STORMWATER ANALYSIS AND DRAINAGE REPORT

Littleton Drive Affordable Housing Project

Wareham, Massachusetts

December 2020

Prepared for:

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

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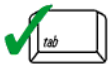
A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

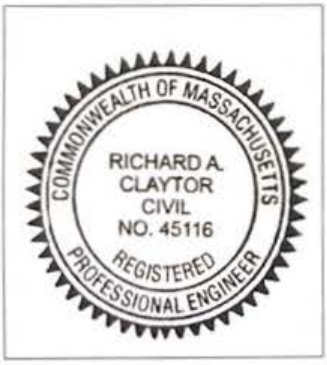
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



12-30-2020

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): Use of natural depressions to manage offsite runoff

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☒ Dynamic Field[1]

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

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

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

1.0 STORMWATER AND DRAINAGE NARRATIVE

This Stormwater Management Report provides a summary of the proposed stormwater management for the Littleton Drive Affordable Housing Project. The purpose of this report is to describe the pre- and post-development site conditions and the practices to be used for reducing stormwater runoff and pollutants during and after construction. The proposed project has been developed to incorporate a series of green stormwater infrastructure (GSI) practices into the overall site and landscape design. The design includes surface GSI bioretention facilities for pre-treatment, recharge and water quality management for 1" of runoff from impervious surfaces. A surface infiltration basin and four underground chamber systems provide storage for peak flow attenuation for the 2-year, 10-year, and 100-year storms.

Due to the proximity of the proposed Project to existing wetlands, adherence to the Massachusetts Stormwater Standards (MASWS) (revised in January 2008) is required. The proposed site design conforms to the Standards by providing stormwater runoff treatment or the first 1-inch runoff from proposed impervious areas contributing to site runoff. On-site attenuation and infiltration is proposed to match or reduce peak runoff conditions for the 2, 10 and 100-year storm events. The proposed stormwater controls will be maintained during and after construction as part of the development regular landscape maintenance and as described further in the Operations and Maintenance Plan.

1.1. Existing Conditions

The project site is located at 4 Littleton Drive in the Town of Wareham, Massachusetts (Latitude 41.749903, Longitude -70.729243) The Town of Wareham identifies the Subject Property as Map 56 Lot 1. Refer to Figures 1 and 2 for regional location and general layout of the Subject Property, respectively.

According to the Town of Wareham Assessors Office, the Subject Property consists of 12.92-acres of land. The Wareham Redevelopment Authority, in its January 2020 RFP, confirms that the actual size of the property is approximately 16.1 acres; the discrepancy is due to previously defined rights-of-way within the Subject Property that will be removed prior to construction.

The Subject Property is mostly wooded with the exception of a few paths with bare earth and historic subgrade utility services installed during a failed subdivision project between approximately 1971 and 1978. There are no formal buildings, structures, or asphalt paved roads on the Subject Property, though there are a few building encroachment from neighboring properties. Entry into the Subject Property was gained by following a walking path off Littleton Drive.

Wetland resource areas were previously identified and delineated by Green Seal Environmental Inc. in December 2019. Horsley Witten Group, Inc. (HW) wetland scientist reviewed this boundary and made minor adjustments to the wetland boundary as now shown on the existing conditions plan. Wetland resource areas were determined in accordance with methods developed by MassDEP, the Massachusetts Wetlands Protection Act regulations.

The existing drainage area to Study Point 1 at Flax Pond is 19.56 acres (852,117 square feet) and is comprised of the following land cover:

Table 1: Existing Land Coverage

Coverage	Area (ft2)	Area (acres)	%
Roadway	1,175	0.03	0.1
Bare Soil-A/Bl	49,389	1.13	5.8
Roof	16,857	0.39	2.0
Woods-A/B	655,706	15.05	77.0
Woods-A	94,715	2.17	11.1
Grass- A/B	16,604	0.38	1.9
Grass-A	17,671	0.41	2.1
TOTAL	852,117	19.56	100%

The existing conditions site draining to Study Point 1 (SP1) is approximately 19.6 acres, and includes nearly all of the subject property comprised of woodlands and bare soil paths and off-site areas consisting of a very small area of paved roads, rooftops, woods and grass areas. The area slopes very gently towards Flax Pond in the southeast corner at SP1.

1.1.1. Soils

According to the Commonwealth of Massachusetts Bureau of Geographical Information ("MassGIS"), soils underlying the Subject Property are classified as Deerfield and Windsor soils (Figure 3). The United States Department of Agriculture Soil Conservation Service identifies these soils as well drained to excessively drained.

The NRCS Soil Map is located in **Appendix A**.

1.2. Proposed Conditions

The proposed project includes the construction of a residential community consisting of a three story Senior's Only building consisting of 44 one-bedroom housing units and 10 multi-unit dwellings offering mixed-income housing. The buildings will be accessed by an internal road, and parking will be provided for each unit. Other site amenities include a community building, community gardens and walking trails. The site will be accessed via Littleton Drive, off Swifts Beach Road. A second, emergency-only point of egress will connect to the low-density residential neighborhood to the site's south and west. The site is to be serviced by Town water and sewer, natural gas, electric and cable service accessed from Littleton Drive. The Applicant has applied for wastewater allocation to support the proposed housing development.. Other site features include:

- Approximately 2,190 linear feet of 24' wide paved streets with perpendicular parking spaces for the 10 multi-unit residential buildings
- A total of 128 paved parking spaces

- ADA accessible sidewalks
- Interior landscaped areas, open spaces, and lighting.

1.2.1. Stormwater Management

The proposed stormwater management includes a GSI approach to capture, treat, infiltrate, and detain runoff, when applicable and to the maximum extent practicable, by using the following Stormwater Control Measures (SCM)s.

Bioretention Areas (BIO)

A bioretention area (sometimes referred to as a “rain garden” or a “biofilter”) is a stormwater management practice to manage and treat stormwater runoff using a conditioned planting soil bed or “filter” media and plants to filter runoff captured in a shallow depression. The method combines physical filtering and adsorption with bio-geochemical processes to remove pollutants. The system consists of an inflow component, a pretreatment element, an overflow structure, a shallow ponding area (6 inches deep), a well-drained planting soil bed, and plants.

Underground Recharge Chambers (URC)

Underground recharge chambers capture, and store stormwater collected from surrounding rooftops and other impervious areas after treatment of the first inch of runoff from upgradient bioretention areas. Drainage pipes direct surface stormwater to subsurface interconnected storage units. Some of the stored water is released directly into the ground mimicking pre-development conditions. Use of stormwater recharge chambers allows stored water to infiltrate and recharge groundwater. Larger storms beyond the infiltration rate of the underlying soils fill the chambers before being discharged either to the down-gradient infiltration basin, or directly to Flax Pond.

Infiltration Basin (IB)

The infiltration basin is a surface stormwater facility that is designed to collect and temporarily store runoff before infiltration into the subsoil. The infiltration basin allows stored water to infiltrate and recharge groundwater. Infiltration basins only receive runoff from adjacent pervious and rooftop areas, and after treatment of the one-inch runoff from upgradient bioretention areas.

Dry Well (Recharge Basin (RB))

A subsurface stormwater facility that is designed to collect and temporarily store rooftop runoff before infiltration into the subsoil. Use of stormwater recharge basins allows stored water to infiltrate and recharge groundwater.

Sediment Forebays

Sediment forebays are also provided at the bioretention areas for pretreatment of the surface water runoff from the proposed pavement and concrete surfaces to allow for sediment to settle from the incoming stormwater runoff prior to conveyance to the bioretention and infiltration basin/chamber systems. The forebays are designed to provide 0.1” of runoff volume as required

by the Massachusetts Stormwater Standards. The sediment forebays are designed to be easily accessed on a regular basis for cleanout and sediment removal. See the Stormwater Operation and Maintenance Plan.

1.2.2. Drainage Areas

The proposed development will occur within an approximately 9.0 acre development area generally in the center of the 16.1 acre parcel with buffer of not less than 50 feet and up to 150 feet to adjacent property lines to remain undeveloped. A 24-foot wide access street will connect into existing Littleton Drive at the northeast corner of the property. A looping path/trail is proposed to surround the development envelope. The proposed site development includes a low impact stormwater management approach, public sewer and water, natural gas and other associated utilities. The total proposed development is comprised of the following land cover:

Table 2: Proposed Land Coverage

Coverage	Area (ft2)	Area (acres)	%
Paved	101,620	2.33	11.8
Bare Soil-A/B	19,134	0.44	2.2
Roof	641,41	1.47	7.5
BMP	19,720	0.45	2.3
Woods-A/B	368,946	8.47	42.9
Woods-A	94,715	2.17	11.0
Grass- A/B	174,819	4.01	20.3
Grass- A	17,671	0.41	2.1
Total	**860,766**	**19.76**	**100%**

The proposed site drainage is divided into ten subcatchments: DA0, DA1E, DAW, DA2, DA3, DA3R, DA4, DA1OS, DA2OS, and DA3OS. The 10 drainage areas ultimately drain to the same study point (SP1) as outlined in the existing conditions above. Pre and Post Drainage maps can be found in **Appendix B**. The 0.2 acre increase in post-developed conditions drainage area is to due to the proposed grading at the beginning of the entrance driveway off of Littleton Drive where this small area of drainage will be managed by SCM P1.

DA0 is approximately 0.20 acres, located in the eastern portion of the property, and includes paved roads, open lawn, and the SCM. This area retains the 100-Year Storm within the SCM but is mapped to SP1.

DA1E is approximately 0.55 acres, also located in eastern portion of the property and includes the upper portion of Littleton Drive, sidewalks, the northern parking lot to the senior building, the SCM and open lawn areas. Runoff drains first to Bioretention area (BIO) P2, which overflows to the underground recharge chambers (C1), located under the parking lot, before discharging to SP1.

DA1W is approximately 0.50 acres, located in the central portion of Littleton Drive The area includes a portion of the roof from the senior building, paved roadway, sidewalks, the SCM, and open lawn/landscaped areas. Runoff drains first to BIO P3, which overflows to the underground recharge chambers (C1), located under the parking lot, before discharging to SP1.

DA2 is approximately 0.74 acres, located along the southwestern boundary of the site. The area includes a portion of the emergency access road, sidewalks, a portion of the rooftop from the senior building, the southern parking lot serving the senior building, the SCM, the community garden, and open lawn/landscaped areas. The area slopes from southeast to northwest. Runoff drains first to BIO P5, which overflows to the underground recharge chambers (C2), located under the southern parking lot, before discharging to SP1.

DA3 is approximately 2.40 acres, located in the central portion of the loop road and multi-unit townhouses and includes the community center. The area includes rooftops, parking for the townhouses and community center, roadway and sidewalks serving the multi-unit townhouses, the SCM, and open lawn/landscaped areas. Runoff drains first to BIO P4, which overflows to the underground recharge chambers (C3), located under the common open lawn/landscaped area, before discharging to the infiltration basin D4.

DA3R is approximately 0.22 acres, located in the eastern side of the loop road. The area includes only the rooftops of three multi-unit townhouses. These rooftops drain to a small underground chamber system (C4) before overflowing to the small depression. The area slopes to the northeast and retains the 100-Year Storm within the natural depression but is mapped to SP1.

DA4 is approximately 2.11 acres, located in the northern portion of the loop road and multi-unit townhouses. The area includes rooftops, parking for the townhouses, roadway and sidewalks serving the multi-unit townhouses, the SCM, and open lawn/landscaped areas. Runoff drains first to BIO P6, which overflows to the infiltration basin D4.

DA1OS is approximately 2.54 acres, located on the northern, mostly undeveloped area of the site. The area is mostly undeveloped forest draining to a natural depression. The area includes mostly undeveloped woods, some bare soil associated with the existing pathways, and open lawn/landscaped areas. The small underground chamber system (C4) draining the rooftops in DA3R overflows during larger storms to the small depression. The area slopes to the northeast and retains the 100-Year Storm within the natural depression but is mapped to SP1.

DA2OS is approximately 1.22 acres, located to the southern portion of the site adjacent to Flax Pond and SP1. The area includes mostly natural undeveloped woods and the existing bare soil pathway. The area slopes directly to Flax Pond and discharged to SP1.

DA3OS is approximately 9.31 acres, located to the northwest of the property and includes off-site existing developed lots consisting of mostly undeveloped woods, existing residential rooftops, lawns, the SCM, and the existing bare soil pathway. The area slopes to the proposed surface infiltration basin (D4) and retains storms in excess of the 100-year event, but is mapped to SP1.

2.0 DRAINAGE DESIGN METHODOLOGY AND ANALYSIS

The drainage design was completed by performing the following series of tasks:

- Site soil evaluations (6 test pits) (**Appendix A**)
- Delineation of drainage areas and sub catchments (**Appendix B**)
- Sizing the bioretention areas, and underground recharge chambers (**Appendix C**)
- Modeling the proposed drainage network with HydroCAD® software (**Appendix D**)
- TSS and Recharge calculations (**Appendix E**)
- Operation and Maintenance Guide (**Appendix F**)
- Groundwater mounding analyses using the Hantush Method (**Appendix G)**

Six soil test pits were excavated on the site to assess the subsurface conditions and determine its suitability for the construction of stormwater management practices. The soil test pit data are included in **Appendix A**. Six test pits are located across the site in locations deemed proximate to proposed infiltration systems but distributed across the site to allow for comparison of groundwater elevations.

The soil map unit comprising the majority of the site is “Deerfield loamy sand 0 to 3 percent slopes.” The Deerfield series is described in the 1969 Soils Survey as consisting “of very deep, moderately well drained soils on terraces, deltas, and outwash plains. They formed in thick deposits of sand derived mainly from granite, gneiss, and quartzite. Typically, these soils have a very dark grayish brown loamy sand surface layer 9 inches thick. The subsoil from 9 to 19 inches is yellowish-brown loamy that is mottled. The subsoil from 19 to 27 inches is mottled sand. The substratum from 27 to 65 inches is olive gray sand. Slopes range from 0 to 15 percent.” MassGIS and the 1969 Plymouth County Soils Survey list Deerfield soils as HSG B while the 2010 on-line Plymouth County Soils Survey HSG List has Deerfield identified as HSG A. Our field observations confirmed a fine sand soil layer as shallow as 41” that confines downward water movement. For hydrologic calculations, HW split the difference between HSG A and B for both pre-development and post-development conditions.

The test pits revealed a soil column that consisted of approximately 3 to 5 inches of organic matter, 2 to 9-inches of loamy sand woodland topsoil overlying 2 inches to 24 inches of loamy sand subsoil. The underlying fine sand substratum extends to the bottom of the deep observation test pits to a depth of up to approximately 10 feet. The entirety of the soil column was a single-grained texture and of a friable consistency.

Groundwater was observed in four test holes (TP-1, TP-2, TP-5 and TP-6), which are distributed across the site. Observed depth to water ranged from 48 inches to 91 inches feet below grade. Redoxymorphic (Redox) features were observed in 5 out of 6 test holes. The Estimated Seasonal High Ground Water (ESHGW) elevation was determined by depth to observed Redox. Using this method, the highest estimated groundwater elevation was determined to be at

elevation 9.8. Perforated pipes were installed in two test pits (TP-2 and Tp-4) to allow for future observation of groundwater prior to development of final construction drawings.

A double-ring infiltrometer test was performed at TP-6, at a depth of 44 inches in the fine sand layer. Results ranged from 9.3 in/hr. to 10.3 in/hr. To be conservative in the HydroCAD drainage model, 50% of the lowest observed rate (4.5 in/hr) will be used in the design of all proposed infiltration areas. This rate coincides with the requirements set forth in the Massachusetts Stormwater Management Standards. Based on the infiltration test data results, existing subsoils, and deep depth to groundwater, this site is feasible for stormwater infiltration.

Soil logs are provided in **Appendix A** and the test pits locations are located on the Grading and Drainage Plan.

The Stormwater Management System has been designed to accomplish the following major objectives:

- To capture and treat, at a minimum, the “first flush” (first one-inch of stormwater runoff) from the impervious surfaces to maintain or improve water quality conditions when compared to existing conditions.
- To provide groundwater recharge to the greatest extent practicable in conformance with the Massachusetts Department of Environmental Protection groundwater recharge criteria.
- To meet or reduce peak flow rates for post-developed conditions as compared to pre-developed conditions at the study point located along the perimeter of Flax Pond.

These objectives are met through the use of the following stormwater management measures:

- Bioretention systems sized to treat the first one-inch of stormwater runoff for water quality treatment of runoff from the driveway, walkways, and parking areas. The systems are equipped with overflows to convey runoff from larger storm events into proposed underground recharge chambers and/or the infiltration basin. (**Appendix C**)
- Underground recharge chambers and infiltration basins sized to infiltrate and detain onsite runoff.
- Dry wells to capture rooftop runoff from three of the multi-unit townhouse buildings.

The proposed Stormwater Management System was designed to accommodate pre-development site hydrologic conditions as well as reduce stormwater pollution from the proposed site conditions. Stormwater runoff quantity was evaluated for the 2-year, 10-year, and 100-year Type III, 24-hour storm events for both pre-development and post-development conditions. Pre-development and post-development conditions were modeled using HydroCAD software, which combines USDA Soil Conservation Service hydrology and hydraulic techniques (commonly known as SCS TR-55 and TR-20) to generate hydrographs (See **Appendix B** for both "Pre-developed" and "Post-developed" Drainage Area Maps). The rainfall amounts used for calculating runoff for the storm events were obtained from the Upper 90th percentile

confidence limit from NOAA Atlas 14 which is being proposed by MassDEP as the new design-rainfall rates in the update to the Massachusetts Stormwater Management Standards. Rainfall values are listed below in Table 3. A summary table of pre- and post-development runoff peak flow rates and volumes is provided in Table 4.

Table 3: Precipitation Values for Design and Hydrological/Hydraulic Analysis

Storm Frequency (24-hour – Type III Storm)	Precipitation Value (inches)
Water Quality Event (WQv)	1" per impervious acre[1]
2-year	3.44
10-Year	5.05
25-Year	6.05
100-Year	7.60

Stormwater runoff quality was evaluated to ensure that pollutant export from the project site was minimized to the maximum extent practicable. The stormwater management system for the site was designed in accordance with the MASWS and the applicable criteria within the Town's Subdivision Regulations and Zoning Bylaw (i.e. the 20-year frequency Storm).

Table 4: Peak Flow and Volume Comparison

STUDY POINT 1 – Flax Pond Wetland Perimeter

DESIGN STORM	PRE-DEVELOPMENT		POST-DEVELOPMENT		PERCENT REDUCTION	
	PEAK FLOW (CFS)	VOLUME (AF)	PEAK FLOW (CFS)	VOLUME (AF)	PEAK FLOW	VOLUME
2 YR	0.15	0.096	0.01	0.008	93.3%	91.7%
10 YR	1.92	0.671	0.17	0.046	91.1%	93.1%
100 YR	11.01	2.342	3.79	0.301	65.6%	86.8.7%

3.0 COMPLIANCE WITH MADEP STORMWATER STANDARDS

The Massachusetts Stormwater Standards were revised in February 2008 to include ten stormwater management standards, established jointly by the DEP and the Office of Coastal Zone Management, and published in the 2008 update of the Stormwater Management Handbook. Projects that are within the jurisdiction of the Wetlands Protection Act Regulations, 310 CMR 10.00 are subjected to these Stormwater Management Standards. For this project, adherence to the Handbook is required as the project is within the jurisdiction of the Wetlands Protection Act. Therefore, the stormwater management system was designed in accordance with the MASWS.

The following is a list of Stormwater Management Standards and accompanying documentation describing compliance of the proposed retrofit project with each Standard:

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

No new untreated stormwater will discharge to wetland areas. The proposed GSI practices have been sized to meet the water quality volume (WQV). Stormwater runoff will flow through the GSI practices before being infiltrated or reaching the study point. Infiltration chambers and an infiltration basin have been designed to ensure that post-development peak flow rates for the 2-, 10- and 100-Year storm events match predevelopment rates for Study Point 1 at the perimeter of the wetland at Flax Pond.

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

Discharge rates for pre and post-development were calculated using HydroCAD® v10.10-4a, and SCS-TR20 based stormwater modeling computer program (**Appendix D**). Post-development peak discharge rates are less than pre-development rates for the 2-, 10-, and 100-year storms. A summary table of these precipitation events is provided in Table 3.Updated rainfall values from NOAA Atlas 14 Upper Confidence Limit were utilized for this analysis.

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.

Under the proposed design, the stormwater runoff is being directed to recharge basins, underground recharge chambers, and a surface infiltration basin. The intent is to recharge groundwater to the maximum extent practicable as required by Standard 3. Since the site is characterized with a high infiltration rate (greater than 2.4 in/hr.), at least 44% of the total suspended solids must be removed prior to discharge to the infiltration structure. The required TSS pretreatment will be done through bioretention practices. TSS and recharge calculations are provided in **Appendix E**. Because storms equal to or great than the 10-year storm are being infiltrated into soils with a separation distance to the seasonal high groundwater elevation, a groundwater mounding analysis is provided in **Appendix G**.

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.**

The stormwater management practices are sized to capture the require water quality volume (**Appendix C**).

The stormwater management pretreatment and treatment systems for the sites have been selected and sized for the most removal of the average annual load of TSS possible. The following removal rates were taken MA Stormwater Handbook:

Bioretention (with sediment forebay): Recommended design rate: 90%

TSS calculations are provided in **Appendix E.** Source controls and pollution prevention will be controlled by the methods outlined in **Sections 5.0 and 7.0**. The proposed Operation and Maintenance Plan was developed to ensure that the stormwater system continues to function as it was designed into the future (**Appendix F**).

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 SCMs 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 LUHPPL; thus, this standard is not applicable.

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 is not located within a Zone II but is considered a Nitrogen Sensitive Area

The project proposed to use stormwater pretreatment, treatment, and infiltration SCMs identified in Standard 6 for discharges within sensitive areas. Infiltrated stormwater likely drains to both the Wareham River and Marks Cove, both of which have been identified a nitrogen sensitive in the 2014 Massachusetts Estuary Project "Report for the Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Wareham River, Broad Marsh and Mark's Cove Embayment System, Wareham, Massachusetts." Sediment forebays with filtering bioretention areas are approved treatment SCMs with 44% TSS reduction prior to infiltration occurring, and subsurface structures, and infiltration basins are approved infiltration SCMs. All are appropriate to maximize nitrogen removal.

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.

This project is not a redevelopment project, therefore, Standard 7 does not apply.

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.

An Erosion and Sediment Control Plan is included in construction documents, and a Pollutant Prevention Plan is included in this Report. Silt fence and/or silt socks are proposed at the limit of work; silt socks are proposed along the downgradient edges of the area of disturbance. Disturbed areas will be stabilized with seeding and mulching, as soon as possible to minimize erosion and sedimentation. Additional pollutant controls during construction are described in **Section 5.0** and on the plans. A Stormwater Pollution Plan (SWPPP) is required as part of the NPDES Construction General Permit and will be submitted prior to construction.

The contractor will be required to establish erosion controls prior to beginning any other project-related work. The Erosion and Sediment Control Plan will also establish the limit of work, beyond which the contractor will not be allowed to perform any project work. It is the contractor's responsibility to monitor and correct erosion control practices throughout the duration of the project. Erosion control measures will not be removed until the project reaches completion as directed by the project engineer or landscape architect.

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

The long-term stormwater operation and maintenance plan for each stormwater best management practice is discussed in **Section 6.0** and provided with this report in **Appendix F**.

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

There will be no illicit discharges to the stormwater management system. The Long-Term Pollution Prevention Plan provided includes measures to prevent illicit discharges.

4.0 CONSTRUCTION ACTIVITIES AND GENERAL CONSTRUCTION SEQUENCE

Construction activities will involve site preparation and earthwork necessary for construction of the proposed project. These activities primarily include the following:

- Erosion control installation
- Clearing and grubbing of existing vegetation within the proposed limits of work
- Excavation stockpiling, and hauling of excavated foundation, topsoil and subsoils
- Rough grading of all disturbed areas
- Construction of stormwater management system
- Construction of new housing units,
- Installation of utilities
- Paving
- Finish grading, final site stabilization and landscaping

Erosion and sediment control (ESC) measures will be installed per the construction plans and specifications prior to commencement of any soil disturbing activities. ESC measures will remain in place until final site stabilization is complete. Topsoil will be separated from the remaining soil and stockpiled on-site for use during site finish grading. The stockpiled topsoil will be protected to prevent erosion and sedimentation.

5.0 POLLUTANT CONTROLS DURING CONSTRUCTION

Controls will be used to reduce erosion during the construction period. Perimeter controls and sediment settling devices will be installed during construction to minimize sediment movement in stormwater and to protect the adjacent properties and buffers on the property.

5.1. Structural Practices

The following are the structural practices that will be implemented as part of the construction activity.

- Silt Fence & Sediment Silt Sock Barrier will be installed prior to commencement of construction. This type of practice creates erosion control barriers to intercept sediment in diffuse runoff. The Town will be informed upon installation so that they may inspect these barriers prior to construction. Portions of the erosion control barriers will be replaced and/or repaired as necessary to prevent erosion. Barriers will be installed parallel to land slope at the perimeter of the work site. In addition, silt fence barriers will be installed around the bioretention areas during construction.

- Silt Sacks (or approved equivalent) will be installed at identified existing catch basins and structure following construction of the proposed catch basins to prevent

sedimentation during the any additional construction. The Silt Sack will be replaced and disposed of off-site if damage is observed.

- Bioretention Area(s) will be graded to within one foot of design elevations until site is fully stabilized to capture sediment during construction. Heavy equipment will not be allowed to operate on the surface location where the systems are planned because soil compaction would adversely impact their long-term performance. Silt fence will be utilized around the perimeter of the bioretention systems during construction. Light earth-moving equipment will be used for excavation and construction of the systems. All excavated materials from the area will be removed and disposed of in an approved location. All bioretention areas will be inspected at least once every seven calendar days and immediately after storm events by the Site Superintendent.

- Slope Stabilization will be installed immediately upon obtaining final grades as shown on the project site plans. Areas that fail to stabilize will be re-graded to final grade and stabilized as necessary. Amount of land disturbed will be minimized to reduce potential for erosion and sedimentation. Stabilization measures shall be initiated within 14 days following the end of construction at each portion of the site and as soon as practicable.

The entire stormwater management systems including overflow spillways and sediment forebays will be inspected upon completion of construction. Sediment will be removed from all elements of the stormwater management system. All control measures must be installed and maintained in accordance with manufacturer's specifications, good engineering practices, and in accordance with this Plan (every seven calendar days and after storm events). If inspections show that a control has failed or been installed incorrectly, the Operator must replace or modify it within 24 hours.

Structural controls will be regularly inspected to ensure proper performance. The following operation and maintenance provisions will be provided:

- Silt fences will be inspected for depth of sediment, tears, to determine if the fabric is securely attached to the fence posts, and to determine if the fence posts are firmly in the ground. Silt fence will be replaced when necessary.

- Silt Socks shall be inspected for depth of sediment and any breaches will promptly be repaired or replaced when necessary.

- Sediment shall be removed where accumulation reaches one-third the above ground height of any barrier.

- Once each workday structural control measures receiving flows from areas that have not been stabilized shall be inspected.

- Remedial action shall be taken in areas where temporary and permanent seeding is deemed inefficient through weekly inspections to establish a stabilized surface.

- All SCMs will be cleared of accumulated foreign debris, including leaves and lawn cuttings.

- All SCMs will be inspected for slope integrity and erosion.
- All control measures will be inspected at least once every 7-calendar days and within 24 hours after storm events of 0.5 inches or more.
- All measures will be maintained in good working order, if a repair is necessary, it will be initiated within 24 hours of discovery.

5.2. Stabilization Practices

The amount of land disturbed during construction will be minimized to reduce the potential for erosion and sedimentation. Prompt surface stabilization will be practiced to control erosion in areas where disturbances cannot be avoided during construction. Stabilization measures shall be initiated within 14 days following the end of construction at each portion of the site. Exceptions to this requirement are allowable when snow cover prevents the initiation of stabilization within 14 days, in which case such measures shall be undertaken as soon as possible.

Stabilization measures that may be used during construction are described below:

- Temporary Seeding – Temporary seeding of disturbed surfaces with fast-growing grasses (annual rye) to provide greater resistance to stormwater runoff and/or wind erosion for areas where construction has temporarily ceased.
- Permanent Seeding – Permanent seeding of surfaces with vegetation, including but not limited to grass, trees, bushes, and shrubs, to stabilize the soil. Establishing a permanent and sustainable ground cover at a site stabilizes the soil while reducing the sediment content in runoff.
- Permanent Planting – the contractor shall install and adequately establish all planting as required at the completion of the project.
- Mulching/Hydro mulching – hydro mulch will be placed on the soil surface to cover and hold in place disturbed soils.

Temporary seeding or other soil stabilization measures will be provided where construction activities have ceased at the site. Topsoil stockpiles will be temporarily seeded or covered to prevent erosion and will be surrounded with silt fence. When the site's final grade has been established, permanent vegetation will be planted on the disturbed areas. The vegetation will consist of grass, shrubs, bushes, and trees.

5.3. Other Types of Controls

Additional controls/practices will be undertaken to reduce pollution in stormwater runoff flows which include, but are not limited to, control of off-site mud tracking from construction site, dust suppression, proper sanitary waste disposal, earthwork procedures timed and conducted in manners aimed to minimize erosion and sedimentation, snow removal plans, proper

management of waste materials, proper management of hazardous waste, proper material stockpiling, and spill prevention and control measures.

- Dust Suppression – Water sprays shall be used to control dust during extended dry periods during construction.

- Sanitary Wastes – All sanitary wastes will be collected from the portable units by a licensed sanitary waste management contractor (as required by local regulations).

- Earthwork – The exposure of disturbed surfaces to stormwater and potential stormwater erosion will be minimized by well-organized earthwork procedures. Stabilization procedures shall be undertaken in accordance with this report. Grubbing during wet seasons will be avoided if feasible.

- Snow Removal Plan – Plowed snow collected from the parking areas will be deposited onto free draining, pervious surfaces, away from the site's drainage conveyance structures to maximize infiltration. Snowmelt runoff that is not infiltrated will be directed to the site's stormwater management system. Snow is not to be plowed or piled onto the stormwater management facility or wetlands.

- Waste Materials – Dumpsters rented from a licensed solid waste management company will be used to store solid waste and debris that cannot be recycled, reused or salvaged. The dumpsters will meet all local and state solid waste management regulations. Dumpsters will be covered when refuse is not being directly deposited or withdrawn from them. Potentially hazardous wastes will be separated from normal wastes, including segregation of storage areas and proper labeling of containers. Removal of all waste from the site will be performed by licensed contractors in accordance with applicable regulatory requirements and disposed of at either local or regional approved facilities. Waste materials will not be buried on-site. All site personnel will be instructed regarding the correct procedures for waste disposal. Notices stating these procedures will be posted at the site. Solvents and flushing materials used during construction and pre-operational cleaning will be provided, handled, managed, and removed by the contractor for appropriate off-site disposal.

- Hazardous Waste Materials – Any disposal of hazardous materials will be completed using the required paperwork. Copies will be provided to the Engineer and to the Town.

- Spill Prevention and Control Measures – To minimize the risk of spills or other accidental exposure of materials and substances to stormwater runoff, the following material management practices will be used throughout the project:

    - An effort will be made to store only enough products required to do the job.
    - All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.
    - Products will be kept in their original containers with the original manufacturer's label.

- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, the maximum amount of a product will be used before disposing of the container.
- Manufacturers' recommendations for proper use and disposal will be followed.
- The site superintendent will conduct daily inspections to ensure proper use and disposal of materials.

To reduce the risk associated with hazardous materials used on the site, the following practices will be used:

- Products will be kept in original containers unless they are not resealable.
- Original labels and material safety data sheets will be retained and kept on-site; they contain important product information.
- If surplus product must be disposed of, manufacturers' or local and state recommended methods for proper disposal will be followed.

- Materials List - Materials or substances listed below are expected to be present on-site during construction:

- Concrete	- Fertilizers
- Asphalt	- Petroleum Based Products
- Paints (enamel and latex)	- Cleaning Solvents
- Metal Studs	- Wood
- Concrete	- Tar
- Sealants	- Adhesives

The following product-specific practices will be followed on-site:

- Petroleum Products - All on-site vehicles will be monitored for leaks and receive preventative maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers which area clearly labeled. Any asphalt substances used on-site will be applied according to the manufacturers' recommendations.

- Fertilizers – Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to stormwater. Products will be stored in a covered shed. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.

- Paints – All containers will be tightly sealed and stored indoors when not required for use. Excess paint will not be discharged to the storm sewer system but will be properly disposed of according to the manufacturers' instructions or state and local regulations.

- Concrete Trucks – Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum wash water on the site.

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and cleanup:

- Manufacturers' recommended methods for spill cleanup will be clearly posted, and site personnel will be made aware of the procedures and location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the material storage area on-site. Equipment and materials will include, but not be limited to, brooms, dustpans, mops, rags, gloves, goggles, speedi-dry, sand, sawdust, and plastic and metal trash containers specifically for this purpose.
- All spills will be cleaned up immediately after discovery. Spills large enough to reach the storm water system will be reported to the National Response Center at 1-800-424-8802.
- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous material will be reported to the appropriate state or local government agency, regardless of the size.
- The site superintendent responsible for the day-to-day site operations will be the spill prevention and clean-up coordinator. He will designate at least three other site personnel who will receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel will be posted in the material storage area and in the on-site office trailer.

6.0 STORMWATER OPERATION AND MAINTENANCE PLAN

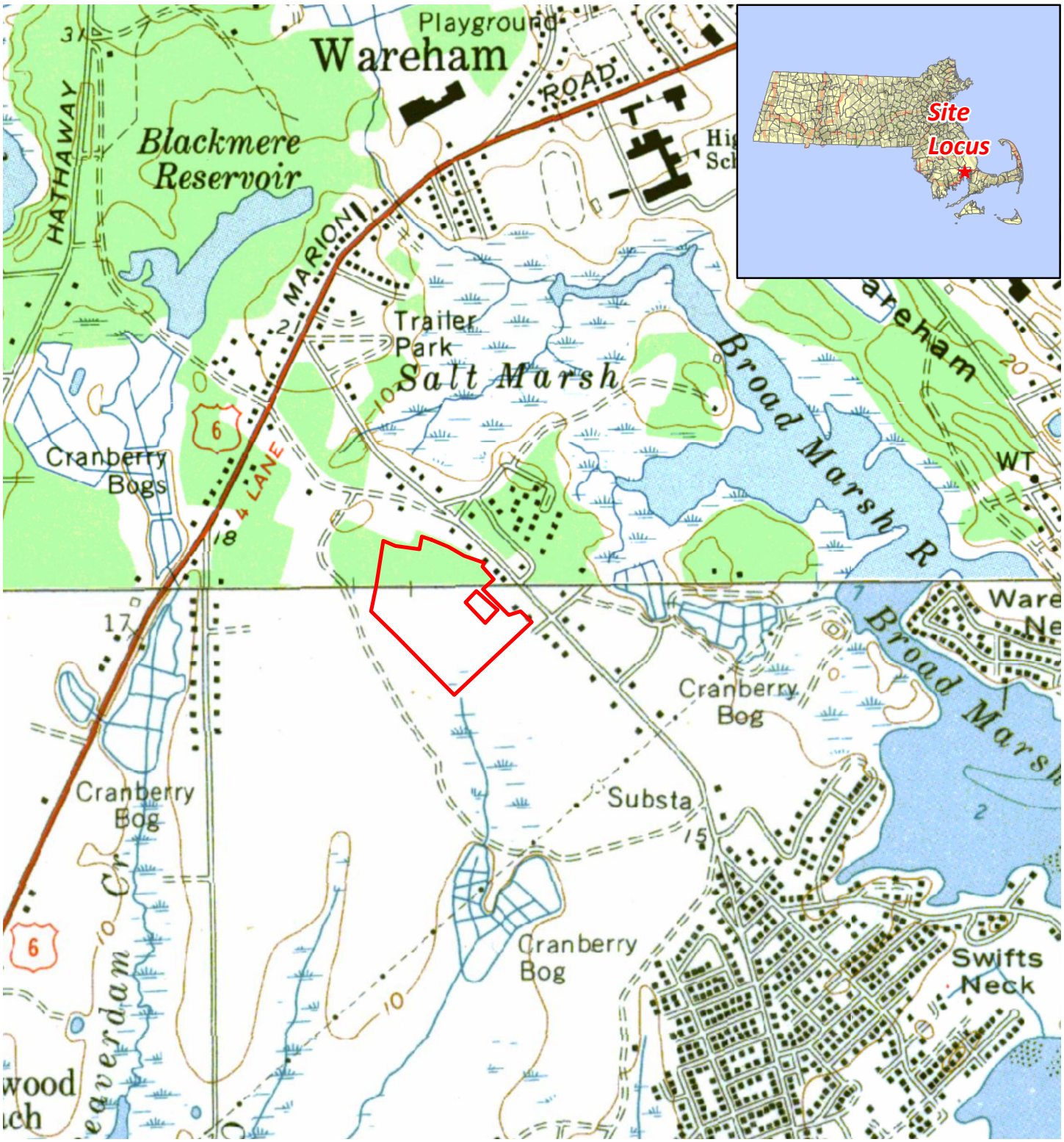
All stormwater management measures and controls identified in this report shall be operated and maintained appropriately during the construction phase of the project and during regular operation of the site in the post-construction period as required on the construction drawings and the separate Stormwater Management Maintenance Plan (**Appendix F**).

7.0 REFERENCES

1. MADEP (Massachusetts Department of Environmental Protection). 2008. Massachusetts Stormwater Standards Manual.

2. Northeast Regional Climate Center and Natural Resources Conservation Service. 2010-2018. Extreme Precipitation for New York and New England. Version 1.12. http://precip.eas.cornell.edu/

FIGURES



Document Path: H:\Projects\2020\20107 Littleton Drive Wareham\GIS\Maps\NOI\USGS_Locus.mxd

Legend

**Wareham/Onset USGS Topographic Quadrangles*

Subject Property

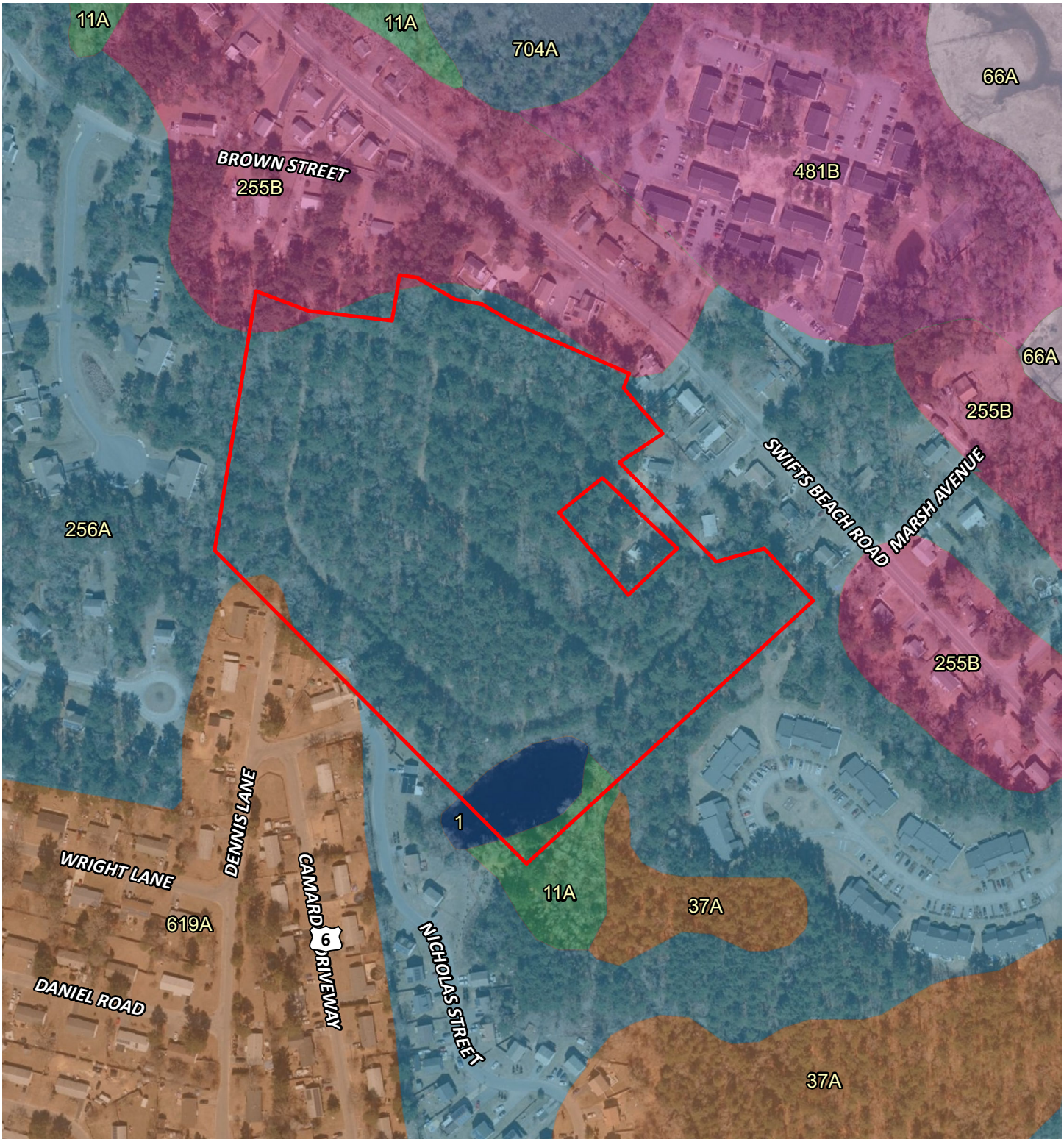
N

0 1,000 Feet

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Unit 1 • Sandwich, MA 02563
508-833-6600 • horsleywitten.com

USGS Locus
Undeveloped Land
4 Littleton Drive
Wareham, MA

Date: 12/16/2020 Figure 1



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Legend

Basemap: Massachusetts 2019 USGS Color Ortho Imagery

- Subject Property
- 1, Water
- 256A, Deerfield, B
- 11A, Rainberry, D
- 255B, Windsor, A
- 37A, Mashpee, D
- 481B, Carver, A
- 619A, Urban land
- 704A, Freetown, D

N

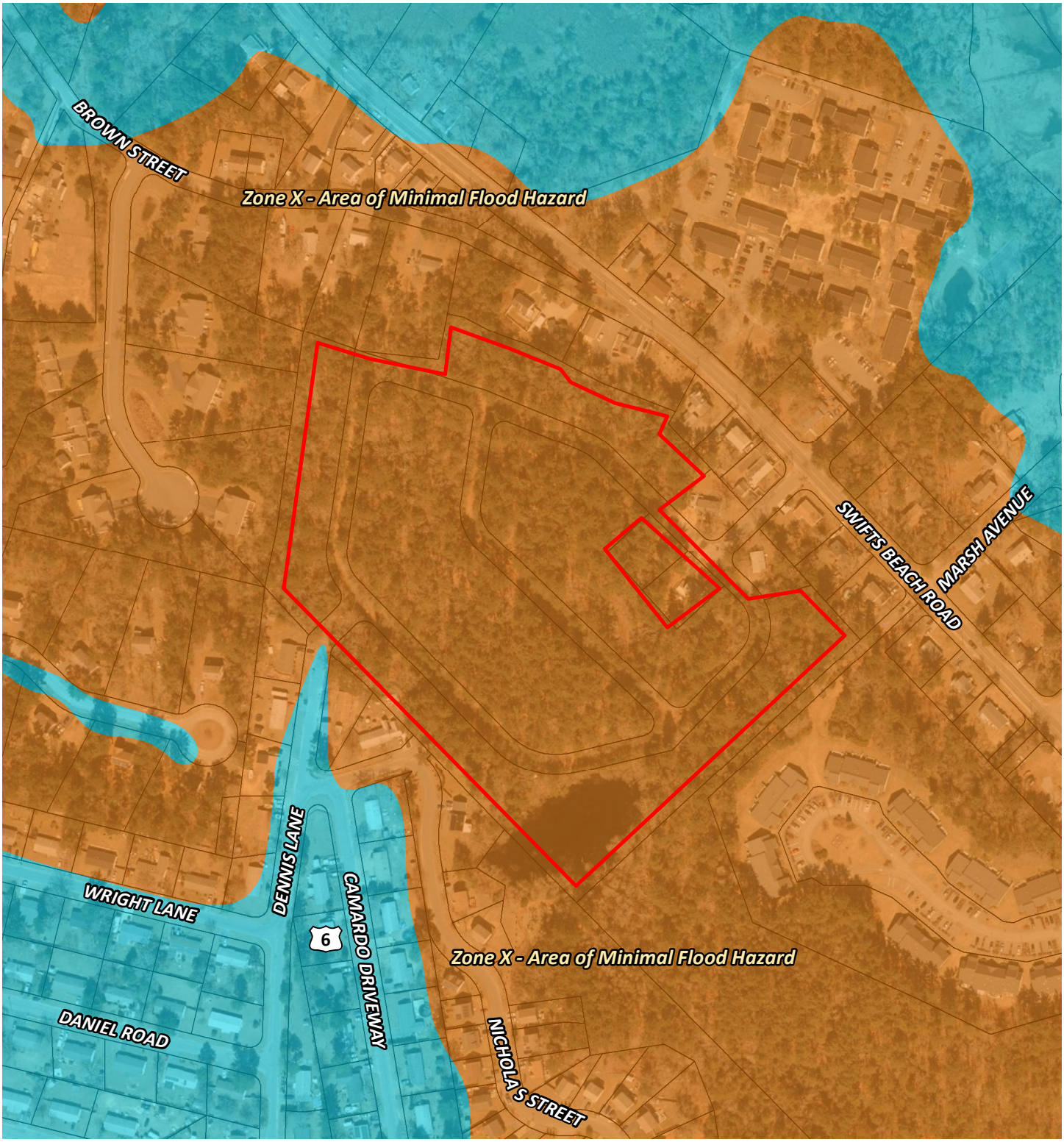
0 200 Feet

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Unit 1 • Sandwich, MA 02563
508-833-6600 • horsleywitten.com

NRCS Soils Map
Undeveloped Land
4 Littleton Drive
Wareham, MA

Date: 12/16/2020

Figure 2



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*2016 NAIP imagery service

- Subject Property
- Parcels

FEMA Flood Hazard

- AE: 1% Annual Chance of Flooding, with BFE
- X: 0.2% Annual Chance of Flooding

N

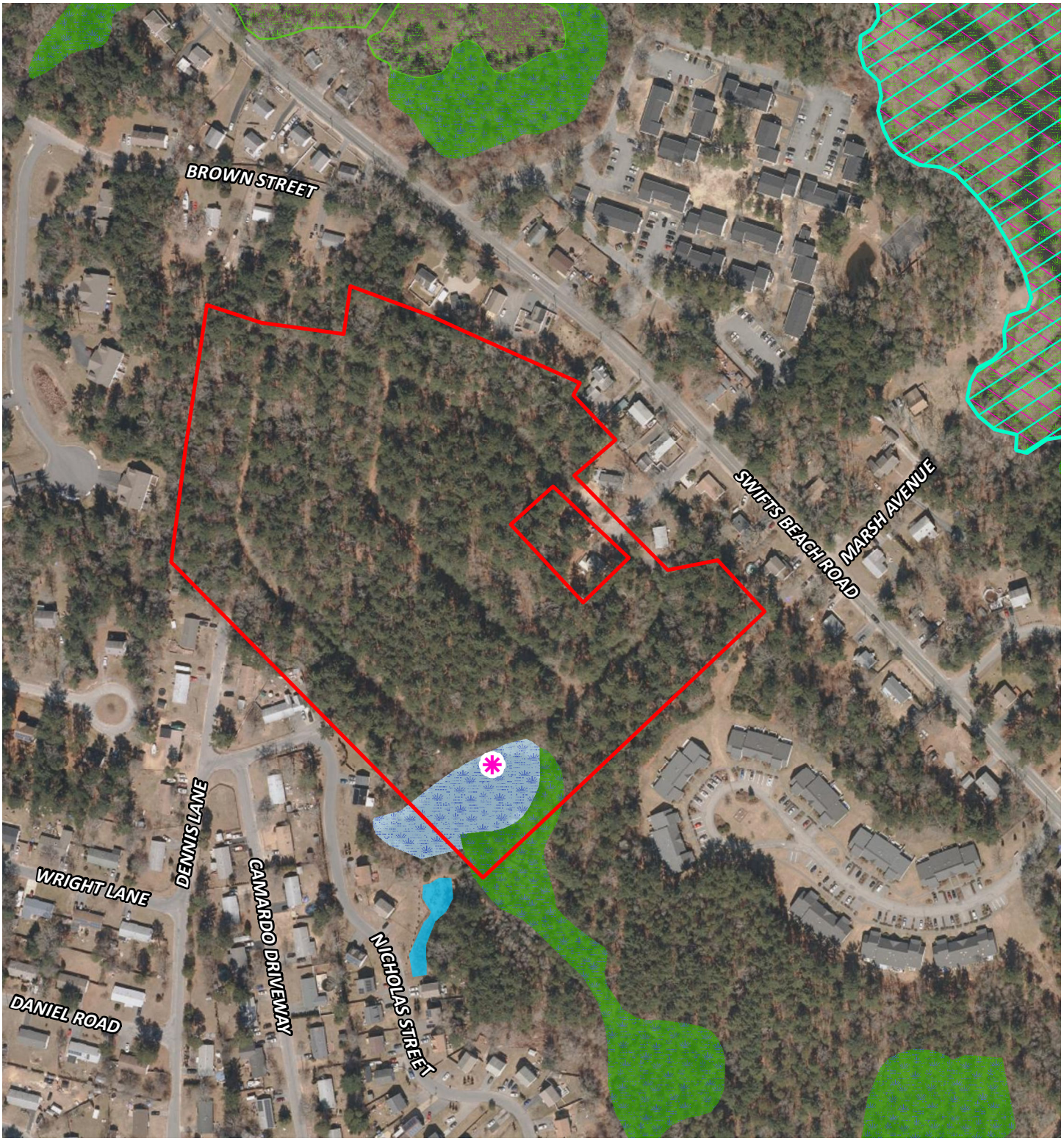
0 200 Feet

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Unit 1 • Sandwich, MA 02563
508-833-6600 • horsleywitten.com

FEMA's National Flood Hazard Layer
Undeveloped Land
4 Littleton Drive
Wareham, MA

Date: 12/16/2020

Figure 3



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Legend

- Subject Property
- Potential Vernal Pools

Natural Heritage Atlas (14th Ed.)

