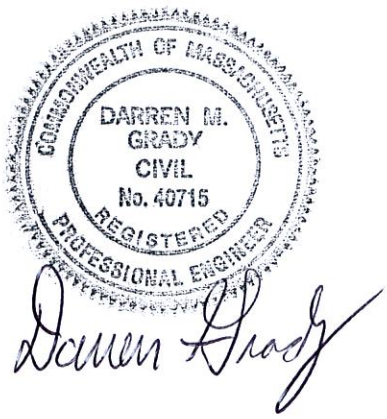
GRADY CONSULTING, L.L.C.
Civil Engineers ♦ Land Surveyors ♦ Landscape Architects

STORMWATER REPORT

Site Plan
81 West Union Street
Ashland, MA
(Phase 2)



81 West Union Street LLC
c/o William J. Rodenhiser
70 Bartzak Drive
Holliston, MA 01746

June 11, 2019

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SUMMARY

This Stormwater Report has been prepared to document compliance with Stormwater Management Standards. The applicant is proposing to develop the second phase of the 8.7 acre property by constructing (1) commercial/retail, and two (2) contractor landscape building . The property is not located in a Flood Plain as shown on Flood Insurance Rate Map Community Panel Number 25017C 0513 F dated July 7, 2014 and not in a Zone II Aquifer Protection zone.

The property is located on 81 West Union Street. The property is currently under construction consisting of the phase 1 storage facility. The proposed drainage systems will consist of catch basins, manholes and Stormceptors connecting to underground storage galleys. Roof run-off will be connected directly into the underground storage galleys.

The analysis was prepared to demonstrate that the proposed development complies with Stormwater Management Requirements and Town of Ashland Planning Board Rules and Regulations. This includes removal of at least 80% of Total Suspended Solids and attenuation of stormwater flows for the proposed development. The attenuation of stormwater flows has been achieved by routing runoff from the proposed development to the two proposed rain gardens.

The analysis has been performed using precipitation rates from the NOAA Atlas 14 and demonstrate that post construction volumes are less than preconstruction volumes.

This analysis is divided into the following sections:

Section I Compliance with Massachusetts Stormwater Management Regulations
Section II Overall Site Analysis
Section III Roof Drain Calculations

The calculations have been performed for the 2, 10, 25, and 100-year 24 hour storm event, using the HydroCAD 10.0 Stormwater Modeling System. This computer program is based upon the TR-55 computer models and uses the SCS Curvilinear Unit rainfall distribution.

The following table summarizes runoff for the pre and post-development conditions.

SUMMARY OF STORMWATER FLOWS
(CFS)

Design Storm		Existing Condition	Proposed Condition
		(SA14)	(Post 1B)
2-year	3.36”	0.00	0.00
10-year	5.26”	0.01	0.00
25-year	6.43”	0.06	0.00
100-year	8.23”	0.19	0.00
		(SA15)	(POST 8)
2-year	3.36”	0.00	0.00
10-year	5.26”	0.07	0.03
25-year	6.43”	0.45	0.17
100-year	8.23”	1.62	0.66

SUMMARY OF STORMWATER VOLUMES
(CF)

Design Storm		Existing Condition	Proposed Condition
		(SA14)	(Post 1A)
2-year	3.36”	3	0.00
10-year	5.26”	203	0.00
25-year	6.43”	458	0.00
100-year	8.23”	999	0.00
		(SA15)	(Post 8)
2-year	3.36”	0	0
10-year	5.26”	1,909	604
25-year	6.43”	4,795	1,428
100-year	8.23”	11,218	3215

(SA#13) = Proposed flow toward basin 1➔ Pond 13P
(SA#14) = Existing flow toward 73 West Union St.
(SA#15) = Existing flow toward wetland.
(Post 1A) =Roof run-off from west side of Building 1 ➔UC#1 (fully infiltrated)
(Post 1B) = Proposed flow toward crushed stone trench ➔ UC#1 (fully infiltrated)
(Post 2A) = Roof run-off from east side Building 1 ➔UC#2 (fully infiltrated)
(Post 3A) =Proposed flow toward catch basin X ➔UC#2 (fully infiltrated)
(Post 3B) = Proposed flow toward catch basin X ➔ UC#2 (fully infiltrated)
(Post 4) = Roof run-off from Building 2 ➔UC#3&4 (fully infiltrated)
(Post 5A) =Proposed flow toward catch basin X ➔UC#3&4 (fully infiltrated)
(Post 5B) = Proposed flow toward catch basin X ➔ UC#3&4 (fully infiltrated)
(Post 6) = Roof run-off from Building 3 ➔UC#3&4 (fully infiltrated)
(Post 7) = Gravel parking lot toward catch basin X➔UC#3&4 (fully infiltrated)
(Post 8) = Existing flow toward wetland. (compare to SA#15)

Section I

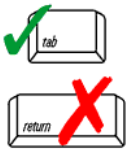
Compliance with Massachusetts Stormwater Management Regulations

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

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.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

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

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

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the

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project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

B. Stormwater Checklist and Certification

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

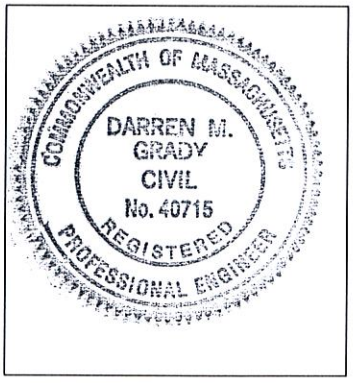
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Darren Grady 6/11/19
Signature and Date

Checklist

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

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Checklist for Stormwater Report

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

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): _____

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Checklist for Stormwater Report

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 (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[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

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☒ 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.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

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
☒ 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

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;
- Street sweeping schedules;

- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- 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.

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

☐ 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.

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Checklist for Stormwater Report

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

☐ 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

☐ 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.

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

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☐ 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

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.

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☐ 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 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:

☐ 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

☐ 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.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

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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.
☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

STANDARD 1. NO UNTREATED DISCHARGES OR EROSION TO WETLANDS
Applicants must demonstrate that there are no new untreated discharges. To demonstrate that all new discharges are adequately treated, applicants may rely on the computations required to demonstrate compliance with Standards 4 through 6. No additional computations are required.

All proposed developed areas are routed through the proposed infiltration galley systems as shown on the Site Plan.

STANDARD 2. PEAK RATE ATTENUATION
"Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates."

No increases in post development peak discharge rates are proposed. Calculations demonstrating this are located in Section II. No increase in post development volumes are proposed.

STANDARD 3. STORMWATER RECHARGE
"Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from 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."

Based on the Natural Resources Conservation Service and soil evaluation, the soils were determined to consist of Hydrologic Soils Group "Type A", sand and loamy sand with Infiltration Rates of 2.4 Inches/hour. This is considered a "rapid infiltration rate."

TABLE 1
REQUIRED RECHARGE VOLUME AND DRAWDOWN

Subareas	Impervious Area (SF)	Required Recharge Volume (Rv) (CF)	Proposed Recharge Volume (CF)	Bottom Area (SF)	Drawdown (Hrs)
Pond 8P UC#1	903	134	413	350	0.6
Pond 4P UC#2	34,089	1,705	12,536	4,148	15.1
Pond 4P UC#3+4	63,275	3,164	22,740	7,566	15.0
	0				

Impervious area includes buildings
Recharge Volume is the calculated volume for the 100 yr storm

Sample Calculation Pond 8P UC#1

Impervious Area = 903 SF
Target Depth Factor (F) = 0.6”

Rv = F x impervious area = 0.6”x 903 SF x 1’/12”= 45.2 CF

Sizing Storage Volume

Using the “static method”, the proposed infiltration device must provide sufficient storage capacity to hold the Required Recharge Volume without taking any infiltration into account. Storage Volume calculated using the average end area shown in Table 1 above and the Pond Reports in Section II

The storage volumes for each building and basin are shown in Table 1.

Drawdown Within 72 Hours

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

Where:
Rv = Storage Volume
K = Saturated Hydraulic Conductivity For “Static” and “Simple Dynamic” Methods, use Rawls Rate (see Table 2.3.3). For “Dynamic Field” Method, use 50% of the in-situ saturated hydraulic conductivity.
Bottom Area = Bottom Area of Recharge Structure

$$\text{Time} = \frac{413\ CF}{(2.41”)(1’/12”)(350\ SF)} = 5.9 \text{ hours} < 72 \text{ hours}$$

Mounding Analysis

“Mounding analysis is required when the vertical separation from the bottom of an exfiltration system to seasonal high groundwater is less than four (4) feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm (e.g., 10-year, 25-year, 50-year, or 100-year 24-hour storm). In such cases, the mounding analysis must demonstrate that the Required Recharge Volume (e.g., infiltration basin storage) is fully dewatered within 72 hours (so the next storm can be stored for exfiltration). The mounding analysis must also show that the groundwater mound that forms under the recharge system will not break out above the land or water surface of a wetland (e.g., it doesn’t increase the water sheet elevation in a Bordering Vegetated Wetland, Salt Marsh, or Land Under Water within the 72-hour evaluation period).”

“The Hantush[1] or other equivalent method may be used to conduct the mounding analysis. The Hantush method predicts the maximum height of the groundwater mound beneath a rectangular or circular recharge area. It assumes unconfined groundwater flow, and that a linear relation exists between the water table elevation and water table decline rate. It results in a water table recession hydrograph depicting exponential decline. The Hantush method is available in

[1] Hantush 1967 – See Reference for Standard 3.

proprietary software and free on-line calculators on theWeb in automated format. If the analysis indicates the mound will prevent the infiltration BMP from fully draining within the 72-hour period, an iterative process must be employed to determine an alternative design that drains within the 72-hour period."

The bottom of the exfiltration systems UC#2, UC#3, UC#4 are greater than 4 feet and do not require a mounding calculation. A mounding calculation is required for UC#1 as shown below:

UC1

Using the Hantush Method, 350 SF (25'long x 14'wide) drain field, a recharge infiltration rate of (413 cf /350 sf)[1] = 1.18 hydraulic conductivity of 4.8 ft/day and an initial saturated thickness of 30 feet we calculated groundwater mounding of 0.76 feet. The mounding will not interfere with dewatering within 72 hours or result in breakout above land.

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

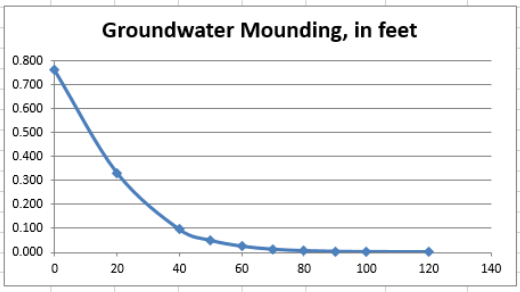
The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.

Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

Input Values		use consistent units (e.g. feet & days **or** inches & hours)	Conversion Table inch/hour	feet/day	
1.1800	R	Recharge (infiltration) rate (feet/day)	0.67	1.33	
0.250	Sy	Specific yield, Sy (dimensionless, between 0 and 1)			
4.80	K	Horizontal hydraulic conductivity, Kh (feet/day)*	2.00	4.00	In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).
12.500	x	1/2 length of basin (x direction, in feet)			
7.000	y	1/2 width of basin (y direction, in feet)	hours	days	
1.000	t	duration of infiltration period (days)	36	1.50	
30.000	hi(0)	initial thickness of saturated zone (feet)			
30.761	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)			
0.761	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)			

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.761	0
0.332	20
0.096	40
0.050	50
0.025	60
0.012	70
0.006	80
0.003	90
0.002	100
0.002	120

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

STANDARD 4. WATER QUALITY

"Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

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

This standard applies after the site is stabilized.[2] Since removal efficiency may vary with each storm, 80% TSS removal is not required for each storm. It is the average removal over the year that is required to meet the standard. The required water quality volume, the runoff volume requiring TSS treatment, is calculated as follows:

The required water quality volume equals 1.0 inch of runoff times the total impervious area of the post-development project site for a discharge

- *from a land use with a higher potential pollutant load;*
- *within an area with a rapid infiltration rate (greater than 2.4 inches per hour);*
- *within a Zone II or Interim Wellhead Protection Area;*
- *near or to the following critical areas:*
  - *Outstanding Resource Waters,*
  - *Special Resource Waters,*
  - *bathing beaches,*
  - *shellfish growing areas,*
  - *cold-water fisheries.*

The required water quality volume equals 0.5 inches of runoff times the total impervious area of the post-development site for all other discharges."

The proposed work meets the requirement for removal of total suspended solids (TSS).

Standard 4 requires the development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long-term pollution prevention plan. The long-term pollution prevention plan shall include the proper procedures for the following:

- *good housekeeping;*
- *storing materials and waste products inside or under cover;*
- *vehicle washing;*
- *routine inspections and maintenance of stormwater BMPs;*
- *spill prevention and response;*

- *maintenance of lawns, gardens, and other landscaped areas;*
- *storage and use of fertilizers, herbicides, and pesticides;*
- *pet waste management;*
- *operation and management of septic systems; and*
  proper management of deicing chemicals and snow.

The long-term pollution prevention plan shall provide that sand piles be contained and stabilized to prevent the discharge of sand to wetlands or water bodies, and, where feasible, covered. If a Total Maximum Daily Load (TMDL) has been developed that indicates that use of fertilizers containing nutrients must be reduced, the long-term pollution prevention plan shall also include a nutrient management plan. The long-term pollution prevention plan may be prepared as a separate document or combined with the Operation and Maintenance Plan required by Standard 9.

The long-term pollution prevention plan will be combined with the Operation and Maintenance Plan required by Standard 9.

WATER QUALITY TREATMENT VOLUME

V_{WQ} = (D_{WQ}/12 inches/foot) * (A_{IMP} * 43,560 square feet/acre)

V_{WQ} = *Required Water Quality Volume* (in cubic feet)
D_{WQ} = Water Quality Depth: one-inch for discharges within a Zone II or Interim Wellhead Protection Area, to or near another critical area, runoff from a LUHPPL, or exfiltration to soils with infiltration rate greater than 2.4 inches/hour or greater; ½-inch for discharges near or to other areas.
A_{IMP} = Impervious Area (in acres)

The site is located in soils with an infiltration rate greater than 2.4 inches/hour so a Water Quality Depth of one-inch is required.

UC#1
V_{WQ} = (1 inch/12 inches/foot) * (903 square feet) = 75 CF **7,699 CF provided**

UC#2
V_{WQ} = (1 inch/12 inches/foot) * (34,089 square feet) = 2,841 CF **12,536 CF provided**

UC#3&4
V_{WQ} = (1 inch/12 inches/foot) * (63,275 square feet) = 5,273 CF **22,740 CF provided**

TSS REMOVAL PERCENTAGE COMPUTATIONS

The following calculations demonstrates the required 80% removal of total suspended solids (TSS) utilizing stormceptors for the two underground drainage systems

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: 81 West Union St, Ashland PH II UC #2

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Stormceptor	.901	1.00	.901	.099
Underground Chamber System	.80	.099	.0792	.020

Total TSS Removal = 98%

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

Project: 81 West Union St PH II

Prepared By: DMG

Date: 5/22/19

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

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: 81 West Union St, Ashland PH II UC# 3

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
STORMCEPTOR	.0832	1.00	.0832	.168
UNDERGROUND CHAMBER SYSTEM	.80	.168	.134	.034

Total TSS Removal = 96.6%

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

Project: 81 West Union St PH II
Prepared By: DMG
Date: 5/22/19

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

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: 81 WEST UNION ST ASHLAND PH II UC # 4

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
STORMCRPTOR	.859	1.00	.859	.141
UNDERGROUND CHAMBER SYSTEM	.80	.141	.113	.028

Total TSS Removal = 97.2

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

Project: 81 WEST UNION ST
Prepared By: DMG
Date: 5/22/19

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

WEST UNION ST
ASHLAND, MA

Area	0.05 ac	Unit Site Designation	UC #2
Weighted C	0.9	Rainfall Station #	68
t_c	5 min		
CDS Model	1515-3	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.00	0.00	9.1
0.04	9.5%	18.8%	0.00	0.00	9.2
0.06	8.7%	27.5%	0.00	0.00	8.5
0.08	10.1%	37.6%	0.00	0.00	9.8
0.10	7.2%	44.8%	0.00	0.00	6.9
0.12	6.0%	50.8%	0.01	0.01	5.8
0.14	6.3%	57.1%	0.01	0.01	6.1
0.16	5.6%	62.7%	0.01	0.01	5.4
0.18	4.7%	67.4%	0.01	0.01	4.5
0.20	3.6%	71.0%	0.01	0.01	3.5
0.25	8.2%	79.1%	0.01	0.01	7.9
0.50	14.9%	94.0%	0.02	0.02	14.3
0.75	3.2%	97.3%	0.03	0.03	3.1
1.00	1.2%	98.5%	0.05	0.05	1.2
1.50	0.7%	99.2%	0.07	0.07	0.7
2.00	0.8%	100.0%	0.09	0.09	0.7
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					96.5
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**90.1%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

WEST UNION ST
ASHLAND, MA

Area	0.55 ac	Unit Site Designation	UC #3
Weighted C	0.9	Rainfall Station #	68
t_c	5 min		
CDS Model	1515-3	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.0
0.04	9.5%	18.8%	0.02	0.02	9.1
0.06	8.7%	27.5%	0.03	0.03	8.3
0.08	10.1%	37.6%	0.04	0.04	9.5
0.10	7.2%	44.8%	0.05	0.05	6.7
0.12	6.0%	50.8%	0.06	0.06	5.6
0.14	6.3%	57.1%	0.07	0.07	5.8
0.16	5.6%	62.7%	0.08	0.08	5.1
0.18	4.7%	67.4%	0.09	0.09	4.3
0.20	3.6%	71.0%	0.10	0.10	3.3
0.25	8.2%	79.1%	0.12	0.12	7.2
0.50	14.9%	94.0%	0.25	0.25	12.0
0.75	3.2%	97.3%	0.37	0.37	2.3
1.00	1.2%	98.5%	0.50	0.50	0.8
1.50	0.7%	99.2%	0.74	0.74	0.3
2.00	0.8%	100.0%	0.99	0.99	0.2
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					89.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**83.2%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

WEST UNION ST
ASHLAND, MA

Area	0.35 ac	Unit Site Designation	UC #4
Weighted C	0.9	Rainfall Station #	68
t_c	5 min		
CDS Model	1515-3	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.0
0.04	9.5%	18.8%	0.01	0.01	9.1
0.06	8.7%	27.5%	0.02	0.02	8.4
0.08	10.1%	37.6%	0.03	0.03	9.6
0.10	7.2%	44.8%	0.03	0.03	6.8
0.12	6.0%	50.8%	0.04	0.04	5.7
0.14	6.3%	57.1%	0.04	0.04	5.9
0.16	5.6%	62.7%	0.05	0.05	5.2
0.18	4.7%	67.4%	0.06	0.06	4.4
0.20	3.6%	71.0%	0.06	0.06	3.4
0.25	8.2%	79.1%	0.08	0.08	7.5
0.50	14.9%	94.0%	0.16	0.16	12.9
0.75	3.2%	97.3%	0.24	0.24	2.6
1.00	1.2%	98.5%	0.32	0.32	0.9
1.50	0.7%	99.2%	0.47	0.47	0.5
2.00	0.8%	100.0%	0.63	0.63	0.4
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					92.4
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**85.9%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

STANDARD 5 LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

The land use is not considered a higher potential pollutant load. There will be no storage of materials with higher potential pollutant loads.

STANDARD 6. CRITICAL AREAS

The land use is not located within a critical area.

STANDARD 7. REDEVELOPMENT PROJECT

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

The project is not a redevelopment project.

STANDARD 8. CONSTRUCTION PERIOD CONTROLS

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

The proposed project will disturb more than one acre of land and will obtain coverage under the NPDES Construction General Permit issued by EPA through preparing a Stormwater Pollution Prevention Plan.

STANDARD 9. LONG-TERM OPERATION AND MAINTENANCE (O&M) PLAN

A Long -Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The Long-Term Operation and Maintenance Plan shall at a minimum include:

1. *Stormwater management system(s) owners;*
2. *The party or parties responsible for operation and maintenance, including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;*
3. *The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks;*
4. *A plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point;*
5. *A description and delineation of public safety features; and*
6. *An estimated operations and maintenance budget.*

STANDARD 10. ILLICIT DISCHARGES PROHIBITED

There are no existing illicit discharges on site. All illicit discharges to the stormwater management system are prohibited.

Illicit Discharge Statement

This statement is intended to meet Standard #10 of the Stormwater Management requirements

Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater.

Except for the potential for deliberate criminal act of discharge by an unauthorized entity for which the property owner has no control, there are to be no illicit discharges into the stormwater system.

_____

Applicant\Owner

NOAA Atlas 14, Volume 10, Version 2
Location name: Ashland Town of, Massachusetts, USA*
Latitude: 42.2522°, Longitude: -71.4727°
Elevation: 238.38 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

AMS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Annual exceedance probability (1/years)								
	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/500	1/1000
5-min	0.368 (0.286–0.471)	0.498 (0.386–0.639)	0.596 (0.460–0.769)	0.726 (0.541–0.977)	0.824 (0.602–1.13)	0.922 (0.655–1.32)	1.04 (0.702–1.52)	1.20 (0.778–1.82)	1.32 (0.836–2.04)
10-min	0.522 (0.406–0.667)	0.705 (0.547–0.905)	0.844 (0.651–1.09)	1.03 (0.766–1.38)	1.17 (0.853–1.61)	1.31 (0.927–1.86)	1.48 (0.994–2.16)	1.70 (1.10–2.57)	1.87 (1.19–2.89)
15-min	0.614 (0.477–0.785)	0.830 (0.643–1.07)	0.993 (0.766–1.28)	1.21 (0.901–1.63)	1.37 (1.00–1.89)	1.54 (1.09–2.19)	1.74 (1.17–2.54)	2.00 (1.30–3.03)	2.20 (1.39–3.40)
30-min	0.841 (0.654–1.08)	1.14 (0.882–1.46)	1.36 (1.05–1.76)	1.66 (1.24–2.23)	1.88 (1.38–2.59)	2.11 (1.49–3.00)	2.38 (1.60–3.48)	2.74 (1.78–4.14)	3.01 (1.91–4.65)
60-min	1.07 (0.831–1.37)	1.45 (1.12–1.85)	1.73 (1.33–2.23)	2.11 (1.57–2.83)	2.39 (1.75–3.29)	2.67 (1.90–3.81)	3.02 (2.03–4.41)	3.48 (2.25–5.26)	3.82 (2.42–5.90)
2-hr	1.36 (1.07–1.73)	1.85 (1.45–2.36)	2.23 (1.73–2.86)	2.72 (2.05–3.66)	3.10 (2.29–4.26)	3.47 (2.50–4.97)	3.99 (2.69–5.79)	4.67 (3.04–7.03)	5.19 (3.30–7.96)
3-hr	1.57 (1.23–1.98)	2.15 (1.68–2.73)	2.59 (2.01–3.30)	3.16 (2.39–4.24)	3.60 (2.67–4.95)	4.04 (2.92–5.78)	4.68 (3.17–6.77)	5.52 (3.59–8.26)	6.15 (3.91–9.39)
6-hr	2.01 (1.59–2.53)	2.76 (2.18–3.49)	3.33 (2.61–4.23)	4.09 (3.10–5.44)	4.66 (3.48–6.36)	5.23 (3.81–7.45)	6.08 (4.13–8.74)	7.21 (4.70–10.7)	8.06 (5.14–12.2)
12-hr	2.55 (2.03–3.19)	3.52 (2.79–4.41)	4.25 (3.36–5.36)	5.22 (3.99–6.90)	5.95 (4.47–8.07)	6.69 (4.89–9.46)	7.77 (5.30–11.1)	9.20 (6.03–13.6)	10.3 (6.58–15.5)
24-hr	3.05 (2.45–3.78)	4.27 (3.41–5.31)	5.19 (4.12–6.49)	6.40 (4.92–8.42)	7.32 (5.53–9.88)	8.24 (6.07–11.6)	9.63 (6.59–13.7)	11.5 (7.53–16.8)	12.8 (8.25–19.2)
2-day	3.42 (2.76–4.21)	4.88 (3.93–6.04)	5.99 (4.79–7.45)	7.45 (5.77–9.76)	8.56 (6.51–11.5)	9.66 (7.18–13.6)	11.4 (7.85–16.1)	13.7 (9.06–20.0)	15.5 (9.98–23.0)
3-day	3.69 (2.99–4.53)	5.25 (4.24–6.47)	6.44 (5.16–7.97)	8.00 (6.21–10.4)	9.18 (7.01–12.3)	10.4 (7.72–14.5)	12.2 (8.43–17.2)	14.7 (9.74–21.4)	16.6 (10.7–24.6)
4-day	3.95 (3.21–4.83)	5.56 (4.50–6.83)	6.78 (5.46–8.38)	8.40 (6.54–10.9)	9.62 (7.36–12.8)	10.8 (8.09–15.1)	12.8 (8.81–17.9)	15.3 (10.1–22.2)	17.3 (11.1–25.4)
7-day	4.66 (3.81–5.67)	6.37 (5.19–7.78)	7.66 (6.20–9.41)	9.37 (7.32–12.1)	10.7 (8.17–14.1)	12.0 (8.91–16.5)	13.9 (9.62–19.3)	16.4 (10.9–23.6)	18.4 (11.9–26.9)
10-day	5.35 (4.38–6.48)	7.12 (5.81–8.66)	8.45 (6.86–10.3)	10.2 (8.00–13.1)	11.6 (8.86–15.2)	12.9 (9.59–17.6)	14.8 (10.3–20.4)	17.3 (11.5–24.7)	19.1 (12.4–27.9)
20-day	7.38 (6.10–8.89)	9.28 (7.63–11.2)	10.7 (8.75–13.0)	12.6 (9.91–15.9)	14.0 (10.8–18.1)	15.5 (11.5–20.7)	17.2 (12.0–23.6)	19.5 (13.0–27.6)	21.2 (13.8–30.7)
30-day	9.04 (7.50–10.8)	11.0 (9.10–13.3)	12.5 (10.3–15.1)	14.5 (11.4–18.2)	16.0 (12.3–20.4)	17.5 (12.9–23.1)	19.0 (13.4–26.0)	21.1 (14.2–29.8)	22.7 (14.8–32.8)
45-day	11.1 (9.22–13.2)	13.1 (10.9–15.7)	14.7 (12.1–17.7)	16.7 (13.2–20.8)	18.3 (14.1–23.2)	19.8 (14.6–25.9)	21.2 (14.9–28.8)	23.1 (15.5–32.4)	24.4 (16.0–35.1)
60-day	12.8 (10.6–15.2)	14.9 (12.4–17.8)	16.4 (13.6–19.8)	18.5 (14.7–23.0)	20.1 (15.5–25.4)	21.7 (16.0–28.1)	23.0 (16.2–31.0)	24.6 (16.6–34.4)	25.8 (16.9–37.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of annual maxima series (AMS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and annual exceedance probability) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/23/2019 at 7:35:06 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

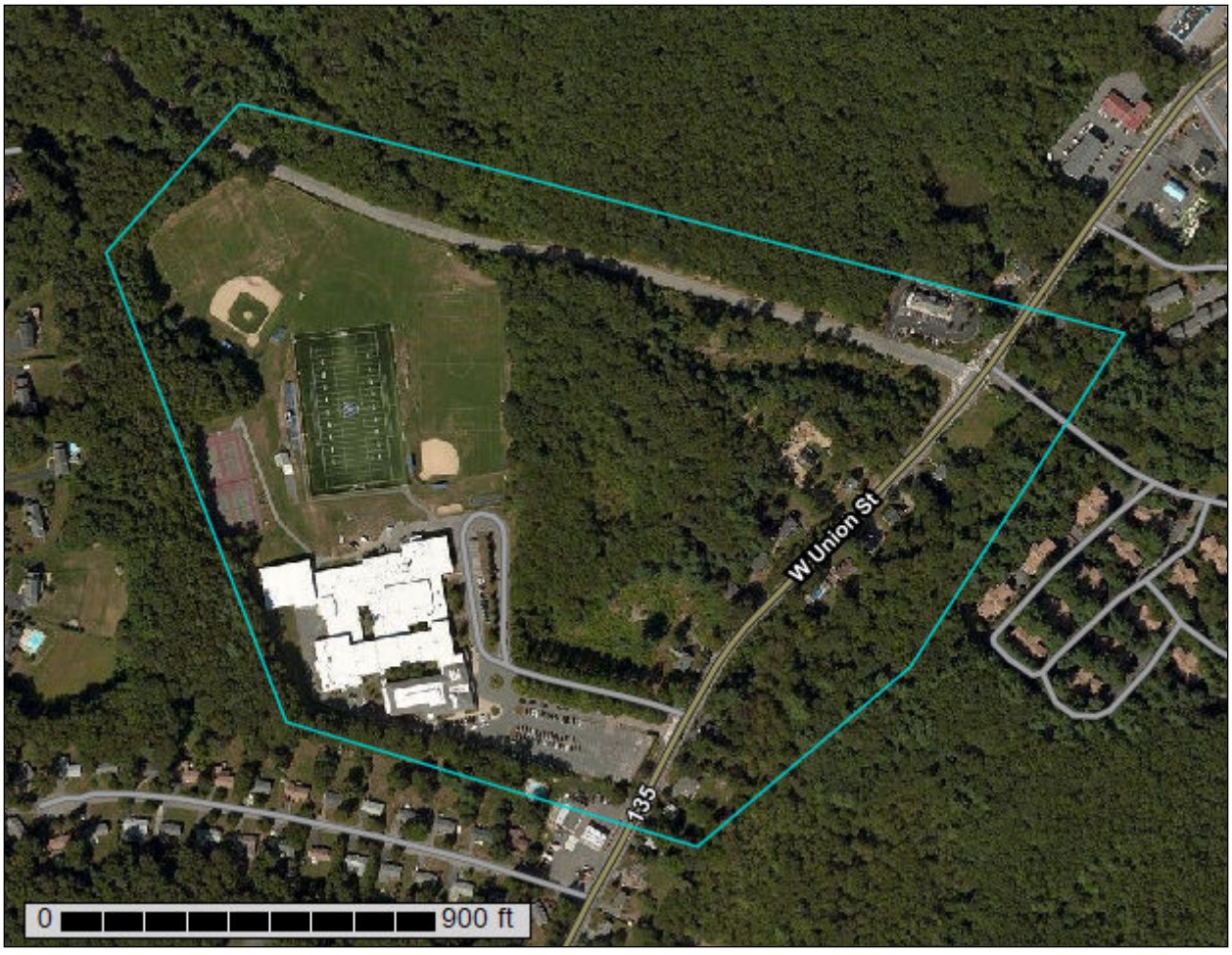
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Middlesex County, Massachusetts



May 22, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

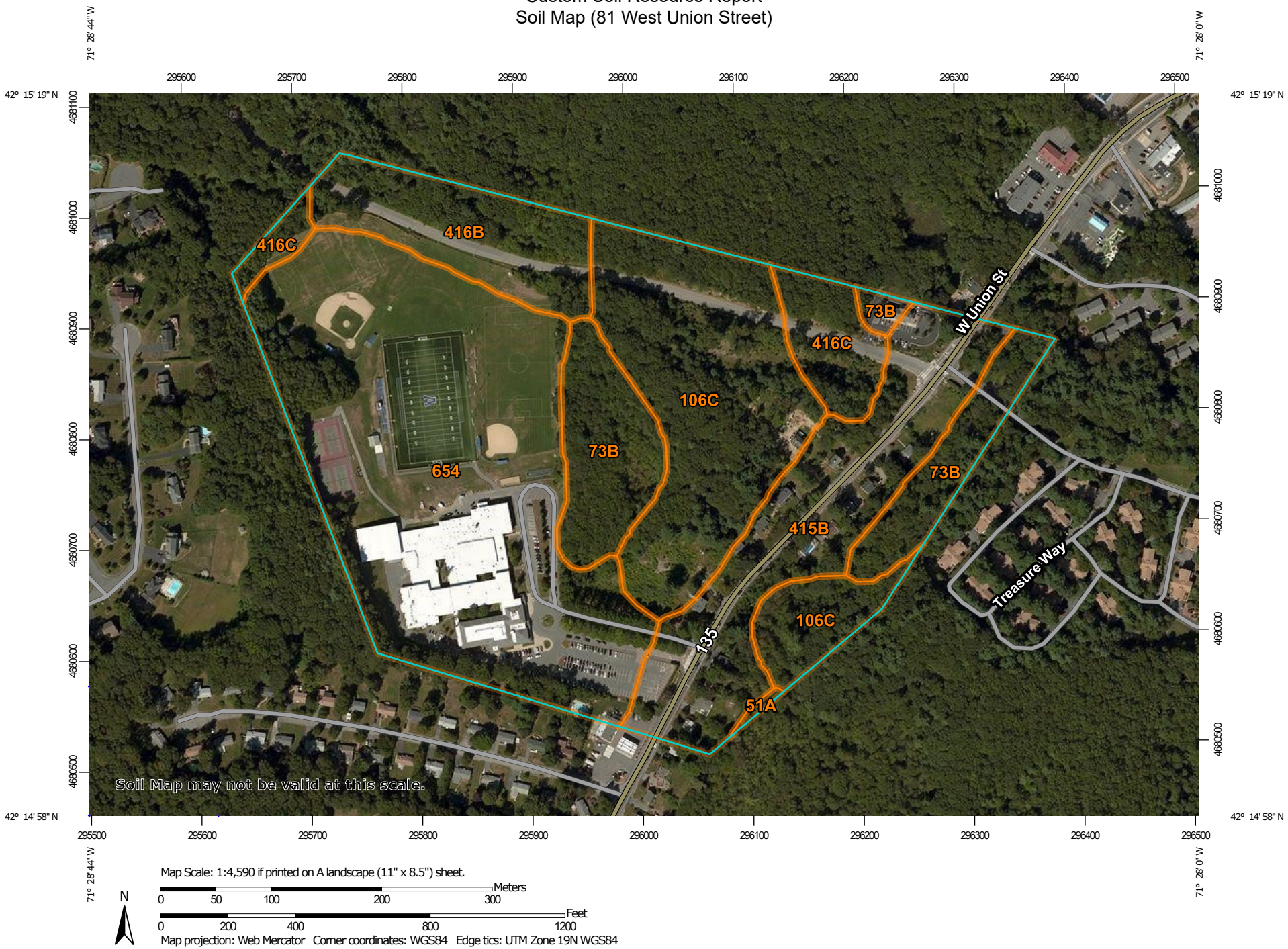
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map (81 West Union Street)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 18, Sep 7, 2018

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

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

Map Unit Legend (81 West Union Street)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
51A	Swansea muck, 0 to 1 percent slopes	0.1	0.2%
73B	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	6.7	11.0%
106C	Narragansett-Hollis-Rock outcrop complex, 3 to 15 percent slopes	13.0	21.2%
415B	Narragansett silt loam, 3 to 8 percent slopes	9.8	16.0%
416B	Narragansett silt loam, 3 to 8 percent slopes, very stony	5.0	8.2%
416C	Narragansett silt loam, 8 to 15 percent slopes, very stony	2.9	4.7%
654	Udorthents, loamy	23.8	38.8%
Totals for Area of Interest		**61.2**	**100.0%**

Map Unit Descriptions (81 West Union Street)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas

are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Middlesex County, Massachusetts

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Swansea and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swansea

Setting

Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

73B—Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w695
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Whitman, extremely stony, and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Whitman, Extremely Stony

Setting

Landform: Drumlins, ground moraines, hills, drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 1 inches: peat
A - 1 to 10 inches: fine sandy loam

Bg - 10 to 17 inches: gravelly fine sandy loam
Cdg - 17 to 61 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 7 to 38 inches to densic material
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Ridgebury, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions, outwash terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Bogs, swamps, marshes
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Woodbridge, extremely stony

Percent of map unit: 1 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

106C—Narragansett-Hollis-Rock outcrop complex, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 98yk
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Narragansett and similar soils: 45 percent
Hollis and similar soils: 20 percent
Rock outcrop: 10 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Narragansett

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable silty eolian deposits and/or friable loamy eolian deposits over loose sandy glaciofluvial deposits derived from metamorphic rock and/or friable sandy basal till derived from metamorphic rock

Typical profile

H1 - 0 to 2 inches: slightly decomposed plant material
H2 - 2 to 7 inches: silt loam
H3 - 7 to 35 inches: silt loam
H4 - 35 to 60 inches: very gravelly loamy sand
H5 - 60 to 65 inches: very gravelly loamy sand

Properties and qualities

Slope: 3 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 35 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Hollis

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Head slope, crest
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable, shallow loamy basal till over granite and gneiss

Typical profile

H1 - 0 to 2 inches: fine sandy loam
H2 - 2 to 14 inches: fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 8 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Granite and gneiss

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Minor Components

Canton

Percent of map unit: 9 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Charlton

Percent of map unit: 6 percent
Landform: Hills, swales
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Scituate

Percent of map unit: 5 percent
Landform: Hillslopes, depressions
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Unnamed

Percent of map unit: 5 percent

415B—Narragansett silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vqrp
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Narragansett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Narragansett

Setting

Landform: Ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits and/or friable silty eolian deposits over loose sandy glaciofluvial deposits derived from metamorphic rock and/or friable sandy basal till derived from metamorphic rock

Typical profile

H1 - 0 to 2 inches: slightly decomposed plant material
H2 - 2 to 7 inches: silt loam
H3 - 7 to 35 inches: silt loam
H4 - 35 to 60 inches: very gravelly loamy sand
H5 - 60 to 65 inches: very gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 35 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Haven

Percent of map unit: 10 percent
Landform: Terraces, plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

416B—Narragansett silt loam, 3 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 9940
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Narragansett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Narragansett

Setting

Landform: Ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits and/or friable silty eolian deposits over loose sandy glaciofluvial deposits derived from metamorphic rock and/or friable sandy basal till derived from metamorphic rock

Typical profile

H1 - 0 to 2 inches: slightly decomposed plant material
H2 - 2 to 7 inches: silt loam
H3 - 7 to 35 inches: silt loam
H4 - 35 to 60 inches: very gravelly loamy sand
H5 - 60 to 65 inches: very gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 35 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Haven
Percent of map unit: 10 percent
Landform: Terraces, plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Canton
Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Scituate
Percent of map unit: 5 percent
Landform: Depressions, hillslopes
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

416C—Narragansett silt loam, 8 to 15 percent slopes, very stony

Map Unit Setting
National map unit symbol: 9941
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Narragansett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Narragansett

Setting
Landform: Ground moraines

Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable silty eolian deposits and/or friable loamy eolian deposits over loose sandy glaciofluvial deposits derived from metamorphic rock and/or friable sandy basal till derived from metamorphic rock

Typical profile

H1 - 0 to 2 inches: slightly decomposed plant material
H2 - 2 to 7 inches: silt loam
H3 - 7 to 35 inches: silt loam
H4 - 35 to 60 inches: very gravelly loamy sand
H5 - 60 to 65 inches: very gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 35 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 10 percent
Landform: Ground moraines, drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Canton

Percent of map unit: 7 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Scituate

Percent of map unit: 3 percent
Landform: Depressions, hillslopes

Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

654—Udorthents, loamy

Map Unit Setting

National map unit symbol: vr1l
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Udorthents, sandy

Percent of map unit: 10 percent
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent
Hydric soil rating: Yes

Urban land

Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

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OPERATION AND MAINTENANCE PLAN
PROPOSED DRAINAGE SYSTEM – DURING CONSTRUCTION
81 West Union Street
Ashland, MA 01721
Phase 2

Owner:

81 West Union Street LLC
c/o William J. Rodenhiser
70 Bartzak Drive
Holliston, MA 01746
Contact: William J. Rodenhiser (508) 429-9553

Party Responsible for Operation and Maintenance:

81 West Union Street LLC
c/o William J. Rodenhiser
70 Bartzak Drive
Holliston, MA 01746
Contact: William J. Rodenhiser (508) 429-9553

Source of Funding:

Operation and Maintenance of this stormwater management system will be the responsibility of the property owner to include its successor and/or assigns, as the same may appear on record with the appropriate register of deeds.

During Construction:

Construction activities shall follow the Construction Sequence shown on the approved plan. During periods of active construction the stormwater management system shall be inspected on a weekly basis and within 24 hours of a storm event of greater than ½". Maintenance tasks shall be performed monthly or after significant rainfall events of 1" of rain or greater. During construction, silt-laden runoff shall be prevented from entering the drainage system and off-site properties. Temporary swales shall be constructed as needed during construction to direct runoff to sediment traps. Infiltration systems shall not be placed in service until after the installation of base course pavement and vegetative stabilization of the areas contributing to the systems.

During dewatering operations, all water pumped from the dewatering shall be directed to a "dirt bag" pumped sediment removal system (or approved equal) as manufactured by ACF Environmental. The unit shall be placed on a crushed stone blanket. Disposal of such "dirt bag" shall occur when the device is full and can no longer effectively filter sediment or allow water to pass at a reasonable flow rate. Disposal of this unit shall be the responsibility of the contractor and shall be as directed by the owner in accordance with applicable local, state, and federal guidelines and regulations.

Stabilized construction entrances shall be placed at the entrances and shall consist of 1½“ to 2” stone and be constructed as shown on the approved plans. The construction entrances shall be inspected daily or as needed.

All erosion and sedimentation control measures shall be in place prior to the commencement of any site work or earthwork operations, shall be maintained during construction, and shall remain in place until all site work is complete and ground cover is established.

Heavy equipment shall not be used on basin bottoms.

All exposed soils not to be paved shall be stabilized as soon as practical. Seed mixes shall only be applied during appropriate periods as recommended by the seed supplier, typically May 1 to October 15. Any exposed soils that can not be stabilized by vegetation during these dates shall be stabilized with hay bales, hay mulch, check dams, jute netting or other acceptable means.

Once each structure is in place, it should be maintained in accordance with the procedures described in the post-construction Operations and Maintenance Plan.

During dry periods where dust is created by construction activities the following control measures should be implemented.

- Sprinkling – The contractor may sprinkle the ground along haul roads and traffic areas until moist.
- Vegetative cover – Areas that are not expected to be disturbed regularly may be stabilized with vegetative cover.
- Mulch – Mulching can be used as a quick and effective means of dust control in recently disturbed areas.
- Spray on chemical soil treatments may be utilized. Application rates shall conform to manufacturers recommendations.

Inspections

The Owner shall be responsible to secure the services of a Professional Engineer to perform inspections as required. Inspections during periods of active construction shall be weekly and within 24 hours of a storm event of greater than ½ “. The Professional Engineer shall perform inspections to insure that the approved plan is being followed with particular attention to the Planning Board Approval and the Construction Sequencing. The Engineer shall be responsible for inspecting the roadway construction and the construction of the stormwater management system. The Engineer shall prepare and submit to the Planning Board, the Inspection Schedule and Evaluation Checklist (see attached) and, if necessary, request the required maintenance and/or repair of the necessary items. This form shall be stamped by the Engineer and the Owner shall be notified that specific changes and/or repairs are necessary.

For additional information, refer to Performance, Standards and Guidelines for Stormwater Management in Massachusetts, published by the Department of Environmental Protection.

STORMWATER MANAGEMENT
BEST MANAGEMENT PRACTICES
INSPECTION SCHEDULE AND EVALUATION CHECKLIST – CONSTRUCTION PHASE 2

PROJECT LOCATION: 81 West Union Street – Ashland, MA Latest Revision: 6/11/19

Stormwater Control Manager: _____ **Stamp**

Best Management Practice	Inspection Frequency (1)	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/ Repair Needed yes/no List items	Date of Cleaning/Repair	Performed By	Water Level in Detention System
Silt fence & silt traps	After every major storm event							
Deep Sump Catch Basins	Weekly or after major storm event.							
Stormceptors	Weekly or after major storm event.							
Vortsentry	Weekly or after major storm event.							
Subsurface Infiltration System(s)	Weekly or after major storm event.							
Dewatering Operations	Daily-during actual dewatering							
Temporary Construction Entrance	Daily or as needed.							

(1) Refer to the Massachusetts Stormwater Management, Volume Two: Stormwater Technical Handbook for recommendations regarding frequency for inspection and maintenance of specific BMPs.

Limited or no use of sodium chloride salts, fertilizers or pesticides recommended. Slow release fertilizer recommended.
Other notes:(Include deviations from: Con Com Order of Conditions, PB Approval, Construction Sequence and Approved Plan)

OPERATION AND MAINTENANCE PLAN
PROPOSED DRAINAGE SYSTEM – POST CONSTRUCTION
81 West Union Street
Ashland, MA 01721
Phase 2

Owner:

81 West Union Street LLC
c/o William J. Rodenhiser
70 Bartzak Drive
Holliston, MA 01746
Contact: William J. Rodenhiser (508) 429-9553

Party Responsible for Operation and Maintenance:

81 West Union Street LLC
c/o William J. Rodenhiser
70 Bartzak Drive
Holliston, MA 01746
Contact: William J. Rodenhiser (508) 429-9553

Source of Funding:
Operation and Maintenance of this stormwater management system will be the responsibility of the owner and shall include its successor and/or assigns or future homeowners association, as the same may appear on record with the appropriate register of deeds.

