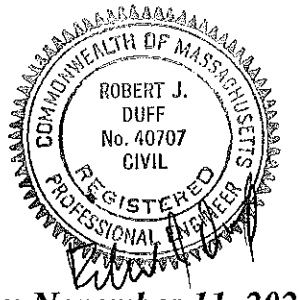
Stormwater Report
230 East Central Street
Franklin, MA



Date: November 11, 2021

Prepared For:
Mohiuddin Ahmed
95 Main Street #100
Westborough, MA 01581

Prepared By:
Guerriere & Halnon, Inc.
55 West Central Street
Franklin, MA 02038

G&H Project F4478

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.

[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.

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

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.

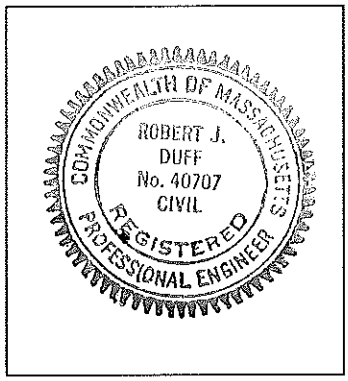
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



Robert J Duff 11-11-2021
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 for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

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 for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

- ☒ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

Project Description

The project locus is a 1.005-acre site located approximately 0.11 miles east of the intersection of East Central Street and King Street/Chestnut Street. Currently the site is occupied by a single-family house and detached shed. The site is identified as Parcel 285-069-000-000 with the Town of Franklin Assessors Department and is located within the Commercial I and Water Resource Zoning Districts – See Appendix 1/Locus Map. Approximately 1.005 acres of run-off generated from the site slopes toward the east ultimately discharging to the southeast corner of property.

Soils on site are in three categories – a Hollis-Rock outcrop-Charlton complex 104C, 0 to 15% slopes, hydrologic group D, Sudbury fine sandy loam, 2 to 8% slopes, hydrologic group B and Urban land, 0 to 15% slopes based on the web soil survey and site observations - See Appendix 2 / NRCS Soil Report.

The project proponent intends to construct a 15,200 SF mixed use building with 46 parking stalls. The new development will consist of vertical concrete curbing, bituminous concrete drive-aisles and parking areas, cement concrete sidewalks, landscaping areas, stormwater infiltration chambers, and associated utilities (i.e. water, sewer, gas, electric and cable). Proposed water will be connected to the Town's existing water service located within the East Central Street right-of way. Sanitary sewer will be connected to the Town's existing sewer system located within an existing sewer easement located at the rear of the property. Storm water run-off will be collected by catch basin to manhole drainage system. Run-off collected within the development will be sent to underground infiltration chambers prior to discharge offsite. All work to be done withing the East Central Street right-of-way will be constructed to the Town of Franklin design standards and specifications.

Pre-development drainage runoff from the entire 1.005± acre site and approximately 0.821± of off-site area was analyzed as one watershed - See Appendix 10 / Drainage Area Plans.

- EX-1 – This watershed drainage area includes approximately 1.005± acres onsite and an additional 0.821± acres off-site. Runoff from this watershed flows in a southwest direction toward the easterly property line, discharging at the abutting residential property and is identified as analysis point (AP-1).

The Post-Development Drainage Analysis regards the area as one watershed –
See Appendix 10 / Drainage Area Plans.

- PR-1 watershed consists of a proposed paved roadway, driveways, roofs and lawn areas. In addition, a portion of the un-developed residential property to the west is included as part of this watershed. All generated runoff is collected in catch basins and conveyed via drainage pipes and is discharged into the proposed infiltration chamber located in the parking area at the southern end of the development, ultimately discharging to the southeast corner of the property identified as analysis point (AP-1).

Post development stormwater runoff will be treated and attenuated by a standard catch basin to manhole collection system. The site has soils that are considered to have high stormwater runoff potential as identified in the NRCS Web Soil Survey information provided in Appendix 2. The site was designed to be in conformance with the Massachusetts Stormwater Management Guidelines, and Town of Franklin Chapter 153 Stormwater Management By-Laws

Compliance with the 10 Stormwater Standards

Standard 1: No new untreated Discharges

The proposed development results in one distinct stormwater discharge location identified as (AP-1). Runoff from the proposed pavement, roof, and landscaped areas on site and runoff from the undeveloped portion of the site to the west, are collected in the proposed underground Infiltration chamber. All the proposed impervious pavement collected in deep sump hooded catch basins and discharged to the infiltration chamber separator row and finally to the infiltration chambers, appropriately sized to treat for 80% TSS removal, prior to discharge to the southwest corner of the site. Clean roof drainage is designed to be collected and discharged to proposed underground infiltration chambers.

Standard 2: Peak Rate Attenuation

HydroCAD, a stormwater design program based on TR-55, was used to evaluate the pre-development and post development peak discharge rates for the 2-, 10-, 25- and 100-year Type III - 24-hour storm events. The rainfall depths (3.2, 4.7, 5.5 and 6.7 inches) associated with the TP-40 rainfall data for storms (2, 10, 25 and 100-year) respectively, were entered into HydroCAD.

To get an accurate model of the stormwater infiltration and surface flows, the underlying soils, surface cover and slopes are considered. The NRCS Soil Survey for the site, included in Appendix 2, depicts the soils on site are in three categories – a Hollis-Rock outcrop-Charlton complex 104C, 0 to 15% slopes, hydrologic group D, Sudbury fine sandy loam, 2 to 8% slopes, hydrologic group B and Urban land, 0 to 15% slopes. The existing soils are depicted relative to the surface cover, defined watershed areas and corresponding Time-of-Concentrations on the Pre-Development drainage plan in Appendix 10.

The HydroCAD model also requires information regarding the site. The existing conditions, or Pre-Development condition, was modeled using one watershed (EX-1) to model the stormwater being discharged to the southeast corner of the easterly property line, identified as analysis point AP-1. The post development condition was evaluated using one watershed area. Post Development Watershed (PR-1) which consist of paved driveways, roofs and lawn areas. All generated runoff is collected in catch basins and discharges into infiltration chambers located in the parking area along the eastern portion of the development. The Post-Development drainage plan, including defined watershed areas and corresponding time-of-concentrations, is included in Appendix 10. The detailed HydroCAD report included in

Appendix 4 includes the calculations demonstrating the post-Development peak flows do not exceed the Pre-Development peak flows.

Runoff rates at the discharge point (AP-1) are required to be maintained to that of existing conditions by reducing the runoff areas and/or temporarily holding runoff in infiltration chambers and releasing it at slower rates to meet existing peak flow rates. Runoff volumes are also required to be maintained in a similar fashion. See Tables 1A and 1B for a complete summary.

Table 1A: Peak Rate Attenuation Summary

	2-yr Storm	**10-yr Storm**	**25-yr Storm**	**100-yr Storm**
Flow to Analysis Point (AP-1)				
Pre-Development	0.59 cfs	1.70 cfs	2.39 cfs	3.52 cfs
Post-Development	0.00 cfs	0.00 cfs	0.00 cfs	0.84 cfs

Table 1B: Runoff Volume

	2-yr Storm	**10-yr Storm**	**25-yr Storm**	**100-yr Storm**
Volume to Analysis Point (AP-1)				
Pre-Development	0.09 af	0.22 af	0.30 af	0.44 af
Post-Development	0.00 af	0.00 af	0.00 af	0.07 af

In addition to peak rate attenuation, on-site storm drain collection system was designed based on the "Rational Method" using Manning's equation to carry a minimum 25-year storm event through the site. The proposed drainage pipes will be Class V reinforced concrete pipe (RCP). On-site storm drain calculations are included in Appendix 11 / Supplemental Attachments.

Standard 3: Recharge

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. Appendix 2 includes the NRCS Soil Survey used for Stage 1 while Appendix 3 includes the on-site soil textural analysis in the specific locations that infiltration is proposed. The information from the NRCS Soil Survey is on the Pre and Post Development drainage plans in Appendix 10.

Recharge Volume

The required recharge volume is determined by calculating the impervious area proposed over the corresponding soil identified in the NRCS Soil Survey. As previously stated, the NRCS Soil Survey lists the site as Hollis-Rock outcrop-Charlton complex 104C, 0 to 15%

slopes, hydrologic group D, Sudbury fine sandy loam, 2 to 8% slopes, hydrologic group B and Urban land, 0 to 15% slopes. While the site consists of an existing developed residential lot, the project is considered a new development project, as noted in Standard 7, therefore the recharge volume was calculated for the total impervious area.

Table 2: Required Recharge Volume Calculation

	Recharge	**Impervious**	**Volume**
Hydrologic Group	(in/sqft)	(sqft)	(cf)
A - *sand*	**0.60**	**25,807**	**1,291**
B - *loam*	**0.35**	**10,431**	**305**
C - *silty loam*	0.25	None	0
D - *clay*	**0.10**	None	0
		Required Recharge Volume Total	**1,596 cf**

Infiltration Chamber Sizing

There are three ways of determining the recharge volume provided by a storm water infiltration system (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 system. This, the most conservative method of determining the recharge volume, does not account for any infiltration that takes place while the system is filling with water and is less dependent on maintenance of the system since the only way for the water below the outlet rim (Elev. 283.40) can leave the system is though infiltration. The following table summarizes the recharge volume provided by the infiltration chambers. Detailed volume calculations for the system are included in Appendix 5 / Stage-Area-Storage Calculations.

Table 3: Chamber Recharge Volumes

	Recharge Volume
Infiltration Chambers	17,777 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-situ 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 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 in Appendix 3 / Field Soils Evaluation.

Table 4: Rawls Rate

	Most Restrictive Soil Texture	Rawls Rate (in/hour)
Infiltration chambers	Loamy Sand	2.41 in/hr

Drawdown time for the infiltration chambers is determined by applying the Rawls Rate across the bottom area of the infiltration chambers. The volume required for drawdown includes the entire volume below in the lowest outlet in the infiltration chambers. The following table summarizes the drawdown time for the system to show it will drawdown within the 72-hour maximum.

Table 5: Chamber Drawdown

	Storage Volume	Bottom Area	Time for Drawdown
Infiltration Chambers	17,777 cf	4,862 sf	19 hour

A groundwater mounding analysis is required when the vertical separation from the bottom of the exfiltration system to the seasonal high groundwater is less than four (4) feet. The infiltration facilities proposed for the site is designed to receive flows from all storm events with greater than four (4) feet separation to groundwater. As such, a groundwater mounding analysis is not required per Mass Stormwater Policy requirements.

<u>MS4 Bylaw Compliance:</u>

Based on the Towns new MS4 stormwater bylaw as specified in Article III – Post Construction Stormwater Management, Section 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 for redevelopments, the on-site stormwater management system shall be designed to retain the volume of runoff equivalent to, or greater than, (0.80) inch multiplied by the total post-construction impervious surface area.

Standard 7 of the MassDEP Stormwater Management Standards indicates that a project that increases the impervious area shall not be considered a redevelopment. This project will have increased impervious area so the 1.0-inch requirement will be used in these calculations.

The total site impervious area, including roofs, is 36,238 square feet. The equivalent 1” of runoff from these surfaces is 3,020 cubic feet. The total storage provided below the outlet structure rim (283.40) is 17,777 cubic feet.

Standard 4: Water Quality

Water Quality Volume

The required water quality volume is determined through a calculation of the proposed impervious pavement throughout the site and a determination of whether the site is in a critical area, or the proposed use is considered to produce a high pollutant load As noted in Standard 5, the land use does not qualify as a use with a high pollutant load. However, as noted in Standard 6, the site is located within the Zone II of a public water supply and is in an area with rapid infiltrations rates. 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 2.41 in/hr or greater, therefore, the water quality volume is calculated at 1.0" over the area of new proposed impervious pavement. Since roof runoff is considered clean and not considered to contribute contaminants to stormwater runoff, the impervious areas associated with the roof is not included in the required water quality volume.

The area of impervious pavement within the proposed site is calculated from the information entered into HydroCAD and can be found in Appendix 4. One inch across 22,026 square feet of impervious pavement requires a water quality volume of 1,836 cubic feet. The total storage provided within the infiltration chambers below the outlet rim (283.40) is 17,777 cubic feet. Detailed calculations for the infiltration system are included in Appendix 5 / Stage-Area-Storage Calculations.

Removal of Total Suspended Solids

The water quality volume, as calculated in the previous section, is treated through "Treatment Trains" to provide a minimum of 80 percent TSS removal including 44 percent TSS removal for pretreatment prior to discharging to the infiltration BMP. The TSS Removal Worksheets are included in Appendix 6 for the proposed treatment train. The infiltration chambers in conjunction with deep sump hooded catch basins and the infiltration chamber separator row complete the treatment trains at 85 percent and 44 percent pretreatment TSS removal.

All the stormwater from the impervious pavement is collected and discharged to the proposed infiltration chambers separator row which is sized to treat 1" of runoff from the 22,026-sf impervious pavement contributing to the system. Detailed calculations for the separator row are included in Appendix 5 / Stage-Area-Storage Calculations.

1"/12" per foot x 22,026 sf = 1,836 cf of storage required

The total storage provided within the infiltration chambers separator row below the weir invert (278.85) is 1,870 cubic feet.

Table 6: Chamber Separator Row Sizing

	Impervious Area being Discharged	Required Volume	Provided Volume
Infiltration Chambers	22,026 cf	1,836 c.f.	1,870 c.f.

Standard 5: Land Uses with Higher Potential Pollutant Loads

The proposed project is not a use that would qualify as a LUHPPL.

Standard 6: Critical Areas

The subject property discharges stormwater within the Zone II of a public water supply. Due to rapid recharge rates present in the infiltration system, 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.

Standard 7: Redevelopment Project

This site is currently a developed residential property with a single-family house and shed. The proposed project will increase the amount of impervious surface therefore this project is not considered a redevelopment project.

Standard 8: Construction Period Controls

A Construction Period Pollution Control Plan is included in Appendix 8 will be followed to prevent discharge of erosion to abutting properties.

Standard 9: Operation and Maintenance Plan

The Operation and Maintenance Plan included in Appendix 7 address the responsibilities of maintaining the stormwater BMPs.

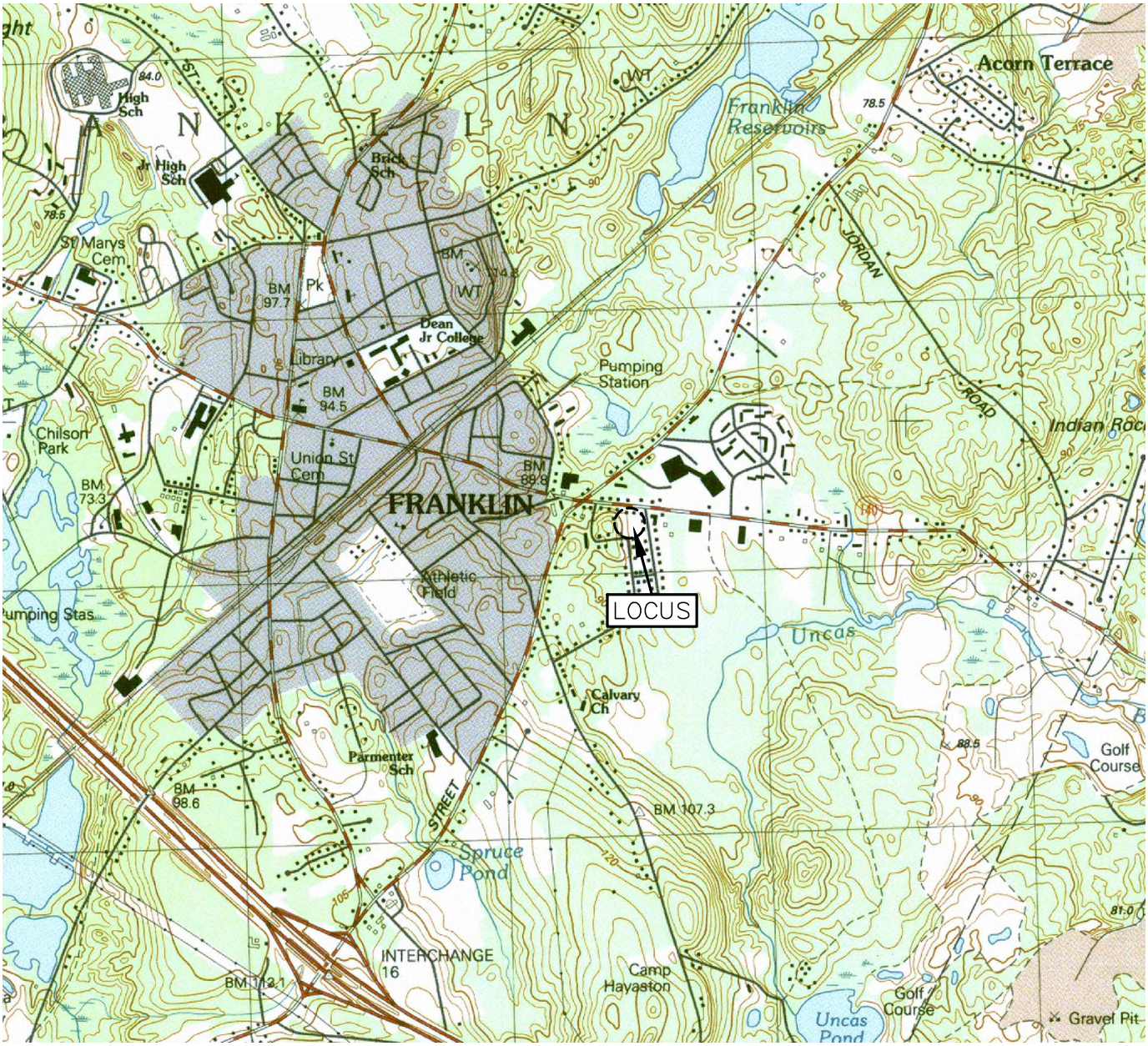
Standard 10: Illicit Discharges to Drainage System

It is the intent of the developer to follow the Construction Period Pollution Prevention Control Plan to mitigate the affects of the proposed project on the adjacent environment. Following completion of construction, the Operation and Maintenance Plan will be provided

to the property manager who will continue, the maintenance of the project. The Illicit Discharge Statement is included in Appendix 9.

