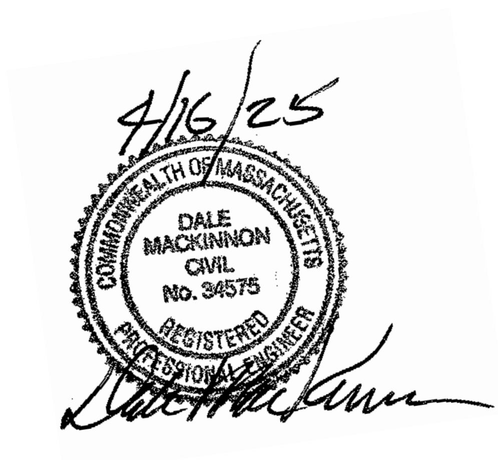
Stormwater Report

for

Guardian Self Storage II

151 Grove Street
Franklin, MA

Date: April 16, 2025



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F-4683

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 that enables verification of supporting calculations.

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

4/16/25

COMMONWEALTH OF MASSACHUSETTS
DALE
MACKINNON
CIVIL
No. 34575
REGISTERED
PROFESSIONAL ENGINEER

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☒ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☒ Grass Channel

☐ Green Roof

☐ Other (describe): ____________________

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (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.

☒ 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.

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

  ☐ is within the Zone II or Interim Wellhead Protection Area

  ☐ is near or to other critical areas

  ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

  ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist (continued)

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

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist (continued)

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

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

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

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

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NARRATIVE

This report was prepared on behalf of the applicant, Jem Partners LLC. The project development area is 147,810 +/- sf. (3.39 +/-Ac.) and is being developed by the owner. The project area is a currently existing vacant, wooded parcel located on Grove St. The property is bordered by the Franklin State Forest to the north and to the west, and commercial properties to the South, and Grove St to the east. The site is located within the Industrial zoning district and has frontage along Grove Street. Portions of the site lie within the jurisdictional buffer of bordering vegetated wetlands. The site does not lie within a FEMA flood zone or the Franklin water resource district.

PROJECT DESCRIPTION

The Applicant is proposing to construct a 36,100 +/- sf two story self storage facility and associated driveways, parking lots, utilities, and grading. Drainage infrastructure associated with the new development will also be constructed. The topography consists of slopes ranging from 0% to 33% grade.

DESCRIPTION OF EXISTING DRAINAGE

The pre-developed site drains principally from north-west to south-east to north, with EX-2 containing approximately 6.77 acres of woodland draining overland and flowing across the project parcel from the west to the east to wetlands (AP-1). Of the 6.77 woodland acres, 3.38 acres are located off-site. EX-1 contains 3.84 acres of woodland to the north/north-east that does ***not*** drain to or across the site, it is intercepted by a trail just north of the site that functions like a swale due to it's locally lower elevation, before it is discharged to Grove St. Additionally, EX-3 contains 0.42 acres of contributing area, consisting entirely of woodland, flows southwest overland from this site to Grove St. These hydrologic areas are shown on the Pre-Development Watershed Plan attached to this report and are denoted as EX-1 through EX-3.

DESCRIPTION OF PROPOSED DRAINAGE FACILITIES

The proposed drainage system to manage stormwater from the proposed development consists of Deep Sump Hooded Catch Basins, Separator Rows, a Forebay, an Infiltration Basin, two separate Cultec Recharger 300HD chamber systems with infiltration, and two Contech water quality units. Stormwater from lawns, driveways, and parking lots, is collected and conveyed by a conventional catch basin and drain manhole system to the chambers for treatment, detention, and infiltration.

In the Post-Development condition, six hydrologic areas were considered. These watershed areas consider the building, driveway, parking, grassed areas, and drainage facilities proposed to be constructed. These hydrologic areas are shown on the Post-Development Watershed Plan attached to this report and are denoted as PR-1 through PR-6.

PR-1 matches that of EX-1 in all qualities given that this area does not impact this site. Given the nature of the topography and close proximity to this site, it was included to demonstrate it does not flow to or across the site.

PR-2 contains approximately 187,831 square feet of contributing area and includes the land which drains directly to AP-1 via a swale along the south side of the site.

PR-3 contains approximately 10,803 square feet of contributing area and includes the land which drains to conventional catch basins and conveyed to WQU #1, then to WQU #2, before being discharged to AP-1.

PR-4 contains approximately 62,243 square feet of contributing area and includes the land which drains directly to the infiltration basin, before being discharged to AP-1.

PR-5 contains approximately 36,100 square feet of contributing area. The roof area of the building is captured by a roof gutter system and conveyed to Chamber System #2 for infiltration. Overflow is conveyed to the Infiltration Basin, before being discharged to AP-1.

PR-6 contains approximately 18,295 square feet of contributing area and includes the land which drains directly to the infiltration basin, before being discharged to AP-1.

This report documents design compliance with the applicable sections of the Massachusetts Stormwater Management Standards 1-10.

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<u>Stormwater Design Parameter:</u>

The stormwater management system was designed to control the post-development rate of peak rainfall runoff from the site by keeping it below the post-development peak rate of rainfall runoff as stated as the objective in the Massachusetts Stormwater Handbook. The calculations were performed using the HydroCAD hydraulic program, developed by applied Microcomputer System. The HydroCAD software is based upon the Soil Conservation Service, "Technical Release 55 – Urban Hydrology for Small Watersheds" and is generally accepted industry methodology.

The analysis was performed for the 2-year, 10-year, 25-year, and 100-year 24-hour storm events.

The following data was required for input:

- Watershed Area: Areas of each watershed were calculated and expressed in square feet for these calculations.
- SCS Curve Number (Cn): Based on the cover type and hydrologic soil group, a weighted curve number (CN) was determined for each of the existing watersheds utilizing Table 2-2a- *Runoff Curve Numbers For Urban Areas* and *Worksheet 2, Runoff Curve Number and Runoff* from the Soil Conservation Service Technical Release 55 – Urban Hydrology for Small Watersheds.
- Time of Concentration, Tc (Minutes): The time of concentration for each watershed was determined by finding the time necessary for runoff to travel from the hydraulically most distant point in the watershed to the point of analysis. This was calculated by using a minimum time of 6 minutes for runoff to reach the most distant catch basin.
- SCS 24-Hour Storm Type: For the greater New England region, a Type III storm rainfall distribution is recommended for drainage calculations and was used for this project.
- Rainfall Precipitation: Rainfall precipitations used the Atlas-14 Volume 10, Version 3 rainfall estimates for the site, obtained from the NOAA Precipitation Frequency Data Server (PFDS) for the 2, 10, 25, and 100 year storm events and are as follows:

2-year storm event:	3.36 inches
10-year storm event:	5.22 inches
25-year storm event:	6.39 inches
100-year storm event:	8.18 inches

An on-site conventional storm drainage collection system is designed based on the "Rational Method" using Manning's equation to carry a minimum 25-year storm event and underground culverts to carry a minimum 50-year storm event through the site (See Pipe Sizing Attachments). The proposed drainage pipes will be Reinforced Concrete Pipe (RCP), unless otherwise noted on the plans.

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

All Paved area runoff from the proposed site will sheet flow across the pavement areas, accumulate into hooded catch basins, connect with drain pipe to either an infiltration basin with forebay or a Cultec chamber system equipped with a Separator Row prior to discharge to the wetlands. No new untreated stormwater discharges are proposed.

Standard 2: Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates.

To meet Standard 2, the post-development peak discharge rate must be equal to or less than pre-development rates to prevent storm damage and downstream and offsite flooding from the 2-year and the 10-year 24-hour storm events.

Peak discharge rates were calculated and evaluated at two analysis points. The points of evaluation are shown on the accompanying watershed plans.

In summary of the attached drainage analysis (HydroCAD), the peak discharge rates at the point of evaluation in cubic feet per second (cfs) are as follows;

	Storm Events	Run off		
		Pre-dev. (cfs)[af]	Proposed (cfs)[af]	Change (cfs)[af]
Analysis Point 1 (AP-1) Wetlands	2-year	(0.36)[0.152]	(0.23)[.105]	(-0.13)[-0.470]
	10-year	(3.75)[0.579]	(2.60)[0.407]	(-1.15)[-0.172]
	25-year	(6.96)[0.938]	(5.47)[0.724]	(-1.49)[-0.214]
	100-year	(12.80)[1.577]	(11.58)[1.325]	(-1.22)[-0.252]

	Storm Events	Run off		
		Pre-dev. (cfs)[af]	Proposed (cfs)[af]	Change (cfs)[af]
Analysis Point 2 (AP-2) Grove St	2-year	(0.25)[0.097]	(0.25)[.096]	(0.00)[-0.001]
	10-year	(2.11)[0.364]	(2.08)[0.350]	(-0.03)[-0.014]
	25-year	(3.86)[0.589]	(3.76)[0.560]	(-0.10)[-0.029]
	100-year	(7.01)[0.989]	(6.78)[0.932]	(-0.23)[-0.057]

Standard 3: Loss of annual recharge to ground water shall be eliminated or minimized through the use of 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.

Soil Evaluation

Soil evaluation is broken down into two stages. Stage 1 identifies the underlying soils just beneath the surface that contribute to how much runoff is generated as stormwater falls and moves across the surface. Stage 2 evaluates the soils in direct contact with the proposed infiltration BMPs. The attachments section includes the NRCS Soil Survey used for Stage 1 while the site plan set includes the on-site soil textural analysis in the specific locations that infiltration is proposed. The information from the NRCS Soil Survey is included on the Pre and Post Development Watershed Plans.

Recharge Volume

The required recharge volume is determined by calculating the impervious area proposed over the corresponding soil identified in the NRCS Soil Survey. Soils underlying the site are defined as map units 71B Ridgebury fine sandy loam (HSG D), and 103B Charlton-Hollis-Rock outcrop complex (HSG D), 254B Merrimac fine sandy loam (HSG A).

Table 2: Required Recharge Volume Calculation

	Recharge	**Impervious**	**Volume**
Hydrologic Group	(in/sqft)	(sqft)	(cf)
A - *sand*	0.60	1,916.0	95.8 cf
B - *loam*	0.35	73,518.0	2144.28 cf
C - *silty loam*	0.25	0	0 cf
D - *clay*	0.10	0	0 cf
		Required Recharge Volume Total	**2,240.08 cf**

Stormwater Basin Sizing

There are three ways of determining the recharge volume provided by a storm water basin (Static, Simple Dynamic and Dynamic Field). The Static Method, used here, includes the volume of water that can be stored beneath the lowest outlet of the basin. This, the most conservative method of determining the recharge volume, doesn't account for any infiltration that takes place while the basin is filling with water and is less dependent on maintenance of the basin since the only way for the water below the lowest invert can leave the basin is though infiltration. The following table summarizes the recharge volume provided by the infiltration basin and infiltration chamber systems. Detailed volume calculations for the basin are included in the attachments.

Table 3: Basin Recharge Volumes

	Recharge Volume
Chamber System #1 @ 289.90	4,007 cf
Chamber System #2 @ 289.40	3,449 cf
Infiltration Basin @ 287.20	5,274 cf
Total	9,279 cf

72-hour Drawdown

When using the conservative Static Method to determine infiltration volume provided, the Rawls Rate is used to represent the infiltration rate in place of a hydraulic conductivity rate. The specific rate chosen is based on the textural analysis of the in-site soil performed by a competent soil professional.

A Massachusetts Certified Soil Evaluator performed an evaluation of the soil at the proposed infiltration BMP. The soil textural analysis for the infiltration BMP is listed below with the associated Rawls Rate used in the HydroCAD calculations. Where textural analysis varied within any single BMP, the most restrictive textural evaluation and Rawls Rate were used. Soil logs of the in situ soil evaluation are included within the Site Plan set.

Table 4: Rawls Rate

	Most Restrictive Soil Texture	Rawls Rate (in/hour)
Chamber System #1	Loamy Sand	2.41 in/hr
Chamber System #2	Loamy Sand	2.41 in/hr
Infiltration Basin	Loamy Sand	2.41 in/hr

Drawdown time for the infiltration chamber systems is modeled by HydroCAD and included in the attachments. The following table summarizes the drawdown time for the basin to show it will drawdown within the 72-hour maximum.

Table 5: Basin Drawdown

	Time for Drawdown
Chamber System	32 hours
Infiltration Basin	34 hours

Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

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

The Water Quality Volume requiring 80% TSS removal, is calculated as follows:

The required water quality volume is based on 1.0" as the soil recharge rate is 2.41 in/hr, meeting the threshold rate of 2.4 in/hr or greater. The water quality volume equals 1.0 inches of runoff times the increased impervious area of the post-development site.

Existing Site Impervious Area	=	0 sf
Proposed Site Impervious Area	=	75,434.0 sf
Total Site Impervious Area Increase	=	75,434.0 sf
Impervious area to be treated	=	**75,434.0 sf**

Total volume to be treated:
1.0" x 1'/12" x 75,434.0 sf = 6,286.17 **cf Water Quality Volume Required**

Provided Water Quality Volume:

Treatment volume (infiltration chamber system #1) = 4,007 cf @ el. 289.90 Outlet Elevation

Treatment volume (infiltration basin) = 5,274 cf @ el. 287.20 Outlet Elevation.

Total Treatment Volume = 9,281 cf

See TSS Removal Calculations in Attachment Section.

Sediment Forebay Sizing

Most of the stormwater from the impervious pavement is collected and discharged to the proposed sediment forebay which is sized to treat 0.1" of runoff from the 21,649 sf of paved impervious area contributing to the basin. Detailed calculations for the sediment forebay are included in Appendix 5 / Stage-Area-Storage Calculations.

0.1"/12" per foot x 21,649 sf = 180.40 cf of storage required

Table 6: Sediment Forebay Sizing

	Impervious Area being Discharged	Required Volume	Provided Volume
Forebay @ Inv.=287.10	21,737 sf	180.40c.f.	549 c.f.

Separator Row Sizing

The proposed Cultec Separator Row(s) were sized by calculating an equivalent water quality flow rate in accordance with the MassDEP Wetlands Program "Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices" and Rhode Island Department of Environmental Management's Alternative Stormwater Technology Certification issued April 9, 2024 for the Cultec Separator Row (see supplemental attachments).

Chamber System:
Water Quality Flow Rate=(qu)(A)(WQV)
Qu = 774 csm/in (6 min Tc, 1.0" WQV)
A = 0.366 Ac = 0.000571875 sq. mi.
WQV = 1.0"
Water Quality Flow Rate = 0.44cfs

The RIDEM certification specifies a maximum treatment flow rate for the Cultech Recharger 330XLHD of 0.15cfs per chamber in Table 1 (the R-300HD has replaced this chamber for commercial applications and maintains extremely similar dimensions). The separator rows for the chamber system are designed as an offline pretreatment BMP as required by the manufacturer specifications.

Chamber System #1 Maximum Treatment Flow Rate provided:
0.15 cfs/chamber x 14 chambers = 2.1cfs

See TSS Removal Calculations in Attachment Section.

Contech Water Quality Unit Sizing

The proposed Contech water quality units were sized by calculating an equivalent water quality flow rate in accordance with the MassDEP Wetlands Program "Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices"

Water Quality Units System
Water Quality Flow Rate=(qu)(A)(WQV)
Qu = 774 csm/in (6 min Tc, 1.0" WQV)
A = 0.182 Ac = 0.000284375 sq. mi.
WQV = 1.0"
Water Quality Flow Rate = 0.22cf

The Contech CDS1515-3-C has a maximum treatment flow rate 1 cfs, and was selected for this project.

See TSS Removal Calculations in Attachment Section.

MS4 Bylaw Compliance:

Based on the Town of Franklin MS4 stormwater bylaw as specified in § 153-16 (B)(1)(a), new developments require the on-site stormwater management systems to be designed to retain the volume of runoff equivalent to, or greater than, one (1.0) inch multiplied by the total post-construction impervious surface area, and/or remove 90% of the average annual load of Total Suspended Solids (TSS) generated from the total post construction impervious area on site and 60% of the average annual load of Total Phosphorous (TP) generated from the post construction impervious surface area on site..

The total impervious area, including roofs, is 75,434.0 square feet. The equivalent 1" of runoff from these surfaces is 6,286.2 cubic feet. The total storage provided below the lowest inverts out are as follows. See Appendix 5 – Stage -Area-Storage calculations.

Chamber system #1 @ Elev. 289.90 = 4,007 cf Total Storage Volume Required = 1,328.6 cf
Infiltration Basin @ Elev. 287.20 = 5,274 cf Total Storage Volume Required = 4,820.6 cf

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 is incorporated into the Operation and Maintenance Plan required by Standard 9.

Standard 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The proposed project is not a use with higher potential pollutant loads.

Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

The subject property does not discharge stormwater within the Franklin Groundwater Protection District. Due to rapid recharge rates present in the infiltration BMP's, the Water Quality Volume is calculated using the required 1.0" rule, and 44% TSS removal is achieved prior to discharge to the infiltration chambers. See Standard 4 for computations. The design utilizes stormwater BMPs designated as suitable for critical areas within the Massachusetts Stormwater Handbook.

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable:

This project is not a redevelopment project and meets all applicable stormwater standards.

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

During land disturbance and construction activities, project proponents must implement controls that prevent erosion, control sediment movement, and stabilize exposed soils to prevent pollutants from moving offsite or entering wetlands or waters. Land disturbance activities include demolition, construction, clearing, excavation, grading, filling, and reconstruction.

Construction Period Pollution Prevention Plan and Erosion and Sedimentation Control.
EPA NPDES – Storm Water Pollution Prevention Plan (SWPPP)

A. Names of Persons or Entities Responsible for Plan Compliance

Mark Yadisernia
Jem Partners LLC
599 Washington Street
Franklin, MA 02038
Tel: 310-415-6804
Email:markyada@yahoo.com

B. Construction Period Pollution Prevention Measures

1. Inventory materials to be present on site during construction.
2. Train employees and subcontractors in prevention and clean up procedures.
3. All materials stored on site will be stored in their appropriate containers and if possible under a roof or covered.
4. Follow manufacturer's recommendation for disposal of used containers.
5. Store only enough products on site to do the job.
6. On site equipment, fueling and maintenance measures:
   a. Inspect on-site vehicles and equipment daily for leaks.
   b. Conduct all vehicle and equipment maintenance and refueling outside of 100' wetland buffer, away from storm drains.
   c. Perform major repairs and maintenance off site.
   d. Use drip pans, drip cloths or absorbent pads when replacing spent fuels.
   e. Collect spent fuels and remove from site, per Local and State regulations.
   f. Maintain a clean construction entrance; install a crushed stone apron where truck traffic is frequent to reduce soil compaction constant sweeping is required and limit tracking of sediment into streets, sweeping street when silt is observed on street.
7. A temporary concrete washout station and equipment wash station shall be located on the site. Areas shall be surrounded with a silt fence and or Filter Mitt to contain materials and provide ease of cleanup.
8. Stockpile materials and maintain Erosion Control around the materials where it can easily be accessed. Anticipated stockpile materials include excess topsoil subsoils, and ledge/rock, trees, stumps, and other vegetative debris, and stones from an existing foundation to be removed. Maintain easy access to clean up materials to include brooms, mops, rags gloves, goggles, sand, sawdust, plastic and metal trash containers. Locate stockpile locations outside the 100' wetland buffers identified on the site plans.
9. Stabilize areas of temporary or permanent disturbance within 7 days of completion, or, if work remains, if these areas are expected to remain open for greater than 14 days. Utilize

New England Erosion Control/Restoration seed mix unless otherwise identified on site plans or within wetland replication plan.

10. Stabilize soil stockpiles with hydroseeding if expected to remain unused for greater than 14 days. Use New England Erosion Control/Restoration seed mix or approved equivalent.
11. Clean up spills.
    a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry cleanup methods (sawdust, cat litter and/or rags and absorbent pads).
    b. Sweep up dry materials immediately. Never wash them away or bury them.
    c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil in a certified container and notify a certified hauler for removal.
    d. Report significant spills to the Fire Department.

12. It is the responsibility of the site superintendent or employees designated by the Applicant to inspect erosion control and repair as needed, also to inspect all on site vehicles for leaks and check all containers on site that may contain hazardous materials daily.

C. Site Development Plans

1. See Site Plan set "Site Plan and Special Permit for Guardian Self Storage II" dated January 8, 2025 and revised through April 10, 2025, prepared by Guerriere & Halnon, Inc.

D. Construction Erosion and Sedimentation Control Plan;

1. See Site Plan set "Site Plan and Special Permit for Guardian Self Storage II" dated January 8, 2025 and revised through April 10, 2025, prepared by Guerriere & Halnon, Inc.

E. Plans

1. Construction Sequencing Plan
    a. A NPDES NOI shall be filed with the EPA.
    b. Record Order of Conditions - The site superintendent shall be aware of all the Conditions contained within the Order including inspection schedules.
    c. Install DEP File # Sign prior to commencement of work.
    d. Prior to any work on the site including tree/brush clearing, the approved limit of clearing as well as the location of the proposed erosion control devices (such as silt fence/straw bales, etc.) must be staked on the ground under the direction of a Massachusetts registered Professional Land Surveyor.
    e. Install erosion control barriers at locations depicted on the plans.
    f. Erosion control to be inspected by either the design engineer (or agent) or an erosion control monitor appointed by the Town of Franklin.
    g. Extra erosion control devices (at least 10% of the linear footage required for the site) shall be stored on the site to be used in case of an emergency (large storm).
    h. Perform tree/brush removal.
    i. Strip off top and subsoil. Stockpile material to be reused away from any drainage inlet or protected wetland areas, remove excess material from the site. Install and maintain erosion control barrier around stockpile.

j. Rough grade site, maintaining temporary low areas/sediment traps for sediment accumulation and away from the wetlands and prevent sedimentation from migrating from the site.
k. Construct stormwater chamber system and infiltration basin. Install pipes, manholes and catch basins. Stabilize side slopes with loam, seed and mulch.
l. Install underground utilities; protect all open drainage structures with erosion/siltation control devices, and rope off any areas susceptible to heavy vehicle damage.
m. Begin construction of building.
n. Prepare compacted pavement base.
o. Loam and seed (mulch as required) disturbed areas of site other than immediately adjacent to work area.
p. Upon all catchment structures and mitigation features becoming operational, install pavement up to binder finish grade. Straw bales backed by crushed stone to be provided on down gradient side of catch basins to direct water to temporary basin.
q. Install curbing and catch basin curb inlets.
r. Install final pavement wearing course.
s. Finish grade - loam and seed (mulch as required adjacent to parking lot.
t. Maintain all erosion control devices until site is stabilized and final inspections are performed.

The Contractor shall be responsible to schedule any required inspections of their work.

2. Construction Waste Management Plan
   a. Dumpster for trash and bulk waste collection shall be provided separately for construction.
   b. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material are recommended.
   c. Segregate and provide containers for disposal options for waste.
   d. Do not bury waste and debris on site.
   e. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
   f. The sewer system is only for disposal of human waste.

F. Operation and Maintenance of Erosion and Sedimentation Controls

The operation and maintenance of sedimentation control shall be the responsibility of the contractor. The inspection and maintenance of the storm water component shall be performed as noted below. The contractor shall, at all times have erosion control in place. The contractor, based on future weather reports shall prepare and inspect all erosion control devices; cleaning, repairing and upgrading is a priority so that the devices perform as per design. Inspect the site during rain events. **Don't stay away from the site.** At a minimum, there should be inspection to assure the devices are not clogged or plugged, or that devices have not been destroyed or damaged during the rain event. After a storm event inspection is required to clean and repair any damage components. Immediate repair is required.

G. Inspection and Maintenance Schedules

1. Inspection must be conducted at least once every 7 days and within 24 hours prior to and after the end of a storm event 0.25 inches or greater.
2. Inspection frequency can be reduced to once a month if:

a. The site is temporarily stabilized.
b. Runoff is unlikely due to winter conditions, when site is covered with snow or ice.

3. Inspections must be conducted by qualified personnel, "qualified personnel" means a person knowledgeable in the principles and practice of erosion and sediment controls and who possess the skills to assess the conditions and take measures to maintain and ensure proper operation, also to conclude if the erosion control methods selected are effective.
4. For each inspection, the inspection report must include:
   a. The inspection date.
   b. Names, titles of personnel making the inspection.
   c. Weather information for the period since the last inspection.
   d. Weather information at the time of the inspection.
   e. Locations of discharges of sediment from the site, if any.
   f. Locations of BMP's that need to be maintained.
   g. Locations where additional BMP's may be required.
   h. Corrective action required or any changes to the SWPPP that may be necessary.
5. Qualified personnel shall inspect the following in-place work;

<u>Inspection Schedule:</u>

Erosion Control	Weekly
Catch Basins	Weekly
Temporary Sedimentation Traps/Basins	Weekly
Pavement Sweeping	Weekly

Please Note: Special inspections shall also be made after a significant rainfall event.

<u>Maintenance Schedule</u>

Erosion Control Devices Failure	Immediately
Temporary Sedimentation Traps/Basins	As needed
Pavement Sweeping	14 days minimum and prior to any significant rain event.

Please Note: Special maintenance shall also be made after a significant rainfall event.

H. <u>Inspection and Maintenance Log Form</u>.

1. See Construction Phase Inspection and Maintenance Form attached

Standard 9: A Long –Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that storm water management systems function as designed.

The following shall serve as the (O&M) Plan required by Standard 9, as well as the Long-Term Pollution Prevention Plan required by Standard 4.

A. Names of Persons or Entities Responsible for Plan Compliance;

Jem Partners LLC (c/o Mark Yadasernia)
599 Washington Street
Franklin, MA 02038
Tel: 310-415-6804
Email:markyada@yahoo.com

Amendments to the maintenance schedule must be made by Mutual Agreement of the Franklin DPW Director and the responsible parties. Owner must submit documentation of satisfactorily completed maintenance to the Franklin DPW on an annual basis.

Responsible Party's Signature______________________________________

It is the intent of the Applicant to have the site completed and released by the various town Departments and Boards.

B. Stormwater Management System Owner

Jem Partners LLC (c/o Mark Yadasernia)
599 Washington Street
Franklin, MA 02038
Tel: 310-415-6804
Email:markyada@yahoo.com

The property owner must notify the Franklin DPW Director of any changes in ownership or assignment of financial responsibility to a new entity. Notification must be provided to future property owners of the presence of the stormwater management system, as well as its Operation and Maintenance requirements. A copy of this Long Term O&M Plan must be provided to new owners, and a disclosure notice included within the Deed notifying the new owner of their responsibility for the Stormwater Management System and the requirements of this O&M Plan.

Owner Signature____

C. Good housekeeping practices

1. Maintain site, landscaping and vegetation.
2. Sweep and pick up litter on pavements and grounds.
3. Deliveries shall be monitored by owners or representative to ensure that if any spillage occurs, it shall be contained and cleaned up immediately.
4. Maintain pavement and curbing in good repair.

D. Requirements for routine inspections and maintenance of stormwater BMPs

1. Plans: The storm water Operation and Maintenance Plan shall consist of all Plans, documents and all local state and federal approvals as required for the subject property.
2. Record Keeping:
    a. Maintain a log of all operation and maintenance activities for at least three years following construction, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location);

3. Descriptions and Designs: The Best Management Practices (BMP) incorporated into the design include the following;
    a. Pavement Sweeping – Stipulated within the Construction Period Pollution Prevention Plan, the Long Term Pollution Prevention Plan, and the Operation and Maintenance Plan. As the amount of TSS removal is discretionary, no credit was taken within the calculations for this BMP.
    b. Deep sump catch basins with hoods installed to promote TSS Removal of solids and control floatable pollutants. This BMP has a design rate of 25% TSS Removal.
    c. Infiltration basins and sediment forebays provided to promote the required 80% TSS Removal. Refer to TSS Removal Worksheet in Standard 4 for treatment train.
    d. Contech Water Quality Manholes - installed to promote TSS Removal of solids. These proprietary BMPs have a variable rate of TSS removal, see manufacturer calculations in attachment section of this report.
    e. Cultec Separator Rows – Subsurface pretreatment device integral with infiltration chambers and function as a subsurface sediment forebay. Separator rows provide 25% TSS removal as pretreatment prior to discharge to the infiltration BMP by capturing the water quality volume and filtering it through a geotextile fabric which surrounds the separator row. Excess runoff is routed to the infiltration chambers via a high invert overflow header.
    f. Infiltration Chambers – subsurface infiltration BMP provides the required groundwater recharge and has a design rate of 80% TSS Removal. Refer to TSS Removal Worksheet included in the Attachments.
    g. Spill Containment Kit to contain and clean-up spills that could occur on site.

4. BMP Maintenance: After construction it is the responsibility of the owner to perform maintenance. The owner shall also be responsible for the maintenance of the existing stormwater BMPs on the abutting Walgreens property. The cleaning of the components of the stormwater management system shall generally be as follows:
    a. Pavement: The owner shall keep the pavement swept with a mechanical sweeper or hand swept semi-annually at a minimum.
    b. Catch Basins: Shall be cleaned by excavating, pumping or vacuuming. The sediment shall be disposed of off-site by the Owner. Inspect quarterly, remove silt when ¼ full.
    c. Water Quality Manholes: Inspect twice a year. Clean structure when sediment accumulation reaches a depth of 2.0ft. Cleaning is generally done with the combination of a high pressure spray jet and vacuum truck and is the most effective and convenient method. A maintenance log shall be kept for all maintenance activities
    d. Sediment Forebay/Infiltration Basin: Preventative maintenance shall be performed at least four times per year. Inspection shall be performed after every major storm

for the first three months and monthly thereafter, and when there are discharges through the high outlet orifice. Mowing of the buffer area, and bottom of basin; removal of trash and debris; removal of grass clippings and organic matter to be performed at least twice per year. Pretreatment devices shall be inspected every other month and a least twice a year and after every major storm event.

e. Cultec Separator Row: Inspect every six months for the first year of service, and then annually thereafter. Clean structure when sediment accumulation reaches a depth of 3 inches. Cleaning is generally done with the combination of a high pressure spray jet and vacuum truck and is the most effective and convenient method. A maintenance log shall be kept for all maintenance activities. Follow the Cultec Separator Row Inspection and Maintenance guide.

f. Infiltration Chambers: Inspect after 2 years of commission using the inspection port via a CCTV and inspect every year thereafter or as needed depending on rainfall and site conditions. Cleaning with high pressure water through culvert cleaning nozzle when sediment accumulation reaches a depth of 3 inches or more. A maintenance log shall be kept for all maintenance activities.

g. Basin outfalls and rip-rap aprons: Preventative maintenance shall be performed at least four times per year. Inspection shall be performed after every major storm for the first three months and monthly thereafter. Removal of trash and debris; removal of grass clippings and organic matter, and removal of accumulated silt to be performed at least twice per year.

5. Access Provisions: All of the components of the storm water system will be accessible by the Owner

E. <u>Spill prevention and response plans</u>

1. Train employees and subcontractors in prevention and clean up procedures.
2. All materials stored on site will be stored in their appropriate containers under a roof or in the approved underground storage tanks.
3. No hazardous materials are to be stored outside.
4. Follow manufacturer's recommendation for disposal of used containers.
5. On site equipment, fueling and maintenance measures:
    a. Inspect on-site vehicles and equipment daily for leaks.
    b. Conduct all vehicle and equipment maintenance off Site and refueling in one location, away from storm drains and wetlands. No vehicle washing is allowed on impervious surfaces draining into the stormwater management system, and is recommended for pervious vegetated areas only.
6. Clean up spills.
    a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry clean-up methods (sawdust, cat litter and/or rags and absorbent pads).
    b. Sweep up dry materials immediately. Never wash them away or bury them.
    c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
    d. Report significant spills to the Fire Department, Conservation Commission and Board of Health.
    e. Floatables shall be promptly and completely removed from catch basins, water quality units, and other drainage structures following a spill.

F. Provisions for maintenance of lawns, gardens, and other landscaped areas

Dispose of clippings away from storm drainage, wetland resource areas, and their buffers.

G. Requirements for storage and use of fertilizers, herbicides, and pesticides

The application of fertilizers, herbicides, or pesticides will be done by professional certified contractor. Only slow release, organic options are permitted for use within wetland jurisdictional buffer areas. Storage these chemicals is not permitted with 100' of the wetland resource area.

H. Provisions for solid waste management

1. Waste Management Plan
    a. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material is recommended.
    b. Do not bury waste and debris on site.
    c. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
    d. No hazardous waste are to be disposed of in the on-site dumpster, and must be disposed of in accordance with all applicable regulations.

I. Snow disposal and plowing plans

Snow storage areas are designated on the site plan. No snow is to be stored within wetland resources, stormwater management areas, or parking spaces. Snow storage signs are to be provided adjacent to the wetland resource area as shown on the site plan. Excess snow that cannot be stored within the designated snow storage areas is to be removed and disposed of off-site within 72 hours.

J. Winter Road Salt and/or Sand Use and Storage restrictions

No sand, salt, or chemicals for de-icing will be stored outside. No de-icer shall be used without the authorization of the Franklin Conservation Commission. Calcium Chloride is proposed for use as the primary de-icing chemical.

K. Pavement sweeping schedules

Sweeping, the act of cleaning pavement can be done by mechanical sweepers, vacuum sweeper or hand sweeper. The quantity of sand is a direct correlation with the treatment of ice and snow and the types of chemicals and spreaders that are being used on site to manage snow. If a liquid de-icer such as calcium chloride is used as a pretreatment to new events the amount of sand is minimized. Sweeping for this site should be done semi-annually at a minimum. Collecting the particulate before it enters the catch basins is cheaper and more environmentally friendly than in a catch basin mixing with oils and greases in the surface water runoff in catch basins.

L. Provisions for prevention of illicit discharges to the stormwater management system

The discharge into the stormwater system is not being violated, see attachment for illicit discharges compliance.

M. Training the staff or personnel involved with implementing Long-Term Pollution Prevention Plan

The owner shall develop policies and procedures for containing the illicit spilling of oils, soda, beer, paper, and litter. These wastes provide a degrading of the water quality. The placement of signs and trash barrels with lids around the site would contribute to clean water quality site conditions.

N. List of Emergency contacts for implementing Long-Term Pollution Prevention Plan:

Jem Partners LLC (c/o Mark Yadasernia)
599 Washington Street
Franklin, MA 02038
Tel: 310-415-6804
Email:markyada@yahoo.com

BMP	Estimated Maintenance Cost
Pavement sweeping	$ 400 per year
Catch basin cleaning	$ 200 per catch basin per cleaning
Sediment Forebay &	
Infiltration Basin	
Contech Hydrodynamic Separators	$ 500 per manhole per cleaning
Separator Row &	$ 200 per cleaning
Infiltration Chambers	$ 1,000 per cleaning per chamber system
Spill Containment Kit	$ 750 purchase price

LONG TERM OPERATION AND MAINTENANCE PLAN (O&M PLAN)

STANDARD 9: A LONG -TERM OPERATION AND MAINTENANCE (O&M) PLAN SHALL BE DEVELOPED AND IMPLEMENTED TO ENSURE THAT STORM WATER MANAGEMENT SYSTEMS FUNCTION AS DESIGNED.

THE FOLLOWING SHALL SERVE AS THE (O&M) PLAN REQUIRED BY STANDARD 9, AS WELL AS THE LONG-TERM POLLUTION PREVENTION PLAN REQUIRED BY STANDARD 4.

A. NAMES OF PERSONS OR ENTITIES RESPONSIBLE FOR PLAN COMPLIANCE:

JEM PARTNERS LLC (C/O MARK YADASERNIA)
599 WASHINGTON STREET
FRANKLIN, MA 02038
TEL: 310-415-6804
EMAIL: MARKYADA@YAHOO.COM

AMENDMENTS TO THE MAINTENANCE SCHEDULE MUST BE MADE BY MUTUAL AGREEMENT OF THE FRANKLIN DPW DIRECTOR AND THE RESPONSIBLE PARTIES. OWNER MUST SUBMIT DOCUMENTATION OF SATISFACTORILY COMPLETED MAINTENANCE TO THE FRANKLIN DPW ON AN ANNUAL BASIS.

IT IS THE INTENT OF THE APPLICANT TO HAVE THE SITE COMPLETED AND RELEASED BY THE VARIOUS TOWN DEPARTMENTS AND BOARDS.

B. STORMWATER MANAGEMENT SYSTEM OWNER

JEM PARTNERS LLC (C/O MARK YADASERNIA)
599 WASHINGTON STREET
FRANKLIN, MA 02038
TEL: XXX-XXX-XXXX310-415-6804
EMAIL: MARKYADA@YAHOO.COM

THE PROPERTY OWNER MUST NOTIFY THE FRANKLIN DPW DIRECTOR OF ANY CHANGES IN OWNERSHIP OR ASSIGNMENT OF FINANCIAL RESPONSIBILITY TO A NEW ENTITY. NOTIFICATION MUST BE PROVIDED TO FUTURE PROPERTY OWNERS OF THE PRESENCE OF THE STORMWATER MANAGEMENT SYSTEM, AS WELL AS ITS OPERATION AND MAINTENANCE REQUIREMENTS. A COPY OF THIS LONG TERM O&M PLAN MUST BE PROVIDED TO NEW OWNERS, AND A DISCLOSURE NOTICE INCLUDED WITHIN THE DEED NOTIFYING THE NEW OWNER OF THEIR RESPONSIBILITY FOR THE STORMWATER MANAGEMENT SYSTEM AND THE REQUIREMENTS OF THIS O&M PLAN.

C. GOOD HOUSEKEEPING PRACTICES

1. MAINTAIN SITE, LANDSCAPING AND VEGETATION.
2. SWEEP AND PICK UP LITTER ON PAVEMENTS AND GROUNDS.
3. DELIVERIES SHALL BE MONITORED BY OWNERS OR REPRESENTATIVE TO ENSURE THAT IF ANY SPILLAGE OCCURS, IT SHALL BE CONTAINED AND CLEANED UP IMMEDIATELY.
4. MAINTAIN PAVEMENT AND CURBING IN GOOD REPAIR.

D. REQUIREMENTS FOR ROUTINE INSPECTIONS AND MAINTENANCE OF STORMWATER BMPS

1. PLANS: THE STORM WATER OPERATION AND MAINTENANCE PLAN SHALL CONSIST OF ALL PLANS, DOCUMENTS AND ALL LOCAL STATE AND FEDERAL APPROVALS AS REQUIRED FOR THE SUBJECT PROPERTY.
2. RECORD KEEPING:
   a. MAINTAIN A LOG OF ALL OPERATION AND MAINTENANCE ACTIVITIES FOR AT LEAST THREE YEARS FOLLOWING CONSTRUCTION, INCLUDING INSPECTIONS, REPAIRS, REPLACEMENT AND DISPOSAL (FOR DISPOSAL, THE LOG SHALL INDICATE THE TYPE OF MATERIAL AND THE DISPOSAL LOCATION);
3. DESCRIPTIONS AND DESIGNS: THE BEST MANAGEMENT PRACTICES (BMP) INCORPORATED INTO THE DESIGN INCLUDE THE FOLLOWING;
   a. PAVEMENT SWEEPING – STIPULATED WITHIN THE CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN, THE LONG TERM POLLUTION PREVENTION PLAN, AND THE OPERATION AND MAINTENANCE PLAN. AS THE AMOUNT OF TSS REMOVAL IS DISCRETIONARY, NO CREDIT WAS TAKEN WITHIN THE CALCULATIONS FOR THIS BMP.
   b. DEEP SUMP CATCH BASINS WITH HOODS INSTALLED TO PROMOTE TSS REMOVAL OF SOLIDS AND CONTROL FLOATABLE POLLUTANTS. THIS BMP HAS A DESIGN RATE OF 25% TSS REMOVAL.
   c. INFILTRATION BASINS AND SEDIMENT FOREBAYS PROVIDED TO PROMOTE THE REQUIRED 80% TSS REMOVAL. REFER TO TSS REMOVAL WORKSHEET IN STANDARD 4 FOR TREATMENT TRAIN.
   d. CONTECH WATER QUALITY MANHOLES – INSTALLED TO PROMOTE TSS REMOVAL OF SOLIDS. THESE PROPRIETARY BMPS HAVE A VARIABLE RATE OF TSS REMOVAL, SEE MANUFACTURER CALCULATIONS IN ATTACHMENT SECTION OF THIS REPORT.
   e. CULTEC SEPARATOR ROWS – SUBSURFACE PRETREATMENT DEVICE INTEGRAL WITH INFILTRATION CHAMBERS AND FUNCTION AS A SUBSURFACE SEDIMENT FOREBAY. SEPARATOR ROWS PROVIDE 25% TSS REMOVAL AS PRETREATMENT PRIOR TO DISCHARGE TO THE INFILTRATION BMP BY CAPTURING THE WATER QUALITY VOLUME AND FILTERING IT THROUGH A GEOTEXTILE FABRIC WHICH SURROUNDS THE SEPARATOR ROW. EXCESS RUNOFF IS ROUTED TO THE INFILTRATION CHAMBERS VIA A HIGH INVERT OVERFLOW HEADER.
   f. INFILTRATION CHAMBERS – SUBSURFACE INFILTRATION BMP PROVIDES THE REQUIRED GROUNDWATER RECHARGE AND HAS A DESIGN RATE OF 80% TSS REMOVAL. REFER TO TSS REMOVAL WORKSHEET INCLUDED IN THE ATTACHMENTS.
   g. SPILL CONTAINMENT KIT TO CONTAIN AND CLEAN-UP SPILLS THAT COULD OCCUR ON SITE.
4. BMP MAINTENANCE: AFTER CONSTRUCTION IT IS THE RESPONSIBILITY OF THE OWNER TO PERFORM MAINTENANCE. THE OWNER SHALL ALSO BE RESPONSIBLE FOR THE MAINTENANCE OF THE EXISTING STORMWATER BMPS ON THE ABUTTING WALGREENS PROPERTY. THE CLEANING OF THE COMPONENTS OF THE STORMWATER MANAGEMENT SYSTEM SHALL GENERALLY BE AS FOLLOWS:
   a. PAVEMENT: THE OWNER SHALL KEEP THE PAVEMENT SWEPT WITH A MECHANICAL SWEEPER OR HAND SWEPT SEMI-ANNUALLY AT A MINIMUM.
   b. CATCH BASINS: SHALL BE CLEANED BY EXCAVATING, PUMPING OR VACUUMING. THE SEDIMENT SHALL BE DISPOSED OF OFF-SITE BY THE OWNER. INSPECT QUARTERLY, REMOVE SILT WHEN ¼ FULL.
   c. WATER QUALITY MANHOLES: INSPECT TWICE A YEAR. CLEAN STRUCTURE WHEN SEDIMENT ACCUMULATION REACHES A DEPTH OF 2.0FT. CLEANING IS GENERALLY DONE WITH THE COMBINATION OF A HIGH PRESSURE SPRAY JET AND VACUUM TRUCK AND IS THE MOST EFFECTIVE AND CONVENIENT METHOD. A MAINTENANCE LOG SHALL BE KEPT FOR ALL MAINTENANCE ACTIVITIES
   d. SEDIMENT FOREBAY/INFILTRATION BASIN: PREVENTATIVE MAINTENANCE SHALL BE PERFORMED AT LEAST FOUR TIMES PER YEAR. INSPECTION SHALL BE PERFORMED AFTER EVERY MAJOR STORM FOR THE FIRST THREE MONTHS AND MONTHLY THEREAFTER, AND WHEN THERE ARE DISCHARGES THROUGH THE HIGH OUTLET ORIFICE. MOWING OF THE BUFFER AREA, AND BOTTOM OF BASIN; REMOVAL OF TRASH AND DEBRIS; REMOVAL OF GRASS CLIPPINGS AND ORGANIC MATTER TO BE PERFORMED AT LEAST TWICE PER YEAR. PRETREATMENT DEVICES SHALL BE INSPECTED EVERY OTHER MONTH AND A LEAST TWICE A YEAR AND AFTER EVERY MAJOR STORM EVENT.
   e. CULTEC SEPARATOR ROW: INSPECT EVERY SIX MONTHS FOR THE FIRST YEAR OF SERVICE, AND THEN ANNUALLY THEREAFTER. CLEAN STRUCTURE WHEN SEDIMENT ACCUMULATION REACHES A DEPTH OF 3 INCHES. CLEANING IS GENERALLY DONE WITH THE COMBINATION OF A HIGH PRESSURE SPRAY JET AND VACUUM TRUCK AND IS THE MOST EFFECTIVE AND CONVENIENT METHOD. A MAINTENANCE LOG SHALL BE KEPT FOR ALL MAINTENANCE ACTIVITIES. FOLLOW THE CULTEC SEPARATOR ROW INSPECTION AND MAINTENANCE GUIDE.
   f. INFILTRATION CHAMBERS: INSPECT AFTER 2 YEARS OF COMMISSION USING THE INSPECTION PORT VIA A CCTV AND INSPECT EVERY YEAR THEREAFTER OR AS NEEDED DEPENDING ON RAINFALL AND SITE CONDITIONS. CLEANING WITH HIGH PRESSURE WATER THROUGH CULVERT CLEANING NOZZLE WHEN SEDIMENT ACCUMULATION REACHES A DEPTH OF 3 INCHES OR MORE. A MAINTENANCE LOG SHALL BE KEPT FOR ALL MAINTENANCE ACTIVITIES.
   g. BASIN OUTFALLS AND RIP-RAP APRONS: PREVENTATIVE MAINTENANCE SHALL BE PERFORMED AT LEAST FOUR TIMES PER YEAR. INSPECTION SHALL BE PERFORMED AFTER EVERY MAJOR STORM FOR THE FIRST THREE MONTHS AND MONTHLY THEREAFTER. REMOVAL OF TRASH AND DEBRIS; REMOVAL OF GRASS CLIPPINGS AND ORGANIC MATTER, AND REMOVAL OF ACCUMULATED SILT TO BE PERFORMED AT LEAST TWICE PER YEAR.
5. ACCESS PROVISIONS: ALL OF THE COMPONENTS OF THE STORM WATER SYSTEM WILL BE ACCESSIBLE BY THE OWNER

E. SPILL PREVENTION AND RESPONSE PLANS

1. TRAIN EMPLOYEES AND SUBCONTRACTORS IN PREVENTION AND CLEAN UP PROCEDURES.
2. ALL MATERIALS STORED ON SITE WILL BE STORED IN THEIR APPROPRIATE CONTAINERS UNDER A ROOF OR IN THE APPROVED UNDERGROUND STORAGE TANKS.
3. NO HAZARDOUS MATERIALS ARE TO BE STORED OUTSIDE.
4. FOLLOW MANUFACTURER'S RECOMMENDATION FOR DISPOSAL OF USED CONTAINERS.
5. ON SITE EQUIPMENT, FUELING AND MAINTENANCE MEASURES:
   a. INSPECT ON-SITE VEHICLES AND EQUIPMENT DAILY FOR LEAKS.
   b. CONDUCT ALL VEHICLE AND EQUIPMENT MAINTENANCE OFF SITE AND REFUELING IN ONE LOCATION, AWAY FROM STORM DRAINS AND WETLANDS. NO VEHICLE WASHING IS ALLOWED ON IMPERVIOUS SURFACES DRAINING INTO THE STORMWATER MANAGEMENT SYSTEM, AND IS RECOMMENDED FOR PERVIOUS VEGETATED AREAS ONLY.
6. CLEAN UP SPILLS.
   a. NEVER HOSE DOWN "DIRTY" PAVEMENT OR IMPERMEABLE SURFACES WHERE FLUIDS HAVE SPILLED. USE DRY CLEAN-UP METHODS (SAWDUST, CAT LITTER AND/OR RAGS AND ABSORBENT PADS).
   b. SWEEP UP DRY MATERIALS IMMEDIATELY. NEVER WASH THEM AWAY OR BURY THEM.
   c. CLEAN UP SPILLS ON DIRT AREAS BY DIGGING UP AND PROPERLY DISPOSING OF CONTAMINATED SOIL.
   d. REPORT SIGNIFICANT SPILLS TO THE FIRE DEPARTMENT, CONSERVATION COMMISSION AND BOARD OF HEALTH.
   e. FLOATABLES SHALL BE PROMPTLY AND COMPLETELY REMOVED FROM CATCH BASINS, WATER QUALITY UNITS, AND OTHER DRAINAGE STRUCTURES FOLLOWING A SPILL.

F. PROVISIONS FOR MAINTENANCE OF LAWNS, GARDENS, AND OTHER LANDSCAPED AREAS

DISPOSE OF CLIPPINGS AWAY FROM STORM DRAINAGE, WETLAND RESOURCE AREAS, AND THEIR BUFFERS.

G. REQUIREMENTS FOR STORAGE AND USE OF FERTILIZERS, HERBICIDES, AND PESTICIDES

THE APPLICATION OF FERTILIZERS, HERBICIDES, OR PESTICIDES WILL BE DONE BY PROFESSIONAL CERTIFIED CONTRACTOR. ONLY SLOW RELEASE, ORGANIC OPTIONS ARE PERMITTED FOR USE WITHIN WETLAND JURISDICTIONAL BUFFER AREAS. STORAGE THESE CHEMICALS IS NOT PERMITTED WITH 100' OF THE WETLAND RESOURCE AREA.

H. PROVISIONS FOR SOLID WASTE MANAGEMENT

1. WASTE MANAGEMENT PLAN
   a. RECYCLE MATERIALS WHENEVER POSSIBLE (PAPER, PLASTER CARDBOARD, METAL CANS). SEPARATE CONTAINERS FOR MATERIAL IS RECOMMENDED.
   b. DO NOT BURY WASTE AND DEBRIS ON SITE.
   c. CERTIFIED HAULERS WILL BE HIRED TO REMOVE THE DUMPSTER CONTAINER WASTE AS NEEDED. RECYCLING PRODUCTS WILL ALSO BE REMOVED OFF SITE WEEKLY.
   d. NO HAZARDOUS WASTE ARE TO BE DISPOSED OF IN THE ON-SITE DUMPSTER, AND MUST BE DISPOSED OF IN ACCORDANCE WITH ALL APPLICABLE REGULATIONS.

I. SNOW DISPOSAL AND PLOWING PLANS

SNOW STORAGE AREAS ARE DESIGNATED ON THE SITE PLAN. NO SNOW IS TO BE STORED WITHIN WETLAND RESOURCES, STORMWATER MANAGEMENT AREAS, OR PARKING SPACES. SNOW STORAGE SIGNS ARE TO BE PROVIDED ADJACENT TO THE WETLAND RESOURCE AREA AS SHOWN ON THE SITE PLAN. EXCESS SNOW THAT CANNOT BE STORED WITHIN THE DESIGNATED SNOW STORAGE AREAS IS TO BE REMOVED AND DISPOSED OF OFF-SITE WITHIN 72 HOURS.

J. WINTER ROAD SALT AND/OR SAND USE AND STORAGE RESTRICTIONS

NO SAND, SALT, OR CHEMICALS FOR DE-ICING WILL BE STORED OUTSIDE. NO DE-ICER SHALL BE USED WITHOUT THE AUTHORIZATION OF THE FRANKLIN CONSERVATION COMMISSION. CALCIUM CHLORIDE IS PROPOSED FOR USE AS THE PRIMARY DE-ICING CHEMICAL.

K. PAVEMENT SWEEPING SCHEDULES

SWEEPING, THE ACT OF CLEANING PAVEMENT CAN BE DONE BY MECHANICAL SWEEPERS, VACUUM SWEEPER OR HAND SWEEPER. THE QUANTITY OF SAND IS A DIRECT CORRELATION WITH THE TREATMENT OF ICE AND SNOW AND THE TYPES OF CHEMICALS AND SPREADERS THAT ARE BEING USED ON SITE TO MANAGE SNOW. IF A LIQUID DE-ICER SUCH AS CALCIUM CHLORIDE IS USED AS A PRETREATMENT TO NEW EVENTS THE AMOUNT OF SAND IS MINIMIZED. SWEEPING FOR THIS SITE SHOULD BE DONE SEMI-ANNUALLY AT A MINIMUM. COLLECTING THE PARTICULATE BEFORE IT ENTERS THE CATCH BASINS IS CHEAPER AND MORE ENVIRONMENTALLY FRIENDLY THAN IN A CATCH BASIN MIXING WITH OILS AND GREASES IN THE SURFACE WATER RUNOFF IN CATCH BASINS.

L. PROVISIONS FOR PREVENTION OF ILLICIT DISCHARGES TO THE STORMWATER MANAGEMENT SYSTEM

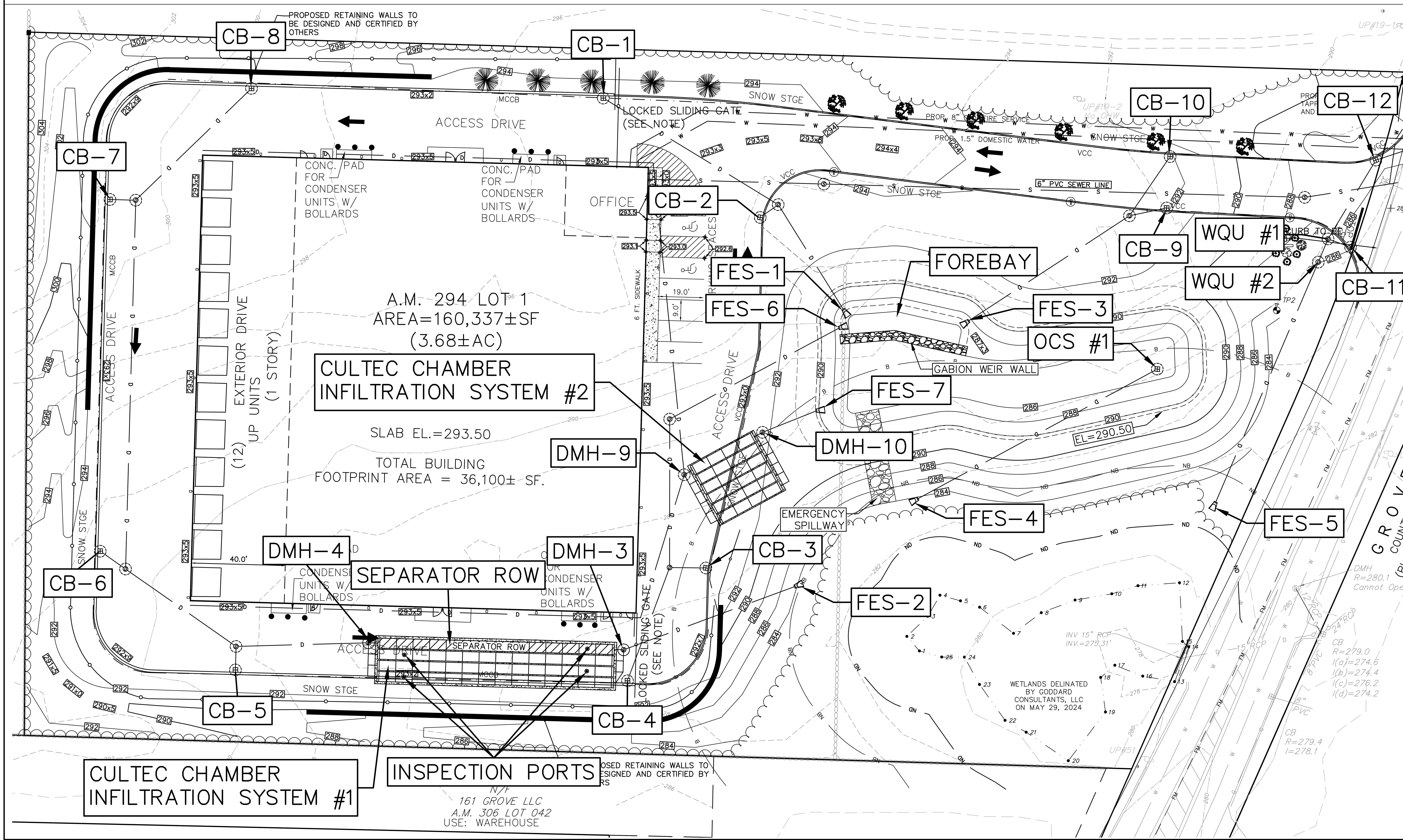
THE DISCHARGE INTO THE STORMWATER SYSTEM IS NOT BEING VIOLATED, SEE ATTACHMENT FOR ILLICIT DISCHARGES COMPLIANCE.

M. TRAINING THE STAFF OR PERSONNEL INVOLVED WITH IMPLEMENTING LONG-TERM POLLUTION PREVENTION PLAN CONDITIONS. THE OWNER SHALL DEVELOP POLICIES AND PROCEDURES FOR CONTAINING THE ILLICIT SPILLING OF OILS, SODA, BEER, PAPER, AND LITTER. THESE WASTES PROVIDE A DEGRADING OF THE WATER QUALITY. THE PLACEMENT OF SIGNS AND TRASH BARRELS WITH LIDS AROUND THE SITE WOULD CONTRIBUTE TO CLEAN WATER QUALITY SITE CONDITIONS.

N. LIST OF EMERGENCY CONTACTS FOR IMPLEMENTING LONG-TERM POLLUTION PREVENTION PLAN:

JEM PARTNERS LLC (C/O MARK YADASERNIA)
599 WASHINGTON STREET
FRANKLIN, MA 02038
TEL: XXX-XXX-XXXX310-415-6804
EMAIL: MARKYADA@YAHOO.COM

BMP	ESTIMATED MAINTENANCE COST
PAVEMENT SWEEPING	$ 400 PER YEAR
CATCH BASIN CLEANING	$ 200 PER CATCH BASIN PER CLEANING
SEDIMENT FOREBAY & INFILTRATION BASIN	$ 200 PER CLEANING
CONTECH HYDRODYNAMIC SEPARATORS	$ 500 PER MANHOLE PER CLEANING
SEPARATOR ROW & INFILTRATION CHAMBERS	$ 1,000 PER CLEANING PER CHAMBER SYSTEM
SPILL CONTAINMENT KIT	$ 750 PURCHASE PRICE



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LEGAL NOTES

UTILITIES ARE PLOTTED AS A COMPILATION OF RECORD DOCUMENTS, MARKINGS AND OTHER OBSERVED EVIDENCE TO DEVELOP A VIEW OF THE UNDERGROUND UTILITIES AND SHOULD BE CONSIDERED APPROXIMATE LACKING EXCAVATION. THE EXACT LOCATION OF UNDERGROUND FEATURES CANNOT BE ACCURATELY, COMPLETELY AND RELIABLY DEPICTED. ADDITIONAL UTILITIES, NOT EVIDENCED BY RECORD DOCUMENTS OR OBSERVED PHYSICAL EVIDENCE, MAY EXIST. CONTRACTORS (IN ACCORDANCE WITH MASS.G.L. CHAPTER 82 SECTION 40 AS AMENDED) MUST CONTACT ALL UTILITY COMPANIES BEFORE EXCAVATING AND DRILLING AND CALL DIGSAFE AT 1(888)DIG-SAFE{7233}.

CONSTRUCTION ON THIS LAND IS SUBJECT TO ANY EASEMENTS, RIGHTS-OF-WAY, RESTRICTIONS, RESERVATIONS, OR OTHER LIMITATIONS WHICH MAY BE REVEALED BY AN EXAMINATION OF THE TITLE.

OWNER

JEM PARTNERS LLC
599 WASHINGTON STREET
FRANKLIN, MA. 02038

DEED BOOK 42015 PAGE 493
A.M. 294 LOT 1

OPERATIONS AND MAINTENANCE PLAN FOR SELF STORAGE BUILDING
151 GROVE STREET
FRANKLIN MASSACHUSETTS

O&M PLAN

JANUARY 8, 2025

DATE	REVISION DESCRIPTION
4/10/2025	PER PLANNING & CONSV. COMMENTS

GRAPHIC SCALE: 1"=30'
0 10 20 30 40 50 75 FEET
0 5 10 15 20 25 METERS

Guerriere & Halnon, Inc.
ENGINEERING & LAND SURVEYING
55 WEST CENTRAL ST. FRANKLIN, MA 02038
PH. (508) 528-3221
FX. (508) 528-7921
www.gandhengineering.com

SHEET 1 OF 1
JOB NO. F4683

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

Standard 10 prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site, including stormwater best management practices and any pipes intended to transport stormwater to the ground water, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

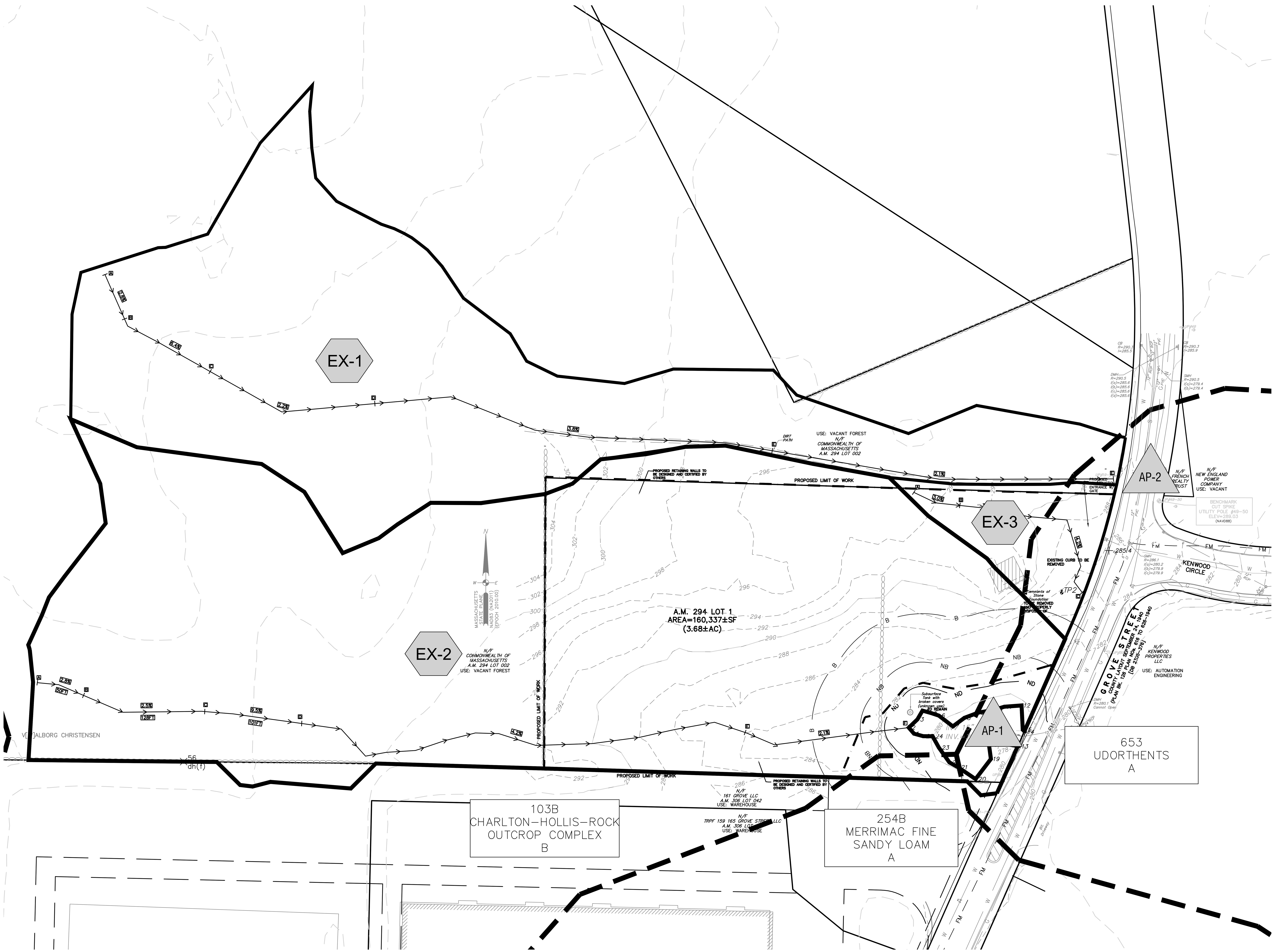
Illicit Discharge Compliance Statement

It is the intent of the Applicant, JEM Partners LLC, 599 Washington Street, Franklin, MA 02038 to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. There will be no connection to the storm water system to inadvertently direct other types of liquids, chemicals or solids into the storm drainage system. The Owner will also promote a clean Green Environment by mitigating spills onto pavements; oils, soda, chemicals, pet waste, debris and litter.

Respectfully Acknowledged,

WATERSHED PLAN

Pre and Post Development Conditions



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APPROVED DATE:

FRANKLIN PLANNING BOARD

BEING A MAJORITY

LEGAL NOTES

UTILITIES ARE PLOTTED AS A COMPILATION OF RECORD DOCUMENTS, MARKINGS AND OTHER OBSERVED EVIDENCE TO DEVELOP A VIEW OF THE UNDERGROUND UTILITIES AND SHOULD BE CONSIDERED APPROXIMATE LACKING EXCAVATION. THE EXACT LOCATION OF UNDERGROUND FEATURES CANNOT BE ACCURATELY, COMPLETELY AND RELIABLY DEPICTED. ADDITIONAL UTILITIES, NOT EVIDENCED BY RECORD DOCUMENTS OR OBSERVED PHYSICAL EVIDENCE, MAY EXIST. CONTRACTORS (IN ACCORDANCE WITH MASS.G.L. CHAPTER 82 SECTION 40 AS AMENDED) MUST CONTACT ALL UTILITY COMPANIES BEFORE EXCAVATING AND DRILLING AND CALL DIGSAFE AT 1(888)DIG-SAFE{7233}.

