Stantec

Stormwater Report

Masconomet Regional School District Field Renovations
Boxford, Massachusetts
20 Endicott Road, Boxford MA

Submission Date: January 18th, 2024

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EXECUTIVE SUMMARY

Masconomet Regional School District proposes to convert their existing two athletic fields into turf fields, along with redeveloping their baseball field. The proposed project includes seating and associated parking lots for both athletic fields. In addition, there is a proposed building along with walkways and landscaping. The western field will be a practice field and junior varsity field, and the eastern field will be used by the varsity team.

The project has site constraints which include resource areas such as bordering vegetated wetlands and the Ipswich River.

The project is considered to be a new development due to the proposed increase in impervious area within the site. The hydrologic analysis and associated stormwater management design has been completed for the project and meets all stormwater management standards. This stormwater report will establish design criteria for the proposed project and outline how the stormwater management standards are met.

Geotechnical investigations and soil evaluations have been performed to evaluate the soil conditions for the stormwater management design. Results from the geotechnical report indicate sandy soils that are consistent with the Natural Resources Conservation Service (NRCS) soil report.

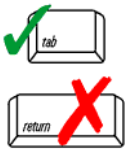
STORMWATER MANAGEMENT CHECKLIST

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.

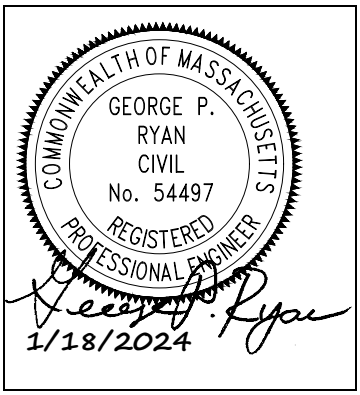
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



Digitally signed by Ryan, George
Date: 2024.01.18 13:39:18-05'00'

Signature and Date

Checklist

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

☑ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☑ Soil Analysis provided.

☑ Required Recharge Volume calculation provided.

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

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

☑ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

1.0 EXISTING CONDITIONS

1.1 SITE LOCATION

The project site is in the Town of Boxford. The project site is bound by Route 95 to the West, the Ipswich River to the South and South-East, Fish Brook to the North-East, and Endicott Road to the North and North-West. For the stormwater analysis, the watershed boundary was established as 15.66-acre portion of the site. The watershed boundary includes two multi-use athletic fields, a baseball field, and proposed parking area.

1.2 SITE PEDOLOGY

Soil Types

The Natural Resources Conservation Service (NRCS) Soil Survey of Essex County, Massachusetts indicates that the soil onsite is composed predominately of Udorthents, smoothed, Map Unit 651. Other soil groups onsite are as follows:

- **Merrimac fine sandy loam, 0 to 3 percent slopes, Map Unit 254A**
- **Saco variant silt loam, frequently ponded, 0 to 1 percent slopes, frequently flooded, Map Unit 718A**

Hydrologic Soil Groups

The NRCS classification for Hydrologic Soil Groups (HSG) for the above listed soils varies between A, B and D. Much of the property is classified as either Udorthents or Merrimac fine sandy loam, both of which are assigned Hydrologic Soil Group C. A small portion of the site is classified as Saco variant silt loam, which is assigned both Hydrologic Soil Group B and D. The location and description of the Saco variant silt loam that is present on the site aligns closer with characteristics of Hydrologic Soil Group B, and therefor for purposed of the stormwater modeling HSG B was used in both the existing and proposed conditions. A summary of the NRCS Soil Survey Report can be found in Appendix A.

Subsurface Explorations

Between July 17th and July 24th of 2023, Haley & Aldrich (H&A) conducted a total of eight (8) test boring explorations and twenty (20) geoprobe explorations. The test boring explorations were designated as HA-1 through HA-8 and were drilled to depths of 27 to 32 feet below ground surface. The geoprobes were designated as GP-1 through GP-18, INFL-1 and INFL-2, and were drilled to depths 10 feet below ground surface.

The geotechnical report produced by Haley & Aldrich can be found in Appendix A.

1.3 GROUNDWATER ELEVATIONS

As part of the subsurface explorations performed by Haley & Aldrich, eight (8) test boring explorations and twenty (20) geoprobe explorations were conducted. A summary of the groundwater elevations observed in the boring explorations can be found in Table 1 – Groundwater Elevations. Refer to the geotechnical report in Appendix A for a figure showing the locations of the borings.

Table 1 – Groundwater Elevations

Test Boring	*Groundwater Elevation*
HA-1	46.6
HA-2	46.6
HA-3	45.5
HA-4	45.2
HA-5	44.5
HA-6	42.0
HA-7	41.6
HA-8	45.0

1.4 DESIGN POINTS

Design points serve as comparison points for the peak discharge rates of the pre- and post-development hydrologic conditions. Design points are often established at either the site's property line or at a hydrologic point of interest downstream from the project site. In total, three design points were established to compare the existing and proposed condition peak discharge rates for the Site. *(*Figure 1-1 – Existing Watershed Plan*)*

DP-1 – 21" Concrete Pipe
Stormwater runoff from a portion of the site's parking area along with surface runoff from the western athletic field and baseball field is collected into catch basins and routed through a drainage conveyance system that ultimately converges into a 21" concrete pipe. The 21" pipe is routed underneath the existing field to a flare-end-section where it discharges stormwater flow into the Ipswich River.

To avoid disturbance to any wetland resource areas, the proposed stormwater conveyance design re-uses the existing 21" concrete pipe that discharges into the Ipswich River. To ensure that the pipe maintained adequate capacity for stormwater conveyance, it was crucial to ensure that peak rates were not increased in the pipe, therefore making it worthy of being a design point.

DP-2 – 24" Reinforced Concrete Pipe
Stormwater runoff from a portion of the site's parking area is collected into catch basins and routed through a drainage conveyance system that ultimately converges into a 24" reinforced concrete drainage pipe. The 24" pipe is routed underneath the existing field to a flared-end-section where it discharges stormwater flow into the Ipswich River.

To avoid disturbance to any wetland resource areas, the proposed stormwater conveyance design re-uses the existing 24" reinforced concrete pipe that discharges to the Ipswich River. To ensure that the pipe maintained adequate capacity for stormwater conveyance, it was crucial to ensure that peak rates were not increased in the pipe, therefore making it worthy of being a design point.

DP-3 – Ipswich River:
Stormwater runoff from eastern most athletic field is directly routed to the Ipswich River via surface flow. In addition, the stormwater routed through designs points one and two both discharge to the Ipswich River, making the river the ultimate destination for all stormwater runoff that results from the site.

1.5 EXISTING HYDROLOGIC CONDITIONS

For the existing conditions analysis, the Site was divided into three subcatchment areas *(*Figure 1-1 – Existing Watershed Plan*)*. The following provides a general description of each subcatchment:

Subcatchment EX-1 is comprised of a portion of the site's parking area. Stormwater runoff sheet flows into catch basins where it is routed through a stormwater conveyance system, through a 21-inch concrete pipe (DP-1) and ultimately discharges into the Ipswich River (DP-3).

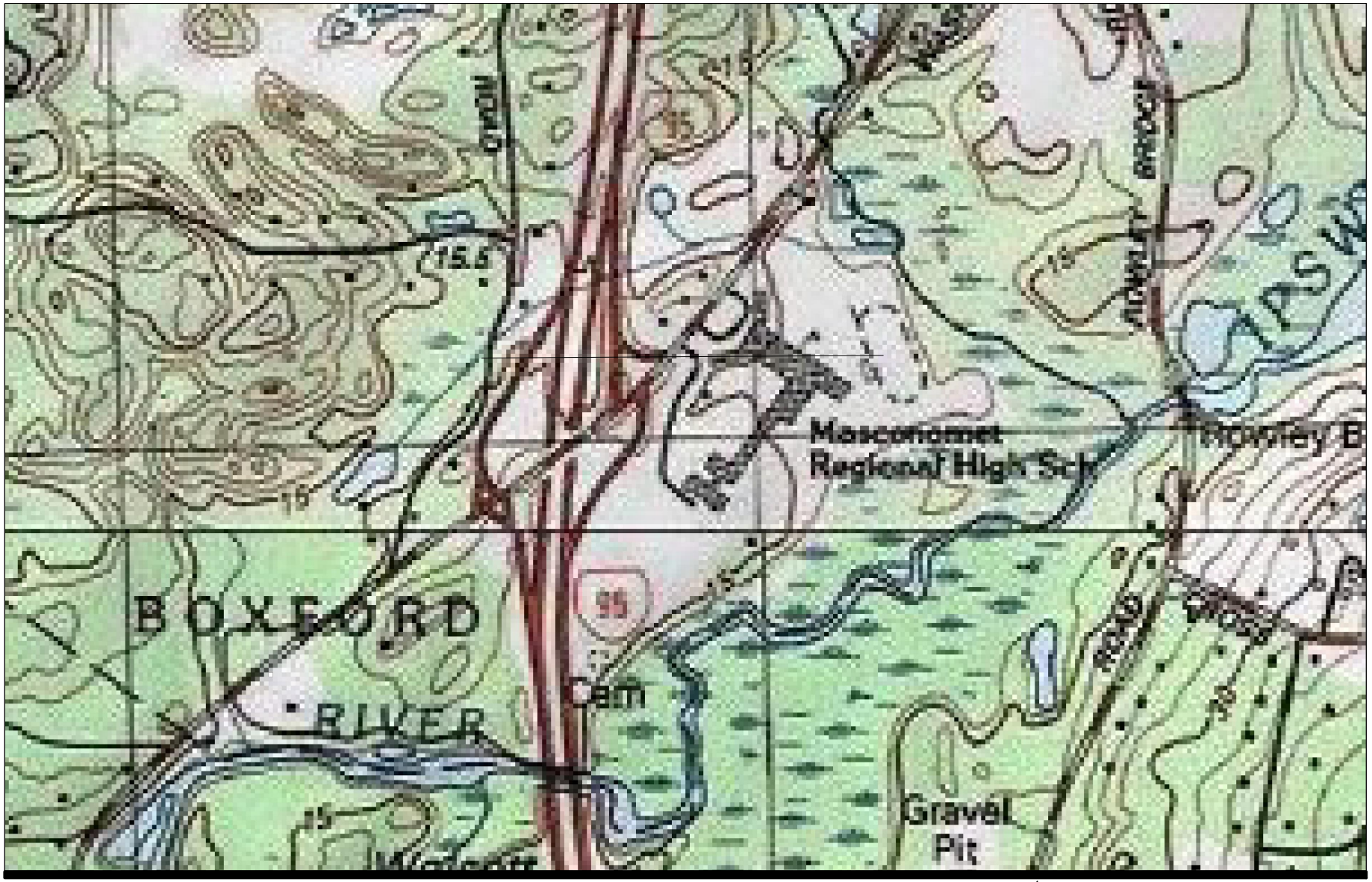
Subcatchment EX-2 is comprised of pervious area, including the western athletic field and baseball fields. Stormwater runoff sheet flows into catch basins where it is routed through a stormwater conveyance system, through a 21-inch concrete pipe (DP-1) and ultimately discharges into the Ipswich River (DP-3).

Subcatchment EX-3 is comprised of a portion of the site's parking area. Stormwater runoff sheets flows into catch basins where it is routed through a stormwater conveyance system, through a 24-inch reinforced concrete pipe (DP-2) and ultimately discharges into the Ipswich River (DP-3).

Subcatchment EX-4 is comprised of pervious area, including the eastern athletic field and land along the Ipswich River. Stormwater runoff sheets flows directly into the Ipswich River (DP-3).

Table 2 – Existing Subcatchment Summary

Subcatchment Area I.D.	*Area (sf)*	*Time of Concentration, T_c (min. 6.0 minutes)*	*Curve Number, CN*
EX-1	133,902	6.0	87
EX-2	290,906	15.9	39
EX-3	25,497	6.0	93
EX-4	231,675	12.5	43
Total	**681,980**	**----**	**52**



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Client/Project

JANUARY 2024

Masconomet Fields, Boxford

Figure No.

1

Title

AERIAL EXHIBIT

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Client/Project

JANUARY 2024

MASCONOMET FIELD, BOXFORD

SCALE: 1" = 750'

Figure No.

2

Title

AERIAL EXHIBIT

SOURCE: GOOGLE EARTH

National Flood Hazard Layer FIRMette

FEMA

70°58'48"W 42°37'51"N

70°58'10"W 42°37'25"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

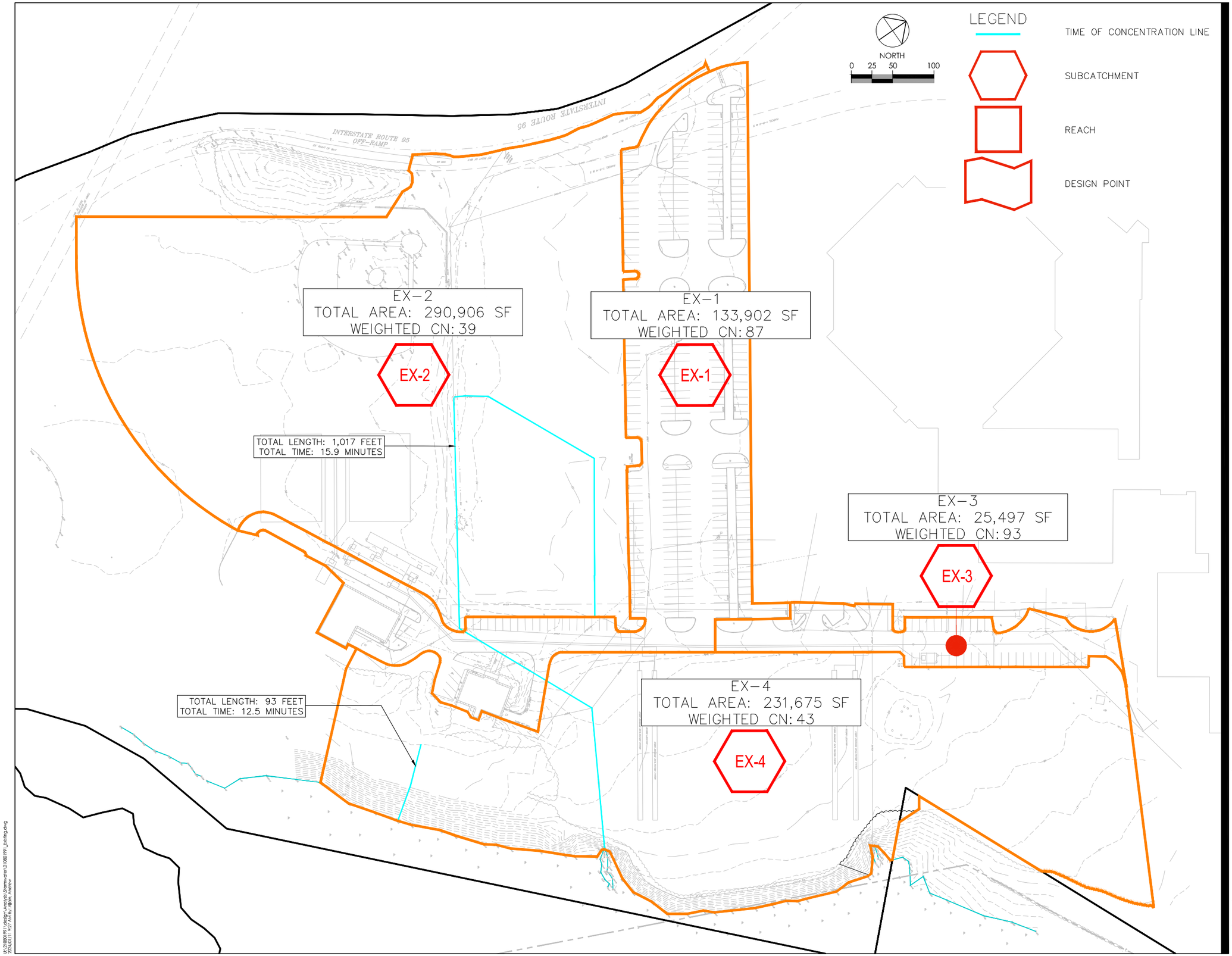
N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/17/2024 at 10:01 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



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Notes

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File Name: 210801991_Existing.dwg		Dwn.	Chkd.	Dsgn. MM.DD.YY

Permit-Seal

Client/Project

MASCONOMET REGIONAL HIGH SCHOOL

20 ENDICOTT ROAD, BOXFORD MA

Title

EXISTING WATERSHED PLAN

Project No.	Scale	Date
210801991	1" = 50'	01/18/2024

Sheet

Drawing No.
EX-WS

2.0 PROPOSED CONDITIONS

2.1 PROJECT CLASSIFICATION

The proposed Project is considered a new development. Hydrologic analysis has been performed and stormwater management standards have been met based on the proposed development.

2.2 METHODOLOGY AND DESIGN CRITERIA

2.2.1 Methodology

Site drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies facilitated by the computer program HydroCAD 10.00 (HydroCAD) by HydroCAD Software Solutions, LLC. Utilizing the HydroCAD software, a hydrologic model was developed to generate peak runoff rates for both the existing and proposed conditions. Design criteria for the hydrologic model includes subcatchments, design points, soil conditions, curve numbers, time of concentration, and design storms.

Curve numbers for each subcatchment are based on the different ground cover and underlying hydrologic soil group types. The curve numbers were based on the SCS TR-55 methodology and can be found in the attached HydroCAD reports.

2.2.1.1 Time of Concentration

The Time of Concentration (Tc) for each subcatchment was determined by finding the time necessary for runoff to travel from the most hydrologically distant point in the subcatchment to the Design Point. The travel path was drawn based on the topography of the Site and the time was calculated using TR-55 methodology. A minimum Tc value of 6.0 minutes was used for watersheds with calculated Tc values less than 6.0 minutes.

2.2.2 Design Rainfall Data

For both the existing and proposed conditions, the hydrologic model analyzed the Site's performance during the 2-, 10-, and 100-year storm events. The events were based on the Type-III, 24-hour duration storm. Rainfall depths used were taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 data. *Table 3 – Design Storm Events* contains a summary of the design storms that were used.

Table 3 – Design Storm Events

Storm Event	*Rainfall Depth Modeled (in.)*
2-year	**3.24**
10-year	**5.12**
100-year	**8.10**

2.2.3 Watershed Delineation

For the proposed hydrologic conditions analysis, the Site was divided into seven subcatchment areas (Figure 2-1 Proposed Watershed Plan). The peak discharge rates for the post-development conditions were analyzed at the three design points. The following provides a general description of each subcatchment:

Subcatchment PR-1 is comprised of the site's roof area and a large portion of the site's parking area. The hydrology of this portion of the site remains unaltered from the existing site conditions. Stormwater runoff will be captured and routed through a series of catch basins and drain manholes before it is ultimately routed through an existing 21-inch concrete pipe (DP-1) that discharges to the Ipswich River (DP-3).

Subcatchment PR-2 is comprised of a parking lot, baseball field, walkways, seating, building, and grass areas associated with the western synthetic turf field and the baseball field. Stormwater runoff from this area will be captured and routed through catch basins and drain manholes into the perforated pipe infiltration system (PERF-1) below the western turf field. The system ultimately outlets through an existing 21-inch concrete pipe (DP-1) that discharges to the Ipswich River (DP-3).

Subcatchment PR-3 is the western synthetic turf field. Stormwater runoff from this area will be routed into the subsurface gravel (FIELD-1) which overflows into the perforated pipe infiltration system (PERF-1) below the field. The system then outlets through an existing 21-inch concrete pipe (DP-1) that discharges to the Ipswich River (DP-3).

Subcatchment PR-4 is comprised of a small portion of the site's parking lot area. Stormwater runoff will be captured and routed through a series of catch basins and drain manholes before it is ultimately routed through an existing 24-inch reinforced concrete pipe (DP-2) that discharges to the Ipswich River (DP-3).

Subcatchment PR-5 is comprised of a portion of the site's parking lot area. Stormwater runoff from this area will be captured and routed through catch basins and drain manholes into the perforated pipe infiltration system (PERF-2) below the eastern turf field. The system ultimately outlets through an existing 24-inch reinforced concrete pipe (DP-2) that discharges to the Ipswich River (DP-3).

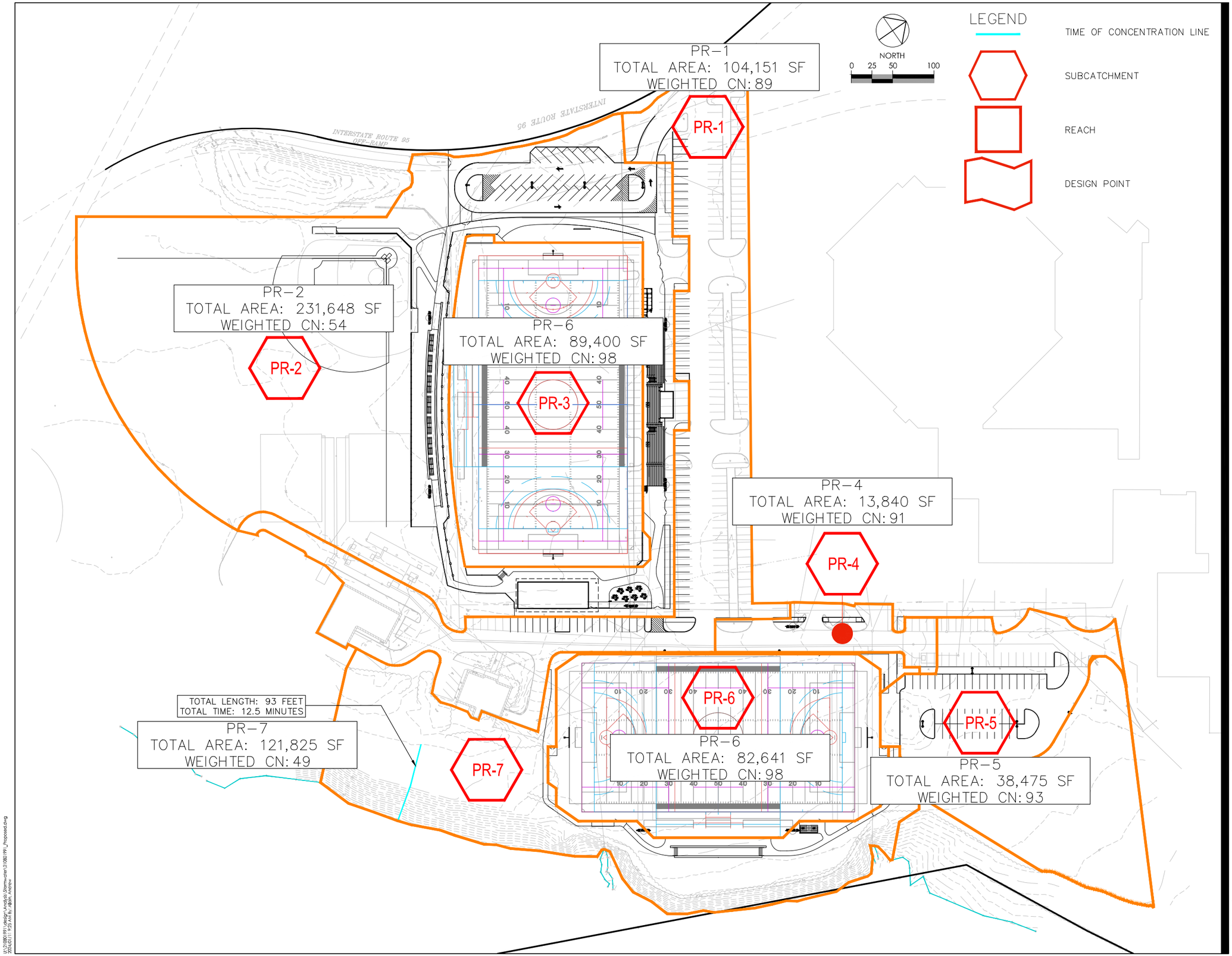
Subcatchment PR-6 is the eastern synthetic turf field. Stormwater runoff from this area will be routed into the subsurface gravel (FIELD-2) which overflows into the perforated pipe infiltration system (PERF-2) below the field. The system then outlets through an existing 24-inch reinforced concrete pipe (DP-2) that discharges to the Ipswich River (DP-3).

Subcatchment PR-7 is comprised of the portion of the site that discharges directly to the Ipswich River (DP-3). Stormwater runoff from this area flows over the surface, where it ultimately makes its way to the Ipswich River (DP-3).

Table 4 – Proposed Subcatchment Summary contains a summary of the proposed subcatchments and their corresponding area, time of concentration, and curve number.

Table 4 – Proposed Subcatchment Summary

Subcatchment Area I.D.	*Area (sf)*	*Time of Concentration, Tc (min. 6.0 minutes)*	*Curve Number, CN*
PR-1	104,151	6	89
PR-2	231,648	6	54
PR-3	89,400	6	98
PR-4	13,840	6	91
PR-5	38,475	6	93
PR-6	82,641	6	98
PR-7	121,825	12.5	49
Total	**681,980**	----	**72**



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Permit-Seal

Client/Project

MASCONOMET REGIONAL HIGH SCHOOL

20 ENDICOTT ROAD, BOXFORD MA

Title

PROPOSED WATERSHED PLAN

Project No.	Scale	Date
210801991	1" = 50'	01/18/2024

Sheet

Drawing No.
PR-WS

3.0 STORMWATER MANAGEMENT STANDARDS

The following section documents the Project's compliance with all ten standards for stormwater management as defined by the Massachusetts Department of Environmental Protection's (MassDEP) *Stormwater Management Standards*. The requirements for documenting compliance can be found within MassDEP's *Massachusetts Stormwater Handbook*.

3.1 STANDARD 1 – UNTREATED DISCHARGE

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

No new stormwater outfalls are proposed as part of the proposed development. To avoid disturbance to the wetland resource area, the stormwater runoff will be routed to the two existing outfalls; 21" concrete pipe and 24" reinforced concrete pipe. As described in more detail in later sections, the two existing outfalls have been chosen as design points and will therefore see a reduction in flow rates from the existing condition. Due to the reduction in flow rates, the proposed condition will mitigate erosion as compared to the existing condition.

Therefore, the Project complies with Standard 1.

3.2 STANDARD 2 – PEAK RATE ATTENUATION

Standard 2 states that "stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates."

The proposed stormwater management systems are designed to attenuate all storms up to and including the 100-year, 24-hour event. In doing so, the post-development peak discharge rates do not exceed the pre-development peak discharges rates. The following sections outline the methodology and design criteria used in the development of a hydrologic model that represents the Site in the pre- and post-conditions. Table 5 – Peak Discharge Runoff Rate provides a summary of pre- and post-development peak flow rates, HydroCAD reports can be found in Appendices E & F.

3.2.1 Peak Discharge Runoff Rates Summary

The peak discharge runoff rates were calculated for the 2-, 10-, 100-year storm events for both proposed and existing conditions to demonstrate that proposed peak runoff rates do not exceed existing at all design points. *Table 5 – Peak Discharge Runoff Rate* contains a summary of the existing and proposed runoff rates.

Table 5 – Peak Discharge Runoff Rate

	Design Point	*2-Year Storm (3.24")*	*10-Year Storm (5.12")*	*100-Year Storm (8.10")*
DP-1	Existing Rate (cfs)	7.02	13.01	23.68
	Proposed Rate (cfs)	**5.90**	**10.57**	**21.51**
DP-2	Existing Rate (cfs)	1.65	2.78	4.54
	Proposed Rate (cfs)	**0.85**	**2.47**	**4.47**
DP-3	Existing Rate (cfs)	8.67	15.80	32.05
	Proposed Rate (cfs)	**6.75**	**13.30**	**30.11**

Proposed peak rates do not exceed existing rates, and therefore the Project complies with Standard 2.

3.3 STANDARD 3 – STORMWATER RECHARGE

Standard 3 states that the "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 the 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."

3.3.1 Required Recharge Volume

As described in Section 2.4, the NRCS Soil Survey of Middlesex County, Massachusetts indicates that the soil on-site is composed of soil types that have been assigned an HSG ratings of "A", "B", "C" and "D". Per the Massachusetts Stormwater Handbook, sites with soils that have been assigned an HSG rating of "A" are required to recharge a volume equal to the product 0.60 inches per square foot (sf), "B" are required to recharge 0.35 inches per square foot (sf), "C" are required to recharge 0.25 inches per square foot (sf) and "D" are required to recharge 0.10 inches per square foot (sf).

The required recharge volume has been calculated accordingly, as depicted in Table 6 – Required Recharge Volume.

Table 6 – Required Recharge Volume

Hydrologic Soil Group	*HSG A*	*HSG B*	*HSG C*	*HSG D*	∑
∆ Imp. Area within Soil Group (sf)	69,438	0	0	0	69,438
Required Recharge Depth (in/sf)	0.60	0.35	0.25	0.10	-----
Required Recharge Volume (cf)	3,472	0	0	0	**3,472**

3.3.2 Provided Recharge Volume

The Massachusetts Stormwater Handbook specifies three methods that may be used to determine what size infiltration system is required to provide the required recharge volume. The three methods include the Static method, the Simple Dynamic method, and the Dynamic Field method. The Static method was used to design the four subsurface infiltration systems. The "Static" method assumes that the required recharge volume is stored prior to any stormwater leaving the system. Table 7 – Provided Recharge Volume shows the provided recharge volume for each infiltration BMPs using the Static method.

Table 7 – Provided Recharge Volume

Infiltration BMP	*Provided Recharge Volume (cf)*
FIELD-1	6,751
PERF-1	3,779
FIELD-2	6,198
PERF-2	1,365
Total	18,093

The provided recharge volume exceeds the required recharge volume for each infiltration BMP. Supporting calculations can be found in Appendix B.

3.3.3 Drawdown Requirement

The Massachusetts Stormwater Handbook requires that all infiltration BMPs drawdown within 72 hours of a storm event. Drawdown time is calculated by dividing the required recharge volume by the product of the saturated hydraulic conductivity and the bottom surface area of the system, as noted below. When the Static method is used for sizing an infiltration BMP the Massachusetts Stormwater Handbook requires the use of the Rawls rate. The Rawls rate depends on the soil textural classification at the elevation of proposed infiltration. To calculate drawdown time for the proposed infiltration systems the most conservative HSG "A" Rawls rate of 2.41 inches per hour was used.

$$T_{drawdown} = \frac{Rv}{(K)(Area_{bottom})}$$

Where: $T_{drawdown}$ = Drawdown Time

R_v = Required Recharge Volume

K = Saturated Hydraulic Conductivity

$Area_{bottom}$ = Surface Area of System Bottom

The stormwater systems have been designed to drawdown within 72 hours of a storm event. A summary of the 72-hour drawdown times can be found in Table 8 – Drawdown Time Summary below which shows the infiltration rate, bottom surface area, and drawdown time of each proposed infiltration system.

Table 8 – Drawdown Time Summary

Infiltration BMP	*K (in/hour)*	*Bottom Area (sf)*	*Drawdown Time (hr)*
FIELD-1	2.41	89,400	0.4
PERF-1	2.41	4,950	3.8
FIELD-2	2.41	82,641	0.4
PERF-2	2.41	3,400	2.0

The proposed infiltration BMPs drawdown within 72 hours. Supporting calculations can be found in Appendix B.

3.3.4 Separation from Seasonal High Groundwater

The Massachusetts Stormwater Handbook requires two feet of vertical separation between the bottom of an infiltration system and the seasonal high groundwater table. Based off test pit and boring information

estimated seasonal high groundwater varies at each proposed infiltration BMP.***Error! Reference source not found.*** Below shows the bottom elevation of each proposed infiltration system and the estimated seasonal high groundwater elevation.

Table 9 – Groundwater Separation Summary

Infiltration BMP	*Bottom System Elevation (ft)*	*ESHGW (ft)*	*Separation from ESHGW (ft)*
FIELD-1	53.5	46.6	6.9
PERF-1	48.6	46.6	2.0
FIELD-2	51.0	42.0	9.0
PERF-2	44.0	42.0	2.0

The proposed infiltration BMPs provide adequate separation from seasonal high groundwater. Supporting geotechnical report can be found in Appendix A.

3.4 STANDARD 4 – WATER QUALITY

Standard 4 states that “Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids.”

Standard 4 is met when a project complies with all the following criteria:

1. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained.
2. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
3. Pre-treatment is provided in accordance with the Massachusetts Stormwater Handbook.

3.4.1 Required & Provided Water Quality Volume

Table 10 – Required Water Quality Volume below contains a summary of the required water quality volume for the proposed project.

Table 10 – Required Water Quality Volume

	Site Imp. Area (sf)	*Water Quality Depth (inch)*	*Required Water Quality Volume (cf)*	*Provided Water Quality Volume (cf)*
FIELD-1	0	0.5	0	6,751
PERF-1	54,805	0.5	2,284	3,779
FIELD-2	0	0.5	0	6,198
PERF-2	32,267	0.5	1,344	1,365

Supporting calculations regarding required water quality volume can be found in Appendix C.

3.4.2 TSS Removal

The Massachusetts Stormwater Handbook requires that stormwater management systems remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This is accomplished by routing stormwater runoff through one or more “process” or “treatment” trains. Each treatment train consists of one or more stormwater BMPs that are designed to remove TSS from runoff. The

Massachusetts Stormwater Handbook assigns TSS removal credits to various stormwater BMPs. A stormwater BMP is presumed to achieve the assigned TSS removal rate if the specific stormwater BMP is sized to meet the required water quality volume.

The proposed stormwater management system achieves greater than 80% TSS removal rate for each treatment train. Each treatment train is composed of a series of pre-treatment and treatment BMPs that reduce TSS loading prior to discharge. The proposed treatment trains are described in the following:

Treatment Train #1 – Parking Lots

Surface stormwater runoff from the new parking lot areas will be collected by deep sump catch basins, prior to being routed to either of the proposed perforated pipe infiltration systems.

$$Starting\ TSS\ Load\ (100\%) * Deep\ Sump\ Catch\ Basin\ (25\%) * Infiltration\ Basin\ (80\%) = Remaining\ Load$$

$$Starting\ TSS\ Load\ (100\%) * Deep\ Sump\ Catch\ Basin\ (25\%) = 75\%\ TSS\ Remaining$$

$$75\%\ TSS\ Remaining * Infiltration\ Basin\ (80\%) = \ 15\%\ TSS\ Remaining$$

$$15\%\ TSS\ Remaining = 85\%\ TSS\ Removal$$

Treatment train #1 achieves 85% TSS removal.

Treatment Train #2 – Fields

Surface stormwater runoff from both of the synthetic turf fields will be routed through underdrains and into either of the proposed perforated pipe infiltration systems.

$$Starting\ TSS\ Load\ (100\%) * Infiltration\ Basin\ (80\%) = Remaining\ Load$$

$$Starting\ TSS\ Load\ (100\%) * Infitration\ Basin\ (80\%) = 20\%\ TSS\ Remaining$$

$$20\%\ TSS\ Remaining = 80\%\ TSS\ Removal$$

Treatment train #2 achieves 80% TSS removal.

The proposed stormwater conveyance design provides TSS removal exceeding the stormwater management standards. Therefore, the Project complies with Standard 4.

3.4.3 Long-Term Pollution Prevention Plan

A long-term pollution prevention plan for the Project is included as part of the Operation and Maintenance Plan and can be found in Appendix D. The Operation and Maintenance Plan includes a site map delineating the specific stormwater BMPs present at the Site, a log for tracking maintenance of each stormwater BMP, and manufacturers' maintenance guidelines for proprietary technology.

Therefore, the Project complies with the Long-Term Pollution Prevention requirement of Standard 4.

3.5 STANDARD 5 – LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS (LUHPPL)

Standard 5 states that "for land uses with higher potential pollutant loads [LUHPPL], 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 site is not considered a LUHPPL, as defined by the Massachusetts Department of Environmental Protection, therefore Standard 5 is not applicable.

3.6 STANDARD 6 – CRITICAL AREAS

Standard 6 states that "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."

Critical areas include any one of the following, as defined by the Massachusetts Department of Environmental Protection:

- Outstanding Resource Waters
- Special Resource Waters
- Zone I Recharge Areas
- Zone II Recharge Areas
- Interim Wellhead Protection Areas
- Zone A Recharge Areas
- Bathing Beaches
- Cold-water Fisheries
- Shellfish Growing Areas

The proposed stormwater management system does not discharge near or to any of the above listed critical areas.

Therefore, the Project complies with Standard 6.

3.7 STANDARD 7 – REDEVELOPMENT PROJECTS

Standard 7 states that "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."

A project may be classified as a redevelopment if it meets any one of the following criteria:

1. Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving.
2. Development, rehabilitation, expansion, and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area.
3. Remedial projects specifically designed to provide improved stormwater management, such as projects related to separate storm drains and sanitary sewers and stormwater retrofit projects.

The project is considered a new development and thus complies fully with all the stormwater management standards.

Therefore, the Project complies with Standard 7.

3.8 STANDARD 8 – EROSION AND SEDIMENTATION CONTROL PLAN

Standard 8 states that “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.”

Sedimentation and erosion controls will be installed and maintained throughout all phases of construction. Land disturbance will be evaluated on a parcel-by-parcel basis. A draft Stormwater Pollution Prevention Plan (SWPPP) has been prepared and is attached in Appendix G. The final SWPPP will be submitted prior to land disturbance.

Therefore, the Project complies with Standard 8.

3.9 STANDARD 9 – OPERATION AND MAINTENANCE PLAN

Standard 9 states that “a long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.”

An Operation and Maintenance Plan, Maintenance Log and Operation and Maintenance Figure have been prepared for the site and are attached in Appendix D.

Therefore, the Project complies with Standard 9.

3.10 STANDARD 10 – ILLICIT DISCHARGES

Standard 10 states that “all illicit discharges to the stormwater management system are prohibited.” As stated in the Massachusetts Stormwater Handbook, “The stormwater management system is the system for conveying, treating, and infiltrating stormwater onsite, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater.

Proponents of projects within Wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the project area and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system.”

Standard 10 also states that “The Illicit Discharge Compliance Statement must be accompanied by a project area map that is drawn to scale and that identifies the location of any systems for conveying stormwater on the project area and shows that these systems do not allow the entry of any illicit discharges into the stormwater management system. The project area map shall identify the location of any systems for conveying wastewater and/or groundwater on the project area and show that there are no connections between the stormwater and wastewater management systems and the location of any measures taken to prevent the entry of illicit discharges into the stormwater management system. Illicit discharge statements will be submitted prior to the discharge of any stormwater to post-construction BMPs.

APPENDICES

Appendix A SOILS INFORMATION

NATURAL RESOURCES CONSERVATION SERVICE (NRCS) SOIL REPORT

HALEY & ALDRICH GEOTECHNICAL REPORT

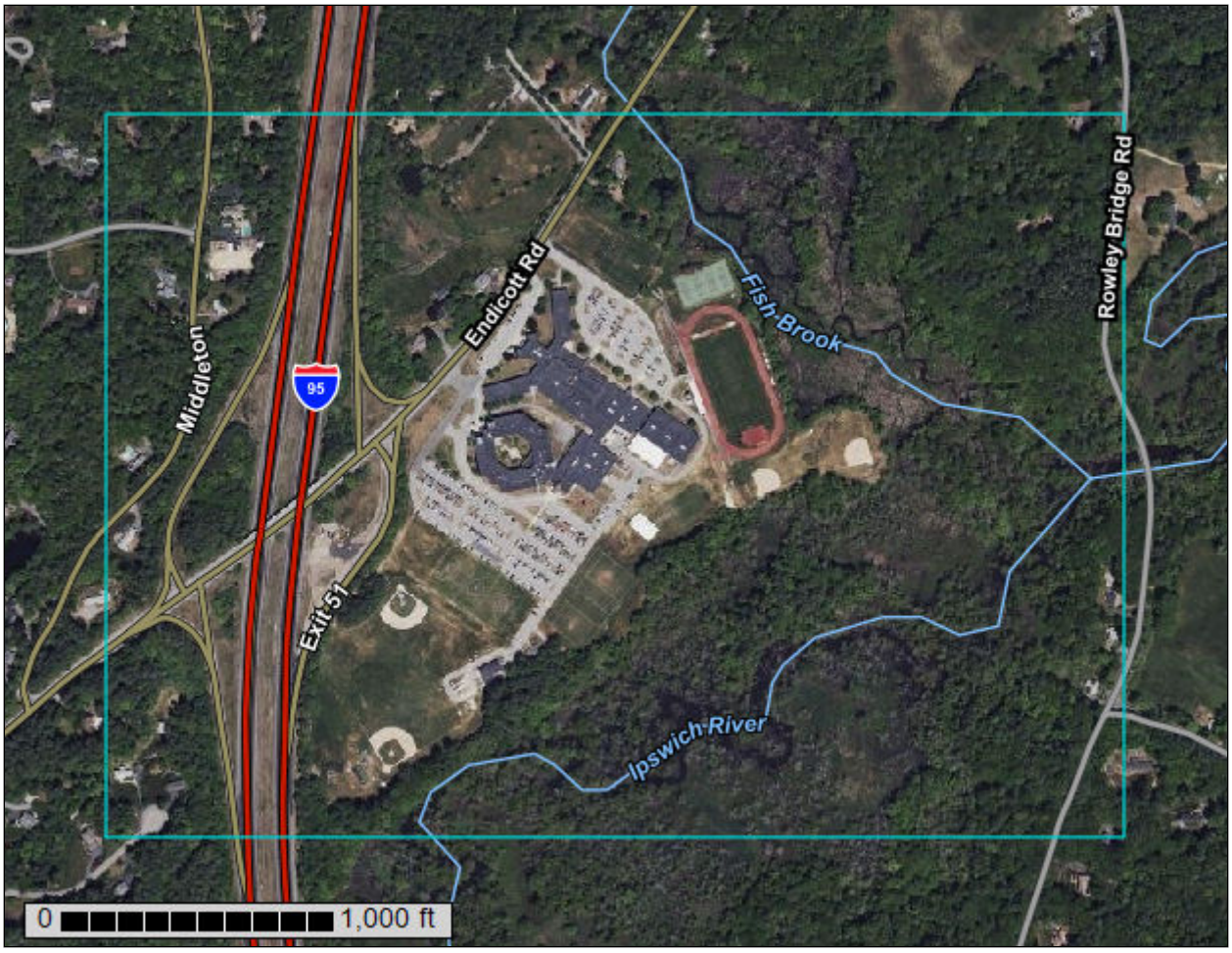
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Essex County, Massachusetts, Northern Part



October 24, 2023

Soil Map

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


70° 58' 59" W
70° 57' 53" W
42° 37' 52" N
42° 37' 20" N
337400
337500
337600
337700
337800
337900
338000
338100
338200
338300
338400
338500
338600
338700
338800
4721700
4721600
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4721400
4721300
4721200
4721100
4721000
4720900
4720800
717E
711C
421D
1
421B
713A
255B
421C
31A
73A
6A
718A
255A
421C
256A
711C
713A
31A
95
51A
711C
651
1
31A
256A
254C
Exit 51
253B
31A
Endicott
254A
260B
717E
711C
6A
254A
255B
421D
257E
32B
713A
Soil Map may not be valid at this scale.
Map Scale: 1:6,840 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
100
200
400
600
Feet
0
300
600
1200
1800
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 19, Sep 10, 2023

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Map Unit Legend (Soil Map)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	0.5	0.2%
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	9.0	3.9%
31A	Walpole sandy loam, 0 to 3 percent slopes	11.3	4.9%
32B	Wareham loamy sand, 3 to 8 percent slopes	0.7	0.3%
51A	Swansea muck, 0 to 1 percent slopes	1.2	0.5%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	1.9	0.8%
253B	Hinckley loamy sand, 3 to 8 percent slopes	2.4	1.0%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	6.9	3.0%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	1.7	0.7%
255A	Windsor loamy sand, 0 to 3 percent slopes	7.5	3.3%
255B	Windsor loamy sand, 3 to 8 percent slopes	3.3	1.4%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	12.7	5.5%
257E	Hinckley and Windsor soils, 25 to 35 percent slopes	1.1	0.5%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	0.2	0.1%
421B	Canton fine sandy loam, 0 to 8 percent slopes, very stony	5.5	2.4%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	1.1	0.5%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	6.0	2.6%
651	Udorthents, smoothed	61.4	26.8%
711C	Charlton-Rock outcrop-Hollis complex, 8 to 15 percent slopes	17.2	7.5%
713A	Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded	3.9	1.7%
717E	Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes	4.8	2.1%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
718A	Saco variant silt loam, frequently ponded, 0 to 1 percent slopes, frequently flooded	68.7	30.1%
Totals for Area of Interest		**228.6**	**100.0%**

Map Unit Descriptions (Soil Map)

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

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

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

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

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

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

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

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

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

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

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

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

HALEY & ALDRICH, INC.
465 Medford St.
Suite 2200
Boston, MA 02129
617.886.7400

30 August 2023
File No. 0207135-000

Stantec
40 Water Street
Boston, MA 02109

Attention: Josh Atkinson

Subject: Geotechnical Letter
Masconomet Regional School District Field Renovations
Boxford, MA

Ladies and Gentlemen:

This letter report provides a summary of the subsurface explorations conducted for the Masconomet Regional School District Phase 1 of the Synthetic Turf Feasibility Study located at 20 Endicott Road, Boxford, MA (refer to Figure 1). The purpose of the subsurface investigation program was to obtain information on the subsurface conditions and provide geotechnical design recommendations and construction considerations for the two (2) proposed synthetic turf fields to replace the existing natural grass athletic fields, design of new athletic lighting foundations, and design of athletic support structures. The work reported herein was undertaken by Haley & Aldrich, Inc. (Haley & Aldrich) in accordance with our agreement dated 20 December 2022 and your subsequent written authorization.

Site Conditions

EXISTING CONDITIONS

The project site consists of two (2) natural grass athletic fields that were constructed between 2002 and 2003 according to historic aerial images. Prior to construction, the area of the existing soccer field (shown on the left in Image 1) was a school building and the area of the lacrosse field (on the right in Image 1) was undeveloped. Existing site grades are approximately Elevation (El.) 54 (NAVD88)[1] at the soccer field and El. 51 at the lacrosse field. At the time of this report, documents for demolition of the school building or construction documents for the new fields were not available for our review.

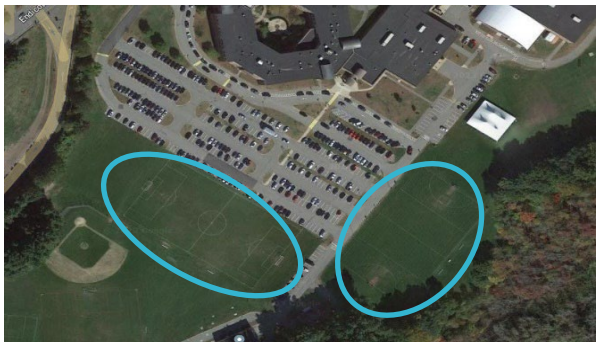

Image 1 Image taken from Google Maps. Approximate limits of Phase 1 work shown in "blue"

[1] Elevations in this report are in feet and reference the North American Vertical Datum of 1988 (NAVD88).

PROPOSED RENOVATION

We understand that the Phase 1 renovations are proposed to replace the existing grass fields with artificial turf fields and install sports lighting, bleachers, and an athletic support building containing restrooms, team rooms, concessions, and storage space.

Subsurface Investigation Program

TEST BORING AND GEOPROBE EXPLORATIONS

The designation and approximate location of subsurface explorations are indicated on the attached Figure 1. The locations of the recent subsurface explorations were measured in the field by Haley & Aldrich personnel from existing site features and therefore are considered approximate.

Between 17 July and 24 July 2023, Northern Drill Service, Inc. of Northborough, Massachusetts conducted a total of eight (8) test boring explorations designated as HA-1 through HA-8 and twenty (20) geoprobe explorations designated as GP-1 through GP-18, INFL-1, and INFL-2. The test boring explorations were drilling to depths ranging from 27 to 32 feet (ft) below ground surface (bgs) using a truck-mounted drill rig. The geoprobes were each drilled to 10 ft bgs using a track-mounted geoprobe rig. Refer to the test boring and geoprobe logs included in Appendix A for additional information.

SUBSURFACE CONDITIONS

Subsurface soil conditions encountered in the recent explorations consisted of the following generalized sequence of subsurface units, listed in descending order of occurrence below ground surface.

Generalized Subsurface Stratum	Depth Top of Stratum (ft)	Stratum Thickness (ft)
Topsoil	0.0	0.5 to 2.0
Fill	0.5 to 2.0	0.8 to 10.0
Glacial Deposits	1.0 to 11.2	Not Determined

A detailed description of the units encountered is provided below.

Topsoil – Topsoil was encountered in each of the subsurface explorations at ground surface up to 2.0 ft bgs. The topsoil generally consisted of brown silty SAND with varying amounts of gravel, grass roots, plant matter.

Fill – The Fill encountered generally consisted of medium dense dark brown SAND with varying amounts of silt, gravel, asphalt, brick, and grass roots. Where encountered, the Fill layer generally ranged from 0.8 to 10.0 ft in thickness. Fill encountered in HA-7 and HA-8 also included either pockets or 1 to 3 inch (in.) thick layers of organic soil. Fill was not encountered in explorations HA-3, GP-11, GP-15, or INFL-2.

Glacial Deposits – Glacial Deposits were encountered below the fill or topsoil in each exploration between 1.0 to 11.2 ft bgs. The Glacial Deposits (Glaciolacustrine Deposits) generally consisted of loose to medium dense gray to light brown poorly-graded SAND with varying amounts of silt and gravel.

GROUNDWATER MEASUREMENTS

Groundwater was encountered at depths between 6.0 and 10.1 ft bgs during drilling the test boring explorations.

Groundwater observation wells were not installed as part of the recently completed subsurface exploration program. Groundwater levels recorded during drilling of the test boring explorations are not anticipated to have stabilized and may not represent actual groundwater conditions at the site. Additionally, groundwater levels are also influenced by precipitation, the presence of below grade structures and utilities in the area, leakage into or out of utility pipes, the infiltration of surface water runoff, building underdrain systems, localized water recharging and other factors. Groundwater conditions encountered during subsequent site visits and/or during construction may differ from those reported herein.

