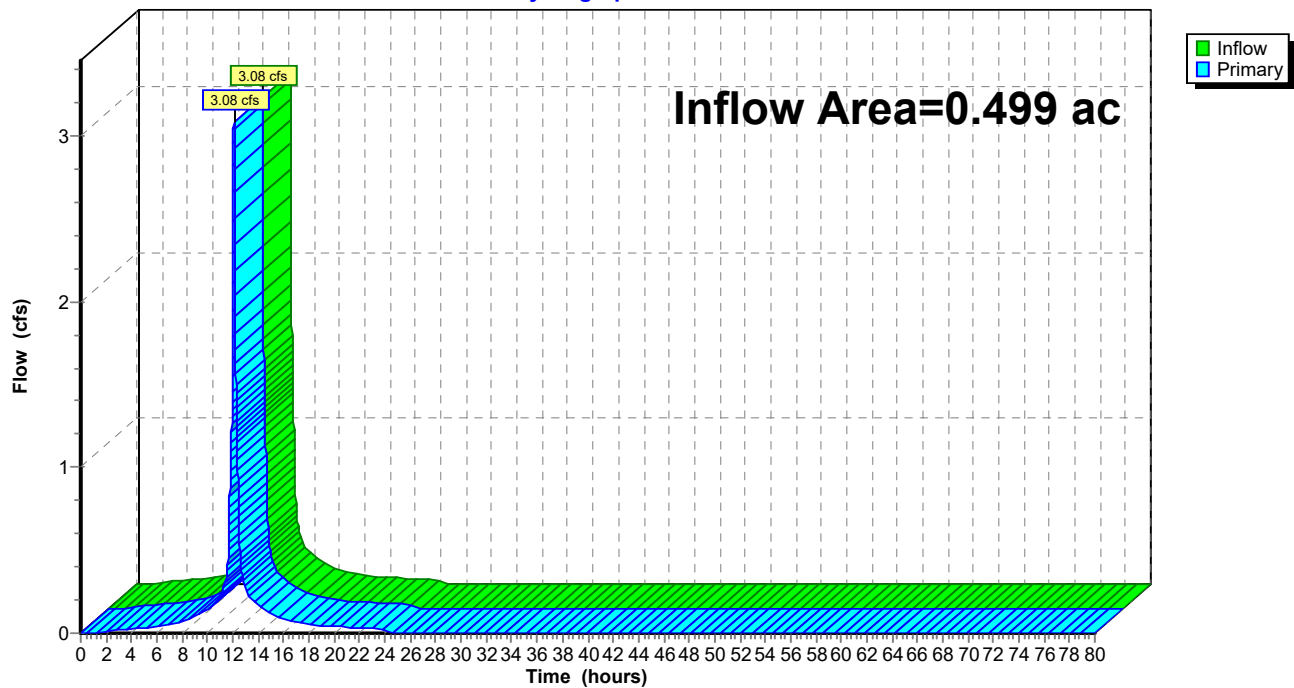
Summary for Link 1L: Somerville Drainage

Inflow Area = 0.499 ac, 88.71% Impervious, Inflow Depth = 5.97" for 25-YR event
Inflow = 3.08 cfs @ 12.08 hrs, Volume= 0.248 af
Primary = 3.08 cfs @ 12.08 hrs, Volume= 0.248 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 1L: Somerville Drainage

Hydrograph



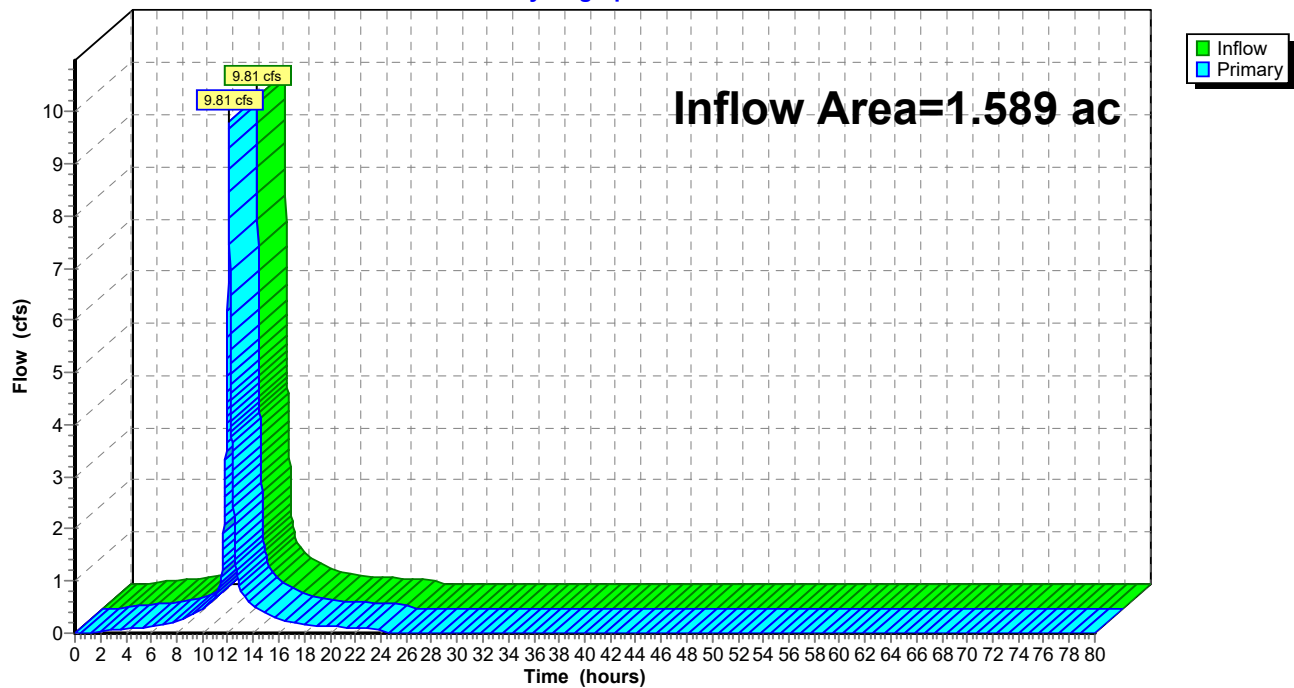
Summary for Link 2L: Somerville Drainage

Inflow Area = 1.589 ac, 91.63% Impervious, Inflow Depth = 5.97" for 25-YR event
Inflow = 9.81 cfs @ 12.08 hrs, Volume= 0.791 af
Primary = 9.81 cfs @ 12.08 hrs, Volume= 0.791 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 2L: Somerville Drainage