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OWNER

JEM PARTNERS LLC
599 WASHINGTON STREET
FRANKLIN, MA. 02038

DEED BOOK 42015 PAGE 493
A.M. 294 LOT 1

SITE PLAN AND SPECIAL PERMIT FOR GUARDIAN SELF STORAGE II 151 GROVE STREET FRANKLIN MASSACHUSETTS

PRE-DEVELOPMENT WATERSHED PLAN

JANUARY 8, 2025

DATE	REVISION DESCRIPTION
4/10/2025	PER PLANNING AND CONSV. COMMENTS

GRAPHIC SCALE: 1"=50'

Guerriere & Halnon, Inc.
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SHEET 1 OF 1

JOB NO. F4683

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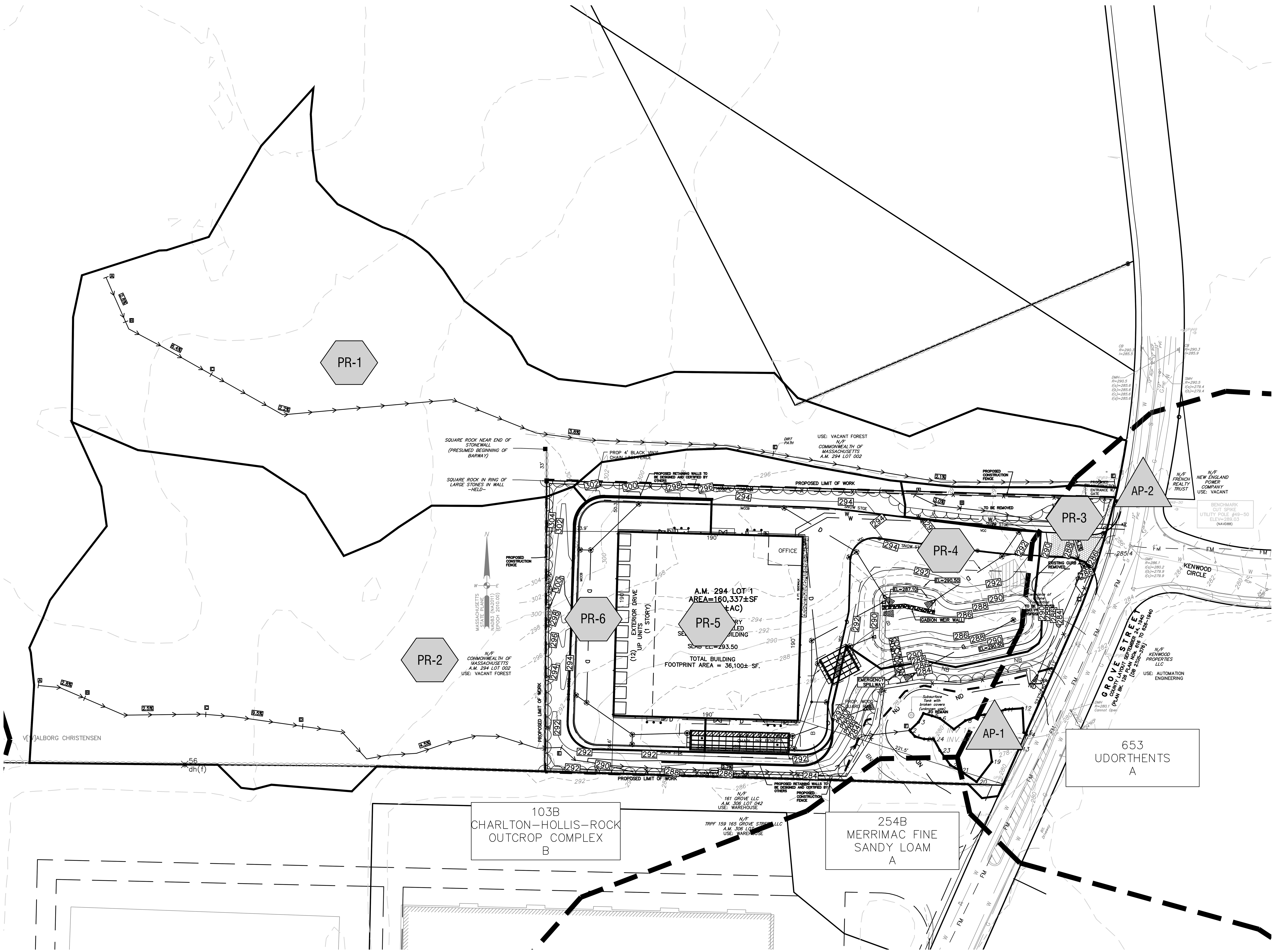

APPROVED DATE:

FRANKLIN PLANNING BOARD

BEING A MAJORITY

LEGAL NOTES

UTILITIES ARE PLOTTED AS A COMPILATION OF RECORD DOCUMENTS, MARKINGS AND OTHER OBSERVED EVIDENCE TO DEVELOP A VIEW OF THE UNDERGROUND UTILITIES AND SHOULD BE CONSIDERED APPROXIMATE. LACKING EXCAVATION, THE EXACT LOCATION OF UNDERGROUND FEATURES CANNOT BE ACCURATELY, COMPLETELY AND RELIABLY DEPICTED. ADDITIONAL UTILITIES, NOT EVIDENCED BY RECORD DOCUMENTS OR OBSERVED PHYSICAL EVIDENCE, MAY EXIST. CONTRACTORS (IN ACCORDANCE WITH MASS.G.L. CHAPTER 82 SECTION 40 AS AMENDED) MUST CONTACT ALL UTILITY COMPANIES BEFORE EXCAVATING AND DRILLING AND CALL DIGSAFE AT 1(888)DIG-SAFE{7233}.

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OWNER

JEM PARTNERS LLC
599 WASHINGTON STREET
FRANKLIN, MA. 02038

DEED BOOK 42015 PAGE 493
A.M. 294 LOT 1

SITE PLAN AND SPECIAL PERMIT FOR GUARDIAN SELF STORAGE II 151 GROVE STREET FRANKLIN MASSACHUSETTS

POST-DEVELOPMENT WATERSHED PLAN

JANUARY 8, 2025

DATE	REVISION DESCRIPTION
4/10/2025	PER PLANNING AND CONSV. COMMENTS

GRAPHIC SCALE: 1"=50'

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SHEET 1 OF 1

JOB NO. F4683

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<u>DRAINAGE ANALYSIS</u>

HydroCAD Calculations – Pre-Post Development Conditions

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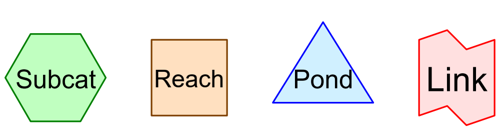


Routing Diagram for F4683 PRE
Prepared by Guerriere & Halnon Inc, Printed 4/16/2025
HydroCAD® 10.20-5c s/n 00417 © 2023 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC	P2 (inches)
1	2-Year	NOAA10 24-hr	D	Default	24.00	1	3.36	2	3.36
2	10-Year	NOAA10 24-hr	D	Default	24.00	1	5.22	2	5.22
3	25-Year	NOAA10 24-hr	D	Default	24.00	1	6.39	2	6.39
4	100-Year	NOAA10 24-hr	D	Default	24.00	1	8.18	2	8.18

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.445	30	Woods, Good, HSG A (EX-1, EX-2, EX-3)
10.589	55	Woods, Good, HSG B (EX-1, EX-2, EX-3)
11.034	**54**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.445	HSG A	EX-1, EX-2, EX-3
10.589	HSG B	EX-1, EX-2, EX-3
0.000	HSG C	
0.000	HSG D	
0.000	Other	
11.034		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.445	10.589	0.000	0.000	0.000	11.034	Woods, Good	EX-1, EX-2, EX-3
0.445	**10.589**	**0.000**	**0.000**	**0.000**	**11.034**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=3.846 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=1,108' Tc=31.2 min CN=55 Runoff=0.25 cfs 0.096 af

SubcatchmentEX-2: EX-2 Runoff Area=6.767 ac 0.00% Impervious Runoff Depth=0.27"
Flow Length=929' Tc=26.1 min CN=54 Runoff=0.36 cfs 0.152 af

SubcatchmentEX-3: EX-3 Runoff Area=0.421 ac 0.00% Impervious Runoff Depth=0.04"
Flow Length=243' Tc=13.3 min CN=43 Runoff=0.00 cfs 0.001 af

Pond AP-1: WETLANDS Inflow=0.36 cfs 0.152 af
Primary=0.36 cfs 0.152 af

Pond AP-2: GROVE STREET Inflow=0.25 cfs 0.097 af
Primary=0.25 cfs 0.097 af

Total Runoff Area = 11.034 ac Runoff Volume = 0.249 af Average Runoff Depth = 0.27"
100.00% Pervious = 11.034 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-1: EX-1

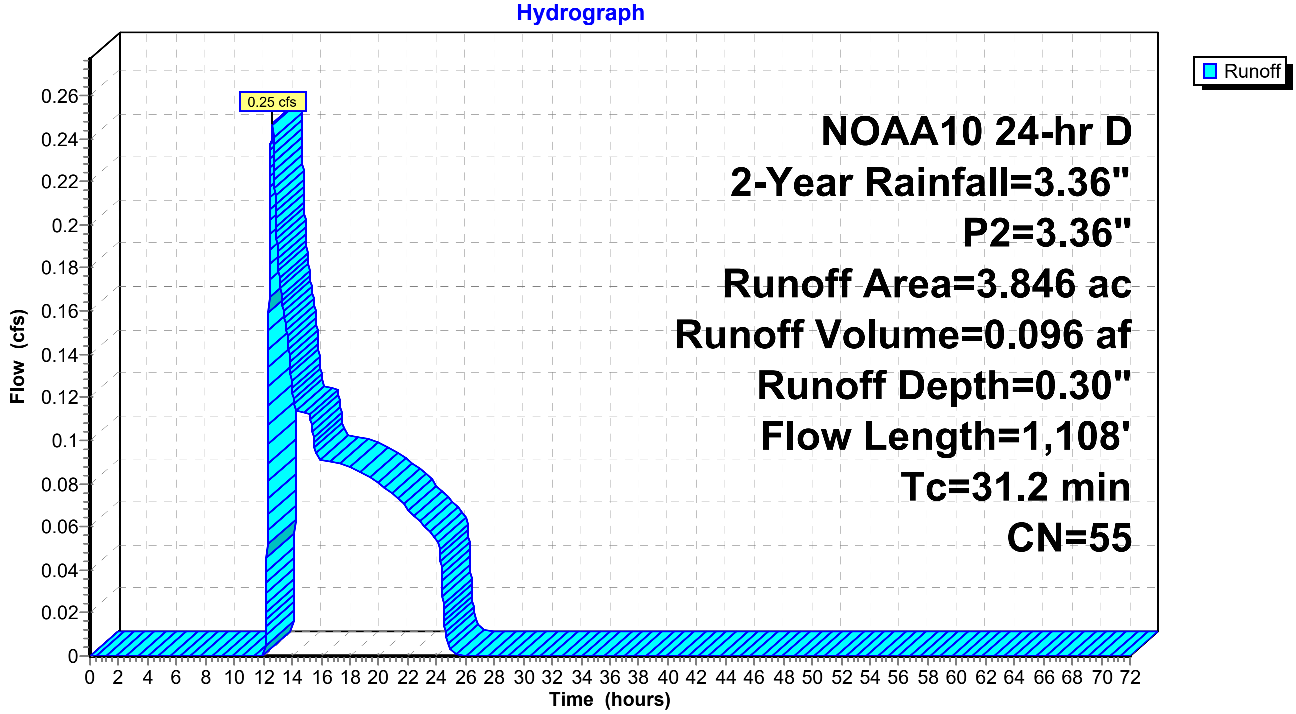
Runoff = 0.25 cfs @ 12.61 hrs, Volume= 0.096 af, Depth= 0.30"
Routed to Pond AP-2 : GROVE STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

Area (ac)	CN	Description
0.034	30	Woods, Good, HSG A
3.812	55	Woods, Good, HSG B
3.846	55	Weighted Average
3.846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0280	0.08		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.36"
1.4	105	0.0640	1.26		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
4.1	181	0.0220	0.74		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.1	418	0.0380	0.97		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
8.1	354	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
31.2	1,108	Total			

Subcatchment EX-1: EX-1



Summary for Subcatchment EX-2: EX-2

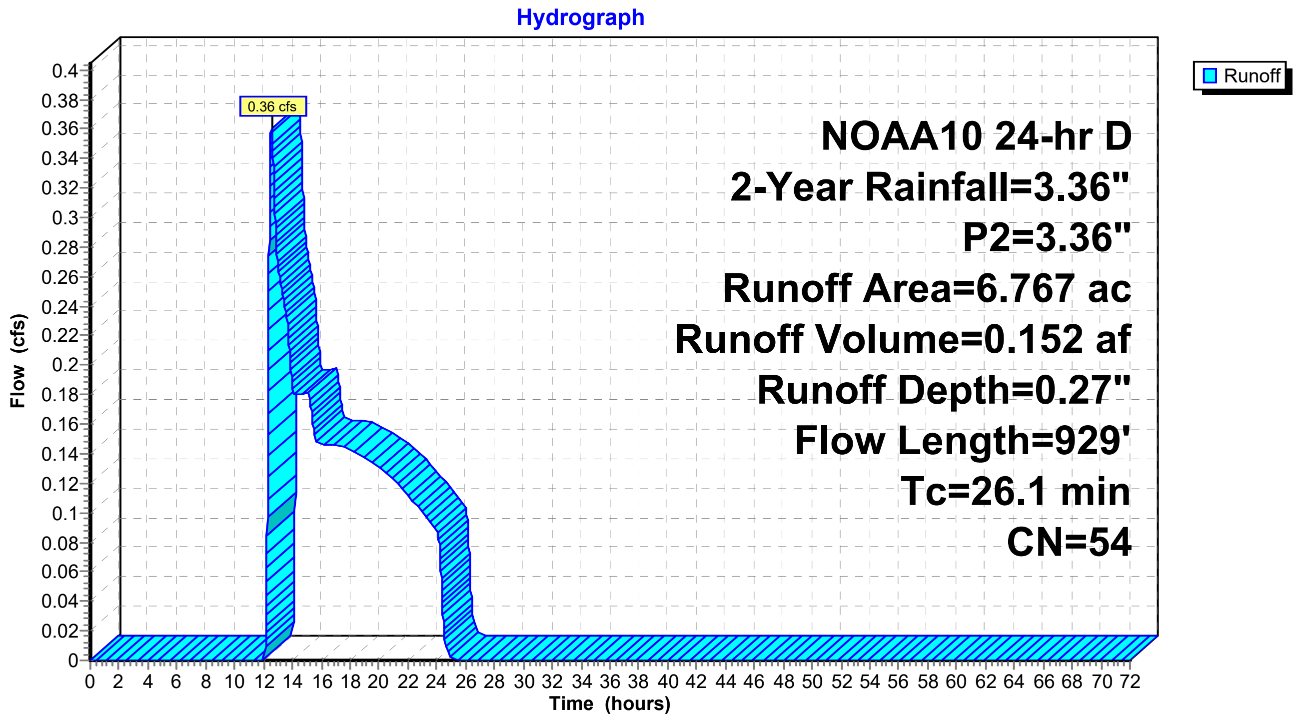
Runoff = 0.36 cfs @ 12.55 hrs, Volume= 0.152 af, Depth= 0.27"
Routed to Pond AP-1 : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

Area (ac)	CN	Description
0.055	30	Woods, Good, HSG A
0.153	30	Woods, Good, HSG A
6.559	55	Woods, Good, HSG B
6.767	54	Weighted Average
6.767		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0280	0.08		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.36"
2.7	128	0.0250	0.79		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.1	101	0.0950	1.54		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.8	478	0.0420	1.02		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
4.0	172	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
26.1	929	Total			

Subcatchment EX-2: EX-2



Summary for Subcatchment EX-3: EX-3

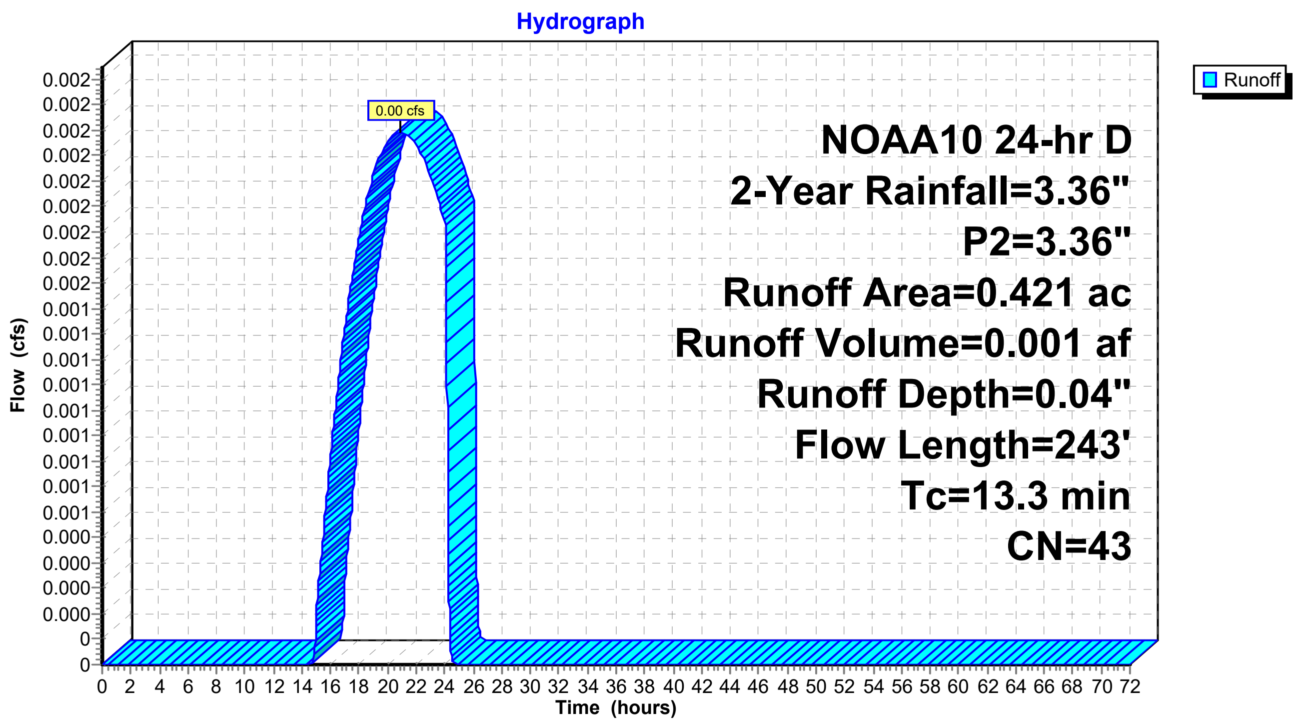
Runoff = 0.00 cfs @ 20.91 hrs, Volume= 0.001 af, Depth= 0.04"
Routed to Pond AP-2 : GROVE STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

Area (ac)	CN	Description
0.204	30	Woods, Good, HSG A
0.218	55	Woods, Good, HSG B
0.421	43	Weighted Average
0.421		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.36"
3.1	193	0.0420	1.02		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
13.3	243	Total			

Subcatchment EX-3: EX-3



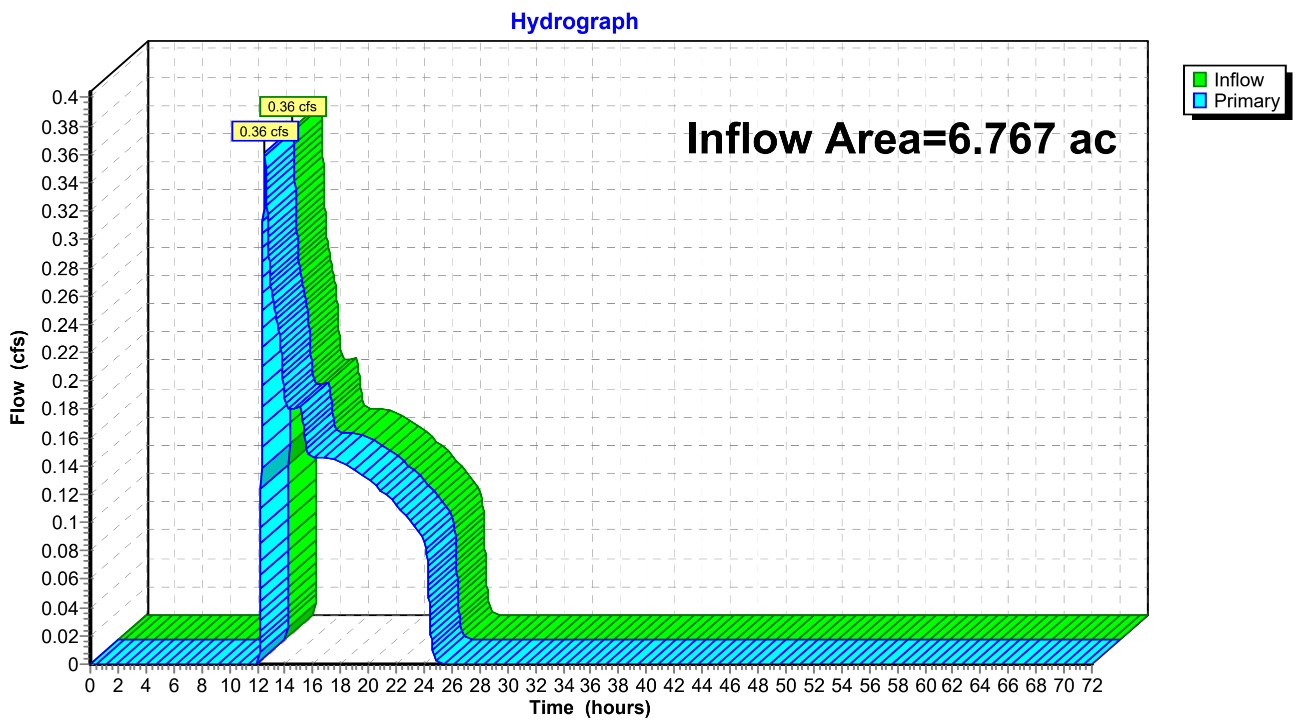
Summary for Pond AP-1: WETLANDS

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

Inflow Area =	6.767 ac,	0.00% Impervious, Inflow Depth = 0.27"	for 2-Year event	
Inflow =	0.36 cfs @	12.55 hrs, Volume=	0.152 af	
Primary =	0.36 cfs @	12.55 hrs, Volume=	0.152 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: WETLANDS



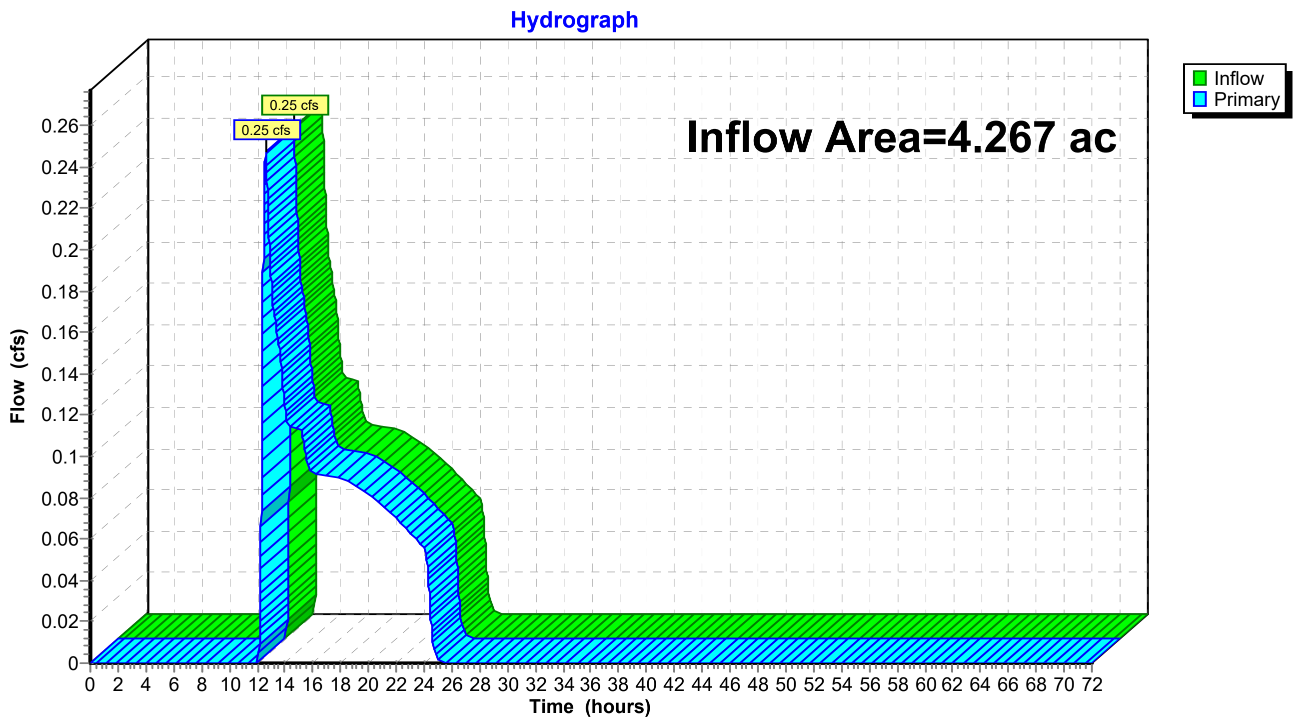
Summary for Pond AP-2: GROVE STREET

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

Inflow Area =	4.267 ac,	0.00% Impervious,	Inflow Depth = 0.27"	for 2-Year event
Inflow =	0.25 cfs @	12.61 hrs, Volume=	0.097 af	
Primary =	0.25 cfs @	12.61 hrs, Volume=	0.097 af, Atten= 0%, Lag= 0.0 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-2: GROVE STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=3.846 ac 0.00% Impervious Runoff Depth=1.09"
Flow Length=1,108' Tc=29.1 min CN=55 Runoff=2.08 cfs 0.350 af

SubcatchmentEX-2: EX-2 Runoff Area=6.767 ac 0.00% Impervious Runoff Depth=1.03"
Flow Length=929' Tc=24.0 min CN=54 Runoff=3.75 cfs 0.579 af

SubcatchmentEX-3: EX-3 Runoff Area=0.421 ac 0.00% Impervious Runoff Depth=0.42"
Flow Length=243' Tc=11.3 min CN=43 Runoff=0.05 cfs 0.015 af

Pond AP-1: WETLANDS Inflow=3.75 cfs 0.579 af
Primary=3.75 cfs 0.579 af

Pond AP-2: GROVE STREET Inflow=2.11 cfs 0.364 af
Primary=2.11 cfs 0.364 af

Total Runoff Area = 11.034 ac Runoff Volume = 0.944 af Average Runoff Depth = 1.03"
100.00% Pervious = 11.034 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-1: EX-1

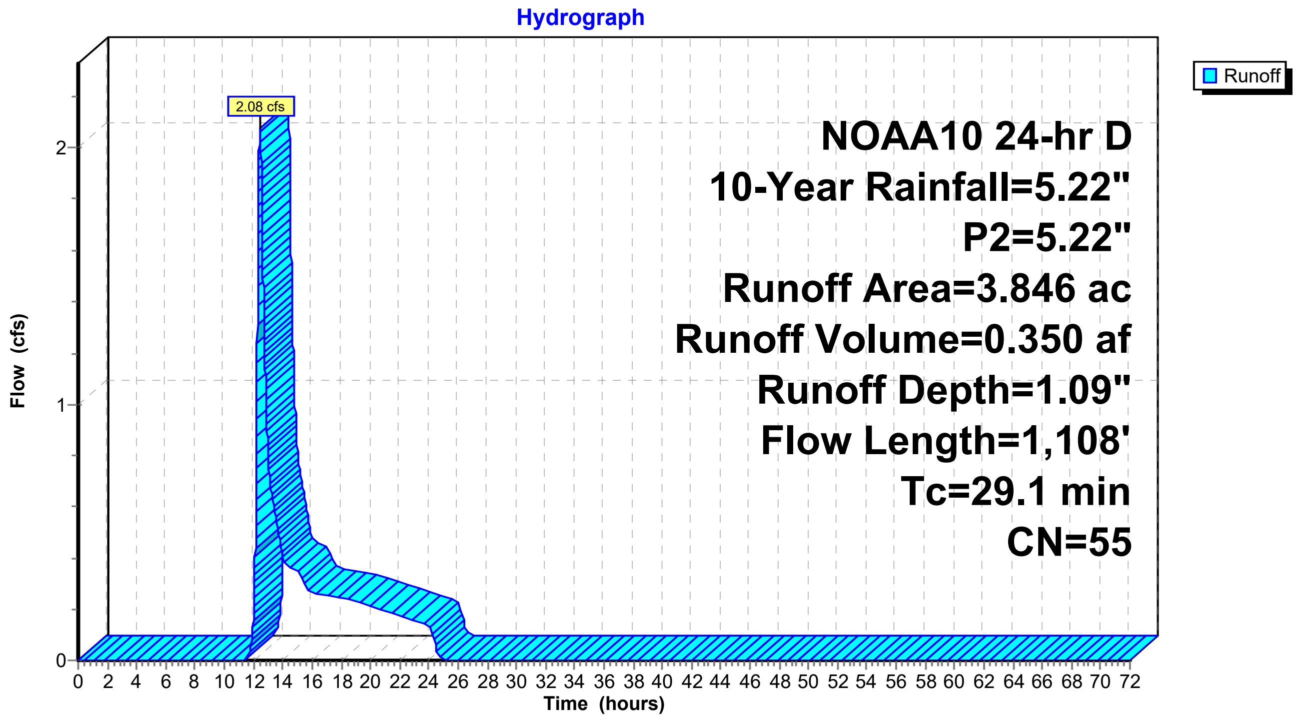
Runoff = 2.08 cfs @ 12.45 hrs, Volume= 0.350 af, Depth= 1.09"
Routed to Pond AP-2 : GROVE STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

Area (ac)	CN	Description
0.034	30	Woods, Good, HSG A
3.812	55	Woods, Good, HSG B
3.846	55	Weighted Average
3.846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0280	0.10		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 5.22"
1.4	105	0.0640	1.26		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
4.1	181	0.0220	0.74		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.1	418	0.0380	0.97		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
8.1	354	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
29.1	1,108	Total			

Subcatchment EX-1: EX-1



Summary for Subcatchment EX-2: EX-2

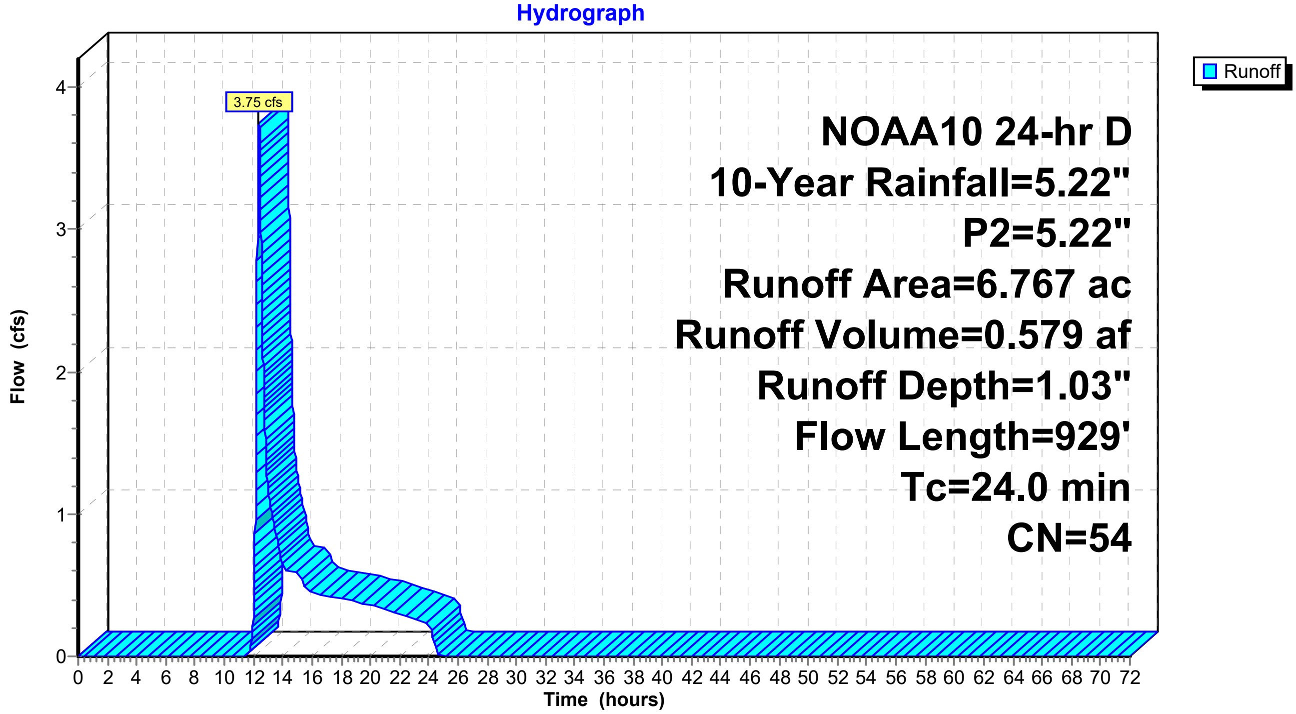
Runoff = 3.75 cfs @ 12.37 hrs, Volume= 0.579 af, Depth= 1.03"
Routed to Pond AP-1 : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

Area (ac)	CN	Description
0.055	30	Woods, Good, HSG A
0.153	30	Woods, Good, HSG A
6.559	55	Woods, Good, HSG B
6.767	54	Weighted Average
6.767		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0280	0.10		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 5.22"
2.7	128	0.0250	0.79		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.1	101	0.0950	1.54		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.8	478	0.0420	1.02		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
4.0	172	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
24.0	929	Total			

Subcatchment EX-2: EX-2



Summary for Subcatchment EX-3: EX-3

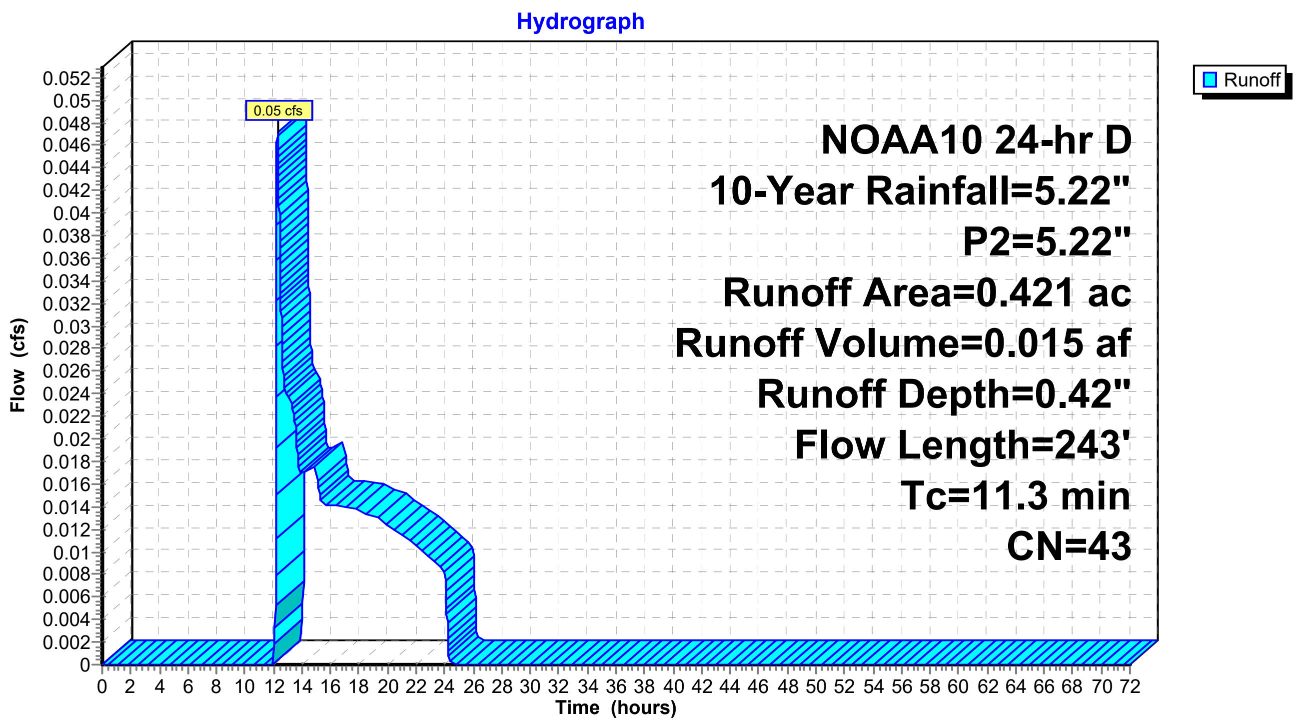
Runoff = 0.05 cfs @ 12.27 hrs, Volume= 0.015 af, Depth= 0.42"
Routed to Pond AP-2 : GROVE STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

Area (ac)	CN	Description
0.204	30	Woods, Good, HSG A
0.218	55	Woods, Good, HSG B
0.421	43	Weighted Average
0.421		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0300	0.10		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 5.22"
3.1	193	0.0420	1.02		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
11.3	243	Total			

Subcatchment EX-3: EX-3



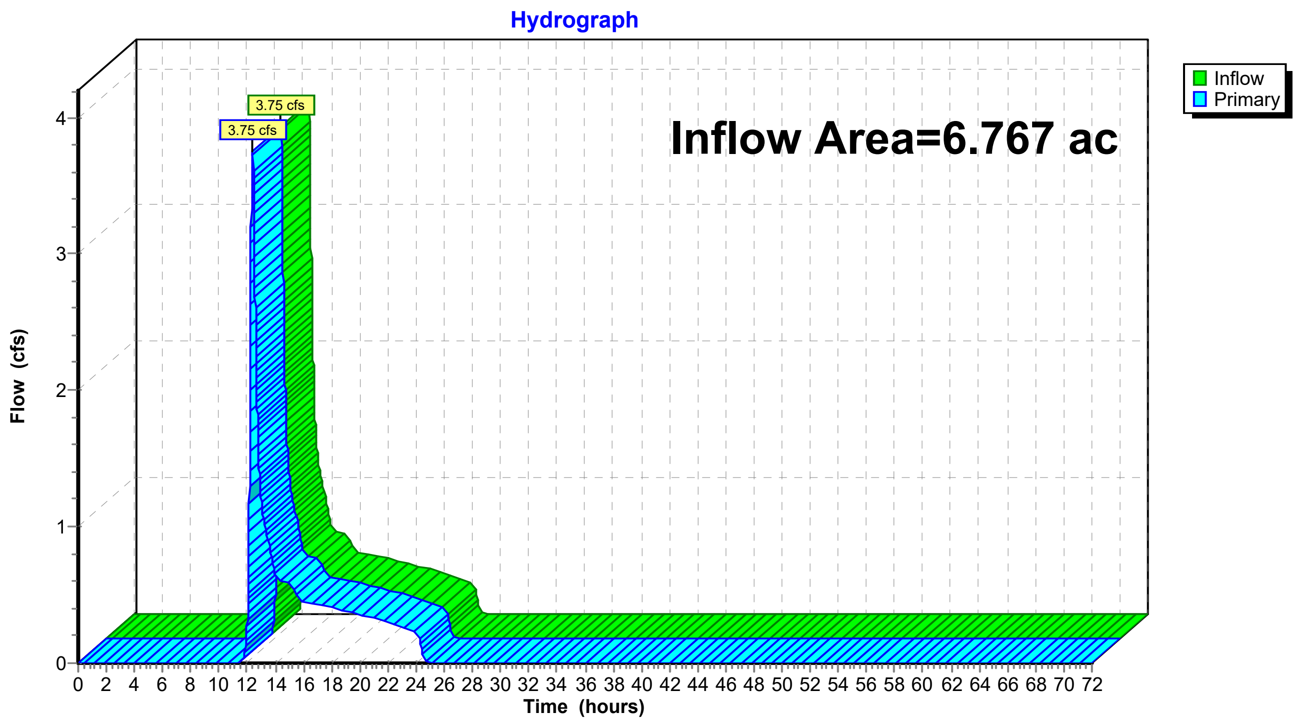
Summary for Pond AP-1: WETLANDS

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

Inflow Area =	6.767 ac,	0.00% Impervious, Inflow Depth = 1.03"	for 10-Year event	
Inflow =	3.75 cfs @	12.37 hrs, Volume=	0.579 af	
Primary =	3.75 cfs @	12.37 hrs, Volume=	0.579 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: WETLANDS



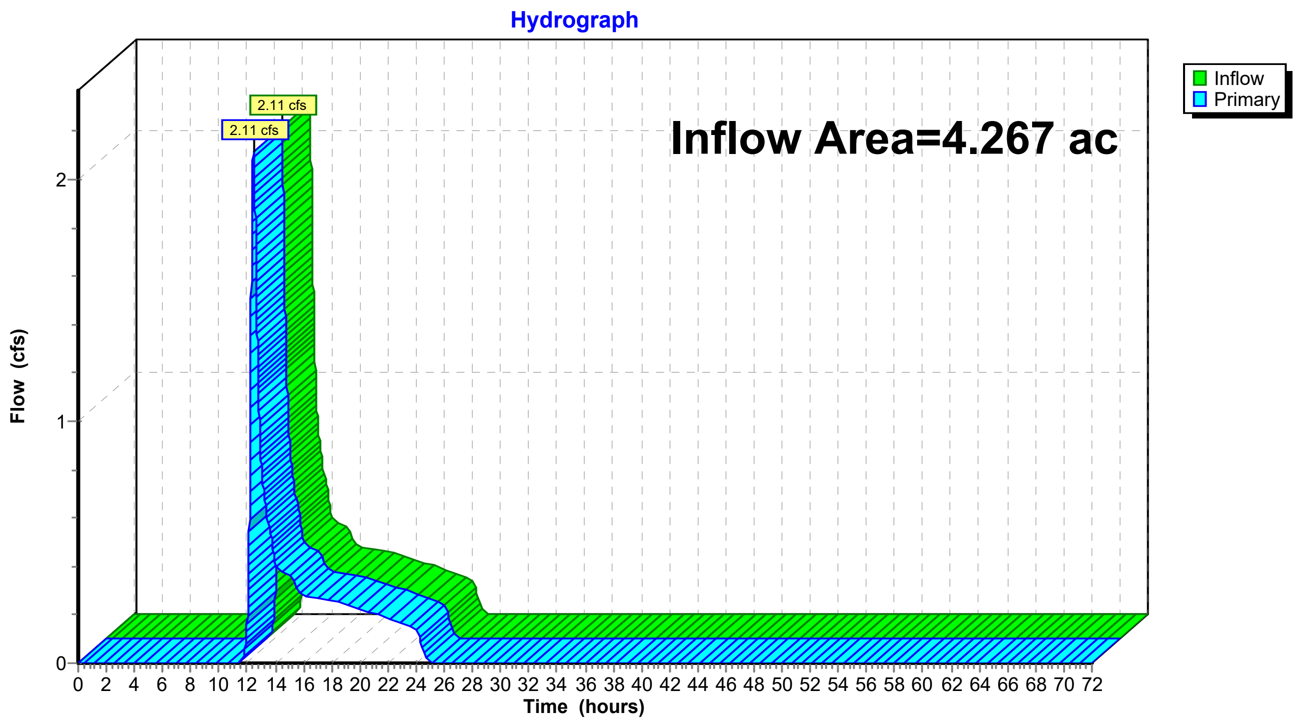
Summary for Pond AP-2: GROVE STREET

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

Inflow Area = 4.267 ac, 0.00% Impervious, Inflow Depth = 1.02" for 10-Year event
Inflow = 2.11 cfs @ 12.45 hrs, Volume= 0.364 af
Primary = 2.11 cfs @ 12.45 hrs, Volume= 0.364 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-2: GROVE STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=3.846 ac 0.00% Impervious Runoff Depth=1.75"
Flow Length=1,108' Tc=28.3 min CN=55 Runoff=3.76 cfs 0.560 af

SubcatchmentEX-2: EX-2 Runoff Area=6.767 ac 0.00% Impervious Runoff Depth=1.66"
Flow Length=929' Tc=23.2 min CN=54 Runoff=6.96 cfs 0.938 af

SubcatchmentEX-3: EX-3 Runoff Area=0.421 ac 0.00% Impervious Runoff Depth=0.82"
Flow Length=243' Tc=10.5 min CN=43 Runoff=0.21 cfs 0.029 af

Pond AP-1: WETLANDS Inflow=6.96 cfs 0.938 af
Primary=6.96 cfs 0.938 af

Pond AP-2: GROVE STREET Inflow=3.86 cfs 0.589 af
Primary=3.86 cfs 0.589 af

Total Runoff Area = 11.034 ac Runoff Volume = 1.527 af Average Runoff Depth = 1.66"
100.00% Pervious = 11.034 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-1: EX-1

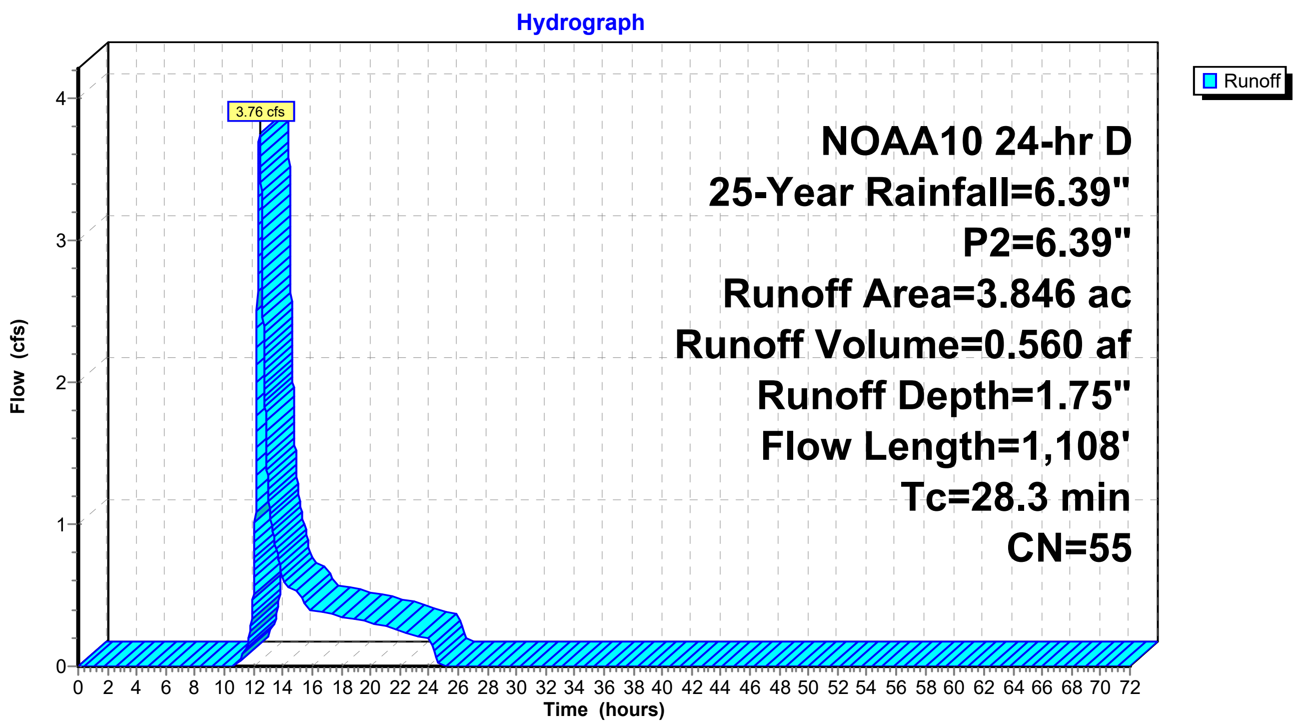
Runoff = 3.76 cfs @ 12.42 hrs, Volume= 0.560 af, Depth= 1.75"
Routed to Pond AP-2 : GROVE STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

Area (ac)	CN	Description
0.034	30	Woods, Good, HSG A
3.812	55	Woods, Good, HSG B
3.846	55	Weighted Average
3.846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0280	0.11		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 6.39"
1.4	105	0.0640	1.26		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
4.1	181	0.0220	0.74		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.1	418	0.0380	0.97		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
8.1	354	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
28.3	1,108	Total			

Subcatchment EX-1: EX-1



Summary for Subcatchment EX-2: EX-2

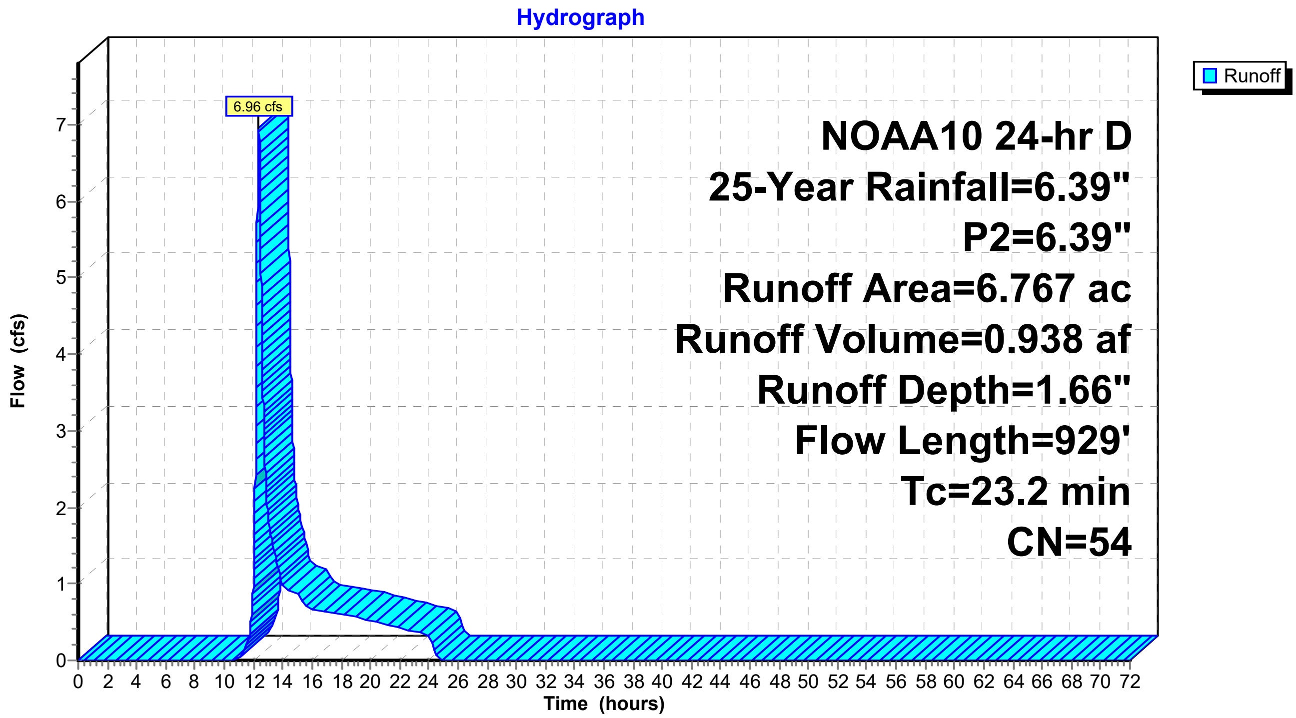
Runoff = 6.96 cfs @ 12.35 hrs, Volume= 0.938 af, Depth= 1.66"
Routed to Pond AP-1 : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

Area (ac)	CN	Description
0.055	30	Woods, Good, HSG A
0.153	30	Woods, Good, HSG A
6.559	55	Woods, Good, HSG B
6.767	54	Weighted Average
6.767		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0280	0.11		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 6.39"
2.7	128	0.0250	0.79		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.1	101	0.0950	1.54		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.8	478	0.0420	1.02		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
4.0	172	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
23.2	929	Total			

Subcatchment EX-2: EX-2



Summary for Subcatchment EX-3: EX-3

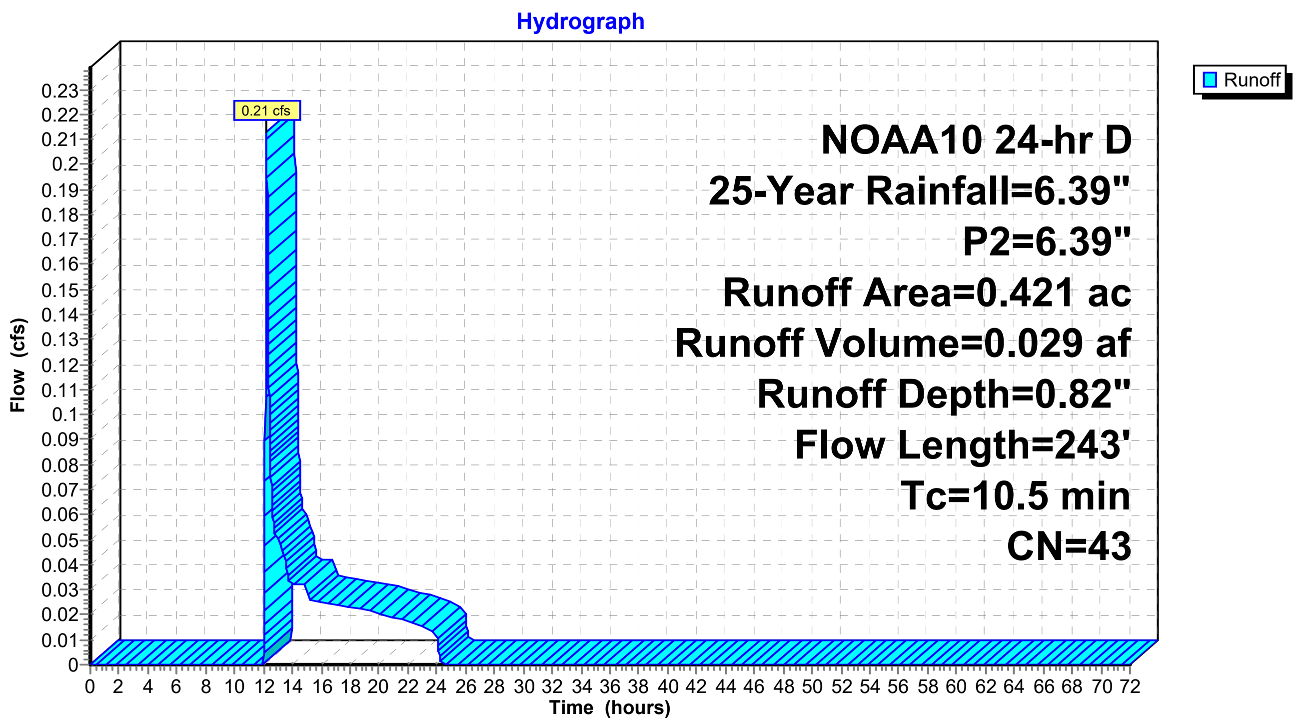
Runoff = 0.21 cfs @ 12.21 hrs, Volume= 0.029 af, Depth= 0.82"
Routed to Pond AP-2 : GROVE STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

Area (ac)	CN	Description
0.204	30	Woods, Good, HSG A
0.218	55	Woods, Good, HSG B
0.421	43	Weighted Average
0.421		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0300	0.11		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 6.39"
3.1	193	0.0420	1.02		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
10.5	243	Total			

Subcatchment EX-3: EX-3



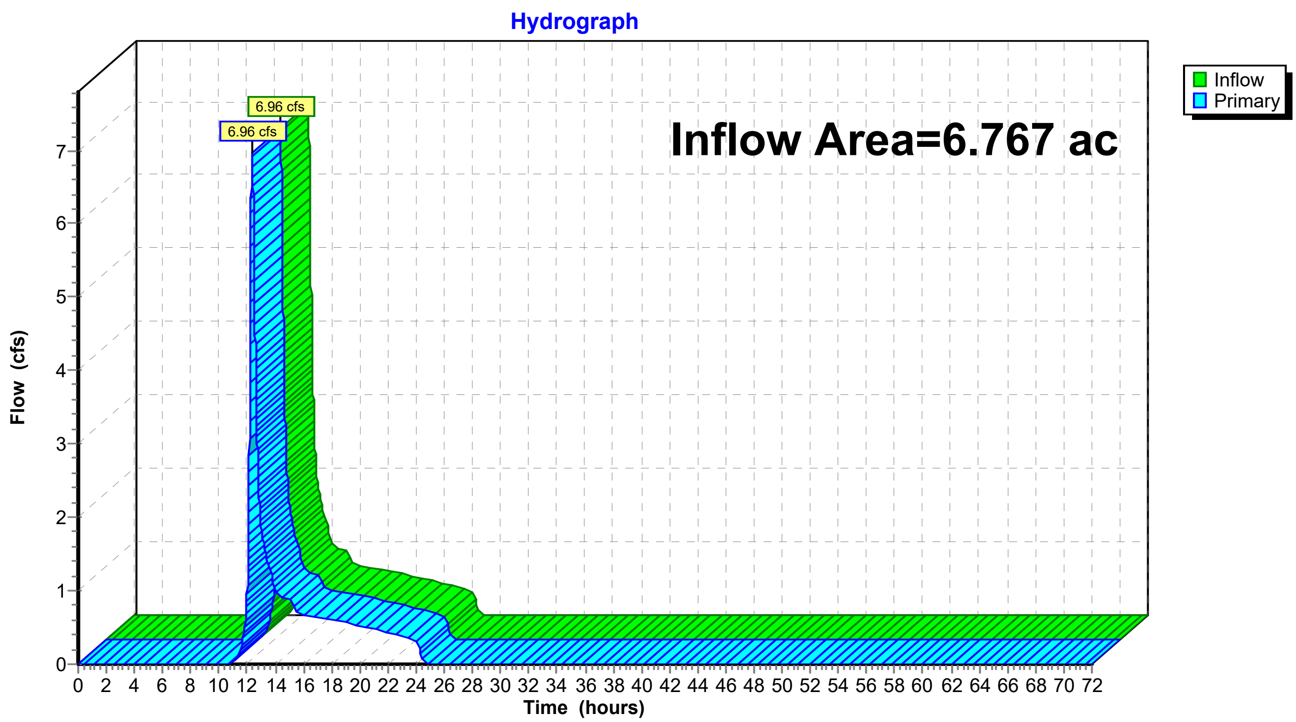
Summary for Pond AP-1: WETLANDS

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

Inflow Area = 6.767 ac, 0.00% Impervious, Inflow Depth = 1.66" for 25-Year event
Inflow = 6.96 cfs @ 12.35 hrs, Volume= 0.938 af
Primary = 6.96 cfs @ 12.35 hrs, Volume= 0.938 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: WETLANDS



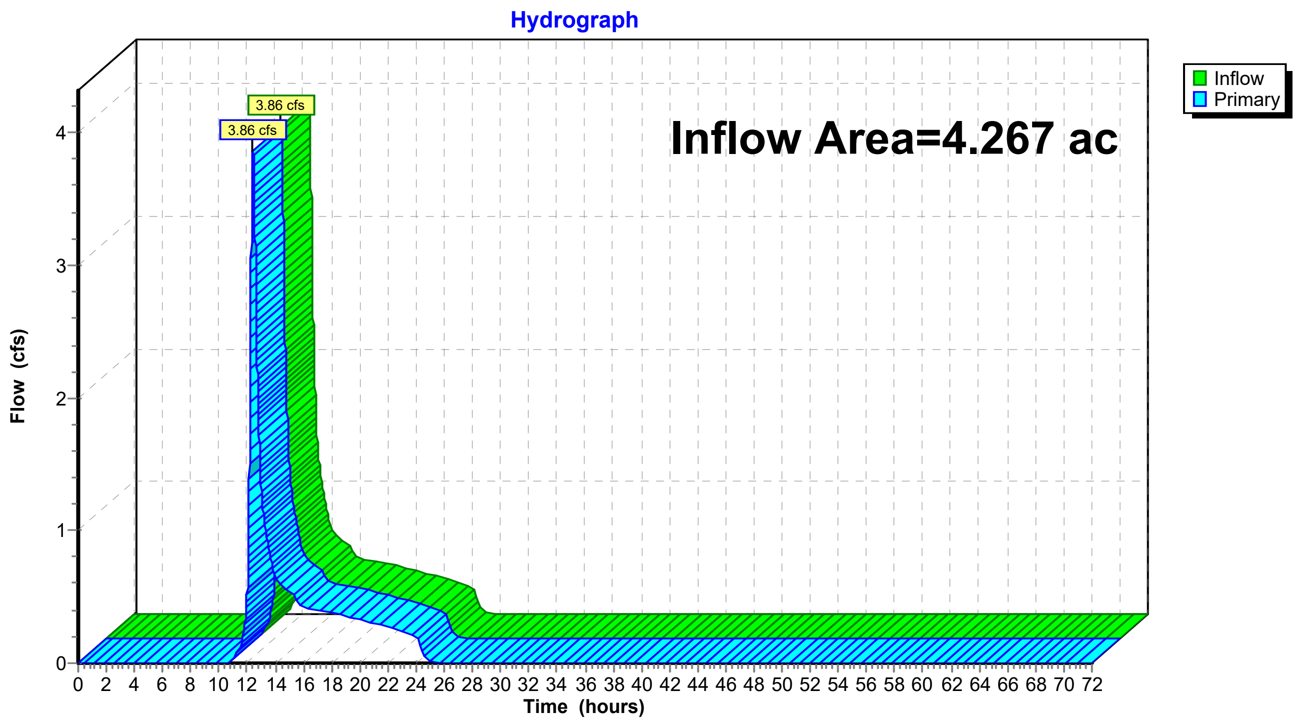
Summary for Pond AP-2: GROVE STREET

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

Inflow Area =	4.267 ac,	0.00% Impervious, Inflow Depth = 1.66"	for 25-Year event
Inflow =	3.86 cfs @	12.42 hrs, Volume=	0.589 af
Primary =	3.86 cfs @	12.42 hrs, Volume=	0.589 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-2: GROVE STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=3.846 ac 0.00% Impervious Runoff Depth=2.91"
Flow Length=1,108' Tc=27.4 min CN=55 Runoff=6.78 cfs 0.932 af

SubcatchmentEX-2: EX-2 Runoff Area=6.767 ac 0.00% Impervious Runoff Depth=2.80"
Flow Length=929' Tc=22.3 min CN=54 Runoff=12.80 cfs 1.577 af

SubcatchmentEX-3: EX-3 Runoff Area=0.421 ac 0.00% Impervious Runoff Depth=1.63"
Flow Length=243' Tc=9.7 min CN=43 Runoff=0.61 cfs 0.057 af

Pond AP-1: WETLANDS Inflow=12.80 cfs 1.577 af
Primary=12.80 cfs 1.577 af

Pond AP-2: GROVE STREET Inflow=7.01 cfs 0.989 af
Primary=7.01 cfs 0.989 af

Total Runoff Area = 11.034 ac Runoff Volume = 2.566 af Average Runoff Depth = 2.79"
100.00% Pervious = 11.034 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-1: EX-1

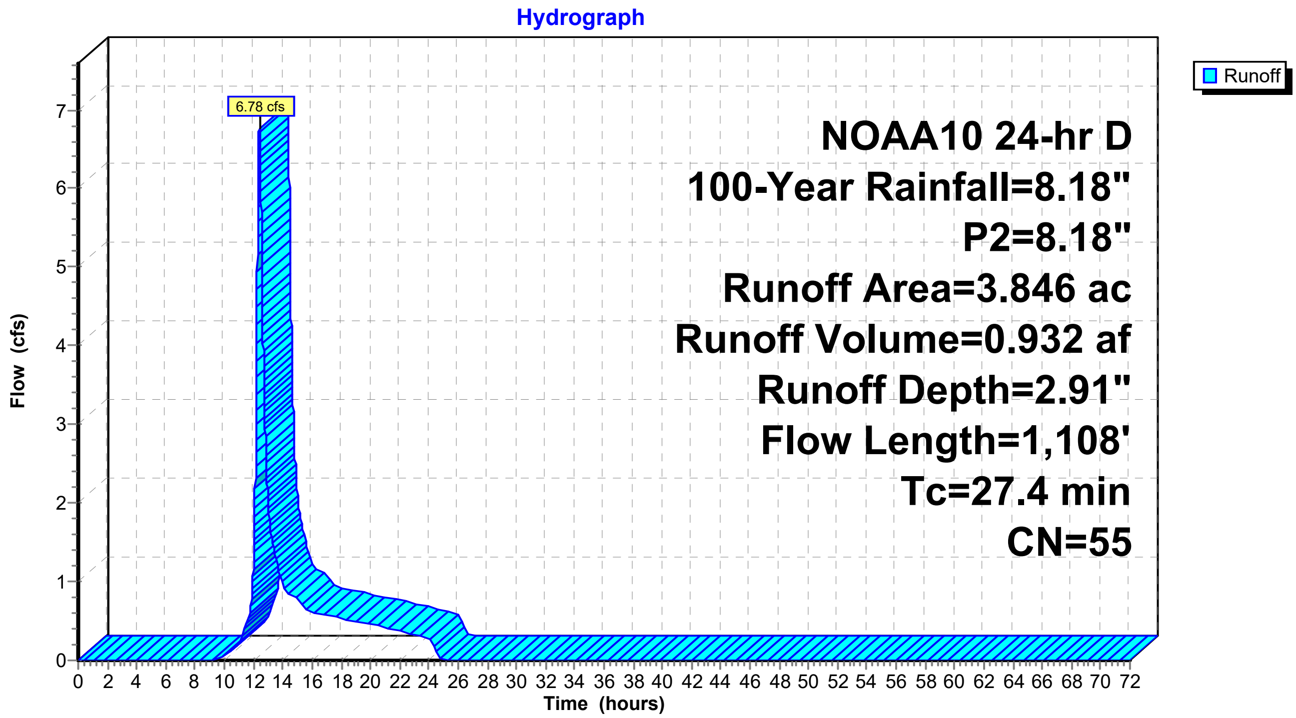
Runoff = 6.78 cfs @ 12.39 hrs, Volume= 0.932 af, Depth= 2.91"
Routed to Pond AP-2 : GROVE STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