Post Construction Inspection and Maintenance:

Street Sweeping

Streets shall be swept at least twice per year. Sweeping shall be completed during the early spring, no later than May 1st, before sediment from winter sanding operations is washed into the drainage system. Disposal of the accumulated sediment shall be in accordance with applicable local, state, and federal guidelines and regulations.

Deep Sump Catch Basins

Deep sump catch basins shall become part of the roadway system and shall be inspected after every major storm event during construction and cleaned when sediment exceeds 18" depth. After construction when all slopes have been stabilized, basins shall be cleaned a minimum of four times per year. Disposal of the accumulated sediment shall be in accordance with applicable local, state, and federal guidelines and regulations.

Stormceptor Unit(s)

New Installations
The condition of each unit shall be checked after every runoff event for the first 30 days. The visual inspection shall ascertain that the unit is functioning properly (weir structure is not blocked) and shall measure the amount of sediment that has accumulated in the sump and floating trash and debris in the separation chamber. This can be done with a calibrated "dip stick" so that the depth of deposition can be tracked. Schedules for inspections and cleanout shall be based on storm events and pollutant accumulation.

Ongoing Operation
During the rainfall season, the unit shall be inspected at least once every 30 days. The floatables shall be removed and the sump cleaned when the sump is 85% full. If floatables accumulate more rapidly than the settleable solids, the floatables shall be removed using a vactor truck or dip net when the layer is two feet thick.

Cleanout of the Stormceptor units shall be performed no later than May 1st because of the nature of pollutants collected and the potential for odor generation from the decomposition of material collected and retained. This end of season cleanout will assist in preventing the discharge of pore water for the Stormceptor units during periods of low rainfall. The Stormceptor unit shall be cleaned at least twice yearly.

Cleanout and Disposal
Standard vactoring operations shall be employed in the cleanout of the Stormceptor units. Disposal of material from the Stormceptor units shall be in accordance with applicable local, state, and federal guidelines and regulations. Disposal of the decant material to a POTW is recommended. Field decanting to the storm drainage system shall not be permitted. Solids can be disposed similar to normal practices for materials collected from catch basin cleaning.

The embankments of the basin shall be mowed periodically, to prevent the establishment of woody vegetation on the berms. Embankments and spillways shall be inspected annually for general structural integrity, with immediate corrective action as warranted by inspection.

VortSentry HS36

Responsibility for maintenance: Owner

New Installations
The condition of each unit shall be checked after every runoff event for the first 30 days. The visual inspection shall ascertain that the unit is functioning properly and shall measure the amount of sediment that has accumulated in the sump and floating trash and debris in the separation chamber. This can be done with a calibrated "dip stick" or stadia rod so that the depth of deposition can be tracked. Schedules for inspections and cleanout shall be based on storm events and pollutant accumulation.

Ongoing Operation

During the rainfall season, the unit shall be inspected at least once every 30 days. The floatables shall be removed and the sump cleaned when the sump is at a depth of 2 feet. If floatables accumulate more rapidly than the settleable solids, the floatables shall be removed using a vactor truck or dip net when the layer is two feet thick.

Cleanout of the units shall be performed no later than May 1st because of the nature of pollutants collected and the potential for odor generation from the decomposition of material collected and retained. This end of season cleanout will assist in preventing the discharge of pore water for the units during periods of low rainfall. The units shall be cleaned at least twice yearly.

Cleanout and Disposal

Standard vactoring operations shall be employed in the cleanout of the units. Disposal of material from the units shall be in accordance with applicable local, state, and federal guidelines and regulations. Disposal of the decant material to a POTW is recommended. Field decanting to the storm drainage system shall not be permitted. Solids can be disposed similar to normal practices for materials collected from catch basin cleaning.

Subsurface Structures

Responsibility for maintenance: Owner

After construction, the subsurface structures shall be inspected for proper function and stabilization after every major storm event until the lot is completely developed and stabilized. Inspect each subsurface structure at least twice per year or if lack of performance is observed and perform necessary corrective measures to maintain infiltration capacity; as required by the Stormwater Management Policy.

Lawn Fertilization

Lawn fertilizer shall be slow release and limited to 3 lbs per 1000 s.f. per year.

Snow Management

Snow shall be collected and stored adjacent to the road and driveway as shown on the Tributary Area Post Development Plan. The party responsible for snow plowing is the party listed at the beginning of the Operation and Maintenance Plan.

Records

Records of inspection and maintenance shall be kept up to date and available for review and inspection by the Town's official, if requested.

STORMWATER MANAGEMENT
BEST MANAGEMENT PRACTICES

INSPECTION SCHEDULE AND EVALUATION CHECKLIST – POST CONSTRUCTION PHASE 2

PROJECT LOCATION: 81 West Union Street –Ashland, MA Latest Revision: 6/11/19

Best Management Practice	Inspection Frequency (1)	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/ Repair Needed yes/no List items	Date of Cleaning/Repair	Performed By	Water Level in Detention System
Deep Sump Catch Basins	Four times per year							
Stormceptors	Twice per year							
Vortsentry	Twice per year							
Subsurface Infiltration System(s)	Twice per year							

(1) Refer to the Massachusetts Stormwater Management, Volume Two: Stormwater Technical Handbook for recommendations regarding frequency for inspection and maintenance of specific BMPs.

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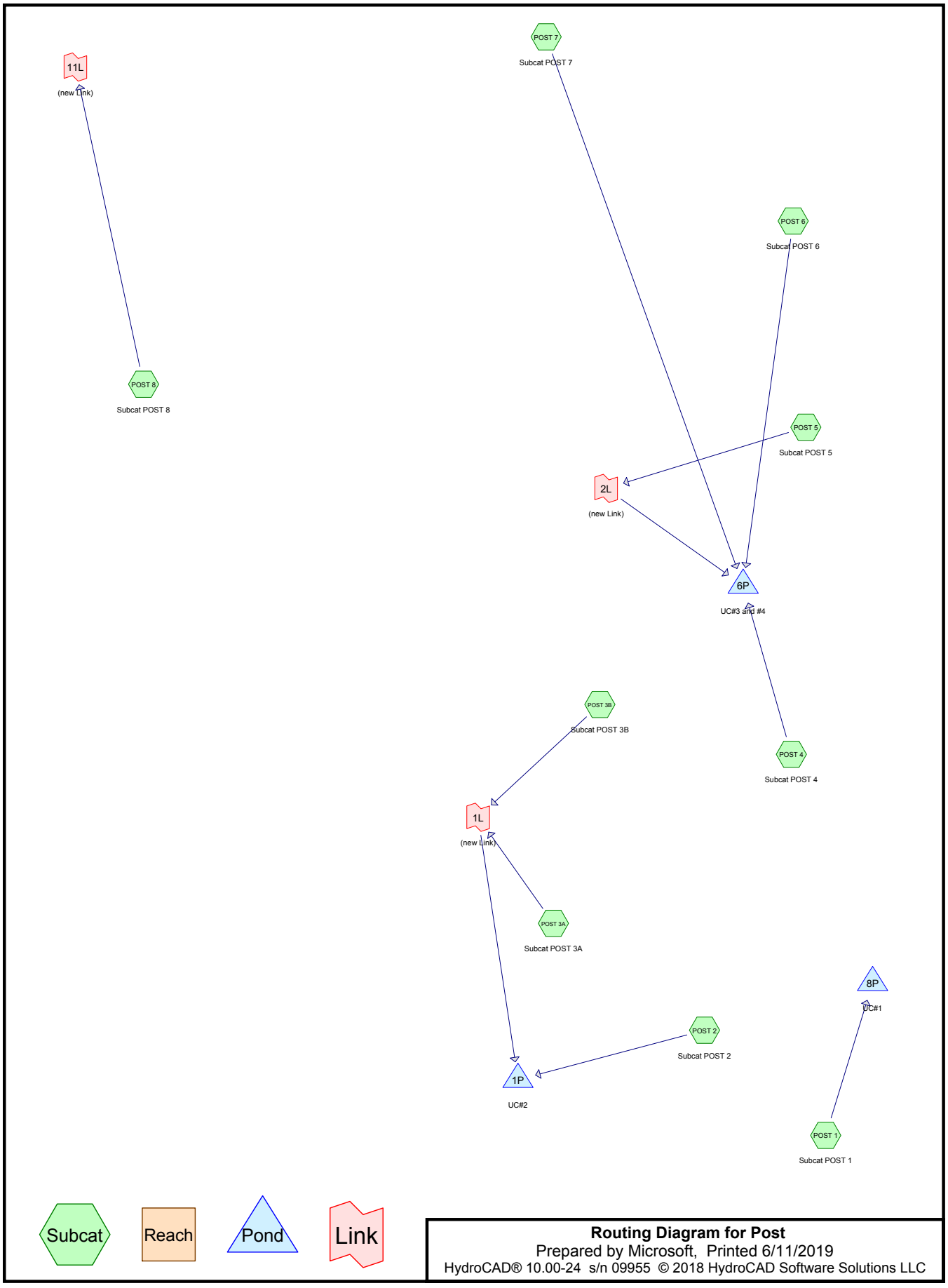
Stormwater Control Manager: **Stamp**

Section II

Overall Site Analysis


11L
(new Link)
POST 8
Subcat POST 8
POST 7
Subcat POST 7
POST 6
Subcat POST 6
POST 5
Subcat POST 5
2L
(new Link)
6P
UC#3 and #4
POST 4
Subcat POST 4
POST 3B
Subcat POST 3B
1L
(new Link)
POST 3A
Subcat POST 3A
8P
UC#1
POST 2
Subcat POST 2
1P
UC#2
POST 1
Subcat POST 1
Subcat
Reach
Pond
Link
Routing Diagram for Post
Prepared by Microsoft, Printed 6/11/2019
HydroCAD® 10.00-24 s/n 09955 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
12,336	49	50-75% Grass cover, Fair, HSG A (POST 1, POST 3A, POST 5, POST 7, POST 8)
71,354	98	Paved roads w/curbs & sewers, HSG A (POST 1, POST 3A, POST 3B, POST 5, POST 7)
26,913	98	Roofs, HSG A (POST 2, POST 4, POST 6)
29,172	36	Woods, Fair, HSG A (POST 3A, POST 5, POST 8)
139,776	**81**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
139,776	HSG A	POST 1, POST 2, POST 3A, POST 3B, POST 4, POST 5, POST 6, POST 7, POST 8
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
139,776		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
12,336	0	0	0	0	12,336	50-75% Grass cover, Fair
71,354	0	0	0	0	71,354	Paved roads w/curbs & sewers
26,913	0	0	0	0	26,913	Roofs
29,172	0	0	0	0	29,172	Woods, Fair
139,776	**0**	**0**	**0**	**0**	**139,776**	**TOTAL AREA**

Time span=0.50-26.00 hrs, dt=0.02 hrs, 1276 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment POST 1: Subcat POST 1 Runoff Area=2,656 sf 33.98% Impervious Runoff Depth=0.73"
Tc=6.0 min CN=66 Runoff=0.04 cfs 161 cf

Subcatchment POST 2: Subcat POST 2 Runoff Area=5,620 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=0.42 cfs 1,464 cf

Subcatchment POST 3A: Subcat POST 3A Runoff Area=29,107 sf 89.64% Impervious Runoff Depth=2.60"
Tc=6.0 min CN=93 Runoff=1.96 cfs 6,306 cf

Subcatchment POST 3B: Subcat POST 3B Runoff Area=2,378 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=0.18 cfs 620 cf

Subcatchment POST 4: Subcat POST 4 Runoff Area=8,584 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=0.64 cfs 2,237 cf

Subcatchment POST 5: Subcat POST 5 Runoff Area=29,480 sf 90.51% Impervious Runoff Depth=2.60"
Tc=6.0 min CN=93 Runoff=1.99 cfs 6,387 cf

Subcatchment POST 6: Subcat POST 6 Runoff Area=12,709 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=0.95 cfs 3,312 cf

Subcatchment POST 7: Subcat POST 7 Runoff Area=15,963 sf 95.84% Impervious Runoff Depth=2.91"
Tc=6.0 min CN=96 Runoff=1.16 cfs 3,867 cf

Subcatchment POST 8: Subcat POST 8 Runoff Area=33,279 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=38 Runoff=0.00 cfs 2 cf

Pond 1P: UC#2 Peak Elev=243.26' Storage=3,118 cf Inflow=2.56 cfs 8,390 cf
Outflow=0.23 cfs 8,390 cf

Pond 6P: UC#3 and #4 Peak Elev=242.95' Storage=5,822 cf Inflow=4.74 cfs 15,802 cf
Outflow=0.42 cfs 15,802 cf

Pond 8P: UC#1 Peak Elev=239.38' Storage=18 cf Inflow=0.04 cfs 161 cf
Outflow=0.02 cfs 161 cf

Link 1L: (new Link) Inflow=2.14 cfs 6,926 cf
Primary=2.14 cfs 6,926 cf

Link 2L: (new Link) Inflow=1.99 cfs 6,387 cf
Primary=1.99 cfs 6,387 cf

Link 11L: (new Link) Inflow=0.00 cfs 2 cf
Primary=0.00 cfs 2 cf

Total Runoff Area = 139,776 sf Runoff Volume = 24,354 cf Average Runoff Depth = 2.09"
29.70% Pervious = 41,509 sf 70.30% Impervious = 98,267 sf

Summary for Subcatchment POST 1: Subcat POST 1

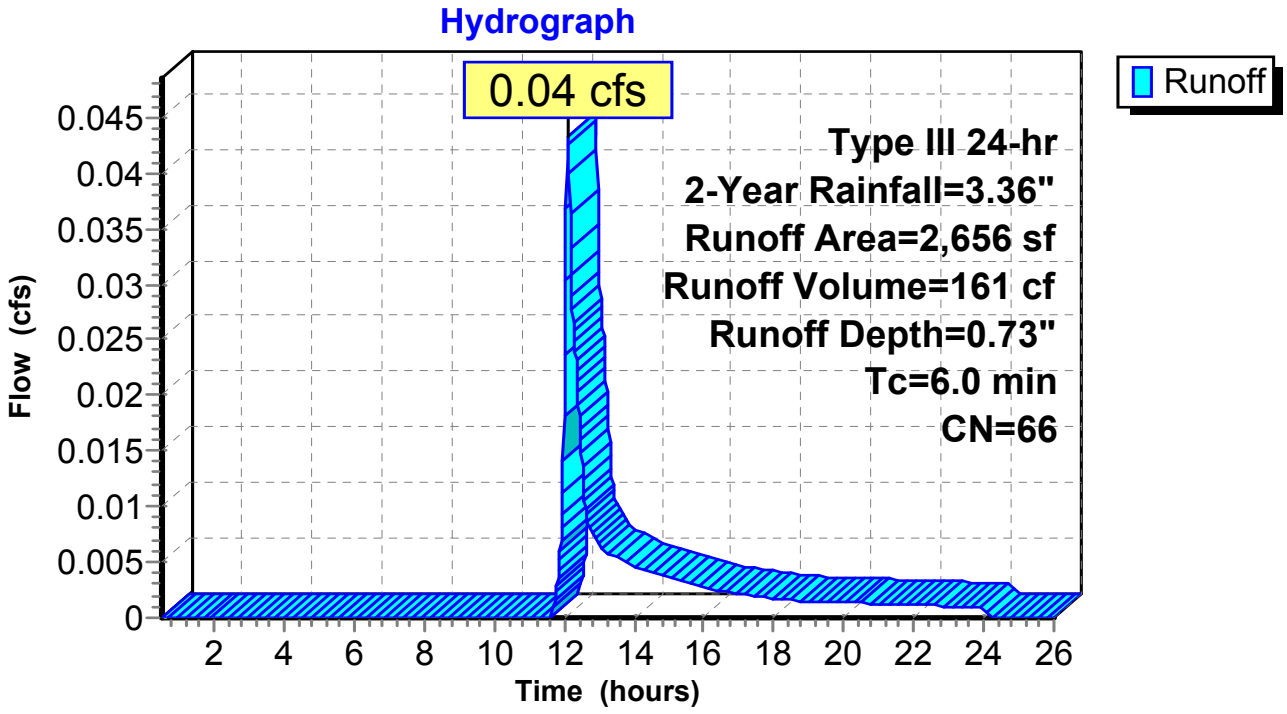
Runoff = 0.04 cfs @ 12.10 hrs, Volume= 161 cf, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
1,754	49	50-75% Grass cover, Fair, HSG A
903	98	Paved roads w/curbs & sewers, HSG A
2,656	66	Weighted Average
1,754		66.02% Pervious Area
903		33.98% Impervious Area

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

Subcatchment POST 1: Subcat POST 1



Summary for Subcatchment POST 2: Subcat POST 2

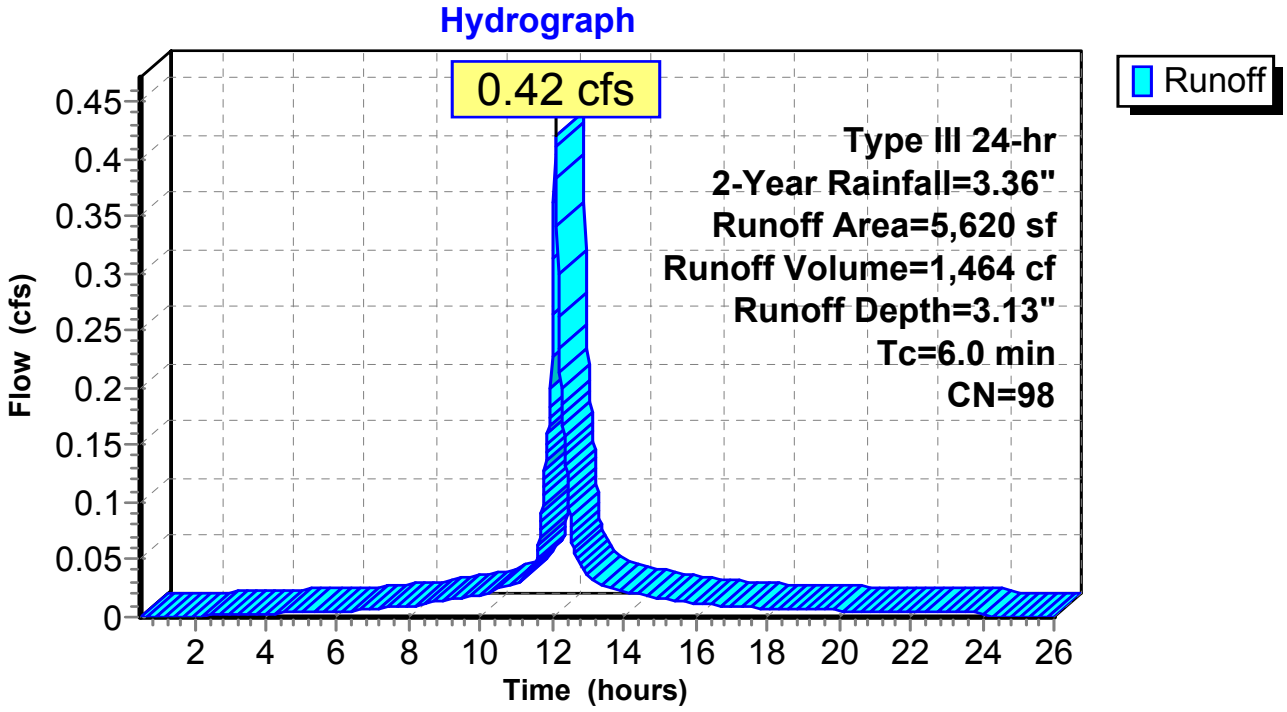
Runoff = 0.42 cfs @ 12.08 hrs, Volume= 1,464 cf, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
5,620	98	Roofs, HSG A
5,620		100.00% Impervious Area

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

Subcatchment POST 2: Subcat POST 2



Summary for Subcatchment POST 3A: Subcat POST 3A

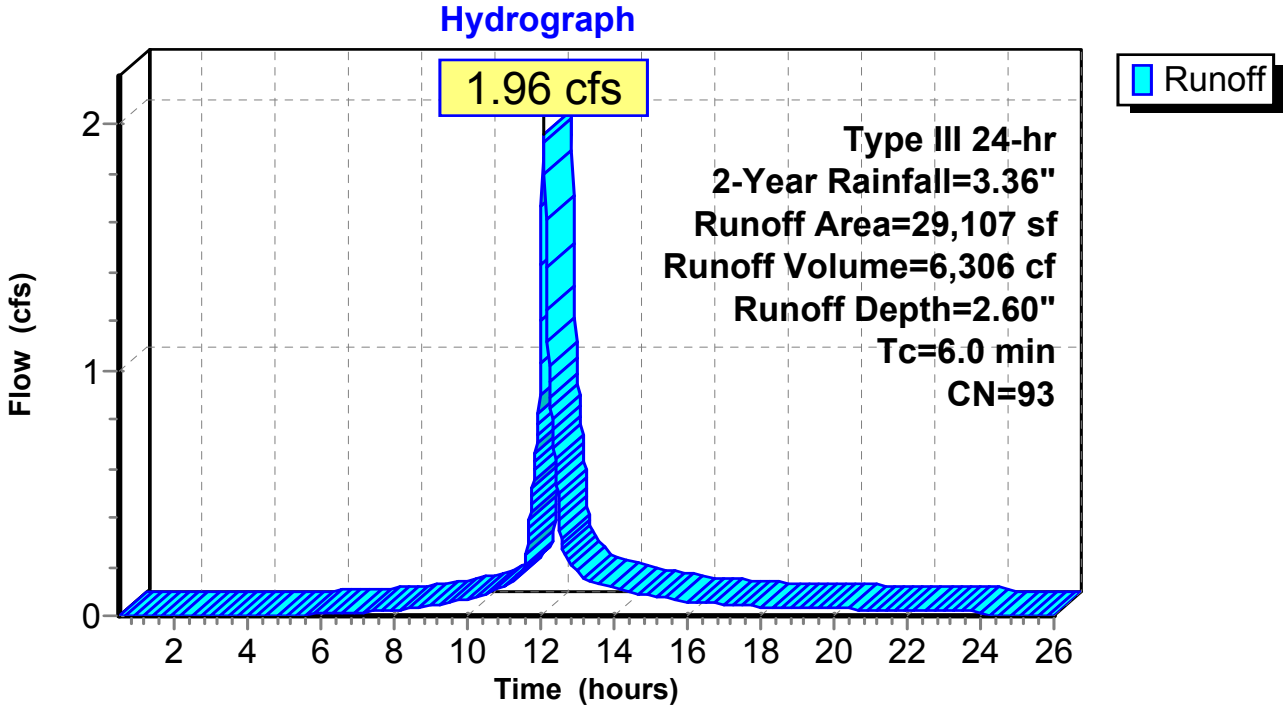
Runoff = 1.96 cfs @ 12.09 hrs, Volume= 6,306 cf, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
3,016	49	50-75% Grass cover, Fair, HSG A
26,091	98	Paved roads w/curbs & sewers, HSG A
0	36	Woods, Fair, HSG A
29,107	93	Weighted Average
3,016		10.36% Pervious Area
26,091		89.64% Impervious Area

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

Subcatchment POST 3A: Subcat POST 3A



Summary for Subcatchment POST 3B: Subcat POST 3B

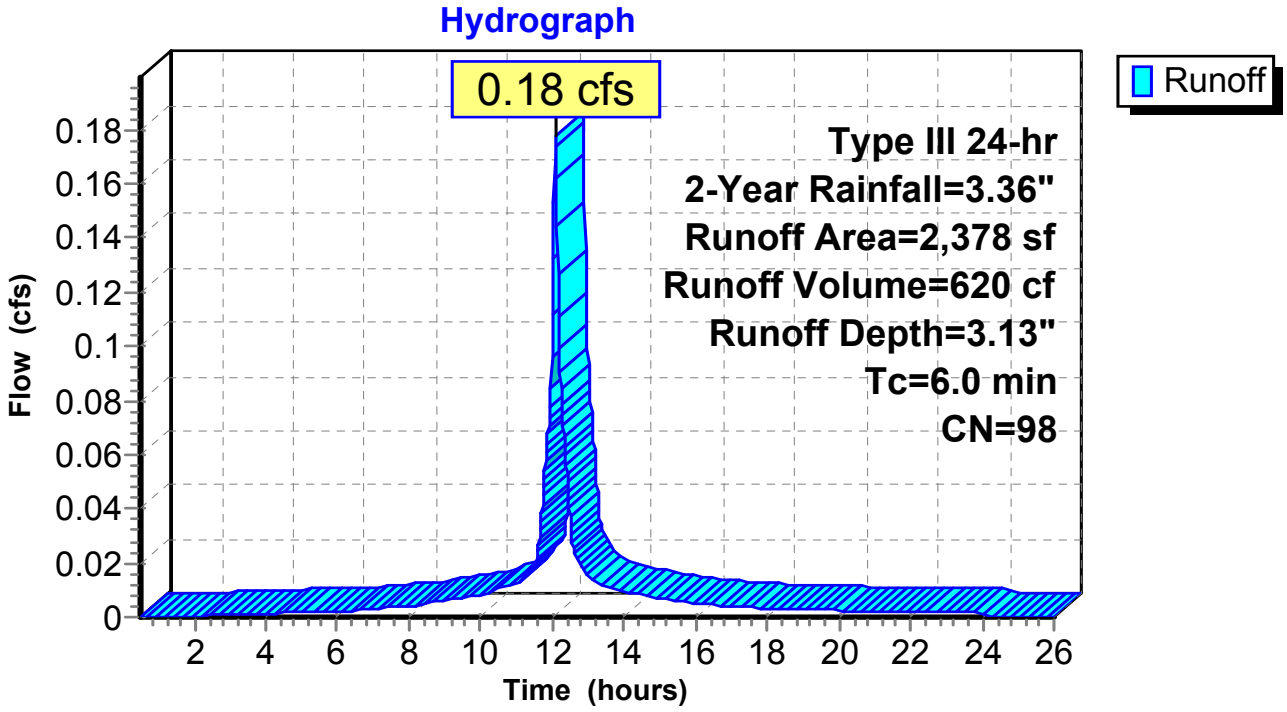
Runoff = 0.18 cfs @ 12.08 hrs, Volume= 620 cf, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
2,378	98	Paved roads w/curbs & sewers, HSG A
2,378		100.00% Impervious Area

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

Subcatchment POST 3B: Subcat POST 3B



Summary for Subcatchment POST 4: Subcat POST 4

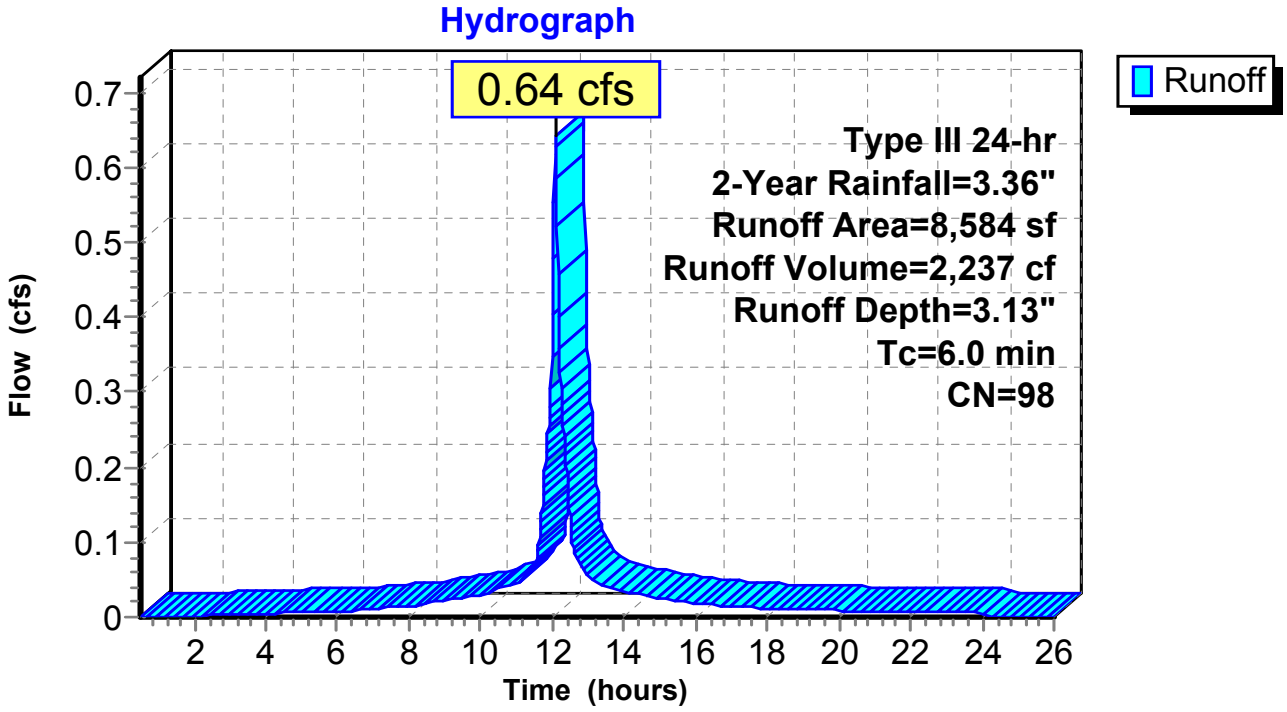
Runoff = 0.64 cfs @ 12.08 hrs, Volume= 2,237 cf, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
8,584	98	Roofs, HSG A
8,584		100.00% Impervious Area

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

Subcatchment POST 4: Subcat POST 4



Summary for Subcatchment POST 5: Subcat POST 5

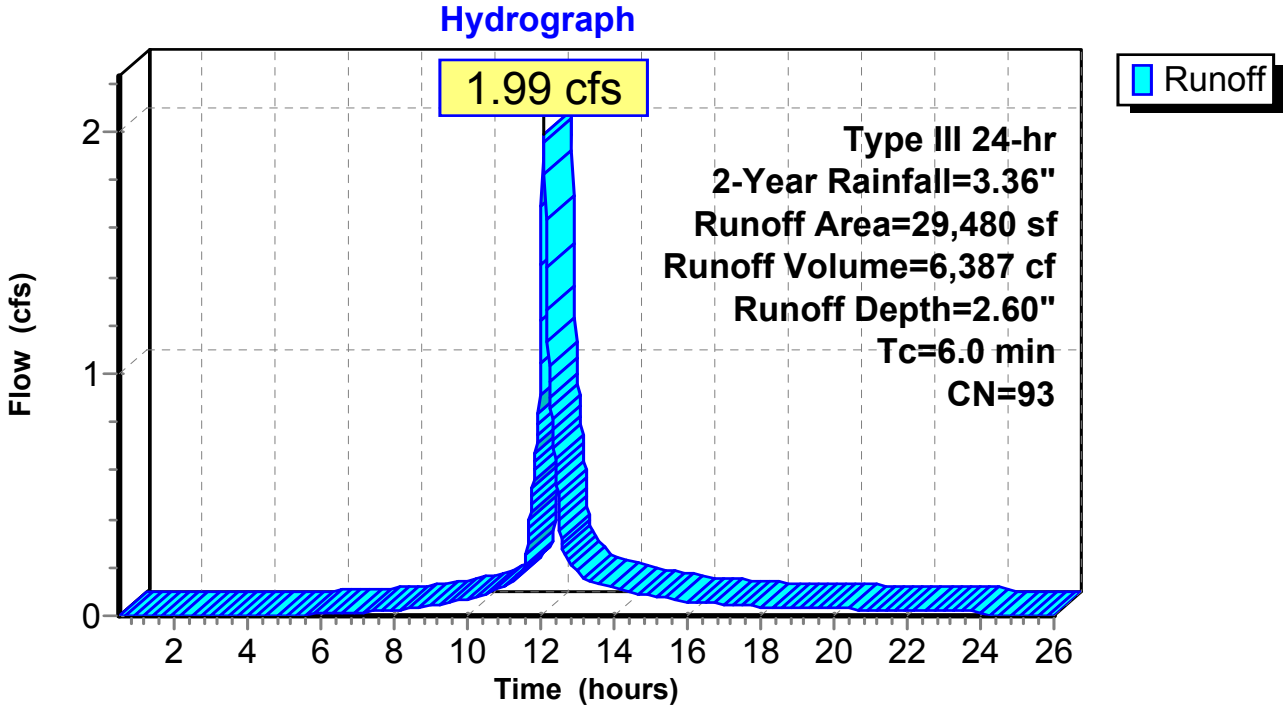
Runoff = 1.99 cfs @ 12.09 hrs, Volume= 6,387 cf, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
2,796	49	50-75% Grass cover, Fair, HSG A
26,684	98	Paved roads w/curbs & sewers, HSG A
0	36	Woods, Fair, HSG A
29,480	93	Weighted Average
2,796		9.49% Pervious Area
26,684		90.51% Impervious Area

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

Subcatchment POST 5: Subcat POST 5



Summary for Subcatchment POST 6: Subcat POST 6

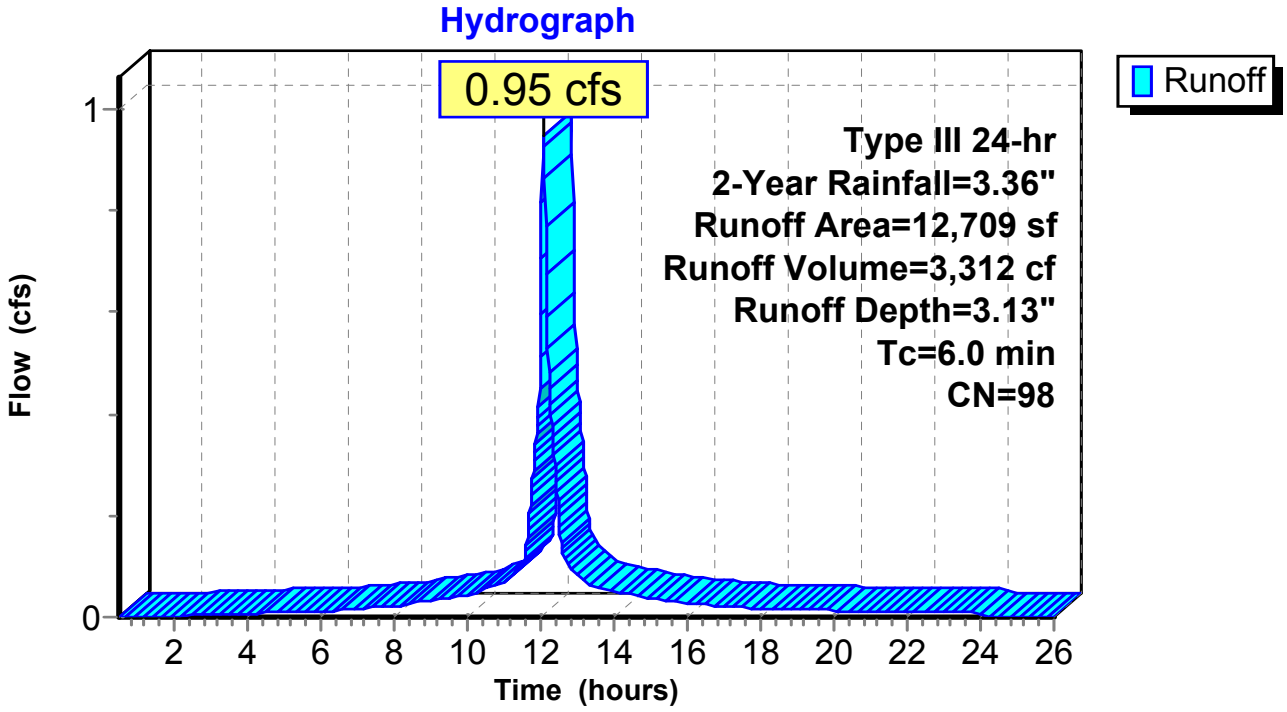
Runoff = 0.95 cfs @ 12.08 hrs, Volume= 3,312 cf, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
12,709	98	Roofs, HSG A
12,709		100.00% Impervious Area

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

Subcatchment POST 6: Subcat POST 6



Summary for Subcatchment POST 7: Subcat POST 7

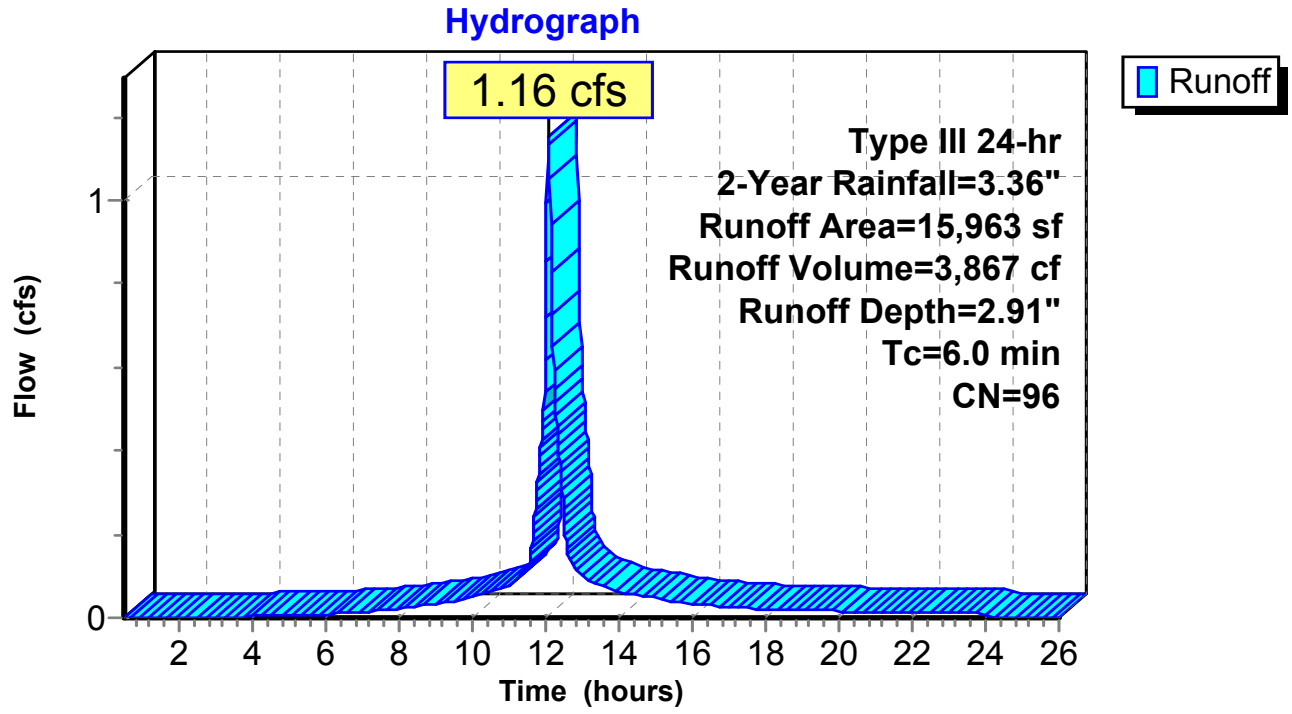
Runoff = 1.16 cfs @ 12.08 hrs, Volume= 3,867 cf, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
665	49	50-75% Grass cover, Fair, HSG A
15,298	98	Paved roads w/curbs & sewers, HSG A
15,963	96	Weighted Average
665		4.16% Pervious Area
15,298		95.84% Impervious Area

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

Subcatchment POST 7: Subcat POST 7



Summary for Subcatchment POST 8: Subcat POST 8

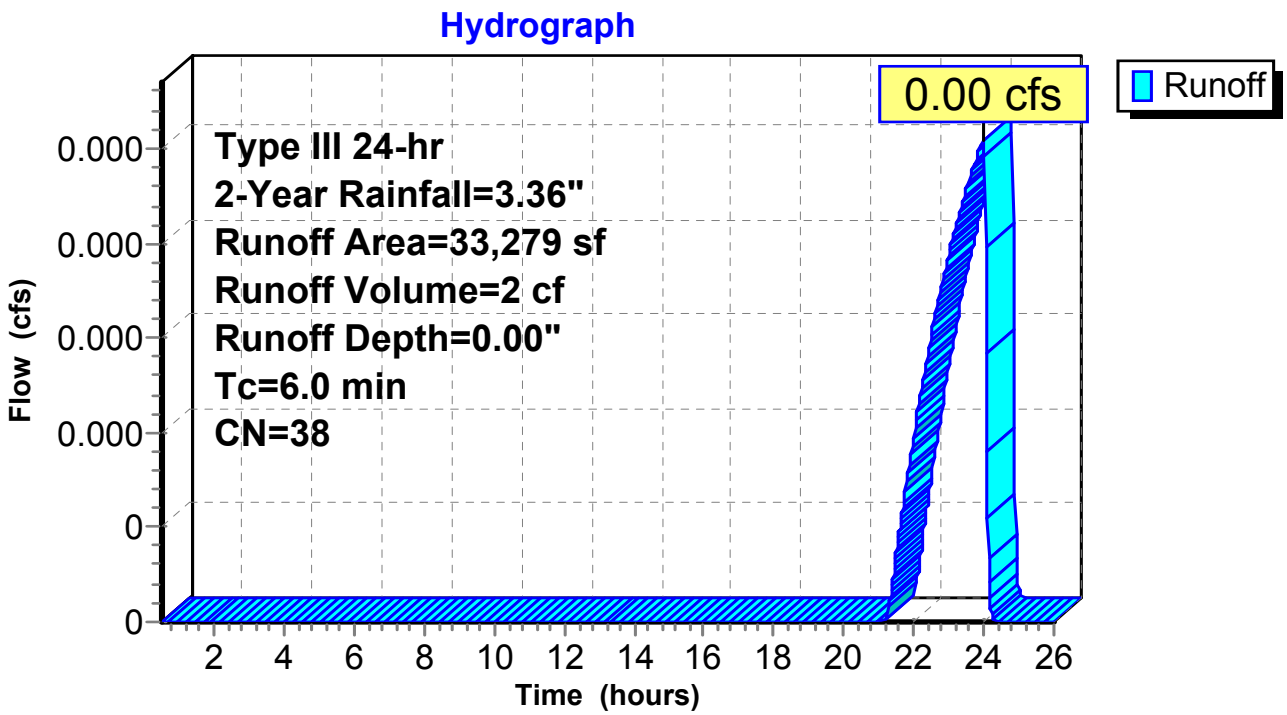
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 2 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
4,107	49	50-75% Grass cover, Fair, HSG A
29,172	36	Woods, Fair, HSG A
33,279	38	Weighted Average
33,279		100.00% Pervious Area

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

Subcatchment POST 8: Subcat POST 8



Summary for Pond 1P: UC#2

Inflow Area = 37,104 sf, 91.87% Impervious, Inflow Depth = 2.71" for 2-Year event
Inflow = 2.56 cfs @ 12.08 hrs, Volume= 8,390 cf
Outflow = 0.23 cfs @ 11.50 hrs, Volume= 8,390 cf, Atten= 91%, Lag= 0.0 min
Discarded = 0.23 cfs @ 11.50 hrs, Volume= 8,390 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 243.26' @ 12.97 hrs Surf.Area= 4,148 sf Storage= 3,118 cf

Plug-Flow detention time= 102.8 min calculated for 8,390 cf (100% of inflow)
Center-of-Mass det. time= 102.8 min (884.9 - 782.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	242.00'	3,421 cf	**44.60'W x 93.00'L x 5.00'H Field A** 20,739 cf Overall - 12,187 cf Embedded = 8,552 cf x 40.0% Voids
#2A	242.50'	9,179 cf	**Concrete Galley 4x4x4** x 207 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 207 Chambers in 9 Rows
		12,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	242.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.23 cfs @ 11.50 hrs HW=242.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Pond 1P: UC#2 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)
Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

52.8" Wide + 6.0" Spacing = 58.8" C-C Row Spacing

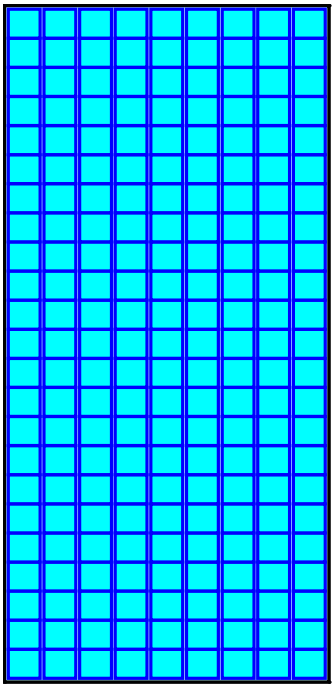
23 Chambers/Row x 4.00' Long = 92.00' Row Length +6.0" End Stone x 2 = 93.00' Base Length
9 Rows x 52.8" Wide + 6.0" Spacing x 8 + 6.0" Side Stone x 2 = 44.60' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

207 Chambers x 44.3 cf = 9,179.3 cf Chamber Storage
207 Chambers x 58.9 cf = 12,187.4 cf Displacement

20,739.0 cf Field - 12,187.4 cf Chambers = 8,551.6 cf Stone x 40.0% Voids = 3,420.6 cf Stone Storage