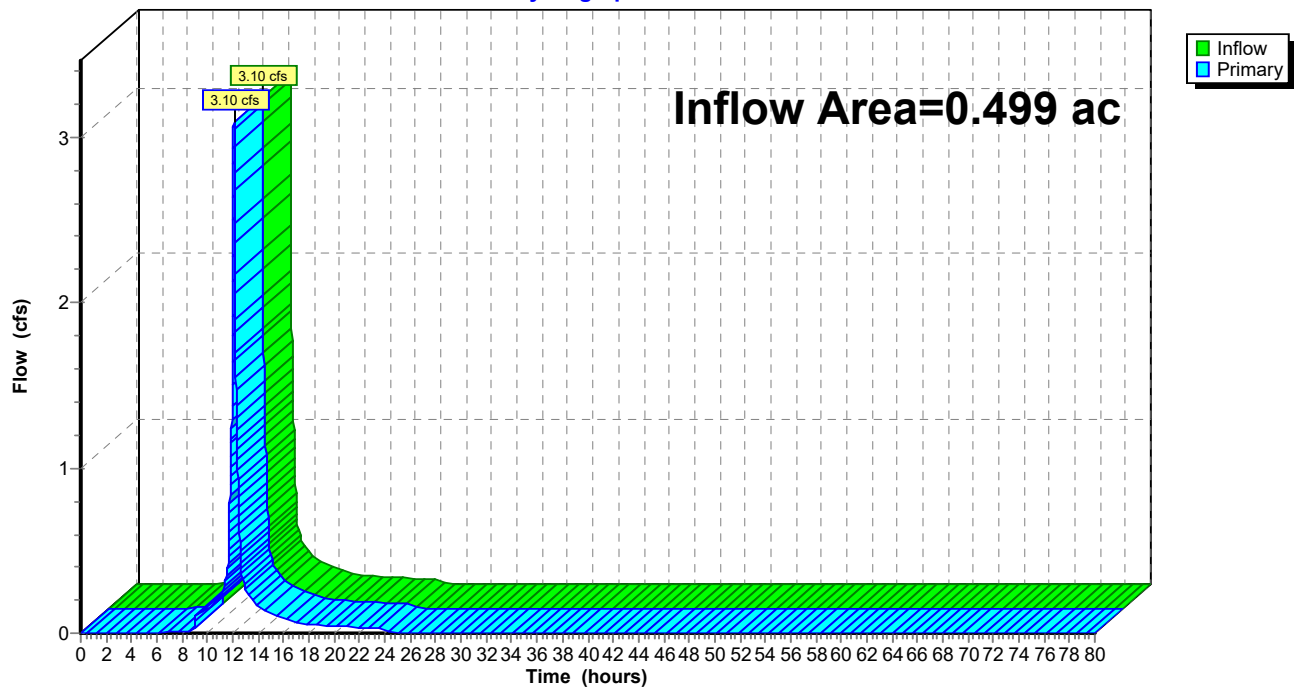
Hydrograph



Summary for Link 3L: Somerville Drainage

Inflow Area = 0.499 ac, 97.89% Impervious, Inflow Depth = 5.46" for 25-YR event
Inflow = 3.10 cfs @ 12.09 hrs, Volume= 0.227 af
Primary = 3.10 cfs @ 12.09 hrs, Volume= 0.227 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 3L: Somerville Drainage**Hydrograph**

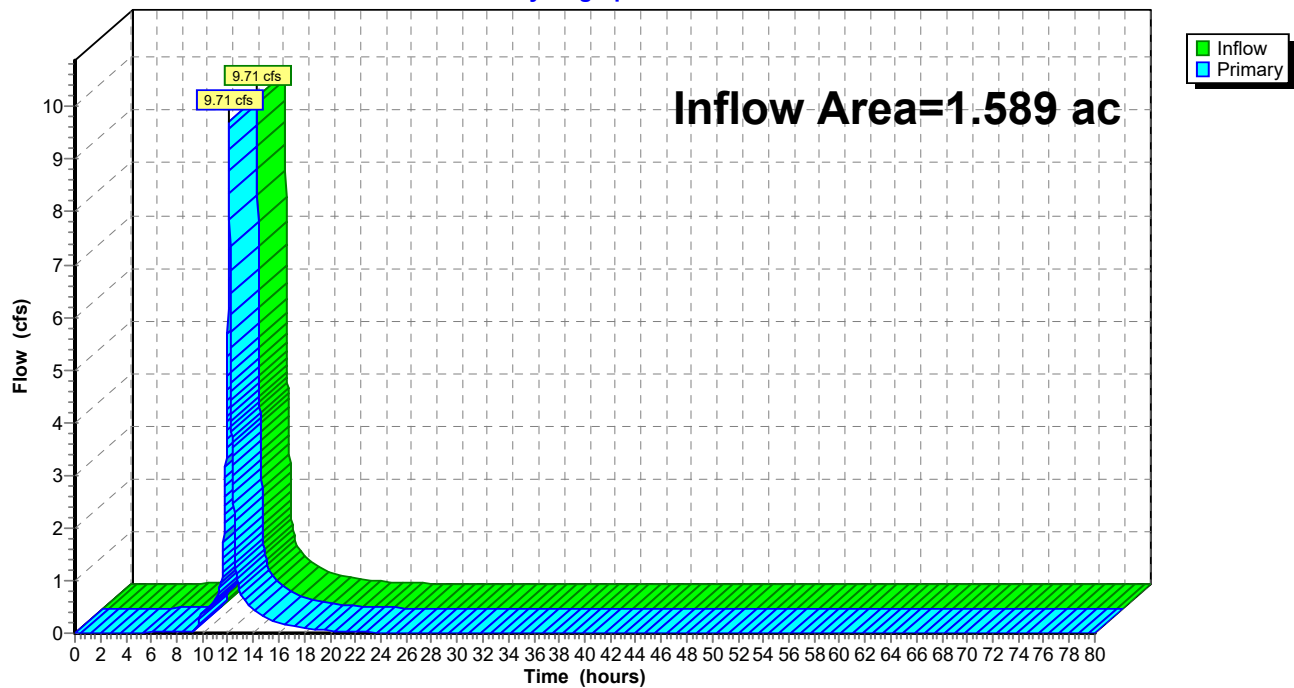
Summary for Link 4L: Somerville Drainage

Inflow Area = 1.589 ac, 100.00% Impervious, Inflow Depth = 4.60" for 25-YR event
Inflow = 9.71 cfs @ 12.09 hrs, Volume= 0.609 af
Primary = 9.71 cfs @ 12.09 hrs, Volume= 0.609 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 4L: Somerville Drainage

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.14"

Printed 10/10/2018

Page 114

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX Hotel Runoff Area=21,734 sf 88.71% Impervious Runoff Depth=7.78"
Flow Length=261' Tc=6.0 min CN=97 Runoff=3.98 cfs 0.323 af

Subcatchment2S: EX Residential Runoff Area=69,198 sf 91.63% Impervious Runoff Depth=7.78"
Flow Length=233' Tc=6.0 min CN=97 Runoff=12.66 cfs 1.030 af

Subcatchment3Sa: PR Hotel - Offsite Runoff Area=2,394 sf 100.00% Impervious Runoff Depth=7.90"
Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af

Subcatchment3Sb: PR Hotel Runoff Area=19,340 sf 97.63% Impervious Runoff Depth=7.78"
Flow Length=140' Tc=6.0 min CN=97 Runoff=3.54 cfs 0.288 af

Subcatchment4S: PR Residential - Site Runoff Area=8,001 sf 100.00% Impervious Runoff Depth=7.90"
Flow Length=60' Slope=0.0210 '/' Tc=6.0 min CN=98 Runoff=1.47 cfs 0.121 af

Subcatchment5S: PR Residential - Runoff Area=61,197 sf 100.00% Impervious Runoff Depth=7.90"
Tc=6.0 min CN=98 Runoff=11.23 cfs 0.925 af