Area (ac)	CN	Description
0.034	30	Woods, Good, HSG A
3.812	55	Woods, Good, HSG B
3.846	55	Weighted Average
3.846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0280	0.12		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 8.18"
1.4	105	0.0640	1.26		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
4.1	181	0.0220	0.74		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.1	418	0.0380	0.97		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
8.1	354	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
27.4	1,108	Total			

Subcatchment EX-1: EX-1



Summary for Subcatchment EX-2: EX-2

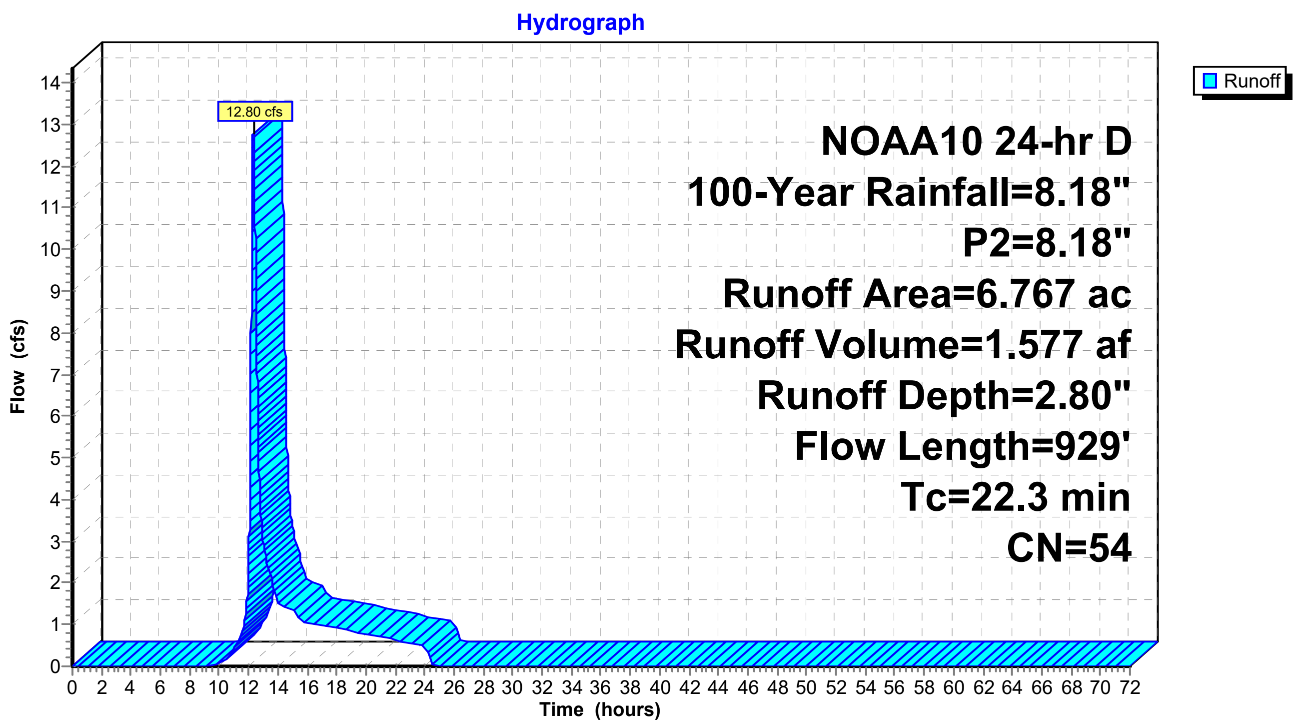
Runoff = 12.80 cfs @ 12.32 hrs, Volume= 1.577 af, Depth= 2.80"
Routed to Pond AP-1 : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

Area (ac)	CN	Description
0.055	30	Woods, Good, HSG A
0.153	30	Woods, Good, HSG A
6.559	55	Woods, Good, HSG B
6.767	54	Weighted Average
6.767		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0280	0.12		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 8.18"
2.7	128	0.0250	0.79		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.1	101	0.0950	1.54		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.8	478	0.0420	1.02		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
4.0	172	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
22.3	929	Total			

Subcatchment EX-2: EX-2



Summary for Subcatchment EX-3: EX-3

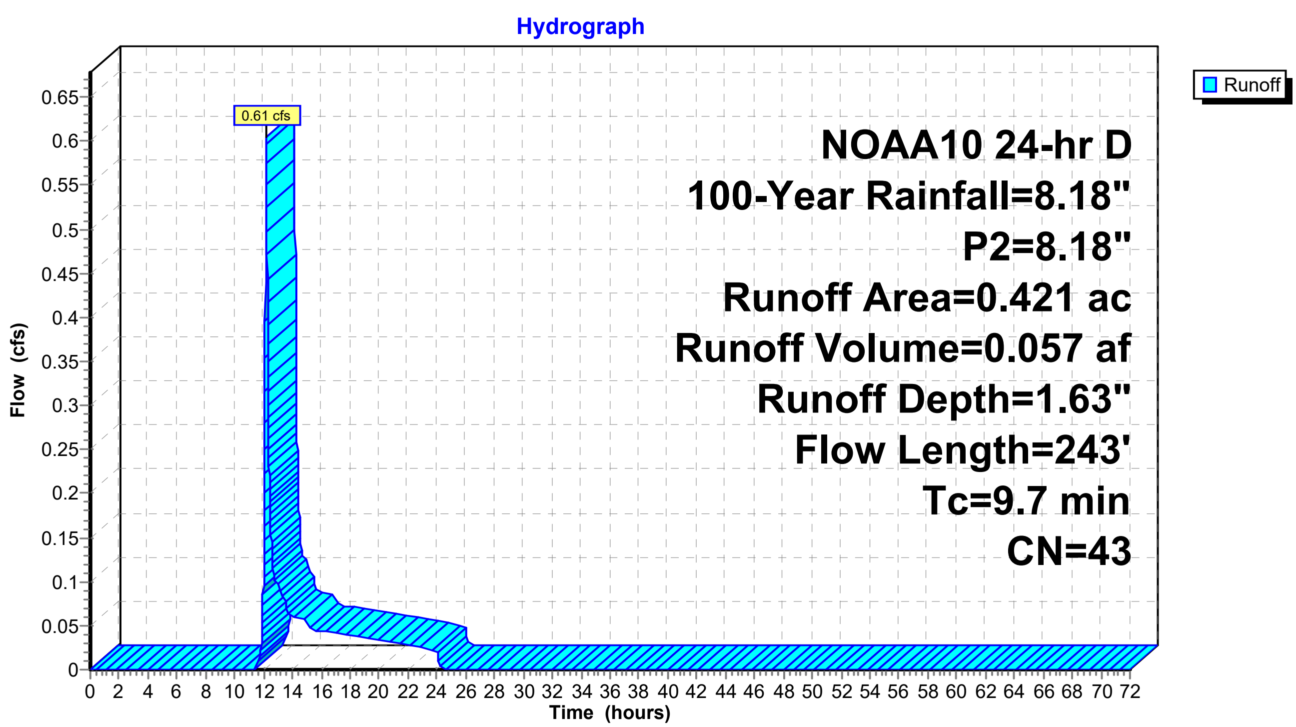
Runoff = 0.61 cfs @ 12.18 hrs, Volume= 0.057 af, Depth= 1.63"
Routed to Pond AP-2 : GROVE STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

Area (ac)	CN	Description
0.204	30	Woods, Good, HSG A
0.218	55	Woods, Good, HSG B
0.421	43	Weighted Average
0.421		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.0300	0.13		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 8.18"
3.1	193	0.0420	1.02		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
9.7	243	Total			

Subcatchment EX-3: EX-3

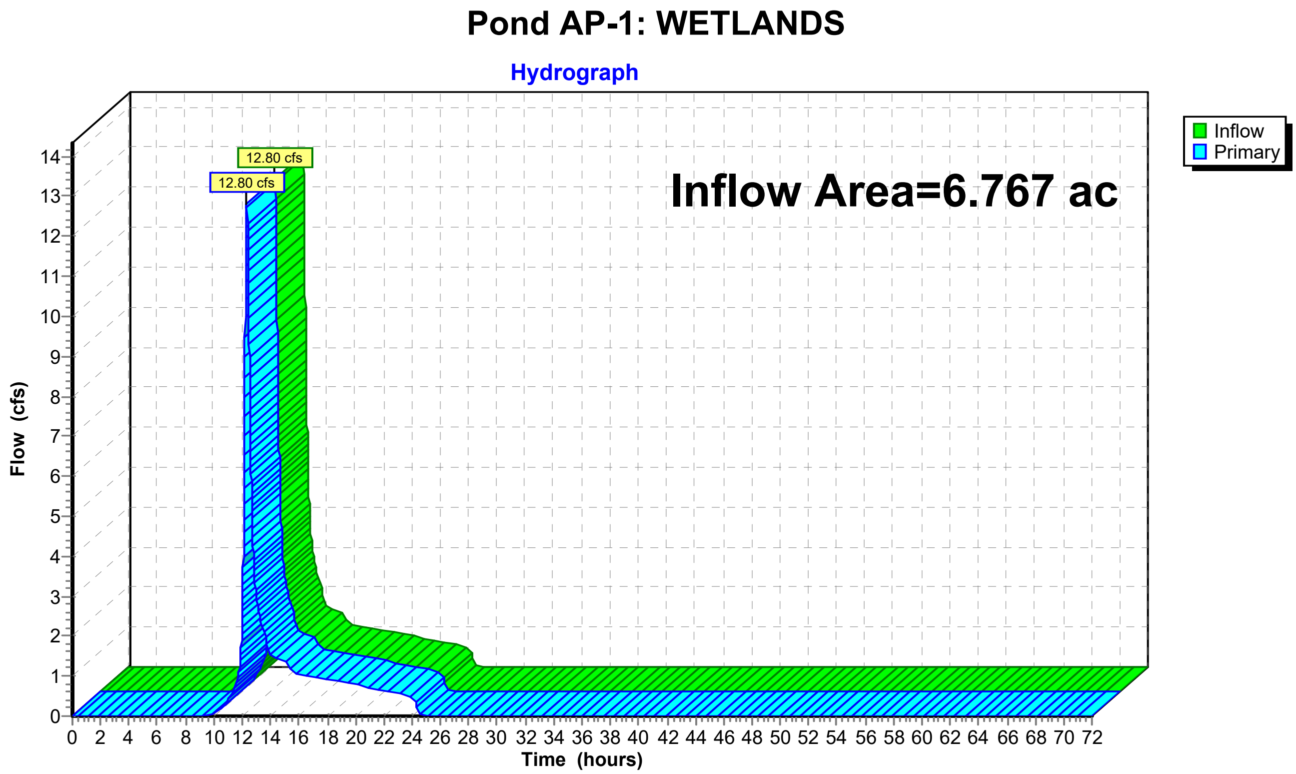


Summary for Pond AP-1: WETLANDS

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

Inflow Area = 6.767 ac, 0.00% Impervious, Inflow Depth = 2.80" for 100-Year event
Inflow = 12.80 cfs @ 12.32 hrs, Volume= 1.577 af
Primary = 12.80 cfs @ 12.32 hrs, Volume= 1.577 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



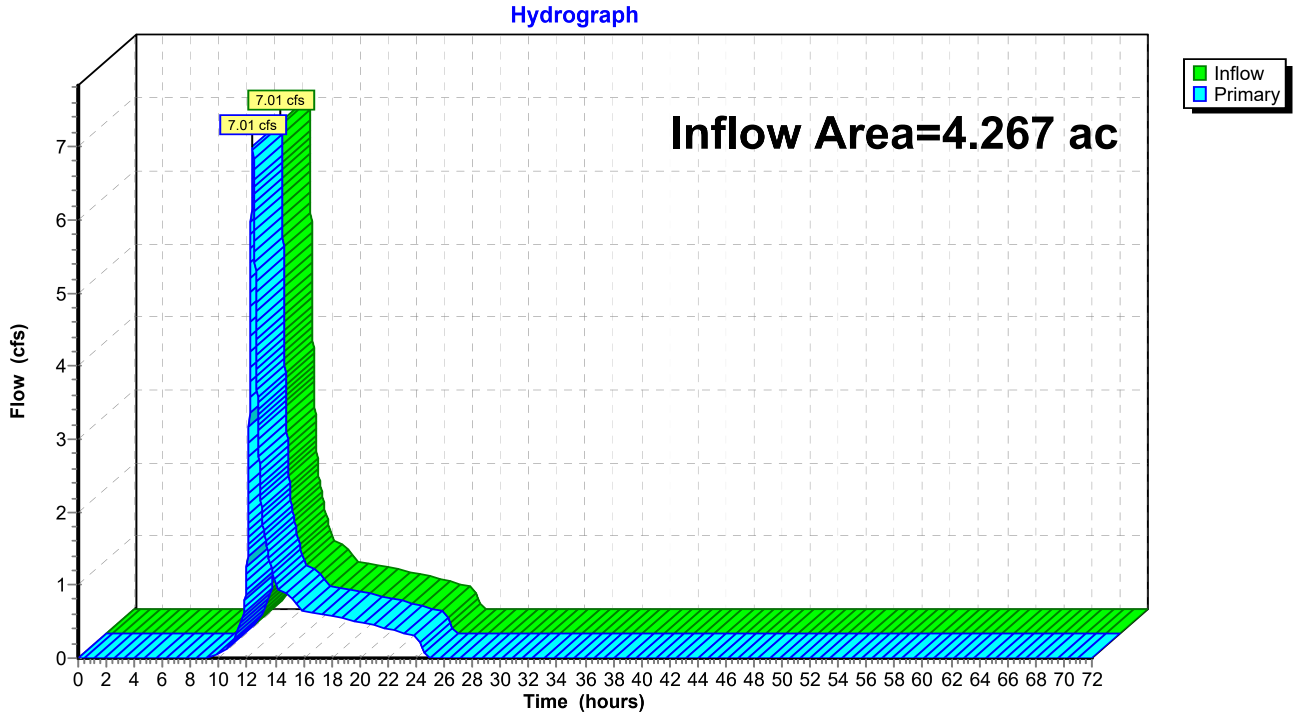
Summary for Pond AP-2: GROVE STREET

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

Inflow Area =	4.267 ac,	0.00% Impervious, Inflow Depth = 2.78"	for 100-Year event
Inflow =	7.01 cfs @	12.39 hrs, Volume=	0.989 af
Primary =	7.01 cfs @	12.39 hrs, Volume=	0.989 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-2: GROVE STREET



Events for Subcatchment EX-1: EX-1

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	0.25	0.096	0.30
10-Year	5.22	2.08	0.350	1.09
25-Year	6.39	3.76	0.560	1.75
100-Year	**8.18**	**6.78**	**0.932**	**2.91**

Events for Subcatchment EX-2: EX-2

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	0.36	0.152	0.27
10-Year	5.22	3.75	0.579	1.03
25-Year	6.39	6.96	0.938	1.66
100-Year	**8.18**	**12.80**	**1.577**	**2.80**

Events for Subcatchment EX-3: EX-3

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	0.00	0.001	0.04
10-Year	5.22	0.05	0.015	0.42
25-Year	6.39	0.21	0.029	0.82
100-Year	**8.18**	**0.61**	**0.057**	**1.63**

Events for Pond AP-1: WETLANDS

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
2-Year	0.36	0.36	**0.00**	**0.000**
10-Year	3.75	3.75	0.00	0.000
25-Year	6.96	6.96	0.00	0.000
100-Year	**12.80**	**12.80**	0.00	0.000

Events for Pond AP-2: GROVE STREET

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
2-Year	0.25	0.25	**0.00**	**0.000**
10-Year	2.11	2.11	0.00	0.000
25-Year	3.86	3.86	0.00	0.000
100-Year	**7.01**	**7.01**	0.00	0.000

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Routing Diagram for F4683 POST
Prepared by Guerriere & Halnon Inc, Printed 4/16/2025
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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC	P2 (inches)
1	2-Year	NOAA10 24-hr	D	Default	24.00	1	3.36	2	3.36
2	10-Year	NOAA10 24-hr	D	Default	24.00	1	5.22	2	5.22
3	25-Year	NOAA10 24-hr	D	Default	24.00	1	6.39	2	6.39
4	100-Year	NOAA10 24-hr	D	Default	24.00	1	8.18	2	8.18

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.209	39	>75% Grass cover, Good, HSG A (PR-2, PR-3, PR-4)
1.067	61	>75% Grass cover, Good, HSG B (PR-1, PR-2, PR-3, PR-4, PR-6)
0.044	98	Paved parking, HSG A (PR-3, PR-4)
1.687	98	Paved parking, HSG B (PR-4, PR-5, PR-6)
0.007	98	Pond Surface, HSG A (PR-4)
0.181	98	Pond Surface, HSG B (PR-4)
0.186	30	Woods, Good, HSG A (PR-1, PR-2, PR-3)
7.656	55	Woods, Good, HSG B (PR-1, PR-2, PR-3, PR-4)
11.038	**62**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.446	HSG A	PR-1, PR-2, PR-3, PR-4
10.592	HSG B	PR-1, PR-2, PR-3, PR-4, PR-5, PR-6
0.000	HSG C	
0.000	HSG D	
0.000	Other	
11.038		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.209	1.067	0.000	0.000	0.000	1.276	>75% Grass cover, Good	PR-1, PR-2, PR-3, PR-4, PR-6
0.044	1.687	0.000	0.000	0.000	1.732	Paved parking	PR-3, PR-4, PR-5, PR-6
0.007	0.181	0.000	0.000	0.000	0.188	Pond Surface	PR-4
0.186	7.656	0.000	0.000	0.000	7.842	Woods, Good	PR-1, PR-2, PR-3, PR-4
0.446	**10.592**	**0.000**	**0.000**	**0.000**	**11.038**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: PR-1 Runoff Area=3.846 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=1,108' Tc=31.2 min CN=55 Runoff=0.25 cfs 0.096 af

SubcatchmentPR-2: PR-2 Runoff Area=4.312 ac 0.00% Impervious Runoff Depth=0.27"
Flow Length=945' Tc=21.2 min CN=54 Runoff=0.25 cfs 0.097 af

SubcatchmentPR-3: PR-3 Runoff Area=0.249 ac 16.12% Impervious Runoff Depth=0.40"
Tc=6.0 min CN=58 Runoff=0.07 cfs 0.008 af

SubcatchmentPR-4: PR-4 Runoff Area=60,243 sf 49.50% Impervious Runoff Depth=1.39"
Tc=6.0 min CN=78 Runoff=2.40 cfs 0.160 af

SubcatchmentPR-5: PR-5 Runoff Area=36,100 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=2.81 cfs 0.216 af

SubcatchmentPR-6: PR-6 Runoff Area=18,265 sf 87.22% Impervious Runoff Depth=2.60"
Tc=6.0 min CN=93 Runoff=1.29 cfs 0.091 af

Reach 1R: SWALE Avg. Flow Depth=0.11' Max Vel=0.83 fps Inflow=0.25 cfs 0.097 af
n=0.069 L=546.7' S=0.0346 '/' Capacity=14.25 cfs Outflow=0.21 cfs 0.097 af

Pond 1P: ROOF DRAIN CHAMBER BASIN (#2) Peak Elev=286.69' Storage=74 cf Inflow=2.81 cfs 0.216 af
Discarded=2.41 cfs 0.216 af Primary=0.00 cfs 0.000 af Outflow=2.41 cfs 0.216 af

Pond 7P: INFILTRATION BASIN (OPEN AIR) Peak Elev=286.49' Storage=2,123 cf Inflow=2.40 cfs 0.160 af
Discarded=0.19 cfs 0.160 af Primary=0.00 cfs 0.000 af Outflow=0.19 cfs 0.160 af

Pond 10P: PAVEMENT CHAMBER BASIN Peak Elev=287.86' Storage=1,043 cf Inflow=1.29 cfs 0.091 af
Discarded=0.12 cfs 0.091 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.091 af

Pond AP-1: WETLANDS Inflow=0.23 cfs 0.105 af
Primary=0.23 cfs 0.105 af

Pond AP-2: GROVE ST Inflow=0.25 cfs 0.096 af
Primary=0.25 cfs 0.096 af

Total Runoff Area = 11.038 ac Runoff Volume = 0.668 af Average Runoff Depth = 0.73"
82.61% Pervious = 9.119 ac 17.39% Impervious = 1.919 ac

Summary for Subcatchment PR-1: PR-1

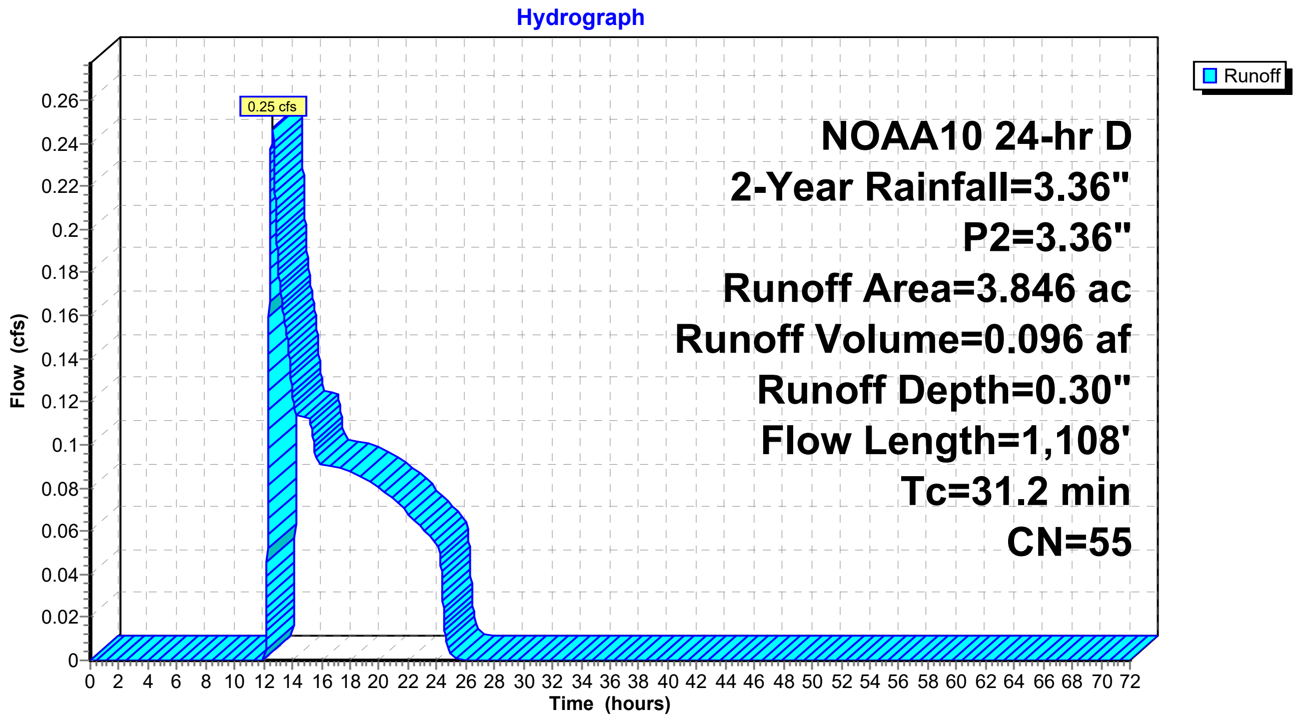
Runoff = 0.25 cfs @ 12.61 hrs, Volume= 0.096 af, Depth= 0.30"
Routed to Pond AP-2 : GROVE ST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

Area (ac)	CN	Description
0.034	30	Woods, Good, HSG A
0.007	61	>75% Grass cover, Good, HSG B
3.805	55	Woods, Good, HSG B
3.846	55	Weighted Average
3.846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0280	0.08		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.36"
1.4	105	0.0640	1.26		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
4.1	181	0.0220	0.74		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.1	418	0.0380	0.97		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
8.1	354	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
31.2	1,108	Total			

Subcatchment PR-1: PR-1



Summary for Subcatchment PR-2: PR-2

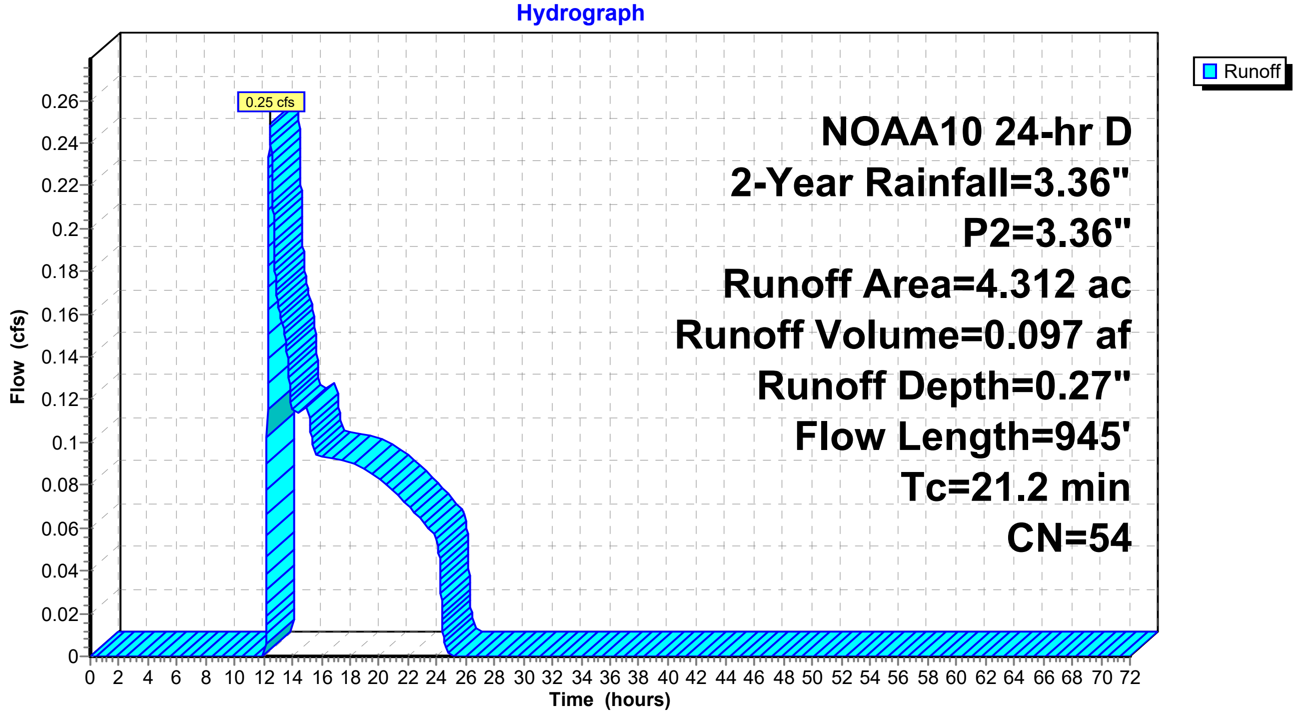
Runoff = 0.25 cfs @ 12.46 hrs, Volume= 0.097 af, Depth= 0.27"
Routed to Reach 1R : SWALE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

Area (ac)	CN	Description
0.055	30	Woods, Good, HSG A
0.128	39	>75% Grass cover, Good, HSG A
0.000	98	Paved parking, HSG A
0.000	98	Paved parking, HSG A
0.076	30	Woods, Good, HSG A
0.000	30	Woods, Good, HSG A
0.008	30	Woods, Good, HSG A
3.379	55	Woods, Good, HSG B
0.173	55	Woods, Good, HSG B
0.493	61	>75% Grass cover, Good, HSG B
4.312	54	Weighted Average
4.312		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0280	0.08		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.36"
2.5	128	0.0280	0.84		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.1	101	0.0950	1.54		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
4.5	284	0.0450	1.06		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
2.6	382	0.0270	2.46		**Shallow Concentrated Flow, E-->F** Grassed Waterway Kv= 15.0 fps
21.2	945	Total			

Subcatchment PR-2: PR-2



Summary for Subcatchment PR-3: PR-3

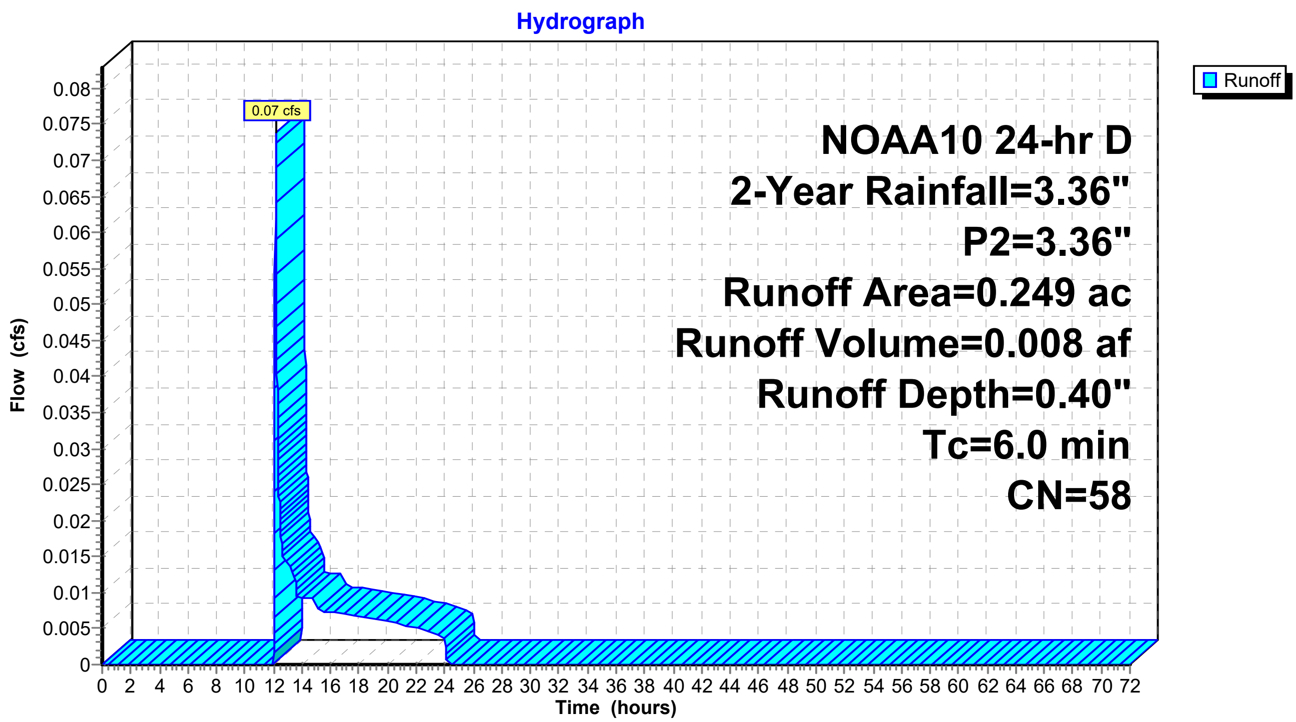
Runoff = 0.07 cfs @ 12.15 hrs, Volume= 0.008 af, Depth= 0.40"
Routed to Pond AP-1 : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

Area (ac)	CN	Description
0.012	30	Woods, Good, HSG A
0.040	98	Paved parking, HSG A
0.053	39	>75% Grass cover, Good, HSG A
0.001	30	Woods, Good, HSG A
0.073	55	Woods, Good, HSG B
0.040	61	>75% Grass cover, Good, HSG B
0.029	55	Woods, Good, HSG B
0.249	58	Weighted Average
0.209		83.88% Pervious Area
0.040		16.12% Impervious Area

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

Subcatchment PR-3: PR-3



Summary for Subcatchment PR-4: PR-4

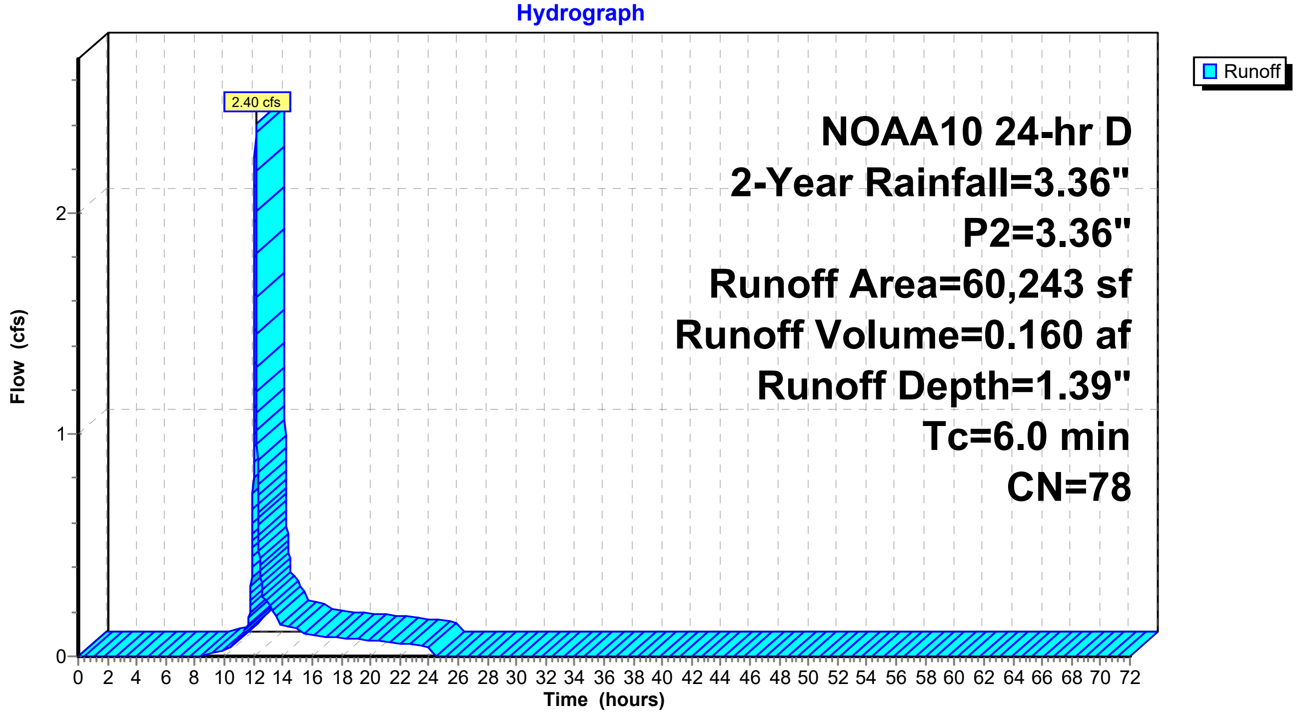
Runoff = 2.40 cfs @ 12.13 hrs, Volume= 0.160 af, Depth= 1.39"
Routed to Pond 7P : INFILTRATION BASIN (OPEN AIR)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

	Area (sf)	CN	Description
	1,228	39	>75% Grass cover, Good, HSG A
	0	39	>75% Grass cover, Good, HSG A
	174	98	Paved parking, HSG A
	0	55	Woods, Good, HSG B
	8,407	55	Woods, Good, HSG B
	174	55	Woods, Good, HSG B
	21,475	98	Paved parking, HSG B
	131	61	>75% Grass cover, Good, HSG B
	14,384	61	>75% Grass cover, Good, HSG B
	6,098	61	>75% Grass cover, Good, HSG B
*	7,875	98	Pond Surface, HSG B
*	297	98	Pond Surface, HSG A
	60,243	78	Weighted Average
	30,422		50.50% Pervious Area
	29,821		49.50% Impervious Area

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

Subcatchment PR-4: PR-4



Summary for Subcatchment PR-5: PR-5

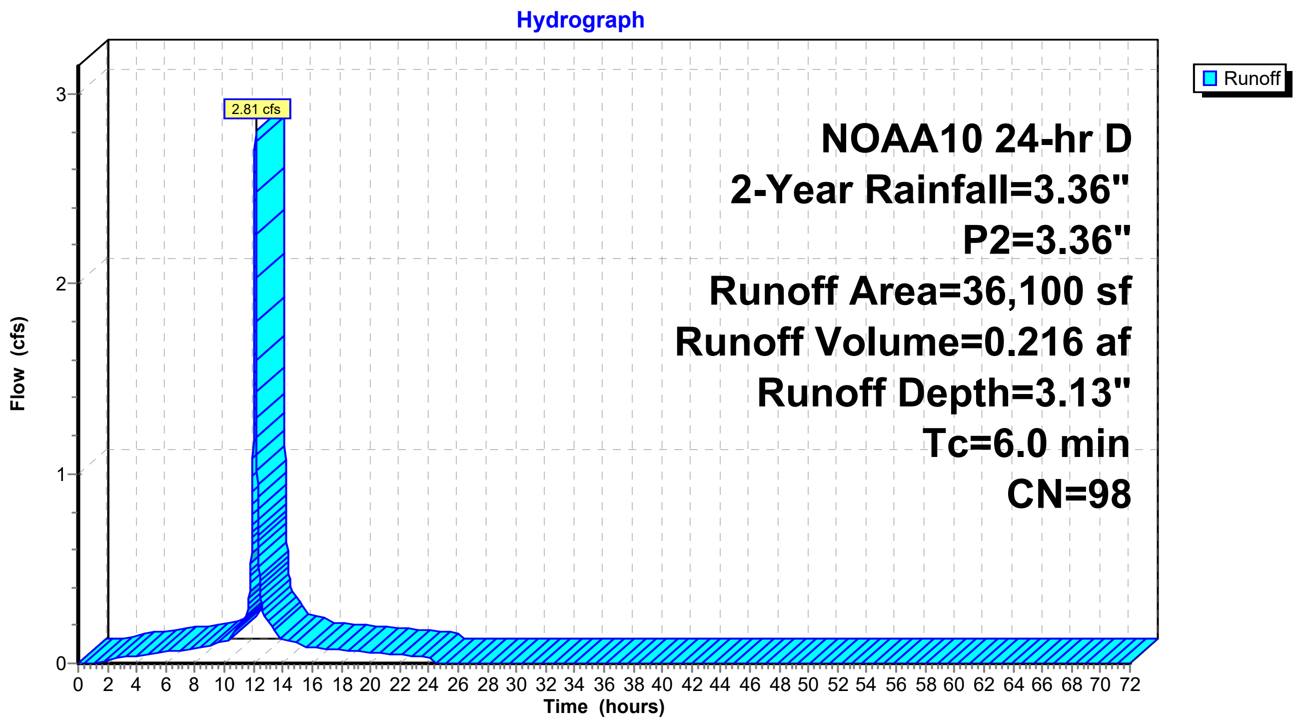
Runoff = 2.81 cfs @ 12.13 hrs, Volume= 0.216 af, Depth= 3.13"
Routed to Pond 1P : ROOF DRAIN CHAMBER BASIN (#2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

Area (sf)	CN	Description
36,100	98	Paved parking, HSG B
36,100		100.00% Impervious Area

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

Subcatchment PR-5: PR-5



Summary for Subcatchment PR-6: PR-6

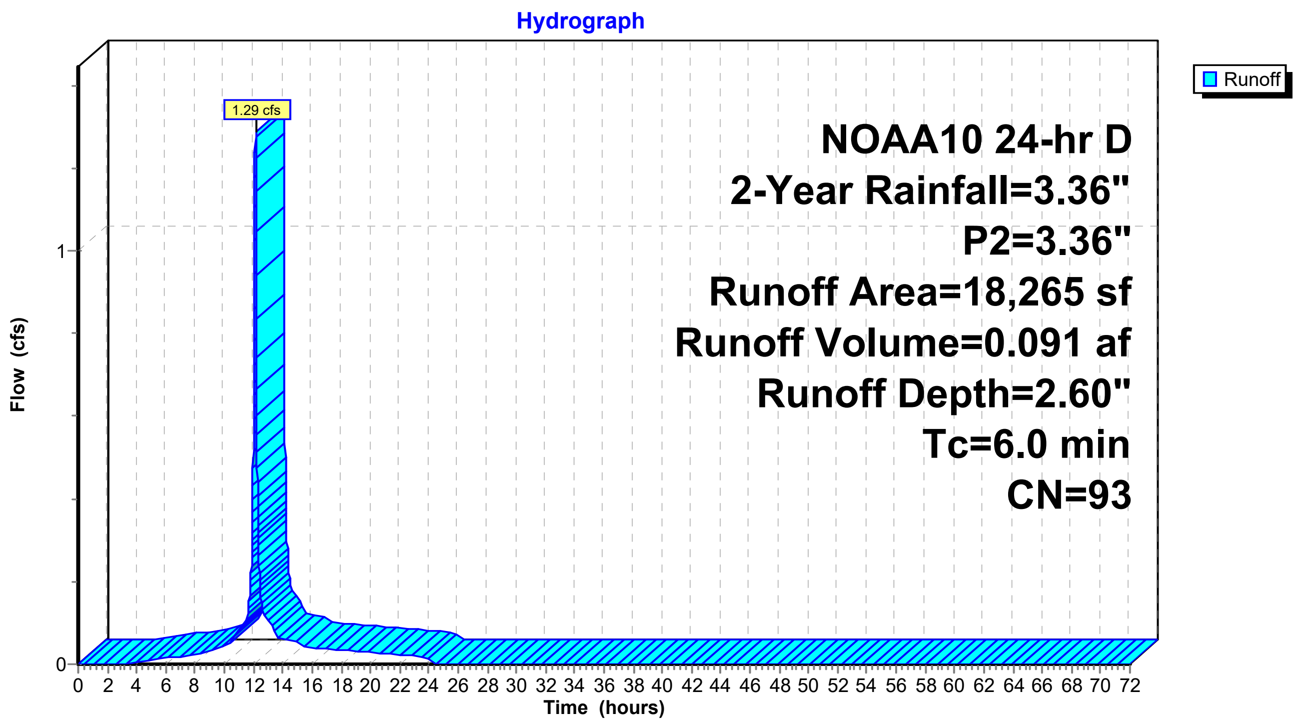
Runoff = 1.29 cfs @ 12.13 hrs, Volume= 0.091 af, Depth= 2.60"
Routed to Pond 10P : PAVEMENT CHAMBER BASIN (#1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.36", P2=3.36"

Area (sf)	CN	Description
15,932	98	Paved parking, HSG B
2,333	61	>75% Grass cover, Good, HSG B
18,265	93	Weighted Average
2,333		12.78% Pervious Area
15,932		87.22% Impervious Area

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

Subcatchment PR-6: PR-6



Summary for Reach 1R: SWALE

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=1)

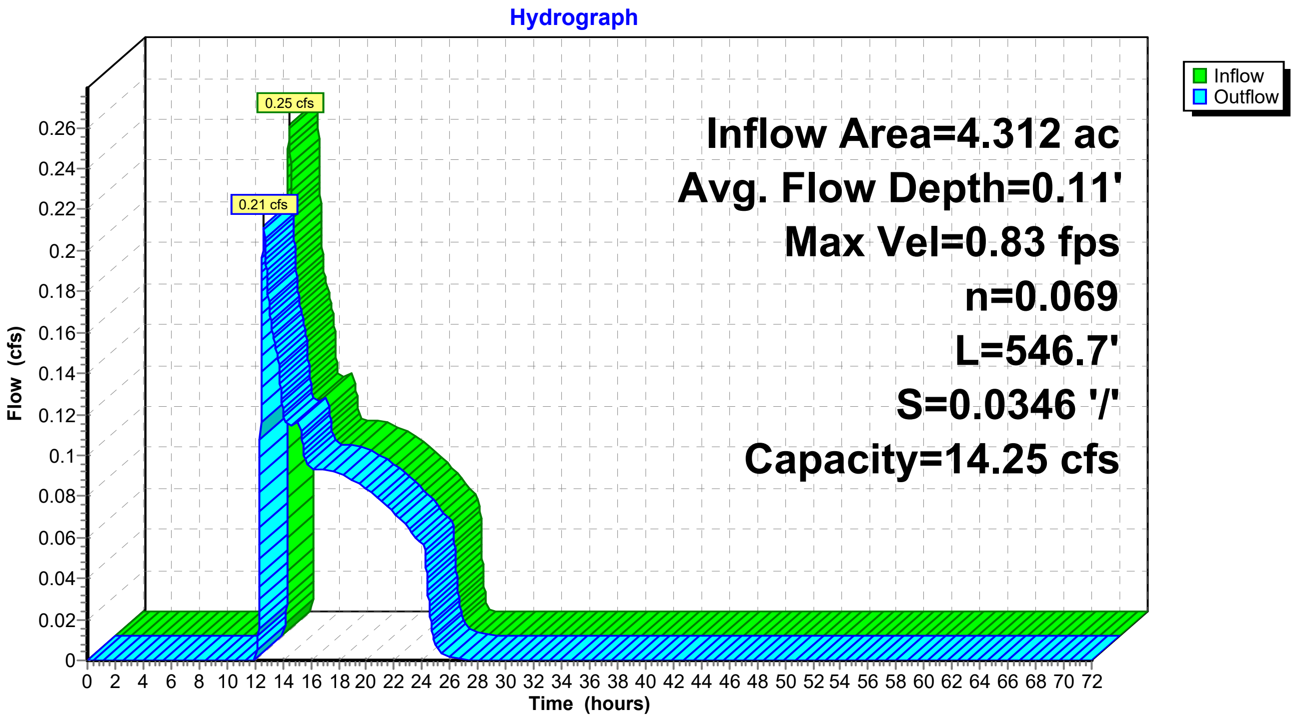
Inflow Area = 4.312 ac, 0.00% Impervious, Inflow Depth = 0.27" for 2-Year event
Inflow = 0.25 cfs @ 12.46 hrs, Volume= 0.097 af
Outflow = 0.21 cfs @ 12.65 hrs, Volume= 0.097 af, Atten= 15%, Lag= 11.4 min
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.83 fps, Min. Travel Time= 11.0 min
Avg. Velocity = 0.49 fps, Avg. Travel Time= 18.5 min

Peak Storage= 139 cf @ 12.65 hrs
Average Depth at Peak Storage= 0.11' , Surface Width= 2.66'
Defined Flood Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.25 cfs
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.25 cfs

2.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 546.7' Slope= 0.0346 '/'
Inlet Invert= 302.00', Outlet Invert= 283.10'

Reach 1R: SWALE



Summary for Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=2)

Inflow Area = 0.829 ac,100.00% Impervious, Inflow Depth = 3.13" for 2-Year event
Inflow = 2.81 cfs @ 12.13 hrs, Volume= 0.216 af
Outflow = 2.41 cfs @ 12.11 hrs, Volume= 0.216 af, Atten= 14%, Lag= 0.0 min
Discarded = 2.41 cfs @ 12.11 hrs, Volume= 0.216 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 7P : INFILTRATION BASIN (OPEN AIR)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 286.69' @ 12.16 hrs Surf.Area= 958 sf Storage= 74 cf

Plug-Flow detention time= 0.1 min calculated for 0.216 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (759.5 - 759.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	286.50'	885 cf	**30.00'W x 31.93'L x 3.50'H Field A** 3,353 cf Overall - 1,142 cf Embedded = 2,211 cf x 40.0% Voids
#2A	287.00'	1,142 cf	**Cultec R-300HD** x 24 Inside #1 Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap 24 Chambers in 6 Rows Cap Storage= 2.7 cf x 2 x 6 rows = 31.9 cf
		2,026 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	288.50'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	286.50'	**2.41 cfs Exfiltration at all elevations** Phase-In= 0.01'
#3	Device 1	289.40'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=2.41 cfs @ 12.11 hrs HW=286.54' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 2.41 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=286.50' TW=286.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: ROOF DRAIN CHAMBER BASIN (#2) - Chamber Wizard Field A

Chamber Model = Cultec R-300HD (Cultec Recharger® 300HD)
Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap
Cap Storage= 2.7 cf x 2 x 6 rows = 31.9 cf

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

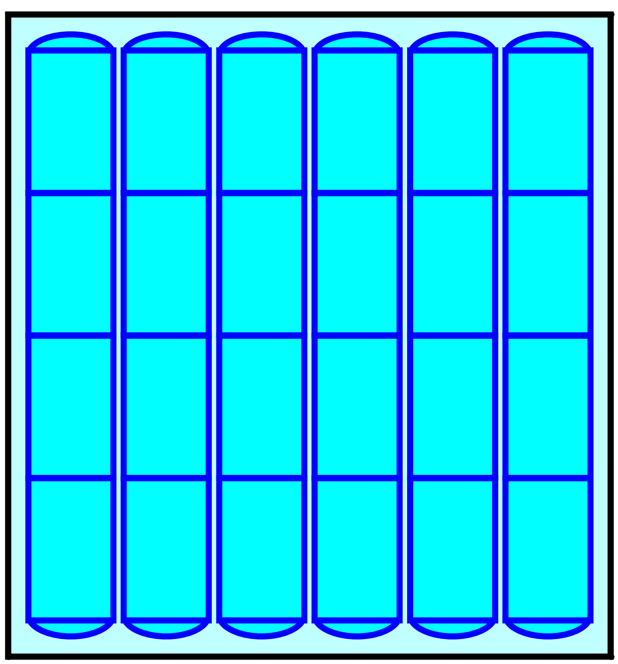
4 Chambers/Row x 7.08' Long +0.80' Cap Length x 2 = 29.93' Row Length +12.0" End Stone x 2 = 31.93' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

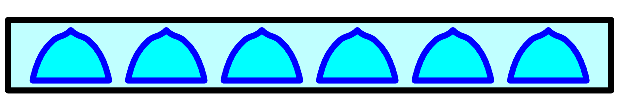
24 Chambers x 46.2 cf + 2.7 cf Cap Volume x 2 x 6 Rows = 1,141.7 cf Chamber Storage

3,353.0 cf Field - 1,141.7 cf Chambers = 2,211.3 cf Stone x 40.0% Voids = 884.5 cf Stone Storage

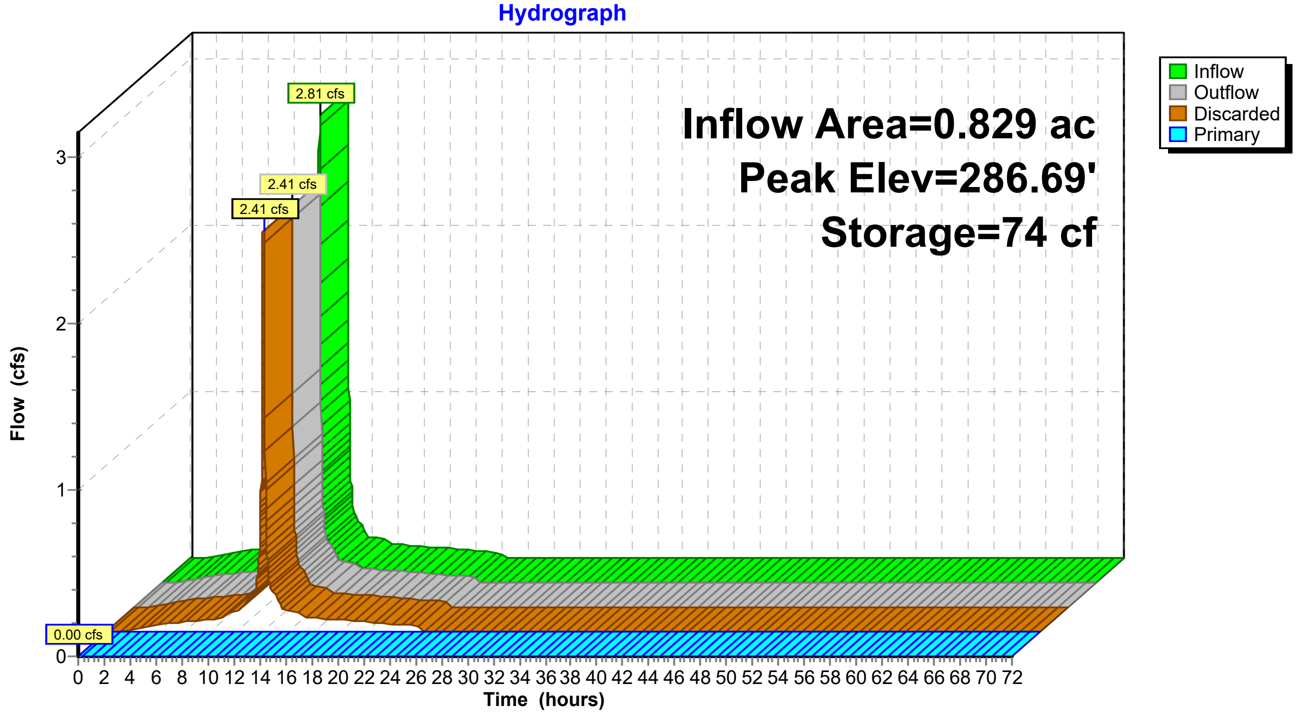
Chamber Storage + Stone Storage = 2,026.2 cf = 0.047 af
Overall Storage Efficiency = 60.4%
Overall System Size = 31.93' x 30.00' x 3.50'

24 Chambers
124.2 cy Field
81.9 cy Stone





Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)



Summary for Pond 7P: INFILTRATION BASIN (OPEN AIR)

Inflow Area = 2.212 ac, 68.42% Impervious, Inflow Depth = 0.87" for 2-Year event
Inflow = 2.40 cfs @ 12.13 hrs, Volume= 0.160 af
Outflow = 0.19 cfs @ 13.44 hrs, Volume= 0.160 af, Atten= 92%, Lag= 78.5 min
Discarded = 0.19 cfs @ 13.44 hrs, Volume= 0.160 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 286.49' @ 13.44 hrs Surf.Area= 3,410 sf Storage= 2,123 cf

Plug-Flow detention time= 96.8 min calculated for 0.160 af (100% of inflow)
Center-of-Mass det. time= 96.8 min (978.7 - 882.0)

Volume	Invert	Avail.Storage	Storage Description
#1	286.00'	19,274 cf	**INFILTRATION BASIN (Prismatic)** Listed below
#2	286.00'	3,737 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
		23,011 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
286.00	2,949	0	0
288.00	4,824	7,773	7,773
290.00	6,677	11,501	19,274

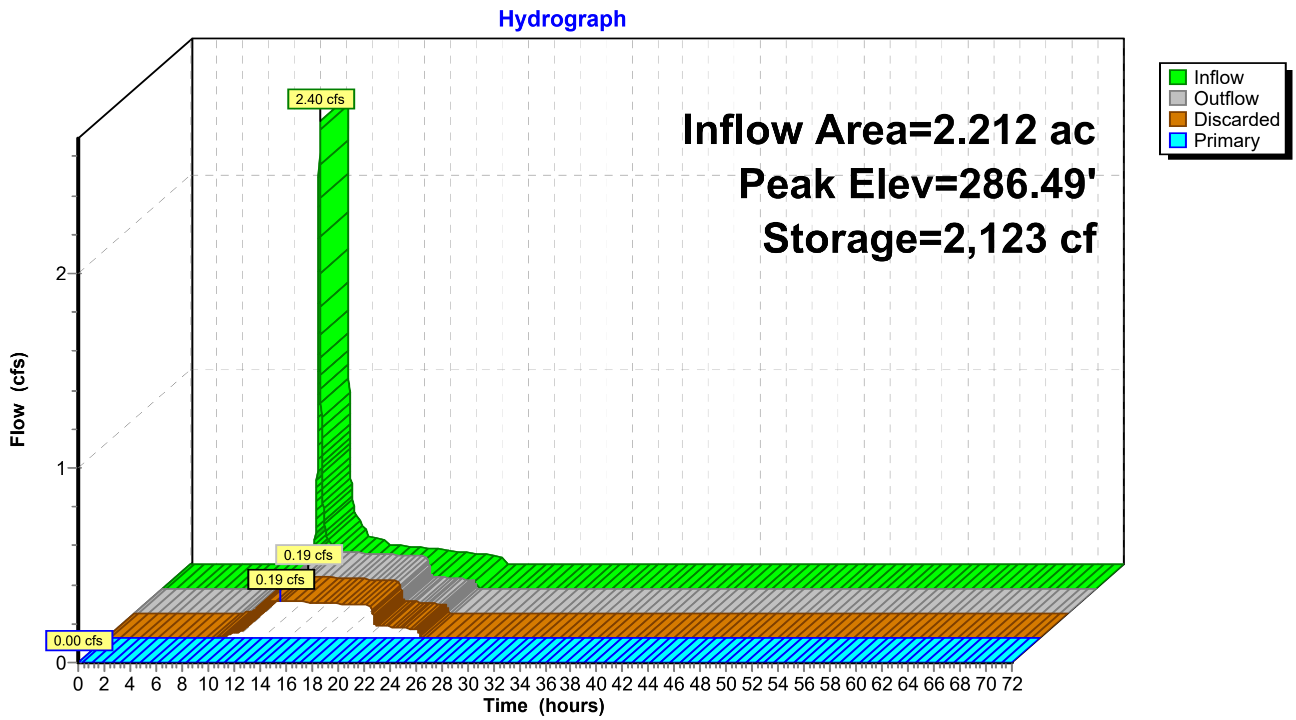
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
286.00	384	0	0
287.10	607	545	545
288.00	972	711	1,256
290.00	1,509	2,481	3,737

Device	Routing	Invert	Outlet Devices
#1	Primary	286.00'	**15.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	286.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#3	Primary	289.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Device 1	289.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	287.20'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.19 cfs @ 13.44 hrs HW=286.49' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=286.00' TW=0.00' (Dynamic Tailwater)
├**1=Orifice/Grate** (Controls 0.00 cfs)
│├**4=Orifice/Grate** (Controls 0.00 cfs)
│└**5=Orifice/Grate** (Controls 0.00 cfs)
└**3=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 7P: INFILTRATION BASIN (OPEN AIR)



Summary for Pond 10P: PAVEMENT CHAMBER BASIN (#1)

Inflow Area = 0.419 ac, 87.22% Impervious, Inflow Depth = 2.60" for 2-Year event
Inflow = 1.29 cfs @ 12.13 hrs, Volume= 0.091 af
Outflow = 0.12 cfs @ 11.78 hrs, Volume= 0.091 af, Atten= 91%, Lag= 0.0 min
Discarded = 0.12 cfs @ 11.78 hrs, Volume= 0.091 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 287.86' @ 12.77 hrs Surf.Area= 2,107 sf Storage= 1,043 cf

Plug-Flow detention time= 54.6 min calculated for 0.091 af (100% of inflow)
Center-of-Mass det. time= 54.6 min (860.2 - 805.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	287.00'	1,905 cf	**20.50'W x 102.77'L x 3.50'H Field A** 7,374 cf Overall - 2,611 cf Embedded = 4,763 cf x 40.0% Voids
#2A	287.50'	2,611 cf	**Cultec R-300HD** x 56 Inside #1 Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap 56 Chambers in 4 Rows Cap Storage= 2.7 cf x 2 x 4 rows = 21.2 cf
		4,516 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	287.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Device 1	289.90'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#3	Discarded	287.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.12 cfs @ 11.78 hrs HW=287.04' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=287.00' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Controls 0.00 cfs)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 10P: PAVEMENT CHAMBER BASIN (#1) - Chamber Wizard Field A

Chamber Model = Cultec R-300HD (Cultec Recharger®300HD)
Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap
Cap Storage= 2.7 cf x 2 x 4 rows = 21.2 cf

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

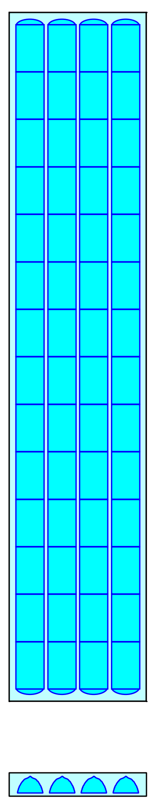
14 Chambers/Row x 7.08' Long +0.80' Cap Length x 2 = 100.77' Row Length +12.0" End Stone x 2 = 102.77' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

56 Chambers x 46.2 cf + 2.7 cf Cap Volume x 2 x 4 Rows = 2,610.8 cf Chamber Storage

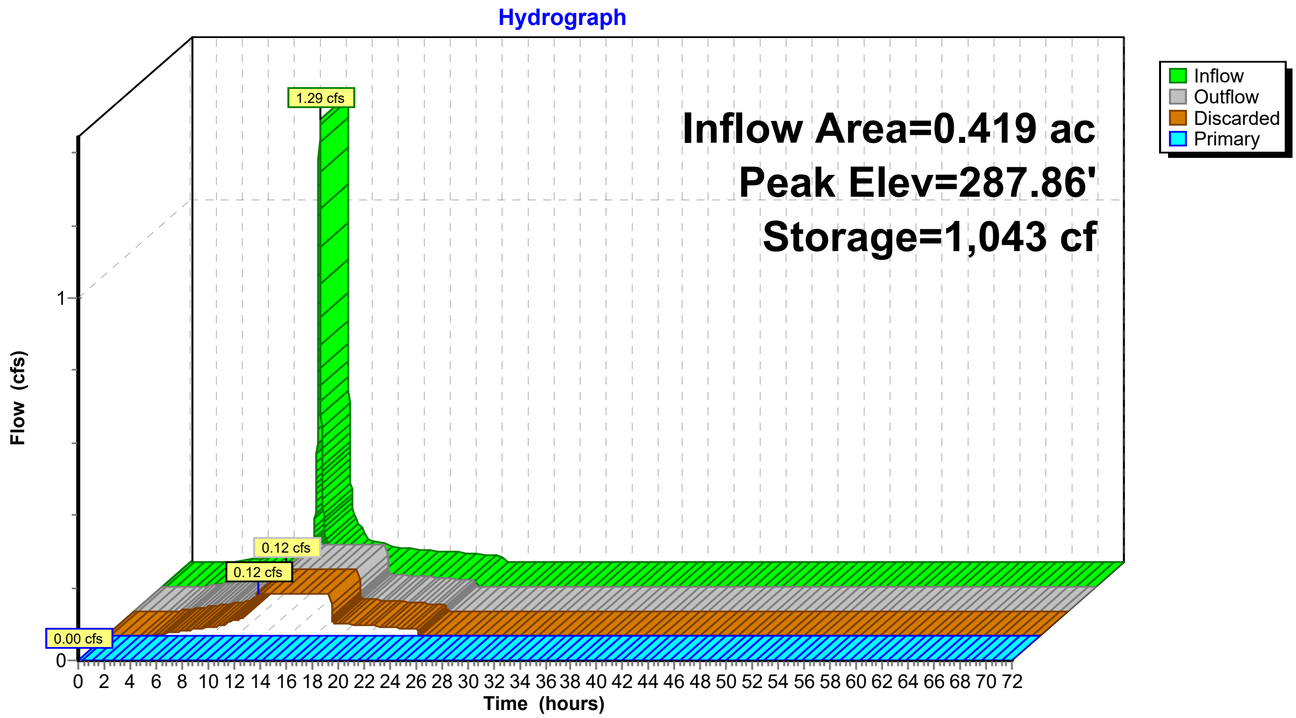
7,373.5 cf Field - 2,610.8 cf Chambers = 4,762.7 cf Stone x 40.0% Voids = 1,905.1 cf Stone Storage

Chamber Storage + Stone Storage = 4,515.9 cf = 0.104 af
Overall Storage Efficiency = 61.2%
Overall System Size = 102.77' x 20.50' x 3.50'

56 Chambers
273.1 cy Field
176.4 cy Stone



Pond 10P: PAVEMENT CHAMBER BASIN (#1)

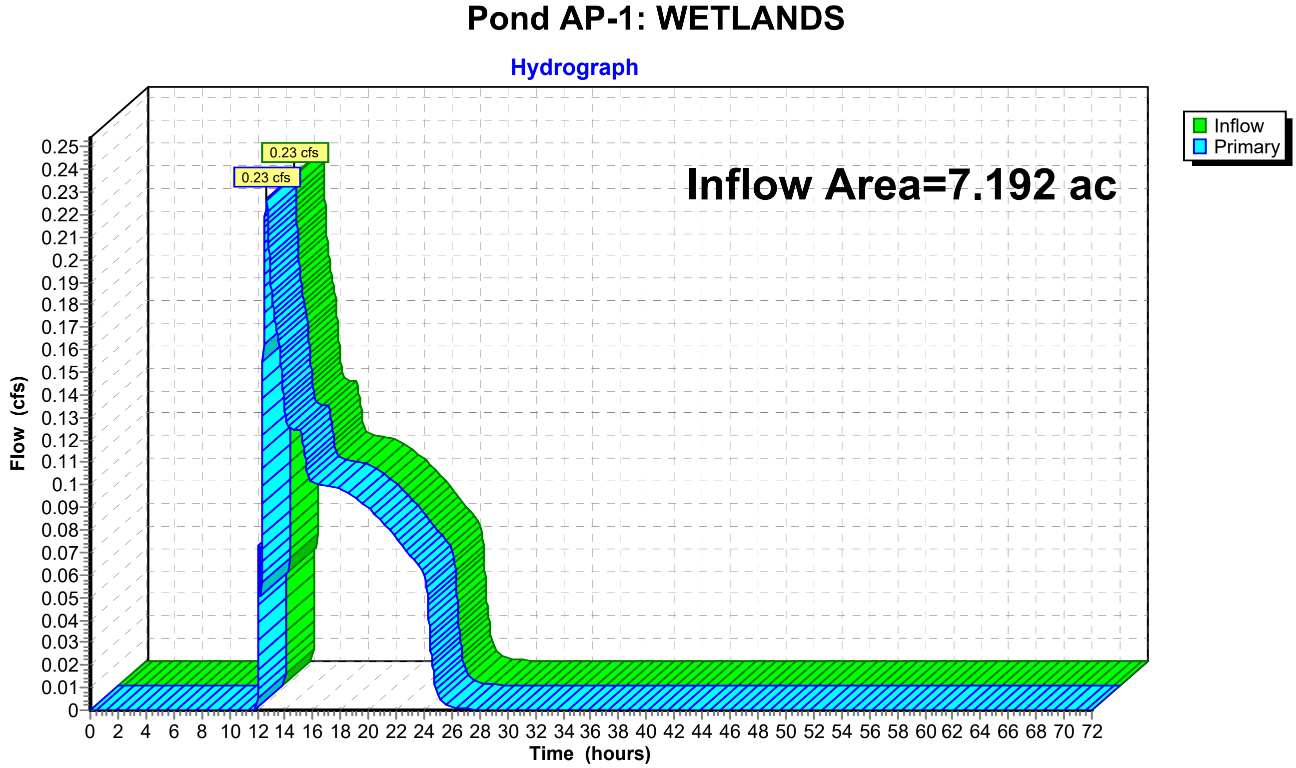


Summary for Pond AP-1: WETLANDS

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

Inflow Area = 7.192 ac, 26.69% Impervious, Inflow Depth = 0.18" for 2-Year event
Inflow = 0.23 cfs @ 12.64 hrs, Volume= 0.105 af
Primary = 0.23 cfs @ 12.64 hrs, Volume= 0.105 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