Locus Map

Appendix 1



U.S.G.S.
Quadrangle

Scale: 1"=2000'

0 2000' 4000' 6000' 8000'

LOCUS MAP

230 EAST CENTRAL STREET
FRANKLIN, Massachusetts

Date: JULY 29, 2021 | *Project No. F-4478*

Guerriere & Halnon, Inc.
Engineering & Land Surveying
55 WEST CENTRAL STREET FRANKLIN, MA. 02038
PH: (508) 528-3221
WWW.GUERRIEREANDHALNON.COM

NRCS Soils Report

Appendix 2

Map Scale: 1:1,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 45 90 180 270

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

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

Date(s) aerial images were photographed: Jul 5, 2019—Jul 8, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	D	0.6	12.9%
260B	Sudbury fine sandy loam, 2 to 8 percent slopes	B	1.3	28.6%
602	Urban land, 0 to 15 percent slopes		2.6	58.5%
Totals for Area of Interest			**4.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

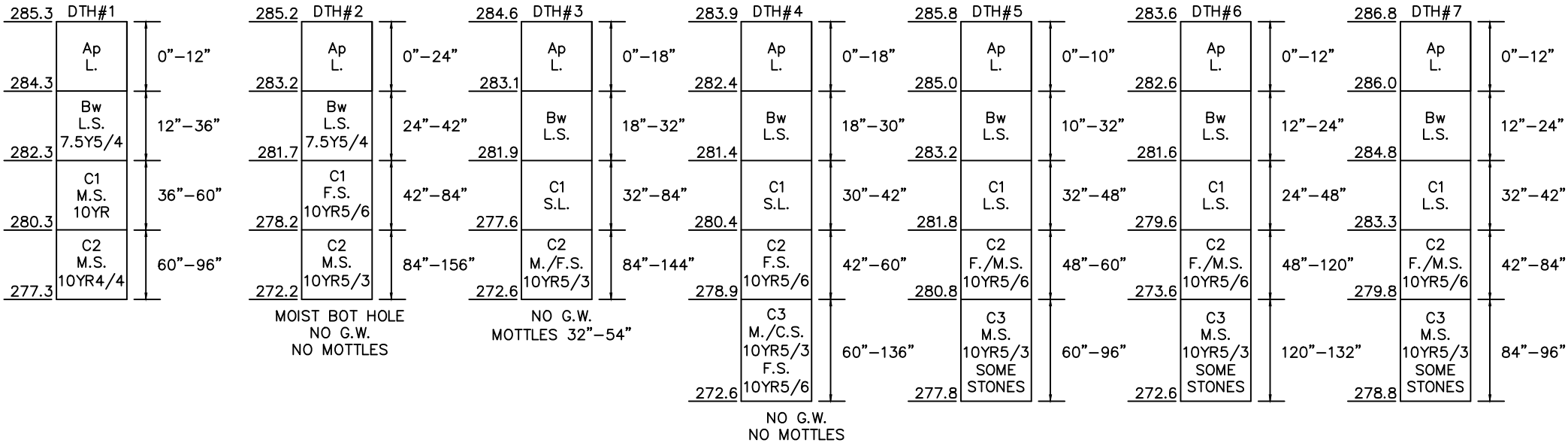
Tie-break Rule: Higher

Field Soils Evaluation

Appendix 3

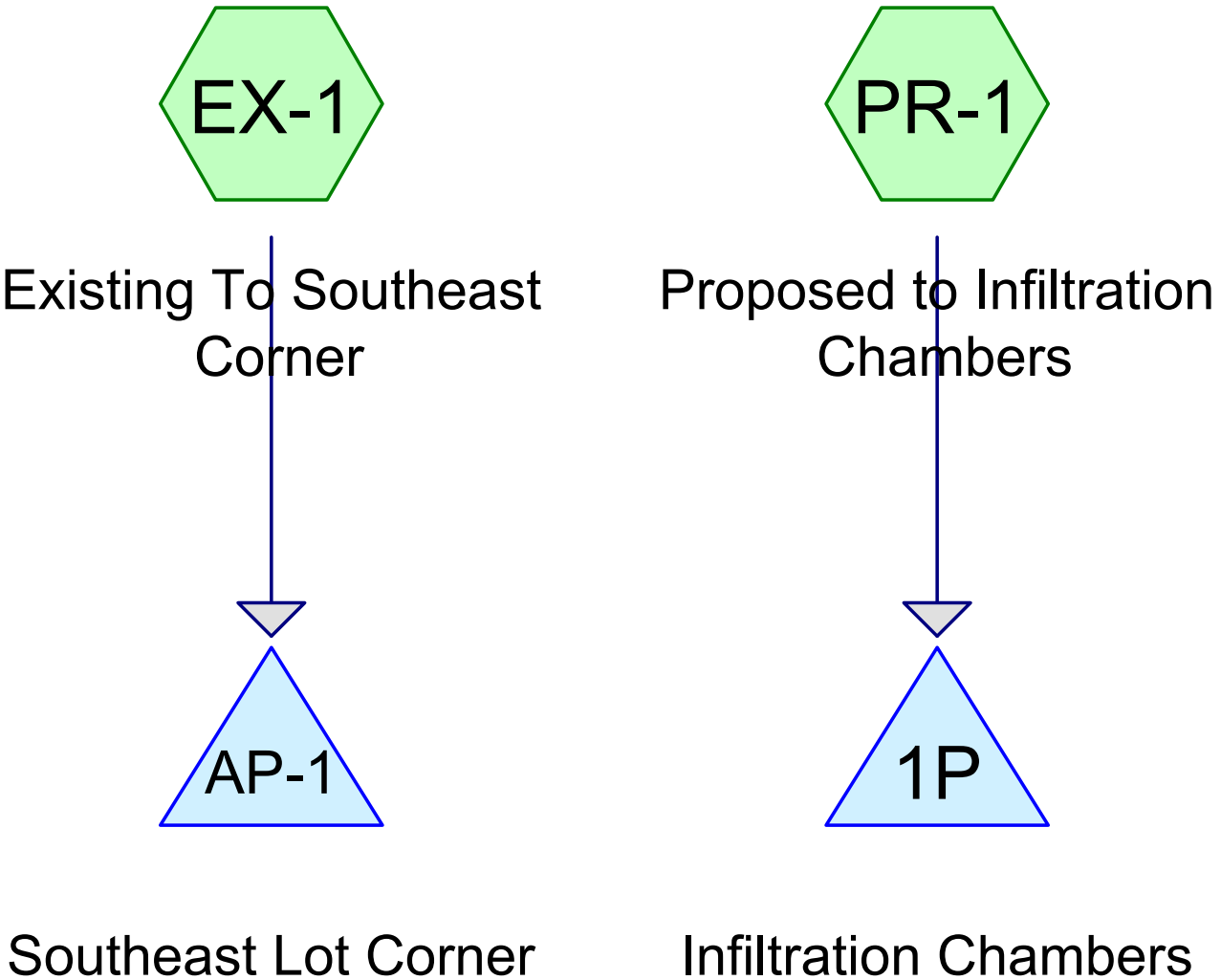
DEEP TESTS TAKEN 11/14/17 BY DN PERC. TESTS TAKEN 11/14/17 BY DN

SOIL EVALUATOR DON NIELSEN SOIL EVALUATOR DON NIELSEN



HydroCAD Calculations

Appendix 4



Subcat Reach Pond Link

Routing Diagram for F-4478 PRE AND POST - 902HD
Prepared by Guerriere & Halnon, Inc., Printed 11/11/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.149	54	1/2 acre lots, 25% imp, HSG A (EX-1, PR-1)
0.017	70	1/2 acre lots, 25% imp, HSG B (EX-1, PR-1)
0.953	85	1/2 acre lots, 25% imp, HSG D (EX-1, PR-1)
0.253	39	>75% Grass cover, Good, HSG A (EX-1)
0.123	61	>75% Grass cover, Good, HSG A (PR-1)
0.070	61	>75% Grass cover, Good, HSG B (PR-1)
0.016	80	>75% Grass cover, Good, HSG D (PR-1)
0.003	96	Gravel surface, HSG A (PR-1)
0.020	96	Gravel surface, HSG B (PR-1)
0.022	96	Gravel surface, HSG D (PR-1)
0.349	98	Paved parking, HSG A (EX-1, PR-1)
0.232	98	Paved parking, HSG B (PR-1)
0.359	98	Roofs, HSG A (EX-1, PR-1)
0.007	98	Roofs, HSG B (PR-1)
0.000	98	Roofs, HSG D (PR-1)
0.409	55	Woods, Good, HSG A (EX-1, PR-1)
0.424	55	Woods, Good, HSG B (EX-1, PR-1)
0.245	77	Woods, Good, HSG D (EX-1, PR-1)
3.652	**75**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.646	HSG A	EX-1, PR-1
0.770	HSG B	EX-1, PR-1
0.000	HSG C	
1.236	HSG D	EX-1, PR-1
0.000	Other	
3.652		**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
0.149	0.017	0.000	0.953	0.000	1.118	1/2 acre lots, 25% imp	EX-1, PR-1
0.376	0.070	0.000	0.016	0.000	0.462	>75% Grass cover, Good	EX-1, PR-1
0.003	0.020	0.000	0.022	0.000	0.045	Gravel surface	PR-1
0.349	0.232	0.000	0.000	0.000	0.582	Paved parking	EX-1, PR-1
0.359	0.007	0.000	0.000	0.000	0.366	Roofs	EX-1, PR-1
0.409	0.424	0.000	0.245	0.000	1.079	Woods, Good	EX-1, PR-1
1.646	**0.770**	**0.000**	**1.236**	**0.000**	**3.652**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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

Subcatchment EX-1: Existing To Runoff Area=79,540 sf 13.99% Impervious Runoff Depth=0.60"
Flow Length=362' Tc=28.0 min CN=65 Runoff=0.59 cfs 0.091 af

Subcatchment PR-1: Proposed to Runoff Area=79,540 sf 53.22% Impervious Runoff Depth=1.84"
Tc=6.0 min CN=86 Runoff=3.85 cfs 0.279 af

Pond 1P: Infiltration Chambers Peak Elev=278.37' Storage=5,216 cf Inflow=3.85 cfs 0.279 af
Discarded=0.27 cfs 0.279 af Primary=0.00 cfs 0.000 af Outflow=0.27 cfs 0.279 af

Pond 2P: Separator Row Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af

Pond AP-1: Southeast Lot Corner Inflow=0.59 cfs 0.091 af
Primary=0.59 cfs 0.091 af

Total Runoff Area = 3.652 ac Runoff Volume = 0.371 af Average Runoff Depth = 1.22"
66.39% Pervious = 2.425 ac 33.61% Impervious = 1.227 ac

Summary for Subcatchment EX-1: Existing To Southeast Corner

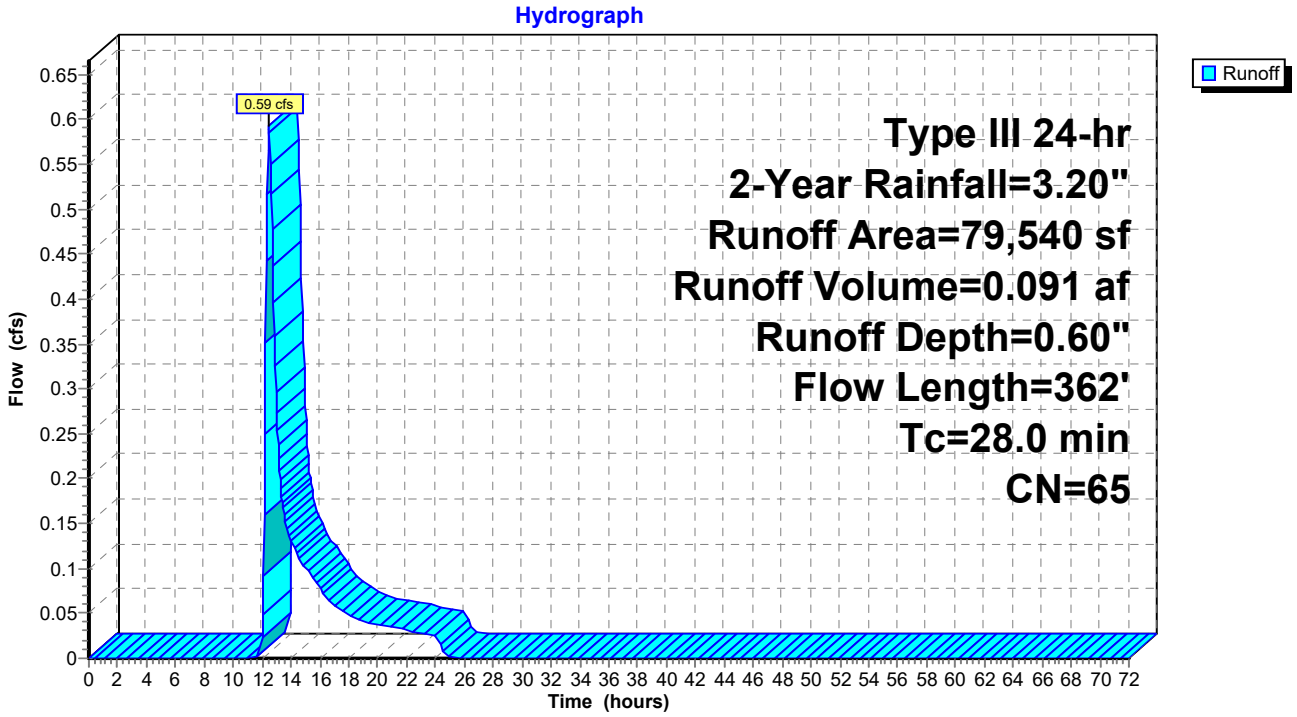
Runoff = 0.59 cfs @ 12.48 hrs, Volume= 0.091 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	3,296	98	Paved parking, HSG A
	1,742	98	Roofs, HSG A
	11,035	39	>75% Grass cover, Good, HSG A
*	16,511	55	Woods, Good, HSG A
	16,413	55	Woods, Good, HSG B
	6,174	77	Woods, Good, HSG D
	20,750	85	1/2 acre lots, 25% imp, HSG D
	364	70	1/2 acre lots, 25% imp, HSG B
	3,255	54	1/2 acre lots, 25% imp, HSG A
	79,540	65	Weighted Average
	68,410		86.01% Pervious Area
	11,130		13.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	132	0.0950	0.09		**Sheet Flow, SEGMENT A-B** Woods: Dense underbrush n= 0.800 P2= 3.20"
0.4	66	0.3030	2.75		**Shallow Concentrated Flow, SEGMENT B-C** Woodland Kv= 5.0 fps
0.9	92	0.1300	1.80		**Shallow Concentrated Flow, SEGMENT C-D** Woodland Kv= 5.0 fps
1.7	72	0.0210	0.72		**Shallow Concentrated Flow, SEGMENT D-E** Woodland Kv= 5.0 fps
28.0	362	Total			

Subcatchment EX-1: Existing To Southeast Corner



Summary for Subcatchment PR-1: Proposed to Infiltration Chambers

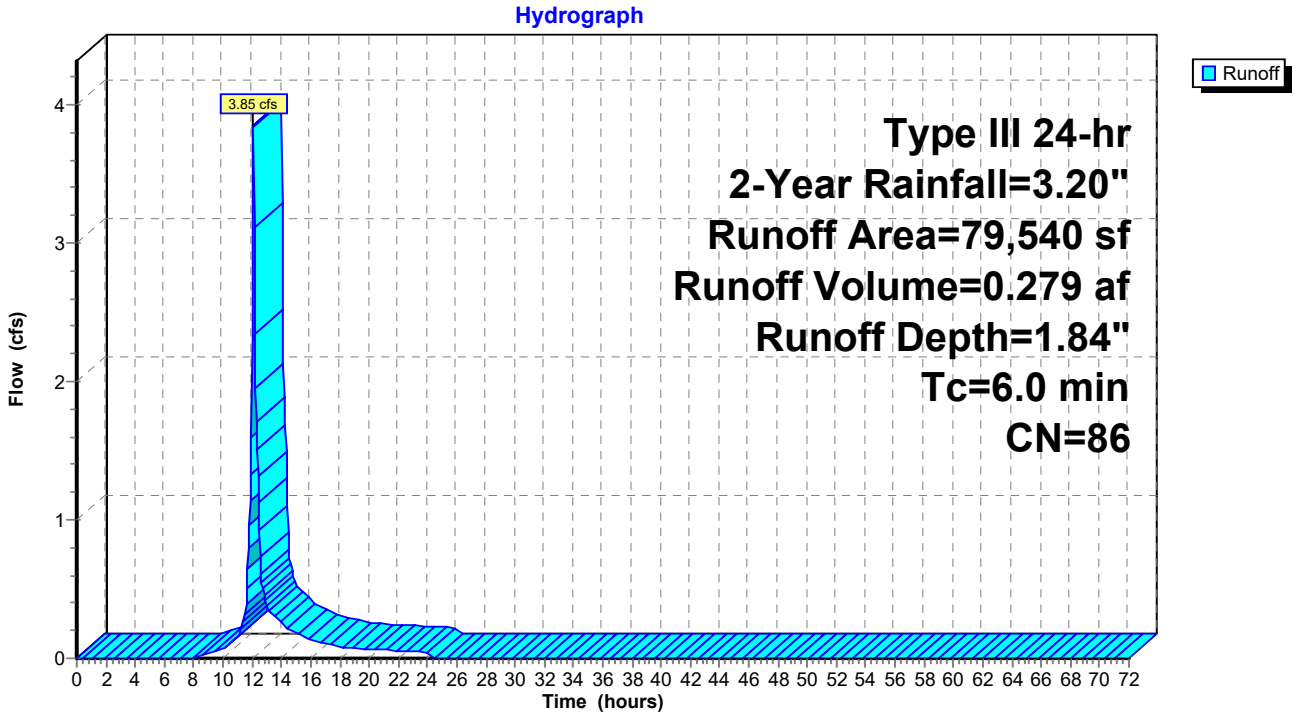
Runoff = 3.85 cfs @ 12.09 hrs, Volume= 0.279 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	13,897	98	Roofs, HSG A
	306	98	Roofs, HSG B
	10	98	Roofs, HSG D
	11,910	98	Paved parking, HSG A
	10,125	98	Paved parking, HSG B
	131	96	Gravel surface, HSG A
	871	96	Gravel surface, HSG B
	951	96	Gravel surface, HSG D
*	5,359	61	>75% Grass cover, Good, HSG A
	3,035	61	>75% Grass cover, Good, HSG B
	710	80	>75% Grass cover, Good, HSG D
*	1,318	55	Woods, Good, HSG A
	2,065	55	Woods, Good, HSG B
	4,505	77	Woods, Good, HSG D
	3,247	54	1/2 acre lots, 25% imp, HSG A
	357	70	1/2 acre lots, 25% imp, HSG B
	20,743	85	1/2 acre lots, 25% imp, HSG D
	79,540	86	Weighted Average
	37,205		46.78% Pervious Area
	42,335		53.22% Impervious Area

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

Subcatchment PR-1: Proposed to Infiltration Chambers



Summary for Pond 1P: Infiltration Chambers

Inflow Area = 1.826 ac, 53.22% Impervious, Inflow Depth = 1.84" for 2-Year event
Inflow = 3.85 cfs @ 12.09 hrs, Volume= 0.279 af
Outflow = 0.27 cfs @ 11.75 hrs, Volume= 0.279 af, Atten= 93%, Lag= 0.0 min
Discarded = 0.27 cfs @ 11.75 hrs, Volume= 0.279 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 278.37' @ 13.80 hrs Surf.Area= 4,861 sf Storage= 5,216 cf
Flood Elev= 283.65' Surf.Area= 4,861 sf Storage= 17,875 cf

Plug-Flow detention time= 176.6 min calculated for 0.279 af (100% of inflow)
Center-of-Mass det. time= 176.5 min (999.0 - 822.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	276.70'	6,718 cf	**30.25'W x 160.70'L x 5.75'H Field A** 27,952 cf Overall - 11,157 cf Embedded = 16,795 cf x 40.0% Voids
#2A	277.45'	11,157 cf	**Cultec R-902HD** x 172 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 4 Rows of 43 Chambers Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		17,875 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	277.95'	**12.0" Round Culvert** L= 104.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 277.95' / 277.95' S= 0.0000 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Primary	283.40'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	276.70'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.27 cfs @ 11.75 hrs HW=276.81' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=276.70' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)
└**1=Culvert** (Controls 0.00 cfs)

Pond 1P: Infiltration Chambers - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

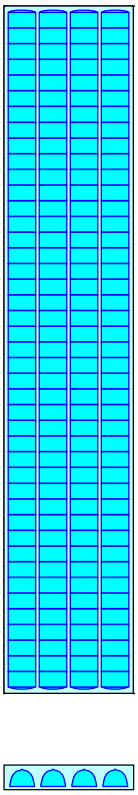
43 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 158.70' Row Length +12.0" End Stone x 2 = 160.70' Base Length
4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

172 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 11,156.5 cf Chamber Storage

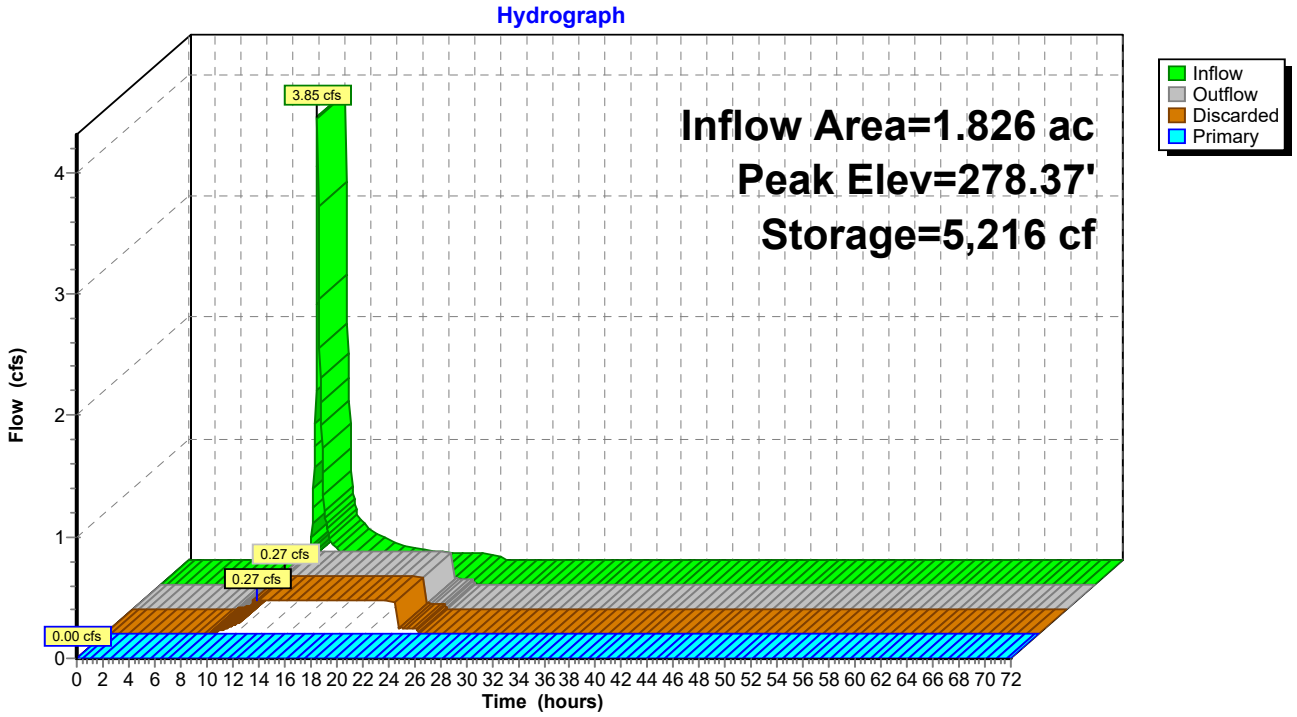
27,951.8 cf Field - 11,156.5 cf Chambers = 16,795.3 cf Stone x 40.0% Voids = 6,718.1 cf Stone Storage

