

## 12. STORMWATER MANAGEMENT PLAN & CALCULATIONS

The MMC staff parking garage project site consists of portions of the 222 St. John Street (Cowcatcher), 184 St. John Street (Eagles), and the Union Station Plaza property through an access easement. Within the stormwater design, these properties have been combined and evaluated as a single project site. Applicable regulations that govern stormwater management on this site include Section 5 of the City of Portland Technical Manual, Chapter 32 of the City of Portland Code of Ordinances, and the Maine Stormwater Best Management Practices (BMP) Manual. Under Section 5 of the City Technical Manual, the project is subject to the Redevelopment Standards and is required to adhere to the General Standards of the Maine Department of Environmental Protection Chapter 500 Stormwater Regulations.

The project will disturb greater than one acre of land; will result in a decrease of approximately 14,506 square feet (SF) of impervious area; and will result in the redevelopment of a non-roof impervious area greater than 5,000 SF. The project will therefore be required to meet the Basic Standards for erosion & sedimentation control, and the General Standards for treatment of redeveloped area. The project is not required to meet the Flooding Standard, as there is no new impervious surface proposed, however the project has been designed to minimize the impact of project flows on the surrounding stormdrain system. A small portion of the project area on the 184 St. John Street property will be connected to the existing separated stormdrain in St. John Street, east of the site. Drainage was not previously connected in this direction. The remainder of the post-development flows for the redeveloped site will be managed to reduce the flow to the existing downstream stormwater collection system west of the site. Adequate provisions have been made to collect, treat, and detain the required amount of stormwater runoff generated from the site. The following sections describe the design methodology and the proposed means of compliance with these standards.

### 12.1 Stormwater Modeling Methodology

Stormwater modeling was completed using the HydroCAD 10.0 Stormwater Modeling System by Applied Microcomputer Systems, which uses TR-20 runoff calculations methodology. The HydroCAD output for both the pre- and post-development models are attached to this section. The Chapter 500 Stormwater regulations define standard rainfall amounts for the 2-year, 10-year, and 25-year, 24-hour storm events; a Type III rainfall distribution was applied to the storm events.

Subcatchment drainage areas were delineated based on topographical information. HydroCAD provides a lookup table for curve number (CN), which is a measure of the retention and runoff properties of various surfaces based on the Hydrological Soil Group (HSG) and land cover type. The calculation of CN is based on TR-55 methodology. The HSG for the site was taken from the USDA Natural Resources Conservation Service Web Soil Survey, a copy of the survey map is attached; the Site consists of HSG Type A (representative of the most permeable soils) within the 184 St. John Street property and unclassifiable soils within the current 222 St. John Street Parking lot. The unclassifiable soils have been modeled as HSG Type D, the HSG representing the least permeable soil condition. The area of each land cover type was delineated using ground cover information from existing condition survey and GIS sources, and HydroCAD computed the final CN for each subcatchment based on the area-weighted average.

The Time of Concentration ( $T_c$ ) is the time required for runoff to travel from the most hydrologically distant point of a watershed to the point of discharge. The  $T_c$  for each subcatchment drainage area was computed within HydroCAD using TR-55 methodology as the sum of the travel times for each consecutive flow segments along the longest hydraulic flow path. The longest hydraulic flow path was delineated utilizing contour data and partitioned into segments based on flow types, land cover, and slopes. The primary types of flow consist of sheet flow, shallow concentrated flow, and channel flow. A minimum  $T_c$  of six minutes was utilized for all subcatchments.

## 12.2 Pre- and Post-Development Site Conditions

For the purpose of this stormwater analysis, the model has been limited to the project area, which includes portions of the following properties:

- 222 St. John Street Property parking lot (Cowcatcher LLC);
- 184 St. John Street Property parking lot (Fraternal Order of Eagles); and
- A portion of the Union Station Plaza Parcel parking lot (Union Station Plaza Limited Partnership).

Areas proposed to be redeveloped as part of the design have been included within stormwater calculations described below. Two stormwater study points have been defined, an existing 30-inch stormdrain in St. John Street to the east of the site and an existing 18-inch stormdrain crossing the railroad tracks to the west of the site.

### 12.2.1 Pre-Development

Currently, stormwater runoff generated from the existing parking lot collects via catch basins into a closed storm drain system installed within the parking lots. The parking lot area is primarily flat and allows for additional relief along the western property line adjacent to the neighboring railroad tracks. The project area connects to a stormdrain system that continues through the main parking lot for 222 St. John Street and Union Station Plaza. These existing 18-inch diameter stormdrain pipes convey stormwater runoff from the site, to the west under the railroad tracks into the City of Portland's separated stormwater system that crosses Ogdensburg Street / County Way into the County Jail property.

Stormwater runoff generated from existing southern parking lot located on the 184 St. John Street Property, collects via a single catch basin and connects to the existing stormdrain located within St. John Street.

Existing drainage patterns and site features are shown on the Pre-Development Drainage Plan provided in this section. For the purposes of our analysis, we have used the existing 18-inch stormdrain system as the pre-development study point. A closed circuit television (CCTV) inspection of a portion of the downstream stormdrain system was completed by the applicant, and the results of that inspection show that the existing 18-inch concrete pipe is in good condition.

### 12.2.2 Post-Development

The proposed redevelopment will consist of the construction of a new free-standing parking garage, entrance driveways, a surface parking lot, walkways, landscaping and associated stormwater management systems. Proposed work will primarily consist of the redevelopment of existing paved parking lot areas. Drainage from the project area will discharge to two locations. The majority of the redeveloped area will continue to discharge via direct pipe connection into the existing 18-inch stormdrain that discharges to the west under the railroad tracks into the City's stormwater infrastructure. The redeveloped area along St. John Street, including an access driveway and associated landscaping, will be redirected to the existing stormwater drainage utilities within St. John Street. Proposed drainage patterns and features are shown on the Post-Development Stormwater figure provided in this section.

#### 12.2.2.1 West Stormdrain

Stormwater runoff from the majority of the project site will be intercepted by a closed stormwater system that connects to a proprietary subsurface stormwater treatment system which will store and treat stormwater runoff generated from the following areas:

- Top deck of the parking garage and lobby structure roof, discharged to the system via internal garage plumbing;

- Crushed stone planting area which extends along the southern and western faces of the parking garage; and
- Northern surface parking lot, an adjacent grade level entrance driveway, and associated landscaping.

Details of the proposed treatment and storage are provided in the discussions of the General and Flooding Standards that follow in this report.

### 12.2.2.2 East Stormdrain

Stormwater runoff from the redeveloped area along St. John Street will be intercepted by a closed stormwater system that connects to a proprietary stormwater treatment system which will be installed within a new catch basin in the proposed entrance drive. The existing condition in this area is a parking lot that connects to the stormdrain to the west. This project proposes to instead direct stormwater from this area to the east into the existing 30-inch separated stormdrain in St. John Street. This is a small part of the overall project site, and the flow from this area will not be significant (see the Flooding Standard discussion below). Discussions with Brad Roland from the City of Portland Department of Public Works have indicated that the St. John Street stormdrain should have adequate capacity for the proposed connection.

The existing parking lot located to the south of the Fraternal Order of the Eagles building is proposed to be redeveloped. Stormwater runoff in this area will remain the same as previously described and will discharge into the existing stormdrain within St. John Street.

## 12.3 Basic Standards (Soil Erosion and Sedimentation Control)

These standards address erosion and sedimentation control, inspection and maintenance, and good housekeeping practices. The application includes erosion and sediment control plans, details, and notes. These notes cover good housekeeping practices. The Erosion and Sedimentation Control Plan for the proposed project is provided below. Additional erosion and sedimentation controls are located within the construction management plan and detail the sequence of the management practice installation.

### 12.3.1 Erosion and Sedimentation Control Plan

The overall goal of the Soil Erosion and Sedimentation Plan is to restrict the potential for erosion and sedimentation at the site and down-gradient of the site. A variety of erosion control techniques will be implemented to achieve this goal. During construction, these include:

- Positive grades throughout the construction site to direct flow to sediment control barriers;
- Diversion barriers to keep upslope runoff from flowing through the construction site;
- Installation and maintenance of sedimentation barriers adjacent to downhill areas of the perimeter of the project site;
- Installation and maintenance of construction entrances at the travelled interface between stabilized and non-stabilized portions of the project site;
- Controls for fugitive dust, debris, and other materials;
- Permanent seeding or mulching applied as soon as areas are at final grades; and
- Inspection of all in-place measures after every significant rainfall until permanent measures are in place.

Structural measures for erosion and sedimentation control will be installed where shown on the Demolition Plan, which is included in the drawings attached to Section 3 of this Report; details for the proposed measures are also included in

the drawings. Erosion and sedimentation control measures will be implemented in accordance with the “Maine Erosion and Sedimentation Handbook for Construction: Best Management Practices” and will be installed prior to earth disturbing activities. Temporary measures will be removed after the areas are permanently stabilized.

Permanent erosion control measures will include surface ground cover, including vegetation, pavement, crushed stone, and rip rap. Areas of concentrated flow will be protected from erosion by establishing vegetation and riprap. All measures will be maintained in effective operating condition. The Contractor will be responsible for implementing and maintaining all erosion and sediment control measures and will use the attached inspection report form or equivalent.

Due to the size of the site, the project will be required to conform with the Maine Construction General Permit. A Notice of Intent to Comply will be filed for the project prior to the start of construction, and will be provided to the City upon filing.

## 12.4 General Standard (Water Quality)

The City of Portland Technical Manual requires that all projects, not subject to the requirements of an existing Site Law or Stormwater Management Law Permit, that include redevelopment of non-roof impervious area greater than 5,000 square feet, and are subject to the City of Portland Review, provide stormwater quality treatment in accordance with the General Standard for no less than 50% of the redeveloped non-roof impervious area.

No new developed area will be created as part of this project, as the Site is already entirely developed. A majority of the site will be disturbed. The project will result in a net decrease of approximately 14,506 SF of impervious area. The project will result in approximately 146,887 square feet of redeveloped non-roof impervious area; it should be noted that the garage top deck is not considered “roof” under this analysis and is therefore counted toward the redeveloped area requiring treatment. The redevelopment standard requires 50% of this redevelopment area to be treated, requiring that a minimum 73,444 square feet of area be treated for this project.

A Jellyfish Filter with below-grade R-Tanks for water quality volume storage has been selected as the primary water quality treatment BMP for the Site. This system will provide treatment for the west stormdrain area (as described earlier under post-development site conditions). Alternative methods were considered, such as an underdrained subsurface sand filter, but were not selected due to elevation constraints associated with discharging to the existing stormdrain system located on the Union Station Plaza property. Above-grade storage systems, like underdrained soil filters and rain gardens, were also ruled out as there is limited available space on the Site.

Adequate provisions have been made to collect stormwater runoff from the project area via a series of catch basins and inlets, which drain to an underground R-Tank storage system designed to store the Water Quality Volume prior to treatment by the Jellyfish Filter. The proposed R-Tank System and Jellyfish Filter are proposed to be installed below-grade in the surface parking lot to the north of the parking garage and will collect, store and treat stormwater runoff generated from the post-development areas described above in Section 12.1.1.2.

The Jellyfish Filter is a proprietary system, which has been reviewed and approved for use by the MaineDEP; a copy of the approval letter is attached in this section. The proposed Jellyfish Filter has been sized to meet the MaineDEP approval standards to treat a minimum Water Quality Volume of 1-inch runoff from impervious areas and 0.4-inch runoff from pervious areas. Please see attached calculations demonstrating that the filter has been adequately sized to treat the required Water Quality Volume.

The Jellyfish Filter will be installed to provide treatment of greater than the minimum required area. The entire area of the site that is tributary to the proposed treatment system is approximately 157,512 square feet. Of this area, 125,012 square feet is redeveloped, non-roof impervious surface which exceeds the 73,444 square feet required for 50% treatment of the redeveloped impervious area.

A second treatment system is proposed for the east stormdrain area, which ties into St. John Street. This StormBasin catch basin filter will be installed within the redeveloped garage entrance along St. John Street. While the StormBasin filter is not an approved Maine DEP proprietary treatment option, the proposed stormdrain will aid in removal of pollutants generated within the highly trafficked entrance, providing treatment beyond the total amount required by the City's standards.

**Table 12-1** outlines the areas as described, demonstrating conformance with the City of Portland Redevelopment Standards.

**Table 12-1: Stormwater Treatment Area Breakdown**

	Area (SF)	Area(AC)
<b><u>Total Project Area:</u></b>	235,937	5.42
<b><u>Proposed Disturbed Area:</u></b>	210662	4.84
<b><u>Total Impervious Surface Area:</u></b>		
<b>Existing:</b>	196,461	4.51
<b>Proposed:</b>	182,485	4.19
<b>Reduction:</b>	(13,976)	0.32
<b><u>Redeveloped Non-Roof Impervious Area:</u></b>		
<b>Total (includes top floor of garage):</b>	153,295	3.52
<b>Required Treatment Area (50%):</b>	76,648	1.76
<b><u>Provided Treatment Area:</u></b>		
<b><u>Jellyfish Filter &amp; R-tanks</u></b>		
<b>Total Area Treated:</b>	160,921	3.69
<b>Total Redeveloped Non-Roof Impervious Area Treated:</b>	<b>126,626</b>	<b>2.906</b>
<b>Percentage of Redeveloped Non-Roof Impervious Area Treated:</b>	<b>83%</b>	
<b><u>StormBasin Catch Basin Filter</u></b>		
<b>Total Area Treated:</b>	<b>10,000</b>	<b>0.75</b>
<b>Total Redeveloped Non-Roof Impervious Area Treated:</b>	<b>4,743</b>	<b>0.21</b>
<b>Percentage of Redeveloped Non-Roof Impervious Area Treated:</b>	<b>3.2%</b>	
<b>Total Percentage of Redeveloped Non-Roof Impervious Area Treated by Both Systems:</b>	<b>86.2%</b>	

### 12.5 Flooding Standard (Water Quantity)

In accordance with the City of Portland's Redevelopment Standards, the adherence to the Flooding Standard is not required for the site, as there is no new impervious or new developed surface proposed. However, based upon good engineering practices, and current site constraints, the stormwater management system has been evaluated for the

24-hour, Type III storm event of the 2-,10-, and 25-year frequencies to ensure that peak flows from the Post-Development design of the site do not result in a negative impact on their tributary drainage systems.

The existing parking lot currently discharges to a stormdrain system that runs through the Union Station Plaza property and underneath the railroad tracks, connecting to an existing City-owned stormdrain system on Ogdensburg Street and County Way at the County Jail property located west of the project site. Examination of existing conditions on the site shows that the existing 18-inch stormdrain piping is not sized to adequately to handle current flows, and anecdotal evidence notes that ponding does occur in the parking lot during larger storm events. CCTV inspection of the existing pipe has shown that the existing RCP pipe is in good condition.

The intent of our design is to manage stormwater such that the post-development peak flows are reduced to flow rates that can be accommodated within the existing 18-inch stormdrain pipe west of the site. This is accomplished by increasing the size of the R-tank storage system. Based upon proposed conditions, the 18-inch pipe is able to convey 9.31 cfs of flow at 95% of its full capacity based upon the Manning’s Equation. Reviewing the peak flow calculations for this study point (see **Table 12-2**), the pipe capacity is exceeded in the existing conditions during all storm events. With no additional storage the existing conditions flood the parking lot. The proposed stormwater system will provide adequate storage such that flows from the project site will be reduced to a rate this below the 18-inch pipe’s capacity during all evaluated storm events, including the 25-year storm event. Although, utilizing strictly the Manning’s Equation for a single pipe the proposed exceed the capacity of a 18-inch pipe, the provided HydroCAD model utilizes dynamic routing which takes into account possible backflow into the storage system during larger storm events. The HydroCAD model for Post-Development shows that there is an excess of 1-foot of freeboard within the manhole in which the system connects (DMH-2).

The small portion of the site that will newly connect to the St. John Street stormdrain to the east of the site will result in flow to the 30-inch separated stormdrain system, where stormwater does not currently exist. The City has indicated that this increase can be handled by the existing infrastructure.

Adequate provisions have been made to collect and discharge stormwater generated from the developed area of the Site. The HydroCAD reports for both Pre-and Post-Development Conditions are attached to this Section. The tables below provides a summary of the peak runoff rates for the 24-hour, 2-year, 10-year, and 25-year Type III storm events.

**Table 12-2: Summary of Peak Runoff Rates to Study Point 1 – 18-inch Stormdrain**

	PEAK RUNOFF RATE (CFS)		
	2-YEAR STORM	10-YEAR STORM	25-YEAR STORM
<b>Pre-Development (Existing) Site</b>	11.20	21.56	27.70
<b>Post-Development Site</b>	4.49	11.83	18.94
<b>Difference</b>	<b>-6.71</b>	<b>-9.73</b>	<b>-8.76</b>

**Table 12-3: Summary of Peak Runoff Rates to Study Point 2 – 30-inch St. John Street Stormdrain**

	PEAK RUNOFF RATE (CFS)		
	2-YEAR STORM	10-YEAR STORM	25-YEAR STORM
Pre-Development (Existing) Site	0.41	0.62	0.78
Post-Development Site	1.50	2.70	3.70
Difference	+1.09	+2.08	+2.92

**Table 12-4: Summary of Peak Runoff Rates Overall Project Site**

	PEAK RUNOFF RATE (CFS)		
	2-YEAR STORM	10-YEAR STORM	25-YEAR STORM
Pre-Developed (Existing) Site	11.31	22.18	28.48
Post-Development	5.99	14.53	22.64
Difference	-5.32	-7.65	-5.84

As the Site's peak runoff rate has been reduced, the proposed development is not anticipated to result in adverse effects, including flooding and erosion to abutting and downstream properties. All on-site piping has been designed to accommodate the 25-year storm event without resulting in flooding onto adjacent properties.

## 12.6 Inspection and Maintenance of Stormwater Systems

General inspection and maintenance during and after construction must take place in accordance with the requirements outlined in Chapter 500, Stormwater Management, Appendix B, Inspection and Maintenance and Stormwater Management, Maine Department of Environmental Protection Publication No. DEPLW0738. During construction, the contractor will be responsible for inspection and maintaining the Site. Upon completion, the property owner will be responsible for implementing the maintenance and inspection requirements for the stormwater management system associated with the new development. The responsible party will ensure that stormwater management facilities are properly maintained and inspected in accordance with the Stormwater Inspection and Maintenance Plan provided in this section.

## 12.7 Attachments

- Stormwater Erosion & Sedimentation Control Inspection Report Form
- USDA Natural Resources Conservation Service Web Soil Survey HSG Map
- Jellyfish Filter Sizing Calculations
- MaineDEP Jellyfish Filter approval letter
- Pre-Development Stormwater Figure

- Post-Development Stormwater Figure
- Pre-Development HydroCAD Report
- Post-Development HydroCAD Report
- Inspection and Maintenance Plan
- Jellyfish Filter Maintenance Guide
- BMP Maintenance Log
- StormBasin Maintenance Guide



A

B

C

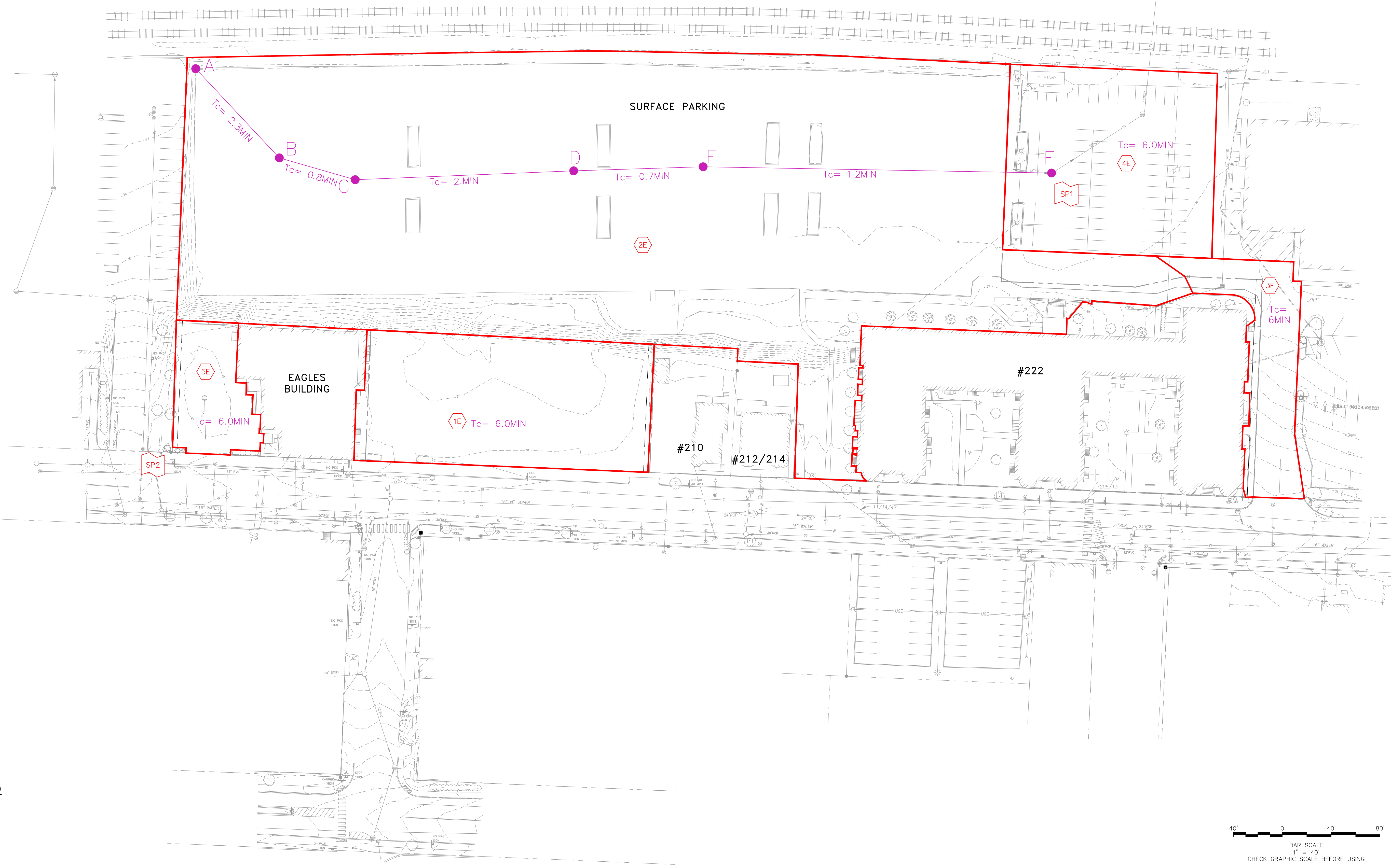
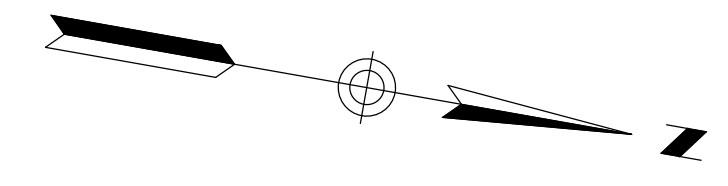
D

A





B

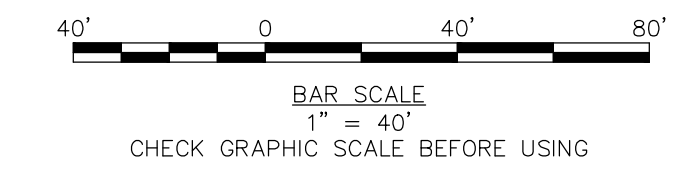
C

D



**STORMWATER LEGEND**

-  SUBCATCHMENT AREAS
-  STUDY POINT
-  TIME OF CONCENTRATION (Tc) FLOW LINE
-  LIMIT OF DRAINAGE AREA



SITE PLAN APPLICATION - NOT FOR CONSTRUCTION

41 Hutchins Drive  
Portland, Maine 04102  
800.426.4262 | www.woodardcurran.com



WOODARD & CURRAN  
COMMITMENT & INTEGRITY DRIVE RESULTS

THIS DOCUMENT IS THE PROPERTY OF WOODARD & CURRAN INC AND ITS CLIENT. IT IS TO BE USED ONLY FOR THE PROJECT AND LOCATION SPECIFICALLY IDENTIFIED. REPRODUCTION OR DISTRIBUTION WITHOUT WRITTEN PERMISSION IS PROHIBITED.

REV	DESCRIPTION	DATE

DESIGNED BY: CMS  
CHECKED BY: DAS  
DRAWN BY: BCL  
DATE: 02/15/18  
SCALE: 1" = 40'

**PRE DEVELOPMENT STORMWATER FIGURE**

MAINE MEDICAL CENTER  
22 BRANHALL STREET  
PORTLAND, ME 04102

MMC ST. JOHN STREET  
EMPLOYEE PARKING GARAGE

JOB NO.: 0231158.00  
DATE: JUNE 22, 2018  
SCALE: 1" = 40'  
SHEET: 1 OF 2

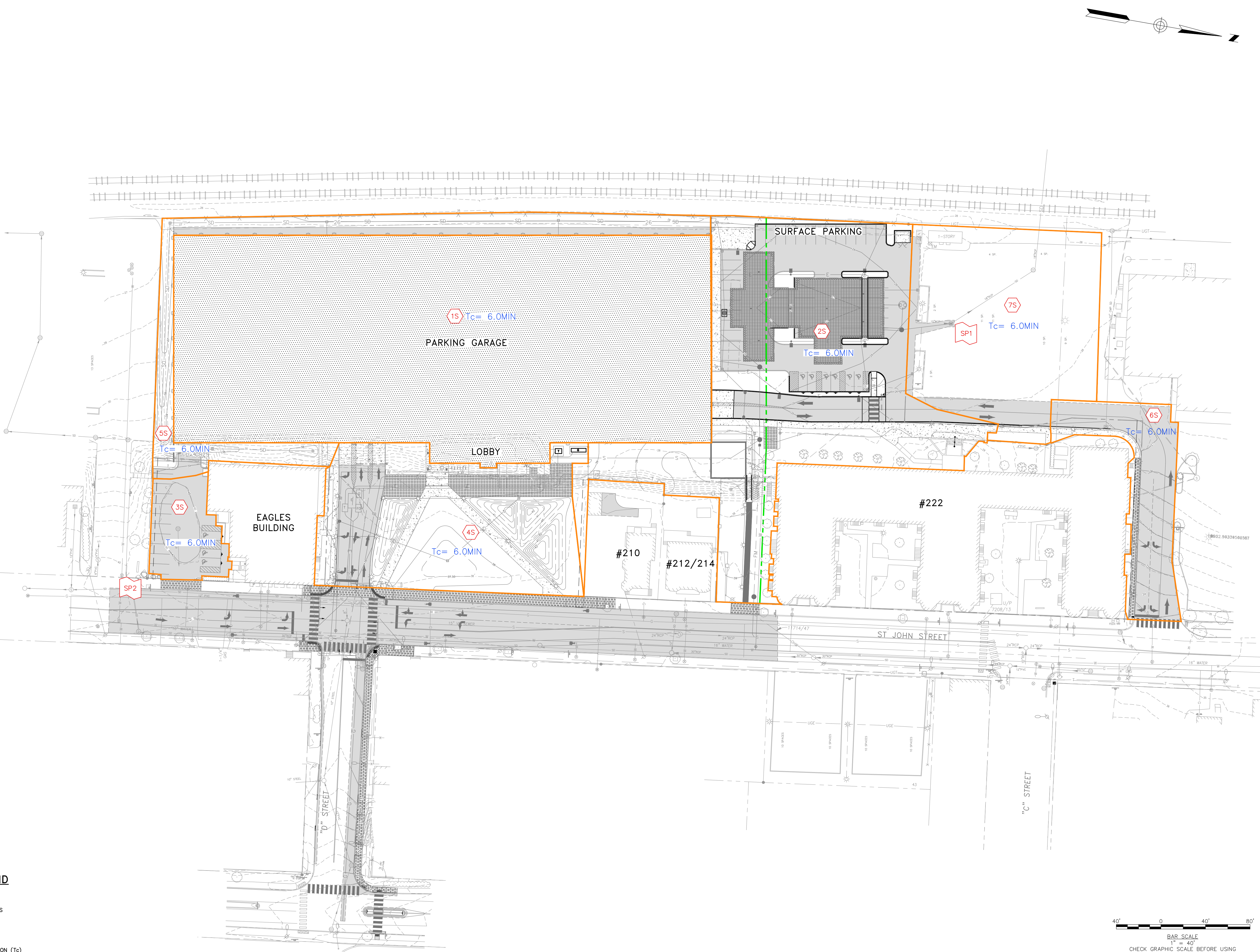
**PRE**

woodardcurran.com\shared\Projects\0231158.00 Maine Med Ctr - Parking Garage\wip\Drawings\Redesign Phase\0231158.00 SW 7.24.18.dwg, Jul 24, 2018 - 11:31am  
 C:\Users\jmc\OneDrive\Documents\0231158.00 Maine Med Ctr - Parking Garage\wip\Drawings\Redesign Phase\0231158.00 SW 7.24.18.dwg, Jul 24, 2018 - 11:31am

41 Hutchins Drive  
Portland, Maine 04102  
800.426.4262 | www.woodardcurran.com

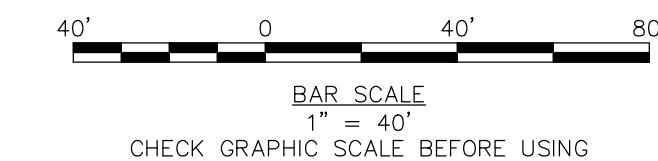
**WOODARD & CURRAN**  
COMMITMENT & INTEGRITY DRIVE RESULTS

THIS DOCUMENT IS THE PROPERTY OF WOODARD & CURRAN INC. AND ITS CLIENT. IT IS TO BE USED ONLY FOR THE PROJECT, ADDRESS, PERMITS, FEES, AND PURPOSES SPECIFIED HEREIN.