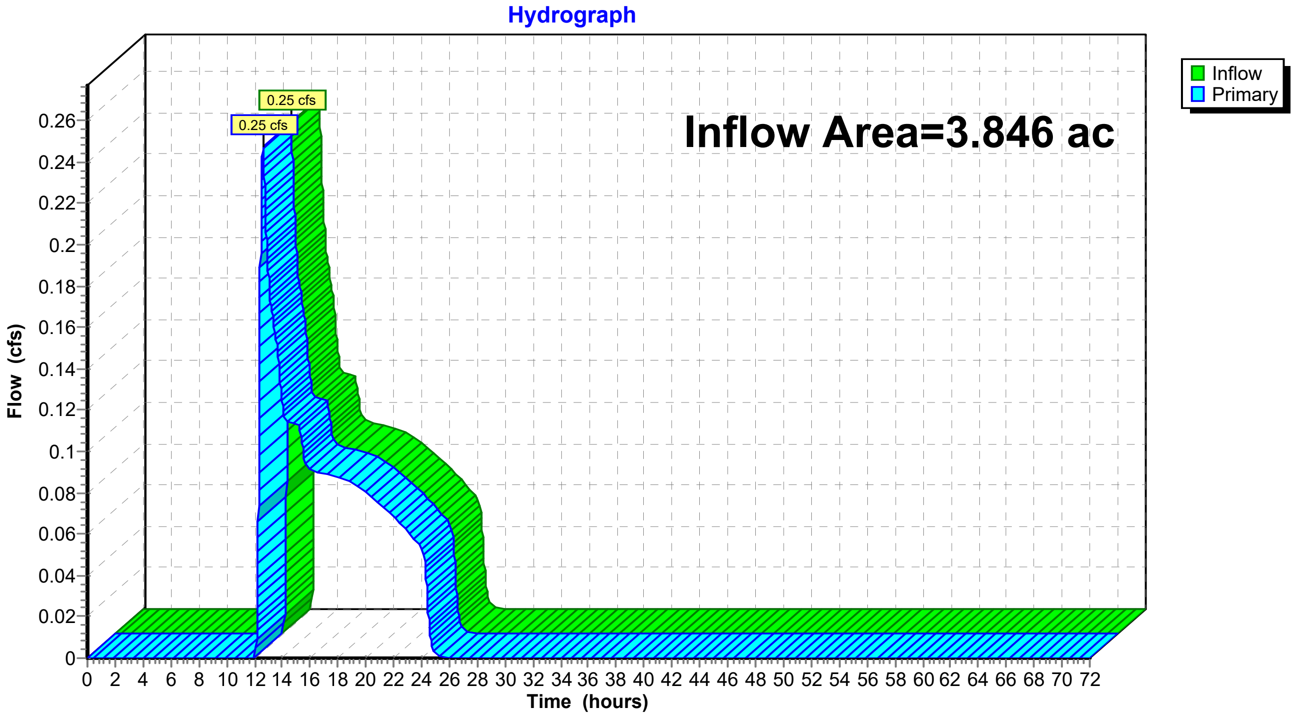
Summary for Pond AP-2: GROVE ST

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

Inflow Area =	3.846 ac,	0.00% Impervious, Inflow Depth = 0.30"	for 2-Year event
Inflow =	0.25 cfs @	12.61 hrs, Volume=	0.096 af
Primary =	0.25 cfs @	12.61 hrs, Volume=	0.096 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-2: GROVE ST



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: PR-1 Runoff Area=3.846 ac 0.00% Impervious Runoff Depth=1.09"
Flow Length=1,108' Tc=29.1 min CN=55 Runoff=2.08 cfs 0.350 af

SubcatchmentPR-2: PR-2 Runoff Area=4.312 ac 0.00% Impervious Runoff Depth=1.03"
Flow Length=945' Tc=19.1 min CN=54 Runoff=2.72 cfs 0.369 af

SubcatchmentPR-3: PR-3 Runoff Area=0.249 ac 16.12% Impervious Runoff Depth=1.29"
Tc=6.0 min CN=58 Runoff=0.37 cfs 0.027 af

SubcatchmentPR-4: PR-4 Runoff Area=60,243 sf 49.50% Impervious Runoff Depth=2.90"
Tc=6.0 min CN=78 Runoff=5.01 cfs 0.334 af

SubcatchmentPR-5: PR-5 Runoff Area=36,100 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=4.40 cfs 0.344 af

SubcatchmentPR-6: PR-6 Runoff Area=18,265 sf 87.22% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=93 Runoff=2.12 cfs 0.154 af

Reach 1R: SWALE Avg. Flow Depth=0.43' Max Vel=1.79 fps Inflow=2.72 cfs 0.369 af
n=0.069 L=546.7' S=0.0346 '/' Capacity=14.25 cfs Outflow=2.51 cfs 0.369 af

Pond 1P: ROOF DRAIN CHAMBER BASIN (#2) Peak Elev=287.66' Storage=700 cf Inflow=4.40 cfs 0.344 af
Discarded=2.41 cfs 0.344 af Primary=0.00 cfs 0.000 af Outflow=2.41 cfs 0.344 af

Pond 7P: INFILTRATION BASIN (OPEN AIR) Peak Elev=287.30' Storage=5,748 cf Inflow=5.01 cfs 0.334 af
Discarded=0.23 cfs 0.323 af Primary=0.08 cfs 0.011 af Outflow=0.31 cfs 0.334 af

Pond 10P: PAVEMENT CHAMBER BASIN Peak Elev=288.60' Storage=2,270 cf Inflow=2.12 cfs 0.154 af
Discarded=0.12 cfs 0.154 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.154 af

Pond AP-1: WETLANDS Inflow=2.60 cfs 0.407 af
Primary=2.60 cfs 0.407 af

Pond AP-2: GROVE ST Inflow=2.08 cfs 0.350 af
Primary=2.08 cfs 0.350 af

Total Runoff Area = 11.038 ac Runoff Volume = 1.578 af Average Runoff Depth = 1.72"
82.61% Pervious = 9.119 ac 17.39% Impervious = 1.919 ac

Summary for Subcatchment PR-1: PR-1

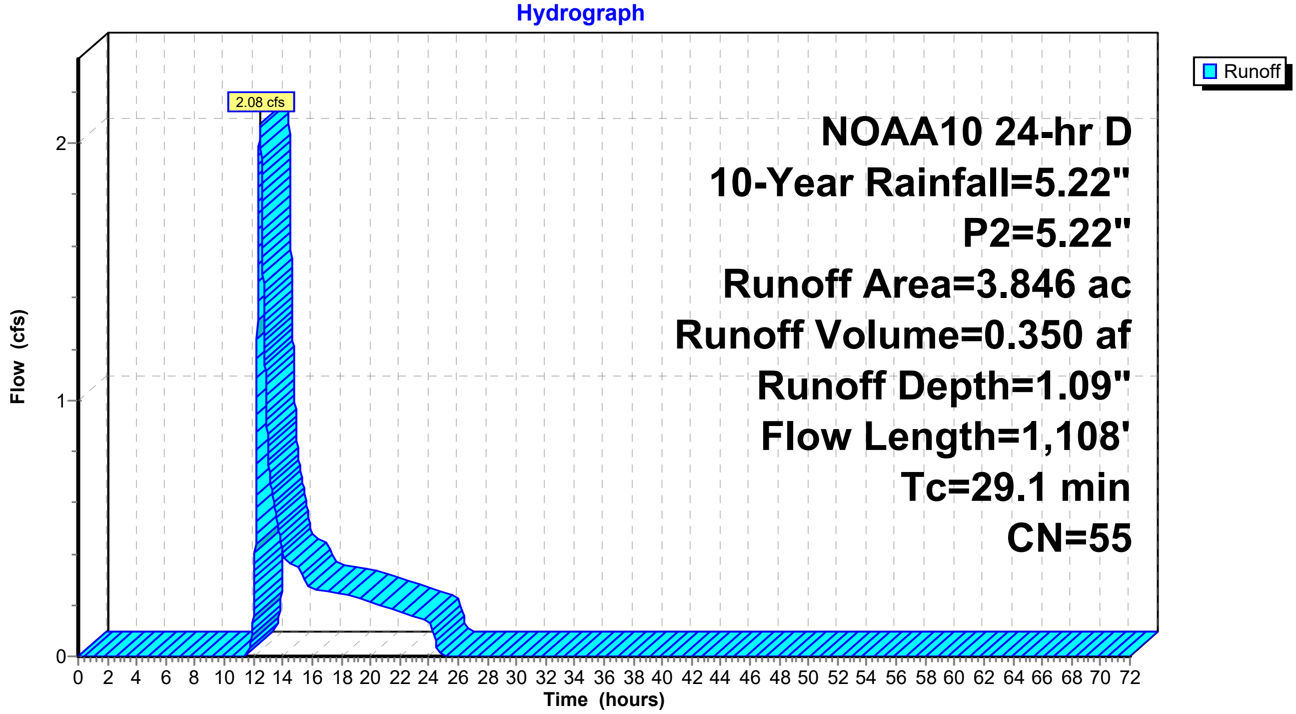
Runoff = 2.08 cfs @ 12.45 hrs, Volume= 0.350 af, Depth= 1.09"
Routed to Pond AP-2 : GROVE ST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

Area (ac)	CN	Description
0.034	30	Woods, Good, HSG A
0.007	61	>75% Grass cover, Good, HSG B
3.805	55	Woods, Good, HSG B
3.846	55	Weighted Average
3.846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0280	0.10		**Sheet Flow, A-->B**
					Woods: Light underbrush n= 0.400 P2= 5.22"
1.4	105	0.0640	1.26		**Shallow Concentrated Flow, B-->C**
					Woodland Kv= 5.0 fps
4.1	181	0.0220	0.74		**Shallow Concentrated Flow, C-->D**
					Woodland Kv= 5.0 fps
7.1	418	0.0380	0.97		**Shallow Concentrated Flow, D-->E**
					Woodland Kv= 5.0 fps
8.1	354	0.0210	0.72		**Shallow Concentrated Flow, E-->F**
					Woodland Kv= 5.0 fps
29.1	1,108	Total			

Subcatchment PR-1: PR-1



Summary for Subcatchment PR-2: PR-2

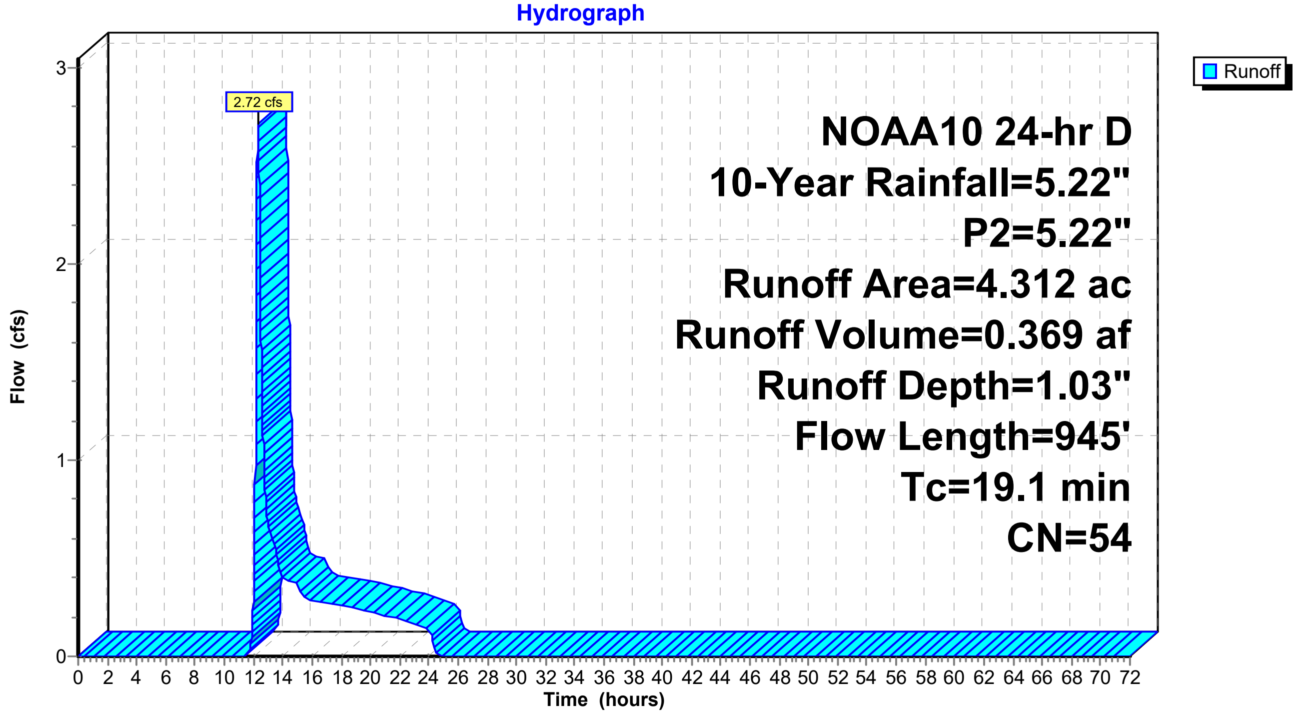
Runoff = 2.72 cfs @ 12.31 hrs, Volume= 0.369 af, Depth= 1.03"
Routed to Reach 1R : SWALE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

Area (ac)	CN	Description
0.055	30	Woods, Good, HSG A
0.128	39	>75% Grass cover, Good, HSG A
0.000	98	Paved parking, HSG A
0.000	98	Paved parking, HSG A
0.076	30	Woods, Good, HSG A
0.000	30	Woods, Good, HSG A
0.008	30	Woods, Good, HSG A
3.379	55	Woods, Good, HSG B
0.173	55	Woods, Good, HSG B
0.493	61	>75% Grass cover, Good, HSG B
4.312	54	Weighted Average
4.312		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0280	0.10		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 5.22"
2.5	128	0.0280	0.84		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.1	101	0.0950	1.54		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
4.5	284	0.0450	1.06		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
2.6	382	0.0270	2.46		**Shallow Concentrated Flow, E-->F** Grassed Waterway Kv= 15.0 fps
19.1	945	Total			

Subcatchment PR-2: PR-2



Summary for Subcatchment PR-3: PR-3

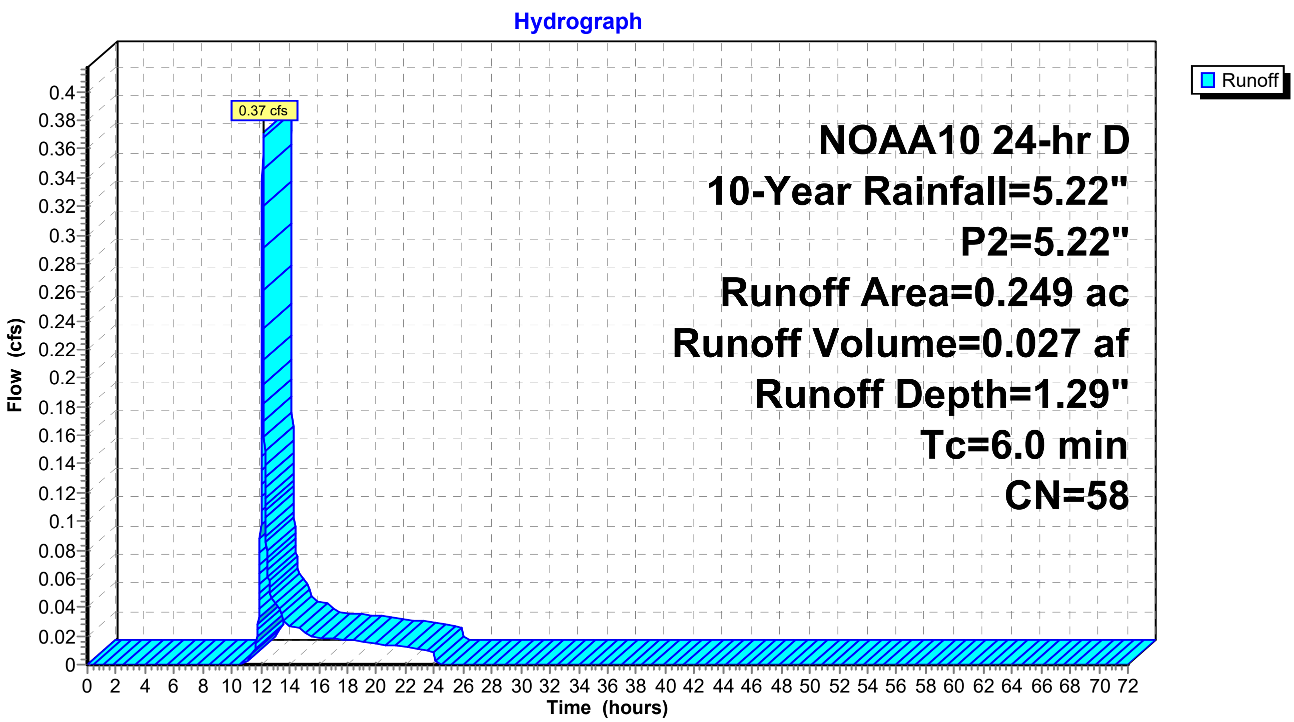
Runoff = 0.37 cfs @ 12.14 hrs, Volume= 0.027 af, Depth= 1.29"
Routed to Pond AP-1 : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

Area (ac)	CN	Description
0.012	30	Woods, Good, HSG A
0.040	98	Paved parking, HSG A
0.053	39	>75% Grass cover, Good, HSG A
0.001	30	Woods, Good, HSG A
0.073	55	Woods, Good, HSG B
0.040	61	>75% Grass cover, Good, HSG B
0.029	55	Woods, Good, HSG B
0.249	58	Weighted Average
0.209		83.88% Pervious Area
0.040		16.12% Impervious Area

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

Subcatchment PR-3: PR-3



Summary for Subcatchment PR-4: PR-4

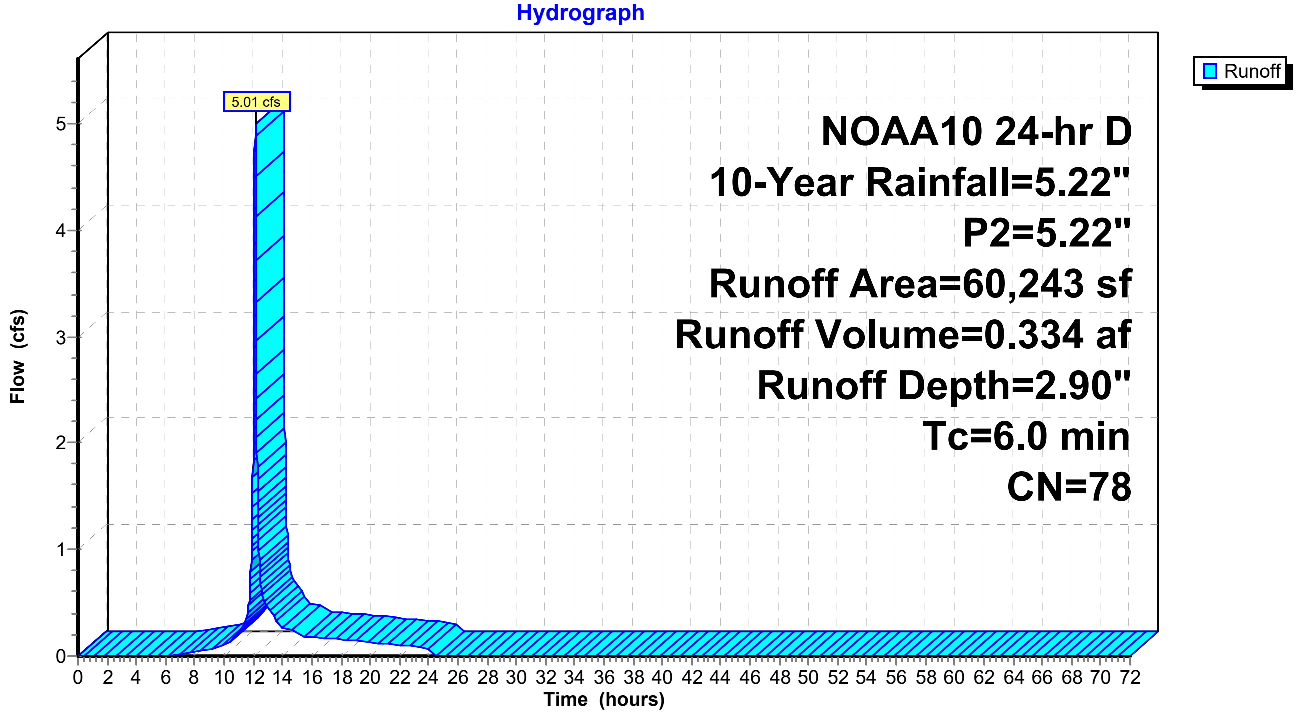
Runoff = 5.01 cfs @ 12.13 hrs, Volume= 0.334 af, Depth= 2.90"
Routed to Pond 7P : INFILTRATION BASIN (OPEN AIR)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

	Area (sf)	CN	Description
	1,228	39	>75% Grass cover, Good, HSG A
	0	39	>75% Grass cover, Good, HSG A
	174	98	Paved parking, HSG A
	0	55	Woods, Good, HSG B
	8,407	55	Woods, Good, HSG B
	174	55	Woods, Good, HSG B
	21,475	98	Paved parking, HSG B
	131	61	>75% Grass cover, Good, HSG B
	14,384	61	>75% Grass cover, Good, HSG B
	6,098	61	>75% Grass cover, Good, HSG B
*	7,875	98	Pond Surface, HSG B
*	297	98	Pond Surface, HSG A
	60,243	78	Weighted Average
	30,422		50.50% Pervious Area
	29,821		49.50% Impervious Area

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

Subcatchment PR-4: PR-4



Summary for Subcatchment PR-5: PR-5

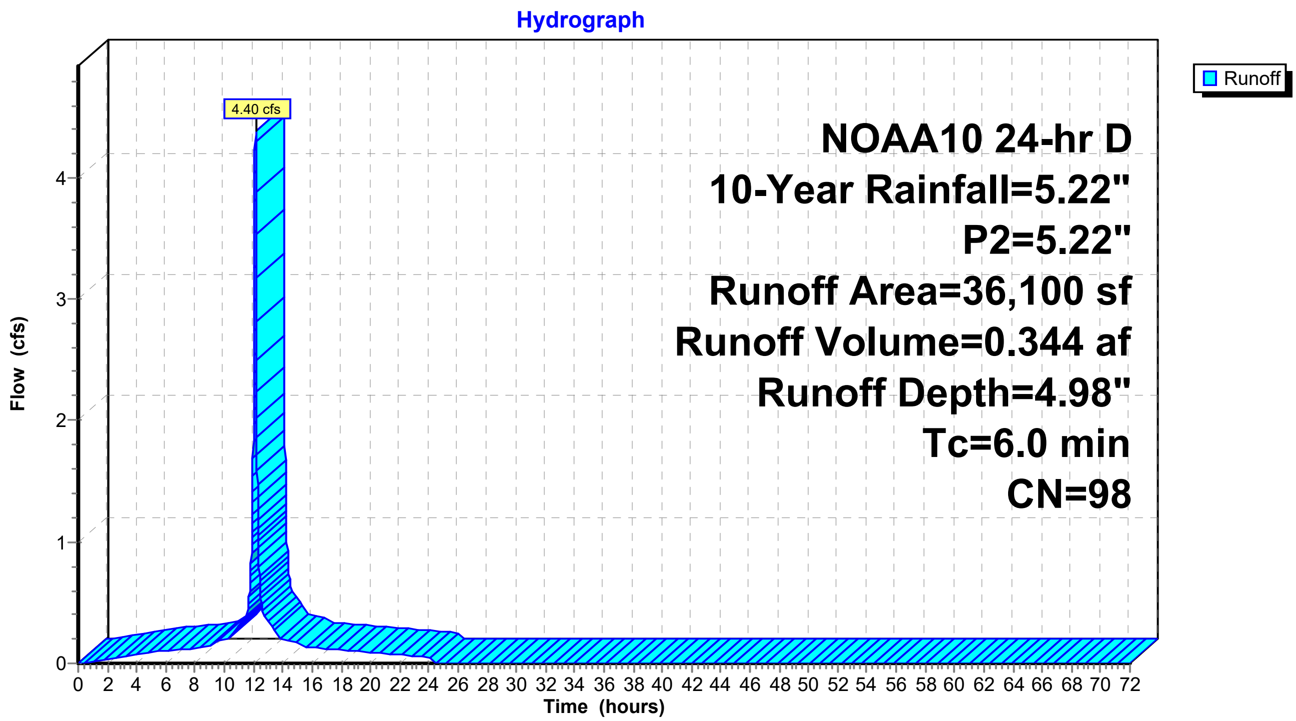
Runoff = 4.40 cfs @ 12.13 hrs, Volume= 0.344 af, Depth= 4.98"
Routed to Pond 1P : ROOF DRAIN CHAMBER BASIN (#2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

Area (sf)	CN	Description
36,100	98	Paved parking, HSG B
36,100		100.00% Impervious Area

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

Subcatchment PR-5: PR-5



Summary for Subcatchment PR-6: PR-6

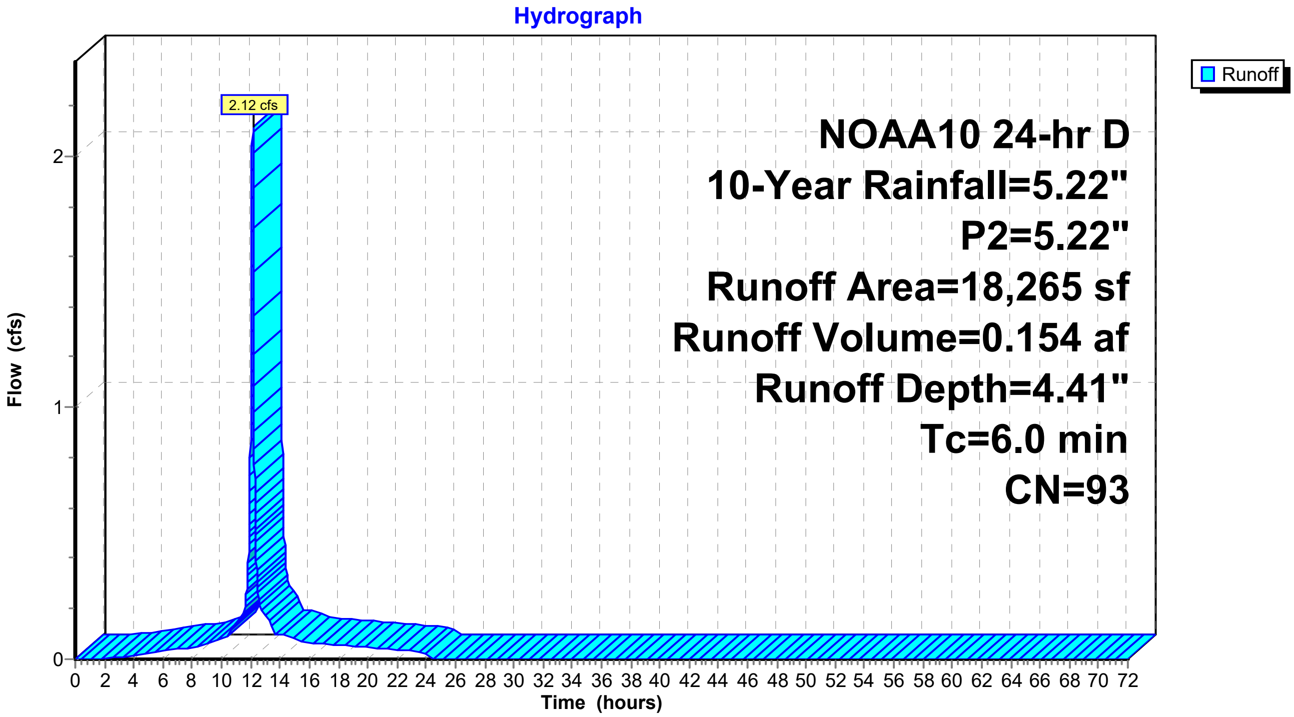
Runoff = 2.12 cfs @ 12.13 hrs, Volume= 0.154 af, Depth= 4.41"
Routed to Pond 10P : PAVEMENT CHAMBER BASIN (#1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.22", P2=5.22"

Area (sf)	CN	Description
15,932	98	Paved parking, HSG B
2,333	61	>75% Grass cover, Good, HSG B
18,265	93	Weighted Average
2,333		12.78% Pervious Area
15,932		87.22% Impervious Area

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

Subcatchment PR-6: PR-6



Summary for Reach 1R: SWALE

Inflow Area = 4.312 ac, 0.00% Impervious, Inflow Depth = 1.03" for 10-Year event
Inflow = 2.72 cfs @ 12.31 hrs, Volume= 0.369 af
Outflow = 2.51 cfs @ 12.37 hrs, Volume= 0.369 af, Atten= 8%, Lag= 4.0 min
Routed to Pond AP-1 : WETLANDS

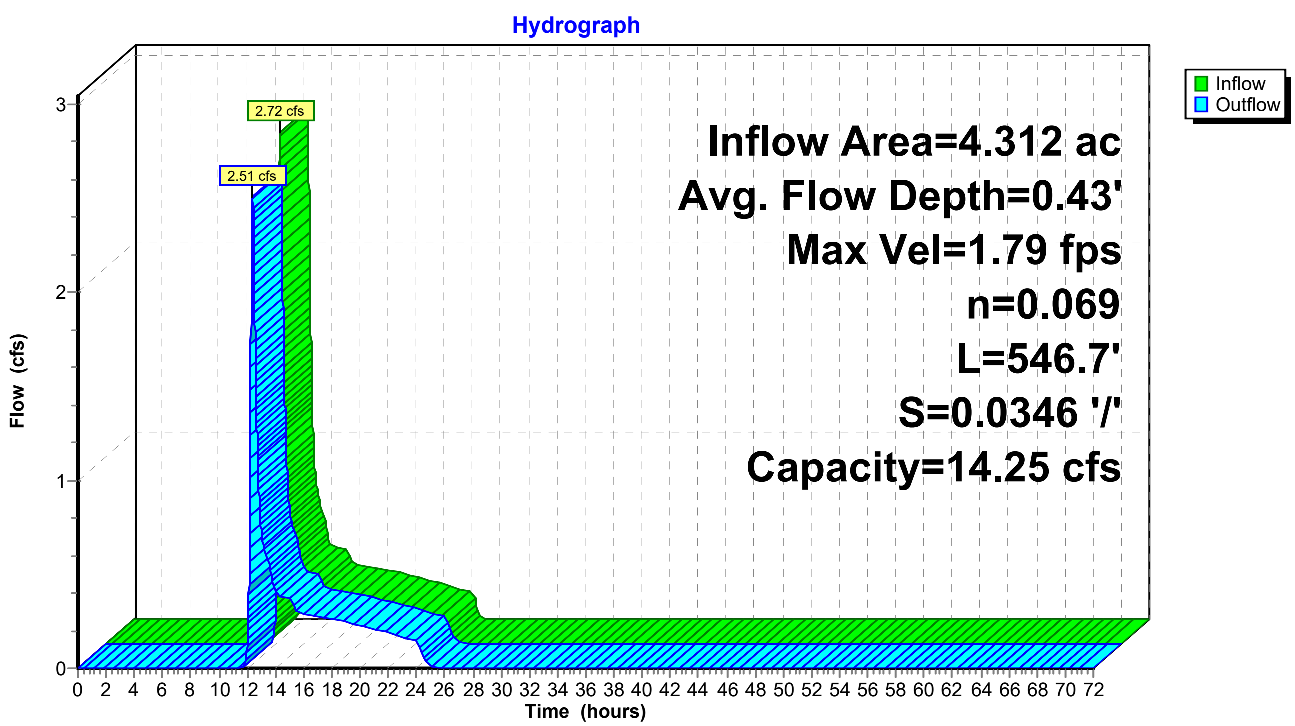
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.79 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 13.0 min

Peak Storage= 767 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.43' , Surface Width= 4.57'
Defined Flood Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.25 cfs
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.25 cfs

2.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 546.7' Slope= 0.0346 '/'
Inlet Invert= 302.00', Outlet Invert= 283.10'

‡

Reach 1R: SWALE



Summary for Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=11)

Inflow Area = 0.829 ac,100.00% Impervious, Inflow Depth = 4.98" for 10-Year event
Inflow = 4.40 cfs @ 12.13 hrs, Volume= 0.344 af
Outflow = 2.41 cfs @ 12.05 hrs, Volume= 0.344 af, Atten= 45%, Lag= 0.0 min
Discarded = 2.41 cfs @ 12.05 hrs, Volume= 0.344 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 7P : INFILTRATION BASIN (OPEN AIR)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 287.66' @ 12.20 hrs Surf.Area= 958 sf Storage= 700 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.5 min (750.3 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	286.50'	885 cf	**30.00'W x 31.93'L x 3.50'H Field A** 3,353 cf Overall - 1,142 cf Embedded = 2,211 cf x 40.0% Voids
#2A	287.00'	1,142 cf	**Cultec R-300HD** x 24 Inside #1 Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap 24 Chambers in 6 Rows Cap Storage= 2.7 cf x 2 x 6 rows = 31.9 cf
		2,026 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	288.50'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	286.50'	**2.41 cfs Exfiltration at all elevations** Phase-In= 0.01'
#3	Device 1	289.40'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=2.41 cfs @ 12.05 hrs HW=286.54' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 2.41 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=286.50' TW=286.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: ROOF DRAIN CHAMBER BASIN (#2) - Chamber Wizard Field A

Chamber Model = Cultec R-300HD (Cultec Recharger®300HD)
Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap
Cap Storage= 2.7 cf x 2 x 6 rows = 31.9 cf

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

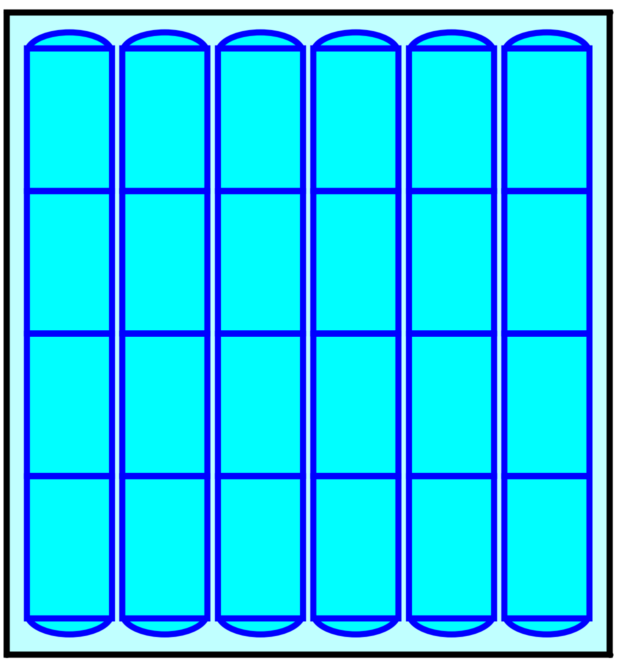
4 Chambers/Row x 7.08' Long +0.80' Cap Length x 2 = 29.93' Row Length +12.0" End Stone x 2 = 31.93' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

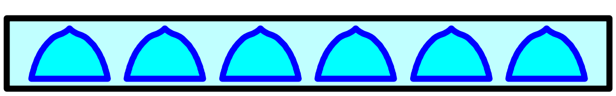
24 Chambers x 46.2 cf + 2.7 cf Cap Volume x 2 x 6 Rows = 1,141.7 cf Chamber Storage

3,353.0 cf Field - 1,141.7 cf Chambers = 2,211.3 cf Stone x 40.0% Voids = 884.5 cf Stone Storage

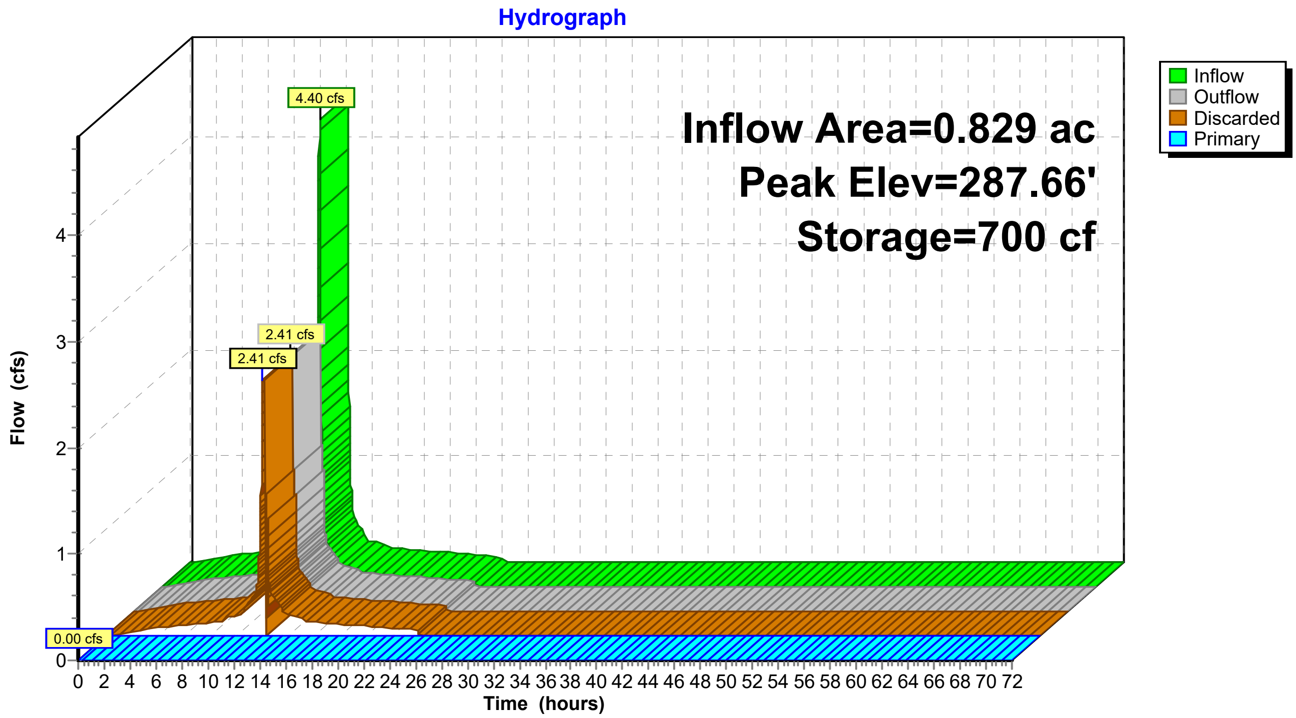
Chamber Storage + Stone Storage = 2,026.2 cf = 0.047 af
Overall Storage Efficiency = 60.4%
Overall System Size = 31.93' x 30.00' x 3.50'

24 Chambers
124.2 cy Field
81.9 cy Stone





Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)



Summary for Pond 7P: INFILTRATION BASIN (OPEN AIR)

Inflow Area = 2.212 ac, 68.42% Impervious, Inflow Depth = 1.81" for 10-Year event
Inflow = 5.01 cfs @ 12.13 hrs, Volume= 0.334 af
Outflow = 0.31 cfs @ 13.58 hrs, Volume= 0.334 af, Atten= 94%, Lag= 86.8 min
Discarded = 0.23 cfs @ 13.58 hrs, Volume= 0.323 af
Primary = 0.08 cfs @ 13.58 hrs, Volume= 0.011 af
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 287.30' @ 13.58 hrs Surf.Area= 4,172 sf Storage= 5,748 cf

Plug-Flow detention time= 256.6 min calculated for 0.334 af (100% of inflow)
Center-of-Mass det. time= 256.6 min (1,109.4 - 852.8)

Volume	Invert	Avail.Storage	Storage Description
#1	286.00'	19,274 cf	**INFILTRATION BASIN (Prismatic)** Listed below
#2	286.00'	3,737 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
		23,011 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
286.00	2,949	0	0
288.00	4,824	7,773	7,773
290.00	6,677	11,501	19,274

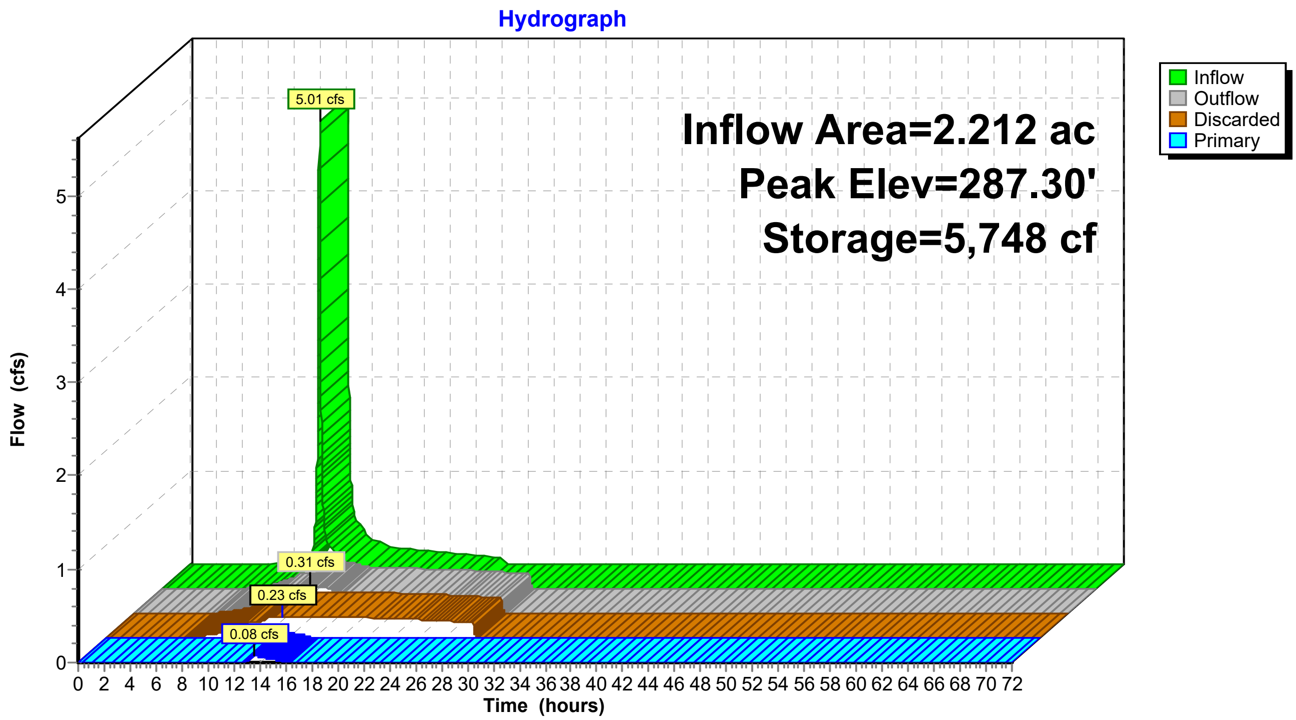
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
286.00	384	0	0
287.10	607	545	545
288.00	972	711	1,256
290.00	1,509	2,481	3,737

Device	Routing	Invert	Outlet Devices
#1	Primary	286.00'	**15.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	286.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#3	Primary	289.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Device 1	289.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	287.20'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.23 cfs @ 13.58 hrs HW=287.30' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.08 cfs @ 13.58 hrs HW=287.30' TW=0.00' (Dynamic Tailwater)
├─**1=Orifice/Grate** (Passes 0.08 cfs of 4.87 cfs potential flow)
│ ├─**4=Orifice/Grate** (Controls 0.00 cfs)
│ └─**5=Orifice/Grate** (Orifice Controls 0.08 cfs @ 1.10 fps)
└─**3=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 7P: INFILTRATION BASIN (OPEN AIR)



Summary for Pond 10P: PAVEMENT CHAMBER BASIN (#1)

Inflow Area = 0.419 ac, 87.22% Impervious, Inflow Depth = 4.41" for 10-Year event
Inflow = 2.12 cfs @ 12.13 hrs, Volume= 0.154 af
Outflow = 0.12 cfs @ 11.10 hrs, Volume= 0.154 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.12 cfs @ 11.10 hrs, Volume= 0.154 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 288.60' @ 13.57 hrs Surf.Area= 2,107 sf Storage= 2,270 cf

Plug-Flow detention time= 150.0 min calculated for 0.154 af (100% of inflow)
Center-of-Mass det. time= 150.0 min (937.0 - 787.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	287.00'	1,905 cf	**20.50'W x 102.77'L x 3.50'H Field A** 7,374 cf Overall - 2,611 cf Embedded = 4,763 cf x 40.0% Voids
#2A	287.50'	2,611 cf	**Cultec R-300HD** x 56 Inside #1 Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap 56 Chambers in 4 Rows Cap Storage= 2.7 cf x 2 x 4 rows = 21.2 cf
		4,516 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	287.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Device 1	289.90'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#3	Discarded	287.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.12 cfs @ 11.10 hrs HW=287.04' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=287.00' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Controls 0.00 cfs)
  └─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 10P: PAVEMENT CHAMBER BASIN (#1) - Chamber Wizard Field A

Chamber Model = Cultec R-300HD (Cultec Recharger®300HD)
Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap
Cap Storage= 2.7 cf x 2 x 4 rows = 21.2 cf

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

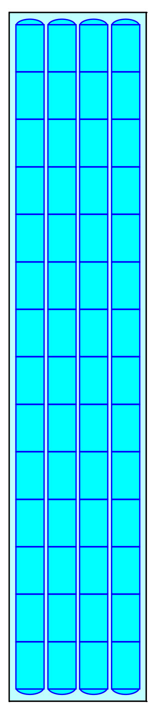
14 Chambers/Row x 7.08' Long +0.80' Cap Length x 2 = 100.77' Row Length +12.0" End Stone x 2 = 102.77' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

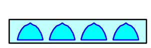
56 Chambers x 46.2 cf + 2.7 cf Cap Volume x 2 x 4 Rows = 2,610.8 cf Chamber Storage

7,373.5 cf Field - 2,610.8 cf Chambers = 4,762.7 cf Stone x 40.0% Voids = 1,905.1 cf Stone Storage

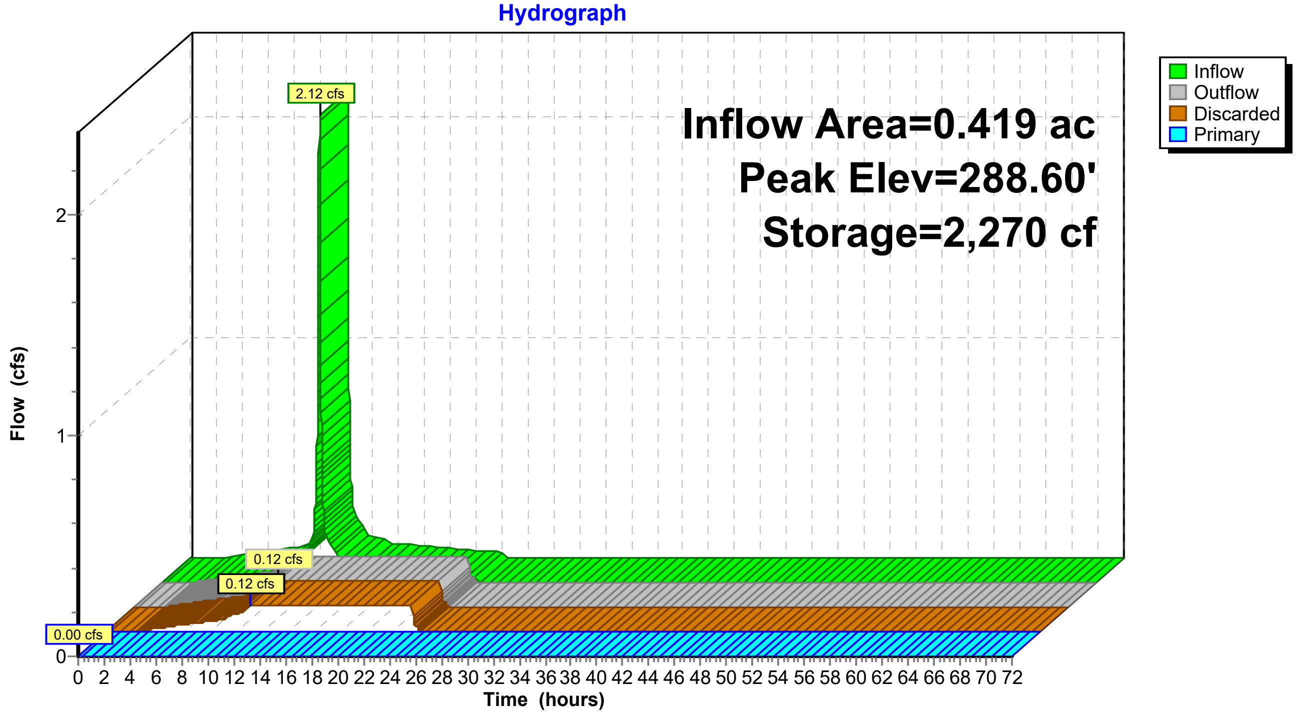
Chamber Storage + Stone Storage = 4,515.9 cf = 0.104 af
Overall Storage Efficiency = 61.2%
Overall System Size = 102.77' x 20.50' x 3.50'

56 Chambers
273.1 cy Field
176.4 cy Stone





Pond 10P: PAVEMENT CHAMBER BASIN (#1)



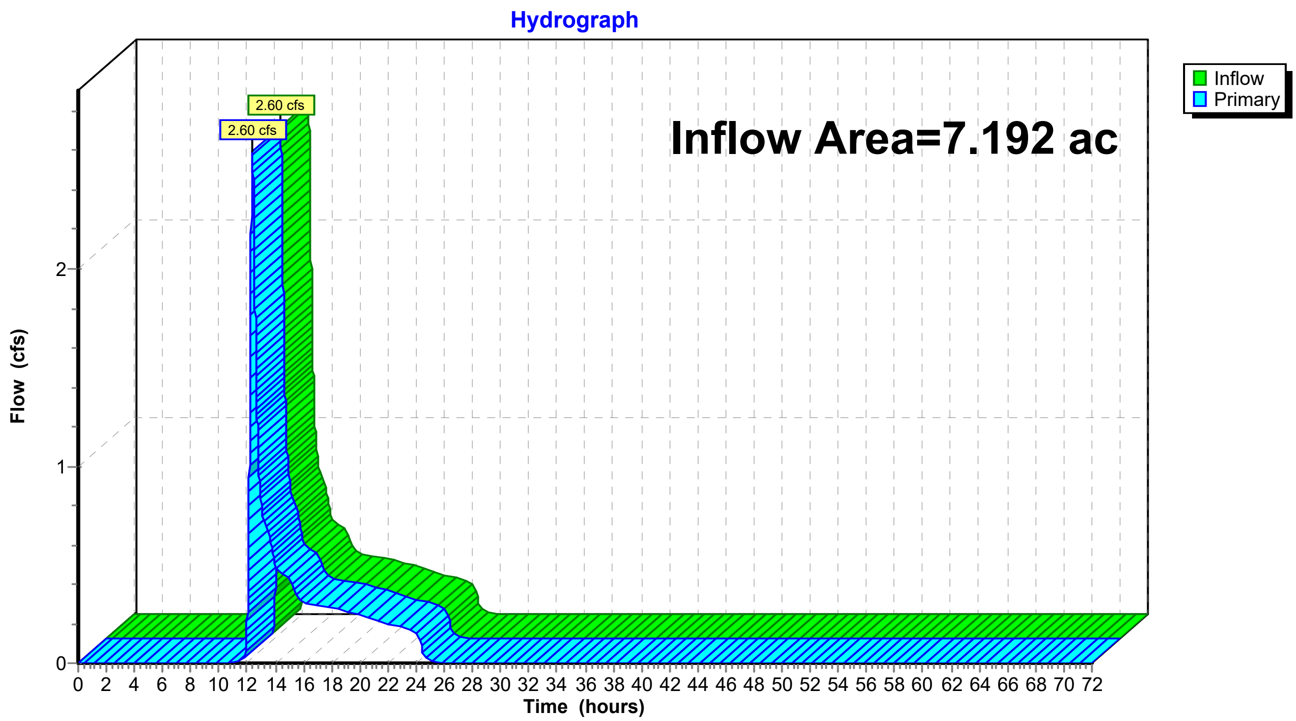
Summary for Pond AP-1: WETLANDS

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

Inflow Area =	7.192 ac,	26.69% Impervious,	Inflow Depth = 0.68"	for 10-Year event
Inflow =	2.60 cfs @	12.37 hrs, Volume=	0.407 af	
Primary =	2.60 cfs @	12.37 hrs, Volume=	0.407 af, Atten= 0%, Lag= 0.0 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: WETLANDS

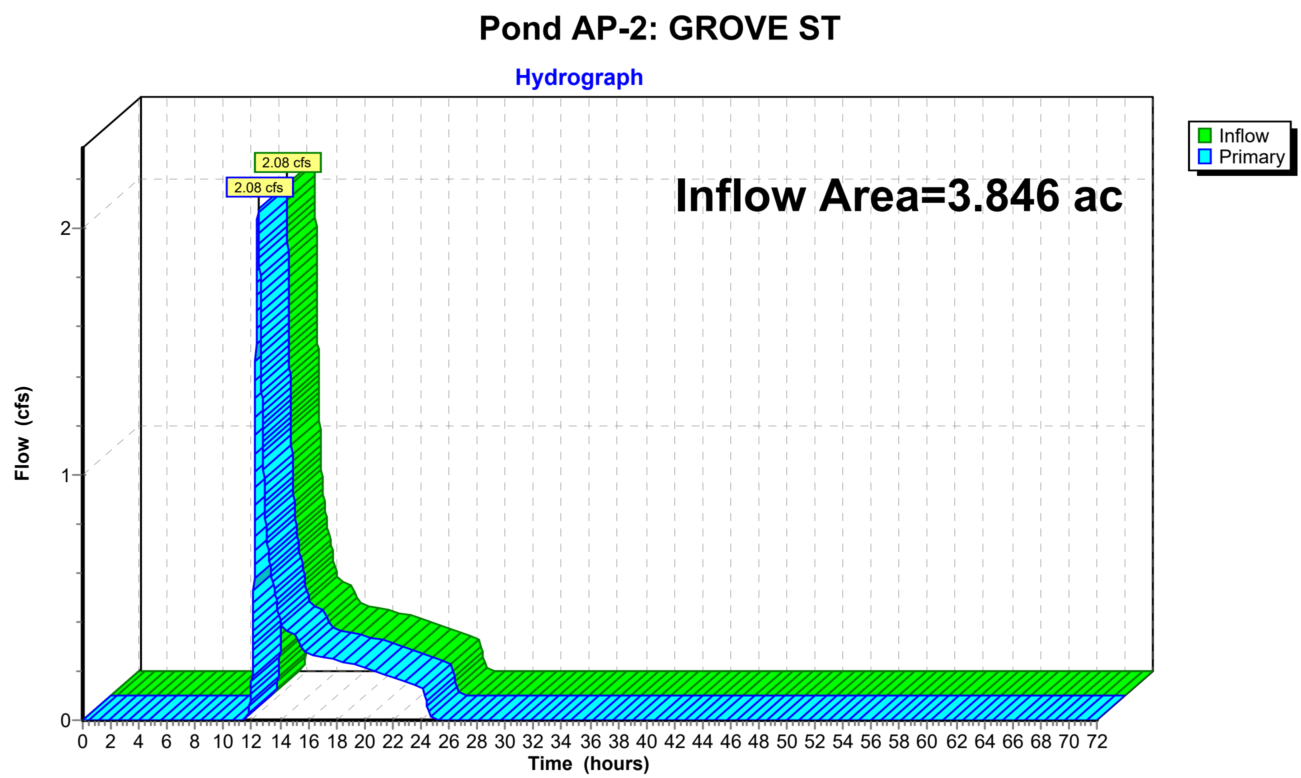


Summary for Pond AP-2: GROVE ST

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

Inflow Area =	3.846 ac,	0.00% Impervious, Inflow Depth = 1.09"	for 10-Year event
Inflow =	2.08 cfs @	12.45 hrs, Volume=	0.350 af
Primary =	2.08 cfs @	12.45 hrs, Volume=	0.350 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: PR-1 Runoff Area=3.846 ac 0.00% Impervious Runoff Depth=1.75"
Flow Length=1,108' Tc=28.3 min CN=55 Runoff=3.76 cfs 0.560 af

SubcatchmentPR-2: PR-2 Runoff Area=4.312 ac 0.00% Impervious Runoff Depth=1.66"
Flow Length=945' Tc=18.3 min CN=54 Runoff=5.06 cfs 0.598 af

SubcatchmentPR-3: PR-3 Runoff Area=0.249 ac 16.12% Impervious Runoff Depth=2.00"
Tc=6.0 min CN=58 Runoff=0.61 cfs 0.042 af

SubcatchmentPR-4: PR-4 Runoff Area=60,243 sf 49.50% Impervious Runoff Depth=3.93"
Tc=6.0 min CN=78 Runoff=6.73 cfs 0.452 af

SubcatchmentPR-5: PR-5 Runoff Area=36,100 sf 100.00% Impervious Runoff Depth=6.15"
Tc=6.0 min CN=98 Runoff=5.39 cfs 0.425 af

SubcatchmentPR-6: PR-6 Runoff Area=18,265 sf 87.22% Impervious Runoff Depth=5.57"
Tc=6.0 min CN=93 Runoff=2.64 cfs 0.195 af

Reach 1R: SWALE Avg. Flow Depth=0.59' Max Vel=2.13 fps Inflow=5.06 cfs 0.598 af
n=0.069 L=546.7' S=0.0346 '/' Capacity=14.25 cfs Outflow=4.76 cfs 0.598 af

Pond 1P: ROOF DRAIN CHAMBER BASIN Peak Elev=288.45' Storage=1,257 cf Inflow=5.39 cfs 0.425 af
Discarded=2.41 cfs 0.425 af Primary=0.00 cfs 0.000 af Outflow=2.41 cfs 0.425 af

Pond 7P: INFILTRATION BASIN (OPEN AIR) Peak Elev=287.53' Storage=6,774 cf Inflow=6.73 cfs 0.452 af
Discarded=0.24 cfs 0.367 af Primary=0.66 cfs 0.085 af Outflow=0.91 cfs 0.452 af

Pond 10P: PAVEMENT CHAMBER BASIN Peak Elev=289.18' Storage=3,150 cf Inflow=2.64 cfs 0.195 af
Discarded=0.12 cfs 0.195 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.195 af

Pond AP-1: WETLANDS Inflow=5.47 cfs 0.724 af
Primary=5.47 cfs 0.724 af

Pond AP-2: GROVE ST Inflow=3.76 cfs 0.560 af
Primary=3.76 cfs 0.560 af

Total Runoff Area = 11.038 ac Runoff Volume = 2.271 af Average Runoff Depth = 2.47"
82.61% Pervious = 9.119 ac 17.39% Impervious = 1.919 ac

Summary for Subcatchment PR-1: PR-1

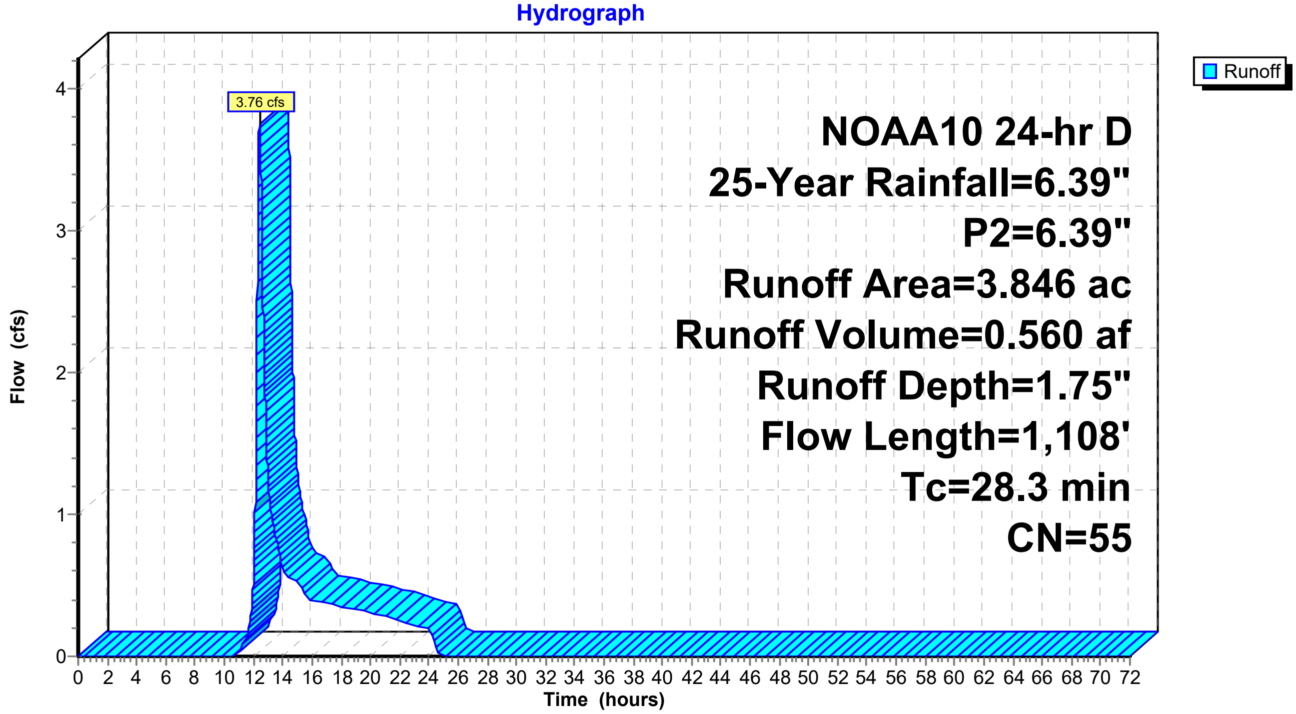
Runoff = 3.76 cfs @ 12.42 hrs, Volume= 0.560 af, Depth= 1.75"
Routed to Pond AP-2 : GROVE ST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

Area (ac)	CN	Description
0.034	30	Woods, Good, HSG A
0.007	61	>75% Grass cover, Good, HSG B
3.805	55	Woods, Good, HSG B
3.846	55	Weighted Average
3.846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0280	0.11		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 6.39"
1.4	105	0.0640	1.26		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
4.1	181	0.0220	0.74		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
7.1	418	0.0380	0.97		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
8.1	354	0.0210	0.72		**Shallow Concentrated Flow, E-->F** Woodland Kv= 5.0 fps
28.3	1,108	Total			

Subcatchment PR-1: PR-1



Summary for Subcatchment PR-2: PR-2

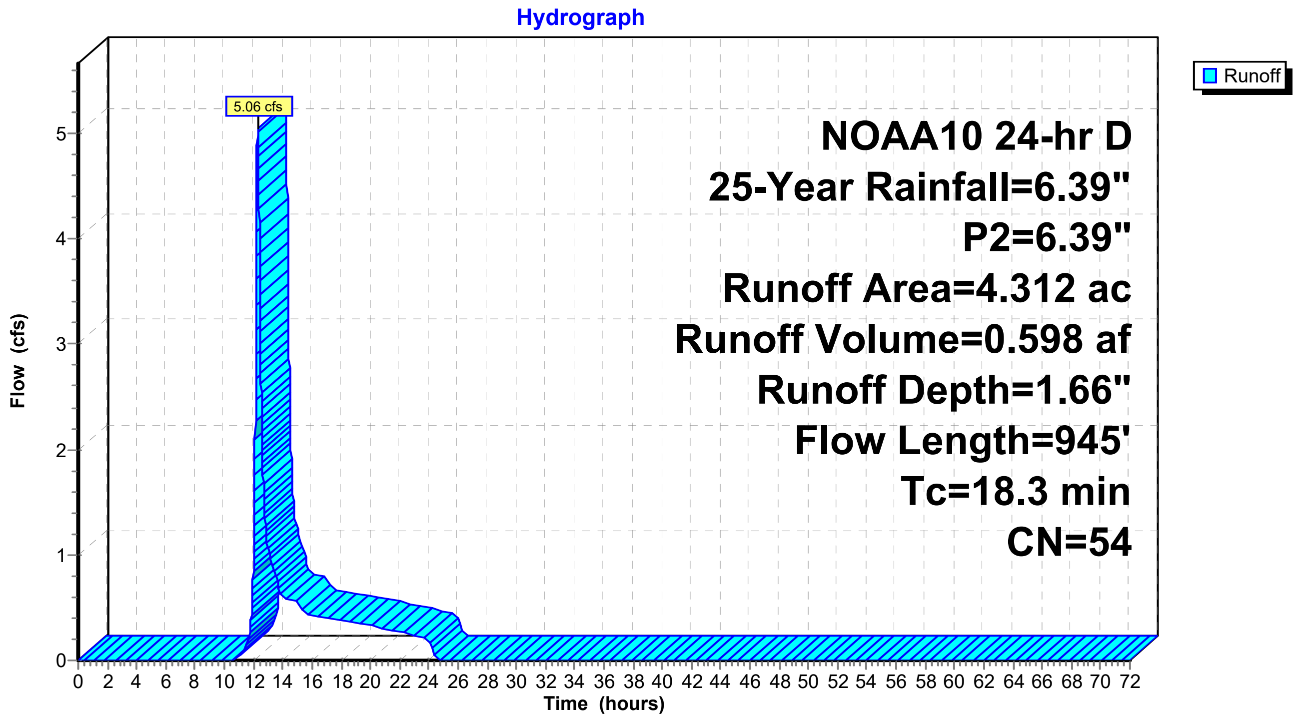
Runoff = 5.06 cfs @ 12.29 hrs, Volume= 0.598 af, Depth= 1.66"
Routed to Reach 1R : SWALE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

