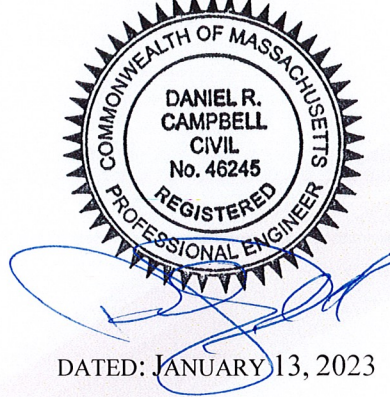


**STORMWATER REPORT**

FOR  
**15 LIBERTY WAY  
FRANKLIN, MA**



DATED: JANUARY 13, 2023

Prepared By:  
**Level Design Group, L.L.C.**  
**249 South Street, Unit 1**  
**Plainville, MA 02762**

Applicant:  
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Property Owner:  
**Oliver Street Capital**  
**125 High Street, Suite 220**  
**Boston, MA 02110**

**LDG Project No.: 2081.00**



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## **HYDROLOGIC SUMMARY**

### **METHODOLOGY**

The HydroCAD computer program (Hydro CAD) was used to model the existing and proposed hydrology of the site and design a stormwater management system. HydroCAD generates flood hydrographs dependent upon the type of land use, vegetation, soil types, land slope, watershed areas and rainfall data. HydroCAD also takes into account the antecedent moisture condition of the soil. The peak rate of runoff and volume of runoff are projected for the input storm frequency events (design storms).

Rainfall data was obtained from the Northeast Regional Climate Center and are based on Extreme Precipitation Events for the 2-, 10-, 25- and 100-year return periods for Franklin, Massachusetts. A 24-hour type III rainfall distribution was used in the HydroCAD analysis as prescribed for New England by the Northeast Regional Climate Center. A copy of the precipitation table is included herein.

### **PRE-DEVELOPMENT CONDITIONS**

The existing site property is located at 15 Liberty Way between Constitution Boulevard and Rachael Circle. The existing property is developed and contains an approximately 95,000 square foot warehouse, paved driveway, and paved parking areas for cars and for trailer trucks. For the purposes of hydrological calculations, the proposed development consists of approximately 105,320 square feet located at the rear of the existing warehouse as shown on the site plans.

The existing topography of the site generally slopes from east to west and directs runoff to an existing stormwater basin located onsite. The southeastern corner of the site slopes south directing runoff to the existing paved driveway and parking area to the site east of the existing warehouse. The land cover is mostly wooded area and also includes pavement from the rear portion of the existing driveway and some grass areas.

Test pits were dug on-site in the areas of the proposed detention basin to verify the groundwater elevation. Groundwater depth in the area of the detention basin varies between approximately 2.5-feet to 3-feet below the surface. The soil logs of the test pits are attached.

The on-site soils as classified by the Soil Survey for Norfolk County Massachusetts are:

312B – Woodbridge fine sandy loam; 0 to 8 percent slopes; Hydrologic Soil Group (HSG) C/D

See the attached SCS soils documentation herein for additional soil details

### **POST-DEVELOPMENT CONDITIONS**

The Applicant is proposing construct a new paved area to provide additional driveway and trailer parking area at the rear of the site. The project will also include the installation of a new stormwater management system and associated grading for this development.

A new fully compliant stormwater management system has been designed to mitigate the impacts of the proposed site redevelopment. Runoff from the impervious areas will be directed to new catch basins and trench drains which will convey runoff to a subsurface detention basin. The subsurface detention basin will provide water quality treatment as well as attenuate peak rates of runoff.

A fully compliant stormwater management system for the entire site addressing compliance with the 10 MADEP Stormwater Standards will be part of the site redevelopment. Site improvements have been made to the maximum extent practicable in accordance with MADEP Stormwater Regulations.

### **STANDARD 1: Untreated Discharges**

Stormwater Management Standard 1 requires that, “No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth”.

This standard is met by the proposed redevelopment not creating any new non-treated stormwater discharges and improving an existing residential site with no existing stormwater management system. All surface runoff from proposed impervious areas, with the exception of a redeveloped portion of the existing driveway, is collected in deep sump catch basins and trench drains and directed to a Stormceptor treatment unit prior to discharging to a subsurface detention basin. Overflow from the subsurface detention basin discharges from an outlet control structure to the existing detention basin through a 15” HPDE pipe. All discharges are designed to be placed in areas which mimic existing drainage flow patterns.

**Redevelopment:** The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 1.

Full compliance with Standard 1 is required for new outfalls.

- What BMPs are proposed to ensure that all new discharges associated with the discharge are adequately treated? Proprietary Treatment Units, Subsurface detention basin
- What BMPs are proposed to ensure that no new discharges cause erosion in wetlands or waters of the Commonwealth? rip rap outlets are proposed in the existing stormwater basin designed to prevent erosion.
- Will the proposed discharge comply with all applicable requirements of the Massachusetts Clean Waters Act and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00? yes

Existing outfalls shall be brought into compliance with Standard 1 to the maximum extent practicable.

- Are there any existing discharges associated with the redevelopment project for which new treatment could be provided? No existing outfalls
- If so, the proponent shall specify the stormwater BMP retrofit measures that have been considered to ensure that the discharges are adequately treated and indicate the reasons for adopting or rejecting those measures. (See Section entitled “Retrofit of Existing BMPs”.) N/A
- What BMPs have been considered to prevent erosion from existing stormwater discharges? N/A

## **STANDARD 2: Peak Rate Control and Flood Prevention**

Stormwater Management Standard 2 requires that, “Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage.”

This standard is met by the proposed development mitigating the post-development peak discharge rates at the designated control points for all design storm events. This is accomplished by directing stormwater flow to a subsurface detention basin. Below is a description of the design points used in the hydrologic analysis and a summary of pre- and post- development discharge rates. The proposed development will reduce the peak rate of runoff at all the design points and provide ample groundwater recharge.

**Redevelopment:** The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 2.

### **Compliance to the Maximum Extent Practicable:**

- Does the redevelopment design meet Standard 2, comparing post-development to pre-development conditions? Yes
- If not, the applicant shall document an analysis of alternative approaches for meeting the Standard. (See Menu of Strategies to Reduce Runoff and Peak Flows and/or Increase Recharge Menu included at the end of this chapter.) N/A

### **Improvement of existing conditions:**

- Does the project reduce the volume and/or rate of runoff to less than current estimated conditions? Has the applicant considered all the alternatives for reducing the volume and/or rate of runoff from the site? (See Menu.) Yes
- Is the project located within a watershed subject to damage by flooding during the 2-year or 10-year 24-hour storm event? If so, does the project design provide for attenuation of the 2-year and 10-year 24-hour storm event to less than current estimated conditions? Have measures been implemented to reduce the volume of runoff from the site resulting from the 2 year or 10 year 24 hour storm event? (See Menu.) N/A
- Is the project located adjacent to a water body or watercourse subject to adverse impacts from flooding during the 100-year 24-hour storm event? If so, are portions of the site available to increase flood storage adjacent to existing Bordering Land Subject to Flooding (BLSF)? N/A
- Have measures been implemented to attenuate peak rates of discharge during the 100-year 24-hour storm event to less than the peak rates under current estimated conditions? Have measures been implemented to reduce the volume of runoff from the site resulting from the 100-year 24-hour storm event? (See Menu.) Yes

## SUMMARY OF PEAK STORMWATER RUNOFF (CFS)

Three design points were utilized to analyze the runoff characteristics of the site. Design Point 1 (DP-1) is the existing detention basin. Design Point 2 (DP-2) is the existing paved driveway and parking area to the east of the existing warehouse. Design Point 3 (DP-3) is the northwestern corner of the property. The pre- and post- development peak discharge rates for all analyzed design storms is summarized in the following table:

<b>Design Point 1 (DP-1)</b>		
Storm	Pre-Dev. Flow	Post-Dev. Flow
2-yr	1.49 cfs	1.40 cfs
10-yr	4.53 cfs	4.29 cfs
25-yr	6.49 cfs	5.91 cfs
100-yr	9.57 cfs	8.86 cfs
<b>Design Point 2 (DP-2)</b>		
	Pre-Dev. Flow	Post-Dev. Flow
2-yr	0.41 cfs	0.41 cfs
10-yr	0.94 cfs	0.70 cfs
25-yr	1.26 cfs	0.86 cfs
100-yr	1.73 cfs	1.11 cfs
<b>Design Point 3 (DP-3)</b>		
2-yr	0.05 cfs	0.03 cfs
10-yr	0.13 cfs	0.08 cfs
25-yr	0.19 cfs	0.10 cfs
100-yr	0.27 cfs	0.14 cfs

The net peak discharge for DP-1 is controlled by the subsurface detention basin and does not increase flows off site for any of the evaluated design storms. The net peak discharges for both DP-2 and DP-3 are un-controlled and flow off-site overland as occurs in existing conditions. Based on the proposed grading and the locations of new catch basins and trench drains, there is a reduction in total area contributing to both DP-2 and DP-3 and the proposed development does not increase flows to these design points for any of the evaluated design storms from existing conditions.

### **STANDARD 3: Recharge to Groundwater**

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



## GROUND WATER RECHARGE

The proposed project will result in an increase in impervious area to a total of approximately 80,078 square feet. The on-site soils of the areas contributing to the proposed subsurface detention system as classified by the Soil Survey for Norfolk County Massachusetts are 312B – Woodbridge fine sandy loam 0 to 8 percent slopes with a hydrologic soil group classification of HSG C/D. On-site soil textures are sandy loam based on test pits performed by Level Design Group, LLC. Based on the HSA “C/D” soil classification, the shallow depth to groundwater, and the existing and proposed topography, infiltration systems conforming to Massachusetts Stormwater Regulations are not practical and no infiltration is proposed for the site. Instead, A Subsurface detention system is proposed that is partially located within the Estimated Seasonal High Groundwater Table. This system is proposed to be wrapped in linear low density polyethylene liner.

## ALTERNATIVE ANALYSIS

Due to site constraints including low permeability soils and shallow groundwater depth, infiltration is not proposed at the site. Porous pavement was considered as a potential alternative to provide infiltration, however, because the pavement will primarily be used by trailer trucks, this option was not practical. Site infiltration measures will be provided through both the proposed rip rap swale and the existing detention basin. No changes are proposed to the existing detention basin however it is being utilized as an outlet for the proposed stormwater improvements for the development. Post development flows to the basin are decreased from pre development conditions.

**Redevelopment:** The project has been designed comply with Massachusetts Stormwater Regulations for Standard 3 to the Maximum Extent Practicable.

Compliance to the Maximum Extent Practicable:

- Does the redevelopment design meet Standard 3, comparing post-development to pre-development conditions? No
- If not, the applicant shall document an analysis of alternative approaches for meeting the Standard? See Alternatives Analysis above.
- What soil types are present on the site? Is the site is comprised solely of C and D soils and bedrock at the land surface? Solely of C and D soils
- Does the project include sites where recharge is proposed at or adjacent to an area classified as contaminated, sites where contamination has been capped in place, sites that have an Activity and Use Limitation (AUL) that precludes inducing runoff to the groundwater, pursuant to MGL Chapter 21E and the Massachusetts Contingency Plan 310 CMR 40.0000; sites that are the location of a solid waste landfill as defined in 310 CMR 19.000; or sites where groundwater from the recharge location flows directly toward a solid waste landfill or 21E site?<sup>1</sup> N/A
- Is the stormwater runoff from a land use with a higher potential pollutant load? N/A
- Is the discharge to the ground located within the Zone II or Interim Wellhead Protection Area of a public water supply? No
- Does the site have an infiltration rate greater than 2.4 inches per hour? No

Improvements to Existing Conditions:

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<sup>1</sup> A mounding analysis is needed if a site falls within this category. See Volume 3.

- Does the project increase the required recharge volume over existing (developed) conditions? If so, can the project be redesigned to reduce the required recharge volume by decreasing impervious surfaces (make building higher, put parking under the building, narrower roads, sidewalks on only one side of street, etc.) or using low impact development techniques such as porous pavement? The site increases the recharge volume requirement. Porous pavement was considered as an alternative to provide infiltration but is not practical based on it being primarily utilized by trailer trucks.
- Is the project located within a basin or sub-basin that has been categorized as under high or medium stress by the Massachusetts Water Resources Commission, or where there is other evidence that there are rivers and streams experiencing low flow problems? If so, have measures been considered to replace the natural recharge lost as a result of the prior development? (See Menu.) N/A
- Has the applicant evaluated measures for reducing site runoff? (See Menu.) Yes, See Alternatives Analysis above.

#### **STANDARD 4: 80% TSS Removal**

Stormwater Management Standard 4 requires that, “Stormwater management systems must be designed to remove 80% of the average annual post-construction of Total Suspended Solids (TSS). This standard is met when:

- a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained;
- b. Stormwater BMPs are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook and;
- c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook”

To achieve the required 80% TSS removal, new stormwater BMP’s will be installed. A subsurface detention basin is proposed which will collect runoff from all impervious areas within Drainage Area P-1a and provide the maximum level of stormwater treatment practicable. A proprietary stormwater treatment unit is proposed which provides treatment prior to discharge to the subsurface detention basin. MADEP TSS Removal Sheets are included herein which show 80% TSS removal by the proprietary stormwater treatment unit and the subsurface detention basin meeting the requirements for total treatment.

#### Water Quality Calculations:

##### CDS Stormwater Treatment Unit Sizing

Water quality treatment is provided by using CDS treatment units. The CDS Units are sized using the *Massachusetts Department of Environmental Protection Wetlands Program – Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices*.

The water quality flow calculations are detailed below:

##### Flow to DHM-2/CDS

$$Q_{1.0}=(q_u)(A)(WQV)$$



$q_u = 774$  csm/in for a  $T_c$  of 0.1 hours (taken from Figure 2 of the Massachusetts Department of Environmental Protection Wetlands program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate)

$A = 1.633$  Acres

$WQV = 1.0$  inches

$Q_{1.0} = (774 \text{ csm/in}) (1.633 \text{ acres}) (0.0015625 \text{ sq. mi / acre}) (1.0 \text{ inch})$

**$Q_{1.0} = 1.97 \text{ cfs} < \text{CDS Model 2020-5 Inlet Unit with a Treatment Capacity} = 2.20 \text{ cfs}$**

Flow to CB-3/STC-450i

$Q_{1.0} = (q_u)(A)(WQV)$

$q_u = 774$  csm/in for a  $T_c$  of 0.1 hours (taken from Figure 2 of the Massachusetts Department of Environmental Protection Wetlands program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate)

$A = 0.071$  Acres

$WQV = 1.0$  inches

$Q_{1.0} = (774 \text{ csm/in}) (0.071 \text{ acres}) (0.0015625 \text{ sq. mi / acre}) (1.0 \text{ inch})$

**$Q_{1.0} = 0.09 \text{ cfs} < \text{STC-450i with a Treatment Capacity} = 0.40 \text{ cfs}$**

**Redevelopment:** The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 4.

Full compliance for any component that is not a redevelopment

Full compliance with the long-term pollution plan requirement for new developments and redevelopments.

- Has the proponent developed a long-term pollution plan that fully meets the requirements of Standard 4? A Long Term Pollution Prevention Plan is provided
- Does the pollution prevention plan include the following source control measures?
  - Street sweeping - yes
  - Proper management of snow, salt, sand and other deicing chemicals – yes
  - Proper management of fertilizers, herbicides and pesticides - yes
  - Stabilization of existing eroding surfaces - yes

Compliance to the Maximum Extent Practicable for the other requirements:

- Does the redevelopment design provide for treatment of all runoff from existing (as well as new) impervious areas to achieve 80% TSS removal? If 80% TSS removal is not achieved, has the stormwater management system been designed to remove TSS to the maximum extent practicable? 80% TSS removal achieved
- Have the proposed stormwater BMPs been properly sized to capture the prescribed runoff volume? Yes

- One inch rule applies for discharge
  - within a Zone II or Interim Wellhead Protection Area, - N/A
  - near or to another critical area, - N/A
  - from a land use with a higher potential pollutant load - N/A
  - to the ground where the infiltration rate is greater than 2.4 inches per hour - N/A
- Has adequate pretreatment been proposed?
  - 44% TSS Removal Pretreatment Requirement applies if:
    - Stormwater runoff is from a land use with a higher potential pollutant load
    - Stormwater is discharged - Yes, 44% TSS removal achieved (Zone II and rapid infiltration)
      - To the ground within the Zone II or Interim Wellhead Protection Area of a Public Water Supply - N/A
      - To the ground with an infiltration rate greater than 2.4 inches per hour - N/A
      - Near or to an Outstanding Resource Water, Special Resource Water, Cold-Water Fishery, Shellfish Growing Area, or Bathing Beach. - N/A
- If the stormwater BMPs do not meet all the requirements set forth above, the applicant shall document an analysis of alternative approaches for meeting these requirements. (See Section on Retrofitting Existing BMPs (the “Retrofit Section”). N/A

#### Improvements to Existing Conditions:

- Have measures been provided to achieve at least partial compliance with the TSS removal standard? Fully complies
- Have any of the best management practices in the Retrofit Section been considered? N/A
- Have any of the following pollution prevention measures been considered?  
Operation & Maintenance and Long Term Pollution Prevention Plans have been prepared for the site in accordance with Massachusetts Stormwater regulations and are included in the Stormwater Report.
  - Reduction or elimination of winter sanding, where safe and prudent to do so
  - Tighter controls over the application of fertilizers, herbicides, and pesticides
  - Landscaping that reduces the need for fertilizer, herbicides and pesticides
  - High frequency sweeping of paved surfaces using vacuum sweepers
  - Improved catch basin cleaning
  - Waterfowl control programs

Are there any discharges (new or existing) to impaired waters? If so, see TMDL section. N/A

#### **STANDARD 5: Higher Potential Pollutant Loads**

Stormwater Management Standard 5 requires that, “For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt and stormwater runoff, the proponent shall use the specific stormwater BMPs determined by the

Department to be suitable for such use as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 2, §26-53, and the regulations promulgated thereunder at 314 CMF 3.00, 314 CMR 4.00 and 314 CMR 5.00.”

The proposed use is not considered a use that would generate Higher Potential Pollutant Loads.

**Redevelopment:** The project use is not considered a use that would generate Higher Potential Pollutant Loads.

### **STANDARD 6: Critical Areas**

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

The development site is not located within a Critical Area as defined by the Massachusetts Stormwater Handbook.

**Redevelopment:** The project is not located in a critical area as defined by the Massachusetts Stormwater Regulations for Standard 6.

### **STANDARD 7: Redevelopment and Other Projects Subject to the Standards only to the Maximum Extent Practicable**

The definition of a Redevelopment Project under the definition provided in the MADEP Stormwater Handbook for Standard 7 is listed below:

“Development rehabilitation, expansion and phased projected on previously developed sites, provided that redevelopment results in no net increase in impervious area.”

The proposed development is not considered a Redevelopment Project and fully complies with the requirements of the MADEP Stormwater Management Standards.

### **STANDARD 8: Erosion and Sediment Control**

Stormwater Management Standard 8 requires that, “A plan to control construction-related impacts, including erosion sedimentation and other pollutant sources during construction and land disturbance

activities (construction period erosion, sedimentation, and pollution prevention plan), must be developed and implemented.”

This standard is met through the type and style of construction. The existing driveway will, to the extent possible, remain intact until the proposed driveway is to be graded and paved. This will provide a pad for wheel cleaning prior to the vehicle exit on Washington Street. The site is self-contained with abutting properties draining overland to the rear of the subject property. Thereby there will be no additional erosion from this property to abutting properties. With careful construction the project will limit erosion potential through the development itself and no additional structural measures, passive or active, are proposed. A Construction Period Pollution and Erosion & Sedimentation Control Plan has also been prepared and is included as part of the Stormwater Report.

**Redevelopment:** The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 8.

All redevelopment projects shall fully comply with Standard 8.

- Has the proponent submitted a construction period erosion, sedimentation and pollution prevention plan that meets the requirements of Standard 8?  
A draft Stormwater Pollution Prevention Plan is included with the stormwater report and will be finalized prior to the start of construction.

#### **STANDARD 9: Operation and Maintenance**

Stormwater Management Standard 9 requires that, “A long-term operation and maintenance plan must be developed and implemented to ensure that stormwater management systems function as designed”.

This standard is fully met with development and implementation of an Operation and Maintenance Plan is included in Stormwater Management Report.

**Redevelopment:** The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 9.

All redevelopment projects shall fully comply with Standard 9.

- Has the proponent submitted a long-term Operation and Maintenance plan that meets the requirements of Standard 9?  
O&M included in Stormwater Report

#### **STANDARD 10: Illicit Discharges**

Stormwater Management Standard 10 requires that, “All illicit discharges to the stormwater management system are prohibited”.

This standard is fully met with development and implementation of a Long-Term Pollution Prevention which is included in the Stormwater Management Report. An Illicit Discharge statement has been prepared and is included herein.

**Redevelopment:** The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 10.

All redevelopment projects shall fully comply with Standard 10.

- Are there any known or suspected illicit discharges to the stormwater management system at the redevelopment project site? No
- Has an illicit connection detection program been implemented using visual screening, dye or smoke testing? No
- Have an Illicit Discharge Compliance Statement and associated site map been submitted verifying that there are no illicit discharges to the stormwater management system at the site? Yes

Improvements to Existing Conditions:

- Once all illicit discharges are removed, has the proponent implemented any measures to prevent additional illicit discharges? N/A

## CONCLUSION

The proposed redevelopment of this parcel will be a significant improvement to the area and to the resource area on and adjacent to the site. The proposed 2081 redevelopment meets or exceeds the current MADEP Stormwater Management Standards and Guidelines and provides a stormwater management system that will maintain water quality while attenuating peak rates of runoff at the control points. This was achieved by using pretreatment BMPs and directing the stormwater runoff to a subsurface detention basin which attenuates peak flows while providing a high level of TSS removal. An Operation and Maintenance Plan for post-construction maintenance of the Stormwater Management System has been developed and is included with this report.





## **MADEP Stormwater Report Checklist**





# Checklist for Stormwater Report

## A. Introduction

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the [Massachusetts Stormwater Handbook](#). The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.<sup>1</sup> This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8<sup>2</sup>
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

<sup>1</sup> The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

<sup>2</sup> For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



# Checklist for Stormwater Report

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## B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

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### Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

---

Signature and Date

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## Checklist

**Project Type:** Is the application for new development, redevelopment, or a mix of new and redevelopment?

- ☐ New development
- ☐ Redevelopment
- ☒ Mix of New Development and Redevelopment



# Checklist for Stormwater Report

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## Checklist (continued)

**LID Measures:** Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): \_\_\_\_\_

## Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 2: Peak Rate Attenuation

- ☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- ☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- ☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

### Standard 3: Recharge

- ☒ Soil Analysis provided.
- ☐ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.
  - ☐ Static
  - ☐ Simple Dynamic
  - ☐ Dynamic Field<sup>1</sup>
- ☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.
- ☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- ☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
  - ☒ Site is comprised solely of C and D soils and/or bedrock at the land surface
  - ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
  - ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
  - ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- ☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- ☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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<sup>1</sup> 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.





# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 3: Recharge (continued)

- ☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

### Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
  - Provisions for storing materials and waste products inside or under cover;
  - Vehicle washing controls;
  - Requirements for routine inspections and maintenance of stormwater BMPs;
  - Spill prevention and response plans;
  - Provisions for maintenance of lawns, gardens, and other landscaped areas;
  - Requirements for storage and use of fertilizers, herbicides, and pesticides;
  - Pet waste management provisions;
  - Provisions for operation and management of septic systems;
  - Provisions for solid waste management;
  - Snow disposal and plowing plans relative to Wetland Resource Areas;
  - Winter Road Salt and/or Sand Use and Storage restrictions;
  - Street sweeping schedules;
  - Provisions for prevention of illicit discharges to the stormwater management system;
  - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
  - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
  - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- ☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
- ☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
- ☐ is within the Zone II or Interim Wellhead Protection Area
  - ☐ is near or to other critical areas
  - ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
  - ☐ involves runoff from land uses with higher potential pollutant loads.
- ☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.
- ☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 4: Water Quality (continued)

- ☒ The BMP is sized (and calculations provided) based on:
  - ☐ The ½" or 1" Water Quality Volume or
  - ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

### Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- ☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- ☐ The NPDES Multi-Sector General Permit does **not** cover the land use.
- ☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

### Standard 6: Critical Areas

- ☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☐ Critical areas and BMPs are identified in the Stormwater Report.



# Checklist for Stormwater Report

---

## Checklist (continued)

### Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- ☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
  - ☐ Limited Project
  - ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
  - ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
  - ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
  - ☐ Bike Path and/or Foot Path
  - ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.
- ☒ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- ☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

### Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
  - Construction Period Operation and Maintenance Plan;
  - Names of Persons or Entity Responsible for Plan Compliance;
  - Construction Period Pollution Prevention Measures;
  - Erosion and Sedimentation Control Plan Drawings;
  - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
  - Vegetation Planning;
  - Site Development Plan;
  - Construction Sequencing Plan;
  - Sequencing of Erosion and Sedimentation Controls;
  - Operation and Maintenance of Erosion and Sedimentation Controls;
  - Inspection Schedule;
  - Maintenance Schedule;
  - Inspection and Maintenance Log Form.
- ☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



# Checklist for Stormwater Report

---

## Checklist (continued)

### Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☐ The project is **not** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

### Standard 9: Operation and Maintenance Plan

- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
  - ☒ Name of the stormwater management system owners;
  - ☒ Party responsible for operation and maintenance;
  - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
  - ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
  - ☒ Description and delineation of public safety features;
  - ☒ Estimated operation and maintenance budget; and
  - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
  - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
  - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

### Standard 10: Prohibition of Illicit Discharges

- ☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

## **Aerial Photograph (MAGIS)**







# 15 Liberty Way

Franklin, MA

1 inch = 300 Feet



January 17, 2023

[www.cai-tech.com](http://www.cai-tech.com)



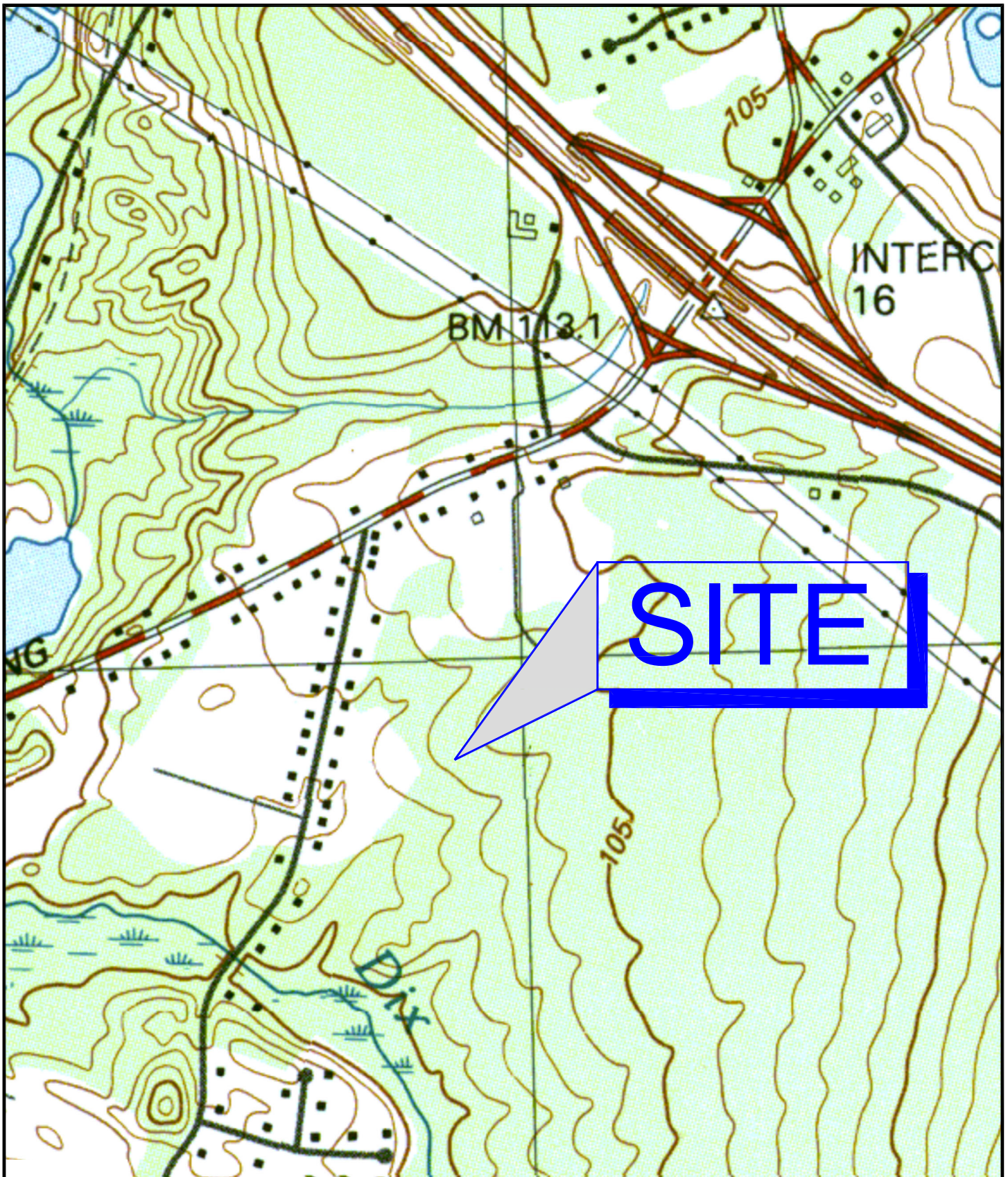
This information is believed to be correct but is subject to change and is not warranted.



## **USGS Topographic Map (MAGIS)**







USGS LOCUS MAP



CIVIL ENGINEERS AND LAND SURVEYORS  
249 SOUTH STREET, UNIT 1  
PLAINVILLE, MA 02762  
508.695.2221 (F) 508.695.2219  
WWW.LEVELDG.COM

15 LIBERTY WAY  
FRANKLIN, MA

PROJ NO.: 2081.00  
SCALE: 1" = 1,000'



## **On-Site Soils Documentation**





**Project No:** 2081.00  
**Project:** 15 Liberty Way Franklin  
**Date of Testing** 11/16/22

**Soil Evaluator** Adam Hunt E.I.T. SE# 12794  
**Temp** 48F Rain

**Test Hole No.:** TH-1 Ground Elevation at Hole = 334.70  
**Time:** 10:15 AM Groundwater Elevation = 331.78

Depth (inches)	Horizon	Color	Texture	Redox Depth	Redox Color	Comments
0-10	A	10YR 2/2	SL			
10-24	B	10YR 5/6	SL			
24-108	C1	2.5Y 6/3	SL	35"		Very Compact
Weeping Observed		none				
Standing Water Observed		none				
Redox Observed		35"				

**Test Hole No.:** TH-2 Ground Elevation at Hole = 331.05  
**Time:** 11:00 AM Groundwater Elevation = 328.38

Depth (inches)	Horizon	Color	Texture	Redox Depth	Redox Color	Comments
0-12	A	10YR 2/2	SL			
12-24	B	10YR 5/6	SL			
24-120	C1	2.5Y 6/3	SL	32"		Very Compact
Weeping Observed		none				
Standing Water Observed		none				
Redox Observed		32"				

**Test Hole No.:** TH-3 Ground Elevation at Hole = 328.50  
**Time:** 11:45 AM Groundwater Elevation = 326.00

Depth (inches)	Horizon	Color	Texture	Redox Depth	Redox Color	Comments
0-12	A	10YR 2/2	SL			
12-28	B	10YR 5/6	SL			
28-72	C1	2.5Y 6/3	SL	30"		Very Compact
Weeping Observed		none				
Standing Water Observed		none				
Redox Observed		30"				

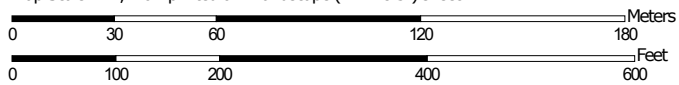


# Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts (15 Liberty Way Franklin, MA)



Soil Map may not be valid at this scale.

Map Scale: 1:2,220 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge ticks: UTM Zone 19N WGS84




**Natural Resources  
Conservation Service**

Web Soil Survey  
National Cooperative Soil Survey

1/16/2023  
Page 1 of 4

## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points



 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available


### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts  
 Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	0.3	1.5%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D	18.8	98.5%
<b>Totals for Area of Interest</b>			<b>19.0</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## **MADEP TSS Removal Calculation Sheets**





INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: CB#1 to CDS Unit (full treatment)

TSS Removal  
Calculation Worksheet

A BMP <sup>1</sup>	B TSS Removal Rate <sup>1</sup>	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump & Hooded CBs	0.25	1.00	0.25	0.75
CDS Unit	0.74	0.75	0.55	0.20

Total TSS Removal =

80%

Separate Form Needs to  
be Completed for Each  
Outlet or BMP Train

Project: 15 Liberty Way  
Prepared By: APH  
Date: 1/25/23

\*Equals remaining load from previous BMP (E)  
which enters the BMP

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location:

TSS Removal  
Calculation Worksheet

A BMP <sup>1</sup>	B TSS Removal Rate <sup>1</sup>	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
CDS Unit	0.74	1.00	0.74	0.26

Total TSS Removal =

74%

Separate Form Needs to  
be Completed for Each  
Outlet or BMP Train

Project:   
 Prepared By:   
 Date:

\*Equals remaining load from previous BMP (E)  
which enters the BMP

## **Illicit Discharge Statement**



# Illicit Discharge Statement

*Under the Massachusetts Wetlands Protection Act – Stormwater Management Standards*  
For

15 LIBERTY WAY  
FRANKLIN, MA

All illicit discharges to the Stormwater Management System are prohibited. The Stormwater Management System is the system for conveying, treating, and infiltrating stormwater. Illicit discharges to Stormwater Management Systems are discharges that are not entirely comprised of stormwater, but do not include discharges from the following activities or facilities:

- Firefighting
- Water Line Flushing
- Potable Water Sources
- Landscape Irrigation
- Potable Water Sources
- Uncontaminated Groundwater
- Air-conditioning Condensation
- Dechlorinated Water from Swimming Pools
- Water used for street washing
- Water used for clean residential buildings without detergents
- Foundation Drains

The site will be operated and maintained in accordance with the Operation and Maintenance Plan dated January 13, 2023 prepared by Level Design Group, LLC.

I, \_\_\_\_\_ (***Applicant***) do hereby agree to comply with requirements set forth within the Illicit Discharge Statement and will not knowingly discharge illicit materials to the stormwater management system once it is brought online **upon** completion of construction.