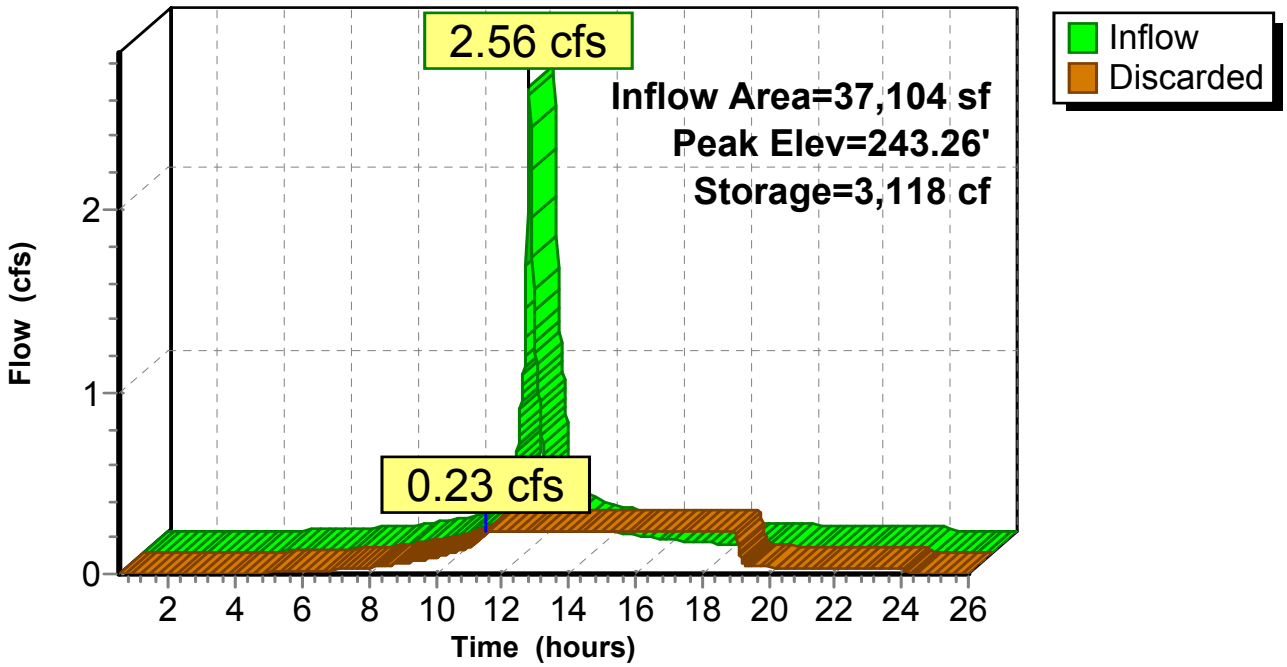
Chamber Storage + Stone Storage = 12,600.0 cf = 0.289 af
Overall Storage Efficiency = 60.8%
Overall System Size = 93.00' x 44.60' x 5.00'

207 Chambers @ $ 300.00 /ea = $ 62,100.00
768.1 cy Field Excavation @ $ 10.00 /cy = $ 7,681.11
316.7 cy Stone @ $ 30.00 /cy = $ 9,501.78
Total Cost = $ 79,282.89



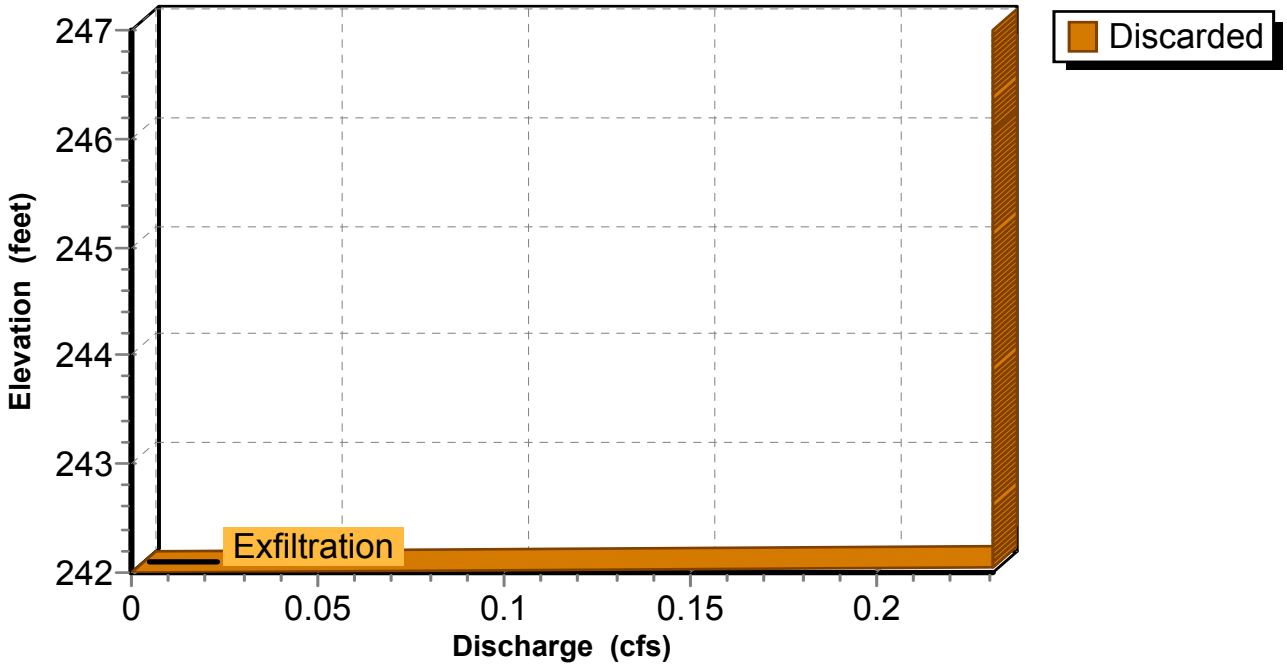
Pond 1P: UC#2

Hydrograph

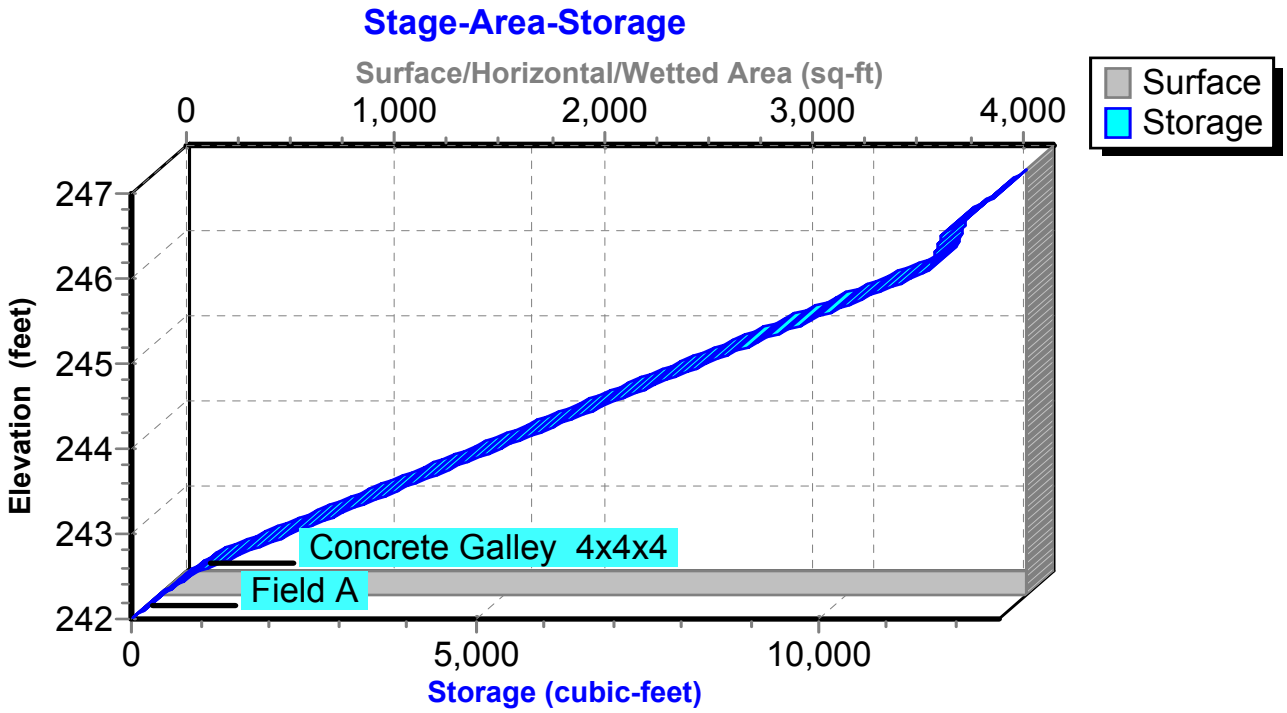


Pond 1P: UC#2

Stage-Discharge



Pond 1P: UC#2


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
1,000
2,000
3,000
4,000
Surface
Storage
247
246
245
244
243
242
Elevation (feet)
Concrete Galley 4x4x4
Field A
0
5,000
10,000
Storage (cubic-feet)

Summary for Pond 6P: UC#3 and #4

Inflow Area = 66,736 sf, 94.81% Impervious, Inflow Depth = 2.84" for 2-Year event
Inflow = 4.74 cfs @ 12.08 hrs, Volume= 15,802 cf
Outflow = 0.42 cfs @ 11.44 hrs, Volume= 15,802 cf, Atten= 91%, Lag= 0.0 min
Discarded = 0.42 cfs @ 11.44 hrs, Volume= 15,802 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 242.95' @ 12.97 hrs Surf.Area= 7,566 sf Storage= 5,822 cf

Plug-Flow detention time= 103.3 min calculated for 15,802 cf (100% of inflow)
Center-of-Mass det. time= 103.3 min (877.3 - 774.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	241.70'	5,335 cf	**36.20'W x 209.00'L x 5.00'H Field A** 37,829 cf Overall - 24,493 cf Embedded = 13,336 cf x 40.0% Voids
#2A	242.20'	18,447 cf	**Concrete Galley 4x4x4** x 416 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 416 Chambers in 8 Rows
		23,782 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	241.70'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.42 cfs @ 11.44 hrs HW=241.75' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.42 cfs)

Pond 6P: UC#3 and #4 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)
Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

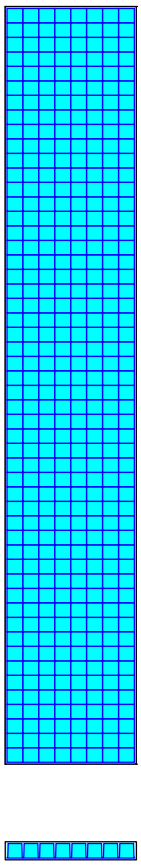
52 Chambers/Row x 4.00' Long = 208.00' Row Length +6.0" End Stone x 2 = 209.00' Base Length
8 Rows x 52.8" Wide + 6.0" Side Stone x 2 = 36.20' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

416 Chambers x 44.3 cf = 18,447.4 cf Chamber Storage
416 Chambers x 58.9 cf = 24,492.6 cf Displacement

37,829.0 cf Field - 24,492.6 cf Chambers = 13,336.4 cf Stone x 40.0% Voids = 5,334.6 cf Stone Storage

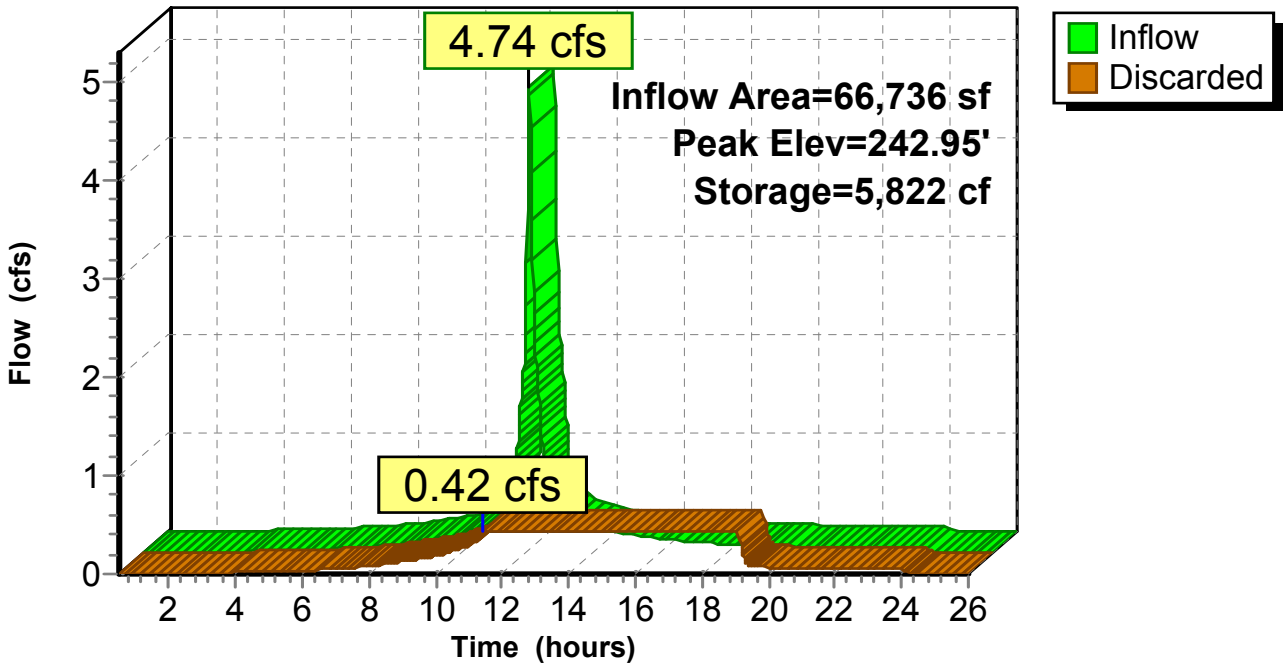
Chamber Storage + Stone Storage = 23,782.0 cf = 0.546 af
Overall Storage Efficiency = 62.9%
Overall System Size = 209.00' x 36.20' x 5.00'

416 Chambers @ $ 300.00 /ea = $ 124,800.00
1,401.1 cy Field Excavation @ $ 10.00 /cy = $ 14,010.74
493.9 cy Stone @ $ 30.00 /cy = $ 14,818.27
Total Cost = $ 153,629.01



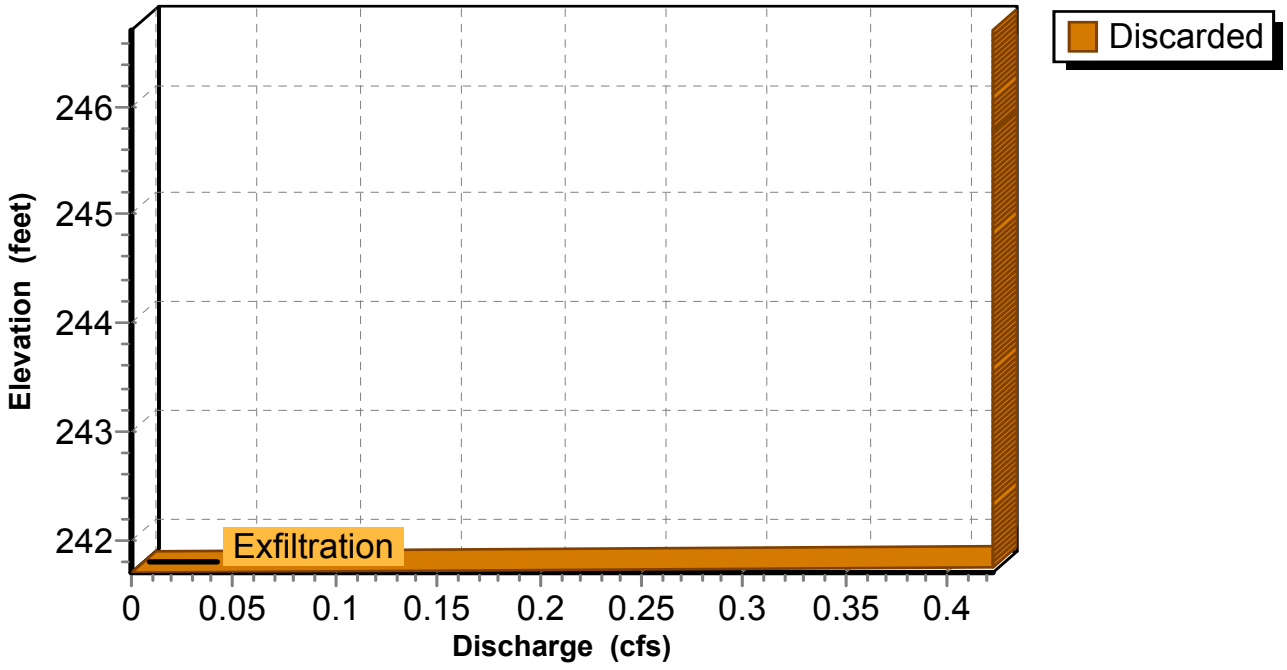
Pond 6P: UC#3 and #4

Hydrograph

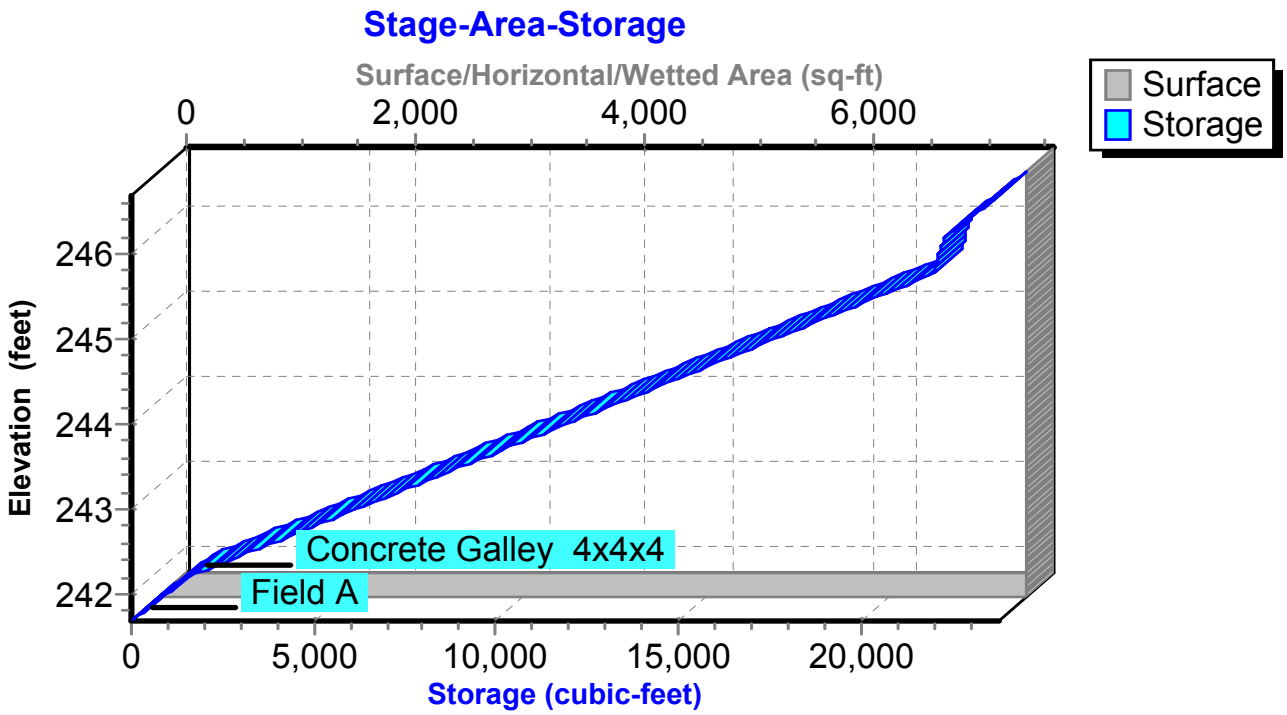


Pond 6P: UC#3 and #4

Stage-Discharge



Pond 6P: UC#3 and #4



Summary for Pond 8P: UC#1

Inflow Area = 2,656 sf, 33.98% Impervious, Inflow Depth = 0.73" for 2-Year event
Inflow = 0.04 cfs @ 12.10 hrs, Volume= 161 cf
Outflow = 0.02 cfs @ 12.06 hrs, Volume= 161 cf, Atten= 55%, Lag= 0.0 min
Discarded = 0.02 cfs @ 12.06 hrs, Volume= 161 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 239.38' @ 12.41 hrs Surf.Area= 350 sf Storage= 18 cf

Plug-Flow detention time= 5.9 min calculated for 160 cf (100% of inflow)
Center-of-Mass det. time= 5.9 min (892.6 - 886.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	239.25'	177 cf	**14.00'W x 25.00'L x 2.50'H Field A** 875 cf Overall - 432 cf Embedded = 443 cf x 40.0% Voids
#2A	239.75'	290 cf	**Concrete Galley 4x8x1.5** x 9 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 9 Chambers in 3 Rows
		467 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	239.25'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 12.06 hrs HW=239.28' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 8P: UC#1 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x8x1.5 (Concrete Galley, UCPI 18" Low Profile Galley or equivalent)
Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf
Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf

48.0" Wide + 6.0" Spacing = 54.0" C-C Row Spacing

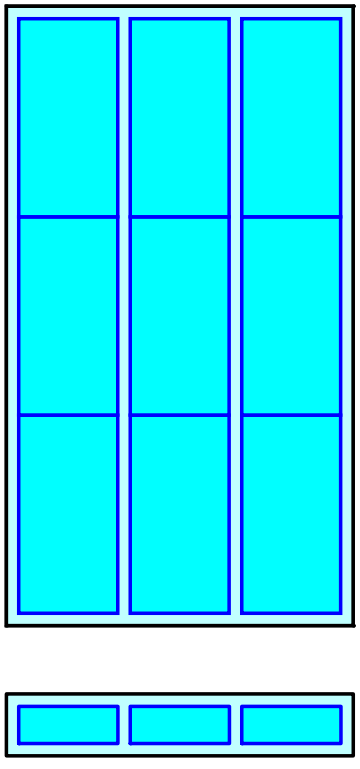
3 Chambers/Row x 8.00' Long = 24.00' Row Length +6.0" End Stone x 2 = 25.00' Base Length
3 Rows x 48.0" Wide + 6.0" Spacing x 2 + 6.0" Side Stone x 2 = 14.00' Base Width
6.0" Base + 18.0" Chamber Height + 6.0" Cover = 2.50' Field Height

9 Chambers x 32.2 cf = 289.6 cf Chamber Storage
9 Chambers x 48.0 cf = 432.0 cf Displacement

875.0 cf Field - 432.0 cf Chambers = 443.0 cf Stone x 40.0% Voids = 177.2 cf Stone Storage

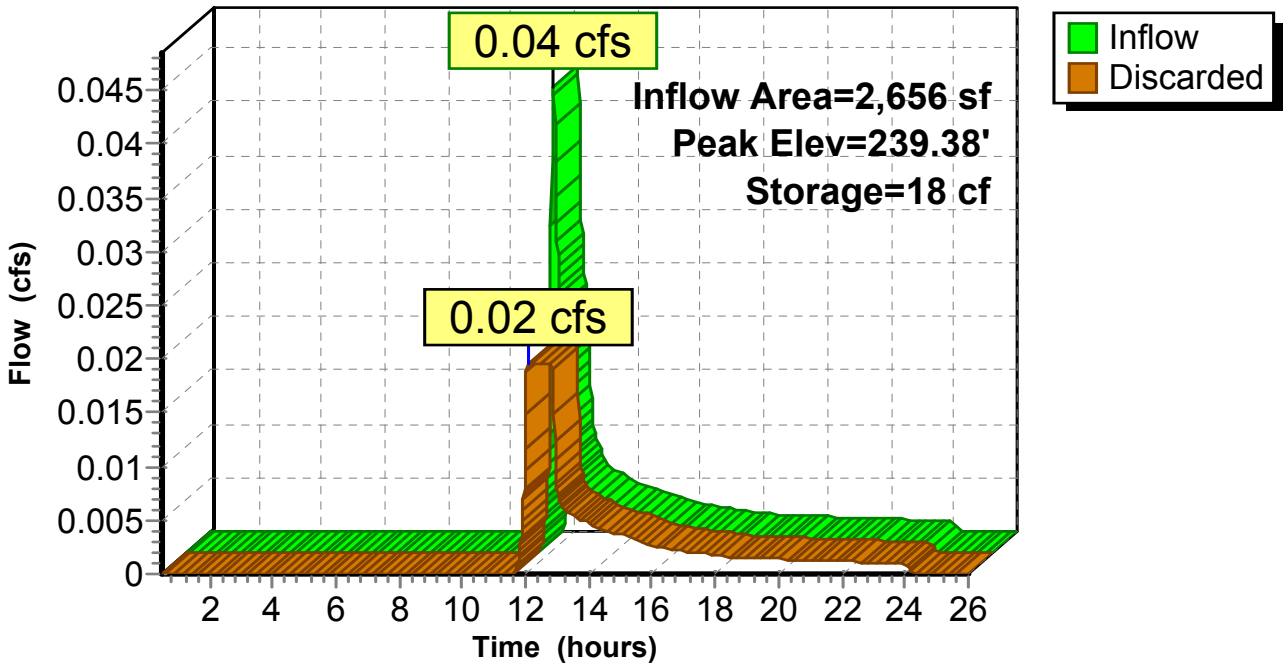
Chamber Storage + Stone Storage = 466.8 cf = 0.011 af
Overall Storage Efficiency = 53.3%
Overall System Size = 25.00' x 14.00' x 2.50'

9 Chambers @ $ 0.00 /ea = $ 0.00
32.4 cy Field Excavation @ $ 10.00 /cy = $ 324.07
16.4 cy Stone @ $ 30.00 /cy = $ 492.22
Total Cost = $ 816.30



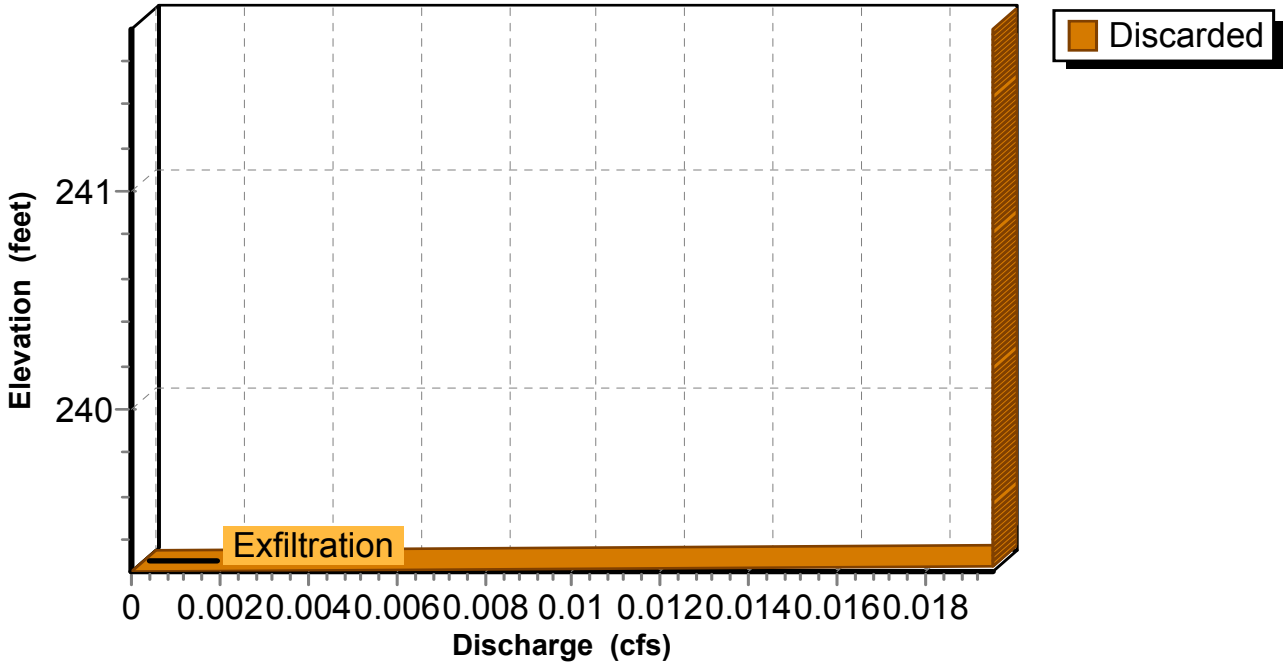
Pond 8P: UC#1

Hydrograph

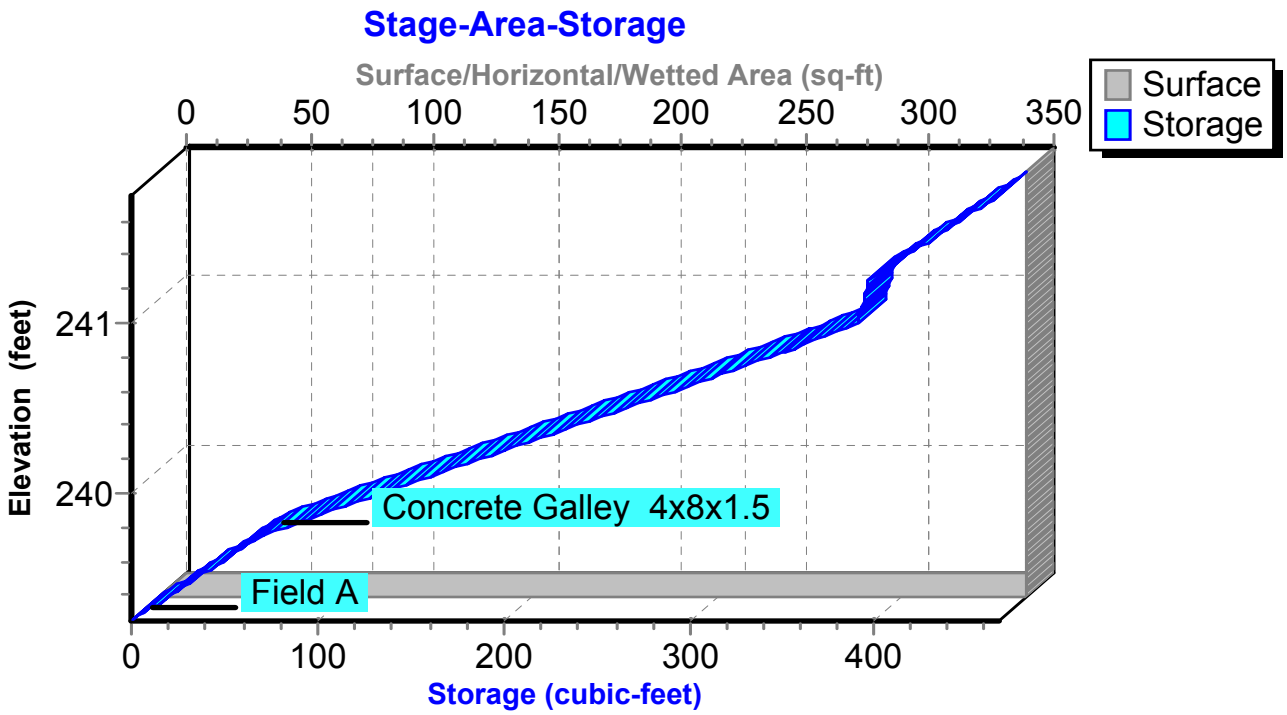


Pond 8P: UC#1

Stage-Discharge



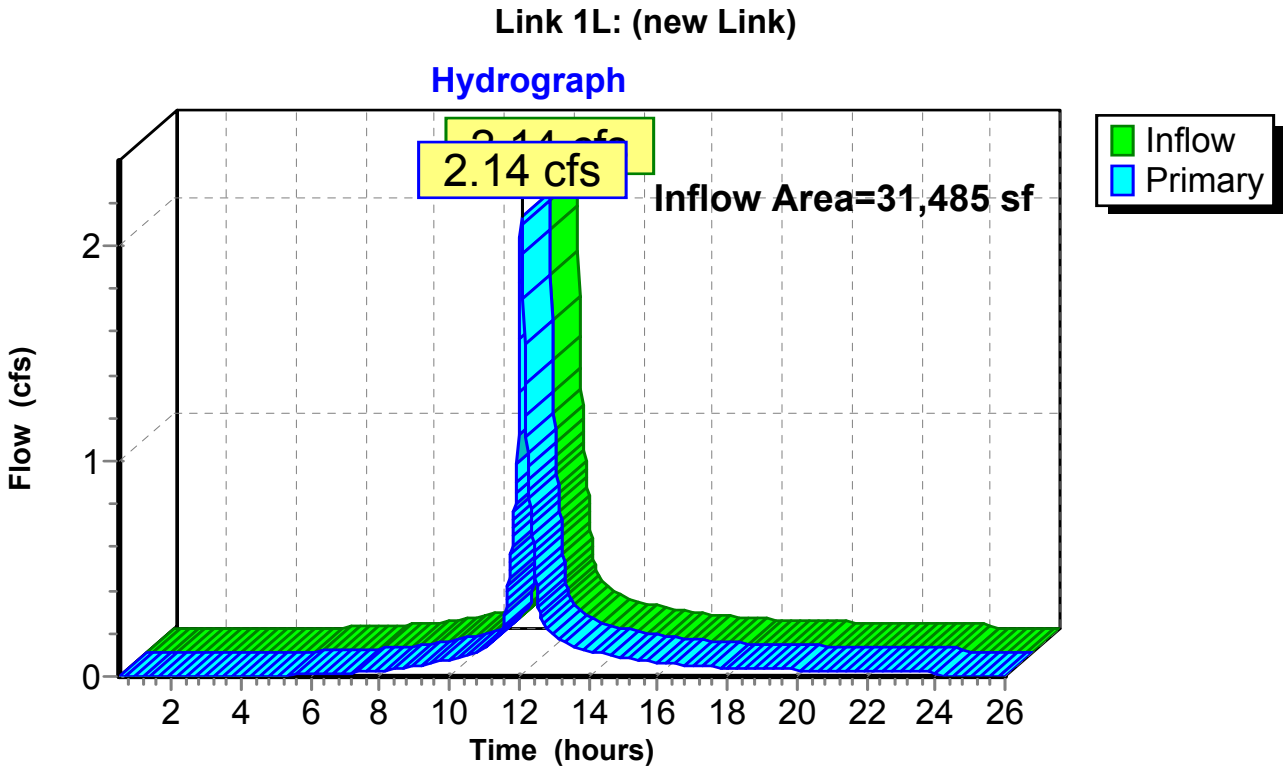
Pond 8P: UC#1


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
50
100
150
200
250
300
350
Surface
Storage
Elevation (feet)
241
240
Concrete Galley 4x8x1.5
Field A
0
100
200
300
400
Storage (cubic-feet)

Summary for Link 1L: (new Link)

Inflow Area = 31,485 sf, 90.42% Impervious, Inflow Depth = 2.64" for 2-Year event
Inflow = 2.14 cfs @ 12.08 hrs, Volume= 6,926 cf
Primary = 2.14 cfs @ 12.08 hrs, Volume= 6,926 cf, Atten= 0%, Lag= 0.0 min

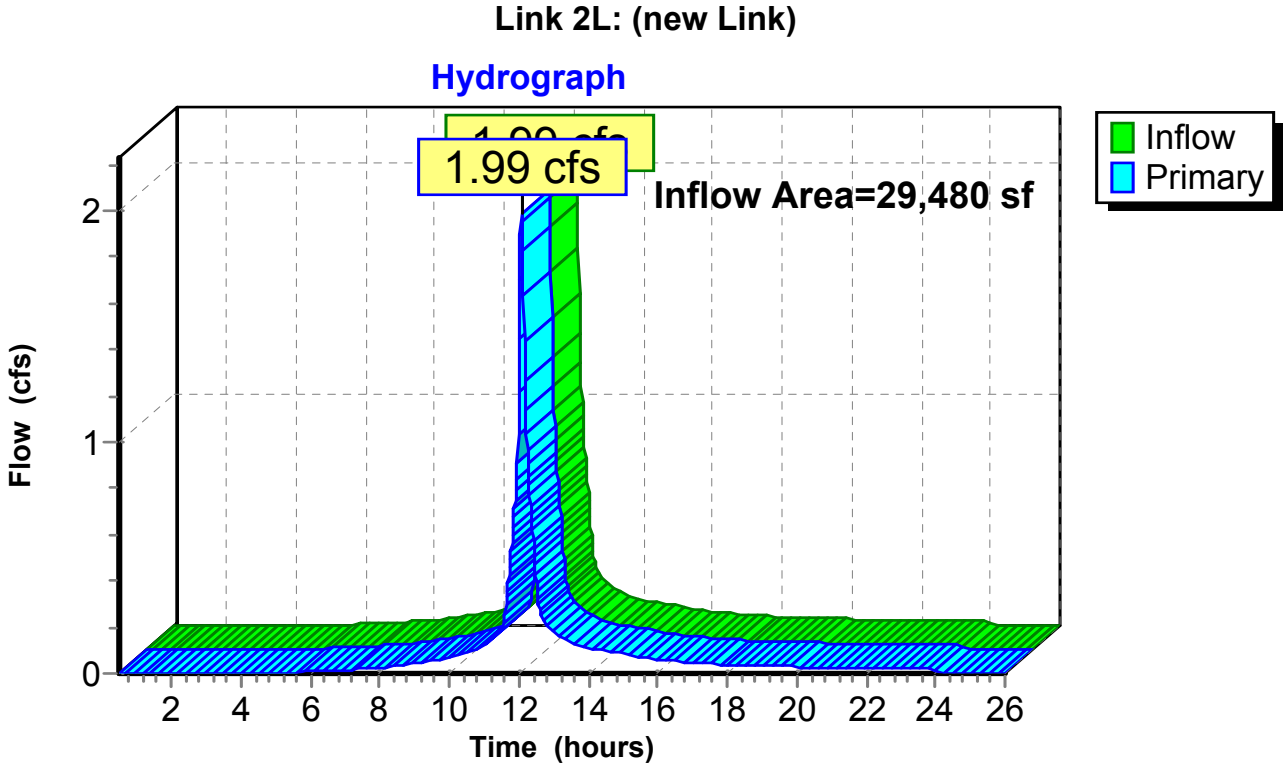
Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs



Summary for Link 2L: (new Link)

Inflow Area = 29,480 sf, 90.51% Impervious, Inflow Depth = 2.60" for 2-Year event
Inflow = 1.99 cfs @ 12.09 hrs, Volume= 6,387 cf
Primary = 1.99 cfs @ 12.09 hrs, Volume= 6,387 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs

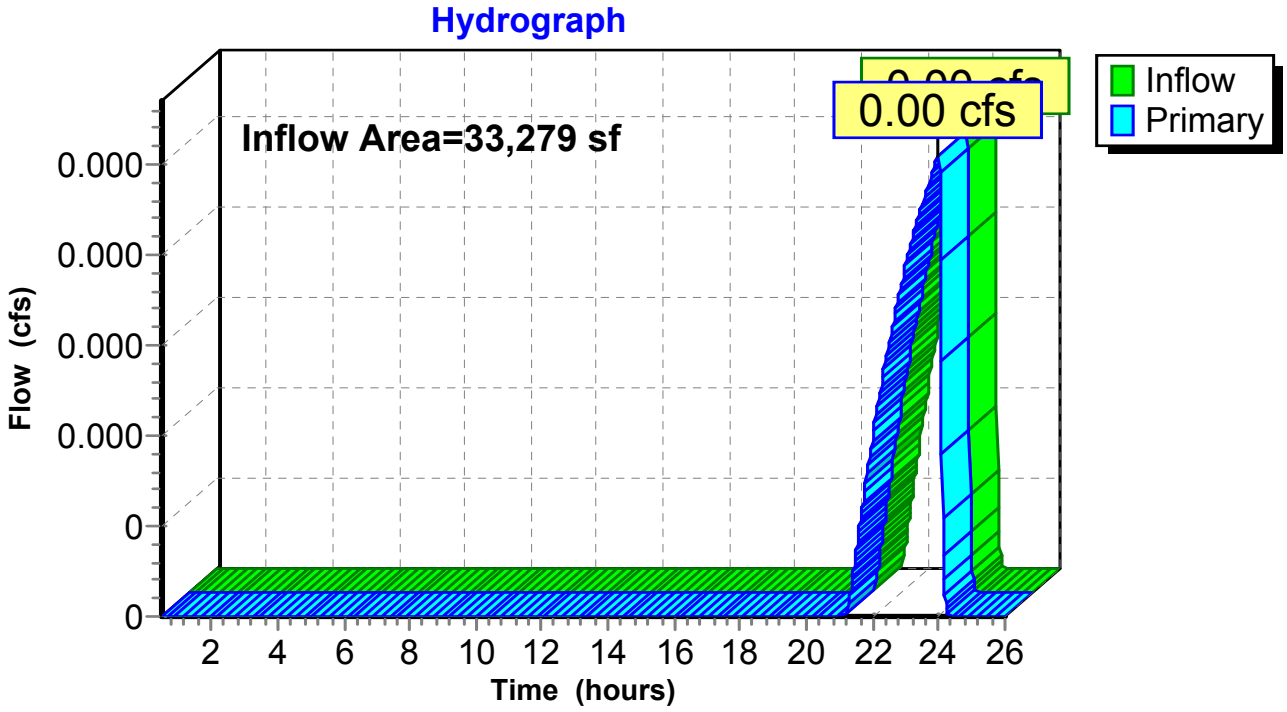


Summary for Link 11L: (new Link)

Inflow Area = 33,279 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 24.00 hrs, Volume= 2 cf
Primary = 0.00 cfs @ 24.00 hrs, Volume= 2 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs

Link 11L: (new Link)



Time span=0.50-26.00 hrs, dt=0.02 hrs, 1276 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment POST 1: Subcat POST 1 Runoff Area=2,656 sf 33.98% Impervious Runoff Depth=1.91"
Tc=6.0 min CN=66 Runoff=0.13 cfs 422 cf

Subcatchment POST 2: Subcat POST 2 Runoff Area=5,620 sf 100.00% Impervious Runoff Depth=5.02"
Tc=6.0 min CN=98 Runoff=0.66 cfs 2,352 cf

Subcatchment POST 3A: Subcat POST 3A Runoff Area=29,107 sf 89.64% Impervious Runoff Depth=4.45"
Tc=6.0 min CN=93 Runoff=3.26 cfs 10,802 cf

Subcatchment POST 3B: Subcat POST 3B Runoff Area=2,378 sf 100.00% Impervious Runoff Depth=5.02"
Tc=6.0 min CN=98 Runoff=0.28 cfs 995 cf

Subcatchment POST 4: Subcat POST 4 Runoff Area=8,584 sf 100.00% Impervious Runoff Depth=5.02"
Tc=6.0 min CN=98 Runoff=1.01 cfs 3,593 cf

Subcatchment POST 5: Subcat POST 5 Runoff Area=29,480 sf 90.51% Impervious Runoff Depth=4.45"
Tc=6.0 min CN=93 Runoff=3.31 cfs 10,941 cf

Subcatchment POST 6: Subcat POST 6 Runoff Area=12,709 sf 100.00% Impervious Runoff Depth=5.02"
Tc=6.0 min CN=98 Runoff=1.50 cfs 5,320 cf

Subcatchment POST 7: Subcat POST 7 Runoff Area=15,963 sf 95.84% Impervious Runoff Depth=4.79"
Tc=6.0 min CN=96 Runoff=1.86 cfs 6,373 cf

Subcatchment POST 8: Subcat POST 8 Runoff Area=33,279 sf 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=38 Runoff=0.03 cfs 604 cf

Pond 1P: UC#2 Peak Elev=244.32' Storage=6,315 cf Inflow=4.21 cfs 14,150 cf
Outflow=0.23 cfs 14,150 cf

Pond 6P: UC#3 and #4 Peak Elev=243.95' Storage=11,570 cf Inflow=7.67 cfs 26,226 cf
Outflow=0.42 cfs 26,226 cf

Pond 8P: UC#1 Peak Elev=239.97' Storage=127 cf Inflow=0.13 cfs 422 cf
Outflow=0.02 cfs 422 cf

Link 1L: (new Link) Inflow=3.54 cfs 11,797 cf
Primary=3.54 cfs 11,797 cf

Link 2L: (new Link) Inflow=3.31 cfs 10,941 cf
Primary=3.31 cfs 10,941 cf

Link 11L: (new Link) Inflow=0.03 cfs 604 cf
Primary=0.03 cfs 604 cf

Total Runoff Area = 139,776 sf Runoff Volume = 41,402 cf Average Runoff Depth = 3.55"
29.70% Pervious = 41,509 sf 70.30% Impervious = 98,267 sf