Area (ac)	CN	Description
0.055	30	Woods, Good, HSG A
0.128	39	>75% Grass cover, Good, HSG A
0.000	98	Paved parking, HSG A
0.000	98	Paved parking, HSG A
0.076	30	Woods, Good, HSG A
0.000	30	Woods, Good, HSG A
0.008	30	Woods, Good, HSG A
3.379	55	Woods, Good, HSG B
0.173	55	Woods, Good, HSG B
0.493	61	>75% Grass cover, Good, HSG B
4.312	54	Weighted Average
4.312		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0280	0.11		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 6.39"
2.5	128	0.0280	0.84		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.1	101	0.0950	1.54		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
4.5	284	0.0450	1.06		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
2.6	382	0.0270	2.46		**Shallow Concentrated Flow, E-->F** Grassed Waterway Kv= 15.0 fps
18.3	945	Total			

Subcatchment PR-2: PR-2



Summary for Subcatchment PR-3: PR-3

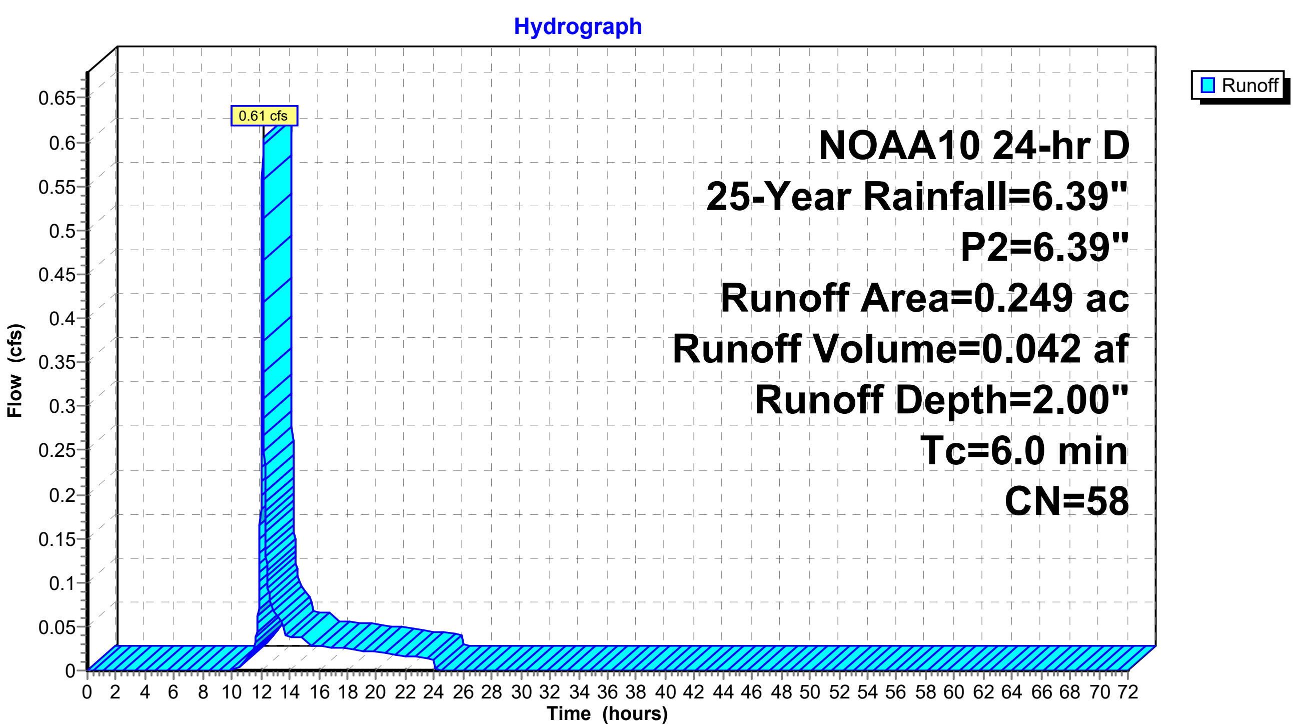
Runoff = 0.61 cfs @ 12.14 hrs, Volume= 0.042 af, Depth= 2.00"
Routed to Pond AP-1 : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

Area (ac)	CN	Description
0.012	30	Woods, Good, HSG A
0.040	98	Paved parking, HSG A
0.053	39	>75% Grass cover, Good, HSG A
0.001	30	Woods, Good, HSG A
0.073	55	Woods, Good, HSG B
0.040	61	>75% Grass cover, Good, HSG B
0.029	55	Woods, Good, HSG B
0.249	58	Weighted Average
0.209		83.88% Pervious Area
0.040		16.12% Impervious Area

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

Subcatchment PR-3: PR-3



Summary for Subcatchment PR-4: PR-4

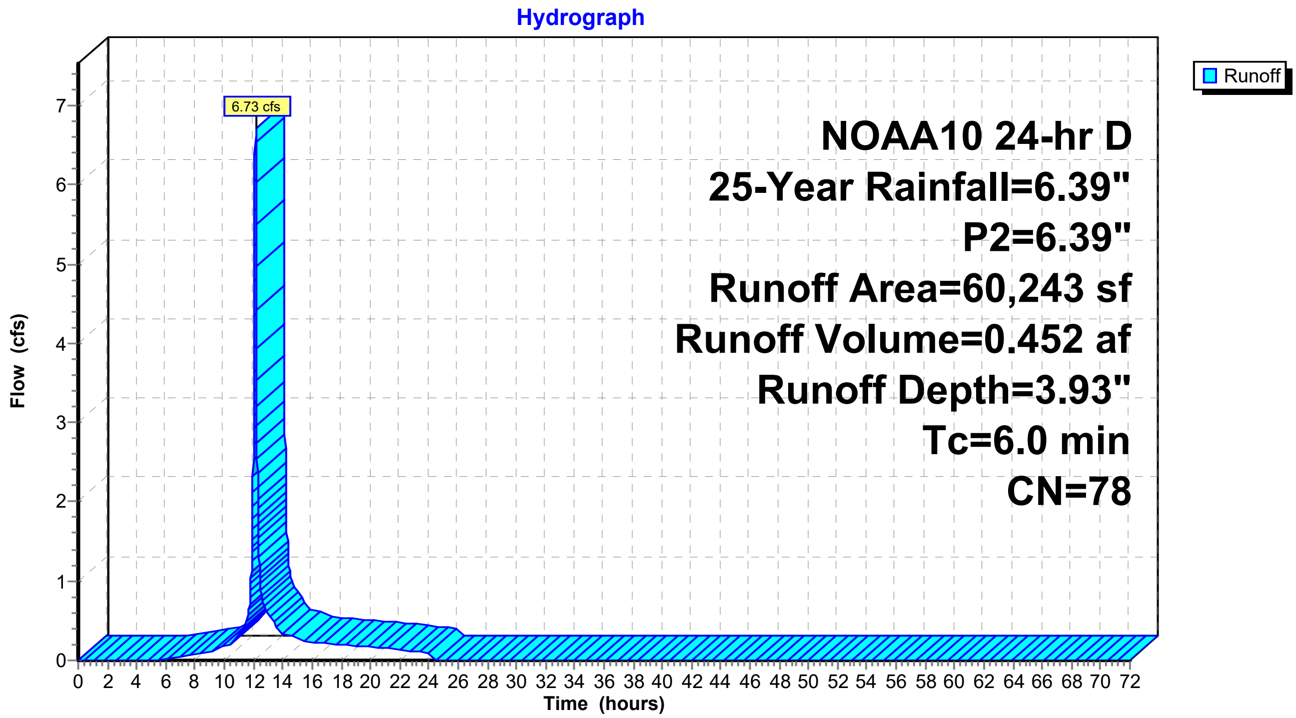
Runoff = 6.73 cfs @ 12.13 hrs, Volume= 0.452 af, Depth= 3.93"
Routed to Pond 7P : INFILTRATION BASIN (OPEN AIR)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

	Area (sf)	CN	Description
	1,228	39	>75% Grass cover, Good, HSG A
	0	39	>75% Grass cover, Good, HSG A
	174	98	Paved parking, HSG A
	0	55	Woods, Good, HSG B
	8,407	55	Woods, Good, HSG B
	174	55	Woods, Good, HSG B
	21,475	98	Paved parking, HSG B
	131	61	>75% Grass cover, Good, HSG B
	14,384	61	>75% Grass cover, Good, HSG B
	6,098	61	>75% Grass cover, Good, HSG B
*	7,875	98	Pond Surface, HSG B
*	297	98	Pond Surface, HSG A
	60,243	78	Weighted Average
	30,422		50.50% Pervious Area
	29,821		49.50% Impervious Area

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

Subcatchment PR-4: PR-4



Summary for Subcatchment PR-5: PR-5

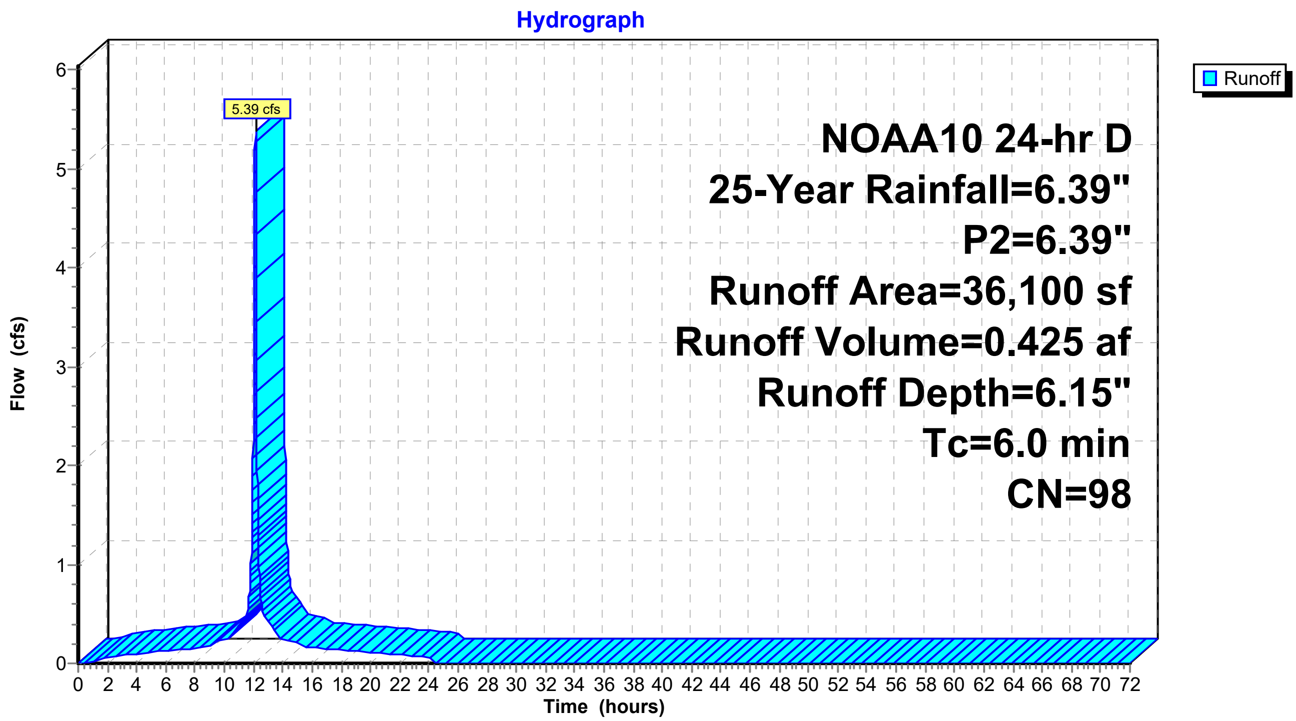
Runoff = 5.39 cfs @ 12.13 hrs, Volume= 0.425 af, Depth= 6.15"
Routed to Pond 1P : ROOF DRAIN CHAMBER BASIN (#2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

Area (sf)	CN	Description
36,100	98	Paved parking, HSG B
36,100		100.00% Impervious Area

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

Subcatchment PR-5: PR-5



Summary for Subcatchment PR-6: PR-6

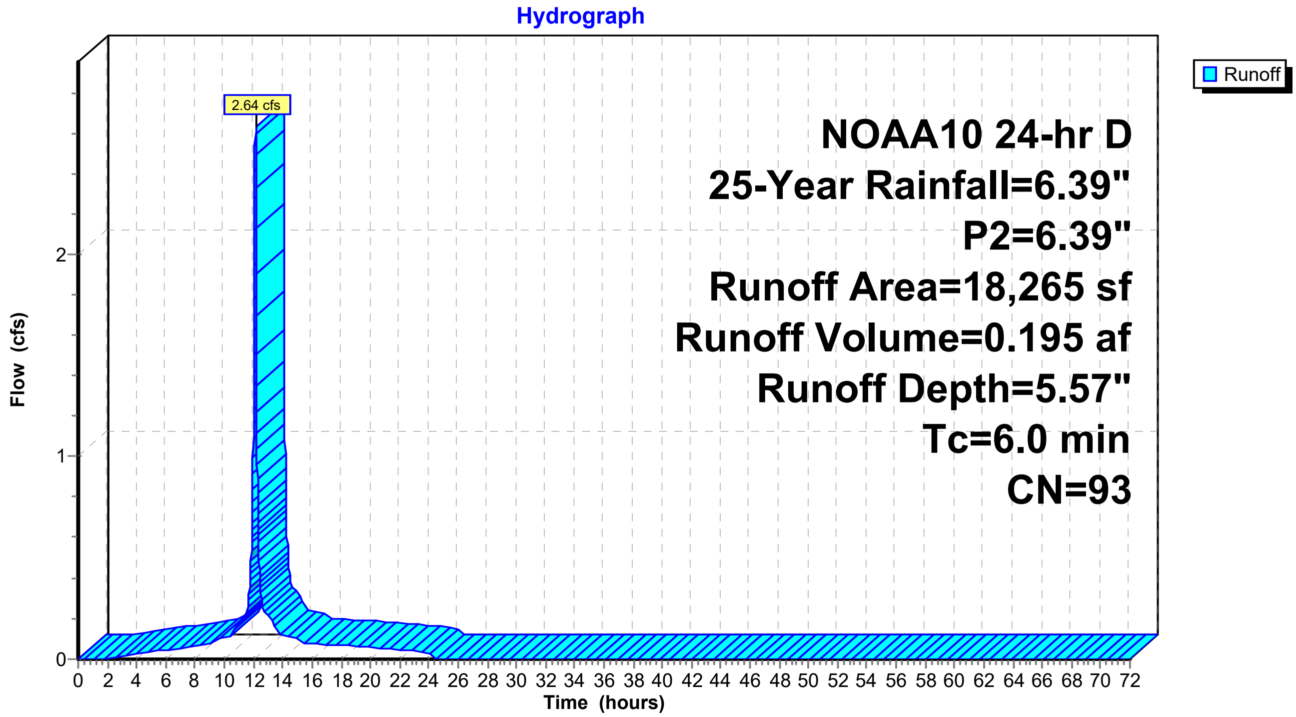
Runoff = 2.64 cfs @ 12.13 hrs, Volume= 0.195 af, Depth= 5.57"
Routed to Pond 10P : PAVEMENT CHAMBER BASIN (#1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.39", P2=6.39"

Area (sf)	CN	Description
15,932	98	Paved parking, HSG B
2,333	61	>75% Grass cover, Good, HSG B
18,265	93	Weighted Average
2,333		12.78% Pervious Area
15,932		87.22% Impervious Area

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

Subcatchment PR-6: PR-6



Summary for Reach 1R: SWALE

Inflow Area = 4.312 ac, 0.00% Impervious, Inflow Depth = 1.66" for 25-Year event
Inflow = 5.06 cfs @ 12.29 hrs, Volume= 0.598 af
Outflow = 4.76 cfs @ 12.34 hrs, Volume= 0.598 af, Atten= 6%, Lag= 3.2 min
Routed to Pond AP-1 : WETLANDS

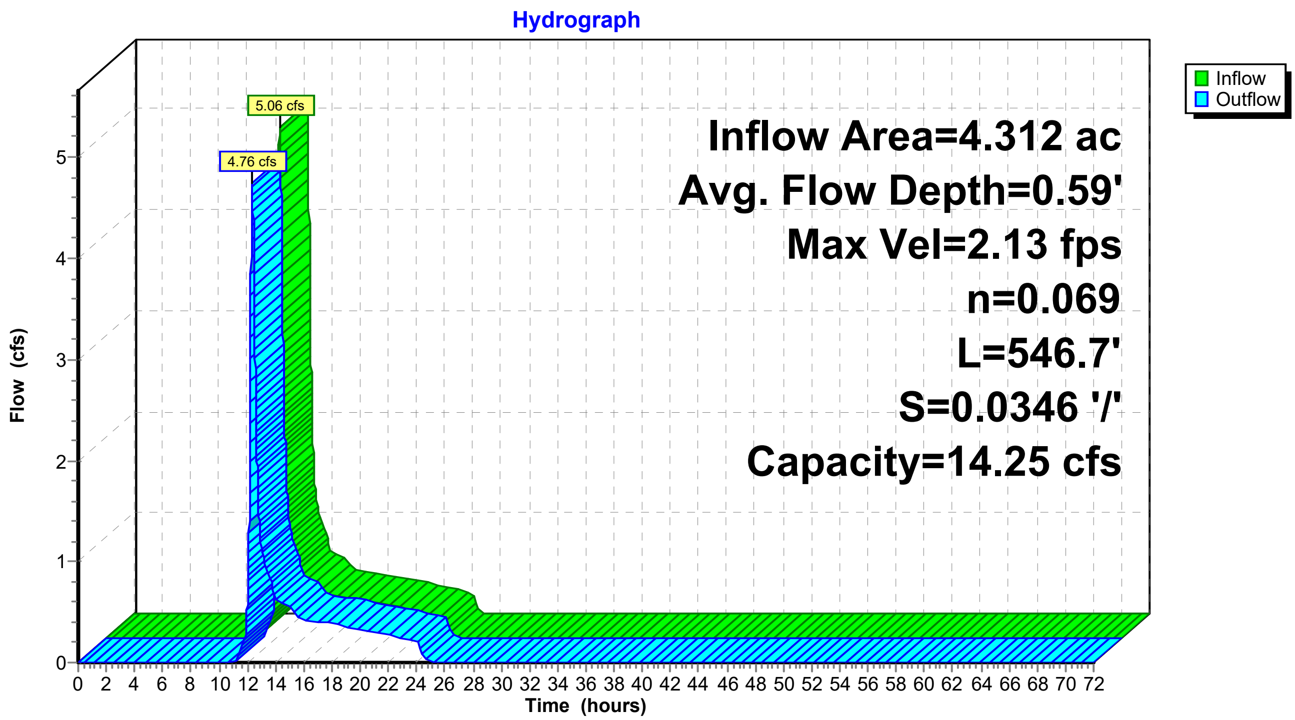
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.13 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.79 fps, Avg. Travel Time= 11.5 min

Peak Storage= 1,219 cf @ 12.34 hrs
Average Depth at Peak Storage= 0.59' , Surface Width= 5.55'
Defined Flood Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.25 cfs
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.25 cfs

2.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 546.7' Slope= 0.0346 '/'
Inlet Invert= 302.00', Outlet Invert= 283.10'

‡

Reach 1R: SWALE



Summary for Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=9)

Inflow Area = 0.829 ac,100.00% Impervious, Inflow Depth = 6.15" for 25-Year event
Inflow = 5.39 cfs @ 12.13 hrs, Volume= 0.425 af
Outflow = 2.41 cfs @ 12.01 hrs, Volume= 0.425 af, Atten= 55%, Lag= 0.0 min
Discarded = 2.41 cfs @ 12.01 hrs, Volume= 0.425 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 7P : INFILTRATION BASIN (OPEN AIR)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 288.45' @ 12.22 hrs Surf.Area= 958 sf Storage= 1,257 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 1.1 min (747.3 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	286.50'	885 cf	**30.00'W x 31.93'L x 3.50'H Field A** 3,353 cf Overall - 1,142 cf Embedded = 2,211 cf x 40.0% Voids
#2A	287.00'	1,142 cf	**Cultec R-300HD** x 24 Inside #1 Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap 24 Chambers in 6 Rows Cap Storage= 2.7 cf x 2 x 6 rows = 31.9 cf
		2,026 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	288.50'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	286.50'	**2.41 cfs Exfiltration at all elevations** Phase-In= 0.01'
#3	Device 1	289.40'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=2.41 cfs @ 12.01 hrs HW=286.54' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 2.41 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=286.50' TW=286.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: ROOF DRAIN CHAMBER BASIN (#2) - Chamber Wizard Field A

Chamber Model = Cultec R-300HD (Cultec Recharger®300HD)
Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap
Cap Storage= 2.7 cf x 2 x 6 rows = 31.9 cf

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

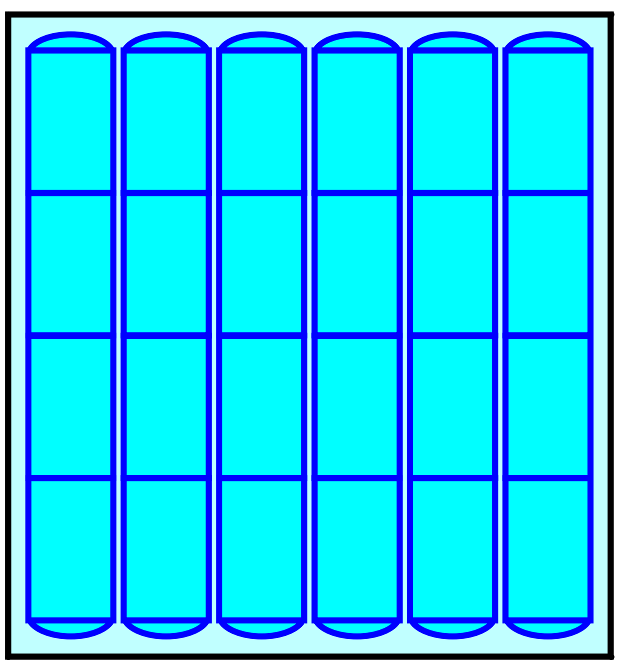
4 Chambers/Row x 7.08' Long +0.80' Cap Length x 2 = 29.93' Row Length +12.0" End Stone x 2 = 31.93' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

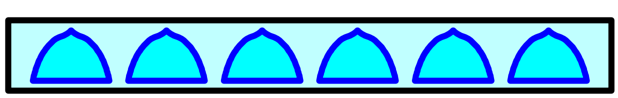
24 Chambers x 46.2 cf + 2.7 cf Cap Volume x 2 x 6 Rows = 1,141.7 cf Chamber Storage

3,353.0 cf Field - 1,141.7 cf Chambers = 2,211.3 cf Stone x 40.0% Voids = 884.5 cf Stone Storage

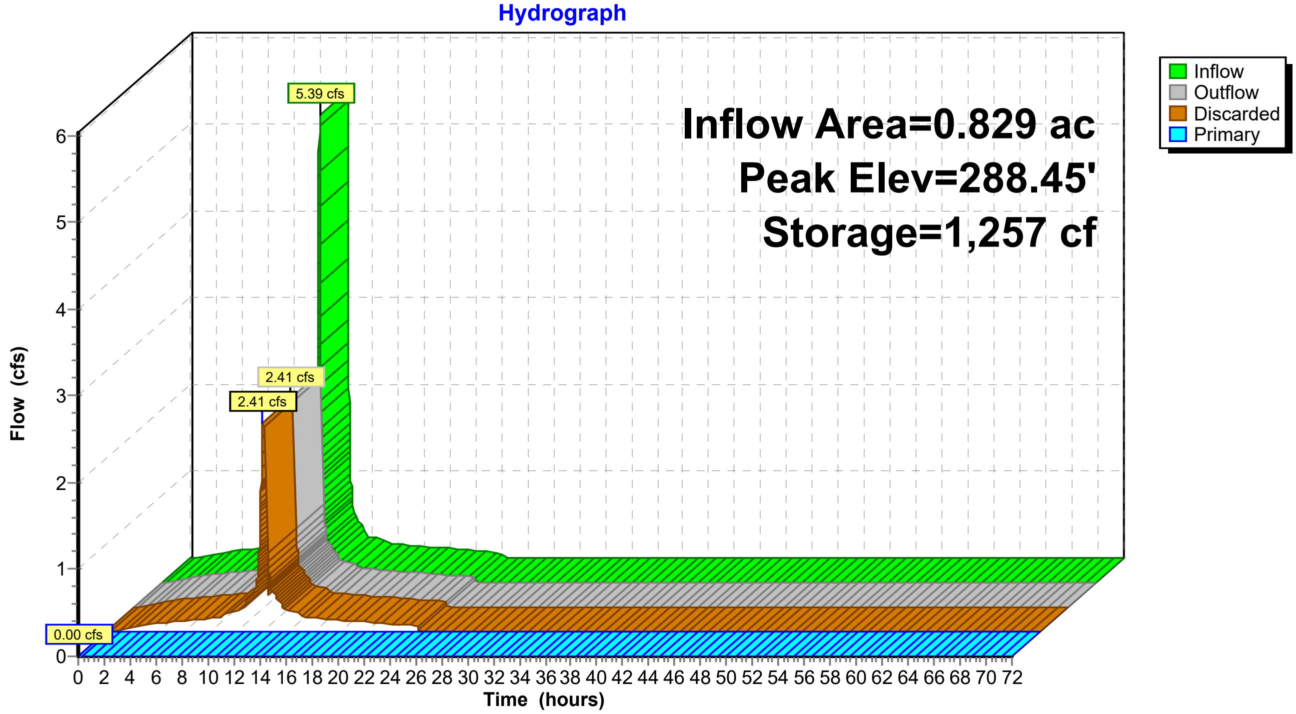
Chamber Storage + Stone Storage = 2,026.2 cf = 0.047 af
Overall Storage Efficiency = 60.4%
Overall System Size = 31.93' x 30.00' x 3.50'

24 Chambers
124.2 cy Field
81.9 cy Stone





Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)



Summary for Pond 7P: INFILTRATION BASIN (OPEN AIR)

Inflow Area = 2.212 ac, 68.42% Impervious, Inflow Depth = 2.45" for 25-Year event
Inflow = 6.73 cfs @ 12.13 hrs, Volume= 0.452 af
Outflow = 0.91 cfs @ 12.50 hrs, Volume= 0.452 af, Atten= 87%, Lag= 21.9 min
Discarded = 0.24 cfs @ 12.50 hrs, Volume= 0.367 af
Primary = 0.66 cfs @ 12.50 hrs, Volume= 0.085 af
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 287.53' @ 12.50 hrs Surf.Area= 4,380 sf Storage= 6,774 cf

Plug-Flow detention time= 227.8 min calculated for 0.452 af (100% of inflow)
Center-of-Mass det. time= 227.8 min (1,068.6 - 840.8)

Volume	Invert	Avail.Storage	Storage Description
#1	286.00'	19,274 cf	**INFILTRATION BASIN (Prismatic)** Listed below
#2	286.00'	3,737 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
		23,011 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
286.00	2,949	0	0
288.00	4,824	7,773	7,773
290.00	6,677	11,501	19,274

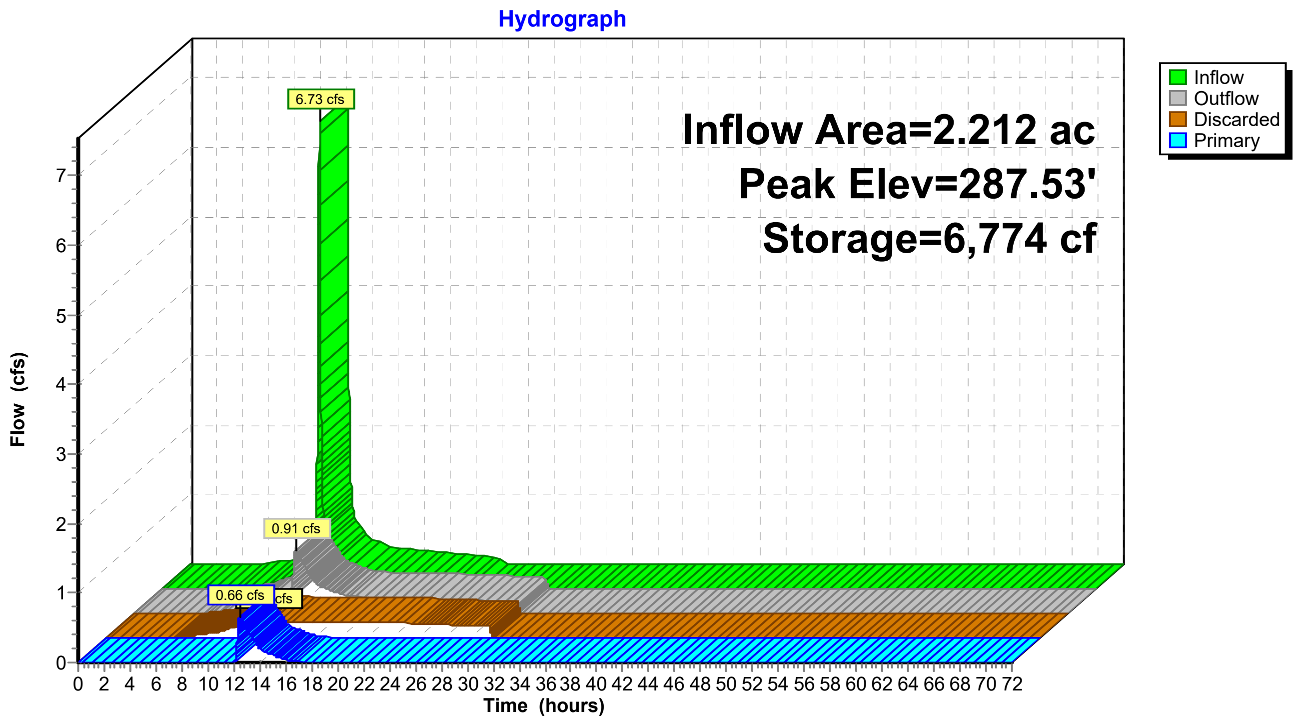
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
286.00	384	0	0
287.10	607	545	545
288.00	972	711	1,256
290.00	1,509	2,481	3,737

Device	Routing	Invert	Outlet Devices
#1	Primary	286.00'	**15.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	286.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#3	Primary	289.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Device 1	289.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	287.20'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.24 cfs @ 12.50 hrs HW=287.53' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=0.66 cfs @ 12.50 hrs HW=287.53' TW=0.00' (Dynamic Tailwater)
├**1=Orifice/Grate** (Passes 0.66 cfs of 5.61 cfs potential flow)
│ ├**4=Orifice/Grate** (Controls 0.00 cfs)
│ └**5=Orifice/Grate** (Orifice Controls 0.66 cfs @ 1.95 fps)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: INFILTRATION BASIN (OPEN AIR)



Summary for Pond 10P: PAVEMENT CHAMBER BASIN (#1)

Inflow Area = 0.419 ac, 87.22% Impervious, Inflow Depth = 5.57" for 25-Year event
Inflow = 2.64 cfs @ 12.13 hrs, Volume= 0.195 af
Outflow = 0.12 cfs @ 10.79 hrs, Volume= 0.195 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.12 cfs @ 10.79 hrs, Volume= 0.195 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 289.18' @ 14.18 hrs Surf.Area= 2,107 sf Storage= 3,150 cf

Plug-Flow detention time= 226.3 min calculated for 0.195 af (100% of inflow)
Center-of-Mass det. time= 226.3 min (1,005.8 - 779.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	287.00'	1,905 cf	**20.50'W x 102.77'L x 3.50'H Field A** 7,374 cf Overall - 2,611 cf Embedded = 4,763 cf x 40.0% Voids
#2A	287.50'	2,611 cf	**Cultec R-300HD** x 56 Inside #1 Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap 56 Chambers in 4 Rows Cap Storage= 2.7 cf x 2 x 4 rows = 21.2 cf
		4,516 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	287.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Device 1	289.90'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#3	Discarded	287.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.12 cfs @ 10.79 hrs HW=287.04' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=287.00' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Controls 0.00 cfs)
  └─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 10P: PAVEMENT CHAMBER BASIN (#1) - Chamber Wizard Field A

Chamber Model = Cultec R-300HD (Cultec Recharger® 300HD)
Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap
Cap Storage= 2.7 cf x 2 x 4 rows = 21.2 cf

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

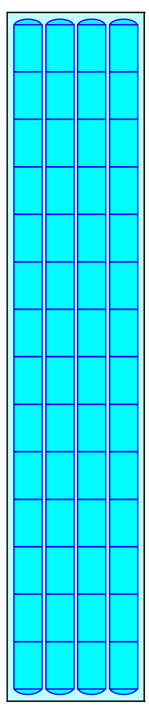
14 Chambers/Row x 7.08' Long +0.80' Cap Length x 2 = 100.77' Row Length +12.0" End Stone x 2 = 102.77' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

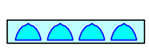
56 Chambers x 46.2 cf + 2.7 cf Cap Volume x 2 x 4 Rows = 2,610.8 cf Chamber Storage

7,373.5 cf Field - 2,610.8 cf Chambers = 4,762.7 cf Stone x 40.0% Voids = 1,905.1 cf Stone Storage

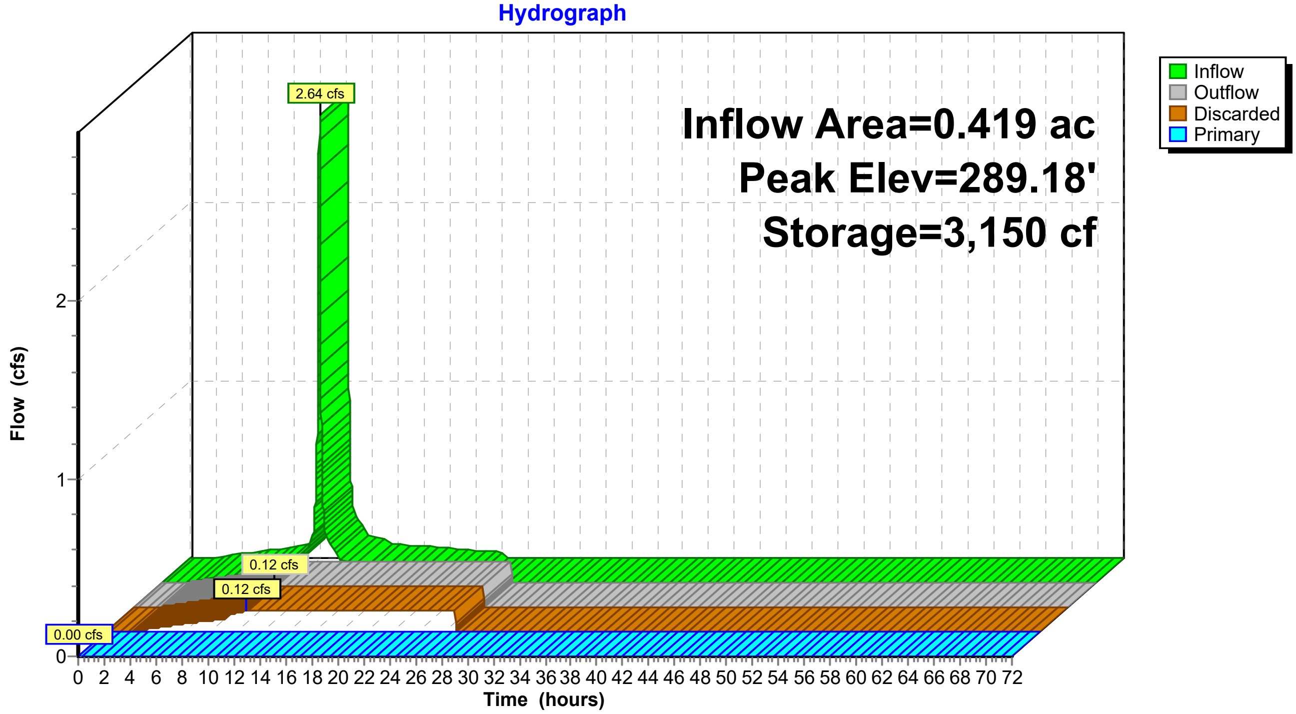
Chamber Storage + Stone Storage = 4,515.9 cf = 0.104 af
Overall Storage Efficiency = 61.2%
Overall System Size = 102.77' x 20.50' x 3.50'

56 Chambers
273.1 cy Field
176.4 cy Stone





Pond 10P: PAVEMENT CHAMBER BASIN (#1)

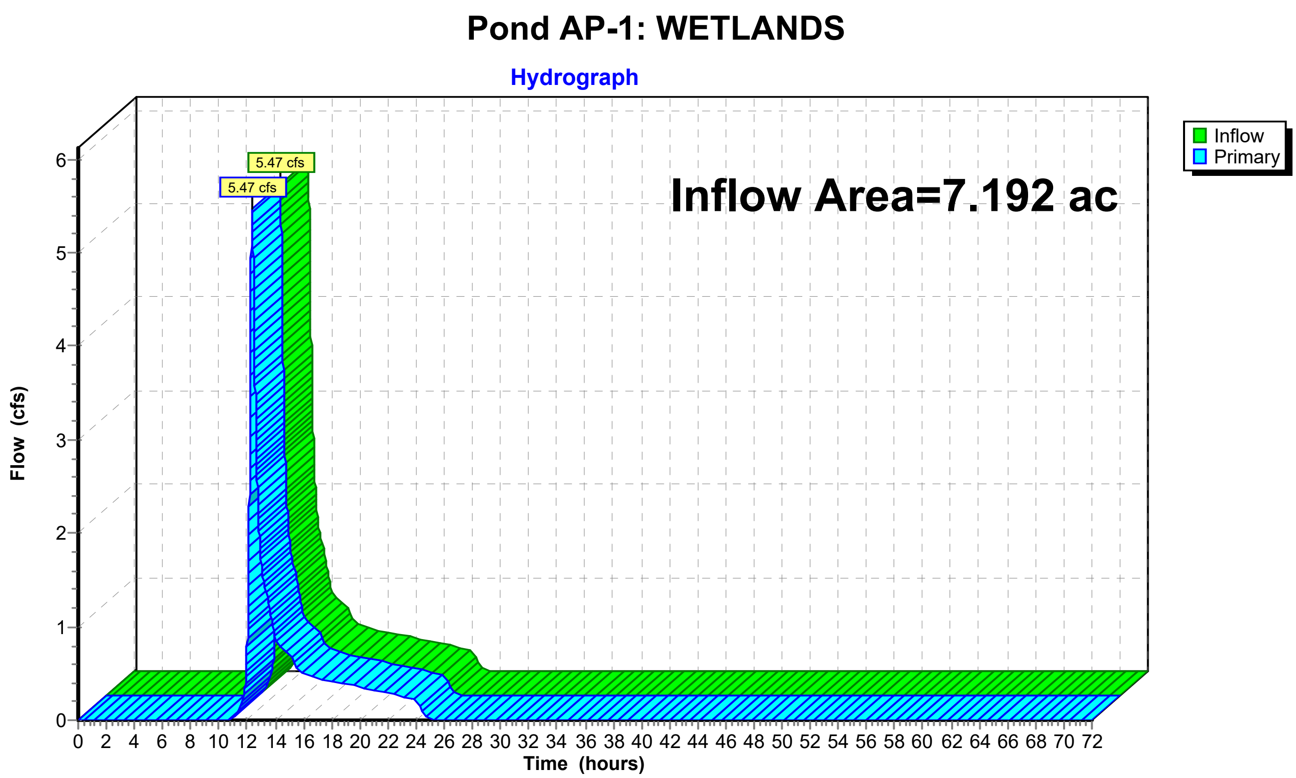


Summary for Pond AP-1: WETLANDS

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

Inflow Area = 7.192 ac, 26.69% Impervious, Inflow Depth = 1.21" for 25-Year event
Inflow = 5.47 cfs @ 12.35 hrs, Volume= 0.724 af
Primary = 5.47 cfs @ 12.35 hrs, Volume= 0.724 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



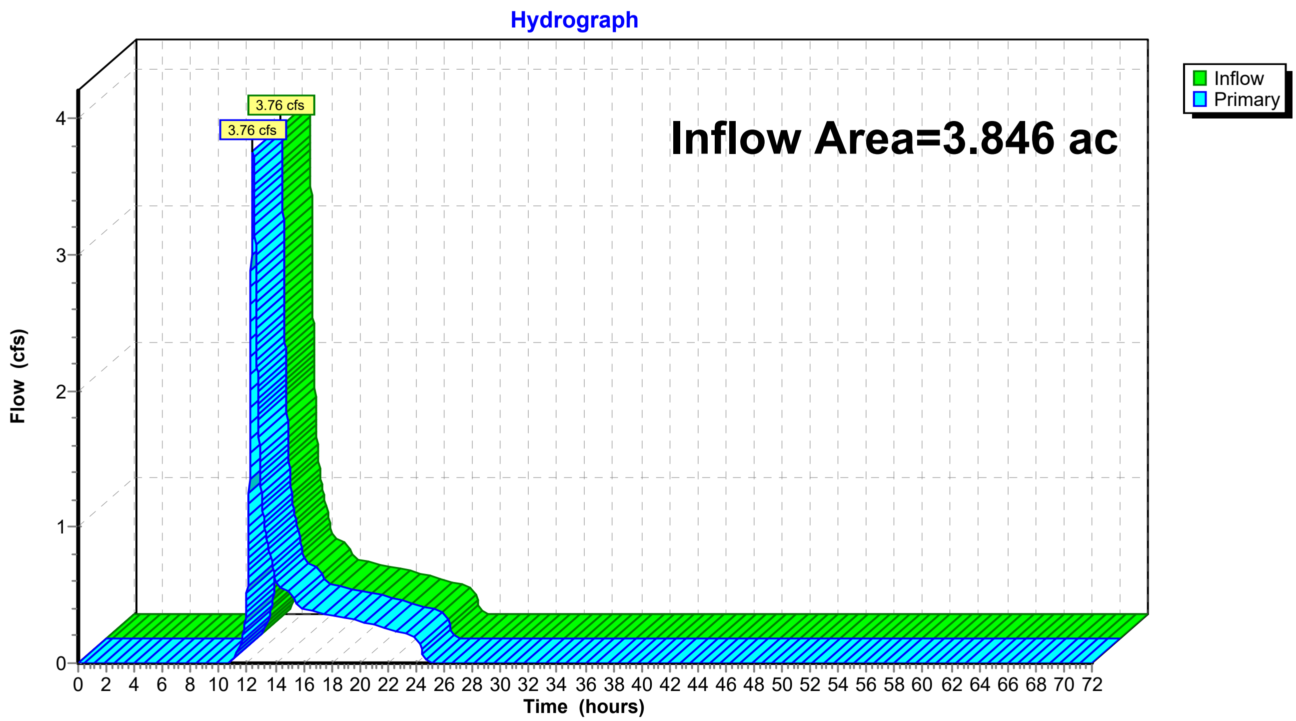
Summary for Pond AP-2: GROVE ST

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

Inflow Area =	3.846 ac,	0.00% Impervious, Inflow Depth = 1.75"	for 25-Year event
Inflow =	3.76 cfs @	12.42 hrs, Volume=	0.560 af
Primary =	3.76 cfs @	12.42 hrs, Volume=	0.560 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-2: GROVE ST



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: PR-1 Runoff Area=3.846 ac 0.00% Impervious Runoff Depth=2.91"
Flow Length=1,108' Tc=27.4 min CN=55 Runoff=6.78 cfs 0.932 af

SubcatchmentPR-2: PR-2 Runoff Area=4.312 ac 0.00% Impervious Runoff Depth=2.80"
Flow Length=945' Tc=17.4 min CN=54 Runoff=9.36 cfs 1.005 af

SubcatchmentPR-3: PR-3 Runoff Area=0.249 ac 16.12% Impervious Runoff Depth=3.24"
Tc=6.0 min CN=58 Runoff=1.01 cfs 0.067 af

SubcatchmentPR-4: PR-4 Runoff Area=60,243 sf 49.50% Impervious Runoff Depth=5.56"
Tc=6.0 min CN=78 Runoff=9.39 cfs 0.641 af

SubcatchmentPR-5: PR-5 Runoff Area=36,100 sf 100.00% Impervious Runoff Depth=7.94"
Tc=6.0 min CN=98 Runoff=6.91 cfs 0.548 af

SubcatchmentPR-6: PR-6 Runoff Area=18,265 sf 87.22% Impervious Runoff Depth=7.34"
Tc=6.0 min CN=93 Runoff=3.42 cfs 0.257 af

Reach 1R: SWALE Avg. Flow Depth=0.80' Max Vel=2.52 fps Inflow=9.36 cfs 1.005 af
n=0.069 L=546.7' S=0.0346 '/' Capacity=14.25 cfs Outflow=8.89 cfs 1.005 af

Pond 1P: ROOF DRAIN CHAMBER BASIN Peak Elev=289.69' Storage=1,907 cf Inflow=6.91 cfs 0.548 af
Discarded=2.41 cfs 0.538 af Primary=2.48 cfs 0.010 af Outflow=4.89 cfs 0.548 af

Pond 7P: INFILTRATION BASIN (OPEN AIR) Peak Elev=288.05' Storage=9,375 cf Inflow=9.39 cfs 0.651 af
Discarded=0.27 cfs 0.415 af Primary=2.42 cfs 0.236 af Outflow=2.69 cfs 0.651 af

Pond 10P: PAVEMENT CHAMBER BASIN Peak Elev=289.95' Storage=4,054 cf Inflow=3.42 cfs 0.257 af
Discarded=0.12 cfs 0.240 af Primary=0.20 cfs 0.017 af Outflow=0.31 cfs 0.257 af

Pond AP-1: WETLANDS Inflow=11.58 cfs 1.325 af
Primary=11.58 cfs 1.325 af

Pond AP-2: GROVE ST Inflow=6.78 cfs 0.932 af
Primary=6.78 cfs 0.932 af

Total Runoff Area = 11.038 ac Runoff Volume = 3.450 af Average Runoff Depth = 3.75"
82.61% Pervious = 9.119 ac 17.39% Impervious = 1.919 ac

Summary for Subcatchment PR-1: PR-1

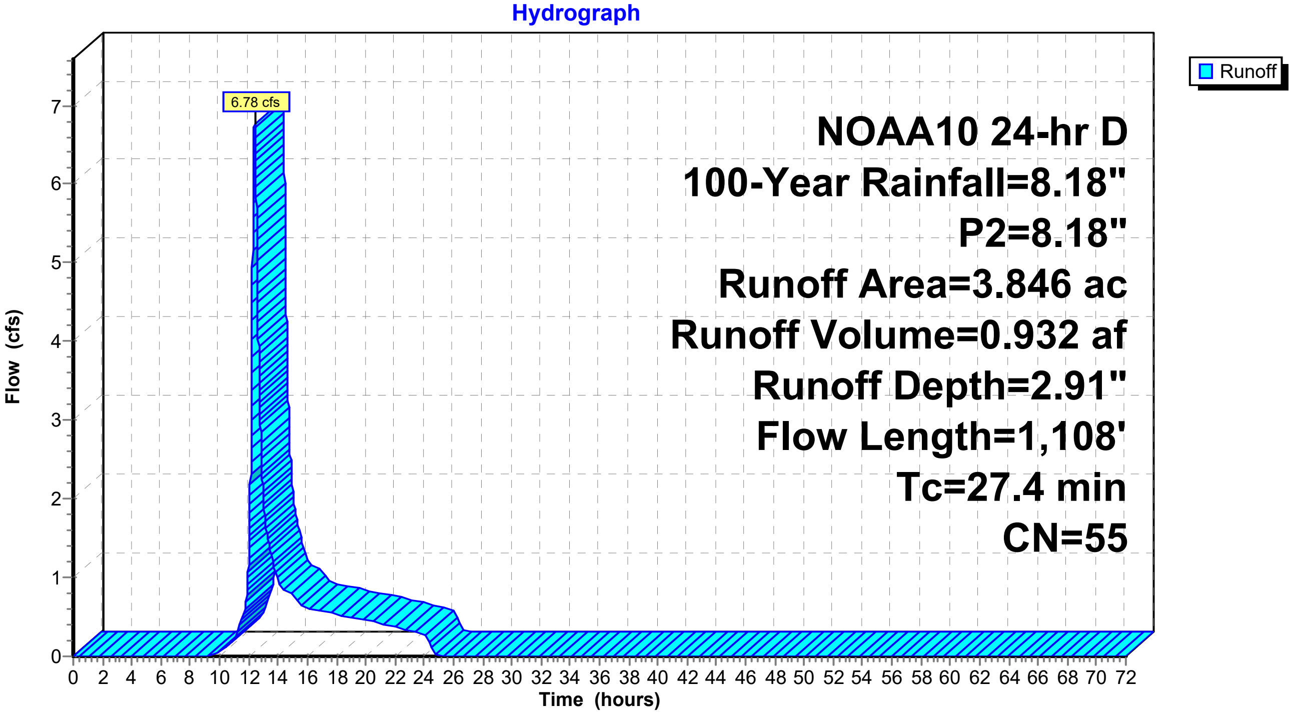
Runoff = 6.78 cfs @ 12.39 hrs, Volume= 0.932 af, Depth= 2.91"
Routed to Pond AP-2 : GROVE ST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

Area (ac)	CN	Description
0.034	30	Woods, Good, HSG A
0.007	61	>75% Grass cover, Good, HSG B
3.805	55	Woods, Good, HSG B
3.846	55	Weighted Average
3.846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0280	0.12		**Sheet Flow, A-->B**
					Woods: Light underbrush n= 0.400 P2= 8.18"
1.4	105	0.0640	1.26		**Shallow Concentrated Flow, B-->C**
					Woodland Kv= 5.0 fps
4.1	181	0.0220	0.74		**Shallow Concentrated Flow, C-->D**
					Woodland Kv= 5.0 fps
7.1	418	0.0380	0.97		**Shallow Concentrated Flow, D-->E**
					Woodland Kv= 5.0 fps
8.1	354	0.0210	0.72		**Shallow Concentrated Flow, E-->F**
					Woodland Kv= 5.0 fps
27.4	1,108	Total			

Subcatchment PR-1: PR-1



Summary for Subcatchment PR-2: PR-2

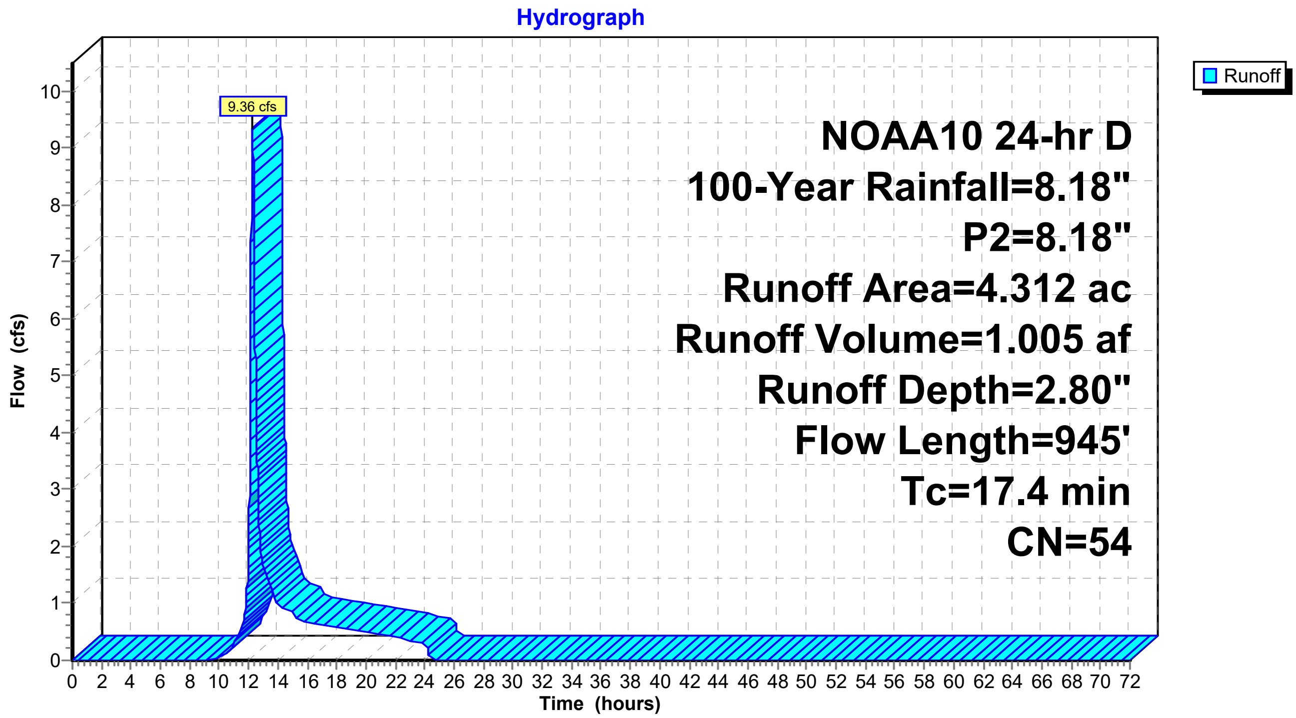
Runoff = 9.36 cfs @ 12.27 hrs, Volume= 1.005 af, Depth= 2.80"
Routed to Reach 1R : SWALE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

Area (ac)	CN	Description
0.055	30	Woods, Good, HSG A
0.128	39	>75% Grass cover, Good, HSG A
0.000	98	Paved parking, HSG A
0.000	98	Paved parking, HSG A
0.076	30	Woods, Good, HSG A
0.000	30	Woods, Good, HSG A
0.008	30	Woods, Good, HSG A
3.379	55	Woods, Good, HSG B
0.173	55	Woods, Good, HSG B
0.493	61	>75% Grass cover, Good, HSG B
4.312	54	Weighted Average
4.312		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0280	0.12		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 8.18"
2.5	128	0.0280	0.84		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.1	101	0.0950	1.54		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
4.5	284	0.0450	1.06		**Shallow Concentrated Flow, D-->E** Woodland Kv= 5.0 fps
2.6	382	0.0270	2.46		**Shallow Concentrated Flow, E-->F** Grassed Waterway Kv= 15.0 fps
17.4	945	Total			

Subcatchment PR-2: PR-2



Summary for Subcatchment PR-3: PR-3

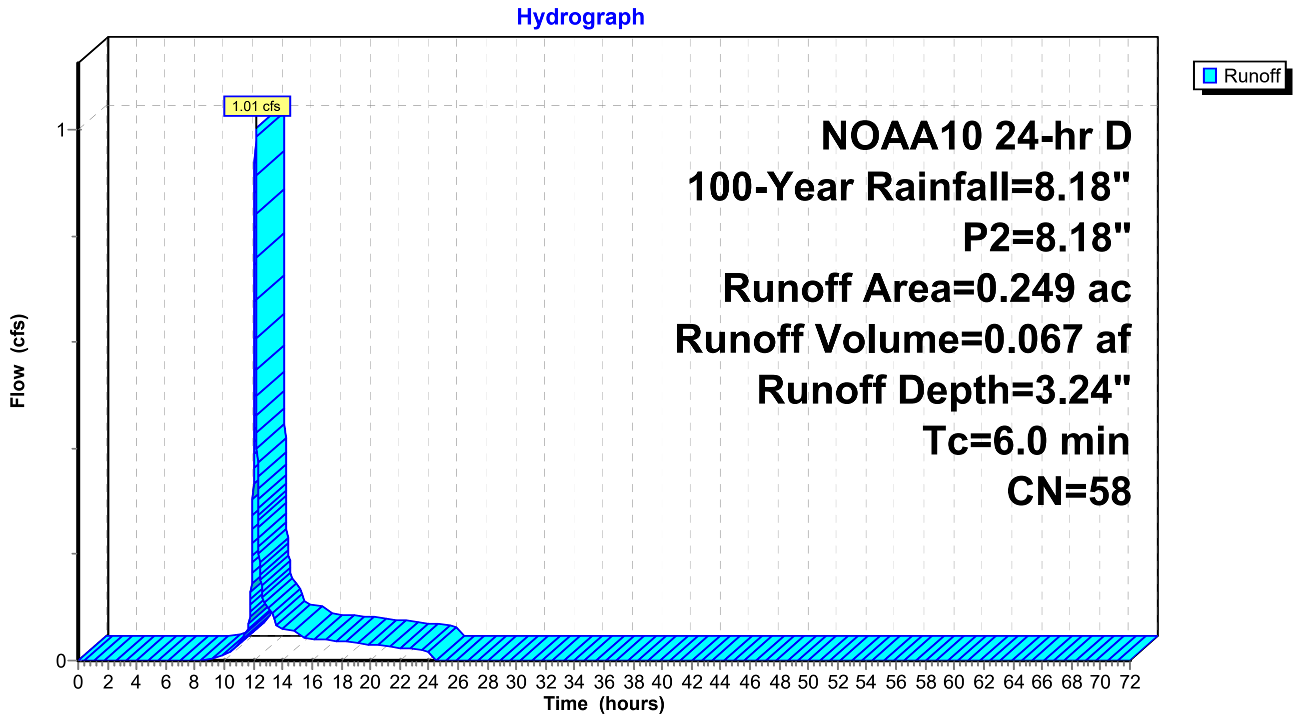
Runoff = 1.01 cfs @ 12.13 hrs, Volume= 0.067 af, Depth= 3.24"
Routed to Pond AP-1 : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

Area (ac)	CN	Description
0.012	30	Woods, Good, HSG A
0.040	98	Paved parking, HSG A
0.053	39	>75% Grass cover, Good, HSG A
0.001	30	Woods, Good, HSG A
0.073	55	Woods, Good, HSG B
0.040	61	>75% Grass cover, Good, HSG B
0.029	55	Woods, Good, HSG B
0.249	58	Weighted Average
0.209		83.88% Pervious Area
0.040		16.12% Impervious Area

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

Subcatchment PR-3: PR-3



Summary for Subcatchment PR-4: PR-4

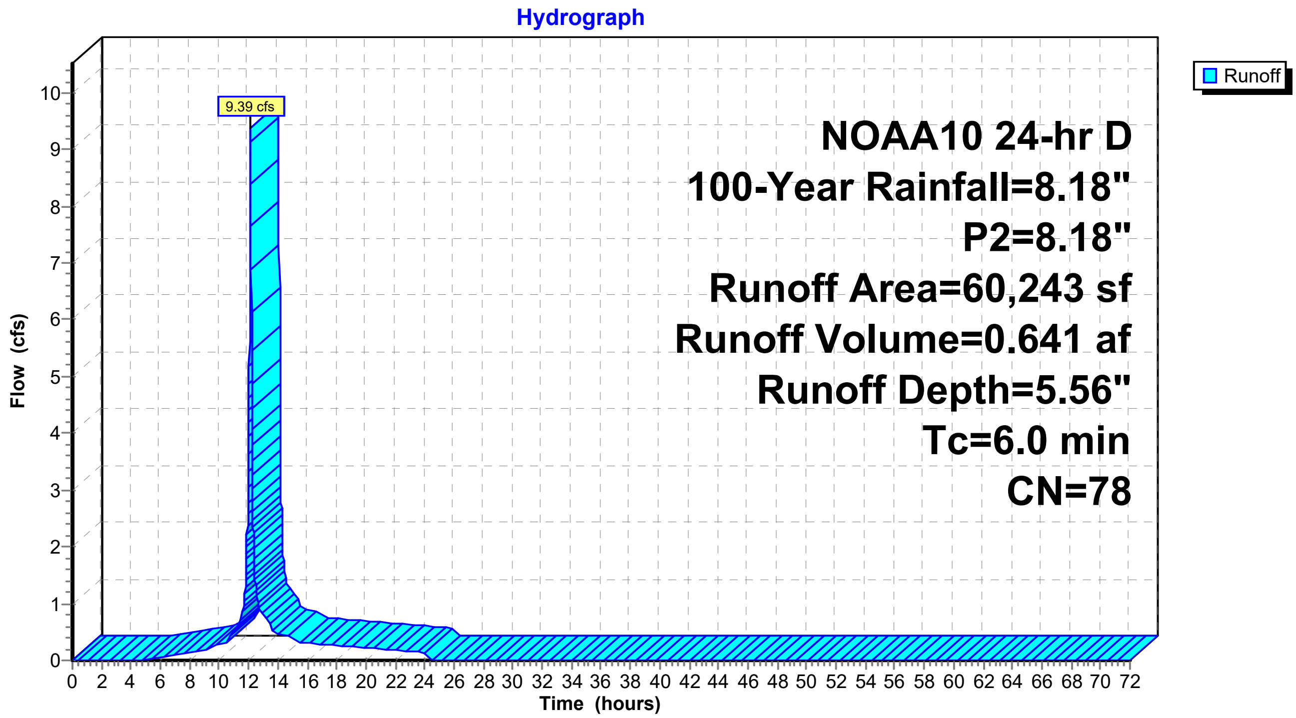
Runoff = 9.39 cfs @ 12.13 hrs, Volume= 0.641 af, Depth= 5.56"
Routed to Pond 7P : INFILTRATION BASIN (OPEN AIR)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

	Area (sf)	CN	Description
	1,228	39	>75% Grass cover, Good, HSG A
	0	39	>75% Grass cover, Good, HSG A
	174	98	Paved parking, HSG A
	0	55	Woods, Good, HSG B
	8,407	55	Woods, Good, HSG B
	174	55	Woods, Good, HSG B
	21,475	98	Paved parking, HSG B
	131	61	>75% Grass cover, Good, HSG B
	14,384	61	>75% Grass cover, Good, HSG B
	6,098	61	>75% Grass cover, Good, HSG B
*	7,875	98	Pond Surface, HSG B
*	297	98	Pond Surface, HSG A
	60,243	78	Weighted Average
	30,422		50.50% Pervious Area
	29,821		49.50% Impervious Area

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

Subcatchment PR-4: PR-4



Summary for Subcatchment PR-5: PR-5

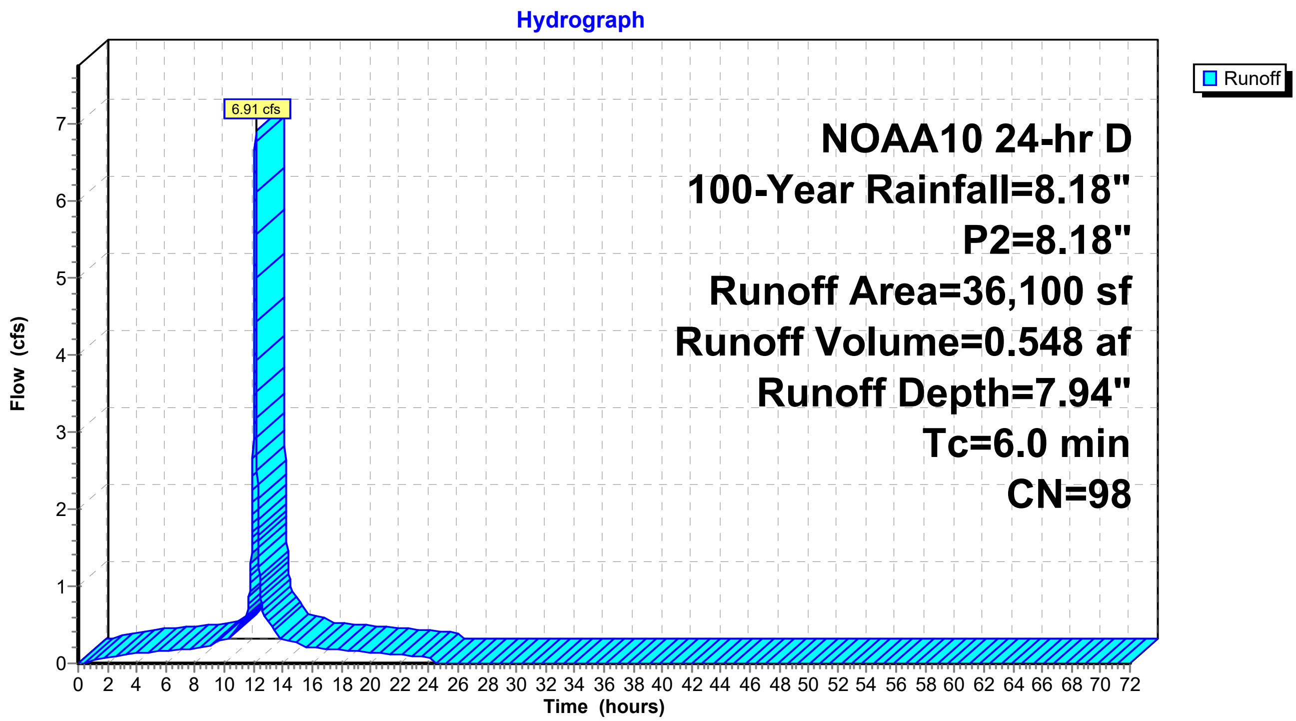
Runoff = 6.91 cfs @ 12.13 hrs, Volume= 0.548 af, Depth= 7.94"
Routed to Pond 1P : ROOF DRAIN CHAMBER BASIN (#2)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

