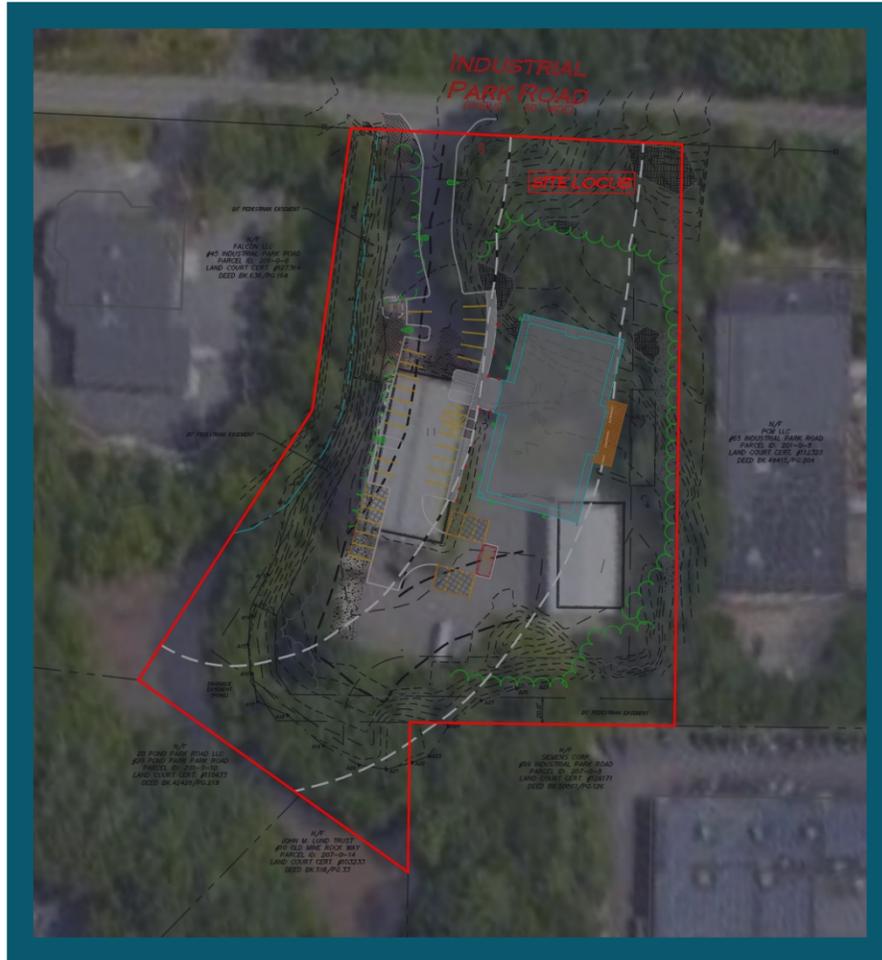




DRAINAGE REPORT

**ALLEN & MAJOR
ASSOCIATES, INC.**

Proposed Office Building
55 Industrial Park Road
Hingham, MA



APPLICANT:

Fifty-Five Saxon Hingham LLC
Syliva Driver
25 Recreation Park Drive
Hingham, MA 02043

PREPARED BY:

Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347



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Lakeville, MA 02347

ISSUED:

October 17, 2024

REVISED:

June 10, 2025

A&M PROJECT NO.:

1179-20A



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**SECTION 1.0 -
DRAINAGE REPORT**



Introduction

The purpose of this drainage report is to provide an overview of the proposed stormwater management system (SMS) for the Office Building to be located at 55 Industrial Park Road in Hingham, MA. The report will show by means of narrative, calculations and exhibits that the proposed stormwater management system will meet or exceed the Massachusetts Department of Environmental Protection (MassDEP) stormwater standards, and the Town of Hingham Stormwater Management Regulations.

The proposed site improvements include the demolishing of two buildings, clearing of existing vegetation and construction of one office building footprint and related infrastructure of surface parking, landscaping and underground utilities site. The project will be serviced by connecting existing utilities off Industrial Park Road.

The proposed SMS incorporates structural and non-structural Best Management Practices (BMPs) to provide stormwater peak flow mitigation, quality treatment, and conveyance.

The SMS includes catch basins, infiltration basins, drain manholes, roof drains, underground piping, underground infiltration chambers, and an Operation & Maintenance Plan.

Site Categorization for Stormwater Regulations

The proposed site improvements at 55 Industrial Park Road are considered a mix of new and redevelopment MassDEP Stormwater Management Standards with a net decrease in impervious area. However, the project will meet all of new development Stormwater Management Standards listed within the MA DEP Stormwater Handbook.

Site Location and Access

The site is a single lot with 250 feet of frontage on Industrial Park Road, entirely within the town of Hingham. The parcel is located approximately 360 feet from the intersection of Industrial Park Road and Pond Park Road.

The parcel is abutted by five properties. On the western border there is Falcon LLC #45 industrial park road, parcel id: 201-0-6, land court cert. #127364, deed bk.636/pg.164. In the southwestern border there is 20 pond park road LLC, #20 pond park road, parcel id: 201-0-10, land court cert. #118433, deed bk.42426/pg.219. In the southern most border there is John M. Lund trust, #10 old mine rock way, parcel id: 207-0-14, land court cert. #103233, deed bk.516/pg.33. In the Southeastern border there is Siemens CORP., #99 industrial park road, parcel id: 207-0-8, land court cert. #128171, deed bk.50861/pg.126. The last Abutter on the eastern border is PCM LLC, #65 industrial park road, parcel id: 201-0-8, land court cert. #112328, deed bk.49415/pg.204.



The site is accessed by an existing curb cut along Industrial Park Road. The proposed curb cut will be in the same location.

Existing Site Conditions

The site currently includes two buildings with asphalt parking areas and a driveway. The site topography generally flows from east to west. The site has been broken into four subcatchments that all drain to the same study point in the wetlands on the south west portion of the site for drainage analysis.

Watershed

The subject property is located within the Weir River Watershed. At about 23.4 square miles, the Weir River Watershed is a sub-basin of the Boston Harbor Watershed. The watershed feeds directly into the Boston harbor.

Existing Soil Conditions

The on-site soils were identified using the USDA Natural Resources Conservation Services (NRCS) Soil Survey for Plymouth County. The site is primarily soil type B. A copy of the NRCS Custom Soil Resource Report is included in the appendix of this report.

FEMA Floodplain/Environmental Due Diligence

There are no portions of the site located within the FEMA Zone "AE" Special Flood Hazard Area Subject to Inundation by the 1% Annual Chance Flood (100-year floodplain). The official Flood Insurance Rate Map (FIRM) effective date JULY 3, 2024, community panel 25023C0091L. See section 3 of this report for a copy of the FEMA FIRM. FEMA flood zone A is noted on the property.

Environmentally Sensitive Zones

The Commonwealth of Massachusetts asserts control over numerous protected and regulated areas including: Areas of Critical Environmental Concern (ACEC); Outstanding Resource Waters (ORWs); Priority and Protected Habitat for rare and endangered species, and areas protected under the Wetlands Protection Act. The subject property is not located within any of these regulated areas.

Drainage Analysis Methodology

A peak rate of runoff will be determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.
2. HydroCAD © Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.00-24. The HydroCAD program was used to generate the runoff



hydrographs for the watershed areas, to determine discharge/ stage/storage characteristics for the stormwater BMPs, to perform drainage routing and to combine the results of the runoff hydrographs. HydroCAD uses the TR-20 methodology of the SCS Unit Hydrograph procedure (SCS-UH).

Proposed Conditions – Peak Rate of Runoff

The stormwater runoff analysis of the existing and proposed conditions includes an estimate of the peak rate of runoff from various rainfall events. Peak runoff rates were developed using TR55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD computer program. Further, the analysis has been prepared in accordance with the MassDEP and the town of Hingham requirements and standard engineering practices. The peak rate of runoff has been estimated for each watershed during the 2, 10, and 100-year storm events.

The proposed stormwater management system for the site consists of catch basins, infiltration basins, drain manholes, roof drains, underground piping, and underground infiltration chambers. These systems have been designed in accordance with the MA DEP Stormwater Management Policy to recharge groundwater and reduce rate of runoff from the parcel.

Study Point #1 has infiltration basins and an infiltration chamber system. All of these systems are designed to retain and infiltrate stormwater. Overflow from these systems is directed towards the wetlands area that is modeled as Study Point 1.

The stormwater runoff model indicates that the proposed site development reduces the rate of runoff during all storm events at the identified points of analysis. The following table provide a summary of the estimated peak rate, in Cubic Feet per Second (CFS) and total runoff volume, in cubic-feet (CF) at the Study Point for each of the design storm events. The HydroCAD worksheets are included in Section 4 and 5 of this report.

STUDY POINT #1 (Flow to Wetlands)			
	2-Year	10-Year	100-Year
Existing Flow (CFS)	1.96	5.38	10.99
Proposed Flow (CFS)	0.88	3.04	9.00
Decrease (CFS)	1.08	2.34	1.99
Existing Volume (CF)	8,909	20,016	41,392
Proposed Volume (CF)	4,494	13,223	33,199
Change (CF)	4,415	6,793	8,193

MASSDEP Stormwater Performance Standards

The MA DEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for stormwater management. The intent is to implement the stormwater management standards through the review of Notice of Intent



filings by the issuing authority (Conservation Commission or DEP). The following section outlines how the proposed Stormwater Management System meets the standards set forth by the Policy.

BMP's implemented in the design include –

- Deep Sump Catch Basins
- Subsurface Structures
- Surface Infiltration Basins
- Specific maintenance schedule

Stormwater Best Management Practices (BMP's) have been incorporated into the design of the project to mitigate the anticipated pollutant loading. An Operations and Maintenance Plan has been developed for the project, which addresses the long-term maintenance requirements of the proposed system.

Temporary erosion and sedimentation controls will be incorporated into the construction phase of the project. These temporary controls may include straw bale and/or silt fence barriers, inlet sediment traps, slope stabilization, and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10) Stormwater Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The Standards are enumerated below as well as descriptions and supporting calculations as to how the Project will comply with the Standards:

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

The proposed development will not introduce any new stormwater conveyances (e.g. outfalls) that discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

2. *Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.*

The proposed development has been designed so that the post-development peak discharge rates do not exceed the predevelopment peak discharge rates. A summary of the existing and proposed discharge rates is included within this document.

3. *Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low*



impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The existing annual recharge for the site has been approximated in the proposed condition. There are proposed subsurface infiltration systems designed to meet this requirement. Stormwater runoff generated from the impervious areas of the proposed development are routed through these infiltration BMPs. The proposed Recharge Volume is based on the Static Method per the MA DEP Stormwater Management Standards, Volume 3, Chapter 1.

See the appendix located at section 6 of this report for stormwater recharge calculations.

4. *Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:*
- *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;*
 - *Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and*
 - *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

Standard #4 is met when structural stormwater best management practices are sized to capture and treat the required water quality volume and pretreatment is provided in accordance with the Massachusetts Stormwater Handbook. Standard #4 also requires that suitable source control measures are identified in the Long-term Pollution Prevention Plan. The water quality volume for the site redevelopment is captured and treated using catch basins, infiltration basins, drain manholes, roof drains, underground piping, and underground infiltration chambers.



The implemented BMPs have been designed to treat the contributing water quality volume. These water quality calculations can be seen within the appendix of this report.

The proposed stormwater management system has been designed to remove 85% of the average annual post-construction load for each treatment train, minimum. The TSS removal calculations can be seen within the appendix of this report.

The TSS removal efficiencies for the proprietary separator are based on the values assigned under the Technology Acceptance and Reciprocity Partnership (TARP) testing protocol. The TARP is a workgroup of the Environmental Council of States that was originally comprised of California, Illinois, Maryland, Massachusetts, New Jersey, New York, Pennsylvania and Virginia. TARP is recognized in the MA DEP Stormwater Management Handbook as a valid source for assigning TSS removal efficiencies for proprietary separators.

5. *For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.*

The site is not considered a land use with higher potential pollutant loads.

6. *Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or*



wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

The project site does not discharge stormwater within a Zone II or Interim Wellhead Protection Area or near a critical area. Critical Areas are Outstanding Resource Waters as designated in 314 CMR 4.00, Special Resource Waters as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02, bathing beaches as defined in 105 CMR 445.000, cold-water fisheries as defined in 314 CMR 9.02 and 310 CMR 10.04, and shellfish growing areas as defined in 314 CMR 9.02 and 310 CMR 10.04.

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

The proposed project is considered a mix of new and redevelopment under the Stormwater Management Handbook guidelines. However all stormwater standards have been met.

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

A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction has been developed. A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

9. *A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.*

A Long-Term Operation & Maintenance (O&M) Plan has been developed for the proposed stormwater management system and is included within this document. See Section 2.0 of this report.



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

There are no expected illicit discharges to the stormwater management system. The applicant will submit the Illicit Discharge Compliance Statement prior to the discharge of stormwater runoff to the post-construction stormwater best management practices and prior to the issuance of a Certificate of Compliance.

See the next page for the MassDEP Stormwater Checklist.



Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.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 8²
- 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.



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

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): Subsurface Infiltration and Detention System

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 Field¹
- 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.



**SECTION 2.0 -
OPERATION &
MAINTENANCE PLAN**



Introduction

In accordance with the standards set forth by the Stormwater Management Policy issued by the Massachusetts Department of Environmental Protection (MassDEP), Allen & Major Associates, Inc. has prepared the following Operations & Maintenance (O&M) Plan for the development at 55 Industrial Park Road in Hingham, MA.

The plan is broken down into three major sections. The first section describes construction-related erosion and sedimentation controls (Demolition & Construction Maintenance Plan). The second section describes the long-term pollution prevention measures (Long Term Pollution Prevention Plan). The third section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long-Term Maintenance Plan – Facilities Description).

Notification Procedures for Change of Responsibility for O&M

The Stormwater Management System (SMS) for this project is owned by Fifty-Five Saxon Hingham LLC (owner). The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance Plan.

The owner shall submit an annual summary report and the completed Operation & Maintenance Schedule & Checklist to the Conservation Commission (via email or print copy), highlighting inspection and maintenance activities including performances of BMPs. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the Commission that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the Commission of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the Commission.



Contact Information

Stormwater Management System Owner: Fifty-Five Saxon Hingham LLC
25 Recreation Park Drive
Hingham, MA
Phone: (781) 875-3300

Emergency Contact Information:

Fifty-Five Saxon Hingham LLC (Owner/Operator)	Phone: (781) 875-3300
Allen & Major Associates, Inc. (Site Civil Engineer)	Phone: (508) 923-1010
Town of Hingham Department of Public Works	Phone: (781) 741-1430
Town of Hingham Conservation Commission	Phone: (781) 741-1445
Town of Hingham Fire Department (non-emergency line)	Phone: (781) 741-1480
MassDEP Emergency Response	Phone: (888) 304-1133
Clean Harbors Inc (24-Hour Line)	Phone: (800) 645-8265

Demolition & Construction Maintenance Plan

1. Call Digsafe: 1-888-344-7233
2. Contact the Town of Hingham at least three (3) days prior to start of demolition and/or construction activities.
3. Install Erosion Control measures as shown on the Plans prepared by A&M. The Hingham Conservation Commission shall review the installation of straw bales and silt fencing prior to the start of any site demolition work. Install Construction fencing if determined to be necessary at the commencement of construction.
4. Install construction entrances, straw bales, and silt fence at the locations shown on the Erosion Control Plan prepared by A&M.
5. Site access shall be achieved only from the designated construction entrances.
6. Cut and clear trees in construction areas only (within the limit of work; see plans).
7. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.



8. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.
9. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on-site for review.
10. All erosion control measures shall be maintained, repaired, or replaced as required or at the direction of the owner's engineer or the Town.
11. Sediment accumulation up-gradient of the straw bales, silt fence, and stone check dams greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.
12. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.
13. Install stone check dams on-site during construction as needed. Refer to the erosion control details. Temporary sediment basins combined with stone check dams shall be installed on-site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.
14. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
15. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
16. Dust pollution shall be controlled using on-site water trucks and/or an approved soil stabilization product.
17. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly. The report shall document any deficiencies and corrective actions taken by the applicant.

Long-Term Pollution Prevention Plan

Standard #4 from the MassDEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance Plan of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures of the LTPPP.



- Housekeeping
The existing development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland areas. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

- Storing of Materials & Water Products
The trash and waste program for the site includes exterior dumpsters. There is a trash contractor used to pick up the waste material in the dumpsters. The stormwater drainage system has water quality inlets designed to capture trash and debris.

- Vehicle Washing
Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The existing development does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

- Spill Prevention & Response
Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the buildings and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:
 1. Spill hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
 2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
 3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
 4. All spills shall be cleaned up immediately after discovery.



5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at (888) 304-1333.
 6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.
- Maintenance of Lawns, Gardens, and Other Landscaped Areas

It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff/landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trees shall be planted over the drain lines or recharge area, and that only shallow rooted plants and shrubs will be allowed.

 - Fertilizer

Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ration of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

Type:	LESCO® 28-0-12 (Lawn Fertilizer)
	MERIT® 0.2 Plus Turf Fertilizer
	MOMENTUM™ Force Weed & Feed
 - Suggested Aeration Program



In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

o Landscape Maintenance Program Practices:

▪ Lawn

1. Mow a minimum of once a week in spring, to a height of 2" to 2 1/2" high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cut, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.
2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
4. Do not remove grass clippings after mowing.
5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.



- Shrubs
 1. Mulch not more than 3" depth with shredded pine or fir bark.
 2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals are to occur within 6" of the ground to open up shrub and maintain two-year wood (the blooming wood).
 3. Hand-prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
- Trees
 1. Provide aftercare of new tree plantings for the first three years.
 2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
 3. Water once a week for the first year; twice a month for the second; once a month for the third year.
 4. Prune trees on a four-year cycle.
- Invasive Species
 1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

- Storage and Use of Herbicides and Pesticides

Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) should be retained who is licensed with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Department of Agricultural Resources.

The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor household or structural pests, refer to 333 CMR 13.08.



Before beginning each application, the applicator must post a Department approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator's best judgment. It is intended to give sufficient notice so that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

1. Name and phone number of pest control company;
 2. Date and time of the application;
 3. Name and license number of the applicator;
 4. Target pests; and
 5. Name and EPA Registration Number of pesticide products applied.
- Pet Waste Management
The owner's landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the development. The pet waste shall be disposed of in accordance with local and state regulations.
 - Operations and Management of Septic Systems
The septic system shall be maintained in accordance with the requirements of the Hingham Board of Health and the State Environmental Code.
 - Management of Deicing Chemicals and Snow
Snow will be stockpiled on site until the accumulated snow becomes a hazard to the daily operations of the site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to MassDEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations

The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. If used, the de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. If used, de-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand.



Long-Term Maintenance Plan – Facilities Description

A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

The following is a description of the Stormwater Management System for the project site.

Stormwater Collection System – On-Site:

The stormwater collection system is a series of inlets located at low points within the limits of the paved area. All of the proposed on-site catch basins incorporate a deep sump and hooded outlet. The catch basins are connected by a closed gravity pipe network that pass through proprietary separators prior to entering the underground detention chambers.

Structural Pretreatment BMPs: Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

- **Deep Sump Catch Basin:**
Precast structure equipped with grated inlet and 4' sump to allow sediment to settle out.
- **Isolator Row:**
Single row of underground chambers wrapped in geotextile to filter out sediment. Equipped with overflow into remaining chambers.
- **Sediment Forebay:**
Shallow ponding area situated before an infiltration basin equipped with a spillway and design to settle out sediment prior to overflow.

Infiltration BMPs:

- **Subsurface Structures:**
Underground chambers surrounded by stone used to store large volumes of stormwater and allow for infiltration into the groundwater.

Other Maintenance Activity:

- **Mosquito Control** - Both above ground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance, and treatment with larvicides can minimize this potential. See



the supplemental information for Mosquito Control in Stormwater Management Practices, and the Operation and Maintenance Plan Schedule for inspection schedule.

- Street Sweeping - Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Inspection and Maintenance Frequency and Corrective Measures

In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the previously described BMPs will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the footprint of the SMS.

Supplemental Information

- Operation & Maintenance Plan Schedule
- Massachusetts Stormwater Handbook, Chapter 5, Miscellaneous Stormwater Topics, Mosquito Control in Stormwater Management Practices.

OPERATION AND MAINTENANCE PLAN SCHEDULE

Date: 10-17-2024



Project: Office Building/Office Parks
Project Address: 55 Industrial Park Road, Hingham, MA
Responsible for O&M Plan: Saxon Partners
Address: 25 Recreation Park Drive Hingham, MA 02043
Phone: (781) -875-3300

All information within table is derived from Massachusetts Stormwater Handbook: Volume 2, Chapter 2

BMP CATEGORY	BMP OR MAINTENANCE ACTIVITY	SCHEDULE/FREQUENCY	NOTES	ESTIMATED ANNUAL MAINTENANCE COST	INSPECTION PERFORMED	
					DATE:	BY:
STRUCTURAL PRETREATMENT BMPs	DEEP SUMP CATCH BASIN	Four times per year (quarterly).	Inspect and clean catch basin units whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.	\$1,000		
INFILTRATION BMPs	INFILTRATION BASIN	Inspect after every major storm during first 3 months of operation and twice a year thereafter. Clean pretreatment devices twice a year and after every major storm.	Inspect to ensure proper functioning. Mow the buffer area, side slopes, and basin bottom if grassed floor; rake if stone bottom; remove trash and debris; remove grass clippings and accumulated organic matter. Inspect and clean pretreatment devices.	\$1,500		
	SUBSURFACE STRUCTURES	Inspect structure inlets at least twice a year. Remove debris that may clog the system as needed.	Because subsurface structures are installed underground, they are extremely difficult to maintain. Remove any debris that might clog the system.	\$500		

BMP ACCESSORIES	OUTLET STRUCTURES	Periodic cleaning of Outlet Control Structures as needed.	Clear trash and debris as necessary.	\$500		
OTHER MAINTENANCE ACTIVITY	MISQUITO CONTROL	Inspect BMPs as needed to ensure the system's drainage time is less than the maximum 72 hour period.	Massachusetts stormwater handbook requires all stormwater practices that are designed to drain do so within 72 hours to reduce the number of mosquitos that mature to adults since the aquatic stage of a mosquito is 7-10 days.	\$100		
	SNOW STORAGE	Clear and remove snow to approved storage locations as necessary to ensure systems are working properly and are protected from meltwater pollutants.	Carefully select snow disposal sites before winter. Avoid dumping removed snow over catch basins, or in detention ponds, sediment forebays, rivers, wetlands, and flood plains. It is also prohibited to dump snow in the bioretention basins or gravel swales.	\$500		
	STREET SWEEPING	Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring.	Sweep, power broom or vacuum paved areas. Submit information that confirms that all street sweepings have been completed in accordance with state and local requirements	\$2,000		

Chapter 5 Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within 3 days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

Some stormwater practices are designed to include permanent wet pools. These practices – if maintained properly – can limit mosquito breeding by providing habitat for mosquito predators. Additional measures that can be taken to reduce mosquito populations include increasing water circulation, attracting mosquito predators by adding suitable habitat, and applying larvicides.

The Massachusetts State Reclamation and Mosquito Control Board (SRMCB), through the Massachusetts Mosquito Control Districts, can undertake further mosquito control actions specifically for the purpose of mosquito control pursuant to Massachusetts General Law Chapter 252. The Mosquito Control Board, <http://www.mass.gov/agr/mosquito/>, describes mosquito control methods and is in the process of developing guidance documents that describe Best Management Practices for mosquito control projects.

The SRMCB and Mosquito Control Districts are not responsible for operating and maintaining stormwater BMPs to reduce mosquito populations. The owners of property that construct the stormwater BMPs or municipalities that “accept” them through local subdivision approval are responsible for their maintenance.¹ The SRMCB is composed of officials from MassDEP, Department of Agricultural Resources, and Department of Conservation and Recreation. The nine (9) Mosquito Control Districts overseen by the SRMCB are located throughout Massachusetts, covering 176 municipalities.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the following actions:

- **Minimize Land Disturbance:** Minimizing land disturbance reduces the likelihood of mosquito breeding by reducing silt in runoff that will cause construction period controls to clog and retain standing pools of water for more than 72 hours.
- **Catch Basin inlets:** Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads

¹ MassDEP and MassHighway understand that the numerous stormwater BMPs along state highways pose a unique challenge. To address this challenge, the 2004 MassHighway Stormwater Handbook will provide additional information on appropriate operation and maintenance practices for mosquito control when the Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards..

caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (*Bs*) using a licensed pesticide applicator.

- **Check Dams:** If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- **Design construction period sediment traps** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide *Bs* after it rains from June through October, until the first frost occurs.
- **Construction period open conveyances:** When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- **Revegetating Disturbed Surfaces:** Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- **Sediment fences/hay bale barriers:** When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

Post-Construction Stormwater Treatment Practices

- Mosquito control begins with the environmentally sensitive site design. Environmentally sensitive site design that minimizes impervious surfaces reduces the amount of stormwater runoff. Disconnecting runoff using the LID Site Design credits outlined in the Massachusetts Stormwater Handbook reduces the amount of stormwater that must be conveyed to a treatment practice. Utilizing green roofs minimizes runoff from smaller storms. Storage media must be designed to dewater within 72 hours after precipitation.
- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
 - **Bioretention Areas/Rain Gardens/Sand Filter:** These practices tend not to result in mosquito breeding. If any level spreaders, weirs or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
 - **Infiltration Trenches:** This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
 - **Constructed Stormwater Wetlands:** Habitat features can be incorporated in constructed stormwater wetlands to attract dragonflies, amphibians, turtles, birds, bats, and other natural predators of mosquitoes.
 - **Wet Basins:** Wet basins can be designed to incorporate fish habitat features, such as deep pools. Introduce fish in consultation with Massachusetts Division of Fisheries and Wildlife. Vegetation within wet basins designed as fish habitat must be properly managed to ensure that vegetation does not overtake the habitat. Proper design to ensure that no low circulation or “dead” zones are created may reduce the potential for mosquito breeding. Introducing bubblers may increase water circulation in the wet basin.

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- **Basins:** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open.
- **BMPs without a permanent pool of water:** All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Wallace indicates that extended dry extended detention basins may breed more mosquitoes than wet basins. It is, therefore, imperative to design outlets from extended dry detention basins to completely dewater within the 72-hour period.
- **Energy Dissipators and Flow Spreaders:** Currier and Moeller, 2000 indicate that shallow recesses in energy dissipators and flow spreaders trap water where mosquitoes breed. Set the riprap in grout to reduce the shallow recesses and minimize mosquito breeding.
- **Outlet control structures:** Debris trapped in small orifices or on trash racks of outlet control structures such as multiple stage outlet risers may clog the orifices or the trash rack, causing a standing pool of water. Optimize the orifice size or trash rack mesh size to provide required peak rate attenuation/water quality detention/retention time while minimizing clogging.
- **Rain Barrels and Cisterns:** Seal lids to reduce the likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over inlets. The cistern system should be designed to ensure that all collected water is drained into it within 72 hours.
- **Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins:** Seal all manhole covers to reduce likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over the outlet (CALTRANS 2004).

The Operation and Maintenance Plan should provide for mosquito prevention and control.

- **Check dams:** Inspect permanent check dams on the schedule set forth in the O&M Plan. Inspect check dams 72 hours after storms for standing water ponding behind the dam. Take corrective action if standing water is found.
- **Cisterns:** Apply *Bs* larvicide in the cistern if any evidence of mosquitoes is found. The Operation and Maintenance Plan shall specify how often larvicides should be applied to waters in the cistern.
- **Water quality swales:** Remove and properly dispose of any accumulated sediment as scheduled in the Operation and Maintenance Plan.
- **Larvicide Treatment:** The Operation and Maintenance Plan must include measures to minimize mosquito breeding, including larviciding.
- The party identified in the Operation and Maintenance Plan as responsible for maintenance shall see that larvicides are applied as necessary to the following stormwater treatment practices: catch basins, oil/grit separators, wet basins, wet water quality swales, dry extended detention basins, infiltration basins, and constructed stormwater wetlands. The Operation and Maintenance Plan must ensure that all larvicides are applied by a licensed pesticide applicator and in compliance with all pesticide label requirements.
- The Operation and Maintenance Plan should identify the appropriate larvicide and the time and method of application. For example, *Bacillus sphaericus* (*Bs*), the preferred

larvicide for stormwater BMPs, should be hand-broadcast.² Alternatively, Altosid, a Methopren product, may be used. Because some practices are designed to dewater between storms, such as dry extended detention and infiltration basins, the Operation and Maintenance Plan should provide that larviciding must be conducted during or immediately after wet weather, when the detention or infiltration basin has a standing pool of water, unless a product is used that can withstand extended dry periods.

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² *Bacillus thuringiensis israelensis* or *Bti* is usually applied by helicopter to wetlands and floodplains

Roads and Stormwater BMPs

In general, the stormwater BMPs used for land development projects can also be used for new roadways and roadway improvement projects. However, for improvement of existing roads, there are often constraints that limit the choice of BMP. These constraints derive from the linear configuration of the road, the limited area within the existing right-of-way, the structural and safety requirements attendant to good roadway design, and the long-term maintainability of the roadway drainage systems. The MassHighway Handbook provides strategies for dealing with the constraints associated with providing stormwater BMPs for roadway redevelopment projects.

Roadway design can minimize impacts caused by stormwater. Reducing roadway width reduces the total and peak volume of runoff. Designing a road with country drainage (no road shoulders or curbs) disconnects roadway runoff. Disconnection of roadway runoff is eligible for the Low Impact Site Design Credit provided the drainage is disconnected in accordance with specifications outlined in Volume 3.

Like other parties, municipalities that work within wetlands jurisdictional areas and adjacent buffer zones must design and implement structural stormwater best management practices in accordance with the Stormwater Management Standards and the Stormwater Management Handbook. In addition, in municipalities and areas where state agencies operate stormwater systems, the DPWs (or other town or state agencies) must meet the “good housekeeping” requirement of the municipality’s or agency’s MS4 permit.

MassHighway has taken stormwater management one step further by working with MassDEP to develop the MassHighway Storm Water Handbook for Highways and Bridges. The purpose of the MassHighway Handbook is to provide guidance for persons involved in the design, permitting, review and implementation of state highway projects, especially those involving existing roadways where physical constraints often limit the stormwater management options available. These constraints, like those common to redevelopment sites, may make it difficult to comply precisely with the requirements of the Stormwater Management Standards and the Massachusetts Stormwater Handbook.³ In response to these constraints, MassDEP and MHD developed specific design, permitting, review and implementation practices that meet the unique challenges of providing environmental protection for existing state roads. The information in the MassHighway Handbook may also aid in the planning and design of projects to build new highways and to add lanes to existing highways, since they may face similar difficulties in meeting the requirements of the Stormwater Management Standards.

Although it is very useful, the MassHighway Handbook does not allow MassHighway projects to proceed without individual review and approval by the issuing authority when subject to the Wetlands Protection Act Regulations, 310 CMR 10.00, or the 401 Water Quality Certification Regulations, 314 CMR 9.00. For example, MassHighway must provide a Conservation Commission with a project-specific Operation and Maintenance Plan in accordance with Standard 9 that documents how the project’s post-construction BMPs will be operated and maintained.⁴

³ The 2004 MassHighway Handbook outlines standardized methods for dealing with these constraints as they apply to highway redevelopment projects. MassDEP and MassHighway intend to work together to provide guidance for add a lane projects when the 2004 Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards.

⁴ The general permit for municipal separate storm sewer systems (the MS4 Permit) requires MassHighway to develop and implement procedures for the proper operation and maintenance of stormwater BMPs. To

Some municipalities have asked if the MassHighway Handbook governs municipal road projects. The answer is no.⁵ The MassHighway Handbook was developed in response to the unique problems and challenges arising out of the management of the state highway system. Like other project proponents, cities and towns planning road or other projects in areas subject to jurisdiction under the Wetlands Protection Act must design and implement LID, non-structural and structural best management practices in accordance with the Stormwater Management Standards and the Massachusetts Stormwater Handbook.

avoid duplication of effort, MassHighway may be able rely on the same procedures to fulfill the operation and maintenance requirements of Standard 9 and the MS 4 Permit.

⁵ Although the MassHighway Handbook does not govern municipal road projects, cities and towns may find some of the information presented in the Handbook useful.



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

Massachusetts Department of Environmental Protection Bureau of Water Resources Snow Disposal Guidance

Effective Date: December 23, 2019

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: Bureau of Resource Protection (BRP) Snow Disposal Guideline No. BRPG97-1 issued December 12, 1997 and BRPG01-01 issued March 8, 2001; Bureau of Water Resources (BWR) snow disposal guidance issued December 21, 2015 and December 12, 2018.

Approved by: Kathleen Baskin, Assistant Commissioner, Bureau of Water Resources

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are protective of wetlands, drinking water, and water bodies, and are acceptable to the Massachusetts Department of Environmental Protection (MassDEP), Bureau of Water Resources.

APPLICABILITY: These Guidelines are issued by MassDEP's Bureau of Water Resources on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to all federal agencies, state agencies, state authorities, municipal agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While MassDEP is aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into

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waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything that occurs on the land has the potential to impact the Commonwealth's water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help federal agencies, state agencies, state authorities, municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter. Following these guidelines and obtaining the necessary approvals may also help municipalities in cases when seeking reimbursement for snow disposal costs from the Federal Emergency Management Agency is possible.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas or upland locations on impervious surfaces away from water resources and drinking water wells. At these locations, the snow meltwater can filter into the soil, leaving behind sand and debris which can be removed in the spring. The following conditions should be followed:

- Within water supply Zone A and Zone II, avoid storage or disposal of snow and ice containing deicing chemicals that has been collected from streets located outside these zones. Municipalities may have a water supply protection land use control that prohibits the disposal of snow and ice containing deicing chemicals from outside the Zone A and Zone II, subject to the Massachusetts Drinking Water Regulations at 310 CMR 22.20C and 310 CMR 22.21(2).
- Avoid storage or disposal of snow or ice in Interim Wellhead Protection Areas (IWPA) of public water supply wells, and within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater.
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage systems including detention basins, swales or ditches. Snow combined with sand and debris may block a stormwater drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Recommended Site Selection Procedures

It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

- Estimate how much snow disposal capacity may be needed for the season so that an adequate number of disposal sites can be selected and prepared.
- Identify sites that could potentially be used for snow disposal, such as municipal open space (e.g., parking lots or parks).
- Select sites located in upland locations that are not likely to impact sensitive environmental resources first.
- If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

Snow Disposal Mapping Assistance

MassDEP has an online mapping tool to assist in identifying possible locations to potentially dispose of snow. MassDEP encourages municipalities to use this tool to identify possible snow disposal options. The tool identifies wetland resource areas, public drinking water supplies and other sensitive locations where snow should not be disposed. The tool may be accessed through the Internet at the following web address:

<https://maps.env.state.ma.us/dep/arcgis/js/templates/PSE/>.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- Wherever possible maintain a 50-foot vegetated buffer between the disposal site and adjacent waterbodies to filter pollutants from the meltwater.
- Clear debris from the site prior to using the site for snow disposal.
- Clear debris from the site and properly dispose of it at the end of the snow season, and no later than May 15.

3. SNOW DISPOSAL APPROVALS

Proper snow disposal may be undertaken through one of the following approval procedures:

- Routine snow disposal – Minimal, if any, administrative review is required in these cases when upland and pervious snow disposal locations or upland locations on impervious surfaces that have functioning and maintained stormwater management systems have been identified, mapped, and used for snow disposal following ordinary snowfalls. Use of upland and pervious snow disposal sites avoids wetland resource areas and allows snow meltwater to recharge groundwater and will help filter pollutants, sand, and other debris. This process will address the majority of snow removal efforts until an entity exhausts all available upland snow disposal sites. The location and mapping of snow disposal sites will help facilitate each entity's routine snow management efforts.
- Emergency Certifications – If an entity demonstrates that there is no remaining capacity at upland snow disposal locations, local conservation commissions may issue an Emergency Certification under the Massachusetts Wetlands Protection regulations to authorize snow disposal in buffer zones to wetlands, certain open water areas, and certain wetland resource areas (i.e. within flood plains). Emergency Certifications can only be issued at the request of a public agency or by order of a public agency for the protection of the health or safety of citizens, and are limited to those activities necessary to abate the emergency. See 310 CMR 10.06(1)-(4). Use the following guidelines in these emergency situations:
 - Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
 - Do not dispose of snow in salt marshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPA's of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
 - Do not dispose of snow where trucks may cause shoreline damage or erosion.
 - Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.
- Severe Weather Emergency Declarations – In the event of a large-scale severe weather event, MassDEP may issue a broader Emergency Declaration under the Wetlands Protection Act which allows federal agencies, state agencies, state authorities, municipalities, and businesses greater flexibility in snow disposal practices. Emergency Declarations typically authorize greater snow disposal options while protecting especially sensitive resources such as public drinking water supplies, vernal pools, land containing shellfish, FEMA designated floodways, coastal dunes, and salt marsh. In the event of severe winter storm emergencies, the snow disposal site maps created by municipalities will enable MassDEP and the Massachusetts Emergency Management Agency (MEMA) in helping communities identify appropriate snow disposal locations.

If upland disposal sites have been exhausted, the Emergency Declaration issued by MassDEP allows for snow disposal near water bodies. In these situations, a buffer of at

least 50 feet, preferably vegetated, should still be maintained between the site and the waterbody. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, the Emergency Declaration issued by MassDEP may allow disposal of snow in certain waterbodies under certain conditions. *A federal agency, state agency, state authority, municipality or business seeking to dispose of snow in a waterbody should take the following steps:*

- Call the emergency contact phone number [(888) 304-1133] and notify the MEMA of the municipality's intent.
- MEMA will ask for some information about where the requested disposal will take place.
- MEMA will confirm that the disposal is consistent with MassDEP's Severe Weather Emergency Declaration and these guidelines and is therefore approved.

During declared statewide snow emergency events, MassDEP's website will also highlight the emergency contact phone number [(888) 304-1133] for authorizations and inquiries. For further non-emergency information about this Guidance you may contact your MassDEP Regional Office Service Center:

Northeast Regional Office, Wilmington, 978-694-3246
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7650
Western Regional Office, Springfield, 413-755-2114

CDS[®] Inspection and Maintenance Guide



Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allow both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine whether the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.



CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities



Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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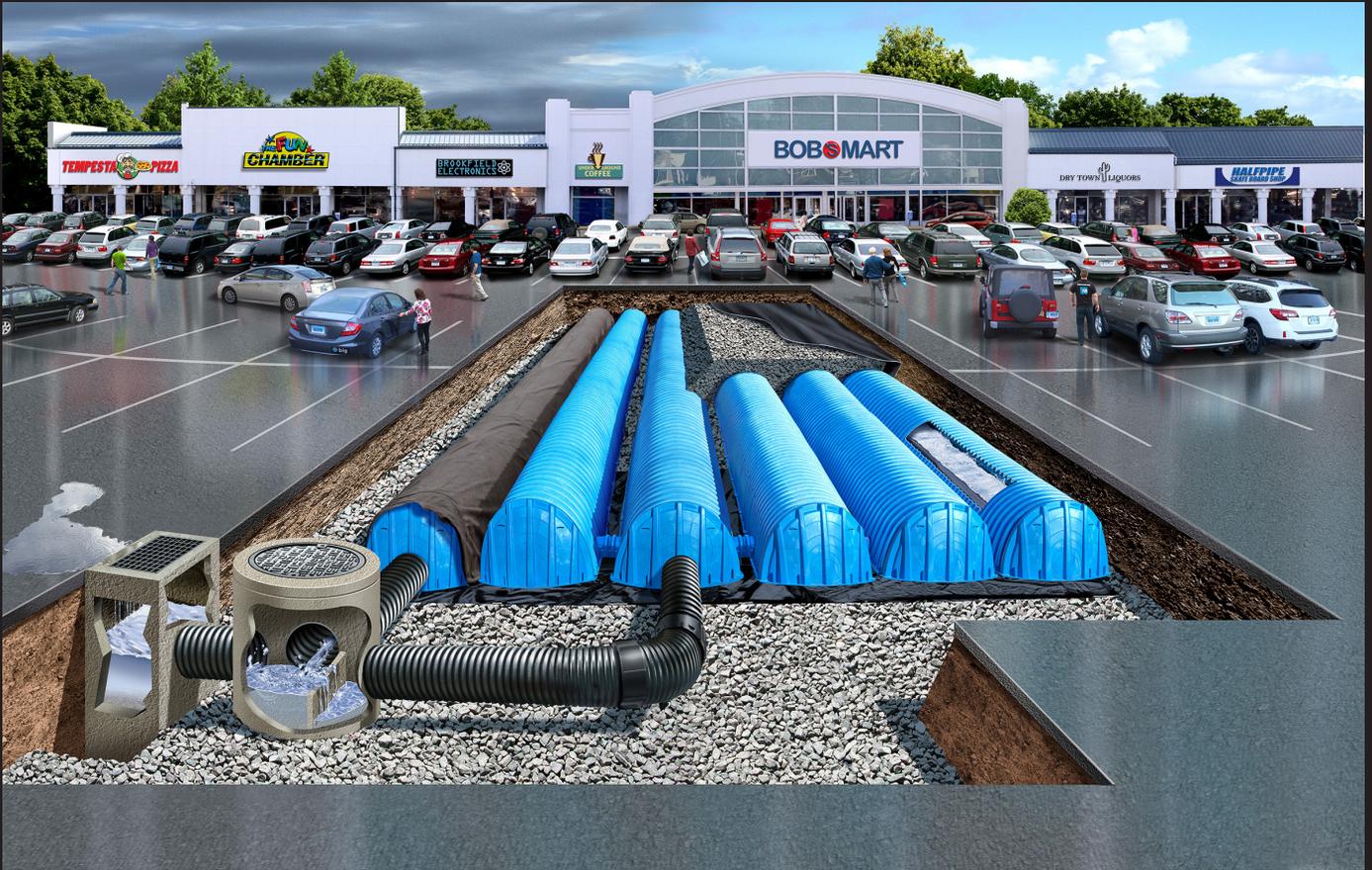
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CONTACTOR® & RECHARGER®

STORMWATER MANAGEMENT SOLUTIONS



OPERATION & MAINTENANCE GUIDELINES FOR CULTEC STORMWATER MANAGEMENT SYSTEMS



OPERATIONS AND MAINTENANCE GUIDELINES

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P.O. Box 280
878 Federal Road
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www.cultec.com

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

This manual contains guidelines recommended by CULTEC 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 pretreatment 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)

	Frequency	Action
Inlets and Outlets	Every 3 years	<ul style="list-style-type: none"> Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
	Spring and Fall	<ul style="list-style-type: none"> Check inlet and outlets for clogging and remove any debris as required.
CULTEC Stormwater Chambers	2 years after commissioning	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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. 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 1 st year	<ul style="list-style-type: none"> Check for depressions in areas over and surrounding the stormwater management system.
	Spring and Fall	<ul style="list-style-type: none"> Check for depressions in areas over and surrounding the stormwater management system.
	Yearly	<ul style="list-style-type: none"> 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 at 1-800-428-5832.



WQMP Operation & Maintenance (O&M) Plan

Project Name: _____

Prepared for:

Project Name: _____

Address: _____

City, State Zip: _____

Prepared on:

Date: _____

This O&M Plan describes the designated responsible party for implementation of this WQMP, including: operation and maintenance of all the structural BMP(s), conducting the training/educational program and duties, and any other necessary activities. The O&M Plan includes detailed inspection and maintenance requirements for all structural BMPs, including copies of any maintenance contract agreements, manufacturer’s maintenance requirements, permits, etc.

8.1.1 Project Information

Project name	
Address	
City, State Zip	
Site size	
List of structural BMPs, number of each	
Other notes	

8.1.2 Responsible Party

The responsible party for implementation of this WQMP is:

Name of Person or HOA Property Manager	
Address	
City, State Zip	
Phone number	
24-Hour Emergency Contact number	
Email	

8.1.3 Record Keeping

Parties responsible for the O&M plan shall retain records for at least 5 years.

All training and educational activities and BMP operation and maintenance shall be documented to verify compliance with this O&M Plan. A sample Training Log and Inspection and Maintenance Log are included in this document.

8.1.4 Electronic Data Submittal

This document along with the Site Plan and Attachments shall be provided in PDF format. AutoCAD files and/or GIS coordinates of BMPs shall also be submitted to the City.

Appendix ____

BMP SITE PLAN

Site plan is preferred on minimum 11" by 17" colored sheets, as long as legible.

Minor Maintenance

Frequency		Action
Monthly in first year		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
<input type="checkbox"/> Month 1	Date:	
<input type="checkbox"/> Month 2	Date:	
<input type="checkbox"/> Month 3	Date:	
<input type="checkbox"/> Month 4	Date:	
<input type="checkbox"/> Month 5	Date:	
<input type="checkbox"/> Month 6	Date:	
<input type="checkbox"/> Month 7	Date:	
<input type="checkbox"/> Month 8	Date:	
<input type="checkbox"/> Month 9	Date:	
<input type="checkbox"/> Month 10	Date:	
<input type="checkbox"/> Month 11	Date:	
<input type="checkbox"/> Month 12	Date:	
Spring and Fall		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
One year after commissioning and every third year following		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
<input type="checkbox"/> Year 1	Date:	
<input type="checkbox"/> Year 4	Date:	
<input type="checkbox"/> Year 7	Date:	
<input type="checkbox"/> Year 10	Date:	
<input type="checkbox"/> Year 13	Date:	
<input type="checkbox"/> Year 16	Date:	
<input type="checkbox"/> Year 19	Date:	
<input type="checkbox"/> Year 22	Date:	

Major Maintenance

Frequency		Action
Inlets and Outlets	Every 3 years	
	Notes	
	<input type="checkbox"/> Year 1	Date:
	<input type="checkbox"/> Year 4	Date:
	<input type="checkbox"/> Year 7	Date:
	<input type="checkbox"/> Year 10	Date:
	<input type="checkbox"/> Year 13	Date:
	<input type="checkbox"/> Year 16	Date:
	<input type="checkbox"/> Year 19	Date:
	<input type="checkbox"/> Year 22	Date:
	Spring and Fall	
	Notes	
	<input type="checkbox"/> Spring	Date:
	<input type="checkbox"/> Fall	Date:
	<input type="checkbox"/> Spring	Date:
	<input type="checkbox"/> Fall	Date:
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
<input type="checkbox"/> Spring	Date:	
<input type="checkbox"/> Fall	Date:	
CULTEC Stormwater Chambers	2 years after commissioning	
	<input type="checkbox"/> Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. <input type="checkbox"/> Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.	
	Notes	
<input type="checkbox"/> Year 2	Date:	

Major Maintenance

Frequency		Action
CULTEC Stormwater Chambers	9 years after commissioning every 9 years following	
	<ul style="list-style-type: none"> <input type="checkbox"/> Clean stormwater management chambers and feed connectors of any debris. <input type="checkbox"/> Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. <input type="checkbox"/> Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended. 	
	Notes	
	<input type="checkbox"/> Year 9	Date:
	<input type="checkbox"/> Year 18	Date:
	<input type="checkbox"/> Year 27	Date:
	<input type="checkbox"/> Year 36	Date:
45 years after commissioning		
<ul style="list-style-type: none"> <input type="checkbox"/> Clean stormwater management chambers and feed connectors of any debris. <input type="checkbox"/> Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. <input type="checkbox"/> Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique. <input type="checkbox"/> Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. <input type="checkbox"/> Attain the appropriate approvals as required. <input type="checkbox"/> Establish a new operation and maintenance schedule. 		
Notes		
<input type="checkbox"/> Year 45	Date:	

Major Maintenance

Frequency		Action	
Surrounding Site	Monthly in 1st year		
	<input type="checkbox"/> Check for depressions in areas over and surrounding the stormwater management system.		
	Notes		
	<input type="checkbox"/> Month 1	Date:	
	<input type="checkbox"/> Month 2	Date:	
	<input type="checkbox"/> Month 3	Date:	
	<input type="checkbox"/> Month 4	Date:	
	<input type="checkbox"/> Month 5	Date:	
	<input type="checkbox"/> Month 6	Date:	
	<input type="checkbox"/> Month 7	Date:	
	<input type="checkbox"/> Month 8	Date:	
	<input type="checkbox"/> Month 9	Date:	
	<input type="checkbox"/> Month 10	Date:	
	<input type="checkbox"/> Month 11	Date:	
	<input type="checkbox"/> Month 12	Date:	
	Spring and Fall		
	<input type="checkbox"/> Check for depressions in areas over and surrounding the stormwater management system.		
	Notes		
	<input type="checkbox"/> Spring	Date:	
	<input type="checkbox"/> Fall	Date:	
	<input type="checkbox"/> Spring	Date:	
	<input type="checkbox"/> Fall	Date:	
	<input type="checkbox"/> Spring	Date:	
	<input type="checkbox"/> Fall	Date:	
	<input type="checkbox"/> Spring	Date:	
	<input type="checkbox"/> Fall	Date:	
	<input type="checkbox"/> Spring	Date:	
	<input type="checkbox"/> Fall	Date:	
	<input type="checkbox"/> Spring	Date:	
	<input type="checkbox"/> Fall	Date:	
	Yearly		
	<input type="checkbox"/> Confirm that no unauthorized modifications have been performed to the site.		
Notes			
<input type="checkbox"/> Year 1	Date:		
<input type="checkbox"/> Year 2	Date:		
<input type="checkbox"/> Year 3	Date:		
<input type="checkbox"/> Year 4	Date:		
<input type="checkbox"/> Year 5	Date:		
<input type="checkbox"/> Year 6	Date:		
<input type="checkbox"/> Year 7	Date:		



CULTEC

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

P: (203) 775-4416 • Toll Free: 1(800) 4-CULTEC • www.cultec.com

RETENTION • DETENTION • INFILTRATION • WATER QUALITY



Inspection & Maintenance Guide for Corrugated Steel Pipe Underground Infiltration Systems

Safety: Before entering into any storm sewer or underground detention/infiltration system check to make sure all OSHA and local safety regulations and guidelines are observed during the maintenance process. Hard hats, safety glasses, steel-toed boots and any other appropriate personal protective equipment shall be worn at all times.

Frequency: Inspections shall be completed annually.

Inspection Check List:

√ Check quality of parking lot surface.

- Is there evidence of potholes or sinkholes?
- Is there evidence of an unusual amount of silt and soil build-up on the surface?

√ Check for pipe symmetry (uniform curvature).

- Flexible steel pipe is designed to handle minor deflections. Pipe structures deflected more than 7% from design shape, or those that show localized distortions may require further investigation.

√ Check for pipe joint quality.

- Is there evidence of backfill material infiltrating into the pipe structure?

√ Silt Deposition

- If accumulated silt is interfering with the operation of the infiltration system (i.e.: blocking infiltration holes or if silt deposition has significantly reduced the storage capacity of the system) it should be removed. This can be accomplished by the use of a “clam shell” device or vactor truck.

Maintenance:

Underground storm water detention and retention systems should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size or configuration of the system.

Inspection

Inspection is the key to effective maintenance and is easily performed. CONTECH recommends ongoing quarterly inspections of the accumulated sediment. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations, or in equipment wash-down areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice. CONTECH suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

Cleaning

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities.

**Stormceptor[®] STC
Owner's Manual**



Table of Contents

TITLE	SECTION
Stormceptor Overview	1
Stormceptor Operation and Components	2
Stormceptor Identification	3
Stormceptor Inspection and Maintenance	4
<i>Recommended Stormceptor Inspection Procedure</i>	
<i>Recommended Stormceptor Maintenance Procedure</i>	
Contact Information	5

For patent information, go to www.ContechES.com/ip.

Your selection of a Stormceptor® means that you have chosen the most recognized and efficient stormwater oil/sediment separator available for protecting the environment. Stormceptor is a pollution control device often referred to as a “Hydrodynamic Separator (HDS)” or an “Oil Grit Separator (OGS)”, engineered to remove and retain pollutants from stormwater runoff to protect our lakes, rivers and streams from the harmful effects of non-point source pollution.

1 – Stormceptor Overview

Stormceptor is a patented stormwater quality structure most often utilized as a treatment component of the underground storm drain network for stormwater pollution prevention. Stormceptor is designed to remove sediment, total suspended solids (TSS), other pollutants attached to sediment, hydrocarbons and free oil from stormwater runoff. Collectively the Stormceptor provides spill protection and prevents non-point source pollution from entering downstream waterways.

Key benefits of Stormceptor include:

- Removes sediment, suspended solids, debris, nutrients, heavy metals, and hydrocarbons (oil and grease) from runoff and snowmelt.
- Will not scour or re-suspend trapped pollutants.
- Provides sediment and oil storage.
- Provides spill control for accidents, commercial and industrial developments.
- Easy to inspect and maintain (vacuum truck).
- “STORMCEPTOR” is clearly marked on the access cover (excluding inlet designs).
- Relatively small footprint.
- 3rd Party tested and independently verified.
- Dedicated team of experts available to provide support.

Model Types:

- STC (Standard)
- EOS (Extended Oil Storage)
- OSR (Oil and Sand Removal)
- MAX (Custom designed unit, specific to site)

Configuration Types:

- Inlet unit (accommodates inlet flow entry, and multi-pipe entry)
- In-Line (accommodates multi-pipe entry)
- Submerged Unit (accommodates the site’s tailwater conditions)
- Series Unit (combines treatment in two systems)

PLEASE MAINTAIN YOUR STORMCEPTOR

To ensure long-term environmental protection through continued performance as originally designed for your site, Stormceptor must be maintained, as any stormwater treatment practice does. The need for maintenance is determined through inspection of the Stormceptor. Procedures for inspection are provided within this document. Maintenance of the Stormceptor is performed from the surface via vacuum truck.

If you require information about Stormceptor, or assistance in finding resources to facilitate inspections or maintenance of your Stormceptor please call Contech at 1-800-338-1122.

2 – Stormceptor Operation and Components

Stormceptor is a flexibly designed underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention using patented flow separation technology. Stormceptor creates a non-turbulent treatment environment below the insert platform within the system. The insert diverts water into the lower chamber, allowing free oils and debris to rise, and sediment to settle under relatively low velocity conditions. These pollutants are trapped and stored below the insert and protected from large runoff events for later removal during the maintenance procedure.

With thousands of units operating worldwide, Stormceptor delivers reliable protection every day, in every storm. The patented Stormceptor design prohibits the scour and release of captured pollutants, ensuring superior water quality treatment and protection during even the most extreme storm events. Stormceptor’s proven performance is backed by the longest record of lab and field verification in the industry.

Stormceptor Schematic and Component Functions

Below are schematics of two common Stormceptor configurations with key components identified and their functions briefly described.