Chamber Storage + Stone Storage = 17,874.6 cf = 0.410 af
Overall Storage Efficiency = 63.9%
Overall System Size = 160.70' x 30.25' x 5.75'

172 Chambers
1,035.3 cy Field
622.0 cy Stone



Pond 1P: Infiltration Chambers



Summary for Pond 2P: Separator Row

Volume	Invert	Avail.Storage	Storage Description
#1A	276.70'	1,980 cf	**8.50'W x 157.03'L x 5.75'H Field A** 7,675 cf Overall - 2,724 cf Embedded = 4,951 cf x 40.0% Voids
#2A	277.45'	2,724 cf	**Cultec R-902HD** x 42 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf
		4,705 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.70'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Pond 2P: Separator Row - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf

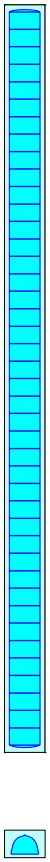
42 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 155.03' Row Length +12.0" End Stone x 2 = 157.03' Base Length
1 Rows x 78.0" Wide + 12.0" Side Stone x 2 = 8.50' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

42 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 1 Rows = 2,724.4 cf Chamber Storage

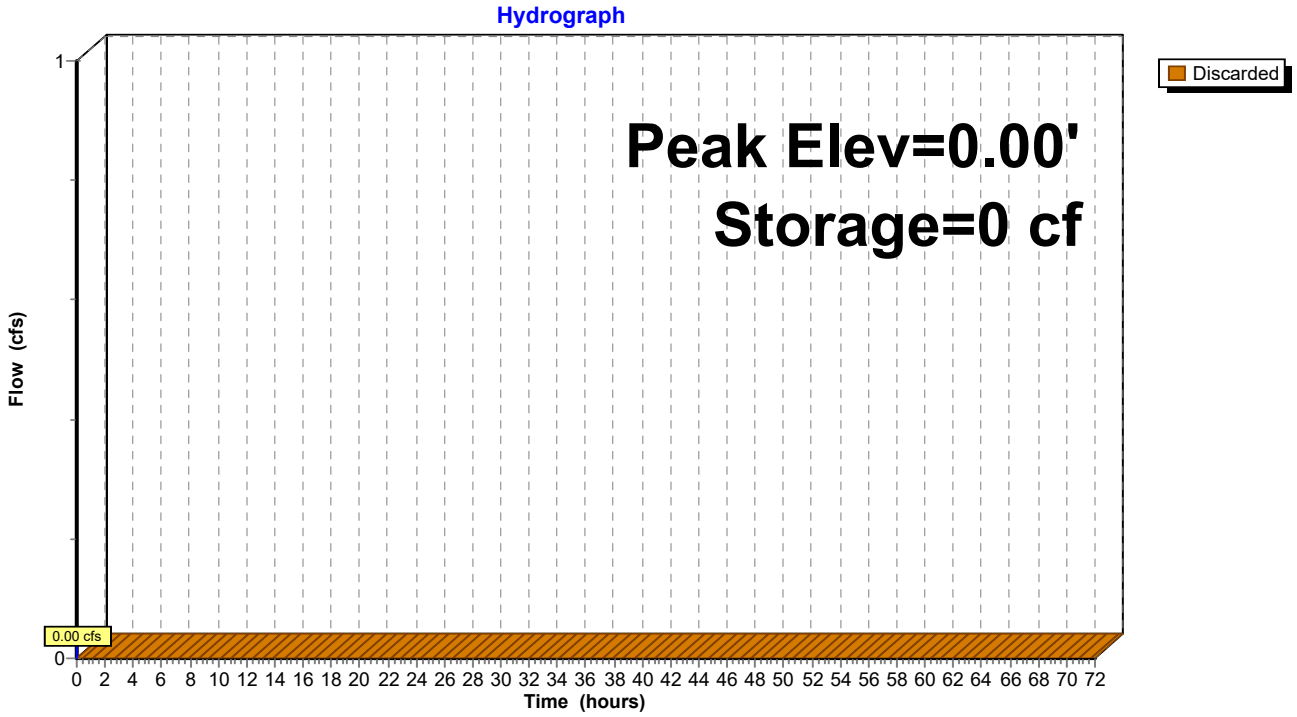
7,675.0 cf Field - 2,724.4 cf Chambers = 4,950.6 cf Stone x 40.0% Voids = 1,980.2 cf Stone Storage

Chamber Storage + Stone Storage = 4,704.6 cf = 0.108 af
Overall Storage Efficiency = 61.3%
Overall System Size = 157.03' x 8.50' x 5.75'

42 Chambers
284.3 cy Field
183.4 cy Stone



Pond 2P: Separator Row

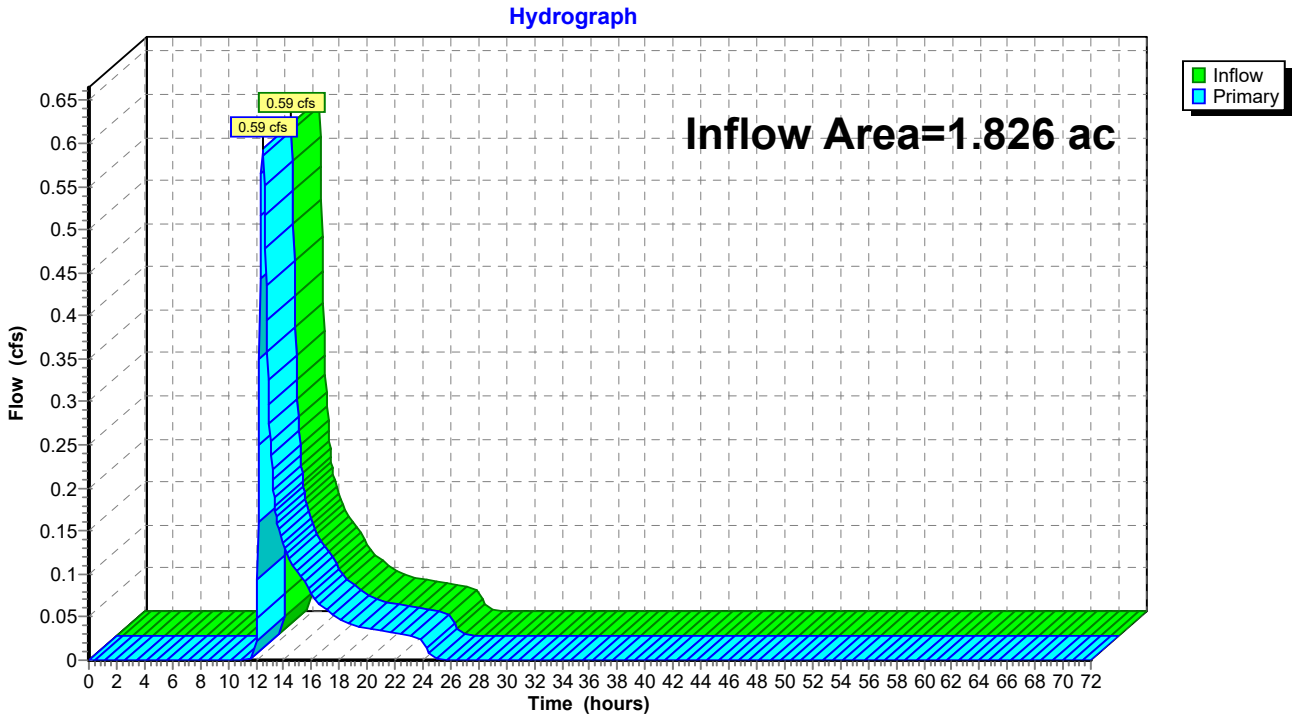


Summary for Pond AP-1: Southeast Lot Corner

Inflow Area = 1.826 ac, 13.99% Impervious, Inflow Depth = 0.60" for 2-Year event
Inflow = 0.59 cfs @ 12.48 hrs, Volume= 0.091 af
Primary = 0.59 cfs @ 12.48 hrs, Volume= 0.091 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Pond AP-1: Southeast Lot Corner



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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

Subcatchment EX-1: Existing To Runoff Area=79,540 sf 13.99% Impervious Runoff Depth=1.46"
Flow Length=362' Tc=28.0 min CN=65 Runoff=1.70 cfs 0.222 af

Subcatchment PR-1: Proposed to Runoff Area=79,540 sf 53.22% Impervious Runoff Depth=3.19"
Tc=6.0 min CN=86 Runoff=6.60 cfs 0.485 af

Pond 1P: Infiltration Chambers Peak Elev=279.92' Storage=11,235 cf Inflow=6.60 cfs 0.485 af
Discarded=0.27 cfs 0.485 af Primary=0.00 cfs 0.000 af Outflow=0.27 cfs 0.485 af

Pond 2P: Separator Row Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af

Pond AP-1: Southeast Lot Corner Inflow=1.70 cfs 0.222 af
Primary=1.70 cfs 0.222 af

Total Runoff Area = 3.652 ac Runoff Volume = 0.707 af Average Runoff Depth = 2.32"
66.39% Pervious = 2.425 ac 33.61% Impervious = 1.227 ac

Summary for Subcatchment EX-1: Existing To Southeast Corner

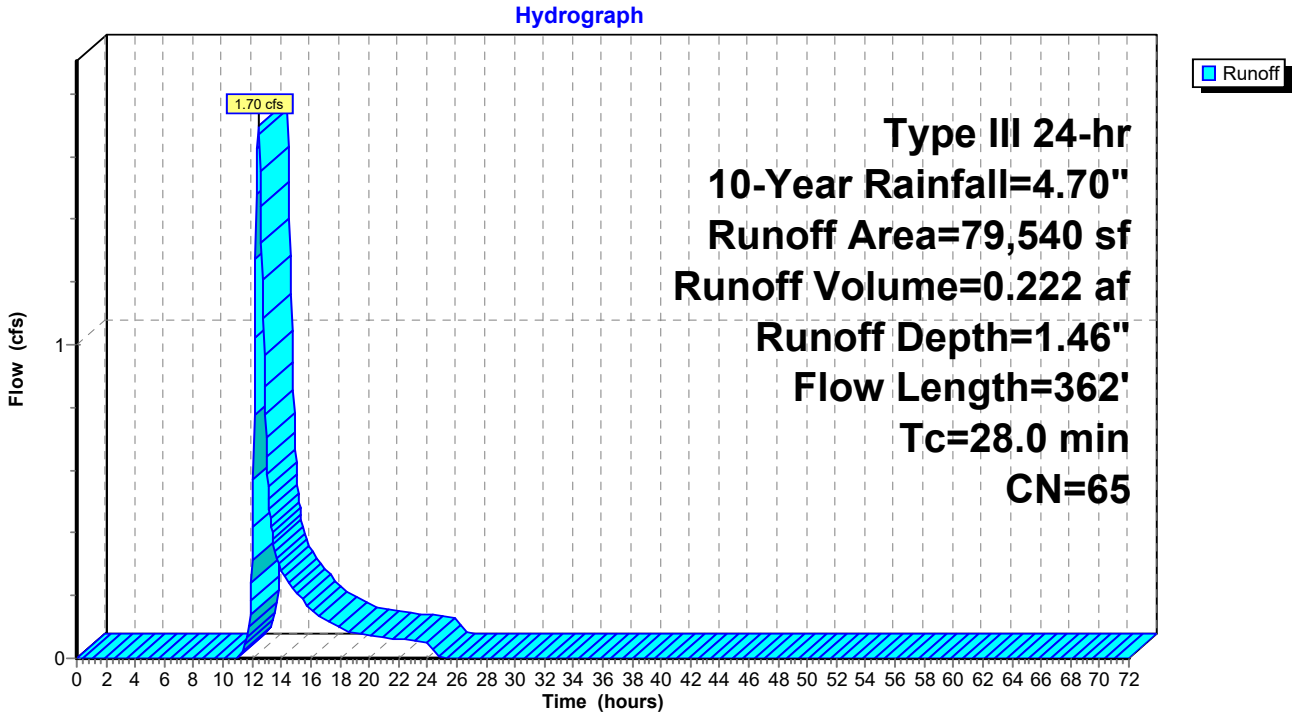
Runoff = 1.70 cfs @ 12.43 hrs, Volume= 0.222 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

	Area (sf)	CN	Description
	3,296	98	Paved parking, HSG A
	1,742	98	Roofs, HSG A
	11,035	39	>75% Grass cover, Good, HSG A
*	16,511	55	Woods, Good, HSG A
	16,413	55	Woods, Good, HSG B
	6,174	77	Woods, Good, HSG D
	20,750	85	1/2 acre lots, 25% imp, HSG D
	364	70	1/2 acre lots, 25% imp, HSG B
	3,255	54	1/2 acre lots, 25% imp, HSG A
	79,540	65	Weighted Average
	68,410		86.01% Pervious Area
	11,130		13.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	132	0.0950	0.09		**Sheet Flow, SEGMENT A-B** Woods: Dense underbrush n= 0.800 P2= 3.20"
0.4	66	0.3030	2.75		**Shallow Concentrated Flow, SEGMENT B-C** Woodland Kv= 5.0 fps
0.9	92	0.1300	1.80		**Shallow Concentrated Flow, SEGMENT C-D** Woodland Kv= 5.0 fps
1.7	72	0.0210	0.72		**Shallow Concentrated Flow, SEGMENT D-E** Woodland Kv= 5.0 fps
28.0	362	Total			

Subcatchment EX-1: Existing To Southeast Corner



Summary for Subcatchment PR-1: Proposed to Infiltration Chambers

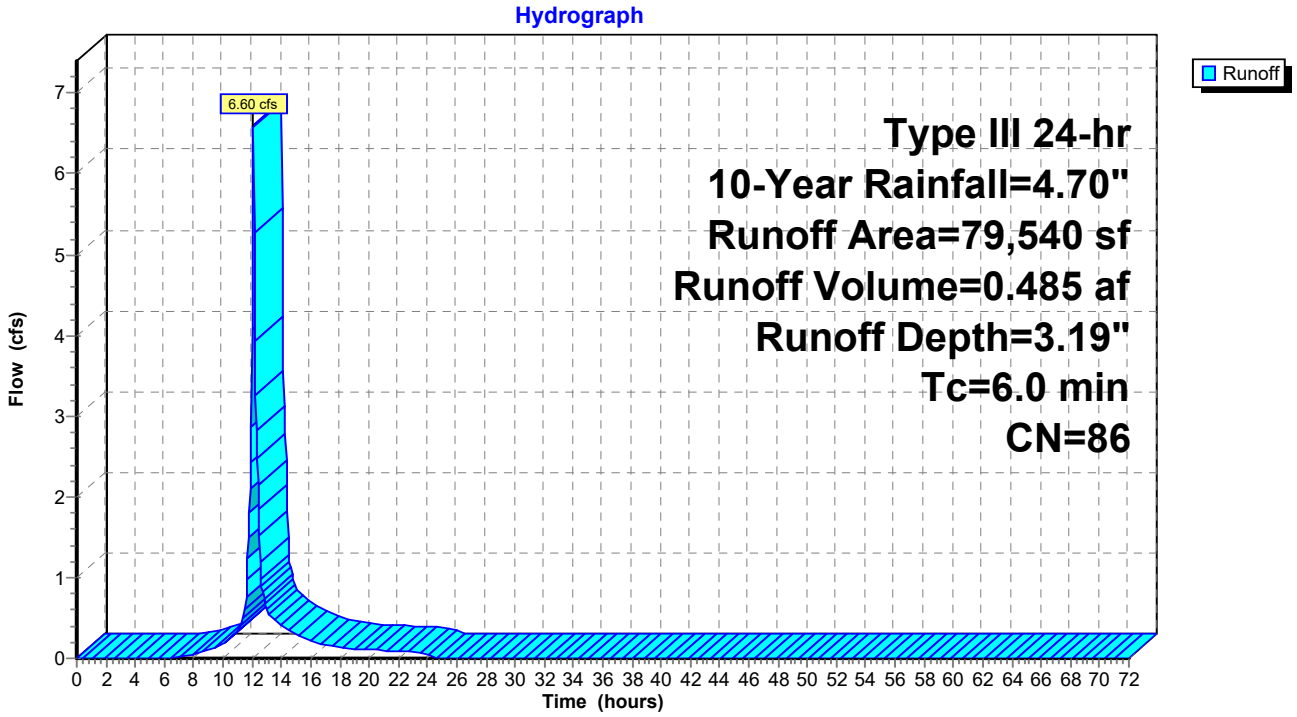
Runoff = 6.60 cfs @ 12.09 hrs, Volume= 0.485 af, Depth= 3.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

	Area (sf)	CN	Description
	13,897	98	Roofs, HSG A
	306	98	Roofs, HSG B
	10	98	Roofs, HSG D
	11,910	98	Paved parking, HSG A
	10,125	98	Paved parking, HSG B
	131	96	Gravel surface, HSG A
	871	96	Gravel surface, HSG B
	951	96	Gravel surface, HSG D
*	5,359	61	>75% Grass cover, Good, HSG A
	3,035	61	>75% Grass cover, Good, HSG B
	710	80	>75% Grass cover, Good, HSG D
*	1,318	55	Woods, Good, HSG A
	2,065	55	Woods, Good, HSG B
	4,505	77	Woods, Good, HSG D
	3,247	54	1/2 acre lots, 25% imp, HSG A
	357	70	1/2 acre lots, 25% imp, HSG B
	20,743	85	1/2 acre lots, 25% imp, HSG D
	79,540	86	Weighted Average
	37,205		46.78% Pervious Area
	42,335		53.22% Impervious Area

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

Subcatchment PR-1: Proposed to Infiltration Chambers



Summary for Pond 1P: Infiltration Chambers

Inflow Area = 1.826 ac, 53.22% Impervious, Inflow Depth = 3.19" for 10-Year event
Inflow = 6.60 cfs @ 12.09 hrs, Volume= 0.485 af
Outflow = 0.27 cfs @ 11.20 hrs, Volume= 0.485 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.27 cfs @ 11.20 hrs, Volume= 0.485 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 279.92' @ 15.35 hrs Surf.Area= 4,861 sf Storage= 11,235 cf
Flood Elev= 283.65' Surf.Area= 4,861 sf Storage= 17,875 cf

Plug-Flow detention time= 393.3 min calculated for 0.485 af (100% of inflow)
Center-of-Mass det. time= 393.4 min (1,200.2 - 806.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	276.70'	6,718 cf	**30.25'W x 160.70'L x 5.75'H Field A** 27,952 cf Overall - 11,157 cf Embedded = 16,795 cf x 40.0% Voids
#2A	277.45'	11,157 cf	**Cultec R-902HD** x 172 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 4 Rows of 43 Chambers Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		17,875 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	277.95'	**12.0" Round Culvert** L= 104.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 277.95' / 277.95' S= 0.0000 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Primary	283.40'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	276.70'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.27 cfs @ 11.20 hrs HW=276.77' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=276.70' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)
└**1=Culvert** (Controls 0.00 cfs)

Pond 1P: Infiltration Chambers - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

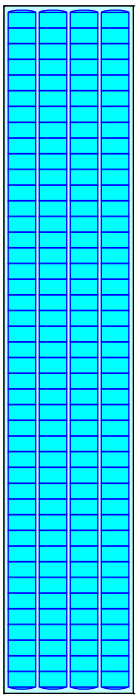
43 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 158.70' Row Length +12.0" End Stone x 2 = 160.70' Base Length
4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

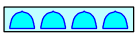
172 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 11,156.5 cf Chamber Storage

27,951.8 cf Field - 11,156.5 cf Chambers = 16,795.3 cf Stone x 40.0% Voids = 6,718.1 cf Stone Storage