Area (sf)	CN	Description
36,100	98	Paved parking, HSG B
36,100		100.00% Impervious Area

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

Subcatchment PR-5: PR-5



Summary for Subcatchment PR-6: PR-6

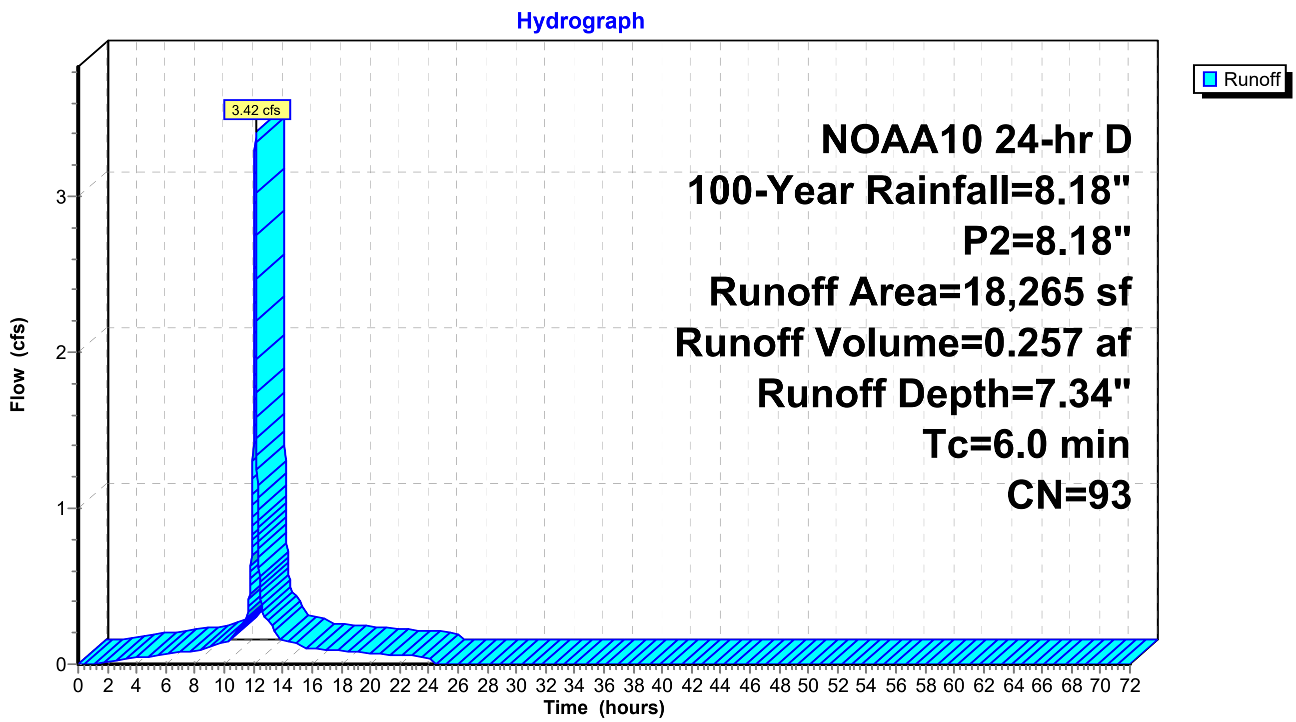
Runoff = 3.42 cfs @ 12.13 hrs, Volume= 0.257 af, Depth= 7.34"
Routed to Pond 10P : PAVEMENT CHAMBER BASIN (#1)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.18", P2=8.18"

Area (sf)	CN	Description
15,932	98	Paved parking, HSG B
2,333	61	>75% Grass cover, Good, HSG B
18,265	93	Weighted Average
2,333		12.78% Pervious Area
15,932		87.22% Impervious Area

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

Subcatchment PR-6: PR-6



Summary for Reach 1R: SWALE

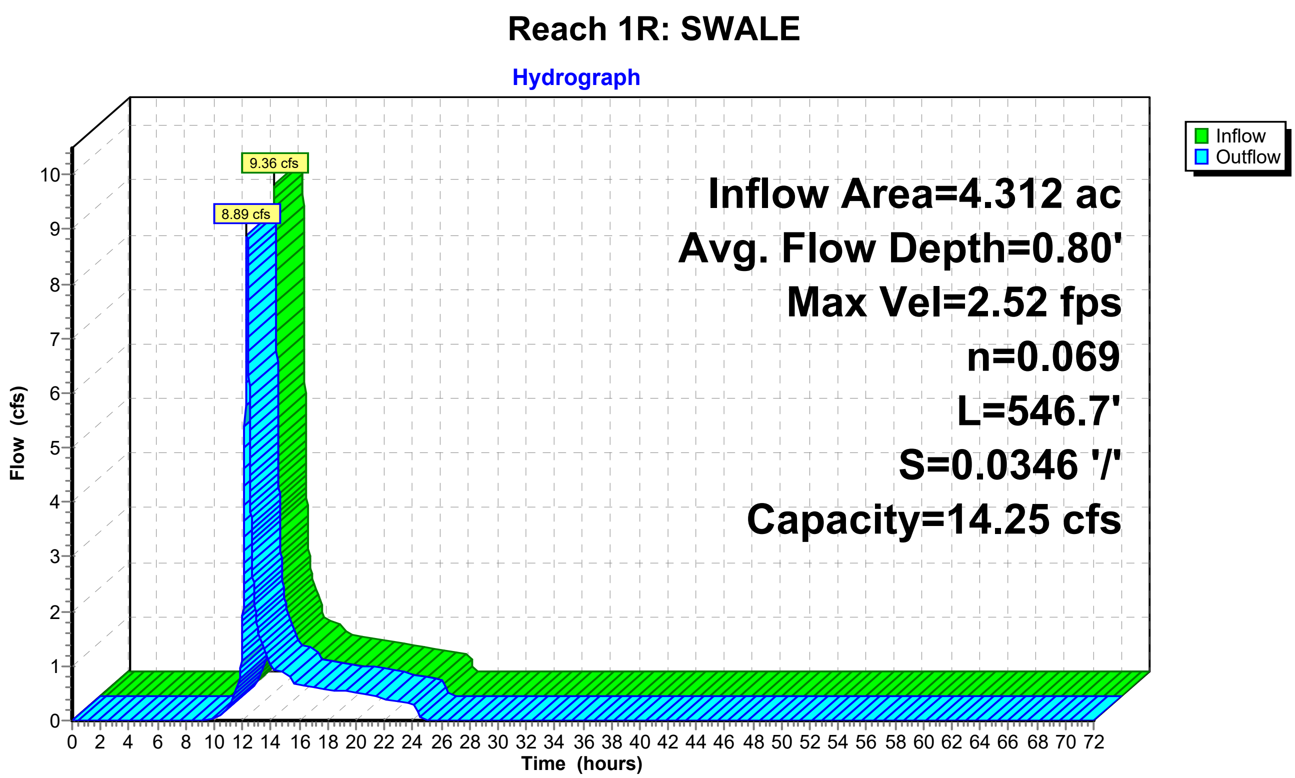
Inflow Area = 4.312 ac, 0.00% Impervious, Inflow Depth = 2.80" for 100-Year event
Inflow = 9.36 cfs @ 12.27 hrs, Volume= 1.005 af
Outflow = 8.89 cfs @ 12.31 hrs, Volume= 1.005 af, Atten= 5%, Lag= 2.8 min
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.52 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 10.2 min

Peak Storage= 1,929 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.80' , Surface Width= 6.81'
Defined Flood Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.25 cfs
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.25 cfs

2.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 546.7' Slope= 0.0346 '/'
Inlet Invert= 302.00', Outlet Invert= 283.10'

‡



Summary for Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=6)

Inflow Area = 0.829 ac,100.00% Impervious, Inflow Depth = 7.94" for 100-Year event
Inflow = 6.91 cfs @ 12.13 hrs, Volume= 0.548 af
Outflow = 4.89 cfs @ 12.18 hrs, Volume= 0.548 af, Atten= 29%, Lag= 3.3 min
Discarded = 2.41 cfs @ 11.98 hrs, Volume= 0.538 af
Primary = 2.48 cfs @ 12.18 hrs, Volume= 0.010 af
Routed to Pond 7P : INFILTRATION BASIN (OPEN AIR)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 289.69' @ 12.18 hrs Surf.Area= 958 sf Storage= 1,907 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 1.8 min (744.2 - 742.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	286.50'	885 cf	**30.00'W x 31.93'L x 3.50'H Field A** 3,353 cf Overall - 1,142 cf Embedded = 2,211 cf x 40.0% Voids
#2A	287.00'	1,142 cf	**Cultec R-300HD** x 24 Inside #1 Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap 24 Chambers in 6 Rows Cap Storage= 2.7 cf x 2 x 6 rows = 31.9 cf
		2,026 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	288.50'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	286.50'	**2.41 cfs Exfiltration at all elevations** Phase-In= 0.01'
#3	Device 1	289.40'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=2.41 cfs @ 11.98 hrs HW=286.56' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 2.41 cfs)

Primary OutFlow Max=2.32 cfs @ 12.18 hrs HW=289.67' TW=287.89' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Passes 2.32 cfs of 3.11 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 2.32 cfs @ 1.71 fps)

Pond 1P: ROOF DRAIN CHAMBER BASIN (#2) - Chamber Wizard Field A

Chamber Model = Cultec R-300HD (Cultec Recharger®300HD)
Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap
Cap Storage= 2.7 cf x 2 x 6 rows = 31.9 cf

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

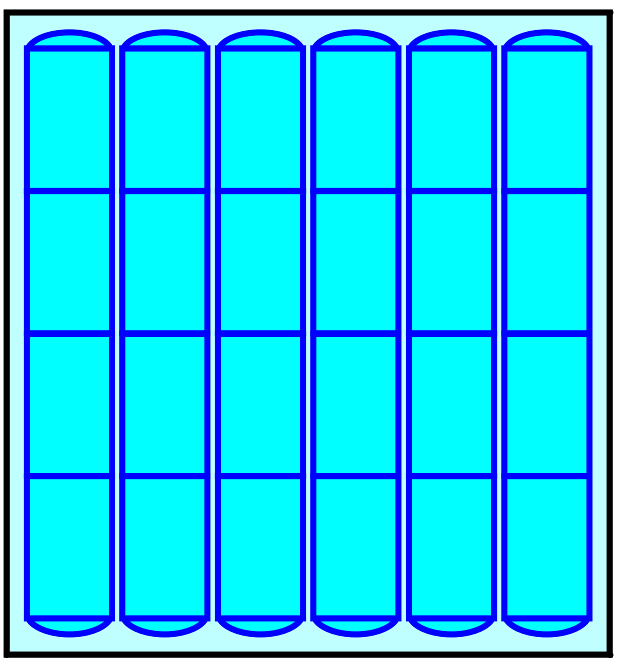
4 Chambers/Row x 7.08' Long +0.80' Cap Length x 2 = 29.93' Row Length +12.0" End Stone x 2 = 31.93' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

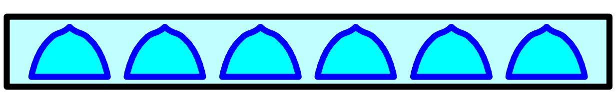
24 Chambers x 46.2 cf + 2.7 cf Cap Volume x 2 x 6 Rows = 1,141.7 cf Chamber Storage

3,353.0 cf Field - 1,141.7 cf Chambers = 2,211.3 cf Stone x 40.0% Voids = 884.5 cf Stone Storage

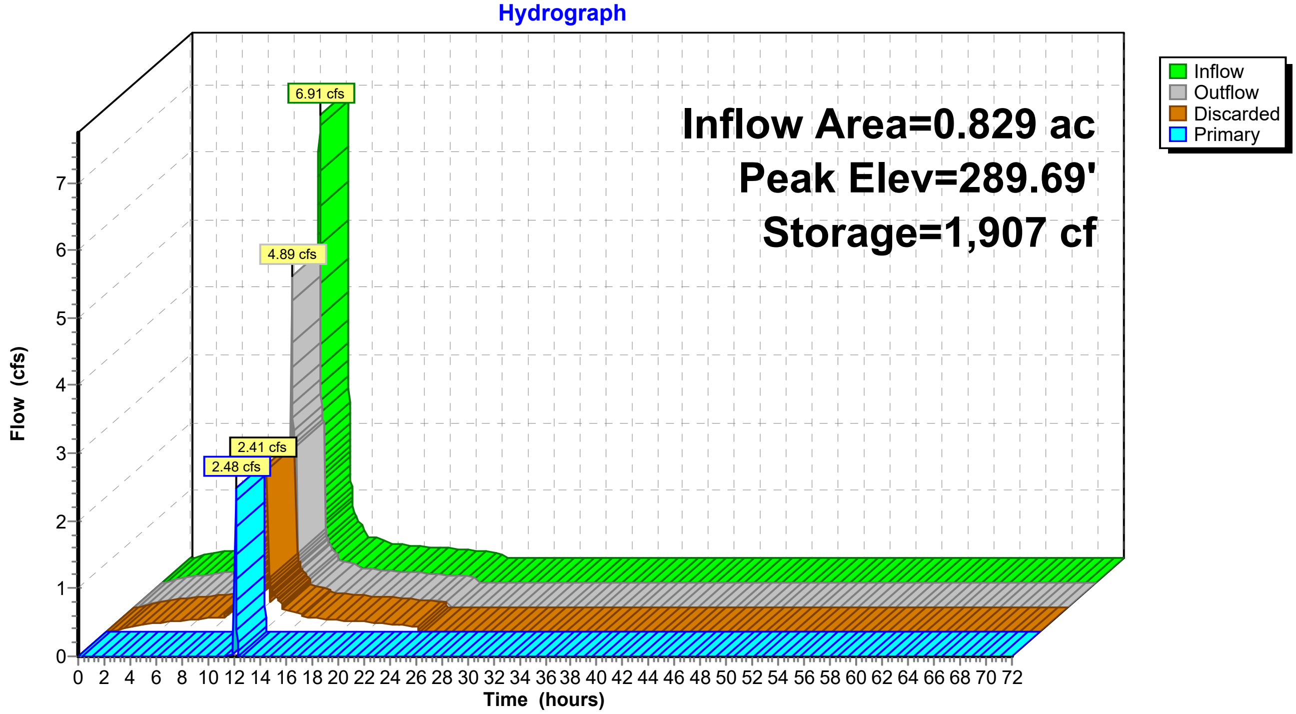
Chamber Storage + Stone Storage = 2,026.2 cf = 0.047 af
Overall Storage Efficiency = 60.4%
Overall System Size = 31.93' x 30.00' x 3.50'

24 Chambers
124.2 cy Field
81.9 cy Stone





Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)



Summary for Pond 7P: INFILTRATION BASIN (OPEN AIR)

Inflow Area = 2.212 ac, 68.42% Impervious, Inflow Depth = 3.53" for 100-Year event
Inflow = 9.39 cfs @ 12.13 hrs, Volume= 0.651 af
Outflow = 2.69 cfs @ 12.29 hrs, Volume= 0.651 af, Atten= 71%, Lag= 9.4 min
Discarded = 0.27 cfs @ 12.29 hrs, Volume= 0.415 af
Primary = 2.42 cfs @ 12.29 hrs, Volume= 0.236 af
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 288.05' @ 12.29 hrs Surf.Area= 4,872 sf Storage= 9,375 cf

Plug-Flow detention time= 187.2 min calculated for 0.651 af (100% of inflow)
Center-of-Mass det. time= 187.2 min (1,012.9 - 825.6)

Volume	Invert	Avail.Storage	Storage Description
#1	286.00'	19,274 cf	**INFILTRATION BASIN (Prismatic)** Listed below
#2	286.00'	3,737 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
		23,011 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
286.00	2,949	0	0
288.00	4,824	7,773	7,773
290.00	6,677	11,501	19,274

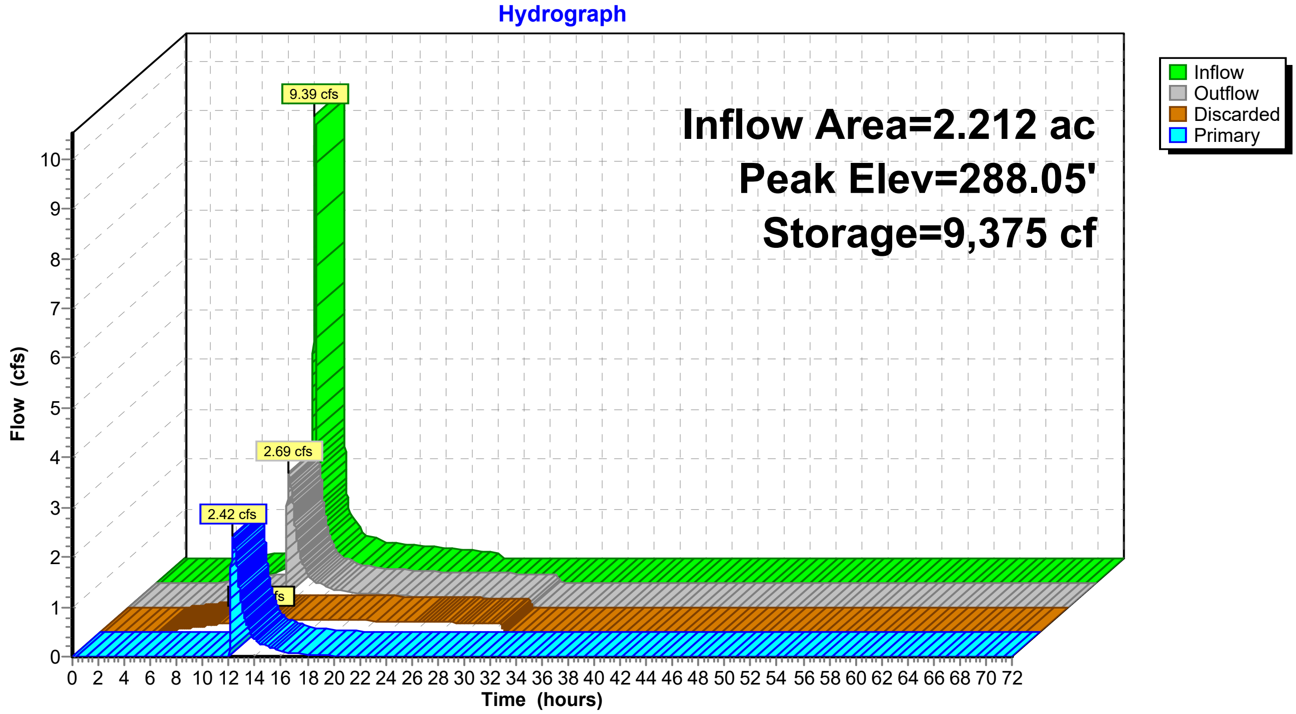
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
286.00	384	0	0
287.10	607	545	545
288.00	972	711	1,256
290.00	1,509	2,481	3,737

Device	Routing	Invert	Outlet Devices
#1	Primary	286.00'	**15.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	286.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#3	Primary	289.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Device 1	289.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	287.20'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.27 cfs @ 12.29 hrs HW=288.05' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=2.42 cfs @ 12.29 hrs HW=288.05' TW=0.00' (Dynamic Tailwater)
├**1=Orifice/Grate** (Passes 2.42 cfs of 7.06 cfs potential flow)
│├**4=Orifice/Grate** (Controls 0.00 cfs)
│└**5=Orifice/Grate** (Orifice Controls 2.42 cfs @ 3.47 fps)
└**3=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 7P: INFILTRATION BASIN (OPEN AIR)



Summary for Pond 10P: PAVEMENT CHAMBER BASIN (#1)

Inflow Area = 0.419 ac, 87.22% Impervious, Inflow Depth = 7.34" for 100-Year event
Inflow = 3.42 cfs @ 12.13 hrs, Volume= 0.257 af
Outflow = 0.31 cfs @ 12.69 hrs, Volume= 0.257 af, Atten= 91%, Lag= 33.7 min
Discarded = 0.12 cfs @ 9.65 hrs, Volume= 0.240 af
Primary = 0.20 cfs @ 12.69 hrs, Volume= 0.017 af
Routed to Pond AP-1 : WETLANDS

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 289.95' @ 12.69 hrs Surf.Area= 2,107 sf Storage= 4,054 cf

Plug-Flow detention time= 282.2 min calculated for 0.256 af (100% of inflow)
Center-of-Mass det. time= 282.2 min (1,053.4 - 771.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	287.00'	1,905 cf	**20.50'W x 102.77'L x 3.50'H Field A** 7,374 cf Overall - 2,611 cf Embedded = 4,763 cf x 40.0% Voids
#2A	287.50'	2,611 cf	**Cultec R-300HD** x 56 Inside #1 Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap 56 Chambers in 4 Rows Cap Storage= 2.7 cf x 2 x 4 rows = 21.2 cf
		4,516 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	287.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Device 1	289.90'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#3	Discarded	287.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.12 cfs @ 9.65 hrs HW=287.04' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.20 cfs @ 12.69 hrs HW=289.95' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Passes 0.20 cfs of 5.92 cfs potential flow)
  └─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.20 cfs @ 0.75 fps)

Pond 10P: PAVEMENT CHAMBER BASIN (#1) - Chamber Wizard Field A

Chamber Model = Cultec R-300HD (Cultec Recharger®300HD)
Effective Size= 45.6"W x 30.0"H => 6.53 sf x 7.08'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.54'L with 0.46' Overlap
Cap Storage= 2.7 cf x 2 x 4 rows = 21.2 cf

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

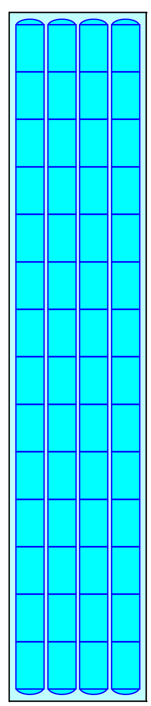
14 Chambers/Row x 7.08' Long +0.80' Cap Length x 2 = 100.77' Row Length +12.0" End Stone x 2 = 102.77' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

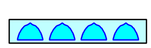
56 Chambers x 46.2 cf + 2.7 cf Cap Volume x 2 x 4 Rows = 2,610.8 cf Chamber Storage

7,373.5 cf Field - 2,610.8 cf Chambers = 4,762.7 cf Stone x 40.0% Voids = 1,905.1 cf Stone Storage

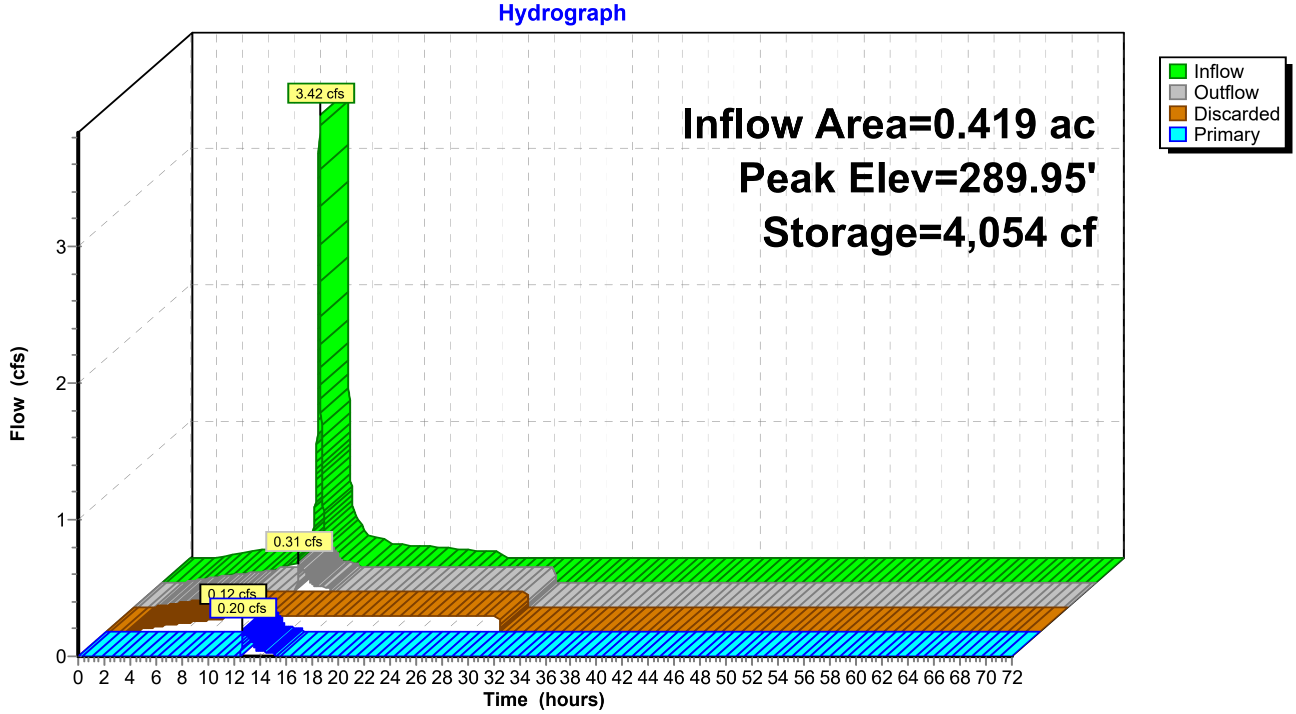
Chamber Storage + Stone Storage = 4,515.9 cf = 0.104 af
Overall Storage Efficiency = 61.2%
Overall System Size = 102.77' x 20.50' x 3.50'

56 Chambers
273.1 cy Field
176.4 cy Stone





Pond 10P: PAVEMENT CHAMBER BASIN (#1)



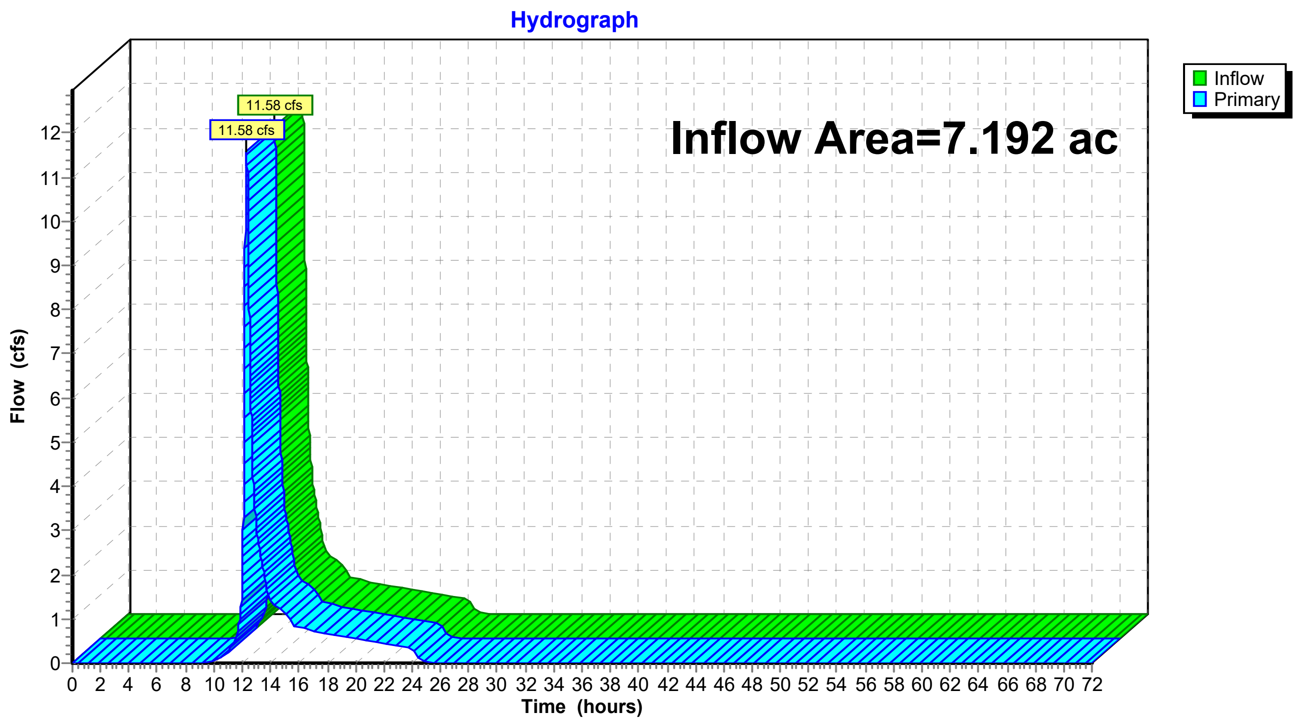
Summary for Pond AP-1: WETLANDS

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

Inflow Area = 7.192 ac, 26.69% Impervious, Inflow Depth = 2.21" for 100-Year event
Inflow = 11.58 cfs @ 12.31 hrs, Volume= 1.325 af
Primary = 11.58 cfs @ 12.31 hrs, Volume= 1.325 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: WETLANDS

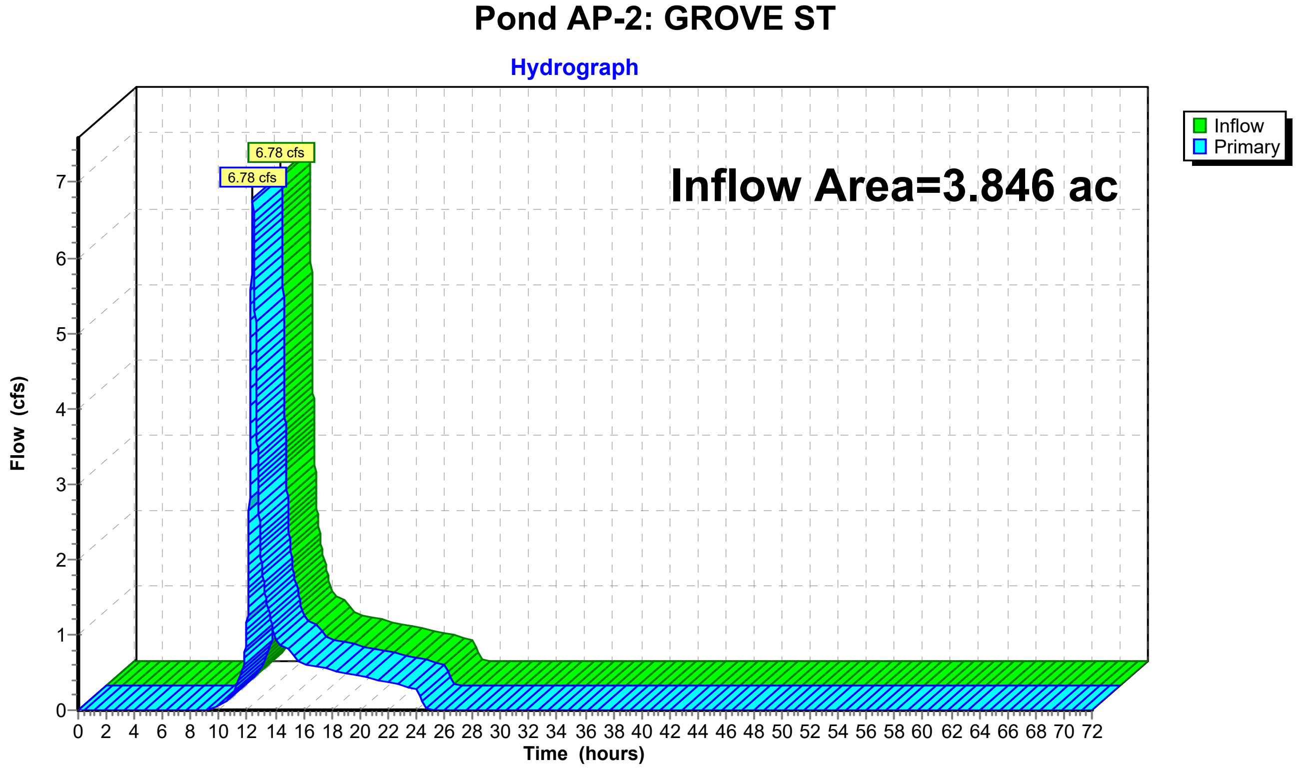


Summary for Pond AP-2: GROVE ST

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

Inflow Area =	3.846 ac,	0.00% Impervious, Inflow Depth = 2.91"	for 100-Year event	
Inflow =	6.78 cfs @	12.39 hrs, Volume=	0.932 af	
Primary =	6.78 cfs @	12.39 hrs, Volume=	0.932 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



Events for Subcatchment PR-1: PR-1

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	0.25	0.096	0.30
10-Year	5.22	2.08	0.350	1.09
25-Year	6.39	3.76	0.560	1.75
100-Year	**8.18**	**6.78**	**0.932**	**2.91**

Events for Subcatchment PR-2: PR-2

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	0.25	0.097	0.27
10-Year	5.22	2.72	0.369	1.03
25-Year	6.39	5.06	0.598	1.66
100-Year	**8.18**	**9.36**	**1.005**	**2.80**

Events for Subcatchment PR-3: PR-3

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	0.07	0.008	0.40
10-Year	5.22	0.37	0.027	1.29
25-Year	6.39	0.61	0.042	2.00
100-Year	**8.18**	**1.01**	**0.067**	**3.24**

Events for Subcatchment PR-4: PR-4

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	2.40	0.160	1.39
10-Year	5.22	5.01	0.334	2.90
25-Year	6.39	6.73	0.452	3.93
100-Year	**8.18**	**9.39**	**0.641**	**5.56**

Events for Subcatchment PR-5: PR-5

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	2.81	0.216	3.13
10-Year	5.22	4.40	0.344	4.98
25-Year	6.39	5.39	0.425	6.15
100-Year	**8.18**	**6.91**	**0.548**	**7.94**

Events for Subcatchment PR-6: PR-6

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-Year	3.36	1.29	0.091	2.60
10-Year	5.22	2.12	0.154	4.41
25-Year	6.39	2.64	0.195	5.57
100-Year	**8.18**	**3.42**	**0.257**	**7.34**

Events for Reach 1R: SWALE

Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
2-Year	0.25	0.21	302.11	139
10-Year	2.72	2.51	302.43	767
25-Year	5.06	4.76	302.59	1,219
100-Year	**9.36**	**8.89**	**302.80**	**1,929**

Events for Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)

Event	Inflow (cfs)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
2-Year	2.81	2.41	**2.41**	0.00	286.69	74
10-Year	4.40	2.41	2.41	0.00	287.66	700
25-Year	5.39	2.41	2.41	0.00	288.45	1,257
100-Year	**6.91**	**4.89**	2.41	**2.48**	**289.69**	**1,907**

Events for Pond 7P: INFILTRATION BASIN (OPEN AIR)

Event	Inflow (cfs)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
2-Year	2.40	0.19	0.19	0.00	286.49	2,123
10-Year	5.01	0.31	0.23	0.08	287.30	5,748
25-Year	6.73	0.91	0.24	0.66	287.53	6,774
100-Year	**9.39**	**2.69**	**0.27**	**2.42**	**288.05**	**9,375**

Events for Pond 10P: PAVEMENT CHAMBER BASIN (#1)

Event	Inflow (cfs)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
2-Year	1.29	0.12	**0.12**	0.00	287.86	1,043
10-Year	2.12	0.12	0.12	0.00	288.60	2,270
25-Year	2.64	0.12	0.12	0.00	289.18	3,150
100-Year	**3.42**	**0.31**	0.12	**0.20**	**289.95**	**4,054**

Events for Pond AP-1: WETLANDS

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
2-Year	0.23	0.23	**0.00**	**0.000**
10-Year	2.60	2.60	0.00	0.000
25-Year	5.47	5.47	0.00	0.000
100-Year	**11.58**	**11.58**	0.00	0.000

Events for Pond AP-2: GROVE ST

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
2-Year	0.25	0.25	**0.00**	**0.000**
10-Year	2.08	2.08	0.00	0.000
25-Year	3.76	3.76	0.00	0.000
100-Year	**6.78**	**6.78**	0.00	0.000

DRAWDOWN CALCULATIONS (100-YR)

Hydrograph for Pond 10P: PAVEMENT CHAMBER BASIN (#1)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	287.00	0.00	0.00	0.00
2.00	0.01	1	287.00	0.01	0.01	0.00
4.00	0.04	3	287.00	0.04	0.04	0.00
6.00	0.06	5	287.01	0.06	0.06	0.00
8.00	0.09	6	287.01	0.09	**0.09**	0.00
10.00	0.14	54	287.06	0.12	**0.12**	0.00
12.00	**1.62**	**1,408**	**288.07**	**0.12**	0.12	**0.00**
14.00	**0.15**	**4,023**	**289.92**	**0.16**	0.12	**0.04**
16.00	0.10	3,974	289.86	0.12	0.12	0.00
18.00	0.09	3,808	289.70	0.12	0.12	0.00
20.00	0.07	3,534	289.47	0.12	0.12	0.00
22.00	0.06	3,152	289.18	0.12	0.12	0.00
24.00	0.04	2,662	288.85	0.12	0.12	0.00
26.00	0.00	1,829	288.32	0.12	0.12	0.00
28.00	0.00	983	287.82	0.12	0.12	0.00
30.00	0.00	137	287.16	0.12	0.12	0.00
32.00	0.00	0	287.00	0.00	0.00	0.00
34.00	0.00	0	287.00	0.00	0.00	0.00
36.00	0.00	0	287.00	0.00	0.00	0.00
38.00	0.00	0	287.00	0.00	0.00	0.00
40.00	0.00	0	287.00	0.00	0.00	0.00
42.00	0.00	0	287.00	0.00	0.00	0.00
44.00	0.00	0	287.00	0.00	0.00	0.00
46.00	0.00	0	287.00	0.00	0.00	0.00
48.00	0.00	0	287.00	0.00	0.00	0.00
50.00	0.00	0	287.00	0.00	0.00	0.00
52.00	0.00	0	287.00	0.00	0.00	0.00
54.00	0.00	0	287.00	0.00	0.00	0.00
56.00	0.00	0	287.00	0.00	0.00	0.00
58.00	0.00	0	287.00	0.00	0.00	0.00
60.00	0.00	0	287.00	0.00	0.00	0.00
62.00	0.00	0	287.00	0.00	0.00	0.00
64.00	0.00	0	287.00	0.00	0.00	0.00
66.00	0.00	0	287.00	0.00	0.00	0.00
68.00	0.00	0	287.00	0.00	0.00	0.00
70.00	0.00	0	287.00	0.00	0.00	0.00
72.00	0.00	0	287.00	0.00	0.00	0.00

Hydrograph for Pond 1P: ROOF DRAIN CHAMBER BASIN (#2)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	286.50	0.00	0.00	0.00
2.00	0.08	0	286.50	0.08	0.08	0.00
4.00	0.13	0	286.50	0.13	0.13	0.00
6.00	0.16	0	286.50	0.16	0.16	0.00
8.00	0.20	0	286.50	0.20	0.20	0.00
10.00	0.30	0	286.50	0.30	**0.30**	0.00
12.00	**3.30**	**73**	**286.69**	**2.41**	**2.41**	**0.00**
14.00	**0.31**	**0**	**286.50**	**0.31**	0.31	**0.00**
16.00	0.20	0	286.50	0.20	0.20	0.00
18.00	0.17	0	286.50	0.17	0.17	0.00
20.00	0.14	0	286.50	0.14	0.14	0.00
22.00	0.11	0	286.50	0.11	0.11	0.00
24.00	0.08	0	286.50	0.08	0.08	0.00
26.00	0.00	0	286.50	0.00	0.00	0.00
28.00	0.00	0	286.50	0.00	0.00	0.00
30.00	0.00	0	286.50	0.00	0.00	0.00
32.00	0.00	0	286.50	0.00	0.00	0.00
34.00	0.00	0	286.50	0.00	0.00	0.00
36.00	0.00	0	286.50	0.00	0.00	0.00
38.00	0.00	0	286.50	0.00	0.00	0.00
40.00	0.00	0	286.50	0.00	0.00	0.00
42.00	0.00	0	286.50	0.00	0.00	0.00
44.00	0.00	0	286.50	0.00	0.00	0.00
46.00	0.00	0	286.50	0.00	0.00	0.00
48.00	0.00	0	286.50	0.00	0.00	0.00
50.00	0.00	0	286.50	0.00	0.00	0.00
52.00	0.00	0	286.50	0.00	0.00	0.00
54.00	0.00	0	286.50	0.00	0.00	0.00
56.00	0.00	0	286.50	0.00	0.00	0.00
58.00	0.00	0	286.50	0.00	0.00	0.00
60.00	0.00	0	286.50	0.00	0.00	0.00
62.00	0.00	0	286.50	0.00	0.00	0.00
64.00	0.00	0	286.50	0.00	0.00	0.00
66.00	0.00	0	286.50	0.00	0.00	0.00
68.00	0.00	0	286.50	0.00	0.00	0.00
70.00	0.00	0	286.50	0.00	0.00	0.00
72.00	0.00	0	286.50	0.00	0.00	0.00

Hydrograph for Pond 7P: INFILTRATION BASIN (OPEN AIR)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	286.00	0.00	0.00	0.00
2.00	0.00	0	286.00	0.00	0.00	0.00
4.00	0.00	0	286.00	0.00	0.00	0.00
6.00	0.06	14	286.00	0.05	0.05	0.00
8.00	0.13	33	286.01	0.13	0.13	0.00
10.00	0.28	303	286.07	0.17	0.17	0.00
12.00	**4.20**	**4,138**	**286.95**	**0.21**	**0.21**	**0.00**
14.00	**0.46**	**6,312**	**287.43**	**0.58**	**0.24**	**0.34**
16.00	0.31	5,851	287.33	0.35	0.23	0.11
18.00	0.26	5,666	287.29	0.29	0.23	0.05
20.00	0.22	5,496	287.25	0.25	0.23	0.02
22.00	0.17	5,230	287.19	0.23	0.23	0.00
24.00	0.13	4,710	287.08	0.22	0.22	0.00
26.00	0.00	3,226	286.74	0.20	0.20	0.00
28.00	0.00	1,822	286.42	0.19	0.19	0.00
30.00	0.00	535	286.13	0.17	0.17	0.00
32.00	0.00	0	286.00	0.00	0.00	0.00
34.00	0.00	0	286.00	0.00	0.00	0.00
36.00	0.00	0	286.00	0.00	0.00	0.00
38.00	0.00	0	286.00	0.00	0.00	0.00
40.00	0.00	0	286.00	0.00	0.00	0.00
42.00	0.00	0	286.00	0.00	0.00	0.00
44.00	0.00	0	286.00	0.00	0.00	0.00
46.00	0.00	0	286.00	0.00	0.00	0.00
48.00	0.00	0	286.00	0.00	0.00	0.00
50.00	0.00	0	286.00	0.00	0.00	0.00
52.00	0.00	0	286.00	0.00	0.00	0.00
54.00	0.00	0	286.00	0.00	0.00	0.00
56.00	0.00	0	286.00	0.00	0.00	0.00
58.00	0.00	0	286.00	0.00	0.00	0.00
60.00	0.00	0	286.00	0.00	0.00	0.00
62.00	0.00	0	286.00	0.00	0.00	0.00
64.00	0.00	0	286.00	0.00	0.00	0.00
66.00	0.00	0	286.00	0.00	0.00	0.00
68.00	0.00	0	286.00	0.00	0.00	0.00
70.00	0.00	0	286.00	0.00	0.00	0.00
72.00	0.00	0	286.00	0.00	0.00	0.00

DRAINAGE ANALYSIS

Storm Drain Calculations – Rational Method and Catchment Area Calculation

Land Use Coefficients "C"

Pave	0.90
Gravel	0.80
Wetland	0.72
Grass	0.30
Woods	0.25
Roof	0.90

Area	Land Use Area Impervious (acres)	Gravel (acres)	Wetland (acres)	Pervious (acres)	Woods (acres)	Roof (acres)	Total (acres)	Weighted "C"		SF		**CA**
CB 1	0.110			0.134	0.110	0.000	0.354	0.47		15,420	CB 1	0.1667
CB 2	0.136			0.015	0.000	0.000	0.151	0.84		6,578	CB 2	0.1269
CB 3	0.085			0.012	0.000	0.000	0.097	0.83		4,225	CB 3	0.0801
CB 4	0.019			0.082	0.000	0.000	0.101	0.41		4,400	CB 4	0.0417
CB 5	0.079			0.018	0.000	0.000	0.097	0.79		4,225	CB 5	0.0765
CB 6	0.104			0.018	0.000	0.000	0.122	0.81		5,314	CB 6	0.099
CB 7	0.104			0.018	0.000	0.000	0.122	0.81		5,314	CB 7	0.099
CB 8	0.079			0.018	0.000	0.000	0.097	0.79		4,225	CB 8	0.0765
CB 9	0.036			0.014	0.000	0.000	0.050	0.73		2,178	CB 9	0.0366
CB 10	0.036			0.014	0.000	0.000	0.050	0.73		2,178	CB 10	0.0366
CB 11	0.026			0.082	0.116	0.000	0.224	0.34		9,757	CB 11	0.077
CB 12	0.027			0.004	0.000	0.000	0.031	0.82		1,350	CB 12	0.0255
ROOF NW	0.092			0.000	0.000	0.092	0.183	0.90		7,980	ROOF NW	0.16487604
ROOF N-MID	0.161			0.000	0.000	0.161	0.323	0.90		14,060	ROOF N-MID	0.29049588
ROOF NE	0.161			0.000	0.000	0.161	0.323	0.90		14,060	ROOF NE	0.29049588
ROOF SW	0.092			0.000	0.000	0.092	0.183	0.90		7,980	ROOF SW	0.16487604
ROOF S-MID	0.161			0.000	0.000	0.161	0.323	0.90		14,060	ROOF S-MID	0.29049588
ROOF SE	0.161			0.000	0.000	0.161	0.323	0.90		14,060	ROOF SE	0.29049588
SUBTOTAL	1.670	0.000	0.000	0.429	0.226	0.253	3.153			65,165.8		0.2936
OVERALL TOTALS	1.670			0.429	0.226	0.253	2.578		0.000	**112,285.7620**	Check	

Guerriere & Halnon, Inc.
55 West Central Steet
Franklin, MA 01757-0235

Project: 151 Grove St, Franklin MA
Job No. 4683

DESIGN COMPUTATIONS FOR STORM DRAINS

Prepared By BDH | Date 3/27/2025 | Revised 4/16/2025
Checked By ________ | Date | Revised

Drainage Area	Upper Structure	Lower Structure	Sum of CA's (sf)	Time of Concentration (Tc) (min)	Rainfall Intensity (I) (in/hr)	Actual Peak Flow Rate (Q) (cfs)	Pipe Diameter (in)	Slope (ft/ft)	Roughness Coefficient (n)	Design Flow Full (Q) (cfs)	CHECK	Velocity Flow Full (V) (fps)	Actual Velocity (V) (fps)	Length of Pipe (L)* (ft)	Time in pipe (min)	Total Fall (ft)	Invert Elevation: Elev. Upper End	Invert Elevation: Elev. Lower End	Destination
	CB 1	DMH-1	0.17	6.00	8.02	1.34	12	0.005	0.013	2.50	GOOD	3.18	1.70	87.3	0.46	0.43	288.09	287.66	INFILTRATION BASIN
	CB 2	DMH-1	0.13	6.00	8.02	1.02	12	0.005	0.013	2.59	GOOD	3.30	1.30	9.4	0.05	0.05	287.68	287.63	
	CB 3	DMH-2	0.08	6.00	8.02	0.64	12	0.002	0.013	1.74	GOOD	2.21	0.82	21.1	0.16	0.05	287.71	287.66	
	CB 4	DMH-2	0.04	6.00	8.02	0.33	12	0.003	0.013	2.07	GOOD	2.63	0.43	77.2	0.49	0.26	288.49	288.23	
	CB 5	DMH-5	0.08	6.00	8.02	0.61	12	0.005	0.013	2.52	GOOD	3.21	0.78	10.0	0.05	0.05	288.13	288.08	SUBSURFACE CHAMBER INFILTRATION SYSTEM #1
	CB 6	DMH-6	0.10	6.00	8.02	0.79	12	0.005	0.013	2.60	GOOD	3.30	1.01	13.2	0.07	0.07	288.44	288.37	
	CB 7	DMH-7	0.10	6.00	8.02	0.79	12	0.005	0.013	2.63	GOOD	3.35	1.01	11.0	0.05	0.06	289.32	289.26	
	CB 8	DMH-7	0.08	6.00	8.02	0.61	12	0.005	0.013	2.51	GOOD	3.19	0.78	68.6	0.36	0.34	289.60	289.26	
	CB 9	DMH-8	0.04	6.00	8.02	0.29	12	0.005	0.013	2.50	GOOD	3.19	0.37	16.2	0.08	0.08	288.93	288.85	
	CB 10	DMH-8	0.04	6.00	8.02	0.29	12	0.005	0.013	2.49	GOOD	3.17	0.37	30.6	0.16	0.15	289.00	288.85	
	CB 11	WQU #1	0.08	6.00	8.02	0.62	12	0.005	0.013	2.49	GOOD	3.17	0.79	10.2	0.05	0.05	281.76	281.71	WQU #2
	CB 12	WQU #1	0.03	6.00	8.02	0.20	12	0.005	0.013	2.54	GOOD	3.24	0.26	39.3	0.20	0.20	281.91	281.71	
	ROOF NW	ROOF N-MID	0.16	6.00	8.02	1.32	12	0.005	0.013	2.52	GOOD	3.21	1.68	40.0	0.21	0.20	291.17	290.97	SUBSURFACE CHAMBER INFILTRATION SYSTEM #2 (ROOF DRAIN SYSTEM)
	ROOF N-MID	ROOF NE	0.29	6.21	8.02	2.33	12	0.005	0.013	2.52	GOOD	3.21	2.97	152.0	0.79	0.76	290.97	290.21	
	ROOF NE	DMH-9	0.29	7.00	8.02	2.33	12	0.008	0.013	3.25	GOOD	4.13	2.97	133.6	0.54	1.11	290.21	289.10	
	ROOF SW	ROOF S-MID	0.16	6.00	8.02	1.32	12	0.005	0.013	2.52	GOOD	3.21	1.68	40.0	0.21	0.20	290.83	290.63	
	ROOF S-MID	ROOF SE	0.29	6.21	8.02	2.33	12	0.005	0.013	2.52	GOOD	3.21	2.97	152.0	0.79	0.76	290.63	289.87	
	ROOF SE	DMH-9	0.29	7.00	8.02	2.33	12	0.012	0.013	3.92	GOOD	4.99	2.97	63.8	0.21	0.77	289.87	289.10	
	DMH-1	FES-1	0.29	6.46	8.02	2.35	12	0.005	0.013	2.50	GOOD	3.18	3.00	52.9	0.28	0.26	287.56	287.30	INFILTRATION BASIN
	DMH-9	CHAMBERS #2	0.58	7.54	7.44	4.32	15	0.026	0.013	10.47	GOOD	8.53	3.52	4.0	0.01	0.11	287.23	287.13	
	CHAMBERS #2	DMH-10	0.58	7.54	7.44	4.32	12	0.025	0.013	5.63	GOOD	7.17	5.50	4.0	0.01	0.10	287.75	287.65	
	DMH-10	FES-7	0.58	7.55	7.44	4.32	15	0.005	0.013	4.48	GOOD	3.65	3.52	24.9	0.11	0.12	287.42	287.30	
	DMH-2	DMH-11	0.12	6.49	8.02	0.98	12	0.002	0.013	1.42	GOOD	1.80	1.24	63.3	0.58	0.10	287.81	287.71	
	DMH-11	FES-6	0.12	7.07	7.44	0.91	12	0.005	0.013	2.52	GOOD	3.20	1.15	82.2	0.43	0.41	287.71	287.30	
	DMH-7	DMH-6	0.18	6.36	8.02	1.41	12	0.005	0.013	2.53	GOOD	3.21	1.79	157.3	0.82	0.79	289.16	288.37	SUBSURFACE CHAMBER INFILTRATION SYSTEM #1
	DMH-6	DMH-5	0.27	7.17	7.44	2.04	12	0.005	0.013	2.53	GOOD	3.22	2.60	57.5	0.30	0.29	288.27	287.98	
	DMH-5	CHAMBERS #1	0.27	7.47	7.44	2.04	12	0.070	0.013	9.43	GOOD	12.00	2.60	4.0	0.01	0.28	287.88	287.60	
	CHAMBERS #1	DMH-3	0.27	7.47	7.44	2.04	12	0.220	0.013	16.71	GOOD	21.28	2.60	4.0	0.00	0.88	287.88	287.00	AP-1 WETLANDS
	DMH-3	FES-2	0.27	7.48	7.44	2.04	12	0.044	0.013	7.51	GOOD	9.56	2.60	78.8	0.14	3.50	287.50	284.00	
	DMH-8	FES-3	0.07	6.16	8.02	0.59	12	0.005	0.013	2.64	GOOD	3.36	0.75	82.1	0.41	0.45	287.75	287.30	INFILTRATION BASIN
	INFIL. BASIN	OCS #1	0.78	7.54	7.44	5.77	15	0.017	0.013	8.47	GOOD	6.90	4.70	116.3	0.28	2.00	286.00	284.00	AP-1 WETLANDS
	WQU #1	WQU #2	0.10	6.20	8.02	0.82	12	0.009	0.013	3.44	GOOD	4.38	1.05	10.7	0.04	0.10	281.71	281.61	
	WQU #2	FES-5	0.10	6.24	8.02	0.82	12	0.005	0.013	2.52	GOOD	3.21	1.05	111.6	0.58	0.56	281.46	280.90	

Pipe lengths were taken from center of structures

* 25 Year basin outflow from HydroCAD used to approximate design flow

USDA WEB SOIL SURVEY

United States Department of Agriculture

NRCS

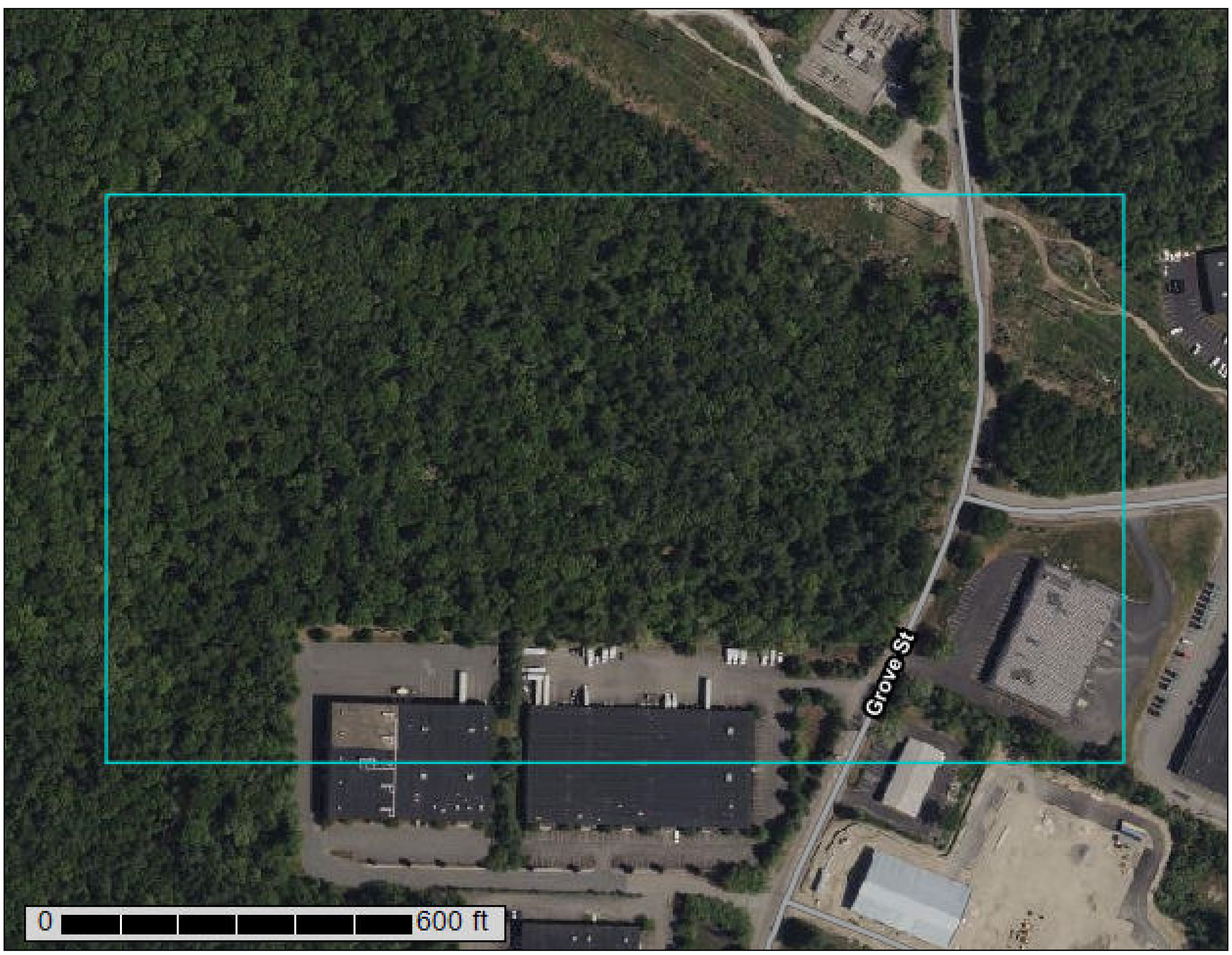
Natural Resources Conservation Service

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

Norfolk and Suffolk Counties, Massachusetts

151 Grove St, Franklin MA



January 9, 2025

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

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: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 20, Aug 27, 2024

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	3.5	8.9%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	28.1	71.9%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	2.8	7.1%
653	Udorthents, sandy	4.8	12.2%
Totals for Area of Interest		**39.0**	**100.0%**

Map Unit Descriptions

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.

Norfolk and Suffolk Counties, Massachusetts

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c
Elevation: 0 to 1,290 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

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

Description of Ridgebury, Extremely Stony

Setting

Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, 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

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Drainage class: Poorly drained
Runoff class: Very high
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: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY009CT - Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 8 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

103B—Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vktd
Elevation: 0 to 480 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 40 percent
Hollis and similar soils: 25 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope

Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy ablation till derived from granite

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
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 supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till derived from igneous rock

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
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 supply, 0 to 60 inches: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Minor Components

Canton

Percent of map unit: 7 percent
Hydric soil rating: No

Chatfield

Percent of map unit: 5 percent
Hydric soil rating: No

Scituate

Percent of map unit: 2 percent
Hydric soil rating: No

Whitman

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 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: All areas are prime farmland

Map Unit Composition

Merrimac and similar soils: 86 percent
Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash plains, deltas, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Windsor

Percent of map unit: 3 percent
Landform: Dunes, deltas, outwash terraces, outwash plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread, riser
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Walpole

Percent of map unit: 1 percent
Landform: Depressions
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

653—Udorthents, sandy

Map Unit Setting

National map unit symbol: vky8
Elevation: 0 to 3,000 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: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Riser, tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Excavated and filled sandy glaciofluvial deposits

Typical profile

H1 - 0 to 6 inches: variable
H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: Unranked

Minor Components

Udorthents

Percent of map unit: 8 percent
Hydric soil rating: Unranked

Urban land

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

Swansea

Percent of map unit: 2 percent
Landform: Bogs
Hydric soil rating: Yes

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TSS REMOVAL CALCULATIONS

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: 151 Grove St, Franklin, MA

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)
Deep Sump and Hooded Catch Basin	0.25	**1.00**	0.25	0.75
Sediment Forebay	0.25	0.75	0.19	0.56

PRETREATMENT

Total TSS Removal = 44%

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

Project: F-4683
Prepared By: Brian Hassett
Date: 4-16-2025

*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

Mass. Dept. of Environmental Protection

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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)
Infiltration Basin	0.80	**1.00**	0.80	0.20

Total TSS Removal = 80%

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

Project: F-4683
Prepared By: Brian Hassett
Date: 4-16-2025

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

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TSS Removal Calculation Worksheet

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Deep Sump and Hooded Catch Basin	0.25	**1.00**	0.25	0.75
Separator Row	0.25	0.75	0.19	0.56

PRETREATMENT

Total TSS Removal = 44%

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Location: 151 Grove St, Franklin, MA

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)
Deep Sump and Hooded Catch Basin	0.25	**1.00**	0.25	0.75
Contech WQMH	0.50	0.75	0.375	0.375
Contech WQMH	0.50	0.375	0.1875	0.1875

Total TSS Removal = 81.25%

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

Project: F-4683

Prepared By: Brian Hassett

Date: 4-16-2025

*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

Mass. Dept. of Environmental Protection

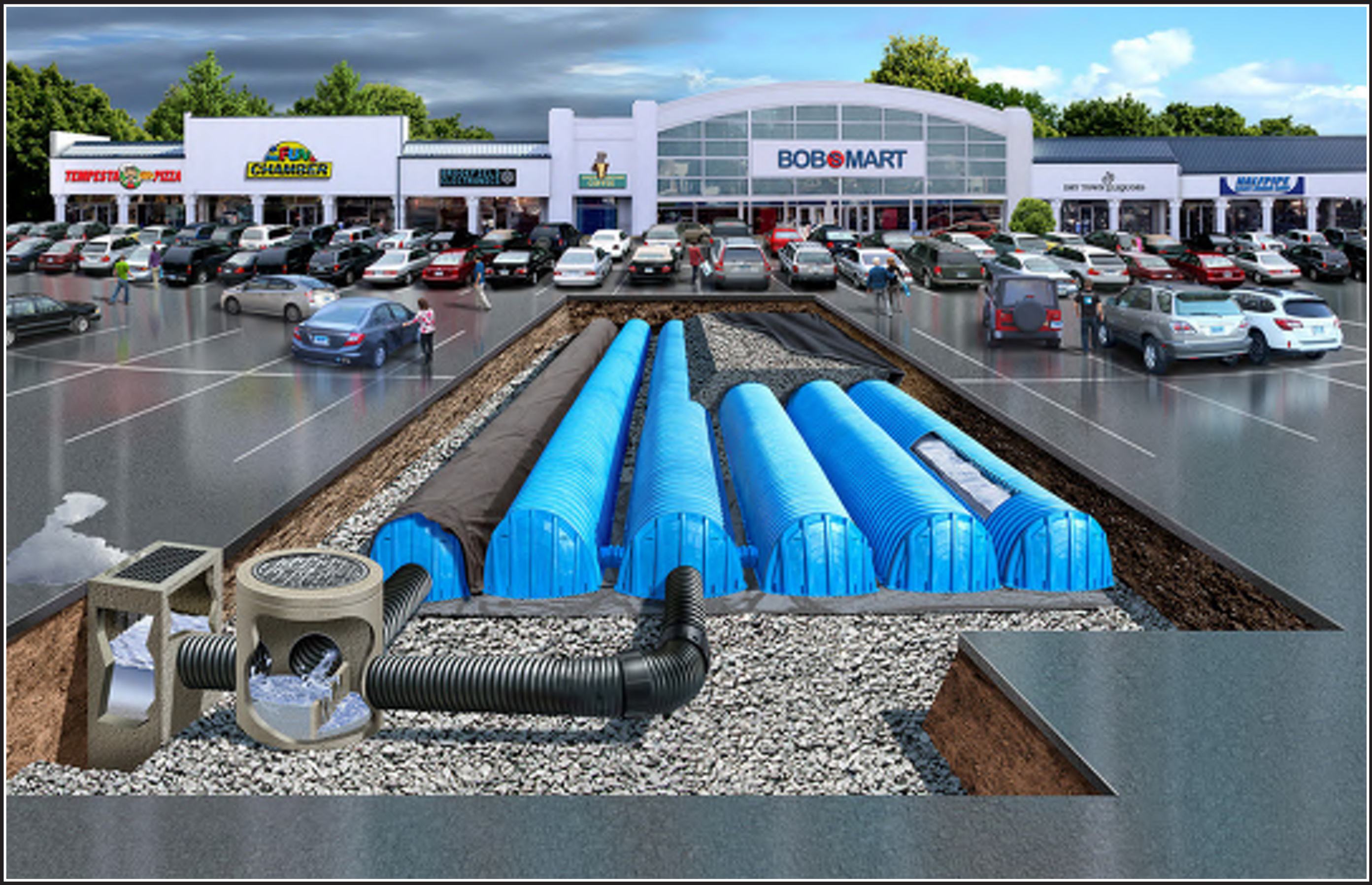
SUPPLEMENT ATTACHMENTS

Post Construction Inspection Report
151 Grove Street,
Franklin, Massachusetts

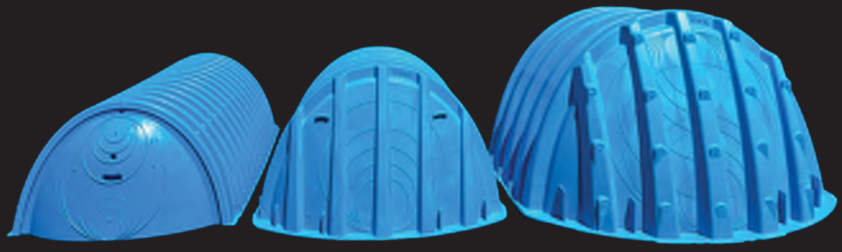
INSPECTION DATE:						
Person Inspecting		Weather				Other Personnel Present
		Clear				
Item	**N/A***	**sat.****	**NMR*****	**CAM****	**MCA***	**Comments:**
Pavement Swept						
Catch Basins						
CB #1						
CB #2						
CB #3						
CB #4						
CB #5						
CB #6						
CB #7						
CB #8						
CB #9						
CB #10						
CB #11						
CB #12						
Water Quality Manholes						
WQMH #1						
WQMH #2						
Cultec Chamber System #1						
Separator Row						
Inspection Port						
Cultec Chamber System #2						
Inlet Manhole / Chambers						
Inspection Port						
Surface Infiltration Basin #1						
Sediment Forebay						
Inlet Rip-Rap						
Gabion Weir Wall						
Infiltration Basin						
Outlet Control Structure						
Outlet Rip-rap						
Emergency Spillway						
NMR* normal maintenance requested						
N/A* not applicable at the time of inspection						
CAM* corrective action - minor						
SAT* satisfactory conditions as compliant						
MCA* Major corrective action						

RECHARGER® 300HD, 360HD, & 902HD

STORMWATER MANAGEMENT SOLUTIONS



INSTALLATION INSTRUCTIONS



RETENTION • DETENTION • INFILTRATION • WATER QUALITY

CULTEC®

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CULTEC reserves the right to make design and/or specification changes at any time without notice at CULTEC's sole discretion.

