DORSET DRIVE
SUBDIVISION OFF
ROUTE 39
HARWICH, MA

STORM WATER REPORT

FOR COMPLIANCE WITH THE MASSACHUSETTS STORMWATER POLICY

February 1, 2023
Revised March 21, 2023
Revised April 6, 2023

PREPARED FOR

EASTWARD HOMES BUSINESS TRUST

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Background

Dorset is a proposed residential subdivision comprised of 3 lots situated on 8.5 acres of land in East Harwich, MA.

Untreated stormwater generated within the Dorset Drive subdivision has the potential to impact a source of municipal drinking water. No known wetland resource areas are within the immediate area. Since the project lies within an area of contribution to municipal wells and has rapid infiltration soils, stormwater controls that meet the standards of the Massachusetts Stormwater Policy shall are proposed.

Stormwater generated on the site would be discharged to an area considered a "Sensitive Area" pursuant to the Massachusetts Stormwater Policy.

The following report documents compliance with the Massachusetts Stormwater Policy and follows the procedures outlined in the Massachusetts Stormwater Handbook, Volume 3, Chapter 1; Documenting Compliance.

LID Measures

LID credits are being requested.

Credit 1. Environmentally Sensitive Development

In order to be eligible for this Credit, a residential project is required to have less than 1 dwelling per acre. All of the lots are greater than 1 acre in size.

Credit 2. Rooftop Runoff Directed to Qualifying Pervious Area

There may be opportunities to direct roof runoff to Qualifying Pervious Areas for all of the lots. The existing landform is generally shallower in slope than 5%. Although no development plans for individuals lots have been prepared at this time, it is recommended that the project be conditioned that individual site plans for the lots depict roof runoff being directed to Qualifying Pervious Areas.

Credit 3. Roadway, Driveway or Parking Lot Runoff Directed to Qualifying Pervious Area.

The roadway cannot be directed towards a Qualifying Pervious Area. The Subdivision Rules and Regulations require that stormwater runoff be directed to subsurface infiltration structures.

Standard 1 No New Untreated Discharges

No new untreated discharges are proposed.

All storm water generated from new impervious surfaces shall be directed towards new stormwater BMPs.

Standard 2 Peak Rate Attenuation

Existing stormwater runoff generated on the site generally sheet flows down to the southwest corner of the property at a natural depression.

The area is predominantly second and third growth forest land with a healthy canopy and understory. For the HydroCad™ analysis of predevelopment, a runoff coefficient of 30 has been used.

The predevelopment site consists of one discharge point within the area to be developed, being the southwest corner of the property. No distinct channels were observed to break the site into smaller watersheds.

The attached predevelopment HydroCad™ output depicts that negligible runoff occurs from the 2 yr. storm event and a very small runoff from the 25 yr. storm event. Runoff can be expected from the 100 year storm event. Since no runoff is directed to a coastal embayment, post construction on-site controls shall be required to attenuate the 100 year storm event.

PREDEVELOPMENT HydroCad™ RESULTS

Drainage Area	2 Yr. Storm (cfs)	25 Yr. Storm (cfs)	100 Yr. Storm (cfs)
	0.00	0.03	0.31

Pursuant to the Town of Harwich Subdivision Rules and Regulations, it is required that the 25 yr. storm event be captured and infiltrated on site.

The proposed roadway has been divided up into two (2) post development drainage areas and a drainage area that includes the driveway for Lot 3. Runoff from each drainage area within the roadway shall be directed to standard deep sump catch basins and then to subsurface infiltration basins (leaching catch basins). The following is summation of the HydroCad™ outputs for each drainage area prior to routing to infiltration BMPs.

POSTDEVELOPMENT TR55 RESULTS

Drainage Area	2 Yr. Storm (cfs)	25 Yr. Storm (cfs)	100 Yr. Storm (cfs)
1	0.15	0.66	1.19
2	0.44	1.47	2.49
3	0.08	0.51	0.99

Design Assumptions

Deep observation test pits were not performed on the subject site. On site sewage disposal system plans for abutting properties were obtained and deep observation hole logs for each design were reviewed. Soils were found to be medium to coarse sand identified in the Barnstable County Soil Survey as Carver Series. The depths of pervious material were found to be consistent throughout the area.

For design purposes, the maximum rate of 8.27 inches per hour as required by the Stormwater Handbook shall be used.

The Stormwater Handbook also requires that only bottom area be considered. This along with the 8.27 inches per hour infiltration rate produces an extremely conservative infiltration design for the 25 yr. storm event.

The infiltration basins consist of standard 6 ft. diameter, 1,000 gallon precast concrete leach pits. Two configurations have been selected depending on the size of the areas of contribution and available areas for disposal. The configurations are all based upon a 6 ft. diameter structure with ¾" to 1 ½" double washed stone placed evenly around the structure. 2 to 4 precast structures have been selected for each configuration.

The corresponding effective capacities are as follows:

No. of Pits (Depth)	Bottom Area (sf.)	Sidewall Area (sf.)	Volume (cf)*
2 (6 ft.)	294	384	784
5 (6 ft.)	714	742	1,916

*A void ratio of 0.35 is presumed for the placed stone aggregate.

Town of Harwich Zoning Regulations limit the amount of site coverage to 25% of the lot. Since the lots are approximately 44,000 sf. in size, each has the potential to have up to 11,000 sf. of impervious surfaces.

For design purposes, only the residential driveways and the roadway shall be included in the calculations of impervious area within each roadway drainage area. Up to 1,500 sf. of driveway per building lot is included in the design. In addition, it is presumed that each lot will create 10,000 sf. of lawn and all remaining areas that do not include building and hardscape will remain natural woods or more substantial landscape cover.

It is a condition of this design that when each lot is subsequently developed, the homeowner/developer shall be required to provide additional stormwater controls for the dwelling and exterior hardscape features such as patios, swimming pools and decks. It is recommended that the Planning Board adopt such conditions as necessary to ensure future compliance.

Drainage Calculations

HydroCad™ stormwater modeling software was used for determining depth of runoff, peak rates of runoff, infiltration sizing and detention area design for each drainage area.

The Planning Board Rules and Regulations require that the 25-year, 24-hour storm event be infiltrated.

Appendix 1 details the drainage calculations for each drainage area. The results show that stormwater controls for each drainage area have the capacity to infiltrate the 25 yr – 24 hr. storm event.

Rainfall events greater than the 25 yr. storm event will fill the infiltration systems beyond capacity and the excess flow will discharge upwards through the infiltration pits and be

disbursed onto a man made low area around each infiltration area. The low areas shall have sufficient area to contain up to a 100 yr. storm event.

Overflow from each system will pond within low areas created at each infiltration point. The areas have been sized to contain the entire excess flow from the 100 yr. storm event. The total volume of runoff is expected to flood the depression to depths not to exceed 1.0 ft. The bottom of the detention areas is assumed to be impervious. The stored overflow will infiltrate through the subsurface structures using a frame and grate installed on one of the infiltration pits.

Conclusion

Each of the post development drainage areas that receive runoff from disturbed areas have been designed to infiltrate up to a 25 yr. storm event. No increase in runoff shall occur from the 2 yr. or 25 yr. storm event.

Excess runoff from the 100 yr. storm event shall be contained within man-made detention areas adjacent to Dorset Drive.

Standard 3 Recharge

Runoff from all new impervious surfaces is directed to stormwater BMPs that have been designed to capture and infiltrate a 25 year storm event which is far greater than the amount required by Standard 3.

Drainage Area	25 Yr Runoff Volume (cf)	Total Impervious Area (sf)	Water Quality/Recharge Volume (cf)
1	1,745	4,490	375
2	3,965	10,190	850
3	1,180	3,005	250

Conclusion

Each of the infiltration structures have been designed to capture and infiltrate 1 in. of runoff from impervious areas.

All runoff is contained within the site.

Standard 4 Water Quality

Long Term Pollution Prevention Plan

A Long Term Pollution Prevention Plan has been prepared for this development. A homeowner's association shall be created. The association shall be responsible for implementation of the Long Term Pollution Prevention Plan.

Required Water Quality Volume

As stated above, the stormwater BMPs have been designed to capture and infiltrate a 25 year storm event which is greater that the Water Quality Volume required by Standard 4

TSS and Phosphorus Removal

No discharge of stormwater is proposed to any surface waters or wetland resource areas. All runoff is directed to infiltration basins that have been designed to contain up to and including the 24 hour – 100 year storm event.

Deep sump catch basins shall be used as a pretreatment BMP prior to routing of stormwater to leaching basins and then ultimately to groundwater.

Pursuant to Appendix B of the New Hampshire Stormwater Manual states that the anticipated TSS removal for Leaching Dry Wells (basins) is 90% and Phosphorus removal is estimated at 60%.

The Minnesota Stormwater Manual presumes that if all stormwater is infiltrated a 100% reduction in Phosphorus is provided.

Portions of both documents are provided in Appendix II.

Standard 5

Land Uses with Higher Potential Pollutant Loads

The project is not considered a Land Use with a Higher Potential Pollutant Load

Standard 6

Critical Areas

The project is located within rapid infiltration rate soils and DEP approved zones of contribution to municipal wells. Therefore, the area is considered a Critical Area.

Standard 7

Redevelopment

This is not considered a Redevelopment Project.

Standard 8

Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Stormwater Pollution Prevention Plan (SWPPP) shall be prepared for this project by the project owner and construction general contractor. An Erosion Control Plan has been prepared for this project and are part of the construction documents.

Standard 9

Post Construction Stormwater Controls Operation & Maintenance Plan

A Post Construction Stormwater Controls Operation & Maintenance Plan has been prepared for this project.

Standard 10

Illicit Discharges

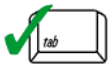
Statement: No materials other than stormwater shall be discharged to the stormwater controls. Homeowners shall be made aware of the existence of the stormwater BMPs through a Homeowner's Association and restrictive Covenant that prohibits any activity that could damage the treatment BMPs or the environment including but not limited to disposal of pesticides, paints and solvents, motor oil and yard waste.

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

David A Clark, PE

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

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

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

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

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

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

Stormwater Operation and Maintenance Plan

Turtle Run Subdivision, East Harwich, MA

Project Information

Site

Dorset Drive Subdivision
Off Route 39
East Harwich, MA 02645

Site Owner

Eastward Companies Business Trust
935 Main Street
Chatham, MA 02633
508 945 5291

Site Supervisor

President Dorset Drive Homeowners Association
(To Be Determined)
Name: _____
Telephone: _____
Cell phone: _____
Email: _____

Roadway Owner – Members of the Dorset Drive Homeowners Association

A common control entity shall be created for roadway maintenance in the form of a homeowner's association. Final documents creating the association shall be forwarded to the Harwich Planning Board following upon creation of the entity and recording at the Registry of Deeds.

Description of Stormwater Maintenance Measures

The following Operation and Maintenance (O&M) program is proposed to ensure the continued effectiveness of the stormwater management system.

Catch Basins

- All catch basins shall be inspected and cleaned a minimum of at least two times per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary.
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

Drainage Manholes

- All manholes shall be inspected and cleaned a minimum of at least four times per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the manhole and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary.

Subsurface Infiltration System

- The subsurface infiltration systems will be inspected at least once each year by removing the manhole covers and determining the thickness of sediment that has accumulated in the bottom. If sediment is more than three inches deep, it must be suspended via flushing with clean water and removed using a vacuum truck.
- System will be observed after rainfalls to see if it is properly draining and functioning.

Roof Drain Leaders

- Perform routine roof inspections quarterly.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.
- Clean inlets draining to the subsurface bed twice per year as necessary.

Construction
Storm Water Pollution
Prevention Plan
for
Eastward Homes Business Trust
Tax Map 98 Parcels B1-1, B1-2, B1-3
Dorset Drive
East Harwich, MA 02645

GENERAL CONTRACTOR
EASTWARD HOMES BUSINESS TRUST
155 CROWELL ROAD
CHATHAM, MA 02633

Date
February 3, 2023

Prepared By: Clark Engineering LLC
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1.0 INTRODUCTION

1.1 Background

In 1972, Congress passed the Federal Water Pollution Control Act (FWPCA), also known as the Clean Water Act (CWA), to restore and maintain the quality of the nation's waterways. The ultimate goal was to make sure that rivers and streams were fishable, and drinkable. In 1987, the Water Quality Act (WQA) added provisions to the CWA that allowed the EPA to govern storm water discharges from construction sites. In 1998, EPA published the final notice for General Permits for Storm Water Discharges from Construction Activities Disturbing 1 Acre or Greater (63 Federal Register 7898, February 14, 1998). The general permit includes provisions for development of a Storm Water Pollution Prevention Plan (SWPPP) to maximize the potential benefits of pollution prevention and sediment and erosion control measures at construction sites.

Development, implementation, and maintenance of the SWPPP will provide Eastward Homes Business Trust (general contractor) with the framework for reducing soil erosion and minimizing pollutants in storm water during construction of __Dorset Drive, East Harwich, MA (the Facility). The SWPPP will:

Define the characteristics of the site and the type of construction which will be occurring;

Describe the site plan for the Facility to be constructed;

Describe the practices that will be implemented to control erosion and the release of pollutants in storm water;

Create an implementation schedule to ensure that the practices described in this SWPPP are in fact implemented and to evaluate the plan's effectiveness in reducing erosion, sediment, and pollutant levels in storm water discharged from the site; and

Describe the final stabilization/termination design to minimize erosion and prevent storm water impacts after construction is complete.

1.2 SWPPP Content

This SWPPP includes the following:

- Identification of the SWPPP coordinator with a description of this person's duties;
- Identification of the storm water pollution prevention team that will assist in implementation of the SWPPP during construction.
- Description of the existing site conditions including existing land use for the site (i.e., wooded areas, open grassed areas, pavement, buildings, etc.), soil types at the site, as well as the location of surface waters which are located on or next to the site (wetlands, streams, rivers, lakes, ponds, etc.);
- Identification of the body or bodies of water which will receive runoff from the construction site, including the ultimate body of water that receives the storm water;
- Identification of drainage areas and potential storm water contaminants;
- Description of storm water management controls and various Best Management Practices (BMPs) necessary to reduce erosion, sediment and pollutants in storm water discharge;
- Description of the Facility monitoring plan and how controls will be coordinated with construction activities, and
- Description of the implementation schedule and provisions for amendment of the plan.

2.0 SWPPP COORDINATOR AND DUTIES

The construction site SWPPP coordinator for the facility is Donald Poyant (phone number (508) 945-2300 with Eastward Homes Business Trust (general contractor). Mr. Poyant's duties include the following:

- Implement the SWPPP plan with the aid of the SWPPP team;
- Oversee maintenance practices identified as BMPs in the SWPPP;
- Implement and oversee employee training;
- Contact or provide for inspection and monitoring activities;
- Identify other potential pollutant sources and make sure they are added to the plan;
- Identify any deficiencies in the SWPPP and make sure they are corrected; and
- Ensure that any changes in construction plans are addressed in the SWPPP.

To aid in the implementation of the SWPPP plan, the members of the SWPPP team are John Marsh and Bryan Barrows. John Marsh will ensure that all housekeeping and monitoring procedures are implemented while Bryan Barrows will ensure the integrity of the structural BMPs.

3.0 FACILITY DESCRIPTION

3.1 Site Location

The construction site is located off Orleans Road, East Harwich, Massachusetts. Figure 1 is an Assessor's Map showing the location of the site. The facility is an 8.5 acre parcel located on Map 98, shown as Parcels B1-1, B1-2 & B1-3. The facility is bound to the north by other residential properties, to the south by residential properties, to the east by Church Street and to the west by Orleans Road.

3.2 Construction Type

Eastward Homes Business Trust are planning to build a 600 ft. long paved roadway to serve as access to 3 single family dwellings. The facility will consist of a 14 ft. wide asphalt road way. Three stormwater control systems have been designed to capture runoff from the roadway and the driveways of the 3 residential dwellings. The systems shall have the capacity to contain and infiltrate a 100 year - 24 hour storm event.

Eastward Homes Business Trust and their various subcontractors will be on-site from approximately 7:00 AM until 6:00 PM, six days per week.

Clearing, grading, construction of the stormwater controls, roadway and driveway paving, and site landscape restoration is expected to be complete within 12 months following ground breaking.

3.3 Existing Site Conditions

The 8.5 acre property is currently undeveloped and is heavily wooded with a mix of pitch pine and oak. The property slopes from the rear towards Orleans Road at about a 5% grade.

No wetlands resource areas exist on or adjacent to the site. The site is not located within a state designated area that is mapped habitat for rare species. The site is within the mapped zone of contribution to a municipal groundwater supply well.

Stormwater runoff generated on the site flows unabated into a low spot near the southwest corner of the property.

3.4 **Site Plan**

Figure 2 is a site map of the existing conditions with the proposed subdivision and property boundaries superimposed.

Figure 3 is a site map showing property boundaries, the proposed location of the roadway, driveway and stormwater controls and the proposed limit of clearing.

Before any site work begins, a siltation fence shall be installed along the southerly property line and along Orleans Road. A sediment control sock shall be installed within the existing municipal stormwater catchbasin located on Orleans Road.

Work shall start with the clearing and grubbing of the construction entrance. All vegetative cover and top soil shall be removed. The construction entrance shall then be installed in accordance with the Erosion Control Plan. The temporary construction entrance (Figure 4) shall consist of 4 in. to 6 in. crushed stone. The stone shall serve as a sediment trap to reduce the "tracking" of soils onto Orleans Road.

Work shall then proceed to the clearing and grubbing of the remainder of the roadway. A 15,000 sf. portion of Lot 1 shall also be cleared and grubbed to serve as a stockpiling area for construction material and top soil to be used for site restoration.

The roadway shall then be brought to rough finish subgrade. Upon completion of the initial grading. permanent stormwater controls shall be installed. The inlets to all drainage structures shall be protected with sediment control BMPs as shown on the Erosion Control Plan.

Figures 5 and 6 depicts the locations of the two (2) permanent stormwater BMPs and their drainage areas.

A description of each drainage area is provided in Table 1.

TABLE 1

STORMWATER BMPs

System 1	1-4 ft. I.D. Precast deep sump manhole (catchbasin). 2- 6ft. I.D. 6 ft. Deep Precast leaching catchbasins w/ 4 ft. of 1 3/4 in. stone.
System 2	3-4 ft. I.D. Precast deep sump manhole (catchbasin). 5- 6ft. I.D. 6 ft. Deep Precast leaching catchbasins w/ 4 ft. of 1 3/4 in. stone.
System 3	1-4 ft. I.D. Precast deep sump manhole (catchbasin). 2- 6ft. I.D. 6 ft. Deep Precast leaching catchbasins w/ 4 ft. of 1 3/4 in. stone.

Upon completion of the stormwater controls work shall commence on the installation of public and private utilities. Municipal water and sewer, electrical, communications and natural gas shall be installed as shown on the Construction Drawings.

Work shall then proceed to final grading of the roadway. Two courses of hot mix asphalt shall be installed to a total thickness of 4".

Upon completion of all roadway construction, the site will then be cleaned of all construction material in preparation of final side slope stabilization. Side slopes shall be covered with a minimum of 6 in. of good quality loam and then hydroseeded with a native grass mixture.

The project will be deemed completed when grass cover has been established on all disturbed areas.

4 IDENTIFICATION OF POTENTIAL STORM WATER CONTAMINANTS

The purpose of this section is to identify pollutants that could impact storm water during construction of the facility.

4.1 Significant Material Inventory

Pollutants that result from clearing, grading, excavation and building materials and have the potential to be present in storm water runoff are listed in Table 2. This table includes information regarding material type, chemical and physical description, and the specific regulated storm water pollutants associated with each material.

TABLE 2

POTENTIAL STORMWATER POLLUTANTS

Material	Description
Earth Stock Pile	TSS

4.2 **Potential Areas for Storm Water Contamination**

The following potential areas of storm water contamination were identified and evaluated;

Cleared and graded areas;
Construction site entrance; and
Asphalt paving operations.

Table 3 presents site specific information regarding storm water pollution potential from each of these areas.

TABLE 3

POTENTIAL AREAS for STORMWATER CONTAMINATION

Area	Description
Cleared and graded areas	At all times cleared and graded areas shall be pitched towards the temporary sediment basins. If cleared areas are to be exposed for more than 4 weeks, those areas shall be either loamed and seeded or covered with an erosion control geo-textile.
Construction site entrance	A temporary construction entrance shall be installed prior to site clearing and re-grading. The entrance shall remain in place and maintained in good condition until such time as the base course of asphalt is installed.
Asphalt paving operations	The asphalt sub-contractor shall provide a work protocol to ensure that potentially hazardous materials used during the paving operation are safely handled and stored so as not to create a source of pollution.

4.3 A Summary of Available Storm Water Sampling Data

No storm water sampling data is available for the site.

5 STORM WATER MANAGEMENT CONTROLS

The purpose of this section is to identify the types of temporary and permanent erosion and sediment controls that will be used during construction activities. The controls will provide soil stabilization for disturbed areas and structural controls to divert runoff and remove sediment. This section will also address control of other potential storm water pollutant sources such as construction materials (concrete dust, solvents, and asphalt), waste disposal, control of vehicle traffic, and sanitary waste disposal.

5.1 Temporary and Permanent Erosion Control Practices

Best Management Procedures (BMPs) have been developed and the location of these BMPs are shown in Figures 3 & 4. A number of the BMPs included in this plan have been developed to serve as post-construction storm water controls.

Site-Wide Control Measures

To prevent soil from washing onto Orleans Road, the following BMPs will be implemented:

- A silt fence barrier will be placed along the perimeter of the area to be cleared and graded before any clearing or grading takes place. In addition, straw wattles shall be added along the southerly property line as a backup to prevent stormwater from migrating to abutting properties.
- Two (2) sedimentation basins will be constructed near along the proposed roadway before construction begins. The sedimentation basins, with an approximate depth of two feet and a combined surface area of 3,000 sf., will be constructed to a volume of 5,000 cubic feet and are expected to remove 80 percent of suspended solids from the site's storm water runoff. The sedimentation basin has been designed to contain runoff from the 2- year/24-hour storms. The sedimentation basin will remain as a temporary storm water detention structure until such time as the entire site has been stabilized.
- All cleared and graded soils will be sloped to the sedimentation basin.
- Within 28 days after clearing and grading, disturbed areas shall be stabilized by loam and seeding with an erosion control grass mixture.
- Top soil stock piles will be stabilized with temporary seed and mulch no later than fourteen days from the last construction activities in that area.
- Areas of the site which are to be paved will be temporarily stabilized by applying the gravel sub-base until asphalt is applied.

- Once construction of the roadway is nearly complete, vegetated side slopes will remain as a permanent storm water control measure until such time as final landscaping is complete.

5.2 Construction Practices to Minimize Storm Water Contamination

All waste materials will be collected and stored in a securely lidded metal dumpster. All trash and construction debris from the site shall be deposited in the dumpster. The dumpster will be emptied on an as needed basis and all material shall be disposed of in a licensed landfill. No construction materials will be buried on-site. All personnel will be instructed regarding the correct procedure for waste disposal. All sanitary waste will be collected from the portable units a minimum of two times per week. Good housekeeping and spill control practices will be followed during construction to minimize storm water contamination from petroleum products, fertilizers and concrete. Good housekeeping practices for each drainage area are listed below.

Drainage Areas 1 & 2

To prevent storm water contamination from the drainage areas, the following BMPs will be implemented:

- All vehicles on-site shall be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage.
- No petroleum products will be stored on-site. Fuel for the refueling of excavation equipment shall be brought on site when needed.
- Spill kits shall be on hand during all fueling operations.