Soil Laboratory Testing

Grain size distribution testing was performed on two (2) samples, one sample collected from each of the geoprobes INFL-1 and INFL-2 to support preliminary efforts for the proposed infiltration design. The soil samples (collected from 5 to 10 ft below ground surface) were submitted to the Haley & Aldrich Geotechnical Laboratory for soil grain size analysis. Soil grain size analyses indicate the soils at depths between 5 and 10 ft below ground surface were characterized as poorly graded SAND with varying amounts of silt. The soil sample at the INFL-1 location had 12% fines, whereas the soil sample at the INFL-2 location had 35% fines. The results of the grain size analyses are included in Appendix B.

Based on preliminary review of soil grain size distribution test results and our calculated estimates for infiltration rates within the Glaciolacustrine Deposits, Haley & Aldrich recommends an estimated infiltration value of 5.0 in/hr and 0.1 in/hr be utilized for evaluating infiltration system locations at the INFL-1 and INFL-2 locations, respectively. As the infiltration design is progressed further, additional testing will be required to meet stormwater design regulations.

Geotechnical Design Considerations

Site Development

Construction will require management of existing on-site materials. In order to minimize the cost of transporting and disposing of material off-site, every effort should be made by the designers and contractor to process and reuse excavated material on-site, whether in landscaped areas around the site, or for material meeting specific geotechnical criteria as backfill.

Existing utilities to be abandoned will require cut-and-capping beyond the plan limits of the work and/or complete removal. Existing, active utilities to remain and new utilities to be installed will require coordination with new work to avoid potential design conflicts, and construction activities will need to be coordinated to not impact operation of active utilities to remain or new utilities to be constructed. Additionally, construction activities will need to be coordinated to not interrupt/impact underground utilities.

Synthetic Turf Field

- We understand that the new field is planned to be constructed such that the playing surface will be generally at the same grade as the current natural grass field. As such, preparation of the subgrade immediately below the synthetic turf system will require excavation/stripping and removal of all Topsoil. Depending on final design subgrade preparation, this may also include excavation of Fill and natural soils within the limits of the field.

- In some areas where the anticipated topsoil thickness extends below the design subgrade elevation, we recommend that the excavation extend to a depth to completely remove the topsoil materials, followed by controlled placement and compaction of an approved backfill material up to design subgrade elevation. Backfill materials may include previously excavated fill soils encountered during the stripping/removal of the near surface soils or may require importing granular fill. At a minimum, imported backfill shall consist of well graded granular materials containing less than 20% fines. Backfill placed to raise grades to the design subgrade elevation shall be compacted to 95% of the material's maximum dry unit weight (determined in accordance with ASTM D1557) using appropriate compactive efforts. As a minimum, each layer of fill should receive four complete coverages with suitable compaction equipment.

- Re-use of any excavated soils will be dependent upon visual characterization of the materials and results of grain size analyses and laboratory compaction tests. Accordingly, we recommend to the extent possible, that an on-site location be established for segregating and stockpiling excavated soils.

- Following completion of excavation to strip/remove the near surface soils down to design subgrade elevation for the turf system, static roll the surface using a large compaction roller to prepare a firm, dry and stable subgrade. If, during static rolling of the subgrades pumping or weaving conditions are observed, alternate compaction techniques may be required and/or additional subgrade preparation may be recommended (e.g., removal and replacement of soft, compressible soils).

- At all times prior to placement of the turf system, we recommend maintaining a dry and undisturbed design subgrade to promote a stable working surface to receive the turf system. Temporary re-grading outside the limits of the new field may be considered to divert possible surface water runoff away from the work areas. Construction dewatering is not anticipated to be required; however, if it becomes necessary, the contractor shall make efforts to discharge dewatering effluent on-site at distances away from the work areas so as not to disturb subgrade preparation and to allow for construction in-the-dry.

- The turf system subgrade soils are anticipated to consist primarily of Fill or Glacial Deposits. In the event the work is conducted during winter conditions, be advised that these types of soils could be susceptible to disturbance due to freezing and thawing temperatures and the contractor would have to sequence their operations, including protection of exposed and excavated (i.e., stockpiled) soils from moisture, to allow for successful completion of the work.

- For the permanent condition, the maintenance, protection and long-term performance of the synthetic turf field will require an effective stormwater runoff collection and management system. At a minimum, the sub-turf drainage systems must be designed such that the system is entirely and at all times above groundwater level. Pending further discussions with Stantec regarding final surface grading and estimated runoff volume calculations, we recommend a sub-turf drainage system design comprised of a layer of double-washed, 3/4-in. crushed stone (Stantec to determine minimum thickness required) with perforated HDPE pipes (sized by Stantec) embedded within the crushed stone to effectively collect and transport by gravity any accumulated runoff water that filters from the turf layer above to an appropriately sized on-site collection/groundwater recharge/infiltration system (or direct discharge into a permitted storm drain). Prior to placing the crushed stone and perforated piping, a nonwoven geotextile fabric (Mirafi 160N or similar) should be placed on top of the prepared and approved subgrade.

Sport Lighting and Bleacher System

As a general recommendation, foundation design and construction should be performed in accordance with applicable provisions of the 9th Edition of the Massachusetts State Building Code. If construction permits are obtained after the new 10th Edition of the Building Code is promulgated or the grace period, if one is granted, then Haley & Aldrich will need to review the recommendations provided herein to ensure that they address any changes to the Building Code.

Typically, the lighting system includes a pre-cast concrete "base" encased in concrete and designed to bear on natural inorganic soils. The diameter and design depth of the foundation element into the Glacial Deposits will depend on the anticipated combined foundation loadings (vertical, lateral and moment loads) calculated by the designer of the foundations based on the criteria in the below table.

Sport Lighting Foundation Design Criteria

	Fill	Glacial Deposits
Total Unit Weight (lb/ft^3)	120	125
Buoyant Unit Weight (lb/ft^3)	57.6	62.6
Effective Friction Angle (deg)	25	30
Undrained Shear Strength (psf)	NA	NA
Active Earth Pressure Coefficient (K_a)	0.4	0.33
Passive Earth Pressure Coefficient (K_p)	1.6 (1)	2.0 (1)

Note:
1. Passive Earth Pressure Coefficient (K_p) includes a factor of safety of 1.5.

Footing foundations for the Bleacher System should be designed based on an allowable bearing pressure of 3.0 kips per square foot (ksf) in the glacial deposits. The footing should bear at least 4 ft below the lowest ground surface exposed to freezing. Footings should be designed to provide resistance to sliding, overturning, and uplift. We recommend a minimum factor of safety of 1.5 for sliding, and 2.0 for overturning.

Athletics Support Building (restroom, team rooms, concessions, and storage)

The following recommendations pertain to the permanent design of the at grade proposed structure, intended primarily for members of the project team responsible for design. As we currently understand, below grade space is not anticipated as part of the design for the proposed structure.

- The building site can be classified as Seismic Site Class D.

- Excavations to Glacial Deposits will be required to achieve footing foundation subgrades. Accordingly, construction of the building may be supported on conventional footing foundations. Foundation bearing conditions are anticipated to consist of naturally deposited Glacial Deposits or compacted Granular Fill bearing on glacial soil subgrades.

- Footing foundations should be designed to bear on naturally deposited inorganic Glacial Deposits or on compacted Granular Fill after removal of unsuitable materials at an allowable bearing pressure of 3 ksf.

- Footings founded on soils should bear a minimum of 4 ft below the lowest adjacent ground surface exposed to freezing.

- For footings with least lateral dimension less than 3 ft, the allowable bearing pressure in tons per square foot should be 1/3 of the recommended allowable bearing pressure multiplied by the least lateral dimension in feet. In no instance should footings be less than 18 in. wide.

- Footings shall bear below a line drawn upward and outward on a 2 horizontal to 1 vertical slope from the bottom outside edge of any utility trenches, or other localized excavation, located below-grade or below slab.

- It is recommended that the ground floor slab be designed as a slab-on-grade, bearing directly on a minimum thickness of 12 in. of compacted Granular Fill placed on a prepared soil subgrade.

- Lateral loads acting on the structure can be resisted by passive earth pressures acting against below grade portions of the structure such as footings or grade beams and frictional resistance between the bottom of concrete foundations and the underlying soil. Passive forces to resist lateral loads may be calculated based on an equivalent fluid unit weight of soil equal to 300 pounds per cubic foot (pcf). This value assumes that granular backfill is placed and systematically compacted in lifts. If the backfill is not systematically compacted, an equivalent fluid weight of 100 pcf should be used.

- In computing frictional resistance forces between soil and concrete on the underside of footings, a coefficient of friction equal to 0.5 is recommended for design. Note: This would not apply to soil supported slabs having vapor protection beneath.

Construction Considerations

The primary purpose of this section of the report is to comment on items related to excavation, earthwork, and related geotechnical engineering aspects of the proposed construction.

Subgrade Preparation

The Fill and Glacial soils on-site generally contain large quantities of fine-grained materials (fine sand with varying amounts of silt) and will be susceptible to weaving during compaction during rain events which may require changes in compaction techniques. As such, management of soils during subgrade preparation for the synthetic turf field will require surface water and erosion control.

As mentioned previously in this report, the existing natural grass soccer field is located within the limits of a former school building. Demolition documents were not available at the time of this report, but as noted in the geoprobe logs asphalt and bricks were noted within the Fill. If building demolition debris greater than 12-in. diameter is observed at subgrade elevation, the demolition debris should be removed, disposed off-site, and the excavation backfilled with granular onsite soils or compacted Granular Fill.

Following completion of excavation to strip/remove the near-surface soils down to design subgrade elevation for the turf system, static roll the subgrade using a large compaction roller to prepare a firm, dry, and stable subgrade. If, during static rolling of the subgrades pumping or weaving conditions are observed, alternate compaction techniques may be required and/or additional subgrade preparation may be recommended (e.g., removal and replacement of soft, compressible soils). Tree stumps and roots should be removed to the degree possible and when encountered.

At all times prior to placement of the turf system, we recommend maintaining a dry and undisturbed design subgrade to ensure a stable working surface to receive the turf system. Temporary re-grading outside the limits of the new field will be required to divert surface runoff away from the work areas. Construction dewatering is not anticipated; however, if it becomes necessary, efforts should be taken by the contractor to discharge dewatering effluent on-site at distances away from the work areas so as not to disturb subgrade preparation.

Filling and Backfilling

Compacted Granular Fill beneath the fields should consist of suitable bank-run sand and gravel, free of clay, organic material, snow, ice, or other unsuitable materials and should be well-graded within the following limits:

Sieve Size	Percent Finer by Weight
3 in.	100
No. 4	30 - 90
No. 40	10 - 50
No. 200	0 - 8

Compacted Granular Fill should be placed in loose lift thicknesses not exceeding 9 in. and should be compacted to a dry density of at least 95% of the maximum dry density as determined in accordance with ASTM Test Designation D1557. As a minimum, each layer of fill should receive four complete coverages with suitable compaction equipment.

Control of Surface Water Runoff

Control of surface water runoff into excavations will be necessary in order to retain the integrity of the subgrade soils. The contractor should control the flow of surface water into excavations at all times. Careful water control will be necessary to retain the integrity of the subgrade soils. Dewatering of excavations during construction can likely be performed using collection trenches and shallow sump wells. Every effort should be made to collect and recharge collected water on-site. If off-site discharge of collected water is required, dewatering will need to be performed with all applicable Federal, State and Local Regulations.

Handling and Disposal of Excavated Soil

In order to minimize the cost of transporting and disposing of material off-site, every effort should be made by the designers and contractor to reuse excavated material on-site, whether in landscaped areas around the site, or for material meeting specific geotechnical criteria as backfill.

The excavation work will most likely generate quantities of excavated soils, a portion of which will require special handling during off-site disposal. The management of these excavated soils must be performed in compliance with all applicable Federal, State, and Local Regulations.

Limitations

This report was prepared in accordance with our authorized Agreement with Stantec and our proposal dated 20 December 2022. This report has been prepared for the specific application to the Masconomet Regional School District Phase 1 of the Synthetic Turf Feasibility Study.

The nature and extent of variations in the subsurface conditions between explorations may not become evident until construction, and the project design may change from our current understanding. Any additional information pertaining to the project that becomes available should be provided to Haley & Aldrich, so that our conclusions and recommendations can be reviewed and modified, as necessary.

We appreciate the opportunity to provide engineering services on this project. Please do not hesitate to call if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.

Megan Hamilton, PE (NY)
Assistant Project Manager

R. Scott Goldkamp, PE (MA/NH)
Principal

Attachments:

Figure 1 – Site and Subsurface Exploration Location Plan
Appendix A – Test Boring and Geoprobe Exploration Logs
Appendix B – Geotechnical Laboratory Test Results

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LEGEND

HA-1

DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING DRILLED BETWEEN 17 AND 20 JULY 2023 BY NEW ENGLAND BORING CONTRACTORS AND OBSERVED BY HALEY & ALDRICH, INC.

GP-1

DESIGNATION AND APPROXIMATE LOCATION OF GEOPROBE DRILLED BETWEEN 21 AND 24 JULY 2023 BY NEW ENGLAND BORING CONTRACTORS AND OBSERVED BY HALEY & ALDRICH, INC.

NOTES

1. BASE PLAN TAKEN FROM "CONCEPTUAL MASTER PLAN" DRAWING IN THE MASCONOMET REGIONAL SCHOOL DISTRICT SYNTHETIC TURF FEASIBILTY STUDY DATED OCTOBER 2022 AND PROVIDED BY STANTEC.

0' 20' 40' 80' 120'

MASCONOMET FIELD RENOVATIONS
BOXFORD, MASSACHUSETTS

HALEY ALDRICH

SITE AND SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
AUGUST 2023

FIGURE 1

APPENDIX A
Test Boring and Geoprobe Exploration Logs

IDENTIFICATION AND DESCRIPTION OF SUBSURFACE MATERIALS

SOIL

Soil description on logs of subsurface explorations are based on Standard Penetration Test results, visual-manual examination of exposed soil and soil samples, and the results of laboratory tests on selected samples. The criteria, descriptive terms and definitions are as follows:

DENSITY OR CONSISTENCY

Density of Cohesionless Soils	Penetration Resistance (Blows per ft.)	Consistency of Cohesive Soils	Penetration Resistance (Blows per ft.)
Very Loose	0-4	Very Soft	0-2
Loose	5-10	Soft	3-4
Medium	11-30	Medium	5-8
Dense	31-50	Stiff	9-15
Very Dense	over 50	Very Stiff	16-30
		Hard	over 30

PENETRATION RESISTANCE

Standard Penetration Test (ASTM D-1586) - Number of blows required to drive a standard 2 in. O.D. split spoon sampler 1 ft. with a 140 lb. weight falling freely through 30 in.

COLOR: Basic colors and combinations: black, brown, gray, yellow-brown, etc.

SUPPLEMENTAL SOIL TERMINOLOGY:

Laminae	- 0 to 1/16 in. thick (cohesive)
Parting	- 0 to 1/16 in. thick (granular)
Seam	- 1/16 to 1/2 in. thick
Layer	- 1/2 to 12 in. thick
Stratum	- > 12 in. thick
Pocket	- Small, erratic deposit less than 12 in. size
Lens	- Lenticular deposit larger than a pocket
Occasional	- One or less per 12 in. of thickness
Frequent	- More than one per 12 in. of thickness
Interbedded	- Alternating soil layers of differing composition
Varved	- Alternating thin seams of silt and clay
Mottled	- Variation of color

GEOLOGIC INTERPRETATION

Deposit type - GLACIAL TILL, ALLUVIUM, FILL.....

The natural soils are identified by criteria of Unified Soil Classification System (USCS), with appropriate group symbol in parenthesis for each soil description. Fill materials may not be classified by USCS criteria.

U.S. Standard Series Seive — Clear Square Sieve Openings

12"	3"	3/4"	4	10	40	200
Boulders	Cobbles	Gravel: Coarse / Fine		Sand: Coarse / Medium / Fine		Silts and Clays
305 mm	76 mm	19 mm	4.75 mm	2.00 mm	0.43 mm	0.074 mm

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			Group Symbol	Graphic Symbol	TYPICAL NAMES
Coarse grained soils: more than half is larger than number 200 sieve	Gravels: More than half of coarse fraction is larger than number 4 sieve	Gravels with little or no fines	GW		Well graded gravels, gravel-sand mixtures
			GP		Poorly graded gravels, gravel-sand mixtures
		Gravels with over 12% fines	GM		Silty gravels, poorly graded gravel-sand-silt mixtures
			GC		Clayey gravels, poorly graded gravel-sand-clay mixtures
	Sands: More than half of coarse fraction is smaller than number 4 sieve	Sands with little or no fines	SW		Well graded sands, gravelly sands
			SP		Poorly graded sands, gravelly sands
		Sands with over 12% fines	SM		Silty sands, poorly graded sand-silt mixtures
			SC		Clayey sands, poorly graded sand-clay mixtures
Fined-grained soils: more than half smaller than number 200 sieve	Silts and Clays: Liquid limit 50% or less		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL		Organic clays and organic silty clays of low plasticity
	Silts and Clays: Liquid limit greater than 50%		MH		Inorganic silty, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH		Inorganic clays of high plasticity, fat clays
			OH		Organic clays of medium to high plasticity, organic silts
Highly organic soils			PT		Peat and other highly organic soils

GENERAL NOTES

1. Logs of subsurface explorations depict soil, rock and groundwater conditions only at the locations specified on the dates indicated. Subsurface conditions may vary at other locations and at other times.
2. Water levels noted on the logs were measured at the times and under the conditions indicated. During test borings, these water levels could have been affected by the introduction of water into the borehole, extraction of tools on other procedures and thus may not reflect actual groundwater level at the test boring location. Groundwater level fluctuations may also occur as a result of variations in precipitation, temperature, season, tides, adjacent construction activities and pumping of water supply wells and construction dewatering systems.

ROCK

Rock descriptions noted on logs of subsurface explorations are based on visual-manual examination of exposed rock outcrops and core samples. The criteria, descriptive terms and definitions used are as follows:

FIELD HARDNESS: A measure of resistance to scratching.

Very Hard	Cannot be scratched with a knife point or sharp pick.
Hard	Can be scratched with a knife point or sharp pick, only with difficulty.
Moderately Hard	Can be readily scratched with a knife point or pick.
Medium Hard	Can be grooved or gouged 1/16 in. deep with firm pressure on a knife point or sharp pick.
Soft	Can be grooved or gouged easily with a knife point or pick.
Very Soft	Can be carved with a knife and excavated with a pick point.

WEATHERING: The action of organic and inorganic and chemical and physical processes resulting in alteration of color, texture and composition.

Fresh-FR	No visible sign of alteration, except perhaps slight discoloration on major discontinuity surfaces.
Slight-SL	Discoloration of rock material and discontinuity surfaces. All rock may be discolored and/or somewhat weaker than in its fresh condition.
Moderate-MOD	Less than half the rock material is decomposed and/or disintegrated to a soil. Some fresh or discolored rock is present as either a continuous framework or as corestones.
High-HIGH	More than half the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present as either a discontinuous framework or as corestones.
Complete-COMP	All rock material is decomposed and/or disintegrated to soil. The original mass structure is largely intact.
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There has been a large change of volume, but the material has not been significantly transported.

COLOR: Basic colors and combinations: gray, light gray, brown, red-brown.

TEXTURE: Size, shape and arrangements of constituents.

Term	Size: Igneous	Size: Sedimentary
Coarse-grained	> 5 mm	> 2 mm
Medium-grained	1 - 5 mm	0.625 - 2 mm
Fine-grained	< 1 mm	< 0.625 mm
Aphanitic	Individual grains invisible to the unaided eye.	

LITHOLOGY: Rock classification and modifiers; accepted formation names.

DISCONTINUITIES:

Type	Definition
Joint	A natural fracture along which no displacement has occurred. May occur in parallel groups called sets.
Shear	A natural fracture along which displacement has occurred. Surface may be slickensided or striated.
Fault	A natural fracture along which displacement has occurred. Usually lined with gouge and slickensides.
Shear or Fault Zone	Zone of fractured rock and gouge bordering the displacement plane.

ORIENTATION/ATTITUDE:

Term	Angle (degrees)
Horizontal	0-5
Low Angle	6-35
Moderately Dipping	36-55
High Angle	56-85
Vertical	86-100

SPACING:

Discontinuity Term	Bedding Term	Inches
Extremely Close	Extremely Thin	< 3/4
Very Close	Very Thin	3/4 - 2.5
Close	Thin	2.5 - 8
Moderate	Medium	8 - 24
Wide	Thick	24 - 80
Very Wide	Very Thick	80 - 240
Extremely Wide	Extremely Thick	> 240

PERSISTENCE/CONTINUITY:

Term	Feet
Very Low	0-3
Low	3-10
Medium	10-35
High	35-65
Very High	> 65

APERTURE/GAP:

Term	Distance
Very Tight	< 0.1mm
Tight	0.1mm-0.25mm
Partly Open	0.25mm-0.5mm
Open	0.5mm-2.5mm
Moderately Wide	2.5mm-1cm
Wide	> 1cm
Very Wide	1cm-10cm
Extremely Wide	10cm-1m
Cavernous	> 1m

POROSITY:

Type

Primary:
Pre-depositional and depositional inter- and intra- granular, particle, or crystalline pores.

Secondary:
Solution features including pits, vugs, caverns, molds, and channels.
Fracture features including joints, shears, faults, shrinkage and breccia fabrics.

Term	Size
Micro	< 0.0625 mm
Meso	0.0625-4.0 mm
Mega	4.0-256 mm

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SUBSURFACE EXPLORATION KEY

J:\GRAPHICS\TEMP\MCELENEY-TF\FIELD SERVICES\SUBSURFACE EXPLORATION LOG KEYS\SUBSURFACE EXPLORATION KEY2008-1027.DWG

TEST BORING REPORT

Boring No. HA-1

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 0207135-000
Sheet No. 1 of 2
Start 18 July 2023
Finish 18 July 2023
Driller S. Shaw
H&A Rep. F. Tierney
Elevation 54.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S		Rig Make & Model: Mobile Drill B53
Inside Diameter (in.)	4.0	1.4		Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW driven to 25 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		GB1	0.0 2.0	SM	53.5	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	25	40	25				
				SM	0.5	-TOPSOIL-		5	5	25	50	15				
					52.0	Dark brown to orange silty SAND (SM), no structure, slight organic odor, moist, glass bottle, trash, 10% grass roots and surface organics										
	4 6 6 6	S2 22	2.0 4.0	SP	2.0	-FILL- Medium dense tan to orange poorly-graded SAND (SP), no structure, no odor, dry			5	10	85					
5	6 9 11 8	S3 22	4.0 6.0	SP		Medium dense tan to poorly-graded SAND (SP), no structure, no odor, dry -GLACIOLACUSTRINE DEPOSITS-			5	10	85					
	10 10 11 7	S4 17	6.0 8.0	SP		Medium dense tan to poorly-graded SAND (SP), no structure, no odor, dry			5	15	80					
	6 7 7 8	S5 23	8.0 10.0	SP		Medium dense tan poorly-graded SAND (SP), frequently bedded, no odor, moist, frequent layers of orange alteration					100					
10	5 6 7 7	S6 10	10.0 12.0	SP		Medium dense tan poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration				5	95					
15	5 6 9 8	S7 13	15.0 17.0	SP		Medium dense tan poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration				5	95					
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/18/23	09:12		25.0	27.0	9.1
07/18/23	09:38		0.0	27.0	7.4

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 27.0
Rock Cored (ft) -
Samples S9

Boring No. HA-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-1
File No. 0207135-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	5 4 2 4	S8 21	20.0 22.0	SP		Medium dense tan poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration -GLACIOLACUSTRINE DEPOSITS-				5	95					
25	9 16 19 19	S9	25.0 27.0	SP		Medium dense tan poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration				5	95					
					27.0 27.0	BOTTOM OF EXPLORATION 27.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-1

TEST BORING REPORT

Boring No. HA-2

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 0207135-000
Sheet No. 1 of 2
Start 17 July 2023
Finish 17 July 2023
Driller S. Shaw
H&A Rep. F. Tierney
Elevation 54.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S		Rig Make & Model: Mobile Drill B53
Inside Diameter (in.)	4.0	1.4		Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW driven to 25 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		GB1	0.0 2.0	SM		Dark brown silty SAND with gravel (SM), no structure, slight organic odor, moist, trace 2-in. asphalt fragments	5	5	10	15	35	30				
					52.0 2.0	-TOPSOIL-										
	9 11 13 12	S2 23	2.0 4.0	SM	51.2 2.8	Medium dense dark brown silty SAND with gravel (SM), no structure, slight organic odor, moist, trace 2-in. asphalt fragments	5	5	10	15	35	30				
				SP		-FILL-					100					
						Light brown to orange poorly-graded SAND (SP), frequently varved, no odor, moist										
	12 14 13 10	S3 23	4.0 6.0	SP		Medium dense tan poorly-graded SAND (SP), infrequently mottled, no odor, dry				5	95					
5						-GLACIOLACUSTRINE DEPOSITS-										
	11 8 9 6	S4 23	6.0 8.0	SP		Medium dense tan poorly-graded SAND (SP), frequently bedded, no odor, moist, frequent layers of orange alteration					100					
	6 6 7 5	S5 24	8.0 10.0	SP		Medium dense light brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration					100					
10	4 5 6 7	S6	10.0 12.0	SP		Medium dense gray-brown and light brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration					100					
15	6 8 9 9	S7 15	15.0 17.0	SP		Medium dense gray-brown and light brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration					100					
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/17/23	12:22	0.0	15.0	27.0	7.4
07/17/23	13:22	0.0	0.0	27.0	9.4

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 27.0
Rock Cored (ft) -
Samples S7

Boring No. HA-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-2
File No. 0207135-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	6 6 6 6	S8 20	20.0 22.0	SP		Medium dense gray-brown and light brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration -GLACIOLACUSTRINE DEPOSITS-					100					
25	4 4 5 6	S9 18	25.0 27.0	SP		Loose gray-brown and light brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration					100					
					27.0 27.0	BOTTOM OF EXPLORATION 27.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-2

TEST BORING REPORT

Boring No. HA-3

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 0207135-000
Sheet No. 1 of 2
Start 17 July 2023
Finish 17 July 2023
Driller S. Shaw
H&A Rep. F. Tierney
Elevation 54.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S		Rig Make & Model: Mobile Drill B53
Inside Diameter (in.)	4.0	1.4		Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW driven to 25 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		GB1	0.0 2.0	SM		Dark brown and brown silty SAND with gravel (SM), no structure, slight organic odor, moist	5	5	10	15	35	30				
					53.0 1.0	Note: Encountered piece of fragmented iron pipe.										
	9 9 11 12	S2 20	1.0 3.0	SP		-TOPSOIL- Medium dense light brown poorly-graded SAND (SP), no structure, no odor, dry			5	10	85					
	13 13 12 12	S3 23	3.0 5.0	SP		Medium dense tan poorly-graded SAND (SP), infrequently mottled, no odor, dry -GLACIOLACUSTRINE DEPOSITS-				5	95					
5	11 9 9 8	S4 24	5.0 7.0	SP		Medium dense tan poorly-graded SAND (SP), infrequently mottled, no odor, dry				5	95					
	9 7 6 6	S5 21	7.0 9.0	SP		Medium dense tan and light brown poorly-graded SAND (SP), no odor, moist				5	95					
10	5 7 7 8	S6 11	9.0 11.0	SP		Medium dense gray-brown and light brown poorly-graded SAND (SP), no structure, no odor, moist					95	5				
15	5 9 9 8	S7 15	15.0 17.0	SP		Medium dense light brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration					100					
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/17/23	10:17	0.0	25.0	27.0	8.5
07/17/23	11:16		0.0	27.0	9.8

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 27.0
Rock Cored (ft) -
Samples S9

Boring No. HA-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-3
File No. 0207135-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	4 6 5 5	S8 15	20.0 22.0	SP		Medium dense tan poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration Note: Mica and coarse sand in wash.					100					
						-GLACIOLACUSTRINE DEPOSITS-										
25	10 12 12 10	S9 13	25.0 27.0	SP		Tan poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers fine sand					100					
					27.0 27.0	BOTTOM OF EXPLORATION 27.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-3

TEST BORING REPORT

Boring No. HA-4

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 0207135-000
Sheet No. 1 of 2
Start 20 July 2023
Finish 20 July 2023
Driller S. Shaw
H&A Rep. F. Tierney
Elevation 54.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S		Rig Make & Model: Mobile Drill B53
Inside Diameter (in.)	4.0	1.4		Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW driven to 25 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		GB1	0.0 2.0	SM		Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	25	40	25				
					52.0	-TOPSOIL-										
	15 14 9 6	S2 18	2.0 4.0	SM	2.0	Medium dense dark brown and gray silty SAND (SM), no structure, no odor, dry to moist		5	5	20	40	30				
						-FILL-										
	13 14 14 9	S3 21	4.0 6.0	SM	49.7 4.3	Medium dense brown silty SAND (SM), no structure, no odor, dry			5	20	60	15				
5				SP		Medium dense tan poorly-graded SAND (SP), no structure, no odor, dry				10	90					
						-GLACIOLACUSTRINE DEPOSITS-										
	10 8 8 6	S4 18	6.0 8.0	SP		Loose to medium dense tan poorly-graded SAND (SP), no structure, no odor, dry				10	90					
				SP		Medium dense light brown and orange poorly-graded SAND (SP), frequently bedded, no odor, moist					100					
	6 4 4 5	S5 18	8.0 10.0	SP		Loose light brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet					100					
10	3 4 4 6	S6 13	10.0 12.0	SP		Loose gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange and brown alteration					100					
15	4 4 5 4	S7 18	15.0 17.0	SP		Loose gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange and brown alteration					100					
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/20/23	12:46		15.0	27.0	9.2
07/20/23	12:55		0.0	27.0	8.8

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 27.0
Rock Cored (ft) -
Samples S9

Boring No. HA-4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-4
File No. 0207135-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	5 7 8 10	S8 15	20.0 22.0	SP		Medium dense gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of brown alteration -GLACIOLACUSTRINE DEPOSITS-					100					
25	8 10 11 13	S9 17	25.0 27.0	SP		Medium dense gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of brown alteration					95	5				
					27.0 27.0	BOTTOM OF EXPLORATION 27.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-4

TEST BORING REPORT

Boring No. HA-5

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 0207135-000
Sheet No. 1 of 2
Start 20 July 2023
Finish 20 July 2023
Driller S. Shaw
H&A Rep. F. Tierney
Elevation 54.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S		Rig Make & Model: Mobile Drill B53
Inside Diameter (in.)	4.0	1.4		Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW driven to 25 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		GB1	0.0 2.0	SM	53.0	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	25	40	25				
				SM	1.0	-TOPSOIL-		5	5	25	50	15				
	8 9 14 14	S2 20	2.0 4.0		51.5	Medium dense dark brown to orange silty SAND (SM), no structure, slight organic odor, moist, 10% grass roots and surface organics -FILL-										
				SP	2.5	Medium dense light brown to tan poorly-graded SAND (SP), infrequently bedded, no odor, dry				10	90					
	4 17 14 12	S3 20	4.0 6.0	SP		Dense light brown and tan poorly-graded SAND (SP), infrequently bedded, no odor, dry, infrequent layers of orange alteration				5	95					
5						-GLACIOLACUSTRINE DEPOSITS-										
	7 11 9 12	S4 4	6.0 8.0	SM		Medium dense brown and tan silty SAND (SM), no structure, no odor, dry to moist			5	5	70	20				
	10 7 7 7	S5 22	8.0 10.0	SP		Medium dense gray-brown to light brown poorly-graded SAND (SP), infrequently bedded, no odor, moist	5			5	90					
10	4 5 6 8	S6 12	10.0 12.0	SP		Medium dense gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet					100					
15	4 4 2 5	S7 18	15.0 17.0	SP		Loose gray-brown to light brown poorly-graded SAND (SP), frequently bedded, wet					100					
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/20/23	11:54		15.0	27.0	9.5

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 27.0
Rock Cored (ft) -
Samples S9

Boring No. HA-5

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-5
File No. 0207135-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	2 3 6 3	S8 23	20.0 22.0	SP		Loose gray-brown poorly-graded SAND (SP), frequently bedded, no odor, wet -GLACIOLACUSTRINE DEPOSITS-					95	5				
25	6 5 4 5	S9 16	25.0 27.0	SP		Loose gray-brown poorly-graded SAND (SP), frequently bedded, no odor, wet					95	5				
					27.0 27.0	BOTTOM OF EXPLORATION 27.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-5

TEST BORING REPORT

Boring No. HA-6

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 0207135-000
Sheet No. 1 of 2
Start 19 July 2023
Finish 19 July 2023
Driller S. Shaw
H&A Rep. F. Tierney
Elevation 51.0
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S		Rig Make & Model: Mobile Drill B53
Inside Diameter (in.)	4.0	1.4		Bit Type: Roller Bit
Hammer Weight (lb)	150	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW driven to 25 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		GB1	0.0 1.5	SM	49.5 1.5	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter -TOPSOIL-		5	5	25	40	25				
				SP		Light brown to tan poorly-graded SAND (SP), no structure, no odor, dry -FILL-			5	10	75	10				
	10 12 10 10	S2 21	3.0 5.0		47.0 4.0											
				SP		Medium dense tan poorly-graded SAND (SP), bedded, no odor, dry to moist					100					
5	9 12 11 10	S3 20	5.0 7.0	SP		Medium dense tan poorly-graded SAND (SP), frequently bedded, no odor, dry to moist -GLACIOLACUSTRINE DEPOSITS-					100					
	10 8 6 7	S4 24	7.0 9.0	SP		Medium dense tan to gray-brown poorly-graded SAND (SP), infrequently bedded, no odor, moist					100					
10	5 6 7 7	S5 13	9.0 11.0	SP		Medium dense tan to orange poorly-graded SAND (SP), infrequently bedded, no odor, wet					100					
	7 8 7 7	S6 15	11.0 13.0	SP		Medium dense gray-brown to orange poorly-graded SAND (SP), infrequently bedded, no odor, wet					100					
15																
	7 5 7 11	S7 22	16.0 18.0	SP		Medium dense gray-brown poorly-graded SAND (SP), infrequently bedded, no odor, wet					100					
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/19/23	11:20		15.0	28.0	9.0
07/19/23	12:20		0.0	28.0	10.1

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	28.0
Rock Cored (ft)	-
Samples	S9

Boring No. HA-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-6
File No. 0207135-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	11 15 17 20	S8 20	21.0 23.0	SP		Dense gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet					100					
						-GLACIOLACUSTRINE DEPOSITS-										
25																
	11 11 15 12	S9 17	26.0 28.0	SP		Medium dense gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet					100					
					23.0 28.0	BOTTOM OF EXPLORATION 28.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-6

TEST BORING REPORT

Boring No. HA-7

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 0207135-000
Sheet No. 1 of 2
Start 18 July 2023
Finish 18 July 2023
Driller S. Shaw
H&A Rep. F. Tierney
Elevation 51.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S		Rig Make & Model: Mobile Drill B53
Inside Diameter (in.)	4.0	1.4		Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW driven to 25 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		GB1	0.0 2.0	SM	50.0	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	25	40	25				
				SP	1.0	-TOPSOIL-			5	10	75	10				
	4 3 4 3	S2 20	2.0 4.0	SM		Light brown poorly-graded SAND (SP), no structure, no odor, dry Loose brown and tan silty SAND (SM), no structure, no odor, dry -FILL-				10	75	15				
5	2 3 4 2	S3 8	4.0 6.0	SM		Loose brown silty SAND (SM), no structure, no odor, moist			5	10	65	20				
	1 1 2 2	S4 18	6.0 8.0	SM		Very loose brown silty SAND (SM), no structure, no odor, moist, appears disturbed				5	75	20				
	1 2 1 2	S5 16	8.0 10.0	SM		Very loose brown silty SAND (SM), no structure, no odor, moist				5	75	20				
10	2 1 3 2	S6 14	10.0 12.0	SM		Dark brown silty SAND (SM), no structure, no odor, moist, trace organic soil pockets, trace rootlets from 9 to 9.7 ft Black 50% wood, 0.2-in. to 1-in. wood chips, 50% fine sand and organic soil pockets, appears disturbed, observed from 9.7 to 10 ft in S5 and 10 to 11 ft in S6					70	30				
				SP	40.0 11.0	Medium dense tan to gray-brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration -GLACIOLACUSTRINE DEPOSITS-				5	95				
15	10 10 10 10	S7 17	15.0 17.0	SP		Medium dense tan to gray-brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration				5	95				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/18/23	11:31	0.0	25.0	30.0	9.9
07/18/23	11:45		0.0	32.0	9.4

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 32.0
Rock Cored (ft) -
Samples S10

Boring No. HA-7

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-7
File No. 0207135-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	5 5 8 9	S8	20.0 22.0	SP		Medium dense tan to gray-brown poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration -GLACIOLACUSTRINE DEPOSITS-				5	95					
25	8 13 14 16	S9 19	25.0 27.0	SP		Medium dense gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration, orange iron staining at 26.5 ft				5	95					
30	5 11 12 12	S10 18	30.0 32.0	SP		Medium dense gray-brown and orange poorly-graded SAND (SP), frequently bedded, no odor, wet, frequent layers of orange alteration, orange iron staining at 31.5 ft				5	95					
					19.0 32.0	BOTTOM OF EXPLORATION 32.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-7

TEST BORING REPORT

Boring No. HA-8

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 0207135-000
Sheet No. 1 of 2
Start 19 July 2023
Finish 19 July 2023
Driller S. Shaw
H&A Rep. F. Tierney
Elevation 51.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S		Rig Make & Model: Mobile Drill B53
Inside Diameter (in.)	4.0	1.4		Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW driven to 25 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		GB1	0.0 – 0.2	SM		Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	25	40	25				
					49.6	-TOPSOIL-										
				SP	1.4 / 49.0	Light brown poorly-graded SAND (SP), no structure, no odor, dry			5	10	75	10				
	3 2 3 3	S2 21	2.0 – 4.0	SM	2.0	Loose light brown and tan silty SAND (SM), no structure, no odor, dry				10	75	15				
						-FILL-										
	8 8 8	S3 19	4.0 – 5.5	SP-SM		Medium dense light brown and tan poorly-graded SAND with silt (SP-SM), no structure, no odor, dry, infrequent 1-in. to 3-in. layers of brown organic soil				10	80	10				
5																
	12 14 13 8	S4 22	6.0 – 8.0	SP		Medium dense light brown and tan poorly-graded SAND (SP), no structure, no odor, dry to moist, infrequent 1-in. to 3-in. layers of brown organic soil, appears disturbed			5	10	85					
	7 6 6 6	S5 24	8.0 – 10.0	SP		Medium dense light brown and orange poorly-graded SAND (SP), no structure, no odor, moist to wet, infrequent 1-in. to 3-in. layers of brown organic soil, appears disturbed			5	10	80	5				
10	2 4 7 8	S6 15	10.0 – 12.0	SP		Medium dense light brown and orange poorly-graded SAND (SP), no structure, no odor, moist to wet, appears disturbed			5	10	80	5				
				SP	39.8 / 11.2	Medium dense gray-brown poorly-graded SAND (SP), layered, no odor, wet, frequent layers of brown and orange alteration					100					
						-GLACIOLACUSTRINE DEPOSITS-										
15	2 5 7 8	S7 17	15.0 – 17.0	SP		Medium dense gray-brown poorly-graded SAND (SP), layered, no odor, wet, frequent layers of brown and orange alteration					100					
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/19/23	09:52		15.0	32.0	6.0

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 32.0
Rock Cored (ft) -
Samples S10

Boring No. HA-8

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-8
File No. 0207135-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	5 7 7 7	S8 21	20.0 22.0	SP		Medium dense gray-brown and orange poorly-graded SAND (SP), layered, no odor, wet, frequent layers of brown and orange alteration -GLACIOLACUSTRINE DEPOSITS-					100					
25	7 9 8 9	S9 14	25.0 27.0	SP		Medium dense gray-brown and orange poorly-graded SAND (SP), layered, no odor, wet, frequent layers of brown and orange alteration					100					
30	6 6 8 10	S10 16	30.0 32.0	SM		Medium dense gray-brown and orange silty SAND (SM), layered, no odor, wet, frequent layers of brown and orange alteration					70	30				
					19.0 32.0	BOTTOM OF EXPLORATION 32.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-8

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-1

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	P U S H	G1 57	0.0 5.0	53.5	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
				0.5	SM	-TOPSOIL-	5	5	5	25	45	15				
				51.9		Brown and tan silty SAND with gravel (SM), no structure, no odor, dry to moist, trace brick, trace asphalt fragments and gravel										
				2.1	SP	-FILL-			5	10	80	5				
						Orange to tan poorly-graded SAND (SP), no structure, no odor, dry										
						-GLACIOLACUSTRINE DEPOSITS-										
				49.5												
5				4.5	SP	Gray-brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist				5	95					
	P U S H	G2 48	5.0 10.0			-GLACIOLACUSTRINE DEPOSITS-										
10				44.0												
				10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Splitspoon Sample
- G - Geoprobe

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-2

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 60	0.0 5.0	53.2	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
				0.8	SM	-TOPSOIL-	5	5	5	25	45	15				
				52.0		Dark brown and tan silty SAND with gravel (SM), no structure, no odor, dry to moist, trace grass roots and surface organics, trace brick, trace asphalt fragments and gravel										
				2.0	SP	-FILL-			5	10	80	5				
						Orange to tan poorly-graded SAND (SP), no structure, no odor, dry										
						-GLACIOLACUSTRINE DEPOSITS-										
5	PUSH	G2 56	5.0 10.0													
				46.2												
				7.8	SP	Tan to light brown poorly-graded SAND (SP), frequently bedded, no odor, dry to moist				100						
						-GLACIOLACUSTRINE DEPOSITS-										
10				44.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-3

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Cutting Head
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	P U S H	G1 56	0.0 5.0	52.8	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
				1.2		-TOPSOIL-										
					SP	Orange to tan poorly-graded SAND (SP), no structure, no odor, dry			5	10	80	5				
				51.6		-GLACIOLACUSTRINE DEPOSITS-										
				2.4	SP	Light brown and tan poorly-graded SAND (SP), frequently bedded, dry to moist					100					
						-GLACIOLACUSTRINE DEPOSITS-										
5	P U S H	G2 52	5.0 10.0													
10				44.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-4

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 42	0.0 5.0	53.6 0.4	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
					SM	-TOPSOIL-	5	10	10	10	45	20				
						Dark brown to brown (SM), no structure, no odor, dry to moist, 15% cobbles										
						-FILL-										
5	PUSH	G2 60	5.0 10.0	47.3 6.7	SP	Orange to tan poorly-graded SAND (SP), no structure, no odor, dry			5	10	80	5				
						-GLACIOLACUSTRINE DEPOSITS-										
				46.0 8.0	SP	Tan to light brown poorly-graded SAND (SP), frequently bedded, no odor, dry to moist					100					
						-GLACIOLACUSTRINE DEPOSITS-										
10				44.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Splitspoon Sample
- G - Geoprobe

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-5

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 43	0.0 5.0	53.5 0.5	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
					SM	-TOPSOIL-	5	5	5	25	45	15				
						Brown silty SAND (SM), no structure, no odor, dry to moist, trace grass roots and surface organics, trace brick, trace asphalt fragments and gravel										
						-FILL-										
5	PUSH	G2 60	5.0 10.0													
				47.3 6.7	SP	Tan to light brown poorly-graded SAND (SP), infrequently bedded, no odor, dry to moist				100						
						-GLACIOLACUSTRINE DEPOSITS-										
10				44.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-6

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	P U S H	G1 45	0.0 5.0	53.0 1.0	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
					SM	-TOPSOIL-	5	5	5	25	45	15				
						Dark brown and tan silty SAND with gravel (SM), no structure, no odor, dry to moist, trace grass roots and surface organics, trace brick, trace asphalt fragments and gravel										
						-FILL-										
5	P U S H	G2 22	5.0 10.0													
10				44.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-7

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 46	0.0 5.0	53.0	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
				1.0		-TOPSOIL-										
				52.0		Gray to black fragmented asphalt and gravel										
				2.0		-ASPHALT-										
					SP	Orange to tan poorly-graded SAND (SP), no structure, no odor, dry			5	10	80	5				
						-GLACIOLACUSTRINE DEPOSITS-										
5	PUSH	G2 48	5.0 10.0													
				45.5												
				8.5	SP	Tan to light-brown poorly-graded SAND (SP), frequently bedded, no odor, dry to moist					100					
10				44.0		-GLACIOLACUSTRINE DEPOSITS-										
				10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-7

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-8

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 50	0.0 5.0	53.5 0.5	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
					SM	-TOPSOIL-	5	5	5	25	45	15				
						Brown to light brown silty SAND (SM), no structure, slight organic odor, moist, 5% to 10% asphalt fragments, trace brick										
				50.8		-FILL-										
				3.2	SP	Tan poorly-graded SAND (SP), occasional layer, no odor, dry				10	85	5				
5	PUSH	G2 60	5.0 10.0			-GLACIOLACUSTRINE DEPOSITS-										
				46.7 7.3	SP	Tan to light brown poorly-graded SAND (SP), frequently bedded, no odor, dry to moist					100					
						-GLACIOLACUSTRINE DEPOSITS-										
10				44.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-8

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-9

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 51	0.0 5.0	52.1	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter -TOPSOIL-		5	5	20	40	30				
				1.9	SM	Medium dense dark brown to orange silty SAND (SM), no structure, slight organic odor, moist, 10% grass roots and surface organics -FILL-	5	5	5	25	45	15				
				50.0 4.0	SP	Orange to tan poorly-graded SAND (SP), no structure, no odor, dry -GLACIOLACUSTRINE DEPOSITS-			5	10	80	5				
5	PUSH	G2 60	5.0 10.0	47.4 6.6	SP	Tan to light-brown poorly-graded SAND (SP), infrequently bedded, no odor, dry to moist -GLACIOLACUSTRINE DEPOSITS-					100					
10				44.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-9

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-10

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 48	0.0 5.0	50.6	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
				0.4	SP	-TOPSOIL-	5	5	5	10	65	10				
						Light brown poorly-graded SAND with gravel (SP), no structure, no odor, dry, trace asphalt, trace grass roots, trace brick										
				48.4		-FILL-										
				2.6	SP	Orange to tan poorly-graded SAND (SP), infrequently layered, no odor, dry			5	10	80	5				
				47.0		-GLACIOLACUSTRINE DEPOSITS-										
				4.0	SP	Light-brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist				5	95					
5	PUSH	G2 60	5.0 10.0			-GLACIOLACUSTRINE DEPOSITS-										
10				41.0												
				10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-10

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-11

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 42	0.0 5.0	49.6 1.4	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter -TOPSOIL-		5	5	20	40	30				
					SP	Light brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist -GLACIOLACUSTRINE DEPOSITS-		5		5	90					
5	PUSH	G2 42	5.0 10.0													
10				41.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data						Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Splitspoon Sample G - Geoprobe	Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft) 10.0 Rock Cored (ft) - Samples G2 **Boring No. GP-11**

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-12

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 48	0.0 5.0	50.0	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
				1.0	SP	-TOPSOIL- Light brown and brown poorly-graded SAND (SP), no structure, no odor, dry, trace asphalt, trace grass roots, trace brick -FILL-			5	10	75	10				
				48.1 2.9	SP	Orange to tan poorly-graded SAND (SP), infrequently layered, no odor, dry -GLACIOLACUSTRINE DEPOSITS-			5	10	80	5				
5	PUSH	G2 60	5.0 10.0													
				42.8 8.2	SP	Light brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist -GLACIOLACUSTRINE DEPOSITS-				5	95					
10				41.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-12

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-13

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 40	0.0 5.0	50.5 0.5	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
					SP	-TOPSOIL-			5	10	75	10				
				48.6 2.4		Light brown poorly-graded SAND (SP), no structure, no odor, dry, trace asphalt, trace grass roots -FILL-										
					SP	Orange to tan poorly-graded SAND (SP), no structure, no odor, dry -GLACIOLACUSTRINE DEPOSITS-			5	10	80	5				
5	PUSH	G2 54	5.0 10.0													
				43.5 7.5	SP	Gray-brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist -GLACIOLACUSTRINE DEPOSITS-				5	95					
10				41.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-13

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-14

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 58	0.0 5.0	49.3 1.7	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter -TOPSOIL-		5	5	20	40	30				
				48.2 2.8	SP	Light brown and brown poorly-graded SAND (SP), no structure, no odor, dry, trace asphalt, trace grass roots, trace brick -FILL-			5	10	75	10				
					SP	Orange to tan poorly-graded SAND (SP), infrequently layered, no odor, dry -GLACIOLACUSTRINE DEPOSITS-			5	10	80	5				
5	PUSH	G2 60	5.0 10.0													
				44.0 7.0	SP	Light brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist -GLACIOLACUSTRINE DEPOSITS-				5	95					
10				41.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-14

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-15

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 43	0.0 5.0	49.6 1.4	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter -TOPSOIL-		5	5	20	40	30				
					SP	Light brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist -GLACIOLACUSTRINE DEPOSITS-				5	95					
5	PUSH	G2 45	5.0 10.0													
10				41.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data						Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Splitspoon Sample G - Geoprobe	Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft) 10.0 Rock Cored (ft) - Samples G2 **Boring No. GP-15**

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-16

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 60	0.0 5.0	49.7 1.3	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter -TOPSOIL-		5	5	20	40	30				
				47.9 3.1	SP	Light brown and brown poorly-graded SAND (SP), no structure, no odor, dry, trace asphalt, trace grass roots, trace brick -FILL-			5	10	75	10				
					SP	Orange to tan poorly-graded SAND (SP), layer, no odor, dry -GLACIOLACUSTRINE DEPOSITS-			5	10	80	5				
5	PUSH	G2 52	5.0 10.0	44.8 6.2	SP	Light brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist				5	95					
					SP	Gray-brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist -GLACIOLACUSTRINE DEPOSITS-					100					
10				41.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-16

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-17

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	P U S H	G1 55	0.0 5.0	50.5 0.5	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter\		5	5	20	40	30				
				49.4	SP	-TOPSOIL-			5	10	75	10				
				1.6	SP	Light brown poorly-graded SAND (SP), no structure, no odor, dry, trace asphalt, trace grass roots			5	5	90					
						-FILL-										
						Gray-brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist										
						-GLACIOLACUSTRINE DEPOSITS-										
5	P U S H	G2 60	5.0 10.0													
				41.0	SM	Dark brown to brown poorly-graded SAND (SM), frequently bedded, slight organic odor, moist			5	5	70	20				
10				10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Splitspoon Sample
- G - Geoprobe

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

Boring No. GP-17

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. GP-18

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 52	0.0 5.0	49.5 1.5	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter -TOPSOIL-		5	5	20	40	30				
				48.0 3.0	SM	Light brown and gray silty SAND (SM), no structure, no odor, dry to moist, trace brick, trace clay fines, trace asphalt -FILL-		5	5	15	60	15				
					SP	Light brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist -GLACIOLACUSTRINE DEPOSITS-			5	5	90					
5	PUSH	G2 46	5.0 10.0													
10				41.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data						Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Splitspoon Sample G - Geoprobe	Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft) 10.0 Rock Cored (ft) - Samples G2 **Boring No. GP-18**

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. INFL-1

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	21 July 2023
Finish	21 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	54.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	P U S H	G1 50	0.0 5.0	53.1	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
				0.9	SM	-TOPSOIL-	5	5	5	25	45	15				
						Brown and tan silty SAND with gravel (SM), no structure, no odor, dry to moist, trace grass roots and surface organics, trace brick, trace asphalt fragments and gravel										
						-FILL-										
				49.8 4.2	SP	Tan to light brown poorly-graded SAND (SP), infrequently bedded, no odor, moist					90	10				
5	P U S H	G2 55	5.0 10.0			-GLACIOLACUSTRINE DEPOSITS-										
10				44.0 10.0		BOTTOM OF EXPLORATION 10.0 FT.										