Summary for Subcatchment POST 1: Subcat POST 1

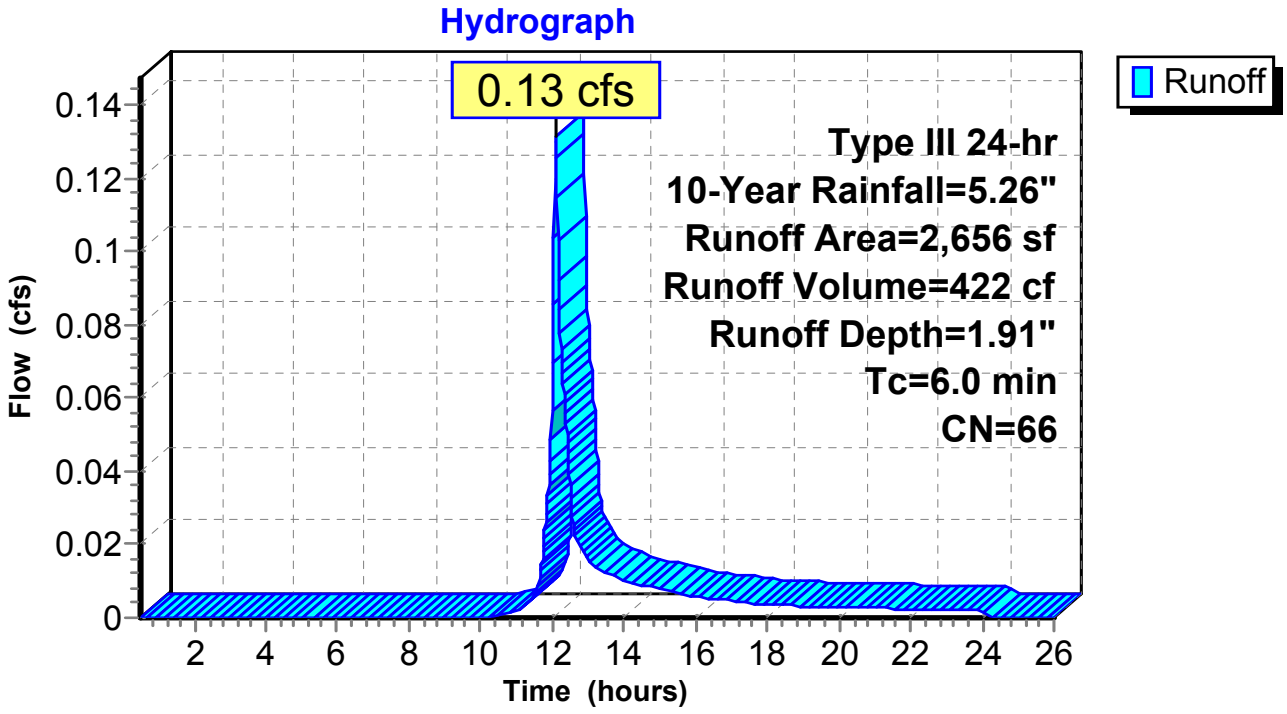
Runoff = 0.13 cfs @ 12.09 hrs, Volume= 422 cf, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
1,754	49	50-75% Grass cover, Fair, HSG A
903	98	Paved roads w/curbs & sewers, HSG A
2,656	66	Weighted Average
1,754		66.02% Pervious Area
903		33.98% Impervious Area

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

Subcatchment POST 1: Subcat POST 1



Summary for Subcatchment POST 2: Subcat POST 2

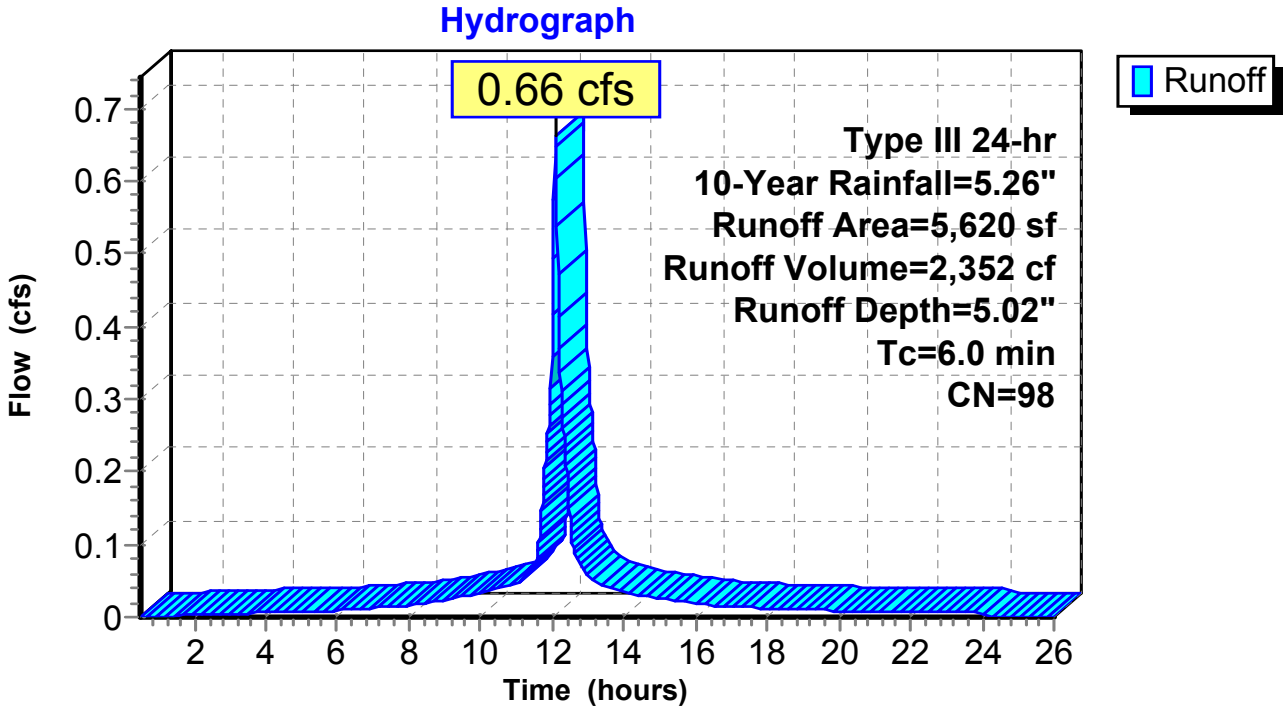
Runoff = 0.66 cfs @ 12.08 hrs, Volume= 2,352 cf, Depth= 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
5,620	98	Roofs, HSG A
5,620		100.00% Impervious Area

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

Subcatchment POST 2: Subcat POST 2



Summary for Subcatchment POST 3A: Subcat POST 3A

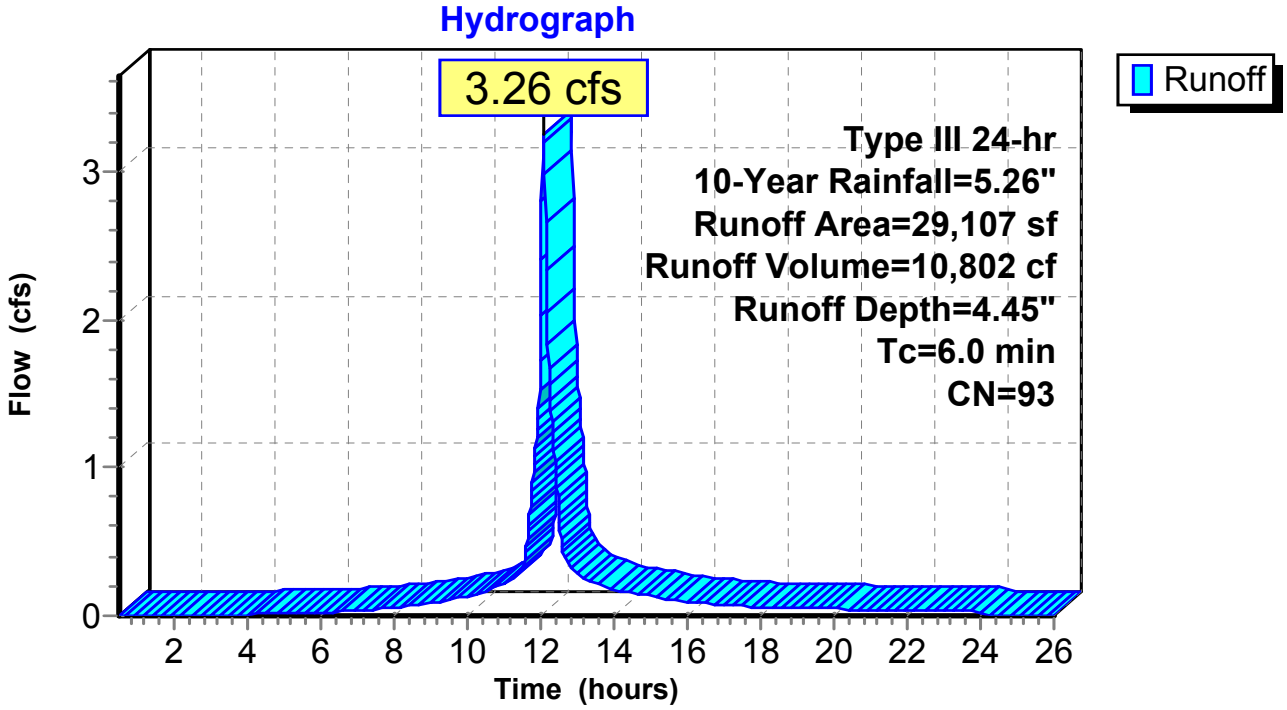
Runoff = 3.26 cfs @ 12.08 hrs, Volume= 10,802 cf, Depth= 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
3,016	49	50-75% Grass cover, Fair, HSG A
26,091	98	Paved roads w/curbs & sewers, HSG A
0	36	Woods, Fair, HSG A
29,107	93	Weighted Average
3,016		10.36% Pervious Area
26,091		89.64% Impervious Area

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

Subcatchment POST 3A: Subcat POST 3A



Summary for Subcatchment POST 3B: Subcat POST 3B

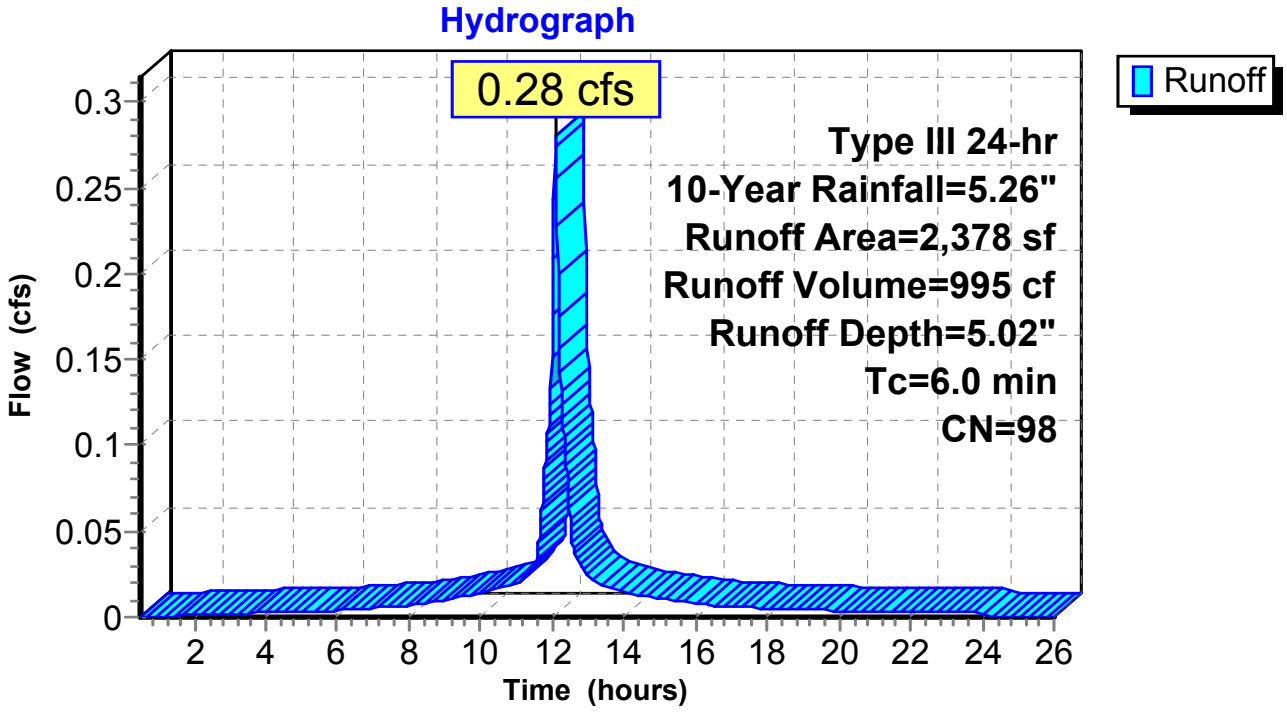
Runoff = 0.28 cfs @ 12.08 hrs, Volume= 995 cf, Depth= 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
2,378	98	Paved roads w/curbs & sewers, HSG A
2,378		100.00% Impervious Area

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

Subcatchment POST 3B: Subcat POST 3B



Summary for Subcatchment POST 4: Subcat POST 4

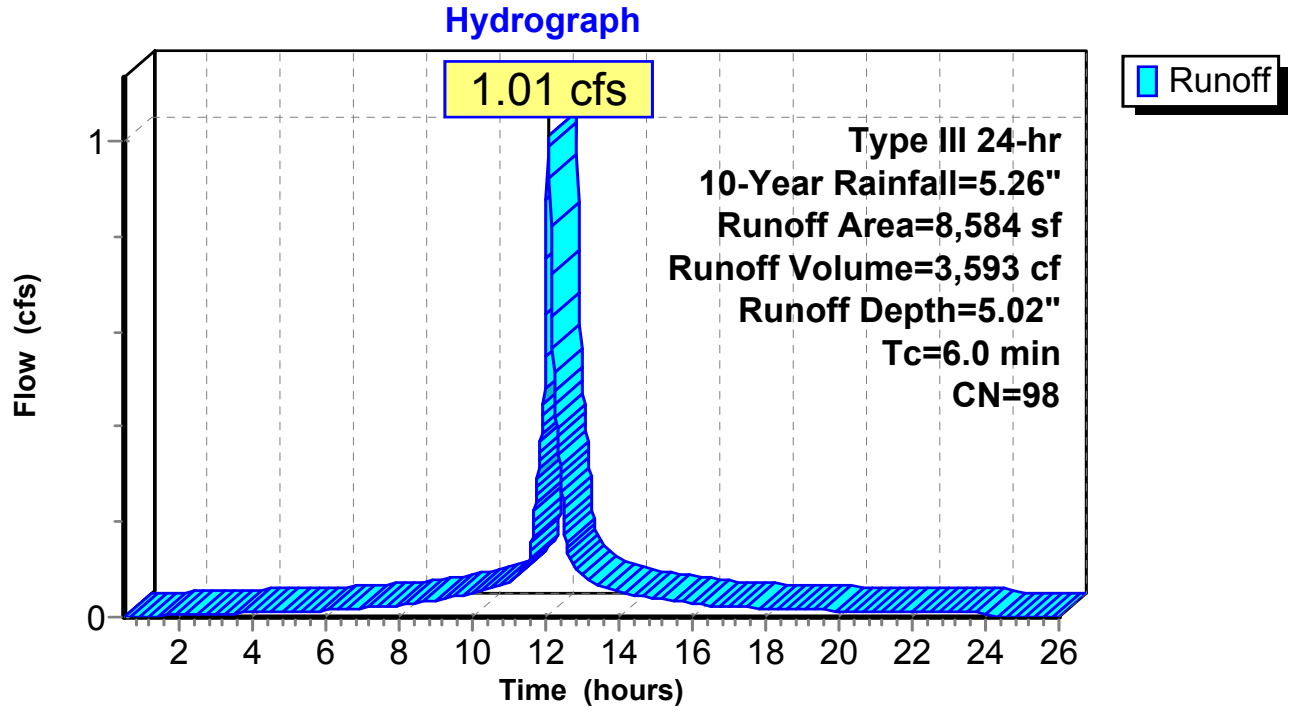
Runoff = 1.01 cfs @ 12.08 hrs, Volume= 3,593 cf, Depth= 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
8,584	98	Roofs, HSG A
8,584		100.00% Impervious Area

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

Subcatchment POST 4: Subcat POST 4



Summary for Subcatchment POST 5: Subcat POST 5

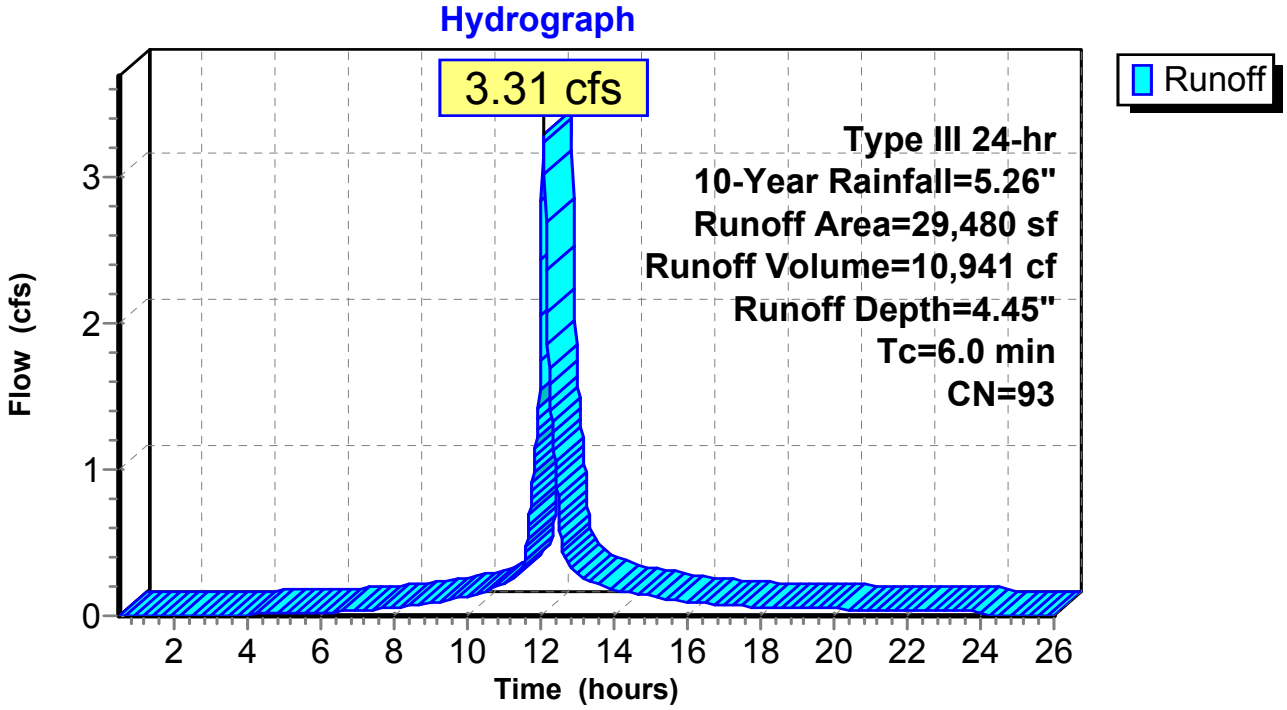
Runoff = 3.31 cfs @ 12.08 hrs, Volume= 10,941 cf, Depth= 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
2,796	49	50-75% Grass cover, Fair, HSG A
26,684	98	Paved roads w/curbs & sewers, HSG A
0	36	Woods, Fair, HSG A
29,480	93	Weighted Average
2,796		9.49% Pervious Area
26,684		90.51% Impervious Area

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

Subcatchment POST 5: Subcat POST 5



Summary for Subcatchment POST 6: Subcat POST 6

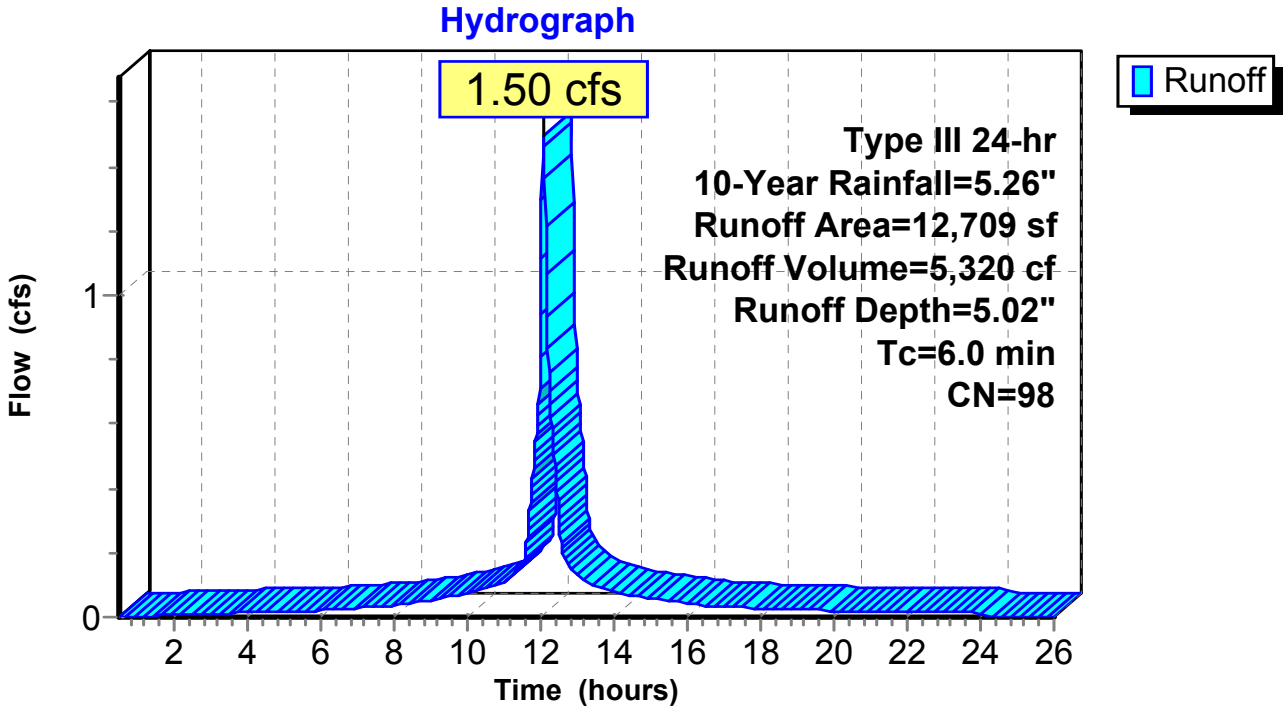
Runoff = 1.50 cfs @ 12.08 hrs, Volume= 5,320 cf, Depth= 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
12,709	98	Roofs, HSG A
12,709		100.00% Impervious Area

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

Subcatchment POST 6: Subcat POST 6



Summary for Subcatchment POST 7: Subcat POST 7

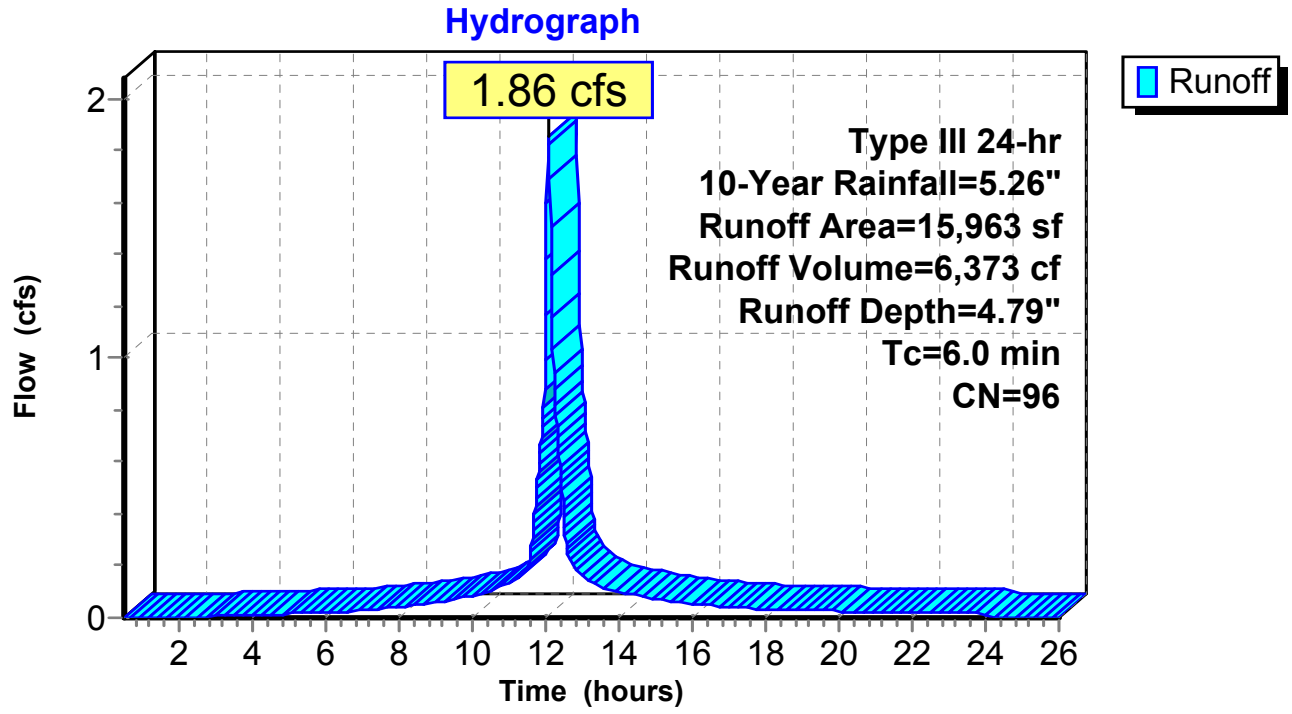
Runoff = 1.86 cfs @ 12.08 hrs, Volume= 6,373 cf, Depth= 4.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
665	49	50-75% Grass cover, Fair, HSG A
15,298	98	Paved roads w/curbs & sewers, HSG A
15,963	96	Weighted Average
665		4.16% Pervious Area
15,298		95.84% Impervious Area

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

Subcatchment POST 7: Subcat POST 7



Summary for Subcatchment POST 8: Subcat POST 8

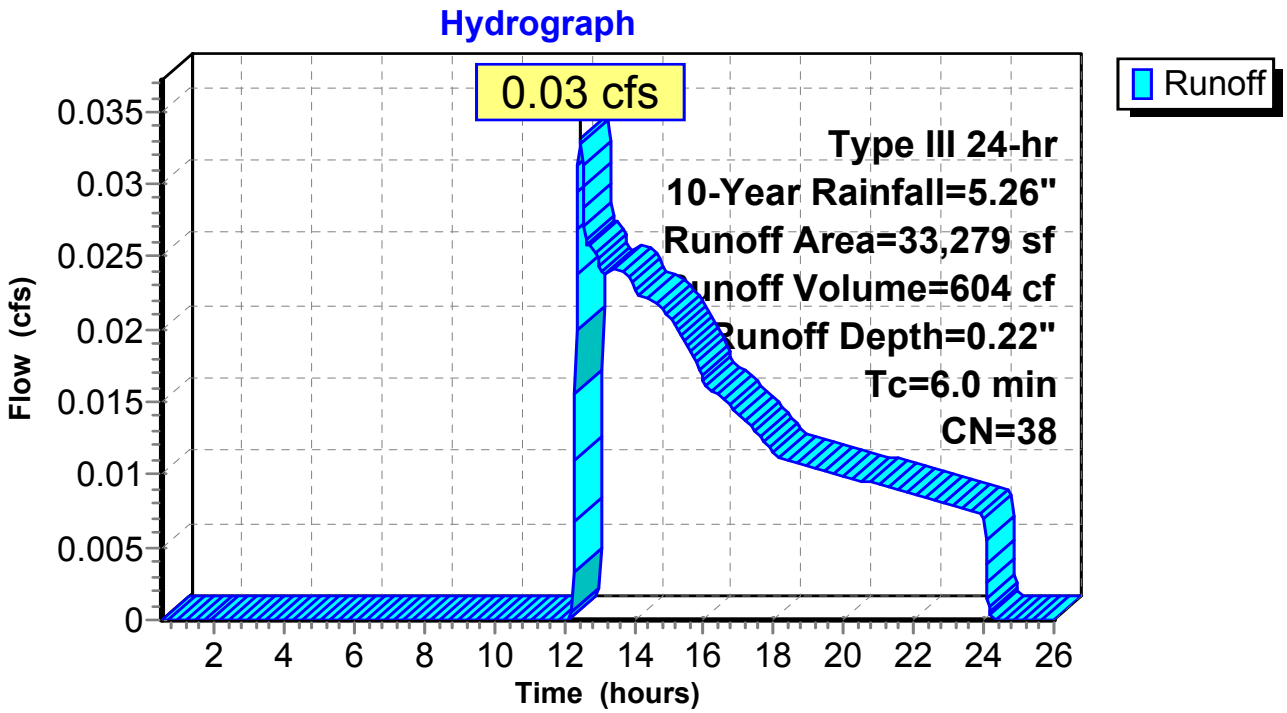
Runoff = 0.03 cfs @ 12.47 hrs, Volume= 604 cf, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=5.26"

Area (sf)	CN	Description
4,107	49	50-75% Grass cover, Fair, HSG A
29,172	36	Woods, Fair, HSG A
33,279	38	Weighted Average
33,279		100.00% Pervious Area

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

Subcatchment POST 8: Subcat POST 8



Summary for Pond 1P: UC#2

Inflow Area = 37,104 sf, 91.87% Impervious, Inflow Depth = 4.58" for 10-Year event
Inflow = 4.21 cfs @ 12.08 hrs, Volume= 14,150 cf
Outflow = 0.23 cfs @ 10.68 hrs, Volume= 14,150 cf, Atten= 95%, Lag= 0.0 min
Discarded = 0.23 cfs @ 10.68 hrs, Volume= 14,150 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 244.32' @ 13.96 hrs Surf.Area= 4,148 sf Storage= 6,315 cf

Plug-Flow detention time= 230.4 min calculated for 14,138 cf (100% of inflow)
Center-of-Mass det. time= 230.3 min (1,000.0 - 769.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	242.00'	3,421 cf	**44.60'W x 93.00'L x 5.00'H Field A** 20,739 cf Overall - 12,187 cf Embedded = 8,552 cf x 40.0% Voids
#2A	242.50'	9,179 cf	**Concrete Galley 4x4x4** x 207 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 207 Chambers in 9 Rows
		12,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	242.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.23 cfs @ 10.68 hrs HW=242.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Pond 1P: UC#2 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)
Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

52.8" Wide + 6.0" Spacing = 58.8" C-C Row Spacing

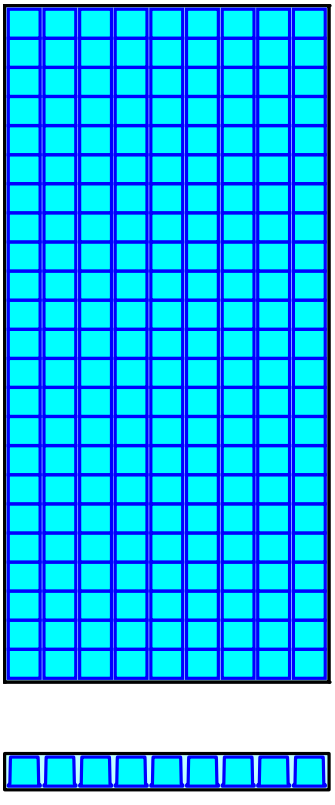
23 Chambers/Row x 4.00' Long = 92.00' Row Length +6.0" End Stone x 2 = 93.00' Base Length
9 Rows x 52.8" Wide + 6.0" Spacing x 8 + 6.0" Side Stone x 2 = 44.60' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

207 Chambers x 44.3 cf = 9,179.3 cf Chamber Storage
207 Chambers x 58.9 cf = 12,187.4 cf Displacement

20,739.0 cf Field - 12,187.4 cf Chambers = 8,551.6 cf Stone x 40.0% Voids = 3,420.6 cf Stone Storage

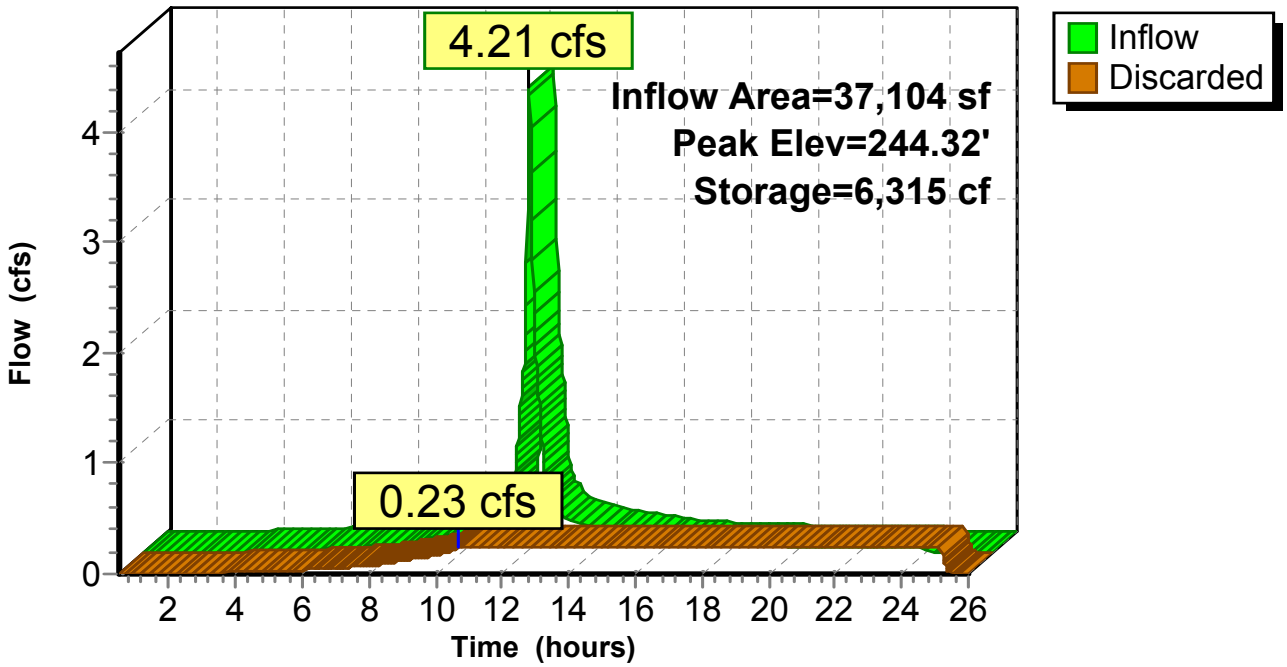
Chamber Storage + Stone Storage = 12,600.0 cf = 0.289 af
Overall Storage Efficiency = 60.8%
Overall System Size = 93.00' x 44.60' x 5.00'

207 Chambers @ $ 300.00 /ea = $ 62,100.00
768.1 cy Field Excavation @ $ 10.00 /cy = $ 7,681.11
316.7 cy Stone @ $ 30.00 /cy = $ 9,501.78
Total Cost = $ 79,282.89



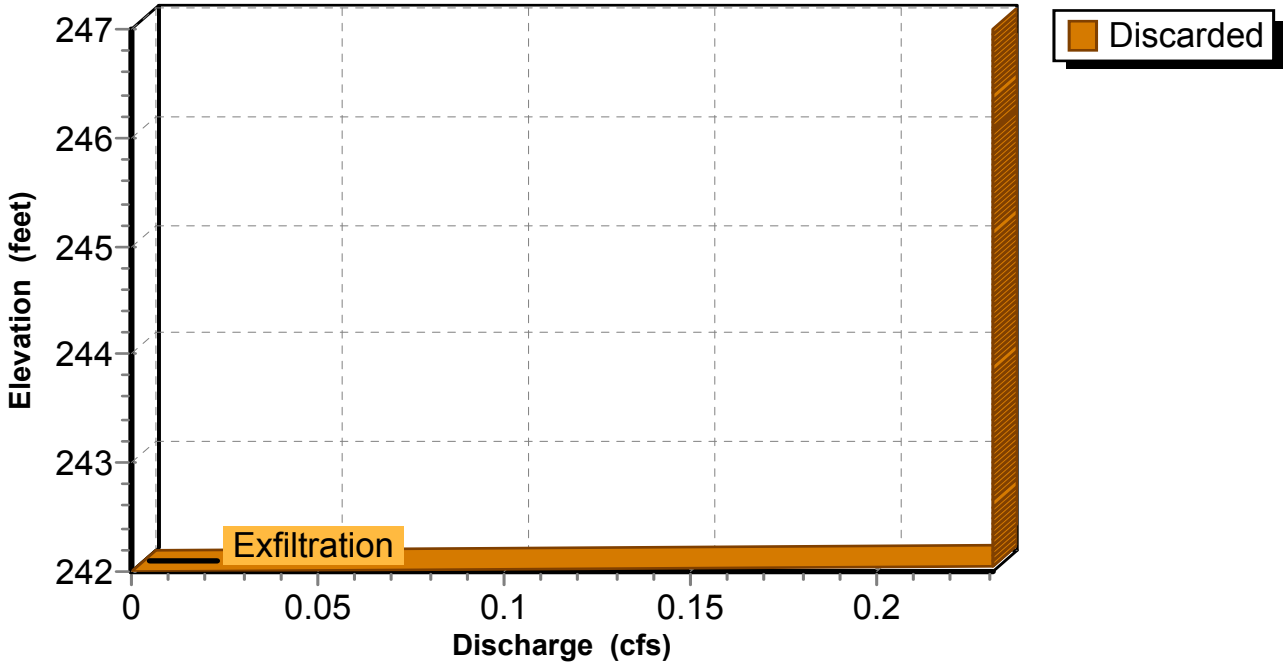
Pond 1P: UC#2

Hydrograph

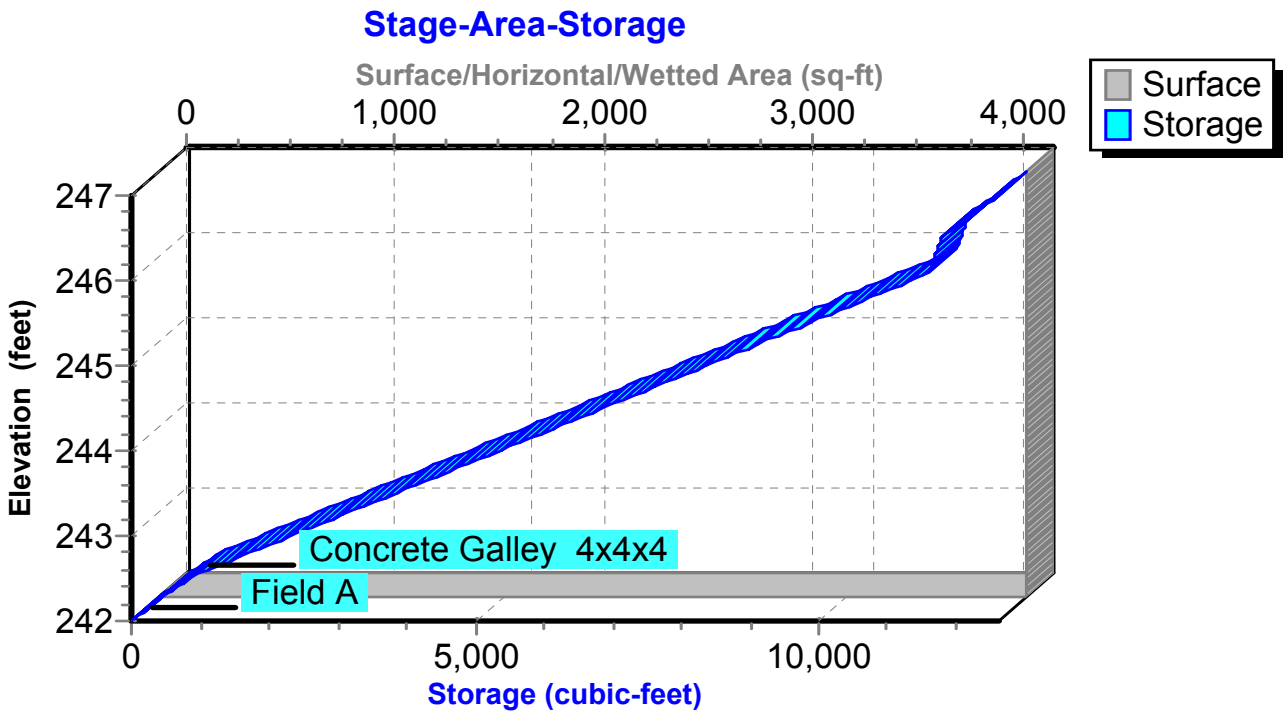


Pond 1P: UC#2

Stage-Discharge



Pond 1P: UC#2


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
1,000
2,000
3,000
4,000
Surface
Storage
247
246
245
244
243
242
Elevation (feet)
Concrete Galley 4x4x4
Field A
0
5,000
10,000
Storage (cubic-feet)

Summary for Pond 6P: UC#3 and #4

Inflow Area = 66,736 sf, 94.81% Impervious, Inflow Depth = 4.72" for 10-Year event
Inflow = 7.67 cfs @ 12.08 hrs, Volume= 26,226 cf
Outflow = 0.42 cfs @ 10.60 hrs, Volume= 26,226 cf, Atten= 95%, Lag= 0.0 min
Discarded = 0.42 cfs @ 10.60 hrs, Volume= 26,226 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 243.95' @ 13.94 hrs Surf.Area= 7,566 sf Storage= 11,570 cf

Plug-Flow detention time= 227.6 min calculated for 26,226 cf (100% of inflow)
Center-of-Mass det. time= 227.6 min (990.5 - 762.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	241.70'	5,335 cf	**36.20'W x 209.00'L x 5.00'H Field A** 37,829 cf Overall - 24,493 cf Embedded = 13,336 cf x 40.0% Voids
#2A	242.20'	18,447 cf	**Concrete Galley 4x4x4** x 416 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 416 Chambers in 8 Rows
		23,782 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	241.70'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.42 cfs @ 10.60 hrs HW=241.75' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.42 cfs)

Pond 6P: UC#3 and #4 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)
Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

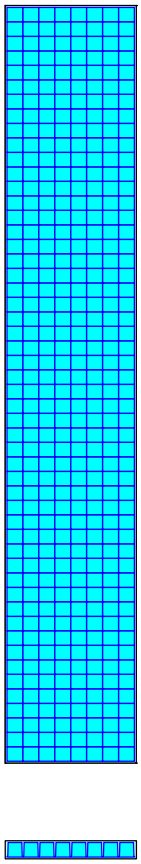
52 Chambers/Row x 4.00' Long = 208.00' Row Length +6.0" End Stone x 2 = 209.00' Base Length
8 Rows x 52.8" Wide + 6.0" Side Stone x 2 = 36.20' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

416 Chambers x 44.3 cf = 18,447.4 cf Chamber Storage
416 Chambers x 58.9 cf = 24,492.6 cf Displacement

37,829.0 cf Field - 24,492.6 cf Chambers = 13,336.4 cf Stone x 40.0% Voids = 5,334.6 cf Stone Storage

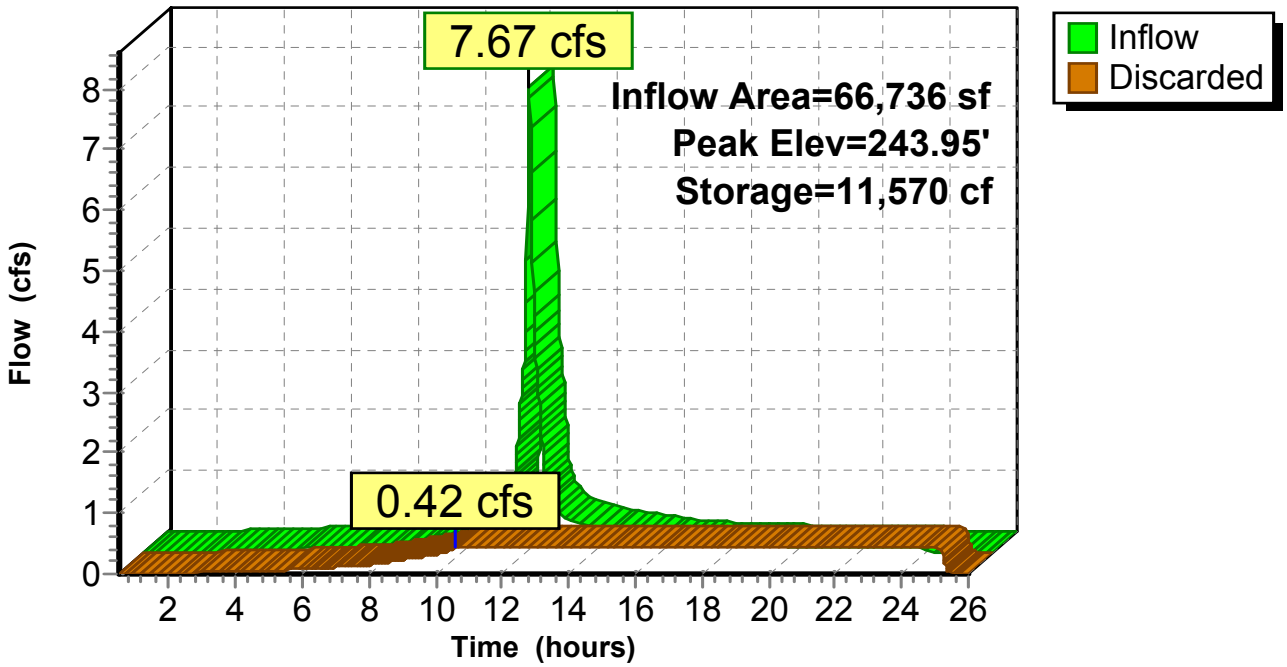
Chamber Storage + Stone Storage = 23,782.0 cf = 0.546 af
Overall Storage Efficiency = 62.9%
Overall System Size = 209.00' x 36.20' x 5.00'