Pond 7P: Subsurface Infiltration #1 Peak Elev=9.00' Storage=0.024 af Inflow=3.54 cfs 0.288 af
Outflow=3.55 cfs 0.266 af

Pond 8P: Perforated Pipe Peak Elev=8.91' Storage=2,799 cf Inflow=11.23 cfs 0.925 af
Discarded=0.08 cfs 0.202 af Primary=11.08 cfs 0.723 af Outflow=11.16 cfs 0.925 af

Link 1L: Somerville Drainage Inflow=3.98 cfs 0.323 af
Primary=3.98 cfs 0.323 af

Link 2L: Somerville Drainage Inflow=12.66 cfs 1.030 af
Primary=12.66 cfs 1.030 af

Link 3L: Somerville Drainage Inflow=3.99 cfs 0.302 af
Primary=3.99 cfs 0.302 af

Link 4L: Somerville Drainage Inflow=12.54 cfs 0.844 af
Primary=12.54 cfs 0.844 af

Total Runoff Area = 4.175 ac Runoff Volume = 2.723 af Average Runoff Depth = 7.83"
4.79% Pervious = 0.200 ac 95.21% Impervious = 3.975 ac

13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.14"

Printed 10/10/2018

Page 115

Summary for Subcatchment 1S: EX Hotel

Runoff = 3.98 cfs @ 12.08 hrs, Volume= 0.323 af, Depth= 7.78"

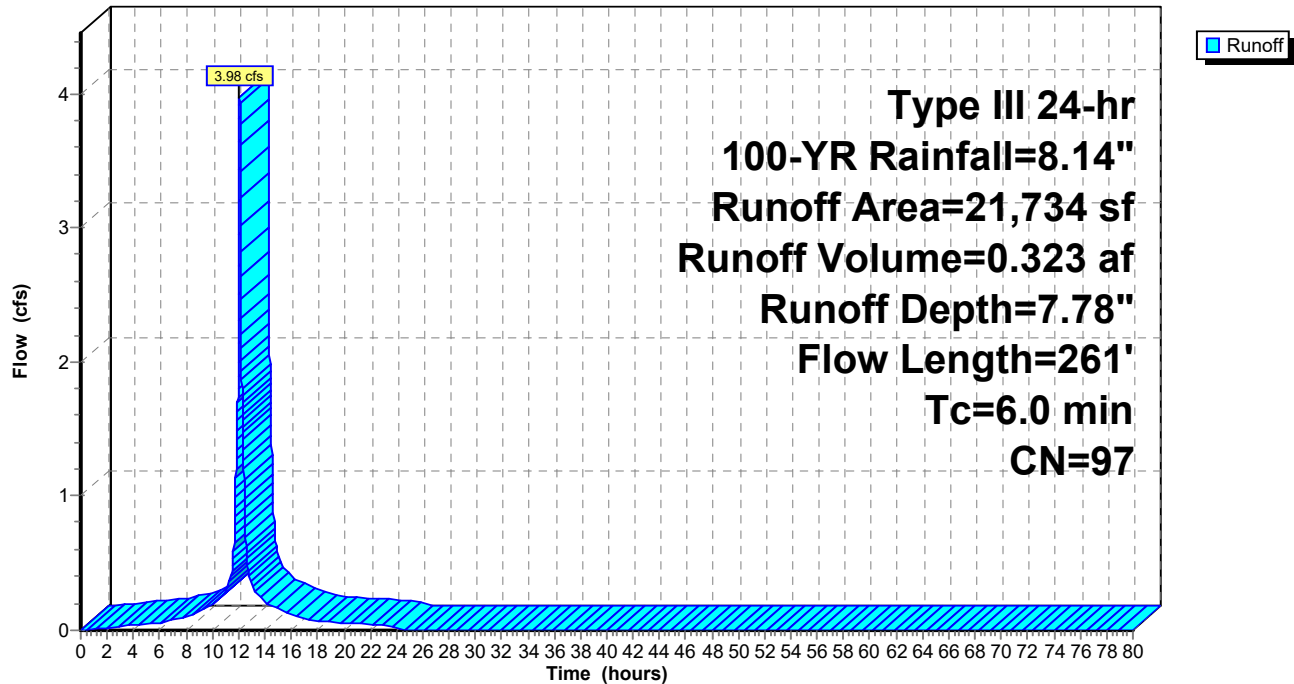
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.14"

	Area (sf)	CN	Description
*	19,281	98	Paved parking
	2,453	89	<50% Grass cover, Poor, HSG D
	21,734	97	Weighted Average
	2,453		11.29% Pervious Area
	19,281		88.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	4	0.1262	0.45		Sheet Flow, Fallow n= 0.050 P2= 3.19"
0.8	46	0.0120	0.96		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.0	1	0.0125	2.27		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	91	0.0789	11.49	4.01	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.4	82	0.0066	3.32	1.16	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
0.1	37	0.0195	5.71	1.99	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
1.5	261	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: EX Hotel

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.14"

Printed 10/10/2018

Page 117

Summary for Subcatchment 2S: EX Residential

Runoff = 12.66 cfs @ 12.08 hrs, Volume= 1.030 af, Depth= 7.78"

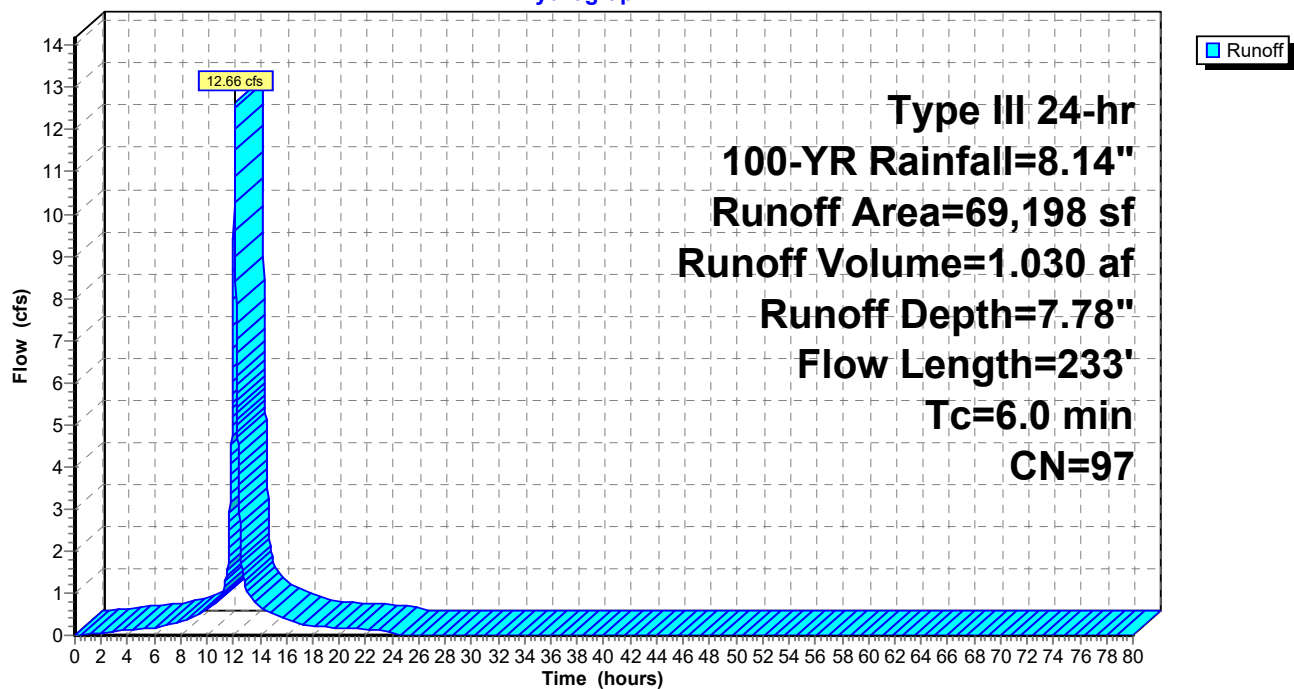
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.14"