**STORMWATER LEGEND**

- 1S SUBCATCHMENT AREAS
- SP1 STUDY POINT
- TIME OF CONCENTRATION (Tc) FLOW LINE
- LIMIT OF DRAINAGE AREA



REV	DESCRIPTION	DATE

DESIGNED BY: CMS  
CHECKED BY: DAS  
DRAWN BY: BCL  
DATE: 02/19/2018  
SCALE: 1" = 40'

**POST DEVELOPMENT STORMWATER FIGURE**

MAINE MEDICAL CENTER  
22 BRANHALL STREET  
PORTLAND, ME 04102

MMC ST. JOHN STREET  
EMPLOYEE PARKING GARAGE

JOB NO.: 0231158.00  
DATE: JUNE 22, 2018  
SCALE: 1" = 40"  
SHEET: 2 OF 2

POST

SITE PLAN APPLICATION - NOT FOR CONSTRUCTION



41 HUTCHINS DRIVE  
PORTLAND, MAINE 04102  
TEL. (207) 774-2112  
FAX (207) 774-6635

CLIENT MAINE MEDICAL CENTER  
PROJECT 222 St. John STREET GARAGE  
DESIGNED BY CMS DATE 7-23-18  
CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
PROJECT NO. 0231158 SHEET NO. 1 OF 1

WATER Quality Volume for Jersey Filter System

$$WQV = (1'' - \text{IMPERVIOUS AREA}) + (0.4'' \cdot \text{PERVIOUS AREA})$$

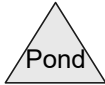
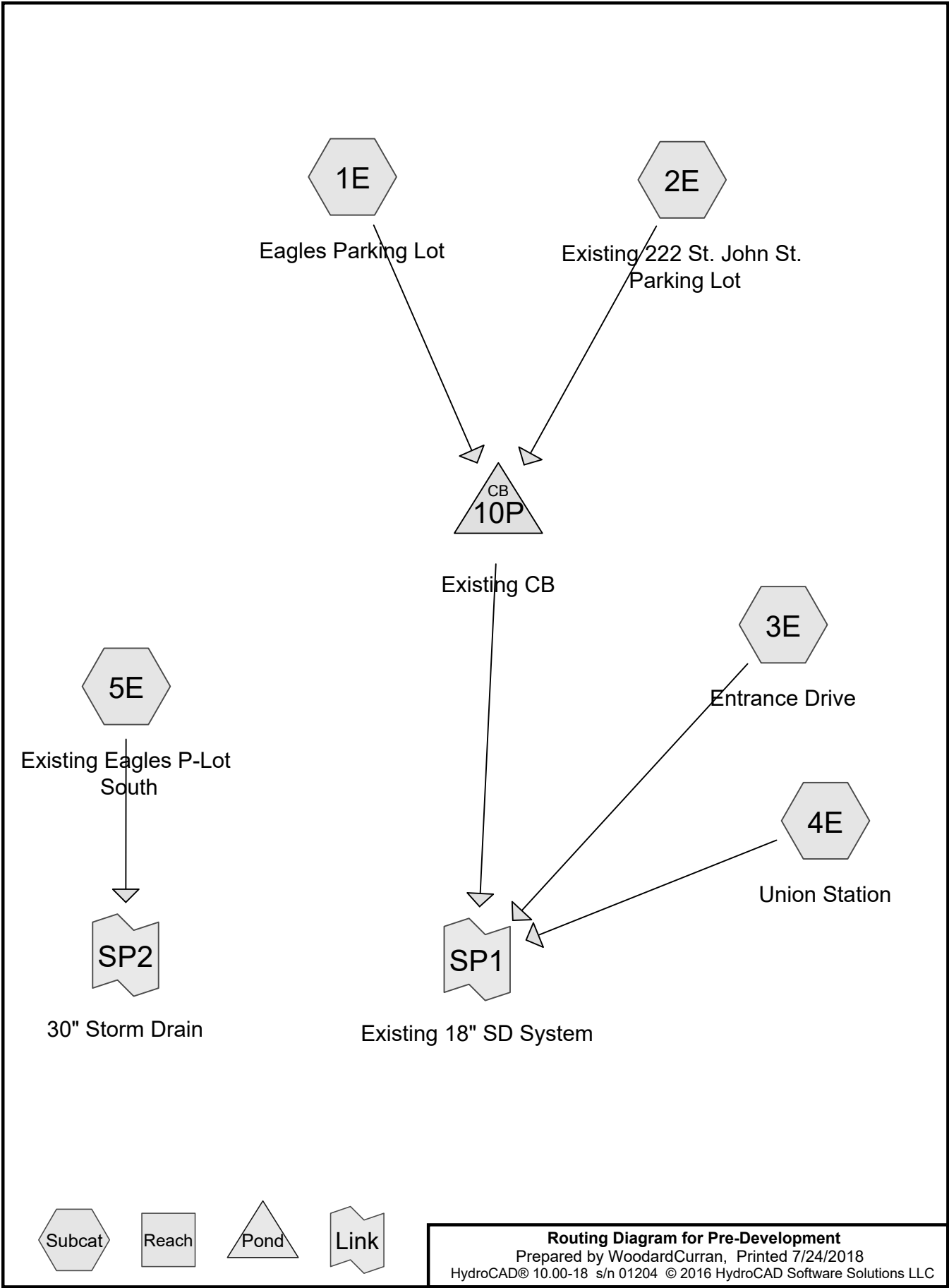
→ IMPERVIOUS AREA = 128,333 (INCLUDES LOBBY ROOF)  
→ PERVIOUS AREA = 31,480

$$= (1''/12'' \cdot 128,333 \text{ SF}) + (0.4''/12'' \cdot 31,480 \text{ SF})$$

$$= 10,694.42 \text{ CF} + 1,049.33 \text{ CF}$$

$$= 11,743 \text{ CF REQUIRED}$$

$$\star WQV \text{ PROVIDED} = 11,832 \text{ CF} > 11,743 \text{ CF}$$



**Routing Diagram for Pre-Development**  
 Prepared by WoodardCurran, Printed 7/24/2018  
 HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

## Pre-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Printed 7/24/2018

Page 2

### Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
35,714	98	(3E, 4E)
18,343	79	50-75% Grass cover, Fair, HSG C (2E)
3,718	70	Brush, Fair, HSG C (1E)
129,899	98	Paved parking, HSG B (2E)
20,184	76	Woods/grass comb., Fair, HSG C (2E)
6,150	98	existing P-lot (5E)
21,798	98	parking lot (1E)
<b>235,806</b>	<b>94</b>	<b>TOTAL AREA</b>

## Pre-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Printed 7/24/2018

Page 3

### Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
129,899	HSG B	2E
42,245	HSG C	1E, 2E
0	HSG D	
63,662	Other	1E, 3E, 4E, 5E
<b>235,806</b>		<b>TOTAL AREA</b>

# Pre-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Printed 7/24/2018

Page 4

## Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	0	0	35,714	35,714	
0	0	18,343	0	0	18,343	50-75% Grass cover, Fair
0	0	3,718	0	0	3,718	Brush, Fair
0	129,899	0	0	0	129,899	Paved parking
0	0	20,184	0	0	20,184	Woods/grass comb., Fair
0	0	0	0	6,150	6,150	existing P-lot
0	0	0	0	21,798	21,798	parking lot
<b>0</b>	<b>129,899</b>	<b>42,245</b>	<b>0</b>	<b>63,662</b>	<b>235,806</b>	<b>TOTAL AREA</b>

## Pre-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Printed 7/24/2018

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	2E	0.00	0.00	179.0	0.0009	0.012	12.0	0.0	0.0
2	2E	0.00	0.00	105.0	0.0029	0.012	12.0	0.0	0.0
3	2E	0.00	0.00	285.0	0.0047	0.012	15.0	0.0	0.0
4	10P	20.50	19.15	281.0	0.0048	0.011	18.0	0.0	0.0



## Pre-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 6

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1E: Eagles Parking Lot**      Runoff Area=25,516 sf   85.43% Impervious   Runoff Depth>2.31"  
Tc=6.0 min   CN=94   Runoff=1.58 cfs   4,917 cf

**Subcatchment2E: Existing 222 St. John**      Runoff Area=168,426 sf   77.13% Impervious   Runoff Depth>2.22"  
Flow Length=734'   Tc=7.0 min   CN=93   Runoff=9.85 cfs   31,138 cf

**Subcatchment3E: Entrance Drive**      Runoff Area=9,847 sf   100.00% Impervious   Runoff Depth>2.68"  
Tc=6.0 min   CN=98   Runoff=0.66 cfs   2,201 cf

**Subcatchment4E: Union Station**      Runoff Area=25,867 sf   100.00% Impervious   Runoff Depth>2.68"  
Tc=6.0 min   CN=98   Runoff=1.74 cfs   5,781 cf

**Subcatchment5E: Existing Eagles P-Lot**      Runoff Area=6,150 sf   100.00% Impervious   Runoff Depth>2.68"  
Tc=6.0 min   CN=98   Runoff=0.41 cfs   1,374 cf

**Pond 10P: Existing CB**      Peak Elev=24.27'   Inflow=11.42 cfs   36,055 cf  
18.0" Round Culvert   n=0.011   L=281.0'   S=0.0048 '/'   Outflow=11.42 cfs   36,055 cf

**Link SP1: Existing 18" SD System**      Inflow=13.81 cfs   44,037 cf  
Primary=13.81 cfs   44,037 cf

**Link SP2: 30" Storm Drain**      Inflow=0.41 cfs   1,374 cf  
Primary=0.41 cfs   1,374 cf

**Total Runoff Area = 235,806 sf   Runoff Volume = 45,411 cf   Average Runoff Depth = 2.31"**  
**17.92% Pervious = 42,245 sf   82.08% Impervious = 193,561 sf**

**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 7

**Summary for Subcatchment 1E: Eagles Parking Lot**

Runoff = 1.58 cfs @ 12.09 hrs, Volume= 4,917 cf, Depth> 2.31"

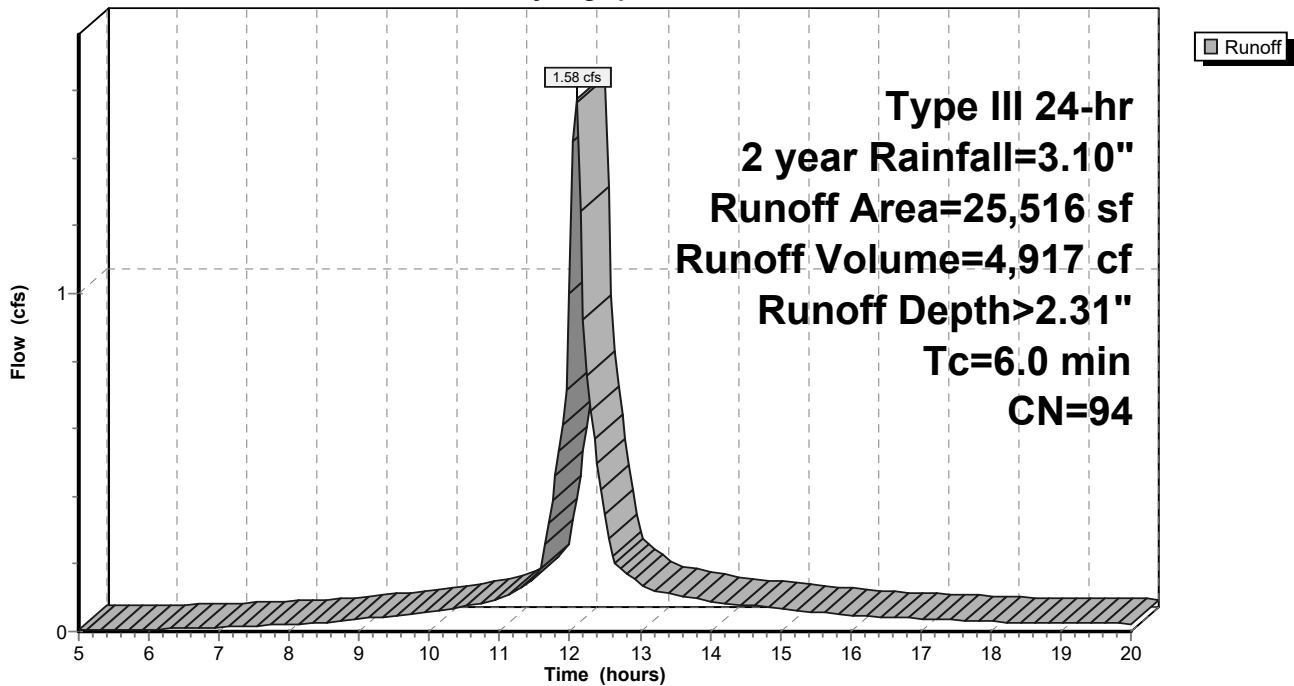
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2 year Rainfall=3.10"

Area (sf)	CN	Description
3,718	70	Brush, Fair, HSG C
* 21,798	98	parking lot
25,516	94	Weighted Average
3,718		14.57% Pervious Area
21,798		85.43% Impervious Area

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

**Subcatchment 1E: Eagles Parking Lot**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 8

**Summary for Subcatchment 2E: Existing 222 St. John St. Parking Lot**

Runoff = 9.85 cfs @ 12.10 hrs, Volume= 31,138 cf, Depth> 2.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2 year Rainfall=3.10"

Area (sf)	CN	Description
129,899	98	Paved parking, HSG B
18,343	79	50-75% Grass cover, Fair, HSG C
20,184	76	Woods/grass comb., Fair, HSG C
168,426	93	Weighted Average
38,527		22.87% Pervious Area
129,899		77.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	100	0.0044	0.74		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.8	65	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.0	179	0.0009	1.47	1.16	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.7	105	0.0029	2.65	2.08	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
1.2	285	0.0047	3.91	4.80	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
7.0	734	Total			

**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

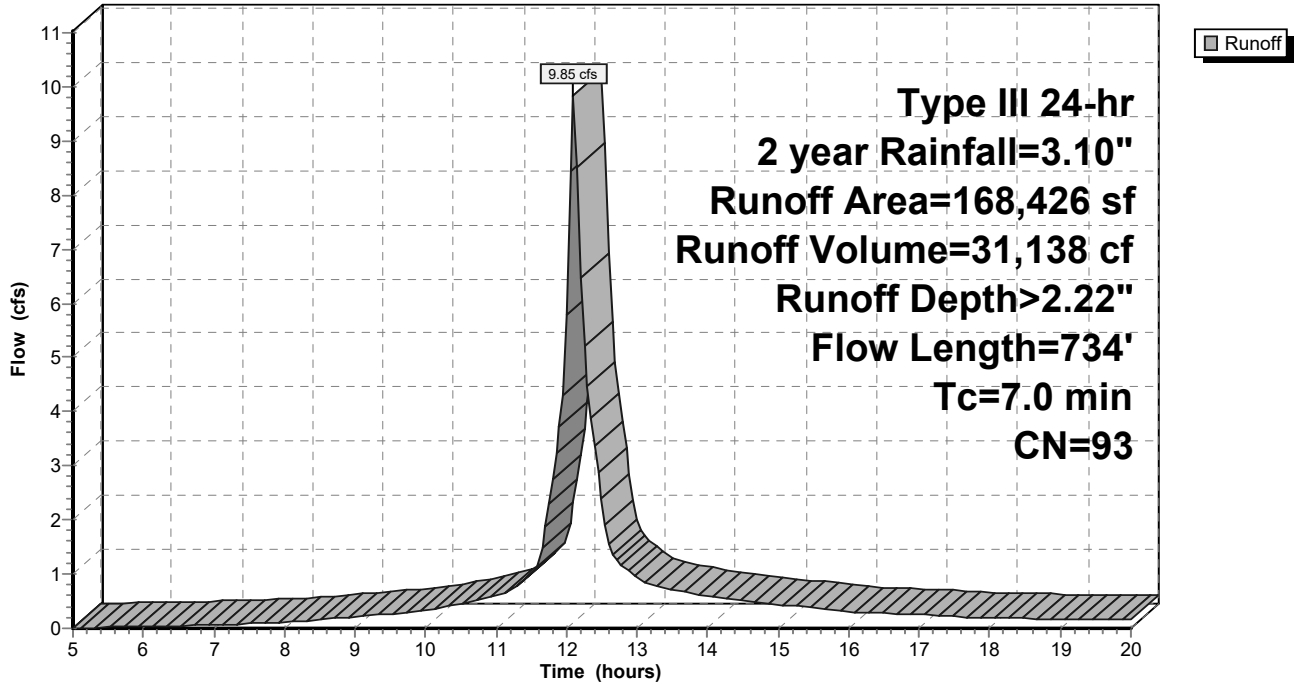
Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 9

**Subcatchment 2E: Existing 222 St. John St. Parking Lot**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 10

**Summary for Subcatchment 3E: Entrance Drive**

Runoff = 0.66 cfs @ 12.09 hrs, Volume= 2,201 cf, Depth> 2.68"

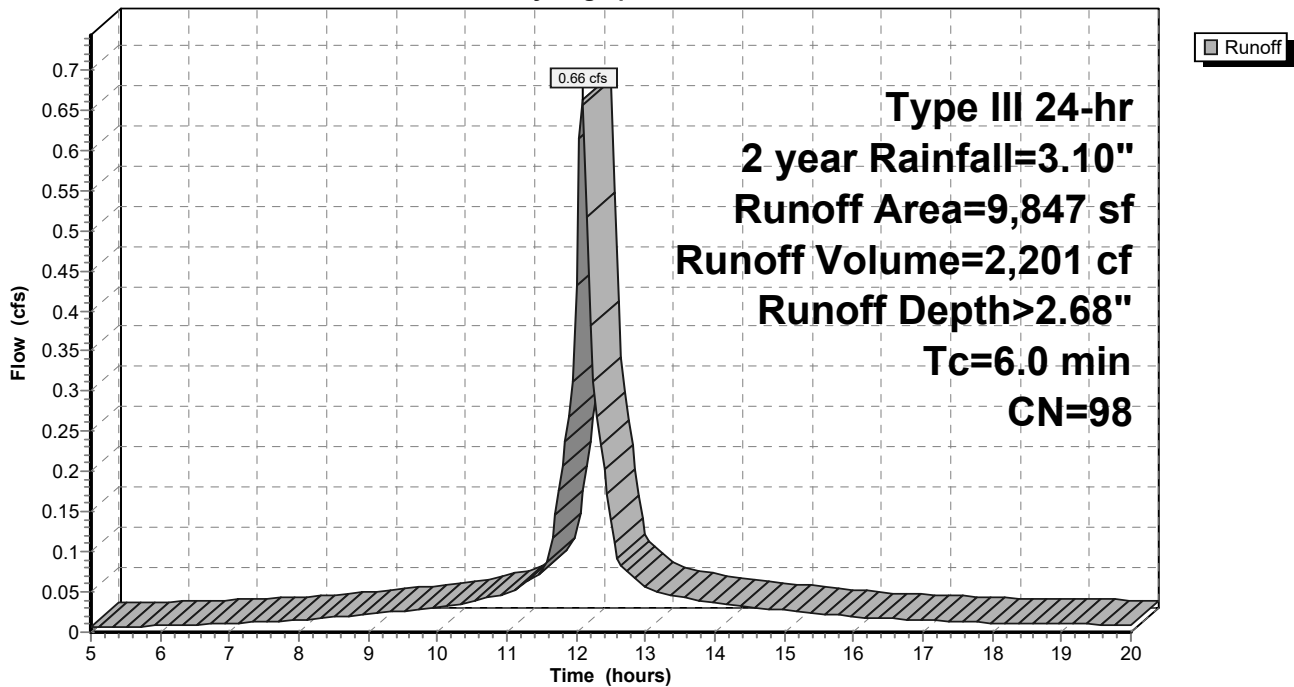
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2 year Rainfall=3.10"

Area (sf)	CN	Description
* 9,847	98	
9,847		100.00% Impervious Area

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

**Subcatchment 3E: Entrance Drive**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 11

**Summary for Subcatchment 4E: Union Station**

Runoff = 1.74 cfs @ 12.09 hrs, Volume= 5,781 cf, Depth> 2.68"

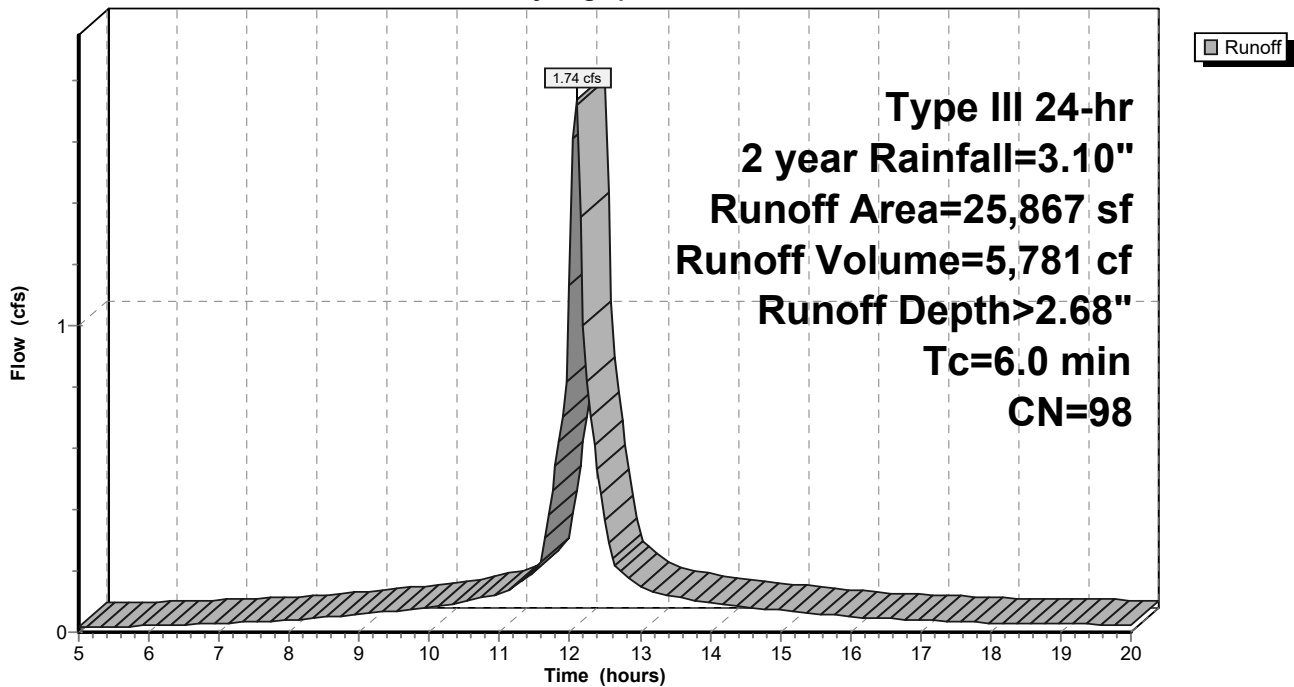
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2 year Rainfall=3.10"

Area (sf)	CN	Description
* 25,867	98	
25,867		100.00% Impervious Area

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

**Subcatchment 4E: Union Station**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 12

**Summary for Subcatchment 5E: Existing Eagles P-Lot South**

Runoff = 0.41 cfs @ 12.09 hrs, Volume= 1,374 cf, Depth> 2.68"

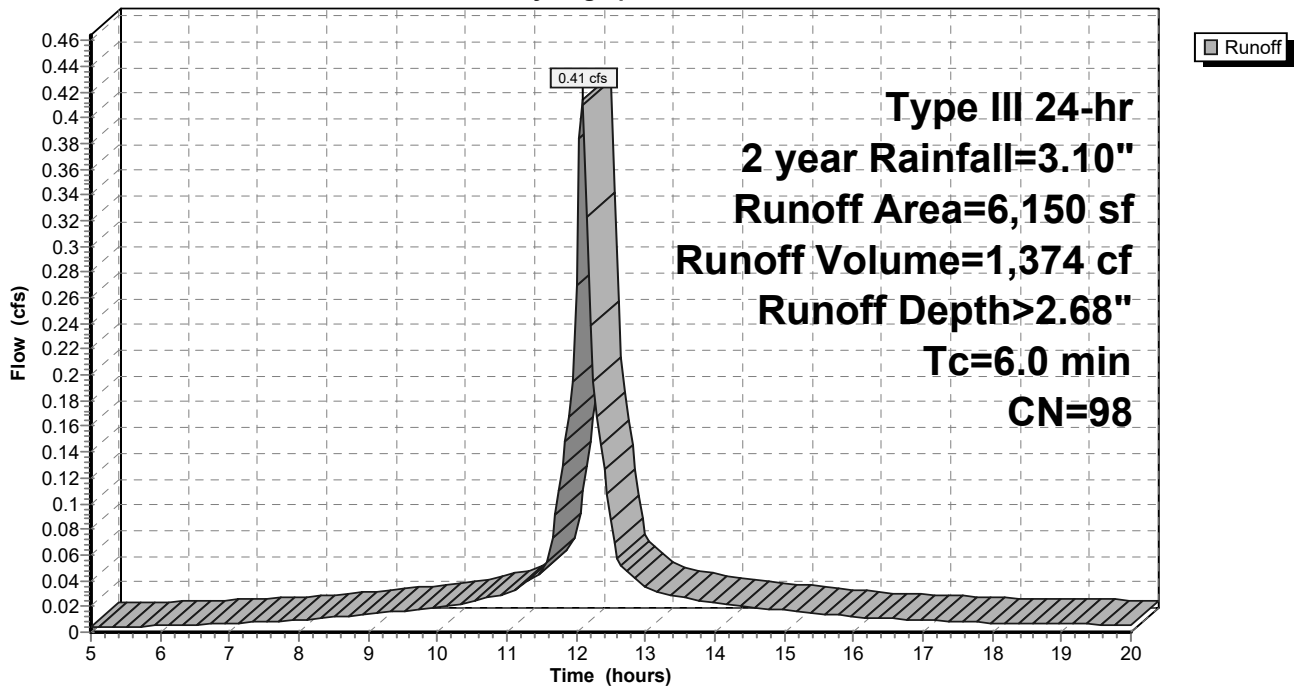
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2 year Rainfall=3.10"

Area (sf)	CN	Description
* 6,150	98	existing P-lot
6,150		100.00% Impervious Area

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

**Subcatchment 5E: Existing Eagles P-Lot South**

Hydrograph



# Pre-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 13

## Summary for Pond 10P: Existing CB

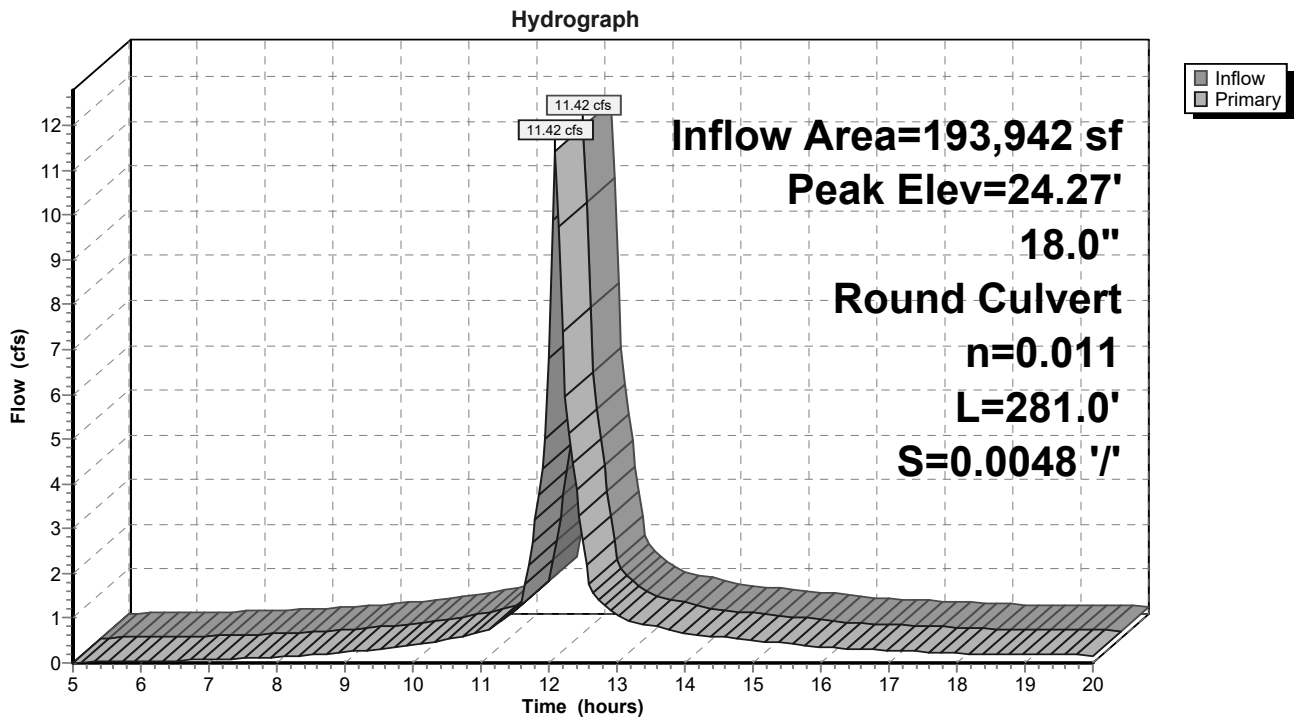
Inflow Area = 193,942 sf, 78.22% Impervious, Inflow Depth > 2.23" for 2 year event  
Inflow = 11.42 cfs @ 12.10 hrs, Volume= 36,055 cf  
Outflow = 11.42 cfs @ 12.10 hrs, Volume= 36,055 cf, Atten= 0%, Lag= 0.0 min  
Primary = 11.42 cfs @ 12.10 hrs, Volume= 36,055 cf

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Peak Elev= 24.27' @ 12.10 hrs

Device #	Routing	Invert	Outlet Devices
#1	Primary	20.50'	<b>18.0" Round Culvert</b> L= 281.0' Ke= 0.900 Inlet / Outlet Invert= 20.50' / 19.15' S= 0.0048 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

**Primary OutFlow** Max=11.38 cfs @ 12.10 hrs HW=24.25' TW=0.00' (Dynamic Tailwater)  
↑1=Culvert (Barrel Controls 11.38 cfs @ 6.44 fps)

## Pond 10P: Existing CB





**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 14

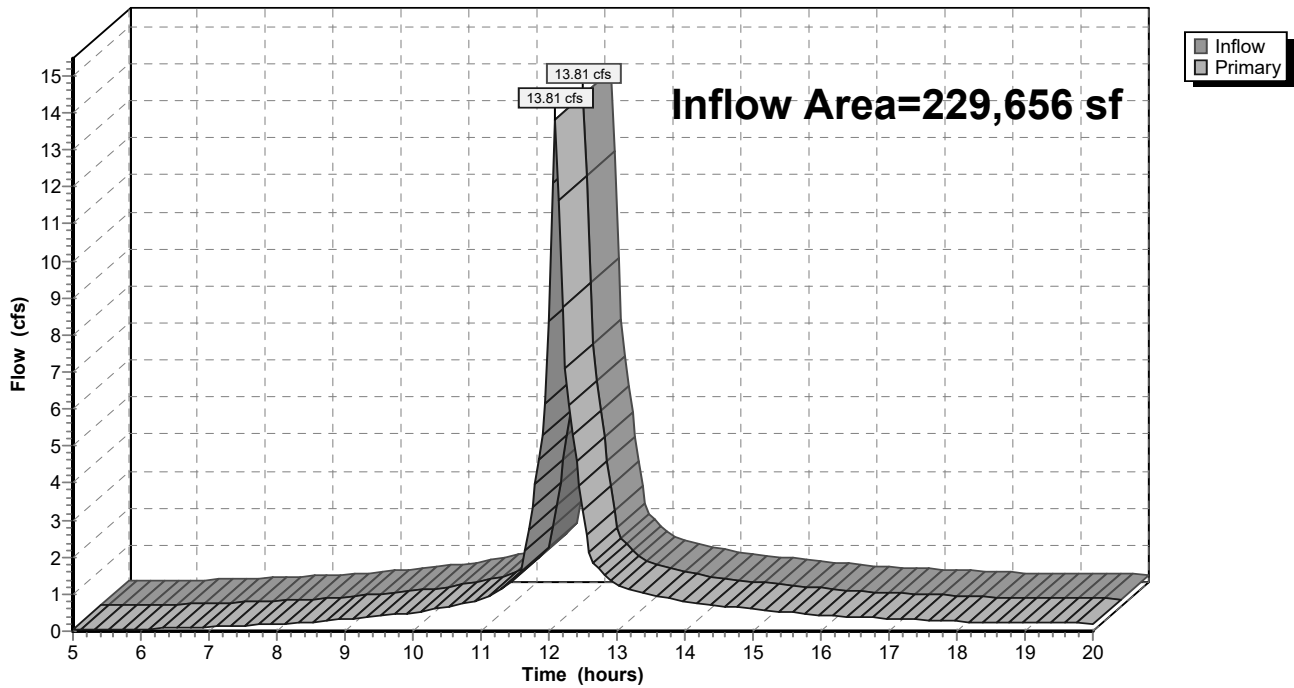
**Summary for Link SP1: Existing 18" SD System**

Inflow Area = 229,656 sf, 81.61% Impervious, Inflow Depth > 2.30" for 2 year event  
Inflow = 13.81 cfs @ 12.10 hrs, Volume= 44,037 cf  
Primary = 13.81 cfs @ 12.10 hrs, Volume= 44,037 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Link SP1: Existing 18" SD System**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 15