- **Manhole access cover** – provides access to the subsurface components
- **Precast reinforced concrete structure** – provides the vessel's watertight structural support
- **Fiberglass insert** – separates vessel into upper and lower chambers
- **Weir** – directs incoming stormwater and oil spills into the lower chamber
- **Orifice plate** – prevents scour of accumulated pollutants
- **Inlet drop tee** – conveys stormwater into the lower chamber
- **Fiberglass skirt** – provides double-wall containment of hydrocarbons
- **Outlet riser pipe** – conveys treated water to the upper chamber; primary vacuum line access port for sediment removal
- **Oil inspection port** – primary access for measuring oil depth and oil removal
- **Safety grate** – safety measure to cover riser pipe in the event of manned entry into vessel

Figure 1.

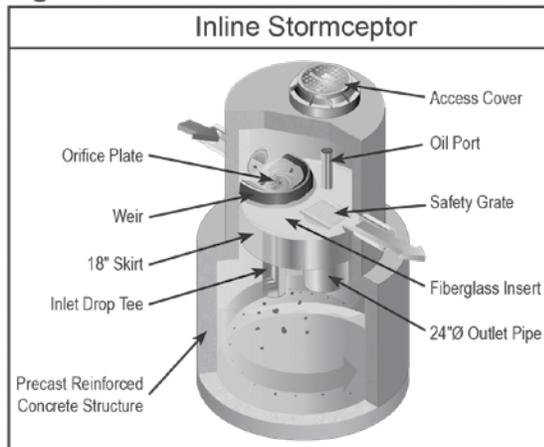
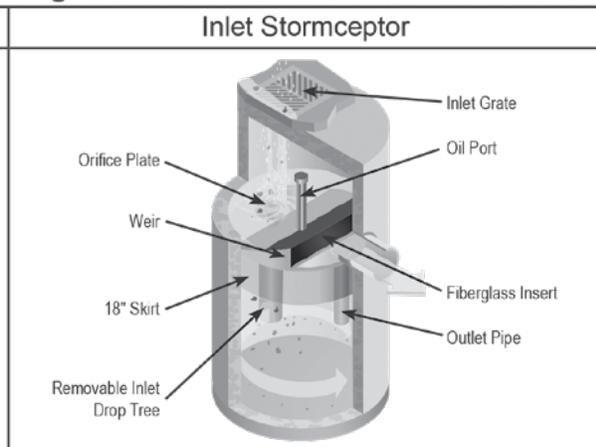


Figure 2.



3 – Stormceptor Identification

Stormceptor is available in both precast concrete and fiberglass vessels, with precast concrete often being the dominant material of construction.

In the Stormceptor, a patented, engineered fiberglass insert separates the structure into an upper chamber and lower chamber. The lower chamber will remain full of water, as this is where the pollutants are sequestered for later removal. Multiple Stormceptor model (STC, OSR, EOS and MAX) configurations exist, each to be inspected and maintained in a similar fashion.

Each unit is easily identifiable as a Stormceptor by the trade name "Stormceptor" embossed on each access cover at the surface. To determine the location of "inlet" Stormceptor units with horizontal catch basin inlet, look down into the grate as the Stormceptor insert will be visible. The name "Stormceptor" is not embossed on inlet models due to the variability of inlet grates used/approved across North America.

Once the location of the Stormceptor is determined, the model number may be identified by comparing the measured depth from the fiberglass insert level at the outlet pipe's invert (water level) to the bottom of the tank using Table 1.

In addition, starting in 1996 a metal serial number tag containing the model number has been affixed to the inside of the unit, on the fiberglass insert. If the unit does not have a serial number, or if there is any uncertainty regarding the size of the unit using depth measurements, please contact your local Contech Representative for assistance.

Sizes/Models

Typical general dimensions and capacities of the standard precast STC, EOS and OSR Stormceptor models are provided in Tables 1 and 2. Typical rim to invert measurements are provided later in this document. The total depth for cleaning will be the sum of the depth from outlet pipe invert (generally the water level) to rim (grade) and the depth from outlet pipe invert to the precast bottom of the unit. Note that depths and capacities may vary slightly between regions.

STC Model	Insert to Base (in.)
450	60
900	55
1200	71
1800	105
2400	94
3600	134
4800	128
6000	150
7200	134
11000*	128
13000*	150
16000*	134

Notes:

1. Depth Below Pipe Inlet Invert to the Inside Top Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.

*Consist of two chamber structures in series.

STC Model	Hydrocarbon Storage Capacity (gal)	Sediment Capacity (ft ³)
450	86	46
900	251	89
1200	251	127
1800	251	207
2400	840	205
3600	840	373
4800	909	543
6000	909	687
7200	1059	839
11000*	2797	1089
13000*	2797	1374
16000*	3055	1677

Notes:

1. Hydrocarbon and Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

*Consist of two chamber structures in series

4 – Stormceptor Inspection and Maintenance

Regular inspection and maintenance is a proven, cost-effective way to maximize water resource protection for all stormwater pollution control practices, and is required to insure proper functioning of the Stormceptor. Both inspection and maintenance of the Stormceptor is easily performed from the surface. Stormceptor's patented technology has no moving parts, simplifying the inspection and maintenance process.

Please refer to the following information and guidelines before conducting inspection and maintenance activities.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess the sediment accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

When is maintenance cleaning needed?

- For optimum performance, the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, which is approximately 15% of the unit's total storage capacity (see Table 3). The frequency should be adjusted based on historical inspection results due to variable site pollutant loading.

- Sediment removal is easier when removed on a regular basis at or prior to the recommended maintenance sediment depths, as sediment build-up can compact making removal more difficult.
- The unit should be cleaned out immediately after an oil, fuel or chemical spill.

What conditions can compromise Stormceptor performance?

- If construction sediment and debris is not removed prior to activating the Stormceptor unit, maintenance frequency may be reduced.
- If the system is not maintained regularly and fills with sediment and debris beyond the capacity as indicated in Table 2, pollutant removal efficiency may be reduced.
- If an oil spill(s) exceeds the oil capacity of the system, subsequent spills may not be captured.
- If debris clogs the inlet of the system, removal efficiency of sediment and hydrocarbons may be reduced.
- If a downstream blockage occurs, a backwater condition may occur for the Stormceptor and removal efficiency of sediment and hydrocarbons may be reduced.

What training is required?

The Stormceptor is to be inspected and maintained by professional vacuum cleaning service providers with experience in the maintenance of underground tanks, sewers and catch basins.

For typical inspection and maintenance activities, no specific supplemental training is required

Recommended Stormceptor Inspection Procedure:

- Stormceptor is to be inspected from grade through a standard surface manhole access cover.
- Sediment and oil depth inspections are performed with a sediment probe and oil dipstick.
- Oil depth is measured through the oil inspection port, either a 4-inch or 6-inch diameter port.
- Sediment depth can be measured through the oil inspection port or the 24-inch diameter outlet riser pipe.
- Inspections also involve a visual inspection of the internal components of the system.

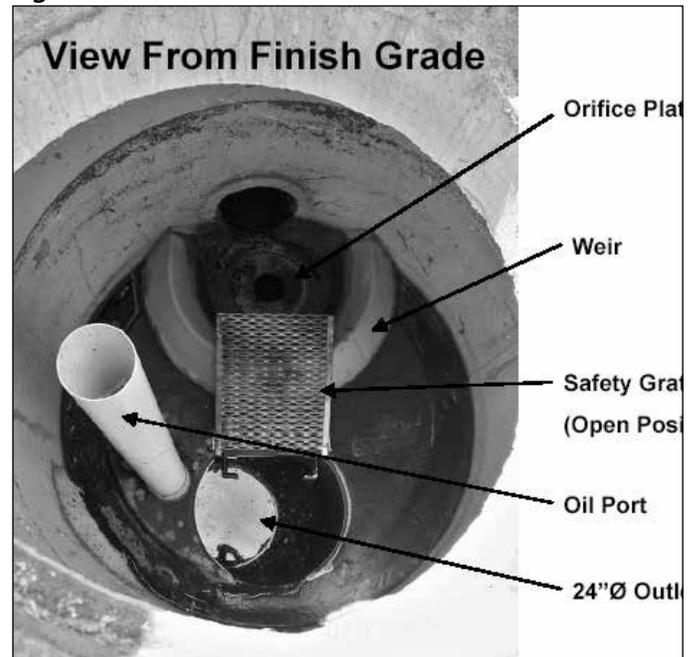
Figure 3.



What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, hoist and safety harness for specially trained personnel if confined space entry is required

Figure 4.



Recommended Stormceptor Maintenance Procedure

Maintenance of Stormceptor is performed using a vacuum truck. No entry into the unit is required for maintenance. **DO NOT ENTER THE STORMCEPTOR CHAMBER** unless you have the proper personal safety equipment, have been trained and are qualified to enter a confined space, as identified by local Occupational Safety and Health Regulations (e.g. 29 CFR 1910.146). Without the proper equipment, training and permit, entry into confined spaces can result in serious bodily harm and potentially death. Consult local and/or state regulations to determine the requirements for confined space entry. Be aware, and take precaution that the Stormceptor fiberglass insert may be slippery. In addition, be aware that some units do not have a safety grate to cover the outlet riser pipe that leads to the submerged, lower chamber.

- Ideally maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is to be maintained through a standard surface manhole access cover.
- Insert the oil dipstick into the oil inspection port. If oil is present, pump off the oil layer into separate containment using a small pump and tubing.
- Maintenance cleaning of accumulated sediment is performed with a vacuum truck.
 - » For 6-ft diameter models and larger, the vacuum hose is inserted into the lower chamber via the 24-inch outlet riser pipe (See Fig. 5).
 - » For 4-ft diameter model, the removable drop tee is lifted out, and the vacuum hose is inserted into the lower chamber via the 12-inch drop tee hole (See Fig. 6).

Figure 5.

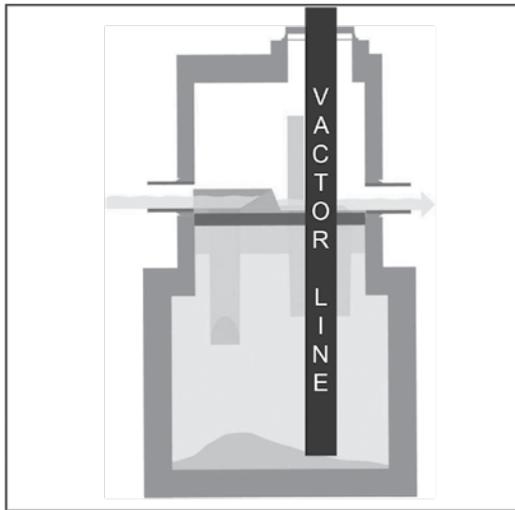
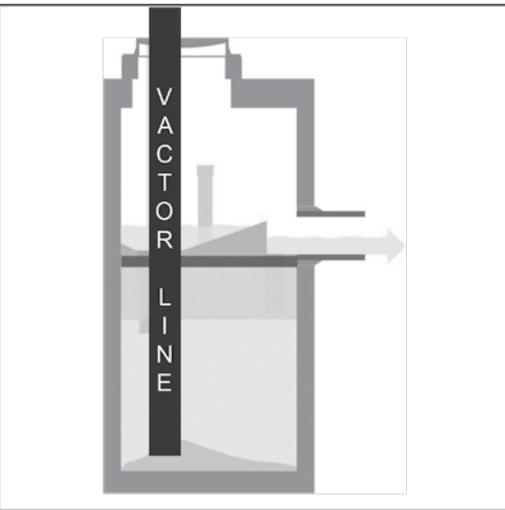


Figure 6.



- Using the vacuum hose, decant the water from the lower chamber into a separate containment tank or to the sanitary sewer, if permitted by the local regulating authority.
- Remove the sediment sludge from the bottom of the unit using the vacuum hose. For large Stormceptor units, a flexible hose is often connected to the primary vacuum line for ease of movement in the lower chamber.
- Units that have not been maintained regularly, have surpassed the maximum recommended sediment capacity, or contain damaged components may require manned entry by trained personnel using safe and proper confined space entry procedures.

What is required for proper disposal?

The requirements for the disposal of material removed from Stormceptor units are similar to that of any other stormwater treatment Best Management Practices (BMP). Local guidelines should be consulted prior to disposal of the separator contents. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste. This could be site and pollutant dependent. In some cases, approval from the disposal facility operator/agency may be required.

What about oil spills?

Stormceptor is often implemented in areas where there is high potential for oil, fuel or other hydrocarbon or chemical spills. Stormceptor units should be cleaned immediately after a spill occurs by a licensed liquid waste hauler. You should also notify the appropriate regulatory agencies as required in the event of a spill.

What if I see an oil rainbow or sheen at the Stormceptor outlet?

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a hydrocarbon rainbow or sheen can be seen at very small oil concentrations (< 10 ppm). Stormceptor is effective at removing 95% of free oil, and the appearance of a sheen at the outlet with high influent oil concentrations does not mean unit is not working to this level of removal. In addition, if the influent oil is emulsified, the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified or dissolved oil conditions.

What factors affect the costs involved with inspection/maintenance?

The Vacuum Service Industry for stormwater drainage and sewer systems is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean Stormceptor units will vary. Inspection and maintenance costs are most often based on unit size, the number of units on a site, sediment/oil/hazardous material loads, transportation distances, tipping fees, disposal requirements and other local regulations.

What factors predict maintenance frequency?

Maintenance frequency will vary with the amount of pollution on your site (number of hydrocarbon spills, amount of sediment, site activity and use, etc.). It is recommended that the frequency of maintenance be increased or reduced based on local conditions. If the sediment load is high from an unstable site or sediment loads transported from upstream catchments, maintenance may be required semi-annually. Conversely once a site has stabilized, maintenance may be required less frequently (for example: two to seven year, site and situation dependent). Maintenance should be performed immediately after an oil spill or once the sediment depth in Stormceptor reaches the value specified in Table 3 based on the unit size.

STC Model	Maintenance Sediment Depth (in)
450	8
900	8
1200	10
1800	15
2400	12
3600	17
4800	15
6000	18
7200	15
11000*	17
13000*	20
16000*	17

Notes:

1. The values above are for typical standard units.

* Per structure.

Replacement parts

Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. Therefore, inspection and maintenance activities are generally focused on pollutant removal. However, if replacements parts are necessary, they may be purchased by contacting your local Contech Representative or call 800-338-1122.

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to Stormceptor’s long and effective service life.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: _____

Allowable Sediment Depth: _____

Serial Number: _____

Installation Date: _____

Location Description of Unit: _____

Other Comments: _____

5 – Contact Information

Questions regarding the Stormceptor can be addressed by contacting your local Contech representative or by calling 800-338-1122.



SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

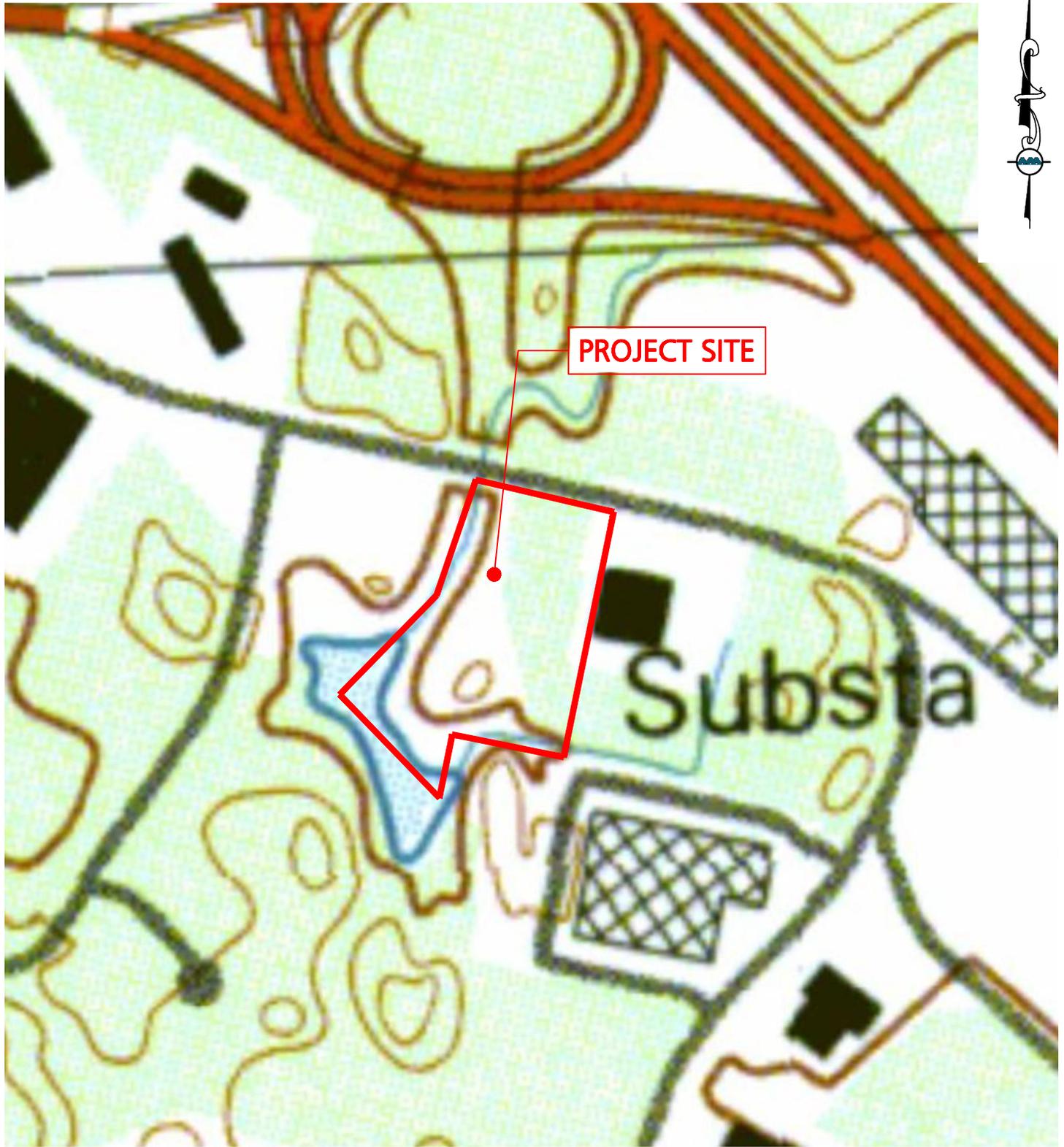
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**SECTION 3.0 -
EXHIBITS**



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ALLEN & MAJOR ASSOCIATES, INC.

civil engineering ♦ land surveying environmental consulting ♦ landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ♦ LAKEVILLE, MA ♦ MANCHESTER, NH

PROJECT:

**55 INDUSTRIAL PARK ROAD
HINGHAM, MA**

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USGS SITE LOCUS MAP

PROJECT NO. 1179-20A DATE: 10-17-2024

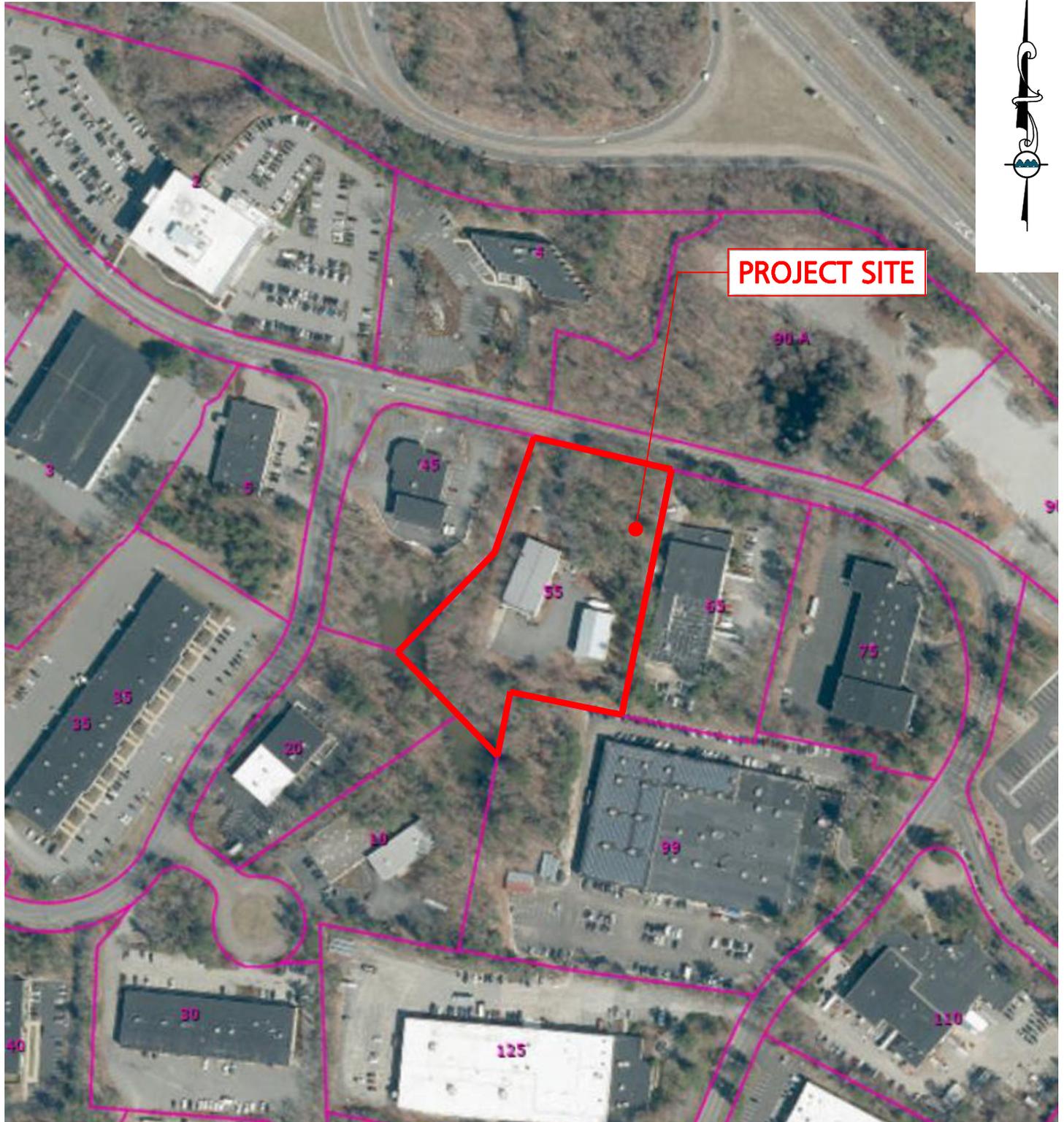
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DESIGNED BY: SMF CHECKED BY: PLC

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EX-1



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consulting ♦ landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
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PROJECT:

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AERIAL PHOTO

PROJECT NO. 1179-20A DATE: 10-17-2024

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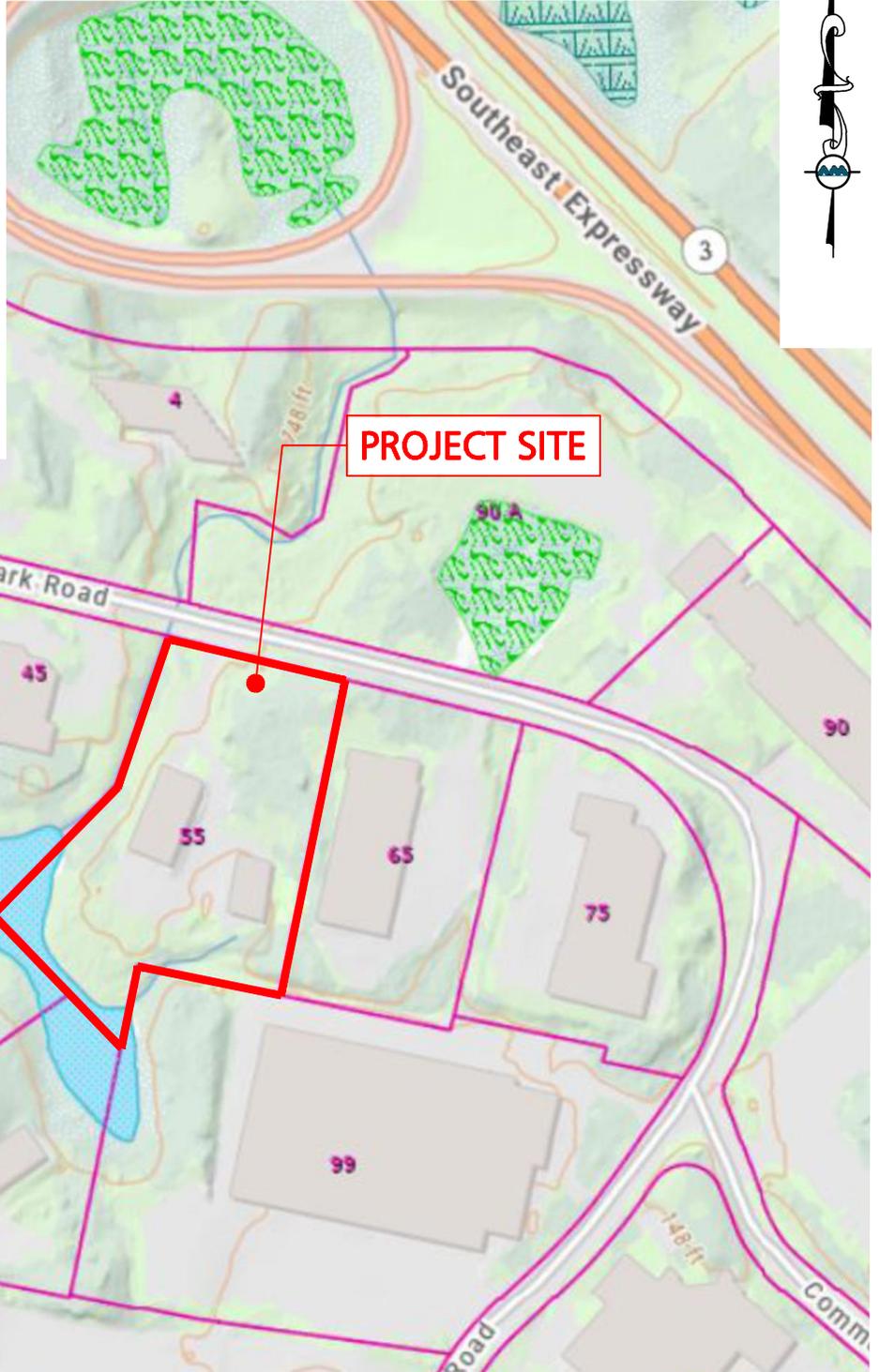
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SHEET No.

EX-2

LEGEND

-  Coastal Bank Bluff or Sea Cliff
-  Coastal Beach
-  Coastal Dune
-  Cranberry Bog
-  Deep Marsh
-  Barrier Beach-Open Water
-  Open Water
-  Rocky Intertidal Shore
-  Salt Marsh
-  Shallow Marsh Meadow or Fen
-  Shrub Swamp
-  Tidal Flat
-  Wooded Swamp Coniferous
-  Wooded Swamp Deciduous
-  Wooded Swamp Mixed Trees



MA MAPPER DEP WETLANDS

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 www.allenmajor.com
 100 COMMERCE WAY
 P.O. BOX 2118
 WOBURN MA 01888-0118
 TEL: (781) 935-6889
 FAX: (781) 935-2896
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PROJECT:

**55 INDUSTRIAL PARK ROAD
 HINGHAM, MA**

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WETLANDS MAP

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SHEET No.
EX-3

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
 The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevation determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

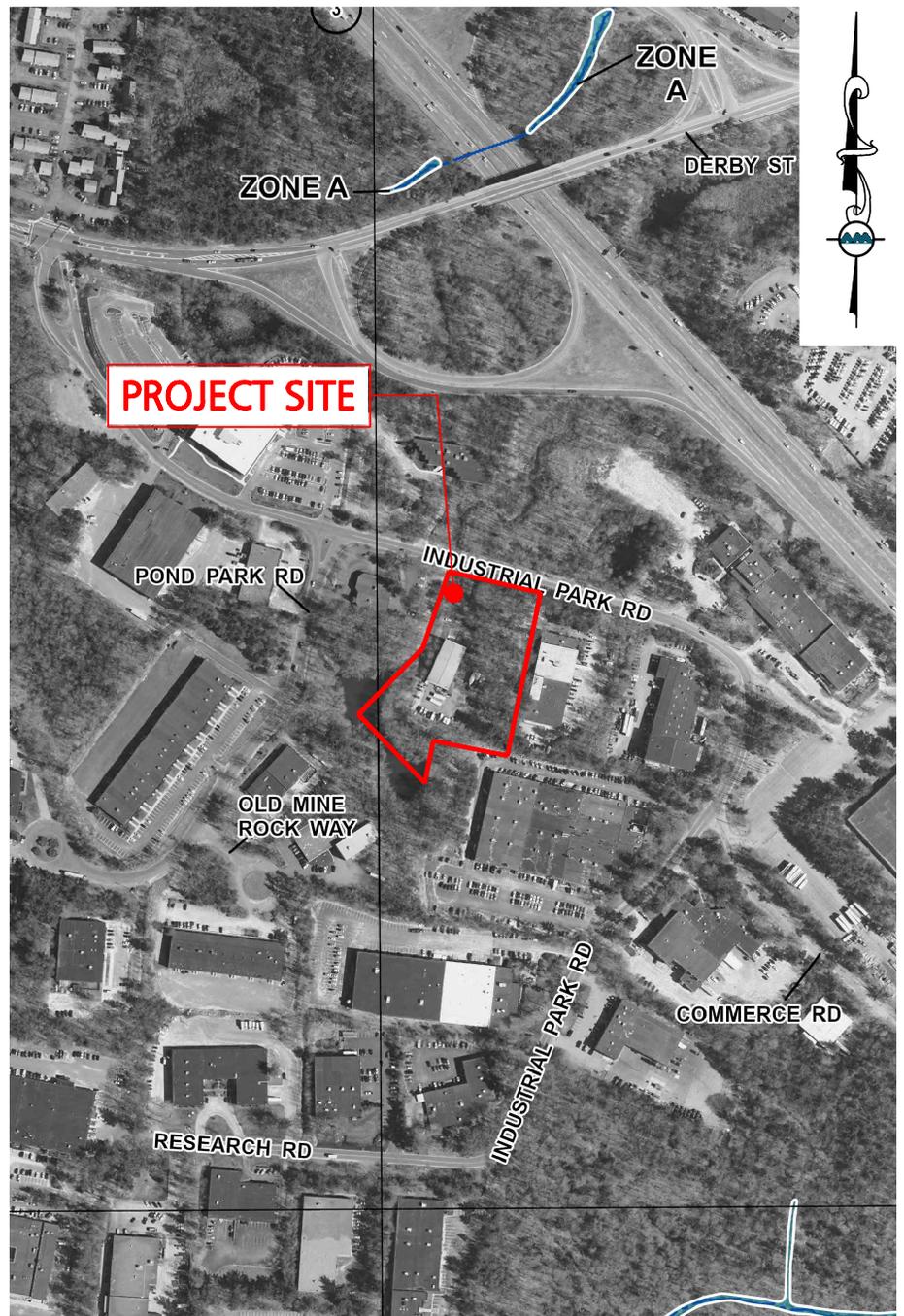
- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevation flood depths, or flood velocities.
- Base Flood Elevation line and value; elevation in feet*
- Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- Cross section line
- Transect line
- Culvert
- Bridge
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 1000-meter ticks; Massachusetts State Plane Mainland Zone (FIPS Zone 2001), Lambert Conformal Conic projection
- 1000-meter Universal Transverse Mercator grid values, zone 19N
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River Mile

MAP REPOSITORIES
 Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTY-WIDE
 FLOOD INSURANCE RATE MAP
 July 3, 2012



**FEMA FLOOD INSURANCE RATE MAP
 ESSEX COUNTY, MASSACHUSETTS
 COMMUNITY PANEL 91 OF 650
 MAP NUMBER 25023C0091L
 EFFECTIVE DATE: JULY 3, 2024**

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civil engineering ♦ land surveying environmental
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 www.allenmajor.com
 100 COMMERCE WAY
 P.O. BOX 2118
 WOBURN MA 01888-0118
 TEL: (781) 935-6889
 FAX: (781) 935-2896
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PROJECT:

**55 INDUSTRIAL PARK ROAD
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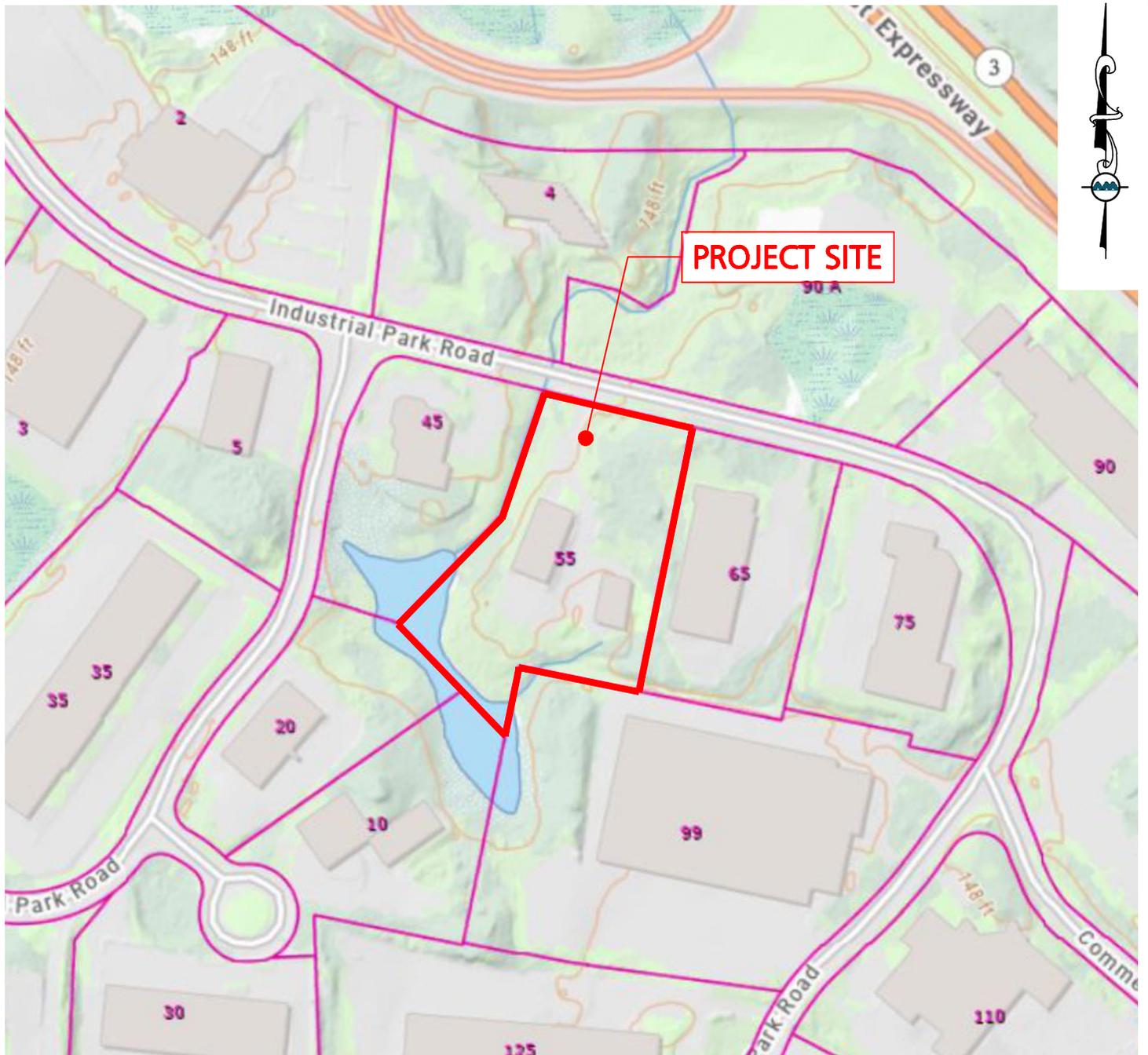
FEMA FIRM MAP

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SHEET No.

EX-4



PROJECT SITE

LEGEND

- NHESP Priority Habitats of Rare Species
- NHESP Estimated Habitats of Rare Wildlife
- Property Tax Parcels

MA MAPPER PRIORITY & ESTIMATED HABITATS

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 www.allenmajor.com
 100 COMMERCE WAY
 P.O. BOX 2118
 WOBURN MA 01888-0118
 TEL: (781) 935-6889
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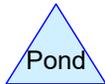
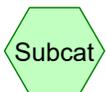
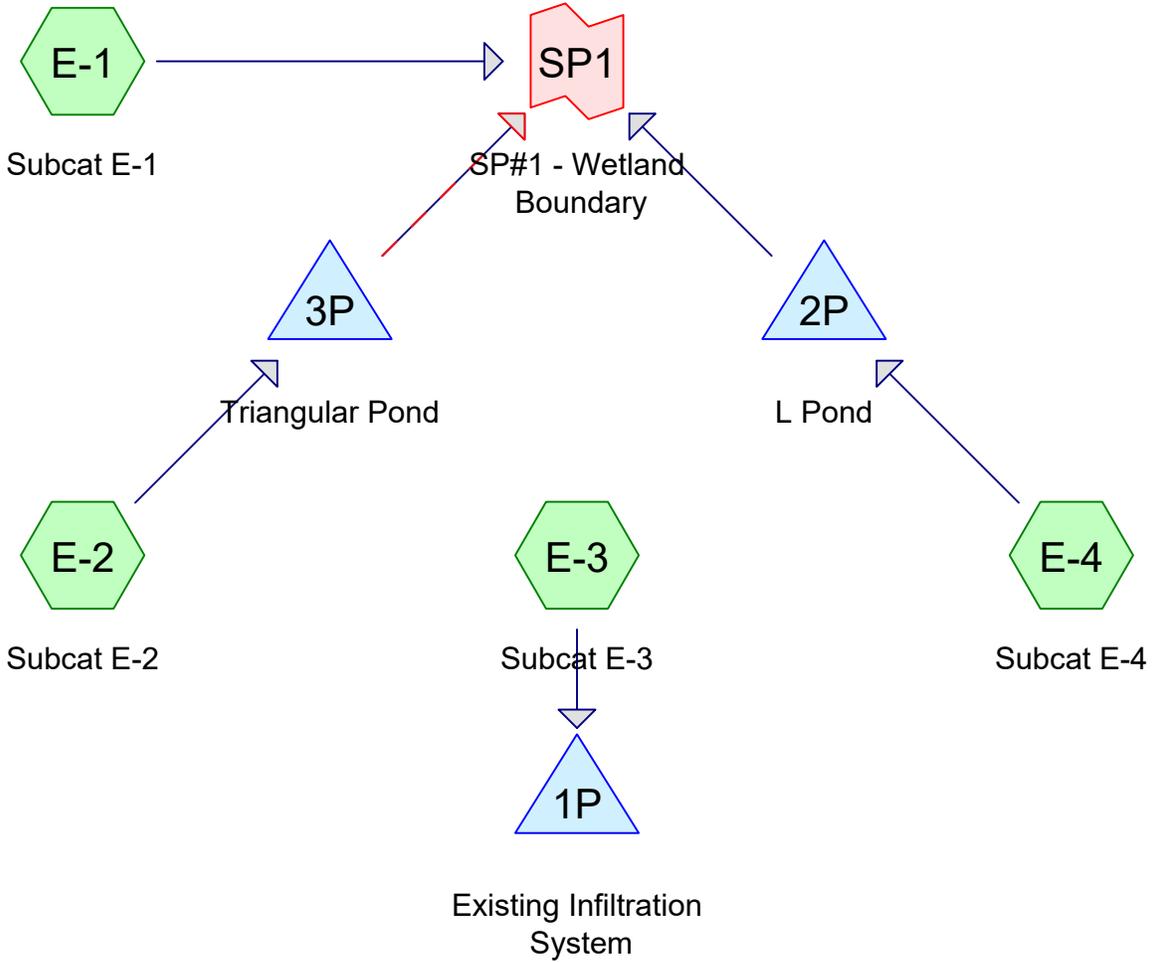
PRIORITY & ESTIMATED HABITATS			
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SCALE:	1"=250'	DWG. NAME:	EXHIBITS
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SHEET No.
EX-5



**SECTION 4.0 -
EXISTING DRAINAGE
ANALYSIS**



Routing Diagram for 1179-20A - Existing HydroCAD
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1179-20A - Existing HydroCAD

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Project Notes

Rainfall events imported from "Atlas-14-Rain.txt" for 447 MA Plymouth

1179-20A - Existing HydroCAD

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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.36	2
2	10-Year	Type III 24-hr		Default	24.00	1	5.12	2
3	100-Year	Type III 24-hr		Default	24.00	1	7.93	2

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
74,456	61	>75% Grass cover, Good, HSG B (E-1, E-2, E-4)
32,452	98	Paved parking, HSG B (E-1, E-2, E-4)
11,479	98	Roofs, HSG B (E-1, E-2, E-3)
118,387	75	TOTAL AREA

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Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
118,387	HSG B	E-1, E-2, E-3, E-4
0	HSG C	
0	HSG D	
0	Other	
118,387		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	74,456	0	0	0	74,456	>75% Grass cover, Good	
0	32,452	0	0	0	32,452	Paved parking	
0	11,479	0	0	0	11,479	Roofs	
0	118,387	0	0	0	118,387	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	E-2	0.00	0.00	15.0	0.0200	0.013	0.0	12.0	0.0	
2	3P	147.00	145.00	30.0	0.0667	0.013	0.0	6.0	0.0	

1179-20A - Existing HydroCAD

Type III 24-hr 2-Year Rainfall=3.36"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Subcat E-1 Runoff Area=72,274 sf 29.43% Impervious Runoff Depth=1.03"
Flow Length=291' Tc=12.6 min CN=72 Runoff=1.49 cfs 6,206 cf

Subcatchment E-2: Subcat E-2 Runoff Area=28,760 sf 60.45% Impervious Runoff Depth=1.74"
Flow Length=328' Tc=11.0 min CN=83 Runoff=1.13 cfs 4,174 cf

Subcatchment E-3: Subcat E-3 Runoff Area=4,031 sf 100.00% Impervious Runoff Depth=3.13"
Tc=0.0 min CN=98 Runoff=0.35 cfs 1,050 cf

Subcatchment E-4: Subcat E-4 Runoff Area=13,322 sf 9.33% Impervious Runoff Depth=0.64"
Flow Length=200' Tc=8.2 min CN=64 Runoff=0.16 cfs 706 cf

Pond 1P: Existing Infiltration System Peak Elev=148.24' Storage=422 cf Inflow=0.35 cfs 1,050 cf
Outflow=0.02 cfs 1,050 cf

Pond 2P: L Pond Peak Elev=148.47' Storage=267 cf Inflow=0.16 cfs 706 cf
Discarded=0.02 cfs 706 cf Primary=0.00 cfs 0 cf Outflow=0.02 cfs 706 cf

Pond 3P: Triangular Pond Peak Elev=147.70' Storage=1,241 cf Inflow=1.13 cfs 4,174 cf
Discarded=0.03 cfs 1,363 cf Primary=0.56 cfs 2,703 cf Secondary=0.00 cfs 0 cf Outflow=0.59 cfs 4,066 cf

Link SP1: SP#1 - Wetland Boundary Inflow=1.96 cfs 8,909 cf
Primary=1.96 cfs 8,909 cf

Total Runoff Area = 118,387 sf Runoff Volume = 12,136 cf Average Runoff Depth = 1.23"
62.89% Pervious = 74,456 sf 37.11% Impervious = 43,931 sf

1179-20A - Existing HydroCAD

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Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Subcatchment E-1: Subcat E-1

Runoff = 1.49 cfs @ 12.19 hrs, Volume= 6,206 cf, Depth= 1.03"

Routed to Link SP1 : SP#1 - Wetland Boundary

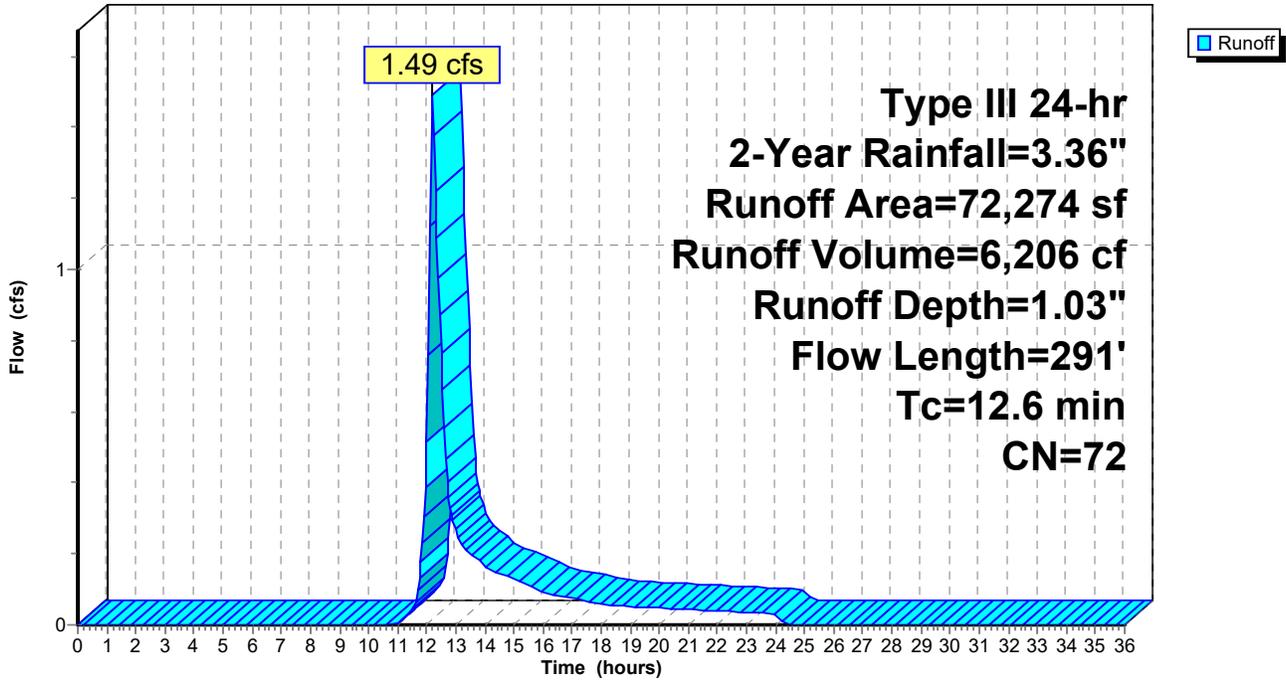
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
51,002	61	>75% Grass cover, Good, HSG B
17,153	98	Paved parking, HSG B
4,119	98	Roofs, HSG B
72,274	72	Weighted Average
51,002		70.57% Pervious Area
21,272		29.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.28"
3.0	178	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.2	36	0.0300	3.52		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.2	27	0.1000	2.21		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
12.6	291	Total			

Subcatchment E-1: Subcat E-1

Hydrograph



1179-20A - Existing HydroCAD

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Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Subcatchment E-2: Subcat E-2

Runoff = 1.13 cfs @ 12.16 hrs, Volume= 4,174 cf, Depth= 1.74"
 Routed to Pond 3P : Triangular Pond

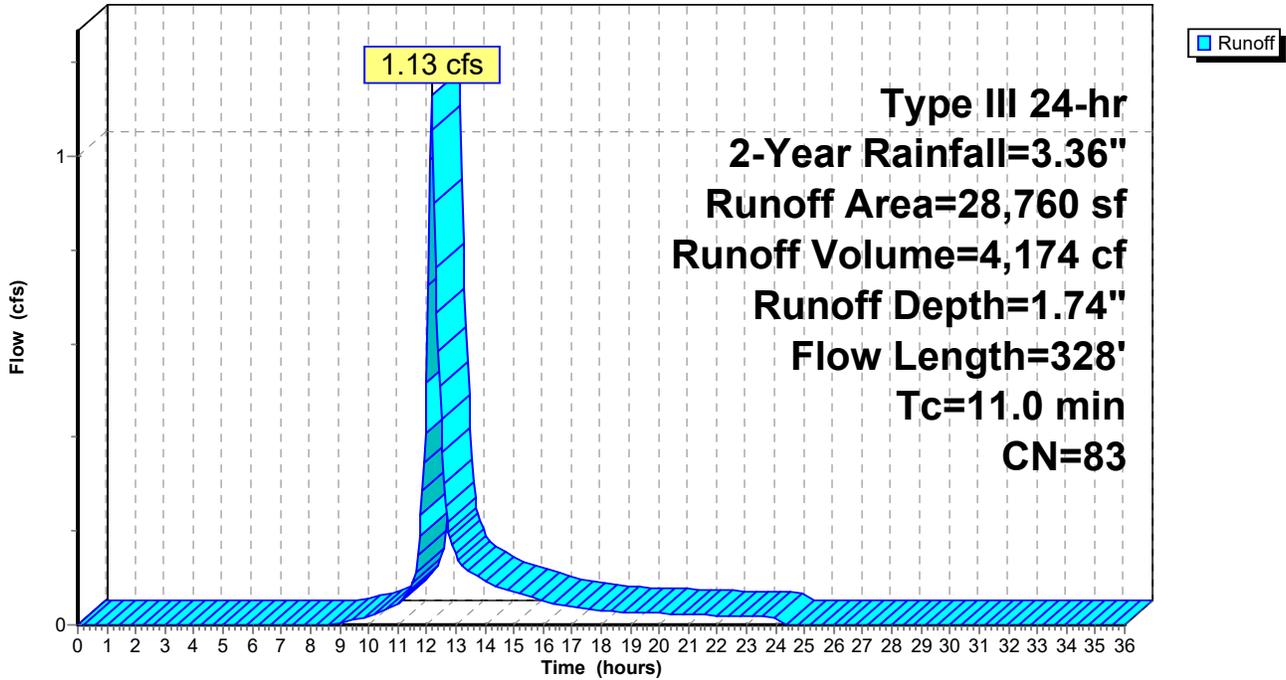
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
11,375	61	>75% Grass cover, Good, HSG B
14,056	98	Paved parking, HSG B
3,329	98	Roofs, HSG B
28,760	83	Weighted Average
11,375		39.55% Pervious Area
17,385		60.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0500	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
1.2	83	0.0500	1.12		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.4	172	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.0	15	0.0200	6.42	5.04	Pipe Channel, D-E 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.0	8	0.0500	3.35		Shallow Concentrated Flow, E-F Grassed Waterway Kv= 15.0 fps
11.0	328	Total			

Subcatchment E-2: Subcat E-2

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Subcatchment E-3: Subcat E-3

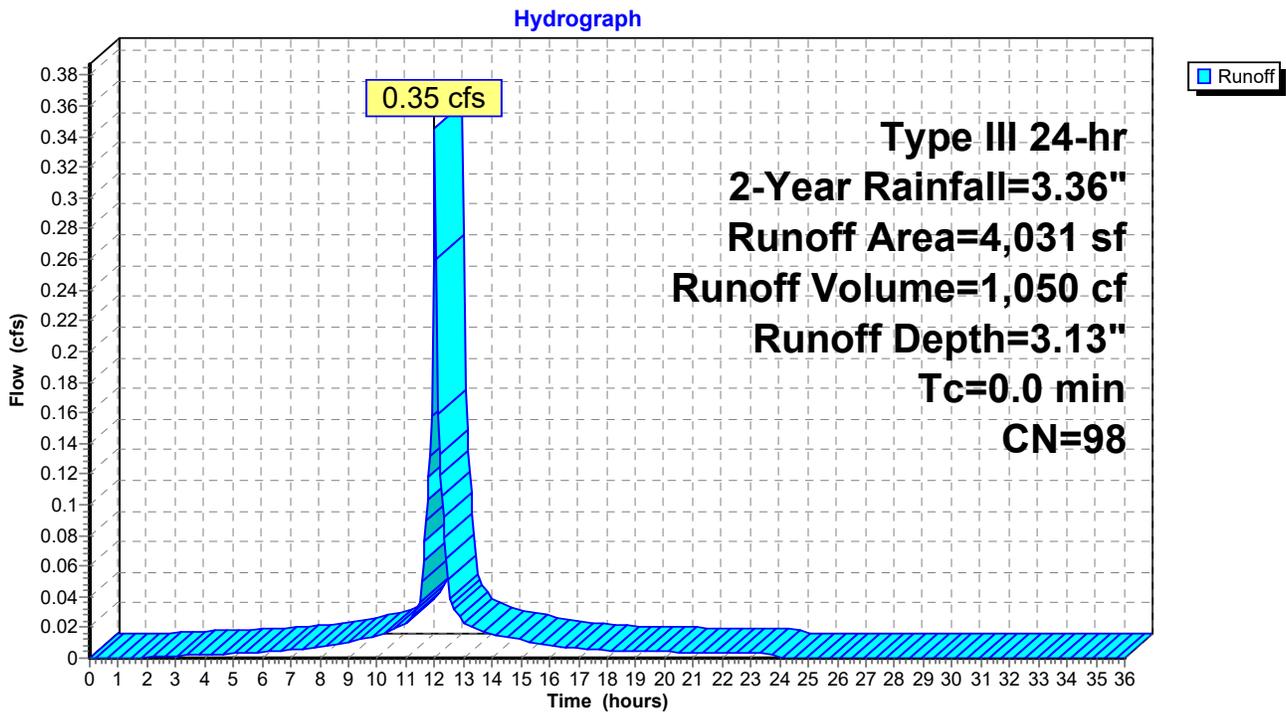
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.35 cfs @ 12.00 hrs, Volume= 1,050 cf, Depth= 3.13"
Routed to Pond 1P : Existing Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
4,031	98	Roofs, HSG B
4,031		100.00% Impervious Area

Subcatchment E-3: Subcat E-3



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Summary for Subcatchment E-4: Subcat E-4

Runoff = 0.16 cfs @ 12.15 hrs, Volume= 706 cf, Depth= 0.64"
 Routed to Pond 2P : L Pond

