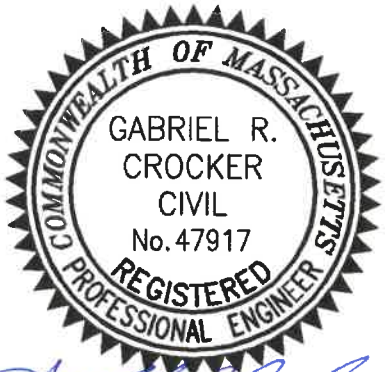
Stormwater Analysis & Report
For
Residential Definitive Subdivision at Massapoag Street Weymouth, MA

April, 2020
Revised November 19, 2021
Revised January 11, 2022

Prepared for:
Weathervane Massapoag, LLC.
190 Old Derby Street, Suite 311
Hingham, MA 02043

Prepared by:
Crocker Design Group, LLC
2 Sharp Street, Unit A
Hingham, MA 02043



1-11-2022

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SECTION 1 - NARRATIVE

1.1 EXECUTIVE SUMMARY

In accordance with the provisions of the Rules and Regulations of the Planning Board of Weymouth, Massachusetts Governing the Subdivision of Land, the Applicant, Weathervane Massapoag, LLC proposes to develop a residential subdivision consisting of seven (7) single family lots as an extension to the existing Massapoag Street, a private-way.

The site is bounded by existing residential properties to the east and south, woods and wetlands to the north and west. The site topography ranges from a high of approximately 206' in front of the existing house and then slopes down toward the existing wetlands along the north, west and south sides, to an approximate low elevation of 162 to the north, 167 to the west and 183 to the south and to Massapoag Street at 190 +/- to the east. The Braintree town line exists along the western edge of the property. The site is mostly wooded and includes an existing single-family residential house with existing driveway and shed. **The extension of Massapoag Street, including the roundabout has been constructed along with utilities within the road right of way. Please refer to the Definitive Subdivision Plans revised 1/11/22.**

The property consists of 5.4 +/- acres in total in Weymouth and approximately 0.08 acres in Braintree (note the Braintree land is not counted toward the required subdivision and/or zoning requirements in Weymouth). The property is Zoned Residence R-1 and is located within the Watershed Protection District. **The wetland to the north of the project is tributary to the Mill River which is and Outstanding Resource Water and a critical area under the MA DEP Stormwater Standards.** The site is entirely outside of the FEMA 100-year floodplain and is not located within any NHESP Estimated or Priority Habitat areas. Please refer to Section 1.9 - Figures for the accompanying figures.

The proposed project consists of subdividing the property into seven (7) single-family residential parcels meeting the requirements of the Residence R-1 district and Watershed Protection District as well as the subdivision roadway extension and associated drainage and utility infrastructure. The project is considered a new development and has been designed to comply with the Massachusetts Stormwater Regulations. The Applicant is seeking several subdivision design waivers as you'll see on the plans and accompanying Planning Board Application submittal.

1.2 OBJECTIVE OF CALCULATIONS

The purpose of this stormwater analysis is to examine the stormwater runoff from the proposed site based upon the Massachusetts Department of Environmental Protection Stormwater Management Standards and the applicable provisions of the Town of Weymouth subdivision requirements.

The goal of the stormwater management system design on this project is to provide improved water quality, match/reduce post-development peak runoff rates below pre-development peak flow rates, minimize total area of land disturbance needed, maximize the opportunities for recharge and infiltration, and protect the surrounding area from any potential flooding and/or environmental impacts associated with the unmitigated condition. The following stormwater hydrology calculations were performed using the 2-year, 10-year, 25-year, and 100-year frequency, **NOAA-14 precipitation data** and were compared for both pre-development and post-development conditions.

1.3 METHODOLOGY

We utilized the latest version of Hydro CAD for the overall stormwater hydrology/routing analysis to assess and compare peak rates of runoff at the various discharge points from the subject property. We then utilized the Hydraflow Storm Sewers Extension Pack through AutoCAD Civil 3d to analyze the pipe design and to select appropriate pipe sizing.

Refer to Section 1.3 – Hydrocad Model, which includes the detailed print-out of the HydroCAD Model Reports for the 2, 10, 25 and 100-year storms as well as Section 7 – Hydraulic Pipe Analysis / Sizing, which includes the Hydraflow reports for the 10 and 100-year storms for pipe capacity analysis and sizing.

1.4 SITE HYDROLOGY

Existing Conditions

Please refer to the attached Existing Conditions Watershed Analysis Plan in Section 3 of this report. The property has been divided into several subcatchment areas based on the existing site topography and flow paths. These subcatchments then combine where appropriate from an analysis standpoint where they discharge toward wetland resource areas and the existing Massapoag Street right-of-way. Each subcatchment area has been analyzed and assigned an appropriate Curve Number to represent the existing vegetative cover and underlying soils conditions. Times of concentration have been computed and the extent of pervious vs. impervious cover computed. This data was then input into HydroCAD to determine peak rates of runoff at the various design points (identified as "Points of Analysis") which provide the locations for which to compare existing versus proposed conditions to document compliance that the peak rates have been reduced in the regulatory storm events as required. A Summary table is provided in the Hydrology Model Results and Conclusions Section below.

Proposed Conditions

Please refer to the attached Proposed Conditions Watershed Analysis Plan in Section 3 of this report. The proposed subdivision has been divided several subcatchment areas and

the stormwater underground infiltration chambers and their respective outlets have been modeled. Appropriate Times of Concentration and Curve Numbers have been assigned for each catchment area. A Summary table is provided in the Hydrology Model Results and Conclusions Section below.

Hydrology Model Results and Conclusions

The goal of the stormwater design for the project is to fully comply with the Massachusetts Stormwater Standards and the Town of Weymouth regulations. This analysis confirms that the stormwater system is receiving proper treatment and peak rates of runoff have been matched or reduced to below pre-development rates using stormwater Best Management Practices including deep sump hooded catch basins, **grass conveyance swales, two (2) underground infiltration chamber systems. The underground infiltration systems proposed include the ADS Isolator Row treatment system. The underground infiltration systems, have been sized and designed to meet the required TSS removal, to infiltrate the required recharge and provide peak flow attenuation.** The water quality (CDS) unit has been properly sized in accordance with MADEP guidance for water quality flows. The results of the pre- and post-development hydrology calculations provided in Section 3 are summarized in the following table:

Peak Rate Analysis				
Point of Analysis	**2-Yr (CFS)**	**10-Yr (CFS)**	**25-Yr (CFS)**	**100-Yr (CFS)**
#1 Existing	0.00	0.01	0.06	0.39
#1 Proposed	0.00	0.00	0.01	**0.39**
#2 Existing	0.00	0.01	0.05	0.43
#2 Proposed	0.00	0.01	0.05	**0.30**
#3 Existing	0.00	0.05	0.16	0.48
#3 Proposed	0.00	0.01	0.04	**0.17**
#4 Existing	0.08	0.15	0.20	0.26
#4 Proposed	0.00	0.00	0.00	0.00

Point of Analysis	2-Yr (AcFt)	10-Yr (AcFt)	25-Yr (AcFt)	100-Yr (AcFt)
#1 Existing	0.000	0.008	0.027	0.074
#1 Proposed	0.000	0.001	0.004	0.084
#2 Existing	0.000	0.006	0.030	0.095
#2 Proposed	0.00	0.006	0.017	0.084
#3 Existing	0.001	0.012	0.025	0.050
#3 Proposed	0.000	0.004	0.009	0.020
#4 Existing	0.006	0.011	0.015	0.020
#4 Proposed	0.000	0.000	0.000	0.000
Total Existing	0.007	0.037	0.097	0.239
Total Proposed	0.000	0.011	0.030	0.188

In all cases storm events, the proposed peak rates are less than or equal to the predevelopment peak rates. The project results in an overall decrease in stormwater volume discharge for all storm events. Collectively there is less volume discharging to the wetlands in the proposed condition compared to the existing.

As can be seen based on the above tables, the peak stormwater runoff rates **and volumes** generated by the development are the same or less in post development conditions versus the existing conditions in all cases. Refer to Section 3 for copies of the HydroCAD Analysis and pre and post development watershed plans.

1.5 STORMWATER MANAGEMENT

The following section describes each of the ten (10) Massachusetts Stormwater Management Standards and describes how the project complies with each.

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

All new stormwater system conveyances are treated prior to discharge. The drainage system has been designed to direct stormwater runoff from impervious areas through stormwater BMPs designed to capture, convey, treat, detain, recharge and infiltrate the runoff prior to discharge.

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

The stormwater BMPs employed result in peak discharge rates not being exceeded from predevelopment conditions.

Standard 3: Recharge – Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The stormwater system has been designed to comply and exceed the minimum recharge volume requirements.

Standard 4: Water Quality – Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

The project utilizes deep sump hooded catch basins and ADS Isolator Row Underground Infiltration chambers to fully comply with the TSS requirements of 80% removal. The chambers are designed to treat the 1" water quality volume (WQV) for the impervious area captured on site due to the site being within a critical area. In addition, deep sump hooded catch basins are proposed. Calculations for water quality volume can be found in Section 4.3, and treatment train efficiency can be found in Section 4.4. A long-term Operation and Maintenance Manual for these systems can be found in Section 5.

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

The project is not considered a LUHPPL (Land Use with Higher Potential Pollutant Load).

Standard 6: Critical Areas – Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near

or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

The wetland to the north of the project is tributary to the Mill River which is and Outstanding Resource Water and a critical area under the MA DEP Stormwater Standards, therefore the project has been design to comply with all applicable Stormwater Standards and to treat 1-inch of water quality volume.

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

The project qualifies as a new development and has been designed to comply with the requirements as if it were entirely new development.

Standard 8: Construction Period Pollution Prevention Plan and Erosion and Sedimentation Control – A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

An Erosion and Sedimentation Controls Plan has been incorporated into the Site Plans.

Standard 9: Operation and Maintenance Plan – A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

A long-term Operation and Maintenance Plan has been incorporated herein. See Section 5 of the Report.

Standard 10: Prohibition of Illicit Discharges – All illicit discharges to the stormwater management system are prohibited.

An Illicit Discharge Compliance Statement is included as required.

1.6 BEST MANAGEMENT PRACTICES (BMP'S)

A system of deep sump hooded catch basins, and underground infiltration chambers will be used to treat stormwater runoff on the site. See Section 4.5: Total Suspended Solids (TSS) Calculations.

1.7 PIPE SIZING

Refer to Section 7 for the output results from the Hydraflow Sewer Storm Sewers Extension for AutoCAD Civil 3D. Hydraflow utilized the Rational Method. The tributary area for each inlet/subcatchment area has been computed along with pipe length, slope and friction coefficient. The Rational Method is then utilized to determine the hydraulic grade line. For design purposes, this approach was used to size the pipes such that the 10-year storm event is contained within the pipe. The 100-year storm was then checked to confirm the hydraulic grade line for the pipe network does not exceed the rim elevations of the drainage structures.

1.8 CONCLUSION

In conclusion, the project has been designed in accordance with the requirements of the MA Stormwater Management Regulations and in compliance with the Town of Weymouth Stormwater Management and Erosion Control By-Law.

1.9 FIGURES

The following pages contain the following accompanying figures:

FIG 1 SITE LOCUS USGS MAP
FIG 2 SITE LOCUS ORTHOGRAPHIC MAP
FIG 3 NHESP HABITAT MAP
FIG 4 FEMA FLOODPLAIN MAP
FIG 5 MASSDEP WETLANDS MAP

CROCKER DESIGN GROUP, LLC.

2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-820-0416

MASSACHUSETTS

TITLE:

USGS MAP

MASSPOAG STREET,
WEYMOTH, MA

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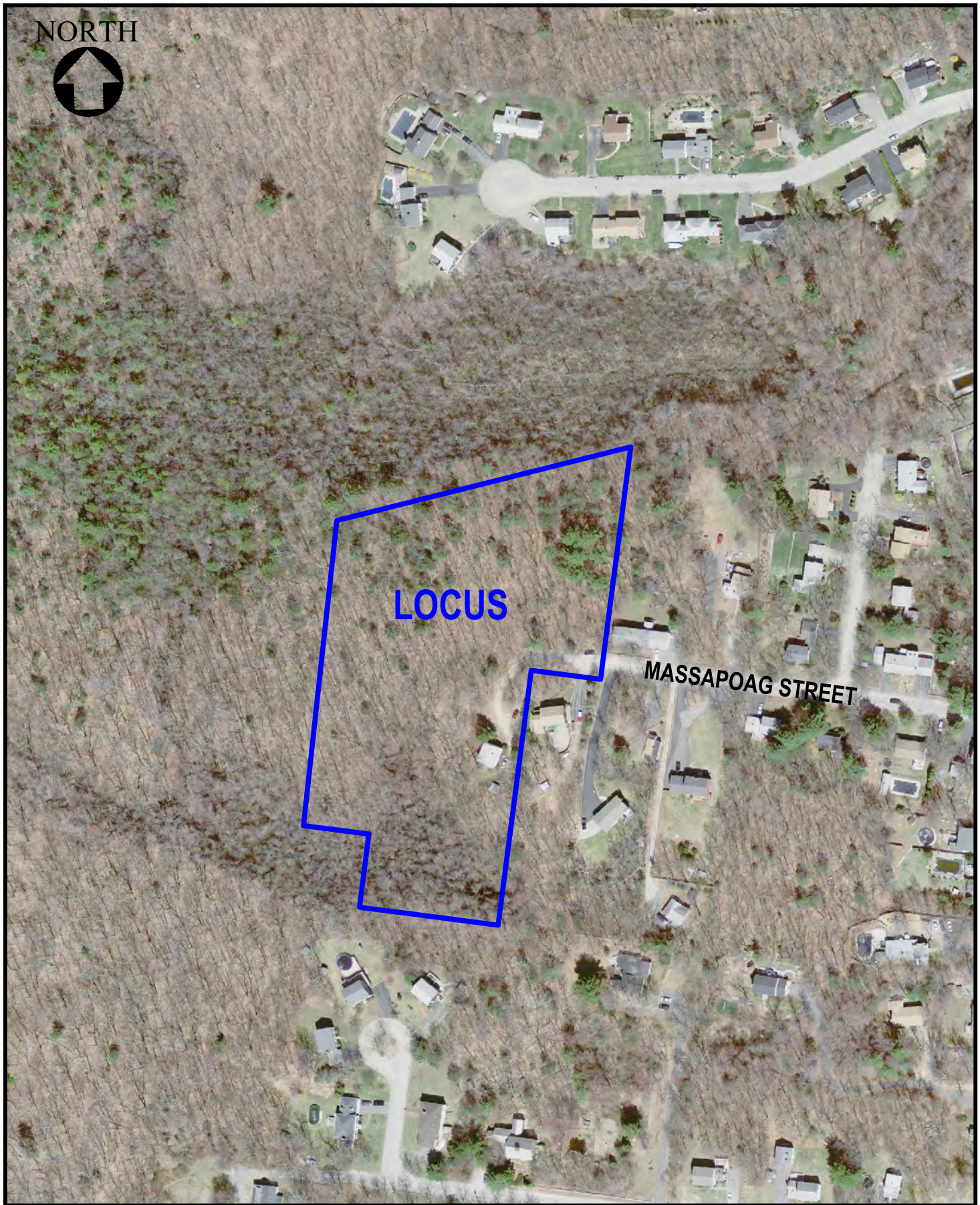

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2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-820-0416

MASSACHUSETTS

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AERIAL MAP

MASSPOAG STREET,
WEYMOUTH, MA

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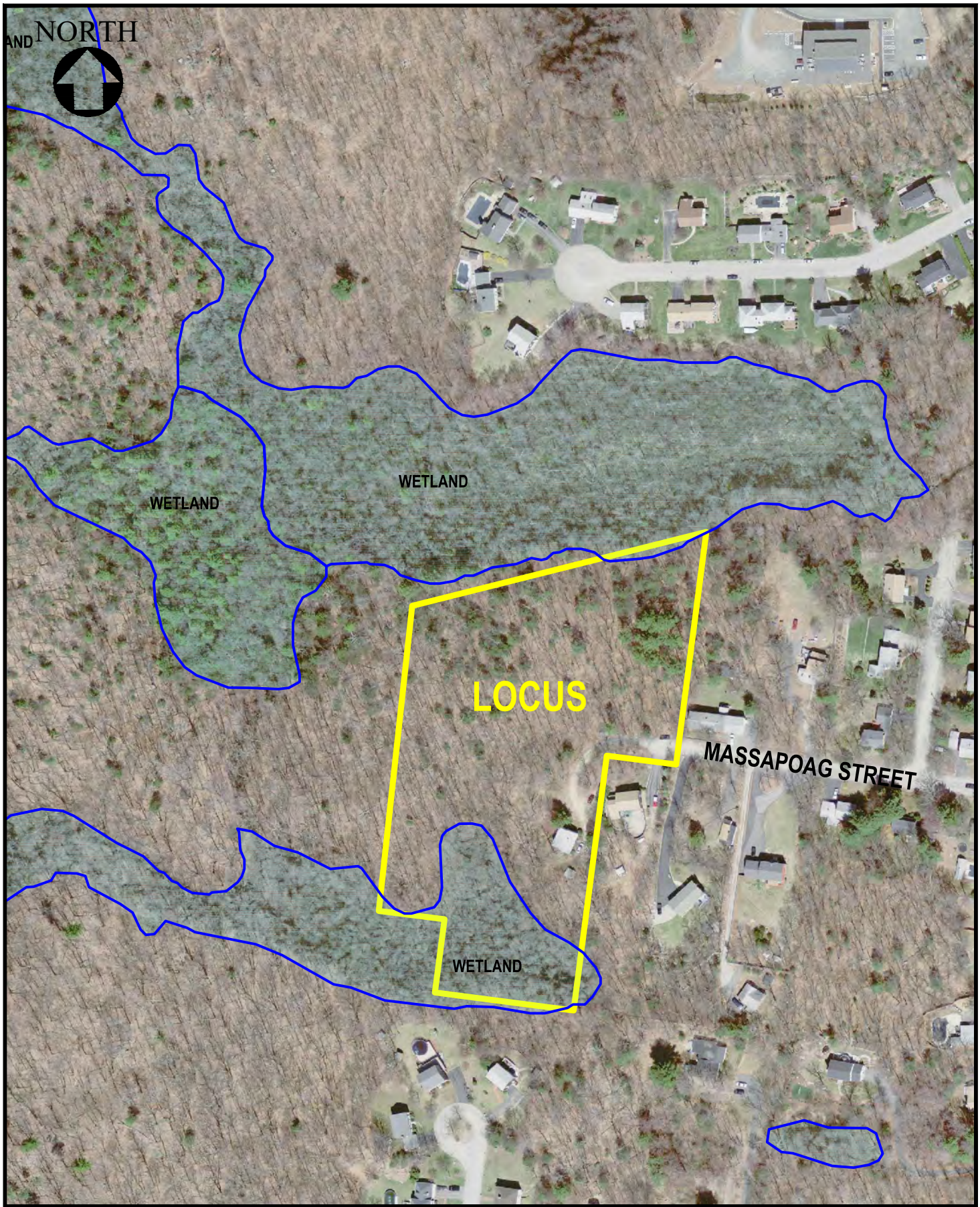

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GIS WETLAND MAP

MASSPOAG STREET,
WEYMOUTH, MA

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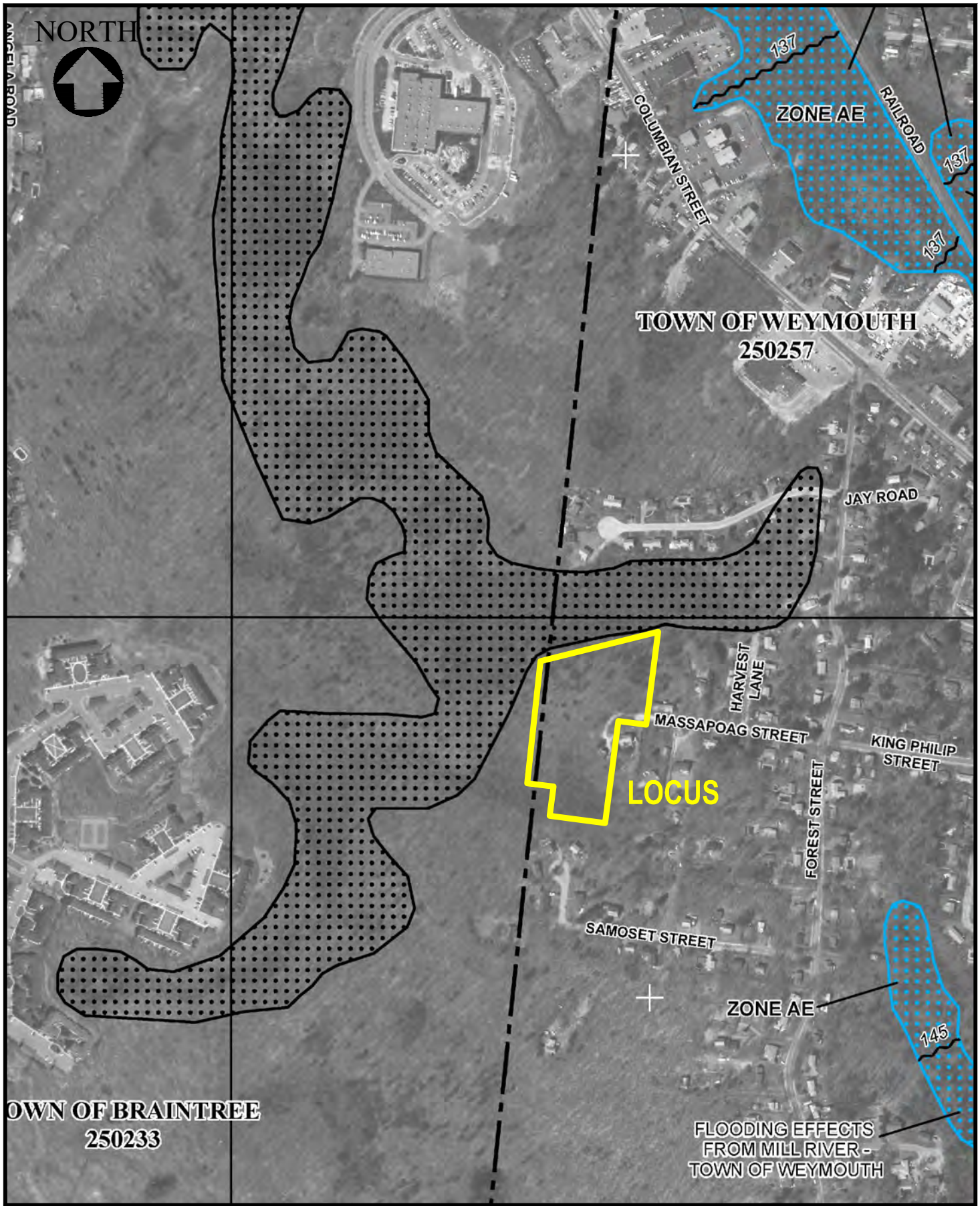

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HINGHAM, MA 02043
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FEMA MAP

MASSPOAG STREET,
WEYMOUTH, MA

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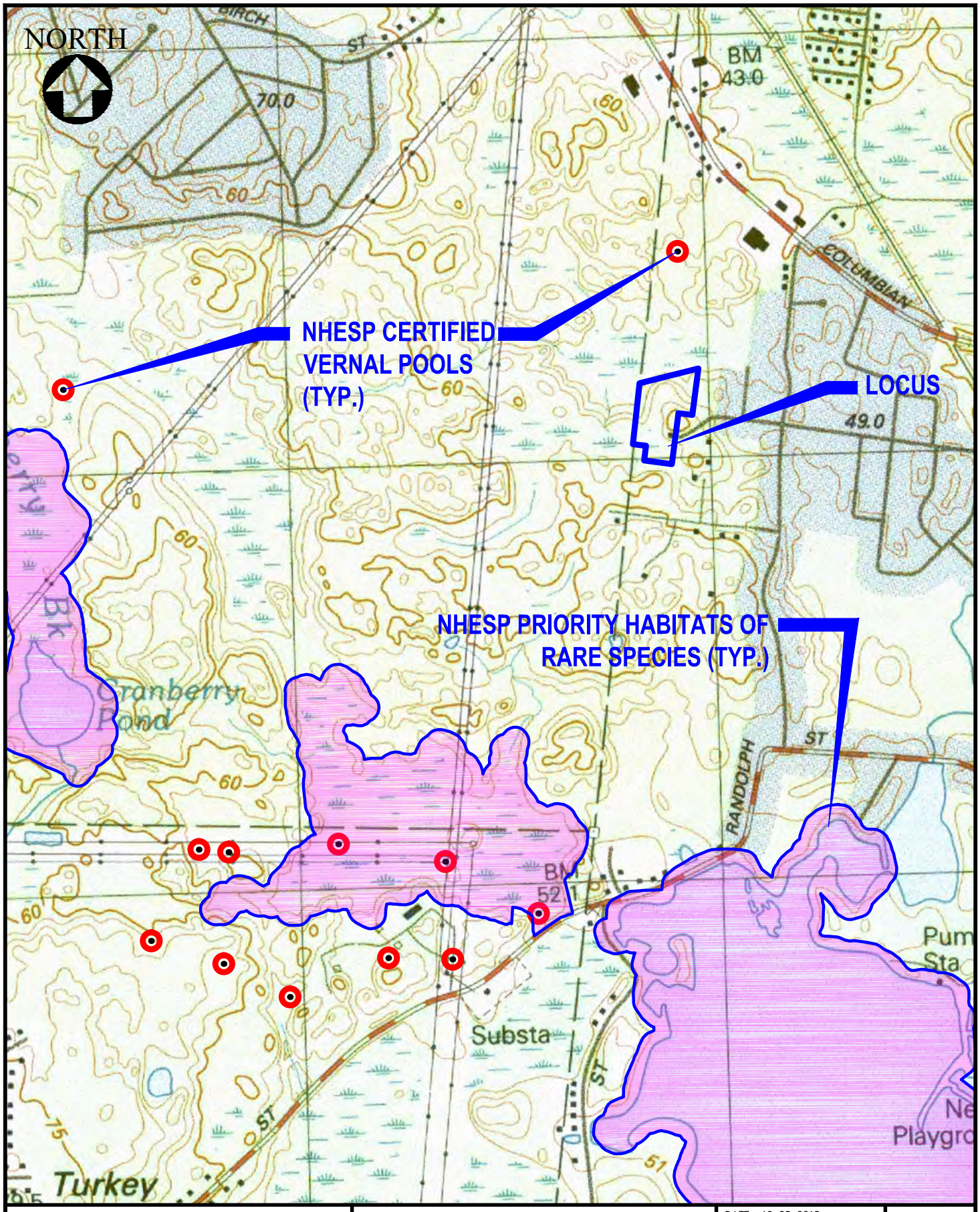

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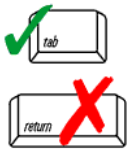
SECTION 2 – STORMWATER CHECKLIST

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.

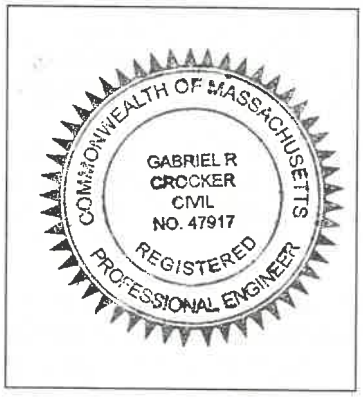
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



Signature and Date 1/13/2022

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.

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Standard 10: Massachusetts Stormwater Standards Handbook

Illicit discharges are defined as discharges into waters of the State or municipal separate stormwater system (MS4) that are not entirely comprised of stormwater. Exclusions for non-stormwater discharges into drainage systems include activities or facilities for firefighting, water line flushing, landscape irrigation, uncontaminated groundwater discharge, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, water used to clean residential buildings without detergents, water used for street washing, and flows from riparian habitats/wetlands. These exclusions are subject to change and are under the discretion of the local governing authority.

To the best of our knowledge and professional belief no illicit discharges to the stormwater system, surface waters, or wetland resource areas will remain on the site after construction. We will agree to implement a pollution prevention plan to prevent illicit discharges into the stormwater management system. The design of the site based on the plans entitled "DIVISION SUBDIVISION PLAN FOR MASSAPOAG STREET, WEYMOUTH, MA" prepared by Crocker Design Group, LLC, 2 Sharp Street, Unit A, Hingham, Massachusetts, show a separation and no direct connection between the stormwater management systems and the wastewater and/ or groundwater on the site. To the maximum extent practicable, the design prevents entry of illicit discharges into the stormwater management system.

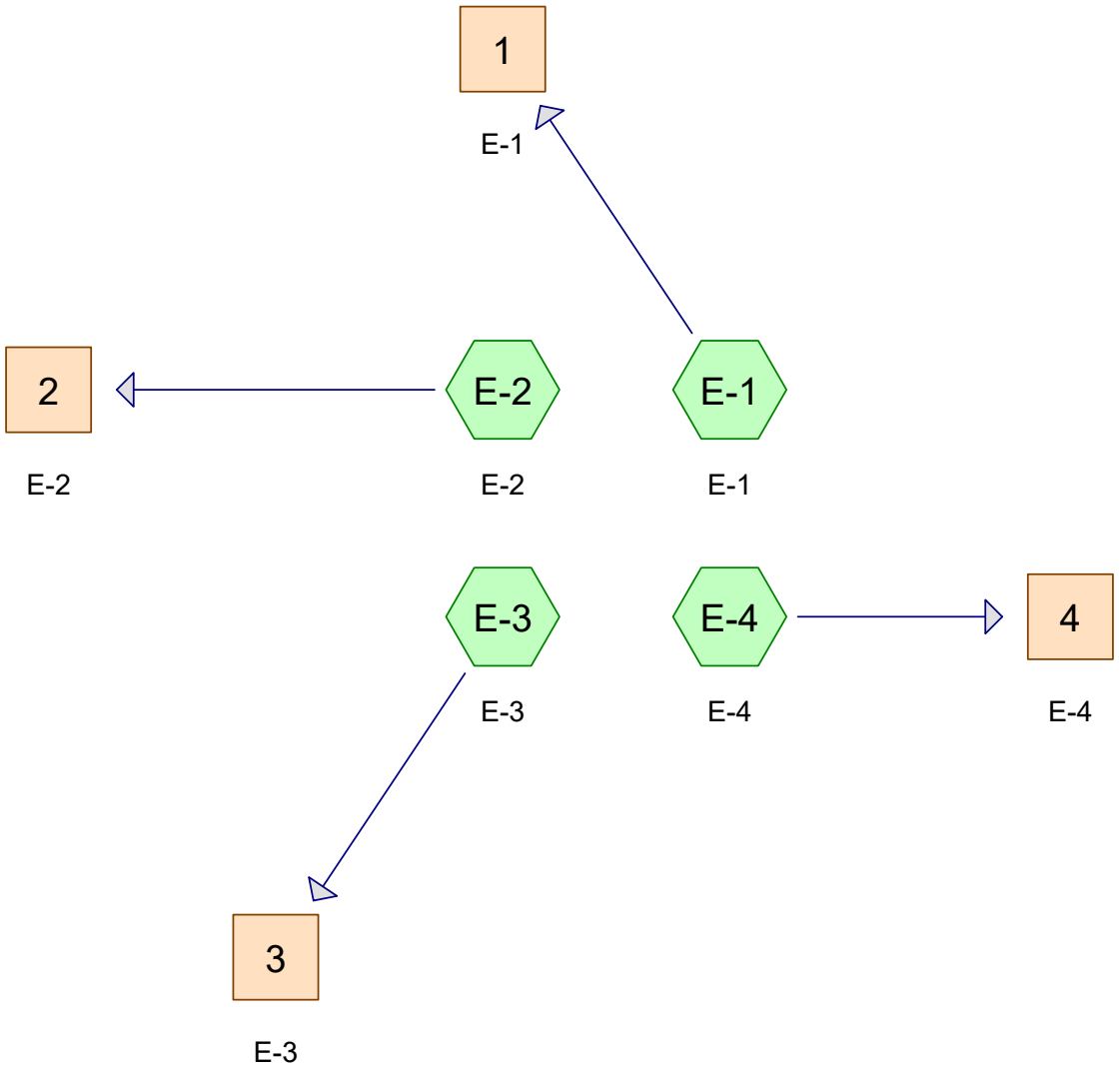
Engineer's Name: Gabe Crocker
(please print)

Engineer's Signature: _____ Date: 1/11/2022

Company: Crocker Design Group, LLC.

SECTION 3 – STORMATER HYDROLOGY MODEL

3.1 EXISTING HYDROLOGY



Routing Diagram for Massapoag Watershed with EC noaa
Prepared by {enter your company name here}, Printed 1/4/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.010	49	50-75% Grass cover, Fair, HSG A (E-4)
0.141	98	Paved parking, HSG A (E-1, E-2, E-3, E-4)
3.594	32	Woods/grass comb., Good, HSG A (E-1, E-2, E-3)

Summary for Subcatchment E-1: E-1

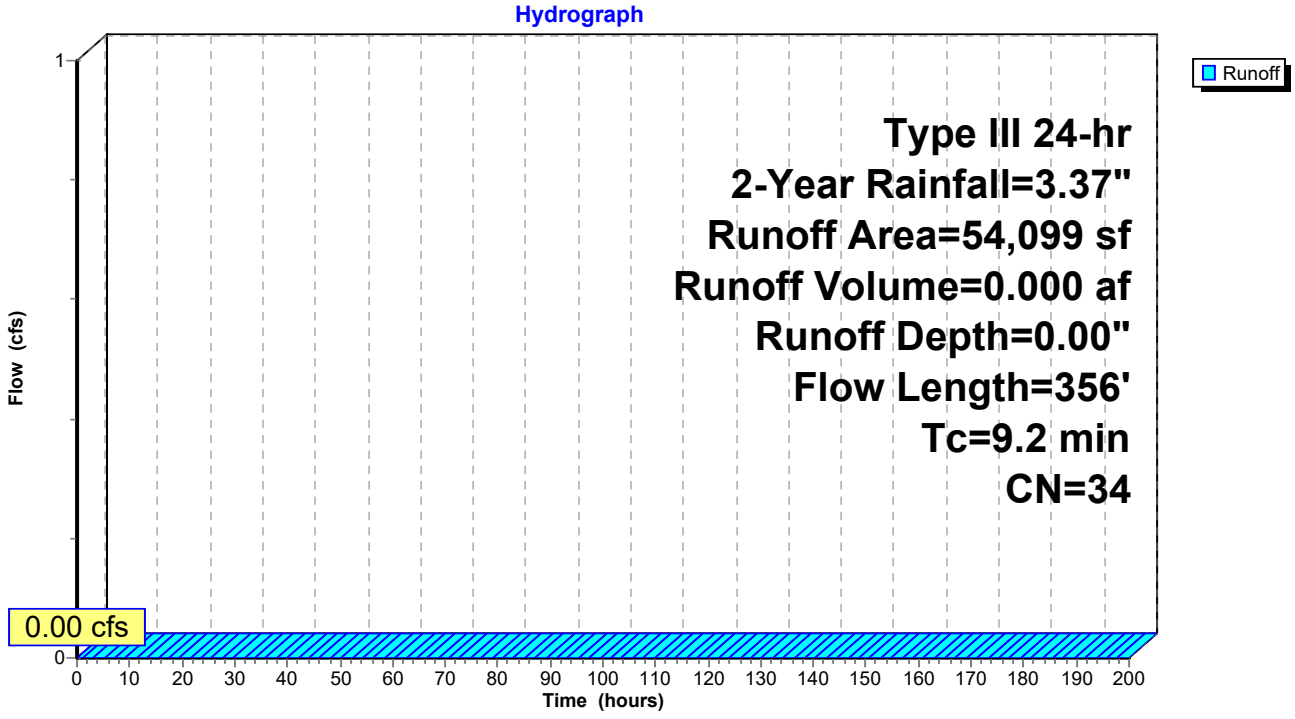
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

Area (sf)	CN	Description
52,183	32	Woods/grass comb., Good, HSG A
1,916	98	Paved parking, HSG A
54,099	34	Weighted Average
52,183		96.46% Pervious Area
1,916		3.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.7	306	0.1400	1.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.2	356	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

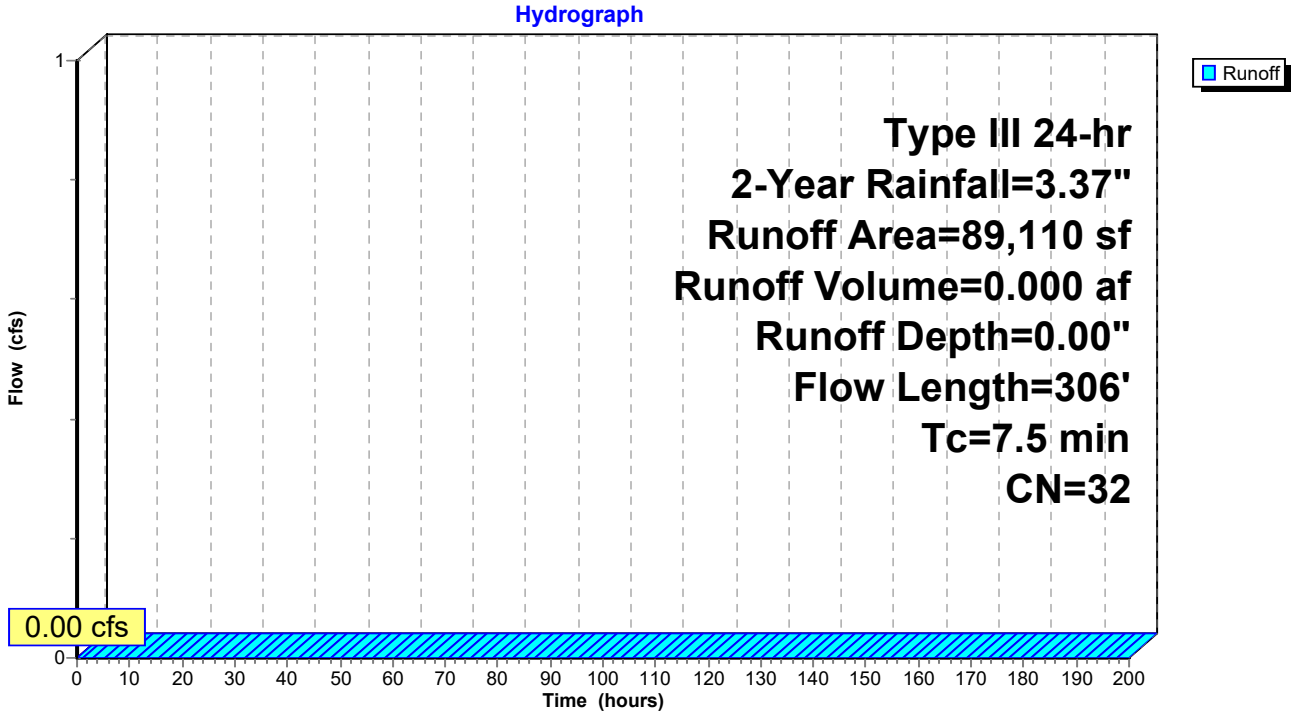
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

Area (sf)	CN	Description
88,738	32	Woods/grass comb., Good, HSG A
372	98	Paved parking, HSG A
89,110	32	Weighted Average
88,738		99.58% Pervious Area
372		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	256	0.1100	1.66		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.5	306	Total			

Subcatchment E-2: E-2



Summary for Subcatchment E-3: E-3

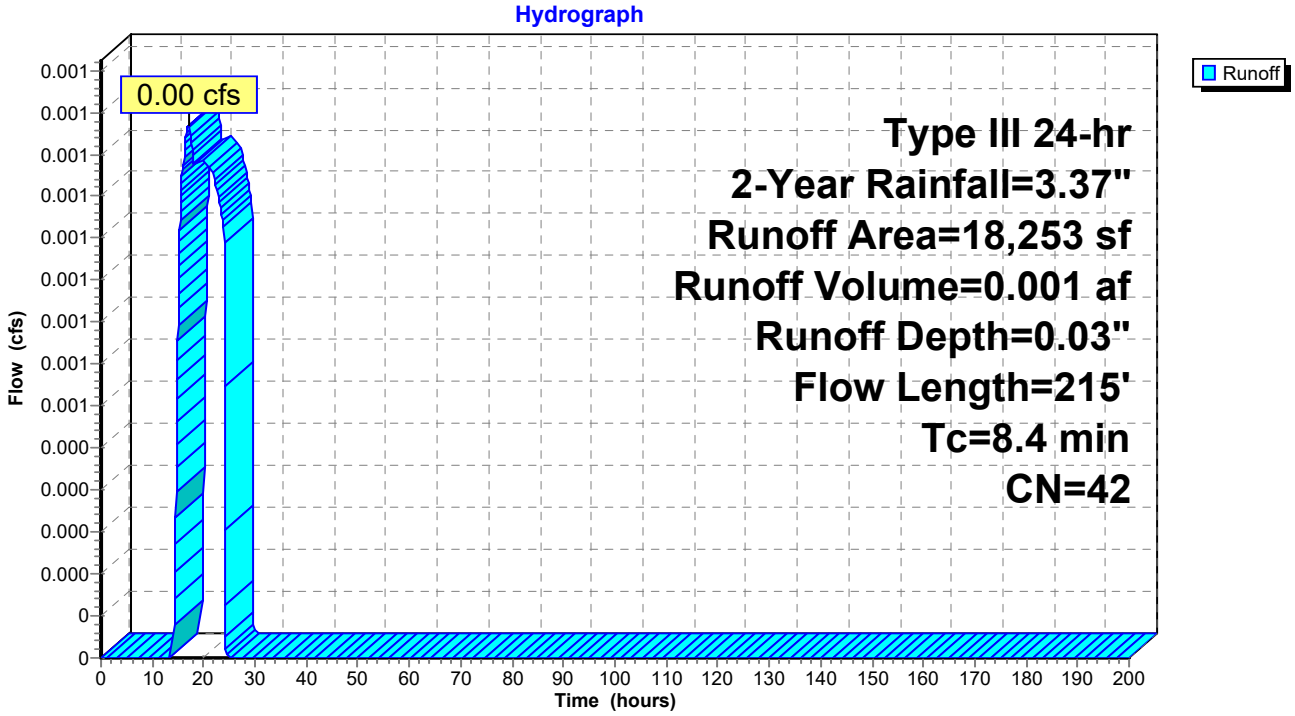
Runoff = 0.00 cfs @ 17.05 hrs, Volume= 0.001 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

Area (sf)	CN	Description
15,616	32	Woods/grass comb., Good, HSG A
2,637	98	Paved parking, HSG A
18,253	42	Weighted Average
15,616		85.55% Pervious Area
2,637		14.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.2	165	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.4	215	Total			

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

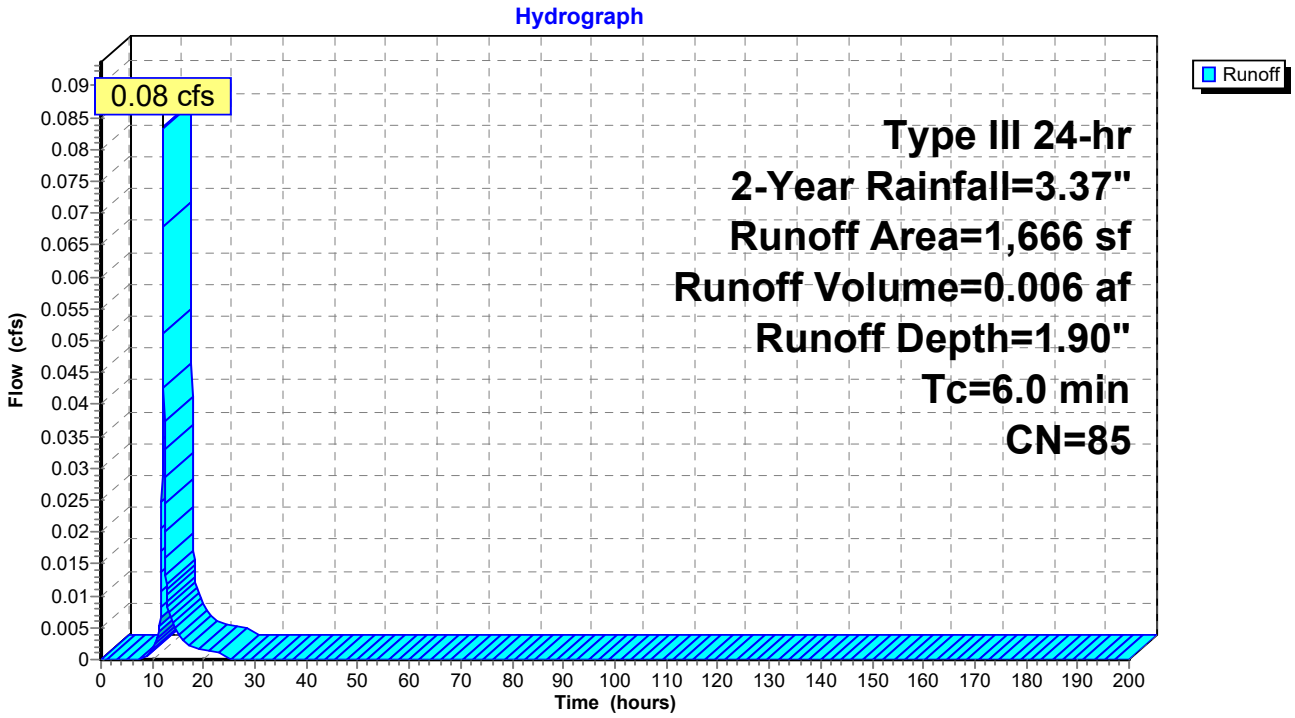
Runoff = 0.08 cfs @ 12.09 hrs, Volume= 0.006 af, Depth= 1.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

Area (sf)	CN	Description
1,210	98	Paved parking, HSG A
456	49	50-75% Grass cover, Fair, HSG A
1,666	85	Weighted Average
456		27.37% Pervious Area
1,210		72.63% Impervious Area

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

Subcatchment E-4: E-4

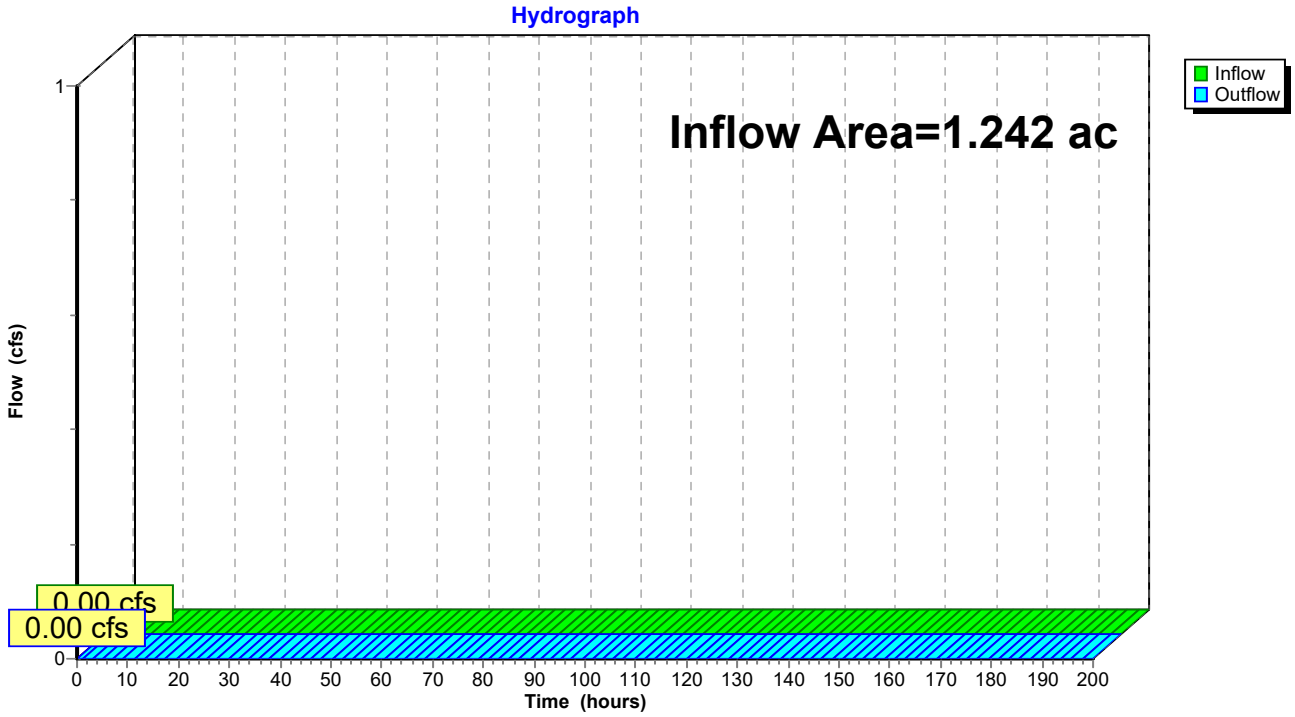


Summary for Reach 1: E-1

Inflow Area = 1.242 ac, 3.54% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 1: E-1

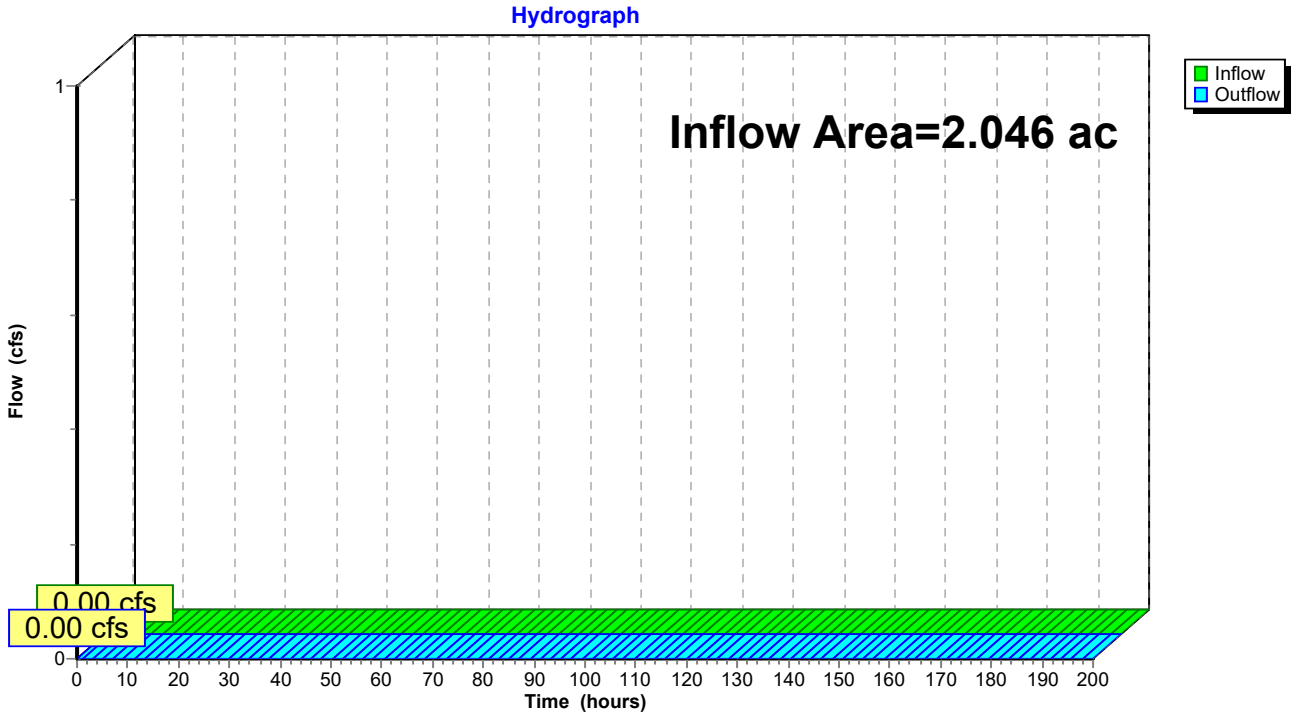


Summary for Reach 2: E-2

Inflow Area = 2.046 ac, 0.42% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 2: E-2

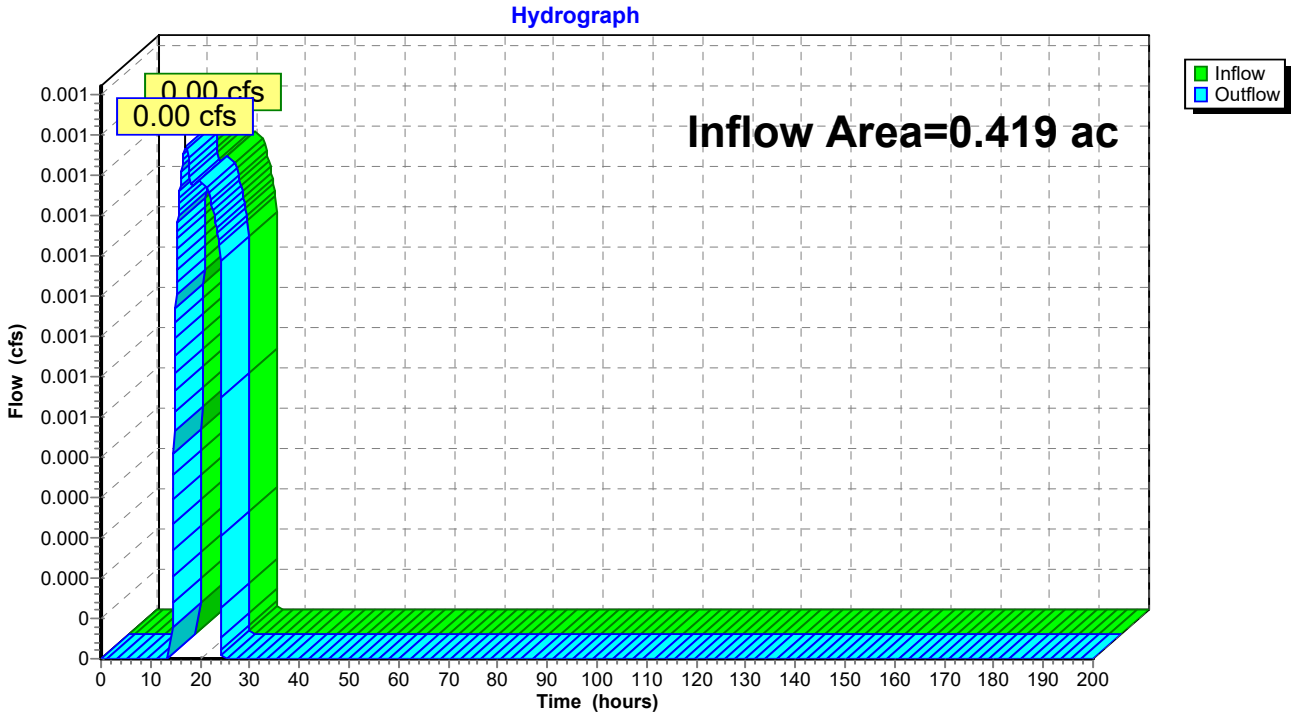


Summary for Reach 3: E-3

Inflow Area = 0.419 ac, 14.45% Impervious, Inflow Depth = 0.03" for 2-Year event
Inflow = 0.00 cfs @ 17.05 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 17.05 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 3: E-3

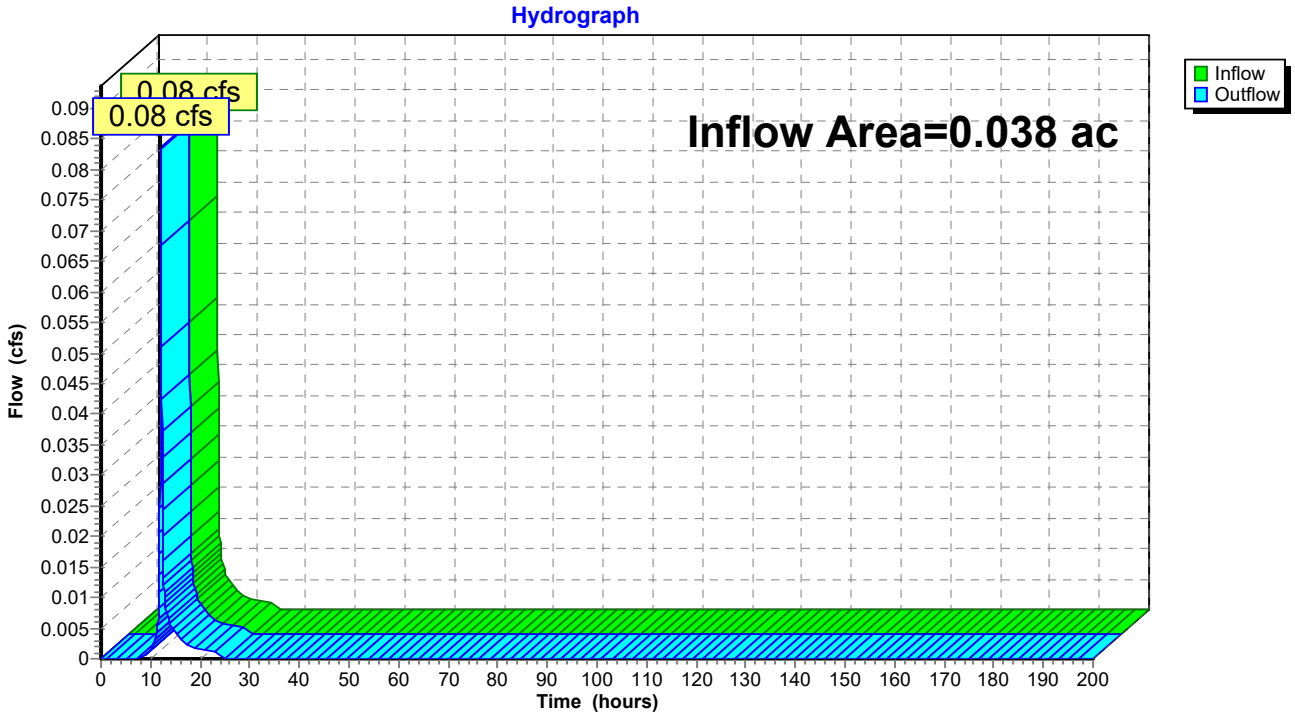


Summary for Reach 4: E-4

Inflow Area = 0.038 ac, 72.63% Impervious, Inflow Depth = 1.90" for 2-Year event
Inflow = 0.08 cfs @ 12.09 hrs, Volume= 0.006 af
Outflow = 0.08 cfs @ 12.09 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 4: E-4



Summary for Subcatchment E-1: E-1

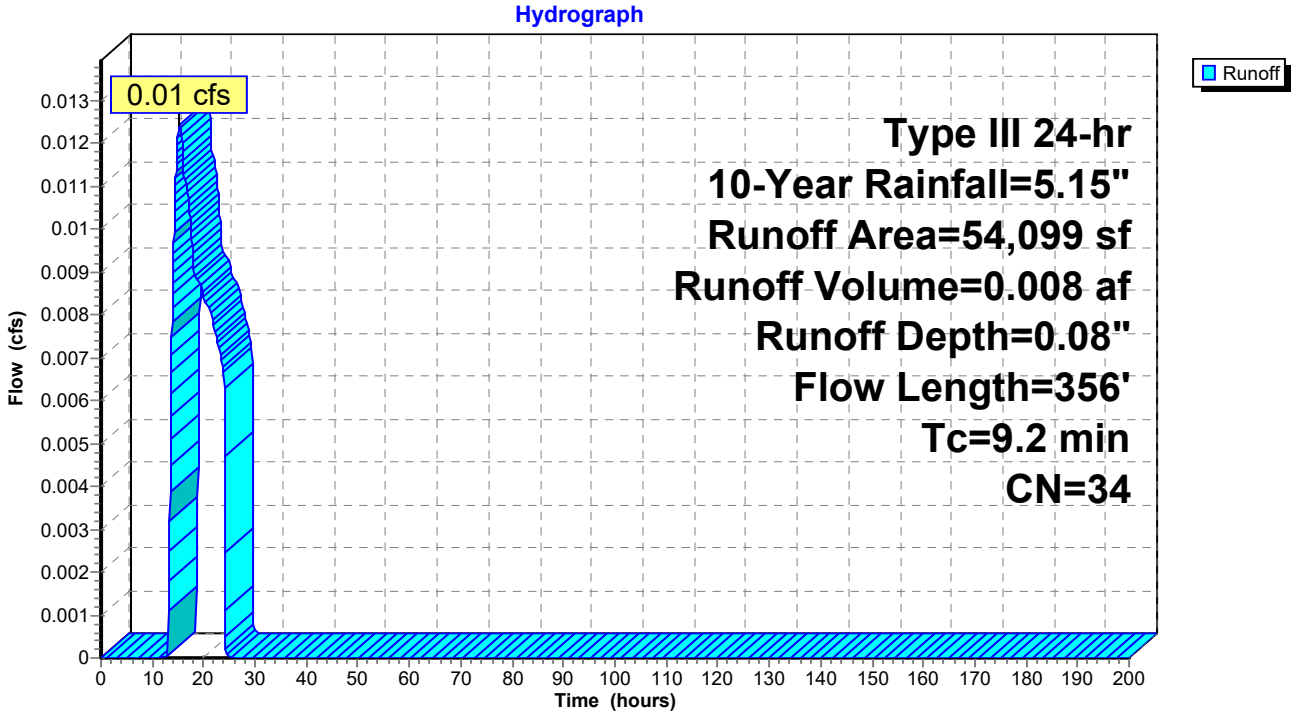
Runoff = 0.01 cfs @ 15.30 hrs, Volume= 0.008 af, Depth= 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
52,183	32	Woods/grass comb., Good, HSG A
1,916	98	Paved parking, HSG A
54,099	34	Weighted Average
52,183		96.46% Pervious Area
1,916		3.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.7	306	0.1400	1.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.2	356	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