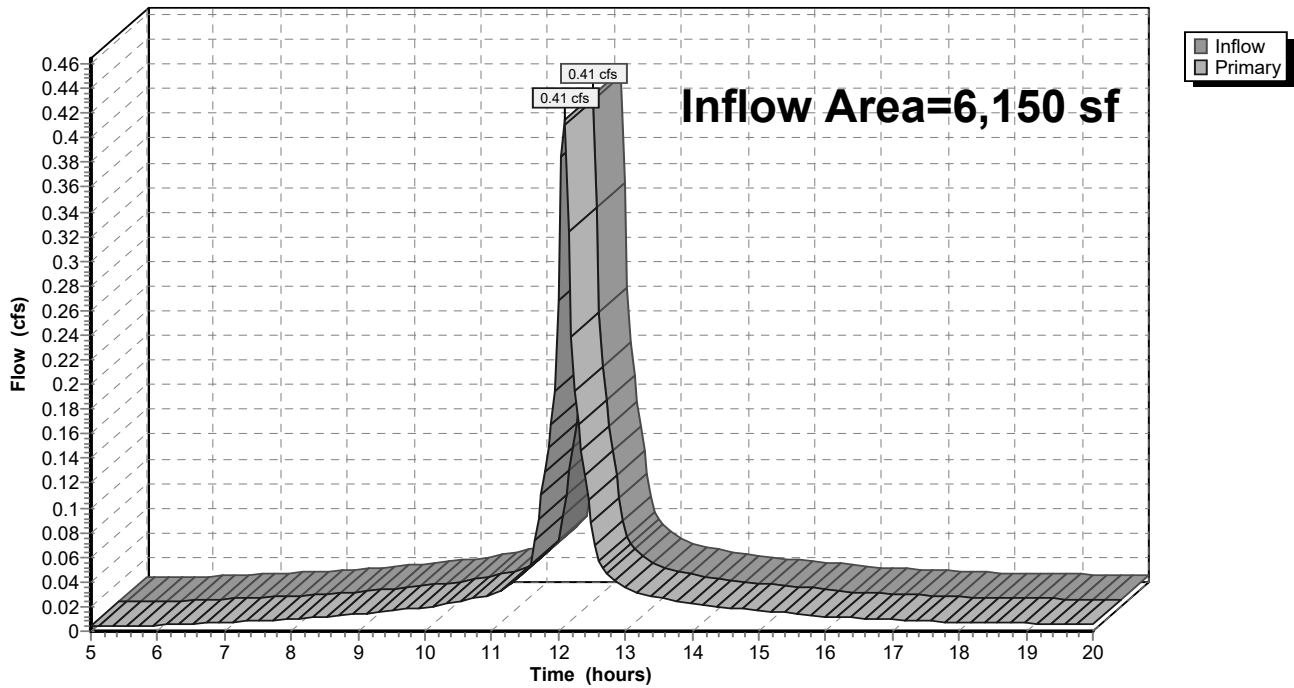
**Summary for Link SP2: 30" Storm Drain**

Inflow Area = 6,150 sf, 100.00% Impervious, Inflow Depth > 2.68" for 2 year event  
Inflow = 0.41 cfs @ 12.09 hrs, Volume= 1,374 cf  
Primary = 0.41 cfs @ 12.09 hrs, Volume= 1,374 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Link SP2: 30" Storm Drain**

Hydrograph



**Pre-Development**

Type III 24-hr 10 year Rainfall=4.60"

Prepared by WoodardCurran

Printed 7/24/2018

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Page 16

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1E: Eagles Parking Lot** Runoff Area=25,516 sf 85.43% Impervious Runoff Depth>3.69"  
Tc=6.0 min CN=94 Runoff=2.45 cfs 7,856 cf

**Subcatchment2E: Existing 222 St. John** Runoff Area=168,426 sf 77.13% Impervious Runoff Depth>3.60"  
Flow Length=734' Tc=7.0 min CN=93 Runoff=15.54 cfs 50,460 cf

**Subcatchment3E: Entrance Drive** Runoff Area=9,847 sf 100.00% Impervious Runoff Depth>4.05"  
Tc=6.0 min CN=98 Runoff=0.99 cfs 3,327 cf

**Subcatchment4E: Union Station** Runoff Area=25,867 sf 100.00% Impervious Runoff Depth>4.05"  
Tc=6.0 min CN=98 Runoff=2.61 cfs 8,739 cf

**Subcatchment5E: Existing Eagles P-Lot** Runoff Area=6,150 sf 100.00% Impervious Runoff Depth>4.05"  
Tc=6.0 min CN=98 Runoff=0.62 cfs 2,078 cf

**Pond 10P: Existing CB** Peak Elev=29.62' Inflow=17.98 cfs 58,316 cf  
18.0" Round Culvert n=0.011 L=281.0' S=0.0048 'l' Outflow=17.98 cfs 58,316 cf

**Link SP1: Existing 18" SD System** Inflow=21.56 cfs 70,381 cf  
Primary=21.56 cfs 70,381 cf

**Link SP2: 30" Storm Drain** Inflow=0.62 cfs 2,078 cf  
Primary=0.62 cfs 2,078 cf

**Total Runoff Area = 235,806 sf Runoff Volume = 72,459 cf Average Runoff Depth = 3.69"**  
**17.92% Pervious = 42,245 sf 82.08% Impervious = 193,561 sf**

**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 17

**Summary for Subcatchment 1E: Eagles Parking Lot**

Runoff = 2.45 cfs @ 12.09 hrs, Volume= 7,856 cf, Depth> 3.69"

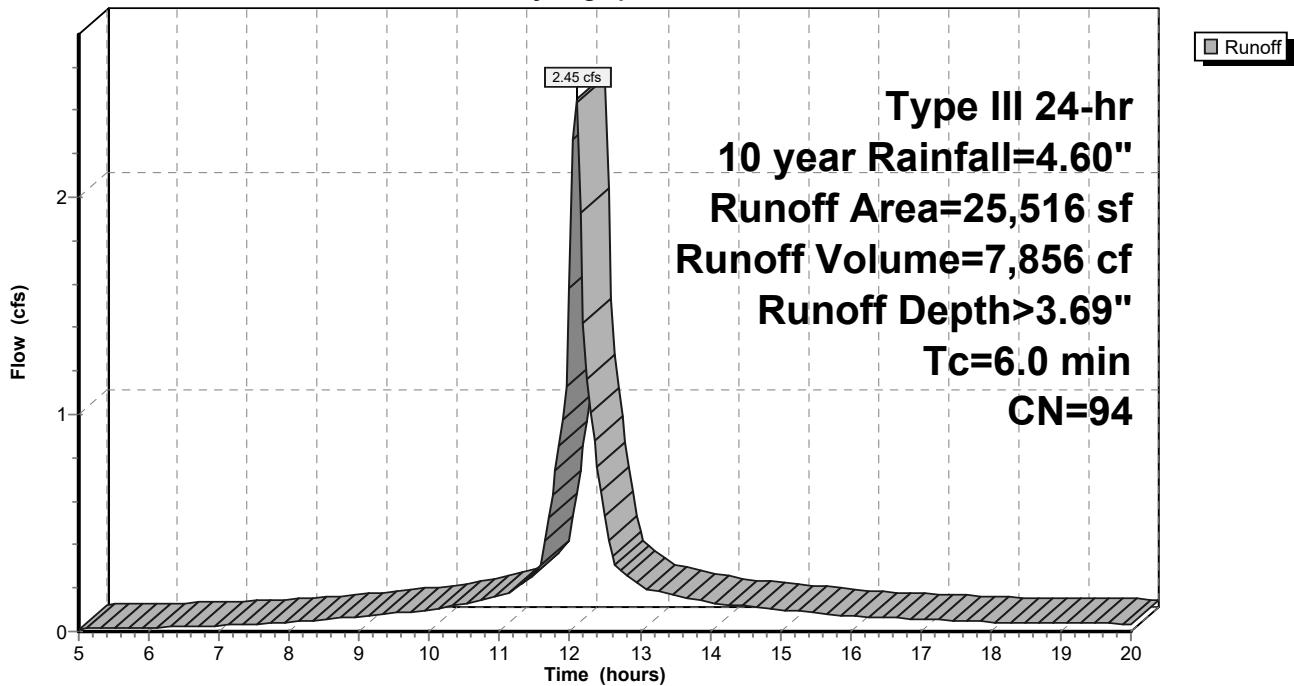
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10 year Rainfall=4.60"

Area (sf)	CN	Description
3,718	70	Brush, Fair, HSG C
* 21,798	98	parking lot
25,516	94	Weighted Average
3,718		14.57% Pervious Area
21,798		85.43% Impervious Area

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

**Subcatchment 1E: Eagles Parking Lot**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 18

**Summary for Subcatchment 2E: Existing 222 St. John St. Parking Lot**

Runoff = 15.54 cfs @ 12.10 hrs, Volume= 50,460 cf, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10 year Rainfall=4.60"

Area (sf)	CN	Description
129,899	98	Paved parking, HSG B
18,343	79	50-75% Grass cover, Fair, HSG C
20,184	76	Woods/grass comb., Fair, HSG C
168,426	93	Weighted Average
38,527		22.87% Pervious Area
129,899		77.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	100	0.0044	0.74		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.8	65	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.0	179	0.0009	1.47	1.16	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.7	105	0.0029	2.65	2.08	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
1.2	285	0.0047	3.91	4.80	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
7.0	734	Total			

**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

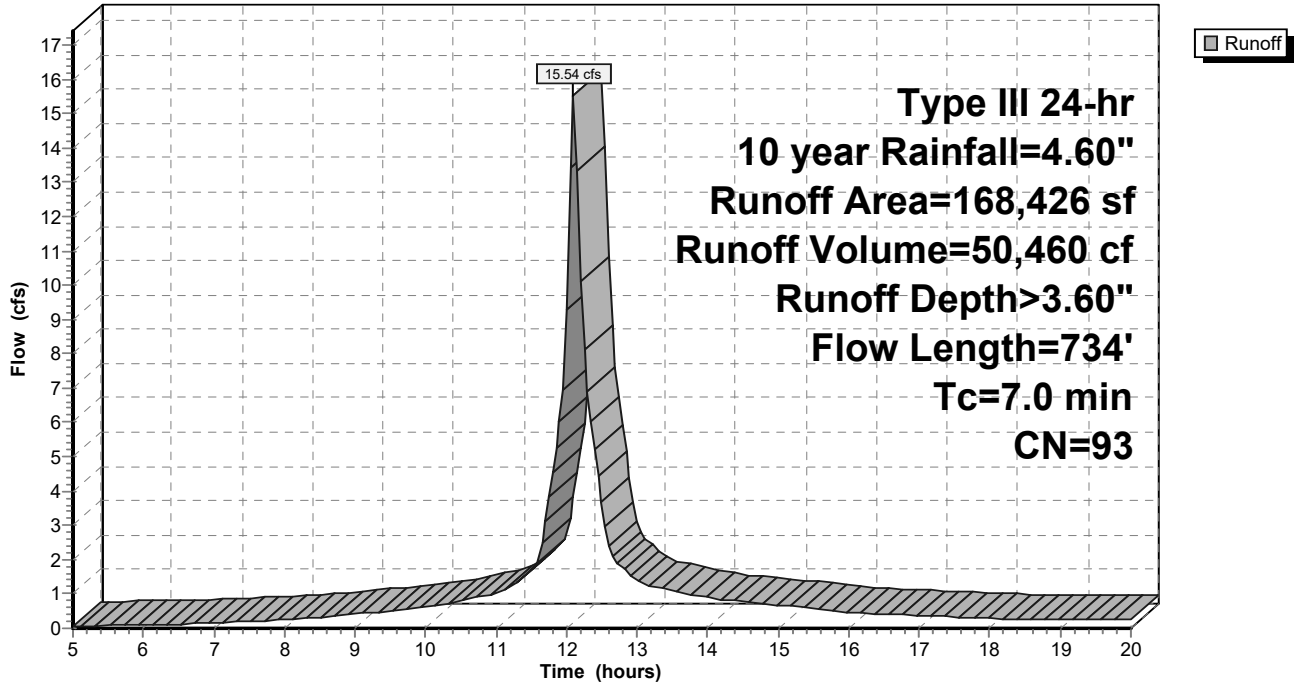
Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 19

**Subcatchment 2E: Existing 222 St. John St. Parking Lot**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 20

**Summary for Subcatchment 3E: Entrance Drive**

Runoff = 0.99 cfs @ 12.09 hrs, Volume= 3,327 cf, Depth> 4.05"

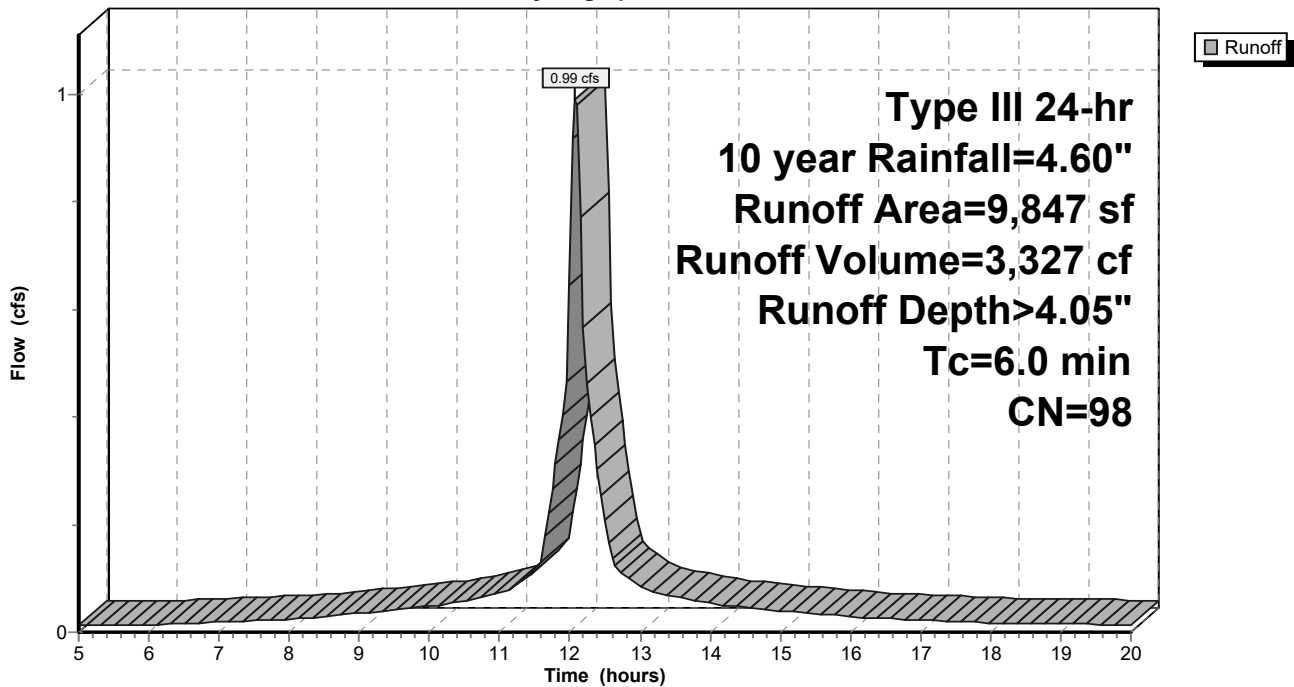
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10 year Rainfall=4.60"

Area (sf)	CN	Description
* 9,847	98	
9,847		100.00% Impervious Area

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

**Subcatchment 3E: Entrance Drive**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 21

**Summary for Subcatchment 4E: Union Station**

Runoff = 2.61 cfs @ 12.09 hrs, Volume= 8,739 cf, Depth> 4.05"

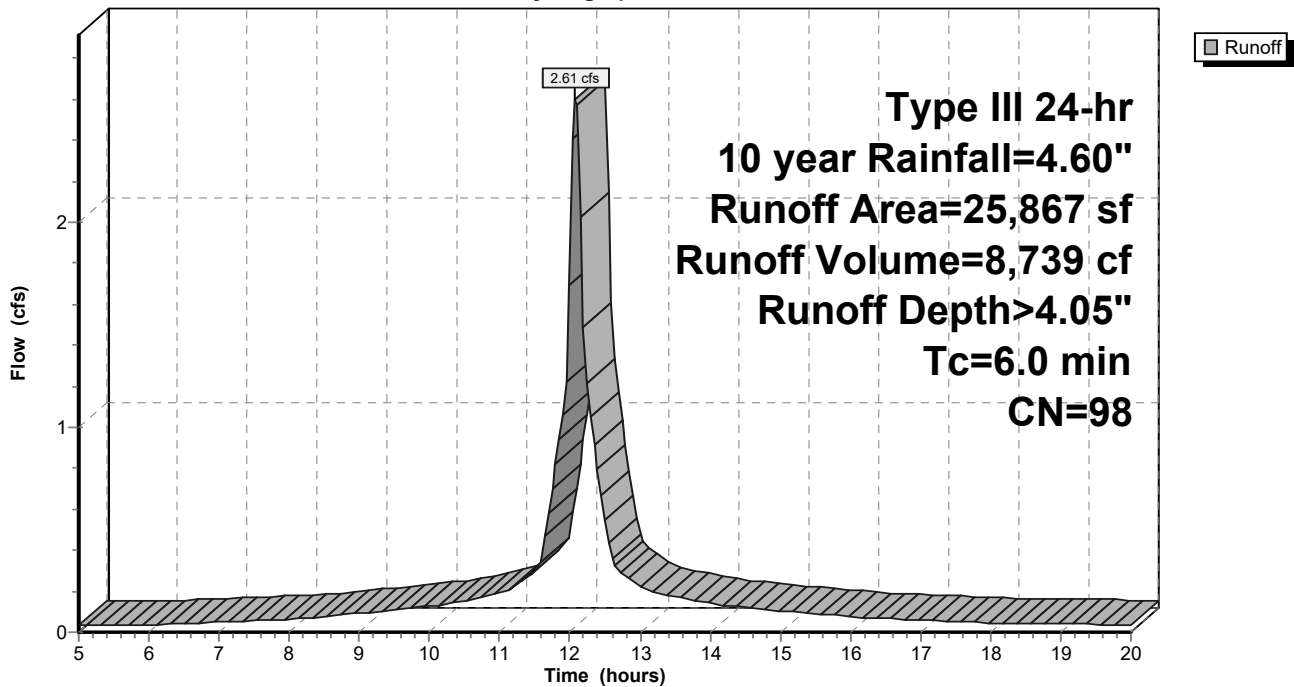
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10 year Rainfall=4.60"

Area (sf)	CN	Description
* 25,867	98	
25,867		100.00% Impervious Area

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

**Subcatchment 4E: Union Station**

Hydrograph





**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 22

**Summary for Subcatchment 5E: Existing Eagles P-Lot South**

Runoff = 0.62 cfs @ 12.09 hrs, Volume= 2,078 cf, Depth> 4.05"

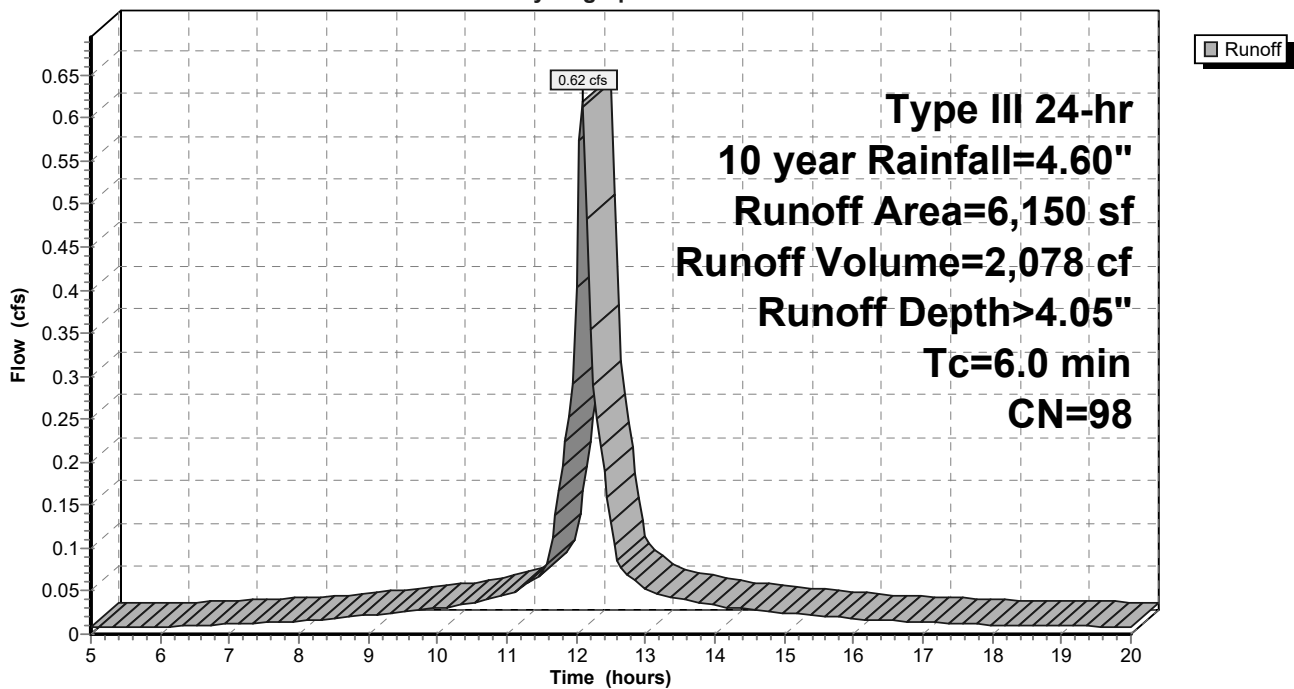
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10 year Rainfall=4.60"

Area (sf)	CN	Description
* 6,150	98	existing P-lot
6,150		100.00% Impervious Area

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

**Subcatchment 5E: Existing Eagles P-Lot South**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 23

**Summary for Pond 10P: Existing CB**

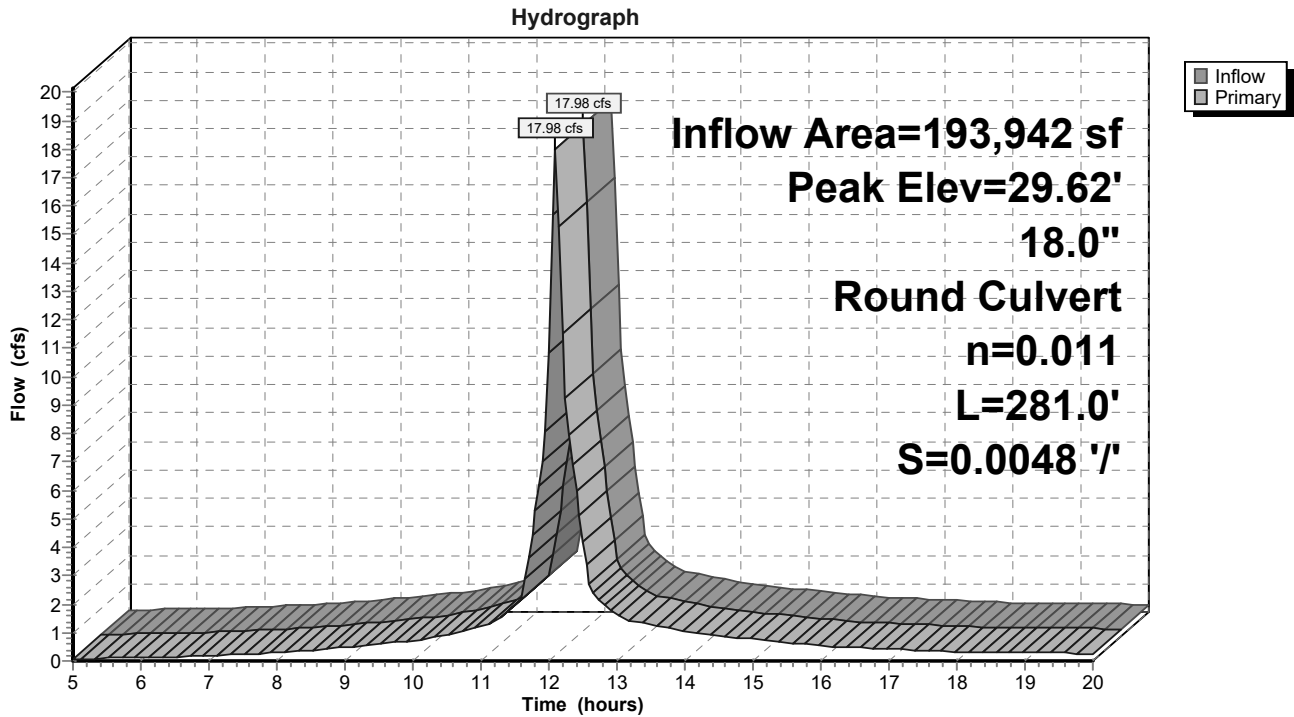
Inflow Area = 193,942 sf, 78.22% Impervious, Inflow Depth > 3.61" for 10 year event  
Inflow = 17.98 cfs @ 12.10 hrs, Volume= 58,316 cf  
Outflow = 17.98 cfs @ 12.10 hrs, Volume= 58,316 cf, Atten= 0%, Lag= 0.0 min  
Primary = 17.98 cfs @ 12.10 hrs, Volume= 58,316 cf

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Peak Elev= 29.62' @ 12.10 hrs

Device #	Routing	Invert	Outlet Devices
1	Primary	20.50'	<b>18.0" Round Culvert</b> L= 281.0' Ke= 0.900 Inlet / Outlet Invert= 20.50' / 19.15' S= 0.0048 '/ Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

**Primary OutFlow** Max=17.89 cfs @ 12.10 hrs HW=29.53' TW=0.00' (Dynamic Tailwater)  
↑1=Culvert (Barrel Controls 17.89 cfs @ 10.12 fps)

**Pond 10P: Existing CB**



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 24

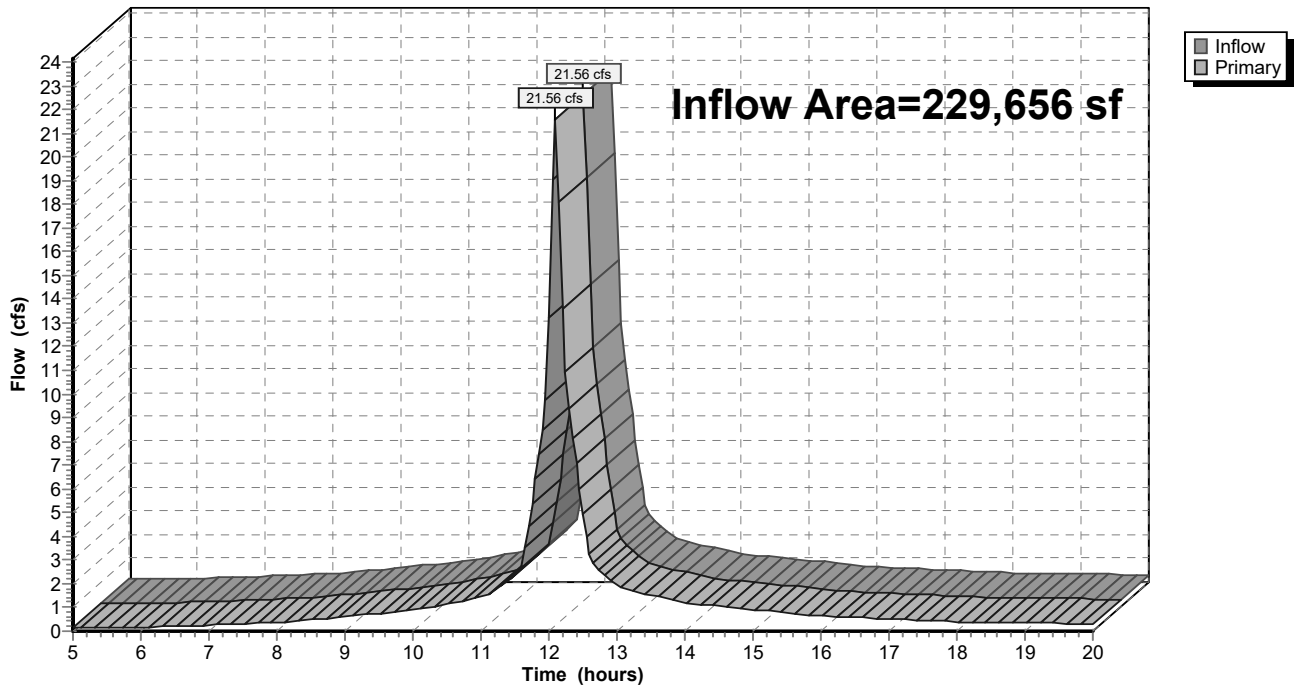
**Summary for Link SP1: Existing 18" SD System**

Inflow Area = 229,656 sf, 81.61% Impervious, Inflow Depth > 3.68" for 10 year event  
Inflow = 21.56 cfs @ 12.10 hrs, Volume= 70,381 cf  
Primary = 21.56 cfs @ 12.10 hrs, Volume= 70,381 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Link SP1: Existing 18" SD System**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 25

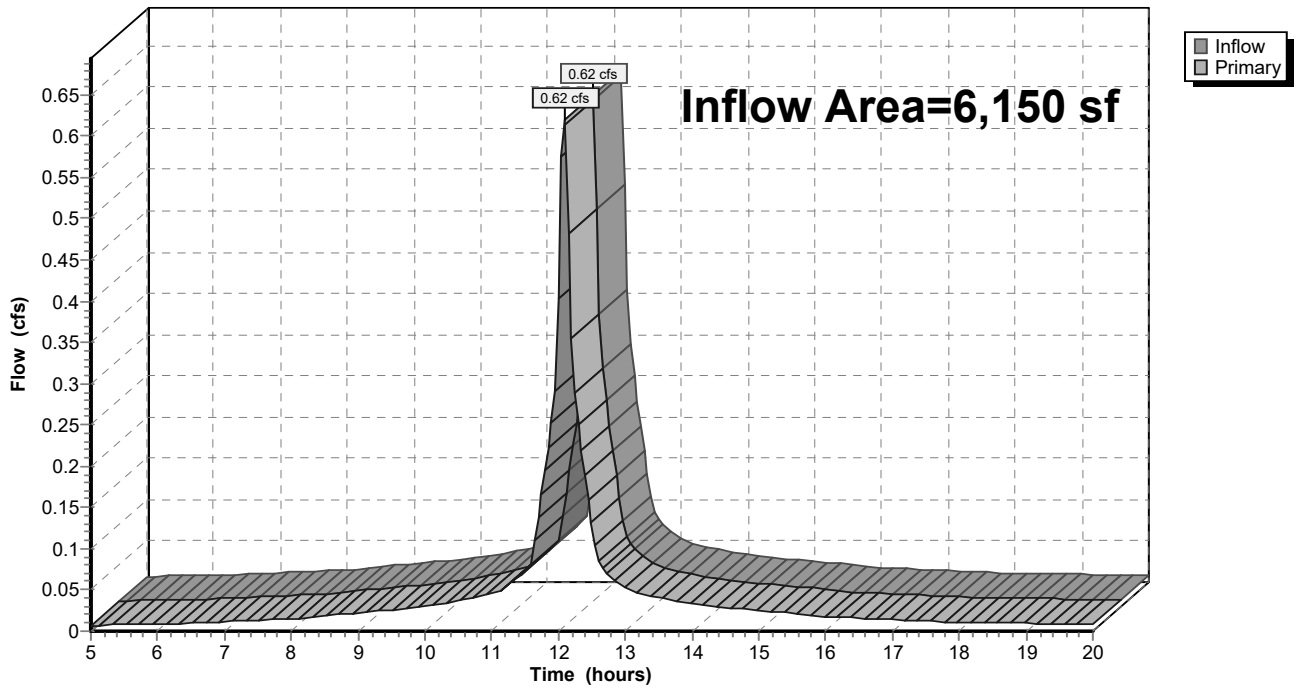
**Summary for Link SP2: 30" Storm Drain**