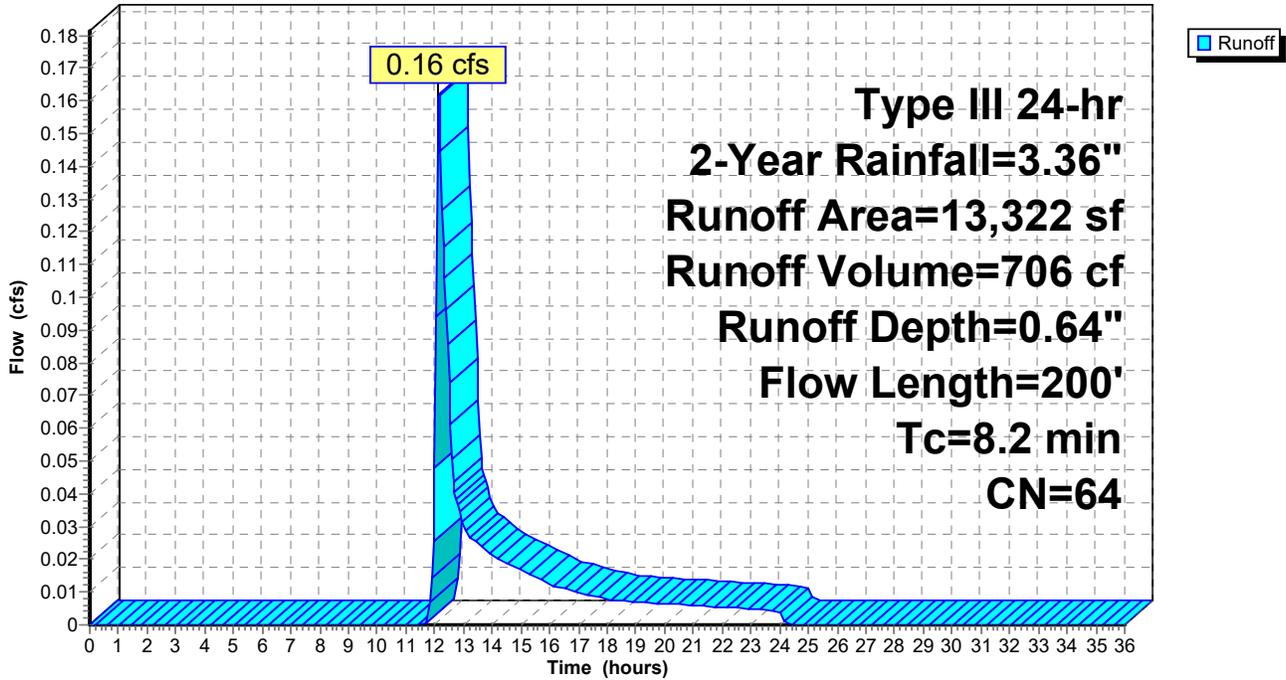
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
12,079	61	>75% Grass cover, Good, HSG B
1,243	98	Paved parking, HSG B
13,322	64	Weighted Average
12,079		90.67% Pervious Area
1,243		9.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1200	0.14		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
0.5	30	0.0333	0.91		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
0.2	20	0.0500	1.57		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.5	20	0.0010	0.64		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
1.1	80	0.0300	1.21		Shallow Concentrated Flow, E-F Short Grass Pasture Kv= 7.0 fps
8.2	200	Total			

Subcatchment E-4: Subcat E-4

Hydrograph



1179-20A - Existing HydroCAD

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Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Pond 1P: Existing Infiltration System

Inflow Area = 4,031 sf, 100.00% Impervious, Inflow Depth = 3.13" for 2-Year event
Inflow = 0.35 cfs @ 12.00 hrs, Volume= 1,050 cf
Outflow = 0.02 cfs @ 10.95 hrs, Volume= 1,050 cf, Atten= 94%, Lag= 0.0 min
Discarded = 0.02 cfs @ 10.95 hrs, Volume= 1,050 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 148.24' @ 13.32 hrs Surf.Area= 863 sf Storage= 422 cf

Plug-Flow detention time= 161.9 min calculated for 1,049 cf (100% of inflow)
Center-of-Mass det. time= 161.7 min (911.5 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	147.40'	689 cf	19.17'W x 45.00'L x 3.21'H Field A 2,767 cf Overall - 1,044 cf Embedded = 1,723 cf x 40.0% Voids
#2A	147.90'	1,044 cf	Cultec R-280HD x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 4 rows
		1,733 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.40'	1.020 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 10.95 hrs HW=147.43' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

1179-20A - Existing HydroCAD

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Type III 24-hr 2-Year Rainfall=3.36"

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Pond 1P: Existing Infiltration System - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf

Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap

Row Length Adjustment= +1.00' x 6.07 sf x 4 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

6 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 43.00' Row Length +12.0" End Stone x 2 = 45.00' Base Length

4 Rows x 47.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 19.17' Base Width

6.0" Stone Base + 26.5" Chamber Height + 6.0" Stone Cover = 3.21' Field Height

24 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 4 Rows = 1,044.3 cf Chamber Storage

2,767.2 cf Field - 1,044.3 cf Chambers = 1,722.8 cf Stone x 40.0% Voids = 689.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,733.5 cf = 0.040 af

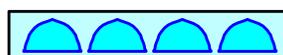
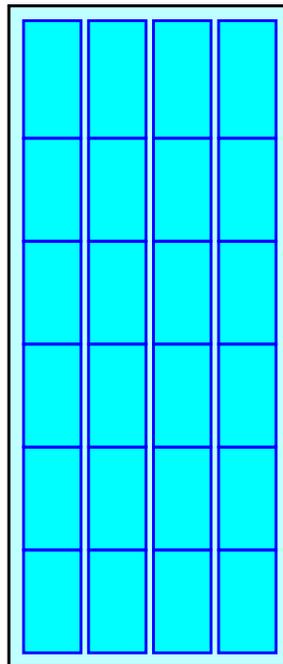
Overall Storage Efficiency = 62.6%

Overall System Size = 45.00' x 19.17' x 3.21'

24 Chambers

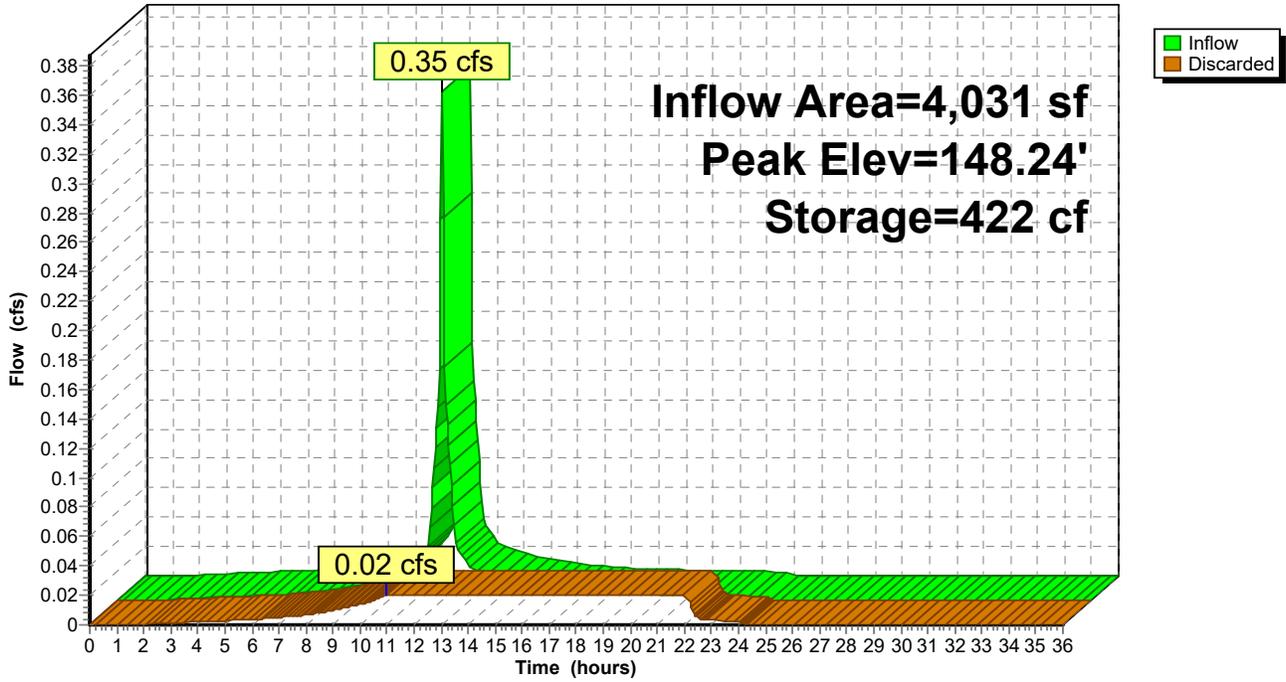
102.5 cy Field

63.8 cy Stone



Pond 1P: Existing Infiltration System

Hydrograph



1179-20A - Existing HydroCAD

Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Pond 2P: L Pond

Inflow Area = 13,322 sf, 9.33% Impervious, Inflow Depth = 0.64" for 2-Year event
 Inflow = 0.16 cfs @ 12.15 hrs, Volume= 706 cf
 Outflow = 0.02 cfs @ 14.69 hrs, Volume= 706 cf, Atten= 89%, Lag= 152.8 min
 Discarded = 0.02 cfs @ 14.69 hrs, Volume= 706 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 148.47' @ 14.69 hrs Surf.Area= 761 sf Storage= 267 cf

Plug-Flow detention time= 182.4 min calculated for 706 cf (100% of inflow)
 Center-of-Mass det. time= 182.2 min (1,079.1 - 896.9)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	1,674 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	369	0	0
149.00	1,197	783	783
149.50	1,667	716	1,499
149.60	1,837	175	1,674

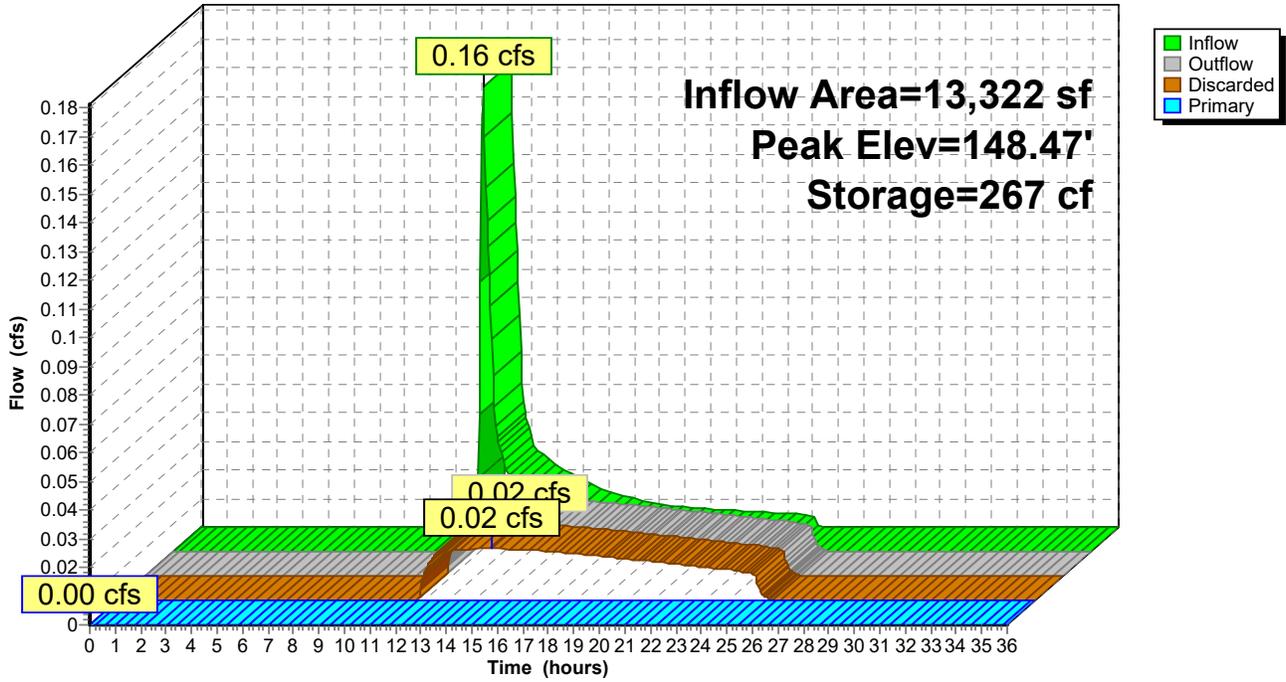
Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	149.50'	5.0' long x 2.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.02 cfs @ 14.69 hrs HW=148.47' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.00' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: L Pond

Hydrograph



1179-20A - Existing HydroCAD

Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Pond 3P: Triangular Pond

Inflow Area = 28,760 sf, 60.45% Impervious, Inflow Depth = 1.74" for 2-Year event
 Inflow = 1.13 cfs @ 12.16 hrs, Volume= 4,174 cf
 Outflow = 0.59 cfs @ 12.40 hrs, Volume= 4,066 cf, Atten= 48%, Lag= 14.4 min
 Discarded = 0.03 cfs @ 12.40 hrs, Volume= 1,363 cf
 Primary = 0.56 cfs @ 12.40 hrs, Volume= 2,703 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 147.70' @ 12.40 hrs Surf.Area= 1,186 sf Storage= 1,241 cf

Plug-Flow detention time= 159.2 min calculated for 4,061 cf (97% of inflow)
 Center-of-Mass det. time= 145.3 min (980.6 - 835.3)

Volume	Invert	Avail.Storage	Storage Description
#1	145.10'	1,767 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
145.10	1	0	0
146.00	232	105	105
147.00	709	471	575
148.00	1,388	1,049	1,624
148.10	1,467	143	1,767

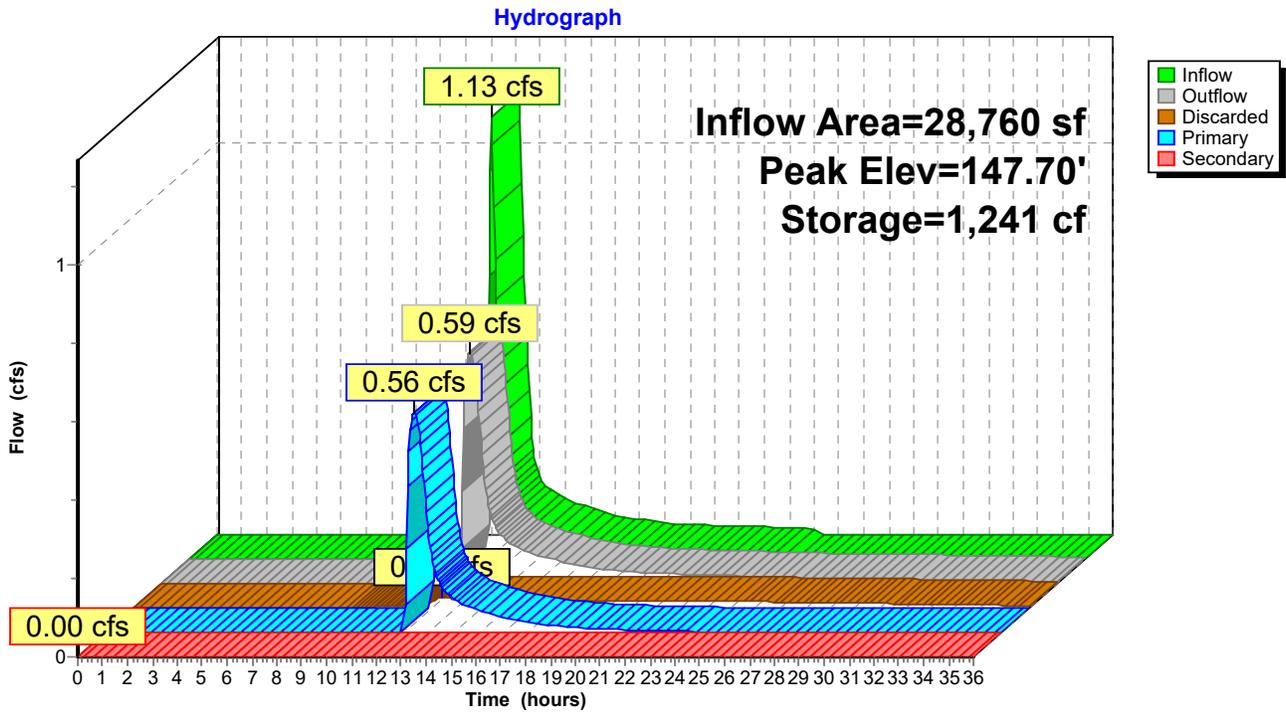
Device	Routing	Invert	Outlet Devices
#1	Discarded	145.10'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.00'	6.0" Round Culvert L= 30.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 147.00' / 145.00' S= 0.0667 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Secondary	148.00'	5.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.03 cfs @ 12.40 hrs HW=147.70' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.56 cfs @ 12.40 hrs HW=147.70' (Free Discharge)
 ↳ **2=Culvert** (Inlet Controls 0.56 cfs @ 2.86 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=145.10' (Free Discharge)
 ↳ **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Triangular Pond

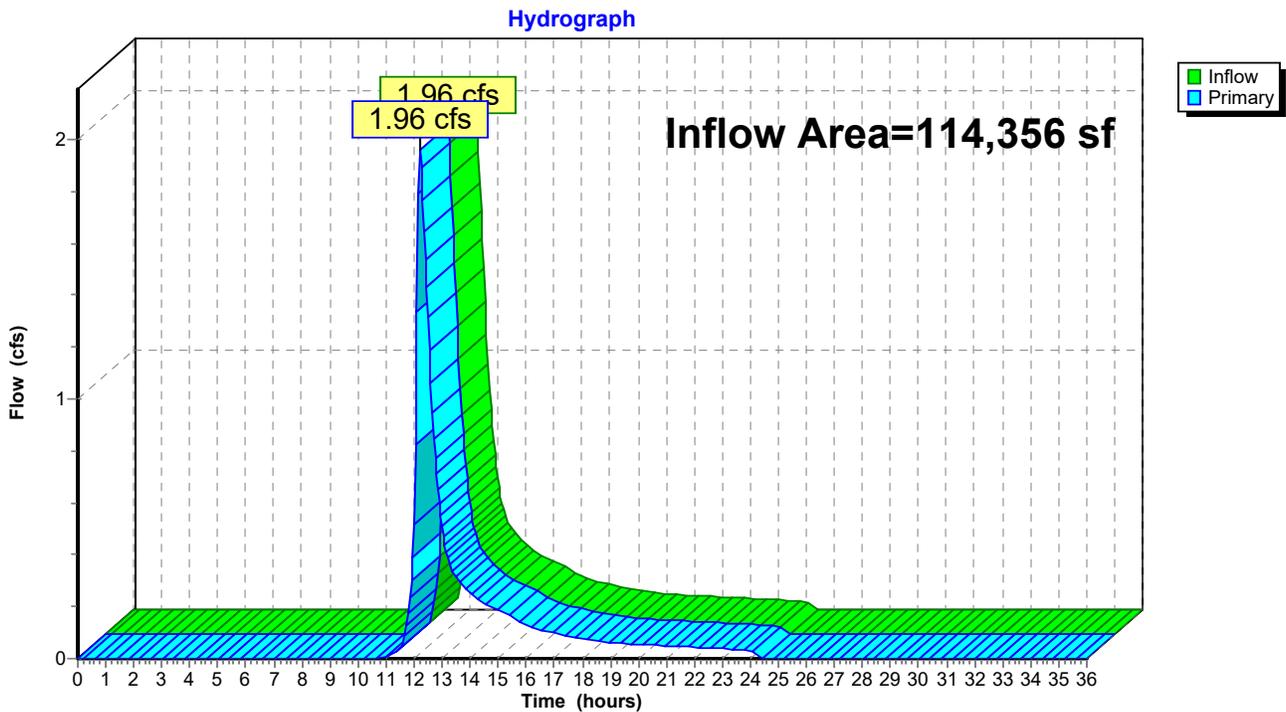


Summary for Link SP1: SP#1 - Wetland Boundary

Inflow Area = 114,356 sf, 34.89% Impervious, Inflow Depth = 0.93" for 2-Year event
Inflow = 1.96 cfs @ 12.21 hrs, Volume= 8,909 cf
Primary = 1.96 cfs @ 12.21 hrs, Volume= 8,909 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link SP1: SP#1 - Wetland Boundary



1179-20A - Existing HydroCAD

Type III 24-hr 10-Year Rainfall=5.12"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Subcat E-1	Runoff Area=72,274 sf 29.43% Impervious Runoff Depth=2.29" Flow Length=291' Tc=12.6 min CN=72 Runoff=3.52 cfs 13,796 cf
Subcatchment E-2: Subcat E-2	Runoff Area=28,760 sf 60.45% Impervious Runoff Depth=3.28" Flow Length=328' Tc=11.0 min CN=83 Runoff=2.13 cfs 7,868 cf
Subcatchment E-3: Subcat E-3	Runoff Area=4,031 sf 100.00% Impervious Runoff Depth=4.88" Tc=0.0 min CN=98 Runoff=0.53 cfs 1,640 cf
Subcatchment E-4: Subcat E-4	Runoff Area=13,322 sf 9.33% Impervious Runoff Depth=1.66" Flow Length=200' Tc=8.2 min CN=64 Runoff=0.51 cfs 1,842 cf
Pond 1P: Existing Infiltration System	Peak Elev=148.75' Storage=783 cf Inflow=0.53 cfs 1,640 cf Outflow=0.02 cfs 1,640 cf
Pond 2P: L Pond	Peak Elev=149.15' Storage=968 cf Inflow=0.51 cfs 1,842 cf Discarded=0.03 cfs 1,842 cf Primary=0.00 cfs 0 cf Outflow=0.03 cfs 1,842 cf
Pond 3P: Triangular Pond	Peak Elev=148.22' Storage=1,767 cf Inflow=2.13 cfs 7,868 cf Discarded=0.03 cfs 1,533 cf Primary=0.82 cfs 5,548 cf Secondary=1.13 cfs 672 cf Outflow=1.98 cfs 7,752 cf
Link SP1: SP#1 - Wetland Boundary	Inflow=5.38 cfs 20,016 cf Primary=5.38 cfs 20,016 cf

Total Runoff Area = 118,387 sf Runoff Volume = 25,146 cf Average Runoff Depth = 2.55"
62.89% Pervious = 74,456 sf 37.11% Impervious = 43,931 sf

1179-20A - Existing HydroCAD

Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Subcatchment E-1: Subcat E-1

Runoff = 3.52 cfs @ 12.18 hrs, Volume= 13,796 cf, Depth= 2.29"
 Routed to Link SP1 : SP#1 - Wetland Boundary

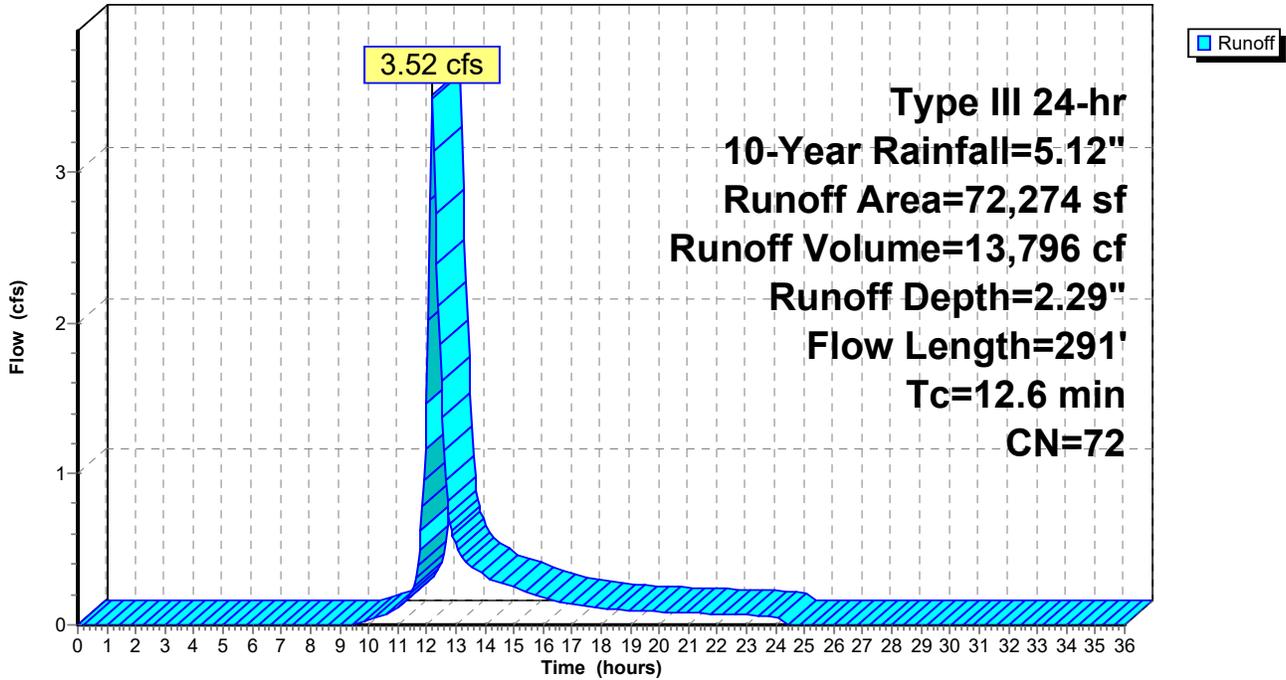
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
51,002	61	>75% Grass cover, Good, HSG B
17,153	98	Paved parking, HSG B
4,119	98	Roofs, HSG B
72,274	72	Weighted Average
51,002		70.57% Pervious Area
21,272		29.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.28"
3.0	178	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.2	36	0.0300	3.52		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.2	27	0.1000	2.21		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
12.6	291	Total			

Subcatchment E-1: Subcat E-1

Hydrograph



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Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Subcatchment E-2: Subcat E-2

Runoff = 2.13 cfs @ 12.15 hrs, Volume= 7,868 cf, Depth= 3.28"
 Routed to Pond 3P : Triangular Pond

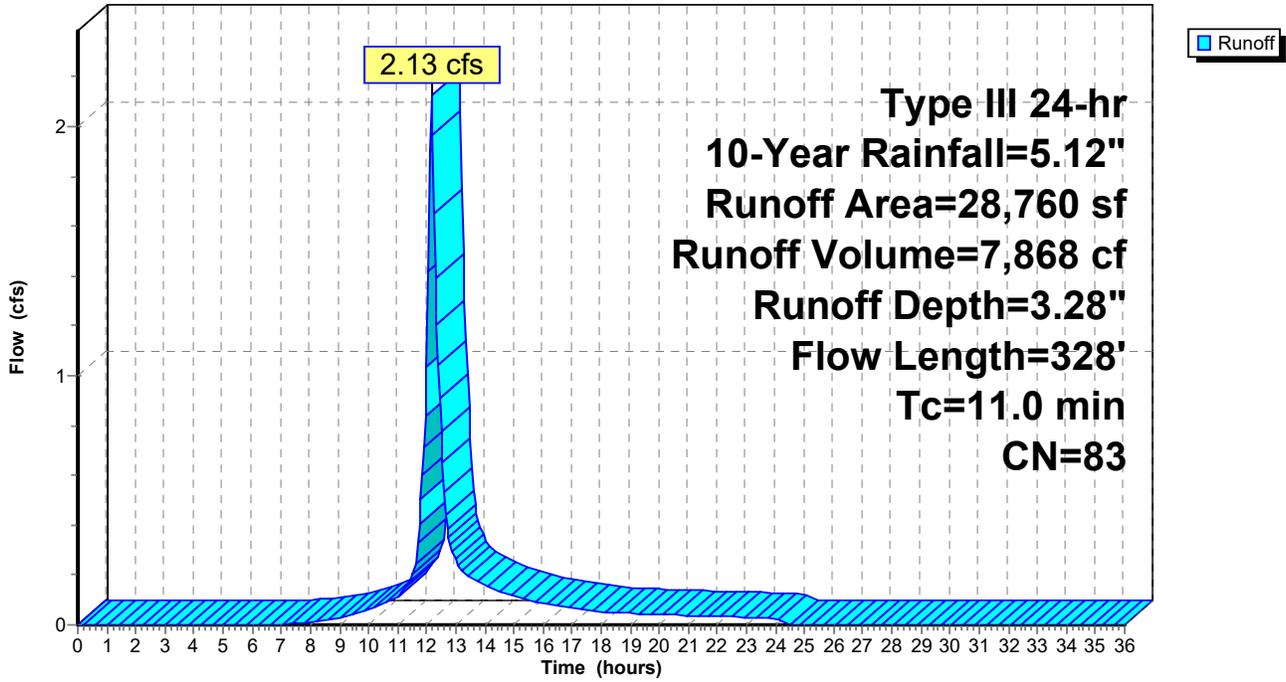
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
11,375	61	>75% Grass cover, Good, HSG B
14,056	98	Paved parking, HSG B
3,329	98	Roofs, HSG B
28,760	83	Weighted Average
11,375		39.55% Pervious Area
17,385		60.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0500	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
1.2	83	0.0500	1.12		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.4	172	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.0	15	0.0200	6.42	5.04	Pipe Channel, D-E 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.0	8	0.0500	3.35		Shallow Concentrated Flow, E-F Grassed Waterway Kv= 15.0 fps
11.0	328	Total			

Subcatchment E-2: Subcat E-2

Hydrograph



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Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Subcatchment E-3: Subcat E-3

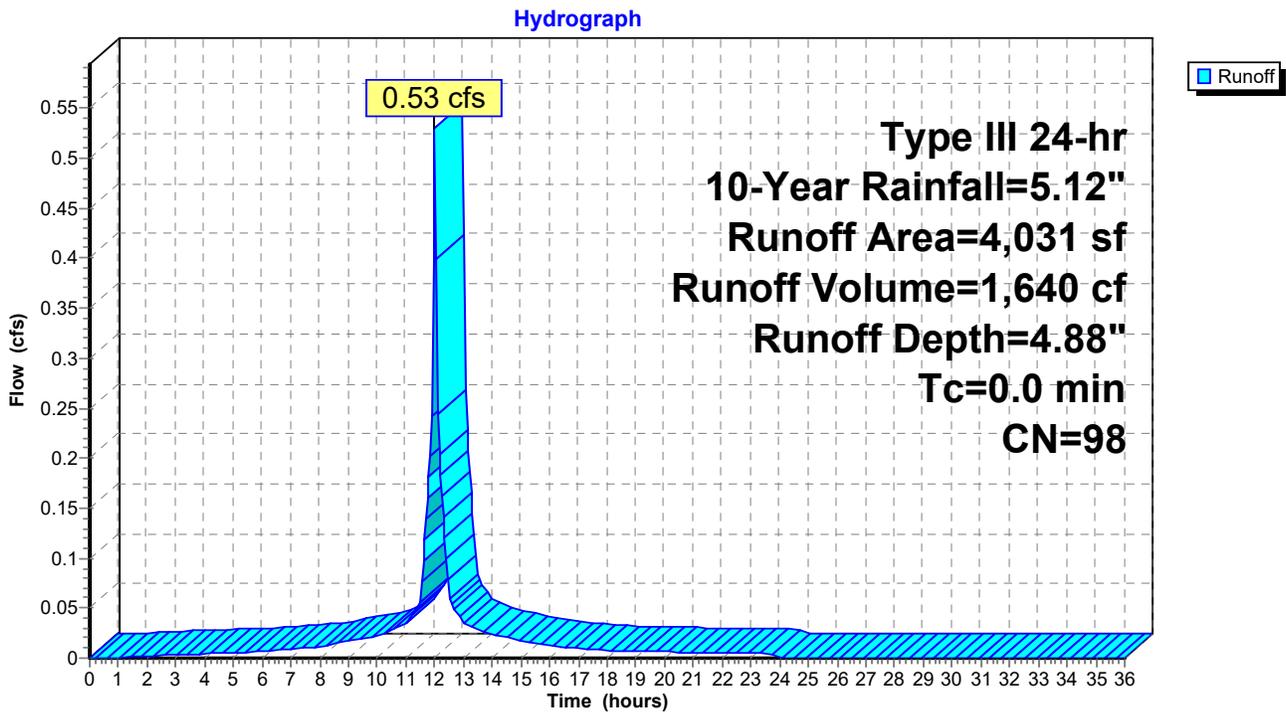
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.53 cfs @ 12.00 hrs, Volume= 1,640 cf, Depth= 4.88"
Routed to Pond 1P : Existing Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
4,031	98	Roofs, HSG B
4,031		100.00% Impervious Area

Subcatchment E-3: Subcat E-3



1179-20A - Existing HydroCAD

Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Subcatchment E-4: Subcat E-4

Runoff = 0.51 cfs @ 12.13 hrs, Volume= 1,842 cf, Depth= 1.66"
 Routed to Pond 2P : L Pond

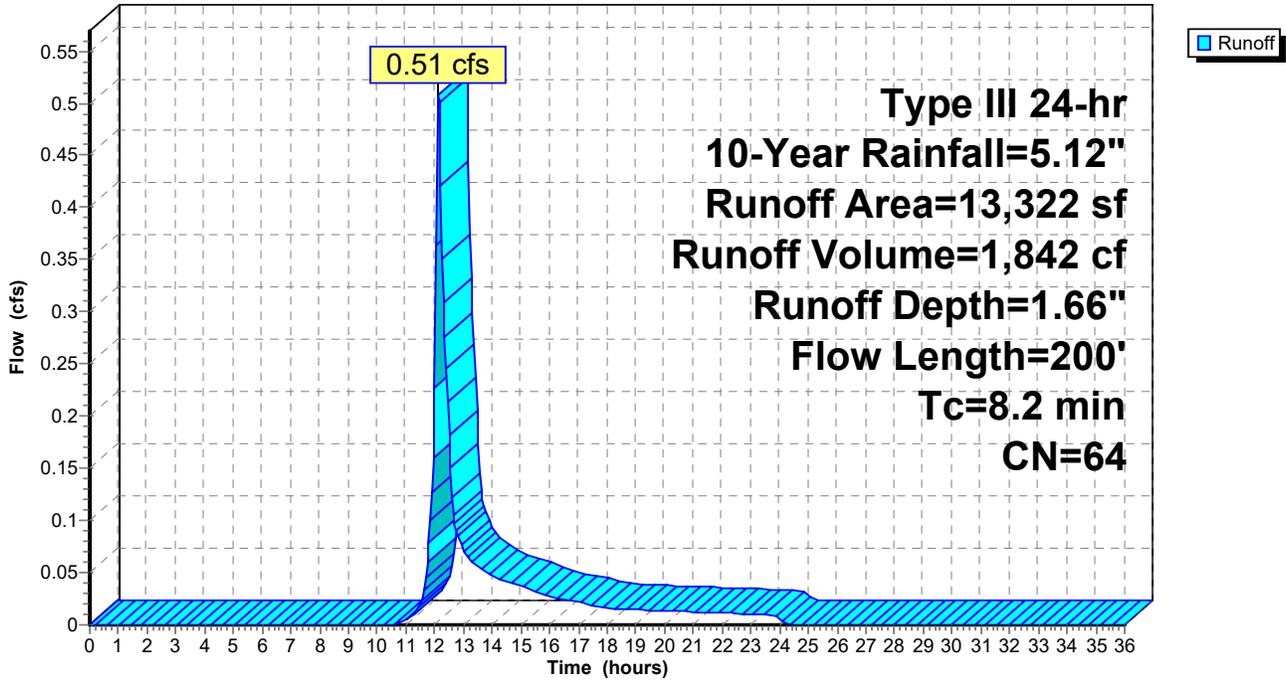
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
12,079	61	>75% Grass cover, Good, HSG B
1,243	98	Paved parking, HSG B
13,322	64	Weighted Average
12,079		90.67% Pervious Area
1,243		9.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1200	0.14		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
0.5	30	0.0333	0.91		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
0.2	20	0.0500	1.57		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.5	20	0.0010	0.64		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
1.1	80	0.0300	1.21		Shallow Concentrated Flow, E-F Short Grass Pasture Kv= 7.0 fps
8.2	200	Total			

Subcatchment E-4: Subcat E-4

Hydrograph



Summary for Pond 1P: Existing Infiltration System

Inflow Area = 4,031 sf, 100.00% Impervious, Inflow Depth = 4.88" for 10-Year event
 Inflow = 0.53 cfs @ 12.00 hrs, Volume= 1,640 cf
 Outflow = 0.02 cfs @ 9.75 hrs, Volume= 1,640 cf, Atten= 96%, Lag= 0.0 min
 Discarded = 0.02 cfs @ 9.75 hrs, Volume= 1,640 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 148.75' @ 14.55 hrs Surf.Area= 863 sf Storage= 783 cf

Plug-Flow detention time= 321.2 min calculated for 1,638 cf (100% of inflow)
 Center-of-Mass det. time= 321.2 min (1,063.3 - 742.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	147.40'	689 cf	19.17'W x 45.00'L x 3.21'H Field A 2,767 cf Overall - 1,044 cf Embedded = 1,723 cf x 40.0% Voids
#2A	147.90'	1,044 cf	Cultec R-280HD x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 4 rows
		1,733 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.40'	1.020 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 9.75 hrs HW=147.43' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

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Type III 24-hr 10-Year Rainfall=5.12"

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Pond 1P: Existing Infiltration System - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf

Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap

Row Length Adjustment= +1.00' x 6.07 sf x 4 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

6 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 43.00' Row Length +12.0" End Stone x 2 = 45.00' Base Length

4 Rows x 47.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 19.17' Base Width

6.0" Stone Base + 26.5" Chamber Height + 6.0" Stone Cover = 3.21' Field Height

24 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 4 Rows = 1,044.3 cf Chamber Storage

2,767.2 cf Field - 1,044.3 cf Chambers = 1,722.8 cf Stone x 40.0% Voids = 689.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,733.5 cf = 0.040 af

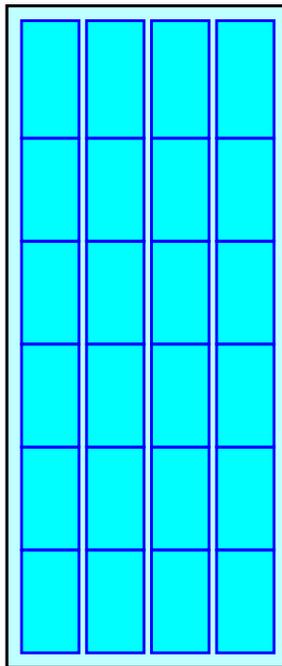
Overall Storage Efficiency = 62.6%

Overall System Size = 45.00' x 19.17' x 3.21'

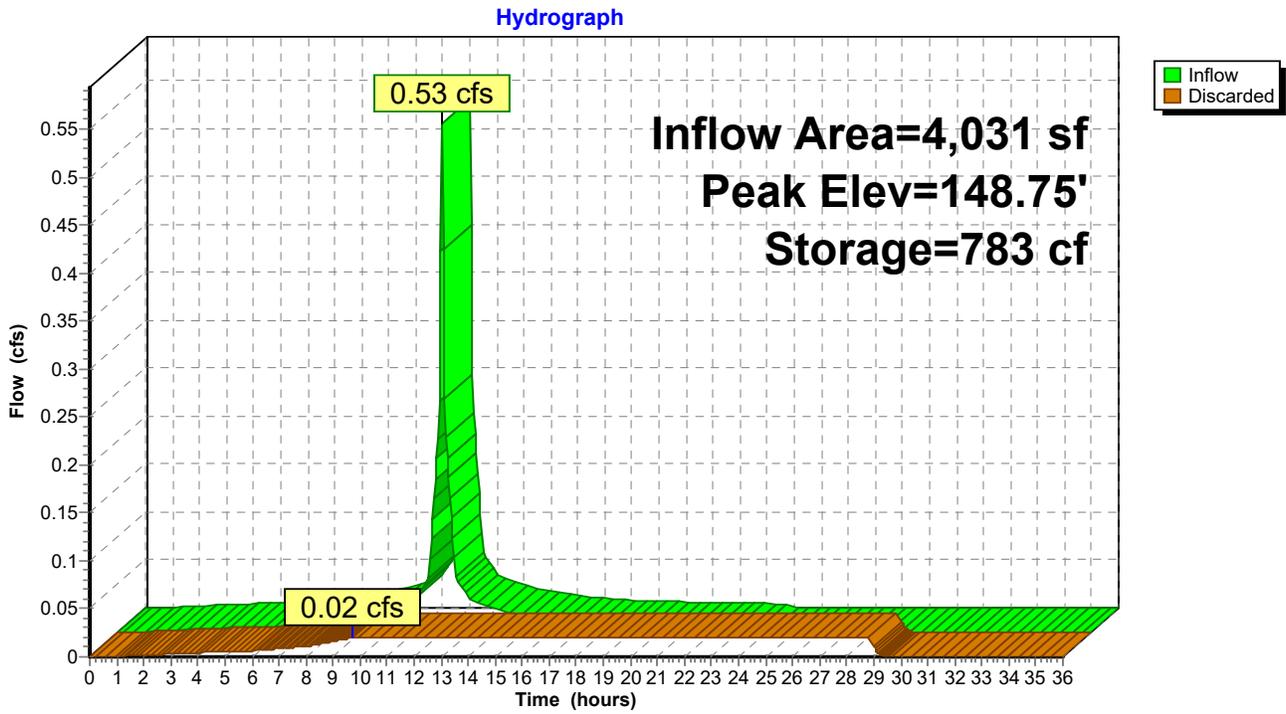
24 Chambers

102.5 cy Field

63.8 cy Stone



Pond 1P: Existing Infiltration System



1179-20A - Existing HydroCAD

Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Pond 2P: L Pond

Inflow Area = 13,322 sf, 9.33% Impervious, Inflow Depth = 1.66" for 10-Year event
 Inflow = 0.51 cfs @ 12.13 hrs, Volume= 1,842 cf
 Outflow = 0.03 cfs @ 15.52 hrs, Volume= 1,842 cf, Atten= 94%, Lag= 203.4 min
 Discarded = 0.03 cfs @ 15.52 hrs, Volume= 1,842 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 149.15' @ 15.52 hrs Surf.Area= 1,334 sf Storage= 968 cf

Plug-Flow detention time= 390.9 min calculated for 1,842 cf (100% of inflow)
 Center-of-Mass det. time= 390.9 min (1,255.0 - 864.2)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	1,674 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	369	0	0
149.00	1,197	783	783
149.50	1,667	716	1,499
149.60	1,837	175	1,674

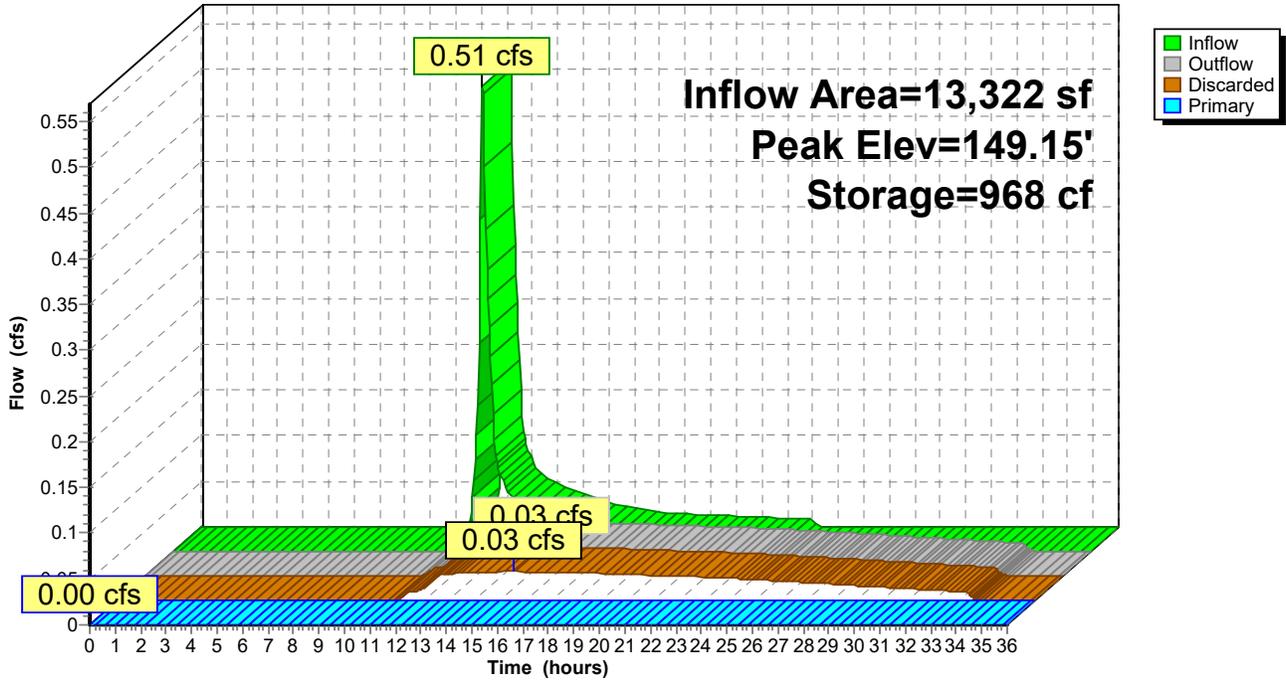
Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	149.50'	5.0' long x 2.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.03 cfs @ 15.52 hrs HW=149.15' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.00' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: L Pond

Hydrograph



Summary for Pond 3P: Triangular Pond

[93] Warning: Storage range exceeded by 0.12'

Inflow Area = 28,760 sf, 60.45% Impervious, Inflow Depth = 3.28" for 10-Year event
 Inflow = 2.13 cfs @ 12.15 hrs, Volume= 7,868 cf
 Outflow = 1.98 cfs @ 12.22 hrs, Volume= 7,752 cf, Atten= 7%, Lag= 3.8 min
 Discarded = 0.03 cfs @ 12.20 hrs, Volume= 1,533 cf
 Primary = 0.82 cfs @ 12.22 hrs, Volume= 5,548 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary
 Secondary = 1.13 cfs @ 12.22 hrs, Volume= 672 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 148.22' @ 12.22 hrs Surf.Area= 1,467 sf Storage= 1,767 cf

Plug-Flow detention time= 99.3 min calculated for 7,752 cf (99% of inflow)
 Center-of-Mass det. time= 90.4 min (907.6 - 817.1)

Volume	Invert	Avail.Storage	Storage Description
#1	145.10'	1,767 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
145.10	1	0	0
146.00	232	105	105
147.00	709	471	575
148.00	1,388	1,049	1,624
148.10	1,467	143	1,767

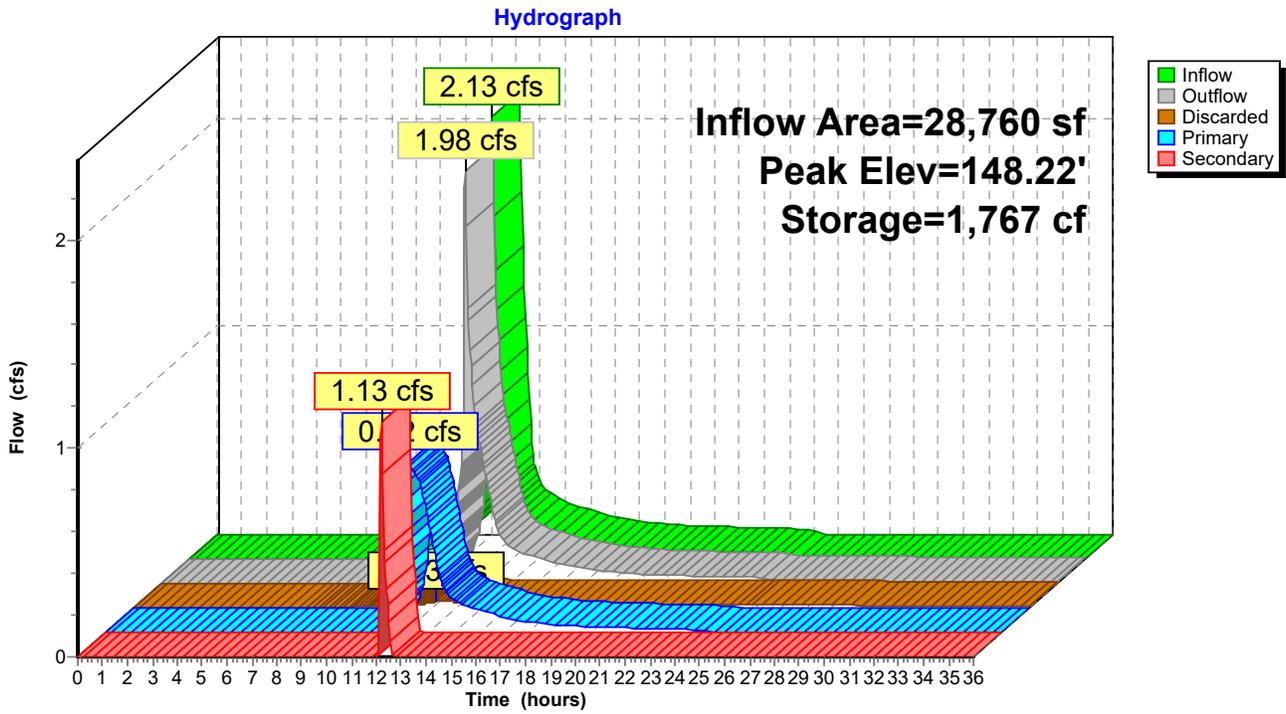
Device	Routing	Invert	Outlet Devices
#1	Discarded	145.10'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.00'	6.0" Round Culvert L= 30.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 147.00' / 145.00' S= 0.0667 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Secondary	148.00'	5.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.03 cfs @ 12.20 hrs HW=148.20' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.81 cfs @ 12.22 hrs HW=148.19' (Free Discharge)
 ↑2=Culvert (Inlet Controls 0.81 cfs @ 4.12 fps)

Secondary OutFlow Max=0.98 cfs @ 12.22 hrs HW=148.19' (Free Discharge)
 ↑3=Broad-Crested Rectangular Weir (Weir Controls 0.98 cfs @ 1.02 fps)

Pond 3P: Triangular Pond

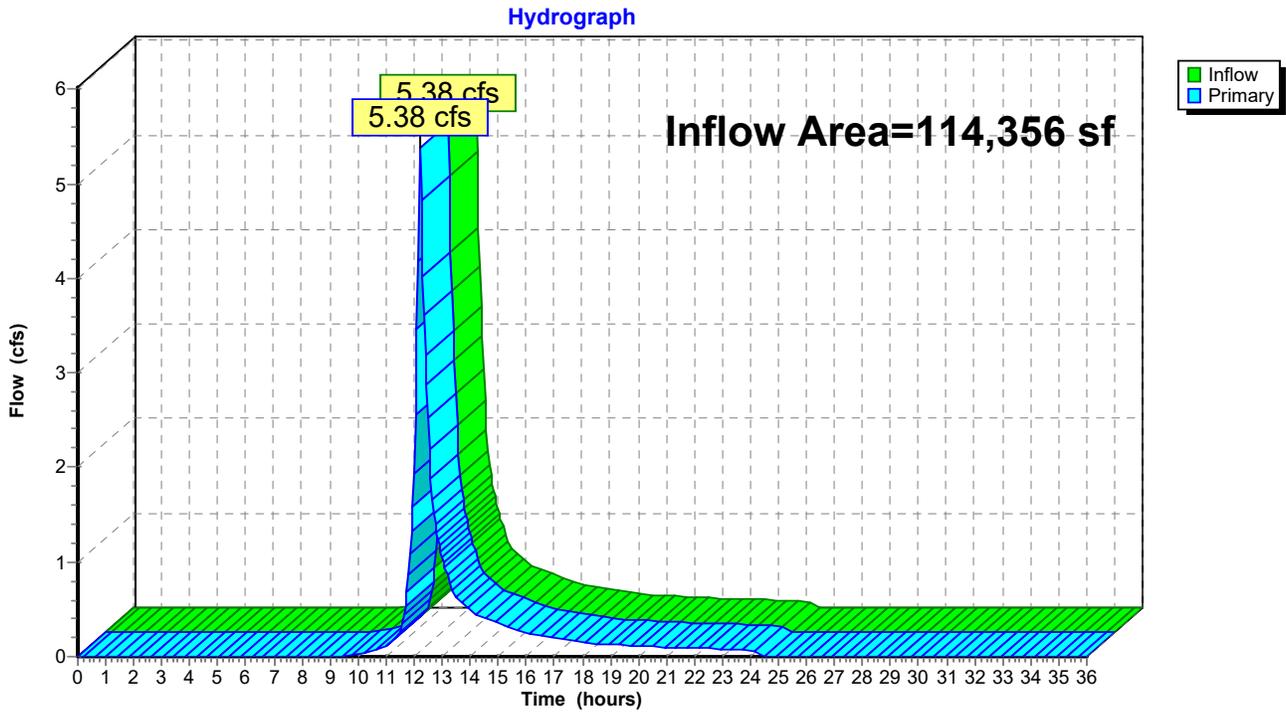


Summary for Link SP1: SP#1 - Wetland Boundary

Inflow Area = 114,356 sf, 34.89% Impervious, Inflow Depth = 2.10" for 10-Year event
Inflow = 5.38 cfs @ 12.21 hrs, Volume= 20,016 cf
Primary = 5.38 cfs @ 12.21 hrs, Volume= 20,016 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link SP1: SP#1 - Wetland Boundary



1179-20A - Existing HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Subcat E-1

Runoff Area=72,274 sf 29.43% Impervious Runoff Depth=4.63"
Flow Length=291' Tc=12.6 min CN=72 Runoff=7.23 cfs 27,904 cf

Subcatchment E-2: Subcat E-2

Runoff Area=28,760 sf 60.45% Impervious Runoff Depth=5.91"
Flow Length=328' Tc=11.0 min CN=83 Runoff=3.75 cfs 14,166 cf

Subcatchment E-3: Subcat E-3

Runoff Area=4,031 sf 100.00% Impervious Runoff Depth=7.69"
Tc=0.0 min CN=98 Runoff=0.82 cfs 2,583 cf

Subcatchment E-4: Subcat E-4

Runoff Area=13,322 sf 9.33% Impervious Runoff Depth=3.73"
Flow Length=200' Tc=8.2 min CN=64 Runoff=1.21 cfs 4,136 cf

Pond 1P: Existing Infiltration System

Peak Elev=149.87' Storage=1,471 cf Inflow=0.82 cfs 2,583 cf
Outflow=0.02 cfs 2,278 cf

Pond 2P: L Pond

Peak Elev=149.60' Storage=1,668 cf Inflow=1.21 cfs 4,136 cf
Discarded=0.04 cfs 2,828 cf Primary=0.38 cfs 1,169 cf Outflow=0.43 cfs 3,997 cf

Pond 3P: Triangular Pond

Peak Elev=148.38' Storage=1,767 cf Inflow=3.75 cfs 14,166 cf
Discarded=0.03 cfs 1,726 cf Primary=0.89 cfs 9,234 cf Secondary=2.87 cfs 3,084 cf Outflow=3.79 cfs 14,045 cf

Link SP1: SP#1 - Wetland Boundary

Inflow=10.99 cfs 41,392 cf
Primary=10.99 cfs 41,392 cf

**Total Runoff Area = 118,387 sf Runoff Volume = 48,789 cf Average Runoff Depth = 4.95"
62.89% Pervious = 74,456 sf 37.11% Impervious = 43,931 sf**

1179-20A - Existing HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Subcatchment E-1: Subcat E-1

Runoff = 7.23 cfs @ 12.17 hrs, Volume= 27,904 cf, Depth= 4.63"