Signature: \_\_\_\_\_

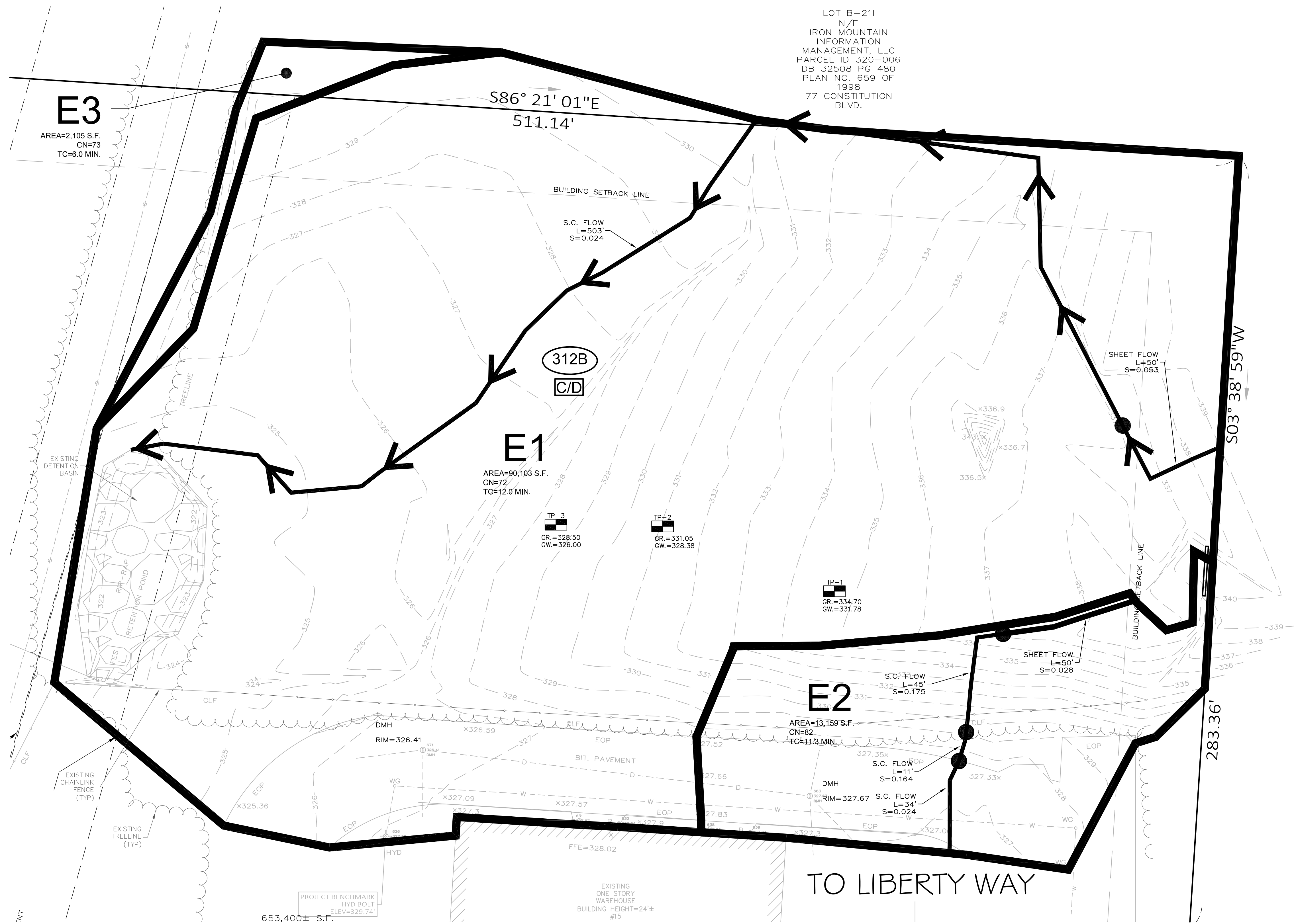
Date: \_\_\_\_\_





## **Existing Drainage Plan & HydroCAD Diagram**





WATERSHED LEGEND



SOIL TYPE



HYDROLOGIC SOIL GROUP

SOILS



WOODBIDGE FINE SANDY LOAM

LIBERTY PARKING EXPANSION

MAP SHEET 320, PARCEL 004  
15 LIBERTY WAY  
FRANKLIN, MASSACHUSETTS

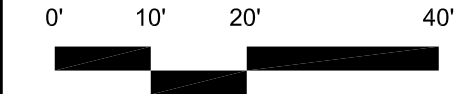


249 SOUTH STREET, UNIT 1  
PLAINVILLE, MA 02762  
TEL: (508) 695-2221 FAX: (508) 695-2219

EXISTING  
DRAINAGE

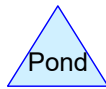
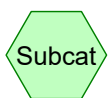
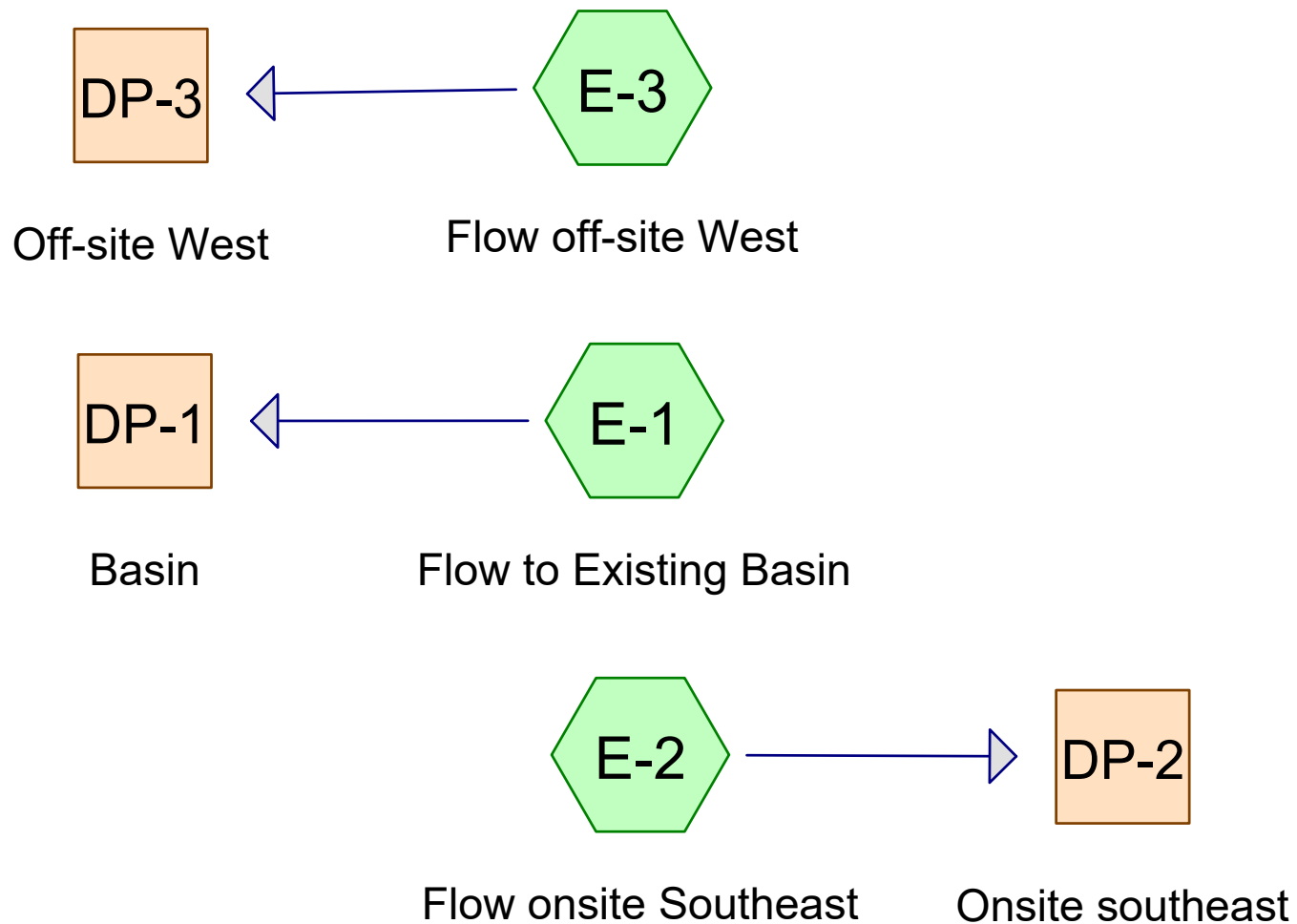
D-1.0

SHEET 1 OF 2



2081.00





### Routing Diagram for Existing-2

Prepared by {enter your company name here}, Printed 2/1/2023  
HydroCAD® 10.00-26 s/n 04015 © 2020 HydroCAD Software Solutions LLC



**HydroCAD Analysis**  
**Existing Conditions – 2 Year Storm**





**Existing-2**

Prepared by {enter your company name here}  
HydroCAD® 10.00-26 s/n 04015 © 2020 HydroCAD Software Solutions LLC

Printed 2/1/2023

Page 1

**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
9,896	79	50-75% Grass cover, Fair, HSG C (E-1, E-2, E-3)
10,479	98	Paved parking (E-1, E-2)
84,992	70	Woods, Good, HSG C (E-1, E-2, E-3)
<b>105,367</b>	<b>74</b>	<b>TOTAL AREA</b>

**Existing-2**

Prepared by {enter your company name here}  
HydroCAD® 10.00-26 s/n 04015 © 2020 HydroCAD Software Solutions LLC

Printed 2/1/2023

Page 2

**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
94,888	HSG C	E-1, E-2, E-3
0	HSG D	
10,479	Other	E-1, E-2
<b>105,367</b>		<b>TOTAL AREA</b>

**Existing-2**

Prepared by {enter your company name here}

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Page 3

**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	Subcatchment Numbers
0	0	9,896	0	0	9,896	50-75% Grass cover, Fair	E-1, E-2, E-3
0	0	0	0	10,479	10,479	Paved parking	E-1, E-2
0	0	84,992	0	0	84,992	Woods, Good	E-1, E-2, E-3
<b>0</b>	<b>0</b>	<b>94,888</b>	<b>0</b>	<b>10,479</b>	<b>105,367</b>	<b>TOTAL AREA</b>	

**Existing-2**

Prepared by {enter your company name here}

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Type III 24-hr 2-Year Rainfall=3.05"

Printed 2/1/2023

Page 4

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment E-1: Flow to Existing Basin**

Runoff Area=90,103 sf 6.06% Impervious Runoff Depth=0.84"  
 Flow Length=553' Tc=12.0 min CN=72 Runoff=1.49 cfs 6,292 cf

**Subcatchment E-2: Flow onsite Southeast**

Runoff Area=13,159 sf 38.16% Impervious Runoff Depth=1.42"  
 Flow Length=140' Tc=11.3 min CN=82 Runoff=0.42 cfs 1,555 cf

**Subcatchment E-3: Flow off-site West**

Runoff Area=2,105 sf 0.00% Impervious Runoff Depth=0.89"  
 Tc=6.0 min CN=73 Runoff=0.05 cfs 156 cf

**Reach DP-1: Basin**

Inflow=1.49 cfs 6,292 cf  
 Outflow=1.49 cfs 6,292 cf

**Reach DP-2: Onsite southeast**

Inflow=0.42 cfs 1,555 cf  
 Outflow=0.42 cfs 1,555 cf

**Reach DP-3: Off-site West**

Inflow=0.05 cfs 156 cf  
 Outflow=0.05 cfs 156 cf

**Total Runoff Area = 105,367 sf Runoff Volume = 8,003 cf Average Runoff Depth = 0.91"**  
**90.05% Pervious = 94,888 sf 9.95% Impervious = 10,479 sf**

**Existing-2**

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Type III 24-hr 2-Year Rainfall=3.05"

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**Summary for Subcatchment E-1: Flow to Existing Basin**

Runoff = 1.49 cfs @ 12.19 hrs, Volume= 6,292 cf, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 5,457	98	Paved parking
76,777	70	Woods, Good, HSG C
7,869	79	50-75% Grass cover, Fair, HSG C
90,103	72	Weighted Average
84,646		93.94% Pervious Area
5,457		6.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		Sheet Flow, Sheet Flow
3.4	503	0.0240	2.49		Woods: Light underbrush n= 0.400 P2= 3.05"
					Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
12.0	553	Total			

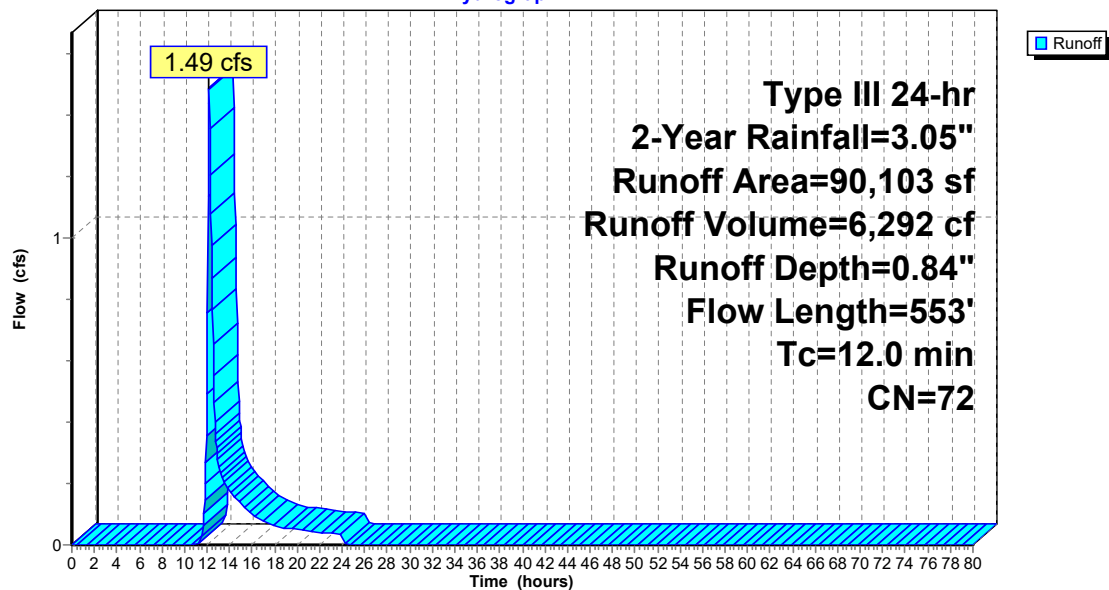
**Existing-2**

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Type III 24-hr 2-Year Rainfall=3.05"

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**Subcatchment E-1: Flow to Existing Basin****Hydrograph**

**Existing-2**

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Type III 24-hr 2-Year Rainfall=3.05"

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**Summary for Subcatchment E-2: Flow onsite Southeast**

Runoff = 0.42 cfs @ 12.16 hrs, Volume= 1,555 cf, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 5,022	98	Paved parking
6,746	70	Woods, Good, HSG C
1,391	79	50-75% Grass cover, Fair, HSG C
13,159	82	Weighted Average
8,137		61.84% Pervious Area
5,022		38.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
11.3	140	Total			

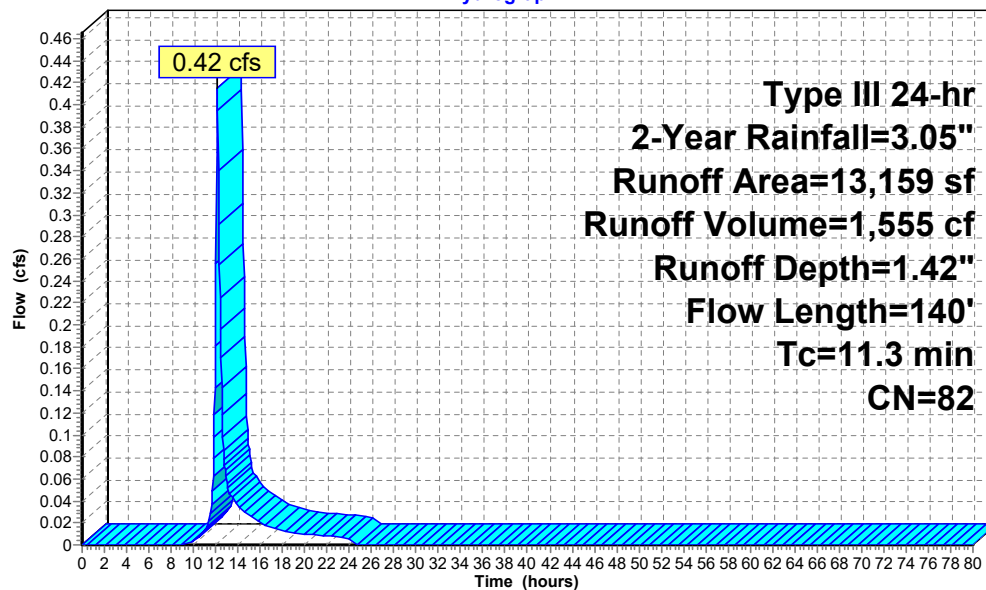
**Existing-2**

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Type III 24-hr 2-Year Rainfall=3.05"

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**Subcatchment E-2: Flow onsite Southeast****Hydrograph**

Runoff

**Existing-2**

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Type III 24-hr 2-Year Rainfall=3.05"

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**Summary for Subcatchment E-3: Flow off-site West**

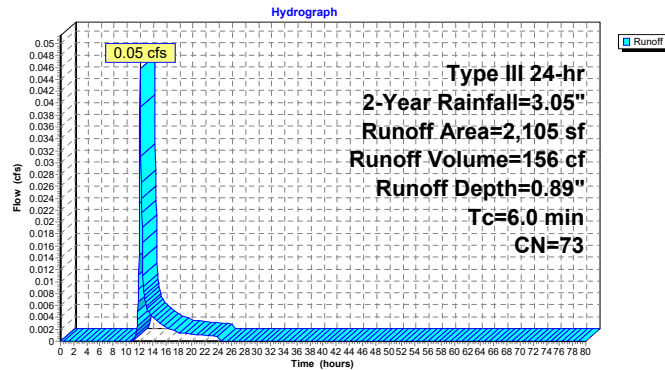
Runoff = 0.05 cfs @ 12.10 hrs, Volume= 156 cf, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
1,469	70	Woods, Good, HSG C
636	79	50-75% Grass cover, Fair, HSG C
2,105	73	Weighted Average
2,105		100.00% Pervious Area

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

**Subcatchment E-3: Flow off-site West****Existing-2**

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Type III 24-hr 2-Year Rainfall=3.05"

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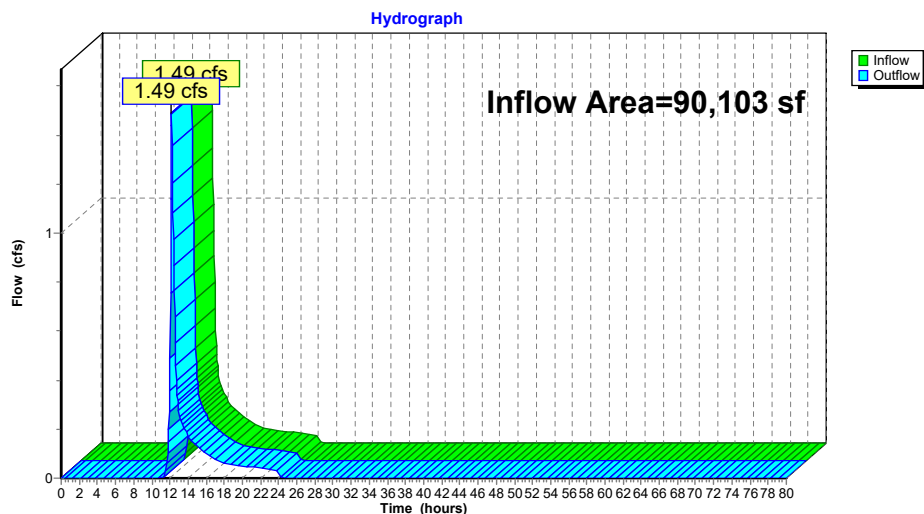
Page 10

**Summary for Reach DP-1: Basin**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 90,103 sf, 6.06% Impervious, Inflow Depth = 0.84" for 2-Year event  
 Inflow = 1.49 cfs @ 12.19 hrs, Volume= 6,292 cf  
 Outflow = 1.49 cfs @ 12.19 hrs, Volume= 6,292 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-1: Basin**

## Existing-2

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Type III 24-hr 2-Year Rainfall=3.05"

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### Summary for Reach DP-2: Onsite southeast

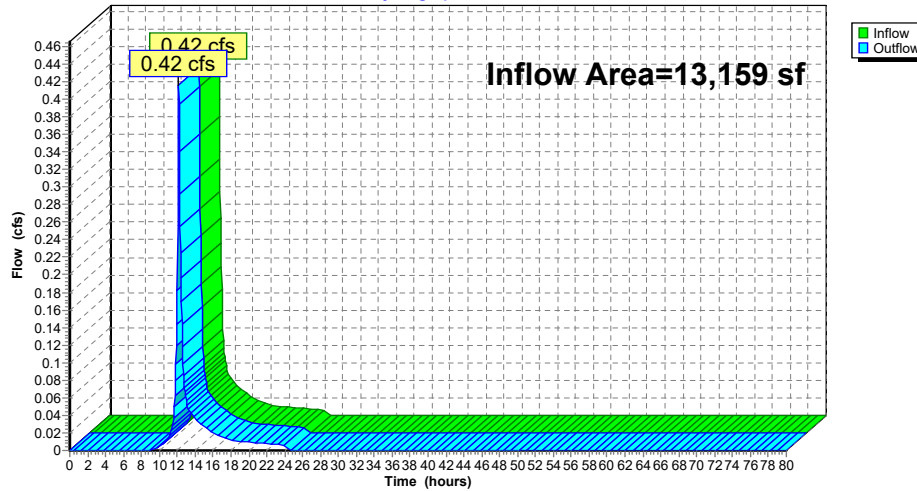
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 13,159 sf, 38.16% Impervious, Inflow Depth = 1.42" for 2-Year event  
Inflow = 0.42 cfs @ 12.16 hrs, Volume= 1,555 cf  
Outflow = 0.42 cfs @ 12.16 hrs, Volume= 1,555 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

#### Reach DP-2: Onsite southeast

Hydrograph



## Existing-2

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Type III 24-hr 2-Year Rainfall=3.05"

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### Summary for Reach DP-3: Off-site West

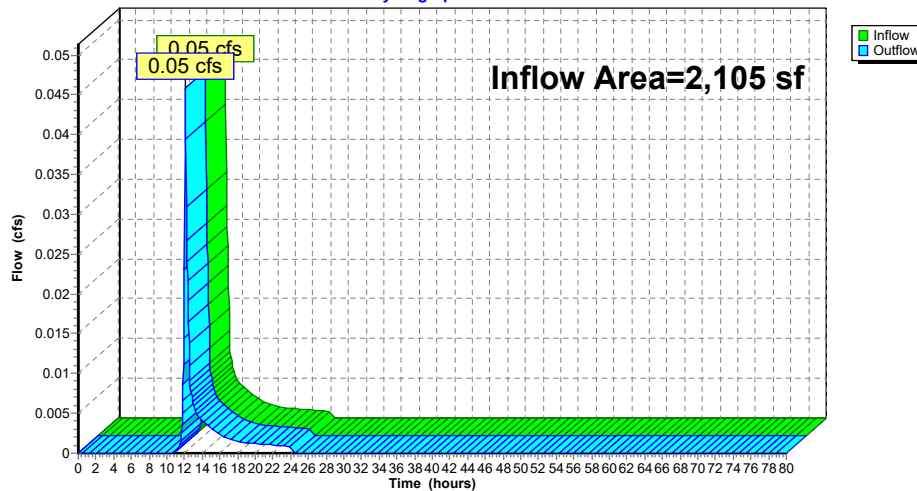
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2,105 sf, 0.00% Impervious, Inflow Depth = 0.89" for 2-Year event  
Inflow = 0.05 cfs @ 12.10 hrs, Volume= 156 cf  
Outflow = 0.05 cfs @ 12.10 hrs, Volume= 156 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

#### Reach DP-3: Off-site West

Hydrograph



# **HydroCAD Analysis**

## **Existing Conditions – 10 Year Storm**





**Existing-2**

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**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
9,896	79	50-75% Grass cover, Fair, HSG C (E-1, E-2, E-3)
10,479	98	Paved parking (E-1, E-2)
84,992	70	Woods, Good, HSG C (E-1, E-2, E-3)
<b>105,367</b>	<b>74</b>	<b>TOTAL AREA</b>

**Existing-2**

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**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
94,888	HSG C	E-1, E-2, E-3
0	HSG D	
10,479	Other	E-1, E-2
<b>105,367</b>		<b>TOTAL AREA</b>

**Existing-2**

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**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	Subcatchment Numbers
0	0	9,896	0	0	9,896	50-75% Grass cover, Fair	E-1, E-2, E-3
0	0	0	0	10,479	10,479	Paved parking	E-1, E-2
0	0	84,992	0	0	84,992	Woods, Good	E-1, E-2, E-3
<b>0</b>	<b>0</b>	<b>94,888</b>	<b>0</b>	<b>10,479</b>	<b>105,367</b>	<b>TOTAL AREA</b>	

**Existing-2**

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

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Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment E-1: Flow to Existing Basin**

Runoff Area=90,103 sf 6.06% Impervious Runoff Depth=2.31"  
 Flow Length=553' Tc=12.0 min CN=72 Runoff=4.53 cfs 17,375 cf

**Subcatchment E-2: Flow onsite Southeast**

Runoff Area=13,159 sf 38.16% Impervious Runoff Depth=3.21"  
 Flow Length=140' Tc=11.3 min CN=82 Runoff=0.95 cfs 3,524 cf

**Subcatchment E-3: Flow off-site West**

Runoff Area=2,105 sf 0.00% Impervious Runoff Depth=2.40"  
 Tc=6.0 min CN=73 Runoff=0.13 cfs 421 cf

**Reach DP-1: Basin**

Inflow=4.53 cfs 17,375 cf  
 Outflow=4.53 cfs 17,375 cf

**Reach DP-2: Onsite southeast**

Inflow=0.95 cfs 3,524 cf  
 Outflow=0.95 cfs 3,524 cf

**Reach DP-3: Off-site West**

Inflow=0.13 cfs 421 cf  
 Outflow=0.13 cfs 421 cf

**Total Runoff Area = 105,367 sf Runoff Volume = 21,320 cf Average Runoff Depth = 2.43"**  
**90.05% Pervious = 94,888 sf 9.95% Impervious = 10,479 sf**

**Existing-2**

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

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**Summary for Subcatchment E-1: Flow to Existing Basin**

Runoff = 4.53 cfs @ 12.17 hrs, Volume= 17,375 cf, Depth= 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 5,457	98	Paved parking
76,777	70	Woods, Good, HSG C
7,869	79	50-75% Grass cover, Fair, HSG C
90,103	72	Weighted Average
84,646		93.94% Pervious Area
5,457		6.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		Sheet Flow, Sheet Flow
3.4	503	0.0240	2.49		Woods: Light underbrush n= 0.400 P2= 3.05"
					Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
12.0	553	Total			

**Existing-2**

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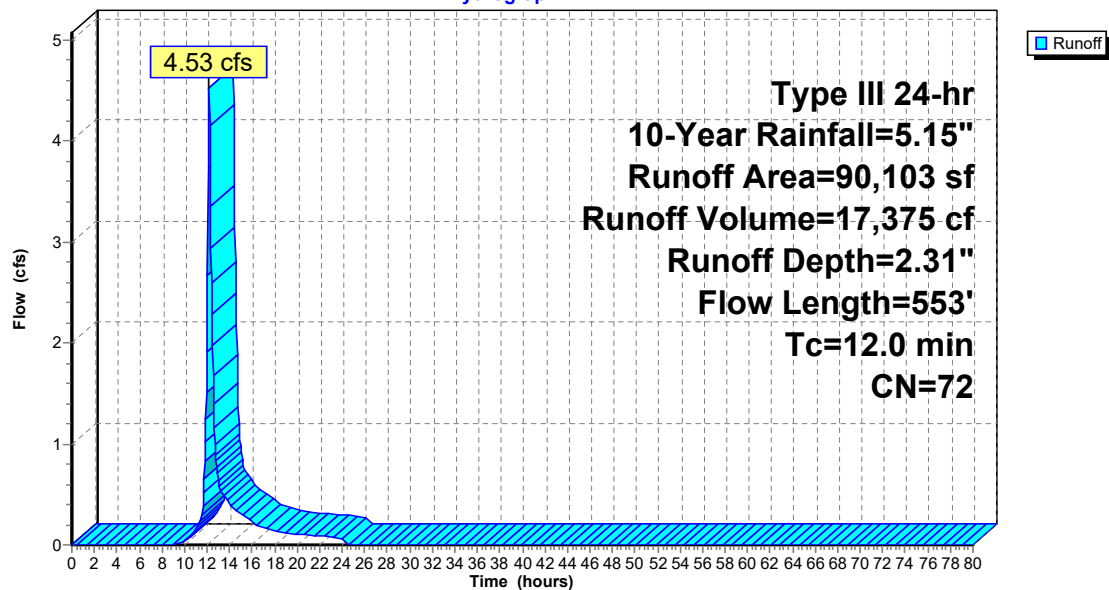
Type III 24-hr 10-Year Rainfall=5.15"

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**Subcatchment E-1: Flow to Existing Basin**

Hydrograph



**Existing-2**

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

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**Summary for Subcatchment E-2: Flow onsite Southeast**

Runoff = 0.95 cfs @ 12.16 hrs, Volume= 3,524 cf, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 5,022	98	Paved parking
6,746	70	Woods, Good, HSG C
1,391	79	50-75% Grass cover, Fair, HSG C
13,159	82	Weighted Average
8,137		61.84% Pervious Area
5,022		38.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
11.3	140	Total			

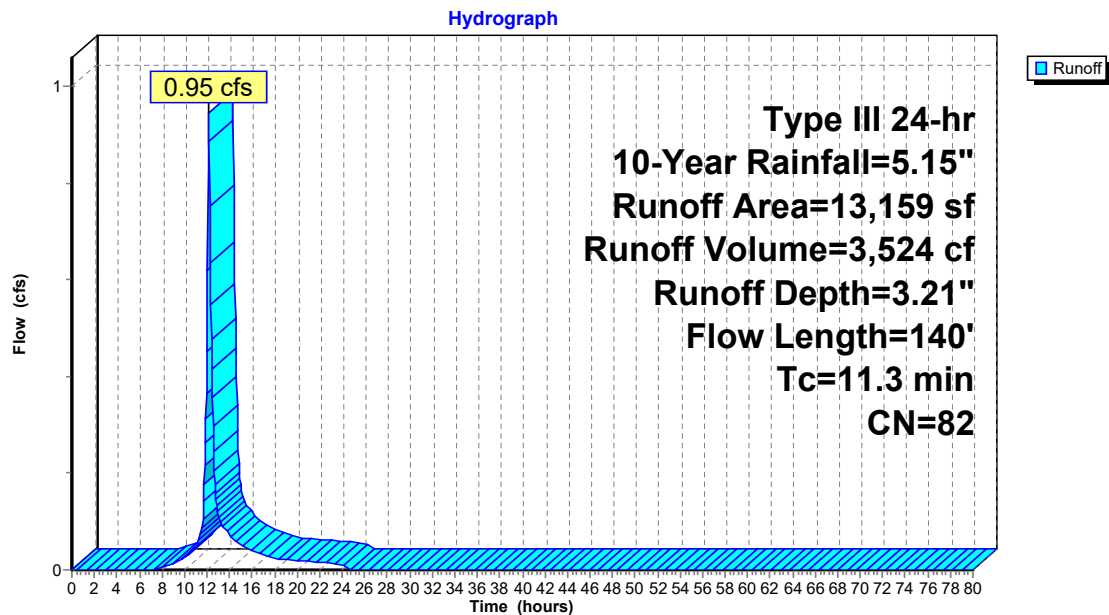
**Existing-2**

Prepared by {enter your company name here}  
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Type III 24-hr 10-Year Rainfall=5.15"

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**Subcatchment E-2: Flow onsite Southeast**

**Existing-2**

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

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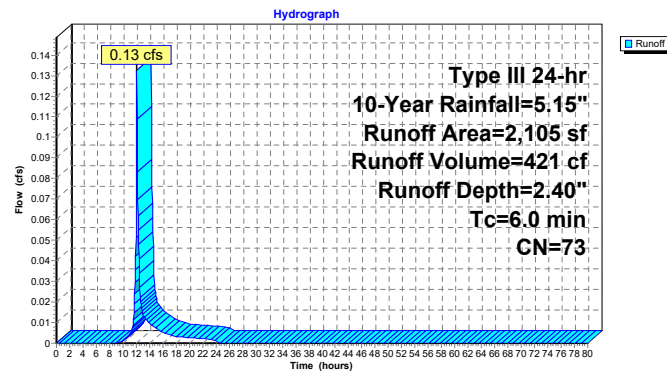
**Summary for Subcatchment E-3: Flow off-site West**

Runoff = 0.13 cfs @ 12.10 hrs, Volume= 421 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
1,469	70	Woods, Good, HSG C
636	79	50-75% Grass cover, Fair, HSG C
2,105	73	Weighted Average
2,105		100.00% Pervious Area

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

**Subcatchment E-3: Flow off-site West****Existing-2**

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

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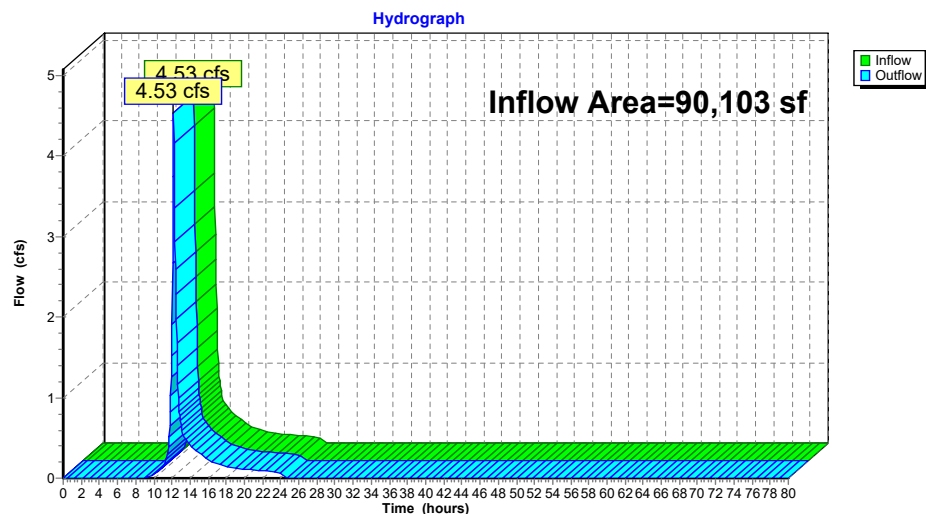
Page 10

**Summary for Reach DP-1: Basin**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 90,103 sf, 6.06% Impervious, Inflow Depth = 2.31" for 10-Year event  
 Inflow = 4.53 cfs @ 12.17 hrs, Volume= 17,375 cf  
 Outflow = 4.53 cfs @ 12.17 hrs, Volume= 17,375 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-1: Basin**

**Existing-2**

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

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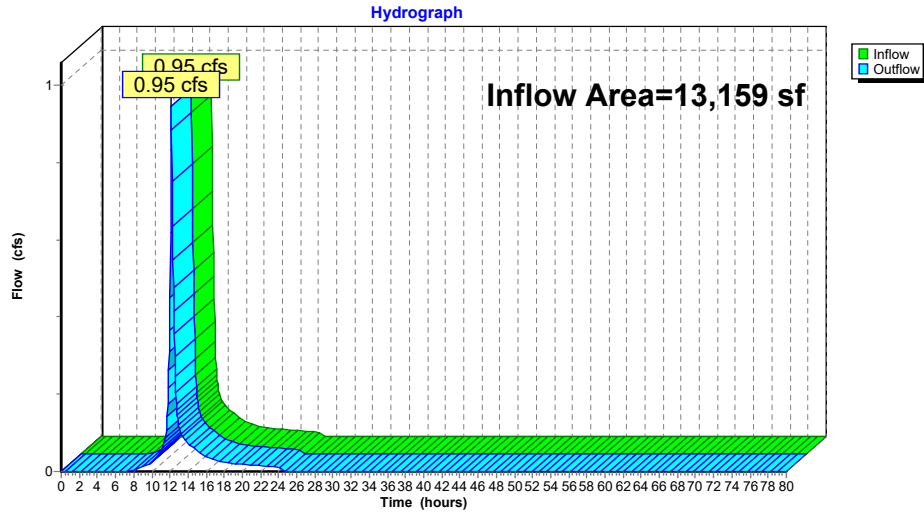
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**Summary for Reach DP-2: Onsite southeast**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 13,159 sf, 38.16% Impervious, Inflow Depth = 3.21" for 10-Year event  
Inflow = 0.95 cfs @ 12.16 hrs, Volume= 3,524 cf  
Outflow = 0.95 cfs @ 12.16 hrs, Volume= 3,524 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-2: Onsite southeast****Existing-2**

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

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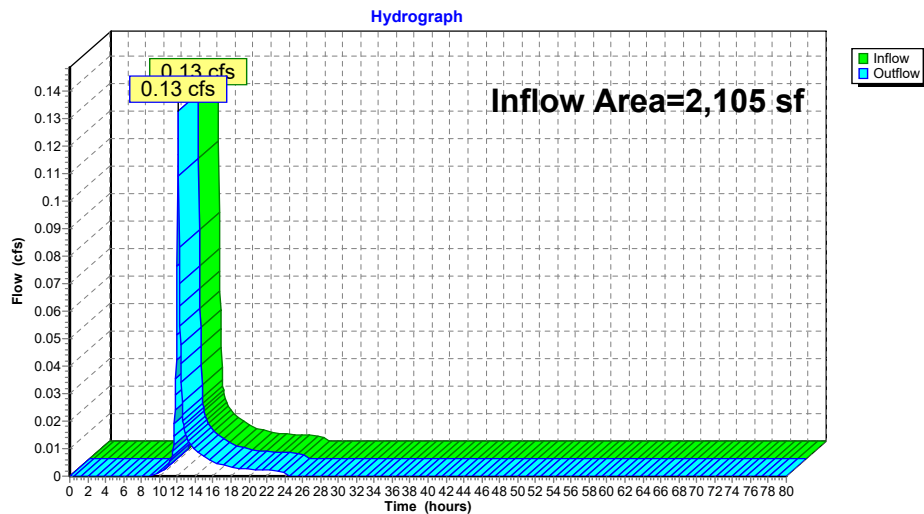
Page 12

**Summary for Reach DP-3: Off-site West**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2,105 sf, 0.00% Impervious, Inflow Depth = 2.40" for 10-Year event  
Inflow = 0.13 cfs @ 12.10 hrs, Volume= 421 cf  
Outflow = 0.13 cfs @ 12.10 hrs, Volume= 421 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-3: Off-site West**

# **HydroCAD Analysis**

## **Existing Conditions - 25 Year Storm**





**Existing-2**

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**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
9,896	79	50-75% Grass cover, Fair, HSG C (E-1, E-2, E-3)
10,479	98	Paved parking (E-1, E-2)
84,992	70	Woods, Good, HSG C (E-1, E-2, E-3)
<b>105,367</b>	<b>74</b>	<b>TOTAL AREA</b>

**Existing-2**

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**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
94,888	HSG C	E-1, E-2, E-3
0	HSG D	
10,479	Other	E-1, E-2
<b>105,367</b>		<b>TOTAL AREA</b>

**Existing-2**

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**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	Subcatchment Numbers
0	0	9,896	0	0	9,896	50-75% Grass cover, Fair	E-1, E-2, E-3
0	0	0	0	10,479	10,479	Paved parking	E-1, E-2
0	0	84,992	0	0	84,992	Woods, Good	E-1, E-2, E-3
<b>0</b>	<b>0</b>	<b>94,888</b>	<b>0</b>	<b>10,479</b>	<b>105,367</b>	<b>TOTAL AREA</b>	

**Existing-2**

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Type III 24-hr 25-Year Rainfall=6.35"

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Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment E-1: Flow to Existing Basin**

Runoff Area=90,103 sf 6.06% Impervious Runoff Depth=3.28"  
 Flow Length=553' Tc=12.0 min CN=72 Runoff=6.49 cfs 24,642 cf

**Subcatchment E-2: Flow onsite Southeast**

Runoff Area=13,159 sf 38.16% Impervious Runoff Depth=4.31"  
 Flow Length=140' Tc=11.3 min CN=82 Runoff=1.26 cfs 4,727 cf

**Subcatchment E-3: Flow off-site West**

Runoff Area=2,105 sf 0.00% Impervious Runoff Depth=3.38"  
 Tc=6.0 min CN=73 Runoff=0.19 cfs 593 cf

**Reach DP-1: Basin**

Inflow=6.49 cfs 24,642 cf  
 Outflow=6.49 cfs 24,642 cf

**Reach DP-2: Onsite southeast**

Inflow=1.26 cfs 4,727 cf  
 Outflow=1.26 cfs 4,727 cf

**Reach DP-3: Off-site West**

Inflow=0.19 cfs 593 cf  
 Outflow=0.19 cfs 593 cf

**Total Runoff Area = 105,367 sf Runoff Volume = 29,962 cf Average Runoff Depth = 3.41"**  
**90.05% Pervious = 94,888 sf 9.95% Impervious = 10,479 sf**

**Existing-2**

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Type III 24-hr 25-Year Rainfall=6.35"

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**Summary for Subcatchment E-1: Flow to Existing Basin**

Runoff = 6.49 cfs @ 12.17 hrs, Volume= 24,642 cf, Depth= 3.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 5,457	98	Paved parking
76,777	70	Woods, Good, HSG C
7,869	79	50-75% Grass cover, Fair, HSG C
90,103	72	Weighted Average
84,646		93.94% Pervious Area
5,457		6.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		Sheet Flow, Sheet Flow
3.4	503	0.0240	2.49		Woods: Light underbrush n= 0.400 P2= 3.05"
					Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
12.0	553	Total			

**Existing-2**

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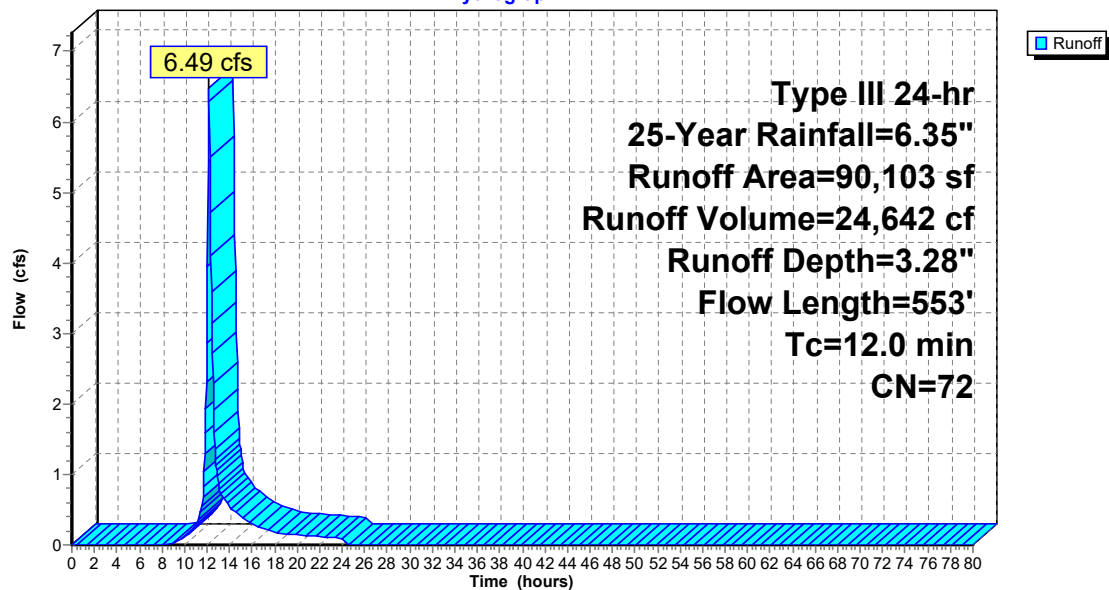
Type III 24-hr 25-Year Rainfall=6.35"

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**Subcatchment E-1: Flow to Existing Basin**

Hydrograph



**Existing-2**

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Type III 24-hr 25-Year Rainfall=6.35"

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**Summary for Subcatchment E-2: Flow onsite Southeast**

Runoff = 1.26 cfs @ 12.16 hrs, Volume= 4,727 cf, Depth= 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 5,022	98	Paved parking
6,746	70	Woods, Good, HSG C
1,391	79	50-75% Grass cover, Fair, HSG C
13,159	82	Weighted Average
8,137		61.84% Pervious Area
5,022		38.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
11.3	140	Total			

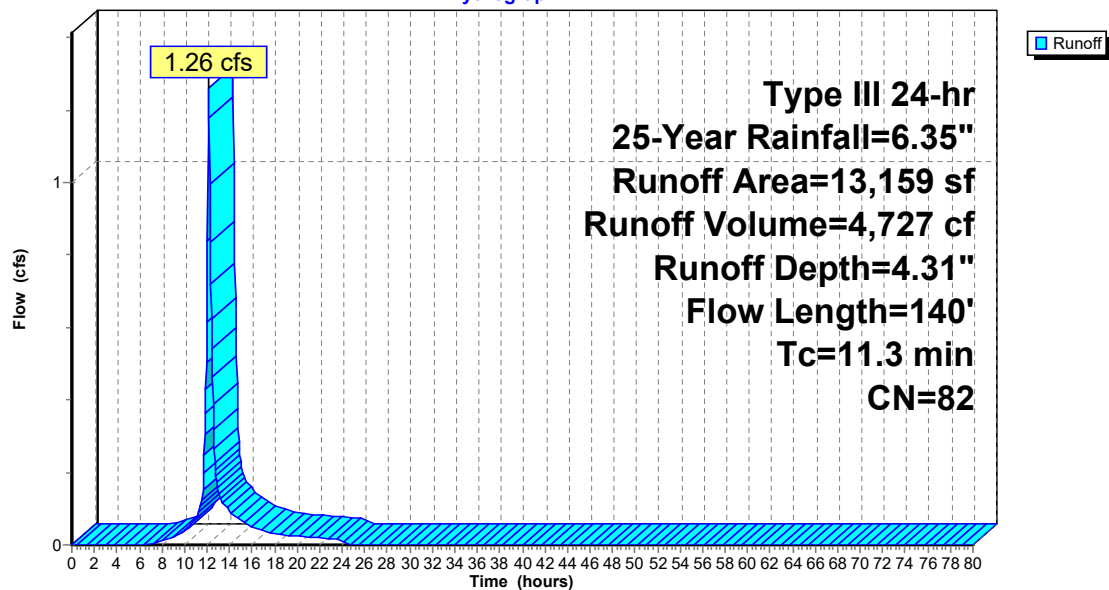
**Existing-2**

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Type III 24-hr 25-Year Rainfall=6.35"