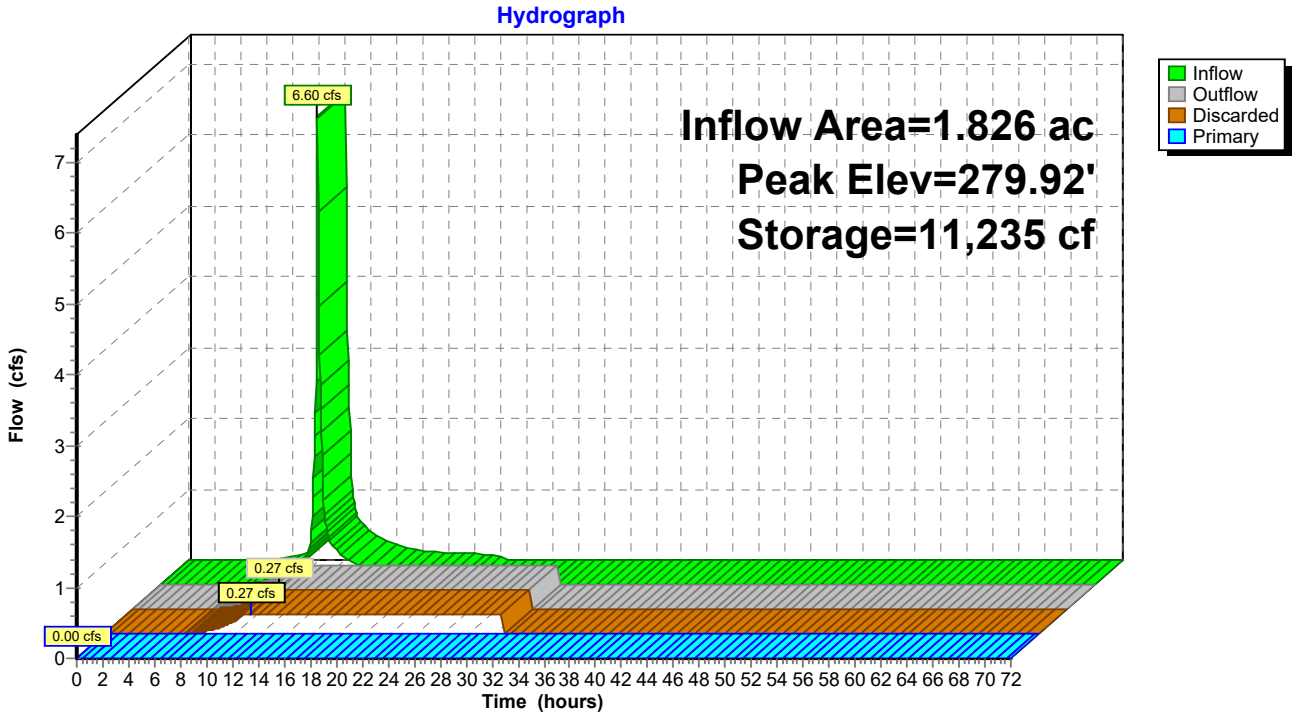
Chamber Storage + Stone Storage = 17,874.6 cf = 0.410 af
Overall Storage Efficiency = 63.9%
Overall System Size = 160.70' x 30.25' x 5.75'

172 Chambers
1,035.3 cy Field
622.0 cy Stone





Pond 1P: Infiltration Chambers



Summary for Pond 2P: Separator Row

Volume	Invert	Avail.Storage	Storage Description
#1A	276.70'	1,980 cf	**8.50'W x 157.03'L x 5.75'H Field A** 7,675 cf Overall - 2,724 cf Embedded = 4,951 cf x 40.0% Voids
#2A	277.45'	2,724 cf	**Cultec R-902HD** x 42 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf
		4,705 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.70'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Pond 2P: Separator Row - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf

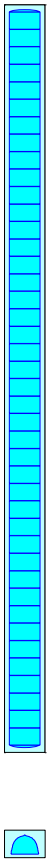
42 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 155.03' Row Length +12.0" End Stone x 2 = 157.03' Base Length
1 Rows x 78.0" Wide + 12.0" Side Stone x 2 = 8.50' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

42 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 1 Rows = 2,724.4 cf Chamber Storage

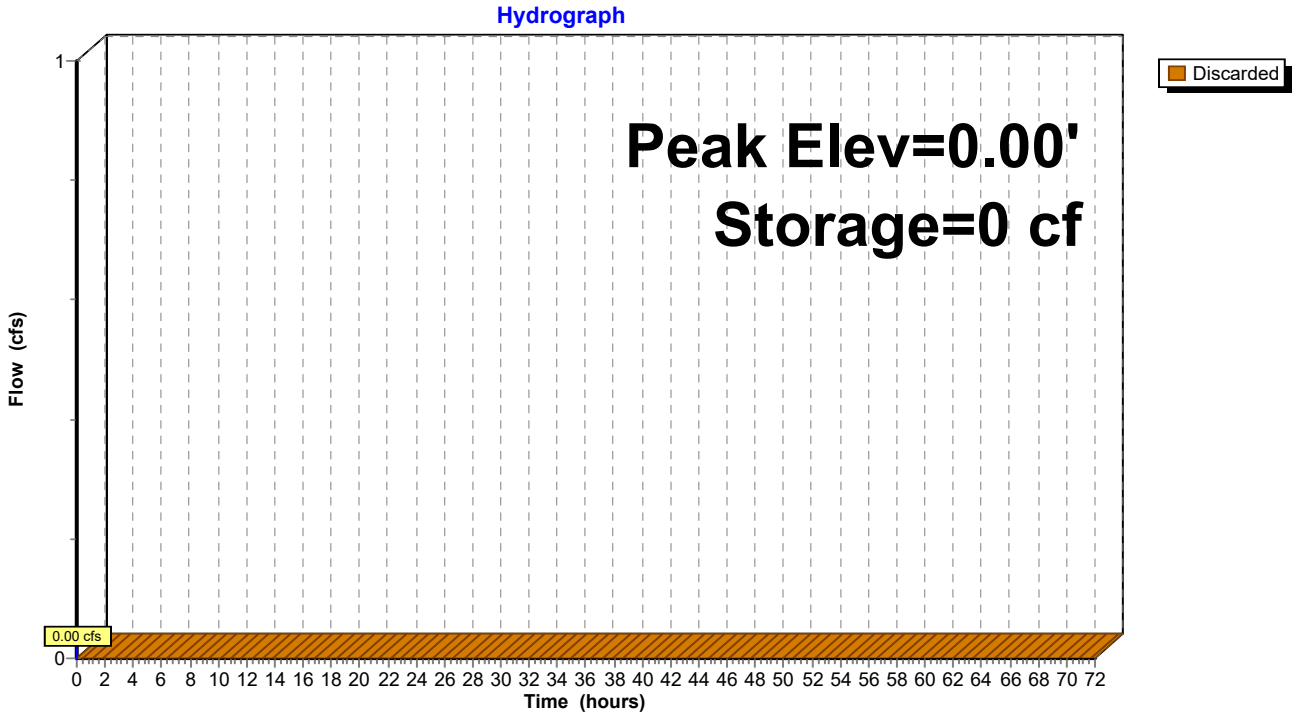
7,675.0 cf Field - 2,724.4 cf Chambers = 4,950.6 cf Stone x 40.0% Voids = 1,980.2 cf Stone Storage

Chamber Storage + Stone Storage = 4,704.6 cf = 0.108 af
Overall Storage Efficiency = 61.3%
Overall System Size = 157.03' x 8.50' x 5.75'

42 Chambers
284.3 cy Field
183.4 cy Stone



Pond 2P: Separator Row

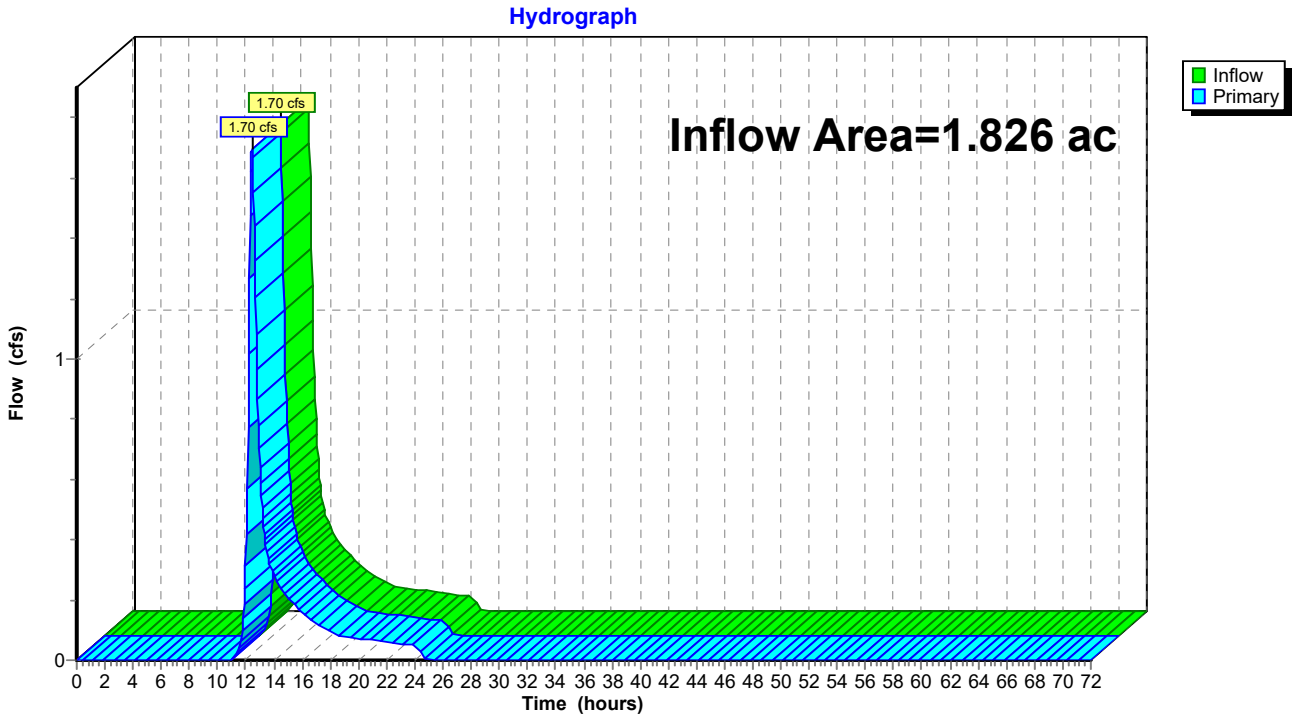


Summary for Pond AP-1: Southeast Lot Corner

Inflow Area = 1.826 ac, 13.99% Impervious, Inflow Depth = 1.46" for 10-Year event
Inflow = 1.70 cfs @ 12.43 hrs, Volume= 0.222 af
Primary = 1.70 cfs @ 12.43 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Pond AP-1: Southeast Lot Corner



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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

Subcatchment EX-1: Existing To Runoff Area=79,540 sf 13.99% Impervious Runoff Depth=1.99"
Flow Length=362' Tc=28.0 min CN=65 Runoff=2.39 cfs 0.304 af

Subcatchment PR-1: Proposed to Runoff Area=79,540 sf 53.22% Impervious Runoff Depth=3.94"
Tc=6.0 min CN=86 Runoff=8.09 cfs 0.599 af

Pond 1P: Infiltration Chambers Peak Elev=281.02' Storage=14,927 cf Inflow=8.09 cfs 0.599 af
Discarded=0.27 cfs 0.599 af Primary=0.00 cfs 0.000 af Outflow=0.27 cfs 0.599 af

Pond 2P: Separator Row Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af

Pond AP-1: Southeast Lot Corner Inflow=2.39 cfs 0.304 af
Primary=2.39 cfs 0.304 af

Total Runoff Area = 3.652 ac Runoff Volume = 0.902 af Average Runoff Depth = 2.97"
66.39% Pervious = 2.425 ac 33.61% Impervious = 1.227 ac

Summary for Subcatchment EX-1: Existing To Southeast Corner

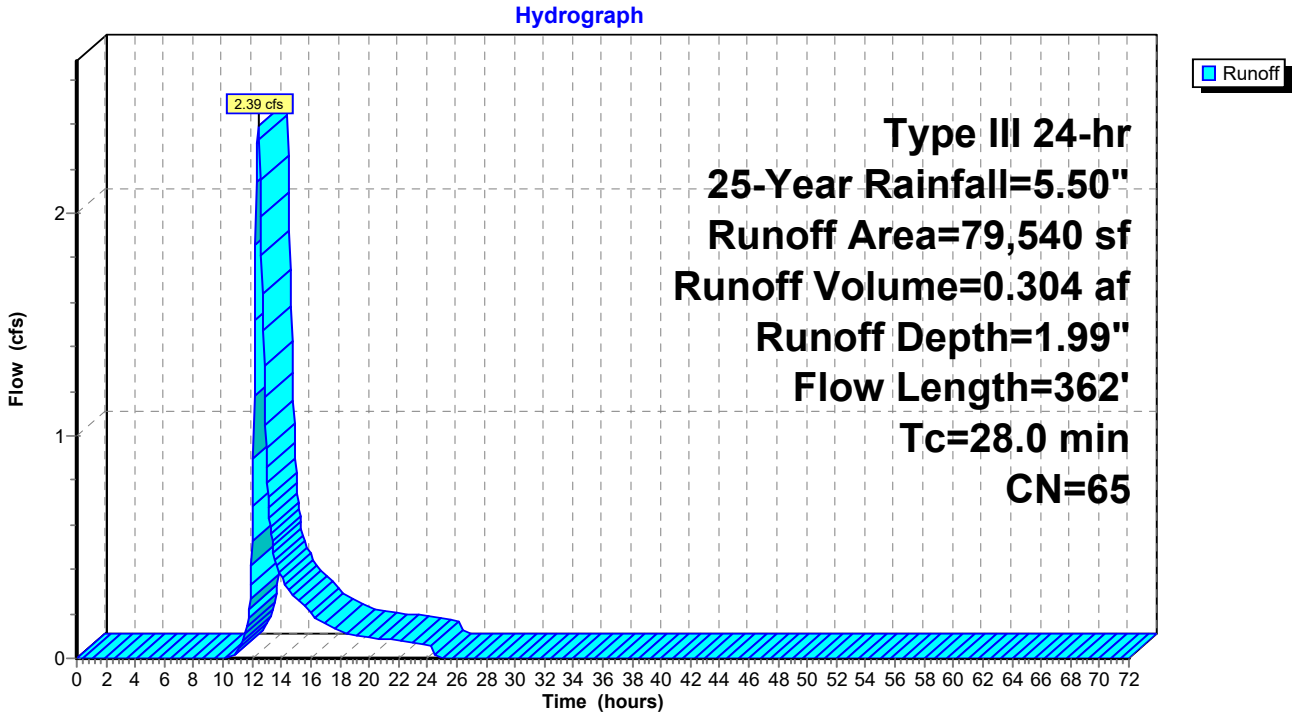
Runoff = 2.39 cfs @ 12.42 hrs, Volume= 0.304 af, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
	3,296	98	Paved parking, HSG A
	1,742	98	Roofs, HSG A
	11,035	39	>75% Grass cover, Good, HSG A
*	16,511	55	Woods, Good, HSG A
	16,413	55	Woods, Good, HSG B
	6,174	77	Woods, Good, HSG D
	20,750	85	1/2 acre lots, 25% imp, HSG D
	364	70	1/2 acre lots, 25% imp, HSG B
	3,255	54	1/2 acre lots, 25% imp, HSG A
	79,540	65	Weighted Average
	68,410		86.01% Pervious Area
	11,130		13.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	132	0.0950	0.09		**Sheet Flow, SEGMENT A-B** Woods: Dense underbrush n= 0.800 P2= 3.20"
0.4	66	0.3030	2.75		**Shallow Concentrated Flow, SEGMENT B-C** Woodland Kv= 5.0 fps
0.9	92	0.1300	1.80		**Shallow Concentrated Flow, SEGMENT C-D** Woodland Kv= 5.0 fps
1.7	72	0.0210	0.72		**Shallow Concentrated Flow, SEGMENT D-E** Woodland Kv= 5.0 fps
28.0	362	Total			

Subcatchment EX-1: Existing To Southeast Corner



Summary for Subcatchment PR-1: Proposed to Infiltration Chambers

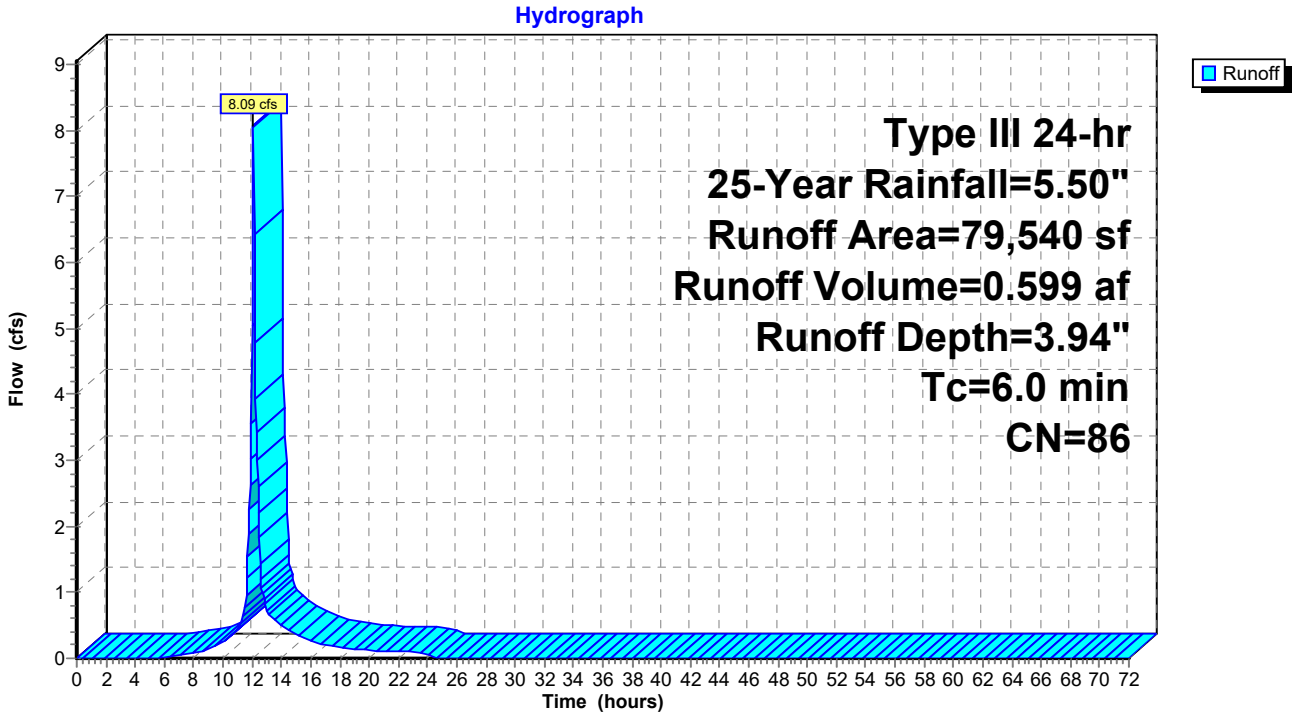
Runoff = 8.09 cfs @ 12.09 hrs, Volume= 0.599 af, Depth= 3.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
	13,897	98	Roofs, HSG A
	306	98	Roofs, HSG B
	10	98	Roofs, HSG D
	11,910	98	Paved parking, HSG A
	10,125	98	Paved parking, HSG B
	131	96	Gravel surface, HSG A
	871	96	Gravel surface, HSG B
	951	96	Gravel surface, HSG D
*	5,359	61	>75% Grass cover, Good, HSG A
	3,035	61	>75% Grass cover, Good, HSG B
	710	80	>75% Grass cover, Good, HSG D
*	1,318	55	Woods, Good, HSG A
	2,065	55	Woods, Good, HSG B
	4,505	77	Woods, Good, HSG D
	3,247	54	1/2 acre lots, 25% imp, HSG A
	357	70	1/2 acre lots, 25% imp, HSG B
	20,743	85	1/2 acre lots, 25% imp, HSG D
	79,540	86	Weighted Average
	37,205		46.78% Pervious Area
	42,335		53.22% Impervious Area

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

Subcatchment PR-1: Proposed to Infiltration Chambers



Summary for Pond 1P: Infiltration Chambers

Inflow Area = 1.826 ac, 53.22% Impervious, Inflow Depth = 3.94" for 25-Year event
Inflow = 8.09 cfs @ 12.09 hrs, Volume= 0.599 af
Outflow = 0.27 cfs @ 10.75 hrs, Volume= 0.599 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.27 cfs @ 10.75 hrs, Volume= 0.599 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 281.02' @ 15.85 hrs Surf.Area= 4,861 sf Storage= 14,927 cf
Flood Elev= 283.65' Surf.Area= 4,861 sf Storage= 17,875 cf

Plug-Flow detention time= 517.2 min calculated for 0.599 af (100% of inflow)
Center-of-Mass det. time= 517.4 min (1,318.3 - 800.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	276.70'	6,718 cf	**30.25'W x 160.70'L x 5.75'H Field A** 27,952 cf Overall - 11,157 cf Embedded = 16,795 cf x 40.0% Voids
#2A	277.45'	11,157 cf	**Cultec R-902HD** x 172 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 4 Rows of 43 Chambers Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		17,875 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	277.95'	**12.0" Round Culvert** L= 104.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 277.95' / 277.95' S= 0.0000 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Primary	283.40'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	276.70'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.27 cfs @ 10.75 hrs HW=276.77' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=276.70' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)
└**1=Culvert** (Controls 0.00 cfs)