Routed to Link SP1 : SP#1 - Wetland Boundary

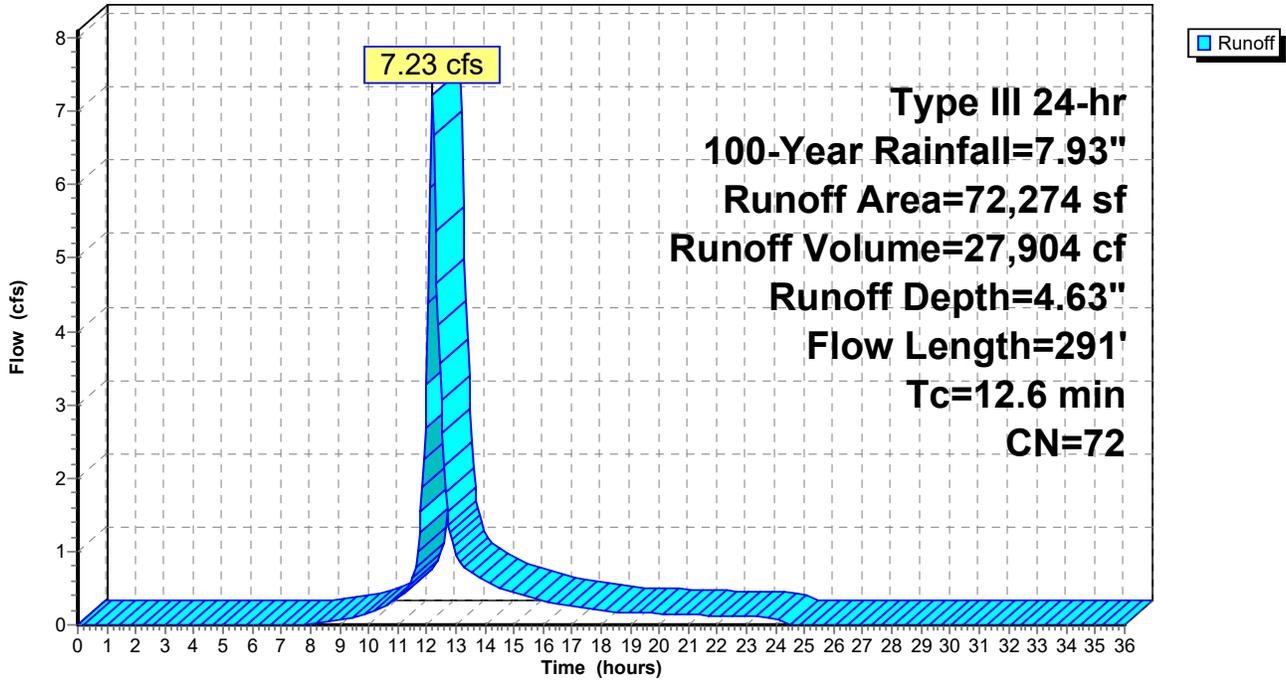
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
51,002	61	>75% Grass cover, Good, HSG B
17,153	98	Paved parking, HSG B
4,119	98	Roofs, HSG B
72,274	72	Weighted Average
51,002		70.57% Pervious Area
21,272		29.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.28"
3.0	178	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.2	36	0.0300	3.52		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.2	27	0.1000	2.21		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
12.6	291	Total			

Subcatchment E-1: Subcat E-1

Hydrograph



1179-20A - Existing HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Subcatchment E-2: Subcat E-2

Runoff = 3.75 cfs @ 12.15 hrs, Volume= 14,166 cf, Depth= 5.91"
 Routed to Pond 3P : Triangular Pond

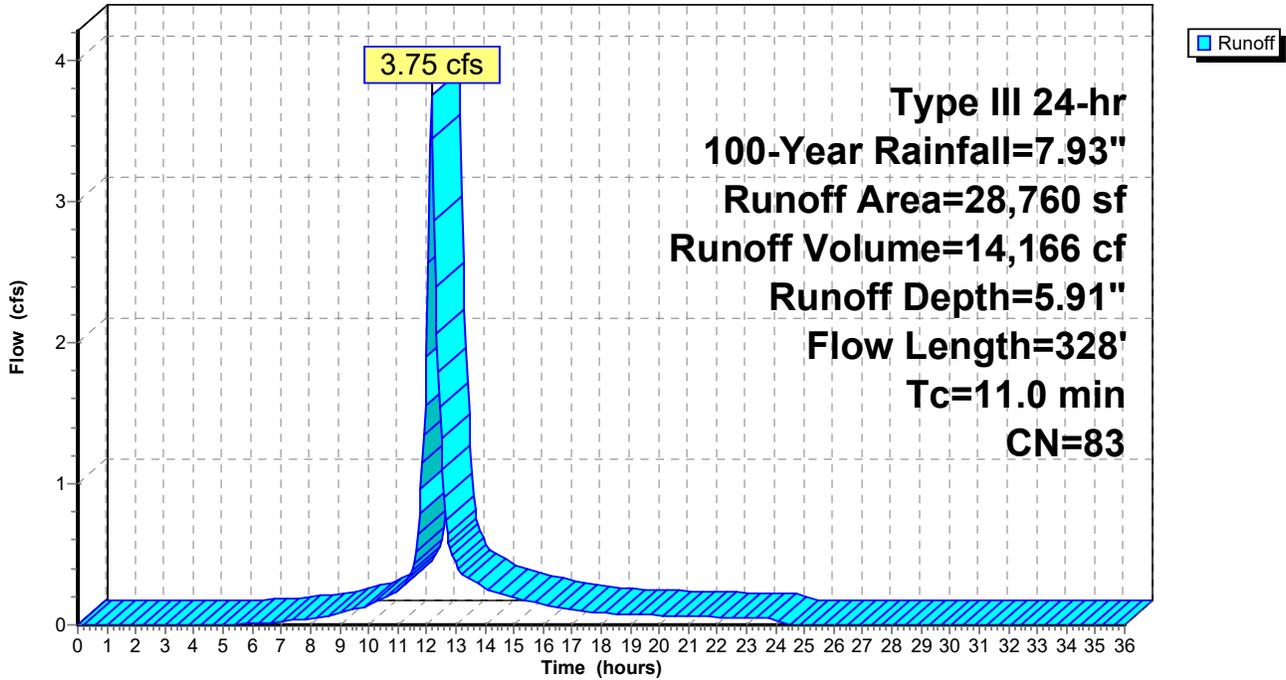
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
11,375	61	>75% Grass cover, Good, HSG B
14,056	98	Paved parking, HSG B
3,329	98	Roofs, HSG B
28,760	83	Weighted Average
11,375		39.55% Pervious Area
17,385		60.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0500	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
1.2	83	0.0500	1.12		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.4	172	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.0	15	0.0200	6.42	5.04	Pipe Channel, D-E 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.0	8	0.0500	3.35		Shallow Concentrated Flow, E-F Grassed Waterway Kv= 15.0 fps
11.0	328	Total			

Subcatchment E-2: Subcat E-2

Hydrograph



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Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Subcatchment E-3: Subcat E-3

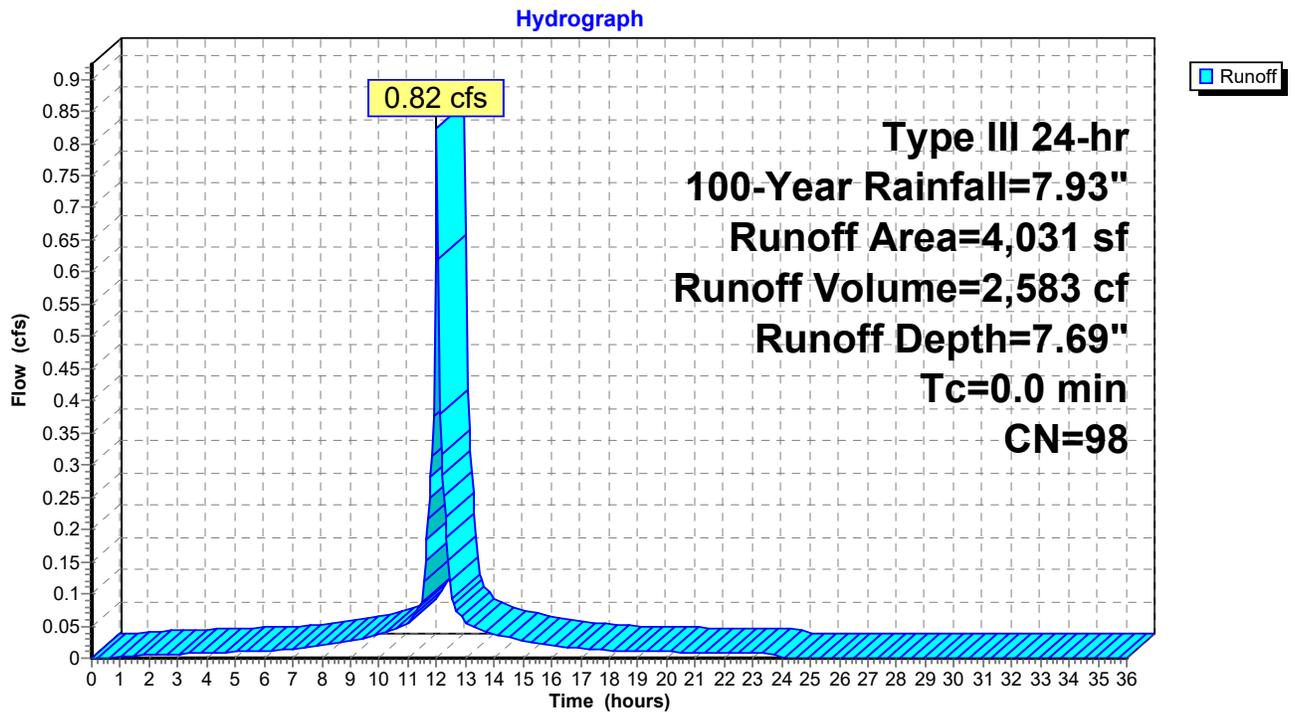
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.82 cfs @ 12.00 hrs, Volume= 2,583 cf, Depth= 7.69"
Routed to Pond 1P : Existing Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
4,031	98	Roofs, HSG B
4,031		100.00% Impervious Area

Subcatchment E-3: Subcat E-3



1179-20A - Existing HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Subcatchment E-4: Subcat E-4

Runoff = 1.21 cfs @ 12.12 hrs, Volume= 4,136 cf, Depth= 3.73"
 Routed to Pond 2P : L Pond

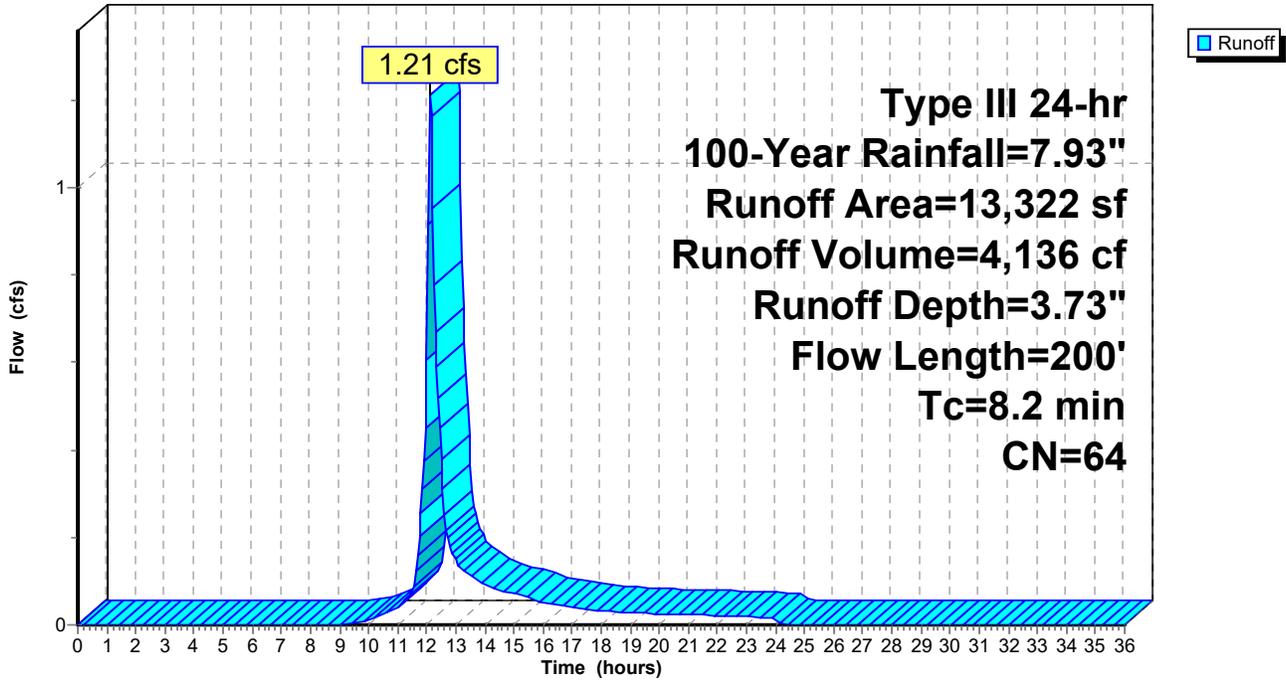
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
12,079	61	>75% Grass cover, Good, HSG B
1,243	98	Paved parking, HSG B
13,322	64	Weighted Average
12,079		90.67% Pervious Area
1,243		9.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1200	0.14		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
0.5	30	0.0333	0.91		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
0.2	20	0.0500	1.57		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.5	20	0.0010	0.64		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
1.1	80	0.0300	1.21		Shallow Concentrated Flow, E-F Short Grass Pasture Kv= 7.0 fps
8.2	200	Total			

Subcatchment E-4: Subcat E-4

Hydrograph



1179-20A - Existing HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Pond 1P: Existing Infiltration System

Inflow Area = 4,031 sf, 100.00% Impervious, Inflow Depth = 7.69" for 100-Year event
 Inflow = 0.82 cfs @ 12.00 hrs, Volume= 2,583 cf
 Outflow = 0.02 cfs @ 8.40 hrs, Volume= 2,278 cf, Atten= 98%, Lag= 0.0 min
 Discarded = 0.02 cfs @ 8.40 hrs, Volume= 2,278 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 149.87' @ 15.87 hrs Surf.Area= 863 sf Storage= 1,471 cf

Plug-Flow detention time= 542.9 min calculated for 2,274 cf (88% of inflow)
 Center-of-Mass det. time= 487.3 min (1,223.0 - 735.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	147.40'	689 cf	19.17'W x 45.00'L x 3.21'H Field A 2,767 cf Overall - 1,044 cf Embedded = 1,723 cf x 40.0% Voids
#2A	147.90'	1,044 cf	Cultec R-280HD x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 4 rows
		1,733 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.40'	1.020 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 8.40 hrs HW=147.43' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)

1179-20A - Existing HydroCAD

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Type III 24-hr 100-Year Rainfall=7.93"

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Pond 1P: Existing Infiltration System - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf

Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap

Row Length Adjustment= +1.00' x 6.07 sf x 4 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

6 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 43.00' Row Length +12.0" End Stone x 2 = 45.00' Base Length

4 Rows x 47.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 19.17' Base Width

6.0" Stone Base + 26.5" Chamber Height + 6.0" Stone Cover = 3.21' Field Height

24 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 4 Rows = 1,044.3 cf Chamber Storage

2,767.2 cf Field - 1,044.3 cf Chambers = 1,722.8 cf Stone x 40.0% Voids = 689.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,733.5 cf = 0.040 af

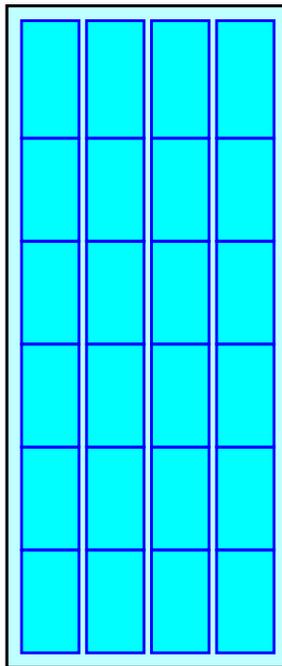
Overall Storage Efficiency = 62.6%

Overall System Size = 45.00' x 19.17' x 3.21'

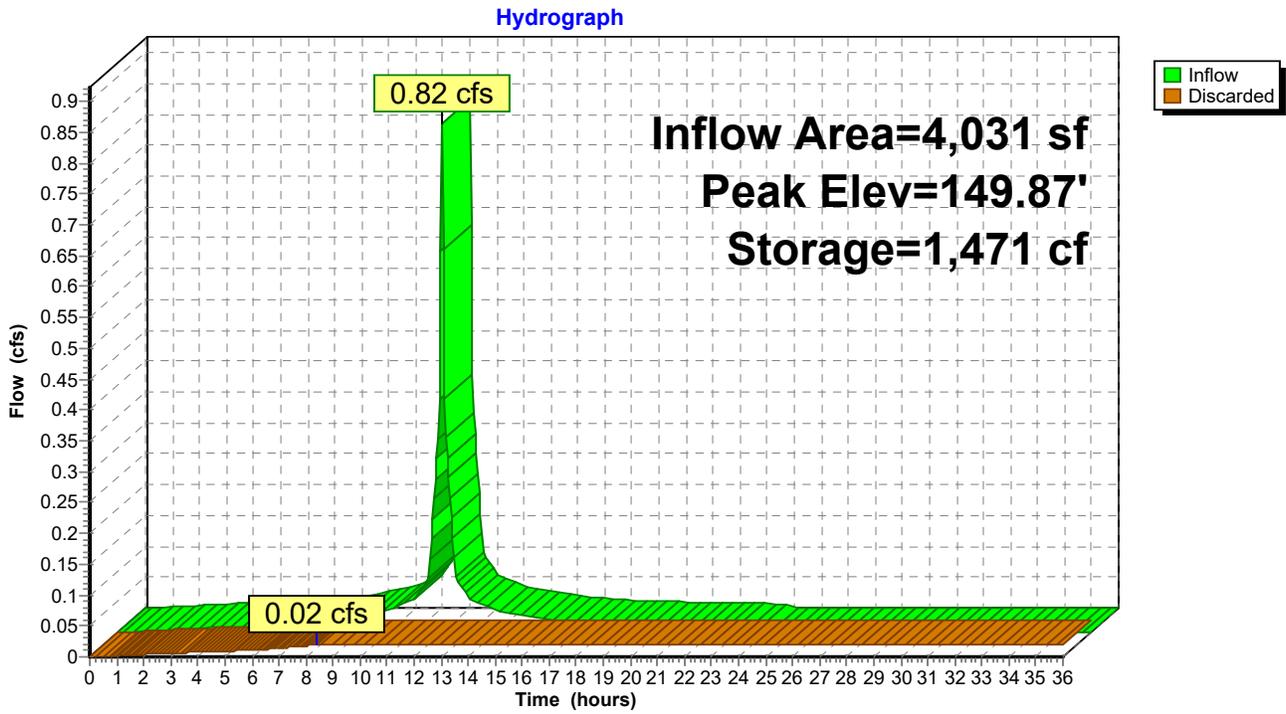
24 Chambers

102.5 cy Field

63.8 cy Stone



Pond 1P: Existing Infiltration System



1179-20A - Existing HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Pond 2P: L Pond

Inflow Area = 13,322 sf, 9.33% Impervious, Inflow Depth = 3.73" for 100-Year event
 Inflow = 1.21 cfs @ 12.12 hrs, Volume= 4,136 cf
 Outflow = 0.43 cfs @ 12.47 hrs, Volume= 3,997 cf, Atten= 65%, Lag= 21.1 min
 Discarded = 0.04 cfs @ 12.47 hrs, Volume= 2,828 cf
 Primary = 0.38 cfs @ 12.47 hrs, Volume= 1,169 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 149.60' @ 12.47 hrs Surf.Area= 1,831 sf Storage= 1,668 cf

Plug-Flow detention time= 340.6 min calculated for 3,992 cf (97% of inflow)
 Center-of-Mass det. time= 322.5 min (1,162.4 - 839.9)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	1,674 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	369	0	0
149.00	1,197	783	783
149.50	1,667	716	1,499
149.60	1,837	175	1,674

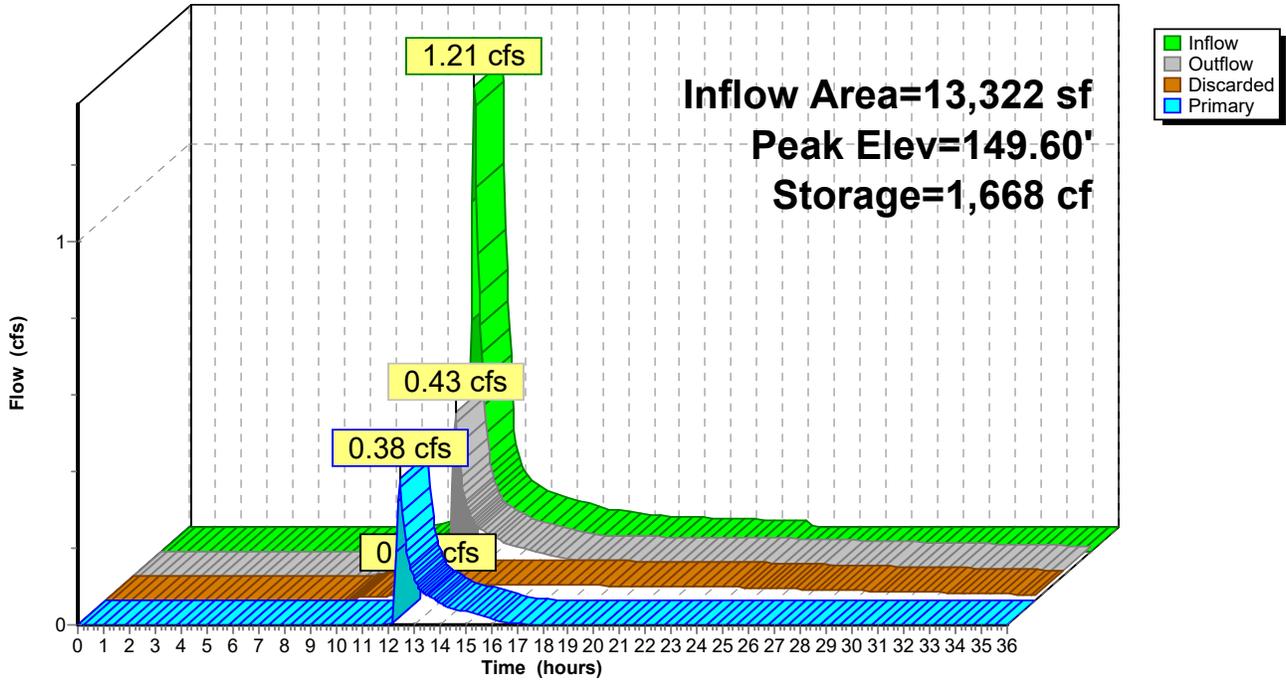
Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	149.50'	5.0' long x 2.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.04 cfs @ 12.47 hrs HW=149.60' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.37 cfs @ 12.47 hrs HW=149.60' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.37 cfs @ 0.78 fps)

Pond 2P: L Pond

Hydrograph



Summary for Pond 3P: Triangular Pond

[93] Warning: Storage range exceeded by 0.28'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

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

Inflow Area = 28,760 sf, 60.45% Impervious, Inflow Depth = 5.91" for 100-Year event
 Inflow = 3.75 cfs @ 12.15 hrs, Volume= 14,166 cf
 Outflow = 3.79 cfs @ 12.20 hrs, Volume= 14,045 cf, Atten= 0%, Lag= 2.9 min
 Discarded = 0.03 cfs @ 12.05 hrs, Volume= 1,726 cf
 Primary = 0.89 cfs @ 12.20 hrs, Volume= 9,234 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary
 Secondary = 2.87 cfs @ 12.20 hrs, Volume= 3,084 cf
 Routed to Link SP1 : SP#1 - Wetland Boundary

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 148.38' @ 12.20 hrs Surf.Area= 1,467 sf Storage= 1,767 cf

Plug-Flow detention time= 63.7 min calculated for 14,026 cf (99% of inflow)
 Center-of-Mass det. time= 59.2 min (859.8 - 800.6)

Volume	Invert	Avail.Storage	Storage Description
#1	145.10'	1,767 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
145.10	1	0	0
146.00	232	105	105
147.00	709	471	575
148.00	1,388	1,049	1,624
148.10	1,467	143	1,767

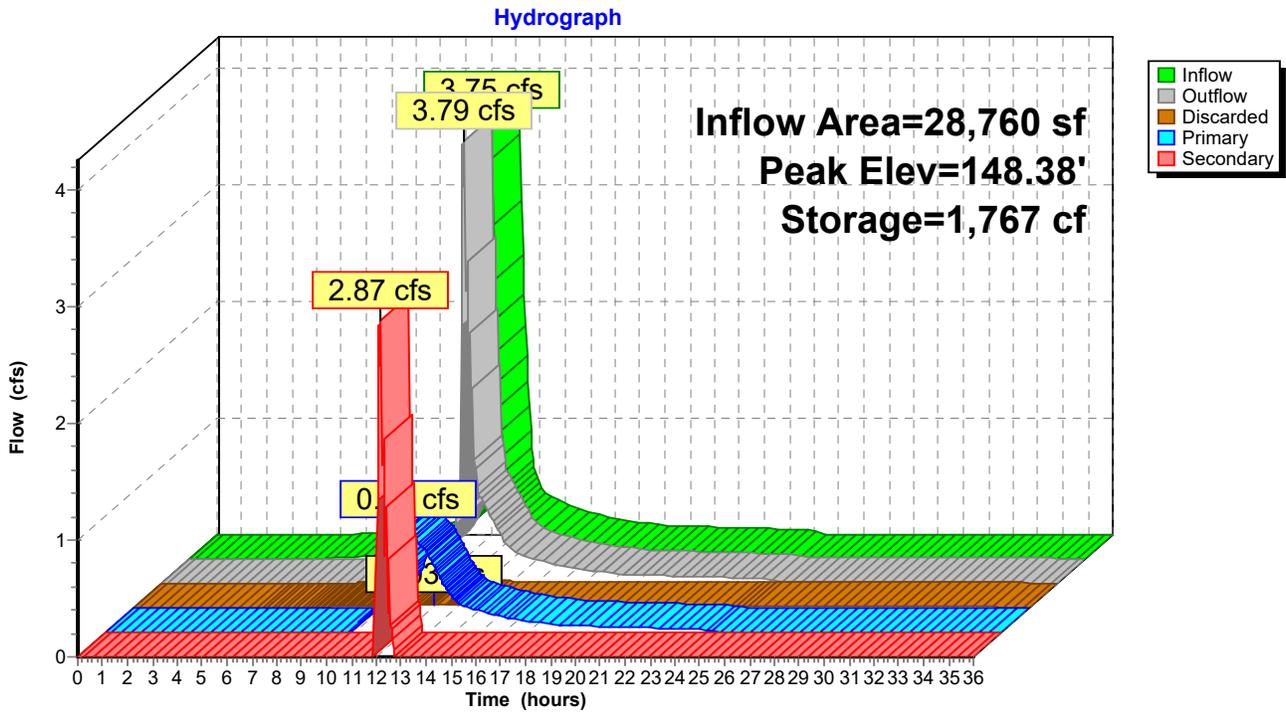
Device	Routing	Invert	Outlet Devices
#1	Discarded	145.10'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.00'	6.0" Round Culvert L= 30.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 147.00' / 145.00' S= 0.0667 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Secondary	148.00'	5.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.03 cfs @ 12.05 hrs HW=148.23' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.89 cfs @ 12.20 hrs HW=148.38' (Free Discharge)
 ↑2=Culvert (Inlet Controls 0.89 cfs @ 4.51 fps)

Secondary OutFlow Max=2.87 cfs @ 12.20 hrs HW=148.38' (Free Discharge)
 ↑3=Broad-Crested Rectangular Weir (Weir Controls 2.87 cfs @ 1.52 fps)

Pond 3P: Triangular Pond



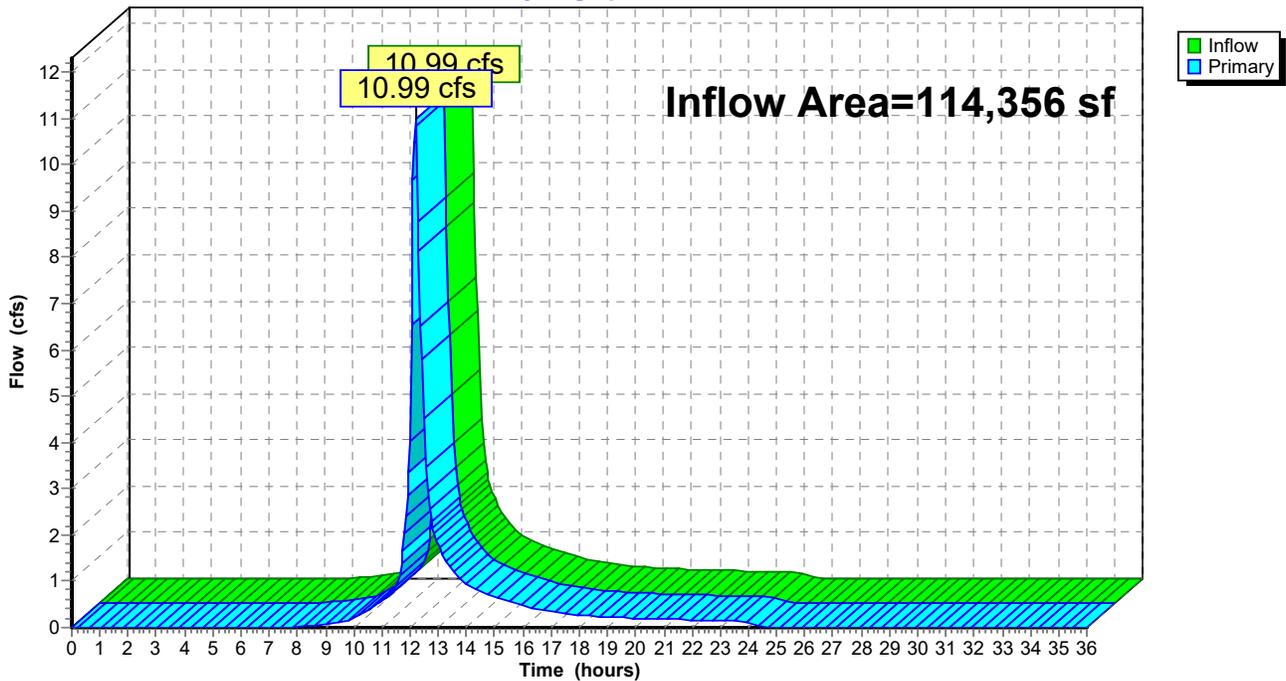
Summary for Link SP1: SP#1 - Wetland Boundary

Inflow Area = 114,356 sf, 34.89% Impervious, Inflow Depth = 4.34" for 100-Year event
Inflow = 10.99 cfs @ 12.18 hrs, Volume= 41,392 cf
Primary = 10.99 cfs @ 12.18 hrs, Volume= 41,392 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link SP1: SP#1 - Wetland Boundary

Hydrograph



M:\PROJECTS\1179-20A\CIVIL\DRAWINGS\CURRENT\C-1179-20A_WATERSHED-EXISTING.DWG



LEGEND

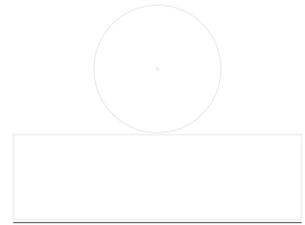
EXISTING WATERSHED

SUBCATCHMENT BOUNDARY

To FLOW PATH

SUBCATCHMENT LABEL

ISSUED FOR REVIEW
OCTOBER 17, 2024



PROFESSIONAL ENGINEER FOR ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

APPLICANT/OWNER:

FIFTY-FIVE SAXON HINGHAM
25 RECREATION PARK DRIVE, SUITE 204
HINGHAM, MA 02043

PROJECT:

OFFICE BUILDING
55 INDUSTRIAL
PARK ROAD
HINGHAM, MA

PROJECT NO. 1179-20A DATE: 10-17-2024

SCALE: 1" = 30' DWG. NAME: C-1179-20

DESIGNED BY: PLC CHECKED BY: PLC

PREPARED BY:



ALLEN & MAJOR ASSOCIATES, INC.

civil engineering • land surveying
environmental consulting • landscape architecture
www.allenmajor.com

10 MAIN STREET
LAKEVILLE, MA 02347
TEL: (508) 923-1010
FAX: (508) 923-6309

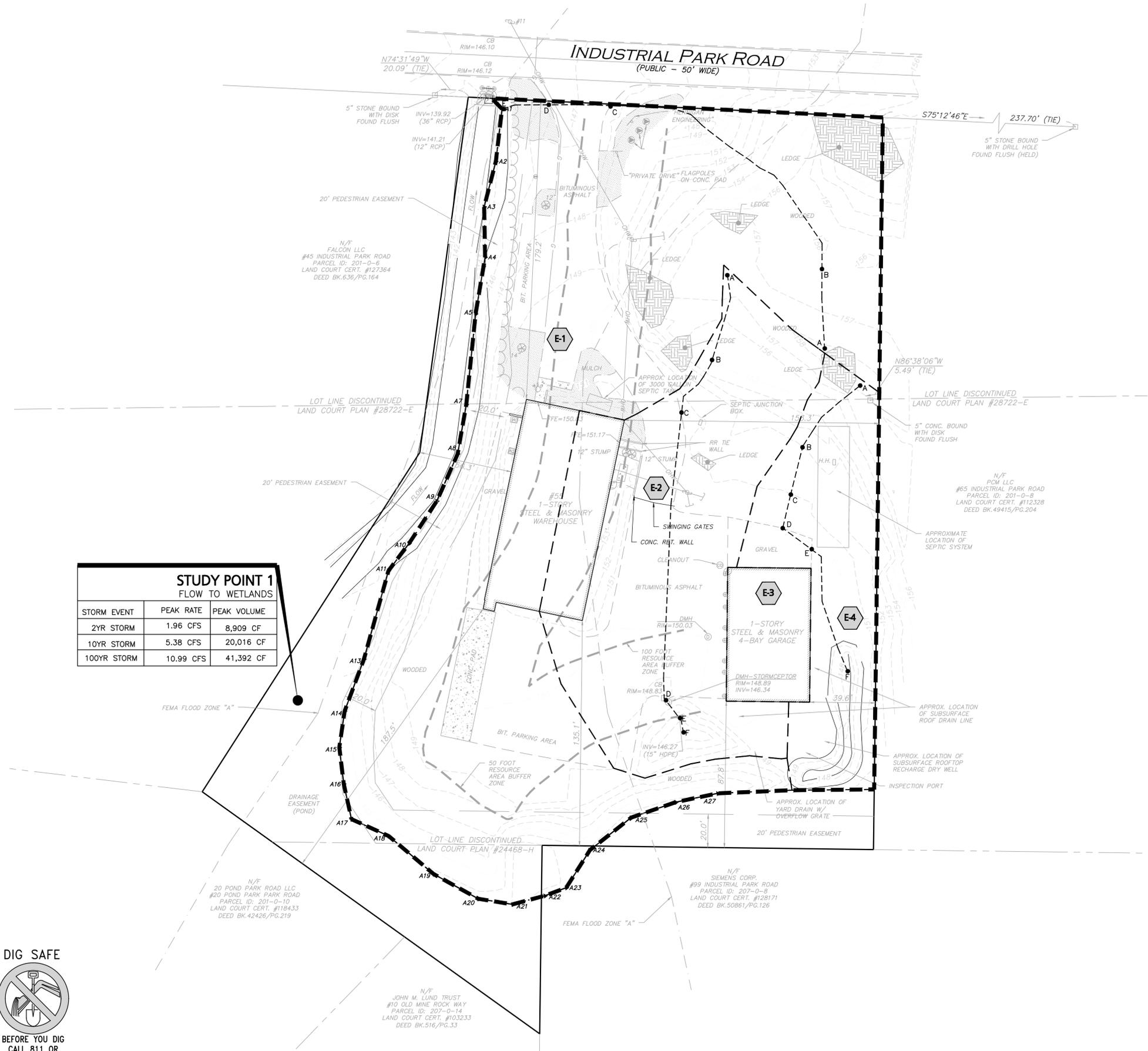
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EXISTING WATERSHED PLAN EWS

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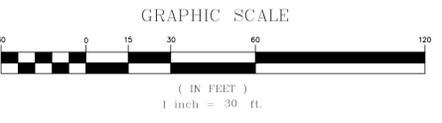


STUDY POINT 1
FLOW TO WETLANDS

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	1.96 CFS	8,909 CF
10YR STORM	5.38 CFS	20,016 CF
100YR STORM	10.99 CFS	41,392 CF

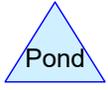
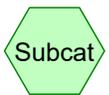
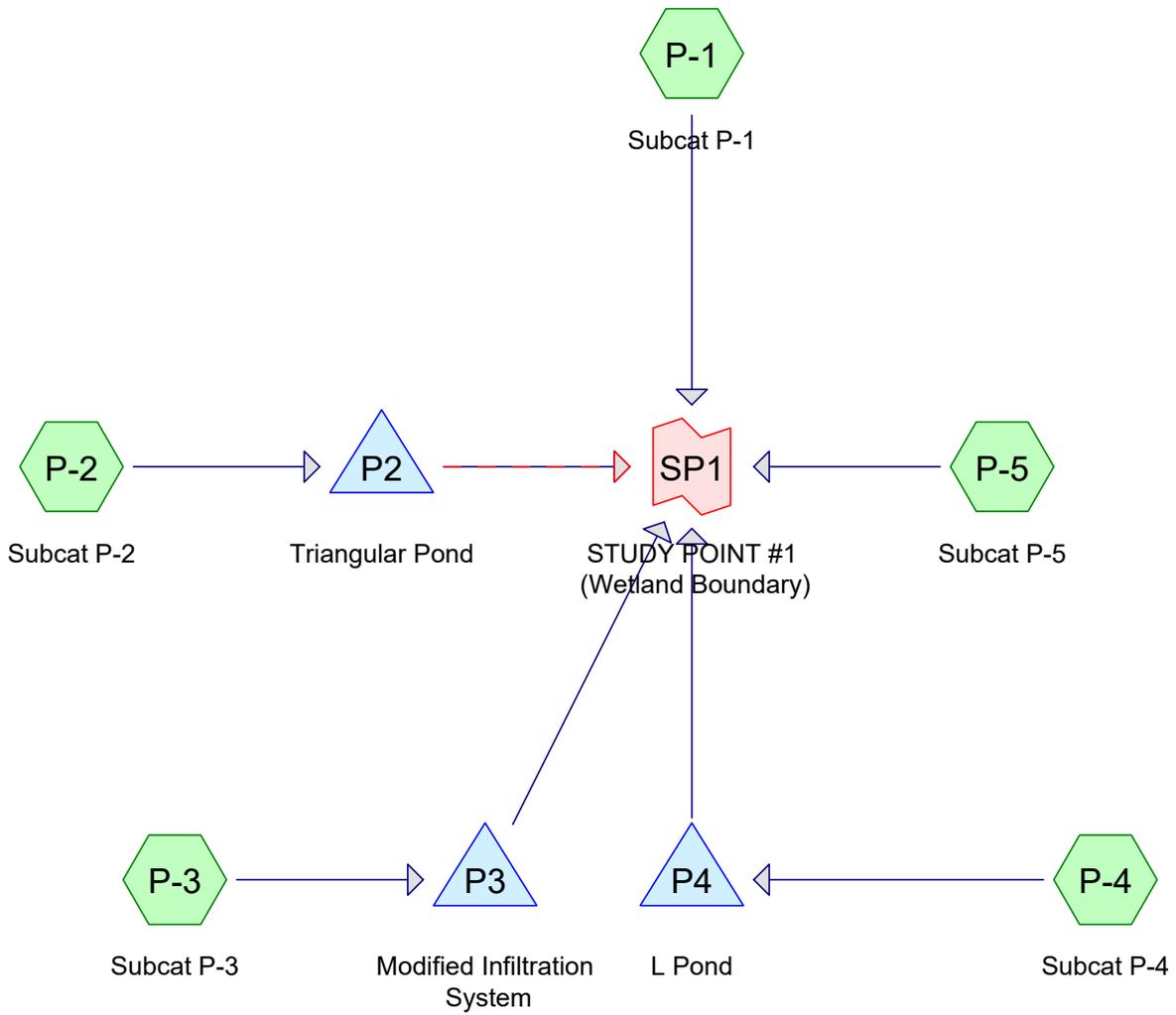
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1-888-344-7233





**SECTION 5.0 -
PROPOSED DRAINAGE
ANALYSIS**



Routing Diagram for 1179-20A - Proposed HydroCAD
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1179-20A - Proposed HydroCAD

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Page 2

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.36	2
2	10-Year	Type III 24-hr		Default	24.00	1	5.12	2
3	100-Year	Type III 24-hr		Default	24.00	1	7.93	2

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
43,482	61	>75% Grass cover, Good, HSG B (P-1, P-2, P-4, P-5)
17,579	98	Paved parking, HSG B (P-1, P-2, P-4, P-5)
11,290	98	Roofs, HSG B (P-3)
46,035	55	Woods, Good, HSG B (P-1, P-4, P-5)
118,385	68	TOTAL AREA

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Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
118,385	HSG B	P-1, P-2, P-3, P-4, P-5
0	HSG C	
0	HSG D	
0	Other	
118,385		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	43,482	0	0	0	43,482	>75% Grass cover, Good
0	17,579	0	0	0	17,579	Paved parking
0	11,290	0	0	0	11,290	Roofs
0	46,035	0	0	0	46,035	Woods, Good
0	118,385	0	0	0	118,385	TOTAL AREA

Sub
Num

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	P-1	0.00	0.00	24.0	0.5100	0.013	0.0	12.0	0.0	
2	P-2	0.00	0.00	118.0	0.0040	0.013	0.0	15.0	0.0	
3	P-3	0.00	0.00	146.0	0.0050	0.013	0.0	10.0	0.0	
4	P-3	0.00	0.00	69.0	0.0160	0.013	0.0	10.0	0.0	
5	P2	147.20	145.00	30.0	0.0733	0.013	0.0	6.0	0.0	
6	P3	147.90	147.80	10.0	0.0100	0.012	0.0	12.0	0.0	

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Type III 24-hr 2-Year Rainfall=3.36"

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Page 7

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Subcat P-1	Runoff Area=36,180 sf 22.60% Impervious Runoff Depth=0.77" Flow Length=385' Tc=11.1 min CN=67 Runoff=0.53 cfs 2,329 cf
Subcatchment P-2: Subcat P-2	Runoff Area=11,784 sf 74.78% Impervious Runoff Depth=2.23" Flow Length=258' Tc=6.0 min CN=89 Runoff=0.69 cfs 2,188 cf
Subcatchment P-3: Subcat P-3	Runoff Area=11,290 sf 100.00% Impervious Runoff Depth=3.13" Flow Length=215' Tc=6.0 min CN=98 Runoff=0.83 cfs 2,942 cf
Subcatchment P-4: Subcat P-4	Runoff Area=18,107 sf 3.26% Impervious Runoff Depth=0.47" Flow Length=235' Tc=7.2 min CN=60 Runoff=0.14 cfs 713 cf
Subcatchment P-5: Subcat P-5	Runoff Area=41,025 sf 0.00% Impervious Runoff Depth=0.40" Flow Length=124' Tc=6.6 min CN=58 Runoff=0.23 cfs 1,365 cf
Pond P2: Triangular Pond	Peak Elev=147.51' Storage=881 cf Inflow=0.69 cfs 2,188 cf Discarded=0.02 cfs 1,387 cf Primary=0.21 cfs 800 cf Secondary=0.00 cfs 0 cf Outflow=0.24 cfs 2,187 cf
Pond P3: Modified Infiltration System	Peak Elev=149.65' Storage=1,679 cf Inflow=0.83 cfs 2,942 cf Discarded=0.03 cfs 2,703 cf Primary=0.00 cfs 0 cf Outflow=0.03 cfs 2,703 cf
Pond P4: L Pond	Peak Elev=148.45' Storage=253 cf Inflow=0.14 cfs 713 cf Discarded=0.02 cfs 713 cf Primary=0.00 cfs 0 cf Outflow=0.02 cfs 713 cf
Link SP1: STUDY POINT #1 (Wetland Boundary)	Inflow=0.88 cfs 4,494 cf Primary=0.88 cfs 4,494 cf

Total Runoff Area = 118,385 sf Runoff Volume = 9,537 cf Average Runoff Depth = 0.97"
75.61% Pervious = 89,516 sf 24.39% Impervious = 28,869 sf

1179-20A - Proposed HydroCAD

Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.53 cfs @ 12.18 hrs, Volume= 2,329 cf, Depth= 0.77"

Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
12,321	61	>75% Grass cover, Good, HSG B
8,177	98	Paved parking, HSG B
15,681	55	Woods, Good, HSG B
36,180	67	Weighted Average
28,003		77.40% Pervious Area
8,177		22.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0800	0.12		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
0.6	45	0.0666	1.29		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
2.9	145	0.0138	0.82		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.6	121	0.0270	3.34		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
0.0	24	0.5100	32.40	25.44	Pipe Channel, E-F 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
11.1	385	Total			

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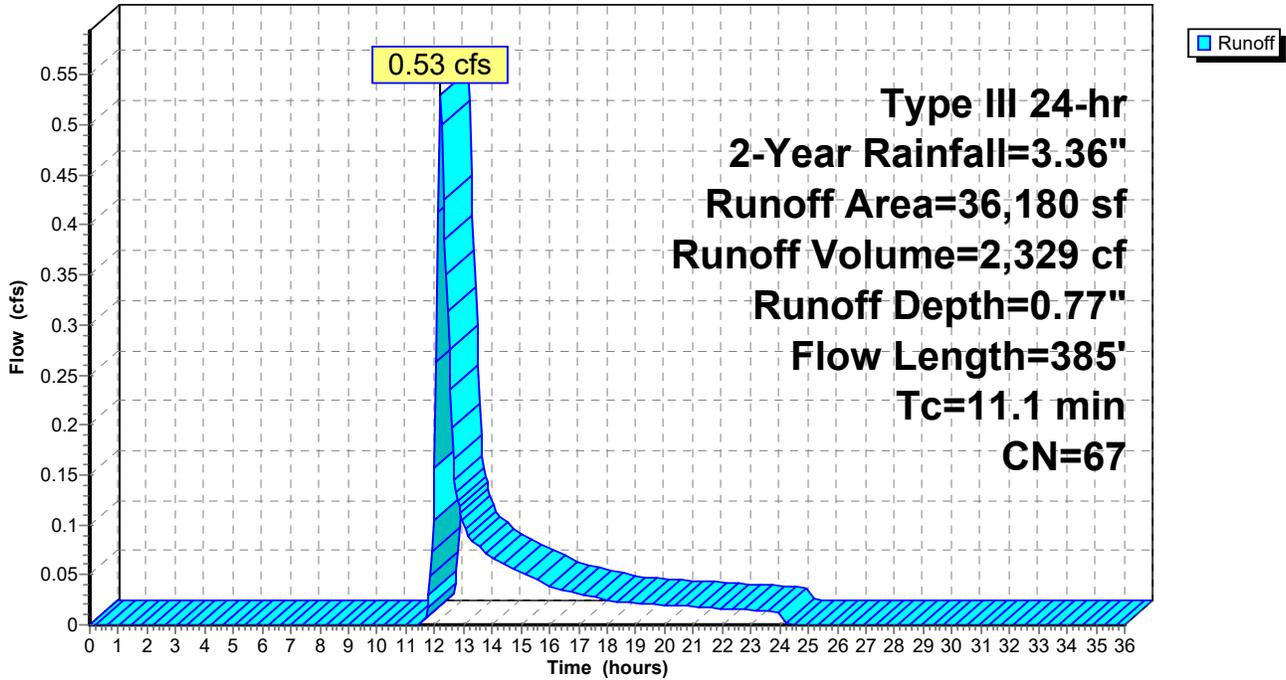
Type III 24-hr 2-Year Rainfall=3.36"

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Subcatchment P-1: Subcat P-1

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.36"

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Hydrograph for Subcatchment P-1: Subcat P-1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	3.36	0.77	0.00
0.50	0.02	0.00	0.00	27.00	3.36	0.77	0.00
1.00	0.03	0.00	0.00	27.50	3.36	0.77	0.00
1.50	0.05	0.00	0.00	28.00	3.36	0.77	0.00
2.00	0.07	0.00	0.00	28.50	3.36	0.77	0.00
2.50	0.08	0.00	0.00	29.00	3.36	0.77	0.00
3.00	0.10	0.00	0.00	29.50	3.36	0.77	0.00
3.50	0.12	0.00	0.00	30.00	3.36	0.77	0.00
4.00	0.14	0.00	0.00	30.50	3.36	0.77	0.00
4.50	0.17	0.00	0.00	31.00	3.36	0.77	0.00
5.00	0.19	0.00	0.00	31.50	3.36	0.77	0.00
5.50	0.22	0.00	0.00	32.00	3.36	0.77	0.00
6.00	0.24	0.00	0.00	32.50	3.36	0.77	0.00
6.50	0.27	0.00	0.00	33.00	3.36	0.77	0.00
7.00	0.30	0.00	0.00	33.50	3.36	0.77	0.00
7.50	0.34	0.00	0.00	34.00	3.36	0.77	0.00
8.00	0.38	0.00	0.00	34.50	3.36	0.77	0.00
8.50	0.43	0.00	0.00	35.00	3.36	0.77	0.00
9.00	0.49	0.00	0.00	35.50	3.36	0.77	0.00
9.50	0.56	0.00	0.00	36.00	3.36	0.77	0.00
10.00	0.64	0.00	0.00				
10.50	0.73	0.00	0.00				
11.00	0.84	0.00	0.00				
11.50	1.00	0.00	0.00				
12.00	1.68	0.09	0.16				
12.50	2.36	0.30	0.28				
13.00	2.52	0.36	0.10				
13.50	2.63	0.41	0.08				
14.00	2.72	0.45	0.07				
14.50	2.80	0.49	0.06				
15.00	2.87	0.52	0.05				
15.50	2.93	0.55	0.05				
16.00	2.98	0.57	0.04				
16.50	3.02	0.59	0.03				
17.00	3.06	0.61	0.03				
17.50	3.09	0.63	0.03				
18.00	3.12	0.64	0.02				
18.50	3.14	0.66	0.02				
19.00	3.17	0.67	0.02				
19.50	3.19	0.68	0.02				
20.00	3.22	0.70	0.02				
20.50	3.24	0.71	0.02				
21.00	3.26	0.72	0.02				
21.50	3.28	0.73	0.02				
22.00	3.30	0.74	0.02				
22.50	3.31	0.75	0.02				
23.00	3.33	0.76	0.01				
23.50	3.35	0.76	0.01				
24.00	3.36	0.77	0.01				
24.50	3.36	0.77	0.00				
25.00	3.36	0.77	0.00				
25.50	3.36	0.77	0.00				
26.00	3.36	0.77	0.00				

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Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.69 cfs @ 12.09 hrs, Volume= 2,188 cf, Depth= 2.23"

Routed to Pond P2 : Triangular Pond

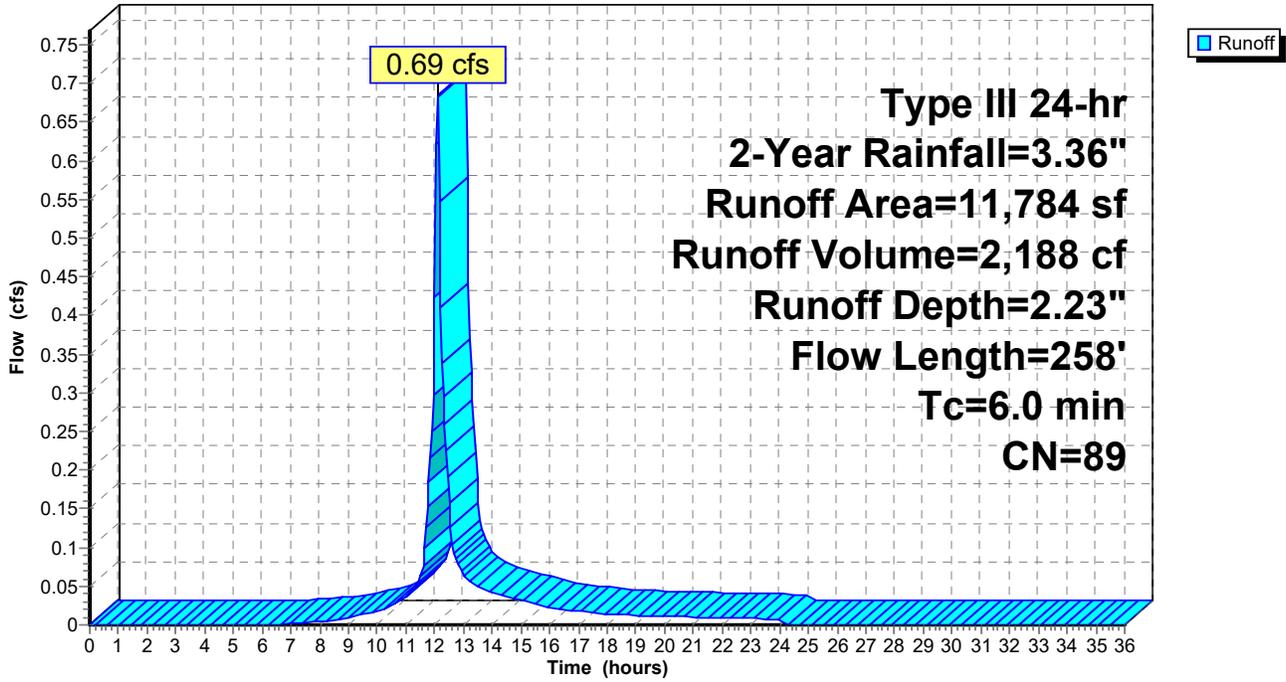
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
2,972	61	>75% Grass cover, Good, HSG B
8,812	98	Paved parking, HSG B
11,784	89	Weighted Average
2,972		25.22% Pervious Area
8,812		74.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	20	0.0150	0.11		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
0.5	30	0.0150	0.98		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.28"
0.6	90	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.6	118	0.0040	3.33	4.09	Pipe Channel, D-E 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
4.7	258	Total, Increased to minimum Tc = 6.0 min			

Subcatchment P-2: Subcat P-2

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.36"