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**Subcatchment E-2: Flow onsite Southeast****Hydrograph**

**Existing-2**

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Type III 24-hr 25-Year Rainfall=6.35"

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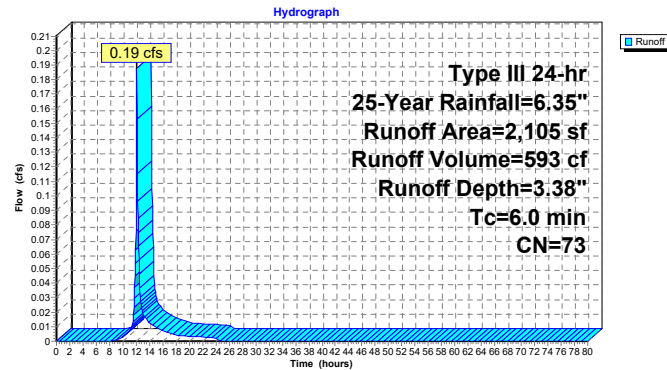
**Summary for Subcatchment E-3: Flow off-site West**

Runoff = 0.19 cfs @ 12.09 hrs, Volume= 593 cf, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
1,469	70	Woods, Good, HSG C
636	79	50-75% Grass cover, Fair, HSG C
2,105	73	Weighted Average
2,105		100.00% Pervious Area

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

**Subcatchment E-3: Flow off-site West****Existing-2**

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Type III 24-hr 25-Year Rainfall=6.35"

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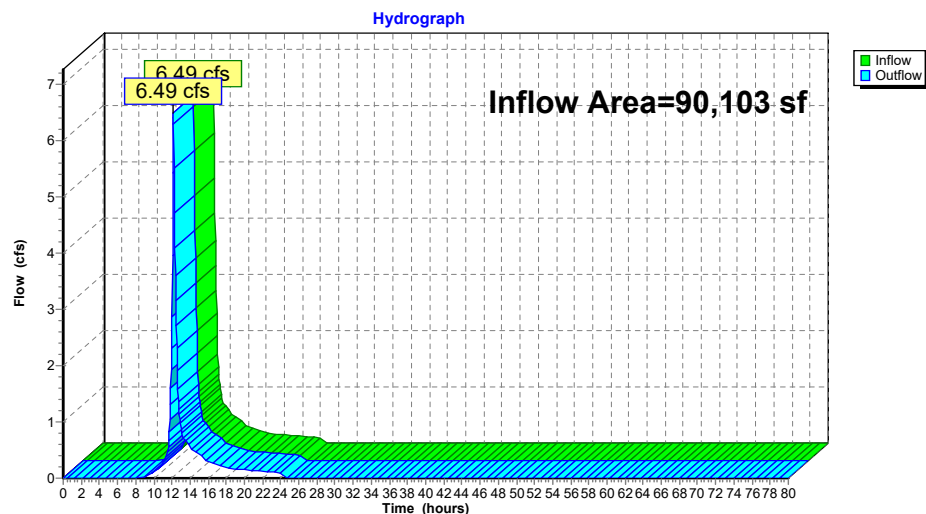
Page 10

**Summary for Reach DP-1: Basin**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 90,103 sf, 6.06% Impervious, Inflow Depth = 3.28" for 25-Year event  
 Inflow = 6.49 cfs @ 12.17 hrs, Volume= 24,642 cf  
 Outflow = 6.49 cfs @ 12.17 hrs, Volume= 24,642 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-1: Basin**

**Existing-2**

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Type III 24-hr 25-Year Rainfall=6.35"

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**Summary for Reach DP-2: Onsite southeast**

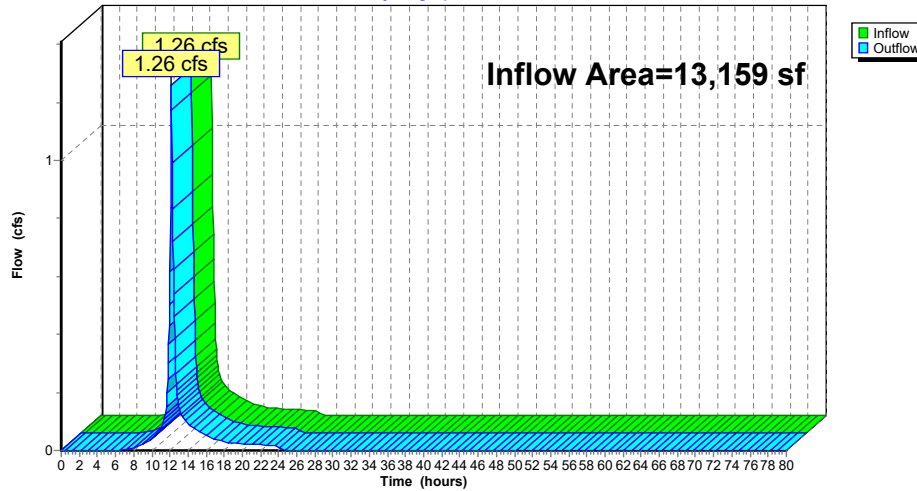
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 13,159 sf, 38.16% Impervious, Inflow Depth = 4.31" for 25-Year event  
Inflow = 1.26 cfs @ 12.16 hrs, Volume= 4,727 cf  
Outflow = 1.26 cfs @ 12.16 hrs, Volume= 4,727 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-2: Onsite southeast**

Hydrograph

**Existing-2**

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Type III 24-hr 25-Year Rainfall=6.35"

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**Summary for Reach DP-3: Off-site West**

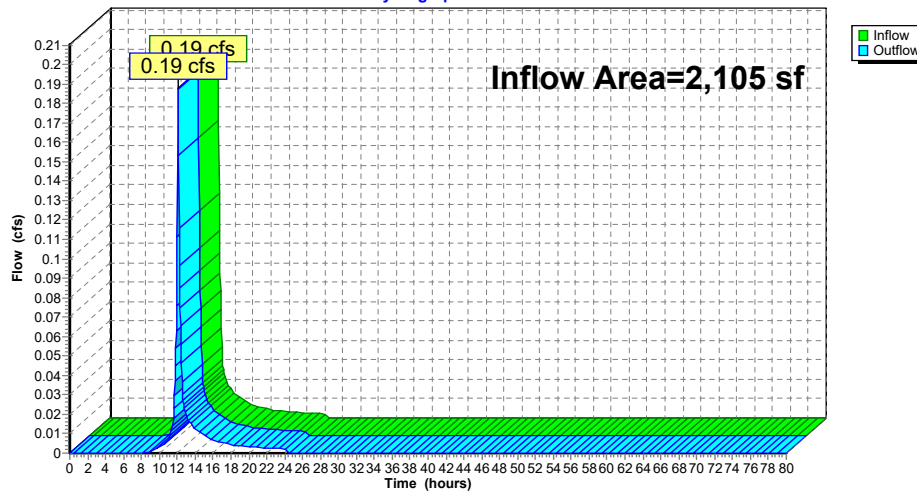
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2,105 sf, 0.00% Impervious, Inflow Depth = 3.38" for 25-Year event  
Inflow = 0.19 cfs @ 12.09 hrs, Volume= 593 cf  
Outflow = 0.19 cfs @ 12.09 hrs, Volume= 593 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-3: Off-site West**

Hydrograph





**HydroCAD Analysis**  
**Existing Conditions - 100 Year Storm**



**Existing-2**

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Page 1

**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
9,896	79	50-75% Grass cover, Fair, HSG C (E-1, E-2, E-3)
10,479	98	Paved parking (E-1, E-2)
84,992	70	Woods, Good, HSG C (E-1, E-2, E-3)
<b>105,367</b>	<b>74</b>	<b>TOTAL AREA</b>

**Existing-2**

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**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
94,888	HSG C	E-1, E-2, E-3
0	HSG D	
10,479	Other	E-1, E-2
<b>105,367</b>		<b>TOTAL AREA</b>

**Existing-2**

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**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	Subcatchment Numbers
0	0	9,896	0	0	9,896	50-75% Grass cover, Fair	E-1, E-2, E-3
0	0	0	0	10,479	10,479	Paved parking	E-1, E-2
0	0	84,992	0	0	84,992	Woods, Good	E-1, E-2, E-3
<b>0</b>	<b>0</b>	<b>94,888</b>	<b>0</b>	<b>10,479</b>	<b>105,367</b>	<b>TOTAL AREA</b>	

**Existing-2**

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Type III 24-hr 100-Year Rainfall=8.16"

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Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment E-1: Flow to Existing Basin**

Runoff Area=90,103 sf 6.06% Impervious Runoff Depth=4.84"  
 Flow Length=553' Tc=12.0 min CN=72 Runoff=9.57 cfs 36,305 cf

**Subcatchment E-2: Flow onsite Southeast**

Runoff Area=13,159 sf 38.16% Impervious Runoff Depth=6.01"  
 Flow Length=140' Tc=11.3 min CN=82 Runoff=1.74 cfs 6,592 cf

**Subcatchment E-3: Flow off-site West**

Runoff Area=2,105 sf 0.00% Impervious Runoff Depth=4.95"  
 Tc=6.0 min CN=73 Runoff=0.27 cfs 869 cf

**Reach DP-1: Basin**

Inflow=9.57 cfs 36,305 cf  
 Outflow=9.57 cfs 36,305 cf

**Reach DP-2: Onsite southeast**

Inflow=1.74 cfs 6,592 cf  
 Outflow=1.74 cfs 6,592 cf

**Reach DP-3: Off-site West**

Inflow=0.27 cfs 869 cf  
 Outflow=0.27 cfs 869 cf

**Total Runoff Area = 105,367 sf Runoff Volume = 43,766 cf Average Runoff Depth = 4.98"**  
**90.05% Pervious = 94,888 sf 9.95% Impervious = 10,479 sf**

**Existing-2**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Summary for Subcatchment E-1: Flow to Existing Basin**

Runoff = 9.57 cfs @ 12.17 hrs, Volume= 36,305 cf, Depth= 4.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 5,457	98	Paved parking
76,777	70	Woods, Good, HSG C
7,869	79	50-75% Grass cover, Fair, HSG C
90,103	72	Weighted Average
84,646		93.94% Pervious Area
5,457		6.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		Sheet Flow, Sheet Flow
3.4	503	0.0240	2.49		Woods: Light underbrush n= 0.400 P2= 3.05"
					Shallow Concentrated Flow,
					Unpaved Kv= 16.1 fps
12.0	553	Total			

**Existing-2**

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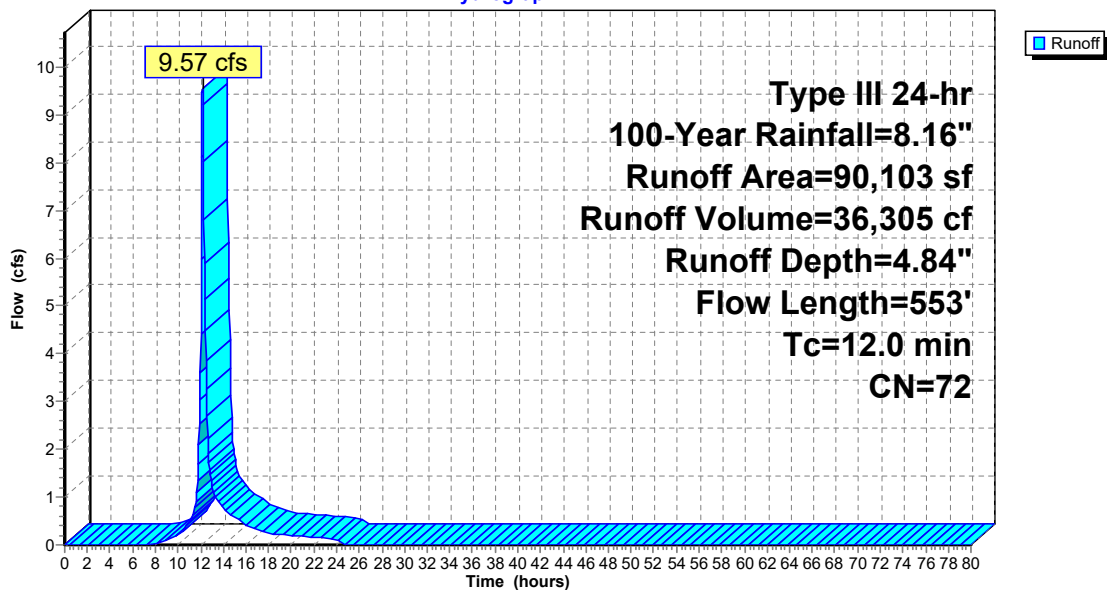
Type III 24-hr 100-Year Rainfall=8.16"

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**Subcatchment E-1: Flow to Existing Basin**

Hydrograph



**Existing-2**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Summary for Subcatchment E-2: Flow onsite Southeast**

Runoff = 1.74 cfs @ 12.16 hrs, Volume= 6,592 cf, Depth= 6.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 5,022	98	Paved parking
6,746	70	Woods, Good, HSG C
1,391	79	50-75% Grass cover, Fair, HSG C
13,159	82	Weighted Average
8,137		61.84% Pervious Area
5,022		38.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
11.3	140	Total			

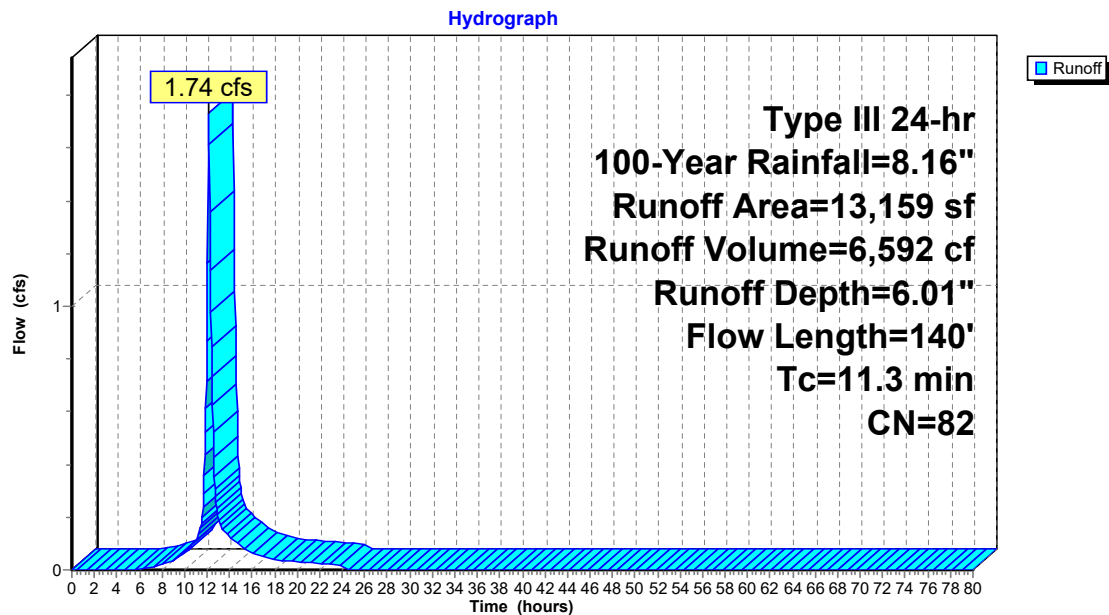
**Existing-2**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Subcatchment E-2: Flow onsite Southeast**

**Existing-2**

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Type III 24-hr 100-Year Rainfall=8.16"

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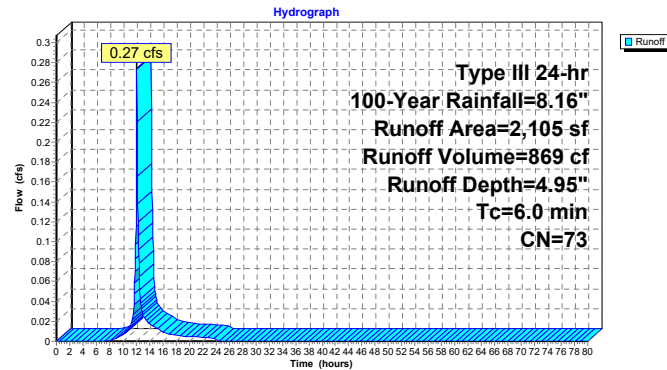
**Summary for Subcatchment E-3: Flow off-site West**

Runoff = 0.27 cfs @ 12.09 hrs, Volume= 869 cf, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
1,469	70	Woods, Good, HSG C
636	79	50-75% Grass cover, Fair, HSG C
2,105	73	Weighted Average
2,105		100.00% Pervious Area

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

**Subcatchment E-3: Flow off-site West****Existing-2**

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Type III 24-hr 100-Year Rainfall=8.16"

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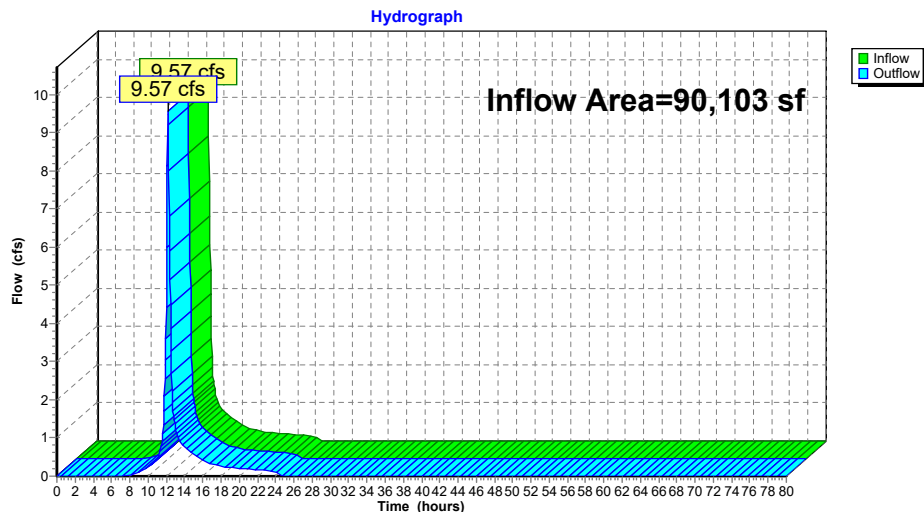
Page 10

**Summary for Reach DP-1: Basin**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 90,103 sf, 6.06% Impervious, Inflow Depth = 4.84" for 100-Year event  
Inflow = 9.57 cfs @ 12.17 hrs, Volume= 36,305 cf  
Outflow = 9.57 cfs @ 12.17 hrs, Volume= 36,305 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-1: Basin**

## Existing-2

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Type III 24-hr 100-Year Rainfall=8.16"

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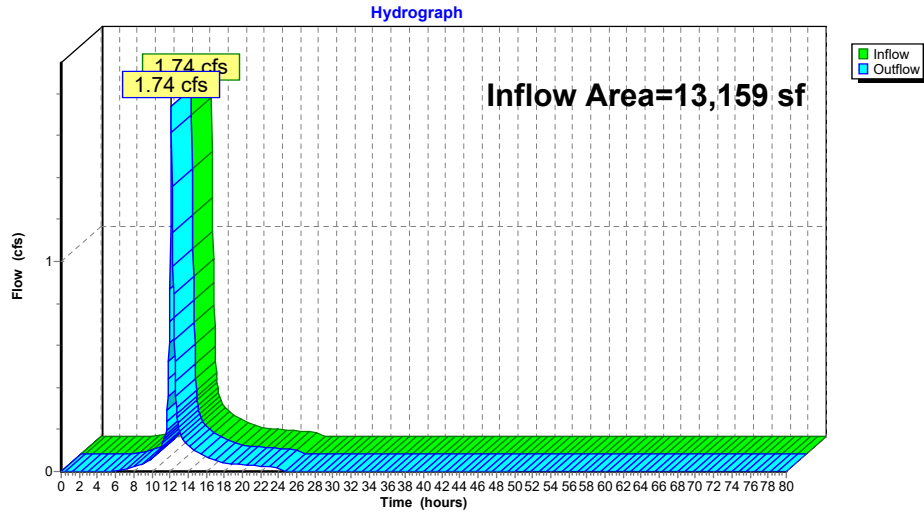
### Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 13,159 sf, 38.16% Impervious, Inflow Depth = 6.01" for 100-Year event  
Inflow = 1.74 cfs @ 12.16 hrs, Volume= 6,592 cf  
Outflow = 1.74 cfs @ 12.16 hrs, Volume= 6,592 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

#### Reach DP-2: Onsite southeast



## Existing-2

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Type III 24-hr 100-Year Rainfall=8.16"

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Page 12

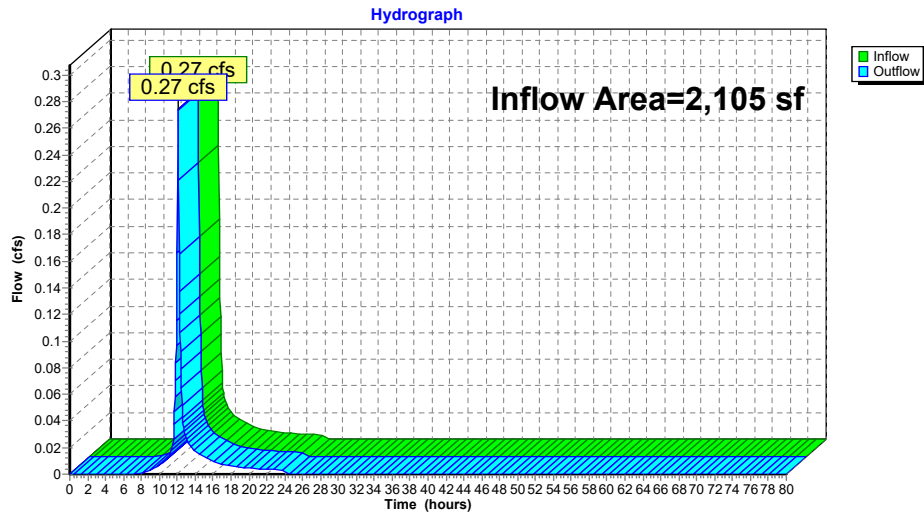
### Summary for Reach DP-3: Off-site West

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2,105 sf, 0.00% Impervious, Inflow Depth = 4.95" for 100-Year event  
Inflow = 0.27 cfs @ 12.09 hrs, Volume= 869 cf  
Outflow = 0.27 cfs @ 12.09 hrs, Volume= 869 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

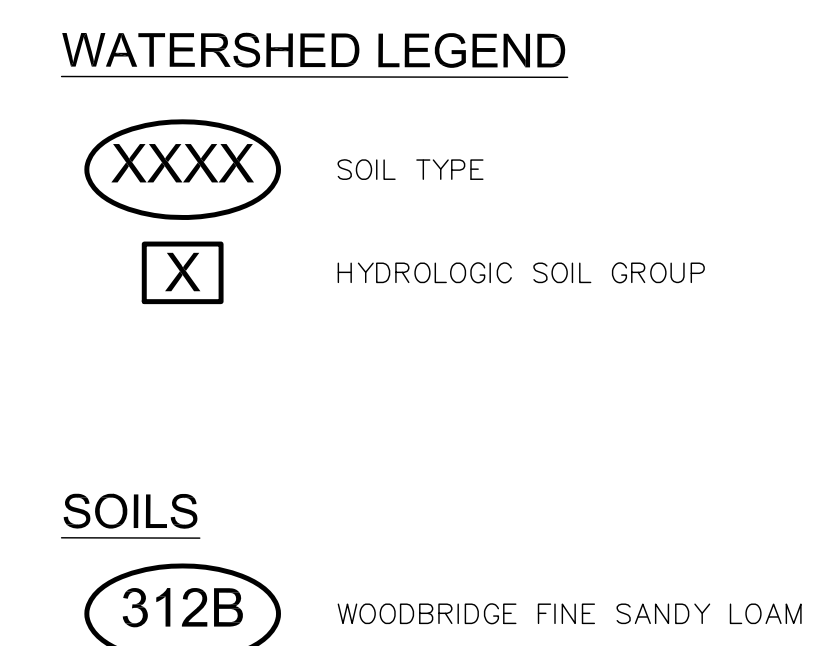
#### Reach DP-3: Off-site West





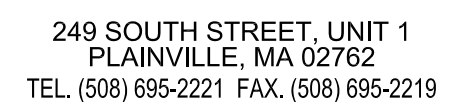
## **Proposed Drainage Plan & HydroCAD Diagram**





DATE :	JANUARY 13, 2023
DRAWN :	AH / DRC
SCALE :	1" = 20'

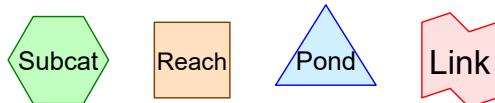
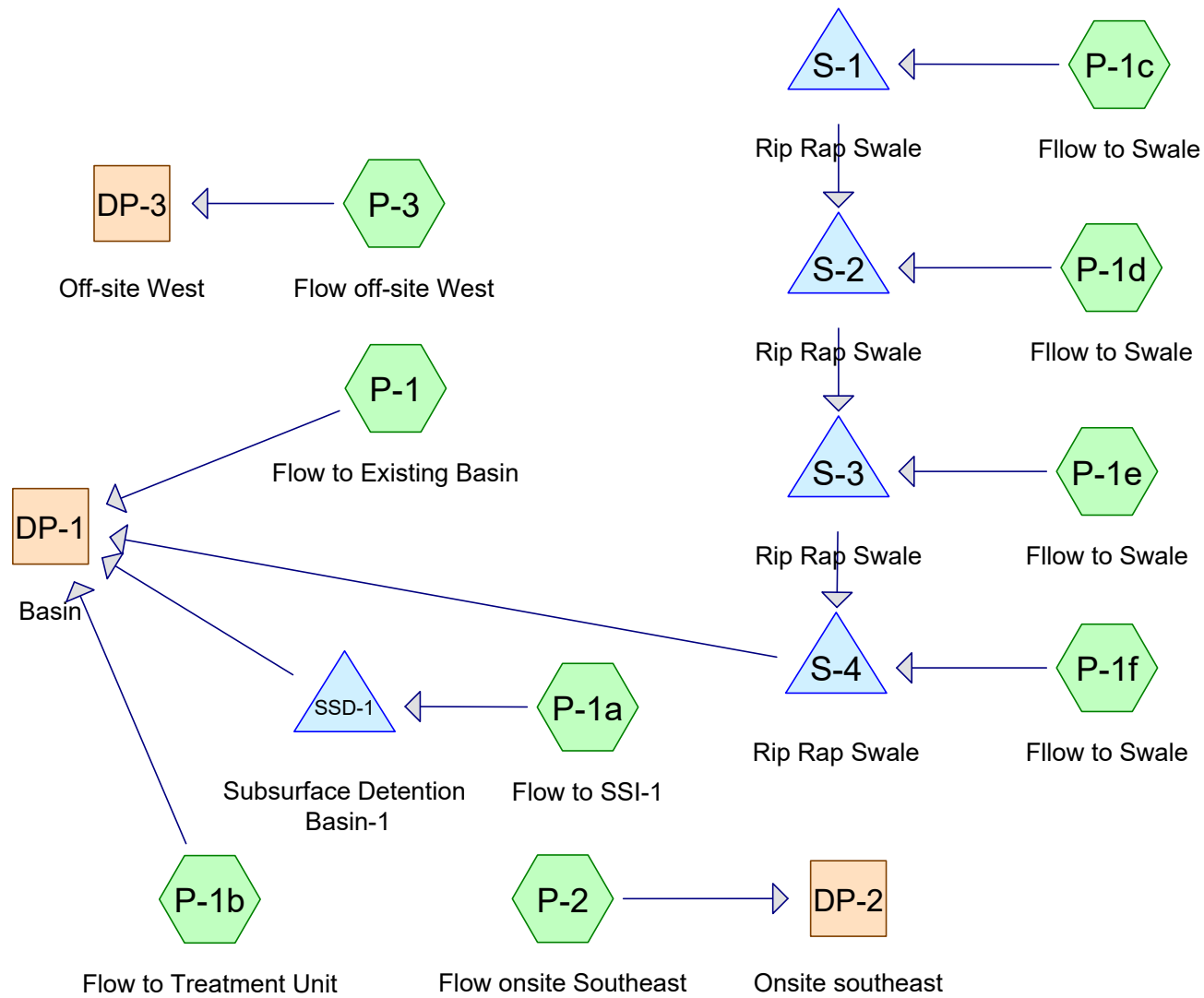
MAP SHEET 320, PARCEL 004  
15 LIBERTY WAY  
FRANKLIN, MASSACHUSETTS



# D-2.0







### Routing Diagram for Proposed-6

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**HydroCAD Analysis**  
**Proposed Conditions - 2 Year Storm**





**Proposed-6**

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Page 1

**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
18,555	79	50-75% Grass cover, Fair, HSG C (P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3)
80,078	98	Paved parking (P-1a, P-1b, P-2)
1,396	66	Rip Rap Swale (P-1c, P-1d, P-1e, P-1f)
5,338	70	Woods, Good, HSG C (P-1, P-1c, P-1d, P-1e, P-1f, P-3)
<b>105,367</b>	<b>93</b>	<b>TOTAL AREA</b>

**Proposed-6**

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**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
23,893	HSG C	P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3
0	HSG D	
81,474	Other	P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2
<b>105,367</b>		<b>TOTAL AREA</b>

**Proposed-6**

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Page 3

**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	Subcatchment Numbers
0	0	18,555	0	0	18,555	50-75% Grass cover, Fair	P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3
0	0	0	0	80,078	80,078	Paved parking	P-1a, P-1b, P-2
0	0	0	0	1,396	1,396	Rip Rap Swale	P-1c, P-1d, P-1e, P-1f
0	0	5,338	0	0	5,338	Woods, Good	P-1, P-1c, P-1d, P-1e, P-1f, P-3
<b>0</b>	<b>0</b>	<b>23,893</b>	<b>0</b>	<b>81,474</b>	<b>105,367</b>	<b>TOTAL AREA</b>	

**Proposed-6**

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**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	SSD-1	322.50	322.00	21.3	0.0235	0.013	15.0	0.0	0.0

**Proposed-6**

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Type III 24-hr 2-Year Rainfall=3.05"

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Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P-1: Flow to Existing Basin**

Runoff Area=18,417 sf 0.00% Impervious Runoff Depth=1.11"  
 Flow Length=461' Tc=10.0 min CN=77 Runoff=0.46 cfs 1,697 cf

**Subcatchment P-1a: Flow to SSI-1**

Runoff Area=71,428 sf 99.59% Impervious Runoff Depth=2.82"  
 Tc=6.0 min CN=98 Runoff=4.74 cfs 16,774 cf

**Subcatchment P-1b: Flow to Treatment Unit**

Runoff Area=3,571 sf 87.17% Impervious Runoff Depth=2.60"  
 Tc=6.0 min CN=96 Runoff=0.23 cfs 774 cf

**Subcatchment P-1c: Flow to Swale**

Runoff Area=1,317 sf 0.00% Impervious Runoff Depth=0.84"  
 Tc=6.0 min CN=72 Runoff=0.03 cfs 92 cf

**Subcatchment P-1d: Flow to Swale**

Runoff Area=1,184 sf 0.00% Impervious Runoff Depth=0.94"  
 Tc=6.0 min CN=74 Runoff=0.03 cfs 93 cf

**Subcatchment P-1e: Flow to Swale**

Runoff Area=1,184 sf 0.00% Impervious Runoff Depth=0.99"  
 Tc=6.0 min CN=75 Runoff=0.03 cfs 98 cf

**Subcatchment P-1f: Flow to Swale**

Runoff Area=1,071 sf 0.00% Impervious Runoff Depth=0.94"  
 Tc=6.0 min CN=74 Runoff=0.03 cfs 84 cf

**Subcatchment P-2: Flow onsite Southeast**

Runoff Area=6,213 sf 93.87% Impervious Runoff Depth=2.71"  
 Tc=6.0 min CN=97 Runoff=0.41 cfs 1,402 cf

**Subcatchment P-3: Flow off-site West**

Runoff Area=982 sf 0.00% Impervious Runoff Depth=1.23"  
 Tc=6.0 min CN=79 Runoff=0.03 cfs 100 cf

**Reach DP-1: Basin**

Inflow=1.40 cfs 17,732 cf  
 Outflow=1.40 cfs 17,732 cf

**Reach DP-2: Onsite southeast**

Inflow=0.41 cfs 1,402 cf  
 Outflow=0.41 cfs 1,402 cf

**Proposed-6**

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**Reach DP-3: Off-site West**

Inflow=0.03 cfs 100 cf  
 Outflow=0.03 cfs 100 cf

**Pond S-1: Rip Rap Swale**

Peak Elev=333.17' Storage=92 cf Inflow=0.03 cfs 92 cf  
 Outflow=0.00 cfs 0 cf

**Pond S-2: Rip Rap Swale**

Peak Elev=331.73' Storage=93 cf Inflow=0.03 cfs 93 cf  
 Outflow=0.00 cfs 0 cf

**Pond S-3: Rip Rap Swale**

Peak Elev=330.29' Storage=98 cf Inflow=0.03 cfs 98 cf  
 Outflow=0.00 cfs 0 cf

**Pond S-4: Rip Rap Swale**

Peak Elev=328.70' Storage=84 cf Inflow=0.03 cfs 84 cf  
 Outflow=0.00 cfs 0 cf

**Pond SSD-1: Subsurface Detention Basin-1**

Peak Elev=323.63' Storage=8,316 cf Inflow=4.74 cfs 16,774 cf  
 Outflow=1.01 cfs 15,261 cf

**Total Runoff Area = 105,367 sf Runoff Volume = 21,114 cf Average Runoff Depth = 2.40"**  
**24.00% Pervious = 25,289 sf 76.00% Impervious = 80,078 sf**

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**Summary for Subcatchment P-1: Flow to Existing Basin**

Runoff = 0.46 cfs @ 12.15 hrs, Volume= 1,697 cf, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
4,454	70	Woods, Good, HSG C
13,963	79	50-75% Grass cover, Fair, HSG C
18,417	77	Weighted Average
18,417		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0800	0.11		<b>Sheet Flow, Sheet Flow</b>
					Woods: Light underbrush n= 0.400 P2= 3.05"
2.7	411	0.0240	2.49		<b>Shallow Concentrated Flow,</b>
					Unpaved Kv= 16.1 fps
10.0	461	Total			

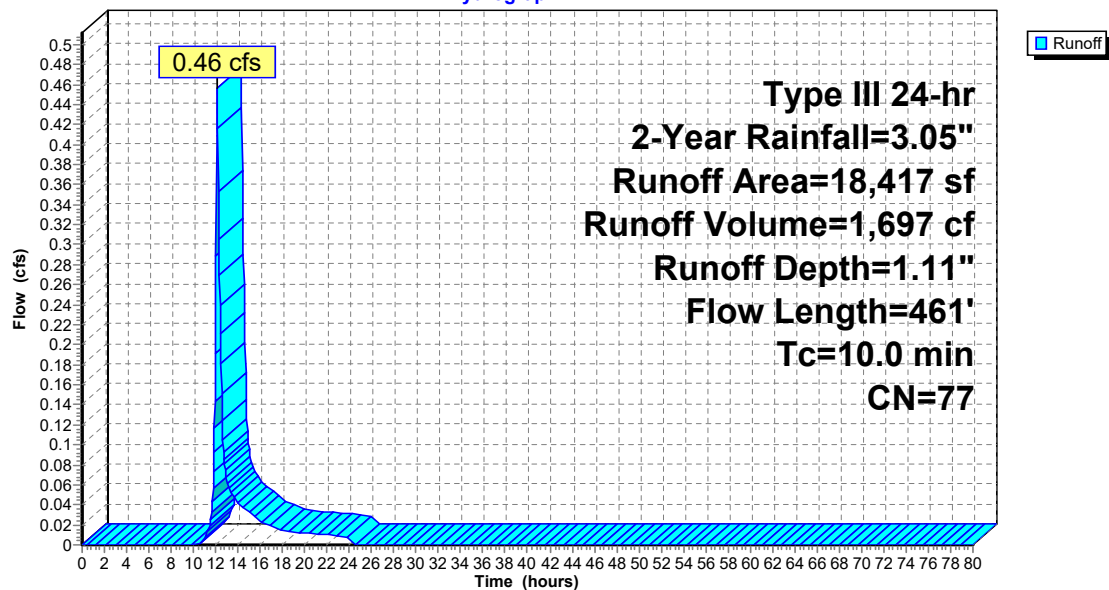
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**Subcatchment P-1: Flow to Existing Basin****Hydrograph**

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**Summary for Subcatchment P-1a: Flow to SSI-1**

Runoff = 4.74 cfs @ 12.09 hrs, Volume= 16,774 cf, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 71,133	98	Paved parking
295	79	50-75% Grass cover, Fair, HSG C
71,428	98	Weighted Average
295		0.41% Pervious Area
71,133		99.59% Impervious Area

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

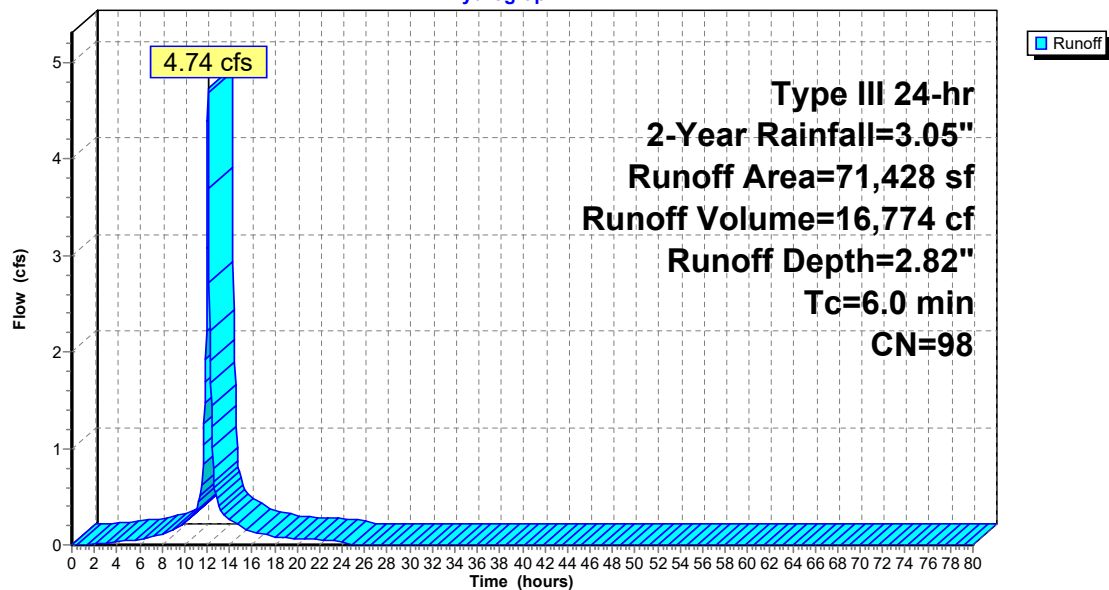
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**Subcatchment P-1a: Flow to SSI-1****Hydrograph**

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**Summary for Subcatchment P-1b: Flow to Treatment Unit**

Runoff = 0.23 cfs @ 12.09 hrs, Volume= 774 cf, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 3,113	98	Paved parking
458	79	50-75% Grass cover, Fair, HSG C
3,571	96	Weighted Average
458		12.83% Pervious Area
3,113		87.17% Impervious Area