- NHESP Priority Habitats of Rare Species
- NHESP Estimated Habitats of Rare Wildlife

MassDEP Wetlands (2005)

- Marsh/Bog
- Wooded marsh
- Salt Marsh
- Open Water

Basemap: Massachusetts 2019 USGS Color Ortho Imagery

N

0 200 Feet

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Unit 1 • Sandwich, MA 02563
508-833-6600 • horsleywitten.com

Existing Constraints Undeveloped Land 4 Littleton Drive Wareham, MA

Date: 12/16/2020

Figure 4

APPENDIX A

Site Soil Evaluations

NRCS Soils Report

Commonwealth of Massachusetts

City/Town of Wareham

Soil Suitability Assessment

On-Site Review

Deep Observation Hole Number: 1 (Hole #) | 12/18/2020 (Date) | 8:00 am- 3:00 pm (Time) | 38F, Cloudy (Weather) | (Latitude) | (Longitude)

1. Land Use: Woods (e.g. woodland, agricultural field, vacant lot, etc.) | low brush/woods (Vegetation) | None (Surface Stones (e.g. cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: see site plan

2. Soil Parent Material: Outwash | Outwash plain (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances From:

Open Water Body	>100'	feet	Drainage Way	>100'	feet	Wetlands	>100'	feet
Property Line	>100'	feet	Drinking Water Well	NA	feet	Other		feet

4. Unsuitable Materials Present: ☐ Yes ☑ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☑ Yes ☐ No If Yes: _____ Depth weeping from pit 90" Depth standing water in hole

Soil Log

Depth (in)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles/Stones			
5-0	O			-	-	-	-	-			
0-9	Ap	LS	10 YR 4/1	-	-	-	<1	<1	M	L	
9-33	Bw	LS	10 YR 6/6	-	-	-	<1	<1	M	L	
33-96	C	FMS	10 YR 7/3	64"	7.5 YR 6/8 10 YR 8/2	25%	<1	<1	M	Fr	

Additional Notes:

Commonwealth of Massachusetts

City/Town of Wareham

Soil Suitability Assessment

On-Site Review

Deep Observation Hole Number: 2 (Hole #) | 12/18/2020 (Date) | 8:00 am- 3:00 pm (Time) | 38F, Cloudy (Weather) | (Latitude) | (Longitude)

1. Land Use: Woods (e.g. woodland, agricultural field, vacant lot, etc.) | low brush/woods (Vegetation) | None (Surface Stones (e.g. cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: see site plan

2. Soil Parent Material: Outwash | Outwash plain (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances From:

Open Water Body	>100'	feet	Drainage Way	>100'	feet	Wetlands	>100'	feet
Property Line	>100'	feet	Drinking Water Well	NA	feet	Other		feet

4. Unsuitable Materials Present: ☐ Yes ☑ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☑ Yes ☐ No If Yes: 91" Depth weeping from pit _____ Depth standing water in hole

Soil Log

Depth (in)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles/Stones			
3-0	O			-	-	-	-	-			
0-2	A	LS	10 YR 5/1	-	-	-	<1	<1	M	L	
2-4	Bw_1	LS	10 YR 3/3	-	-	-	<1	<1	M	L	
4-24	Bw_2	LS	10 YR 7/6				<1	<1	M	L	
24-100	C	FS	10 YR 7/3	48"	5 YR 5/8 5 YR 7/1	25%	<1	<1	M	Fr	

Additional Notes:

Commonwealth of Massachusetts

City/Town of Wareham

Soil Suitability Assessment

On-Site Review

Deep Observation Hole Number: 3 (Hole #) | 12/18/2020 (Date) | 8:00 am- 3:00 pm (Time) | 38F, Cloudy (Weather) | (Latitude) | (Longitude)

1. Land Use: Woods (e.g. woodland, agricultural field, vacant lot, etc.) | low brush/woods (Vegetation) | None (Surface Stones (e.g. cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: see site plan

2. Soil Parent Material: Outwash | Outwash plain (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances From:

Open Water Body	>100'	feet	Drainage Way	>100'	feet	Wetlands	>100'	feet
Property Line	>100'	feet	Drinking Water Well	NA	feet	Other		feet

4. Unsuitable Materials Present: ☐ Yes ☑ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☑ No If Yes: NA Depth weeping from pit NA Depth standing water in hole

Soil Log

Depth (in)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles/Stones			
4-0	O			-	-	-	-	-			
0-2	A	LS	10 YR 4/1	-	-	-	<1	<1	M	L	
2-4	E	LS	10 YR 5/1	-	-	-	<1	<1	M	L	
4-24	Bw	LS	10 YR 6/6	-	-	-	<1	<1	M	L	
24-32	C_1	CS	10 YR 6/6	-	-	-	5	<1	M	L	
32-126	C_2	FS	10 YR 7/4	-	-	-	<1	<1	M	Fr	

Additional Notes:

Commonwealth of Massachusetts

City/Town of Wareham

Soil Suitability Assessment

On-Site Review

Deep Observation Hole Number: 4 (Hole #) | 12/18/2020 (Date) | 8:00 am- 3:00 pm (Time) | 38F, Cloudy (Weather) | (Latitude) | (Longitude)

1. Land Use: Woods (e.g. woodland, agricultural field, vacant lot, etc.) | low brush/woods (Vegetation) | None (Surface Stones (e.g. cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: see site plan

2. Soil Parent Material: Outwash | Outwash plain (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances From:

Open Water Body	>100'	feet	Drainage Way	>100'	feet	Wetlands	>100'	feet
Property Line	>100'	feet	Drinking Water Well	NA	feet	Other		feet

4. Unsuitable Materials Present: ☐ Yes ☑ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☑ No If Yes: NA Depth weeping from pit NA Depth standing water in hole

Soil Log

Depth (in)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles/Stones			
5-0	O			-	-	-	-	-			
0-2	A	LS	10 YR 3/1	-	-	-	<1	<1	M	L	
2-4	E	LS	10 YR 7/1	-	-	-	<1	<1	M	L	
4-6	Bw_1	LS	10 YR 3/4	-	-	-	<1	<1	M	L	
6-18	Bw_2	LS	10 YR 6/8	-	-	-	<1	<1	M	L	
18-24	C_1	CS	10 YR 6/8	-	-	-	15	<1	M	L	
24-108	C_2	FS	10 YR 7/4	-	-	-	<1	<1	M	Fr	

Additional Notes:

Commonwealth of Massachusetts

City/Town of Wareham

Soil Suitability Assessment

On-Site Review

Deep Observation Hole Number: 5 (Hole #) | 12/18/2020 (Date) | 8:00 am- 3:00 pm (Time) | 38F, Cloudy (Weather) | (Latitude) | (Longitude)

1. Land Use: Woods (e.g. woodland, agricultural field, vacant lot, etc.) | low brush/woods (Vegetation) | None (Surface Stones (e.g. cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: see site plan

2. Soil Parent Material: Outwash | Outwash plain (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances From:

Open Water Body	>100'	feet	Drainage Way	>100'	feet	Wetlands	>100'	feet
Property Line	>100'	feet	Drinking Water Well	NA	feet	Other		feet

4. Unsuitable Materials Present: ☐ Yes ☑ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☑ No If Yes: NA Depth weeping from pit 84" Depth standing water in hole

Soil Log

Depth (in)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles/Stones			
3-0	O			-	-	-	-	-			
0-3	A	LS	10 YR 3/1	-	-	-	<1	<1	M	L	
3-5	E	LS	10 YR 7/1	-	-	-	<1	<1	M	L	
5-9	Bw_1	LS	10 YR 5/6	-	-	-	<1	<1	M	L	
9-21	Bw_2	LS	10 YR 6/6	-	-	-	<1	<1	M	L	
21-30	C_1	CS	10 YR 6/6	-	-	-	10	<1	M	L	
30-90	C_2	FS	10 YR 7/2	60"	10 YR 7/8 10 YR 7/3	25%	<1	<1	M	Fr	

Additional Notes:

Commonwealth of Massachusetts

City/Town of Wareham

Soil Suitability Assessment

On-Site Review

Deep Observation Hole Number: 6 (Hole #) | 12/18/2020 (Date) | 8:00 am- 3:00 pm (Time) | 38F, Cloudy (Weather) | (Latitude) | (Longitude)

1. Land Use: Woods (e.g. woodland, agricultural field, vacant lot, etc.) | low brush/woods (Vegetation) | None (Surface Stones (e.g. cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: see site plan

2. Soil Parent Material: Outwash | Outwash plain (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances From:

Open Water Body	>100'	feet	Drainage Way	>100'	feet	Wetlands	>100'	feet
Property Line	>100'	feet	Drinking Water Well	NA	feet	Other		feet

4. Unsuitable Materials Present: ☐ Yes ☑ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☑ No If Yes: NA Depth weeping from pit 70" Depth standing water in hole

Soil Log

Depth (in)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles/Stones			
3-0	O			-	-	-	-	-			
0-3	A	LS	10 YR 3/1	-	-	-	<1	<1	M	L	
3-5	E	LS	10 YR 7/2	-	-	-	<1	<1	M	L	
5-9	Bw_1	LS	10 YR 4/4	-	-	-	<1	<1	M	L	
9-24	Bw_2	LS	10 YR 8/2	-	-	-	<1	<1	M	L	
24-41	C_1	CS	10 YR 7/4	-	-	-	10	<1	M	L	
41-96	C_2	FS	10 YR 8/3	48"	10 YR 7/8 10 YR 7/3	25%	<1	<1	M	Fr	

Additional Notes:

Horsley Witten Group, Inc.
Sustainable Environmental Solutions
www.horsleywitten.com

Double Ring Infiltrometer Test Results
Project: Littleton Drive Affordable Housing
Project No: 20107
Calculated By: JEH
Checked By: RAC

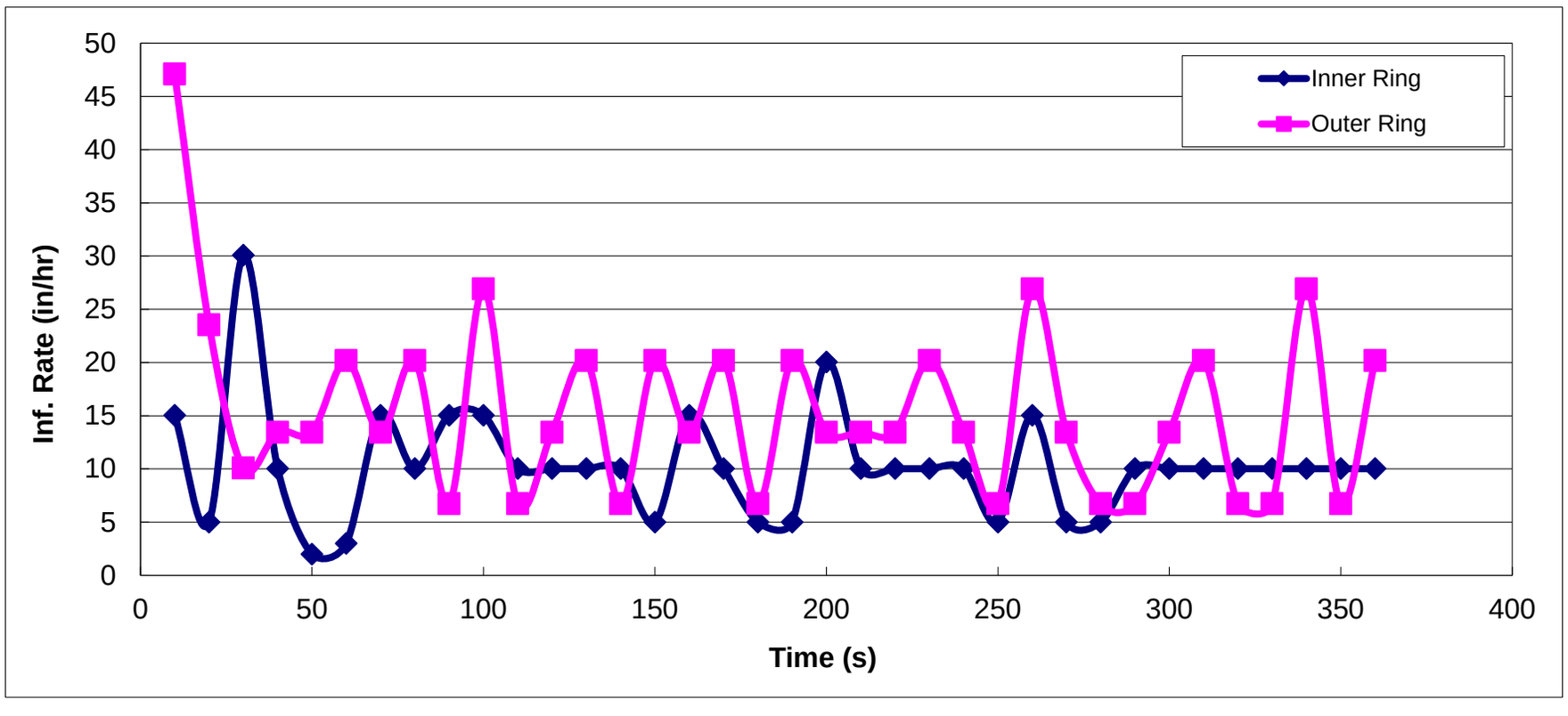
Location: **TP-6**
Date: **12/18/20**
Time: **14:00**
Depth of Test: **44"**

	Depth of Water, H (in)		**Ring Penetration Depth (in)**	
	inner	**outer**	**inner**	**outer**
H_{init}	**3**	**3**	**5**	**5**
H_{final}	**3**	**3**		

Weather: **Mostly sunny**
Air (°F): **35** **H_2O (°F):** **40**

Time (mm:ss)	Time (s)	Δ Time (s)	Inner Ring Level (cm3)	Inner Ring D Level (cm3)	Inner Ring IC (cm/s)	Inner Ring IC (cm/hr)	Inner Ring IC (in/hr)	Outer Ring Level (cm3)	Outer Ring D Level (cm3)	Outer Ring IR (cm/s)	Outer Ring IR (cm/hr)	Outer Ring IC (in/hr)
00:00	0	0		-	-	-	-	0	-	-	-	-
00:10	10	10	75	75	0.011	38	15	700	700	0.033	120	47
00:20	20	10	100	25	0.004	13	5	1050	350	0.017	60	24
00:30	30	10	250	150	0.021	76	30	1200	150	0.007	26	10
00:40	40	10	300	50	0.007	25	10	1400	200	0.009	34	13
00:50	50	10	310	10	0.001	5	2	1600	200	0.009	34	13
01:00	60	10	325	15	0.002	8	3	1900	300	0.014	51	20
01:10	70	10	400	75	0.011	38	15	2100	200	0.009	34	13
01:20	80	10	450	50	0.007	25	10	2400	300	0.014	51	20
01:30	90	10	525	75	0.011	38	15	2500	100	0.005	17	7
01:40	100	10	600	75	0.011	38	15	2900	400	0.019	68	27
01:50	110	10	650	50	0.007	25	10	3000	100	0.005	17	7
02:00	120	10	700	50	0.007	25	10	3200	200	0.009	34	13
02:10	130	10	750	50	0.007	25	10	3500	300	0.014	51	20
02:20	140	10	800	50	0.007	25	10	3600	100	0.005	17	7
02:30	150	10	825	25	0.004	13	5	3900	300	0.014	51	20
02:40	160	10	900	75	0.011	38	15	4100	200	0.009	34	13
02:50	170	10	950	50	0.007	25	10	4400	300	0.014	51	20
03:00	180	10	975	25	0.004	13	5	4500	100	0.005	17	7
03:10	190	10	1000	25	0.004	13	5	4800	300	0.014	51	20
03:30	200	10	1100	100	0.014	51	20	5000	200	0.009	34	13
03:40	210	10	1150	50	0.007	25	10	5200	200	0.009	34	13
03:50	220	10	1200	50	0.007	25	10	5400	200	0.009	34	13
04:00	230	10	1250	50	0.007	25	10	5700	300	0.014	51	20
04:10	240	10	1300	50	0.007	25	10	5900	200	0.009	34	13
04:20	250	10	1325	25	0.004	13	5	6000	100	0.005	17	7
04:30	260	10	1400	75	0.011	38	15	6400	400	0.019	68	27
04:40	270	10	1425	25	0.004	13	5	6600	200	0.009	34	13
04:50	280	10	1450	25	0.004	13	5	6700	100	0.005	17	7
05:00	290	10	1500	50	0.007	25	10	6800	100	0.005	17	7
05:10	300	10	1550	50	0.007	25	10	7000	200	0.009	34	13
05:20	310	10	1600	50	0.007	25	10	7300	300	0.014	51	20
05:30	320	10	1650	50	0.007	25	10	7400	100	0.005	17	7
05:40	330	10	1700	50	0.007	25	10	7500	100	0.005	17	7
05:50	340	10	1750	50	0.007	25	10	7900	400	0.019	68	27
06:00	350	10	1800	50	0.007	25	10	8000	100	0.005	17	7
06:10	360	10	1850	50	0.007	25	10	8300	300	0.014	51	20
		.			**Avg**	**26.2**	**10.3**			**Avg**	**39.4**	**15.5**

Area Inner Ring (cm2)	**707**
Area Outer Ring (cm2)	**2827**
Area Annular Space (cm2)	**2107**



Horsley Witten Group, Inc.
Sustainable Environmental Solutions
www.horsleywitten.com

Double Ring Infiltrometer Test Results
Project: Littleton Drive Affordable Housing
Project No: 20107
Calculated By: JEH
Checked By: RAC

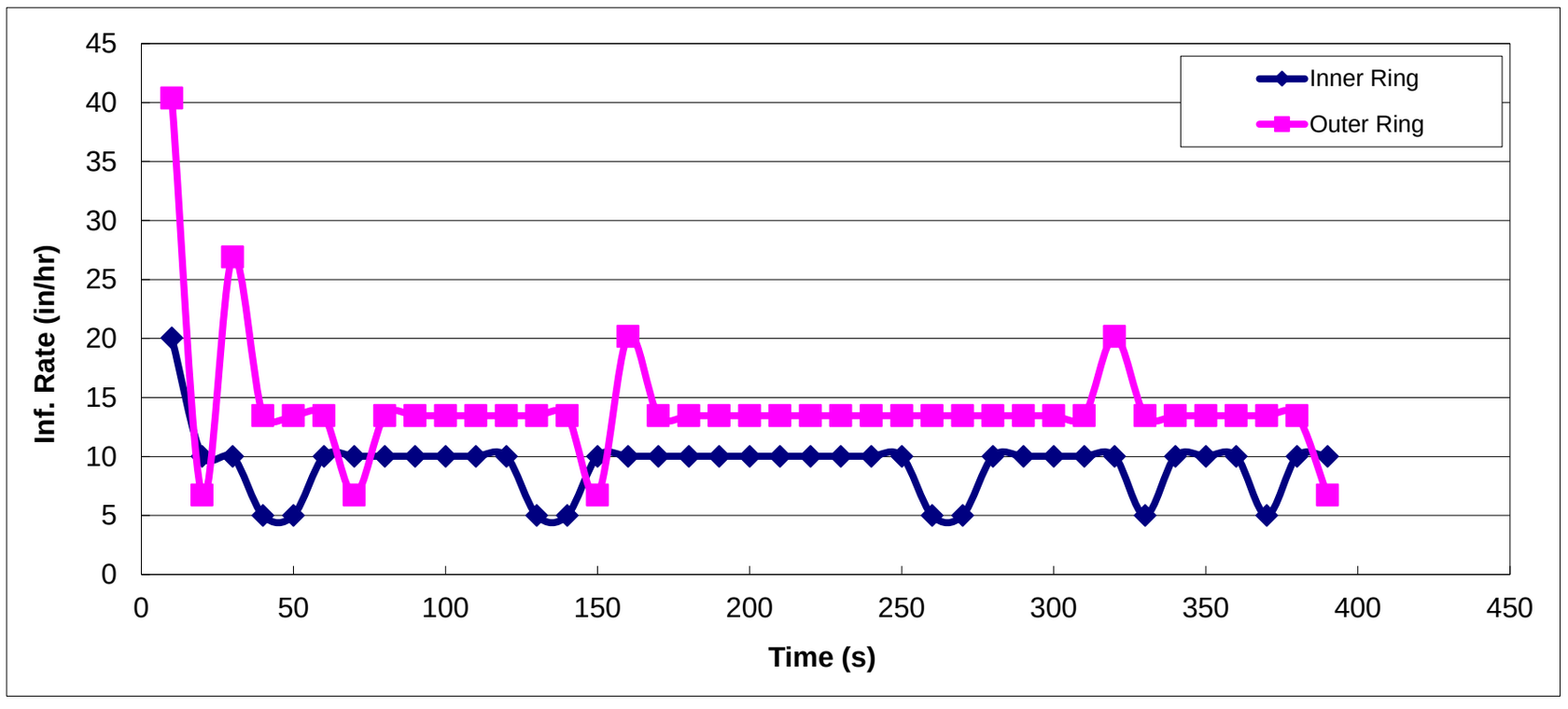
Location: **TP-6**
Date: **12/18/20**
Time: **14:00**
Depth of Test: **44"**

	Depth of Water, H (in)		Ring Penetration Depth (in)	
	inner	**outer**	**inner**	**outer**
H_{init}	**3**	**3**	**5**	**5**
H_{final}	**3**	**3**		

Weather: Mostly sunny
Air (°F): 35 **H_2O (°F): 40**

Time (mm:ss)	Time (s)	Δ Time (s)	Inner Ring					Outer Ring				
			Level (cm3)	D Level (cm3)	IC (cm/s)	IC (cm/hr)	IC (in/hr)	Level (cm3)	D Level (cm3)	IR (cm/s)	IR (cm/hr)	IC (in/hr)
00:00	0	0		-	-	-	-	0	-	-	-	-
00:10	10	10	100	100	0.014	51	20	600	600	0.028	103	40
00:20	20	10	150	50	0.007	25	10	700	100	0.005	17	7
00:30	30	10	200	50	0.007	25	10	1100	400	0.019	68	27
00:40	40	10	225	25	0.004	13	5	1300	200	0.009	34	13
00:50	50	10	250	25	0.004	13	5	1500	200	0.009	34	13
01:00	60	10	300	50	0.007	25	10	1700	200	0.009	34	13
01:10	70	10	350	50	0.007	25	10	1800	100	0.005	17	7
01:20	80	10	400	50	0.007	25	10	2000	200	0.009	34	13
01:30	90	10	450	50	0.007	25	10	2200	200	0.009	34	13
01:40	100	10	500	50	0.007	25	10	2400	200	0.009	34	13
01:50	110	10	550	50	0.007	25	10	2600	200	0.009	34	13
02:00	120	10	600	50	0.007	25	10	2800	200	0.009	34	13
02:10	130	10	625	25	0.004	13	5	3000	200	0.009	34	13
02:20	140	10	650	25	0.004	13	5	3200	200	0.009	34	13
02:30	150	10	700	50	0.007	25	10	3300	100	0.005	17	7
02:40	160	10	750	50	0.007	25	10	3600	300	0.014	51	20
02:50	170	10	800	50	0.007	25	10	3800	200	0.009	34	13
03:00	180	10	850	50	0.007	25	10	4000	200	0.009	34	13
03:10	190	10	900	50	0.007	25	10	4200	200	0.009	34	13
03:30	200	10	950	50	0.007	25	10	4400	200	0.009	34	13
03:40	210	10	1000	50	0.007	25	10	4600	200	0.009	34	13
03:50	220	10	1050	50	0.007	25	10	4800	200	0.009	34	13
04:00	230	10	1100	50	0.007	25	10	5000	200	0.009	34	13
04:10	240	10	1150	50	0.007	25	10	5200	200	0.009	34	13
04:20	250	10	1200	50	0.007	25	10	5400	200	0.009	34	13
04:30	260	10	1225	25	0.004	13	5	5600	200	0.009	34	13
04:40	270	10	1250	25	0.004	13	5	5800	200	0.009	34	13
04:50	280	10	1300	50	0.007	25	10	6000	200	0.009	34	13
05:00	290	10	1350	50	0.007	25	10	6200	200	0.009	34	13
05:10	300	10	1400	50	0.007	25	10	6400	200	0.009	34	13
05:20	310	10	1450	50	0.007	25	10	6600	200	0.009	34	13
05:30	320	10	1500	50	0.007	25	10	6900	300	0.014	51	20
05:40	330	10	1525	25	0.004	13	5	7100	200	0.009	34	13
05:50	340	10	1575	50	0.007	25	10	7300	200	0.009	34	13
06:00	350	10	1625	50	0.007	25	10	7500	200	0.009	34	13
06:10	360	10	1675	50	0.007	25	10	7700	200	0.009	34	13
06:20	370	10	1700	25	0.004	13	5	7900	200	0.009	34	13
06:30	380	10	1750	50	0.007	25	10	8100	200	0.009	34	13
06:40	390	10	1800	50	0.007	25	10	8200	100	0.005	17	7
					Avg	**23.5**	**9.3**			**Avg**	**35.9**	**14.1**

Area Inner Ring (cm2)	**707**
Area Outer Ring (cm2)	**2827**
Area Annular Space (cm2)	**2107**



United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Plymouth County, Massachusetts

Littleton Village

November 17, 2020

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:8,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 100 200 400 600

Feet
0 400 800 1600 2400

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.

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 13, Jun 9, 2020

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

Date(s) aerial images were photographed: Dec 31, 2009—Jul 3, 2017

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	1.6	0.5%
11A	Rainberry coarse sand, 0 to 3 percent slopes	3.8	1.1%
37A	Massasoit - Mashpee complex, 0 to 3 percent slopes	12.3	3.7%
60A	Swansea coarse sand, 0 to 2 percent slopes	13.4	4.0%
66A	Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded	34.0	10.2%
255B	Windsor loamy sand, 3 to 8 percent slopes	71.0	21.2%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	111.5	33.3%
256B	Deerfield loamy fine sand, 3 to 8 percent slopes	12.0	3.6%
480B	Plymouth - Carver complex, 3 to 8 percent slopes	8.3	2.5%
481B	Plymouth - Carver complex, 3 to 8 percent slopes, bouldery	13.1	3.9%
608	Water, ocean	12.1	3.6%
619A	Deerfield-Urban land complex, 0 to 3 percent slopes	32.5	9.7%
665B	Udipsamments, 0 to 8 percent slopes	0.9	0.3%
700A	Udipsamments, wet substratum, 0 to 3 percent slopes	0.0	0.0%
704A	Freetown and Swansea coarse sands, 0 to 3 percent slopes, sanded surface and inactive	8.3	2.5%
Totals for Area of Interest		**334.9**	**100.0%**

Map Unit Descriptions

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

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the

landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present

or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

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

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

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: Kettles, bogs, swamps, marshes, depressions
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: Bogs, marshes, kettles, swamps, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

11A—Rainberry coarse sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9y41
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

Rainberry and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rainberry

Setting

Landform: Kettles, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile

Oi - 0 to 4 inches: slightly decomposed plant material
Oe - 4 to 7 inches: moderately decomposed plant material
A - 7 to 9 inches: coarse sand
Eg - 9 to 13 inches: coarse sand
Bhs1 - 13 to 15 inches: coarse sand
Bhs2 - 15 to 17 inches: coarse sand
Bs - 17 to 21 inches: coarse sand
Bhs3 - 21 to 29 inches: gravelly coarse sand
Cg1 - 29 to 33 inches: gravelly coarse sand
Cg2 - 33 to 67 inches: gravelly 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 high to very high (1.42 to 19.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F149BY008MA - Very Wet Outwash
Hydric soil rating: Yes

Minor Components

Massasoit

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

Mashpee

Percent of map unit: 5 percent
Landform: Terraces, depressions, drainageways

Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Depressions, kettles, bogs, swamps, marshes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Deerfield

Percent of map unit: 2 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

37A—Massasoit - Mashpee complex, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: bd1q
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

Massasoit and similar soils: 55 percent
Mashpee and similar soils: 35 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Massasoit

Setting

Landform: Terraces, drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
Oa - 1 to 3 inches: highly decomposed plant material
A - 3 to 5 inches: fine sand
Eg1 - 5 to 11 inches: fine sand
Eg2 - 11 to 13 inches: fine sand
Bhs - 13 to 17 inches: fine sand
Bsm - 17 to 23 inches: fine sand
Bs - 23 to 26 inches: fine sand
BC - 26 to 43 inches: fine sand
Cg - 43 to 80 inches: loamy very fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to ortstein
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.01 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Occasional
Available water capacity: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

Description of Mashpee

Setting

Landform: Terraces, depressions, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile

Oe1 - 0 to 2 inches: moderately decomposed plant material
Oe2 - 2 to 4 inches: moderately decomposed plant material
Oa - 4 to 5 inches: highly decomposed plant material
AE - 5 to 7 inches: loamy fine sand
Eg - 7 to 11 inches: fine sand
Bh1 - 11 to 13 inches: fine sand
Bh2 - 13 to 17 inches: fine sand
Bs - 17 to 24 inches: loamy fine sand
C1 - 24 to 39 inches: fine sand
C2 - 39 to 65 inches: fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 5.95 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Occasional
Available water capacity: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

Minor Components

Deerfield

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

Rainberry

Percent of map unit: 3 percent
Landform: Depressions, kettles
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: Yes

Squamscott

Percent of map unit: 2 percent
Landform: Lake plains, lake terraces
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

60A—Swansea coarse sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2w68y
Elevation: 0 to 170 feet

Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Swansea, Sanded Surface

Setting

Landform: Depressions, bogs, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy human-transported material over highly decomposed organic material over sandy and gravelly glaciofluvial deposits

Typical profile

^Ap - 0 to 15 inches: coarse sand
2Oab - 15 to 36 inches: muck
2Cg - 36 to 79 inches: sand

Properties and qualities

Slope: 0 to 2 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: FrequentNone
Frequency of ponding: None
Available water capacity: Very high (about 12.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Freetown, sanded surface

Percent of map unit: 5 percent
Landform: Kettles, depressions, bogs
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Aquic udipsamments

Percent of map unit: 3 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread

Down-slope shape: Linear, convex, concave
Across-slope shape: Linear, convex, concave
Hydric soil rating: No

Rainberry, sanded surface

Percent of map unit: 3 percent
Landform: Depressions, kettles
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: Yes

Tihonet

Percent of map unit: 3 percent
Landform: Bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

66A—Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded

Map Unit Setting

National map unit symbol: 2tyqm
Elevation: 0 to 10 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Ipswich and similar soils: 50 percent
Pawcatuck and similar soils: 25 percent
Matunuck and similar soils: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ipswich

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material

Typical profile

Oe - 0 to 42 inches: mucky peat
Oa - 42 to 59 inches: muck

Properties and qualities

Slope: 0 to 2 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 very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (1.0 to 112.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water capacity: Very high (about 26.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded, R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded
Hydric soil rating: Yes

Description of Pawcatuck

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material over sandy mineral material

Typical profile

Oe - 0 to 46 inches: mucky peat
Cg - 46 to 60 inches: mucky sand

Properties and qualities

Slope: 0 to 2 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 very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (1.0 to 112.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water capacity: Very high (about 21.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D

Ecological site: R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded, R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded
Hydric soil rating: Yes

Description of Matunuck

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material over glaciofluvial deposits and/or sandy marine deposits

Typical profile

Oe - 0 to 12 inches: mucky peat
Cg - 12 to 72 inches: sand

Properties and qualities

Slope: 0 to 2 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 very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (1.0 to 112.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water capacity: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded, R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded
Hydric soil rating: Yes

Minor Components

Hooksan

Percent of map unit: 5 percent
Landform: Dunes
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Succotash

Percent of map unit: 5 percent
Landform: Spits on back-barrier flats
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear

Hydric soil rating: No

255B—Windsor loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svkf
Elevation: 0 to 1,210 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Windsor, Loamy Sand

Setting

Landform: Deltas, outwash plains, dunes, outwash terraces
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

O - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley, loamy sand

Percent of map unit: 10 percent
Landform: Deltas, outwash plains, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Deerfield, loamy sand

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

256A—Deerfield loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xfg8
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Deerfield

Setting

Landform: Kame terraces, outwash plains, outwash deltas, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear, concave
Across-slope shape: Concave, linear, convex

Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 11.0
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 7 percent
Landform: Outwash deltas, kame terraces, outwash terraces, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave, convex
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Wareham

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sudbury

Percent of map unit: 2 percent
Landform: Kame terraces, outwash plains, outwash terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear, concave
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Ninigret

Percent of map unit: 1 percent
Landform: Outwash terraces, outwash plains, kame terraces
Landform position (three-dimensional): Tread

Down-slope shape: Linear, convex
Across-slope shape: Concave, convex
Hydric soil rating: No

256B—Deerfield loamy fine sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2xfg9
Elevation: 0 to 1,190 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Deerfield

Setting

Landform: Kame terraces, outwash plains, outwash terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear, concave
Across-slope shape: Concave, linear, convex
Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 11.0
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w

Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Windsor
Percent of map unit: 7 percent
Landform: Outwash deltas, kame terraces, outwash plains, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave, convex
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Wareham
Percent of map unit: 5 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sudbury
Percent of map unit: 2 percent
Landform: Outwash deltas, kame terraces, outwash plains, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave, convex
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Ninigret
Percent of map unit: 1 percent
Landform: Kame terraces, outwash terraces, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, concave
Hydric soil rating: No

480B—Plymouth - Carver complex, 3 to 8 percent slopes

Map Unit Setting
National map unit symbol: bcyz
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
Plymouth and similar soils: 45 percent
Carver and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Plymouth

Setting

Landform: Outwash plains, moraines
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly supraglacial meltout till over sandy and gravelly glaciofluvial deposits

Typical profile

Oi - 0 to 4 inches: slightly decomposed plant material
Oe - 4 to 6 inches: moderately decomposed plant material
A - 6 to 7 inches: loamy coarse sand
E - 7 to 11 inches: coarse sand
Bs - 11 to 15 inches: loamy coarse sand
Bw - 15 to 20 inches: coarse sand
BC - 20 to 29 inches: coarse sand
C - 29 to 64 inches: gravelly coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very 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 capacity: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Description of Carver

Setting

Landform: Outwash plains, pitted outwash plains, moraines
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand

Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Minor Components

Barnstable

Percent of map unit: 10 percent
Landform: Moraines
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, kames
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

481B—Plymouth - Carver complex, 3 to 8 percent slopes, bouldery

Map Unit Setting

National map unit symbol: bcz2
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

Plymouth, bouldery, and similar soils: 45 percent
Carver, bouldery, and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Plymouth, Bouldery

Setting

Landform: Outwash plains, moraines
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly supraglacial meltout till over sandy and gravelly glaciofluvial deposits

Typical profile

Oi - 0 to 4 inches: slightly decomposed plant material
Oe - 4 to 6 inches: moderately decomposed plant material
A - 6 to 7 inches: loamy coarse sand
E - 7 to 11 inches: coarse sand
Bs - 11 to 15 inches: loamy coarse sand
Bw - 15 to 20 inches: coarse sand
BC - 20 to 29 inches: coarse sand
C - 29 to 64 inches: gravelly coarse sand

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 0.1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very 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 capacity: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Description of Carver, Bouldery

Setting

Landform: Outwash plains, pitted outwash plains, moraines
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand
Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 0.1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Minor Components

Barnstable, bouldery

Percent of map unit: 5 percent
Landform: Moraines
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Poquonock, bouldery

Percent of map unit: 5 percent
Landform: Drumlins, ground moraines, till plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, kames
Landform position (two-dimensional): Summit, shoulder

Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

608—Water, ocean

Map Unit Setting
National map unit symbol: bqv2
Elevation: 0 to 70 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition
Water, ocean: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Beaches, sandy
Percent of map unit: 5 percent
Landform: Shores, back-barrier beaches, barrier beaches, beaches
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: Unranked

619A—Deerfield-Urban land complex, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: 2xfgb
Elevation: 0 to 210 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
Deerfield and similar soils: 45 percent
Urban land: 35 percent
Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deerfield

Setting

Landform: Kame terraces, outwash plains, outwash terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear, concave
Across-slope shape: Concave, linear, convex
Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 11.0
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Outwash plains
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 0 inches to manufactured layer
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Walpole
Percent of map unit: 7 percent
Landform: Outwash plains, outwash terraces, outwash deltas, depressions
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Udorthents
Percent of map unit: 5 percent
Landform: Outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Windsor
Percent of map unit: 5 percent
Landform: Outwash plains, outwash terraces, outwash deltas, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave, convex
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Merrimac
Percent of map unit: 3 percent
Landform: Kame terraces, outwash terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave, convex
Hydric soil rating: No

665B—Udipsamments, 0 to 8 percent slopes

Map Unit Setting
National map unit symbol: 2pr8k
Elevation: 0 to 390 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
Udipsamments and similar soils: 80 percent

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

Description of Udipsamments

Setting

Landform: Dikes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Parent material: Sandy human transported material over sandy and gravelly glaciofluvial deposits

Typical profile

^Ap - 0 to 9 inches: loamy sand
C1 - 9 to 22 inches: sand
C2 - 22 to 49 inches: coarse sand
C3 - 49 to 54 inches: sand
C4 - 54 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Udipsamments, wet substratum

Percent of map unit: 10 percent
Landform: Dikes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
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

Tihonet

Percent of map unit: 5 percent
Landform: Bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

700A—Udipsamments, wet substratum, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: bd02
Elevation: 0 to 390 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 195 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udipsamments, Wet Substratum

Setting

Landform: Dikes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Parent material: Sandy human transported material over sandy and gravelly glaciofluvial deposits

Typical profile

^Ap - 0 to 3 inches: loamy fine sand
^C1 - 3 to 20 inches: fine sand
Ab - 20 to 24 inches: loamy fine sand
Bwb - 24 to 31 inches: fine sand
BC - 31 to 44 inches: fine sand
C2 - 44 to 51 inches: fine sand
C3 - 51 to 72 inches: very fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: About 20 to 48 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: R149BY002MA - Coastal Dunes
Hydric soil rating: No

Minor Components

Tihonet

Percent of map unit: 10 percent
Landform: Bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

Udipsamments

Percent of map unit: 5 percent
Landform: Dikes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Ecological site: R149BY002MA - Coastal Dunes
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

704A—Freetown and Swansea coarse sands, 0 to 3 percent slopes, sanded surface and inactive

Map Unit Setting

National map unit symbol: 2tx05
Elevation: 0 to 140 feet
Mean annual precipitation: 40 to 52 inches

Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 190 to 250 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Freetown, sanded surface, inactive, and similar soils: 50 percent
Swansea, sanded surface, inactive, and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown, Sanded Surface, Inactive

Setting

Landform: Kettles, depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy human transported material over organic material

Typical profile

^Ap - 0 to 15 inches: coarse sand
2Oa - 15 to 79 inches: muck

Properties and qualities

Slope: 0 to 3 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: FrequentNone
Frequency of ponding: None
Available water capacity: Very high (about 20.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Description of Swansea, Sanded Surface, Inactive

Setting

Landform: Kettles, depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

^Ap - 0 to 15 inches: coarse sand
Oa - 15 to 36 inches: muck
2Cg - 36 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 capacity: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Rainberry, sanded surface

Percent of map unit: 5 percent
Landform: Kettles, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: Yes

Tihonet

Percent of map unit: 5 percent
Landform: Outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

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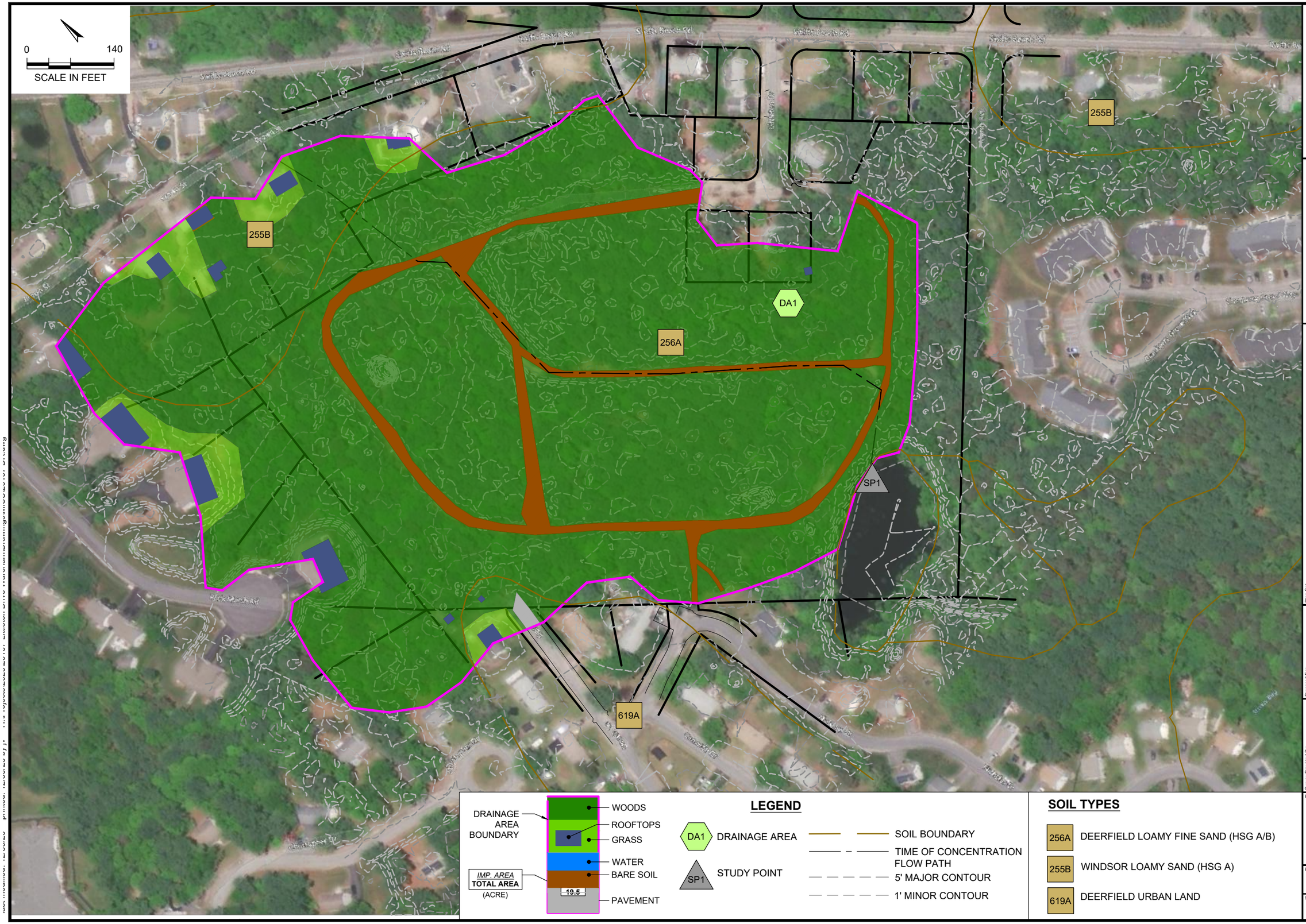
APPENDIX B

Drainage Area Maps



Revisions

Rev	Date	By	Appr	Description

Horsley Witten Group, Inc.
Sustainable Environmental Solutions
90 Route 6A
Sandwich, MA 02563
508-833-6600 voice
508-833-3150 fax

Checked By: RAC
Drawn By: JLV
Design By: JLV
Date: 12/30/2020

Plan Set:

Plan Title: EXISTING DRAINAGE AREA MAP

LITTLETON DRIVE
WAREHAM, MA

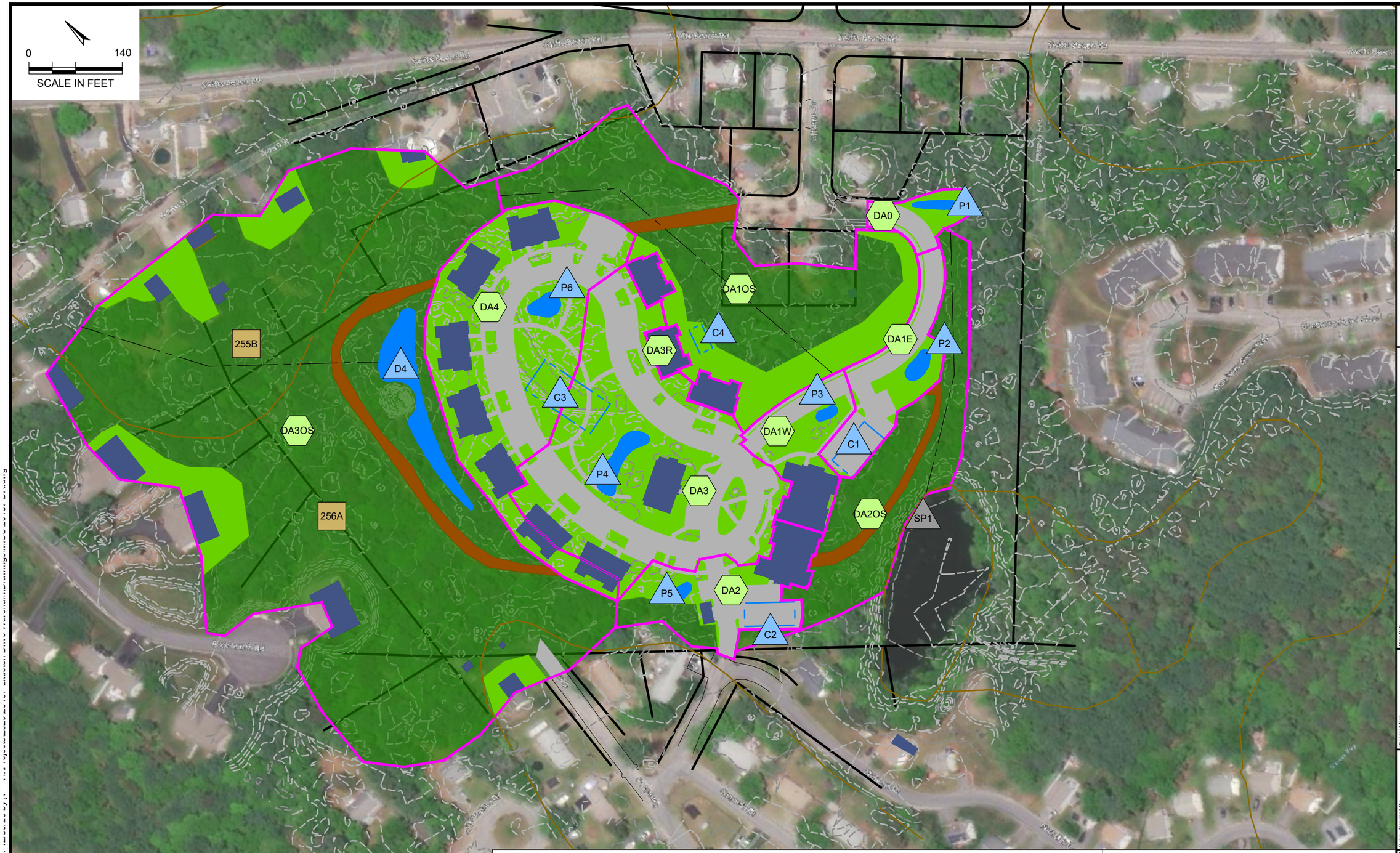
Prepared For:
Penrose Properties, LLC
50 Milk Street, 16th Floor
Boston, MA 02109
Phone: —
Fax: —

Survey Provided By:
Horsley Witten Group, Inc.
90 Route 6A
Phone(508) 833-6600
Fax:(508) 833-3150
Dated: —

Registration:

Project Number: 20107

Sheet Number: 1 of 2



Revisions

Rev	Date	By	Appr	Description

Horsley Witten Group, Inc.
Sustainable Environmental Solutions
90 Route 6A
Sandwich, MA 02563
508-833-6600 voice
508-833-3150 fax

Date: 12/30/2020
Design By: JLV
Drawn By: JLV
Checked By: RAC

Plan Set:

Plan Title: PROPOSED DRAINAGE AREA MAP

LITTLETON DRIVE
WAREHAM, MA

Prepared For:
Penmrose Properties, LLC
50 Milk Street, 16th Floor
Boston, MA 02109
Phone: —
Fax: —

Survey Provided By:
Horsley Witten Group, Inc.
90 Route 6A
Phone:(508) 833-6600
Fax:(508) 833-3150
Dalled: —

Registration:

Project Number: 20107

Sheet Number: 2 of 2

APPENDIX C

GSI Sizing Calculations

Project: Littleton Drive **Project No:** 20107
Project Location: Littleton Drive Wareham, MA
Calculated By: JLV
Checked By: RAC
Date : 12/30/2020

Instructions: Enter values in [ ] cells only. All other cells are formulas or links and do not need to be edited. See cell comments for descriptions and formulas used.