Inflow Area = 6,150 sf, 100.00% Impervious, Inflow Depth > 4.05" for 10 year event  
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 2,078 cf  
Primary = 0.62 cfs @ 12.09 hrs, Volume= 2,078 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Link SP2: 30" Storm Drain**

Hydrograph



## Pre-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 26

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1E: Eagles Parking Lot** Runoff Area=25,516 sf 85.43% Impervious Runoff Depth>4.80"  
Tc=6.0 min CN=94 Runoff=3.15 cfs 10,212 cf

**Subcatchment2E: Existing 222 St. John** Runoff Area=168,426 sf 77.13% Impervious Runoff Depth>4.70"  
Flow Length=734' Tc=7.0 min CN=93 Runoff=20.05 cfs 66,005 cf

**Subcatchment3E: Entrance Drive** Runoff Area=9,847 sf 100.00% Impervious Runoff Depth>5.15"  
Tc=6.0 min CN=98 Runoff=1.25 cfs 4,224 cf

**Subcatchment4E: Union Station** Runoff Area=25,867 sf 100.00% Impervious Runoff Depth>5.15"  
Tc=6.0 min CN=98 Runoff=3.29 cfs 11,095 cf

**Subcatchment5E: Existing Eagles P-Lot** Runoff Area=6,150 sf 100.00% Impervious Runoff Depth>5.15"  
Tc=6.0 min CN=98 Runoff=0.78 cfs 2,638 cf

**Pond 10P: Existing CB** Peak Elev=35.55' Inflow=23.18 cfs 76,217 cf  
18.0" Round Culvert n=0.011 L=281.0' S=0.0048 'l' Outflow=23.18 cfs 76,217 cf

**Link SP1: Existing 18" SD System** Inflow=27.70 cfs 91,536 cf  
Primary=27.70 cfs 91,536 cf

**Link SP2: 30" Storm Drain** Inflow=0.78 cfs 2,638 cf  
Primary=0.78 cfs 2,638 cf

**Total Runoff Area = 235,806 sf Runoff Volume = 94,174 cf Average Runoff Depth = 4.79"**  
**17.92% Pervious = 42,245 sf 82.08% Impervious = 193,561 sf**

**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 27

**Summary for Subcatchment 1E: Eagles Parking Lot**

Runoff = 3.15 cfs @ 12.09 hrs, Volume= 10,212 cf, Depth> 4.80"

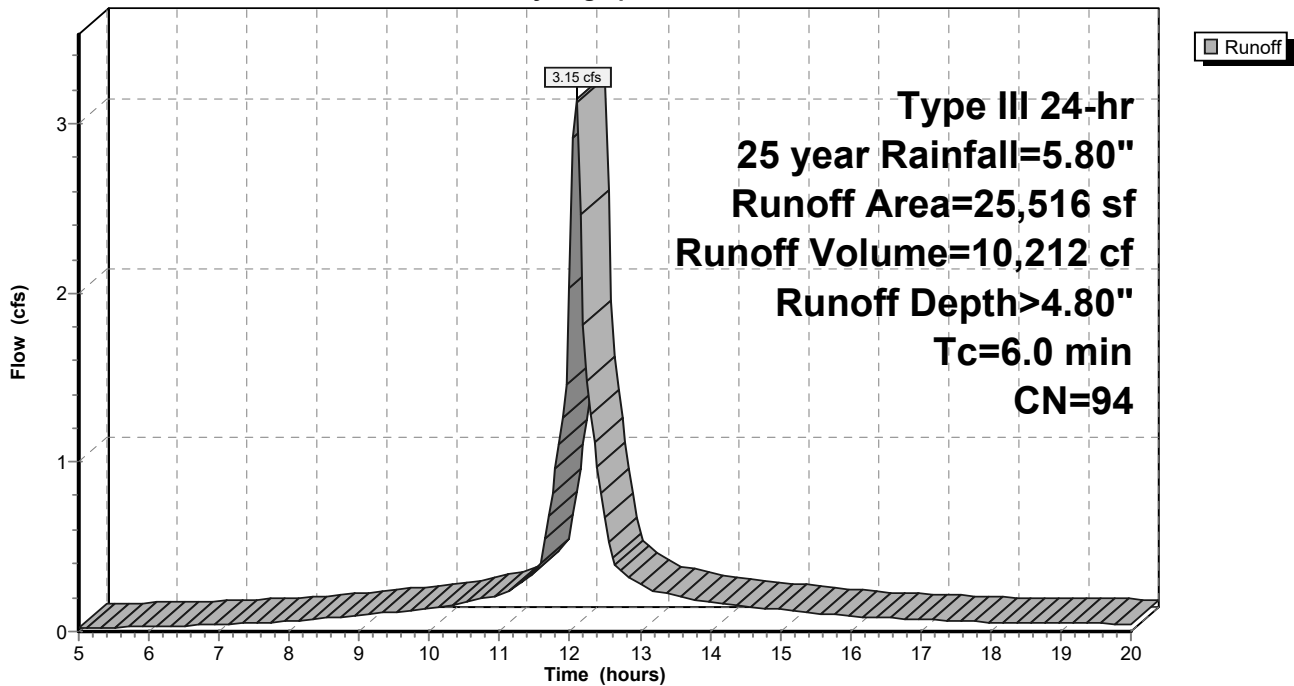
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25 year Rainfall=5.80"

Area (sf)	CN	Description
3,718	70	Brush, Fair, HSG C
* 21,798	98	parking lot
25,516	94	Weighted Average
3,718		14.57% Pervious Area
21,798		85.43% Impervious Area

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

**Subcatchment 1E: Eagles Parking Lot**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 28

**Summary for Subcatchment 2E: Existing 222 St. John St. Parking Lot**

Runoff = 20.05 cfs @ 12.10 hrs, Volume= 66,005 cf, Depth> 4.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25 year Rainfall=5.80"

Area (sf)	CN	Description
129,899	98	Paved parking, HSG B
18,343	79	50-75% Grass cover, Fair, HSG C
20,184	76	Woods/grass comb., Fair, HSG C
168,426	93	Weighted Average
38,527		22.87% Pervious Area
129,899		77.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	100	0.0044	0.74		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.8	65	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.0	179	0.0009	1.47	1.16	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.7	105	0.0029	2.65	2.08	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
1.2	285	0.0047	3.91	4.80	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
7.0	734	Total			

**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

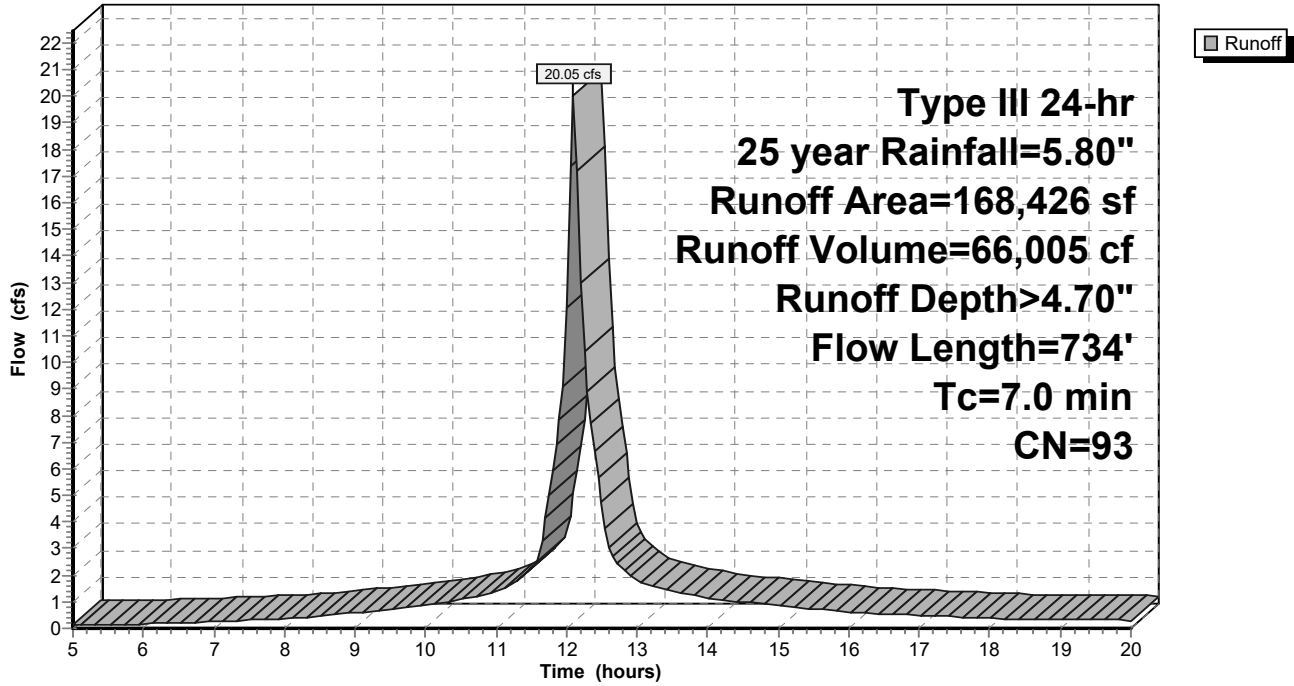
Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 29

**Subcatchment 2E: Existing 222 St. John St. Parking Lot**

Hydrograph





**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 30

**Summary for Subcatchment 3E: Entrance Drive**

Runoff = 1.25 cfs @ 12.09 hrs, Volume= 4,224 cf, Depth> 5.15"

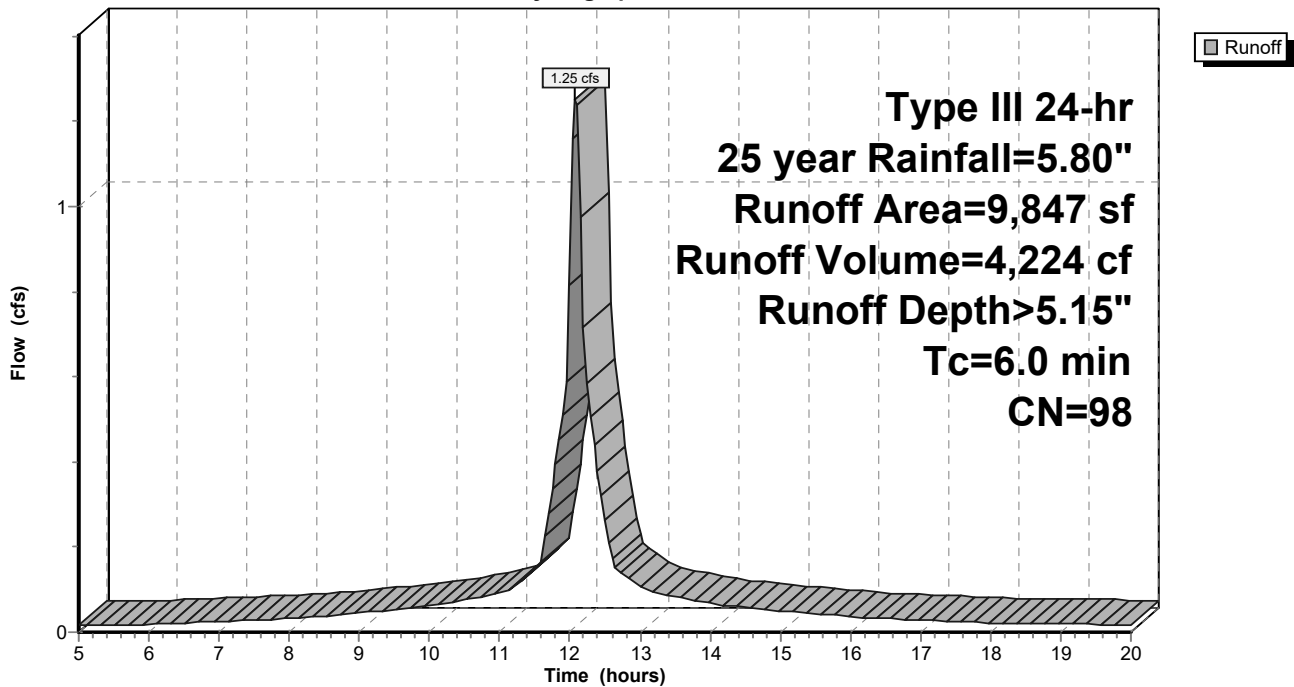
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25 year Rainfall=5.80"

Area (sf)	CN	Description
* 9,847	98	
9,847		100.00% Impervious Area

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

**Subcatchment 3E: Entrance Drive**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 31

**Summary for Subcatchment 4E: Union Station**

Runoff = 3.29 cfs @ 12.09 hrs, Volume= 11,095 cf, Depth> 5.15"

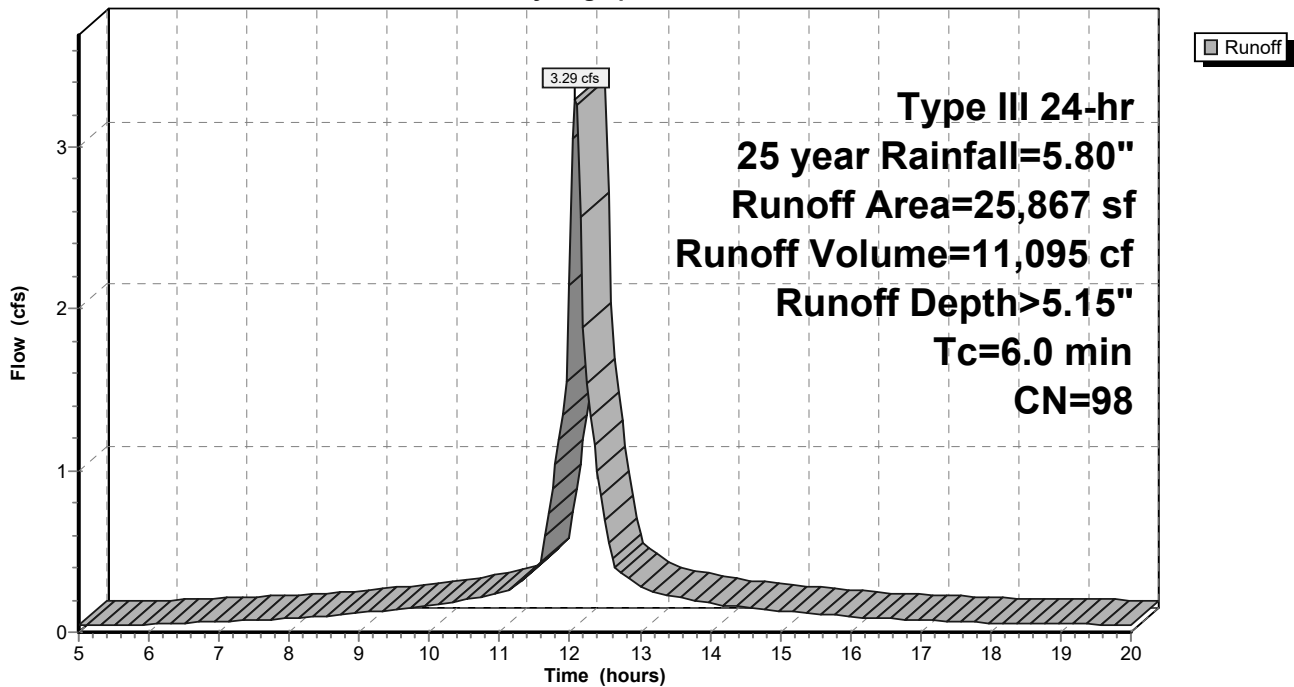
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25 year Rainfall=5.80"

Area (sf)	CN	Description
* 25,867	98	
25,867		100.00% Impervious Area

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

**Subcatchment 4E: Union Station**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 32

**Summary for Subcatchment 5E: Existing Eagles P-Lot South**

Runoff = 0.78 cfs @ 12.09 hrs, Volume= 2,638 cf, Depth> 5.15"

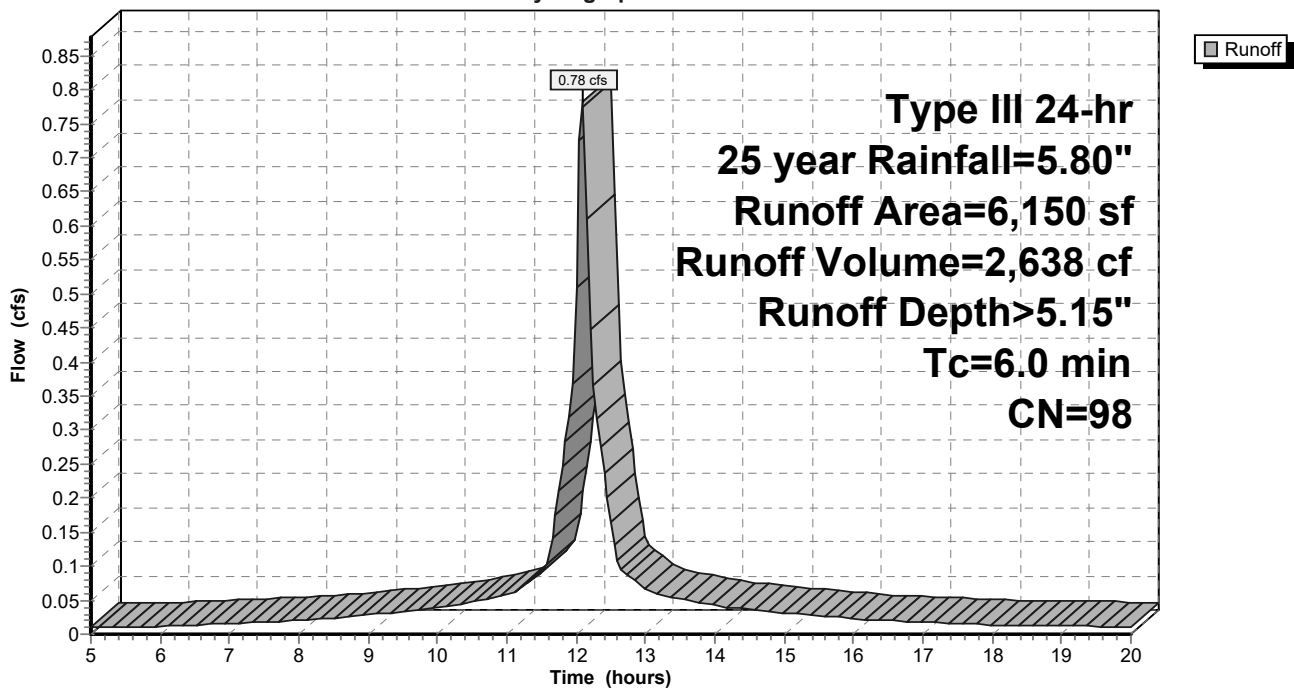
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25 year Rainfall=5.80"

Area (sf)	CN	Description
* 6,150	98	existing P-lot
6,150		100.00% Impervious Area

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

**Subcatchment 5E: Existing Eagles P-Lot South**

Hydrograph



# Pre-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 33

## Summary for Pond 10P: Existing CB

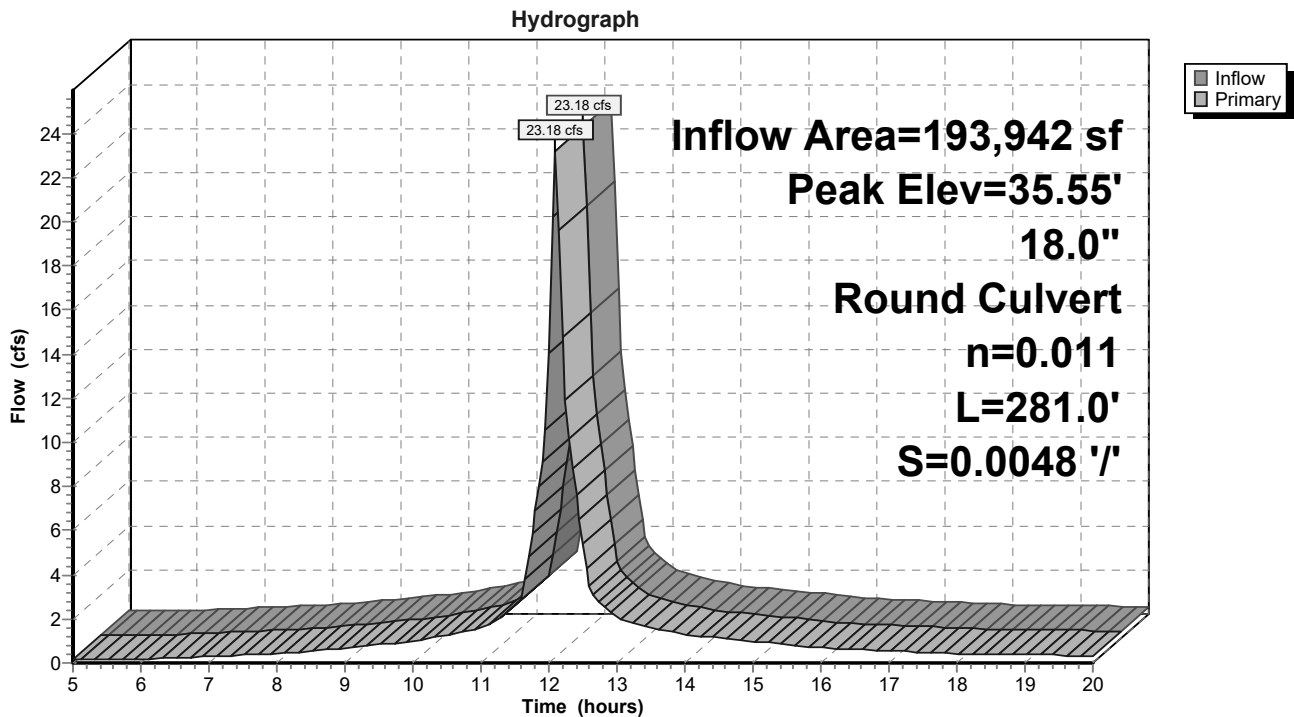
Inflow Area = 193,942 sf, 78.22% Impervious, Inflow Depth > 4.72" for 25 year event  
Inflow = 23.18 cfs @ 12.10 hrs, Volume= 76,217 cf  
Outflow = 23.18 cfs @ 12.10 hrs, Volume= 76,217 cf, Atten= 0%, Lag= 0.0 min  
Primary = 23.18 cfs @ 12.10 hrs, Volume= 76,217 cf

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Peak Elev= 35.55' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.50'	<b>18.0" Round Culvert</b> L= 281.0' Ke= 0.900 Inlet / Outlet Invert= 20.50' / 19.15' S= 0.0048 '/ Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

**Primary OutFlow** Max=23.04 cfs @ 12.10 hrs HW=35.37' TW=0.00' (Dynamic Tailwater)  
↑1=Culvert (Barrel Controls 23.04 cfs @ 13.04 fps)

## Pond 10P: Existing CB



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 34

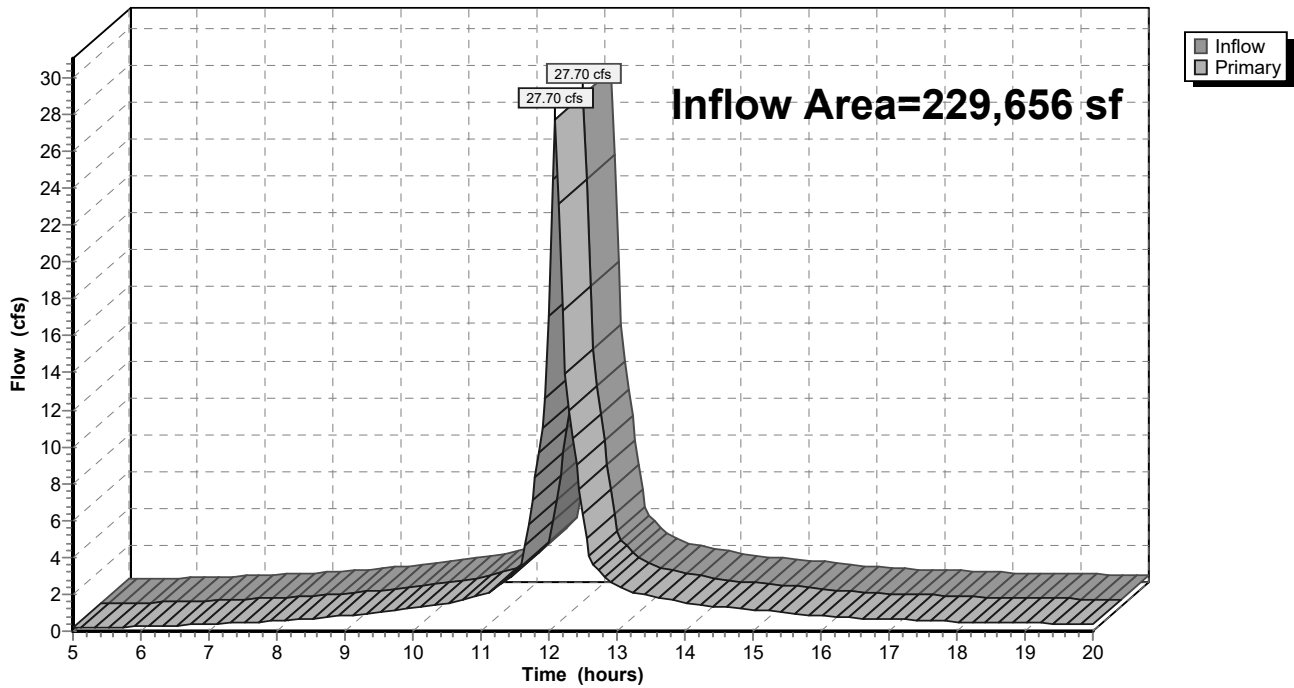
**Summary for Link SP1: Existing 18" SD System**

Inflow Area = 229,656 sf, 81.61% Impervious, Inflow Depth > 4.78" for 25 year event  
Inflow = 27.70 cfs @ 12.10 hrs, Volume= 91,536 cf  
Primary = 27.70 cfs @ 12.10 hrs, Volume= 91,536 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Link SP1: Existing 18" SD System**

Hydrograph



**Pre-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 35

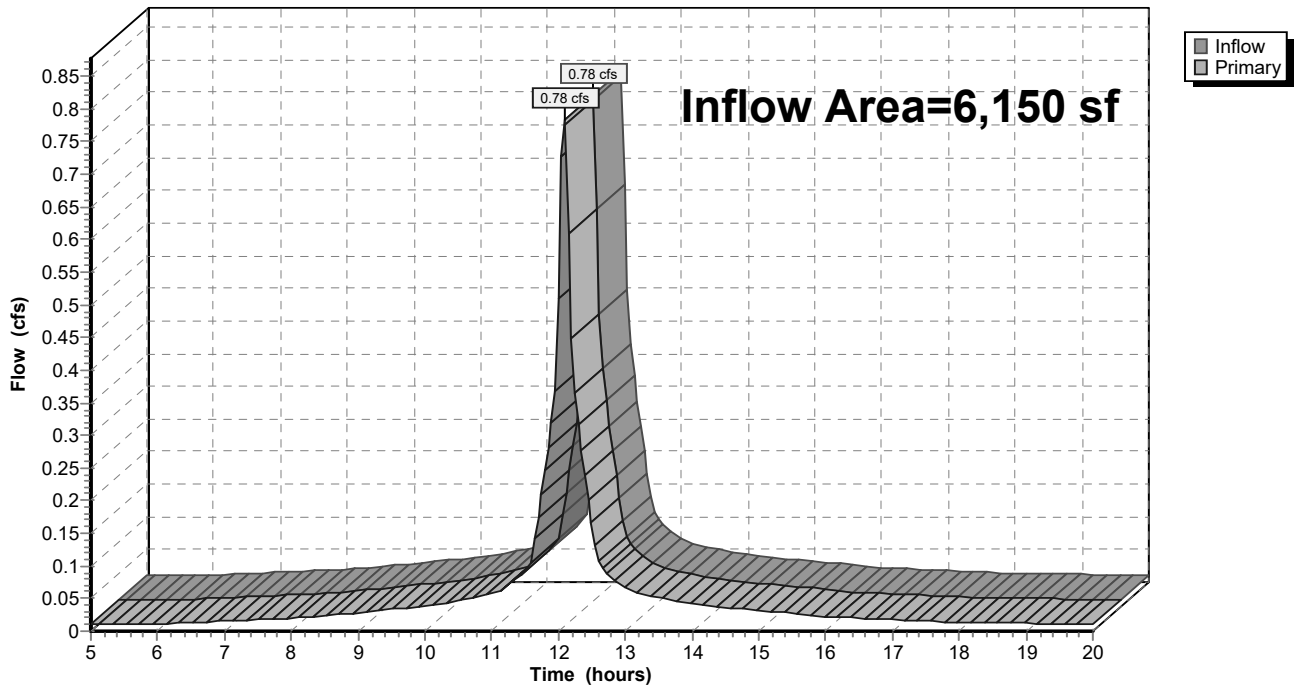
**Summary for Link SP2: 30" Storm Drain**

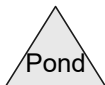
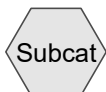
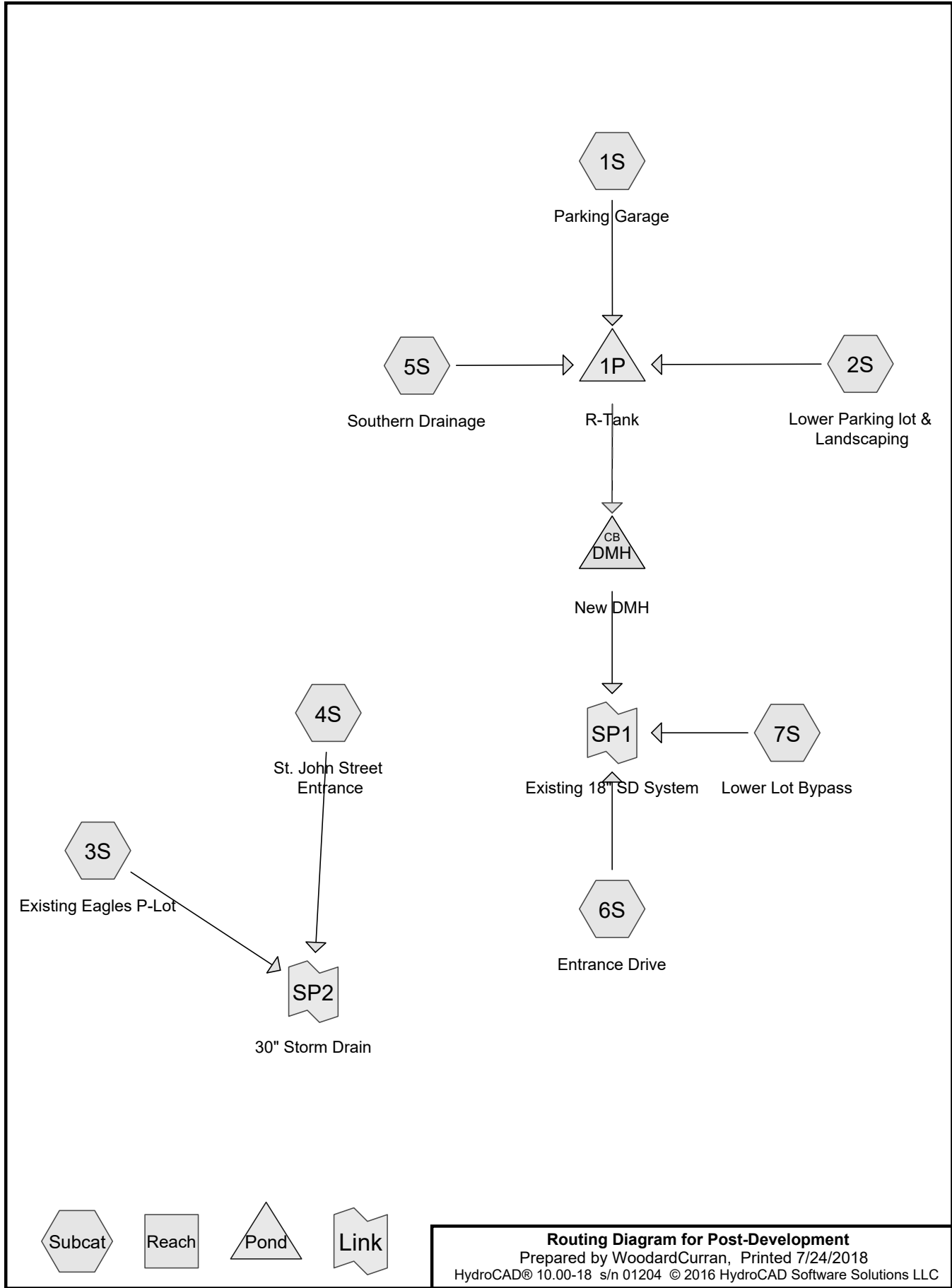
Inflow Area = 6,150 sf, 100.00% Impervious, Inflow Depth > 5.15" for 25 year event  
Inflow = 0.78 cfs @ 12.09 hrs, Volume= 2,638 cf  
Primary = 0.78 cfs @ 12.09 hrs, Volume= 2,638 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Link SP2: 30" Storm Drain**