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

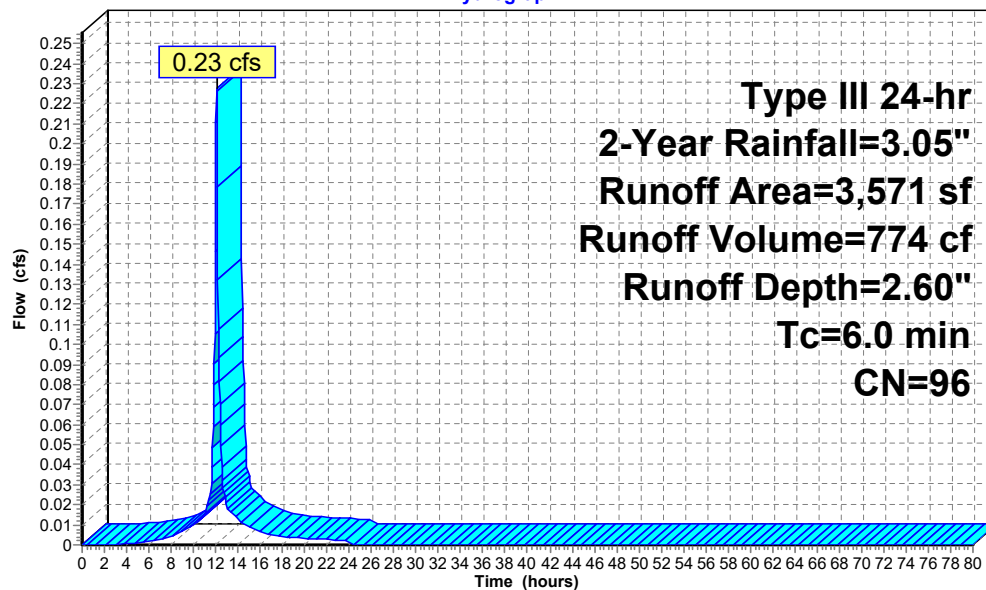
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**Subcatchment P-1b: Flow to Treatment Unit****Hydrograph**

Runoff

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**Summary for Subcatchment P-1c: Fillow to Swale**

Runoff = 0.03 cfs @ 12.10 hrs, Volume= 92 cf, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 339	66	Rip Rap Swale
476	70	Woods, Good, HSG C
502	79	50-75% Grass cover, Fair, HSG C
1,317	72	Weighted Average
1,317		100.00% Pervious Area

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

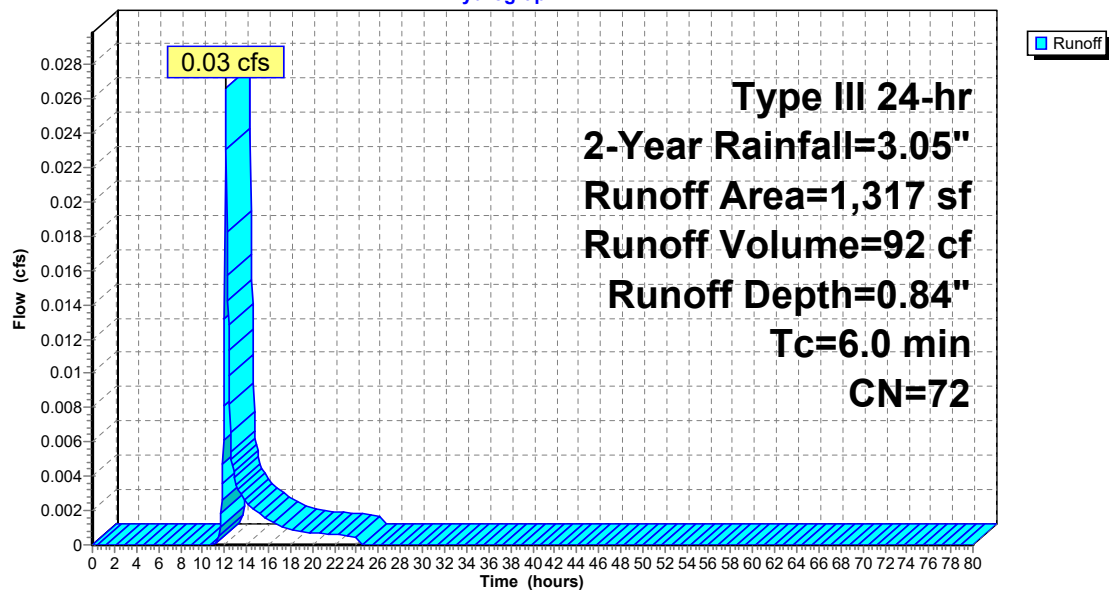
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**Subcatchment P-1c: Fillow to Swale****Hydrograph**

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**Summary for Subcatchment P-1d: Fllow to Swale**

Runoff = 0.03 cfs @ 12.10 hrs, Volume= 93 cf, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 350	66	Rip Rap Swale
216	70	Woods, Good, HSG C
618	79	50-75% Grass cover, Fair, HSG C
1,184	74	Weighted Average
1,184		100.00% Pervious Area

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

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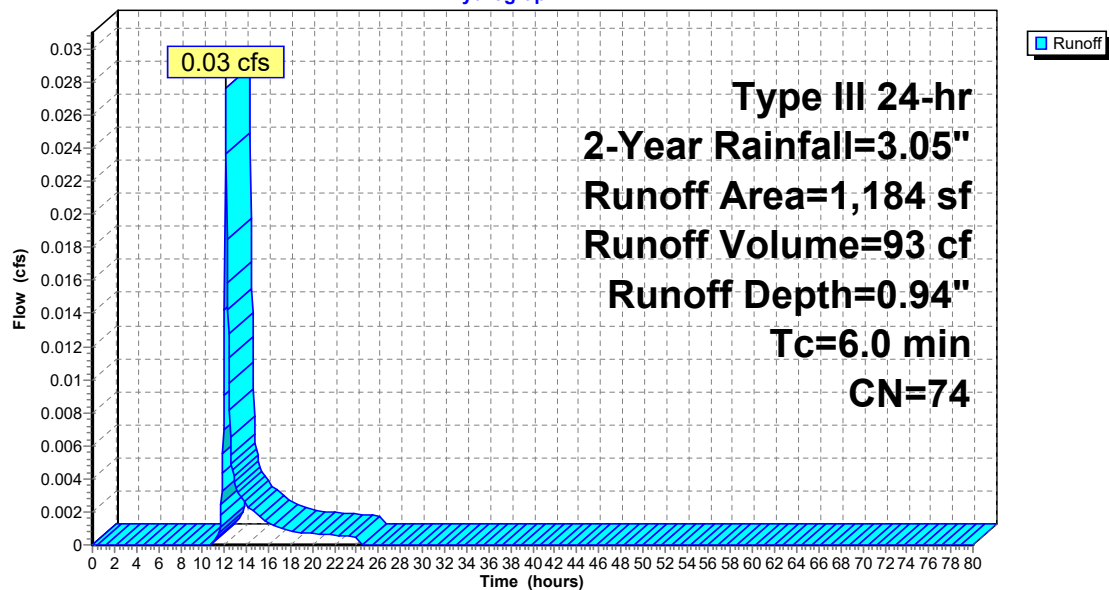
Type III 24-hr 2-Year Rainfall=3.05"

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**Subcatchment P-1d: Fllow to Swale**

Hydrograph





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**Summary for Subcatchment P-1e: Fillow to Swale**

Runoff = 0.03 cfs @ 12.10 hrs, Volume= 98 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 350	66	Rip Rap Swale
58	70	Woods, Good, HSG C
776	79	50-75% Grass cover, Fair, HSG C
1,184	75	Weighted Average
1,184		100.00% Pervious Area

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

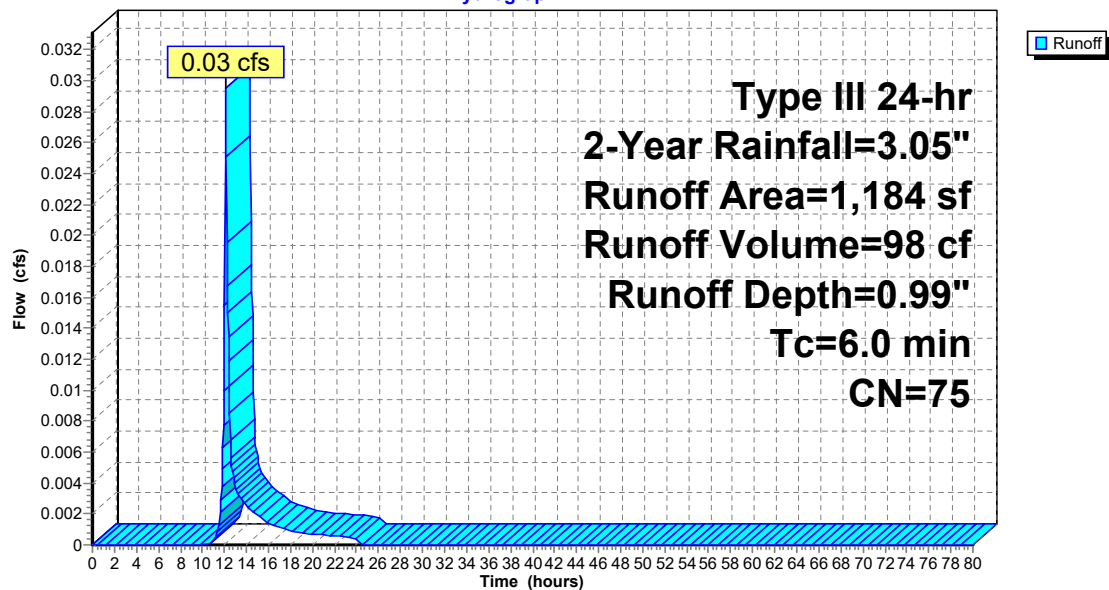
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**Subcatchment P-1e: Fillow to Swale****Hydrograph**

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**Summary for Subcatchment P-1f: Filow to Swale**

Runoff = 0.03 cfs @ 12.10 hrs, Volume= 84 cf, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 357	66	Rip Rap Swale
124	70	Woods, Good, HSG C
590	79	50-75% Grass cover, Fair, HSG C
1,071	74	Weighted Average
1,071		100.00% Pervious Area

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

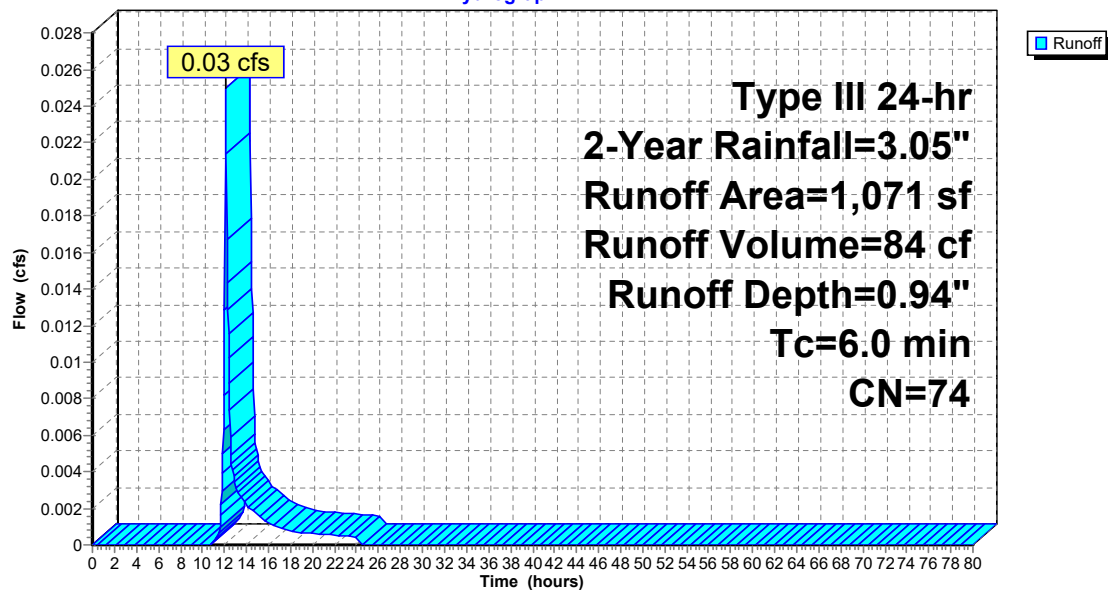
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**Subcatchment P-1f: Filow to Swale****Hydrograph**

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**Summary for Subcatchment P-2: Flow onsite Southeast**

Runoff = 0.41 cfs @ 12.09 hrs, Volume= 1,402 cf, Depth= 2.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
* 5,832	98	Paved parking
381	79	50-75% Grass cover, Fair, HSG C
6,213	97	Weighted Average
381		6.13% Pervious Area
5,832		93.87% Impervious Area

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

**Proposed-6**

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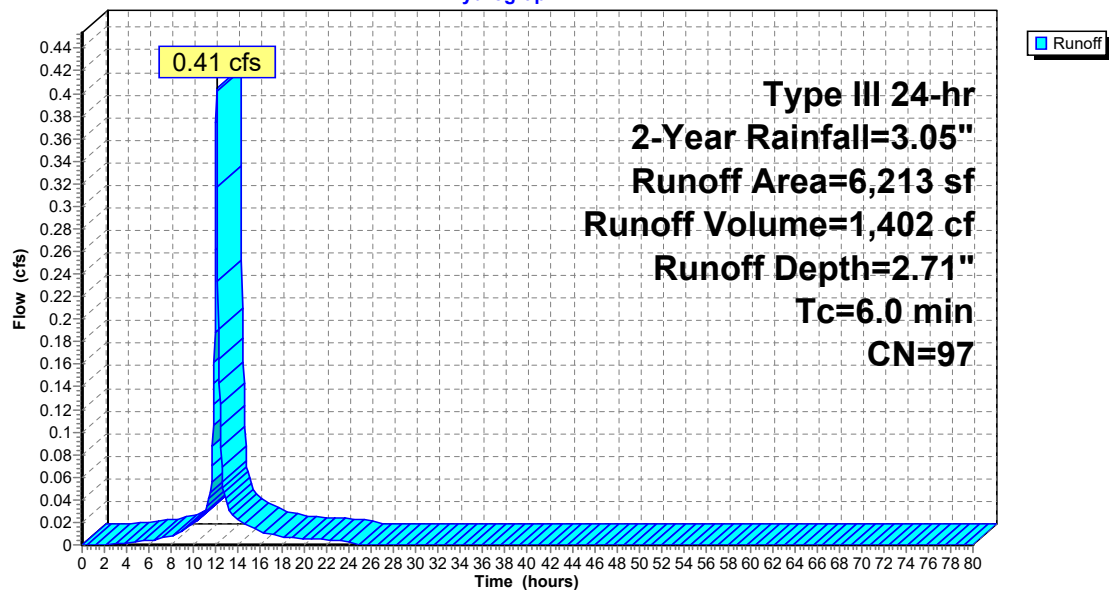
Type III 24-hr 2-Year Rainfall=3.05"

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**Subcatchment P-2: Flow onsite Southeast**

Hydrograph



**Proposed-6**

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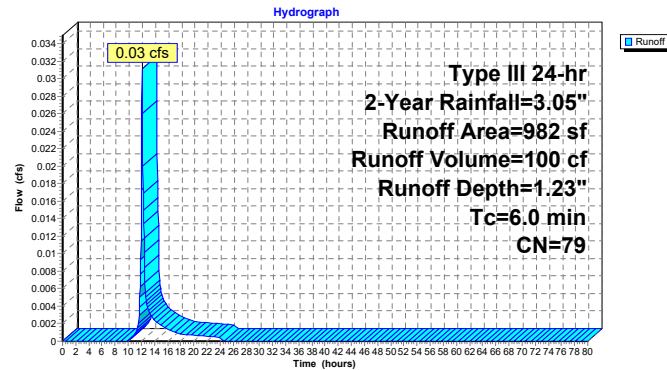
**Summary for Subcatchment P-3: Flow off-site West**

Runoff = 0.03 cfs @ 12.10 hrs, Volume= 100 cf, Depth= 1.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
10	70	Woods, Good, HSG C
972	79	50-75% Grass cover, Fair, HSG C
982	79	Weighted Average
982		100.00% Pervious Area

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

**Subcatchment P-3: Flow off-site West****Proposed-6**

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Type III 24-hr 2-Year Rainfall=3.05"

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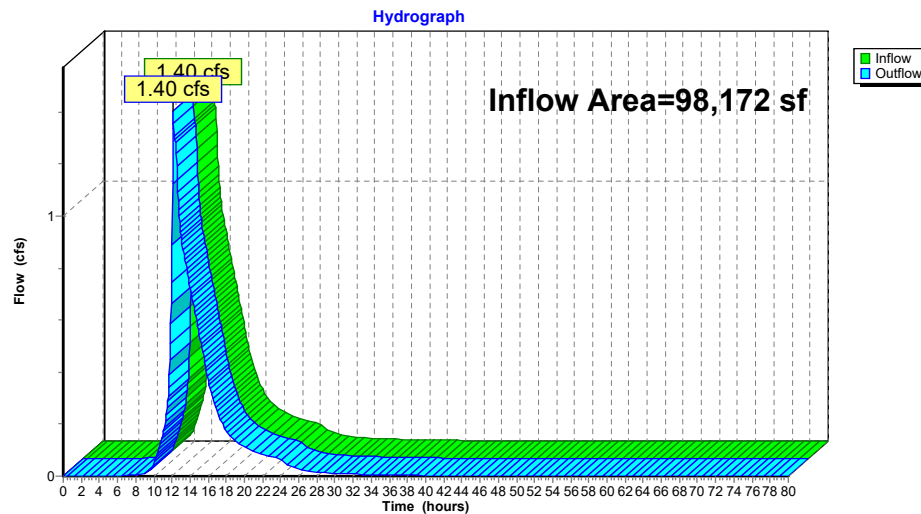
Page 24

**Summary for Reach DP-1: Basin**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 98,172 sf, 75.63% Impervious, Inflow Depth > 2.17" for 2-Year event  
 Inflow = 1.40 cfs @ 12.15 hrs, Volume= 17,732 cf  
 Outflow = 1.40 cfs @ 12.15 hrs, Volume= 17,732 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-1: Basin**

**Proposed-6**

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**Summary for Reach DP-2: Onsite southeast**

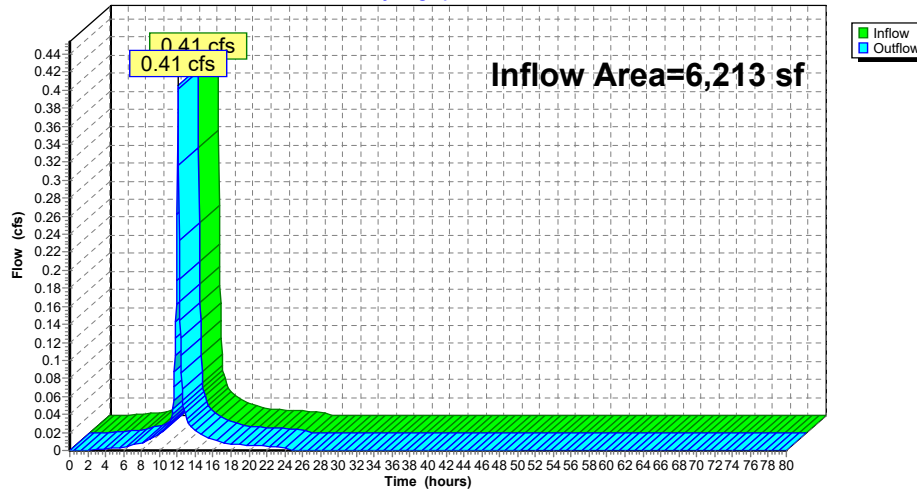
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6,213 sf, 93.87% Impervious, Inflow Depth = 2.71" for 2-Year event  
Inflow = 0.41 cfs @ 12.09 hrs, Volume= 1,402 cf  
Outflow = 0.41 cfs @ 12.09 hrs, Volume= 1,402 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-2: Onsite southeast**

Hydrograph

**Proposed-6**

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**Summary for Reach DP-3: Off-site West**

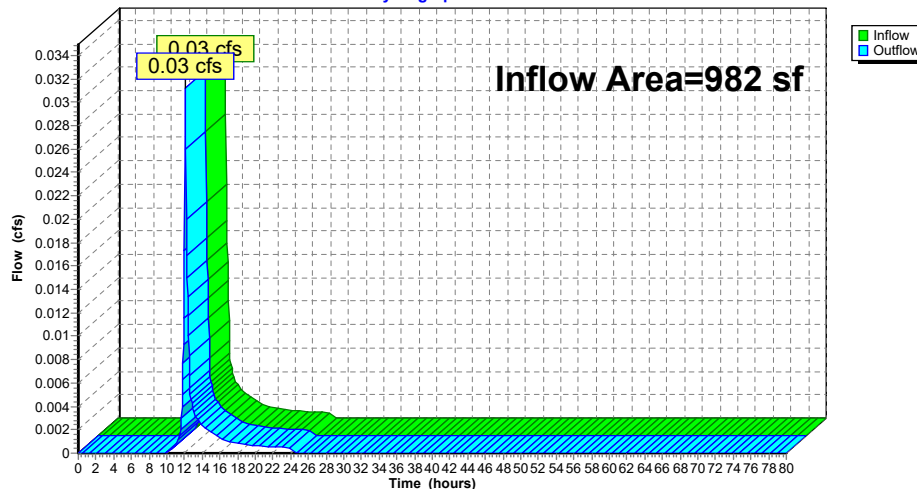
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 982 sf, 0.00% Impervious, Inflow Depth = 1.23" for 2-Year event  
Inflow = 0.03 cfs @ 12.10 hrs, Volume= 100 cf  
Outflow = 0.03 cfs @ 12.10 hrs, Volume= 100 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-3: Off-site West**

Hydrograph



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**Summary for Pond S-1: Rip Rap Swale**

Inflow Area = 1,317 sf, 0.00% Impervious, Inflow Depth = 0.84" for 2-Year event  
 Inflow = 0.03 cfs @ 12.10 hrs, Volume= 92 cf  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6  
 Peak Elev= 333.17' @ 24.40 hrs Surf.Area= 200 sf Storage= 92 cf

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

Volume	Invert	Avail. Storage	Storage Description
#1	331.15'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 414 cf Overall - 114 cf Embedded = 300 cf x 40.0% Voids
#2	332.65'	114 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1
		234 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
331.15	0	0.0	0	0	0
331.50	21	27.2	2	2	59
332.50	171	99.3	84	86	788
332.65	200	104.4	28	114	872
334.15	200	104.4	300	414	1,028

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
332.65	0	0.0	0	0	0
333.00	21	27.2	2	2	59
334.00	171	99.3	84	86	788
334.15	200	104.4	28	114	872

Device	Routing	Invert	Outlet Devices
#1	Primary	334.05'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

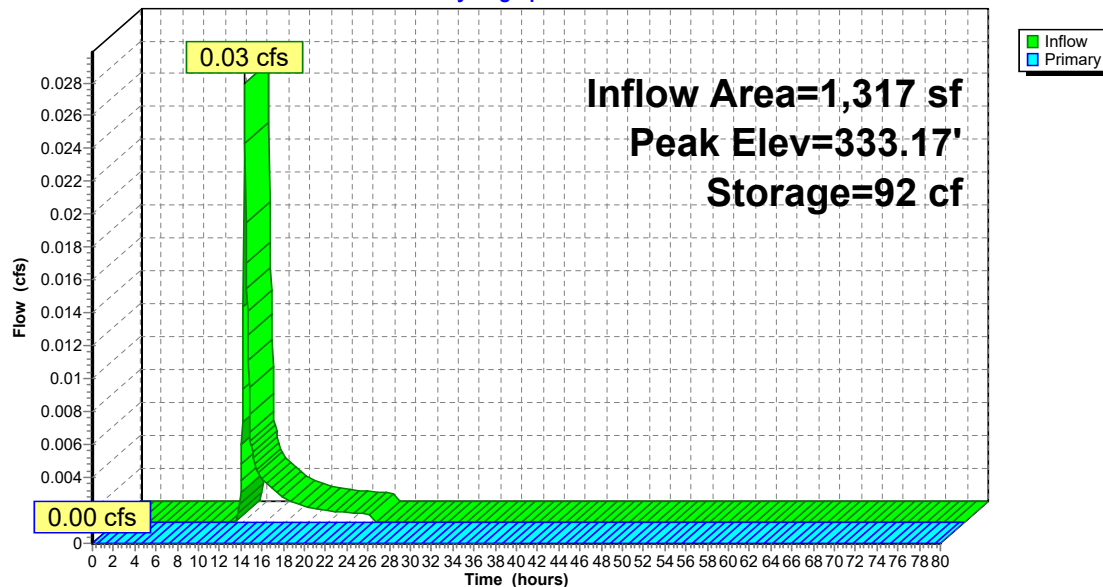
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Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=331.15' (Free Discharge)  
 1=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond S-1: Rip Rap Swale****Hydrograph**

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**Summary for Pond S-2: Rip Rap Swale**

Inflow Area = 2,501 sf, 0.00% Impervious, Inflow Depth = 0.45" for 2-Year event  
 Inflow = 0.03 cfs @ 12.10 hrs, Volume= 93 cf  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6  
 Peak Elev= 331.73' @ 24.40 hrs Surf.Area= 200 sf Storage= 93 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	329.65'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 407 cf Overall - 107 cf Embedded = 300 cf x 40.0% Voids
#2	331.15'	107 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1
		227 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
329.65	0	0.0	0	0	0
330.50	74	61.1	21	21	298
331.15	200	104.5	86	107	873
332.65	200	104.5	300	407	1,029

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
331.15	0	0.0	0	0	0
332.00	74	61.1	21	21	298
332.65	200	104.5	86	107	873

Device	Routing	Invert	Outlet Devices
#1	Primary	332.50'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

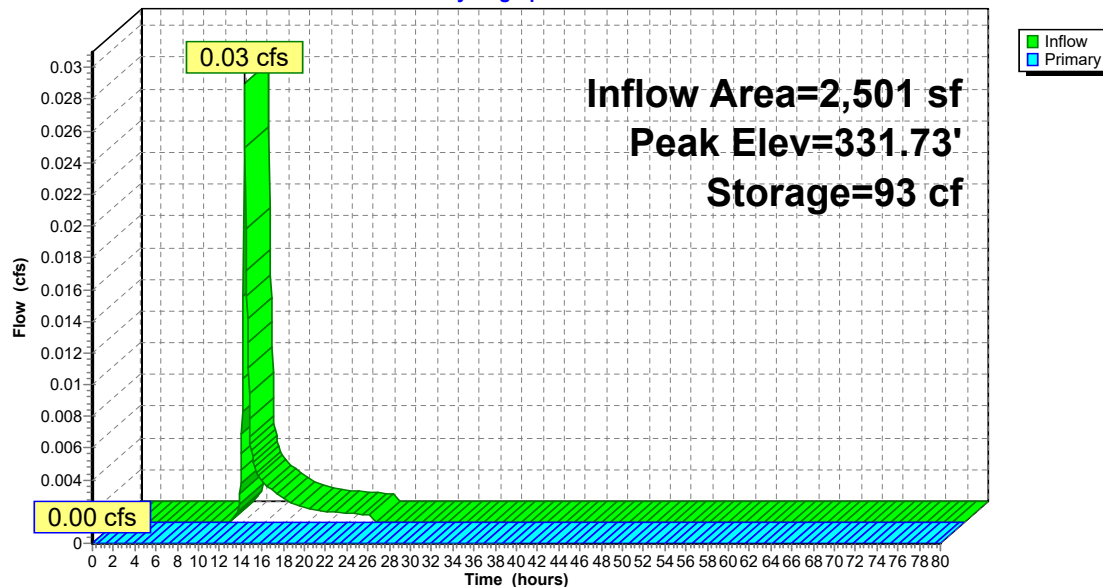
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Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=329.65' (Free Discharge)  
 1=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond S-2: Rip Rap Swale****Hydrograph**

**Proposed-6**

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**Summary for Pond S-3: Rip Rap Swale**

Inflow Area = 3,685 sf, 0.00% Impervious, Inflow Depth = 0.32" for 2-Year event  
 Inflow = 0.03 cfs @ 12.10 hrs, Volume= 98 cf  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6  
 Peak Elev= 330.29' @ 24.40 hrs Surf.Area= 200 sf Storage= 98 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	329.70'	112 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #2
#2	328.20'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)
			412 cf Overall - 112 cf Embedded = 300 cf x 40.0% Voids
			232 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
329.70	0	0.0	0	0	0
330.00	16	23.0	2	2	42
331.00	158	95.1	75	76	722
331.20	200	104.5	36	112	873

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
328.20	0	0.0	0	0	0
328.50	16	23.0	2	2	42
329.50	158	95.1	75	76	722
329.70	200	104.5	36	112	873
331.20	200	104.5	300	412	1,030

Device	Routing	Invert	Outlet Devices
#1	Primary	331.00'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

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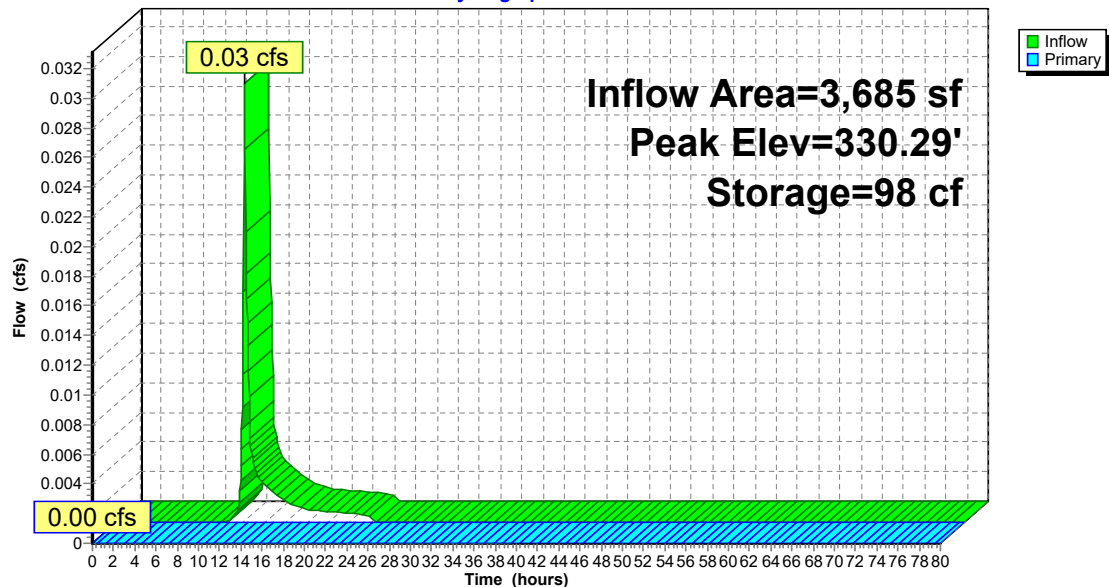
Type III 24-hr 2-Year Rainfall=3.05"

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Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=328.20' (Free Discharge)

1=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond S-3: Rip Rap Swale****Hydrograph**



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**Summary for Pond S-4: Rip Rap Swale**

Inflow Area = 4,756 sf, 0.00% Impervious, Inflow Depth = 0.21" for 2-Year event  
 Inflow = 0.03 cfs @ 12.10 hrs, Volume= 84 cf  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6  
 Peak Elev= 328.70' @ 24.40 hrs Surf.Area= 188 sf Storage= 84 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	328.20'	108 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #2
#2	326.70'	113 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)
			390 cf Overall - 108 cf Embedded = 282 cf x 40.0% Voids
			221 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
328.20	0	0.0	0	0	0
329.00	71	56.9	19	19	259
329.25	112	76.4	23	42	466
329.70	188	102.0	67	108	832

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
326.70	0	0.0	0	0	0
327.50	71	56.9	19	19	259
327.75	112	76.4	23	42	466
328.20	188	102.0	67	108	832
329.70	188	102.0	282	390	985

Device	Routing	Invert	Outlet Devices
#1	Primary	329.25'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

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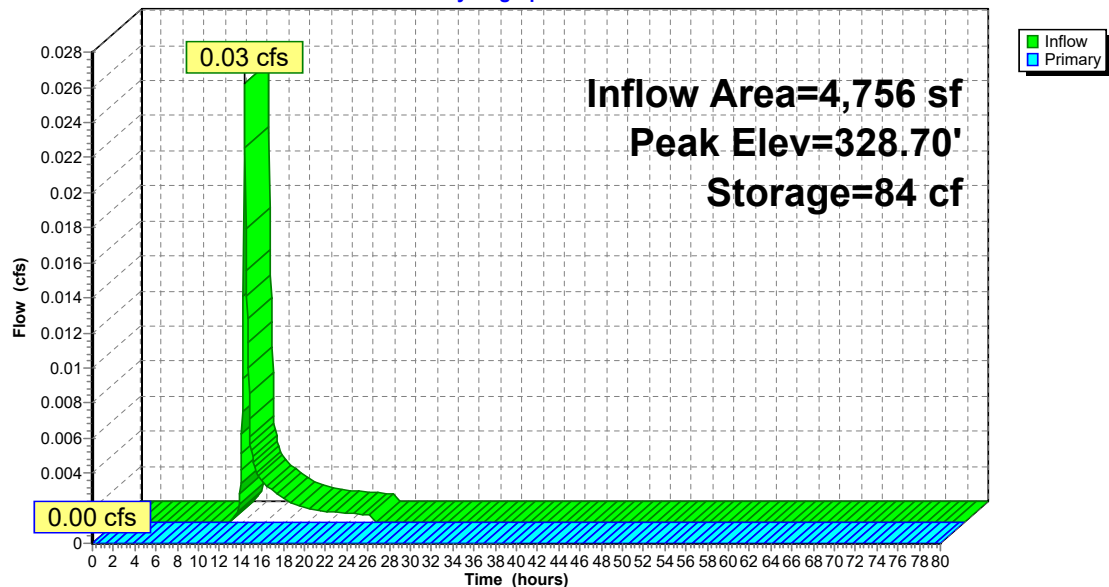
Type III 24-hr 2-Year Rainfall=3.05"

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Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=326.70' (Free Discharge)

1=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond S-4: Rip Rap Swale****Hydrograph**

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**Summary for Pond SSD-1: Subsurface Detention Basin-1**

Inflow Area = 71,428 sf, 99.59% Impervious, Inflow Depth = 2.82" for 2-Year event  
 Inflow = 4.74 cfs @ 12.09 hrs, Volume= 16,774 cf  
 Outflow = 1.01 cfs @ 12.50 hrs, Volume= 15,261 cf, Atten= 79%, Lag= 24.8 min  
 Primary = 1.01 cfs @ 12.50 hrs, Volume= 15,261 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 323.63' @ 12.50 hrs Surf.Area= 7,434 sf Storage= 8,316 cf

Plug-Flow detention time= 234.6 min calculated for 15,261 cf (91% of inflow)  
 Center-of-Mass det. time= 188.6 min ( 946.0 - 757.4 )

Volume	Invert	Avail.Storage	Storage Description
#1A	322.00'	6,586 cf	<b>63.25'W x 117.54'L x 3.50'H Field A</b> 26,020 cf Overall - 9,556 cf Embedded = 16,464 cf x 40.0% Voids
#2A	322.50'	9,556 cf	<b>ADS_StormTech SC-740 +Cap</b> x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 208 Chambers in 13 Rows
		16,141 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	322.50'	<b>15.0" Round Culvert</b> L= 21.3' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 322.50' / 322.00' S= 0.0235 '/ Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	325.25'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#3	Device 1	324.25'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600
#4	Device 1	323.50'	<b>8.0" Vert. Orifice/Grate X 2.00</b> C= 0.600
#5	Device 1	322.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600

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**Primary OutFlow** Max=1.01 cfs @ 12.50 hrs HW=323.63' (Free Discharge)

- 1=Culvert (Passes 1.01 cfs of 4.23 cfs potential flow)
- 2=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)
- 3=Orifice/Grate ( Controls 0.00 cfs)
- 4=Orifice/Grate (Orifice Controls 0.12 cfs @ 1.23 fps)
- 5=Orifice/Grate (Orifice Controls 0.89 cfs @ 4.52 fps)

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**Pond SSD-1: Subsurface Detention Basin-1 - Chamber Wizard Field A**

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

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

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

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

16 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 115.54' Row Length +12.0" End Stone x 2 = 117.54' Base Length

13 Rows x 51.0" Wide + 6.0" Spacing x 12 + 12.0" Side Stone x 2 = 63.25' Base Width

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

208 Chambers x 45.9 cf = 9,555.5 cf Chamber Storage

26,019.7 cf Field - 9,555.5 cf Chambers = 16,464.2 cf Stone x 40.0% Voids = 6,585.7 cf Stone Storage

Chamber Storage + Stone Storage = 16,141.2 cf = 0.371 af

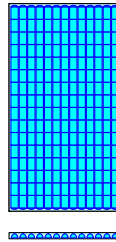
Overall Storage Efficiency = 62.0%

Overall System Size = 117.54' x 63.25' x 3.50'

208 Chambers

963.7 cy Field

609.8 cy Stone

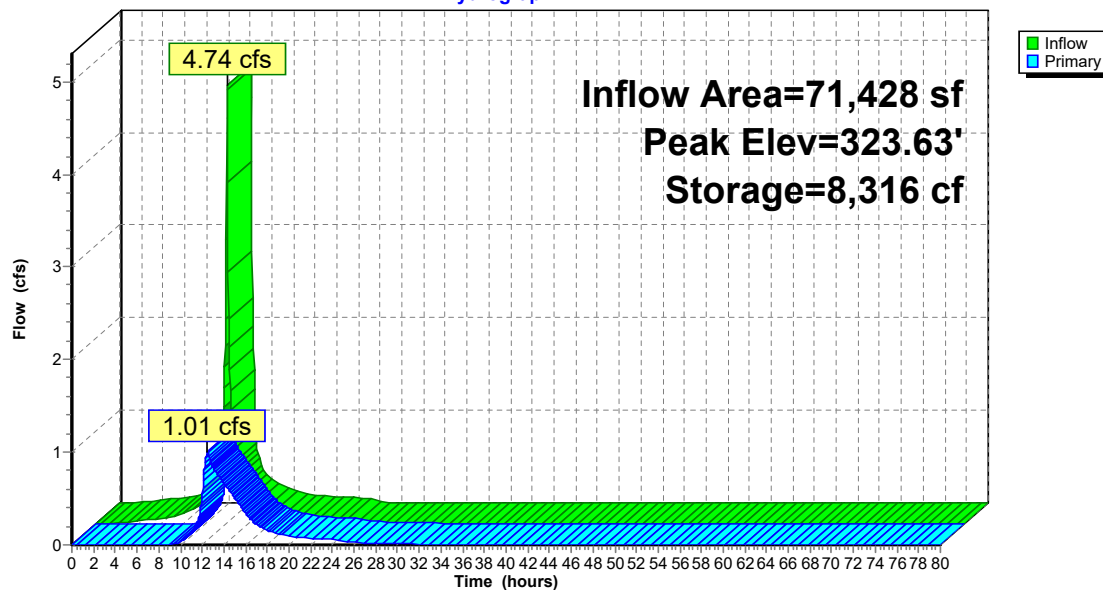
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**Pond SSD-1: Subsurface Detention Basin-1****Hydrograph**



# **HydroCAD Analysis**

## **Proposed Conditions - 10 Year Storm**



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Page 1

**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
18,555	79	50-75% Grass cover, Fair, HSG C (P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3)
80,078	98	Paved parking (P-1a, P-1b, P-2)
1,396	66	Rip Rap Swale (P-1c, P-1d, P-1e, P-1f)
5,338	70	Woods, Good, HSG C (P-1, P-1c, P-1d, P-1e, P-1f, P-3)
<b>105,367</b>	<b>93</b>	<b>TOTAL AREA</b>

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**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
23,893	HSG C	P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3
0	HSG D	
81,474	Other	P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2
<b>105,367</b>		<b>TOTAL AREA</b>

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**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	Subcatchment Numbers
0	0	18,555	0	0	18,555	50-75% Grass cover, Fair	P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3
0	0	0	0	80,078	80,078	Paved parking	P-1a, P-1b, P-2
0	0	0	0	1,396	1,396	Rip Rap Swale	P-1c, P-1d, P-1e, P-1f
0	0	5,338	0	0	5,338	Woods, Good	P-1, P-1c, P-1d, P-1e, P-1f, P-3
<b>0</b>	<b>0</b>	<b>23,893</b>	<b>0</b>	<b>81,474</b>	<b>105,367</b>	<b>TOTAL AREA</b>	

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**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	SSD-1	322.50	322.00	21.3	0.0235	0.013	15.0	0.0	0.0