416 Chambers @ $ 300.00 /ea = $ 124,800.00
1,401.1 cy Field Excavation @ $ 10.00 /cy = $ 14,010.74
493.9 cy Stone @ $ 30.00 /cy = $ 14,818.27
Total Cost = $ 153,629.01



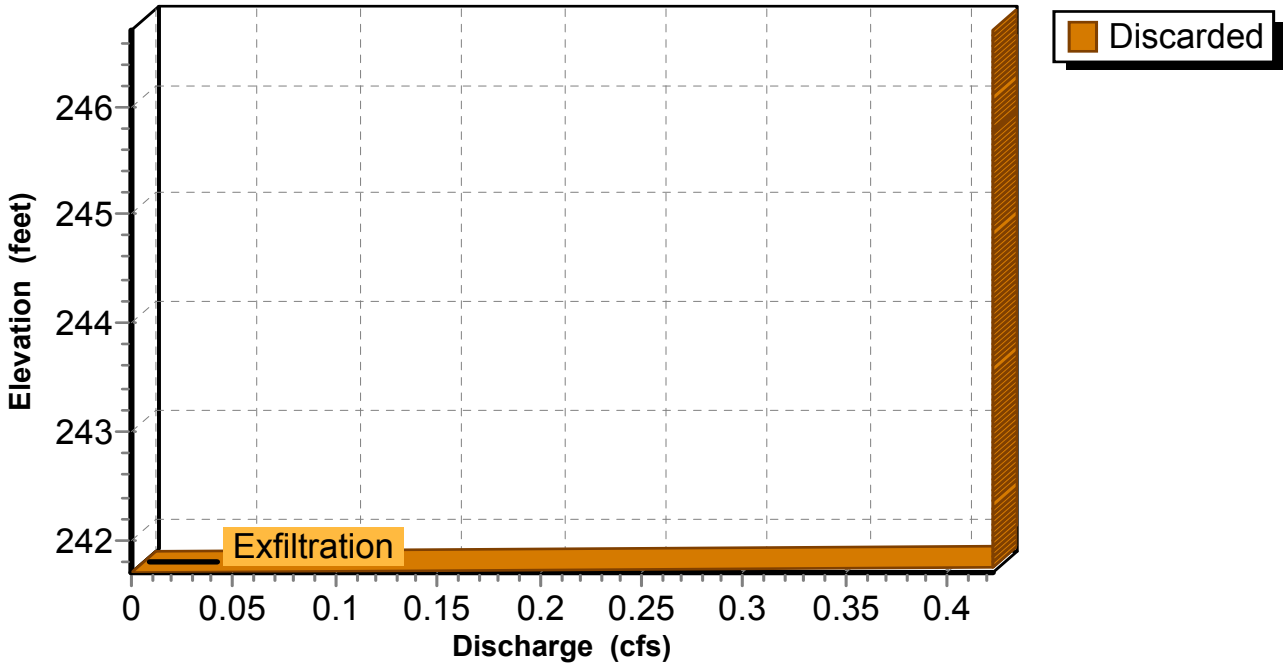
Pond 6P: UC#3 and #4

Hydrograph

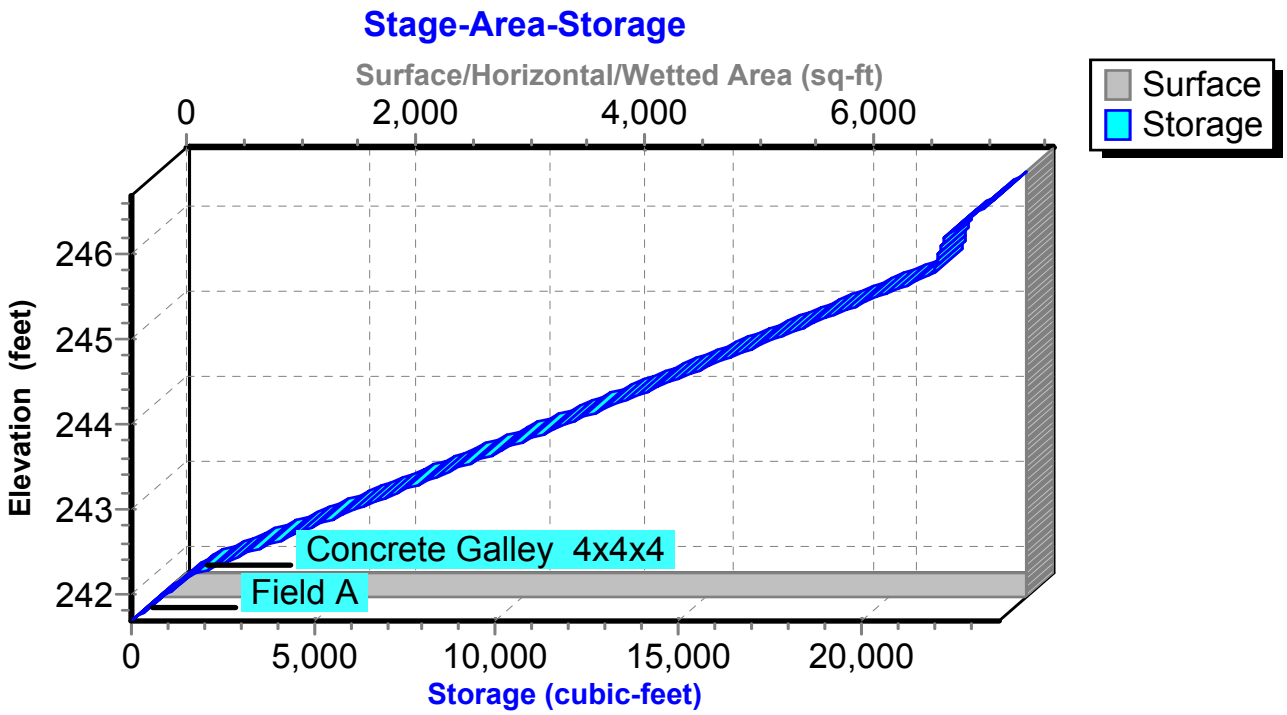


Pond 6P: UC#3 and #4

Stage-Discharge



Pond 6P: UC#3 and #4



Summary for Pond 8P: UC#1

Inflow Area = 2,656 sf, 33.98% Impervious, Inflow Depth = 1.91" for 10-Year event
Inflow = 0.13 cfs @ 12.09 hrs, Volume= 422 cf
Outflow = 0.02 cfs @ 11.82 hrs, Volume= 422 cf, Atten= 85%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.82 hrs, Volume= 422 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 239.97' @ 12.75 hrs Surf.Area= 350 sf Storage= 127 cf

Plug-Flow detention time= 49.5 min calculated for 422 cf (100% of inflow)
Center-of-Mass det. time= 49.5 min (904.6 - 855.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	239.25'	177 cf	**14.00'W x 25.00'L x 2.50'H Field A** 875 cf Overall - 432 cf Embedded = 443 cf x 40.0% Voids
#2A	239.75'	290 cf	**Concrete Galley 4x8x1.5** x 9 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 9 Chambers in 3 Rows
		467 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	239.25'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 11.82 hrs HW=239.28' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 8P: UC#1 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x8x1.5 (Concrete Galley, UCPI 18" Low Profile Galley or equivalent)
Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf
Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf

48.0" Wide + 6.0" Spacing = 54.0" C-C Row Spacing

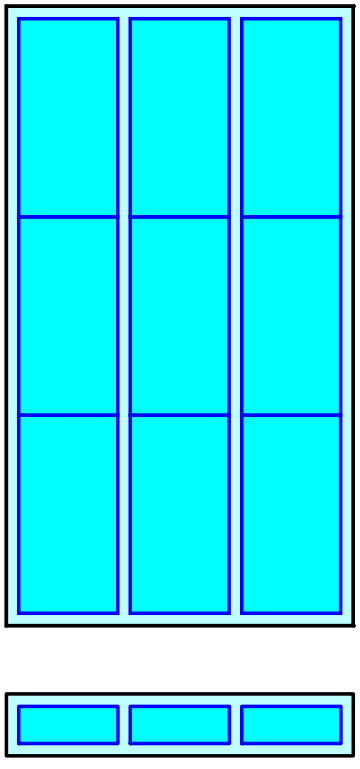
3 Chambers/Row x 8.00' Long = 24.00' Row Length +6.0" End Stone x 2 = 25.00' Base Length
3 Rows x 48.0" Wide + 6.0" Spacing x 2 + 6.0" Side Stone x 2 = 14.00' Base Width
6.0" Base + 18.0" Chamber Height + 6.0" Cover = 2.50' Field Height

9 Chambers x 32.2 cf = 289.6 cf Chamber Storage
9 Chambers x 48.0 cf = 432.0 cf Displacement

875.0 cf Field - 432.0 cf Chambers = 443.0 cf Stone x 40.0% Voids = 177.2 cf Stone Storage

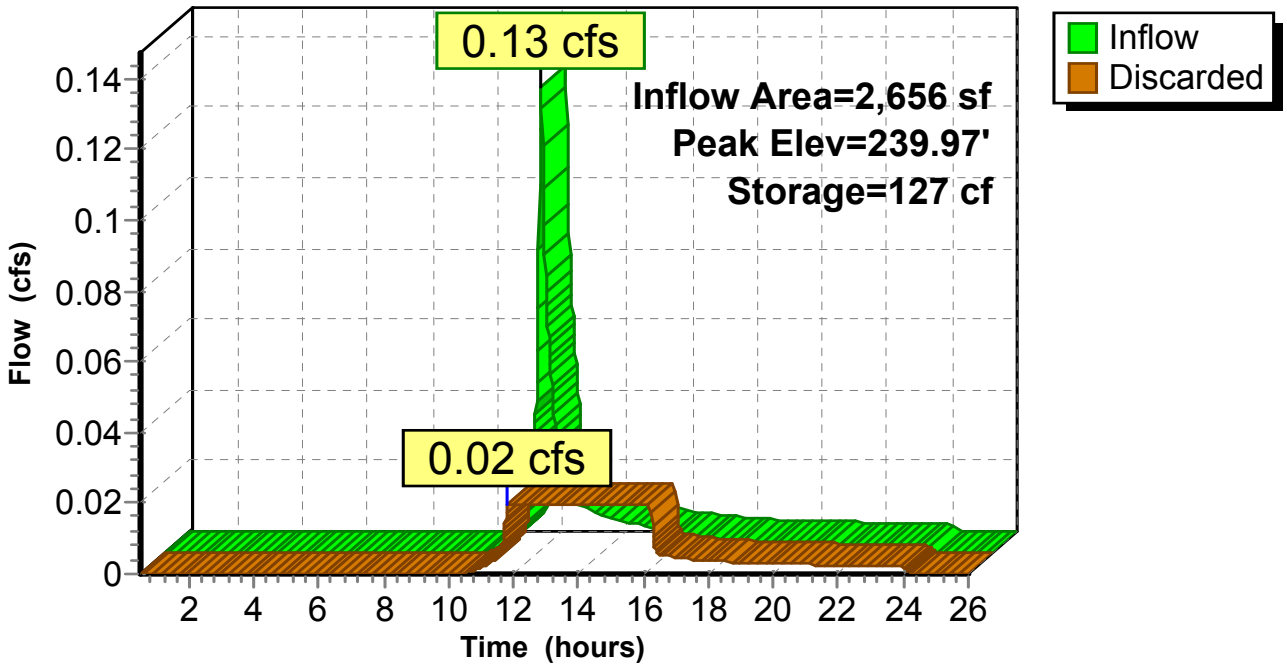
Chamber Storage + Stone Storage = 466.8 cf = 0.011 af
Overall Storage Efficiency = 53.3%
Overall System Size = 25.00' x 14.00' x 2.50'

9 Chambers @ $ 0.00 /ea = $ 0.00
32.4 cy Field Excavation @ $ 10.00 /cy = $ 324.07
16.4 cy Stone @ $ 30.00 /cy = $ 492.22
Total Cost = $ 816.30



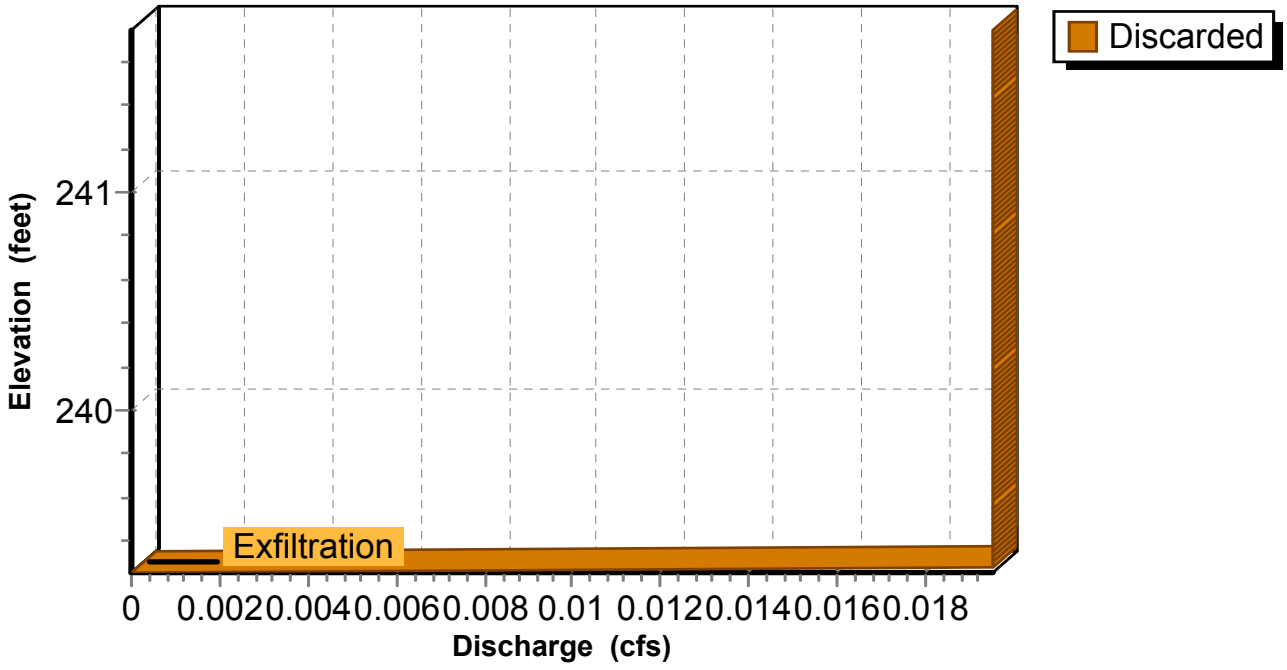
Pond 8P: UC#1

Hydrograph

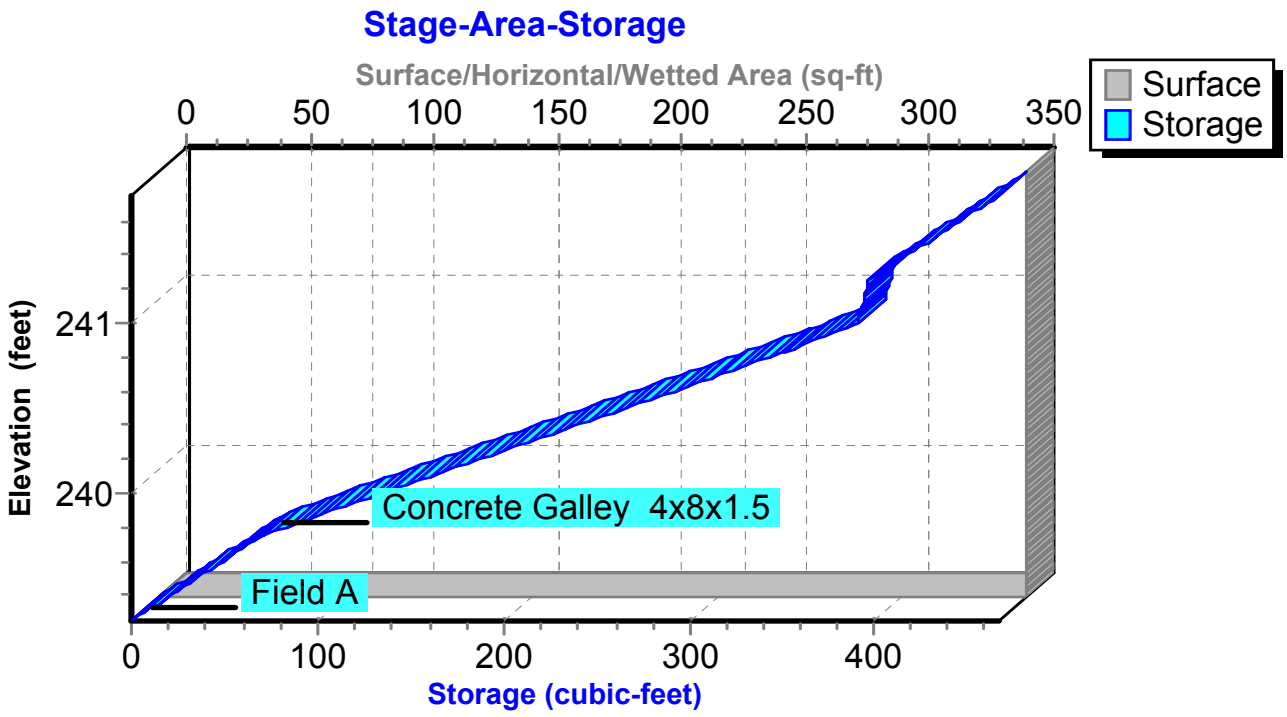


Pond 8P: UC#1

Stage-Discharge



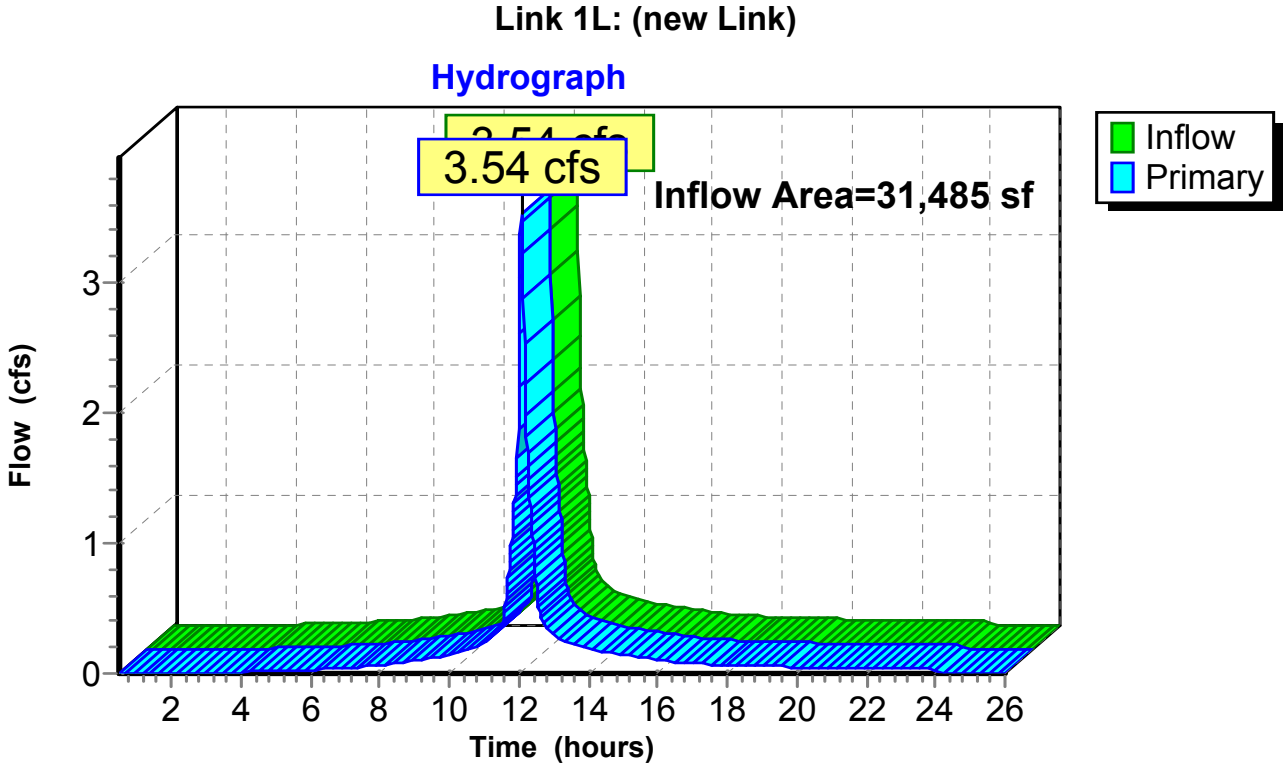
Pond 8P: UC#1


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
50
100
150
200
250
300
350
Surface
Storage
Elevation (feet)
241
240
Concrete Galley 4x8x1.5
Field A
0
100
200
300
400
Storage (cubic-feet)

Summary for Link 1L: (new Link)

Inflow Area = 31,485 sf, 90.42% Impervious, Inflow Depth = 4.50" for 10-Year event
Inflow = 3.54 cfs @ 12.08 hrs, Volume= 11,797 cf
Primary = 3.54 cfs @ 12.08 hrs, Volume= 11,797 cf, Atten= 0%, Lag= 0.0 min

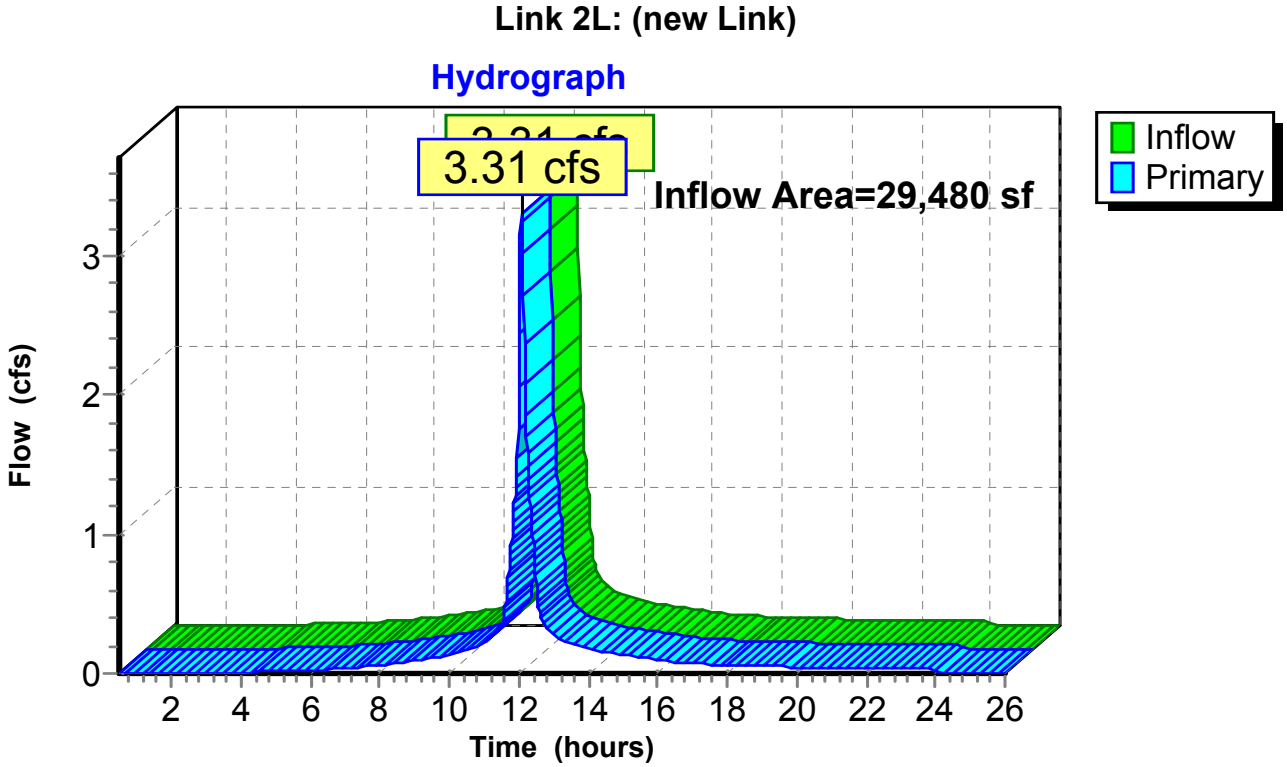
Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs



Summary for Link 2L: (new Link)

Inflow Area = 29,480 sf, 90.51% Impervious, Inflow Depth = 4.45" for 10-Year event
Inflow = 3.31 cfs @ 12.08 hrs, Volume= 10,941 cf
Primary = 3.31 cfs @ 12.08 hrs, Volume= 10,941 cf, Atten= 0%, Lag= 0.0 min

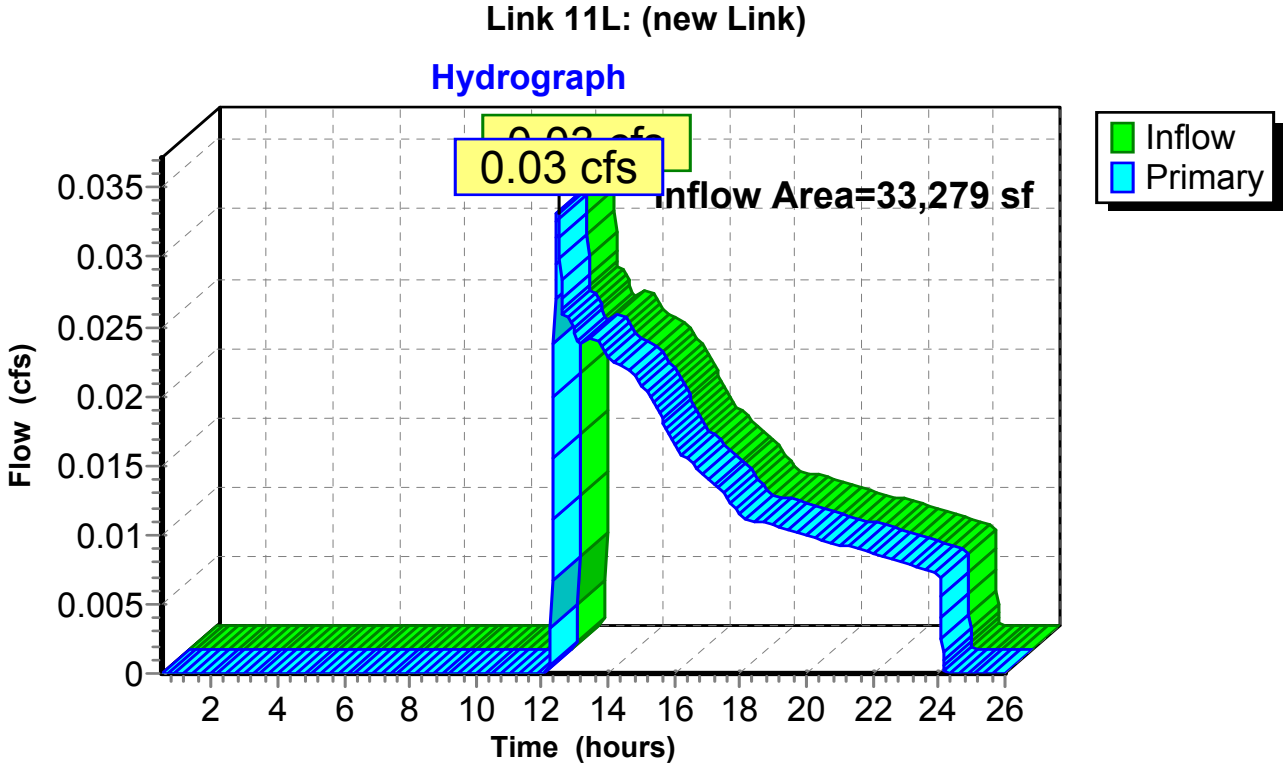
Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs



Summary for Link 11L: (new Link)

Inflow Area = 33,279 sf, 0.00% Impervious, Inflow Depth = 0.22" for 10-Year event
Inflow = 0.03 cfs @ 12.47 hrs, Volume= 604 cf
Primary = 0.03 cfs @ 12.47 hrs, Volume= 604 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs



Time span=0.50-26.00 hrs, dt=0.02 hrs, 1276 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment POST 1: Subcat POST 1 Runoff Area=2,656 sf 33.98% Impervious Runoff Depth=2.76"
Tc=6.0 min CN=66 Runoff=0.19 cfs 612 cf

Subcatchment POST 2: Subcat POST 2 Runoff Area=5,620 sf 100.00% Impervious Runoff Depth=6.19"
Tc=6.0 min CN=98 Runoff=0.81 cfs 2,899 cf

Subcatchment POST 3A: Subcat POST 3A Runoff Area=29,107 sf 89.64% Impervious Runoff Depth=5.61"
Tc=6.0 min CN=93 Runoff=4.06 cfs 13,601 cf

Subcatchment POST 3B: Subcat POST 3B Runoff Area=2,378 sf 100.00% Impervious Runoff Depth=6.19"
Tc=6.0 min CN=98 Runoff=0.34 cfs 1,227 cf

Subcatchment POST 4: Subcat POST 4 Runoff Area=8,584 sf 100.00% Impervious Runoff Depth=6.19"
Tc=6.0 min CN=98 Runoff=1.24 cfs 4,429 cf

Subcatchment POST 5: Subcat POST 5 Runoff Area=29,480 sf 90.51% Impervious Runoff Depth=5.61"
Tc=6.0 min CN=93 Runoff=4.11 cfs 13,775 cf

Subcatchment POST 6: Subcat POST 6 Runoff Area=12,709 sf 100.00% Impervious Runoff Depth=6.19"
Tc=6.0 min CN=98 Runoff=1.84 cfs 6,557 cf

Subcatchment POST 7: Subcat POST 7 Runoff Area=15,963 sf 95.84% Impervious Runoff Depth=5.96"
Tc=6.0 min CN=96 Runoff=2.28 cfs 7,922 cf

Subcatchment POST 8: Subcat POST 8 Runoff Area=33,279 sf 0.00% Impervious Runoff Depth=0.51"
Tc=6.0 min CN=38 Runoff=0.17 cfs 1,428 cf

Pond 1P: UC#2 Peak Elev=245.09' Storage=8,617 cf Inflow=5.21 cfs 17,727 cf
Outflow=0.23 cfs 15,358 cf

Pond 6P: UC#3 and #4 Peak Elev=244.67' Storage=15,701 cf Inflow=9.47 cfs 32,684 cf
Outflow=0.42 cfs 28,442 cf

Pond 8P: UC#1 Peak Elev=240.34' Storage=225 cf Inflow=0.19 cfs 612 cf
Outflow=0.02 cfs 612 cf

Link 1L: (new Link) Inflow=4.40 cfs 14,828 cf
Primary=4.40 cfs 14,828 cf

Link 2L: (new Link) Inflow=4.11 cfs 13,775 cf
Primary=4.11 cfs 13,775 cf

Link 11L: (new Link) Inflow=0.17 cfs 1,428 cf
Primary=0.17 cfs 1,428 cf

Total Runoff Area = 139,776 sf Runoff Volume = 52,451 cf Average Runoff Depth = 4.50"
29.70% Pervious = 41,509 sf 70.30% Impervious = 98,267 sf

Summary for Subcatchment POST 1: Subcat POST 1

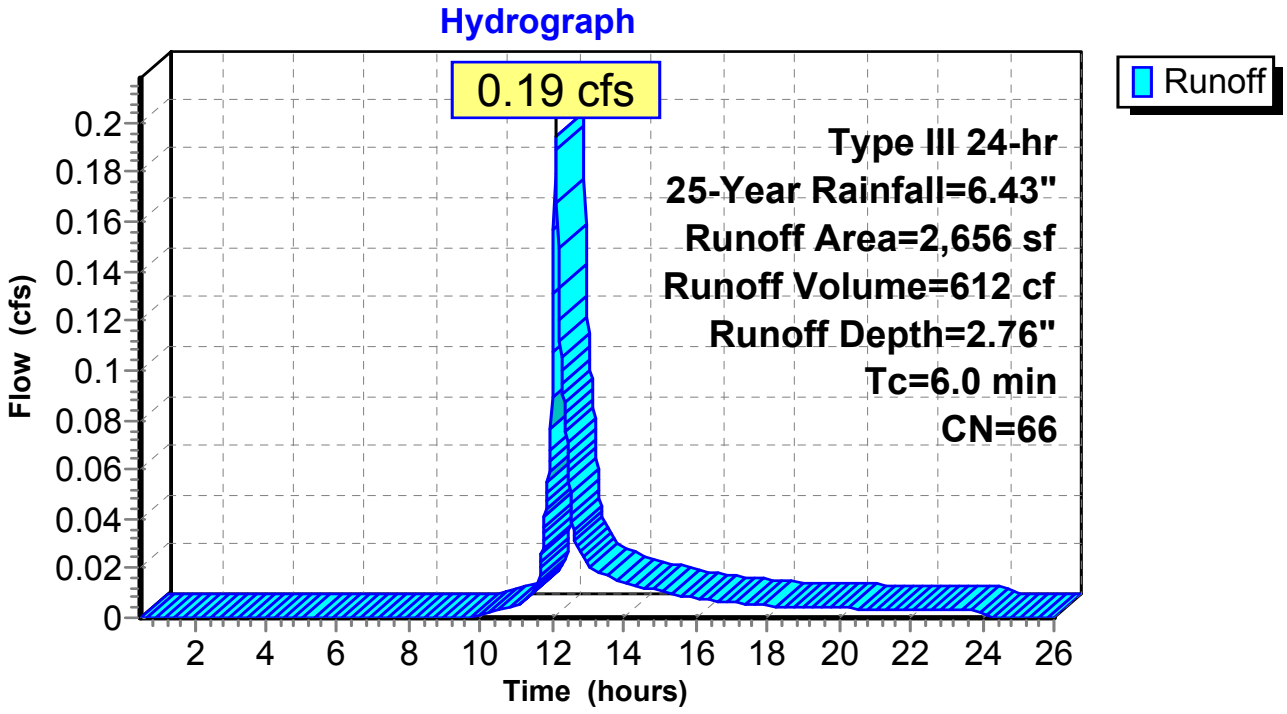
Runoff = 0.19 cfs @ 12.09 hrs, Volume= 612 cf, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
1,754	49	50-75% Grass cover, Fair, HSG A
903	98	Paved roads w/curbs & sewers, HSG A
2,656	66	Weighted Average
1,754		66.02% Pervious Area
903		33.98% Impervious Area

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

Subcatchment POST 1: Subcat POST 1



Summary for Subcatchment POST 2: Subcat POST 2

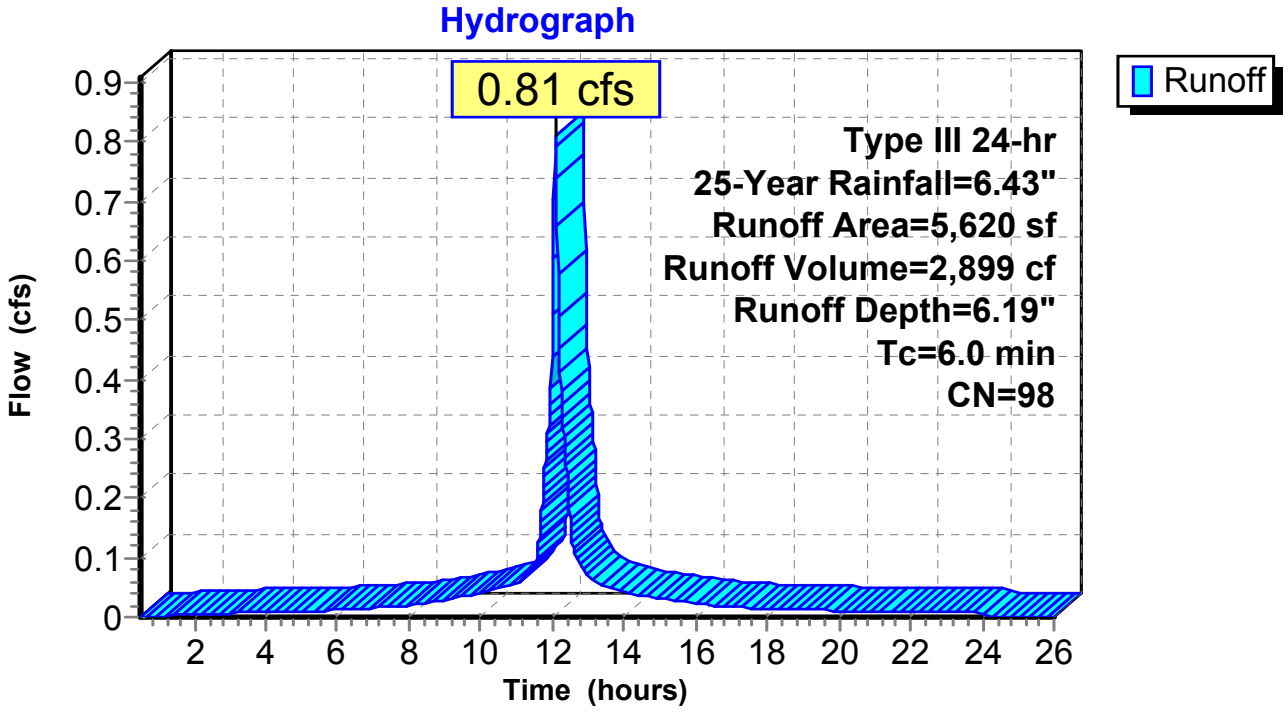
Runoff = 0.81 cfs @ 12.08 hrs, Volume= 2,899 cf, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
5,620	98	Roofs, HSG A
5,620		100.00% Impervious Area

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

Subcatchment POST 2: Subcat POST 2



Summary for Subcatchment POST 3A: Subcat POST 3A

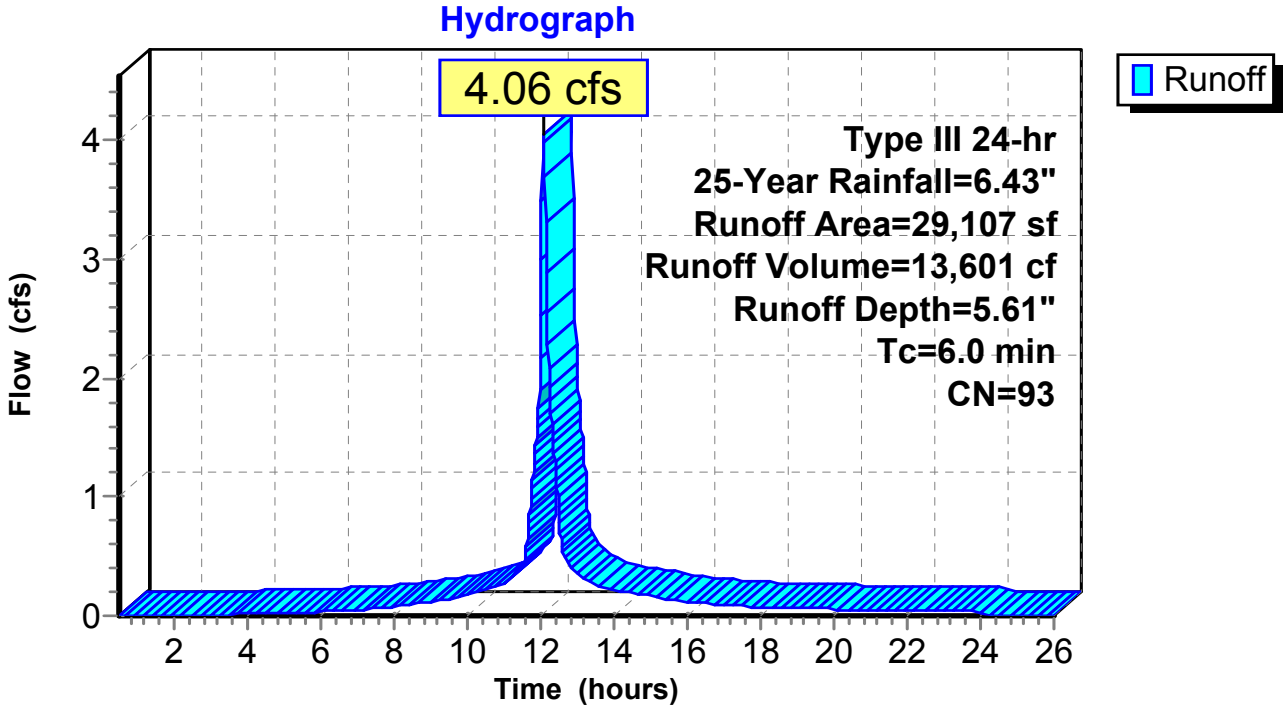
Runoff = 4.06 cfs @ 12.08 hrs, Volume= 13,601 cf, Depth= 5.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
3,016	49	50-75% Grass cover, Fair, HSG A
26,091	98	Paved roads w/curbs & sewers, HSG A
0	36	Woods, Fair, HSG A
29,107	93	Weighted Average
3,016		10.36% Pervious Area
26,091		89.64% Impervious Area

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

Subcatchment POST 3A: Subcat POST 3A



Summary for Subcatchment POST 3B: Subcat POST 3B

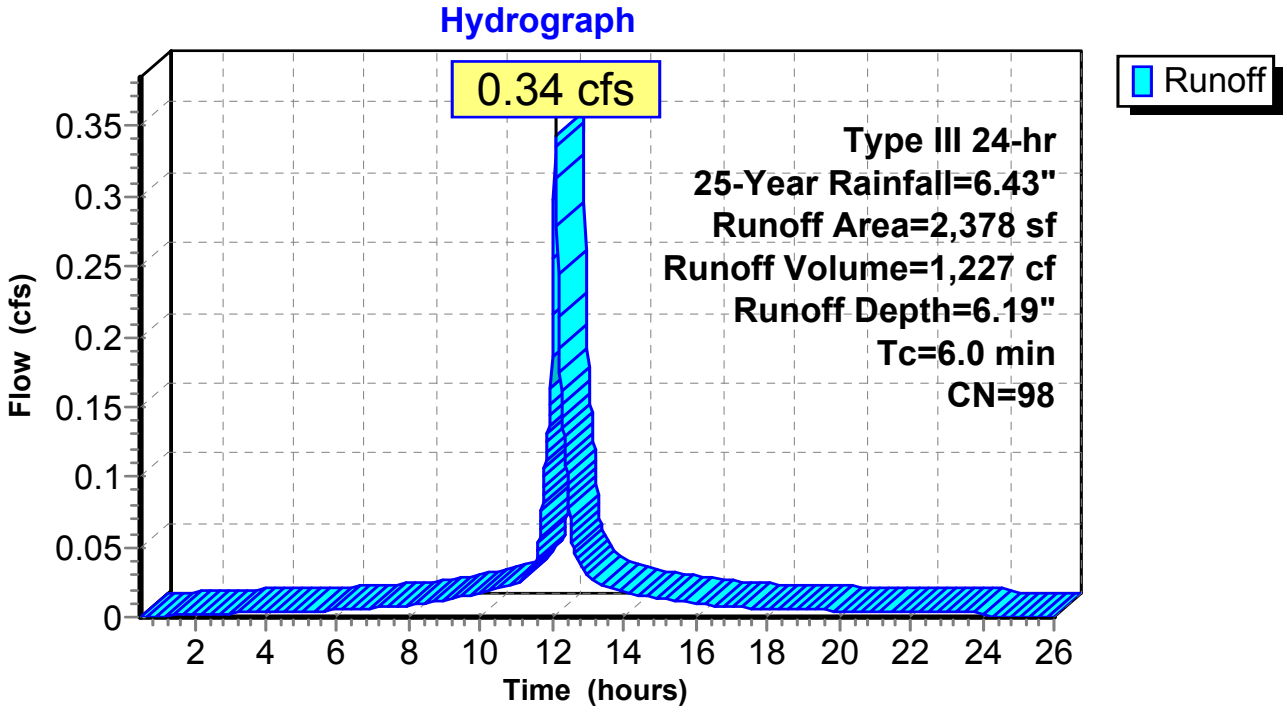
Runoff = 0.34 cfs @ 12.08 hrs, Volume= 1,227 cf, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
2,378	98	Paved roads w/curbs & sewers, HSG A
2,378		100.00% Impervious Area