Water Quality Volume (WQv)
Based upon 1-inch of rainfall times the contributing impervious area contributing impervious area

WQv (cf) = (1" rainfall/12) * Imp. Area (sf)

Storm Type: 1 ***Inch***

DA	Description	% Imp.	Drainage Area		Imp. Area		WQv Required*	WQv required
		%	sf	ac	sf	ac	cf	af
DA1	Littleton Dr North	41%	8,731	0.20	3,600	0.08	300	0.007
DA2	East of Parking	66%	23,804	0.55	15,658	0.36	1,305	0.030
DA3	West of Parking	31%	21,567	0.50	6,706	0.15	559	0.013
DA4	Middle	40%	104,650	2.40	41,974	0.96	3,498	0.080
DA5	Community Garden	34%	32,001	0.73	11,016	0.25	918	0.021
DA6	Middle North	23%	91,735	2.11	21,490	0.49	1,791	0.041
	TOTALS		282488	6.49	100,444	2.31	8,370	0.192

Infiltrating BMP Sizing Calculations

Sizing Equations: Infiltrating BMP

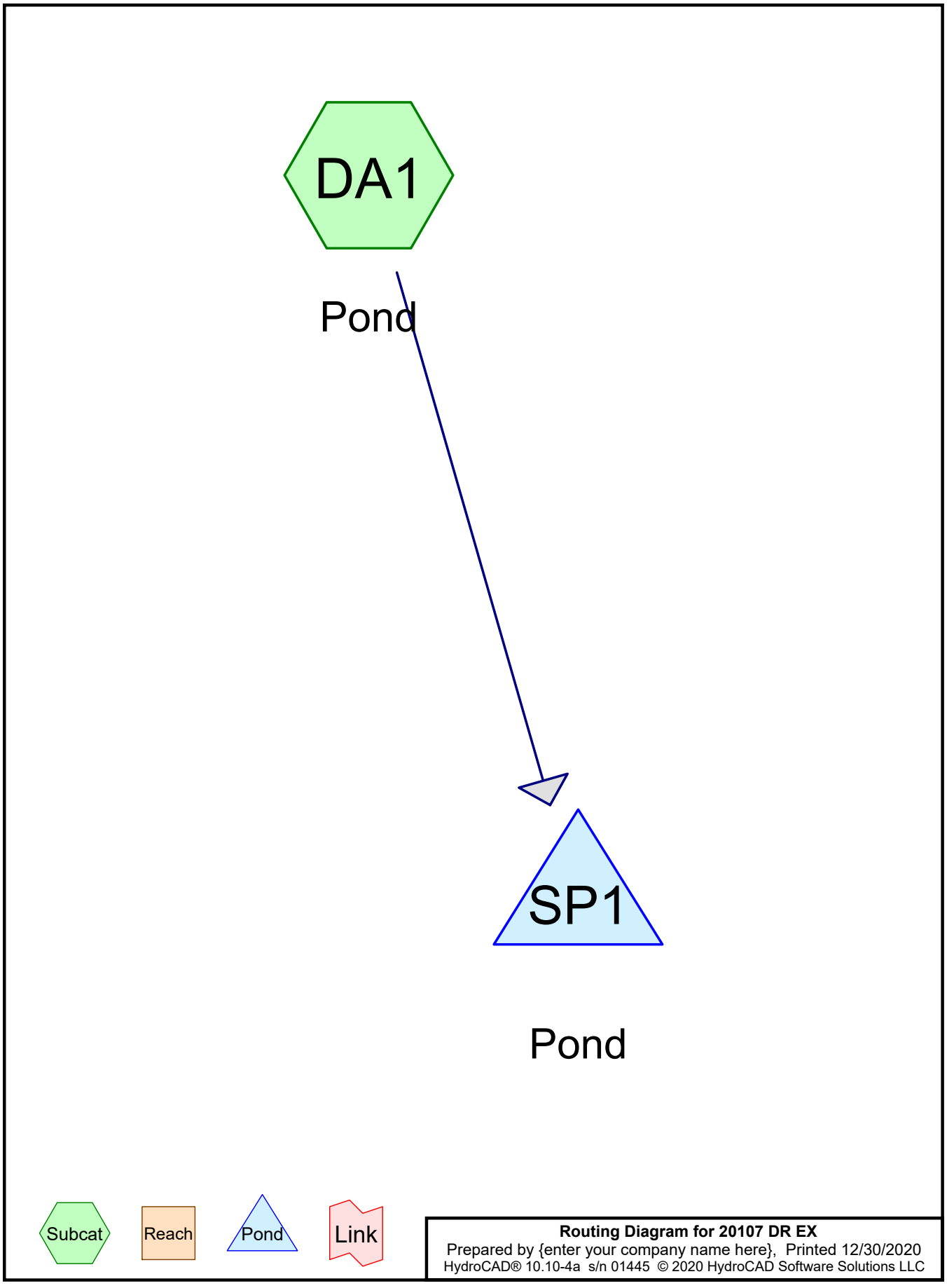
Required Surface Area (sf) = (WQv) (df) / [(k) (hf + df) (tf)]
Where: df = Filter bed depth (ft) k = Coefficient of permeability of filter media (ft/day)
hf = Ave. height of water above filter bed (ft) tf = Design filter bed drain time (days)

BIORETENTION SIZING:

BMP Area	Drainage Area Name	WQv Required (af)	df (ft)	K (ft/day)	hmax-Height of water above filter (in.)	hf=avg of above (ft)	tf (days)	Surface Area Required (sf)	Surface Area Provided (sf)	Sediment Forebay Required 10% WQv (cf)	Sediment Forebay Provided (cf)	WQV Treatment Provided (af)
DA1	Littleton Dr North	0.007	1.50	1	6	0.25	2	129	700	30		0.037
DA2	East of Parking	0.030	1.50	1	6	0.25	2	559	810	130		0.043
DA3	West of Parking	0.013	1.50	1	6	0.25	2	240	300	56		0.016
DA4	Middle	0.080	1.50	1	6	0.25	2	1499	2170	350		0.116
DA5	Community Garden	0.021	1.50	1	6	0.25	2	393	400	92		0.021
DA6	Middle North	0.041	1.50	1	6	0.25	2	768	1000	179		0.054
	TOTALS	0.192						3587	5380	837	0	0.288
							Percentage of Treatment Provided		**150%**		**0%**	**150%**

APPENDIX D

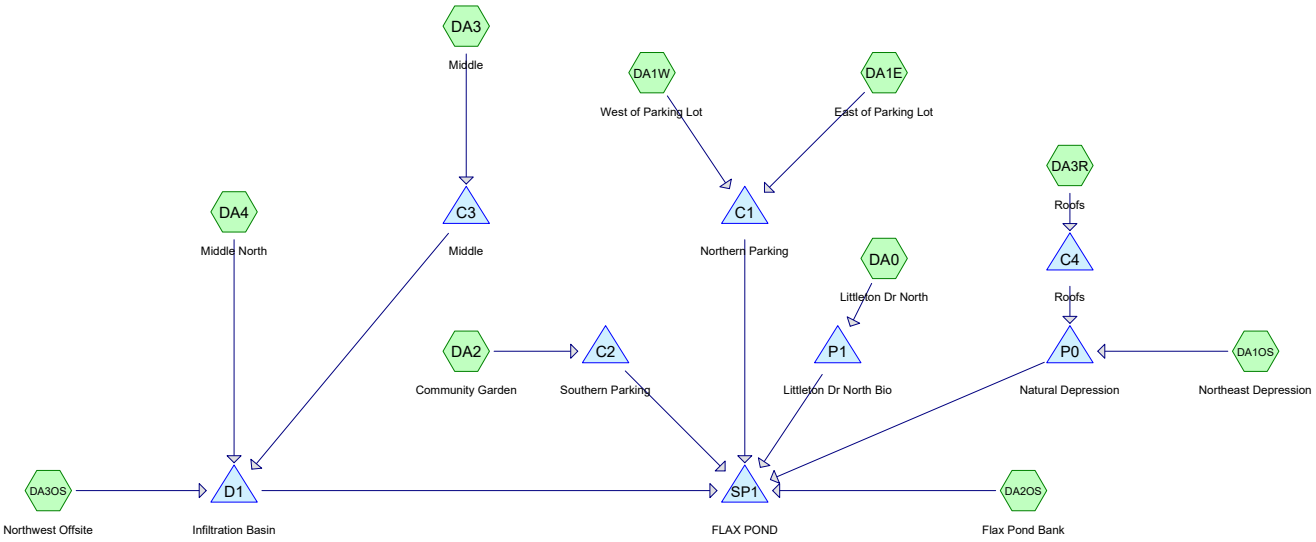
HydroCAD Modeling



Routing Diagram for 20107 DR EX

Prepared by {enter your company name here}, Printed 12/30/2020

HydroCAD® 10.10-4a s/n 01445 © 2020 HydroCAD Software Solutions LLC



Subcat Reach Pond Link

Routing Diagram for 20107 DR PR

Prepared by {enter your company name here}, Printed 12/30/2020

HydroCAD® 10.10-4a s/n 01445 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2yr	Type III 24-hr		Default	24.00	1	3.44	2
2	10yr	Type III 24-hr		Default	24.00	1	5.05	2
3	100yr	Type III 24-hr		Default	24.00	1	7.60	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.406	39	>75% Grass cover, Good, HSG A (DA3OS)
4.013	50	>75% Grass cover, Good, HSG A/B (DA0, DA1E, DA1OS, DA1W, DA2, DA3, DA3OS, DA4)
0.439	77	Dirt roads, HSG A/B (DA1OS, DA2OS, DA3OS)
2.306	98	Paved parking, HSG A (DA0, DA1E, DA1W, DA2, DA3, DA4)
0.027	98	Paved roads w/curbs & sewers, HSG A (DA3OS)
1.472	98	Roofs, HSG A (DA1OS, DA1W, DA2, DA3, DA3OS, DA3R, DA4)
0.453	98	Water Surface, HSG A (DA0, DA1E, DA1W, DA2, DA3, DA3OS, DA4)
2.174	30	Woods, Good, HSG A (DA3OS)
8.470	42	Woods, Good, HSG A/B (DA1OS, DA2, DA2OS, DA3OS)
19.760	**55**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
19.760	HSG A	DA0, DA1E, DA1OS, DA1W, DA2, DA2OS, DA3, DA3OS, DA3R, DA4
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
19.760		**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA0: Littleton Dr North Runoff Area=8,731 sf 49.25% Impervious Runoff Depth=1.20"
Tc=5.0 min CN=74 Runoff=0.27 cfs 0.020 af

Subcatchment DA1E: East of Parking Lot Runoff Area=23,804 sf 70.19% Impervious Runoff Depth=1.89"
Tc=5.0 min CN=84 Runoff=1.21 cfs 0.086 af

Subcatchment DA1OS: Northeast Runoff Area=110,519 sf 0.14% Impervious Runoff Depth=0.07"
Flow Length=600' Slope=0.0100 '/' Tc=44.0 min CN=45 Runoff=0.03 cfs 0.016 af

Subcatchment DA1W: West of Parking Lot Runoff Area=21,567 sf 63.19% Impervious Runoff Depth=1.59"
Tc=5.0 min CN=80 Runoff=0.92 cfs 0.066 af

Subcatchment DA2: Community Garden Runoff Area=32,001 sf 57.61% Impervious Runoff Depth=1.32"
Tc=5.0 min CN=76 Runoff=1.12 cfs 0.081 af

Subcatchment DA2OS: Flax Pond Bank Runoff Area=52,772 sf 0.00% Impervious Runoff Depth=0.07"
Flow Length=400' Slope=0.0100 '/' Tc=37.3 min CN=45 Runoff=0.01 cfs 0.008 af

Subcatchment DA3: Middle Runoff Area=104,650 sf 49.70% Impervious Runoff Depth=1.20"
Tc=5.0 min CN=74 Runoff=3.26 cfs 0.240 af

Subcatchment DA3OS: Northwest Offsite Runoff Area=405,501 sf 7.28% Impervious Runoff Depth=0.06"
Flow Length=450' Slope=0.0100 '/' Tc=39.0 min CN=44 Runoff=0.07 cfs 0.046 af

Subcatchment DA3R: Roofs Runoff Area=9,486 sf 100.00% Impervious Runoff Depth=3.21"
Tc=5.0 min CN=98 Runoff=0.73 cfs 0.058 af

Subcatchment DA4: Middle North Runoff Area=91,735 sf 44.93% Impervious Runoff Depth=1.08"
Tc=5.0 min CN=72 Runoff=2.53 cfs 0.190 af

Pond C1: Northern Parking Peak Elev=13.54' Storage=2,012 cf Inflow=2.13 cfs 0.151 af
Discarded=0.31 cfs 0.151 af Primary=0.00 cfs 0.000 af Outflow=0.31 cfs 0.151 af

Pond C2: Southern Parking Peak Elev=13.05' Storage=750 cf Inflow=1.12 cfs 0.081 af
Discarded=0.27 cfs 0.081 af Primary=0.00 cfs 0.000 af Outflow=0.27 cfs 0.081 af

Pond C3: Middle Peak Elev=13.18' Storage=2,540 cf Inflow=3.26 cfs 0.240 af
Discarded=0.66 cfs 0.240 af Primary=0.00 cfs 0.000 af Outflow=0.66 cfs 0.240 af

Pond C4: Roofs Peak Elev=13.97' Storage=786 cf Inflow=0.73 cfs 0.058 af
Discarded=0.08 cfs 0.058 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.058 af

Pond D1: Infiltration Basin Peak Elev=12.38' Storage=1,172 cf Inflow=2.53 cfs 0.235 af
Outflow=0.95 cfs 0.235 af

Pond P0: Natural Depression Peak Elev=14.00' Storage=2 cf Inflow=0.03 cfs 0.016 af
Outflow=0.03 cfs 0.016 af

Pond P1: Littleton Dr North Bio Peak Elev=13.88' Storage=163 cf Inflow=0.27 cfs 0.020 af
Outflow=0.10 cfs 0.020 af

Pond SP1: FLAX POND Inflow=0.01 cfs 0.008 af
Primary=0.01 cfs 0.008 af

Total Runoff Area = 19.760 ac Runoff Volume = 0.809 af Average Runoff Depth = 0.49"
78.45% Pervious = 15.502 ac 21.55% Impervious = 4.258 ac

Summary for Subcatchment DA0: Littleton Dr North

[49] Hint: Tc<2dt may require smaller dt

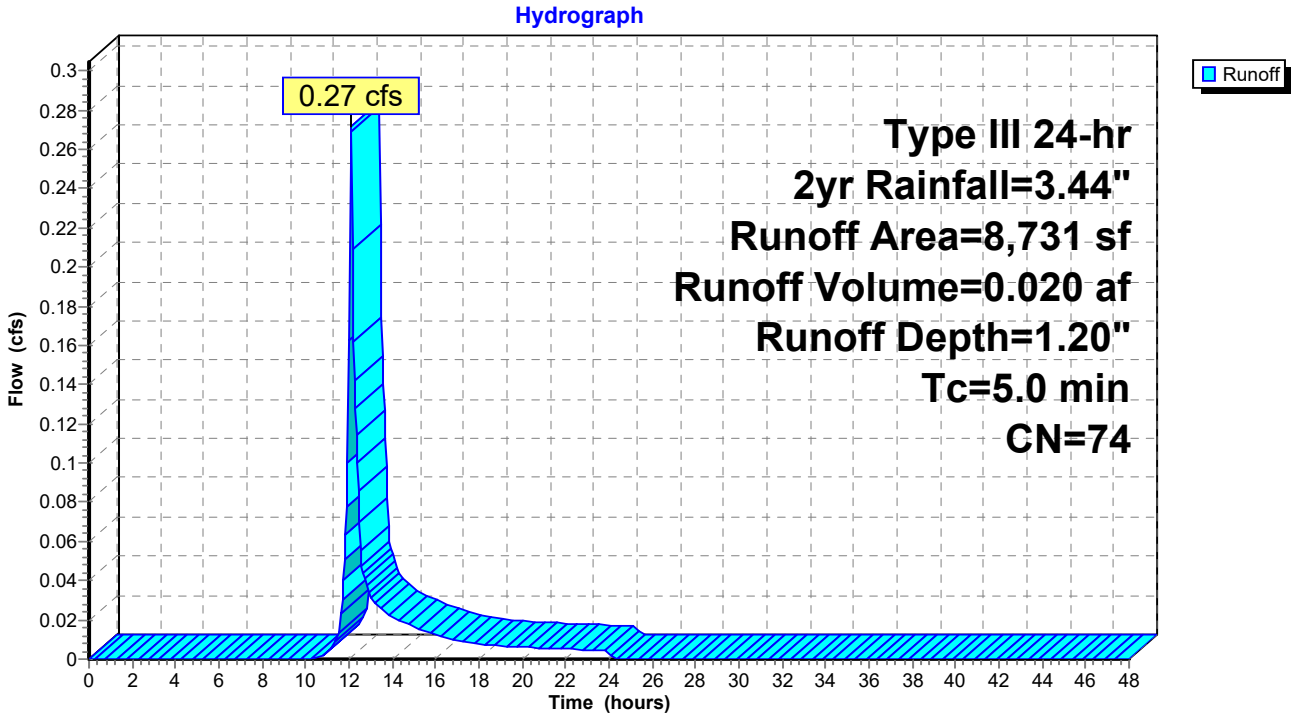
Runoff = 0.27 cfs @ 12.09 hrs, Volume= 0.020 af, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
	3,600	98	Paved parking, HSG A
*	4,431	50	>75% Grass cover, Good, HSG A/B
	700	98	Water Surface, HSG A
	8,731	74	Weighted Average
	4,431		50.75% Pervious Area
	4,300		49.25% Impervious Area

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

Subcatchment DA0: Littleton Dr North



Summary for Subcatchment DA1E: East of Parking Lot

[49] Hint: Tc<2dt may require smaller dt

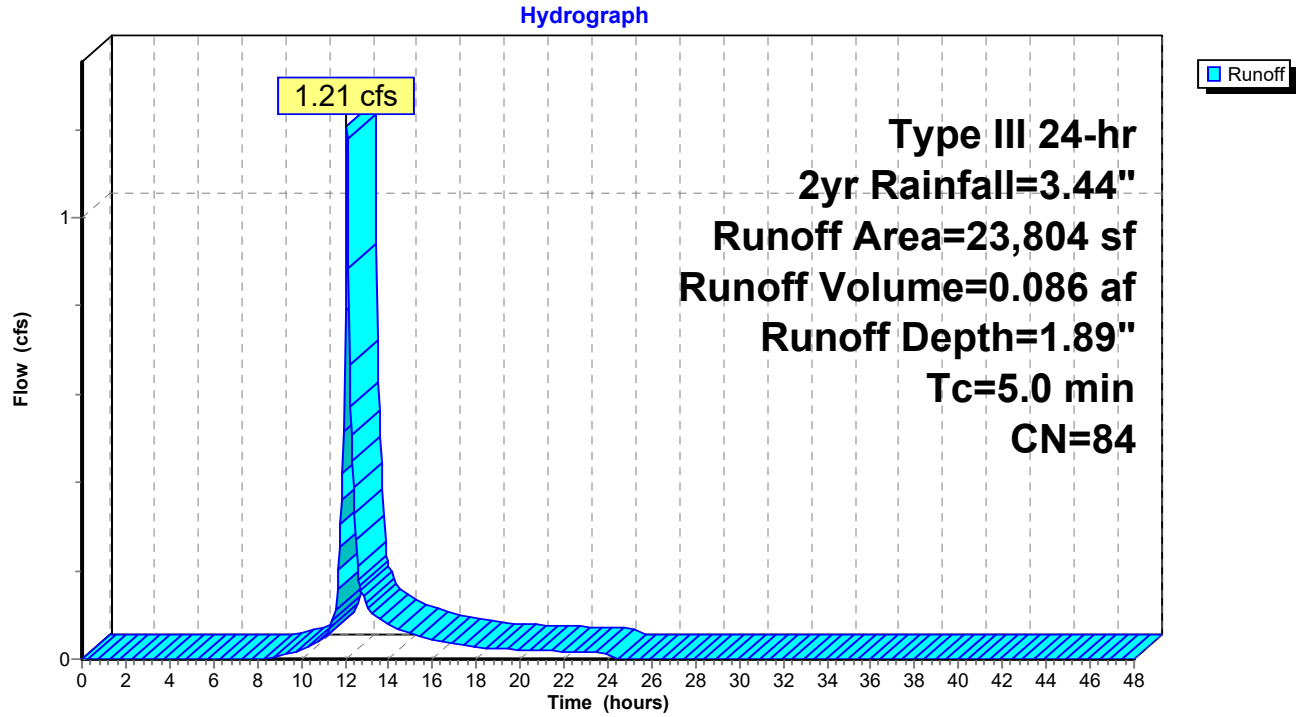
Runoff = 1.21 cfs @ 12.08 hrs, Volume= 0.086 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
	15,658	98	Paved parking, HSG A
*	7,095	50	>75% Grass cover, Good, HSG A/B
	1,051	98	Water Surface, HSG A
	23,804	84	Weighted Average
	7,095		29.81% Pervious Area
	16,709		70.19% Impervious Area

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

Subcatchment DA1E: East of Parking Lot



Summary for Subcatchment DA1OS: Northeast Depression

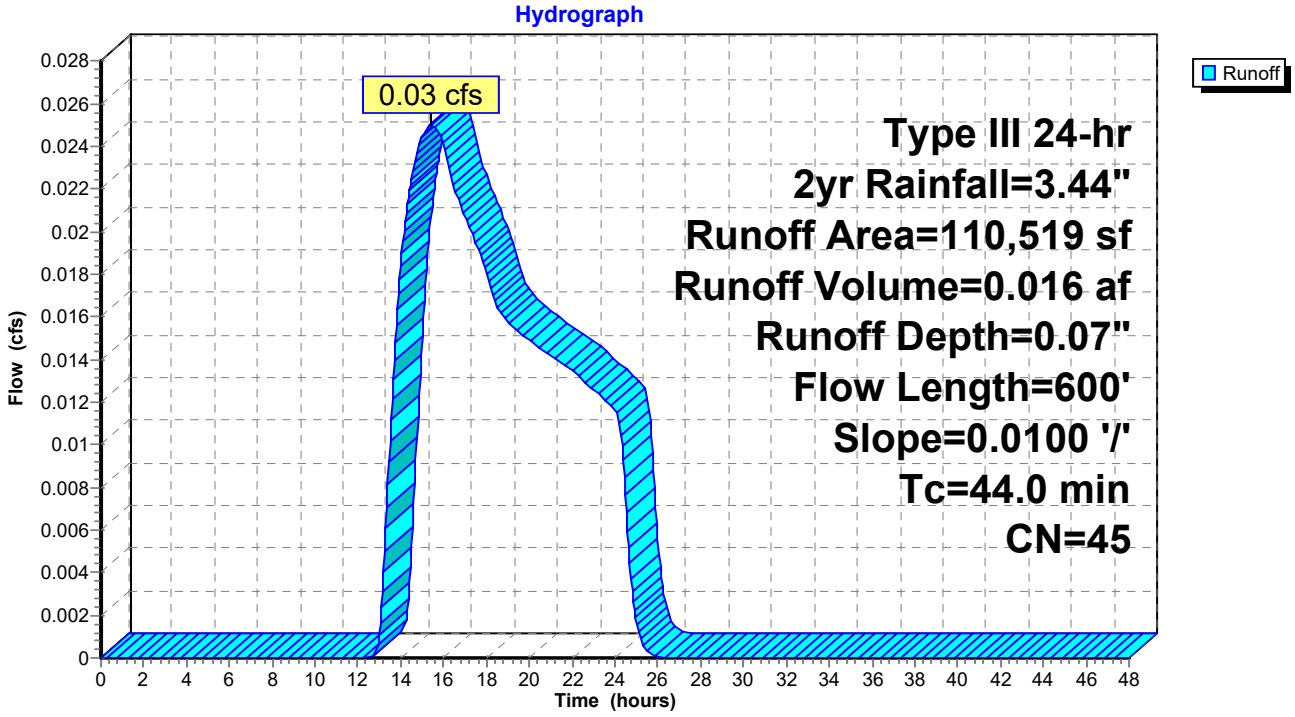
Runoff = 0.03 cfs @ 15.41 hrs, Volume= 0.016 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
	150	98	Roofs, HSG A
*	3,318	77	Dirt roads, HSG A/B
*	78,963	42	Woods, Good, HSG A/B
*	28,088	50	>75% Grass cover, Good, HSG A/B
	110,519	45	Weighted Average
	110,369		99.86% Pervious Area
	150		0.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
16.7	500	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
44.0	600	Total			

Subcatchment DA1OS: Northeast Depression



Summary for Subcatchment DA1W: West of Parking Lot

[49] Hint: Tc<2dt may require smaller dt

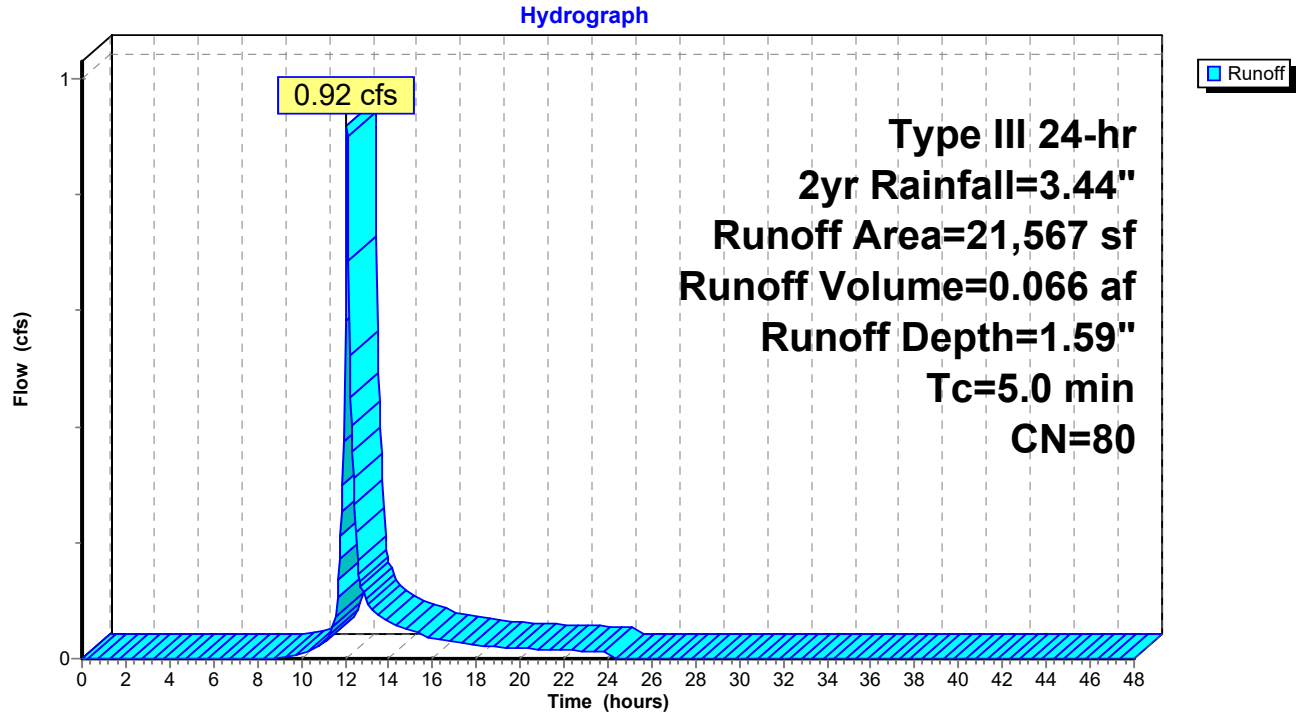
Runoff = 0.92 cfs @ 12.08 hrs, Volume= 0.066 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
	6,706	98	Paved parking, HSG A
*	7,939	50	>75% Grass cover, Good, HSG A/B
	6,467	98	Roofs, HSG A
	455	98	Water Surface, HSG A
	21,567	80	Weighted Average
	7,939		36.81% Pervious Area
	13,628		63.19% Impervious Area

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

Subcatchment DA1W: West of Parking Lot



Summary for Subcatchment DA2: Community Garden

[49] Hint: Tc<2dt may require smaller dt

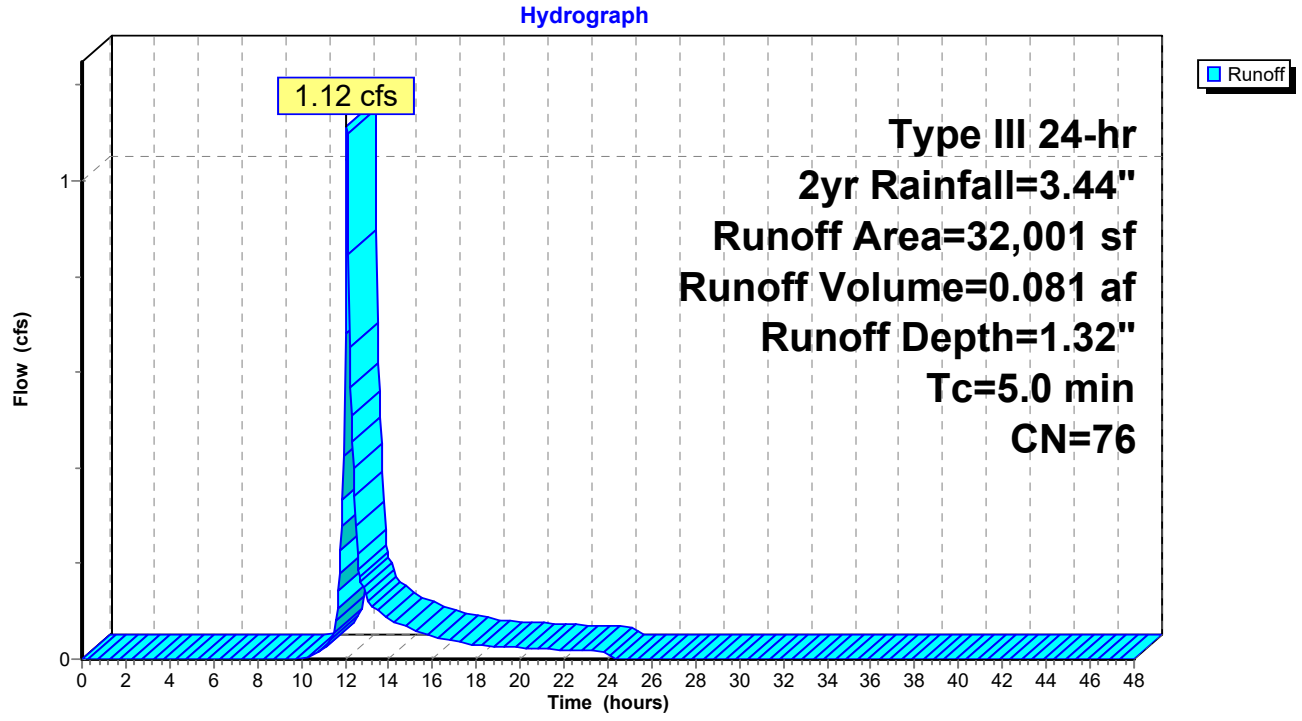
Runoff = 1.12 cfs @ 12.08 hrs, Volume= 0.081 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
	11,016	98	Paved parking, HSG A
*	7,510	50	>75% Grass cover, Good, HSG A/B
	445	98	Water Surface, HSG A
	6,976	98	Roofs, HSG A
*	6,054	42	Woods, Good, HSG A/B
	32,001	76	Weighted Average
	13,564		42.39% Pervious Area
	18,437		57.61% Impervious Area

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

Subcatchment DA2: Community Garden



Summary for Subcatchment DA2OS: Flax Pond Bank

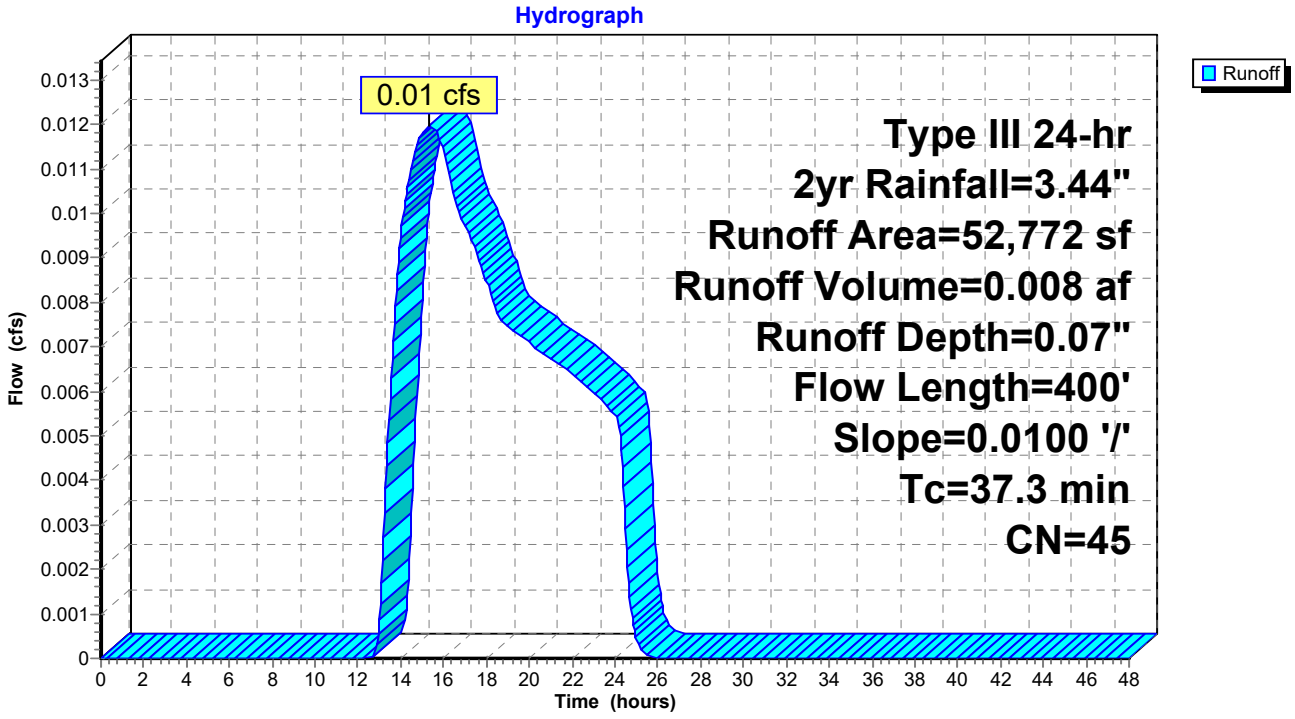
Runoff = 0.01 cfs @ 15.31 hrs, Volume= 0.008 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
*	4,594	77	Dirt roads, HSG A/B
*	48,178	42	Woods, Good, HSG A/B
	52,772	45	Weighted Average
	52,772		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
10.0	300	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
37.3	400	Total			

Subcatchment DA2OS: Flax Pond Bank



Summary for Subcatchment DA3: Middle

[49] Hint: Tc<2dt may require smaller dt

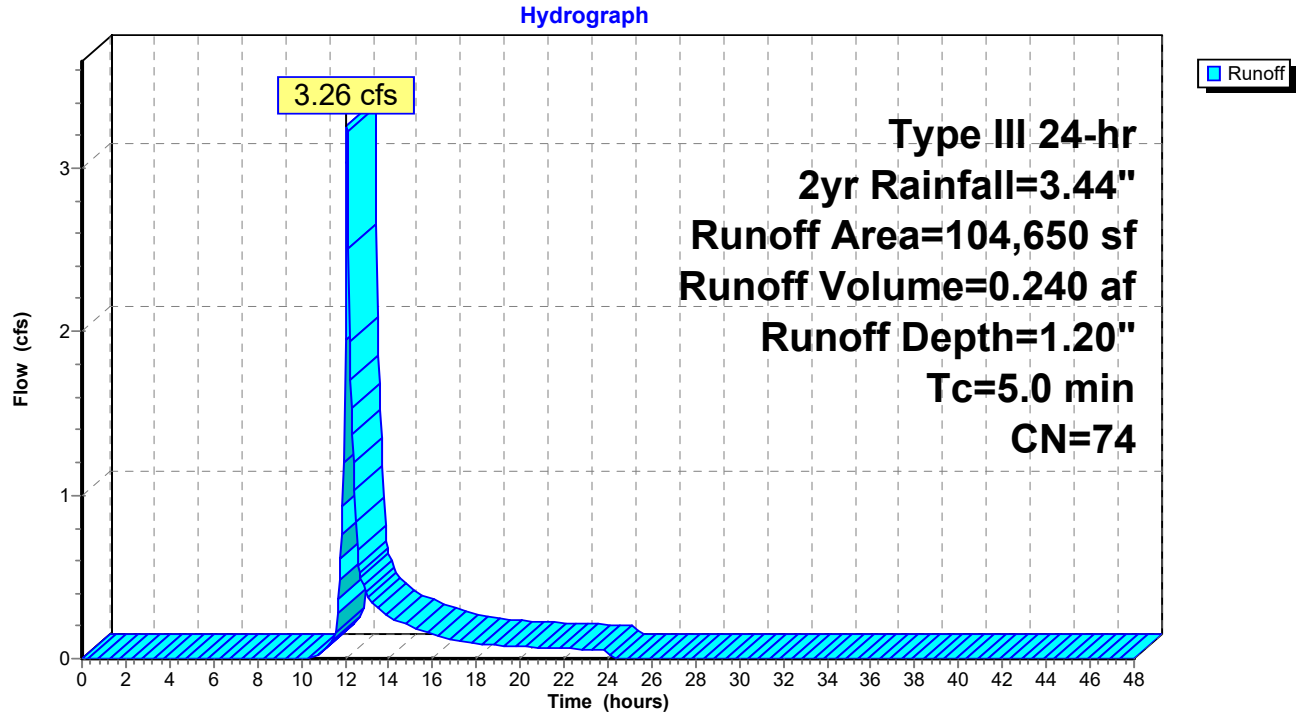
Runoff = 3.26 cfs @ 12.09 hrs, Volume= 0.240 af, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
	41,974	98	Paved parking, HSG A
*	52,638	50	>75% Grass cover, Good, HSG A/B
	7,340	98	Roofs, HSG A
	2,698	98	Water Surface, HSG A
	104,650	74	Weighted Average
	52,638		50.30% Pervious Area
	52,012		49.70% Impervious Area

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

Subcatchment DA3: Middle



Summary for Subcatchment DA3OS: Northwest Offsite

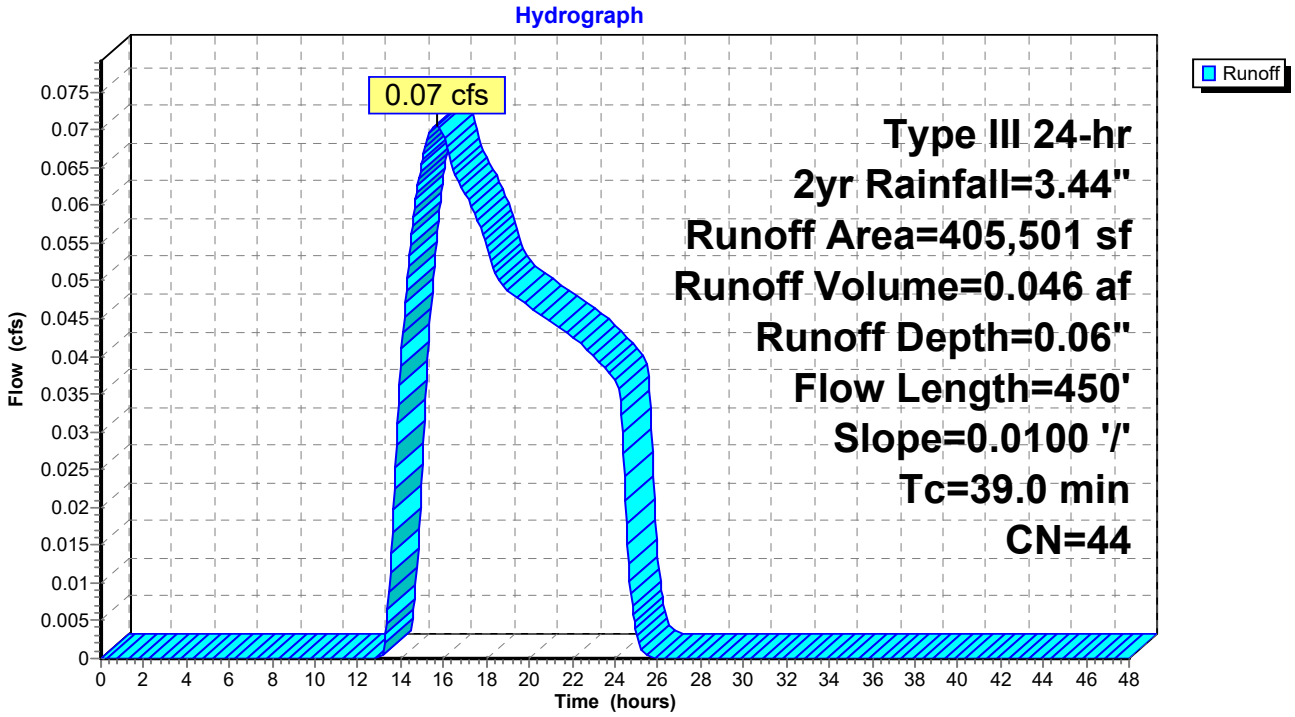
Runoff = 0.07 cfs @ 15.65 hrs, Volume= 0.046 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
	1,176	98	Paved roads w/curbs & sewers, HSG A
	15,531	98	Roofs, HSG A
*	11,222	77	Dirt roads, HSG A/B
*	235,751	42	Woods, Good, HSG A/B
*	16,604	50	>75% Grass cover, Good, HSG A/B
	17,671	39	>75% Grass cover, Good, HSG A
	94,715	30	Woods, Good, HSG A
	12,831	98	Water Surface, HSG A
	405,501	44	Weighted Average
	375,963		92.72% Pervious Area
	29,538		7.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
11.7	350	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
39.0	450	Total			

Subcatchment DA3OS: Northwest Offsite



Summary for Subcatchment DA3R: Roofs

[49] Hint: Tc<2dt may require smaller dt

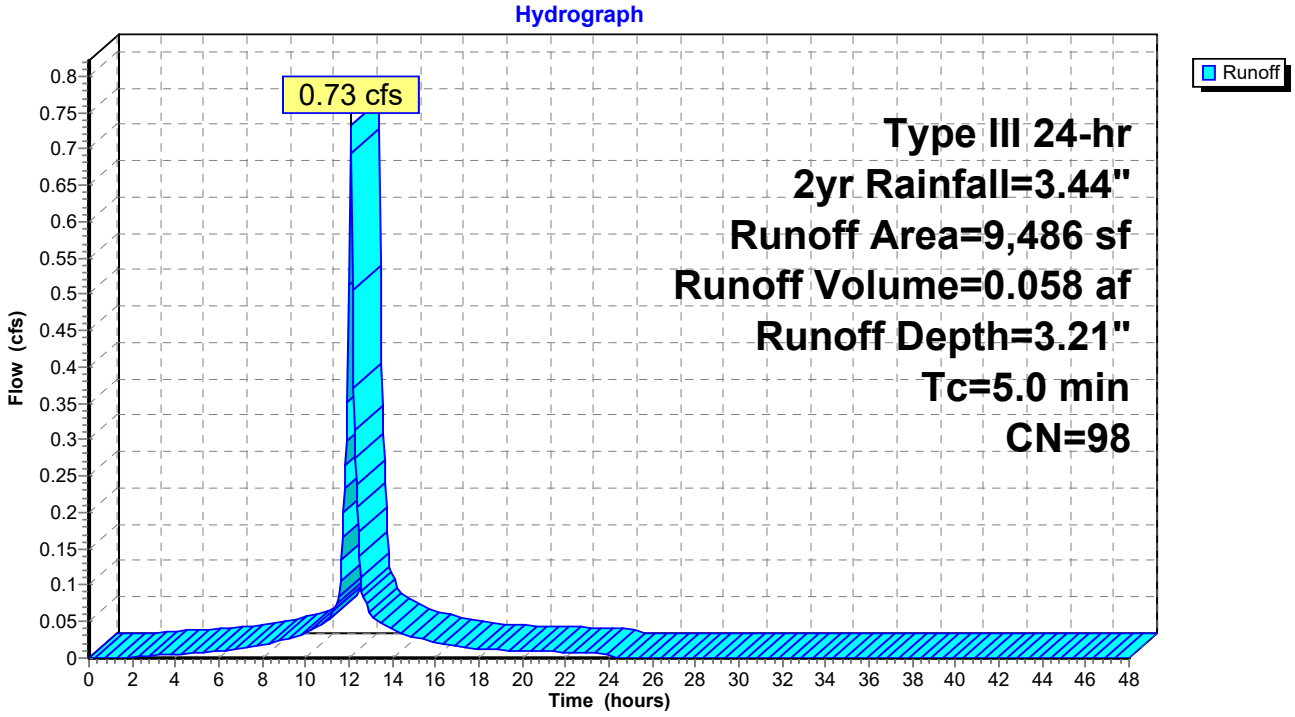
Runoff = 0.73 cfs @ 12.07 hrs, Volume= 0.058 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

Area (sf)	CN	Description
9,486	98	Roofs, HSG A
9,486		100.00% Impervious Area

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

Subcatchment DA3R: Roofs



Summary for Subcatchment DA4: Middle North

[49] Hint: Tc<2dt may require smaller dt

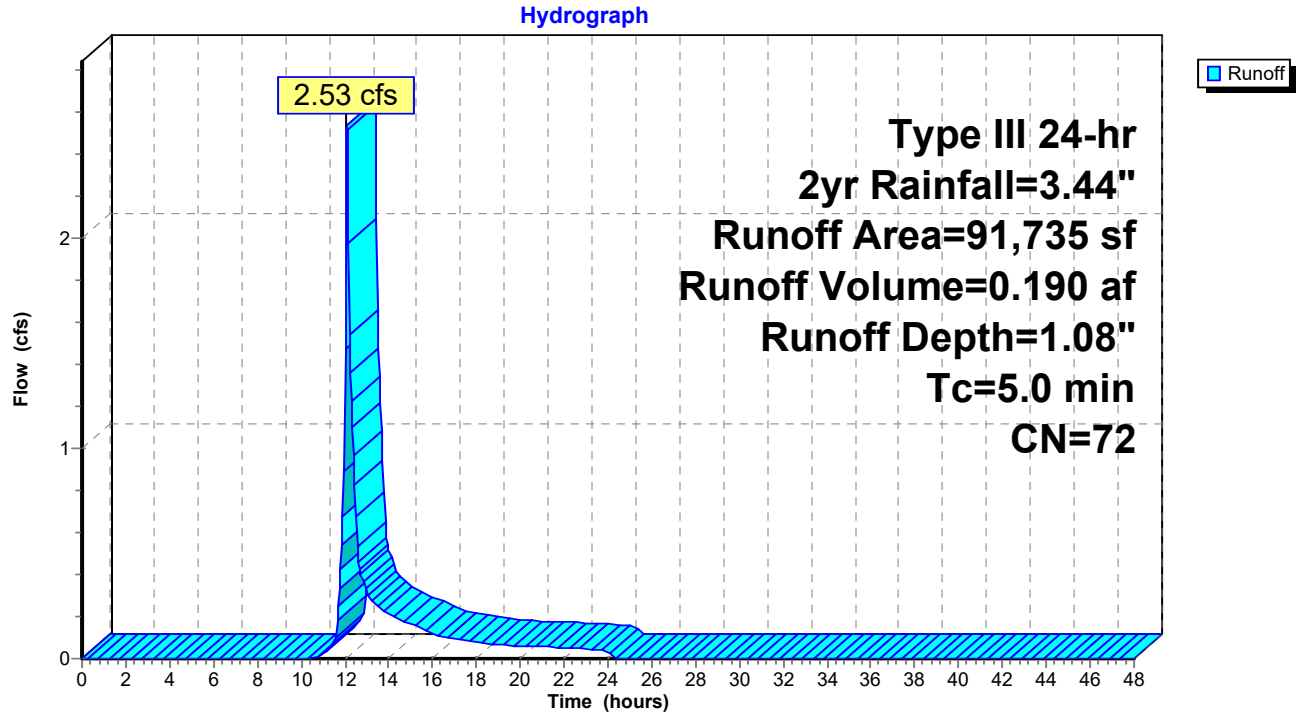
Runoff = 2.53 cfs @ 12.09 hrs, Volume= 0.190 af, Depth= 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (sf)	CN	Description
	21,490	98	Paved parking, HSG A
*	50,514	50	>75% Grass cover, Good, HSG A/B
	18,191	98	Roofs, HSG A
	1,540	98	Water Surface, HSG A
	91,735	72	Weighted Average
	50,514		55.07% Pervious Area
	41,221		44.93% Impervious Area

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

Subcatchment DA4: Middle North



Summary for Pond C1: Northern Parking

Inflow Area = 1.042 ac, 66.86% Impervious, Inflow Depth = 1.74" for 2yr event
Inflow = 2.13 cfs @ 12.08 hrs, Volume= 0.151 af
Outflow = 0.31 cfs @ 11.80 hrs, Volume= 0.151 af, Atten= 86%, Lag= 0.0 min
Discarded = 0.31 cfs @ 11.80 hrs, Volume= 0.151 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 13.54' @ 12.63 hrs Surf.Area= 2,955 sf Storage= 2,012 cf

Plug-Flow detention time= 46.0 min calculated for 0.151 af (100% of inflow)
Center-of-Mass det. time= 45.9 min (876.8 - 830.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	2,959 cf	**39.50'W x 74.82'L x 4.25'H Field A** 12,560 cf Overall - 3,675 cf Embedded = 8,885 cf x 33.3% Voids
#2A	13.00'	3,675 cf	**ADS_StormTech SC-740 +Cap** x 80 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 80 Chambers in 8 Rows
		6,634 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	14.50'	**18.0" Round Culvert** L= 85.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.50' / 13.50' S= 0.0118 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Discarded OutFlow Max=0.31 cfs @ 11.80 hrs HW=12.31' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.25' TW=0.00' (Dynamic Tailwater)
└**3=Culvert** (Controls 0.00 cfs)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond C1: Northern Parking - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

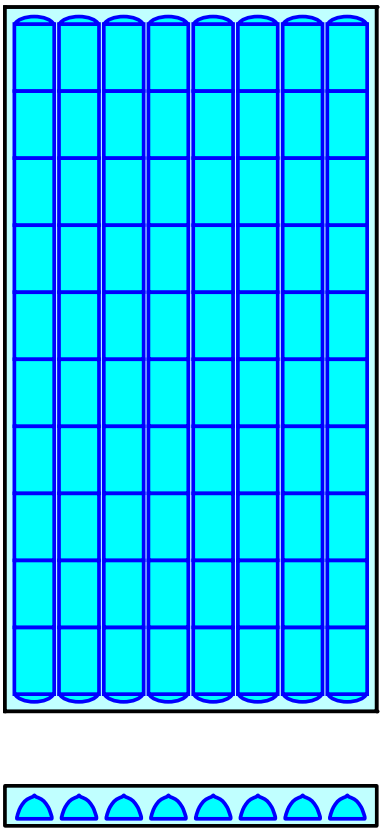
10 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 72.82' Row Length +12.0" End Stone x 2 = 74.82' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

80 Chambers x 45.9 cf = 3,675.2 cf Chamber Storage

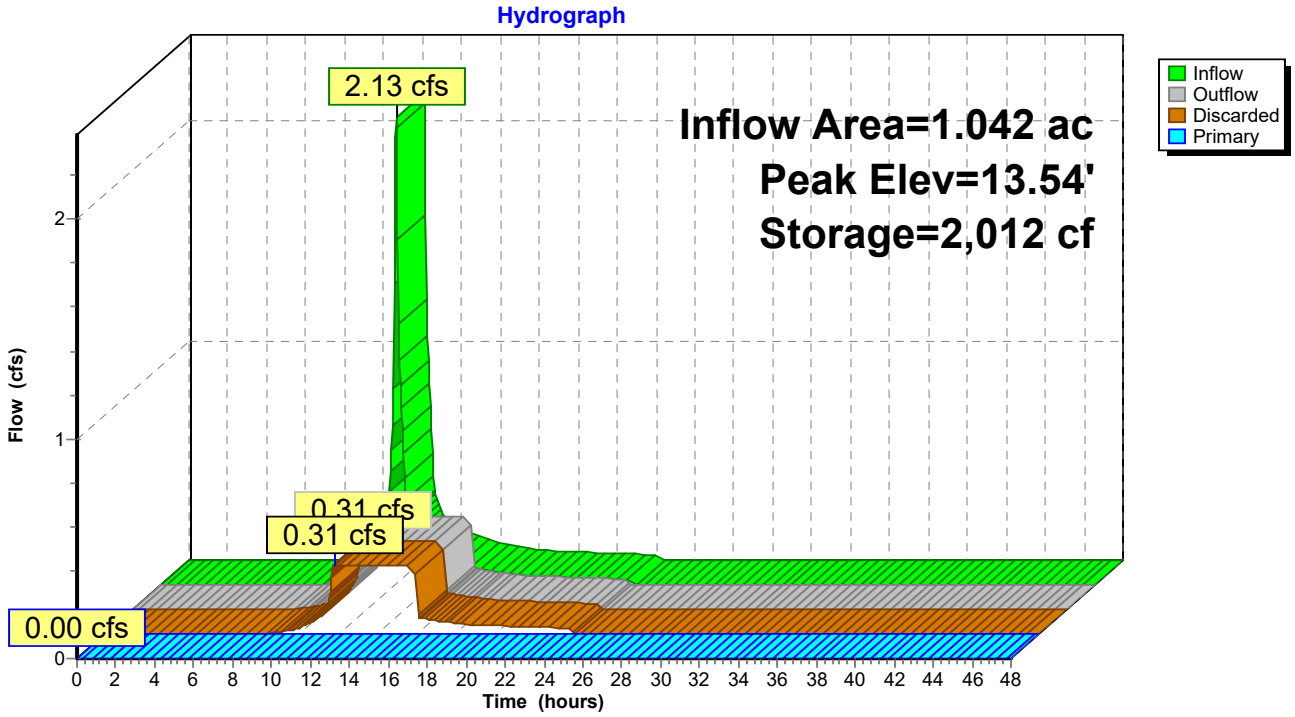
12,559.8 cf Field - 3,675.2 cf Chambers = 8,884.6 cf Stone x 33.3% Voids = 2,958.6 cf Stone Storage