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Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment P-1: Flow to Existing Basin</b>	Runoff Area=18,417 sf 0.00% Impervious Runoff Depth=2.75" Flow Length=461' Tc=10.0 min CN=77 Runoff=1.18 cfs 4,219 cf
<b>Subcatchment P-1a: Flow to SSI-1</b>	Runoff Area=71,428 sf 99.59% Impervious Runoff Depth=4.91" Tc=6.0 min CN=98 Runoff=8.07 cfs 29,243 cf
<b>Subcatchment P-1b: Flow to Treatment Unit</b>	Runoff Area=3,571 sf 87.17% Impervious Runoff Depth=4.68" Tc=6.0 min CN=96 Runoff=0.40 cfs 1,393 cf
<b>Subcatchment P-1c: Flow to Swale</b>	Runoff Area=1,317 sf 0.00% Impervious Runoff Depth=2.31" Tc=6.0 min CN=72 Runoff=0.08 cfs 254 cf
<b>Subcatchment P-1d: Flow to Swale</b>	Runoff Area=1,184 sf 0.00% Impervious Runoff Depth=2.48" Tc=6.0 min CN=74 Runoff=0.08 cfs 245 cf
<b>Subcatchment P-1e: Flow to Swale</b>	Runoff Area=1,184 sf 0.00% Impervious Runoff Depth=2.57" Tc=6.0 min CN=75 Runoff=0.08 cfs 254 cf
<b>Subcatchment P-1f: Flow to Swale</b>	Runoff Area=1,071 sf 0.00% Impervious Runoff Depth=2.48" Tc=6.0 min CN=74 Runoff=0.07 cfs 222 cf
<b>Subcatchment P-2: Flow onsite Southeast</b>	Runoff Area=6,213 sf 93.87% Impervious Runoff Depth=4.80" Tc=6.0 min CN=97 Runoff=0.70 cfs 2,483 cf
<b>Subcatchment P-3: Flow off-site West</b>	Runoff Area=982 sf 0.00% Impervious Runoff Depth=2.93" Tc=6.0 min CN=79 Runoff=0.08 cfs 240 cf
<b>Reach DP-1: Basin</b>	Inflow=4.29 cfs 33,560 cf Outflow=4.29 cfs 33,560 cf
<b>Reach DP-2: Onsite southeast</b>	Inflow=0.70 cfs 2,483 cf Outflow=0.70 cfs 2,483 cf

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<b>Reach DP-3: Off-site West</b>	Inflow=0.08 cfs 240 cf Outflow=0.08 cfs 240 cf
<b>Pond S-1: Rip Rap Swale</b>	Peak Elev=334.05' Storage=215 cf Inflow=0.08 cfs 254 cf Outflow=0.00 cfs 39 cf
<b>Pond S-2: Rip Rap Swale</b>	Peak Elev=332.50' Storage=198 cf Inflow=0.08 cfs 284 cf Outflow=0.00 cfs 86 cf
<b>Pond S-3: Rip Rap Swale</b>	Peak Elev=331.00' Storage=195 cf Inflow=0.08 cfs 340 cf Outflow=0.01 cfs 145 cf
<b>Pond S-4: Rip Rap Swale</b>	Peak Elev=329.25' Storage=148 cf Inflow=0.07 cfs 367 cf Outflow=0.01 cfs 219 cf
<b>Pond SSD-1: Subsurface Detention Basin-1</b>	Peak Elev=324.20' Storage=11,384 cf Inflow=8.07 cfs 29,243 cf Outflow=3.18 cfs 27,728 cf

**Total Runoff Area = 105,367 sf Runoff Volume = 38,553 cf Average Runoff Depth = 4.39"**  
**24.00% Pervious = 25,289 sf 76.00% Impervious = 80,078 sf**

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**Summary for Subcatchment P-1: Flow to Existing Basin**

Runoff = 1.18 cfs @ 12.15 hrs, Volume= 4,219 cf, Depth= 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
4,454	70	Woods, Good, HSG C
13,963	79	50-75% Grass cover, Fair, HSG C
18,417	77	Weighted Average
18,417		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0800	0.11		<b>Sheet Flow, Sheet Flow</b>
					Woods: Light underbrush n= 0.400 P2= 3.05"
2.7	411	0.0240	2.49		<b>Shallow Concentrated Flow,</b>
					Unpaved Kv= 16.1 fps
10.0	461	Total			

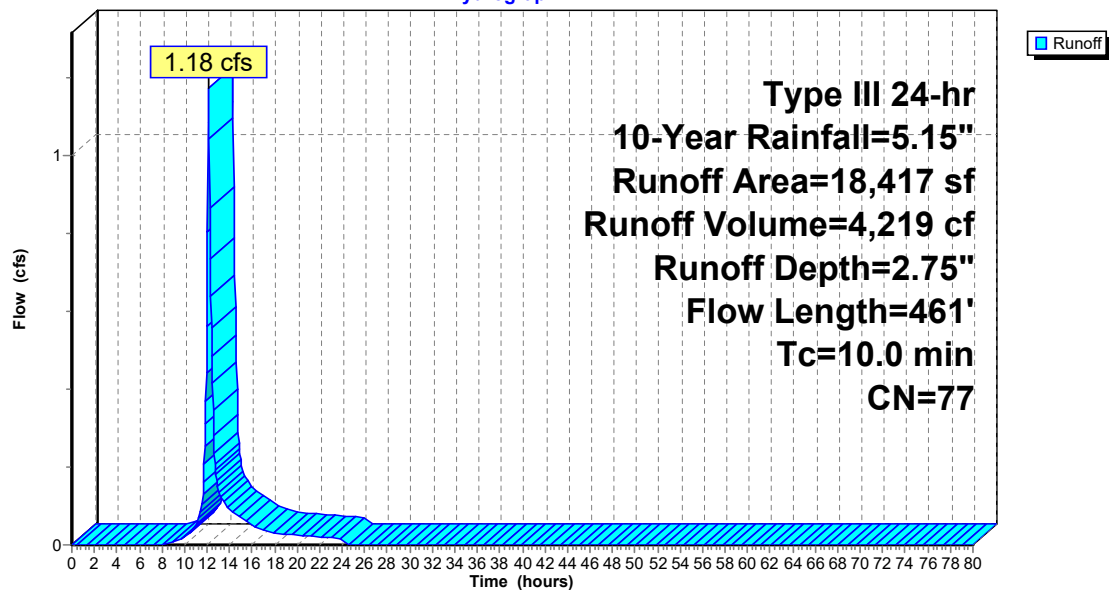
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**Subcatchment P-1: Flow to Existing Basin****Hydrograph**

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**Summary for Subcatchment P-1a: Flow to SSI-1**

Runoff = 8.07 cfs @ 12.09 hrs, Volume= 29,243 cf, Depth= 4.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 71,133	98	Paved parking
295	79	50-75% Grass cover, Fair, HSG C
71,428	98	Weighted Average
295		0.41% Pervious Area
71,133		99.59% Impervious Area

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

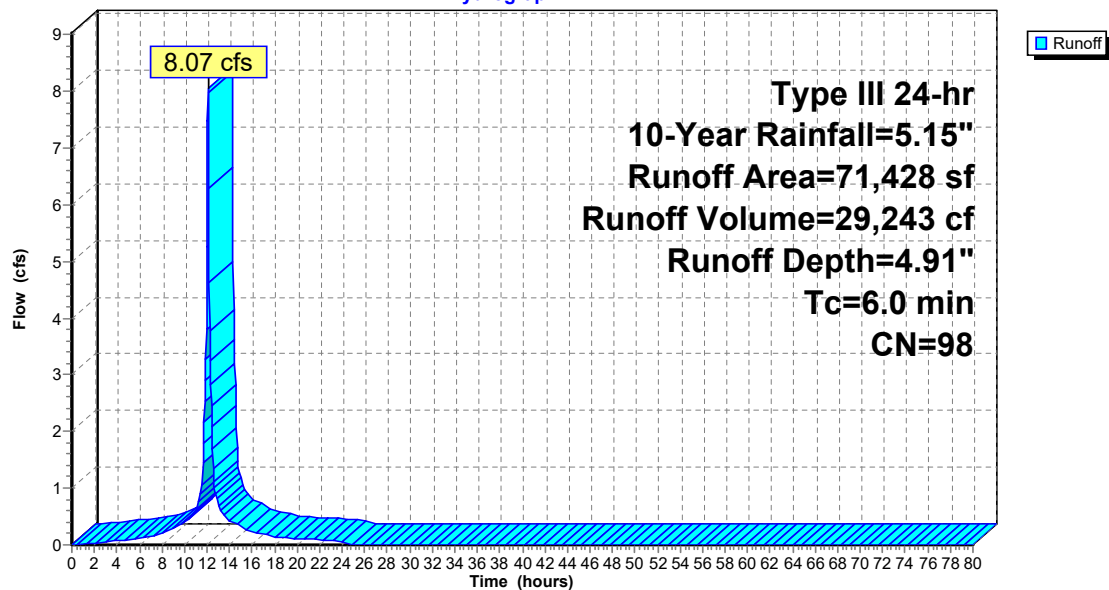
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**Subcatchment P-1a: Flow to SSI-1****Hydrograph**

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**Summary for Subcatchment P-1b: Flow to Treatment Unit**

Runoff = 0.40 cfs @ 12.09 hrs, Volume= 1,393 cf, Depth= 4.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 3,113	98	Paved parking
458	79	50-75% Grass cover, Fair, HSG C
3,571	96	Weighted Average
458		12.83% Pervious Area
3,113		87.17% Impervious Area

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

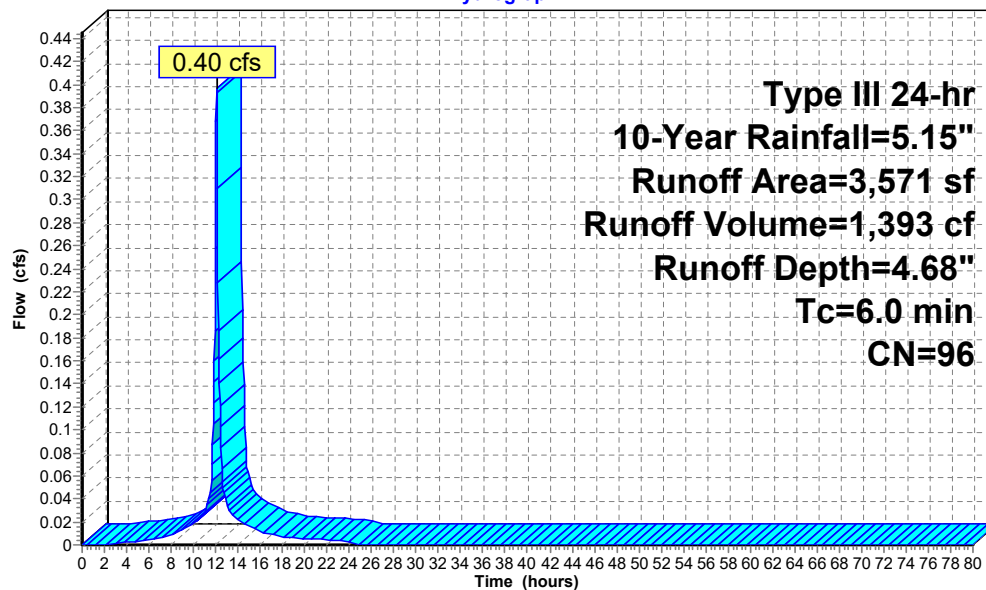
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**Subcatchment P-1b: Flow to Treatment Unit****Hydrograph**

Runoff

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

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**Summary for Subcatchment P-1c: Filow to Swale**

Runoff = 0.08 cfs @ 12.10 hrs, Volume= 254 cf, Depth= 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 339	66	Rip Rap Swale
476	70	Woods, Good, HSG C
502	79	50-75% Grass cover, Fair, HSG C
1,317	72	Weighted Average
1,317		100.00% Pervious Area

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

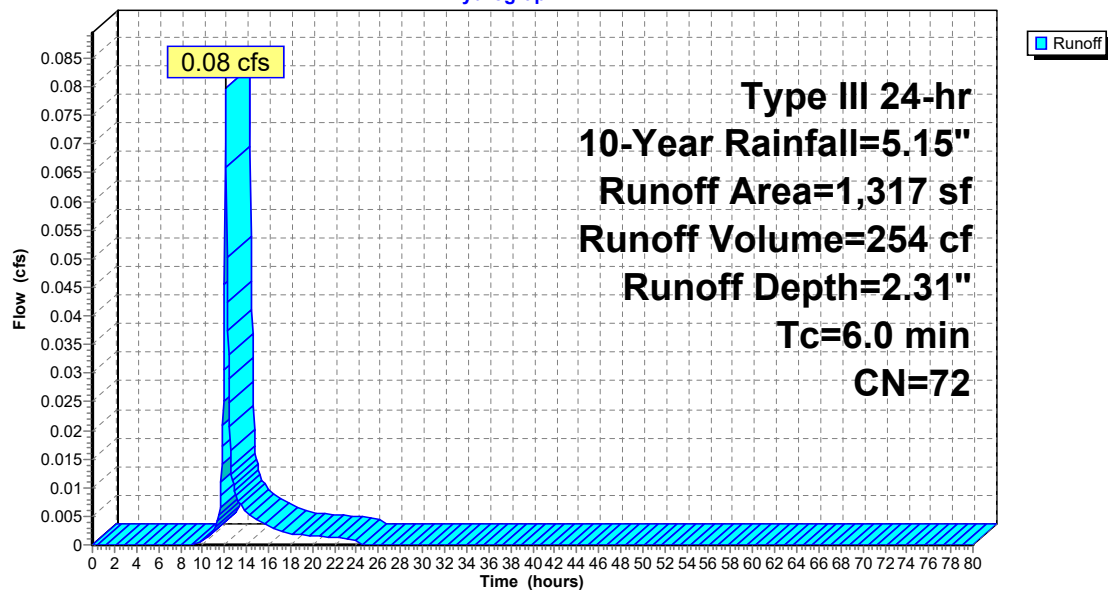
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**Subcatchment P-1c: Filow to Swale****Hydrograph**

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**Summary for Subcatchment P-1d: Filow to Swale**

Runoff = 0.08 cfs @ 12.09 hrs, Volume= 245 cf, Depth= 2.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 350	66	Rip Rap Swale
216	70	Woods, Good, HSG C
618	79	50-75% Grass cover, Fair, HSG C
1,184	74	Weighted Average
1,184		100.00% Pervious Area

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

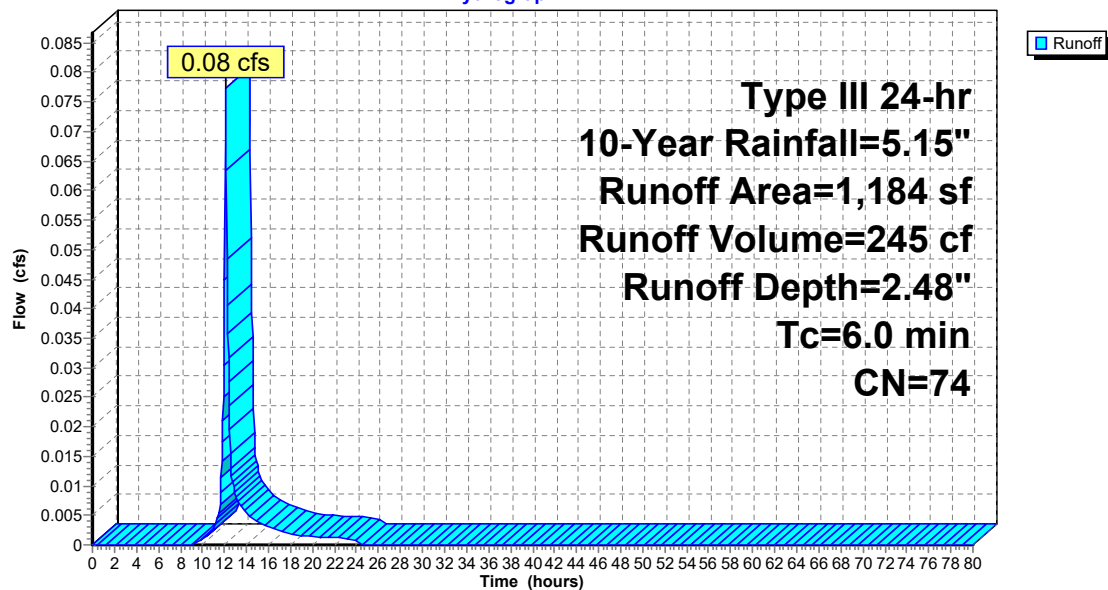
**Proposed-6**

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

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**Subcatchment P-1d: Filow to Swale****Hydrograph**

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**Summary for Subcatchment P-1e: Filow to Swale**

Runoff = 0.08 cfs @ 12.09 hrs, Volume= 254 cf, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 350	66	Rip Rap Swale
58	70	Woods, Good, HSG C
776	79	50-75% Grass cover, Fair, HSG C
1,184	75	Weighted Average
1,184		100.00% Pervious Area

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

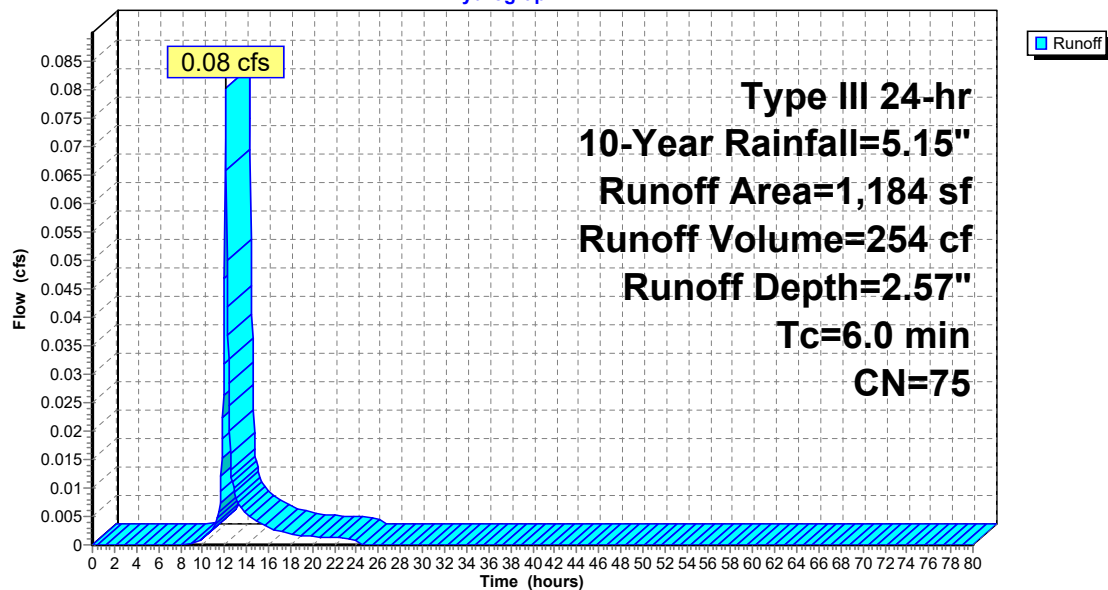
**Proposed-6**

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**Subcatchment P-1e: Filow to Swale****Hydrograph**

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**Summary for Subcatchment P-1f: Filow to Swale**

Runoff = 0.07 cfs @ 12.09 hrs, Volume= 222 cf, Depth= 2.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 357	66	Rip Rap Swale
124	70	Woods, Good, HSG C
590	79	50-75% Grass cover, Fair, HSG C
1,071	74	Weighted Average
1,071		100.00% Pervious Area

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

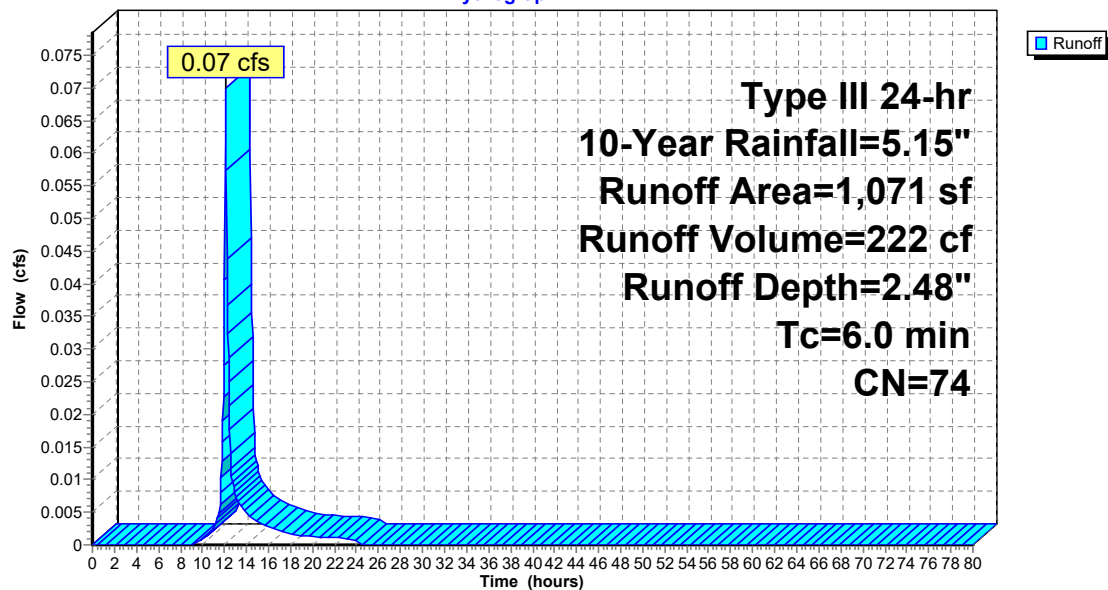
**Proposed-6**

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**Subcatchment P-1f: Filow to Swale****Hydrograph**



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

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**Summary for Subcatchment P-2: Flow onsite Southeast**

Runoff = 0.70 cfs @ 12.09 hrs, Volume= 2,483 cf, Depth= 4.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
* 5,832	98	Paved parking
381	79	50-75% Grass cover, Fair, HSG C
6,213	97	Weighted Average
381		6.13% Pervious Area
5,832		93.87% Impervious Area

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

**Proposed-6**

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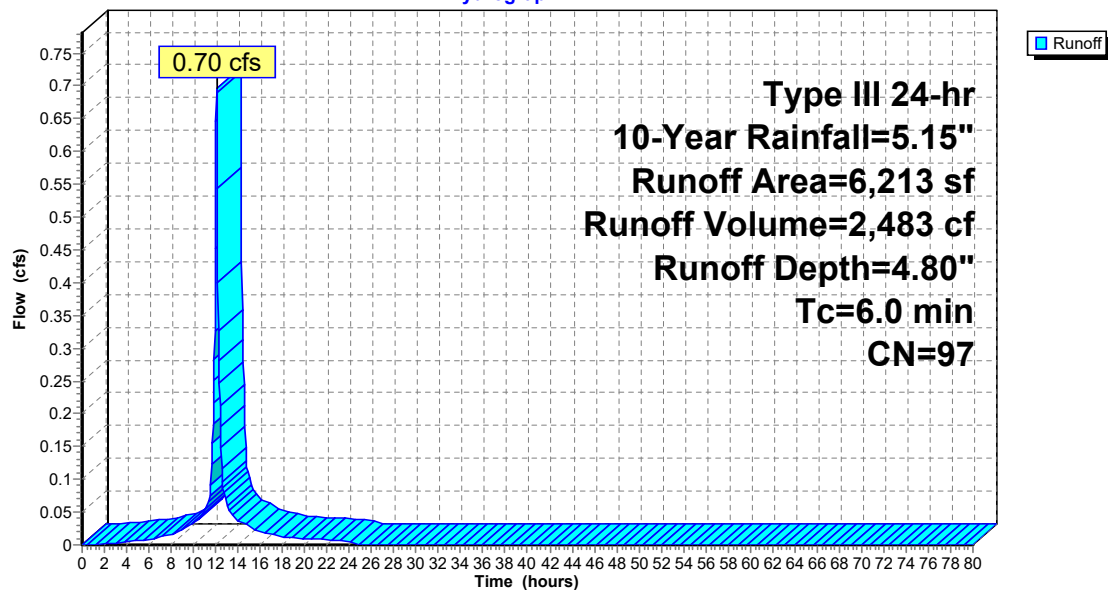
Type III 24-hr 10-Year Rainfall=5.15"

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**Subcatchment P-2: Flow onsite Southeast**

Hydrograph



**Proposed-6**

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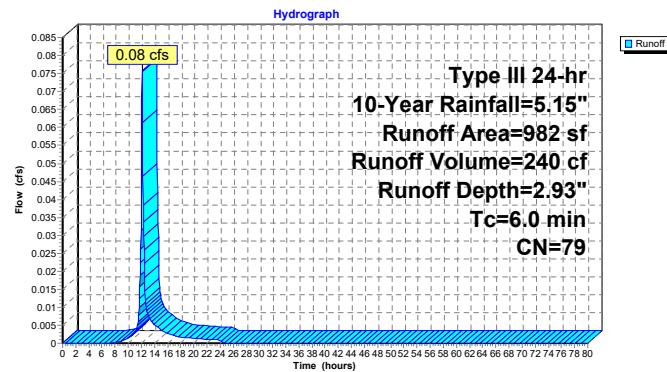
**Summary for Subcatchment P-3: Flow off-site West**

Runoff = 0.08 cfs @ 12.09 hrs, Volume= 240 cf, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
10	70	Woods, Good, HSG C
972	79	50-75% Grass cover, Fair, HSG C
982	79	Weighted Average
982		100.00% Pervious Area

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

**Subcatchment P-3: Flow off-site West****Proposed-6**

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

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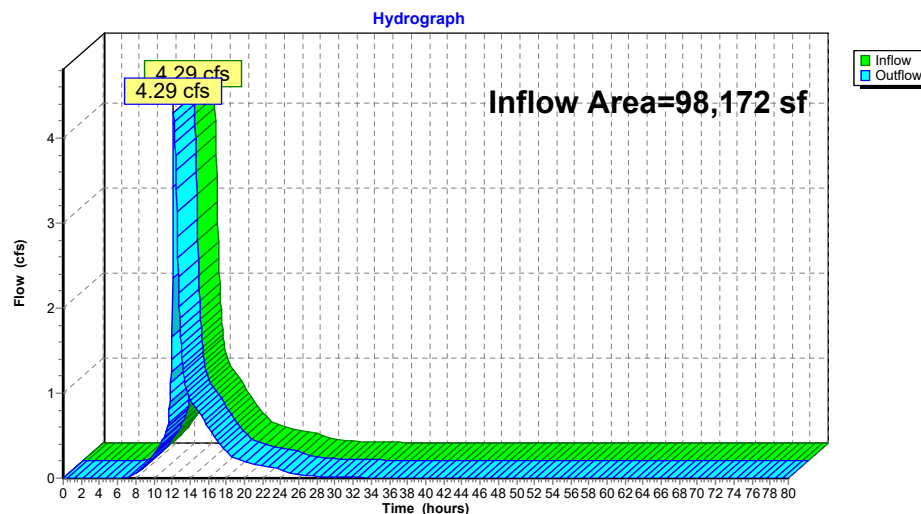
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**Summary for Reach DP-1: Basin**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 98,172 sf, 75.63% Impervious, Inflow Depth = 4.10" for 10-Year event  
 Inflow = 4.29 cfs @ 12.20 hrs, Volume= 33,560 cf  
 Outflow = 4.29 cfs @ 12.20 hrs, Volume= 33,560 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-1: Basin**

**Proposed-6**

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

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**Summary for Reach DP-2: Onsite southeast**

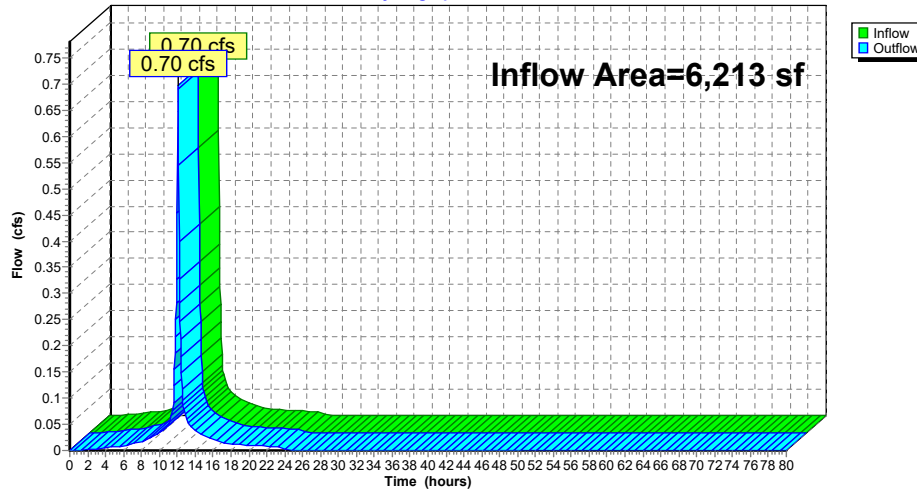
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6,213 sf, 93.87% Impervious, Inflow Depth = 4.80" for 10-Year event  
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 2,483 cf  
Outflow = 0.70 cfs @ 12.09 hrs, Volume= 2,483 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-2: Onsite southeast**

Hydrograph

**Proposed-6**

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

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**Summary for Reach DP-3: Off-site West**

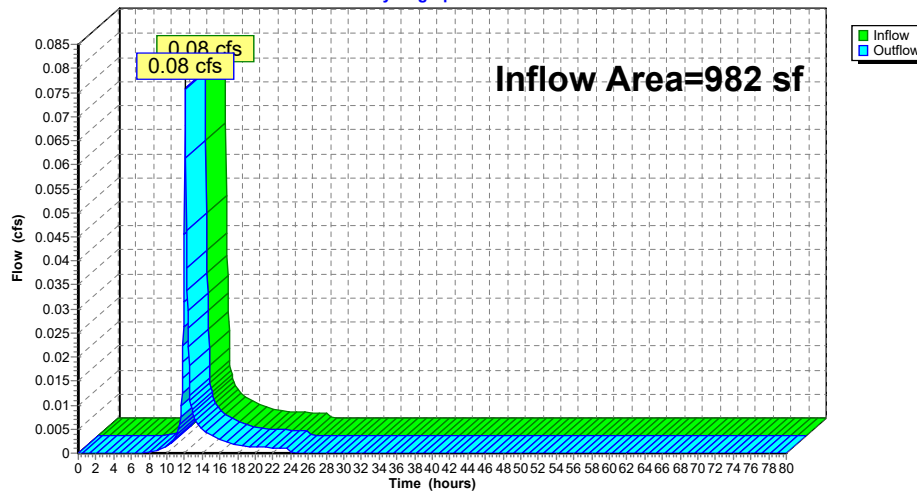
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 982 sf, 0.00% Impervious, Inflow Depth = 2.93" for 10-Year event  
Inflow = 0.08 cfs @ 12.09 hrs, Volume= 240 cf  
Outflow = 0.08 cfs @ 12.09 hrs, Volume= 240 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-3: Off-site West**

Hydrograph



**Proposed-6**

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

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**Summary for Pond S-1: Rip Rap Swale**

Inflow Area = 1,317 sf, 0.00% Impervious, Inflow Depth = 2.31" for 10-Year event  
 Inflow = 0.08 cfs @ 12.10 hrs, Volume= 254 cf  
 Outflow = 0.00 cfs @ 17.20 hrs, Volume= 39 cf, Atten= 97%, Lag= 306.3 min  
 Primary = 0.00 cfs @ 17.20 hrs, Volume= 39 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6  
 Peak Elev= 334.05' @ 17.20 hrs Surf.Area= 200 sf Storage= 215 cf

Plug-Flow detention time= 517.4 min calculated for 39 cf (15% of inflow)  
 Center-of-Mass det. time= 369.3 min ( 1,210.3 - 841.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	331.15'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 414 cf Overall - 114 cf Embedded = 300 cf x 40.0% Voids
#2	332.65'	114 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1
		234 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
331.15	0	0.0	0	0	0
331.50	21	27.2	2	2	59
332.50	171	99.3	84	86	788
332.65	200	104.4	28	114	872
334.15	200	104.4	300	414	1,028

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
332.65	0	0.0	0	0	0
333.00	21	27.2	2	2	59
334.00	171	99.3	84	86	788
334.15	200	104.4	28	114	872

Device	Routing	Invert	Outlet Devices
#1	Primary	334.05'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

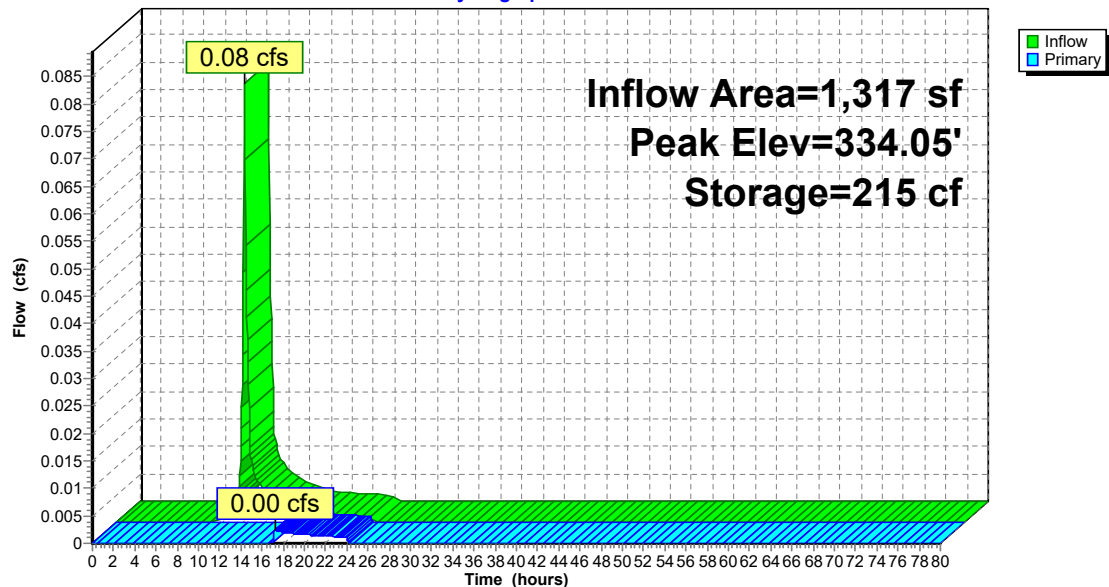
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Type III 24-hr 10-Year Rainfall=5.15"

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Primary OutFlow Max=0.00 cfs @ 17.20 hrs HW=334.05' (Free Discharge)  
 1=Sharp-Crested Rectangular Weir (Weir Controls 0.00 cfs @ 0.11 fps)

**Pond S-1: Rip Rap Swale****Hydrograph**

**Proposed-6**

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**Summary for Pond S-2: Rip Rap Swale**

Inflow Area = 2,501 sf, 0.00% Impervious, Inflow Depth = 1.36" for 10-Year event  
 Inflow = 0.08 cfs @ 12.09 hrs, Volume= 284 cf  
 Outflow = 0.00 cfs @ 17.23 hrs, Volume= 86 cf, Atten= 94%, Lag= 308.2 min  
 Primary = 0.00 cfs @ 17.23 hrs, Volume= 86 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6  
 Peak Elev= 332.50' @ 17.23 hrs Surf.Area= 200 sf Storage= 198 cf

Plug-Flow detention time= 475.9 min calculated for 86 cf (30% of inflow)  
 Center-of-Mass det. time= 296.3 min ( 1,183.8 - 887.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	329.65'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 407 cf Overall - 107 cf Embedded = 300 cf x 40.0% Voids
#2	331.15'	107 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1
		227 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
329.65	0	0.0	0	0	0
330.50	74	61.1	21	21	298
331.15	200	104.5	86	107	873
332.65	200	104.5	300	407	1,029

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
331.15	0	0.0	0	0	0
332.00	74	61.1	21	21	298
332.65	200	104.5	86	107	873

Device	Routing	Invert	Outlet Devices
#1	Primary	332.50'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

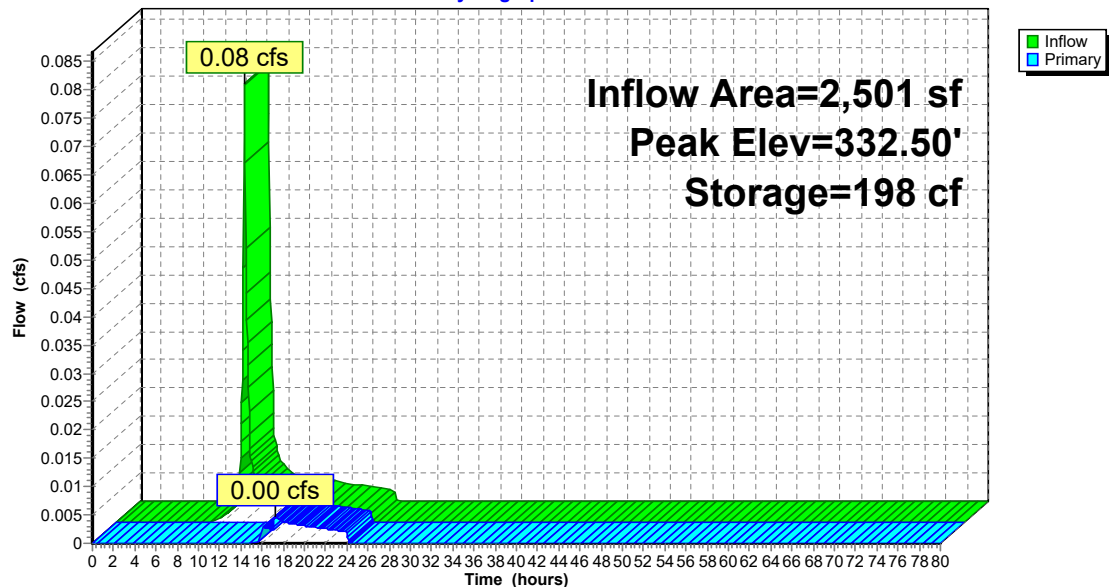
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Primary OutFlow Max=0.00 cfs @ 17.23 hrs HW=332.50' (Free Discharge)  
 1=Sharp-Crested Rectangular Weir (Weir Controls 0.00 cfs @ 0.11 fps)

**Pond S-2: Rip Rap Swale****Hydrograph**

**Proposed-6**

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**Summary for Pond S-3: Rip Rap Swale**

Inflow Area = 3,685 sf, 0.00% Impervious, Inflow Depth = 1.11" for 10-Year event  
 Inflow = 0.08 cfs @ 12.09 hrs, Volume= 340 cf  
 Outflow = 0.01 cfs @ 17.26 hrs, Volume= 145 cf, Atten= 91%, Lag= 309.9 min  
 Primary = 0.01 cfs @ 17.26 hrs, Volume= 145 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6  
 Peak Elev= 331.00' @ 17.26 hrs Surf.Area= 200 sf Storage= 195 cf

Plug-Flow detention time= 438.1 min calculated for 145 cf (43% of inflow)  
 Center-of-Mass det. time= 235.3 min ( 1,157.5 - 922.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	329.70'	112 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #2
#2	328.20'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)
			412 cf Overall - 112 cf Embedded = 300 cf x 40.0% Voids
			232 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
329.70	0	0.0	0	0	0
330.00	16	23.0	2	2	42
331.00	158	95.1	75	76	722
331.20	200	104.5	36	112	873

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
328.20	0	0.0	0	0	0
328.50	16	23.0	2	2	42
329.50	158	95.1	75	76	722
329.70	200	104.5	36	112	873
331.20	200	104.5	300	412	1,030

Device	Routing	Invert	Outlet Devices
#1	Primary	331.00'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

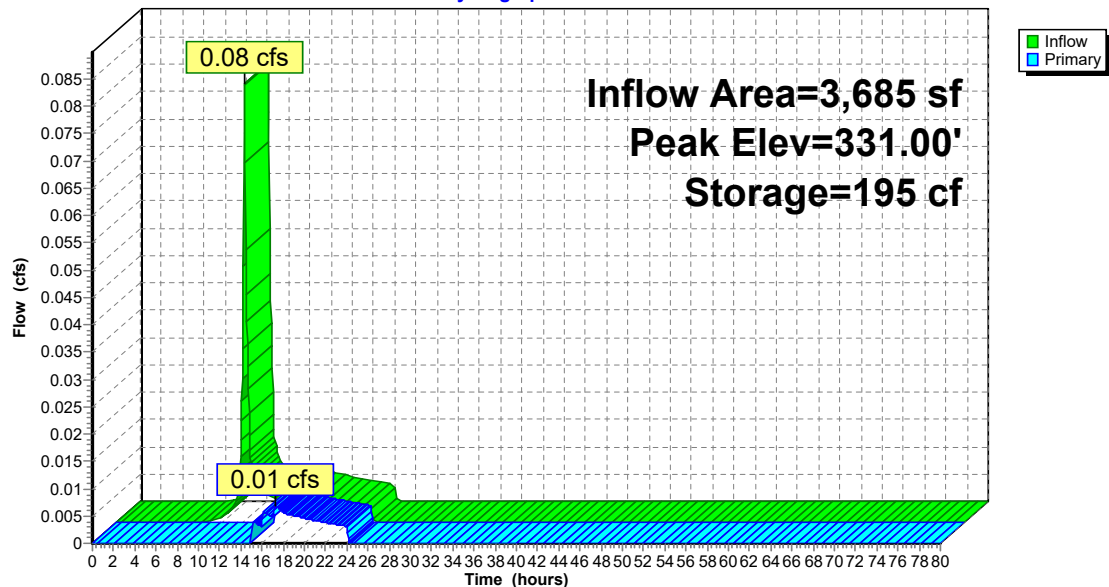
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**Primary OutFlow** Max=0.00 cfs @ 17.26 hrs HW=331.00' (Free Discharge)  
 1=Sharp-Crested Rectangular Weir (Weir Controls 0.00 cfs @ 0.15 fps)