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

Subcatchment POST 3B: Subcat POST 3B



Summary for Subcatchment POST 4: Subcat POST 4

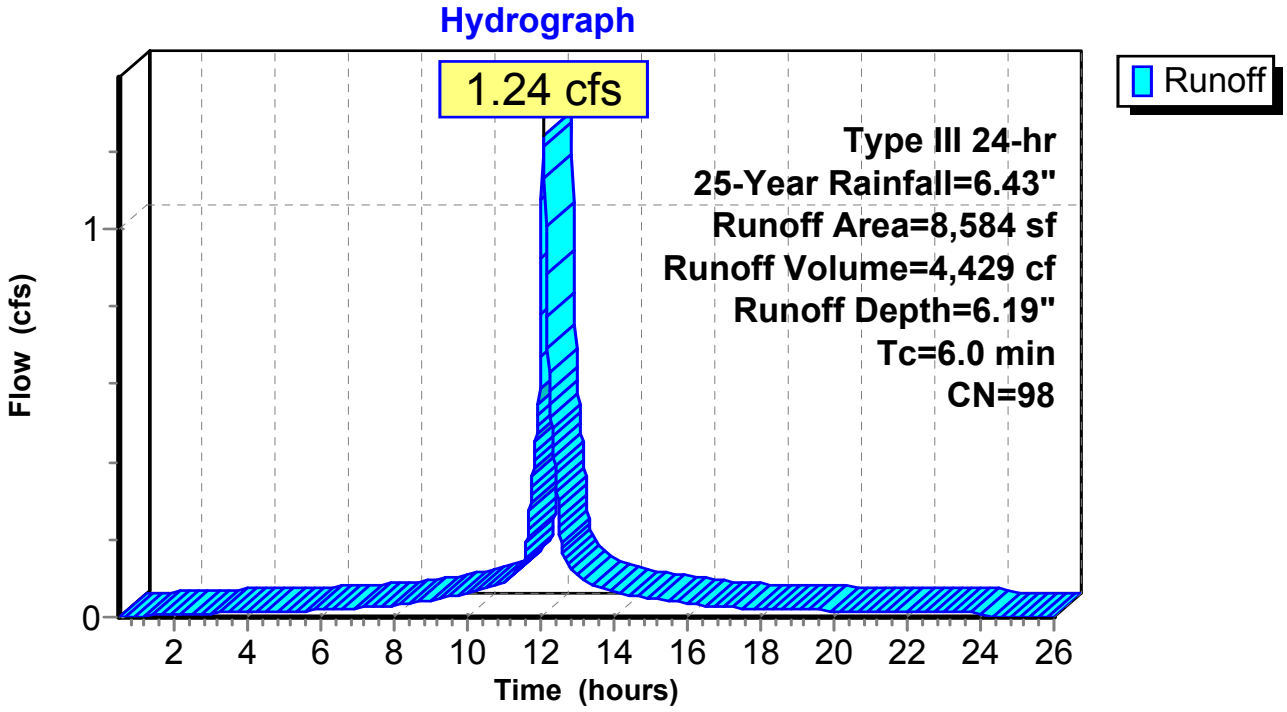
Runoff = 1.24 cfs @ 12.08 hrs, Volume= 4,429 cf, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
8,584	98	Roofs, HSG A
8,584		100.00% Impervious Area

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

Subcatchment POST 4: Subcat POST 4



Summary for Subcatchment POST 5: Subcat POST 5

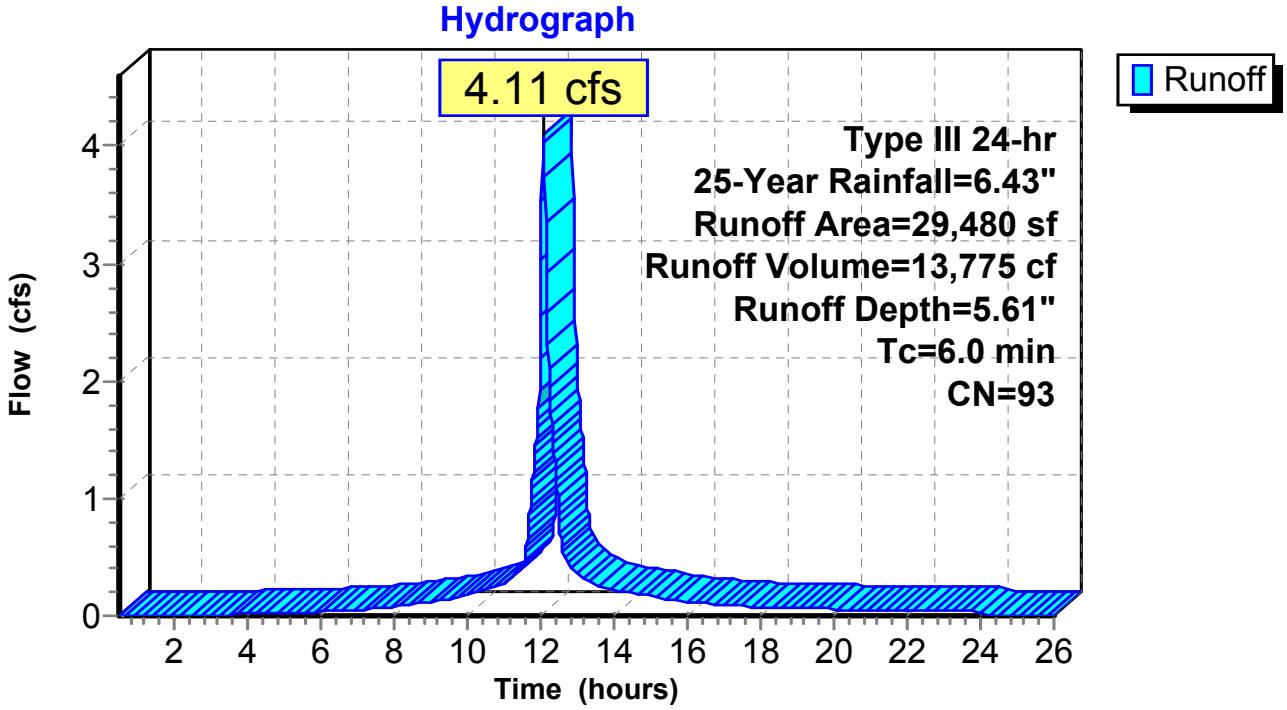
Runoff = 4.11 cfs @ 12.08 hrs, Volume= 13,775 cf, Depth= 5.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
2,796	49	50-75% Grass cover, Fair, HSG A
26,684	98	Paved roads w/curbs & sewers, HSG A
0	36	Woods, Fair, HSG A
29,480	93	Weighted Average
2,796		9.49% Pervious Area
26,684		90.51% Impervious Area

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

Subcatchment POST 5: Subcat POST 5



Summary for Subcatchment POST 6: Subcat POST 6

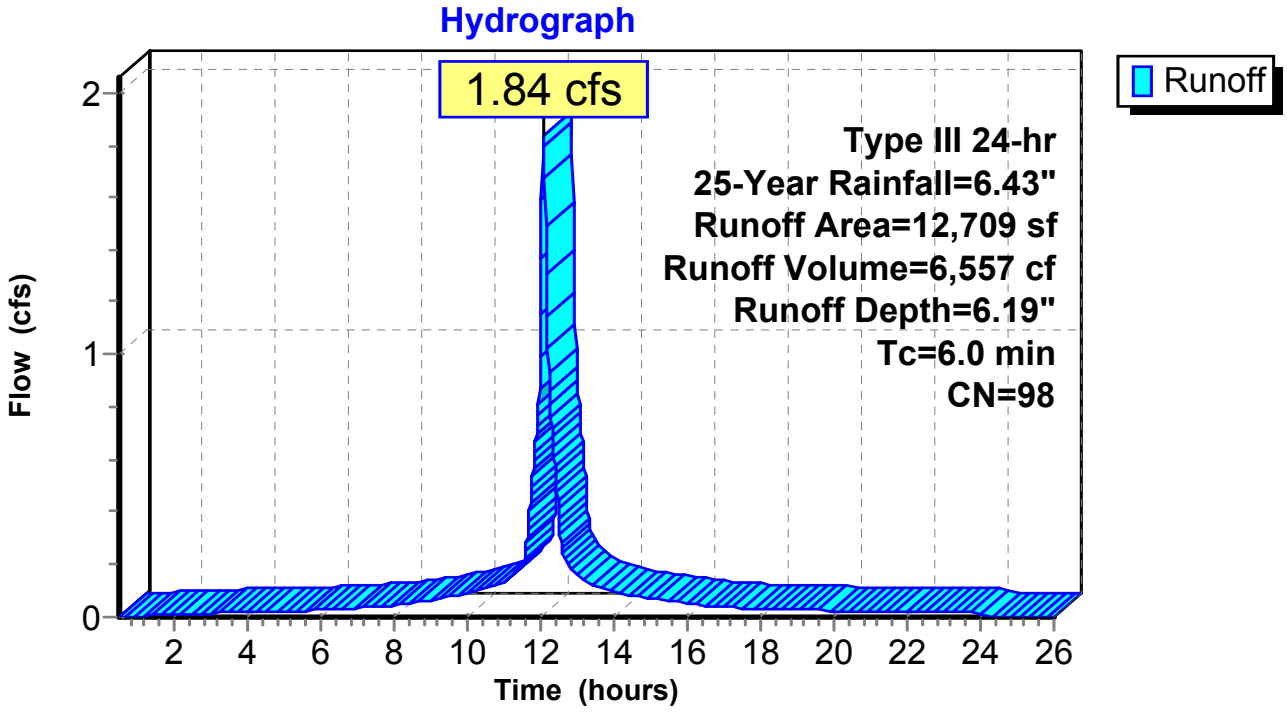
Runoff = 1.84 cfs @ 12.08 hrs, Volume= 6,557 cf, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
12,709	98	Roofs, HSG A
12,709		100.00% Impervious Area

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

Subcatchment POST 6: Subcat POST 6



Summary for Subcatchment POST 7: Subcat POST 7

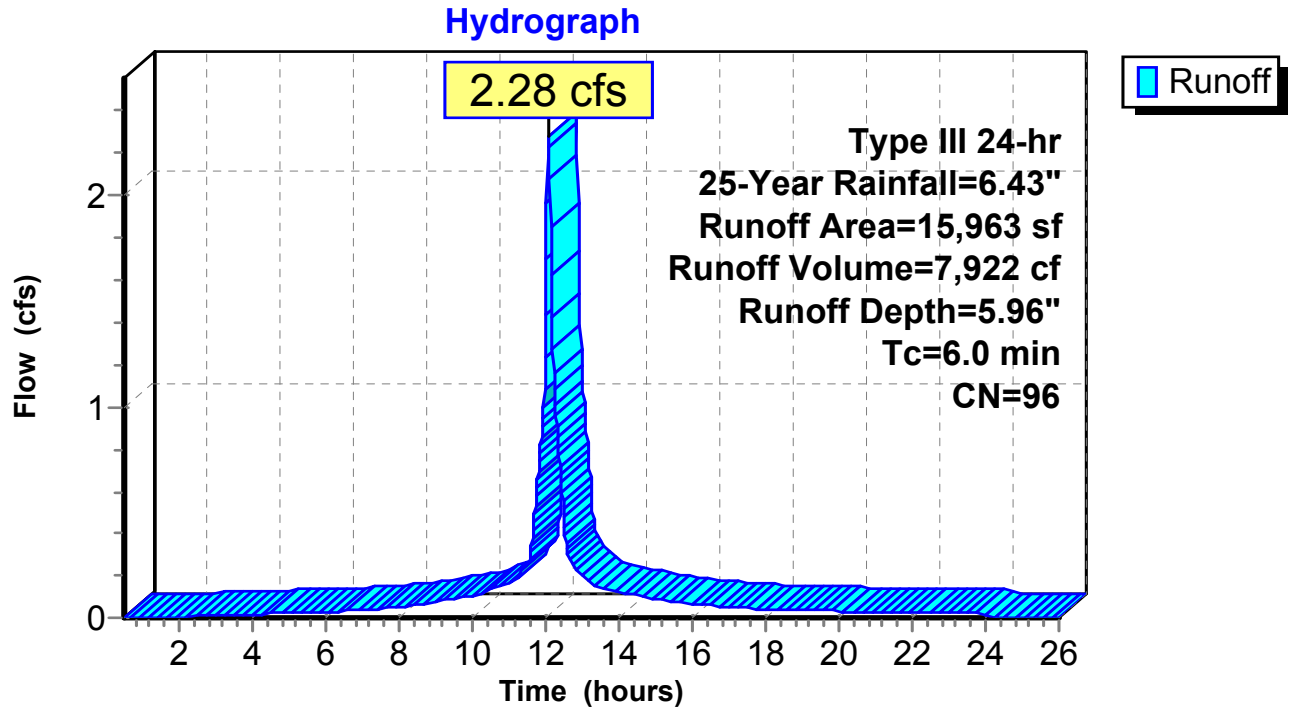
Runoff = 2.28 cfs @ 12.08 hrs, Volume= 7,922 cf, Depth= 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
665	49	50-75% Grass cover, Fair, HSG A
15,298	98	Paved roads w/curbs & sewers, HSG A
15,963	96	Weighted Average
665		4.16% Pervious Area
15,298		95.84% Impervious Area

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

Subcatchment POST 7: Subcat POST 7



Summary for Subcatchment POST 8: Subcat POST 8

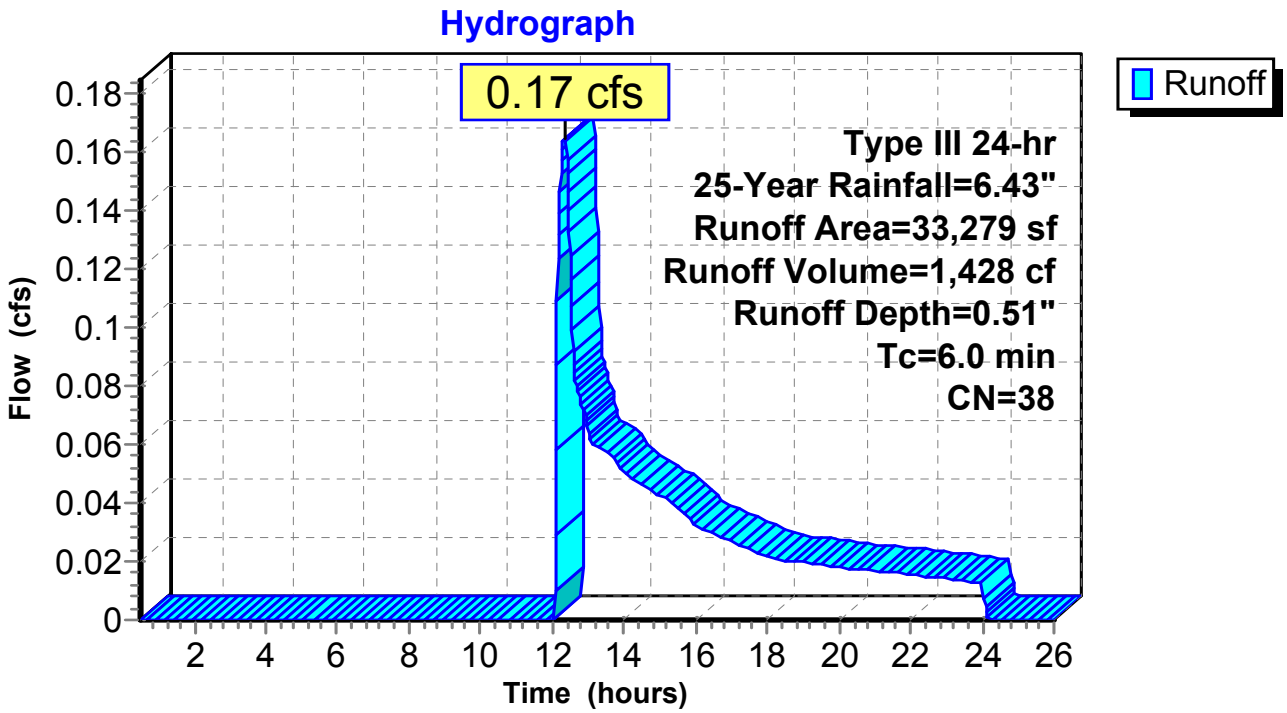
Runoff = 0.17 cfs @ 12.33 hrs, Volume= 1,428 cf, Depth= 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (sf)	CN	Description
4,107	49	50-75% Grass cover, Fair, HSG A
29,172	36	Woods, Fair, HSG A
33,279	38	Weighted Average
33,279		100.00% Pervious Area

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

Subcatchment POST 8: Subcat POST 8



Summary for Pond 1P: UC#2

Inflow Area = 37,104 sf, 91.87% Impervious, Inflow Depth = 5.73" for 25-Year event
Inflow = 5.21 cfs @ 12.08 hrs, Volume= 17,727 cf
Outflow = 0.23 cfs @ 10.16 hrs, Volume= 15,358 cf, Atten= 96%, Lag= 0.0 min
Discarded = 0.23 cfs @ 10.16 hrs, Volume= 15,358 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 245.09' @ 14.66 hrs Surf.Area= 4,148 sf Storage= 8,617 cf

Plug-Flow detention time= 294.4 min calculated for 15,358 cf (87% of inflow)
Center-of-Mass det. time= 234.5 min (999.3 - 764.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	242.00'	3,421 cf	**44.60'W x 93.00'L x 5.00'H Field A** 20,739 cf Overall - 12,187 cf Embedded = 8,552 cf x 40.0% Voids
#2A	242.50'	9,179 cf	**Concrete Galley 4x4x4** x 207 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 207 Chambers in 9 Rows
		12,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	242.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.23 cfs @ 10.16 hrs HW=242.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Pond 1P: UC#2 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)
Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

52.8" Wide + 6.0" Spacing = 58.8" C-C Row Spacing

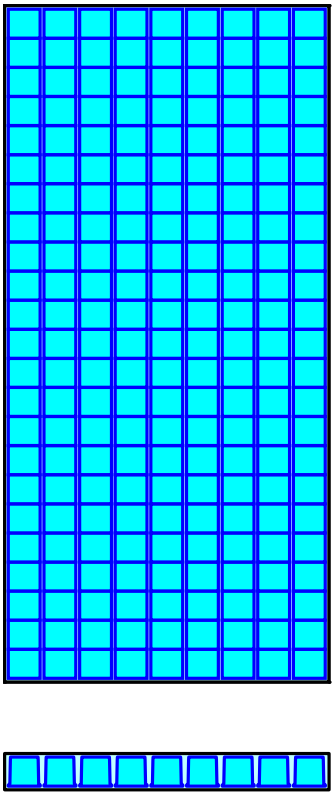
23 Chambers/Row x 4.00' Long = 92.00' Row Length +6.0" End Stone x 2 = 93.00' Base Length
9 Rows x 52.8" Wide + 6.0" Spacing x 8 + 6.0" Side Stone x 2 = 44.60' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

207 Chambers x 44.3 cf = 9,179.3 cf Chamber Storage
207 Chambers x 58.9 cf = 12,187.4 cf Displacement

20,739.0 cf Field - 12,187.4 cf Chambers = 8,551.6 cf Stone x 40.0% Voids = 3,420.6 cf Stone Storage

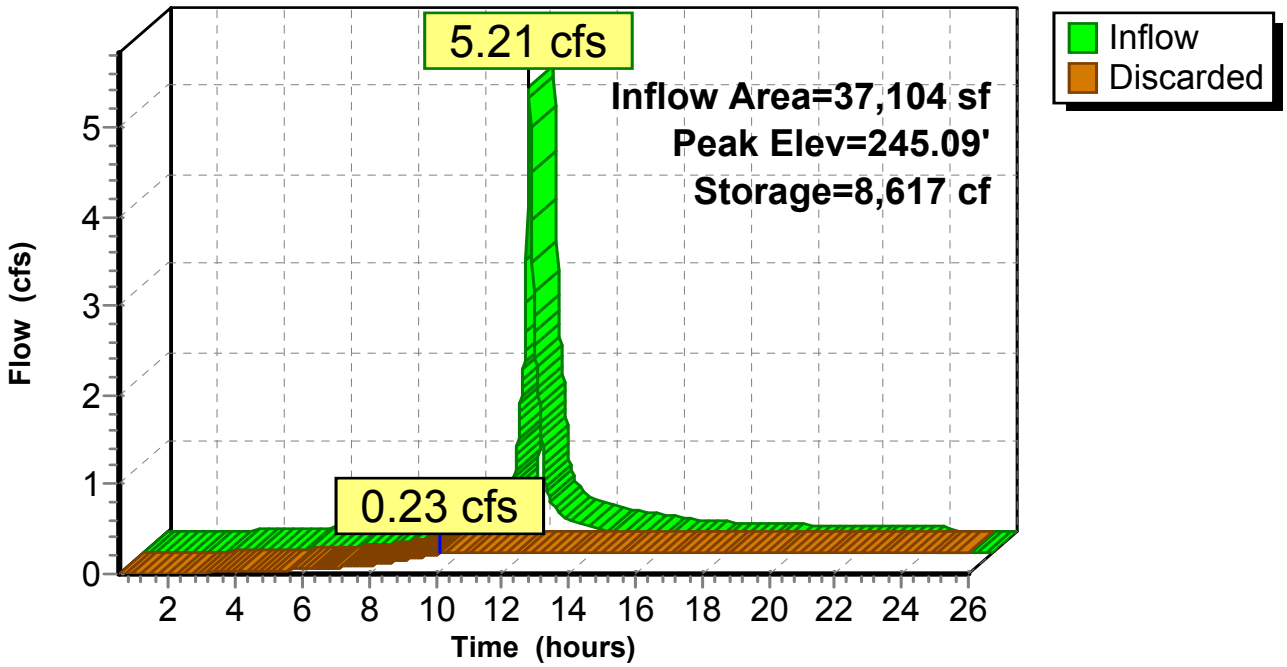
Chamber Storage + Stone Storage = 12,600.0 cf = 0.289 af
Overall Storage Efficiency = 60.8%
Overall System Size = 93.00' x 44.60' x 5.00'

207 Chambers @ $ 300.00 /ea = $ 62,100.00
768.1 cy Field Excavation @ $ 10.00 /cy = $ 7,681.11
316.7 cy Stone @ $ 30.00 /cy = $ 9,501.78
Total Cost = $ 79,282.89



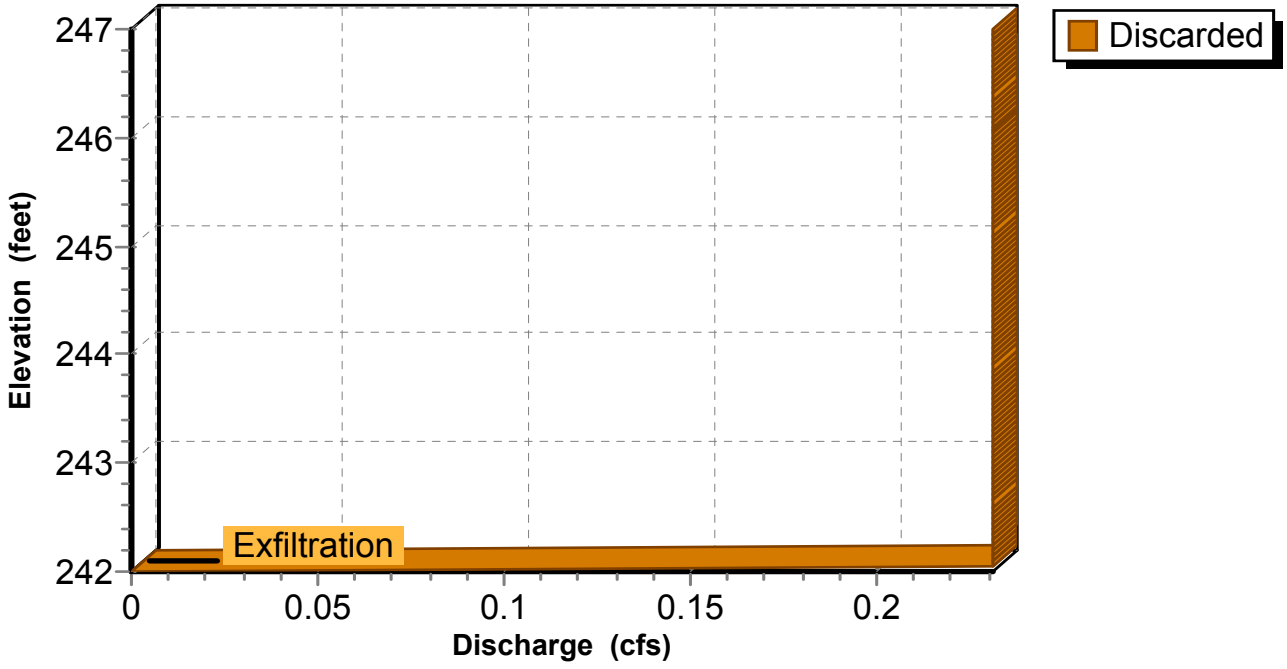
Pond 1P: UC#2

Hydrograph

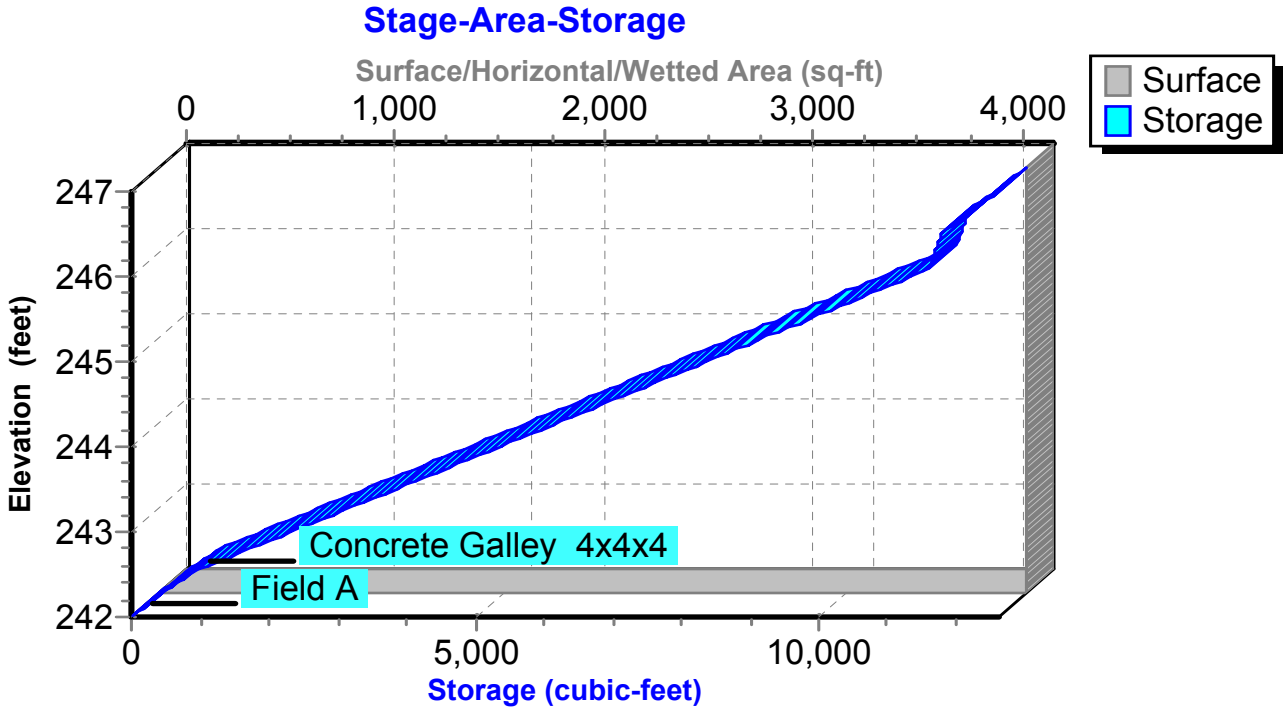


Pond 1P: UC#2

Stage-Discharge



Pond 1P: UC#2


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
1,000
2,000
3,000
4,000
Surface
Storage
247
246
245
244
243
242
Elevation (feet)
Concrete Galley 4x4x4
Field A
0
5,000
10,000
Storage (cubic-feet)

Summary for Pond 6P: UC#3 and #4

Inflow Area = 66,736 sf, 94.81% Impervious, Inflow Depth = 5.88" for 25-Year event
Inflow = 9.47 cfs @ 12.08 hrs, Volume= 32,684 cf
Outflow = 0.42 cfs @ 10.06 hrs, Volume= 28,442 cf, Atten= 96%, Lag= 0.0 min
Discarded = 0.42 cfs @ 10.06 hrs, Volume= 28,442 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 244.67' @ 14.63 hrs Surf.Area= 7,566 sf Storage= 15,701 cf

Plug-Flow detention time= 290.0 min calculated for 28,419 cf (87% of inflow)
Center-of-Mass det. time= 231.1 min (989.7 - 758.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	241.70'	5,335 cf	**36.20'W x 209.00'L x 5.00'H Field A** 37,829 cf Overall - 24,493 cf Embedded = 13,336 cf x 40.0% Voids
#2A	242.20'	18,447 cf	**Concrete Galley 4x4x4** x 416 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 416 Chambers in 8 Rows
		23,782 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	241.70'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.42 cfs @ 10.06 hrs HW=241.75' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.42 cfs)

Pond 6P: UC#3 and #4 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)
Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

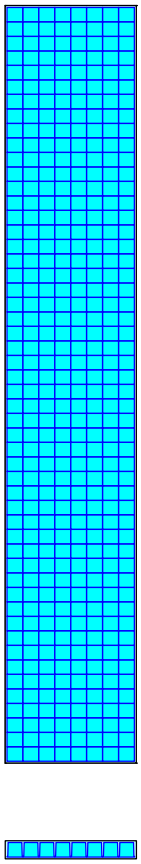
52 Chambers/Row x 4.00' Long = 208.00' Row Length +6.0" End Stone x 2 = 209.00' Base Length
8 Rows x 52.8" Wide + 6.0" Side Stone x 2 = 36.20' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

416 Chambers x 44.3 cf = 18,447.4 cf Chamber Storage
416 Chambers x 58.9 cf = 24,492.6 cf Displacement

37,829.0 cf Field - 24,492.6 cf Chambers = 13,336.4 cf Stone x 40.0% Voids = 5,334.6 cf Stone Storage

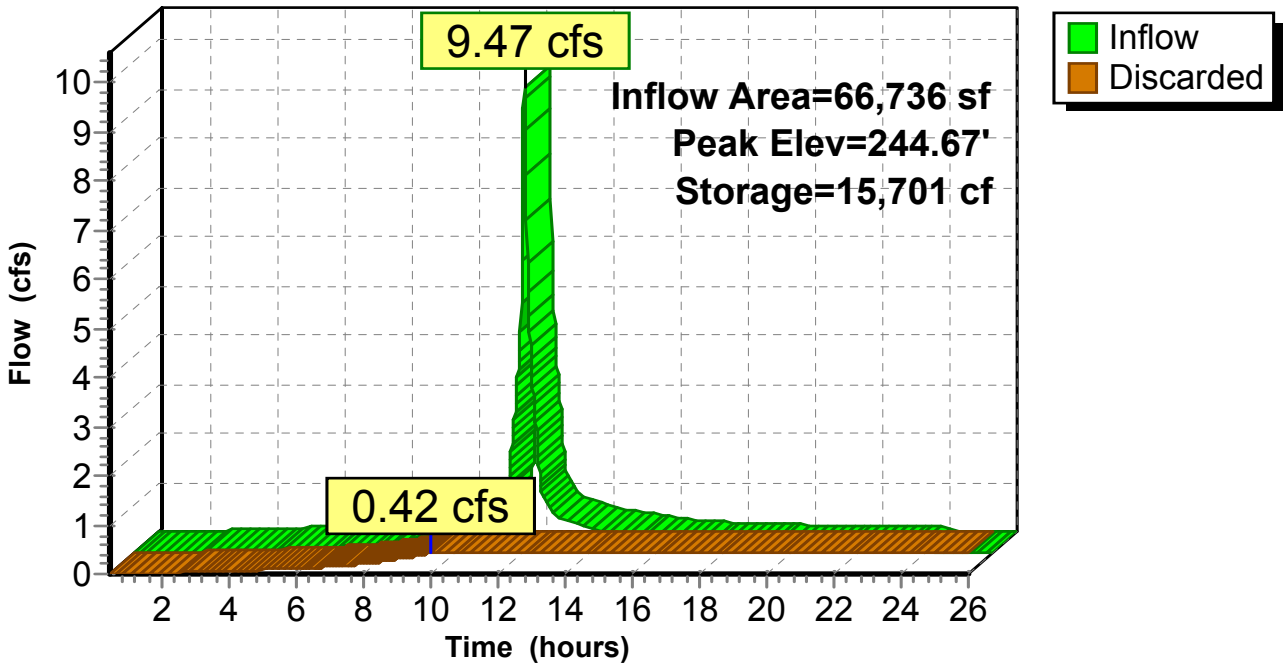
Chamber Storage + Stone Storage = 23,782.0 cf = 0.546 af
Overall Storage Efficiency = 62.9%
Overall System Size = 209.00' x 36.20' x 5.00'

416 Chambers @ $ 300.00 /ea = $ 124,800.00
1,401.1 cy Field Excavation @ $ 10.00 /cy = $ 14,010.74
493.9 cy Stone @ $ 30.00 /cy = $ 14,818.27
Total Cost = $ 153,629.01



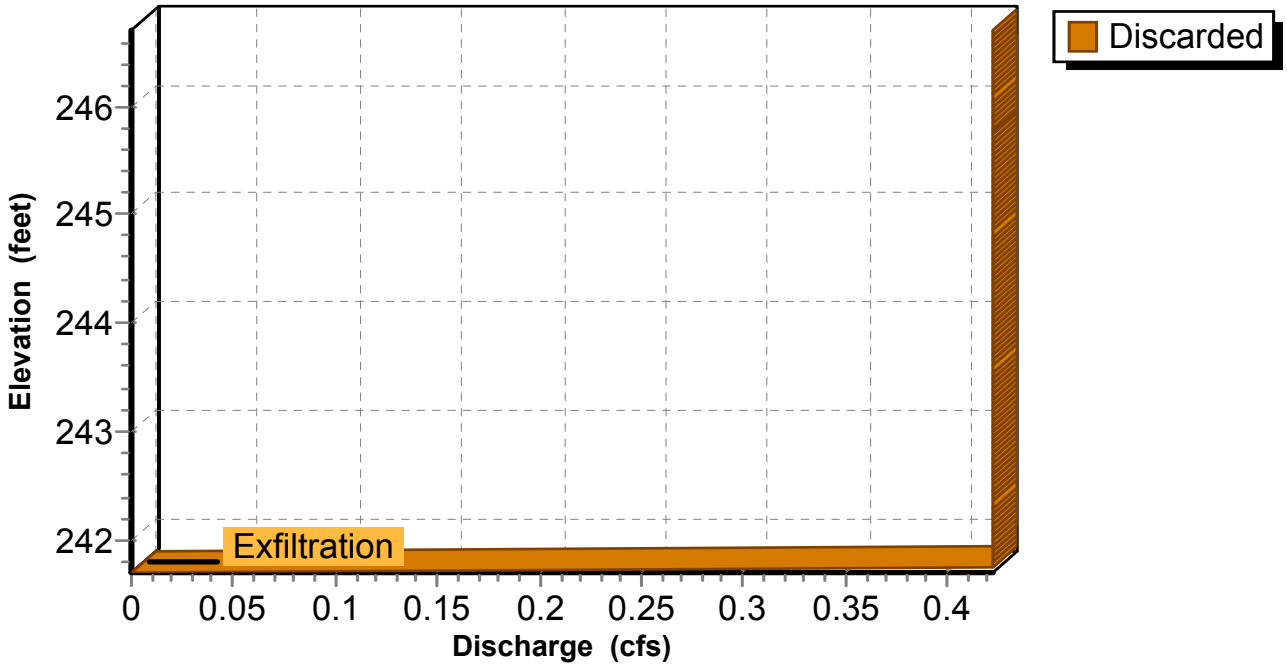
Pond 6P: UC#3 and #4

Hydrograph

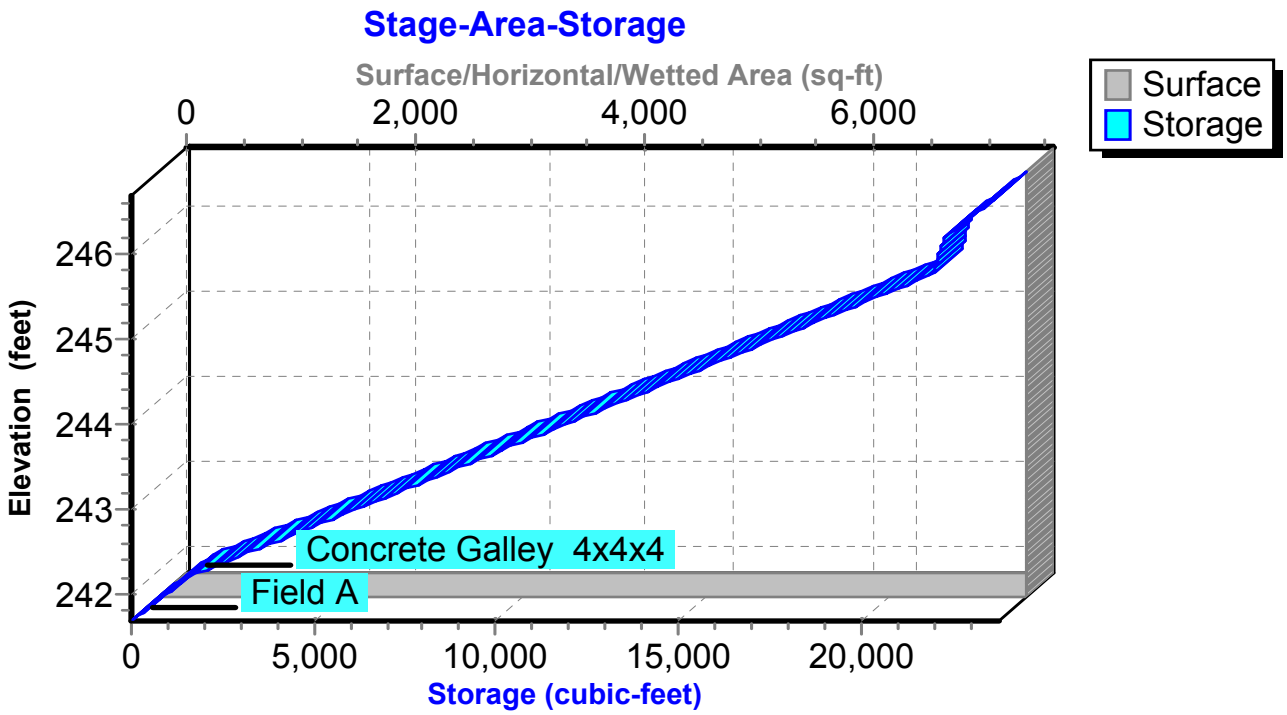


Pond 6P: UC#3 and #4

Stage-Discharge



Pond 6P: UC#3 and #4



Summary for Pond 8P: UC#1

Inflow Area = 2,656 sf, 33.98% Impervious, Inflow Depth = 2.76" for 25-Year event
Inflow = 0.19 cfs @ 12.09 hrs, Volume= 612 cf
Outflow = 0.02 cfs @ 11.70 hrs, Volume= 612 cf, Atten= 90%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.70 hrs, Volume= 612 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 240.34' @ 13.10 hrs Surf.Area= 350 sf Storage= 225 cf

Plug-Flow detention time= 101.6 min calculated for 611 cf (100% of inflow)
Center-of-Mass det. time= 101.5 min (945.6 - 844.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	239.25'	177 cf	**14.00'W x 25.00'L x 2.50'H Field A** 875 cf Overall - 432 cf Embedded = 443 cf x 40.0% Voids
#2A	239.75'	290 cf	**Concrete Galley 4x8x1.5** x 9 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 9 Chambers in 3 Rows
		467 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	239.25'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 11.70 hrs HW=239.28' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 8P: UC#1 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x8x1.5 (Concrete Galley, UCPI 18" Low Profile Galley or equivalent)
Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf
Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf

48.0" Wide + 6.0" Spacing = 54.0" C-C Row Spacing

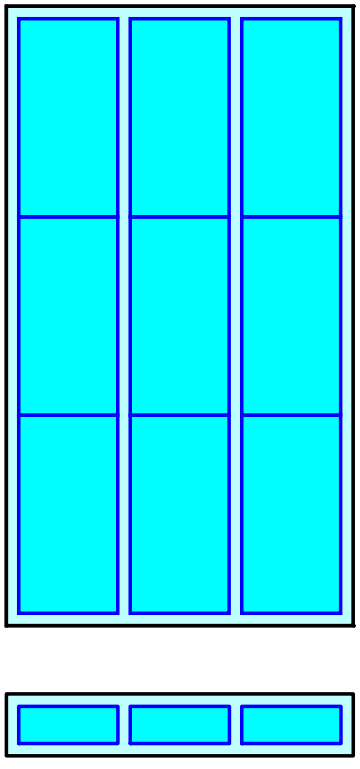
3 Chambers/Row x 8.00' Long = 24.00' Row Length +6.0" End Stone x 2 = 25.00' Base Length
3 Rows x 48.0" Wide + 6.0" Spacing x 2 + 6.0" Side Stone x 2 = 14.00' Base Width
6.0" Base + 18.0" Chamber Height + 6.0" Cover = 2.50' Field Height

9 Chambers x 32.2 cf = 289.6 cf Chamber Storage
9 Chambers x 48.0 cf = 432.0 cf Displacement

875.0 cf Field - 432.0 cf Chambers = 443.0 cf Stone x 40.0% Voids = 177.2 cf Stone Storage

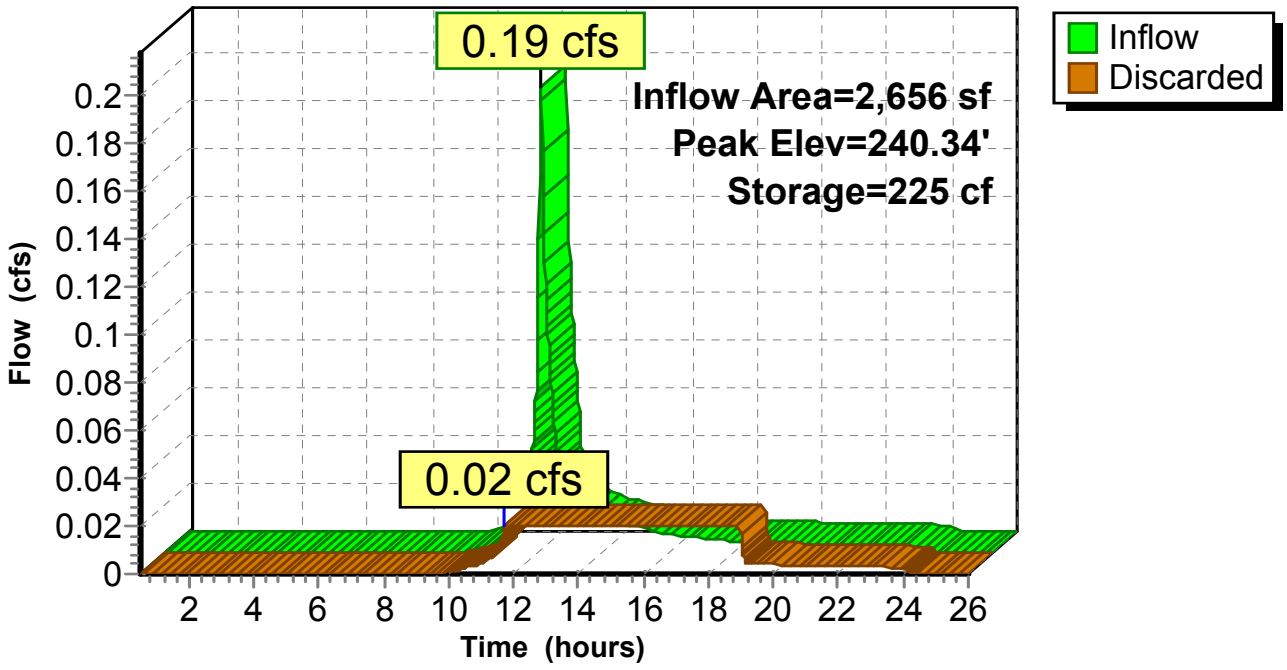
Chamber Storage + Stone Storage = 466.8 cf = 0.011 af
Overall Storage Efficiency = 53.3%
Overall System Size = 25.00' x 14.00' x 2.50'

9 Chambers @ $ 0.00 /ea = $ 0.00
32.4 cy Field Excavation @ $ 10.00 /cy = $ 324.07
16.4 cy Stone @ $ 30.00 /cy = $ 492.22
Total Cost = $ 816.30