Hydrograph





**Routing Diagram for Post-Development**  
 Prepared by WoodardCurran, Printed 7/24/2018  
 HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

## Post-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Printed 7/24/2018

Page 2

### Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
513	84	50-75% Grass cover, Fair, HSG D (6S)
20,799	74	>75% Grass cover, Good, HSG C (4S)
20,397	80	>75% Grass cover, Good, HSG D (2S)
11,050	89	Crushed Stone (5S)
591	98	Eagles lot p-lot (5S)
28,534	98	Entrance Drive & Walks (7S)
9,891	98	Entrance Road (6S)
483	79	Landscaped area (7S)
9,319	98	New entrance drive and walks (4S)
32,944	98	Paved Parking Lot (2S)
89,825	98	Paved parking, HSG B (1S)
2,186	98	Roofs, HSG B (1S)
3,715	98	Sidewalk (5S)
213	89	eagles lot stone (5S)
5,477	98	existing P-lot (3S)
<b>235,937</b>	<b>94</b>	<b>TOTAL AREA</b>



## Post-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Printed 7/24/2018

Page 3

### Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
92,011	HSG B	1S
20,799	HSG C	4S
20,910	HSG D	2S, 6S
102,217	Other	2S, 3S, 4S, 5S, 6S, 7S
<b>235,937</b>		<b>TOTAL AREA</b>

## Post-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Printed 7/24/2018

Page 4

### Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	0	513	0	513	50-75% Grass cover, Fair
0	0	20,799	20,397	0	41,196	>75% Grass cover, Good
0	0	0	0	11,050	11,050	Crushed Stone
0	0	0	0	591	591	Eagles lot p-lot
0	0	0	0	28,534	28,534	Entrance Drive & Walks
0	0	0	0	9,891	9,891	Entrance Road
0	0	0	0	483	483	Landscaped area
0	0	0	0	9,319	9,319	New entrane drive and walks
0	0	0	0	32,944	32,944	Paved Parking Lot
0	89,825	0	0	0	89,825	Paved parking
0	2,186	0	0	0	2,186	Roofs
0	0	0	0	3,715	3,715	Sidewalk
0	0	0	0	213	213	eagles lot stone
0	0	0	0	5,477	5,477	existing P-lot
<b>0</b>	<b>92,011</b>	<b>20,799</b>	<b>20,910</b>	<b>102,217</b>	<b>235,937</b>	<b>TOTAL AREA</b>

## Post-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Printed 7/24/2018

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	1P	19.58	19.58	15.0	0.0000	0.012	15.0	0.0	0.0
2	1P	21.13	21.00	15.0	0.0087	0.012	15.0	0.0	0.0
3	DMH	19.25	19.15	40.0	0.0025	0.013	18.0	0.0	0.0

**Post-Development**

Type III 24-hr 2 year Rainfall=3.10"

Prepared by WoodardCurran

Printed 7/24/2018

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Page 6

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1S: Parking Garage** Runoff Area=92,011 sf 100.00% Impervious Runoff Depth=2.87"  
Tc=6.0 min CN=98 Runoff=6.35 cfs 21,990 cf

**Subcatchment2S: Lower Parking lot &** Runoff Area=53,341 sf 61.76% Impervious Runoff Depth=2.16"  
Tc=6.0 min CN=91 Runoff=3.06 cfs 9,622 cf

**Subcatchment3S: Existing Eagles P-Lot** Runoff Area=5,477 sf 100.00% Impervious Runoff Depth=2.87"  
Tc=6.0 min CN=98 Runoff=0.38 cfs 1,309 cf

**Subcatchment4S: St. John Street Entrance** Runoff Area=30,118 sf 30.94% Impervious Runoff Depth=1.39"  
Tc=6.0 min CN=81 Runoff=1.12 cfs 3,491 cf

**Subcatchment5S: Southern Drainage** Runoff Area=15,569 sf 27.66% Impervious Runoff Depth=2.16"  
Tc=6.0 min CN=91 Runoff=0.89 cfs 2,808 cf

**Subcatchment6S: Entrance Drive** Runoff Area=10,404 sf 95.07% Impervious Runoff Depth=2.76"  
Tc=5.0 min CN=97 Runoff=0.73 cfs 2,391 cf

**Subcatchment7S: Lower Lot Bypass** Runoff Area=29,017 sf 98.34% Impervious Runoff Depth=2.87"  
Tc=6.0 min CN=98 Runoff=2.00 cfs 6,935 cf

**Pond 1P: R-Tank** Peak Elev=21.87' Storage=17,455 cf Inflow=10.31 cfs 34,420 cf  
Primary=0.03 cfs 4,370 cf Secondary=3.48 cfs 20,406 cf Outflow=3.51 cfs 24,776 cf

**Pond DMH: New DMH** Peak Elev=20.45' Inflow=3.51 cfs 24,776 cf  
18.0" Round Culvert n=0.013 L=40.0' S=0.0025 '/' Outflow=3.51 cfs 24,776 cf

**Link SP1: Existing 18" SD System** Inflow=4.49 cfs 34,102 cf  
Primary=4.49 cfs 34,102 cf

**Link SP2: 30" Storm Drain** Inflow=1.50 cfs 4,800 cf  
Primary=1.50 cfs 4,800 cf

**Total Runoff Area = 235,937 sf Runoff Volume = 48,545 cf Average Runoff Depth = 2.47"**  
**22.66% Pervious = 53,455 sf 77.34% Impervious = 182,482 sf**

**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 7

**Summary for Subcatchment 1S: Parking Garage**

Runoff = 6.35 cfs @ 12.08 hrs, Volume= 21,990 cf, Depth= 2.87"

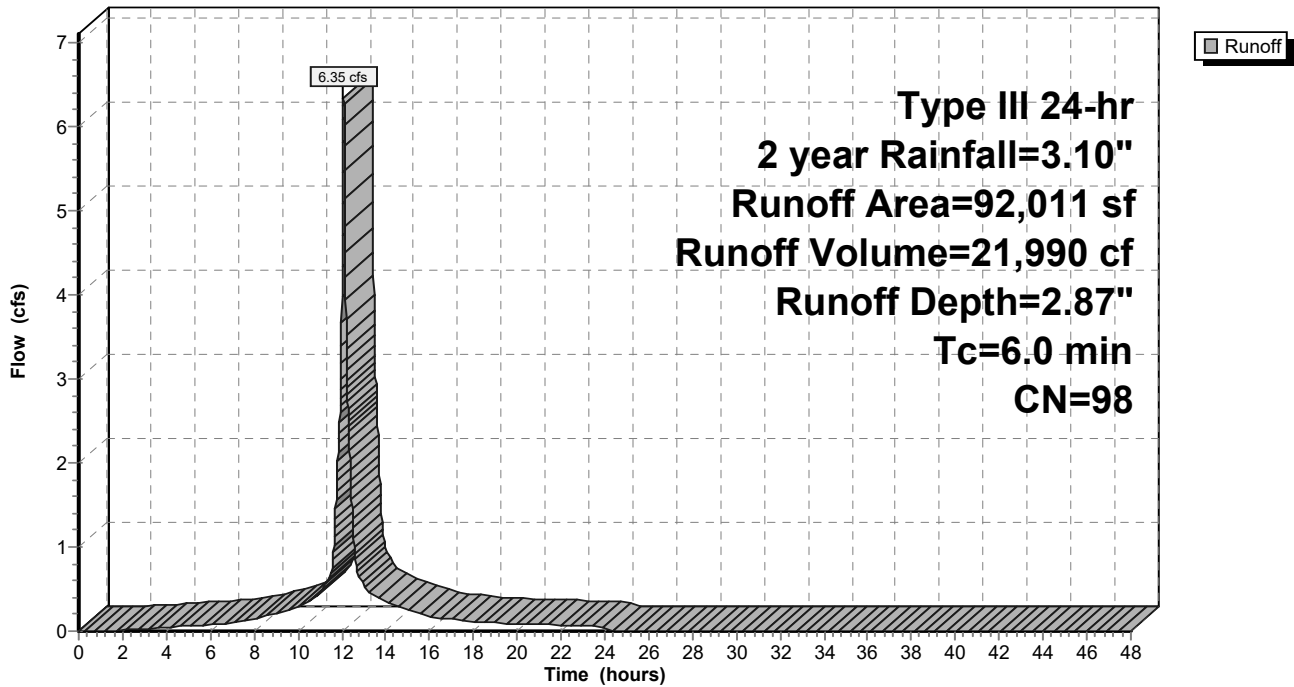
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 year Rainfall=3.10"

Area (sf)	CN	Description
89,825	98	Paved parking, HSG B
2,186	98	Roofs, HSG B
92,011	98	Weighted Average
92,011		100.00% Impervious Area

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

**Subcatchment 1S: Parking Garage**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 8

**Summary for Subcatchment 2S: Lower Parking lot & Landscaping**

Runoff = 3.06 cfs @ 12.09 hrs, Volume= 9,622 cf, Depth= 2.16"

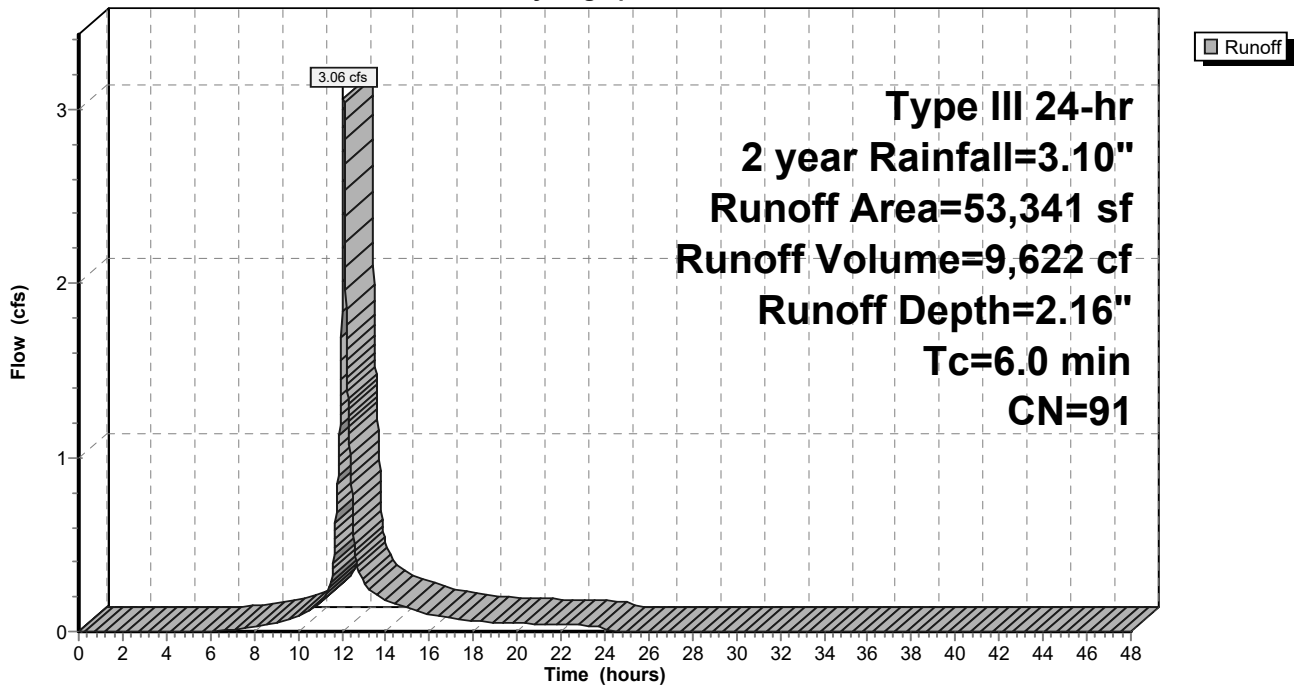
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 year Rainfall=3.10"

	Area (sf)	CN	Description
*	32,944	98	Paved Parking Lot
	20,397	80	>75% Grass cover, Good, HSG D
	53,341	91	Weighted Average
	20,397		38.24% Pervious Area
	32,944		61.76% Impervious Area

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

**Subcatchment 2S: Lower Parking lot & Landscaping**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 9

**Summary for Subcatchment 3S: Existing Eagles P-Lot**

Runoff = 0.38 cfs @ 12.08 hrs, Volume= 1,309 cf, Depth= 2.87"

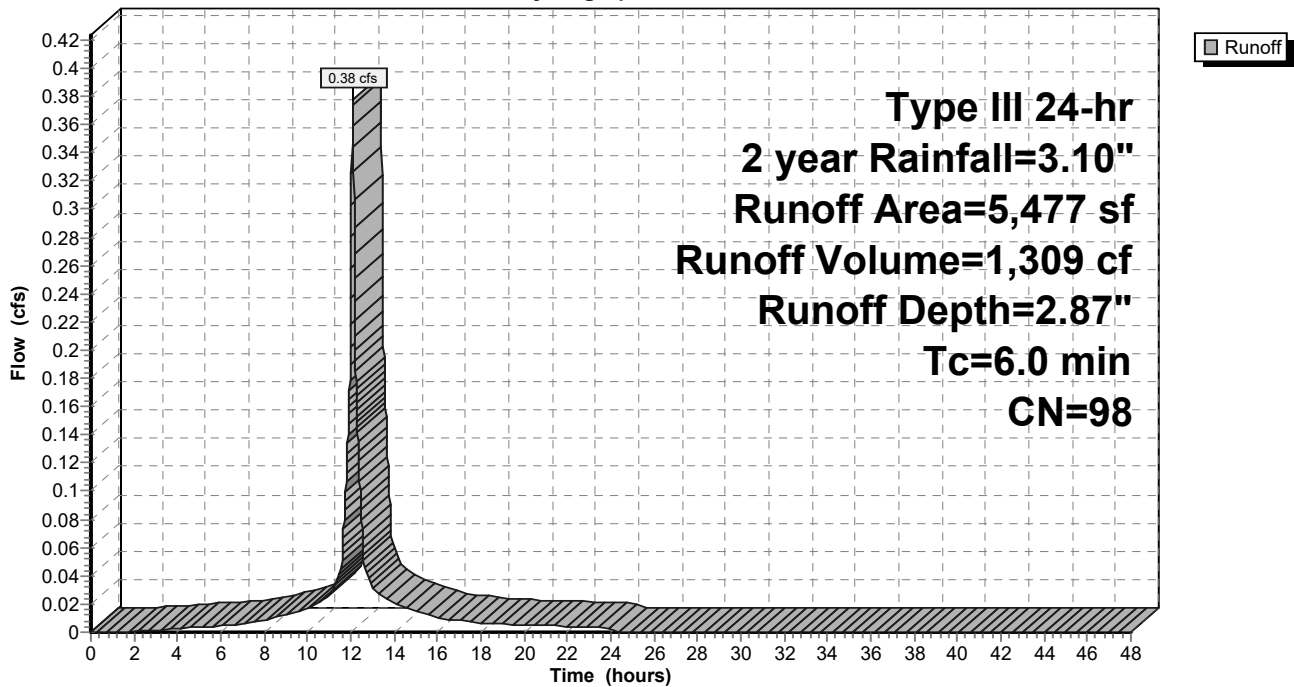
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2 year Rainfall=3.10"

Area (sf)	CN	Description
* 5,477	98	existing P-lot
5,477		100.00% Impervious Area

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

**Subcatchment 3S: Existing Eagles P-Lot**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 10

**Summary for Subcatchment 4S: St. John Street Entrance**

Runoff = 1.12 cfs @ 12.09 hrs, Volume= 3,491 cf, Depth= 1.39"

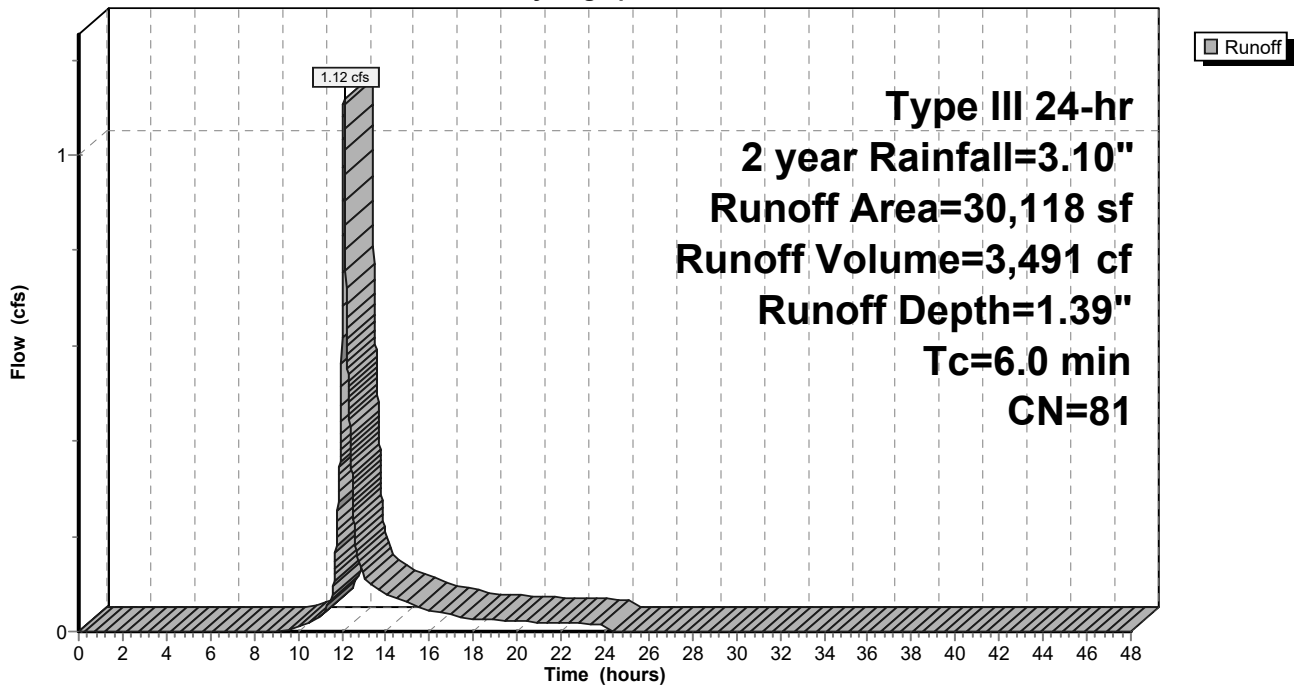
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 year Rainfall=3.10"

	Area (sf)	CN	Description
*	9,319	98	New entrane drive and walks
	20,799	74	>75% Grass cover, Good, HSG C
	30,118	81	Weighted Average
	20,799		69.06% Pervious Area
	9,319		30.94% Impervious Area

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

**Subcatchment 4S: St. John Street Entrance**

Hydrograph





**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 11

**Summary for Subcatchment 5S: Southern Drainage**

Runoff = 0.89 cfs @ 12.09 hrs, Volume= 2,808 cf, Depth= 2.16"

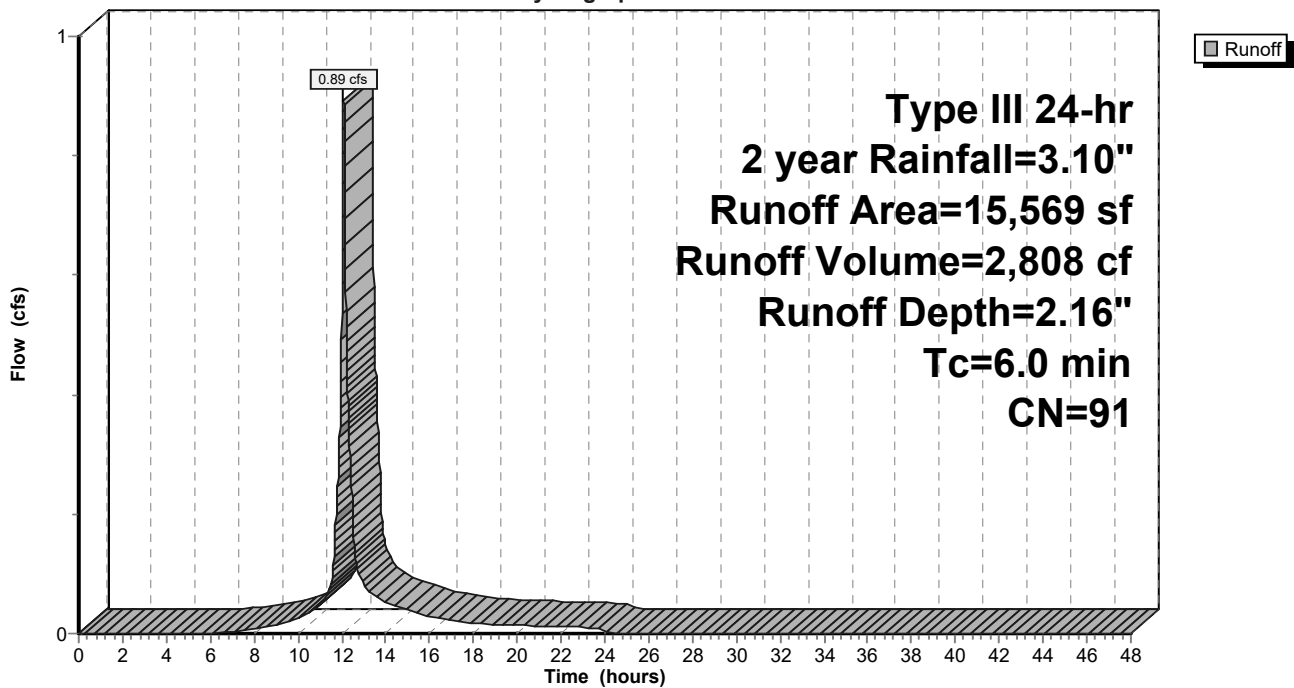
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 year Rainfall=3.10"

	Area (sf)	CN	Description
*	11,050	89	Crushed Stone
*	3,715	98	Sidewalk
*	591	98	Eagles lot p-lot
*	213	89	eagles lot stone
	15,569	91	Weighted Average
	11,263		72.34% Pervious Area
	4,306		27.66% Impervious Area

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

**Subcatchment 5S: Southern Drainage**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 12

**Summary for Subcatchment 6S: Entrance Drive**

Runoff = 0.73 cfs @ 12.07 hrs, Volume= 2,391 cf, Depth= 2.76"

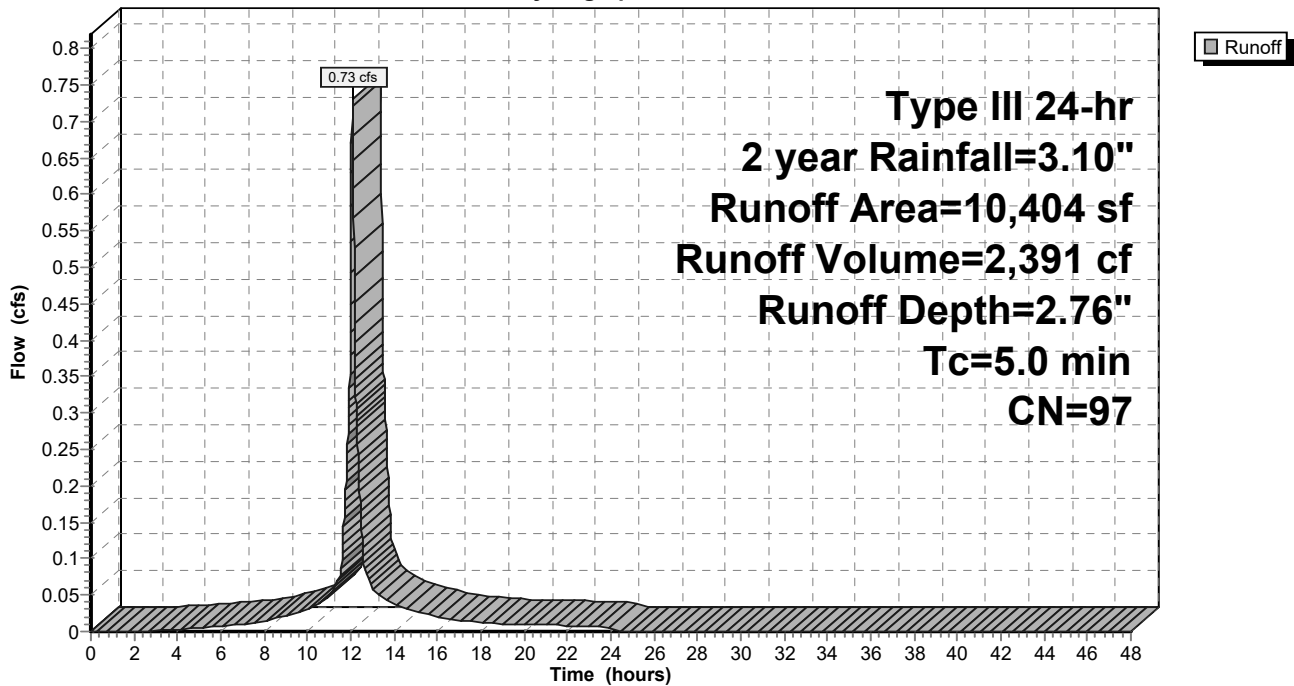
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 year Rainfall=3.10"

	Area (sf)	CN	Description
*	9,891	98	Entrance Road
	513	84	50-75% Grass cover, Fair, HSG D
	10,404	97	Weighted Average
	513		4.93% Pervious Area
	9,891		95.07% Impervious Area

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

**Subcatchment 6S: Entrance Drive**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 13

**Summary for Subcatchment 7S: Lower Lot Bypass**

Runoff = 2.00 cfs @ 12.08 hrs, Volume= 6,935 cf, Depth= 2.87"

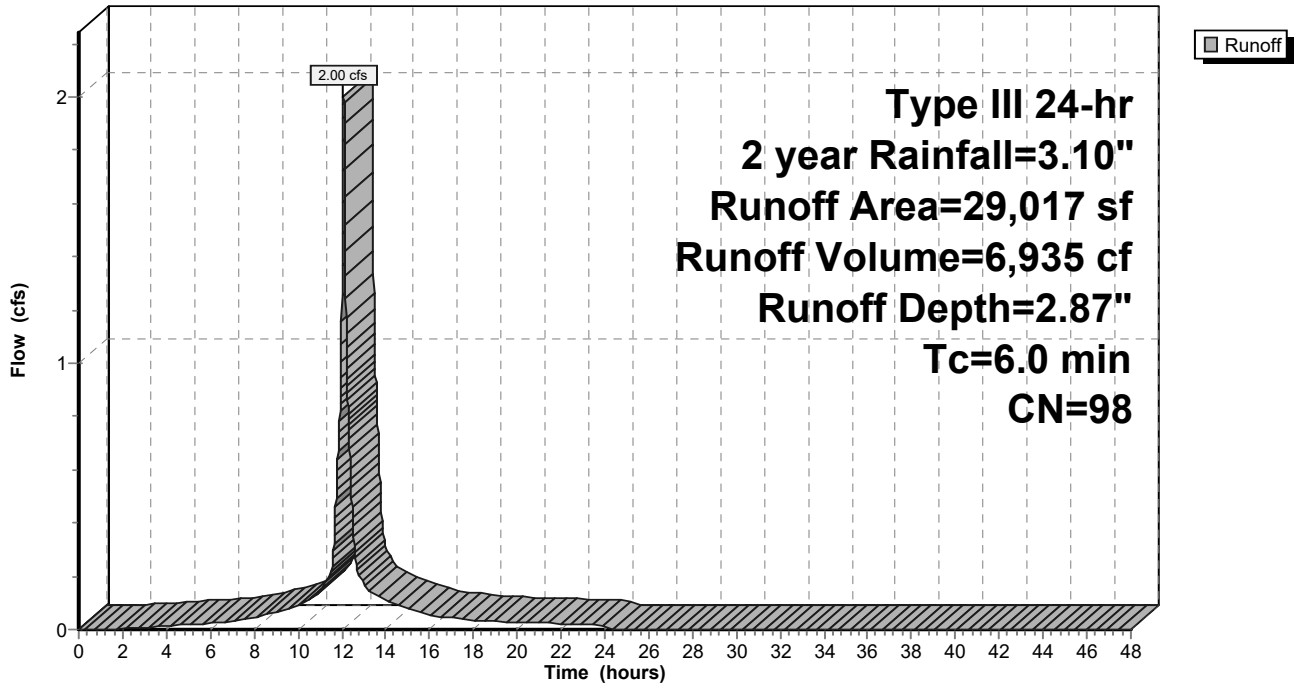
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 year Rainfall=3.10"

	Area (sf)	CN	Description
*	28,534	98	Entrance Drive & Walks
*	483	79	Landscaped area
	29,017	98	Weighted Average
	483		1.66% Pervious Area
	28,534		98.34% Impervious Area

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

**Subcatchment 7S: Lower Lot Bypass**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 14

**Summary for Pond 1P: R-Tank**

Inflow Area = 160,921 sf, 80.33% Impervious, Inflow Depth = 2.57" for 2 year event  
 Inflow = 10.31 cfs @ 12.08 hrs, Volume= 34,420 cf  
 Outflow = 3.51 cfs @ 12.36 hrs, Volume= 24,776 cf, Atten= 66%, Lag= 16.7 min  
 Primary = 0.03 cfs @ 15.87 hrs, Volume= 4,370 cf  
 Secondary = 3.48 cfs @ 12.36 hrs, Volume= 20,406 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 21.87' @ 12.36 hrs Surf.Area= 8,682 sf Storage= 17,455 cf

Plug-Flow detention time= 344.8 min calculated for 24,776 cf (72% of inflow)  
 Center-of-Mass det. time= 253.8 min ( 1,027.7 - 773.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	19.58'	4,733 cf	<b>Stone Envelope (Prismatic)</b> Listed below (Recalc) 33,165 cf Overall - 21,333 cf Embedded = 11,832 cf x 40.0% Voids
#2	19.58'	20,267 cf	<b>R-Tank Modules (Prismatic)</b> Listed below (Recalc) Inside #1 21,333 cf Overall x 95.0% Voids
		24,999 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.58	8,682	0	0
23.40	8,682	33,165	33,165