Contact Information:
For general information on our other products and services, please contact our offices within the United States at 1-(800)428-5832, (203)775-4416 ext. 202, or e-mail us at CT-CustomerService@cultec.com.

For technical support, please call (203)775-4416 ext. 203 or e-mail CT-Tech@cultec.com.

Visit www.cultec.com/downloads.html for Product Downloads and CAD details.

Doc ID: CLT009 08-24
August 2024
You are using version CLT009 08-24 of our CULTEC Installation Instructions for Recharger® 300HD, 360HD, and 902HD Stormwater Systems.

These instructions are for single-layer traffic applications only. For multi-layer applications, contact CULTEC.
All illustrations and photos shown herein are examples of typical situations. Be sure to follow the engineer's drawings.
Actual designs may vary.

Required Materials and Equipment

- Proper geotechnical soil evaluation by a qualified engineer or soil scientist to determine suitability of structural installation
- OSHA compliance
- CULTEC warning tape, or equivalent
- Assurances from local utilities that no underground gas, electrical or other potentially dangerous pipelines or conduits are already buried at the site
- Acceptable 1– 2 inch washed, crushed stone as shown in Table 3, page 18. Cleanliness of stone to be verified by engineer.
- Acceptable fill material
- CULTEC No. 410™ non-woven geotextile or equivalent
- CULTEC AFAB-HPF woven geotextile or equivalent, as required
- All CULTEC chambers and accessories as specified in the engineer's plans including CULTEC No. 410™ non-woven geotextile, CULTEC StormFilter® and CULTEC AFAB-HPF woven geotextile, where applicable. Check CULTEC chambers for damage prior to installation. Do not use damaged CULTEC chambers. Contact your supplier immediately to report damage or packing list discrepancies.
- Reciprocating saw or router
- Stone bucket
- Stone conveyor and/or tracked excavator
- Transit or laser level measuring device
- Compaction equipment

Requirements for CULTEC Chamber System Installations

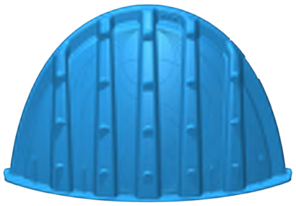
- CULTEC systems must be designed and installed in accordance with CULTEC's minimum requirements. Failure to do so will void the limited warranty. To request a copy and submit the CULTEC limited warranty, call CULTEC at 203-775-4416 or visit www.cultec.com.
- Installing contractors are expected to comprehend and use the most current installation instructions prior to beginning a system installation. If there is any question as to whether these are the most current instructions, contact CULTEC at (203)775-4416 or visit www.cultec.com.
- Contact CULTEC at least thirty days prior to system installation to arrange a pre-construction meeting.
- All CULTEC system designs must be certified by a registered professional engineer.
- Use these installation instructions as a guideline only. Actual design may vary. Refer to approved construction drawings for job-specific details. Be sure to follow the engineer's drawings as your primary guide.
- System cover/backfill requirements will vary based on installation type.
- Any discrepancies with the system sub-grade soil's bearing capacity must be reported to the design engineer.
- Non-woven geotextile must be used as specified in the engineer's drawings.
- Erosion and sediment-control measures must meet local codes and the design engineer's specifications throughout the entire site construction process.
- Responsibility for preventing vehicles that exceed CULTEC's requirements from traveling across or parking over the chamber system lies solely with the contractor throughout the entire site construction process. The placement of warning tape, temporary fencing, and/or appropriately located signs is highly recommended. Imprinted warning tape is available from CULTEC. For Acceptable Vehicle Load information, refer to Table 1 on page 16.

Chamber Specification Information

	Recharger 300HD Chamber	Recharger 360HD Chamber	Recharger 902HD Chamber
Size (L x W x H)	7.54′ x 51″ x 30″	4.17′ x 60″ x 36″	4.25' x 78" x 48"
Installed Length	7.08′	3.67′	3.67'
Length Adjustment per Row with two end caps installed	0.89′	2.50′	1.03'
when not using end caps	0.46′	0.50′	0.58'
Chamber Storage	6.53 ft³/ft	10.00 ft³/ft	17.31 ft³/ft
	46.27 ft³/unit	36.66 ft³/unit	63.47 ft³/unit
Minimum Installed Storage	10.57 ft³/ft	15.20 ft³/ft	27.06 ft³/ft
	74.44 ft³/unit	55.73 ft³/unit	99.28 ft³/unit
Minimum Area Required	33.65 ft²	21.08 ft²	26.58 ft²
Minimum Center-to-Center Spacing	4.75′	5.75′	7.25'
Minimum Spacing Between Chambers	6″	9″	9″
Minimum Cover Requirements	18″ (Paved)	18″ (Paved)	24″ (Paved)
	24″ (Unpaved)	24″ (Unpaved)	30″ (Unpaved)
Maximum Allowable Cover	12′	12′	8.3'
Maximum Allowable O.D. in Side Portal	10″ HDPE, 12″ PVC	10″ HDPE, 12″ PVC	10″ HDPE, 12″ PVC
Compatible Feed Connector	HVLV FC-24 Feed Connector	HVLV FC-48 Feed Connector	HVLV FC-48 Feed Connector

End Cap Specification Information

	Recharger 300HD End Cap	Recharger 360HD End Cap	Recharger 902HD End Cap
Size (L x W x H)	12.2″ x 45.9″ x 29.3″	18″ x 60″ x 36.5″	28.0″ x 78.0″ x 48.5″
Installed Length	9.6″	15″	24"
End Cap Storage	3.32 ft³/ft	5.17 ft³/ft	9.01 ft³/ft
	2.66 ft³/unit (interlocked)	6.46 ft³/unit (interlocked)	18.02 ft³/unit (interlocked)
Minimum Installed Storage	16.95 ft³/ft	12.40 ft³/ft	22.08 ft³/ft
	13.56 ft³/unit	15.50 ft³/unit	44.16 ft³/unit
Maximum Inlet Opening in End Cap	24″ HDPE, 24″ PVC	24″ HDPE, 30″ PVC	30" HDPE, 36″ PVC



All dimensions are nominal. Actual dimensions may vary on-site due to shipping and temperature.

For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

CULTEC HVLV Feed Connector Specification Information

	HVLV FC-24 Feed Connector	HVLV® FC-48 Feed Connector
Length	24.2”	49"
Installed Length (exposed)	6”	9" min.
Width	16”	16"
Height	12”	12"
Chamber Storage Capacity	0.91 ft³/ft	0.91 ft³/ft
Pipe Comparison	Greater flow capacity than 12” pipe	Greater flow capacity than 12" pipe
Compatible Models	Recharger 300HD	Recharger 360HD, Recharger 902HD
		

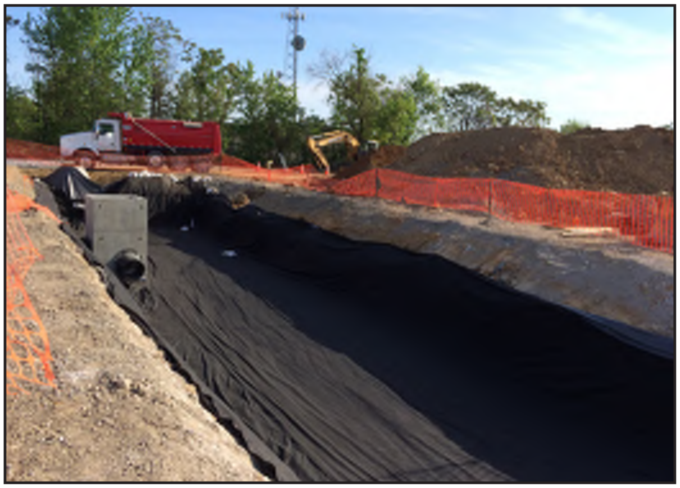
Site Preparation and Excavation

- Excavate and level the area per engineer’s drawings. Refer to plan view and cross-section details and excavate bed to accommodate chambers and manifold system. Be sure to allow for a minimum 12 inch stone border around the perimeter of the system and unforeseen overages in your excavation calculations.

- Remove any standing water and maintain positive drainage of the site throughout the installation. Dewatering procedures must be used, if necessary.

- Prepare the sub-grade soil for the chamber bed as specified by the engineer’s drawings.

- Place CULTEC No. 410™ non-woven geotextile (or equivalent) on the excavated bed bottom and perimeter sidewalls as specified by the engineer’s drawings. CULTEC No. 410™ non-woven geotextile is required on the sides and over the top of the system. It is also recommended on the system bottom. Overlap the geotextile by at least 24 inches where the fabric edges meet.



- Disperse a level base of 1 to 2 inch diameter washed, crushed stone over the entire area of the bed bottom. Refer to the engineer’s drawings for sub-grade soil preparation and required stone foundation thickness.

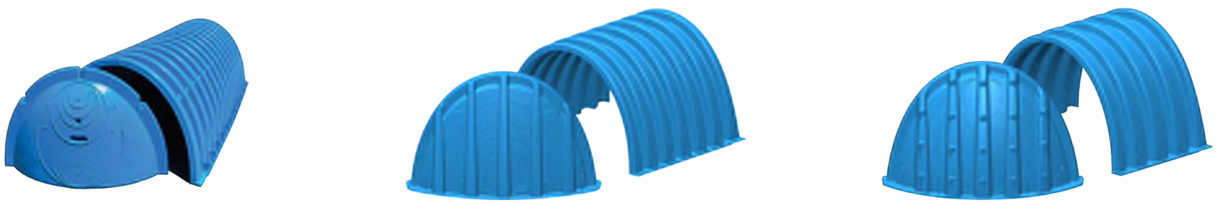
- Compact the stone base to achieve a flat, level unyielding surface. For vibratory roller use, refer to Table 1 on page 16 for recommended guidelines.

Chamber Information for Recharger® Models 300HD, 360HD, & 902HD

Directional arrows located on the top of the chamber point towards the Small Rib End.

CULTEC Recharger® 300HD, 360HD, & 902HD Chambers

The Recharger models 300HD, 360HD, & 902HD chambers come in only one model type which is fully open on both ends. The chamber requires the coordinating End Cap (*sold separately*) to cap rows of chambers or to create single stand alone units. One rib is dimensionally smaller to be able to interlock with additional units. A directional arrow points towards the small rib end. Typically, the build of the row begins with the large rib end facing you.



Shown: Recharger 300HD, 360HD, & Recharger 902HD Chambers with End Caps.

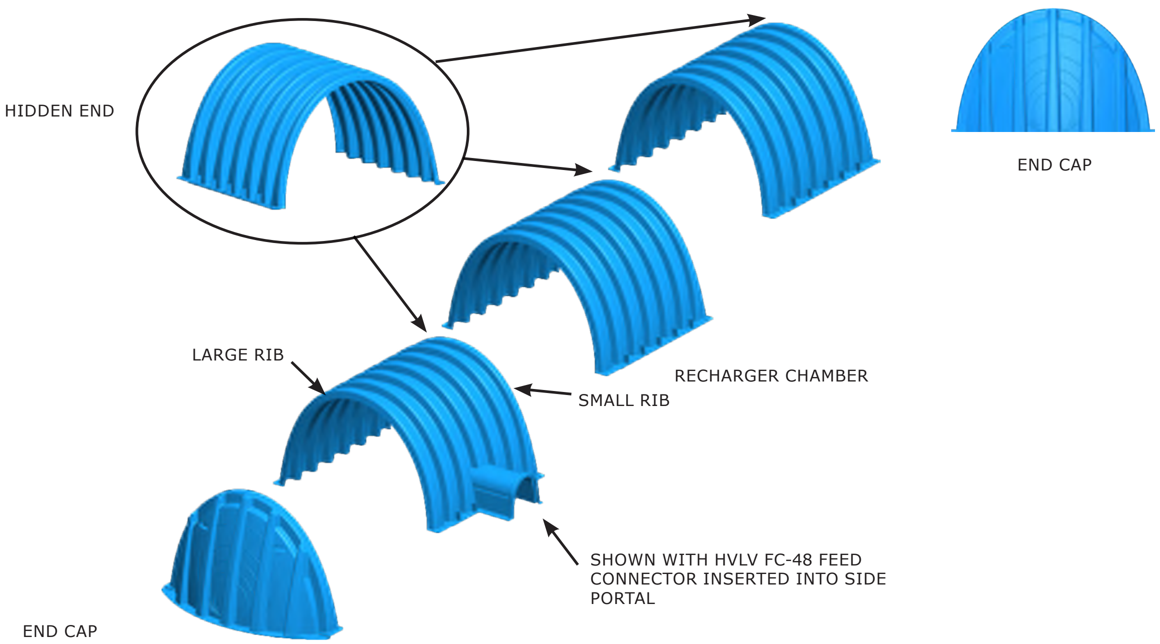
CULTEC Recharger® 300HD, 360HD, & 902HD End Caps

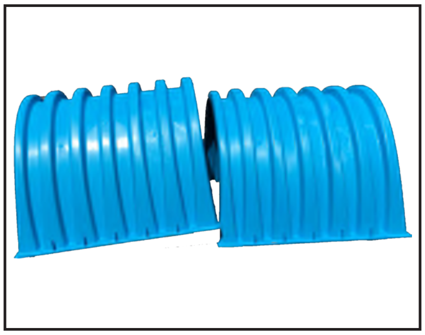
The End Cap is used in conjunction with the chamber to cap rows of chambers or to create single stand alone units.

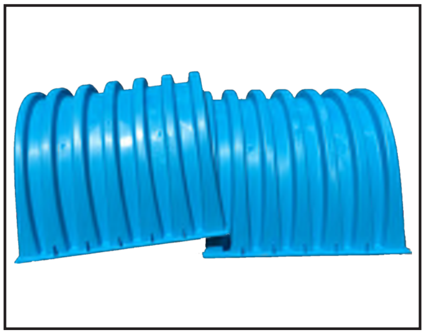
Shown: Recharger 300HD End Cap, 360HD End Cap & Recharger 902HD End Cap

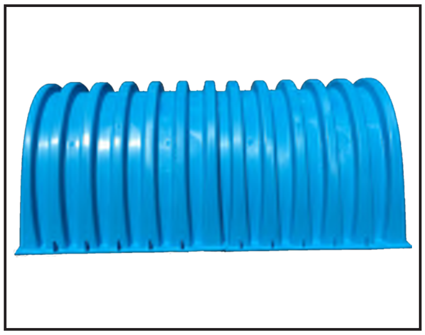
Typical Installation Method

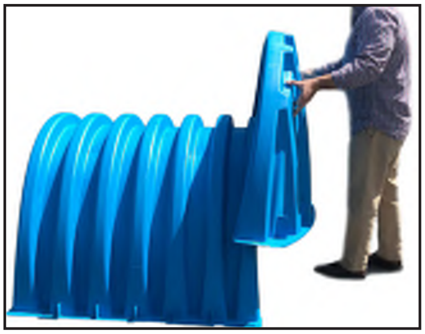
Interlock Recharger chambers using the overlapping rib connection.
Cap the ends of the lines using the Recharger End Cap.











Chamber Preparation and Installation

CULTEC Recharger® 300HD, 360HD, & 902HD chambers have the distinctive features of being fully open on both ends and utilize an overlapping rib connection. CULTEC chamber ribs are dimensionally sized with a large rib and a smaller rib to allow for an easy interlocking rib connection. The chambers require a separate end cap to cap off lines.

- Identify and group the chambers and end caps to ensure proper quantity and usage.
- Trim all side portals, end caps and inspection ports prior to installation for easier handling during trimming.
- Place one Recharger chamber for each row of units to be installed. Directional arrows point towards the small rib end of the chamber.
- If using the side portal internal manifold feature, trim the side portal(s) according to guidelines located on the sidewall of the chamber, as required. Insert one end of the HVLV Feed Connector into the trimmed portal to create the internal manifold. Refer to Installation of Manifold section on page 9.
- Place the next Recharger chamber so the directional arrow located in the center of the unit points downstream towards the end of the line. Overlap the large rib over the small rib of the preceding chamber's end wall, interlocking the chambers together. When placing chambers take care to maintain separation requirements, measuring from the base of the chamber.
- To ease backfilling requirements, only install as many chambers as the stone-laying bucket or conveyor can reach.
- Place stone taking care not to drop stone over the last rib to be overlapped.
- Continue chamber and stone placement to extend the length of the row.
- Use the Recharger End Caps to cap off chamber rows. To install the end cap, lift the end cap above the chamber and slide down the chamber rib.
- Prior to the placement of the next line of chambers, check and correct the level and alignment of the chamber units, where needed.

Installation of Manifold

Utilize the side portals located on the chamber as an internal manifold in locations where indicated on the engineer’s drawings. HVLV® Feed Connectors are inserted into the portals to promote flow. An additional external manifold is not required unless specified by the engineer’s design.

- CULTEC AFAB-HPF woven geotextile is to be placed under all chambers utilizing the internal manifold feature and under all chambers accepting inlet/outlet pipe connections per engineer’s drawings. If inserting a pipe 18” diameter or larger into the CULTEC chamber, the use of CULTEC AFAB-HPF woven geotextile is recommended to prevent washout of the bedding stone.

- Most installations are designed with the internal manifold located at the ends of the chamber bed. However, the side portal internal manifold feature allows for the manifold to be located at any point within the chamber run. Refer to system design for manifold location(s).
- Using a reciprocating saw or router, trim the sidewall portals of the units that are to receive the HVLV Feed Connectors. Feed connectors may be placed on any chamber requiring a manifold, as indicated by the engineer’s drawings.

- Place the HVLV Feed Connector into the side portal of the chambers per engineer’s drawings. Maintain the required minimum separation between chamber rows.
- Check for correct center-to-center spacing of chamber runs according to engineer’s drawings before proceeding to next row.
- Insert inflow/outflow pipe(s) into end cap or side portal as detailed on engineer’s drawings. Maximum inlet sizes for the end caps are:
  - Recharger 300HD: 24” HDPE, 24” PVC
  - Recharger 360HD: 24” HDPE, 30” PVC
  - Recharger 902HD: 30” HDPE, 36” PVC
- Maximum pipe sizes for the side portals are: 10” HDPE, 12” PVC. There is no need to feed every row if utilizing the internal manifold feature.

If the manifold installation detail does not include CULTEC’s side portal internal manifold, proceed according to the engineer’s drawings for pipe manifold installation.

How to Trim CULTEC Chamber to Accommodate Pipe on End Cap

When using a conventional pipe manifold or inlet / outlet pipes, the contractor is required to trim the CULTEC Recharger End Cap on-site. Here are some quick steps to ensure a successful outcome:

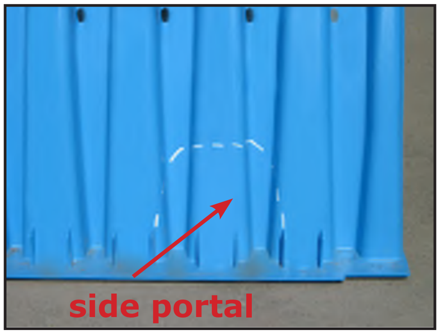
- Lay out chambers according to engineered plans.
- Directional arrows located at the top of the chamber point towards the small rib end.
- Install end caps on the chambers as detailed on the engineer's drawing.
- Locate the proper diameter pipe outline on the end cap to accommodate the designed pipe size and invert elevation.
- Drill a hole on the chamber end wall large enough to accommodate a saw blade.
- Following the etched outline, use a reciprocating saw to trim out the opening to accommodate the pipe. Trimming should be within 1/4" tolerance of pipe O.D. to prevent stone intrusion.
- Insert the pipe or fitting a minimum of 8" into the chamber. This is not required to be a watertight connection. Maximum inlet pipe sizes:
  - Recharger 300HD: 24" HDPE, 24" PVC
  - Recharger 360HD: 24" HDPE, 30" PVC
  - Recharger 902HD: 30" HDPE, 36" PVC
- Backfill as noted in the installation instructions and engineering details.

Trimming may only be performed on end caps or within side portal areas.
Pipe may not be inserted into the sidewall of the chamber unless it is within the side portal trim lines.

For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

How to Trim Side Portal to Accommodate HVLV Feed Connector for Internal Manifold

When using the side portal internal manifold feature, the contractor is required to trim the side portal of the CULTEC Recharger chamber on site.



- Following the guides on the side portal, use a reciprocating saw to trim out the opening to accommodate the HVLV Feed Connector. Trimming should be within 1/4” tolerance of HVLV Feed Connector to prevent soil intrusion.

Trimming may only be performed on the side portal area. Side entry in any other location is unacceptable.

- Insert the HVLV Feed Connector a minimum of 8” into the sidewall of the chamber. This is not required to be a watertight connection.

- Maintain proper minimum separation between chamber rows.

How to Trim Side Portal to Accommodate Pipe for Side Entry

When using the side portal feature as an inlet /outlet location, the contractor is required to trim the side portal of the CULTEC Chamber on site.

- Line up the pipe on the chamber side portal to the designated pipe elevation as detailed on the engineer's drawing. The side portal may accommodate 10" HDPE or 12" PVC pipe.
- Using a grease pen, outline the pipe on the side portal of the CULTEC chamber. See Fig. 1 for acceptable trim area. Do not cut outside the side portal area guides.
- Drill a hole on the chamber side portal large enough to accommodate a saw blade.
- Following the grease pen outline, use a reciprocating saw to trim out the opening to accommodate the pipe. Trimming should be within 1/4" tolerance of pipe O.D. to prevent soil intrusion.
- Insert the pipe or fitting a minimum of 8" into the chamber. This is not required to be a watertight connection.

Fig. 1 - Acceptable Trim Area

Trimming may only be performed on the side portal area. Side entry in any other location is unacceptable.

Embedment Stone Backfill

Backfill using washed, crushed stone. To maintain row separation distance and prevent chamber displacement, slowly distribute stone on top of the center of the chamber crown so that stone trickles down and builds between chamber rows as required. Stone column differential should not exceed 12” between adjacent chamber rows or between chamber rows and perimeter.

Place the stone carefully over the centerline of the chamber crown. Embedment stone must only be placed by an excavator or telescoping conveyor boom. Placement of embedment stone with a bulldozer is not an acceptable method of installation and may cause damage to the chambers. Any chambers damaged using an unacceptable method of backfill are not covered under the CULTEC limited warranty.

Excavator-Placed Stone

Typically the most common method, excavator-placed stone is limited by the reach of the arm. To accommodate this issue with larger beds, it is common to prepare a bed by joining just a few chamber units at a time, then placing the stone and fabric before installing the next few units.

The excavator is usually operated within the excavation area. The excavator may work at grade level over recently placed chambers, provided coverage between the chambers and the excavator tracks meets the minimum requirements.

Telescoping Conveyor Boom Placement

With booms as much as 120-140 feet long, telescoping aggregate conveyors can greatly aid the process of stone placement.

With both stone-placement methods, ladling the stone carefully over the chambers’ centers will secure them in place. Evenly distributing the stones will help prevent chamber movement and maintain row separation.

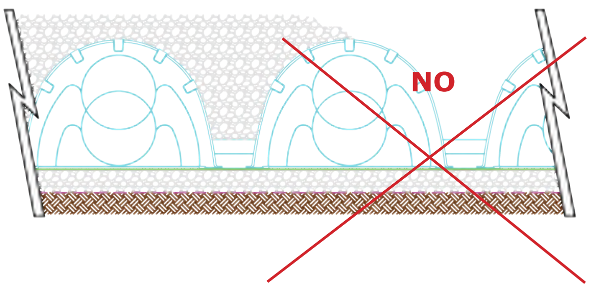
Once secured, stone may be placed to surround the chambers and fill the perimeter areas. Be sure to adhere to manufacturer recommendations and engineer’s drawings for system cover/backfill requirements.

Do not allow equipment to drive over the chambers unless the minimum cover is in place. Use a warning tape (available from CULTEC) to restrict access.

Repeat steps until all of the last chamber units are in place. Be certain to use the Recharger End Caps to end the line of chambers as specified by the drawings.

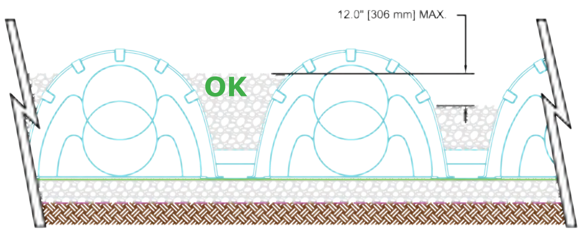
If a manifold system is designed on the back end of the chamber bed, follow manifold installation instructions as described previously.

Stone column height differential should never exceed 12 inches with adjacent chambers or between chamber rows and perimeter. Minimum depth of cover of properly compacted material must be met before allowing vehicles to drive over the bed. Avoid using large rocks and/or organic matter as backfill material. Refer to “Acceptable Fill Materials” or contact the design engineer for approved fill types.



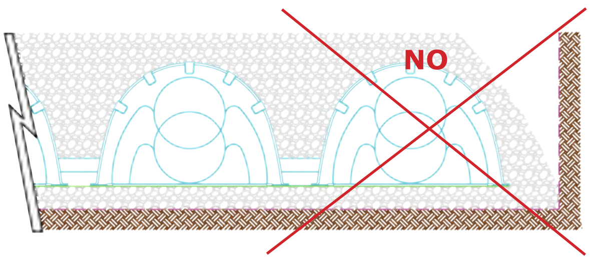
NOTE: CHAMBERS MUST BE BACKFILLED EVENLY.

UNEVEN BACKFILL - INCORRECT INSTALLATION



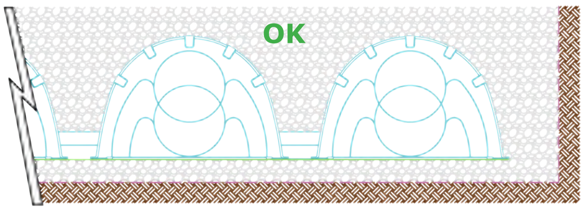
NOTE: STONE HEIGHT IN BETWEEN ROWS AND PERIMETER SHOULD NOT DIFFER BY MORE THAN 12” (300 MM)

EVEN BACKFILL - CORRECT INSTALLATION



NOTE: WHEN FILLING IN PERIMETER, STONE MUST BE FILLED IN EVENLY WITH CHAMBER ROWS.

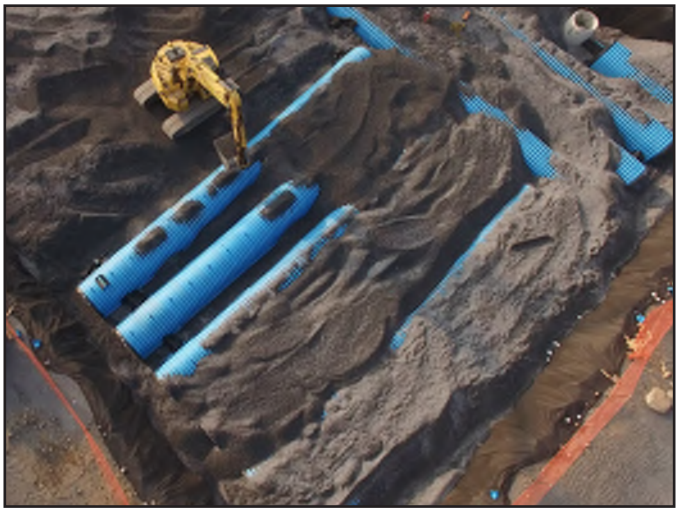
PERIMETER NOT FULLY BACKFILLED
INCORRECT INSTALLATION



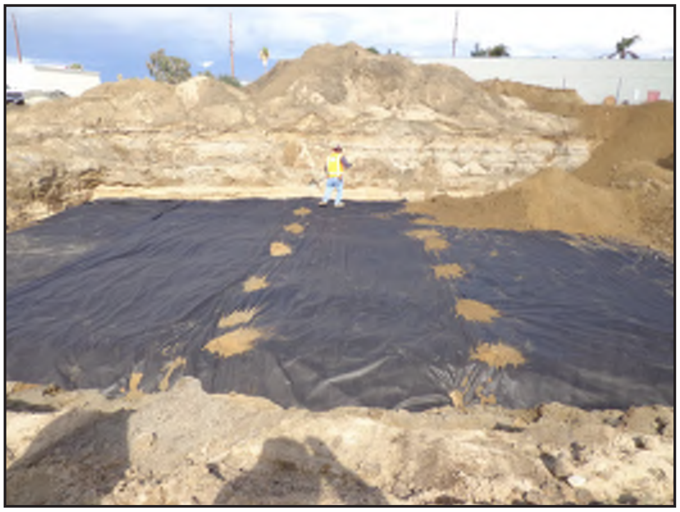
NOTE: PERIMETER STONE MUST BE FULLY BACKFILLED WITH STONE AND EXTEND TO THE EXCAVATION WALL.

PERIMETER FULLY BACKFILLED
CORRECT INSTALLATION

Placement of Top Fabric Layer & System Backfill Process



- Place the stone over the entire bed area as described in previous section.
- Cover the entire installation area with CULTEC No. 410 non-woven geotextile starting from the perimeter and laying it on top of the stone. The geotextile must overlap at least 24 inches at the edges.
- Fill the first 12 inches with enough material (See 3 in Fig. 1, page 18) to meet the requirements as shown in Table 3, page 18. Backfill over the top of the geotextile (See 3 in Fig. 1, page 18) in lifts that do not exceed 6 inches, and disperse the fill with a vehicle that meets the maximum wheel loads or ground pressure limits as specified on specified in Table 1 on page 16.



- Compact each lift of backfill as specified in the engineer's drawings. CULTEC specifies compacting to a minimum of 95% of the standard proctor density using compaction equipment Refer to Table 1, page 16 for acceptable equipment.
- Backfill over the chamber bed (See 4 in Fig. 1, page 18) in 12-inch maximum lifts until the specified grade is achieved. For pavement sub-base or special fill requirements, see engineer's drawings.

NOTE:
Excavation alongside already installed chamber rows backfilled with stone is not acceptable.
No chambers may be added or subtracted from previously installed systems.

Table 1: Maximum Allowable Construction Loads

Material Location (See Fig. 1, p. 18)	Cumulative Cover Depth over Chambers (in)	Maximum Allowable Wheel Loads: Max Axle Load for Trucks (lbs)	Maximum Allowable Wheel Loads: Max Axle Load for Loaders (lbs)	Maximum Allowable Track Loads: Track Shoe Width (in)	Maximum Allowable Track Loads: Max Ground Pressure (psi)	Maximum Allowable Compaction Loads: Maximum Centrifugal Force (lbs)	Maximum Allowable Compaction Loads: Max Gross Vehicle Weight (lbs)
4 Final Fill Material	36 Compacted	32,000	16,000	12	23.8	38,000	16,000
				18	16.3		
				24	12.8		
				30	10.6		
				36	9.1		
	30 Compacted	32,000	16,000	12	20.5	24,000	12,000
				18	14.3		
				24	11.4		
				30	9.5		
				36	8.3		
3 Initial Fill Material	24 Compacted	32,000	16,000	12	17.2	20,000	12,000
				18	12.3		
				24	9.9		
				30	8.4		
				36	7.4		
	24 Loose/Dumped	300HD: 32,000 360HD: 32,000 902HD: 24,000	300HD: 16,000 360HD: 16,000 902HD: 12,000	12	15.6	20,000	12,000
				18	11.3		
				24	9.2		
				30	7.9		
				36	7.0		
	18 Compacted	300HD: 32,000 360HD: 32,000 902HD: 24,000	300HD: 16,000 360HD: 16,000 902HD: 12,000	12	14.0	300HD: 20,000 360HD: 20,000 902HD: NOT ALLOWED	300HD: 12,000 360HD: 12,000 902HD: 5,000
				18	10.3		
				24	8.5		
				30	7.4		
				36	6.6		
	18 Loose/Dumped	300HD: 16,000 360HD: 16,000 902HD: NOT ALLOWED	NOT ALLOWED	12	12.6	NOT ALLOWED	300HD: 12,000 360HD: 12,000 902HD: NOT ALLOWED
				18	9.3		
				24	7.7		
				30	6.7		
				36	6.0		
2 Embedment Stone	12	NOT ALLOWED	NOT ALLOWED	12	10.7	NOT ALLOWED	NOT ALLOWED
				18	8.3		
				24	7.0		
				30	6.3		
				36	5.8		
	6	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED FOR RECHARGER 902HD. 6" FILL DEPTH TRACK LOAD DATA APPLIES TO RECHARGER 360HD ONLY		NOT ALLOWED	NOT ALLOWED
				12	7.4		
				18	6.3		
				24	5.6		
				30	5.3		
				36	5.0		

The use of wheeled equipment without proper cover is strictly prohibited.

For Tracked Vehicles: Ground pressure is vehicle operating weight divided by total truck contact area for both tracks. Turning should be kept to a minimum.

No wheeled vehicles are allowed prior to compacted fill placement

Table 2: Placement Methods and Descriptions

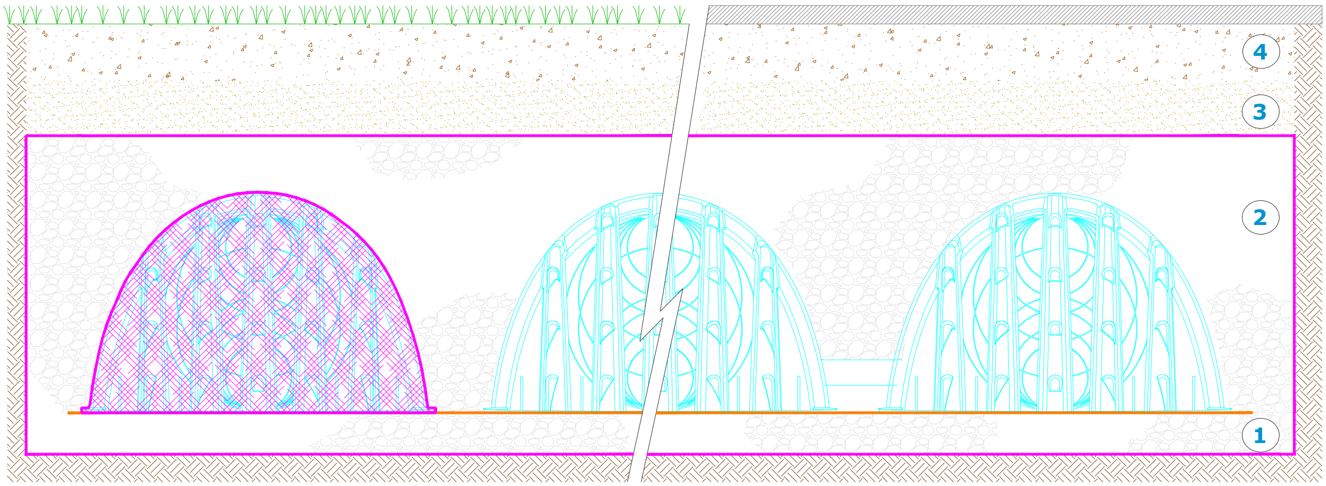
Material Location See Fig. 1, p.18	**Placement Method/ Restrictions**	**Wheel Load Restrictions**	**Track Load Restrictions**	**Compaction Restrictions**
	See Table 1, p. 16 for Maximum Construction Loads			
4 Final Fill Material	A variety of placement methods may be used. All construction loads shall not exceed the maximum values listed in Table 1.	902HD: 36″ minimum cover for dump truck and wheel loader travel 300HD, 360HD: 24″ minimum cover for dump truck and wheel loader travel	Dozers shall push parallel to rows only.	902HD: Roller travel shall be parallel to rows only until 36″ of cover is reached 300HD, 360HD: Roller travel shall be parallel to rows only until 24″ of cover is reached
3 Initial Fill Material	Excavator positioned off of bed or on foundation stone. Small LGP track dozer, track skid steer loaders may be used. Must maintain 12″ minimum fill below tracks at all times.	902HD: Asphalt can be dumped into paver machine when total cumulative fill depth over chambers reaches 24″ 300HD, 360HD: Asphalt can be dumped into paver machine when total cumulative fill depth over chambers reaches 18″	Equipment direction of travel shall be parallel to rows at all times. Equipment shall not be permitted to turn direction over chambers.	Roller travel shall be parallel to rows only. 902HD: Dynamic roller mode shall be used only when total cumulative fill depth over chambers reaches 24″ 300HD, 360HD: Dynamic roller mode shall be used only when total cumulative fill depth over chambers reaches 18″
2 Embedment Stone	No equipment shall be permitted to contact the chambers. Stone conveyor positioned off of bed or on foundation stone. Excavator positioned off of bed or on foundation stone. Stone column height differential between chamber rows shall never exceed 12″. Stone to be placed at the crown of the chamber. No stone shall be pushed over chambers.	No wheel loads allowed. No wheel loaders permitted to dump stone directly onto chambers.	No tracked equipment is allowed on chambers until 12″ of embedment stone is in place.	No rollers allowed.
1 Foundation	A variety of placement methods may be used including but not limited to excavator placement, stone conveyor placement or dozer placement. Plate compact or roll to achieve a flat, unyielding surface. Contractor is responsible for any conditions or requirements relating to subgrade bearing capacity, dewatering or protection of subgrade infiltrative capacity.			

Table 3: Acceptable Fill Materials

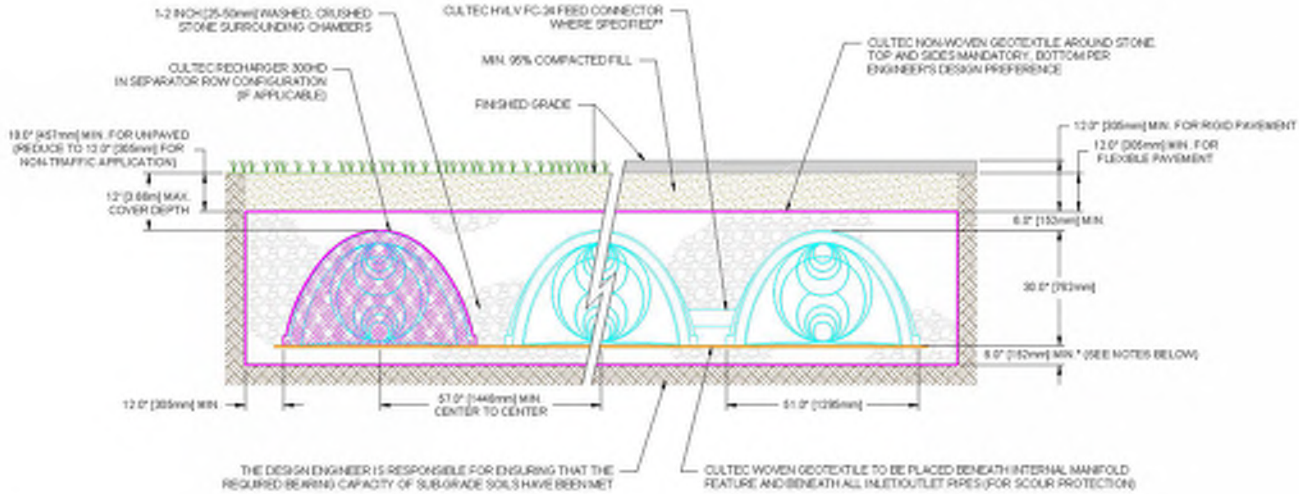
	Material Location	Description	AASHTO M43 Classification	Compaction/ Density Requirement
4	Fill Material for Layer 4 starts from the top of Layer 3 to the bottom of pavement or unpaved finished grade above. Refer to cross section, page 19 for proper minimum fill requirements.	Any soil/rock materials, native soils or per engineer's plans. Check plans for pavement subgrade requirements.	Per engineer's drawings	Prepare per engineer's drawing. Paved installations may have strict material and preparation requirements.
3	Fill Material for Layer 3 starts from top of embedment stone (Layer 2) to minimum required depth above top of chamber. Refer to cross section, page 19 for proper minimum fill requirements.	Granular well-graded soil/aggregate mixtures, <35% fines	3, 4, 5, 6, 7, 8, 9, 10, 56, 57, 67, 68, 78, 89, 467	Compact in 6" lifts to a minimum 95% Standard Proctor density. Refer to Table 1 for acceptable gross vehicle weights.
2	Embedment Stone surrounding chambers and to a minimum elevation above chamber crown. 300HD: 6" min. required 360HD: 6" min. required 902HD: 12" min. required.	Washed, crushed stone with the majority of particles between 1" - 2"	Recharger 300HD: 3, 4, 467, 57 Recharger 360HD: 3, 4, 467, 57 Recharger 902HD: 3, 4	No compaction required.
1	Foundation Stone below chambers per engineer's drawing 300HD: 6" min. required 360HD: 6" min. required 902HD: 9" min. required.	Washed, crushed stone with the majority of particles between 1" - 2"	Recharger 300HD: 3, 4, 467, 57 Recharger 360HD: 3, 4, 467, 57 Recharger 902HD: 3, 4	Plate compact or roll to achieve a flat, unyielding surface.

The listed AASHTO classifications are for gradations. The stone must be washed, crushed and angular. See Table 5, page 20.
For example, the stone must be specified as washed, crushed No. 4 stone. Fill materials shall be free of debris, trash, frozen lumps and other deleterious matter.
Contact CULTEC for gradation requirements for specific projects that do not fall within the above specifications.

Fig. 1. Fill Material Locations - refer to Tables 1-3



Recharger 300HD Typical Cross Section for Traffic Applications

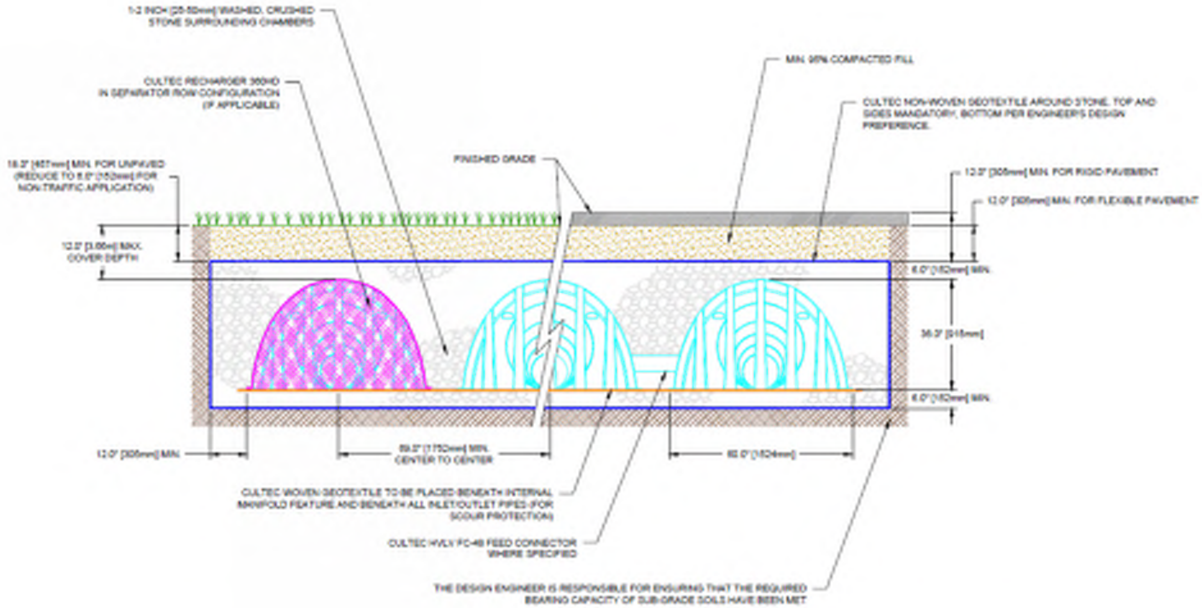


NOTES:

*FOR COVER DEPTHS FROM 18.0" - 8.0' (457mm - 2.44m), INCREASE DEPTH OF BEDDING STONE TO 9.0" (229mm) MIN. FOR COVER DEPTHS GREATER THAN 8.0' (2.44m)
**UTILIZE HVLV FC-24 FEED CONNECTOR FOR 6" (152mm) ROW SPACING. UTILIZE HVLV FC-48 FEED CONNECTOR FOR ROW SPACING GREATER THAN 6" (152mm)

1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
   - 1.a. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   - 1.b. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
   - 1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418 "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
3. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
   - 3.a. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F2418
   - 3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   - 3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

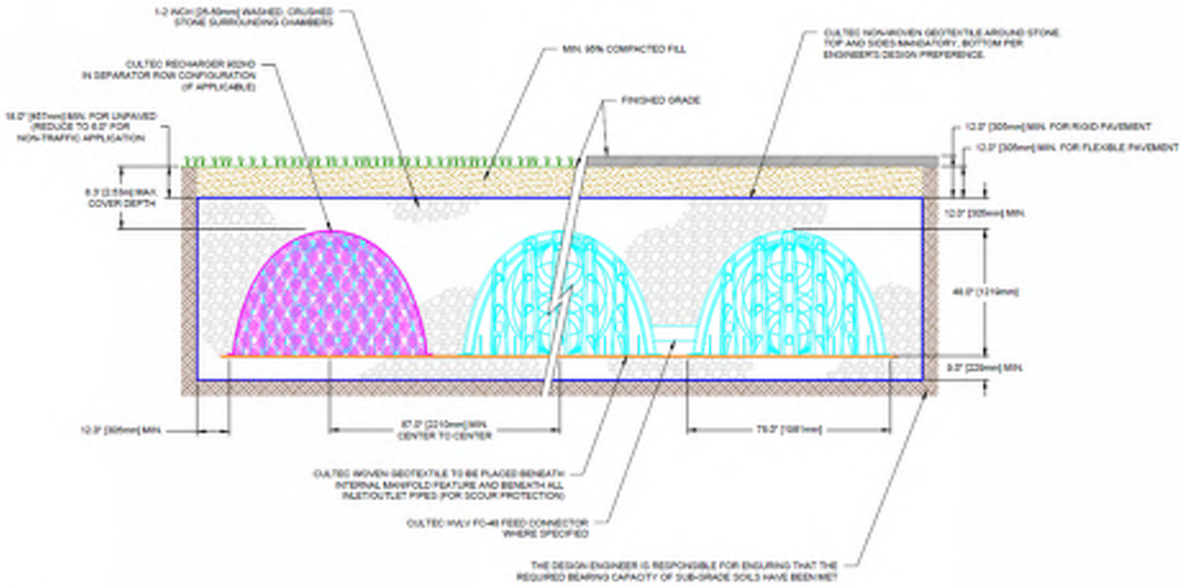
Recharger 360HD Typical Cross Section for Traffic Applications



NOTES:

1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
   - 1.a. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   - 1.b. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
   - 1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3430-20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
3. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
   - 3.a. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
   - 3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   - 3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

Recharger 902HD Typical Cross Section for Traffic Applications



NOTES:

1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
   - 1.a. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   - 1.b. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
   - 1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3430-20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
3. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
   - 3.a. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
   - 3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   - 3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

Special Handling Instructions for Polypropylene, Chambers in Colder Temperatures

CULTEC chambers are manufactured of impact-modified polypropylene, which is inherently resistant to corrosion and chemical breakdown and cold weather impact. Additional UV inhibitors and antioxidants increase the chambers' resistance to sunlight degradation. However, CULTEC recommends that, when installed in cold temperatures below 32° F, the installer take special care when removing the chambers from the stacks, not allowing the chambers to fall from height. Avoid using machinery to handle the chambers. When possible, CULTEC recommends that the stone backfill be placed in temperatures above 32° F to minimize depressions or deflections.


DEERE

Table 3: CULTEC No. 410™ Non-Woven Geotextile Specification Information

Properties	ASTM Test Method	Test Results
Appearance		Black
Weight - Typical	D 5261	4.5 oz/sy
Tensile Strength	D 4632	120 lbs
Elongation @ Break	D 4632	50%
Mullen Burst*	D 3786*	225 psi
Puncture Strength*	D 4833*	65 lbs
CBR Puncture	D 6241	340 lbs
Trapezoid Tear	D 4533	50 lbs
AOS	D 4751	70 US Sieve
Permittivity	D 4491	1.70 Sec^{-1}
Water Flow Rate	D 4491	135 gal/min/sf
UV Resistance @ 500 Hours	D 4355	70%

** Historical averages (current values not available): Mullen Burst Strength ASTM D3786 is no longer recognized by ASTM D-35 on Geosynthetics as an acceptable test method. Puncture Strength ASTM D4833 is not recognized by AASHTO M288 and has been replaced with CBR Puncture ASTM D6241.*
Substitutions must meet or exceed these minimums. Non-woven geotextile placement is mandatory over top and sides of system. Coverage of system bottom is recommended. However, follow engineer's design preference.

Table 4: CULTEC AFAB-HPF Woven Geotextile Specification Information

Properties	ASTM Test Method	Test Results
Appearance		Black
Tensile Strength	D 4632	320 lbs
Elongation @ Break	D 4632	15%
Wide Width Tensile	D 4595	52 kN/m
Wide Width Elongation	D 4595	15%
CBR Puncture	D 6241	1,500 lbs
Trapezoidal Tear	D 4533	120 lbs
Apparent Opening Size	D 4751	30 US Sieve
Permittivity	D 4491	0.2 Sec^{-1}
Water Flow Rate	D 4491	22 g/min/sf
UV Resistance @ 500 Hours	D 4355	70%

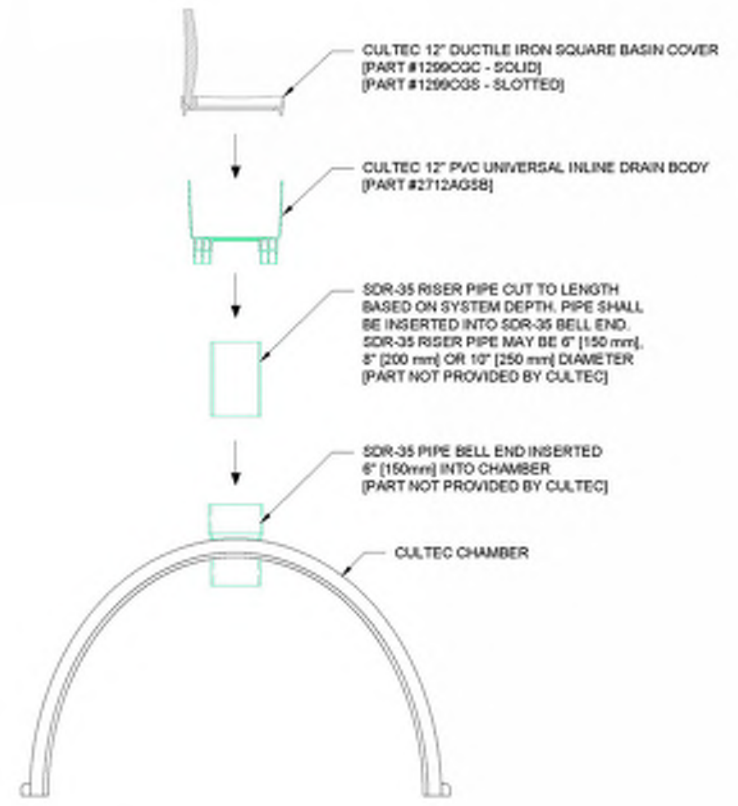
Substitutions must meet or exceed these minimums. To be used as scour protection and in conjunction with CULTEC Separator Row (if specified).

Table 5: Criteria for acceptable 1 - 2 inch washed, crushed, angular stone

Washed Crushed Stone	Description	Criteria
Acceptable	Angular	Stones have sharp edges and relatively plane sides with unpolished surfaces
	Subangular	Stones are similar to angular description but may have slightly rounded edges
Unacceptable	Subrounded	Stones have nearly plane sides but have well-rounded corners and edges
	Rounded	Stones have smoothly curved sides and no edges

See Item 1 and Item 2 of Table 3 on page 18 for additional stone requirements.

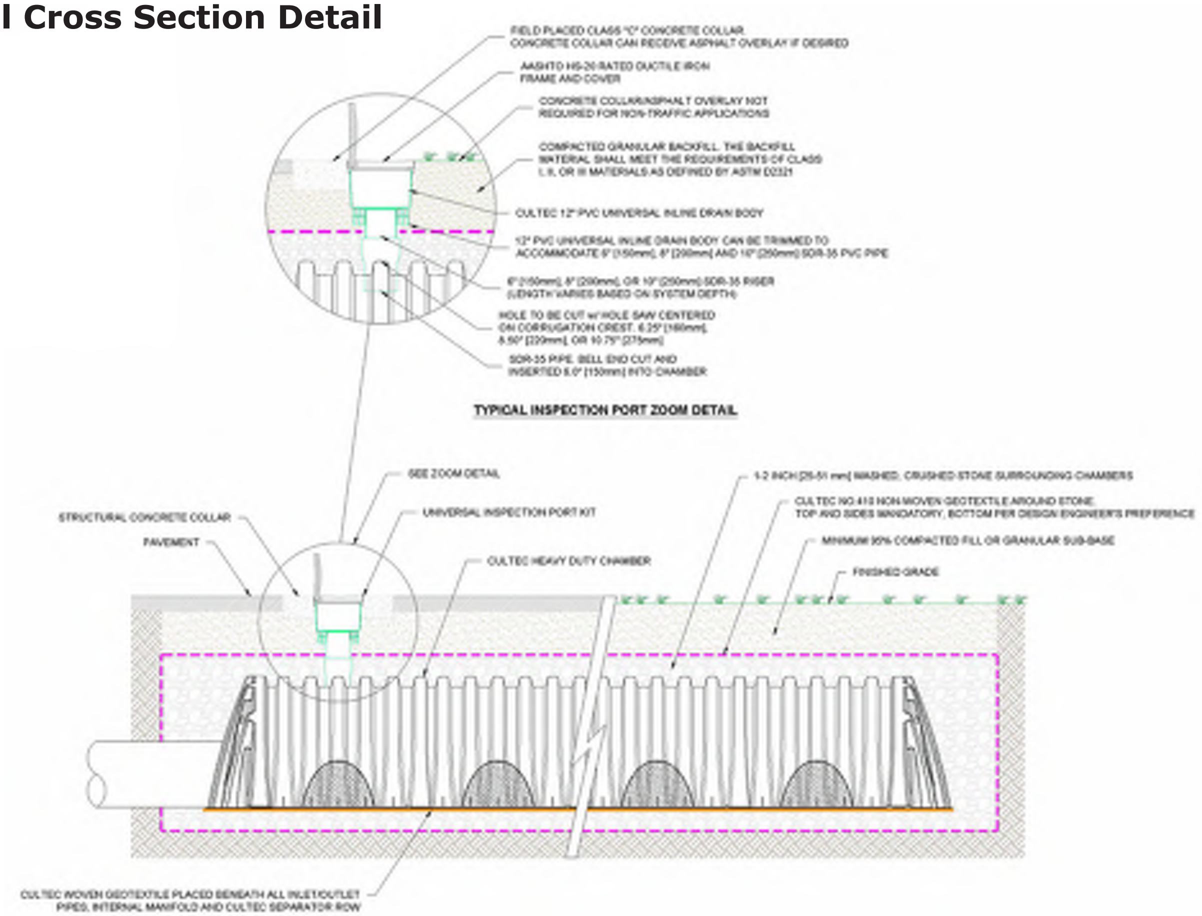
Inspection Port Detail for Paved Traffic Applications



Trim inspection port knock-out with reciprocating saw or hole-saw.

Corrugated pipe is not suitable for inspection port.

Typical Cross Section Detail



For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

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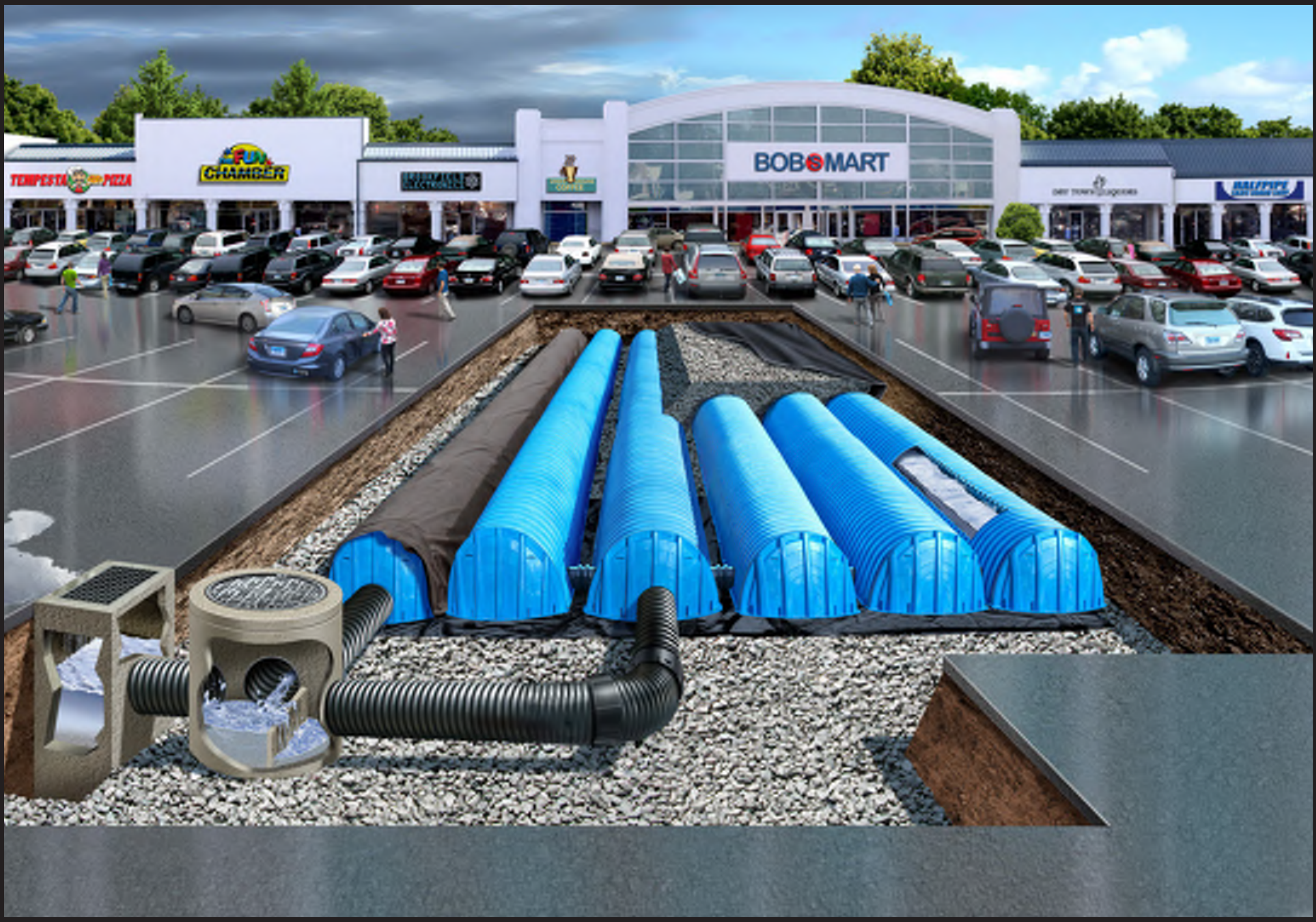
RETENTION • DETENTION • INFILTRATION • WATER QUALITY

CULTEC SEPARATOR™ ROW

WATER QUALITY SYSTEM



OPERATION & MAINTENANCE GUIDE

FOR CULTEC STORMWATER MANAGEMENT SYSTEMS

STORMWATER MANAGEMENT SOLUTIONS

CULTEC®

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Feb 2022

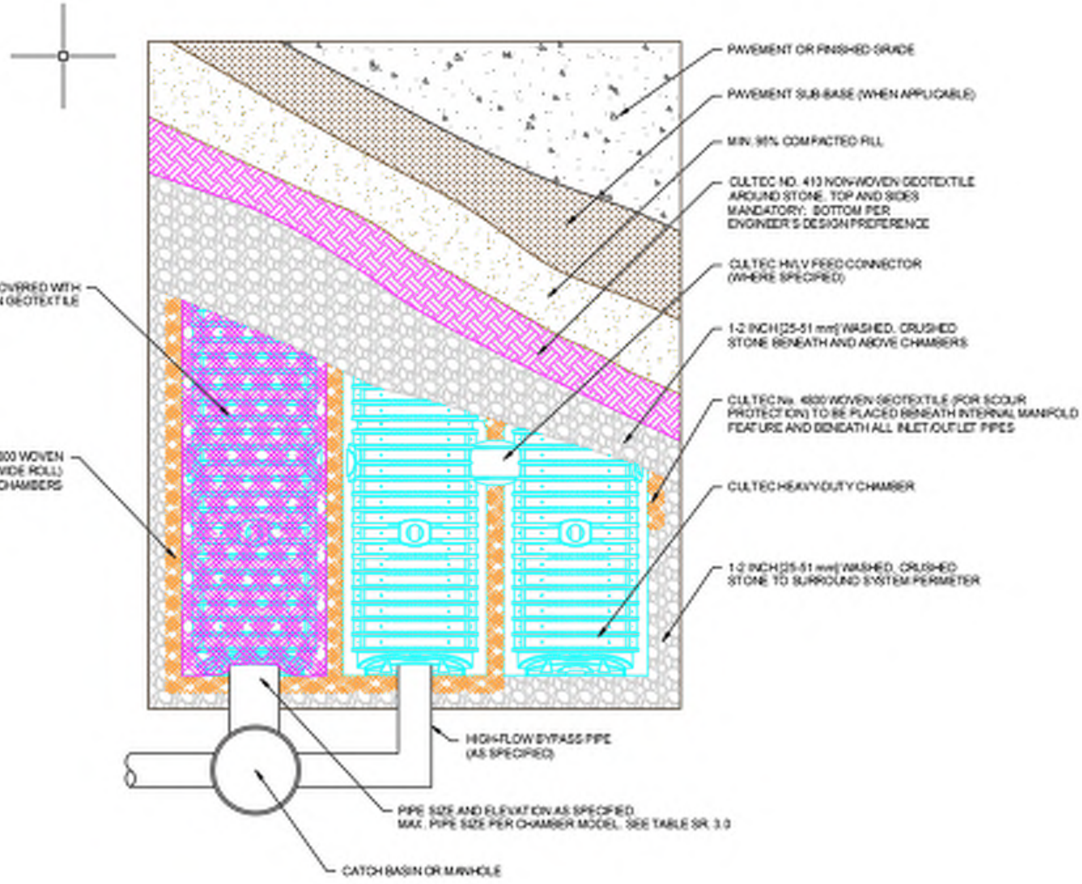
Introduction

CULTEC's Separator™ Row is an inexpensive means of removing Total Suspended Solids from the CULTEC chamber system, as well as providing easier access for inspection and maintenance. The Separator Row is designed to capture the First Flush of a rain event and is typically included as part of the "Treatment Train" for water quality.

The CULTEC Separator Row is a row of CULTEC Contactor or Recharger Chambers that are surrounded on all sides by filter fabric. One layer of CULTEC No. 4800™ Woven Geotextile are placed between the clean foundation stone and the chamber feet. The chambers are then completely wrapped with CULTEC No. 410™ non-woven geotextile. This configuration is designed to trap any sediment and/or debris that may pass through the upstream water-quality structures and into the chamber system.

A manhole is typically located adjacent to the separator row for ease of inspection and maintenance. This manhole is placed upstream of the system and can include a high-flow bypass pipe to pass peak-flows onto adjacent rows of chambers. The upstream manhole is designed with a sump to trap heavier sediment and allow for proper cleaning of the Separator Row. A JetVac process with a high pressure water nozzle is introduced down the Separator Row via the access manhole to clean all sediment and debris from the Separator Row. Captured pollutants are flushed into the sumped access manhole for vacuuming, and the process is repeated until the Separator Row is completely free of sediment and debris.

The Separator Row performance has been tested and verified to the protocols and procedures as defined by Environmental Technology Verification (ETV) Canada to achieve 80% TSS removal.