  No maintenance other than emergency repairs shall occur on-site.
- Asphalt substances used onsite will be applied according to the manufacturer's recommendation.
- Sanitary waste will be collected from portable units a minimum of two times a week to avoid overfilling.
- A covered dumpster will be used for all waste materials.
- All paint containers and curing compounds will be tightly sealed and stored undercover when not required for use. Excess paint will not be discharged to the storm system, but will be properly disposed according to the manufacturer's instructions.
- Materials and equipment necessary for spill cleanup will be kept in a temporary material storage container onsite. Equipment will include, but not be limited to, brooms, dust pans, mops, gloves, goggles, kitty litter, sand, saw dust and plastic and metal trash containers.
- All spills will be cleaned immediately upon discovery. Spills large enough to reach the storm system will be reported to the Harwich Fire Department.
- Concrete trucks shall discharge surplus concrete or drum wash water on the site only in designated areas. Such areas shall be an excavated basin a minimum of 2 ft. in depth and shall be surrounded by a siltation fence.

- Drainage swales shall be constructed to collect and deliver storm water to the sedimentation basin.
- When testing/clearing of water supply lines, the discharge from the tested pipe will be collected and conveyed to the sedimentation basin.
- Dump trucks hauling material from the construction site will be covered with a tarpaulin.

5.3 Coordination of BMPs with Construction Activities

Structural BMPs will be coordinated with construction activities so the BMP is in place before construction begins. The following BMPs will be coordinated with construction activities:

The temporary perimeter controls (silt fences and straw wattles) will be installed before any clearing and grading begins.

Clearing and grading will not occur in any area until it is necessary for construction to proceed.

The stabilized construction site entrance and sedimentation basin will be constructed before clearing and grading begins.

Once construction activity ceases permanently in an area, that area will be stabilized with permanent seed and mulch.

After the entire site is stabilized, the accumulated sediment will be removed from the basin.

The temporary perimeter controls (silt fencing and straw wattles) will not be removed until all construction activities at the site are complete and soils have been stabilized.

5.4 Certification of Compliance with Federal, State and Local Regulations

This SWPPP reflects the United States Environmental Protection Agency and the State of Massachusetts requirements for storm water management and erosion and sediment control, as established in The Massachusetts Stormwater Handbook. There are no other applicable State or Federal requirements for sediment and erosion site plans (or permits), or storm water management site plans (or permits).

6.0 MAINTENANCE/INSPECTION PROCEDURES

6.1 Inspections

Visual inspections of all cleared and graded areas of the construction site will be performed daily and within 24 hours of the end of a storm with rainfall amounts greater than 0.5 inches. The inspection will be conducted by the SWPPP coordinator or his designated storm water team members. The inspection will verify that the structural BMPs described in Section 5 of this SWPPP are in good condition and are minimizing erosion. The inspection will also verify that the procedures used to prevent storm water contamination from construction materials and petroleum products are effective. The following inspection and maintenance practices will be used to maintain erosion and sediment controls:

Built up sediment will be removed from silt fencing when it has reached one-third the height of the fence.

Silt fences will be inspected for depth of sediment, for tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground.

The sediment basin will be inspected for depth of sediment and built up sediment will be removed when it reaches 1 foot in depth.

Temporary and permanent seeding will be inspected for bare spots, washouts, and healthy growth.

The stabilized construction entrance will be inspected for sediment tracked on the road, for clean gravel, and to make sure that all traffic uses the stabilized entrance when leaving the site.

The maintenance inspection report will be made after each inspection. A copy of the report to be completed by the SWPPP coordinator is provided in Appendix A of this SWPPP. Completed forms will be maintained on-site during the entire construction project. Following construction, the completed forms will be retained at the general contractor's office for a minimum of one (1) year. If construction activities or design modifications are made to the site plan which could impact storm water, this SWPPP will be amended appropriately. The amended SWPPP will have a description of the new activities that contribute to the increased pollutant loading and the planned source control activities.

6.2 Employee Training

An employee training program will be developed and implemented to educate employees about the requirements of the SWPPP. This education program will include background on the components and goals of the SWPPP and hands-on training in erosion controls, spill prevention and response, good housekeeping, proper material handling, disposal and control of waste, equipment fueling, and proper storage, washing, and inspection procedures. All employees will be trained prior to their first day on the site.

6.3 Certification

Corporate Certification (Clark Engineering LLC)

I certify under penalty of the law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person(s) who manages the system, pr those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

_____ Date: _____
David A. Clark, P.E.
Clark Engineering LLC

Contractor Certification (Eastward Homes Business Trust)

I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

_____ Date: _____
Name

_____
Title

Contractor Certification (insert *excavation/grading contractor* company name)

I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

_____ Date: _____
Name

_____
Title

Contractor Certification (insert *landscaping contractor* company name)

I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

_____ Date: _____
Name

_____
Title

Appendix C

Description of Stormwater Maintenance Measures

The following Operation and Maintenance (O&M) program is proposed to ensure the continued effectiveness of the stormwater management system.

Catch Basins

- All catch basins shall be inspected and cleaned a minimum of at least two times per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary.
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

Drainage Manholes

- All manholes shall be inspected and cleaned a minimum of at least four times per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the manhole and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary.

Subsurface Infiltration System

- The subsurface infiltration systems will be inspected at least once each year by removing the manhole covers and determining the thickness of sediment that has accumulated in the bottom. If sediment is more than three inches deep, it must be suspended via flushing with clean water and removed using a vacuum truck.
- System will be observed after rainfalls to see if it is properly draining and functioning.

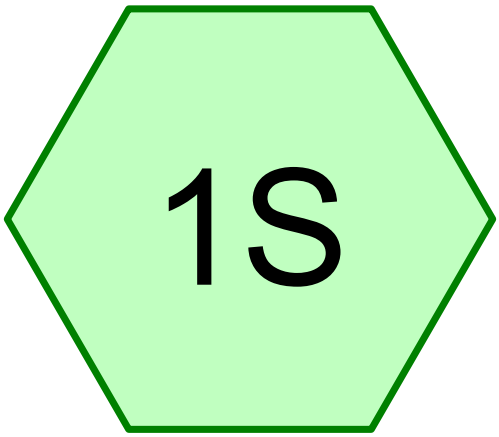
Roof Drain Leaders

- Perform routine roof inspections quarterly.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.
- Clean inlets draining to the subsurface bed twice per year as necessary.

APPENDIX I

DRAINAGE CALCULATIONS

PREDEVELOPMENT DRAINAGE CALCULATIONS



Existing Conditions

Subcat Reach Pond Link

Routing Diagram for Dorset Existing
Prepared by Clark Engineering LLC, Printed 2/1/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	C	Default	24.00	1	3.26	2
2	25-Year	NRCC 24-hr	C	Default	24.00	1	5.88	2
3	100-Year	NRCC 24-hr	C	Default	24.00	1	8.15	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.630	30	Woods, Good, HSG A (1S)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
3.630	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
3.630	0.000	0.000	0.000	0.000	3.630	Woods, Good	1S

Summary for Subcatchment 1S: Existing Conditions

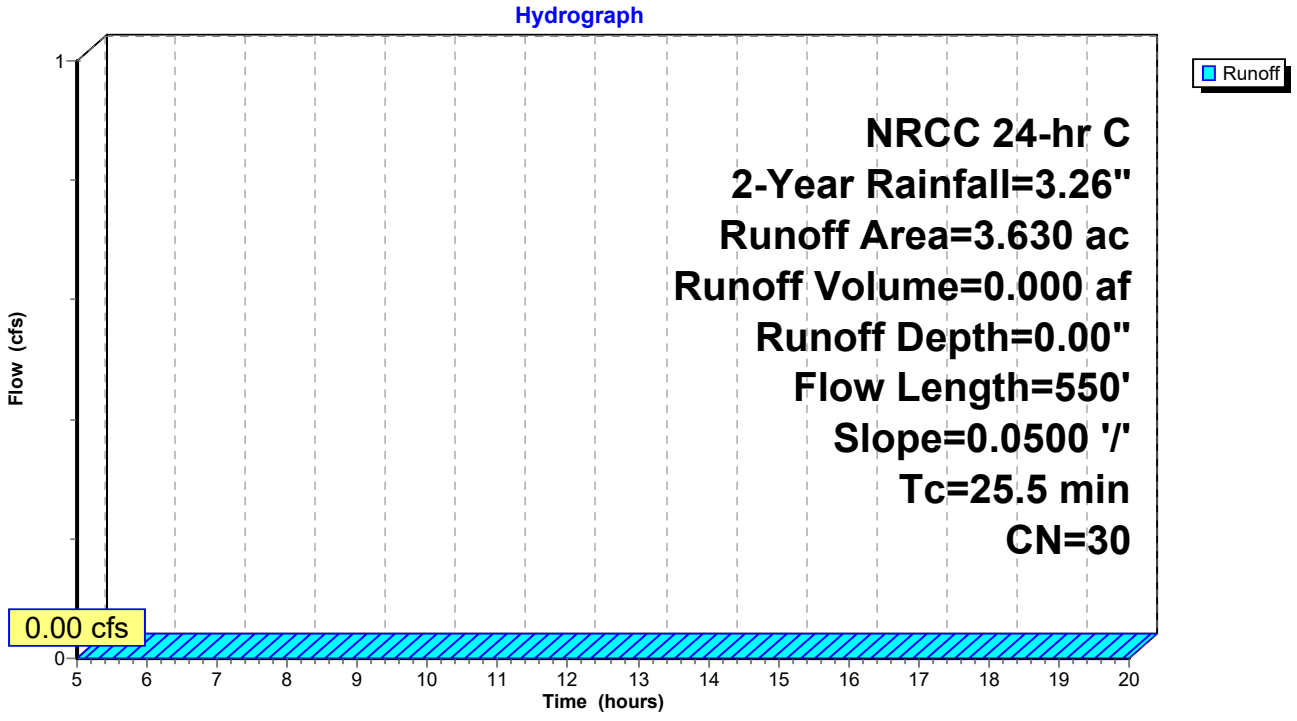
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.26"

Area (ac)	CN	Description
3.630	30	Woods, Good, HSG A
3.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	100	0.0500	0.09		**Sheet Flow, Shet** Woods: Light underbrush n= 0.400 P2= 2.00"
6.7	450	0.0500	1.12		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
25.5	550	Total			

Subcatchment 1S: Existing Conditions



Summary for Subcatchment 1S: Existing Conditions

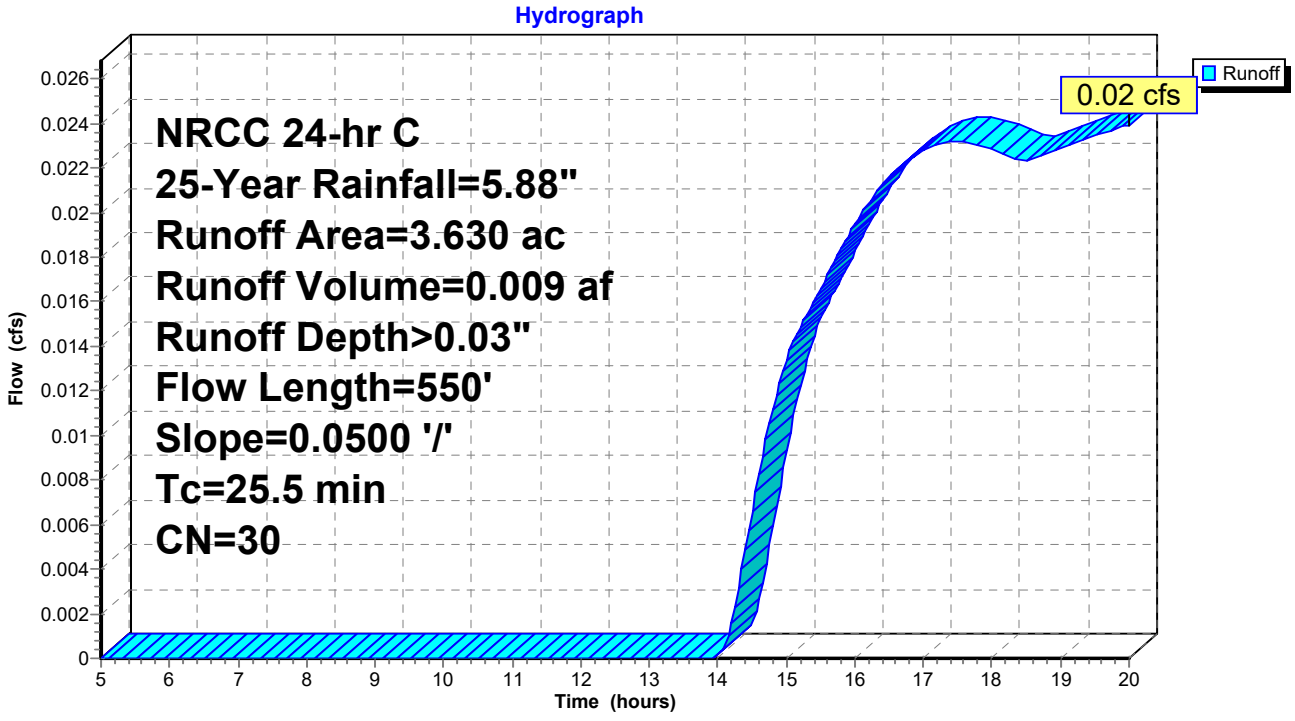
Runoff = 0.02 cfs @ 20.00 hrs, Volume= 0.009 af, Depth> 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=5.88"

Area (ac)	CN	Description
3.630	30	Woods, Good, HSG A
3.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	100	0.0500	0.09		**Sheet Flow, Shet** Woods: Light underbrush n= 0.400 P2= 2.00"
6.7	450	0.0500	1.12		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
25.5	550	Total			

Subcatchment 1S: Existing Conditions



Summary for Subcatchment 1S: Existing Conditions

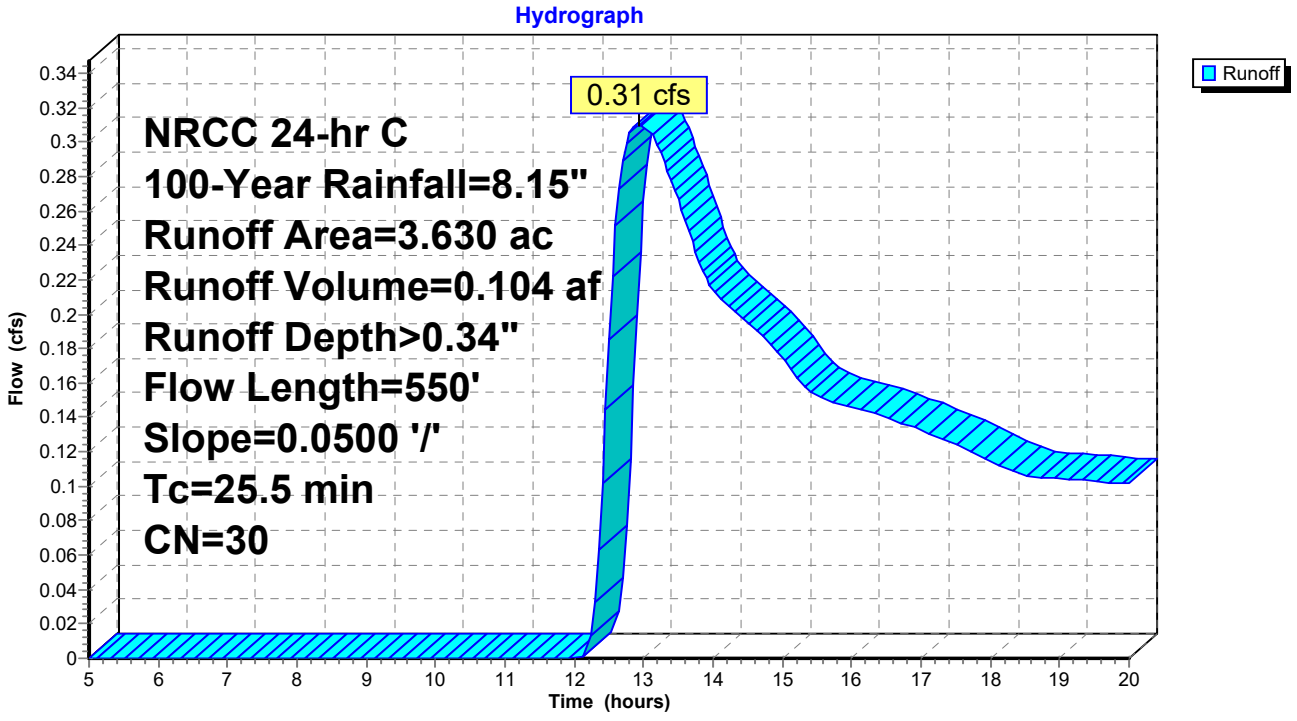
Runoff = 0.31 cfs @ 12.93 hrs, Volume= 0.104 af, Depth> 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.15"

Area (ac)	CN	Description
3.630	30	Woods, Good, HSG A
3.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	100	0.0500	0.09		**Sheet Flow, Shet** Woods: Light underbrush n= 0.400 P2= 2.00"
6.7	450	0.0500	1.12		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
25.5	550	Total			

Subcatchment 1S: Existing Conditions



POSTDEVELOPMENT DRAINAGE CALCULATIONS

DRAINAGE AREA 1

HydroCad™ input variables:

Total area of contribution:	10,900 sf.	0.248 Ac.
Area of pavement w/ no driveways	4,500 sf.	0.103 Ac.
Areas of roadway shoulders, side slopes And undisturbed forest	6,400 sf.	0.145 Ac.

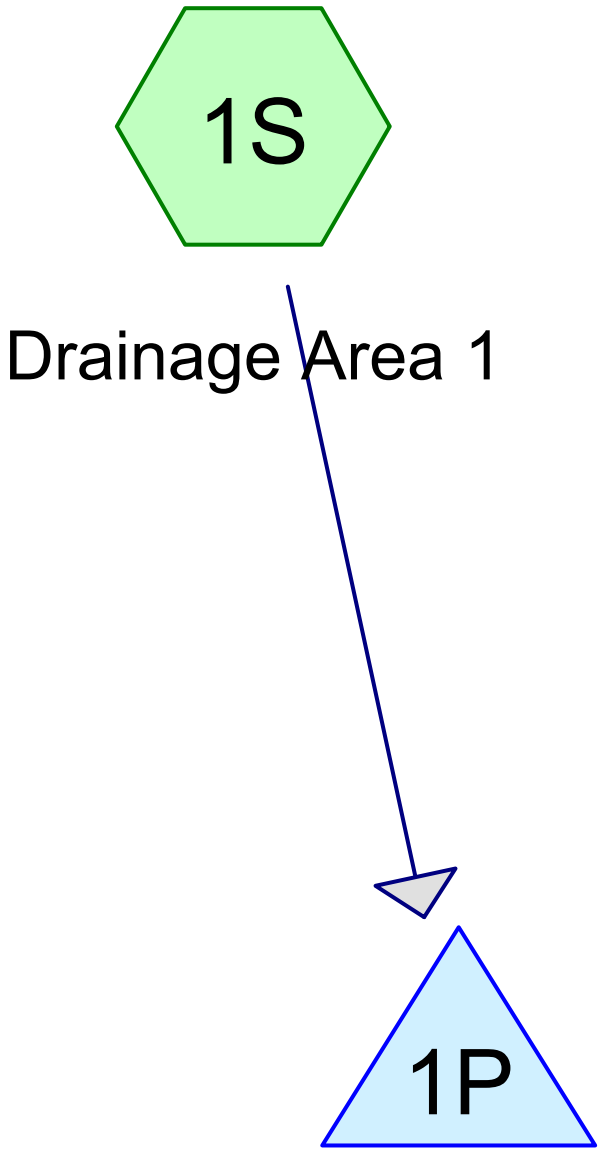
Composite Curve Number 64

Infiltration System:

1 set of **2** - 6ft. x 6 ft. precast pits w/ 4 ft. of stone in trench configuration

Results: HydroCad™

25 Yr. – 24 Hr. Storm	No overflow; Maximum Depth within Infiltration Basin 5.37 ft.; Infiltration Basin dry by end of storm.
100 Yr. – 24 Hr. Storm	Excess discharge occurs. Excess directed to low point on the north side of Dorset Drive. One leaching basin to be fitted with standard frame and grate. Water level drops to frame elevation prior to end of storm.