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.58	7,565	0	0
22.40	7,565	21,333	21,333

Device	Routing	Invert	Outlet Devices
#1	Primary	19.58'	<b>15.0" Round Culvert</b> L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 19.58' / 19.58' S= 0.0000 ' / Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	19.58'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	19.75'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600
#4	Secondary	21.13'	<b>15.0" Round Culvert X 2.00</b> L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 21.13' / 21.00' S= 0.0087 ' / Cc= 0.900 n= 0.012, Flow Area= 1.23 sf

**Primary OutFlow** Max=0.03 cfs @ 15.87 hrs HW=21.34' TW=19.62' (Dynamic Tailwater)

- ↑1=Culvert (Passes 0.03 cfs of 5.25 cfs potential flow)
- ↑2=Orifice/Grate (Orifice Controls 0.03 cfs @ 6.31 fps)
- ↑3=Orifice/Grate (Passes 0.03 cfs of 0.09 cfs potential flow)

**Secondary OutFlow** Max=3.48 cfs @ 12.36 hrs HW=21.87' TW=20.45' (Dynamic Tailwater)

- ↑4=Culvert (Barrel Controls 3.48 cfs @ 3.32 fps)

**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

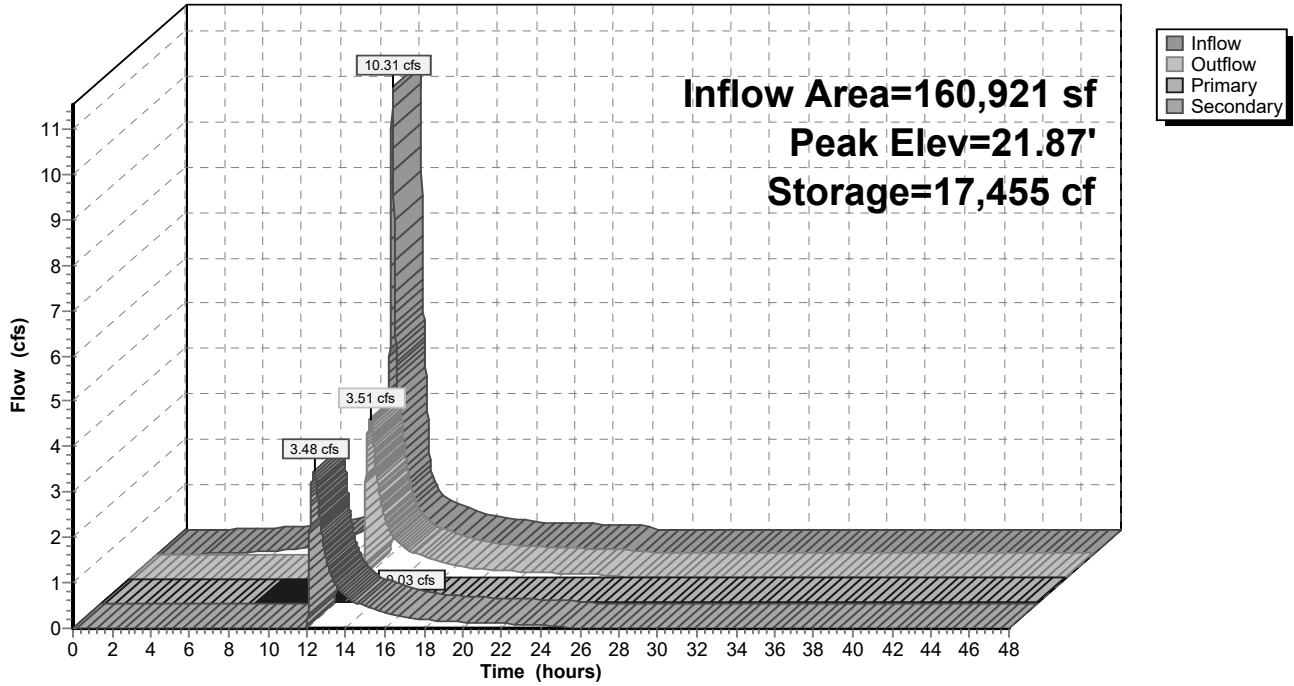
Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 15

**Pond 1P: R-Tank**

Hydrograph



# Post-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 16

## Summary for Pond DMH: New DMH

Inflow Area = 160,921 sf, 80.33% Impervious, Inflow Depth > 1.85" for 2 year event  
Inflow = 3.51 cfs @ 12.36 hrs, Volume= 24,776 cf  
Outflow = 3.51 cfs @ 12.36 hrs, Volume= 24,776 cf, Atten= 0%, Lag= 0.0 min  
Primary = 3.51 cfs @ 12.36 hrs, Volume= 24,776 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 20.45' @ 12.36 hrs

Flood Elev= 26.00'

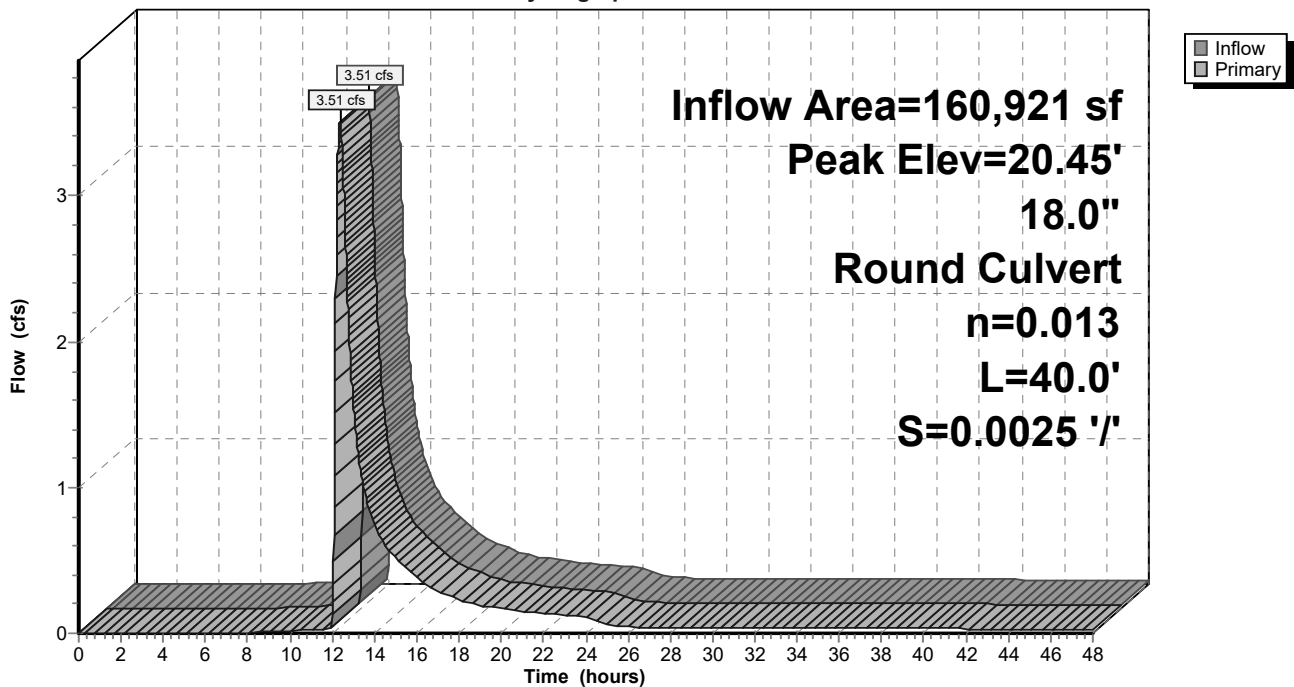
Device	Routing	Invert	Outlet Devices
#1	Primary	19.25'	<b>18.0" Round Culvert</b> L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 19.25' / 19.15' S= 0.0025 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

**Primary OutFlow** Max=3.51 cfs @ 12.36 hrs HW=20.45' TW=0.00' (Dynamic Tailwater)

↑1=Culvert (Barrel Controls 3.51 cfs @ 3.18 fps)

## Pond DMH: New DMH

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 17

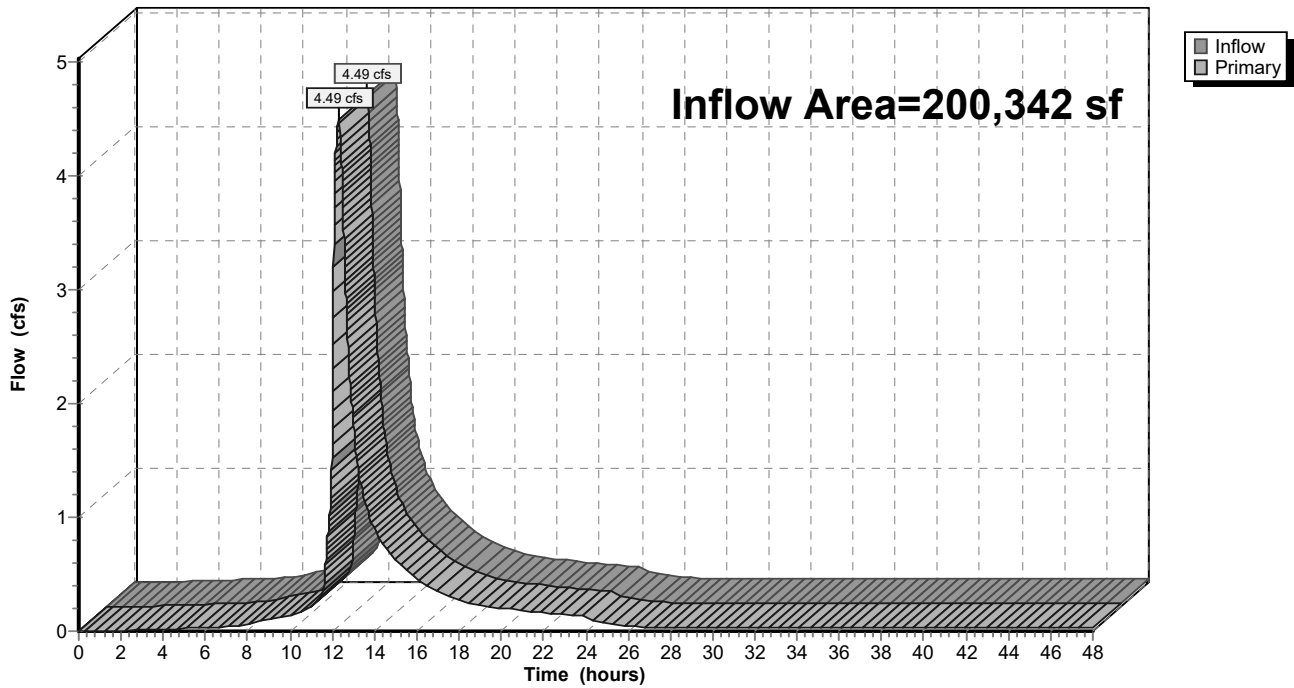
**Summary for Link SP1: Existing 18" SD System**

Inflow Area = 200,342 sf, 83.70% Impervious, Inflow Depth > 2.04" for 2 year event  
Inflow = 4.49 cfs @ 12.30 hrs, Volume= 34,102 cf  
Primary = 4.49 cfs @ 12.30 hrs, Volume= 34,102 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

**Link SP1: Existing 18" SD System**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2 year Rainfall=3.10"

Printed 7/24/2018

Page 18

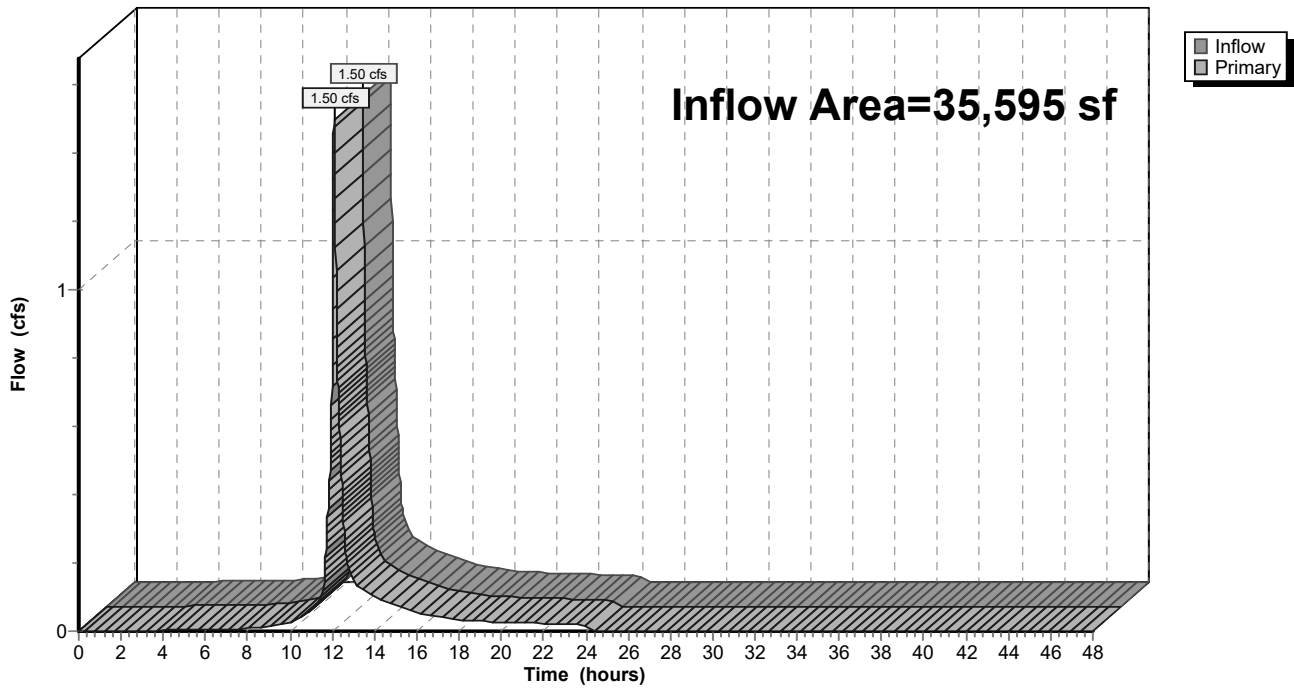
**Summary for Link SP2: 30" Storm Drain**

Inflow Area = 35,595 sf, 41.57% Impervious, Inflow Depth = 1.62" for 2 year event  
Inflow = 1.50 cfs @ 12.09 hrs, Volume= 4,800 cf  
Primary = 1.50 cfs @ 12.09 hrs, Volume= 4,800 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

**Link SP2: 30" Storm Drain**

Hydrograph





**Post-Development**

Type III 24-hr 10 year Rainfall=4.60"

Prepared by WoodardCurran

Printed 7/24/2018

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Page 19

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1S: Parking Garage** Runoff Area=92,011 sf 100.00% Impervious Runoff Depth=4.36"  
Tc=6.0 min CN=98 Runoff=9.50 cfs 33,460 cf

**Subcatchment2S: Lower Parking lot &** Runoff Area=53,341 sf 61.76% Impervious Runoff Depth=3.59"  
Tc=6.0 min CN=91 Runoff=4.97 cfs 15,978 cf

**Subcatchment3S: Existing Eagles P-Lot** Runoff Area=5,477 sf 100.00% Impervious Runoff Depth=4.36"  
Tc=6.0 min CN=98 Runoff=0.57 cfs 1,992 cf

**Subcatchment4S: St. John Street Entrance** Runoff Area=30,118 sf 30.94% Impervious Runoff Depth=2.63"  
Tc=6.0 min CN=81 Runoff=2.14 cfs 6,613 cf

**Subcatchment5S: Southern Drainage** Runoff Area=15,569 sf 27.66% Impervious Runoff Depth=3.59"  
Tc=6.0 min CN=91 Runoff=1.45 cfs 4,664 cf

**Subcatchment6S: Entrance Drive** Runoff Area=10,404 sf 95.07% Impervious Runoff Depth=4.25"  
Tc=5.0 min CN=97 Runoff=1.10 cfs 3,684 cf

**Subcatchment7S: Lower Lot Bypass** Runoff Area=29,017 sf 98.34% Impervious Runoff Depth=4.36"  
Tc=6.0 min CN=98 Runoff=2.99 cfs 10,552 cf

**Pond 1P: R-Tank** Peak Elev=22.53' Storage=21,974 cf Inflow=15.91 cfs 54,102 cf  
Primary=0.03 cfs 4,534 cf Secondary=9.26 cfs 39,879 cf Outflow=9.28 cfs 44,413 cf

**Pond DMH: New DMH** Peak Elev=21.91' Inflow=9.28 cfs 44,413 cf  
18.0" Round Culvert n=0.013 L=40.0' S=0.0025 '/' Outflow=9.28 cfs 44,413 cf

**Link SP1: Existing 18" SD System** Inflow=11.83 cfs 58,649 cf  
Primary=11.83 cfs 58,649 cf

**Link SP2: 30" Storm Drain** Inflow=2.70 cfs 8,605 cf  
Primary=2.70 cfs 8,605 cf

**Total Runoff Area = 235,937 sf Runoff Volume = 76,942 cf Average Runoff Depth = 3.91"**  
**22.66% Pervious = 53,455 sf 77.34% Impervious = 182,482 sf**

**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 20

**Summary for Subcatchment 1S: Parking Garage**

Runoff = 9.50 cfs @ 12.08 hrs, Volume= 33,460 cf, Depth= 4.36"

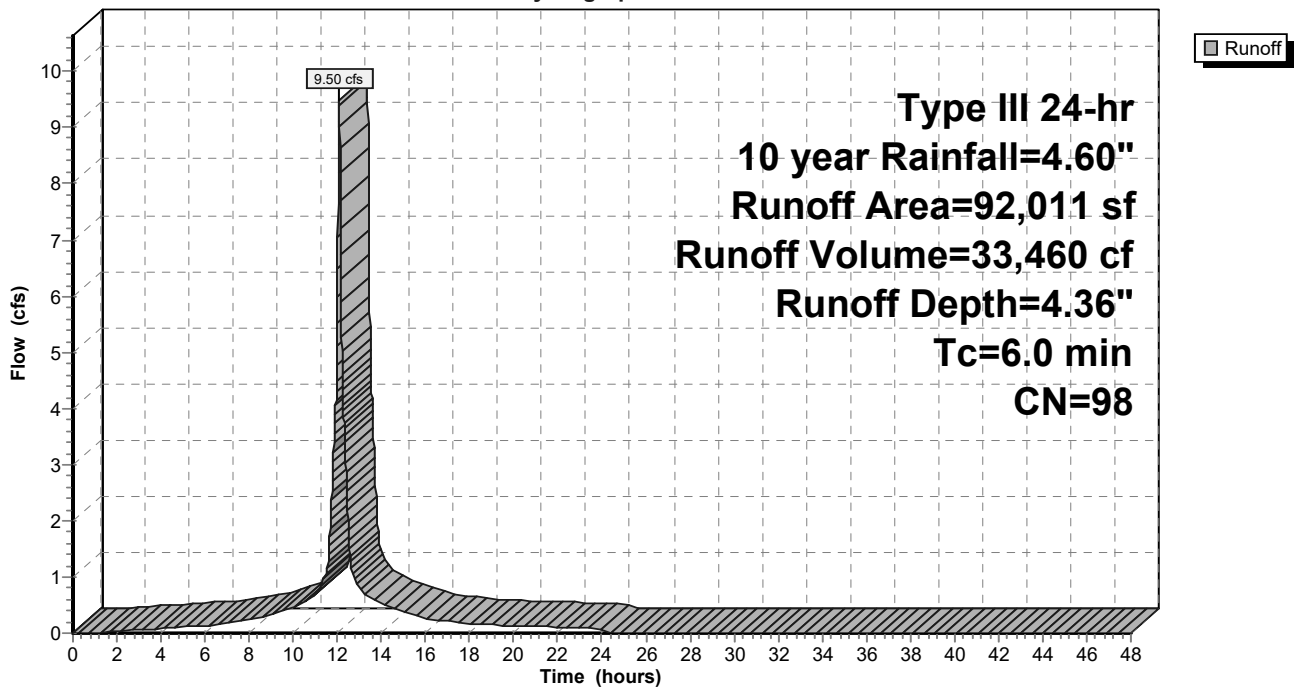
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 year Rainfall=4.60"

Area (sf)	CN	Description
89,825	98	Paved parking, HSG B
2,186	98	Roofs, HSG B
92,011	98	Weighted Average
92,011		100.00% Impervious Area

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

**Subcatchment 1S: Parking Garage**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 21

**Summary for Subcatchment 2S: Lower Parking lot & Landscaping**

Runoff = 4.97 cfs @ 12.08 hrs, Volume= 15,978 cf, Depth= 3.59"

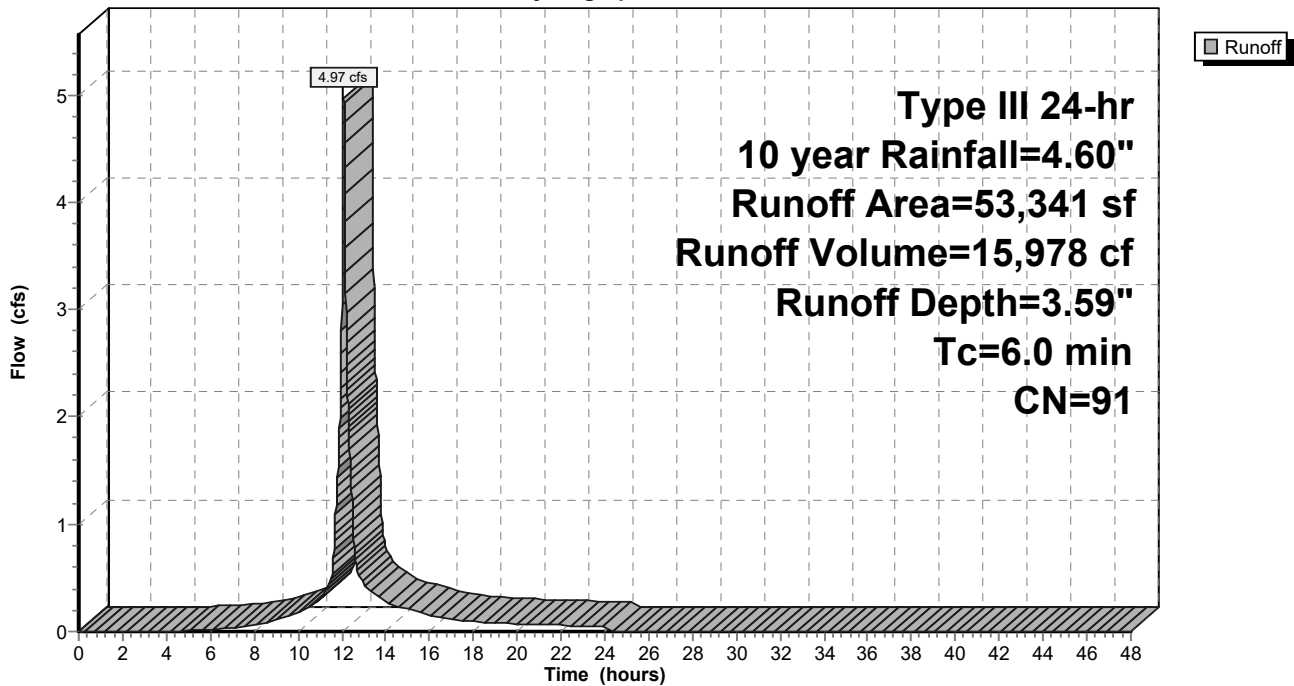
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 year Rainfall=4.60"

	Area (sf)	CN	Description
*	32,944	98	Paved Parking Lot
	20,397	80	>75% Grass cover, Good, HSG D
	53,341	91	Weighted Average
	20,397		38.24% Pervious Area
	32,944		61.76% Impervious Area

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

**Subcatchment 2S: Lower Parking lot & Landscaping**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 22

**Summary for Subcatchment 3S: Existing Eagles P-Lot**

Runoff = 0.57 cfs @ 12.08 hrs, Volume= 1,992 cf, Depth= 4.36"

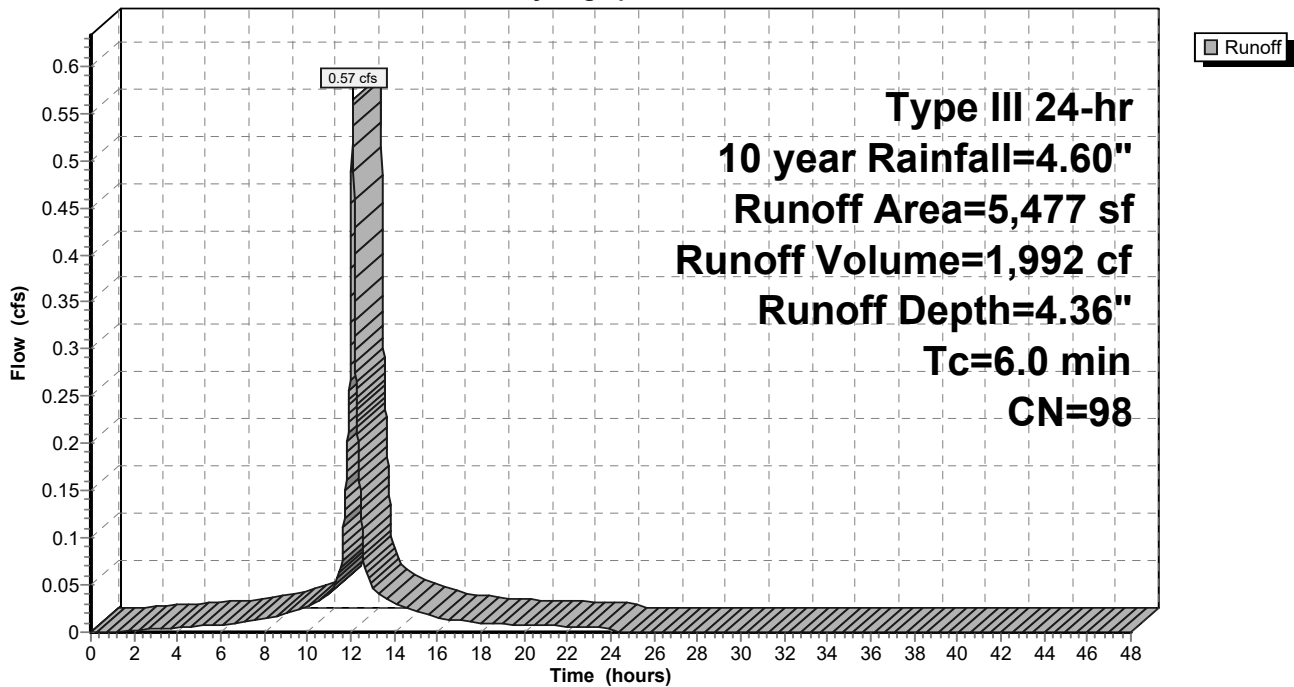
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 year Rainfall=4.60"

Area (sf)	CN	Description
* 5,477	98	existing P-lot
5,477		100.00% Impervious Area

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

**Subcatchment 3S: Existing Eagles P-Lot**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 23

**Summary for Subcatchment 4S: St. John Street Entrance**

Runoff = 2.14 cfs @ 12.09 hrs, Volume= 6,613 cf, Depth= 2.63"

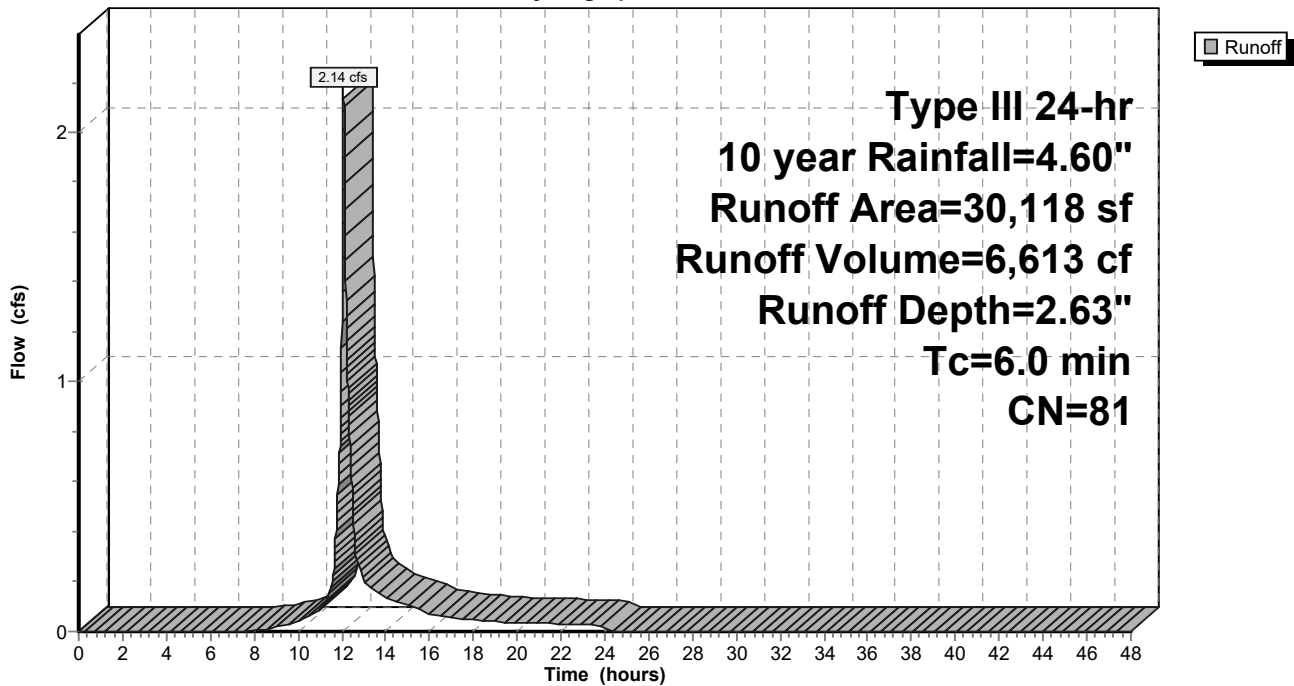
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 year Rainfall=4.60"

	Area (sf)	CN	Description
*	9,319	98	New entrane drive and walks
	20,799	74	>75% Grass cover, Good, HSG C
	30,118	81	Weighted Average
	20,799		69.06% Pervious Area
	9,319		30.94% Impervious Area

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

**Subcatchment 4S: St. John Street Entrance**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 24

**Summary for Subcatchment 5S: Southern Drainage**

Runoff = 1.45 cfs @ 12.08 hrs, Volume= 4,664 cf, Depth= 3.59"