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Hydrograph for Subcatchment P-2: Subcat P-2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	3.36	2.23	0.00
0.50	0.02	0.00	0.00	27.00	3.36	2.23	0.00
1.00	0.03	0.00	0.00	27.50	3.36	2.23	0.00
1.50	0.05	0.00	0.00	28.00	3.36	2.23	0.00
2.00	0.07	0.00	0.00	28.50	3.36	2.23	0.00
2.50	0.08	0.00	0.00	29.00	3.36	2.23	0.00
3.00	0.10	0.00	0.00	29.50	3.36	2.23	0.00
3.50	0.12	0.00	0.00	30.00	3.36	2.23	0.00
4.00	0.14	0.00	0.00	30.50	3.36	2.23	0.00
4.50	0.17	0.00	0.00	31.00	3.36	2.23	0.00
5.00	0.19	0.00	0.00	31.50	3.36	2.23	0.00
5.50	0.22	0.00	0.00	32.00	3.36	2.23	0.00
6.00	0.24	0.00	0.00	32.50	3.36	2.23	0.00
6.50	0.27	0.00	0.00	33.00	3.36	2.23	0.00
7.00	0.30	0.00	0.00	33.50	3.36	2.23	0.00
7.50	0.34	0.01	0.00	34.00	3.36	2.23	0.00
8.00	0.38	0.01	0.00	34.50	3.36	2.23	0.00
8.50	0.43	0.02	0.01	35.00	3.36	2.23	0.00
9.00	0.49	0.04	0.01	35.50	3.36	2.23	0.00
9.50	0.56	0.06	0.01	36.00	3.36	2.23	0.00
10.00	0.64	0.09	0.02				
10.50	0.73	0.13	0.03				
11.00	0.84	0.19	0.03				
11.50	1.00	0.29	0.06				
12.00	1.68	0.77	0.42				
12.50	2.36	1.33	0.16				
13.00	2.52	1.47	0.07				
13.50	2.63	1.57	0.05				
14.00	2.72	1.65	0.04				
14.50	2.80	1.72	0.04				
15.00	2.87	1.78	0.03				
15.50	2.93	1.84	0.03				
16.00	2.98	1.88	0.02				
16.50	3.02	1.92	0.02				
17.00	3.06	1.95	0.02				
17.50	3.09	1.98	0.02				
18.00	3.12	2.01	0.01				
18.50	3.14	2.03	0.01				
19.00	3.17	2.05	0.01				
19.50	3.19	2.08	0.01				
20.00	3.22	2.10	0.01				
20.50	3.24	2.12	0.01				
21.00	3.26	2.13	0.01				
21.50	3.28	2.15	0.01				
22.00	3.30	2.17	0.01				
22.50	3.31	2.18	0.01				
23.00	3.33	2.20	0.01				
23.50	3.35	2.21	0.01				
24.00	3.36	2.23	0.01				
24.50	3.36	2.23	0.00				
25.00	3.36	2.23	0.00				
25.50	3.36	2.23	0.00				
26.00	3.36	2.23	0.00				

1179-20A - Proposed HydroCAD

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Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.83 cfs @ 12.09 hrs, Volume= 2,942 cf, Depth= 3.13"
Routed to Pond P3 : Modified Infiltration System

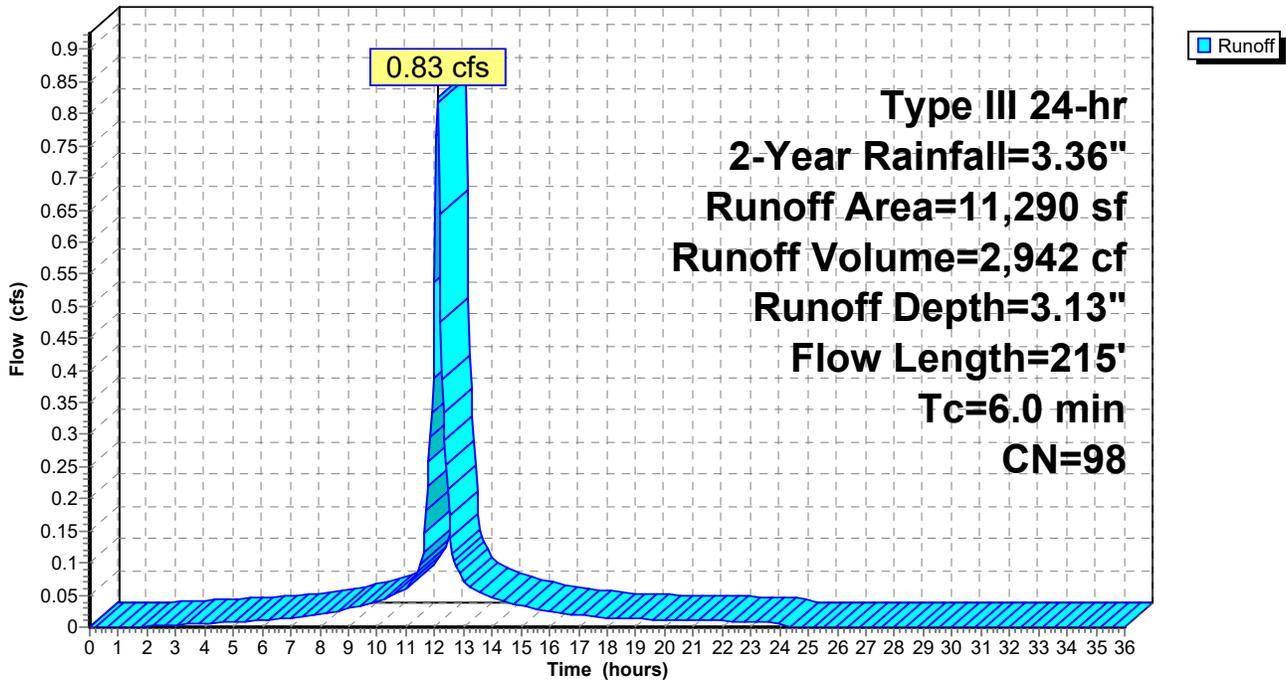
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
11,290	98	Roofs, HSG B
11,290		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	146	0.0050	2.84	1.55	Pipe Channel, 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
0.2	69	0.0160	5.08	2.77	Pipe Channel, 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
1.1	215	Total, Increased to minimum Tc = 6.0 min			

Subcatchment P-3: Subcat P-3

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.36"

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Hydrograph for Subcatchment P-3: Subcat P-3

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	3.36	3.13	0.00
0.50	0.02	0.00	0.00	27.00	3.36	3.13	0.00
1.00	0.03	0.00	0.00	27.50	3.36	3.13	0.00
1.50	0.05	0.00	0.00	28.00	3.36	3.13	0.00
2.00	0.07	0.00	0.00	28.50	3.36	3.13	0.00
2.50	0.08	0.01	0.00	29.00	3.36	3.13	0.00
3.00	0.10	0.01	0.00	29.50	3.36	3.13	0.00
3.50	0.12	0.02	0.01	30.00	3.36	3.13	0.00
4.00	0.14	0.03	0.01	30.50	3.36	3.13	0.00
4.50	0.17	0.05	0.01	31.00	3.36	3.13	0.00
5.00	0.19	0.06	0.01	31.50	3.36	3.13	0.00
5.50	0.22	0.08	0.01	32.00	3.36	3.13	0.00
6.00	0.24	0.10	0.01	32.50	3.36	3.13	0.00
6.50	0.27	0.12	0.01	33.00	3.36	3.13	0.00
7.00	0.30	0.15	0.01	33.50	3.36	3.13	0.00
7.50	0.34	0.18	0.02	34.00	3.36	3.13	0.00
8.00	0.38	0.21	0.02	34.50	3.36	3.13	0.00
8.50	0.43	0.26	0.02	35.00	3.36	3.13	0.00
9.00	0.49	0.31	0.03	35.50	3.36	3.13	0.00
9.50	0.56	0.37	0.03	36.00	3.36	3.13	0.00
10.00	0.64	0.44	0.04				
10.50	0.73	0.53	0.05				
11.00	0.84	0.64	0.06				
11.50	1.00	0.79	0.09				
12.00	1.68	1.46	0.54				
12.50	2.36	2.13	0.17				
13.00	2.52	2.29	0.07				
13.50	2.63	2.40	0.06				
14.00	2.72	2.49	0.04				
14.50	2.80	2.57	0.04				
15.00	2.87	2.64	0.03				
15.50	2.93	2.70	0.03				
16.00	2.98	2.75	0.02				
16.50	3.02	2.79	0.02				
17.00	3.06	2.82	0.02				
17.50	3.09	2.86	0.02				
18.00	3.12	2.89	0.01				
18.50	3.14	2.91	0.01				
19.00	3.17	2.94	0.01				
19.50	3.19	2.96	0.01				
20.00	3.22	2.98	0.01				
20.50	3.24	3.00	0.01				
21.00	3.26	3.02	0.01				
21.50	3.28	3.04	0.01				
22.00	3.30	3.06	0.01				
22.50	3.31	3.08	0.01				
23.00	3.33	3.10	0.01				
23.50	3.35	3.11	0.01				
24.00	3.36	3.13	0.01				
24.50	3.36	3.13	0.00				
25.00	3.36	3.13	0.00				
25.50	3.36	3.13	0.00				
26.00	3.36	3.13	0.00				

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Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Subcatchment P-4: Subcat P-4

Runoff = 0.14 cfs @ 12.15 hrs, Volume= 713 cf, Depth= 0.47"
 Routed to Pond P4 : L Pond

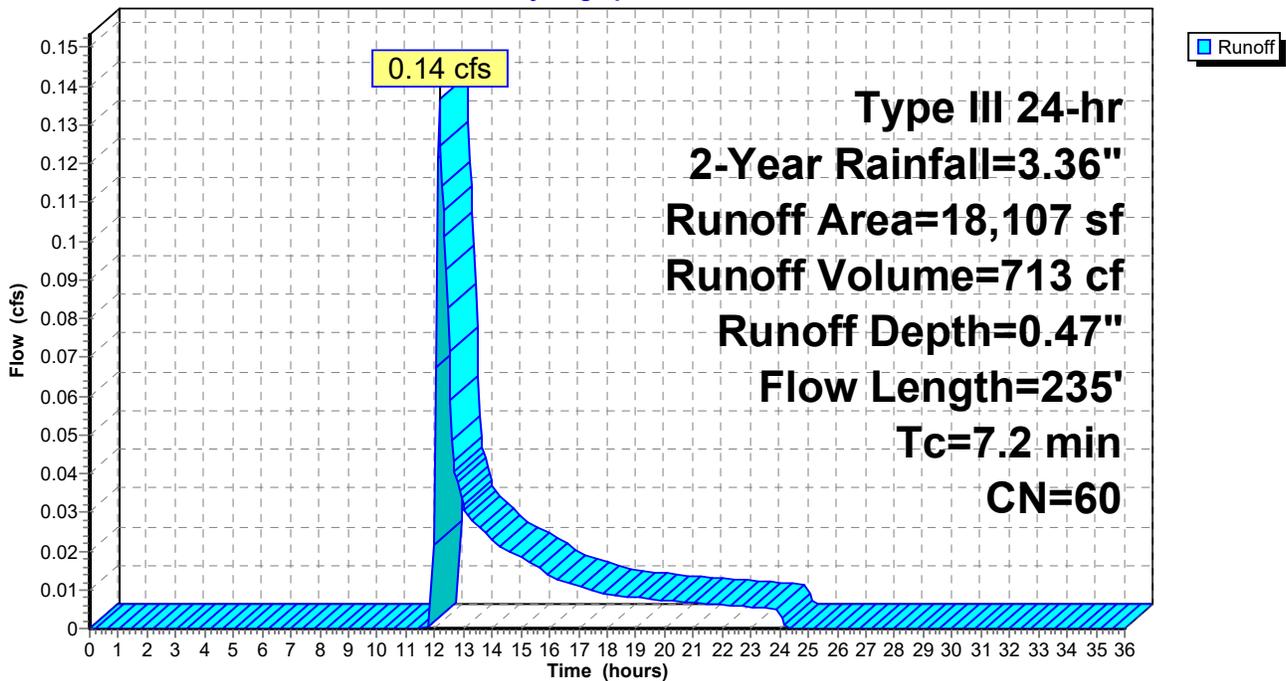
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
9,473	61	>75% Grass cover, Good, HSG B
590	98	Paved parking, HSG B
8,043	55	Woods, Good, HSG B
18,107	60	Weighted Average
17,517		96.74% Pervious Area
590		3.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0800	0.26		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
2.9	120	0.0100	0.70		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.1	65	0.0380	0.97		Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps
7.2	235	Total			

Subcatchment P-4: Subcat P-4

Hydrograph



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Hydrograph for Subcatchment P-4: Subcat P-4

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	3.36	0.47	0.00
0.50	0.02	0.00	0.00	27.00	3.36	0.47	0.00
1.00	0.03	0.00	0.00	27.50	3.36	0.47	0.00
1.50	0.05	0.00	0.00	28.00	3.36	0.47	0.00
2.00	0.07	0.00	0.00	28.50	3.36	0.47	0.00
2.50	0.08	0.00	0.00	29.00	3.36	0.47	0.00
3.00	0.10	0.00	0.00	29.50	3.36	0.47	0.00
3.50	0.12	0.00	0.00	30.00	3.36	0.47	0.00
4.00	0.14	0.00	0.00	30.50	3.36	0.47	0.00
4.50	0.17	0.00	0.00	31.00	3.36	0.47	0.00
5.00	0.19	0.00	0.00	31.50	3.36	0.47	0.00
5.50	0.22	0.00	0.00	32.00	3.36	0.47	0.00
6.00	0.24	0.00	0.00	32.50	3.36	0.47	0.00
6.50	0.27	0.00	0.00	33.00	3.36	0.47	0.00
7.00	0.30	0.00	0.00	33.50	3.36	0.47	0.00
7.50	0.34	0.00	0.00	34.00	3.36	0.47	0.00
8.00	0.38	0.00	0.00	34.50	3.36	0.47	0.00
8.50	0.43	0.00	0.00	35.00	3.36	0.47	0.00
9.00	0.49	0.00	0.00	35.50	3.36	0.47	0.00
9.50	0.56	0.00	0.00	36.00	3.36	0.47	0.00
10.00	0.64	0.00	0.00				
10.50	0.73	0.00	0.00				
11.00	0.84	0.00	0.00				
11.50	1.00	0.00	0.00				
12.00	1.68	0.02	0.02				
12.50	2.36	0.14	0.07				
13.00	2.52	0.18	0.03				
13.50	2.63	0.21	0.03				
14.00	2.72	0.24	0.02				
14.50	2.80	0.27	0.02				
15.00	2.87	0.29	0.02				
15.50	2.93	0.31	0.02				
16.00	2.98	0.33	0.01				
16.50	3.02	0.34	0.01				
17.00	3.06	0.35	0.01				
17.50	3.09	0.37	0.01				
18.00	3.12	0.38	0.01				
18.50	3.14	0.39	0.01				
19.00	3.17	0.40	0.01				
19.50	3.19	0.41	0.01				
20.00	3.22	0.41	0.01				
20.50	3.24	0.42	0.01				
21.00	3.26	0.43	0.01				
21.50	3.28	0.44	0.01				
22.00	3.30	0.45	0.01				
22.50	3.31	0.45	0.01				
23.00	3.33	0.46	0.01				
23.50	3.35	0.47	0.01				
24.00	3.36	0.47	0.00				
24.50	3.36	0.47	0.00				
25.00	3.36	0.47	0.00				
25.50	3.36	0.47	0.00				
26.00	3.36	0.47	0.00				

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Summary for Subcatchment P-5: Subcat P-5

Runoff = 0.23 cfs @ 12.16 hrs, Volume= 1,365 cf, Depth= 0.40"

Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

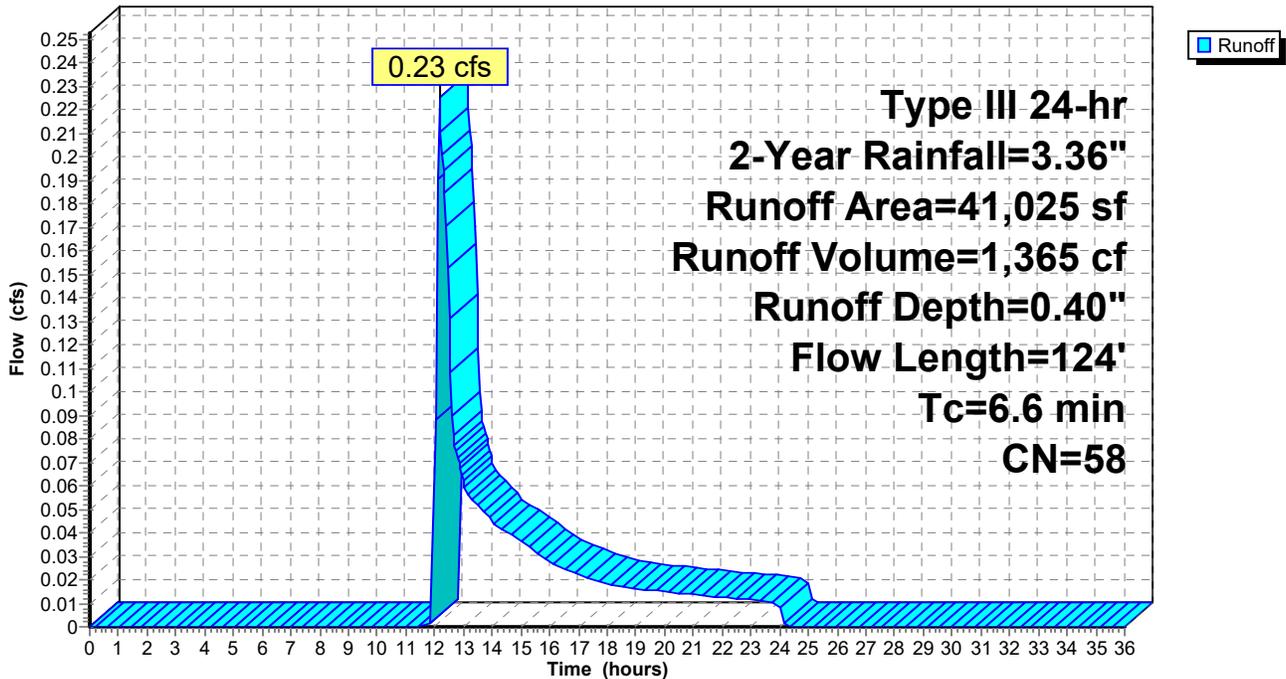
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
18,715	61	>75% Grass cover, Good, HSG B
0	98	Paved parking, HSG B
22,310	55	Woods, Good, HSG B
41,025	58	Weighted Average
41,024		100.00% Pervious Area
0		0.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
1.0	74	0.0600	1.22		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
6.6	124	Total			

Subcatchment P-5: Subcat P-5

Hydrograph



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Hydrograph for Subcatchment P-5: Subcat P-5

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	3.36	0.40	0.00
0.50	0.02	0.00	0.00	27.00	3.36	0.40	0.00
1.00	0.03	0.00	0.00	27.50	3.36	0.40	0.00
1.50	0.05	0.00	0.00	28.00	3.36	0.40	0.00
2.00	0.07	0.00	0.00	28.50	3.36	0.40	0.00
2.50	0.08	0.00	0.00	29.00	3.36	0.40	0.00
3.00	0.10	0.00	0.00	29.50	3.36	0.40	0.00
3.50	0.12	0.00	0.00	30.00	3.36	0.40	0.00
4.00	0.14	0.00	0.00	30.50	3.36	0.40	0.00
4.50	0.17	0.00	0.00	31.00	3.36	0.40	0.00
5.00	0.19	0.00	0.00	31.50	3.36	0.40	0.00
5.50	0.22	0.00	0.00	32.00	3.36	0.40	0.00
6.00	0.24	0.00	0.00	32.50	3.36	0.40	0.00
6.50	0.27	0.00	0.00	33.00	3.36	0.40	0.00
7.00	0.30	0.00	0.00	33.50	3.36	0.40	0.00
7.50	0.34	0.00	0.00	34.00	3.36	0.40	0.00
8.00	0.38	0.00	0.00	34.50	3.36	0.40	0.00
8.50	0.43	0.00	0.00	35.00	3.36	0.40	0.00
9.00	0.49	0.00	0.00	35.50	3.36	0.40	0.00
9.50	0.56	0.00	0.00	36.00	3.36	0.40	0.00
10.00	0.64	0.00	0.00				
10.50	0.73	0.00	0.00				
11.00	0.84	0.00	0.00				
11.50	1.00	0.00	0.00				
12.00	1.68	0.01	0.01				
12.50	2.36	0.10	0.13				
13.00	2.52	0.14	0.06				
13.50	2.63	0.17	0.05				
14.00	2.72	0.19	0.05				
14.50	2.80	0.21	0.04				
15.00	2.87	0.23	0.04				
15.50	2.93	0.25	0.03				
16.00	2.98	0.27	0.03				
16.50	3.02	0.28	0.02				
17.00	3.06	0.29	0.02				
17.50	3.09	0.30	0.02				
18.00	3.12	0.31	0.02				
18.50	3.14	0.32	0.02				
19.00	3.17	0.33	0.02				
19.50	3.19	0.34	0.02				
20.00	3.22	0.35	0.01				
20.50	3.24	0.35	0.01				
21.00	3.26	0.36	0.01				
21.50	3.28	0.37	0.01				
22.00	3.30	0.38	0.01				
22.50	3.31	0.38	0.01				
23.00	3.33	0.39	0.01				
23.50	3.35	0.39	0.01				
24.00	3.36	0.40	0.01				
24.50	3.36	0.40	0.00				
25.00	3.36	0.40	0.00				
25.50	3.36	0.40	0.00				
26.00	3.36	0.40	0.00				

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Summary for Pond P2: Triangular Pond

Inflow Area = 11,784 sf, 74.78% Impervious, Inflow Depth = 2.23" for 2-Year event
 Inflow = 0.69 cfs @ 12.09 hrs, Volume= 2,188 cf
 Outflow = 0.24 cfs @ 12.39 hrs, Volume= 2,187 cf, Atten= 66%, Lag= 17.8 min
 Discarded = 0.02 cfs @ 12.39 hrs, Volume= 1,387 cf
 Primary = 0.21 cfs @ 12.39 hrs, Volume= 800 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 147.51' @ 12.39 hrs Surf.Area= 992 sf Storage= 881 cf

Plug-Flow detention time= 268.2 min calculated for 2,184 cf (100% of inflow)
 Center-of-Mass det. time= 268.6 min (1,077.7 - 809.1)

Volume	Invert	Avail.Storage	Storage Description
#1	146.00'	3,171 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
146.00	230	0	0
147.00	681	456	456
148.00	1,293	987	1,443
148.10	1,300	130	1,572
149.00	2,254	1,599	3,171

Device	Routing	Invert	Outlet Devices
#1	Discarded	146.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.20'	6.0" Round Culvert L= 30.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 147.20' / 145.00' S= 0.0733 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Secondary	148.75'	10.0' long x 7.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.40 2.52 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.68 2.70 2.73 2.78

Discarded OutFlow Max=0.02 cfs @ 12.39 hrs HW=147.51' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.21 cfs @ 12.39 hrs HW=147.51' (Free Discharge)
 ↳ **2=Culvert** (Inlet Controls 0.21 cfs @ 1.67 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=146.00' (Free Discharge)
 ↳ **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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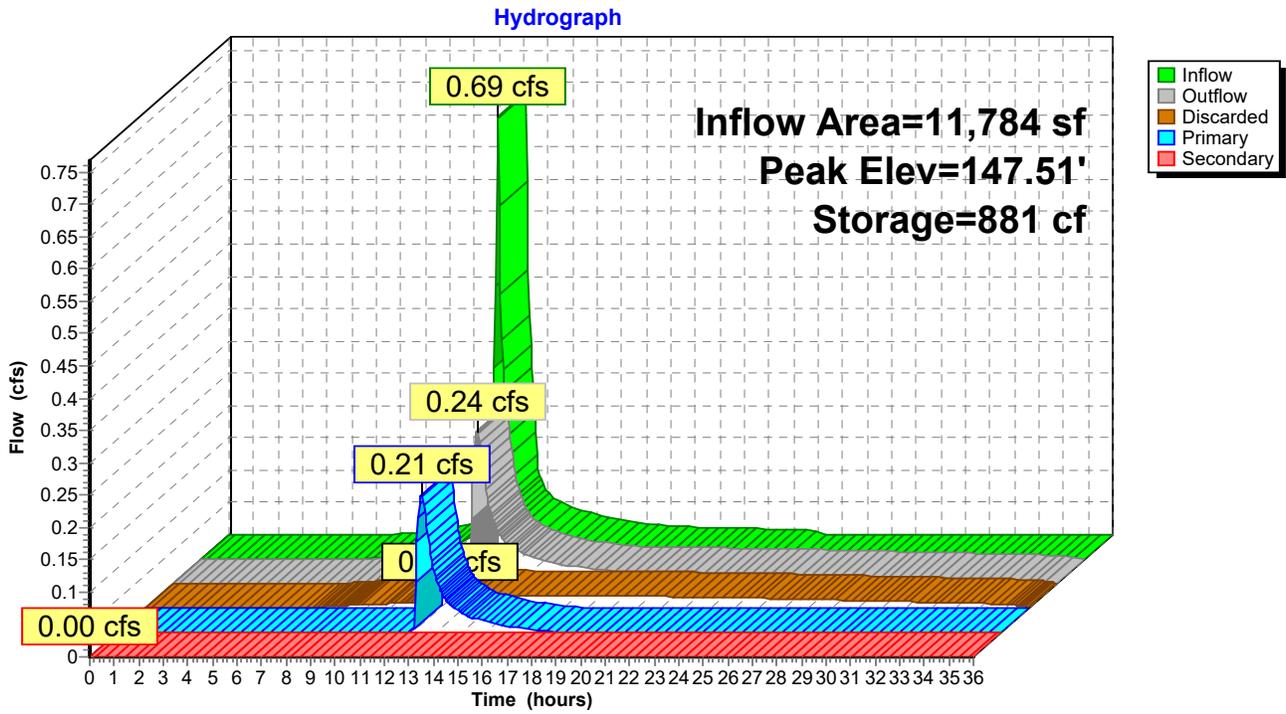
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Pond P2: Triangular Pond



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Hydrograph for Pond P2: Triangular Pond

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	146.00	0.00	0.00	0.00	0.00
1.00	0.00	0	146.00	0.00	0.00	0.00	0.00
2.00	0.00	0	146.00	0.00	0.00	0.00	0.00
3.00	0.00	0	146.00	0.00	0.00	0.00	0.00
4.00	0.00	0	146.00	0.00	0.00	0.00	0.00
5.00	0.00	0	146.00	0.00	0.00	0.00	0.00
6.00	0.00	0	146.00	0.00	0.00	0.00	0.00
7.00	0.00	1	146.00	0.00	0.00	0.00	0.00
8.00	0.00	4	146.02	0.00	0.00	0.00	0.00
9.00	0.01	10	146.04	0.01	0.01	0.00	0.00
10.00	0.02	37	146.14	0.01	0.01	0.00	0.00
11.00	0.03	101	146.33	0.01	0.01	0.00	0.00
12.00	0.42	451	146.99	0.02	0.02	0.00	0.00
13.00	0.07	758	147.38	0.10	0.02	0.08	0.00
14.00	0.04	694	147.31	0.05	0.02	0.03	0.00
15.00	0.03	669	147.28	0.04	0.02	0.02	0.00
16.00	0.02	649	147.26	0.03	0.02	0.01	0.00
17.00	0.02	630	147.23	0.02	0.02	0.00	0.00
18.00	0.01	611	147.21	0.02	0.02	0.00	0.00
19.00	0.01	589	147.18	0.02	0.02	0.00	0.00
20.00	0.01	564	147.15	0.02	0.02	0.00	0.00
21.00	0.01	537	147.11	0.02	0.02	0.00	0.00
22.00	0.01	509	147.08	0.02	0.02	0.00	0.00
23.00	0.01	479	147.03	0.02	0.02	0.00	0.00
24.00	0.01	449	146.99	0.02	0.02	0.00	0.00
25.00	0.00	395	146.91	0.02	0.02	0.00	0.00
26.00	0.00	342	146.82	0.01	0.01	0.00	0.00
27.00	0.00	293	146.74	0.01	0.01	0.00	0.00
28.00	0.00	247	146.65	0.01	0.01	0.00	0.00
29.00	0.00	204	146.57	0.01	0.01	0.00	0.00
30.00	0.00	164	146.48	0.01	0.01	0.00	0.00
31.00	0.00	127	146.40	0.01	0.01	0.00	0.00
32.00	0.00	94	146.31	0.01	0.01	0.00	0.00
33.00	0.00	64	146.23	0.01	0.01	0.00	0.00
34.00	0.00	38	146.14	0.01	0.01	0.00	0.00
35.00	0.00	14	146.06	0.01	0.01	0.00	0.00
36.00	0.00	1	146.00	0.00	0.00	0.00	0.00

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Stage-Area-Storage for Pond P2: Triangular Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
146.00	230	0	148.65	1,883	2,447
146.05	253	12	148.70	1,936	2,543
146.10	275	25	148.75	1,989	2,641
146.15	298	40	148.80	2,042	2,742
146.20	320	55	148.85	2,095	2,845
146.25	343	72	148.90	2,148	2,951
146.30	365	89	148.95	2,201	3,060
146.35	388	108	149.00	2,254	3,171
146.40	410	128			
146.45	433	149			
146.50	456	171			
146.55	478	195			
146.60	501	219			
146.65	523	245			
146.70	546	271			
146.75	568	299			
146.80	591	328			
146.85	613	358			
146.90	636	390			
146.95	658	422			
147.00	681	456			
147.05	712	490			
147.10	742	527			
147.15	773	565			
147.20	803	604			
147.25	834	645			
147.30	865	687			
147.35	895	731			
147.40	926	777			
147.45	956	824			
147.50	987	873			
147.55	1,018	923			
147.60	1,048	974			
147.65	1,079	1,027			
147.70	1,109	1,082			
147.75	1,140	1,138			
147.80	1,171	1,196			
147.85	1,201	1,255			
147.90	1,232	1,316			
147.95	1,262	1,379			
148.00	1,293	1,443			
148.05	1,297	1,507			
148.10	1,300	1,572			
148.15	1,353	1,638			
148.20	1,406	1,707			
148.25	1,459	1,779			
148.30	1,512	1,853			
148.35	1,565	1,930			
148.40	1,618	2,010			
148.45	1,671	2,092			
148.50	1,724	2,177			
148.55	1,777	2,264			
148.60	1,830	2,355			

1179-20A - Proposed HydroCAD

Type III 24-hr 2-Year Rainfall=3.36"

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Summary for Pond P3: Modified Infiltration System

Inflow Area = 11,290 sf, 100.00% Impervious, Inflow Depth = 3.13" for 2-Year event
 Inflow = 0.83 cfs @ 12.09 hrs, Volume= 2,942 cf
 Outflow = 0.03 cfs @ 8.80 hrs, Volume= 2,703 cf, Atten= 97%, Lag= 0.0 min
 Discarded = 0.03 cfs @ 8.80 hrs, Volume= 2,703 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 149.65' @ 15.86 hrs Surf.Area= 1,061 sf Storage= 1,679 cf

Plug-Flow detention time= 545.0 min calculated for 2,703 cf (92% of inflow)
 Center-of-Mass det. time= 502.2 min (1,257.6 - 755.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	147.40'	840 cf	23.58'W x 45.00'L x 3.21'H Field A 3,405 cf Overall - 1,305 cf Embedded = 2,099 cf x 40.0% Voids
#2A	147.90'	1,305 cf	Cultec R-280HD x 30 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 5 rows
		2,145 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.40'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.90'	12.0" Round Culvert L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 147.90' / 147.80' S= 0.0100 1' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#3	Device 2	150.10'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.03 cfs @ 8.80 hrs HW=147.43' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=147.40' (Free Discharge)
 ↑2=Culvert (Controls 0.00 cfs)
 ↑3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

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Type III 24-hr 2-Year Rainfall=3.36"

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Pond P3: Modified Infiltration System - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf

Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap

Row Length Adjustment= +1.00' x 6.07 sf x 5 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

6 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 43.00' Row Length +12.0" End Stone x 2 = 45.00' Base Length

5 Rows x 47.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 23.58' Base Width

6.0" Stone Base + 26.5" Chamber Height + 6.0" Stone Cover = 3.21' Field Height

30 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 5 Rows = 1,305.4 cf Chamber Storage

3,404.8 cf Field - 1,305.4 cf Chambers = 2,099.4 cf Stone x 40.0% Voids = 839.8 cf Stone Storage

Chamber Storage + Stone Storage = 2,145.2 cf = 0.049 af

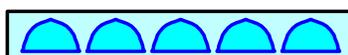
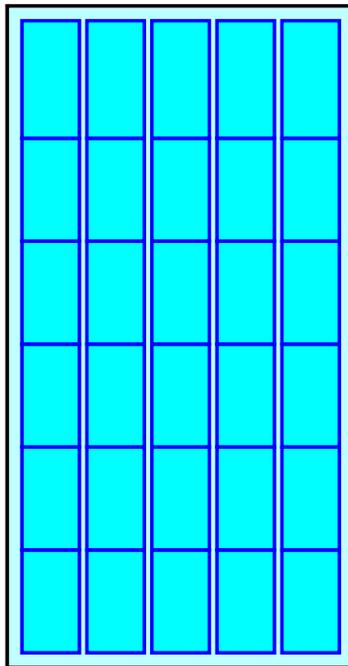
Overall Storage Efficiency = 63.0%

Overall System Size = 45.00' x 23.58' x 3.21'

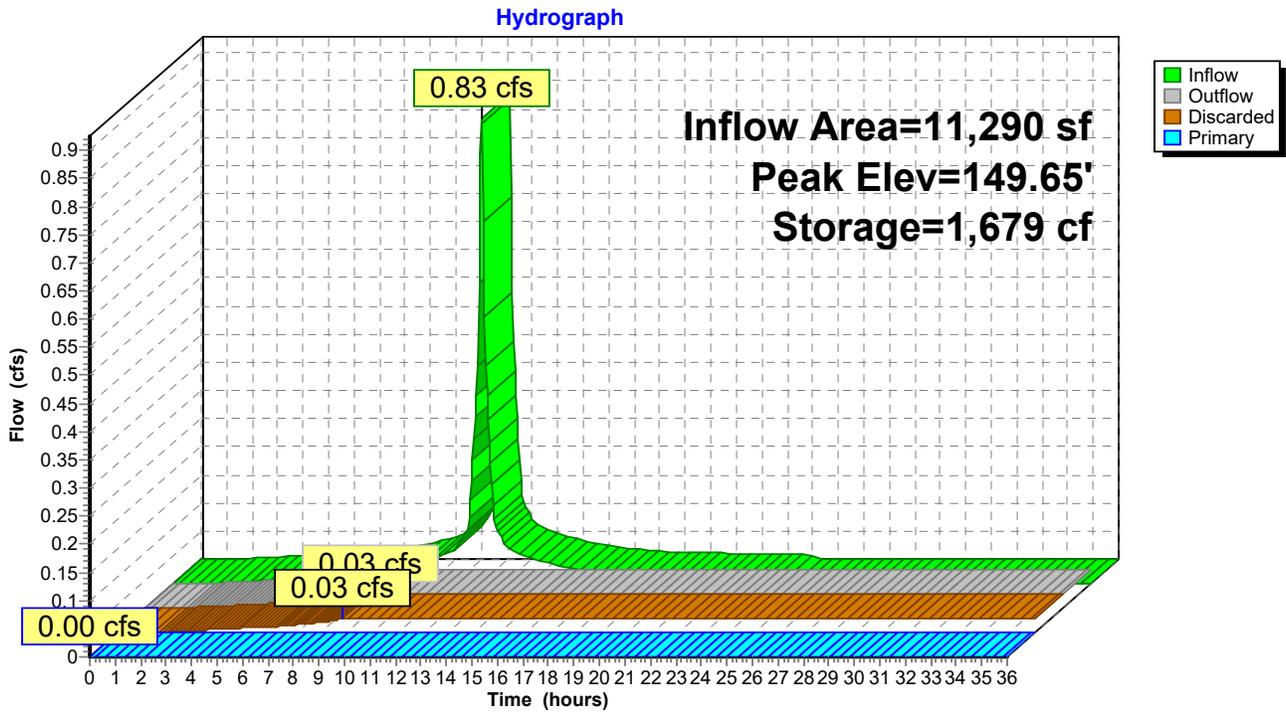
30 Chambers

126.1 cy Field

77.8 cy Stone



Pond P3: Modified Infiltration System



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Hydrograph for Pond P3: Modified Infiltration System

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	147.40	0.00	0.00	0.00
1.00	0.00	0	147.40	0.00	0.00	0.00
2.00	0.00	1	147.40	0.00	0.00	0.00
3.00	0.00	2	147.40	0.00	0.00	0.00
4.00	0.01	3	147.41	0.01	0.01	0.00
5.00	0.01	4	147.41	0.01	0.01	0.00
6.00	0.01	5	147.41	0.01	0.01	0.00
7.00	0.01	8	147.42	0.01	0.01	0.00
8.00	0.02	10	147.42	0.02	0.02	0.00
9.00	0.03	16	147.44	0.03	0.03	0.00
10.00	0.04	48	147.51	0.03	0.03	0.00
11.00	0.06	133	147.71	0.03	0.03	0.00
12.00	0.54	602	148.33	0.03	0.03	0.00
13.00	0.07	1,506	149.41	0.03	0.03	0.00
14.00	0.04	1,616	149.56	0.03	0.03	0.00
15.00	0.03	1,666	149.63	0.03	0.03	0.00
16.00	0.02	1,679	149.65	0.03	0.03	0.00
17.00	0.02	1,664	149.63	0.03	0.03	0.00
18.00	0.01	1,633	149.58	0.03	0.03	0.00
19.00	0.01	1,592	149.53	0.03	0.03	0.00
20.00	0.01	1,545	149.46	0.03	0.03	0.00
21.00	0.01	1,495	149.39	0.03	0.03	0.00
22.00	0.01	1,440	149.32	0.03	0.03	0.00
23.00	0.01	1,383	149.25	0.03	0.03	0.00
24.00	0.01	1,321	149.17	0.03	0.03	0.00
25.00	0.00	1,234	149.06	0.03	0.03	0.00
26.00	0.00	1,143	148.96	0.03	0.03	0.00
27.00	0.00	1,053	148.85	0.03	0.03	0.00
28.00	0.00	963	148.74	0.03	0.03	0.00
29.00	0.00	873	148.64	0.03	0.03	0.00
30.00	0.00	783	148.53	0.03	0.03	0.00
31.00	0.00	692	148.43	0.03	0.03	0.00
32.00	0.00	602	148.33	0.03	0.03	0.00
33.00	0.00	512	148.23	0.03	0.03	0.00
34.00	0.00	422	148.13	0.03	0.03	0.00
35.00	0.00	331	148.03	0.03	0.03	0.00
36.00	0.00	241	147.93	0.03	0.03	0.00

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Stage-Area-Storage for Pond P3: Modified Infiltration System

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
147.40	1,061	0	150.05	1,061	1,908
147.45	1,061	21	150.10	1,061	1,929
147.50	1,061	42	150.15	1,061	1,951
147.55	1,061	64	150.20	1,061	1,972
147.60	1,061	85	150.25	1,061	1,993
147.65	1,061	106	150.30	1,061	2,014
147.70	1,061	127	150.35	1,061	2,036
147.75	1,061	149	150.40	1,061	2,057
147.80	1,061	170	150.45	1,061	2,078
147.85	1,061	191	150.50	1,061	2,099
147.90	1,061	212	150.55	1,061	2,120
147.95	1,061	259	150.60	1,061	2,142
148.00	1,061	305			
148.05	1,061	350			
148.10	1,061	395			
148.15	1,061	441			
148.20	1,061	486			
148.25	1,061	531			
148.30	1,061	576			
148.35	1,061	620			
148.40	1,061	665			
148.45	1,061	709			
148.50	1,061	753			
148.55	1,061	797			
148.60	1,061	841			
148.65	1,061	884			
148.70	1,061	927			
148.75	1,061	970			
148.80	1,061	1,012			
148.85	1,061	1,054			
148.90	1,061	1,097			
148.95	1,061	1,138			
149.00	1,061	1,180			
149.05	1,061	1,222			
149.10	1,061	1,263			
149.15	1,061	1,303			
149.20	1,061	1,343			
149.25	1,061	1,383			
149.30	1,061	1,422			
149.35	1,061	1,460			
149.40	1,061	1,499			
149.45	1,061	1,536			
149.50	1,061	1,573			
149.55	1,061	1,609			
149.60	1,061	1,645			
149.65	1,061	1,680			
149.70	1,061	1,713			
149.75	1,061	1,746			
149.80	1,061	1,778			
149.85	1,061	1,807			
149.90	1,061	1,835			
149.95	1,061	1,861			
150.00	1,061	1,885			

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Summary for Pond P4: L Pond

Inflow Area = 18,107 sf, 3.26% Impervious, Inflow Depth = 0.47" for 2-Year event
 Inflow = 0.14 cfs @ 12.15 hrs, Volume= 713 cf
 Outflow = 0.02 cfs @ 15.19 hrs, Volume= 713 cf, Atten= 87%, Lag= 182.0 min
 Discarded = 0.02 cfs @ 15.19 hrs, Volume= 713 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 148.45' @ 15.19 hrs Surf.Area= 745 sf Storage= 253 cf

Plug-Flow detention time= 178.8 min calculated for 712 cf (100% of inflow)
 Center-of-Mass det. time= 178.7 min (1,093.7 - 915.0)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	1,674 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	369	0	0
149.00	1,197	783	783
149.50	1,667	716	1,499
149.60	1,837	175	1,674

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	149.20'	5.0' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32

Discarded OutFlow Max=0.02 cfs @ 15.19 hrs HW=148.45' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.00' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

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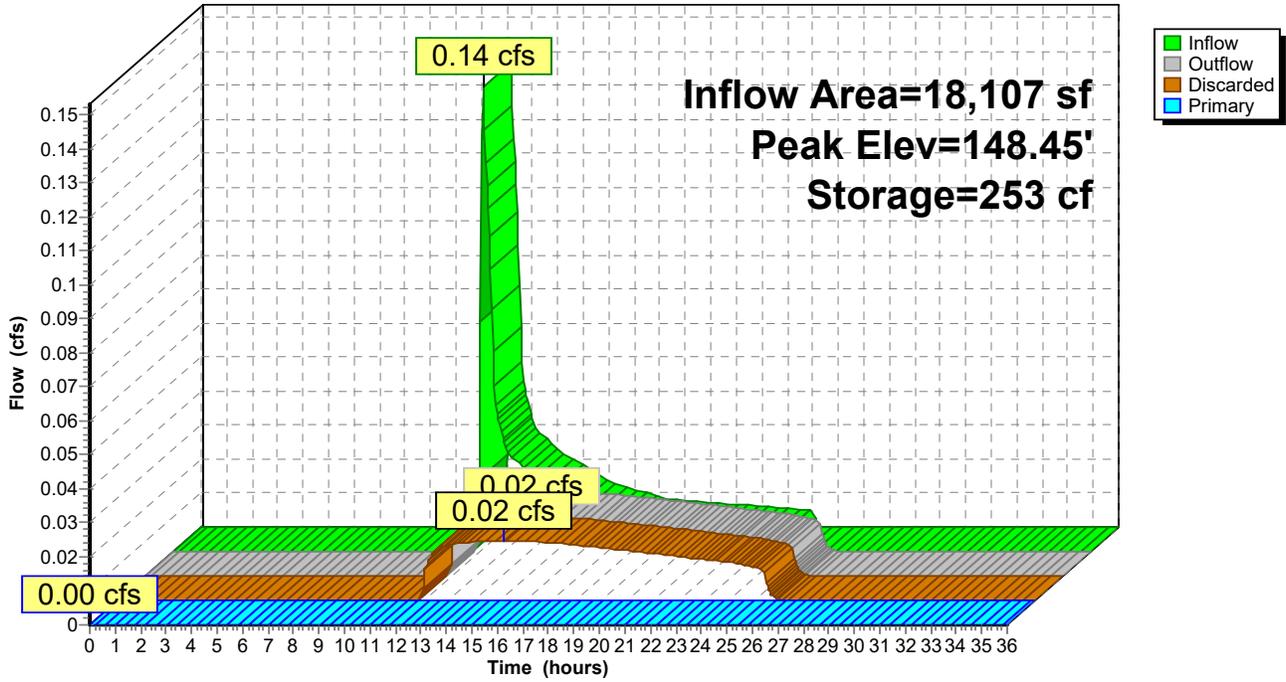
Type III 24-hr 2-Year Rainfall=3.36"

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Pond P4: L Pond

Hydrograph



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Hydrograph for Pond P4: L Pond

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	148.00	0.00	0.00	0.00
1.00	0.00	0	148.00	0.00	0.00	0.00
2.00	0.00	0	148.00	0.00	0.00	0.00
3.00	0.00	0	148.00	0.00	0.00	0.00
4.00	0.00	0	148.00	0.00	0.00	0.00
5.00	0.00	0	148.00	0.00	0.00	0.00
6.00	0.00	0	148.00	0.00	0.00	0.00
7.00	0.00	0	148.00	0.00	0.00	0.00
8.00	0.00	0	148.00	0.00	0.00	0.00
9.00	0.00	0	148.00	0.00	0.00	0.00
10.00	0.00	0	148.00	0.00	0.00	0.00
11.00	0.00	0	148.00	0.00	0.00	0.00
12.00	0.02	2	148.01	0.00	0.00	0.00
13.00	0.03	208	148.39	0.02	0.02	0.00
14.00	0.02	242	148.44	0.02	0.02	0.00
15.00	0.02	253	148.45	0.02	0.02	0.00
16.00	0.01	248	148.45	0.02	0.02	0.00
17.00	0.01	230	148.42	0.02	0.02	0.00
18.00	0.01	206	148.39	0.02	0.02	0.00
19.00	0.01	178	148.35	0.02	0.02	0.00
20.00	0.01	151	148.31	0.01	0.01	0.00
21.00	0.01	125	148.26	0.01	0.01	0.00
22.00	0.01	100	148.22	0.01	0.01	0.00
23.00	0.01	76	148.17	0.01	0.01	0.00
24.00	0.00	53	148.13	0.01	0.01	0.00
25.00	0.00	18	148.05	0.01	0.01	0.00
26.00	0.00	0	148.00	0.00	0.00	0.00
27.00	0.00	0	148.00	0.00	0.00	0.00
28.00	0.00	0	148.00	0.00	0.00	0.00
29.00	0.00	0	148.00	0.00	0.00	0.00
30.00	0.00	0	148.00	0.00	0.00	0.00
31.00	0.00	0	148.00	0.00	0.00	0.00
32.00	0.00	0	148.00	0.00	0.00	0.00
33.00	0.00	0	148.00	0.00	0.00	0.00
34.00	0.00	0	148.00	0.00	0.00	0.00
35.00	0.00	0	148.00	0.00	0.00	0.00
36.00	0.00	0	148.00	0.00	0.00	0.00

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Stage-Area-Storage for Pond P4: L Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
148.00	369	0	149.06	1,253	857
148.02	386	8	149.08	1,272	882
148.04	402	15	149.10	1,291	907
148.06	419	24	149.12	1,310	933
148.08	435	32	149.14	1,329	960
148.10	452	41	149.16	1,347	987
148.12	468	50	149.18	1,366	1,014
148.14	485	60	149.20	1,385	1,041
148.16	501	70	149.22	1,404	1,069
148.18	518	80	149.24	1,423	1,097
148.20	535	90	149.26	1,441	1,126
148.22	551	101	149.28	1,460	1,155
148.24	568	112	149.30	1,479	1,184
148.26	584	124	149.32	1,498	1,214
148.28	601	136	149.34	1,517	1,244
148.30	617	148	149.36	1,535	1,275
148.32	634	160	149.38	1,554	1,306
148.34	651	173	149.40	1,573	1,337
148.36	667	186	149.42	1,592	1,369
148.38	684	200	149.44	1,611	1,401
148.40	700	214	149.46	1,629	1,433
148.42	717	228	149.48	1,648	1,466
148.44	733	243	149.50	1,667	1,499
148.46	750	257	149.52	1,701	1,533
148.48	766	273	149.54	1,735	1,567
148.50	783	288	149.56	1,769	1,602
148.52	800	304	149.58	1,803	1,638
148.54	816	320	149.60	1,837	1,674
148.56	833	336			
148.58	849	353			
148.60	866	370			
148.62	882	388			
148.64	899	406			
148.66	915	424			
148.68	932	442			
148.70	949	461			
148.72	965	480			
148.74	982	500			
148.76	998	520			
148.78	1,015	540			
148.80	1,031	560			
148.82	1,048	581			
148.84	1,065	602			
148.86	1,081	624			
148.88	1,098	645			
148.90	1,114	667			
148.92	1,131	690			
148.94	1,147	713			
148.96	1,164	736			
148.98	1,180	759			
149.00	1,197	783			
149.02	1,216	807			
149.04	1,235	832			

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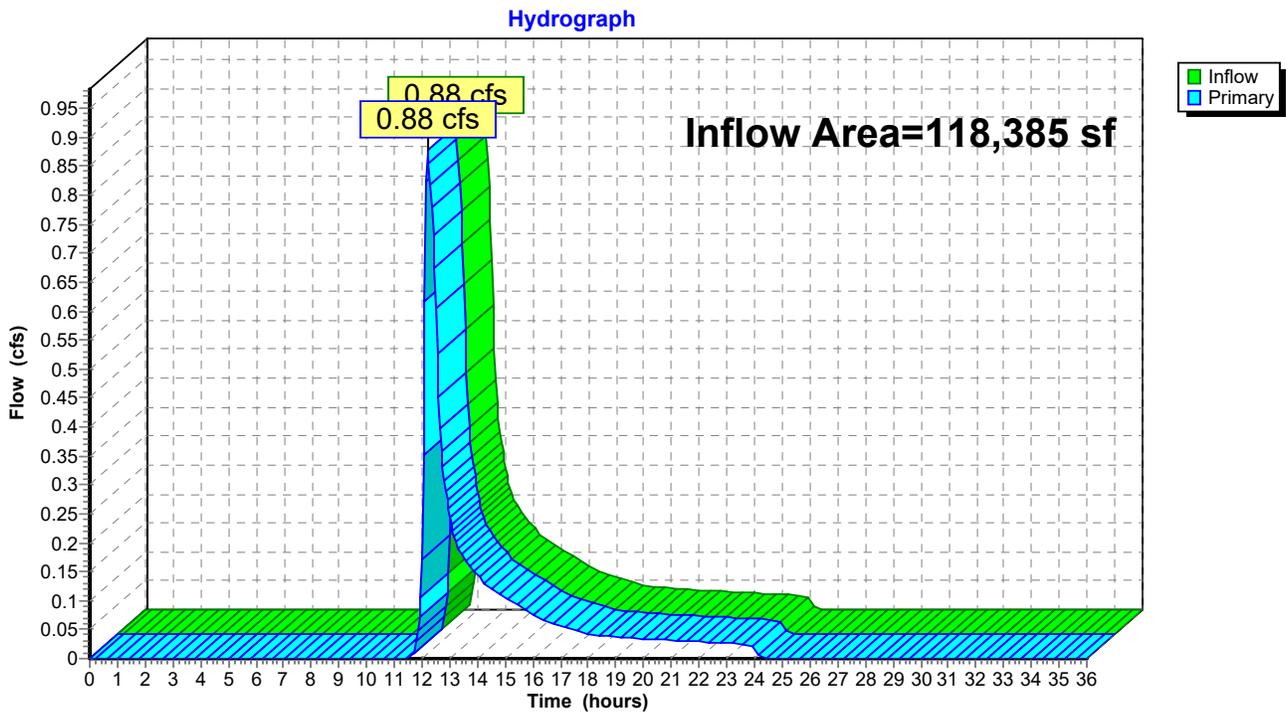
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Summary for Link SP1: STUDY POINT #1 (Wetland Boundary)

Inflow Area = 118,385 sf, 24.39% Impervious, Inflow Depth = 0.46" for 2-Year event
Inflow = 0.88 cfs @ 12.21 hrs, Volume= 4,494 cf
Primary = 0.88 cfs @ 12.21 hrs, Volume= 4,494 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link SP1: STUDY POINT #1 (Wetland Boundary)



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Hydrograph for Link SP1: STUDY POINT #1 (Wetland Boundary)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	26.50	0.00	0.00	0.00
0.50	0.00	0.00	0.00	27.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	27.50	0.00	0.00	0.00
1.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
2.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	35.50	0.00	0.00	0.00
9.50	0.00	0.00	0.00	36.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00				
10.50	0.00	0.00	0.00				
11.00	0.00	0.00	0.00				
11.50	0.00	0.00	0.00				
12.00	0.17	0.00	0.17				
12.50	0.60	0.00	0.60				
13.00	0.25	0.00	0.25				
13.50	0.18	0.00	0.18				
14.00	0.14	0.00	0.14				
14.50	0.12	0.00	0.12				
15.00	0.11	0.00	0.11				
15.50	0.09	0.00	0.09				
16.00	0.07	0.00	0.07				
16.50	0.06	0.00	0.06				
17.00	0.06	0.00	0.06				
17.50	0.05	0.00	0.05				
18.00	0.04	0.00	0.04				
18.50	0.04	0.00	0.04				
19.00	0.04	0.00	0.04				
19.50	0.04	0.00	0.04				
20.00	0.03	0.00	0.03				
20.50	0.03	0.00	0.03				
21.00	0.03	0.00	0.03				
21.50	0.03	0.00	0.03				
22.00	0.03	0.00	0.03				
22.50	0.03	0.00	0.03				
23.00	0.03	0.00	0.03				
23.50	0.03	0.00	0.03				
24.00	0.02	0.00	0.02				
24.50	0.00	0.00	0.00				
25.00	0.00	0.00	0.00				
25.50	0.00	0.00	0.00				
26.00	0.00	0.00	0.00				

1179-20A - Proposed HydroCAD

Type III 24-hr 10-Year Rainfall=5.12"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Subcat P-1	Runoff Area=36,180 sf 22.60% Impervious Runoff Depth=1.89" Flow Length=385' Tc=11.1 min CN=67 Runoff=1.49 cfs 5,690 cf
Subcatchment P-2: Subcat P-2	Runoff Area=11,784 sf 74.78% Impervious Runoff Depth=3.89" Flow Length=258' Tc=6.0 min CN=89 Runoff=1.17 cfs 3,817 cf
Subcatchment P-3: Subcat P-3	Runoff Area=11,290 sf 100.00% Impervious Runoff Depth=4.88" Flow Length=215' Tc=6.0 min CN=98 Runoff=1.27 cfs 4,594 cf
Subcatchment P-4: Subcat P-4	Runoff Area=18,107 sf 3.26% Impervious Runoff Depth=1.37" Flow Length=235' Tc=7.2 min CN=60 Runoff=0.57 cfs 2,070 cf
Subcatchment P-5: Subcat P-5	Runoff Area=41,025 sf 0.00% Impervious Runoff Depth=1.24" Flow Length=124' Tc=6.6 min CN=58 Runoff=1.15 cfs 4,223 cf
Pond P2: Triangular Pond	Peak Elev=147.87' Storage=1,276 cf Inflow=1.17 cfs 3,817 cf Discarded=0.03 cfs 1,604 cf Primary=0.54 cfs 2,182 cf Secondary=0.00 cfs 0 cf Outflow=0.57 cfs 3,786 cf
Pond P3: Modified Infiltration System	Peak Elev=150.24' Storage=1,987 cf Inflow=1.27 cfs 4,594 cf Discarded=0.03 cfs 2,865 cf Primary=0.56 cfs 1,075 cf Outflow=0.58 cfs 3,939 cf
Pond P4: L Pond	Peak Elev=149.21' Storage=1,053 cf Inflow=0.57 cfs 2,070 cf Discarded=0.03 cfs 2,016 cf Primary=0.01 cfs 54 cf Outflow=0.05 cfs 2,070 cf
Link SP1: STUDY POINT #1 (Wetland Boundary)	Inflow=3.04 cfs 13,223 cf Primary=3.04 cfs 13,223 cf