Water Level Data						Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Splitspoon Sample G - Geoprobe	Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft) 10.0 Rock Cored (ft) - Samples G2 **Boring No. INFL-1**

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

GEOPROBE REPORT

Boring No. INFL-2

Project	MASCONOMET FIELD RENOVATIONS, BOXFORD, MA
Client	STANTEC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	0207135-000
Sheet No.	1 of 1
Start	24 July 2023
Finish	24 July 2023
Driller	S. Shaw
H&A Rep.	F. Tierney
Elevation	51.0 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		G		Rig Make & Model: Geoprobe 6712DT
Inside Diameter (in.)		1.5		Bit Type: Geoprobe Spoon
Hammer Weight (lb)		AUTO	-	Drill Mud: None
Hammer Fall (in.)			-	Casing: None
				Hoist/Hammer: Winch Automatic hammer
				PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME & SYMBOL, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	PUSH	G1 60	0.0 5.0	50.0 1.0	SM	Dark brown silty SAND (SM), no structure, slight organic odor, moist, 10% to 20% grass roots and plant matter		5	5	20	40	30				
					SP	-TOPSOIL-										
						Light brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist				5	95					
						-GLACIOLACUSTRINE DEPOSITS-										
5	PUSH	G2 60	5.0 10.0		SP	Light brown to tan poorly-graded SAND (SP), frequently bedded, no odor, moist				5	60	35				
10				41.0 10.0		BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Splitspoon Sample
G - Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	G2

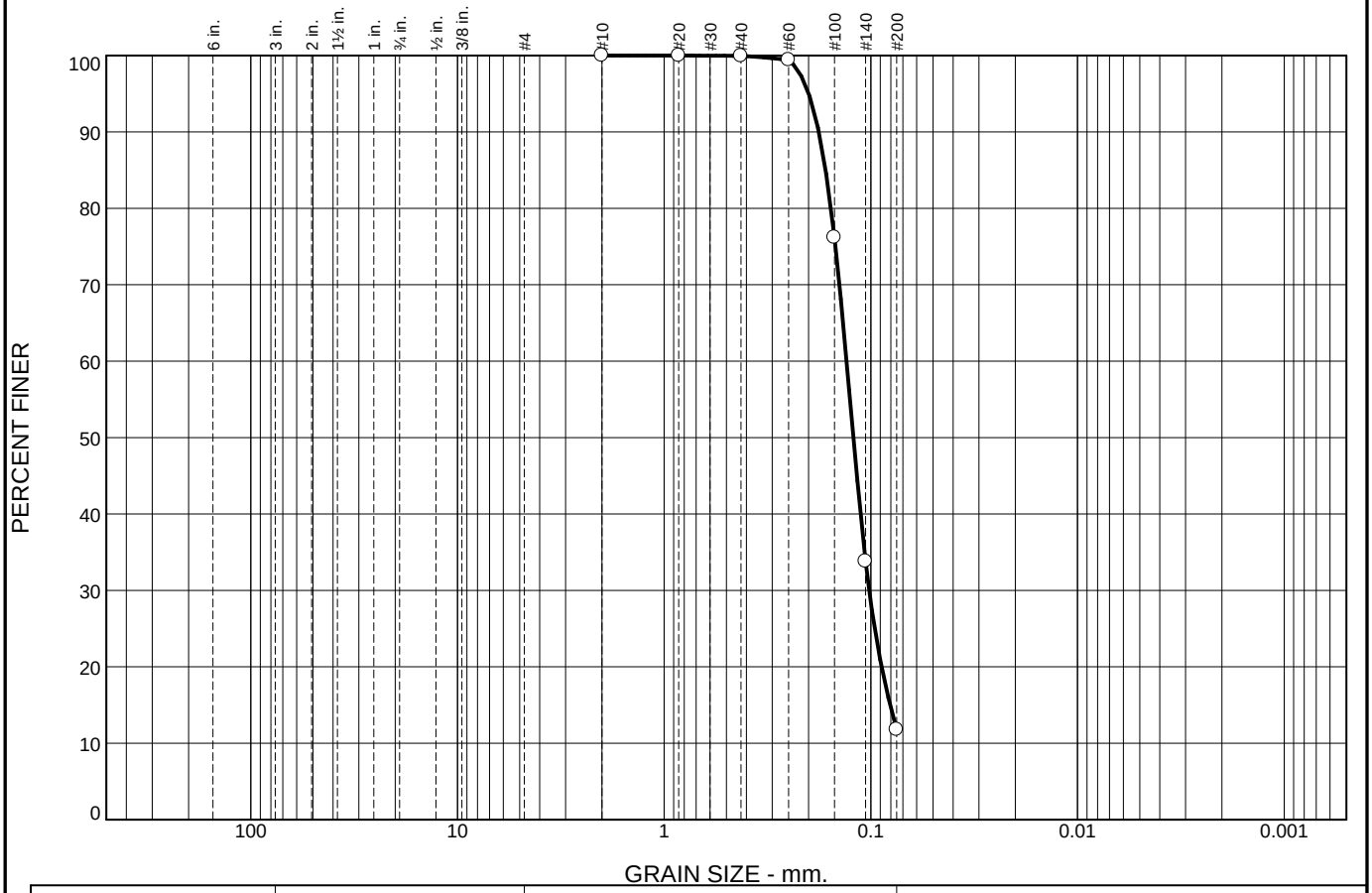
Boring No. INFL-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

APPENDIX B
Geotechnical Laboratory Test Results

U.S. STANDARD SIEVE SIZE



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.0	88.2	11.8	

	Expl. No.	Sample No.	Depth (ft)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	INFL-1	S01	5.0-10.0				22.6			SP-SM

	Sample Description
○	Light brown poorly graded sand with silt

Remarks:

HALEY ALDRICH

Masconomet Field Improvements
Boxford, Massachusetts

GRAIN SIZE DISTRIBUTION

DATE: 8/1/2023

FILE NO: 207135-000

U.S. STANDARD SIEVE SIZE

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.2	0.3	2.1	61.0	35.4	1.0

	Expl. No.	Sample No.	Depth (ft)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	INFL-2	S01	5.0-10.0				19.3	8.35	1.01	SM

	Sample Description
○	Light brown silty sand

Remarks:

HALEY ALDRICH

Masconomet Field Improvements
Boxford, Massachusetts

GRAIN SIZE DISTRIBUTION

DATE: 8/8/2023

FILE NO: 207135-000

Appendix B SUPPORTING STORMWATER CALCULATIONS

RECHARGE VOLUME CALCULATIONS

DRAWDOWN CALCULATIONS

STAGE-STORAGE TABLES

Stantec

Stantec Planning and Landscape Architecture P.C.
40 Water Street, 3rd Floor
Boston, MA 02109

Recharge Volume Calculations

Project:	Masconomet Field	Project #:	210801991
Location:	Boxford, MA	Date:	12/14/2023
Calculated by:	AA	Revised:	
Checked by:	GR		

Recharge Volume Calculations

Objective: To size a groundwater recharge systems that will approximate the annual recharge of pre-development conditions.

Methodology: MassDEP Stormwater Handbook (Volume Three, Chapter 1). Utilize the Static Method for the sizing of the infiltration BMPs.

Design Criteria/Recharge Requirements:

Hydrologic Soil Group	Volume to Recharge	
A	0.60	inches times Total Imp. Area
B	0.35	inches times Total Imp. Area
C	0.25	inches times Total Imp. Area
D	0.10	inches times Total Imp. Area

In accordance with the above Recharge Requirements table, 0.25 inches times the total impervious area of HSG "C" type soils. Poor soil conditions and high bedrock make infiltration in the portions of the site with HSG "D" soils infeasible.

Required Recharge Volume:

Area Summary

Total Proposed Impervious Area =	**201,690**	sf
Existing Impervious Area =	**132,252**	sf
Impervious Area to be Recharged =	**69,438**	sf
Impervious Area Draining to Infiltration BMPs=	**92,947**	sf

Required Recharge

Hydrologic Soil Group =	*HSG A*	*HSG B*	*HSG C*	*HSG D*	**Σ**	
Δ Impervious Area within Soil Group =	69,438	0	0	0	**69,438**	sf
Required Recharge Depth =	0.60	0.35	0.25	0.10	**------**	in/sf impervious
Required Recharge Volume =	3,472	0	0	0	**3,472**	cf

Provided Recharge Volume:

Commercial Systems:

Subsurface Infiltration System "FIELD-1"
System Outlet Elevation = 53.75 ft
System Storage Capacity at Outlet Elevation = 6,751 cf

Subsurface Infiltration System "PERF-1"
System Outlet Elevation = 50.05 ft
System Storage Capacity at Outlet Elevation = 3,779 cf

Subsurface Infiltration System "FIELD-2"
System Outlet Elevation = 51.25 ft
System Storage Capacity at Outlet Elevation = 6,198 cf

Subsurface Infiltration System "PERF-2"
System Outlet Elevation = 44.95 ft
System Storage Capacity at Outlet Elevation = 1,365 cf

Provided Recharge Volume Summary:

Commercial Systems

	Area (sf)	Hydrologic Soil Group	Provided Recharge per System (cf)
Impervious Area Contributing to Pond "FIELD-1" =	0	A	6,751
Impervious Area Contributing to Pond "PERF-1" =	57,680	A	3,779
Impervious Area Contributing to Pond "FIELD-2" =	0	A	6,198
Impervious Area Contributing to Pond "PERF-2" =	35,267	A	1,365
Impervious Area Draining to Infiltration BMP =	**92,947**		**18,093**

Summary:

Cumulative Storage (cf) = **18,093** > **3,472**

Stantec Planning and Landscape Architecture P.C.
40 Water Street, 3rd Floor
Boston, MA 02109

Drawdown Calculations

Project:	Masconomet Field	Project #:	210801991
Location:	Boxford, MA	Date:	12/14/2023
Calculated by:	AA	Revised:	
Checked by:	GR		

Drawdown Calculations

Objective: Demonstrate that all infiltration BMPs drawdown within 72 hours of a rain event.

Methodology: MassDEP Stormwater Handbook (Volume Three, Chapter 1).

Design Criteria: For infiltration systems sized using the Static Method, the drawdown calculation shall utilize the Rawls Rate for exfiltration.

$$\text{Drawdown Time} = \frac{Rv}{(K \times \text{Bottom Area})}$$

Where: Rv = Required Recharge Volume
K = Permeability Rate

Drawdown Time:

72-Hour Drawdown Summary (Recharge Volume)

Infiltration BMP	K (in/hr)	Bottom Area (sf)	Rv (cf)	Rv Drawdown Time (hr)
Subsurface Infiltration System "FIELD-1"	2.41	89,400	6,751	0.4
Subsurface Infiltration System "PERF-1"	2.41	4,950	3,779	3.8
Subsurface Infiltration System "FIELD-2"	2.41	82,641	6,198	0.4
Subsurface Infiltration System "PERF-2"	2.41	3,400	1,365	2.0

The infiltration BMPs draw down within 72 hours. Therefore, the Project complies with 72-hour drawdown requirement of Standard 3.

Stage-Area-Storage for Pond FIELD-1: Subsurface Stone

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
53.50	**90,007**	0
53.52	90,007	540
53.54	90,007	1,080
53.56	90,007	1,620
53.58	90,007	2,160
53.60	90,007	2,700
53.62	90,007	3,240
53.64	90,007	3,780
53.66	90,007	4,320
53.68	90,007	4,860
53.70	90,007	5,400
53.72	90,007	5,940
53.74	90,007	6,481
53.76	90,007	7,021
53.78	90,007	7,561
53.80	90,007	8,101
53.82	90,007	8,641
53.84	90,007	9,181
53.86	90,007	9,721
53.88	90,007	10,261
53.90	90,007	10,801
53.92	90,007	11,341
53.94	90,007	11,881
53.96	90,007	12,421
53.98	90,007	12,961
54.00	90,007	13,501
54.02	90,007	14,041
54.04	90,007	14,581
54.06	90,007	15,121
54.08	90,007	15,661
54.10	90,007	16,201
54.12	90,007	16,741
54.14	90,007	17,281
54.16	90,007	17,821
54.18	90,007	18,361
54.20	90,007	18,901
54.22	90,007	19,442
54.24	90,007	19,982
54.26	90,007	20,522
54.28	90,007	21,062
54.30	90,007	21,602
54.32	90,007	22,142
54.34	90,007	22,682
54.36	90,007	23,222
54.38	90,007	23,762
54.40	90,007	24,302
54.42	90,007	24,842
54.44	90,007	25,382
54.46	90,007	25,922
54.48	90,007	26,462
54.50	90,007	**27,002**
54.52	90,007	27,002
54.54	90,007	27,002
54.56	90,007	27,002
54.58	90,007	27,002
54.60	90,007	27,002
54.62	90,007	27,002
54.64	90,007	27,002
54.66	90,007	27,002
54.68	90,007	27,002
54.70	90,007	27,002
54.72	90,007	27,002
54.74	90,007	27,002

Stage-Area-Storage for Pond FIELD-2: Subsurface Stone

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
51.00	**82,641**	0
51.02	82,641	496
51.04	82,641	992
51.06	82,641	1,488
51.08	82,641	1,983
51.10	82,641	2,479
51.12	82,641	2,975
51.14	82,641	3,471
51.16	82,641	3,967
51.18	82,641	4,463
51.20	82,641	4,958
51.22	82,641	5,454
51.24	82,641	5,950
51.26	82,641	6,446
51.28	82,641	6,942
51.30	82,641	7,438
51.32	82,641	7,934
51.34	82,641	8,429
51.36	82,641	8,925
51.38	82,641	9,421
51.40	82,641	9,917
51.42	82,641	10,413
51.44	82,641	10,909
51.46	82,641	11,404
51.48	82,641	11,900
51.50	82,641	12,396
51.52	82,641	12,892
51.54	82,641	13,388
51.56	82,641	13,884
51.58	82,641	14,380
51.60	82,641	14,875
51.62	82,641	15,371
51.64	82,641	15,867
51.66	82,641	16,363
51.68	82,641	16,859
51.70	82,641	17,355
51.72	82,641	17,850
51.74	82,641	18,346
51.76	82,641	18,842
51.78	82,641	19,338
51.80	82,641	19,834
51.82	82,641	20,330
51.84	82,641	20,826
51.86	82,641	21,321
51.88	82,641	21,817
51.90	82,641	22,313
51.92	82,641	22,809
51.94	82,641	23,305
51.96	82,641	23,801
51.98	82,641	24,296
52.00	82,641	**24,792**
52.02	82,641	24,792
52.04	82,641	24,792
52.06	82,641	24,792
52.08	82,641	24,792
52.10	82,641	24,792
52.12	82,641	24,792
52.14	82,641	24,792
52.16	82,641	24,792
52.18	82,641	24,792
52.20	82,641	24,792
52.22	82,641	24,792
52.24	82,641	24,792

Stage-Area-Storage for Pond PERF-1: 42" Perforated Pipe

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
47.25	**4,950**	0
47.30	4,950	74
47.35	4,950	149
47.40	4,950	223
47.45	4,950	297
47.50	4,950	371
47.55	4,950	445
47.60	4,950	520
47.65	4,950	594
47.70	4,950	668
47.75	4,950	743
47.80	4,950	838
47.85	4,950	951
47.90	4,950	1,075
47.95	4,950	1,208
48.00	4,950	1,349
48.05	4,950	1,495
48.10	4,950	1,648
48.15	4,950	1,805
48.20	4,950	1,968
48.25	4,950	2,134
48.30	4,950	2,305
48.35	4,950	2,479
48.40	4,950	2,656
48.45	4,950	2,837
48.50	4,950	3,020
48.55	4,950	3,206
48.60	4,950	3,395
48.65	4,950	3,586
48.70	4,950	3,779
48.75	4,950	3,974
48.80	4,950	4,171
48.85	4,950	4,370
48.90	4,950	4,570
48.95	4,950	4,771
49.00	4,950	4,974
49.05	4,950	5,178
49.10	4,950	5,383
49.15	4,950	5,589
49.20	4,950	5,795
49.25	4,950	6,003
49.30	4,950	6,211
49.35	4,950	6,419
49.40	4,950	6,628
49.45	4,950	6,836
49.50	4,950	7,045
49.55	4,950	7,254
49.60	4,950	7,463
49.65	4,950	7,672
49.70	4,950	7,880
49.75	4,950	8,088
49.80	4,950	8,295
49.85	4,950	8,502
49.90	4,950	8,708
49.95	4,950	8,913
50.00	4,950	9,117
50.05	4,950	9,320
50.10	4,950	9,521
50.15	4,950	9,721
50.20	4,950	9,920
50.25	4,950	10,117
50.30	4,950	10,312
50.35	4,950	10,505
50.40	4,950	10,696
50.45	4,950	10,884
50.50	4,950	11,071
50.55	4,950	11,254
50.60	4,950	11,435
50.65	4,950	11,612
50.70	4,950	11,786
50.75	4,950	11,957
50.80	4,950	12,123
50.85	4,950	12,285
50.90	4,950	12,443
50.95	4,950	12,595
51.00	4,950	12,742
51.05	4,950	12,882
51.10	4,950	13,015
51.15	4,950	13,140
51.20	4,950	13,253
51.25	4,950	13,348
51.30	4,950	13,423
51.35	4,950	13,497
51.40	4,950	13,571
51.45	4,950	13,645
51.50	4,950	13,720
51.55	4,950	13,794
51.60	4,950	13,868
51.65	4,950	13,942
51.70	4,950	14,017
51.75	4,950	**14,091**

Stage-Area-Storage for Pond PERF-2: 36" Perforated Pipe

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
44.00	**3,400**	0
44.05	3,400	51
44.10	3,400	102
44.15	3,400	153
44.20	3,400	204
44.25	3,400	255
44.30	3,400	306
44.35	3,400	357
44.40	3,400	408
44.45	3,400	459
44.50	3,400	510
44.55	3,400	576
44.60	3,400	655
44.65	3,400	742
44.70	3,400	834
44.75	3,400	932
44.80	3,400	1,035
44.85	3,400	1,141
44.90	3,400	1,251
44.95	3,400	1,365
45.00	3,400	1,481
45.05	3,400	1,600
45.10	3,400	1,721
45.15	3,400	1,844
45.20	3,400	1,970
45.25	3,400	2,097
45.30	3,400	2,226
45.35	3,400	2,357
45.40	3,400	2,489
45.45	3,400	2,623
45.50	3,400	2,757
45.55	3,400	2,893
45.60	3,400	3,029
45.65	3,400	3,167
45.70	3,400	3,305
45.75	3,400	3,444
45.80	3,400	3,583
45.85	3,400	3,723
45.90	3,400	3,863
45.95	3,400	4,003
46.00	3,400	4,143
46.05	3,400	4,283
46.10	3,400	4,423
46.15	3,400	4,563
46.20	3,400	4,703
46.25	3,400	4,842
46.30	3,400	4,981
46.35	3,400	5,119
46.40	3,400	5,256
46.45	3,400	5,393
46.50	3,400	5,529
46.55	3,400	5,663
46.60	3,400	5,797
46.65	3,400	5,929
46.70	3,400	6,059
46.75	3,400	6,189
46.80	3,400	6,316
46.85	3,400	6,442
46.90	3,400	6,565
46.95	3,400	6,686
47.00	3,400	6,805
47.05	3,400	6,921
47.10	3,400	7,034
47.15	3,400	7,144
47.20	3,400	7,251
47.25	3,400	7,353
47.30	3,400	7,451
47.35	3,400	7,544
47.40	3,400	7,631
47.45	3,400	7,710
47.50	3,400	7,776
47.55	3,400	7,827
47.60	3,400	7,878
47.65	3,400	7,929
47.70	3,400	7,980
47.75	3,400	8,031
47.80	3,400	8,082
47.85	3,400	8,133
47.90	3,400	8,184
47.95	3,400	8,235
48.00	3,400	**8,286**

Appendix C WATER QUALITY CALCULATIONS

WATER QUALITY VOLUME CALCULATIONS

TSS REMOVAL WORKSHEET

Stantec Planning and Landscape Architecture P.C.
40 Water Street, 3rd Floor
Boston, MA 02109

Water Quality Volume Calculations

Project:	Masconomet Field	Project #:	210801991
Location:	Boxford, MA	Date:	12/14/2023
Calculated by:	AA	Revised:	
Checked by:	GR		

Water Quality Volume Calculations

Objective: To treat the water quality volume as required by Standard 4 of the MassDEP Stormwater Management Standards

Methodology: MassDEP Stormwater Handbook (Volume Three, Chapter 1).

Design Criteria: Treat a volume of stormwater equal to the product of the contributing onsite impervious area and the required water quality volume factor.

Required Water Quality Volume:

Site Summary	Total Impervious Area =	**201,690**	sf
	Roof Impervious Area =	**9,675**	sf
	Site Impervious Area =	**192,015**	sf

Required Water Quality Volume per infiltration BMP:

	Site Imp. Area (sf)	Water Quality Depth (inch)	Required Water Quality Volume (cf)	Provided Water Quality Volume (cf)
Site Impervious Area Draining to Pond "FIELD-1" =	0	0.5	0	6,751
Site Impervious Area Draining to Pond "PERF-1" =	54,805	0.5	2,284	3,779
Site Impervious Area Draining to Pond "FIELD-2" =	0	0.5	0	6,198
Site Impervious Area Draining to Pond "PERF-2" =	32,267	0.5	1,344	1,365
Impervious Area Draining to Infiltration BMP =	**87,072**	**----**	**3,628**	**18,093**

Note:
1. Impervious Area Contributing to Infiltration BMPs ONLY includes site impervious area and does NOT include roof area, as it is already considered clean.

Provided Water Quality Volume:

Subsurface Infiltration System "FIELD-1"		
System Outlet Elevation =	53.75	ft
System Storage Capacity at Outlet Elevation =	6,751	cf
Subsurface Infiltration System "PERF-1"		
System Outlet Elevation =	50.05	ft
System Storage Capacity at Outlet Elevation =	3,779	cf
Subsurface Infiltration System "FIELD-2"		
System Outlet Elevation =	51.25	ft
System Storage Capacity at Outlet Elevation =	6,198	cf
Subsurface Infiltration System "PERF-2"		
System Outlet Elevation =	44.95	ft
System Storage Capacity at Outlet Elevation =	1,365	cf

Note:
Impervious Area Contributing to Infiltration BMPs ONLY includes site impervious area and does NOT include roof area, as it is already considered clean.

Stantec Planning and Landscape Architecture P.C.
40 Water Street, 3rd Floor
Boston, MA 02109

Total Suspended Soilds (TSS) Removal Worksheet

Project:	Masconomet Field	Project #:	210801991
Location:	Boxford, MA	Date:	12/14/2023
Calculated by:	AA	Revised:	
Checked by:	GR		

Objective: To provide TSS removal as required by Standard 4 of the MassDEP Stormwater Management Standards

Methodology: MassDEP Stormwater Handbook (Volume Three, Chapter 1).

Design Criteria: Treat a volume of stormwater equal to the product of the contributing onsite impervious area and the required water quality volulme factor.

Treatment Train #1

BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (BxC)	Remaining Load (C-D)	TSS Removal Rate
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75	25%
Infiltration Basin	0.80	0.75	0.60	0.15	85%

Total TSS Removal = 85%

Treatment Train #2

BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (BxC)	Remaining Load (C-D)	TSS Removal Rate
Infiltration Basin	0.80	1.00	0.80	0.20	80%

Total TSS Removal = 80%

Appendix D OPERATIONS AND MAINTENANCE PLAN

OPERATIONS AND MAINTENANCE PLAN

OPERATIONS AND MAINTENANCE LOG

OPERATIONS AND MAINTENANCE FIGURE

Operation and Maintenance Plan

Masconomet Regional School District
20 Endicott Road
Boxford, MA 01921

Issued: 1/18/2024

Prepared for:

Michael M. Harvey
Masconomet Regional School District
20 Endicott Road
Boxford, MA 01921

Prepared by:

Stantec Consulting Services, Inc
40 Water Street
Boston, MA 02109

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Executive Summary

The Operation and Maintenance Plan for Masconomet Regional School District Field Renovations, located at 20 Endicott Road, Boxford MA provides current and future operators of the property with site-specific guidance on the Best Management Practices (BMPs) for stormwater controls installed at the property. The stormwater management system constructed at the property includes several stormwater BMPs that require continuous maintenance to ensure that all components function as designed. Insufficient maintenance may result in the deterioration of pollutant controls, a reduction in groundwater recharge, the discharge of pollutants to off-site infrastructure, and property flooding. Pollution prevention measures are grouped into three general categories: non-structural pollutant controls, structural pollutant controls, and spill prevention/good housekeeping. The maintenance program for structural pollutant controls has been developed in according with Volume 2 Chapter 2 of the Massachusetts Department of Environmental Protection's *Massachusetts Stormwater Handbook*. A figure depicting the location of each structural pollutant control is included in Appendix A. An operation and maintenance log for each structural pollutant control is included in Appendix B. The manufacturers' maintenance guidelines for each proprietary structural BMP are included in Appendix C.

1.0 OWNERSHIP/RESPONSIBLE PARTY

1.1 OWNER OF THE SYSTEM

Michael M. Harvey
20 Endicott Road
Boxford, MA 01921

Name: _____

Company: _____

Title: _____

Signature: _____

Date: _____

1.2 RESPONSIBILITY FOR OPERATION AND MAINTENANCE

The land owner of record is the responsible party for the operation and maintenance of the stormwater system. The land owner shall retain a Qualified Inspector who shall submit, on an annual basis by January 1st of each year, a written certification to the Stormwater Agency documenting that work has been done to properly operate and maintain the stormwater management facilities consistent with the approved O&M plan. The [land owner of record] responsible for the operation and maintenance of a stormwater management system shall prepare records of all maintenance and repairs." A copy of the Operation and Maintenance Log form is included in Appendix B.

The Town of Boxford Rules and Regulations for Stormwater Management and Erosion Control (Regulations) designates the Department of Public Works as the administrative agency responsible for implementing and enforcing the rules and regulations. A "Qualified Inspector" defined as "[a] person knowledgeable in the principles and practice of erosion and sediment controls and pollution prevention, who possesses the skills to assess conditions at the construction Site that could impact stormwater quality, and the skills to assess the effectiveness of any stormwater management facilities selected and installed to meet the requirements of this permit. The inspector must have a practical knowledge of stormwater hydrology and stormwater management techniques, including the maintenance requirements

for stormwater management facilities; and the inspector must have the ability to determine if stormwater BMPS and facilities are performing as intended."

1.3 RESPONSIBILITY FOR FINANCING MAINTENANCE AND EMERGENCY REPAIRS

The land owner of record is the responsible party for financing maintenance and emergency repairs for the stormwater system.

1.4 INSPECTION AND MAINTENANCE LOG

An operation and maintenance log can be found under Appendix B. The operation and maintenance log must be updated by the land owner (or their designee), as required, per the Operation and Maintenance Plan. A copy of the operation and maintenance log should be maintained on-site at all times.

2.0 NON-STRUCTURAL POLLUTANT CONTROLS

Non-structural pollutant controls involve prevention procedures that aim to minimize the quantity of sediment, debris, and pollutants that enter the stormwater management system. Non-structural stormwater controls at the property include bituminous asphalt pavement maintenance, the regulation of deicing chemicals, and the use of specialty fertilizers.

2.1 BITUMINOUS ASPHALT PAVEMENT MAINTENANCE

Parking areas on the property generate several stormwater pollutants, such as sediment, salt, heavy metals, and oils/lubricants. Sidewalks generate similar pollutants when pedestrians track pollutants. To prevent pollutants from washing into catch basins during rain events and snow melt, a pavement maintenance program should be instituted. Parking areas should be swept and/or vacuumed quarterly by industrial equipment (e.g. street sweeper). At a minimum, street sweeping should be performed in late fall (October/November), following leaf abscission, and early spring (April/May), following the conclusion of winter surface treatment practices.

2.2 DEICING CHEMICALS

The use of road salt (sodium chloride) should be minimized during winter months to prevent salt from entering the stormwater management system. When permitted, salt substitutes, such as calcium magnesium acetate (CMA) should be used in place of traditional road salt. Furthermore, deicing chemicals should be limited to areas with pedestrian traffic, such as the parking areas and sidewalks connecting the parking areas to the building.

2.3 FERTILIZER USAGE

The use of slow-release, organic fertilizers should be limited within landscaped areas to minimize the amount of nutrients migrating downstream the drainage network. Additionally, fertilizer usage should be reduced once all proposed landscaping areas are established.

3.0 STRUCTURAL POLLUTANT CONTROLS

The proposed stormwater management system is designed to protect runoff water quality through the removal of sediment and pollutants. Minimum operation and maintenance requirements for the structural pollutant controls used to separate and capture stormwater pollutants are described below.

3.1 CATCH BASINS AND AREA DRAINS

All catch basins include a four-foot deep sump and a hooded outlet pipe to trap debris, sediments, and floating contaminants. Area drains located within landscaped areas will include two-foot sumps. This design practice, in coordination with the minimal usage of sand and regular street sweeping, provides a multi-level source control approach that prevents sand, sediment, and litter from discharging to the stormwater detention and infiltration basin. Regular maintenance and cleaning of catch basins and area drains will ensure adequate performance of these structures.

The proper removal of pollutants associated with trash and sediments only occurs when catch basins and area drains are cleaned out regularly. Frequent cleaning will reduce the likelihood that trash and sediments will be re-suspended and discharged from the drain inlet. In addition, frequent cleaning will result in greater available volume for future deposition of trash and sediment. More frequent sweeping of paved surfaces should result in reduced sediment accumulation in catch basins, reduced the cleaning effort required for each downstream stormwater BMP, and reduced disposal costs.

Inspections and Cleaning

- All catch basins shall be inspected at least two times per year at the end of the foliage and snow-removal seasons.
- Sediment and/or floatable pollutants must also be removed two times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. All sediment/pollutants shall be disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction should be repaired.
- During colder periods, the catch basin grates must be kept free of snow and ice.

- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

3.2 DRAINAGE MANHOLES AND OUTLET CONTROL STRUCTURES

Drainage manholes and outlet control structures shall be inspected to remove any sediment build up and to remove any obstructions to the runoff flow. Special care shall be taken to inspect the orifices and above the weir for any potential obstructions.

Inspections and Cleaning

- All drainage manhole structures and outlet control structures shall be inspected at least two times at the end of the foliage and snow-removal seasons.
- Sediment must also be removed two times per year. All sediment/pollutants shall be disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction should be repaired.

3.3 SUBSURFACE INFILTRATION SYSTEM

The manufacturer's recommended maintenance instructions are included in Appendix C. In addition to the manufacturer's recommendations, the subsurface infiltration systems should undergo the following minor and major inspection and cleaning schedule (next page):

Inspections and Cleaning (Minor)

Component	Frequency	Action
Inlets and Outlets	Monthly in first year	• Check inlets and outlets for clogging; remove any debris as required
	Spring and fall of each year	• Check inlets and outlets for clogging; remove any debris as required
	One year after commissioning *and* every third year	• Check inlets and outlets for clogging; remove any debris as required
All System Components	After any storm event greater than 3 inches over 24 hours	• Inspect for operation integrity, and remove any debris as required

Inspections and Cleaning (Major)

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

3.4 VEGETATED AREAS

Although not a structural component of the drainage system, the maintenance of vegetated areas may impact the function of the overall stormwater management system. This includes the health/density of vegetative cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings.

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.

Initial Post-Construction Inspection

During the initial period of vegetation establishment pruning and weeding are required once in first year by contractor or owner. Any dead vegetation/plantings found after the first year should be replaced. Proper mulching is mandatory and regular watering may be required initially to ensure proper establishment of new vegetation.

Long-Term Maintenance

The planted areas should be inspected on a semi-annual basis and any litter removed. Weeds and invasive plant species should be removed by hand. Maintain planted areas adjacent to pavement to prevent soil washout. Immediately clean any soil deposits on pavement. Leaf litter and other detritus should be removed twice per year. If needed to maintain aesthetic appearance, perennial plantings may be trimmed at the end of the growing season.

Trees and shrubs should be inspected annually to evaluate health and attended to as necessary. Seeded ground cover or grass areas should not receive mulching. Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming. Plant alternative mixtures of grass species in the event of unsuccessful establishment. The grass vegetation should not be cut to a height less than four inches.

Fertilizer usage should be avoided. If deemed necessary, slow release fertilizer should be used. Fertilizer should be used to begin the establishment of vegetation in bare or damaged areas, but should not be applied on a regular basis unless necessary. Inspect planted areas on a semi-annual basis and remove any litter.

- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.

- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.

Pesticide/Herbicide Usage

The Project will require that landscaping maintenance contractors implement a program to test soils at the site every five years and to limit the amount of fertilizer, pesticides, and herbicides to only what is needed to maintain healthy plant materials and landscaped areas.

No pesticides or herbicides are to be used unless a single spot treatment is required for a specific control application.

After establishment, fertilizer usage should be avoided. If deemed necessary, slow release fertilizer should be used, and applied only in the minimum amounts recommended by the manufacturer. Once applied, the fertilizer should be worked into the soil to limit exposure to stormwater. Storage should be in a covered area; and the contents of any partially used bags should be transferred to a sealable, plastic bin to avoid spills.

Fertilizer should be used to begin the establishment of vegetation in bare or damaged areas but should not be applied on a regular basis unless necessary.

Records of soil management, application dates, planting dates, preventive measures, treatments, and other appropriate information should be kept. This information should be used as a reference when fertilizer/pesticide/herbicide management decisions in the future.

4.0 SPILL PREVENTION AND GOOD HOUSEKEEPING

4.1 SPILL PREVENTION AND CONTROL

The owner or the property management designee should implement a spill prevention program, which should include stormwater contamination assessment, flow diversion, record keeping, internal reporting, employee training, and preventive maintenance. The Owner or the property management designee should be responsible for training of people in the proper handling and cleanup of spilled materials. No spilled hazardous materials or hazardous wastes should be allowed to come in contact with stormwater discharges. If such contact occurs, the stormwater discharge should be contained on-site until appropriate measures in compliance with state and federal regulations are taken to dispose of such contaminated stormwater.

In order to minimize the potential for a spill of hazardous materials to come into contact with stormwater, the following steps should be implemented:

1. All materials with hazardous properties (such as pesticides, petroleum products, fertilizers, detergents, construction chemicals, acids, paints, paint solvents, cleaning solvents, additives for

soil stabilization, concrete curing compounds and additives, etc.) should be stored in a secure location, with their lids on, preferably under cover, when not in use.

2. The minimum practical quantity of all such materials should be kept on the site.
3. A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic, and metal trash containers, etc.) should be provided at the maintenance area of the site.
4. The manufacturers' recommended methods for spill cleanup should be clearly posted and site personnel should be trained regarding these procedures and the location of the information and cleanup supplies.

In the event of a spill, the following procedures should be followed:

1. The owner or its property management designee should be notified immediately.
2. All spills should be cleaned up immediately after discovery.
3. The spill area should be kept well ventilated and personnel should wear appropriate personal protective equipment (PPE) to prevent injury from contact with the hazardous substances.
4. Materials and equipment necessary for spill cleanup should be kept in the material storage area on-site. Equipment and materials may include, as appropriate, shovels, wheel barrows, brooms, dust pans, mops, rags, gloves, goggles, kitty litter or Speedi-Dry, sand, sawdust, and plastic and metal trash containers specifically designated for this purpose.
5. Spills of toxic or hazardous material in excess of reportable quantities, as established in the Massachusetts Contingency Plan (MCP), should be reported to the Massachusetts Department of Environmental Protection Division of Hazardous Waste (888)304-1133. Additionally, the local fire department should be called immediately at 911.

The owner or its property management designee should be the spill prevention and response coordinator. The owner or its property management designee should designate individuals who should receive spill prevention and response training. These individuals should become responsible for a particular phase of prevention and response. The names of these personnel should be posted in the material storage area and other applicable areas onsite.

4.2 SNOW STORAGE/DISPOSAL

Snow storage/disposal should be allowed in landscaped islands and underutilized parking spaces. Snow should not be stored in the sediment forebays, pea gravel diaphragm, or extended dry detention basin. Storing snow within the sediment forebay or extended dry detention basin may consolidate soil within the BMP (reducing natural infiltration capabilities) or damage vegetation. Snow should not be stored directly on any catch basins as this will impeded snow melt from being capture and result in ponding at other areas of the site.

4.3 MATERIALS MANAGEMENT AND HOUSEKEEPING PRACTICES

The following product-specific practices should be followed on-site. Recommendations are provided for petroleum products, fertilizers, solvents, paints, and other hazardous substances.

4.3.1 Petroleum Products

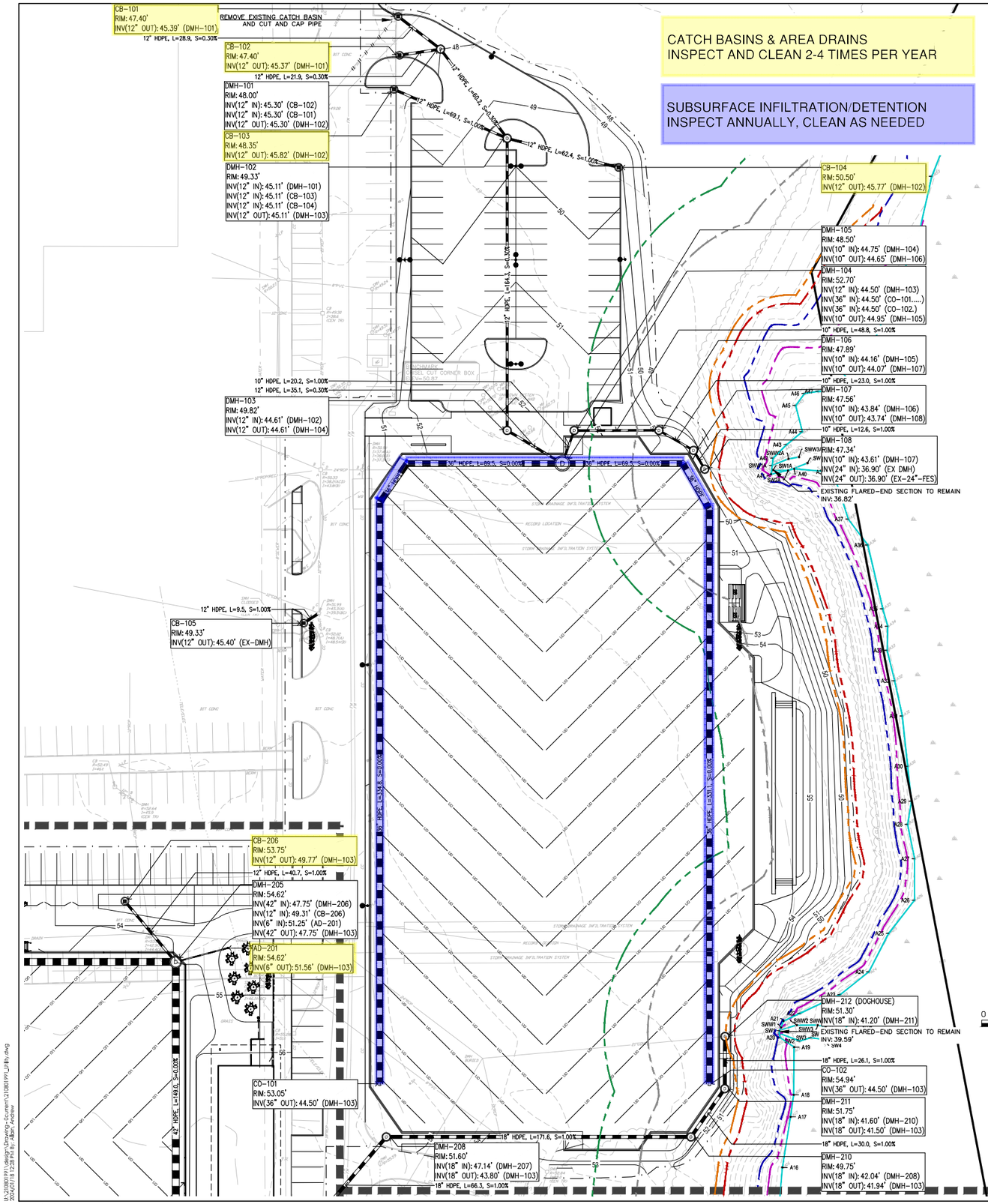
No vehicle maintenance or handling of petroleum products should occur on site. Aside from necessary diesel fuel for the emergency generator, no petroleum products or asphalt substances should be stored on-site.

4.3.2 Solvents, Paints, and other Hazardous Substances

All containers should be tightly sealed and stored indoors when not required for use. Excess materials should not be discharged to the storm sewer system, but should be properly disposed according to manufacturer's instructions or state and local regulations. Outside storage on the property should be prohibited.

APPENDICES

Appendix A OPERATION AND MAINTENANCE SITE MAP



UTILITY NOTES

1. EXISTING CONDITIONS INFORMATION IS REPRODUCED FROM THE SURVEY PREPARED BY PRECISION LAND SURVEYING, INC. OF SOUTHBOROUGH, MA, DATED AUGUST 7, 2023.
2. PRIOR TO THE START OF ANY EXCAVATION FOR THE PROJECT, BOTH ON AND OFF THE SITE, THE CONTRACTOR SHALL NOTIFY DIGSAFE AND BE PROVIDED WITH A DIGSAFE NUMBER INDICATING THAT ALL EXISTING UTILITIES HAVE BEEN LOCATED AND MARKED.
3. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE TOWN OF BOXFORD PUBLIC WORKS DEPARTMENT SPECIFICATIONS.
4. ALL WORK TO BE DONE WITHIN PUBLIC RIGHT-OF-WAYS SHALL CONFORM TO THE REQUIRSMENTS AND SPECIFICATIONS OF THE TOWN OF BOXFORD PUBLIC WORKS DEPARTMENT AND/OR THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION.
5. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES THAT MAY BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ALL UNDERGROUND UTILITIES.
6. THE CONTRACTOR SHALL MAINTAIN OR ADJUST TO NEW FINISH GRADE, AS NECESSARY, ALL UTILITY AND SITE STRUCTURES SUCH AS LIGHT POLES, SIGN POLES, MANHOLES, CATCH BASINS, HAND HOLES, WATER AND GAS GATES, HYDRANTS, ETC., FROM MAINTAINED UTILITY AND SITE SYSTEMS, UNLESS OTHERWISE NOTED OR DIRECTED BY OWNER'S REPRESENTATIVE. THE CONTRACTOR SHALL ALTER THE MASONRY OF THE TOP SECTION OF ALL EXISTING DRAIN AND SEWER STRUCTURES, AS NECESSARY, FOR CHANGES IN GRADE. CONTRACTOR SHALL RESET UTILITY FRAMES, GRATES, AND COVERS MEANT TO BE FLUSH WITH GRADE (CLEANOUTS, UTILITY MANHOLES, CATCH BASINS, INLETS, ETC.) THAT ARE AFFECTED BY SITE WORK OR GRADE CHANGES, WHETHER SPECIFICALLY NOTED ON PLANS OR NOT.
7. ALL SEWER PIPES SHALL BE PVC PER ASTM D3034, SDR-35 AND ASTM D1784 WITH RUBBER GASKET JOINTS, UNLESS OTHERWISE NOTED.
8. SITE LIGHTING IS SHOWN ON THIS PLAN FOR COORDINATION PURPOSES ONLY. REFER TO ELECTRICAL PLANS FOR EXACT TYPE AND LOCATION.
9. AREAS OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION, AT THE CONTRACTOR'S EXPENSE.
10. THE LOCATION, SIZE, DEPTH, AND SPECIFICATIONS FOR CONSTRUCTION OF PRIVATE UTILITY SERVICES SHALL BE PROVIDED BY, AND APPROVED BY, THE RESPECTIVE UTILITY COMPANY (GAS/TELEPHONE/ELECTRICAL) AND INSTALLED ACCORDING TO THOSE REQUIREMENTS. THE CONTRACTOR SHALL COORDINATE THE INSTALLATION, ALTERATION, OR ADJUSTMENT OF THE UTILITY CONNECTIONS WITH THE RESPECTIVE COMPANIES PRIOR TO ANY UTILITY CONSTRUCTION.
11. ALL CEMENT LINED DUCTILE IRON JOINTS AT FITTINGS (CLASS 52.) VALVES, AND HYDRANT LATERALS SHALL BE MECHANICAL WITH NEOPRENE GASKETS. JOINTS AT OTHER LOCATIONS SHALL BE PUSH-ON TYPE WITH NEOPRENE OR SYNTHETIC RUBBER GASKETS. ALL WATER GATES SHALL OPEN AS PER MUNICIPAL REQUIREMENTS. ALL WATER LINES SHALL HAVE A MINIMUM OF FIVE FEET OF GROUND COVER AND A MINIMUM SEPARATION OF TEN FEET FROM THE SEWER SYSTEM. AT WATER AND SEWER CROSSINGS, THE WATER LINE SHALL BE ENCASED IN SIX INCHES OF CONCRETE FOR A DISTANCE OF TEN FEET ON EITHER SIDE OF THE CROSSING.
12. PROTECT AND MAINTAIN EXISTING ON-SITE DRAINAGE STRUCTURES AND PIPES UNLESS OTHERWISE NOTED.
13. THIS PROJECT DISTURBS MORE THAN ONE ACRE OF LAND AND REQUIRES A PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES. AT LEAST 14 DAYS PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR SHALL FILE AN ELECTRONIC NOTICE OF INTENT (eNOI) WITH THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (U.S. EPA) FOR CONSTRUCTION DISCHARGES ASSOCIATED WITH THIS PROJECT AND MAINTAIN A STORMWATER POLLUTION PREVENTION PLAN (SWPPP) IN ACCORDANCE WITH NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) REGULATIONS.
14. CONTRACTOR SHALL MAINTAIN POSITIVE DRAINAGE AWAY FROM ALL BUILDING FOUNDATIONS, STRUCTURES AND PLANTING BEDS.
15. ENSURE ALL EXISTING (TO REMAIN) AND PROPOSED MANHOLE COVERS PROPERLY IDENTIFY UTILITIES SERVICED.
16. BITUMINOUS CONCRETE ELEVATIONS SHALL BE 1/4 INCH ABOVE THE RIM ELEVATION SHOWN FOR EACH CATCH BASIN.
17. ALL PROPOSED STORM DRAIN LINES SHALL BE 12" NON-PERFORATED HDPE UNLESS OTHERWISE NOTED ON PLANS.
18. REFER TO ARCHITECTURAL/PLUMBING PLANS FOR PROPOSED LOCATION OF UTILITY SERVICE STUBS AT BUILDING. FINAL DESIGN AND LOCATIONS OF UTILITY SERVICE STUBS WILL BE PROVIDED BY THE ARCHITECT.
19. ALL EROSION AND SEDIMENTATION CONTROLS SHALL BE INSTALLED PRIOR TO COMMENCEMENT OF ANY EARTH MOVING ACTIVITIES. REFER TO SITE PREPARATION PLAN FOR COMPLETE EROSION AND SEDIMENTATION CONTROLS.
20. WHERE AN EXISTING UTILITY IS FOUND TO BE IN CONFLICT WITH THE PROPOSED WORK, THE CONTRACTOR SHALL ACCURATELY DETERMINE THE LOCATION, ELEVATION, AND SIZE OF THE UTILITY AND TRANSMIT THIS INFORMATION TO THE ENGINEER WITHOUT DELAY.
21. ALL PIPING WITHIN 10 FEET OF BUILDING IS COVERED UNDER THE COMMONWEALTH OF MASSACHUSETTS UNIFORM STATE PLUMBING CODE AND IS SHOWN FOR COORDINATION ONLY. REFER TO PLUMBING PLANS AND SPECIFICATIONS FOR UTILITY WORK WITHIN 10 FEET OF BUILDING.
22. THE ENGINEER-OF-RECORD SHALL WITNESS INSTALLATION OF ALL SUBSURFACE INFILTRATION SYSTEMS. IF THE SUBSURFACE SOIL CONDITIONS DIFFER FROM THAT SHOWN ON THE PLAN, THE DESIGN SHALL BE MODIFIED AND RESUBMITTED TO THE CITY/TOWN OF BOXFORD FOR APPROVAL PRIOR TO CONTINUING INSTALLATION.
23. THE USE OF FIRE HYDRANTS FOR CONSTRUCTION IS NOT PERMITTED WITHOUT PRIOR APPROVAL FROM THE CITY/TOWN OF BOXFORD WATER AND SEWER DEPARTMENT AND FIRE DEPARTMENT.
24. CONTRACTOR SHALL COORDINATE ANY WATER SHUT DOWNS THE CITY/TOWN OF BOXFORD WATER AND SEWER DEPARTMENT AND FIRE DEPARTMENT.
25. ALL TRENCH EXCAVATION CONTRACTORS SHALL COMPLY WITH MASSACHUSETTS GENERAL LAWS CHAPTER 82A, TRENCH EXCAVATION SAFETY REQUIREMENTS, TO PROTECT THE GENERAL PUBLIC FROM UNAUTHORIZED ACCESS TO UNATTENDED TRENCHES. TRENCH EXCAVATION PERMITS ARE REQUIRED. THIS APPLIES TO ALL TRENCHES ON PUBLIC AND PRIVATE PROPERTY.