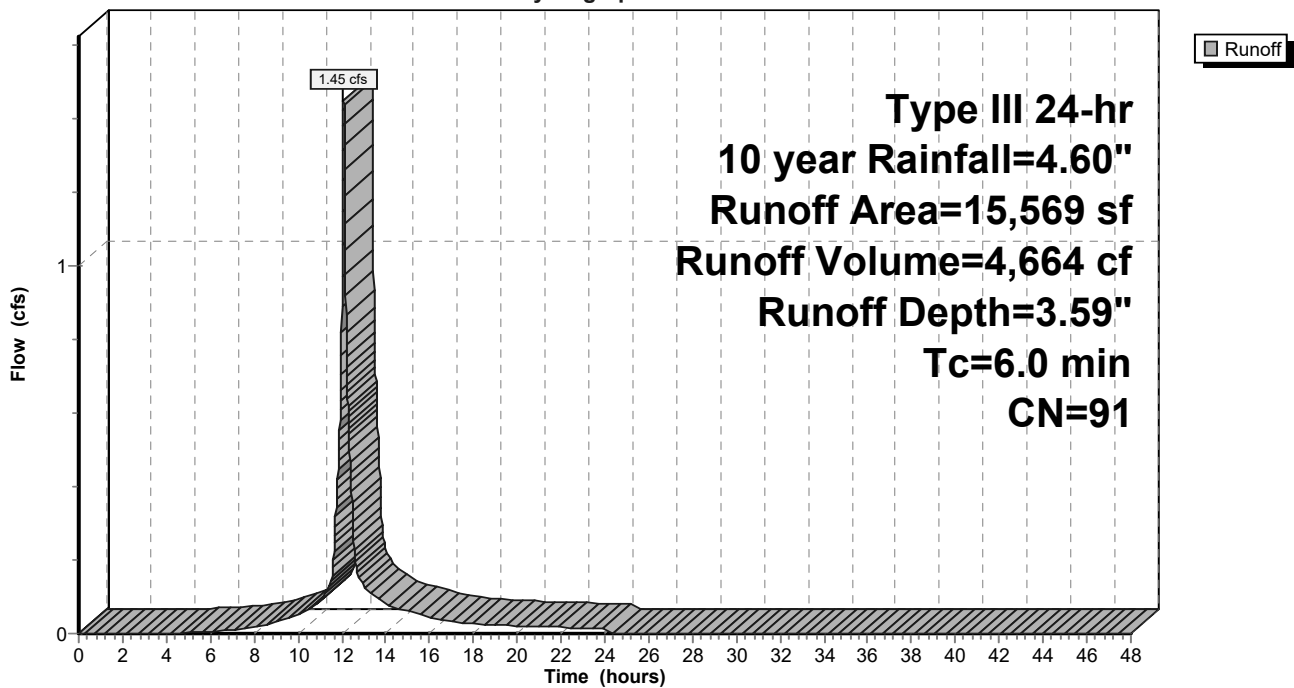
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10 year Rainfall=4.60"

	Area (sf)	CN	Description
*	11,050	89	Crushed Stone
*	3,715	98	Sidewalk
*	591	98	Eagles lot p-lot
*	213	89	eagles lot stone
	15,569	91	Weighted Average
	11,263		72.34% Pervious Area
	4,306		27.66% Impervious Area

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

**Subcatchment 5S: Southern Drainage**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 25

**Summary for Subcatchment 6S: Entrance Drive**

Runoff = 1.10 cfs @ 12.07 hrs, Volume= 3,684 cf, Depth= 4.25"

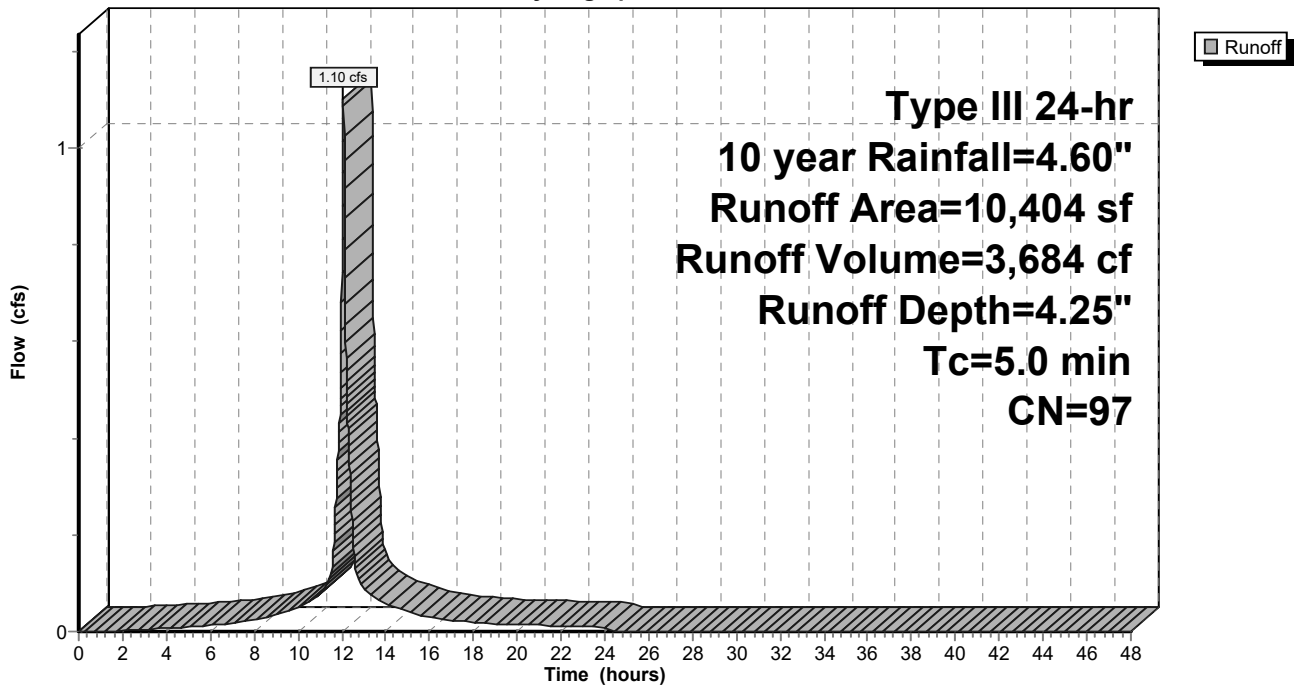
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 year Rainfall=4.60"

	Area (sf)	CN	Description
*	9,891	98	Entrance Road
	513	84	50-75% Grass cover, Fair, HSG D
	10,404	97	Weighted Average
	513		4.93% Pervious Area
	9,891		95.07% Impervious Area

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

**Subcatchment 6S: Entrance Drive**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 26

**Summary for Subcatchment 7S: Lower Lot Bypass**

Runoff = 2.99 cfs @ 12.08 hrs, Volume= 10,552 cf, Depth= 4.36"

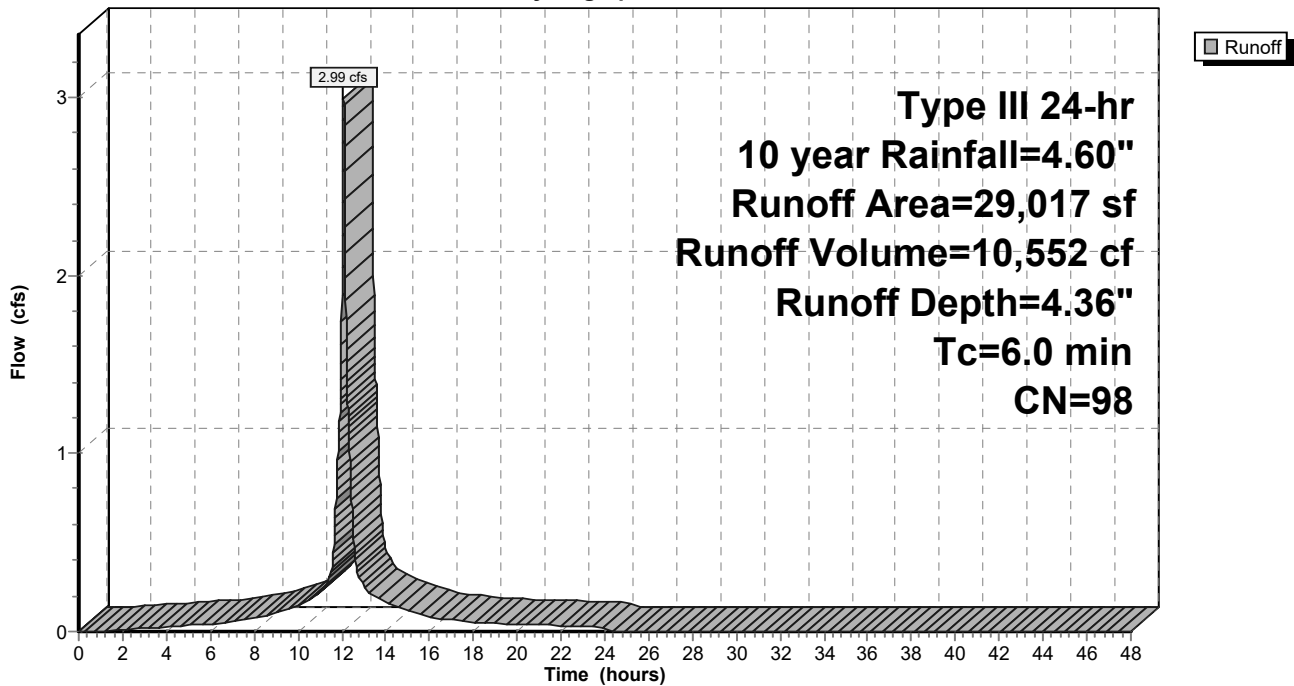
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 year Rainfall=4.60"

	Area (sf)	CN	Description
*	28,534	98	Entrance Drive & Walks
*	483	79	Landscaped area
	29,017	98	Weighted Average
	483		1.66% Pervious Area
	28,534		98.34% Impervious Area

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

**Subcatchment 7S: Lower Lot Bypass**

Hydrograph





**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 27

**Summary for Pond 1P: R-Tank**

Inflow Area = 160,921 sf, 80.33% Impervious, Inflow Depth = 4.03" for 10 year event  
 Inflow = 15.91 cfs @ 12.08 hrs, Volume= 54,102 cf  
 Outflow = 9.28 cfs @ 12.18 hrs, Volume= 44,413 cf, Atten= 42%, Lag= 5.9 min  
 Primary = 0.03 cfs @ 17.26 hrs, Volume= 4,534 cf  
 Secondary = 9.26 cfs @ 12.18 hrs, Volume= 39,879 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 22.53' @ 12.19 hrs Surf.Area= 8,682 sf Storage= 21,974 cf

Plug-Flow detention time= 241.4 min calculated for 44,413 cf (82% of inflow)  
 Center-of-Mass det. time= 169.5 min ( 934.2 - 764.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	19.58'	4,733 cf	<b>Stone Envelope (Prismatic)</b> Listed below (Recalc) 33,165 cf Overall - 21,333 cf Embedded = 11,832 cf x 40.0% Voids
#2	19.58'	20,267 cf	<b>R-Tank Modules (Prismatic)</b> Listed below (Recalc) Inside #1 21,333 cf Overall x 95.0% Voids
		24,999 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.58	8,682	0	0
23.40	8,682	33,165	33,165

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.58	7,565	0	0
22.40	7,565	21,333	21,333

Device	Routing	Invert	Outlet Devices
#1	Primary	19.58'	<b>15.0" Round Culvert</b> L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 19.58' / 19.58' S= 0.0000 ' / Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	19.58'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	19.75'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600
#4	Secondary	21.13'	<b>15.0" Round Culvert X 2.00</b> L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 21.13' / 21.00' S= 0.0087 ' / Cc= 0.900 n= 0.012, Flow Area= 1.23 sf

**Primary OutFlow** Max=0.03 cfs @ 17.26 hrs HW=21.34' TW=19.62' (Dynamic Tailwater)

- ↑1=Culvert (Passes 0.03 cfs of 5.25 cfs potential flow)
- ↑2=Orifice/Grate (Orifice Controls 0.03 cfs @ 6.31 fps)
- ↑3=Orifice/Grate (Passes 0.03 cfs of 0.09 cfs potential flow)

**Secondary OutFlow** Max=9.26 cfs @ 12.18 hrs HW=22.53' TW=21.90' (Dynamic Tailwater)

- ↑4=Culvert (Barrel Controls 9.26 cfs @ 4.22 fps)

**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

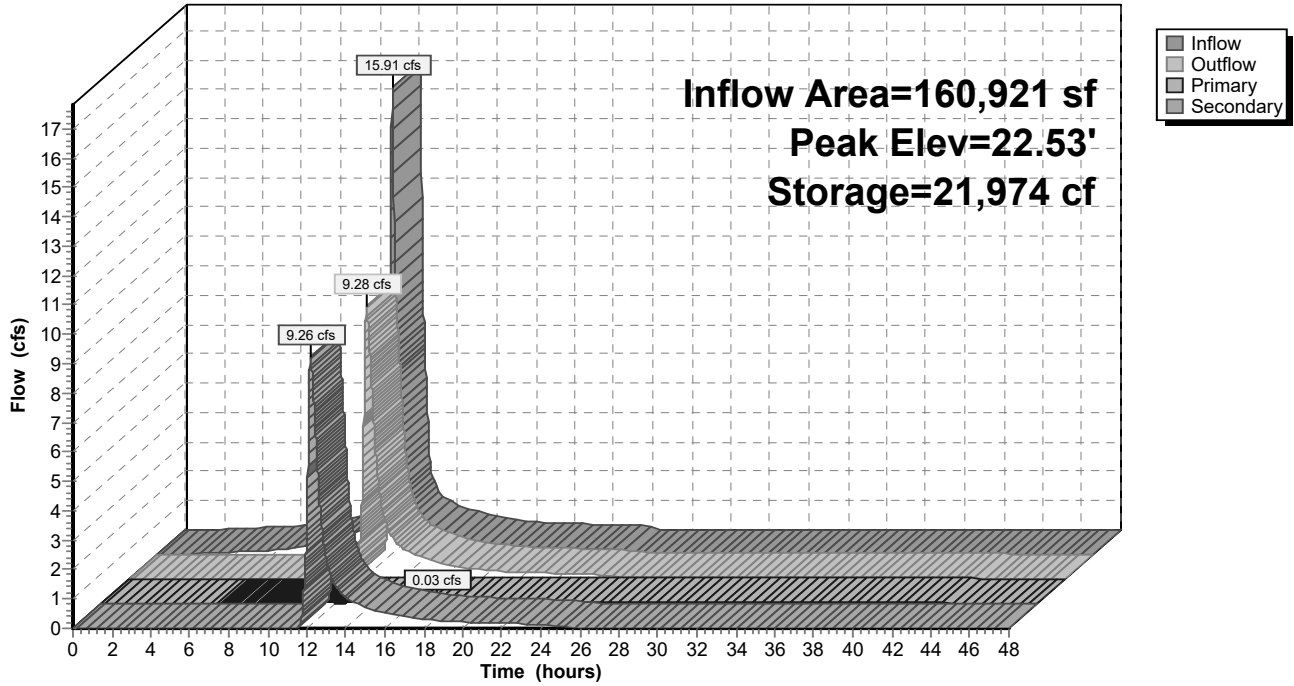
Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 28

**Pond 1P: R-Tank**

Hydrograph



# Post-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 29

## Summary for Pond DMH: New DMH

Inflow Area = 160,921 sf, 80.33% Impervious, Inflow Depth > 3.31" for 10 year event  
Inflow = 9.28 cfs @ 12.18 hrs, Volume= 44,413 cf  
Outflow = 9.28 cfs @ 12.18 hrs, Volume= 44,413 cf, Atten= 0%, Lag= 0.0 min  
Primary = 9.28 cfs @ 12.18 hrs, Volume= 44,413 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 21.91' @ 12.18 hrs

Flood Elev= 26.00'

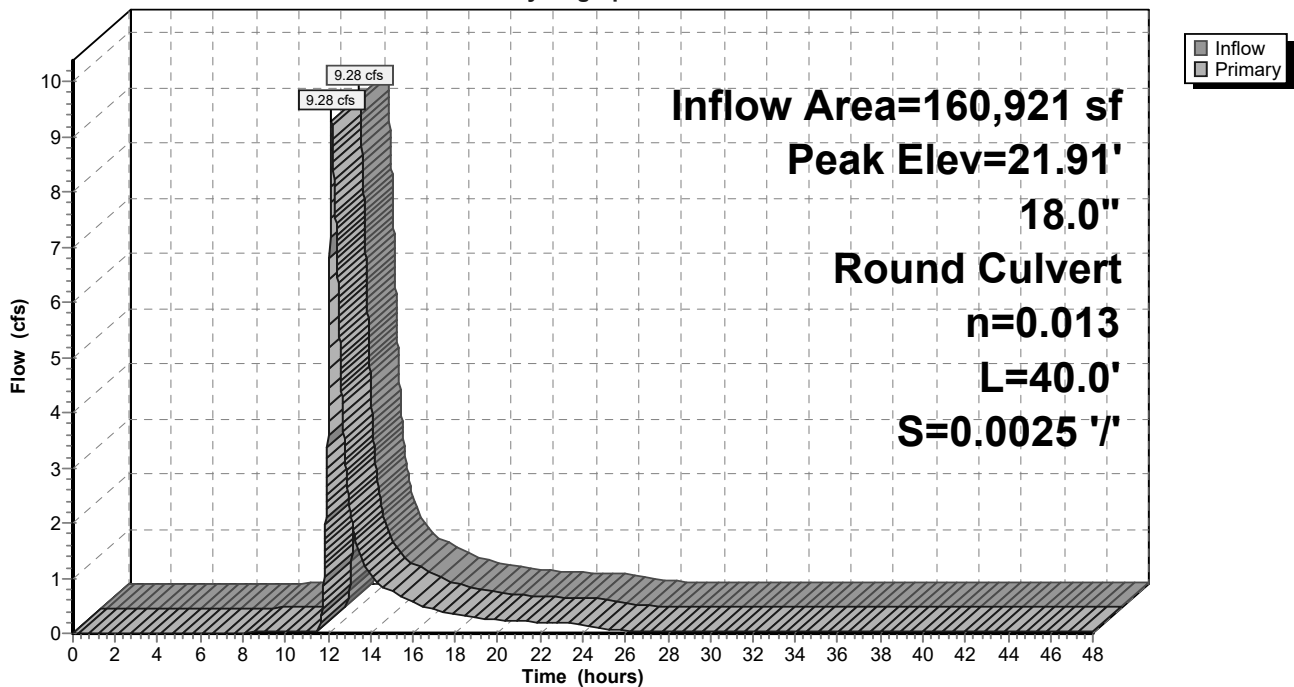
Device	Routing	Invert	Outlet Devices
#1	Primary	19.25'	<b>18.0" Round Culvert</b> L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 19.25' / 19.15' S= 0.0025 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

**Primary OutFlow** Max=9.27 cfs @ 12.18 hrs HW=21.90' TW=0.00' (Dynamic Tailwater)

↑1=Culvert (Inlet Controls 9.27 cfs @ 5.25 fps)

## Pond DMH: New DMH

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 30

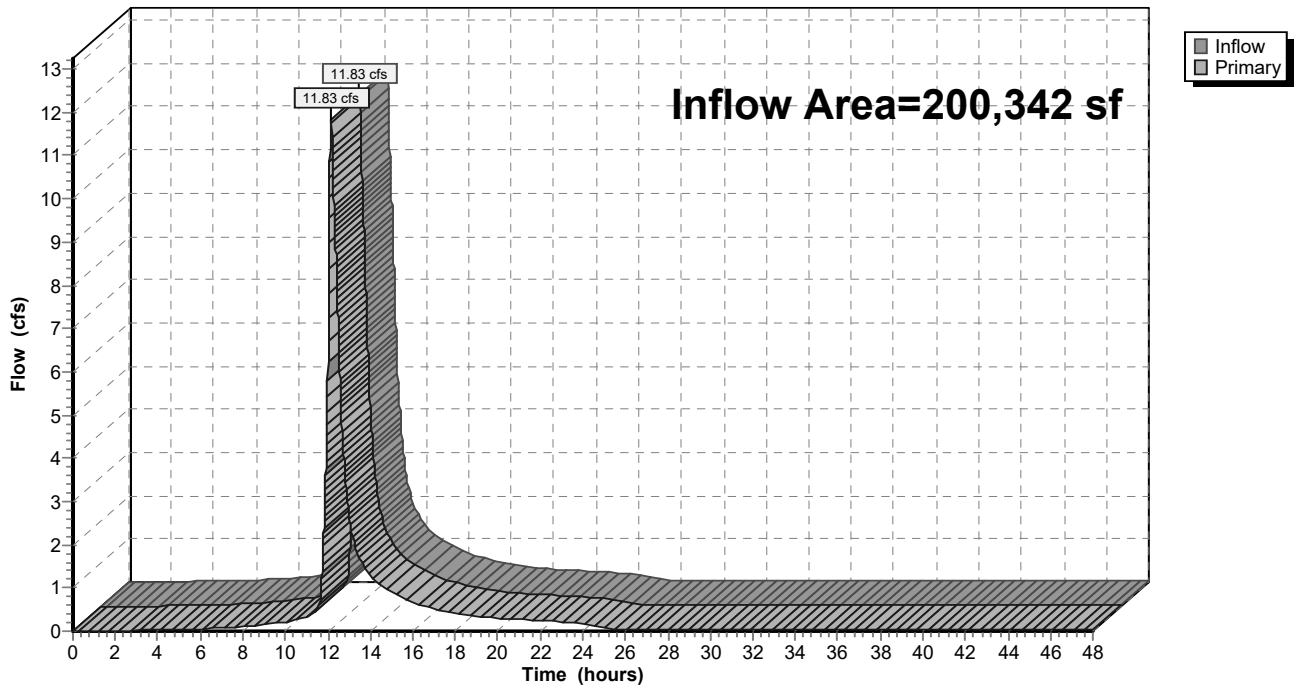
**Summary for Link SP1: Existing 18" SD System**

Inflow Area = 200,342 sf, 83.70% Impervious, Inflow Depth > 3.51" for 10 year event  
Inflow = 11.83 cfs @ 12.16 hrs, Volume= 58,649 cf  
Primary = 11.83 cfs @ 12.16 hrs, Volume= 58,649 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

**Link SP1: Existing 18" SD System**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10 year Rainfall=4.60"

Printed 7/24/2018

Page 31

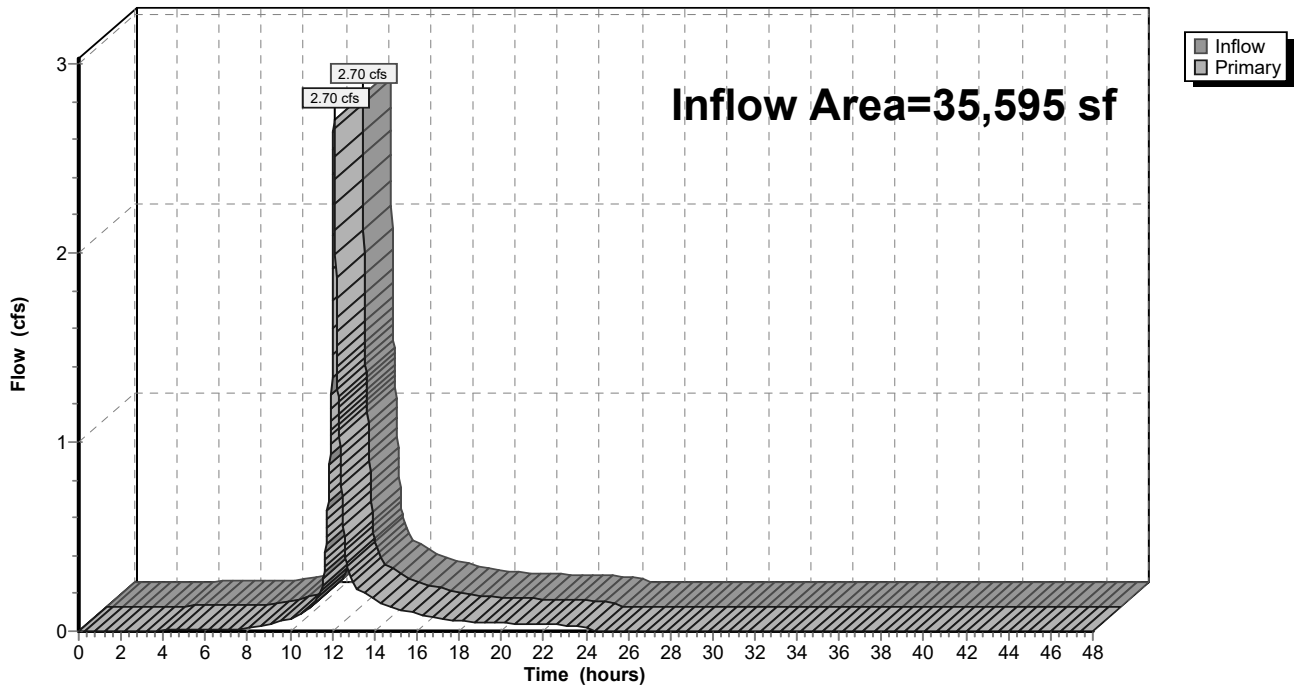
**Summary for Link SP2: 30" Storm Drain**

Inflow Area = 35,595 sf, 41.57% Impervious, Inflow Depth = 2.90" for 10 year event  
Inflow = 2.70 cfs @ 12.09 hrs, Volume= 8,605 cf  
Primary = 2.70 cfs @ 12.09 hrs, Volume= 8,605 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

**Link SP2: 30" Storm Drain**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 32

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1S: Parking Garage** Runoff Area=92,011 sf 100.00% Impervious Runoff Depth=5.56"  
Tc=6.0 min CN=98 Runoff=12.00 cfs 42,648 cf

**Subcatchment2S: Lower Parking lot &** Runoff Area=53,341 sf 61.76% Impervious Runoff Depth=4.76"  
Tc=6.0 min CN=91 Runoff=6.48 cfs 21,166 cf

**Subcatchment3S: Existing Eagles P-Lot** Runoff Area=5,477 sf 100.00% Impervious Runoff Depth=5.56"  
Tc=6.0 min CN=98 Runoff=0.71 cfs 2,539 cf

**Subcatchment4S: St. John Street Entrance** Runoff Area=30,118 sf 30.94% Impervious Runoff Depth=3.70"  
Tc=6.0 min CN=81 Runoff=2.99 cfs 9,291 cf

**Subcatchment5S: Southern Drainage** Runoff Area=15,569 sf 27.66% Impervious Runoff Depth=4.76"  
Tc=6.0 min CN=91 Runoff=1.89 cfs 6,178 cf

**Subcatchment6S: Entrance Drive** Runoff Area=10,404 sf 95.07% Impervious Runoff Depth=5.44"  
Tc=5.0 min CN=97 Runoff=1.40 cfs 4,721 cf

**Subcatchment7S: Lower Lot Bypass** Runoff Area=29,017 sf 98.34% Impervious Runoff Depth=5.56"  
Tc=6.0 min CN=98 Runoff=3.79 cfs 13,450 cf

**Pond 1P: R-Tank** Peak Elev=23.30' Storage=24,643 cf Inflow=20.37 cfs 69,991 cf  
Primary=0.05 cfs 4,667 cf Secondary=14.68 cfs 56,063 cf Outflow=14.73 cfs 60,280 cf

**Pond DMH: New DMH** Peak Elev=24.81' Inflow=14.73 cfs 60,730 cf  
18.0" Round Culvert n=0.013 L=40.0' S=0.0025 'l' Outflow=14.73 cfs 60,730 cf

**Link SP1: Existing 18" SD System** Inflow=18.94 cfs 78,900 cf  
Primary=18.94 cfs 78,900 cf

**Link SP2: 30" Storm Drain** Inflow=3.70 cfs 11,830 cf  
Primary=3.70 cfs 11,830 cf

**Total Runoff Area = 235,937 sf Runoff Volume = 99,991 cf Average Runoff Depth = 5.09"**  
**22.66% Pervious = 53,455 sf 77.34% Impervious = 182,482 sf**

**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 33

**Summary for Subcatchment 1S: Parking Garage**

Runoff = 12.00 cfs @ 12.08 hrs, Volume= 42,648 cf, Depth= 5.56"

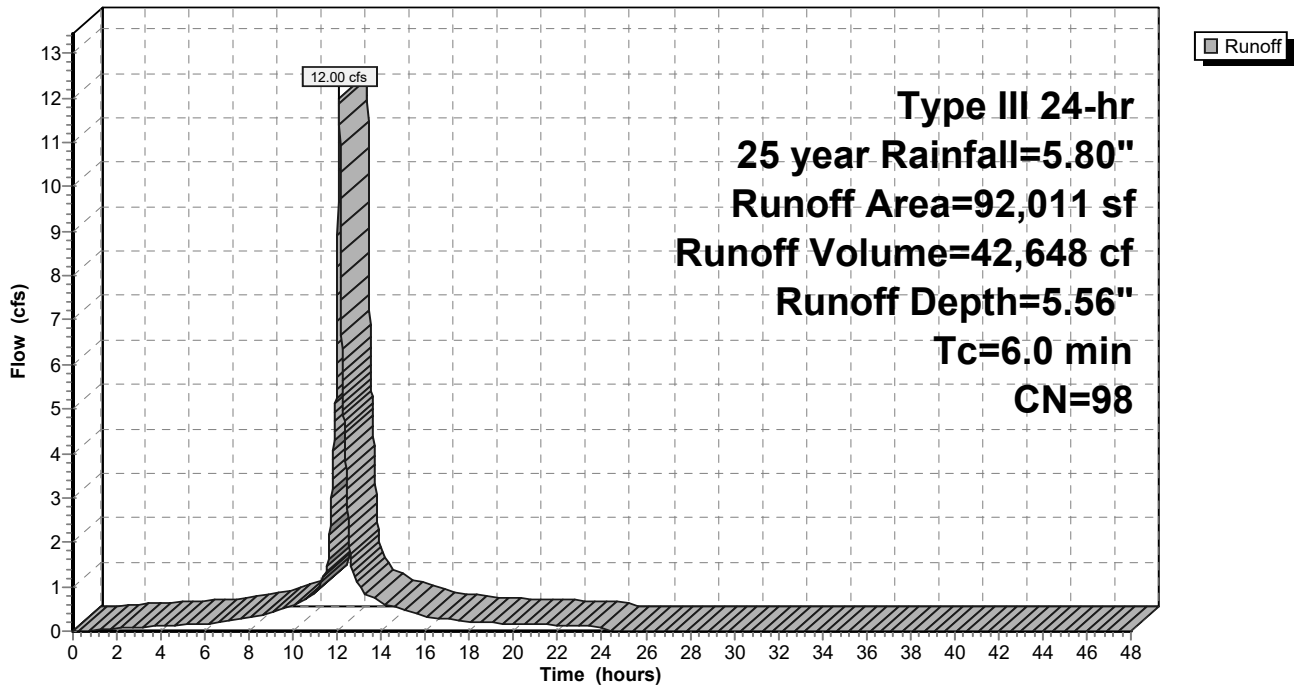
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25 year Rainfall=5.80"

Area (sf)	CN	Description
89,825	98	Paved parking, HSG B
2,186	98	Roofs, HSG B
92,011	98	Weighted Average
92,011		100.00% Impervious Area

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

**Subcatchment 1S: Parking Garage**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 34

**Summary for Subcatchment 2S: Lower Parking lot & Landscaping**

Runoff = 6.48 cfs @ 12.08 hrs, Volume= 21,166 cf, Depth= 4.76"