	Area (sf)	CN	Description
*	5,325	98	Roof - City Club
*	8,096	98	Roof - Paradigm
	5,794	89	<50% Grass cover, Poor, HSG D
*	49,983	98	Paved parking, conc
	69,198	97	Weighted Average
	5,794		8.37% Pervious Area
	63,404		91.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0044	0.46		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
1.6	20	0.0800	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.19"
0.6	20	0.0040	0.52		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.2	30	0.0234	3.11		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	134	0.0167	5.29	1.85	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
0.0	20	0.0366	7.83	2.73	Pipe Channel, 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011
3.1	233	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: EX Residential

Hydrograph



Summary for Subcatchment 3Sa: PR Hotel - Offsite

Runoff = 0.44 cfs @ 12.08 hrs, Volume= 0.036 af, Depth= 7.90"

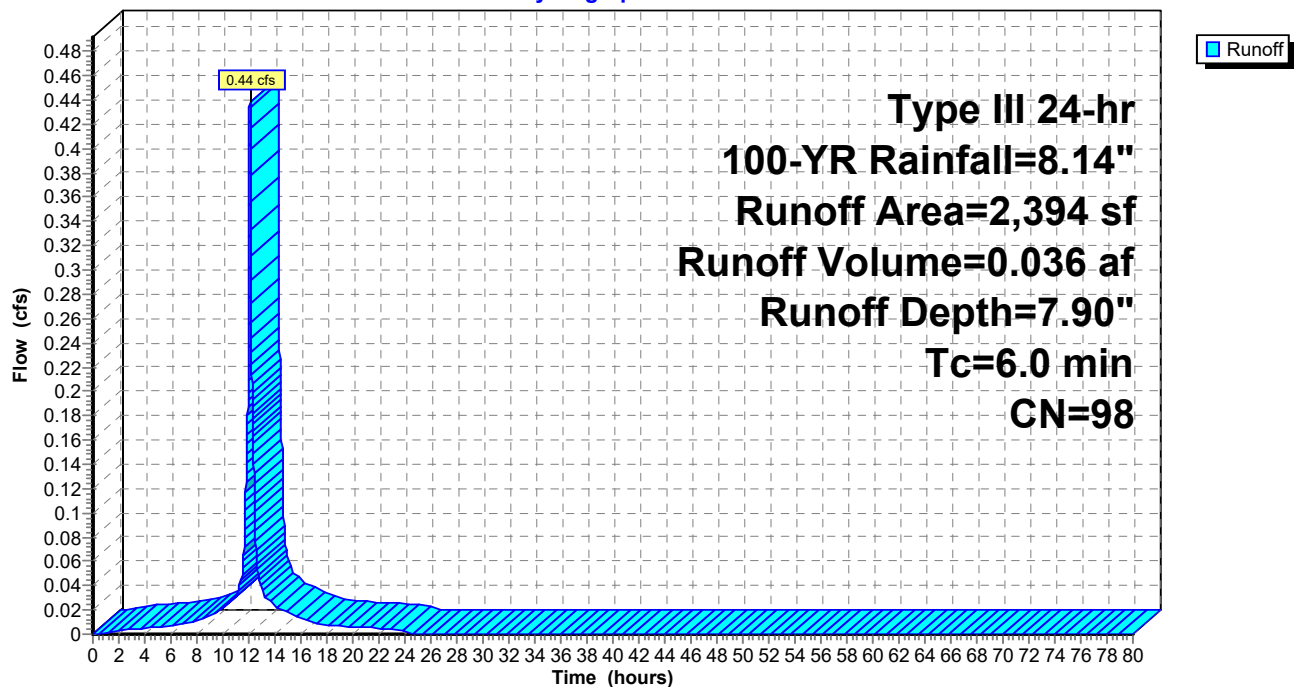
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.14"

	Area (sf)	CN	Description
*	2,394	98	Paved parking
	2,394		100.00% Impervious Area

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

Subcatchment 3Sa: PR Hotel - Offsite

Hydrograph



13788.00_EX vs PR

Prepared by VHB

HydroCAD® 10.00-19 s/n 01038 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=8.14"

Printed 10/10/2018

Page 120

Summary for Subcatchment 3Sb: PR Hotel

Runoff = 3.54 cfs @ 12.08 hrs, Volume= 0.288 af, Depth= 7.78"

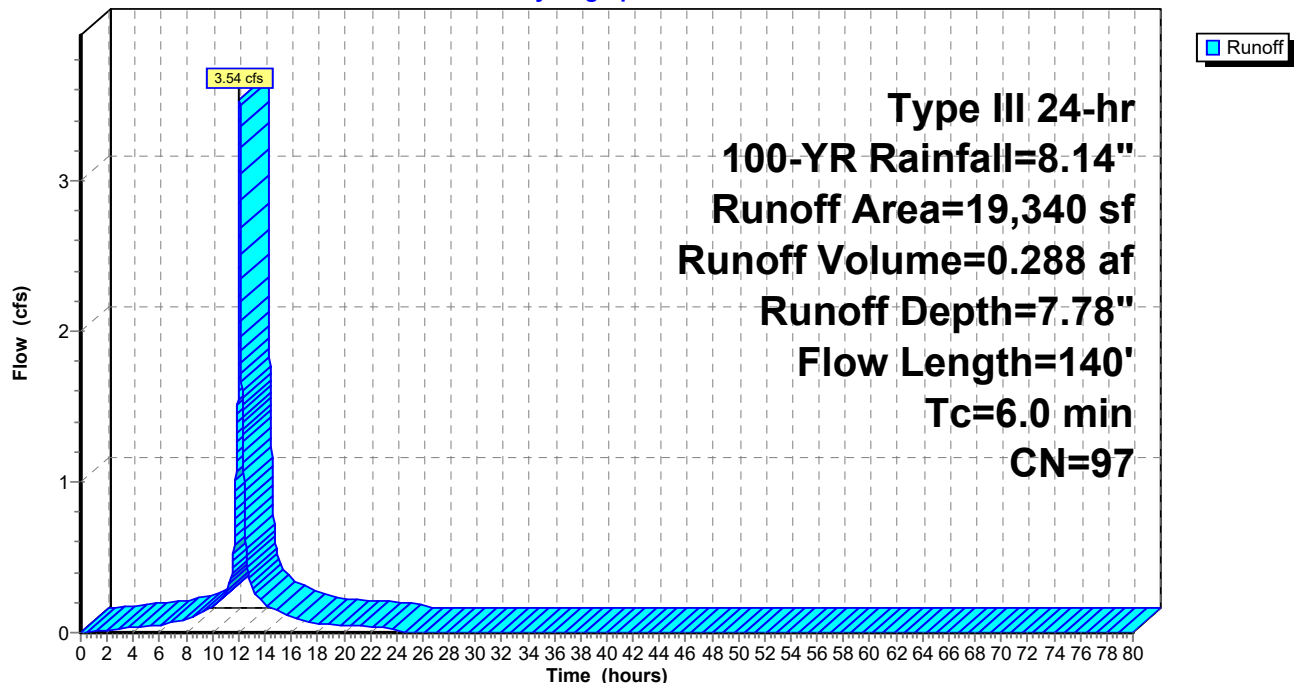
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.14"