Total Runoff Area = 118,385 sf Runoff Volume = 20,394 cf Average Runoff Depth = 2.07"
75.61% Pervious = 89,516 sf 24.39% Impervious = 28,869 sf

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Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Subcatchment P-1: Subcat P-1

Runoff = 1.49 cfs @ 12.16 hrs, Volume= 5,690 cf, Depth= 1.89"

Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

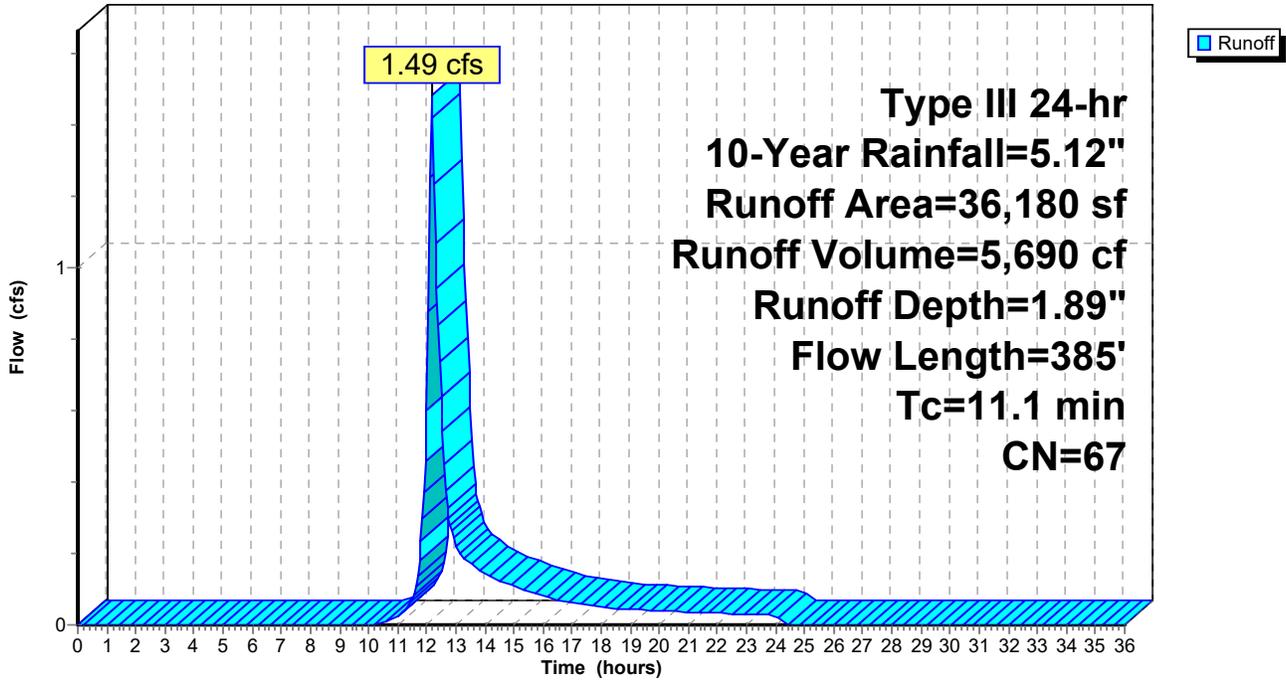
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
12,321	61	>75% Grass cover, Good, HSG B
8,177	98	Paved parking, HSG B
15,681	55	Woods, Good, HSG B
36,180	67	Weighted Average
28,003		77.40% Pervious Area
8,177		22.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0800	0.12		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
0.6	45	0.0666	1.29		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
2.9	145	0.0138	0.82		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.6	121	0.0270	3.34		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
0.0	24	0.5100	32.40	25.44	Pipe Channel, E-F 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
11.1	385	Total			

Subcatchment P-1: Subcat P-1

Hydrograph



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Type III 24-hr 10-Year Rainfall=5.12"

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Hydrograph for Subcatchment P-1: Subcat P-1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	5.12	1.89	0.00
0.50	0.03	0.00	0.00	27.00	5.12	1.89	0.00
1.00	0.05	0.00	0.00	27.50	5.12	1.89	0.00
1.50	0.08	0.00	0.00	28.00	5.12	1.89	0.00
2.00	0.10	0.00	0.00	28.50	5.12	1.89	0.00
2.50	0.13	0.00	0.00	29.00	5.12	1.89	0.00
3.00	0.16	0.00	0.00	29.50	5.12	1.89	0.00
3.50	0.19	0.00	0.00	30.00	5.12	1.89	0.00
4.00	0.22	0.00	0.00	30.50	5.12	1.89	0.00
4.50	0.25	0.00	0.00	31.00	5.12	1.89	0.00
5.00	0.29	0.00	0.00	31.50	5.12	1.89	0.00
5.50	0.33	0.00	0.00	32.00	5.12	1.89	0.00
6.00	0.37	0.00	0.00	32.50	5.12	1.89	0.00
6.50	0.41	0.00	0.00	33.00	5.12	1.89	0.00
7.00	0.46	0.00	0.00	33.50	5.12	1.89	0.00
7.50	0.52	0.00	0.00	34.00	5.12	1.89	0.00
8.00	0.58	0.00	0.00	34.50	5.12	1.89	0.00
8.50	0.66	0.00	0.00	35.00	5.12	1.89	0.00
9.00	0.75	0.00	0.00	35.50	5.12	1.89	0.00
9.50	0.85	0.00	0.00	36.00	5.12	1.89	0.00
10.00	0.97	0.00	0.00				
10.50	1.11	0.00	0.01				
11.00	1.28	0.02	0.03				
11.50	1.53	0.05	0.07				
12.00	2.56	0.38	0.60				
12.50	3.59	0.90	0.64				
13.00	3.84	1.05	0.23				
13.50	4.01	1.15	0.17				
14.00	4.15	1.24	0.14				
14.50	4.27	1.31	0.12				
15.00	4.37	1.38	0.11				
15.50	4.46	1.44	0.09				
16.00	4.54	1.49	0.08				
16.50	4.60	1.53	0.07				
17.00	4.66	1.57	0.06				
17.50	4.71	1.60	0.06				
18.00	4.75	1.63	0.05				
18.50	4.79	1.66	0.05				
19.00	4.83	1.69	0.04				
19.50	4.87	1.71	0.04				
20.00	4.90	1.73	0.04				
20.50	4.93	1.76	0.04				
21.00	4.96	1.78	0.04				
21.50	4.99	1.80	0.03				
22.00	5.02	1.82	0.03				
22.50	5.05	1.84	0.03				
23.00	5.07	1.85	0.03				
23.50	5.10	1.87	0.03				
24.00	5.12	1.89	0.03				
24.50	5.12	1.89	0.00				
25.00	5.12	1.89	0.00				
25.50	5.12	1.89	0.00				
26.00	5.12	1.89	0.00				

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Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Subcatchment P-2: Subcat P-2

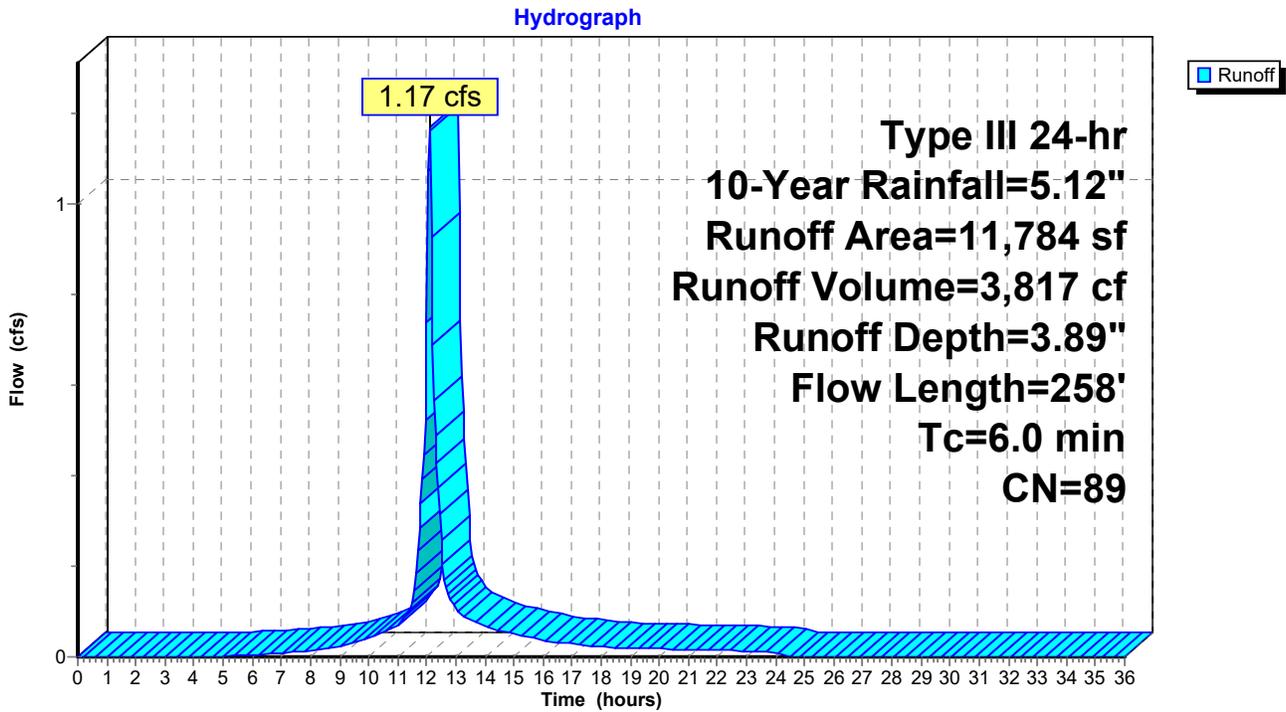
Runoff = 1.17 cfs @ 12.09 hrs, Volume= 3,817 cf, Depth= 3.89"
 Routed to Pond P2 : Triangular Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
2,972	61	>75% Grass cover, Good, HSG B
8,812	98	Paved parking, HSG B
11,784	89	Weighted Average
2,972		25.22% Pervious Area
8,812		74.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	20	0.0150	0.11		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
0.5	30	0.0150	0.98		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.28"
0.6	90	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.6	118	0.0040	3.33	4.09	Pipe Channel, D-E 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
4.7	258	Total, Increased to minimum Tc = 6.0 min			

Subcatchment P-2: Subcat P-2



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Type III 24-hr 10-Year Rainfall=5.12"

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Hydrograph for Subcatchment P-2: Subcat P-2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	5.12	3.89	0.00
0.50	0.03	0.00	0.00	27.00	5.12	3.89	0.00
1.00	0.05	0.00	0.00	27.50	5.12	3.89	0.00
1.50	0.08	0.00	0.00	28.00	5.12	3.89	0.00
2.00	0.10	0.00	0.00	28.50	5.12	3.89	0.00
2.50	0.13	0.00	0.00	29.00	5.12	3.89	0.00
3.00	0.16	0.00	0.00	29.50	5.12	3.89	0.00
3.50	0.19	0.00	0.00	30.00	5.12	3.89	0.00
4.00	0.22	0.00	0.00	30.50	5.12	3.89	0.00
4.50	0.25	0.00	0.00	31.00	5.12	3.89	0.00
5.00	0.29	0.00	0.00	31.50	5.12	3.89	0.00
5.50	0.33	0.01	0.00	32.00	5.12	3.89	0.00
6.00	0.37	0.01	0.00	32.50	5.12	3.89	0.00
6.50	0.41	0.02	0.01	33.00	5.12	3.89	0.00
7.00	0.46	0.03	0.01	33.50	5.12	3.89	0.00
7.50	0.52	0.05	0.01	34.00	5.12	3.89	0.00
8.00	0.58	0.07	0.01	34.50	5.12	3.89	0.00
8.50	0.66	0.10	0.02	35.00	5.12	3.89	0.00
9.00	0.75	0.14	0.02	35.50	5.12	3.89	0.00
9.50	0.85	0.20	0.03	36.00	5.12	3.89	0.00
10.00	0.97	0.27	0.04				
10.50	1.11	0.35	0.05				
11.00	1.28	0.47	0.07				
11.50	1.53	0.65	0.12				
12.00	2.56	1.51	0.74				
12.50	3.59	2.44	0.26				
13.00	3.84	2.67	0.11				
13.50	4.01	2.83	0.08				
14.00	4.15	2.97	0.07				
14.50	4.27	3.08	0.06				
15.00	4.37	3.18	0.05				
15.50	4.46	3.26	0.04				
16.00	4.54	3.33	0.04				
16.50	4.60	3.39	0.03				
17.00	4.66	3.44	0.03				
17.50	4.71	3.49	0.03				
18.00	4.75	3.53	0.02				
18.50	4.79	3.57	0.02				
19.00	4.83	3.61	0.02				
19.50	4.87	3.64	0.02				
20.00	4.90	3.68	0.02				
20.50	4.93	3.71	0.02				
21.00	4.96	3.74	0.02				
21.50	4.99	3.77	0.02				
22.00	5.02	3.79	0.01				
22.50	5.05	3.82	0.01				
23.00	5.07	3.84	0.01				
23.50	5.10	3.87	0.01				
24.00	5.12	3.89	0.01				
24.50	5.12	3.89	0.00				
25.00	5.12	3.89	0.00				
25.50	5.12	3.89	0.00				
26.00	5.12	3.89	0.00				

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Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Subcatchment P-3: Subcat P-3

Runoff = 1.27 cfs @ 12.09 hrs, Volume= 4,594 cf, Depth= 4.88"
 Routed to Pond P3 : Modified Infiltration System

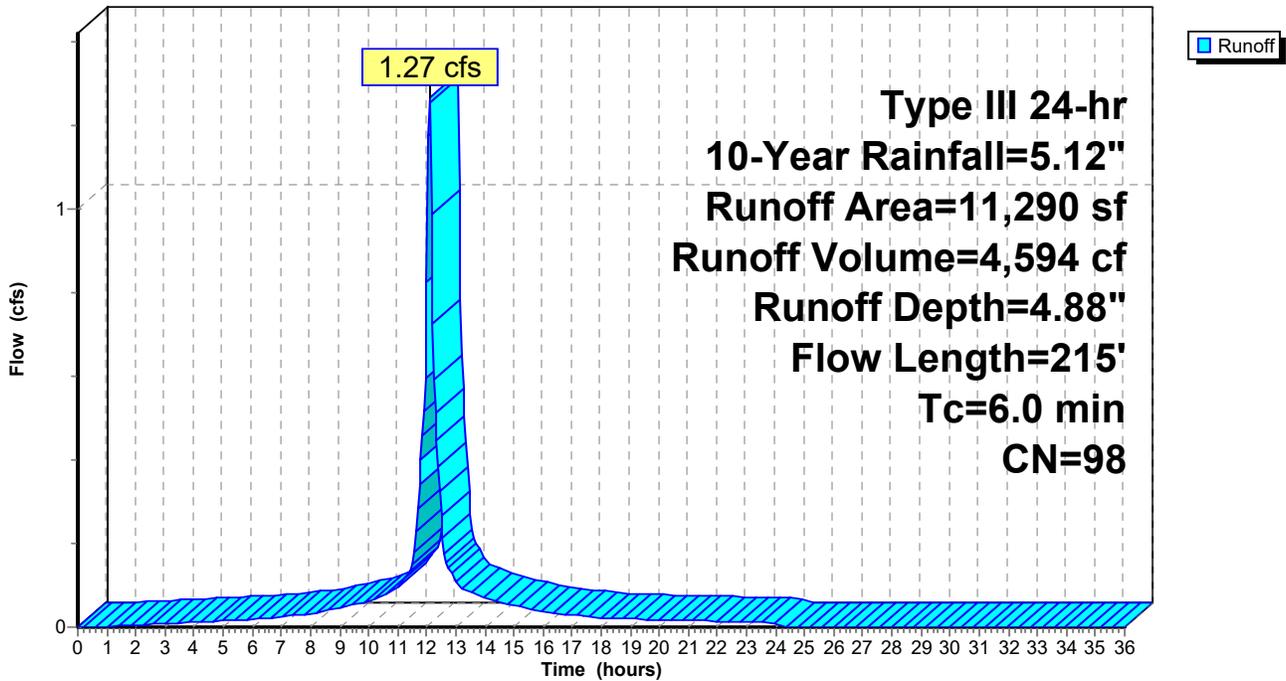
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
11,290	98	Roofs, HSG B
11,290		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	146	0.0050	2.84	1.55	Pipe Channel, 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
0.2	69	0.0160	5.08	2.77	Pipe Channel, 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
1.1	215	Total, Increased to minimum Tc = 6.0 min			

Subcatchment P-3: Subcat P-3

Hydrograph



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Type III 24-hr 10-Year Rainfall=5.12"

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Hydrograph for Subcatchment P-3: Subcat P-3

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	5.12	4.88	0.00
0.50	0.03	0.00	0.00	27.00	5.12	4.88	0.00
1.00	0.05	0.00	0.00	27.50	5.12	4.88	0.00
1.50	0.08	0.01	0.00	28.00	5.12	4.88	0.00
2.00	0.10	0.01	0.01	28.50	5.12	4.88	0.00
2.50	0.13	0.03	0.01	29.00	5.12	4.88	0.00
3.00	0.16	0.04	0.01	29.50	5.12	4.88	0.00
3.50	0.19	0.06	0.01	30.00	5.12	4.88	0.00
4.00	0.22	0.08	0.01	30.50	5.12	4.88	0.00
4.50	0.25	0.11	0.01	31.00	5.12	4.88	0.00
5.00	0.29	0.14	0.02	31.50	5.12	4.88	0.00
5.50	0.33	0.17	0.02	32.00	5.12	4.88	0.00
6.00	0.37	0.20	0.02	32.50	5.12	4.88	0.00
6.50	0.41	0.24	0.02	33.00	5.12	4.88	0.00
7.00	0.46	0.28	0.02	33.50	5.12	4.88	0.00
7.50	0.52	0.34	0.03	34.00	5.12	4.88	0.00
8.00	0.58	0.39	0.03	34.50	5.12	4.88	0.00
8.50	0.66	0.46	0.04	35.00	5.12	4.88	0.00
9.00	0.75	0.55	0.05	35.50	5.12	4.88	0.00
9.50	0.85	0.65	0.05	36.00	5.12	4.88	0.00
10.00	0.97	0.76	0.06				
10.50	1.11	0.90	0.08				
11.00	1.28	1.06	0.09				
11.50	1.53	1.31	0.15				
12.00	2.56	2.33	0.82				
12.50	3.59	3.36	0.27				
13.00	3.84	3.61	0.11				
13.50	4.01	3.78	0.08				
14.00	4.15	3.92	0.07				
14.50	4.27	4.03	0.06				
15.00	4.37	4.14	0.05				
15.50	4.46	4.23	0.04				
16.00	4.54	4.30	0.04				
16.50	4.60	4.36	0.03				
17.00	4.66	4.42	0.03				
17.50	4.71	4.47	0.03				
18.00	4.75	4.51	0.02				
18.50	4.79	4.55	0.02				
19.00	4.83	4.59	0.02				
19.50	4.87	4.63	0.02				
20.00	4.90	4.66	0.02				
20.50	4.93	4.70	0.02				
21.00	4.96	4.73	0.02				
21.50	4.99	4.76	0.02				
22.00	5.02	4.78	0.01				
22.50	5.05	4.81	0.01				
23.00	5.07	4.84	0.01				
23.50	5.10	4.86	0.01				
24.00	5.12	4.88	0.01				
24.50	5.12	4.88	0.00				
25.00	5.12	4.88	0.00				
25.50	5.12	4.88	0.00				
26.00	5.12	4.88	0.00				

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Summary for Subcatchment P-4: Subcat P-4

Runoff = 0.57 cfs @ 12.12 hrs, Volume= 2,070 cf, Depth= 1.37"
 Routed to Pond P4 : L Pond

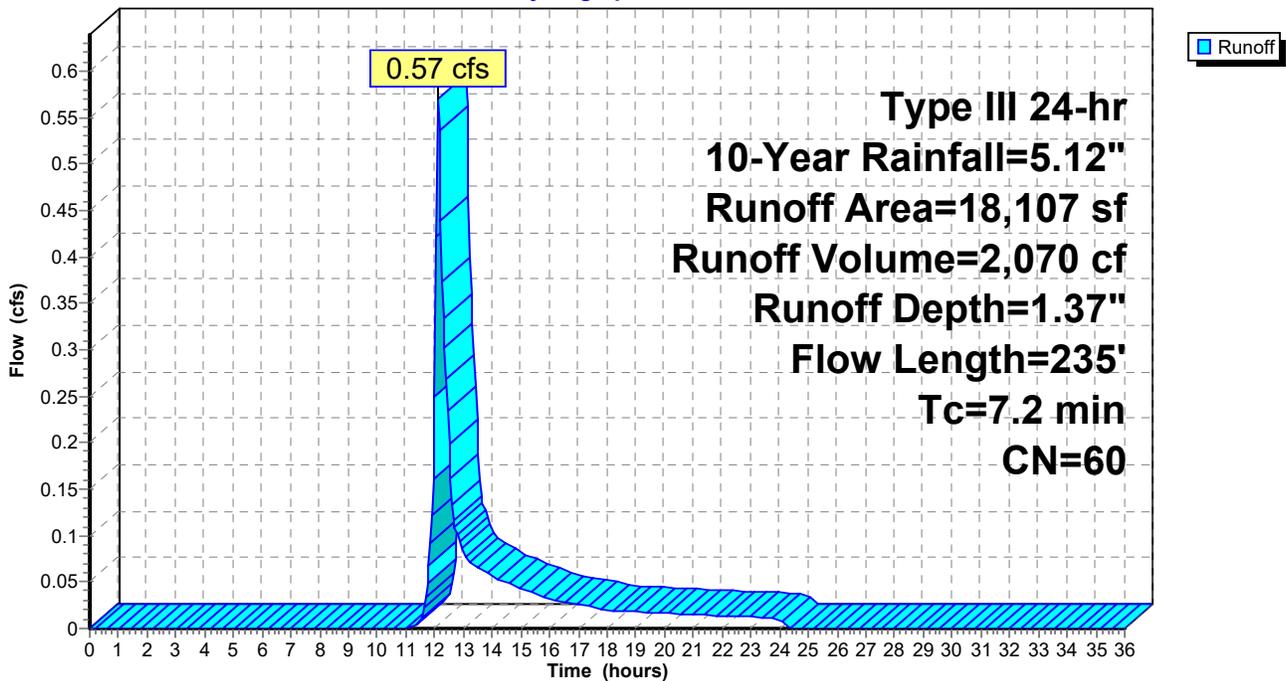
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
9,473	61	>75% Grass cover, Good, HSG B
590	98	Paved parking, HSG B
8,043	55	Woods, Good, HSG B
18,107	60	Weighted Average
17,517		96.74% Pervious Area
590		3.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0800	0.26		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
2.9	120	0.0100	0.70		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.1	65	0.0380	0.97		Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps
7.2	235	Total			

Subcatchment P-4: Subcat P-4

Hydrograph



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Type III 24-hr 10-Year Rainfall=5.12"

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Hydrograph for Subcatchment P-4: Subcat P-4

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	5.12	1.37	0.00
0.50	0.03	0.00	0.00	27.00	5.12	1.37	0.00
1.00	0.05	0.00	0.00	27.50	5.12	1.37	0.00
1.50	0.08	0.00	0.00	28.00	5.12	1.37	0.00
2.00	0.10	0.00	0.00	28.50	5.12	1.37	0.00
2.50	0.13	0.00	0.00	29.00	5.12	1.37	0.00
3.00	0.16	0.00	0.00	29.50	5.12	1.37	0.00
3.50	0.19	0.00	0.00	30.00	5.12	1.37	0.00
4.00	0.22	0.00	0.00	30.50	5.12	1.37	0.00
4.50	0.25	0.00	0.00	31.00	5.12	1.37	0.00
5.00	0.29	0.00	0.00	31.50	5.12	1.37	0.00
5.50	0.33	0.00	0.00	32.00	5.12	1.37	0.00
6.00	0.37	0.00	0.00	32.50	5.12	1.37	0.00
6.50	0.41	0.00	0.00	33.00	5.12	1.37	0.00
7.00	0.46	0.00	0.00	33.50	5.12	1.37	0.00
7.50	0.52	0.00	0.00	34.00	5.12	1.37	0.00
8.00	0.58	0.00	0.00	34.50	5.12	1.37	0.00
8.50	0.66	0.00	0.00	35.00	5.12	1.37	0.00
9.00	0.75	0.00	0.00	35.50	5.12	1.37	0.00
9.50	0.85	0.00	0.00	36.00	5.12	1.37	0.00
10.00	0.97	0.00	0.00				
10.50	1.11	0.00	0.00				
11.00	1.28	0.00	0.00				
11.50	1.53	0.01	0.01				
12.00	2.56	0.19	0.25				
12.50	3.59	0.57	0.20				
13.00	3.84	0.68	0.08				
13.50	4.01	0.77	0.07				
14.00	4.15	0.84	0.06				
14.50	4.27	0.90	0.05				
15.00	4.37	0.95	0.04				
15.50	4.46	1.00	0.04				
16.00	4.54	1.04	0.03				
16.50	4.60	1.07	0.03				
17.00	4.66	1.11	0.03				
17.50	4.71	1.13	0.02				
18.00	4.75	1.16	0.02				
18.50	4.79	1.18	0.02				
19.00	4.83	1.20	0.02				
19.50	4.87	1.22	0.02				
20.00	4.90	1.24	0.02				
20.50	4.93	1.26	0.02				
21.00	4.96	1.28	0.01				
21.50	4.99	1.30	0.01				
22.00	5.02	1.31	0.01				
22.50	5.05	1.33	0.01				
23.00	5.07	1.34	0.01				
23.50	5.10	1.36	0.01				
24.00	5.12	1.37	0.01				
24.50	5.12	1.37	0.00				
25.00	5.12	1.37	0.00				
25.50	5.12	1.37	0.00				
26.00	5.12	1.37	0.00				

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Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Subcatchment P-5: Subcat P-5

Runoff = 1.15 cfs @ 12.11 hrs, Volume= 4,223 cf, Depth= 1.24"

Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

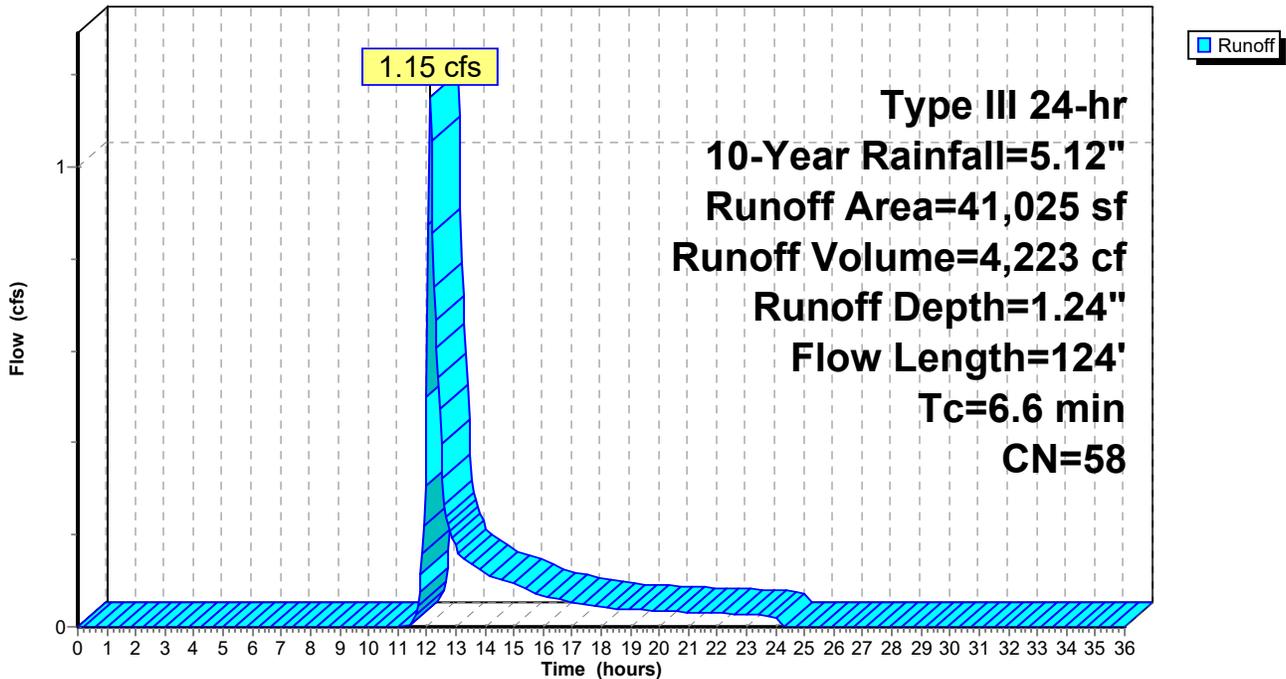
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.12"

Area (sf)	CN	Description
18,715	61	>75% Grass cover, Good, HSG B
0	98	Paved parking, HSG B
22,310	55	Woods, Good, HSG B
41,025	58	Weighted Average
41,024		100.00% Pervious Area
0		0.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
1.0	74	0.0600	1.22		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
6.6	124	Total			

Subcatchment P-5: Subcat P-5

Hydrograph



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Hydrograph for Subcatchment P-5: Subcat P-5

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	5.12	1.24	0.00
0.50	0.03	0.00	0.00	27.00	5.12	1.24	0.00
1.00	0.05	0.00	0.00	27.50	5.12	1.24	0.00
1.50	0.08	0.00	0.00	28.00	5.12	1.24	0.00
2.00	0.10	0.00	0.00	28.50	5.12	1.24	0.00
2.50	0.13	0.00	0.00	29.00	5.12	1.24	0.00
3.00	0.16	0.00	0.00	29.50	5.12	1.24	0.00
3.50	0.19	0.00	0.00	30.00	5.12	1.24	0.00
4.00	0.22	0.00	0.00	30.50	5.12	1.24	0.00
4.50	0.25	0.00	0.00	31.00	5.12	1.24	0.00
5.00	0.29	0.00	0.00	31.50	5.12	1.24	0.00
5.50	0.33	0.00	0.00	32.00	5.12	1.24	0.00
6.00	0.37	0.00	0.00	32.50	5.12	1.24	0.00
6.50	0.41	0.00	0.00	33.00	5.12	1.24	0.00
7.00	0.46	0.00	0.00	33.50	5.12	1.24	0.00
7.50	0.52	0.00	0.00	34.00	5.12	1.24	0.00
8.00	0.58	0.00	0.00	34.50	5.12	1.24	0.00
8.50	0.66	0.00	0.00	35.00	5.12	1.24	0.00
9.00	0.75	0.00	0.00	35.50	5.12	1.24	0.00
9.50	0.85	0.00	0.00	36.00	5.12	1.24	0.00
10.00	0.97	0.00	0.00				
10.50	1.11	0.00	0.00				
11.00	1.28	0.00	0.00				
11.50	1.53	0.00	0.00				
12.00	2.56	0.15	0.50				
12.50	3.59	0.49	0.40				
13.00	3.84	0.59	0.17				
13.50	4.01	0.67	0.14				
14.00	4.15	0.74	0.12				
14.50	4.27	0.79	0.10				
15.00	4.37	0.84	0.09				
15.50	4.46	0.89	0.08				
16.00	4.54	0.92	0.07				
16.50	4.60	0.96	0.06				
17.00	4.66	0.99	0.05				
17.50	4.71	1.01	0.05				
18.00	4.75	1.03	0.04				
18.50	4.79	1.06	0.04				
19.00	4.83	1.08	0.04				
19.50	4.87	1.10	0.04				
20.00	4.90	1.11	0.03				
20.50	4.93	1.13	0.03				
21.00	4.96	1.15	0.03				
21.50	4.99	1.17	0.03				
22.00	5.02	1.18	0.03				
22.50	5.05	1.20	0.03				
23.00	5.07	1.21	0.03				
23.50	5.10	1.22	0.02				
24.00	5.12	1.24	0.02				
24.50	5.12	1.24	0.00				
25.00	5.12	1.24	0.00				
25.50	5.12	1.24	0.00				
26.00	5.12	1.24	0.00				

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Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Pond P2: Triangular Pond

Inflow Area = 11,784 sf, 74.78% Impervious, Inflow Depth = 3.89" for 10-Year event
 Inflow = 1.17 cfs @ 12.09 hrs, Volume= 3,817 cf
 Outflow = 0.57 cfs @ 12.26 hrs, Volume= 3,786 cf, Atten= 51%, Lag= 10.0 min
 Discarded = 0.03 cfs @ 12.26 hrs, Volume= 1,604 cf
 Primary = 0.54 cfs @ 12.26 hrs, Volume= 2,182 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 147.87' @ 12.26 hrs Surf.Area= 1,212 sf Storage= 1,276 cf

Plug-Flow detention time= 185.2 min calculated for 3,781 cf (99% of inflow)
 Center-of-Mass det. time= 180.8 min (974.4 - 793.6)

Volume	Invert	Avail.Storage	Storage Description
#1	146.00'	3,171 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
146.00	230	0	0
147.00	681	456	456
148.00	1,293	987	1,443
148.10	1,300	130	1,572
149.00	2,254	1,599	3,171

Device	Routing	Invert	Outlet Devices
#1	Discarded	146.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.20'	6.0" Round Culvert L= 30.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 147.20' / 145.00' S= 0.0733 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Secondary	148.75'	10.0' long x 7.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.40 2.52 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.68 2.70 2.73 2.78

Discarded OutFlow Max=0.03 cfs @ 12.26 hrs HW=147.87' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.54 cfs @ 12.26 hrs HW=147.87' (Free Discharge)
 ↳ **2=Culvert** (Inlet Controls 0.54 cfs @ 2.74 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=146.00' (Free Discharge)
 ↳ **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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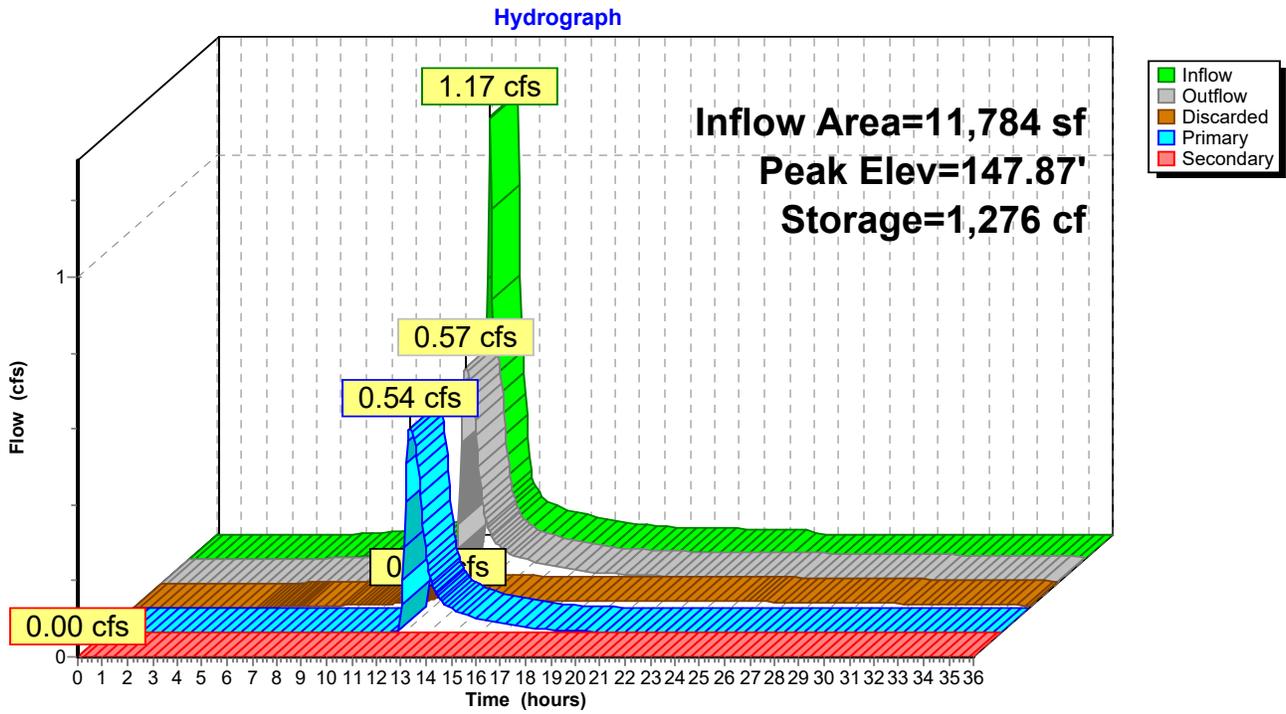
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Type III 24-hr 10-Year Rainfall=5.12"

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Pond P2: Triangular Pond



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Hydrograph for Pond P2: Triangular Pond

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	146.00	0.00	0.00	0.00	0.00
1.00	0.00	0	146.00	0.00	0.00	0.00	0.00
2.00	0.00	0	146.00	0.00	0.00	0.00	0.00
3.00	0.00	0	146.00	0.00	0.00	0.00	0.00
4.00	0.00	0	146.00	0.00	0.00	0.00	0.00
5.00	0.00	1	146.00	0.00	0.00	0.00	0.00
6.00	0.00	3	146.01	0.00	0.00	0.00	0.00
7.00	0.01	8	146.03	0.01	0.01	0.00	0.00
8.00	0.01	23	146.09	0.01	0.01	0.00	0.00
9.00	0.02	64	146.23	0.01	0.01	0.00	0.00
10.00	0.04	146	146.44	0.01	0.01	0.00	0.00
11.00	0.07	296	146.74	0.01	0.01	0.00	0.00
12.00	0.74	890	147.52	0.25	0.02	0.22	0.00
13.00	0.11	837	147.46	0.18	0.02	0.16	0.00
14.00	0.07	732	147.35	0.08	0.02	0.06	0.00
15.00	0.05	703	147.32	0.06	0.02	0.04	0.00
16.00	0.04	680	147.29	0.04	0.02	0.02	0.00
17.00	0.03	660	147.27	0.03	0.02	0.01	0.00
18.00	0.02	644	147.25	0.03	0.02	0.01	0.00
19.00	0.02	630	147.23	0.02	0.02	0.00	0.00
20.00	0.02	619	147.22	0.02	0.02	0.00	0.00
21.00	0.02	607	147.20	0.02	0.02	0.00	0.00
22.00	0.01	594	147.19	0.02	0.02	0.00	0.00
23.00	0.01	576	147.17	0.02	0.02	0.00	0.00
24.00	0.01	555	147.14	0.02	0.02	0.00	0.00
25.00	0.00	496	147.06	0.02	0.02	0.00	0.00
26.00	0.00	437	146.97	0.02	0.02	0.00	0.00
27.00	0.00	382	146.89	0.01	0.01	0.00	0.00
28.00	0.00	330	146.80	0.01	0.01	0.00	0.00
29.00	0.00	281	146.72	0.01	0.01	0.00	0.00
30.00	0.00	236	146.63	0.01	0.01	0.00	0.00
31.00	0.00	194	146.55	0.01	0.01	0.00	0.00
32.00	0.00	155	146.46	0.01	0.01	0.00	0.00
33.00	0.00	119	146.38	0.01	0.01	0.00	0.00
34.00	0.00	87	146.29	0.01	0.01	0.00	0.00
35.00	0.00	57	146.21	0.01	0.01	0.00	0.00
36.00	0.00	32	146.12	0.01	0.01	0.00	0.00

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Stage-Area-Storage for Pond P2: Triangular Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
146.00	230	0	148.65	1,883	2,447
146.05	253	12	148.70	1,936	2,543
146.10	275	25	148.75	1,989	2,641
146.15	298	40	148.80	2,042	2,742
146.20	320	55	148.85	2,095	2,845
146.25	343	72	148.90	2,148	2,951
146.30	365	89	148.95	2,201	3,060
146.35	388	108	149.00	2,254	3,171
146.40	410	128			
146.45	433	149			
146.50	456	171			
146.55	478	195			
146.60	501	219			
146.65	523	245			
146.70	546	271			
146.75	568	299			
146.80	591	328			
146.85	613	358			
146.90	636	390			
146.95	658	422			
147.00	681	456			
147.05	712	490			
147.10	742	527			
147.15	773	565			
147.20	803	604			
147.25	834	645			
147.30	865	687			
147.35	895	731			
147.40	926	777			
147.45	956	824			
147.50	987	873			
147.55	1,018	923			
147.60	1,048	974			
147.65	1,079	1,027			
147.70	1,109	1,082			
147.75	1,140	1,138			
147.80	1,171	1,196			
147.85	1,201	1,255			
147.90	1,232	1,316			
147.95	1,262	1,379			
148.00	1,293	1,443			
148.05	1,297	1,507			
148.10	1,300	1,572			
148.15	1,353	1,638			
148.20	1,406	1,707			
148.25	1,459	1,779			
148.30	1,512	1,853			
148.35	1,565	1,930			
148.40	1,618	2,010			
148.45	1,671	2,092			
148.50	1,724	2,177			
148.55	1,777	2,264			
148.60	1,830	2,355			

Summary for Pond P3: Modified Infiltration System

Inflow Area = 11,290 sf, 100.00% Impervious, Inflow Depth = 4.88" for 10-Year event
 Inflow = 1.27 cfs @ 12.09 hrs, Volume= 4,594 cf
 Outflow = 0.58 cfs @ 12.31 hrs, Volume= 3,939 cf, Atten= 54%, Lag= 13.5 min
 Discarded = 0.03 cfs @ 7.25 hrs, Volume= 2,865 cf
 Primary = 0.56 cfs @ 12.31 hrs, Volume= 1,075 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 150.24' @ 12.31 hrs Surf.Area= 1,061 sf Storage= 1,987 cf

Plug-Flow detention time= 408.5 min calculated for 3,939 cf (86% of inflow)
 Center-of-Mass det. time= 345.3 min (1,092.9 - 747.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	147.40'	840 cf	23.58'W x 45.00'L x 3.21'H Field A 3,405 cf Overall - 1,305 cf Embedded = 2,099 cf x 40.0% Voids
#2A	147.90'	1,305 cf	Cultec R-280HD x 30 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 5 rows
		2,145 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.40'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.90'	12.0" Round Culvert L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 147.90' / 147.80' S= 0.0100 1' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#3	Device 2	150.10'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.03 cfs @ 7.25 hrs HW=147.43' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.52 cfs @ 12.31 hrs HW=150.23' (Free Discharge)
 ↑2=Culvert (Passes 0.52 cfs of 4.04 cfs potential flow)
 ↑3=Broad-Crested Rectangular Weir (Weir Controls 0.52 cfs @ 1.01 fps)

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Pond P3: Modified Infiltration System - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf

Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap

Row Length Adjustment= +1.00' x 6.07 sf x 5 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

6 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 43.00' Row Length +12.0" End Stone x 2 = 45.00' Base Length

5 Rows x 47.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 23.58' Base Width

6.0" Stone Base + 26.5" Chamber Height + 6.0" Stone Cover = 3.21' Field Height

30 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 5 Rows = 1,305.4 cf Chamber Storage

3,404.8 cf Field - 1,305.4 cf Chambers = 2,099.4 cf Stone x 40.0% Voids = 839.8 cf Stone Storage

Chamber Storage + Stone Storage = 2,145.2 cf = 0.049 af

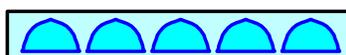
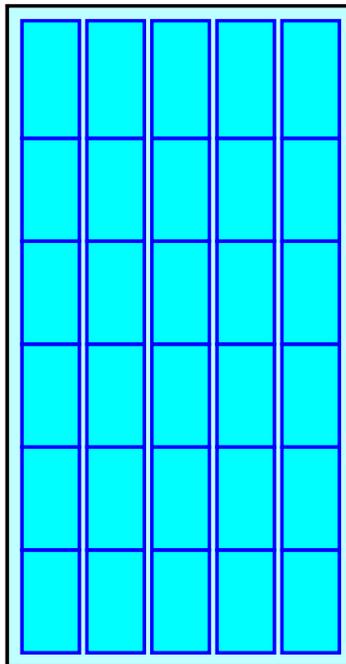
Overall Storage Efficiency = 63.0%

Overall System Size = 45.00' x 23.58' x 3.21'

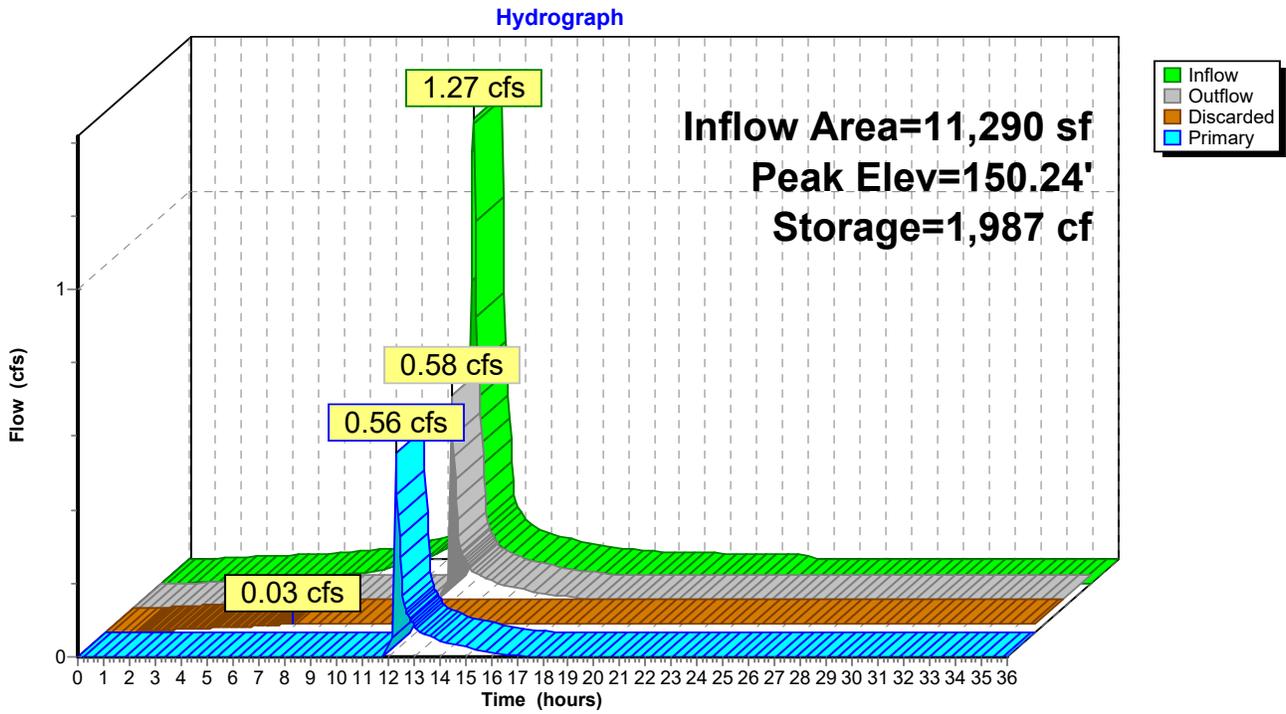
30 Chambers

126.1 cy Field

77.8 cy Stone



Pond P3: Modified Infiltration System



1179-20A - Proposed HydroCAD

Type III 24-hr 10-Year Rainfall=5.12"

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Hydrograph for Pond P3: Modified Infiltration System

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	147.40	0.00	0.00	0.00
1.00	0.00	0	147.40	0.00	0.00	0.00
2.00	0.01	3	147.41	0.00	0.00	0.00
3.00	0.01	5	147.41	0.01	0.01	0.00
4.00	0.01	6	147.41	0.01	0.01	0.00
5.00	0.02	8	147.42	0.01	0.01	0.00
6.00	0.02	10	147.42	0.02	0.02	0.00
7.00	0.02	13	147.43	0.02	0.02	0.00
8.00	0.03	24	147.46	0.03	0.03	0.00
9.00	0.05	72	147.57	0.03	0.03	0.00
10.00	0.06	177	147.82	0.03	0.03	0.00
11.00	0.09	362	148.06	0.03	0.03	0.00
12.00	0.82	1,136	148.95	0.03	0.03	0.00
13.00	0.11	1,946	150.14	0.11	0.03	0.09
14.00	0.07	1,940	150.12	0.07	0.03	0.05
15.00	0.05	1,936	150.11	0.05	0.03	0.03
16.00	0.04	1,932	150.11	0.04	0.03	0.01
17.00	0.03	1,930	150.10	0.03	0.03	0.00
18.00	0.02	1,927	150.09	0.03	0.03	0.00
19.00	0.02	1,911	150.06	0.03	0.03	0.00
20.00	0.02	1,887	150.00	0.03	0.03	0.00
21.00	0.02	1,858	149.94	0.03	0.03	0.00
22.00	0.01	1,822	149.88	0.03	0.03	0.00
23.00	0.01	1,782	149.81	0.03	0.03	0.00
24.00	0.01	1,735	149.73	0.03	0.03	0.00
25.00	0.00	1,649	149.61	0.03	0.03	0.00
26.00	0.00	1,559	149.48	0.03	0.03	0.00
27.00	0.00	1,469	149.36	0.03	0.03	0.00
28.00	0.00	1,378	149.24	0.03	0.03	0.00
29.00	0.00	1,288	149.13	0.03	0.03	0.00
30.00	0.00	1,198	149.02	0.03	0.03	0.00
31.00	0.00	1,108	148.91	0.03	0.03	0.00
32.00	0.00	1,018	148.81	0.03	0.03	0.00
33.00	0.00	927	148.70	0.03	0.03	0.00
34.00	0.00	837	148.60	0.03	0.03	0.00
35.00	0.00	747	148.49	0.03	0.03	0.00
36.00	0.00	657	148.39	0.03	0.03	0.00

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Stage-Area-Storage for Pond P3: Modified Infiltration System

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
147.40	1,061	0	150.05	1,061	1,908
147.45	1,061	21	150.10	1,061	1,929
147.50	1,061	42	150.15	1,061	1,951
147.55	1,061	64	150.20	1,061	1,972
147.60	1,061	85	150.25	1,061	1,993
147.65	1,061	106	150.30	1,061	2,014
147.70	1,061	127	150.35	1,061	2,036
147.75	1,061	149	150.40	1,061	2,057
147.80	1,061	170	150.45	1,061	2,078
147.85	1,061	191	150.50	1,061	2,099
147.90	1,061	212	150.55	1,061	2,120
147.95	1,061	259	150.60	1,061	2,142
148.00	1,061	305			
148.05	1,061	350			
148.10	1,061	395			
148.15	1,061	441			
148.20	1,061	486			
148.25	1,061	531			
148.30	1,061	576			
148.35	1,061	620			
148.40	1,061	665			
148.45	1,061	709			
148.50	1,061	753			
148.55	1,061	797			
148.60	1,061	841			
148.65	1,061	884			
148.70	1,061	927			
148.75	1,061	970			
148.80	1,061	1,012			
148.85	1,061	1,054			
148.90	1,061	1,097			
148.95	1,061	1,138			
149.00	1,061	1,180			
149.05	1,061	1,222			
149.10	1,061	1,263			
149.15	1,061	1,303			
149.20	1,061	1,343			
149.25	1,061	1,383			
149.30	1,061	1,422			
149.35	1,061	1,460			
149.40	1,061	1,499			
149.45	1,061	1,536			
149.50	1,061	1,573			
149.55	1,061	1,609			
149.60	1,061	1,645			
149.65	1,061	1,680			
149.70	1,061	1,713			
149.75	1,061	1,746			
149.80	1,061	1,778			
149.85	1,061	1,807			
149.90	1,061	1,835			
149.95	1,061	1,861			
150.00	1,061	1,885			

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Type III 24-hr 10-Year Rainfall=5.12"

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Summary for Pond P4: L Pond

Inflow Area = 18,107 sf, 3.26% Impervious, Inflow Depth = 1.37" for 10-Year event
 Inflow = 0.57 cfs @ 12.12 hrs, Volume= 2,070 cf
 Outflow = 0.05 cfs @ 14.81 hrs, Volume= 2,070 cf, Atten= 92%, Lag= 161.6 min
 Discarded = 0.03 cfs @ 14.81 hrs, Volume= 2,016 cf
 Primary = 0.01 cfs @ 14.81 hrs, Volume= 54 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 149.21' @ 14.81 hrs Surf.Area= 1,393 sf Storage= 1,053 cf

Plug-Flow detention time= 403.6 min calculated for 2,070 cf (100% of inflow)
 Center-of-Mass det. time= 403.6 min (1,278.4 - 874.8)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	1,674 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	369	0	0
149.00	1,197	783	783
149.50	1,667	716	1,499
149.60	1,837	175	1,674