LEGEND

- PROPERTY LINE
- LIMIT OF WORK LINE
- BORDERING VEGETATED WETLAND
- AE ZONE ELEV. 40 FEMA 100 YEAR FLOOD ZONE BORDERING LAND SUBJECT TO FLOODING (LSF)
- ZONE X
- 25 NO DISTURB'
- 30' MINIMUM SETBACK FOR ASSUMED RETAINING WALLS, OTHER SOLID/IMPERVIOUS CONSTRUCTION
- 75' BUFFER ZONE
- 100' BUFFER ZONE
- 0'-100' OUTER RIPARIAN ZONE RIVER FRONT AREA
- 100'-200' OUTER RIPARIAN ZONE RIVER FRONT AREA
- PROPOSED STORM DRAIN LINE
- UD — UD UNDERDRAIN
- STORM DRAIN MANHOLE (DMH)
- CATCH BASIN (CB)
- CO CLEANOUT (CO)
- HDPE HIGH-DENSITY POLYETHYLENE

Stantec

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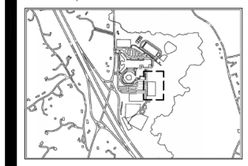
Consultants

Notes

Locus Map



ISSUED FOR NOTICE OF INTENT	SDL	JA	01.18.2024
Issued	By	Appd.	MM.DD.YY

File Name: 210801991_Utility.dwg

Dwn.	Chkd.	Dsgn.	01.18.2024
			MM.DD.YY

Permit/Seal

Client/Project
MASCONOMET REGIONAL SCHOOL DISTRICT

SYNTHETIC TURF FIELDS NOTICE OF INTENT
BOXFORD, MA

Project No.: 210801991
Scale: AS NOTED

Title
DRAINAGE AND GRADING PLAN

Drawing No.
CU-101

Appendix B OPERATION AND MAINTENANCE LOG

Masconomet Regional School District

Boxford, MA

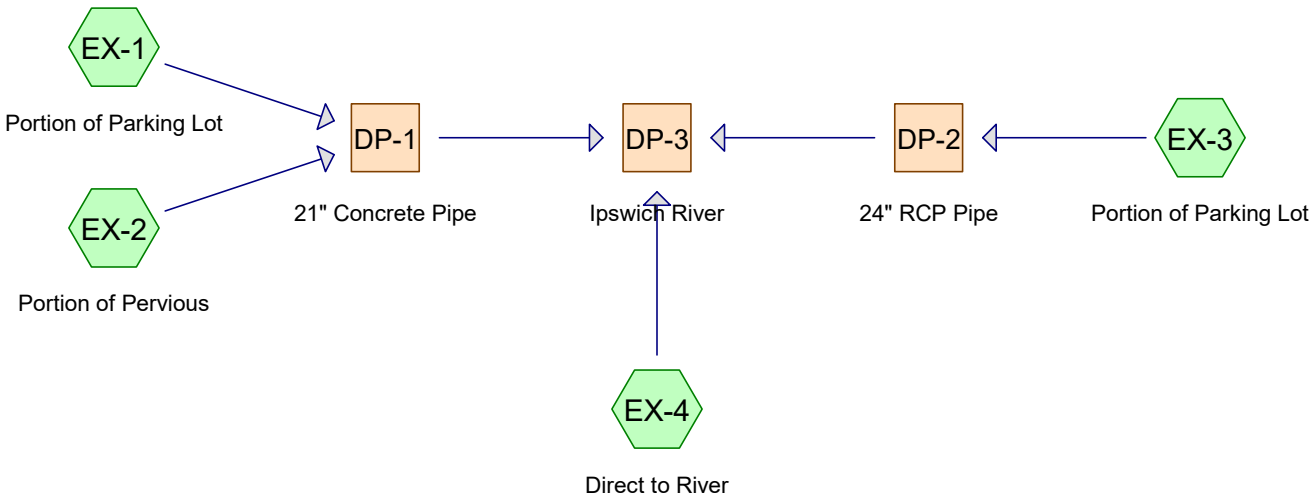
Operation and Maintenance Log
Inspection Year:_____

Structural Best Management Practice	Action	Date Completed	Completed By	Condition	Additional Actions	Date Completed	Completed By	Comments
Catch Basins/Area Drains – Inspect two to four times per year. Clean two times per year.	Inspect							
Subsurface Infiltration System – Inspect annually. Clean as required.	Inspect							
Stormwater Outfalls - Inspect annaully. Maintain vegetation and repair riprap as required.	Inspect							
Vegetated Areas Maintenance - Inspect twice annually in the spring and the fall.	Inspect							
Overall Site Inspection - Twice annually.	Inspect							

Appendix E EXISTING HYDROLOGIC CONDITIONS

EXISTING CONDITIONS HYDROCAD REPORT

Existing Conditions



Subcat Reach Pond Link

Routing Diagram for Existing Conditions
Prepared by Stantec Consulting Ltd., Printed 1/16/2024

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
17,062	39	>75% Grass cover, Good, HSG A (Map Unit 254A) (EX-1, EX-2, EX-4)
454,878	39	>75% Grass cover, Good, HSG A (Map Unit 651) (EX-1, EX-2, EX-3, EX-4)
25,219	61	>75% Grass cover, Good, HSG B (Map Unit 718A) (EX-4)
5,898	98	Paved parking, HSG A (Map Unit 254A) (EX-1)
119,554	98	Paved parking, HSG A (Map Unit 651) (EX-1, EX-3)
4,331	98	Roofs, HSG A (Map Unit 254A) (EX-1)
2,469	98	Roofs, HSG A (Map Unit 651) (EX-1)
15,368	30	Woods, Good, HSG A (Map Unit 651) (EX-4)
37,201	55	Woods, Good, HSG B (Map Unit 718A) (EX-4)
681,980	**52**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
619,560	HSG A	EX-1, EX-2, EX-3, EX-4
62,420	HSG B	EX-4
0	HSG C	
0	HSG D	
0	Other	
681,980		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	EX-2	0.00	0.00	637.0	0.0090	0.012	21.0	0.0	0.0

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Portion of Parking Runoff Area=133,902 sf 81.21% Impervious Runoff Depth=1.95"
Tc=6.0 min CN=87 Runoff=7.02 cfs 21,762 cf

Subcatchment EX-2: Portion of Pervious Runoff Area=290,906 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,017' Tc=15.9 min CN=39 Runoff=0.00 cfs 19 cf

Subcatchment EX-3: Portion of Parking Lot Runoff Area=25,497 sf 92.23% Impervious Runoff Depth=2.48"
Tc=6.0 min CN=93 Runoff=1.65 cfs 5,278 cf

Subcatchment EX-4: Direct to River Runoff Area=231,675 sf 0.00% Impervious Runoff Depth=0.03"
Flow Length=93' Tc=12.5 min CN=43 Runoff=0.02 cfs 484 cf

Reach DP-1: 21" Concrete Pipe Inflow=7.02 cfs 21,782 cf
Outflow=7.02 cfs 21,782 cf

Reach DP-2: 24" RCP Pipe Inflow=1.65 cfs 5,278 cf
Outflow=1.65 cfs 5,278 cf

Reach DP-3: Ipswich River Inflow=8.67 cfs 27,544 cf
Outflow=8.67 cfs 27,544 cf

Total Runoff Area = 681,980 sf Runoff Volume = 27,544 cf Average Runoff Depth = 0.48"
80.61% Pervious = 549,728 sf 19.39% Impervious = 132,252 sf

Summary for Subcatchment EX-1: Portion of Parking Lot

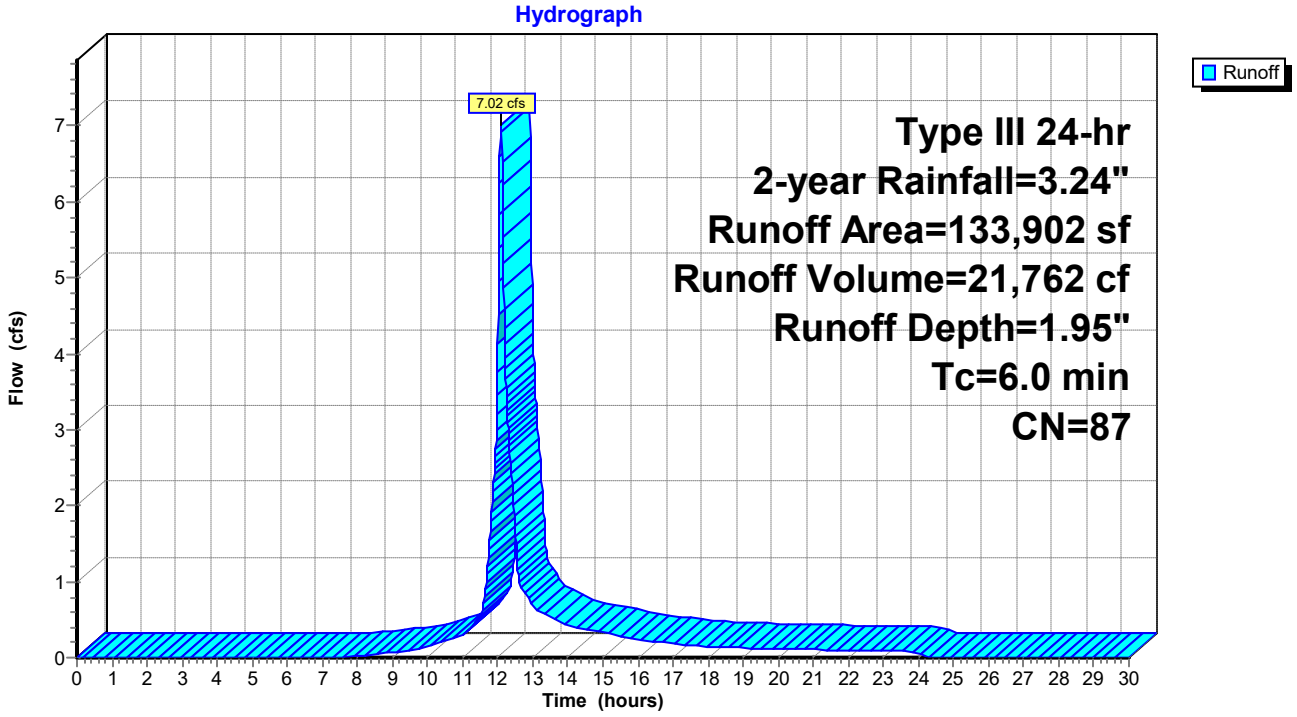
Runoff = 7.02 cfs @ 12.09 hrs, Volume= 21,762 cf, Depth= 1.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	2,469	98	Roofs, HSG A (Map Unit 651)
*	4,331	98	Roofs, HSG A (Map Unit 254A)
*	9,746	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	5,898	98	Paved parking, HSG A (Map Unit 254A)
*	15,420	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	96,038	98	Paved parking, HSG A (Map Unit 651)
	133,902	87	Weighted Average
	25,166		18.79% Pervious Area
	108,736		81.21% Impervious Area

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

Subcatchment EX-1: Portion of Parking Lot



Summary for Subcatchment EX-2: Portion of Pervious

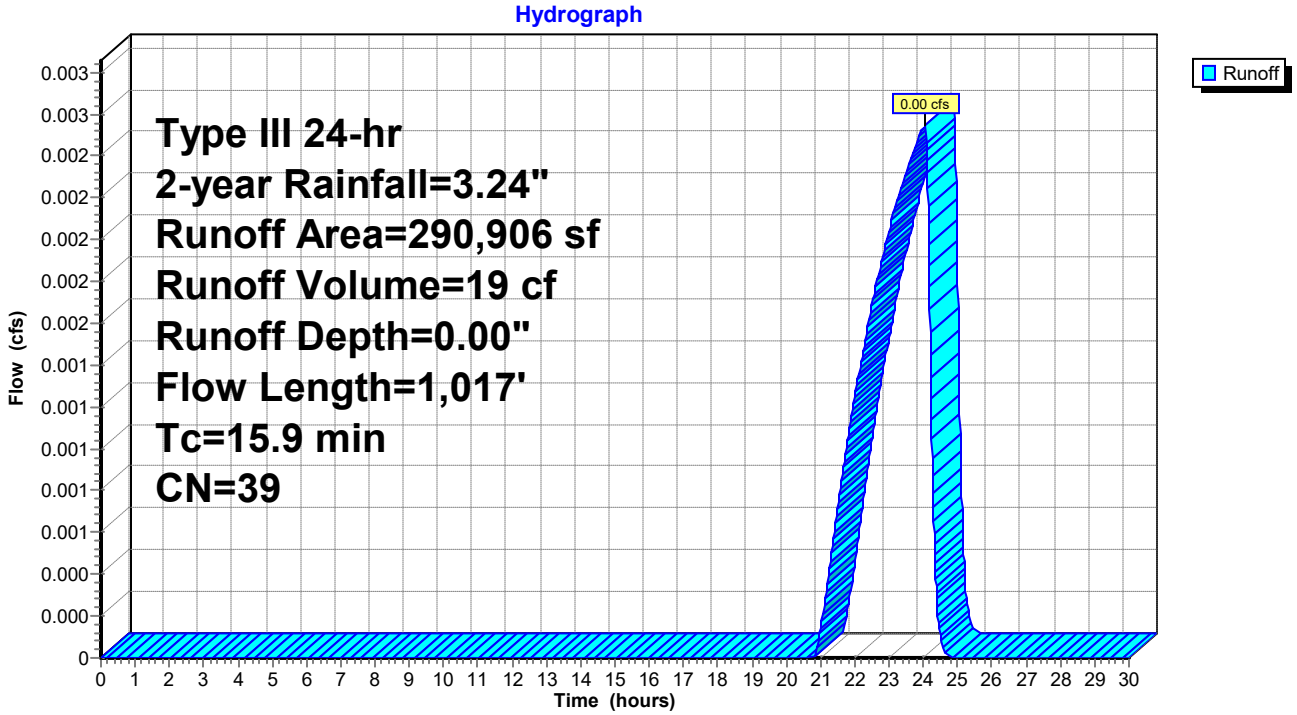
Runoff = 0.00 cfs @ 24.04 hrs, Volume= 19 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	6,806	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	284,100	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	290,906	39	Weighted Average
	290,906		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.24"
7.4	330	0.0112	0.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	637	0.0090	6.77	16.28	**Pipe Channel,** 21.0" Round Area= 2.4 sf Perim= 5.5' r= 0.44' n= 0.012 Concrete pipe, finished
15.9	1,017	Total			

Subcatchment EX-2: Portion of Pervious



Summary for Subcatchment EX-3: Portion of Parking Lot

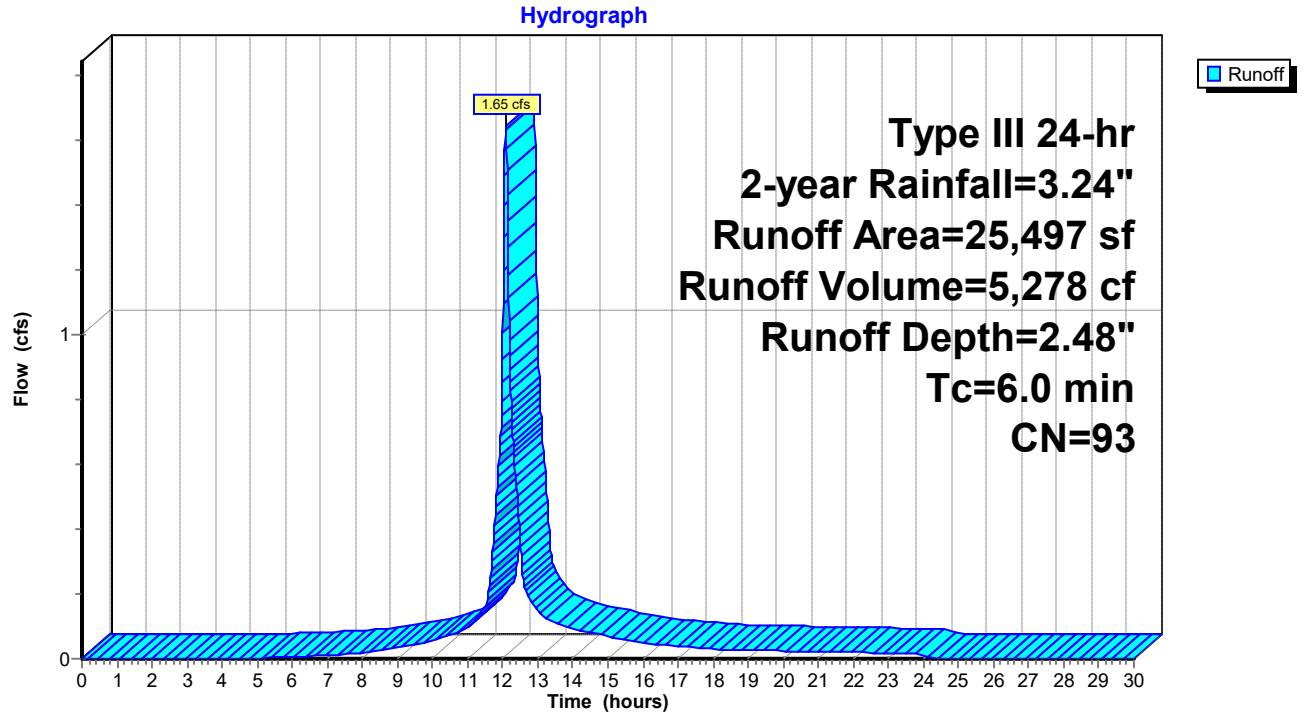
Runoff = 1.65 cfs @ 12.09 hrs, Volume= 5,278 cf, Depth= 2.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	23,516	98	Paved parking, HSG A (Map Unit 651)
*	1,981	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	25,497	93	Weighted Average
	1,981		7.77% Pervious Area
	23,516		92.23% Impervious Area

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

Subcatchment EX-3: Portion of Parking Lot



Summary for Subcatchment EX-4: Direct to River

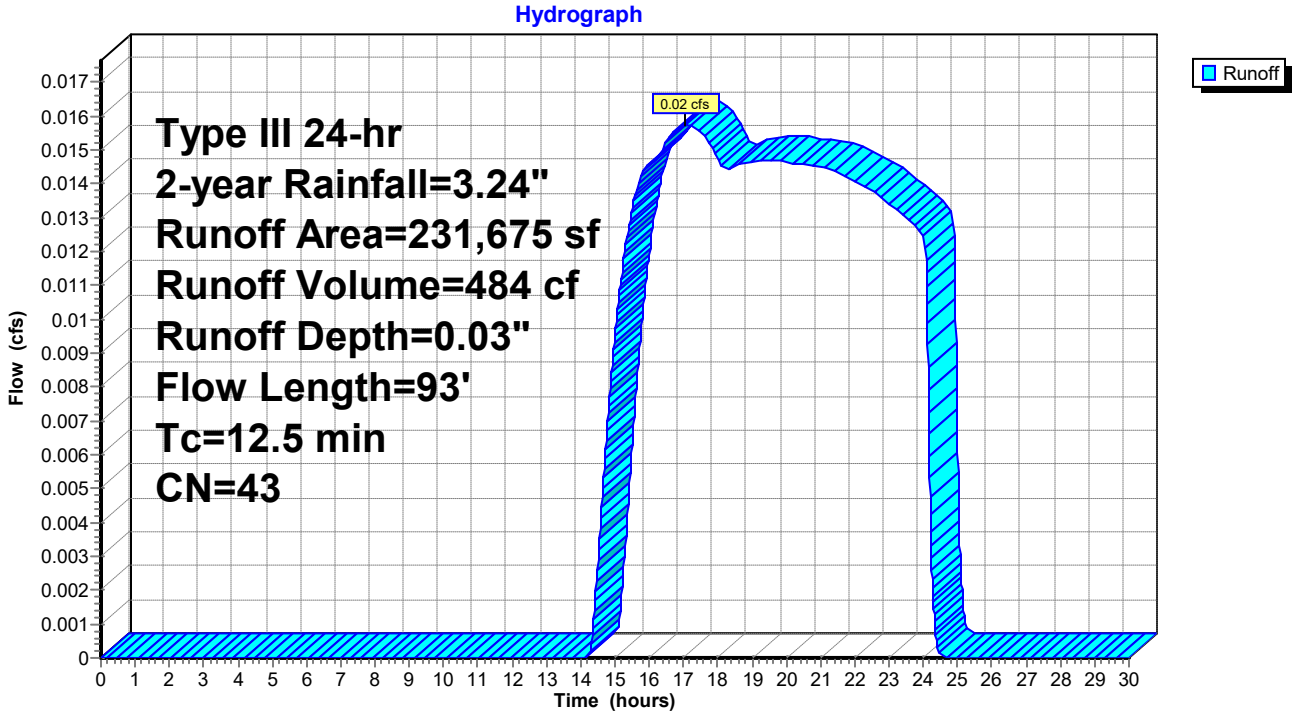
Runoff = 0.02 cfs @ 17.07 hrs, Volume= 484 cf, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	153,377	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	510	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	25,219	61	>75% Grass cover, Good, HSG B (Map Unit 718A)
*	15,368	30	Woods, Good, HSG A (Map Unit 651)
*	37,201	55	Woods, Good, HSG B (Map Unit 718A)
	231,675	43	Weighted Average
	231,675		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.24"
0.2	43	0.3950	3.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.5	93	Total			

Subcatchment EX-4: Direct to River

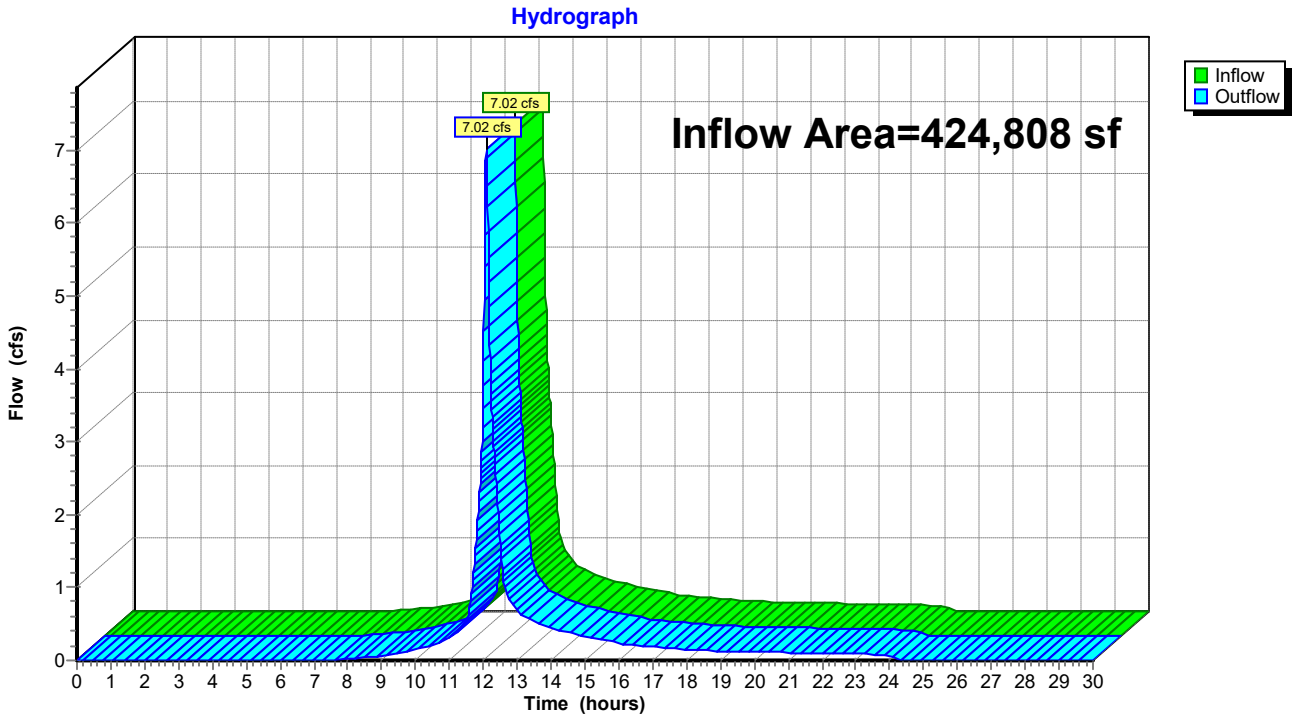


Summary for Reach DP-1: 21" Concrete Pipe

Inflow Area = 424,808 sf, 25.60% Impervious, Inflow Depth = 0.62" for 2-year event
Inflow = 7.02 cfs @ 12.09 hrs, Volume= 21,782 cf
Outflow = 7.02 cfs @ 12.09 hrs, Volume= 21,782 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-1: 21" Concrete Pipe

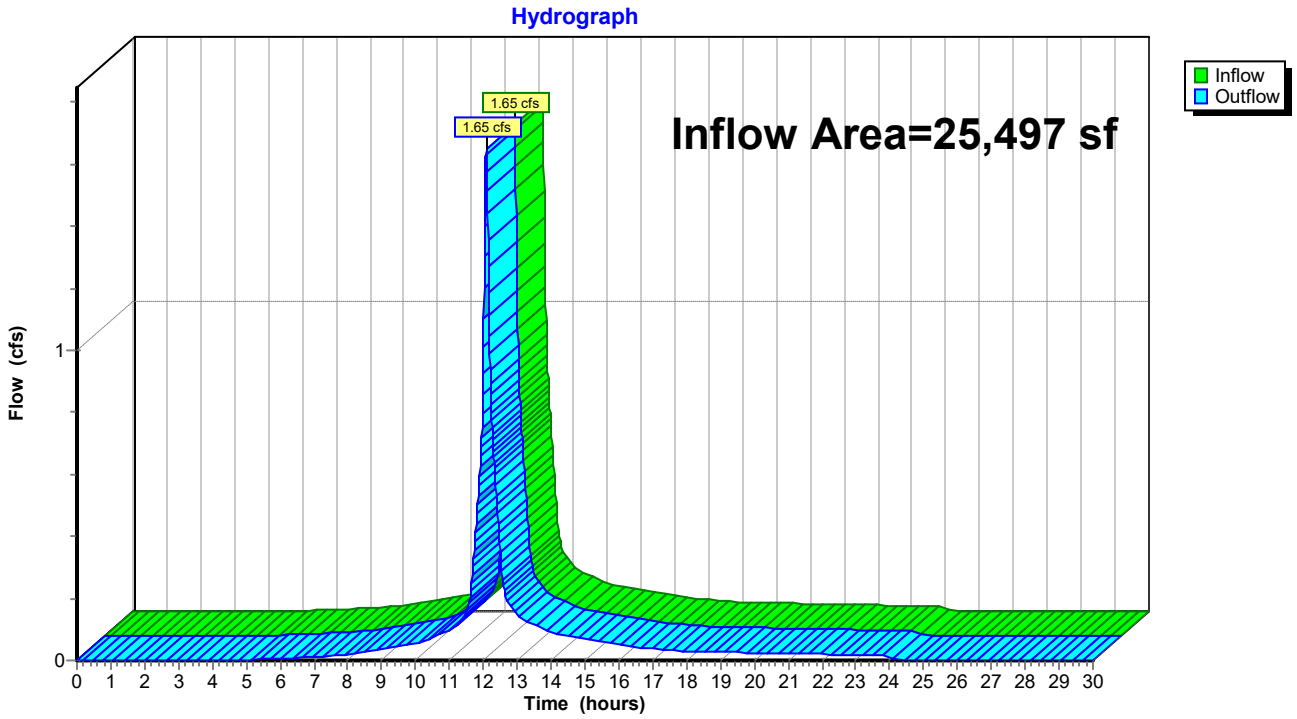


Summary for Reach DP-2: 24" RCP Pipe

Inflow Area = 25,497 sf, 92.23% Impervious, Inflow Depth = 2.48" for 2-year event
Inflow = 1.65 cfs @ 12.09 hrs, Volume= 5,278 cf
Outflow = 1.65 cfs @ 12.09 hrs, Volume= 5,278 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-2: 24" RCP Pipe

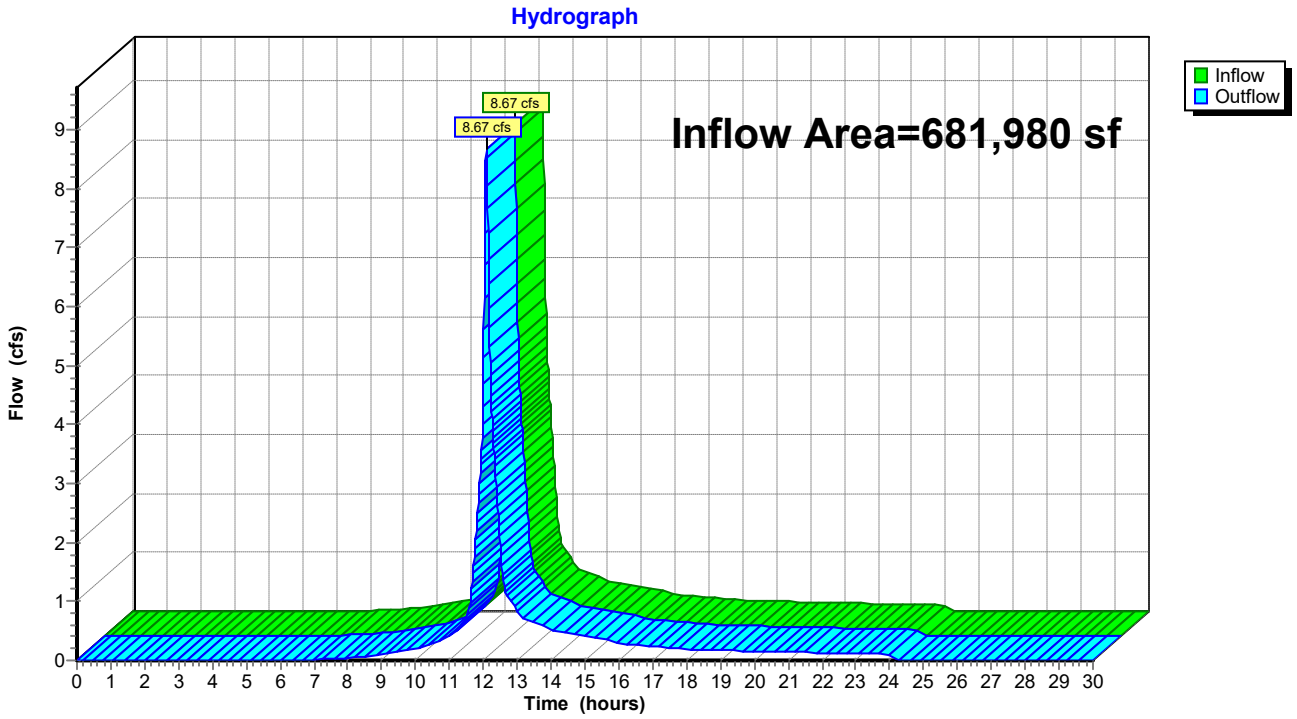


Summary for Reach DP-3: Ipswich River

Inflow Area = 681,980 sf, 19.39% Impervious, Inflow Depth = 0.48" for 2-year event
Inflow = 8.67 cfs @ 12.09 hrs, Volume= 27,544 cf
Outflow = 8.67 cfs @ 12.09 hrs, Volume= 27,544 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-3: Ipswich River



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Portion of Parking Runoff Area=133,902 sf 81.21% Impervious Runoff Depth=3.68"
Tc=6.0 min CN=87 Runoff=13.01 cfs 41,068 cf

Subcatchment EX-2: Portion of Pervious Runoff Area=290,906 sf 0.00% Impervious Runoff Depth=0.22"
Flow Length=1,017' Tc=15.9 min CN=39 Runoff=0.28 cfs 5,454 cf

Subcatchment EX-3: Portion of Parking Lot Runoff Area=25,497 sf 92.23% Impervious Runoff Depth=4.32"
Tc=6.0 min CN=93 Runoff=2.78 cfs 9,170 cf

Subcatchment EX-4: Direct to River Runoff Area=231,675 sf 0.00% Impervious Runoff Depth=0.39"
Flow Length=93' Tc=12.5 min CN=43 Runoff=0.78 cfs 7,483 cf

Reach DP-1: 21" Concrete Pipe Inflow=13.01 cfs 46,523 cf
Outflow=13.01 cfs 46,523 cf

Reach DP-2: 24" RCP Pipe Inflow=2.78 cfs 9,170 cf
Outflow=2.78 cfs 9,170 cf

Reach DP-3: Ipswich River Inflow=15.80 cfs 63,176 cf
Outflow=15.80 cfs 63,176 cf

Total Runoff Area = 681,980 sf Runoff Volume = 63,176 cf Average Runoff Depth = 1.11"
80.61% Pervious = 549,728 sf 19.39% Impervious = 132,252 sf

Summary for Subcatchment EX-1: Portion of Parking Lot

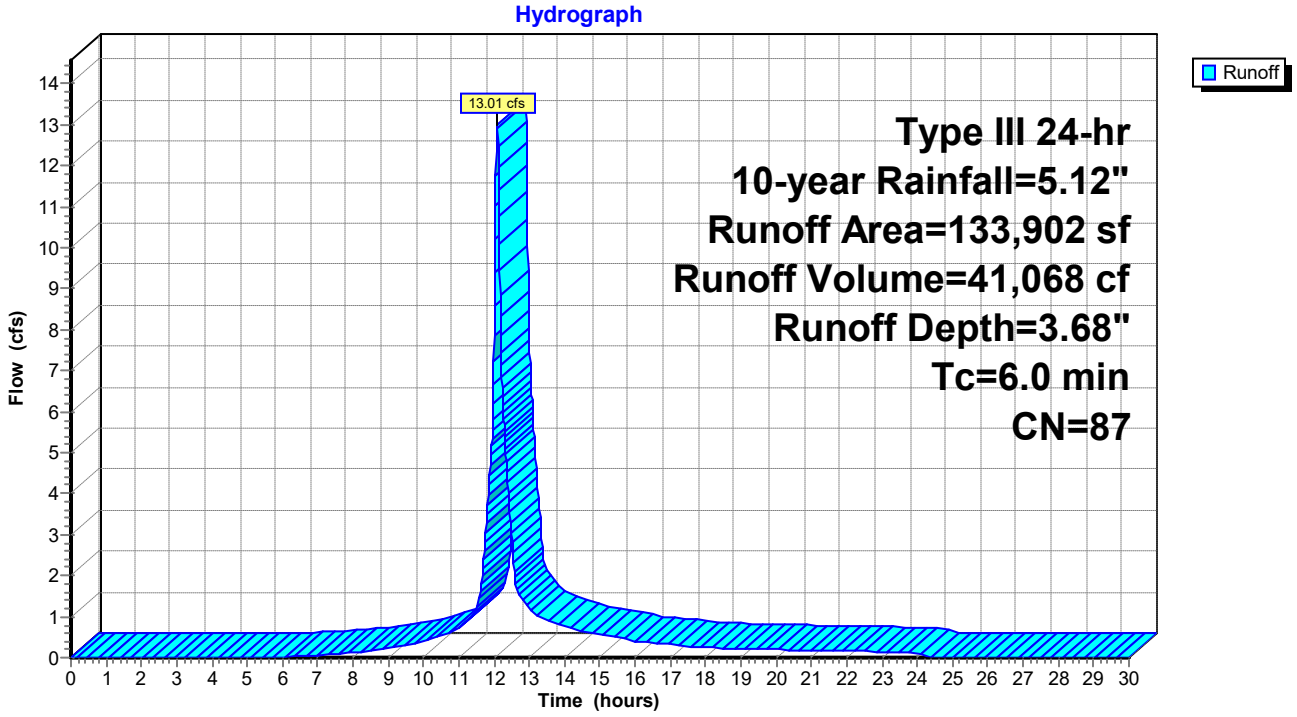
Runoff = 13.01 cfs @ 12.09 hrs, Volume= 41,068 cf, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	2,469	98	Roofs, HSG A (Map Unit 651)
*	4,331	98	Roofs, HSG A (Map Unit 254A)
*	9,746	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	5,898	98	Paved parking, HSG A (Map Unit 254A)
*	15,420	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	96,038	98	Paved parking, HSG A (Map Unit 651)
	133,902	87	Weighted Average
	25,166		18.79% Pervious Area
	108,736		81.21% Impervious Area

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

Subcatchment EX-1: Portion of Parking Lot



Summary for Subcatchment EX-2: Portion of Pervious

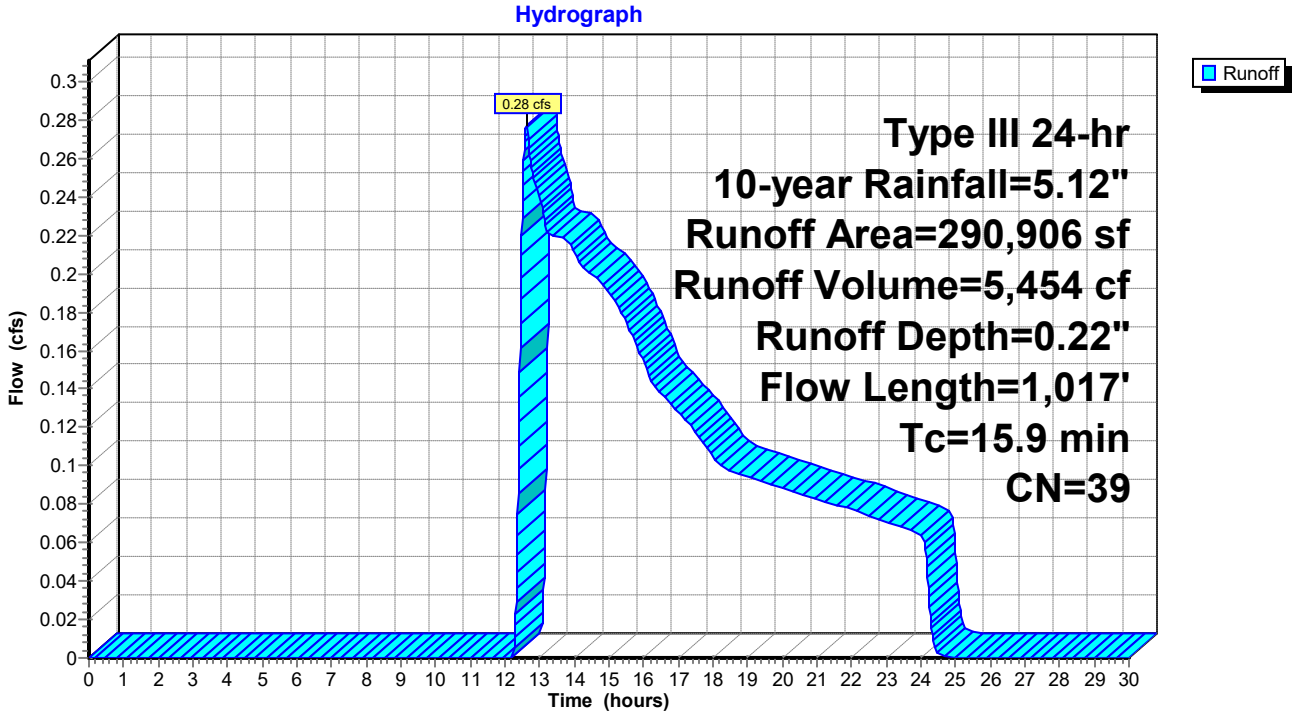
Runoff = 0.28 cfs @ 12.61 hrs, Volume= 5,454 cf, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	6,806	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	284,100	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	290,906	39	Weighted Average
	290,906		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.24"
7.4	330	0.0112	0.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	637	0.0090	6.77	16.28	**Pipe Channel,** 21.0" Round Area= 2.4 sf Perim= 5.5' r= 0.44' n= 0.012 Concrete pipe, finished
15.9	1,017	Total			

Subcatchment EX-2: Portion of Pervious



Summary for Subcatchment EX-3: Portion of Parking Lot

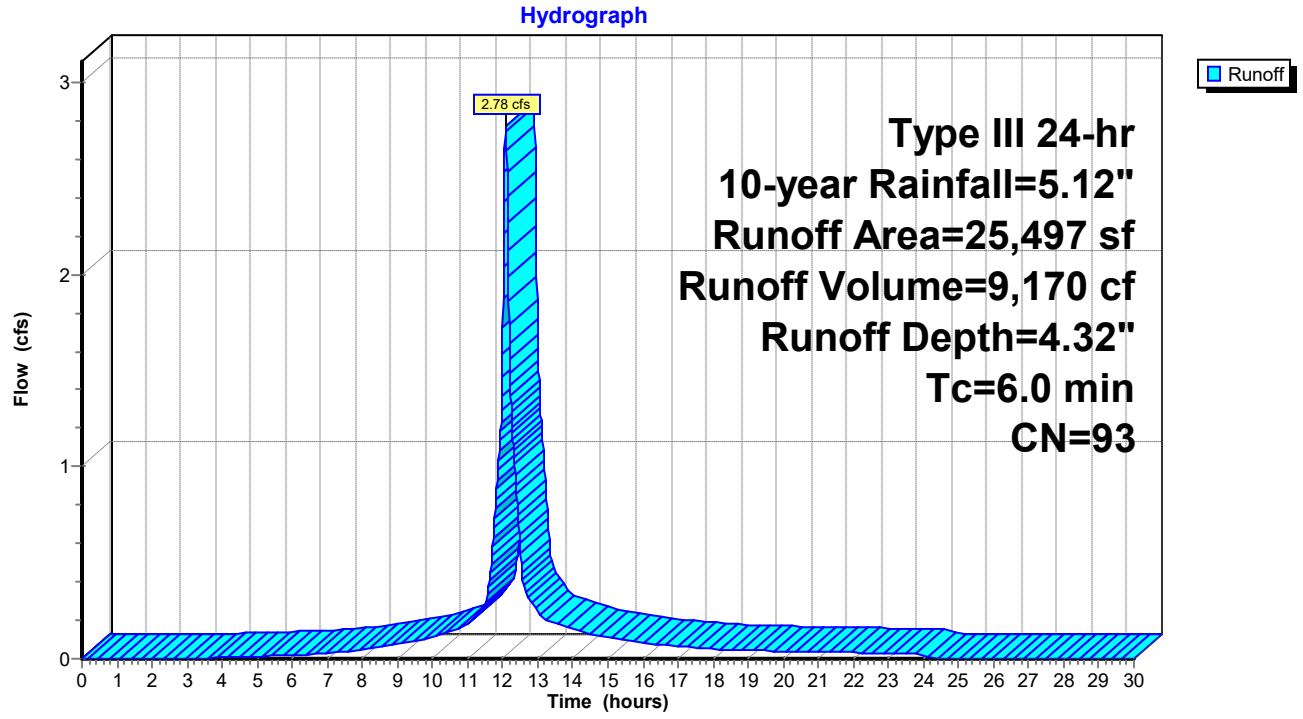
Runoff = 2.78 cfs @ 12.08 hrs, Volume= 9,170 cf, Depth= 4.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	23,516	98	Paved parking, HSG A (Map Unit 651)
*	1,981	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	25,497	93	Weighted Average
	1,981		7.77% Pervious Area
	23,516		92.23% Impervious Area

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

Subcatchment EX-3: Portion of Parking Lot



Summary for Subcatchment EX-4: Direct to River

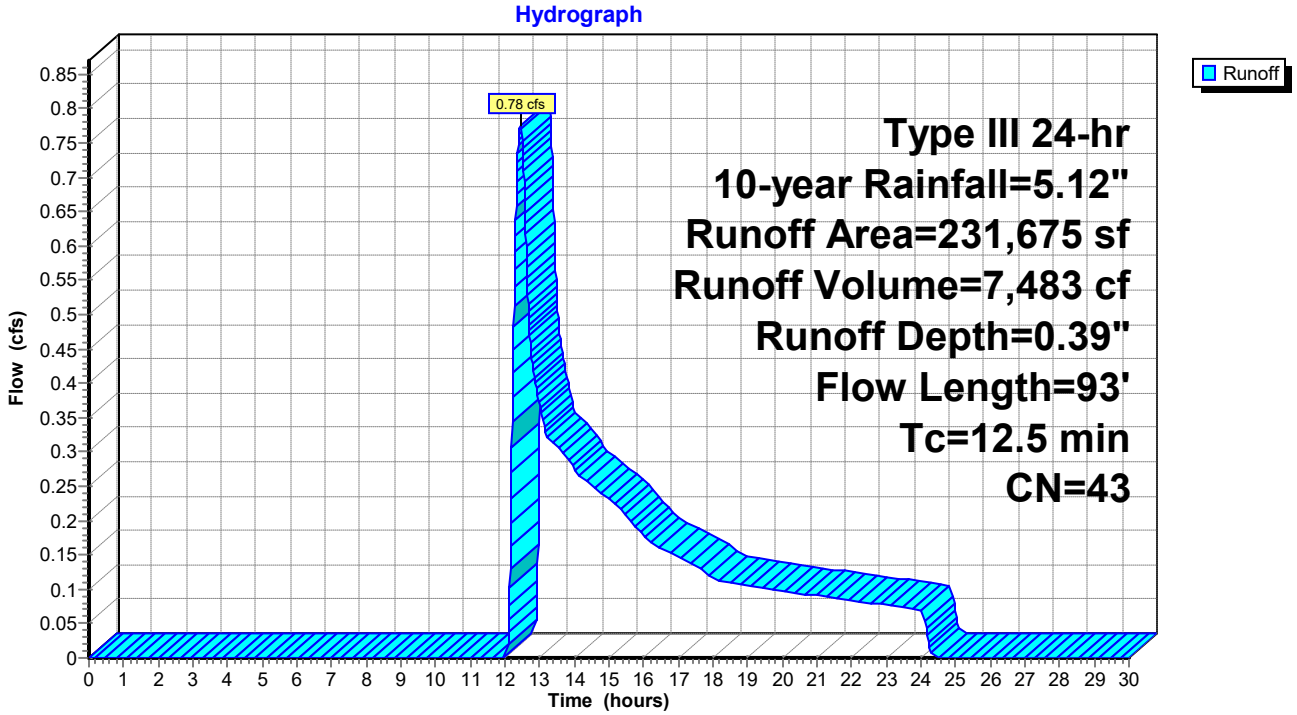
Runoff = 0.78 cfs @ 12.44 hrs, Volume= 7,483 cf, Depth= 0.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	153,377	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	510	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	25,219	61	>75% Grass cover, Good, HSG B (Map Unit 718A)
*	15,368	30	Woods, Good, HSG A (Map Unit 651)
*	37,201	55	Woods, Good, HSG B (Map Unit 718A)
	231,675	43	Weighted Average
	231,675		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.24"
0.2	43	0.3950	3.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.5	93	Total			

Subcatchment EX-4: Direct to River

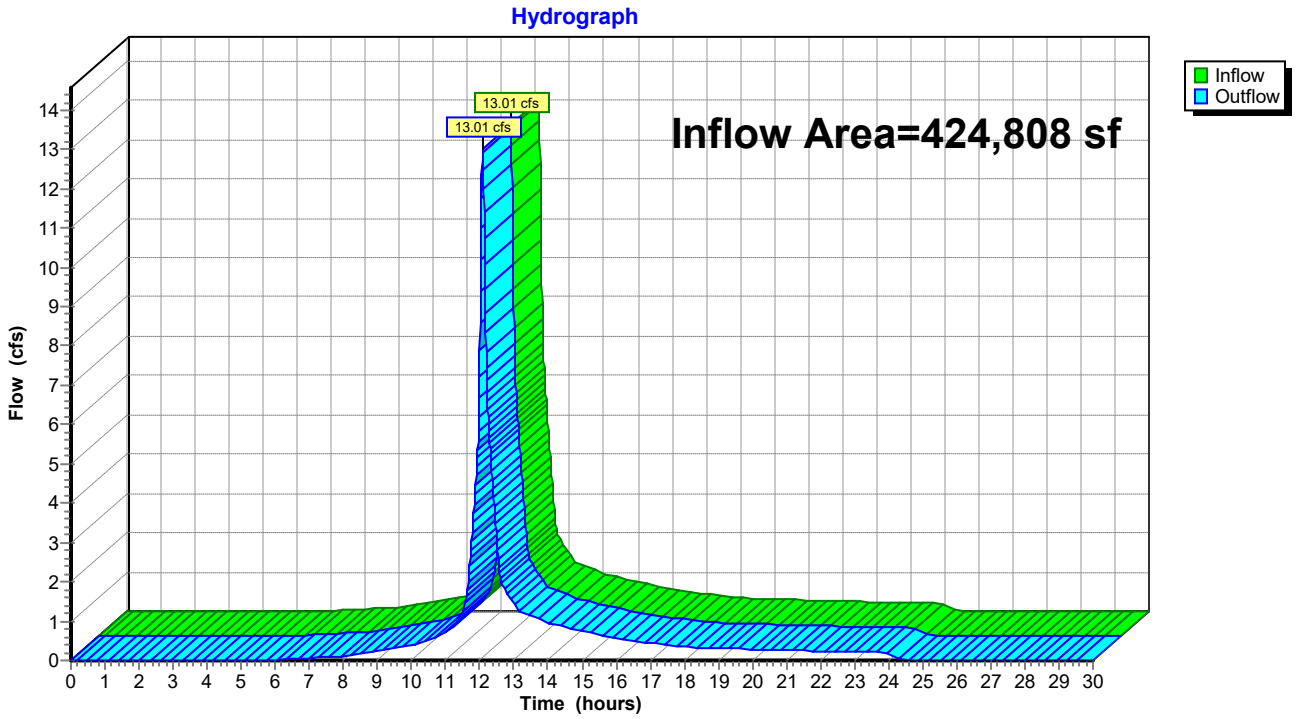


Summary for Reach DP-1: 21" Concrete Pipe

Inflow Area = 424,808 sf, 25.60% Impervious, Inflow Depth = 1.31" for 10-year event
Inflow = 13.01 cfs @ 12.09 hrs, Volume= 46,523 cf
Outflow = 13.01 cfs @ 12.09 hrs, Volume= 46,523 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-1: 21" Concrete Pipe