Chamber Storage + Stone Storage = 6,633.8 cf = 0.152 af
Overall Storage Efficiency = 52.8%
Overall System Size = 74.82' x 39.50' x 4.25'

80 Chambers
465.2 cy Field
329.1 cy Stone



Pond C1: Northern Parking



Summary for Pond C2: Southern Parking

Inflow Area = 0.735 ac, 57.61% Impervious, Inflow Depth = 1.32" for 2yr event
Inflow = 1.12 cfs @ 12.08 hrs, Volume= 0.081 af
Outflow = 0.27 cfs @ 12.00 hrs, Volume= 0.081 af, Atten= 76%, Lag= 0.0 min
Discarded = 0.27 cfs @ 12.00 hrs, Volume= 0.081 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 13.05' @ 12.51 hrs Surf.Area= 2,600 sf Storage= 750 cf

Plug-Flow detention time= 15.2 min calculated for 0.081 af (100% of inflow)
Center-of-Mass det. time= 15.2 min (865.7 - 850.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	2,609 cf	**34.75'W x 74.82'L x 4.25'H Field A** 11,049 cf Overall - 3,216 cf Embedded = 7,834 cf x 33.3% Voids
#2A	13.00'	3,216 cf	**ADS_StormTech SC-740 +Cap** x 70 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 70 Chambers in 7 Rows
		5,824 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	14.50'	**10.0" Round Culvert** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 14.50' / 14.20' S= 0.0043 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.27 cfs @ 12.00 hrs HW=12.35' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.25' TW=0.00' (Dynamic Tailwater)
└**3=Culvert** (Controls 0.00 cfs)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond C2: Southern Parking - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

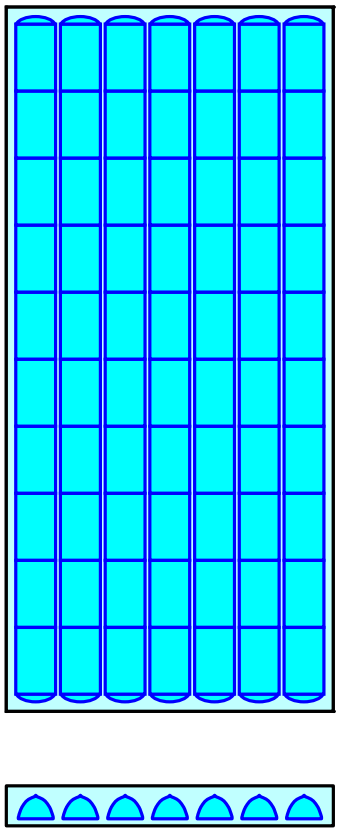
10 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 72.82' Row Length +12.0" End Stone x 2 = 74.82' Base Length
7 Rows x 51.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 34.75' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

70 Chambers x 45.9 cf = 3,215.8 cf Chamber Storage

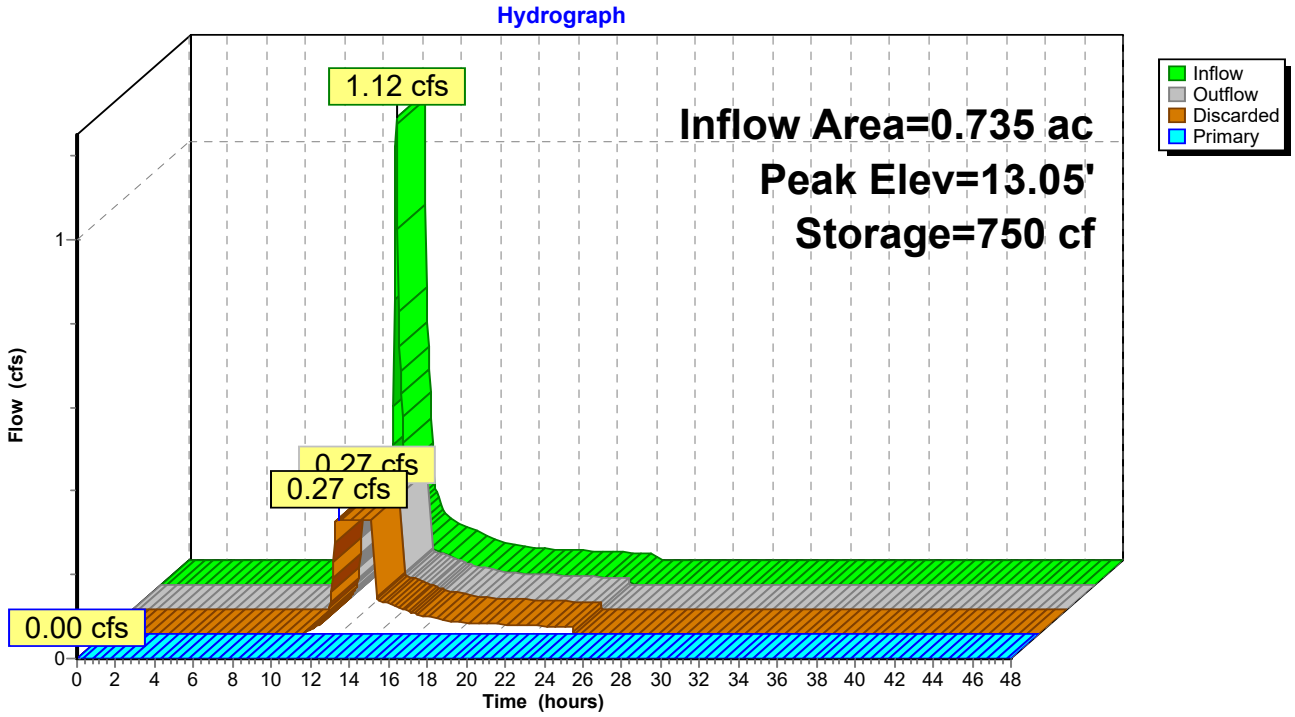
11,049.5 cf Field - 3,215.8 cf Chambers = 7,833.7 cf Stone x 33.3% Voids = 2,608.6 cf Stone Storage

Chamber Storage + Stone Storage = 5,824.4 cf = 0.134 af
Overall Storage Efficiency = 52.7%
Overall System Size = 74.82' x 34.75' x 4.25'

70 Chambers
409.2 cy Field
290.1 cy Stone



Pond C2: Southern Parking



Summary for Pond C3: Middle

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

Inflow Area = 2.402 ac, 49.70% Impervious, Inflow Depth = 1.20" for 2yr event
Inflow = 3.26 cfs @ 12.09 hrs, Volume= 0.240 af
Outflow = 0.66 cfs @ 11.95 hrs, Volume= 0.240 af, Atten= 80%, Lag= 0.0 min
Discarded = 0.66 cfs @ 11.95 hrs, Volume= 0.240 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 13.18' @ 12.56 hrs Surf.Area= 6,318 sf Storage= 2,540 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 23.7 min (880.4 - 856.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	6,249 cf	**53.75'W x 117.54'L x 4.25'H Field A** 26,850 cf Overall - 8,085 cf Embedded = 18,764 cf x 33.3% Voids
#2A	13.00'	8,085 cf	**ADS_StormTech SC-740 +Cap** x 176 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 176 Chambers in 11 Rows
		14,334 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	13.60'	**18.0" Round Culvert** L= 112.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 13.60' / 13.00' S= 0.0054 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Discarded OutFlow Max=0.66 cfs @ 11.95 hrs HW=12.31' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.66 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.25' TW=12.25' (Dynamic Tailwater)
↑└**3=Culvert** (Controls 0.00 cfs)
↑└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond C3: Middle - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

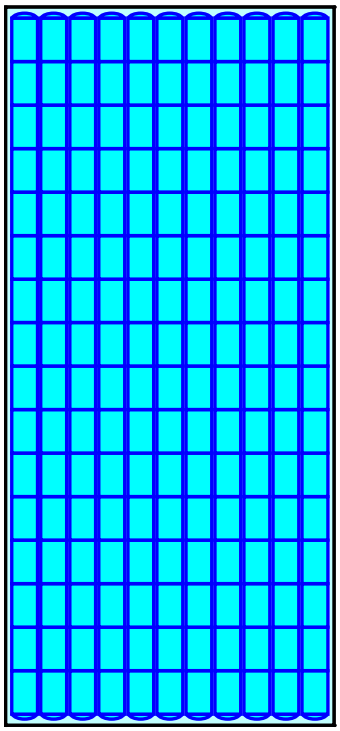
16 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 115.54' Row Length +12.0" End Stone x 2 = 117.54' Base Length
11 Rows x 51.0" Wide + 6.0" Spacing x 10 + 12.0" Side Stone x 2 = 53.75' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

176 Chambers x 45.9 cf = 8,085.4 cf Chamber Storage

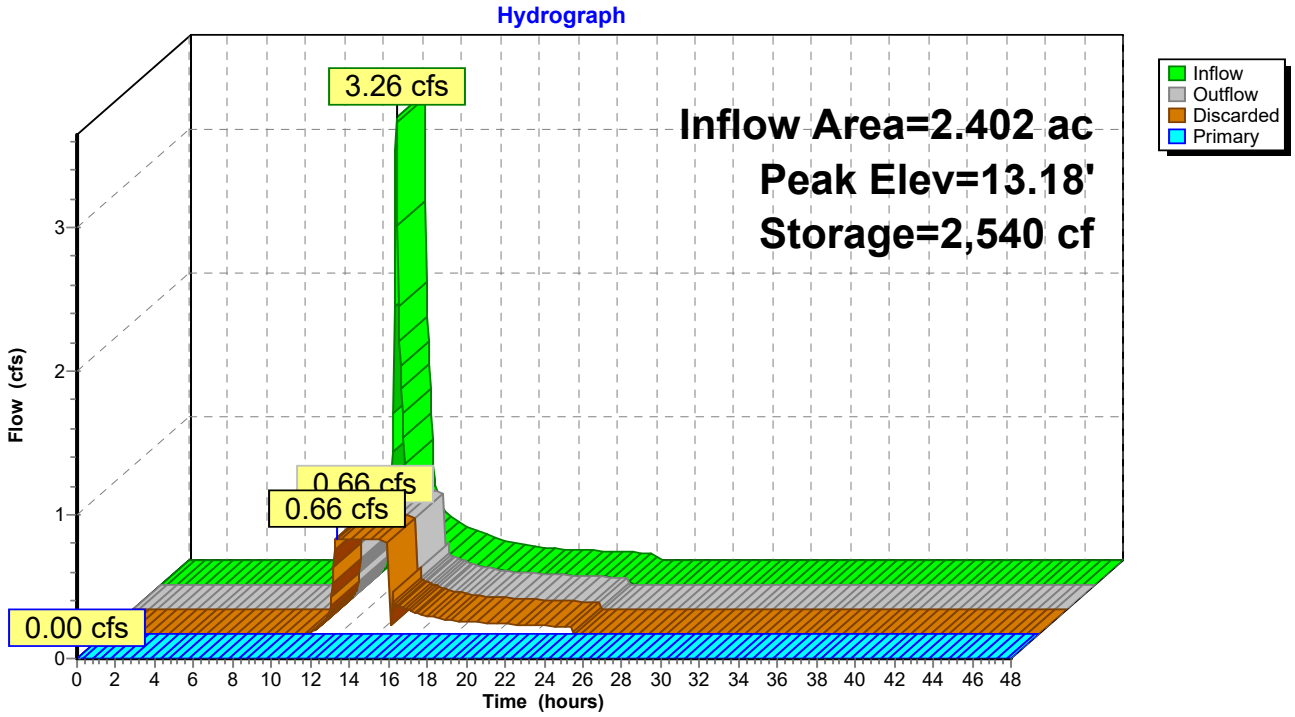
26,849.8 cf Field - 8,085.4 cf Chambers = 18,764.3 cf Stone x 33.3% Voids = 6,248.5 cf Stone Storage

Chamber Storage + Stone Storage = 14,334.0 cf = 0.329 af
Overall Storage Efficiency = 53.4%
Overall System Size = 117.54' x 53.75' x 4.25'

176 Chambers
994.4 cy Field
695.0 cy Stone



Pond C3: Middle



Summary for Pond C4: Roofs

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

Inflow Area = 0.218 ac,100.00% Impervious, Inflow Depth = 3.21" for 2yr event
Inflow = 0.73 cfs @ 12.07 hrs, Volume= 0.058 af
Outflow = 0.08 cfs @ 11.65 hrs, Volume= 0.058 af, Atten= 89%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.65 hrs, Volume= 0.058 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 13.97' @ 12.67 hrs Surf.Area= 804 sf Storage= 786 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 58.6 min (812.6 - 754.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	832 cf	**20.50'W x 39.22'L x 4.25'H Field A** 3,417 cf Overall - 919 cf Embedded = 2,498 cf x 33.3% Voids
#2A	13.00'	919 cf	**ADS_StormTech SC-740 +Cap** x 20 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 20 Chambers in 4 Rows
		1,751 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	14.50'	**8.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.50' / 14.00' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.08 cfs @ 11.65 hrs HW=12.30' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.25' TW=14.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond C4: Roofs - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

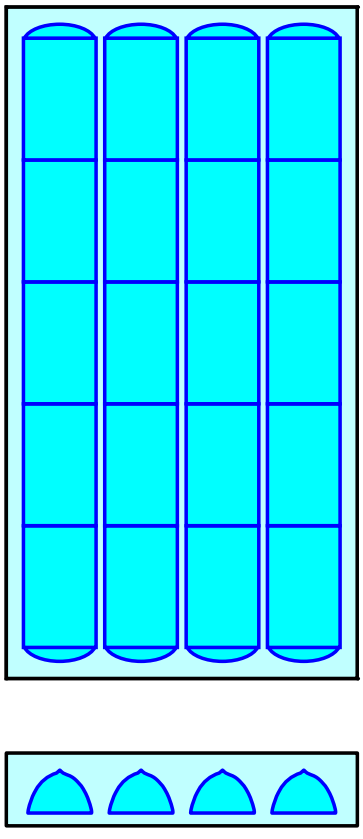
5 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 37.22' Row Length +12.0" End Stone x 2 = 39.22' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

20 Chambers x 45.9 cf = 918.8 cf Chamber Storage

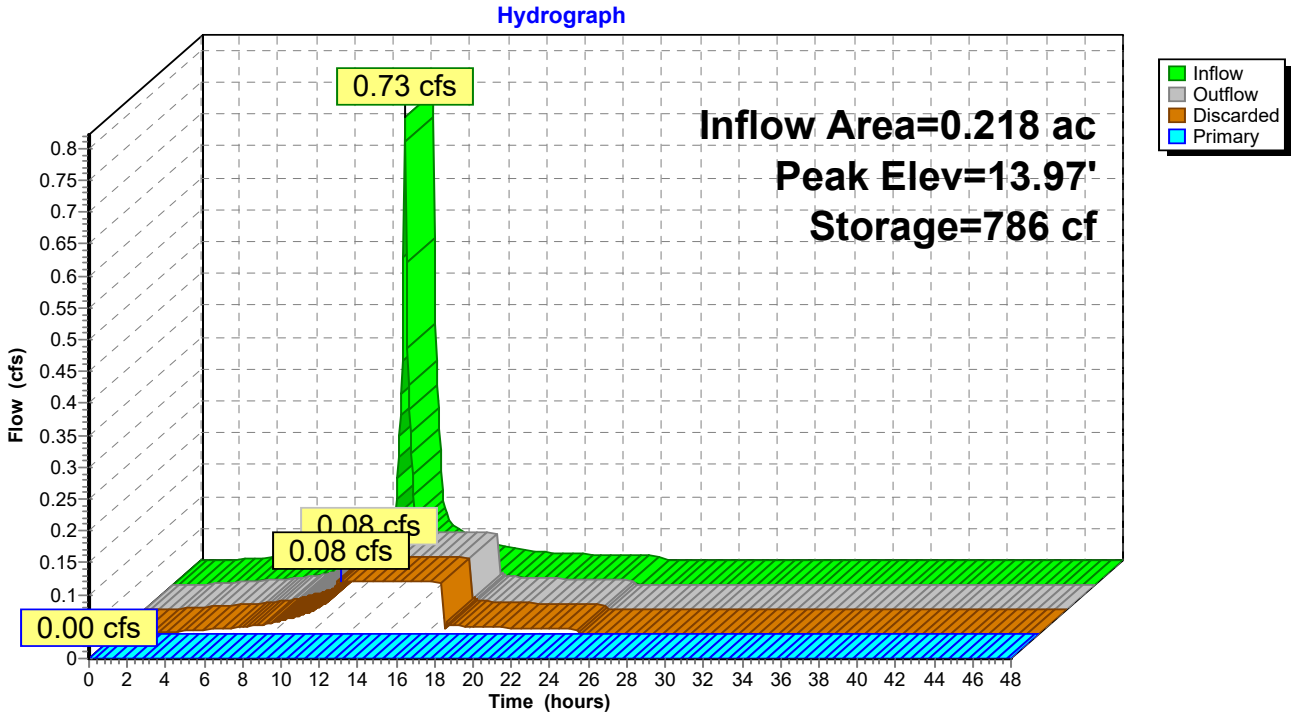
3,416.8 cf Field - 918.8 cf Chambers = 2,498.0 cf Stone x 33.3% Voids = 831.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,750.6 cf = 0.040 af
Overall Storage Efficiency = 51.2%
Overall System Size = 39.22' x 20.50' x 4.25'

20 Chambers
126.5 cy Field
92.5 cy Stone



Pond C4: Roofs



Summary for Pond D1: Infiltration Basin

Inflow Area = 13.817 ac, 20.40% Impervious, Inflow Depth = 0.20" for 2yr event
Inflow = 2.53 cfs @ 12.09 hrs, Volume= 0.235 af
Outflow = 0.95 cfs @ 12.40 hrs, Volume= 0.235 af, Atten= 62%, Lag= 19.0 min
Discarded = 0.95 cfs @ 12.40 hrs, Volume= 0.235 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 12.38' @ 12.40 hrs Surf.Area= 9,129 sf Storage= 1,172 cf

Plug-Flow detention time= 5.8 min calculated for 0.235 af (100% of inflow)
Center-of-Mass det. time= 5.7 min (918.1 - 912.3)

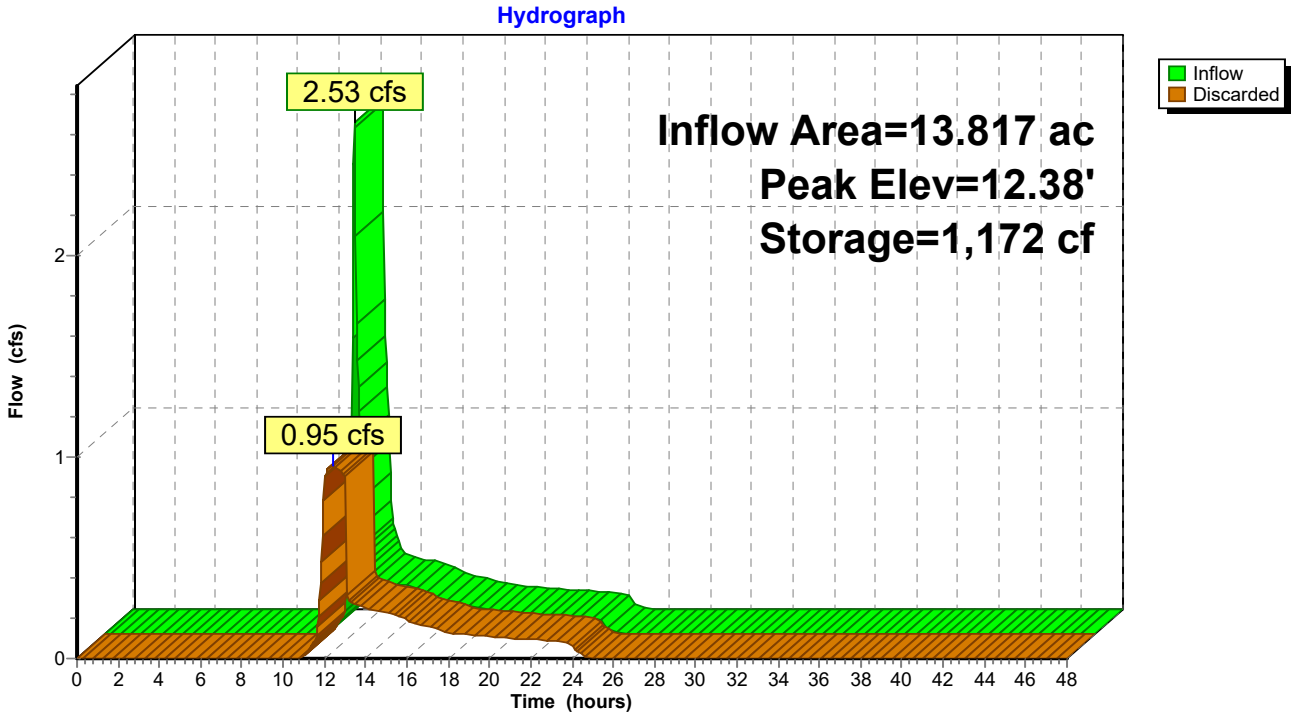
Volume	Invert	Avail.Storage	Storage Description
#1	12.25'	106,725 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.25	8,600	0	0
12.50	9,600	2,275	2,275
13.00	11,200	5,200	7,475
14.00	16,200	13,700	21,175
14.50	88,000	26,050	47,225
15.00	150,000	59,500	106,725

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.95 cfs @ 12.40 hrs HW=12.38' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.95 cfs)

Pond D1: Infiltration Basin



Summary for Pond P0: Natural Depression

Inflow Area = 2.755 ac, 8.03% Impervious, Inflow Depth = 0.07" for 2yr event
Inflow = 0.03 cfs @ 15.41 hrs, Volume= 0.016 af
Outflow = 0.03 cfs @ 15.46 hrs, Volume= 0.016 af, Atten= 0%, Lag= 3.0 min
Discarded = 0.03 cfs @ 15.46 hrs, Volume= 0.016 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.00' @ 15.46 hrs Surf.Area= 5,706 sf Storage= 2 cf

Plug-Flow detention time= 1.6 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 1.6 min (1,101.6 - 1,100.0)

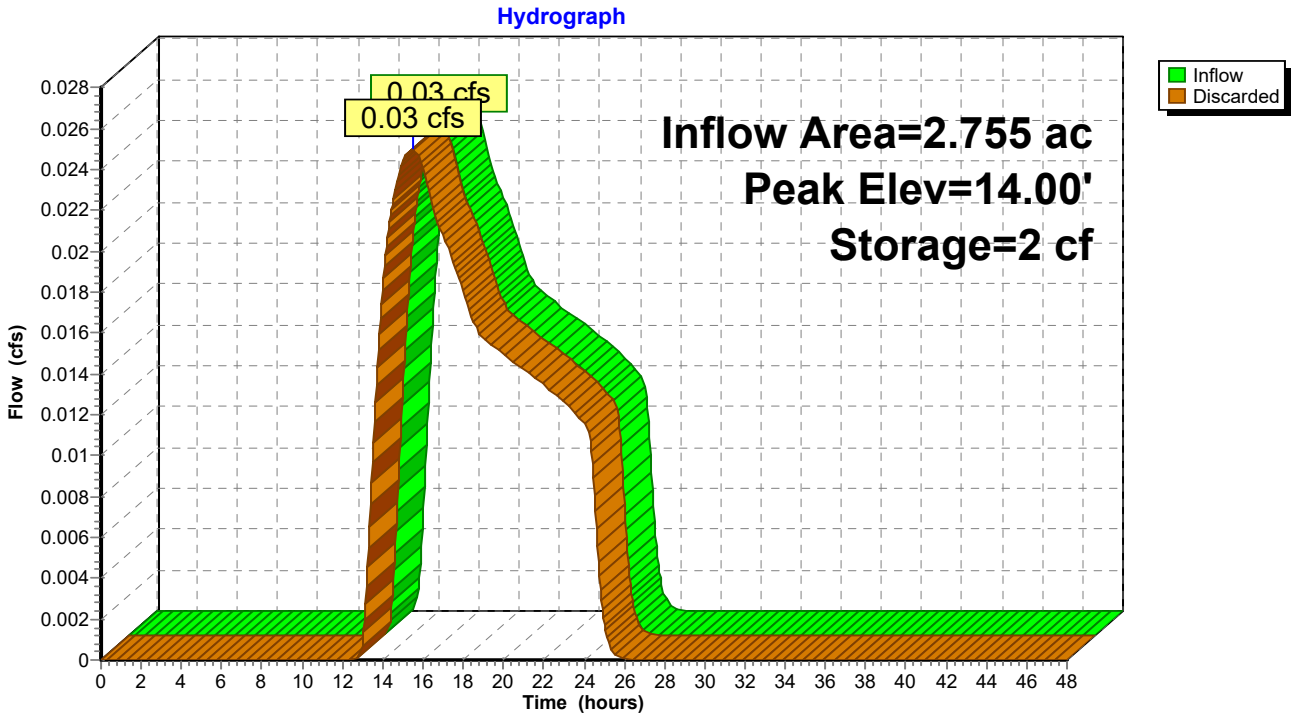
Volume	Invert	Avail.Storage	Storage Description
#1	14.00'	4,675 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
14.00	5,700	0	0
14.50	13,000	4,675	4,675

Device	Routing	Invert	Outlet Devices
#1	Discarded	14.00'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.03 cfs @ 15.46 hrs HW=14.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond P0: Natural Depression



Summary for Pond P1: Littleton Dr North Bio

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=101)

Inflow Area = 0.200 ac, 49.25% Impervious, Inflow Depth = 1.20" for 2yr event
Inflow = 0.27 cfs @ 12.09 hrs, Volume= 0.020 af
Outflow = 0.10 cfs @ 12.41 hrs, Volume= 0.020 af, Atten= 65%, Lag= 19.7 min
Discarded = 0.10 cfs @ 12.41 hrs, Volume= 0.020 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 13.88' @ 12.41 hrs Surf.Area= 1,724 sf Storage= 163 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 11.2 min (867.9 - 856.7)

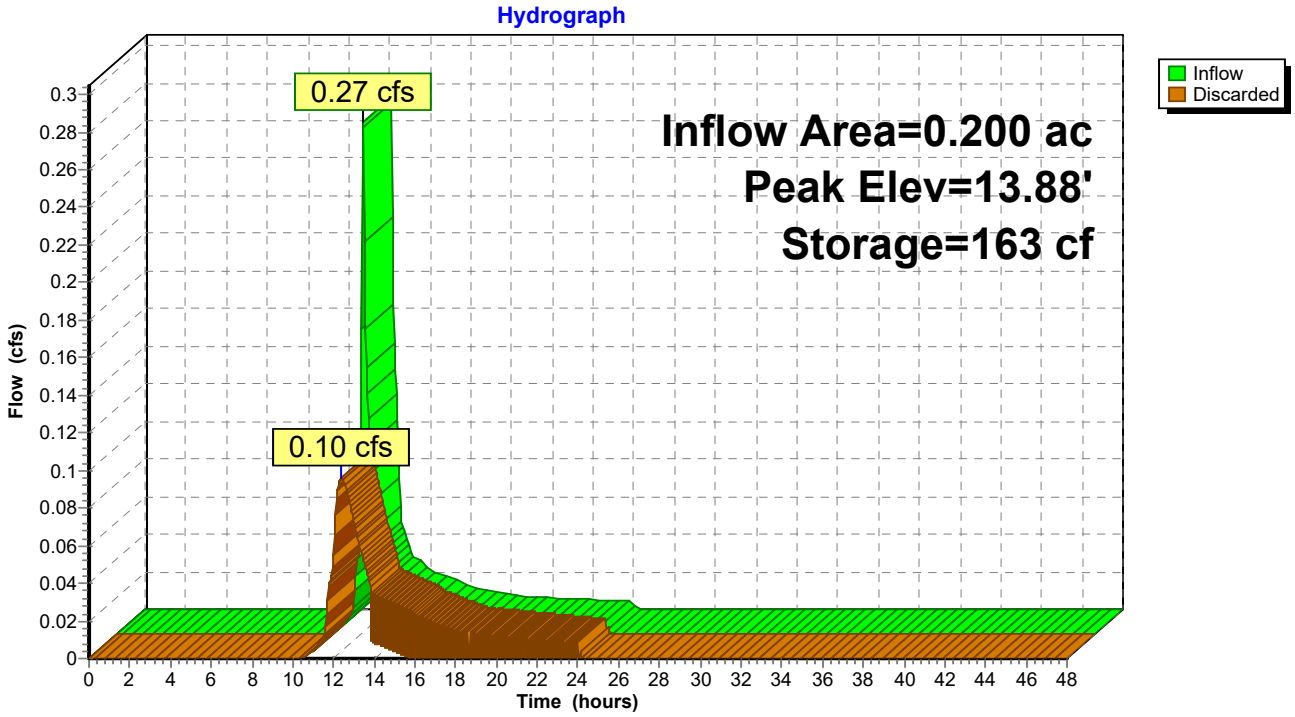
Volume	Invert	Avail.Storage	Storage Description
#1	13.75'	3,534 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.75	700	0	0
14.00	2,600	413	413
14.25	2,800	675	1,088
15.00	3,725	2,447	3,534

Device	Routing	Invert	Outlet Devices
#1	Discarded	13.75'	**2.410 in/hr Exfiltration over Surface area above 13.00'** Excluded Surface area = 0 sf

Discarded OutFlow Max=0.10 cfs @ 12.41 hrs HW=13.88' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Pond P1: Littleton Dr North Bio



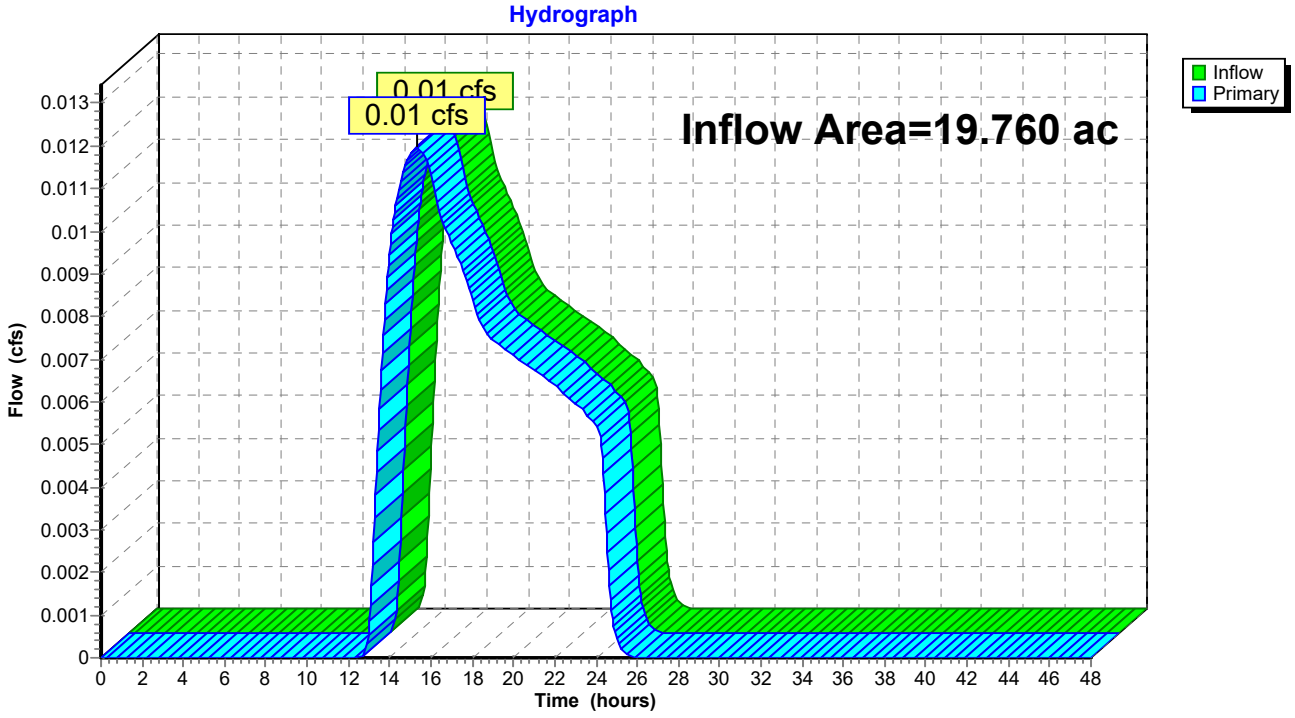
Summary for Pond SP1: FLAX POND

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

Inflow Area = 19.760 ac, 21.55% Impervious, Inflow Depth = 0.00" for 2yr event
Inflow = 0.01 cfs @ 15.31 hrs, Volume= 0.008 af
Primary = 0.01 cfs @ 15.31 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2

Pond SP1: FLAX POND



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA0: Littleton Dr North Runoff Area=8,731 sf 49.25% Impervious Runoff Depth=2.40"
Tc=5.0 min CN=74 Runoff=0.56 cfs 0.040 af

Subcatchment DA1E: East of Parking Lot Runoff Area=23,804 sf 70.19% Impervious Runoff Depth=3.32"
Tc=5.0 min CN=84 Runoff=2.12 cfs 0.151 af

Subcatchment DA1OS: Northeast Runoff Area=110,519 sf 0.14% Impervious Runoff Depth=0.46"
Flow Length=600' Slope=0.0100 '/' Tc=44.0 min CN=45 Runoff=0.33 cfs 0.097 af

Subcatchment DA1W: West of Parking Lot Runoff Area=21,567 sf 63.19% Impervious Runoff Depth=2.94"
Tc=5.0 min CN=80 Runoff=1.70 cfs 0.121 af

Subcatchment DA2: Community Garden Runoff Area=32,001 sf 57.61% Impervious Runoff Depth=2.58"
Tc=5.0 min CN=76 Runoff=2.22 cfs 0.158 af

Subcatchment DA2OS: Flax Pond Bank Runoff Area=52,772 sf 0.00% Impervious Runoff Depth=0.46"
Flow Length=400' Slope=0.0100 '/' Tc=37.3 min CN=45 Runoff=0.17 cfs 0.046 af

Subcatchment DA3: Middle Runoff Area=104,650 sf 49.70% Impervious Runoff Depth=2.40"
Tc=5.0 min CN=74 Runoff=6.76 cfs 0.481 af

Subcatchment DA3OS: Northwest Offsite Runoff Area=405,501 sf 7.28% Impervious Runoff Depth=0.41"
Flow Length=450' Slope=0.0100 '/' Tc=39.0 min CN=44 Runoff=1.06 cfs 0.319 af

Subcatchment DA3R: Roofs Runoff Area=9,486 sf 100.00% Impervious Runoff Depth=4.81"
Tc=5.0 min CN=98 Runoff=1.08 cfs 0.087 af

Subcatchment DA4: Middle North Runoff Area=91,735 sf 44.93% Impervious Runoff Depth=2.24"
Tc=5.0 min CN=72 Runoff=5.48 cfs 0.392 af

Pond C1: Northern Parking Peak Elev=14.82' Storage=4,705 cf Inflow=3.81 cfs 0.272 af
Discarded=0.31 cfs 0.272 af Primary=0.00 cfs 0.000 af Outflow=0.31 cfs 0.272 af

Pond C2: Southern Parking Peak Elev=13.80' Storage=2,287 cf Inflow=2.22 cfs 0.158 af
Discarded=0.27 cfs 0.158 af Primary=0.00 cfs 0.000 af Outflow=0.27 cfs 0.158 af

Pond C3: Middle Peak Elev=14.25' Storage=7,746 cf Inflow=6.76 cfs 0.481 af
Discarded=0.66 cfs 0.481 af Primary=0.00 cfs 0.000 af Outflow=0.66 cfs 0.481 af

Pond C4: Roofs Peak Elev=14.77' Storage=1,205 cf Inflow=1.08 cfs 0.087 af
Discarded=0.08 cfs 0.081 af Primary=0.18 cfs 0.006 af Outflow=0.26 cfs 0.087 af

Pond D1: Infiltration Basin Peak Elev=12.89' Storage=6,305 cf Inflow=5.49 cfs 0.712 af
Outflow=1.13 cfs 0.712 af

Pond P0: Natural Depression Peak Elev=14.01' Storage=36 cf Inflow=0.38 cfs 0.103 af
Outflow=0.38 cfs 0.103 af

Pond P1: Littleton Dr North Bio Peak Elev=14.02' Storage=458 cf Inflow=0.56 cfs 0.040 af
Outflow=0.15 cfs 0.040 af

Pond SP1: FLAX POND Inflow=0.17 cfs 0.046 af
Primary=0.17 cfs 0.046 af

Total Runoff Area = 19.760 ac Runoff Volume = 1.894 af Average Runoff Depth = 1.15"
78.45% Pervious = 15.502 ac 21.55% Impervious = 4.258 ac

Summary for Subcatchment DA0: Littleton Dr North

[49] Hint: Tc<2dt may require smaller dt

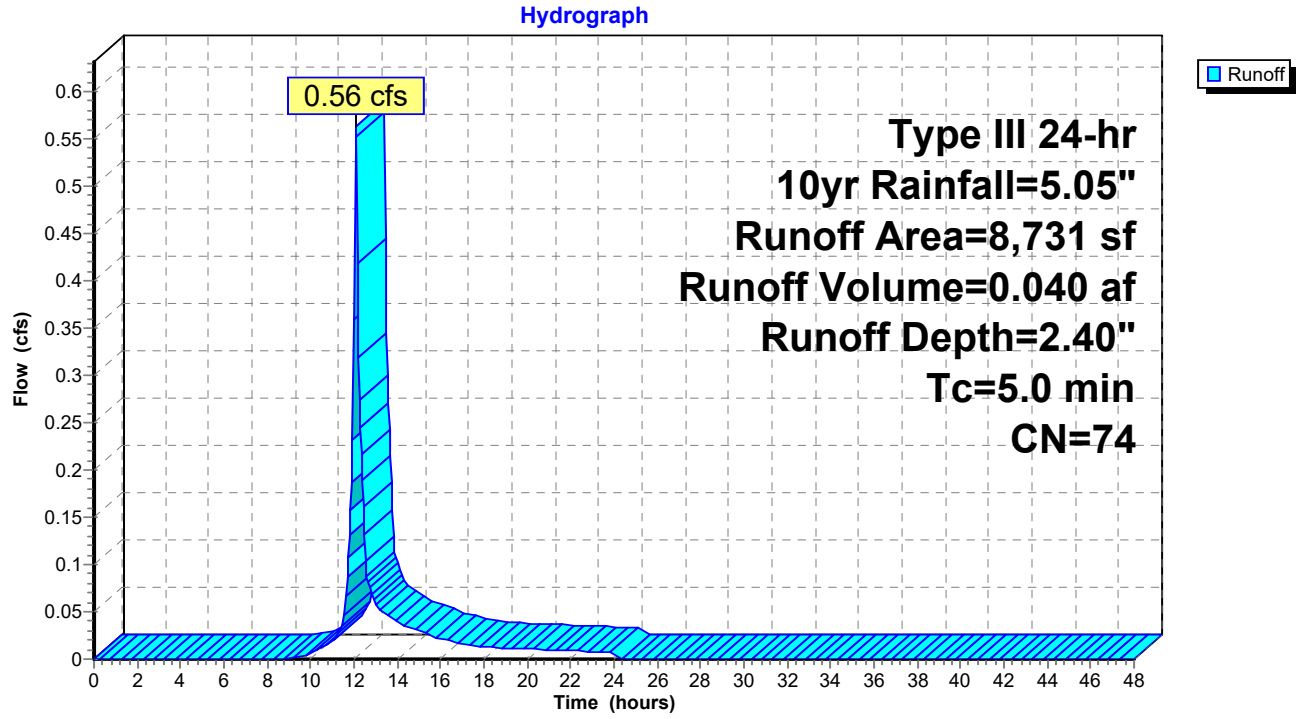
Runoff = 0.56 cfs @ 12.08 hrs, Volume= 0.040 af, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
	3,600	98	Paved parking, HSG A
*	4,431	50	>75% Grass cover, Good, HSG A/B
	700	98	Water Surface, HSG A
	8,731	74	Weighted Average
	4,431		50.75% Pervious Area
	4,300		49.25% Impervious Area

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

Subcatchment DA0: Littleton Dr North



Summary for Subcatchment DA1E: East of Parking Lot

[49] Hint: Tc<2dt may require smaller dt

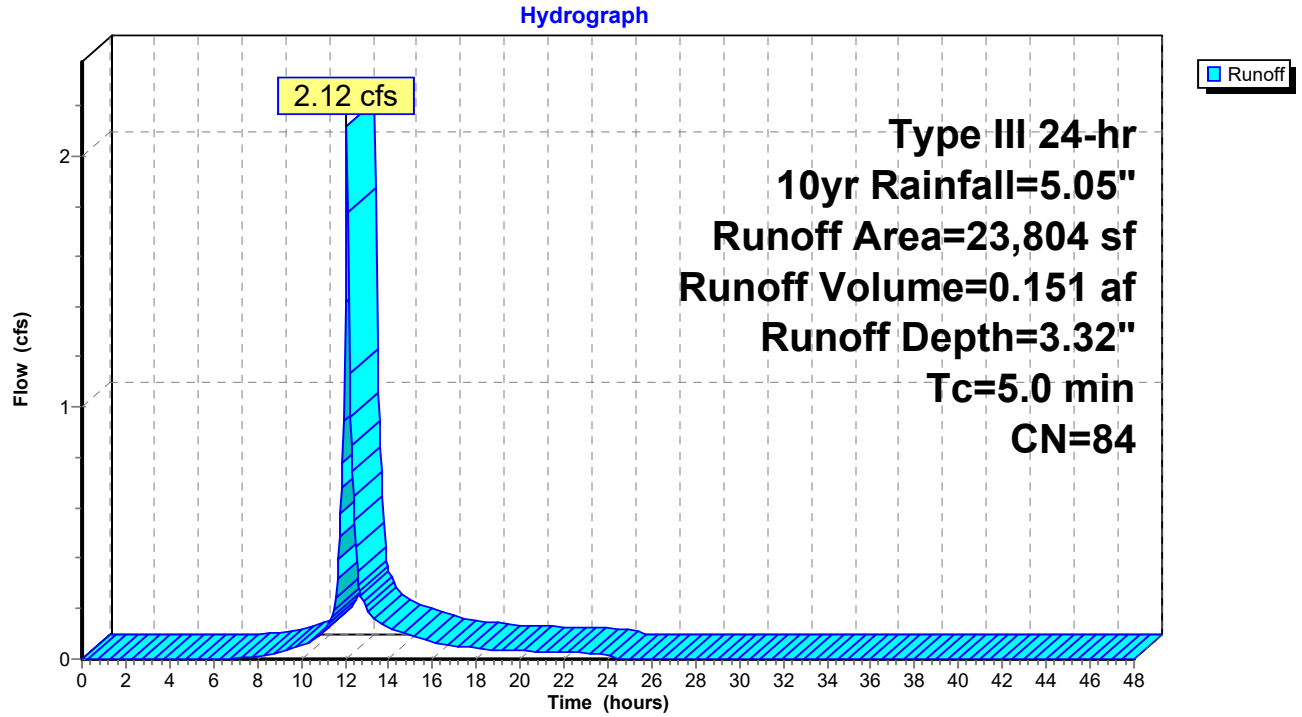
Runoff = 2.12 cfs @ 12.07 hrs, Volume= 0.151 af, Depth= 3.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
	15,658	98	Paved parking, HSG A
*	7,095	50	>75% Grass cover, Good, HSG A/B
	1,051	98	Water Surface, HSG A
	23,804	84	Weighted Average
	7,095		29.81% Pervious Area
	16,709		70.19% Impervious Area

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

Subcatchment DA1E: East of Parking Lot



Summary for Subcatchment DA1OS: Northeast Depression

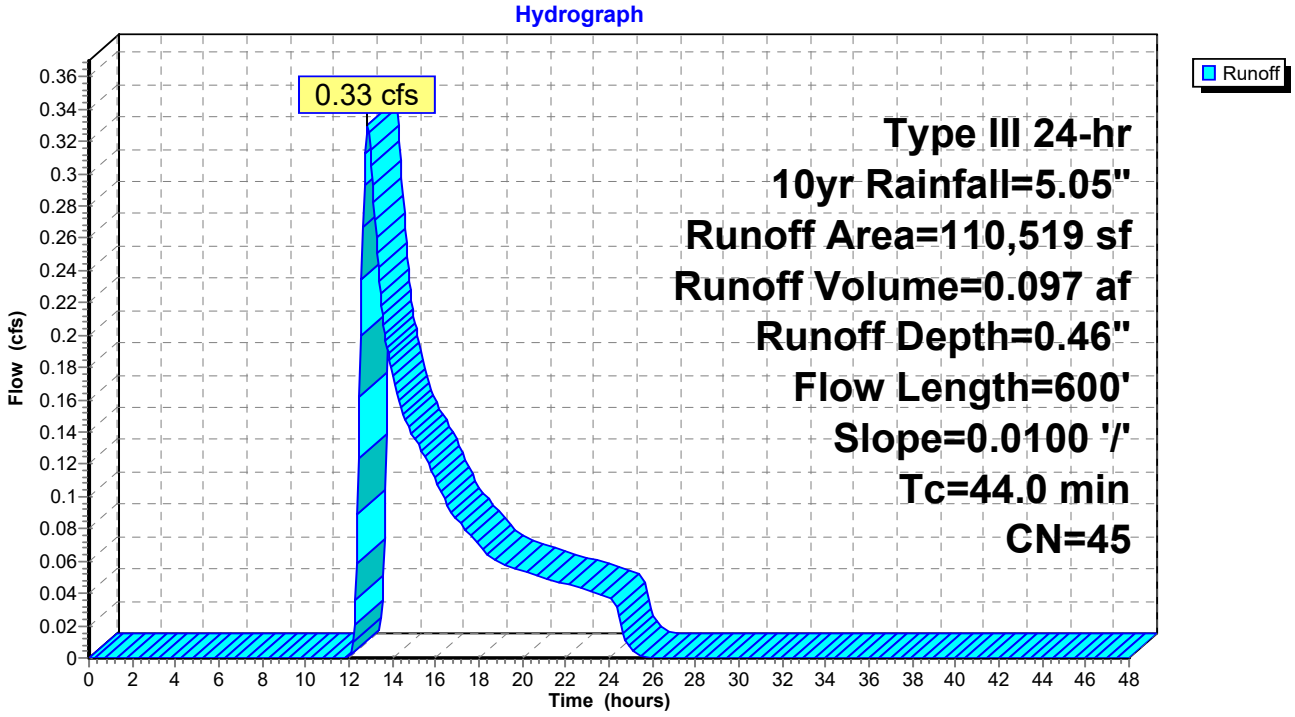
Runoff = 0.33 cfs @ 12.86 hrs, Volume= 0.097 af, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
	150	98	Roofs, HSG A
*	3,318	77	Dirt roads, HSG A/B
*	78,963	42	Woods, Good, HSG A/B
*	28,088	50	>75% Grass cover, Good, HSG A/B
	110,519	45	Weighted Average
	110,369		99.86% Pervious Area
	150		0.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
16.7	500	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
44.0	600	Total			

Subcatchment DA1OS: Northeast Depression



Summary for Subcatchment DA1W: West of Parking Lot

[49] Hint: Tc<2dt may require smaller dt

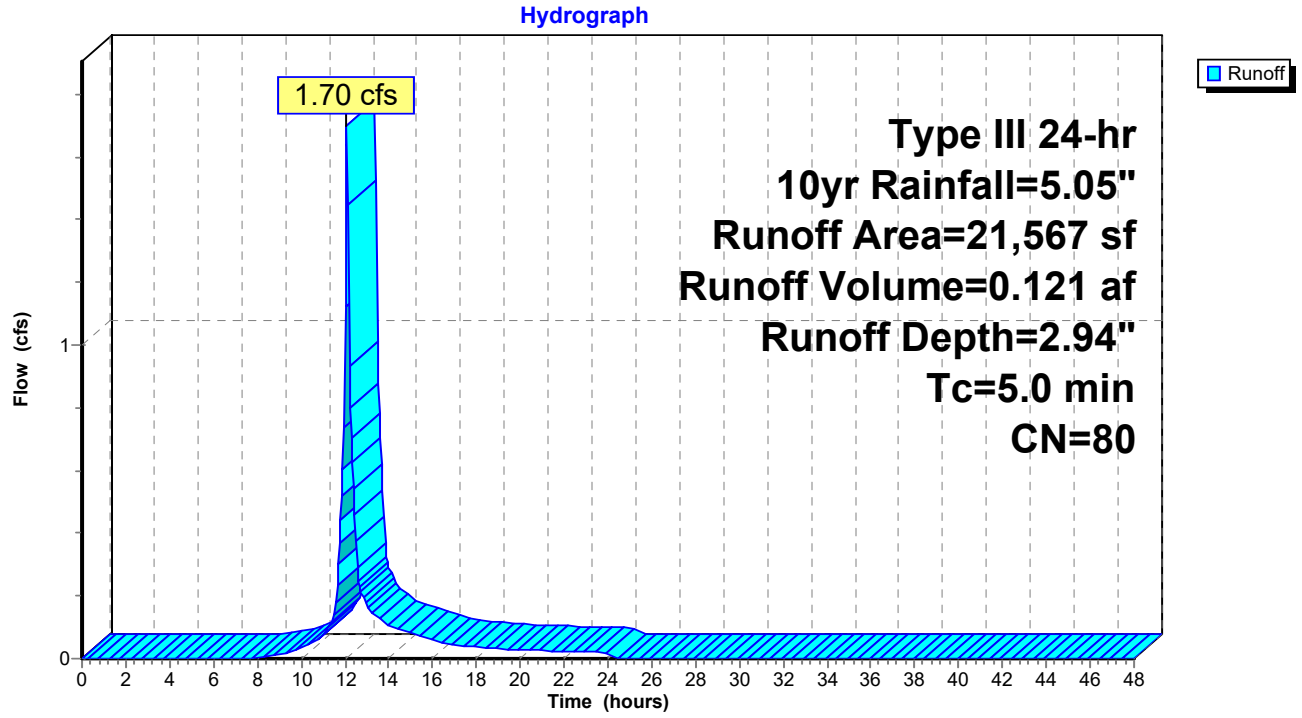
Runoff = 1.70 cfs @ 12.08 hrs, Volume= 0.121 af, Depth= 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
	6,706	98	Paved parking, HSG A
*	7,939	50	>75% Grass cover, Good, HSG A/B
	6,467	98	Roofs, HSG A
	455	98	Water Surface, HSG A
	21,567	80	Weighted Average
	7,939		36.81% Pervious Area
	13,628		63.19% Impervious Area