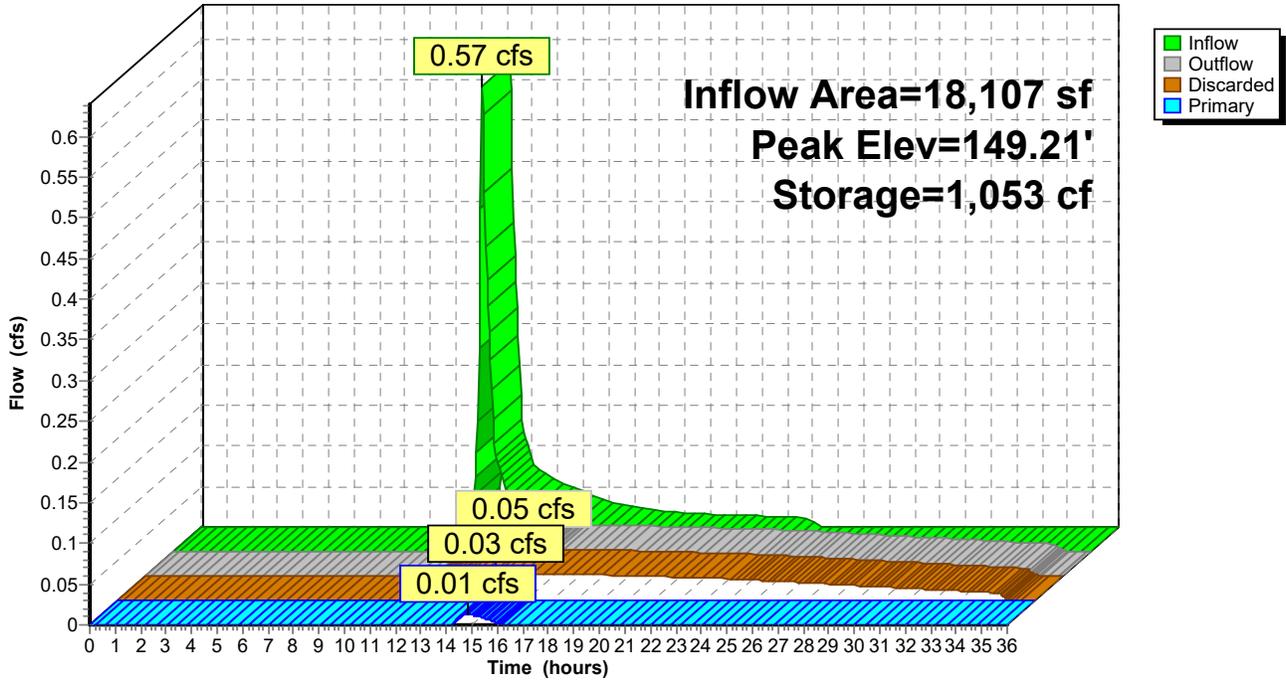
Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	149.20'	5.0' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32

Discarded OutFlow Max=0.03 cfs @ 14.81 hrs HW=149.21' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.01 cfs @ 14.81 hrs HW=149.21' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.23 fps)

Pond P4: L Pond

Hydrograph



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Type III 24-hr 10-Year Rainfall=5.12"

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Hydrograph for Pond P4: L Pond

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	148.00	0.00	0.00	0.00
1.00	0.00	0	148.00	0.00	0.00	0.00
2.00	0.00	0	148.00	0.00	0.00	0.00
3.00	0.00	0	148.00	0.00	0.00	0.00
4.00	0.00	0	148.00	0.00	0.00	0.00
5.00	0.00	0	148.00	0.00	0.00	0.00
6.00	0.00	0	148.00	0.00	0.00	0.00
7.00	0.00	0	148.00	0.00	0.00	0.00
8.00	0.00	0	148.00	0.00	0.00	0.00
9.00	0.00	0	148.00	0.00	0.00	0.00
10.00	0.00	0	148.00	0.00	0.00	0.00
11.00	0.00	0	148.00	0.00	0.00	0.00
12.00	0.25	113	148.24	0.01	0.01	0.00
13.00	0.08	891	149.09	0.03	0.03	0.00
14.00	0.06	1,019	149.18	0.03	0.03	0.00
15.00	0.04	1,052	149.21	0.05	0.03	0.01
16.00	0.03	1,043	149.20	0.03	0.03	0.00
17.00	0.03	1,027	149.19	0.03	0.03	0.00
18.00	0.02	993	149.16	0.03	0.03	0.00
19.00	0.02	947	149.13	0.03	0.03	0.00
20.00	0.02	898	149.09	0.03	0.03	0.00
21.00	0.01	846	149.05	0.03	0.03	0.00
22.00	0.01	794	149.01	0.03	0.03	0.00
23.00	0.01	740	148.96	0.03	0.03	0.00
24.00	0.01	684	148.91	0.03	0.03	0.00
25.00	0.00	596	148.83	0.03	0.03	0.00
26.00	0.00	508	148.75	0.02	0.02	0.00
27.00	0.00	427	148.66	0.02	0.02	0.00
28.00	0.00	352	148.58	0.02	0.02	0.00
29.00	0.00	283	148.49	0.02	0.02	0.00
30.00	0.00	220	148.41	0.02	0.02	0.00
31.00	0.00	163	148.32	0.02	0.02	0.00
32.00	0.00	112	148.24	0.01	0.01	0.00
33.00	0.00	67	148.15	0.01	0.01	0.00
34.00	0.00	27	148.07	0.01	0.01	0.00
35.00	0.00	1	148.00	0.00	0.00	0.00
36.00	0.00	0	148.00	0.00	0.00	0.00

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Type III 24-hr 10-Year Rainfall=5.12"

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Stage-Area-Storage for Pond P4: L Pond

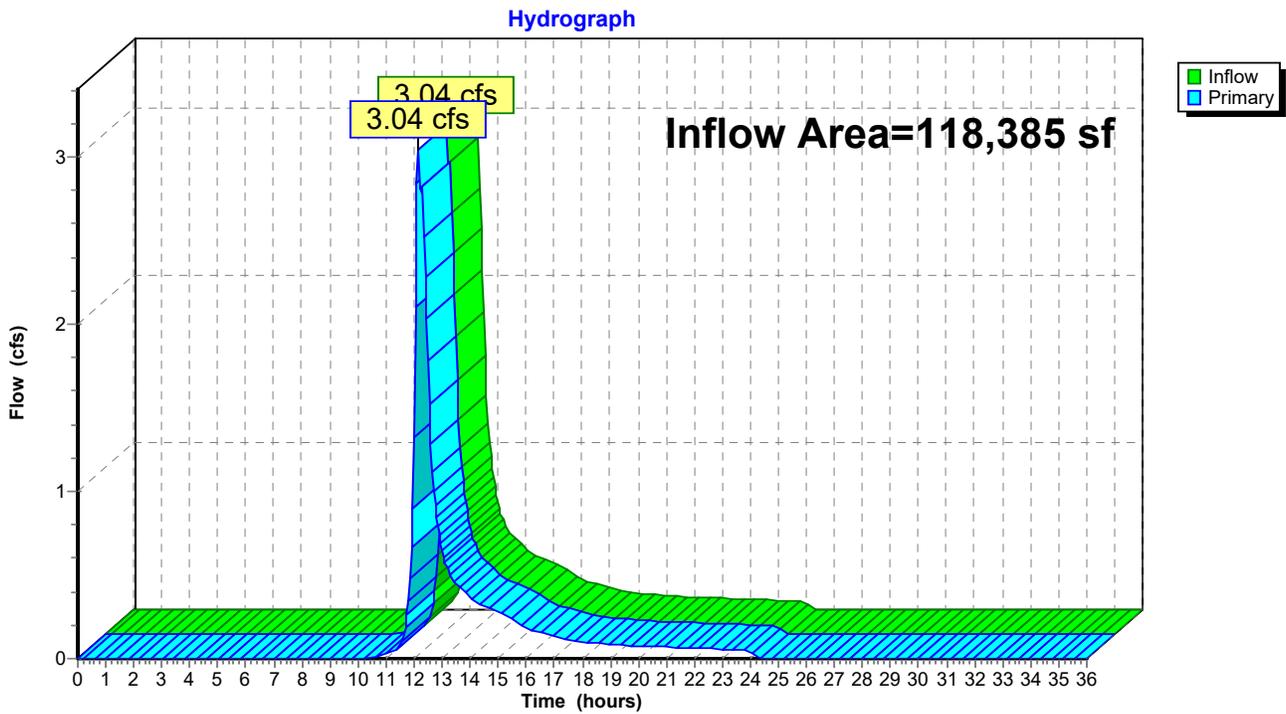
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
148.00	369	0	149.06	1,253	857
148.02	386	8	149.08	1,272	882
148.04	402	15	149.10	1,291	907
148.06	419	24	149.12	1,310	933
148.08	435	32	149.14	1,329	960
148.10	452	41	149.16	1,347	987
148.12	468	50	149.18	1,366	1,014
148.14	485	60	149.20	1,385	1,041
148.16	501	70	149.22	1,404	1,069
148.18	518	80	149.24	1,423	1,097
148.20	535	90	149.26	1,441	1,126
148.22	551	101	149.28	1,460	1,155
148.24	568	112	149.30	1,479	1,184
148.26	584	124	149.32	1,498	1,214
148.28	601	136	149.34	1,517	1,244
148.30	617	148	149.36	1,535	1,275
148.32	634	160	149.38	1,554	1,306
148.34	651	173	149.40	1,573	1,337
148.36	667	186	149.42	1,592	1,369
148.38	684	200	149.44	1,611	1,401
148.40	700	214	149.46	1,629	1,433
148.42	717	228	149.48	1,648	1,466
148.44	733	243	149.50	1,667	1,499
148.46	750	257	149.52	1,701	1,533
148.48	766	273	149.54	1,735	1,567
148.50	783	288	149.56	1,769	1,602
148.52	800	304	149.58	1,803	1,638
148.54	816	320	149.60	1,837	1,674
148.56	833	336			
148.58	849	353			
148.60	866	370			
148.62	882	388			
148.64	899	406			
148.66	915	424			
148.68	932	442			
148.70	949	461			
148.72	965	480			
148.74	982	500			
148.76	998	520			
148.78	1,015	540			
148.80	1,031	560			
148.82	1,048	581			
148.84	1,065	602			
148.86	1,081	624			
148.88	1,098	645			
148.90	1,114	667			
148.92	1,131	690			
148.94	1,147	713			
148.96	1,164	736			
148.98	1,180	759			
149.00	1,197	783			
149.02	1,216	807			
149.04	1,235	832			

Summary for Link SP1: STUDY POINT #1 (Wetland Boundary)

Inflow Area = 118,385 sf, 24.39% Impervious, Inflow Depth = 1.34" for 10-Year event
Inflow = 3.04 cfs @ 12.15 hrs, Volume= 13,223 cf
Primary = 3.04 cfs @ 12.15 hrs, Volume= 13,223 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link SP1: STUDY POINT #1 (Wetland Boundary)



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Type III 24-hr 10-Year Rainfall=5.12"

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Hydrograph for Link SP1: STUDY POINT #1 (Wetland Boundary)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	26.50	0.00	0.00	0.00
0.50	0.00	0.00	0.00	27.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	27.50	0.00	0.00	0.00
1.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
2.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	35.50	0.00	0.00	0.00
9.50	0.00	0.00	0.00	36.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00				
10.50	0.01	0.00	0.01				
11.00	0.03	0.00	0.03				
11.50	0.07	0.00	0.07				
12.00	1.32	0.00	1.32				
12.50	1.77	0.00	1.77				
13.00	0.65	0.00	0.65				
13.50	0.45	0.00	0.45				
14.00	0.36	0.00	0.36				
14.50	0.32	0.00	0.32				
15.00	0.28	0.00	0.28				
15.50	0.23	0.00	0.23				
16.00	0.18	0.00	0.18				
16.50	0.15	0.00	0.15				
17.00	0.13	0.00	0.13				
17.50	0.11	0.00	0.11				
18.00	0.10	0.00	0.10				
18.50	0.09	0.00	0.09				
19.00	0.08	0.00	0.08				
19.50	0.08	0.00	0.08				
20.00	0.08	0.00	0.08				
20.50	0.07	0.00	0.07				
21.00	0.07	0.00	0.07				
21.50	0.06	0.00	0.06				
22.00	0.06	0.00	0.06				
22.50	0.06	0.00	0.06				
23.00	0.06	0.00	0.06				
23.50	0.05	0.00	0.05				
24.00	0.05	0.00	0.05				
24.50	0.00	0.00	0.00				
25.00	0.00	0.00	0.00				
25.50	0.00	0.00	0.00				
26.00	0.00	0.00	0.00				

1179-20A - Proposed HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Subcat P-1	Runoff Area=36,180 sf 22.60% Impervious Runoff Depth=4.06" Flow Length=385' Tc=11.1 min CN=67 Runoff=3.31 cfs 12,251 cf
Subcatchment P-2: Subcat P-2	Runoff Area=11,784 sf 74.78% Impervious Runoff Depth=6.62" Flow Length=258' Tc=6.0 min CN=89 Runoff=1.93 cfs 6,499 cf
Subcatchment P-3: Subcat P-3	Runoff Area=11,290 sf 100.00% Impervious Runoff Depth=7.69" Flow Length=215' Tc=6.0 min CN=98 Runoff=1.97 cfs 7,235 cf
Subcatchment P-4: Subcat P-4	Runoff Area=18,107 sf 3.26% Impervious Runoff Depth=3.28" Flow Length=235' Tc=7.2 min CN=60 Runoff=1.49 cfs 4,951 cf
Subcatchment P-5: Subcat P-5	Runoff Area=41,025 sf 0.00% Impervious Runoff Depth=3.06" Flow Length=124' Tc=6.6 min CN=58 Runoff=3.19 cfs 10,466 cf
Pond P2: Triangular Pond	Peak Elev=148.34' Storage=1,916 cf Inflow=1.93 cfs 6,499 cf Discarded=0.04 cfs 1,824 cf Primary=0.79 cfs 4,618 cf Secondary=0.00 cfs 0 cf Outflow=0.82 cfs 6,442 cf
Pond P3: Modified Infiltration System	Peak Elev=150.40' Storage=2,058 cf Inflow=1.97 cfs 7,235 cf Discarded=0.03 cfs 3,033 cf Primary=1.92 cfs 3,392 cf Outflow=1.94 cfs 6,425 cf
Pond P4: L Pond	Peak Elev=149.38' Storage=1,301 cf Inflow=1.49 cfs 4,951 cf Discarded=0.04 cfs 2,425 cf Primary=0.93 cfs 2,472 cf Outflow=0.96 cfs 4,897 cf
Link SP1: STUDY POINT #1 (Wetland Boundary)	Inflow=9.00 cfs 33,199 cf Primary=9.00 cfs 33,199 cf

Total Runoff Area = 118,385 sf Runoff Volume = 41,402 cf Average Runoff Depth = 4.20"
75.61% Pervious = 89,516 sf 24.39% Impervious = 28,869 sf

1179-20A - Proposed HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Subcatchment P-1: Subcat P-1

Runoff = 3.31 cfs @ 12.16 hrs, Volume= 12,251 cf, Depth= 4.06"

Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
12,321	61	>75% Grass cover, Good, HSG B
8,177	98	Paved parking, HSG B
15,681	55	Woods, Good, HSG B
36,180	67	Weighted Average
28,003		77.40% Pervious Area
8,177		22.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0800	0.12		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.28"
0.6	45	0.0666	1.29		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
2.9	145	0.0138	0.82		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.6	121	0.0270	3.34		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
0.0	24	0.5100	32.40	25.44	Pipe Channel, E-F 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
11.1	385	Total			

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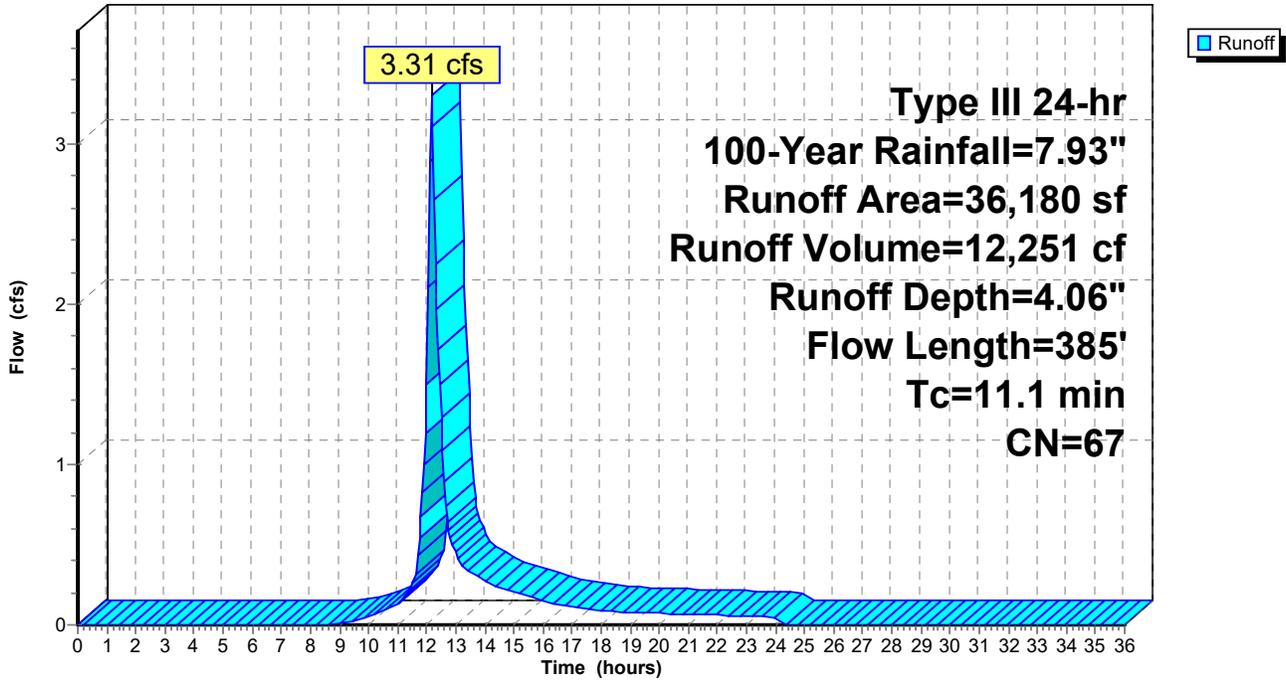
Type III 24-hr 100-Year Rainfall=7.93"

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Subcatchment P-1: Subcat P-1

Hydrograph



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Type III 24-hr 100-Year Rainfall=7.93"

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Hydrograph for Subcatchment P-1: Subcat P-1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	7.93	4.06	0.00
0.50	0.04	0.00	0.00	27.00	7.93	4.06	0.00
1.00	0.08	0.00	0.00	27.50	7.93	4.06	0.00
1.50	0.12	0.00	0.00	28.00	7.93	4.06	0.00
2.00	0.16	0.00	0.00	28.50	7.93	4.06	0.00
2.50	0.20	0.00	0.00	29.00	7.93	4.06	0.00
3.00	0.24	0.00	0.00	29.50	7.93	4.06	0.00
3.50	0.29	0.00	0.00	30.00	7.93	4.06	0.00
4.00	0.34	0.00	0.00	30.50	7.93	4.06	0.00
4.50	0.39	0.00	0.00	31.00	7.93	4.06	0.00
5.00	0.45	0.00	0.00	31.50	7.93	4.06	0.00
5.50	0.51	0.00	0.00	32.00	7.93	4.06	0.00
6.00	0.57	0.00	0.00	32.50	7.93	4.06	0.00
6.50	0.64	0.00	0.00	33.00	7.93	4.06	0.00
7.00	0.72	0.00	0.00	33.50	7.93	4.06	0.00
7.50	0.81	0.00	0.00	34.00	7.93	4.06	0.00
8.00	0.90	0.00	0.00	34.50	7.93	4.06	0.00
8.50	1.02	0.00	0.00	35.00	7.93	4.06	0.00
9.00	1.16	0.01	0.01	35.50	7.93	4.06	0.00
9.50	1.32	0.02	0.03	36.00	7.93	4.06	0.00
10.00	1.50	0.05	0.05				
10.50	1.72	0.09	0.08				
11.00	1.98	0.17	0.13				
11.50	2.36	0.30	0.25				
12.00	3.96	1.12	1.50				
12.50	5.57	2.21	1.29				
13.00	5.95	2.49	0.44				
13.50	6.21	2.69	0.33				
14.00	6.43	2.86	0.27				
14.50	6.61	3.00	0.23				
15.00	6.77	3.13	0.21				
15.50	6.91	3.24	0.18				
16.00	7.03	3.33	0.15				
16.50	7.12	3.41	0.13				
17.00	7.21	3.48	0.12				
17.50	7.29	3.54	0.10				
18.00	7.36	3.60	0.09				
18.50	7.42	3.65	0.08				
19.00	7.48	3.69	0.08				
19.50	7.54	3.74	0.08				
20.00	7.59	3.78	0.07				
20.50	7.64	3.82	0.07				
21.00	7.69	3.86	0.07				
21.50	7.73	3.90	0.06				
22.00	7.78	3.94	0.06				
22.50	7.82	3.97	0.06				
23.00	7.86	4.00	0.05				
23.50	7.90	4.03	0.05				
24.00	7.93	4.06	0.05				
24.50	7.93	4.06	0.00				
25.00	7.93	4.06	0.00				
25.50	7.93	4.06	0.00				
26.00	7.93	4.06	0.00				

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Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Subcatchment P-2: Subcat P-2

Runoff = 1.93 cfs @ 12.09 hrs, Volume= 6,499 cf, Depth= 6.62"

Routed to Pond P2 : Triangular Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
2,972	61	>75% Grass cover, Good, HSG B
8,812	98	Paved parking, HSG B
11,784	89	Weighted Average
2,972		25.22% Pervious Area
8,812		74.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	20	0.0150	0.11		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
0.5	30	0.0150	0.98		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.28"
0.6	90	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.6	118	0.0040	3.33	4.09	Pipe Channel, D-E 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
4.7	258	Total, Increased to minimum Tc = 6.0 min			

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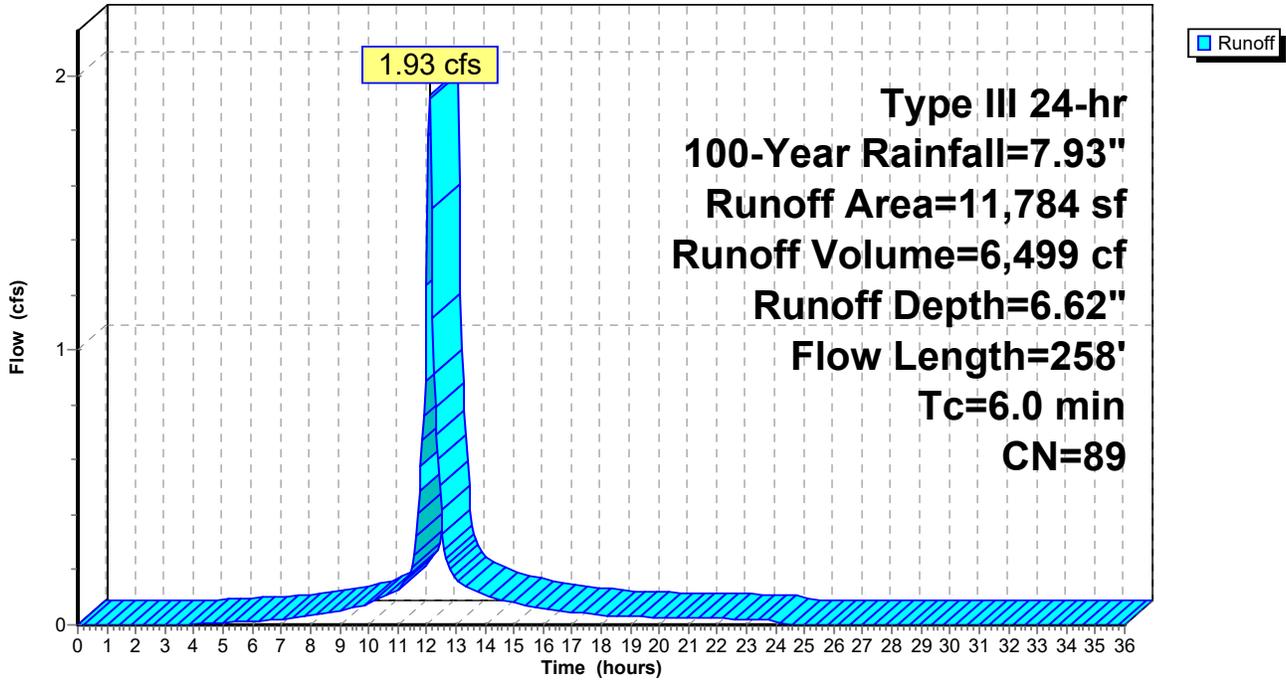
Type III 24-hr 100-Year Rainfall=7.93"

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Subcatchment P-2: Subcat P-2

Hydrograph



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Type III 24-hr 100-Year Rainfall=7.93"

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Hydrograph for Subcatchment P-2: Subcat P-2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	7.93	6.62	0.00
0.50	0.04	0.00	0.00	27.00	7.93	6.62	0.00
1.00	0.08	0.00	0.00	27.50	7.93	6.62	0.00
1.50	0.12	0.00	0.00	28.00	7.93	6.62	0.00
2.00	0.16	0.00	0.00	28.50	7.93	6.62	0.00
2.50	0.20	0.00	0.00	29.00	7.93	6.62	0.00
3.00	0.24	0.00	0.00	29.50	7.93	6.62	0.00
3.50	0.29	0.00	0.00	30.00	7.93	6.62	0.00
4.00	0.34	0.01	0.00	30.50	7.93	6.62	0.00
4.50	0.39	0.02	0.01	31.00	7.93	6.62	0.00
5.00	0.45	0.03	0.01	31.50	7.93	6.62	0.00
5.50	0.51	0.05	0.01	32.00	7.93	6.62	0.00
6.00	0.57	0.07	0.01	32.50	7.93	6.62	0.00
6.50	0.64	0.09	0.02	33.00	7.93	6.62	0.00
7.00	0.72	0.13	0.02	33.50	7.93	6.62	0.00
7.50	0.81	0.17	0.03	34.00	7.93	6.62	0.00
8.00	0.90	0.23	0.03	34.50	7.93	6.62	0.00
8.50	1.02	0.30	0.04	35.00	7.93	6.62	0.00
9.00	1.16	0.38	0.05	35.50	7.93	6.62	0.00
9.50	1.32	0.50	0.06	36.00	7.93	6.62	0.00
10.00	1.50	0.63	0.08				
10.50	1.72	0.80	0.10				
11.00	1.98	1.01	0.13				
11.50	2.36	1.34	0.20				
12.00	3.96	2.79	1.24				
12.50	5.57	4.32	0.42				
13.00	5.95	4.68	0.17				
13.50	6.21	4.94	0.13				
14.00	6.43	5.15	0.11				
14.50	6.61	5.33	0.09				
15.00	6.77	5.49	0.08				
15.50	6.91	5.62	0.07				
16.00	7.03	5.73	0.06				
16.50	7.12	5.83	0.05				
17.00	7.21	5.92	0.05				
17.50	7.29	5.99	0.04				
18.00	7.36	6.06	0.03				
18.50	7.42	6.12	0.03				
19.00	7.48	6.18	0.03				
19.50	7.54	6.23	0.03				
20.00	7.59	6.28	0.03				
20.50	7.64	6.33	0.03				
21.00	7.69	6.38	0.03				
21.50	7.73	6.43	0.02				
22.00	7.78	6.47	0.02				
22.50	7.82	6.51	0.02				
23.00	7.86	6.55	0.02				
23.50	7.90	6.58	0.02				
24.00	7.93	6.62	0.02				
24.50	7.93	6.62	0.00				
25.00	7.93	6.62	0.00				
25.50	7.93	6.62	0.00				
26.00	7.93	6.62	0.00				

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Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Subcatchment P-3: Subcat P-3

[47] Hint: Peak is 127% of capacity of segment #1

Runoff = 1.97 cfs @ 12.09 hrs, Volume= 7,235 cf, Depth= 7.69"
 Routed to Pond P3 : Modified Infiltration System

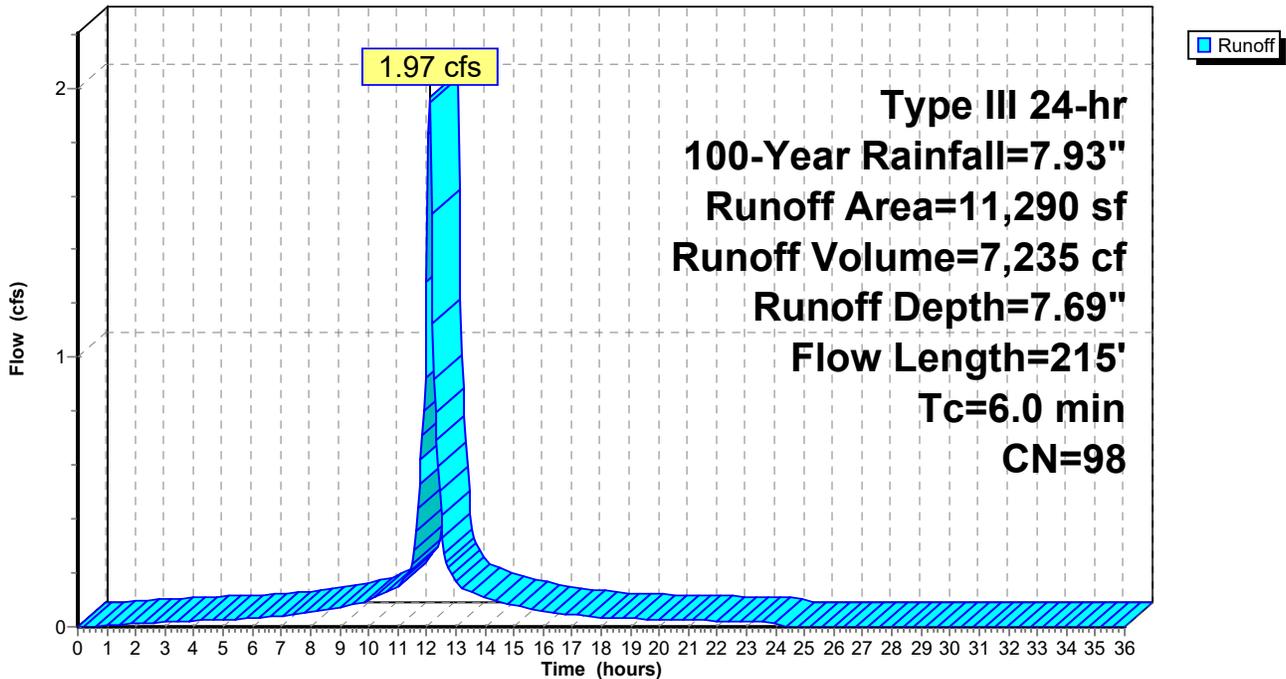
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
11,290	98	Roofs, HSG B
11,290		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	146	0.0050	2.84	1.55	Pipe Channel, 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
0.2	69	0.0160	5.08	2.77	Pipe Channel, 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
1.1	215	Total, Increased to minimum Tc = 6.0 min			

Subcatchment P-3: Subcat P-3

Hydrograph



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Hydrograph for Subcatchment P-3: Subcat P-3

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	7.93	7.69	0.00
0.50	0.04	0.00	0.00	27.00	7.93	7.69	0.00
1.00	0.08	0.01	0.01	27.50	7.93	7.69	0.00
1.50	0.12	0.02	0.01	28.00	7.93	7.69	0.00
2.00	0.16	0.04	0.01	28.50	7.93	7.69	0.00
2.50	0.20	0.07	0.01	29.00	7.93	7.69	0.00
3.00	0.24	0.10	0.02	29.50	7.93	7.69	0.00
3.50	0.29	0.14	0.02	30.00	7.93	7.69	0.00
4.00	0.34	0.18	0.02	30.50	7.93	7.69	0.00
4.50	0.39	0.22	0.02	31.00	7.93	7.69	0.00
5.00	0.45	0.27	0.03	31.50	7.93	7.69	0.00
5.50	0.51	0.33	0.03	32.00	7.93	7.69	0.00
6.00	0.57	0.38	0.03	32.50	7.93	7.69	0.00
6.50	0.64	0.45	0.03	33.00	7.93	7.69	0.00
7.00	0.72	0.52	0.04	33.50	7.93	7.69	0.00
7.50	0.81	0.60	0.05	34.00	7.93	7.69	0.00
8.00	0.90	0.70	0.05	34.50	7.93	7.69	0.00
8.50	1.02	0.81	0.06	35.00	7.93	7.69	0.00
9.00	1.16	0.94	0.07	35.50	7.93	7.69	0.00
9.50	1.32	1.10	0.09	36.00	7.93	7.69	0.00
10.00	1.50	1.28	0.10				
10.50	1.72	1.49	0.12				
11.00	1.98	1.76	0.15				
11.50	2.36	2.13	0.23				
12.00	3.96	3.73	1.28				
12.50	5.57	5.33	0.42				
13.00	5.95	5.71	0.17				
13.50	6.21	5.97	0.13				
14.00	6.43	6.19	0.11				
14.50	6.61	6.38	0.09				
15.00	6.77	6.54	0.08				
15.50	6.91	6.67	0.07				
16.00	7.03	6.79	0.06				
16.50	7.12	6.88	0.05				
17.00	7.21	6.97	0.04				
17.50	7.29	7.05	0.04				
18.00	7.36	7.12	0.03				
18.50	7.42	7.18	0.03				
19.00	7.48	7.24	0.03				
19.50	7.54	7.30	0.03				
20.00	7.59	7.35	0.03				
20.50	7.64	7.40	0.03				
21.00	7.69	7.45	0.02				
21.50	7.73	7.49	0.02				
22.00	7.78	7.54	0.02				
22.50	7.82	7.58	0.02				
23.00	7.86	7.62	0.02				
23.50	7.90	7.66	0.02				
24.00	7.93	7.69	0.02				
24.50	7.93	7.69	0.00				
25.00	7.93	7.69	0.00				
25.50	7.93	7.69	0.00				
26.00	7.93	7.69	0.00				

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Summary for Subcatchment P-4: Subcat P-4

Runoff = 1.49 cfs @ 12.11 hrs, Volume= 4,951 cf, Depth= 3.28"
 Routed to Pond P4 : L Pond

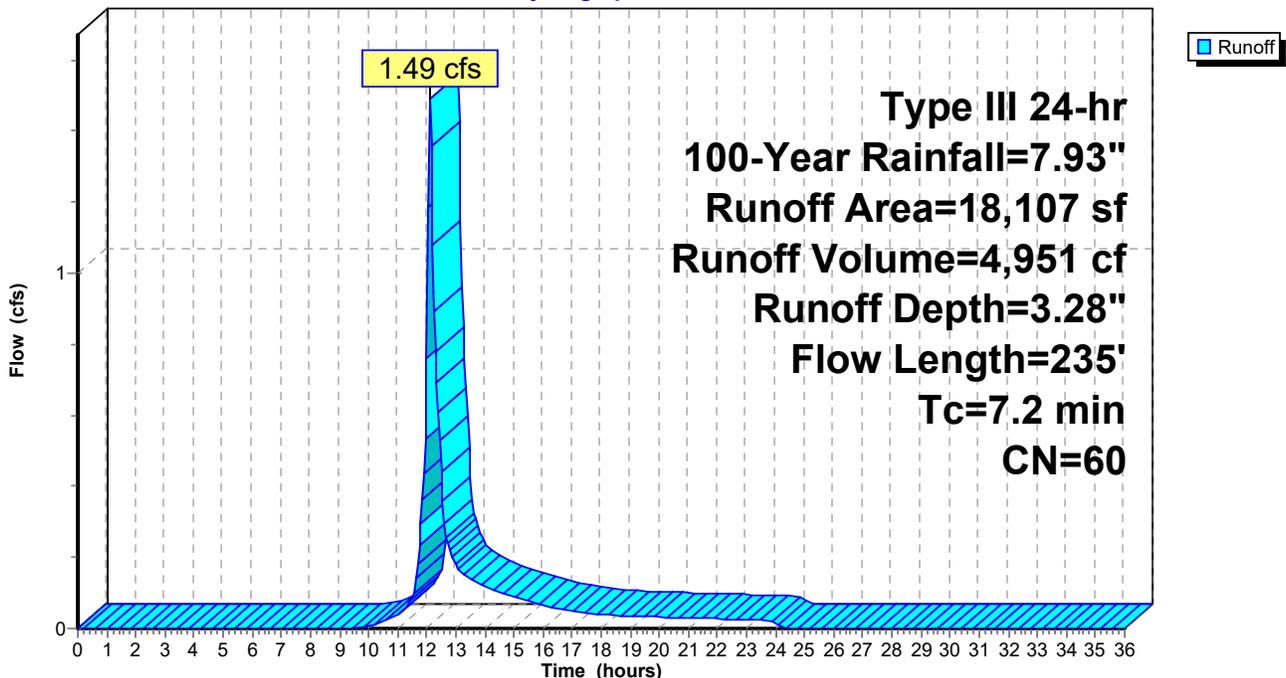
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
9,473	61	>75% Grass cover, Good, HSG B
590	98	Paved parking, HSG B
8,043	55	Woods, Good, HSG B
18,107	60	Weighted Average
17,517		96.74% Pervious Area
590		3.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0800	0.26		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
2.9	120	0.0100	0.70		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.1	65	0.0380	0.97		Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps
7.2	235	Total			

Subcatchment P-4: Subcat P-4

Hydrograph



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Type III 24-hr 100-Year Rainfall=7.93"

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Hydrograph for Subcatchment P-4: Subcat P-4

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	7.93	3.28	0.00
0.50	0.04	0.00	0.00	27.00	7.93	3.28	0.00
1.00	0.08	0.00	0.00	27.50	7.93	3.28	0.00
1.50	0.12	0.00	0.00	28.00	7.93	3.28	0.00
2.00	0.16	0.00	0.00	28.50	7.93	3.28	0.00
2.50	0.20	0.00	0.00	29.00	7.93	3.28	0.00
3.00	0.24	0.00	0.00	29.50	7.93	3.28	0.00
3.50	0.29	0.00	0.00	30.00	7.93	3.28	0.00
4.00	0.34	0.00	0.00	30.50	7.93	3.28	0.00
4.50	0.39	0.00	0.00	31.00	7.93	3.28	0.00
5.00	0.45	0.00	0.00	31.50	7.93	3.28	0.00
5.50	0.51	0.00	0.00	32.00	7.93	3.28	0.00
6.00	0.57	0.00	0.00	32.50	7.93	3.28	0.00
6.50	0.64	0.00	0.00	33.00	7.93	3.28	0.00
7.00	0.72	0.00	0.00	33.50	7.93	3.28	0.00
7.50	0.81	0.00	0.00	34.00	7.93	3.28	0.00
8.00	0.90	0.00	0.00	34.50	7.93	3.28	0.00
8.50	1.02	0.00	0.00	35.00	7.93	3.28	0.00
9.00	1.16	0.00	0.00	35.50	7.93	3.28	0.00
9.50	1.32	0.00	0.00	36.00	7.93	3.28	0.00
10.00	1.50	0.00	0.01				
10.50	1.72	0.02	0.02				
11.00	1.98	0.06	0.04				
11.50	2.36	0.14	0.08				
12.00	3.96	0.74	0.76				
12.50	5.57	1.64	0.44				
13.00	5.95	1.89	0.18				
13.50	6.21	2.06	0.14				
14.00	6.43	2.21	0.12				
14.50	6.61	2.33	0.10				
15.00	6.77	2.45	0.09				
15.50	6.91	2.54	0.08				
16.00	7.03	2.62	0.06				
16.50	7.12	2.69	0.06				
17.00	7.21	2.75	0.05				
17.50	7.29	2.81	0.05				
18.00	7.36	2.86	0.04				
18.50	7.42	2.91	0.04				
19.00	7.48	2.95	0.04				
19.50	7.54	2.99	0.03				
20.00	7.59	3.03	0.03				
20.50	7.64	3.07	0.03				
21.00	7.69	3.10	0.03				
21.50	7.73	3.13	0.03				
22.00	7.78	3.17	0.03				
22.50	7.82	3.20	0.03				
23.00	7.86	3.23	0.02				
23.50	7.90	3.25	0.02				
24.00	7.93	3.28	0.02				
24.50	7.93	3.28	0.00				
25.00	7.93	3.28	0.00				
25.50	7.93	3.28	0.00				
26.00	7.93	3.28	0.00				

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Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Subcatchment P-5: Subcat P-5

Runoff = 3.19 cfs @ 12.10 hrs, Volume= 10,466 cf, Depth= 3.06"

Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

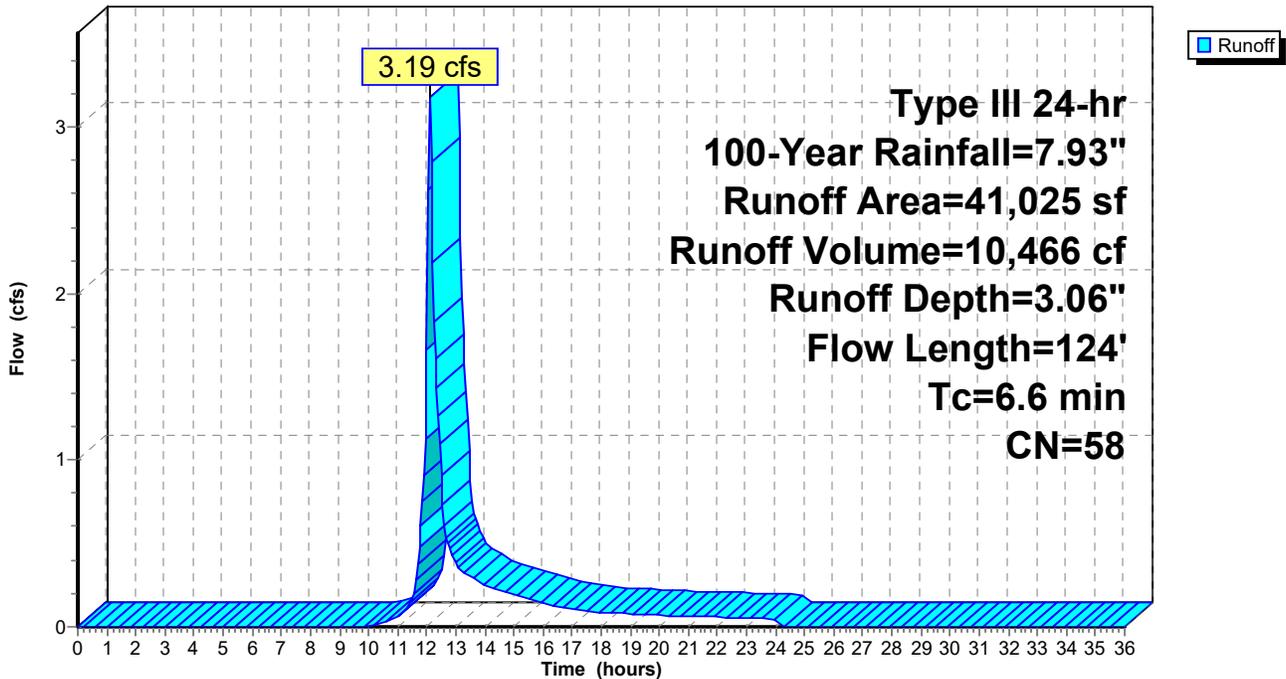
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=7.93"

Area (sf)	CN	Description
18,715	61	>75% Grass cover, Good, HSG B
0	98	Paved parking, HSG B
22,310	55	Woods, Good, HSG B
41,025	58	Weighted Average
41,024		100.00% Pervious Area
0		0.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.28"
1.0	74	0.0600	1.22		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
6.6	124	Total			

Subcatchment P-5: Subcat P-5

Hydrograph



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Type III 24-hr 100-Year Rainfall=7.93"

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Hydrograph for Subcatchment P-5: Subcat P-5

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.50	7.93	3.06	0.00
0.50	0.04	0.00	0.00	27.00	7.93	3.06	0.00
1.00	0.08	0.00	0.00	27.50	7.93	3.06	0.00
1.50	0.12	0.00	0.00	28.00	7.93	3.06	0.00
2.00	0.16	0.00	0.00	28.50	7.93	3.06	0.00
2.50	0.20	0.00	0.00	29.00	7.93	3.06	0.00
3.00	0.24	0.00	0.00	29.50	7.93	3.06	0.00
3.50	0.29	0.00	0.00	30.00	7.93	3.06	0.00
4.00	0.34	0.00	0.00	30.50	7.93	3.06	0.00
4.50	0.39	0.00	0.00	31.00	7.93	3.06	0.00
5.00	0.45	0.00	0.00	31.50	7.93	3.06	0.00
5.50	0.51	0.00	0.00	32.00	7.93	3.06	0.00
6.00	0.57	0.00	0.00	32.50	7.93	3.06	0.00
6.50	0.64	0.00	0.00	33.00	7.93	3.06	0.00
7.00	0.72	0.00	0.00	33.50	7.93	3.06	0.00
7.50	0.81	0.00	0.00	34.00	7.93	3.06	0.00
8.00	0.90	0.00	0.00	34.50	7.93	3.06	0.00
8.50	1.02	0.00	0.00	35.00	7.93	3.06	0.00
9.00	1.16	0.00	0.00	35.50	7.93	3.06	0.00
9.50	1.32	0.00	0.00	36.00	7.93	3.06	0.00
10.00	1.50	0.00	0.00				
10.50	1.72	0.01	0.03				
11.00	1.98	0.04	0.06				
11.50	2.36	0.10	0.16				
12.00	3.96	0.65	1.67				
12.50	5.57	1.49	0.91				
13.00	5.95	1.72	0.38				
13.50	6.21	1.89	0.30				
14.00	6.43	2.03	0.25				
14.50	6.61	2.15	0.22				
15.00	6.77	2.26	0.19				
15.50	6.91	2.35	0.17				
16.00	7.03	2.43	0.14				
16.50	7.12	2.49	0.12				
17.00	7.21	2.55	0.11				
17.50	7.29	2.61	0.10				
18.00	7.36	2.66	0.09				
18.50	7.42	2.70	0.08				
19.00	7.48	2.74	0.08				
19.50	7.54	2.78	0.07				
20.00	7.59	2.82	0.07				
20.50	7.64	2.85	0.07				
21.00	7.69	2.89	0.06				
21.50	7.73	2.92	0.06				
22.00	7.78	2.95	0.06				
22.50	7.82	2.98	0.06				
23.00	7.86	3.01	0.05				
23.50	7.90	3.04	0.05				
24.00	7.93	3.06	0.05				
24.50	7.93	3.06	0.00				
25.00	7.93	3.06	0.00				
25.50	7.93	3.06	0.00				
26.00	7.93	3.06	0.00				

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Summary for Pond P2: Triangular Pond

Inflow Area = 11,784 sf, 74.78% Impervious, Inflow Depth = 6.62" for 100-Year event
 Inflow = 1.93 cfs @ 12.09 hrs, Volume= 6,499 cf
 Outflow = 0.82 cfs @ 12.29 hrs, Volume= 6,442 cf, Atten= 57%, Lag= 12.1 min
 Discarded = 0.04 cfs @ 12.29 hrs, Volume= 1,824 cf
 Primary = 0.79 cfs @ 12.29 hrs, Volume= 4,618 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 148.34' @ 12.29 hrs Surf.Area= 1,555 sf Storage= 1,916 cf

Plug-Flow detention time= 131.5 min calculated for 6,442 cf (99% of inflow)
 Center-of-Mass det. time= 125.9 min (905.2 - 779.3)

Volume	Invert	Avail.Storage	Storage Description
#1	146.00'	3,171 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
146.00	230	0	0
147.00	681	456	456
148.00	1,293	987	1,443
148.10	1,300	130	1,572
149.00	2,254	1,599	3,171

Device	Routing	Invert	Outlet Devices
#1	Discarded	146.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.20'	6.0" Round Culvert L= 30.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 147.20' / 145.00' S= 0.0733 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Secondary	148.75'	10.0' long x 7.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.40 2.52 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.68 2.70 2.73 2.78

Discarded OutFlow Max=0.04 cfs @ 12.29 hrs HW=148.34' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.79 cfs @ 12.29 hrs HW=148.34' (Free Discharge)
 ↳ **2=Culvert** (Inlet Controls 0.79 cfs @ 4.01 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=146.00' (Free Discharge)
 ↳ **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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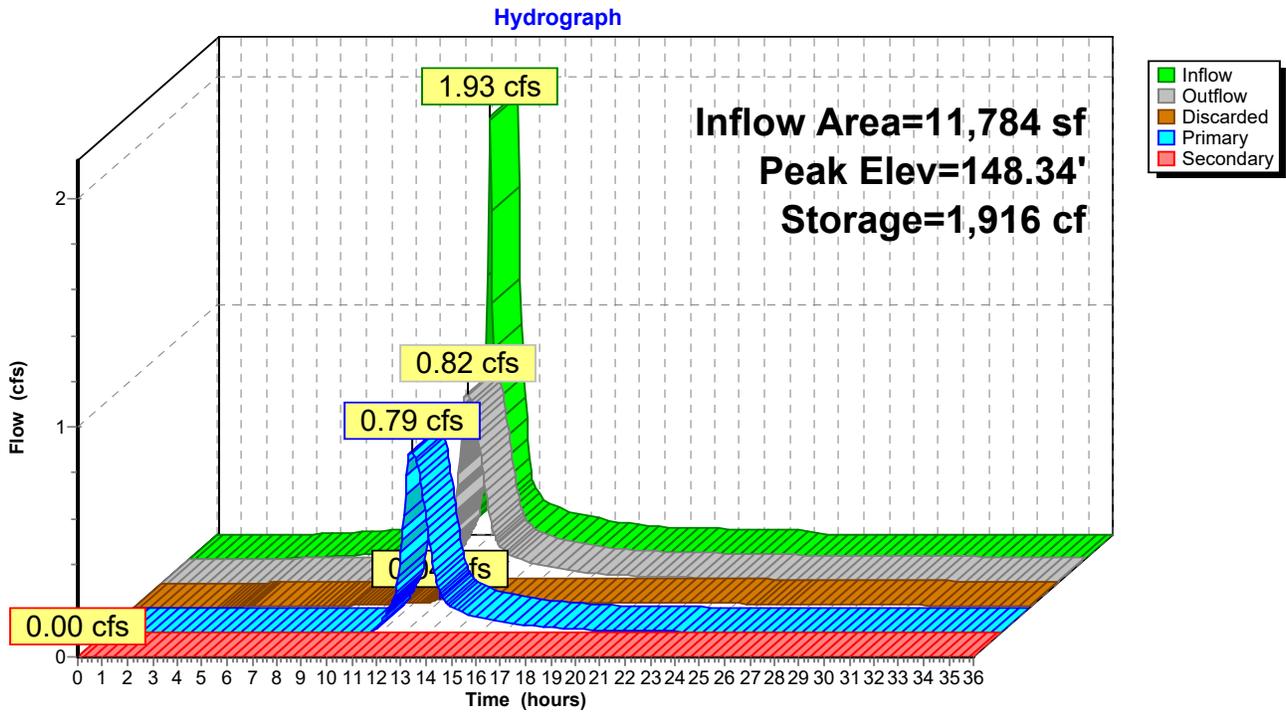
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Pond P2: Triangular Pond



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Hydrograph for Pond P2: Triangular Pond

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	146.00	0.00	0.00	0.00	0.00
1.00	0.00	0	146.00	0.00	0.00	0.00	0.00
2.00	0.00	0	146.00	0.00	0.00	0.00	0.00
3.00	0.00	0	146.00	0.00	0.00	0.00	0.00
4.00	0.00	3	146.01	0.00	0.00	0.00	0.00
5.00	0.01	8	146.03	0.01	0.01	0.00	0.00
6.00	0.01	23	146.09	0.01	0.01	0.00	0.00
7.00	0.02	56	146.20	0.01	0.01	0.00	0.00
8.00	0.03	119	146.38	0.01	0.01	0.00	0.00
9.00	0.05	227	146.62	0.01	0.01	0.00	0.00
10.00	0.08	410	146.93	0.02	0.02	0.00	0.00
11.00	0.13	694	147.31	0.05	0.02	0.03	0.00
12.00	1.24	1,226	147.83	0.54	0.03	0.51	0.00
13.00	0.17	1,080	147.70	0.44	0.03	0.42	0.00
14.00	0.11	783	147.41	0.13	0.02	0.10	0.00
15.00	0.08	743	147.36	0.09	0.02	0.07	0.00
16.00	0.06	714	147.33	0.07	0.02	0.04	0.00
17.00	0.05	692	147.31	0.05	0.02	0.03	0.00
18.00	0.03	675	147.29	0.04	0.02	0.02	0.00
19.00	0.03	661	147.27	0.03	0.02	0.01	0.00
20.00	0.03	654	147.26	0.03	0.02	0.01	0.00
21.00	0.03	646	147.25	0.03	0.02	0.01	0.00
22.00	0.02	639	147.24	0.03	0.02	0.01	0.00
23.00	0.02	631	147.23	0.02	0.02	0.00	0.00
24.00	0.02	622	147.22	0.02	0.02	0.00	0.00
25.00	0.00	560	147.14	0.02	0.02	0.00	0.00
26.00	0.00	496	147.06	0.02	0.02	0.00	0.00
27.00	0.00	438	146.97	0.02	0.02	0.00	0.00
28.00	0.00	382	146.89	0.01	0.01	0.00	0.00
29.00	0.00	330	146.80	0.01	0.01	0.00	0.00
30.00	0.00	282	146.72	0.01	0.01	0.00	0.00
31.00	0.00	236	146.63	0.01	0.01	0.00	0.00
32.00	0.00	194	146.55	0.01	0.01	0.00	0.00
33.00	0.00	155	146.46	0.01	0.01	0.00	0.00
34.00	0.00	119	146.38	0.01	0.01	0.00	0.00
35.00	0.00	87	146.29	0.01	0.01	0.00	0.00
36.00	0.00	58	146.21	0.01	0.01	0.00	0.00

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Stage-Area-Storage for Pond P2: Triangular Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
146.00	230	0	148.65	1,883	2,447
146.05	253	12	148.70	1,936	2,543
146.10	275	25	148.75	1,989	2,641
146.15	298	40	148.80	2,042	2,742
146.20	320	55	148.85	2,095	2,845
146.25	343	72	148.90	2,148	2,951
146.30	365	89	148.95	2,201	3,060
146.35	388	108	149.00	2,254	3,171
146.40	410	128			
146.45	433	149			
146.50	456	171			
146.55	478	195			
146.60	501	219			
146.65	523	245			
146.70	546	271			
146.75	568	299			
146.80	591	328			
146.85	613	358			
146.90	636	390			
146.95	658	422			
147.00	681	456			
147.05	712	490			
147.10	742	527			
147.15	773	565			
147.20	803	604			
147.25	834	645			
147.30	865	687			
147.35	895	731			
147.40	926	777			
147.45	956	824			
147.50	987	873			
147.55	1,018	923			
147.60	1,048	974			
147.65	1,079	1,027			
147.70	1,109	1,082			
147.75	1,140	1,138			
147.80	1,171	1,196			
147.85	1,201	1,255			
147.90	1,232	1,316			
147.95	1,262	1,379			
148.00	1,293	1,443			
148.05	1,297	1,507			
148.10	1,300	1,572			
148.15	1,353	1,638			
148.20	1,406	1,707			
148.25	1,459	1,779			
148.30	1,512	1,853			
148.35	1,565	1,930			
148.40	1,618	2,010			
148.45	1,671	2,092			
148.50	1,724	2,177			
148.55	1,777	2,264			
148.60	1,830	2,355			

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Summary for Pond P3: Modified Infiltration System

Inflow Area = 11,290 sf, 100.00% Impervious, Inflow Depth = 7.69" for 100-Year event
 Inflow = 1.97 cfs @ 12.09 hrs, Volume= 7,235 cf
 Outflow = 1.94 cfs @ 12.10 hrs, Volume= 6,425 cf, Atten= 1%, Lag= 0.6 min
 Discarded = 0.03 cfs @ 4.85 hrs, Volume= 3,033 cf
 Primary = 1.92 cfs @ 12.10 hrs, Volume= 3,392 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 150.40' @ 12.10 hrs Surf.Area= 1,061 sf Storage= 2,058 cf