Pond 1P: Infiltration Chambers - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

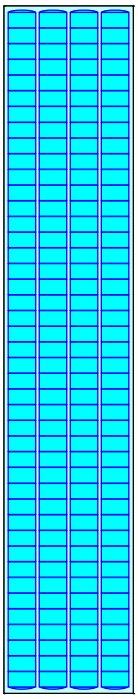
43 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 158.70' Row Length +12.0" End Stone x 2 = 160.70' Base Length
4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

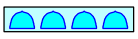
172 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 11,156.5 cf Chamber Storage

27,951.8 cf Field - 11,156.5 cf Chambers = 16,795.3 cf Stone x 40.0% Voids = 6,718.1 cf Stone Storage

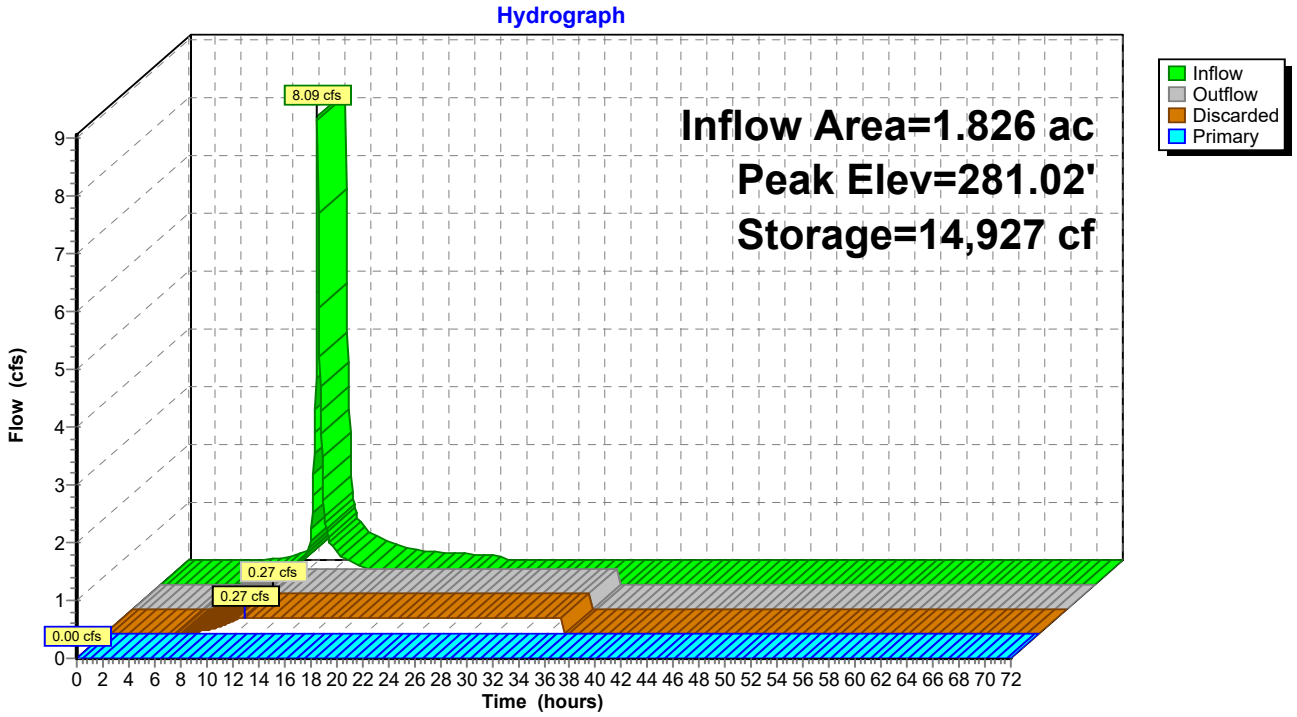
Chamber Storage + Stone Storage = 17,874.6 cf = 0.410 af
Overall Storage Efficiency = 63.9%
Overall System Size = 160.70' x 30.25' x 5.75'

172 Chambers
1,035.3 cy Field
622.0 cy Stone





Pond 1P: Infiltration Chambers



Summary for Pond 2P: Separator Row

Volume	Invert	Avail.Storage	Storage Description
#1A	276.70'	1,980 cf	**8.50'W x 157.03'L x 5.75'H Field A** 7,675 cf Overall - 2,724 cf Embedded = 4,951 cf x 40.0% Voids
#2A	277.45'	2,724 cf	**Cultec R-902HD** x 42 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf
		4,705 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.70'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Pond 2P: Separator Row - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf

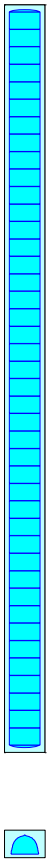
42 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 155.03' Row Length +12.0" End Stone x 2 = 157.03' Base Length
1 Rows x 78.0" Wide + 12.0" Side Stone x 2 = 8.50' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

42 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 1 Rows = 2,724.4 cf Chamber Storage

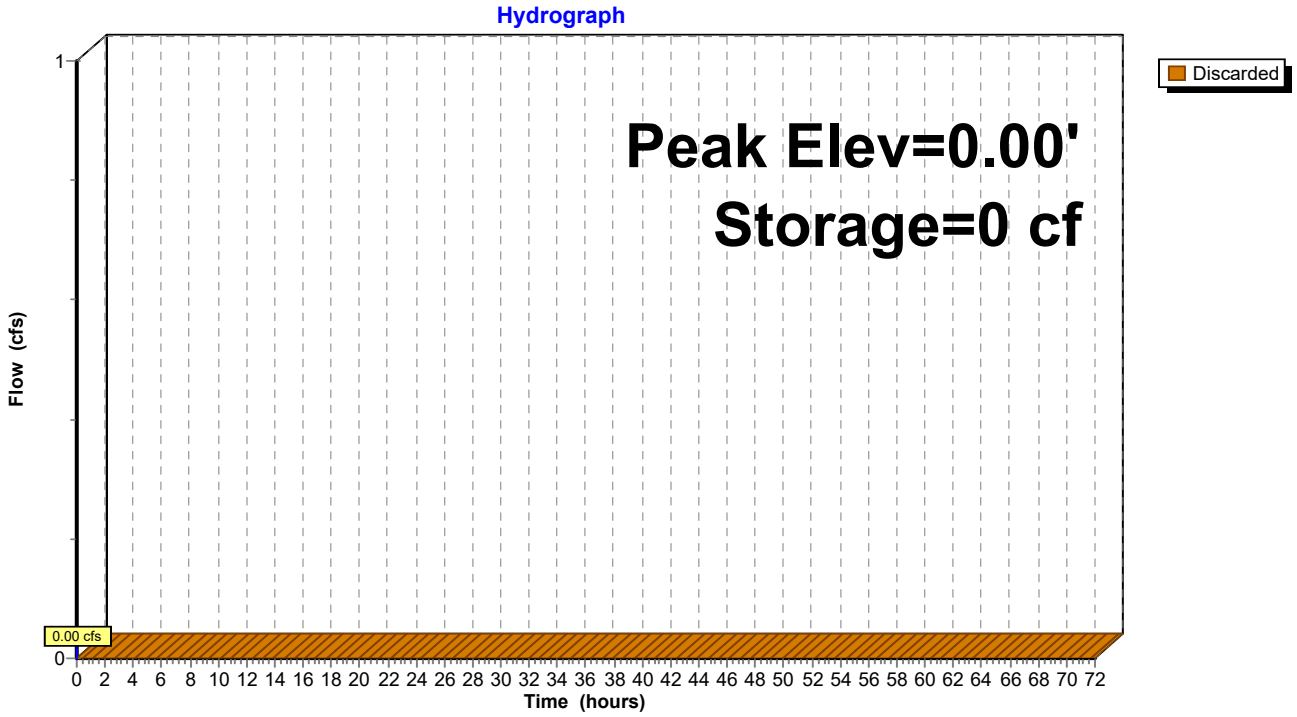
7,675.0 cf Field - 2,724.4 cf Chambers = 4,950.6 cf Stone x 40.0% Voids = 1,980.2 cf Stone Storage

Chamber Storage + Stone Storage = 4,704.6 cf = 0.108 af
Overall Storage Efficiency = 61.3%
Overall System Size = 157.03' x 8.50' x 5.75'

42 Chambers
284.3 cy Field
183.4 cy Stone



Pond 2P: Separator Row

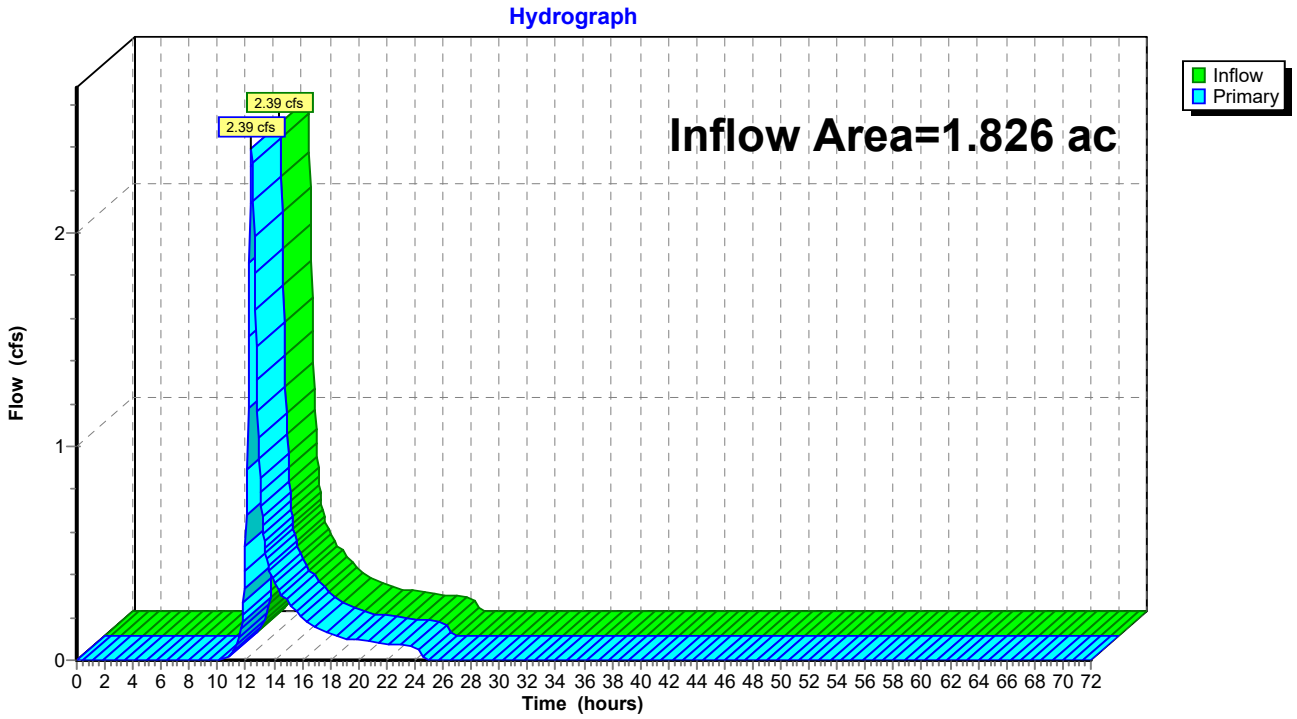


Summary for Pond AP-1: Southeast Lot Corner

Inflow Area = 1.826 ac, 13.99% Impervious, Inflow Depth = 1.99" for 25-Year event
Inflow = 2.39 cfs @ 12.42 hrs, Volume= 0.304 af
Primary = 2.39 cfs @ 12.42 hrs, Volume= 0.304 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Pond AP-1: Southeast Lot Corner



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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

Subcatchment EX-1: Existing To Runoff Area=79,540 sf 13.99% Impervious Runoff Depth=2.87"
Flow Length=362' Tc=28.0 min CN=65 Runoff=3.52 cfs 0.437 af

Subcatchment PR-1: Proposed to Runoff Area=79,540 sf 53.22% Impervious Runoff Depth=5.08"
Tc=6.0 min CN=86 Runoff=10.31 cfs 0.773 af

Pond 1P: Infiltration Chambers Peak Elev=283.50' Storage=17,875 cf Inflow=10.31 cfs 0.773 af
Discarded=0.27 cfs 0.705 af Primary=0.84 cfs 0.068 af Outflow=1.11 cfs 0.773 af

Pond 2P: Separator Row Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af

Pond AP-1: Southeast Lot Corner Inflow=3.52 cfs 0.437 af
Primary=3.52 cfs 0.437 af

Total Runoff Area = 3.652 ac Runoff Volume = 1.210 af Average Runoff Depth = 3.98"
66.39% Pervious = 2.425 ac 33.61% Impervious = 1.227 ac

Summary for Subcatchment EX-1: Existing To Southeast Corner

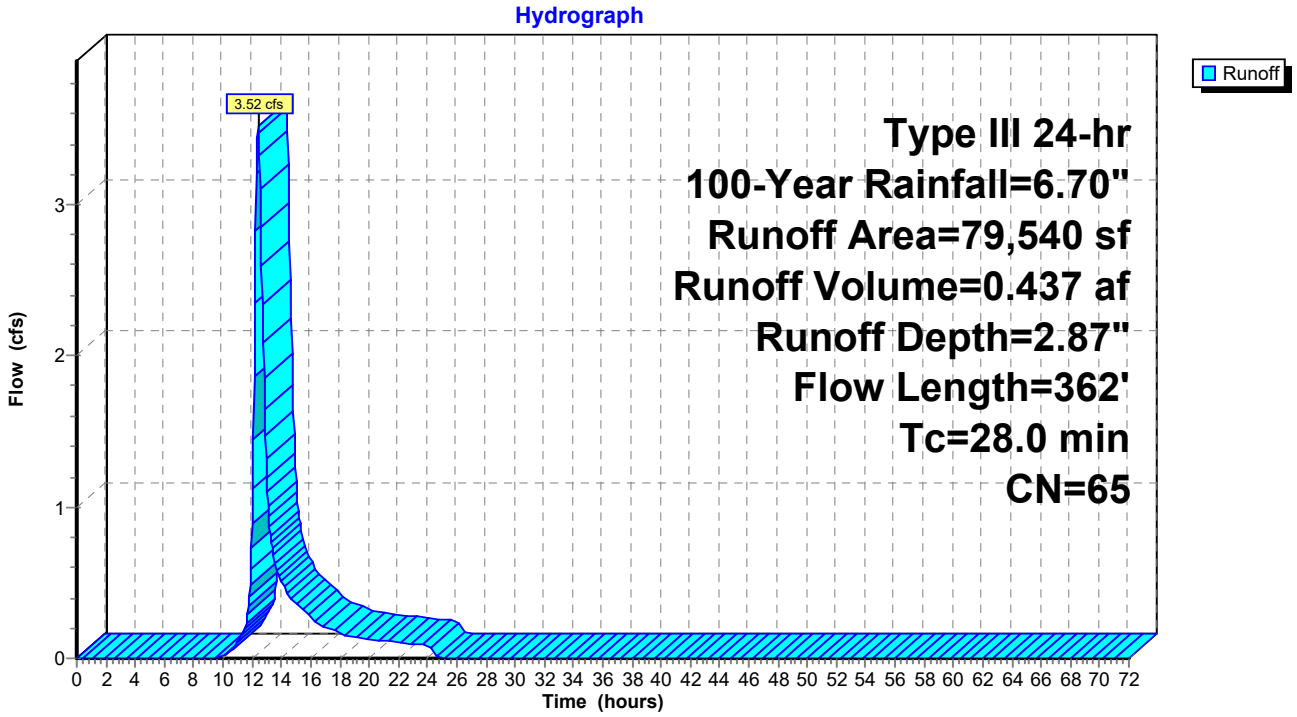
Runoff = 3.52 cfs @ 12.41 hrs, Volume= 0.437 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

	Area (sf)	CN	Description
	3,296	98	Paved parking, HSG A
	1,742	98	Roofs, HSG A
	11,035	39	>75% Grass cover, Good, HSG A
*	16,511	55	Woods, Good, HSG A
	16,413	55	Woods, Good, HSG B
	6,174	77	Woods, Good, HSG D
	20,750	85	1/2 acre lots, 25% imp, HSG D
	364	70	1/2 acre lots, 25% imp, HSG B
	3,255	54	1/2 acre lots, 25% imp, HSG A
	79,540	65	Weighted Average
	68,410		86.01% Pervious Area
	11,130		13.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	132	0.0950	0.09		**Sheet Flow, SEGMENT A-B** Woods: Dense underbrush n= 0.800 P2= 3.20"
0.4	66	0.3030	2.75		**Shallow Concentrated Flow, SEGMENT B-C** Woodland Kv= 5.0 fps
0.9	92	0.1300	1.80		**Shallow Concentrated Flow, SEGMENT C-D** Woodland Kv= 5.0 fps
1.7	72	0.0210	0.72		**Shallow Concentrated Flow, SEGMENT D-E** Woodland Kv= 5.0 fps
28.0	362	Total			

Subcatchment EX-1: Existing To Southeast Corner



Summary for Subcatchment PR-1: Proposed to Infiltration Chambers

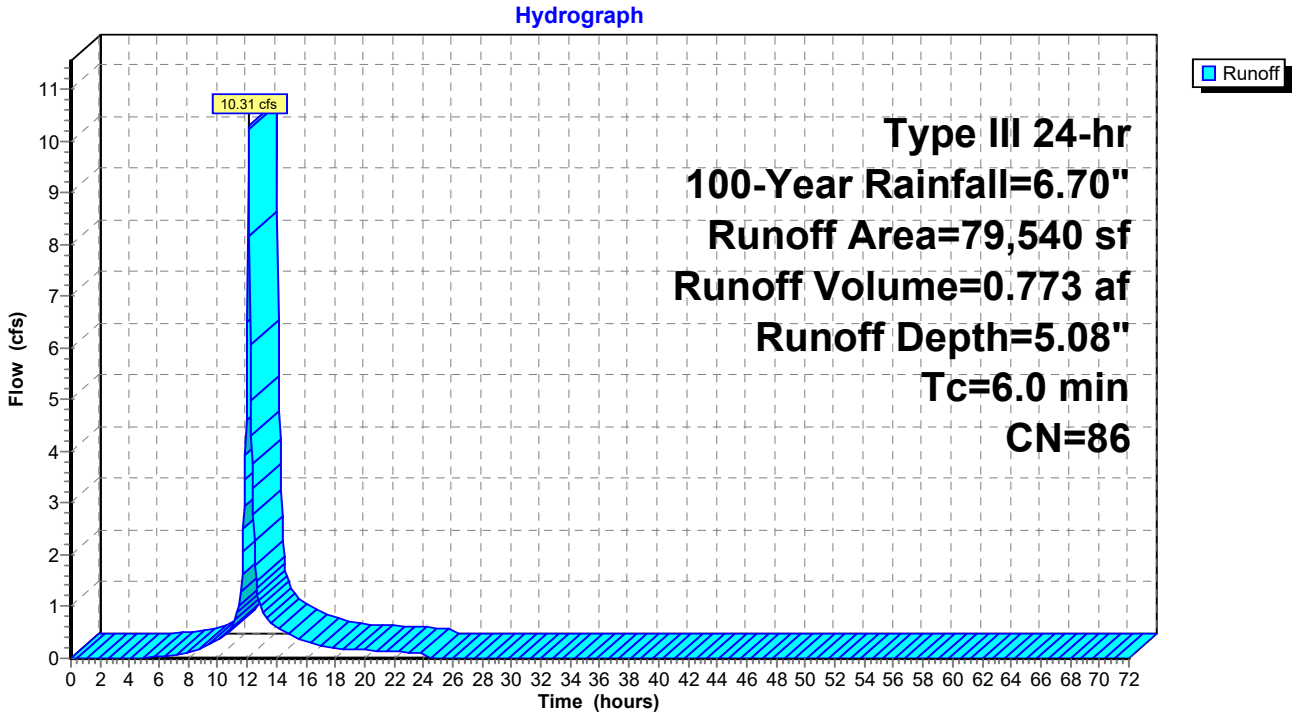
Runoff = 10.31 cfs @ 12.09 hrs, Volume= 0.773 af, Depth= 5.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

	Area (sf)	CN	Description
	13,897	98	Roofs, HSG A
	306	98	Roofs, HSG B
	10	98	Roofs, HSG D
	11,910	98	Paved parking, HSG A
	10,125	98	Paved parking, HSG B
	131	96	Gravel surface, HSG A
	871	96	Gravel surface, HSG B
	951	96	Gravel surface, HSG D
*	5,359	61	>75% Grass cover, Good, HSG A
	3,035	61	>75% Grass cover, Good, HSG B
	710	80	>75% Grass cover, Good, HSG D
*	1,318	55	Woods, Good, HSG A
	2,065	55	Woods, Good, HSG B
	4,505	77	Woods, Good, HSG D
	3,247	54	1/2 acre lots, 25% imp, HSG A
	357	70	1/2 acre lots, 25% imp, HSG B
	20,743	85	1/2 acre lots, 25% imp, HSG D
	79,540	86	Weighted Average
	37,205		46.78% Pervious Area
	42,335		53.22% Impervious Area