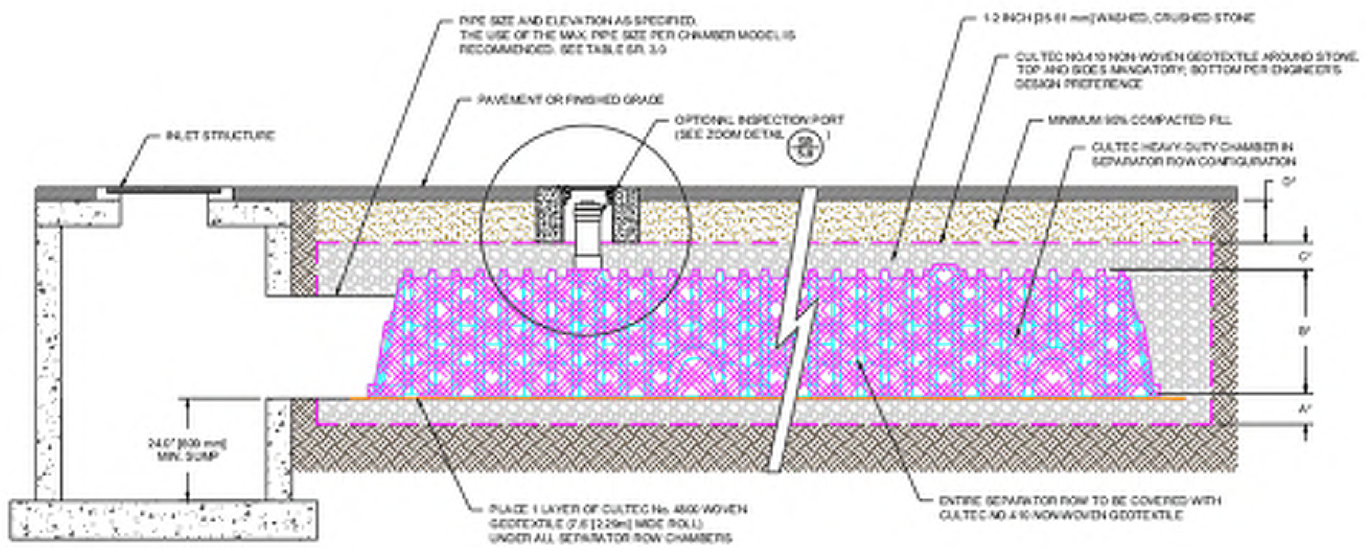
Design

There is no single design to achieve a high level of water quality. The CULTEC Separator Row should be designed as part of an overall best management practices water quality system. Pre-treatment devices such as sump catch basins, inlet baffles and proprietary oil-grit separators and filter systems can all be incorporated upstream of the CULTEC Separator Row. Sumped access/ diversion manholes should be installed directly upstream of the Separator Row.

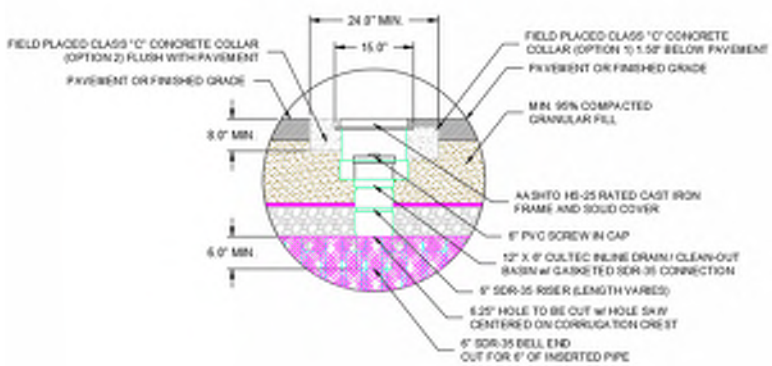
The following is a list of recommended design practices to ensure proper maintenance for the life of the system:

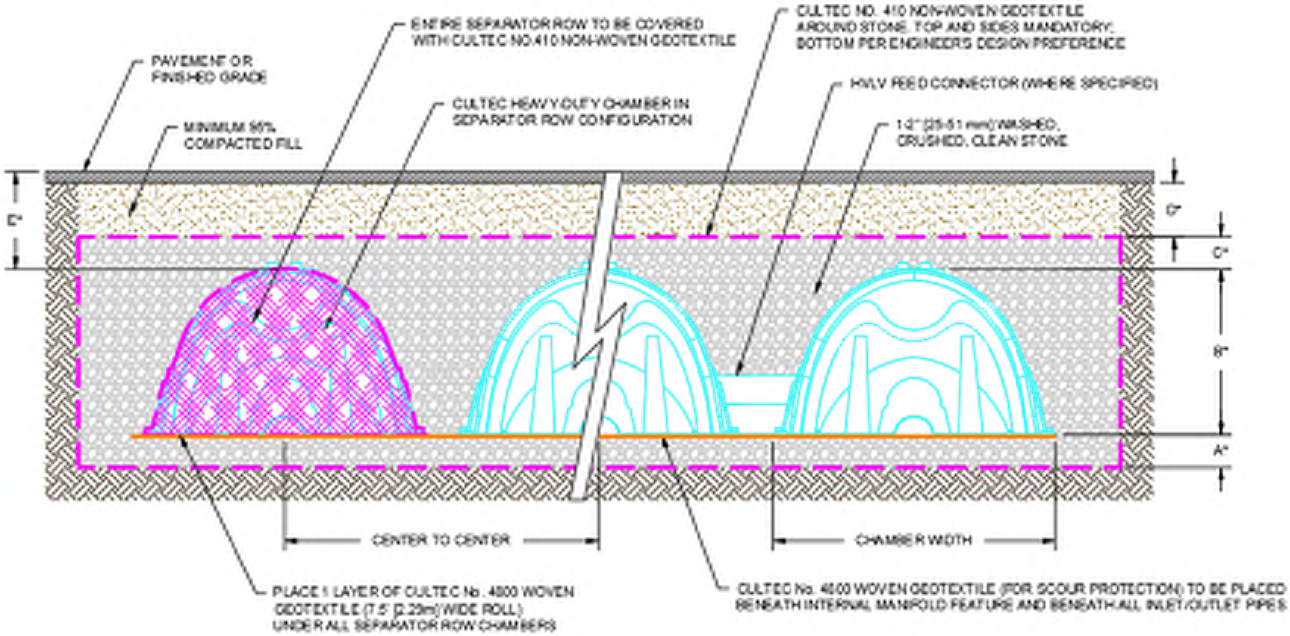
- Install sumped access/diversion manholes, including a minimum 24” (600 mm) sump, directly upstream of the Separator Row.
- Include a high-flow bypass pipe to divert peak flows that exceed the capacity of the Separator Row to adjacent rows.
- Connect the access manhole to the Separator Row with the largest diameter pipe allowable based on the CULTEC chamber model used.
- Maintain a minimum distance between the access manhole and the Separator Row to promote efficient maintenance.
- Include at least one inspection port per Separator Row for periodic inspection.

Note: Typical JetVac maintenance reels have a maximum of 400 feet (121.9 m) of available hose. Consider this when designing the length of the CULTEC Separator Rows.



*SEE SR 3.0 - CROSS SECTION TABLE REFERENCE





*SEE SR 3.0 - CROSS SECTION TABLE REFERENCE

Table SR 3.0

	Description	Contactor 100HD	Recharger 150XLHD	Recharger 280HD	Recharger 330XLHD	Recharger 360HD	Recharger 902HD
A	Min. depth of stone base	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	9″ 229 m
B	Chamber height	12.5″ 318 mm	18.5″ 470 mm	26.5″ 673 mm	30.5″ 775 mm	36″ 914 mm	48″ 1219 mm
C	Min. depth of stone required above units for traffic applications	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	12″ 305 mm
D	Min. depth required of 95% compacted fill for paved traffic application	8″ 203 mm	8″ 203 mm	8″ 203 mm	10″ 254 mm	12″ 305 mm	12″ 305 mm
E	Max. depth of cover allowed above crown of chamber	12′ 3.65 m	12′ 3.65 m	12′ 3.65 m	12′ 3.65 m	12′ 3.65 m	8.5′ 2.59 m
	Max. allowable pipe size into chamber end wall/end cap	10″ 250 mm	12″ 300 mm	18″ 450 mm	24″ 600 mm	24″ 600 mm	24″ 600 mm

Inspection and Maintenance

CULTEC recommends inspection of the Separator Row to be performed every six months for the first year of service. Future inspection frequency can be adjusted based upon previous inspection observations. However annual inspections are recommended. Inspection of the Separator Row can be achieved via an inspection port riser installed during construction. This inspection port riser will connect the top of the Separator Row chambers to finished grade with a removable lid. Alternatively the Separator Row may be inspected via the manhole(s) located at the end(s) of the Separator Row. However this method of inspection requires confined space entry. If entry into the manhole is required, all local and OSHA rules for confined space entries must be strictly followed.

To inspect:

- Remove the inspection port lid from the floor box frame.
- Remove the riser pipe cap.
- With a flashlight and stadia rod, measure the depth of sediment.
- Record results in a maintenance log.
- When depth of sediment exceeds 3” (76 mm), use the JetVac procedure described below.

The JetVac process utilizes a high pressure water nozzle controlled from the surface. The high pressure nozzle is introduced down the Separator Row via the access manhole(s). The high pressure water cleans all sediment and debris from the Separator Row as the nozzle is retrieved. Captured pollutants are flushed into the sumped access manhole for vacuuming. This process is repeated until the Separator Row is completely free of sediment and debris. A small diameter culvert cleaning nozzle is recommended for this procedure.


High pressure water nozzle

Cleaning Separator Row and pipes with high pressure water nozzle

SEPARATOR ROW: Separator Row prior to cleaning


ADJACENT ROW: When the Separator Row is working properly, the adjacent rows will not show signs of sediment.

For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

Inspection and Maintenance Record

Date	Mode of Access	Frequency	Depth of Sediment	Actions	Expenses	Inspector	Notes
Ex.	Inspection Port	Semi-annually	2”	Measure sediment depth with stadia rod. Visually inspect	$100	DPG	Depth of Sediment was measured via Northeast Inspection Port Adjacent to MH-1. Sediment depth was found to be 2”. No further action required at this time.
Ex.	Access Manhole	Annually					

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RETENTION • DETENTION • INFILTRATION • WATER QUALITY

SEPARATOR ROW™ SPECIFICATIONS

GENERAL

1. CULTEC'S SEPARATOR ROW IS USED AS AN INEXPENSIVE MEANS OF REMOVING TOTAL SUSPENDED SOLIDS FROM THE CHAMBER SYSTEM, AS WELL AS PROVIDING EASIER ACCESS FOR INSPECTION AND MAINTENANCE.

2. THE SEPARATOR ROW PERFORMANCE SHALL BE TESTED AND VERIFIED TO THE PROTOCOLS AND PROCEDURES AS DEFINED BY ENVIRONMENTAL TECHNOLOGY VERIFICATION (ETV) CANADA TO ACHIEVE 80% TSS REMOVAL.

INSTALLATION INSTRUCTIONS

A SEPARATOR ROW IS INSTALLED ON A 1-2 INCH [25-51 mm] WASHED, CRUSHED STONE BASE. TYPICALLY, THE CULTEC CHAMBER MODEL USED FOR THE SEPARATOR ROW IS THE SAME CHAMBER USED THROUGHOUT THE ENTIRE CHAMBER BED.

STORMWATER IS DISTRIBUTED TO THE SEPARATOR ROW BY A PRIMARY FEED SYSTEM THAT DIVERTS FLOW TO THE SEPARATOR ROW AND A SECONDARY BYPASS FEED SYSTEM THAT DIVERTS THE FLOW OF CLEAN WATER TO THE OTHER PARTS OF THE UNDERGROUND STORMWATER MANAGEMENT SYSTEM. THE DISTRIBUTION SYSTEM MAY BE BY PIPES SET AT A LOWER ELEVATION THAT PERMIT THE FIRST FLUSH TO THE SEPARATOR ROW VERSUS OTHER PARTS OF THE UNDERGROUND STORMWATER SYSTEM. THIS INITIAL FLOW MAY BE MANAGED BY A BAFFLE OR WEIR. THE SIZING OF THE PIPE(S) THAT PROVIDE STORM WATER TO THE SEPARATOR ROW IS TO BE DETERMINED BY THE DESIGN ENGINEER AND IS BASED UPON THE REQUIREMENT TO ACCOMMODATE THE DESIGN FLOW AND SERVICE CONVENIENCE.

THE CHAMBERS UTILIZED IN THE SEPARATOR ROW ARE TO BE COMPLETELY WRAPPED WITH CULTEC NON-WOVEN GEOTEXTILE. THIS CREATES A PASS-THROUGH FILTER ARRANGEMENT TO SEPARATE TOTAL SUSPENDED SOLIDS IN THE TRANSFER OF STORM WATER TO OTHER CHAMBERS THROUGHOUT THE UNDERGROUND STORMWATER MANAGEMENT SYSTEM.

ONCE WRAPPED, THE SEPARATOR ROW IS TO THEN PLACED ENTIRELY OVER 1 LAYER OF CULTEC AFAB-HPF WOVEN GEOTEXTILE. THIS CULTEC AFAB-HPF WOVEN GEOTEXTILE PROVIDES A DURABLE SURFACE WITHIN THE ROW FOR MAINTENANCE PROCEDURES AS WELL AS TO PREVENT ANY SCOURING OF THE STONE BASE DURING HIGH PRESSURE JETTING.

THE RECOMMENDED INSTALLATION OF SEPARATOR ROW CHAMBERS, IN REGARD TO STONE SEPARATION AND STONE ABOVE THE UNIT, ALONG WITH OTHER MINIMUM COVER, MATERIALS AND METHOD SPECIFICATIONS DETAILED FOR THE PROPER INSTALLATION, IS THE SAME AS CULTEC'S REQUIREMENT DETAILED IN THE COMPANY'S INSTALLATION GUIDELINES WITH THE EXCEPTION OF THE PLACEMENT OF THE REQUIRED FILTERING FABRICS. PLEASE REFER TO CULTEC'S CURRENT INSTALLATION INSTRUCTIONS FOR STORMWATER CHAMBERS AS A GUIDE.

MAINTENANCE PROCEDURES

CULTEC RECOMMENDS INSPECTIONS OF THE SEPARATOR ROW TO BE PERFORMED EVERY SIX MONTHS FOR THE FIRST YEAR. THE FREQUENCY OF INSPECTION CAN THEN BE ADJUSTED BASED UPON PREVIOUS OBSERVATION OF SEDIMENT DEPOSITION.

WHILE CLEANING IS POSSIBLE FROM A SINGLE MANHOLE IN SHORTER LINES, A CLEAN-OUT OPTION FROM EITHER END OF A LINE IS PREFERABLE, PARTICULARLY FOR LONGER RUNS. CLEANING INVOLVES FLUSHING SEDIMENT FROM THE BASE FABRIC OF THE SEPARATOR ROW.

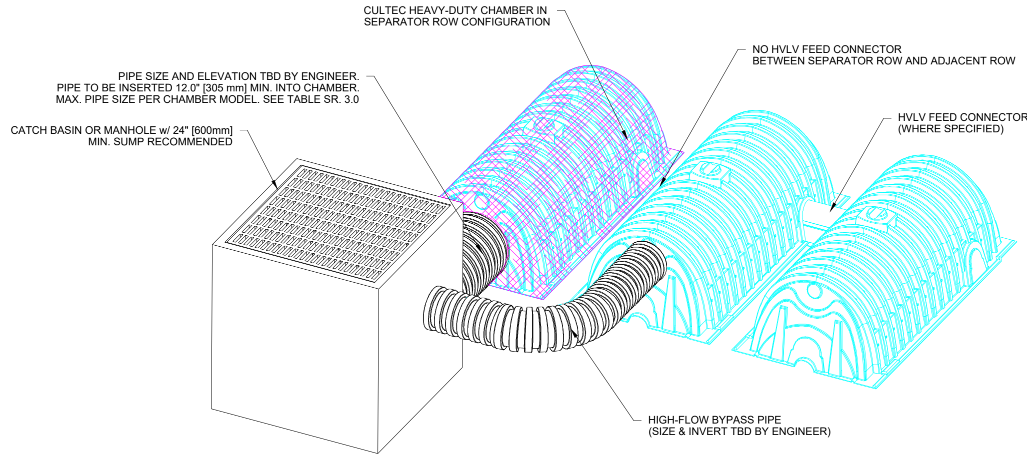
ACCESS WILL BE PROVIDED VIA A MANHOLE(S) LOCATED AT THE END(S) OF THE ROW FOR CLEAN OUT.

MAINTENANCE OF THE SEPARATOR ROW IS TO BE ACCOMPLISHED WITH A JETVAC PROCESS.

THE JETVAC IS TO BE SENT DOWN THE ENTIRE LENGTH OF THE SEPARATOR ROW. AS THE HIGH PRESSURE WATER NOZZLE IS RETRIEVED, THE CAPTURED SEDIMENTS ARE PUSHED BACK INTO THE MANHOLE FOR VACUUMING.

SR 1.0

GENERAL NOTES



SR 2.0

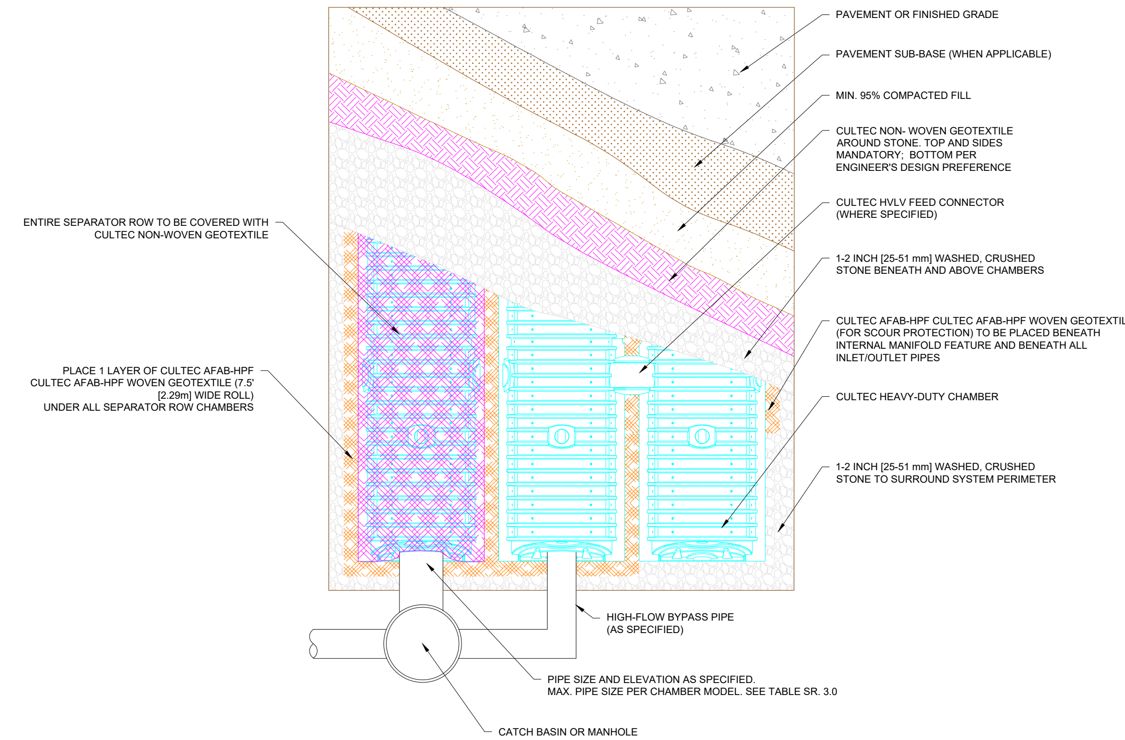
TYPICAL SEPARATOR ROW CONFIGURATION INLET CONNECTION

		CULTEC CHAMBER MODEL					
	DESCRIPTION	CONTACTOR 100HD	RECHARGER 150XLHD	RECHARGER 280HD	RECHARGER 300HD	RECHARGER 360HD	RECHARGER 902HD
A¹	MIN. DEPTH OF STONE BASE	6" 152 mm	6" 152 mm	6" 152 mm	6" 152 mm	6" 152 mm	9" 229 mm
B	CHAMBER HEIGHT	12.5" 318 mm	18.5" 470 mm	26.5" 673 mm	30.0" 762 mm	36.0" 914 mm	48" 1219 mm
C¹	MIN. DEPTH OF STONE REQUIRED ABOVE UNITS FOR TRAFFIC APPLICATIONS	6" 152 mm	6" 152 mm	6" 152 mm	6" 152 mm	6" 152 mm	12" 305 mm
D	MIN. DEPTH REQUIRED OF 95% COMPACTED FILL FOR PAVED TRAFFIC	8" 203 mm	8" 203 mm	8" 203 mm	10" 254 mm	10" 254 mm	12" 305 mm
E	MAX. DEPTH OF COVER ALLOWED ABOVE CROWN OF CHAMBER	12' 3.65 m	12' 3.65 m	12' 3.65 m	12' 3.65 m	12' 3.65 m	8.3' 2.53 m
F	MIN. ROW SPACING	4" 102 mm	6" 152 mm	5" 127 mm	6" 152 mm	6" 152 mm	9" 229mm
G	CHAMBER WIDTH	36" 914 mm	33" 838 mm	47" 1194 mm	51" 1295 mm	60" 1525 mm	78" 1981 mm
	MAX. PIPE SIZE TO CHAMBER ENDWALL/ENDCAP (CORRUGATED HDPE)	10" 250 mm	12" 300 mm	18" 450 mm	24" 600 mm	24" 600 mm	30" 750 mm

NOTE¹: STONE ABOVE AND BELOW UNITS MAY VARY PER SYSTEM.
SEE SYSTEM LAYOUT FOR STONE REQUIREMENTS

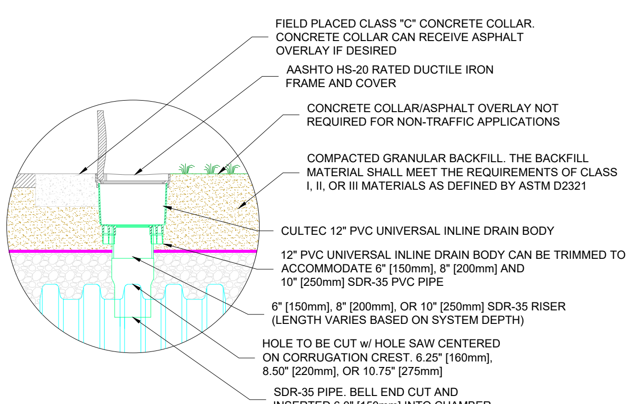
SR 3.0

CROSS SECTION TABLE REFERENCE



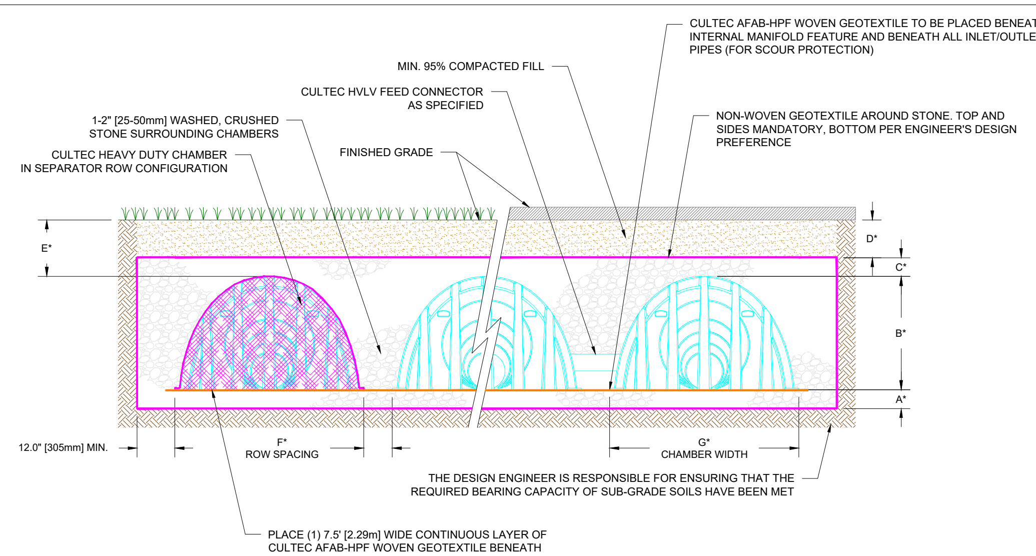
SR 4.0

TYPICAL SEPARATOR ROW CONFIGURATION PLAN VIEW



SR 5.0

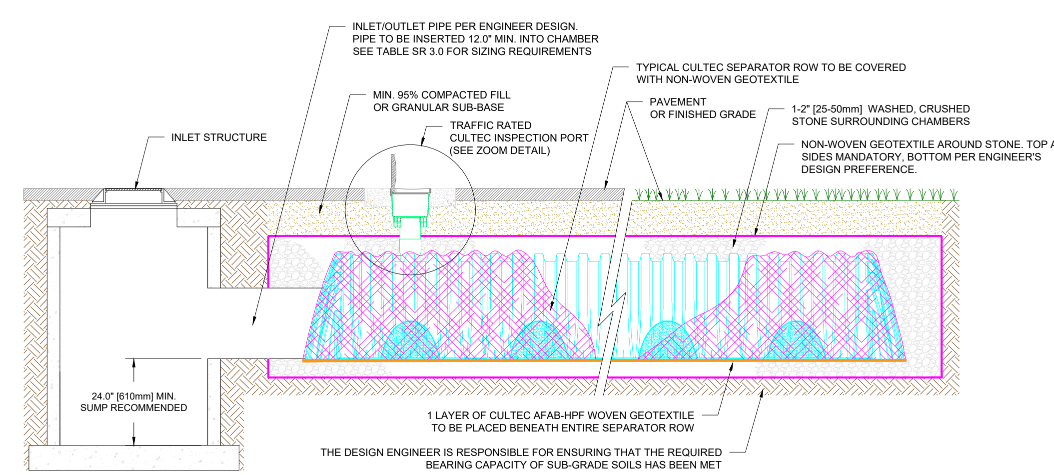
CULTEC INSPECTION PORT - ZOOM DETAIL



* SEE SR 3.0 - CROSS SECTION TABLE REFERENCE

SR 6.0

TYPICAL SEPARATOR ROW CONFIGURATION CROSS SECTION



* SEE SR 3.0 - CROSS SECTION TABLE REFERENCE

SR 7.0

TYPICAL SEPARATOR ROW CONFIGURATION CROSS SECTION WITH INSPECTION PORT DETAIL

CULTEC STORMWATER CHAMBER

DATE:	10/2024
CHECKED BY:	DPG
SHEET NO:	1 OF 1
PROJECT NO:	N/A
DESIGNED BY:	TECH
SCALE:	N.T.S

CULTEC SEPARATOR ROW DETAILS

CULTEC
Subsurface Stormwater Management Systems
878 Federal Road
Brookfield, CT 06804
PH: 1(203) 775-4416
PH: 1(800) 4-CULTEC
CT-tech@cultec.com
www.cultec.com

1.02

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

January 9, 2015

Derek M. Berg
CONTECH Engineered Solutions, LLC
71 US Route 1, Suite F
Scarborough, ME 04074

Re: MTD Lab Certification for the
Continuous Deflective Separator (CDS®) Stormwater Treatment Device
By Contech Engineered Solutions LLC

TSS Removal Rate 50%

Dear Mr. Berg:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7 (c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Contech Engineered Solutions, LLC has requested a Laboratory Certification for the CDS® Stormwater Treatment Device.

The projects falls under the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the aforementioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification Appendix for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the Continuous Deflective Separator (CDS®) Stormwater Treatment Device by Contech Engineered Solutions LLC at a TSS removal rate of 50% when designed, operated and maintained in accordance with the information provided in the Verification Appendix.

Be advised a detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all of the items identified in the Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance of the New Jersey Stormwater Best Management Practices Manual.

If you have any questions regarding the above information, please contact Mr. Titus Magnanao of my office at (609) 633-7021.

Sincerely,

James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

C: Chron File
Richard Magee, NJCAT
Madhu Guru, DLUR
Ravi Patraju, NJDEP
Elizabeth Dragon, BNPC
Titus Magnanao, BNPC

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

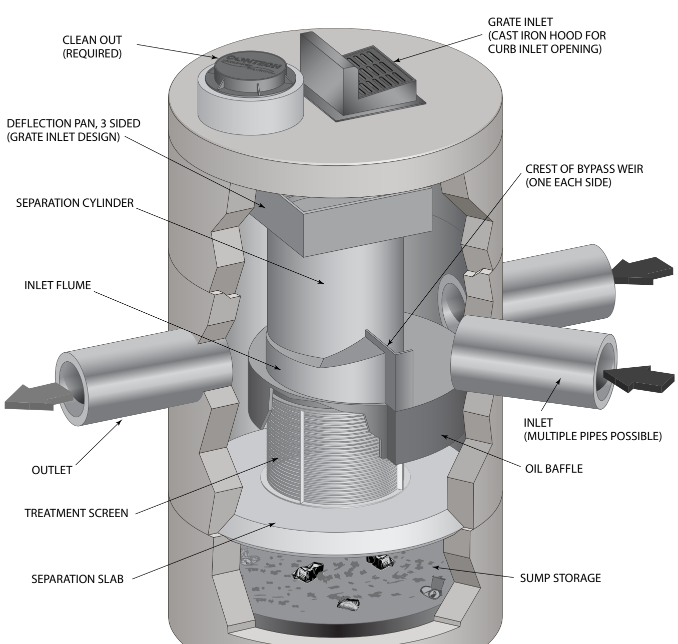
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

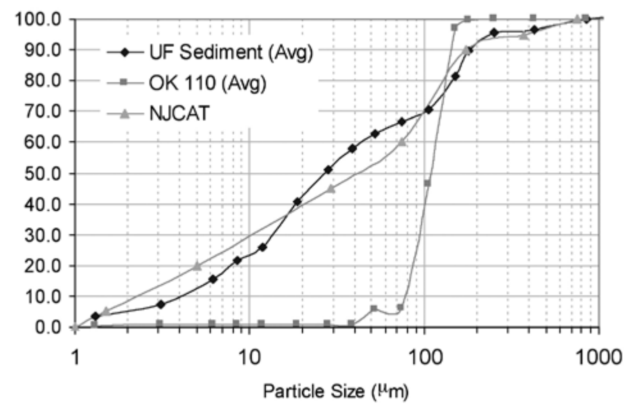


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

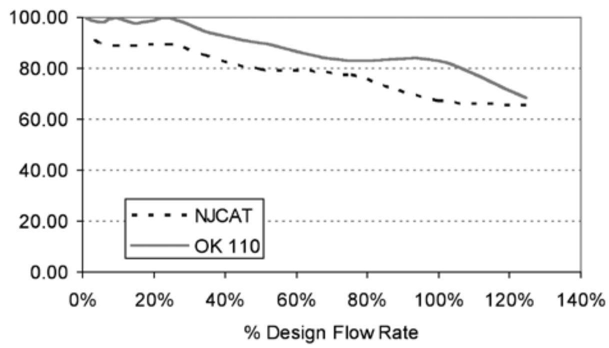


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

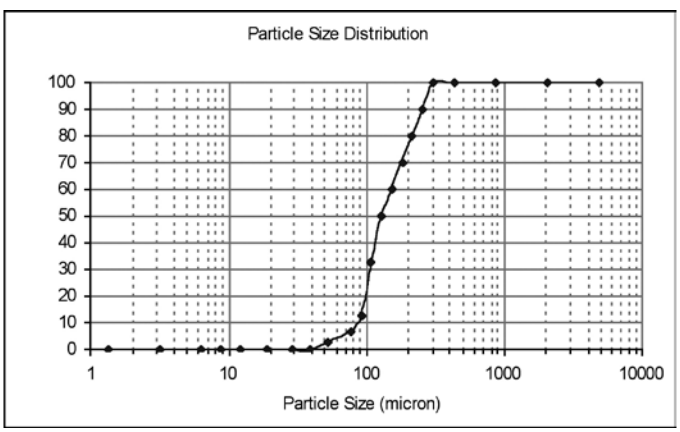


Figure 3. WASDOE PSD

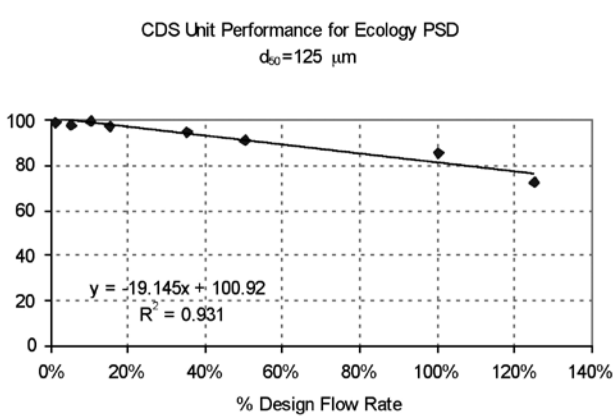


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

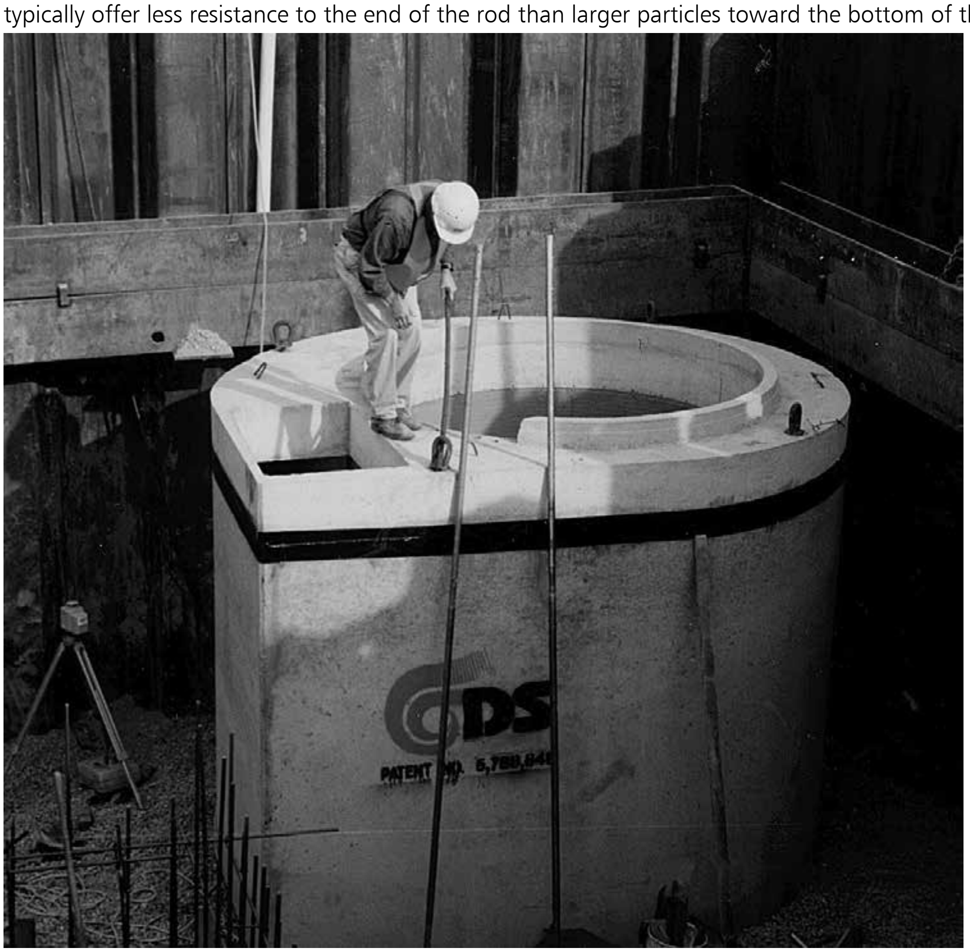
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

CONTECH® ENGINEERED SOLUTIONS
800-338-1122
www.ContechES.com

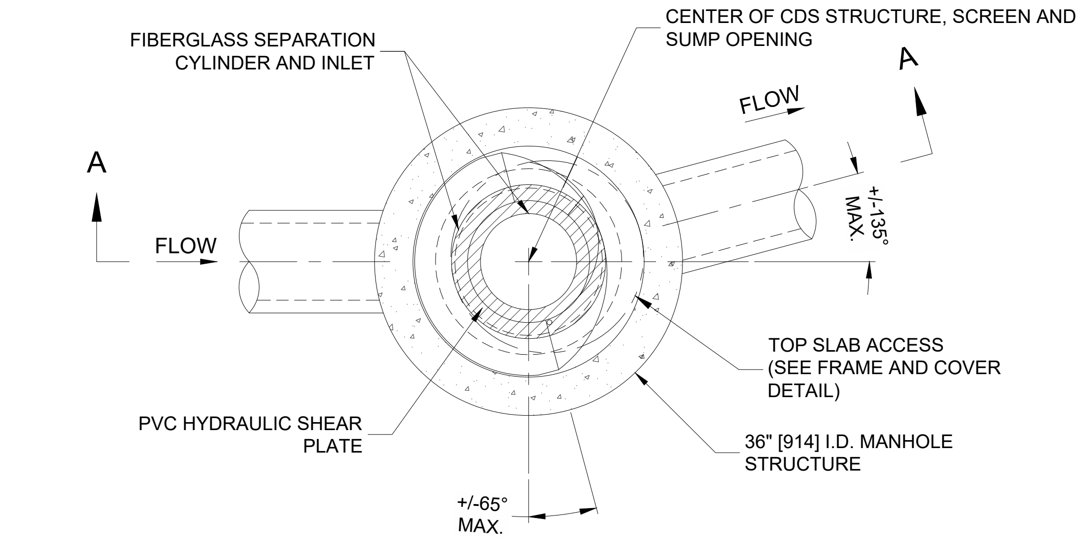
Contech Engineered Solutions provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, earth stabilization and stormwater treatment products. For information on other Contech division offerings, visit www.ContechES.com or call 800.338.1122

cds_manual 3/17 PDF

CDS1515-3-C DESIGN NOTES

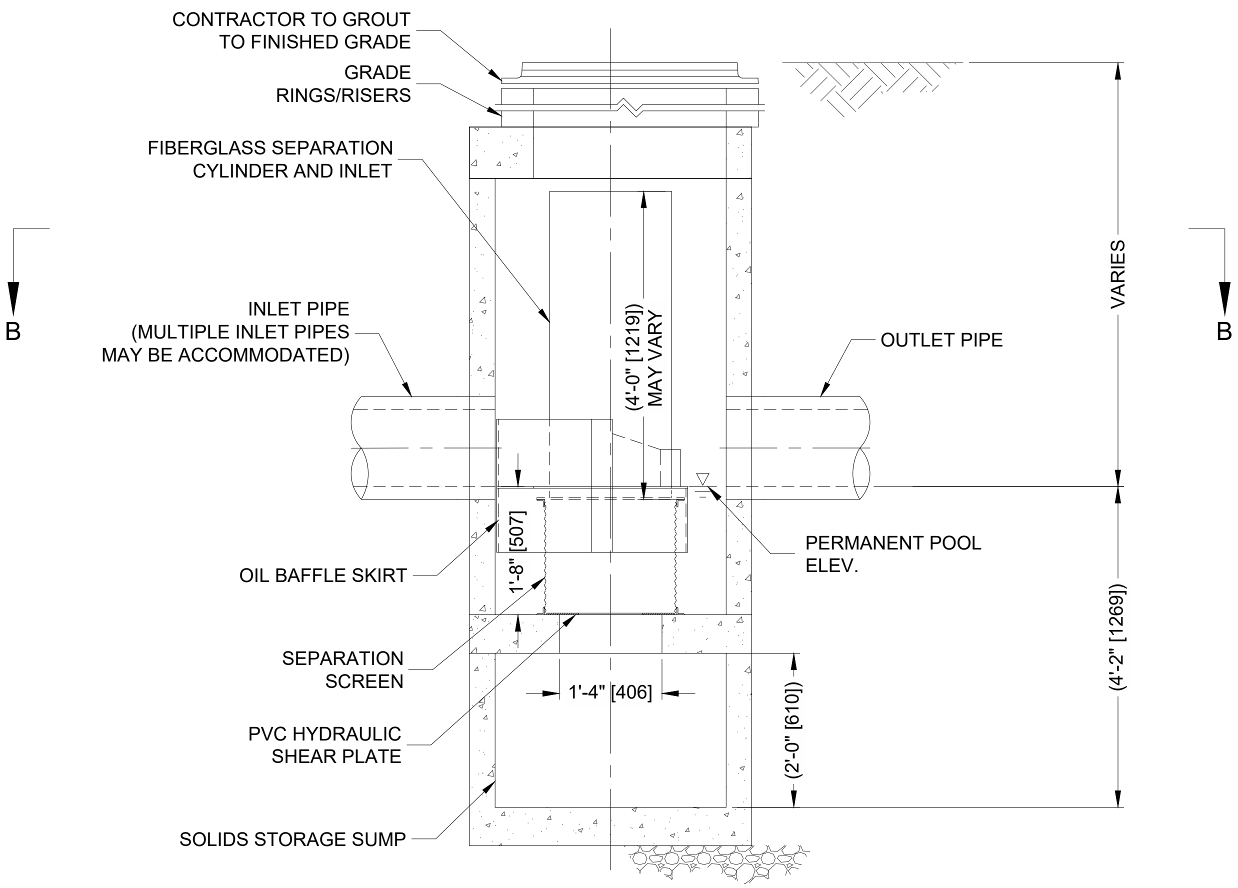
CDS1515-3-C RATED TREATMENT CAPACITY IS 1.0 CFS, OR PER LOCAL REGULATIONS.

THE STANDARD CDS1515-3-C CONFIGURATION IS SHOWN.



PLAN VIEW B-B

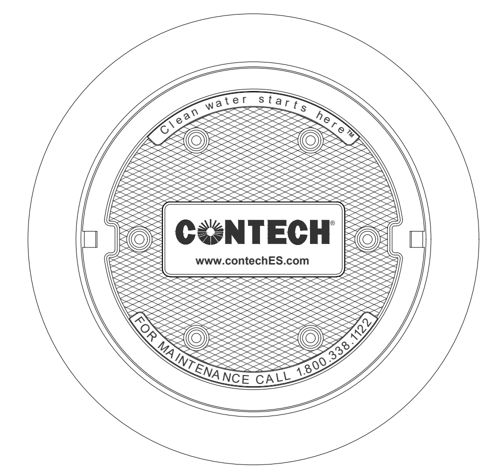
N.T.S.



ELEVATION A-A

N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.



FRAME AND COVER

(DIAMETER VARIES)

N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			
* PER ENGINEER OF RECORD			

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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CDS1515-3-C
ONLINE CDS
STANDARD DETAIL

\\AD.CONTECH-CPI.COM\ROOT\STORMWATER\JURISDICTIONS\USA\MA_SDE DESIGN TOOLS_STANDARD DETAILS\CDS1515-3-C-DTL.DWG 8/6/2018 4:16 PM

Rhode Island Department of Environmental Management

Office of Water Resources – Stormwater Technology Review Committee

235 Promenade St. Providence, RI 02908 Ph: 401-222-4700

Alternative Stormwater Technology Certification

Vendor Contact:
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Standards and Compliance Manager
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Michelle.mangan@cultec.com
www.cultec.com
Ph: 475-289-7083

Technology Name:
Separator™ Row

Approval Type:
Pretreatment/Retrofits

Certification Dates:
Issued: April 9, 2024
Expires: April 9, 2029

CERTIFICATION:

The Rhode Island Stormwater Technology Review Committee which consists of members from the Department of Environmental Management (DEM), Department of Transportation (DOT) and the Coastal Resources Management Council (CRMC) have reviewed the **Separator™ Row** application for certification of its Technology Approval and accepted use for Stormwater Treatment in the State of Rhode Island.

In accordance with Stormwater Rule 250-RICR-150-10-8.9B, **Cultec** has petitioned the permitting agencies to certify the **Separator™ Row** as an acceptable structural stormwater control described in Stormwater Rule 250-RICR-150-10-8.31. They have submitted monitoring results and supporting information developed in accordance with the provisions of the Technology Assessment Protocol (TAP) for Innovative and Emerging Technologies as described in in Stormwater Rule 250-RICR-150-10 Sections 8.39 and 8.40.

The **Separator™ Row** is granted reciprocity in Rhode Island as a proprietary stormwater treatment technology, given that it has been issued an Environmental Technology Verification (ETV) in accordance with International Organization for Standardization (ISO) 14034:2016 – Laboratory Testing of Oil-Grit Separators (June 2014). The laboratory study was conducted at Good Harbour Laboratories in Mississauga, Ontario, Canada with third-party verification provided by Globe Performance Solutions. The ISO is not a member of the Technology Acceptance Reciprocity Protocol (TARP) and the ETV is not equivalent to an approval from the Washington Department of Ecology Technology Assessment Protocol (TAPE). However, the TAPE program takes data from ETV studies into consideration when evaluating the effectiveness of emerging stormwater treatment technologies. Furthermore, the Massachusetts Department of Environmental Protection (DEP) allows the **Separator™ Row** to be utilized to meet TSS removal requirements. Additionally, the RIDEM has historically allowed the use of this device for the purpose of pre-treatment. This Environmental Technology Verification recognizes the **Separator™ Row** as a stormwater treatment technology which provides at least 25% removal of total suspended solids when operating at the maximum treatment flow rate for each device specified in the attached ***Table 1: Separator™ Row Sizing Table.*** The State of Massachusetts is a member of the Technology Acceptance Reciprocity Partnership (TARP). As per Stormwater Rule 250-RICR-150-10-8.39, both TAPE and TARP approved devices are allowed reciprocity consideration in Rhode Island.

The **Separator™ Row** is a pre-treatment or retrofit device that captures TSS from stormwater runoff as described in Stormwater Rule 250-RICR-150-10-8.31. It is an open-bottom thermoplastic molded arch whose sides are wrapped in non-woven geotextile filter fabric and bottom lined with a woven geotextile filter fabric. The device is designed to remove trash and sediment from stormwater. This product was developed by **Cultec.** The **Separator™ Row** is approved for off-line use only.

The manufacturer has demonstrated that this product meets the minimum water quality standards for pretreatment as described in Stormwater Rule 250-RICR-150-10-8.31. The **Separator™ Row** is approved for at least **25%** removal of total suspended solids (TSS) when designed using flow rates specified in the attached ***Table 1: Separator™ Row Sizing Table*** which is based on a maximum loading rate of 2.1 gallons per minute per square foot of bottom chamber area. The **Separator™ Row** is NOT recognized for removal of Pathogens, Total Phosphorus or Nitrogen. This device may be used as pretreatment or retrofit device provided that the design, installation, and maintenance are conducted in accordance with the following terms and conditions:

I. GENERAL CERTIFICATION REQUIREMENTS

1. The system must adhere to the manufacturer's specification for the **Separator™ Row** located in the general notes section of the Cultec **Separator™ Row** detail sheet that is located on the last page of this certification letter. The detail sheet containing the **Separator™ Row** specifications can also be found at: https://cultec.com/Asset/separator-row-stormwater-details.pdf

2. The system must be installed in accordance with the manufacturer's installation manual for the **Separator™ Row**, which can be found at: https://cultec.com/Asset/CLT058-stormwater-installation-instructions-c4-330xlhd.pdf and https://cultec.com/Asset/CLT009-recharger-360hd-902hd-installation-instructions-stormwater-imperial.pdf

3. The **Separator™ Row** is **certified as a pretreatment** device in accordance with Stormwater Rule 250-RICR-150-10-8.31, provided the device treats the flow of the first inch of runoff from the capture area, unless waived by the state permitting agency. The system's design must utilize flow rates, impervious catchment sizes, and maximum sediment capacities listed in the attached ***Table 1: Separator™ Row Sizing Table.***

4. The system must be designed to meet the following requirements:

    a. The device must be attached to an upstream flow-splitter diversion manhole with either a weir or an elevated bypass manifold designed to ensure that the first inch of runoff is routed to the device prior to bypass. The weir or elevated bypass manifold's invert must be located at least 9" above the bottom invert of the **Separator™ Row** chamber elevation.

    b. If the upstream flow-splitter diversion manhole is designed with a weir, then the manhole must be at least 30" wide. The manhole must be at least 48" wide if its rim is more than 4' above the invert of the device.

    c. The upstream flow-splitter diversion manhole must also provide a 2' sump.

    d. Each individual row of **Separator™ Row** chambers must be directly connected to a maintenance access manhole.

    e. The inlet pipe connecting the diversion manhole to the device must be the maximum allowable diameter per chamber as specified on the vendor's construction details.

    f. The inlet must be the only pipe connected to the **Separator™ Row**. No outlet pipes shall be directly connected to the pre-treatment chambers.

    g. Each device must provide an inspection port at the point located furthest from the inlet.

    h. The maximum distance between maintenance access manholes connected to each individual row of **Separator™ Row** chambers shall not exceed 200' to ensure that the JetVac hose is sufficiently long.

5. This device is **certified as a retrofit device** in accordance with Stormwater Rule 250-RICR-150-10-8.6A. Retrofits are allowed flexibility with regards to the eleven minimum standards described in Sections 8.6 through 8.17 of Stormwater Rule 250-RICR-150-10, but in general they are considered

effective if they capture at least 50% of the catchment and meet the target water quality treatment of at least the first 0.5 inches of the water quality volume.

6. The approved devices shall be located such that they are accessible for maintenance and/or emergency removal of oil or chemical spills.

7. The device cannot be used in series with another Hydrodynamic separator to achieve enhanced removal rates for TSS.

II. MAINTENANCE REQUIREMENTS

1. Standard permitting conditions for inclusion of this technology will, at a minimum include the following:

   a. Each individual owner must ensure that any and all of their proprietary stormwater treatment devices are maintained in accordance with the manufacturer's specifications, which are provided in the **Cultec Separator™ Row** Operation & Maintenance Manual: https://cultec.com/Asset/CLT043-cultec-separator-row-o-m.pdf

   b. Each individual owner must ensure that any and all of their proprietary stormwater pre-treatment devices are maintained in accordance with the requirements stated in Stormwater Rule 250-RICR-150-10-8.31-C, which requires the device to be inspected a minimum of 2 times per year. Additionally, the device must be cleaned out with a JetVac when either pollutant removal capacity is reduced by 50% or more, or when average sediment depth is 3" or greater.

   c. All material removed from the unit must be properly disposed of and is the responsibility of the owner.

   d. The applicant must include a copy of the **Separator™ Row** Inspection and Maintenance Guide in their project specific long-term operation and maintenance plan.

2. The applicant must provide evidence of a maintenance contract which extends for a minimum of two years. The contracted maintenance provider must receive training by **Cultec** on how to properly maintain **Separator™ Row** devices. This requirement excludes maintenance providers recognized by the RIDEM to be qualified in maintenance of **Separator™ Row** devices.

III. REPORTING REQUIREMENTS

1. Upon request from the owner of any **Separator™ Row** system installed in the State of Rhode Island, the vendor shall provide the owner with a recommended maintenance schedule after the first year of the device's operation. If a recommended maintenance schedule is requested by the owner after the first year of the device's operation, then the owner is responsible for notifying the vendor of any additional pollutant loading sites where contributing drainage areas may be subject to further development (i.e., strip malls).

2. The Vendor shall immediately notify the RIDEM Office of Water Resources if and when any changes are made to the model name or number of any **Separator™ Row** device for all models applicable to this certification.

3. The Vendor shall immediately notify the RIDEM Office of Water Resources if and when any revisions are made to the design, installation operation and maintenance manuals for all models applicable to this certification. Revisions deemed by the RIDEM to be substantial, may require re-application to the Alternative Stormwater Technology Program.

4. The Vendor shall notify the RIDEM at least thirty (30) days following any proposed transfer of ownership of the Component technology. Notification shall include the name and address of the new owner and a written agreement between the existing and new owner specifying a date for transfer of ownership, responsibility, and liability for the Component. All provisions of this Certification shall be applicable to any new owners.

IV. RIGHTS OF THE RIDEM AND CRMC

1. The RIDEM may suspend, modify, or revoke this approval for cause, including but not limited to non-compliance with any of the conditions or provisions of this approval, misrepresentation, or failure to fully disclose all relevant data, or receipt of new information indicating that the use of the **Separator™ Row** system is contrary to the public interest, public health, or the environment.

2. This approval does not represent an endorsement of the **Separator™ Row** system by the RIDEM, RIDOT or CRMC. This letter of approval may be reproduced only in its entirety.

3. The **Separator™ Row** General Specification and **Separator™ Row** Operation and Maintenance Manual referenced herein are approved upon the date of approval of this Certification.

4. The RIDEM reserves the right to suspend or revoke this Certification if updated design, installation, and O&M manuals are not provided to the RIDEM within thirty (30) days of RIDEM request or one hundred and eighty (180) days prior to the expiration date of this Certification. All revisions must be reviewed and approved by the RIDEM prior to re-certification.

Eric A. Beck, P.E. Date
Administrator of Groundwater and Freshwater Wetlands Protection

SEE ATTACHMENTS ON NEXT PAGE:

Table 1: Separator™ Row Sizing Table

Model #	Chamber Dimensions (H x W x L)	Chamber Bottom Surface Area (ft^2)	Maximum Treatment Flow Rate per Chamber (cfs)	Approximate Maximum Impervious Treatment Area (acres)
Contactor® 100HD	12.5” x 36” x 8’	22.5	0.11	0.095
Recharger® 150XLHD	18.5” x 33” x 11’	24.0	0.11	0.105
Recharger® 180HD	20.5” x 36” x 7.33’	19.0	0.09	0.083
Recharger® 280HD	26.5” x 47” x 8’	27.4	0.13	0.114
Recharger® 330XLHD	30.5” x 52” x 8.5’	31.3	0.15	0.130
Recharger® 360HD	36” x 60” x 4.17’	18.4	0.09	0.077
Recharger® 902HD	48” x 78” x 4.25’	23.9	0.11	0.102

TYPICAL STANDARD DETAIL FOR SEPARATOR™ ROW - ON NEXT PAGE

SEPARATOR ROW™ SPECIFICATIONS

GENERAL

1. CULTEC'S SEPARATOR ROW IS USED AS AN INEXPENSIVE MEANS OF REMOVING TOTAL SUSPENDED SOLIDS FROM THE CHAMBER SYSTEM, AS WELL AS PROVIDING EASIER ACCESS FOR INSPECTION AND MAINTENANCE.

2. THE SEPARATOR ROW PERFORMANCE SHALL BE TESTED AND VERIFIED TO THE PROTOCOLS AND PROCEDURES AS DEFINED BY ENVIRONMENTAL TECHNOLOGY VERIFICATION (ETV) CANADA TO ACHIEVE 80% TSS REMOVAL.

INSTALLATION INSTRUCTIONS

A SEPARATOR ROW IS INSTALLED ON A 1-2 INCH [25-51 mm] WASHED, CRUSHED STONE BASE. TYPICALLY, THE CULTEC CHAMBER MODEL USED FOR THE SEPARATOR ROW IS THE SAME CHAMBER USED THROUGHOUT THE ENTIRE CHAMBER BED.

STORMWATER IS DISTRIBUTED TO THE SEPARATOR ROW BY A PRIMARY FEED SYSTEM THAT DIVERTS FLOW TO THE SEPARATOR ROW AND A SECONDARY BYPASS FEED SYSTEM THAT DIVERTS THE FLOW OF CLEAN WATER TO THE OTHER PARTS OF THE UNDERGROUND STORMWATER MANAGEMENT SYSTEM. THE DISTRIBUTION SYSTEM MAY BE BY PIPES SET AT A LOWER ELEVATION THAT PERMIT THE FIRST FLUSH TO THE SEPARATOR ROW VERSUS OTHER PARTS OF THE UNDERGROUND STORMWATER SYSTEM. THIS INITIAL FLOW MAY BE MANAGED BY A BAFFLE OR WEIR. THE SIZING OF THE PIPE(S) THAT PROVIDE STORM WATER TO THE SEPARATOR ROW IS TO BE DETERMINED BY THE DESIGN ENGINEER AND IS BASED UPON THE REQUIREMENT TO ACCOMMODATE THE DESIGN FLOW AND SERVICE CONVENIENCE.

THE CHAMBERS UTILIZED IN THE SEPARATOR ROW ARE TO BE COMPLETELY WRAPPED WITH CULTEC NO. 410 NON-WOVEN GEOTEXTILE. THIS CREATES A PASS-THROUGH FILTER ARRANGEMENT TO SEPARATE TOTAL SUSPENDED SOLIDS IN THE TRANSFER OF STORM WATER TO OTHER CHAMBERS THROUGHOUT THE UNDERGROUND STORMWATER MANAGEMENT SYSTEM.

ONCE WRAPPED, THE SEPARATOR ROW IS TO THEN PLACED ENTIRELY OVER 1 LAYER OF CULTEC No. 4800 WOVEN GEOTEXTILE. THIS WOVEN GEOTEXTILE PROVIDES A DURABLE SURFACE WITHIN THE ROW FOR MAINTENANCE PROCEDURES AS WELL AS TO PREVENT ANY SCOURING OF THE STONE BASE DURING HIGH PRESSURE JETTING.

THE RECOMMENDED INSTALLATION OF SEPARATOR ROW CHAMBERS, IN REGARD TO STONE SEPARATION AND STONE ABOVE THE UNIT, ALONG WITH OTHER MINIMUM BURIAL, MATERIALS AND METHOD SPECIFICATIONS DETAILED FOR THE PROPER INSTALLATION, IS THE SAME AS CULTEC'S REQUIREMENT DETAILED IN THE COMPANY'S INSTALLATION GUIDELINES WITH THE EXCEPTION OF THE PLACEMENT OF THE REQUIRED FILTERING FABRICS. PLEASE REFER TO CULTEC'S CURRENT INSTALLATION INSTRUCTIONS FOR STORMWATER CHAMBERS AS A GUIDE.

MAINTENANCE PROCEDURES

CULTEC RECOMMENDS INSPECTIONS OF THE SEPARATOR ROW TO BE PERFORMED EVERY SIX MONTHS FOR THE FIRST YEAR. THE FREQUENCY OF INSPECTION CAN THEN BE ADJUSTED BASED UPON PREVIOUS OBSERVATION OF SEDIMENT DEPOSITION.

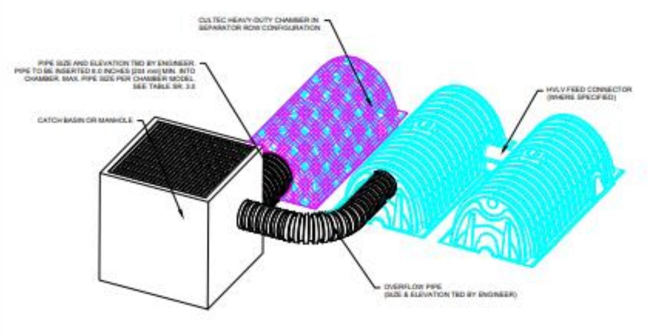
WHILE CLEANING IS POSSIBLE FROM A SINGLE MANHOLE IN SHORTER LINES, A CLEAN-OUT OPTION FROM EITHER END OF A LINE IS PREFERABLE, PARTICULARLY FOR LONGER RUNS. CLEANING INVOLVES FLUSHING SEDIMENT FROM THE BASE FABRIC OF THE SEPARATOR ROW.

ACCESS WILL BE PROVIDED VIA A MANHOLE(S) LOCATED AT THE END(S) OF THE ROW FOR CLEAN OUT.

MAINTENANCE OF THE SEPARATOR ROW IS TO BE ACCOMPLISHED WITH A JETVAC PROCESS.

THE JETVAC IS TO BE SENT DOWN THE ENTIRE LENGTH OF THE SEPARATOR ROW. AS THE HIGH PRESSURE WATER NOZZLE IS RETRIEVED, THE CAPTURED SEDIMENTS ARE PUSHED BACK INTO THE MANHOLE FOR VACUUMING.

SR 1.0 **GENERAL NOTES**

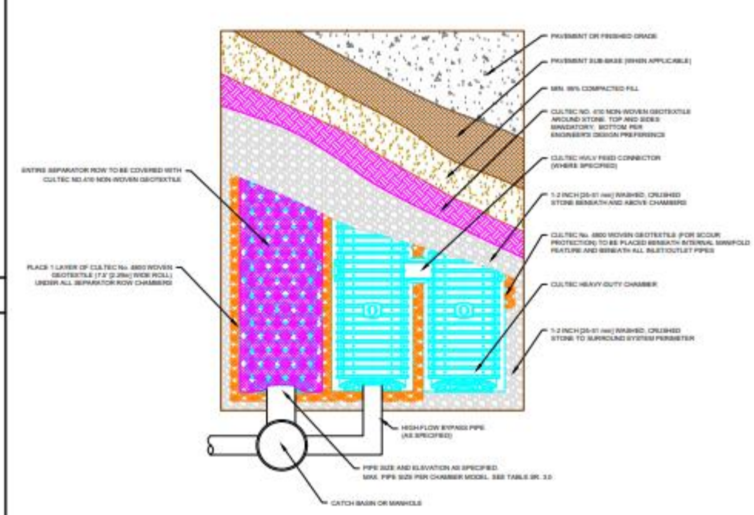


SR 2.0 **TYPICAL SEPARATOR ROW CONFIGURATION INLET CONNECTION**

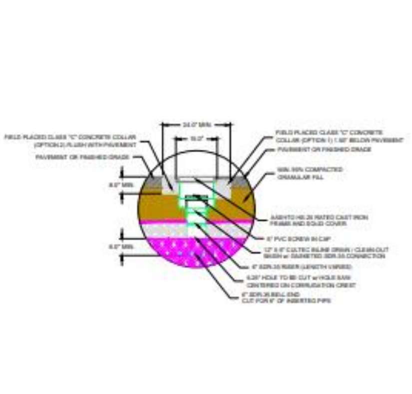
	CULTEC CHAMBER MODEL					
	DESCRIPTION	CONTACTOR 100HD	RECHARGER 150XLHD	RECHARGER 280HD	RECHARGER 330XLHD	RECHARGER 902HD
A'	MIN. DEPTH OF STONE BASE	6" 152 mm	6" 152 mm	6" 152 mm	6" 152 mm	9" 229 mm
B	CHAMBER HEIGHT	12.5" 318 mm	18.5" 470 mm	26.5" 673 mm	30.5" 775 mm	48" 1219 mm
C'	MIN. DEPTH OF STONE REQUIRED ABOVE UNITS FOR TRAFFIC APPLICATIONS	6" 152 mm	6" 152 mm	6" 152 mm	6" 152 mm	12" 305 mm
D	MIN. DEPTH REQUIRED OF 95% COMPACTED FILL FOR PAVED TRAFFIC	8" 203 mm	8" 203 mm	8" 203 mm	10" 254 mm	12" 305 mm
E	MAX. DEPTH OF COVER ALLOWED ABOVE CROWN OF CHAMBER	12' 3.65 m	12' 3.65 m	12' 3.65 m	12' 3.65 m	8.3' 2.53 m
	MAX. PIPE SIZE TO CHAMBER ENDWALL/ENDCAP	10" 250 mm	12" 300 mm	18" 450 mm	24" 600 mm	24" 600 mm

NOTE[1]: STONE ABOVE AND BELOW UNITS MAY VARY PER SYSTEM. SEE SYSTEM LAYOUT FOR STONE REQUIREMENTS

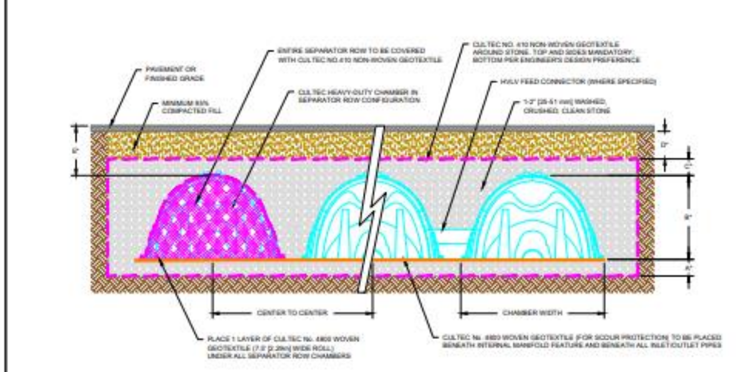
SR 3.0 **CROSS SECTION TABLE REFERENCE**



SR 4.0 **TYPICAL SEPARATOR ROW CONFIGURATION PLAN VIEW**

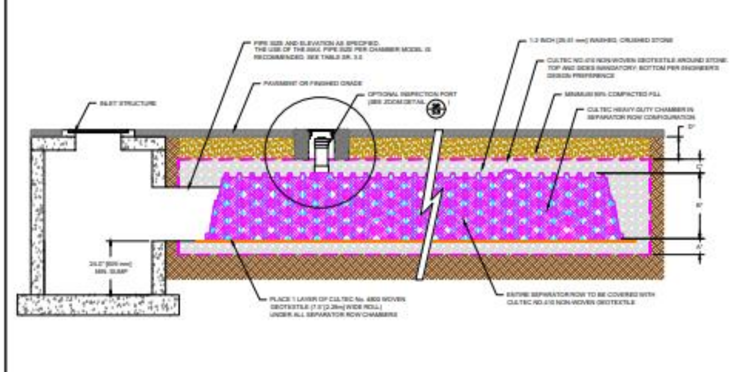


SR 5.0 **TYPICAL INSPECTION PORT - ZOOM DETAIL**



* SEE SR 3.0 - CROSS SECTION TABLE REFERENCE

SR 6.0 **TYPICAL SEPARATOR ROW CONFIGURATION CROSS SECTION**



* SEE SR 3.0 - CROSS SECTION TABLE REFERENCE

SR 7.0 **TYPICAL SEPARATOR ROW CONFIGURATION CROSS SECTION WITH INSPECTION PORT DETAIL**

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SEPARATOR ROW
DETAIL SHEET
TRAFFIC APPLICATION

SEPARATOR ROW DETAIL SHEET	
PROJECT NO: -	DATE: 08/2018
DESIGNED BY: CULTEC, INC	CHECKED BY: TECH
SCALE: N.T.S.	SHEET NO: -