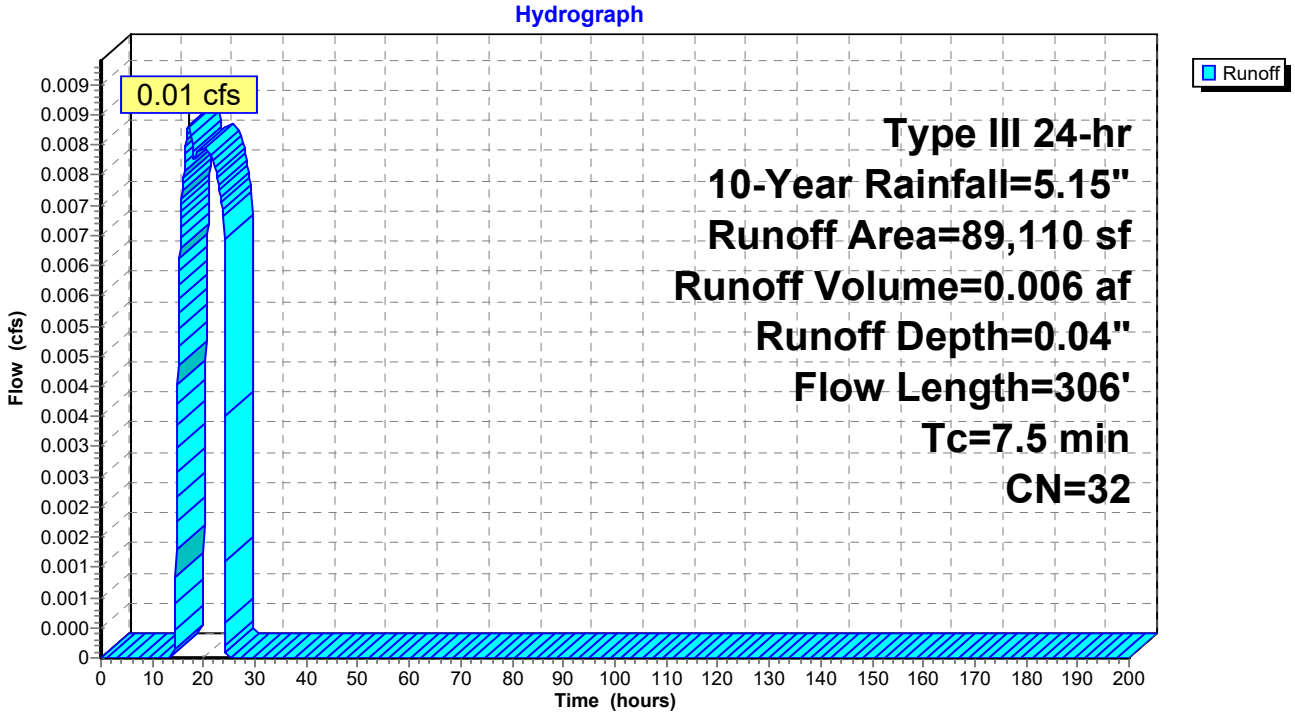
Runoff = 0.01 cfs @ 17.14 hrs, Volume= 0.006 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
88,738	32	Woods/grass comb., Good, HSG A
372	98	Paved parking, HSG A
89,110	32	Weighted Average
88,738		99.58% Pervious Area
372		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	256	0.1100	1.66		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.5	306	Total			

Subcatchment E-2: E-2



Summary for Subcatchment E-3: E-3

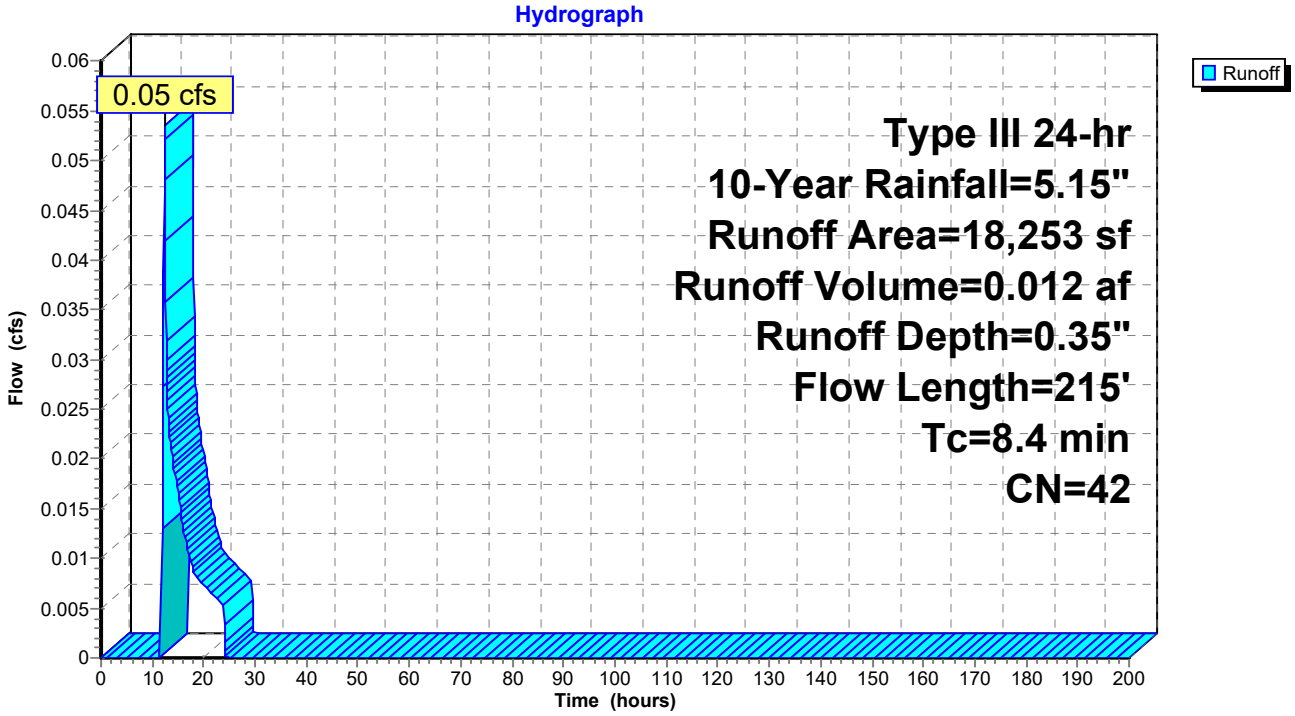
Runoff = 0.05 cfs @ 12.40 hrs, Volume= 0.012 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
15,616	32	Woods/grass comb., Good, HSG A
2,637	98	Paved parking, HSG A
18,253	42	Weighted Average
15,616		85.55% Pervious Area
2,637		14.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.2	165	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.4	215	Total			

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

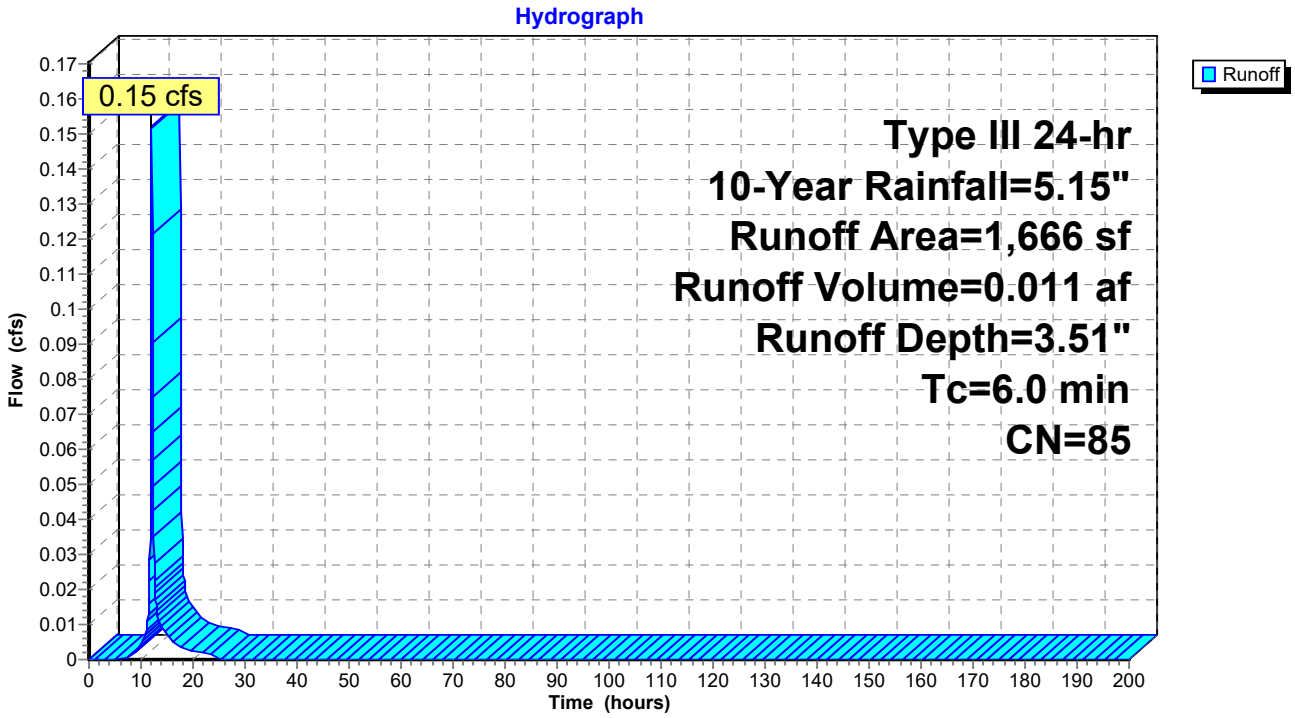
Runoff = 0.15 cfs @ 12.09 hrs, Volume= 0.011 af, Depth= 3.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
1,210	98	Paved parking, HSG A
456	49	50-75% Grass cover, Fair, HSG A
1,666	85	Weighted Average
456		27.37% Pervious Area
1,210		72.63% Impervious Area

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

Subcatchment E-4: E-4

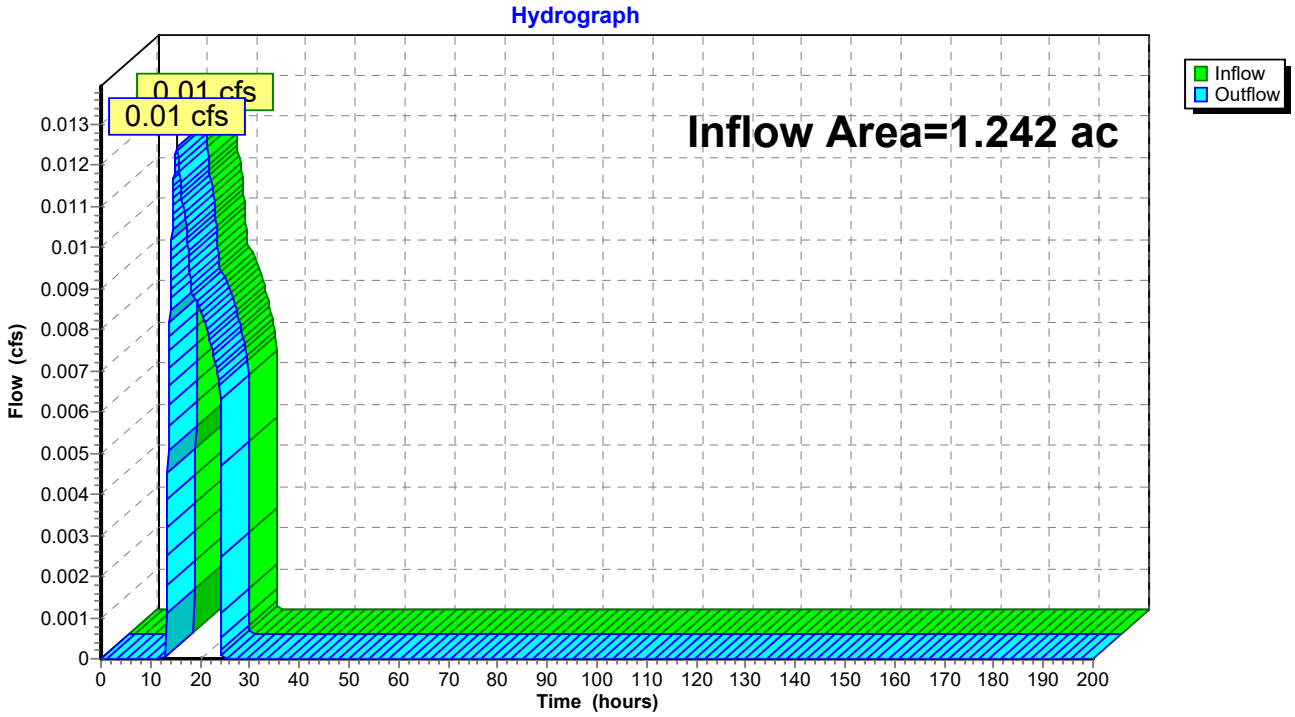


Summary for Reach 1: E-1

Inflow Area = 1.242 ac, 3.54% Impervious, Inflow Depth = 0.08" for 10-Year event
Inflow = 0.01 cfs @ 15.30 hrs, Volume= 0.008 af
Outflow = 0.01 cfs @ 15.30 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 1: E-1

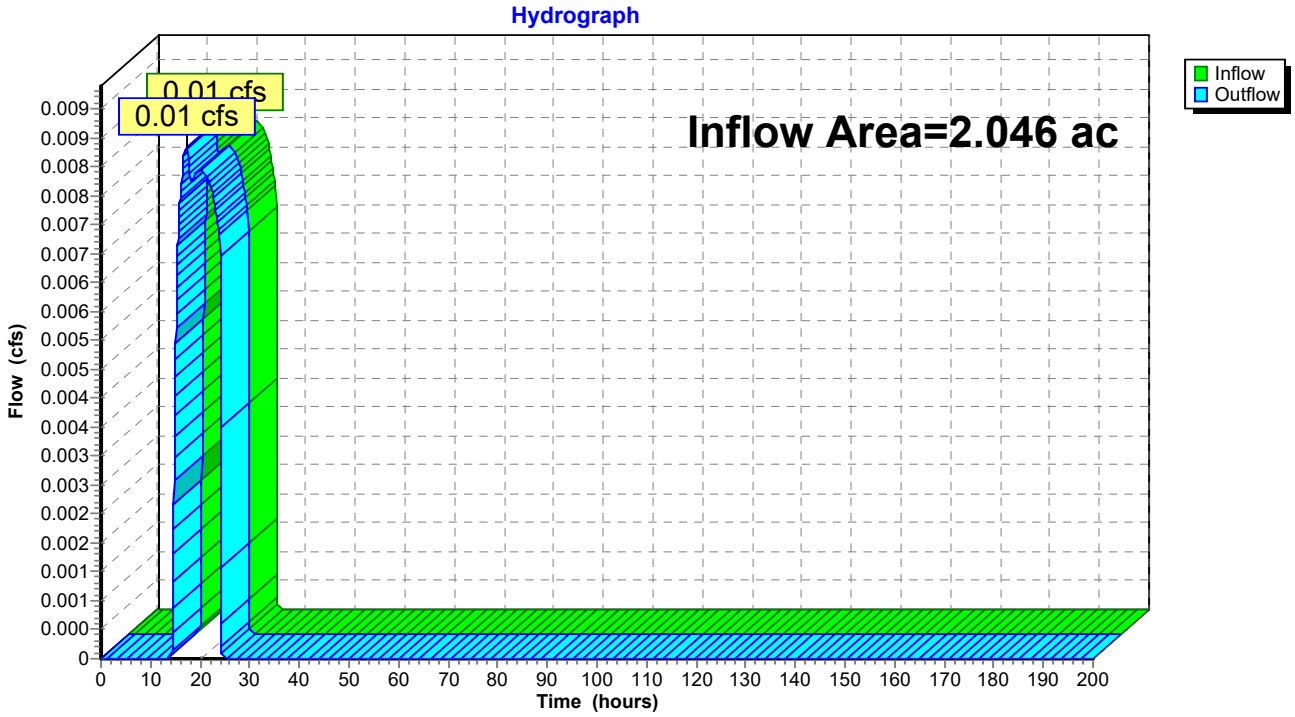


Summary for Reach 2: E-2

Inflow Area = 2.046 ac, 0.42% Impervious, Inflow Depth = 0.04" for 10-Year event
Inflow = 0.01 cfs @ 17.14 hrs, Volume= 0.006 af
Outflow = 0.01 cfs @ 17.14 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 2: E-2

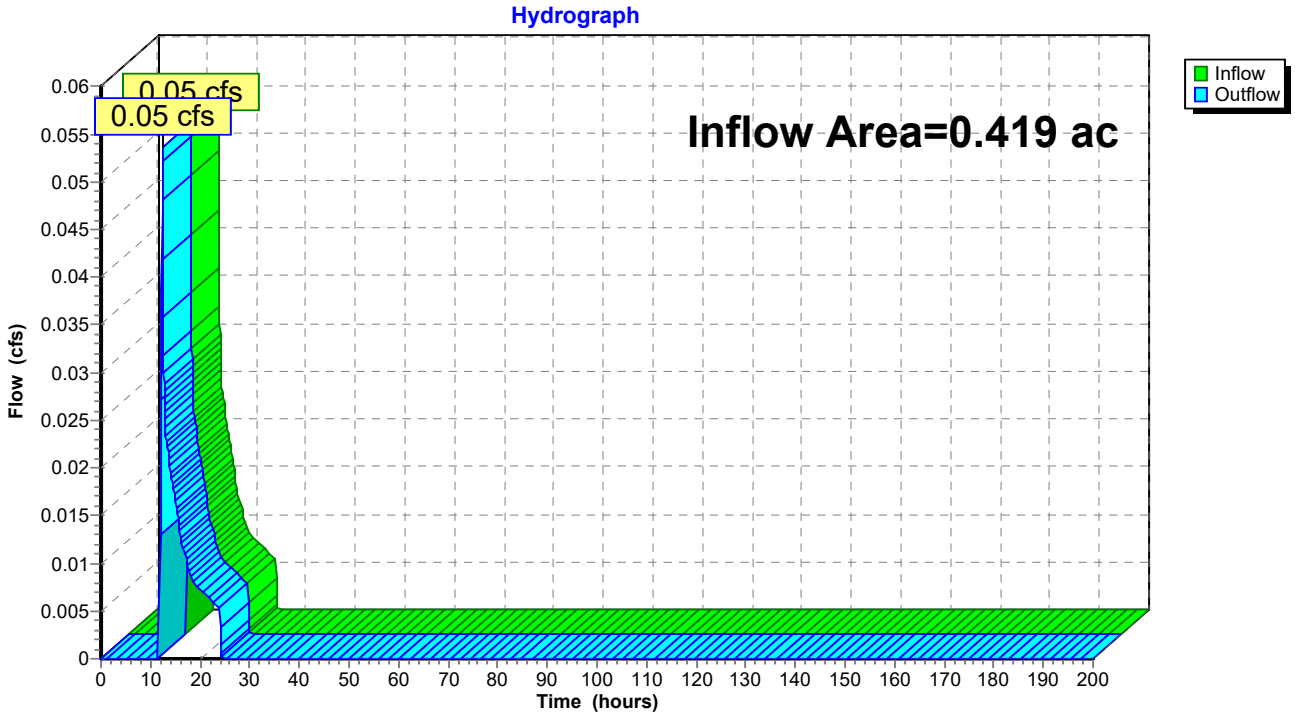


Summary for Reach 3: E-3

Inflow Area = 0.419 ac, 14.45% Impervious, Inflow Depth = 0.35" for 10-Year event
Inflow = 0.05 cfs @ 12.40 hrs, Volume= 0.012 af
Outflow = 0.05 cfs @ 12.40 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 3: E-3

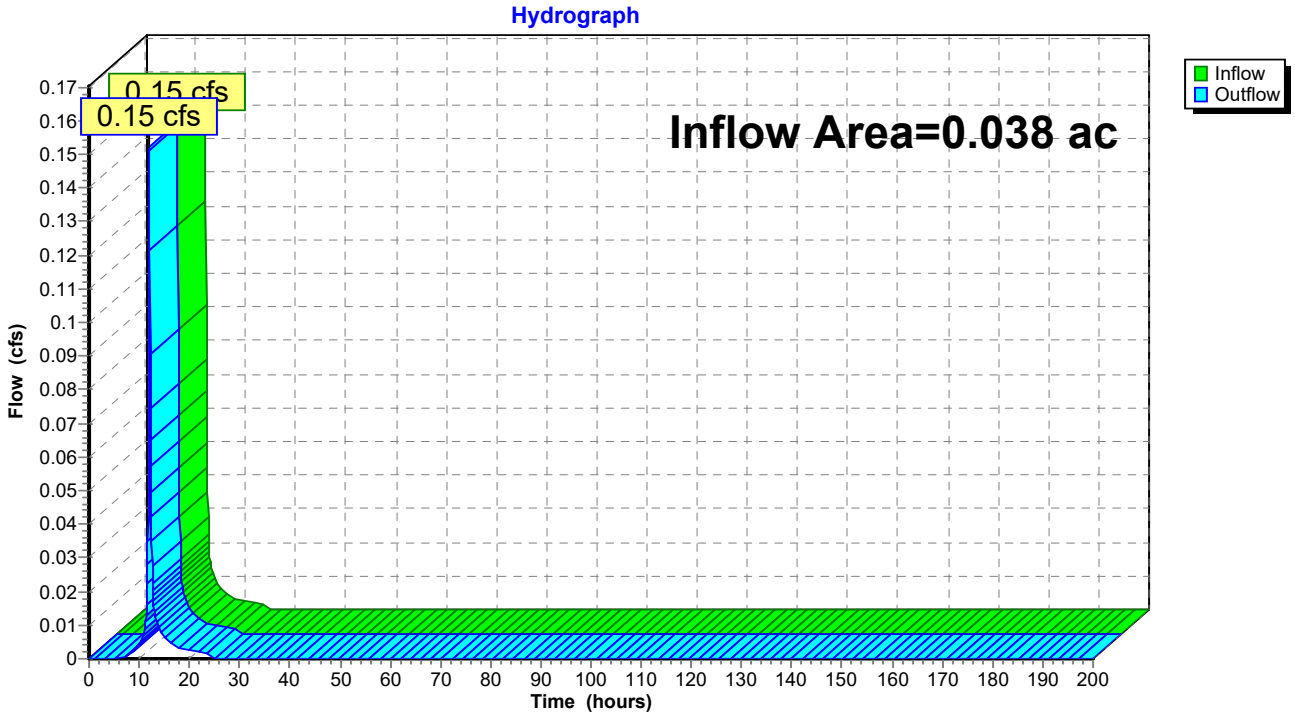


Summary for Reach 4: E-4

Inflow Area = 0.038 ac, 72.63% Impervious, Inflow Depth = 3.51" for 10-Year event
Inflow = 0.15 cfs @ 12.09 hrs, Volume= 0.011 af
Outflow = 0.15 cfs @ 12.09 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 4: E-4



Summary for Subcatchment E-1: E-1

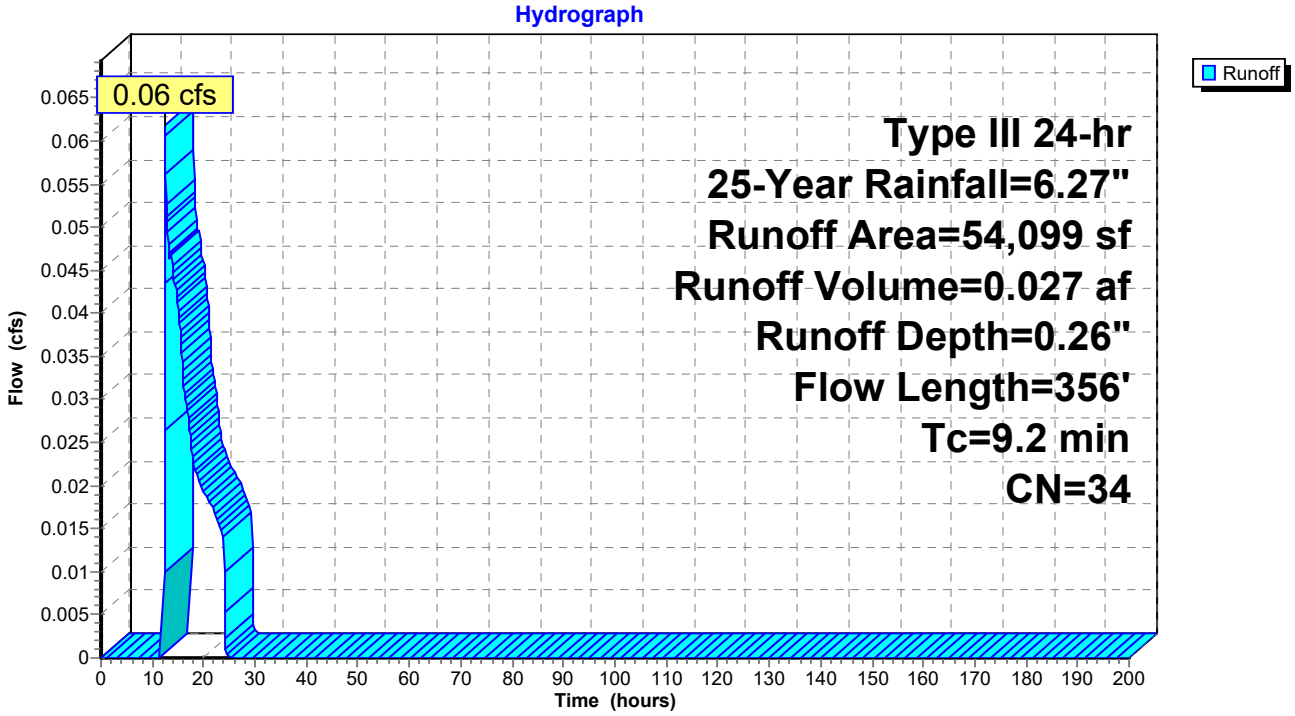
Runoff = 0.06 cfs @ 12.52 hrs, Volume= 0.027 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

Area (sf)	CN	Description
52,183	32	Woods/grass comb., Good, HSG A
1,916	98	Paved parking, HSG A
54,099	34	Weighted Average
52,183		96.46% Pervious Area
1,916		3.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.7	306	0.1400	1.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.2	356	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

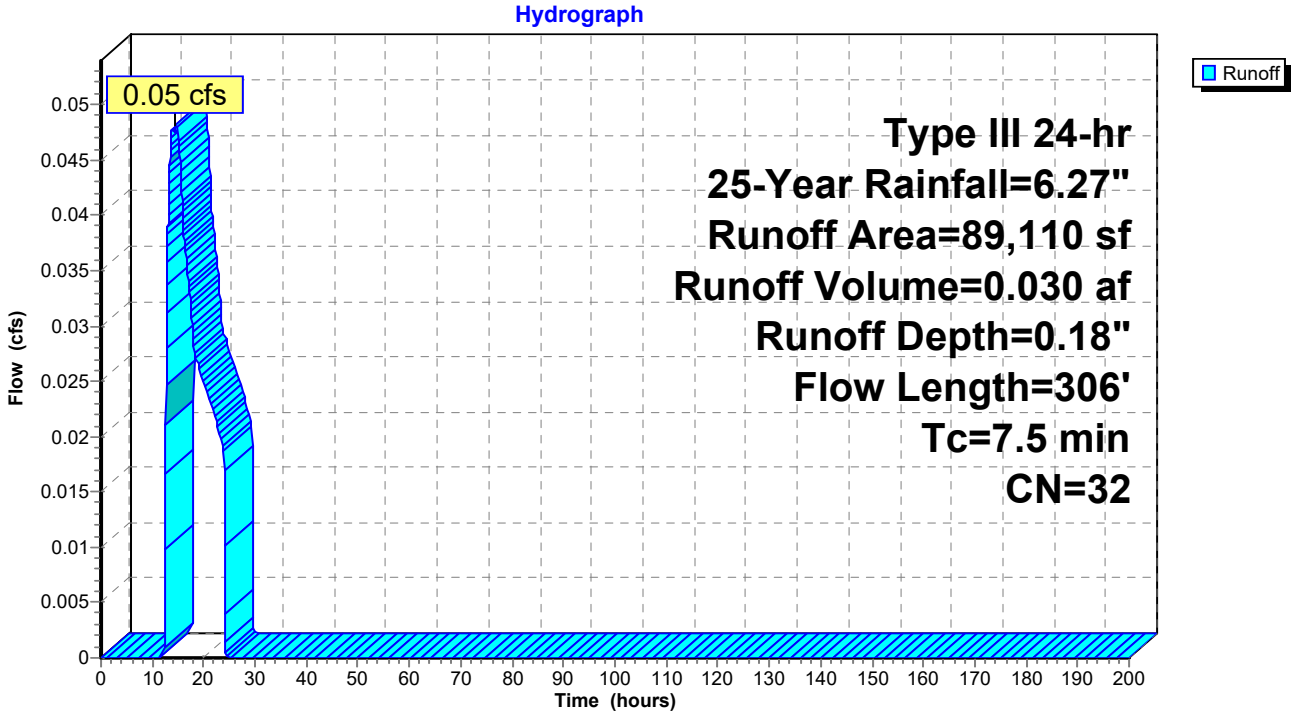
Runoff = 0.05 cfs @ 14.58 hrs, Volume= 0.030 af, Depth= 0.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

Area (sf)	CN	Description
88,738	32	Woods/grass comb., Good, HSG A
372	98	Paved parking, HSG A
89,110	32	Weighted Average
88,738		99.58% Pervious Area
372		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	256	0.1100	1.66		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.5	306	Total			

Subcatchment E-2: E-2



Summary for Subcatchment E-3: E-3

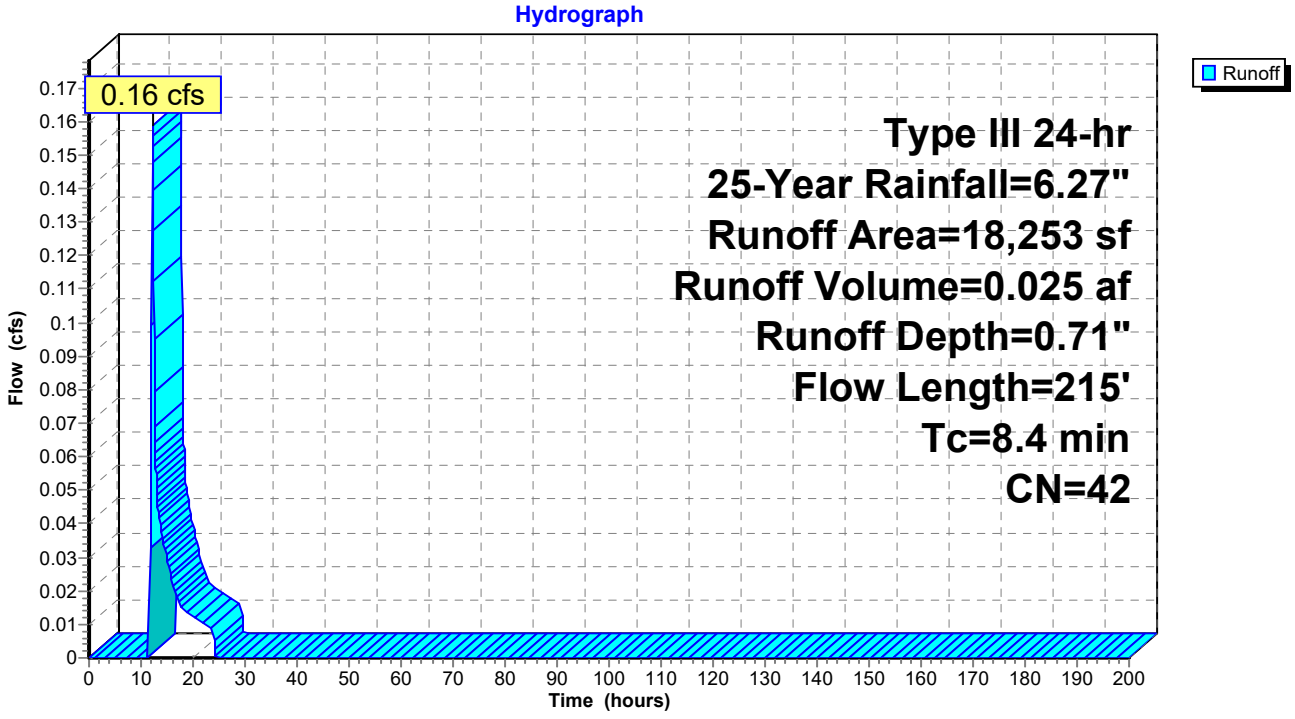
Runoff = 0.16 cfs @ 12.21 hrs, Volume= 0.025 af, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

Area (sf)	CN	Description
15,616	32	Woods/grass comb., Good, HSG A
2,637	98	Paved parking, HSG A
18,253	42	Weighted Average
15,616		85.55% Pervious Area
2,637		14.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.2	165	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.4	215	Total			

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

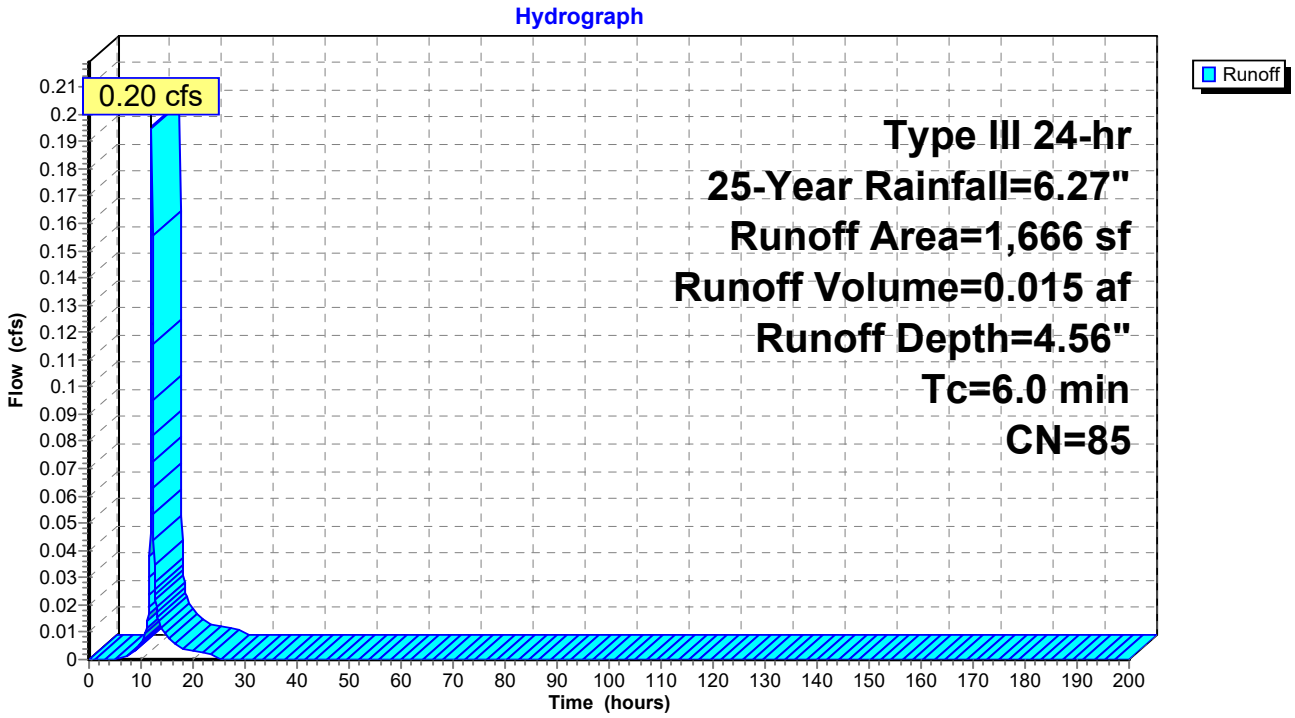
Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.015 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

Area (sf)	CN	Description
1,210	98	Paved parking, HSG A
456	49	50-75% Grass cover, Fair, HSG A
1,666	85	Weighted Average
456		27.37% Pervious Area
1,210		72.63% Impervious Area

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

Subcatchment E-4: E-4

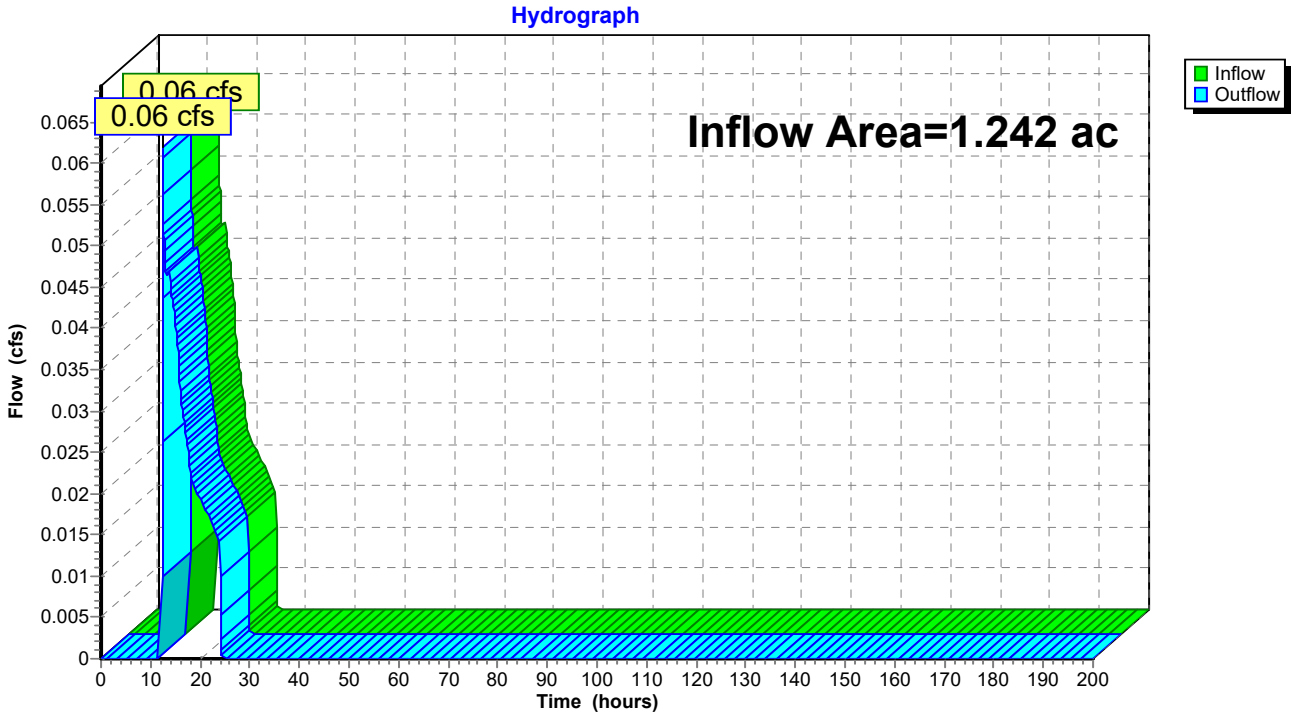


Summary for Reach 1: E-1

Inflow Area = 1.242 ac, 3.54% Impervious, Inflow Depth = 0.26" for 25-Year event
Inflow = 0.06 cfs @ 12.52 hrs, Volume= 0.027 af
Outflow = 0.06 cfs @ 12.52 hrs, Volume= 0.027 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 1: E-1

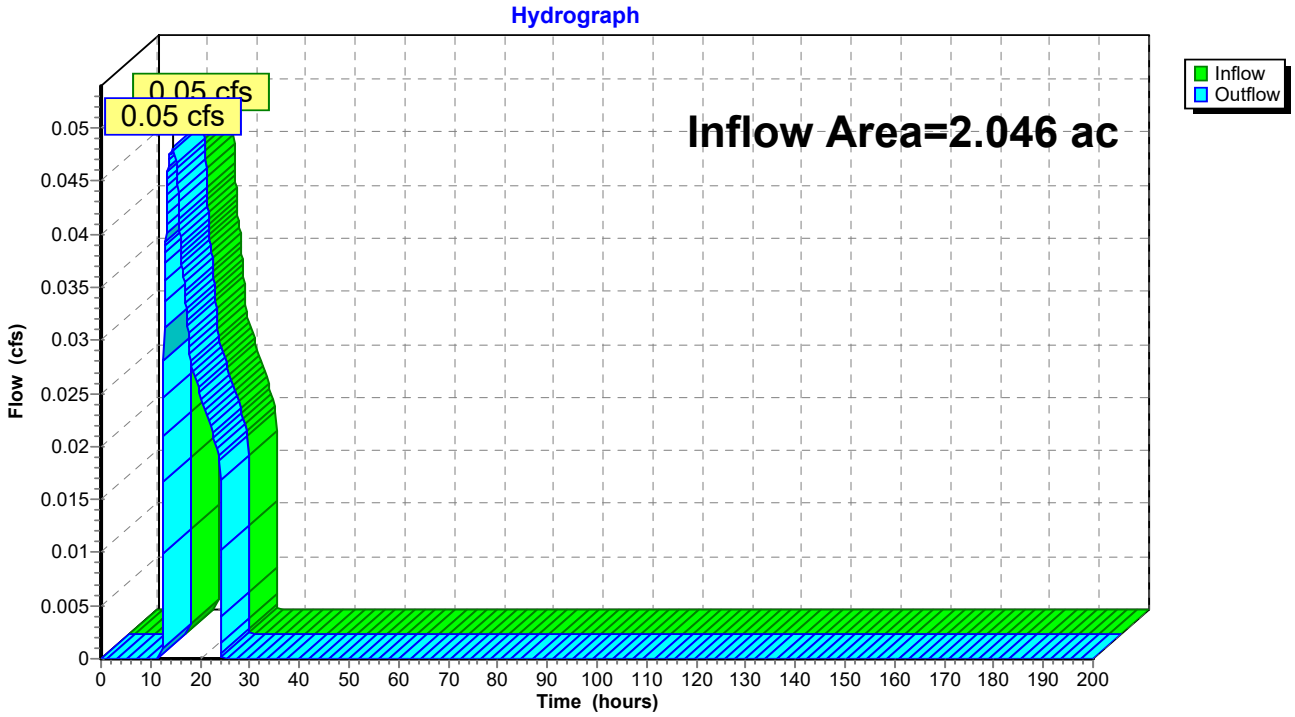


Summary for Reach 2: E-2

Inflow Area = 2.046 ac, 0.42% Impervious, Inflow Depth = 0.18" for 25-Year event
Inflow = 0.05 cfs @ 14.58 hrs, Volume= 0.030 af
Outflow = 0.05 cfs @ 14.58 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 2: E-2

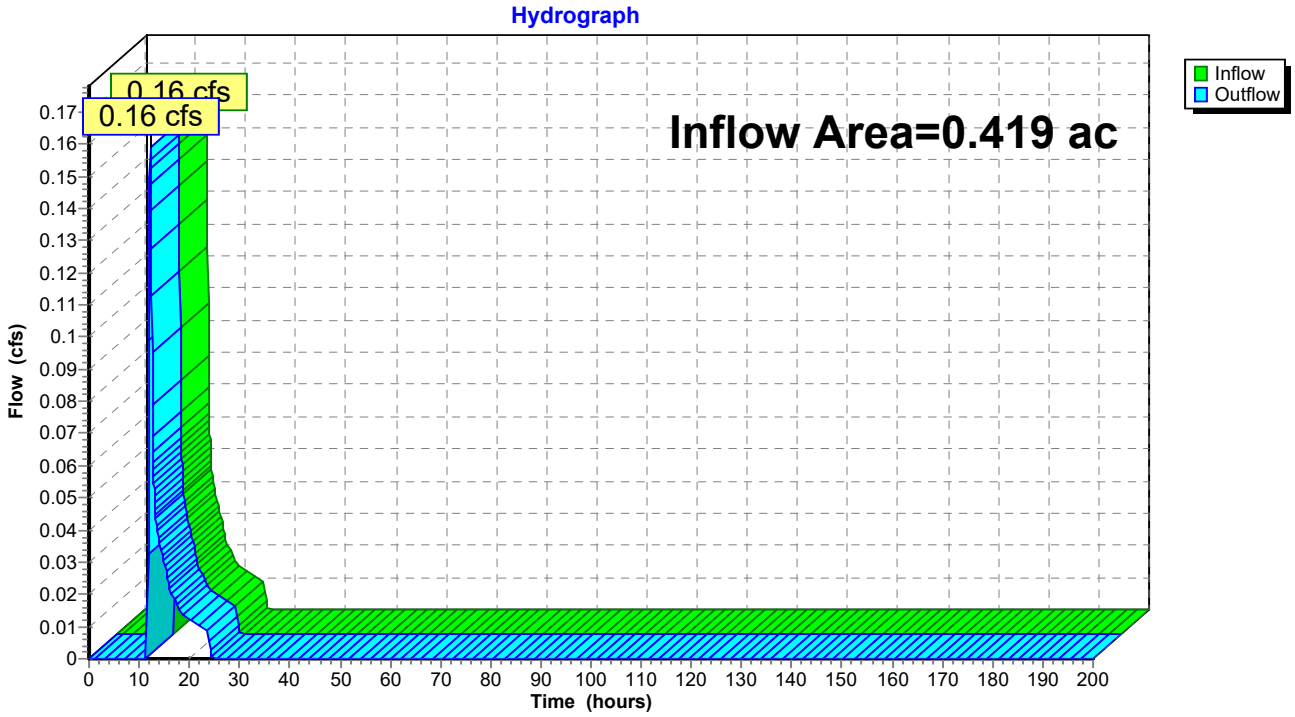


Summary for Reach 3: E-3

Inflow Area = 0.419 ac, 14.45% Impervious, Inflow Depth = 0.71" for 25-Year event
Inflow = 0.16 cfs @ 12.21 hrs, Volume= 0.025 af
Outflow = 0.16 cfs @ 12.21 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 3: E-3

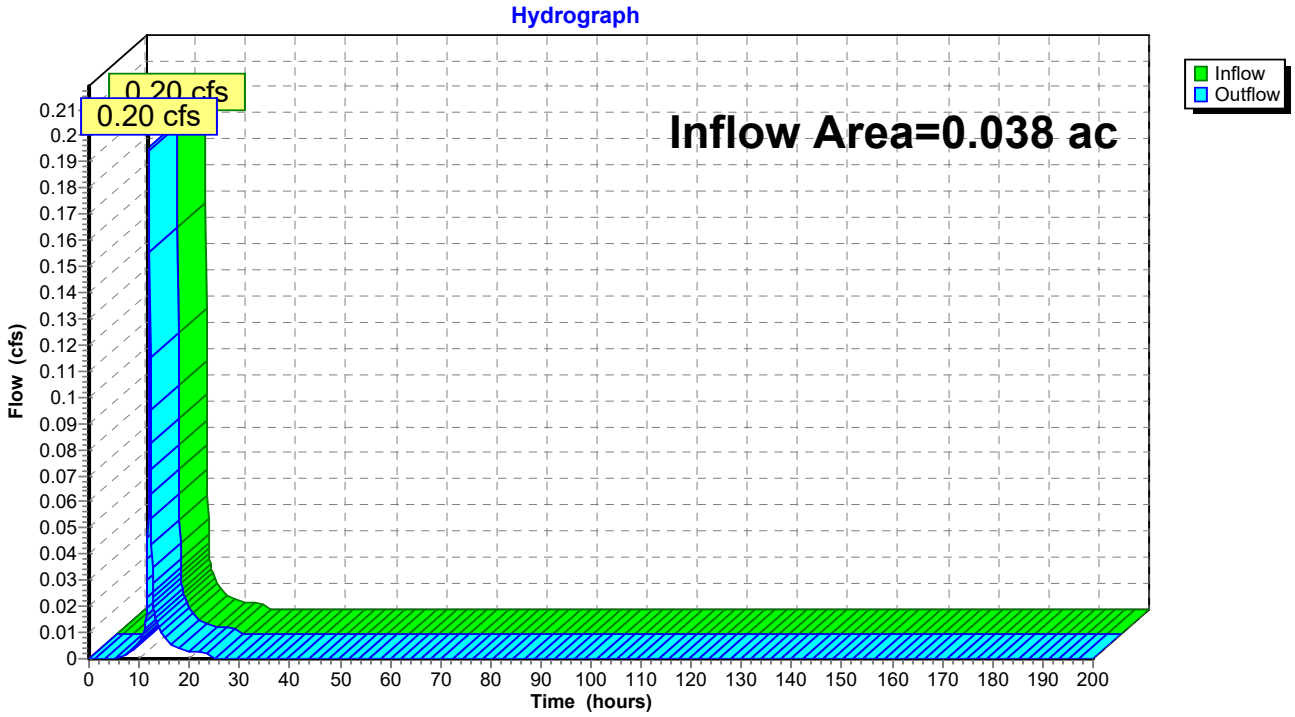


Summary for Reach 4: E-4

Inflow Area = 0.038 ac, 72.63% Impervious, Inflow Depth = 4.56" for 25-Year event
Inflow = 0.20 cfs @ 12.09 hrs, Volume= 0.015 af
Outflow = 0.20 cfs @ 12.09 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 4: E-4



Summary for Subcatchment E-1: E-1

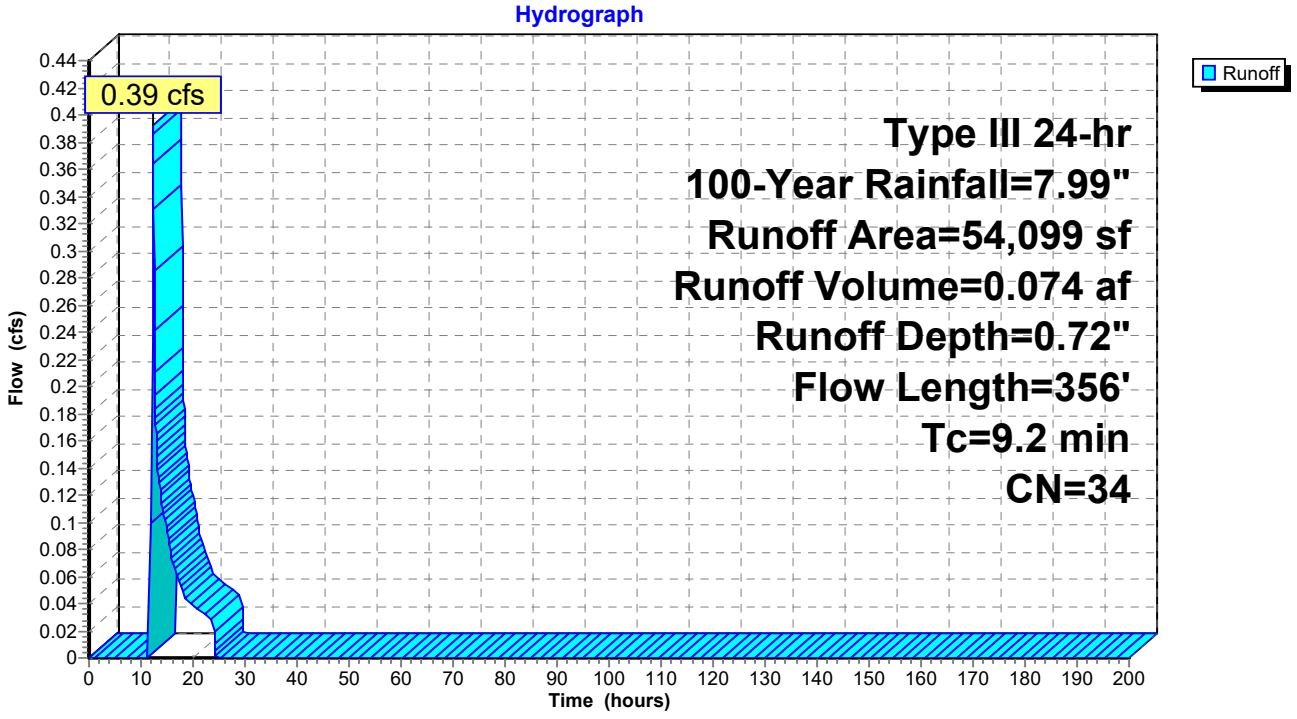
Runoff = 0.39 cfs @ 12.35 hrs, Volume= 0.074 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
52,183	32	Woods/grass comb., Good, HSG A
1,916	98	Paved parking, HSG A
54,099	34	Weighted Average
52,183		96.46% Pervious Area
1,916		3.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.7	306	0.1400	1.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.2	356	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

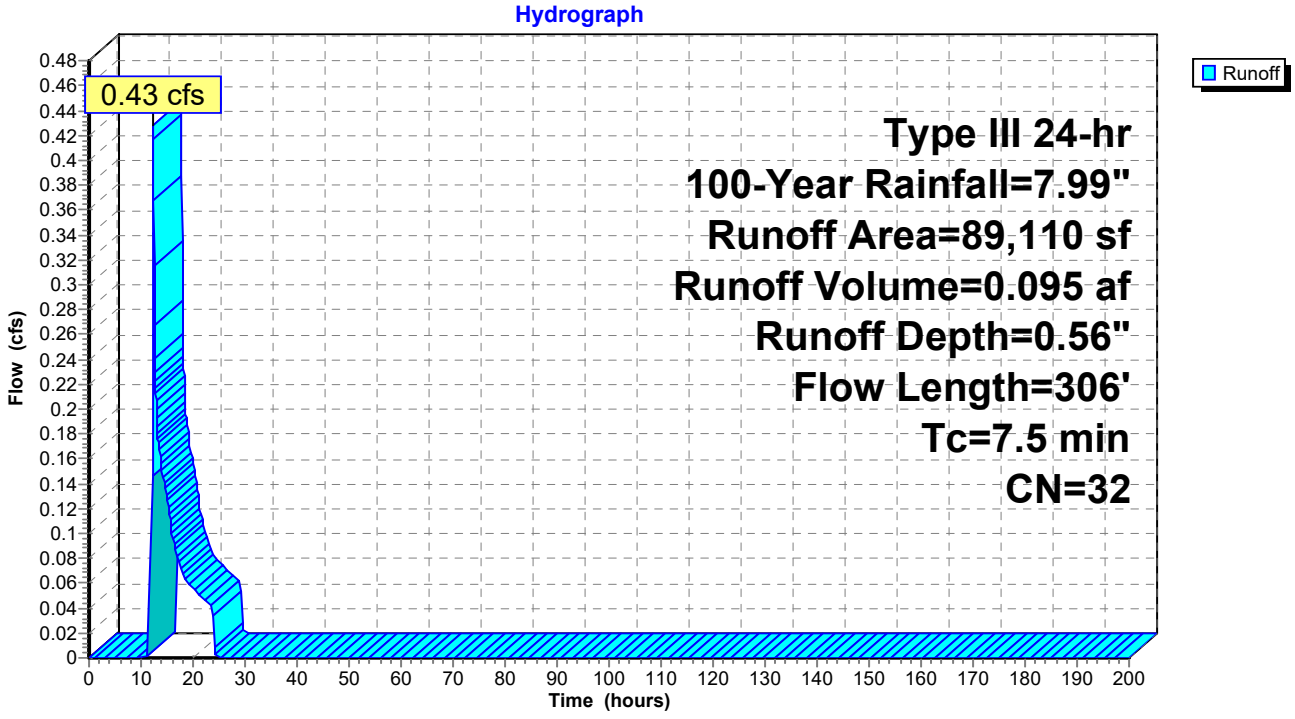
Runoff = 0.43 cfs @ 12.38 hrs, Volume= 0.095 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
88,738	32	Woods/grass comb., Good, HSG A
372	98	Paved parking, HSG A
89,110	32	Weighted Average
88,738		99.58% Pervious Area
372		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	256	0.1100	1.66		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.5	306	Total			

Subcatchment E-2: E-2



Summary for Subcatchment E-3: E-3

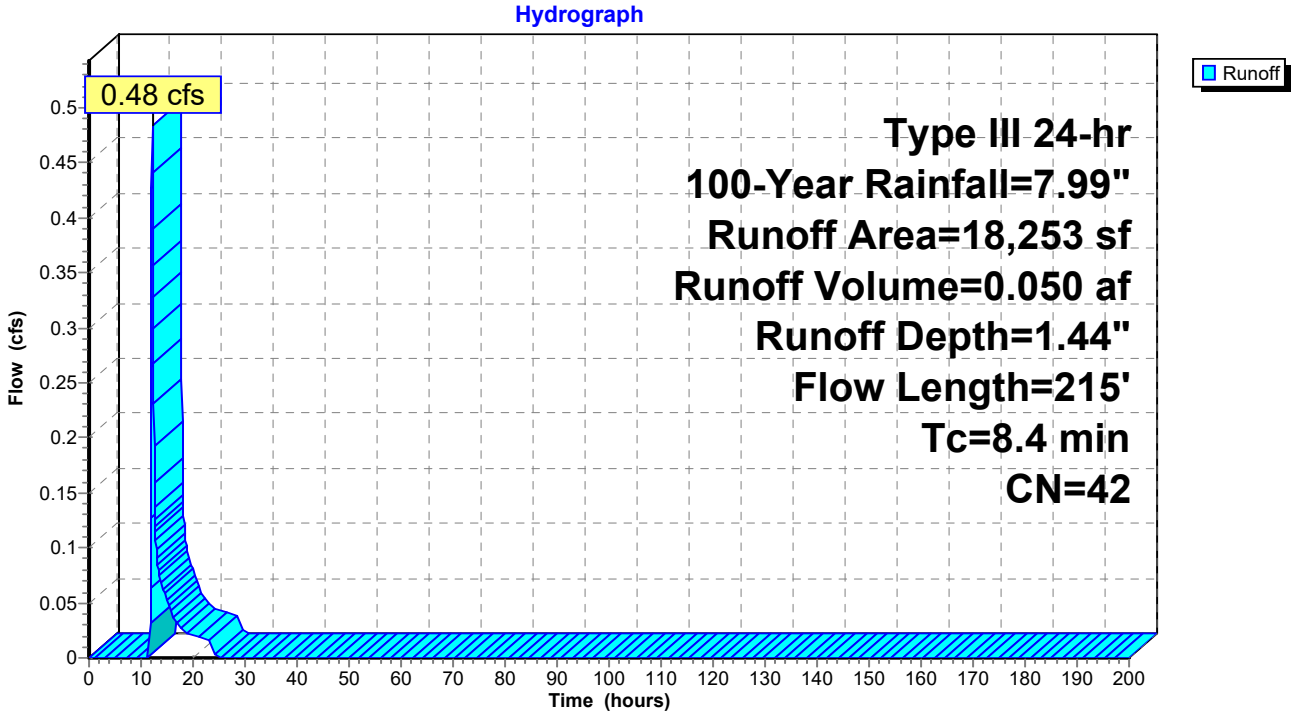
Runoff = 0.48 cfs @ 12.15 hrs, Volume= 0.050 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
15,616	32	Woods/grass comb., Good, HSG A
2,637	98	Paved parking, HSG A
18,253	42	Weighted Average
15,616		85.55% Pervious Area
2,637		14.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.2	165	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.4	215	Total			

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

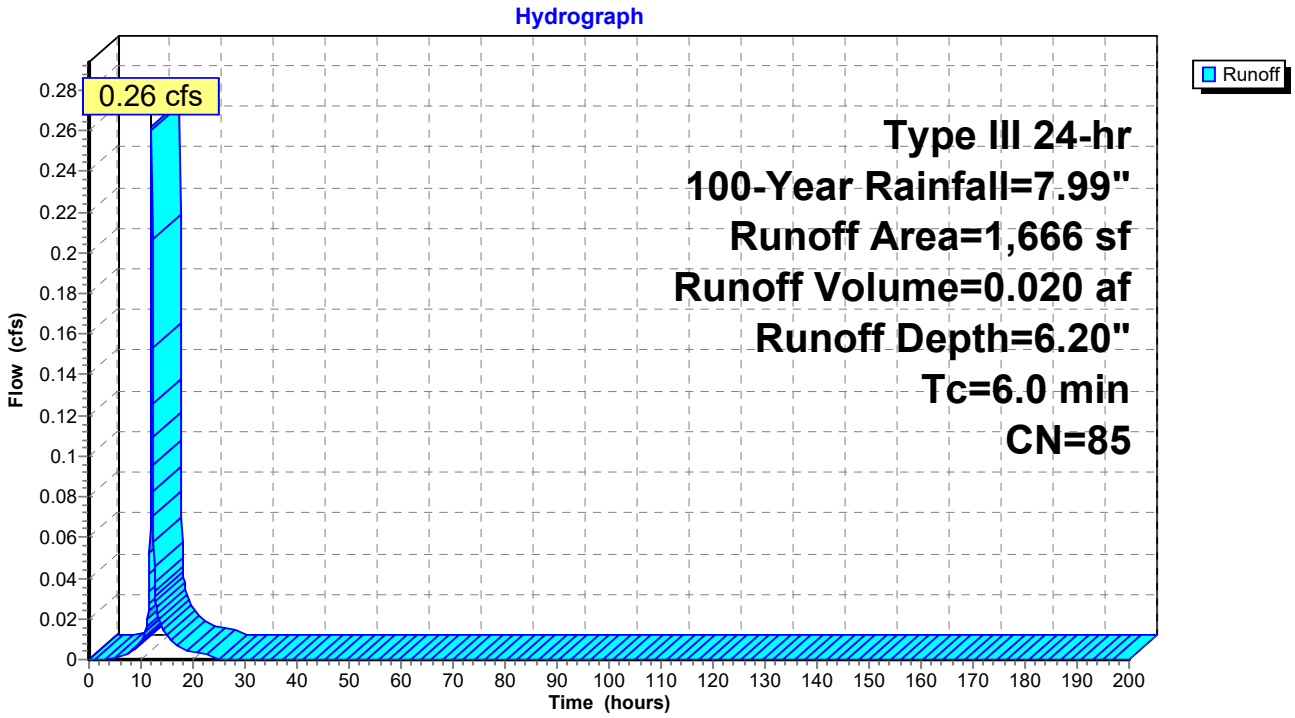
Runoff = 0.26 cfs @ 12.09 hrs, Volume= 0.020 af, Depth= 6.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
1,210	98	Paved parking, HSG A
456	49	50-75% Grass cover, Fair, HSG A
1,666	85	Weighted Average
456		27.37% Pervious Area
1,210		72.63% Impervious Area