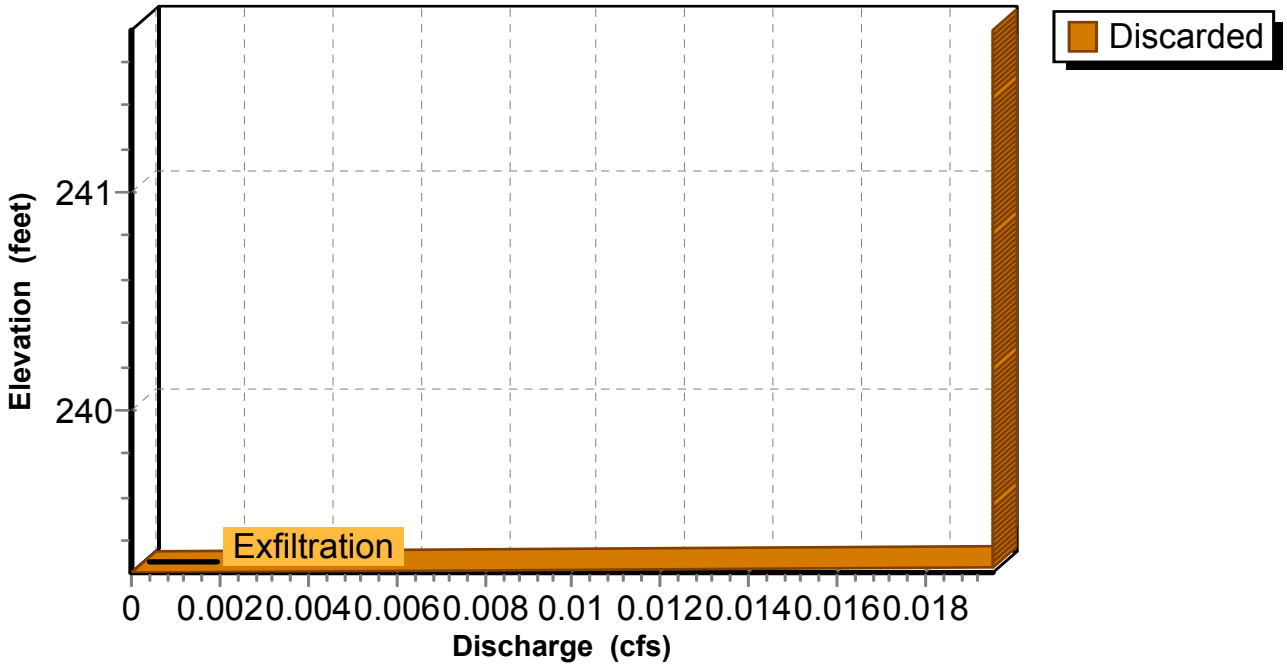
Pond 8P: UC#1

Hydrograph

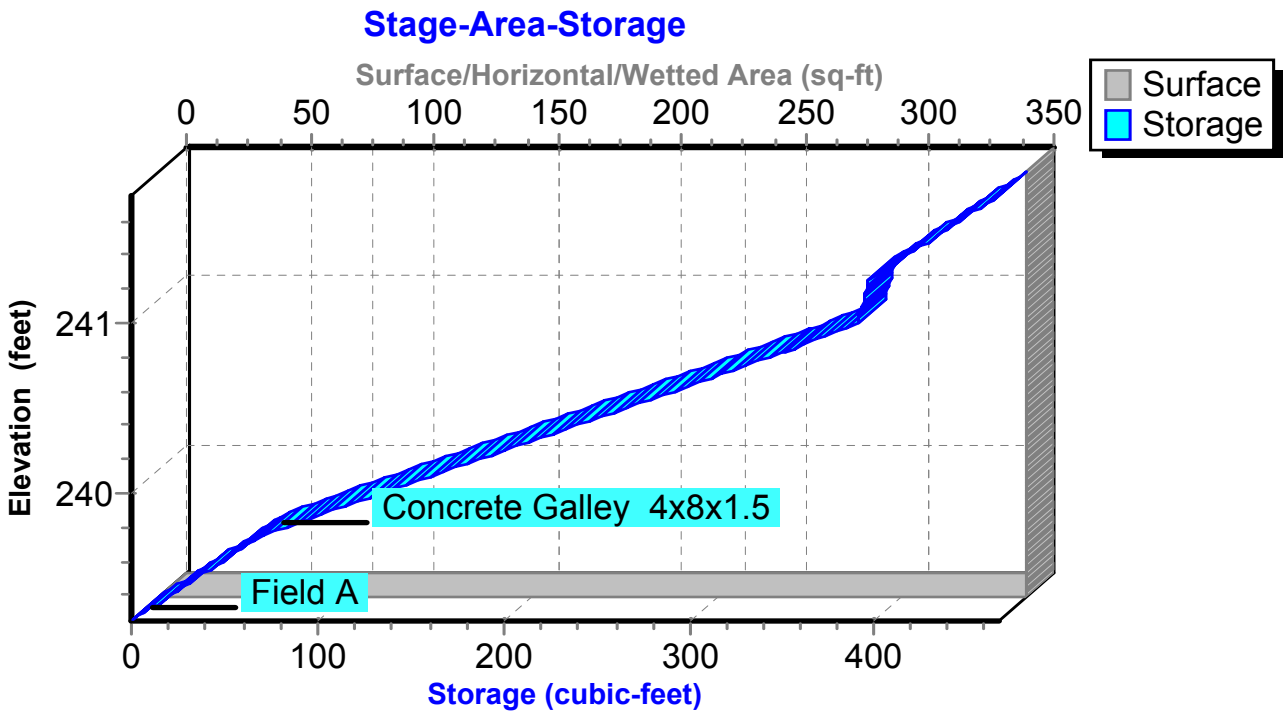


Pond 8P: UC#1

Stage-Discharge



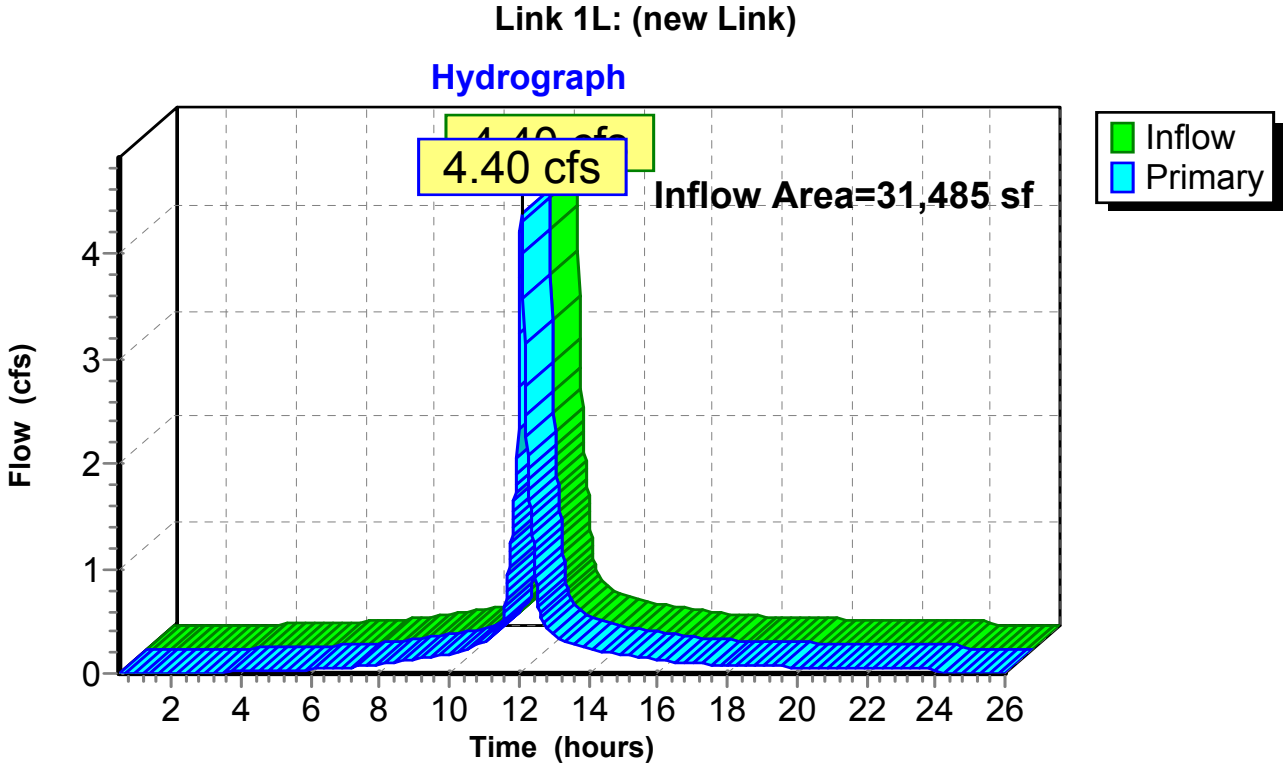
Pond 8P: UC#1


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
50
100
150
200
250
300
350
Surface
Storage
Elevation (feet)
241
240
Concrete Galley 4x8x1.5
Field A
0
100
200
300
400
Storage (cubic-feet)

Summary for Link 1L: (new Link)

Inflow Area = 31,485 sf, 90.42% Impervious, Inflow Depth = 5.65" for 25-Year event
Inflow = 4.40 cfs @ 12.08 hrs, Volume= 14,828 cf
Primary = 4.40 cfs @ 12.08 hrs, Volume= 14,828 cf, Atten= 0%, Lag= 0.0 min

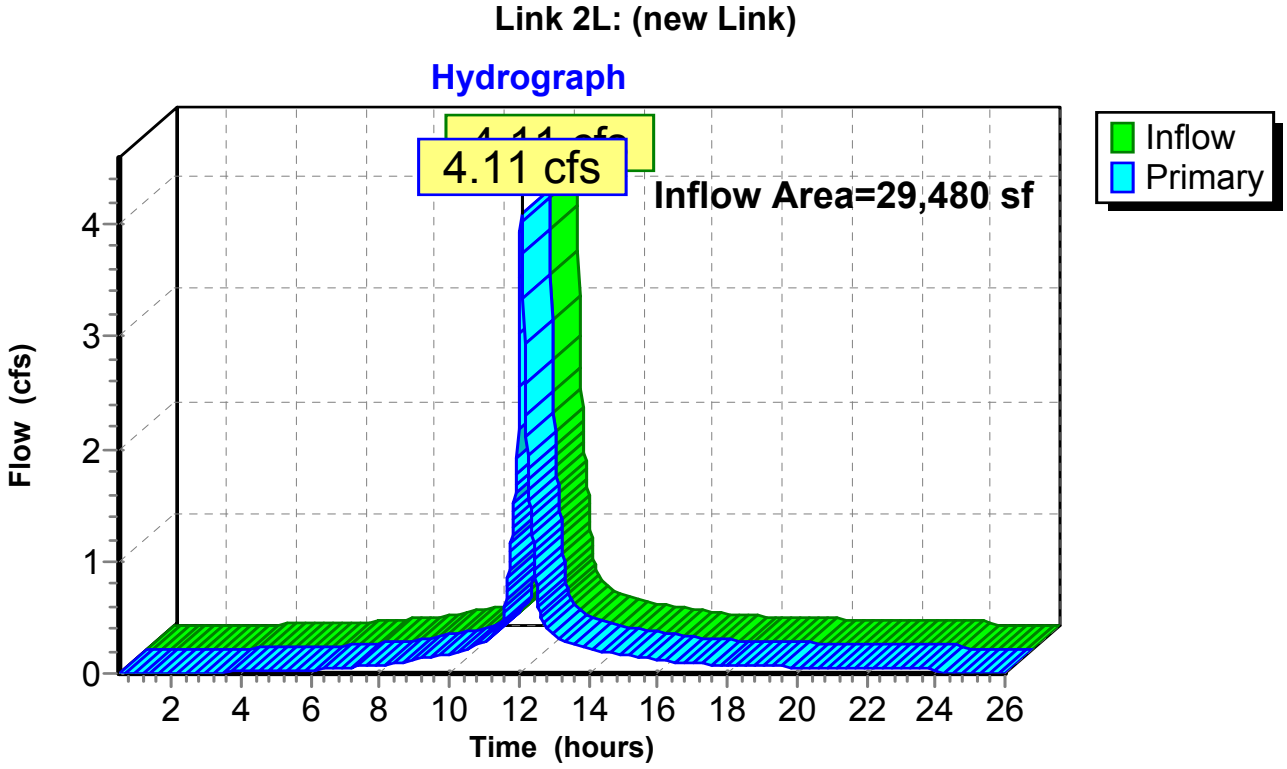
Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs



Summary for Link 2L: (new Link)

Inflow Area = 29,480 sf, 90.51% Impervious, Inflow Depth = 5.61" for 25-Year event
Inflow = 4.11 cfs @ 12.08 hrs, Volume= 13,775 cf
Primary = 4.11 cfs @ 12.08 hrs, Volume= 13,775 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs

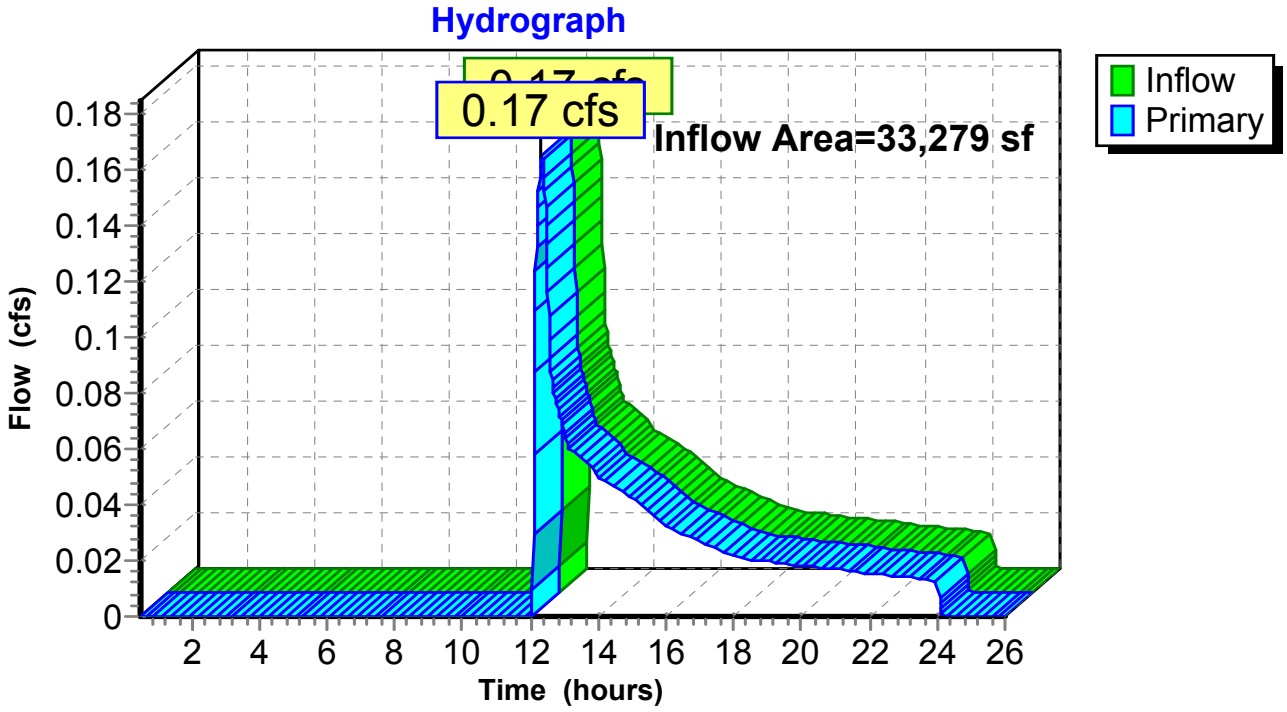


Summary for Link 11L: (new Link)

Inflow Area = 33,279 sf, 0.00% Impervious, Inflow Depth = 0.51" for 25-Year event
Inflow = 0.17 cfs @ 12.33 hrs, Volume= 1,428 cf
Primary = 0.17 cfs @ 12.33 hrs, Volume= 1,428 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs

Link 11L: (new Link)



Time span=0.50-26.00 hrs, dt=0.02 hrs, 1276 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment POST 1: Subcat POST 1 Runoff Area=2,656 sf 33.98% Impervious Runoff Depth=4.20"
Tc=6.0 min CN=66 Runoff=0.30 cfs 929 cf

Subcatchment POST 2: Subcat POST 2 Runoff Area=5,620 sf 100.00% Impervious Runoff Depth=7.99"
Tc=6.0 min CN=98 Runoff=1.04 cfs 3,742 cf

Subcatchment POST 3A: Subcat POST 3A Runoff Area=29,107 sf 89.64% Impervious Runoff Depth=7.39"
Tc=6.0 min CN=93 Runoff=5.26 cfs 17,927 cf

Subcatchment POST 3B: Subcat POST 3B Runoff Area=2,378 sf 100.00% Impervious Runoff Depth=7.99"
Tc=6.0 min CN=98 Runoff=0.44 cfs 1,583 cf

Subcatchment POST 4: Subcat POST 4 Runoff Area=8,584 sf 100.00% Impervious Runoff Depth=7.99"
Tc=6.0 min CN=98 Runoff=1.59 cfs 5,716 cf

Subcatchment POST 5: Subcat POST 5 Runoff Area=29,480 sf 90.51% Impervious Runoff Depth=7.39"
Tc=6.0 min CN=93 Runoff=5.33 cfs 18,157 cf

Subcatchment POST 6: Subcat POST 6 Runoff Area=12,709 sf 100.00% Impervious Runoff Depth=7.99"
Tc=6.0 min CN=98 Runoff=2.35 cfs 8,462 cf

Subcatchment POST 7: Subcat POST 7 Runoff Area=15,963 sf 95.84% Impervious Runoff Depth=7.75"
Tc=6.0 min CN=96 Runoff=2.94 cfs 10,310 cf

Subcatchment POST 8: Subcat POST 8 Runoff Area=33,279 sf 0.00% Impervious Runoff Depth=1.16"
Tc=6.0 min CN=38 Runoff=0.66 cfs 3,215 cf

Pond 1P: UC#2 Peak Elev=246.96' Storage=12,536 cf Inflow=6.75 cfs 23,252 cf
Outflow=0.23 cfs 16,149 cf

Pond 6P: UC#3 and #4 Peak Elev=246.36' Storage=22,740 cf Inflow=12.21 cfs 42,645 cf
Outflow=0.42 cfs 29,886 cf

Pond 8P: UC#1 Peak Elev=241.37' Storage=413 cf Inflow=0.30 cfs 929 cf
Outflow=0.02 cfs 929 cf

Link 1L: (new Link) Inflow=5.70 cfs 19,510 cf
Primary=5.70 cfs 19,510 cf

Link 2L: (new Link) Inflow=5.33 cfs 18,157 cf
Primary=5.33 cfs 18,157 cf

Link 11L: (new Link) Inflow=0.66 cfs 3,215 cf
Primary=0.66 cfs 3,215 cf

Total Runoff Area = 139,776 sf Runoff Volume = 70,040 cf Average Runoff Depth = 6.01"
29.70% Pervious = 41,509 sf 70.30% Impervious = 98,267 sf

Summary for Subcatchment POST 1: Subcat POST 1

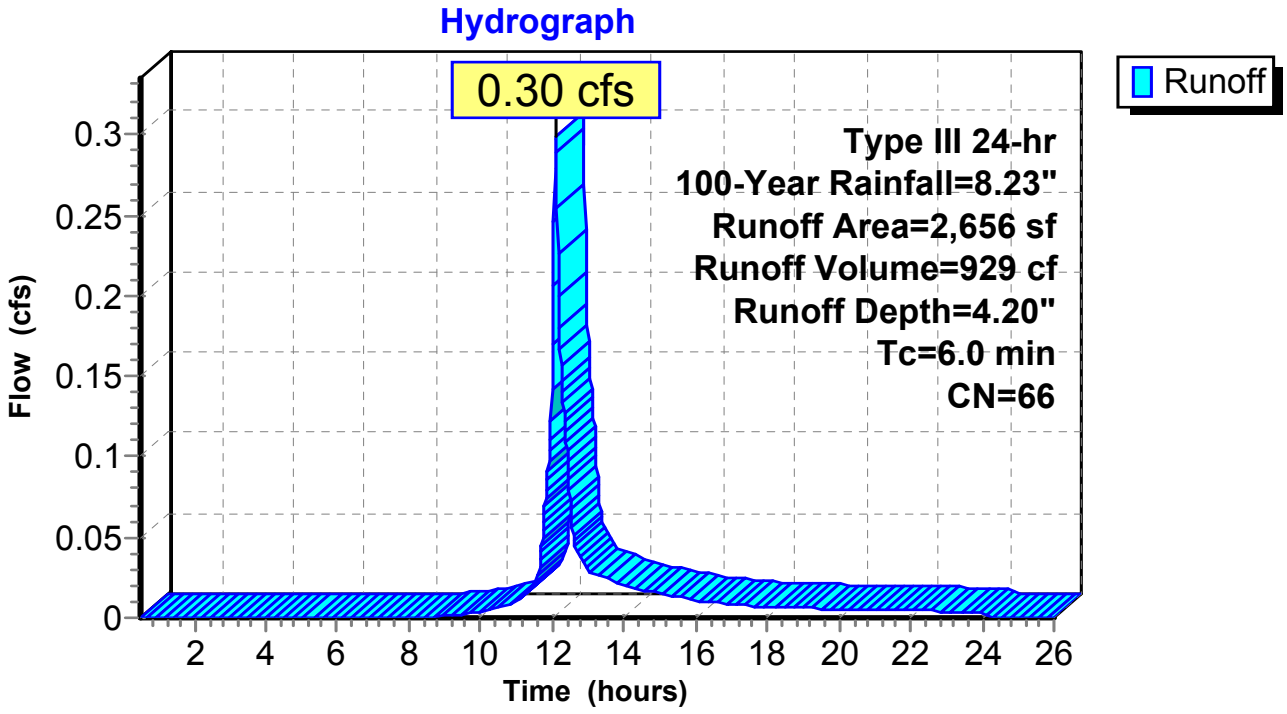
Runoff = 0.30 cfs @ 12.09 hrs, Volume= 929 cf, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
1,754	49	50-75% Grass cover, Fair, HSG A
903	98	Paved roads w/curbs & sewers, HSG A
2,656	66	Weighted Average
1,754		66.02% Pervious Area
903		33.98% Impervious Area

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

Subcatchment POST 1: Subcat POST 1



Summary for Subcatchment POST 2: Subcat POST 2

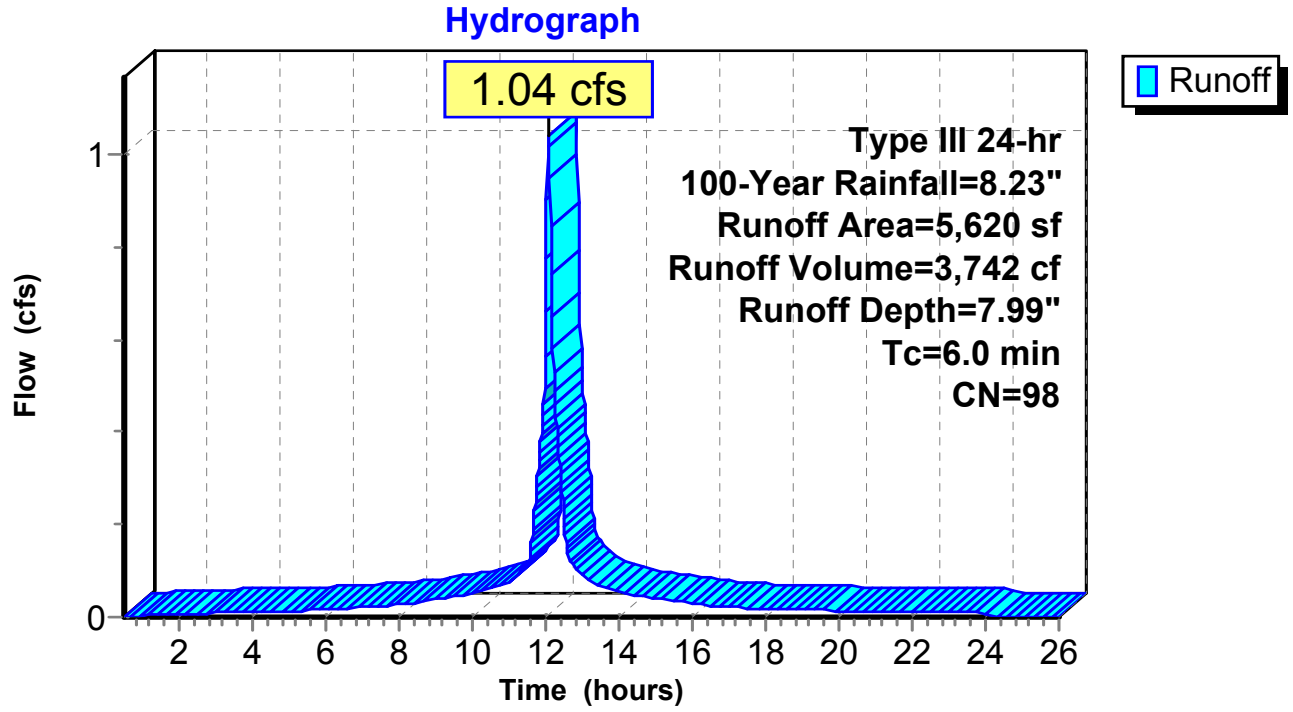
Runoff = 1.04 cfs @ 12.08 hrs, Volume= 3,742 cf, Depth= 7.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
5,620	98	Roofs, HSG A
5,620		100.00% Impervious Area

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

Subcatchment POST 2: Subcat POST 2



Summary for Subcatchment POST 3A: Subcat POST 3A

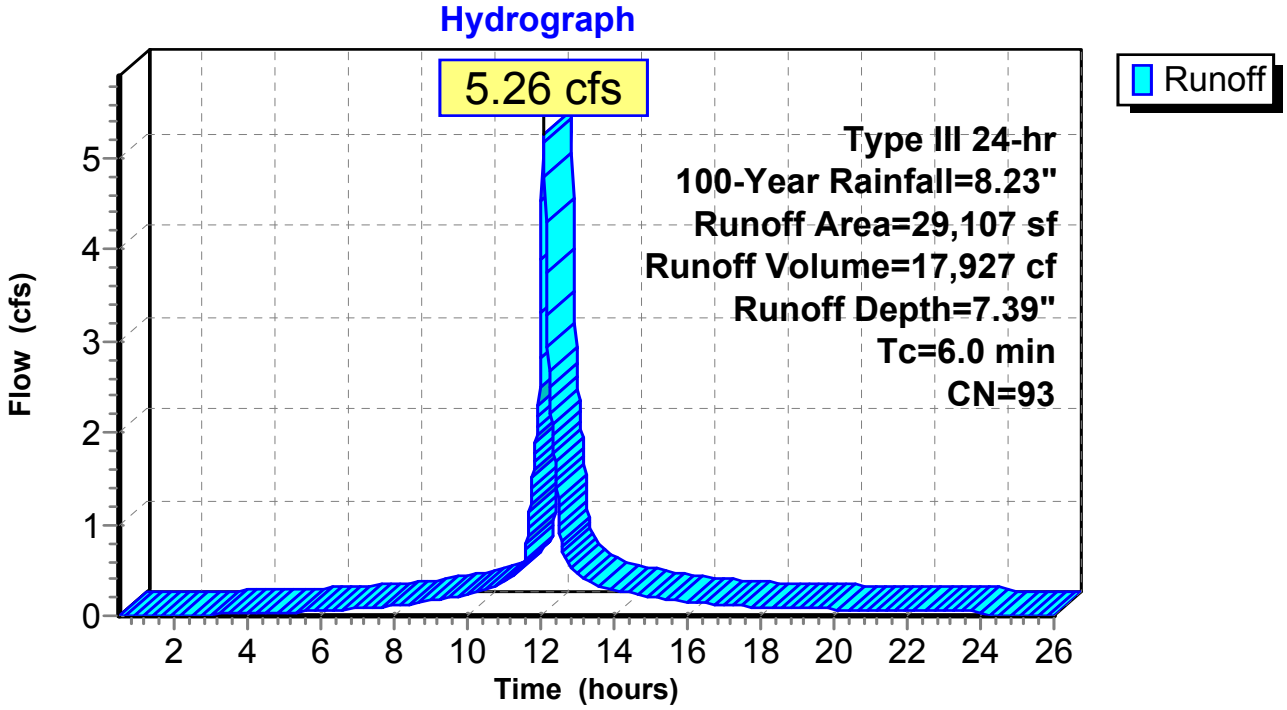
Runoff = 5.26 cfs @ 12.08 hrs, Volume= 17,927 cf, Depth= 7.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
3,016	49	50-75% Grass cover, Fair, HSG A
26,091	98	Paved roads w/curbs & sewers, HSG A
0	36	Woods, Fair, HSG A
29,107	93	Weighted Average
3,016		10.36% Pervious Area
26,091		89.64% Impervious Area

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

Subcatchment POST 3A: Subcat POST 3A



Summary for Subcatchment POST 3B: Subcat POST 3B

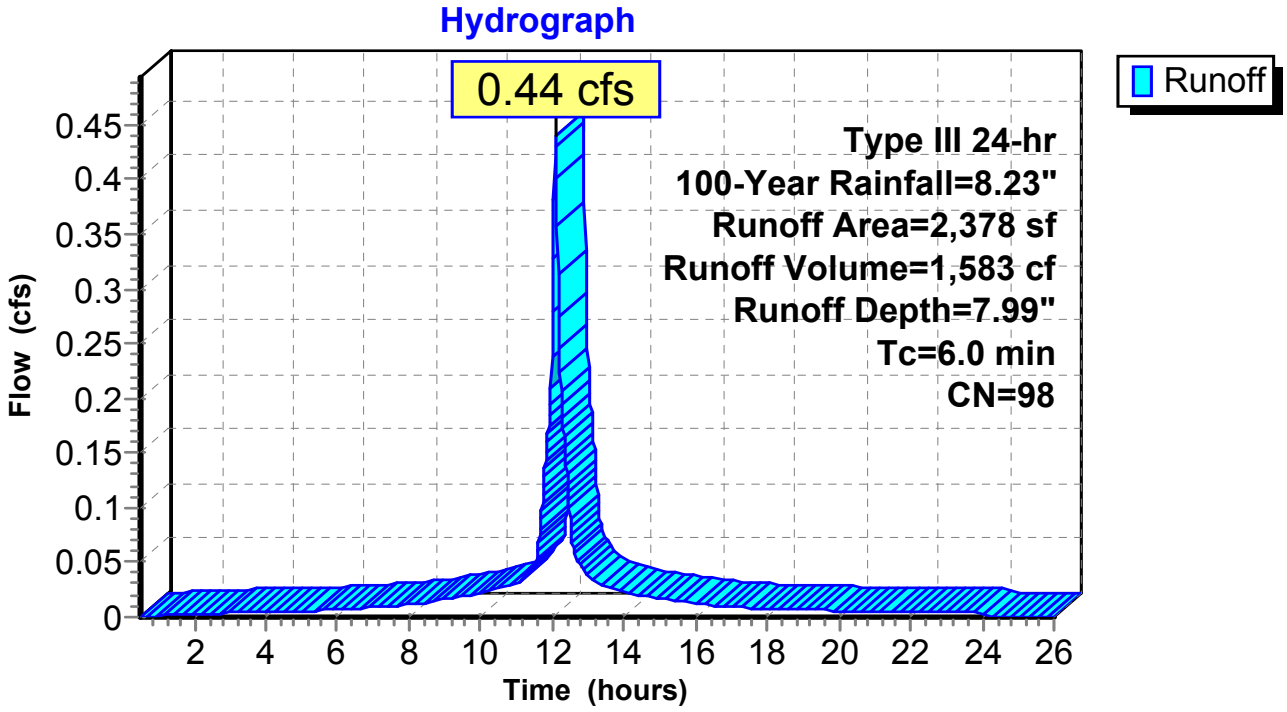
Runoff = 0.44 cfs @ 12.08 hrs, Volume= 1,583 cf, Depth= 7.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
2,378	98	Paved roads w/curbs & sewers, HSG A
2,378		100.00% Impervious Area

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

Subcatchment POST 3B: Subcat POST 3B



Summary for Subcatchment POST 4: Subcat POST 4

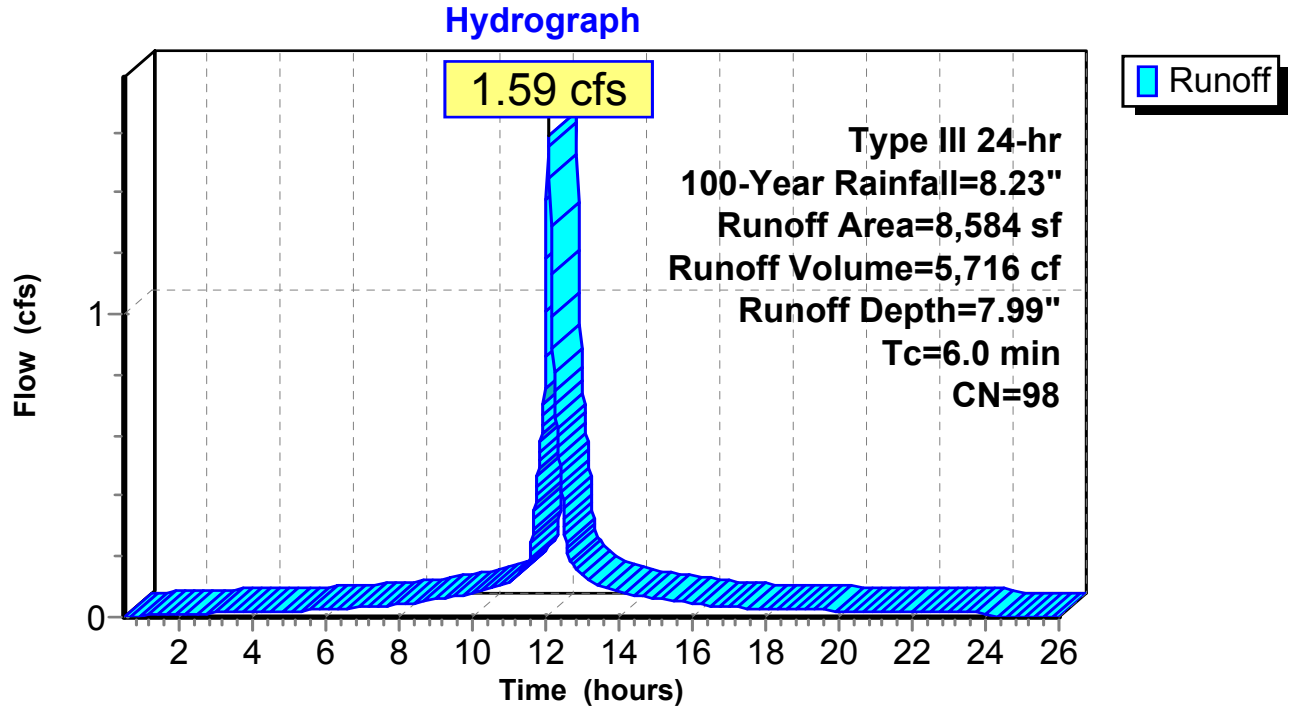
Runoff = 1.59 cfs @ 12.08 hrs, Volume= 5,716 cf, Depth= 7.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
8,584	98	Roofs, HSG A
8,584		100.00% Impervious Area

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

Subcatchment POST 4: Subcat POST 4



Summary for Subcatchment POST 5: Subcat POST 5

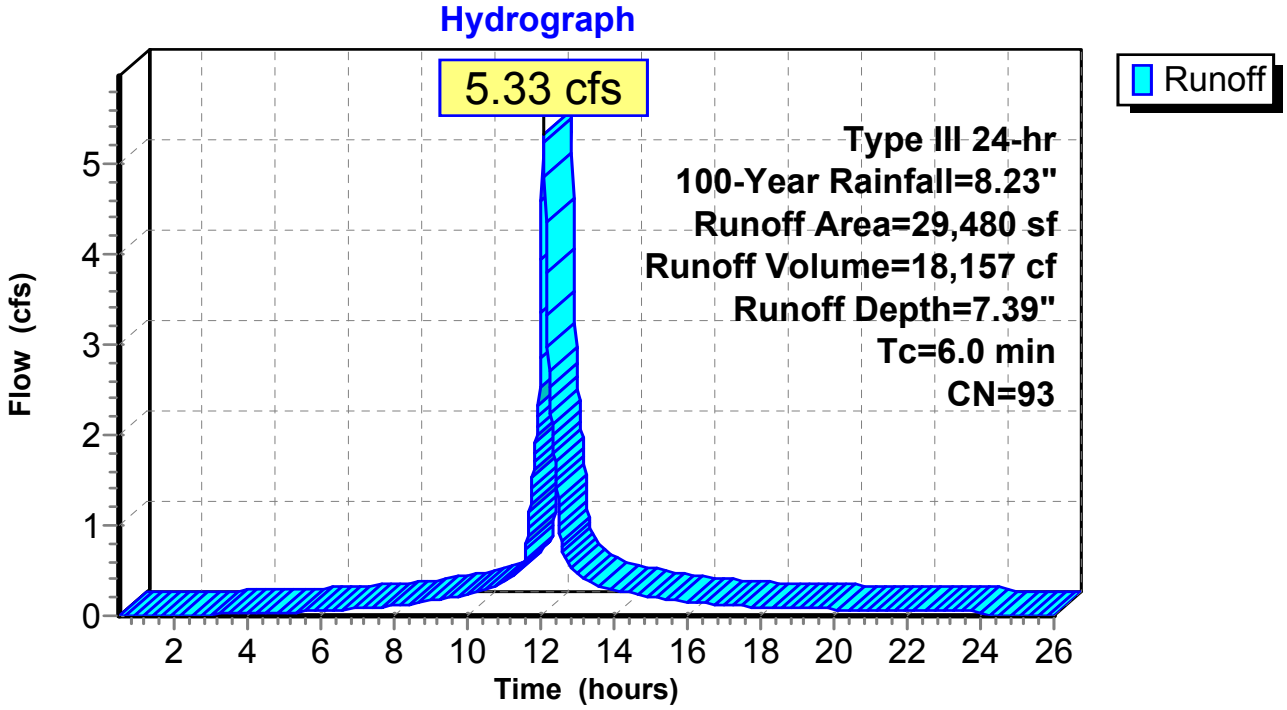
Runoff = 5.33 cfs @ 12.08 hrs, Volume= 18,157 cf, Depth= 7.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
2,796	49	50-75% Grass cover, Fair, HSG A
26,684	98	Paved roads w/curbs & sewers, HSG A
0	36	Woods, Fair, HSG A
29,480	93	Weighted Average
2,796		9.49% Pervious Area
26,684		90.51% Impervious Area

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

Subcatchment POST 5: Subcat POST 5



Summary for Subcatchment POST 6: Subcat POST 6

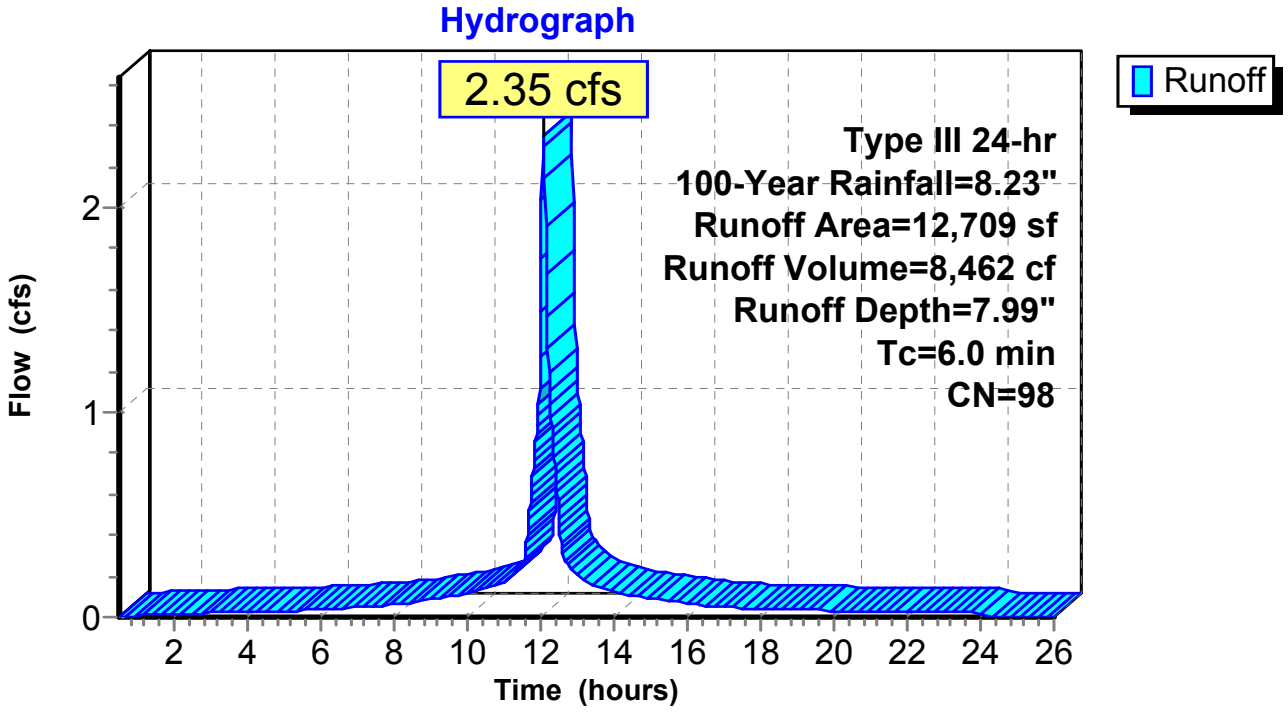
Runoff = 2.35 cfs @ 12.08 hrs, Volume= 8,462 cf, Depth= 7.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
12,709	98	Roofs, HSG A
12,709		100.00% Impervious Area

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

Subcatchment POST 6: Subcat POST 6



Summary for Subcatchment POST 7: Subcat POST 7

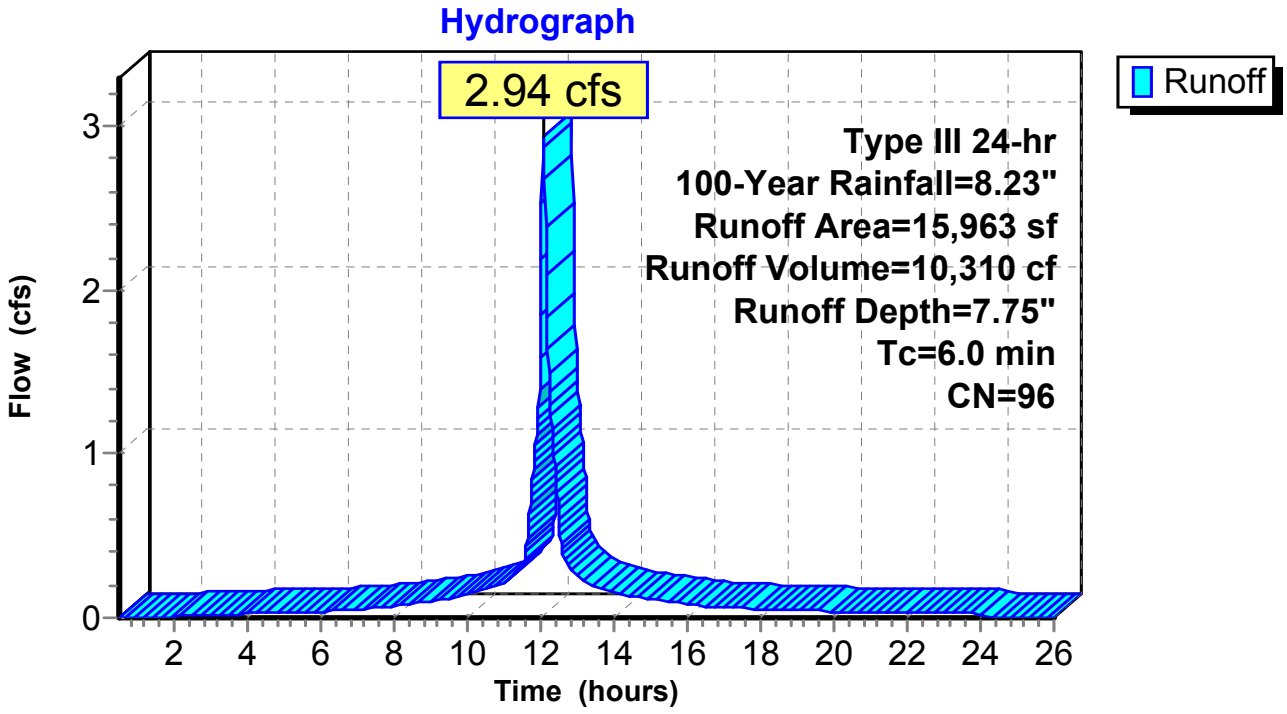
Runoff = 2.94 cfs @ 12.08 hrs, Volume= 10,310 cf, Depth= 7.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
665	49	50-75% Grass cover, Fair, HSG A
15,298	98	Paved roads w/curbs & sewers, HSG A
15,963	96	Weighted Average
665		4.16% Pervious Area
15,298		95.84% Impervious Area