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

Subcatchment DA1W: West of Parking Lot



Summary for Subcatchment DA2: Community Garden

[49] Hint: Tc<2dt may require smaller dt

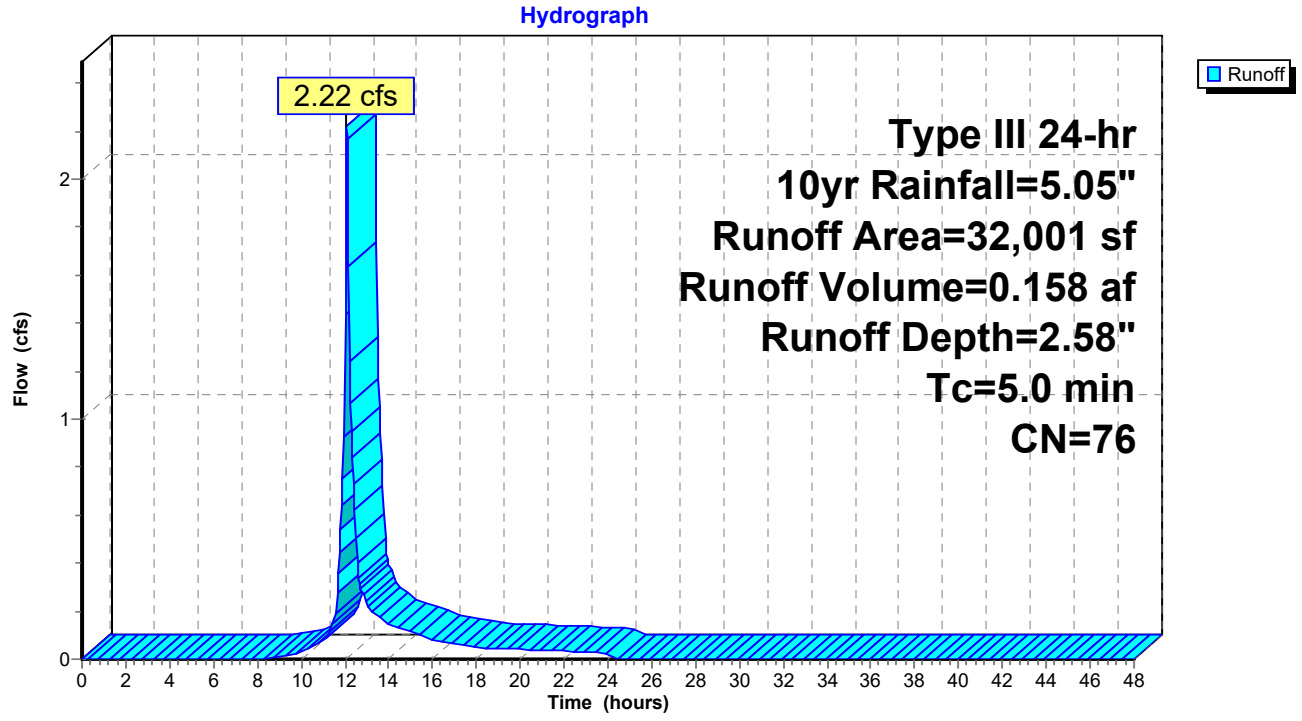
Runoff = 2.22 cfs @ 12.08 hrs, Volume= 0.158 af, Depth= 2.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
	11,016	98	Paved parking, HSG A
*	7,510	50	>75% Grass cover, Good, HSG A/B
	445	98	Water Surface, HSG A
	6,976	98	Roofs, HSG A
*	6,054	42	Woods, Good, HSG A/B
	32,001	76	Weighted Average
	13,564		42.39% Pervious Area
	18,437		57.61% Impervious Area

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

Subcatchment DA2: Community Garden



Summary for Subcatchment DA2OS: Flax Pond Bank

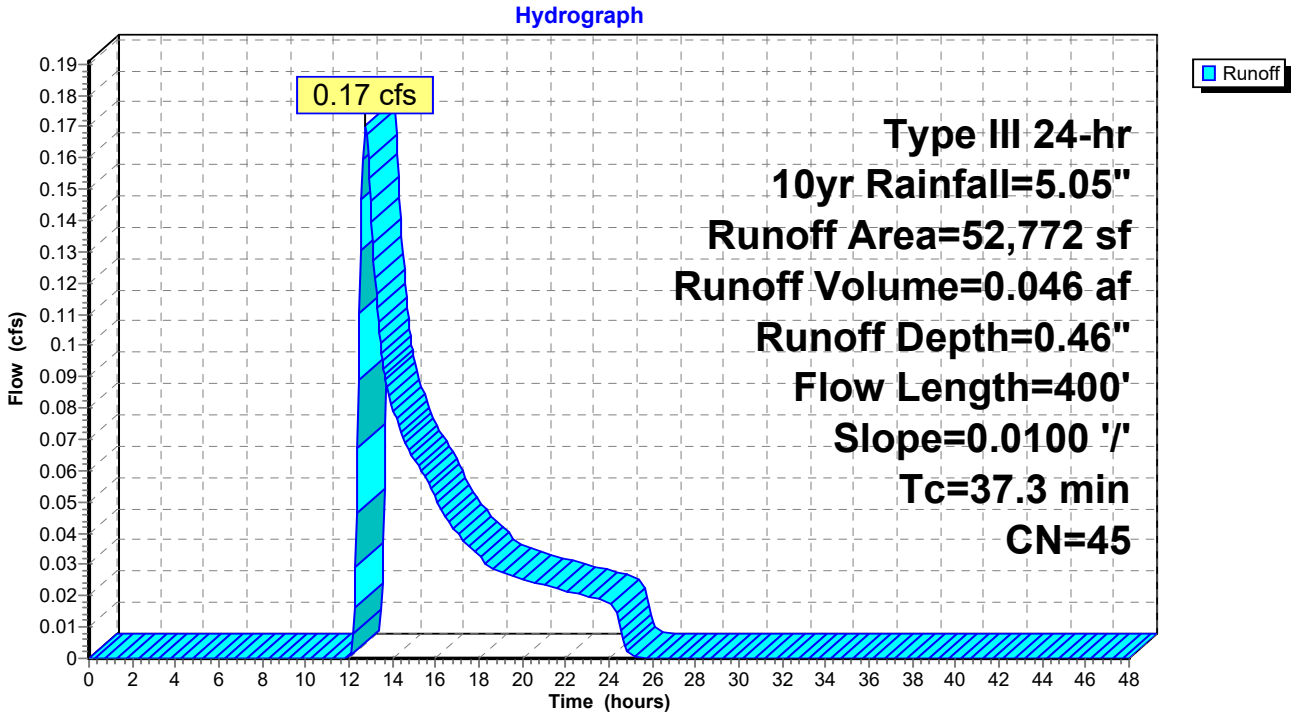
Runoff = 0.17 cfs @ 12.76 hrs, Volume= 0.046 af, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
*	4,594	77	Dirt roads, HSG A/B
*	48,178	42	Woods, Good, HSG A/B
	52,772	45	Weighted Average
	52,772		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
10.0	300	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
37.3	400	Total			

Subcatchment DA2OS: Flax Pond Bank



Summary for Subcatchment DA3: Middle

[49] Hint: Tc<2dt may require smaller dt

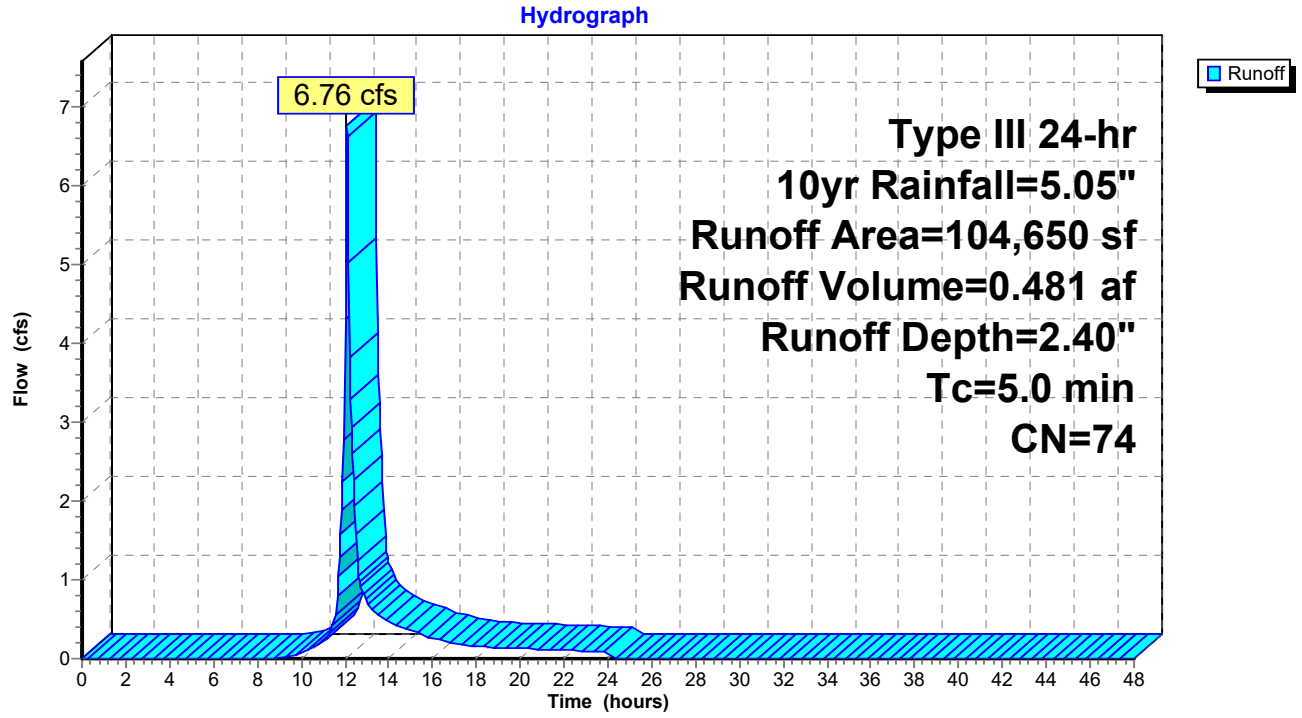
Runoff = 6.76 cfs @ 12.08 hrs, Volume= 0.481 af, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
	41,974	98	Paved parking, HSG A
*	52,638	50	>75% Grass cover, Good, HSG A/B
	7,340	98	Roofs, HSG A
	2,698	98	Water Surface, HSG A
	104,650	74	Weighted Average
	52,638		50.30% Pervious Area
	52,012		49.70% Impervious Area

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

Subcatchment DA3: Middle



Summary for Subcatchment DA3OS: Northwest Offsite

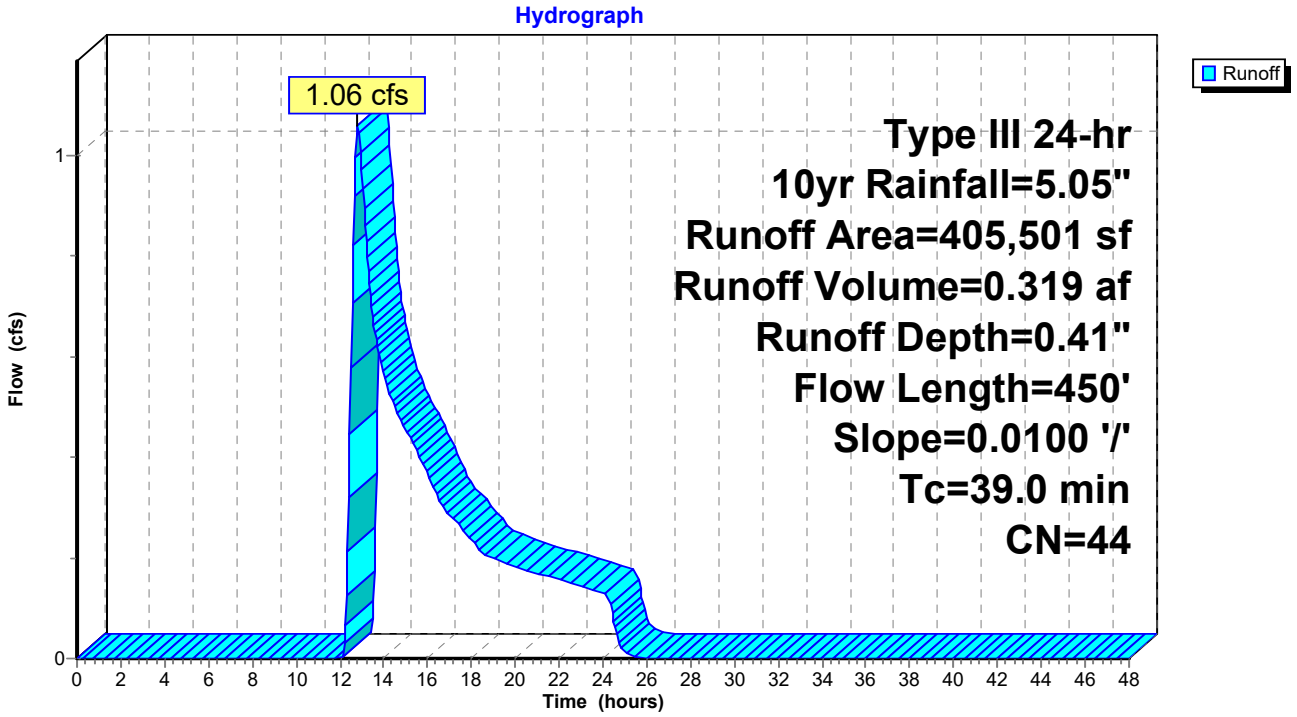
Runoff = 1.06 cfs @ 12.82 hrs, Volume= 0.319 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
	1,176	98	Paved roads w/curbs & sewers, HSG A
	15,531	98	Roofs, HSG A
*	11,222	77	Dirt roads, HSG A/B
*	235,751	42	Woods, Good, HSG A/B
*	16,604	50	>75% Grass cover, Good, HSG A/B
	17,671	39	>75% Grass cover, Good, HSG A
	94,715	30	Woods, Good, HSG A
	12,831	98	Water Surface, HSG A
	405,501	44	Weighted Average
	375,963		92.72% Pervious Area
	29,538		7.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
11.7	350	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
39.0	450	Total			

Subcatchment DA3OS: Northwest Offsite



Summary for Subcatchment DA3R: Roofs

[49] Hint: Tc<2dt may require smaller dt

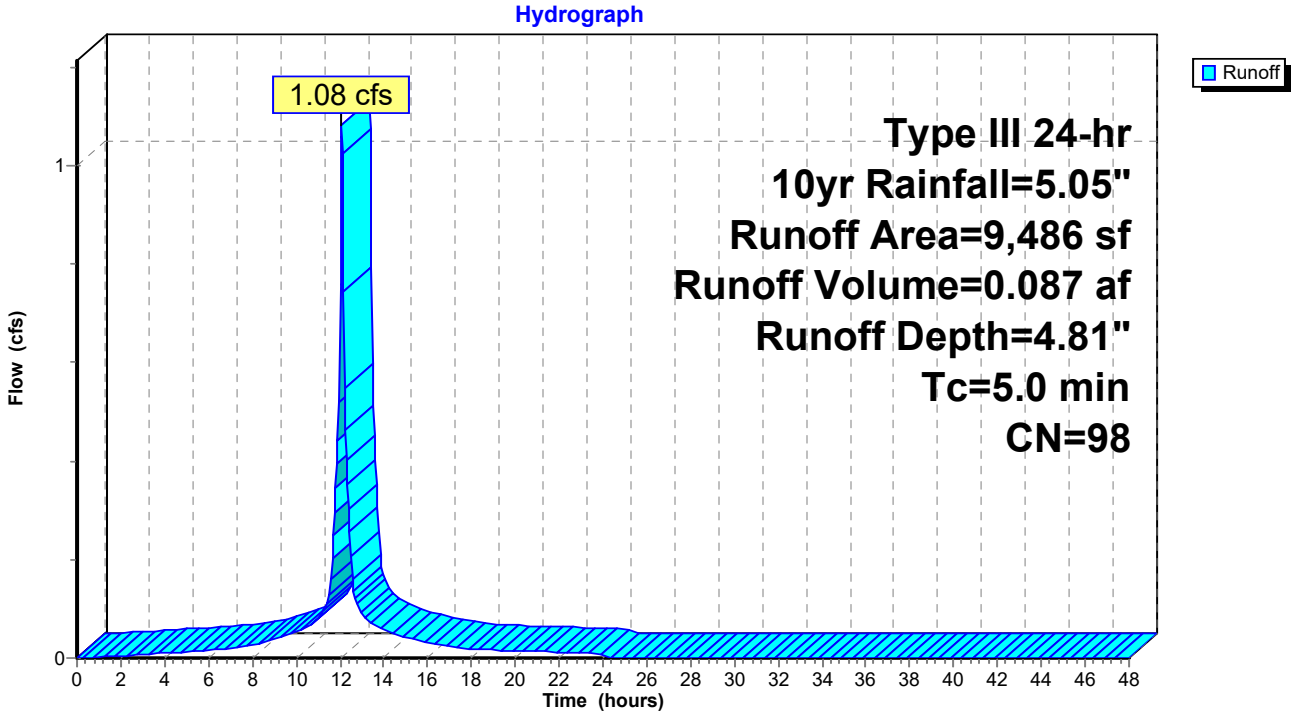
Runoff = 1.08 cfs @ 12.07 hrs, Volume= 0.087 af, Depth= 4.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

Area (sf)	CN	Description
9,486	98	Roofs, HSG A
9,486		100.00% Impervious Area

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

Subcatchment DA3R: Roofs



Summary for Subcatchment DA4: Middle North

[49] Hint: Tc<2dt may require smaller dt

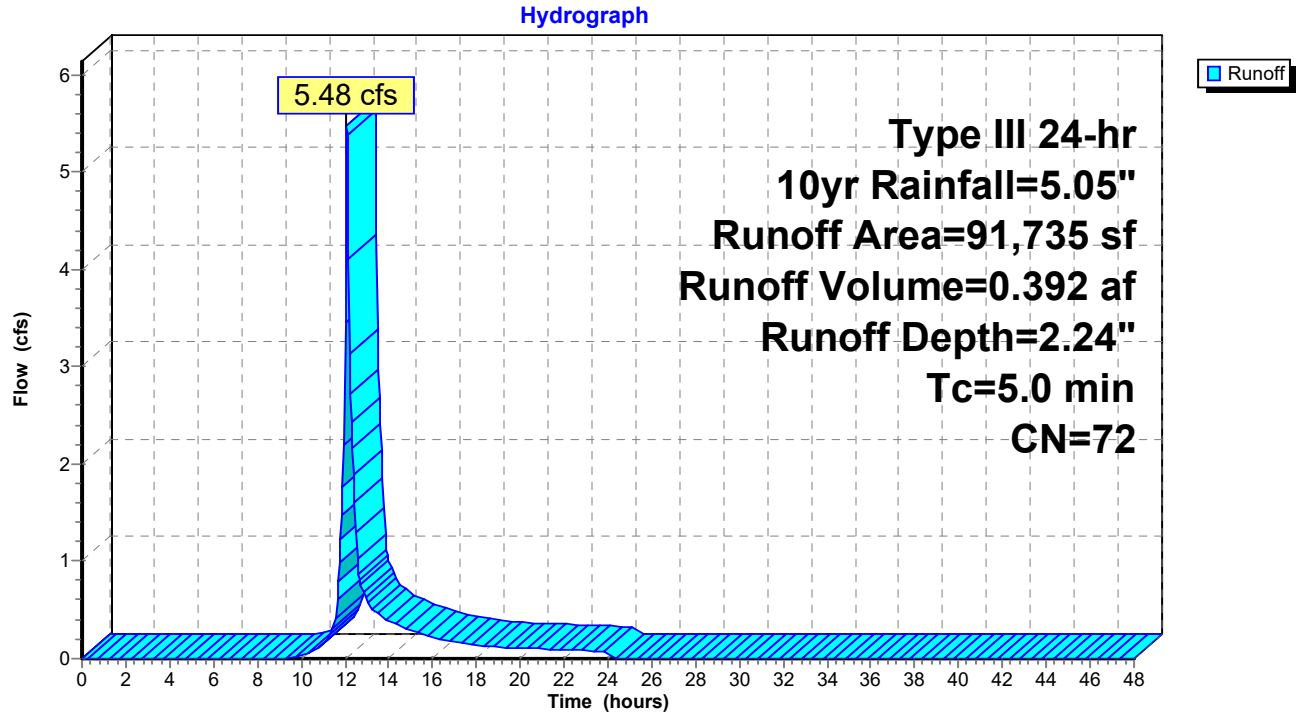
Runoff = 5.48 cfs @ 12.08 hrs, Volume= 0.392 af, Depth= 2.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (sf)	CN	Description
	21,490	98	Paved parking, HSG A
*	50,514	50	>75% Grass cover, Good, HSG A/B
	18,191	98	Roofs, HSG A
	1,540	98	Water Surface, HSG A
	91,735	72	Weighted Average
	50,514		55.07% Pervious Area
	41,221		44.93% Impervious Area

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

Subcatchment DA4: Middle North



Summary for Pond C1: Northern Parking

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

Inflow Area = 1.042 ac, 66.86% Impervious, Inflow Depth = 3.14" for 10yr event
Inflow = 3.81 cfs @ 12.08 hrs, Volume= 0.272 af
Outflow = 0.31 cfs @ 11.65 hrs, Volume= 0.272 af, Atten= 92%, Lag= 0.0 min
Discarded = 0.31 cfs @ 11.65 hrs, Volume= 0.272 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.82' @ 13.27 hrs Surf.Area= 2,955 sf Storage= 4,705 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 130.5 min (944.7 - 814.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	2,959 cf	**39.50'W x 74.82'L x 4.25'H Field A** 12,560 cf Overall - 3,675 cf Embedded = 8,885 cf x 33.3% Voids
#2A	13.00'	3,675 cf	**ADS_StormTech SC-740 +Cap** x 80 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 80 Chambers in 8 Rows
		6,634 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	14.50'	**18.0" Round Culvert** L= 85.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.50' / 13.50' S= 0.0118 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Discarded OutFlow Max=0.31 cfs @ 11.65 hrs HW=12.31' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.25' TW=0.00' (Dynamic Tailwater)
↑└**3=Culvert** (Controls 0.00 cfs)
↑└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond C1: Northern Parking - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

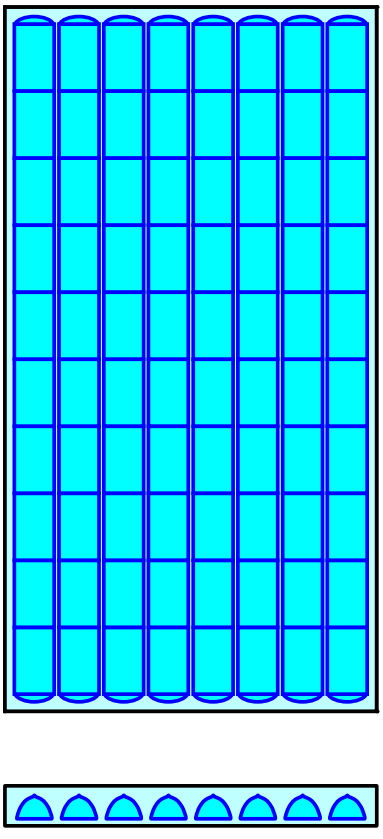
10 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 72.82' Row Length +12.0" End Stone x 2 = 74.82' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

80 Chambers x 45.9 cf = 3,675.2 cf Chamber Storage

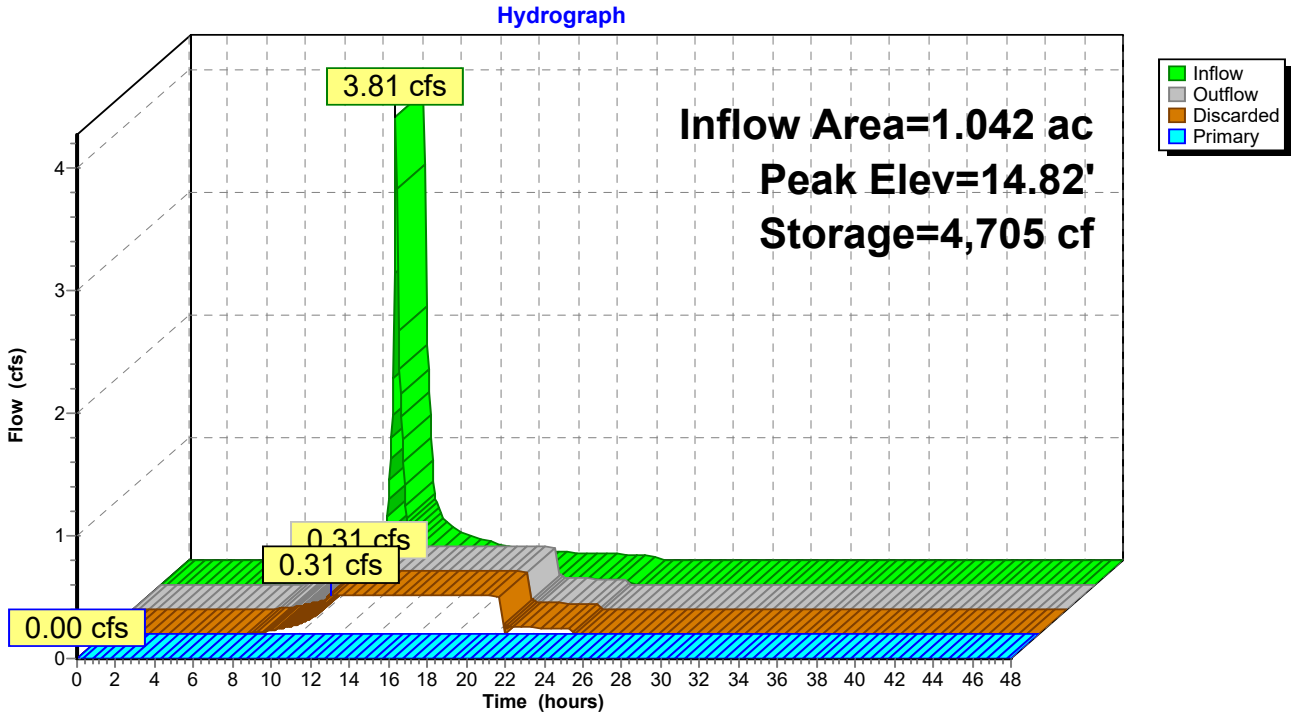
12,559.8 cf Field - 3,675.2 cf Chambers = 8,884.6 cf Stone x 33.3% Voids = 2,958.6 cf Stone Storage

Chamber Storage + Stone Storage = 6,633.8 cf = 0.152 af
Overall Storage Efficiency = 52.8%
Overall System Size = 74.82' x 39.50' x 4.25'

80 Chambers
465.2 cy Field
329.1 cy Stone



Pond C1: Northern Parking



Summary for Pond C2: Southern Parking

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

Inflow Area = 0.735 ac, 57.61% Impervious, Inflow Depth = 2.58" for 10yr event
Inflow = 2.22 cfs @ 12.08 hrs, Volume= 0.158 af
Outflow = 0.27 cfs @ 11.75 hrs, Volume= 0.158 af, Atten= 88%, Lag= 0.0 min
Discarded = 0.27 cfs @ 11.75 hrs, Volume= 0.158 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 13.80' @ 12.81 hrs Surf.Area= 2,600 sf Storage= 2,287 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 64.7 min (895.6 - 830.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	2,609 cf	**34.75'W x 74.82'L x 4.25'H Field A** 11,049 cf Overall - 3,216 cf Embedded = 7,834 cf x 33.3% Voids
#2A	13.00'	3,216 cf	**ADS_StormTech SC-740 +Cap** x 70 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 70 Chambers in 7 Rows
		5,824 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	14.50'	**10.0" Round Culvert** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 14.50' / 14.20' S= 0.0043 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.27 cfs @ 11.75 hrs HW=12.30' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.25' TW=0.00' (Dynamic Tailwater)
↑└**3=Culvert** (Controls 0.00 cfs)
↑└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond C2: Southern Parking - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

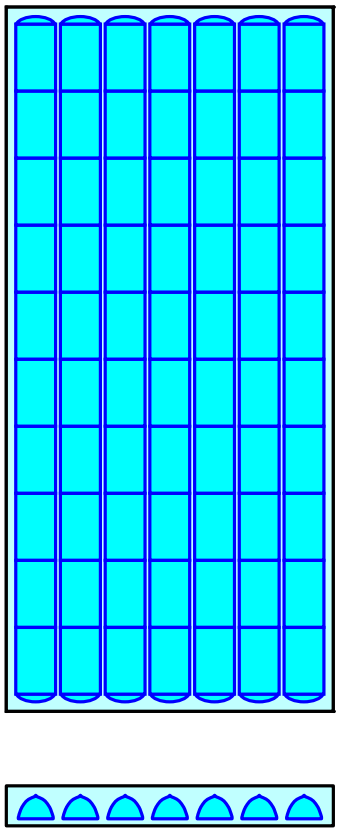
10 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 72.82' Row Length +12.0" End Stone x 2 = 74.82' Base Length
7 Rows x 51.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 34.75' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

70 Chambers x 45.9 cf = 3,215.8 cf Chamber Storage

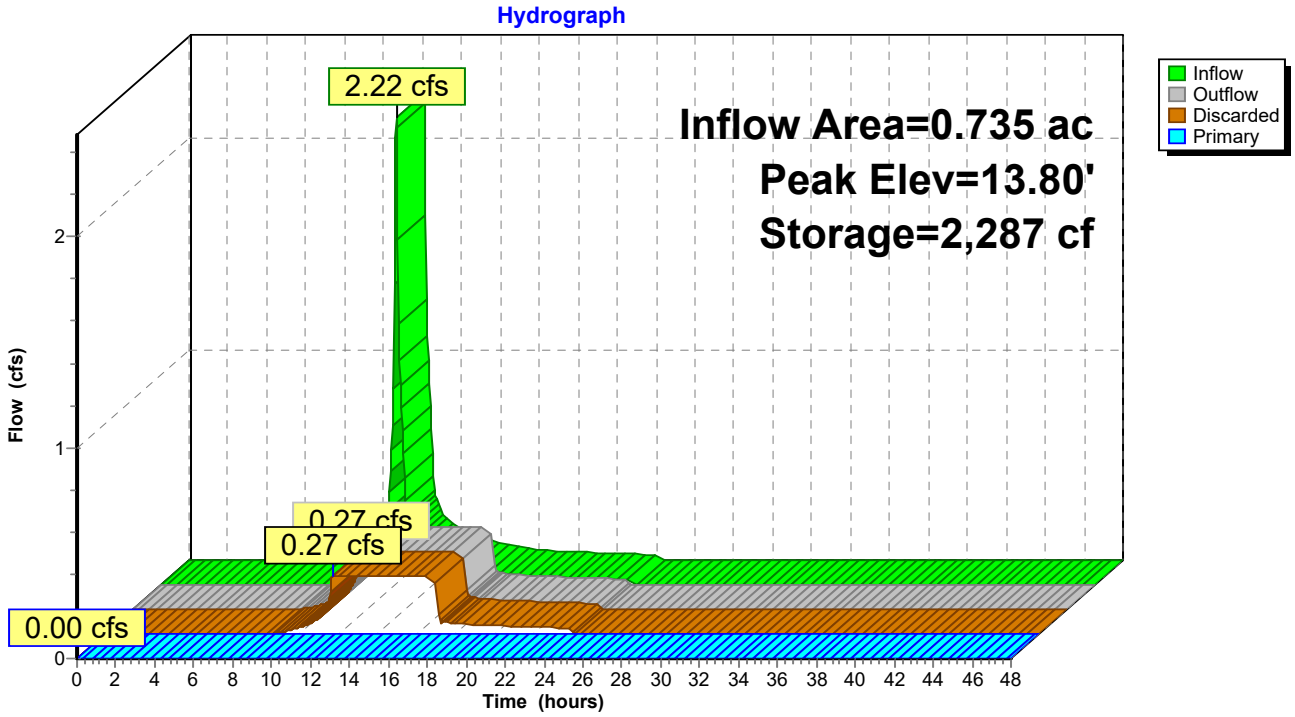
11,049.5 cf Field - 3,215.8 cf Chambers = 7,833.7 cf Stone x 33.3% Voids = 2,608.6 cf Stone Storage

Chamber Storage + Stone Storage = 5,824.4 cf = 0.134 af
Overall Storage Efficiency = 52.7%
Overall System Size = 74.82' x 34.75' x 4.25'

70 Chambers
409.2 cy Field
290.1 cy Stone



Pond C2: Southern Parking



Summary for Pond C3: Middle

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

Inflow Area = 2.402 ac, 49.70% Impervious, Inflow Depth = 2.40" for 10yr event
Inflow = 6.76 cfs @ 12.08 hrs, Volume= 0.481 af
Outflow = 0.66 cfs @ 11.75 hrs, Volume= 0.481 af, Atten= 90%, Lag= 0.0 min
Discarded = 0.66 cfs @ 11.75 hrs, Volume= 0.481 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.25' @ 13.06 hrs Surf.Area= 6,318 sf Storage= 7,746 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 101.1 min (937.1 - 836.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	6,249 cf	**53.75'W x 117.54'L x 4.25'H Field A** 26,850 cf Overall - 8,085 cf Embedded = 18,764 cf x 33.3% Voids
#2A	13.00'	8,085 cf	**ADS_StormTech SC-740 +Cap** x 176 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 176 Chambers in 11 Rows
		14,334 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	13.60'	**18.0" Round Culvert** L= 112.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 13.60' / 13.00' S= 0.0054 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Discarded OutFlow Max=0.66 cfs @ 11.75 hrs HW=12.33' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.66 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.25' TW=12.25' (Dynamic Tailwater)
↑└**3=Culvert** (Controls 0.00 cfs)
↑└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond C3: Middle - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

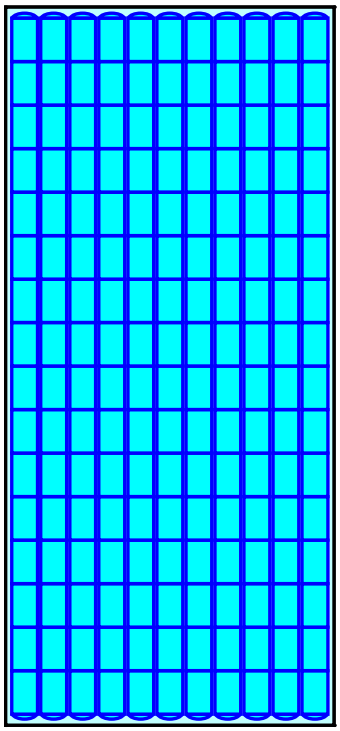
16 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 115.54' Row Length +12.0" End Stone x 2 = 117.54' Base Length
11 Rows x 51.0" Wide + 6.0" Spacing x 10 + 12.0" Side Stone x 2 = 53.75' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

176 Chambers x 45.9 cf = 8,085.4 cf Chamber Storage

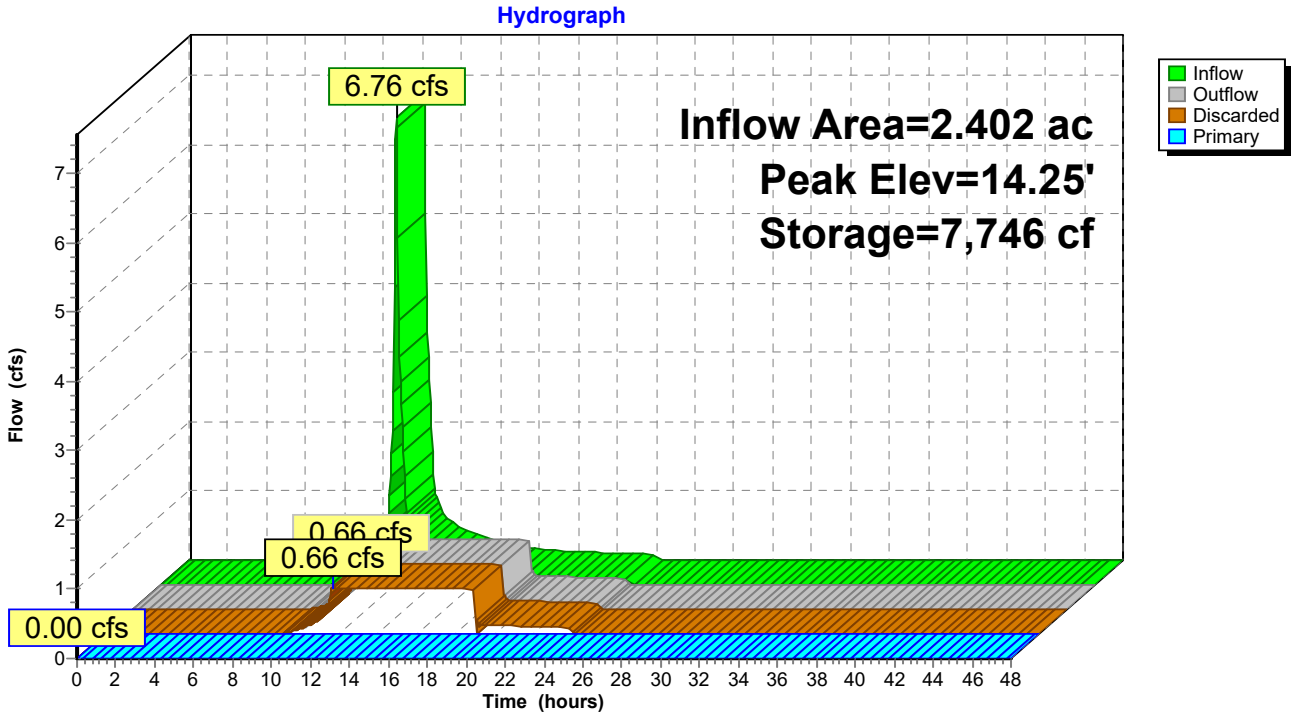
26,849.8 cf Field - 8,085.4 cf Chambers = 18,764.3 cf Stone x 33.3% Voids = 6,248.5 cf Stone Storage

Chamber Storage + Stone Storage = 14,334.0 cf = 0.329 af
Overall Storage Efficiency = 53.4%
Overall System Size = 117.54' x 53.75' x 4.25'

176 Chambers
994.4 cy Field
695.0 cy Stone



Pond C3: Middle



Summary for Pond C4: Roofs

Inflow Area = 0.218 ac,100.00% Impervious, Inflow Depth = 4.81" for 10yr event
Inflow = 1.08 cfs @ 12.07 hrs, Volume= 0.087 af
Outflow = 0.26 cfs @ 12.45 hrs, Volume= 0.087 af, Atten= 76%, Lag= 22.6 min
Discarded = 0.08 cfs @ 11.35 hrs, Volume= 0.081 af
Primary = 0.18 cfs @ 12.45 hrs, Volume= 0.006 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.77' @ 12.45 hrs Surf.Area= 804 sf Storage= 1,205 cf

Plug-Flow detention time= 85.2 min calculated for 0.087 af (100% of inflow)
Center-of-Mass det. time= 85.1 min (832.0 - 746.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	832 cf	**20.50'W x 39.22'L x 4.25'H Field A** 3,417 cf Overall - 919 cf Embedded = 2,498 cf x 33.3% Voids
#2A	13.00'	919 cf	**ADS_StormTech SC-740 +Cap** x 20 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 20 Chambers in 4 Rows
		1,751 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	14.50'	**8.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.50' / 14.00' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.08 cfs @ 11.35 hrs HW=12.30' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.18 cfs @ 12.45 hrs HW=14.77' TW=14.00' (Dynamic Tailwater)
↑**2=Culvert** (Inlet Controls 0.18 cfs @ 1.39 fps)

Pond C4: Roofs - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

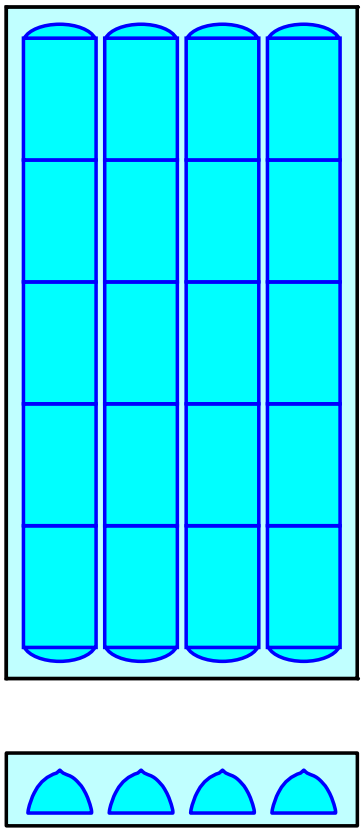
5 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 37.22' Row Length +12.0" End Stone x 2 = 39.22' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

20 Chambers x 45.9 cf = 918.8 cf Chamber Storage

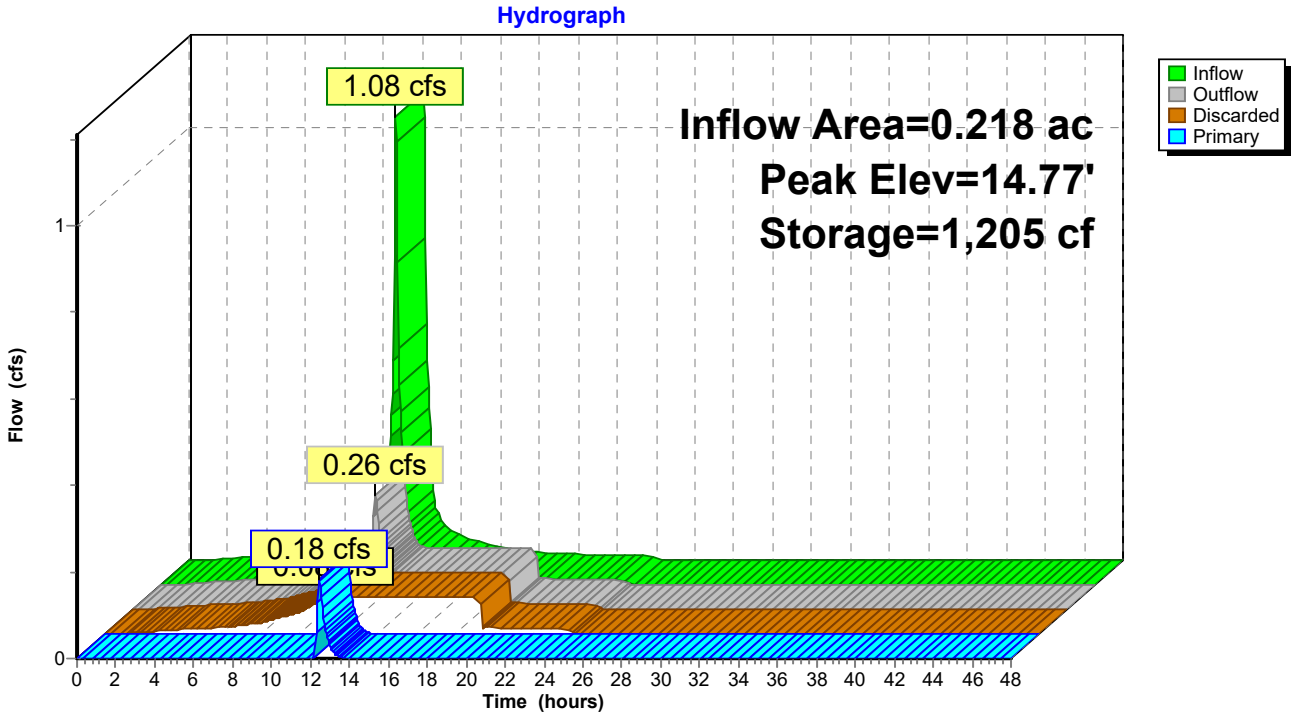
3,416.8 cf Field - 918.8 cf Chambers = 2,498.0 cf Stone x 33.3% Voids = 831.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,750.6 cf = 0.040 af
Overall Storage Efficiency = 51.2%
Overall System Size = 39.22' x 20.50' x 4.25'

20 Chambers
126.5 cy Field
92.5 cy Stone



Pond C4: Roofs



Summary for Pond D1: Infiltration Basin

Inflow Area = 13.817 ac, 20.40% Impervious, Inflow Depth = 0.62" for 10yr event
Inflow = 5.49 cfs @ 12.08 hrs, Volume= 0.712 af
Outflow = 1.13 cfs @ 13.53 hrs, Volume= 0.712 af, Atten= 79%, Lag= 87.2 min
Discarded = 1.13 cfs @ 13.53 hrs, Volume= 0.712 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 12.89' @ 13.53 hrs Surf.Area= 10,861 sf Storage= 6,305 cf

Plug-Flow detention time= 48.2 min calculated for 0.711 af (100% of inflow)
Center-of-Mass det. time= 48.2 min (952.9 - 904.8)

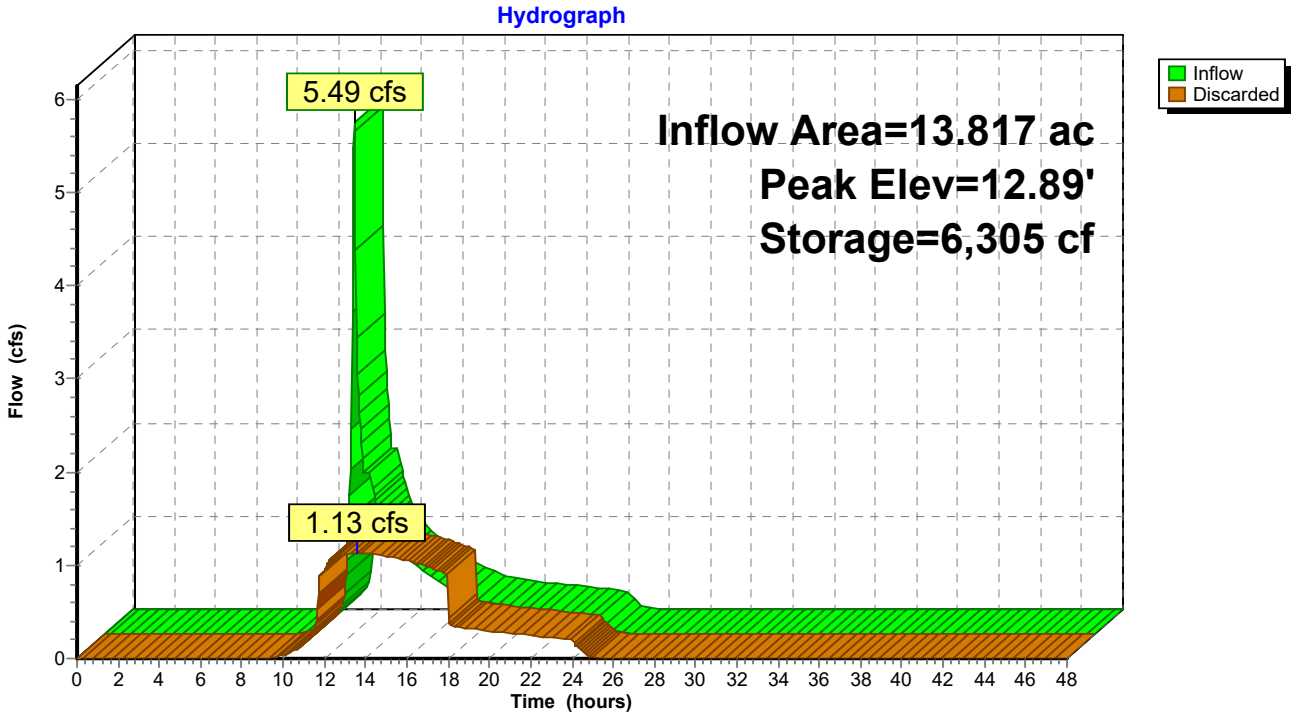
Volume	Invert	Avail.Storage	Storage Description
#1	12.25'	106,725 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.25	8,600	0	0
12.50	9,600	2,275	2,275
13.00	11,200	5,200	7,475
14.00	16,200	13,700	21,175
14.50	88,000	26,050	47,225
15.00	150,000	59,500	106,725

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=1.13 cfs @ 13.53 hrs HW=12.89' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.13 cfs)

Pond D1: Infiltration Basin



Summary for Pond P0: Natural Depression

Inflow Area = 2.755 ac, 8.03% Impervious, Inflow Depth = 0.45" for 10yr event
Inflow = 0.38 cfs @ 12.80 hrs, Volume= 0.103 af
Outflow = 0.38 cfs @ 12.83 hrs, Volume= 0.103 af, Atten= 0%, Lag= 1.6 min
Discarded = 0.38 cfs @ 12.83 hrs, Volume= 0.103 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.01' @ 12.83 hrs Surf.Area= 5,792 sf Storage= 36 cf

Plug-Flow detention time= 1.6 min calculated for 0.103 af (100% of inflow)
Center-of-Mass det. time= 1.6 min (967.5 - 965.9)