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

Subcatchment E-4: E-4

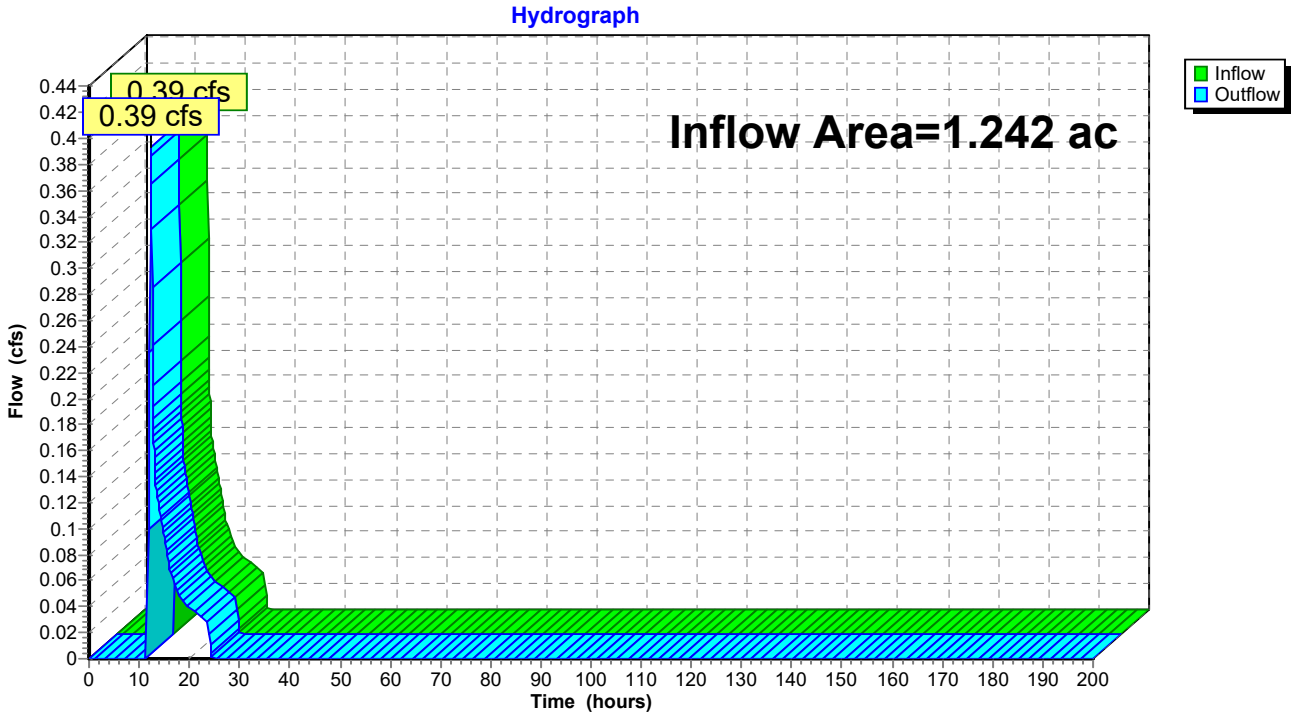


Summary for Reach 1: E-1

Inflow Area = 1.242 ac, 3.54% Impervious, Inflow Depth = 0.72" for 100-Year event
Inflow = 0.39 cfs @ 12.35 hrs, Volume= 0.074 af
Outflow = 0.39 cfs @ 12.35 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 1: E-1

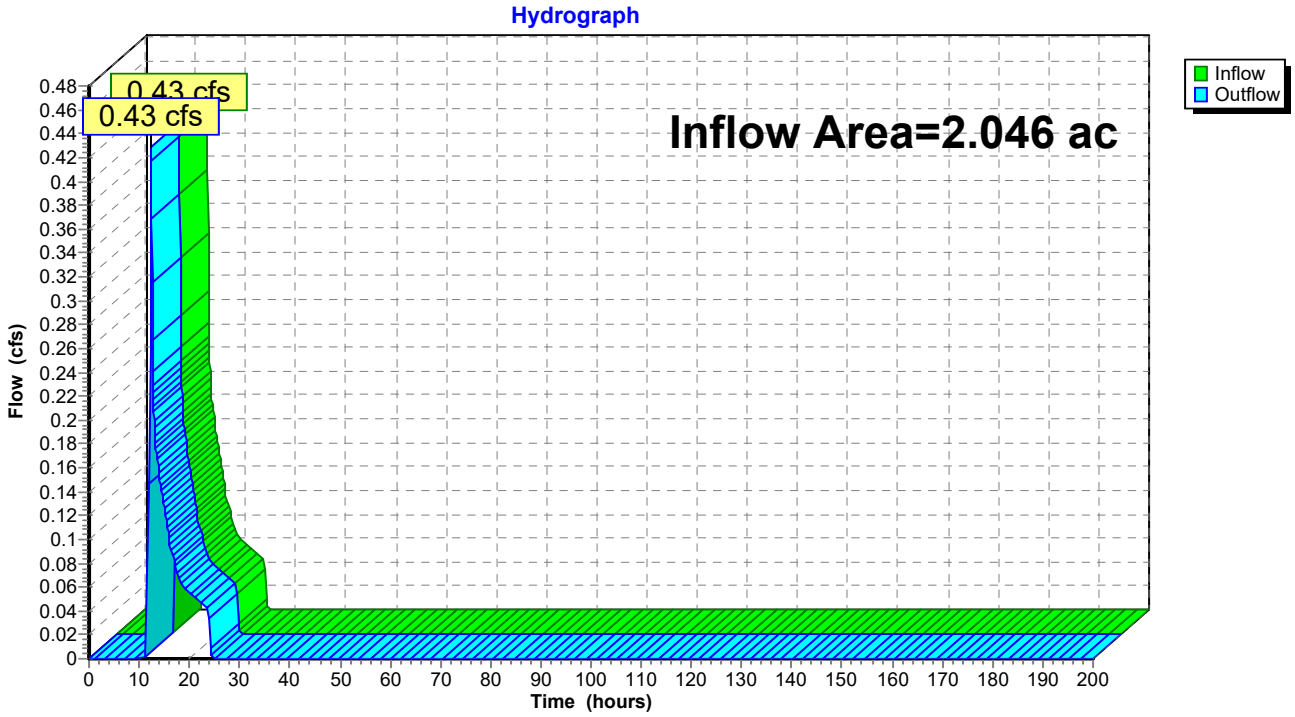


Summary for Reach 2: E-2

Inflow Area = 2.046 ac, 0.42% Impervious, Inflow Depth = 0.56" for 100-Year event
Inflow = 0.43 cfs @ 12.38 hrs, Volume= 0.095 af
Outflow = 0.43 cfs @ 12.38 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 2: E-2

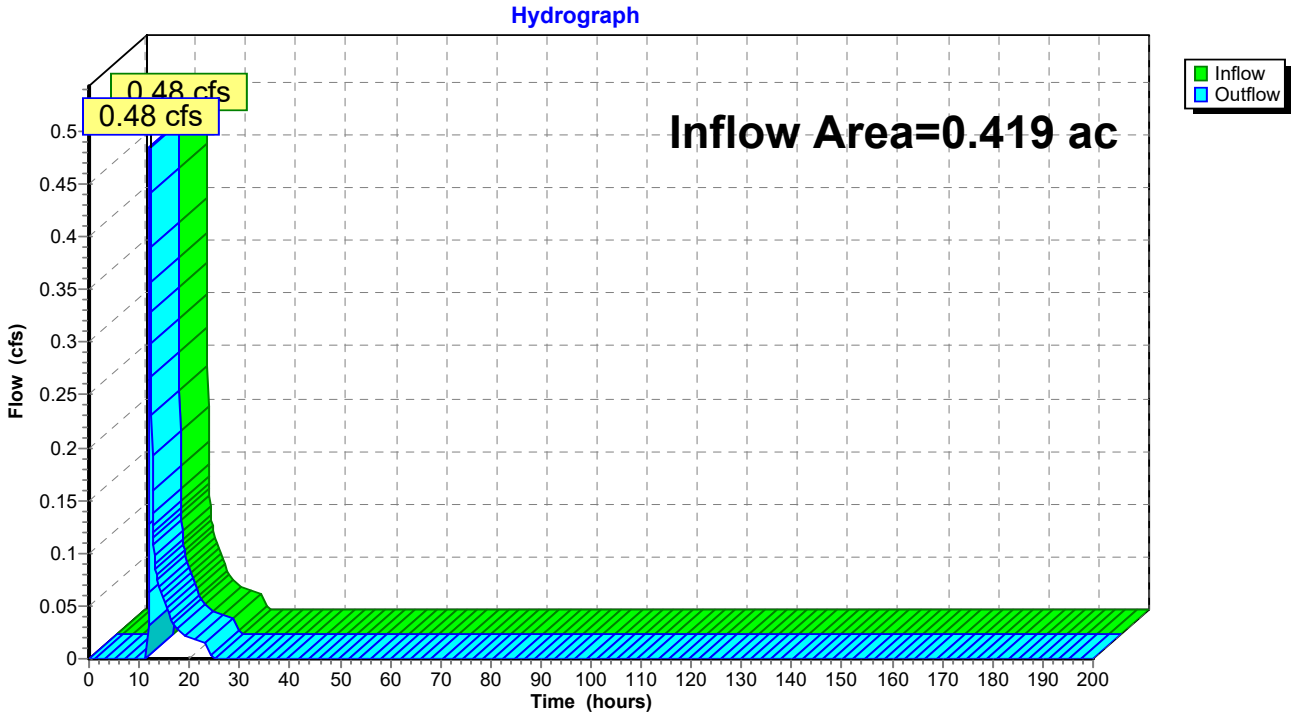


Summary for Reach 3: E-3

Inflow Area = 0.419 ac, 14.45% Impervious, Inflow Depth = 1.44" for 100-Year event
Inflow = 0.48 cfs @ 12.15 hrs, Volume= 0.050 af
Outflow = 0.48 cfs @ 12.15 hrs, Volume= 0.050 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 3: E-3

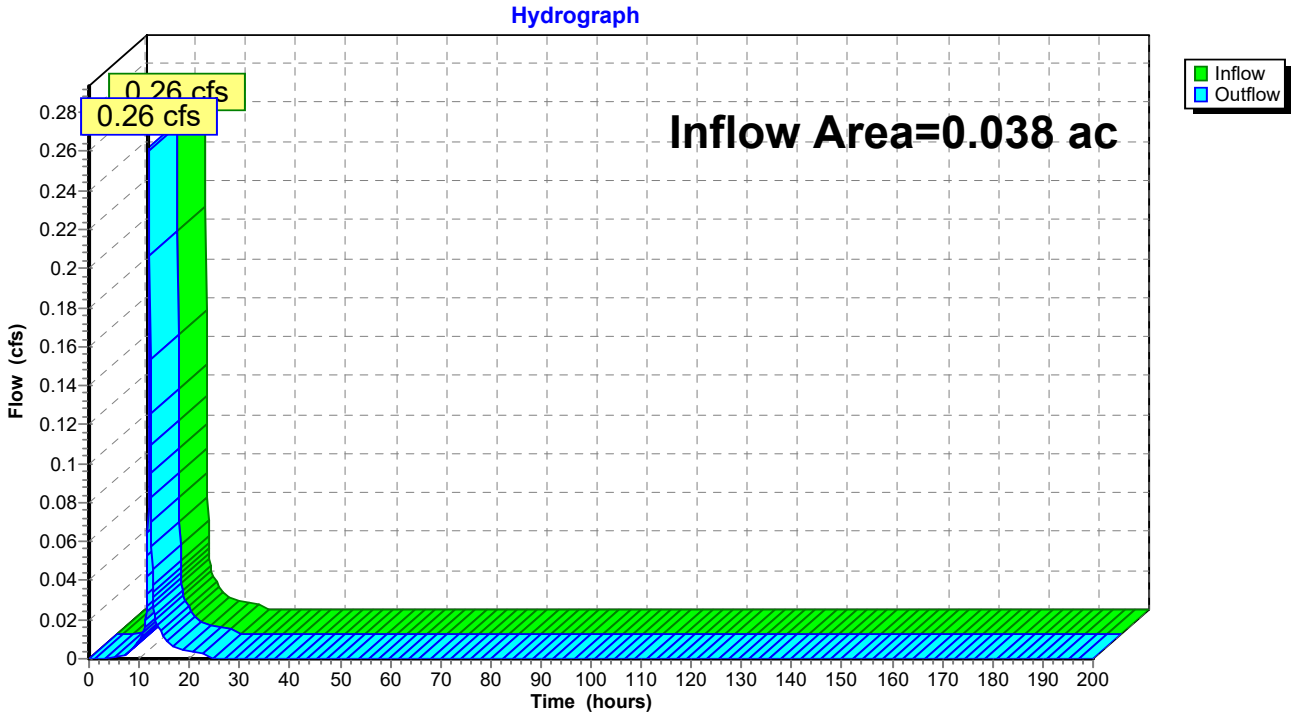


Summary for Reach 4: E-4

Inflow Area = 0.038 ac, 72.63% Impervious, Inflow Depth = 6.20" for 100-Year event
Inflow = 0.26 cfs @ 12.09 hrs, Volume= 0.020 af
Outflow = 0.26 cfs @ 12.09 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 4: E-4



52
(HR-B/D)

424C
(HR-A)

52
(HR-B/D)

POINT OF DISCHARGE 1
PEAK DISCHARGE SUMMARY
2-YEAR STORM = 0.00 cfs
10-YEAR STORM = 0.01 cfs
25-YEAR STORM = 0.06 cfs
100-YEAR STORM = 0.39 cfs

POINT OF DISCHARGE 2
PEAK DISCHARGE SUMMARY
2-YEAR STORM = 0.00 cfs
10-YEAR STORM = 0.01 cfs
25-YEAR STORM = 0.05 cfs
100-YEAR STORM = 0.43 cfs

POINT OF DISCHARGE 3
PEAK DISCHARGE SUMMARY
2-YEAR STORM = 0.00 cfs
10-YEAR STORM = 0.05 cfs
25-YEAR STORM = 0.16 cfs
100-YEAR STORM = 0.48 cfs

POINT OF DISCHARGE 4
PEAK DISCHARGE SUMMARY
2-YEAR STORM = 0.08 cfs
10-YEAR STORM = 0.15 cfs
25-YEAR STORM = 0.20 cfs
100-YEAR STORM = 0.26 cfs

E-1
AREA=54,099 SF
TC=9.2 MIN.
CN=32

E-2
AREA=89,110 SF
TC=7.5 MIN.
CN=30

E-3
AREA=18,253 SF
TC=8.4 MIN.
CN=40

E-4
AREA=1,666 SF
TC=6.0 MIN.
CN=82

306 FT SCF
258 FT SCF
50 FT SF
50 FT SF
50 FT SF
50 FT SF
166 FT SCF

MASSAPOAG STREET

Map unit symbol	Map unit name	Rating
52	Freetown muck, 0 to 1 percent slopes	B/D
424C	Canton fine sandy loam, 8 to 15 percent slopes, extremely bouldery	A

SF=SHEET FLOW
SCF= SHALLOW CONCENTRATED FLOW

APPROVAL UNDER THE SUBDIVISION CONTROL LAW
WEYMOUTH PLANNING BOARD

DATE:

PLANNING BOARD ENDORSEMENT DOES NOT IMPLY CONFORMANCE WITH TOWN OF WEYMOUTH ZONING BY-LAW.

N

SCALE

FOR REGISTRY USE ONLY

40 20 0 40 80

Date	Description	No.
10.08.21	REV. PER CON. COMM. AND TOWN ENG. COMMENTS	3.
4.23.20	REVISED PER TOWN STAFF COMMENTS	2.
2.05.19	REVISED WETLAND FLAGS AND LOT	1.

Revisions

COMMONWEALTH OF MASSACHUSETTS
GABRIEL R. CROCKER
CIVIL
No. 47917
REGISTERED PROFESSIONAL ENGINEER

10-8-2021

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

CROCKER DESIGN GROUP, LLC.

2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-820-0416

MASSACHUSETTS

Project

DEFINITIVE SUBDIVISION PLAN

MASSAPOAG STREET
WEYMOUTH, MA

Prepared for

BRISTOL BROS. DEVELOPMENT CORP.

190 OLD DERBY STREET, SUITE 311
HINGHAM, MA 02043

Drawing Title

EXISTING CONDITIONS WATERSHED ANALYSIS PLAN

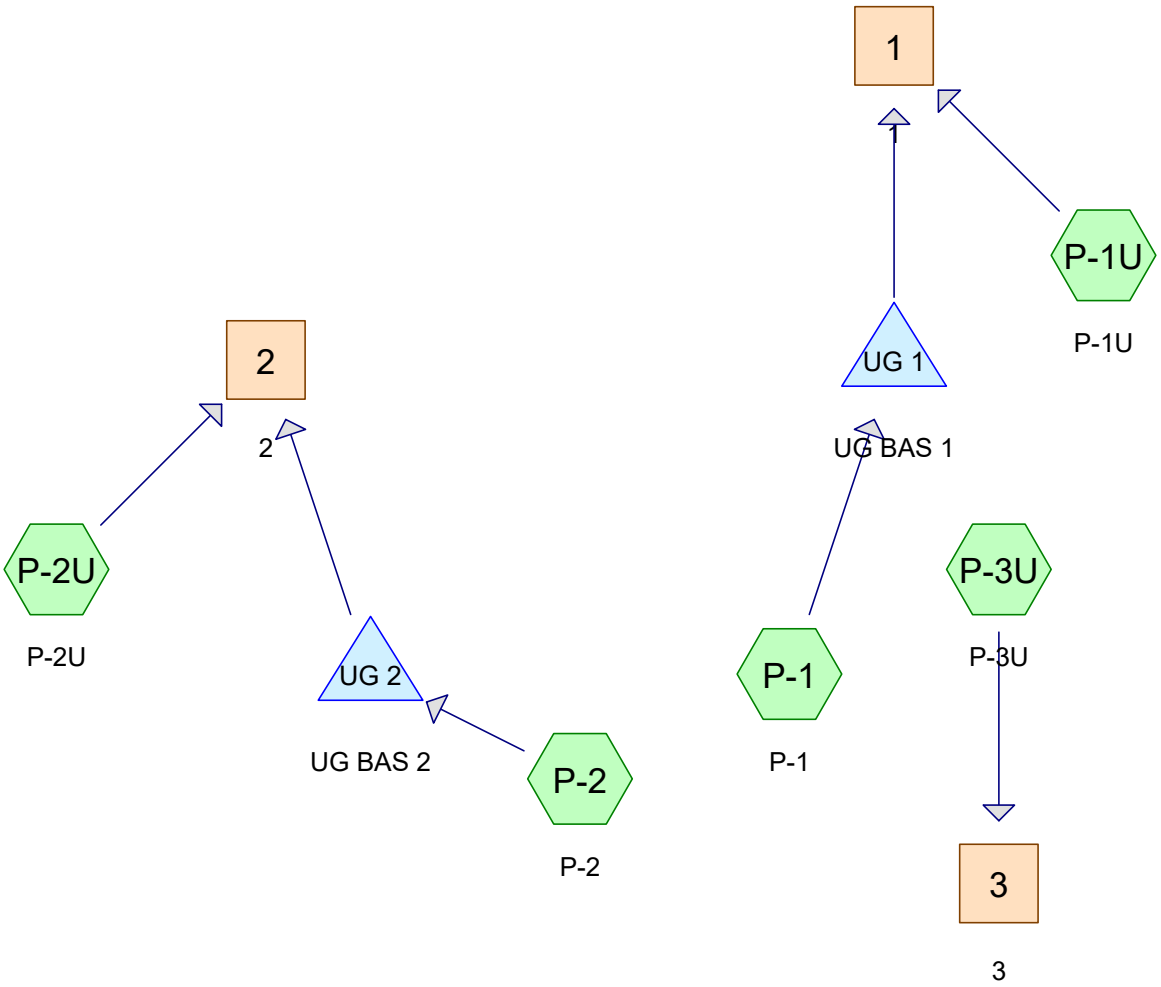
Project No.	100-029
Date	12.20.2018
Scale	1"=40'
Drawn By	SZA
Approved By	GC

Drawing No.

EW-1

SECTION 3 – STORMATER HYDROLOGY MODEL

3.2 PROPOSED HYDROLOGY



Subcat Reach Pond Link

Routing Diagram for Massapoag Watershed with PC noaa
Prepared by {enter your company name here}, Printed 1/4/2022

Project Notes

Rainfall events imported from "Massapoag Watershed with EC noaa.hcp"

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.061	98	2 driveways (P-1)
0.103	98	3 houses (P-2)
0.207	98	4 houses (P-1)
0.114	98	5 driveways (P-2)
2.315	39	>75% Grass cover, Good, HSG A (P-1, P-1U, P-2)
0.264	98	Massapoag road (P-1, P-2)
0.029	98	POOL (P-1)
0.970	32	Woods/grass comb., Good, HSG A (P-1U, P-2U, P-3U)
0.020	98	ex house to remain (P-3U)
0.031	98	ex. offsite driveways, HSG A (P-1)
0.067	98	exist offsite houses, HSG A (P-1)
0.080	60	rip rap, HSG A (P-2U)

Summary for Subcatchment P-1: P-1

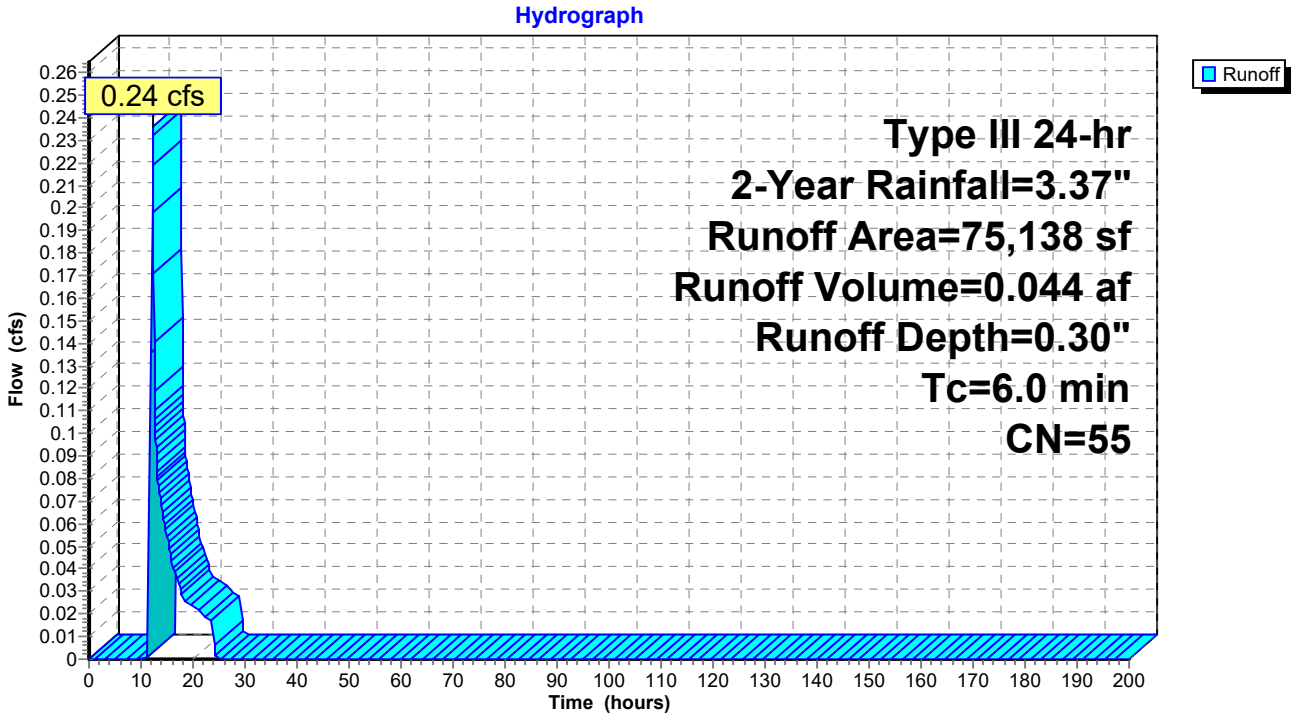
Runoff = 0.24 cfs @ 12.30 hrs, Volume= 0.044 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

	Area (sf)	CN	Description
*	2,640	98	2 driveways
	55,358	39	>75% Grass cover, Good, HSG A
*	9,000	98	4 houses
*	2,600	98	Massapoag road
*	2,930	98	exist offsite houses, HSG A
*	1,350	98	ex. offsite driveways, HSG A
*	1,260	98	POOL
	75,138	55	Weighted Average
	55,358		73.68% Pervious Area
	19,780		26.32% Impervious Area

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

Subcatchment P-1: P-1



Summary for Subcatchment P-1U: P-1U

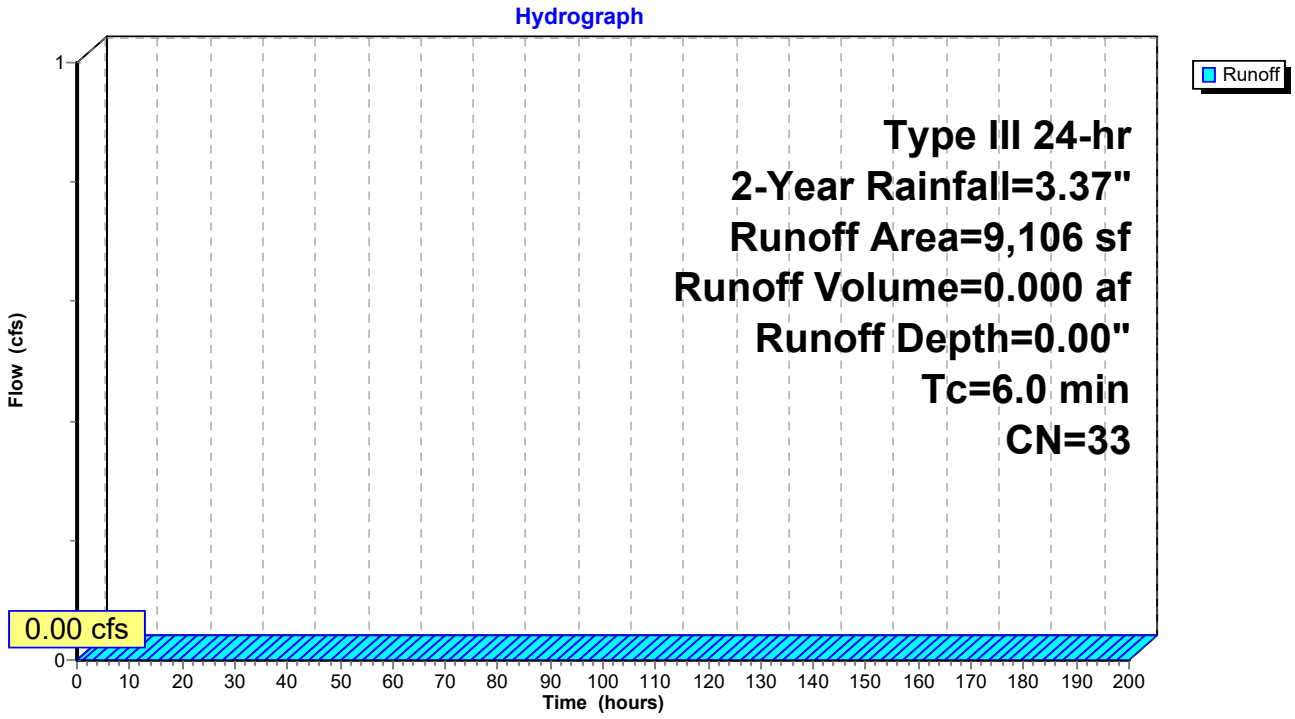
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

Area (sf)	CN	Description
1,000	39	>75% Grass cover, Good, HSG A
8,106	32	Woods/grass comb., Good, HSG A
9,106	33	Weighted Average
9,106		100.00% Pervious Area

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

Subcatchment P-1U: P-1U



Summary for Subcatchment P-2: P-2

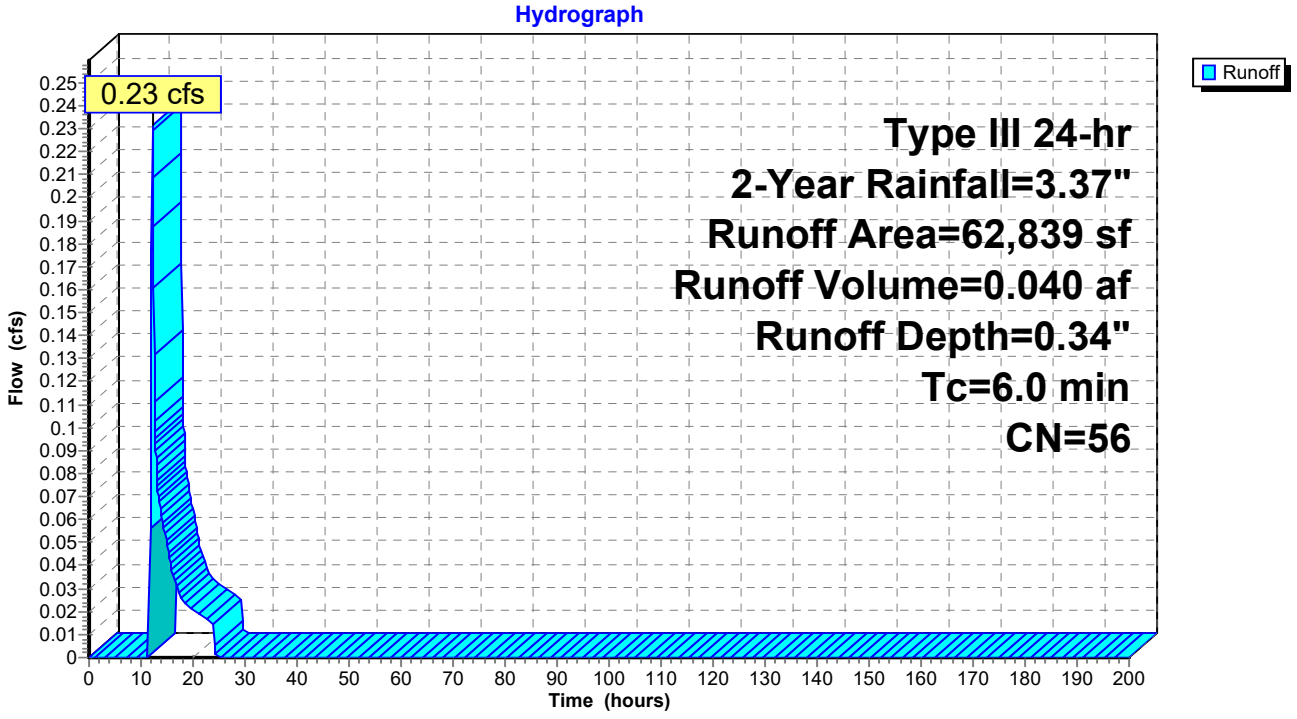
Runoff = 0.23 cfs @ 12.25 hrs, Volume= 0.040 af, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

	Area (sf)	CN	Description
*	4,960	98	5 driveways
	44,479	39	>75% Grass cover, Good, HSG A
*	8,900	98	Massapoag road
*	4,500	98	3 houses
	62,839	56	Weighted Average
	44,479		70.78% Pervious Area
	18,360		29.22% Impervious Area

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

Subcatchment P-2: P-2



Summary for Subcatchment P-2U: P-2U

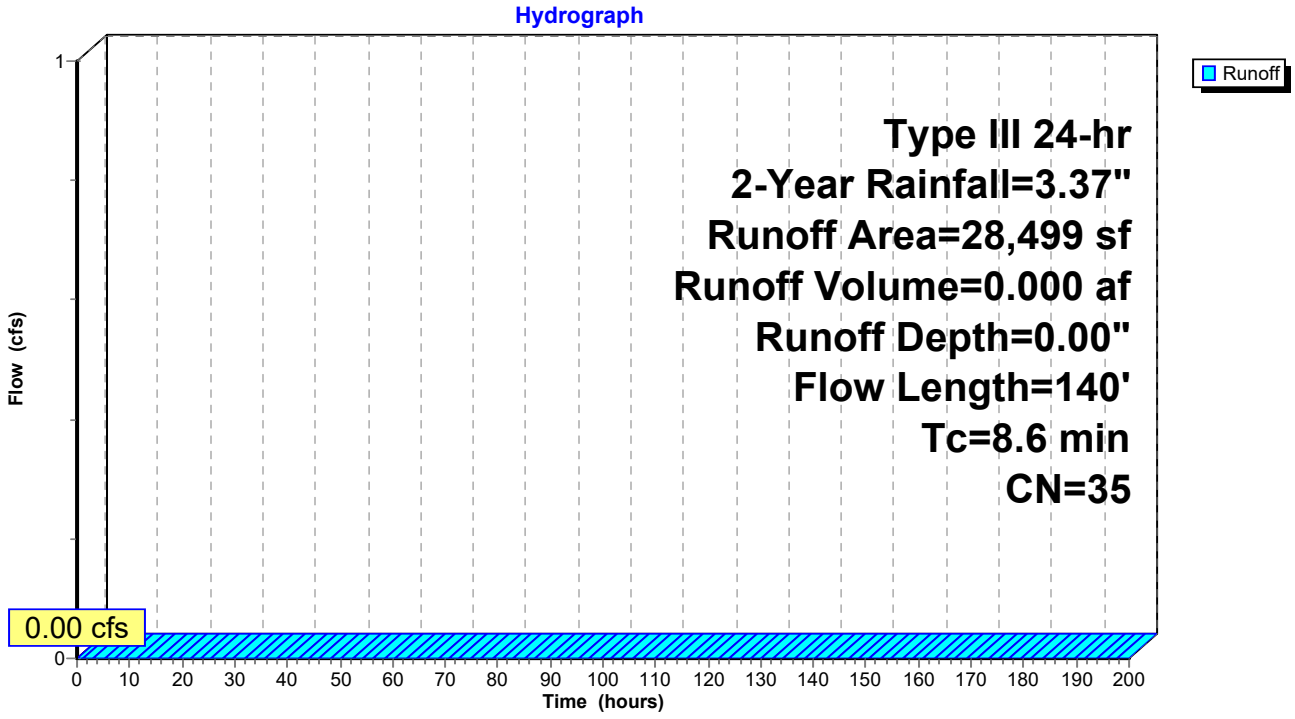
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

	Area (sf)	CN	Description
	24,999	32	Woods/grass comb., Good, HSG A
*	3,500	60	rip rap, HSG A
	28,499	35	Weighted Average
	28,499		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0700	0.11		**Sheet Flow, AB** Woods: Light underbrush n= 0.400 P2= 3.20"
1.1	90	0.0800	1.41		**Shallow Concentrated Flow, BC** Woodland Kv= 5.0 fps
8.6	140	Total			

Subcatchment P-2U: P-2U



Summary for Subcatchment P-3U: P-3U

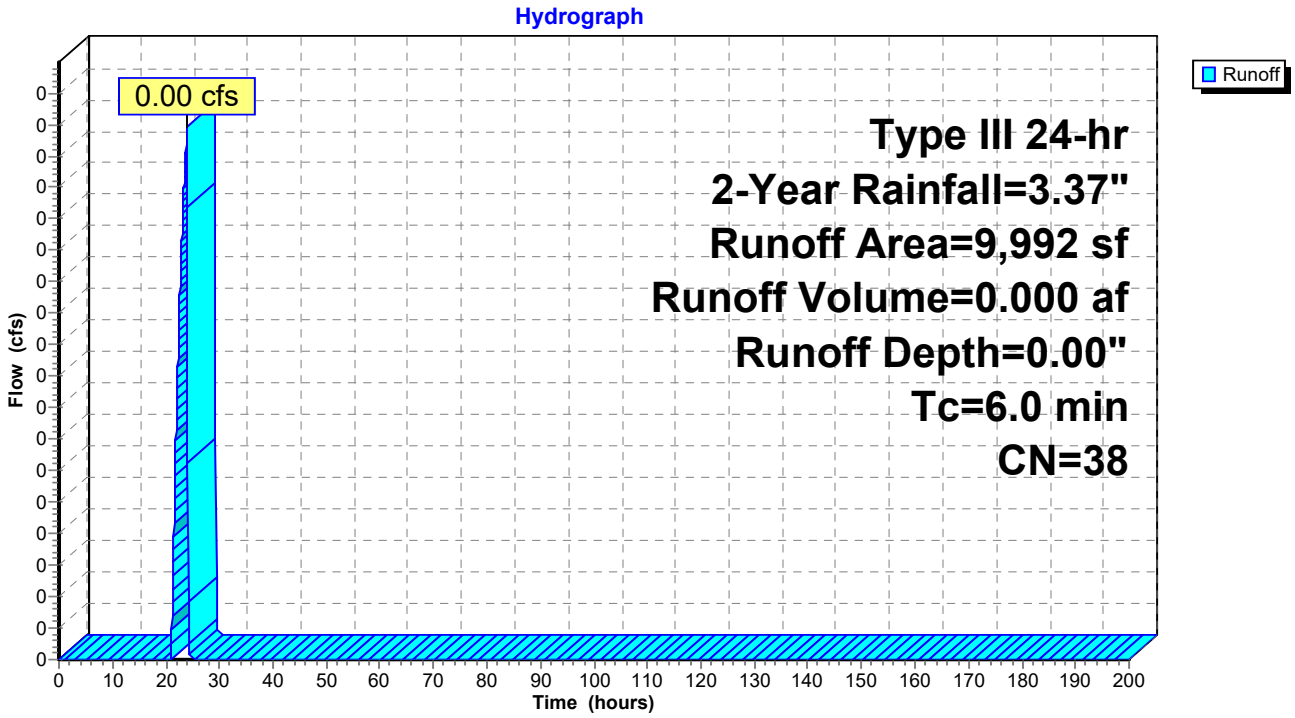
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.37"

	Area (sf)	CN	Description
	9,142	32	Woods/grass comb., Good, HSG A
*	850	98	ex house to remain
	9,992	38	Weighted Average
	9,142		91.49% Pervious Area
	850		8.51% Impervious Area

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

Subcatchment P-3U: P-3U

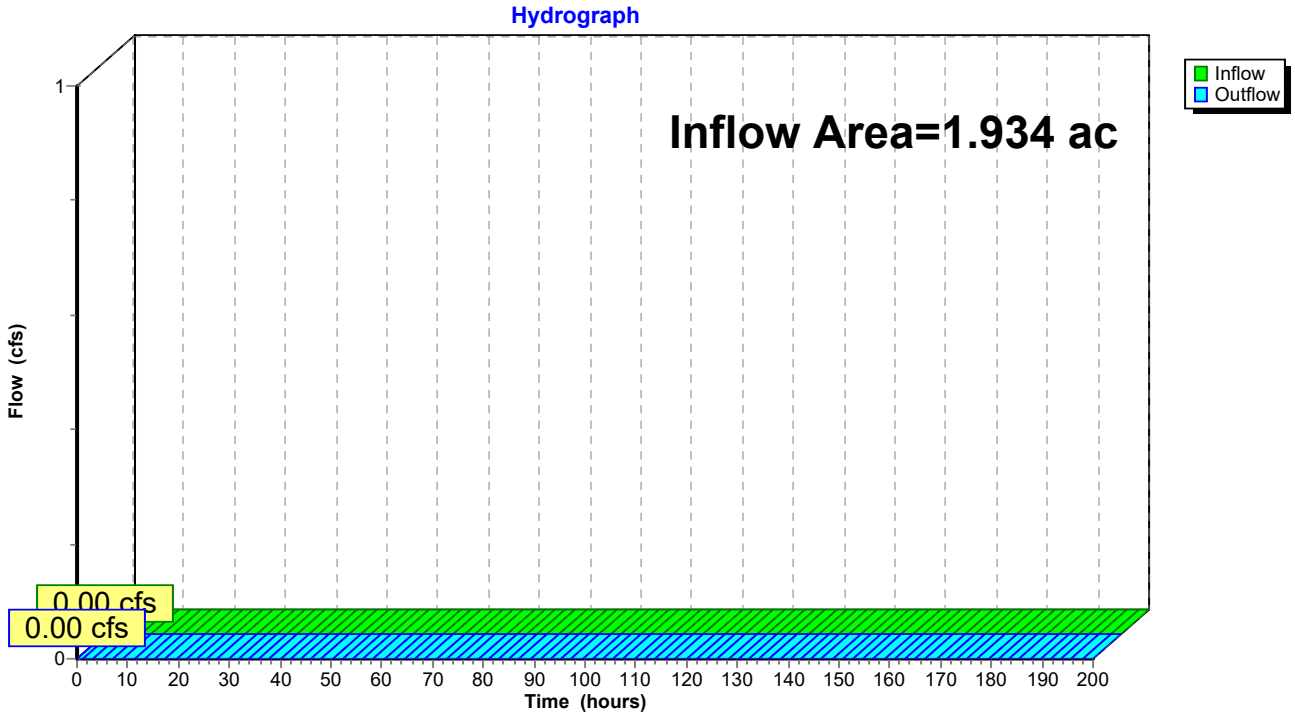


Summary for Reach 1: 1

Inflow Area = 1.934 ac, 23.48% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 1: 1

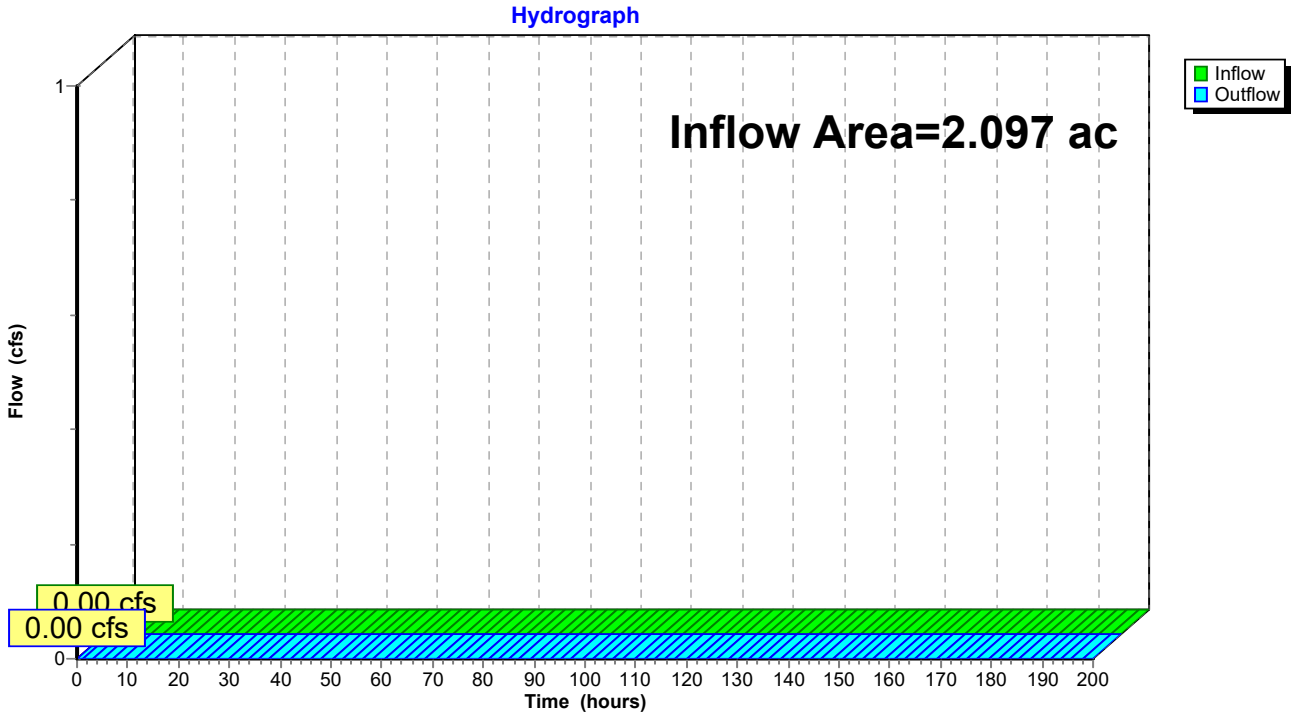


Summary for Reach 2: 2

Inflow Area = 2.097 ac, 20.10% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 2: 2

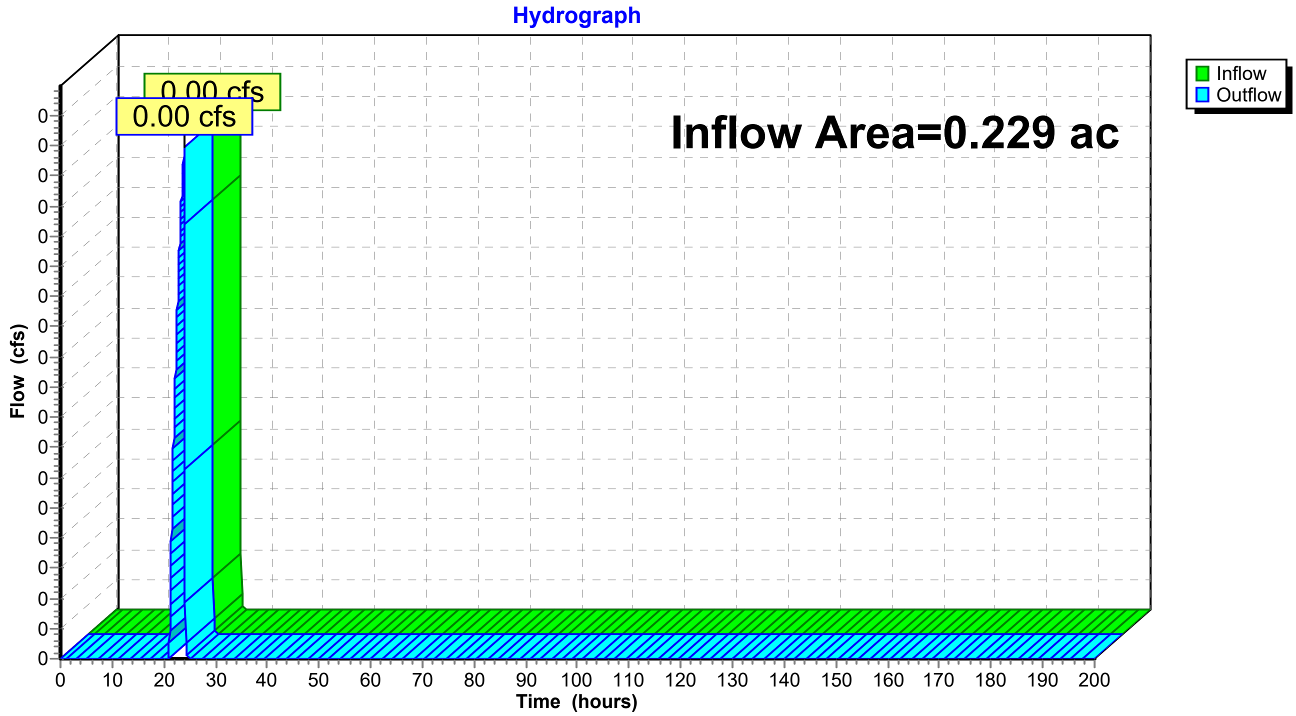


Summary for Reach 3: 3

Inflow Area = 0.229 ac, 8.51% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 3: 3



Summary for Pond UG 1: UG BAS 1

Inflow Area = 1.725 ac, 26.32% Impervious, Inflow Depth = 0.30" for 2-Year event
Inflow = 0.24 cfs @ 12.30 hrs, Volume= 0.044 af
Outflow = 0.20 cfs @ 12.30 hrs, Volume= 0.044 af, Atten= 16%, Lag= 0.0 min
Discarded = 0.20 cfs @ 12.30 hrs, Volume= 0.044 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 165.05' @ 12.45 hrs Surf.Area= 3,544 sf Storage= 73 cf

Plug-Flow detention time= 4.6 min calculated for 0.044 af (100% of inflow)
Center-of-Mass det. time= 4.6 min (949.7 - 945.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	165.00'	3,197 cf	**58.50'W x 60.58'L x 3.50'H Field A** 12,403 cf Overall - 4,410 cf Embedded = 7,993 cf x 40.0% Voids
#2A	165.50'	4,410 cf	**ADS_StormTech SC-740 +Cap** x 96 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 96 Chambers in 12 Rows
		7,607 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	165.00'	**2.410 in/hr Exfiltration over Horizontal area**
#2	Device 3	167.96'	**5.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	167.78'	**12.0" Round RCP_Round 12"** L= 17.7' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 167.78' / 167.60' S= 0.0102 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Discarded OutFlow Max=0.20 cfs @ 12.30 hrs HW=165.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.20 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=165.00' (Free Discharge)
↑**3=RCP_Round 12"** (Controls 0.00 cfs)
↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond UG 1: UG BAS 1 - Chamber Wizard Field A

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

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

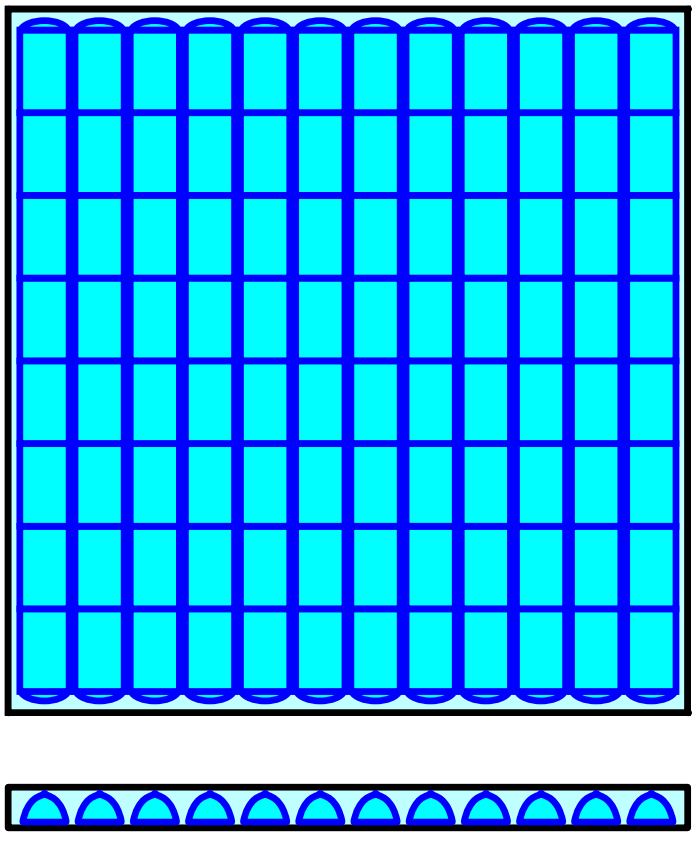
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
12 Rows x 51.0" Wide + 6.0" Spacing x 11 + 12.0" Side Stone x 2 = 58.50' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

96 Chambers x 45.9 cf = 4,410.2 cf Chamber Storage

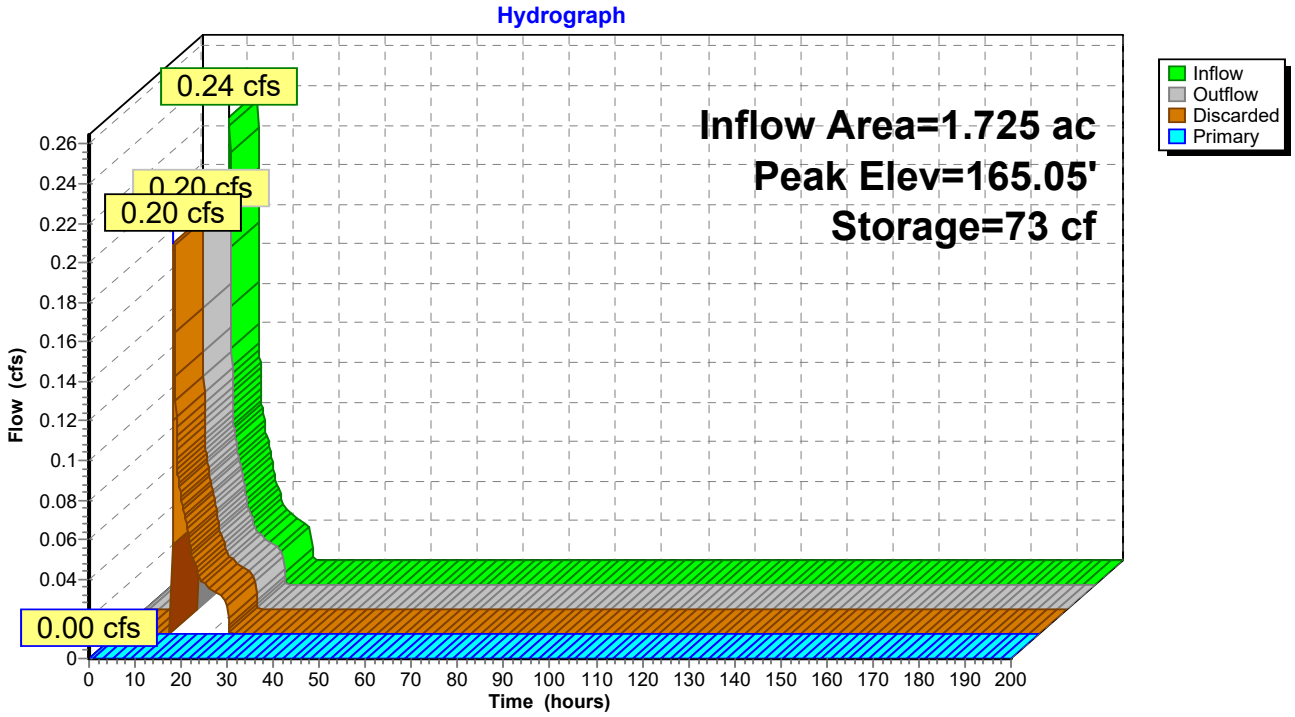
12,403.1 cf Field - 4,410.2 cf Chambers = 7,992.8 cf Stone x 40.0% Voids = 3,197.1 cf Stone Storage

Chamber Storage + Stone Storage = 7,607.4 cf = 0.175 af
Overall Storage Efficiency = 61.3%
Overall System Size = 60.58' x 58.50' x 3.50'

96 Chambers
459.4 cy Field
296.0 cy Stone



Pond UG 1: UG BAS 1



Summary for Pond UG 2: UG BAS 2

Inflow Area = 1.443 ac, 29.22% Impervious, Inflow Depth = 0.34" for 2-Year event
Inflow = 0.23 cfs @ 12.25 hrs, Volume= 0.040 af
Outflow = 0.12 cfs @ 12.57 hrs, Volume= 0.040 af, Atten= 47%, Lag= 19.1 min
Discarded = 0.12 cfs @ 12.57 hrs, Volume= 0.040 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 165.19' @ 12.57 hrs Surf.Area= 2,179 sf Storage= 165 cf

Plug-Flow detention time= 9.6 min calculated for 0.040 af (100% of inflow)
Center-of-Mass det. time= 9.6 min (947.4 - 937.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	165.00'	3,357 cf	**80.08'W x 27.21'L x 5.67'H Field A** 12,348 cf Overall - 3,956 cf Embedded = 8,392 cf x 40.0% Voids
#2A	165.75'	3,956 cf	**ADS_StormTech MC-3500 d +Cap** x 33 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 33 Chambers in 11 Rows Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf
		7,313 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	165.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Device 3	170.20'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	167.14'	**12.0" Round RCP_Round 12"** L= 17.2' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 167.14' / 166.80' S= 0.0198 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Discarded OutFlow Max=0.12 cfs @ 12.57 hrs HW=165.19' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=165.00' (Free Discharge)
↑—**3=RCP_Round 12"** (Controls 0.00 cfs)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond UG 2: UG BAS 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

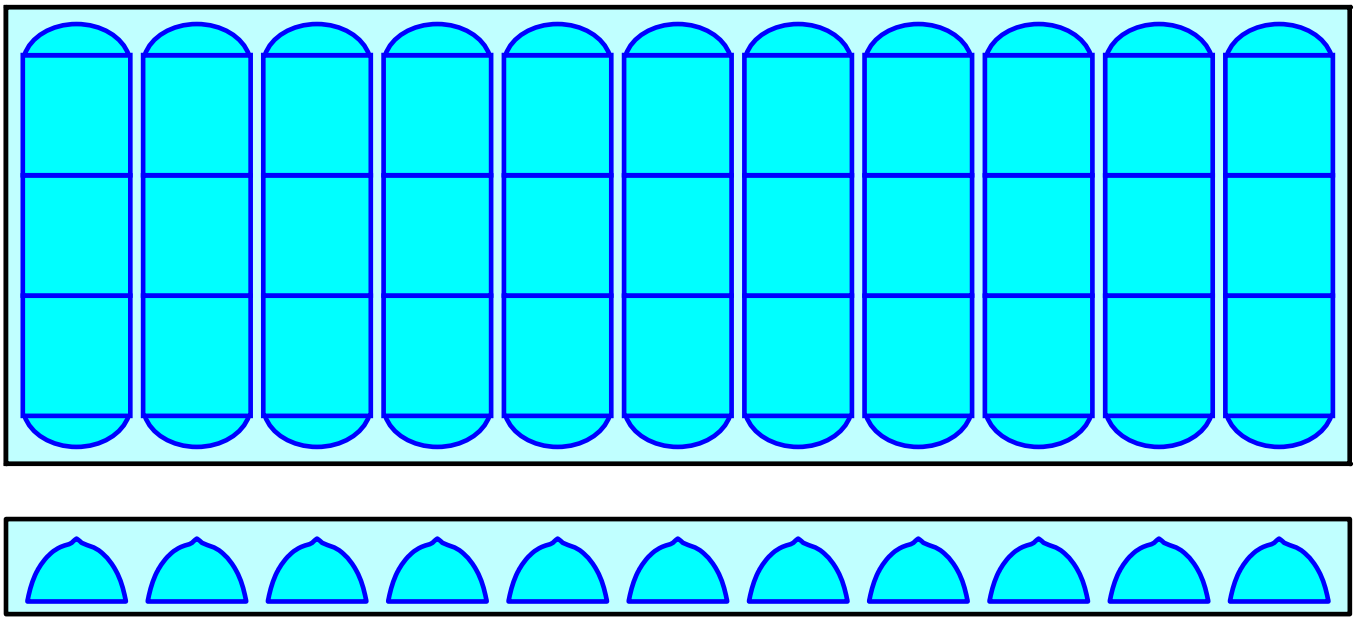
3 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 25.21' Row Length +12.0" End Stone x 2 = 27.21' Base Length
11 Rows x 77.0" Wide + 9.0" Spacing x 10 + 12.0" Side Stone x 2 = 80.08' Base Width
9.0" Base + 45.0" Chamber Height + 14.0" Cover = 5.67' Field Height

33 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 11 Rows = 3,956.2 cf Chamber Storage

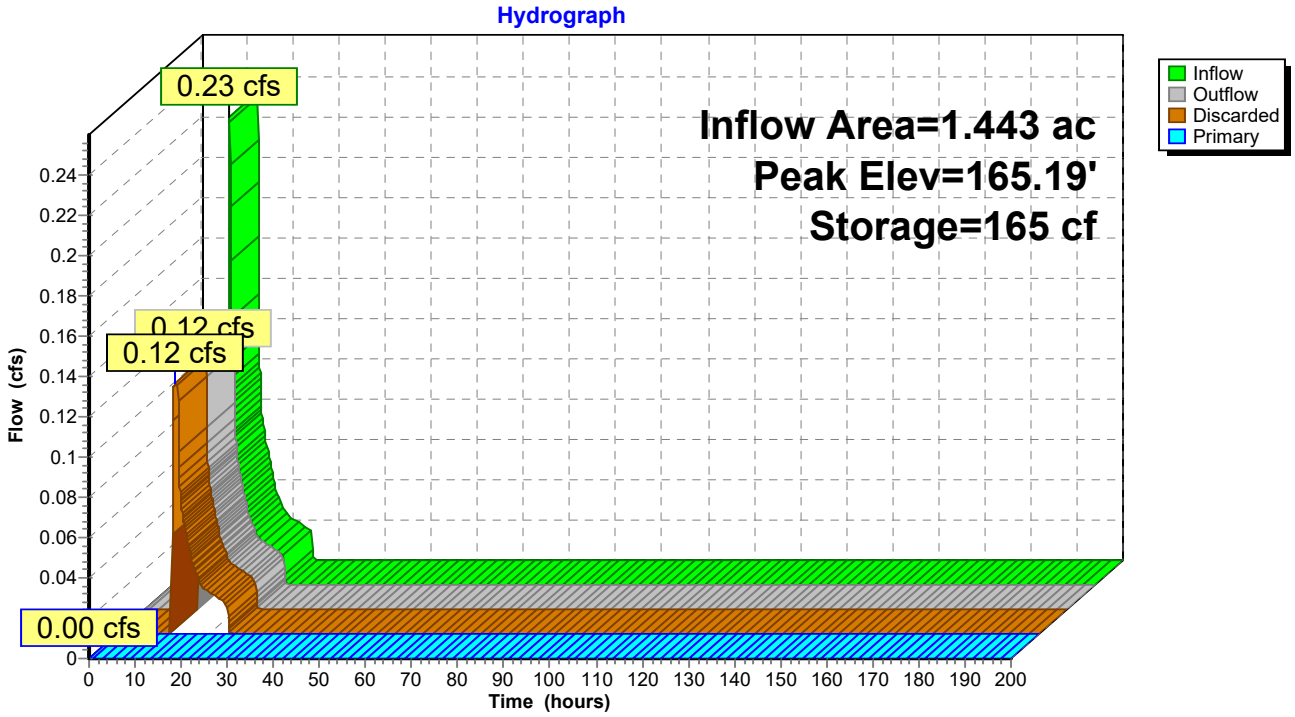
12,348.0 cf Field - 3,956.2 cf Chambers = 8,391.8 cf Stone x 40.0% Voids = 3,356.7 cf Stone Storage