INFILTRATION BASINS
1

Subcat Reach Pond Link

Routing Diagram for Dorset Drainage Area 1
Prepared by Clark Engineering LLC, Printed 2/1/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	C	Default	24.00	1	3.26	2
2	25-Year	NRCC 24-hr	C	Default	24.00	1	5.88	2
3	100-Year	NRCC 24-hr	C	Default	24.00	1	8.15	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.145	39	>75% Grass cover, Good, HSG A (1S)
0.103	98	Pavement (1S)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.145	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.103	Other	1S

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.145	0.000	0.000	0.000	0.000	0.145	>75% Grass cover, Good	1S
0.000	0.000	0.000	0.000	0.103	0.103	Pavement	1S

Summary for Subcatchment 1S: Drainage Area 1

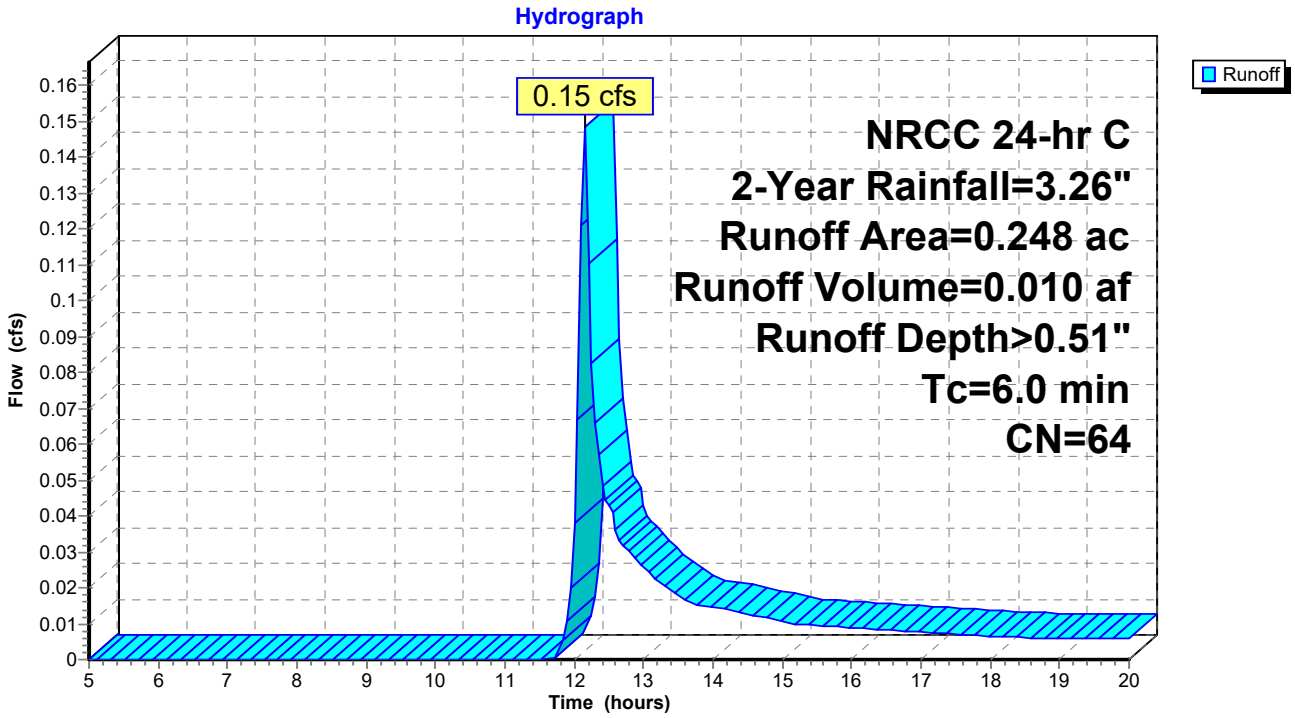
Runoff = 0.15 cfs @ 12.15 hrs, Volume= 0.010 af, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.26"

	Area (ac)	CN	Description
	0.145	39	>75% Grass cover, Good, HSG A
*	0.103	98	Pavement
	0.248	64	Weighted Average
	0.145		58.47% Pervious Area
	0.103		41.53% Impervious Area

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

Subcatchment 1S: Drainage Area 1



Summary for Pond 1P: INFILTRATION BASINS 1

Inflow Area = 0.248 ac, 41.53% Impervious, Inflow Depth > 0.51" for 2-Year event
Inflow = 0.15 cfs @ 12.15 hrs, Volume= 0.010 af
Outflow = 0.06 cfs @ 12.10 hrs, Volume= 0.010 af, Atten= 62%, Lag= 0.0 min
Discarded = 0.06 cfs @ 12.10 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 60.12' @ 12.36 hrs Surf.Area= 0.007 ac Storage= 0.001 af

Plug-Flow detention time= 6.8 min calculated for 0.010 af (99% of inflow)
Center-of-Mass det. time= 5.8 min (855.1 - 849.3)

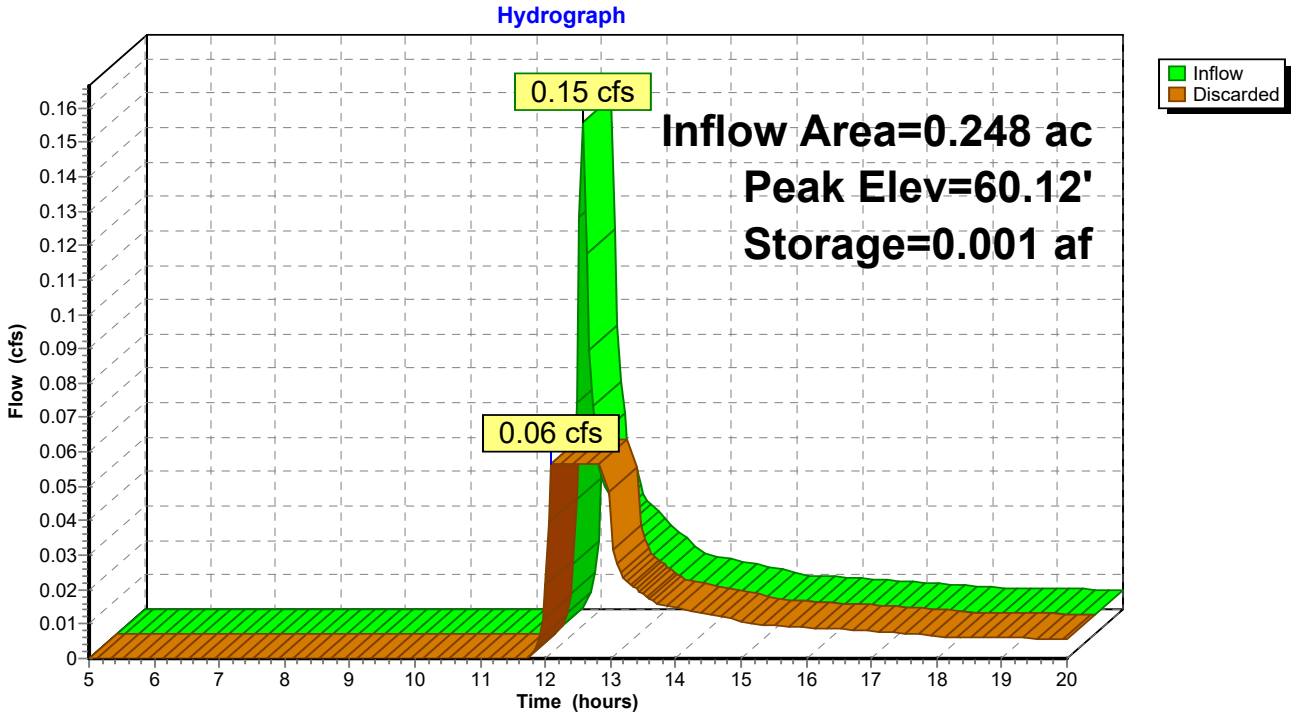
Volume	Invert	Avail.Storage	Storage Description
#1	59.70'	0.010 af	**14.00'W x 21.00'L x 6.00'H Prismatoid** 0.040 af Overall - 0.011 af Embedded = 0.030 af x 35.0% Voids
#2	59.70'	0.008 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 0.011 af Overall - 6.0" Wall Thickness = 0.008 af
#3	65.70'	0.000 af	**1.00'D x 1.50'H Vertical Cone/Cylinder**
#4	67.20'	0.091 af	**Custom Stage Data (Prismatic)** Listed below -Impervious
		0.110 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
67.20	0.001	0.000	0.000
68.00	0.046	0.019	0.019
69.00	0.099	0.072	0.091

Device	Routing	Invert	Outlet Devices
#1	Discarded	59.70'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 12.10 hrs HW=59.83' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Pond 1P: INFILTRATION BASINS 1



Summary for Subcatchment 1S: Drainage Area 1

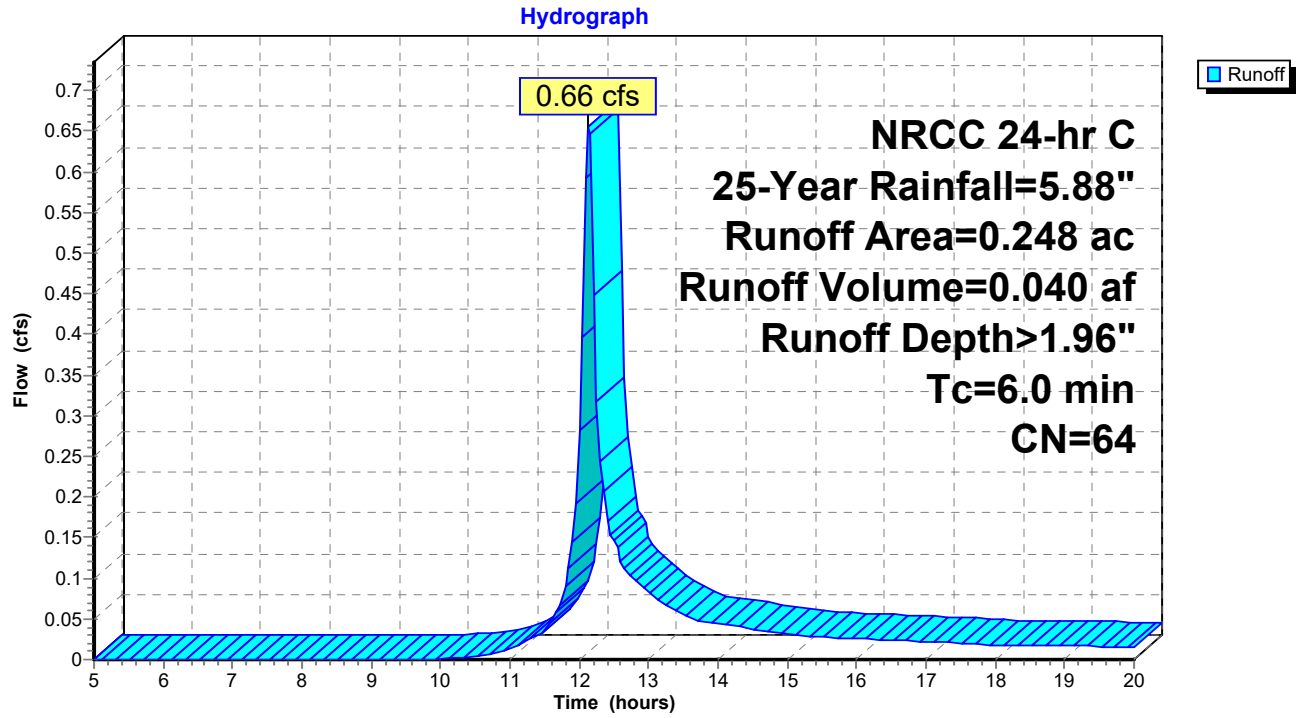
Runoff = 0.66 cfs @ 12.14 hrs, Volume= 0.040 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=5.88"

	Area (ac)	CN	Description
	0.145	39	>75% Grass cover, Good, HSG A
*	0.103	98	Pavement
	0.248	64	Weighted Average
	0.145		58.47% Pervious Area
	0.103		41.53% Impervious Area

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

Subcatchment 1S: Drainage Area 1



Summary for Pond 1P: INFILTRATION BASINS 1

Inflow Area = 0.248 ac, 41.53% Impervious, Inflow Depth > 1.96" for 25-Year event
Inflow = 0.66 cfs @ 12.14 hrs, Volume= 0.040 af
Outflow = 0.06 cfs @ 11.75 hrs, Volume= 0.040 af, Atten= 91%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.75 hrs, Volume= 0.040 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 65.07' @ 13.48 hrs Surf.Area= 0.007 ac Storage= 0.016 af

Plug-Flow detention time= 122.9 min calculated for 0.040 af (100% of inflow)
Center-of-Mass det. time= 122.0 min (937.0 - 815.0)

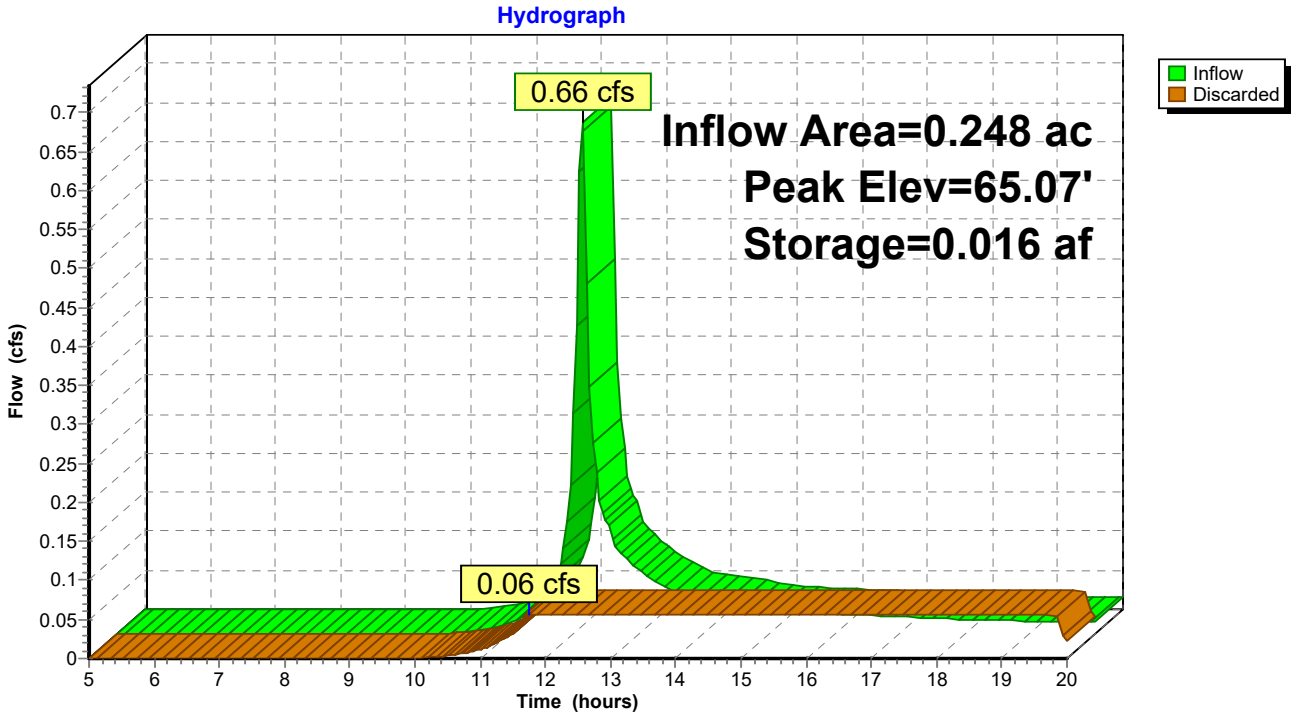
Volume	Invert	Avail.Storage	Storage Description
#1	59.70'	0.010 af	**14.00'W x 21.00'L x 6.00'H Prismatoid** 0.040 af Overall - 0.011 af Embedded = 0.030 af x 35.0% Voids
#2	59.70'	0.008 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 0.011 af Overall - 6.0" Wall Thickness = 0.008 af
#3	65.70'	0.000 af	**1.00'D x 1.50'H Vertical Cone/Cylinder**
#4	67.20'	0.091 af	**Custom Stage Data (Prismatic)** Listed below -Impervious
		0.110 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
67.20	0.001	0.000	0.000
68.00	0.046	0.019	0.019
69.00	0.099	0.072	0.091

Device	Routing	Invert	Outlet Devices
#1	Discarded	59.70'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 11.75 hrs HW=59.81' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Pond 1P: INFILTRATION BASINS 1



Summary for Subcatchment 1S: Drainage Area 1

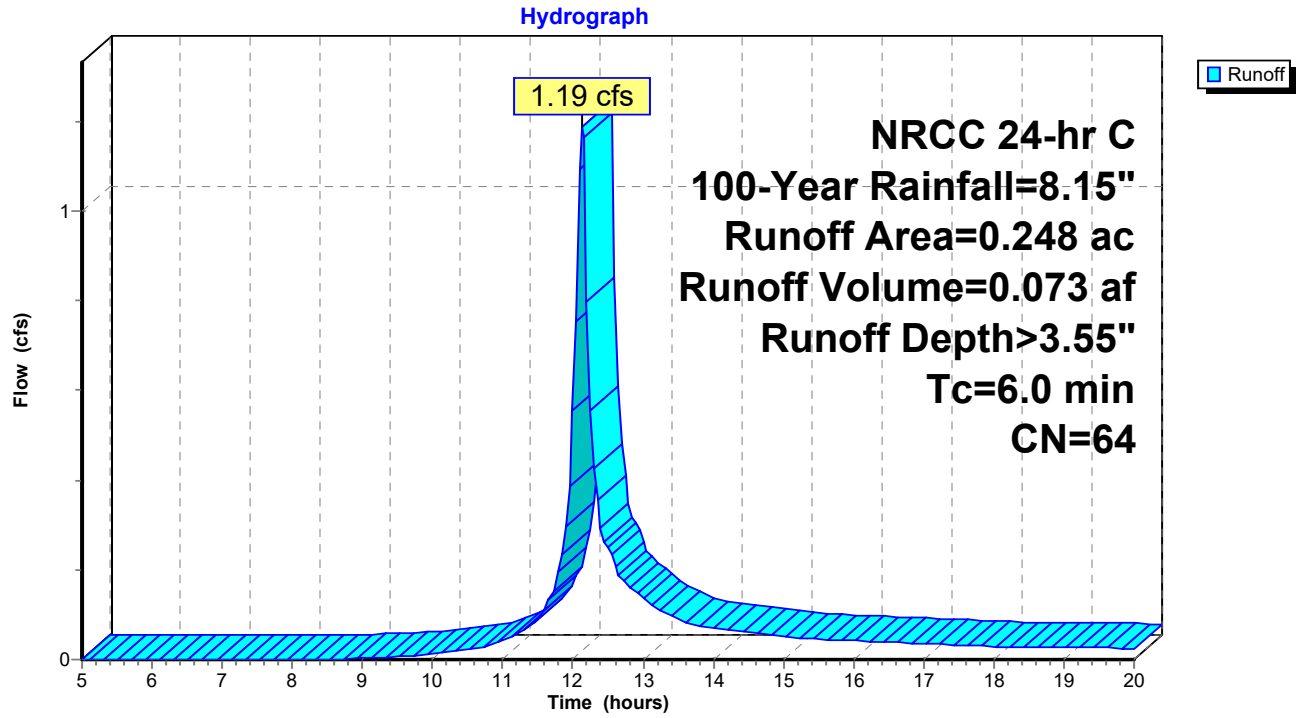
Runoff = 1.19 cfs @ 12.13 hrs, Volume= 0.073 af, Depth> 3.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.15"

	Area (ac)	CN	Description
	0.145	39	>75% Grass cover, Good, HSG A
*	0.103	98	Pavement
	0.248	64	Weighted Average
	0.145		58.47% Pervious Area
	0.103		41.53% Impervious Area

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

Subcatchment 1S: Drainage Area 1



Summary for Pond 1P: INFILTRATION BASINS 1

Inflow Area = 0.248 ac, 41.53% Impervious, Inflow Depth > 3.55" for 100-Year event
Inflow = 1.19 cfs @ 12.13 hrs, Volume= 0.073 af
Outflow = 0.06 cfs @ 12.20 hrs, Volume= 0.044 af, Atten= 95%, Lag= 4.0 min
Discarded = 0.06 cfs @ 12.20 hrs, Volume= 0.044 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 68.02' @ 14.73 hrs Surf.Area= 0.007 ac Storage= 0.039 af

Plug-Flow detention time= 194.2 min calculated for 0.044 af (60% of inflow)
Center-of-Mass det. time= 113.8 min (914.7 - 800.9)

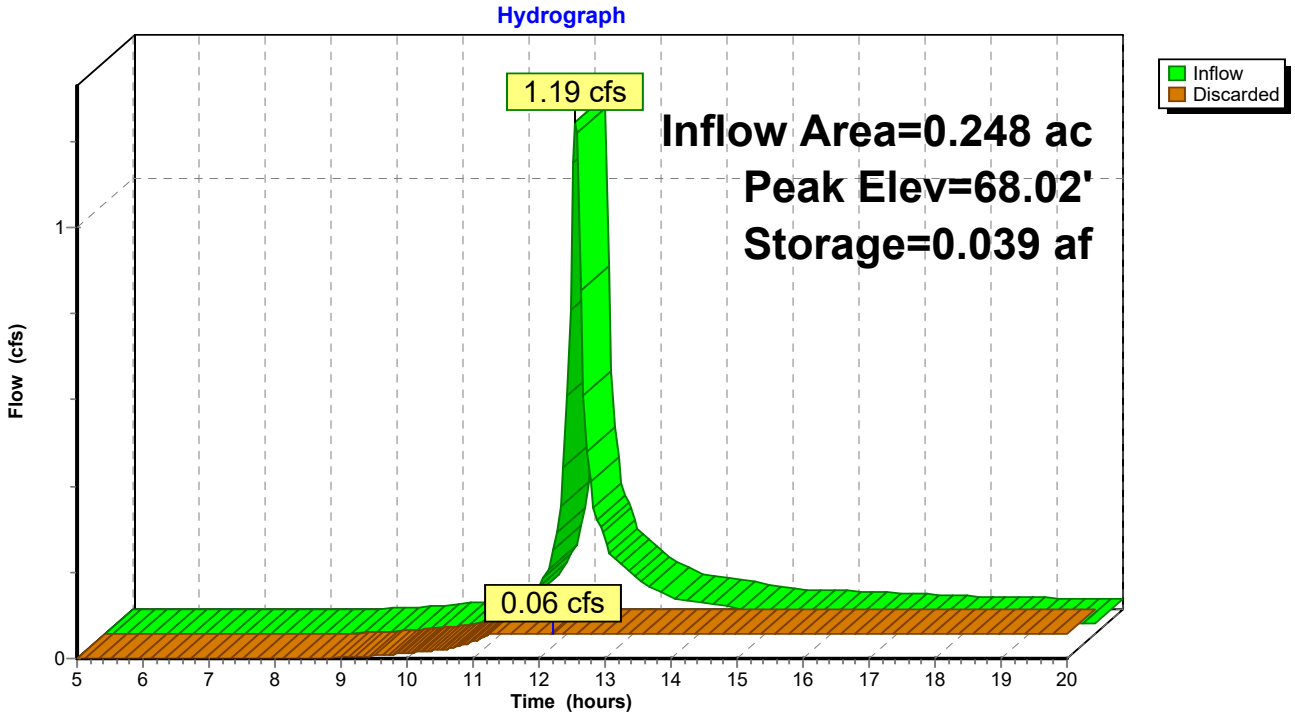
Volume	Invert	Avail.Storage	Storage Description
#1	59.70'	0.010 af	**14.00'W x 21.00'L x 6.00'H Prismatoid** 0.040 af Overall - 0.011 af Embedded = 0.030 af x 35.0% Voids
#2	59.70'	0.008 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 0.011 af Overall - 6.0" Wall Thickness = 0.008 af
#3	65.70'	0.000 af	**1.00'D x 1.50'H Vertical Cone/Cylinder**
#4	67.20'	0.091 af	**Custom Stage Data (Prismatic)** Listed below -Impervious
		0.110 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
67.20	0.001	0.000	0.000
68.00	0.046	0.019	0.019
69.00	0.099	0.072	0.091

Device	Routing	Invert	Outlet Devices
#1	Discarded	59.70'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 12.20 hrs HW=67.33' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Pond 1P: INFILTRATION BASINS 1



Hydrograph for Pond 1P: INFILTRATION BASINS 1

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Discarded (cfs)
5.00	0.00	0.000	59.70	0.00
5.50	0.00	0.000	59.70	0.00
6.00	0.00	0.000	59.70	0.00
6.50	0.00	0.000	59.70	0.00
7.00	0.00	0.000	59.70	0.00
7.50	0.00	0.000	59.70	0.00
8.00	0.00	0.000	59.70	0.00
8.50	0.00	0.000	59.70	0.00
9.00	0.00	0.000	59.70	0.00
9.50	0.00	0.000	59.70	0.00
10.00	0.00	0.000	59.70	0.00
10.50	0.00	0.000	59.71	0.00
11.00	0.01	0.000	59.72	0.01
11.50	0.04	0.000	59.75	**0.03**
12.00	**0.28**	0.002	60.40	**0.06**
12.50	**0.15**	0.014	64.24	0.06
13.00	0.08	0.016	64.92	0.06
13.50	0.06	**0.016**	**65.07**	0.06
14.00	0.04	0.016	64.96	0.06
14.50	0.04	0.015	64.75	0.06
15.00	0.03	0.014	64.46	0.06
15.50	0.03	0.013	64.08	0.06
16.00	0.03	0.012	63.68	0.06
16.50	0.02	0.011	63.26	0.06
17.00	0.02	0.009	62.81	0.06
17.50	0.02	0.008	62.33	0.06
18.00	0.02	0.006	61.82	0.06
18.50	0.02	0.005	61.29	0.06
19.00	0.02	0.003	60.76	0.06
19.50	0.02	0.002	60.21	0.06
20.00	0.02	0.000	59.74	0.02
20.50	0.02	0.000	59.73	0.02
21.00	0.01	0.000	59.72	0.01
21.50	0.01	0.000	59.72	0.01
22.00	0.01	0.000	59.72	0.01
22.50	0.01	0.000	59.72	0.01
23.00	0.01	0.000	59.72	0.01
23.50	0.01	0.000	59.72	0.01
24.00	0.01	0.000	59.72	0.01

Hydrograph for Pond 1P: INFILTRATION BASINS 1

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Discarded (cfs)
5.00	0.00	0.000	59.70	0.00
5.50	0.00	0.000	59.70	0.00
6.00	0.00	0.000	59.70	0.00
6.50	0.00	0.000	59.70	0.00
7.00	0.00	0.000	59.70	0.00
7.50	0.00	0.000	59.70	0.00
8.00	0.00	0.000	59.70	0.00
8.50	0.00	0.000	59.70	0.00
9.00	0.00	0.000	59.70	0.00
9.50	0.01	0.000	59.71	0.01
10.00	0.01	0.000	59.72	0.01
10.50	0.02	0.000	59.73	0.02
11.00	0.04	0.000	59.76	0.04
11.50	0.09	0.001	59.92	0.06
12.00	**0.56**	0.007	61.99	**0.06**
12.50	**0.25**	0.030	67.69	**0.06**
13.00	0.14	0.035	67.91	0.06
13.50	0.09	0.037	68.00	0.06
14.00	0.07	0.038	68.01	0.06
14.50	0.06	**0.039**	**68.02**	0.06
15.00	0.05	**0.039**	**68.02**	0.06
15.50	0.04	0.038	68.01	0.06
16.00	0.04	0.038	68.01	0.06
16.50	0.04	0.037	67.99	0.06
17.00	0.04	0.036	67.96	0.06
17.50	0.03	0.035	67.92	0.06
18.00	0.03	0.034	67.87	0.06
18.50	0.03	0.033	67.82	0.06
19.00	0.03	0.032	67.77	0.06
19.50	0.03	0.030	67.72	0.06
20.00	0.02	0.029	67.66	0.06
20.50	0.02	0.028	67.61	0.06
21.00	0.02	0.026	67.55	0.06
21.50	0.02	0.025	67.49	0.06
22.00	0.02	0.024	67.43	0.06
22.50	0.02	0.022	67.37	0.06
23.00	0.02	0.021	67.30	0.06
23.50	0.02	0.019	67.24	0.06
24.00	0.02	0.018	65.49	0.06

DRAINAGE AREA 2

HydroCad™ input variables:

Total area of contribution:	19,400 sf.	0.443 Ac.
Area of roadway pavement	8,300 sf.	0.165 Ac.
Area of driveways lots 1 and 2	3,000 sf.	0.069 Ac.
Areas of roadway shoulders, side slopes And undisturbed forest	8,100 sf.	0.209 Ac.