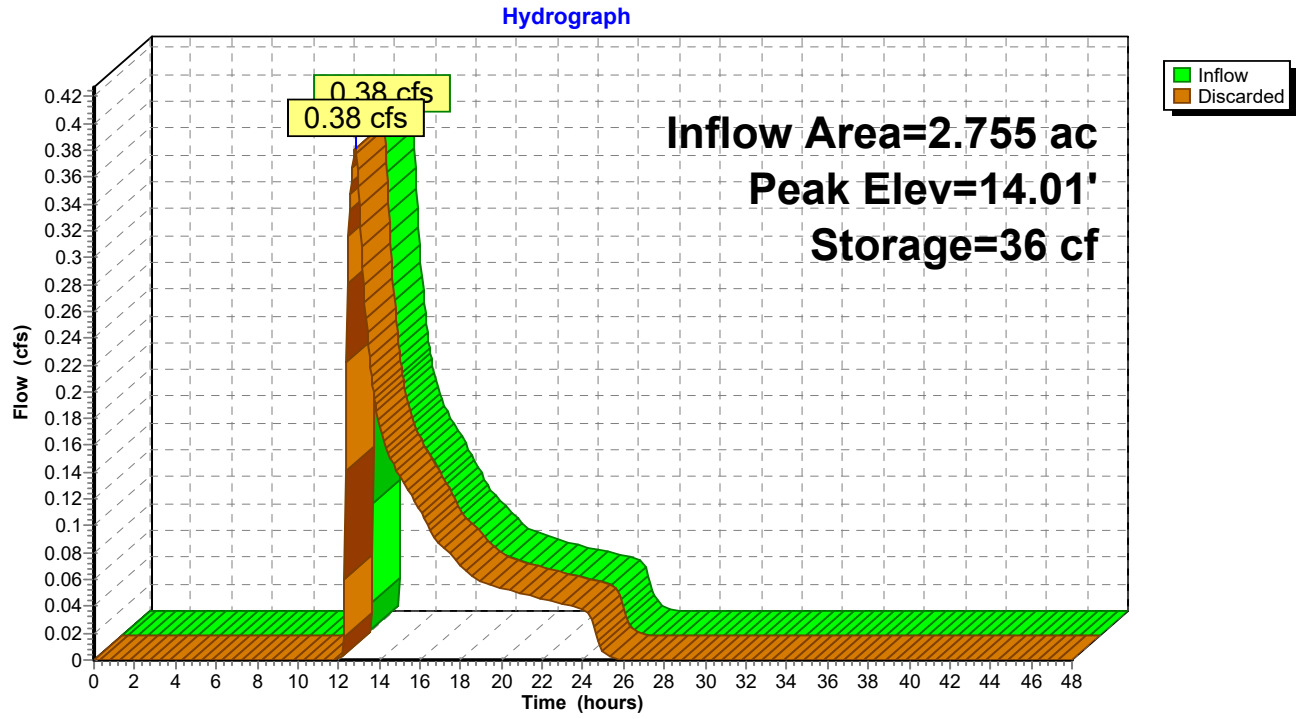
Volume	Invert	Avail.Storage	Storage Description
#1	14.00'	4,675 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
14.00	5,700	0	0
14.50	13,000	4,675	4,675

Device	Routing	Invert	Outlet Devices
#1	Discarded	14.00'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.38 cfs @ 12.83 hrs HW=14.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.38 cfs)

Pond P0: Natural Depression



Summary for Pond P1: Littleton Dr North Bio

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

Inflow Area = 0.200 ac, 49.25% Impervious, Inflow Depth = 2.40" for 10yr event
Inflow = 0.56 cfs @ 12.08 hrs, Volume= 0.040 af
Outflow = 0.15 cfs @ 12.48 hrs, Volume= 0.040 af, Atten= 74%, Lag= 23.7 min
Discarded = 0.15 cfs @ 12.48 hrs, Volume= 0.040 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.02' @ 12.48 hrs Surf.Area= 2,614 sf Storage= 458 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 23.6 min (859.6 - 836.0)

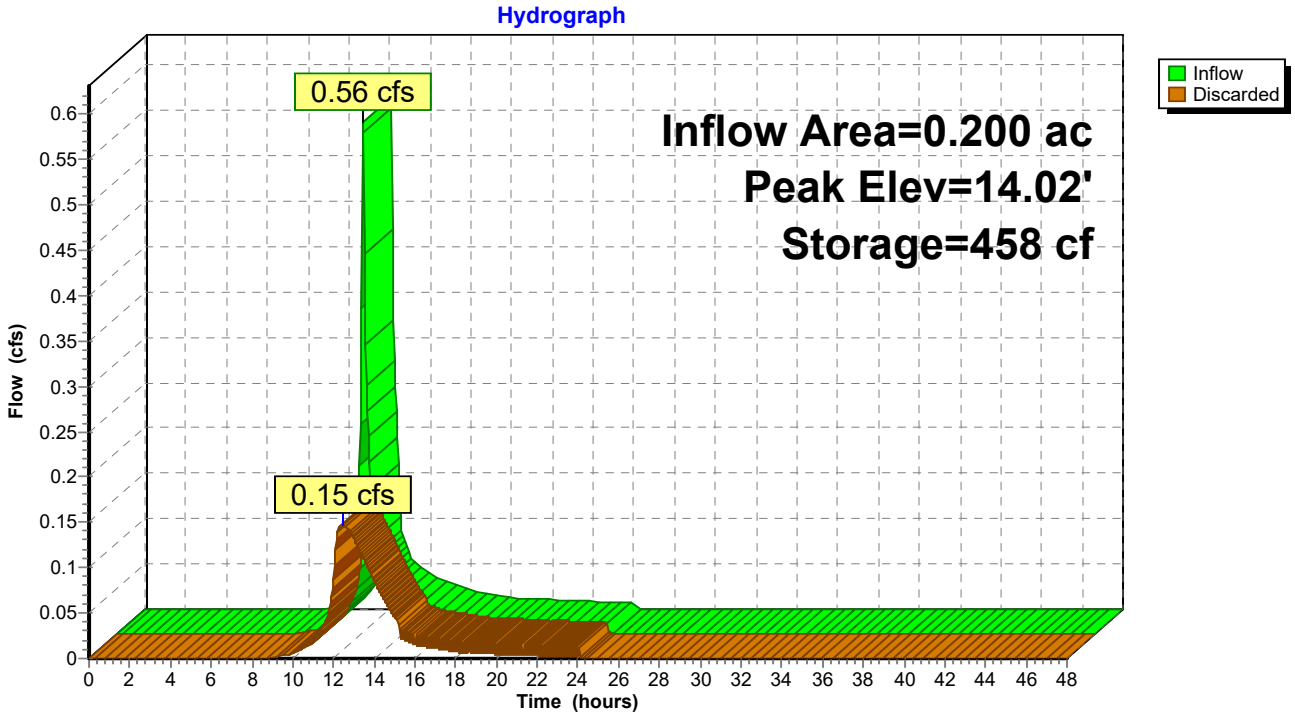
Volume	Invert	Avail.Storage	Storage Description
#1	13.75'	3,534 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.75	700	0	0
14.00	2,600	413	413
14.25	2,800	675	1,088
15.00	3,725	2,447	3,534

Device	Routing	Invert	Outlet Devices
#1	Discarded	13.75'	**2.410 in/hr Exfiltration over Surface area above 13.00'** Excluded Surface area = 0 sf

Discarded OutFlow Max=0.15 cfs @ 12.48 hrs HW=14.02' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Pond P1: Littleton Dr North Bio



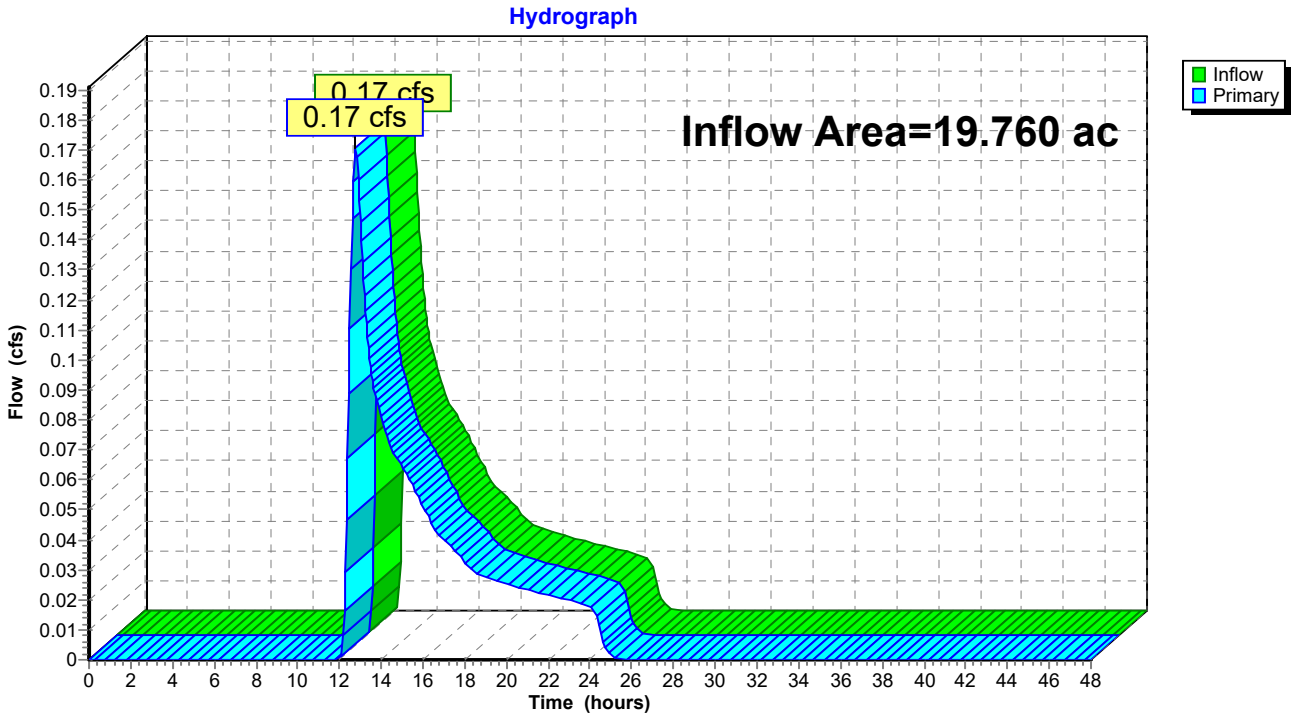
Summary for Pond SP1: FLAX POND

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

Inflow Area = 19.760 ac, 21.55% Impervious, Inflow Depth = 0.03" for 10yr event
Inflow = 0.17 cfs @ 12.76 hrs, Volume= 0.046 af
Primary = 0.17 cfs @ 12.76 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2

Pond SP1: FLAX POND



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA0: Littleton Dr North Runoff Area=8,731 sf 49.25% Impervious Runoff Depth=4.57"
Tc=5.0 min CN=74 Runoff=1.07 cfs 0.076 af

Subcatchment DA1E: East of Parking Lot Runoff Area=23,804 sf 70.19% Impervious Runoff Depth=5.71"
Tc=5.0 min CN=84 Runoff=3.58 cfs 0.260 af

Subcatchment DA1OS: Northeast Runoff Area=110,519 sf 0.14% Impervious Runoff Depth=1.53"
Flow Length=600' Slope=0.0100 '/' Tc=44.0 min CN=45 Runoff=1.74 cfs 0.323 af

Subcatchment DA1W: West of Parking Lot Runoff Area=21,567 sf 63.19% Impervious Runoff Depth=5.25"
Tc=5.0 min CN=80 Runoff=3.02 cfs 0.217 af

Subcatchment DA2: Community Garden Runoff Area=32,001 sf 57.61% Impervious Runoff Depth=4.80"
Tc=5.0 min CN=76 Runoff=4.11 cfs 0.294 af

Subcatchment DA2OS: Flax Pond Bank Runoff Area=52,772 sf 0.00% Impervious Runoff Depth=1.53"
Flow Length=400' Slope=0.0100 '/' Tc=37.3 min CN=45 Runoff=0.91 cfs 0.154 af

Subcatchment DA3: Middle Runoff Area=104,650 sf 49.70% Impervious Runoff Depth=4.57"
Tc=5.0 min CN=74 Runoff=12.85 cfs 0.915 af

Subcatchment DA3OS: Northwest Offsite Runoff Area=405,501 sf 7.28% Impervious Runoff Depth=1.44"
Flow Length=450' Slope=0.0100 '/' Tc=39.0 min CN=44 Runoff=6.25 cfs 1.115 af

Subcatchment DA3R: Roofs Runoff Area=9,486 sf 100.00% Impervious Runoff Depth=7.36"
Tc=5.0 min CN=98 Runoff=1.64 cfs 0.134 af

Subcatchment DA4: Middle North Runoff Area=91,735 sf 44.93% Impervious Runoff Depth=4.35"
Tc=5.0 min CN=72 Runoff=10.73 cfs 0.763 af

Pond C1: Northern Parking Peak Elev=15.54' Storage=5,685 cf Inflow=6.60 cfs 0.477 af
Discarded=0.31 cfs 0.357 af Primary=3.56 cfs 0.120 af Outflow=3.87 cfs 0.477 af

Pond C2: Southern Parking Peak Elev=15.18' Storage=4,628 cf Inflow=4.11 cfs 0.294 af
Discarded=0.27 cfs 0.267 af Primary=0.82 cfs 0.026 af Outflow=1.09 cfs 0.294 af

Pond C3: Middle Peak Elev=15.54' Storage=12,316 cf Inflow=12.85 cfs 0.915 af
Discarded=0.66 cfs 0.721 af Primary=4.82 cfs 0.194 af Outflow=5.48 cfs 0.915 af

Pond C4: Roofs Peak Elev=15.29' Storage=1,423 cf Inflow=1.64 cfs 0.134 af
Discarded=0.08 cfs 0.101 af Primary=0.90 cfs 0.033 af Outflow=0.98 cfs 0.134 af

Pond D1: Infiltration Basin Peak Elev=14.22' Storage=28,339 cf Inflow=12.07 cfs 2.071 af
Outflow=5.02 cfs 2.071 af

Pond P0: Natural Depression Peak Elev=14.32' Storage=2,567 cf Inflow=1.90 cfs 0.356 af
Outflow=1.08 cfs 0.356 af

Pond P1: Littleton Dr North Bio Peak Elev=14.27' Storage=1,152 cf Inflow=1.07 cfs 0.076 af
Outflow=0.16 cfs 0.076 af

Pond SP1: FLAX POND Inflow=3.79 cfs 0.301 af
Primary=3.79 cfs 0.301 af

Total Runoff Area = 19.760 ac Runoff Volume = 4.250 af Average Runoff Depth = 2.58"
78.45% Pervious = 15.502 ac 21.55% Impervious = 4.258 ac

Summary for Subcatchment DA0: Littleton Dr North

[49] Hint: Tc<2dt may require smaller dt

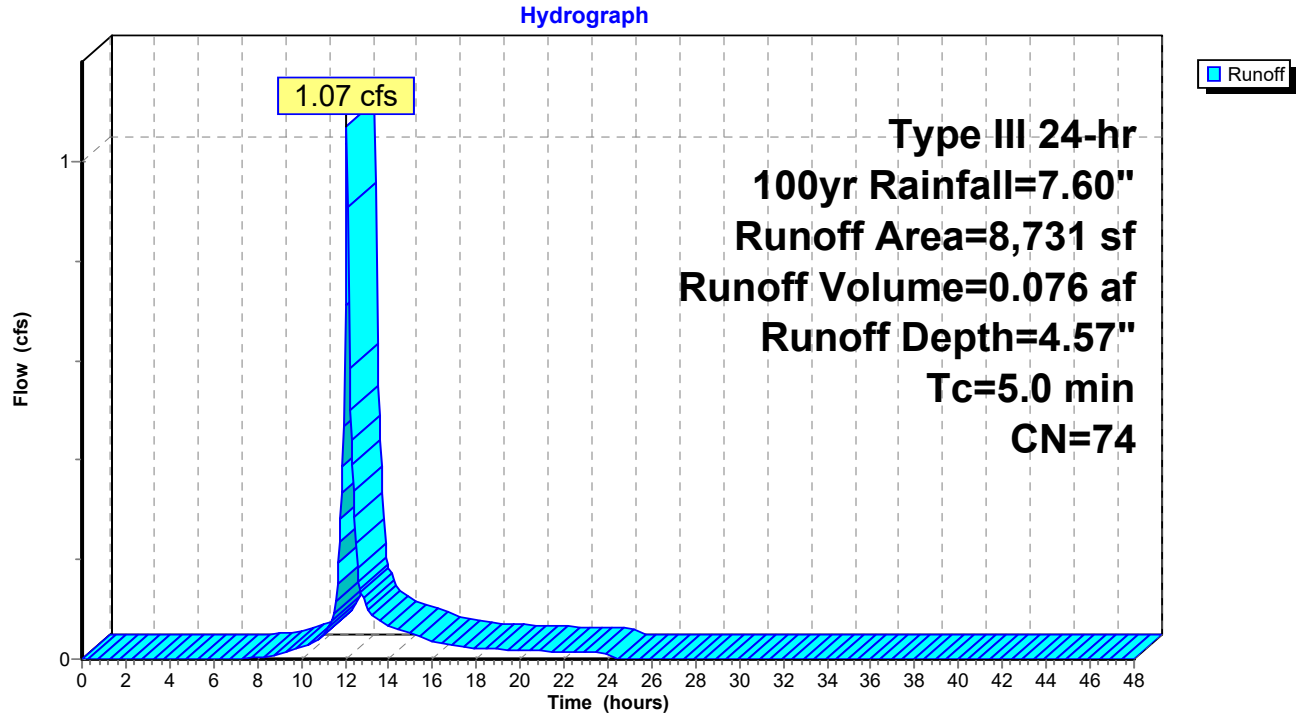
Runoff = 1.07 cfs @ 12.08 hrs, Volume= 0.076 af, Depth= 4.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
	3,600	98	Paved parking, HSG A
*	4,431	50	>75% Grass cover, Good, HSG A/B
	700	98	Water Surface, HSG A
	8,731	74	Weighted Average
	4,431		50.75% Pervious Area
	4,300		49.25% Impervious Area

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

Subcatchment DA0: Littleton Dr North



Summary for Subcatchment DA1E: East of Parking Lot

[49] Hint: Tc<2dt may require smaller dt

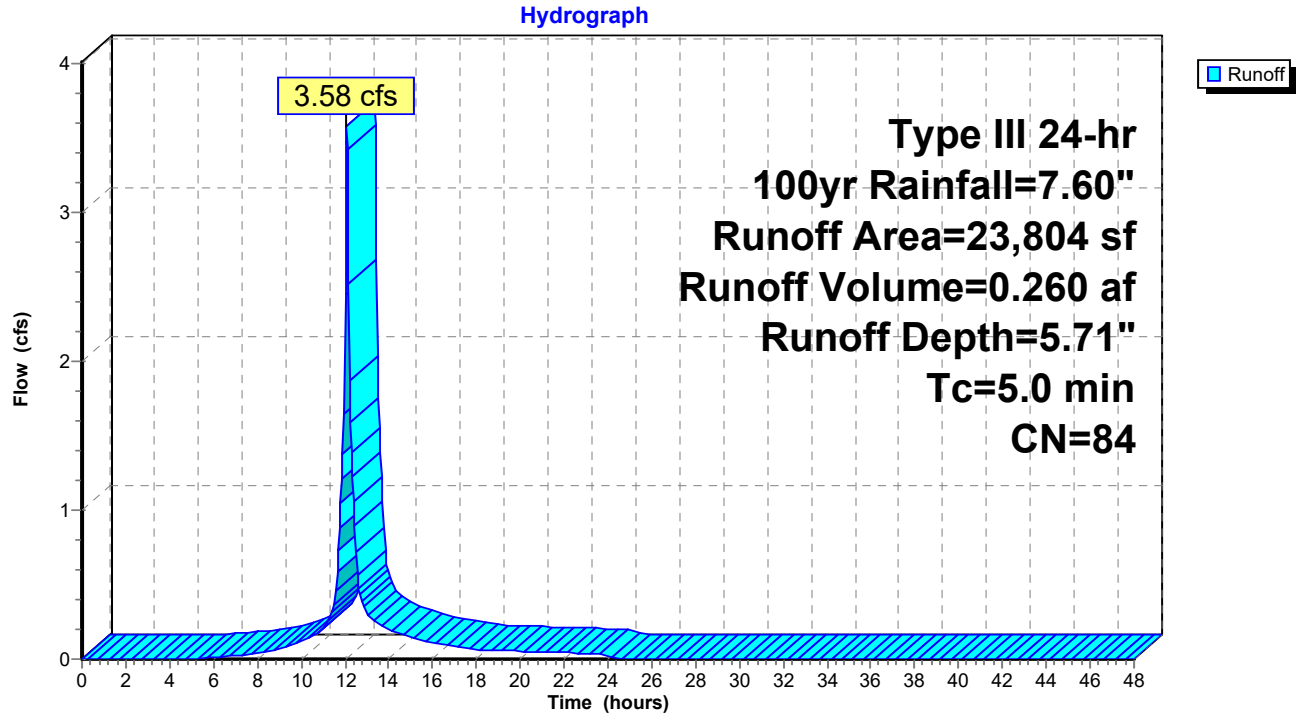
Runoff = 3.58 cfs @ 12.07 hrs, Volume= 0.260 af, Depth= 5.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
	15,658	98	Paved parking, HSG A
*	7,095	50	>75% Grass cover, Good, HSG A/B
	1,051	98	Water Surface, HSG A
	23,804	84	Weighted Average
	7,095		29.81% Pervious Area
	16,709		70.19% Impervious Area

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

Subcatchment DA1E: East of Parking Lot



Summary for Subcatchment DA1OS: Northeast Depression

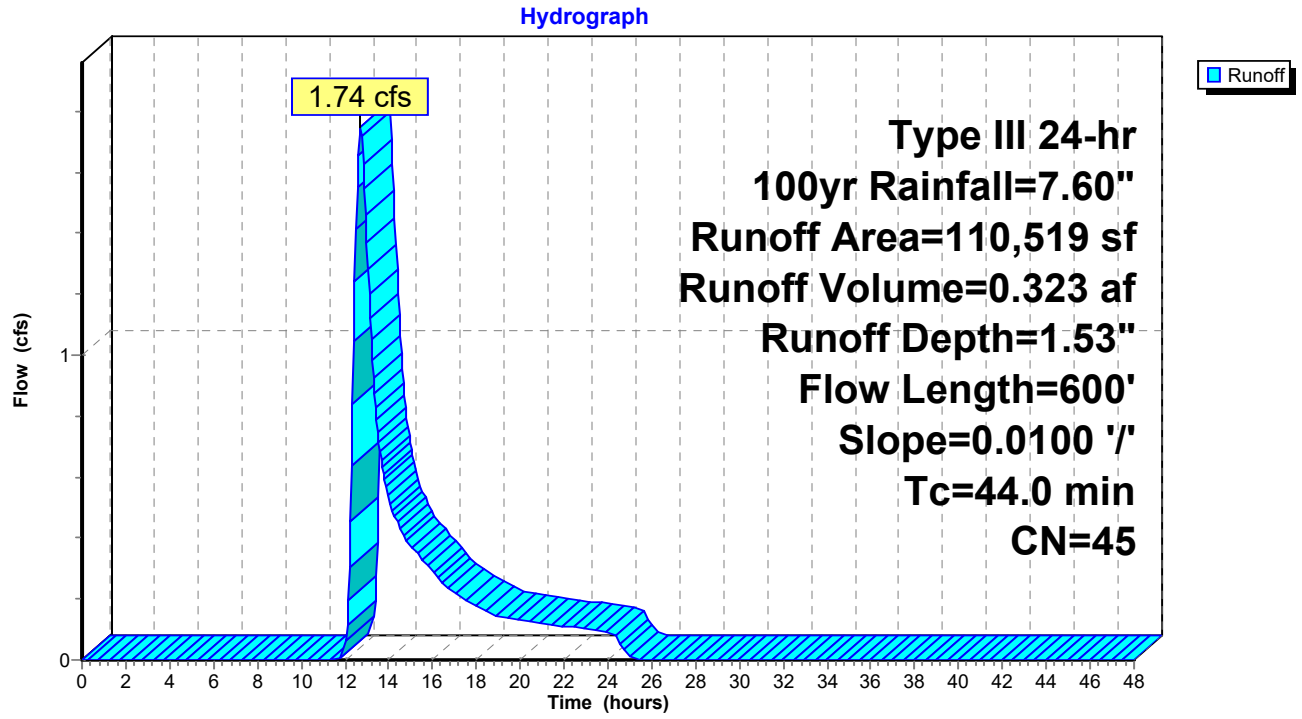
Runoff = 1.74 cfs @ 12.71 hrs, Volume= 0.323 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
	150	98	Roofs, HSG A
*	3,318	77	Dirt roads, HSG A/B
*	78,963	42	Woods, Good, HSG A/B
*	28,088	50	>75% Grass cover, Good, HSG A/B
	110,519	45	Weighted Average
	110,369		99.86% Pervious Area
	150		0.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
16.7	500	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
44.0	600	Total			

Subcatchment DA1OS: Northeast Depression



Summary for Subcatchment DA1W: West of Parking Lot

[49] Hint: Tc<2dt may require smaller dt

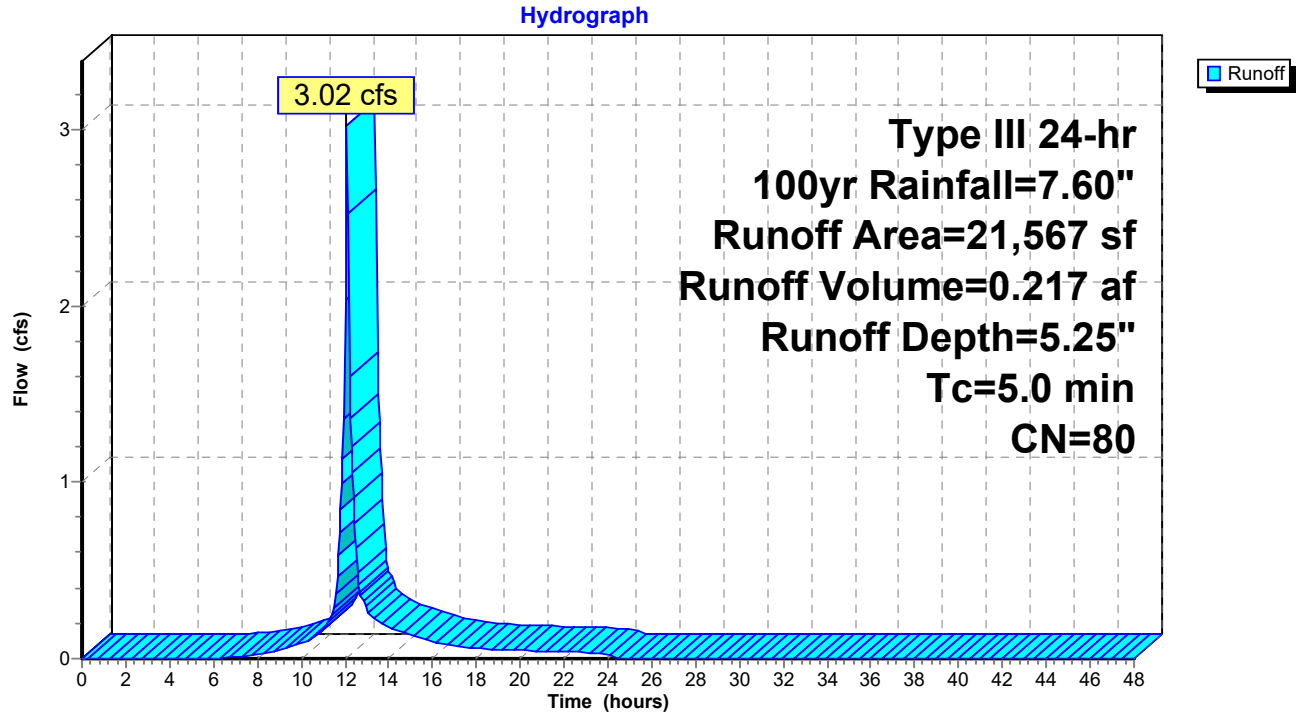
Runoff = 3.02 cfs @ 12.07 hrs, Volume= 0.217 af, Depth= 5.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
	6,706	98	Paved parking, HSG A
*	7,939	50	>75% Grass cover, Good, HSG A/B
	6,467	98	Roofs, HSG A
	455	98	Water Surface, HSG A
	21,567	80	Weighted Average
	7,939		36.81% Pervious Area
	13,628		63.19% Impervious Area

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

Subcatchment DA1W: West of Parking Lot



Summary for Subcatchment DA2: Community Garden

[49] Hint: Tc<2dt may require smaller dt

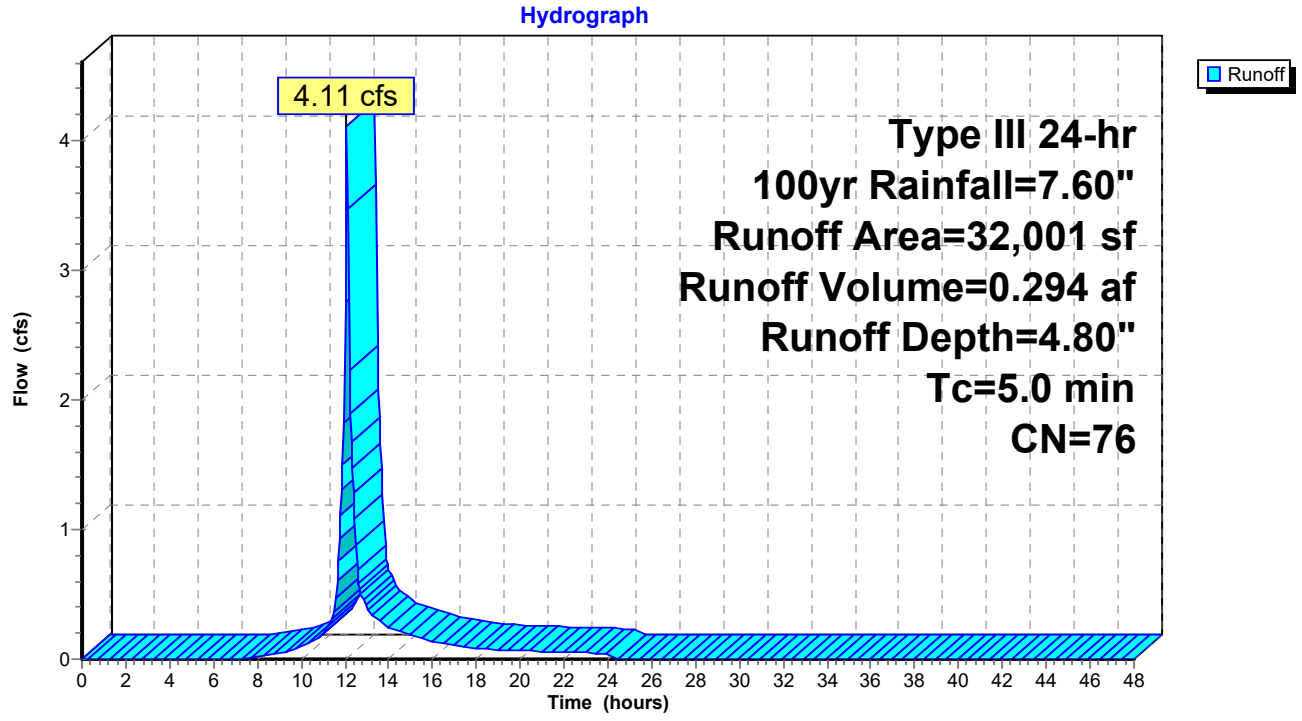
Runoff = 4.11 cfs @ 12.08 hrs, Volume= 0.294 af, Depth= 4.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
	11,016	98	Paved parking, HSG A
*	7,510	50	>75% Grass cover, Good, HSG A/B
	445	98	Water Surface, HSG A
	6,976	98	Roofs, HSG A
*	6,054	42	Woods, Good, HSG A/B
	32,001	76	Weighted Average
	13,564		42.39% Pervious Area
	18,437		57.61% Impervious Area

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

Subcatchment DA2: Community Garden



Summary for Subcatchment DA2OS: Flax Pond Bank

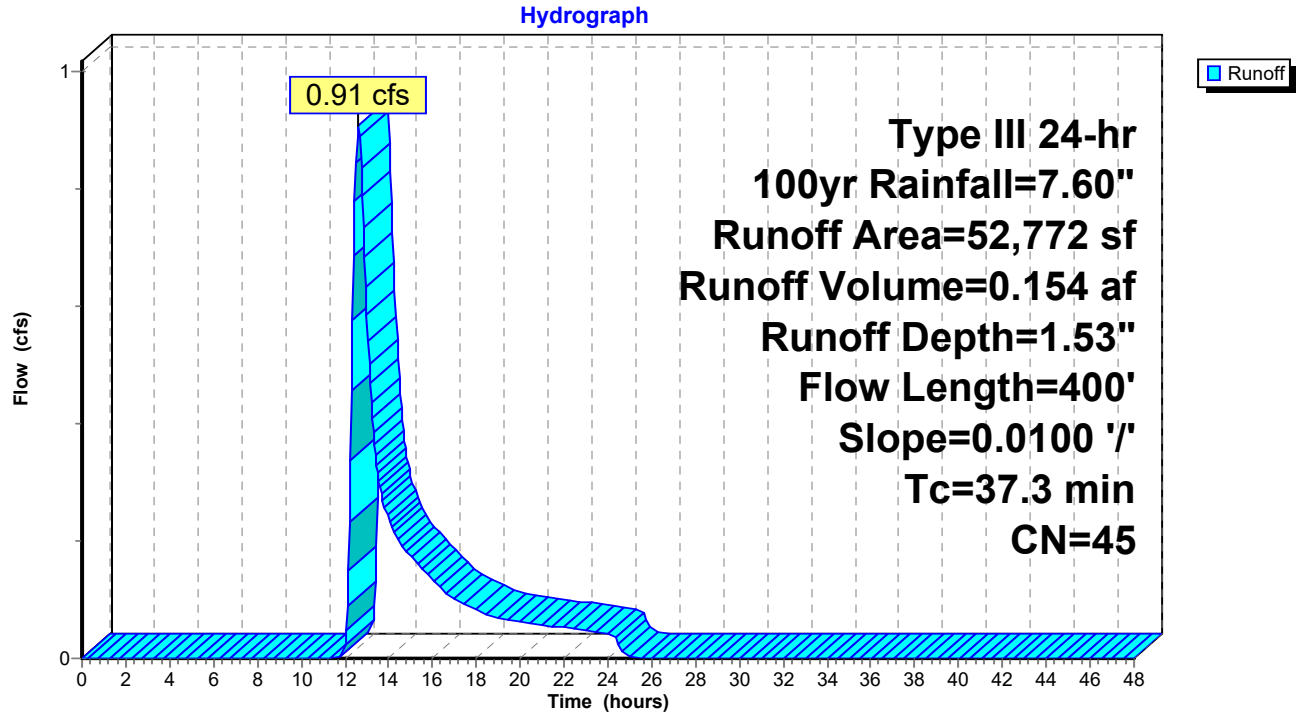
Runoff = 0.91 cfs @ 12.61 hrs, Volume= 0.154 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
*	4,594	77	Dirt roads, HSG A/B
*	48,178	42	Woods, Good, HSG A/B
	52,772	45	Weighted Average
	52,772		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
10.0	300	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
37.3	400	Total			

Subcatchment DA2OS: Flax Pond Bank



Summary for Subcatchment DA3: Middle

[49] Hint: Tc<2dt may require smaller dt

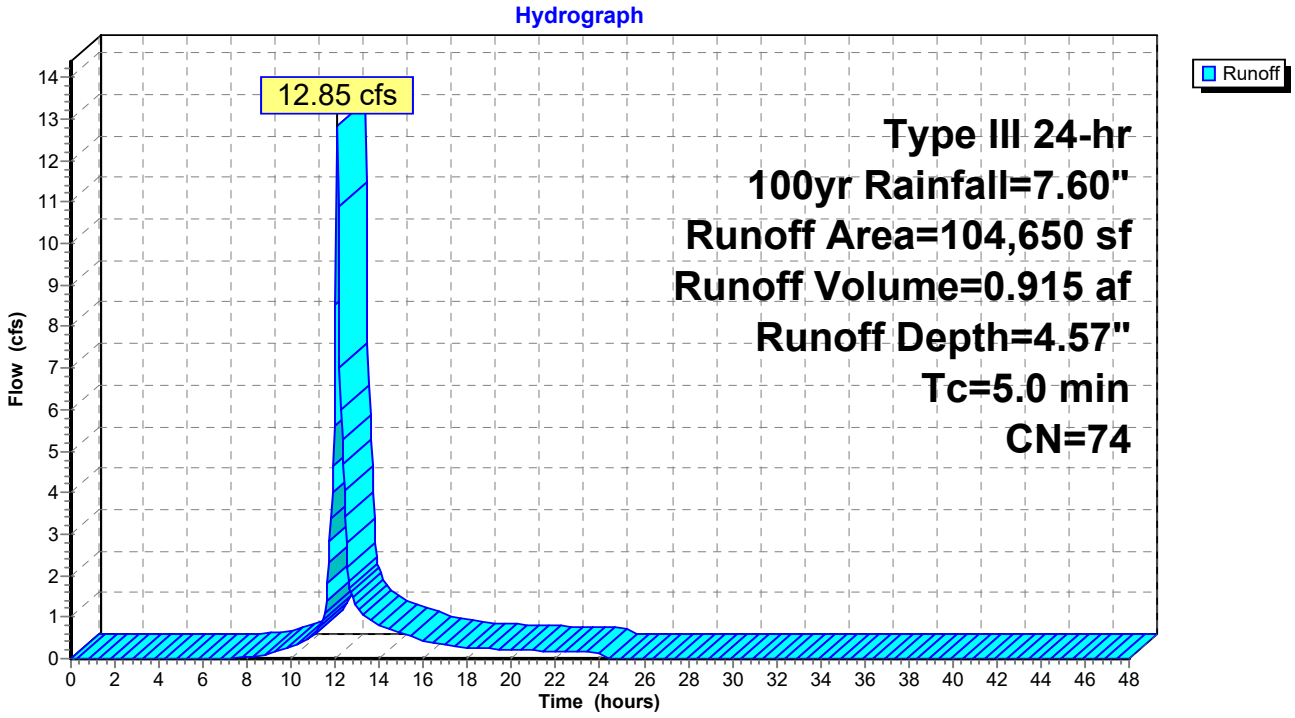
Runoff = 12.85 cfs @ 12.08 hrs, Volume= 0.915 af, Depth= 4.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
	41,974	98	Paved parking, HSG A
*	52,638	50	>75% Grass cover, Good, HSG A/B
	7,340	98	Roofs, HSG A
	2,698	98	Water Surface, HSG A
	104,650	74	Weighted Average
	52,638		50.30% Pervious Area
	52,012		49.70% Impervious Area

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

Subcatchment DA3: Middle



Summary for Subcatchment DA3OS: Northwest Offsite

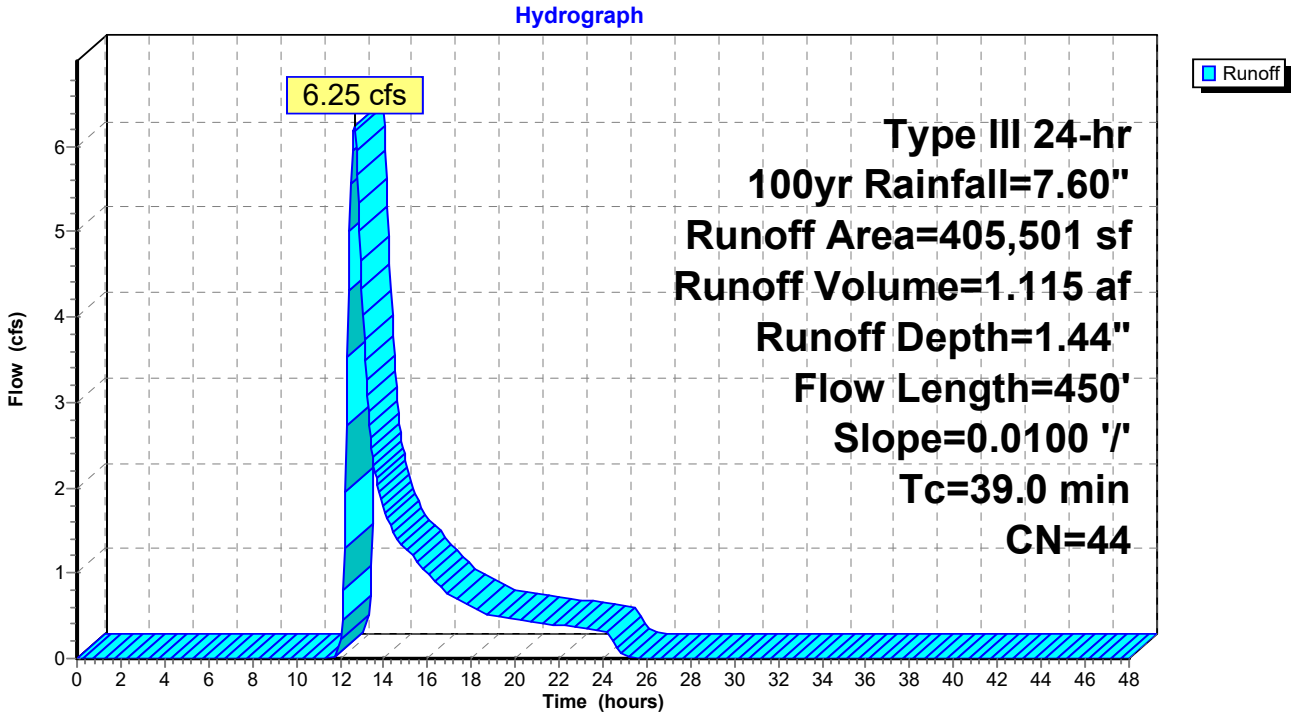
Runoff = 6.25 cfs @ 12.65 hrs, Volume= 1.115 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
	1,176	98	Paved roads w/curbs & sewers, HSG A
	15,531	98	Roofs, HSG A
*	11,222	77	Dirt roads, HSG A/B
*	235,751	42	Woods, Good, HSG A/B
*	16,604	50	>75% Grass cover, Good, HSG A/B
	17,671	39	>75% Grass cover, Good, HSG A
	94,715	30	Woods, Good, HSG A
	12,831	98	Water Surface, HSG A
	405,501	44	Weighted Average
	375,963		92.72% Pervious Area
	29,538		7.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
11.7	350	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
39.0	450	Total			

Subcatchment DA3OS: Northwest Offsite



Summary for Subcatchment DA3R: Roofs

[49] Hint: Tc<2dt may require smaller dt

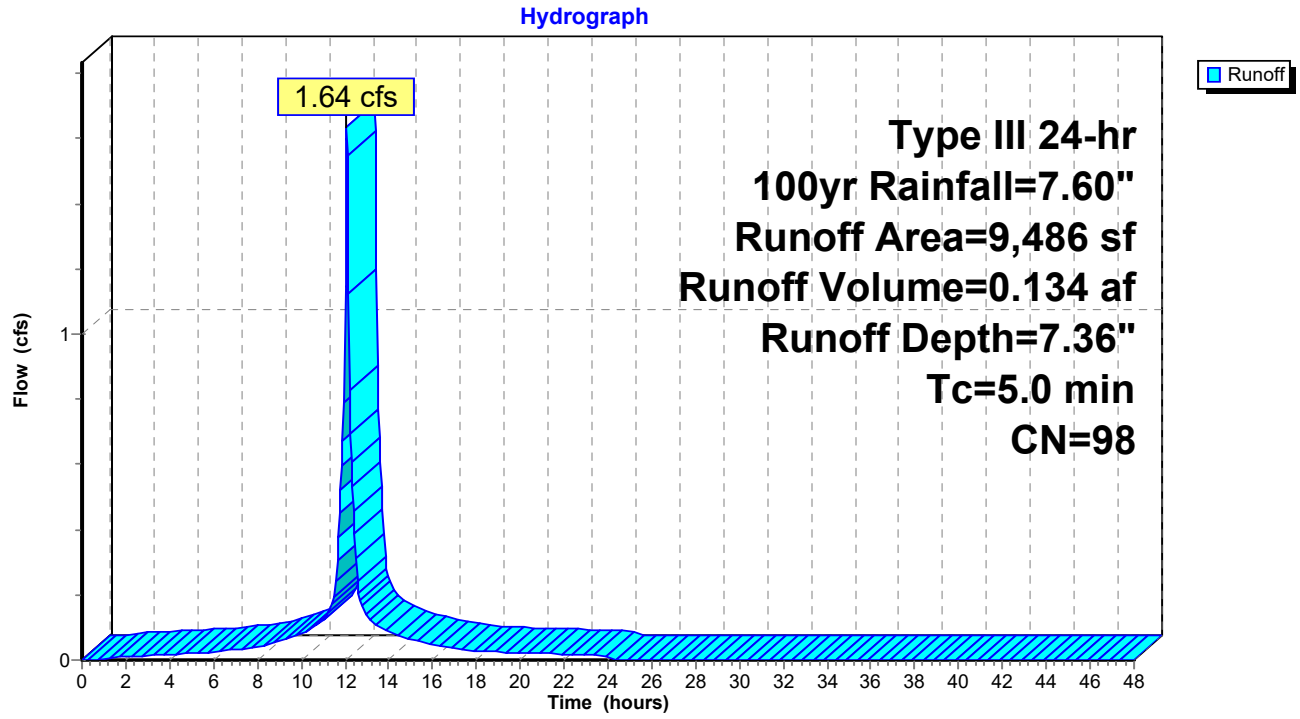
Runoff = 1.64 cfs @ 12.07 hrs, Volume= 0.134 af, Depth= 7.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

Area (sf)	CN	Description
9,486	98	Roofs, HSG A
9,486		100.00% Impervious Area

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

Subcatchment DA3R: Roofs



Summary for Subcatchment DA4: Middle North

[49] Hint: Tc<2dt may require smaller dt

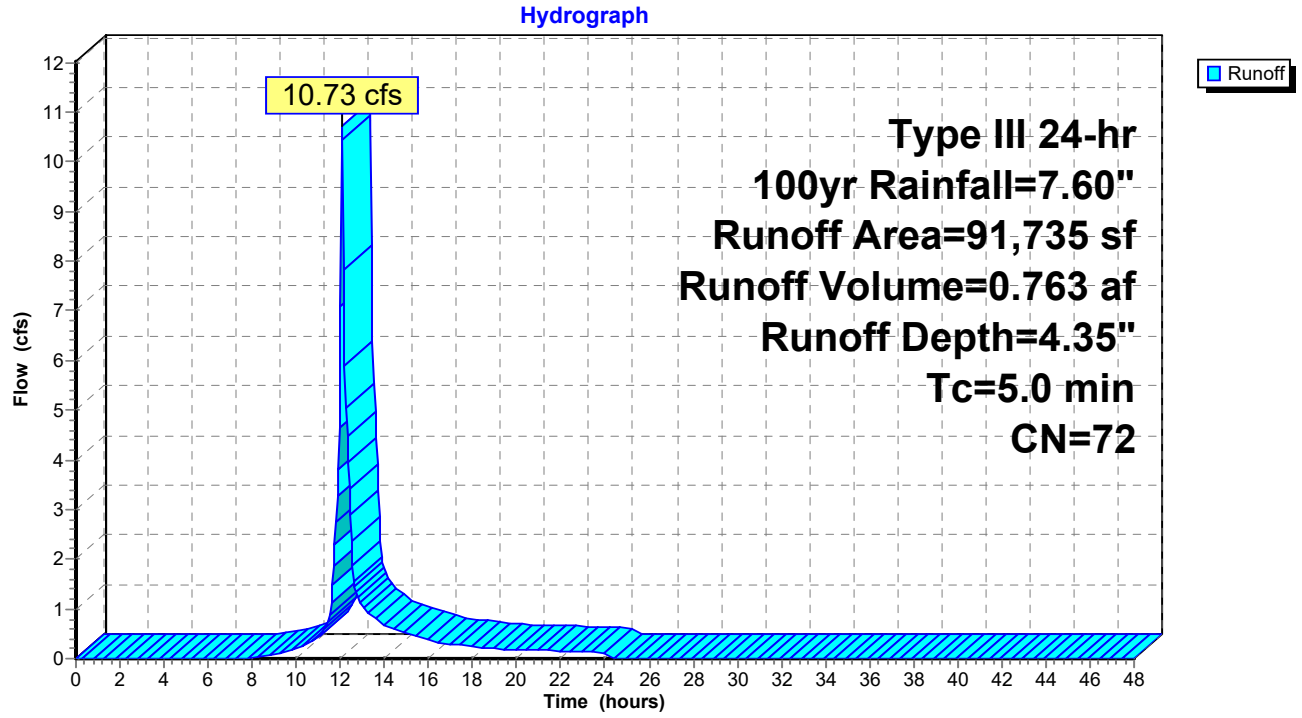
Runoff = 10.73 cfs @ 12.08 hrs, Volume= 0.763 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (sf)	CN	Description
	21,490	98	Paved parking, HSG A
*	50,514	50	>75% Grass cover, Good, HSG A/B
	18,191	98	Roofs, HSG A
	1,540	98	Water Surface, HSG A
	91,735	72	Weighted Average
	50,514		55.07% Pervious Area
	41,221		44.93% Impervious Area

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

Subcatchment DA4: Middle North



Summary for Pond C1: Northern Parking

Inflow Area = 1.042 ac, 66.86% Impervious, Inflow Depth = 5.49" for 100yr event
Inflow = 6.60 cfs @ 12.07 hrs, Volume= 0.477 af
Outflow = 3.87 cfs @ 12.20 hrs, Volume= 0.477 af, Atten= 41%, Lag= 7.5 min
Discarded = 0.31 cfs @ 11.05 hrs, Volume= 0.357 af
Primary = 3.56 cfs @ 12.20 hrs, Volume= 0.120 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 15.54' @ 12.20 hrs Surf.Area= 2,955 sf Storage= 5,685 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 112.2 min (910.7 - 798.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	2,959 cf	**39.50'W x 74.82'L x 4.25'H Field A** 12,560 cf Overall - 3,675 cf Embedded = 8,885 cf x 33.3% Voids
#2A	13.00'	3,675 cf	**ADS_StormTech SC-740 +Cap** x 80 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 80 Chambers in 8 Rows
		6,634 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	14.50'	**18.0" Round Culvert** L= 85.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.50' / 13.50' S= 0.0118 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Discarded OutFlow Max=0.31 cfs @ 11.05 hrs HW=12.30' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=3.55 cfs @ 12.20 hrs HW=15.53' TW=0.00' (Dynamic Tailwater)
└**3=Culvert** (Inlet Controls 3.55 cfs @ 2.73 fps)
└**2=Broad-Crested Rectangular Weir** (Passes 3.55 cfs of 4.72 cfs potential flow)