	Area (sf)	CN	Description
*	13,484	98	Roof - Hotel
*	5,398	98	Parking, sidewalks, pavers, walls, etc
	458	74	>75% Grass cover, Good, HSG C
	19,340	97	Weighted Average
	458		2.37% Pervious Area
	18,882		97.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0150	1.07		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.4	72	0.0233	3.10		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	18	0.0150	4.82	3.78	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Corrugated PE, smooth interior
1.3	140	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3Sb: PR Hotel

Hydrograph



Summary for Subcatchment 4S: PR Residential - Site

Runoff = 1.47 cfs @ 12.08 hrs, Volume= 0.121 af, Depth= 7.90"

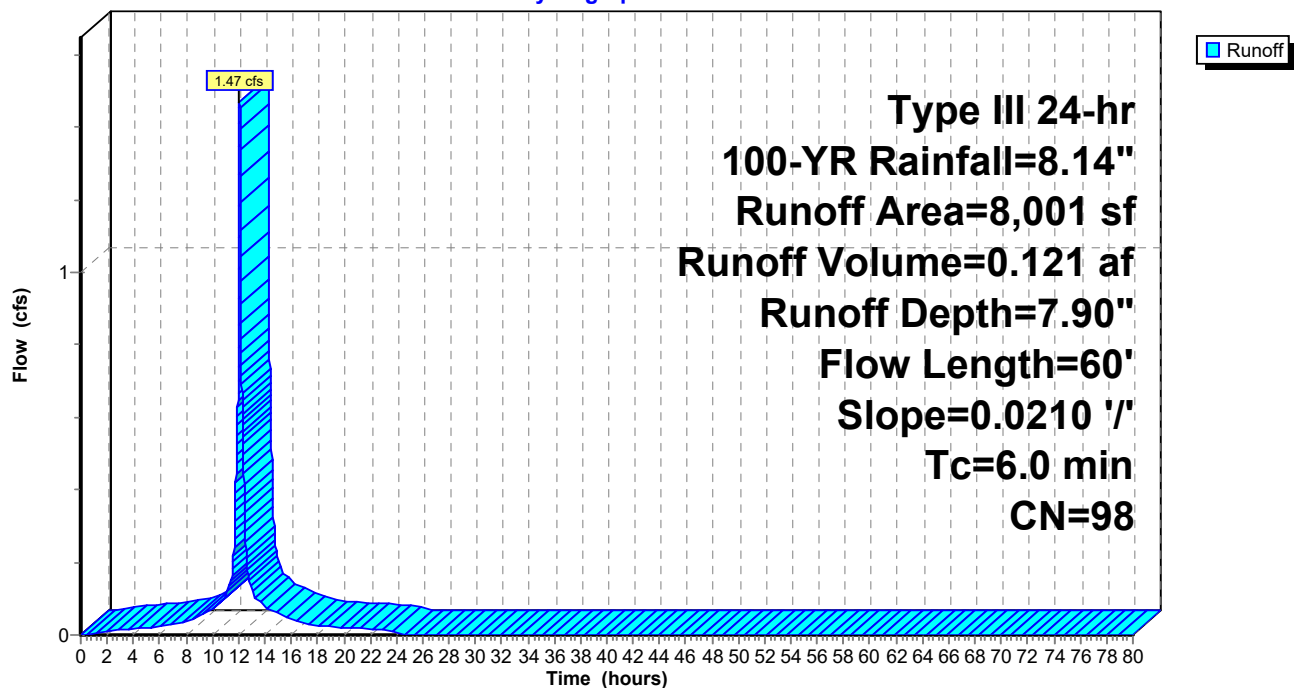
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.14"

Area (sf)	CN	Description
* 8,001	98	Unconnected pavement
8,001		100.00% Impervious Area
8,001		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0210	1.22		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.19"
0.1	10	0.0210	2.94		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.8	60	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: PR Residential - Site

Hydrograph



Summary for Subcatchment 5S: PR Residential - Rooftop

Runoff = 11.23 cfs @ 12.08 hrs, Volume= 0.925 af, Depth= 7.90"

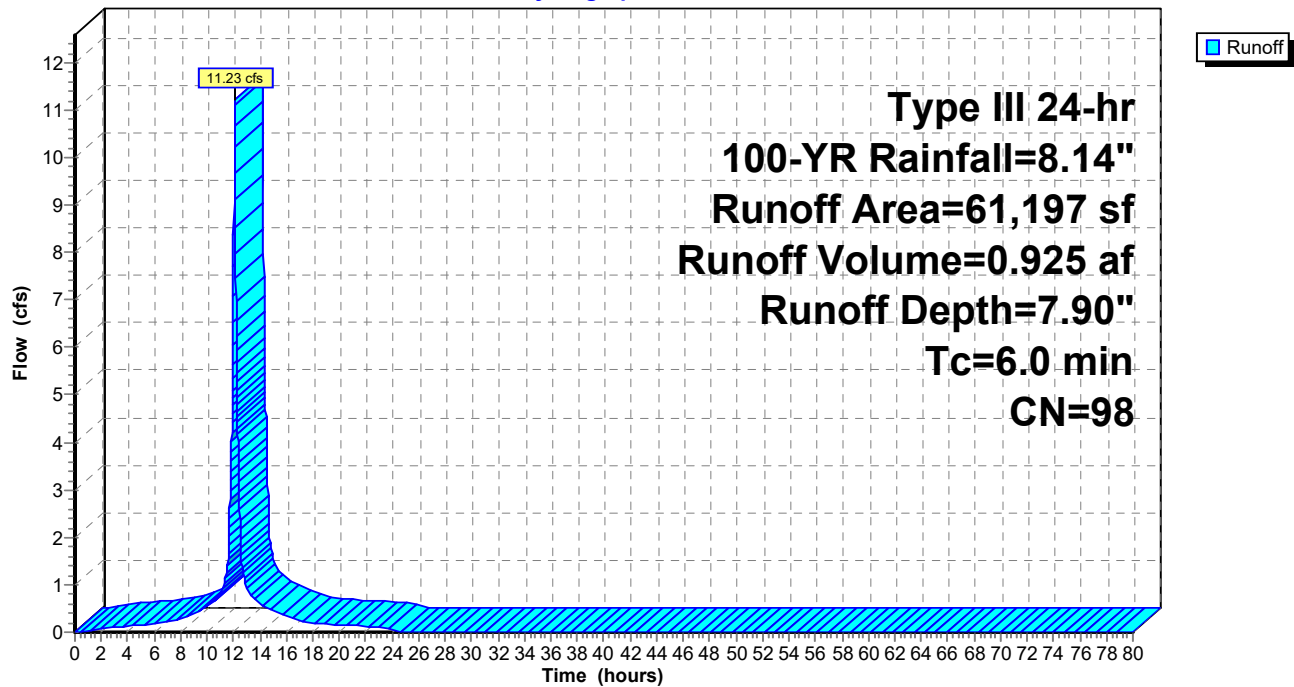
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=8.14"