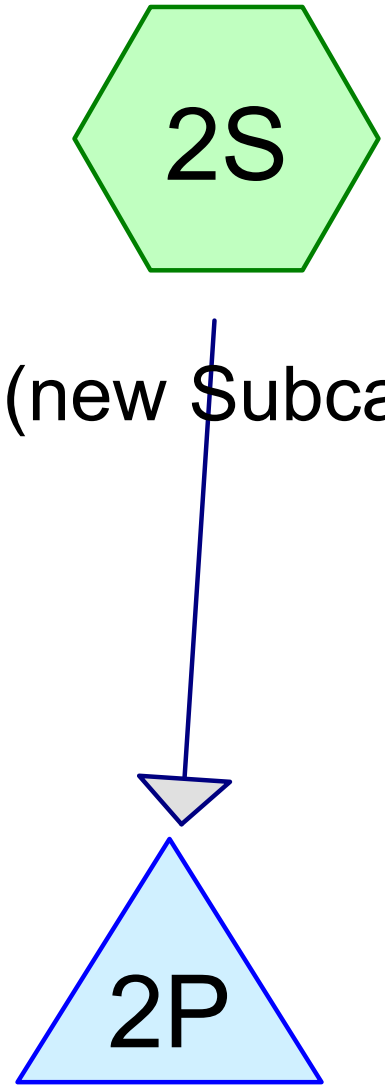
Composite Curve Number 70

Infiltration System:

1 set of 5 - 6ft. x 6 ft. precast pits w/ 4 ft. of stone in trench configuration

Results:

25 Yr. – 24 Hr. Storm	No overflow; Maximum Depth within Infiltration Basin 14.71 ft.; Infiltration Basin dry by end of storm.
100 Yr. – 24 Hr. Storm	Excess discharge of occurs. Excess directed to low point on the north side of Dorset Drive. One leaching basin to be fitted with standard frame and grate. Water level drops to frame elevation prior to end of storm.



INFILTRATION BASINS
1

Subcat Reach Pond Link

Routing Diagram for Dorset Drainage Area 2
Prepared by Clark Engineering LLC, Printed 2/1/2023

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 4125 MA Harwich Barnstable County East

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	C	Default	24.00	1	3.26	2
2	25-Year	NRCC 24-hr	C	Default	24.00	1	5.88	2
3	100-Year	NRCC 24-hr	C	Default	24.00	1	8.15	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.209	39	>75% Grass cover, Good, HSG A (2S)
0.234	98	Pavement (2S)
0.443	**70**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.209	HSG A	2S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.234	Other	2S
0.443		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.209	0.000	0.000	0.000	0.000	0.209	>75% Grass cover, Good	2S
0.000	0.000	0.000	0.000	0.234	0.234	Pavement	2S
0.209	**0.000**	**0.000**	**0.000**	**0.234**	**0.443**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 2S: (new Subcat) Runoff Area=0.443 ac 52.82% Impervious Runoff Depth>0.76"
Tc=6.0 min CN=70 Runoff=0.44 cfs 0.028 af

Pond 2P: INFILTRATION BASINS 1 Peak Elev=61.98' Storage=0.005 af Inflow=0.44 cfs 0.028 af
Outflow=0.14 cfs 0.028 af

Total Runoff Area = 0.443 ac Runoff Volume = 0.028 af Average Runoff Depth = 0.76"
47.18% Pervious = 0.209 ac 52.82% Impervious = 0.234 ac

Summary for Subcatchment 2S: (new Subcat)

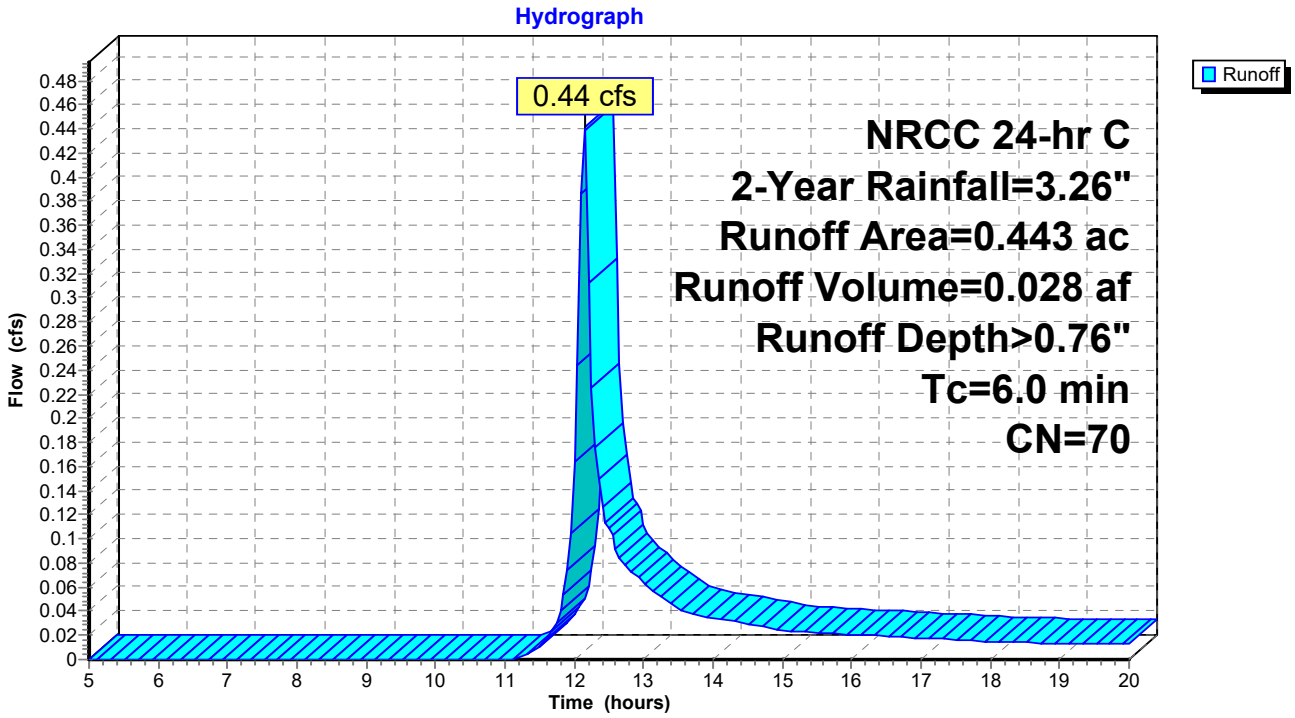
Runoff = 0.44 cfs @ 12.14 hrs, Volume= 0.028 af, Depth> 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.26"

	Area (ac)	CN	Description
	0.209	39	>75% Grass cover, Good, HSG A
*	0.234	98	Pavement
	0.443	70	Weighted Average
	0.209		47.18% Pervious Area
	0.234		52.82% Impervious Area

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

Subcatchment 2S: (new Subcat)



Summary for Pond 2P: INFILTRATION BASINS 1

Inflow Area = 0.443 ac, 52.82% Impervious, Inflow Depth > 0.76" for 2-Year event
Inflow = 0.44 cfs @ 12.14 hrs, Volume= 0.028 af
Outflow = 0.14 cfs @ 12.05 hrs, Volume= 0.028 af, Atten= 69%, Lag= 0.0 min
Discarded = 0.14 cfs @ 12.05 hrs, Volume= 0.028 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 61.98' @ 12.38 hrs Surf.Area= 0.016 ac Storage= 0.005 af

Plug-Flow detention time= 9.9 min calculated for 0.028 af (99% of inflow)
Center-of-Mass det. time= 9.1 min (840.3 - 831.2)

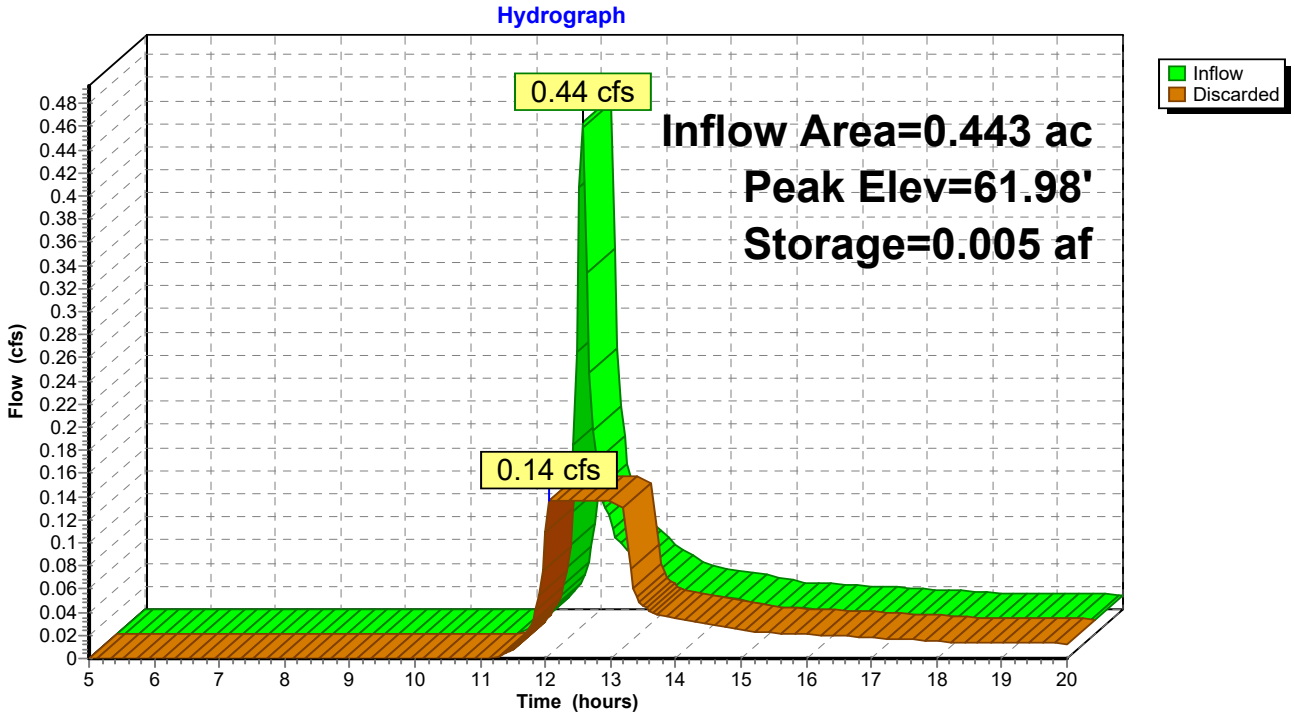
Volume	Invert	Avail.Storage	Storage Description
#1	61.35'	0.025 af	**14.00'W x 51.00'L x 6.00'H Prismatoid** 0.098 af Overall - 0.027 af Embedded = 0.072 af x 35.0% Voids
#2	61.35'	0.019 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 5 Inside #1 0.027 af Overall - 6.0" Wall Thickness = 0.019 af
#3	67.35'	0.000 af	**1.00'D x 1.50'H Vertical Cone/Cylinder**
#4	68.85'	0.088 af	**Custom Stage Data (Prismatic)** Listed below -Impervious
		0.132 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
68.85	0.001	0.000	0.000
69.50	0.046	0.015	0.015
70.50	0.099	0.072	0.088

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.35'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.14 cfs @ 12.05 hrs HW=61.47' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Pond 2P: INFILTRATION BASINS 1



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 2S: (new Subcat) Runoff Area=0.443 ac 52.82% Impervious Runoff Depth>2.46"
Tc=6.0 min CN=70 Runoff=1.47 cfs 0.091 af

Pond 2P: INFILTRATION BASINS 1 Peak Elev=66.09' Storage=0.035 af Inflow=1.47 cfs 0.091 af
Outflow=0.14 cfs 0.091 af

Total Runoff Area = 0.443 ac Runoff Volume = 0.091 af Average Runoff Depth = 2.46"
47.18% Pervious = 0.209 ac 52.82% Impervious = 0.234 ac

Summary for Subcatchment 2S: (new Subcat)

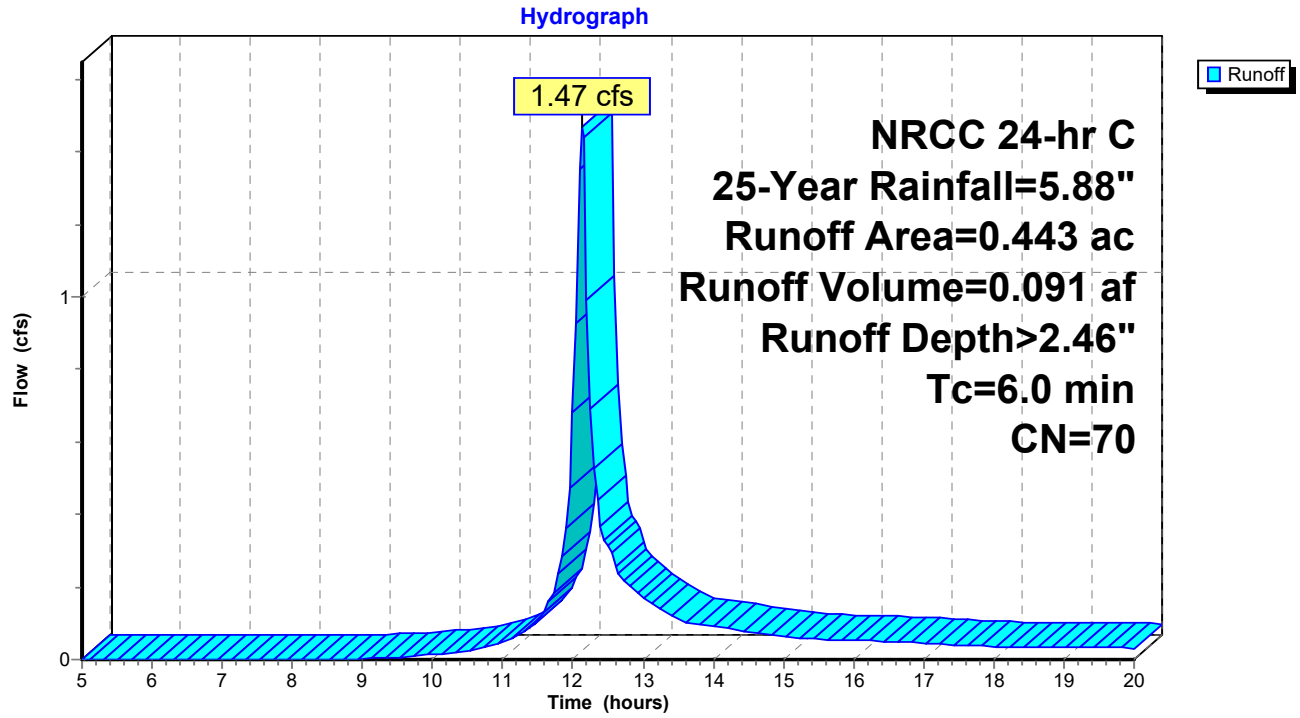
Runoff = 1.47 cfs @ 12.13 hrs, Volume= 0.091 af, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=5.88"

	Area (ac)	CN	Description
	0.209	39	>75% Grass cover, Good, HSG A
*	0.234	98	Pavement
	0.443	70	Weighted Average
	0.209		47.18% Pervious Area
	0.234		52.82% Impervious Area

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

Subcatchment 2S: (new Subcat)



Summary for Pond 2P: INFILTRATION BASINS 1

Inflow Area = 0.443 ac, 52.82% Impervious, Inflow Depth > 2.46" for 25-Year event
Inflow = 1.47 cfs @ 12.13 hrs, Volume= 0.091 af
Outflow = 0.14 cfs @ 11.65 hrs, Volume= 0.091 af, Atten= 91%, Lag= 0.0 min
Discarded = 0.14 cfs @ 11.65 hrs, Volume= 0.091 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 66.09' @ 13.28 hrs Surf.Area= 0.016 ac Storage= 0.035 af

Plug-Flow detention time= 100.9 min calculated for 0.090 af (99% of inflow)
Center-of-Mass det. time= 99.9 min (903.1 - 803.2)

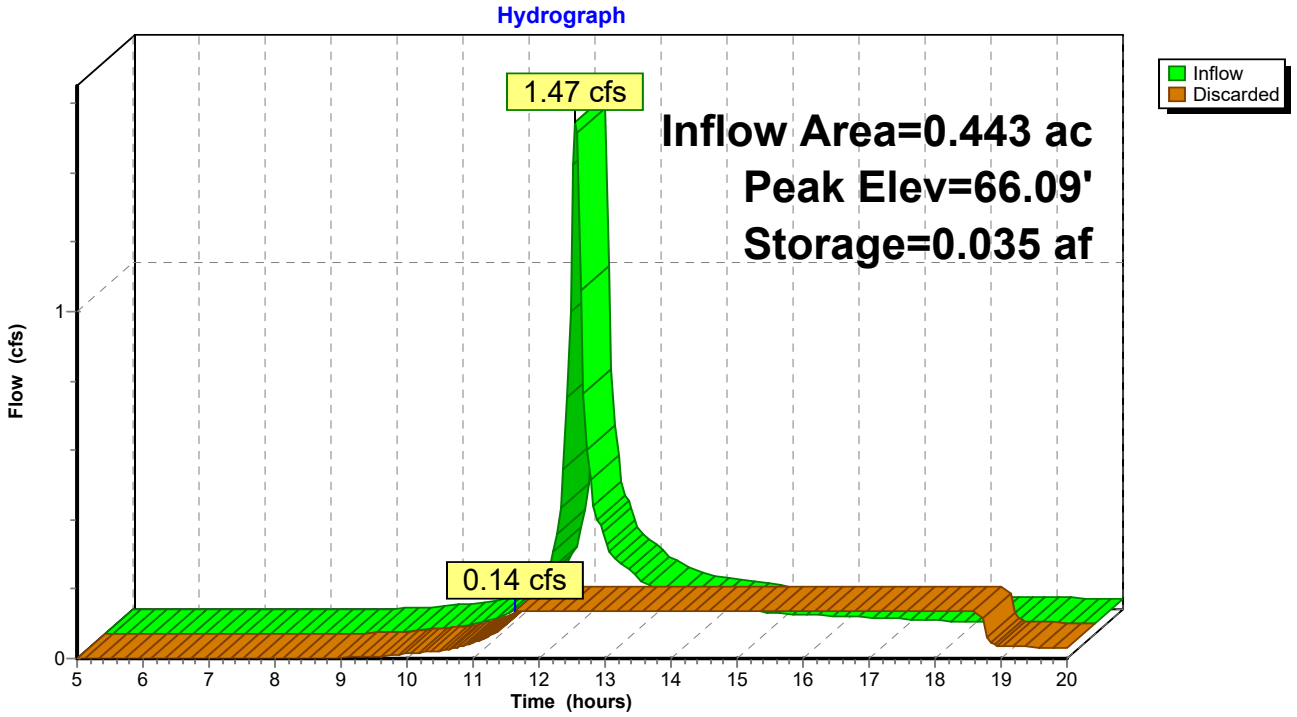
Volume	Invert	Avail.Storage	Storage Description
#1	61.35'	0.025 af	**14.00'W x 51.00'L x 6.00'H Prismatoid** 0.098 af Overall - 0.027 af Embedded = 0.072 af x 35.0% Voids
#2	61.35'	0.019 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 5 Inside #1 0.027 af Overall - 6.0" Wall Thickness = 0.019 af
#3	67.35'	0.000 af	**1.00'D x 1.50'H Vertical Cone/Cylinder**
#4	68.85'	0.088 af	**Custom Stage Data (Prismatic)** Listed below -Impervious
		0.132 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
68.85	0.001	0.000	0.000
69.50	0.046	0.015	0.015
70.50	0.099	0.072	0.088

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.35'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.14 cfs @ 11.65 hrs HW=61.44' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Pond 2P: INFILTRATION BASINS 1



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 2S: (new Subcat) Runoff Area=0.443 ac 52.82% Impervious Runoff Depth>4.22"
Tc=6.0 min CN=70 Runoff=2.49 cfs 0.156 af

Pond 2P: INFILTRATION BASINS 1 Peak Elev=69.72' Storage=0.076 af Inflow=2.49 cfs 0.156 af
Outflow=0.14 cfs 0.111 af

Total Runoff Area = 0.443 ac Runoff Volume = 0.156 af Average Runoff Depth = 4.22"
47.18% Pervious = 0.209 ac 52.82% Impervious = 0.234 ac

Summary for Subcatchment 2S: (new Subcat)