**Pond S-3: Rip Rap Swale****Hydrograph**

**Proposed-6**

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**Summary for Pond S-4: Rip Rap Swale**

Inflow Area = 4,756 sf, 0.00% Impervious, Inflow Depth = 0.93" for 10-Year event  
 Inflow = 0.07 cfs @ 12.09 hrs, Volume= 367 cf  
 Outflow = 0.01 cfs @ 17.27 hrs, Volume= 219 cf, Atten= 87%, Lag= 310.3 min  
 Primary = 0.01 cfs @ 17.27 hrs, Volume= 219 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6  
 Peak Elev= 329.25' @ 17.27 hrs Surf.Area= 188 sf Storage= 148 cf

Plug-Flow detention time= 320.0 min calculated for 219 cf (60% of inflow)  
 Center-of-Mass det. time= 155.6 min ( 1,118.7 - 963.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	328.20'	108 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #2
#2	326.70'	113 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)
			390 cf Overall - 108 cf Embedded = 282 cf x 40.0% Voids
			221 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
328.20	0	0.0	0	0	0
329.00	71	56.9	19	19	259
329.25	112	76.4	23	42	466
329.70	188	102.0	67	108	832

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
326.70	0	0.0	0	0	0
327.50	71	56.9	19	19	259
327.75	112	76.4	23	42	466
328.20	188	102.0	67	108	832
329.70	188	102.0	282	390	985

Device	Routing	Invert	Outlet Devices
#1	Primary	329.25'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

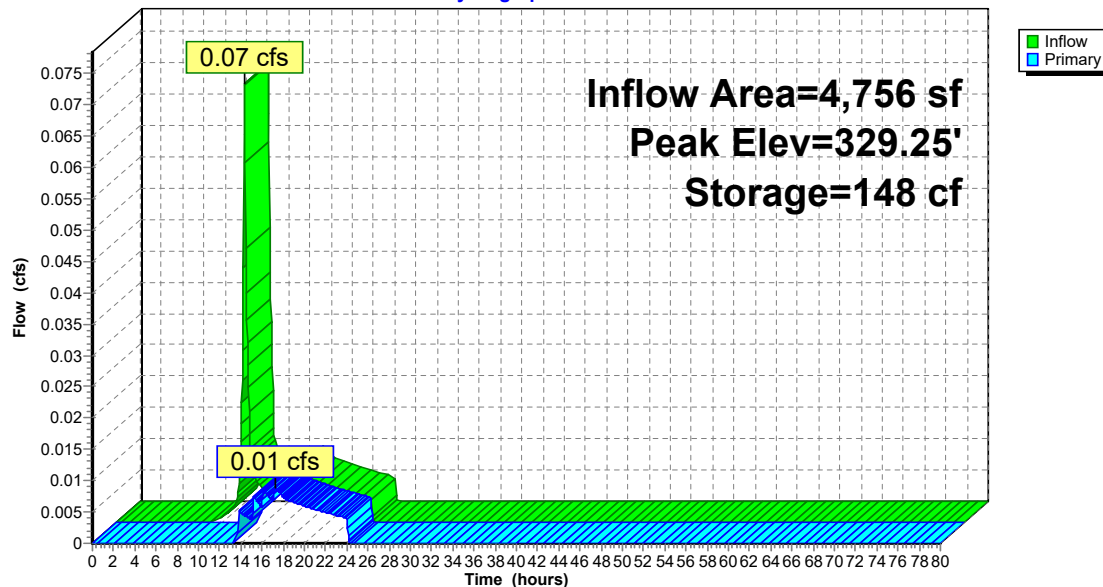
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Primary OutFlow Max=0.00 cfs @ 17.27 hrs HW=329.25' (Free Discharge)  
 1=Sharp-Crested Rectangular Weir (Weir Controls 0.00 cfs @ 0.15 fps)

**Pond S-4: Rip Rap Swale****Hydrograph**

**Proposed-6**

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**Summary for Pond SSD-1: Subsurface Detention Basin-1**

Inflow Area = 71,428 sf, 99.59% Impervious, Inflow Depth = 4.91" for 10-Year event  
 Inflow = 8.07 cfs @ 12.09 hrs, Volume= 29,243 cf  
 Outflow = 3.18 cfs @ 12.31 hrs, Volume= 27,728 cf, Atten= 61%, Lag= 13.5 min  
 Primary = 3.18 cfs @ 12.31 hrs, Volume= 27,728 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 324.20' @ 12.31 hrs Surf.Area= 7,434 sf Storage= 11,384 cf

Plug-Flow detention time= 174.8 min calculated for 27,728 cf (95% of inflow)  
 Center-of-Mass det. time= 144.7 min ( 892.2 - 747.5 )

Volume	Invert	Avail.Storage	Storage Description
#1A	322.00'	6,586 cf	<b>63.25'W x 117.54'L x 3.50'H Field A</b> 26,020 cf Overall - 9,556 cf Embedded = 16,464 cf x 40.0% Voids
#2A	322.50'	9,556 cf	<b>ADS_StormTech SC-740 +Cap</b> x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 208 Chambers in 13 Rows
		16,141 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	322.50'	<b>15.0" Round Culvert</b> L= 21.3' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 322.50' / 322.00' S= 0.0235 '/ Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	325.25'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#3	Device 1	324.25'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600
#4	Device 1	323.50'	<b>8.0" Vert. Orifice/Grate X 2.00</b> C= 0.600
#5	Device 1	322.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600

**Proposed-6**

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**Primary OutFlow** Max=3.17 cfs @ 12.31 hrs HW=324.20' (Free Discharge)

- 1=Culvert (Passes 3.17 cfs of 6.13 cfs potential flow)
- 2=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)
- 3=Orifice/Grate ( Controls 0.00 cfs)
- 4=Orifice/Grate (Orifice Controls 2.03 cfs @ 2.91 fps)
- 5=Orifice/Grate (Orifice Controls 1.14 cfs @ 5.80 fps)



**Proposed-6**

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### Pond SSD-1: Subsurface Detention Basin-1 - Chamber Wizard Field A

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

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

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

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

16 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 115.54' Row Length +12.0" End Stone x 2 = 117.54' Base Length

13 Rows x 51.0" Wide + 6.0" Spacing x 12 + 12.0" Side Stone x 2 = 63.25' Base Width

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

208 Chambers x 45.9 cf = 9,555.5 cf Chamber Storage

26,019.7 cf Field - 9,555.5 cf Chambers = 16,464.2 cf Stone x 40.0% Voids = 6,585.7 cf Stone Storage

Chamber Storage + Stone Storage = 16,141.2 cf = 0.371 af

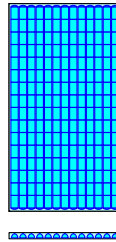
Overall Storage Efficiency = 62.0%

Overall System Size = 117.54' x 63.25' x 3.50'

208 Chambers

963.7 cy Field

609.8 cy Stone

**Proposed-6**

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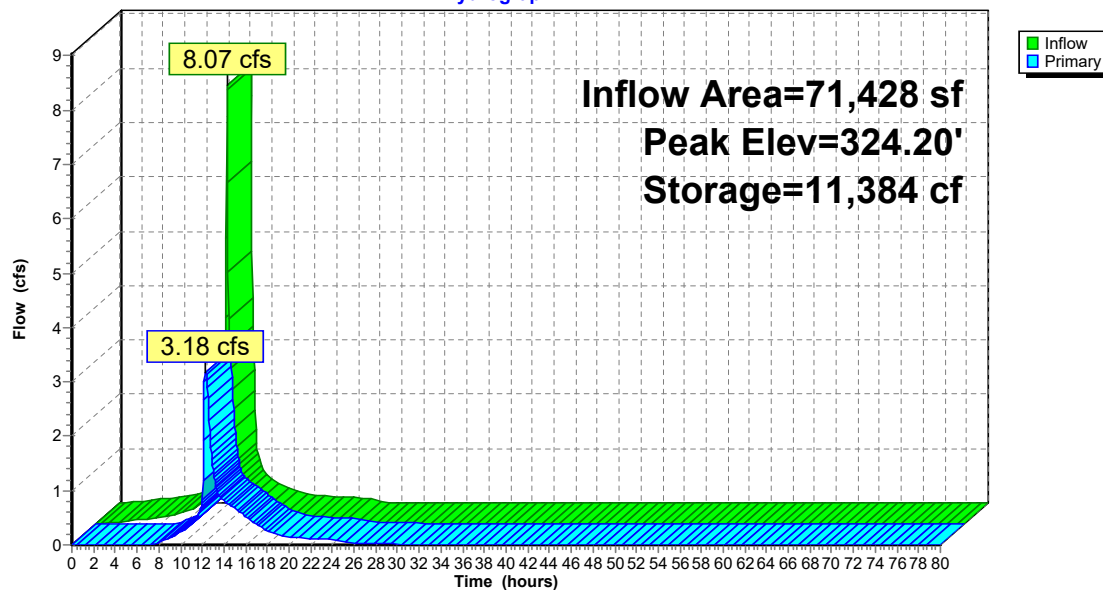
Type III 24-hr 10-Year Rainfall=5.15"

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### Pond SSD-1: Subsurface Detention Basin-1

#### Hydrograph





**HydroCAD Analysis**  
**Proposed Conditions - 25 Year Storm**



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**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
18,555	79	50-75% Grass cover, Fair, HSG C (P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3)
80,078	98	Paved parking (P-1a, P-1b, P-2)
1,396	66	Rip Rap Swale (P-1c, P-1d, P-1e, P-1f)
5,338	70	Woods, Good, HSG C (P-1, P-1c, P-1d, P-1e, P-1f, P-3)
<b>105,367</b>	<b>93</b>	<b>TOTAL AREA</b>

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**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
23,893	HSG C	P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3
0	HSG D	
81,474	Other	P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2
<b>105,367</b>		<b>TOTAL AREA</b>

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**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	Subcatchment Numbers
0	0	18,555	0	0	18,555	50-75% Grass cover, Fair	P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3
0	0	0	0	80,078	80,078	Paved parking	P-1a, P-1b, P-2
0	0	0	0	1,396	1,396	Rip Rap Swale	P-1c, P-1d, P-1e, P-1f
0	0	5,338	0	0	5,338	Woods, Good	P-1, P-1c, P-1d, P-1e, P-1f, P-3
<b>0</b>	<b>0</b>	<b>23,893</b>	<b>0</b>	<b>81,474</b>	<b>105,367</b>	<b>TOTAL AREA</b>	

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**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	SSD-1	322.50	322.00	21.3	0.0235	0.013	15.0	0.0	0.0

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Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P-1: Flow to Existing Basin**

Runoff Area=18,417 sf 0.00% Impervious Runoff Depth=3.79"  
Flow Length=461' Tc=10.0 min CN=77 Runoff=1.62 cfs 5,811 cf

**Subcatchment P-1a: Flow to SSI-1**

Runoff Area=71,428 sf 99.59% Impervious Runoff Depth=6.11"  
Tc=6.0 min CN=98 Runoff=9.97 cfs 36,378 cf

**Subcatchment P-1b: Flow to Treatment Unit**

Runoff Area=3,571 sf 87.17% Impervious Runoff Depth=5.88"  
Tc=6.0 min CN=96 Runoff=0.49 cfs 1,749 cf

**Subcatchment P-1c: Flow to Swale**

Runoff Area=1,317 sf 0.00% Impervious Runoff Depth=3.28"  
Tc=6.0 min CN=72 Runoff=0.11 cfs 360 cf

**Subcatchment P-1d: Flow to Swale**

Runoff Area=1,184 sf 0.00% Impervious Runoff Depth=3.48"  
Tc=6.0 min CN=74 Runoff=0.11 cfs 343 cf

**Subcatchment P-1e: Flow to Swale**

Runoff Area=1,184 sf 0.00% Impervious Runoff Depth=3.58"  
Tc=6.0 min CN=75 Runoff=0.11 cfs 353 cf

**Subcatchment P-1f: Flow to Swale**

Runoff Area=1,071 sf 0.00% Impervious Runoff Depth=3.48"  
Tc=6.0 min CN=74 Runoff=0.10 cfs 311 cf

**Subcatchment P-2: Flow onsite Southeast**

Runoff Area=6,213 sf 93.87% Impervious Runoff Depth=5.99"  
Tc=6.0 min CN=97 Runoff=0.86 cfs 3,103 cf

**Subcatchment P-3: Flow off-site West**

Runoff Area=982 sf 0.00% Impervious Runoff Depth=3.99"  
Tc=6.0 min CN=79 Runoff=0.10 cfs 327 cf

**Reach DP-1: Basin**

Inflow=5.91 cfs 43,035 cf  
Outflow=5.91 cfs 43,035 cf

**Reach DP-2: Onsite southeast**

Inflow=0.86 cfs 3,103 cf  
Outflow=0.86 cfs 3,103 cf

**Proposed-6**

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Type III 24-hr 25-Year Rainfall=6.35"

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**Reach DP-3: Off-site West**

Inflow=0.10 cfs 327 cf  
Outflow=0.10 cfs 327 cf

**Pond S-1: Rip Rap Swale**

Peak Elev=334.06' Storage=216 cf Inflow=0.11 cfs 360 cf  
Outflow=0.01 cfs 145 cf

**Pond S-2: Rip Rap Swale**

Peak Elev=332.51' Storage=199 cf Inflow=0.11 cfs 489 cf  
Outflow=0.02 cfs 291 cf

**Pond S-3: Rip Rap Swale**

Peak Elev=331.01' Storage=196 cf Inflow=0.11 cfs 644 cf  
Outflow=0.03 cfs 450 cf

**Pond S-4: Rip Rap Swale**

Peak Elev=329.26' Storage=149 cf Inflow=0.10 cfs 761 cf  
Outflow=0.04 cfs 615 cf

**Pond SSD-1: Subsurface Detention Basin-1**

Peak Elev=324.55' Storage=13,040 cf Inflow=9.97 cfs 36,378 cf  
Outflow=4.35 cfs 34,861 cf

**Total Runoff Area = 105,367 sf Runoff Volume = 48,735 cf Average Runoff Depth = 5.55"**  
**24.00% Pervious = 25,289 sf 76.00% Impervious = 80,078 sf**

**Proposed-6**

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**Summary for Subcatchment P-1: Flow to Existing Basin**

Runoff = 1.62 cfs @ 12.14 hrs, Volume= 5,811 cf, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
4,454	70	Woods, Good, HSG C
13,963	79	50-75% Grass cover, Fair, HSG C
18,417	77	Weighted Average
18,417		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0800	0.11		<b>Sheet Flow, Sheet Flow</b>
					Woods: Light underbrush n= 0.400 P2= 3.05"
2.7	411	0.0240	2.49		<b>Shallow Concentrated Flow,</b>
					Unpaved Kv= 16.1 fps
10.0	461	Total			

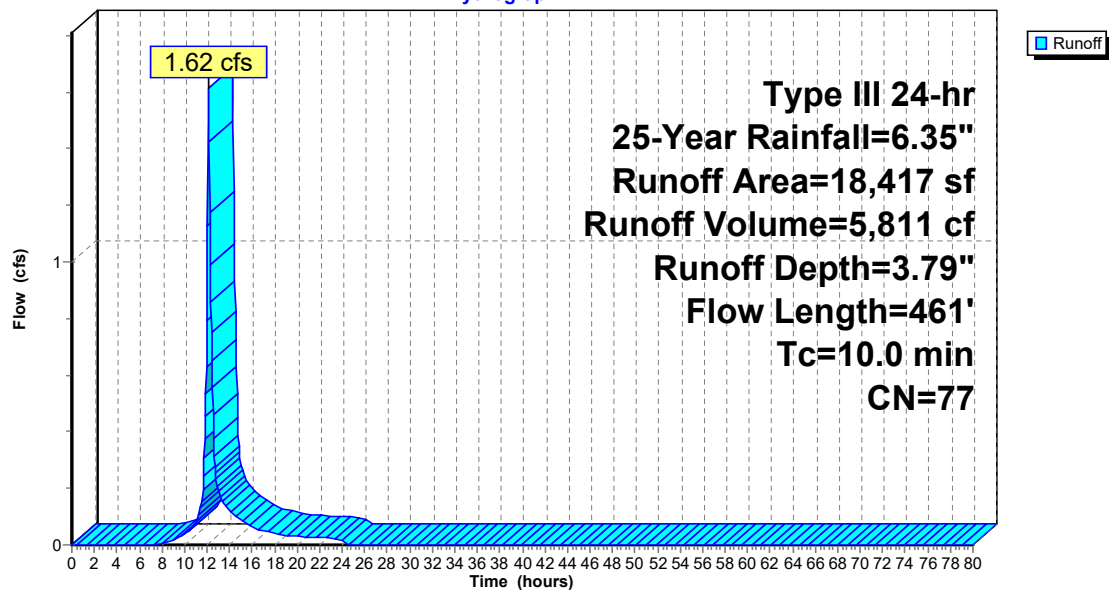
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**Subcatchment P-1: Flow to Existing Basin****Hydrograph**



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**Summary for Subcatchment P-1a: Flow to SSI-1**

Runoff = 9.97 cfs @ 12.09 hrs, Volume= 36,378 cf, Depth= 6.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 71,133	98	Paved parking
295	79	50-75% Grass cover, Fair, HSG C
71,428	98	Weighted Average
295		0.41% Pervious Area
71,133		99.59% Impervious Area

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

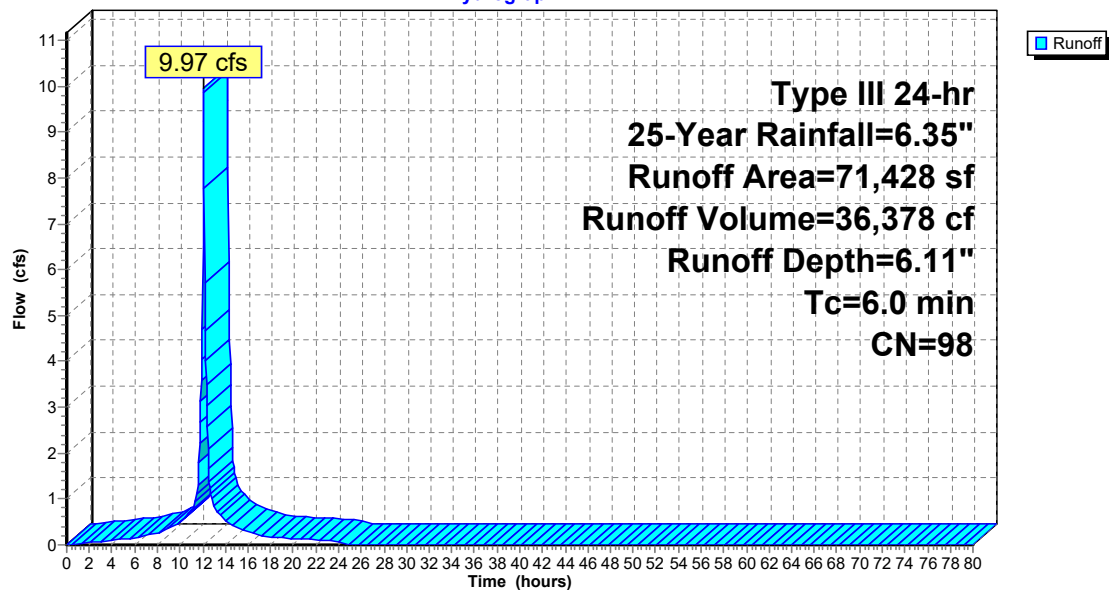
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**Subcatchment P-1a: Flow to SSI-1****Hydrograph**

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**Summary for Subcatchment P-1b: Flow to Treatment Unit**

Runoff = 0.49 cfs @ 12.09 hrs, Volume= 1,749 cf, Depth= 5.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 3,113	98	Paved parking
458	79	50-75% Grass cover, Fair, HSG C
3,571	96	Weighted Average
458		12.83% Pervious Area
3,113		87.17% Impervious Area

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

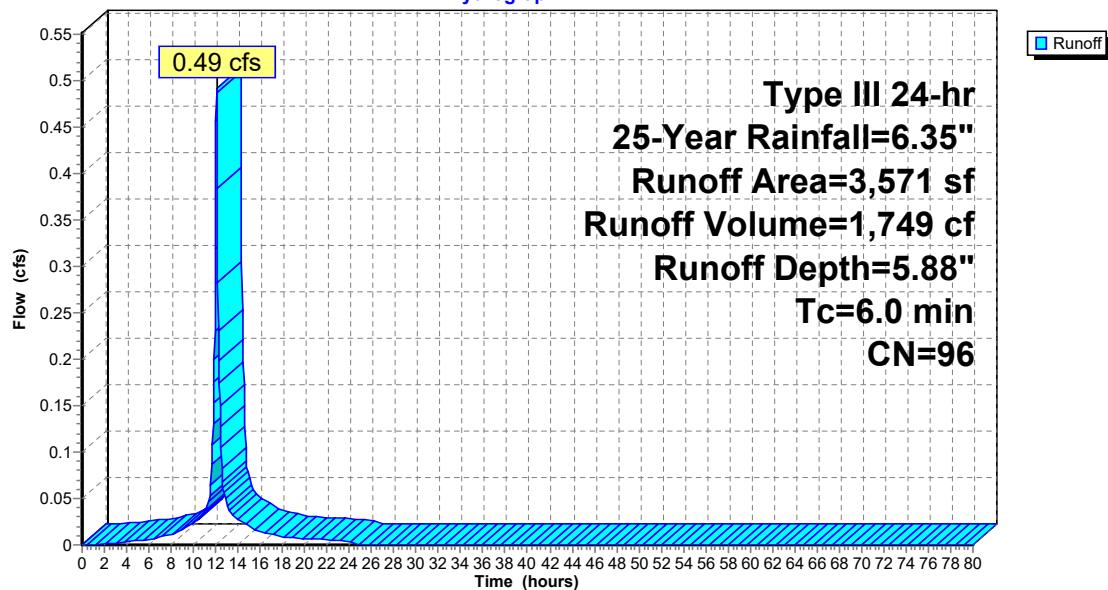
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**Subcatchment P-1b: Flow to Treatment Unit****Hydrograph**

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**Summary for Subcatchment P-1c: Fillow to Swale**

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 360 cf, Depth= 3.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 339	66	Rip Rap Swale
476	70	Woods, Good, HSG C
502	79	50-75% Grass cover, Fair, HSG C
1,317	72	Weighted Average
1,317		100.00% Pervious Area

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

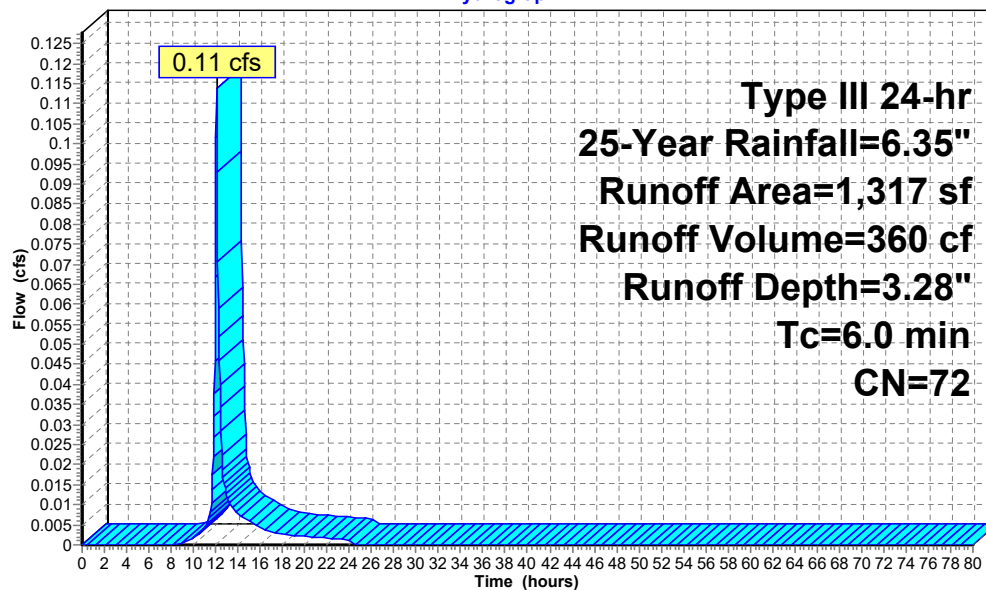
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Type III 24-hr 25-Year Rainfall=6.35"

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**Subcatchment P-1c: Fillow to Swale****Hydrograph**

Runoff

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**Summary for Subcatchment P-1d: Fllow to Swale**

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 343 cf, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 350	66	Rip Rap Swale
216	70	Woods, Good, HSG C
618	79	50-75% Grass cover, Fair, HSG C
1,184	74	Weighted Average
1,184		100.00% Pervious Area

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

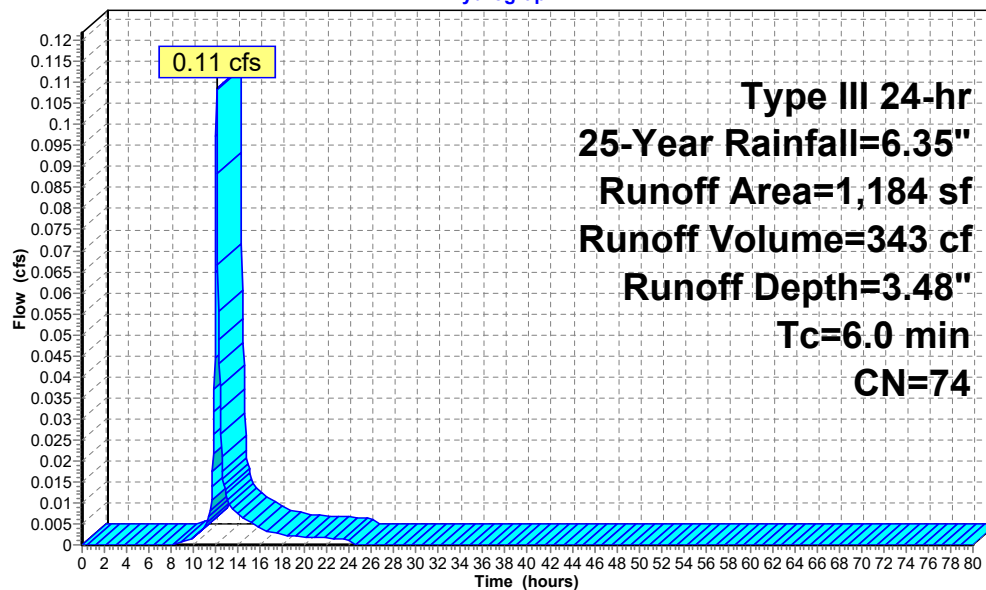
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Type III 24-hr 25-Year Rainfall=6.35"

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**Subcatchment P-1d: Fllow to Swale****Hydrograph**

Runoff

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Type III 24-hr 25-Year Rainfall=6.35"

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**Summary for Subcatchment P-1e: Filow to Swale**

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 353 cf, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 350	66	Rip Rap Swale
58	70	Woods, Good, HSG C
776	79	50-75% Grass cover, Fair, HSG C
1,184	75	Weighted Average
1,184		100.00% Pervious Area

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

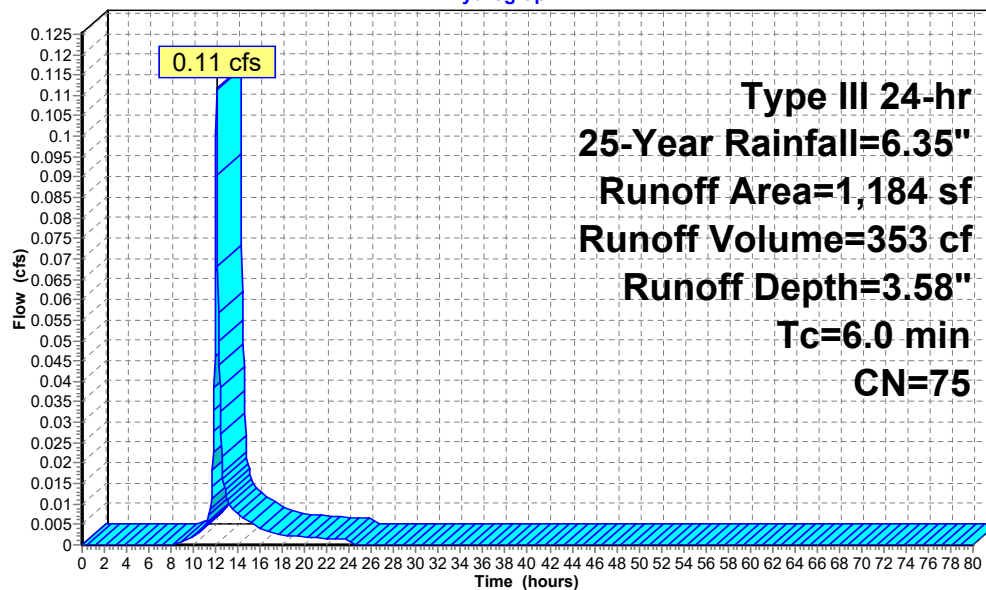
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**Subcatchment P-1e: Filow to Swale****Hydrograph**

Runoff

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**Summary for Subcatchment P-1f: Fillow to Swale**

Runoff = 0.10 cfs @ 12.09 hrs, Volume= 311 cf, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 357	66	Rip Rap Swale
124	70	Woods, Good, HSG C
590	79	50-75% Grass cover, Fair, HSG C
1,071	74	Weighted Average
1,071		100.00% Pervious Area

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

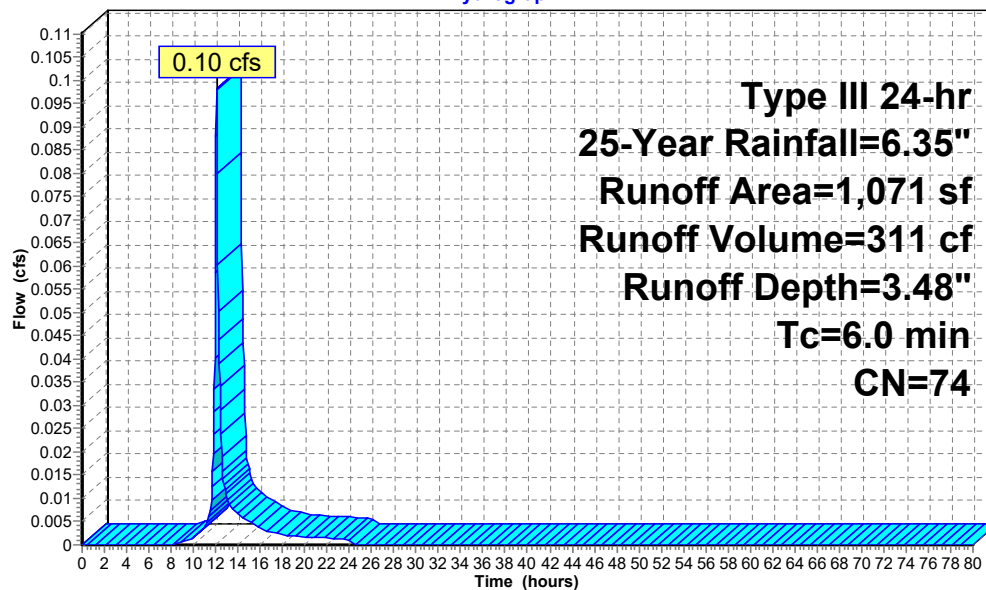
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**Subcatchment P-1f: Fillow to Swale****Hydrograph**

Runoff

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**Summary for Subcatchment P-2: Flow onsite Southeast**

Runoff = 0.86 cfs @ 12.09 hrs, Volume= 3,103 cf, Depth= 5.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
* 5,832	98	Paved parking
381	79	50-75% Grass cover, Fair, HSG C
6,213	97	Weighted Average
381		6.13% Pervious Area
5,832		93.87% Impervious Area

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

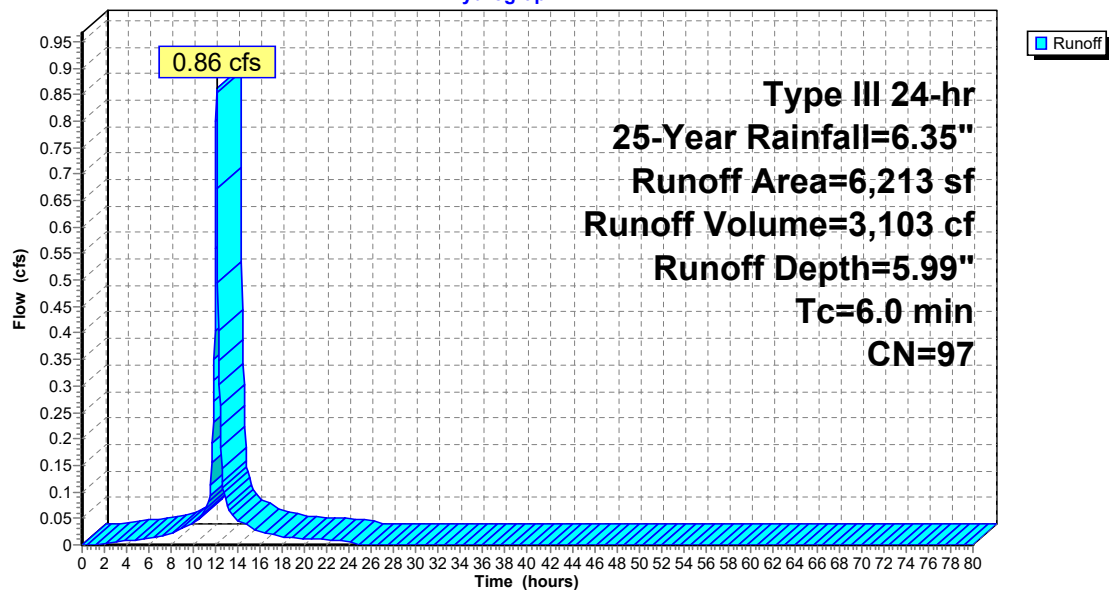
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**Subcatchment P-2: Flow onsite Southeast****Hydrograph**

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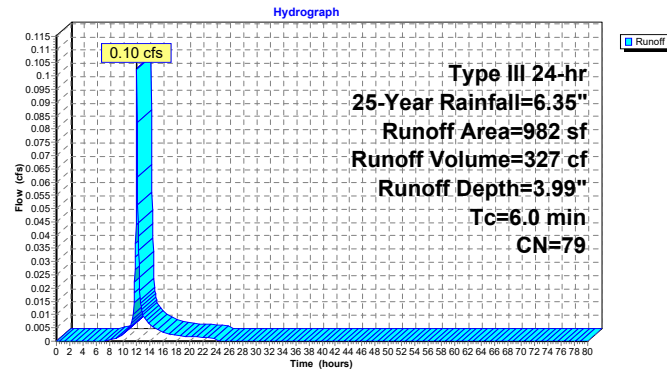
**Summary for Subcatchment P-3: Flow off-site West**

Runoff = 0.10 cfs @ 12.09 hrs, Volume= 327 cf, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
10	70	Woods, Good, HSG C
972	79	50-75% Grass cover, Fair, HSG C
982	79	Weighted Average
982		100.00% Pervious Area

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

**Subcatchment P-3: Flow off-site West****Proposed-6**

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Type III 24-hr 25-Year Rainfall=6.35"

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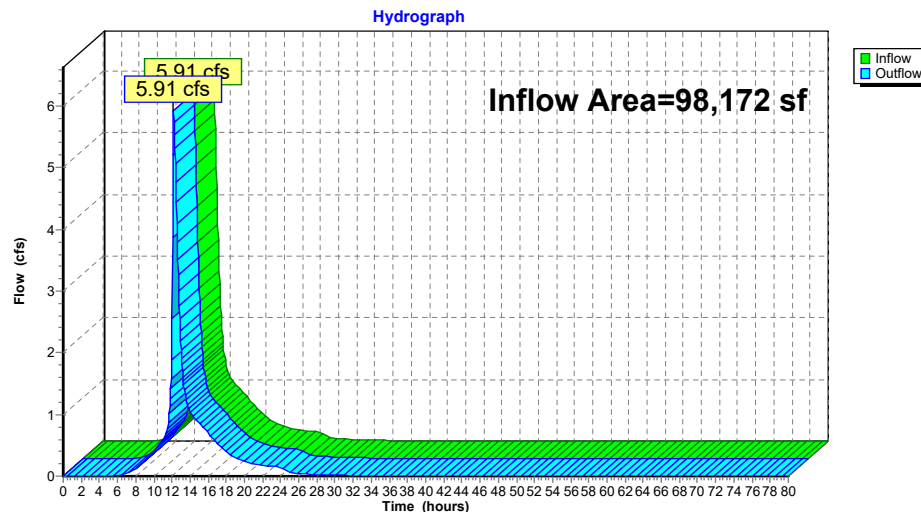
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**Summary for Reach DP-1: Basin**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 98,172 sf, 75.63% Impervious, Inflow Depth = 5.26" for 25-Year event  
 Inflow = 5.91 cfs @ 12.19 hrs, Volume= 43,035 cf  
 Outflow = 5.91 cfs @ 12.19 hrs, Volume= 43,035 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-1: Basin**



**Proposed-6**

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**Summary for Reach DP-2: Onsite southeast**

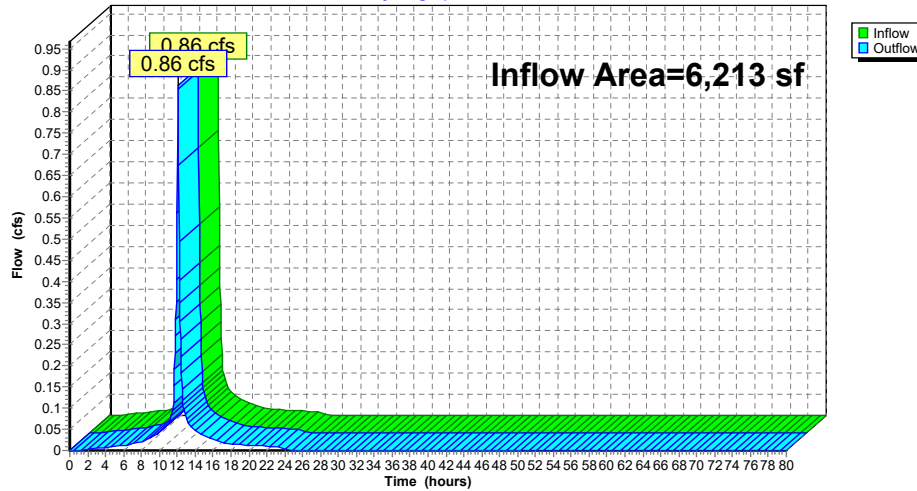
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6,213 sf, 93.87% Impervious, Inflow Depth = 5.99" for 25-Year event  
Inflow = 0.86 cfs @ 12.09 hrs, Volume= 3,103 cf  
Outflow = 0.86 cfs @ 12.09 hrs, Volume= 3,103 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-2: Onsite southeast**

Hydrograph

**Proposed-6**

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**Summary for Reach DP-3: Off-site West**