Chamber Storage + Stone Storage = 7,312.9 cf = 0.168 af
Overall Storage Efficiency = 59.2%
Overall System Size = 27.21' x 80.08' x 5.67'

33 Chambers
457.3 cy Field
310.8 cy Stone



Pond UG 2: UG BAS 2



Summary for Subcatchment P-1: P-1

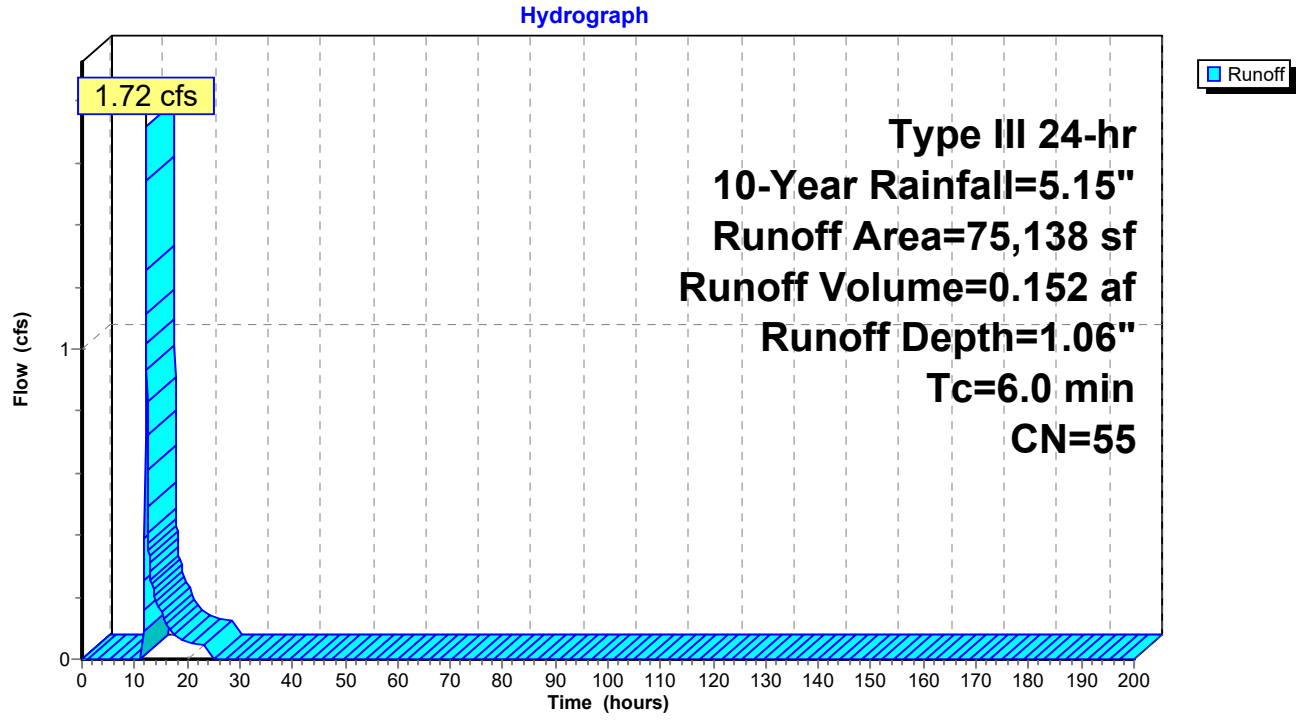
Runoff = 1.72 cfs @ 12.11 hrs, Volume= 0.152 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

	Area (sf)	CN	Description
*	2,640	98	2 driveways
	55,358	39	>75% Grass cover, Good, HSG A
*	9,000	98	4 houses
*	2,600	98	Massapoag road
*	2,930	98	exist offsite houses, HSG A
*	1,350	98	ex. offsite driveways, HSG A
*	1,260	98	POOL
	75,138	55	Weighted Average
	55,358		73.68% Pervious Area
	19,780		26.32% Impervious Area

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

Subcatchment P-1: P-1



Summary for Subcatchment P-1U: P-1U

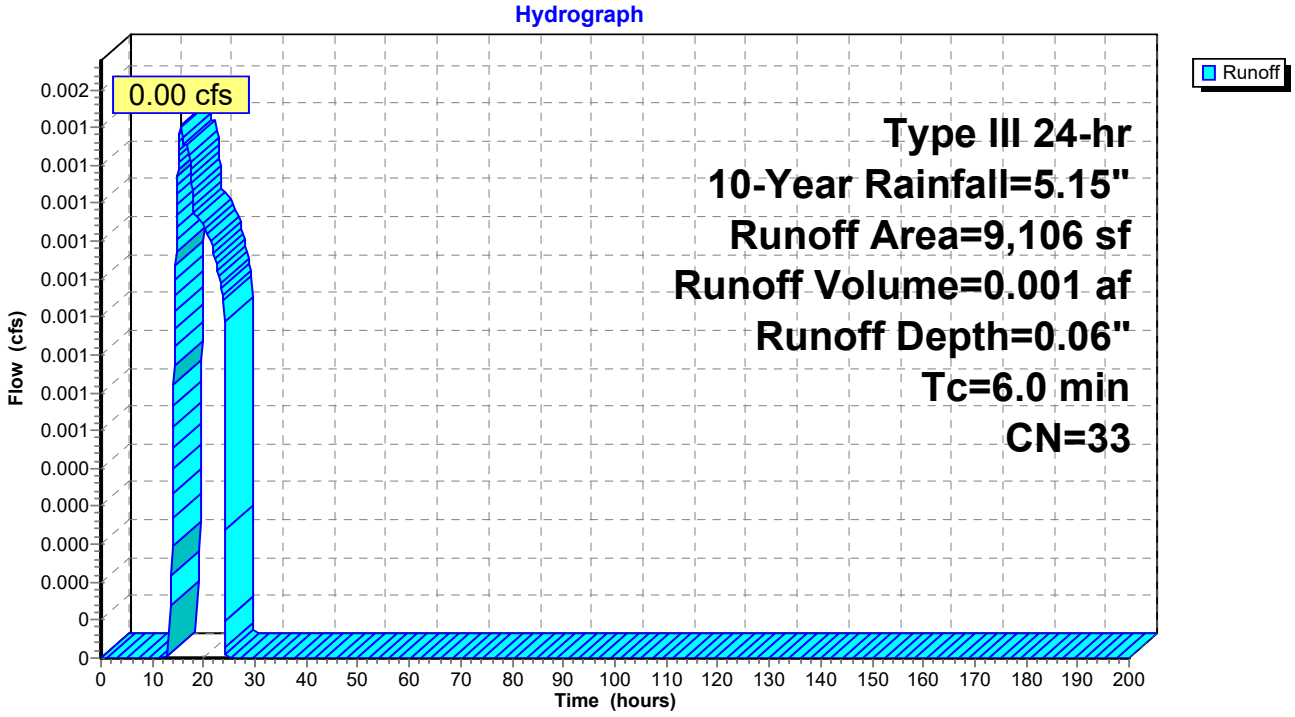
Runoff = 0.00 cfs @ 15.61 hrs, Volume= 0.001 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
1,000	39	>75% Grass cover, Good, HSG A
8,106	32	Woods/grass comb., Good, HSG A
9,106	33	Weighted Average
9,106		100.00% Pervious Area

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

Subcatchment P-1U: P-1U



Summary for Subcatchment P-2: P-2

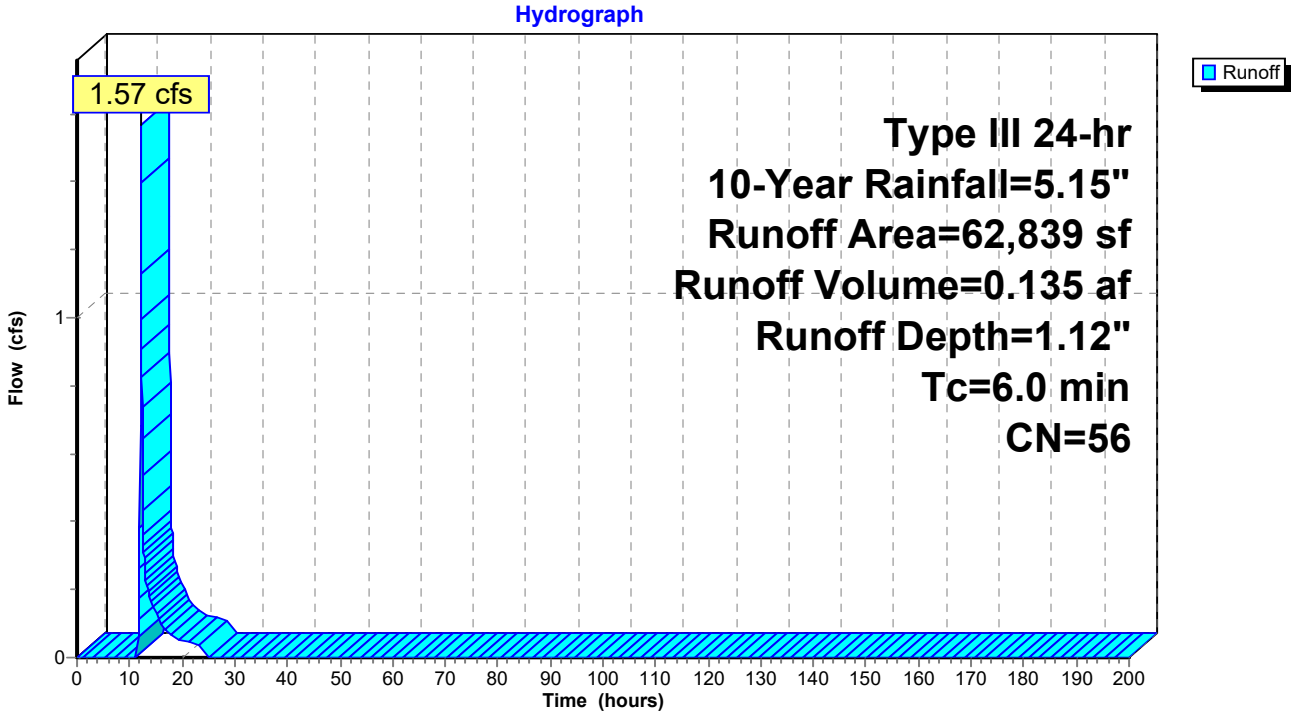
Runoff = 1.57 cfs @ 12.11 hrs, Volume= 0.135 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

	Area (sf)	CN	Description
*	4,960	98	5 driveways
	44,479	39	>75% Grass cover, Good, HSG A
*	8,900	98	Massapoag road
*	4,500	98	3 houses
	62,839	56	Weighted Average
	44,479		70.78% Pervious Area
	18,360		29.22% Impervious Area

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

Subcatchment P-2: P-2



Summary for Subcatchment P-2U: P-2U

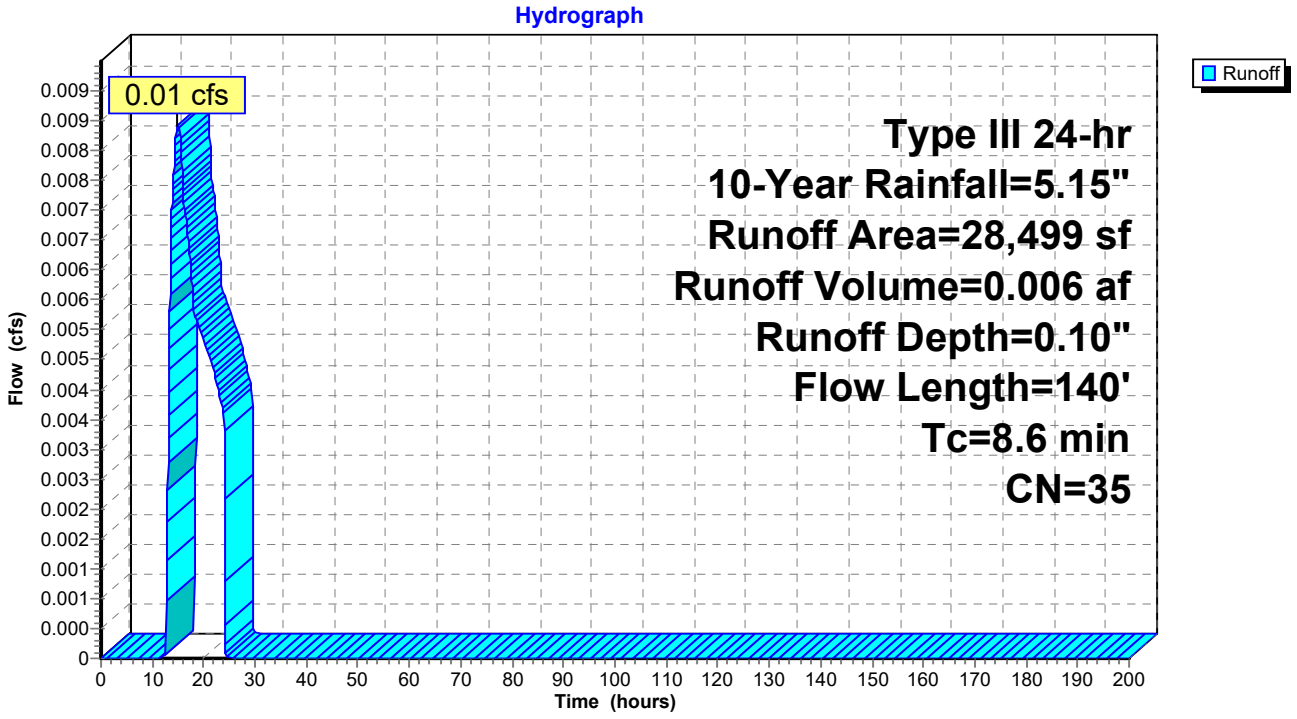
Runoff = 0.01 cfs @ 14.98 hrs, Volume= 0.006 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

	Area (sf)	CN	Description
	24,999	32	Woods/grass comb., Good, HSG A
*	3,500	60	rip rap, HSG A
	28,499	35	Weighted Average
	28,499		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0700	0.11		**Sheet Flow, AB** Woods: Light underbrush n= 0.400 P2= 3.20"
1.1	90	0.0800	1.41		**Shallow Concentrated Flow, BC** Woodland Kv= 5.0 fps
8.6	140	Total			

Subcatchment P-2U: P-2U



Summary for Subcatchment P-3U: P-3U

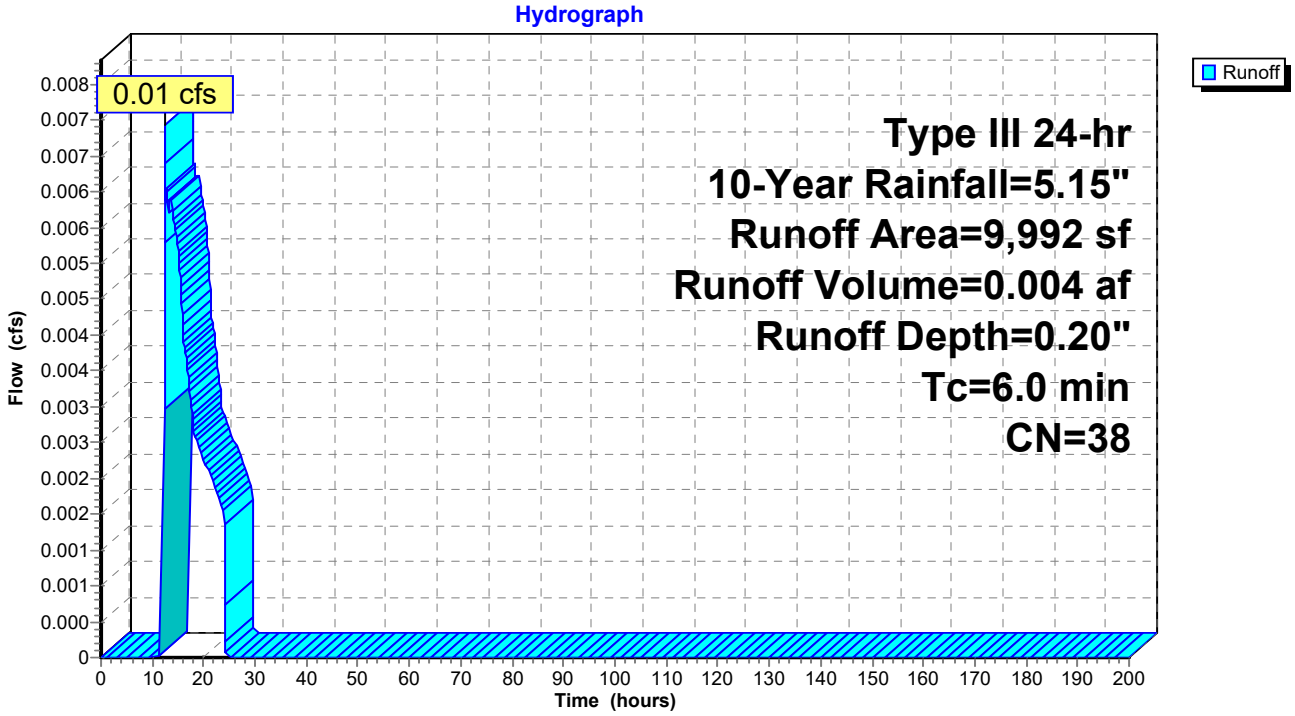
Runoff = 0.01 cfs @ 12.49 hrs, Volume= 0.004 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

	Area (sf)	CN	Description
	9,142	32	Woods/grass comb., Good, HSG A
*	850	98	ex house to remain
	9,992	38	Weighted Average
	9,142		91.49% Pervious Area
	850		8.51% Impervious Area

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

Subcatchment P-3U: P-3U

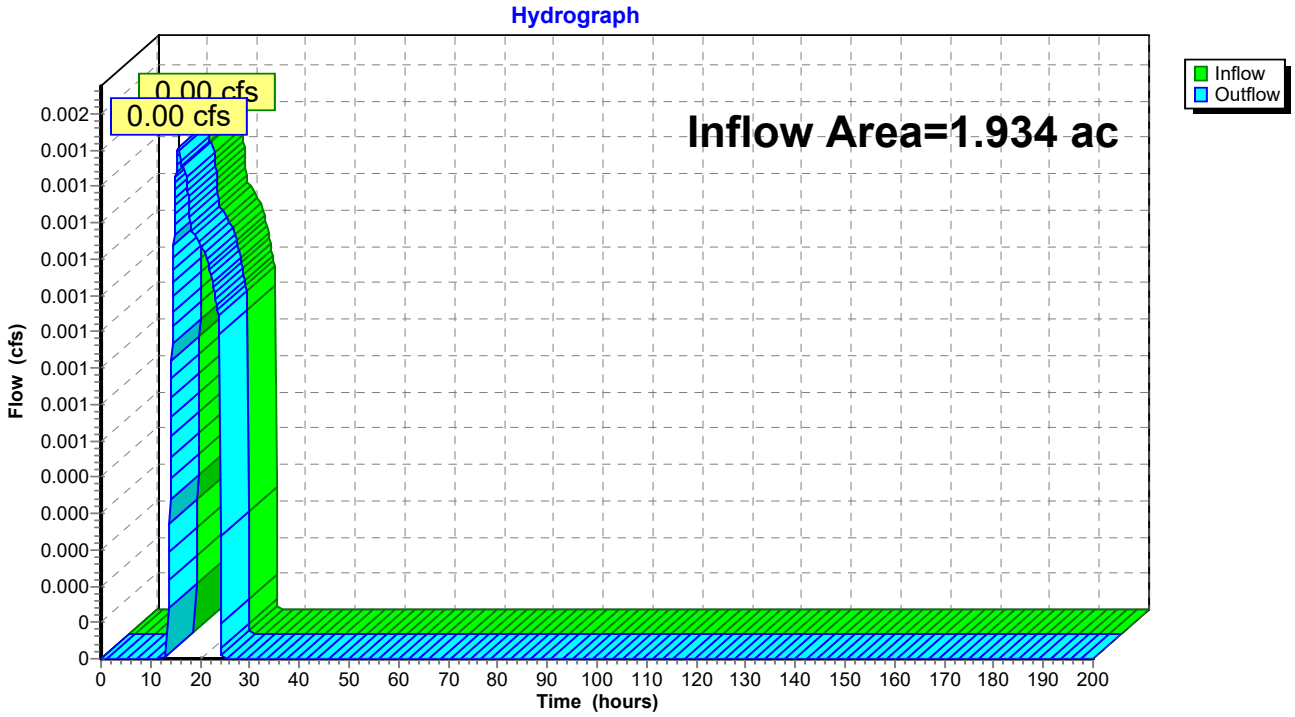


Summary for Reach 1: 1

Inflow Area = 1.934 ac, 23.48% Impervious, Inflow Depth = 0.01" for 10-Year event
Inflow = 0.00 cfs @ 15.61 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 15.61 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 1: 1

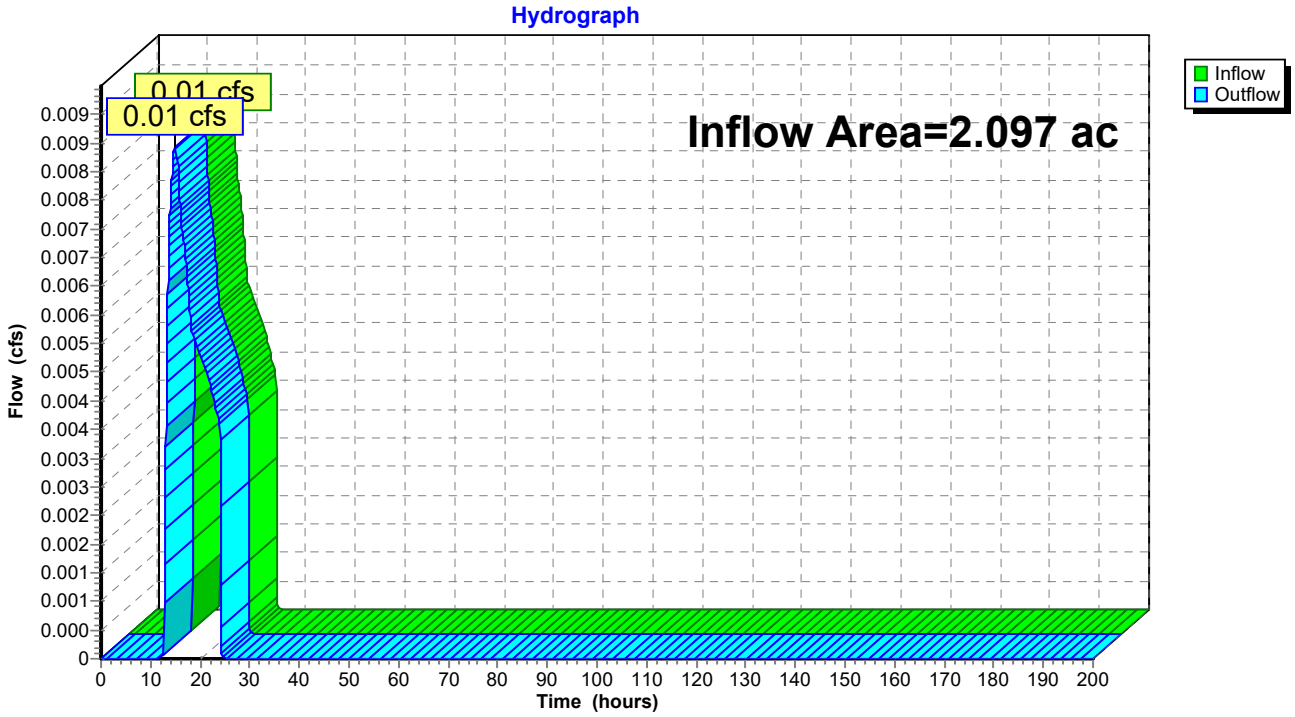


Summary for Reach 2: 2

Inflow Area = 2.097 ac, 20.10% Impervious, Inflow Depth = 0.03" for 10-Year event
Inflow = 0.01 cfs @ 14.98 hrs, Volume= 0.006 af
Outflow = 0.01 cfs @ 14.98 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 2: 2

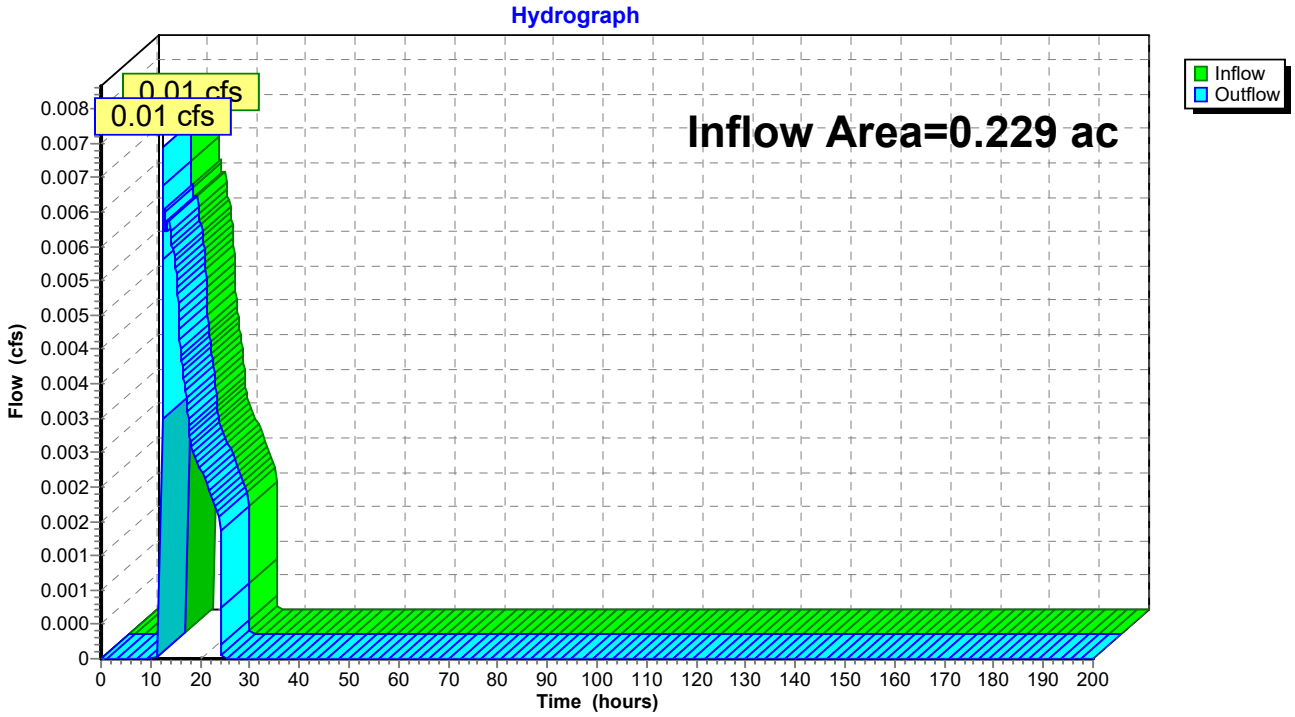


Summary for Reach 3: 3

Inflow Area = 0.229 ac, 8.51% Impervious, Inflow Depth = 0.20" for 10-Year event
Inflow = 0.01 cfs @ 12.49 hrs, Volume= 0.004 af
Outflow = 0.01 cfs @ 12.49 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 3: 3



Summary for Pond UG 1: UG BAS 1

Inflow Area = 1.725 ac, 26.32% Impervious, Inflow Depth = 1.06" for 10-Year event
Inflow = 1.72 cfs @ 12.11 hrs, Volume= 0.152 af
Outflow = 0.20 cfs @ 11.95 hrs, Volume= 0.152 af, Atten= 89%, Lag= 0.0 min
Discarded = 0.20 cfs @ 11.95 hrs, Volume= 0.152 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 166.01' @ 13.90 hrs Surf.Area= 3,544 sf Storage= 2,180 cf

Plug-Flow detention time= 108.8 min calculated for 0.152 af (100% of inflow)
Center-of-Mass det. time= 108.8 min (998.7 - 889.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	165.00'	3,197 cf	**58.50'W x 60.58'L x 3.50'H Field A** 12,403 cf Overall - 4,410 cf Embedded = 7,993 cf x 40.0% Voids
#2A	165.50'	4,410 cf	**ADS_StormTech SC-740 +Cap** x 96 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 96 Chambers in 12 Rows
		7,607 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	165.00'	**2.410 in/hr Exfiltration over Horizontal area**
#2	Device 3	167.96'	**5.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	167.78'	**12.0" Round RCP_Round 12"** L= 17.7' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 167.78' / 167.60' S= 0.0102 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Discarded OutFlow Max=0.20 cfs @ 11.95 hrs HW=165.05' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.20 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=165.00' (Free Discharge)
↑—**3=RCP_Round 12"** (Controls 0.00 cfs)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond UG 1: UG BAS 1 - Chamber Wizard Field A

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

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

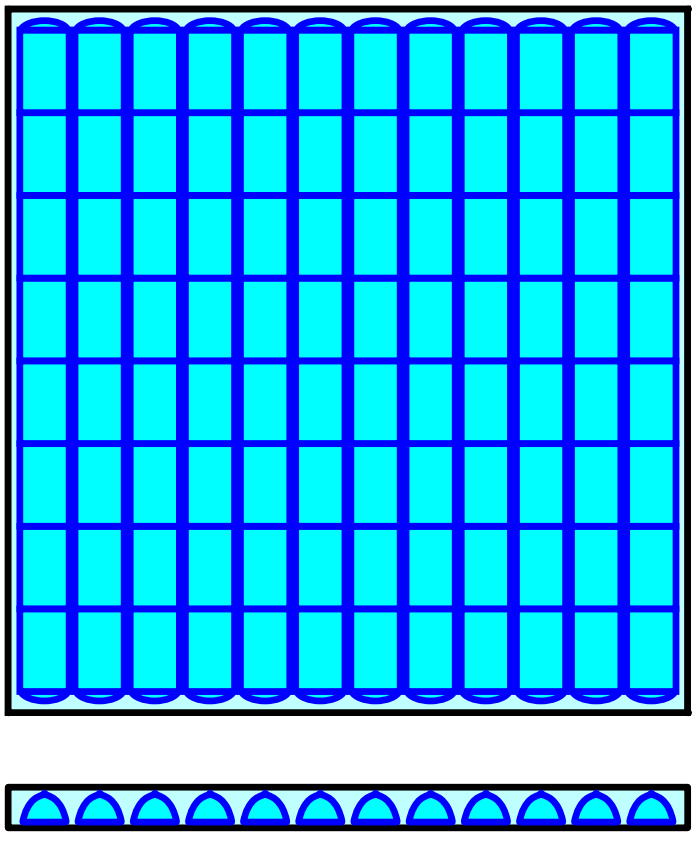
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
12 Rows x 51.0" Wide + 6.0" Spacing x 11 + 12.0" Side Stone x 2 = 58.50' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

96 Chambers x 45.9 cf = 4,410.2 cf Chamber Storage

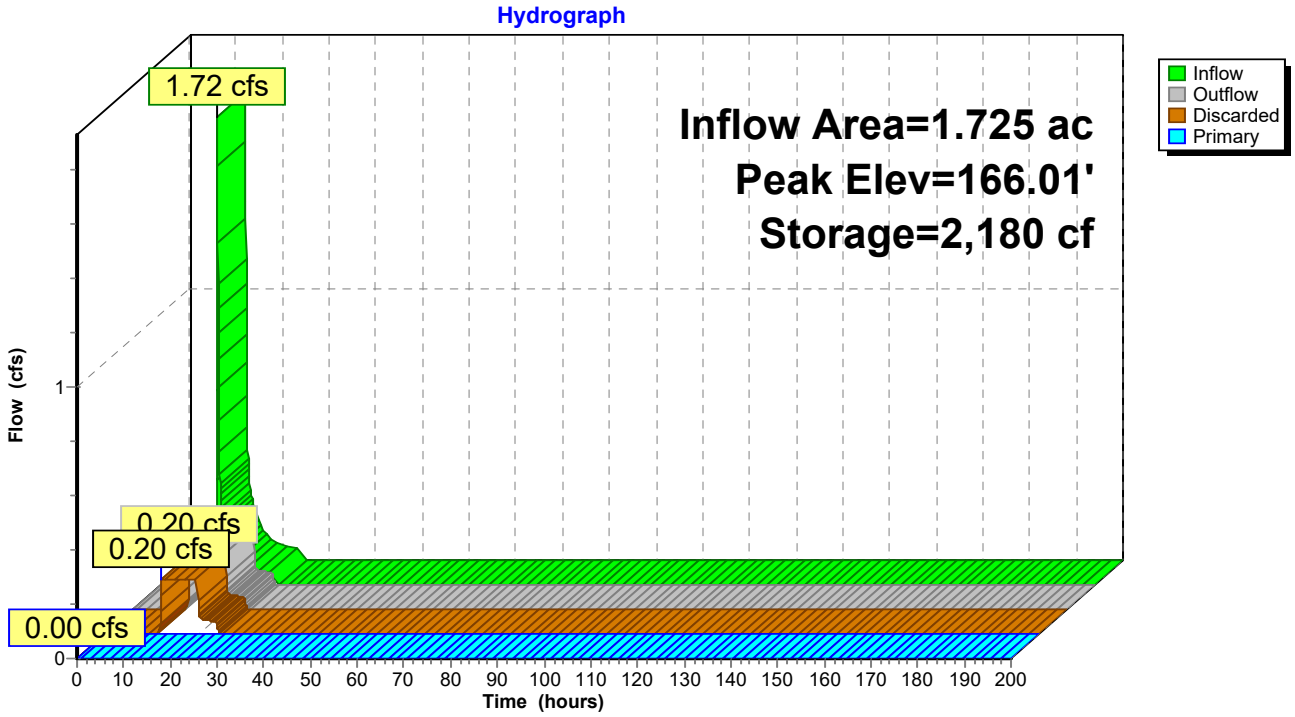
12,403.1 cf Field - 4,410.2 cf Chambers = 7,992.8 cf Stone x 40.0% Voids = 3,197.1 cf Stone Storage

Chamber Storage + Stone Storage = 7,607.4 cf = 0.175 af
Overall Storage Efficiency = 61.3%
Overall System Size = 60.58' x 58.50' x 3.50'

96 Chambers
459.4 cy Field
296.0 cy Stone



Pond UG 1: UG BAS 1



Summary for Pond UG 2: UG BAS 2

Inflow Area = 1.443 ac, 29.22% Impervious, Inflow Depth = 1.12" for 10-Year event
Inflow = 1.57 cfs @ 12.11 hrs, Volume= 0.135 af
Outflow = 0.14 cfs @ 14.71 hrs, Volume= 0.135 af, Atten= 91%, Lag= 155.9 min
Discarded = 0.14 cfs @ 14.71 hrs, Volume= 0.135 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 166.69' @ 14.71 hrs Surf.Area= 2,179 sf Storage= 2,290 cf

Plug-Flow detention time= 177.0 min calculated for 0.135 af (100% of inflow)
Center-of-Mass det. time= 177.0 min (1,063.2 - 886.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	165.00'	3,357 cf	**80.08'W x 27.21'L x 5.67'H Field A** 12,348 cf Overall - 3,956 cf Embedded = 8,392 cf x 40.0% Voids
#2A	165.75'	3,956 cf	**ADS_StormTech MC-3500 d +Cap** x 33 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 33 Chambers in 11 Rows Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf
		7,313 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	165.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Device 3	170.20'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	167.14'	**12.0" Round RCP_Round 12"** L= 17.2' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 167.14' / 166.80' S= 0.0198 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Discarded OutFlow Max=0.14 cfs @ 14.71 hrs HW=166.69' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=165.00' (Free Discharge)
↑—**3=RCP_Round 12"** (Controls 0.00 cfs)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond UG 2: UG BAS 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

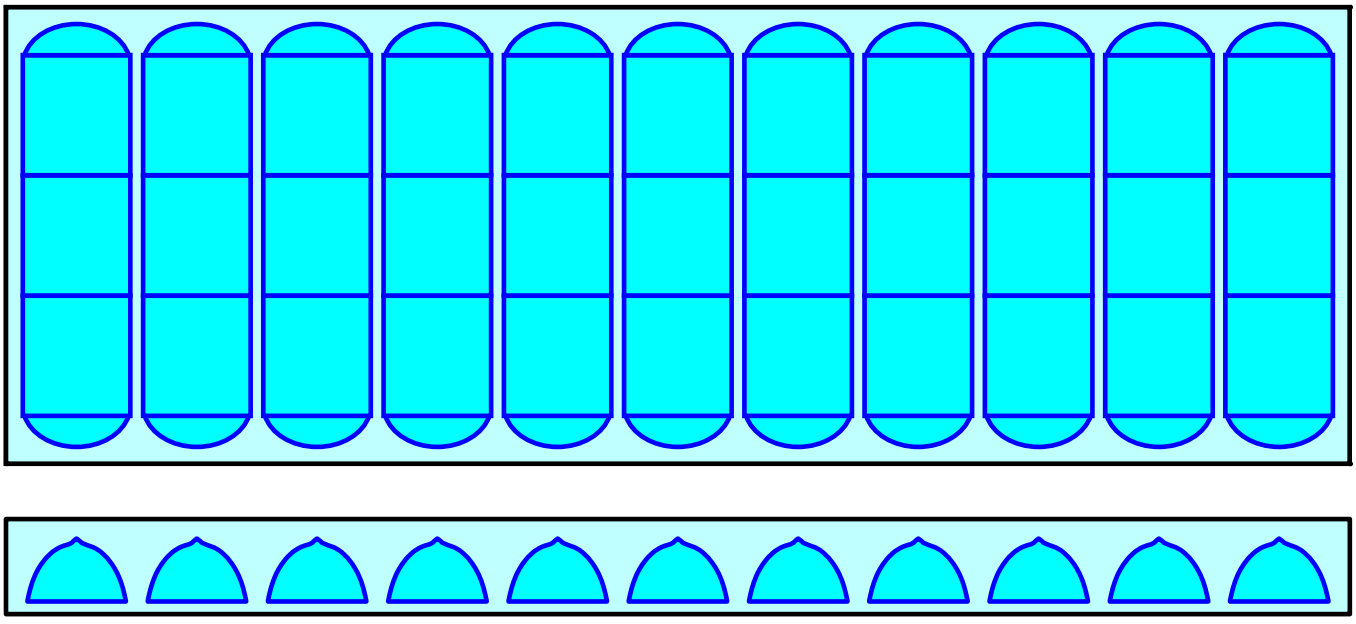
3 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 25.21' Row Length +12.0" End Stone x 2 = 27.21' Base Length
11 Rows x 77.0" Wide + 9.0" Spacing x 10 + 12.0" Side Stone x 2 = 80.08' Base Width
9.0" Base + 45.0" Chamber Height + 14.0" Cover = 5.67' Field Height

33 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 11 Rows = 3,956.2 cf Chamber Storage

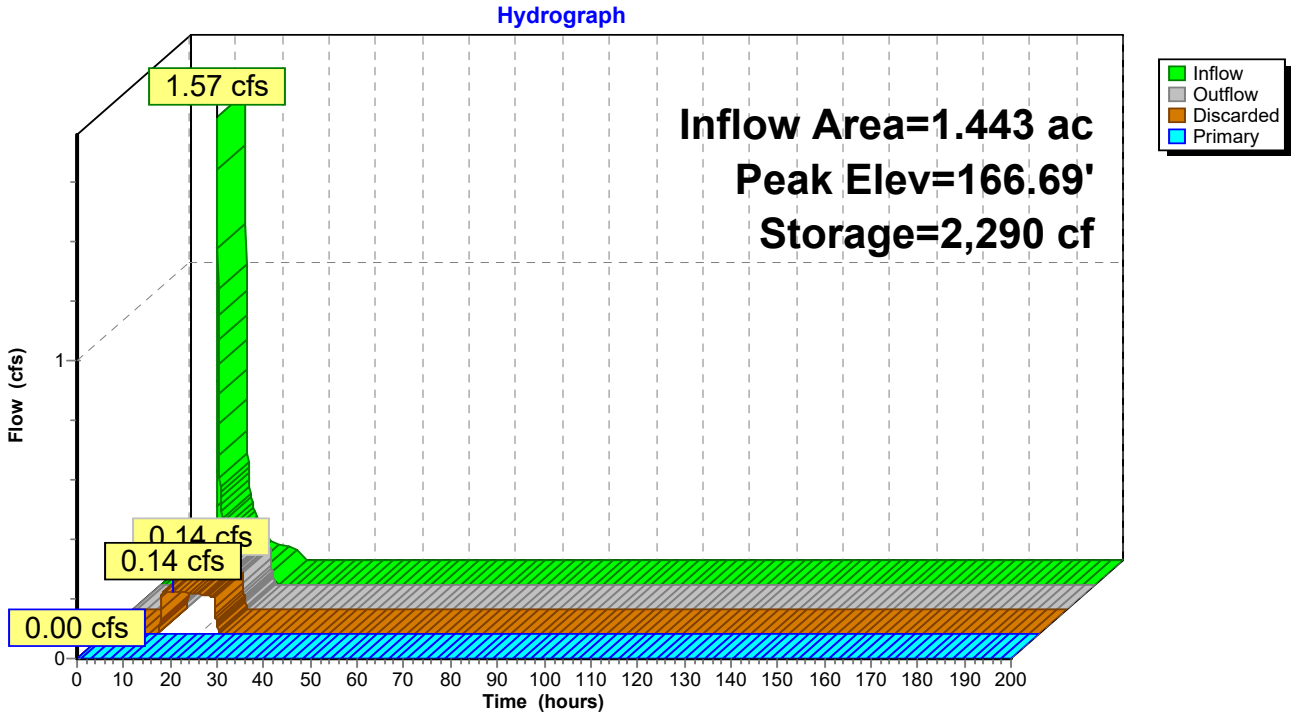
12,348.0 cf Field - 3,956.2 cf Chambers = 8,391.8 cf Stone x 40.0% Voids = 3,356.7 cf Stone Storage

Chamber Storage + Stone Storage = 7,312.9 cf = 0.168 af
Overall Storage Efficiency = 59.2%
Overall System Size = 27.21' x 80.08' x 5.67'

33 Chambers
457.3 cy Field
310.8 cy Stone



Pond UG 2: UG BAS 2



Summary for Subcatchment P-1: P-1

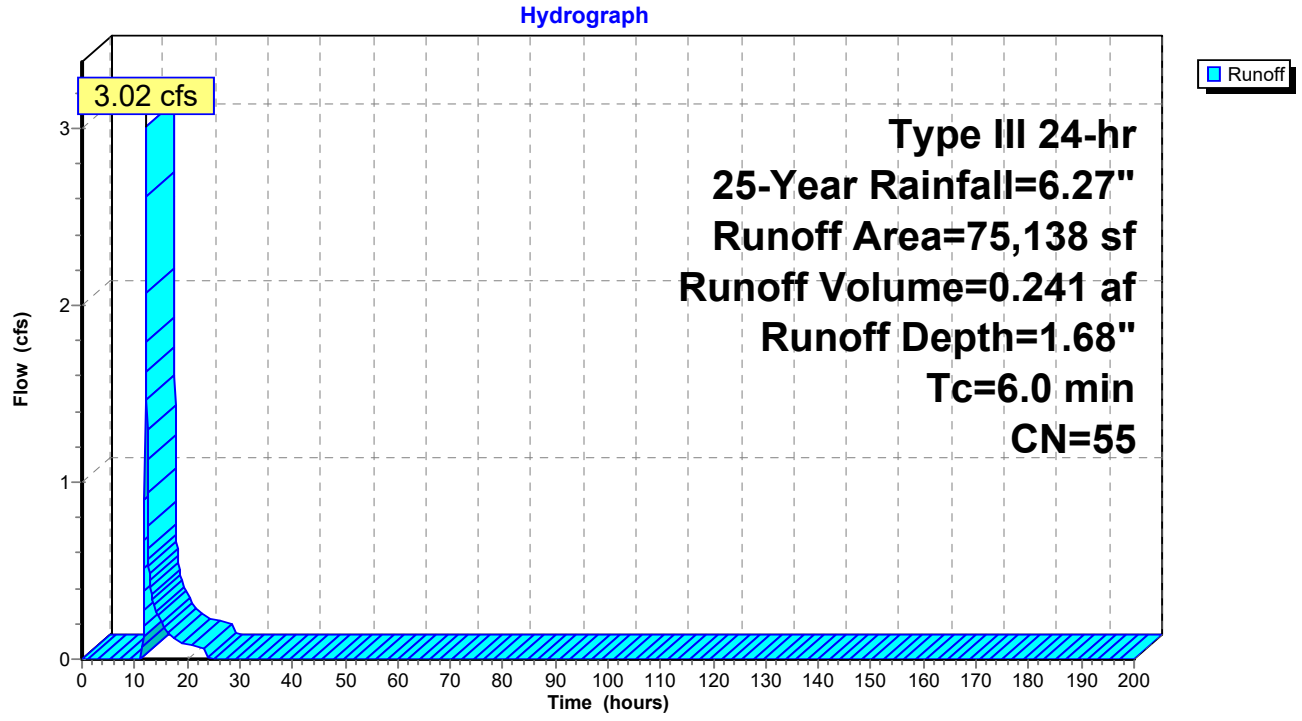
Runoff = 3.02 cfs @ 12.10 hrs, Volume= 0.241 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

	Area (sf)	CN	Description
*	2,640	98	2 driveways
	55,358	39	>75% Grass cover, Good, HSG A
*	9,000	98	4 houses
*	2,600	98	Massapoag road
*	2,930	98	exist offsite houses, HSG A
*	1,350	98	ex. offsite driveways, HSG A
*	1,260	98	POOL
	75,138	55	Weighted Average
	55,358		73.68% Pervious Area
	19,780		26.32% Impervious Area

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

Subcatchment P-1: P-1



Summary for Subcatchment P-1U: P-1U

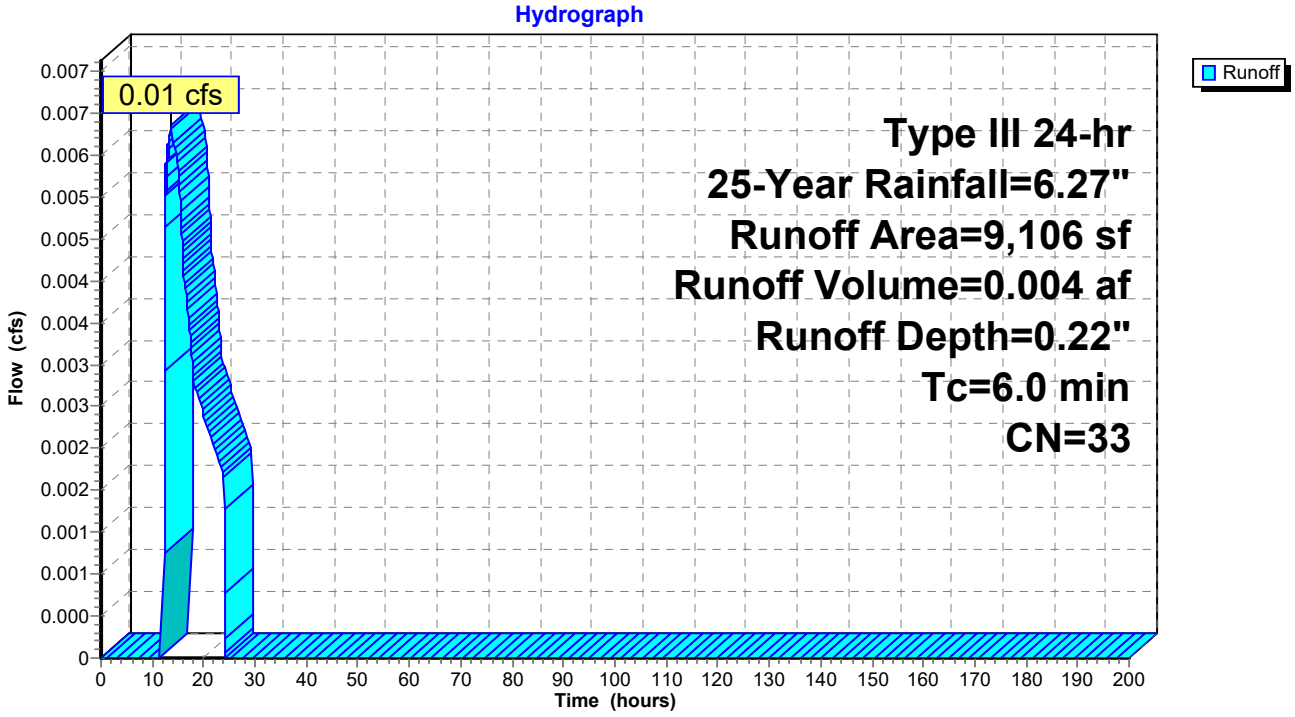
Runoff = 0.01 cfs @ 13.65 hrs, Volume= 0.004 af, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

Area (sf)	CN	Description
1,000	39	>75% Grass cover, Good, HSG A
8,106	32	Woods/grass comb., Good, HSG A
9,106	33	Weighted Average
9,106		100.00% Pervious Area

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

Subcatchment P-1U: P-1U



Summary for Subcatchment P-2: P-2

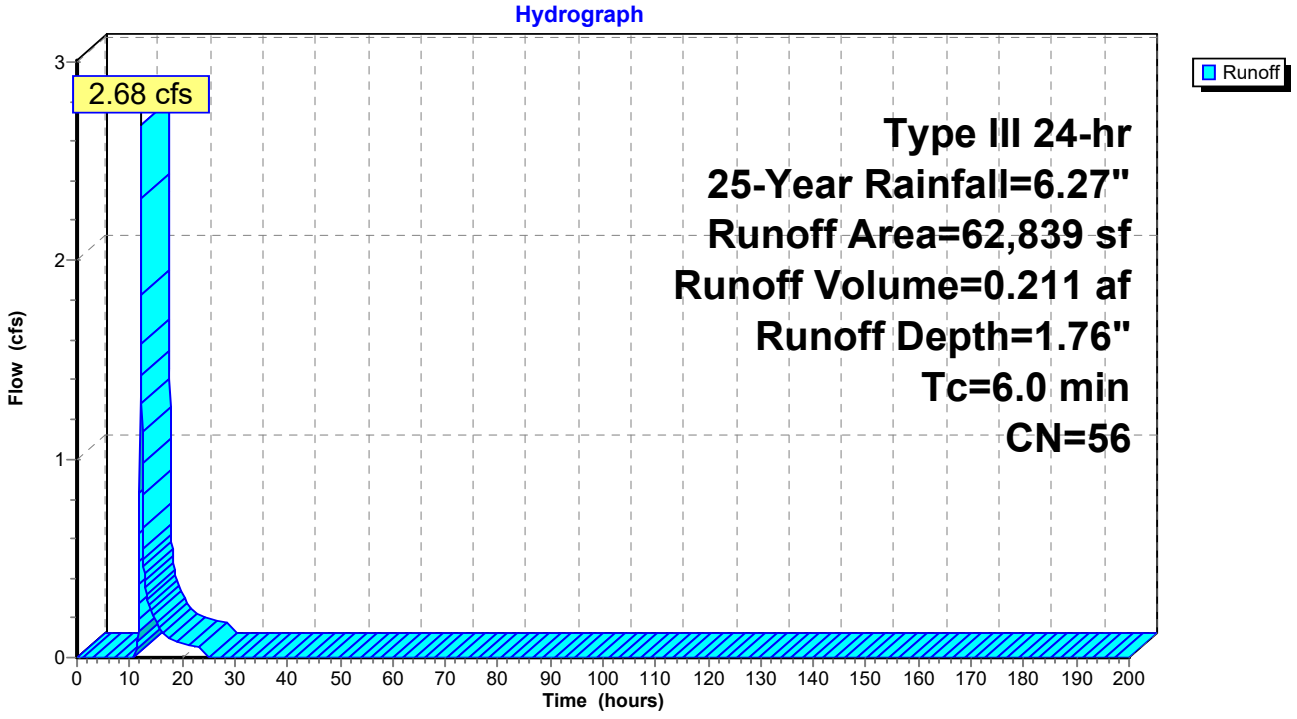
Runoff = 2.68 cfs @ 12.10 hrs, Volume= 0.211 af, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

	Area (sf)	CN	Description
*	4,960	98	5 driveways
	44,479	39	>75% Grass cover, Good, HSG A
*	8,900	98	Massapoag road
*	4,500	98	3 houses
	62,839	56	Weighted Average
	44,479		70.78% Pervious Area
	18,360		29.22% Impervious Area

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

Subcatchment P-2: P-2



Summary for Subcatchment P-2U: P-2U

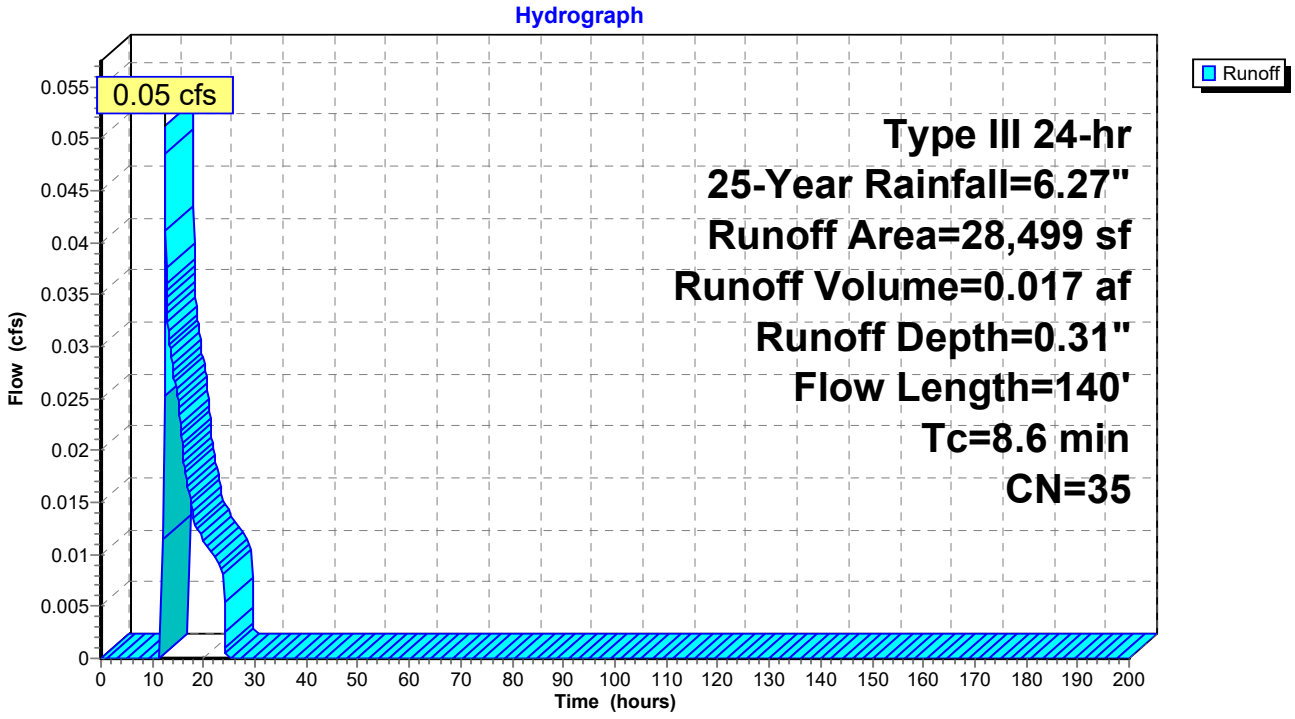
Runoff = 0.05 cfs @ 12.47 hrs, Volume= 0.017 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

	Area (sf)	CN	Description
	24,999	32	Woods/grass comb., Good, HSG A
*	3,500	60	rip rap, HSG A
	28,499	35	Weighted Average
	28,499		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0700	0.11		**Sheet Flow, AB** Woods: Light underbrush n= 0.400 P2= 3.20"
1.1	90	0.0800	1.41		**Shallow Concentrated Flow, BC** Woodland Kv= 5.0 fps
8.6	140	Total			

Subcatchment P-2U: P-2U



Summary for Subcatchment P-3U: P-3U

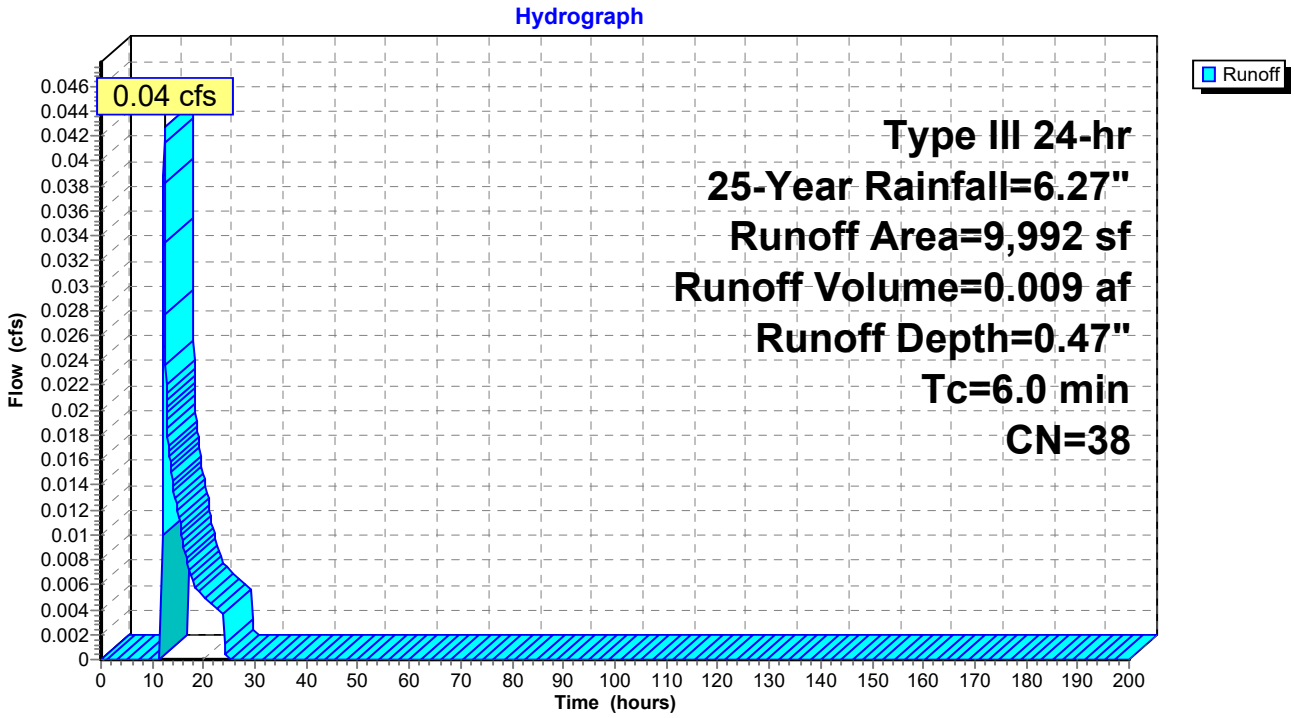
Runoff = 0.04 cfs @ 12.34 hrs, Volume= 0.009 af, Depth= 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.27"

	Area (sf)	CN	Description
	9,142	32	Woods/grass comb., Good, HSG A
*	850	98	ex house to remain
	9,992	38	Weighted Average
	9,142		91.49% Pervious Area
	850		8.51% Impervious Area