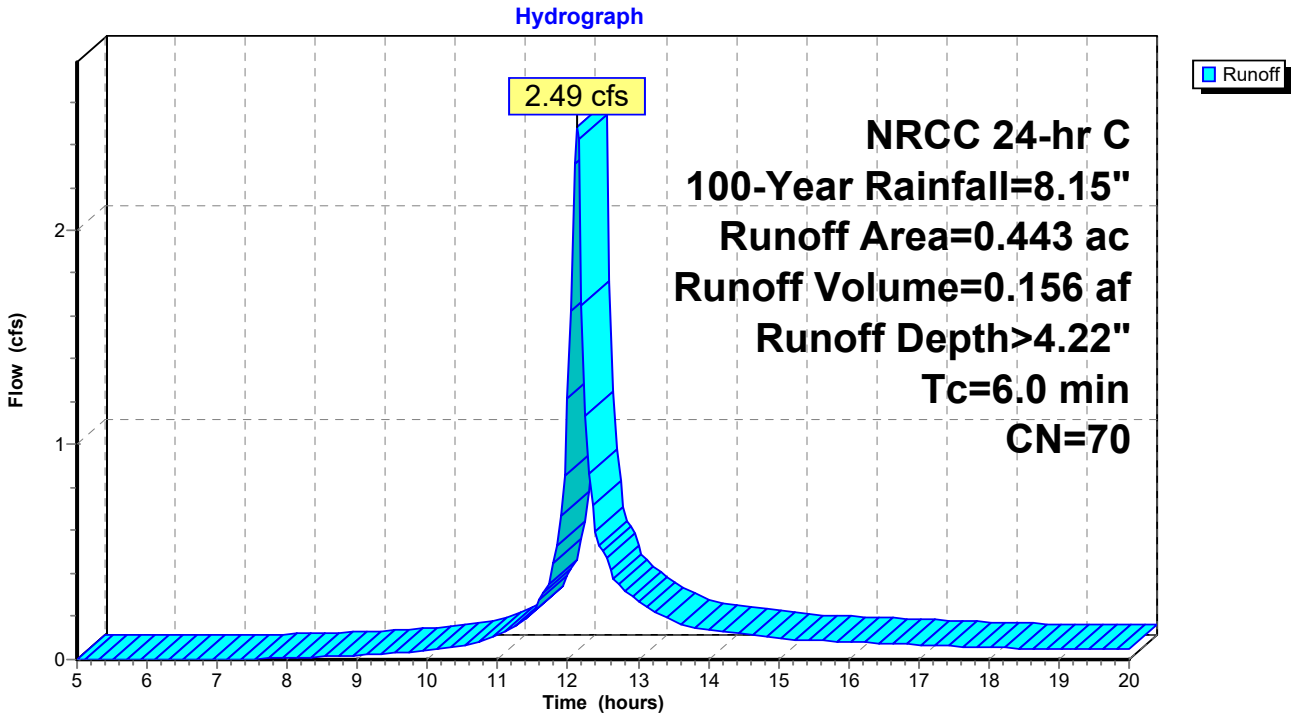
Runoff = 2.49 cfs @ 12.13 hrs, Volume= 0.156 af, Depth> 4.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.15"

	Area (ac)	CN	Description
	0.209	39	>75% Grass cover, Good, HSG A
*	0.234	98	Pavement
	0.443	70	Weighted Average
	0.209		47.18% Pervious Area
	0.234		52.82% Impervious Area

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

Subcatchment 2S: (new Subcat)



Summary for Pond 2P: INFILTRATION BASINS 1

Inflow Area = 0.443 ac, 52.82% Impervious, Inflow Depth > 4.22" for 100-Year event
Inflow = 2.49 cfs @ 12.13 hrs, Volume= 0.156 af
Outflow = 0.14 cfs @ 12.20 hrs, Volume= 0.111 af, Atten= 94%, Lag= 4.1 min
Discarded = 0.14 cfs @ 12.20 hrs, Volume= 0.111 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 69.72' @ 14.13 hrs Surf.Area= 0.016 ac Storage= 0.076 af

Plug-Flow detention time= 182.6 min calculated for 0.110 af (71% of inflow)
Center-of-Mass det. time= 114.8 min (904.9 - 790.1)

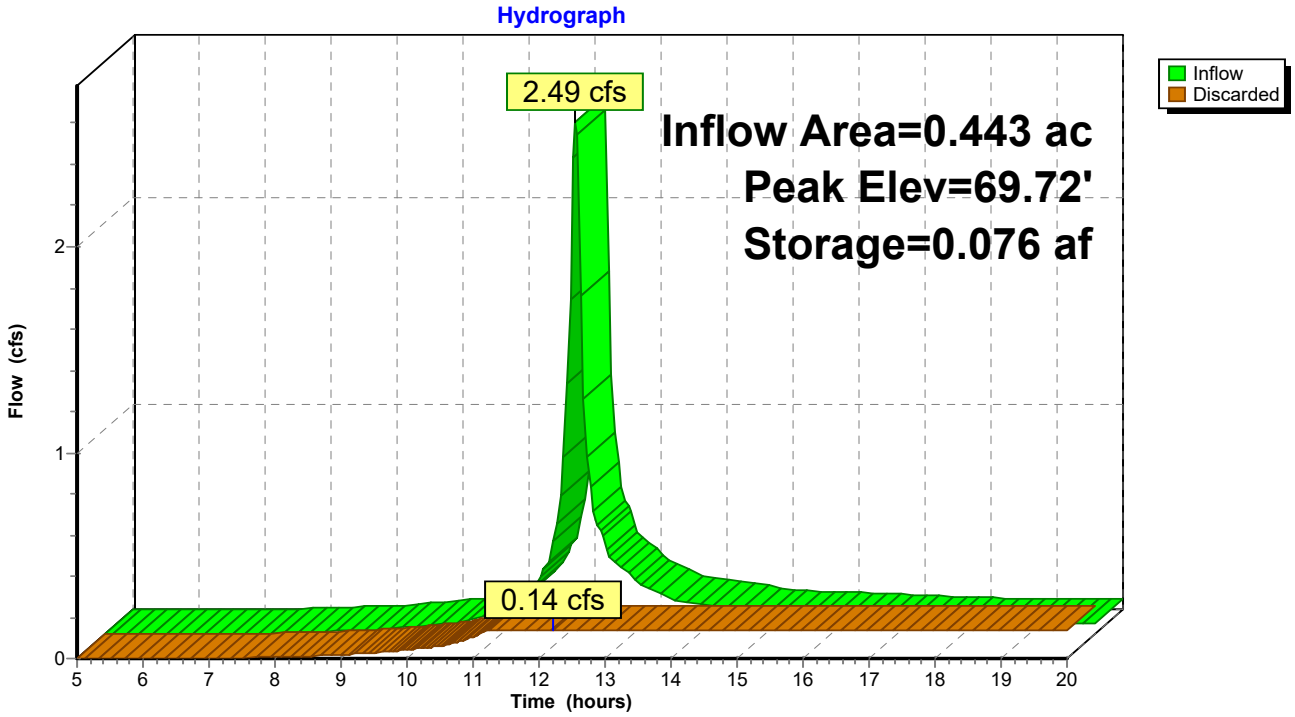
Volume	Invert	Avail.Storage	Storage Description
#1	61.35'	0.025 af	**14.00'W x 51.00'L x 6.00'H Prismatoid** 0.098 af Overall - 0.027 af Embedded = 0.072 af x 35.0% Voids
#2	61.35'	0.019 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 5 Inside #1 0.027 af Overall - 6.0" Wall Thickness = 0.019 af
#3	67.35'	0.000 af	**1.00'D x 1.50'H Vertical Cone/Cylinder**
#4	68.85'	0.088 af	**Custom Stage Data (Prismatic)** Listed below -Impervious
		0.132 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
68.85	0.001	0.000	0.000
69.50	0.046	0.015	0.015
70.50	0.099	0.072	0.088

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.35'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.14 cfs @ 12.20 hrs HW=68.89' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Pond 2P: INFILTRATION BASINS 1



Hydrograph for Pond 2P: INFILTRATION BASINS 1

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Discarded (cfs)
5.00	0.00	0.000	61.35	0.00
5.50	0.00	0.000	61.35	0.00
6.00	0.00	0.000	61.35	0.00
6.50	0.00	0.000	61.35	0.00
7.00	0.00	0.000	61.35	0.00
7.50	0.00	0.000	61.35	0.00
8.00	0.00	0.000	61.35	0.00
8.50	0.00	0.000	61.35	0.00
9.00	0.00	0.000	61.35	0.00
9.50	0.01	0.000	61.35	0.01
10.00	0.01	0.000	61.36	0.01
10.50	0.02	0.000	61.37	0.02
11.00	0.05	0.000	61.38	0.05
11.50	0.11	0.000	61.42	**0.10**
12.00	**0.68**	0.006	62.10	**0.14**
12.50	**0.31**	0.031	65.55	0.14
13.00	0.17	**0.035**	**66.04**	0.14
13.50	0.11	**0.035**	**66.06**	0.14
14.00	0.09	0.033	65.85	0.14
14.50	0.08	0.031	65.56	0.14
15.00	0.06	0.029	65.19	0.14
15.50	0.06	0.025	64.76	0.14
16.00	0.05	0.022	64.30	0.14
16.50	0.05	0.018	63.82	0.14
17.00	0.04	0.015	63.32	0.14
17.50	0.04	0.011	62.80	0.14
18.00	0.04	0.007	62.26	0.14
18.50	0.03	0.003	61.69	0.14
19.00	0.03	0.000	61.37	0.03
19.50	0.03	0.000	61.37	0.03
20.00	0.03	0.000	61.37	0.03
20.50	0.03	0.000	61.37	0.03
21.00	0.03	0.000	61.37	0.03
21.50	0.03	0.000	61.37	0.03
22.00	0.03	0.000	61.37	0.03
22.50	0.03	0.000	61.37	0.03
23.00	0.03	0.000	61.37	0.03
23.50	0.02	0.000	61.37	0.02
24.00	0.02	0.000	61.37	0.02

Hydrograph for Pond 2P: INFILTRATION BASINS 1

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Discarded (cfs)
5.00	0.00	0.000	61.35	0.00
5.50	0.00	0.000	61.35	0.00
6.00	0.00	0.000	61.35	0.00
6.50	0.00	0.000	61.35	0.00
7.00	0.00	0.000	61.35	0.00
7.50	0.00	0.000	61.35	0.00
8.00	0.01	0.000	61.35	0.01
8.50	0.01	0.000	61.36	0.01
9.00	0.02	0.000	61.36	0.02
9.50	0.03	0.000	61.37	0.03
10.00	0.04	0.000	61.38	0.04
10.50	0.06	0.000	61.39	0.06
11.00	0.11	0.001	61.42	0.10
11.50	0.22	0.002	61.58	0.14
12.00	**1.21**	0.016	63.47	**0.14**
12.50	**0.50**	0.063	69.54	**0.14**
13.00	0.27	0.072	69.66	0.14
13.50	0.18	0.075	69.71	0.14
14.00	0.14	**0.076**	**69.72**	0.14
14.50	0.12	**0.076**	**69.72**	0.14
15.00	0.10	0.075	69.70	0.14
15.50	0.09	0.073	69.68	0.14
16.00	0.08	0.071	69.65	0.14
16.50	0.08	0.068	69.61	0.14
17.00	0.07	0.065	69.58	0.14
17.50	0.06	0.063	69.54	0.14
18.00	0.06	0.059	69.47	0.14
18.50	0.05	0.056	69.33	0.14
19.00	0.05	0.052	69.18	0.14
19.50	0.05	0.049	69.03	0.14
20.00	0.05	0.045	68.87	0.14
20.50	0.05	0.041	66.93	0.14
21.00	0.04	0.038	66.42	0.14
21.50	0.04	0.034	65.91	0.14
22.00	0.04	0.030	65.38	0.14
22.50	0.04	0.026	64.85	0.14
23.00	0.04	0.022	64.31	0.14
23.50	0.04	0.018	63.76	0.14
24.00	0.04	0.014	63.20	0.14

DRAINAGE AREA 3 Driveway Lot 3

HydroCad™ input variables:

Total area of contribution:	9,000 sf.	0.207 Ac.
Area of pavement including driveway from lot 3	3,000 sf.	0.069 Ac.
Significant landscape Groundcover	6,000 sf.	0.138 Ac.

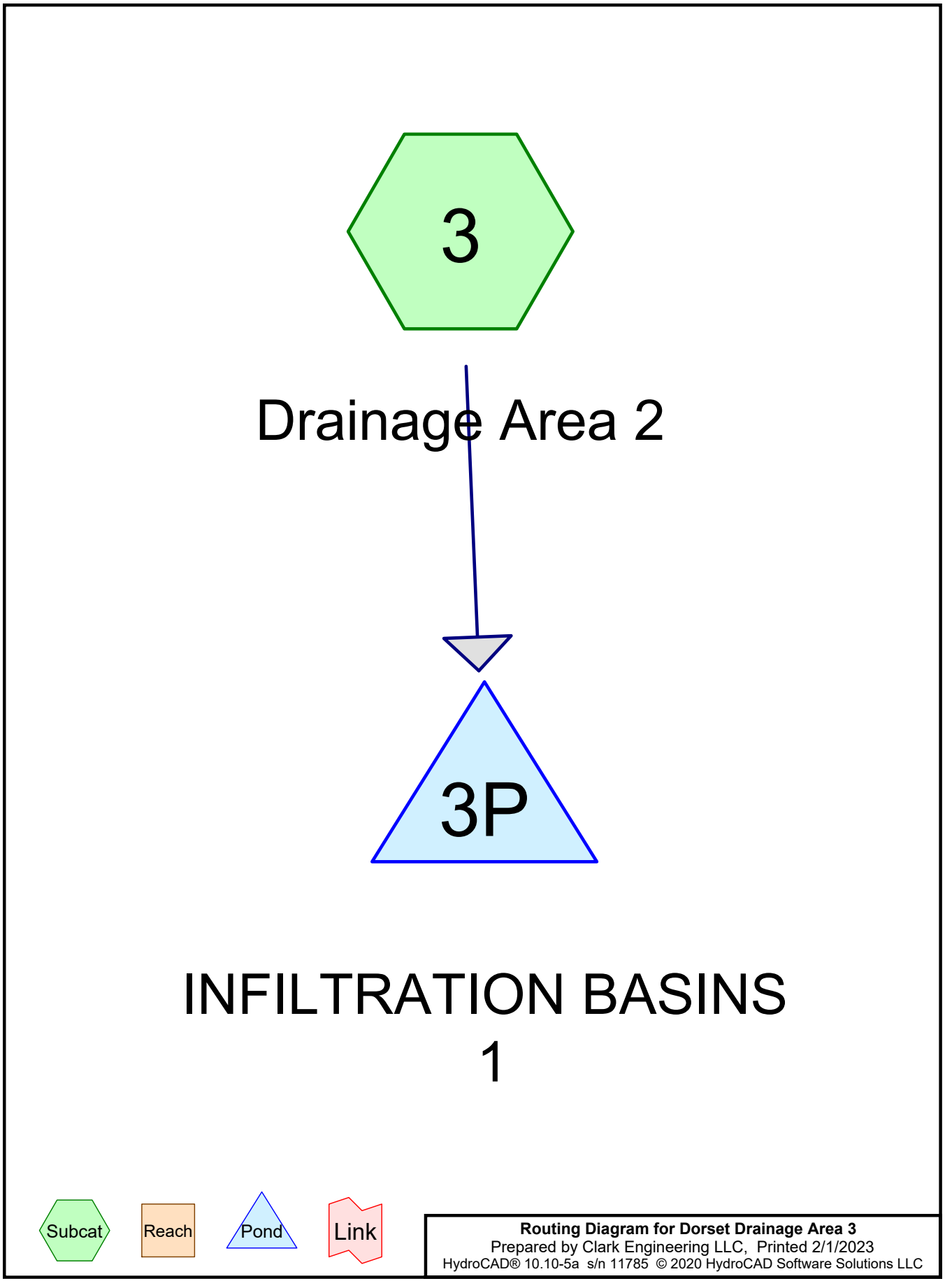
Composite Curve Number 59

Infiltration System:

1 set of 2 - 6ft. x 6 ft. precast pits w/ 4 ft. of stone in trench configuration

Results:

25 Yr. – 24 Hr. Storm	No overflow; Maximum Depth within Infiltration Basin 2.3 ft.; Infiltration Basin dry by end of storm.
100 Yr. – 24 Hr. Storm	Excess discharge of occurs. Excess directed to low point on the north side of Dorset Drive. One leaching basin to be fitted with standard frame and grate. Water level drops to frame elevation prior to end of storm.


3
Drainage Area 2
3P
INFILTRATION BASINS
1
Subcat
Reach
Pond
Link
Routing Diagram for Dorset Drainage Area 3
Prepared by Clark Engineering LLC, Printed 2/1/2023
HydroCAD® 10.10-5a s/n 11785 © 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	2-Year	NRCC 24-hr	C	Default	24.00	1	3.26	2
2	25-Year	NRCC 24-hr	C	Default	24.00	1	5.88	2
3	100-Year	NRCC 24-hr	C	Default	24.00	1	8.15	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.138	39	>75% Grass cover, Good, HSG A (3)
0.069	98	Paved parking, HSG A (3)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.207	HSG A	3
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.138	0.000	0.000	0.000	0.000	0.138	>75% Grass cover, Good	3
0.069	0.000	0.000	0.000	0.000	0.069	Paved parking	3

Summary for Subcatchment 3: Drainage Area 2

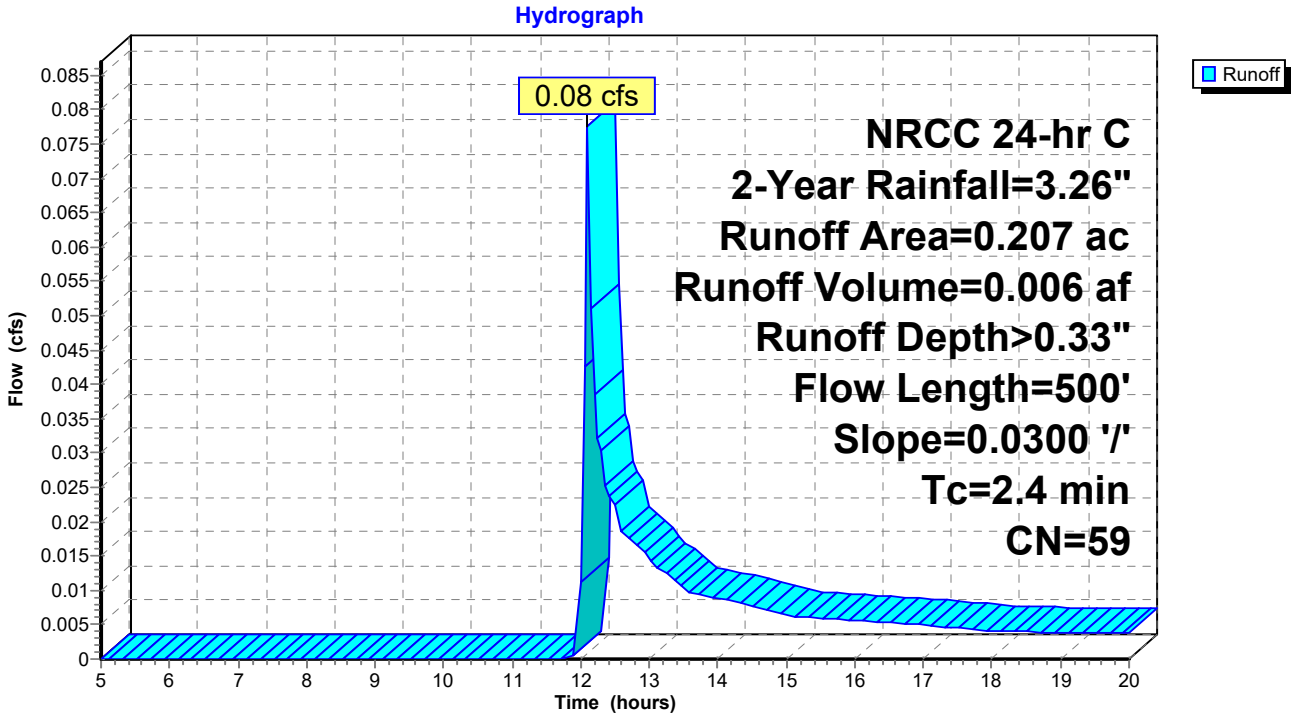
Runoff = 0.08 cfs @ 12.10 hrs, Volume= 0.006 af, Depth> 0.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.26"

Area (ac)	CN	Description
0.069	98	Paved parking, HSG A
0.138	39	>75% Grass cover, Good, HSG A
0.207	59	Weighted Average
0.138		66.67% Pervious Area
0.069		33.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	500	0.0300	3.52		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps

Subcatchment 3: Drainage Area 2



Summary for Pond 3P: INFILTRATION BASINS 1

Inflow Area = 0.207 ac, 33.33% Impervious, Inflow Depth > 0.33" for 2-Year event
Inflow = 0.08 cfs @ 12.10 hrs, Volume= 0.006 af
Outflow = 0.06 cfs @ 12.15 hrs, Volume= 0.006 af, Atten= 26%, Lag= 2.8 min
Discarded = 0.06 cfs @ 12.15 hrs, Volume= 0.006 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 65.07' @ 12.15 hrs Surf.Area= 0.007 ac Storage= 0.000 af

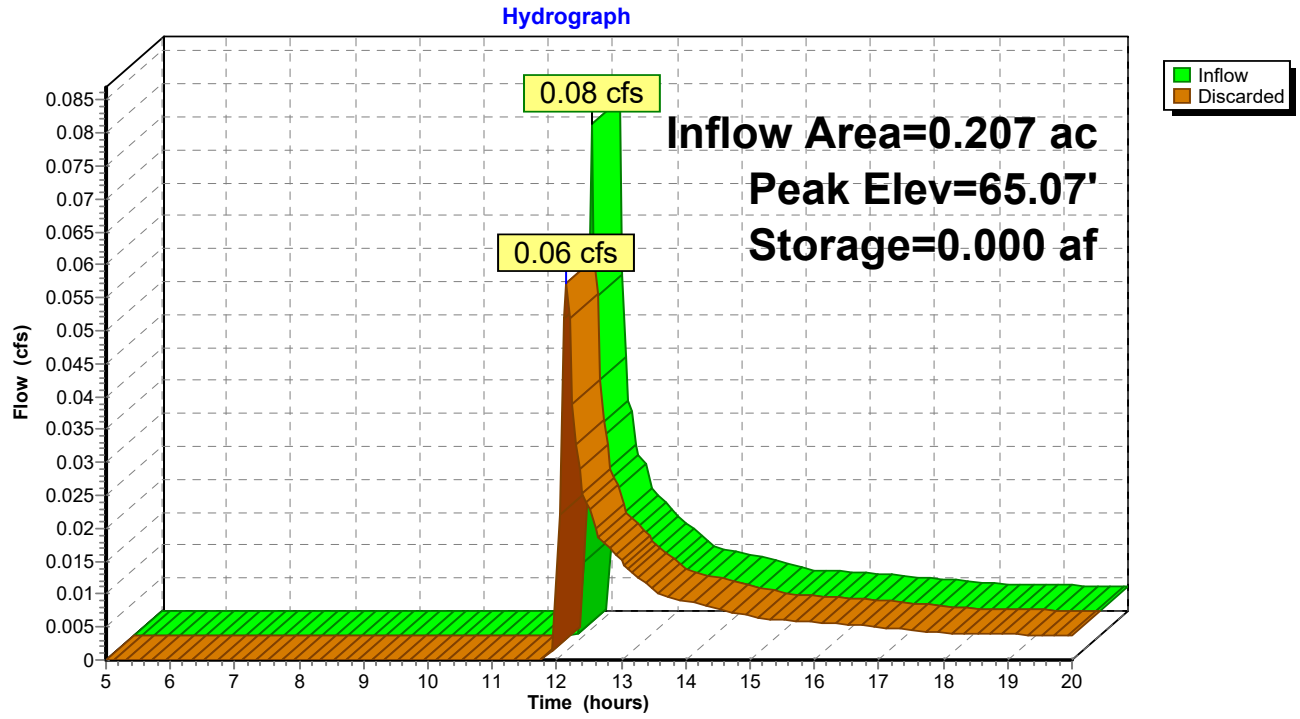
Plug-Flow detention time= 2.3 min calculated for 0.006 af (99% of inflow)
Center-of-Mass det. time= 1.6 min (868.4 - 866.7)