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

Subcatchment PR-1: Proposed to Infiltration Chambers



Summary for Pond 1P: Infiltration Chambers

Inflow Area = 1.826 ac, 53.22% Impervious, Inflow Depth = 5.08" for 100-Year event
Inflow = 10.31 cfs @ 12.09 hrs, Volume= 0.773 af
Outflow = 1.11 cfs @ 13.06 hrs, Volume= 0.773 af, Atten= 89%, Lag= 58.1 min
Discarded = 0.27 cfs @ 10.15 hrs, Volume= 0.705 af
Primary = 0.84 cfs @ 13.06 hrs, Volume= 0.068 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 283.50' @ 13.05 hrs Surf.Area= 4,861 sf Storage= 17,875 cf
Flood Elev= 283.65' Surf.Area= 4,861 sf Storage= 17,875 cf

Plug-Flow detention time= 570.0 min calculated for 0.772 af (100% of inflow)
Center-of-Mass det. time= 570.3 min (1,364.1 - 793.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	276.70'	6,718 cf	**30.25'W x 160.70'L x 5.75'H Field A** 27,952 cf Overall - 11,157 cf Embedded = 16,795 cf x 40.0% Voids
#2A	277.45'	11,157 cf	**Cultec R-902HD** x 172 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 4 Rows of 43 Chambers Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		17,875 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	277.95'	**12.0" Round Culvert** L= 104.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 277.95' / 277.95' S= 0.0000 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Primary	283.40'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	276.70'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.27 cfs @ 10.15 hrs HW=276.77' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.76 cfs @ 13.06 hrs HW=283.49' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.76 cfs @ 1.00 fps)
└**1=Culvert** (Passes 0.76 cfs of 0.89 cfs potential flow)

Pond 1P: Infiltration Chambers - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

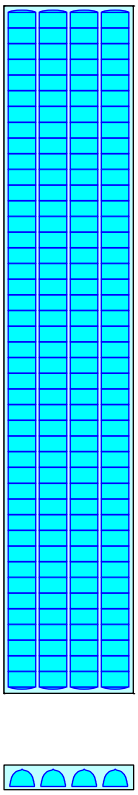
43 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 158.70' Row Length +12.0" End Stone x 2 = 160.70' Base Length
4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

172 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 11,156.5 cf Chamber Storage

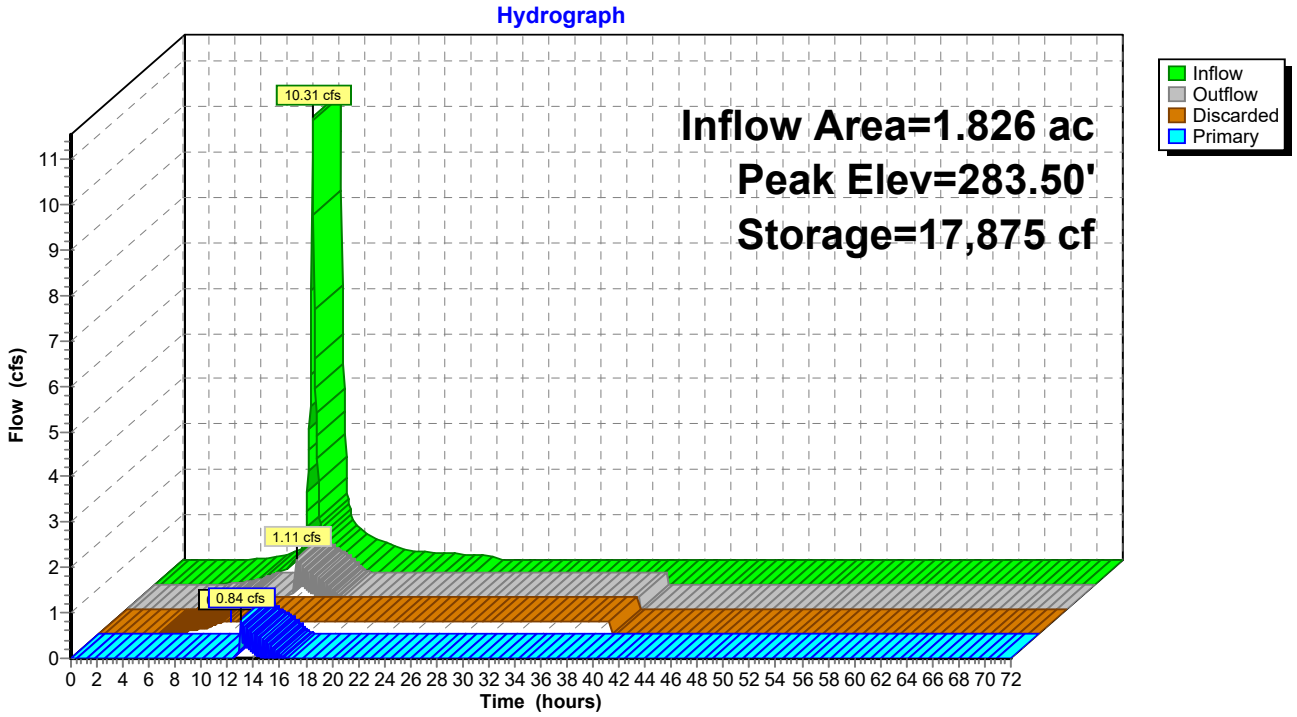
27,951.8 cf Field - 11,156.5 cf Chambers = 16,795.3 cf Stone x 40.0% Voids = 6,718.1 cf Stone Storage

Chamber Storage + Stone Storage = 17,874.6 cf = 0.410 af
Overall Storage Efficiency = 63.9%
Overall System Size = 160.70' x 30.25' x 5.75'

172 Chambers
1,035.3 cy Field
622.0 cy Stone



Pond 1P: Infiltration Chambers



Summary for Pond 2P: Separator Row

Volume	Invert	Avail.Storage	Storage Description
#1A	276.70'	1,980 cf	**8.50'W x 157.03'L x 5.75'H Field A** 7,675 cf Overall - 2,724 cf Embedded = 4,951 cf x 40.0% Voids
#2A	277.45'	2,724 cf	**Cultec R-902HD** x 42 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf
		4,705 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.70'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Pond 2P: Separator Row - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf

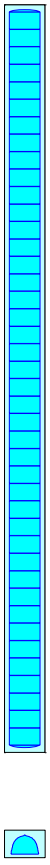
42 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 155.03' Row Length +12.0" End Stone x 2 = 157.03' Base Length
1 Rows x 78.0" Wide + 12.0" Side Stone x 2 = 8.50' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

42 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 1 Rows = 2,724.4 cf Chamber Storage

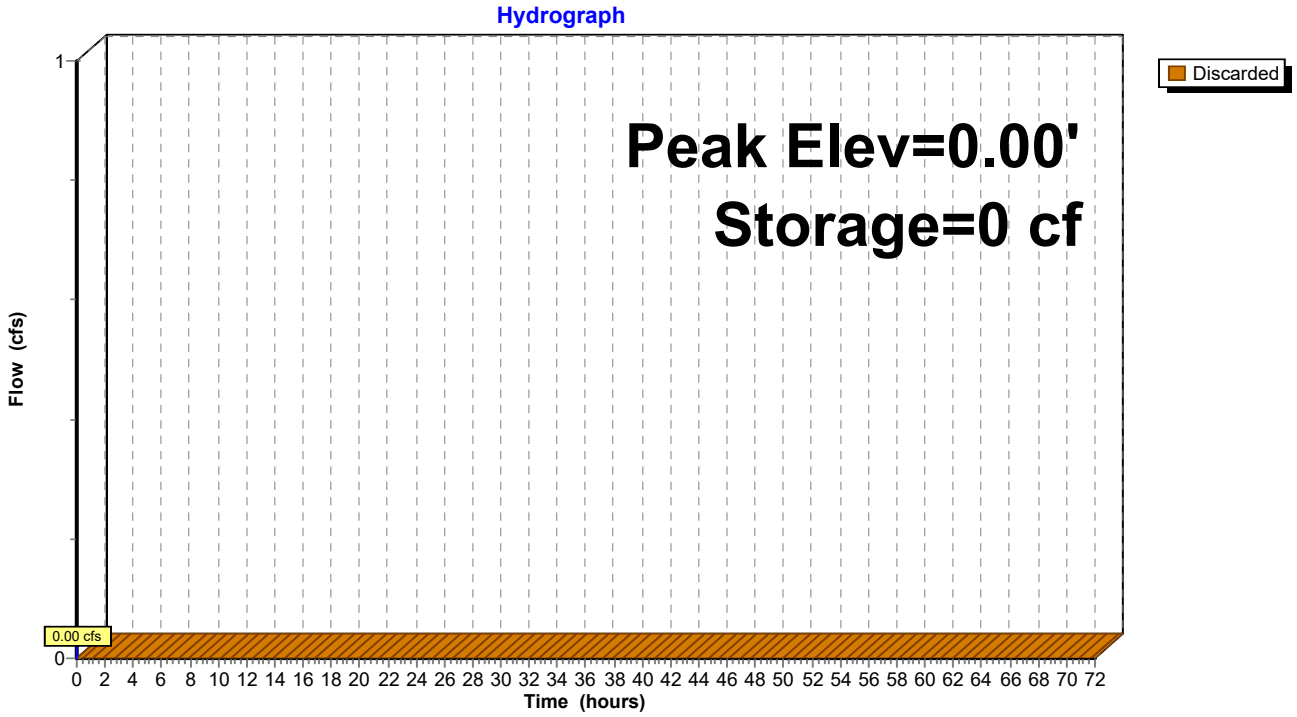
7,675.0 cf Field - 2,724.4 cf Chambers = 4,950.6 cf Stone x 40.0% Voids = 1,980.2 cf Stone Storage

Chamber Storage + Stone Storage = 4,704.6 cf = 0.108 af
Overall Storage Efficiency = 61.3%
Overall System Size = 157.03' x 8.50' x 5.75'

42 Chambers
284.3 cy Field
183.4 cy Stone



Pond 2P: Separator Row

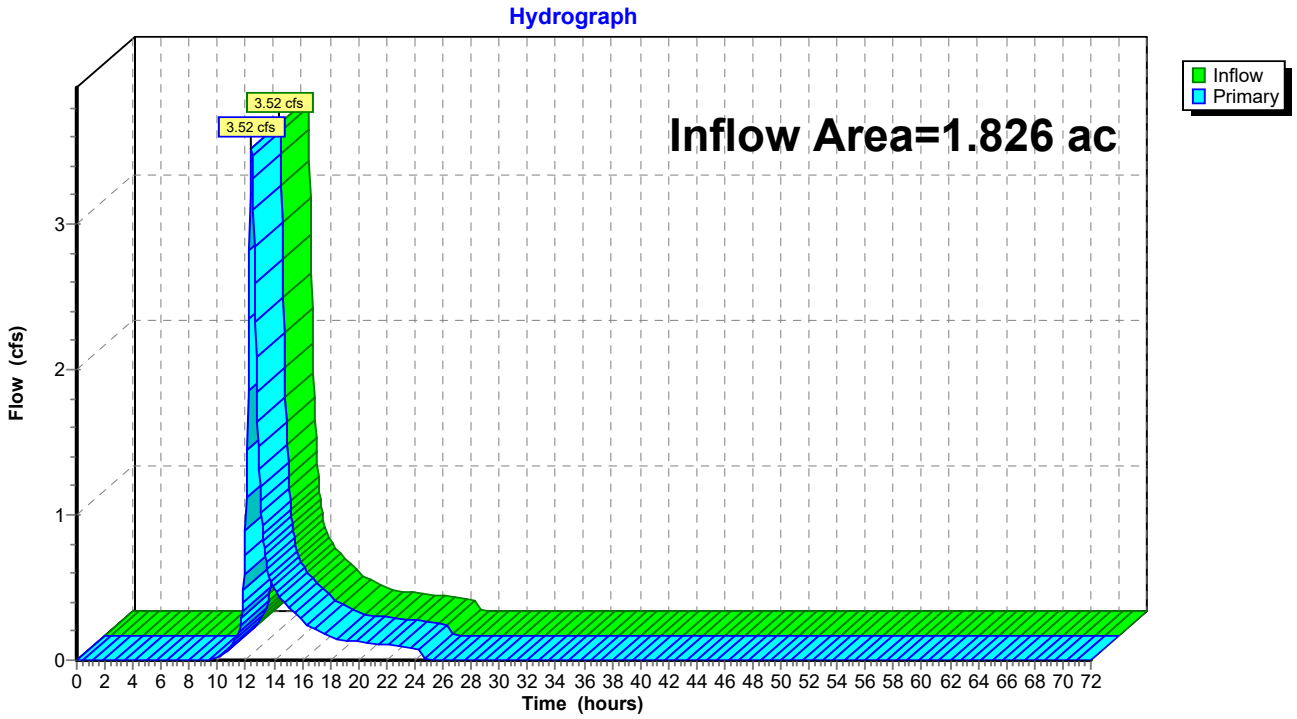


Summary for Pond AP-1: Southeast Lot Corner

Inflow Area = 1.826 ac, 13.99% Impervious, Inflow Depth = 2.87" for 100-Year event
Inflow = 3.52 cfs @ 12.41 hrs, Volume= 0.437 af
Primary = 3.52 cfs @ 12.41 hrs, Volume= 0.437 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Pond AP-1: Southeast Lot Corner



Stage-Area-Storage Calculations

Appendix 5

Stage-Area-Storage for Pond 1P: Infiltration Chambers

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
276.70	**4,861**	0
276.80	4,861	194
276.90	4,861	389
277.00	4,861	583
277.10	4,861	778
277.20	4,861	972
277.30	4,861	1,167
277.40	4,861	1,361
277.50	4,861	1,665
277.60	4,861	2,078
277.70	4,861	2,492
277.80	4,861	2,904
277.90	4,861	3,314
278.00	4,861	3,723
278.10	4,861	4,131
278.20	4,861	4,539
278.30	4,861	4,943
278.40	4,861	5,345
278.50	4,861	5,747
278.60	4,861	6,148
278.70	4,861	6,546
278.80	4,861	6,941
278.90	4,861	7,336
279.00	4,861	7,728
279.10	4,861	8,119
279.20	4,861	8,508
279.30	4,861	8,894
279.40	4,861	9,280
279.50	4,861	9,662
279.60	4,861	10,041
279.70	4,861	10,419
279.80	4,861	10,793
279.90	4,861	11,163
280.00	4,861	11,530
280.10	4,861	11,892
280.20	4,861	12,249
280.30	4,861	12,601
280.40	4,861	12,947
280.50	4,861	13,286
280.60	4,861	13,618
280.70	4,861	13,942
280.80	4,861	14,257
280.90	4,861	14,563
281.00	4,861	14,857
281.10	4,861	15,134
281.20	4,861	15,388
281.30	4,861	15,618
281.40	4,861	15,829
281.50	4,861	16,027
281.60	4,861	16,222
281.70	4,861	16,416
281.80	4,861	16,611
281.90	4,861	16,805
282.00	4,861	17,000
282.10	4,861	17,194
282.20	4,861	17,388
282.30	4,861	17,583
282.40	4,861	**17,777**
282.50	4,861	**17,875**
282.60	4,861	17,875
282.70	4,861	17,875
282.80	4,861	17,875
282.90	4,861	17,875
283.00	4,861	17,875
283.10	4,861	17,875
283.20	4,861	17,875
283.30	4,861	17,875
283.40	4,861	17,875
283.50	4,861	17,875
283.60	4,861	17,875

Volume below outlet structure rim El.=283.40

Stage-Area-Storage for Pond 2P: Separator Row

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
276.70	**1,335**	0
276.80	1,335	53
276.90	1,335	107
277.00	1,335	160
277.10	1,335	214
277.20	1,335	267
277.30	1,335	320
277.40	1,335	374
277.50	1,335	454
277.60	1,335	561
277.70	1,335	668
277.80	1,335	774
277.90	1,335	880
278.00	1,335	986
278.10	1,335	1,092
278.20	1,335	1,197
278.30	1,335	1,302
278.40	1,335	1,406
278.50	1,335	1,510
278.60	1,335	1,613
278.70	1,335	1,717
278.80	1,335	1,819
278.90	1,335	1,921
279.00	1,335	2,023
279.10	1,335	2,124
279.20	1,335	2,225
279.30	1,335	2,326
279.40	1,335	2,426
279.50	1,335	2,525
279.60	1,335	2,623
279.70	1,335	2,722
279.80	1,335	2,819
279.90	1,335	2,915
280.00	1,335	3,011
280.10	1,335	3,105
280.20	1,335	3,198
280.30	1,335	3,290
280.40	1,335	3,380
280.50	1,335	3,469
280.60	1,335	3,556
280.70	1,335	3,641
280.80	1,335	3,724
280.90	1,335	3,804
281.00	1,335	3,882
281.10	1,335	3,956
281.20	1,335	4,024
281.30	1,335	4,086
281.40	1,335	4,143
281.50	1,335	4,197
281.60	1,335	4,251
281.70	1,335	4,304
281.80	1,335	4,358
281.90	1,335	4,411
282.00	1,335	4,464
282.10	1,335	4,518
282.20	1,335	4,571
282.30	1,335	4,625
282.40	1,335	**4,678**
282.50	1,335	**4,705**
282.60	1,335	4,705
282.70	1,335	4,705
282.80	1,335	4,705
282.90	1,335	4,705
283.00	1,335	4,705
283.10	1,335	4,705
283.20	1,335	4,705
283.30	1,335	4,705
283.40	1,335	4,705

Volume below lowest invert out El.=278.85 Vol=1,870 cf

TSS Removal Worksheet

Appendix 6

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: 230 East Central Street, 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
Infiltration Basin	0.80	0.75	0.60	0.15

Total TSS Removal = 85%

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

Project: F-4386

Prepared By: Kyle Pitz

Date: 8/4/2021

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

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

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: 230 East Central Street, 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
Infiltration Basin (Isolator Row)	0.25	0.75	0.19	0.56

Infiltration Basin Pretreatment

Total TSS Removal = 44%

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

Project: F-4386

Prepared By: Kyle Pitz

Date: 8/4/2021

*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

Long Term Operation and Maintenance Plan

Appendix 7

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

A. Names of Persons or Entity Responsible for Plan Compliance

Applicant: Mohiuddin Ahmed
95 Main Street, Suite 100
Westborough, MA 01581
PH: 508-962-1928

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 product 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 in front of building, 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 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. Stockpile materials and maintain Erosion Control around the materials where it can easily be accessed. Maintain easy access to clean up materials to include brooms, mops, rags gloves, goggles, sand, sawdust, plastic and metal trash containers.
8. 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 in a certified container and notify a certified hauler for removal.
   d. Report significant spills to the Fire Department.
9. 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. Erosion and Sedimentation Control Plan.
See Erosion Control Plan prepared by Guerriere & Halnon, Inc. Dated 11/11/21

D. Site Development Plans.
See Site Plan prepared by Guerriere & Halnon, Inc. Dated 11/11/21

E. Construction Plans
1. See Site Plan prepared by Guerriere & Halnon, Inc. Dated 11/11/21

a. Record Order of Conditions - The site superintendent shall be aware of all the Conditions contained within the Order including inspection schedules.
b. Install DEP File # Sign.
c. 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.
d. Install silt fence/hay bales at locations
e. Strip off top and subsoil. Stockpile material to be reused away from the wetland, remove excess material from the site. Install and maintain erosion control barrier around stockpile.
f. Rough grade site, maintaining a temporary low area/sediment trap away from the wetland.
g. Construct drainage outfalls and stilling basin. Stabilize side slopes with loam, seed and mulch.
h. Install underground utilities; protect all open drainage structures with erosion/siltation control devices.
i. Install binder course of bituminous asphalt.
j. Install wearing course of asphalt, and striping (where required).
k. Maintain all erosion control devices until site is stabilized and a Certificate of Compliance is issued by the Conservation Commission.
l. The Contractor shall be responsible to schedule any required inspections of his/her work.

2. Construction Waste Management Plan
m. Dumpster for trash and bulk waste collection shall be provided separately for construction.
n. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material are recommended.
o. Segregate and provide containers for disposal options for waste.
p. Do not bury waste and debris on site.
q. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
r. The sewer system is only for disposal of human waste, and substances permitted for disposal in the site sewer permit with the Town B.O.H.