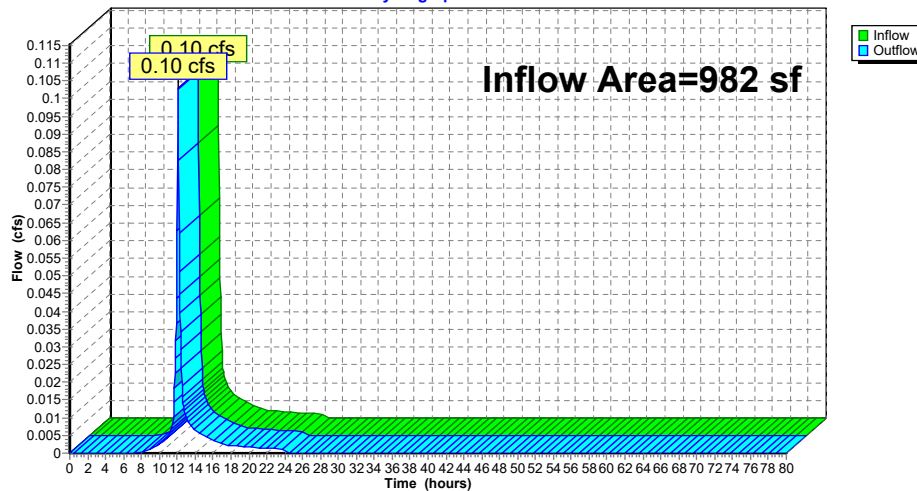
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 982 sf, 0.00% Impervious, Inflow Depth = 3.99" for 25-Year event  
Inflow = 0.10 cfs @ 12.09 hrs, Volume= 327 cf  
Outflow = 0.10 cfs @ 12.09 hrs, Volume= 327 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-3: Off-site West**

Hydrograph



**Proposed-6**

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Type III 24-hr 25-Year Rainfall=6.35"

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**Summary for Pond S-1: Rip Rap Swale**

Inflow Area = 1,317 sf, 0.00% Impervious, Inflow Depth = 3.28" for 25-Year event  
 Inflow = 0.11 cfs @ 12.09 hrs, Volume= 360 cf  
 Outflow = 0.01 cfs @ 13.04 hrs, Volume= 145 cf, Atten= 90%, Lag= 56.7 min  
 Primary = 0.01 cfs @ 13.04 hrs, Volume= 145 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6

Peak Elev= 334.06' @ 13.04 hrs Surf.Area= 200 sf Storage= 216 cf

Plug-Flow detention time= 288.6 min calculated for 145 cf (40% of inflow)

Center-of-Mass det. time= 164.1 min ( 994.9 - 830.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	331.15'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 414 cf Overall - 114 cf Embedded = 300 cf x 40.0% Voids
#2	332.65'	114 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1
		234 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
331.15	0	0.0	0	0	0
331.50	21	27.2	2	2	59
332.50	171	99.3	84	86	788
332.65	200	104.4	28	114	872
334.15	200	104.4	300	414	1,028

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
332.65	0	0.0	0	0	0
333.00	21	27.2	2	2	59
334.00	171	99.3	84	86	788
334.15	200	104.4	28	114	872

Device	Routing	Invert	Outlet Devices
#1	Primary	334.05'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

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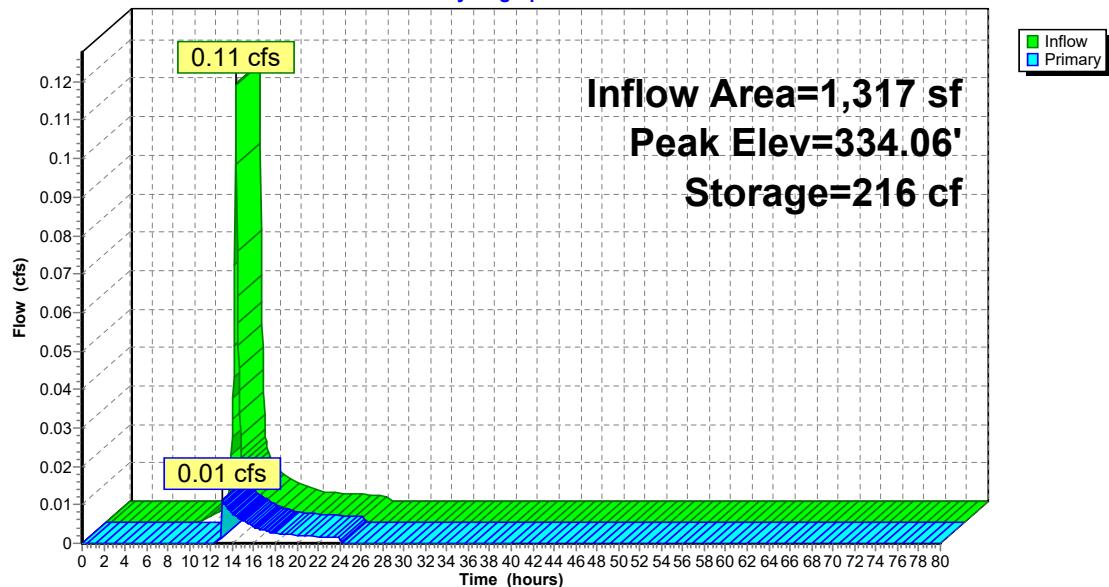
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Primary OutFlow Max=0.01 cfs @ 13.04 hrs HW=334.05' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 0.01 cfs @ 0.23 fps)

**Pond S-1: Rip Rap Swale****Hydrograph**

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**Summary for Pond S-2: Rip Rap Swale**

Inflow Area = 2,501 sf, 0.00% Impervious, Inflow Depth = 2.35" for 25-Year event  
 Inflow = 0.11 cfs @ 12.09 hrs, Volume= 489 cf  
 Outflow = 0.02 cfs @ 13.06 hrs, Volume= 291 cf, Atten= 80%, Lag= 57.8 min  
 Primary = 0.02 cfs @ 13.06 hrs, Volume= 291 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6

Peak Elev= 332.51' @ 13.06 hrs Surf.Area= 200 sf Storage= 199 cf

Plug-Flow detention time= 242.6 min calculated for 291 cf (59% of inflow)

Center-of-Mass det. time= 110.2 min ( 986.7 - 876.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	329.65'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 407 cf Overall - 107 cf Embedded = 300 cf x 40.0% Voids
#2	331.15'	107 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1
		227 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
329.65	0	0.0	0	0	0
330.50	74	61.1	21	21	298
331.15	200	104.5	86	107	873
332.65	200	104.5	300	407	1,029

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
331.15	0	0.0	0	0	0
332.00	74	61.1	21	21	298
332.65	200	104.5	86	107	873

Device	Routing	Invert	Outlet Devices
#1	Primary	332.50'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

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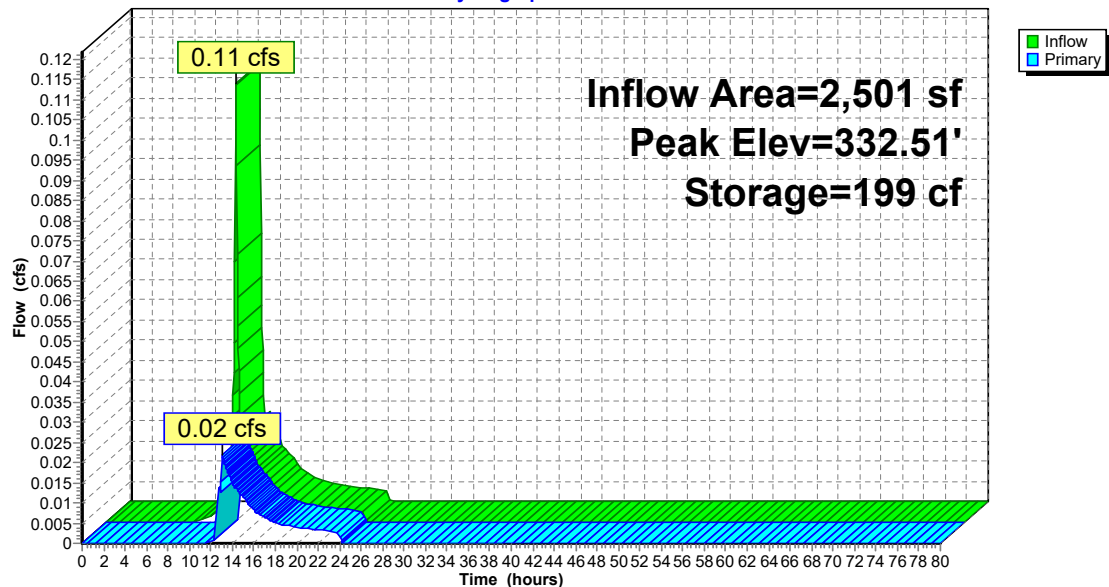
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Primary OutFlow Max=0.01 cfs @ 13.06 hrs HW=332.51' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 0.01 cfs @ 0.24 fps)

**Pond S-2: Rip Rap Swale****Hydrograph**

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**Summary for Pond S-3: Rip Rap Swale**

Inflow Area = 3,685 sf, 0.00% Impervious, Inflow Depth = 2.10" for 25-Year event  
 Inflow = 0.11 cfs @ 12.09 hrs, Volume= 644 cf  
 Outflow = 0.03 cfs @ 13.06 hrs, Volume= 450 cf, Atten= 71%, Lag= 58.2 min  
 Primary = 0.03 cfs @ 13.06 hrs, Volume= 450 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6

Peak Elev= 331.01' @ 13.06 hrs Surf.Area= 200 sf Storage= 196 cf

Plug-Flow detention time= 192.8 min calculated for 450 cf (70% of inflow)

Center-of-Mass det. time= 81.0 min ( 978.3 - 897.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	329.70'	112 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #2
#2	328.20'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)
			412 cf Overall - 112 cf Embedded = 300 cf x 40.0% Voids
232 cf			Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
329.70	0	0.0	0	0	0
330.00	16	23.0	2	2	42
331.00	158	95.1	75	76	722
331.20	200	104.5	36	112	873

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
328.20	0	0.0	0	0	0
328.50	16	23.0	2	2	42
329.50	158	95.1	75	76	722
329.70	200	104.5	36	112	873
331.20	200	104.5	300	412	1,030

Device	Routing	Invert	Outlet Devices
#1	Primary	331.00'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

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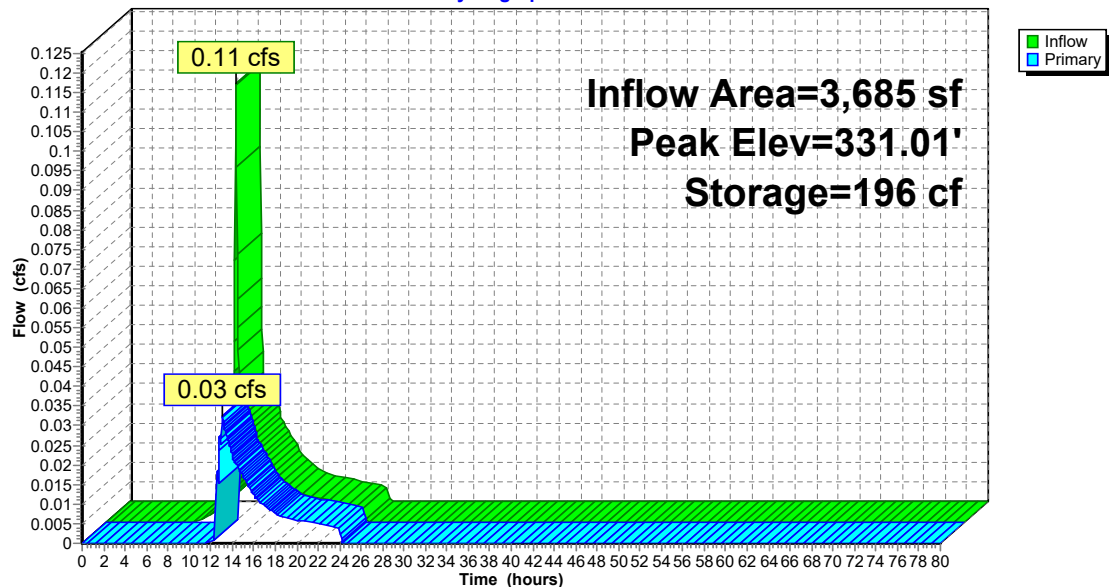
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Primary OutFlow Max=0.02 cfs @ 13.06 hrs HW=331.01' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 0.02 cfs @ 0.33 fps)

**Pond S-3: Rip Rap Swale****Hydrograph**

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**Summary for Pond S-4: Rip Rap Swale**

Inflow Area = 4,756 sf, 0.00% Impervious, Inflow Depth = 1.92" for 25-Year event  
 Inflow = 0.10 cfs @ 12.09 hrs, Volume= 761 cf  
 Outflow = 0.04 cfs @ 13.06 hrs, Volume= 615 cf, Atten= 57%, Lag= 58.2 min  
 Primary = 0.04 cfs @ 13.06 hrs, Volume= 615 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6

Peak Elev= 329.26' @ 13.06 hrs Surf.Area= 188 sf Storage= 149 cf

Plug-Flow detention time= 131.6 min calculated for 615 cf (81% of inflow)

Center-of-Mass det. time= 50.0 min ( 966.2 - 916.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	328.20'	108 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #2
#2	326.70'	113 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)
			390 cf Overall - 108 cf Embedded = 282 cf x 40.0% Voids
			221 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
328.20	0	0.0	0	0	0
329.00	71	56.9	19	19	259
329.25	112	76.4	23	42	466
329.70	188	102.0	67	108	832

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
326.70	0	0.0	0	0	0
327.50	71	56.9	19	19	259
327.75	112	76.4	23	42	466
328.20	188	102.0	67	108	832
329.70	188	102.0	282	390	985

Device	Routing	Invert	Outlet Devices
#1	Primary	329.25'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

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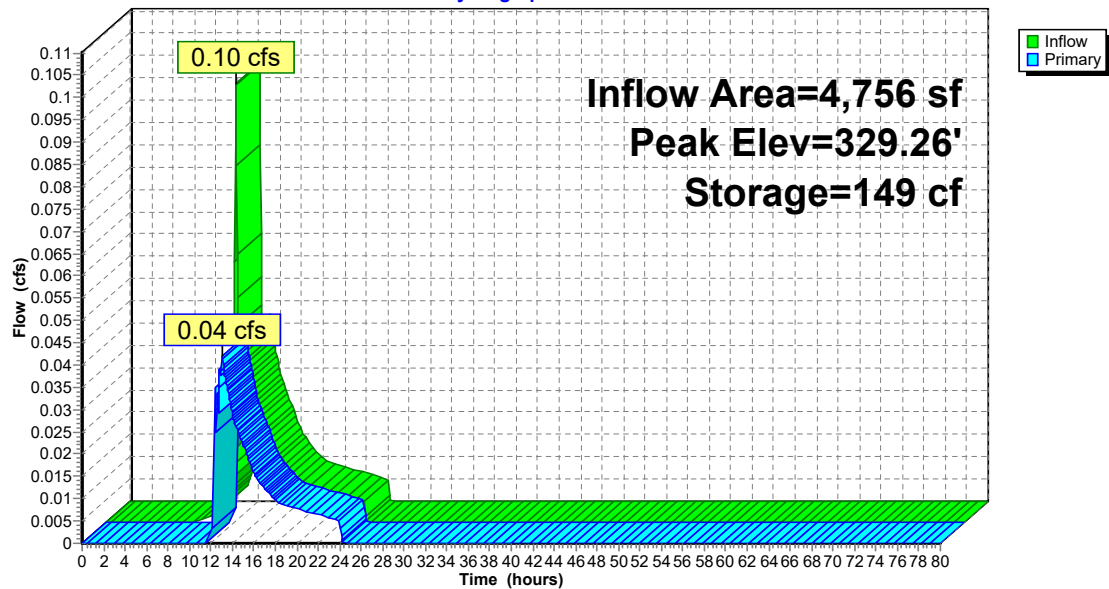
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Primary OutFlow Max=0.02 cfs @ 13.06 hrs HW=329.26' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 0.02 cfs @ 0.34 fps)

**Pond S-4: Rip Rap Swale****Hydrograph**

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**Summary for Pond SSD-1: Subsurface Detention Basin-1**

Inflow Area = 71,428 sf, 99.59% Impervious, Inflow Depth = 6.11" for 25-Year event  
 Inflow = 9.97 cfs @ 12.09 hrs, Volume= 36,378 cf  
 Outflow = 4.35 cfs @ 12.27 hrs, Volume= 34,861 cf, Atten= 56%, Lag= 11.3 min  
 Primary = 4.35 cfs @ 12.27 hrs, Volume= 34,861 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 324.55' @ 12.27 hrs Surf.Area= 7,434 sf Storage= 13,040 cf

Plug-Flow detention time= 153.8 min calculated for 34,839 cf (96% of inflow)  
 Center-of-Mass det. time= 130.5 min ( 874.8 - 744.3 )

Volume	Invert	Avail.Storage	Storage Description
#1A	322.00'	6,586 cf	<b>63.25'W x 117.54'L x 3.50'H Field A</b> 26,020 cf Overall - 9,556 cf Embedded = 16,464 cf x 40.0% Voids
#2A	322.50'	9,556 cf	<b>ADS_StormTech SC-740 +Cap</b> x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 208 Chambers in 13 Rows
		16,141 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	322.50'	<b>15.0" Round Culvert</b> L= 21.3' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 322.50' / 322.00' S= 0.0235 ' /' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	325.25'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#3	Device 1	324.25'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600
#4	Device 1	323.50'	<b>8.0" Vert. Orifice/Grate X 2.00</b> C= 0.600
#5	Device 1	322.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600

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**Primary OutFlow** Max=4.33 cfs @ 12.27 hrs HW=324.55' (Free Discharge)

- 1=Culvert (Passes 4.33 cfs of 7.05 cfs potential flow)
- 2=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)
- 3=Orifice/Grate (Orifice Controls 0.23 cfs @ 1.86 fps)
- 4=Orifice/Grate (Orifice Controls 2.84 cfs @ 4.07 fps)
- 5=Orifice/Grate (Orifice Controls 1.27 cfs @ 6.46 fps)

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### Pond SSD-1: Subsurface Detention Basin-1 - Chamber Wizard Field A

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

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

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

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

16 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 115.54' Row Length +12.0" End Stone x 2 = 117.54' Base Length

13 Rows x 51.0" Wide + 6.0" Spacing x 12 + 12.0" Side Stone x 2 = 63.25' Base Width

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

208 Chambers x 45.9 cf = 9,555.5 cf Chamber Storage

26,019.7 cf Field - 9,555.5 cf Chambers = 16,464.2 cf Stone x 40.0% Voids = 6,585.7 cf Stone Storage

Chamber Storage + Stone Storage = 16,141.2 cf = 0.371 af

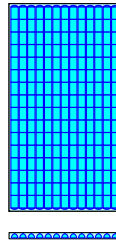
Overall Storage Efficiency = 62.0%

Overall System Size = 117.54' x 63.25' x 3.50'

208 Chambers

963.7 cy Field

609.8 cy Stone

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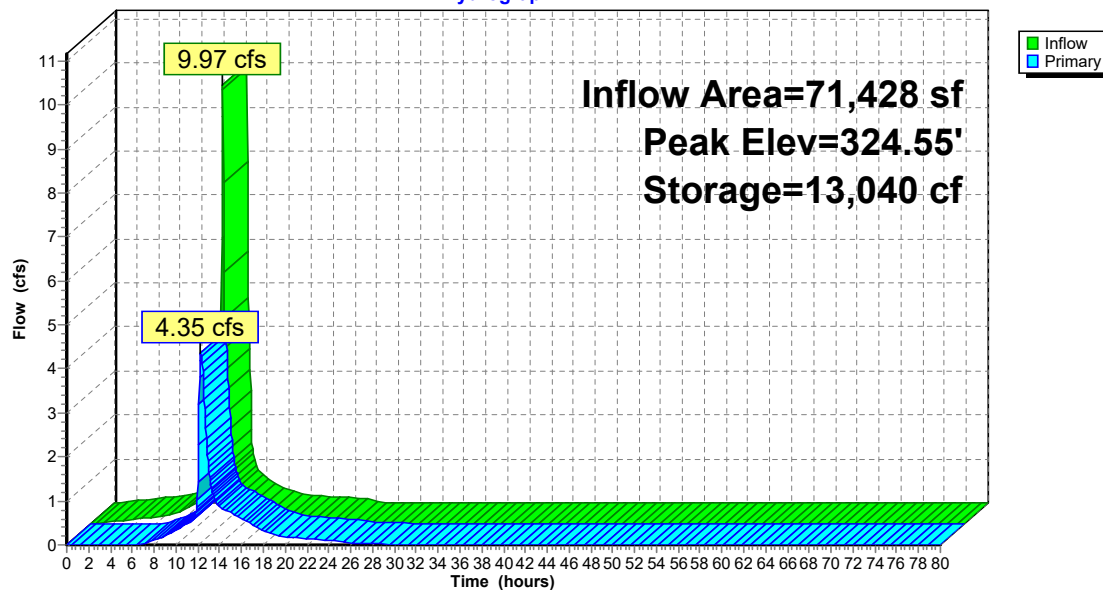
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### Pond SSD-1: Subsurface Detention Basin-1

#### Hydrograph







**HydroCAD Analysis**  
**Proposed Conditions - 100 Year Storm**



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Page 1

**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
18,555	79	50-75% Grass cover, Fair, HSG C (P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3)
80,078	98	Paved parking (P-1a, P-1b, P-2)
1,396	66	Rip Rap Swale (P-1c, P-1d, P-1e, P-1f)
5,338	70	Woods, Good, HSG C (P-1, P-1c, P-1d, P-1e, P-1f, P-3)
<b>105,367</b>	<b>93</b>	<b>TOTAL AREA</b>

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**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
23,893	HSG C	P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3
0	HSG D	
81,474	Other	P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2
<b>105,367</b>		<b>TOTAL AREA</b>

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**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	Subcatchment Numbers
0	0	18,555	0	0	18,555	50-75% Grass cover, Fair	P-1, P-1a, P-1b, P-1c, P-1d, P-1e, P-1f, P-2, P-3
0	0	0	0	80,078	80,078	Paved parking	P-1a, P-1b, P-2
0	0	0	0	1,396	1,396	Rip Rap Swale	P-1c, P-1d, P-1e, P-1f
0	0	5,338	0	0	5,338	Woods, Good	P-1, P-1c, P-1d, P-1e, P-1f, P-3
<b>0</b>	<b>0</b>	<b>23,893</b>	<b>0</b>	<b>81,474</b>	<b>105,367</b>	<b>TOTAL AREA</b>	

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**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	SSD-1	322.50	322.00	21.3	0.0235	0.013	15.0	0.0	0.0

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Type III 24-hr 100-Year Rainfall=8.16"

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Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P-1: Flow to Existing Basin**

Runoff Area=18,417 sf 0.00% Impervious Runoff Depth=5.42"  
 Flow Length=461' Tc=10.0 min CN=77 Runoff=2.30 cfs 8,320 cf

**Subcatchment P-1a: Flow to SSI-1**

Runoff Area=71,428 sf 99.59% Impervious Runoff Depth=7.92"  
 Tc=6.0 min CN=98 Runoff=12.83 cfs 47,143 cf

**Subcatchment P-1b: Flow to Treatment Unit**

Runoff Area=3,571 sf 87.17% Impervious Runoff Depth=7.68"  
 Tc=6.0 min CN=96 Runoff=0.64 cfs 2,286 cf

**Subcatchment P-1c: Flow to Swale**

Runoff Area=1,317 sf 0.00% Impervious Runoff Depth=4.84"  
 Tc=6.0 min CN=72 Runoff=0.17 cfs 531 cf

**Subcatchment P-1d: Flow to Swale**

Runoff Area=1,184 sf 0.00% Impervious Runoff Depth=5.07"  
 Tc=6.0 min CN=74 Runoff=0.16 cfs 500 cf

**Subcatchment P-1e: Flow to Swale**

Runoff Area=1,184 sf 0.00% Impervious Runoff Depth=5.19"  
 Tc=6.0 min CN=75 Runoff=0.16 cfs 512 cf

**Subcatchment P-1f: Flow to Swale**

Runoff Area=1,071 sf 0.00% Impervious Runoff Depth=5.07"  
 Tc=6.0 min CN=74 Runoff=0.14 cfs 452 cf

**Subcatchment P-2: Flow onsite Southeast**

Runoff Area=6,213 sf 93.87% Impervious Runoff Depth=7.80"  
 Tc=6.0 min CN=97 Runoff=1.11 cfs 4,039 cf

**Subcatchment P-3: Flow off-site West**

Runoff Area=982 sf 0.00% Impervious Runoff Depth=5.66"  
 Tc=6.0 min CN=79 Runoff=0.14 cfs 463 cf

**Reach DP-1: Basin**

Inflow=8.86 cfs 57,484 cf  
 Outflow=8.86 cfs 57,484 cf

**Reach DP-2: Onsite southeast**

Inflow=1.11 cfs 4,039 cf  
 Outflow=1.11 cfs 4,039 cf

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Type III 24-hr 100-Year Rainfall=8.16"

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**Reach DP-3: Off-site West**

Inflow=0.14 cfs 463 cf  
 Outflow=0.14 cfs 463 cf

**Pond S-1: Rip Rap Swale**

Peak Elev=334.07' Storage=219 cf Inflow=0.17 cfs 531 cf  
 Outflow=0.09 cfs 319 cf

**Pond S-2: Rip Rap Swale**

Peak Elev=332.54' Storage=205 cf Inflow=0.18 cfs 819 cf  
 Outflow=0.17 cfs 619 cf

**Pond S-3: Rip Rap Swale**

Peak Elev=331.05' Storage=203 cf Inflow=0.27 cfs 1,131 cf  
 Outflow=0.25 cfs 940 cf

**Pond S-4: Rip Rap Swale**

Peak Elev=329.31' Storage=156 cf Inflow=0.34 cfs 1,392 cf  
 Outflow=0.32 cfs 1,248 cf

**Pond SSD-1: Subsurface Detention Basin-1**

Peak Elev=325.21' Storage=15,266 cf Inflow=12.83 cfs 47,143 cf  
 Outflow=6.21 cfs 45,629 cf

**Total Runoff Area = 105,367 sf Runoff Volume = 64,245 cf Average Runoff Depth = 7.32"**  
**24.00% Pervious = 25,289 sf 76.00% Impervious = 80,078 sf**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Summary for Subcatchment P-1: Flow to Existing Basin**

Runoff = 2.30 cfs @ 12.14 hrs, Volume= 8,320 cf, Depth= 5.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
4,454	70	Woods, Good, HSG C
13,963	79	50-75% Grass cover, Fair, HSG C
18,417	77	Weighted Average
18,417		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0800	0.11		<b>Sheet Flow, Sheet Flow</b>
					Woods: Light underbrush n= 0.400 P2= 3.05"
2.7	411	0.0240	2.49		<b>Shallow Concentrated Flow,</b>
					Unpaved Kv= 16.1 fps
10.0	461	Total			

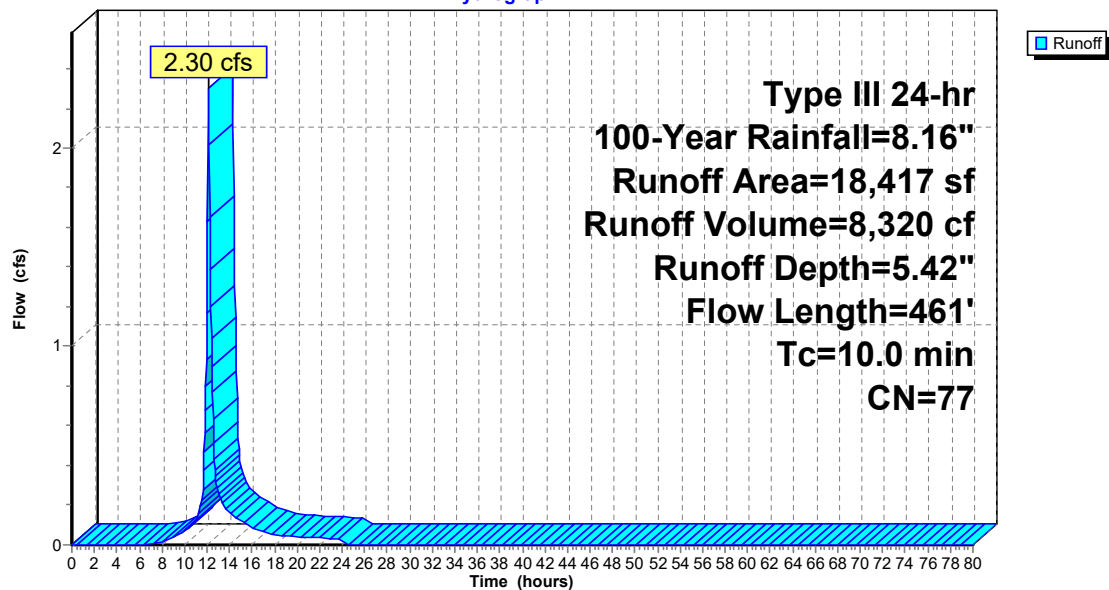
**Proposed-6**

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**Subcatchment P-1: Flow to Existing Basin****Hydrograph**

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**Summary for Subcatchment P-1a: Flow to SSI-1**

Runoff = 12.83 cfs @ 12.09 hrs, Volume= 47,143 cf, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 71,133	98	Paved parking
295	79	50-75% Grass cover, Fair, HSG C
71,428	98	Weighted Average
295		0.41% Pervious Area
71,133		99.59% Impervious Area

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

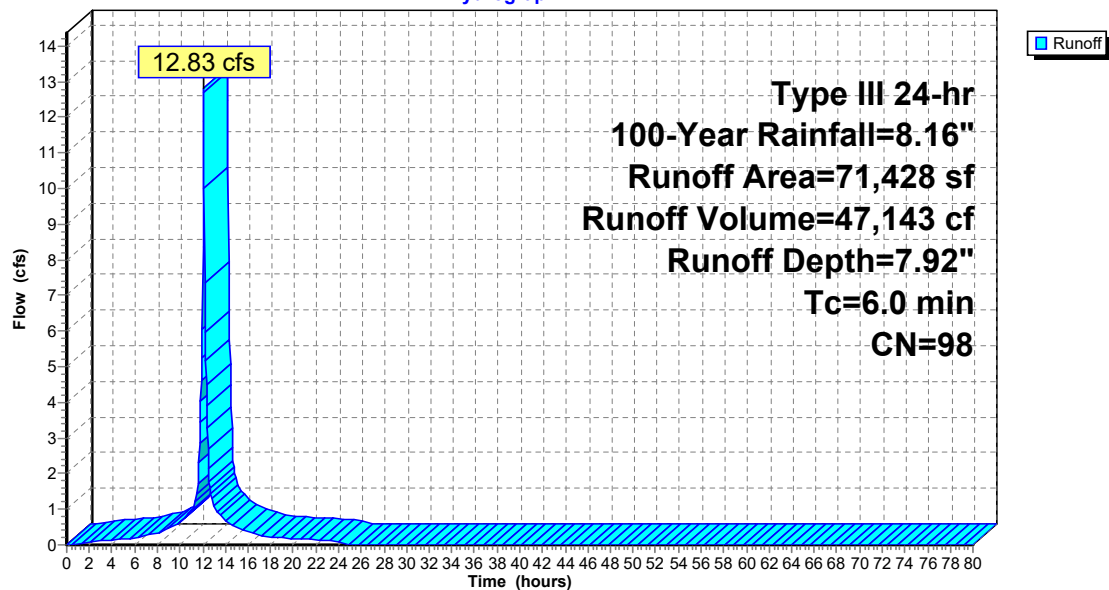
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**Subcatchment P-1a: Flow to SSI-1****Hydrograph**

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**Summary for Subcatchment P-1b: Flow to Treatment Unit**

Runoff = 0.64 cfs @ 12.09 hrs, Volume= 2,286 cf, Depth= 7.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 3,113	98	Paved parking
458	79	50-75% Grass cover, Fair, HSG C
3,571	96	Weighted Average
458		12.83% Pervious Area
3,113		87.17% Impervious Area

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

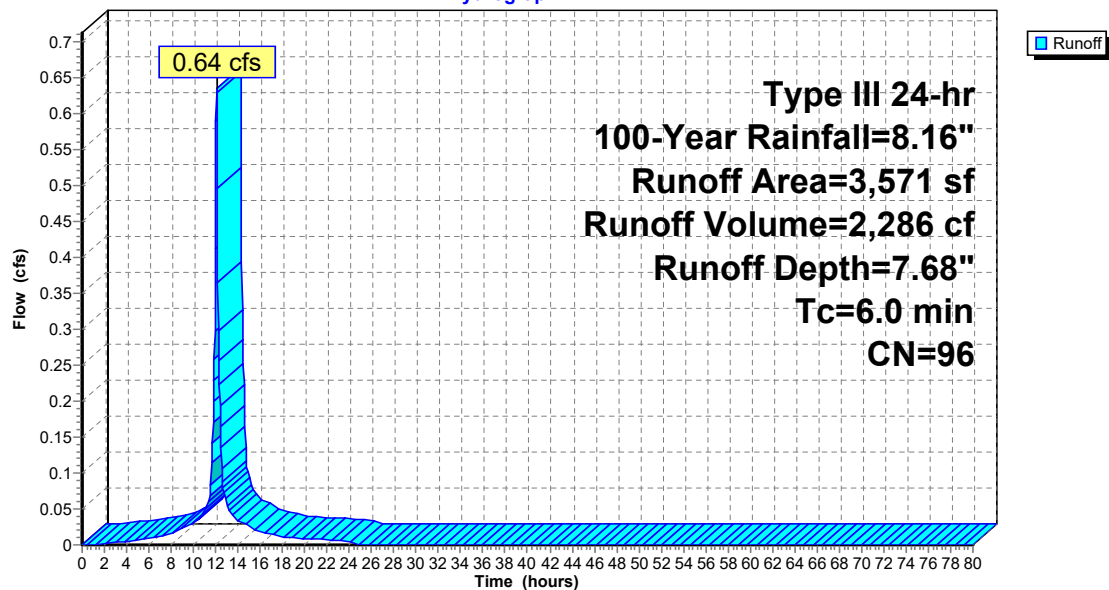
**Proposed-6**

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**Subcatchment P-1b: Flow to Treatment Unit****Hydrograph**



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**Summary for Subcatchment P-1c: Fllow to Swale**

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 531 cf, Depth= 4.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 339	66	Rip Rap Swale
476	70	Woods, Good, HSG C
502	79	50-75% Grass cover, Fair, HSG C
1,317	72	Weighted Average
1,317		100.00% Pervious Area

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

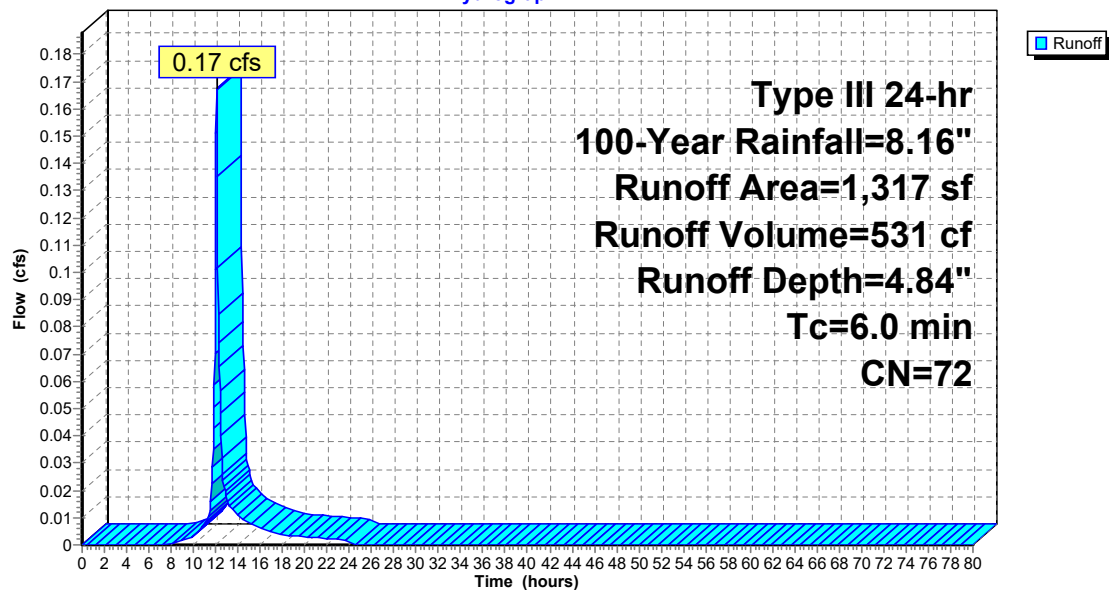
**Proposed-6**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Subcatchment P-1c: Fllow to Swale****Hydrograph**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Summary for Subcatchment P-1d: Fllow to Swale**

Runoff = 0.16 cfs @ 12.09 hrs, Volume= 500 cf, Depth= 5.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 350	66	Rip Rap Swale
216	70	Woods, Good, HSG C
618	79	50-75% Grass cover, Fair, HSG C
1,184	74	Weighted Average
1,184		100.00% Pervious Area

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

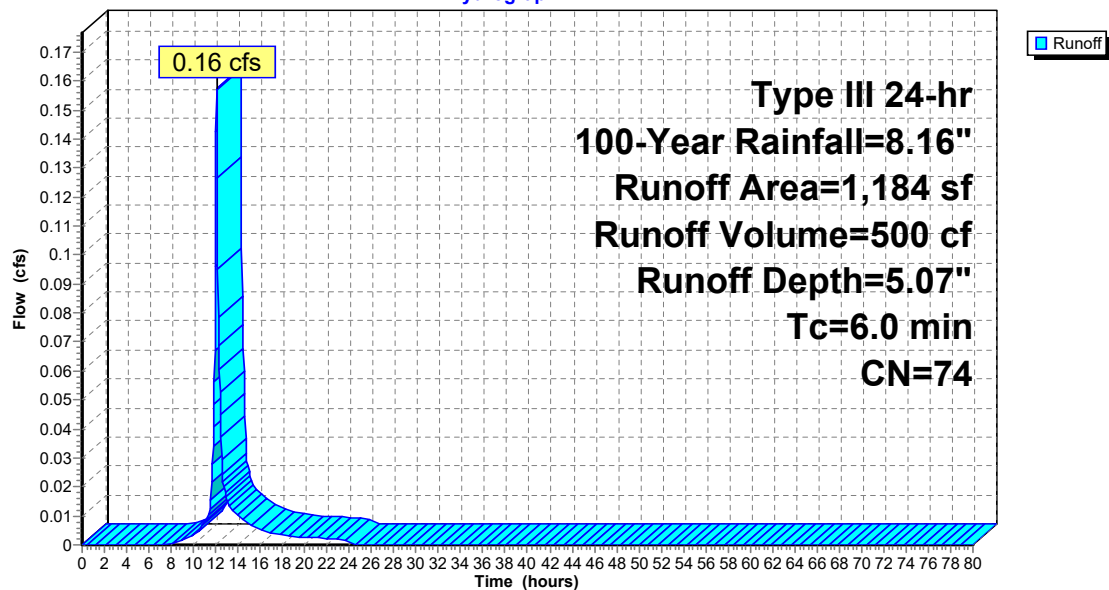
**Proposed-6**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Subcatchment P-1d: Fllow to Swale****Hydrograph**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Summary for Subcatchment P-1e: Fillow to Swale**

Runoff = 0.16 cfs @ 12.09 hrs, Volume= 512 cf, Depth= 5.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 350	66	Rip Rap Swale
58	70	Woods, Good, HSG C
776	79	50-75% Grass cover, Fair, HSG C
1,184	75	Weighted Average
1,184		100.00% Pervious Area

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

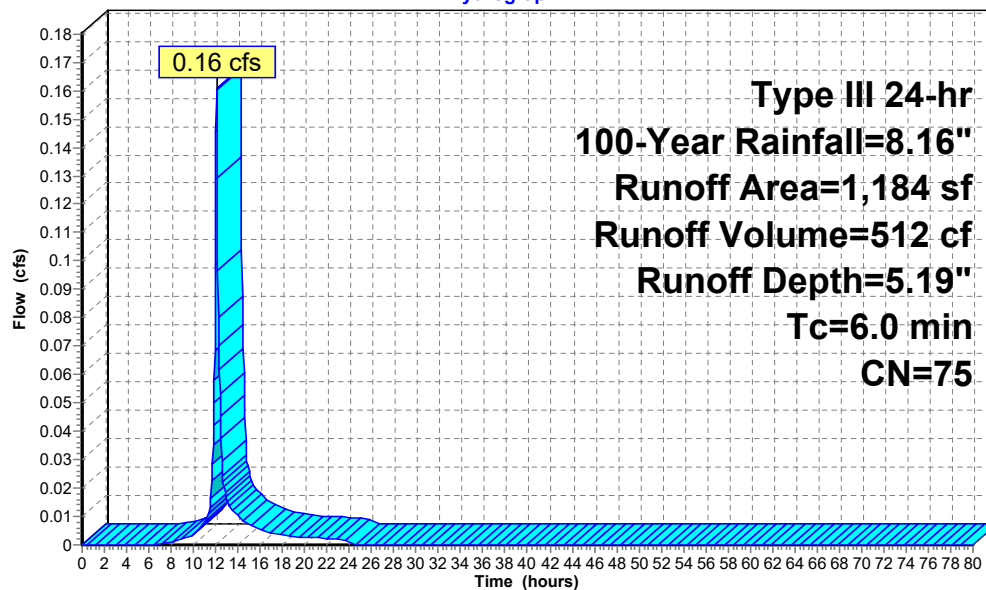
**Proposed-6**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Subcatchment P-1e: Fillow to Swale****Hydrograph**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Summary for Subcatchment P-1f: Fllow to Swale**