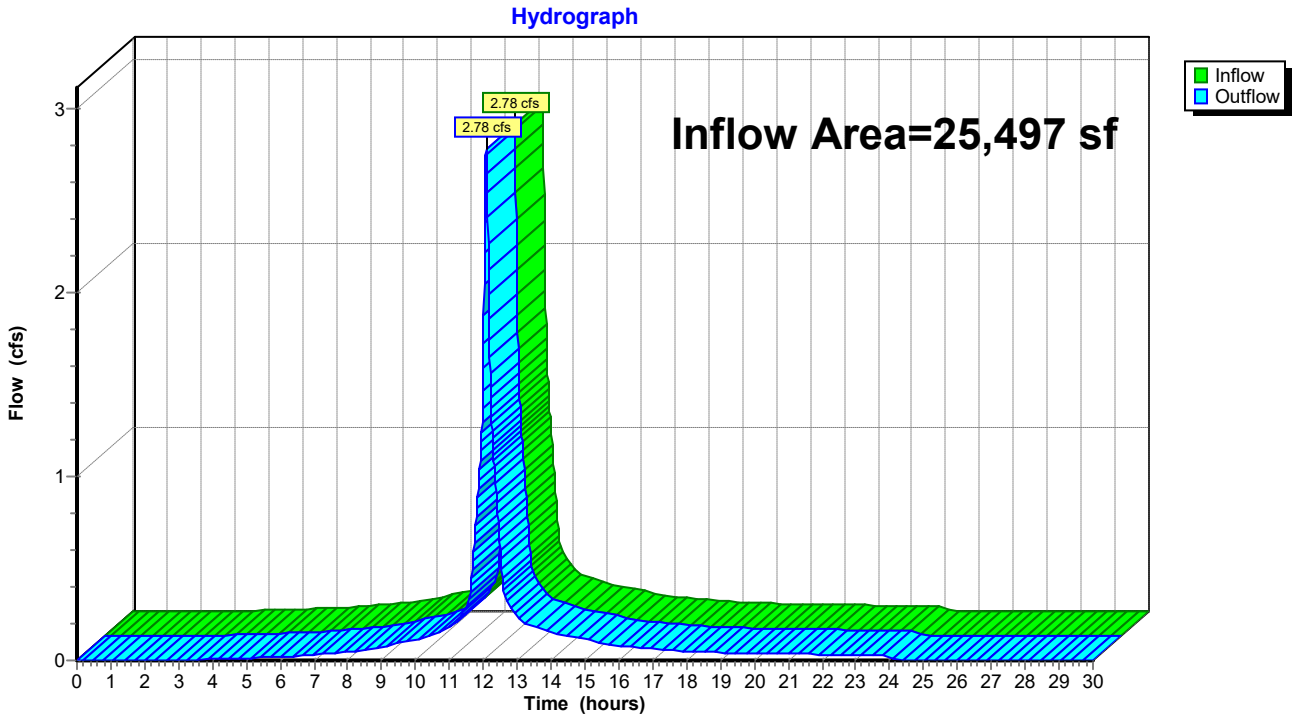


Summary for Reach DP-2: 24" RCP Pipe

Inflow Area = 25,497 sf, 92.23% Impervious, Inflow Depth = 4.32" for 10-year event
Inflow = 2.78 cfs @ 12.08 hrs, Volume= 9,170 cf
Outflow = 2.78 cfs @ 12.08 hrs, Volume= 9,170 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-2: 24" RCP Pipe

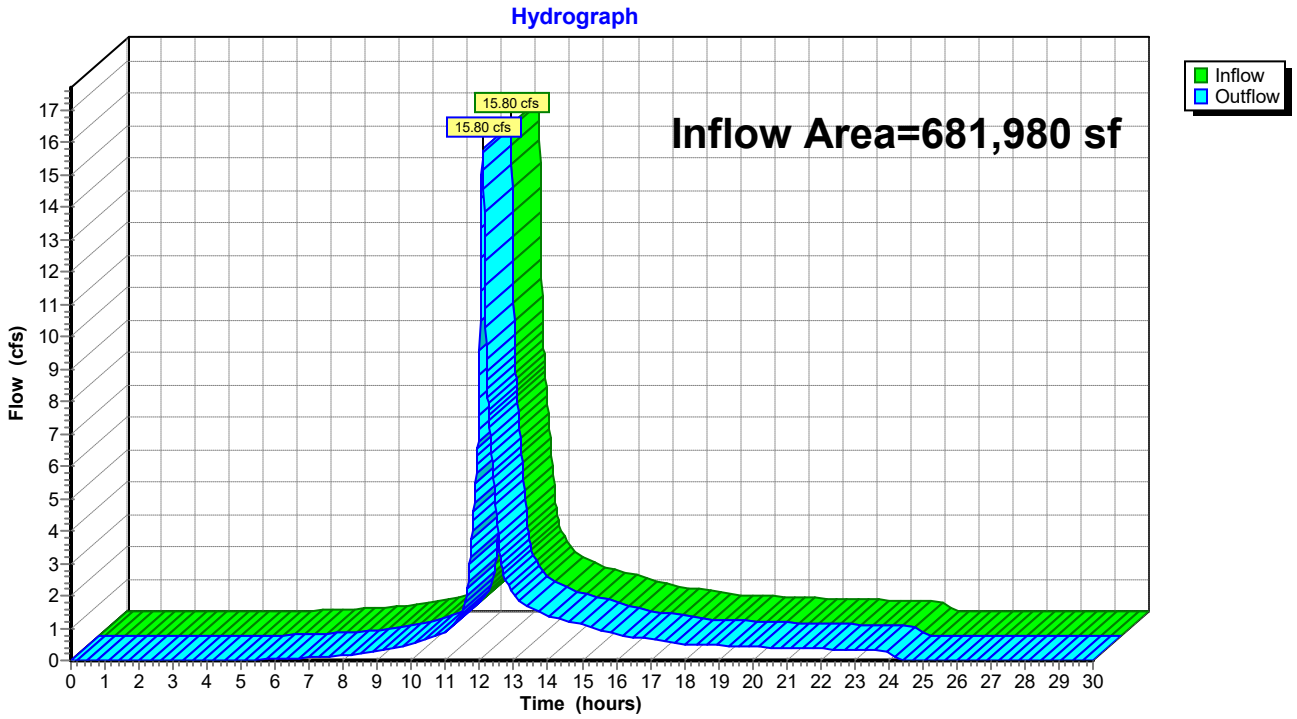


Summary for Reach DP-3: Ipswich River

Inflow Area = 681,980 sf, 19.39% Impervious, Inflow Depth = 1.11" for 10-year event
Inflow = 15.80 cfs @ 12.09 hrs, Volume= 63,176 cf
Outflow = 15.80 cfs @ 12.09 hrs, Volume= 63,176 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-3: Ipswich River



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Portion of Parking Runoff Area=133,902 sf 81.21% Impervious Runoff Depth=6.55"
Tc=6.0 min CN=87 Runoff=22.48 cfs 73,056 cf

Subcatchment EX-2: Portion of Pervious Runoff Area=290,906 sf 0.00% Impervious Runoff Depth=1.20"
Flow Length=1,017' Tc=15.9 min CN=39 Runoff=4.63 cfs 29,071 cf

Subcatchment EX-3: Portion of Parking Lot Runoff Area=25,497 sf 92.23% Impervious Runoff Depth=7.26"
Tc=6.0 min CN=93 Runoff=4.54 cfs 15,430 cf

Subcatchment EX-4: Direct to River Runoff Area=231,675 sf 0.00% Impervious Runoff Depth=1.59"
Flow Length=93' Tc=12.5 min CN=43 Runoff=6.31 cfs 30,645 cf

Reach DP-1: 21" Concrete Pipe Inflow=23.68 cfs 102,127 cf
Outflow=23.68 cfs 102,127 cf

Reach DP-2: 24" RCP Pipe Inflow=4.54 cfs 15,430 cf
Outflow=4.54 cfs 15,430 cf

Reach DP-3: Ipswich River Inflow=32.05 cfs 148,201 cf
Outflow=32.05 cfs 148,201 cf

Total Runoff Area = 681,980 sf Runoff Volume = 148,201 cf Average Runoff Depth = 2.61"
80.61% Pervious = 549,728 sf 19.39% Impervious = 132,252 sf

Summary for Subcatchment EX-1: Portion of Parking Lot

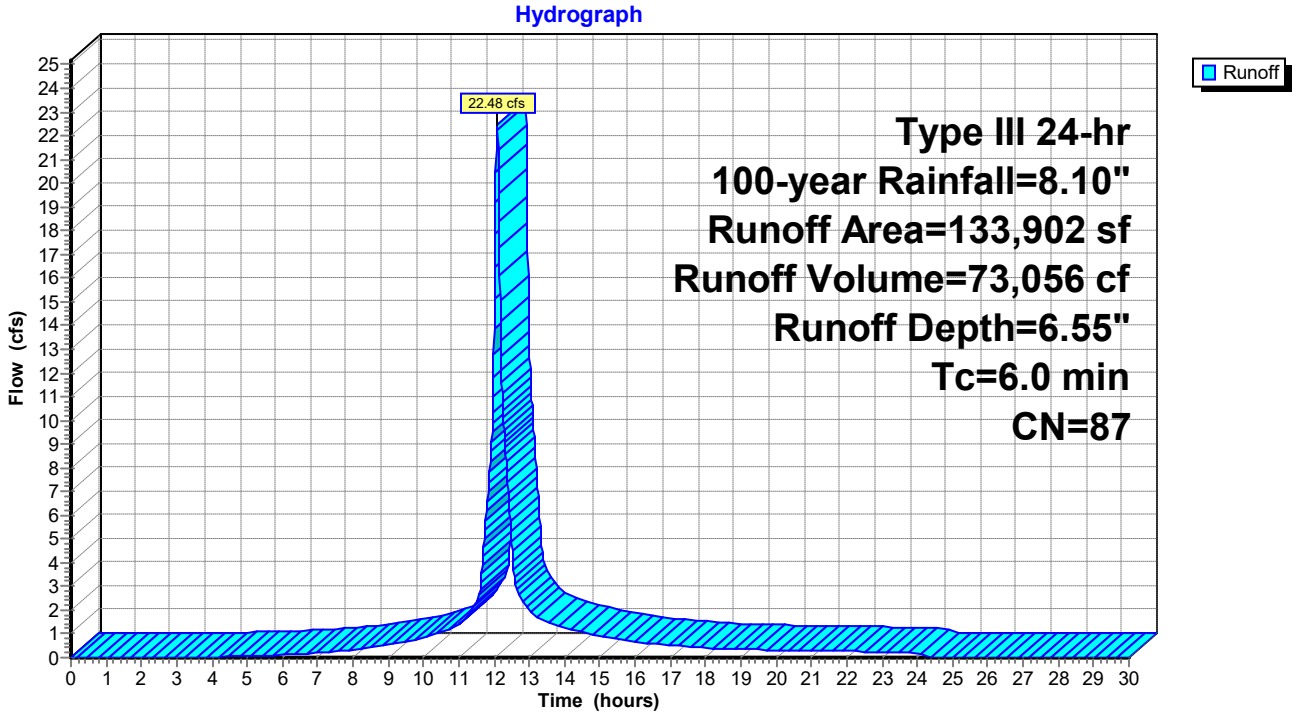
Runoff = 22.48 cfs @ 12.08 hrs, Volume= 73,056 cf, Depth= 6.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	2,469	98	Roofs, HSG A (Map Unit 651)
*	4,331	98	Roofs, HSG A (Map Unit 254A)
*	9,746	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	5,898	98	Paved parking, HSG A (Map Unit 254A)
*	15,420	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	96,038	98	Paved parking, HSG A (Map Unit 651)
	133,902	87	Weighted Average
	25,166		18.79% Pervious Area
	108,736		81.21% Impervious Area

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

Subcatchment EX-1: Portion of Parking Lot



Summary for Subcatchment EX-2: Portion of Pervious

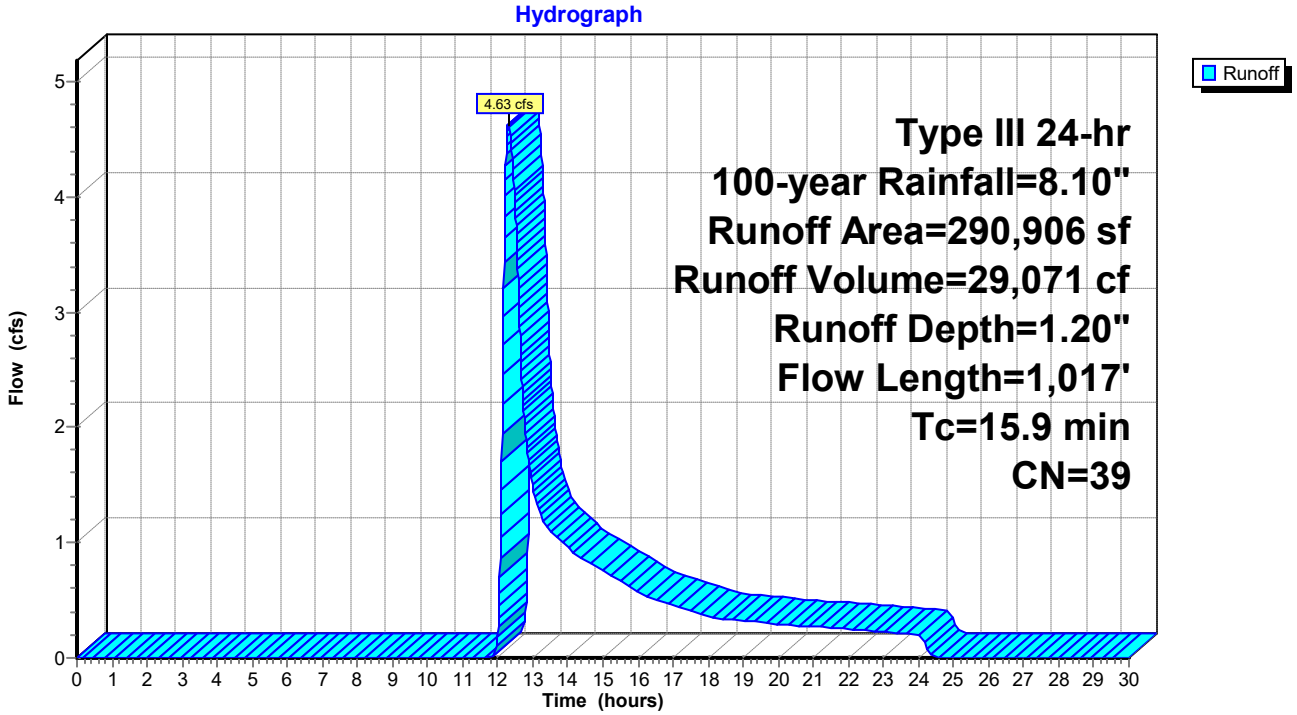
Runoff = 4.63 cfs @ 12.31 hrs, Volume= 29,071 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	6,806	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	284,100	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	290,906	39	Weighted Average
	290,906		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.24"
7.4	330	0.0112	0.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	637	0.0090	6.77	16.28	**Pipe Channel,** 21.0" Round Area= 2.4 sf Perim= 5.5' r= 0.44' n= 0.012 Concrete pipe, finished
15.9	1,017	Total			

Subcatchment EX-2: Portion of Pervious



Summary for Subcatchment EX-3: Portion of Parking Lot

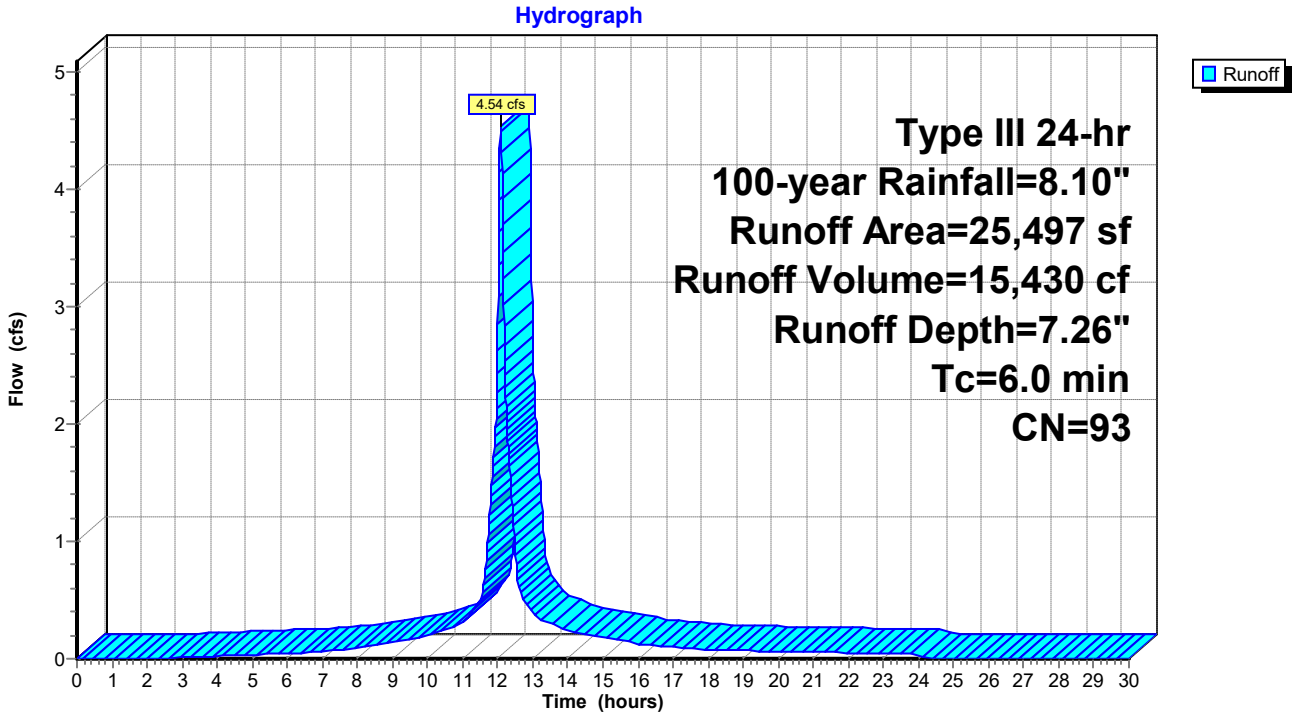
Runoff = 4.54 cfs @ 12.08 hrs, Volume= 15,430 cf, Depth= 7.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	23,516	98	Paved parking, HSG A (Map Unit 651)
*	1,981	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	25,497	93	Weighted Average
	1,981		7.77% Pervious Area
	23,516		92.23% Impervious Area

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

Subcatchment EX-3: Portion of Parking Lot



Summary for Subcatchment EX-4: Direct to River

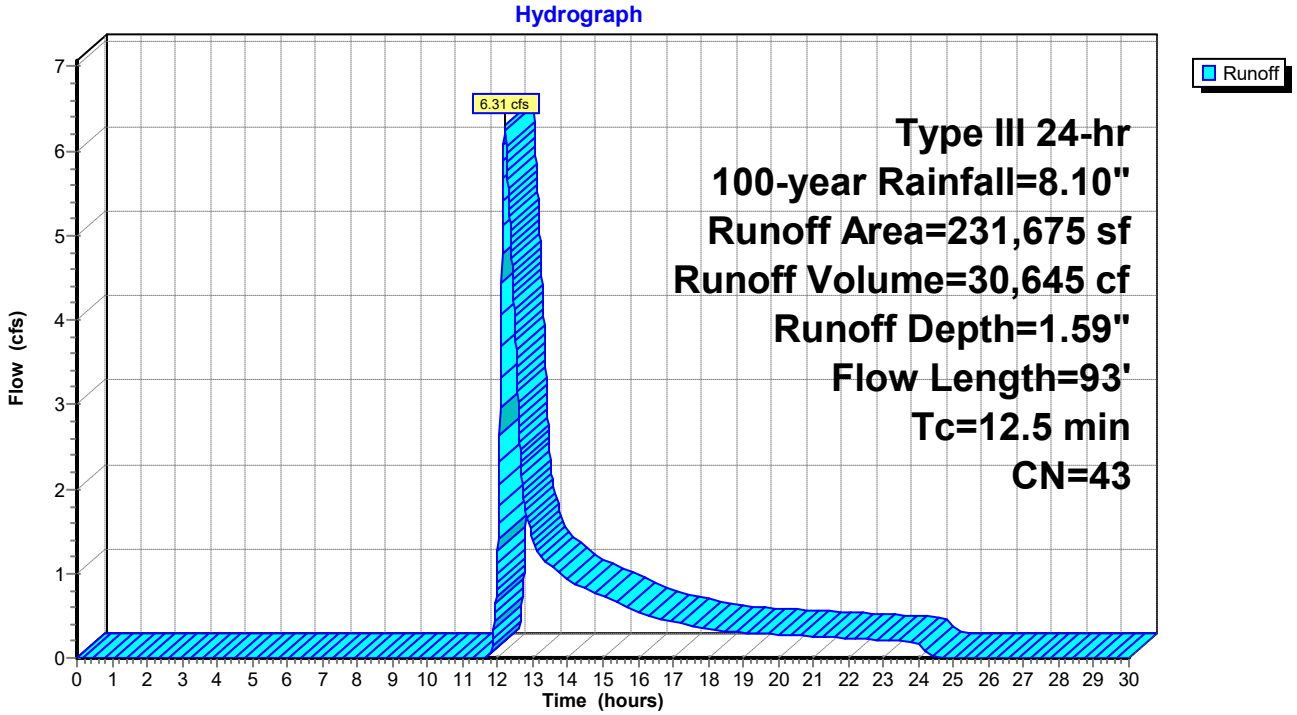
Runoff = 6.31 cfs @ 12.21 hrs, Volume= 30,645 cf, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	153,377	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	510	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	25,219	61	>75% Grass cover, Good, HSG B (Map Unit 718A)
*	15,368	30	Woods, Good, HSG A (Map Unit 651)
*	37,201	55	Woods, Good, HSG B (Map Unit 718A)
	231,675	43	Weighted Average
	231,675		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.24"
0.2	43	0.3950	3.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.5	93	Total			

Subcatchment EX-4: Direct to River

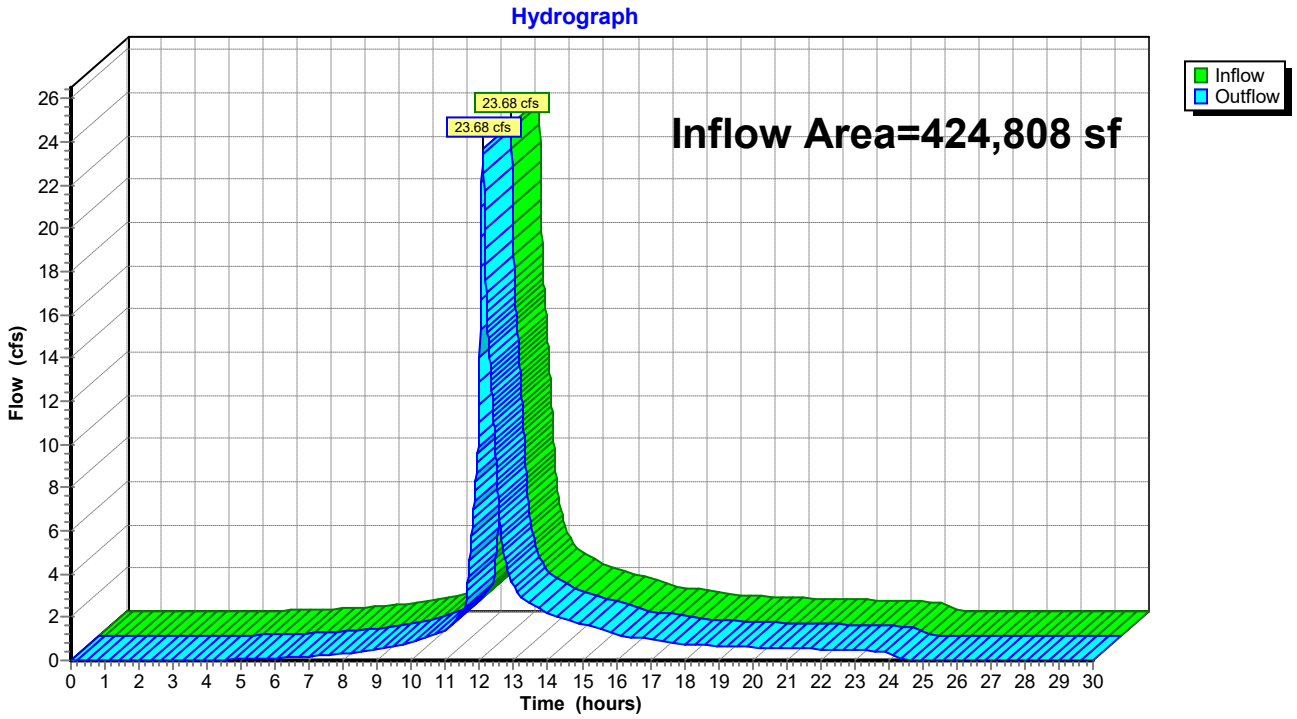


Summary for Reach DP-1: 21" Concrete Pipe

Inflow Area = 424,808 sf, 25.60% Impervious, Inflow Depth = 2.88" for 100-year event
Inflow = 23.68 cfs @ 12.09 hrs, Volume= 102,127 cf
Outflow = 23.68 cfs @ 12.09 hrs, Volume= 102,127 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-1: 21" Concrete Pipe

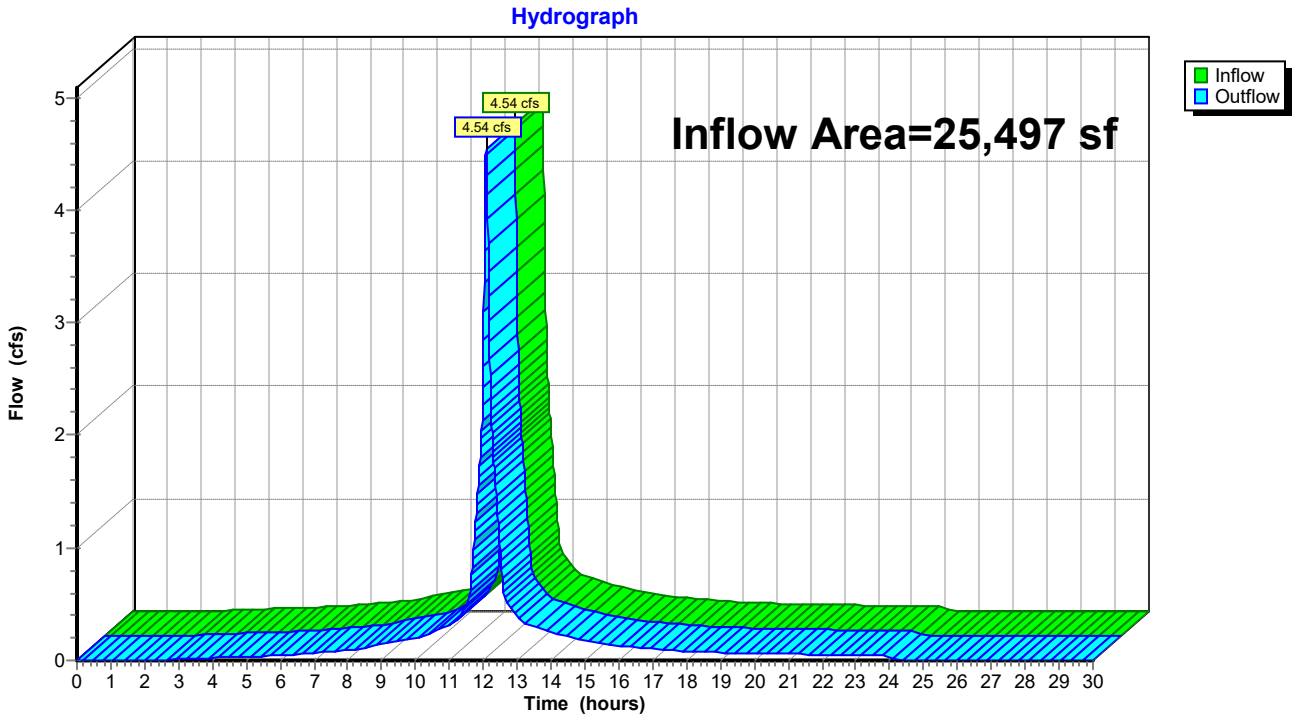


Summary for Reach DP-2: 24" RCP Pipe

Inflow Area = 25,497 sf, 92.23% Impervious, Inflow Depth = 7.26" for 100-year event
Inflow = 4.54 cfs @ 12.08 hrs, Volume= 15,430 cf
Outflow = 4.54 cfs @ 12.08 hrs, Volume= 15,430 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-2: 24" RCP Pipe

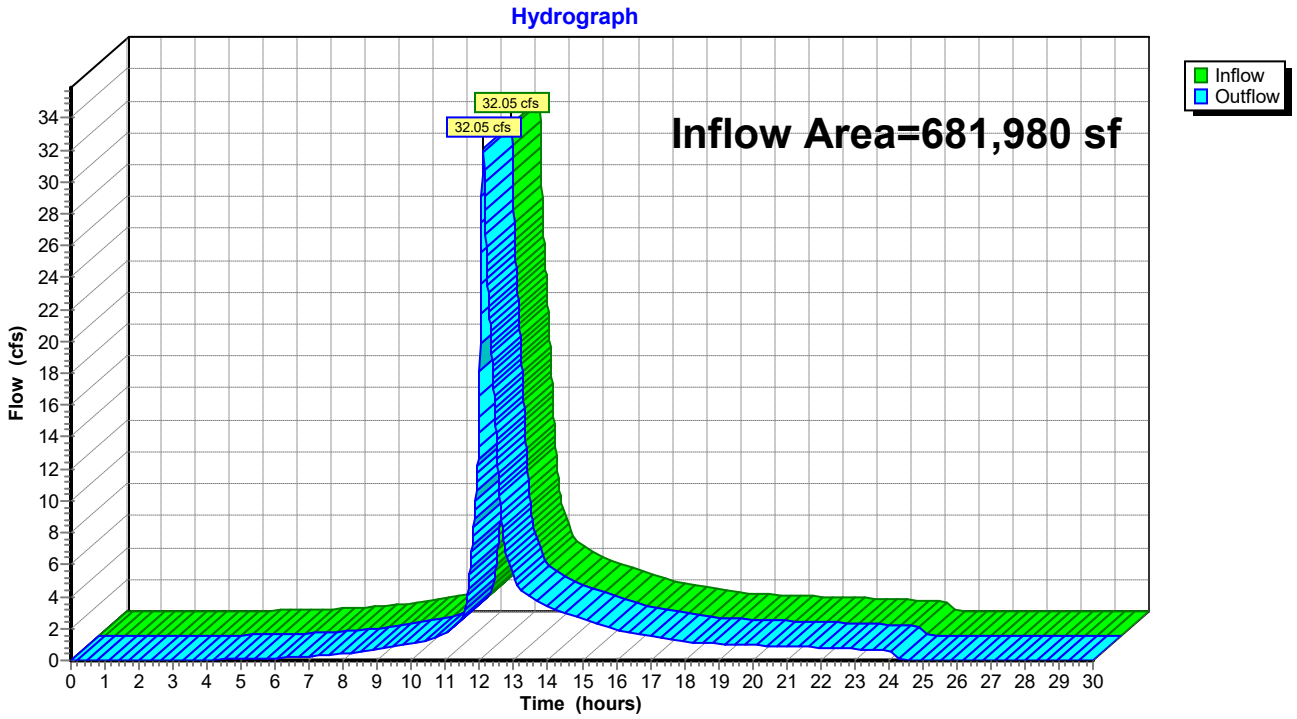


Summary for Reach DP-3: Ipswich River

Inflow Area = 681,980 sf, 19.39% Impervious, Inflow Depth = 2.61" for 100-year event
Inflow = 32.05 cfs @ 12.10 hrs, Volume= 148,201 cf
Outflow = 32.05 cfs @ 12.10 hrs, Volume= 148,201 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

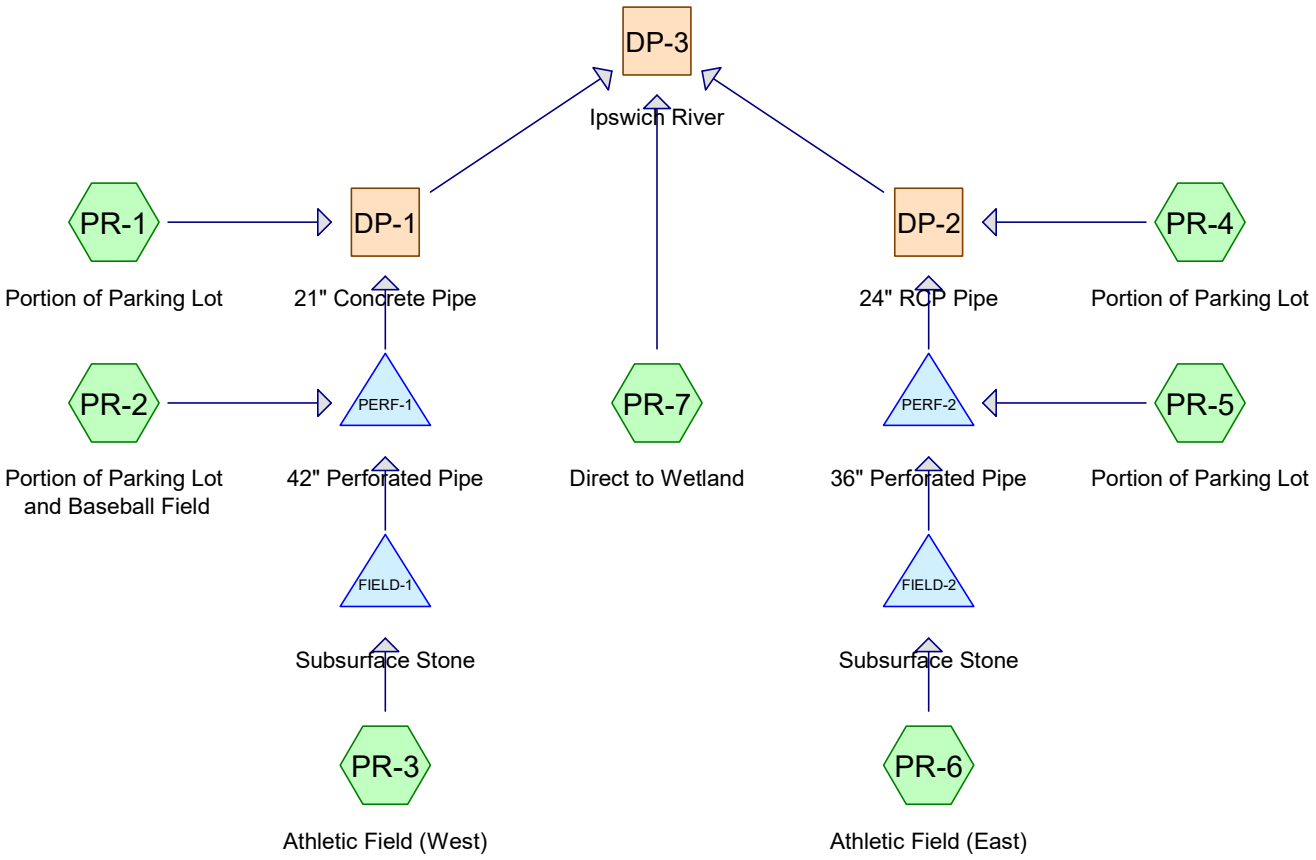
Reach DP-3: Ipswich River



Appendix F PROPOSED HYDROLOGIC CONDITIONS

PROPOSED CONDITIONS HYDROCAD REPORT

Proposed Conditions



Subcat Reach Pond Link

Routing Diagram for Proposed Conditions
Prepared by Stantec Consulting Ltd., Printed 1/18/2024

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
9,138	39	>75% Grass cover, Good, HSG A (Map Unit 254A) (PR-1, PR-2, PR-7)
237,655	39	>75% Grass cover, Good, HSG A (Map Unit 651) (PR-1, PR-2, PR-4, PR-5, PR-7)
11,092	61	>75% Grass cover, Good, HSG B (Map Unit 718A) (PR-7)
9,738	98	Paved parking, HSG A (Map Unit 254A) (PR-1)
177,673	98	Paved parking, HSG A (Map Unit 651) (PR-1, PR-2, PR-4, PR-5, PR-7)
4,604	98	Paved parking, HSG B (Map Unit 718A) (PR-7)
4,331	98	Roofs, HSG A (Map Unit 254A) (PR-1)
5,344	98	Roofs, HSG A (Map Unit 651) (PR-1, PR-2)
160,992	98	Synthetic Turf Field (Map Unit 651) (PR-3, PR-6)
11,049	98	Synthetic Turf Field (Map Unit 718A) (PR-6)
14,690	30	Woods, Good, HSG A (Map Unit 651) (PR-7)
35,674	55	Woods, Good, HSG B (Map Unit 718A) (PR-7)
681,980	**72**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
458,569	HSG A	PR-1, PR-2, PR-4, PR-5, PR-7
51,370	HSG B	PR-7
0	HSG C	
0	HSG D	
172,041	Other	PR-3, PR-6
681,980		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	PERF-1	48.70	48.60	10.0	0.0100	0.013	18.0	0.0	0.0
2	PERF-2	44.95	44.85	10.0	0.0100	0.013	10.0	0.0	0.0

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: Portion of Parking Runoff Area=104,151 sf 84.10% Impervious Runoff Depth=2.12"
Tc=6.0 min CN=89 Runoff=5.90 cfs 18,383 cf

Subcatchment PR-2: Portion of Parking Runoff Area=231,648 sf 24.90% Impervious Runoff Depth=0.23"
Tc=6.0 min CN=54 Runoff=0.49 cfs 4,531 cf

Subcatchment PR-3: Athletic Field (West) Runoff Area=89,400 sf 100.00% Impervious Runoff Depth=3.01"
Tc=6.0 min CN=98 Runoff=6.46 cfs 22,405 cf

Subcatchment PR-4: Portion of Parking Lot Runoff Area=13,840 sf 88.83% Impervious Runoff Depth=2.30"
Tc=6.0 min CN=91 Runoff=0.84 cfs 2,648 cf

Subcatchment PR-5: Portion of Parking Lot Runoff Area=38,475 sf 91.66% Impervious Runoff Depth=2.48"
Tc=6.0 min CN=93 Runoff=2.49 cfs 7,965 cf

Subcatchment PR-6: Athletic Field (East) Runoff Area=82,641 sf 100.00% Impervious Runoff Depth=3.01"
Tc=6.0 min CN=98 Runoff=5.97 cfs 20,711 cf

Subcatchment PR-7: Direct to Wetland Runoff Area=121,825 sf 7.27% Impervious Runoff Depth=0.12"
Flow Length=93' Tc=12.5 min CN=49 Runoff=0.05 cfs 1,178 cf

Reach DP-1: 21" Concrete Pipe Inflow=5.90 cfs 18,383 cf
Outflow=5.90 cfs 18,383 cf

Reach DP-2: 24" RCP Pipe Inflow=0.85 cfs 4,197 cf
Outflow=0.85 cfs 4,197 cf

Reach DP-3: Ipswich River Inflow=6.75 cfs 23,759 cf
Outflow=6.75 cfs 23,759 cf

Pond FIELD-1: Subsurface Stone Peak Elev=53.53' Storage=709 cf Inflow=6.46 cfs 22,405 cf
Discarded=5.02 cfs 22,405 cf Primary=0.00 cfs 0 cf Outflow=5.02 cfs 22,405 cf

Pond FIELD-2: Subsurface Stone Peak Elev=51.03' Storage=667 cf Inflow=5.97 cfs 20,711 cf
Discarded=4.61 cfs 20,711 cf Primary=0.00 cfs 0 cf Outflow=4.61 cfs 20,711 cf

Pond PERF-1: 42" Perforated Pipe Peak Elev=47.42' Storage=259 cf Inflow=0.49 cfs 4,531 cf
Discarded=0.28 cfs 4,531 cf Primary=0.00 cfs 0 cf Outflow=0.28 cfs 4,531 cf

Pond PERF-2: 36" Perforated Pipe Peak Elev=45.39' Storage=2,472 cf Inflow=2.49 cfs 7,965 cf
Discarded=0.19 cfs 6,415 cf Primary=0.48 cfs 1,550 cf Outflow=0.67 cfs 7,965 cf

Total Runoff Area = 681,980 sf Runoff Volume = 77,821 cf Average Runoff Depth = 1.37"
45.20% Pervious = 308,249 sf 54.80% Impervious = 373,731 sf

Summary for Subcatchment PR-1: Portion of Parking Lot

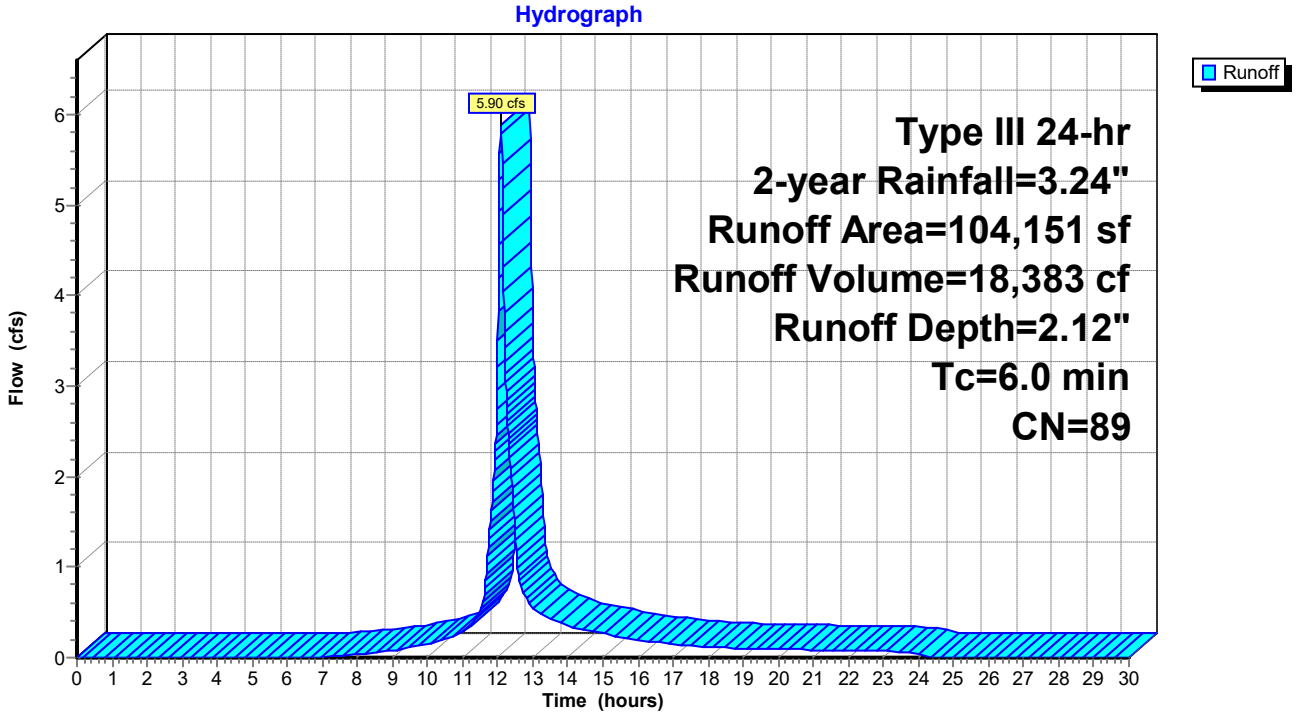
Runoff = 5.90 cfs @ 12.09 hrs, Volume= 18,383 cf, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	2,469	98	Roofs, HSG A (Map Unit 651)
*	4,331	98	Roofs, HSG A (Map Unit 254A)
*	71,056	98	Paved parking, HSG A (Map Unit 651)
*	9,738	98	Paved parking, HSG A (Map Unit 254A)
*	1,820	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	14,737	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	104,151	89	Weighted Average
	16,557		15.90% Pervious Area
	87,594		84.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Update with new baseball field survey**

Subcatchment PR-1: Portion of Parking Lot



Summary for Subcatchment PR-2: Portion of Parking Lot and Baseball Field

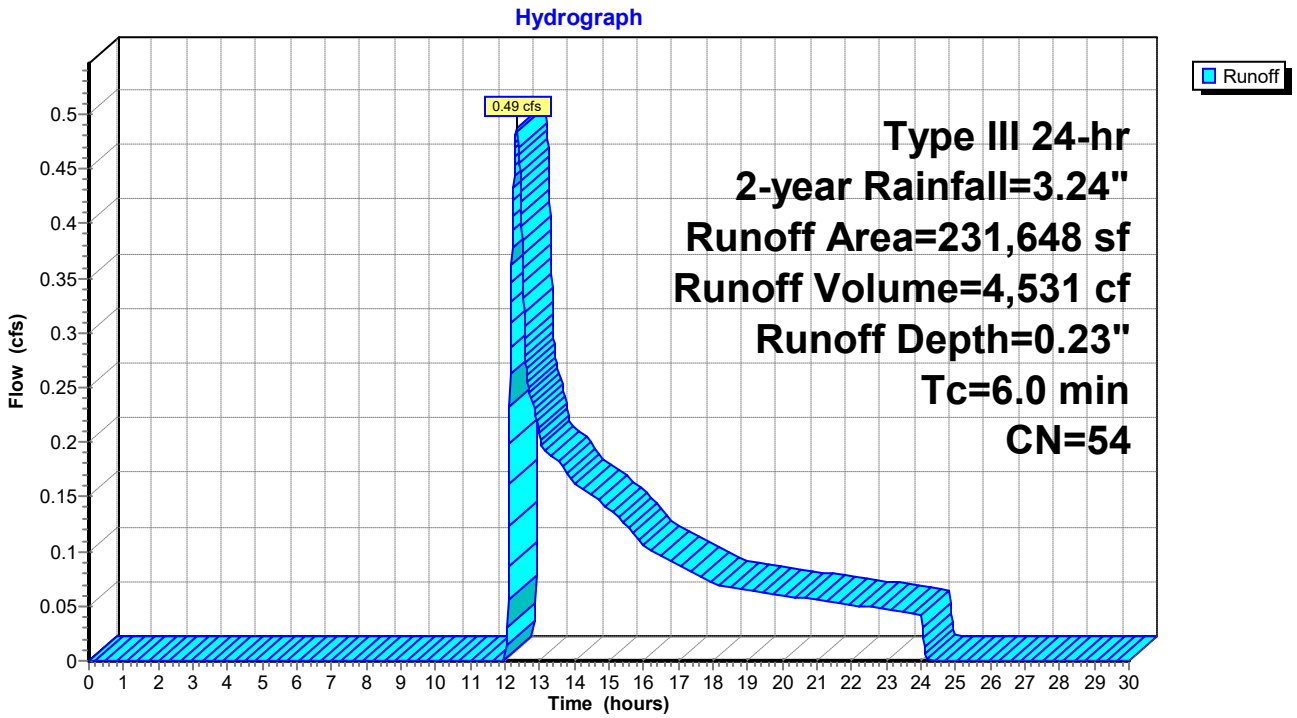
Runoff = 0.49 cfs @ 12.35 hrs, Volume= 4,531 cf, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	2,875	98	Roofs, HSG A (Map Unit 651)
*	54,805	98	Paved parking, HSG A (Map Unit 651)
*	6,808	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	167,160	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	231,648	54	Weighted Average
	173,968		75.10% Pervious Area
	57,680		24.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Update with new baseball field survey**

Subcatchment PR-2: Portion of Parking Lot and Baseball Field



Summary for Subcatchment PR-3: Athletic Field (West)

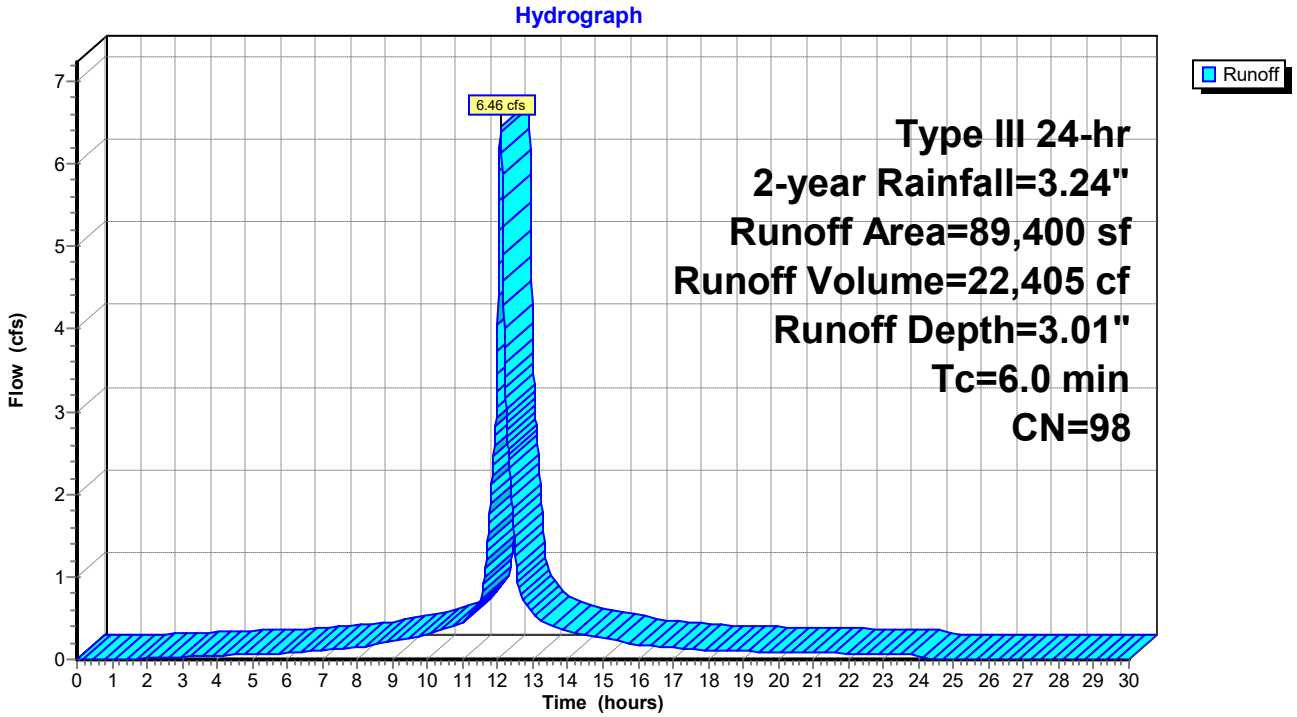
Runoff = 6.46 cfs @ 12.08 hrs, Volume= 22,405 cf, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	89,400	98	Synthetic Turf Field (Map Unit 651)
	89,400		100.00% Impervious Area