Pond C1: Northern Parking - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

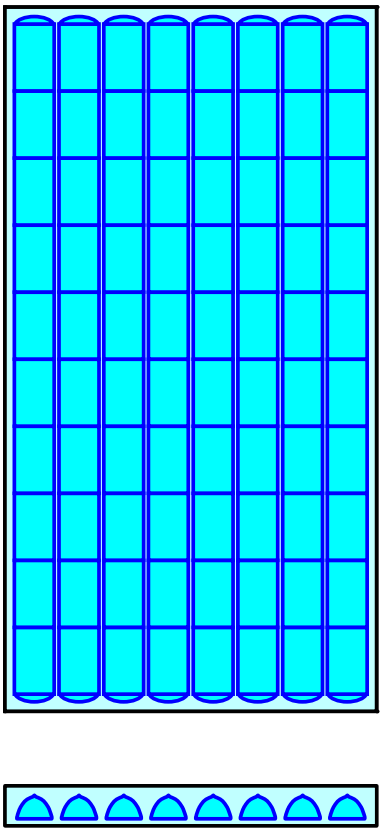
10 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 72.82' Row Length +12.0" End Stone x 2 = 74.82' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

80 Chambers x 45.9 cf = 3,675.2 cf Chamber Storage

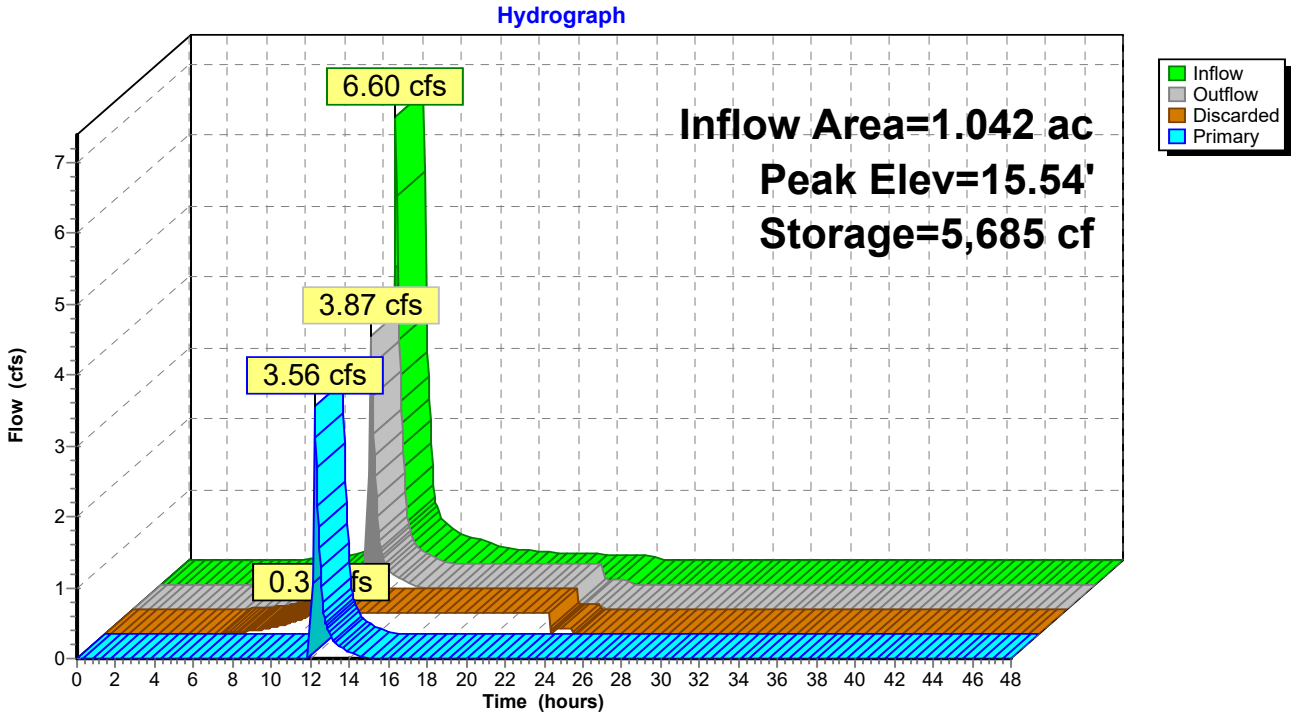
12,559.8 cf Field - 3,675.2 cf Chambers = 8,884.6 cf Stone x 33.3% Voids = 2,958.6 cf Stone Storage

Chamber Storage + Stone Storage = 6,633.8 cf = 0.152 af
Overall Storage Efficiency = 52.8%
Overall System Size = 74.82' x 39.50' x 4.25'

80 Chambers
465.2 cy Field
329.1 cy Stone



Pond C1: Northern Parking



Summary for Pond C2: Southern Parking

Inflow Area = 0.735 ac, 57.61% Impervious, Inflow Depth = 4.80" for 100yr event
Inflow = 4.11 cfs @ 12.08 hrs, Volume= 0.294 af
Outflow = 1.09 cfs @ 12.46 hrs, Volume= 0.294 af, Atten= 73%, Lag= 23.1 min
Discarded = 0.27 cfs @ 11.50 hrs, Volume= 0.267 af
Primary = 0.82 cfs @ 12.46 hrs, Volume= 0.026 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 15.18' @ 12.46 hrs Surf.Area= 2,600 sf Storage= 4,628 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 133.4 min (946.5 - 813.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	2,609 cf	**34.75'W x 74.82'L x 4.25'H Field A** 11,049 cf Overall - 3,216 cf Embedded = 7,834 cf x 33.3% Voids
#2A	13.00'	3,216 cf	**ADS_StormTech SC-740 +Cap** x 70 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 70 Chambers in 7 Rows
		5,824 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	14.50'	**10.0" Round Culvert** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 14.50' / 14.20' S= 0.0043 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.27 cfs @ 11.50 hrs HW=12.29' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.80 cfs @ 12.46 hrs HW=15.17' TW=0.00' (Dynamic Tailwater)
└**3=Culvert** (Passes 0.80 cfs of 0.96 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.80 cfs @ 1.16 fps)

Pond C2: Southern Parking - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

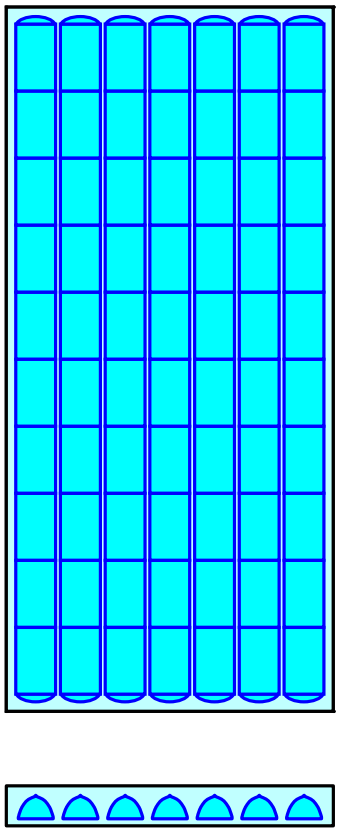
10 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 72.82' Row Length +12.0" End Stone x 2 = 74.82' Base Length
7 Rows x 51.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 34.75' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

70 Chambers x 45.9 cf = 3,215.8 cf Chamber Storage

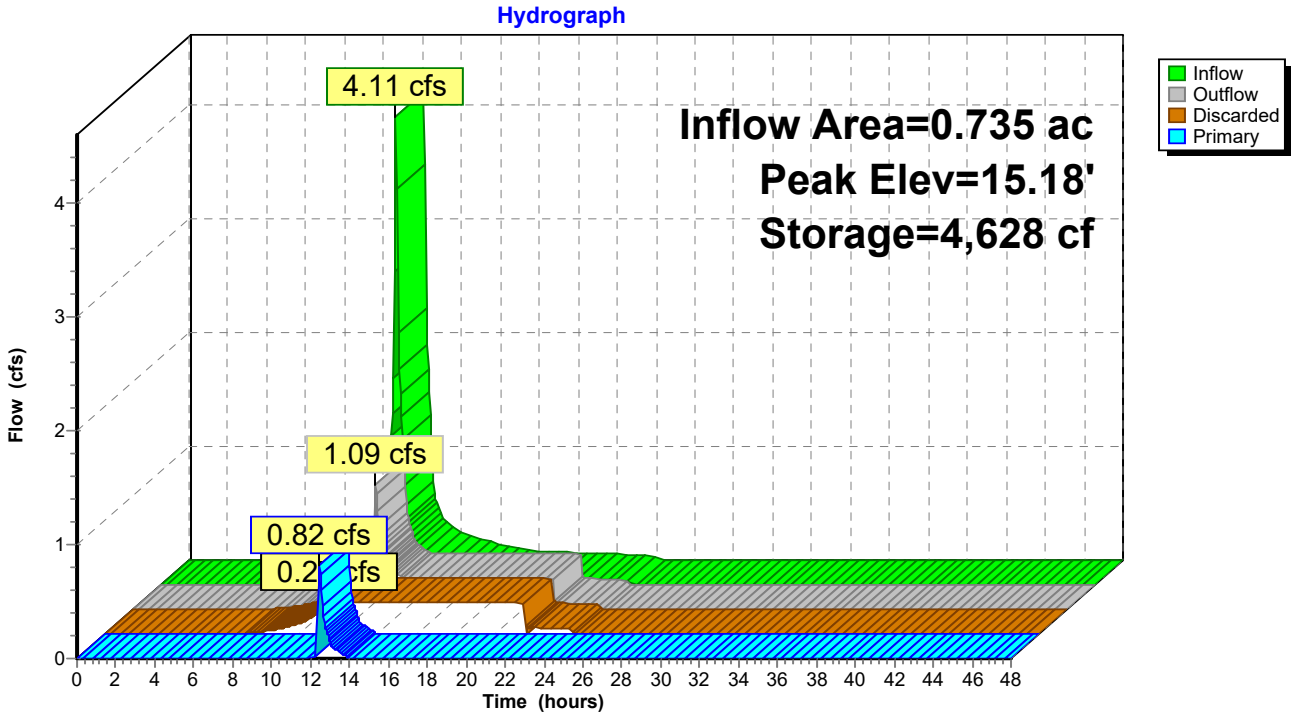
11,049.5 cf Field - 3,215.8 cf Chambers = 7,833.7 cf Stone x 33.3% Voids = 2,608.6 cf Stone Storage

Chamber Storage + Stone Storage = 5,824.4 cf = 0.134 af
Overall Storage Efficiency = 52.7%
Overall System Size = 74.82' x 34.75' x 4.25'

70 Chambers
409.2 cy Field
290.1 cy Stone



Pond C2: Southern Parking



Summary for Pond C3: Middle

Inflow Area = 2.402 ac, 49.70% Impervious, Inflow Depth = 4.57" for 100yr event
Inflow = 12.85 cfs @ 12.08 hrs, Volume= 0.915 af
Outflow = 5.48 cfs @ 12.30 hrs, Volume= 0.915 af, Atten= 57%, Lag= 13.6 min
Discarded = 0.66 cfs @ 11.35 hrs, Volume= 0.721 af
Primary = 4.82 cfs @ 12.30 hrs, Volume= 0.194 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 15.54' @ 12.30 hrs Surf.Area= 6,318 sf Storage= 12,316 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 127.0 min (944.6 - 817.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	6,249 cf	**53.75'W x 117.54'L x 4.25'H Field A** 26,850 cf Overall - 8,085 cf Embedded = 18,764 cf x 33.3% Voids
#2A	13.00'	8,085 cf	**ADS_StormTech SC-740 +Cap** x 176 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 176 Chambers in 11 Rows
		14,334 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Device 3	15.00'	**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
#3	Primary	13.60'	**18.0" Round Culvert** L= 112.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 13.60' / 13.00' S= 0.0054 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Discarded OutFlow Max=0.66 cfs @ 11.35 hrs HW=12.30' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.66 cfs)

Primary OutFlow Max=4.80 cfs @ 12.30 hrs HW=15.54' TW=13.43' (Dynamic Tailwater)
└**3=Culvert** (Passes 4.80 cfs of 8.09 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 4.80 cfs @ 2.23 fps)

Pond C3: Middle - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

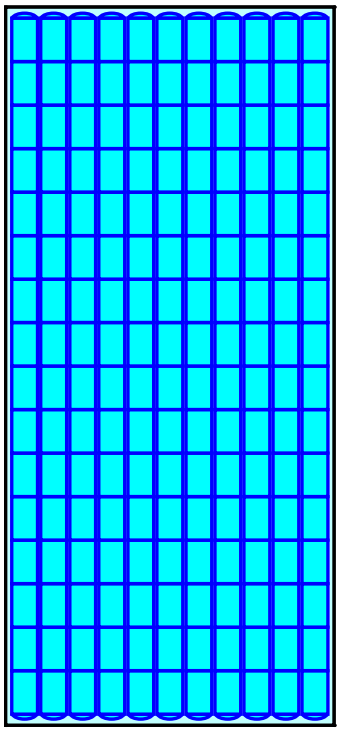
16 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 115.54' Row Length +12.0" End Stone x 2 = 117.54' Base Length
11 Rows x 51.0" Wide + 6.0" Spacing x 10 + 12.0" Side Stone x 2 = 53.75' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

176 Chambers x 45.9 cf = 8,085.4 cf Chamber Storage

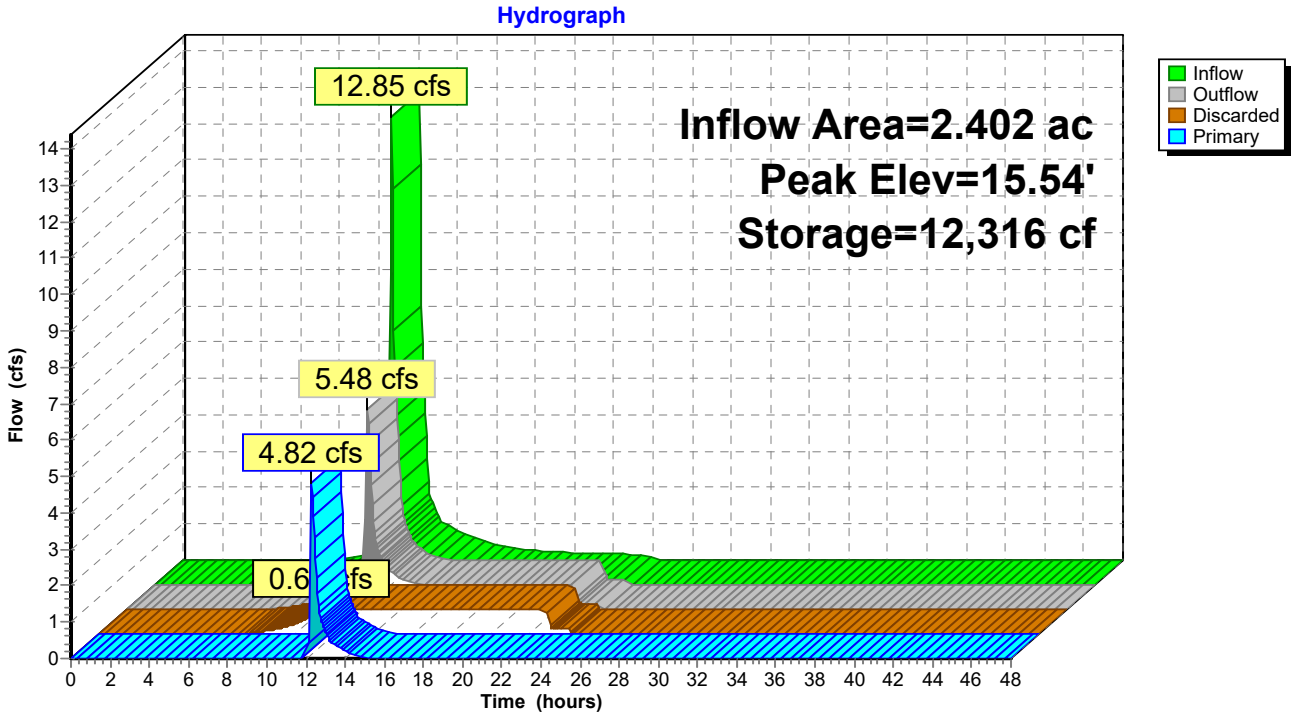
26,849.8 cf Field - 8,085.4 cf Chambers = 18,764.3 cf Stone x 33.3% Voids = 6,248.5 cf Stone Storage

Chamber Storage + Stone Storage = 14,334.0 cf = 0.329 af
Overall Storage Efficiency = 53.4%
Overall System Size = 117.54' x 53.75' x 4.25'

176 Chambers
994.4 cy Field
695.0 cy Stone



Pond C3: Middle



Summary for Pond C4: Roofs

Inflow Area = 0.218 ac,100.00% Impervious, Inflow Depth = 7.36" for 100yr event
Inflow = 1.64 cfs @ 12.07 hrs, Volume= 0.134 af
Outflow = 0.98 cfs @ 12.18 hrs, Volume= 0.134 af, Atten= 40%, Lag= 6.3 min
Discarded = 0.08 cfs @ 10.55 hrs, Volume= 0.101 af
Primary = 0.90 cfs @ 12.18 hrs, Volume= 0.033 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 15.29' @ 12.18 hrs Surf.Area= 804 sf Storage= 1,423 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 74.4 min (815.4 - 740.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	12.25'	832 cf	**20.50'W x 39.22'L x 4.25'H Field A** 3,417 cf Overall - 919 cf Embedded = 2,498 cf x 33.3% Voids
#2A	13.00'	919 cf	**ADS_StormTech SC-740 +Cap** x 20 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 20 Chambers in 4 Rows
		1,751 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	14.50'	**8.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.50' / 14.00' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.08 cfs @ 10.55 hrs HW=12.30' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.89 cfs @ 12.18 hrs HW=15.28' TW=14.03' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 0.89 cfs @ 2.55 fps)

Pond C4: Roofs - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

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

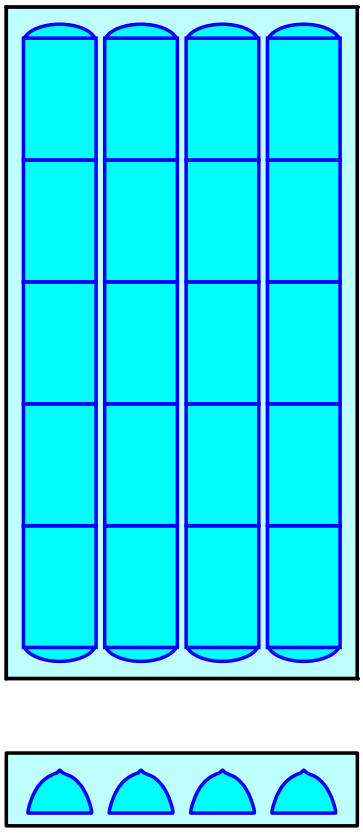
5 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 37.22' Row Length +12.0" End Stone x 2 = 39.22' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
9.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.25' Field Height

20 Chambers x 45.9 cf = 918.8 cf Chamber Storage

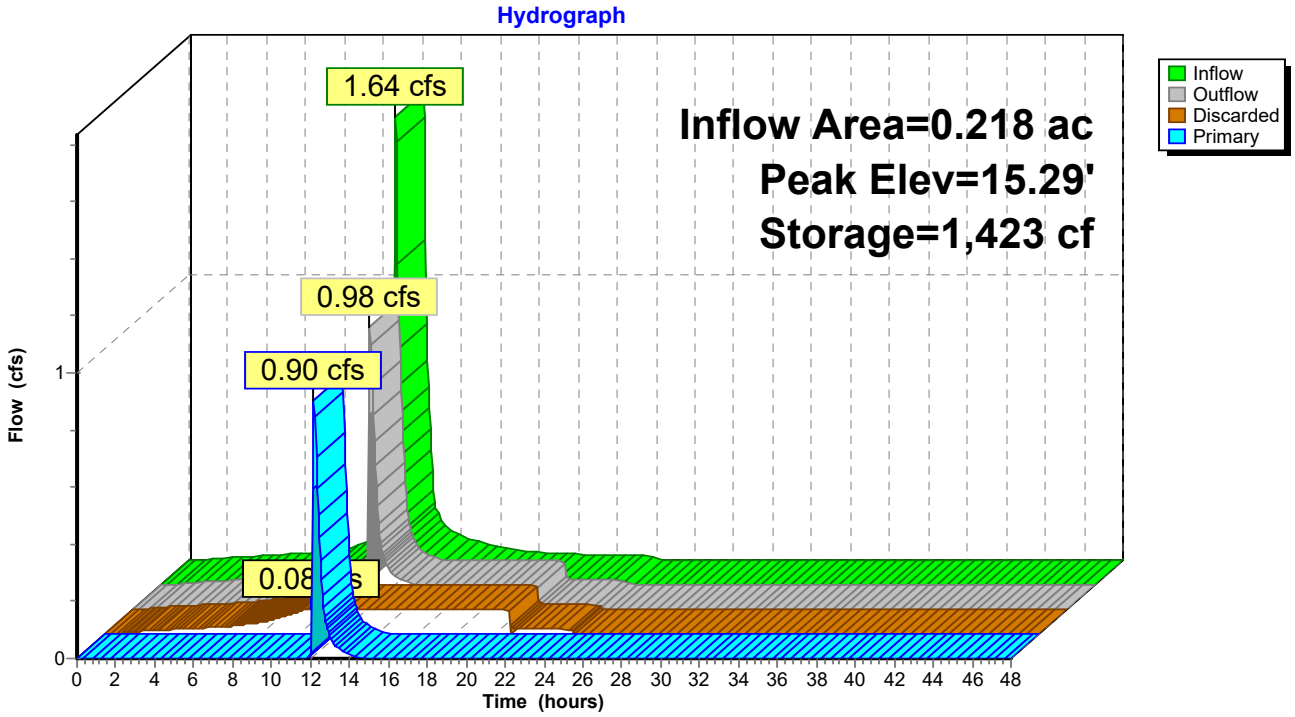
3,416.8 cf Field - 918.8 cf Chambers = 2,498.0 cf Stone x 33.3% Voids = 831.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,750.6 cf = 0.040 af
Overall Storage Efficiency = 51.2%
Overall System Size = 39.22' x 20.50' x 4.25'

20 Chambers
126.5 cy Field
92.5 cy Stone



Pond C4: Roofs



Summary for Pond D1: Infiltration Basin

Inflow Area = 13.817 ac, 20.40% Impervious, Inflow Depth = 1.80" for 100yr event
Inflow = 12.07 cfs @ 12.32 hrs, Volume= 2.071 af
Outflow = 5.02 cfs @ 13.15 hrs, Volume= 2.071 af, Atten= 58%, Lag= 49.6 min
Discarded = 5.02 cfs @ 13.15 hrs, Volume= 2.071 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.22' @ 13.15 hrs Surf.Area= 48,167 sf Storage= 28,339 cf

Plug-Flow detention time= 124.2 min calculated for 2.069 af (100% of inflow)
Center-of-Mass det. time= 124.1 min (996.1 - 872.0)

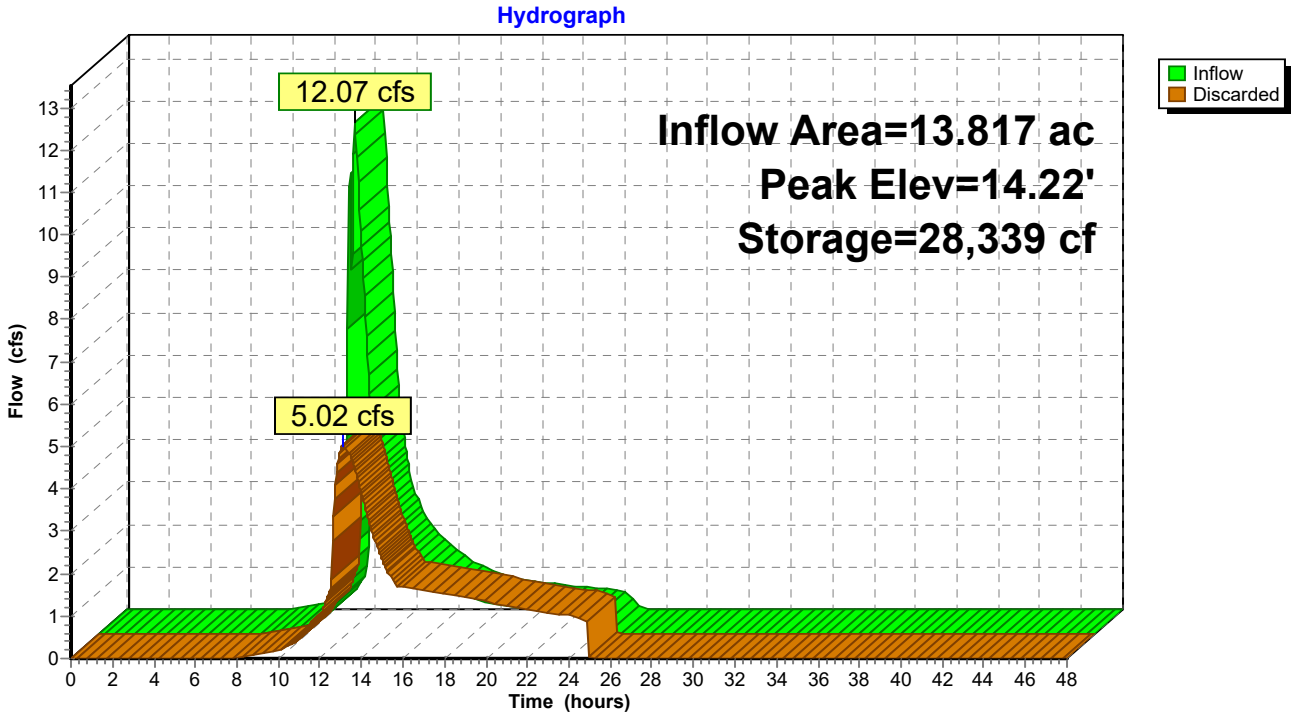
Volume	Invert	Avail.Storage	Storage Description
#1	12.25'	106,725 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.25	8,600	0	0
12.50	9,600	2,275	2,275
13.00	11,200	5,200	7,475
14.00	16,200	13,700	21,175
14.50	88,000	26,050	47,225
15.00	150,000	59,500	106,725

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.25'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=5.02 cfs @ 13.15 hrs HW=14.22' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 5.02 cfs)

Pond D1: Infiltration Basin



Summary for Pond P0: Natural Depression

Inflow Area = 2.755 ac, 8.03% Impervious, Inflow Depth = 1.55" for 100yr event
Inflow = 1.90 cfs @ 12.67 hrs, Volume= 0.356 af
Outflow = 1.08 cfs @ 13.21 hrs, Volume= 0.356 af, Atten= 43%, Lag= 32.5 min
Discarded = 1.08 cfs @ 13.21 hrs, Volume= 0.356 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.32' @ 13.21 hrs Surf.Area= 10,365 sf Storage= 2,567 cf

Plug-Flow detention time= 17.9 min calculated for 0.356 af (100% of inflow)
Center-of-Mass det. time= 17.9 min (927.8 - 909.9)

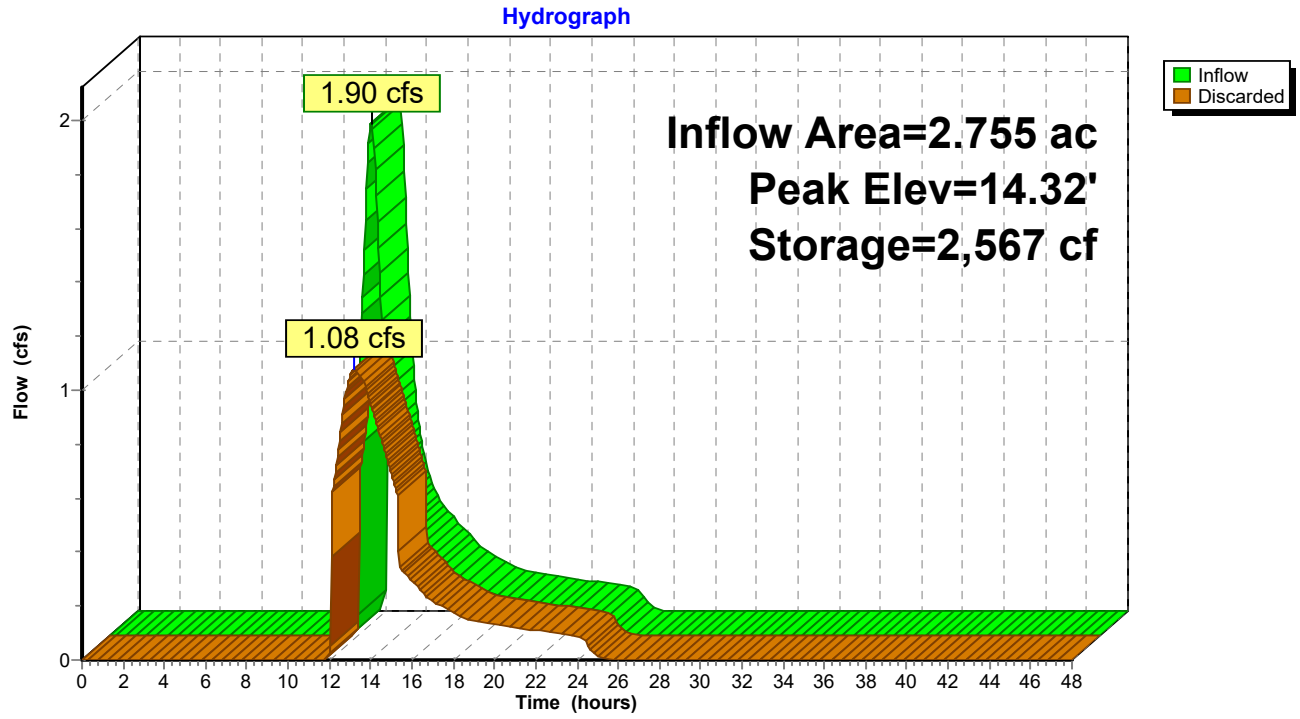
Volume	Invert	Avail.Storage	Storage Description
#1	14.00'	4,675 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
14.00	5,700	0	0
14.50	13,000	4,675	4,675

Device	Routing	Invert	Outlet Devices
#1	Discarded	14.00'	**4.500 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=1.08 cfs @ 13.21 hrs HW=14.32' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.08 cfs)

Pond P0: Natural Depression



Summary for Pond P1: Littleton Dr North Bio

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=65)

Inflow Area = 0.200 ac, 49.25% Impervious, Inflow Depth = 4.57" for 100yr event
Inflow = 1.07 cfs @ 12.08 hrs, Volume= 0.076 af
Outflow = 0.16 cfs @ 12.60 hrs, Volume= 0.076 af, Atten= 85%, Lag= 31.5 min
Discarded = 0.16 cfs @ 12.60 hrs, Volume= 0.076 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 14.27' @ 12.60 hrs Surf.Area= 2,828 sf Storage= 1,152 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 57.8 min (875.3 - 817.5)

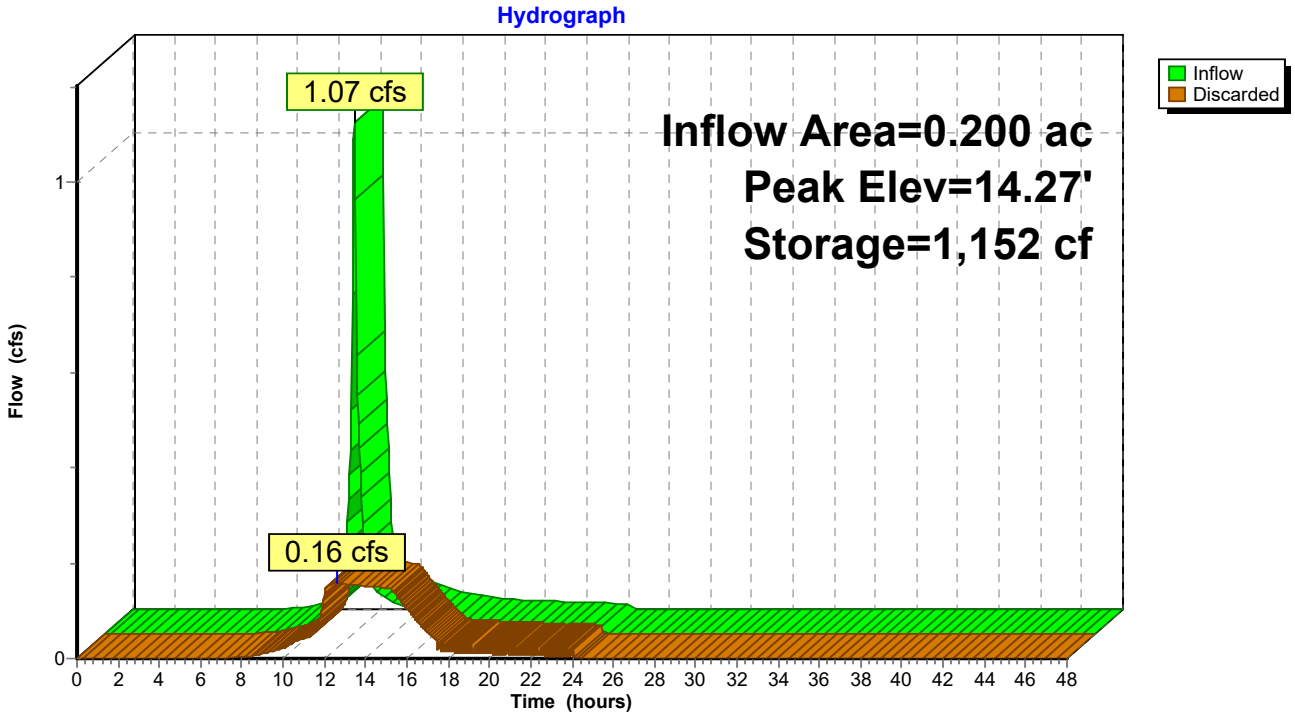
Volume	Invert	Avail.Storage	Storage Description
#1	13.75'	3,534 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.75	700	0	0
14.00	2,600	413	413
14.25	2,800	675	1,088
15.00	3,725	2,447	3,534

Device	Routing	Invert	Outlet Devices
#1	Discarded	13.75'	**2.410 in/hr Exfiltration over Surface area above 13.00'** Excluded Surface area = 0 sf

Discarded OutFlow Max=0.16 cfs @ 12.60 hrs HW=14.27' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Pond P1: Littleton Dr North Bio



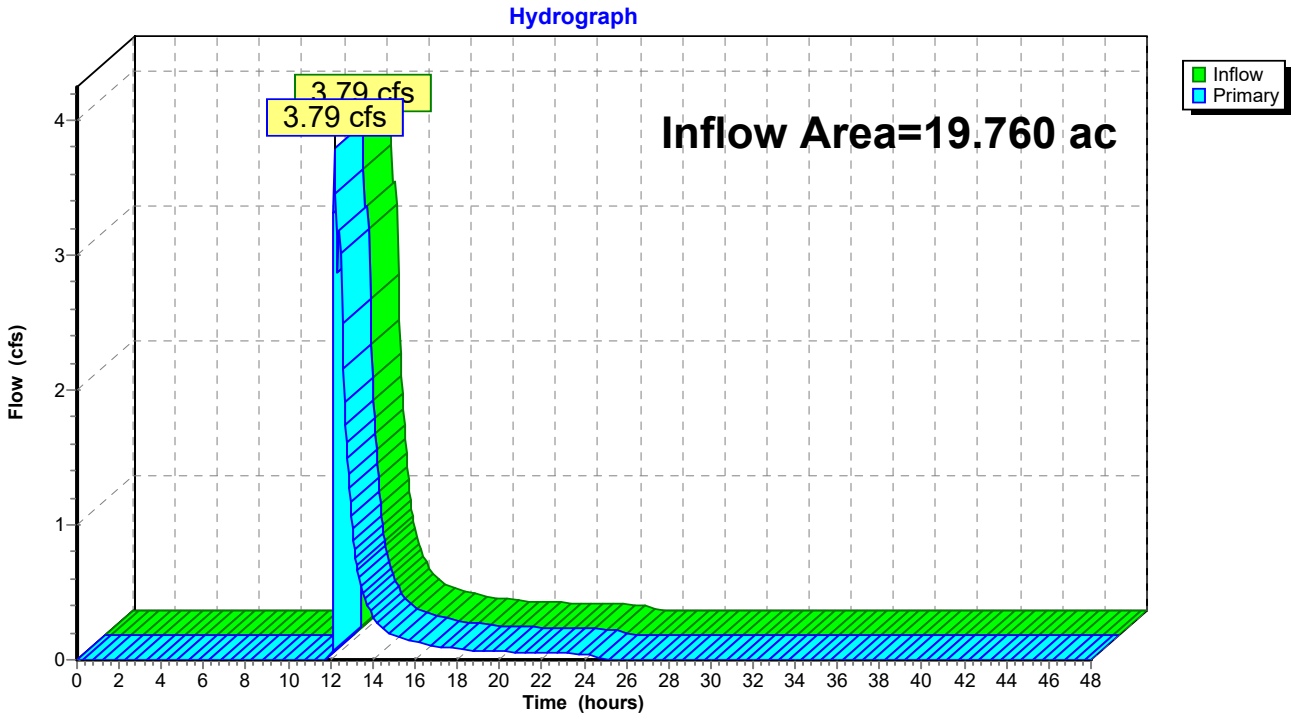
Summary for Pond SP1: FLAX POND

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

Inflow Area = 19.760 ac, 21.55% Impervious, Inflow Depth = 0.18" for 100yr event
Inflow = 3.79 cfs @ 12.20 hrs, Volume= 0.301 af
Primary = 3.79 cfs @ 12.20 hrs, Volume= 0.301 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2

Pond SP1: FLAX POND



Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2yr	Type III 24-hr		Default	24.00	1	3.44	2
2	10yr	Type III 24-hr		Default	24.00	1	5.05	2
3	100yr	Type III 24-hr		Default	24.00	1	7.60	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.406	39	>75% Grass cover, Good, HSG A (DA1)
0.381	50	>75% Grass cover, Good, HSG A/B (DA1)
1.134	77	Dirt roads, HSG A/B (DA1)
0.027	98	Paved roads w/curbs & sewers, HSG A (DA1)
0.387	98	Roofs, HSG A (DA1)
2.174	30	Woods, Good, HSG A (DA1)
15.053	42	Woods, Good, HSG A/B (DA1)
19.562	**44**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
19.562	HSG A	DA1
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
19.562		**TOTAL AREA**

Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 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 DA1: Pond Runoff Area=19.562 ac 2.12% Impervious Runoff Depth=0.06"
Flow Length=1,236' Tc=53.5 min CN=44 Runoff=0.15 cfs 0.096 af

Pond SP1: Pond Inflow=0.15 cfs 0.096 af
Primary=0.15 cfs 0.096 af

Total Runoff Area = 19.562 ac Runoff Volume = 0.096 af Average Runoff Depth = 0.06"
97.88% Pervious = 19.148 ac 2.12% Impervious = 0.414 ac

Summary for Subcatchment DA1: Pond

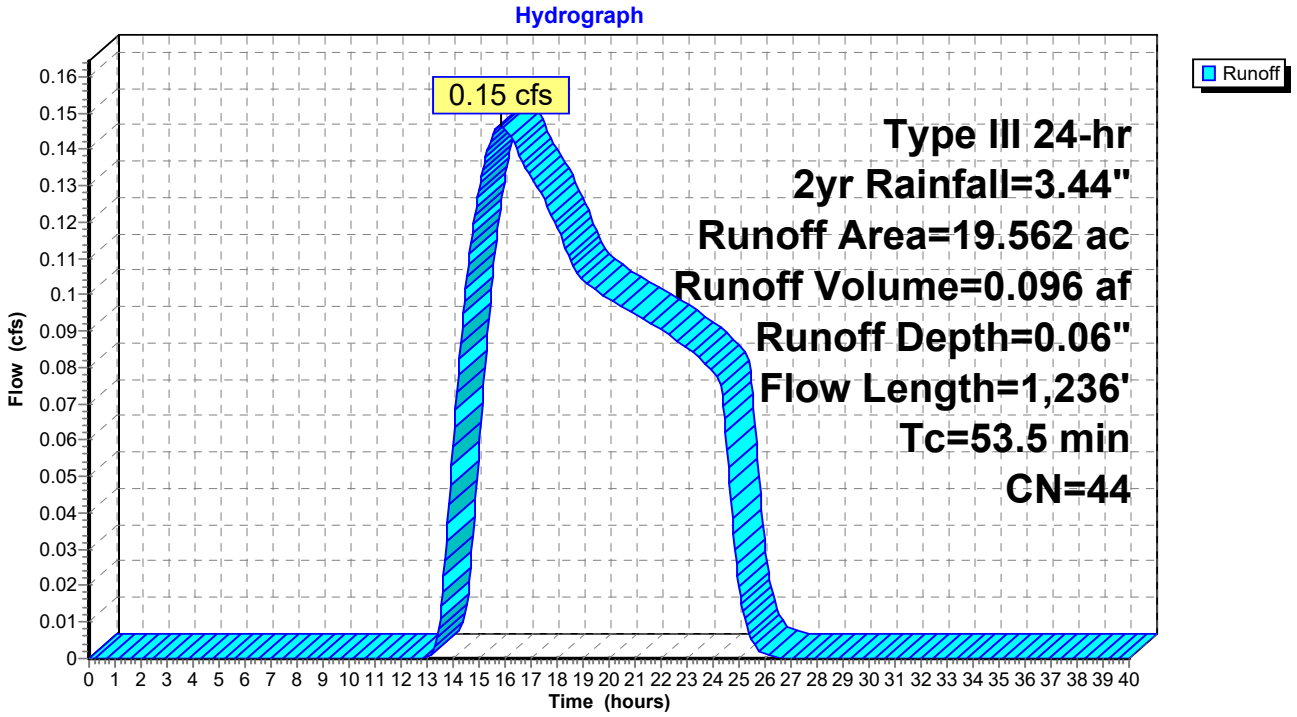
Runoff = 0.15 cfs @ 15.87 hrs, Volume= 0.096 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.44"

	Area (ac)	CN	Description
	0.027	98	Paved roads w/curbs & sewers, HSG A
	0.387	98	Roofs, HSG A
*	1.134	77	Dirt roads, HSG A/B
*	15.053	42	Woods, Good, HSG A/B
*	0.381	50	>75% Grass cover, Good, HSG A/B
	0.406	39	>75% Grass cover, Good, HSG A
	2.174	30	Woods, Good, HSG A
	19.562	44	Weighted Average
	19.148		97.88% Pervious Area
	0.414		2.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
3.5	175	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.7	961	0.0050	0.71		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
53.5	1,236	Total			

Subcatchment DA1: Pond



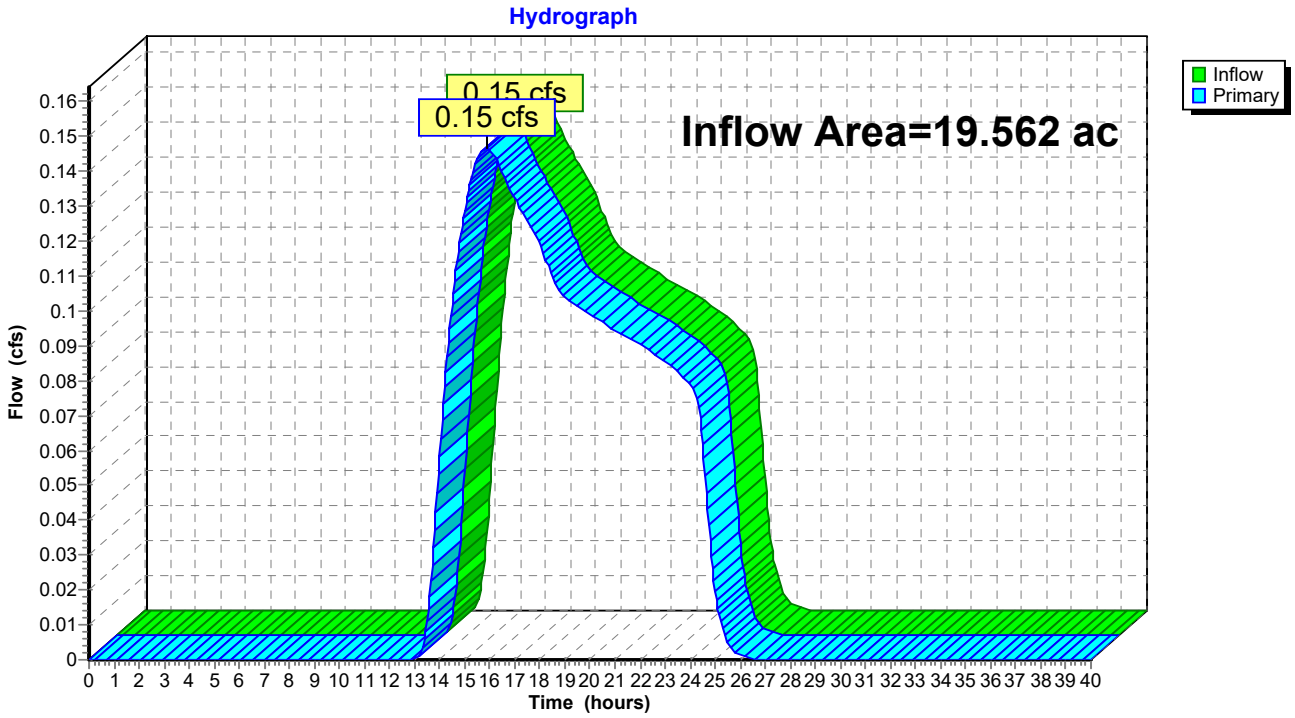
Summary for Pond SP1: Pond

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

Inflow Area = 19.562 ac, 2.12% Impervious, Inflow Depth = 0.06" for 2yr event
Inflow = 0.15 cfs @ 15.87 hrs, Volume= 0.096 af
Primary = 0.15 cfs @ 15.87 hrs, Volume= 0.096 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond SP1: Pond



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 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 DA1: Pond Runoff Area=19.562 ac 2.12% Impervious Runoff Depth=0.41"
Flow Length=1,236' Tc=53.5 min CN=44 Runoff=1.92 cfs 0.671 af

Pond SP1: Pond Inflow=1.92 cfs 0.671 af
Primary=1.92 cfs 0.671 af

Total Runoff Area = 19.562 ac Runoff Volume = 0.671 af Average Runoff Depth = 0.41"
97.88% Pervious = 19.148 ac 2.12% Impervious = 0.414 ac

Summary for Subcatchment DA1: Pond

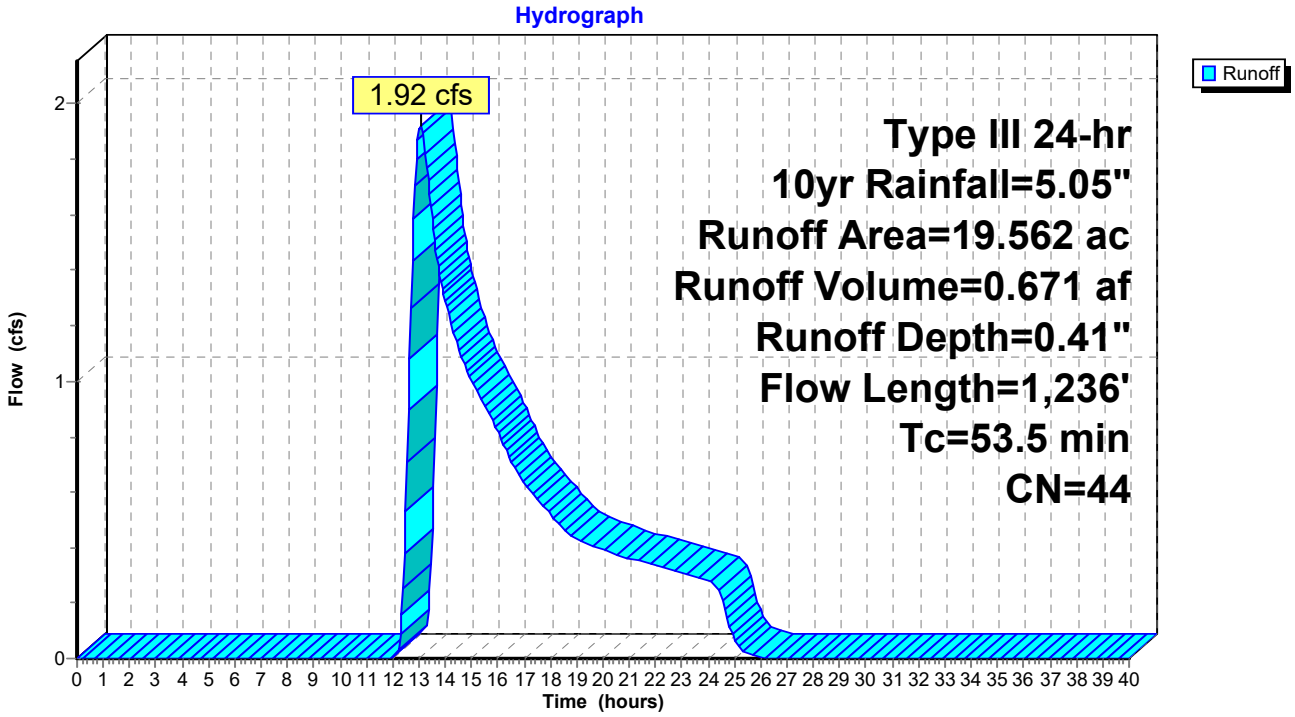
Runoff = 1.92 cfs @ 13.06 hrs, Volume= 0.671 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr Rainfall=5.05"

	Area (ac)	CN	Description
	0.027	98	Paved roads w/curbs & sewers, HSG A
	0.387	98	Roofs, HSG A
*	1.134	77	Dirt roads, HSG A/B
*	15.053	42	Woods, Good, HSG A/B
*	0.381	50	>75% Grass cover, Good, HSG A/B
	0.406	39	>75% Grass cover, Good, HSG A
	2.174	30	Woods, Good, HSG A
	19.562	44	Weighted Average
	19.148		97.88% Pervious Area
	0.414		2.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
3.5	175	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.7	961	0.0050	0.71		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
53.5	1,236	Total			