Volume	Invert	Avail.Storage	Storage Description
#1	65.00'	0.010 af	**14.00'W x 21.00'L x 6.00'H Prismatoid** 0.040 af Overall - 0.011 af Embedded = 0.030 af x 35.0% Voids
#2	65.00'	0.008 af	**6.00'D x 6.00'H Prismatoid** x 2 Inside #1 0.011 af Overall - 6.0" Wall Thickness = 0.008 af
		0.018 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	65.00'	**8.270 in/hr Exfiltration over Wetted area below 72.20'** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 12.15 hrs HW=65.07' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Pond 3P: INFILTRATION BASINS 1



Summary for Subcatchment 3: Drainage Area 2

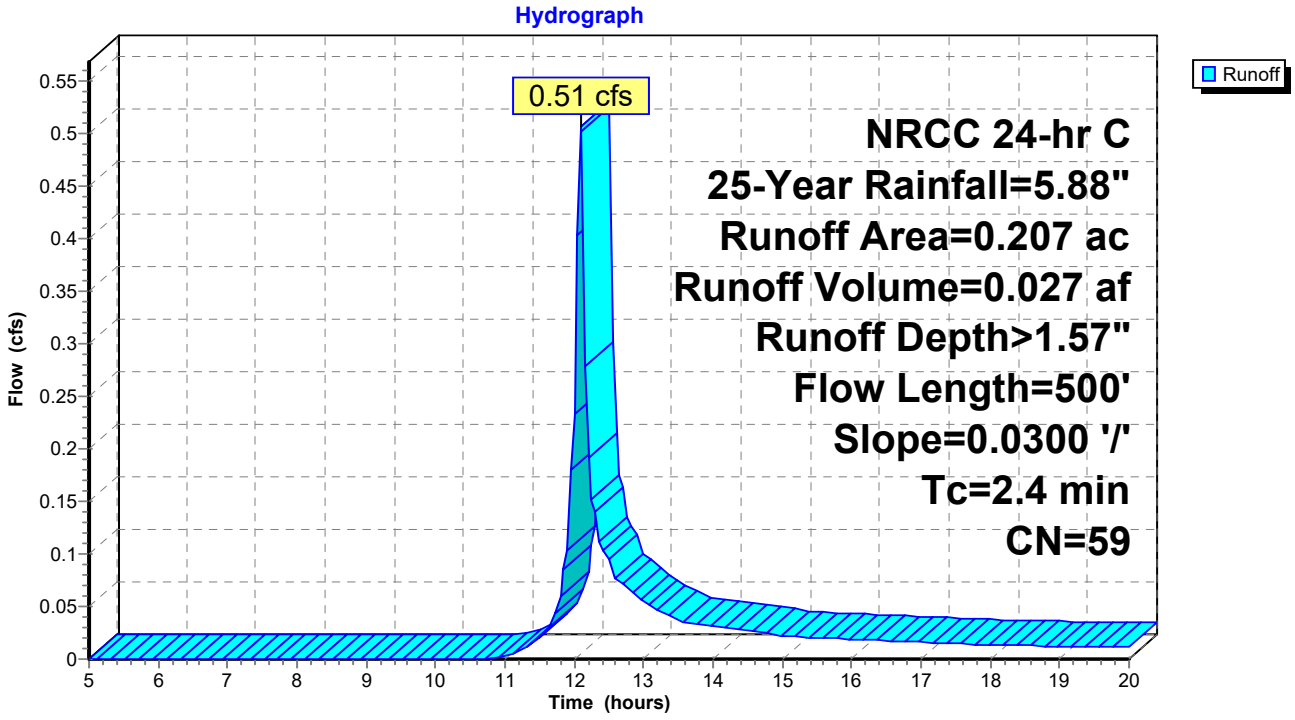
Runoff = 0.51 cfs @ 12.09 hrs, Volume= 0.027 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=5.88"

Area (ac)	CN	Description
0.069	98	Paved parking, HSG A
0.138	39	>75% Grass cover, Good, HSG A
0.207	59	Weighted Average
0.138		66.67% Pervious Area
0.069		33.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	500	0.0300	3.52		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps

Subcatchment 3: Drainage Area 2



Summary for Pond 3P: INFILTRATION BASINS 1

Inflow Area = 0.207 ac, 33.33% Impervious, Inflow Depth > 1.57" for 25-Year event
Inflow = 0.51 cfs @ 12.09 hrs, Volume= 0.027 af
Outflow = 0.09 cfs @ 12.54 hrs, Volume= 0.027 af, Atten= 83%, Lag= 27.3 min
Discarded = 0.09 cfs @ 12.54 hrs, Volume= 0.027 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 67.28' @ 12.54 hrs Surf.Area= 0.007 ac Storage= 0.007 af

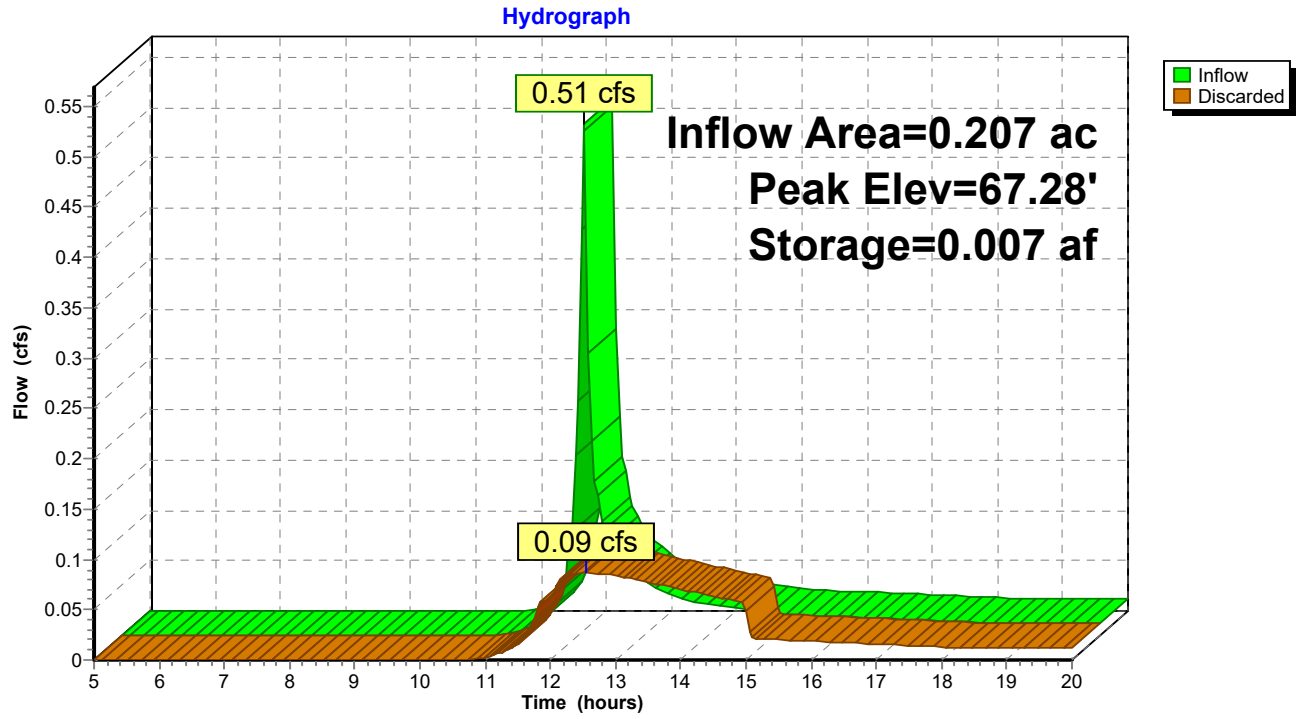
Plug-Flow detention time= 28.7 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 28.1 min (850.9 - 822.8)

Volume	Invert	Avail.Storage	Storage Description
#1	65.00'	0.010 af	**14.00'W x 21.00'L x 6.00'H Prismatoid** 0.040 af Overall - 0.011 af Embedded = 0.030 af x 35.0% Voids
#2	65.00'	0.008 af	**6.00'D x 6.00'H Prismatoid** x 2 Inside #1 0.011 af Overall - 6.0" Wall Thickness = 0.008 af
		0.018 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	65.00'	**8.270 in/hr Exfiltration over Wetted area below 72.20'** Phase-In= 0.01'

Discarded OutFlow Max=0.09 cfs @ 12.54 hrs HW=67.28' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.09 cfs)

Pond 3P: INFILTRATION BASINS 1



Summary for Subcatchment 3: Drainage Area 2

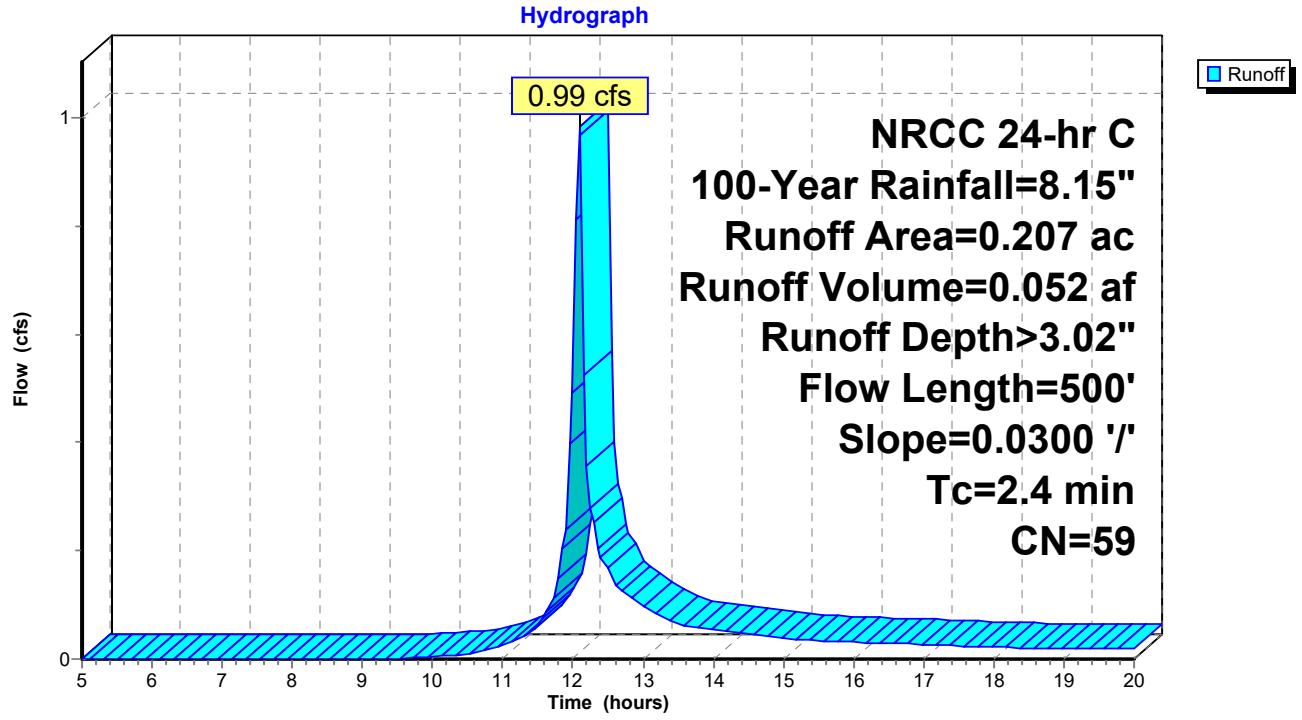
Runoff = 0.99 cfs @ 12.09 hrs, Volume= 0.052 af, Depth> 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.15"

Area (ac)	CN	Description
0.069	98	Paved parking, HSG A
0.138	39	>75% Grass cover, Good, HSG A
0.207	59	Weighted Average
0.138		66.67% Pervious Area
0.069		33.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	500	0.0300	3.52		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps

Subcatchment 3: Drainage Area 2



Summary for Pond 3P: INFILTRATION BASINS 1

Inflow Area = 0.207 ac, 33.33% Impervious, Inflow Depth > 3.02" for 100-Year event
Inflow = 0.99 cfs @ 12.09 hrs, Volume= 0.052 af
Outflow = 0.13 cfs @ 12.64 hrs, Volume= 0.052 af, Atten= 87%, Lag= 32.9 min
Discarded = 0.13 cfs @ 12.64 hrs, Volume= 0.052 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 70.63' @ 12.64 hrs Surf.Area= 0.007 ac Storage= 0.017 af

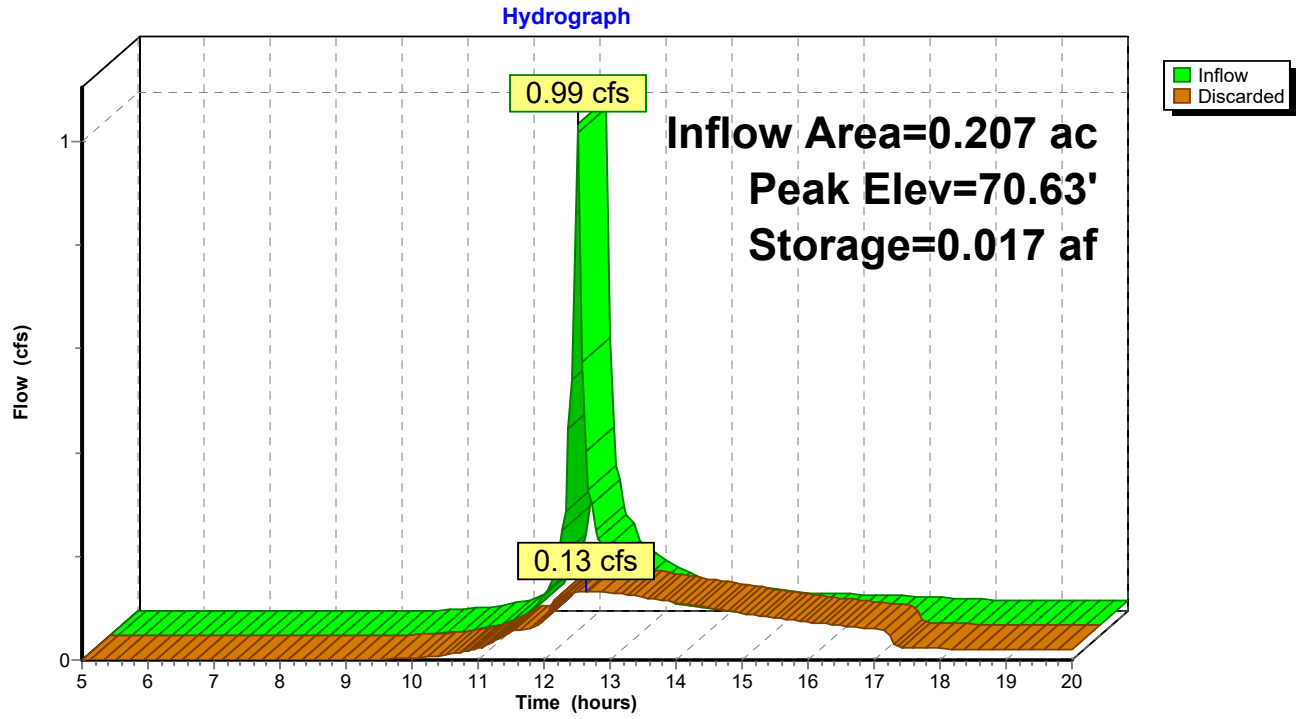
Plug-Flow detention time= 56.9 min calculated for 0.052 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (863.5 - 807.2)

Volume	Invert	Avail.Storage	Storage Description
#1	65.00'	0.010 af	**14.00'W x 21.00'L x 6.00'H Prismatoid** 0.040 af Overall - 0.011 af Embedded = 0.030 af x 35.0% Voids
#2	65.00'	0.008 af	**6.00'D x 6.00'H Prismatoid** x 2 Inside #1 0.011 af Overall - 6.0" Wall Thickness = 0.008 af
		0.018 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	65.00'	**8.270 in/hr Exfiltration over Wetted area below 72.20'** Phase-In= 0.01'

Discarded OutFlow Max=0.13 cfs @ 12.64 hrs HW=70.63' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.13 cfs)

Pond 3P: INFILTRATION BASINS 1



Hydrograph for Pond 3P: INFILTRATION BASINS 1

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Discarded (cfs)
5.00	0.00	0.000	65.00	0.00
5.50	0.00	0.000	65.00	0.00
6.00	0.00	0.000	65.00	0.00
6.50	0.00	0.000	65.00	0.00
7.00	0.00	0.000	65.00	0.00
7.50	0.00	0.000	65.00	0.00
8.00	0.00	0.000	65.00	0.00
8.50	0.00	0.000	65.00	0.00
9.00	0.00	0.000	65.00	0.00
9.50	0.00	0.000	65.00	0.00
10.00	0.00	0.000	65.00	0.00
10.50	0.00	0.000	65.00	0.00
11.00	0.00	0.000	65.00	0.00
11.50	0.02	0.000	65.02	0.02
12.00	**0.23**	0.001	65.44	0.06
12.50	**0.10**	**0.007**	**67.27**	**0.09**
13.00	0.06	**0.006**	**67.06**	**0.08**
13.50	0.04	0.005	66.59	0.08
14.00	0.03	0.003	66.04	0.07
14.50	0.03	0.002	65.53	0.06
15.00	0.02	0.000	65.05	0.05
15.50	0.02	0.000	65.02	0.02
16.00	0.02	0.000	65.02	0.02
16.50	0.02	0.000	65.02	0.02
17.00	0.02	0.000	65.02	0.02
17.50	0.01	0.000	65.02	0.01
18.00	0.01	0.000	65.01	0.01
18.50	0.01	0.000	65.01	0.01
19.00	0.01	0.000	65.01	0.01
19.50	0.01	0.000	65.01	0.01
20.00	0.01	0.000	65.01	0.01
20.50	0.01	0.000	65.01	0.01
21.00	0.01	0.000	65.01	0.01
21.50	0.01	0.000	65.01	0.01
22.00	0.01	0.000	65.01	0.01
22.50	0.01	0.000	65.01	0.01
23.00	0.01	0.000	65.01	0.01
23.50	0.01	0.000	65.01	0.01
24.00	0.01	0.000	65.01	0.01

Hydrograph for Pond 3P: INFILTRATION BASINS 1

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Discarded (cfs)
5.00	0.00	0.000	65.00	0.00
5.50	0.00	0.000	65.00	0.00
6.00	0.00	0.000	65.00	0.00
6.50	0.00	0.000	65.00	0.00
7.00	0.00	0.000	65.00	0.00
7.50	0.00	0.000	65.00	0.00
8.00	0.00	0.000	65.00	0.00
8.50	0.00	0.000	65.00	0.00
9.00	0.00	0.000	65.00	0.00
9.50	0.00	0.000	65.00	0.00
10.00	0.00	0.000	65.00	0.00
10.50	0.01	0.000	65.01	0.01
11.00	0.02	0.000	65.02	0.02
11.50	0.06	0.000	65.06	0.05
12.00	**0.49**	0.005	66.58	0.08
12.50	**0.18**	**0.017**	**70.57**	**0.13**
13.00	0.10	**0.017**	**70.47**	**0.13**
13.50	0.07	0.015	69.85	0.12
14.00	0.05	0.012	69.06	0.11
14.50	0.05	0.010	68.30	0.10
15.00	0.04	0.008	67.57	0.09
15.50	0.03	0.006	66.88	0.08
16.00	0.03	0.004	66.27	0.07
16.50	0.03	0.002	65.74	0.07
17.00	0.03	0.001	65.26	0.06
17.50	0.02	0.000	65.03	0.02
18.00	0.02	0.000	65.02	0.02
18.50	0.02	0.000	65.02	0.02
19.00	0.02	0.000	65.02	0.02
19.50	0.02	0.000	65.02	0.02
20.00	0.02	0.000	65.02	0.02
20.50	0.02	0.000	65.02	0.02
21.00	0.02	0.000	65.02	0.02
21.50	0.02	0.000	65.02	0.02
22.00	0.02	0.000	65.02	0.02
22.50	0.02	0.000	65.02	0.02
23.00	0.02	0.000	65.02	0.02
23.50	0.01	0.000	65.02	0.01
24.00	0.01	0.000	65.01	0.01

Typical Lot Development

HydroCad™ input variables:

Total area of contribution of just impervious surfaces less driveway
8,000 sf. 0.1836 Ac.

Composite Curve Number 98

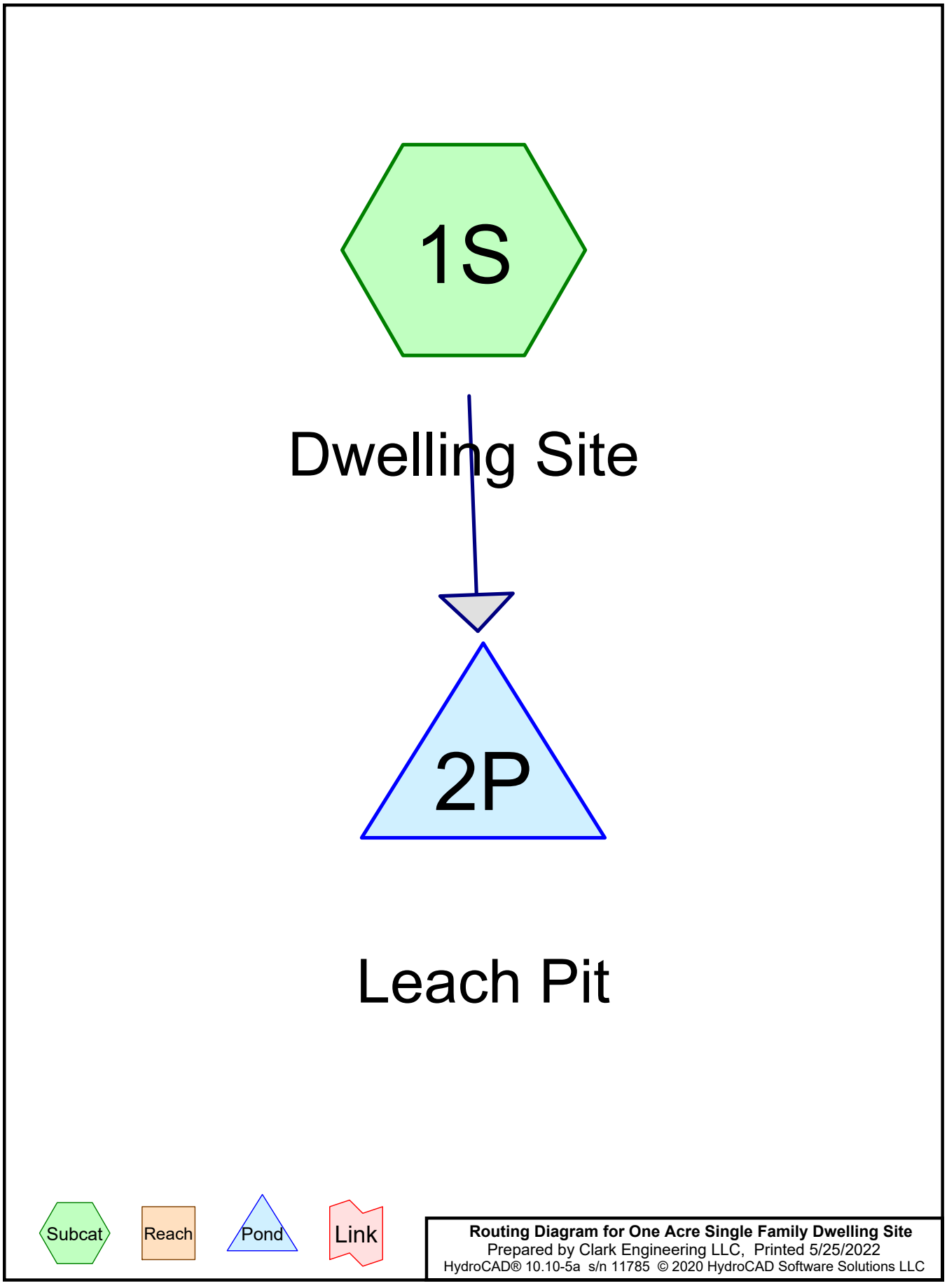
Infiltration System:

4- 6ft. x 6 ft. precast pits w/ 4 ft. of stone in trench configuration

Results:

25 Yr. – 24 Hr. Storm	No overflow; Maximum Depth within Infiltration Basin 2.5'; Time to Exfiltrate 1.7 hrs.
100 Yr. – 24 Hr. Storm	No excess discharge occurs.