F. <u>Operation and Maintenance of Erosion and Sedimentation Controls</u>

The operation and maintenance of sedimentation control shall be the responsibility of the contractor. The inspection and maintenance of the stormwater component shall be performed as noted below. The contractor shall have erosion control in place at all times. 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. Do not 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. <u>Inspection and Maintenance Schedules</u>

1. Inspection must be conducted at least once every 7 days and within 24 hours of the end of a storm event 0.5 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: (See attached inspection and maintenance log)
   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. The owner, or their representative, such as the contractor, shall inspect the following in-place work.

Inspection Schedule:

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

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

Maintenance Schedule

Erosion Control Devices Failure	Immediately
Catch Basins	Sump 1/4 full of sediment
Water Quality Manhole	As needed
Street 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. Inspection and Maintenance Log Form. (Log Form Follows)

Construction Period Pollution Prevention Plan

Appendix 8

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 Entity Responsible for Plan Compliance

Applicant: Mohiuddin Ahmed
95 Main Street, Suite 100
Westborough, MA 01581
PH: 508-962-1928

B. Stormwater Management System Owner

Owner:
Mohiuddin Ahmed
95 Main Street, Suite 100
Westborough, MA 01581
PH: 508-962-1928

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 stormwater 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).
   b. Make this log available to MassDEP and the Conservation Commission upon request; and
   c. Allow MassDEP and the Conservation Commission to inspect each BMP to determine whether the responsible party is implementing the Operation and Maintenance Plan.
3. Descriptions and Designs: The Best Management Practices (BMP) incorporated into the design include the following.
   a. Street 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 Basin/Separator Row to provide the required recharge and the required 44% pretreatment and 80%TSS removal. Refer to TSS Removal Worksheets in Standard 4 for treatment train.
   d. 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 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. Stormwater Infiltration Chamber Inlets and Outlets shall be inspected every three years, spring and fall, and cleaned in accordance with manufacturers recommendations.
    d. Infiltration Chamber Separator Row shall be inspected every six months for the first year and annually thereafter. Inspect using the inspection port via a CCTV. Clean with high pressure water through culvert cleaning nozzle when sediment accumulation reaches a depth of 3 inches or more.
    e. Infiltration Chambers: Inspect using the inspection port via a CCTV twice per year and after every major event for the first few months. A maintenance log shall be kept for all maintenance activities. See supplemental attachments included in this report for additional information.

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. 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 under a roof.
4. Follow manufacturers recommendation for disposal of used containers.
5. Store only enough product 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 in one location, 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.
7. Clean up spills.
    a. Spill Containment Kit to contain and clean-up spills that could occur on site.
    b. 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).
    c. Sweep up dry materials immediately. Never wash them away or bury them.
    d. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
    e. Report significant spills to the Fire Department, Conservation Commission and Board of Health.

F. <u>Provisions for maintenance of lawns, gardens, and other landscaped areas</u>
Use only organic fertilizer. Dispose of clippings outside of the 100-foot buffer zone to the adjacent wetland.

G. Requirements for storage and use of herbicides, and pesticides
The application of herbicides or pesticides will be done by professional certified contractor.

H. Provisions for operation and management of septic system
Site to be serviced by public sewer.

I. Requirements for handling of pet waste
Pet waste should never be dumped or washed into the local storm drain system. Waste shall be picked up immediately and placed in bags and properly disposed of in the garbage to be collected and taken to a landfill.

J. Provisions for washing of vehicles
Washing of vehicles shall be done in an area as to eliminate wash water from being directly discharged to the local storm drain system. Vehicles should be washed in areas where wash water can be held prior to discharging to the sanitary sewer system or in areas where infiltration precludes runoff to storm drains. Avoid using detergents whenever possible.

K. Provisions for solid waste management
1. Waste Management Plan
    a. Dumpster for trash and bulk waste collection shall be stored inside or under a roof.
    b. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material are recommended.
    c. Do not bury waste and debris on site.
    d. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.

L. Snow disposal and plowing plans relative to Wetland Resource Areas
Snow storage is adequate around the site for large storm events.

M. Winter Road Salt and/or Sand Use and Storage restrictions
No sand, salt, or chemicals for de-icing will be stored outside.

N. 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.

O. 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.

P. 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 a clean water quality site conditions.

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

Mohiuddin Ahmed
95 Main Street, Suite 100
Westborough, MA 01581
PH: 508-962-1928

This shall be the contact until such time as the project is sold.

R. Estimated BMP Maintenance Costs

The following prices are estimates of the costs associated with maintenance of the proposed site BMPs. Costs provided are only estimates and may not reflect actual costs to perform the work. Actual costs may vary depending on company/personnel performing the work. Actual costs may increase over time.

BMP	Estimated Maintenance Cost
Pavement sweeping	$ 400 per year
Catch basin cleaning	$ 200 per catch basin per cleaning
Infiltration Chambers	$ 500 per cleaning
Spill Containment Kit	$ 750 purchase price

Illicit Discharge Statement

Appendix 9

Illicit Discharge Compliance Statement

It is the intent of the Applicant, Mohiuddin Ahmed 95 Main Street, Suite 100, Westborough, MA 01581 (508) 962-1928, to control illicit disposal into the storm drainage system. 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 Applicant will also promote a clean Green Environment by mitigating spills onto pavements, oils, chemicals, pet waste, debris and litter.

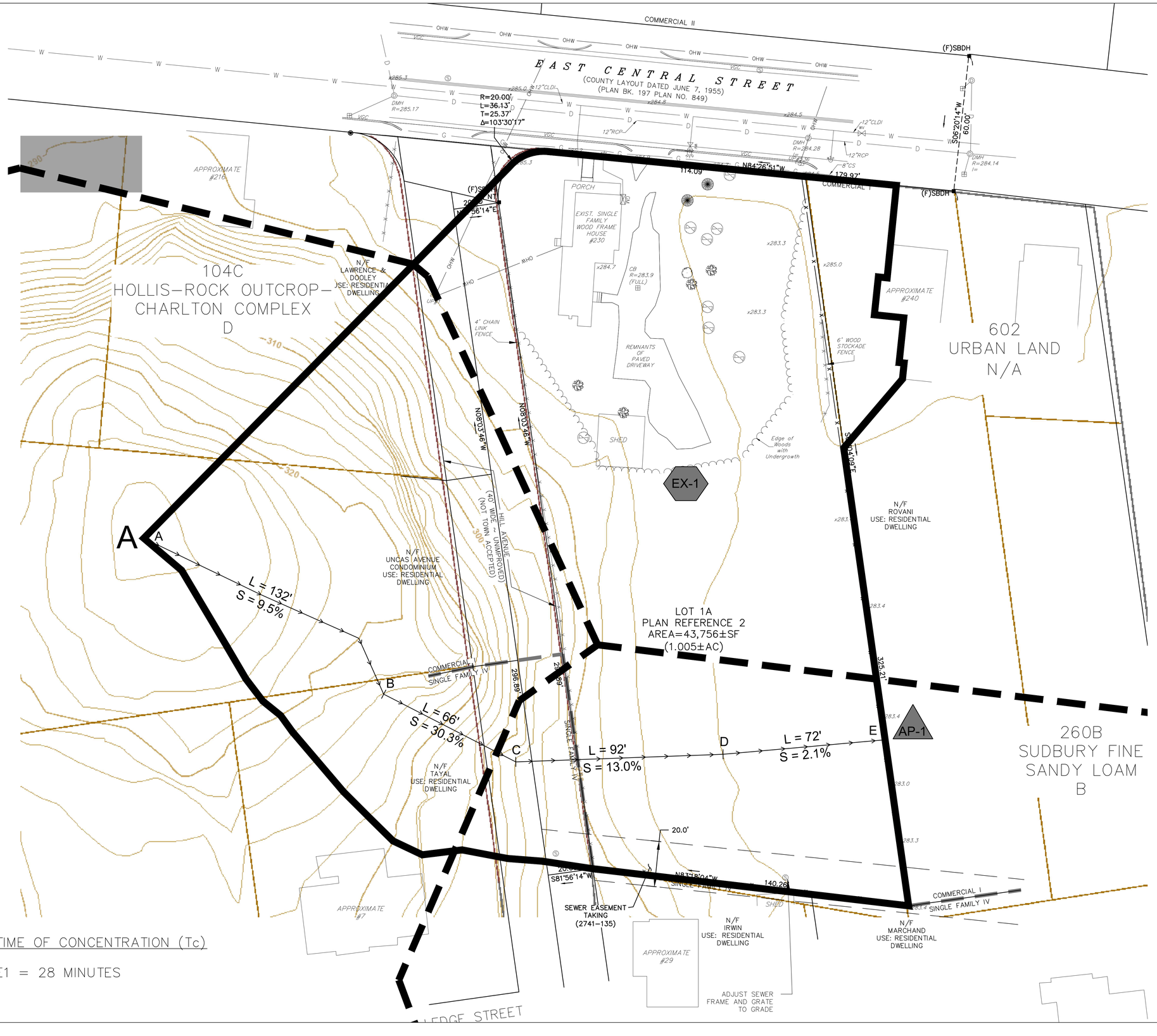
Respectfully Acknowledged,

_____

Mohiuddin Ahmed

Drainage Area Plans

Appendix 10



TIME OF CONCENTRATION (Tc)

E1 = 28 MINUTES

F4478

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. LOOKING 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

TAJ ESTATES OF FRANKLIN II, LLC
95 EAST MAIN STREET, SUITE 100
WESTBOROUGH, MA. 01581

DEED BOOK 40009 PAGE 445
ASSESSORS MAP 285 LOT 069

OWNER/APPLICANT

MOHIUDDIN AHMED
95 MAIN STREET, SUITE 100
WESTBOROUGH, MA. 01581

TAJ ESTATES OF FRANKLIN II
SITE PLAN & SPECIAL PERMIT
230 EAST CENTRAL STREET
FRANKLIN MASSACHUSETTS

EXISTING WATERSHED

NOVEMBER 11, 2021

DATE	REVISION DESCRIPTION

GRAPHIC SCALE: 1"=20'

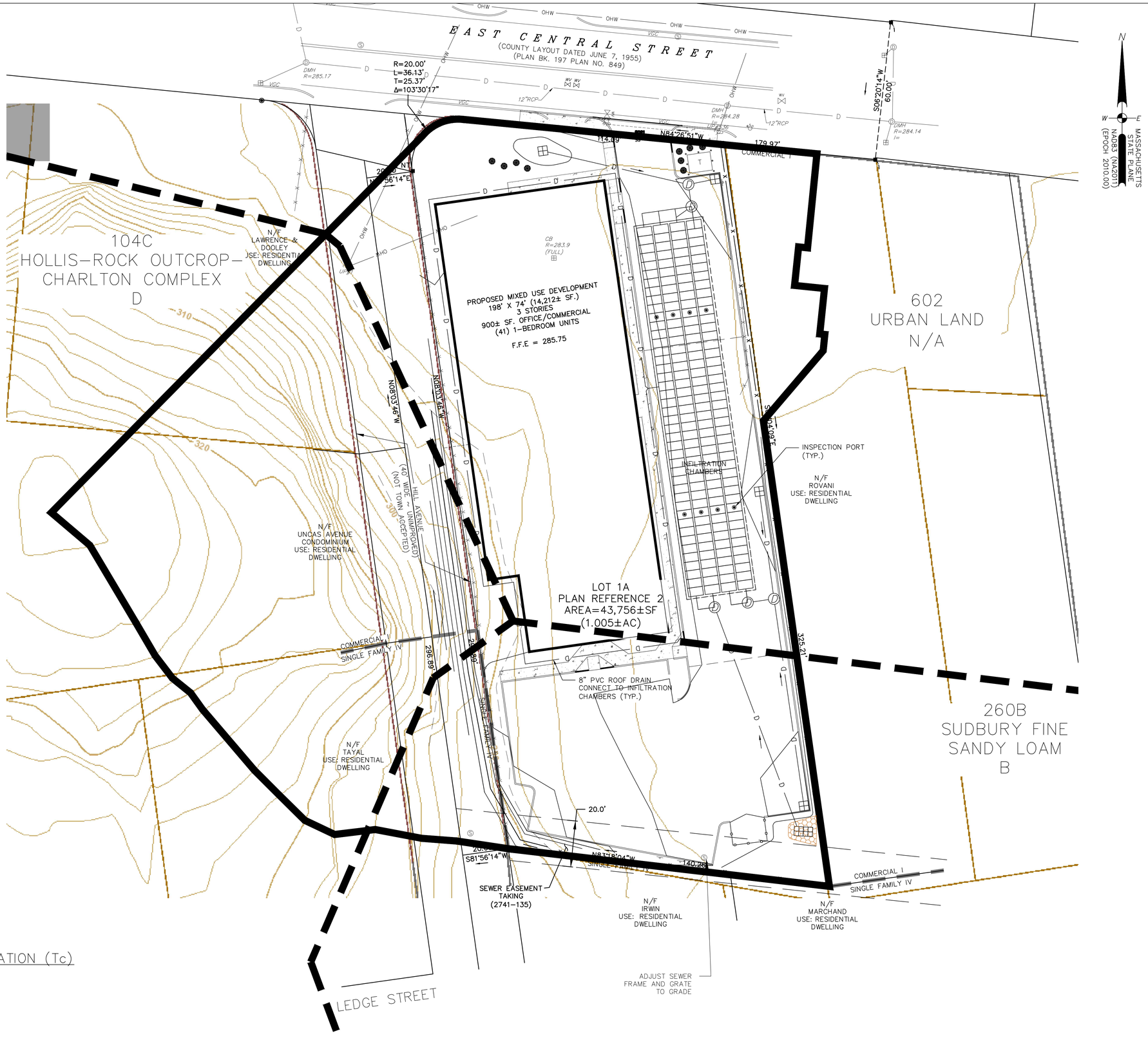
0 5 10 15 20 25 30 40 50 FEET
0 1 2 3 4 5 10 15 20 METERS

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

SHEET 1 OF 2

JOB NO. F4478

G:\C3D\Franklin\F4478 (F4194)\DWG\F4478 CIVIL.dwg, 11/11/2021 1:50:18 PM, [KP]



TIME OF CONCENTRATION (Tc)

P1 = 6 MINUTES

F4478

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. LOOKING 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

TAJ ESTATES OF FRANKLIN II, LLC
95 EAST MAIN STREET, SUITE 100
WESTBOROUGH, MA. 01581

DEED BOOK 40009 PAGE 445
ASSESSORS MAP 285 LOT 069

OWNER/APPLICANT

MOHIUDDIN AHMED
95 MAIN STREET, SUITE 100
WESTBOROUGH, MA. 01581

TAJ ESTATES OF FRANKLIN II
SITE PLAN & SPECIAL PERMIT
230 EAST CENTRAL STREET
FRANKLIN MASSACHUSETTS

PROPOSED CONDITIONS

NOVEMBER 11, 2021

DATE	REVISION DESCRIPTION

GRAPHIC SCALE: 1"=20'

0 5 10 15 20 25 30 40 50 FEET
0 1 2 3 4 5 10 15 20 METERS

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

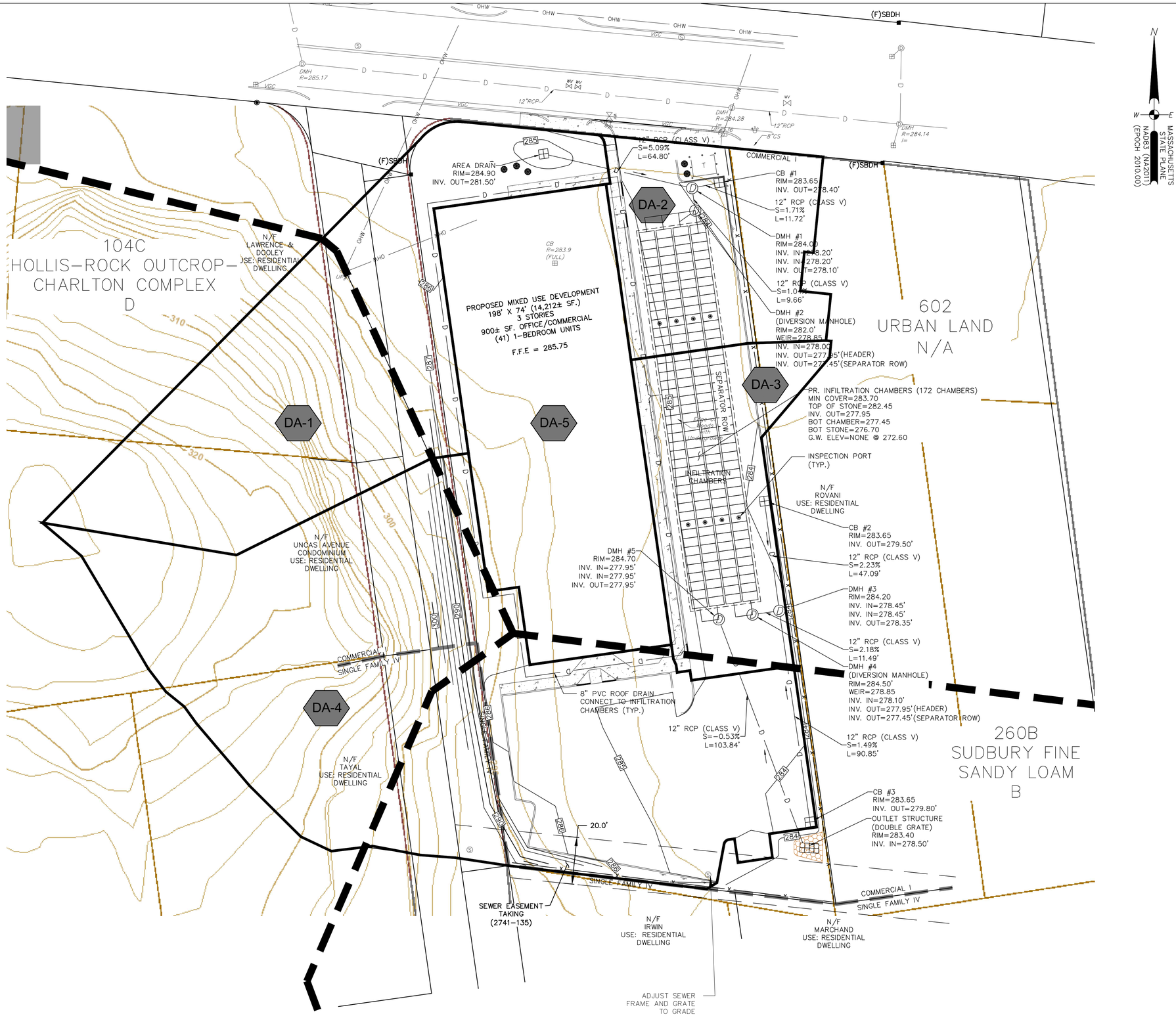
SHEET 2 OF 2

JOB NO. F4478

G:\C3D\Franklin\F4478 (F4194)\DWG\F4478 CIVIL.dwg, 11/11/2021 1:54:16 PM, [KP]

SUPPLEMENTAL ATTACHMENTS

Appendix 11



F4478

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. LOCKING 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

TAJ ESTATES OF FRANKLIN II, LLC
95 EAST MAIN STREET, SUITE 100
WESTBOROUGH, MA. 01581

DEED BOOK 40009 PAGE 445
ASSESSORS MAP 285 LOT 069

OWNER/APPLICANT

MOHIUDDIN AHMED
95 MAIN STREET, SUITE 100
WESTBOROUGH, MA. 01581

TAJ ESTATES OF FRANKLIN II
SITE PLAN & SPECIAL PERMIT
230 EAST CENTRAL STREET
FRANKLIN MASSACHUSETTS

DRAINAGE AREA PLAN

NOVEMBER 11, 2021

DATE	REVISION DESCRIPTION

GRAPHIC SCALE: 1"=20'

0 5 10 15 20 25 30 40 50 FEET
0 1 2 3 4 5 10 15 20 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. F4478

G:\C3D\Franklin\F4478 (F4194)\DWG\F4478 CIVIL.dwg, 11/11/2021 2:41:16 PM, [KP]

DRAINAGE AREAS - 230 East Central Street, Franklin MA

Land Use Coefficients "C"

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

Drainage Area	Land Use Area Impervious (acres)	Gravel (acres)	Wetland (acres)	Pervious (acres)	Woods (acres)	Roof (acres)	Total (acres)	Weighted "C"
DA-1				0.081	0.279		0.390	0.24
DA-2	0.094			0.075			0.170	0.63
DA-3	0.155			0.023			0.178	0.82
DA-4	0.229			0.110	0.384		0.723	0.46
DA-5						0.326	0.326	0.90
SUBTOTAL	0.094			0.156	0.663	0.326	1.787	0.11
OVERALL TOTALS	0.094			0.156	0.000	0.326	1.787	0.11

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

Project: 230 East central Street - Franklin, MA
Job No.: 4478

DESIGN COMPUTATIONS FOR STORM DRAINS

Prepared By: KKP Date: 11/03/2021 Revised:
Checked By: Date: Revised:

Drainage Area	Upper Structure	Lower Structure	Sum of CA's	Time of Concentration (Tc)	Rainfall Intensity (I)	Actual Peak Flow Rate (Q)	Pipe Diameter	Slope	Roughness Coefficient (n)	Design Flow Full (Q)	Velocity Flow Full (V)	Actual Velocity (V)	Length of Pipe (L)*	Time in pipe	Total Fall	Invert Elevation		Rim Elev		Destination
																Elev.	Elev.	Elev.	Elev.	
			(sf)	(min)	(in/hr)	(cfs)	(in)	(ft/ft)		(cfs)	(fps)	(fps)	(ft)	(min)	(ft)	Upper End	Lower End	Upper End	Lower End	
DA-1	LAWN INLET	DMH #1	0.09	6.00	5.80	0.54	12	0.051	0.013	8.04	10.24	0.69	64.8	0.11	3.30	281.50	278.20	284.90	283.95	
DA-2	CB #1	DMH #1	0.11	6.00	5.80	0.62	12	0.017	0.013	4.66	5.93	0.79	11.7	0.03	0.20	278.40	278.20	283.65	283.95	
	DMH #1	DMH #2	0.20	6.11	5.80	1.17	12	0.010	0.013	3.62	4.61	1.49	9.7	0.04	0.10	278.10	278.00	284.00	284.10	
DA-3	CB #2	DMH #3	0.15	6.00	5.80	0.85	12	0.022	0.013	5.32	6.77	1.08	47.1	0.12	1.05	279.50	278.45	283.65	284.20	INFILTRATION CHAMBERS CULTEC R-902HD INFILTRATION SYSTEM
DA-4	CB #3	DMH #3	0.34	6.00	5.80	1.94	12	0.015	0.013	4.36	5.55	2.47	90.1	0.27	1.35	279.80	278.45	283.65	284.20	
DA-3/DA-4	DMH #3	DMH #4	0.48	6.27	5.80	2.79	12	0.022	0.013	5.25	6.69	3.55	11.5	0.03	0.25	278.35	278.10	284.20	284.50	
DA-5	ROOF	CHAMBERS	0.29	6.00	5.80	1.70	8	0.042	0.011	2.93	8.39	4.88	90.4	0.18	3.80	281.25	277.45			

Pipe lengths were taken from center of structures

** 25 yr discharge flow rate from HydroCAD

Contactor® & Recharger®
Stormwater Chambers The Chamber With The Stripe®

Operation and Maintenance Guidelines

CULTEC™

Operation & Maintenance

This manual contains guidelines recommended by CULTEC, Inc. and may be used in conjunction with, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Introduction

The CULTEC Subsurface Stormwater Management System is a high-density polyethylene (HDPE) chamber system arranged in parallel rows surrounded by washed stone. The CULTEC chambers create arch-shaped voids within the washed stone to provide stormwater detention, retention, infiltration, and reclamation. Filter fabric is placed between the native soil and stone interface to prevent the intrusion of fines into the system. In order to minimize the amount of sediment which may enter the CULTEC system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the CULTEC chamber system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with CULTEC chambers. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the CULTEC chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

I. Operation

CULTEC stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. CULTEC subsurface stormwater management chambers operate at peak performance when installed in series with pretreatment. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

II. Inspection and Maintenance Options

A. The CULTEC system may be equipped with an inspection port located on the inlet row. The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the CULTEC Chamber row below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream manhole or through the CULTEC StormFilter Unit (or other pre-treatment device). CCTV inspection of this row can be deployed through this access port to determine if any sediment has accumulated in the inlet row.

B. If the CULTEC bed is not equipped with an inspection port, then access to the inlet row will be through an upstream manhole or the CULTEC StormFilter.

1. Manhole Access
This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

2. StormFilter Access
Remove the manhole cover to allow access to the unit. Typically a 30-inch (750 mm) pipe is used as a riser from the StormFilter to the surface. As in the case with manhole access, this access point requires a technician trained in confined space entry with proper gas detection equipment. This individual must be equipped with the proper safety equipment for entry into the StormFilter. The technician will be lowered onto the StormFilter unit. The hatch on the unit must be removed. Inside the unit are two filters which may be removed according to StormFilter maintenance guidelines. Once these filters are removed the inspector can enter the StormFilter unit to launch the CCTV camera robot.

C. The inlet row of the CULTEC system is placed on a polyethylene liner to prevent scouring of the washed stone beneath this row. This also facilitates the flushing of this row with high pressure water through a culvert cleaning nozzle. The nozzle is deployed through a manhole or the StormFilter and extended to the end of the row. The water is turned on and the inlet row is back-flushed into the manhole or StormFilter. This water is to be removed from the manhole or StormFilter using a vacuum truck.

III. Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the CULTEC stormwater management system:

A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.

B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.

C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.

D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

IV. Suggested Maintenance Schedules

A. Minor Maintenance
The following suggested schedule shall be followed for routine maintenance during the regular operation of the stormwater system:

Frequency	Action
Monthly in first year	Check inlets and outlets for clogging and remove any debris as required.
Spring and Fall	Check inlets and outlets for clogging and remove any debris as required.
One year after commissioning and every third year following	Check inlets and outlets for clogging and remove any debris as required.

B. Major Maintenance
The following suggested maintenance schedule shall be followed to maintain the performance of the CULTEC stormwater management chambers. Additional work may be necessary due to insufficient performance and other issues that might be found during the inspection of the stormwater management chambers. (See table on next page)

Major Maintenance *(continued)*

	Frequency	Action
Inlets and Outlets	Every 3 years	• Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
	Spring and Fall	• Check inlet and outlets for clogging and remove any debris as required.
CULTEC Stormwater Chambers	2 years after commissioning	• Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
	9 years after commissioning every 9 years following	• Clean stormwater management chambers and feed connectors of any debris. • Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended.
	45 years after commissioning	• Clean stormwater management chambers and feed connectors of any debris. • Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. • Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique.
	45 to 50 years after commissioning	• Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. • Attain the appropriate approvals as required. • Establish a new operation and maintenance schedule.
Surrounding Site	Monthly in 1st year	• Check for depressions in areas over and surrounding the stormwater management system.
	Spring and Fall	• Check for depressions in areas over and surrounding the stormwater management system.
	Yearly	• Confirm that no unauthorized modifications have been performed to the site.

For additional information concerning the maintenance of CULTEC Subsurface Stormwater Management Chambers, please contact CULTEC, Inc. at 1-800-428-5832.

CULTEC™
Chamber of Choice™

CULTEC, Inc.
878 Federal Road • P.O. Box 280 • Brookfield, CT 06804
Phone: 203-775-4416 • Toll Free: 800-4-CULTEC • Fax: 203-775-1462
Web: www.cultec.com • E-mail: custservice@cultec.com

CULTEC Separator™ Row
Water Quality System

Operation & Maintenance Guide
for CULTEC Stormwater Management Systems

The Founder of Plastic Chamber Technology

www.cultec.com | 1(800) 4-CULTEC |

CULTEC®

Published by
CULTEC, Inc.
P.O. Box 280
878 Federal Road
Brookfield, Connecticut 06804 USA
www.cultec.com

Disclaimers:
The drawings, photographs and illustrations shown in this document are for illustrative purposes only and are not necessarily to scale.
Actual designs may vary.

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

CULTEC is not responsible for typographical errors.

Protected by one or more of the following patents:
Protected by one or more of the following patents:
U.S. Patents 6,129,482; 6,322,288; 6,854,925; 7,226,241; 7,806,627; 8,366,346; 8,425,148; and others; U.S. Designs D613819; D638,095; D668,318 and others; Canadian Patent 2,591,255 and others; Community Designs 1092191; 1745209; and others.

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

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

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

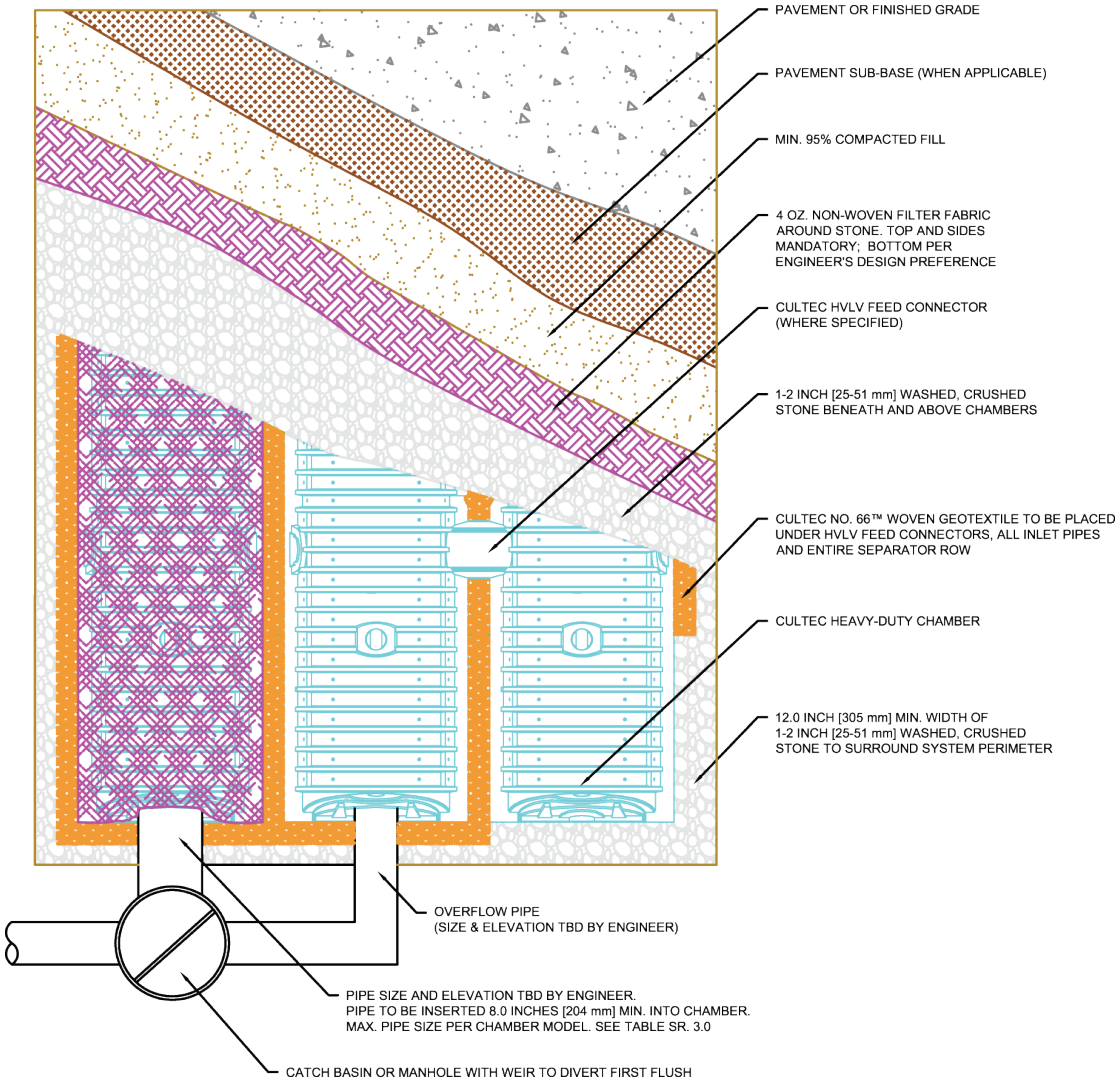
Doc ID: CULG046 03-16
March 2016

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. Two layers of CULTEC No. 66 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.



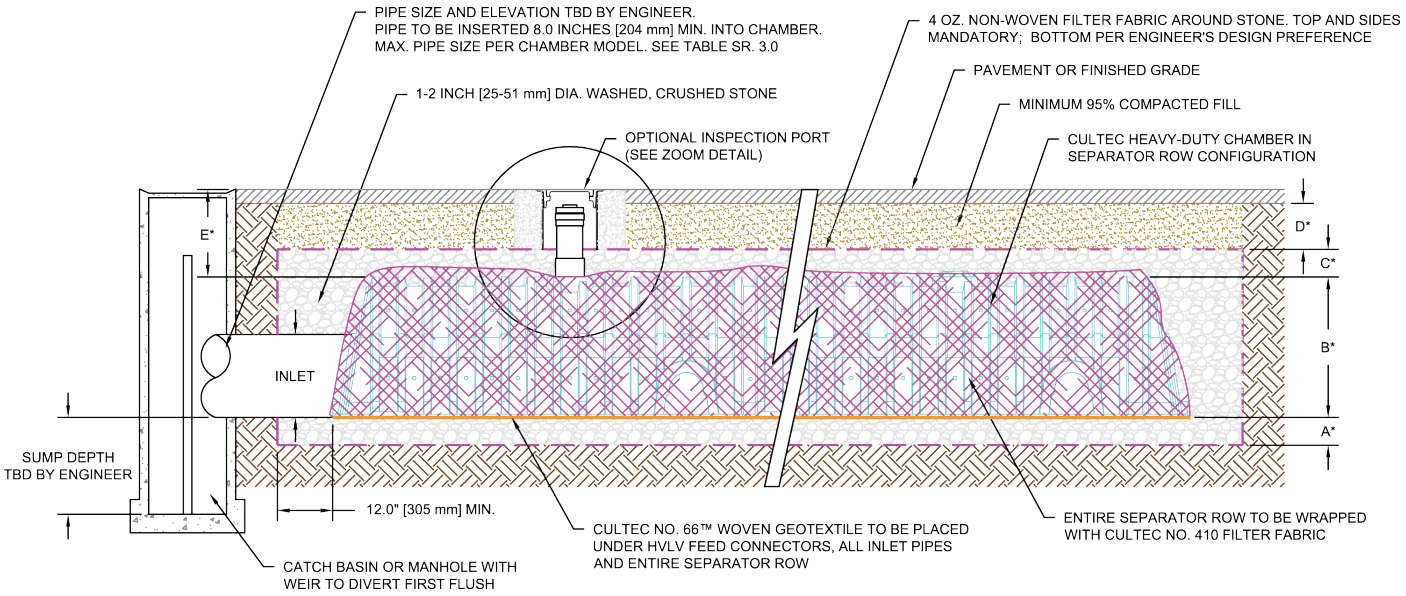
Design

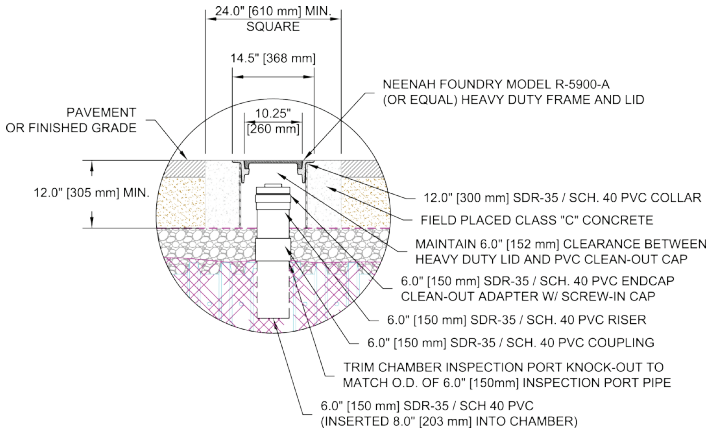
There is no single design to achieve a high level of water quality. The CULTEC Separator Row should be designed as part of an overall best management practices water quality system. Pre-treatment devices such as sump catch basins, inlet baffles and proprietary oil-grit separators and filter systems can 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.





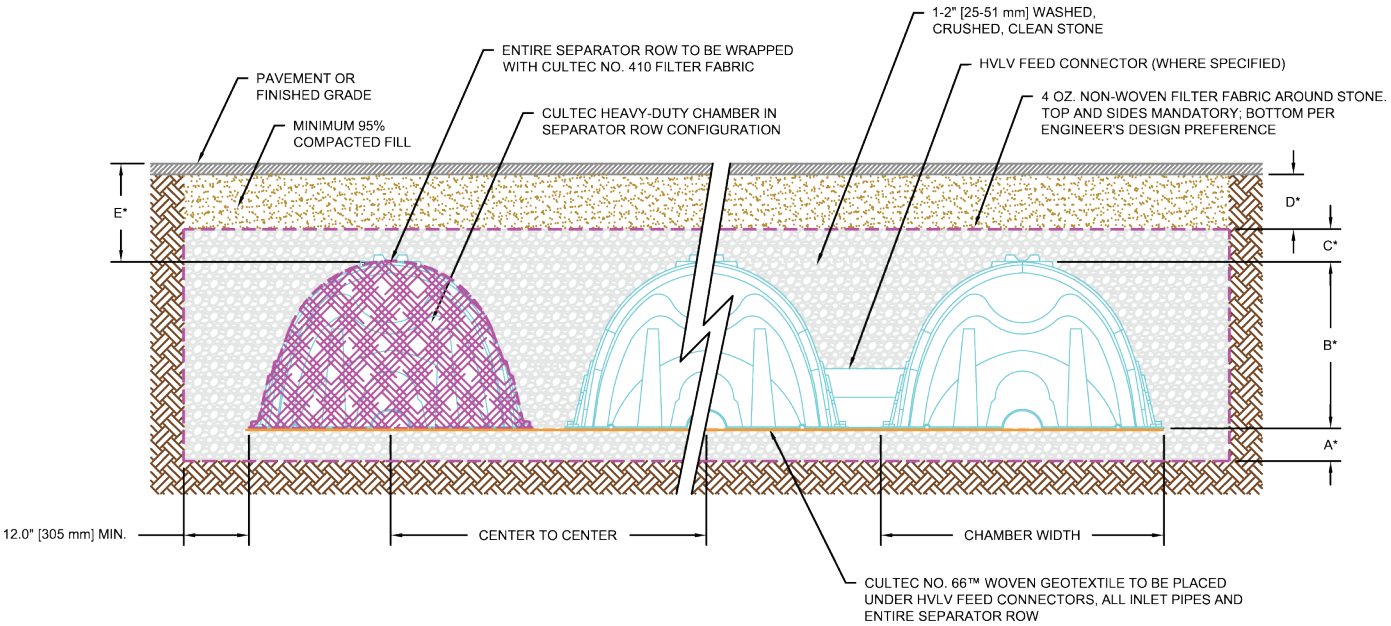


Table SR/3.0

	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 m
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 application	8″ 203 mm	8″ 203 mm	8″ 203 mm	10″ 254 mm	12″ 3305 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	8.5′ 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

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.

Inspection and Maintenance Record

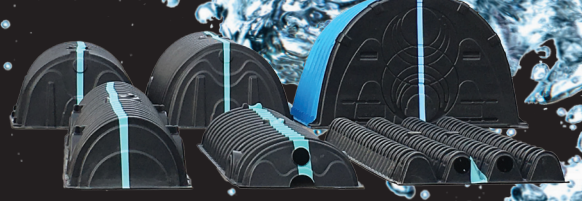
Date	Mode of Access	Frequency	Depth of Sediment	Actions	Expenses	Inspector	Notes
Ex.	Inspection Port	Semi-annually	2”	Measure sediment depth with stadia rod. Visually inspect	$100	DPG	Depth of Sediment was measured via Northeast Inspection Port Adjacent to MH-1. Sediment depth was found to be 2”. No further action required at this time.
Ex.	Access Manhole	Annually					

CULTEC®

The Founder of Plastic Chamber Technology

www.cultec.com | 1(800) 4-CULTEC |

878 Federal Road | P.O. Box 280 | Brookfield , CT 06804 USA



CULG046 03-16

Infiltration Chambers Inspection & Maintenance Log

Model : Cultec Recharger 902HD

Property: 230 East Central Street, Franklin MA

Date	Chamber ID	Depth of Sediment (ft)	Depth to bottom of chamber (ft)	Depth of water (if any) (ft)	Maintenance Personnel	Describe Maintenance Performed / Comments

Infiltration Chambers Inspection & Maintenance Log

Model : Cultec Recharger 902HD

Property: 230 East Central Street, Franklin MA

Date	Chamber ID	Depth of Sediment (ft)	Depth to bottom of chamber (ft)	Depth of water (if any) (ft)	Maintenance Personnel	Describe Maintenance Performed / Comments

Post Construction Inspection Report
230 East Central Street
Franklin, Massachusetts

INSPECTION DATE:

Person Inspecting		Weather				Other Personnel Present
		Clear				

Item	N/A*	sat.**	NMR***	CAM**	MCA*	Comments:
Pavement Swept						
Catch Basins						
LAWN INLET						
CB #1						
CB #2						
CB #3						
Manholes						
DMH #1						
DMH #2						
DMH #3						
DMH #4						
DMH #5						
OUTLET STRUCTURE						
Infiltration Chambers						
Inspection Port 1						
Inspection Port 2						
Inspection Port 3						
Inspection Port 4						
Inspection Port 5						
Inspection Port 6						
Inspection Port 7						
Inspection Port 8						
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						