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

Subcatchment P-3U: P-3U

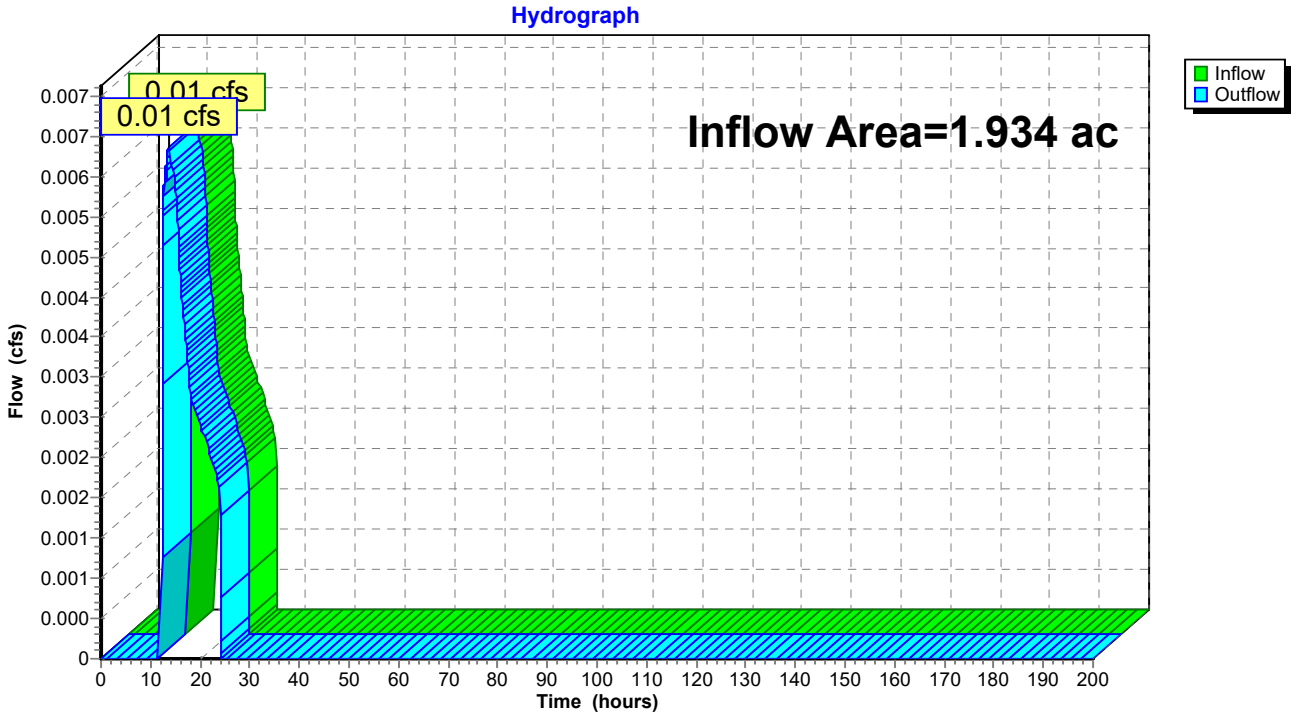


Summary for Reach 1: 1

Inflow Area = 1.934 ac, 23.48% Impervious, Inflow Depth = 0.02" for 25-Year event
Inflow = 0.01 cfs @ 13.65 hrs, Volume= 0.004 af
Outflow = 0.01 cfs @ 13.65 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 1: 1

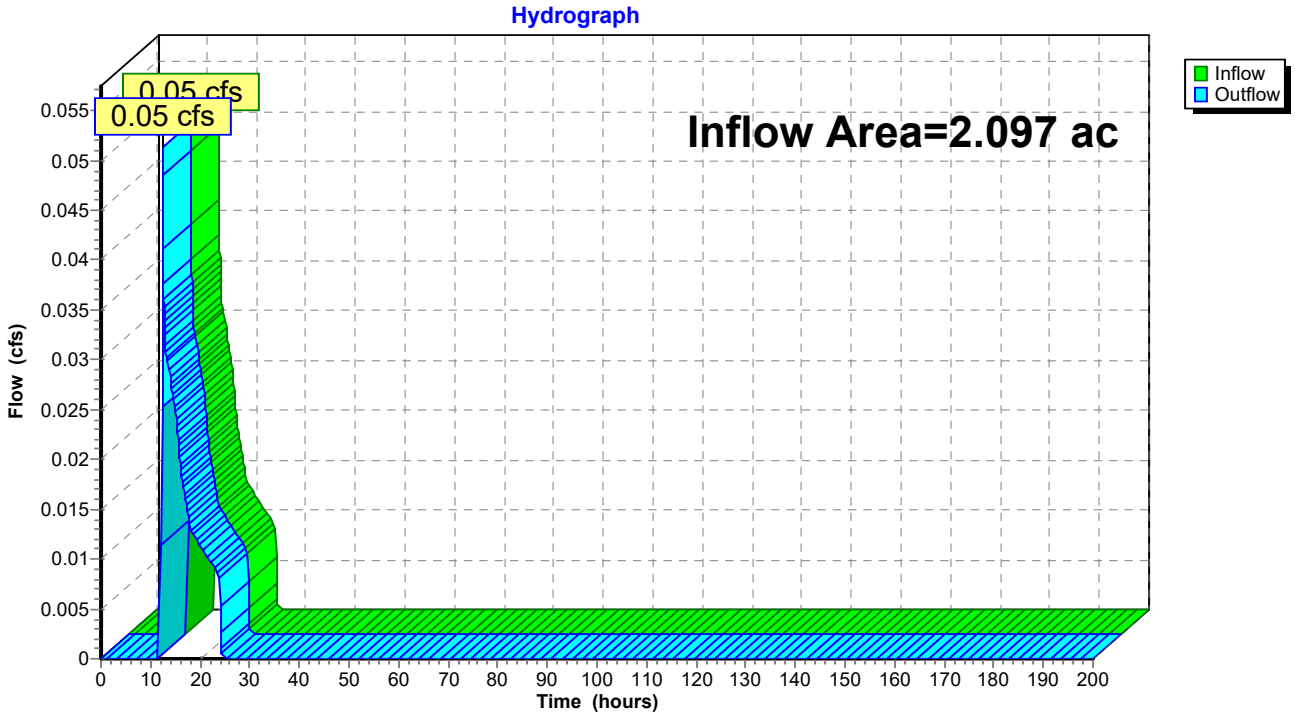


Summary for Reach 2: 2

Inflow Area = 2.097 ac, 20.10% Impervious, Inflow Depth = 0.10" for 25-Year event
Inflow = 0.05 cfs @ 12.47 hrs, Volume= 0.017 af
Outflow = 0.05 cfs @ 12.47 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 2: 2

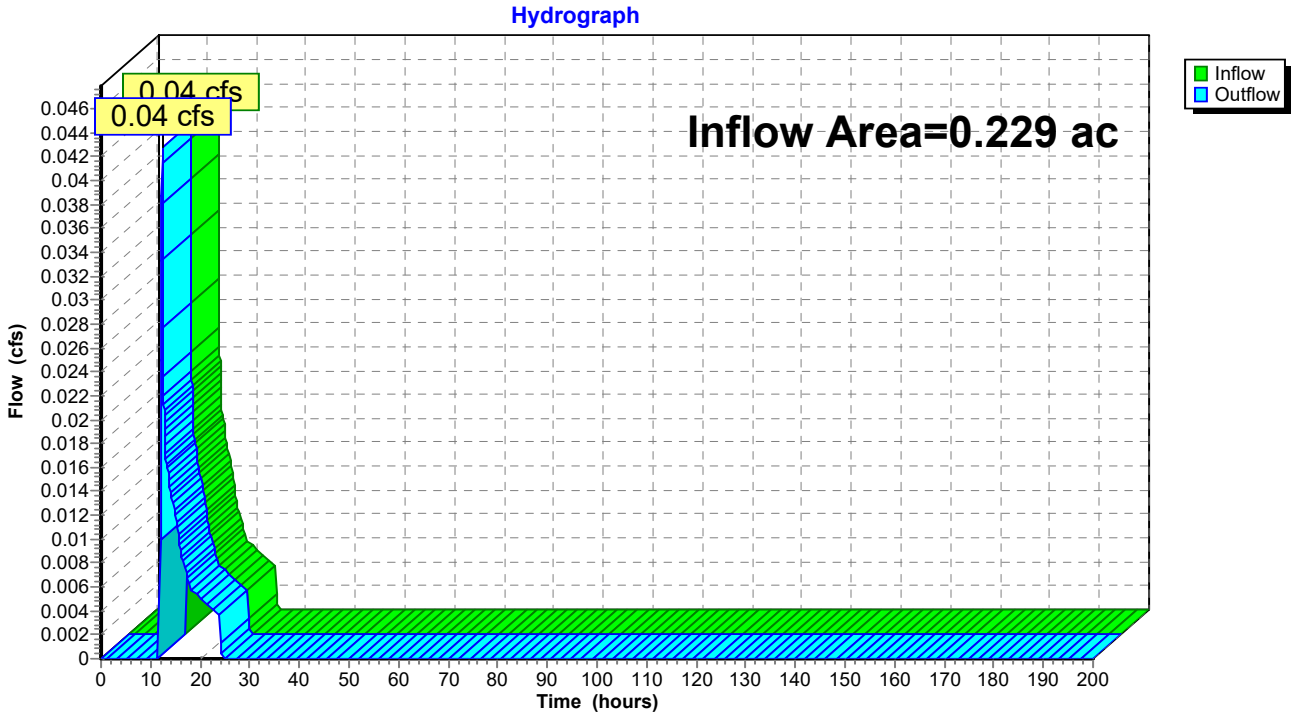


Summary for Reach 3: 3

Inflow Area = 0.229 ac, 8.51% Impervious, Inflow Depth = 0.47" for 25-Year event
Inflow = 0.04 cfs @ 12.34 hrs, Volume= 0.009 af
Outflow = 0.04 cfs @ 12.34 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 3: 3



Summary for Pond UG 1: UG BAS 1

Inflow Area = 1.725 ac, 26.32% Impervious, Inflow Depth = 1.68" for 25-Year event
Inflow = 3.02 cfs @ 12.10 hrs, Volume= 0.241 af
Outflow = 0.20 cfs @ 11.80 hrs, Volume= 0.241 af, Atten= 93%, Lag= 0.0 min
Discarded = 0.20 cfs @ 11.80 hrs, Volume= 0.241 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 166.98' @ 15.39 hrs Surf.Area= 3,544 sf Storage= 4,825 cf

Plug-Flow detention time= 266.2 min calculated for 0.241 af (100% of inflow)
Center-of-Mass det. time= 266.2 min (1,140.0 - 873.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	165.00'	3,197 cf	**58.50'W x 60.58'L x 3.50'H Field A** 12,403 cf Overall - 4,410 cf Embedded = 7,993 cf x 40.0% Voids
#2A	165.50'	4,410 cf	**ADS_StormTech SC-740 +Cap** x 96 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 96 Chambers in 12 Rows
		7,607 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	165.00'	**2.410 in/hr Exfiltration over Horizontal area**
#2	Device 3	167.96'	**5.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	167.78'	**12.0" Round RCP_Round 12"** L= 17.7' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 167.78' / 167.60' S= 0.0102 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Discarded OutFlow Max=0.20 cfs @ 11.80 hrs HW=165.05' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.20 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=165.00' (Free Discharge)
↑—**3=RCP_Round 12"** (Controls 0.00 cfs)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond UG 1: UG BAS 1 - Chamber Wizard Field A

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

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

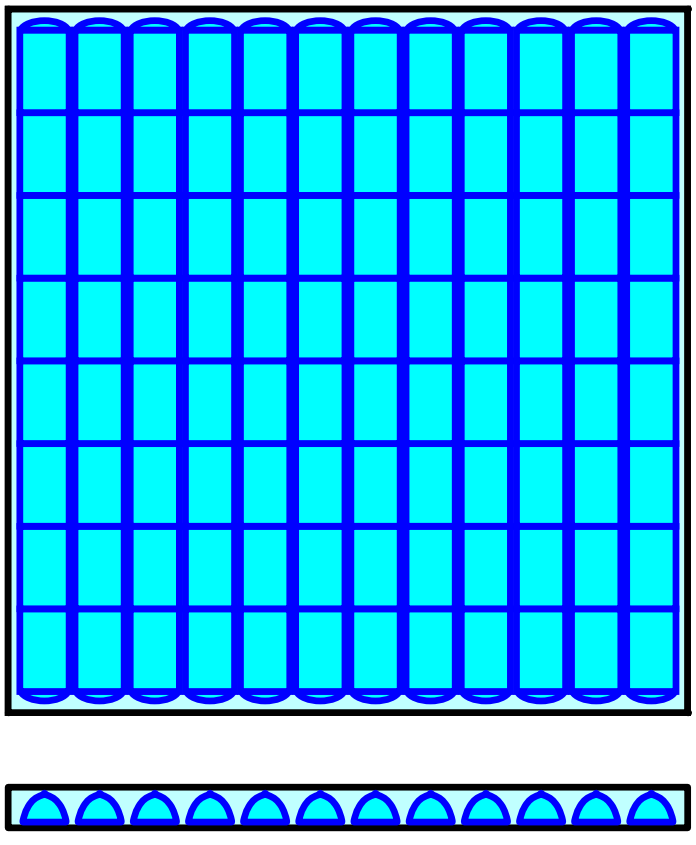
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
12 Rows x 51.0" Wide + 6.0" Spacing x 11 + 12.0" Side Stone x 2 = 58.50' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

96 Chambers x 45.9 cf = 4,410.2 cf Chamber Storage

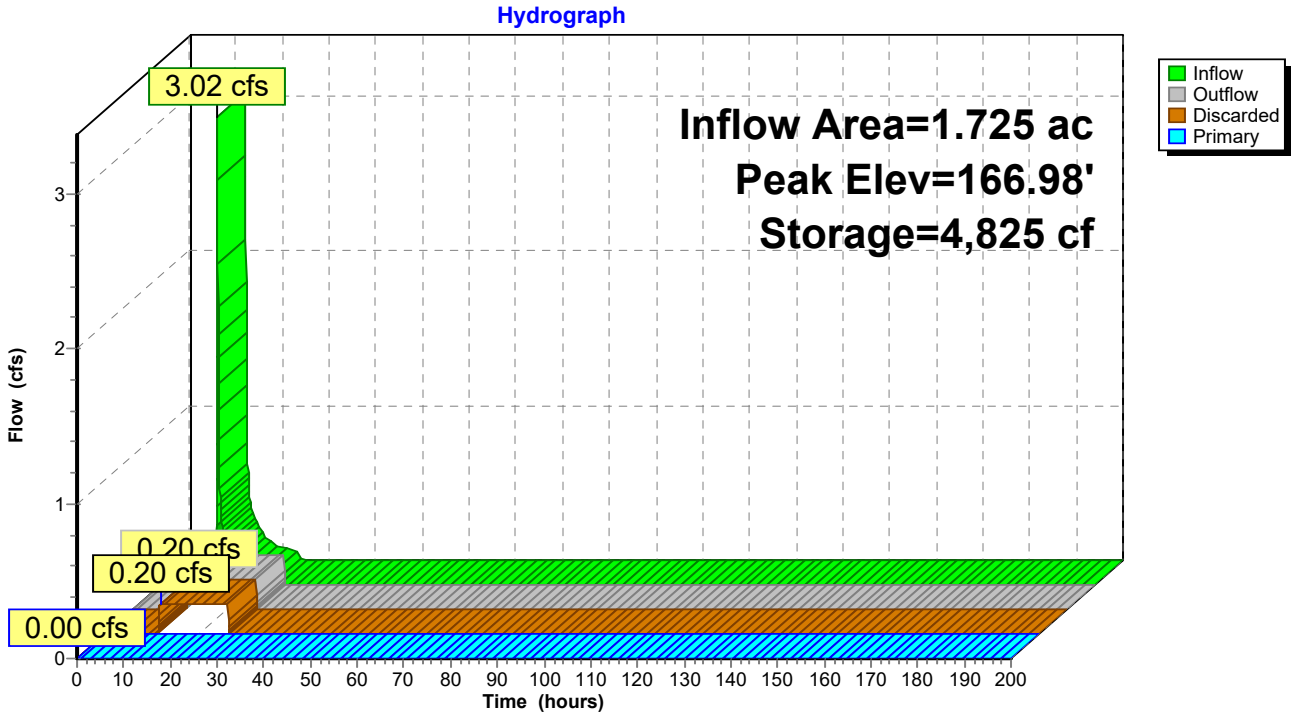
12,403.1 cf Field - 4,410.2 cf Chambers = 7,992.8 cf Stone x 40.0% Voids = 3,197.1 cf Stone Storage

Chamber Storage + Stone Storage = 7,607.4 cf = 0.175 af
Overall Storage Efficiency = 61.3%
Overall System Size = 60.58' x 58.50' x 3.50'

96 Chambers
459.4 cy Field
296.0 cy Stone



Pond UG 1: UG BAS 1



Summary for Pond UG 2: UG BAS 2

Inflow Area = 1.443 ac, 29.22% Impervious, Inflow Depth = 1.76" for 25-Year event
Inflow = 2.68 cfs @ 12.10 hrs, Volume= 0.211 af
Outflow = 0.16 cfs @ 15.62 hrs, Volume= 0.211 af, Atten= 94%, Lag= 211.1 min
Discarded = 0.16 cfs @ 15.62 hrs, Volume= 0.211 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 168.09' @ 15.62 hrs Surf.Area= 2,179 sf Storage= 4,567 cf

Plug-Flow detention time= 332.2 min calculated for 0.211 af (100% of inflow)
Center-of-Mass det. time= 332.2 min (1,203.1 - 870.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	165.00'	3,357 cf	**80.08'W x 27.21'L x 5.67'H Field A** 12,348 cf Overall - 3,956 cf Embedded = 8,392 cf x 40.0% Voids
#2A	165.75'	3,956 cf	**ADS_StormTech MC-3500 d +Cap** x 33 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 33 Chambers in 11 Rows Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf
		7,313 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	165.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Device 3	170.20'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	167.14'	**12.0" Round RCP_Round 12"** L= 17.2' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 167.14' / 166.80' S= 0.0198 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Discarded OutFlow Max=0.16 cfs @ 15.62 hrs HW=168.09' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=165.00' (Free Discharge)
↑—**3=RCP_Round 12"** (Controls 0.00 cfs)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond UG 2: UG BAS 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

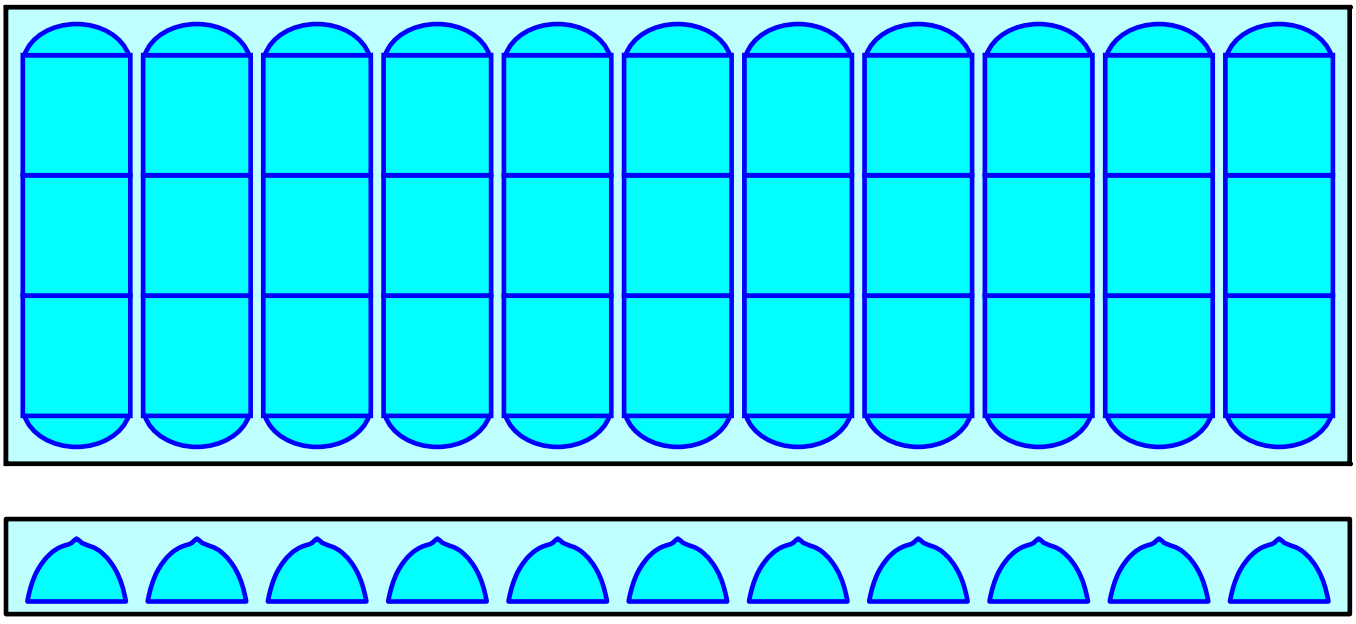
3 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 25.21' Row Length +12.0" End Stone x 2 = 27.21' Base Length
11 Rows x 77.0" Wide + 9.0" Spacing x 10 + 12.0" Side Stone x 2 = 80.08' Base Width
9.0" Base + 45.0" Chamber Height + 14.0" Cover = 5.67' Field Height

33 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 11 Rows = 3,956.2 cf Chamber Storage

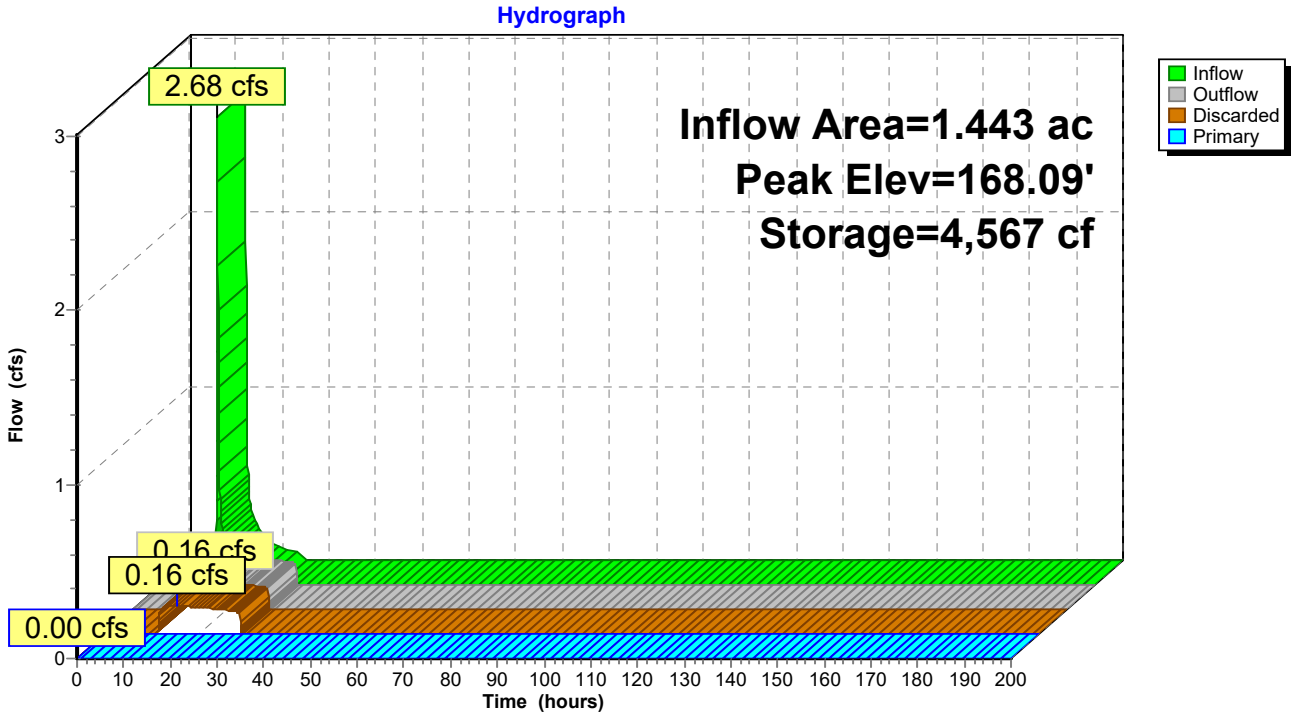
12,348.0 cf Field - 3,956.2 cf Chambers = 8,391.8 cf Stone x 40.0% Voids = 3,356.7 cf Stone Storage

Chamber Storage + Stone Storage = 7,312.9 cf = 0.168 af
Overall Storage Efficiency = 59.2%
Overall System Size = 27.21' x 80.08' x 5.67'

33 Chambers
457.3 cy Field
310.8 cy Stone



Pond UG 2: UG BAS 2



Summary for Subcatchment P-1: P-1

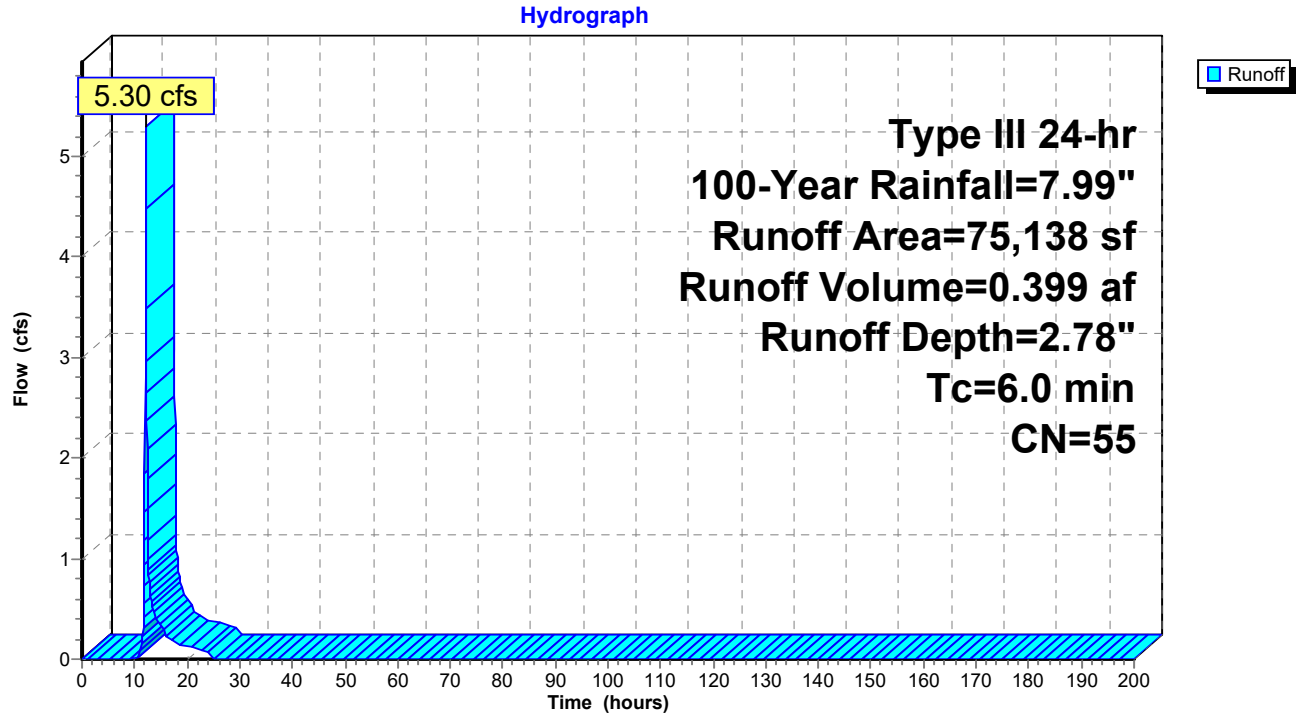
Runoff = 5.30 cfs @ 12.10 hrs, Volume= 0.399 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

	Area (sf)	CN	Description
*	2,640	98	2 driveways
	55,358	39	>75% Grass cover, Good, HSG A
*	9,000	98	4 houses
*	2,600	98	Massapoag road
*	2,930	98	exist offsite houses, HSG A
*	1,350	98	ex. offsite driveways, HSG A
*	1,260	98	POOL
	75,138	55	Weighted Average
	55,358		73.68% Pervious Area
	19,780		26.32% Impervious Area

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

Subcatchment P-1: P-1



Summary for Subcatchment P-1U: P-1U

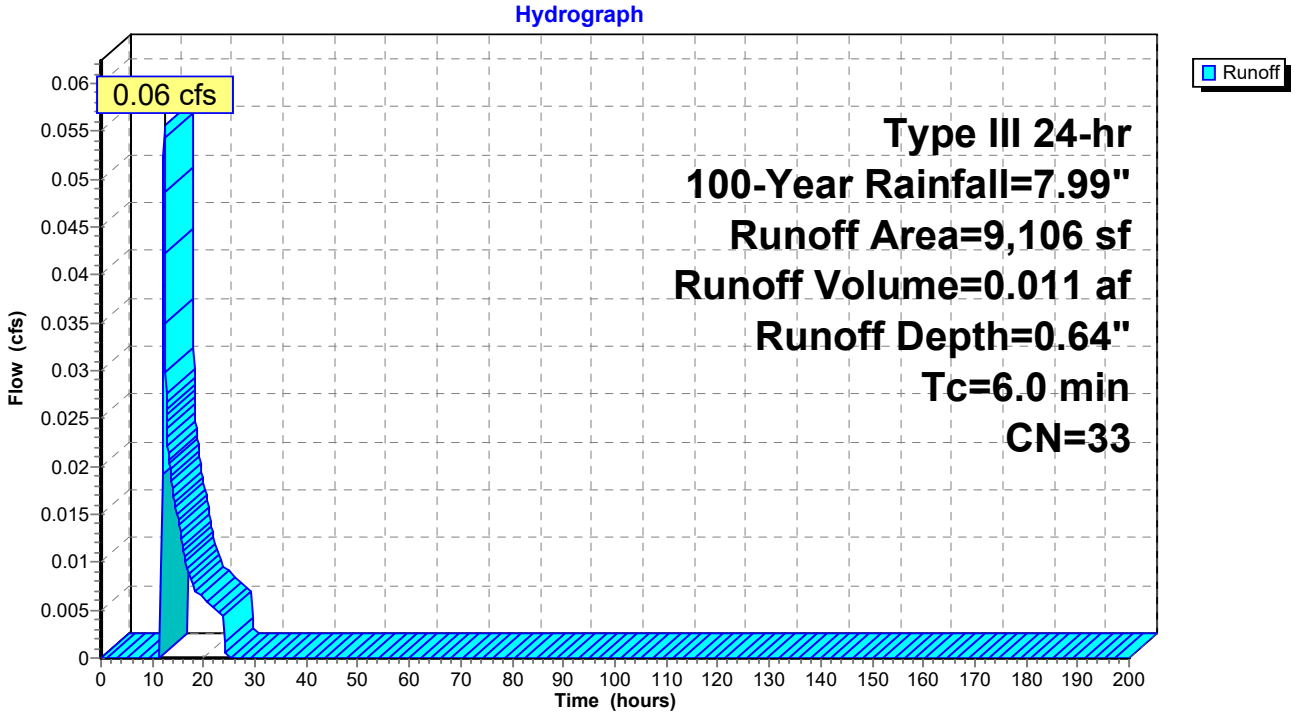
Runoff = 0.06 cfs @ 12.33 hrs, Volume= 0.011 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
1,000	39	>75% Grass cover, Good, HSG A
8,106	32	Woods/grass comb., Good, HSG A
9,106	33	Weighted Average
9,106		100.00% Pervious Area

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

Subcatchment P-1U: P-1U



Summary for Subcatchment P-2: P-2

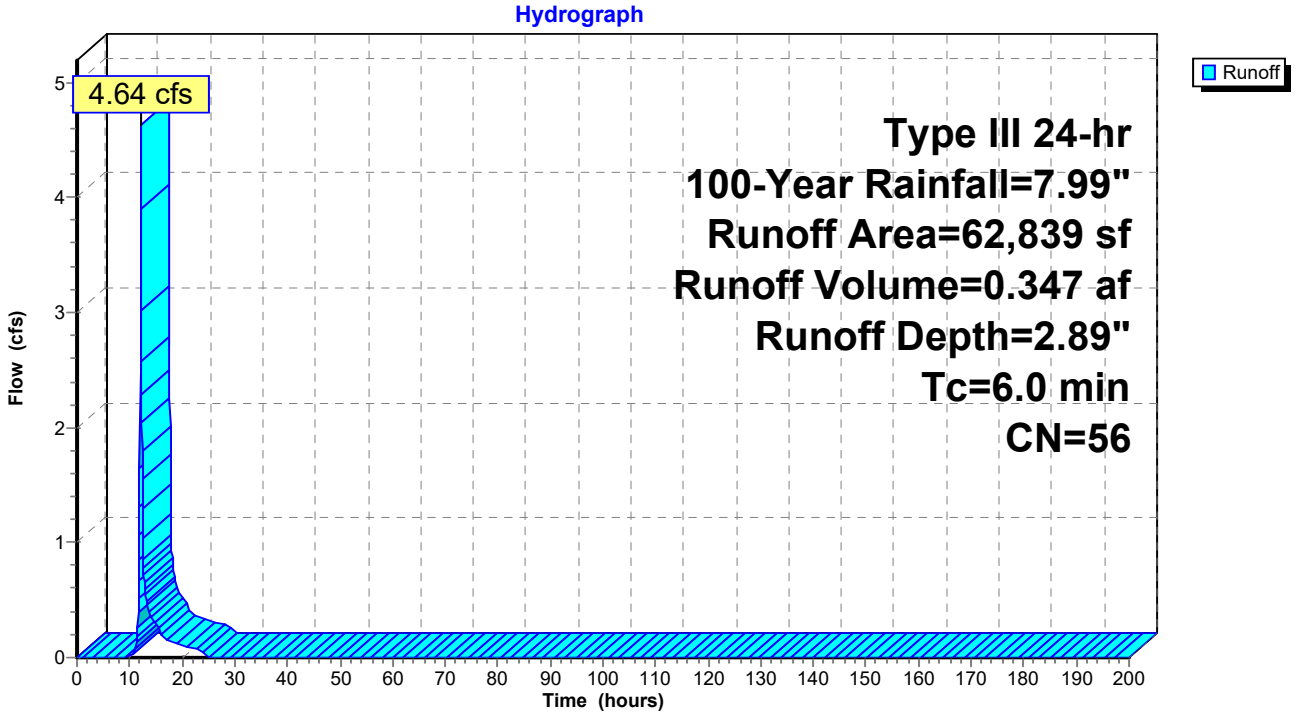
Runoff = 4.64 cfs @ 12.10 hrs, Volume= 0.347 af, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

	Area (sf)	CN	Description
*	4,960	98	5 driveways
	44,479	39	>75% Grass cover, Good, HSG A
*	8,900	98	Massapoag road
*	4,500	98	3 houses
	62,839	56	Weighted Average
	44,479		70.78% Pervious Area
	18,360		29.22% Impervious Area

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

Subcatchment P-2: P-2



Summary for Subcatchment P-2U: P-2U

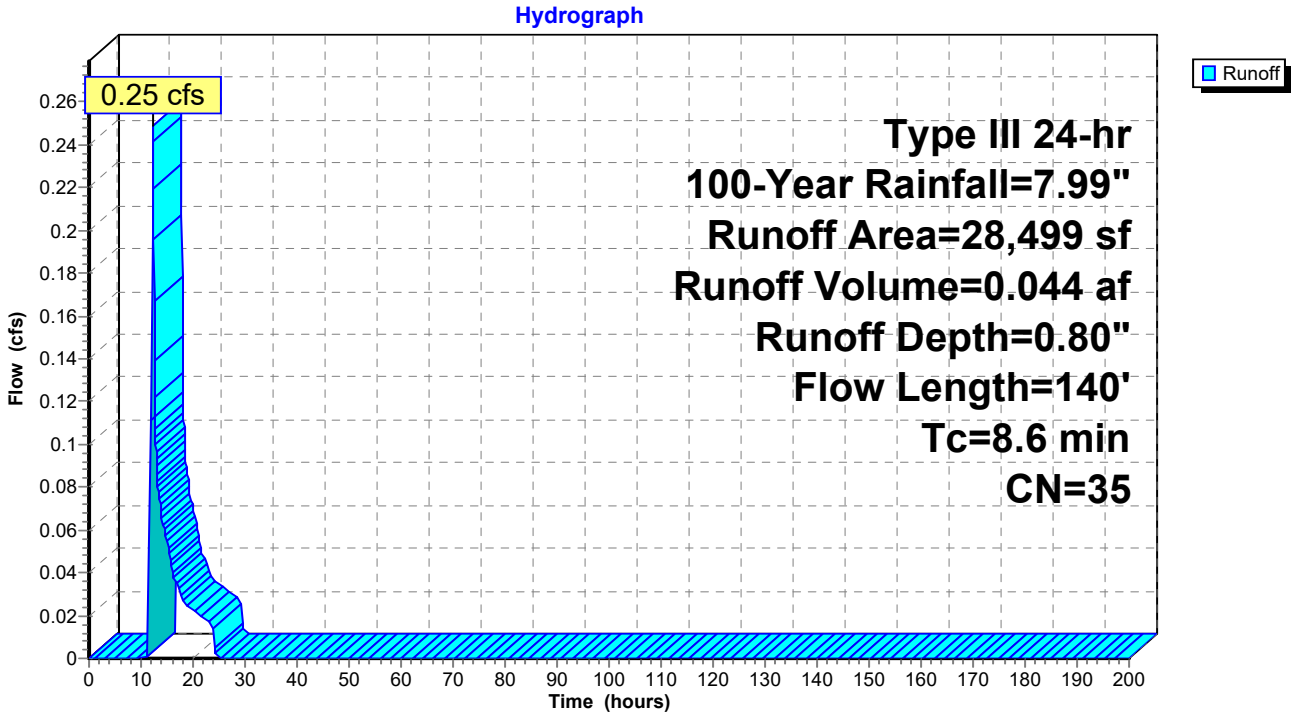
Runoff = 0.25 cfs @ 12.31 hrs, Volume= 0.044 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

	Area (sf)	CN	Description
	24,999	32	Woods/grass comb., Good, HSG A
*	3,500	60	rip rap, HSG A
	28,499	35	Weighted Average
	28,499		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0700	0.11		**Sheet Flow, AB** Woods: Light underbrush n= 0.400 P2= 3.20"
1.1	90	0.0800	1.41		**Shallow Concentrated Flow, BC** Woodland Kv= 5.0 fps
8.6	140	Total			

Subcatchment P-2U: P-2U



Summary for Subcatchment P-3U: P-3U

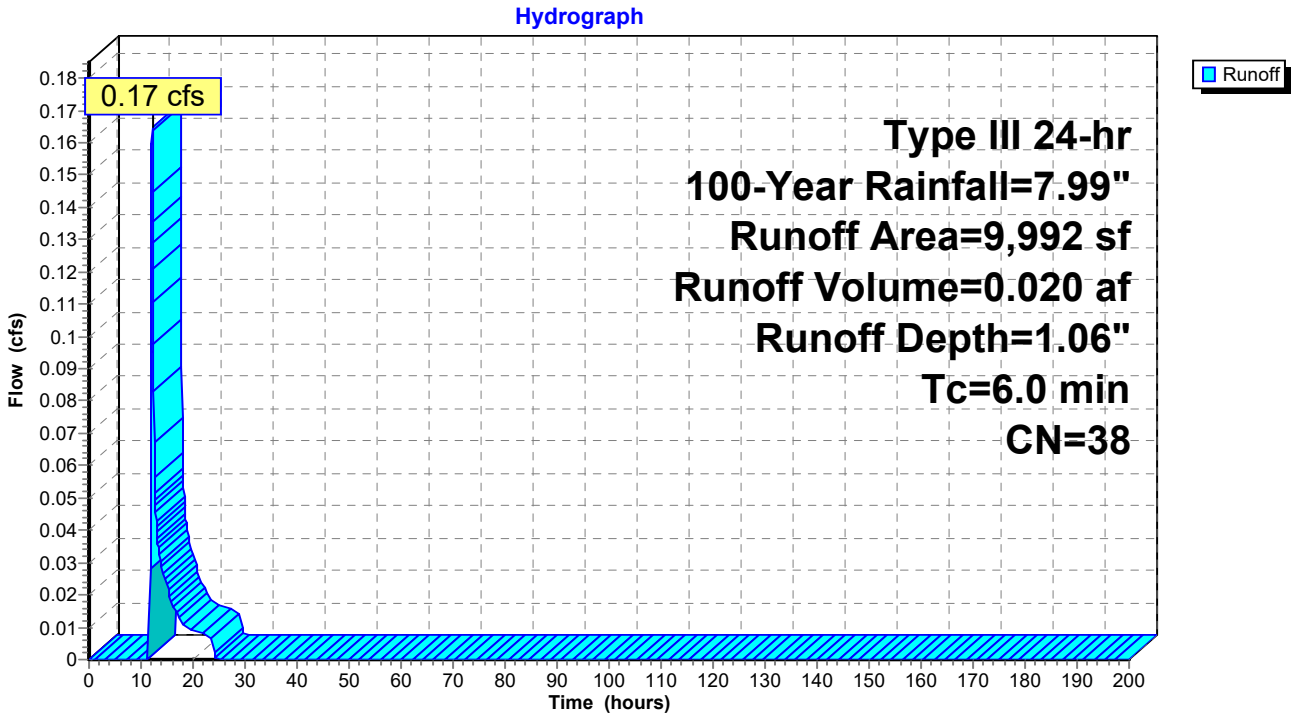
Runoff = 0.17 cfs @ 12.13 hrs, Volume= 0.020 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

	Area (sf)	CN	Description
	9,142	32	Woods/grass comb., Good, HSG A
*	850	98	ex house to remain
	9,992	38	Weighted Average
	9,142		91.49% Pervious Area
	850		8.51% Impervious Area

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

Subcatchment P-3U: P-3U

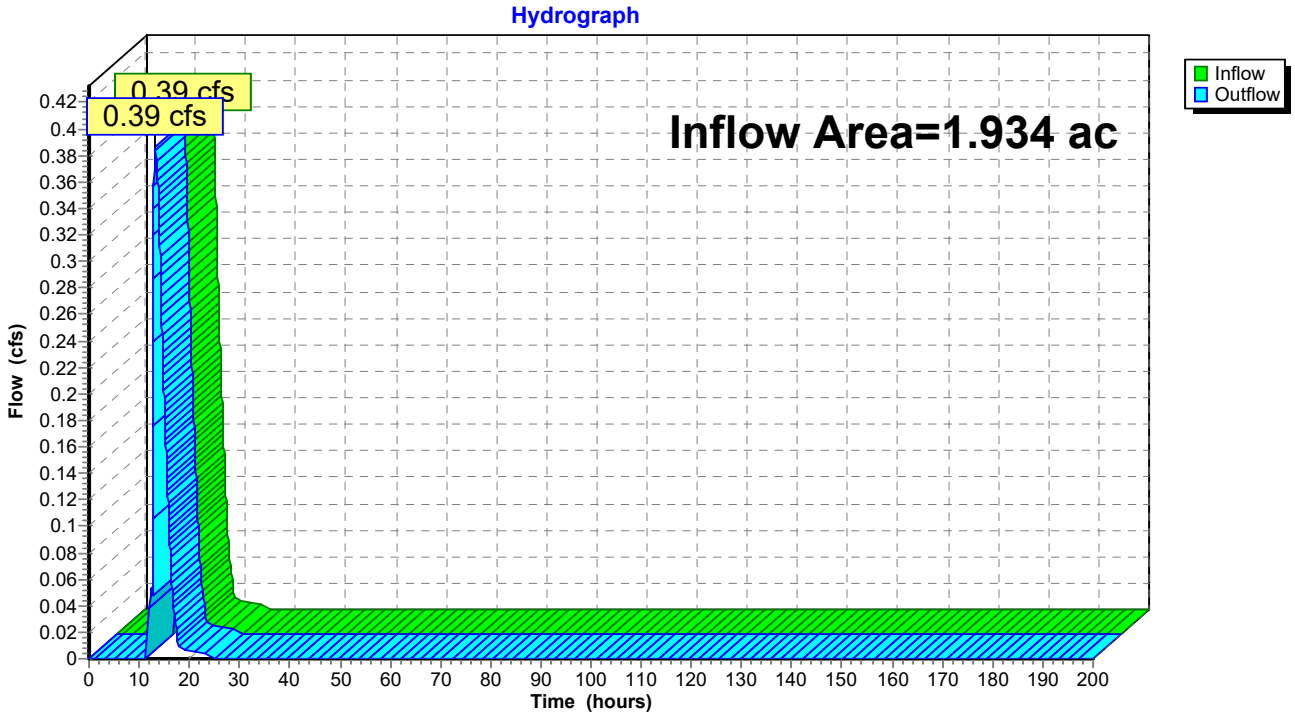


Summary for Reach 1: 1

Inflow Area = 1.934 ac, 23.48% Impervious, Inflow Depth = 0.52" for 100-Year event
Inflow = 0.39 cfs @ 13.21 hrs, Volume= 0.084 af
Outflow = 0.39 cfs @ 13.21 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 1: 1

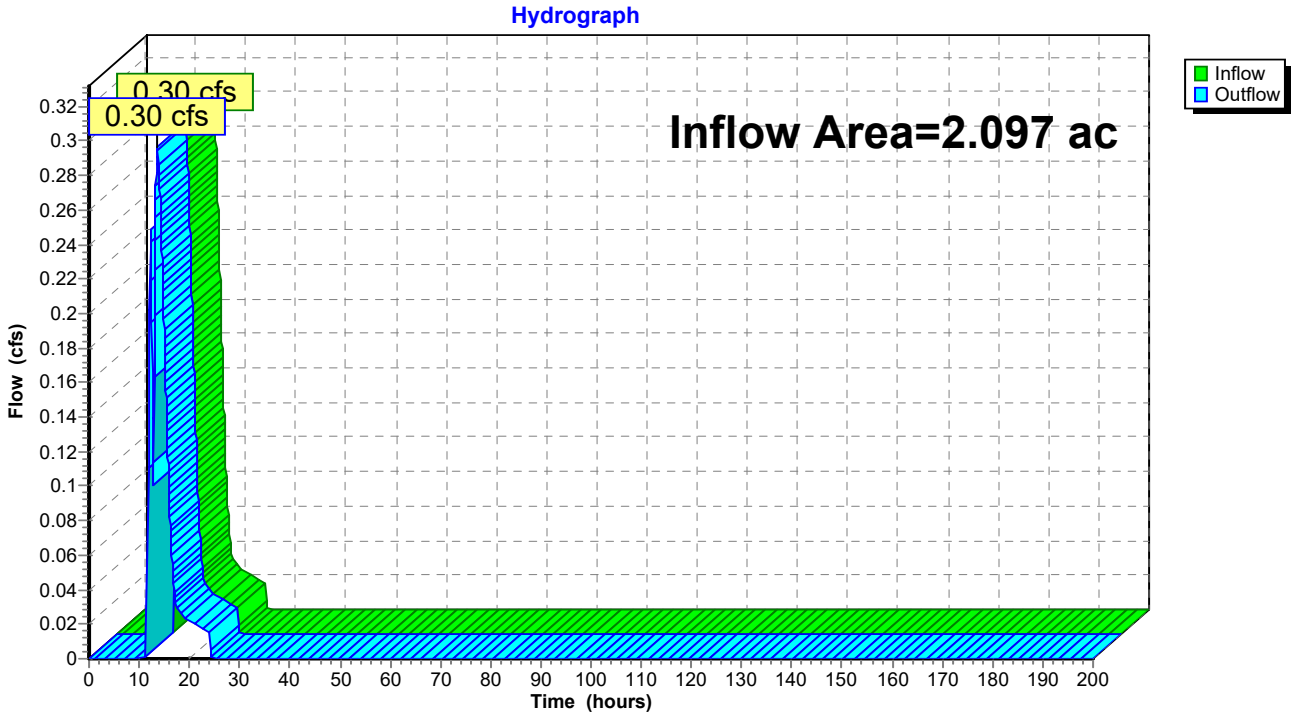


Summary for Reach 2: 2

Inflow Area = 2.097 ac, 20.10% Impervious, Inflow Depth = 0.48" for 100-Year event
Inflow = 0.30 cfs @ 13.64 hrs, Volume= 0.084 af
Outflow = 0.30 cfs @ 13.64 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 2: 2

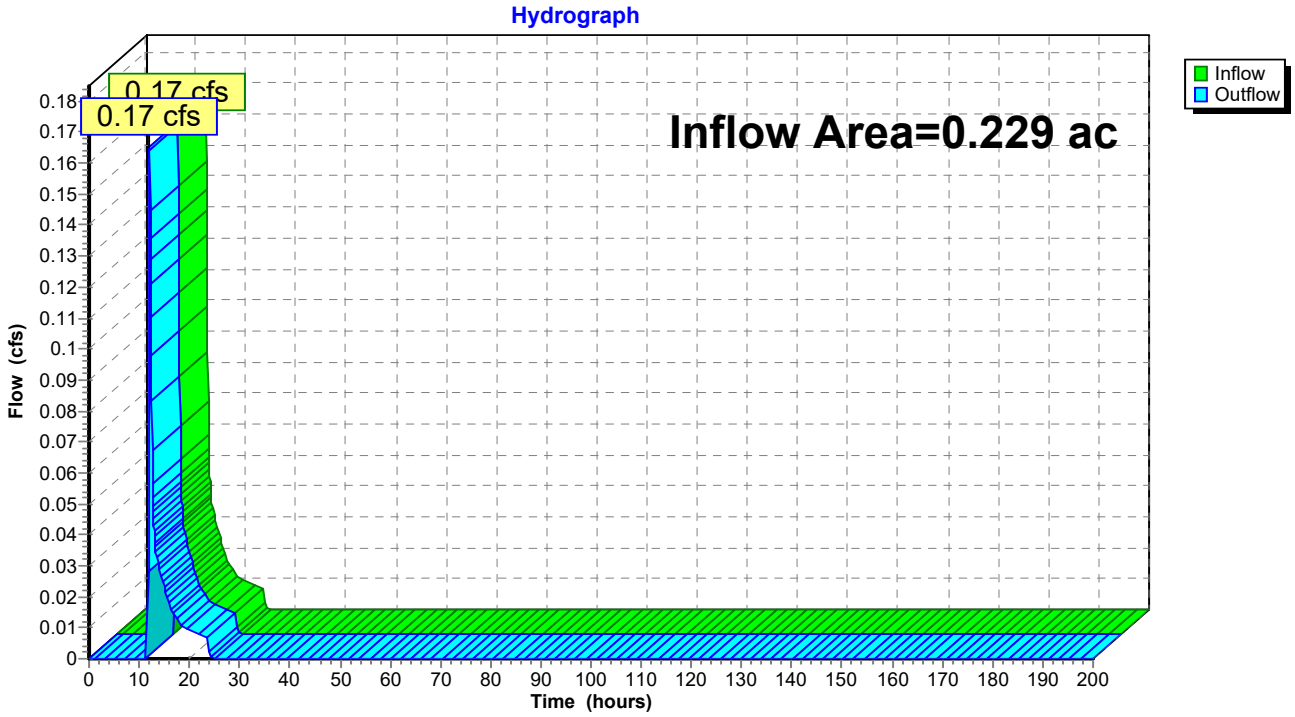


Summary for Reach 3: 3

Inflow Area = 0.229 ac, 8.51% Impervious, Inflow Depth = 1.06" for 100-Year event
Inflow = 0.17 cfs @ 12.13 hrs, Volume= 0.020 af
Outflow = 0.17 cfs @ 12.13 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs

Reach 3: 3



Summary for Pond UG 1: UG BAS 1

Inflow Area = 1.725 ac, 26.32% Impervious, Inflow Depth = 2.78" for 100-Year event
Inflow = 5.30 cfs @ 12.10 hrs, Volume= 0.399 af
Outflow = 0.56 cfs @ 13.22 hrs, Volume= 0.399 af, Atten= 89%, Lag= 67.2 min
Discarded = 0.20 cfs @ 11.55 hrs, Volume= 0.326 af
Primary = 0.37 cfs @ 13.22 hrs, Volume= 0.073 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 168.48' @ 13.22 hrs Surf.Area= 3,544 sf Storage= 7,577 cf

Plug-Flow detention time= 332.2 min calculated for 0.399 af (100% of inflow)
Center-of-Mass det. time= 332.2 min (1,190.0 - 857.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	165.00'	3,197 cf	**58.50'W x 60.58'L x 3.50'H Field A** 12,403 cf Overall - 4,410 cf Embedded = 7,993 cf x 40.0% Voids
#2A	165.50'	4,410 cf	**ADS_StormTech SC-740 +Cap** x 96 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 96 Chambers in 12 Rows
		7,607 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	165.00'	**2.410 in/hr Exfiltration over Horizontal area**
#2	Device 3	167.96'	**5.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	167.78'	**12.0" Round RCP_Round 12"** L= 17.7' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 167.78' / 167.60' S= 0.0102 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Discarded OutFlow Max=0.20 cfs @ 11.55 hrs HW=165.04' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.20 cfs)

Primary OutFlow Max=0.37 cfs @ 13.22 hrs HW=168.48' (Free Discharge)
↑—**3=RCP_Round 12"** (Passes 0.37 cfs of 1.60 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 0.37 cfs @ 2.68 fps)

Pond UG 1: UG BAS 1 - Chamber Wizard Field A

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

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

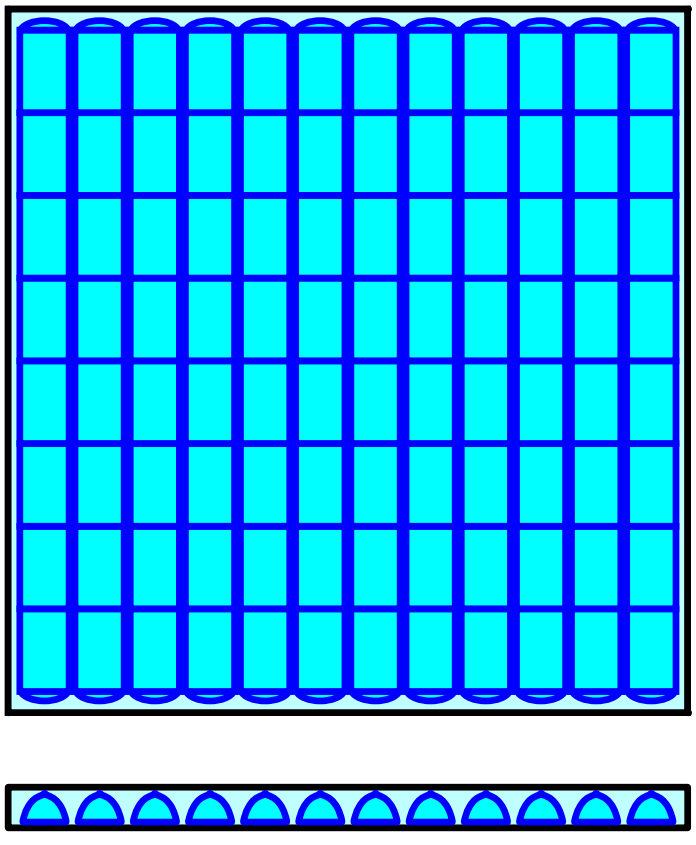
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
12 Rows x 51.0" Wide + 6.0" Spacing x 11 + 12.0" Side Stone x 2 = 58.50' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

96 Chambers x 45.9 cf = 4,410.2 cf Chamber Storage

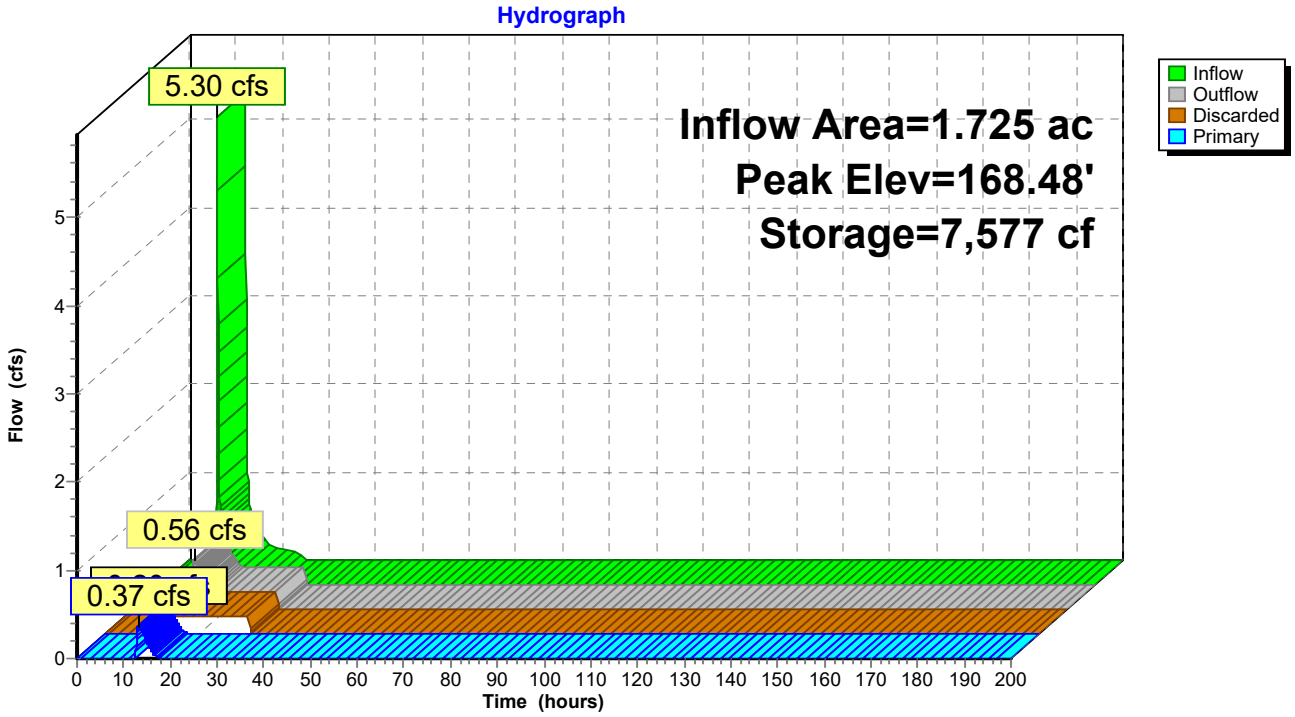
12,403.1 cf Field - 4,410.2 cf Chambers = 7,992.8 cf Stone x 40.0% Voids = 3,197.1 cf Stone Storage

Chamber Storage + Stone Storage = 7,607.4 cf = 0.175 af
Overall Storage Efficiency = 61.3%
Overall System Size = 60.58' x 58.50' x 3.50'

96 Chambers
459.4 cy Field
296.0 cy Stone



Pond UG 1: UG BAS 1



Summary for Pond UG 2: UG BAS 2

Inflow Area = 1.443 ac, 29.22% Impervious, Inflow Depth = 2.89" for 100-Year event
Inflow = 4.64 cfs @ 12.10 hrs, Volume= 0.347 af
Outflow = 0.41 cfs @ 13.71 hrs, Volume= 0.347 af, Atten= 91%, Lag= 96.6 min
Discarded = 0.19 cfs @ 13.71 hrs, Volume= 0.306 af
Primary = 0.22 cfs @ 13.71 hrs, Volume= 0.041 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 170.65' @ 13.71 hrs Surf.Area= 2,179 sf Storage= 7,300 cf

Plug-Flow detention time= 405.9 min calculated for 0.347 af (100% of inflow)
Center-of-Mass det. time= 406.0 min (1,261.4 - 855.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	165.00'	3,357 cf	**80.08'W x 27.21'L x 5.67'H Field A** 12,348 cf Overall - 3,956 cf Embedded = 8,392 cf x 40.0% Voids
#2A	165.75'	3,956 cf	**ADS_StormTech MC-3500 d +Cap** x 33 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 33 Chambers in 11 Rows Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf
		7,313 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	165.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Device 3	170.20'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	167.14'	**12.0" Round RCP_Round 12"** L= 17.2' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 167.14' / 166.80' S= 0.0198 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Discarded OutFlow Max=0.19 cfs @ 13.71 hrs HW=170.65' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.22 cfs @ 13.71 hrs HW=170.65' (Free Discharge)
↑—**3=RCP_Round 12"** (Passes 0.22 cfs of 8.52 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 0.22 cfs @ 2.57 fps)

Pond UG 2: UG BAS 2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

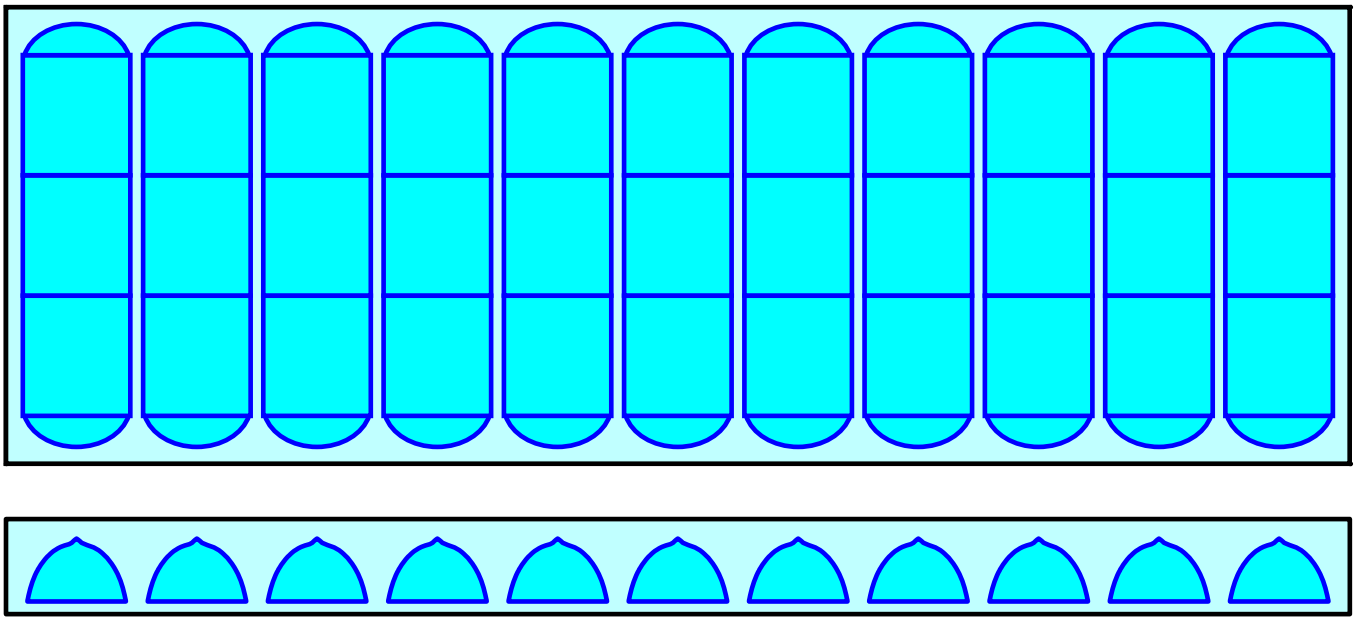
3 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 25.21' Row Length +12.0" End Stone x 2 = 27.21' Base Length
11 Rows x 77.0" Wide + 9.0" Spacing x 10 + 12.0" Side Stone x 2 = 80.08' Base Width
9.0" Base + 45.0" Chamber Height + 14.0" Cover = 5.67' Field Height

33 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 11 Rows = 3,956.2 cf Chamber Storage

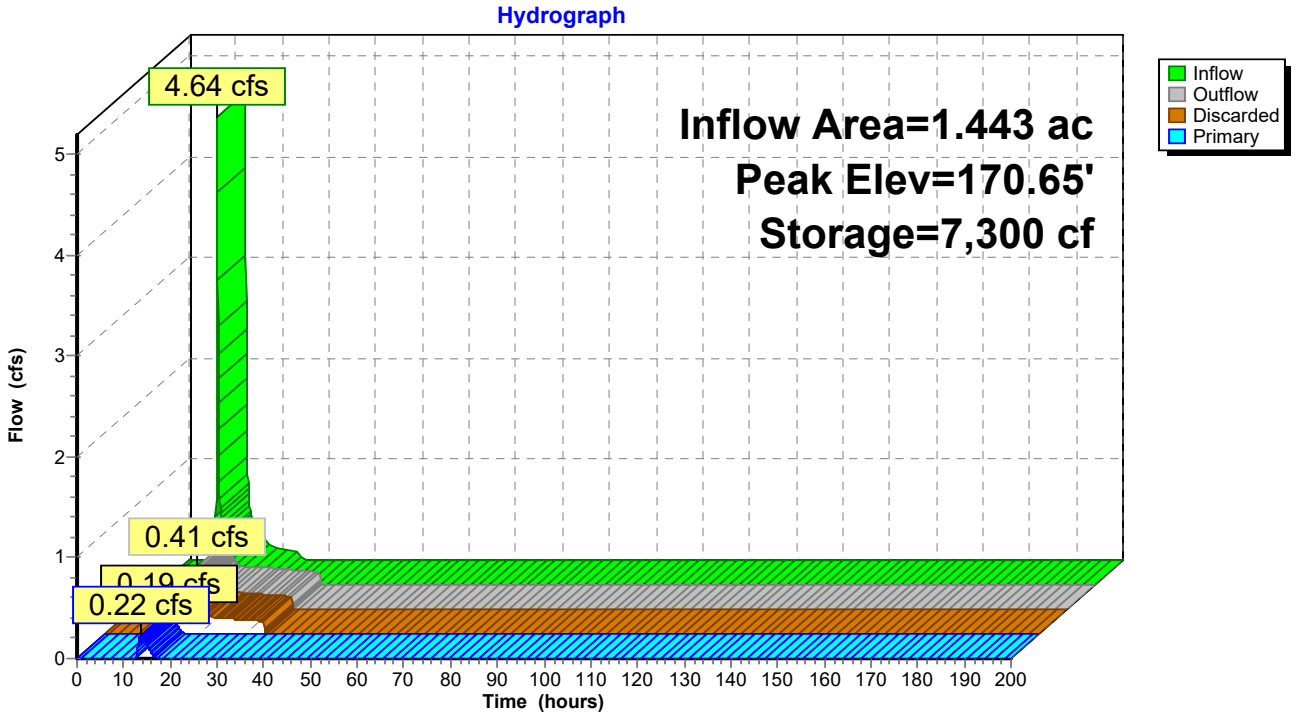
12,348.0 cf Field - 3,956.2 cf Chambers = 8,391.8 cf Stone x 40.0% Voids = 3,356.7 cf Stone Storage

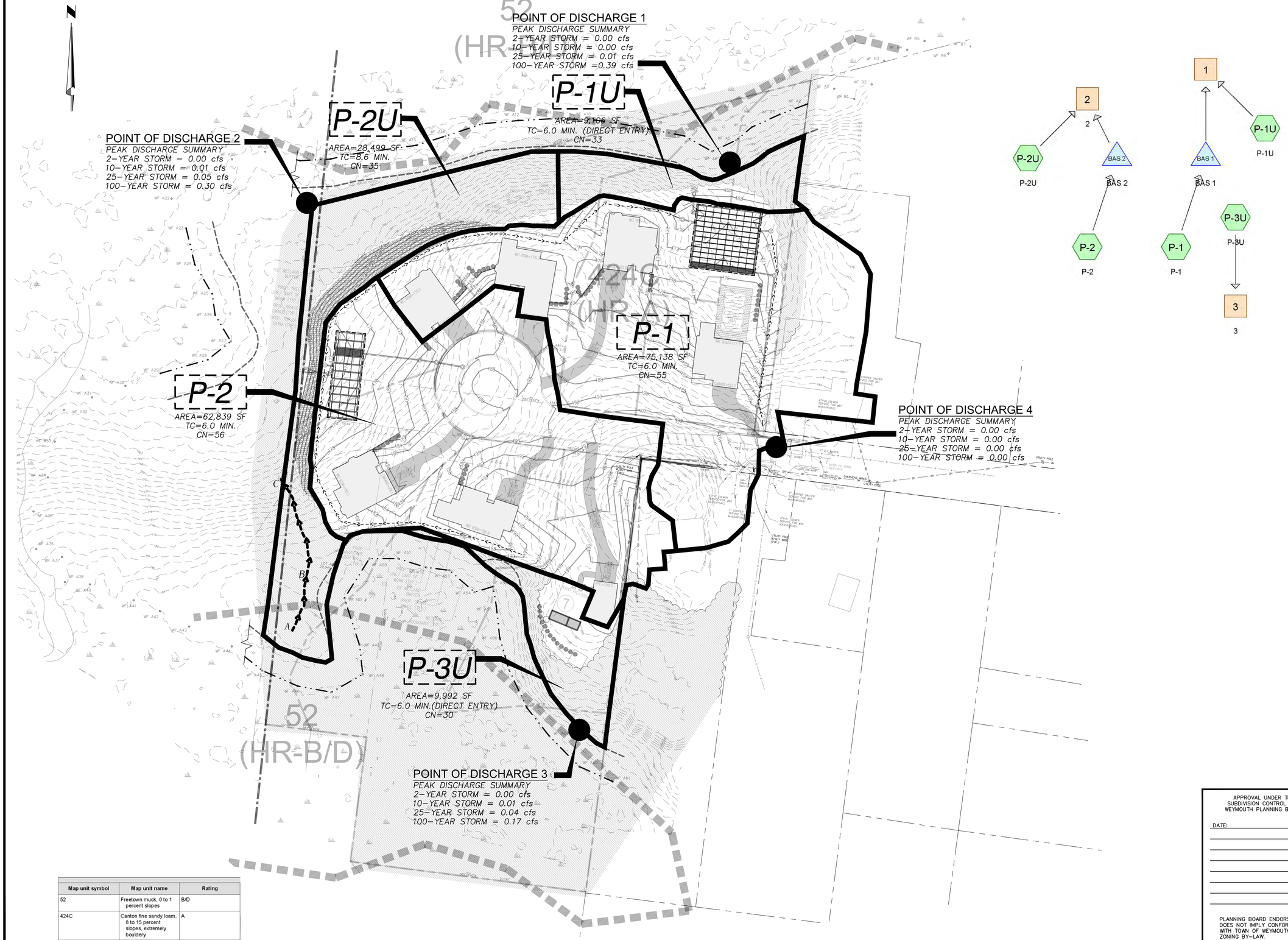
Chamber Storage + Stone Storage = 7,312.9 cf = 0.168 af
Overall Storage Efficiency = 59.2%
Overall System Size = 27.21' x 80.08' x 5.67'

33 Chambers
457.3 cy Field
310.8 cy Stone



Pond UG 2: UG BAS 2





Map unit symbol	Map unit name	Rating
52	Freetown muck, 0 to 1 percent slopes	B/D
424C	Canton fine sandy loam, 8 to 15 percent slopes, extremely bouldery	A

APPROVAL UNDER THE SUBDIVISION CONTROL LAW
WEYMOUTH PLANNING BOARD

DATE: _____

PLANNING BOARD ENDORSEMENT DOES NOT IMPLY CONFORMANCE WITH TOWN OF WEYMOUTH ZONING BY-LAW.