It is recommended that the project be conditioned to include a requirement that a minimum of 4- 6x6 leaching catch basins with 4 ft. of stone each be installed to control runoff from each dwelling or additional stormwater calculations be submitted with individual building permit applications to document compliance that no increase in runoff occurs.



Routing Diagram for One Acre Single Family Dwelling Site
Prepared by Clark Engineering LLC, Printed 5/25/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	C	Default	24.00	1	3.26	2
2	10-Year	NRCC 24-hr	C	Default	24.00	1	4.74	2
3	25-Year	NRCC 24-hr	C	Default	24.00	1	5.88	2
4	100-Year	NRCC 24-hr	C	Default	24.00	1	8.15	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.184	98	Dwelling & Patio (1S)
0.184	**98**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.184	Other	1S
0.184		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	0.184	0.184	Dwelling & Patio	1S
0.000	**0.000**	**0.000**	**0.000**	**0.184**	**0.184**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 1S: Dwelling Site Runoff Area=0.184 ac 100.00% Impervious Runoff Depth>2.77"
Tc=6.0 min CN=98 Runoff=0.59 cfs 0.042 af

Pond 2P: Leach Pit Peak Elev=61.15' Storage=0.006 af Inflow=0.59 cfs 0.042 af
Outflow=0.24 cfs 0.042 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.042 af Average Runoff Depth = 2.77"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.184 ac

Summary for Subcatchment 1S: Dwelling Site

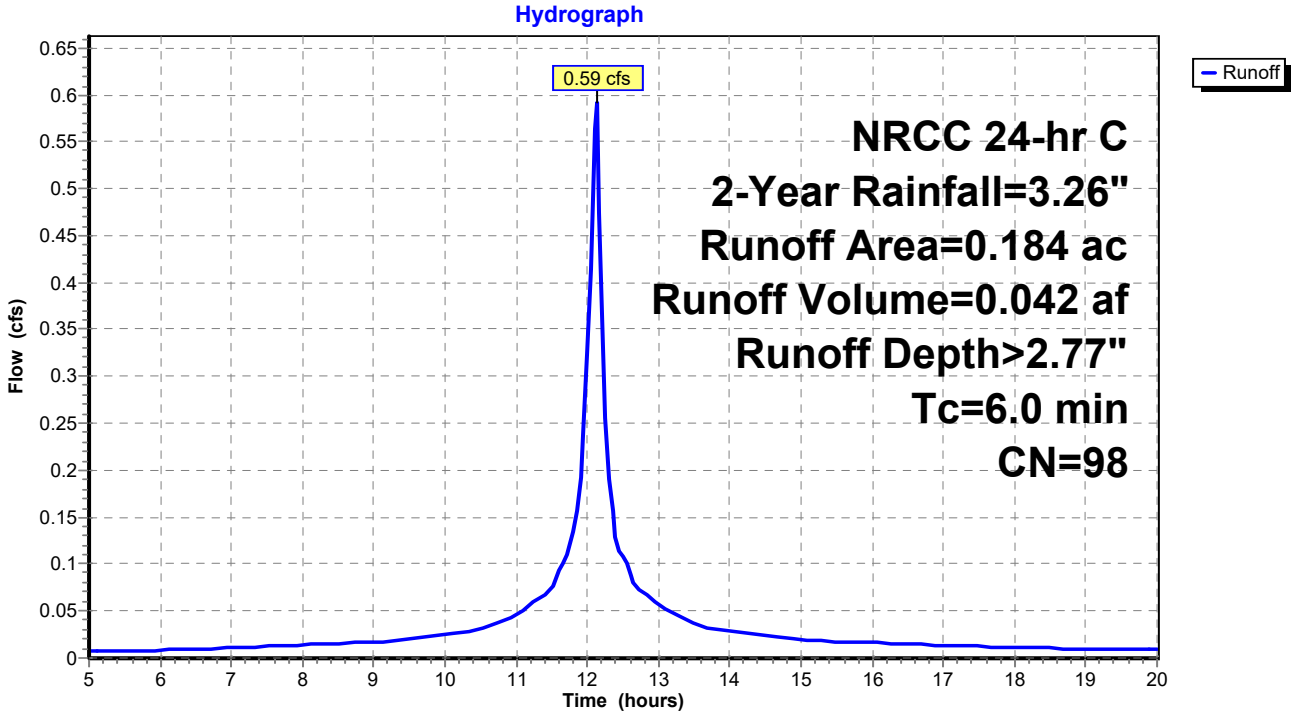
Runoff = 0.59 cfs @ 12.13 hrs, Volume= 0.042 af, Depth> 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.26"

	Area (ac)	CN	Description
*	0.184	98	Dwelling & Patio
	0.184		100.00% Impervious Area

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

Subcatchment 1S: Dwelling Site



Summary for Pond 2P: Leach Pit

Inflow Area = 0.184 ac,100.00% Impervious, Inflow Depth > 2.77" for 2-Year event
Inflow = 0.59 cfs @ 12.13 hrs, Volume= 0.042 af
Outflow = 0.24 cfs @ 12.05 hrs, Volume= 0.042 af, Atten= 60%, Lag= 0.0 min
Discarded = 0.24 cfs @ 12.05 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 61.15' @ 12.27 hrs Surf.Area= 0.028 ac Storage= 0.006 af

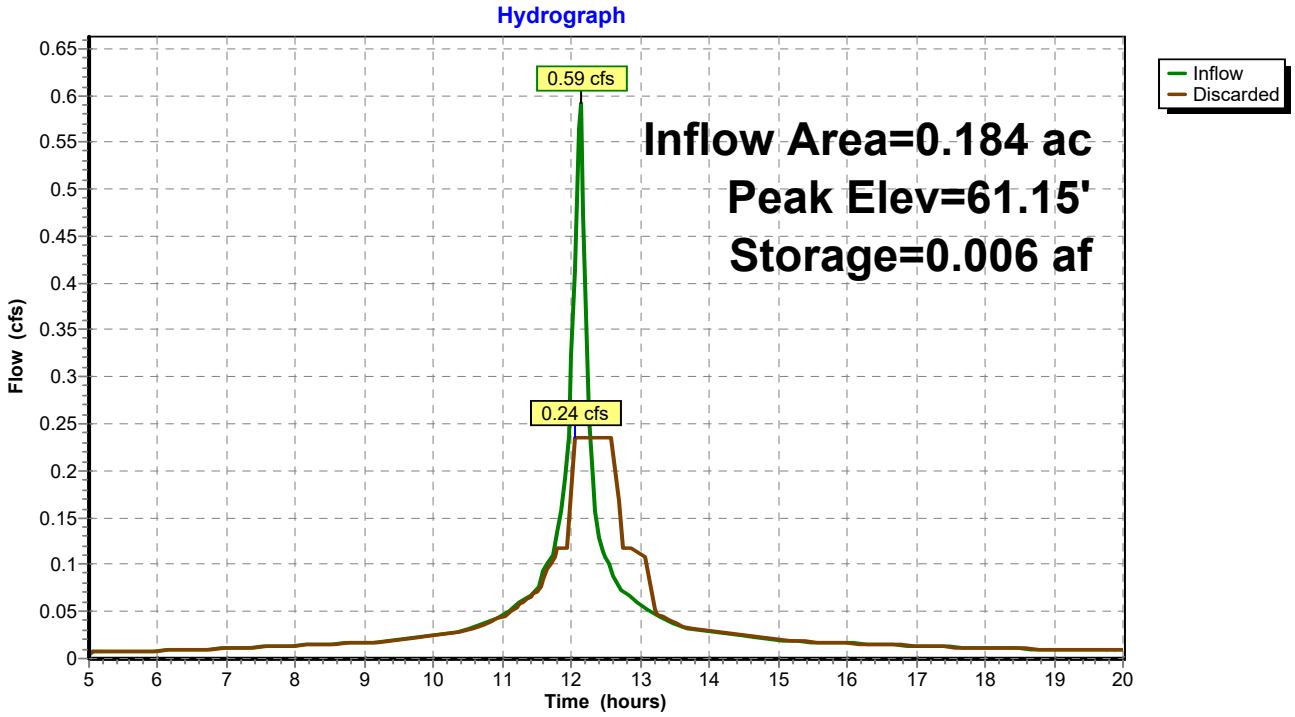
Plug-Flow detention time= 6.8 min calculated for 0.042 af (100% of inflow)
Center-of-Mass det. time= 6.3 min (745.1 - 738.8)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	0.002 af	**14.00'D x 0.50'H Vertical Cone/Cylinder** x 4 0.007 af Overall x 35.0% Voids
#2	60.50'	0.020 af	**14.00'D x 6.00'H Vertical Cone/Cylinder** x 4 0.085 af Overall - 0.018 af Embedded = 0.067 af x 30.0% Voids
#3	60.50'	0.016 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 4 Inside #2 0.018 af Overall - 3.0" Wall Thickness = 0.016 af
		0.038 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.24 cfs @ 12.05 hrs HW=60.51' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Pond 2P: Leach Pit



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 1S: Dwelling Site Runoff Area=0.184 ac 100.00% Impervious Runoff Depth>4.09"
Tc=6.0 min CN=98 Runoff=0.87 cfs 0.063 af

Pond 2P: Leach Pit Peak Elev=62.16' Storage=0.012 af Inflow=0.87 cfs 0.063 af
Outflow=0.24 cfs 0.063 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.063 af Average Runoff Depth = 4.09"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.184 ac

Summary for Subcatchment 1S: Dwelling Site

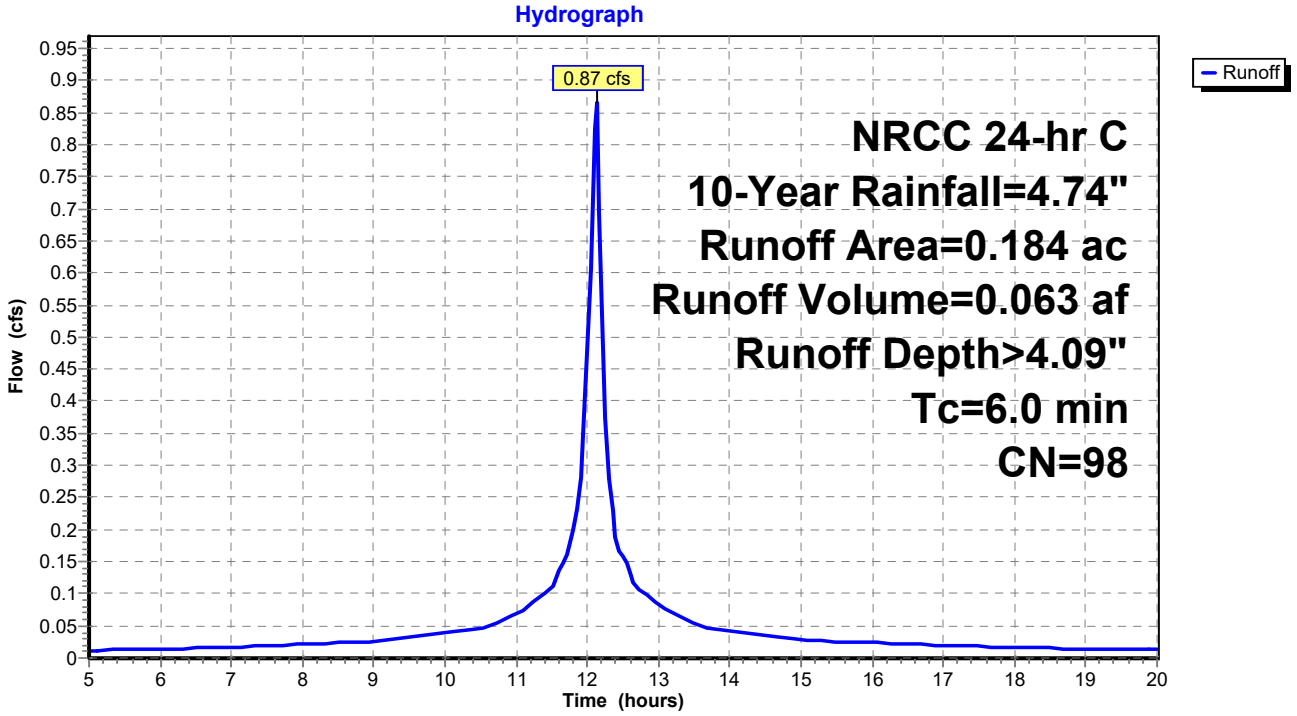
Runoff = 0.87 cfs @ 12.13 hrs, Volume= 0.063 af, Depth> 4.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.74"

	Area (ac)	CN	Description
*	0.184	98	Dwelling & Patio
	0.184		100.00% Impervious Area

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

Subcatchment 1S: Dwelling Site



Summary for Pond 2P: Leach Pit

Inflow Area = 0.184 ac,100.00% Impervious, Inflow Depth > 4.09" for 10-Year event
Inflow = 0.87 cfs @ 12.13 hrs, Volume= 0.063 af
Outflow = 0.24 cfs @ 11.95 hrs, Volume= 0.063 af, Atten= 73%, Lag= 0.0 min
Discarded = 0.24 cfs @ 11.95 hrs, Volume= 0.063 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 62.16' @ 12.35 hrs Surf.Area= 0.028 ac Storage= 0.012 af

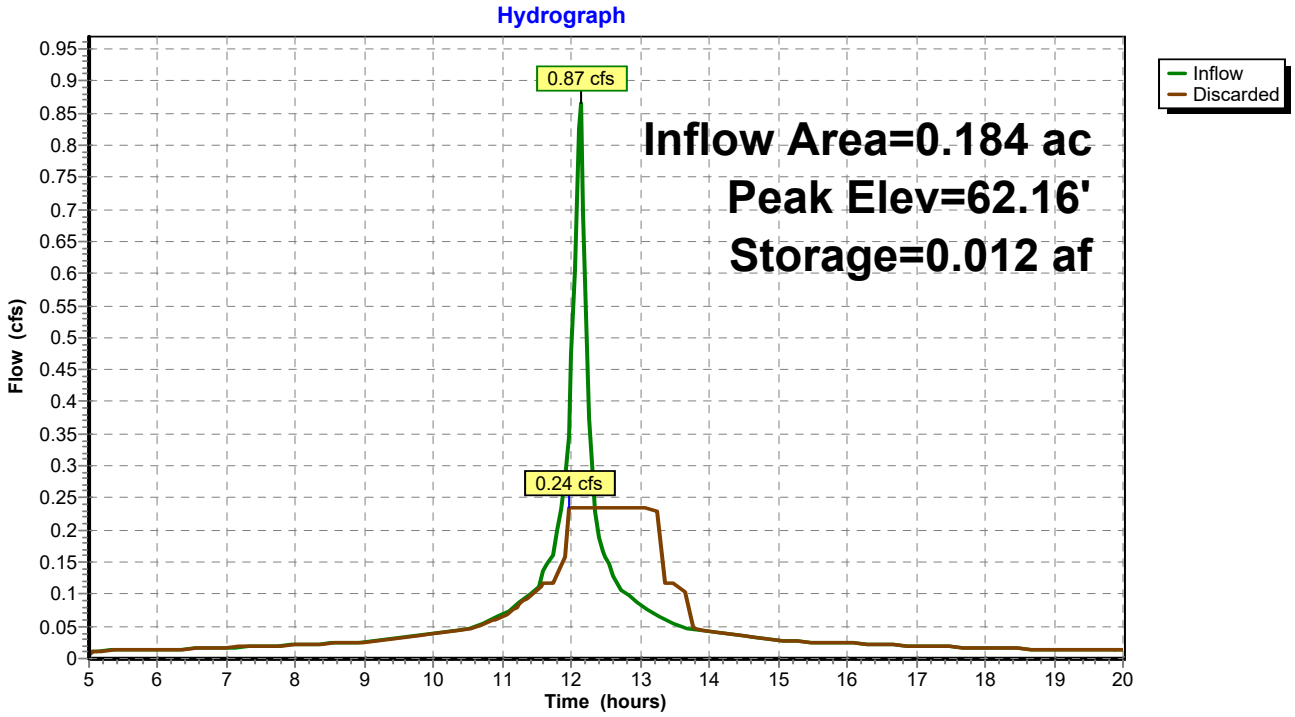
Plug-Flow detention time= 12.6 min calculated for 0.062 af (100% of inflow)
Center-of-Mass det. time= 12.1 min (748.2 - 736.1)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	0.002 af	**14.00'D x 0.50'H Vertical Cone/Cylinder** x 4 0.007 af Overall x 35.0% Voids
#2	60.50'	0.020 af	**14.00'D x 6.00'H Vertical Cone/Cylinder** x 4 0.085 af Overall - 0.018 af Embedded = 0.067 af x 30.0% Voids
#3	60.50'	0.016 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 4 Inside #2 0.018 af Overall - 3.0" Wall Thickness = 0.016 af
		0.038 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.24 cfs @ 11.95 hrs HW=60.52' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Pond 2P: Leach Pit



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 1S: Dwelling Site Runoff Area=0.184 ac 100.00% Impervious Runoff Depth>5.10"
Tc=6.0 min CN=98 Runoff=1.08 cfs 0.078 af

Pond 2P: Leach Pit Peak Elev=63.04' Storage=0.018 af Inflow=1.08 cfs 0.078 af
Outflow=0.24 cfs 0.078 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.078 af Average Runoff Depth = 5.10"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.184 ac

Summary for Subcatchment 1S: Dwelling Site

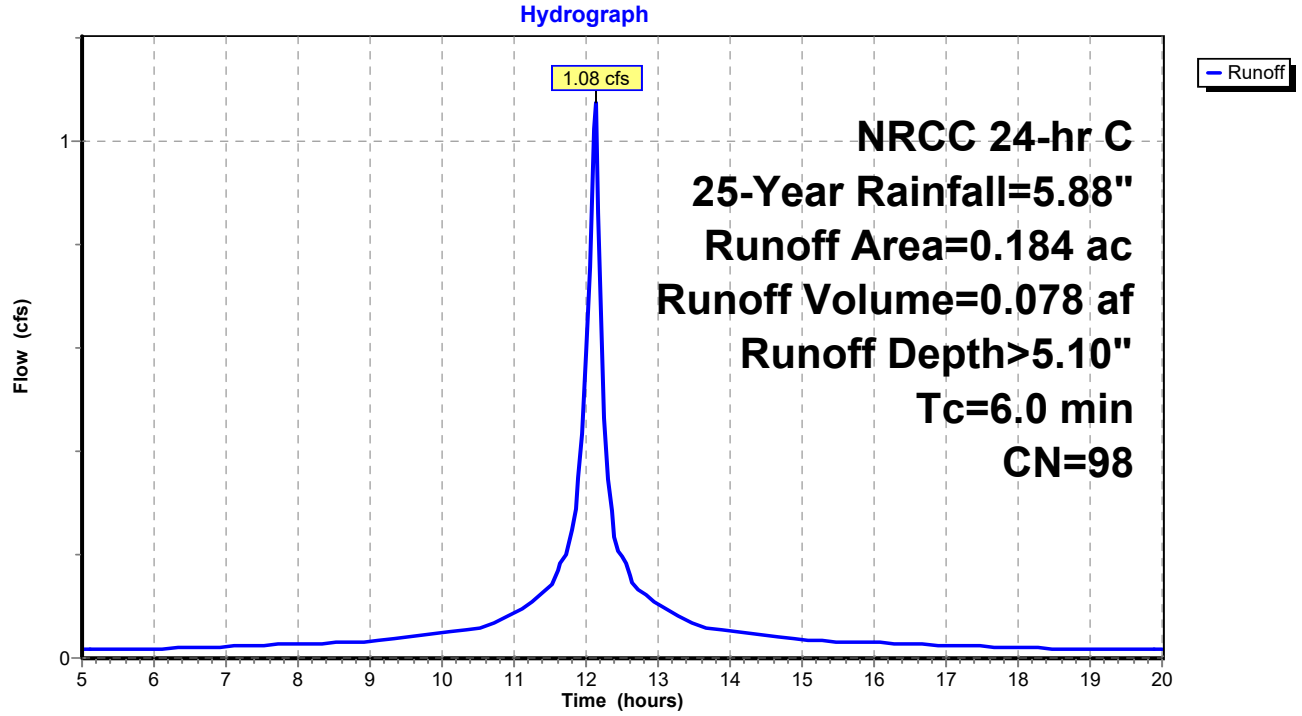
Runoff = 1.08 cfs @ 12.13 hrs, Volume= 0.078 af, Depth> 5.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=5.88"

	Area (ac)	CN	Description
*	0.184	98	Dwelling & Patio
	0.184		100.00% Impervious Area

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

Subcatchment 1S: Dwelling Site



Summary for Pond 2P: Leach Pit

Inflow Area = 0.184 ac,100.00% Impervious, Inflow Depth > 5.10" for 25-Year event
Inflow = 1.08 cfs @ 12.13 hrs, Volume= 0.078 af
Outflow = 0.24 cfs @ 11.90 hrs, Volume= 0.078 af, Atten= 78%, Lag= 0.0 min
Discarded = 0.24 cfs @ 11.90 hrs, Volume= 0.078 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 63.04' @ 12.41 hrs Surf.Area= 0.028 ac Storage= 0.018 af