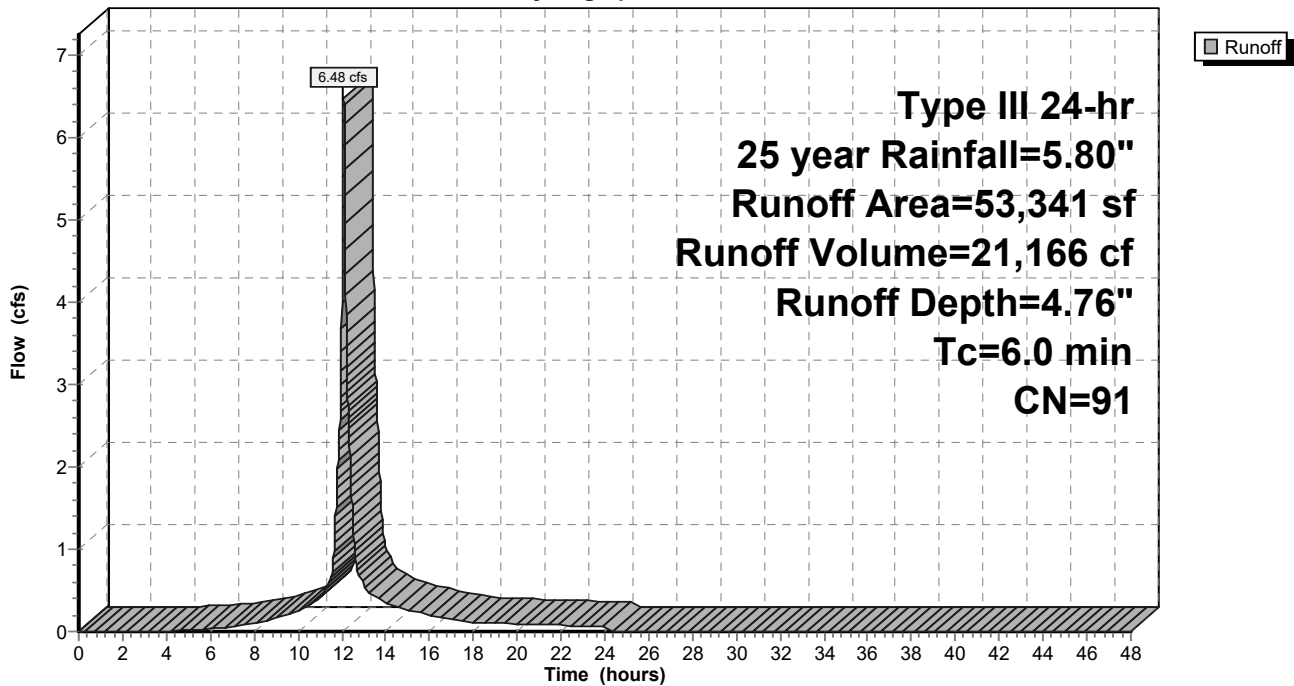
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25 year Rainfall=5.80"

	Area (sf)	CN	Description
*	32,944	98	Paved Parking Lot
	20,397	80	>75% Grass cover, Good, HSG D
	53,341	91	Weighted Average
	20,397		38.24% Pervious Area
	32,944		61.76% Impervious Area

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

**Subcatchment 2S: Lower Parking lot & Landscaping**

Hydrograph





**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 35

**Summary for Subcatchment 3S: Existing Eagles P-Lot**

Runoff = 0.71 cfs @ 12.08 hrs, Volume= 2,539 cf, Depth= 5.56"

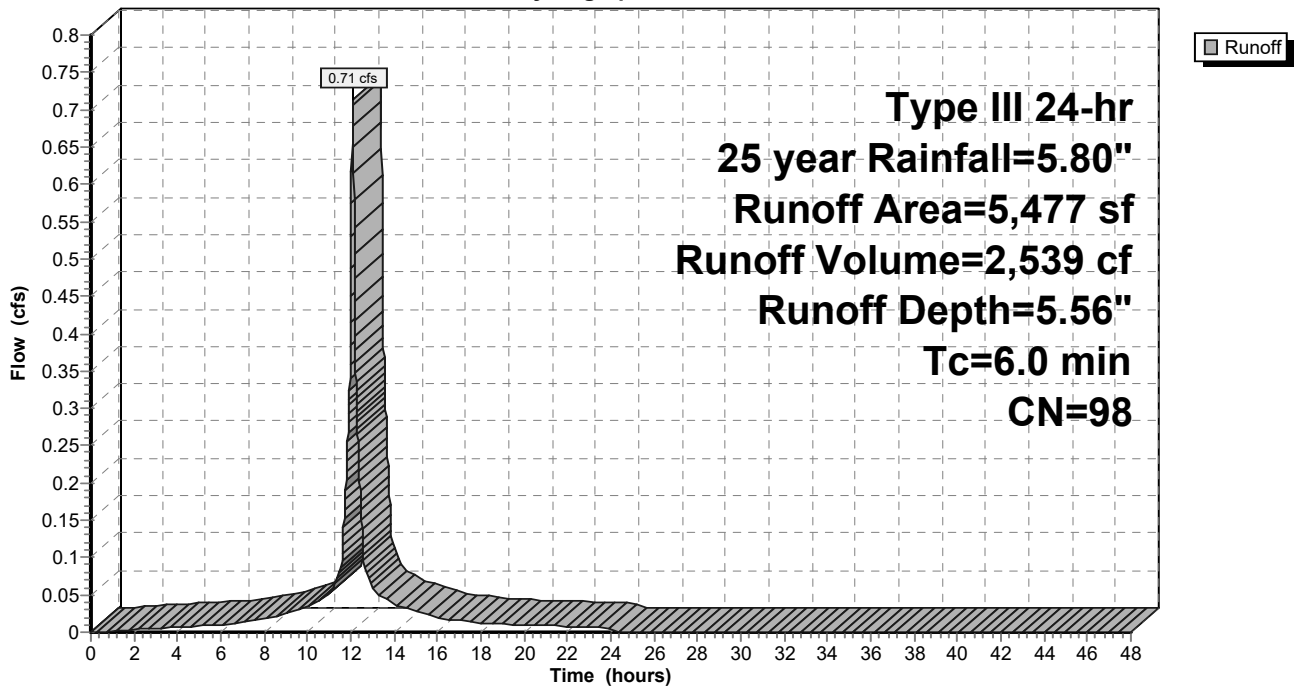
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25 year Rainfall=5.80"

Area (sf)	CN	Description
* 5,477	98	existing P-lot
5,477		100.00% Impervious Area

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

**Subcatchment 3S: Existing Eagles P-Lot**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 36

**Summary for Subcatchment 4S: St. John Street Entrance**

Runoff = 2.99 cfs @ 12.09 hrs, Volume= 9,291 cf, Depth= 3.70"

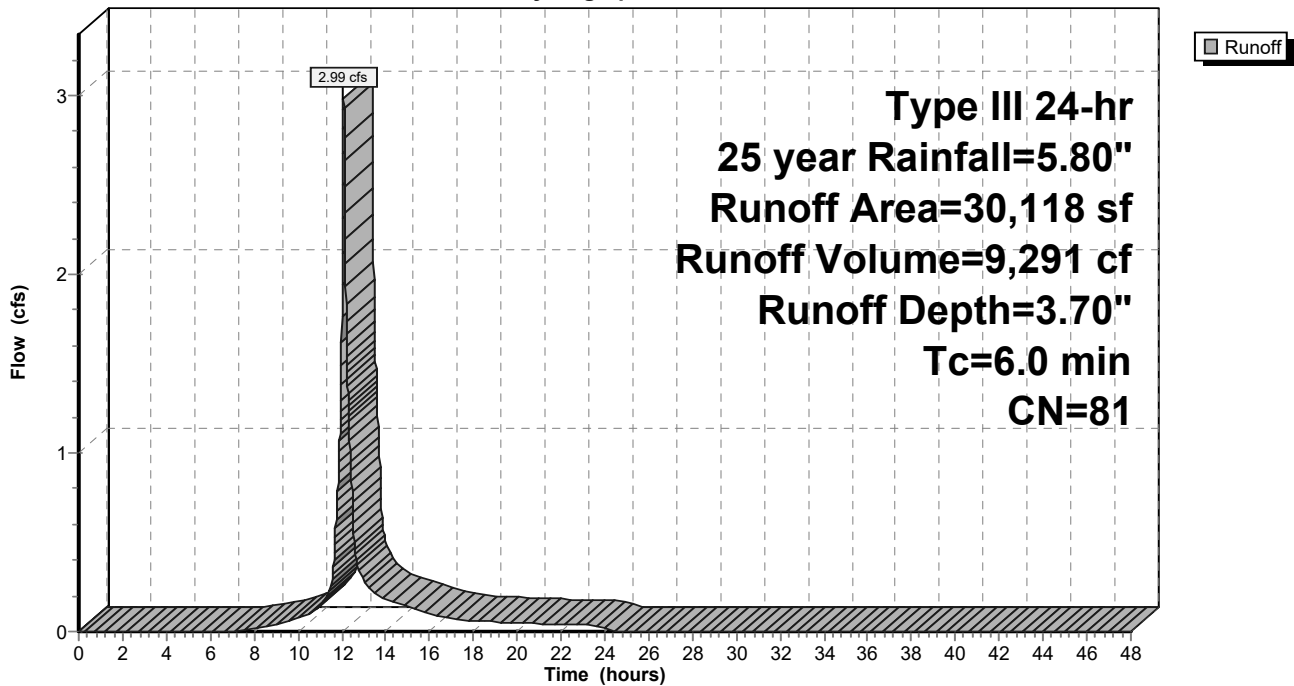
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25 year Rainfall=5.80"

	Area (sf)	CN	Description
*	9,319	98	New entrane drive and walks
	20,799	74	>75% Grass cover, Good, HSG C
	30,118	81	Weighted Average
	20,799		69.06% Pervious Area
	9,319		30.94% Impervious Area

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

**Subcatchment 4S: St. John Street Entrance**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 37

**Summary for Subcatchment 5S: Southern Drainage**

Runoff = 1.89 cfs @ 12.08 hrs, Volume= 6,178 cf, Depth= 4.76"

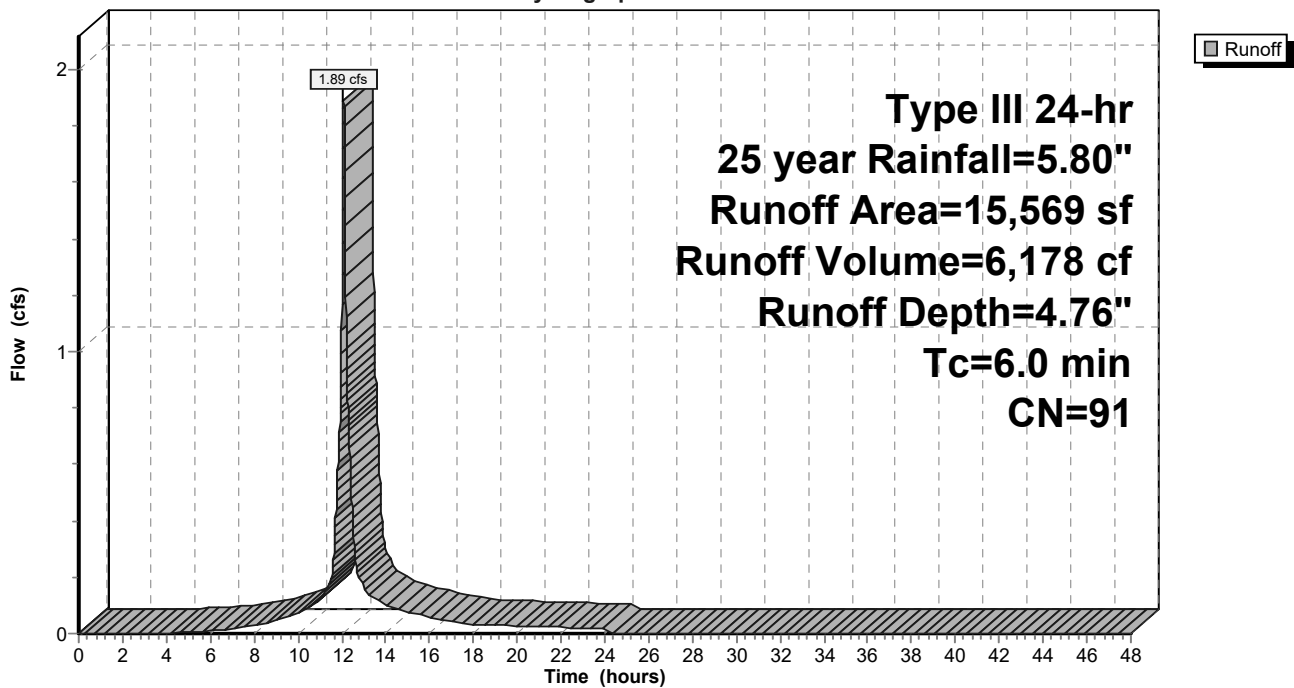
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25 year Rainfall=5.80"

	Area (sf)	CN	Description
*	11,050	89	Crushed Stone
*	3,715	98	Sidewalk
*	591	98	Eagles lot p-lot
*	213	89	eagles lot stone
	15,569	91	Weighted Average
	11,263		72.34% Pervious Area
	4,306		27.66% Impervious Area

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

**Subcatchment 5S: Southern Drainage**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 38

**Summary for Subcatchment 6S: Entrance Drive**

Runoff = 1.40 cfs @ 12.07 hrs, Volume= 4,721 cf, Depth= 5.44"

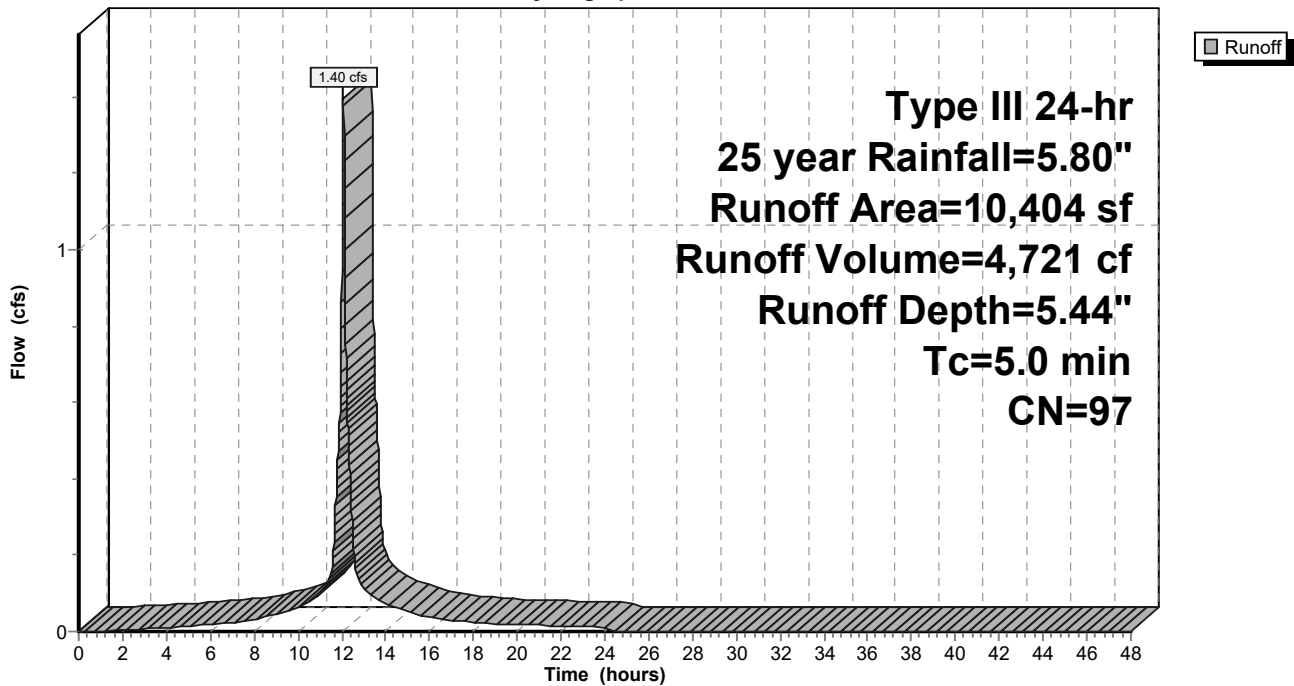
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25 year Rainfall=5.80"

Area (sf)	CN	Description
* 9,891	98	Entrance Road
513	84	50-75% Grass cover, Fair, HSG D
10,404	97	Weighted Average
513		4.93% Pervious Area
9,891		95.07% Impervious Area

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

**Subcatchment 6S: Entrance Drive**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 39

**Summary for Subcatchment 7S: Lower Lot Bypass**

Runoff = 3.79 cfs @ 12.08 hrs, Volume= 13,450 cf, Depth= 5.56"

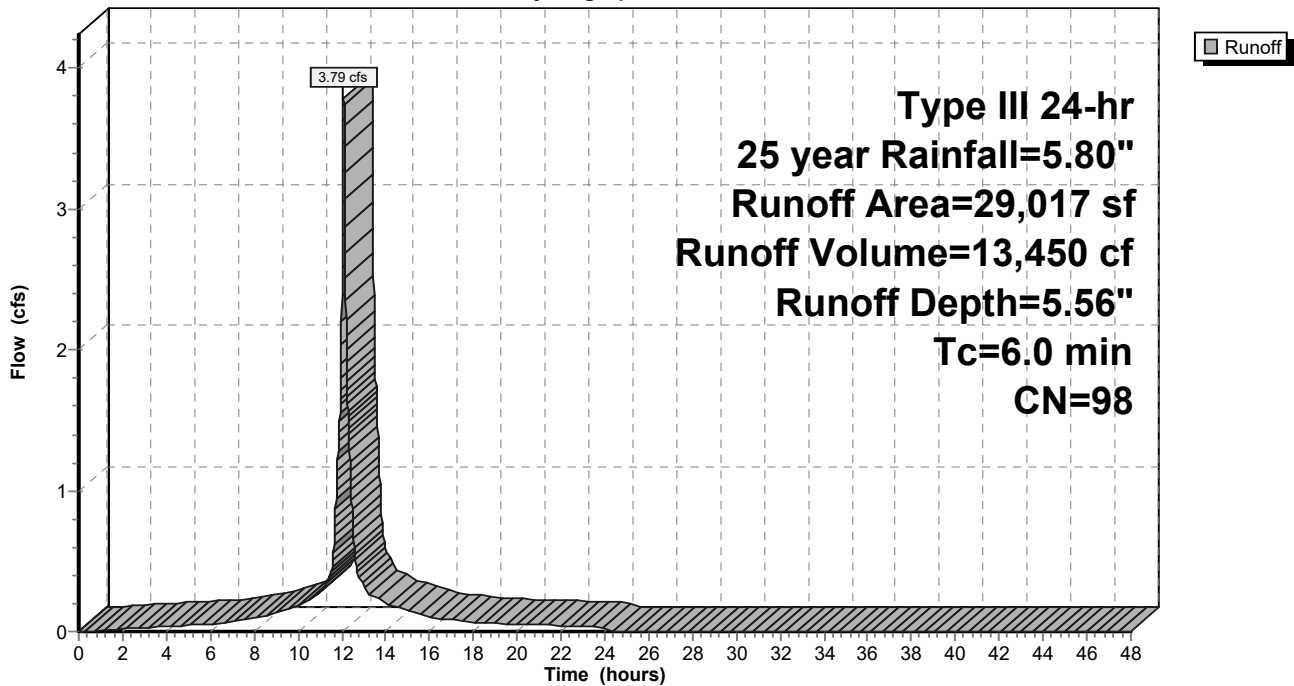
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25 year Rainfall=5.80"

	Area (sf)	CN	Description
*	28,534	98	Entrance Drive & Walks
*	483	79	Landscaped area
	29,017	98	Weighted Average
	483		1.66% Pervious Area
	28,534		98.34% Impervious Area

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

**Subcatchment 7S: Lower Lot Bypass**

Hydrograph



# Post-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 40

## Summary for Pond 1P: R-Tank

Inflow Area = 160,921 sf, 80.33% Impervious, Inflow Depth = 5.22" for 25 year event  
 Inflow = 20.37 cfs @ 12.08 hrs, Volume= 69,991 cf  
 Outflow = 14.73 cfs @ 12.16 hrs, Volume= 60,280 cf, Atten= 28%, Lag= 4.5 min  
 Primary = 0.05 cfs @ 12.16 hrs, Volume= 4,667 cf  
 Secondary = 14.68 cfs @ 12.16 hrs, Volume= 56,063 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 23.30' @ 12.16 hrs Surf.Area= 8,682 sf Storage= 24,643 cf

Plug-Flow detention time= 202.0 min calculated for 60,280 cf (86% of inflow)  
 Center-of-Mass det. time= 140.3 min ( 900.2 - 759.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	19.58'	4,733 cf	<b>Stone Envelope (Prismatic)</b> Listed below (Recalc) 33,165 cf Overall - 21,333 cf Embedded = 11,832 cf x 40.0% Voids
#2	19.58'	20,267 cf	<b>R-Tank Modules (Prismatic)</b> Listed below (Recalc) Inside #1 21,333 cf Overall x 95.0% Voids
		24,999 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.58	8,682	0	0
23.40	8,682	33,165	33,165

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.58	7,565	0	0
22.40	7,565	21,333	21,333

Device	Routing	Invert	Outlet Devices
#1	Primary	19.58'	<b>15.0" Round Culvert</b> L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 19.58' / 19.58' S= 0.0000 ' / Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	19.58'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	19.75'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600
#4	Secondary	21.13'	<b>15.0" Round Culvert X 2.00</b> L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 21.13' / 21.00' S= 0.0087 ' / Cc= 0.900 n= 0.012, Flow Area= 1.23 sf

**Primary OutFlow** Max=0.00 cfs @ 12.16 hrs HW=23.30' TW=24.80' (Dynamic Tailwater)

- ↑1=Culvert ( Controls 0.00 cfs)
- ↑2=Orifice/Grate ( Controls 0.00 cfs)
- ↑3=Orifice/Grate ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 12.16 hrs HW=23.30' TW=24.80' (Dynamic Tailwater)

- ↑4=Culvert ( Controls 0.00 cfs)

**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

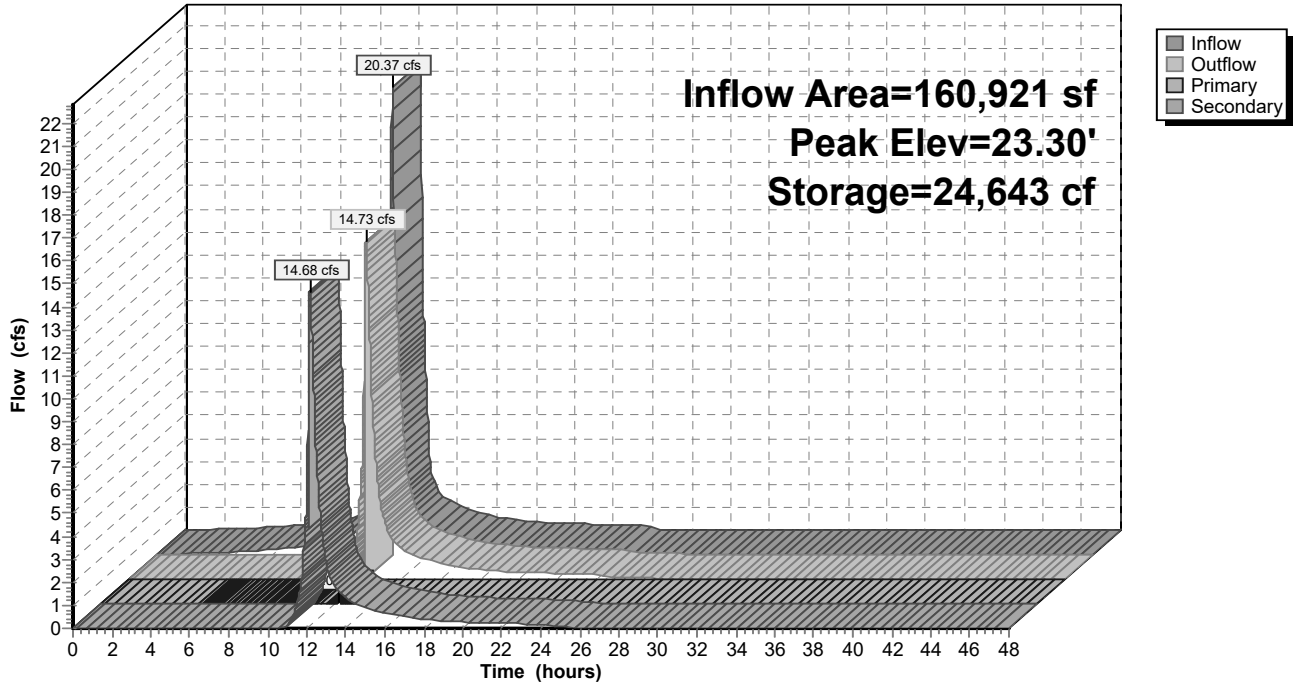
Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 41

**Pond 1P: R-Tank**

Hydrograph



# Post-Development

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 42

## Summary for Pond DMH: New DMH

Inflow Area = 160,921 sf, 80.33% Impervious, Inflow Depth > 4.53" for 25 year event  
Inflow = 14.73 cfs @ 12.16 hrs, Volume= 60,730 cf  
Outflow = 14.73 cfs @ 12.16 hrs, Volume= 60,730 cf, Atten= 0%, Lag= 0.0 min  
Primary = 14.73 cfs @ 12.16 hrs, Volume= 60,730 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 24.81' @ 12.16 hrs

Flood Elev= 26.00'

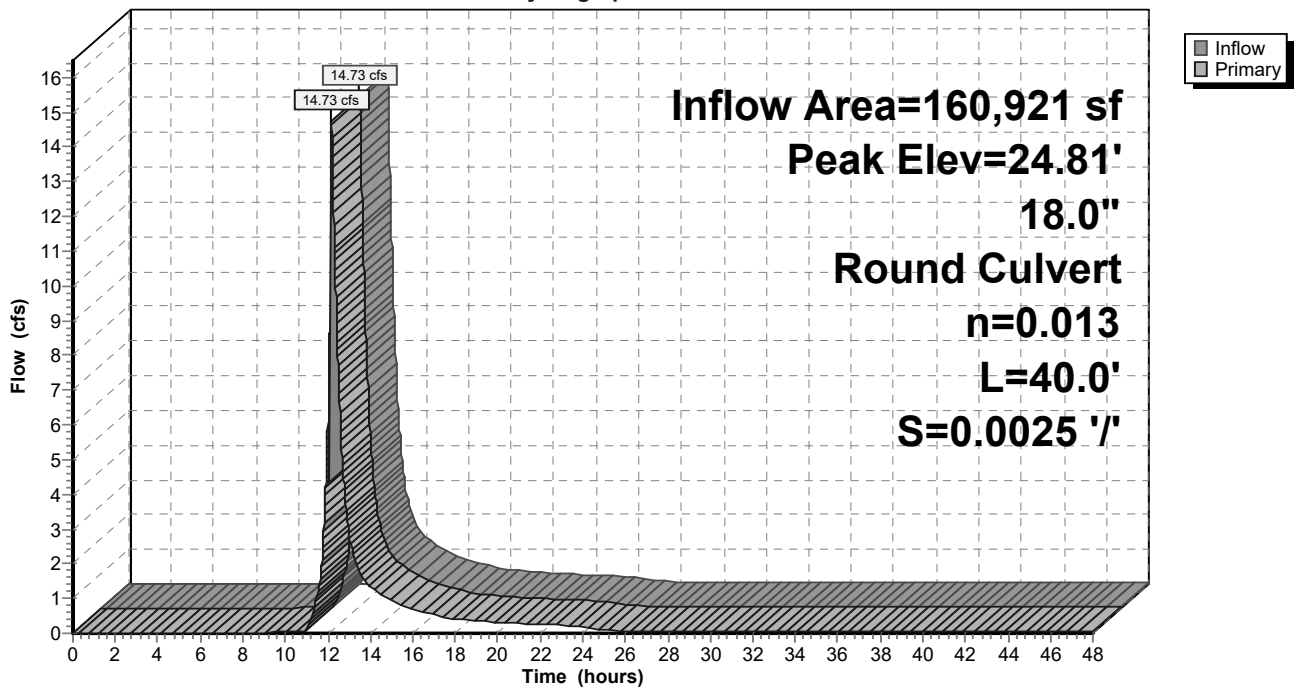
Device	Routing	Invert	Outlet Devices
#1	Primary	19.25'	<b>18.0" Round Culvert</b> L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 19.25' / 19.15' S= 0.0025 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

**Primary OutFlow** Max=14.72 cfs @ 12.16 hrs HW=24.80' TW=0.00' (Dynamic Tailwater)

↑1=Culvert (Inlet Controls 14.72 cfs @ 8.33 fps)

## Pond DMH: New DMH

Hydrograph





**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 43

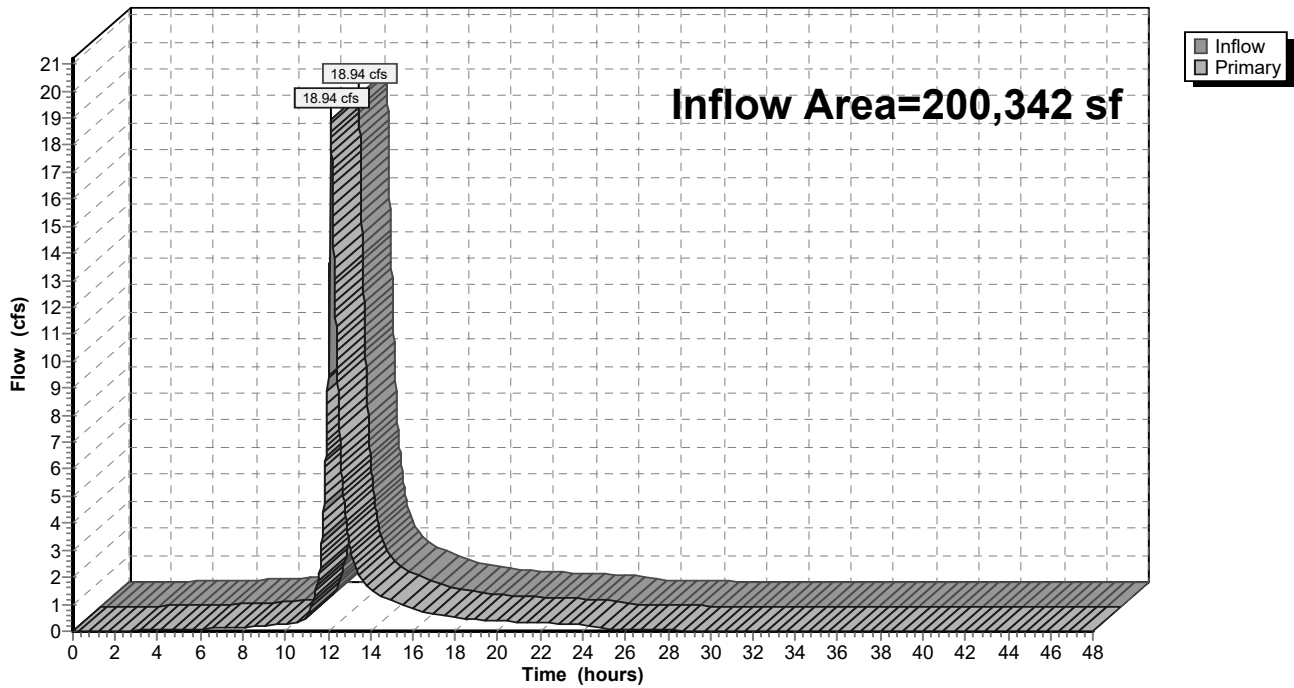
**Summary for Link SP1: Existing 18" SD System**

Inflow Area = 200,342 sf, 83.70% Impervious, Inflow Depth > 4.73" for 25 year event  
Inflow = 18.94 cfs @ 12.12 hrs, Volume= 78,900 cf  
Primary = 18.94 cfs @ 12.12 hrs, Volume= 78,900 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

**Link SP1: Existing 18" SD System**

Hydrograph



**Post-Development**

Prepared by WoodardCurran

HydroCAD® 10.00-18 s/n 01204 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25 year Rainfall=5.80"

Printed 7/24/2018

Page 44

**Summary for Link SP2: 30" Storm Drain**

Inflow Area = 35,595 sf, 41.57% Impervious, Inflow Depth = 3.99" for 25 year event  
Inflow = 3.70 cfs @ 12.09 hrs, Volume= 11,830 cf  
Primary = 3.70 cfs @ 12.09 hrs, Volume= 11,830 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

**Link SP2: 30" Storm Drain**

Hydrograph