Runoff = 0.14 cfs @ 12.09 hrs, Volume= 452 cf, Depth= 5.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 357	66	Rip Rap Swale
124	70	Woods, Good, HSG C
590	79	50-75% Grass cover, Fair, HSG C
1,071	74	Weighted Average
1,071		100.00% Pervious Area

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

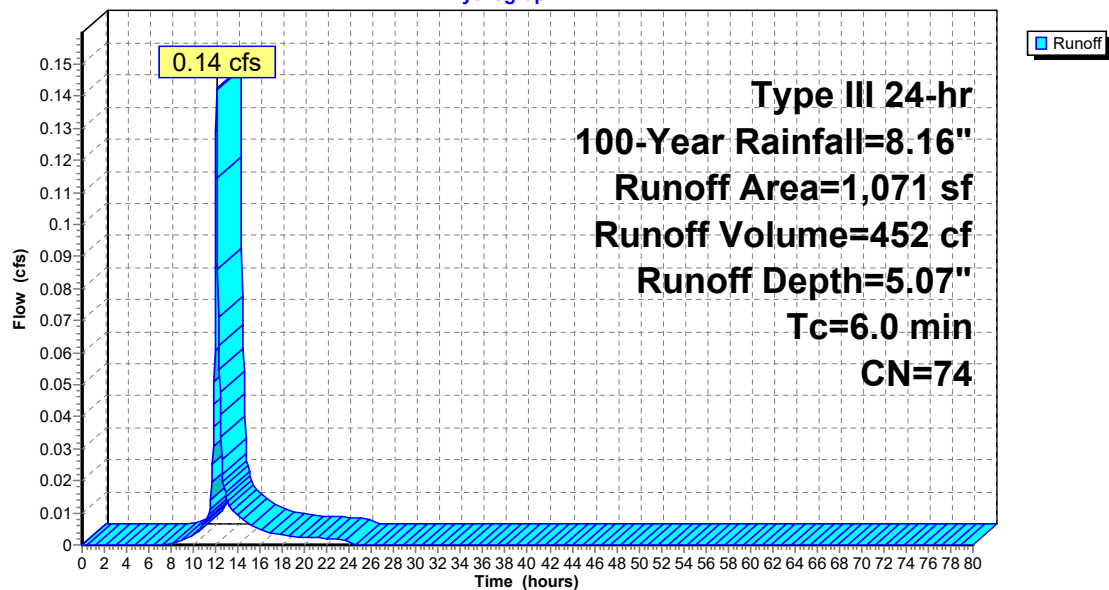
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**Subcatchment P-1f: Fllow to Swale****Hydrograph**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Summary for Subcatchment P-2: Flow onsite Southeast**

Runoff = 1.11 cfs @ 12.09 hrs, Volume= 4,039 cf, Depth= 7.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
* 5,832	98	Paved parking
381	79	50-75% Grass cover, Fair, HSG C
6,213	97	Weighted Average
381		6.13% Pervious Area
5,832		93.87% Impervious Area

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

**Proposed-6**

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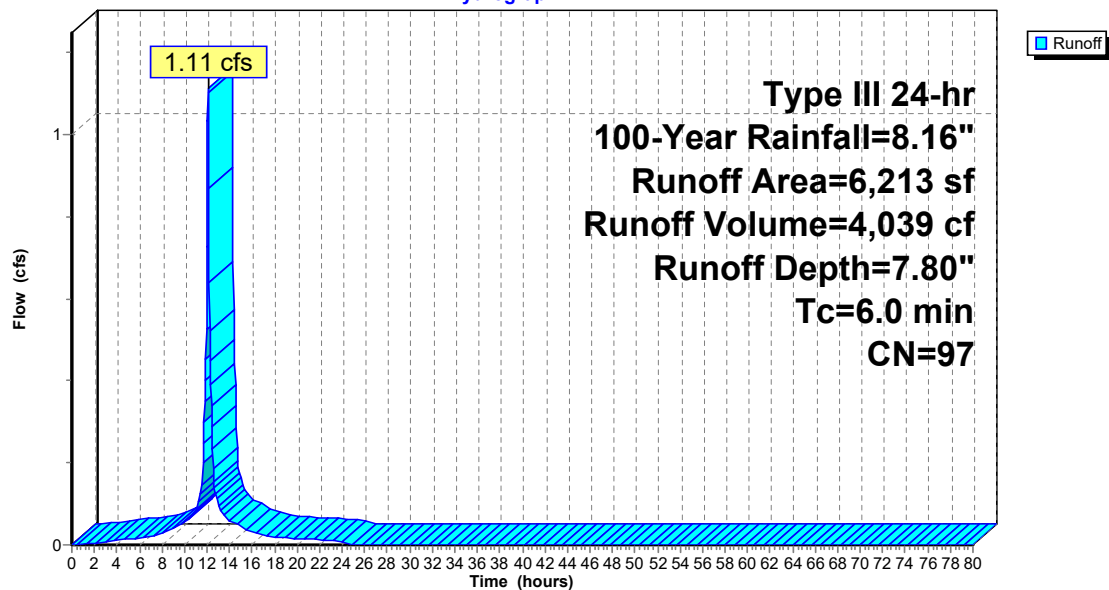
Type III 24-hr 100-Year Rainfall=8.16"

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**Subcatchment P-2: Flow onsite Southeast**

Hydrograph



**Proposed-6**

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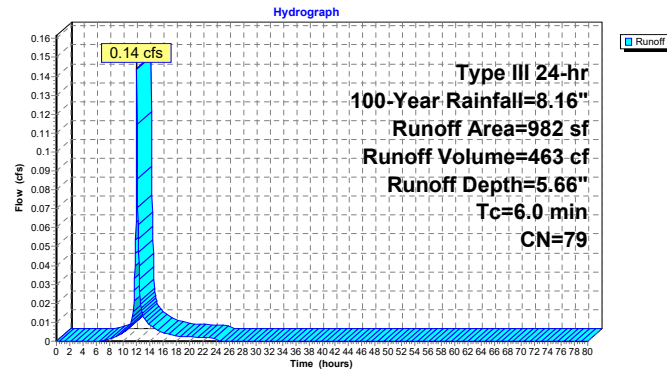
**Summary for Subcatchment P-3: Flow off-site West**

Runoff = 0.14 cfs @ 12.09 hrs, Volume= 463 cf, Depth= 5.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
10	70	Woods, Good, HSG C
972	79	50-75% Grass cover, Fair, HSG C
982	79	Weighted Average
982		100.00% Pervious Area

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

**Subcatchment P-3: Flow off-site West****Proposed-6**

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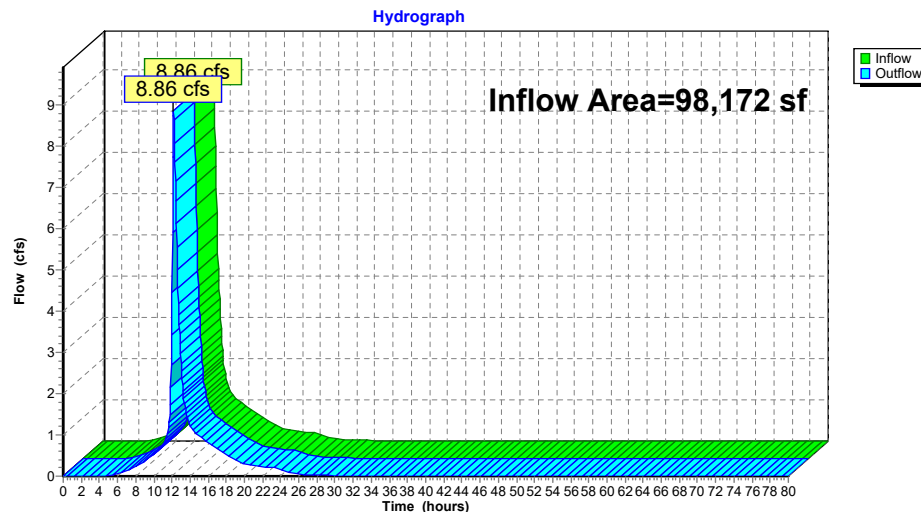
Page 24

**Summary for Reach DP-1: Basin**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 98,172 sf, 75.63% Impervious, Inflow Depth = 7.03" for 100-Year event  
 Inflow = 8.86 cfs @ 12.18 hrs, Volume= 57,484 cf  
 Outflow = 8.86 cfs @ 12.18 hrs, Volume= 57,484 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-1: Basin**

**Proposed-6**

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Type III 24-hr 100-Year Rainfall=8.16"

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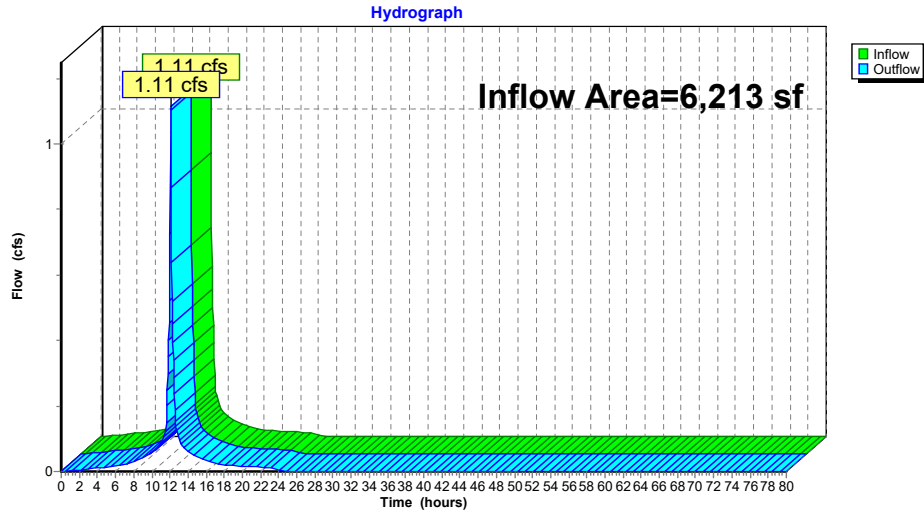
Page 25

**Summary for Reach DP-2: Onsite southeast**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6,213 sf, 93.87% Impervious, Inflow Depth = 7.80" for 100-Year event  
Inflow = 1.11 cfs @ 12.09 hrs, Volume= 4,039 cf  
Outflow = 1.11 cfs @ 12.09 hrs, Volume= 4,039 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-2: Onsite southeast****Proposed-6**

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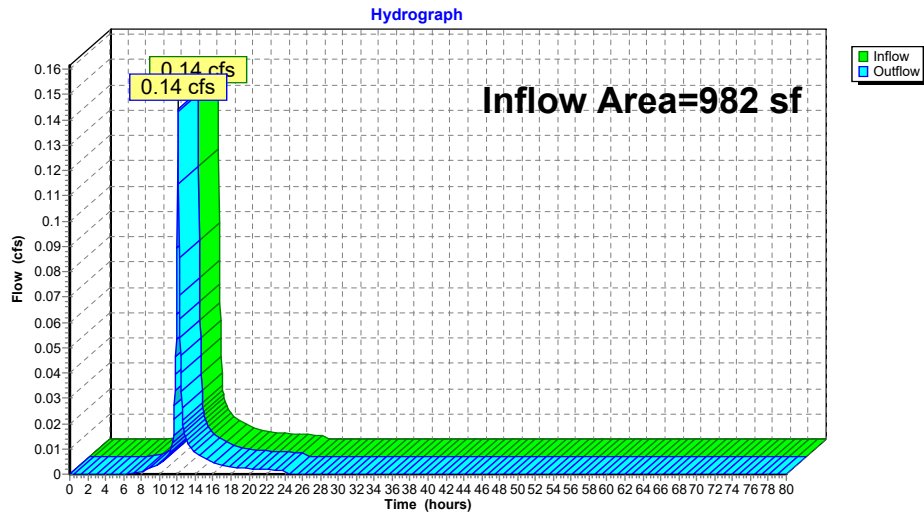
Page 26

**Summary for Reach DP-3: Off-site West**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 982 sf, 0.00% Impervious, Inflow Depth = 5.66" for 100-Year event  
Inflow = 0.14 cfs @ 12.09 hrs, Volume= 463 cf  
Outflow = 0.14 cfs @ 12.09 hrs, Volume= 463 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

**Reach DP-3: Off-site West**

**Proposed-6**

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**Summary for Pond S-1: Rip Rap Swale**

Inflow Area = 1,317 sf, 0.00% Impervious, Inflow Depth = 4.84" for 100-Year event  
 Inflow = 0.17 cfs @ 12.09 hrs, Volume= 531 cf  
 Outflow = 0.09 cfs @ 12.25 hrs, Volume= 319 cf, Atten= 48%, Lag= 9.4 min  
 Primary = 0.09 cfs @ 12.25 hrs, Volume= 319 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6

Peak Elev= 334.07' @ 12.25 hrs Surf.Area= 200 sf Storage= 219 cf

Plug-Flow detention time= 188.5 min calculated for 319 cf (60% of inflow)

Center-of-Mass det. time= 82.2 min ( 901.9 - 819.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	331.15'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 414 cf Overall - 114 cf Embedded = 300 cf x 40.0% Voids
#2	332.65'	114 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1
		234 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
331.15	0	0.0	0	0	0
331.50	21	27.2	2	2	59
332.50	171	99.3	84	86	788
332.65	200	104.4	28	114	872
334.15	200	104.4	300	414	1,028

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
332.65	0	0.0	0	0	0
333.00	21	27.2	2	2	59
334.00	171	99.3	84	86	788
334.15	200	104.4	28	114	872

Device	Routing	Invert	Outlet Devices
#1	Primary	334.05'	7.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

**Proposed-6**

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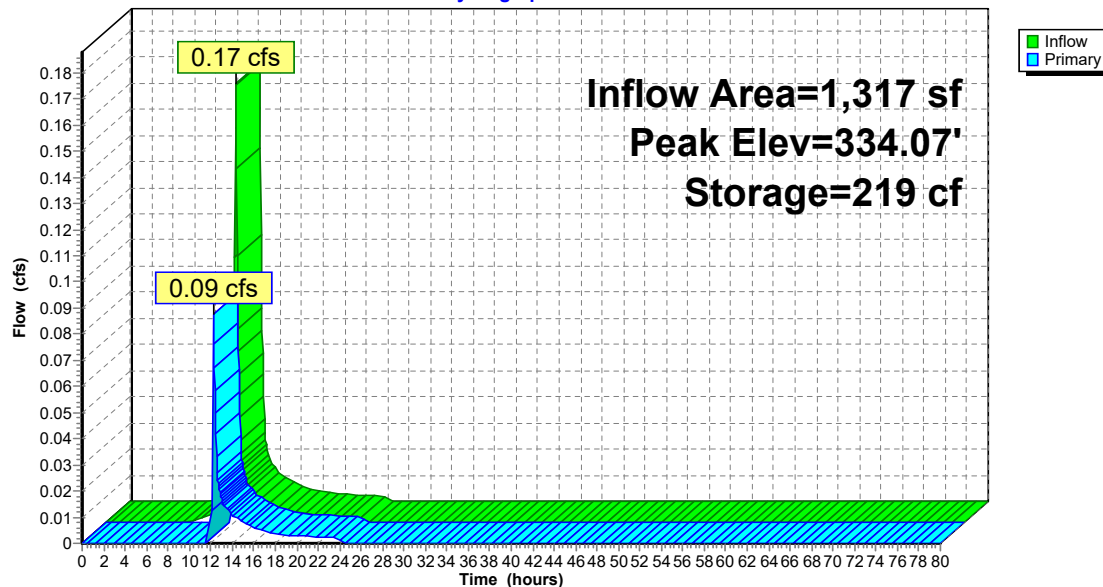
Type III 24-hr 100-Year Rainfall=8.16"

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Primary OutFlow Max=0.08 cfs @ 12.25 hrs HW=334.07' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 0.08 cfs @ 0.49 fps)

**Pond S-1: Rip Rap Swale****Hydrograph**



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**Summary for Pond S-2: Rip Rap Swale**

Inflow Area = 2,501 sf, 0.00% Impervious, Inflow Depth = 3.93" for 100-Year event  
 Inflow = 0.18 cfs @ 12.22 hrs, Volume= 819 cf  
 Outflow = 0.17 cfs @ 12.23 hrs, Volume= 619 cf, Atten= 4%, Lag= 0.7 min  
 Primary = 0.17 cfs @ 12.23 hrs, Volume= 619 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6

Peak Elev= 332.54' @ 12.23 hrs Surf.Area= 200 sf Storage= 205 cf

Plug-Flow detention time= 142.4 min calculated for 619 cf (76% of inflow)

Center-of-Mass det. time= 51.0 min ( 900.2 - 849.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	329.65'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 407 cf Overall - 107 cf Embedded = 300 cf x 40.0% Voids
#2	331.15'	107 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1
		227 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
329.65	0	0.0	0	0	0
330.50	74	61.1	21	21	298
331.15	200	104.5	86	107	873
332.65	200	104.5	300	407	1,029

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
331.15	0	0.0	0	0	0
332.00	74	61.1	21	21	298
332.65	200	104.5	86	107	873

Device	Routing	Invert	Outlet Devices
#1	Primary	332.50'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

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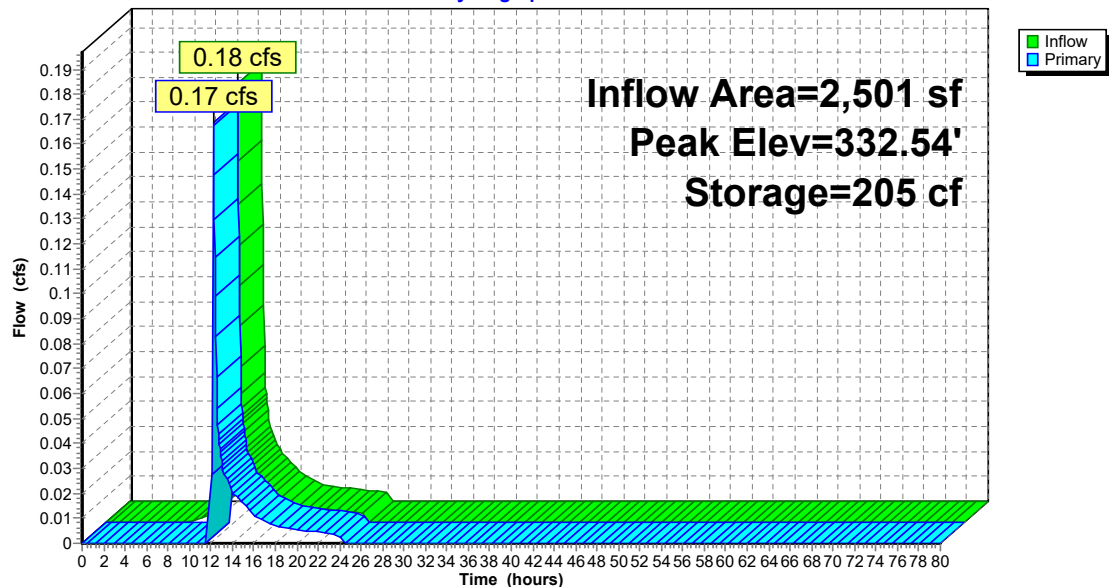
Type III 24-hr 100-Year Rainfall=8.16"

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Primary OutFlow Max=0.16 cfs @ 12.23 hrs HW=332.54' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 0.16 cfs @ 0.63 fps)

**Pond S-2: Rip Rap Swale****Hydrograph**

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**Summary for Pond S-3: Rip Rap Swale**

Inflow Area = 3,685 sf, 0.00% Impervious, Inflow Depth = 3.68" for 100-Year event  
 Inflow = 0.27 cfs @ 12.22 hrs, Volume= 1,131 cf  
 Outflow = 0.25 cfs @ 12.24 hrs, Volume= 940 cf, Atten= 8%, Lag= 1.0 min  
 Primary = 0.25 cfs @ 12.24 hrs, Volume= 940 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6

Peak Elev= 331.05' @ 12.24 hrs Surf.Area= 200 sf Storage= 203 cf

Plug-Flow detention time= 108.5 min calculated for 940 cf (83% of inflow)

Center-of-Mass det. time= 35.7 min ( 896.6 - 860.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	329.70'	112 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #2
#2	328.20'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)
			412 cf Overall - 112 cf Embedded = 300 cf x 40.0% Voids
			232 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
329.70	0	0.0	0	0	0
330.00	16	23.0	2	2	42
331.00	158	95.1	75	76	722
331.20	200	104.5	36	112	873

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
328.20	0	0.0	0	0	0
328.50	16	23.0	2	2	42
329.50	158	95.1	75	76	722
329.70	200	104.5	36	112	873
331.20	200	104.5	300	412	1,030

Device	Routing	Invert	Outlet Devices
#1	Primary	331.00'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

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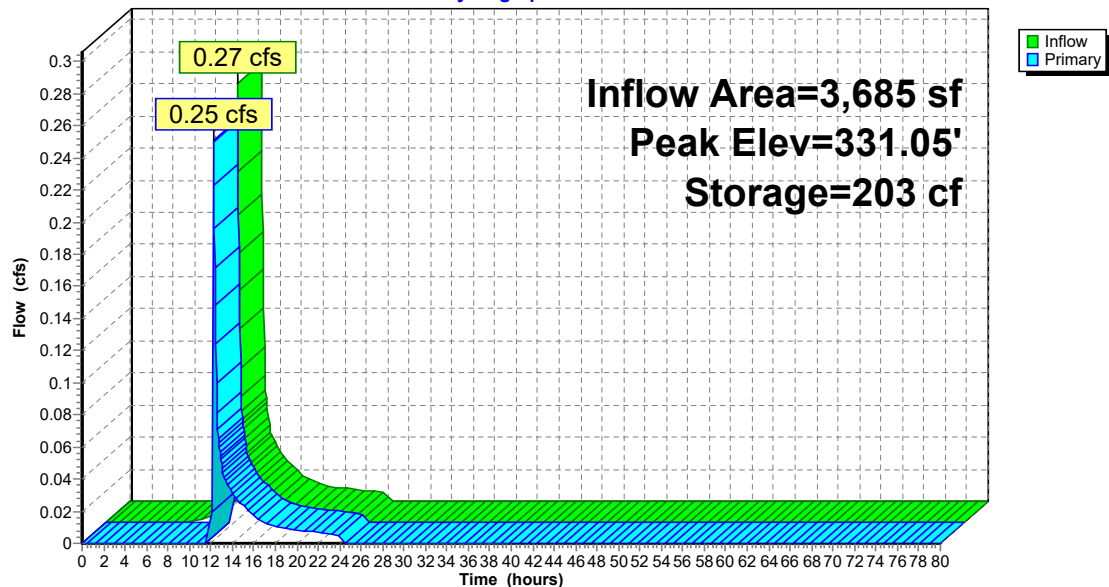
Type III 24-hr 100-Year Rainfall=8.16"

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Primary OutFlow Max=0.25 cfs @ 12.24 hrs HW=331.05' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 0.25 cfs @ 0.72 fps)

**Pond S-3: Rip Rap Swale****Hydrograph**

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**Summary for Pond S-4: Rip Rap Swale**

Inflow Area = 4,756 sf, 0.00% Impervious, Inflow Depth = 3.51" for 100-Year event  
 Inflow = 0.34 cfs @ 12.22 hrs, Volume= 1,392 cf  
 Outflow = 0.32 cfs @ 12.23 hrs, Volume= 1,248 cf, Atten= 5%, Lag= 0.7 min  
 Primary = 0.32 cfs @ 12.23 hrs, Volume= 1,248 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6

Peak Elev= 329.31' @ 12.23 hrs Surf.Area= 188 sf Storage= 156 cf

Plug-Flow detention time= 72.3 min calculated for 1,248 cf (90% of inflow)

Center-of-Mass det. time= 21.9 min ( 892.2 - 870.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	328.20'	108 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #2
#2	326.70'	113 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)
			390 cf Overall - 108 cf Embedded = 282 cf x 40.0% Voids
			221 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
328.20	0	0.0	0	0	0
329.00	71	56.9	19	19	259
329.25	112	76.4	23	42	466
329.70	188	102.0	67	108	832

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
326.70	0	0.0	0	0	0
327.50	71	56.9	19	19	259
327.75	112	76.4	23	42	466
328.20	188	102.0	67	108	832
329.70	188	102.0	282	390	985

Device	Routing	Invert	Outlet Devices
#1	Primary	329.25'	<b>7.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Proposed-6**

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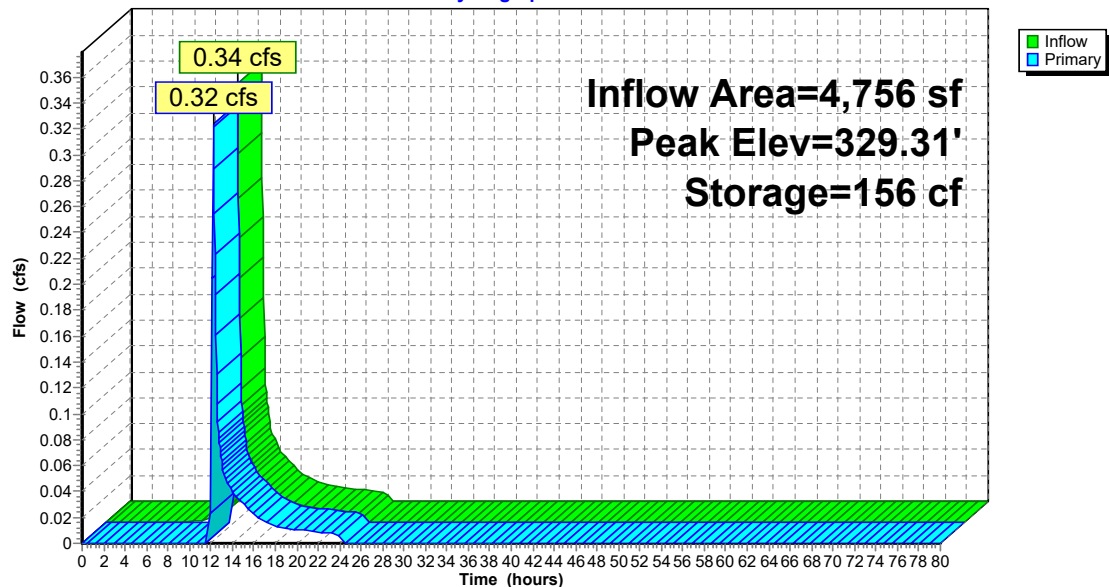
Type III 24-hr 100-Year Rainfall=8.16"

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Primary OutFlow Max=0.32 cfs @ 12.23 hrs HW=329.31' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 0.32 cfs @ 0.79 fps)

**Pond S-4: Rip Rap Swale****Hydrograph**

**Proposed-6**

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**Summary for Pond SSD-1: Subsurface Detention Basin-1**

Inflow Area = 71,428 sf, 99.59% Impervious, Inflow Depth = 7.92" for 100-Year event  
 Inflow = 12.83 cfs @ 12.09 hrs, Volume= 47,143 cf  
 Outflow = 6.21 cfs @ 12.25 hrs, Volume= 45,629 cf, Atten= 52%, Lag= 9.6 min  
 Primary = 6.21 cfs @ 12.25 hrs, Volume= 45,629 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 325.21' @ 12.25 hrs Surf.Area= 7,434 sf Storage= 15,266 cf

Plug-Flow detention time= 135.8 min calculated for 45,629 cf (97% of inflow)  
 Center-of-Mass det. time= 115.6 min ( 856.6 - 741.0 )

Volume	Invert	Avail.Storage	Storage Description
#1A	322.00'	6,586 cf	<b>63.25'W x 117.54'L x 3.50'H Field A</b> 26,020 cf Overall - 9,556 cf Embedded = 16,464 cf x 40.0% Voids
#2A	322.50'	9,556 cf	<b>ADS_StormTech SC-740 +Cap</b> x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 208 Chambers in 13 Rows
		16,141 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	322.50'	<b>15.0" Round Culvert</b> L= 21.3' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 322.50' / 322.00' S= 0.0235 ' / ' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	325.25'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#3	Device 1	324.25'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600
#4	Device 1	323.50'	<b>8.0" Vert. Orifice/Grate X 2.00</b> C= 0.600
#5	Device 1	322.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600

**Proposed-6**

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Type III 24-hr 100-Year Rainfall=8.16"

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**Primary OutFlow** Max=6.21 cfs @ 12.25 hrs HW=325.20' (Free Discharge)

- 1=Culvert (Passes 6.21 cfs of 8.52 cfs potential flow)
- 2=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)
- 3=Orifice/Grate (Orifice Controls 0.79 cfs @ 4.04 fps)
- 4=Orifice/Grate (Orifice Controls 3.94 cfs @ 5.64 fps)
- 5=Orifice/Grate (Orifice Controls 1.48 cfs @ 7.54 fps)

**Proposed-6**

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Type III 24-hr 100-Year Rainfall=8.16"

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### Pond SSD-1: Subsurface Detention Basin-1 - Chamber Wizard Field A

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

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

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

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

16 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 115.54' Row Length +12.0" End Stone x 2 = 117.54' Base Length

13 Rows x 51.0" Wide + 6.0" Spacing x 12 + 12.0" Side Stone x 2 = 63.25' Base Width

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

208 Chambers x 45.9 cf = 9,555.5 cf Chamber Storage

26,019.7 cf Field - 9,555.5 cf Chambers = 16,464.2 cf Stone x 40.0% Voids = 6,585.7 cf Stone Storage

Chamber Storage + Stone Storage = 16,141.2 cf = 0.371 af

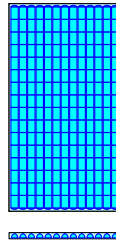
Overall Storage Efficiency = 62.0%

Overall System Size = 117.54' x 63.25' x 3.50'

208 Chambers

963.7 cy Field

609.8 cy Stone

**Proposed-6**

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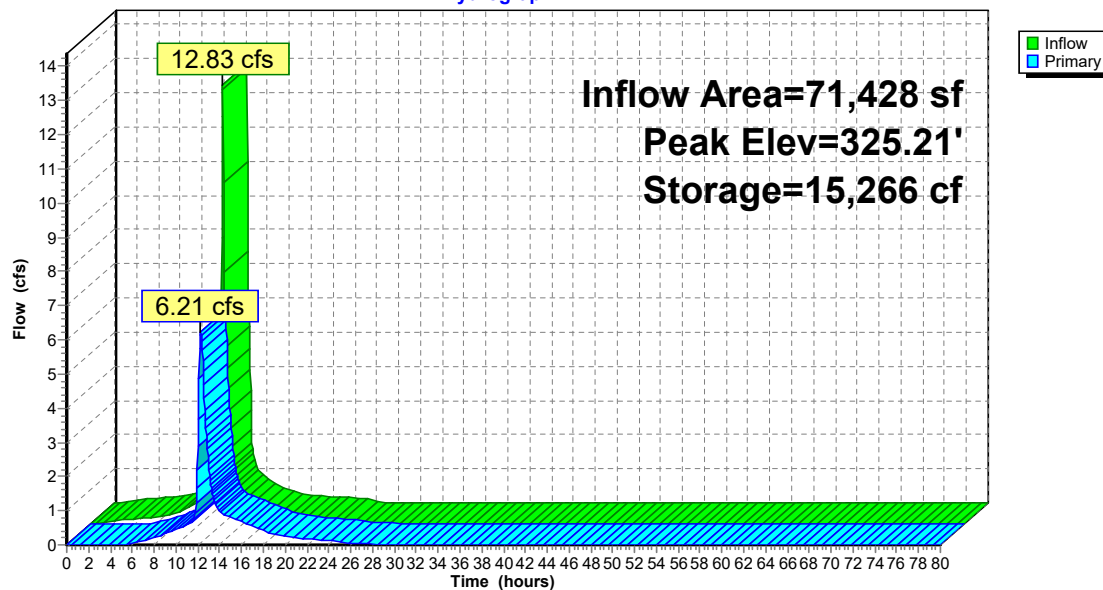
Type III 24-hr 100-Year Rainfall=8.16"

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### Pond SSD-1: Subsurface Detention Basin-1

#### Hydrograph





## **Operation and Maintenance Plan**







**OPERATION AND MAINTENANCE PLAN**  
**FOR**  
**15 LIBERTY WAY**  
**FRANKLIN, MA**

DATED: JANUARY 17, 2023

Prepared By:  
**Level Design Group, L.L.C.**  
**249 South Street, Unit 1**  
**Plainville, MA 02762**

Prepared For:  
**Oliver Street Capital**  
**125 High Street, Suite 220**  
**Boston, MA 02110**

***LDG Project No.:***  
***2081.00***



The proposed Stormwater Management System is designed to function properly provided that routine maintenance is performed. It is the responsibility during construction and until purchase of the units and turnover of the project to a Home Owners Association to be formed, that the Owner and Developer, Oliver Street Capital, shall be responsible for the long-term maintenance and to provide the required maintenance outlined in this plan for the site infiltration systems as well as the remainder of the on-site storm drainage system.

Upon completion of construction and the formation of the Home Owners Association, maintenance of driveways and the stormwater appurtenances required to ensure that sedimentation and pollution is controlled and that storm water detention and infiltration capacity is sustained are the on-going responsibility of the Home Owners Association. To ensure the proper functioning of these facilities the following maintenance practices will be used:

### **DRIVEWAYS AND PARKING AREAS**

#### *Spring Maintenance*

Driveways and Parking Areas are to be swept monthly to remove sand which has accumulated. Sand shall be removed from the site and legally disposed of.

#### *Summer & Fall Maintenance*

Leaves and debris which accumulates within the Driveways and Parking Areas during the summer and fall shall be collected and legally disposed of.

#### *Winter Maintenance & Snow Removal*

Snow removal within Driveways and Parking Area shall be stockpiled in the designated Snow Stockpile Areas outside of the traveled driveways. These areas should be located within or adjacent to the parking surface and should drain to the stormwater management system. Under no circumstances shall snow be directed onto abutting parcels or into the on-site resource areas (wetlands, wetland buffer zone, and riverfront areas).

*Estimated Yearly Cost \$1,000.00 (not including cost for snow plowing)*

### **DEEP SUMP CATCH BASINS**

Catch basins shall be inspected and cleaned four times per year or when the sumps are 50% full.

#### *Spring Maintenance*

Catch basins require the removal of sediment each spring. This procedure is comprised of removing the catch basin grate followed by removal of sediment trapped in the structure with a clamshell shovel. The outlet pipe from the catch basin shall be inspected and any obstructions are to be removed. The sediment and debris removed from the catch basin shall be legally disposed of.

#### *Fall Maintenance*

Catch basin grates shall be cleared of leaves and debris so they may function properly.

*Estimated Yearly Cost \$2,000.00*

### **SUBSURFACE DETENTION BASIN**

#### *Spring Maintenance*

The subsurface detention basin requires monthly inspections for accumulations of settled solids. If these materials have accumulated to a point where removal is necessary this shall be completed immediately. Accumulated trash and debris shall also be removed and legally disposed of during the monthly inspections.

*Estimated Yearly Cost \$500.00*

### **PUBLIC SAFETY FEATURES**

Many of the Public Safety Features of the Stormwater Management System are incorporated into its design. The Infiltration basin was designed to minimize its depth to 2-feet deep. This combined with sediment forebay being approximately 1-foot deep provide for a safe and effective system.

Despite all the well-designed safety features within the Stormwater Management System all components of the system must be properly maintained to be effective. All maintenance procedures detailed above must be done on schedule and documented. Standing or stagnant water provides mosquito-breeding habitat and increases the potential for disease transmission. The basin is designed to fully infiltrate within 72 hours after a storm even which will prevent standing water from becoming a safety hazard. Routine monitoring for and management of mosquito-breeding conditions by qualified maintenance staff is required during the peak breeding season between April and September ensure that unforeseen conditions do not develop.

While risks can be mitigated through proper design and maintenance, it is impossible to entirely eliminate risk. Therefore, education regarding stormwater management facilities and their inherent risks is valuable and should be a part of every community's activity. Employees and tenants of the Facility shall be given an overview of the Stormwater System and which areas to avoid. Public participation also increases the level of maintenance as community members can notify staff if a component of the stormwater system is not functioning properly.

The O&M shall be recorded with the Home Owners Agreement or other approving maintenance agreement to properly notify future owners of maintenance requirements.

## **STORMWATER MANAGEMENT OPERATIONS AND MAINTENANCE LOG**

It is the responsibility of the owner and developer, Oliver Street Capital, to provide the maintenance of the Stormwater Management System Maintenance in accordance with the Town of Franklin Stormwater Management Standards until such time as an entity is created for overall site management at which time the agreement will spell out responsibility with appropriate contact information for all parties. The log form below is a template and shall be reproduced as needed. Copies of all log forms shall be kept on file for a minimum of three years from the date of inspection.

<b>Name of Inspector:</b>
<b>Date and Time of Inspection:</b>
<b>Weather Conditions:</b>

Stormwater BMP	Observations	Action Required



## **Long Term Pollution Prevention Plan**







**LONG TERM POLLUTION PREVENTION PLAN**  
**FOR**  
**15 LIBERTY WAY**  
**FRANKLIN, MA**

DATED: JANUARY 13, 2023

Prepared By:  
**Level Design Group, L.L.C.**  
**249 South Street, Unit 1**  
**Plainville, MA 02762**

Prepared For:  
**Oliver Street Capital**  
**125 High Street, Suite 220**  
**Boston, MA 02110**

***LDG Project No.:***  
***2081.00***



### **GOOD HOUSEKEEPING PRACTICES**

It is the responsibility of the developer, Oliver Street Capital, to provide for maintenance of the parking areas and the storm drainage system until the site is turned over to the condominium association which will be created prior to the sale of any units. The Owner shall utilize good housekeeping practices as outlined in the Operation and Maintenance Plan required for the maintenance of the Stormwater Management System.

### **PROVISIONS FOR STORAGE OF MATERIALS AND WASTE PRODUCTS INSIDE OR UNDER COVER**

The storage of hazardous materials and waste is prohibited from being stored outdoor at the site. Any hazardous materials shall be stored under cover.

### **VEHICLE WASHING CONTROLS**

Outdoor vehicle washing is allowed only for occupants of the condominium development for non-commercial vehicles owned by the residents of the units. No commercial vehicle washing operations is allowed in this area.

### **REQUIREMENTS FOR ROUTINE INSPECTION AND MAINTENANCE OF STORMWATER BMPs**

The Owner / Operator shall keep a Maintenance Log Sheets of scheduled tasks outlined Operation and Maintenance Plan.

### **SPILL PREVENTION AND RESPONSE PLANS**

The risk of significant spills requiring action at this site is limited and will most likely be associated with motor vehicle use or maintenance. In the event of a significant spill contact:

Massachusetts Department of Environmental Protection 24-hour emergency response notification line – (888) 304-1133

### **PROVISIONS FOR MAINTENANCE OF LAWNS, GARDENS, AND OTHER LANDSCAPED AREAS**

The use of chemical fertilizers shall not be used on-site. If chemical fertilizers are required to be used, the fertilizers must be worked into the soil to prevent washouts and stormwater contamination of fertilizers.

### **REQUIREMENTS FOR STORAGE AND USE OF FERTILIZERS, HERBICIDES, AND PESTICIDES**

If fertilizers, herbicides, and pesticides are to be used and stored on site they are to be stored in their original containers and keep in a dry, safe area where children do not have access to.

### **PROVISIONS SOLID WASTE MANAGEMENT**

Solid waste and recycling is to be disposed in designated areas in enclosed dumpsters and receptacles with covers and hauled by private certified waste management service operators. Solid waste management systems shall be inspected and maintained in accordance with state, local, and federal solid waste management regulations.

### **EMERGENCY AND REGULATORY CONTACTS**

Franklin Fire Department:	911 / (508) 528-2323
Franklin Police Department:	911 / (508) 528-1212
Massachusetts Department of Environmental Protection – Central Regional Office:	(508) 792-7650
United State Environmental Protection Agency:	(617) 918-1111

**NPDES Stormwater Pollution Prevention Plan  
(DRAFT – Under separate cover)**