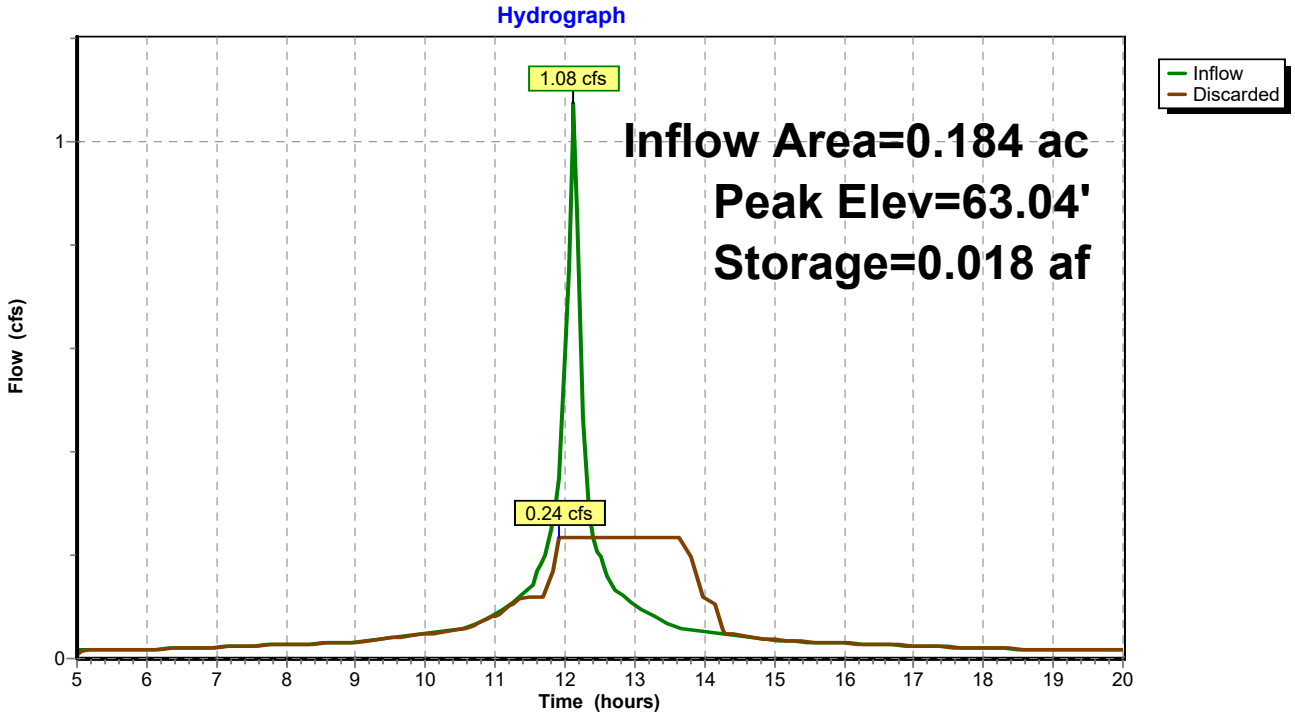
Plug-Flow detention time= 18.5 min calculated for 0.078 af (100% of inflow)
Center-of-Mass det. time= 18.0 min (753.0 - 735.0)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	0.002 af	**14.00'D x 0.50'H Vertical Cone/Cylinder** x 4 0.007 af Overall x 35.0% Voids
#2	60.50'	0.020 af	**14.00'D x 6.00'H Vertical Cone/Cylinder** x 4 0.085 af Overall - 0.018 af Embedded = 0.067 af x 30.0% Voids
#3	60.50'	0.016 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 4 Inside #2 0.018 af Overall - 3.0" Wall Thickness = 0.016 af
		0.038 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.24 cfs @ 11.90 hrs HW=60.56' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Pond 2P: Leach Pit



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 1S: Dwelling Site Runoff Area=0.184 ac 100.00% Impervious Runoff Depth>7.11"
Tc=6.0 min CN=98 Runoff=1.49 cfs 0.109 af

Pond 2P: Leach Pit Peak Elev=65.05' Storage=0.029 af Inflow=1.49 cfs 0.109 af
Outflow=0.24 cfs 0.109 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.109 af Average Runoff Depth = 7.11"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.184 ac

Summary for Subcatchment 1S: Dwelling Site

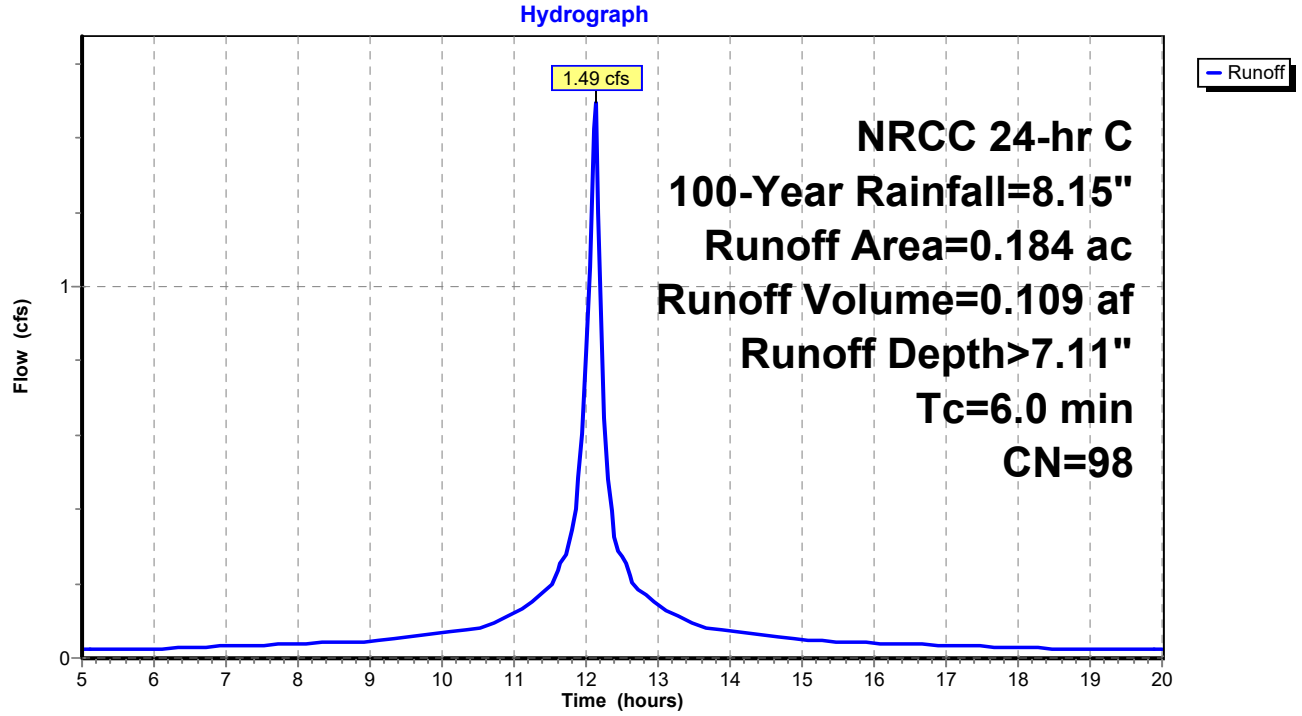
Runoff = 1.49 cfs @ 12.13 hrs, Volume= 0.109 af, Depth> 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.15"

	Area (ac)	CN	Description
*	0.184	98	Dwelling & Patio
	0.184		100.00% Impervious Area

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

Subcatchment 1S: Dwelling Site



Summary for Pond 2P: Leach Pit

Inflow Area = 0.184 ac,100.00% Impervious, Inflow Depth > 7.11" for 100-Year event
Inflow = 1.49 cfs @ 12.13 hrs, Volume= 0.109 af
Outflow = 0.24 cfs @ 11.65 hrs, Volume= 0.109 af, Atten= 84%, Lag= 0.0 min
Discarded = 0.24 cfs @ 11.65 hrs, Volume= 0.109 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 65.05' @ 12.58 hrs Surf.Area= 0.028 ac Storage= 0.029 af

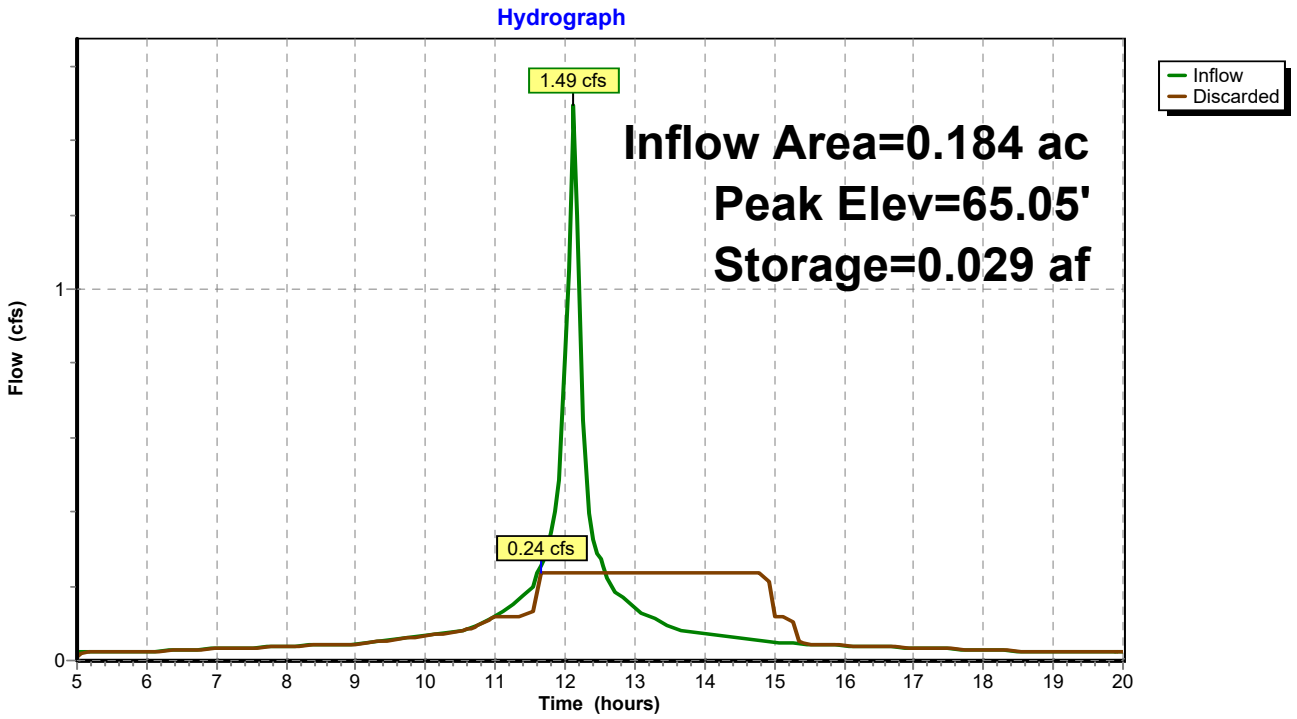
Plug-Flow detention time= 33.6 min calculated for 0.109 af (100% of inflow)
Center-of-Mass det. time= 33.0 min (766.9 - 733.9)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	0.002 af	**14.00'D x 0.50'H Vertical Cone/Cylinder** x 4 0.007 af Overall x 35.0% Voids
#2	60.50'	0.020 af	**14.00'D x 6.00'H Vertical Cone/Cylinder** x 4 0.085 af Overall - 0.018 af Embedded = 0.067 af x 30.0% Voids
#3	60.50'	0.016 af	**6.00'D x 6.00'H Vertical Cone/Cylinder** x 4 Inside #2 0.018 af Overall - 3.0" Wall Thickness = 0.016 af
		0.038 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.24 cfs @ 11.65 hrs HW=60.51' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Pond 2P: Leach Pit



Pipe Sizing

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-Year	NRCC 24-hr	C	Default	24.00	1	5.88	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.121	39	>75% Grass cover, Good, HSG A (1S)
0.109	98	Paved roads w/curbs & sewers, HSG A (1S)

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.121	0.000	0.000	0.000	0.000	0.121	>75% Grass cover, Good	1S
0.109	0.000	0.000	0.000	0.000	0.109	Paved roads w/curbs & sewers	1S

Summary for Subcatchment 1S: (new Subcat)

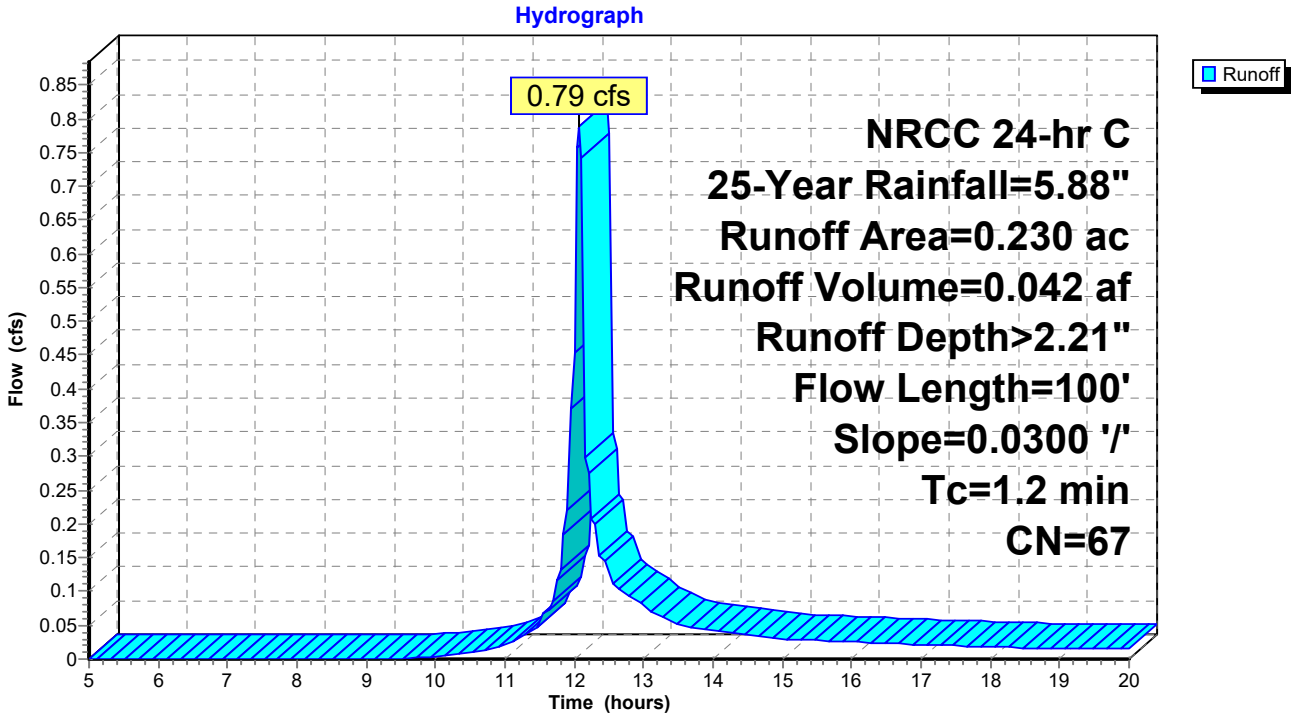
Runoff = 0.79 cfs @ 12.07 hrs, Volume= 0.042 af, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=5.88"

Area (ac)	CN	Description
0.121	39	>75% Grass cover, Good, HSG A
0.109	98	Paved roads w/curbs & sewers, HSG A
0.230	67	Weighted Average
0.121		52.61% Pervious Area
0.109		47.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0300	1.40		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 2.40"

Subcatchment 1S: (new Subcat)



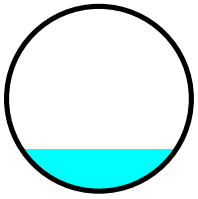
Summary for Reach 2R: (new Reach)

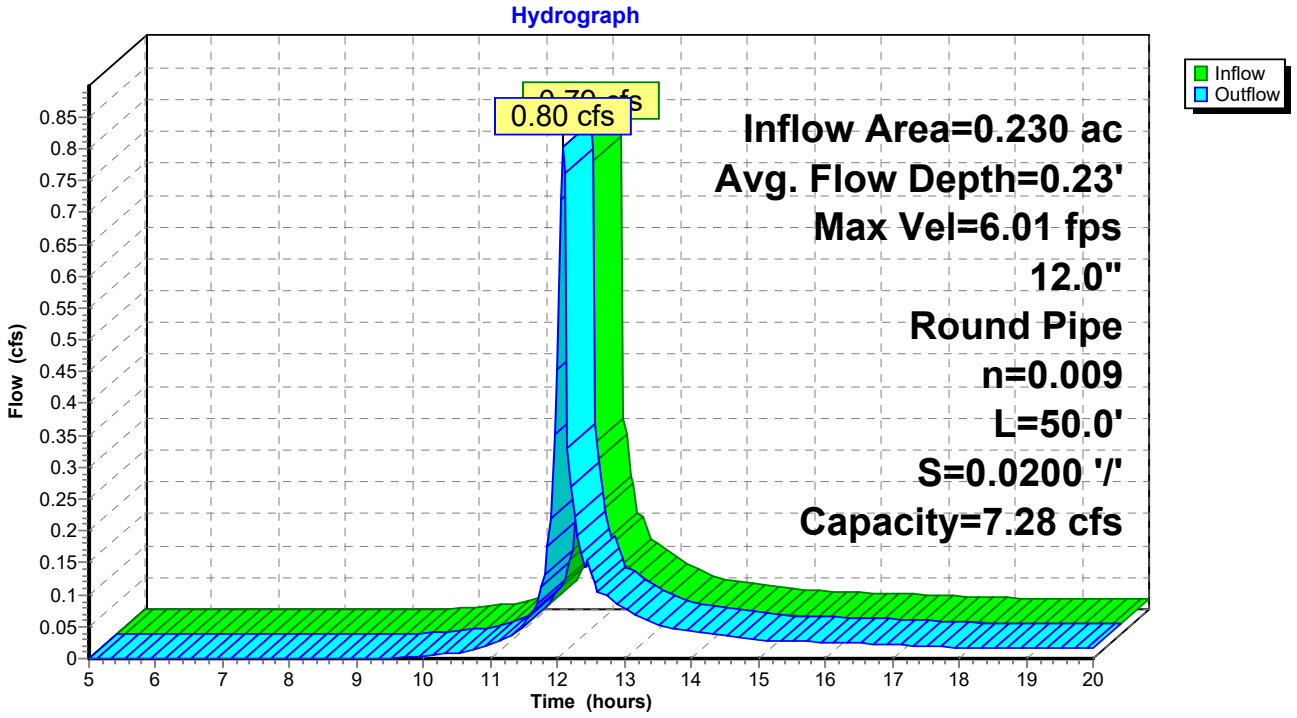
Inflow Area = 0.230 ac, 47.39% Impervious, Inflow Depth > 2.21" for 25-Year event
Inflow = 0.79 cfs @ 12.07 hrs, Volume= 0.042 af
Outflow = 0.80 cfs @ 12.08 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.01 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.29 fps, Avg. Travel Time= 0.4 min

Peak Storage= 7 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.23' , Surface Width= 0.84'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 7.28 cfs

12.0" Round Pipe
n= 0.009 Corrugated PE, smooth interior
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 50.00', Outlet Invert= 49.00'





TSS and Phosphorus Removal
Town of Harwich Selectboard Stormwater Regulation

Under Standard 4 (page 6) of the Stormwater Report it notes that the deep sump catch basins and the leaching catch basins provide a TSS removal of 85%. Section 8.D.1.b.ii of the Town of Harwich Comprehensive Stormwater and Illicit Discharge Regulations (the Stormwater Regulations) require 90% TSS removal from new development projects.

A 90 % TSS removal has been achieved based upon the State of New Hampshire Stormwater Handbook. Documentation that subsurface leaching structures achieving 90 % TSS removal has been added as an Appendix.

Removal of Total Phosphorus. Section 8.D.1.b.ii of the Stormwater Regulations requires 50% TP removal from new development sites.

A 50 % Phosphorus removal has been achieved based upon the State of New Hampshire Stormwater Handbook. Documentation that subsurface leaching structures achieving 90 % Phosphorus removal has been added as an Appendix.

APPENDIX II

Supporting Documents

Appendix B
New Hampshire Stormwater Manual
VOLUME 2 Post-Construction Best Management Practices Selection & Design December 2008

Appendix B.
BMP Pollutant Removal Efficiency

Pollutant Removal Efficiencies for Best Management Practices for Use in Pollutant Loading Analysis

Best Management Practice (BMP) removal efficiencies for pollutant loading analysis for total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP) are presented in the table below. These removal efficiencies were developed by reviewing various literature sources and using best professional judgment based on literature values and general expectation of how values for different BMPS should relate to one another. The intent is to update this information and add BMPs and removal efficiencies for other parameters as more information/data becomes available in the future.

NHDES will consider other BMP removal efficiencies if sufficient documentation is provided.

Please note that all BMPs must be designed in accordance with the specifications in the Alteration of Terrain (AoT) Program Administrative Rules (Env-Wq 1500). If BMPs are not designed in accordance with the AoT Rules, NHDES may require lower removal efficiencies to be used in the analysis.

BMP in Series: When BMPs are placed in series, the BMP with the highest removal efficiency shall be the efficiency used in the model for computing annual loadings. Adding efficiencies together is generally not allowed because removals typically decrease rapidly with decreasing influent concentration and, in the case of primary BMPs (i.e., stormwater ponds, infiltration and filtering practices), pre-treatment is usually part of the design and is therefore, most likely already accounted for in the efficiencies cited for these BMPs.

Pollutant Removal Efficiencies for Best Management Practices for Use in Pollutant Loading Analysis				Values Accepted for Loading Analyses		
BMP Type	**BMP**	**Notes**	**Lit. Ref.**	**TSS**	**TN**	**TP**
Stormwater Ponds	Wet Pond		B, F	70%	35%	45%
	Wet Extended Detention Pond		A, B	80%	55%	68%
	Micropool Extended Detention Pond	TBA				
	Multiple Pond System	TBA				
	Pocket Pond	TBA				
Stormwater Wetlands	Shallow Wetland		A, B, F, I	80%	55%	45%
	Extended Detention Wetland		A, B, F, I	80%	55%	45%
	Pond/Wetland System	TBA				
	Gravel Wetland		H	95%	85%	64%
Infiltration Practices	Infiltration Trench (≥75 ft from surface water)		B, D, I	90%	55%	60%
	Infiltration Trench (<75 ft from surface water)		B, D, I	90%	10%	60%
	Infiltration Basin (≥75 ft from surface water)		A, F, B, D, I	90%	60%	65%
	Infiltration Basin (<75 ft from surface water)		A, F, B, D, I	90%	10%	65%
	Dry Wells			90%	55%	60%
	Drip Edges			90%	55%	60%
Filtering Practices	Aboveground or Underground Sand Filter that infiltrates WQV (≥75 ft from surface water)		A, F, B, D, I	90%	60%	65%
	Aboveground or Underground Sand Filter that infiltrates WQV (<75 ft from surface water)		A, F, B, D, I	90%	10%	65%
	Aboveground or Underground Sand Filter with underdrain		A, I, F, G, H	85%	10%	45%
	Tree Box Filter	TBA				
	Bioretention System		I, G, H	90%	65%	65%
	Permeable Pavement that infiltrates WQV (≥75 ft from surface water)		A, F, B, D, I	90%	60%	65%
	Permeable Pavement that infiltrates WQV (<75 ft from surface water)		A, F, B, D, I	90%	10%	65%
	Permeable Pavement with underdrain		Use TN and TP values for sand filter w/ underdrain and outlet pipe	90%	10%	45%

Pollutant Removal Efficiencies for Best Management Practices for Use in Pollutant Loading Analysis				Values Accepted for Loading Analyses		
BMP Type	**BMP**	**Notes**	**Lit. Ref.**	**TSS**	**TN**	**TP**
Treatment Swales	Flow Through Treatment Swale	TBA				
Vegetated Buffers	Vegetated Buffers		A, B, I	73%	40%	45%
Pre-Treatment Practices	Sediment Forebay	TBA				
	Vegetated Filter Strip		A, B, I	73%	40%	45%
	Vegetated Swale		A, B, C, F, H, I	65%	20%	25%
	Flow-Through Device - Hydrodynamic Separator		A, B, G, H	35%	10%	5%
	Flow-Through Device - ADS Underground Multichamber Water Quality Unit (WQU)		G, H	72%	10%	9%
	Other Flow-Through Devices	TBA				
	Off-line Deep Sump Catch Basin		J, K, L, M	15%	5%	5%