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

Subcatchment PR-3: Athletic Field (West)



Summary for Subcatchment PR-4: Portion of Parking Lot

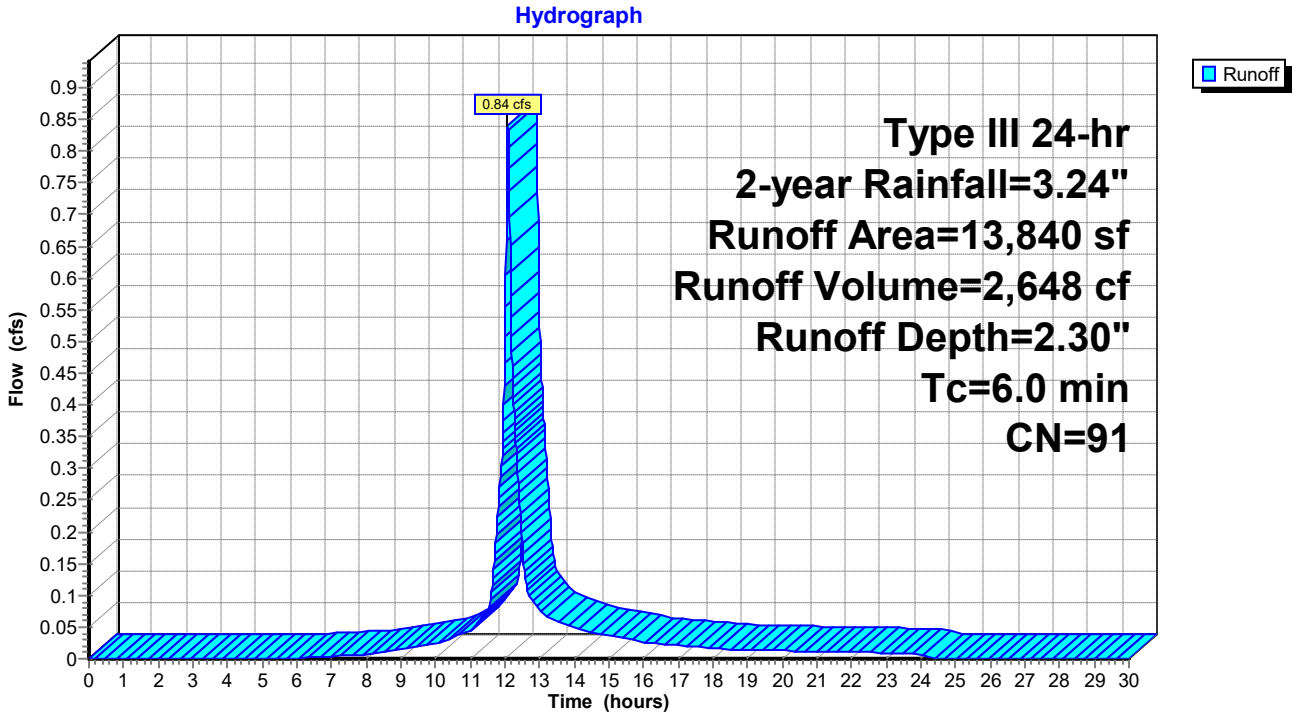
Runoff = 0.84 cfs @ 12.09 hrs, Volume= 2,648 cf, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	12,294	98	Paved parking, HSG A (Map Unit 651)
*	1,546	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	13,840	91	Weighted Average
	1,546		11.17% Pervious Area
	12,294		88.83% Impervious Area

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

Subcatchment PR-4: Portion of Parking Lot



Summary for Subcatchment PR-5: Portion of Parking Lot

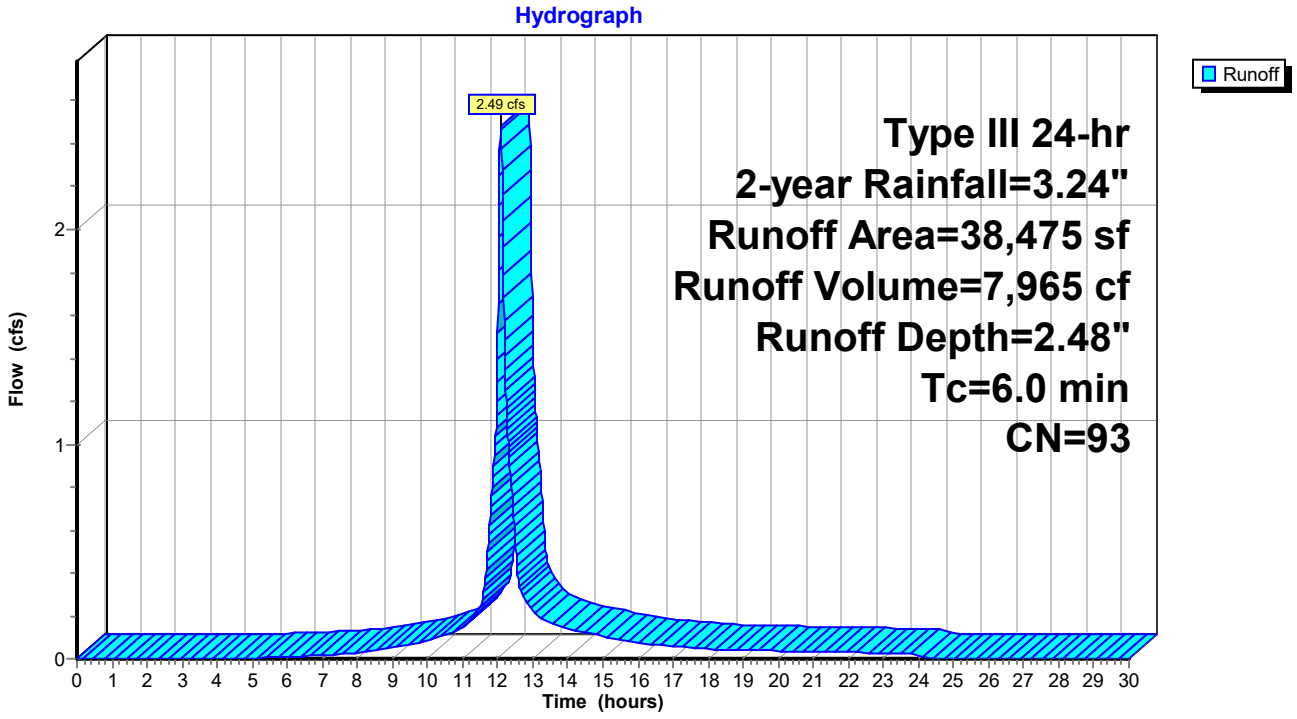
Runoff = 2.49 cfs @ 12.09 hrs, Volume= 7,965 cf, Depth= 2.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	35,267	98	Paved parking, HSG A (Map Unit 651)
*	3,208	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	38,475	93	Weighted Average
	3,208		8.34% Pervious Area
	35,267		91.66% Impervious Area

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

Subcatchment PR-5: Portion of Parking Lot



Summary for Subcatchment PR-6: Athletic Field (East)

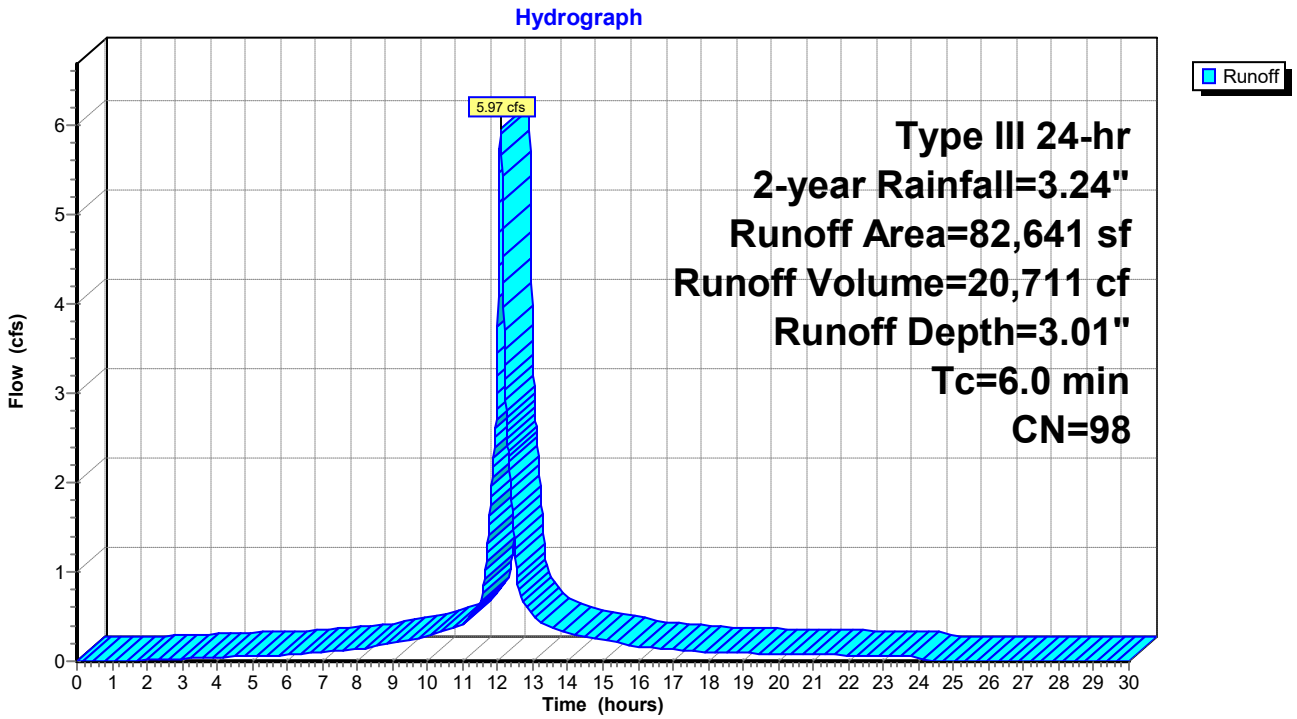
Runoff = 5.97 cfs @ 12.08 hrs, Volume= 20,711 cf, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	71,592	98	Synthetic Turf Field (Map Unit 651)
*	11,049	98	Synthetic Turf Field (Map Unit 718A)
	82,641	98	Weighted Average
	82,641		100.00% Impervious Area

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

Subcatchment PR-6: Athletic Field (East)



Summary for Subcatchment PR-7: Direct to Wetland

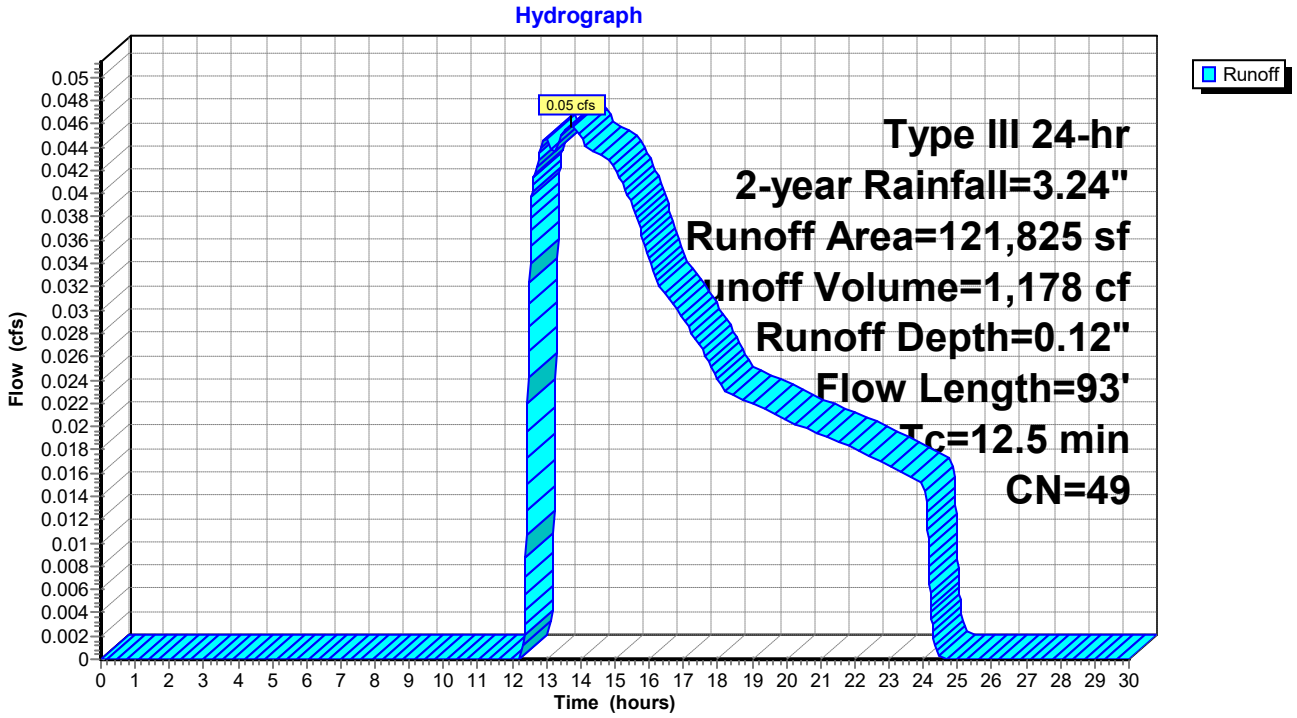
Runoff = 0.05 cfs @ 13.71 hrs, Volume= 1,178 cf, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.24"

	Area (sf)	CN	Description
*	510	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	51,004	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	11,092	61	>75% Grass cover, Good, HSG B (Map Unit 718A)
*	35,674	55	Woods, Good, HSG B (Map Unit 718A)
*	14,690	30	Woods, Good, HSG A (Map Unit 651)
*	4,251	98	Paved parking, HSG A (Map Unit 651)
*	4,604	98	Paved parking, HSG B (Map Unit 718A)
	121,825	49	Weighted Average
	112,970		92.73% Pervious Area
	8,855		7.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.24"
0.2	43	0.3950	3.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.5	93	Total			

Subcatchment PR-7: Direct to Wetland

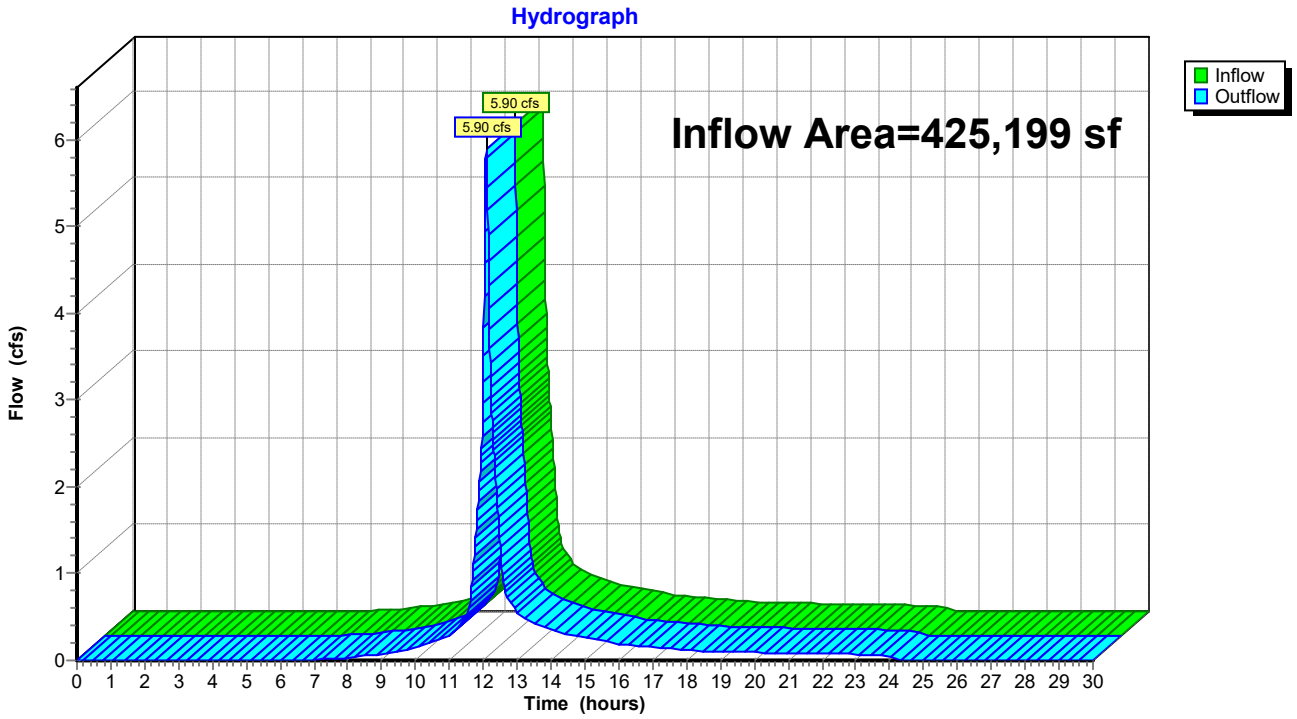


Summary for Reach DP-1: 21" Concrete Pipe

Inflow Area = 425,199 sf, 55.19% Impervious, Inflow Depth = 0.52" for 2-year event
Inflow = 5.90 cfs @ 12.09 hrs, Volume= 18,383 cf
Outflow = 5.90 cfs @ 12.09 hrs, Volume= 18,383 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-1: 21" Concrete Pipe

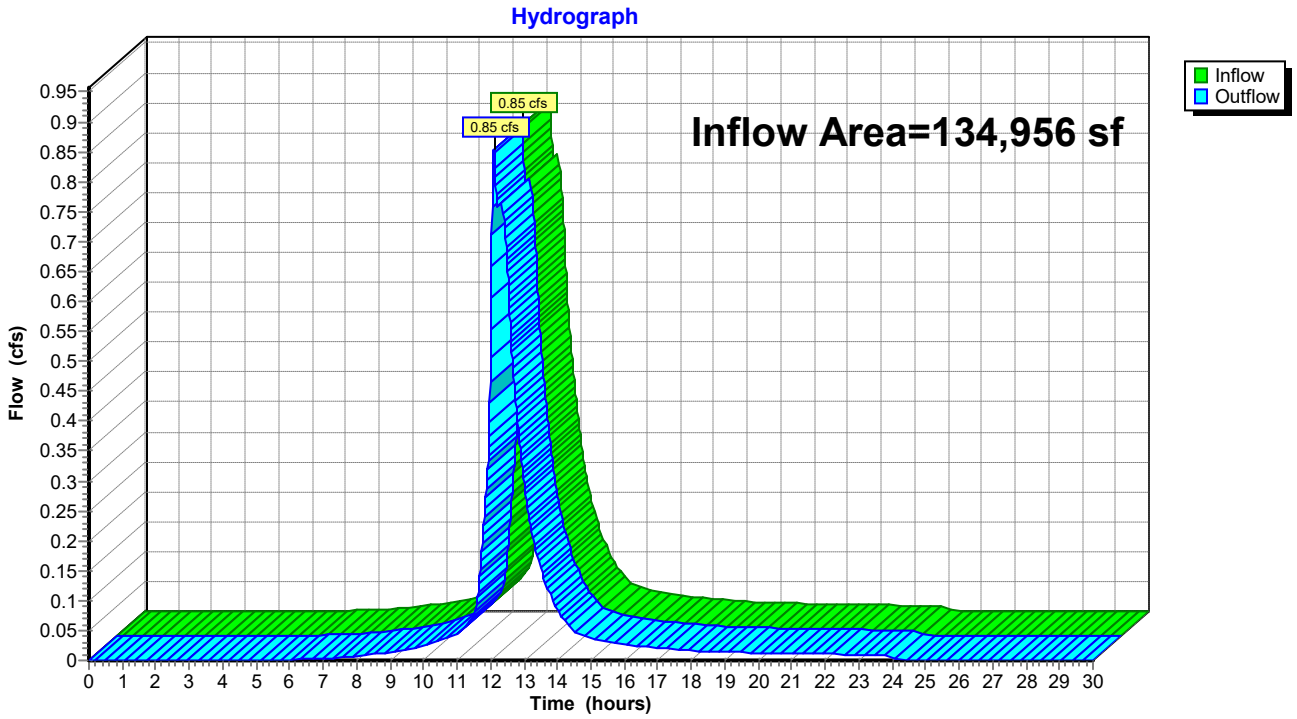


Summary for Reach DP-2: 24" RCP Pipe

Inflow Area = 134,956 sf, 96.48% Impervious, Inflow Depth = 0.37" for 2-year event
Inflow = 0.85 cfs @ 12.10 hrs, Volume= 4,197 cf
Outflow = 0.85 cfs @ 12.10 hrs, Volume= 4,197 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-2: 24" RCP Pipe

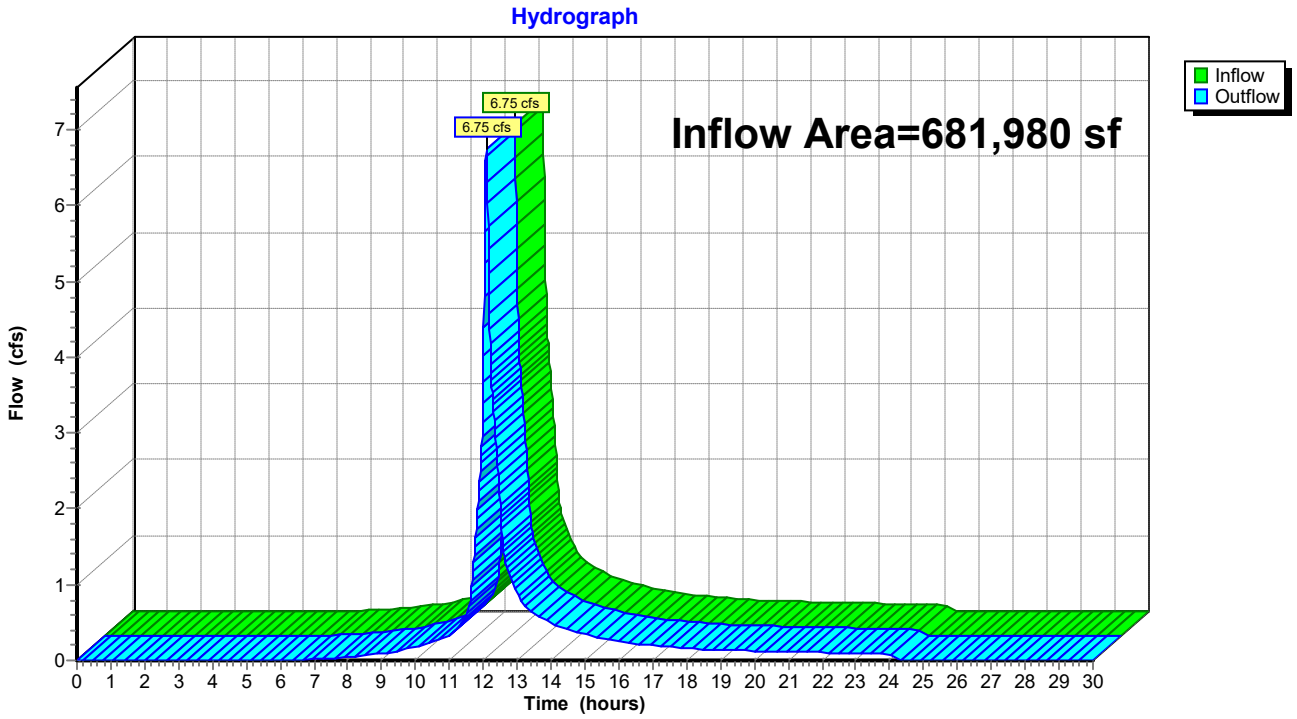


Summary for Reach DP-3: Ipswich River

Inflow Area = 681,980 sf, 54.80% Impervious, Inflow Depth = 0.42" for 2-year event
Inflow = 6.75 cfs @ 12.09 hrs, Volume= 23,759 cf
Outflow = 6.75 cfs @ 12.09 hrs, Volume= 23,759 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-3: Ipswich River



Summary for Pond FIELD-1: Subsurface Stone

Inflow Area = 89,400 sf,100.00% Impervious, Inflow Depth = 3.01" for 2-year event
Inflow = 6.46 cfs @ 12.08 hrs, Volume= 22,405 cf
Outflow = 5.02 cfs @ 12.05 hrs, Volume= 22,405 cf, Atten= 22%, Lag= 0.0 min
Discarded = 5.02 cfs @ 12.05 hrs, Volume= 22,405 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 53.53' @ 12.15 hrs Surf.Area= 90,007 sf Storage= 709 cf

Plug-Flow detention time= 1.2 min calculated for 22,397 cf (100% of inflow)
Center-of-Mass det. time= 1.2 min (757.4 - 756.1)

Volume	Invert	Avail.Storage	Storage Description
#1	53.50'	27,002 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 90,007 cf Overall x 30.0% Voids

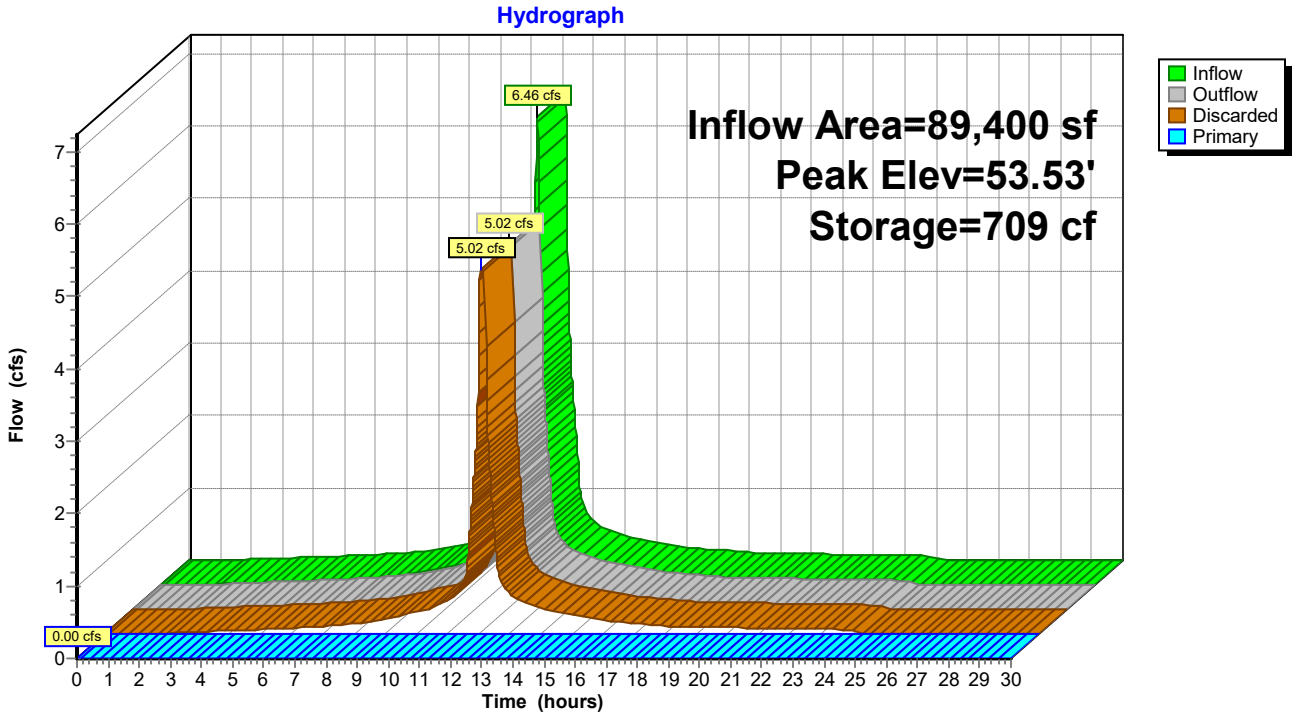
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.50	90,007	0	0
54.50	90,007	90,007	90,007

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	53.75'	**0.500 cfs Constant Flow/Skimmer X 34.00**

Discarded OutFlow Max=5.02 cfs @ 12.05 hrs HW=53.51' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 5.02 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=53.50' (Free Discharge)
↑—**2=Constant Flow/Skimmer** (Controls 0.00 cfs)

Pond FIELD-1: Subsurface Stone



Summary for Pond FIELD-2: Subsurface Stone

Inflow Area = 82,641 sf,100.00% Impervious, Inflow Depth = 3.01" for 2-year event
Inflow = 5.97 cfs @ 12.08 hrs, Volume= 20,711 cf
Outflow = 4.61 cfs @ 12.05 hrs, Volume= 20,711 cf, Atten= 23%, Lag= 0.0 min
Discarded = 4.61 cfs @ 12.05 hrs, Volume= 20,711 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 51.03' @ 12.15 hrs Surf.Area= 82,641 sf Storage= 667 cf

Plug-Flow detention time= 1.2 min calculated for 20,704 cf (100% of inflow)
Center-of-Mass det. time= 1.2 min (757.4 - 756.1)

Volume	Invert	Avail.Storage	Storage Description
#1	51.00'	24,792 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 82,641 cf Overall x 30.0% Voids

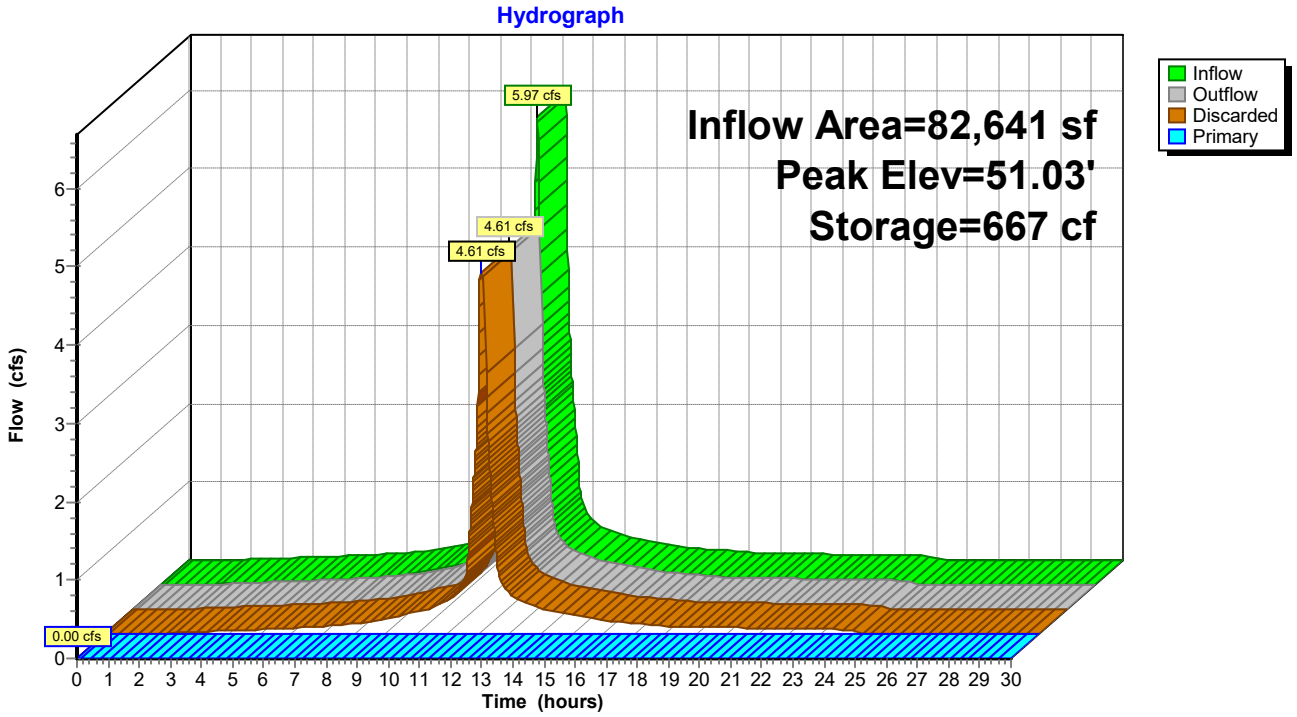
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
51.00	82,641	0	0
52.00	82,641	82,641	82,641

Device	Routing	Invert	Outlet Devices
#1	Discarded	51.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	51.25'	**0.500 cfs Constant Flow/Skimmer X 32.00**

Discarded OutFlow Max=4.61 cfs @ 12.05 hrs HW=51.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 4.61 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=51.00' (Free Discharge)
↑—**2=Constant Flow/Skimmer** (Controls 0.00 cfs)

Pond FIELD-2: Subsurface Stone



Summary for Pond PERF-1: 42" Perforated Pipe

Inflow Area = 321,048 sf, 45.81% Impervious, Inflow Depth = 0.17" for 2-year event
Inflow = 0.49 cfs @ 12.35 hrs, Volume= 4,531 cf
Outflow = 0.28 cfs @ 12.23 hrs, Volume= 4,531 cf, Atten= 43%, Lag= 0.0 min
Discarded = 0.28 cfs @ 12.23 hrs, Volume= 4,531 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 47.42' @ 12.59 hrs Surf.Area= 4,950 sf Storage= 259 cf

Plug-Flow detention time= 5.9 min calculated for 4,531 cf (100% of inflow)
Center-of-Mass det. time= 5.9 min (967.4 - 961.4)

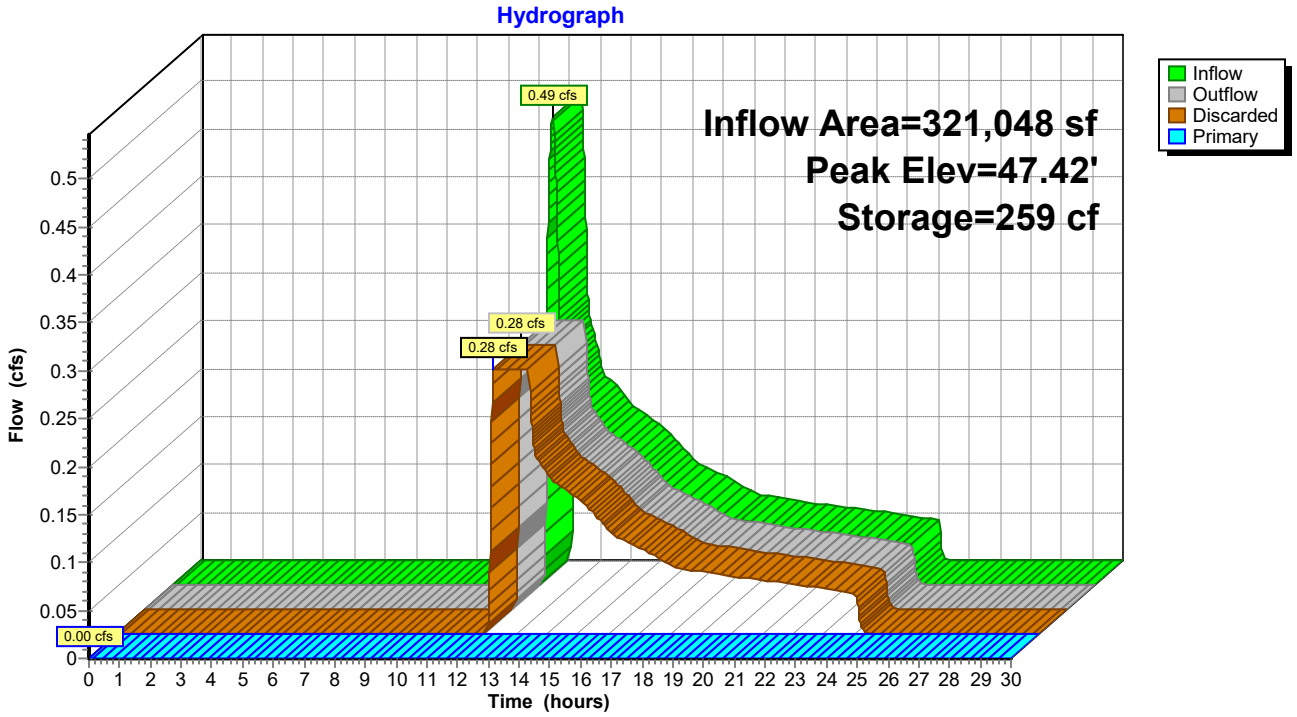
Volume	Invert	Avail.Storage	Storage Description
#1	47.75'	10,583 cf	**42.0" Round Pipe Storage** x 2 Inside #2 L= 550.0'
#2	47.25'	3,508 cf	**4.50'W x 550.00'L x 4.50'H Prismatoid** x 2 22,275 cf Overall - 10,583 cf Embedded = 11,692 cf x 30.0% Voids
		14,091 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	47.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	48.70'	**18.0" Round Culvert** L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 48.70' / 48.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Cast iron, coated, Flow Area= 1.77 sf

Discarded OutFlow Max=0.28 cfs @ 12.23 hrs HW=47.30' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=47.25' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond PERF-1: 42" Perforated Pipe



Summary for Pond PERF-2: 36" Perforated Pipe

Inflow Area = 121,116 sf, 97.35% Impervious, Inflow Depth = 0.79" for 2-year event
Inflow = 2.49 cfs @ 12.09 hrs, Volume= 7,965 cf
Outflow = 0.67 cfs @ 12.44 hrs, Volume= 7,965 cf, Atten= 73%, Lag= 21.4 min
Discarded = 0.19 cfs @ 11.34 hrs, Volume= 6,415 cf
Primary = 0.48 cfs @ 12.44 hrs, Volume= 1,550 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 45.39' @ 12.44 hrs Surf.Area= 3,400 sf Storage= 2,472 cf

Plug-Flow detention time= 59.4 min calculated for 7,962 cf (100% of inflow)
Center-of-Mass det. time= 59.4 min (851.6 - 792.2)

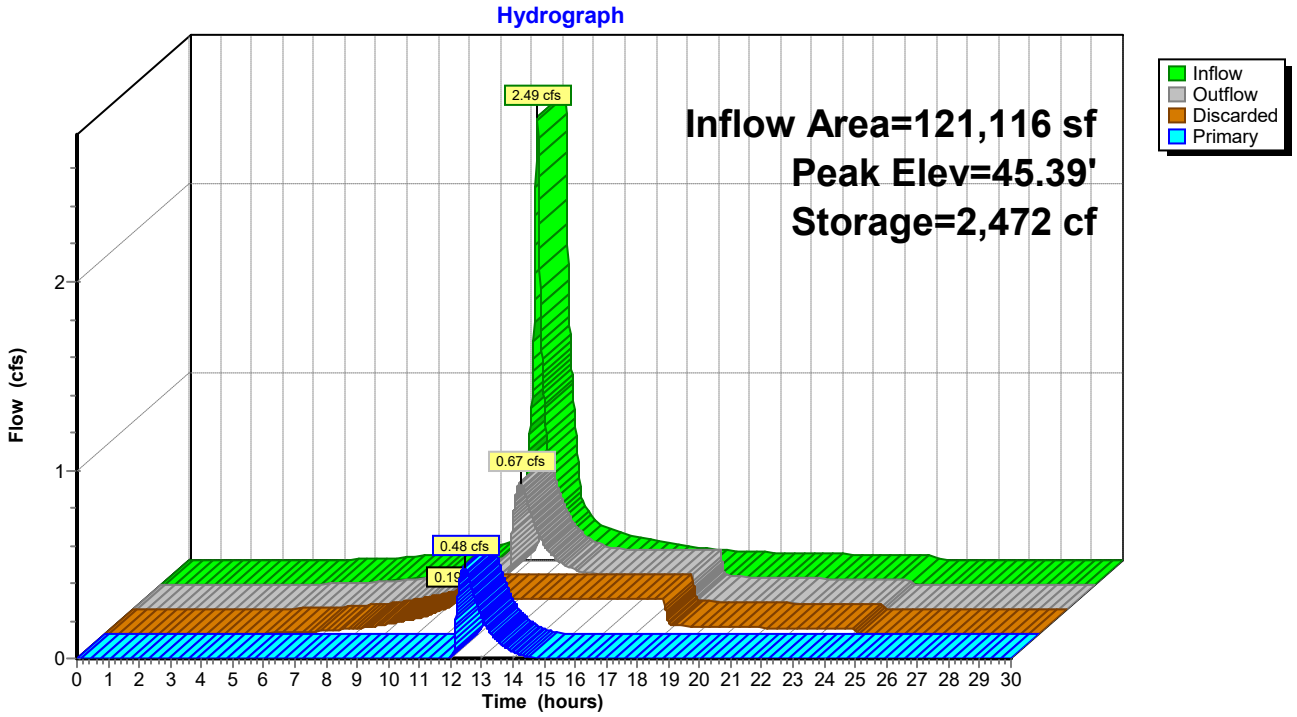
Volume	Invert	Avail.Storage	Storage Description
#1	44.50'	6,008 cf	**36.0" Round Pipe Storage** x 2 Inside #2 L= 425.0'
#2	44.00'	2,278 cf	**4.00'W x 425.00'L x 4.00'H Prismatoid** x 2 13,600 cf Overall - 6,008 cf Embedded = 7,592 cf x 30.0% Voids
		8,286 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	44.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	44.95'	**10.0" Round Culvert** L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 44.95' / 44.85' S= 0.0100 '/' Cc= 0.900 n= 0.013 Cast iron, coated, Flow Area= 0.55 sf

Discarded OutFlow Max=0.19 cfs @ 11.34 hrs HW=44.04' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.48 cfs @ 12.44 hrs HW=45.39' (Free Discharge)
2=Culvert (Barrel Controls 0.48 cfs @ 2.38 fps)

Pond PERF-2: 36" Perforated Pipe



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: Portion of Parking Runoff Area=104,151 sf 84.10% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=89 Runoff=10.57 cfs 33,736 cf

Subcatchment PR-2: Portion of Parking Runoff Area=231,648 sf 24.90% Impervious Runoff Depth=0.98"
Tc=6.0 min CN=54 Runoff=4.81 cfs 18,877 cf

Subcatchment PR-3: Athletic Field (West) Runoff Area=89,400 sf 100.00% Impervious Runoff Depth=4.88"
Tc=6.0 min CN=98 Runoff=10.28 cfs 36,378 cf

Subcatchment PR-4: Portion of Parking Lot Runoff Area=13,840 sf 88.83% Impervious Runoff Depth=4.10"
Tc=6.0 min CN=91 Runoff=1.46 cfs 4,727 cf

Subcatchment PR-5: Portion of Parking Lot Runoff Area=38,475 sf 91.66% Impervious Runoff Depth=4.32"
Tc=6.0 min CN=93 Runoff=4.19 cfs 13,837 cf

Subcatchment PR-6: Athletic Field (East) Runoff Area=82,641 sf 100.00% Impervious Runoff Depth=4.88"
Tc=6.0 min CN=98 Runoff=9.51 cfs 33,628 cf

Subcatchment PR-7: Direct to Wetland Runoff Area=121,825 sf 7.27% Impervious Runoff Depth=0.69"
Flow Length=93' Tc=12.5 min CN=49 Runoff=1.10 cfs 6,970 cf

Reach DP-1: 21" Concrete Pipe Inflow=10.57 cfs 39,100 cf
Outflow=10.57 cfs 39,100 cf

Reach DP-2: 24" RCP Pipe Inflow=2.47 cfs 9,929 cf
Outflow=2.47 cfs 9,929 cf

Reach DP-3: Ipswich River Inflow=13.30 cfs 56,000 cf
Outflow=13.30 cfs 56,000 cf

Pond FIELD-1: Subsurface Stone Peak Elev=53.61' Storage=2,893 cf Inflow=10.28 cfs 36,378 cf
Discarded=5.02 cfs 36,378 cf Primary=0.00 cfs 0 cf Outflow=5.02 cfs 36,378 cf

Pond FIELD-2: Subsurface Stone Peak Elev=51.11' Storage=2,703 cf Inflow=9.51 cfs 33,628 cf
Discarded=4.61 cfs 33,628 cf Primary=0.00 cfs 0 cf Outflow=4.61 cfs 33,628 cf

Pond PERF-1: 42" Perforated Pipe Peak Elev=49.14' Storage=5,540 cf Inflow=4.81 cfs 18,877 cf
Discarded=0.28 cfs 13,513 cf Primary=0.69 cfs 5,365 cf Outflow=0.97 cfs 18,877 cf

Pond PERF-2: 36" Perforated Pipe Peak Elev=45.89' Storage=3,843 cf Inflow=4.19 cfs 13,837 cf
Discarded=0.19 cfs 8,635 cf Primary=1.50 cfs 5,202 cf Outflow=1.69 cfs 13,837 cf

Total Runoff Area = 681,980 sf Runoff Volume = 148,154 cf Average Runoff Depth = 2.61"
45.20% Pervious = 308,249 sf 54.80% Impervious = 373,731 sf

Summary for Subcatchment PR-1: Portion of Parking Lot

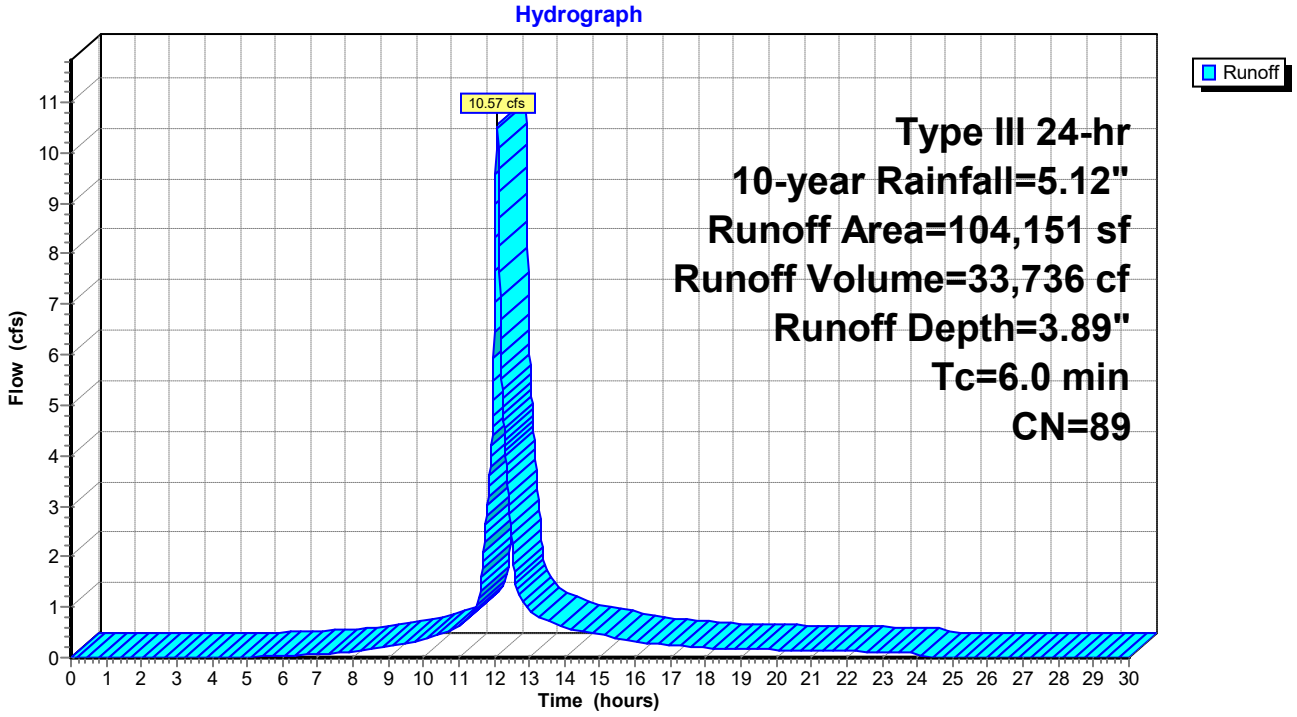
Runoff = 10.57 cfs @ 12.09 hrs, Volume= 33,736 cf, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	2,469	98	Roofs, HSG A (Map Unit 651)
*	4,331	98	Roofs, HSG A (Map Unit 254A)
*	71,056	98	Paved parking, HSG A (Map Unit 651)
*	9,738	98	Paved parking, HSG A (Map Unit 254A)
*	1,820	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	14,737	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	104,151	89	Weighted Average
	16,557		15.90% Pervious Area
	87,594		84.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Update with new baseball field survey**