Area (sf)	CN	Description
* 61,197	98	Roofs
61,197		100.00% Impervious Area

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

Subcatchment 5S: PR Residential - Rooftop

Hydrograph



Summary for Pond 7P: Subsurface Infiltration #1

[93] Warning: Storage range exceeded by 0.40'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.444 ac, 97.63% Impervious, Inflow Depth = 7.78" for 100-YR event
 Inflow = 3.54 cfs @ 12.08 hrs, Volume= 0.288 af
 Outflow = 3.55 cfs @ 12.08 hrs, Volume= 0.266 af, Atten= 0%, Lag= 0.0 min
 Primary = 3.55 cfs @ 12.08 hrs, Volume= 0.266 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 9.00' @ 12.08 hrs Surf.Area= 0.012 ac Storage= 0.024 af

Plug-Flow detention time= 78.2 min calculated for 0.266 af (92% of inflow)
 Center-of-Mass det. time= 37.0 min (783.8 - 746.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.10'	0.011 af	15.75'W x 32.10'L x 3.50'H Field A 0.041 af Overall - 0.013 af Embedded = 0.028 af x 40.0% Voids
#2A	5.60'	0.013 af	ADS_StormTech SC-740 +Cap x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 4 Chambers
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.20'	24.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=3.54 cfs @ 12.08 hrs HW=9.00' (Free Discharge)

↑1=Orifice/Grate (Orifice Controls 3.54 cfs @ 3.04 fps)

Pond 7P: Subsurface Infiltration #1 - Chamber Wizard Field A**Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

4 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 30.10' Row Length +12.0" End Stone x 2 = 32.10' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

12 Chambers x 45.9 cf = 551.3 cf Chamber Storage

1,769.3 cf Field - 551.3 cf Chambers = 1,218.0 cf Stone x 40.0% Voids = 487.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,038.5 cf = 0.024 af

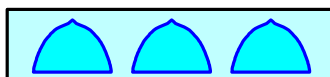
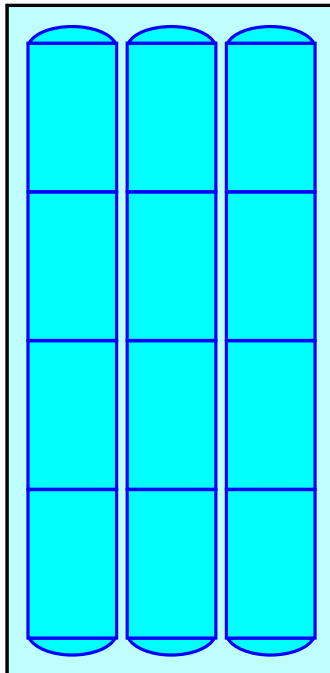
Overall Storage Efficiency = 58.7%

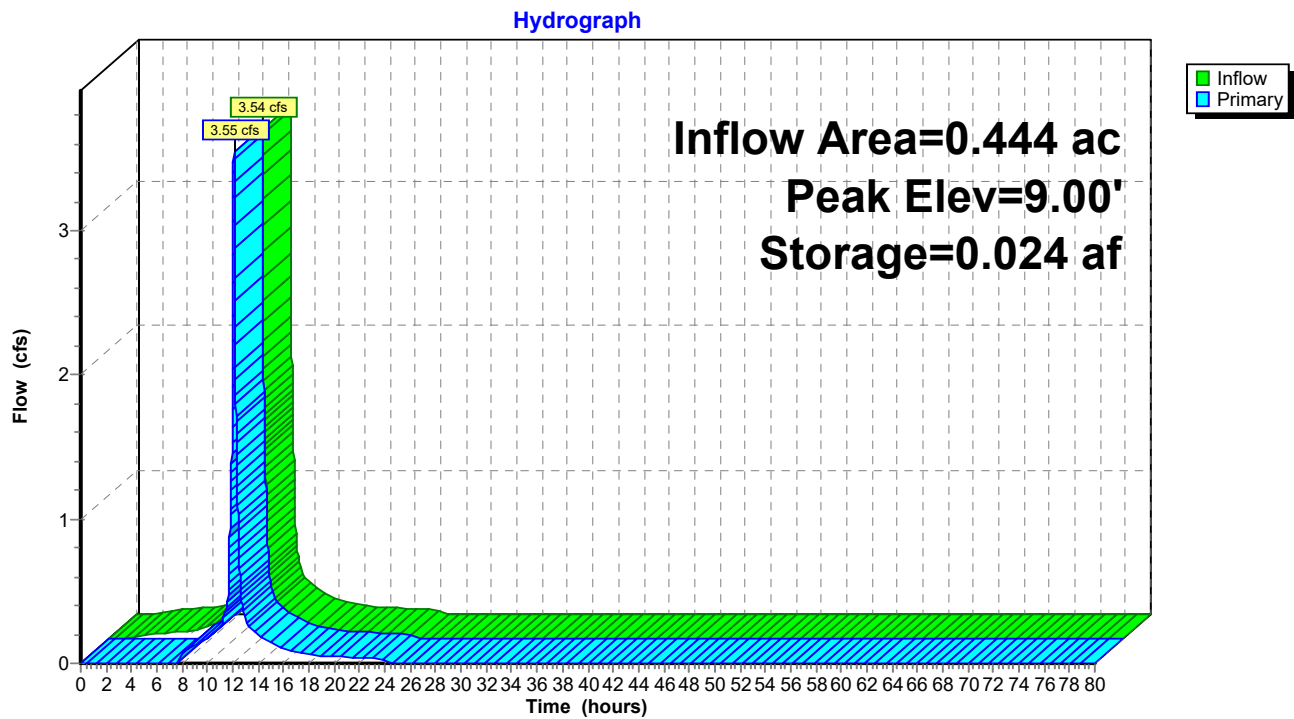
Overall System Size = 32.10' x 15.75' x 3.50'

12 Chambers

65.5 cy Field

45.1 cy Stone



Pond 7P: Subsurface Infiltration #1

Summary for Pond 8P: Perforated Pipe

Inflow Area = 1.405 ac, 100.00% Impervious, Inflow Depth = 7.90" for 100-YR event
 Inflow = 11.23 cfs @ 12.08 hrs, Volume= 0.925 af
 Outflow = 11.16 cfs @ 12.09 hrs, Volume= 0.925 af, Atten= 1%, Lag= 0.5 min
 Discarded = 0.08 cfs @ 2.58 hrs, Volume= 0.202 af
 Primary = 11.08 cfs @ 12.09 hrs, Volume= 0.723 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Peak Elev= 8.91' @ 12.09 hrs Surf.Area= 1,440 sf Storage= 2,799 cf