FOR REGISTRY USE ONLY

Date	Description	No.
1.11.22	REVISED PER DPW COMMENTS	3.
11.19.21	REV. PER CON. COMM. AND TOWN ENG. COMMENTS	3.
4.23.20	REVISED PER TOWN STAFF COMMENTS	2.
2.05.19	REVISED WETLAND FLAGS AND LOT	1.

Revisions

1-11-2022

GABRIEL R. CROCKER
CIVIL
No. 47917
REGISTERED PROFESSIONAL ENGINEER
COMMONWEALTH OF MASSACHUSETTS

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

CROCKER DESIGN GROUP, LLC.

2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-820-0416

MASSACHUSETTS

Project

DEFINITIVE SUBDIVISION PLAN

MASSAPOAG STREET
WEYMOUTH, MA

Prepared for

WEATHERVANE MASSAPOAG, LLC.

190 OLD DERBY STREET, SUITE 311
HINGHAM, MA 02043

Drawing Title

PROPOSED CONDITIONS WATERSHED ANALYSIS PLAN

Project No.	100-029
Date	12.20.2018
Scale	1"=40'
Drawn By	SZA
Approved By	GC

Drawing No. **PW-1**

C:\CDG\Crocker Design Group, LLC\Gabriel Crocker - Projects\100-029 Weymouth - Massapoag Dr Land\Plot sheets\Definitive Subdivision Plans_11-PROP WATERSHED MAP.dwg, PW-1 - PROP WATER, Jan 05, 2022 10:45

SECTION 4 – STORMWATER MANAGEMENT CALCS

4.1 RECHARGE CALCULATIONS

The Required Recharge Volume is computed using the equation provided in the 2008 Massachusetts Stormwater Handbook. The volume is computed as an equivalent depth of rainfall over the proposed impervious areas in accordance with a Target Depth Factor based on the soil classifications. The Calculations is as follows:

- Rv = F x impervious area (Equation 1) Volume 3, Ch 1, page 15
- *Rv = Required Recharge Volume*, expressed in cubic feet, cubic yards, or acre-feet
- *F* = Target Depth Factor associated with each Hydrologic Soil Group (HSG)
- *Impervious Area* = new pavement and new rooftop area
- *The Target Depth Factor "F" per Table 2.3.2, Volume 3, Chapter 1 for each soil classification is as follows:*
    - A soils = 0.60 inches
    - B soils = 0.35 inches
    - C soils = 0.25 inches
    - D soils = 0.10 inches

Based on the above formula, the required recharge volume for the site is as follows:

Recharge Within "A" Soils:

- Impervious Area = 33,890 SF
- 0.6 inches x 1/12 feet x 33,890 SF = 1,695 CUBIC FEET

TOTAL RECHARGE VOLUME REQUIRED = 1,632 CUBIC FEET

Capture Area Adjustment:

Not required. All impervious area associated with the overall development is conveyed to the recharge BMP's.

TOTAL RECHARGE VOLUME PROVIDED = 7,179 CUBIC FEET (see below)

Recharge Volume BMP Table

Infiltration BMP	***Infiltration Rate (in/hr) k***	***Storage (Recharge) Volume (c.f.) Rv***
BAS 1	*2.41*	*4,356*
BAS 2	*2.41*	*2,823*
Totals		***7,179***

The Storage Recharge volume numbers provided in the table above have been derived utilizing the HydroCAD output for stage storage. The following pages provide a copy of those printouts and the cumulative stage-storage up to the controlling invert elevation has been highlighted.

Conclusion:

The recharge provided by the proposed underground systems greatly exceeds the required recharge by 4.40 times. The project satisfies Standard 3 of the Massachusetts DEP Stormwater Regulations accordingly.

4.2 DRAWDOWN TIME

Below are the drawdown time calculations for the infiltration BMPs proposed on the site. The calculation uses estimated hydraulic conductivity values "*K"* in accordance with the Rawls Rates table. The formula below utilized the recommended formula per the MA Stormwater Handbook as follows:

- Drawdown Time = Rv / ((K/12)*Bottom Area)
- Rv = Storage Volume (cf)
- K – Saturated Hydraulic Conductivity per Rawls Rate Table
- Bottom Area = Area of Bottom of Proposed Recharge Structure

Below is a summary table of the drawdown calculations:

BASIN DRAWDOWN CALCULATIONS				
Infiltration BMP	***Infiltration Rate (in/hr) k***	***Storage (Recharge) Volume (c.f.) Rv***	***Bottom Area (s.f.)***	***Draw Down Time(hours)***
BAS 1	*2.41*	*4,356*	*3,544*	6.12
BAS 2	*2.41*	*2,829*	*2179*	6.46
Totals		***7,179***		**12.58**
k = saturated hydraulic conductivity (in/hr) *Rv = storage volume (c.f.)* *Bottom Area (s.f.)* *Volume 3, Chapter 1 of the MA Stormwater Handbook*				

Conclusion:

The calculations show that the infiltration BMP draws down in 12.58 hours which is less than the required 72 hours.

Stage-Area-Storage for Pond UG 2: UG BAS 2

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
165.00	2,179	0
165.10	2,201	87
165.20	2,222	174
165.30	2,243	261
165.40	2,265	349
165.50	2,286	436
165.60	2,308	523
165.70	2,329	610
165.80	2,351	743
165.90	2,372	920
166.00	2,394	1,097
166.10	2,415	1,273
166.20	2,437	1,449
166.30	2,458	1,623
166.40	2,479	1,797
166.50	2,501	1,971
166.60	2,522	2,143
166.70	2,544	2,314
166.80	2,565	2,485
166.90	2,587	2,654
167.00	2,608	2,823
167.10	2,630	2,990
167.20	2,651	3,156
167.30	2,673	3,321
167.40	2,694	3,484
167.50	2,716	3,646
167.60	2,737	3,806
167.70	2,758	3,964
167.80	2,780	4,121
167.90	2,801	4,276
168.00	2,823	4,429
168.10	2,844	4,580
168.20	2,866	4,728
168.30	2,887	4,874
168.40	2,909	5,017
168.50	2,930	5,157
168.60	2,952	5,294
168.70	2,973	5,428
168.80	2,994	5,557
168.90	3,016	5,683
169.00	3,037	5,802
169.10	3,059	5,914
169.20	3,080	6,018
169.30	3,102	6,114
169.40	3,123	6,207
169.50	3,145	6,296
169.60	3,166	6,383
169.70	3,188	6,470
169.80	3,209	6,558
169.90	3,231	6,645
170.00	3,252	6,732
170.10	3,273	6,819
170.20	3,295	6,906
170.30	3,316	6,993
170.40	3,338	7,081
170.50	3,359	7,168
170.60	**3,381**	**7,255**

Stage-Area-Storage for Pond UG 1: UG BAS 1

Elevation (feet)	Horizontal (sq-ft)	Storage (cubic-feet)
165.00	**3,544**	0
165.05	3,544	71
165.10	3,544	142
165.15	3,544	213
165.20	3,544	283
165.25	3,544	354
165.30	3,544	425
165.35	3,544	496
165.40	3,544	567
165.45	3,544	638
165.50	3,544	709
165.55	3,544	856
165.60	3,544	1,003
165.65	3,544	1,150
165.70	3,544	1,296
165.75	3,544	1,442
165.80	3,544	1,588
165.85	3,544	1,733
165.90	3,544	1,877
165.95	3,544	2,021
166.00	3,544	2,165
166.05	3,544	2,307
166.10	3,544	2,449
166.15	3,544	2,591
166.20	3,544	2,732
166.25	3,544	2,872
166.30	3,544	3,011
166.35	3,544	3,150
166.40	3,544	3,287
166.45	3,544	3,424
166.50	3,544	3,560
166.55	3,544	3,696
166.60	3,544	3,830
166.65	3,544	3,963
166.70	3,544	4,095
166.75	3,544	4,226
166.80	3,544	4,356
166.85	3,544	4,485
166.90	3,544	4,613
166.95	3,544	4,739
167.00	3,544	4,864
167.05	3,544	4,988
167.10	3,544	5,111
167.15	3,544	5,231
167.20	3,544	5,350
167.25	3,544	5,468
167.30	3,544	5,583
167.35	3,544	5,696
167.40	3,544	5,808
167.45	3,544	5,917
167.50	3,544	6,024
167.55	3,544	6,129
167.60	3,544	6,231
167.65	3,544	6,329
167.70	3,544	6,423
167.75	3,544	6,512
167.80	3,544	6,596
167.85	3,544	6,676
167.90	3,544	6,752
167.95	3,544	6,827
168.00	3,544	6,899
168.05	3,544	6,970
168.10	3,544	7,040
168.15	3,544	7,111
168.20	3,544	7,182
168.25	3,544	7,253
168.30	3,544	7,324
168.35	3,544	7,395
168.40	3,544	7,466
168.45	3,544	7,536
168.50	3,544	**7,607**
168.55	3,544	7,607
168.60	3,544	7,607
168.65	3,544	7,607
168.70	3,544	7,607
168.75	3,544	7,607

4.3 WATER QUALITY

This site qualifies for the treatment of 1.0" of Rainfall under the MA Stormwater Regulations because the wetland to the North of the project is tributary to Mill River which is and Outstanding Resource Water. Therefore, the wetland the project is discharging to qualifies as a Critical Area. A table has been provided below that provides the sizing of the Isolator Row treatment.

UG Basin / Isolator row	Tributary Area (acres)	Tributary Area (sq miles)	Pervious (sf)	Impervious %	CN Value (Estimated)	WQRD (In)	WQ Volume (cf)	Tc (min)	qu (csm/in)	WQF = qu A Q (cfs)
UG-1	1.44	0.0023	44,475	29%	72	1.00	1528	5	795	0.52
UG-2	1.73	0.0027	55,358	26%	71	1.00	1652	5	795	0.57

ISOLATOR ROW	UNIT TYPE	Treated flow per unit	Flow required to be treated	Number of units Provided	Treated Flow per Isolator Row
		cfs	**cfs**		cfs
UG-1	SC-740	0.26	0.52	8	2.08
UG-2	MC-3500	0.40	0.57	3	1.20

StormTech®

Detention - Retention - Water Quality

Division of ADS

STORMTECH ISOLATOR ROW SIZING CHART					
	SC-310	SC-740	DC-780	MC-3500	MC-4500
Chamber Area (Sq.Ft.)	20	27.8	27.8	43.2	30.1
Treated Flow Rate per chamber (CFS)	0.11	0.15	0.15	0.24	0.17

NOTE: *Testing of the Isolator Row completed by Tennesse Tech has been verified by NJCAT and it has shown to have a TSS removal efficiency of 84% for SIL-CO-SIL 250*

NJCAT verified Treated Flow Rate (GPM / Sq.Ft.) 2.5

NJCAT TECHNOLOGY VERIFICATION

Isolator® Row PLUS

StormTech, LLC

July 2020

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1. Description of Technology

The Isolator® Row PLUS (**shown in Figures 1 and 2**) is the first row of StormTech chambers that is surrounded with filter fabric and connected to a closely located manhole for easy access. The Isolator Row PLUS provides for settling and filtration of sediment as stormwater rises in the chamber and ultimately passes through the filter fabric. The open-bottom chambers allow stormwater to flow out of the chambers, while sediment is captured in the Isolator Row PLUS.

A single layer of proprietary Advanced Drainage Systems (ADS) PLUS fabric is placed between the angular base stone and the Isolator Row PLUS chamber. The geotextile provides the means for stormwater filtration and provides a durable surface for maintenance operations. A non-woven fabric is placed over the chambers. See link to O&M Manual (pg. 23) for installation pictures.

The Isolator Row PLUS is designed to capture the "first flush" runoff and offers the versatility to be sized on a volume basis or a flow basis. An upstream manhole not only provides access to the Isolator Row PLUS but includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row PLUS bypass through a manifold to the other chambers. This is achieved with either an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row PLUS row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row PLUS. After Stormwater flows through the Isolator Row PLUS and into the rest of the StormTech chamber system it is either infiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure. **Since this technology fits under the infiltration basin BMP in the New Jersey Stormwater BMP Manual, it is not eligible for NJDEP MTD certification.**

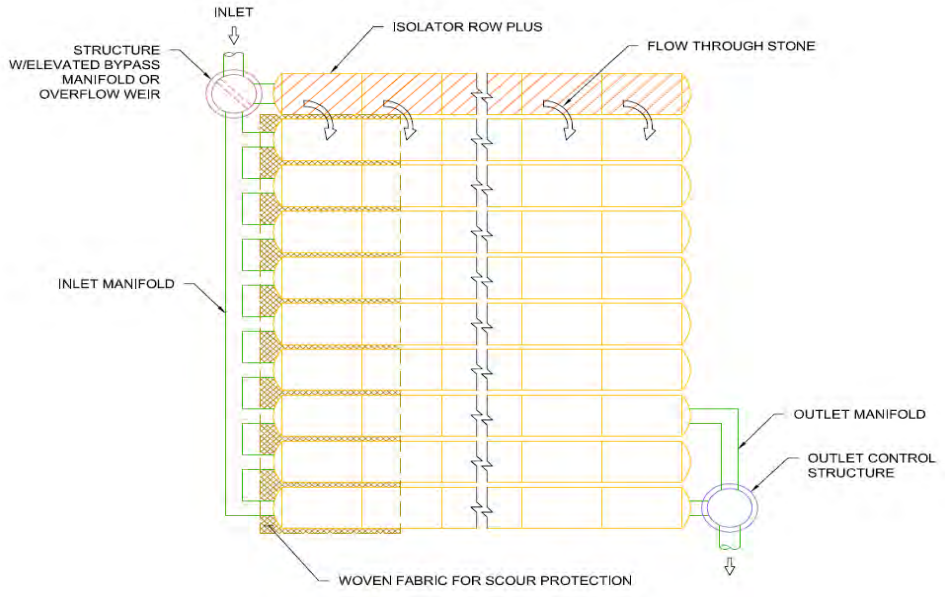


Figure 1 Schematic of the StormTech Isolator Row PLUS System

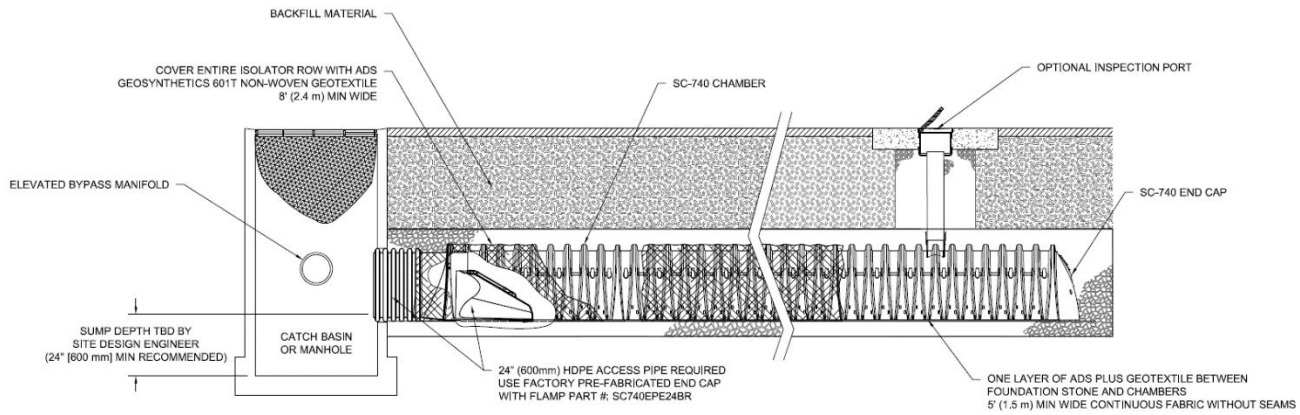


Figure 2 Isolator Row PLUS Detail

2. Laboratory Testing

Beginning in January 2020, two overlapping StormTech SC-740 Isolator Row PLUS commercial size chambers were installed at the BaySaver Laboratory in Mount Airy, Maryland, to evaluate the performance of Isolator Row PLUS on Total Suspended Solid (TSS) removal. Boggs Environmental Consultants (BEC) provided third-party review and oversight of all testing and data collection procedures, in accordance with the *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device (January 2013)*. All sediment concentration samples were analyzed by Fredericktowne Labs (FTL) using ASTM D3977-97 (2019). All sediment PSD analysis was performed by Environmental Consulting Services (ECS), using the methodology of ASTM D422-63 (2007). Prior to the start of testing, a Quality Assurance Project Plan (QAPP), revision dated January 9, 2020, was submitted to, and approved by the New Jersey Corporation for Advanced Technology (NJCAT).

2.1 Test Setup

The testing system, shown in **Figure 3**, consisted of a source tank, feed pump, flow control valve, flow meter, background sample port, screw-auger sediment feeder (doser), and an Isolator Row PLUS test system. This verification report only addresses the performance of the Isolator Row PLUS and not the entire StormTech system, since this is the row designed to remove sediment until the system goes into bypass.

Testing Procedure

The water source was potable water from the Town of Mount Airy Water & Sewer Department, obtained from an onsite tap, which served as the raw water supply for the testing system. Municipal tap water was used to fill the source tank, and then pumped to the system. Flow rate was controlled to the target of 225 gpm by a flow control valve. An inline flow meter (FloCat MFE electromagnetic flow meter) was used to measure the flow, and a SeaMetrics DL76 data logger (pictured in **Figure 4**) recorded the flow at one-minute intervals. The test sediment was

introduced to the inlet stream via a 12 -inch dosing port teed with a 12-inch influent line (pictured in **Figure 5**) located approximately 4 feet upstream of the system inlet. The dosing rate was controlled by a screw-auger Velodyne Barracuda 1000A volumetric feeder with a ½ HP variable speed motor. The dosing rate was set to deliver an amount of sediment that, when mixed with the water from the source tank, would produce influent water with a target test sediment concentration of 200 mg/L.

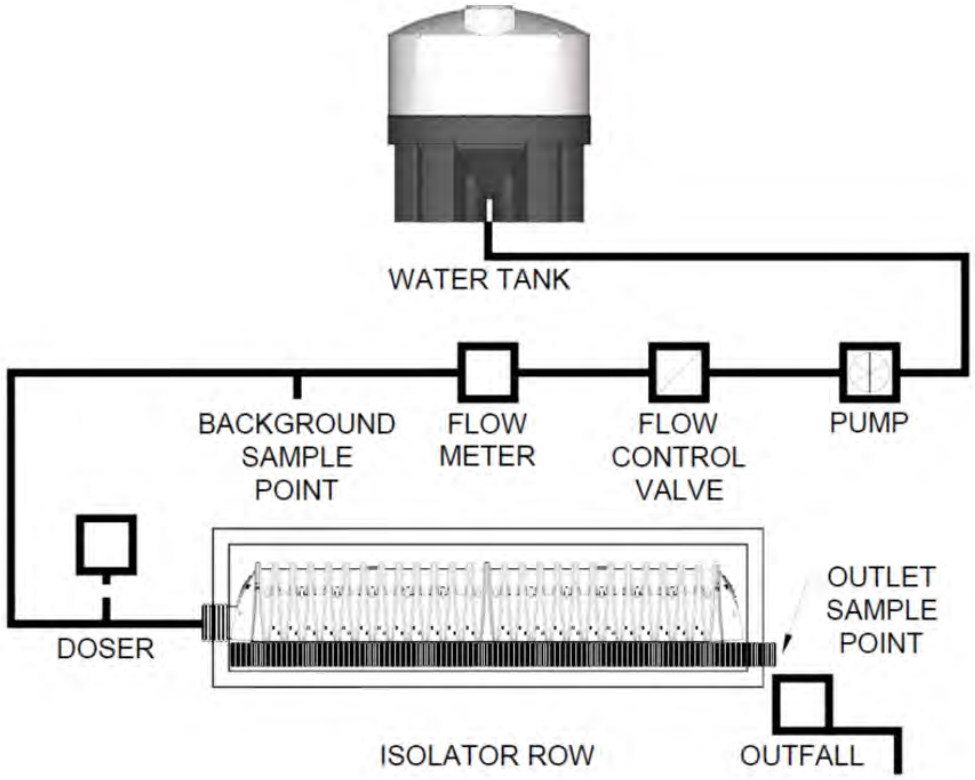


Figure 3 Schematic of the Isolator Row PLUS Test Configuration

The Isolator Row PLUS was installed inside a watertight 16'L x 6'W x 4'H test box (pictured in **Figures 6 and 7**). The Isolator Row PLUS is an arch-shaped stormwater detention/retention sediment collection and filtering device, sealed with end caps, with a 12"-inch inlet pipe welded into the upstream end cap. A ramp apparatus (patent pending) was attached to the inside of the chamber end cap to provide a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance over time by distributing sediment and debris that would otherwise collect at the inlet. It also serves to improve the fluid and solid flow back into the inlet pipe during maintenance and cleaning, and to guide cleaning and inspection equipment back into the inlet pipe when complete.

The chambers were installed on a 10-inch base of washed, angular, crushed stone, (#57, ¾ inch blue stone) containing an 8-inch perforated underdrain pipe running the length of the test box, penetrating the wall of the downstream end of the test box to the discharge collection point. An ADS non-woven geotextile fabric was placed over the top of the chamber row. The chambers were then backfilled with the washed crushed stone up to the top of the chamber elevation.

Additionally, an opening was cut into the top of one chamber to allow for visual monitoring and head measurement. No bypass or weir was installed upstream of the test box.

The test flow entered the chamber via the influent pipe and flowed across the filter fabric, filling the row. The water then flowed through the filter fabric, driven by hydrostatic head. The treated water exited the test box via the underdrain.

Figures 4 and 5 Photographs of Flow Meter and Sediment Delivery Port

Figure 6 Side View Photograph of Isolator Row PLUS Test Box

Figure 7 Top View Photograph of Isolator Row PLUS Test Box

Test Unit and Scaling Explanation

The Isolator Row PLUS used in this test was constructed from two (2) overlapping polypropylene open-bottom StormTech SC-740 chambers (one shortened by 5-in. to enable fitting into the test box), two (2) SC-740 end caps, a ramp apparatus and one layer of ADS PLUS geotextile fabric. The chamber floor filtration area (effective filtration treatment area, EFTA) was approximately 54.5 ft^2. (calculated using an average contact width inside the chamber of 45 in). The target test flow was 225 gpm. The calculated hydraulic loading rate, flow rate/EFTA is 4.13 gpm/ft^2 and the ratio of effective sedimentation treatment area to EFTA is 1.0. Given these data, one can effectively scale the test results for all commercial systems.

Sample Collection

The grab sampling method was used for all sample collection by sweeping a wide-mouth 1-L plastic bottle through the free-discharge effluent stream, to ensure the full cross section of the flow was sampled. The start time for each run was recorded.

The sampling schedule is provided in **Table 1**. The detention time for the Isolator Row PLUS unit operating at 20 inches hydrostatic head (maximum head tested) is 2.1 minutes. To comply with the NJDEP Filter Protocol, after initiating and stabilizing the flow rate at the MTFR and beginning sediment feed, effluent sampling did not begin until the filtration MTD has been in operation for a minimum of three detention times.

Background water samples were collected upstream of the doser (shown in **Figures 3 and 8**) in correspondence with the odd-numbered effluent samples (i.e., Samples E1, E3, E5 at t = 9, 20, 31 minutes).

Table 1 Sampling Schedule for the Isolator Row PLUS Tests

Time (min)	Sample(s)	Time (min)	Sample(s)
0	S1	22	S3
9	E1, BG1	31	E5, BG3
10	E2	32	E6
11	S2	33	Stop Flow
20	E3, BG2	N/A	DDA
21	E4	N/A	DDB

NOTE: S = sediment rate; E = effluent; BG = background; DD = drawdown

Figure 8 Photograph of Background Sampling Port

Two evenly-volume-spaced drawdown samples, DDA and DDB, were taken after the flow and sediment feed to the unit had been stopped.

Sediment injection rates were measured using a stopwatch and the mass collected measured on a calibrated scale once at the very beginning of the run and twice more during the run. A fourth sediment rate sample was taken after the run was finished as an internal check but was not included in the calculations for the report. The duration of each run was 33 minutes.

A Chain of Custody (COC) form was used for each test run to record sampling date and time for externally analyzed samples. Copies of these forms were maintained by BaySaver Laboratory and FTL. Sample bottles were labeled to identify the test run number and sample type (e.g., background, effluent), corresponding to the sample identification on the COC form. BEC was present during each test run and witnessed labeling, completion of COC forms, and packaging of

samples for delivery to the external laboratory (FTL). Each person taking or relinquishing possession of the samples was required to sign a COC form before samples changed hands.

Other Instrumentation and Measurement

Water temperature was recorded every minute by a HOBO data logger placed in the source water tank of the test system. The water level in the Isolator Row PLUS was recorded every 5 minutes by visual observation of a yardstick mounted through the observation port on top of the first chamber. Run and sampling times were measured using a digital timer and a stopwatch, respectively.

2.2 Test Sediment

The test sediment had the particle size distribution (PSD) presented in **Figure 9**. The test sediment was custom-blended using various commercially available silica sands. The resulting blended sediment met the specification for the NJDEP Filter Protocol. The test sediment was batched, labeled, and stored in covered bins for the duration of this project. Under the supervision of BEC, twenty-one subsamples, taken from various locations within the test sediment containers, were composited. From the composite, three random samples were taken for PSD and moisture content analyses, which were performed by ECS, using the methodology of ASTM method D422-63 (2007).

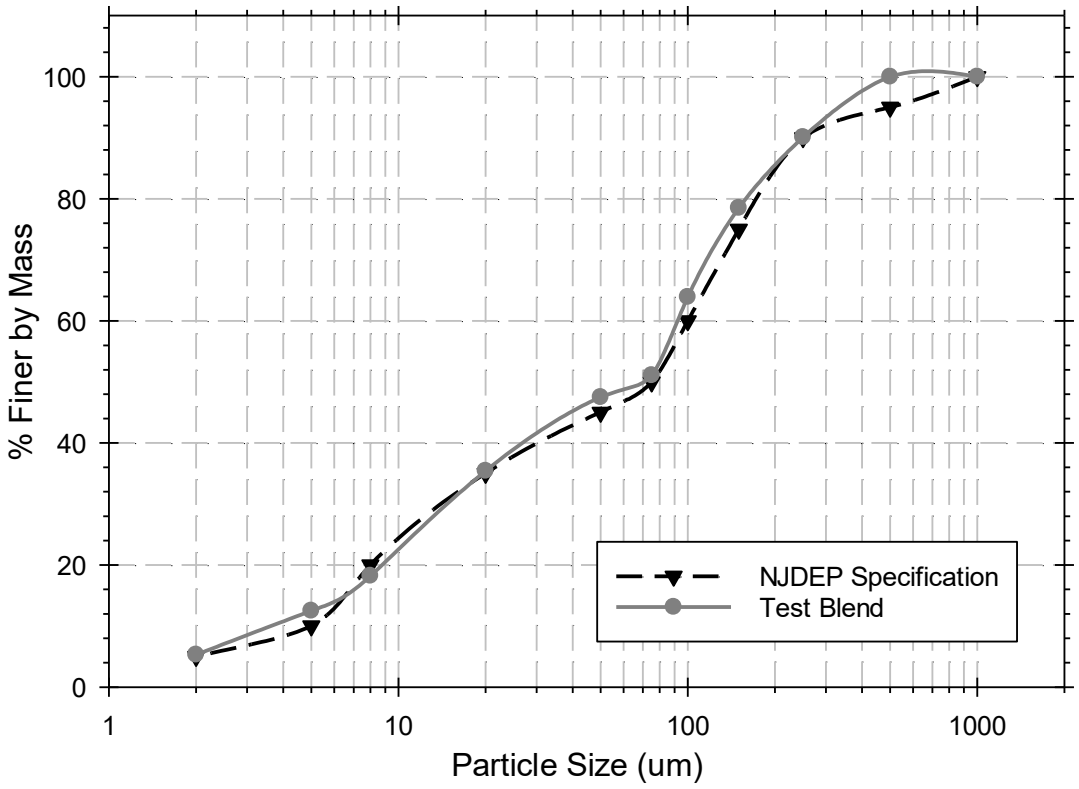


Figure 9 Average Particle Size Distribution of Test Sediment Verified by ECS

The PSD test analysis results are summarized in **Table 2**. ECS results showed that 17-19% of the particles were less than 8 µm and 89-90% of the particles were less than 250 µm. The d_{50} values (approximately 72 µm) also indicated that there was no significant difference between the NJDEP target gradation and the ECS-verified gradation of the test sediment. Thus, the blended test sediment was found to meet the NJDEP particle size specification and was acceptable for use. ECS also analyzed the sediment samples for moisture. The average moisture content was 0.1%.

Table 2 Particle Size Distribution of Test Sediment as Analyzed by ECS

Particle Size (µm)	Test Blend % Finer by Mass Analyzed by ECS				
	NJ Blend A	NJ Blend B	NJ Blend C	Average	NJDEP Specification (minimum % finer)
1000	100.0	100.0	100.0	100.0	98
500	100.0	100.0	100.0	100.0	93
250	90.3	89.8	90.2	90.1	88
150	79.3	78.1	78.1	78.5	73
100	66.0	63.2	62.7	63.9	58
75	52.0	50.9	50.3	51.1	50
50	47.5	47.7	47.4	47.5	43
20	35.9	36.0	34.3	35.4	33
8	18.6	18.7	17.4	18.2	18
5	13.0	13.0	11.6	12.5	8
2	5.5	5.4	5.1	5.3	3
d_{50}	69 µm	72 µm	74 µm	72 µm	75 µm

2.3 Sediment Removal Efficiency Testing

Sediment removal efficiency testing adhered to the guidelines set forth in Section 5 of the NJDEP Laboratory Protocol for Filtration MTDs. The target flow through the system was 225 gpm, with a target sediment concentration of 200 mg/L. All samples were collected in clean, 1-L wide-mouth bottles. Three background samples were taken at 9, 20 and 31 minutes after the test began to ensure the supply water met the sediment concentration requirement. According to the NJDEP Filter Protocol, these background concentrations cannot exceed a TSS concentration of 20 mg/L.

The test sediment screw-auger feeder introduced the test sediment into the influent stream to achieve the target influent TSS concentration of 200 mg/L. According to the NJDEP Filter Protocol, this influent concentration must stay within 10% of target, allowing for a 180 mg/L to 220 mg/L influent concentration. The feeder was calibrated prior to each run. In order to confirm sediment feed rates during the test, in accordance with the NJDEP Filter Protocol, three samples of the test sediment were collected from the injection point (**Figure 3**, "Doser") into a clean one-liter container for verification of sediment feed rate, over an interval timed to the nearest second, with a minimum volume of 0.1 liter or a collection interval not exceeding one minute (whichever came first). The time was measured with a stopwatch. The samples were weighed to the nearest

milligram in the BaySaver Laboratory under the observation of BEC. The sediment feed rate coefficient of variance (COV) for the test sediment samples did not exceed 0.10. The mass from the sediment feed rate measurement samples was subtracted from the total mass introduced to the system when removal efficiency was calculated.

Effluent sampling was performed by the grab sampling method during each run, according to the schedule in **Table 1**. When the test sediment feed was interrupted for test sediment measurements, the next effluent samples were collected after at least three detention times had elapsed. During the drawdown period, two evenly volume-spaced samples were collected after flow and sediment feed had stopped. All sediment concentration samples were analyzed by Fredericktowne Labs (FTL) using ASTM D3977-97 (2019) "Standard Test Methods for Determining Sediment Concentrations in Water Samples."

2.4 Sediment Mass Loading Capacity

The sediment mass loading capacity testing occurred as a continuation of removal efficiency testing, with the target for influent concentration remaining at 200 mg/L, and all aspects of testing procedures kept the same to ensure consistency throughout. The sediment mass loading capacity of the Isolator Row PLUS is defined per the protocol as the point at which the cumulative mass removal drops below 80.0%. For this testing program, the sediment mass loading testing was stopped prior to that point (after Run 16), because it was incorrectly assumed this criterion was reached. Thus, the mass loading is defined as mass loaded into the unit through the end of Run 16.

3. Supporting Documentation

The Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from NJCAT states that copies of the laboratory test reports, all data from performance evaluation test runs, original data, pertinent calculations, and documentation of any maintenance activities that occur during the testing process are to be included in this section. All of this information has been provided to NJCAT and is available upon request. It is not practical to include it in this report.

4. Testing Results

A total of 16 removal efficiency testing runs were completed in accordance with the NJDEP filter protocol. The target flow and influent sediment concentration were 225 gpm and 200 mg/L, respectively. The results from all 16 runs were used to calculate the overall cumulative removal efficiency of the Isolator Row PLUS.

4.1 Flow Rate

Flow was monitored by an inline flow meter (FloCat MFE electromagnetic flow meter) and recorded by a SeaMetrics DL76 data logger every minute during each run. For each run, the flow was maintained within 10% of the target (202.5 – 247.5 gpm). The average flow for all 16 runs was 226.1 gpm. The flow data with coefficient of variance (COV) values for all 16 runs are summarized in **Table 3**.

4.2 Water Temperature

Temperatures were recorded every minute by a HOBO water level logger (U20L-04). On average for all runs, the water temperature during testing was 45.7 degrees Fahrenheit, with a maximum of 52.2 degrees Fahrenheit, meeting the NJDEP Filter Protocol requirement to be below 80 degrees Fahrenheit. Data are summarized in **Table 3**.

Table 3 Flow Rate and Temperature Summary for All Runs

Run	Max Flow (gpm)	Min Flow (gpm)	Average Flow (gpm)	Flow COV	Flow Compliance (COV< 0.1)	Maximum Temperature (Fahrenheit)	NJDEP Temperature Compliance (< 80 F)
1	232.8	223.9	226.3	0.0078	Y	48.2	Y
2	228.9	218.6	220.8	0.0104	Y	51.5	Y
3	229.4	220.0	227.2	0.0094	Y	44.7	Y
4	230.2	218.7	223.2	0.0138	Y	40.5	Y
5	228.7	216.9	222.2	0.0103	Y	44.7	Y
6	227.6	217.0	224.2	0.0115	Y	46.7	Y
7	229.7	221.9	226.4	0.0092	Y	44.6	Y
8	230.3	222.2	226.8	0.0089	Y	43.5	Y
9	233.2	218.4	225.6	0.0136	Y	45.5	Y
10	232.2	219.7	228.4	0.0126	Y	44.7	Y
11	226.9	219.2	224.1	0.0088	Y	52.4	Y
12	232.2	222.1	226.9	0.0107	Y	48.5	Y
13	234.7	221.2	226.1	0.0109	Y	48.5	Y
14	231.9	223.4	228.7	0.0103	Y	45.6	Y
15	236.8	224.1	231.4	0.0131	Y	52.2	Y
16	232.5	221.3	229.0	0.0137	Y	47.8	Y
Average			226.1			45.7	
Max						52.2	

4.3 Head

The head level in the Isolator Row PLUS was recorded to the nearest 1/8 inch every five minutes, through visual observation of a yard stick mounted through the observation port of the first chamber. With each run, after the first several measurements, the head during the run remained the same or increased slightly over that of the previous run. The maximum head reached during all 16 runs was 18.75 inches. Maximum head for each run is summarized in **Table 4**.

Table 4 Maximum Head (inches) for All Runs

Run	Maximum Head (inches)	Run	Maximum Head (inches)
1	9.00	9	17.50
2	12.00	10	18.00
3	14.00	11	17.25
4	15.25	12	18.00
5	15.75	13	18.25
6	16.25	14	18.50
7	17.50	15	18.75
8	17.25	16	18.75

4.4 Sediment Concentration and Removal Efficiency

Background TSS

Municipal tap water was used as the water source during testing. The background TSS concentration for all runs was well below the 20 mg/L NJDEP Protocol limit. Background TSS concentrations for each run are provided in **Table 5**. The average background TSS concentration for each run was subtracted from the effluent and drawdown concentrations to provide adjusted figures, per the protocol.

Sediment Dosing Rate and Influent TSS

Influent TSS concentration was calculated by dividing the total mass of sediment added during a given run by the total volume of water flowing through the MTD during the addition of test sediment during that run. The volume of water flowing through the device during the run was calculated by multiplying the average measured flow by the time of sediment addition only. The average influent TSS was 204.2 mg/L, with individual run averages ranging from 195.9 to 216.7 mg/L. All values are within the target range of 200 ± 20 mg/L. **Tables 6 and 7** provide the measured sediment rates for each run, and the resulting calculated influent TSS concentration. In these tables, NJDEP Protocol compliance is defined as a TSS concentration in the range 180 – 220 mg/L and sediment feed rate COV < 0.1.

Table 5 Background TSS Concentrations

Run	BG TSS 9 min (mg/L)	BG TSS 20 min (mg/L)	BG TSS 31 min (mg/L)	Average (mg/L)	MDL (mg/L)
1	0.5	4	2	2.2	1.0
2	1	1	0.5	0.8	1.0
3	1	0.5	0.5	0.7	1.0
4	0.5	0.5	0.5	0.5	1.0
5	0.5	0.5	0.5	0.5	1.0
6	0.5	0.5	0.5	0.5	1.0
7	0.5	0.5	0.5	0.5	1.0
8	0.5	0.5	0.5	0.5	1.0
9	0.5	0.5	0.5	0.5	1.0
10	0.5	0.5	0.5	0.5	1.0
11	0.5	0.5	0.5	0.5	1.0
12	0.5	0.5	0.5	0.5	1.0
13	0.5	0.5	0.5	0.5	1.0
14	0.5	0.5	0.5	0.5	1.0
15	0.5	0.5	0.5	0.5	1.0
16	0.5	0.5	0.5	0.5	1.0

Note: In cases where the measured background TSS concentration was below the Minimum Detection Level (MDL) of 1.0 mg/L, half the MDL was reported for the background concentration.

Table 6 Sediment Rate Measurements for Runs 1-10

Run	Run Time (min)	Sediment Weight (g)	Duration (s)	Sediment Feed Rate (g/min)	Influent Water Flow Rate (gpm)	Influent TSS Conc. (mg/L)	NJDEP Compliance
1	0	117.767	39.78	177.6	226.3	202.9	Y
	11	110.674	40.16	165.4			
	22	118.819	40.00	178.2			
	COV			0.0418			
2	0	114.921	39.91	172.8	220.8	198.5	Y
	11	106.158	39.96	159.4			
	22	110.429	40.10	165.2			
	COV			0.0404			
3	0	117.364	39.85	176.7	227.2	206.8	Y
	11	116.700	39.90	175.5			
	22	120.156	39.72	181.5			
	COV			0.0179			
4	0	121.043	39.79	182.5	223.2	216.7	Y
	11	125.058	39.88	188.2			
	22	118.657	39.85	178.7			
	COV			0.0261			
5	0	111.624	40.03	167.3	222.2	215.0	Y
	11	117.883	40.00	176.8			
	22	132.393	39.88	199.2			
	COV			0.0904			
6	0	114.723	39.94	172.3	224.2	206.6	Y
	11	119.043	40.03	178.4			
	22	117.644	40.28	175.2			
	COV			0.0174			
7	0	115.351	40.00	173.0	226.4	198.1	Y
	11	110.196	40.25	164.3			
	22	114.603	40.00	171.9			
	COV			0.0281			
8	0	115.664	39.72	174.7	226.8	201.5	Y
	11	117.915	39.93	177.2			
	22	110.840	39.82	167.0			
	COV			0.0307			
9	0	116.845	39.87	175.8	225.6	205.2	Y
	11	114.135	39.81	172.0			
	22	117.894	39.75	178.0			
	COV			0.0172			
10	0	111.306	39.57	168.8	228.4	203.0	Y
	11	119.680	39.81	180.4			
	22	118.275	39.90	177.9			
	COV			0.0347			

Table 7 Sediment Rate Measurements for Runs 11-16

Run #	Run Time (min)	Sediment Weight (g)	Duration (s)	Sediment Feed Rate (g/min)	Influent Water Flow Rate (gpm)	Influent TSS Conc. (mg/L)	NJDEP Compliance
11	0	114.505	39.90	172.2	224.1	207.8	Y
	11	119.160	39.94	179.0			
	22	118.629	40.03	177.8			
	COV			0.0207			
12	0	115.516	39.78	174.2	226.9	208.8	Y
	11	118.805	39.87	178.8			
	22	124.236	40.22	185.3			
	COV			0.0311			
13	0	114.776	39.78	173.1	226.1	198.0	Y
	11	106.924	39.85	161.0			
	22	115.083	39.69	174.0			
	COV			0.0429			
14	0	112.871	39.72	170.5	228.7	199.9	Y
	11	116.869	39.84	176.0			
	22	114.529	39.81	172.6			
	COV			0.0161			
15	0	112.091	39.72	169.3	231.4	195.9	Y
	11	112.200	39.81	169.1			
	22	117.588	39.94	176.6			
	COV			0.0250			
16	0	118.503	39.59	179.6	229.0	202.3	Y
	11	116.834	39.78	176.2			
	22	112.971	39.84	170.1			
	COV			0.0273			

Effluent TSS

During each run, grab samples were taken of the effluent according to the schedule in **Table 1**, and all TSS analyses were conducted by Fredericktowne Labs. For each run, the average effluent concentration was adjusted by subtracting the average background TSS concentration. The average adjusted effluent TSS concentration during testing was 39 mg/L, with individual run averages ranging from 32.0 to 45.5 mg/L. Effluent and adjusted effluent TSS concentrations for each run are given in **Table 8**.

Table 8 Effluent Sample TSS Concentrations

Run	EFF TSS 9 min	EFF TSS 10 min	EFF TSS 20 min	EFF TSS 21 min	EFF TSS 31 min	EFF TSS 32 min	Mean	MDL	Adjusted Effluent TSS
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
1	48	48	47	47	48	48	47.7	1.0	45.5
2	32	32	33	32	35	33	32.8	1.0	32.0
3	33	37	37	40	38	38	37.2	1.0	36.5
4	28	31	34	38	32	38	33.5	1.0	33.0
5	40	41	39	33	42	42	39.5	1.0	39.0
6	38	41	39	37	41	44	40.0	1.0	39.5
7	37	40	37	36	37	38	37.5	1.0	37.0
8	38	41	38	40	32	38	37.8	1.0	37.3
9	35	41	36	36	42	41	38.5	1.0	38.0
10	39	44	34	38	37	41	38.8	1.0	38.3
11	35	41	38	38	38	43	38.8	1.0	38.3
12	36	43	36	41	46	47	41.5	1.0	41.0
13	41	46	37	37	42	45	41.3	1.0	40.8
14	44	49	39	42	42	45	43.5	1.0	43.0
15	40	43	41	39	40	45	41.3	1.0	40.8
16	43	45	41	44	45	46	44.0	1.0	43.5

Note: Adjusted effluent TSS concentration is the average effluent TSS concentration minus the average background TSS concentration (Table 5).

Drawdown TSS

According to the NJDEP Filter Protocol, the amount of sediment that leaves the filter during the drawdown period must be accounted for and documented. During each run, two evenly volume-spaced grab samples were taken of the drawdown, and all TSS analyses were conducted by Fredericktowne Labs. For each run, the average drawdown concentration was adjusted by subtracting the average background TSS concentration (**Table 9)**.

Table 9 Drawdown Sample TSS Concentrations

Run	DDA	DDB	Average	MDL	Adjusted Drawdown TSS
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
1	62	11	36.5	1.0	34.3
2	39	16	27.5	1.0	26.7
3	42	14	28.0	1.0	27.3
4	41	18	29.5	1.0	29.0
5	42	16	29.0	1.0	28.5
6	45	17	31.0	1.0	30.5
7	44	16	30.0	1.0	29.5
8	48	17	32.5	1.0	32.0
9	42	18	30.0	1.0	29.5
10	45	17	31.0	1.0	30.5
11	43	17	30.0	1.0	29.5
12	44	16	30.0	1.0	29.5
13	46	18	32.0	1.0	31.5
14	50	18	34.0	1.0	33.5
15	47	17	32.0	1.0	31.5
16	48	15	31.5	1.0	31.0

Note: Adjusted drawdown TSS concentration is the average drawdown TSS concentration minus the average background TSS concentration (Table 5).

In order to estimate the volume of water during drawdown, under observation by BEC, the unit was filled prior to all testing with clean water and the drawdown volume as a function of time was calculated from the height of the flow stream in the effluent pipe as a function of time. Total drawdown volume was estimated at 268.6 gal at an operating head of 2.5 inches. This volume was used to determine the volume of the void space of the gravel bed, which was then used, along with the dimensions of the Isolator Row PLUS chambers, to calculate the drawdown volume for incremental head levels above 2.5 inches. Adjusted average drawdown TSS concentrations and drawdown losses are given in **Table 10**.

Table 10 Drawdown Losses

Run	Head Level at End of Run (in)	Drawdown Volume (gal)	Average Adjusted Drawdown TSS Conc. (mg/L)	Total Sediment Lost During Drawdown (g)
1	9.00	285.2	34.3	37.1
2	12.00	354.2	26.7	35.7
3	14.00	403.3	27.3	41.7
4	15.25	432.8	29.0	47.5
5	15.75	443.9	28.5	47.9
6	16.25	454.2	30.5	52.4
7	17.50	476.0	29.5	53.2
8	17.00	468.2	32.0	56.7
9	17.25	472.3	29.5	52.7
10	17.75	476.0	30.5	55.0
11	17.25	472.3	29.5	52.7
12	17.5	476.0	29.5	53.2
13	18.00	482.4	31.5	57.5
14	18.25	484.9	33.5	61.5
15	18.50	486.8	31.5	58.1
16	18.25	484.9	31.0	56.9

Removal Efficiency Calculation

Removal efficiency was calculated using the following equation from the NJDEP Filter Protocol:

$$\text{Removal Efficiency (\%)} = \frac{\left(\begin{array}{c}\text{Average Influent}\\ \text{TSS Concentration x}\\ \text{Total Volume}\\ \text{of Test Water}\end{array}\right) - \left(\begin{array}{c}\text{Adjusted Effluent}\\ \text{TSS Concentration x}\\ \text{Total Volume}\\ \text{of Effluent Water}\end{array}\right) - \left(\begin{array}{c}\text{Average}\\ \text{Drawdown Flow}\\ \text{TSS Concentration x}\\ \text{Total Volume}\\ \text{of Drawdown Water}\end{array}\right)}{\text{Average Influent TSS Concentration x Total Volume of Test Water}} \text{ x } 100$$

For each run, sediment concentrations of background, influent, effluent, and drawdown, as well as the calculated removal efficiency, are summarized in **Table 11**. As shown in this summary table, the Isolator Row PLUS demonstrated a cumulative sediment removal efficiency of 81.2% over the course of 16 test runs.

Table 11 Removal Efficiency Results

Run	Average Influent TSS (mg/L)	Influent Water Volume (gal)	Adjusted Average Effluent TSS (mg/L)	Effluent Water Volume (gal)	Adjusted Average Drain Down TSS (mg/L)	Drain Down Water Volume (gal)	Single Run Removal Efficiency (%)	Mass of Captured Sediment (g)	Cumulative Removal Efficiency (%)
1	203	7166	46	6881	34	285	77.8	4282	77.8
2	199	6993	32	6639	27	354	84.0	4415	80.8
3	207	7197	37	6793	27	403	82.6	4654	81.4
4	217	7068	33	6635	29	433	84.9	4923	82.3
5	215	7037	39	6593	29	444	82.2	4705	82.3
6	207	7097	40	6643	31	454	81.2	4504	82.1
7	198	7169	37	6693	30	476	81.6	4386	82.0
8	201	7184	37	6716	32	468	81.6	4473	82.0
9	205	7147	38	6675	30	472	81.8	4539	82.0
10	203	7235	38	6759	31	476	81.4	4523	81.9
11	208	7096	38	6624	30	472	81.8	4567	81.9
12	209	7185	41	6709	30	476	80.7	4584	81.8
13	198	7162	41	6680	32	482	79.7	4277	81.6
14	200	7242	43	6757	34	485	78.8	4318	81.4
15	196	7329	41	6842	32	487	79.5	4320	81.3
16	202	7254	44	6769	31	485	78.9	4384	81.2
Ave.	204.2	7160	39	6713	31	447	81.2	4491	N/A
Cumulative Mass Removed (g)							71854		
Cumulative Mass Removed (lb)							158.4		
Total Mass Loaded (lb)							195.2		
Cumulative Removal Efficiency (%)							81.2		

4.5 Sediment Mass Loading

Sediment mass loading for each run was approximately 12.2 lbs on average. These data are summarized in **Table 12**.

Sediment mass loading was calculated from the summation of the total sediment mass added during dosing in each run.

Table 12 Sediment Mass Loading Summary

Run	Sediment Loading (lbs)	Cumulative Sediment Loading (lbs)	Run	Sediment Loading (lbs)	Cumulative Sediment Loading (lbs)
1	12.1	12.1	9	12.2	110.0
2	11.6	23.7	10	12.3	122.2
3	12.4	36.1	11	12.3	134.5
4	12.8	48.9	12	12.5	147.0
5	12.6	61.5	13	11.8	158.9
6	12.2	73.8	14	12.1	170.9
7	11.9	85.6	15	12.0	182.9
8	12.1	97.7	16	12.2	195.2

Overall, a total of 195.2 lbs of sediment was loaded into the Isolator Row PLUS over the course of the 16 runs. Total captured mass over the 16 runs was 158.4 lbs (**Table 11**).

The relationship between removal efficiency and sediment mass loading is shown in **Figure 10**. The relationship between driving head and sediment mass loading is shown in **Figure 11**.

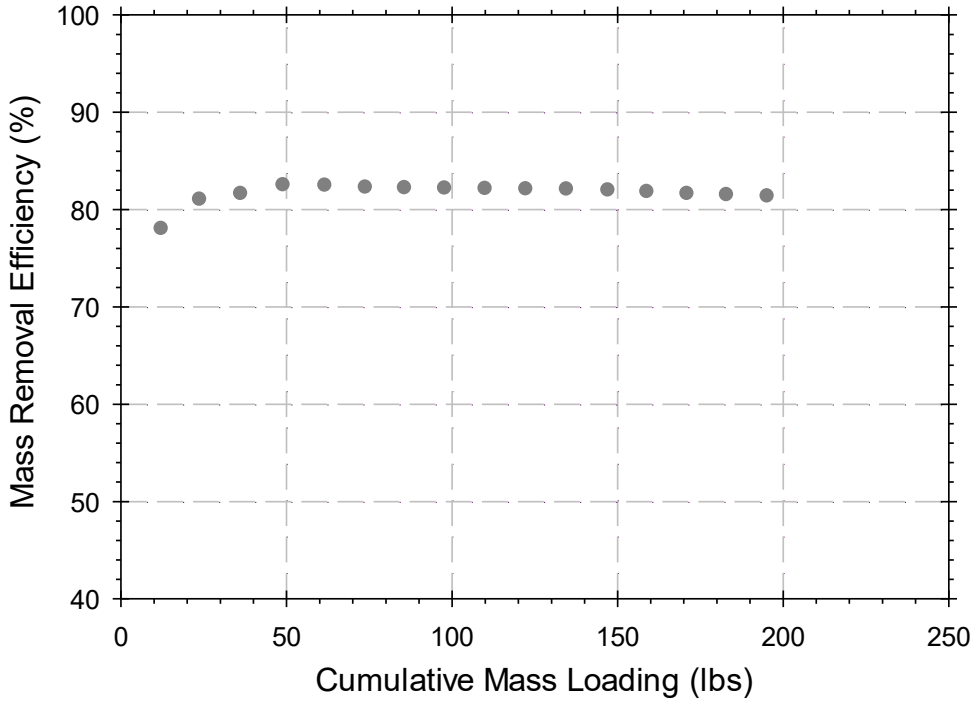


Figure 10 Removal Efficiency vs. Sediment Mass Loading

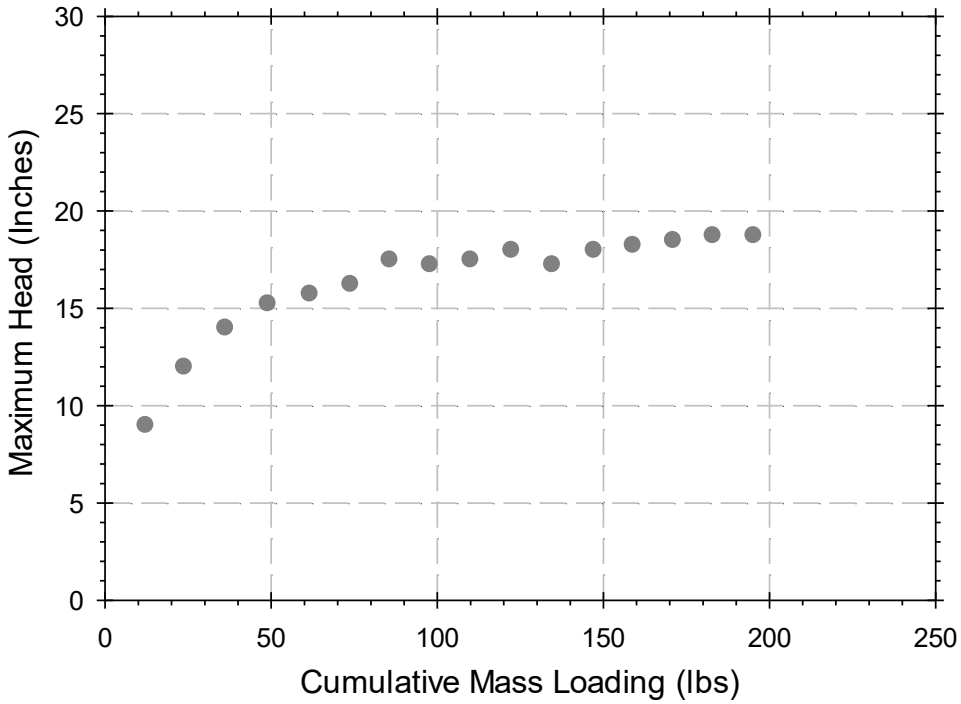


Figure 11 Driving Head vs. Sediment Mass Loading

5. Performance Verification

The Isolator Row PLUS used in this test, constructed from two (2) overlapping StormTech SC-740 chambers and one layer of ADS PLUS fabric, demonstrated a cumulative mass TSS removal efficiency of 81.2% and a sediment mass loading capacity of 3.58 lb./ft^2 (mass capture capacity of 2.91 lb./ft^2) of geotextile fabric filtration area when operated with a driving head < 20 inches at a hydraulic loading rate of 4.13 gpm/ft^2 of geotextile fabric filtration area. The MTFR's and maximum allowable drainage area for other StormTech Isolator Row PLUS models are shown in **Table 13**.