Plug-Flow detention time= 268.5 min calculated for 6,425 cf (89% of inflow)
 Center-of-Mass det. time= 214.0 min (955.3 - 741.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	147.40'	840 cf	23.58'W x 45.00'L x 3.21'H Field A 3,405 cf Overall - 1,305 cf Embedded = 2,099 cf x 40.0% Voids
#2A	147.90'	1,305 cf	Cultec R-280HD x 30 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 5 rows
		2,145 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.40'	1.020 in/hr Exfiltration over Surface area
#2	Primary	147.90'	12.0" Round Culvert L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 147.90' / 147.80' S= 0.0100 1' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#3	Device 2	150.10'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.03 cfs @ 4.85 hrs HW=147.43' (Free Discharge)
 ↑ **1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.90 cfs @ 12.10 hrs HW=150.40' (Free Discharge)
 ↑ **2=Culvert** (Passes 1.90 cfs of 4.22 cfs potential flow)
 ↑ **3=Broad-Crested Rectangular Weir** (Weir Controls 1.90 cfs @ 1.57 fps)

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Pond P3: Modified Infiltration System - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf

Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap

Row Length Adjustment= +1.00' x 6.07 sf x 5 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

6 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 43.00' Row Length +12.0" End Stone x 2 = 45.00' Base Length

5 Rows x 47.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 23.58' Base Width

6.0" Stone Base + 26.5" Chamber Height + 6.0" Stone Cover = 3.21' Field Height

30 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 5 Rows = 1,305.4 cf Chamber Storage

3,404.8 cf Field - 1,305.4 cf Chambers = 2,099.4 cf Stone x 40.0% Voids = 839.8 cf Stone Storage

Chamber Storage + Stone Storage = 2,145.2 cf = 0.049 af

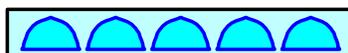
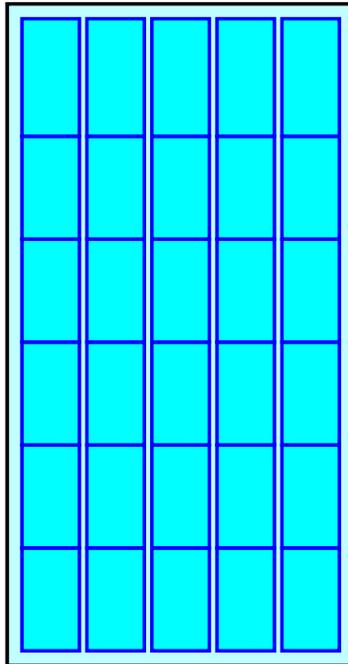
Overall Storage Efficiency = 63.0%

Overall System Size = 45.00' x 23.58' x 3.21'

30 Chambers

126.1 cy Field

77.8 cy Stone



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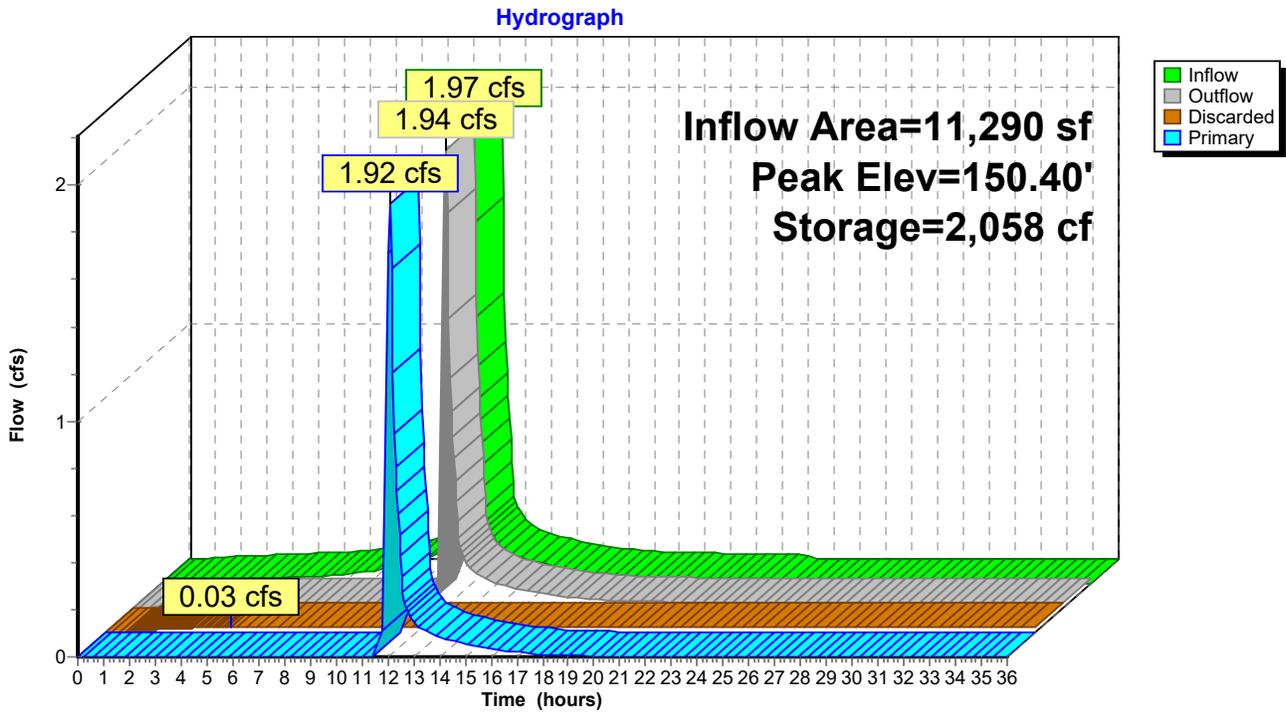
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Pond P3: Modified Infiltration System



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Hydrograph for Pond P3: Modified Infiltration System

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	147.40	0.00	0.00	0.00
1.00	0.01	2	147.40	0.00	0.00	0.00
2.00	0.01	6	147.41	0.01	0.01	0.00
3.00	0.02	9	147.42	0.02	0.02	0.00
4.00	0.02	12	147.43	0.02	0.02	0.00
5.00	0.03	14	147.43	0.03	0.03	0.00
6.00	0.03	26	147.46	0.03	0.03	0.00
7.00	0.04	61	147.54	0.03	0.03	0.00
8.00	0.05	135	147.72	0.03	0.03	0.00
9.00	0.07	267	147.96	0.03	0.03	0.00
10.00	0.10	485	148.20	0.03	0.03	0.00
11.00	0.15	829	148.59	0.03	0.03	0.00
12.00	1.28	2,007	150.28	0.90	0.03	0.88
13.00	0.17	1,953	150.16	0.18	0.03	0.15
14.00	0.11	1,945	150.14	0.11	0.03	0.08
15.00	0.08	1,942	150.13	0.08	0.03	0.06
16.00	0.06	1,937	150.12	0.06	0.03	0.03
17.00	0.04	1,934	150.11	0.05	0.03	0.02
18.00	0.03	1,932	150.11	0.03	0.03	0.01
19.00	0.03	1,931	150.10	0.03	0.03	0.01
20.00	0.03	1,930	150.10	0.03	0.03	0.00
21.00	0.02	1,929	150.10	0.03	0.03	0.00
22.00	0.02	1,924	150.09	0.03	0.03	0.00
23.00	0.02	1,911	150.06	0.03	0.03	0.00
24.00	0.02	1,889	150.01	0.03	0.03	0.00
25.00	0.00	1,805	149.85	0.03	0.03	0.00
26.00	0.00	1,714	149.70	0.03	0.03	0.00
27.00	0.00	1,624	149.57	0.03	0.03	0.00
28.00	0.00	1,534	149.45	0.03	0.03	0.00
29.00	0.00	1,444	149.33	0.03	0.03	0.00
30.00	0.00	1,354	149.21	0.03	0.03	0.00
31.00	0.00	1,263	149.10	0.03	0.03	0.00
32.00	0.00	1,173	148.99	0.03	0.03	0.00
33.00	0.00	1,083	148.88	0.03	0.03	0.00
34.00	0.00	993	148.78	0.03	0.03	0.00
35.00	0.00	903	148.67	0.03	0.03	0.00
36.00	0.00	812	148.57	0.03	0.03	0.00

1179-20A - Proposed HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Stage-Area-Storage for Pond P3: Modified Infiltration System

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
147.40	1,061	0	150.05	1,061	1,908
147.45	1,061	21	150.10	1,061	1,929
147.50	1,061	42	150.15	1,061	1,951
147.55	1,061	64	150.20	1,061	1,972
147.60	1,061	85	150.25	1,061	1,993
147.65	1,061	106	150.30	1,061	2,014
147.70	1,061	127	150.35	1,061	2,036
147.75	1,061	149	150.40	1,061	2,057
147.80	1,061	170	150.45	1,061	2,078
147.85	1,061	191	150.50	1,061	2,099
147.90	1,061	212	150.55	1,061	2,120
147.95	1,061	259	150.60	1,061	2,142
148.00	1,061	305			
148.05	1,061	350			
148.10	1,061	395			
148.15	1,061	441			
148.20	1,061	486			
148.25	1,061	531			
148.30	1,061	576			
148.35	1,061	620			
148.40	1,061	665			
148.45	1,061	709			
148.50	1,061	753			
148.55	1,061	797			
148.60	1,061	841			
148.65	1,061	884			
148.70	1,061	927			
148.75	1,061	970			
148.80	1,061	1,012			
148.85	1,061	1,054			
148.90	1,061	1,097			
148.95	1,061	1,138			
149.00	1,061	1,180			
149.05	1,061	1,222			
149.10	1,061	1,263			
149.15	1,061	1,303			
149.20	1,061	1,343			
149.25	1,061	1,383			
149.30	1,061	1,422			
149.35	1,061	1,460			
149.40	1,061	1,499			
149.45	1,061	1,536			
149.50	1,061	1,573			
149.55	1,061	1,609			
149.60	1,061	1,645			
149.65	1,061	1,680			
149.70	1,061	1,713			
149.75	1,061	1,746			
149.80	1,061	1,778			
149.85	1,061	1,807			
149.90	1,061	1,835			
149.95	1,061	1,861			
150.00	1,061	1,885			

1179-20A - Proposed HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Summary for Pond P4: L Pond

Inflow Area = 18,107 sf, 3.26% Impervious, Inflow Depth = 3.28" for 100-Year event
 Inflow = 1.49 cfs @ 12.11 hrs, Volume= 4,951 cf
 Outflow = 0.96 cfs @ 12.24 hrs, Volume= 4,897 cf, Atten= 35%, Lag= 7.8 min
 Discarded = 0.04 cfs @ 12.24 hrs, Volume= 2,425 cf
 Primary = 0.93 cfs @ 12.24 hrs, Volume= 2,472 cf
 Routed to Link SP1 : STUDY POINT #1 (Wetland Boundary)

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 149.38' @ 12.24 hrs Surf.Area= 1,552 sf Storage= 1,301 cf

Plug-Flow detention time= 213.5 min calculated for 4,891 cf (99% of inflow)
 Center-of-Mass det. time= 208.0 min (1,055.7 - 847.7)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	1,674 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	369	0	0
149.00	1,197	783	783
149.50	1,667	716	1,499
149.60	1,837	175	1,674

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	149.20'	5.0' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32

Discarded OutFlow Max=0.04 cfs @ 12.24 hrs HW=149.38' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.92 cfs @ 12.24 hrs HW=149.38' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.92 cfs @ 1.04 fps)

1179-20A - Proposed HydroCAD

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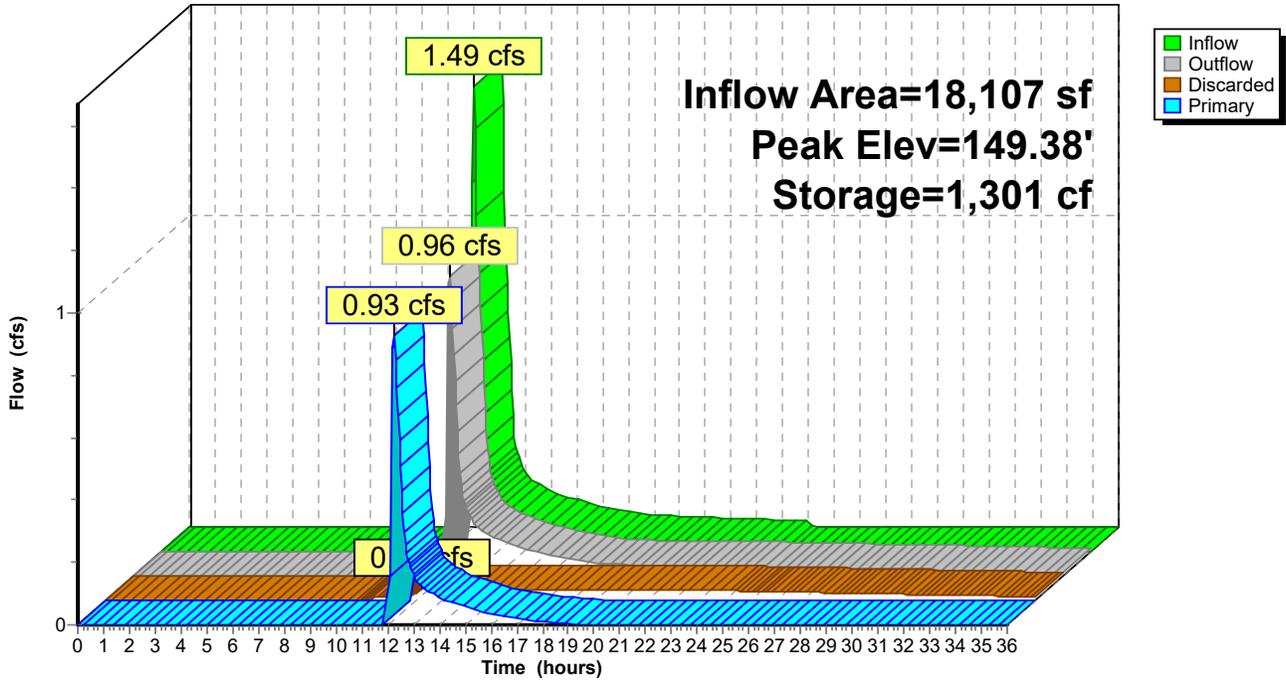
Type III 24-hr 100-Year Rainfall=7.93"

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Pond P4: L Pond

Hydrograph



1179-20A - Proposed HydroCAD

Type III 24-hr 100-Year Rainfall=7.93"

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Hydrograph for Pond P4: L Pond

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	148.00	0.00	0.00	0.00
1.00	0.00	0	148.00	0.00	0.00	0.00
2.00	0.00	0	148.00	0.00	0.00	0.00
3.00	0.00	0	148.00	0.00	0.00	0.00
4.00	0.00	0	148.00	0.00	0.00	0.00
5.00	0.00	0	148.00	0.00	0.00	0.00
6.00	0.00	0	148.00	0.00	0.00	0.00
7.00	0.00	0	148.00	0.00	0.00	0.00
8.00	0.00	0	148.00	0.00	0.00	0.00
9.00	0.00	0	148.00	0.00	0.00	0.00
10.00	0.01	2	148.01	0.00	0.00	0.00
11.00	0.04	40	148.10	0.01	0.01	0.00
12.00	0.76	592	148.83	0.02	0.02	0.00
13.00	0.18	1,119	149.26	0.20	0.03	0.16
14.00	0.12	1,092	149.24	0.12	0.03	0.09
15.00	0.09	1,080	149.23	0.09	0.03	0.06
16.00	0.06	1,068	149.22	0.07	0.03	0.03
17.00	0.05	1,060	149.21	0.05	0.03	0.02
18.00	0.04	1,050	149.21	0.04	0.03	0.01
19.00	0.04	1,044	149.20	0.04	0.03	0.00
20.00	0.03	1,041	149.20	0.03	0.03	0.00
21.00	0.03	1,034	149.20	0.03	0.03	0.00
22.00	0.03	1,019	149.18	0.03	0.03	0.00
23.00	0.02	995	149.17	0.03	0.03	0.00
24.00	0.02	962	149.14	0.03	0.03	0.00
25.00	0.00	861	149.06	0.03	0.03	0.00
26.00	0.00	757	148.98	0.03	0.03	0.00
27.00	0.00	660	148.89	0.03	0.03	0.00
28.00	0.00	569	148.81	0.02	0.02	0.00
29.00	0.00	484	148.72	0.02	0.02	0.00
30.00	0.00	404	148.64	0.02	0.02	0.00
31.00	0.00	331	148.55	0.02	0.02	0.00
32.00	0.00	264	148.47	0.02	0.02	0.00
33.00	0.00	202	148.38	0.02	0.02	0.00
34.00	0.00	147	148.30	0.01	0.01	0.00
35.00	0.00	98	148.21	0.01	0.01	0.00
36.00	0.00	54	148.13	0.01	0.01	0.00

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Stage-Area-Storage for Pond P4: L Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
148.00	369	0	149.06	1,253	857
148.02	386	8	149.08	1,272	882
148.04	402	15	149.10	1,291	907
148.06	419	24	149.12	1,310	933
148.08	435	32	149.14	1,329	960
148.10	452	41	149.16	1,347	987
148.12	468	50	149.18	1,366	1,014
148.14	485	60	149.20	1,385	1,041
148.16	501	70	149.22	1,404	1,069
148.18	518	80	149.24	1,423	1,097
148.20	535	90	149.26	1,441	1,126
148.22	551	101	149.28	1,460	1,155
148.24	568	112	149.30	1,479	1,184
148.26	584	124	149.32	1,498	1,214
148.28	601	136	149.34	1,517	1,244
148.30	617	148	149.36	1,535	1,275
148.32	634	160	149.38	1,554	1,306
148.34	651	173	149.40	1,573	1,337
148.36	667	186	149.42	1,592	1,369
148.38	684	200	149.44	1,611	1,401
148.40	700	214	149.46	1,629	1,433
148.42	717	228	149.48	1,648	1,466
148.44	733	243	149.50	1,667	1,499
148.46	750	257	149.52	1,701	1,533
148.48	766	273	149.54	1,735	1,567
148.50	783	288	149.56	1,769	1,602
148.52	800	304	149.58	1,803	1,638
148.54	816	320	149.60	1,837	1,674
148.56	833	336			
148.58	849	353			
148.60	866	370			
148.62	882	388			
148.64	899	406			
148.66	915	424			
148.68	932	442			
148.70	949	461			
148.72	965	480			
148.74	982	500			
148.76	998	520			
148.78	1,015	540			
148.80	1,031	560			
148.82	1,048	581			
148.84	1,065	602			
148.86	1,081	624			
148.88	1,098	645			
148.90	1,114	667			
148.92	1,131	690			
148.94	1,147	713			
148.96	1,164	736			
148.98	1,180	759			
149.00	1,197	783			
149.02	1,216	807			
149.04	1,235	832			

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Type III 24-hr 100-Year Rainfall=7.93"

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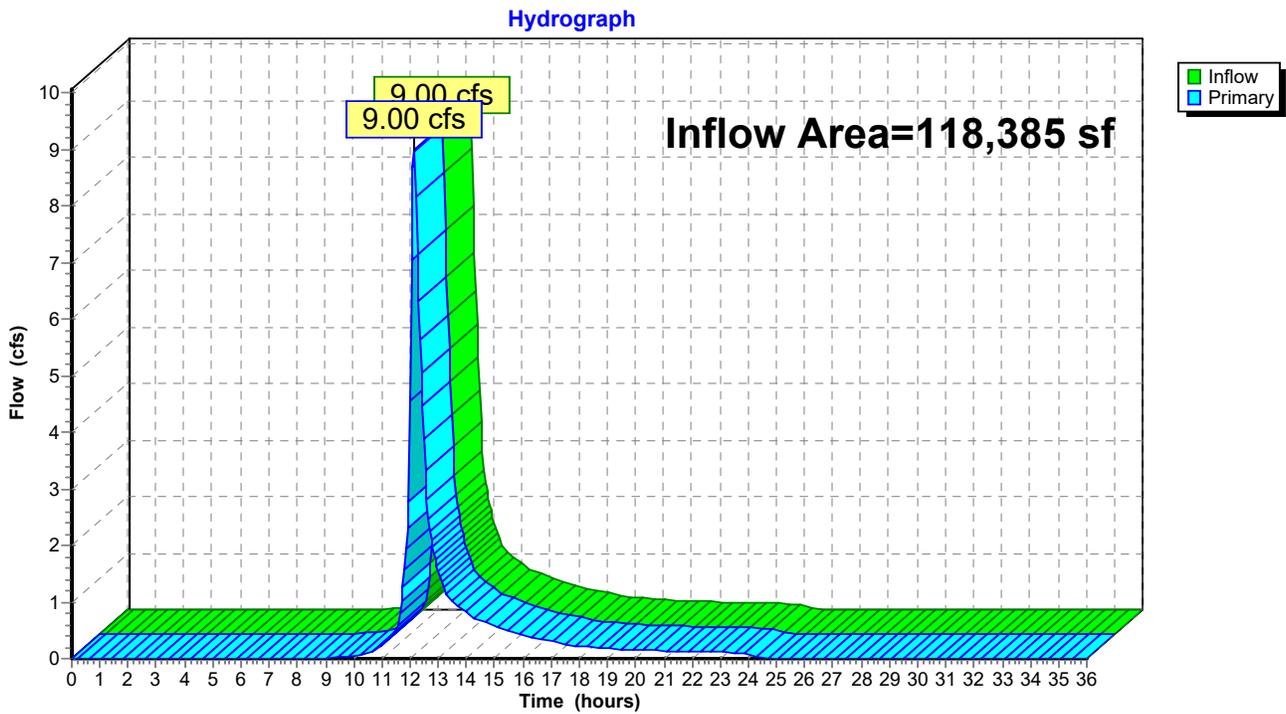
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Summary for Link SP1: STUDY POINT #1 (Wetland Boundary)

Inflow Area = 118,385 sf, 24.39% Impervious, Inflow Depth = 3.37" for 100-Year event
Inflow = 9.00 cfs @ 12.14 hrs, Volume= 33,199 cf
Primary = 9.00 cfs @ 12.14 hrs, Volume= 33,199 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link SP1: STUDY POINT #1 (Wetland Boundary)



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Hydrograph for Link SP1: STUDY POINT #1 (Wetland Boundary)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	26.50	0.00	0.00	0.00
0.50	0.00	0.00	0.00	27.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	27.50	0.00	0.00	0.00
1.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
2.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
9.00	0.01	0.00	0.01	35.50	0.00	0.00	0.00
9.50	0.03	0.00	0.03	36.00	0.00	0.00	0.00
10.00	0.05	0.00	0.05				
10.50	0.11	0.00	0.11				
11.00	0.23	0.00	0.23				
11.50	0.53	0.00	0.53				
12.00	4.56	0.00	4.56				
12.50	3.89	0.00	3.89				
13.00	1.55	0.00	1.55				
13.50	1.01	0.00	1.01				
14.00	0.80	0.00	0.80				
14.50	0.67	0.00	0.67				
15.00	0.58	0.00	0.58				
15.50	0.49	0.00	0.49				
16.00	0.40	0.00	0.40				
16.50	0.34	0.00	0.34				
17.00	0.30	0.00	0.30				
17.50	0.26	0.00	0.26				
18.00	0.22	0.00	0.22				
18.50	0.19	0.00	0.19				
19.00	0.18	0.00	0.18				
19.50	0.17	0.00	0.17				
20.00	0.15	0.00	0.15				
20.50	0.15	0.00	0.15				
21.00	0.14	0.00	0.14				
21.50	0.13	0.00	0.13				
22.00	0.12	0.00	0.12				
22.50	0.12	0.00	0.12				
23.00	0.11	0.00	0.11				
23.50	0.10	0.00	0.10				
24.00	0.10	0.00	0.10				
24.50	0.00	0.00	0.00				
25.00	0.00	0.00	0.00				
25.50	0.00	0.00	0.00				
26.00	0.00	0.00	0.00				

M:\PROJECTS\1179-20A\CIVIL\DRAWINGS\CURRENT\C-1179-20A_WATERSHED-PROPOSED.DWG



LEGEND

EXISTING WATERSHED

PROPOSED WATERSHED

SCS SOILS BOUNDARY

Tc FLOW PATH

SUBCATCHMENT LABEL

SUBCATCHMENT BOUNDARY

FLOW DIRECTION

ISSUED FOR PERMIT MODIFICATION
 FEBRUARY 13, 2025
 REV. 4 - JUNE 10, 2025

PROFESSIONAL ENGINEER FOR
 ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION
4	06-10-2025	ISSUED FOR PERMIT MODIFICATION
3	01-09-2025	PER REVIEW COMMENTS
2	12-23-2024	PER REVIEW COMMENTS
1	11-12-2024	PER MASSEDP INITIAL REVIEW

APPLICANT/OWNER:
 FIFTY-FIVE SAXON HINGHAM LLC
 25 RECREATION PARK DRIVE, SUITE 204
 HINGHAM, MA 02043

PROJECT:
OFFICE BUILDING
55 INDUSTRIAL
PARK ROAD
HINGHAM, MA

PROJECT NO.	1179-20A	DATE:	02/13/2025
SCALE:	1" = 30'	DWG. NAME:	C-1179-20
DESIGNED BY:	PLC	CHECKED BY:	PLC

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
 civil engineering • land surveying
 environmental consulting • landscape architecture
 www.allenmajor.com
 10 MAIN STREET
 LAKEVILLE, MA 02347
 TEL: (508) 923-1010
 FAX: (508) 923-6309

WOBURN, MA • LAKEVILLE, MA • MANCHESTER, NH

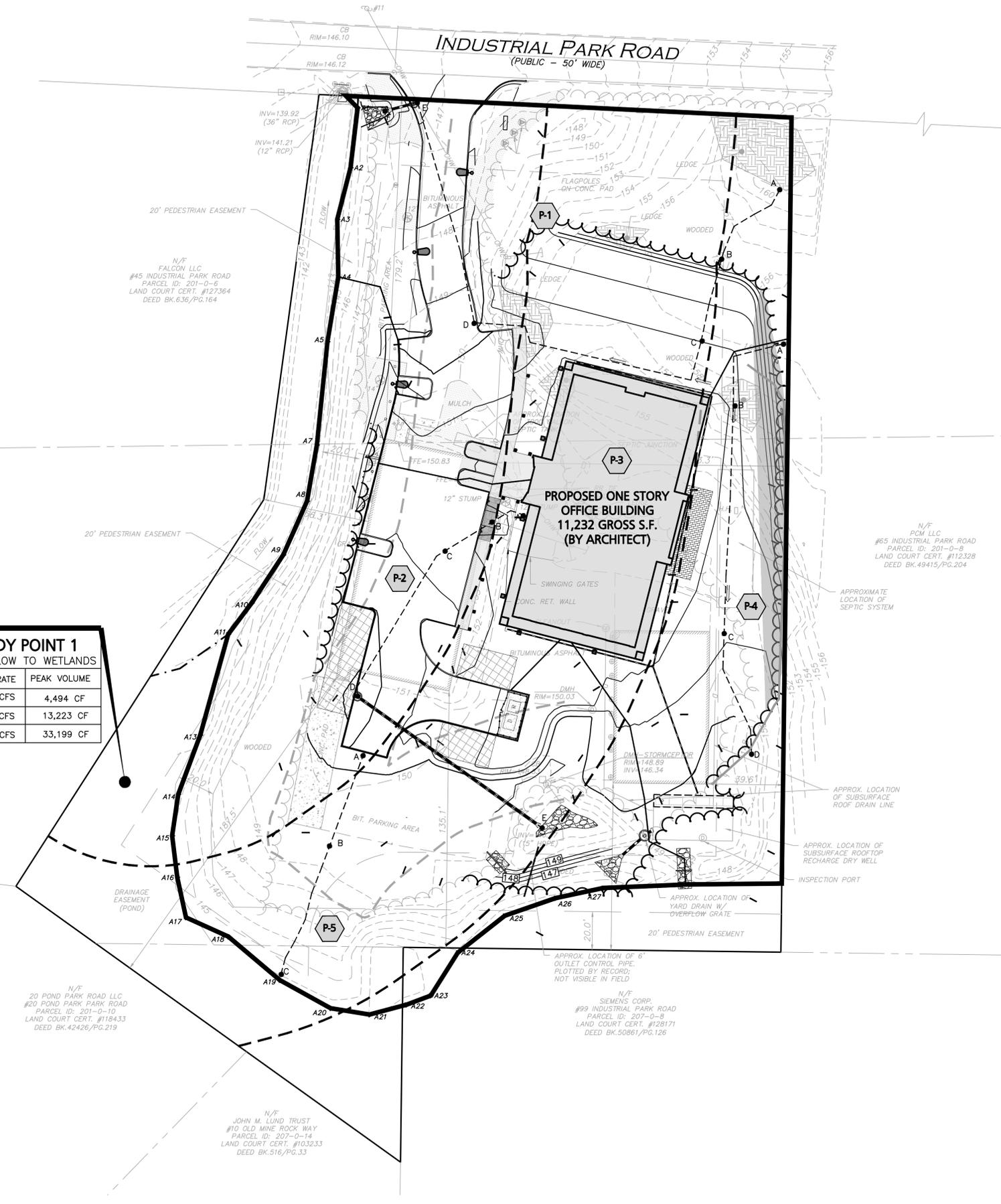
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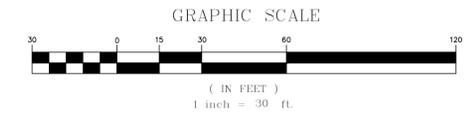
STUDY POINT 1
 FLOW TO WETLANDS

STORM EVENT	PEAK RATE	PEAK VOLUME
2YR STORM	0.88 CFS	4,494 CF
10YR STORM	3.04 CFS	13,223 CF
100YR STORM	9.00 CFS	33,199 CF



DIG SAFE

BEFORE YOU DIG
 CALL 811 OR
 1-888-DIG-SAFE
 1-888-344-7233





**SECTION 6.0 -
APPENDIX**



NOAA Atlas 14, Volume 10, Version 3
 Location name: Hingham, Massachusetts, USA*
 Latitude: 42.1753°, Longitude: -70.9168°
 Elevation: 150 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.302 (0.233-0.386)	0.376 (0.290-0.481)	0.496 (0.381-0.636)	0.595 (0.455-0.768)	0.732 (0.544-0.991)	0.834 (0.609-1.15)	0.943 (0.673-1.36)	1.07 (0.720-1.67)	1.27 (0.823-1.92)	1.44 (0.913-2.22)
10-min	0.428 (0.331-0.548)	0.532 (0.410-0.681)	0.702 (0.540-0.901)	0.843 (0.645-1.09)	1.04 (0.771-1.40)	1.18 (0.883-1.64)	1.34 (0.954-1.93)	1.52 (1.02-2.22)	1.80 (1.17-2.72)	2.04 (1.29-3.14)
15-min	0.504 (0.389-0.644)	0.626 (0.483-0.801)	0.826 (0.635-1.06)	0.992 (0.758-1.28)	1.22 (0.907-1.65)	1.39 (1.02-1.92)	1.57 (1.12-2.27)	1.79 (1.20-2.61)	2.12 (1.37-3.20)	2.40 (1.52-3.69)
30-min	0.699 (0.540-0.894)	0.869 (0.670-1.11)	1.15 (0.882-1.47)	1.38 (1.05-1.78)	1.70 (1.26-2.30)	1.93 (1.41-2.67)	2.18 (1.56-3.15)	2.49 (1.67-3.63)	2.95 (1.91-4.45)	3.35 (2.12-5.15)
60-min	0.894 (0.691-1.14)	1.11 (0.858-1.42)	1.47 (1.13-1.88)	1.76 (1.35-2.28)	2.17 (1.61-2.94)	2.47 (1.81-3.43)	2.80 (2.00-4.04)	3.19 (2.14-4.65)	3.79 (2.45-5.71)	4.30 (2.72-6.60)
2-hr	1.14 (0.881-1.44)	1.43 (1.11-1.82)	1.92 (1.48-2.44)	2.32 (1.78-2.97)	2.87 (2.15-3.87)	3.28 (2.41-4.52)	3.72 (2.68-5.35)	4.27 (2.87-6.17)	5.11 (3.31-7.62)	5.83 (3.70-8.86)
3-hr	1.32 (1.02-1.66)	1.66 (1.29-2.10)	2.22 (1.72-2.82)	2.69 (2.07-3.44)	3.33 (2.50-4.47)	3.81 (2.81-5.22)	4.33 (3.12-6.18)	4.96 (3.35-7.13)	5.94 (3.86-8.81)	6.79 (4.32-10.2)
6-hr	1.73 (1.35-2.17)	2.15 (1.68-2.70)	2.84 (2.21-3.58)	3.41 (2.64-4.32)	4.20 (3.16-5.58)	4.78 (3.54-6.49)	5.41 (3.92-7.64)	6.18 (4.18-8.78)	7.36 (4.80-10.8)	8.37 (5.34-12.5)
12-hr	2.26 (1.78-2.83)	2.76 (2.17-3.44)	3.56 (2.79-4.46)	4.22 (3.29-5.32)	5.14 (3.89-6.76)	5.82 (4.32-7.82)	6.56 (4.75-9.14)	7.43 (5.05-10.5)	8.75 (5.73-12.7)	9.88 (6.32-14.6)
24-hr	2.77 (2.19-3.43)	3.36 (2.65-4.17)	4.32 (3.40-5.38)	5.12 (4.01-6.41)	6.23 (4.73-8.12)	7.05 (5.26-9.38)	7.93 (5.76-10.9)	8.98 (6.13-12.5)	10.6 (6.94-15.2)	11.9 (7.65-17.4)
2-day	3.14 (2.50-3.87)	3.87 (3.08-4.77)	5.07 (4.01-6.26)	6.06 (4.77-7.52)	7.43 (5.68-9.63)	8.44 (6.33-11.2)	9.53 (6.98-13.1)	10.9 (7.44-15.0)	12.9 (8.50-18.3)	14.6 (9.44-21.1)
3-day	3.44 (2.74-4.21)	4.22 (3.37-5.18)	5.51 (4.38-6.78)	6.58 (5.19-8.13)	8.04 (6.17-10.4)	9.13 (6.87-12.0)	10.3 (7.57-14.1)	11.7 (8.06-16.1)	13.9 (9.21-19.7)	15.8 (10.2-22.7)
4-day	3.72 (2.97-4.54)	4.53 (3.62-5.54)	5.85 (4.66-7.18)	6.95 (5.50-8.57)	8.47 (6.51-10.9)	9.59 (7.23-12.6)	10.8 (7.94-14.7)	12.3 (8.45-16.8)	14.5 (9.62-20.4)	16.5 (10.6-23.5)
7-day	4.49 (3.61-5.46)	5.33 (4.28-6.49)	6.71 (5.37-8.19)	7.86 (6.24-9.63)	9.43 (7.27-12.0)	10.6 (8.01-13.8)	11.9 (8.72-15.9)	13.4 (9.23-18.1)	15.6 (10.4-21.7)	17.6 (11.4-24.8)
10-day	5.21 (4.19-6.31)	6.07 (4.89-7.36)	7.49 (6.01-9.11)	8.67 (6.91-10.6)	10.3 (7.94-13.0)	11.5 (8.69-14.8)	12.8 (9.39-17.0)	14.3 (9.89-19.2)	16.5 (11.0-22.8)	18.4 (11.9-25.8)
20-day	7.28 (5.90-8.76)	8.23 (6.66-9.91)	9.78 (7.89-11.8)	11.1 (8.87-13.4)	12.8 (9.94-16.0)	14.2 (10.7-18.0)	15.6 (11.4-20.3)	17.1 (11.9-22.6)	19.1 (12.8-26.1)	20.7 (13.5-28.7)
30-day	9.00 (7.31-10.8)	10.0 (8.13-12.0)	11.7 (9.44-14.0)	13.0 (10.5-15.8)	14.9 (11.6-18.5)	16.4 (12.4-20.6)	17.9 (13.0-22.9)	19.3 (13.5-25.5)	21.2 (14.2-28.8)	22.7 (14.8-31.2)
45-day	11.2 (9.09-13.3)	12.2 (9.97-14.6)	14.0 (11.4-16.8)	15.5 (12.5-18.6)	17.5 (13.6-21.6)	19.1 (14.5-23.8)	20.7 (15.1-26.2)	22.1 (15.5-29.0)	23.9 (16.1-32.1)	25.1 (16.4-34.4)
60-day	13.0 (10.6-15.4)	14.1 (11.5-16.8)	16.0 (13.0-19.1)	17.5 (14.2-21.0)	19.7 (15.3-24.1)	21.4 (16.2-26.5)	23.0 (16.7-29.0)	24.4 (17.1-31.8)	26.1 (17.6-34.9)	27.3 (17.8-37.1)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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

Please refer to NOAA Atlas 14 document for more information.

Manning's Roughness Coefficients ("n")

Conduit	Manning's Coefficients
Closed Conduits	
Asbestos-Cement Pipe	0.011 to 0.015
Brick	0.013 to 0.017
Cast Iron Pipe Cement-lined and seal-coated	0.011 to 0.015
Concrete (Monolithic) Smooth forms	0.012 to 0.014
Rough forms	0.015 to 0.017
Concrete Pipe	0.011 to 0.015
Corrugated-Metal Pipe (1/2 - STUL 34470 2 1/2-inch corrgrtn.) Plain	0.022 to 0.026
Paved invert	0.018 to 0.022
Spun asphalt-lined	0.011 to 0.015
Plastic Pipe (Smooth)	0.011 to 0.015
Vitrified Clay Pipes	0.011 to 0.015
Liner channels	0.013 to 0.017
Open Channels	
Lined Channels Asphalt	0.013 to 0.017
Brick	0.012 to 0.018
Concrete	0.011 to 0.020
Rubble or riprap	0.020 to 0.035
Vegetal	0.030 to 0.040
Excavated or Dredged Earth, straight and uniform	0.020 to 0.030
Earth, winding, fairly uniform	0.025 to 0.040
Rock	0.030 to 0.045
Unmaintained	0.050 to 0.140
Natural Channels (minor streams, top width at flood state < 100 feet) Fairly regular section	0.030 to 0.070
Irregular section with pools	0.040 to 0.100

Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers and the Water Pollution Control Federation, 1969.



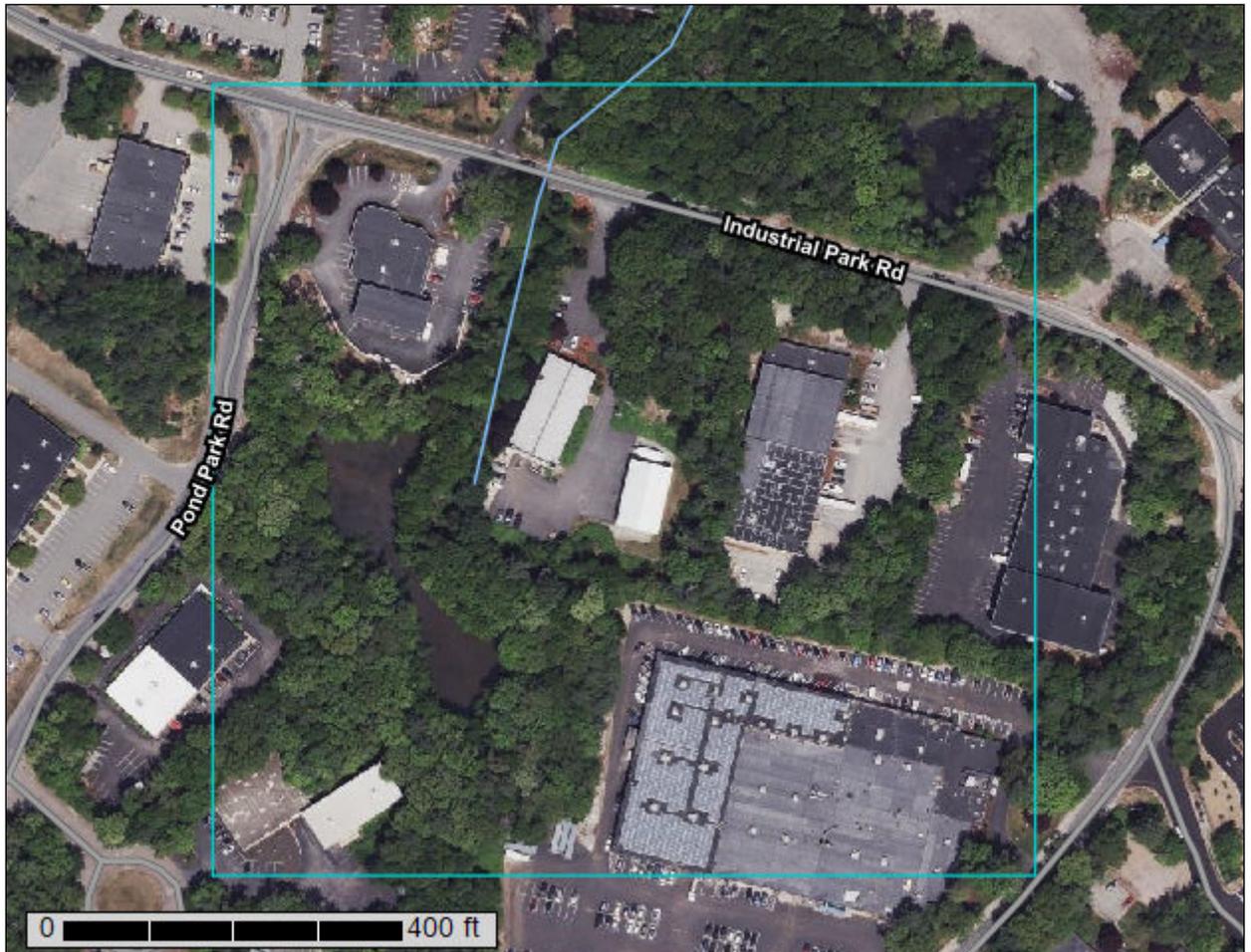
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
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agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Plymouth County, Massachusetts



Preface

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

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

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

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

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

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

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How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report Soil Map



Map Scale: 1:2,410 if printed on A landscape (11" x 8.5") sheet.



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 Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

Water Features

 Streams and Canals

Transportation

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

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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: Plymouth County, Massachusetts
 Survey Area Data: Version 16, Sep 10, 2023

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	0.7	3.4%
51A	Swansea muck, 0 to 1 percent slopes	0.7	3.3%
635C	Canton - Urban land - Rock outcrop complex, 3 to 15 percent slopes	19.6	93.3%
Totals for Area of Interest		21.0	100.0%

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

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landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Plymouth County, Massachusetts

1—Water

Map Unit Setting

National map unit symbol: bd0b
Elevation: 0 to 330 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Swansea

Percent of map unit: 1 percent
Landform: Depressions, marshes, swamps, bogs, kettles
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Freetown

Percent of map unit: 1 percent
Landform: Depressions, swamps, kettles, marshes, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Swansea and similar soils: 80 percent
Minor components: 20 percent

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Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swansea

Setting

Landform: Bogs, swamps

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck

Oa2 - 24 to 34 inches: muck

Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Very poorly drained

Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)

Depth to water table: About 0 to 6 inches

Frequency of flooding: Rare

Frequency of ponding: Frequent

Available water supply, 0 to 60 inches: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8w

Hydrologic Soil Group: B/D

Ecological site: F144AY043MA - Acidic Organic Wetlands

Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent

Landform: Bogs, swamps

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent

Landform: Drainageways, depressions

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Base slope, tread, dip

Down-slope shape: Concave

Across-slope shape: Concave

Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent

Landform: Drainageways, depressions

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Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

635C—Canton - Urban land - Rock outcrop complex, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9y4x
Elevation: 0 to 400 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton and similar soils: 35 percent
Rock outcrop: 30 percent
Urban land: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Till plains, ridges, hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Coarse-loamy eolian deposits over sandy and gravelly supraglacial meltout till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: very fine sandy loam
E - 3 to 4 inches: very fine sandy loam
Bw1 - 4 to 5 inches: very fine sandy loam
Bw2 - 5 to 15 inches: very fine sandy loam
Bw3 - 15 to 24 inches: fine sandy loam
BC - 24 to 28 inches: gravelly loamy sand
2C1 - 28 to 49 inches: gravelly coarse sand
2C2 - 49 to 73 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 3 to 15 percent

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Depth to restrictive feature: 20 to 36 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Interpretive groups

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

Minor Components

Gloucester

Percent of map unit: 5 percent
Landform: Hills, ground moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Udorthents, loamy

Percent of map unit: 5 percent
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

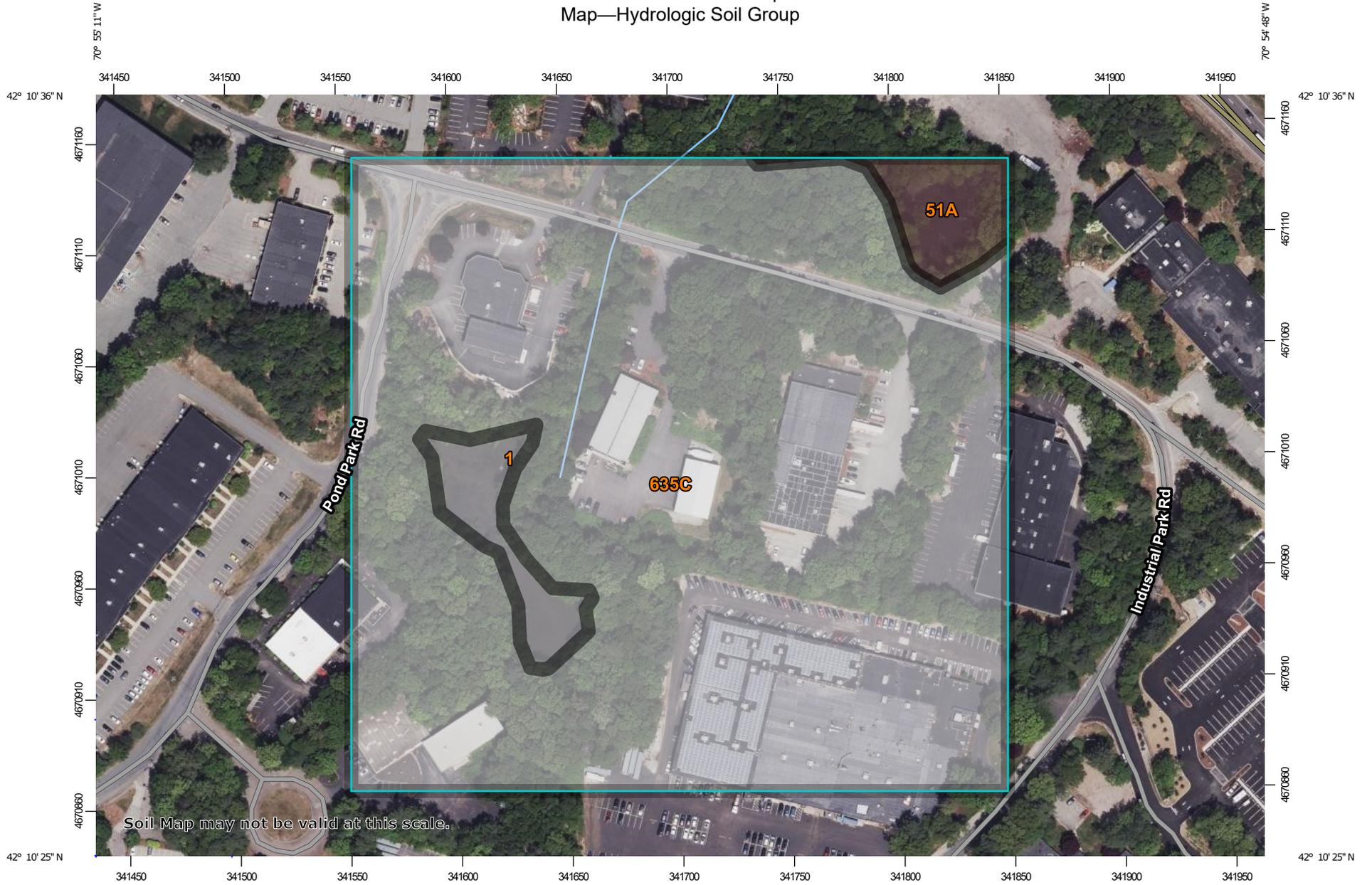
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Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water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

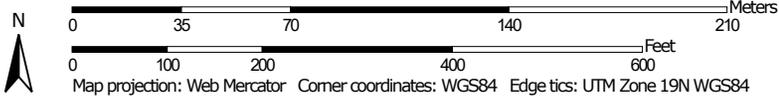
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over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

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Map—Hydrologic Soil Group



Map Scale: 1:2,410 if printed on A landscape (11" x 8.5") sheet.



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 1:12,000.

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: Plymouth County, Massachusetts
 Survey Area Data: Version 16, Sep 10, 2023

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

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

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		0.7	3.4%
51A	Swansea muck, 0 to 1 percent slopes	B/D	0.7	3.3%
635C	Canton - Urban land - Rock outcrop complex, 3 to 15 percent slopes		19.6	93.3%
Totals for Area of Interest			21.0	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Title	MA DEP Standard Calculations	
Project	Office Building/Office Parks	
Location	55 Industrial Park Road	
Date	October 16, 2024	
Revised		

By	SMF
Chk'd	
Apprv'd	

Stormwater Recharge/Water Quality Volume Table

$R_v = F * \text{Impervious Area}$

R_v = Required Recharge Volume, expressed in ft^3 , cubic yards or acre-feet

F = Target Depth Factor associated with each Hydraulic Soil Group

Impervious Area = pavement & rooftop area on site

A_{WQ} = Required Water Quality Treatment Volume, expressed in ft^3

D_{WQ} = Water Quality Depth

A_{IMP} = Impervious Area (excluding non-metal roofs)

Watershed (Pond 1)	Area (Sq. Ft.)	Landscaped	Impervious Area (Square Feet)		Recharge Required			Water Quality Volume Required	
			HSG A (F=.6)	HSG B (F=.35)	F Avg. (Inches)	Impervious Area (Feet)	Rv (ft ³)	D _{WQ} (Inch)	A _{WQ}
P-1	35,486	27,542	0	7,944	0.4	7,944	232	1.0	662
P-2	26,256	7,643	0	18,613	0.4	18,613	543	1.0	1,551
P-3	11,440	0	0	11,440	0.4	11,440	334	1.0	953
P-4	17,559	17,559	0	0	0.0	0	0	1.0	0
P-5	27,645	27,645	0	0	0.0	0	0	1.0	0
Total	118,386	80,389	0	37,997		37,997	1,108		3,166

Title	MA DEP Standard Calculations	
Project	Office Building/Office Parks	
Location	55 Industrial Park Road	
Date	October 16, 2024	

By	SMF
Chk'd	
Apprv'd	

Stormwater Recharge Summary

$R_v = F * \text{Impervious Area}$

R_v = Required Recharge Volume, expressed in ft^3 , cubic yards or acre-feet

F = Target Depth Factor associated with each Hydraulic Soil Group

Impervious Area = pavement & rooftop area on site

	Required (cf)	Provided (cf)	
$AR_v =$	232	2,115	Infiltration Pond #1 (P-1)
$AR_v =$	232	2,115	Total

	Required (cf)	Provided (cf)	
$AR_v =$	543	3,098	Infiltration Pond #2 (P-2)
$AR_v =$	543	3,098	Total

	Required (cf)	Provided (cf)	
$AR_v =$	334	2,060	Infiltration Chambers (P-3)
$AR_v =$	334	2,060	Total

	Required (cf)	Provided (cf)	
$AR_v =$	334	1,599	Infiltration Pond #3 (P-3, P-4)
$AR_v =$	334	1,599	Total

Water Quality Volume

A_{wQ} = Required Water Quality Treatment Volume, expressed in ft^3

D_{wQ} = Water Quality Depth

A_{IMP} = Impervious Area (excluding non-metal roofs)

	Required (cf)	Provided (cf)	
$A_{wQ} =$	662	2,115	Infiltration Pond #1 (P-1)
$A_{wQ} =$	662	2,115	Total

	Required (cf)	Provided (cf)	
$A_{wQ} =$	1,551	3,098	Infiltration Pond #2 (P-2)
$A_{wQ} =$	1,551	3,098	Total

	Required (cf)	Provided (cf)	
$A_{wQ} =$	953	2,060	Infiltration Chambers (P-3)
$A_{wQ} =$	953	2,060	Total

Title	MA DEP Standard Calculations	
Project	Office Building/Office Parks	
Location	55 Industrial Park Road	
Date	October 16, 2024	

By	SMF
Chk'd	
Apprv'd	

	<i>Required (cf)</i>	<i>Provided (cf)</i>	
$A_{wQ} =$	953	1,599	<i>Infiltration Pond #3 (P-3, P-4)</i>
$A_{wQ} =$	953	1,599	<i>Total</i>

Draindown Within 72 Hours

$\text{Time}_{\text{drawdown}} = (Rv)$ (1/Design Infiltration Rate in inches per hour) (Conversion for inches to feet) (1/bottom area in feet)

Infiltration Pond #1 (HSG B)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area (ft ²) =	1,444
Infiltration Volume (ft ³) =	2,115
Time_{drawdown} (Hours)=	17.23

$\text{Time}_{\text{drawdown}} = (Rv)$ (1/Design Infiltration Rate in inches per hour) (Conversion for inches to feet) (1/bottom area in feet)

Infiltration Pond #2 (HSG B)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area (ft ²) =	2,236
Infiltration Volume (ft ³) =	3,098
Time_{drawdown} (Hours)=	16.30

$\text{Time}_{\text{drawdown}} = (Rv)$ (1/Design Infiltration Rate in inches per hour) (Conversion for inches to feet) (1/bottom area in feet)

Infiltration Chambers (HSG B)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area (ft ²) =	1,061
Infiltration Volume (ft ³) =	2,060
Time_{drawdown} (Hours)=	22.84

$\text{Time}_{\text{drawdown}} = (Rv)$ (1/Design Infiltration Rate in inches per hour) (Conversion for inches to feet) (1/bottom area in feet)

Infiltration Pond #3 (HSG B)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area (ft ²) =	1,786
Infiltration Volume (ft ³) =	1,599
Time_{drawdown} (Hours)=	10.53

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location:

TSS Removal Calculation Worksheet

B BMP ¹	C TSS Removal Rate ¹	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
	0.00	1.00	0.00	1.00
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Infiltration Basin	0.80	0.75	0.60	0.15
Sediment Forebay	0.25	0.15	0.04	0.11
	0.00	0.11	0.00	0.11

Total TSS Removal =

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

Project:
 Prepared By:
 Date:

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

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