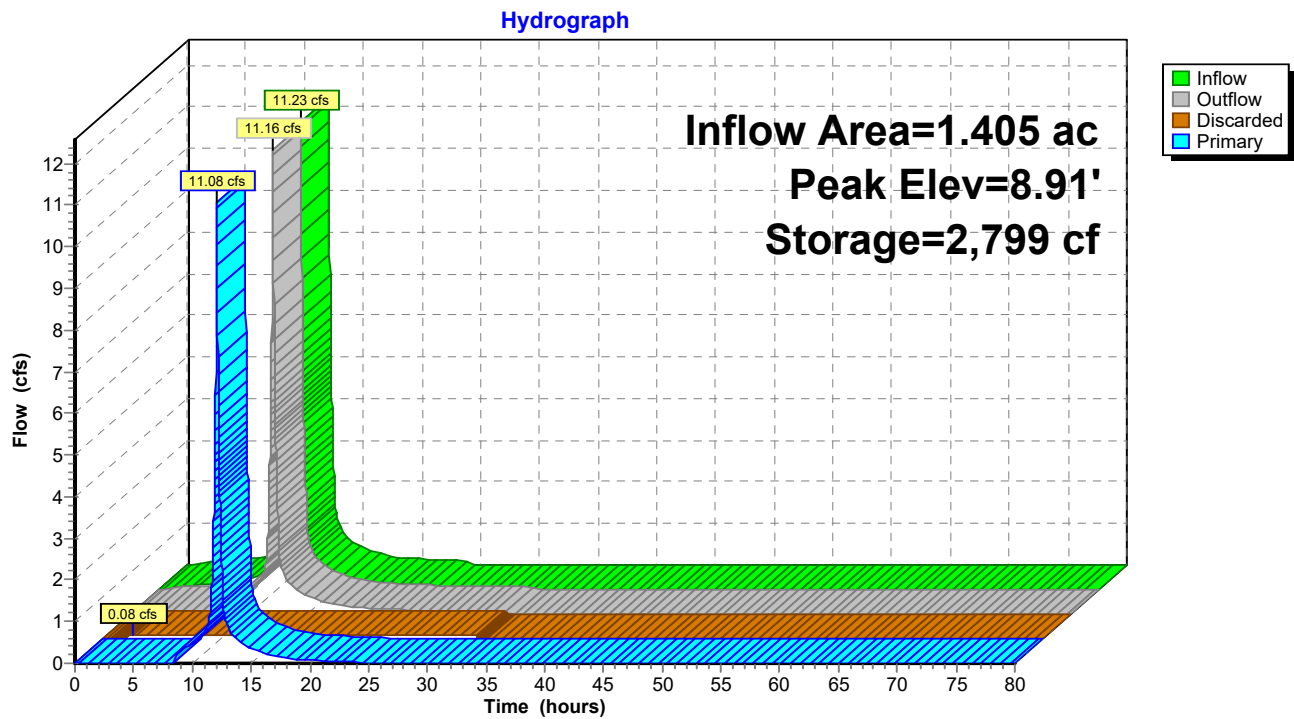
Plug-Flow detention time= 73.3 min calculated for 0.925 af (100% of inflow)
 Center-of-Mass det. time= 73.4 min (814.4 - 741.0)

Volume	Invert	Avail.Storage	Storage Description
#1	6.10'	1,005 cf	24.0" Round Pipe Storage Inside #2 L= 320.0'
#2	5.10'	2,190 cf	4.50'W x 320.00'L x 4.50'H Stone 6,480 cf Overall - 1,005 cf Embedded = 5,475 cf x 40.0% Voids
		3,195 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	24.0" Round Culvert L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.97' S= 0.0150 ' / Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	8.00'	4.0' long x 5.60' rise Sharp-Crested Rectangular Weir 2 End Contraction(s) 6.0' Crest Height
#3	Discarded	5.10'	2.400 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 2.58 hrs HW=5.19' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.08 cfs)

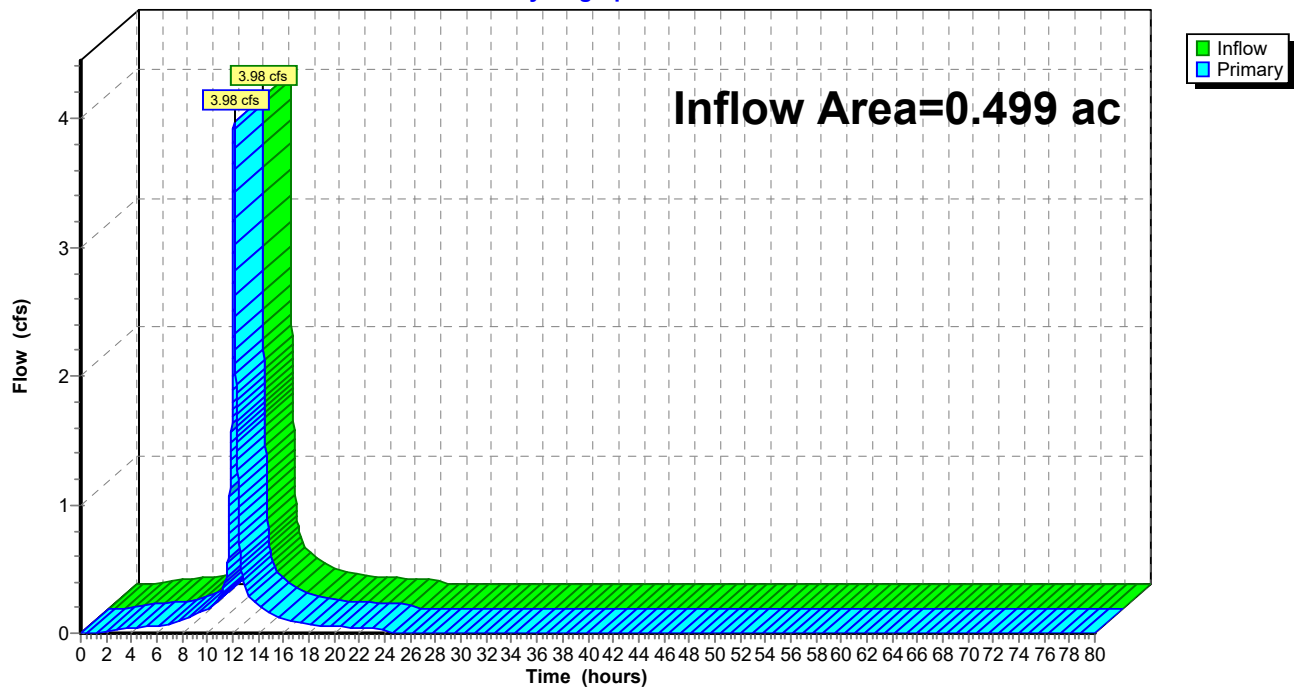
Primary OutFlow Max=11.06 cfs @ 12.09 hrs HW=8.91' (Free Discharge)
 ↑ **1=Culvert** (Passes 11.06 cfs of 36.78 cfs potential flow)
 ↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 11.06 cfs @ 3.18 fps)

Pond 8P: Perforated Pipe

Summary for Link 1L: Somerville Drainage

Inflow Area = 0.499 ac, 88.71% Impervious, Inflow Depth = 7.78" for 100-YR event
Inflow = 3.98 cfs @ 12.08 hrs, Volume= 0.323 af
Primary = 3.98 cfs @ 12.08 hrs, Volume= 0.323 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 1L: Somerville Drainage**Hydrograph**