Table 13 Isolator Row PLUS System Model Sizes and New Jersey Treatment Capacities

Model	Surface Loading Rate (gpm/ft^2) Single Chamber	Effective Filtration Treatment Area (ft^2) Single Chamber	MTFR (cfs)[1] Single Chamber	Mass Loading Capacity (lbs) Single Chamber	Mass Capture Capacity (lbs) Single Chamber	Drainage Area (acres) Single Chamber
StormTech SC-160	4.13	11.45	0.105	41.0	33.4	0.06
StormTech SC-310	4.13	17.7	0.163	63.4	51.6	0.09
StormTech SC-740	4.13	27.8	0.256	99.6	81.0	0.14
StormTech DC-780	4.13	27.8	0.256	99.6	81.0	0.14
StormTech MC-3500	4.13	42.9	0.395	153.7	125.0	0.21
StormTech MC-4500	4.13	30.1	0.277	107.8	87.7	0.15

1. Based on 4.13 gpm/ft^2 of effective filtration treatment area.
2. Drainage Area is based on the equation in the NJDEP Filter Protocol wherein drainage area is calculated by dividing the pounds of mass captured by 600 lb/acre.

6. Design Limitations

Maximum Flow Rate

The StormTech Isolator Row PLUS unit has an MTFR of 0.501 cfs (225 gpm) and an effective filtration treatment area (EFTA) of 54.5 ft^2 (loading rate 4.13 gpm/ft^2).

Slope

The StormTech Isolator Row PLUS is recommended for installation with little to no slope to ensure proper, consistent operation. Steep slopes should be reviewed by ADS/StormTech Engineering support.

Allowable Head Loss

There is an operational head loss associated with the StormTech Isolator Row PLUS. The head loss will increase over time due to the sediment loading to the system. Site-specific treatment flow rates, peak flow rates, pipe diameter, and pipe slopes should be evaluated to ensure there is appropriate head for the system to function properly.

Sediment Load Capacity

Based on laboratory testing results, the StormTech Isolator Row PLUS unit has a mass loading capacity of 195.2 lbs. while operating at a sediment removal efficiency of 81.2%; the total sediment load captured by the tested Isolator Row PLUS is 158.4 lbs.

Pre-treatment Requirements

The StormTech Isolator Row PLUS unit does not require additional pre-treatment.

Configurations

The StormTech Isolator Row PLUS is available in multiple configurations. The length and size can be adjusted to meet project specific design volumes or flow rates.

Structure Load Limitations

The StormTech Isolator Row PLUS, as part of the overall chamber system, is designed to meet the full scope of design requirements of the American Society of Testing Materials (ASTM) International specification F2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers" and produced to the requirements of the ASTM F2418 "Standard Specification for Polypropylene (PP) Corrugated Stormwater Collection Chambers". The StormTech chambers provide the full AASHTO safety factors for live loads and permanent earth loads. The ASTM F 2787 standard provides specific guidance on how to design thermoplastic chambers in accordance with AASHTO Section 12.12. of the AASHTO LRFD Bridge Design Specifications. ASTM F 2787 requires that the safety factors included in the AASHTO guidance are achieved as a prerequisite to meeting ASTM F 2418. The three standards provide both the assurance of product quality and safe structural design.

7. Maintenance Plan

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location, based upon site-specific variables. The type of land use (i.e. industrial, commercial, public, residential), anticipated pollutant load, percent imperviousness, climate, rainfall data, etc., all play a critical role in determining the actual frequency of inspection and maintenance practices.

The Isolator Row PLUS may also be part of a treatment train. By treating stormwater prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row PLUS chamber should be inspected every 6 months for the first year of operation. For subsequent years, the inspection schedule should be adjusted based upon previous observation of sediment deposition.

The Isolator Row PLUS incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the Isolator Row PLUS from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If, upon visual inspection, it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row PLUS, clean-out should be performed.

The Isolator Row PLUS was designed to reduce the cost of periodic maintenance. By "isolating" sediment to just one row of the StormTech system, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high-pressure water nozzle to propel itself down the Isolator Row PLUS while scouring and suspending sediment. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency.

Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear-facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose, allowing maintenance of an Isolator Row PLUS up to 50 chambers long. The JetVac process should only be performed on StormTech Isolator Rows PLUS that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.

Complete details of the design, operation, and maintenance of the Isolator Row PLUS can be found in the StormTech O&M Manual, available online at:
https://www.stormtech.com/download_files/pdf/11081-stormtech-isolator-row-plus-manual-07-20.pdf

8. Statements

The attached pages include signed statements from the manufacturer (Advanced Drainage Systems, Inc.), the third-party environmental consulting firm (Boggs Environmental Consultants, Inc.), and NJCAT. These statements are included as a requirement for the verification process.

June 26th, 2020

Dr. Richard S. Magee, Sc.D., P.E., BCEE
NJCAT
Center for Environmental Systems
Steven Institute of Technology
Castle Point on Hudson
Hoboken, NJ 07030-0000

Dr. Magee,

Advanced Drainage Systems is pleased to provide this letter as our statement certifying that the protocol, "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a filtration Manufactured Treatment Device" (NJDEP Filter Protocol, January 25, 2013), was strictly followed while testing our StormTech Isolator® Row PLUS. The testing was performed at BaySaver Laboratories, located in Mount Airy, MD. All data pertaining to the StormTech Isolator Row PLUS NJDEP Protocol test is included in the Verification Report.

Respectfully,

Greg Spires, PE
General Manager - StormTech
Advanced Drainage Systems
614.325.0032
greg.spires@ads-pipe.com

BOGGS ENVIRONMENTAL CONSULTANTS

Middletown, MD & Morgantown, WV

Administrative Office:
200 W Main Street
Middletown, Maryland 21769
Office (301) 694-5687
Fax (301) 694-9799

June 25, 2020

StormTech
Advanced Drainage Systems, Inc.
520 Cromwell Avenue
Rocky Hill, CT 06067
gregory.spires@ads-pipe.com

ATTENTION Greg Spires, PE
General Manager, StormTech
Advanced Drainage Systems, Inc.

REFERENCE: Third Party Review of Testing Procedures of the Isolator® Row PLUS at the
BaySaver Laboratory
1207 Park Ridge Drive
Mount Airy, MD 21771

BOGGS ENVIRONMENTAL CONSULTANTS, INC. (BEC) provided Third Party Review services for the testing of the Isolator® Row PLUS to evaluate if the required testing meets certification standards established by the New Jersey Department of Environmental Protection (NJDEP).

LABORATORY TESTING PROCEDURES & METHODOLOGIES

The following two procedures and testing requirements were followed during the testing process of the Isolator® Row PLUS:

- *New Jersey Department of Environmental Protection, Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, dated January 25, 2013.*
- *QAPP for Isolator® Row PLUS, New Jersey Department of Environmental Protection Testing,* prepared by StormTech (a subsidiary of Advanced Drainage Systems, Inc.), Revision dated January 9, 2020.

ONSITE THIRD-PARTY OBSERVATION OF TESTING PROCEDURES

BEC was present at the BaySaver Laboratory, at 1207 Park Ridge Drive, in Mount Airy, MD 21771, to observe the following testing of the Isolator® Row PLUS:

- The mixing and establishment of a sediment blend that included manufactured sands that when delivered to the feed water would result in influent Total Suspended Solids (TSS) concentrations within the established range of approximately 200 mg/L and a particle size distribution specified and approved by NJDEP;
- BEC assisted in the establishment of a Procedure Checklist to be used on each run to verify and document the following: Verify that pumps and measurement devices are turned on and functioning; Verification that the correct measurements of dry sediments are added to the doser and feed stream; Document that, background effluent, and duplicate samples are collected at established intervals during the run; and, Recording of periodic flow rates and head measurements during each run;
- Observation of Runs 1 through 16 from January 14, 2020 to February 12, 2020 and verified that that sediment, background, effluent samples were collected during each 33-minute run, and that drawdown samples were collected after the end of each run.
- After sampling was completed for each run, BEC was present for the downloading of flow data as well as sediment feed rates to verify that calculated sediment feed rates met NJDEP protocols for testing. BEC also verified that that sample containers were properly labeled and chain of custodies were filled and were boxed and sealed for delivery to Fredericktowne Labs for analysis of Total Suspended Solids (TSS).

THIRD-PARTY VERIFICATION & OPINIONS

Based on observations during the runs and the reported TSS analytical results, BEC verified the following:

- That the testing of the Isolator® Row PLUS at the BaySaver Laboratory was conducted in accordance with the *New Jersey Department of Environmental Protection, Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, dated January 25, 2013* and procedures established in Advanced Drainage Systems, Inc.'s *QAPP for Isolator® Row PLUS, New Jersey Department of Environmental Protection Testing,* prepared by StormTech (a subsidiary of Advanced Drainage Systems), Revision dated January 9, 2020.
- The report titled *NJCAT Technology Verification, of Isolator® Row PLUS,* prepared by StormTech, dated June 2020, used applicable NJCAT protocol and accurately reflects the testing observed by BEC.

BEC has no financial conflict of interest, as defined in the *Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation of Advanced Technology* (NJEP 2013).

Should you have any questions, contact our office at your earliest convenience.

Sincerely,
BOGGS ENVIRONMENTAL CONSULTANTS, INC.

William R. Warfel
Principal Environmental Scientist

Center for Environmental Systems
Stevens Institute of Technology
One Castle Point
Hoboken, NJ 07030-0000

May 1, 2020

George F. Ives III, P.E.
StormTech, LLC
520 Cromwell Ave
Rocky Hill, CT 06067

Dear Mr. Ives,

Based on my review, evaluation and assessment of the testing conducted on the StormTech , LLC Isolator Row PLUS at the BaySaver Laboratory (Storm Tech, LLC and BaySaver Technologies, LLC are subsidiaries of Advanced Drainage Systems, Inc.), under the independent third-party oversight of Boggs Environmental Consultants (BEC), Inc., the test protocol requirements contained in the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device" (NJDEP Filter Protocol, January 2013) were met or exceeded. Specifically:

Test Sediment Feed

The test blend was custom-blended using various commercially available silica sands under the oversight of BEC. The particle size distribution was independently analyzed by Environmental Consulting Services (ECS), using the methodology of ASTM method D422-63. The blended silica met the specification within tolerance as described in Section 5B of the NJDEP filter protocol and was acceptable for use.

Removal Efficiency Testing

Sixteen (16) removal efficiency testing runs were completed in accordance with the NJDEP filter protocol. The target flow rate was 225 gpm and the influent sediment concentration was 200 mg/L. The average flow rate for all 16 runs was 226.1, with a coefficient of variation (COV) below the flow compliance (COV) < 0.1 for all the runs. Likewise, for all runs the sediment feed rate COV was below the < 0.03 protocol limit. The Isolator Row PLUS demonstrated a cumulative sediment removal efficiency of 81.2% over the course of the 16 test runs.

Sediment Mass Loading Capacity

Mass loading capacity testing was conducted concurrently with removal efficiency testing. The Isolator Row PLUS has a mass loading capture capacity of 158.4 lbs (2.91 lbs/ft^2 of filtration area).

No maintenance was performed on the test system during the entire testing program.

Scour Testing

No scour testing was performed. Hence the Isolator Row PLUS is verified for off-line installation only.

Sincerely,

Richard S. Magee, Sc.D., P.E., BCEE

Specifications

Introduction

- Manufacturer – StormTech, LLC, 520 Cromwell Ave, Rocky Hill, CT 06067
- Website: http://www.StormTech.com. Phone: 888-892-2694
- MTD – StormTech Isolator Row PLUS verified models are shown in **Table 13**
- TSS Removal Rate – 81.2%
- Off-line installation

Detailed Specification

• NJDEP sizing tables and physical dimensions of StormTech Isolator Row PLUS verified models are shown in **Table 13**. These sizing tables are valid for NJ following NJDEP Water Quality Design Storm Event of 1.25" in 2 hours (NJAC 7:8-5.5(a)).

• Maximum inflow drainage area

  ° The maximum inflow drainage area is governed by the maximum treatment flow rate of each model as presented in **Table 13**.

• Driving head will vary for a given Isolator Row PLUS model based on the site-specific configuration. The maximum head without bypass is 36”, but the minimum head varies depending on the flow rate through the unit. Design support is given by StormTech for each project, and site-specific drawings (cut sheets) will be provided that show pipe inverts, finish surface elevation, and peak treatment and maximum flow rates through the unit.

• The drawdown flow exits via the underdrain. A clean filter draws down in approximately 20 minutes.

StormTech®

Detention - Retention - Water Quality

Division of ADS

STORMTECH ISOLATOR ROW SIZING CHART					
	SC-310	SC-740	DC-780	MC-3500	MC-4500
Chamber Area (Sq.Ft.)	20	27.8	27.8	43.2	30.1
Treated Flow Rate per chamber (CFS)	0.11	0.15	0.15	0.24	0.17

NOTE: *Testing of the Isolator Row completed by Tennesse Tech has been verified by NJCAT and it has shown to have a TSS removal efficiency of 84% for SIL-CO-SIL 250*

NJCAT verified Treated Flow Rate (GPM / Sq.Ft.) 2.5

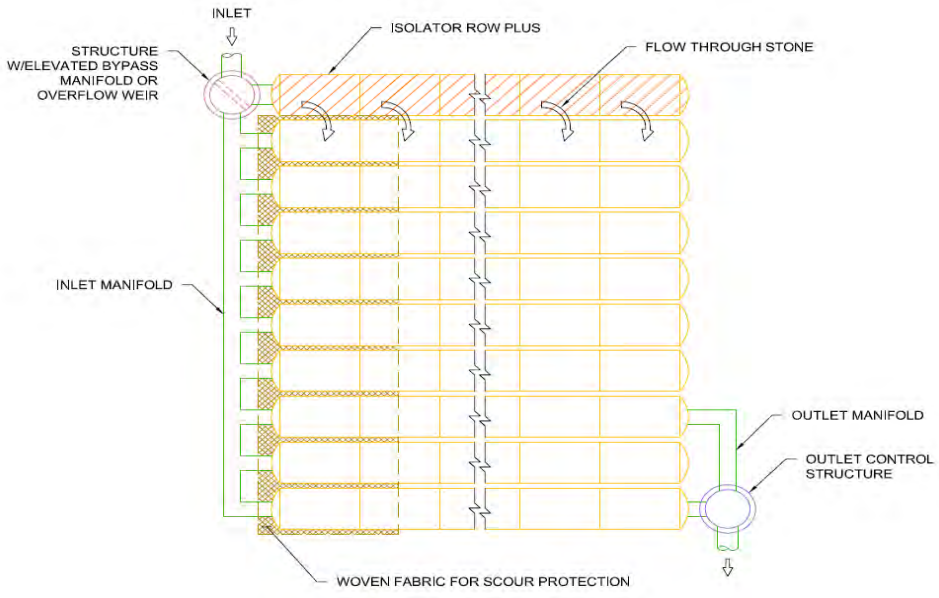
StormTech Isolator Row PLUS – Pollutant Removal

The following information is intended to provide a general overview of the pollutant removal capability of the StormTech Isolator™ Row PLUS, which is a patented filtration type BMP manufactured by StormTech, LLC. The StormTech Isolator Row PLUS is covered under several US and International patents.

I. Description:

The StormTech Isolator Row PLUS is a row or rows of thermoplastic chambers that sit on a layer of ADS PLUS fabric and are connected to a closely located structure for easy access. The chambers provide for settling and filtration of sediment and other contaminants as stormwater rises in the Isolator Row PLUS and ultimately passes through the fabric. The open-bottom chambers allow stormwater to flow out of the chambers. Sediment is captured in the Isolator Row PLUS, protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

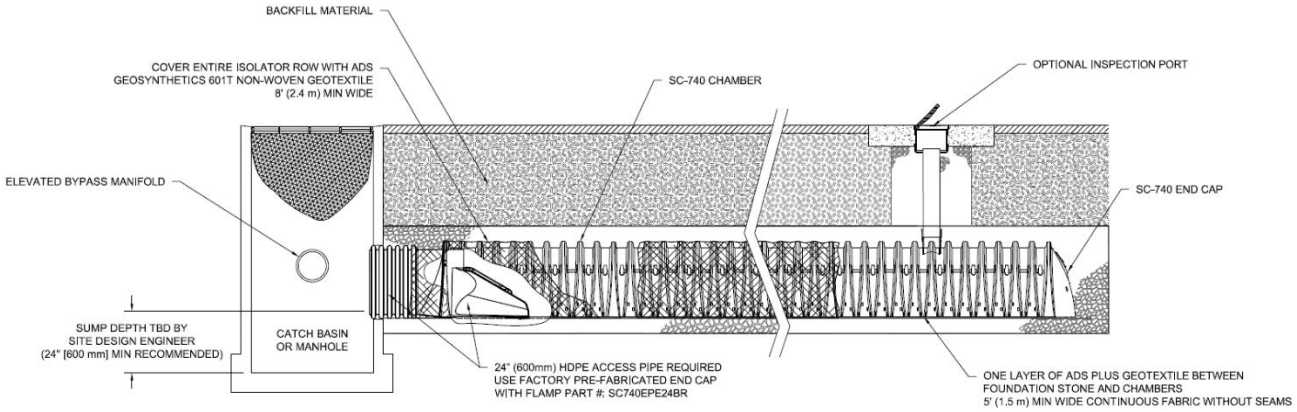
The StormTech Isolator Row PLUS is designed to capture the "first flush" and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole not only provides access to the Isolator Row but includes a high low/concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row bypass through a manifold to the other chambers. This is achieved with either a high-flow weir or an elevated manifold. This creates a differential between the Isolator Row PLUS and the manifold, thus allowing for settlement time in the Isolator Row PLUS.



Schematic of the StormTech Isolator Row PLUS System

Some of the unique features of the Isolator Row that contribute to its effectiveness and practicality include:

- Vast filtration surface area
- Large sediment storage volume
- Easily maintainable by most pipe and sewer maintenance companies
- Large network of ADS personnel that can help with designs and provide onsite guidance
- A state-of-the-art structural design that meets ASTM standards and incorporates AASHTO safety factors for both live loads and permanent dead loads



Isolator Row PLUS Cross Section Detail

II. Applicable Sites:

The Isolator Row PLUS can be effectively used for essentially all developed sites. The most common applications are highly impervious sites such as paved parking areas, roads as well as developed sites that include grassy or other landscaped areas. It is not intended to be used for construction sediments.

III. StormTech System & Isolator Row Testing:

October 2006 – Tennessee Tech University's Civil and Environmental Department prepared the "Performance Evaluation of Sediment Removal Efficiency – StormTech Isolator Row". Testing on a full-scale Isolator Row in a laboratory was done to determine the sediment removal efficiency with two different silica-water slurries in accordance with NJCAT protocols. In August of 2007, the technology was verified by NJCAT. Results are shown in Table 1.

September 2010 – The University of New Hampshire Stormwater Center released the "Final Report on Field Verification Testing of the StormTech Isolator Row Treatment Unit". Testing consisted of determining the water quality performance for multiple stormwater pollutants in accordance with TARP Tier II protocol. Testing was done for a system only consisting of the StormTech Isolator Row. Data was recorded for 23 storm events. Results are shown in Table 1.

January 2020 – BaySaver Technologies prepared the "NJCAT Technology Verification of Isolator Row PLUS". Testing on a full-scale Isolator Row PLUS in a laboratory was done to determine the sediment removal efficiency with a silica-water slurry in accordance with the updated NJCAT protocols. In July of 2020, the technology was verified by NJCAT. Results are shown in Table 1.

June 2020 – North Carolina State University Department of Biological and Agricultural Engineering prepared the technical report "An Evaluation of the StormTech Isolator Row and Subsurface Stormwater Management System at Capital Oaks Retirement Resort, Raleigh, North Carolina". 14 months of monitoring and over 73 precipitation events were completed to study the hydrologic and water quality performance of a StormTech MC-4500 system in Raleigh, NC. Results are shown in Table 1.

Table 1: StormTech Isolator Row 3rd Party Pollutant Removal Efficiency Data

Pollutant	University of New Hampshire (Isolator Row Only) Median	Raleigh, North Carolina (StormTech system with Isolator Row)	Tennessee Tech University (Isolator Row Only)	NJCAT Verification (Isolator Row PLUS only)
Total Suspended Solids	83%*	91%*	84%*	81%**
Total Phosphorus	33%	68%	Not Tested	Not Tested
Total Nitrogen	Not Tested	35%	Not Tested	Not Tested
Total Zinc	81%	Not Tested	Not Tested	Not Tested
Total Petroleum Hydrocarbons	91%	Not Tested	Not Tested	Not Tested

*Based on a flow rate of 2.5 gpm/sf (Isolator Row)
** Based on a flow rate of 4.1 gpm/sf (Isolator Row PLUS)

IV. Product Performance and Design

Minimum 80% TSS removal is achieved by sizing the Isolator Row PLUS to treat the water quality at a specific flow rate per chamber floor area using a single layer of ADS PLUS fabric. The design flow rates for each chamber size are listed below.

Model	Specific Flow Rate	Bottom Area	Flow Per Model
StormTech SC-160LP	4.1 gpm/sf	11.45 sf	0.11 cfs
StormTech SC-310	4.1 gpm/sf	17.7 sf	0.16 cfs
StormTech SC-740	4.1 gpm/sf	27.8 sf	0.26 cfs
StormTech DC-780	4.1 gpm/sf	27.8 sf	0.26 cfs
StormTech MC-3500	4.1 gpm/sf	42.9 sf	0.40 cfs
StormTech MC-4500	4.1 gpm/sf	30.1 sf	0.28 cfs

V. StormTech Isolator Row Approvals:

The StormTech Isolator Row and Isolator Row PLUS have been approved on a project by project basis for tens of thousands of projects around the world. Following are some examples:

- The Isolator Row PLUS is a verified filtration manufactured treatment device by the New Jersey Corporation for Advanced Testing (NJCAT) in accordance with NJDEP Filter Protocols.
- In Ohio, the Isolator Row is approved per the Ohio EPA as a pretreatment to underground storage and can be used for both storage volume and pretreatment as the water quality volume all passes through the Isolator Row.
- The Metropolitan St. Louis Sewer District (MSD) has approved the StormTech Isolator Row as a standalone post-construction stormwater Best Management Practice.
- In Massachusetts, approvals for the State DEP requirement of 80% TSS removal on an annual load basis are issued at the Conservation Commission level, and the Isolator Row is commonly used to meet these criteria.
- In Oregon, the Rogue Valley Storm Water Advisory Team (SWAT) has incorporated the StormTech Isolator Row into their Stormwater Design Manual as a pre-approved proprietary device for stormwater quality treatment.
- The Kansas City Metro Chapter of the American Public Works have included the StormTech Isolator Row wit a value rating of 3.0 in their Manual of Best Management Practices for Stormwater Quality.
- Maine DEP has approved the Isolator Row pollutant removal efficiency based on laboratory testing of 110 micron (US Silica OK-110) particle size
- In Texas, the City of Houston PWE as well as Harris county, has recognized the Isolator Row as an official water quality device.
- Under the New Environmental Technology Evaluation program, the Ontario (Canada) Ministry of the Environment has evaluated the Isolator row and issued a Certificate of Technology Assessment
- The Isolator Row PLUS is currently being evaluated for Canadian Environment Technology Verification (ETV) by VerifiGlobal.

V. Isolator Row Maintenance:

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location, based upon site-specific variables. The type of land use (i.e. industrial, commercial, public, residential), anticipated pollutant load, percent imperviousness, climate, rainfall data, etc., all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection schedule should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If, upon visual inspection, it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediment to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout.

Maintenance is accomplished with the jetvac process. The jetvac process utilizes a high-pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediment. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/jetvac combination vehicles. Selection of an appropriate jetvac nozzle will improve maintenance efficiency.

Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear-facing jets with an effective spread of at least 45" are best. Most jetvac reels have 200 feet of hose, allowing maintenance of an Isolator Row up to 50 chambers long. The jetvac process shall only be performed on StormTech Isolator Rows that have fabric specified by StormTech over their angular base stone.

Complete details of the design, operation, and maintenance of the Isolator Row PLUS can be found in the StormTech Isolator Row and Isolator Row PLUS O&M Manuals.

4.4 RIP RAP SPLASH PAD

Rip rap splash pads are designed to dissipate energy, prevent scour at the stormwater outlet, and minimize the potential for downstream erosion. A riprap splash pad was sized for each of the outlets of the drainage system. The calculations below are in accordance with the methodology of the "2002 Connecticut Guidelines for Soil Erosion and Sediment Control" produced by The Connecticut Council on Soil and Water Conservation.

Rip-Rap Outlet Sizing Calculations							
	Q	Do	TW	La	W	d50	
	(cfs)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(in.)
FES F1	0.6	1.00	0.30	8.95	11.95	0.03	0.37
FES F2	0.4	1.00	0.30	8.70	11.70	0.02	0.24

Conclusion:

As identified above, the discharge points have been designed to accommodate and exceed the required minimum rip-rap stone sizing.

4.5 TSS REMOVAL

The project has been designed to comply with the required 80% TSS (minimum) removal per the Massachusetts Stormwater Regulations. Various combinations of stormwater BMPs including deep sump hooded catch basins, proprietary water quality units and an infiltration basin.

Please refer to the attached TSS calculation sheets that follow:

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: CB A1, CB A2, CB A3, UG-1

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Infiltration Basin (ADS Isolator Row Chamber System)	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.03**	**0.00**	**0.15**
	0.00	**0.03**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: **Massapoag, Weymouth**

Prepared By: **SZA**

Date: **Revised 1/4/22**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: CB A4, CB A5, UG-2

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
UG-1 Infiltration Basin (ADS Isolator Row Chamber System)	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.03**	**0.00**	**0.15**
	0.00	**0.03**	**0.00**	**0.15**

Total TSS Removal = **85%**

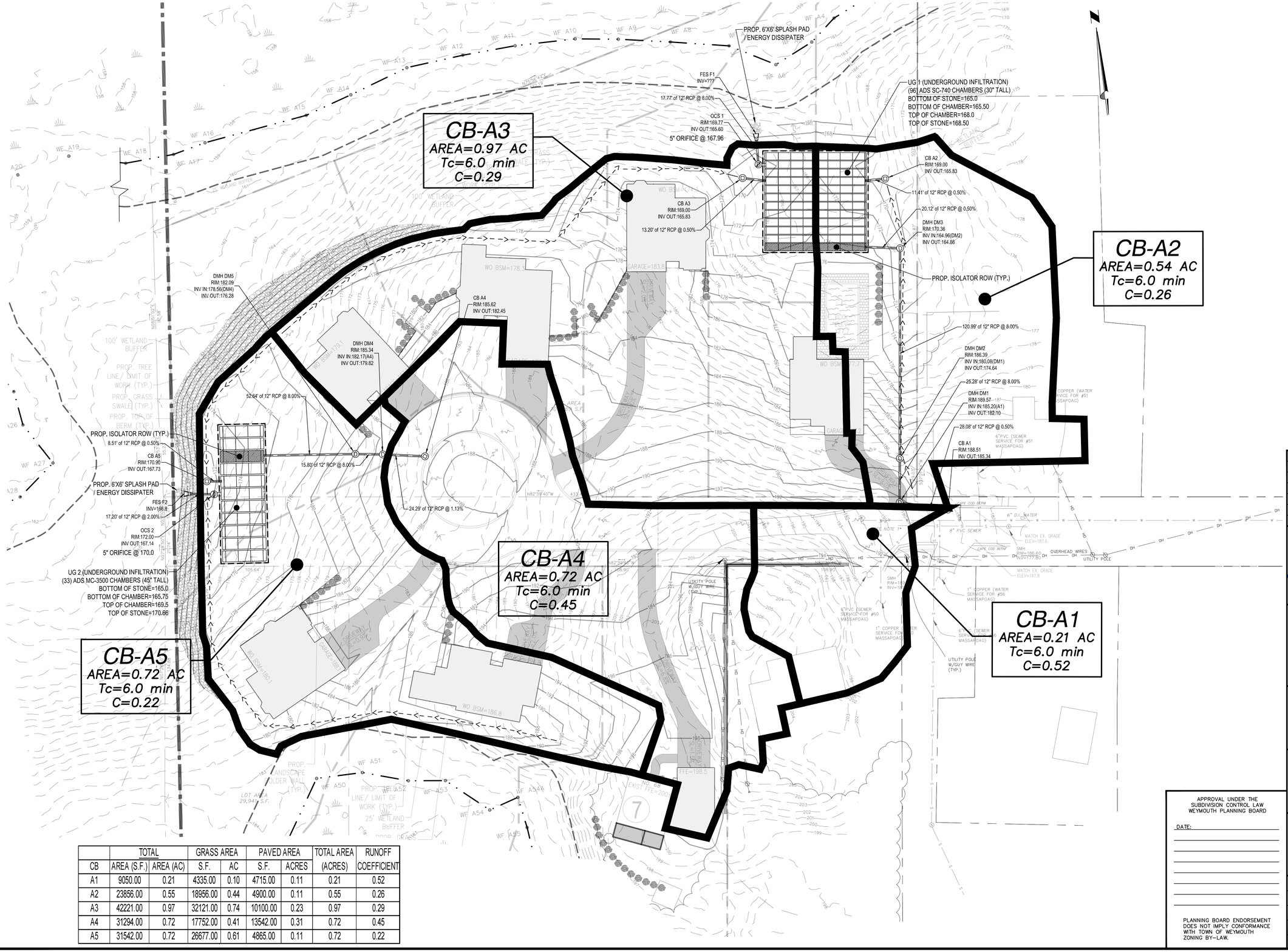
Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Massapoag, Weymouth**

Prepared By: **SZA**

Date: **Revised 1/4/22**

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



	TOTAL		GRASS AREA		PAVED AREA		TOTAL AREA	RUNOFF
CB	AREA (S.F.)	AREA (AC)	S.F.	AC	S.F.	ACRES	(ACRES)	COEFFICIENT
A1	9050.00	0.21	4335.00	0.10	4715.00	0.11	0.21	0.52
A2	23856.00	0.55	18956.00	0.44	4900.00	0.11	0.55	0.26
A3	42221.00	0.97	32121.00	0.74	10100.00	0.23	0.97	0.29
A4	31294.00	0.72	17752.00	0.41	13542.00	0.31	0.72	0.45
A5	31542.00	0.72	26677.00	0.61	4865.00	0.11	0.72	0.22

FOR REGISTRY USE ONLY

Date	Description	No.
	Revisions	
1.11.22	REVISED PER DPW COMMENTS	3.
11.19.21	REV. PER CON. COMM. AND TOWN ENG. COMMENTS	3.
4.23.20	REVISED PER TOWN STAFF COMMENTS	2.
2.05.19	REVISED WETLAND FLAGS AND LOT	1.

COMMONWEALTH OF MASSACHUSETTS
GABRIEL R. CROCKER
CIVIL
No. 47917
REGISTERED PROFESSIONAL ENGINEER

1-11-2022

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

CROCKER DESIGN GROUP, LLC.

2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-820-0416

MASSACHUSETTS

Project

DEFINITIVE SUBDIVISION PLAN

MASSAPOAG STREET
WEYMOUTH, MA

Prepared for

WEATHERVANE MASSAPOAG, LLC.

190 OLD DERBY STREET, SUITE 311
HINGHAM, MA 02043

Drawing Title

PROPOSED SUBCATCHMENT AREA PLAN

APPROVAL UNDER THE SUBDIVISION CONTROL LAW WEYMOUTH PLANNING BOARD

DATE:

PLANNING BOARD ENDORSEMENT DOES NOT IMPLY CONFORMANCE WITH TOWN OF WEYMOUTH ZONING BY-LAW.

Project No.	100-029
Date	12.20.2018
Scale	1"=25'
Drawn By	SZA
Approved By	GC

Drawing No.

PW-2

SECTION 5 – LONG TERM OPERATION & MAINTENANCE

LONG-TERM STORMWATER OPERATION & MAINTENANCE PLAN
MASSAPOAG STREET – DEFINITIVE SUBDIVISION

12/21/2018
Revised 1/5/2022

PROJECT OVERVIEW:

The proposed project consists of construction of a seven (7) lot residential subdivision. The project has been designed to comply with the Massachusetts Stormwater Management Regulations.

Appended to this document is a sample maintenance form and a chart describing the anticipated frequency of tasks.

OWNER AND RESPONSIBLE PARTY:

Applicant/Developer
Bristol Bros. Development Corp
190 Old Derby Street, Suite 311
Hingham, MA 02043

Bristol Bros. Development Corp. plans on creating a Homeowners Association which will include personnel who will be responsible for maintenance of the stormwater management system. For any service beyond their service ability, they subcontract to the appropriate vendors such as street sweeping and catch basin and water quality cleaning, etc.

CONSTRUCTION MANAGEMENT:

A construction manager with adequate knowledge and experience on projects of similar size and scope shall be employed to oversee all site work related construction. The contractor shall incorporate the appropriate techniques to control sediment and erosion pollution during construction in accordance with the *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas* and any conditions of approval from the local conservation commission.

Care should be taken when constructing stormwater control structures. Light earth-moving equipment shall be used to excavate in the vicinity of the infiltration areas. Use of heavy-equipment causes excessive compaction of the soils beneath the basin resulting in reduced infiltration capacity. At no time shall temporary infiltration areas or settling basins be constructed in the vicinity of the proposed infiltration basins in order to prevent the soils from becoming clogged with sediment.

ON-GOING MAINTENANCE CONTRACT

The non-structural and structural approaches recommended below, as well as the required BMP maintenance, will be completed by Bristol Bros. Development Corp.'s contractor, JF Price Co. In Adequate personnel with appropriate training and access to proper equipment will be available to complete the tasks. Future responsible parties must be notified of their responsibility to operate and maintain the system in perpetuity.

MAINTENANCE LOG

The Responsible Party shall develop and maintain a log of inspections, maintenance, repairs, and disposal (including location of disposal) during the life of the project. Records will be maintained for at least 3 years and be made available to the Town of Weymouth in accordance with the provisions of the Massachusetts Stormwater Handbook. A sample of such a maintenance log is provided.

STORMWATER BMP MAINTENANCE

The proposed stormwater management system has been designed with appropriate BMPs aimed at reducing the pollutants discharge based upon the intended use of the property. All BMPs require regular maintenance to function as intended. Some management measures have simple maintenance requirements; others are more involved. The Responsible Party must have all BMPs regularly inspected to ensure they are operating properly on an as needed basis, including during runoff events exceeding 0.5 inches of rainfall.

A description of the non-structural and structural approaches to be incorporated is indicated below. The following best management practices are proposed to be incorporated into the stormwater management design to reduce source runoff and improve stormwater runoff discharge quality. The Responsible Party will regularly inspect all BMPs to ensure they are operating properly. If any deficiencies are identified during these inspections, action to resolve it will be initiated and documented on the maintenance log.

STRUCTURAL BMPs

Deep Sump Hooded Catch Basins/Yard Drains

On a regular basis the inlet pipe and outlet pipe shall be checked for debris and removed as necessary to ensure unobstructed flow of water. Inspections shall occur at least twice annually, once in the fall and then in the spring after the snow melts. Inspections shall verify the tees are secure and free flowing. Depth of sediment below water line. Basins are to be cleaned whenever sediment and hydrocarbons are observed. Basins shall be cleaned using a vacuum pump. All liquid shall be pumped from the sump of each basin at

least once per year. All sediments and hydrocarbons should be properly handled and disposed of in accordance with local, state and federal guidelines and regulations.

Subsurface Infiltration System

The subsurface system (Stormtech ADS Isolator Row Plus, with an impermeable barrier) has been designed with a combination of standard manholes and inspection ports to aid in the removal of sediment and debris. Preventative maintenance shall be performed in accordance with manufacturer's instructions, which is enclosed in this section. Stormtech suggests a minimum of annual inspections and initially the isolator row should be inspected every 6 months for the first year of operation. Cleaning will take place at the completion of construction and as deemed necessary based on the annual inspections. Stormtech recommends using a JetVac to clean and maintain the isolator row. Refer to the enclosed "Stormtech Isolator Row O&M Manual."

NON-STRUCTURAL BMPs

Pavement Sweeping

As street sweeping is a BMP under DEP guidelines, this non-structural BMP is an effective removal of Total Suspended Solids (TSS) in a comprehensive stormwater management program. Litter and debris is to be regularly picked up and removed from the pavement. Paved areas are to be swept a minimum of two times per year, at least once during April and again in September. This BMP is not needed to meet the 80% TSS removal requirement.

Pervious Areas and Slopes

Wherever possible, runoff from paved areas and snowmelt shall be directed over vegetated areas to promote settlement of suspended solids before entering a wetland or resource area. Steep pervious slopes will be permanently vegetated to dissipate energy and reduce potential erosion. No constructed vegetated slopes should exceed 2H:1V. Slopes exceeding 2:1 shall be stabilized with rip-rap or other similar measures to minimize the potential for future erosion. Irrigation system(s) shall be designed and maintained such that water is not applied to/or allowed to run off onto any impervious surfaces. Although overspray or runoff may be unavoidable during periods of high winds. In the event of accidental damage to system components or other unusual circumstances the system components shall be promptly corrected. Maximum of 1 inch of irrigation water will be applied to irrigated areas per week.

Conveyance Swale

Inspect conveyance swales the first few months after construction to make sure that there is no rilling or gullying and that vegetation in the channels is adequate. Thereafter, inspect the channel twice a year for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding and sediment accumulation. Regular

maintenance tasks include mowing, fertilizing, liming, watering, prunin, weeding, and pest control. Mow at least once per year but do no cut the grass shorter than three to four inches. Keep grass height under 6 inches to maintain the design depth necessary to serve as a conveyance. Do not mow excessively, because it may increase the design flow velocity. Remove sediment and debris manually at least once per year. Reseed periodically to maintain the dense growth of grass vegetation.

Drainage Control Structures, Flared End Sections, Trash Racks, Riprap Pads, Swales, and/or Level Spreader Splash Pads

Basin control structures, flared end sections, trash racks, riprap pads and level spreader splash pads shall be inspected and any debris or growth surrounding or within these structures shall be removed. Any/all debris or vegetation encroaching on the control structures our outfall components shall be removed or appropriately trimmed back to maintain the designed control elevation and flow patterns/cross section without impediment. Inspection should occur twice annually, once in the fall and then in the spring after the snow melts. Cleaning will take place at the completion of construction and as deemed necessary based on the inspections and manufacturer's requirements.

Fertilizers

Use of fertilizers shall follow the requirements of 330 CMR 31.0.

Waste Management

Solid waste and recycling will be contained in garbage cans maintained at each residence for routine and regular trash pickup. Waste deposition in the receptacles will be consistent with state and local regulations.

Snow Removal

There shall be no plowing of stockpiling of snow within any resource areas or buffers. Typically, a combination of plowing and/or snow blowing is utilized on the individual driveways and a snow blowing "bobcat" is used to clear the sidewalks. Deicing compounds must be stored or sheltered on impervious pads (i.e. in residential garages and the maintenance facility). Snow that is plowed from the paved driveway surfaces shall be plowed to the edges of the pavement. If capacity of these areas is exceeded, accumulated snow shall be removed.

Stormwater BMP Inspection and Maintenance Log

Facility Name	
Address	
Begin Date	End Date

Date	BMP ID#	BMP Description	Inspected by:	Cause for Inspection	Exceptions Noted	Comments and Actions Taken

Instructions: Record all inspections and maintenance for all treatment BMPs on this form. Use additional log sheets and/or attach extended comments or documentation as necessary. Submit a copy of the completed log with the annual independent inspectors' report to the municipality and start a new log at that time.

BMP ID# — Always use ID# from the Operation and Maintenance Manual.

Inspected by — Note all inspections and maintenance on this form, including the required independent annual inspection.

Cause for inspection — Note if the inspection is routine, pre-rainy-season, post-storm, annual, or in response to a noted problem or complaint.

Exceptions noted — Note any condition that requires correction or indicates a need for maintenance.

Comments and actions taken — Describe any maintenance done and need for follow-up.

Stormwater BMP Inspection Matrix

Conventional & LID Best Management Practices	**Inspection & Maintenance Frequency**	**Erosion& Scour**	**Obstructions**	**Trash & Debris**	**Sediment Build-Up Removal**	**Vegetation Cover**	**Remove/Reset Filter Fabric & Stone As Required**	**Vac Truck Sediment & Contaminants**	**Remove/Reset Riprap as Required**
Catch Basins/Area & Yard Drains	Four times per year								
Pavement Sweeping	Four times per year								
Stone Trench	Twice-Annually (Spring and Fall)								
Subsurface Infiltration Chambers	Twice-Annually (Spring and Fall)								
Conveyance Swale	Twice-Annually (Spring and Fall)								
Outlets (FES, Rip Rap Pad, Level Spreaders)	Twice-Annually (Spring and Fall)								

StormTech
Detention • Retention • Water Quality
An ADS company

Isolator® Row O&M Manual

THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™

ADS®

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160LP, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

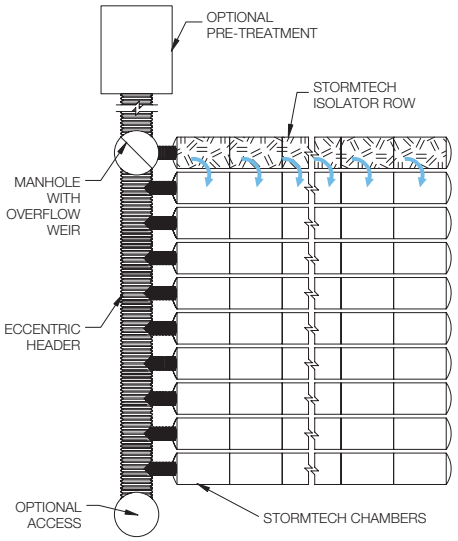
The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

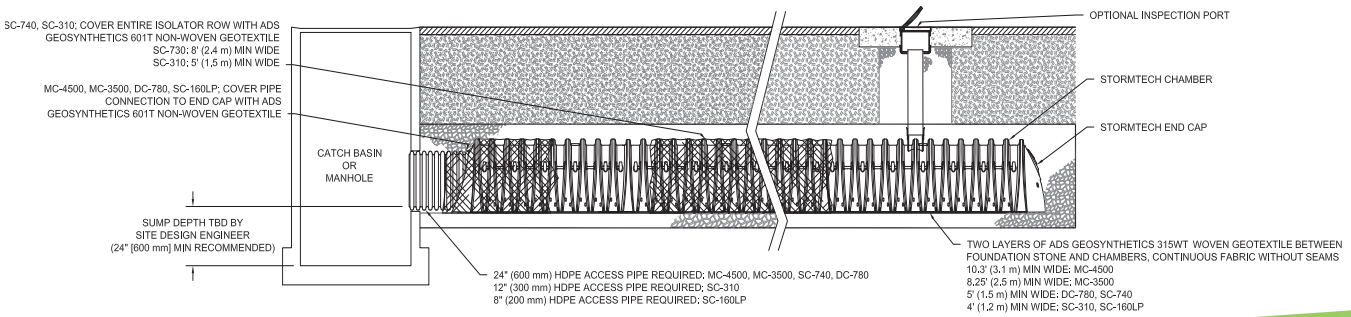
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



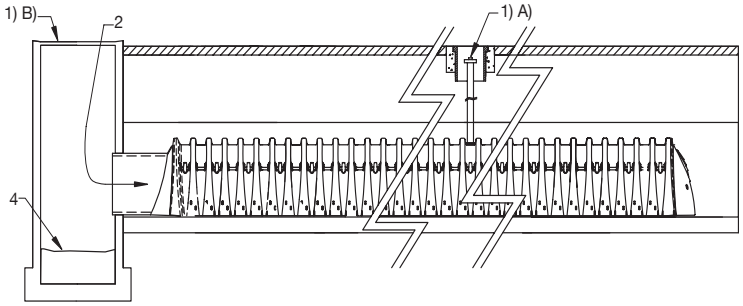
ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1
Inspect Isolator Row for sediment.
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2
Clean out Isolator Row using the JetVac process.
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

STEP 3
Replace all caps, lids and covers, record observations and actions.

STEP 4
Inspect & clean catch basins and manholes upstream of the StormTech system.



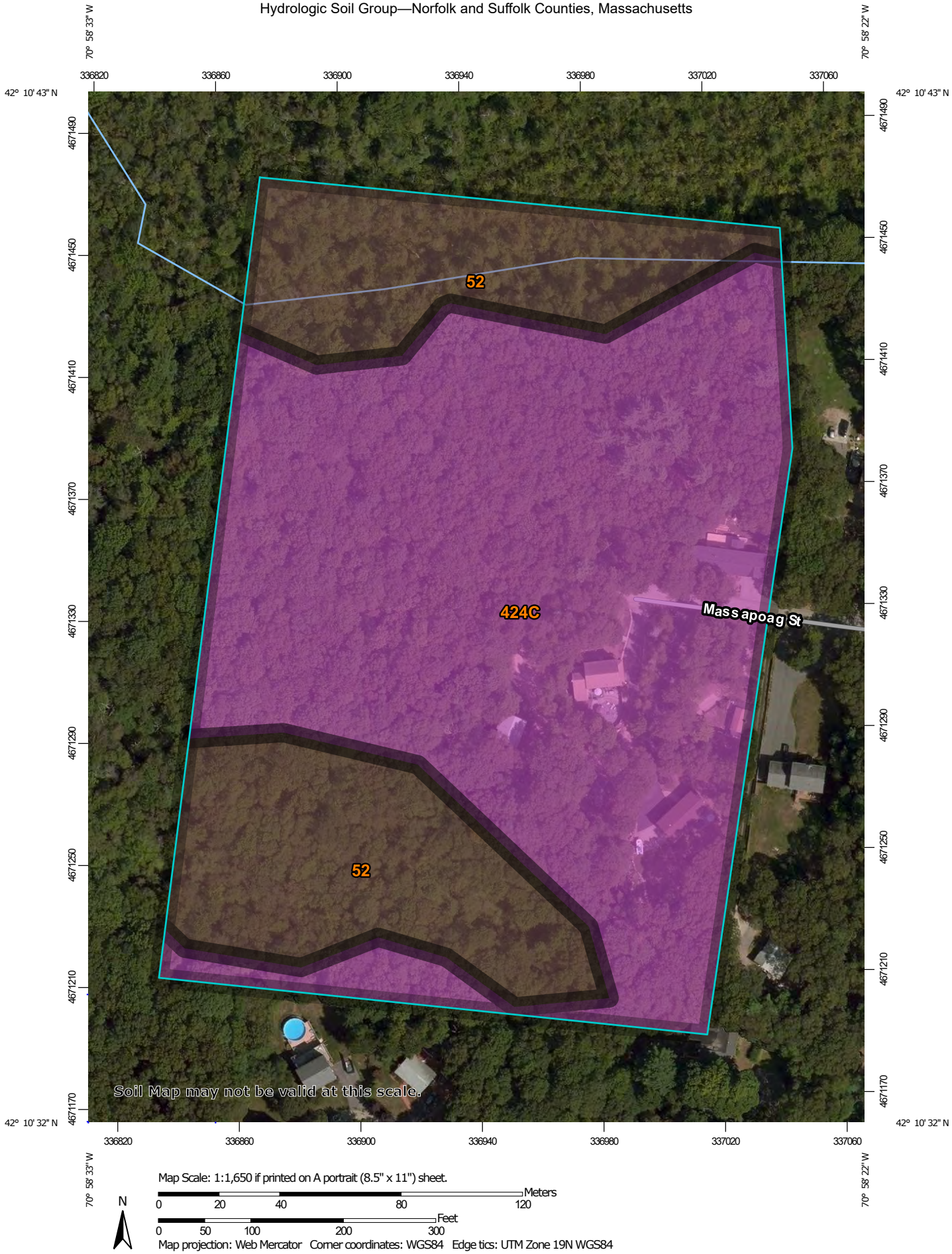
SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

StormTech® Detention • Retention • Water Quality
A division of ADS

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

SECTION 6 – SOILS TESTING DATA



Map Scale: 1:1,650 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 13, Oct 6, 2017

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

Date(s) aerial images were photographed: Aug 26, 2014—Sep 4, 2014

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52	Freetown muck, 0 to 1 percent slopes	B/D	3.7	30.9%
424C	Canton fine sandy loam, 8 to 15 percent slopes, extremely bouldery	A	8.3	69.1%
Totals for Area of Interest			**12.0**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: MS 3-9

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3'	A	10YR 2/2	—	—	—	Sandy Loam	Cl	Cl	Blocky	Soft	
3-20'	B	10YR 5/6	—	—	—	Sandy loam	Cl	Cl	Massive	Soft	
20'-40'	C	10YR 5/4	-	-	-	Loamy Sand	Cl	Cl	Massive	Loose	

Additional Notes:

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: MS 3-3

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3"	A	10YR 2/2	—	—	—	Sandy loam	<1%	<1%	Blocky	Soft	
3-20"	B	10YR 5/6	—	—	—	Sandy loam	<1%	<1%	Massive	Soft	
20+90"	C	10YR 6/4	—	—	—	Loamy Sand	5%	2%	Massive	Loose	

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: MS 3-8

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3"	A	10YR 2-2	—	—	—	Sandy Loam	—	1%	Blocky	Soft	
3"-18"	B	10YR 5/6	—	—	—	"	1%	2%	Massive	Soft	
18-81"	C	10YR 5/4	—	—	—	Loamy Sand	2%	5%	Massive	Loose	

Additional Notes:

Surface Boulders

Refusal @ 81"

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: MS-3-6

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3	A	10YR 2/2	~~0-3~~	—	—	Sandy loam	—	1%	Blocky	Soft	
3-20"	B	10YR 5/1	—	—	—	Sandy loam	<1%	2%	Massive	Soft	
20"-24"	C	10YR 5/4	—	—	—	Sandy loam	1%	2%	Massive	Soft	

Additional Notes:

All Access has loose Surface Boulders

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: MS 3-5

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3'	A	10YR 2/2	–	–	–	Sandy Loam	–	1%	Block	SoN	
3'-23'	B	10YR 5/6	–	–	–	Sandy loam	–	–	Massive	SoN	
23-67'	C	10YR 5/4	–	–	–	Sandy loam	2%	2%			

Additional Notes:

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: MS 3-4

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3"	A	10YR 2/2	—	—	—	Sandy loam	—	<1%	Blocky	Soft	
3"-18"	B	10YR 4/6	—	—	—	Sandy loam	<1%	<1%	Massive	Friable	
18"+36"	C	10YR 5/4	—	—	—	Sandy loam	10%	0%	Massive	Soft/Loose	

Additional Notes:

Refusal, large Bedrock/Ledge
water and mottling NOT observed

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: MS 3-3

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3"	A	10YR 2/2	—	—	—	Sandy Loam	—	1%	Blocky	Soft	
3"-25"	B	10YR 4/6	—	—	—	Sandy Loam	<1%	<1%	Mass	Soft	
25"-88"	C1	10YR 5/4	36"	10YR 5/2	20%	Sandy Loam	2%	<1%	Massive	Firm	
51"-88" C2	C2	10YR 4/4	—	—	—	Loamy Sand	2%	2%	Mass	Loose	

Additional Notes:

water @ 56"

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: MS 3-2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-4"	A	10 YR 3/2	—	—	—	Sandy Loam	—	1%	Block	Soft	
4"-22"	B	10 YR 4/6	—	—	—	Sandy Loam	2%	5%	Block	Soft	
22"-110"	C	10 YR 5/4	—	—	—	Sandy loam	5%	10%	Massive	Soft	

Additional Notes:

No water observed @ 110"

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

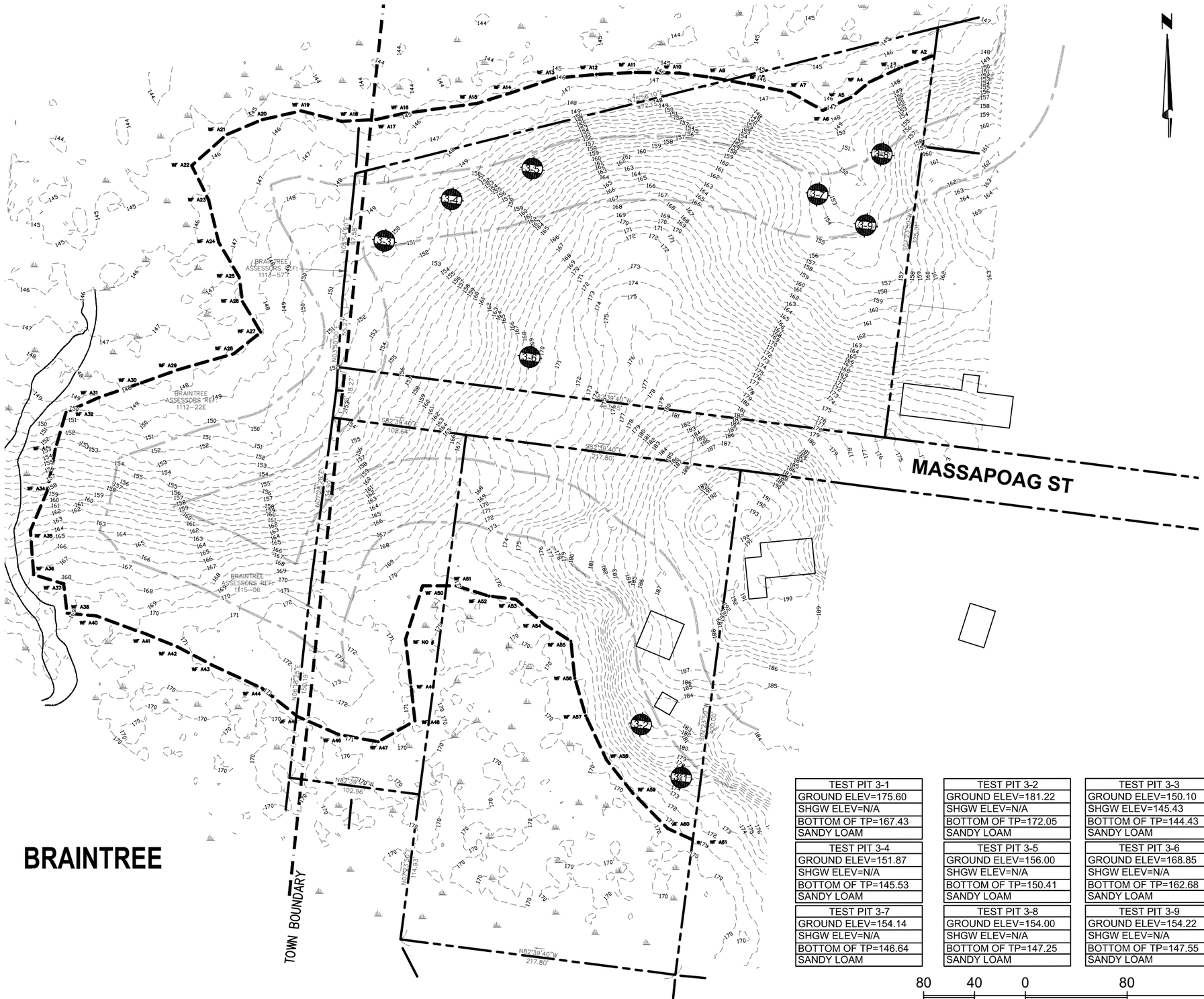
C. On-Site Review (continued)

Deep Observation Hole Number: MP 3-1

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-53"	A	10YR 3/2	-	—	-	Loamy Loam	10%	20%	Blocky	So √V	
53"-87"	B	10YR 4/1	—	—	—	Sand Loam	10%	20%	Blocky	So √V	
87-18"	C	10YR 5/1	-	—	—	Sandy Loam	5%	10%	Massive	So NV	

Additional Notes:

Looks Like Fill, Trash Deep in Profile
B and C appear Natural



TEST PIT 3-1
GROUND ELEV=175.60
SHGW ELEV=N/A
BOTTOM OF TP=167.43
SANDY LOAM

TEST PIT 3-2
GROUND ELEV=181.22
SHGW ELEV=N/A
BOTTOM OF TP=172.05
SANDY LOAM

TEST PIT 3-3
GROUND ELEV=150.10
SHGW ELEV=145.43
BOTTOM OF TP=144.43
SANDY LOAM

TEST PIT 3-4
GROUND ELEV=151.87
SHGW ELEV=N/A
BOTTOM OF TP=145.53
SANDY LOAM

TEST PIT 3-5
GROUND ELEV=156.00
SHGW ELEV=N/A
BOTTOM OF TP=150.41
SANDY LOAM

TEST PIT 3-6
GROUND ELEV=168.85
SHGW ELEV=N/A
BOTTOM OF TP=162.68
SANDY LOAM

TEST PIT 3-7
GROUND ELEV=154.14
SHGW ELEV=N/A
BOTTOM OF TP=146.64
SANDY LOAM

TEST PIT 3-8
GROUND ELEV=154.00
SHGW ELEV=N/A
BOTTOM OF TP=147.25
SANDY LOAM

TEST PIT 3-9
GROUND ELEV=154.22
SHGW ELEV=N/A
BOTTOM OF TP=147.55
SANDY LOAM

Date	Description	No.
	Revisions	

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

CROCKER DESIGN GROUP, LLC.

11 THREE RING RD
SCITUATE, MA 02066
P: 781-820-0416

MASSACHUSETTS MARYLAND FLORIDA RHODE ISLAND

Project

PRELIMINARY PLAN

MASSAPOAG ST.
WEYMOUTH, MA

Prepared for

BRISTOL BROS. DEVELOPMENT CORP.

190 OLD DERBY STREET, SUITE 311
HINGHAM, MA 02043

Drawing Title

TEST PIT PLAN

Project No.	100-029
Date	4.26.2018
Scale	1"=80'
Drawn By	SZA
Approved By	GC

Drawing No.