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

Subcatchment POST 7: Subcat POST 7



Summary for Subcatchment POST 8: Subcat POST 8

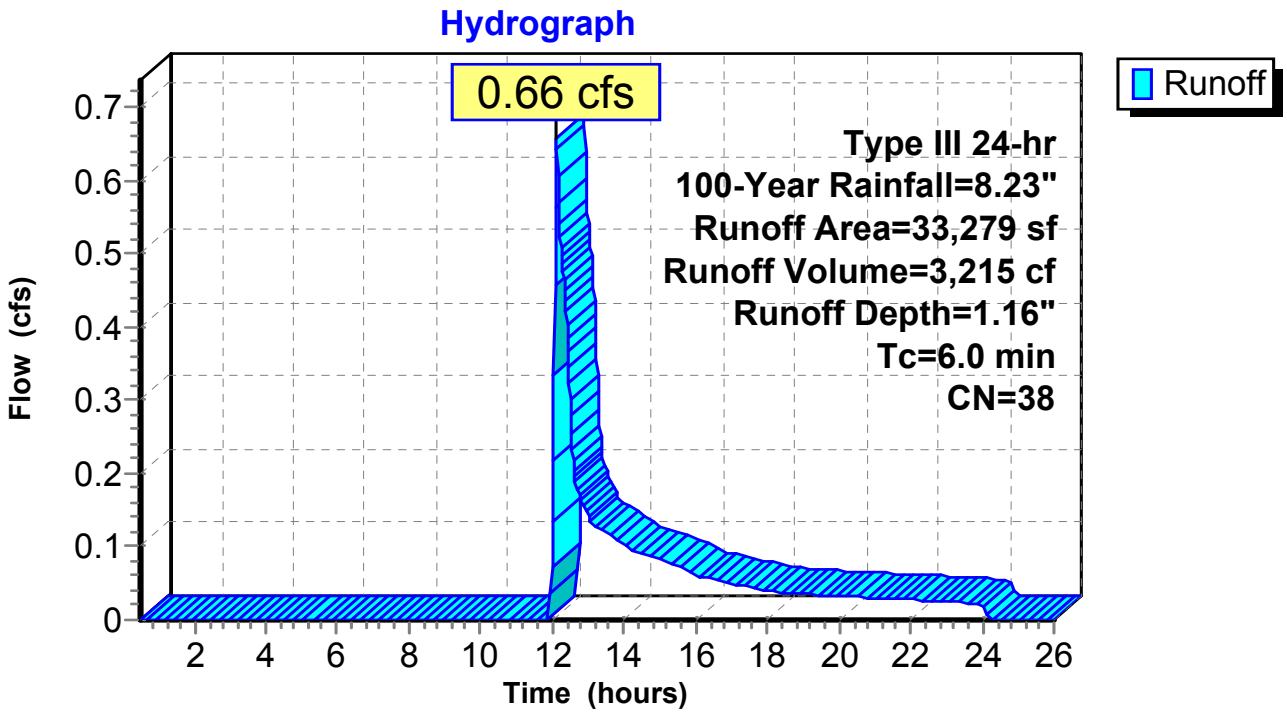
Runoff = 0.66 cfs @ 12.12 hrs, Volume= 3,215 cf, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=8.23"

Area (sf)	CN	Description
4,107	49	50-75% Grass cover, Fair, HSG A
29,172	36	Woods, Fair, HSG A
33,279	38	Weighted Average
33,279		100.00% Pervious Area

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

Subcatchment POST 8: Subcat POST 8



Summary for Pond 1P: UC#2

Inflow Area = 37,104 sf, 91.87% Impervious, Inflow Depth = 7.52" for 100-Year event
Inflow = 6.75 cfs @ 12.08 hrs, Volume= 23,252 cf
Outflow = 0.23 cfs @ 9.24 hrs, Volume= 16,149 cf, Atten= 97%, Lag= 0.0 min
Discarded = 0.23 cfs @ 9.24 hrs, Volume= 16,149 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 246.96' @ 15.49 hrs Surf.Area= 4,148 sf Storage= 12,536 cf

Plug-Flow detention time= 305.9 min calculated for 16,136 cf (69% of inflow)
Center-of-Mass det. time= 211.7 min (970.9 - 759.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	242.00'	3,421 cf	**44.60'W x 93.00'L x 5.00'H Field A** 20,739 cf Overall - 12,187 cf Embedded = 8,552 cf x 40.0% Voids
#2A	242.50'	9,179 cf	**Concrete Galley 4x4x4** x 207 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 207 Chambers in 9 Rows
		12,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	242.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.23 cfs @ 9.24 hrs HW=242.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Pond 1P: UC#2 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)
Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

52.8" Wide + 6.0" Spacing = 58.8" C-C Row Spacing

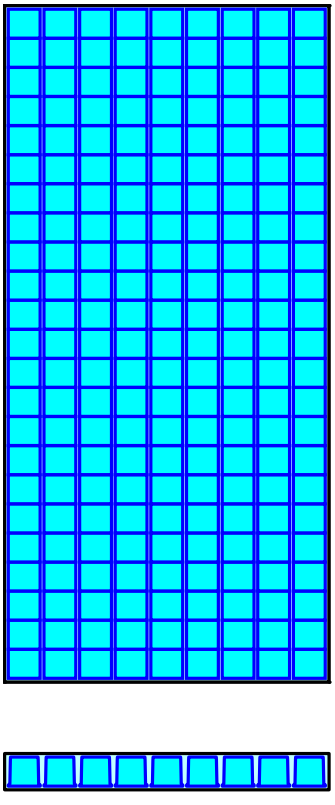
23 Chambers/Row x 4.00' Long = 92.00' Row Length +6.0" End Stone x 2 = 93.00' Base Length
9 Rows x 52.8" Wide + 6.0" Spacing x 8 + 6.0" Side Stone x 2 = 44.60' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

207 Chambers x 44.3 cf = 9,179.3 cf Chamber Storage
207 Chambers x 58.9 cf = 12,187.4 cf Displacement

20,739.0 cf Field - 12,187.4 cf Chambers = 8,551.6 cf Stone x 40.0% Voids = 3,420.6 cf Stone Storage

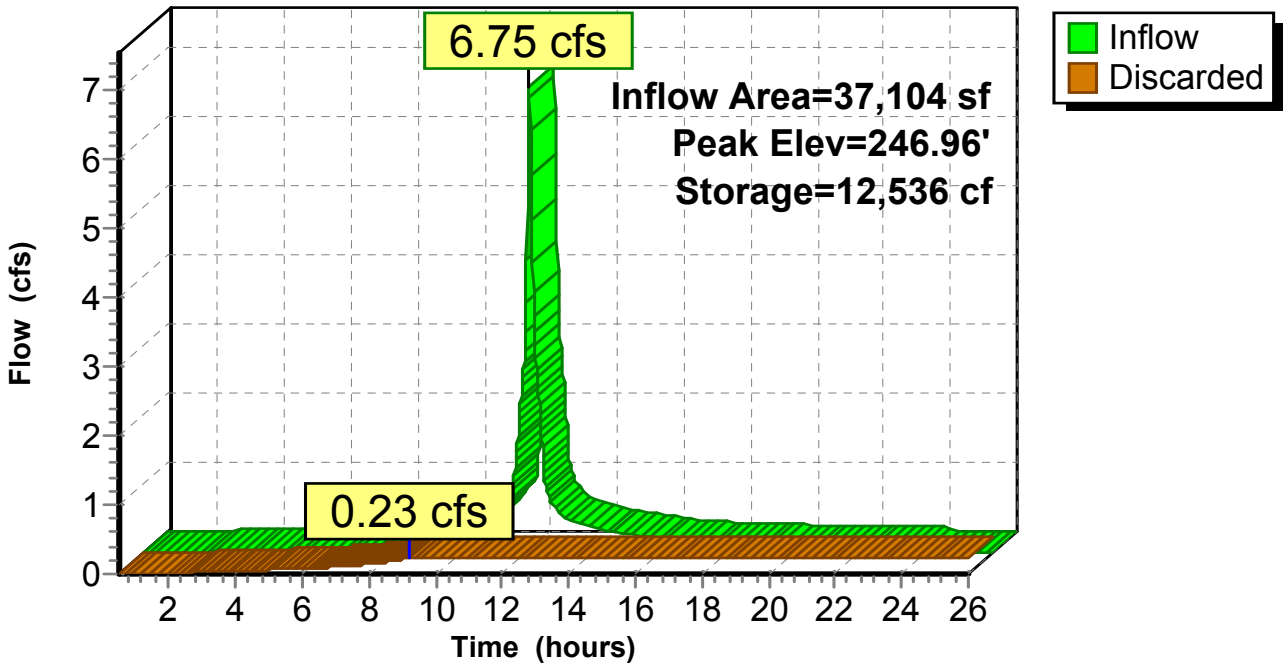
Chamber Storage + Stone Storage = 12,600.0 cf = 0.289 af
Overall Storage Efficiency = 60.8%
Overall System Size = 93.00' x 44.60' x 5.00'

207 Chambers @ $ 300.00 /ea = $ 62,100.00
768.1 cy Field Excavation @ $ 10.00 /cy = $ 7,681.11
316.7 cy Stone @ $ 30.00 /cy = $ 9,501.78
Total Cost = $ 79,282.89



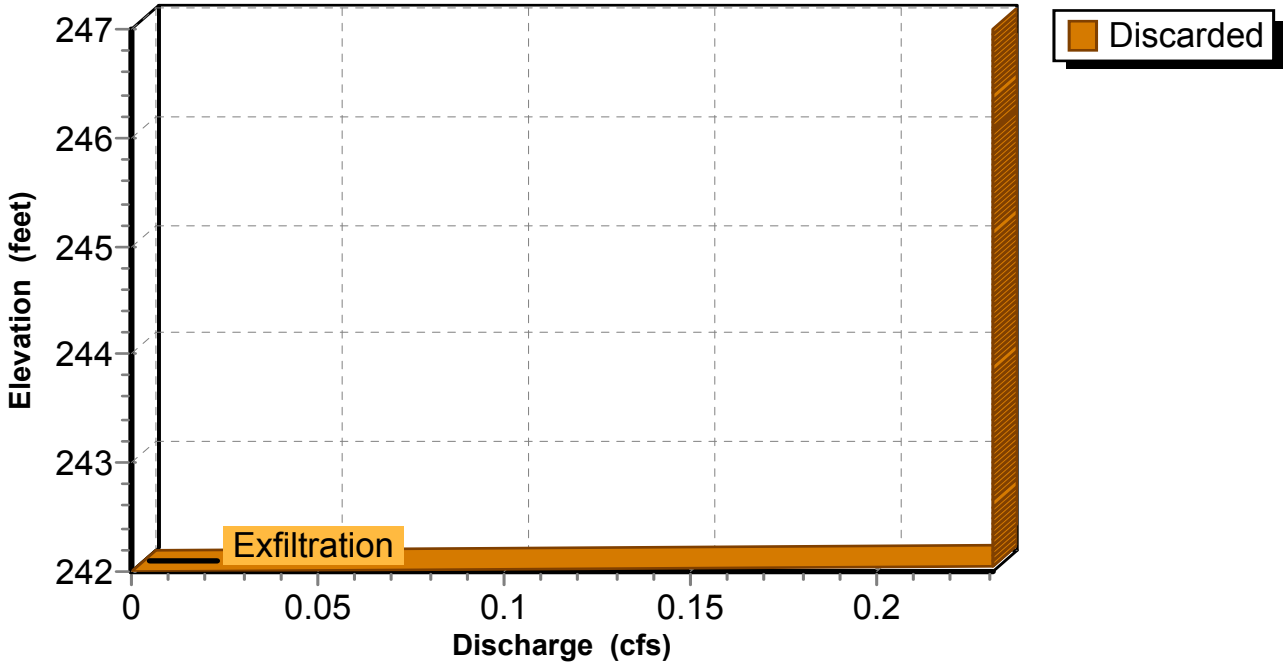
Pond 1P: UC#2

Hydrograph

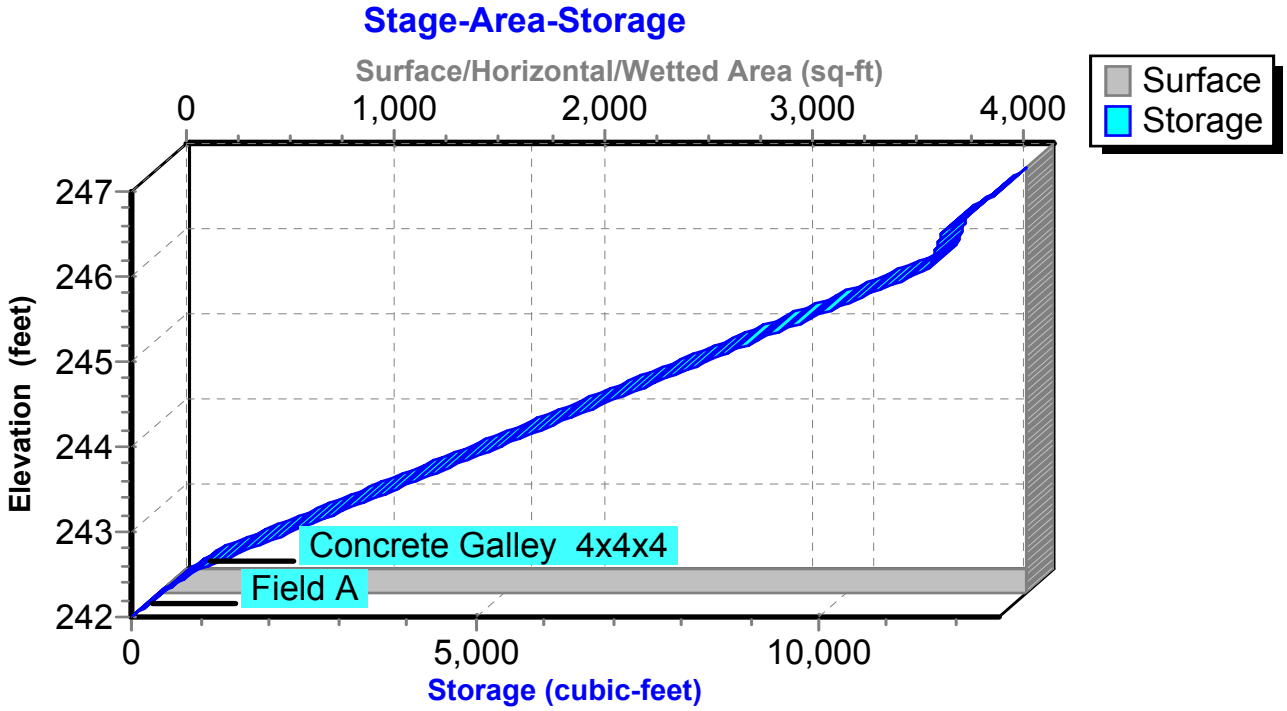


Pond 1P: UC#2

Stage-Discharge



Pond 1P: UC#2


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
1,000
2,000
3,000
4,000
Surface
Storage
247
246
245
244
243
242
Elevation (feet)
Concrete Galley 4x4x4
Field A
0
5,000
10,000
Storage (cubic-feet)

Summary for Pond 6P: UC#3 and #4

Inflow Area = 66,736 sf, 94.81% Impervious, Inflow Depth = 7.67" for 100-Year event
Inflow = 12.21 cfs @ 12.08 hrs, Volume= 42,645 cf
Outflow = 0.42 cfs @ 9.16 hrs, Volume= 29,886 cf, Atten= 97%, Lag= 0.0 min
Discarded = 0.42 cfs @ 9.16 hrs, Volume= 29,886 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 246.36' @ 15.45 hrs Surf.Area= 7,566 sf Storage= 22,740 cf

Plug-Flow detention time= 301.9 min calculated for 29,863 cf (70% of inflow)
Center-of-Mass det. time= 207.8 min (961.4 - 753.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	241.70'	5,335 cf	**36.20'W x 209.00'L x 5.00'H Field A** 37,829 cf Overall - 24,493 cf Embedded = 13,336 cf x 40.0% Voids
#2A	242.20'	18,447 cf	**Concrete Galley 4x4x4** x 416 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 416 Chambers in 8 Rows
		23,782 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	241.70'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.42 cfs @ 9.16 hrs HW=241.75' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.42 cfs)

Pond 6P: UC#3 and #4 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)
Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf
Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

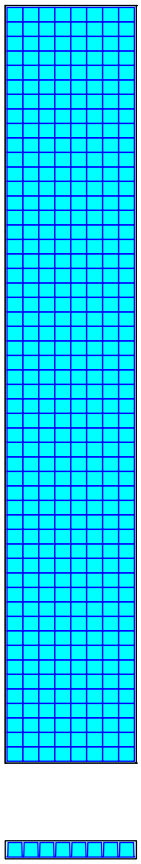
52 Chambers/Row x 4.00' Long = 208.00' Row Length +6.0" End Stone x 2 = 209.00' Base Length
8 Rows x 52.8" Wide + 6.0" Side Stone x 2 = 36.20' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

416 Chambers x 44.3 cf = 18,447.4 cf Chamber Storage
416 Chambers x 58.9 cf = 24,492.6 cf Displacement

37,829.0 cf Field - 24,492.6 cf Chambers = 13,336.4 cf Stone x 40.0% Voids = 5,334.6 cf Stone Storage

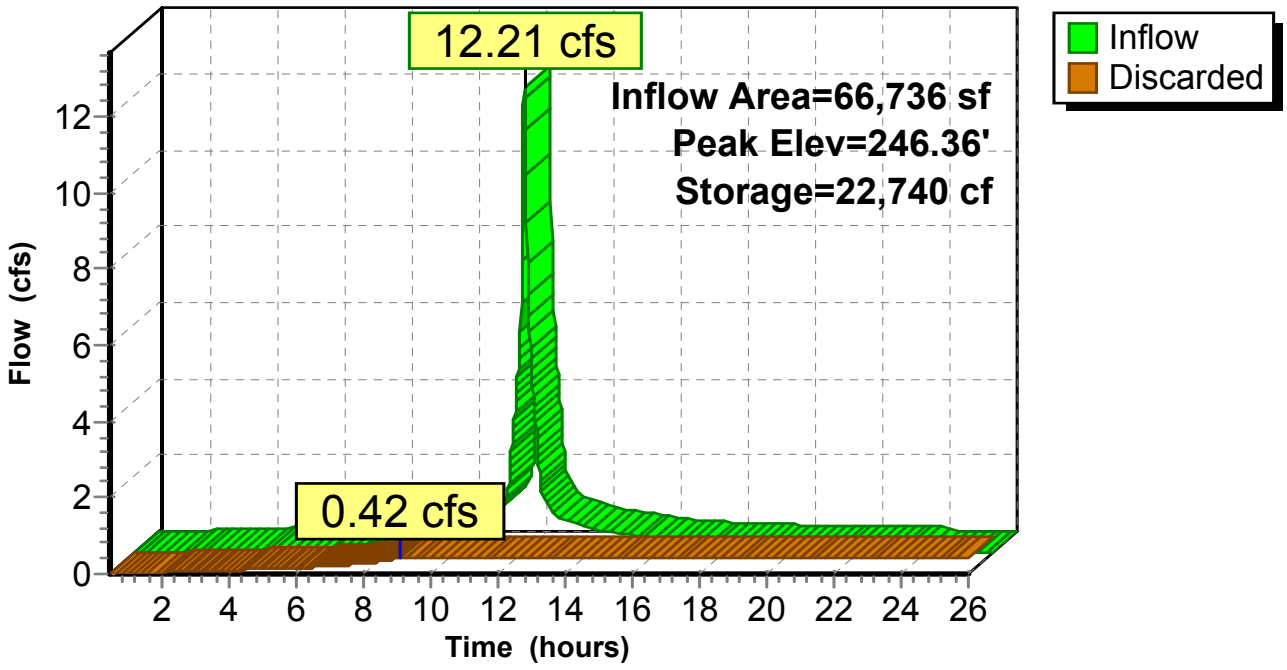
Chamber Storage + Stone Storage = 23,782.0 cf = 0.546 af
Overall Storage Efficiency = 62.9%
Overall System Size = 209.00' x 36.20' x 5.00'

416 Chambers @ $ 300.00 /ea = $ 124,800.00
1,401.1 cy Field Excavation @ $ 10.00 /cy = $ 14,010.74
493.9 cy Stone @ $ 30.00 /cy = $ 14,818.27
Total Cost = $ 153,629.01



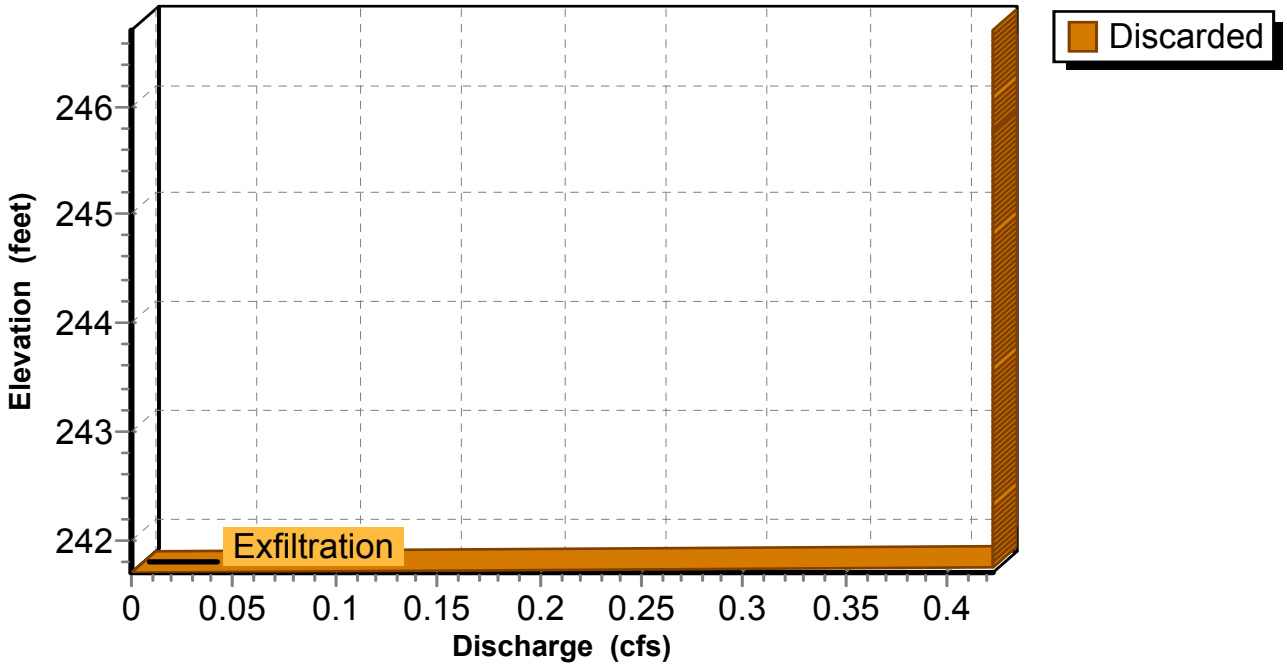
Pond 6P: UC#3 and #4

Hydrograph

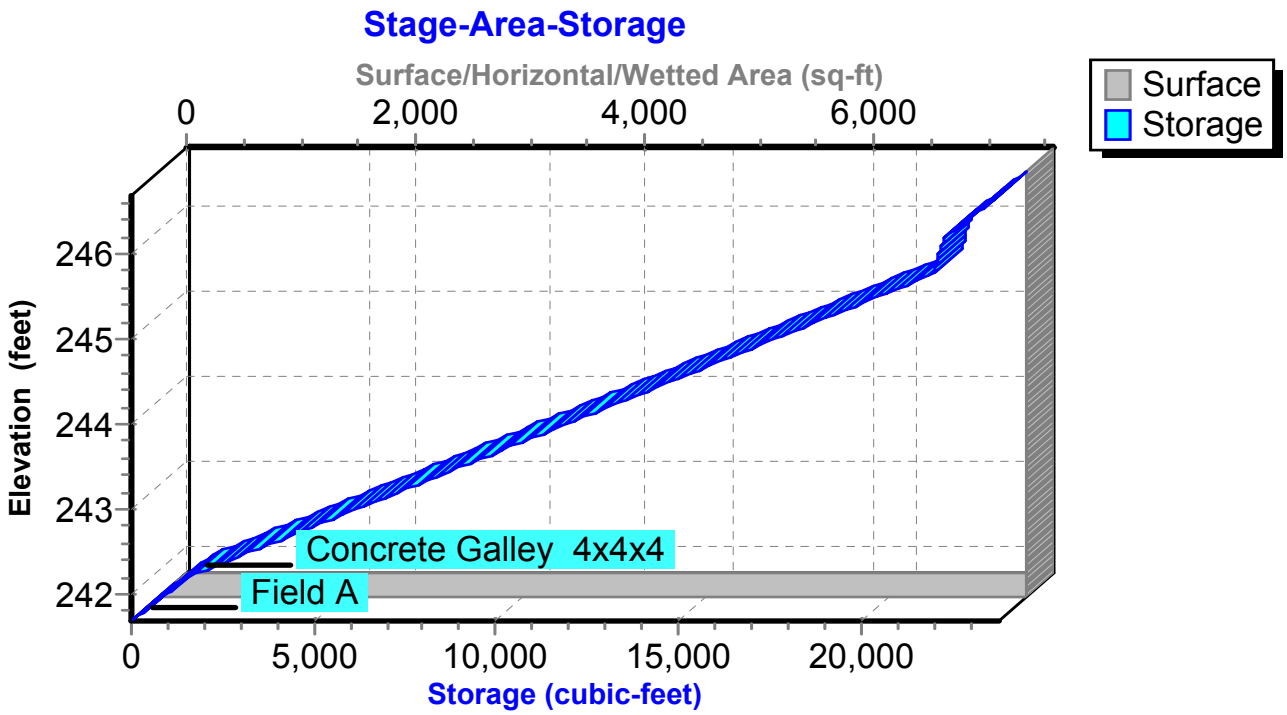


Pond 6P: UC#3 and #4

Stage-Discharge



Pond 6P: UC#3 and #4



Summary for Pond 8P: UC#1

Inflow Area = 2,656 sf, 33.98% Impervious, Inflow Depth = 4.20" for 100-Year event
Inflow = 0.30 cfs @ 12.09 hrs, Volume= 929 cf
Outflow = 0.02 cfs @ 11.52 hrs, Volume= 929 cf, Atten= 93%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.52 hrs, Volume= 929 cf

Routing by Stor-Ind method, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs
Peak Elev= 241.37' @ 14.05 hrs Surf.Area= 350 sf Storage= 413 cf

Plug-Flow detention time= 204.3 min calculated for 929 cf (100% of inflow)
Center-of-Mass det. time= 204.3 min (1,036.1 - 831.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	239.25'	177 cf	**14.00'W x 25.00'L x 2.50'H Field A** 875 cf Overall - 432 cf Embedded = 443 cf x 40.0% Voids
#2A	239.75'	290 cf	**Concrete Galley 4x8x1.5** x 9 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 9 Chambers in 3 Rows
		467 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	239.25'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 11.52 hrs HW=239.28' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 8P: UC#1 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x8x1.5 (Concrete Galley, UCPI 18" Low Profile Galley or equivalent)
Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf
Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf

48.0" Wide + 6.0" Spacing = 54.0" C-C Row Spacing

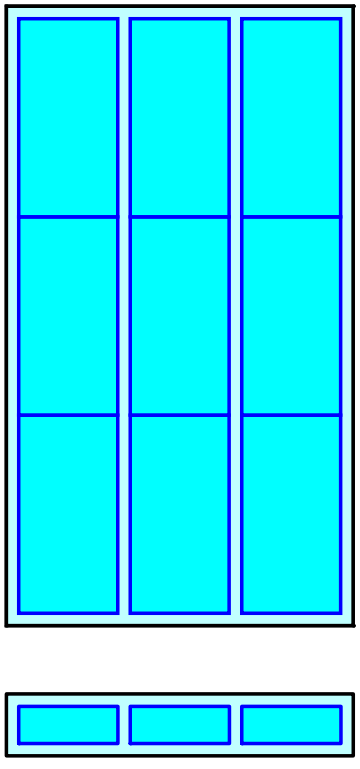
3 Chambers/Row x 8.00' Long = 24.00' Row Length +6.0" End Stone x 2 = 25.00' Base Length
3 Rows x 48.0" Wide + 6.0" Spacing x 2 + 6.0" Side Stone x 2 = 14.00' Base Width
6.0" Base + 18.0" Chamber Height + 6.0" Cover = 2.50' Field Height

9 Chambers x 32.2 cf = 289.6 cf Chamber Storage
9 Chambers x 48.0 cf = 432.0 cf Displacement

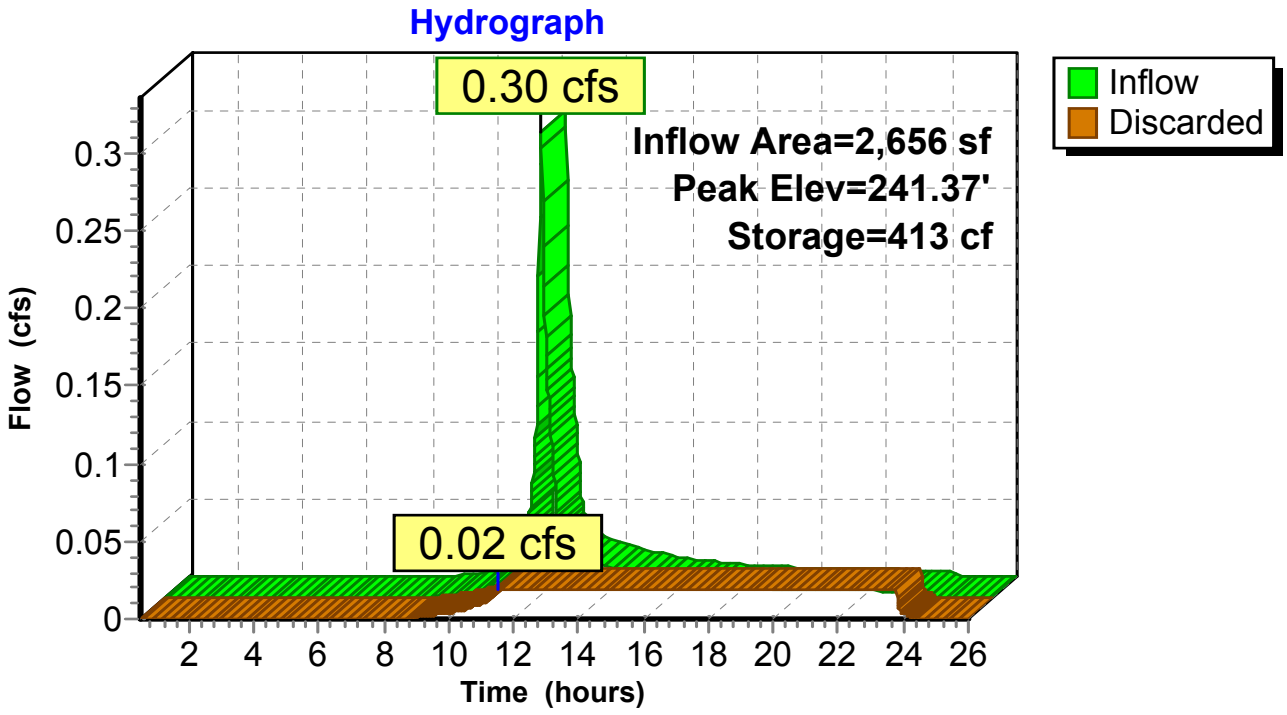
875.0 cf Field - 432.0 cf Chambers = 443.0 cf Stone x 40.0% Voids = 177.2 cf Stone Storage

Chamber Storage + Stone Storage = 466.8 cf = 0.011 af
Overall Storage Efficiency = 53.3%
Overall System Size = 25.00' x 14.00' x 2.50'

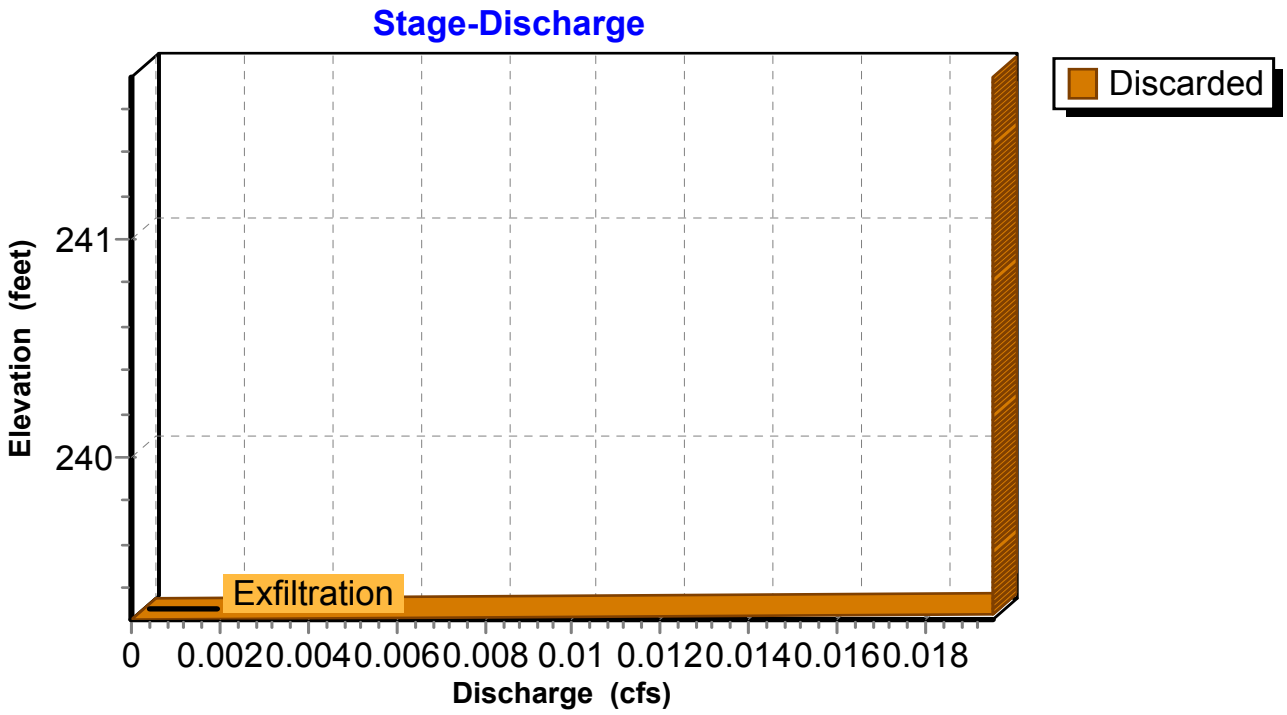
9 Chambers @ $ 0.00 /ea = $ 0.00
32.4 cy Field Excavation @ $ 10.00 /cy = $ 324.07
16.4 cy Stone @ $ 30.00 /cy = $ 492.22
Total Cost = $ 816.30



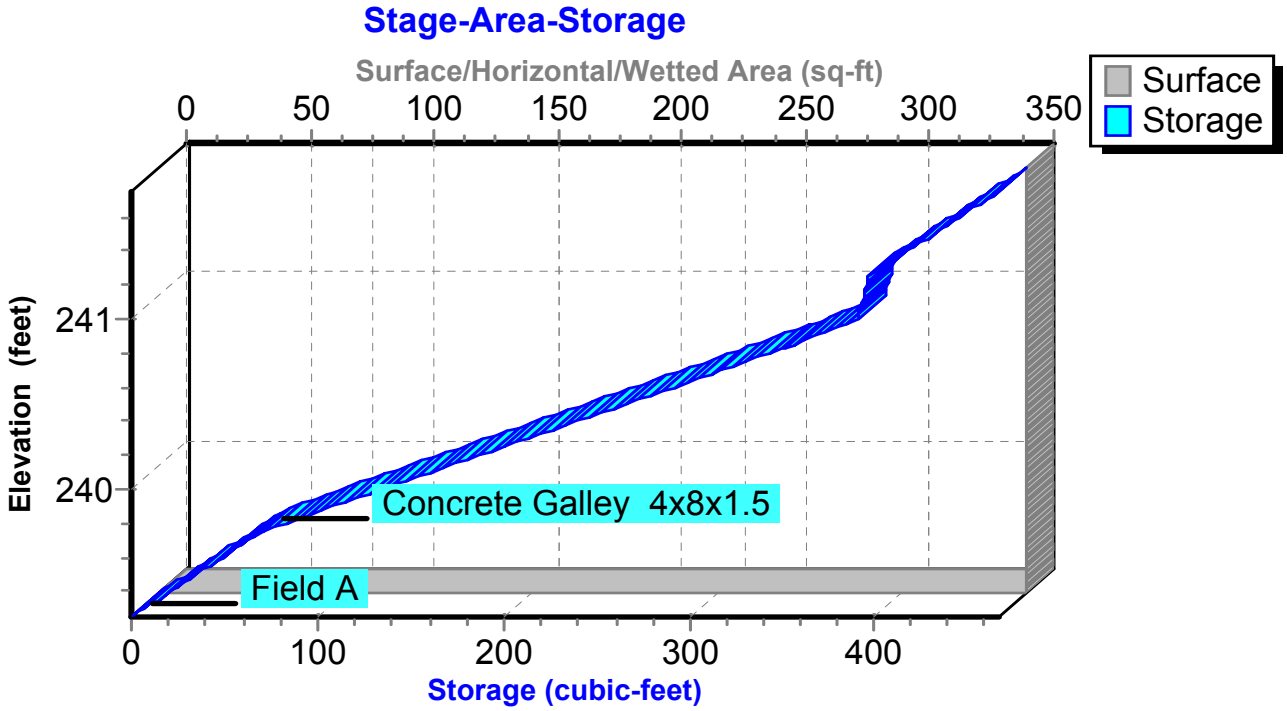
Pond 8P: UC#1



Pond 8P: UC#1



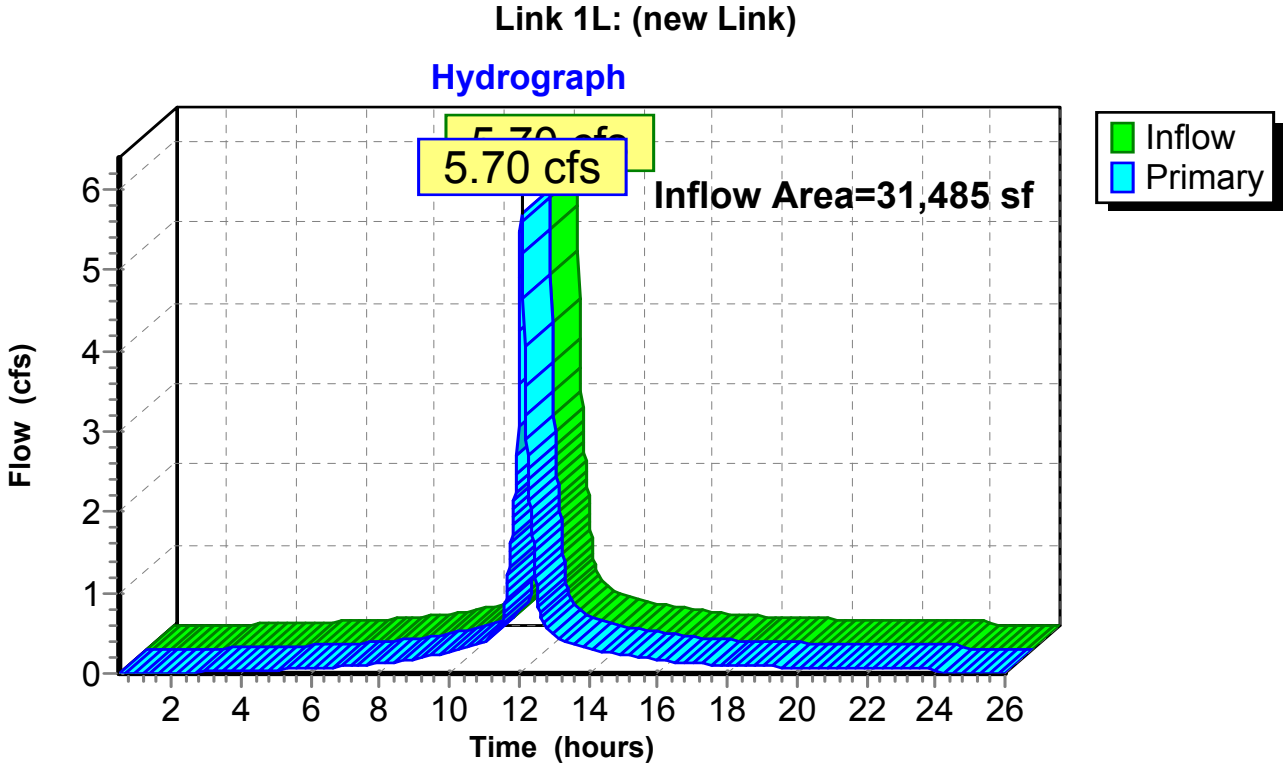
Pond 8P: UC#1


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
50
100
150
200
250
300
350
Surface
Storage
Elevation (feet)
241
240
Concrete Galley 4x8x1.5
Field A
0
100
200
300
400
Storage (cubic-feet)

Summary for Link 1L: (new Link)

Inflow Area = 31,485 sf, 90.42% Impervious, Inflow Depth = 7.44" for 100-Year event
Inflow = 5.70 cfs @ 12.08 hrs, Volume= 19,510 cf
Primary = 5.70 cfs @ 12.08 hrs, Volume= 19,510 cf, Atten= 0%, Lag= 0.0 min

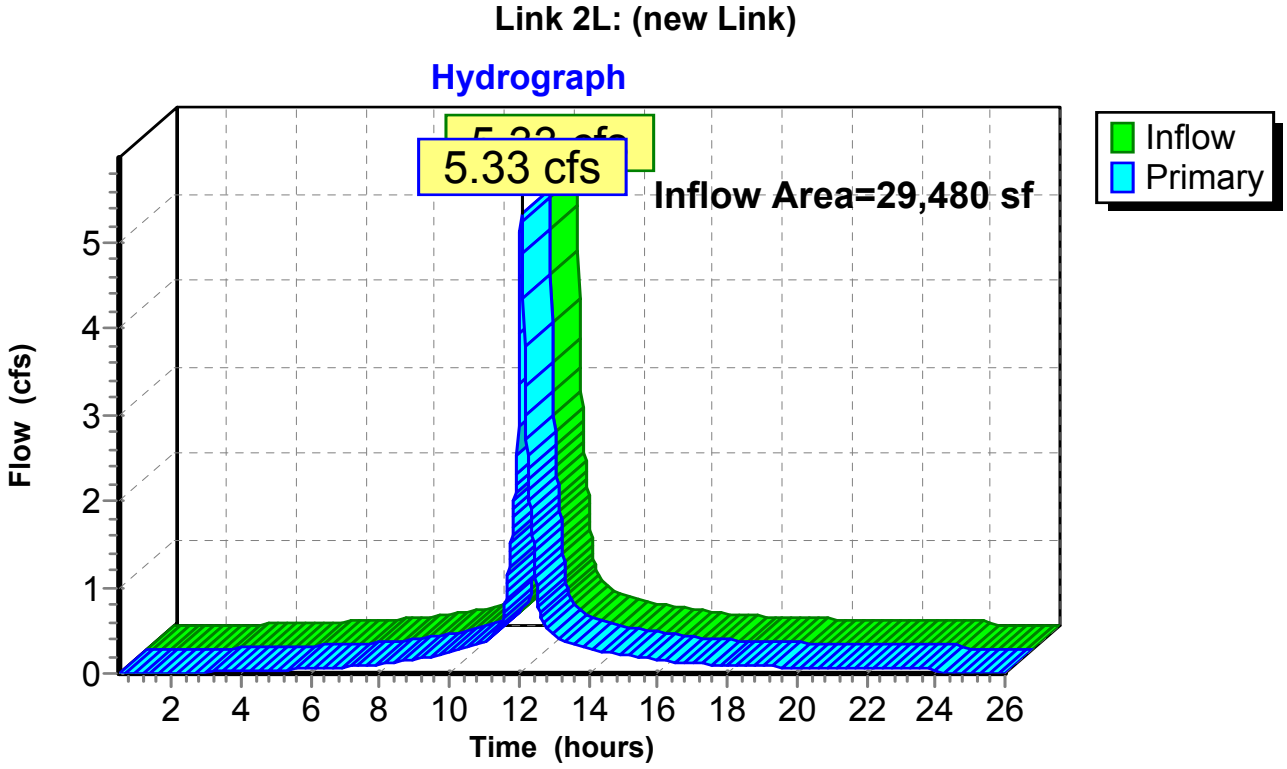
Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs



Summary for Link 2L: (new Link)

Inflow Area = 29,480 sf, 90.51% Impervious, Inflow Depth = 7.39" for 100-Year event
Inflow = 5.33 cfs @ 12.08 hrs, Volume= 18,157 cf
Primary = 5.33 cfs @ 12.08 hrs, Volume= 18,157 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs



Summary for Link 11L: (new Link)

Inflow Area = 33,279 sf, 0.00% Impervious, Inflow Depth = 1.16" for 100-Year event
Inflow = 0.66 cfs @ 12.12 hrs, Volume= 3,215 cf
Primary = 0.66 cfs @ 12.12 hrs, Volume= 3,215 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-26.00 hrs, dt= 0.02 hrs