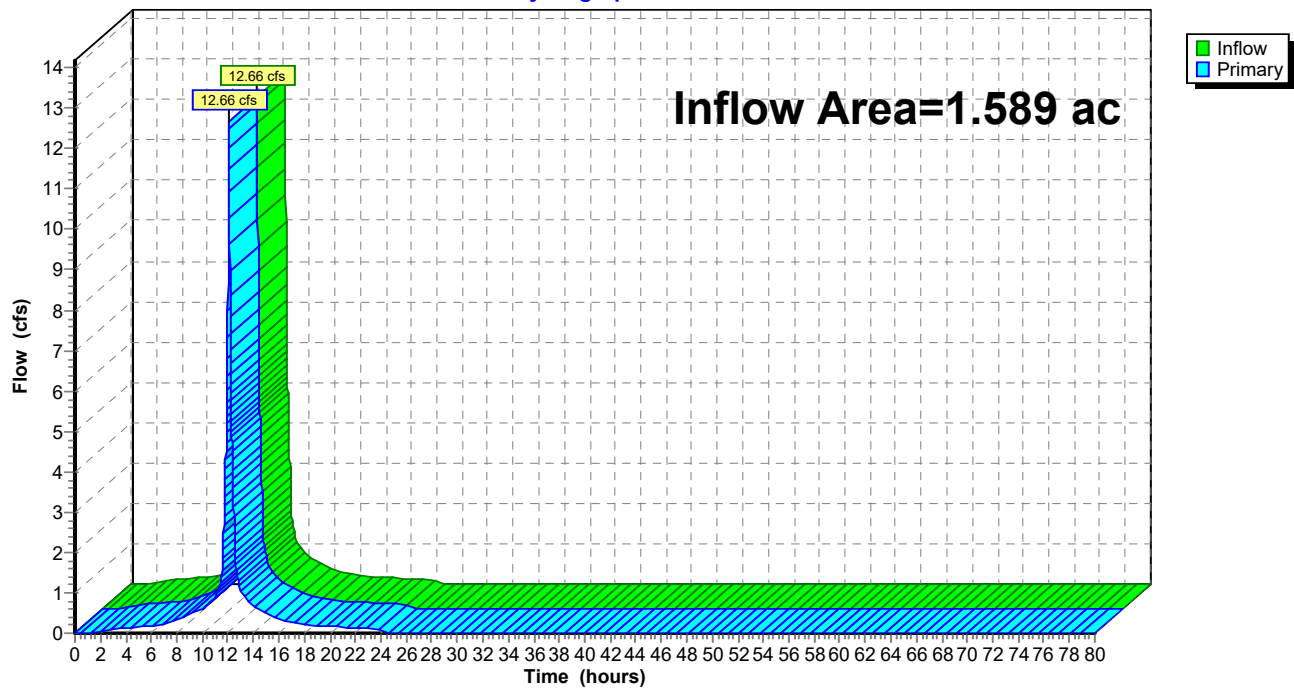
Summary for Link 2L: Somerville Drainage

Inflow Area = 1.589 ac, 91.63% Impervious, Inflow Depth = 7.78" for 100-YR event

Inflow = 12.66 cfs @ 12.08 hrs, Volume= 1.030 af

Primary = 12.66 cfs @ 12.08 hrs, Volume= 1.030 af, Atten= 0%, Lag= 0.0 min

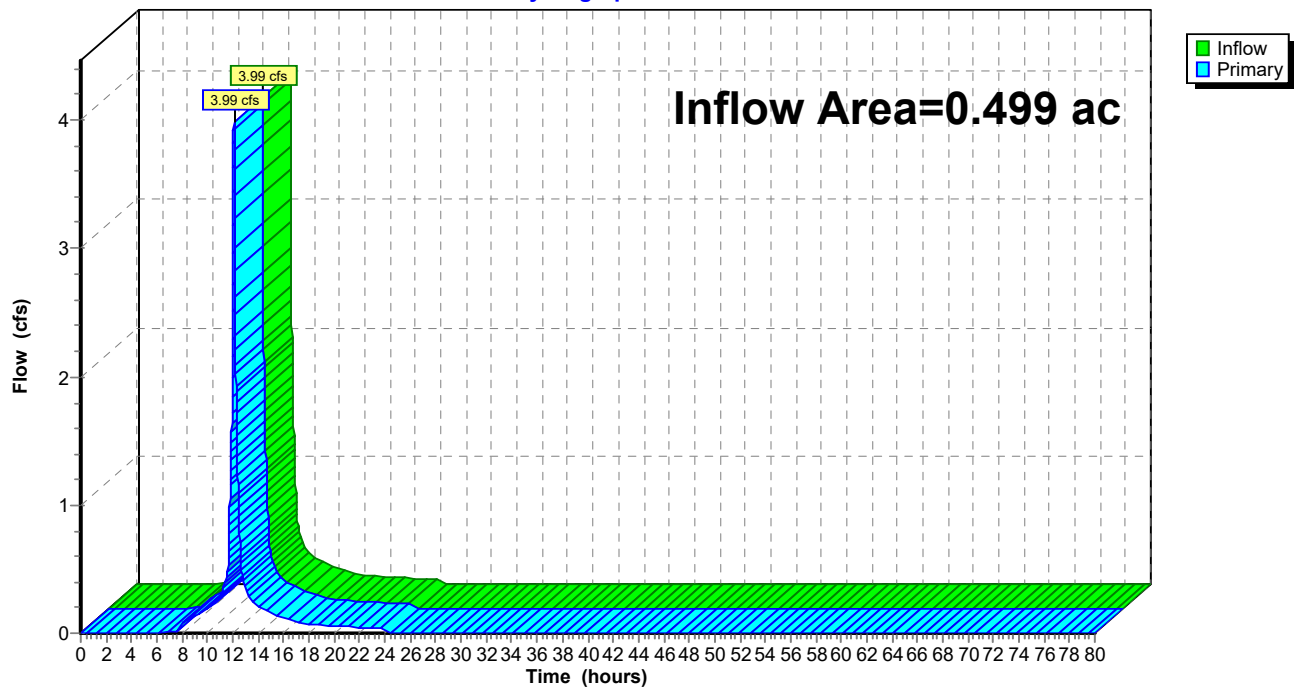
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 2L: Somerville Drainage**Hydrograph**

Summary for Link 3L: Somerville Drainage

Inflow Area = 0.499 ac, 97.89% Impervious, Inflow Depth = 7.26" for 100-YR event
Inflow = 3.99 cfs @ 12.08 hrs, Volume= 0.302 af
Primary = 3.99 cfs @ 12.08 hrs, Volume= 0.302 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 3L: Somerville Drainage**Hydrograph**

Summary for Link 4L: Somerville Drainage

Inflow Area = 1.589 ac, 100.00% Impervious, Inflow Depth = 6.38" for 100-YR event
Inflow = 12.54 cfs @ 12.09 hrs, Volume= 0.844 af
Primary = 12.54 cfs @ 12.09 hrs, Volume= 0.844 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

Link 4L: Somerville Drainage**Hydrograph**