Subcatchment DA1: Pond



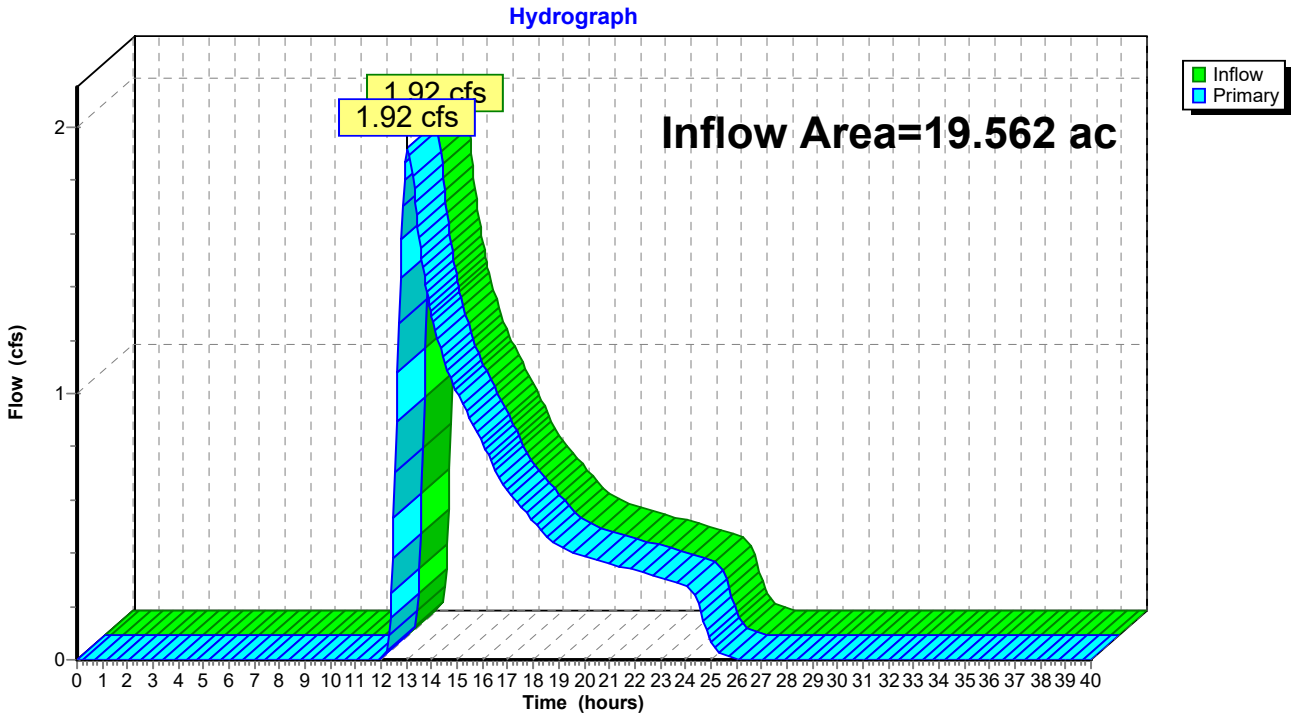
Summary for Pond SP1: Pond

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

Inflow Area = 19.562 ac, 2.12% Impervious, Inflow Depth = 0.41" for 10yr event
Inflow = 1.92 cfs @ 13.06 hrs, Volume= 0.671 af
Primary = 1.92 cfs @ 13.06 hrs, Volume= 0.671 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond SP1: Pond



Time span=0.00-40.00 hrs, dt=0.05 hrs, 801 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 DA1: Pond Runoff Area=19.562 ac 2.12% Impervious Runoff Depth=1.44"
Flow Length=1,236' Tc=53.5 min CN=44 Runoff=11.01 cfs 2.342 af

Pond SP1: Pond Inflow=11.01 cfs 2.342 af
Primary=11.01 cfs 2.342 af

Total Runoff Area = 19.562 ac Runoff Volume = 2.342 af Average Runoff Depth = 1.44"
97.88% Pervious = 19.148 ac 2.12% Impervious = 0.414 ac

Summary for Subcatchment DA1: Pond

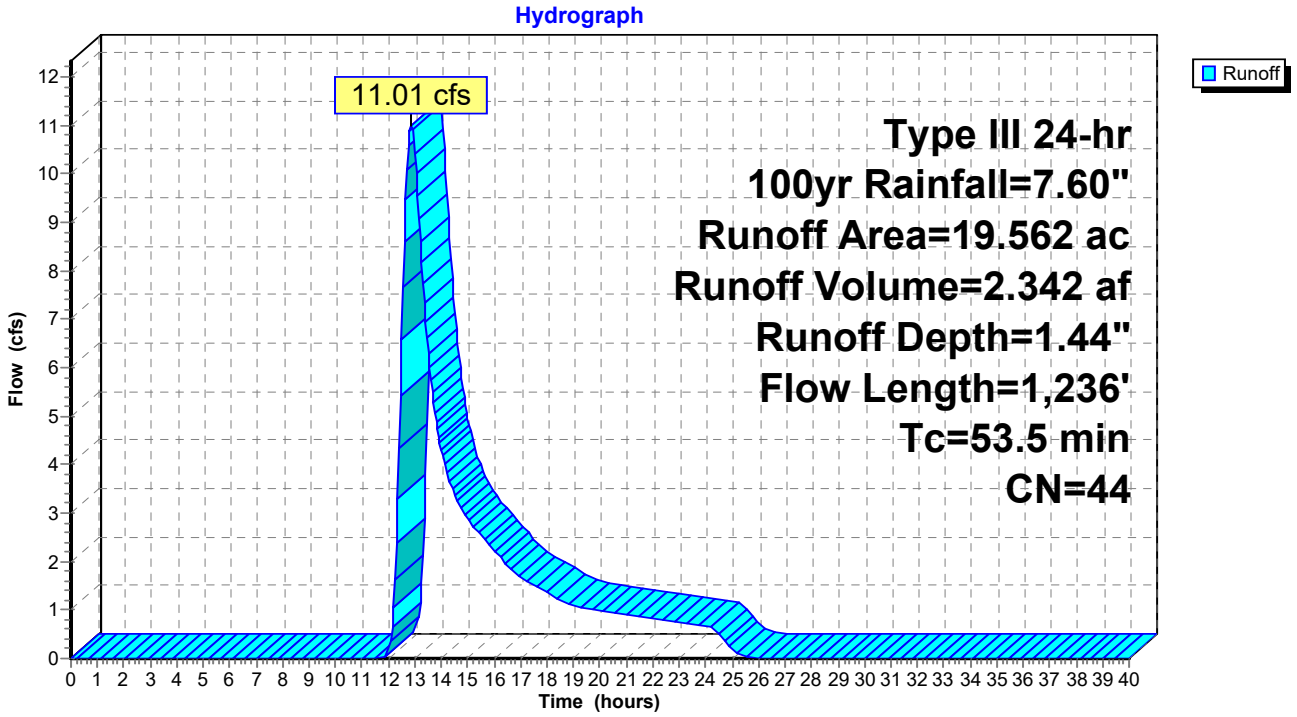
Runoff = 11.01 cfs @ 12.86 hrs, Volume= 2.342 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr Rainfall=7.60"

	Area (ac)	CN	Description
	0.027	98	Paved roads w/curbs & sewers, HSG A
	0.387	98	Roofs, HSG A
*	1.134	77	Dirt roads, HSG A/B
*	15.053	42	Woods, Good, HSG A/B
*	0.381	50	>75% Grass cover, Good, HSG A/B
	0.406	39	>75% Grass cover, Good, HSG A
	2.174	30	Woods, Good, HSG A
	19.562	44	Weighted Average
	19.148		97.88% Pervious Area
	0.414		2.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	100	0.0100	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
3.5	175	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.7	961	0.0050	0.71		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
53.5	1,236	Total			

Subcatchment DA1: Pond



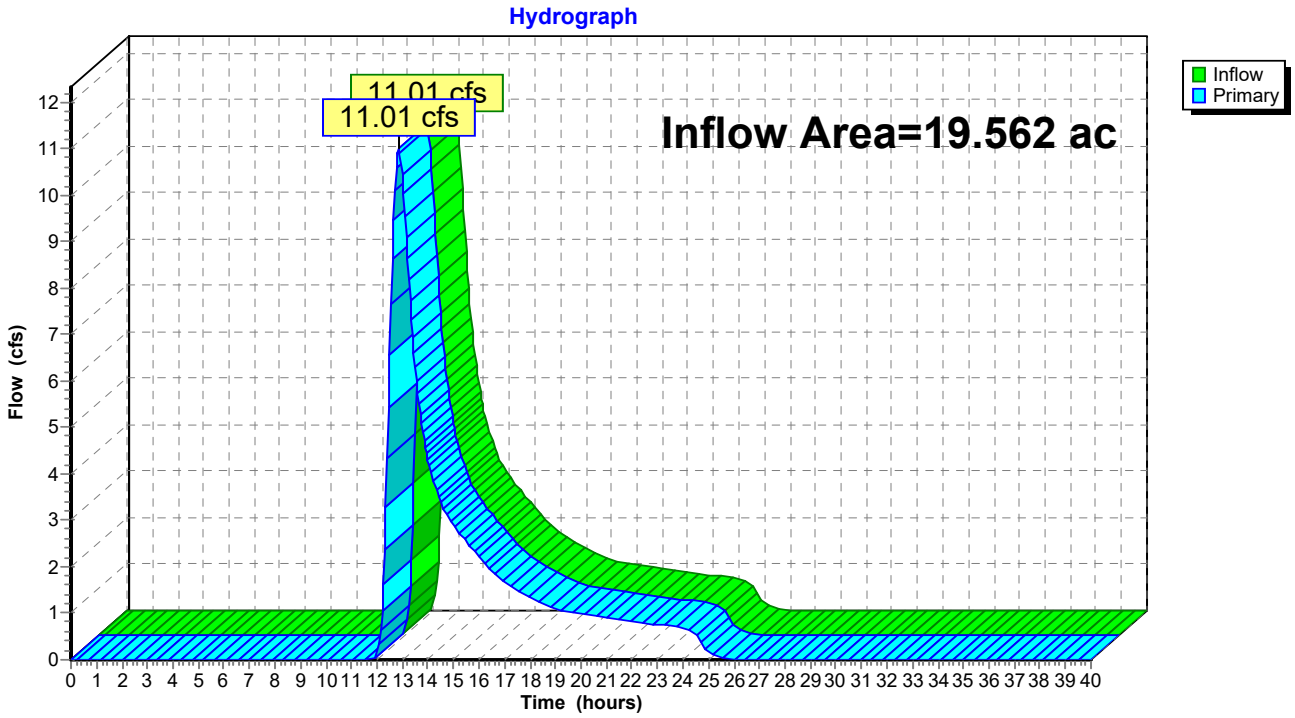
Summary for Pond SP1: Pond

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

Inflow Area = 19.562 ac, 2.12% Impervious, Inflow Depth = 1.44" for 100yr event
Inflow = 11.01 cfs @ 12.86 hrs, Volume= 2.342 af
Primary = 11.01 cfs @ 12.86 hrs, Volume= 2.342 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond SP1: Pond



APPENDIX E

TSS and Recharge Calculations

TSS Removal Calculation Worksheet

Location: Subcatchment DA0

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**

Total TSS Removal = **90%**

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

Location: Subcatchment DA1 to URC-4

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)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
Subsurface Infiltration Structure	**0.80**	**0.10**	**0.08**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**

Total TSS Removal = **98%**

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

Project: 20031
Prepared By: GK
Date: 10/15/2020

*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

Location: Subcatchment DA1E & DA1W to SP1

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)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
Subsurface Infiltration Structure	**0.80**	**0.10**	**0.08**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**

Total TSS Removal = **98%**

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

Location: DA2 to Study Point 1

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)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
Subsurface Infiltration Structure	**0.80**	**0.10**	**0.08**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**

Total TSS Removal = **98%**

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

Location: DA3 to Surface Infiltration Basin overflow to SP1

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)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
Subsurface Infiltration Structure	**0.80**	**0.10**	**0.08**	**0.02**
Infiltration Basin	**0.80**	**0.02**	**0.02**	**0.00**
	0.00	**0.00**	**0.00**	**0.00**
	0.00	**0.00**	**0.00**	**0.00**

Total TSS Removal = **100%**

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

Location: DA4 to Surface Infiltration Basin to SP1

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)
Bioretention Area	0.90	1.00	0.90	0.10
Infiltration Basin	0.80	0.10	0.08	0.02
	0.00	0.02	0.00	0.02
	0.00	0.02	0.00	0.02
	0.00	0.02	0.00	0.02

Total TSS Removal = 98%

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

Location: DA1OS to Natural Depression

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)
Infiltration Basin	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

Total TSS Removal = 80%

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

Location: DA2OS to SP1 (no new imp. Cover)

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
	0.00	1.00	0.00	1.00
	0.00	1.00	0.00	1.00
	0.00	1.00	0.00	1.00
	0.00	1.00	0.00	1.00

Total TSS Removal = 0%

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

Location: DA3OS to Surface Infiltration Basin

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)
Infiltration Basin	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

Total TSS Removal = 80%

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

Location: DA3R to Subsurface Chambers and Natural Depression

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)
Subsurface Infiltration Structure	**0.80**	**1.00**	**0.80**	**0.20**
Infiltration Basin	**0.80**	**0.20**	**0.16**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**

Total TSS Removal = **96%**

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

Project: 20107
Prepared By: RAC
Date: 12/29/2020

*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

From MassDEP Stormwater Handbook Vol. 1

TSS Removal Efficiencies for Best Management Practices	
Best Management Practice (BMP)	**TSS Removal Efficiency**
Non-Structural Pretreatment BMPs	
Street Sweeping	0-10%, See Volume 2, Chapter 1.
Structural Pretreatment BMPs	
Deep Sump Catch Basins	25% only if used for pretreatment and only if off-line
Oil Grit Separator	25% only if used for pretreatment and only if off-line
Proprietary Separators	Varies – see Volume 2, Chapter 4.
Sediment Forebays	25% if used for pretreatment
Vegetated filter strips	10% if at least 25 feet wide, 45% if at least 50 feet wide
Treatment BMPs	
Bioretention Areas including rain gardens	90% provided it is combined with adequate pretreatment
Constructed Stormwater Wetlands	80% provided it is combined with a sediment forebay
Extended Dry Detention Basins	50% provided it is combined with a sediment forebay
Gravel Wetlands	80% provided it is combined with a sediment forebay
Proprietary Media Filters	Varies – see Volume 2, Chapter 4
Sand/Organic Filters	80% provided it is combined with sediment forebay
Treebox filter	80% provided it is combined with adequate pretreatment
Wet Basins	80% provided it is combined with sediment forebay
Conveyance	
Drainage Channels	For conveyance only. No TSS Removal credit.
Grass Channels (formerly biofilter swales)	50% if combined with sediment forebay or equivalent
Water Quality Swale – wet & dry	70% provided it is combined with sediment forebay or equivalent
Infiltration BMPs	
Dry Wells	80% for runoff from non-metal roofs; may also be used for runoff from metal roofs but only if metal roof is not located within a Zone II, or IWPA or at an industrial site
Infiltration Basins & Infiltration Trenches	80% provided it is combined with adequate pretreatment (sediment forebay or vegetated filter strip, grass channel, water quality swale) prior to infiltration
Leaching Catch Basins	80% provided a deep sump catch basin is used for pretreatment
Subsurface Structure	80% provided they are combined with one or more pretreatment BMPs prior to infiltration.
Other BMPs	
Dry Detention Basins	For peak rate attenuation only. No TSS Removal credit.
Green Roofs	See Volume 2. Chapter 2. May reduce required water quality volume. No TSS Removal Credit.
Porous Pavement	80% if designed to prevent runon and with adequate storage capacity. Limited to uses identified in Volume 2, Chapter 2.
Rain Barrels and Cisterns	May reduce required water quality volume. No TSS Removal Credit.

APPENDIX F

Stormwater Operation and Maintenance Plan

(bound separately)

APPENDIX G

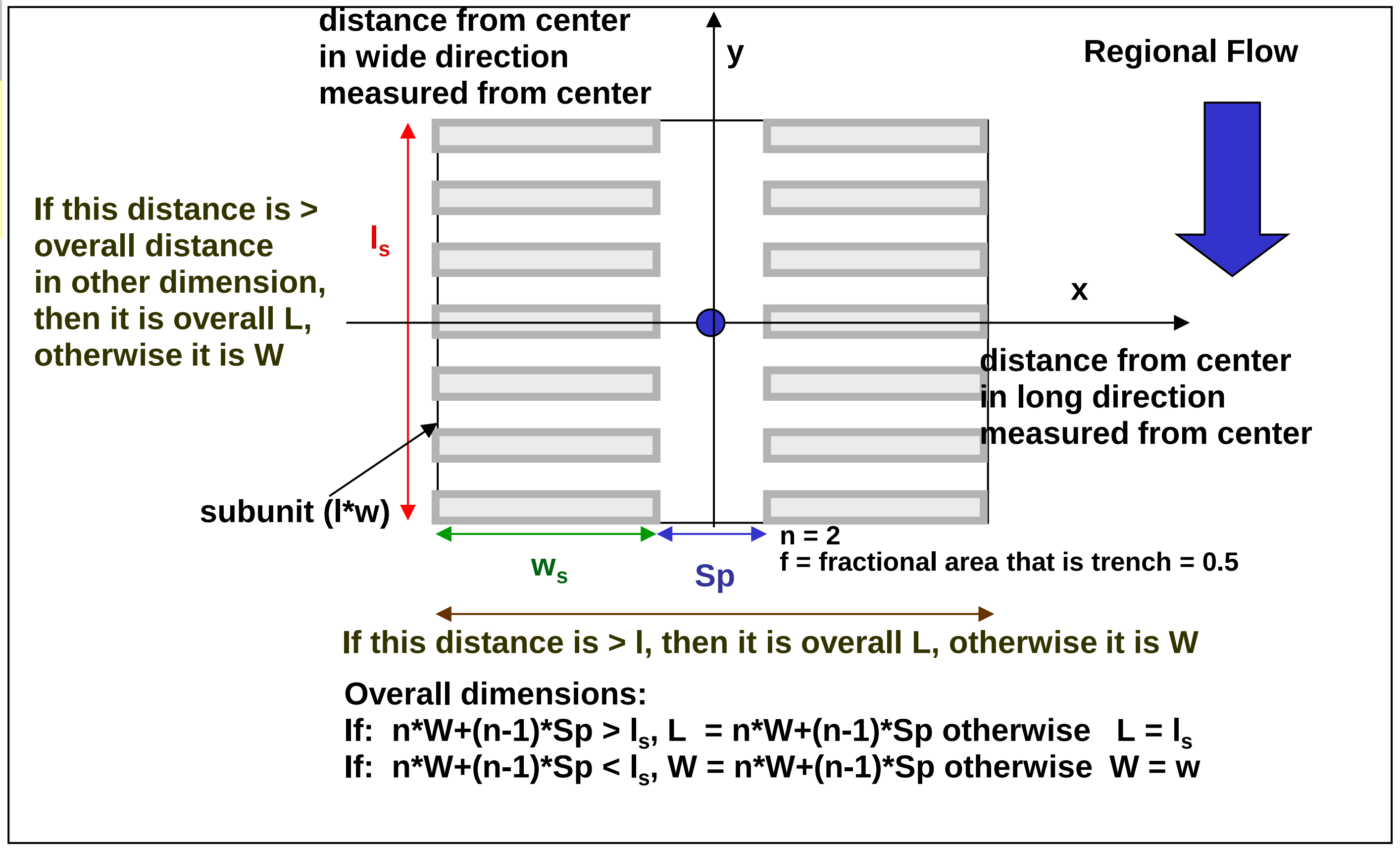
Groundwater Mounding Analysis

CHAMBER GROUP 1

Water Table Mounding calculated based on Hantush 1967, WRR

Enter data in green cells as per their yellow labels, other values will be computed from those entries.

Results are highlighted in pink.



Zmax Beneath Center of Entire Drain Field (L*W)

Meters and Days	Length of Drain Field Subunit	Width of Drain Field Subunit		Separation between Drain Field Subunits	Fraction of Drain Field Subunit that is Trench Area	Horizontal Hydraulic Conductivity	Specific Yield use 0.001 to approximate steady state at 10 years	time use 10 years to approximate steady state
	l_s	w_s		Sp	f	Kh	Sy	time
	ft	ft		ft		ft/days	none	days
	74.82	39.5			1	90	0.001	3650

Number of subunits, n	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q	Zmax 12 iterations	Initial Saturated Thickness	alpha	beta	a2+b2	W part1	W(a2+b2)	S*	z1	hiter	alpha
	ft	ft	ft/day	ft/day	ft/day	gallons/day	ft	ft			NOTE: if a2+b2>0.04, solution is inaccurate						
1	74.82	39.5	7.0163	7.0163	7.0163	155,105	2.341	150	8.42645E-05	4.4486E-05	9.07951E-09	17.940031	17.94003108	9.28182E-08	2.358	151.1792474	8.39352E-05
1	74.82	39.5	7.0163	7.0163	7.0163	155,105	2.341	150	8.42645E-05	4.4486E-05	9.07951E-09	17.940031	17.94003108	9.28182E-08	2.358	151.1792474	8.39352E-05
1	74.82	39.5	7.0163	7.0163	7.0163	155,105	2.341	150	8.42645E-05	4.4486E-05	9.07951E-09	17.940031	17.94003108	9.28182E-08	2.358	151.1792474	8.39352E-05
1	74.82	39.5	7.0163	7.0163	7.0163	155,105	2.341	150	8.42645E-05	4.4486E-05	9.07951E-09	17.940031	17.94003108	9.28182E-08	2.358	151.1792474	8.39352E-05

copy an entire row from above and insert copied cells above this line
to evaluate various loading rates and numbers of subunits

Water Table Rise on Side Slope

Uses Subunit Geometry and Material Properties from Zmax Table

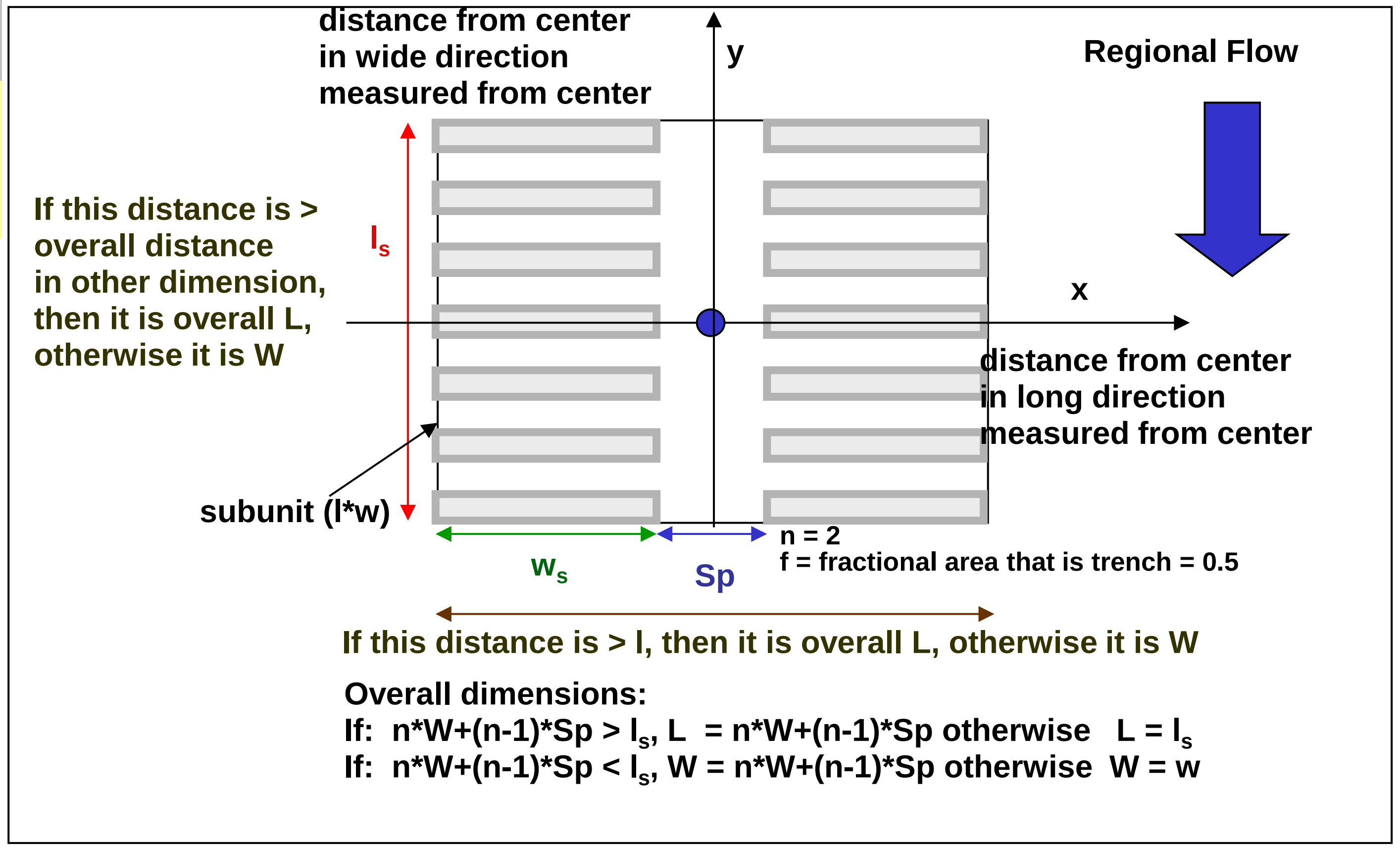
Number of subunits, n	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q l/day	Zsx 12 iterations	Distance from Center of Drain Field in Long Dimension (x in figure)	Distance from Center of Drain Field in Wide Dimension (y in figure)	Initial Saturated Thickness	alpha1	alpha2	beta1	beta2	a2+b2	W part1	W(a2+b2)
	ft	ft	ft/day	ft/day	ft/day	gallons/day	ft	ft	ft	ft					NOTE: if a2+b2>0.04, solution is inaccu		
1	74.82	39.5	7.0163	7.0163	7.0163	155105.076	2.341			150	8.42645E-05	8.426E-05	4.4486E-05	4.4486E-05	9.08E-09	17.94003108	17.94003108
1	74.82	39.5	7.0163	7.0163	7.0163	155105.076	2.341			150	8.42645E-05	8.426E-05	4.4486E-05	4.4486E-05	9.08E-09	17.94003108	17.94003108
1	74.82	39.5	7.0163	7.0163	7.0163	155105.076	2.341			150	8.42645E-05	8.426E-05	4.4486E-05	4.4486E-05	9.08E-09	17.94003108	17.94003108
1	74.82	39.5	7.0163	7.0163	7.0163	155105.076	2.341			150	8.42645E-05	8.426E-05	4.4486E-05	4.4486E-05	9.08E-09	17.94003108	17.94003108

CHAMBER GROUP 2

Water Table Mounding calculated based on Hantush 1967, WRR

Enter data in green cells as per their yellow labels, other values will be computed from those entries.

Results are highlighted in pink.



Zmax Beneath Center of Entire Drain Field (L*W)

Meters and Days	Length of Drain Field Subunit	Width of Drain Field Subunit		Separation between Drain Field Subunits	Fraction of Drain Field Subunit that is Trench Area	Horizontal Hydraulic Conductivity	Specific Yield use 0.001 to approximate steady state at 10 years	time use 10 years to approximate steady state
	l_s	w_s		Sp	f	Kh	Sy	time
	ft	ft		ft		ft/days	none	days
	75.2	34.8			1	90	0.001	3650

Number of subunits, n	L (ft)	W (ft)	q effective in subunit ls x ws (ft/day)	q in trenches (ft/day)	q' effective on LxW (ft/day)	Q (gallons/day)	Zmax 12 iterations (ft)	Initial Saturated Thickness (ft)	alpha	beta	a2+b2	W part1	W(a2+b2)	S*	z1	hiter	alpha
1	75.2	34.8	6.6669	6.6669	6.6669	130,503	1.982	150	8.46924E-05	3.91928E-05	8.70888E-09	17.981708	17.9817078	8.24923E-08	1.994	150.9970613	8.44123E-05
1	75.2	34.8	6.6669	6.6669	6.6669	130,503	1.982	150	8.46924E-05	3.91928E-05	8.70888E-09	17.981708	17.9817078	8.24923E-08	1.994	150.9970613	8.44123E-05
1	75.2	34.8	6.6669	6.6669	6.6669	130,503	1.982	150	8.46924E-05	3.91928E-05	8.70888E-09	17.981708	17.9817078	8.24923E-08	1.994	150.9970613	8.44123E-05
1	75.2	34.8	6.6669	6.6669	6.6669	130,503	1.982	150	8.46924E-05	3.91928E-05	8.70888E-09	17.981708	17.9817078	8.24923E-08	1.994	150.9970613	8.44123E-05

NOTE: if a2+b2>0.04, solution is inaccurate

copy an entire row from above and insert copied cells above this line
to evaluate various loading rates and numbers of subunits

Water Table Rise on Side Slope

Uses Subunit Geometry and Material Properties from Zmax Table

Number of subunits, n	L (ft)	W (ft)	q effective in subunit ls x ws (ft/day)	q in trenches (ft/day)	q' effective on LxW (ft/day)	Q l/day (gallons/day)	Zsx 12 iterations (ft)	Distance from Center of Drain Field in Long Dimension (x in figure) (ft)	Distance from Center of Drain Field in Wide Dimension (y in figure) (ft)	Initial Saturated Thickness (ft)	alpha1	alpha2	beta1	beta2	a2+b2	W part1	W(a2+b2)
1	75.2	34.8	6.6669	6.6669	6.6669	130503.3255	1.982			150	8.46924E-05	8.469E-05	3.91928E-05	3.91928E-05	8.71E-09	17.9817078	17.9817078
1	75.2	34.8	6.6669	6.6669	6.6669	130503.3255	1.982			150	8.46924E-05	8.469E-05	3.91928E-05	3.91928E-05	8.71E-09	17.9817078	17.9817078
1	75.2	34.8	6.6669	6.6669	6.6669	130503.3255	1.982			150	8.46924E-05	8.469E-05	3.91928E-05	3.91928E-05	8.71E-09	17.9817078	17.9817078
1	75.2	34.8	6.6669	6.6669	6.6669	130503.3255	1.982			150	8.46924E-05	8.469E-05	3.91928E-05	3.91928E-05	8.71E-09	17.9817078	17.9817078

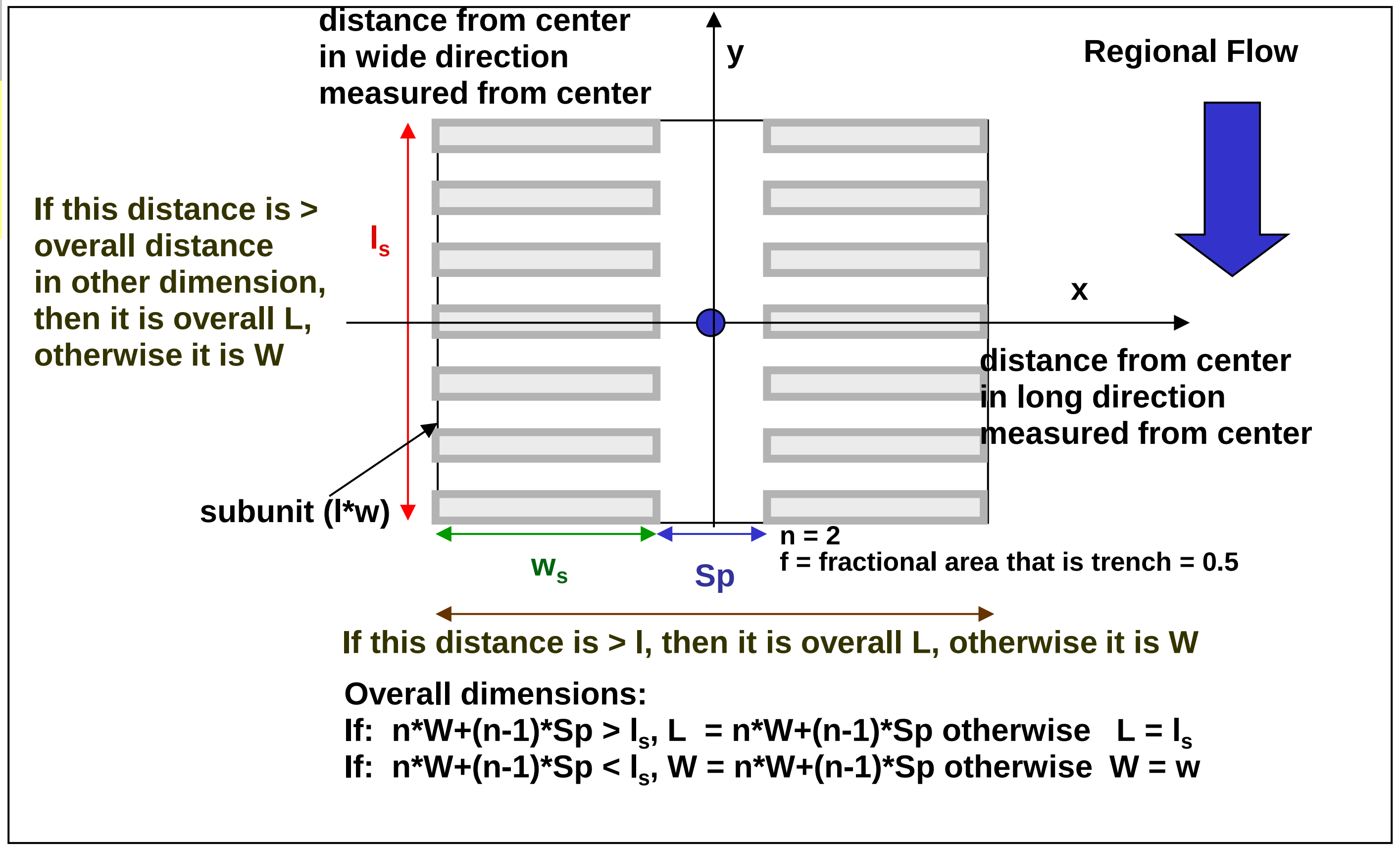
NOTE: if a2+b2>0.04, solution is inaccu

CHAMBER GROUP 3

Water Table Mounding calculated based on Hantush 1967, WRR

Enter data in green cells as per their yellow labels, other values will be computed from those entries.

Results are highlighted in pink.



Zmax Beneath Center of Entire Drain Field (L*W)

Meters and Days	Length of Drain Field Subunit	Width of Drain Field Subunit		Separation between Drain Field Subunits	Fraction of Drain Field Subunit that is Trench Area	Horizontal Hydraulic Conductivity	Specific Yield use 0.001 to approximate steady state at 10 years	time use 10 years to approximate steady state
	l_s	w_s		Sp	f	Kh	Sy	time
	ft	ft		ft		ft/days	none	days
	117.88	53.75			1	90	0.001	3650

NOTE: if a2+b2>0.04, solution is inaccurate

Number of subunits, n	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q	Zmax 12 iterations	Initial Saturated Thickness	alpha	beta	a2+b2	W part1	W(a2+b2)	S*	z1	hiter	alpha
	ft	ft	ft/day	ft/day	ft/day	gallons/day	ft	ft									
1	117.88	53.75	7.4358	7.4358	7.4358	352,408	5.011	150	0.00013276	6.05348E-05	2.12896E-08	17.08783	17.08783001	1.90616E-07	5.087	152.5435708	0.000131648
1	117.88	53.75	7.4358	7.4358	7.4358	352,408	5.011	150	0.00013276	6.05348E-05	2.12896E-08	17.08783	17.08783001	1.90616E-07	5.087	152.5435708	0.000131648
1	117.88	53.75	7.4358	7.4358	7.4358	352,408	5.011	150	0.00013276	6.05348E-05	2.12896E-08	17.08783	17.08783001	1.90616E-07	5.087	152.5435708	0.000131648
1	117.88	53.75	7.4358	7.4358	7.4358	352,408	5.011	150	0.00013276	6.05348E-05	2.12896E-08	17.08783	17.08783001	1.90616E-07	5.087	152.5435708	0.000131648

copy an entire row from above and insert copied cells above this line
to evaluate various loading rates and numbers of subunits

Water Table Rise on Side Slope

Uses Subunit Geometry and Material Properties from Zmax Table

NOTE: if a2+b2>0.04, solution is inaccu

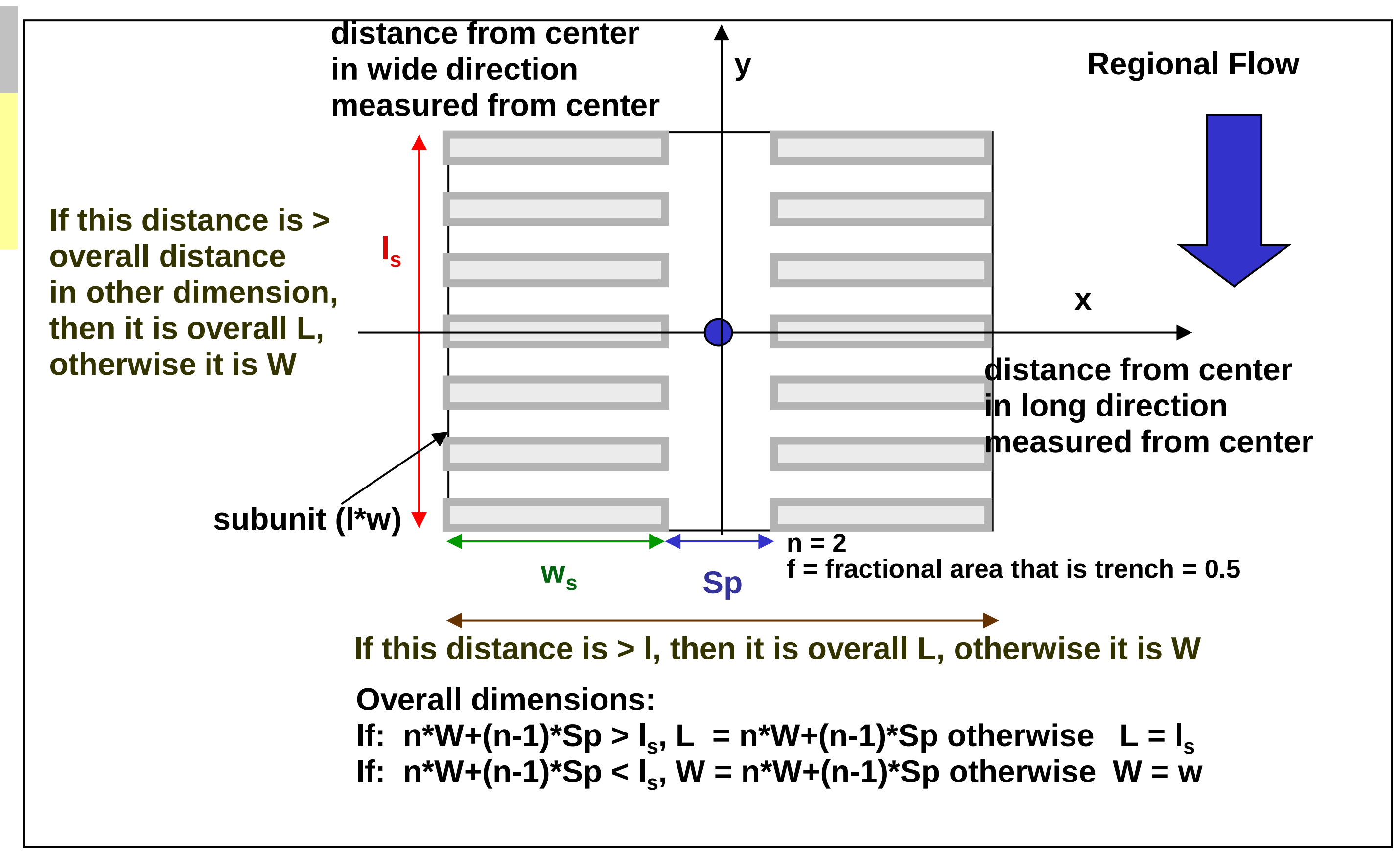
Number of subunits, n	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q l/day	Zsx 12 iterations	Distance from Center of Drain Field in Long Dimension (x in figure)	Distance from Center of Drain Field in Wide Dimension (y in figure)	Initial Saturated Thickness	alpha1	alpha2	beta1	beta2	a2+b2	W part1	W(a2+b2)
	ft	ft	ft/day	ft/day	ft/day	gallons/day	ft	ft	ft	ft							
1	117.88	53.75	7.4358	7.4358	7.4358	352407.8565	5.011			150	0.00013276	0.0001328	6.05348E-05	6.05348E-05	2.13E-08	17.08783001	17.08783001
1	117.88	53.75	7.4358	7.4358	7.4358	352407.8565	5.011			150	0.00013276	0.0001328	6.05348E-05	6.05348E-05	2.13E-08	17.08783001	17.08783001
1	117.88	53.75	7.4358	7.4358	7.4358	352407.8565	5.011			150	0.00013276	0.0001328	6.05348E-05	6.05348E-05	2.13E-08	17.08783001	17.08783001
1	117.88	53.75	7.4358	7.4358	7.4358	352407.8565	5.011			150	0.00013276	0.0001328	6.05348E-05	6.05348E-05	2.13E-08	17.08783001	17.08783001

CHAMBER GROUP 4

Water Table Mounding calculated based on Hantush 1967, WRR

Enter data in green cells as per their yellow labels, other values will be computed from those entries.

Results are highlighted in pink.



Zmax Beneath Center of Entire Drain Field (L*W)

Meters and Days	Length of Drain Field Subunit	Width of Drain Field Subunit		Separation between Drain Field Subunits	Fraction of Drain Field Subunit that is Trench Area	Horizontal Hydraulic Conductivity	Specific Yield use 0.001 to approximate steady state at 10 years	time use 10 years to approximate steady state
	l_s	w_s		Sp	f	Kh	Sy	time
	ft	ft		ft		ft/days	none	days
	20.5	39.22			1	90	0.001	3650

Number of subunits, n	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q	Zmax 12 iterations	Initial Saturated Thickness	alpha	beta	a2+b2	W part1	W(a2+b2)	S*	z1	hiter	alpha
	ft	ft	ft/day	ft/day	ft/day	gallons/day	ft	ft			NOTE: if a2+b2>0.04, solution is inaccurate						
1	39.22	20.5	5.9699	5.9699	5.9699	35,903	0.585	150	4.41707E-05	2.30877E-05	2.48409E-09	19.236144	19.2361435	2.69368E-08	0.586	150.292906	4.41276E-05
1	39.22	20.5	5.9699	5.9699	5.9699	35,903	0.585	150	4.41707E-05	2.30877E-05	2.48409E-09	19.236144	19.2361435	2.69368E-08	0.586	150.292906	4.41276E-05
1	39.22	20.5	5.9699	5.9699	5.9699	35,903	0.585	150	4.41707E-05	2.30877E-05	2.48409E-09	19.236144	19.2361435	2.69368E-08	0.586	150.292906	4.41276E-05
1	39.22	20.5	5.9699	5.9699	5.9699	35,903	0.585	150	4.41707E-05	2.30877E-05	2.48409E-09	19.236144	19.2361435	2.69368E-08	0.586	150.292906	4.41276E-05

copy an entire row from above and insert copied cells above this line
to evaluate various loading rates and numbers of subunits

Water Table Rise on Side Slope

Uses Subunit Geometry and Material Properties from Zmax Table

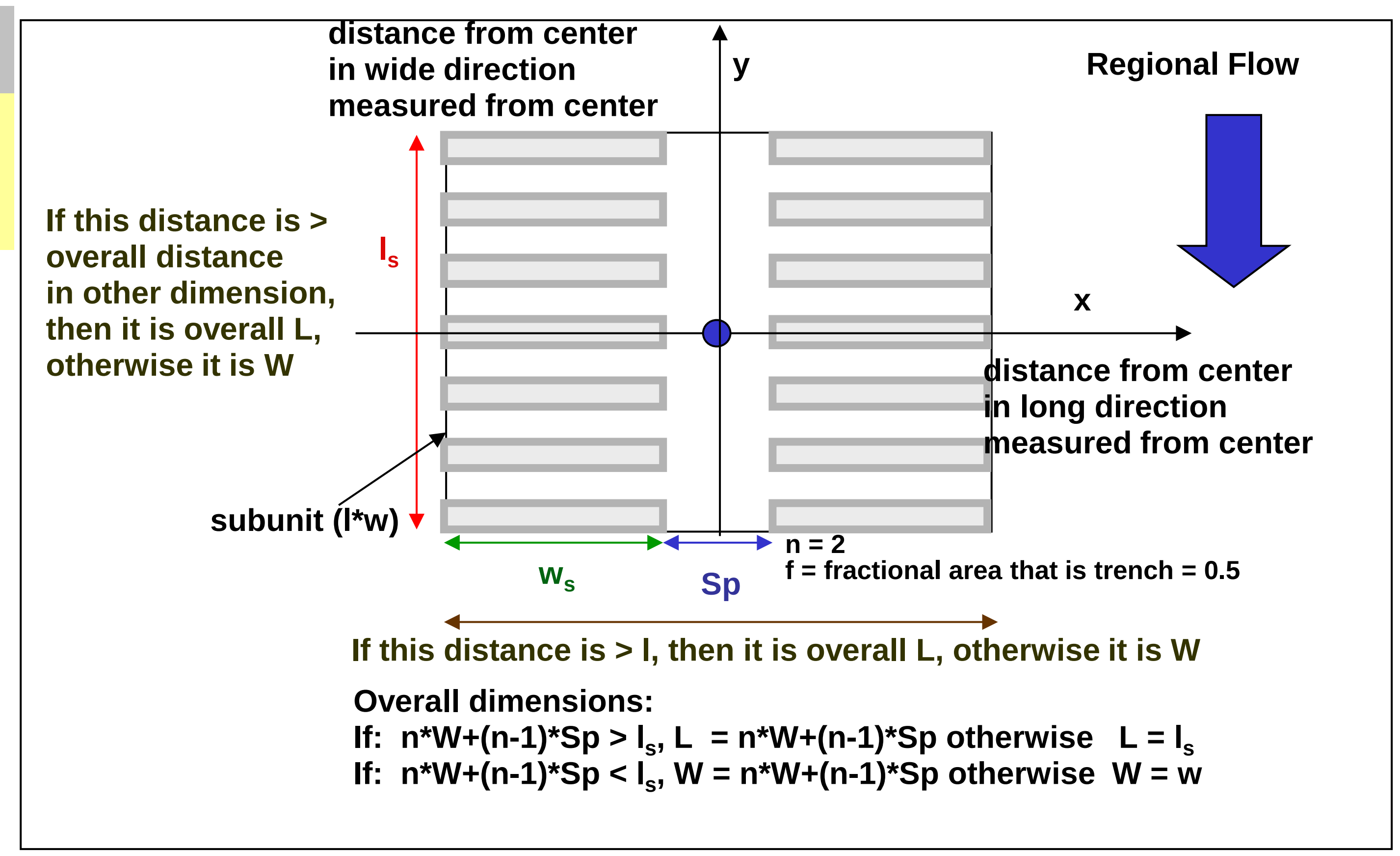
Number of subunits, n	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q l/day	Zsx 12 iterations	Distance from Center of Drain Field in Long Dimension (x in figure)	Distance from Center of Drain Field in Wide Dimension (y in figure)	Initial Saturated Thickness	alpha1	alpha2	beta1	beta2	a2+b2	W part1	W(a2+b2)
	ft	ft	ft/day	ft/day	ft/day	gallons/day	ft	ft	ft	ft					NOTE: if a2+b2>0.04, solution is inaccu		
1	39.22	20.5	5.9699	5.9699	5.9699	35902.85564	0.585			150	4.41707E-05	4.417E-05	2.30877E-05	2.30877E-05	2.48E-09	19.2361435	19.2361435
1	39.22	20.5	5.9699	5.9699	5.9699	35902.85564	0.585			150	4.41707E-05	4.417E-05	2.30877E-05	2.30877E-05	2.48E-09	19.2361435	19.2361435
1	39.22	20.5	5.9699	5.9699	5.9699	35902.85564	0.585			150	4.41707E-05	4.417E-05	2.30877E-05	2.30877E-05	2.48E-09	19.2361435	19.2361435
1	39.22	20.5	5.9699	5.9699	5.9699	35902.85564	0.585			150	4.41707E-05	4.417E-05	2.30877E-05	2.30877E-05	2.48E-09	19.2361435	19.2361435

INFILTRATION BASIN

Water Table Mounding calculated based on Hantush 1967, WRR

Enter data in green cells as per their yellow labels, other values will be computed from those entries.

Results are highlighted in pink.



Zmax Beneath Center of Entire Drain Field (L*W)

Meters and Days	Length of Drain Field Subunit	Width of Drain Field Subunit		Separation between Drain Field Subunits	Fraction of Drain Field Subunit that is Trench Area	Horizontal Hydraulic Conductivity	Specific Yield use 0.001 to approximate steady state at 10 years	time use 10 years to approximate steady state
	l_s	w_s		Sp	f	Kh	Sy	time
	ft	ft		ft		ft/days	none	days
	370	30			1	90	0.001	3650

Number of subunits, n	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q	Zmax 12 iterations	Initial Saturated Thickness	alpha	beta	a2+b2	W part1	W(a2+b2)	S*	z1	hiter	alpha
	ft	ft	ft/day	ft/day	ft/day	gallons/day	ft	ft									
1	370	30	11.4746	11.4746	11.4746	952,712	11.767	150	0.000416705	3.37869E-05	1.74784E-07	14.982498	14.98249795	3.02304E-07	12.168	156.0838299	0.000408503
1	370	30	11.4746	11.4746	11.4746	952,712	11.767	150	0.000416705	3.37869E-05	1.74784E-07	14.982498	14.98249795	3.02304E-07	12.168	156.0838299	0.000408503
1	370	30	11.4746	11.4746	11.4746	952,712	11.767	150	0.000416705	3.37869E-05	1.74784E-07	14.982498	14.98249795	3.02304E-07	12.168	156.0838299	0.000408503
1	370	30	11.4746	11.4746	11.4746	952,712	11.767	150	0.000416705	3.37869E-05	1.74784E-07	14.982498	14.98249795	3.02304E-07	12.168	156.0838299	0.000408503

NOTE: if a2+b2>0.04, solution is inaccurate

copy an entire row from above and insert copied cells above this line
to evaluate various loading rates and numbers of subunits

Water Table Rise on Side Slope

Uses Subunit Geometry and Material Properties from Zmax Table

Number of subunits, n	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q l/day	Zsx 12 iterations	Distance from Center of Drain Field in Long Dimension (x in figure)	Distance from Center of Drain Field in Wide Dimension (y in figure)	Initial Saturated Thickness	alpha1	alpha2	beta1	beta2	a2+b2	W part1	W(a2+b2)
	ft	ft	ft/day	ft/day	ft/day	gallons/day	ft	ft	ft	ft							
1	370	30	11.4746	11.4746	11.4746	952711.6532	11.767			150	0.000416705	0.0004167	3.37869E-05	3.37869E-05	1.75E-07	14.98249795	14.98249795
1	370	30	11.4746	11.4746	11.4746	952711.6532	11.767			150	0.000416705	0.0004167	3.37869E-05	3.37869E-05	1.75E-07	14.98249795	14.98249795
1	370	30	11.4746	11.4746	11.4746	952711.6532	11.767			150	0.000416705	0.0004167	3.37869E-05	3.37869E-05	1.75E-07	14.98249795	14.98249795
1	370	30	11.4746	11.4746	11.4746	952711.6532	11.767			150	0.000416705	0.0004167	3.37869E-05	3.37869E-05	1.75E-07	14.98249795	14.98249795

NOTE: if a2+b2>0.04, solution is inaccu