TP-1

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-1 (Hole #) | 12/28/21 (Date) | 8 AM (Time) | OVERCAST (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use _____ (e.g., woodland, agricultural field, vacant lot, etc.) | _____ Vegetation | _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) | _____ Slope (%)

   Description of Location: _____

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

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Wetlands _____ feet
   Property Line _____ feet | Drinking Water Well _____ feet | Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-12"	B	LS	10YR 5/6	-	-	-	-	-	MASSIVE	FRIABLE	
12"-126"	C	COARSE SAND	10YR 5/3	-	-	-	20-40%	-	SG	LOOSE	with fines & silts. 108" black layer about 3"
											water sweating @ 108"

Additional Notes: WATER OBSERVED AT 9'

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-2 (Hole #) | 12/28/21 (Date) | 10 AM (Time) | OVERCAST (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

   Description of Location: _____

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

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Wetlands _____ feet
   Property Line _____ feet | Drinking Water Well _____ feet | Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-64"	B	LS	10YR 5/6	-	-	-	-	-	MASSIVE	FRIABLE	
64"-126"	C	COARSE SAND	10YR 5/3	-	-	-	10%	-	SG	LOOSE	72" BLACK LAYER ABOUT 3" THICK
											WATER SWEATING/ WEEPING AT 6'

Additional Notes: WATER OBSERVED AT 6'

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-3 (Hole #) | 12/28/21 (Date) | 11 AM (Time) | OVERCAST (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

   Description of Location: _____

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

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Wetlands _____ feet
   Property Line _____ feet | Drinking Water Well _____ feet | Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-64"	B	LS	10YR 5/6	-	-	-	-	-	MASSIVE	FRIABLE	
64"-126"	C	COARSE SAND	10YR 5/3	-	-	-	10%	-	SG	LOOSE	72" BLACK LAYER ABOUT 3" THICK
											WATER SWEATING/ WEEPING AT 6'

Additional Notes: WATER OBSERVED AT 6'

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-4 (Hole #) | 12/28/21 (Date) | 3 PM (Time) | COLD SUNNY (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

   Description of Location: _____

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

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
   Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-2"	O/A	LOAM	10YR 2/2	-	-	-	-	-	MASSIVE	FRIABLE	
2"-24"	B	LS	10YR 5/6	-	-	-	-	-	MASSIVE	FRIABLE	
24"-132"	C	COARSE SAND	10YR 5/3	-	-	-	10%	-	SG	LOOSE	

Additional Notes: Soil was wet @11' didn't observe any water weeping in

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-5 (Hole #) | 12/28/21 (Date) | 4 PM (Time) | COLD SUNNY (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use _____ (e.g., woodland, agricultural field, vacant lot, etc.) | _____ Vegetation | _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) | _____ Slope (%)

   Description of Location: _____

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

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Wetlands _____ feet
   Property Line _____ feet | Drinking Water Well _____ feet | Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

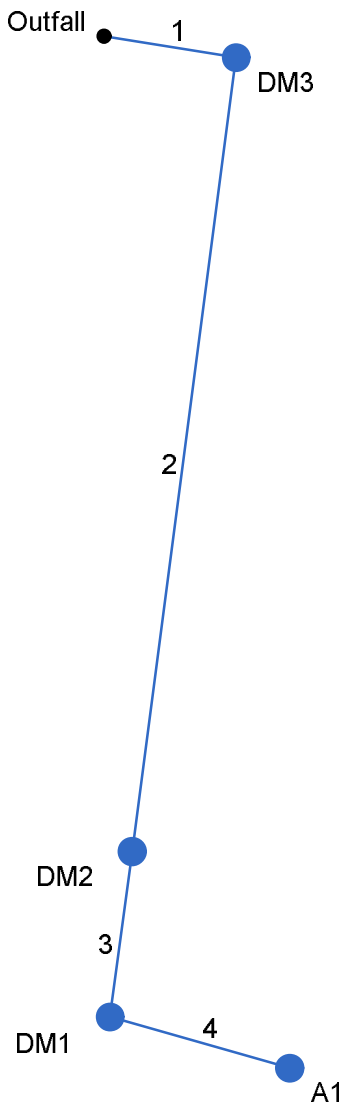
Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-18"	A	LOAM	10YR 2/2	-	-	-	-	-	MASSIVE	FRIABLE	
18"-24"	B	LS	10YR 5/6	-	-	-	-	-	MASSIVE	FRIABLE	
24"-72"	C	COARSE SAND	10YR 5/3	-	-	-	-	-	SG	LOOSE	WITH FINES & SILTS WATER AT 6'

Additional Notes: 6' WATER WEEPING IN, STANDING WATER AT 5'

SECTION 7 – HYDRAULIC PIPE SIZING

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK A.stm	Number of lines: 4	Date: 1/6/2022

Storm Sewers v12.00

Storm Sewer Tabulation

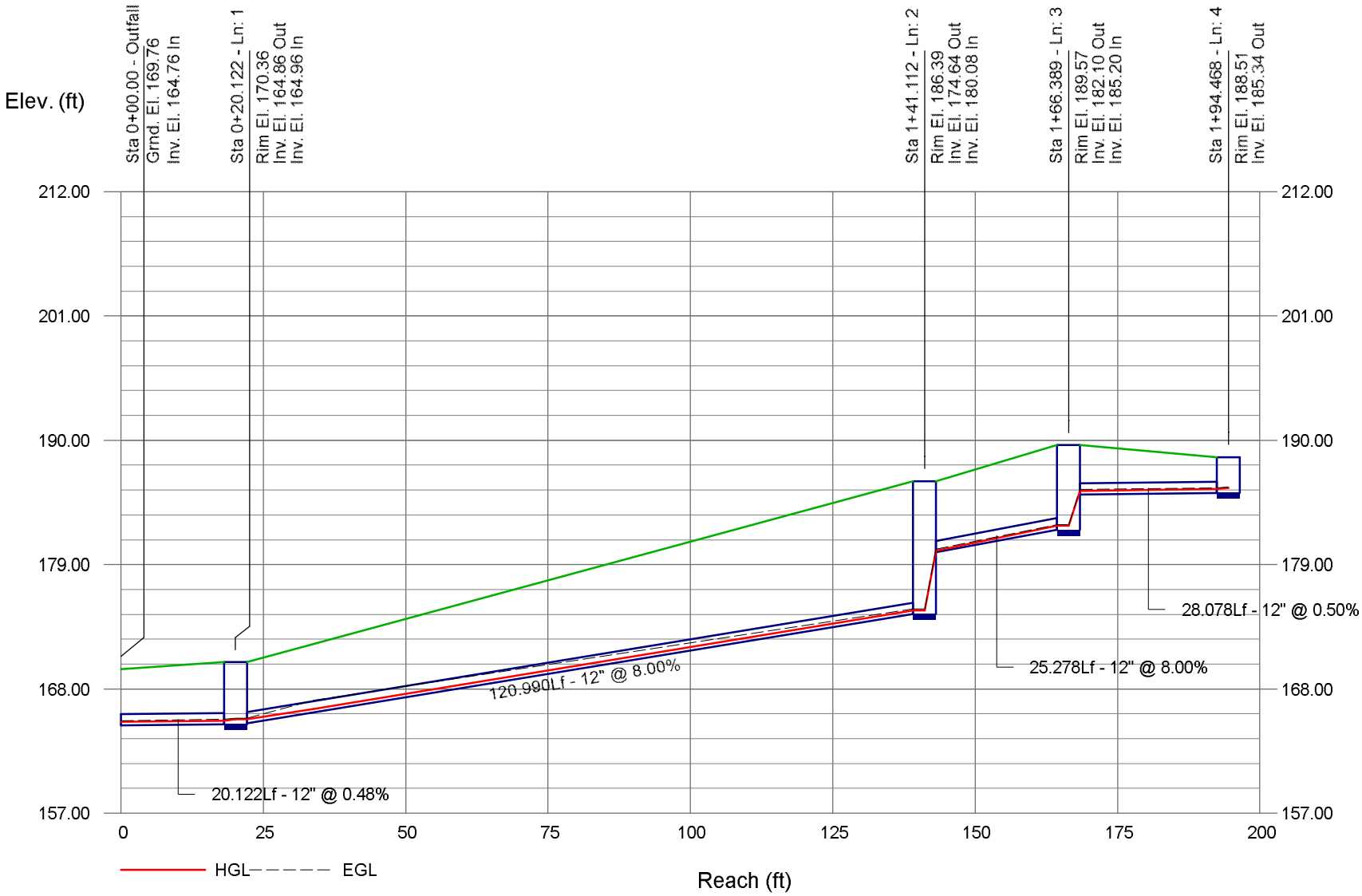
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	20.122	0.00	0.21	0.00	0.00	0.11	0.0	7.0	5.3	0.58	2.47	2.60	12	0.48	164.76	164.86	165.08	165.20	0.00	170.36	Pipe - (433)
2	1	120.990	0.00	0.21	0.00	0.00	0.11	0.0	6.3	5.5	0.60	10.07	2.68	12	8.00	164.96	174.64	165.29	174.96	170.36	186.39	Pipe - (461)
3	2	25.278	0.00	0.21	0.00	0.00	0.11	0.0	6.2	5.5	0.61	10.07	4.90	12	8.00	180.08	182.10	180.24	182.42	186.39	189.57	Pipe - (461) (2)
4	3	28.078	0.21	0.21	0.52	0.11	0.11	6.0	6.0	5.6	0.61	2.51	2.63	12	0.50	185.20	185.34	185.54	185.68	189.57	188.51	Pipe - (434)

Project File: NETWORK A.stm | Number of lines: 4 | Run Date: 1/6/2022

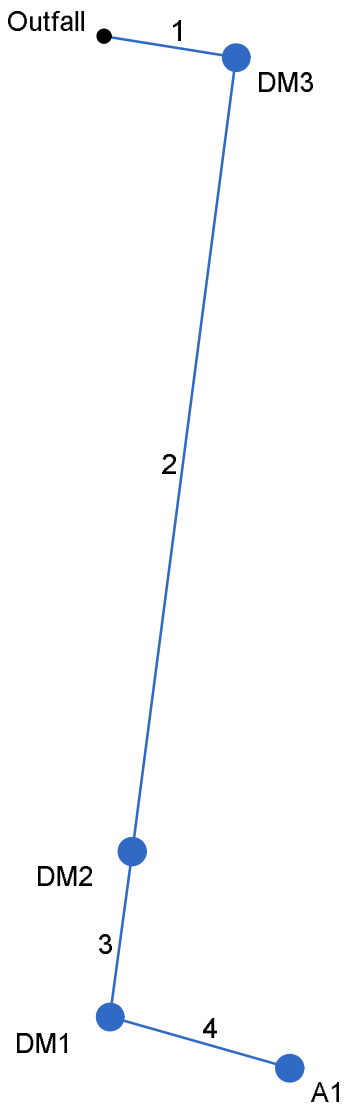
NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK A.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK A.stm	Number of lines: 4	Date: 1/6/2022

Storm Sewers v12.00

Storm Sewer Tabulation

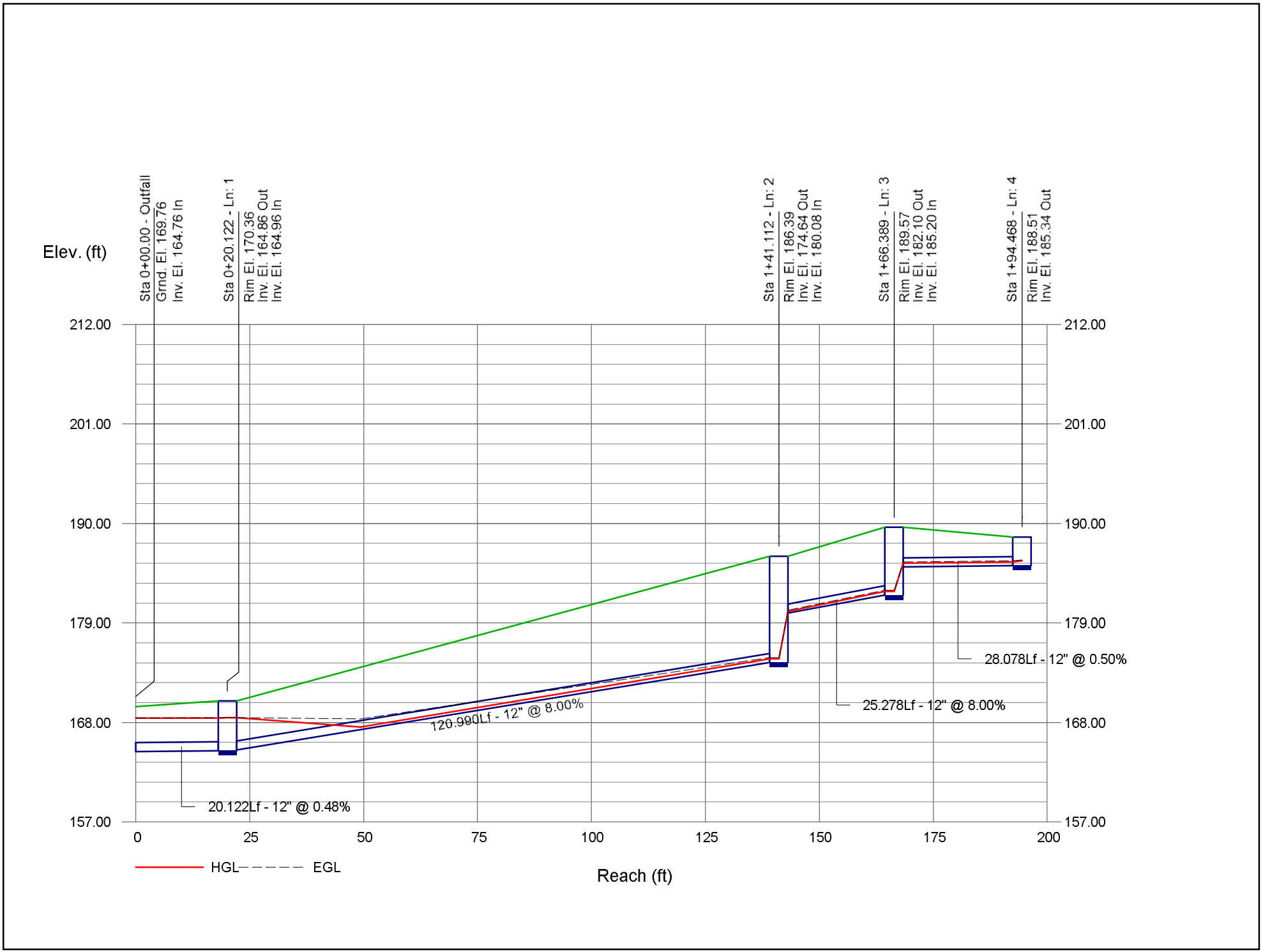
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	20.122	0.00	0.21	0.00	0.00	0.11	0.0	7.2	7.2	0.79	2.47	1.00	12	0.48	164.76	164.86	168.48	168.49	0.00	170.36	Pipe - (433)
2	1	120.990	0.00	0.21	0.00	0.00	0.11	0.0	6.2	7.5	0.82	10.07	2.02	12	8.00	164.96	174.64	168.51	175.01	170.36	186.39	Pipe - (461)
3	2	25.278	0.00	0.21	0.00	0.00	0.11	0.0	6.2	7.5	0.82	10.07	5.36	12	8.00	180.08	182.10	180.27	182.48	186.39	189.57	Pipe - (461) (2)
4	3	28.078	0.21	0.21	0.52	0.11	0.11	6.0	6.0	7.5	0.82	2.51	2.86	12	0.50	185.20	185.34	185.59	185.73	189.57	188.51	Pipe - (434)

Project File: NETWORK A.stm | Number of lines: 4 | Run Date: 1/6/2022

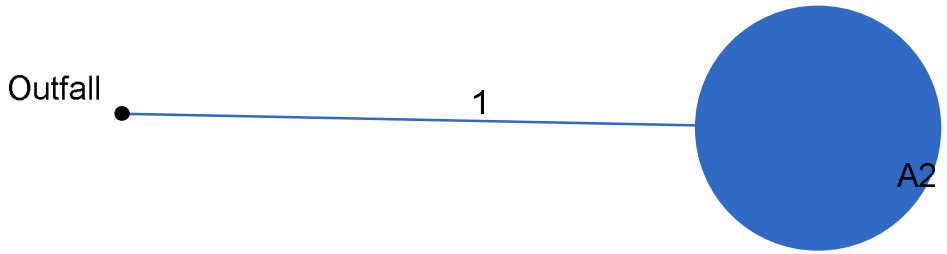
NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK A.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK B.stm	Number of lines: 1	Date: 1/6/2022

Storm Sewer Tabulation

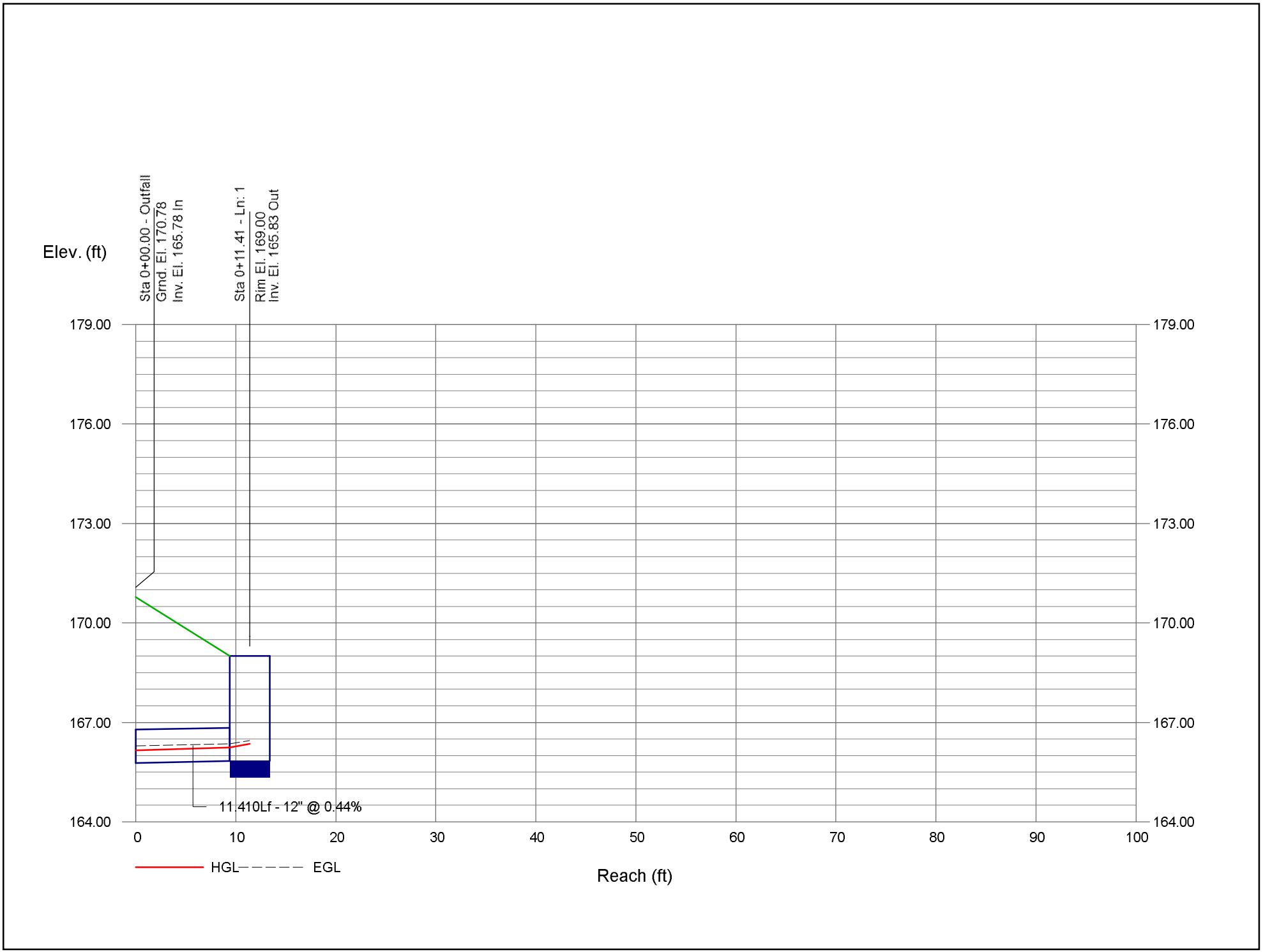
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	11.410	0.55	0.55	0.26	0.14	0.14	6.0	6.0	5.6	0.80	2.36	2.81	12	0.44	165.78	165.83	166.15	166.24	0.00	169.00	Pipe - (434) (1) (1)

Project File: NETWORK B.stm | Number of lines: 1 | Run Date: 1/6/2022

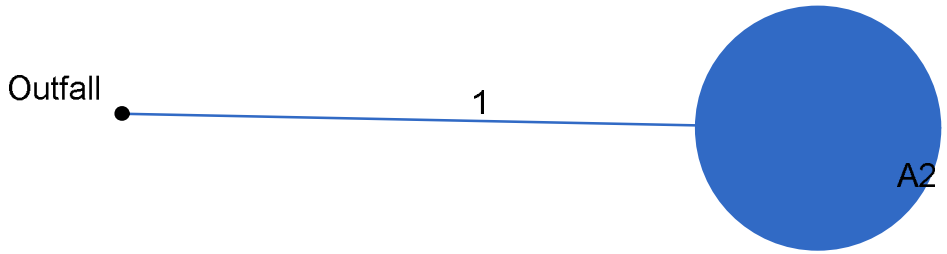
NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK B.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK B.stm	Number of lines: 1	Date: 1/6/2022

Storm Sewer Tabulation

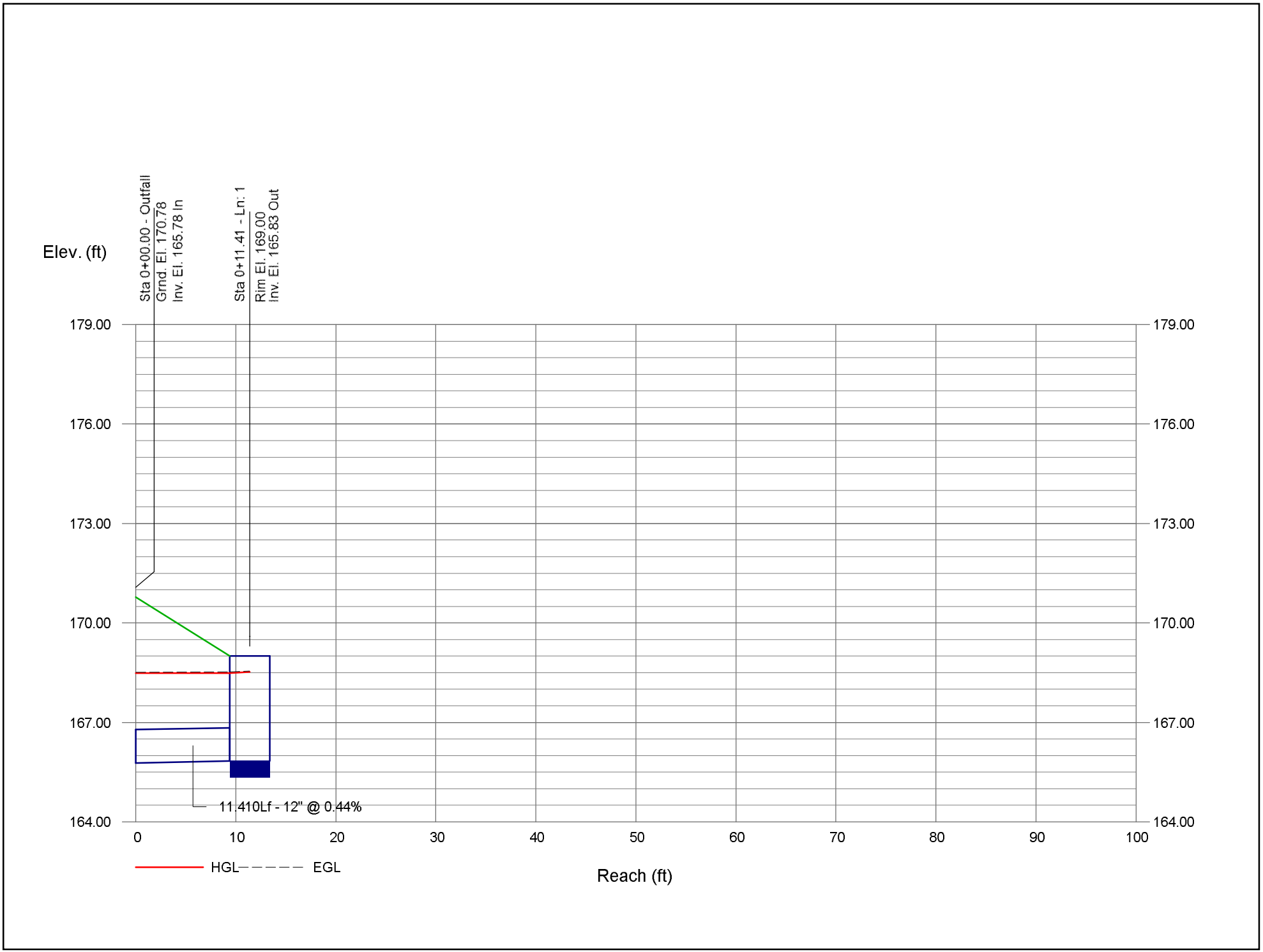
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	11.410	0.55	0.55	0.26	0.14	0.14	6.0	6.0	7.5	1.08	2.36	1.37	12	0.44	165.78	165.83	168.48	168.49	0.00	169.00	Pipe - (434) (1) (1)

Project File: NETWORK B.stm | Number of lines: 1 | Run Date: 1/6/2022

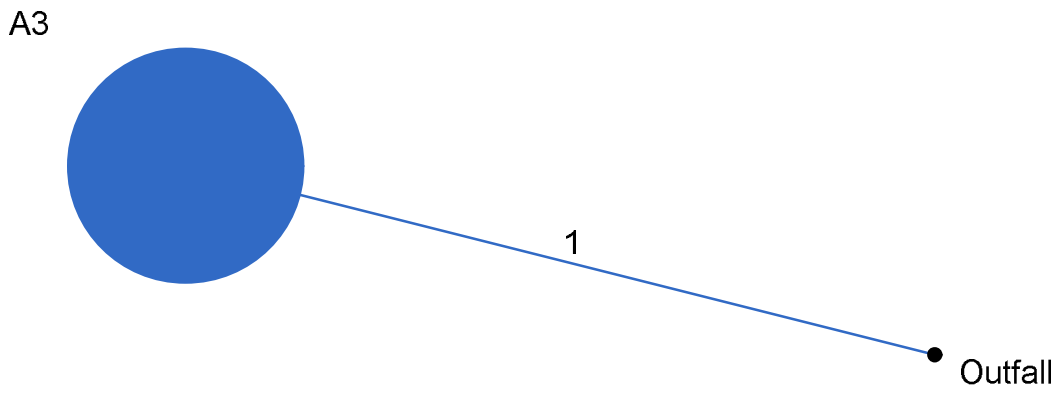
NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK B.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK C.stm	Number of lines: 1	Date: 1/6/2022

Storm Sewer Tabulation

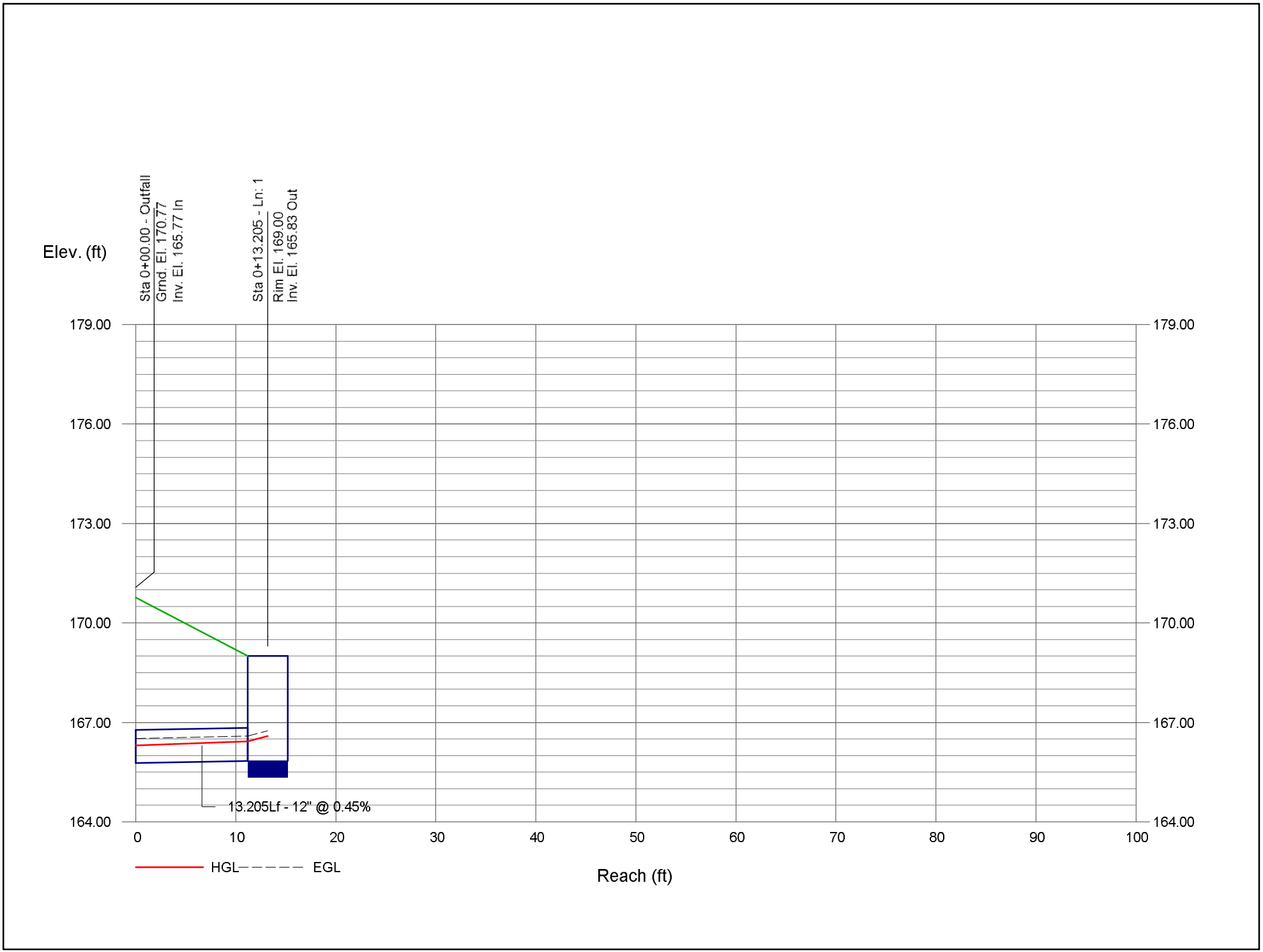
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	13.205	0.97	0.97	0.29	0.28	0.28	6.0	6.0	5.6	1.57	2.40	3.47	12	0.45	165.77	165.83	166.30	166.42	0.00	169.00	Pipe - (434) (1)

Project File: NETWORK C.stm | Number of lines: 1 | Run Date: 1/6/2022

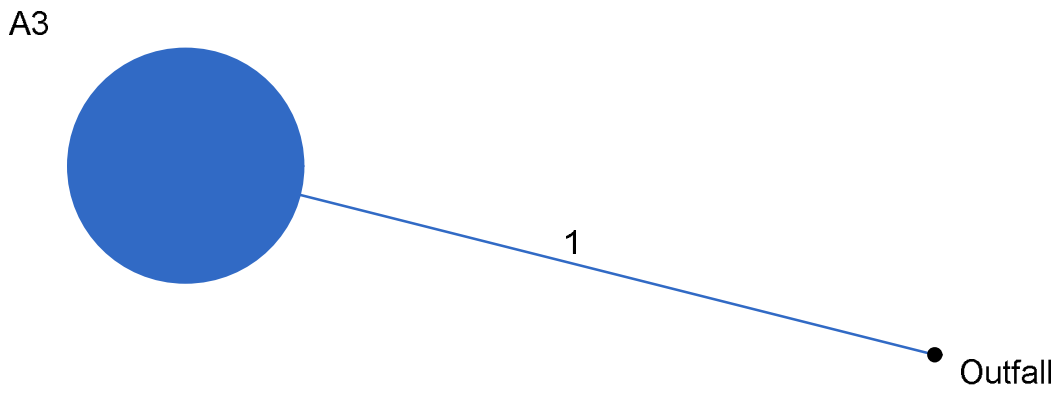
NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK C.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK C.stm	Number of lines: 1	Date: 1/6/2022

Storm Sewer Tabulation

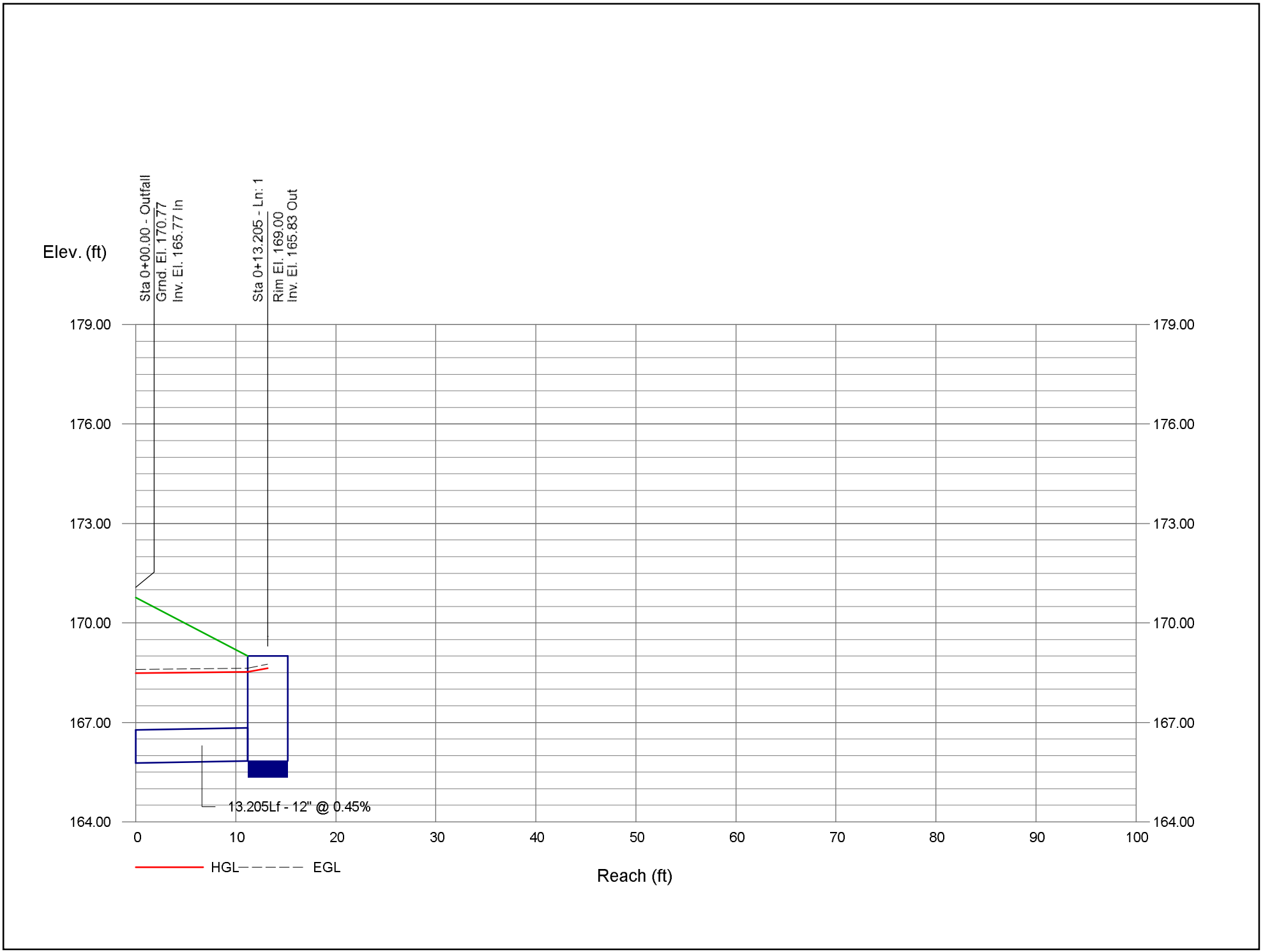
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	13.205	0.97	0.97	0.29	0.28	0.28	6.0	6.0	7.5	2.12	2.40	2.70	12	0.45	165.77	165.83	168.48	168.53	0.00	169.00	Pipe - (434) (1)

Project File: NETWORK C.stm | Number of lines: 1 | Run Date: 1/6/2022

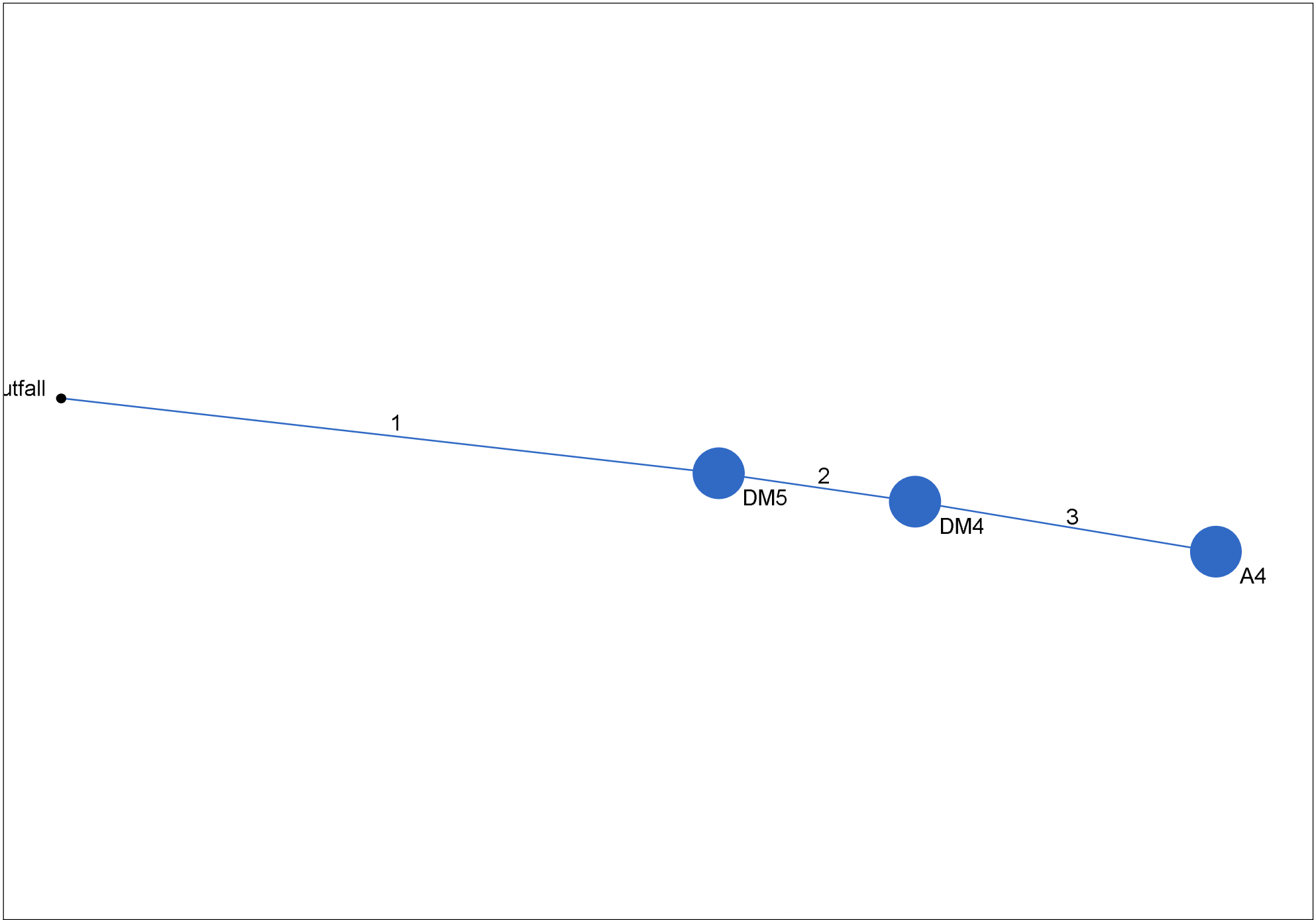
NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK C.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK D.stm	Number of lines: 3	Date: 1/6/2022

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	52.638	0.00	0.72	0.00	0.00	0.32	0.0	6.1	5.6	1.80	10.07	6.79	12	8.00	168.00	172.21	168.29	172.78	0.00	182.56	Pipe - (430) (1)
2	1	15.804	0.00	0.72	0.00	0.00	0.32	0.0	6.1	5.6	1.80	10.07	6.79	12	8.00	177.21	178.47	177.50	179.05	182.56	186.17	Pipe - (430) (1) (1)
3	2	24.292	0.72	0.72	0.45	0.32	0.32	6.0	6.0	5.6	1.81	3.82	4.35	12	1.15	182.17	182.45	182.65	183.02	186.17	185.62	Pipe - (418)

Project File: NETWORK D.stm

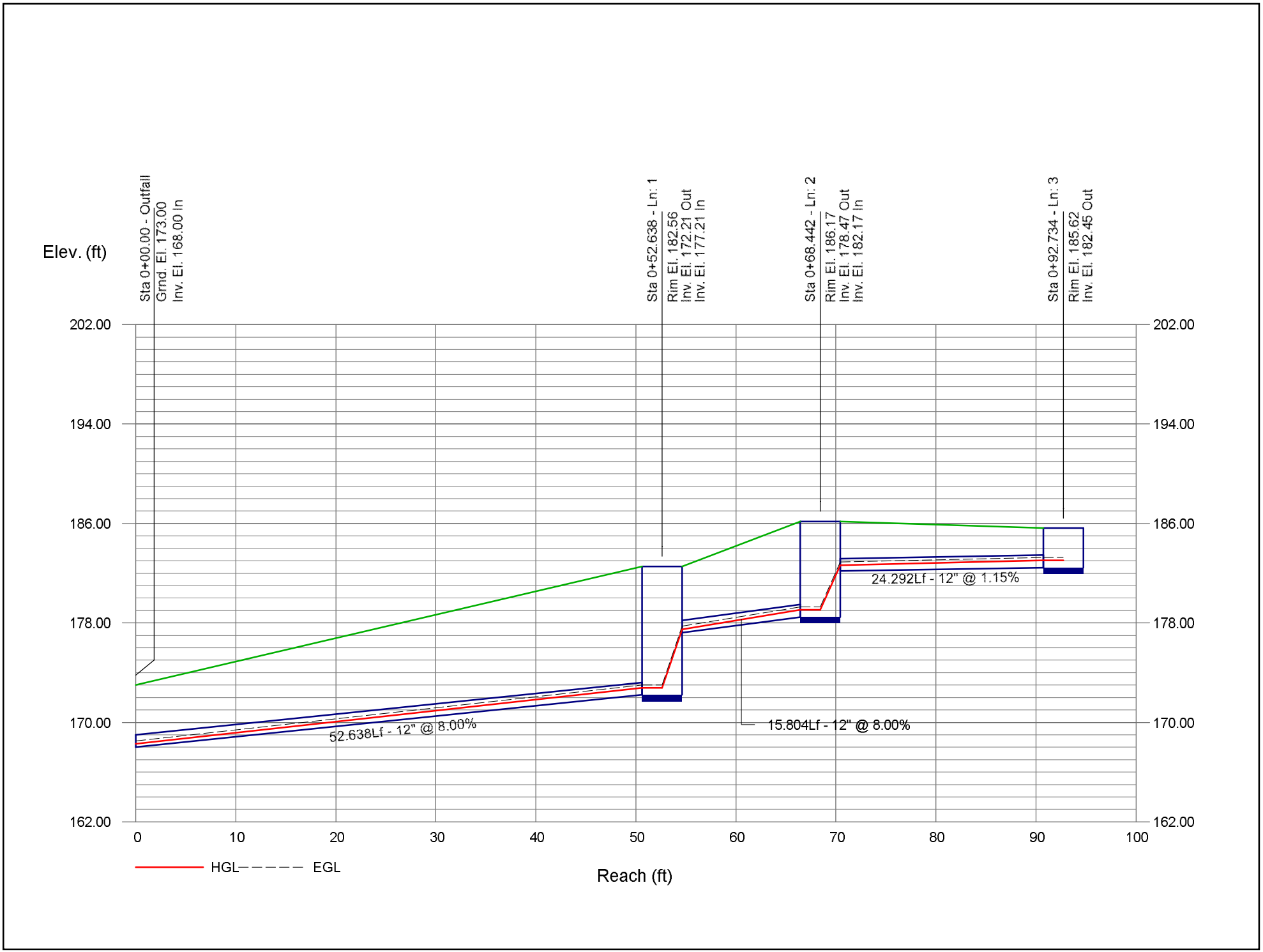
Number of lines: 3

Run Date: 1/6/2022

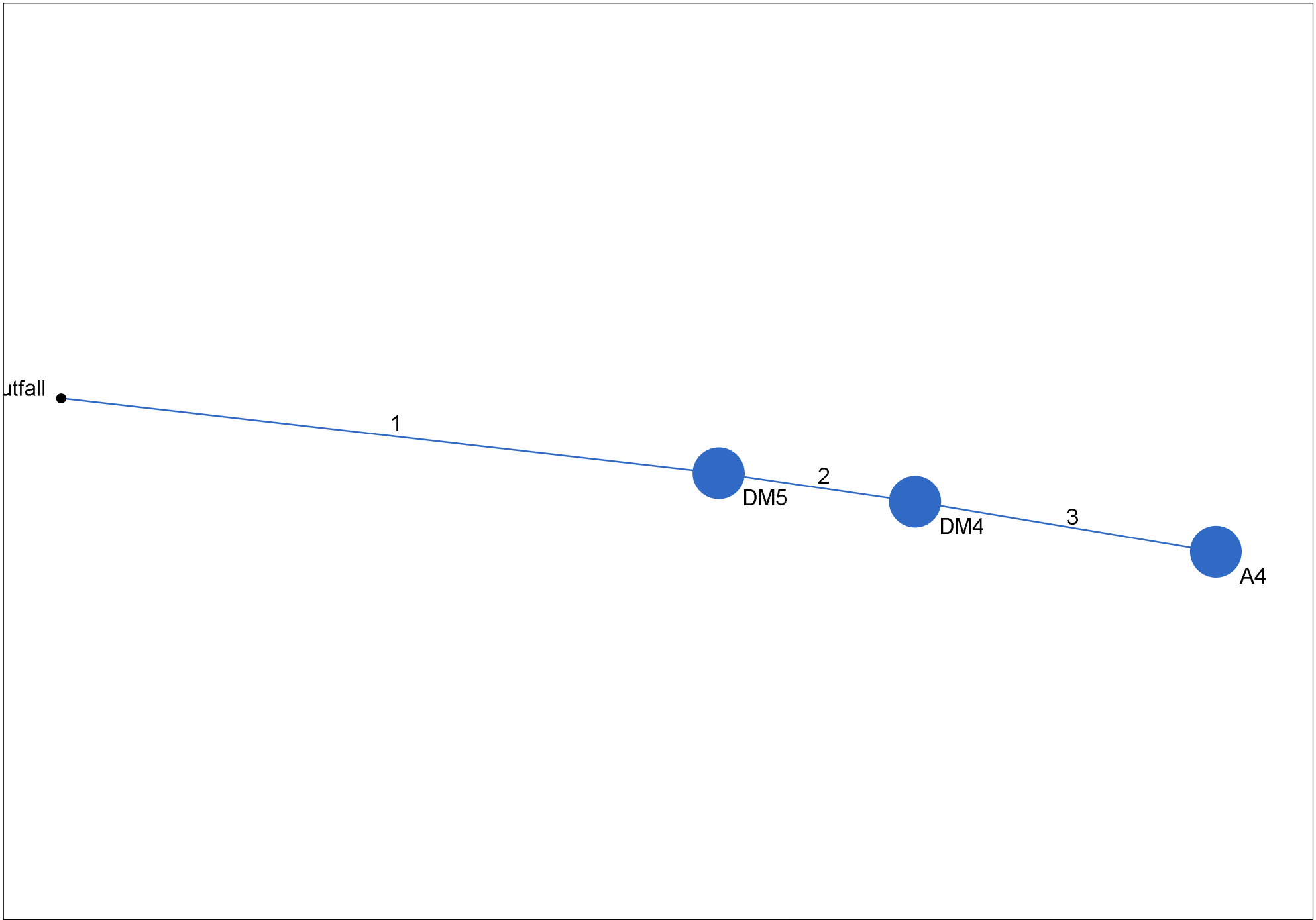
NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK D.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK D.stm	Number of lines: 3	Date: 1/6/2022

Storm Sewers v12.00

Storm Sewer Tabulation

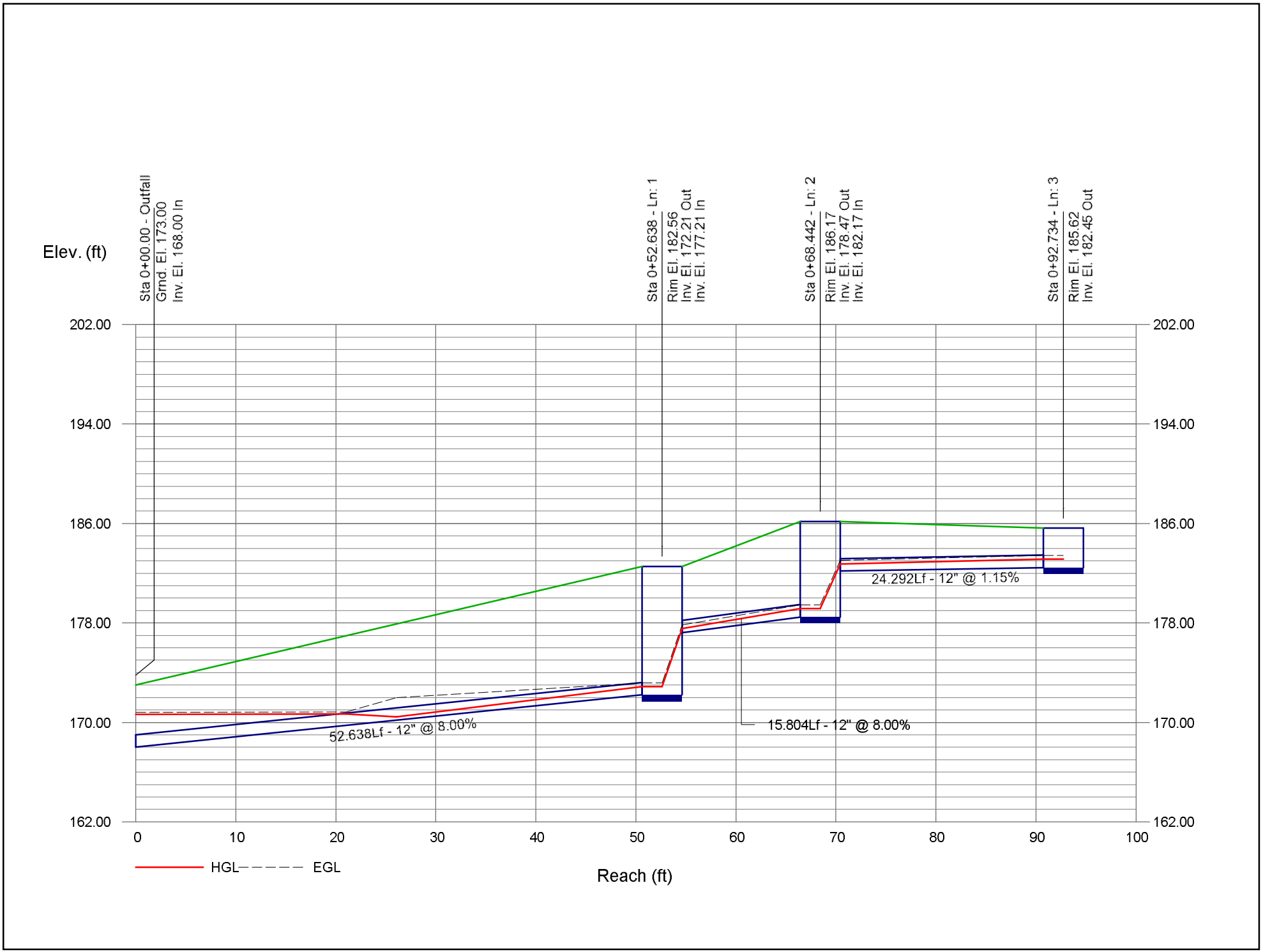
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	52.638	0.00	0.72	0.00	0.00	0.32	0.0	6.1	7.5	2.43	10.07	3.73	12	8.00	168.00	172.21	170.65	172.88	0.00	182.56	Pipe - (430) (1)
2	1	15.804	0.00	0.72	0.00	0.00	0.32	0.0	6.1	7.5	2.43	10.07	7.46	12	8.00	177.21	178.47	177.54	179.14	182.56	186.17	Pipe - (430) (1) (1)
3	2	24.292	0.72	0.72	0.45	0.32	0.32	6.0	6.0	7.5	2.44	3.82	4.77	12	1.15	182.17	182.45	182.75	183.12	186.17	185.62	Pipe - (418)

Project File: NETWORK D.stm | Number of lines: 3 | Run Date: 1/6/2022

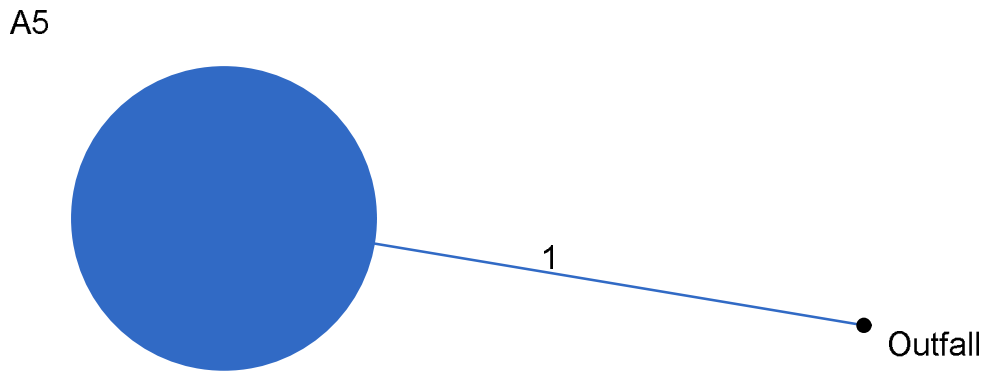
NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK D.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK E.stm	Number of lines: 1	Date: 1/6/2022

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	8.505	0.72	0.72	0.22	0.16	0.16	6.0	6.0	5.6	0.88	2.44	2.94	12	0.47	167.69	167.73	168.08	168.15	0.00	170.90	Pipe - (434) (1) (2)

Project File: NETWORK E.stm

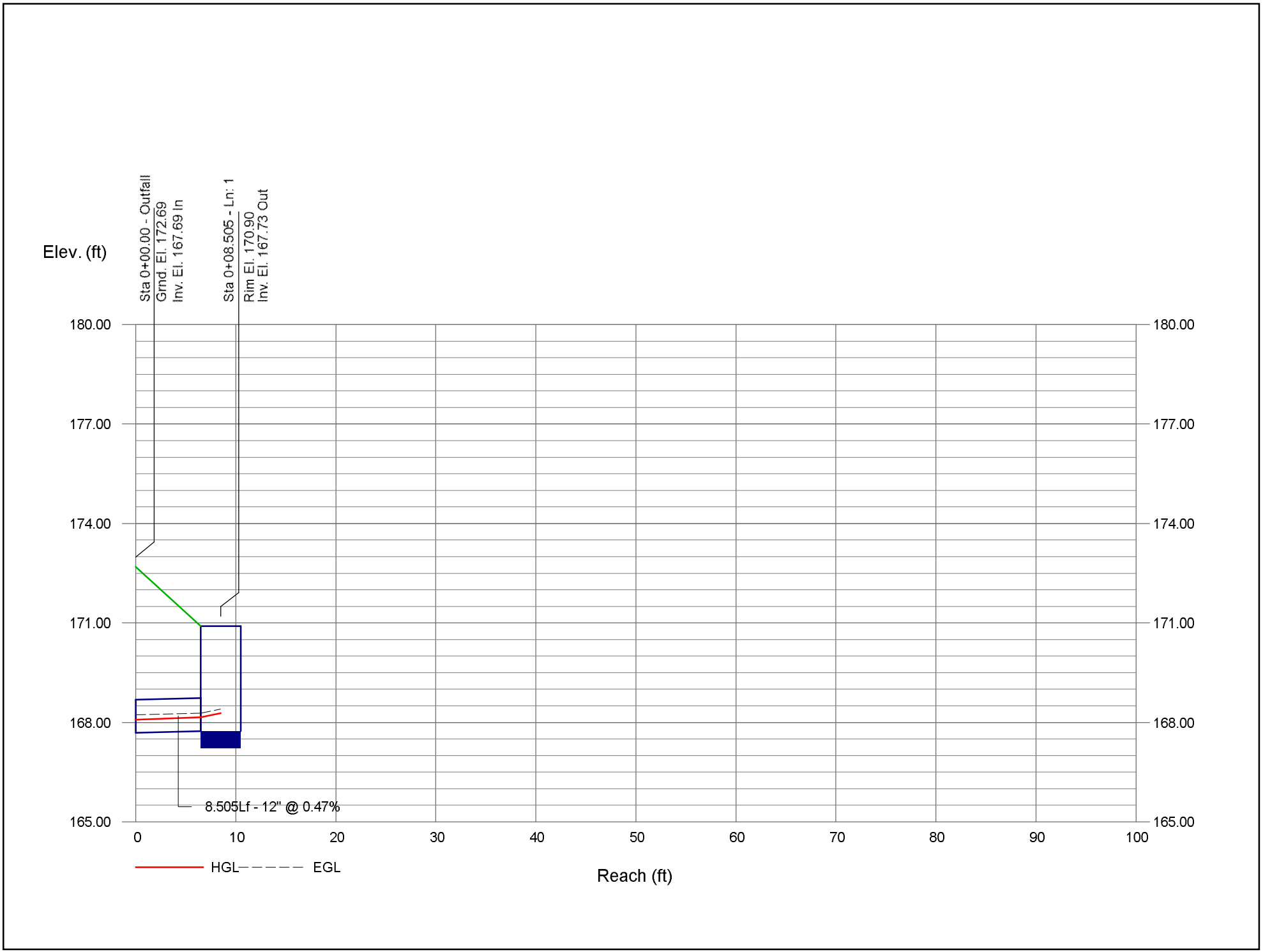
Number of lines: 1

Run Date: 1/6/2022

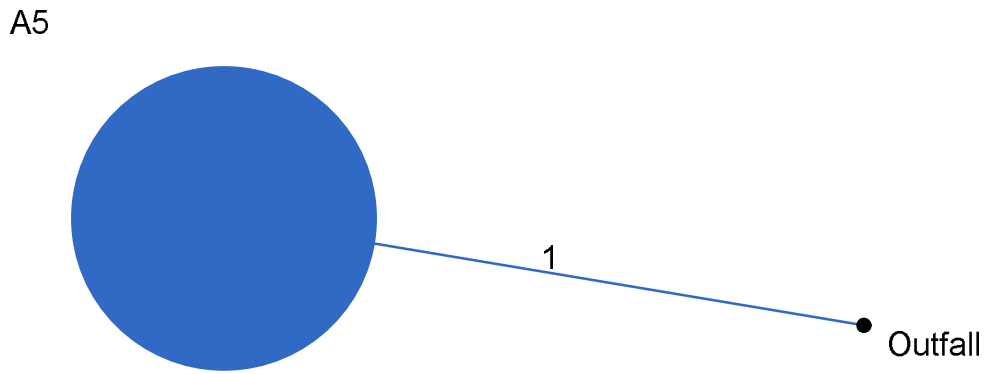
NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK E.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: NETWORK E.stm	Number of lines: 1	Date: 1/6/2022

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	8.505	0.72	0.72	0.22	0.16	0.16	6.0	6.0	7.5	1.19	2.44	1.52	12	0.47	167.69	167.73	170.65	170.66	0.00	170.90	Pipe - (434) (1) (2)

Project File: NETWORK E.stm

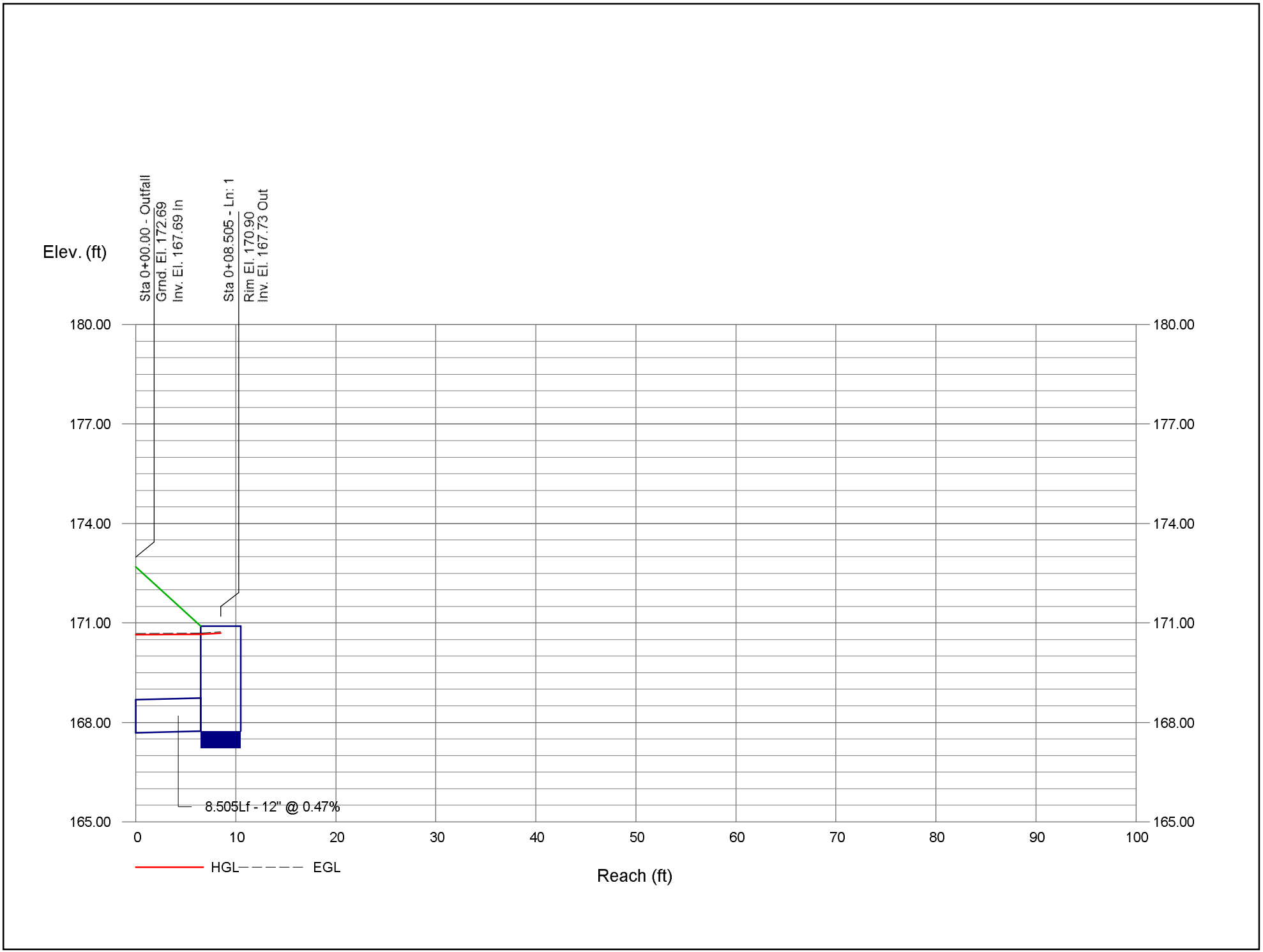
Number of lines: 1

Run Date: 1/6/2022

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: NETWORK E.stm



SECTION 8 – PROJECT PLANS
(Under Separate Cover)