Subcatchment PR-1: Portion of Parking Lot



Summary for Subcatchment PR-2: Portion of Parking Lot and Baseball Field

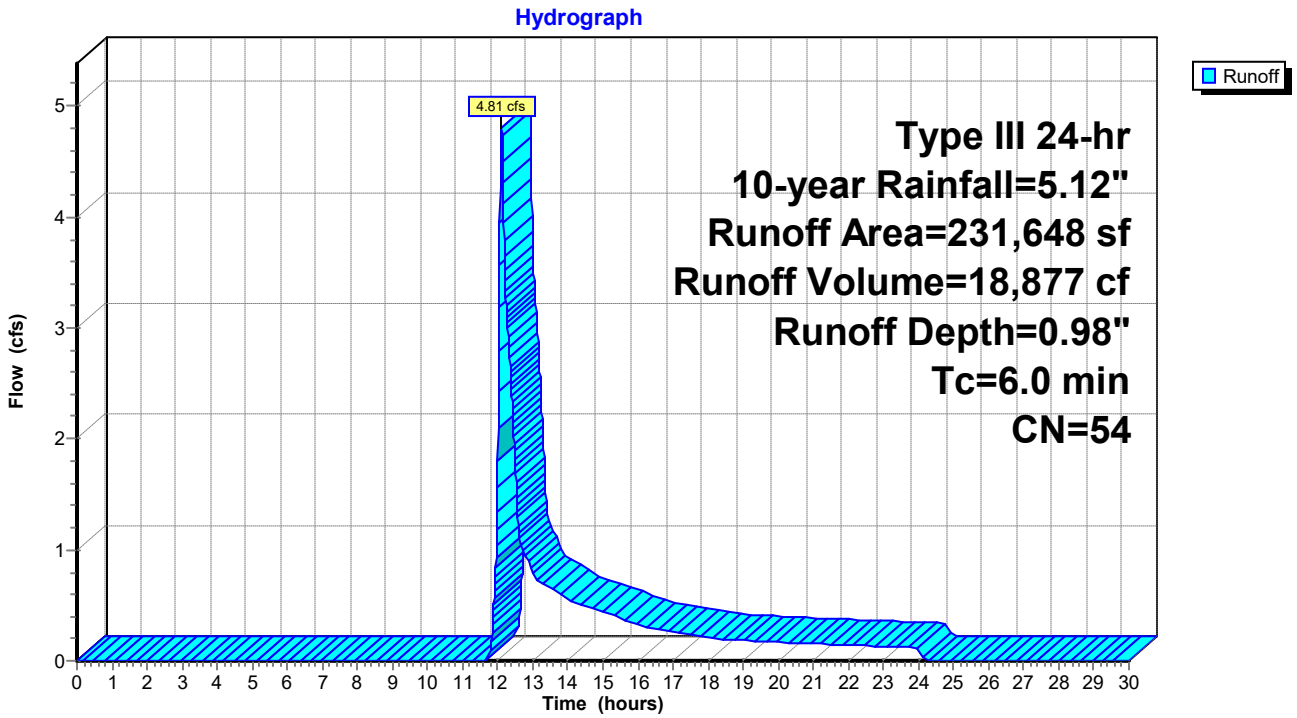
Runoff = 4.81 cfs @ 12.11 hrs, Volume= 18,877 cf, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	2,875	98	Roofs, HSG A (Map Unit 651)
*	54,805	98	Paved parking, HSG A (Map Unit 651)
*	6,808	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	167,160	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	231,648	54	Weighted Average
	173,968		75.10% Pervious Area
	57,680		24.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Update with new baseball field survey**

Subcatchment PR-2: Portion of Parking Lot and Baseball Field



Summary for Subcatchment PR-3: Athletic Field (West)

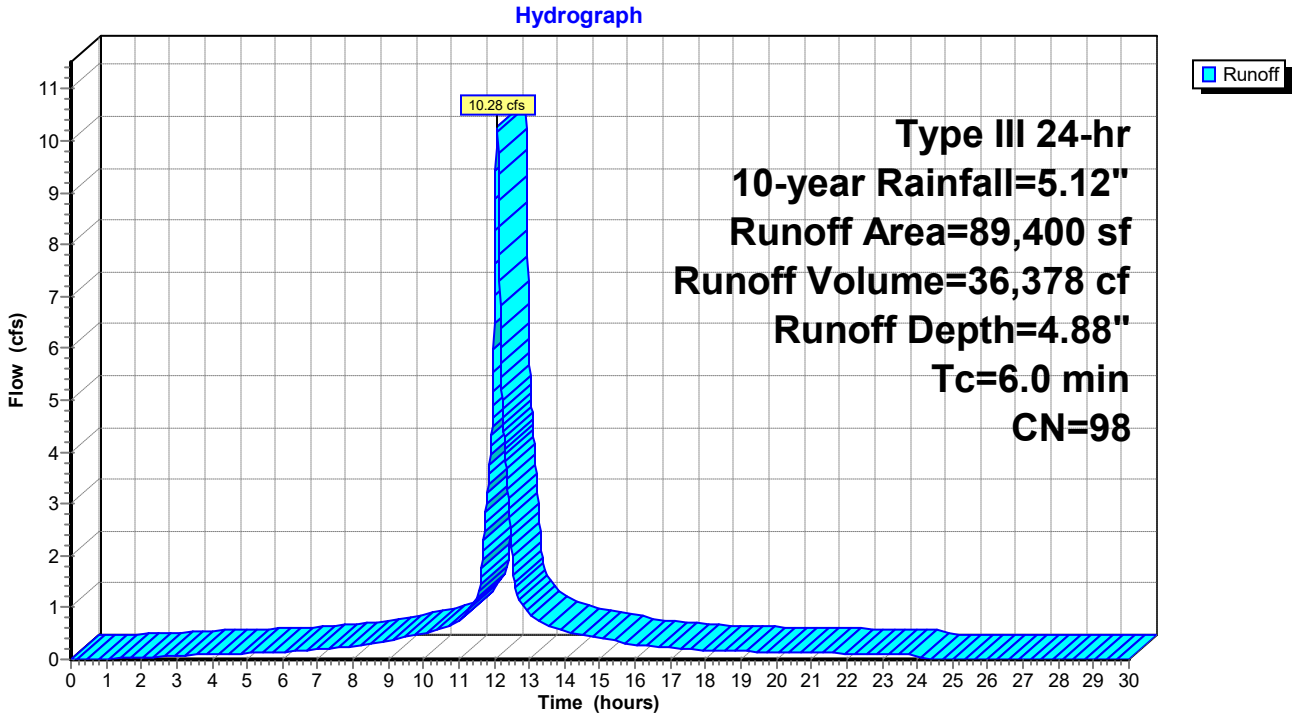
Runoff = 10.28 cfs @ 12.08 hrs, Volume= 36,378 cf, Depth= 4.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	89,400	98	Synthetic Turf Field (Map Unit 651)
	89,400		100.00% Impervious Area

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

Subcatchment PR-3: Athletic Field (West)



Summary for Subcatchment PR-4: Portion of Parking Lot

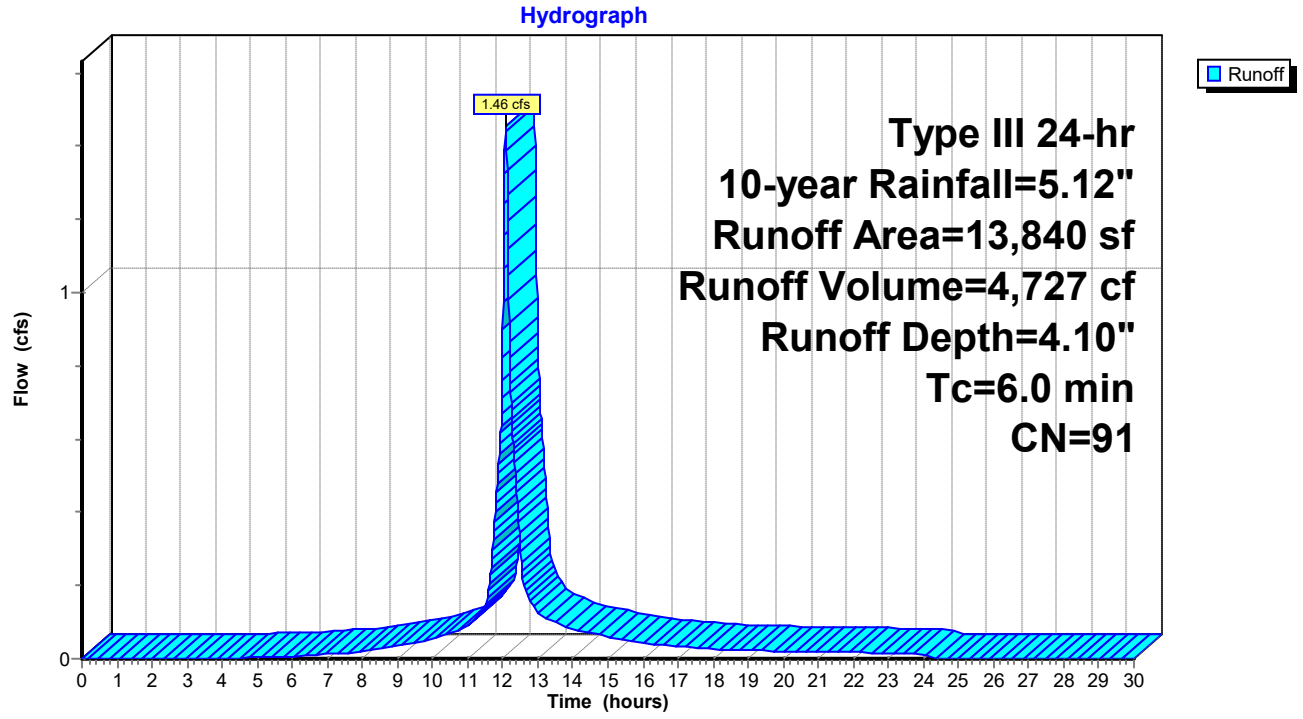
Runoff = 1.46 cfs @ 12.08 hrs, Volume= 4,727 cf, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	12,294	98	Paved parking, HSG A (Map Unit 651)
*	1,546	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	13,840	91	Weighted Average
	1,546		11.17% Pervious Area
	12,294		88.83% Impervious Area

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

Subcatchment PR-4: Portion of Parking Lot



Summary for Subcatchment PR-5: Portion of Parking Lot

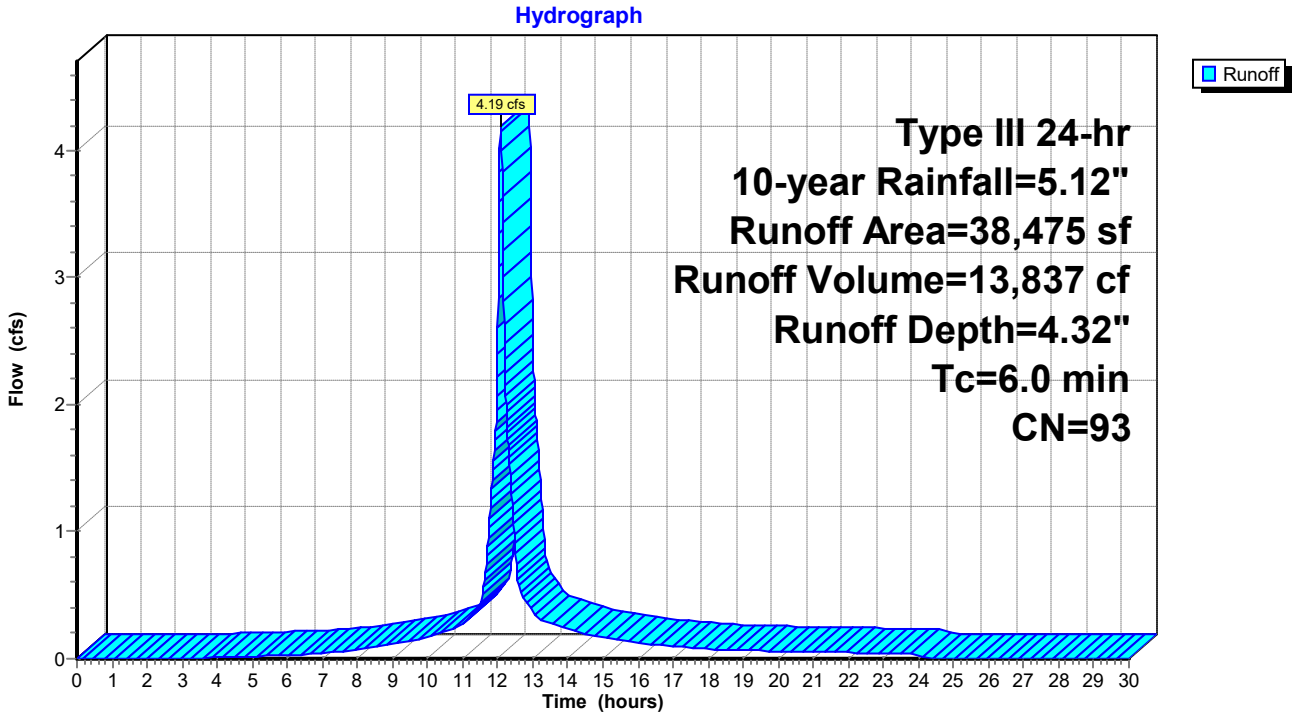
Runoff = 4.19 cfs @ 12.08 hrs, Volume= 13,837 cf, Depth= 4.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	35,267	98	Paved parking, HSG A (Map Unit 651)
*	3,208	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	38,475	93	Weighted Average
	3,208		8.34% Pervious Area
	35,267		91.66% Impervious Area

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

Subcatchment PR-5: Portion of Parking Lot



Summary for Subcatchment PR-6: Athletic Field (East)

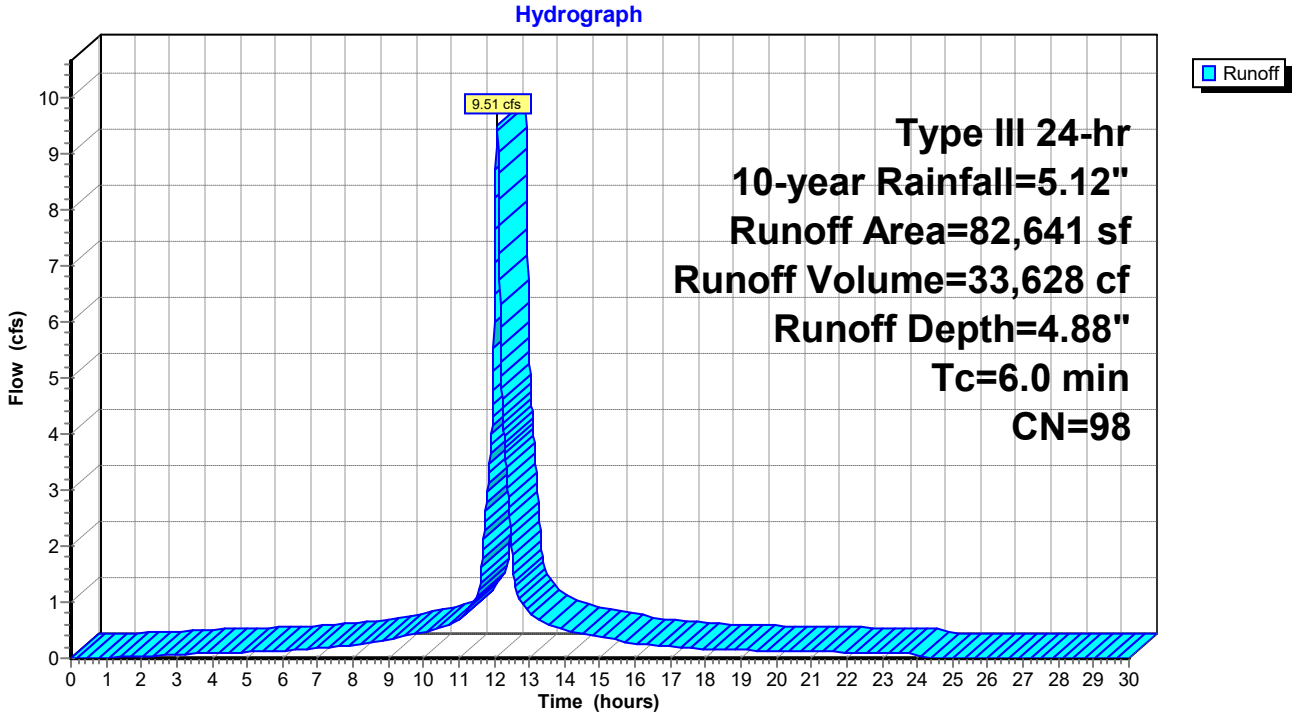
Runoff = 9.51 cfs @ 12.08 hrs, Volume= 33,628 cf, Depth= 4.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	71,592	98	Synthetic Turf Field (Map Unit 651)
*	11,049	98	Synthetic Turf Field (Map Unit 718A)
	82,641	98	Weighted Average
	82,641		100.00% Impervious Area

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

Subcatchment PR-6: Athletic Field (East)



Summary for Subcatchment PR-7: Direct to Wetland

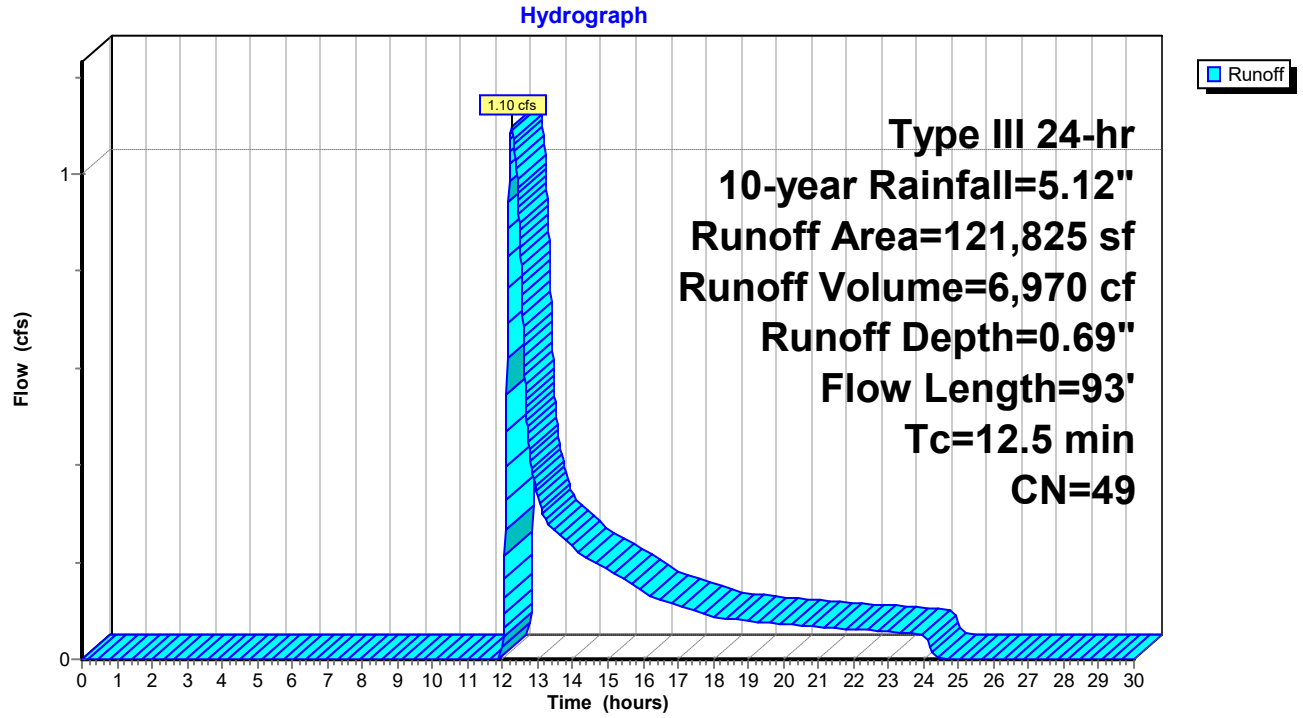
Runoff = 1.10 cfs @ 12.24 hrs, Volume= 6,970 cf, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.12"

	Area (sf)	CN	Description
*	510	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	51,004	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	11,092	61	>75% Grass cover, Good, HSG B (Map Unit 718A)
*	35,674	55	Woods, Good, HSG B (Map Unit 718A)
*	14,690	30	Woods, Good, HSG A (Map Unit 651)
*	4,251	98	Paved parking, HSG A (Map Unit 651)
*	4,604	98	Paved parking, HSG B (Map Unit 718A)
	121,825	49	Weighted Average
	112,970		92.73% Pervious Area
	8,855		7.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.24"
0.2	43	0.3950	3.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.5	93	Total			

Subcatchment PR-7: Direct to Wetland

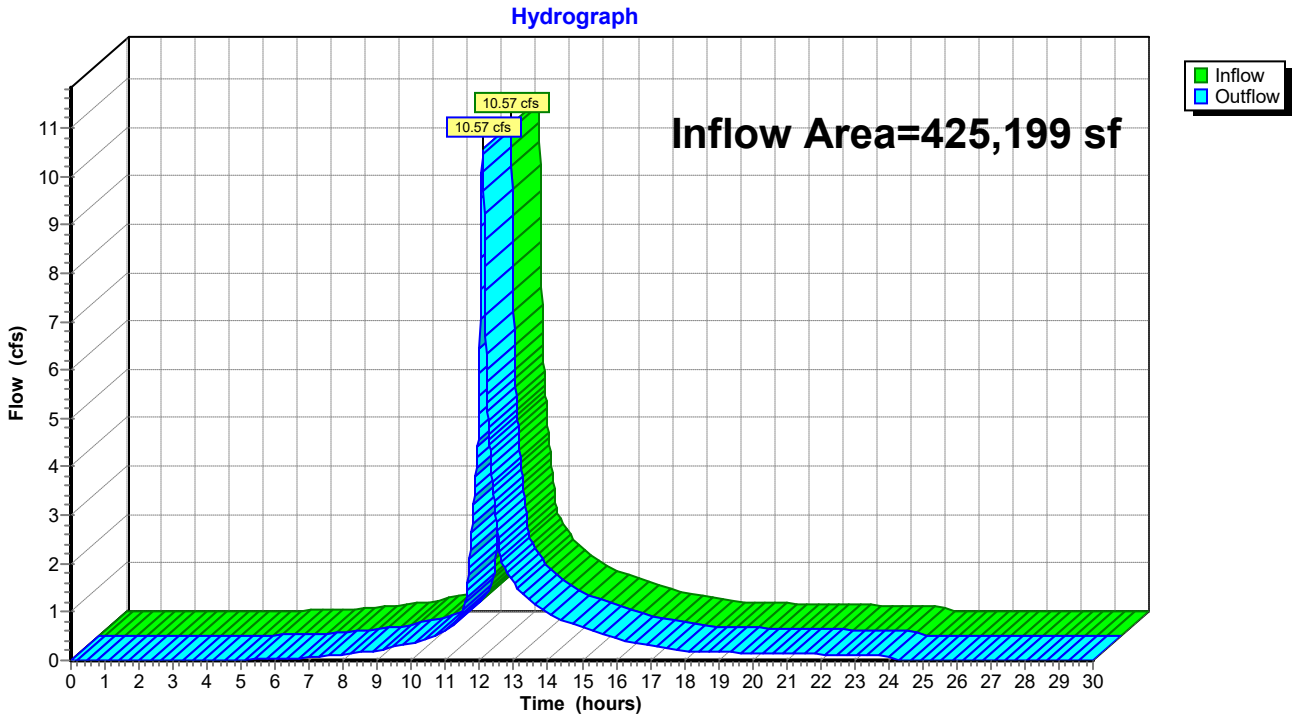


Summary for Reach DP-1: 21" Concrete Pipe

Inflow Area = 425,199 sf, 55.19% Impervious, Inflow Depth = 1.10" for 10-year event
Inflow = 10.57 cfs @ 12.09 hrs, Volume= 39,100 cf
Outflow = 10.57 cfs @ 12.09 hrs, Volume= 39,100 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-1: 21" Concrete Pipe

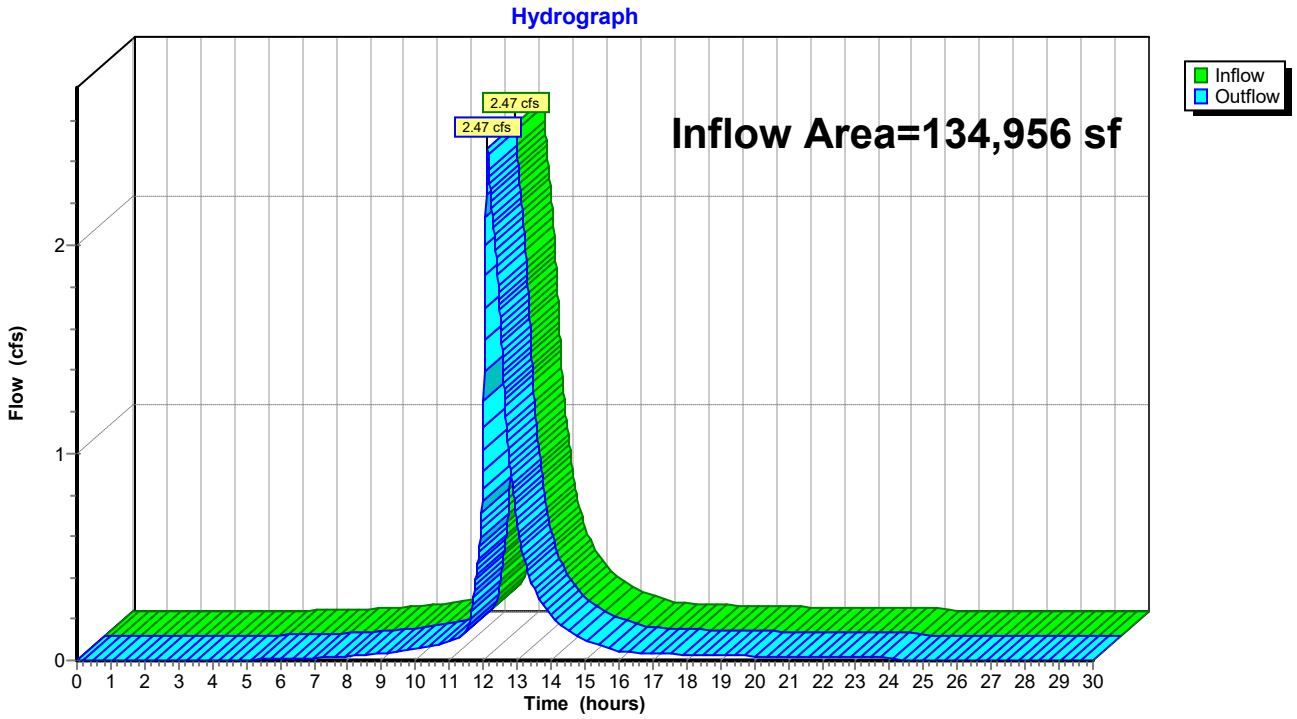


Summary for Reach DP-2: 24" RCP Pipe

Inflow Area = 134,956 sf, 96.48% Impervious, Inflow Depth = 0.88" for 10-year event
Inflow = 2.47 cfs @ 12.13 hrs, Volume= 9,929 cf
Outflow = 2.47 cfs @ 12.13 hrs, Volume= 9,929 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-2: 24" RCP Pipe

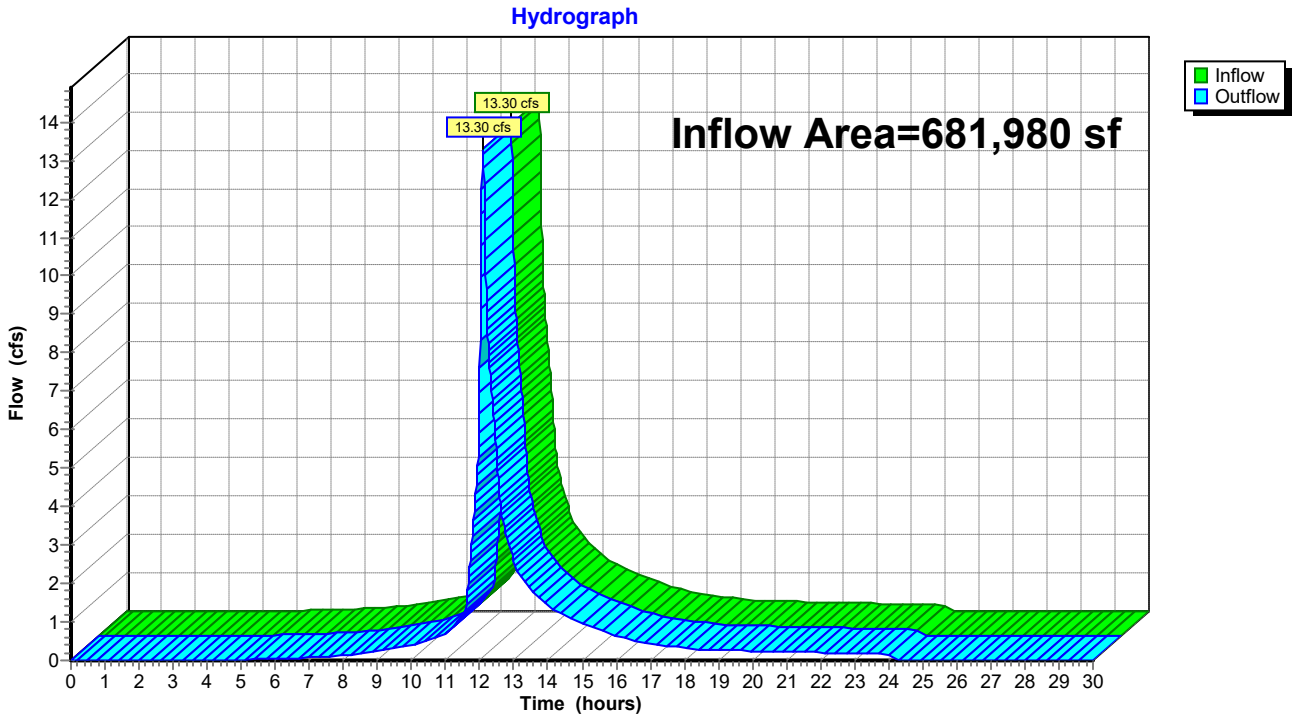


Summary for Reach DP-3: Ipswich River

Inflow Area = 681,980 sf, 54.80% Impervious, Inflow Depth = 0.99" for 10-year event
Inflow = 13.30 cfs @ 12.09 hrs, Volume= 56,000 cf
Outflow = 13.30 cfs @ 12.09 hrs, Volume= 56,000 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-3: Ipswich River



Summary for Pond FIELD-1: Subsurface Stone

Inflow Area = 89,400 sf,100.00% Impervious, Inflow Depth = 4.88" for 10-year event
Inflow = 10.28 cfs @ 12.08 hrs, Volume= 36,378 cf
Outflow = 5.02 cfs @ 11.99 hrs, Volume= 36,378 cf, Atten= 51%, Lag= 0.0 min
Discarded = 5.02 cfs @ 11.99 hrs, Volume= 36,378 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 53.61' @ 12.23 hrs Surf.Area= 90,007 sf Storage= 2,893 cf

Plug-Flow detention time= 2.7 min calculated for 36,366 cf (100% of inflow)
Center-of-Mass det. time= 2.7 min (750.3 - 747.6)

Volume	Invert	Avail.Storage	Storage Description
#1	53.50'	27,002 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 90,007 cf Overall x 30.0% Voids

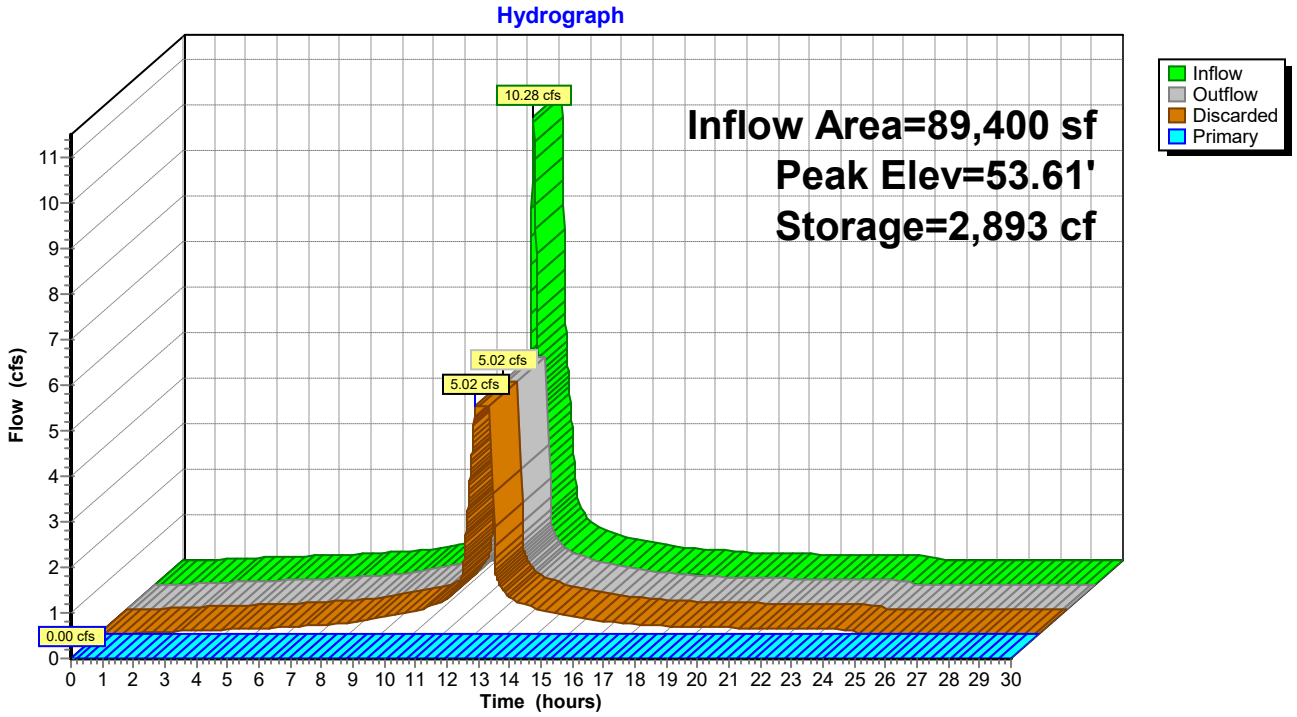
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.50	90,007	0	0
54.50	90,007	90,007	90,007

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	53.75'	**0.500 cfs Constant Flow/Skimmer X 34.00**

Discarded OutFlow Max=5.02 cfs @ 11.99 hrs HW=53.51' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 5.02 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=53.50' (Free Discharge)
↑—**2=Constant Flow/Skimmer** (Controls 0.00 cfs)

Pond FIELD-1: Subsurface Stone



Summary for Pond FIELD-2: Subsurface Stone

Inflow Area = 82,641 sf,100.00% Impervious, Inflow Depth = 4.88" for 10-year event
Inflow = 9.51 cfs @ 12.08 hrs, Volume= 33,628 cf
Outflow = 4.61 cfs @ 11.98 hrs, Volume= 33,628 cf, Atten= 51%, Lag= 0.0 min
Discarded = 4.61 cfs @ 11.98 hrs, Volume= 33,628 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 51.11' @ 12.23 hrs Surf.Area= 82,641 sf Storage= 2,703 cf

Plug-Flow detention time= 2.7 min calculated for 33,617 cf (100% of inflow)
Center-of-Mass det. time= 2.7 min (750.3 - 747.6)

Volume	Invert	Avail.Storage	Storage Description
#1	51.00'	24,792 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 82,641 cf Overall x 30.0% Voids

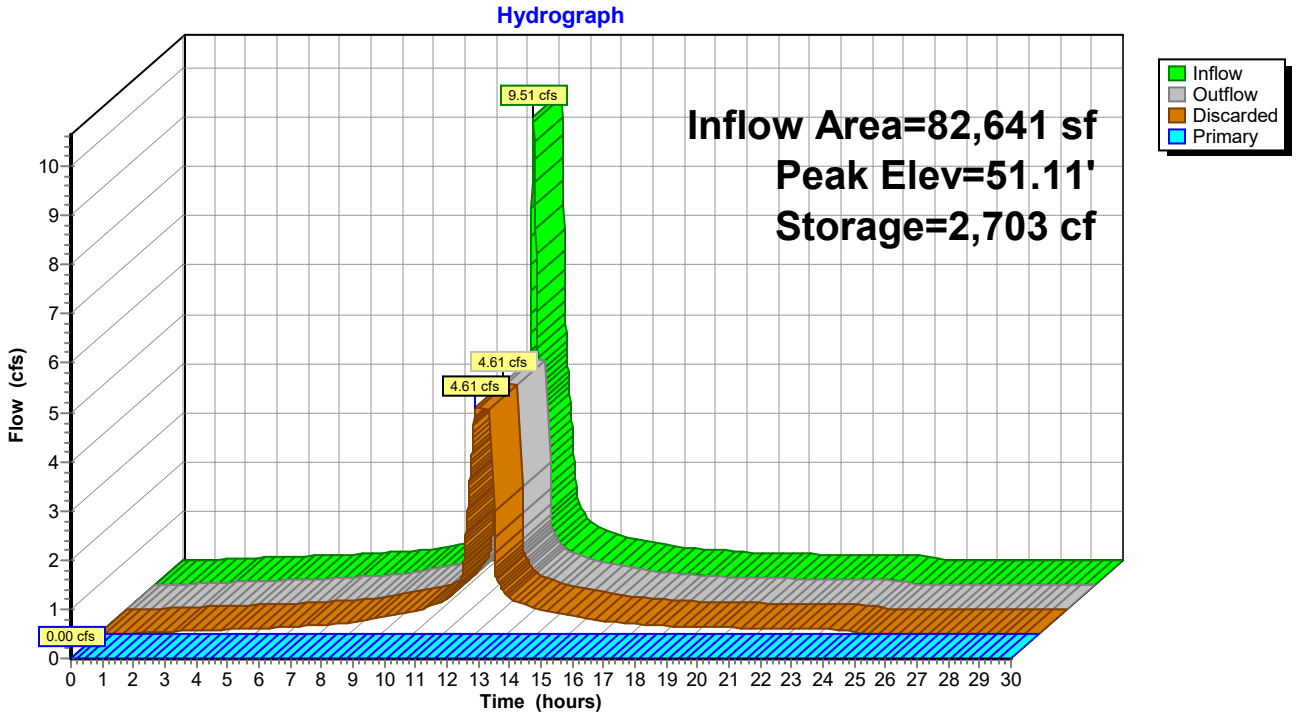
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
51.00	82,641	0	0
52.00	82,641	82,641	82,641

Device	Routing	Invert	Outlet Devices
#1	Discarded	51.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	51.25'	**0.500 cfs Constant Flow/Skimmer X 32.00**

Discarded OutFlow Max=4.61 cfs @ 11.98 hrs HW=51.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 4.61 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=51.00' (Free Discharge)
↑—**2=Constant Flow/Skimmer** (Controls 0.00 cfs)

Pond FIELD-2: Subsurface Stone



Summary for Pond PERF-1: 42" Perforated Pipe

Inflow Area = 321,048 sf, 45.81% Impervious, Inflow Depth = 0.71" for 10-year event
Inflow = 4.81 cfs @ 12.11 hrs, Volume= 18,877 cf
Outflow = 0.97 cfs @ 12.77 hrs, Volume= 18,877 cf, Atten= 80%, Lag= 39.9 min
Discarded = 0.28 cfs @ 11.90 hrs, Volume= 13,513 cf
Primary = 0.69 cfs @ 12.77 hrs, Volume= 5,365 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 49.14' @ 12.77 hrs Surf.Area= 4,950 sf Storage= 5,540 cf

Plug-Flow detention time= 144.6 min calculated for 18,871 cf (100% of inflow)
Center-of-Mass det. time= 144.6 min (1,038.9 - 894.3)

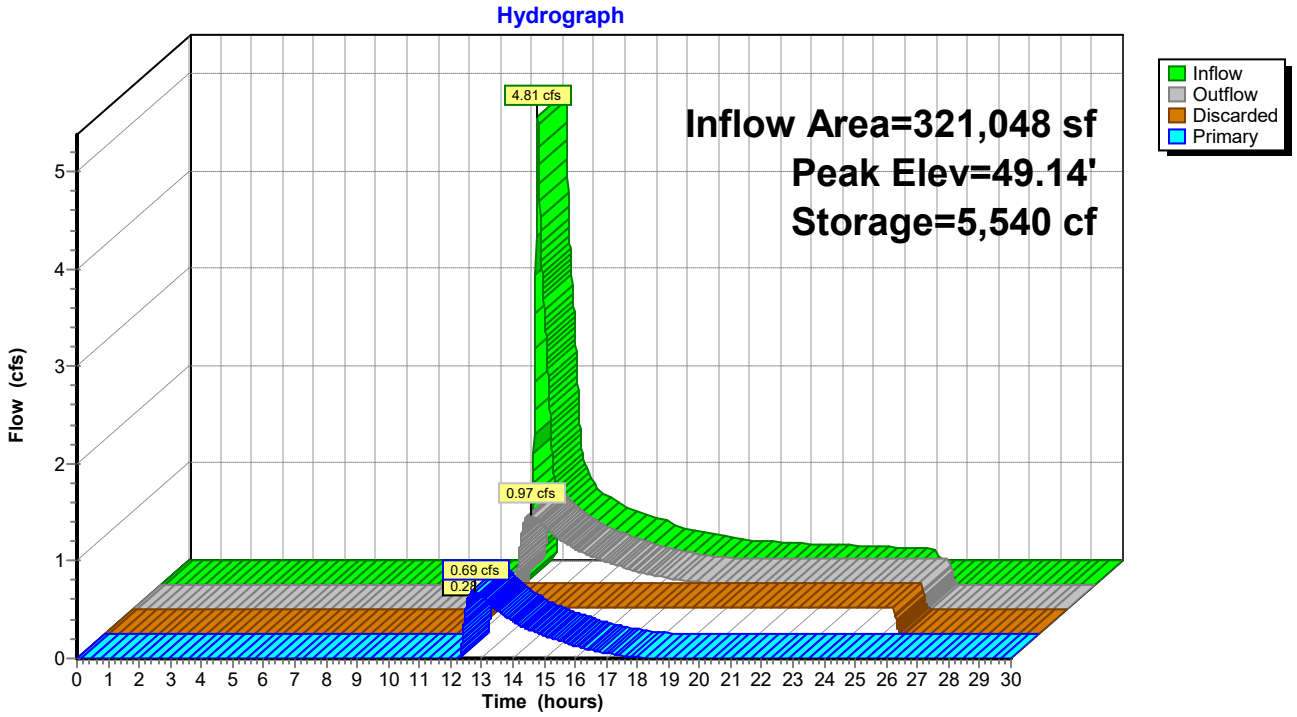
Volume	Invert	Avail.Storage	Storage Description
#1	47.75'	10,583 cf	**42.0" Round Pipe Storage** x 2 Inside #2 L= 550.0'
#2	47.25'	3,508 cf	**4.50'W x 550.00'L x 4.50'H Prismatoid** x 2 22,275 cf Overall - 10,583 cf Embedded = 11,692 cf x 30.0% Voids
		14,091 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	47.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	48.70'	**18.0" Round Culvert** L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 48.70' / 48.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Cast iron, coated, Flow Area= 1.77 sf

Discarded OutFlow Max=0.28 cfs @ 11.90 hrs HW=47.30' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.69 cfs @ 12.77 hrs HW=49.14' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 0.69 cfs @ 2.40 fps)

Pond PERF-1: 42" Perforated Pipe



Summary for Pond PERF-2: 36" Perforated Pipe

Inflow Area = 121,116 sf, 97.35% Impervious, Inflow Depth = 1.37" for 10-year event
Inflow = 4.19 cfs @ 12.08 hrs, Volume= 13,837 cf
Outflow = 1.69 cfs @ 12.30 hrs, Volume= 13,837 cf, Atten= 60%, Lag= 12.7 min
Discarded = 0.19 cfs @ 10.33 hrs, Volume= 8,635 cf
Primary = 1.50 cfs @ 12.30 hrs, Volume= 5,202 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 45.89' @ 12.30 hrs Surf.Area= 3,400 sf Storage= 3,843 cf

Plug-Flow detention time= 53.1 min calculated for 13,837 cf (100% of inflow)
Center-of-Mass det. time= 53.1 min (830.7 - 777.6)

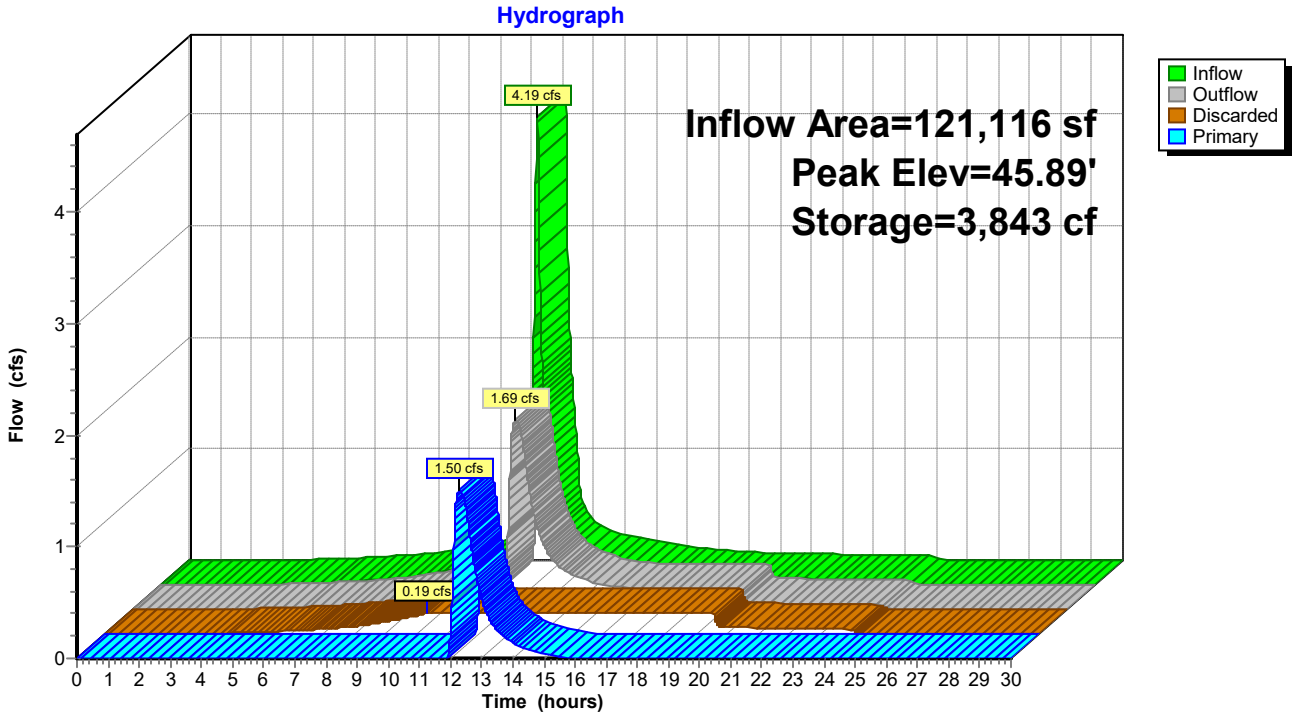
Volume	Invert	Avail.Storage	Storage Description
#1	44.50'	6,008 cf	**36.0" Round Pipe Storage** x 2 Inside #2 L= 425.0'
#2	44.00'	2,278 cf	**4.00'W x 425.00'L x 4.00'H Prismatoid** x 2 13,600 cf Overall - 6,008 cf Embedded = 7,592 cf x 30.0% Voids
		8,286 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	44.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	44.95'	**10.0" Round Culvert** L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 44.95' / 44.85' S= 0.0100 '/' Cc= 0.900 n= 0.013 Cast iron, coated, Flow Area= 0.55 sf

Discarded OutFlow Max=0.19 cfs @ 10.33 hrs HW=44.04' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=1.50 cfs @ 12.30 hrs HW=45.89' (Free Discharge)
2=Culvert (Inlet Controls 1.50 cfs @ 2.76 fps)

Pond PERF-2: 36" Perforated Pipe



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: Portion of Parking Runoff Area=104,151 sf 84.10% Impervious Runoff Depth=6.78"
Tc=6.0 min CN=89 Runoff=17.89 cfs 58,888 cf

Subcatchment PR-2: Portion of Parking Runoff Area=231,648 sf 24.90% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=54 Runoff=16.35 cfs 52,953 cf

Subcatchment PR-3: Athletic Field (West) Runoff Area=89,400 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=16.32 cfs 58,558 cf

Subcatchment PR-4: Portion of Parking Lot Runoff Area=13,840 sf 88.83% Impervious Runoff Depth=7.02"
Tc=6.0 min CN=91 Runoff=2.43 cfs 8,100 cf

Subcatchment PR-5: Portion of Parking Lot Runoff Area=38,475 sf 91.66% Impervious Runoff Depth=7.26"
Tc=6.0 min CN=93 Runoff=6.85 cfs 23,283 cf

Subcatchment PR-6: Athletic Field (East) Runoff Area=82,641 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=15.09 cfs 54,131 cf

Subcatchment PR-7: Direct to Wetland Runoff Area=121,825 sf 7.27% Impervious Runoff Depth=2.21"
Flow Length=93' Tc=12.5 min CN=49 Runoff=5.26 cfs 22,385 cf

Reach DP-1: 21" Concrete Pipe Inflow=21.51 cfs 96,716 cf
Outflow=21.51 cfs 96,716 cf

Reach DP-2: 24" RCP Pipe Inflow=4.47 cfs 22,178 cf
Outflow=4.47 cfs 22,178 cf

Reach DP-3: Ipswich River Inflow=30.11 cfs 141,280 cf
Outflow=30.11 cfs 141,280 cf

Pond FIELD-1: Subsurface Stone Peak Elev=53.75' Storage=6,874 cf Inflow=16.32 cfs 58,558 cf
Discarded=5.02 cfs 56,598 cf Primary=6.24 cfs 1,961 cf Outflow=11.26 cfs 58,558 cf

Pond FIELD-2: Subsurface Stone Peak Elev=51.25' Storage=6,308 cf Inflow=15.09 cfs 54,131 cf
Discarded=4.61 cfs 52,212 cf Primary=5.70 cfs 1,919 cf Outflow=10.31 cfs 54,131 cf

Pond PERF-1: 42" Perforated Pipe Peak Elev=51.16' Storage=13,169 cf Inflow=18.21 cfs 54,913 cf
Discarded=0.28 cfs 17,085 cf Primary=8.79 cfs 37,828 cf Outflow=9.07 cfs 54,913 cf

Pond PERF-2: 36" Perforated Pipe Peak Elev=47.65' Storage=7,933 cf Inflow=10.25 cfs 25,203 cf
Discarded=0.19 cfs 11,125 cf Primary=3.14 cfs 14,078 cf Outflow=3.33 cfs 25,203 cf

Total Runoff Area = 681,980 sf Runoff Volume = 278,298 cf Average Runoff Depth = 4.90"
45.20% Pervious = 308,249 sf 54.80% Impervious = 373,731 sf

Summary for Subcatchment PR-1: Portion of Parking Lot

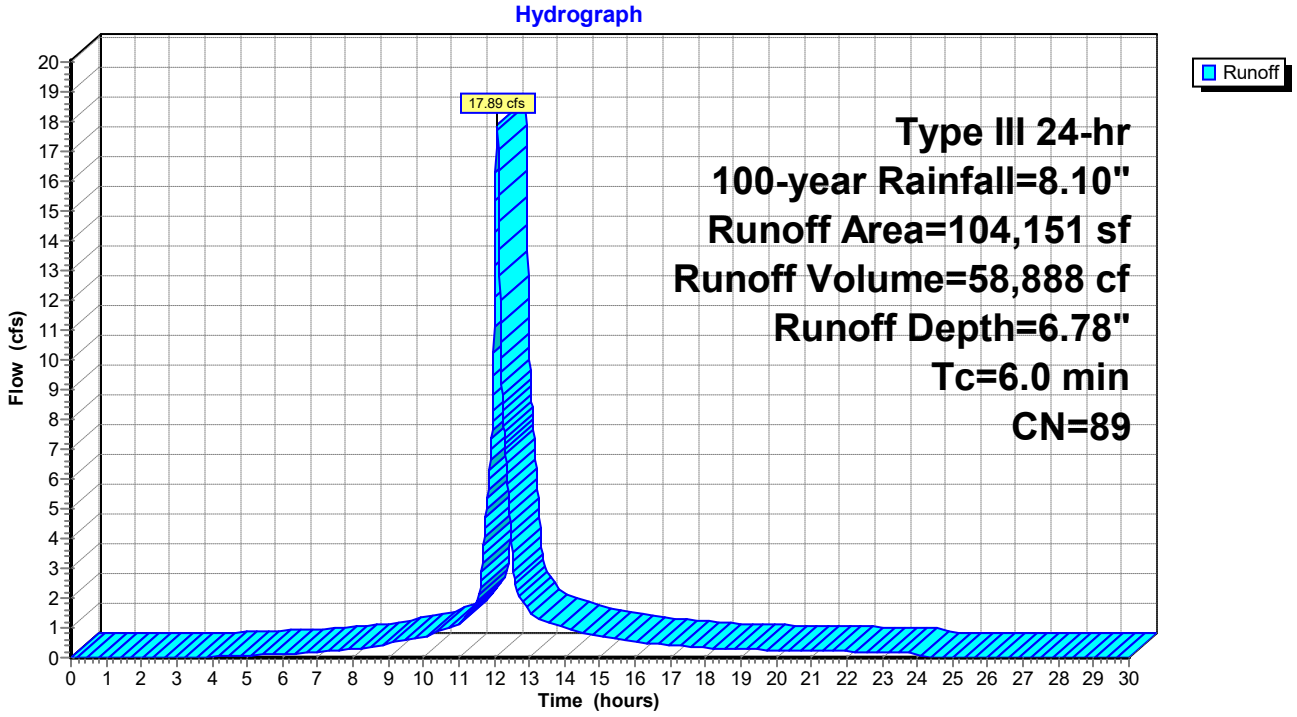
Runoff = 17.89 cfs @ 12.08 hrs, Volume= 58,888 cf, Depth= 6.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	2,469	98	Roofs, HSG A (Map Unit 651)
*	4,331	98	Roofs, HSG A (Map Unit 254A)
*	71,056	98	Paved parking, HSG A (Map Unit 651)
*	9,738	98	Paved parking, HSG A (Map Unit 254A)
*	1,820	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	14,737	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	104,151	89	Weighted Average
	16,557		15.90% Pervious Area
	87,594		84.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Update with new baseball field survey**

Subcatchment PR-1: Portion of Parking Lot



Summary for Subcatchment PR-2: Portion of Parking Lot and Baseball Field

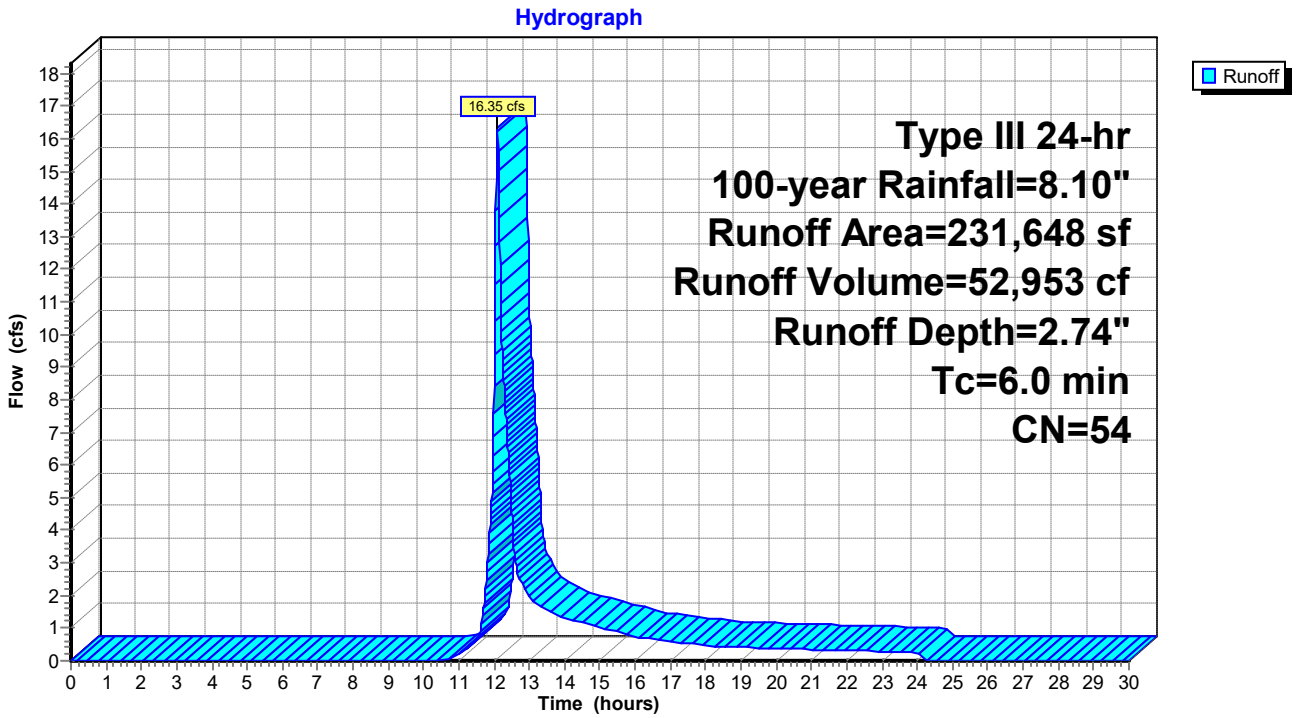
Runoff = 16.35 cfs @ 12.10 hrs, Volume= 52,953 cf, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	2,875	98	Roofs, HSG A (Map Unit 651)
*	54,805	98	Paved parking, HSG A (Map Unit 651)
*	6,808	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	167,160	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	231,648	54	Weighted Average
	173,968		75.10% Pervious Area
	57,680		24.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Update with new baseball field survey**

Subcatchment PR-2: Portion of Parking Lot and Baseball Field



Summary for Subcatchment PR-3: Athletic Field (West)

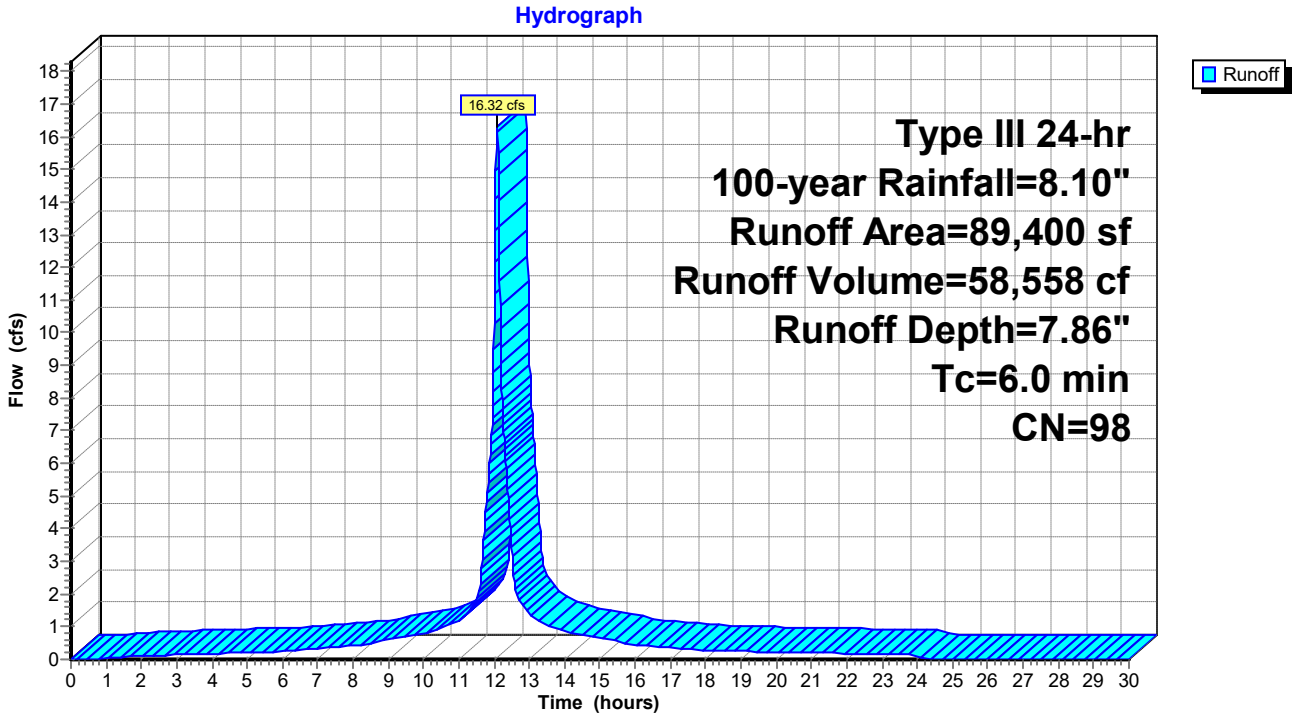
Runoff = 16.32 cfs @ 12.08 hrs, Volume= 58,558 cf, Depth= 7.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	89,400	98	Synthetic Turf Field (Map Unit 651)
	89,400		100.00% Impervious Area

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

Subcatchment PR-3: Athletic Field (West)



Summary for Subcatchment PR-4: Portion of Parking Lot

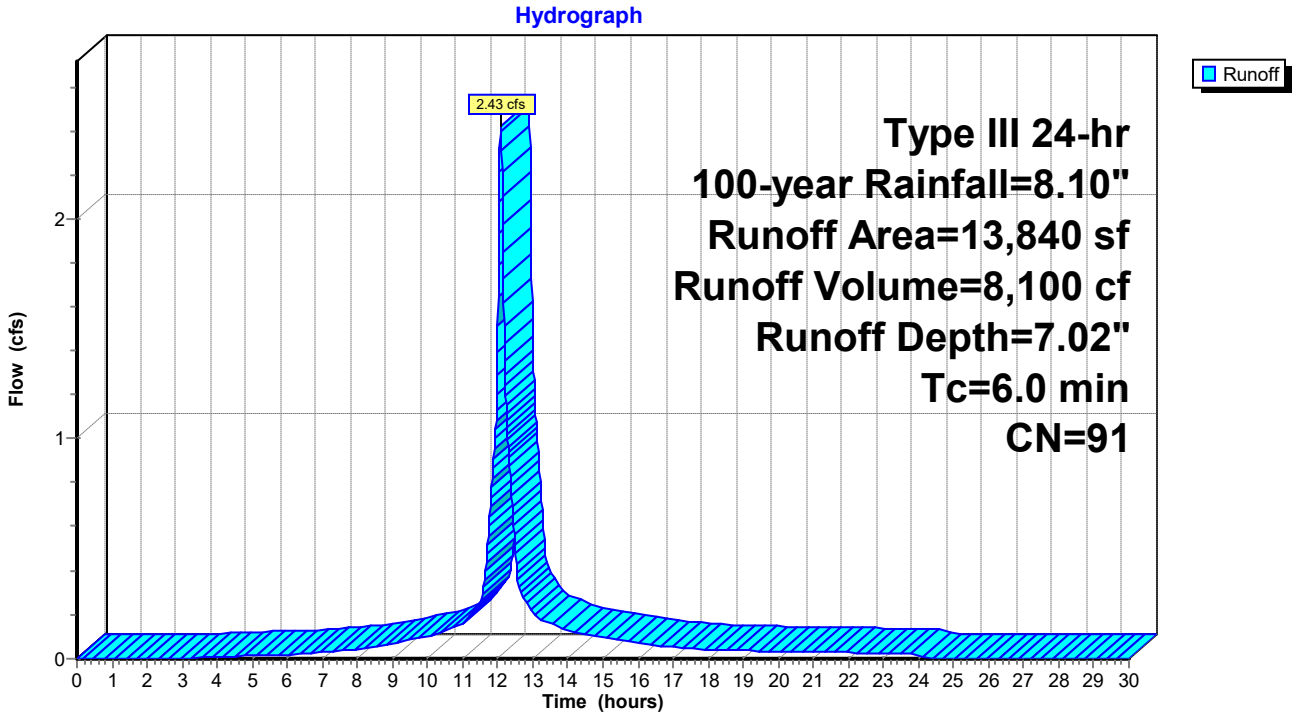
Runoff = 2.43 cfs @ 12.08 hrs, Volume= 8,100 cf, Depth= 7.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	12,294	98	Paved parking, HSG A (Map Unit 651)
*	1,546	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	13,840	91	Weighted Average
	1,546		11.17% Pervious Area
	12,294		88.83% Impervious Area

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

Subcatchment PR-4: Portion of Parking Lot



Summary for Subcatchment PR-5: Portion of Parking Lot

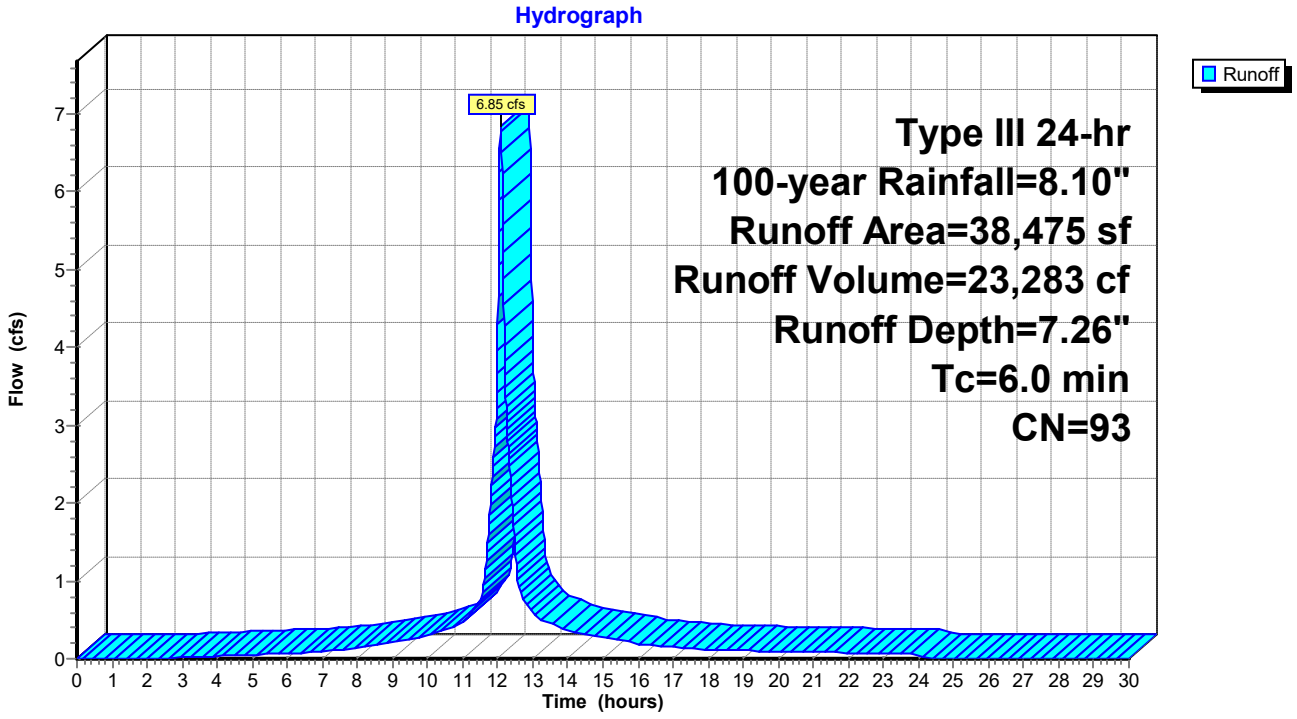
Runoff = 6.85 cfs @ 12.08 hrs, Volume= 23,283 cf, Depth= 7.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	35,267	98	Paved parking, HSG A (Map Unit 651)
*	3,208	39	>75% Grass cover, Good, HSG A (Map Unit 651)
	38,475	93	Weighted Average
	3,208		8.34% Pervious Area
	35,267		91.66% Impervious Area

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

Subcatchment PR-5: Portion of Parking Lot



Summary for Subcatchment PR-6: Athletic Field (East)

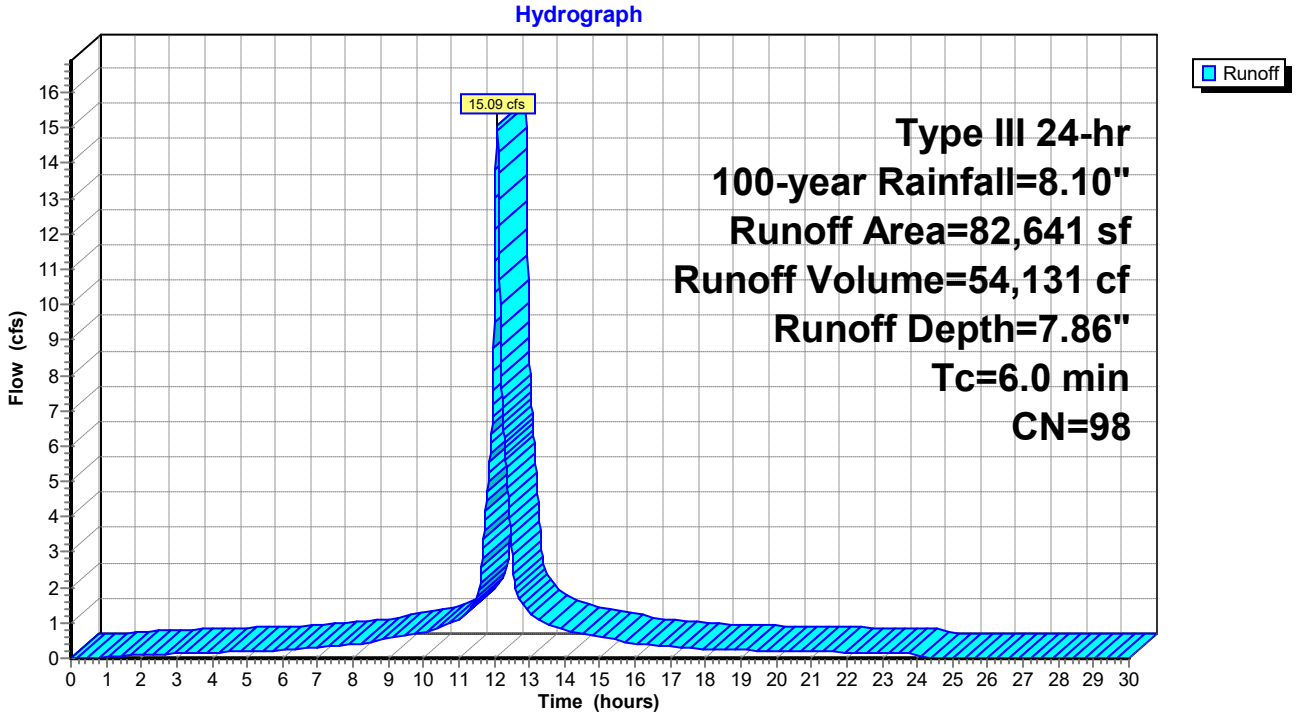
Runoff = 15.09 cfs @ 12.08 hrs, Volume= 54,131 cf, Depth= 7.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	71,592	98	Synthetic Turf Field (Map Unit 651)
*	11,049	98	Synthetic Turf Field (Map Unit 718A)
	82,641	98	Weighted Average
	82,641		100.00% Impervious Area

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

Subcatchment PR-6: Athletic Field (East)



Summary for Subcatchment PR-7: Direct to Wetland

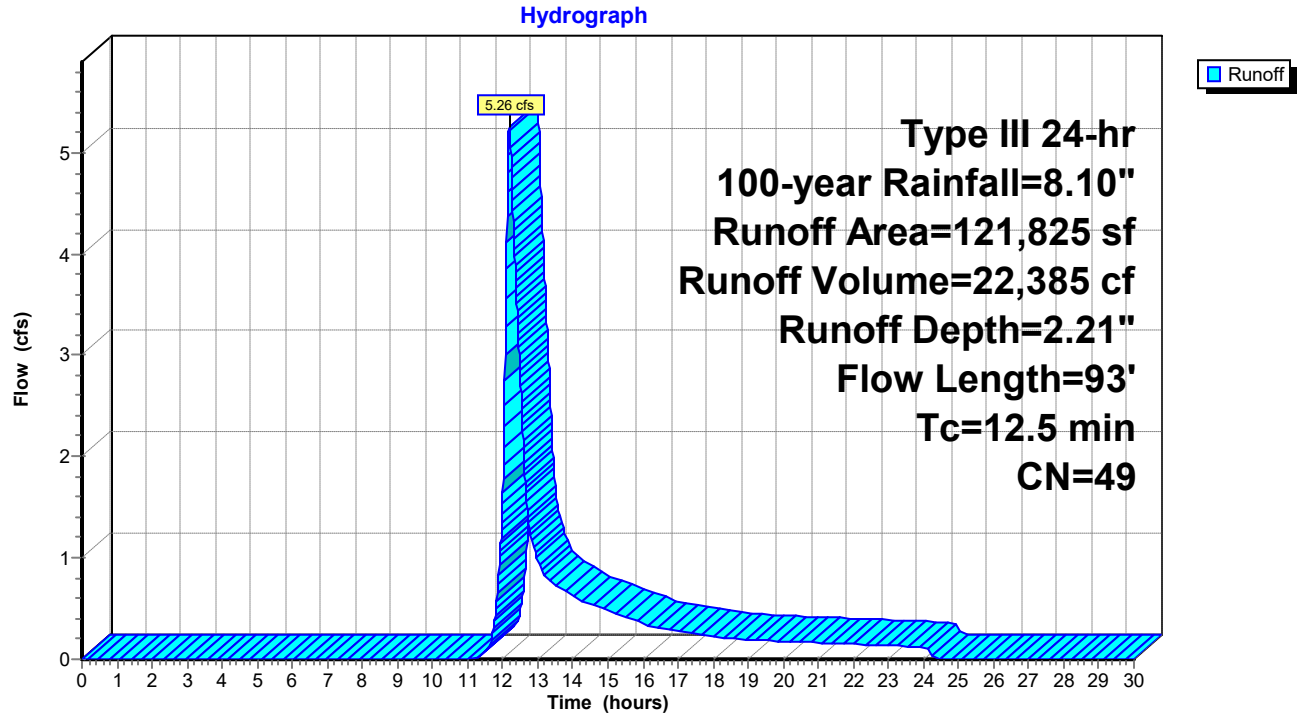
Runoff = 5.26 cfs @ 12.19 hrs, Volume= 22,385 cf, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.10"

	Area (sf)	CN	Description
*	510	39	>75% Grass cover, Good, HSG A (Map Unit 254A)
*	51,004	39	>75% Grass cover, Good, HSG A (Map Unit 651)
*	11,092	61	>75% Grass cover, Good, HSG B (Map Unit 718A)
*	35,674	55	Woods, Good, HSG B (Map Unit 718A)
*	14,690	30	Woods, Good, HSG A (Map Unit 651)
*	4,251	98	Paved parking, HSG A (Map Unit 651)
*	4,604	98	Paved parking, HSG B (Map Unit 718A)
	121,825	49	Weighted Average
	112,970		92.73% Pervious Area
	8,855		7.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.24"
0.2	43	0.3950	3.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.5	93	Total			

Subcatchment PR-7: Direct to Wetland

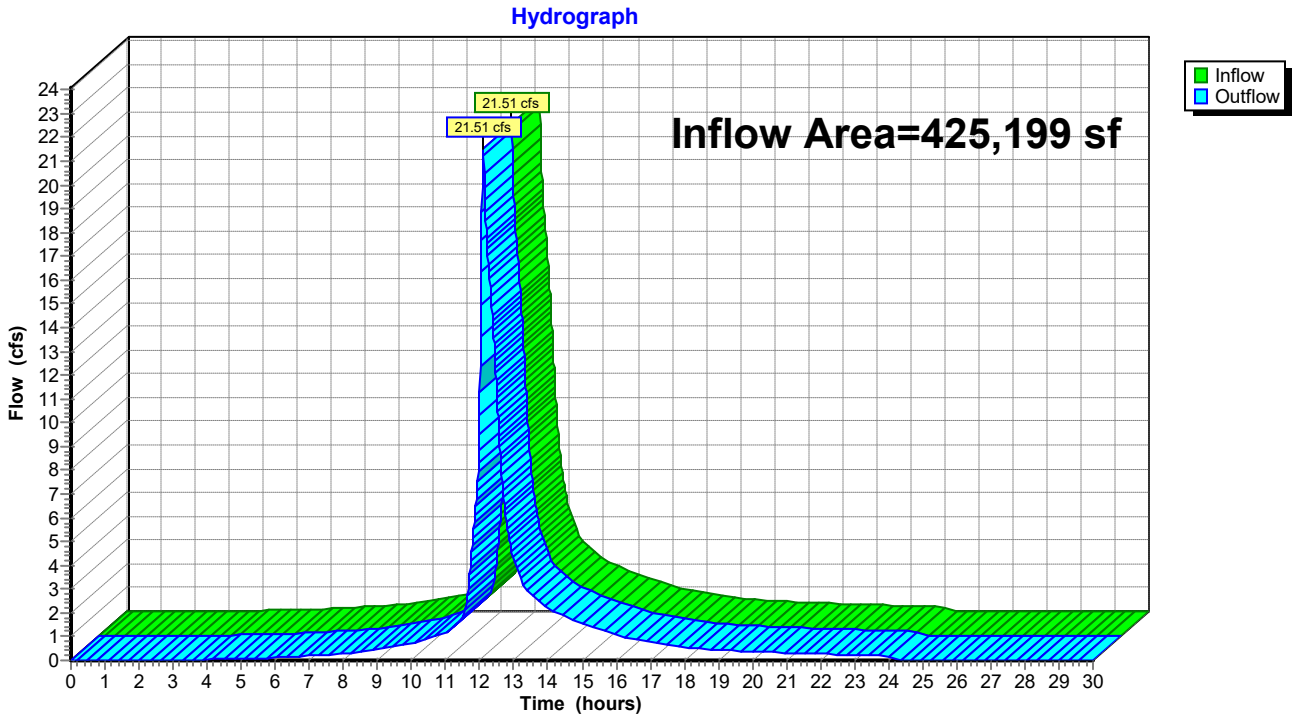


Summary for Reach DP-1: 21" Concrete Pipe

Inflow Area = 425,199 sf, 55.19% Impervious, Inflow Depth = 2.73" for 100-year event
Inflow = 21.51 cfs @ 12.11 hrs, Volume= 96,716 cf
Outflow = 21.51 cfs @ 12.11 hrs, Volume= 96,716 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-1: 21" Concrete Pipe

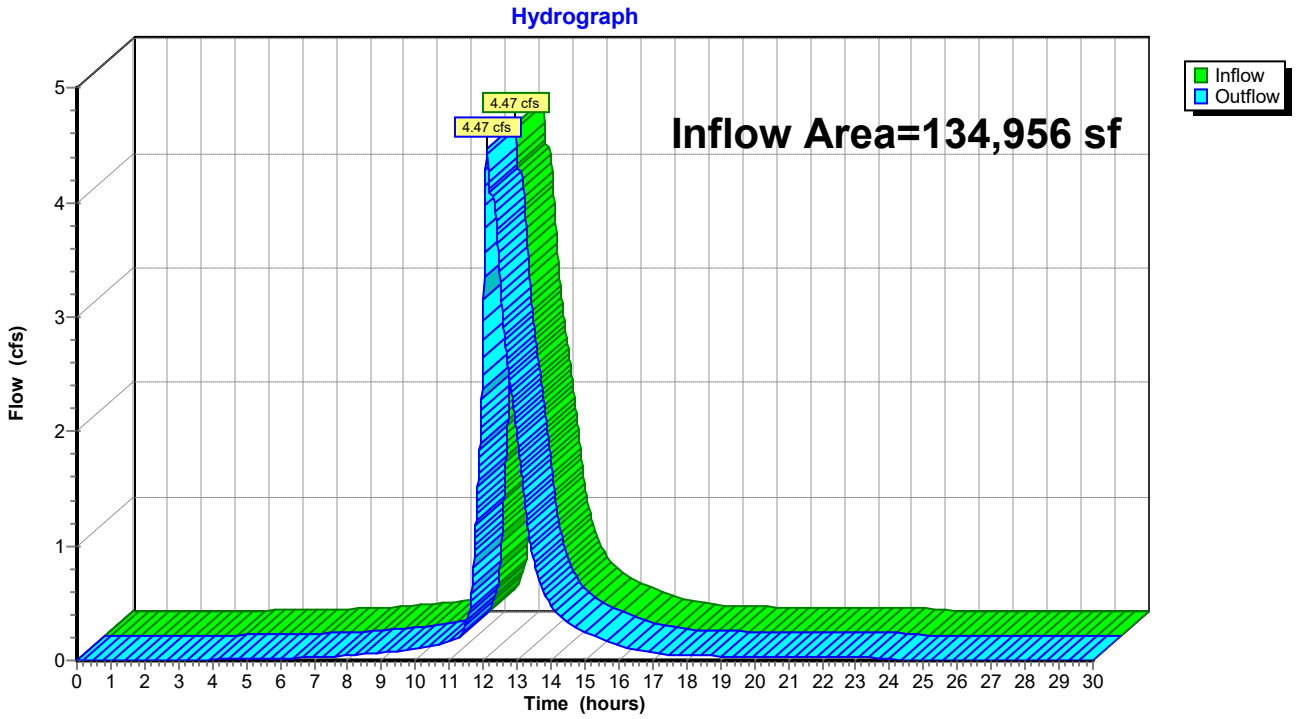


Summary for Reach DP-2: 24" RCP Pipe

Inflow Area = 134,956 sf, 96.48% Impervious, Inflow Depth = 1.97" for 100-year event
Inflow = 4.47 cfs @ 12.10 hrs, Volume= 22,178 cf
Outflow = 4.47 cfs @ 12.10 hrs, Volume= 22,178 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-2: 24" RCP Pipe

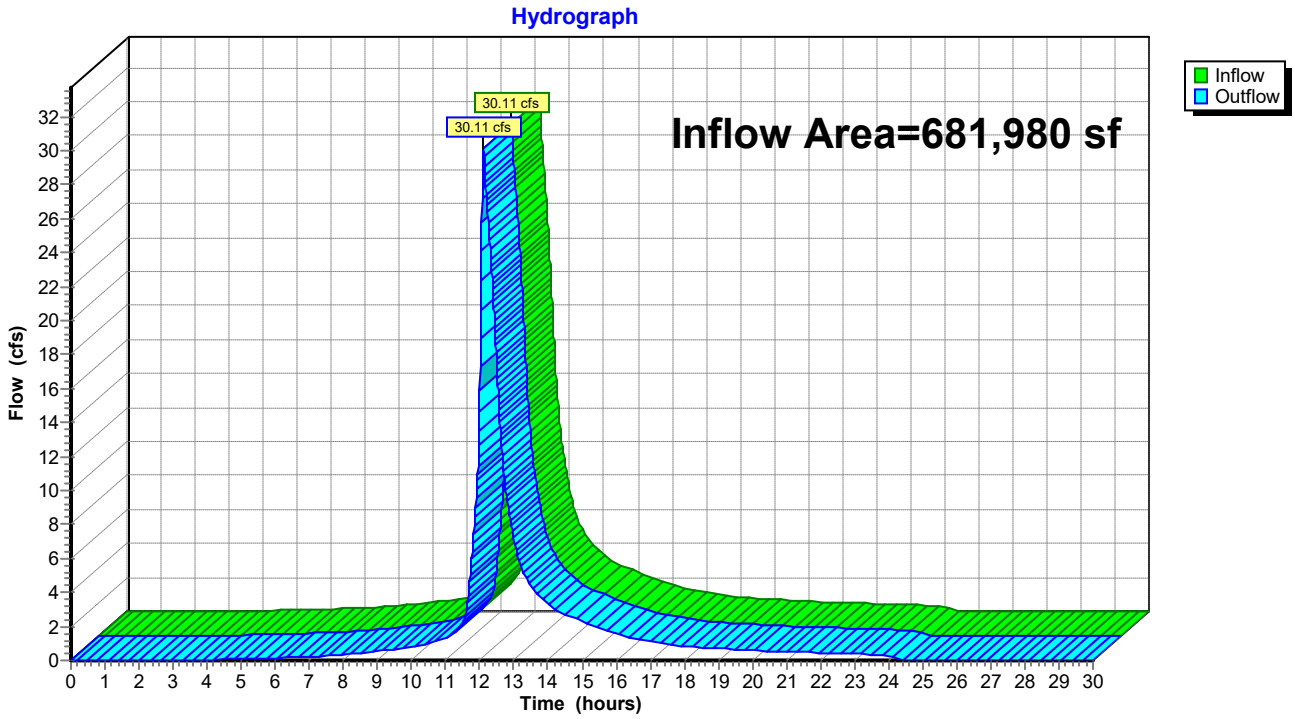


Summary for Reach DP-3: Ipswich River

Inflow Area = 681,980 sf, 54.80% Impervious, Inflow Depth = 2.49" for 100-year event
Inflow = 30.11 cfs @ 12.12 hrs, Volume= 141,280 cf
Outflow = 30.11 cfs @ 12.12 hrs, Volume= 141,280 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach DP-3: Ipswich River



Summary for Pond FIELD-1: Subsurface Stone

Inflow Area = 89,400 sf,100.00% Impervious, Inflow Depth = 7.86" for 100-year event
Inflow = 16.32 cfs @ 12.08 hrs, Volume= 58,558 cf
Outflow = 11.26 cfs @ 12.17 hrs, Volume= 58,558 cf, Atten= 31%, Lag= 5.4 min
Discarded = 5.02 cfs @ 11.82 hrs, Volume= 56,598 cf
Primary = 6.24 cfs @ 12.17 hrs, Volume= 1,961 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 53.75' @ 12.17 hrs Surf.Area= 90,007 sf Storage= 6,874 cf

Plug-Flow detention time= 5.8 min calculated for 58,558 cf (100% of inflow)
Center-of-Mass det. time= 5.8 min (746.9 - 741.1)

Volume	Invert	Avail.Storage	Storage Description
#1	53.50'	27,002 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 90,007 cf Overall x 30.0% Voids

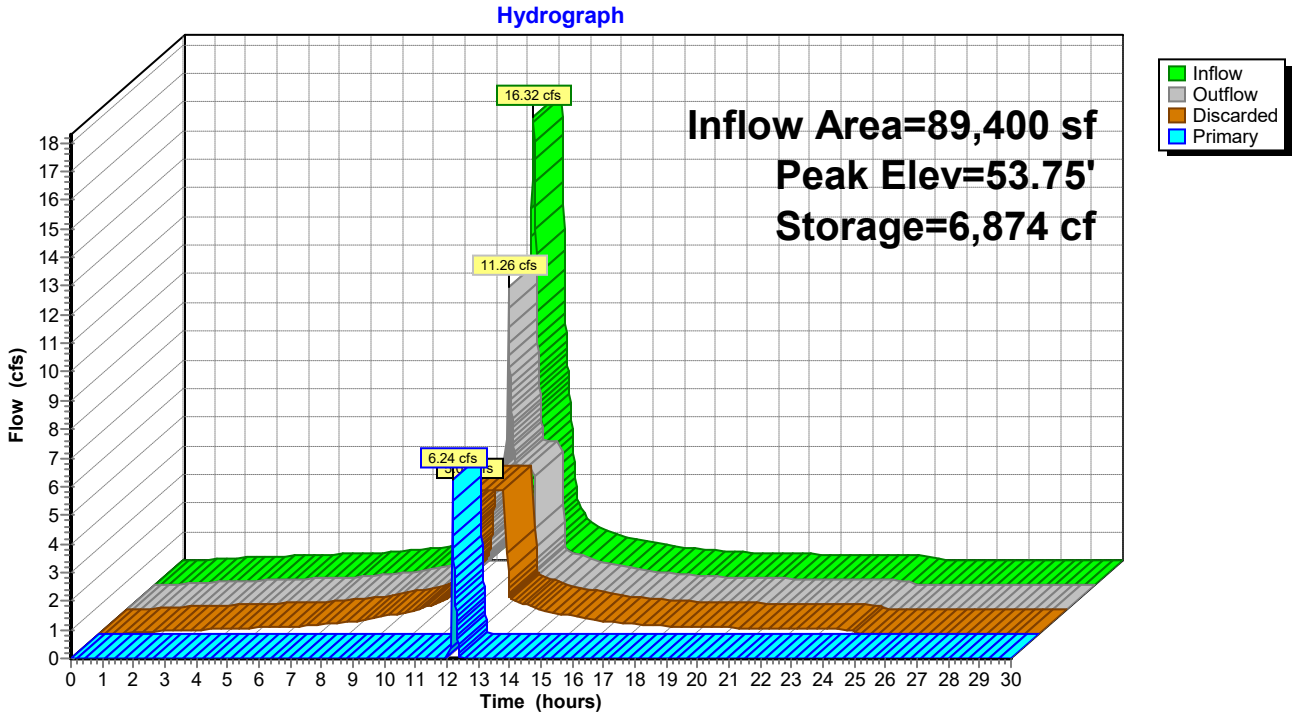
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
53.50	90,007	0	0
54.50	90,007	90,007	90,007

Device	Routing	Invert	Outlet Devices
#1	Discarded	53.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	53.75'	**0.500 cfs Constant Flow/Skimmer X 34.00**

Discarded OutFlow Max=5.02 cfs @ 11.82 hrs HW=53.51' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 5.02 cfs)

Primary OutFlow Max=17.00 cfs @ 12.17 hrs HW=53.75' (Free Discharge)
↑—**2=Constant Flow/Skimmer** (Constant Controls 17.00 cfs)

Pond FIELD-1: Subsurface Stone



Summary for Pond FIELD-2: Subsurface Stone

Inflow Area = 82,641 sf,100.00% Impervious, Inflow Depth = 7.86" for 100-year event
Inflow = 15.09 cfs @ 12.08 hrs, Volume= 54,131 cf
Outflow = 10.31 cfs @ 12.17 hrs, Volume= 54,131 cf, Atten= 32%, Lag= 5.3 min
Discarded = 4.61 cfs @ 11.82 hrs, Volume= 52,212 cf
Primary = 5.70 cfs @ 12.17 hrs, Volume= 1,919 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 51.25' @ 12.17 hrs Surf.Area= 82,641 sf Storage= 6,308 cf

Plug-Flow detention time= 5.8 min calculated for 54,113 cf (100% of inflow)
Center-of-Mass det. time= 5.8 min (746.9 - 741.1)

Volume	Invert	Avail.Storage	Storage Description
#1	51.00'	24,792 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 82,641 cf Overall x 30.0% Voids

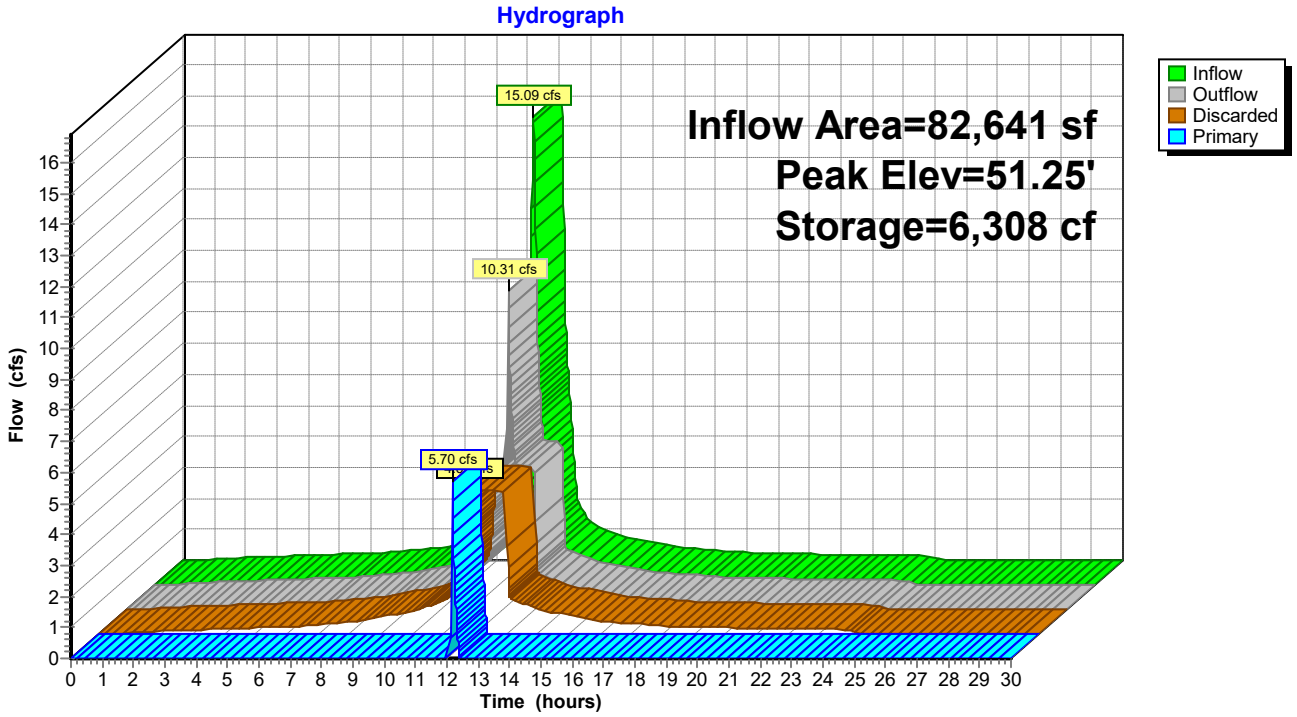
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
51.00	82,641	0	0
52.00	82,641	82,641	82,641

Device	Routing	Invert	Outlet Devices
#1	Discarded	51.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	51.25'	**0.500 cfs Constant Flow/Skimmer X 32.00**

Discarded OutFlow Max=4.61 cfs @ 11.82 hrs HW=51.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 4.61 cfs)

Primary OutFlow Max=16.00 cfs @ 12.17 hrs HW=51.25' (Free Discharge)
↑—**2=Constant Flow/Skimmer** (Constant Controls 16.00 cfs)

Pond FIELD-2: Subsurface Stone



Summary for Pond PERF-1: 42" Perforated Pipe

Inflow Area = 321,048 sf, 45.81% Impervious, Inflow Depth = 2.05" for 100-year event
Inflow = 18.21 cfs @ 12.17 hrs, Volume= 54,913 cf
Outflow = 9.07 cfs @ 12.31 hrs, Volume= 54,913 cf, Atten= 50%, Lag= 8.5 min
Discarded = 0.28 cfs @ 11.22 hrs, Volume= 17,085 cf
Primary = 8.79 cfs @ 12.31 hrs, Volume= 37,828 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 51.16' @ 12.31 hrs Surf.Area= 4,950 sf Storage= 13,169 cf

Plug-Flow detention time= 80.9 min calculated for 54,895 cf (100% of inflow)
Center-of-Mass det. time= 81.0 min (935.9 - 854.9)

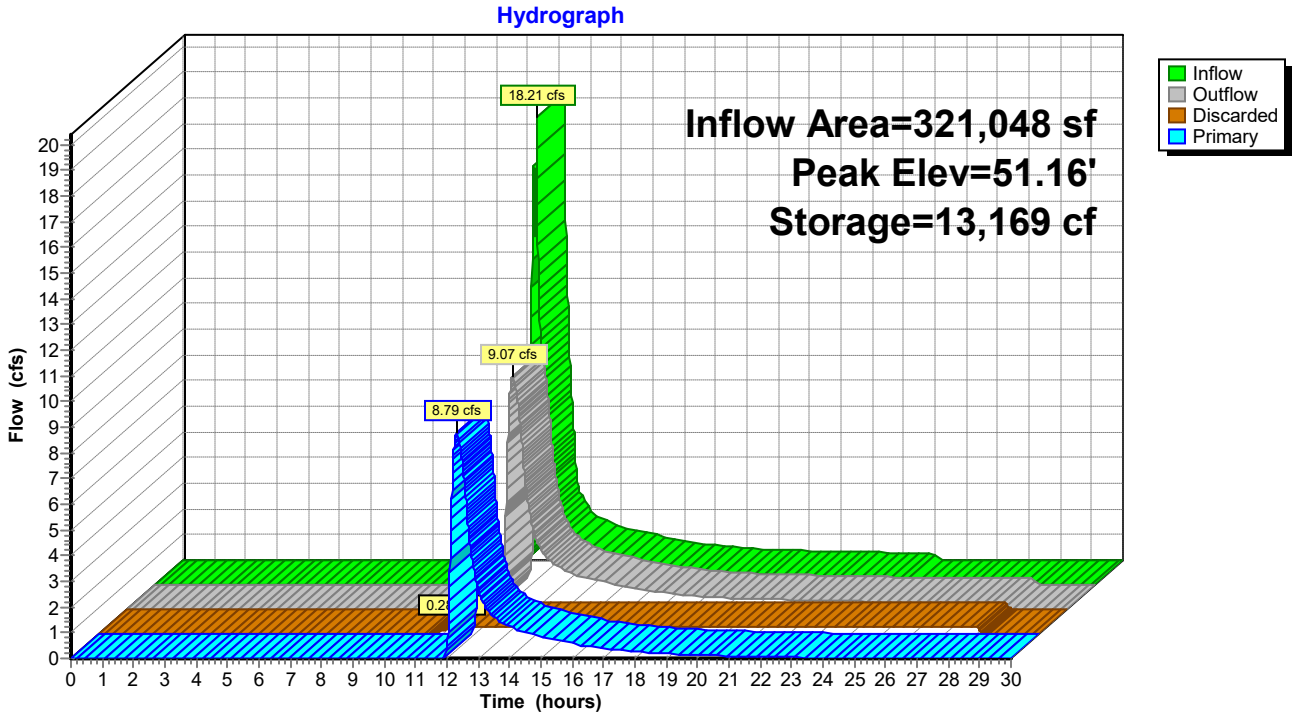
Volume	Invert	Avail.Storage	Storage Description
#1	47.75'	10,583 cf	**42.0" Round Pipe Storage** x 2 Inside #2 L= 550.0'
#2	47.25'	3,508 cf	**4.50'W x 550.00'L x 4.50'H Prismatoid** x 2 22,275 cf Overall - 10,583 cf Embedded = 11,692 cf x 30.0% Voids
		14,091 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	47.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	48.70'	**18.0" Round Culvert** L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 48.70' / 48.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Cast iron, coated, Flow Area= 1.77 sf

Discarded OutFlow Max=0.28 cfs @ 11.22 hrs HW=47.30' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=8.79 cfs @ 12.31 hrs HW=51.16' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 8.79 cfs @ 4.97 fps)

Pond PERF-1: 42" Perforated Pipe



Summary for Pond PERF-2: 36" Perforated Pipe

Inflow Area = 121,116 sf, 97.35% Impervious, Inflow Depth = 2.50" for 100-year event
Inflow = 10.25 cfs @ 12.17 hrs, Volume= 25,203 cf
Outflow = 3.33 cfs @ 12.34 hrs, Volume= 25,203 cf, Atten= 68%, Lag= 10.0 min
Discarded = 0.19 cfs @ 8.76 hrs, Volume= 11,125 cf
Primary = 3.14 cfs @ 12.34 hrs, Volume= 14,078 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 47.65' @ 12.34 hrs Surf.Area= 3,400 sf Storage= 7,933 cf

Plug-Flow detention time= 51.1 min calculated for 25,194 cf (100% of inflow)
Center-of-Mass det. time= 51.1 min (813.8 - 762.6)

Volume	Invert	Avail.Storage	Storage Description
#1	44.50'	6,008 cf	**36.0" Round Pipe Storage** x 2 Inside #2 L= 425.0'
#2	44.00'	2,278 cf	**4.00'W x 425.00'L x 4.00'H Prismatoid** x 2 13,600 cf Overall - 6,008 cf Embedded = 7,592 cf x 30.0% Voids
		8,286 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	44.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	44.95'	**10.0" Round Culvert** L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 44.95' / 44.85' S= 0.0100 '/' Cc= 0.900 n= 0.013 Cast iron, coated, Flow Area= 0.55 sf

Discarded OutFlow Max=0.19 cfs @ 8.76 hrs HW=44.04' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=3.14 cfs @ 12.34 hrs HW=47.65' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 3.14 cfs @ 5.75 fps)

Pond PERF-2: 36" Perforated Pipe