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STORMWATER MANAGEMENT DESIGN
AND
RUNOFF CALCULATIONS REPORT

for

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

Report Prepared by:
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June 26, 2024

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Stormwater Management Report
Narrative and Summary

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

DGT Job No.: F25889

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BRUSH HILL HOMES
STORMWATER MANAGEMENT
NARRATIVE SUMMARY

This report contains the hydrologic computations and design information relative to the existing and proposed stormwater runoff conditions for Brush Hill Homes and associated site improvements at 34 Brush Hill Road in Sherborn, MA. It includes information on the stormwater management system design and assessment of stormwater impacts. There are nearby wetland resource areas located off the property that extend onto the northeast corner and northwest corner of the subject property. A small portion of the proposed on-site sewage disposal system extends into the 100' wetland buffer. Therefore, the project is subject to the Wetlands Protection Act and the Town of Sherborn Wetlands Protection Bylaw and its regulations.

This report includes information demonstrating compliance with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Regulations.

This report includes the following documents as required by various State and Local Regulations:

- MassDEP Stormwater Management Checklist, compliance calculations and Best Management Practices (BMP) design calculations (Section 2).
- The hydrologic models of existing and proposed stormwater runoff conditions for the site are included in Sections 3 and 4, respectively. These sections include the existing and proposed conditions watershed maps.
- Soils Data for the site from on-site soil testing and the Natural Resource Conservation Service (Appendix 1)
- "Long-Term Pollution Prevention Plan" (LTPPP) for the stormwater related management of the site. (Appendix 2)
- "Stormwater Management System Operation and Maintenance Plan" (Appendix 3)

An Erosion and Sediment Control Plan is included in the plans for the project. Because the project will disturb more than one acre, it is also subject to the U.S. EPA's Construction General Permit under the NPDES Program. A full Stormwater Pollution Prevention Plan (SWPPP) will need to be prepared and submitted by the General Contractor for approval prior to the start of construction.

Project Description
The proposed project includes construction of eight (8) single-family houses. Access is provided by a 20-foot paved roadway off Brush Hill Road. The proposed roadway is approximately 1,140 feet long. Other proposed improvements include an on-site sewage disposal system, on-site water supply wells, stormwater management, and site landscaping.

Briefly, the proposed project includes the following:

- Installation of construction period erosion and sedimentation controls.

- Construction of a 1,140-foot long, 20-foot wide, paved roadway
- Construction of eight (8) single-family houses.
- Construction of several retaining walls
- Construction of an on-site sewage disposal system.
- Construction of several stormwater Best Management Practices (BMPs). The BMP treatment trains are designed to provide water quality improvements and to mitigate groundwater recharge and peak flows as required.
- Installation of a private water service and electric/communications services to the proposed houses.

Existing Property Description

The property is known as 34 Brush Hill Road and has an area of 222, 696 square feet (5.112 acres) and is an undeveloped wooded parcel of land (Sherborn Assessor's Map 1, Lot 0, Block 18). The site generally slopes downward (approximately 17%) heading north. Stormwater runoff from the subject site flows to the north and also receives runoff from abutting properties located south of the site. All existing runoff is untreated and uncontrolled. This project is subject to the Massachusetts Wetlands Protection Act and the Town of Sherborn Wetlands Bylaw and its Regulations.

The property is in Zone "X" (areas determined to be outside the 0.2% annual chance floodplain) as shown on FEMA Flood Insurance Rate Map number 25017C0519F Dated July 7, 2014.

Soils and Groundwater

Fourteen (14) soil test pits were performed by DGT Associates at the site to determine soil characteristics and seasonal high groundwater depths for stormwater management and general project purposes. The testing revealed a fine sandy loam topsoil over a firm sandy loam substratum. For detailed information, refer to Appendix 1 for results from the on-site soil testing by DGT Associates and published NRCS data.

Hydrologic Modeling and Computations

The hydrologic analysis of the existing conditions and proposed watershed is based on the nationally recognized watershed modeling techniques developed by the USDA, Soil Conservation Service (SCS). The techniques and runoff models are described in the following SCS publications:

- "Urban Hydrology for Small Watersheds, Technical Release Number 55", 1986 and Technical Release 20.
- National Engineering Handbook, Hydrology, Section 4, 1972.
- "A Method for Estimating Volume and Rate of Runoff in Small Watersheds, Technical Release No. 149" 1973.
- "Hydrology Handbook for Conservation Commissions" March 2002, Mass. DEP.

The watershed modeling was performed using computer software "HydroCAD" version 10.0 by Applied Microcomputer Systems, which is based on the publications referenced above. Best management practices were designed utilizing the MassDEP "Stormwater Management Standards Handbook," February 2008.

Rainfall depths selected for the hydrologic analysis are per the NOAA Atlas 14 Rainfall Data Server. The 24-hour rainfall depths for the subject property are as follows:

2-Year Storm	3.33 inches
10-Year Storm	5.21 inches
25-Year Storm	6.39 inches
100-Year Storm	8.20 inches

Project Design Points and Analysis Points
There are two (2) main Design Points for this project:
- Design Point #1 is at the northeast corner of the property that drains to an off-site wetland.
- Design Point #2 is at the northwest corner of the property that drains to an off-site wetland.

Existing Site Hydrology
- Hydrologic Soil Group:
  The USDA Natural Resources Conservation Service (NRCS) notes that the predominant soil is classified as a Paxton soil, which has a Hydrologic Soil Group C (HSG C). Based on observed conditions at the site and soil evaluation, HSG C is appropriate.

- Existing Runoff Flow Patterns and Existing Drainage System:
  The entire site currently flows uncontrolled to each of the two noted design points above.

Existing Conditions Hydrologic Model
The following items are noted:
- Watershed boundaries are shown on the Existing Conditions Watershed Map (WSD-EX) in Section 3 of this report. The boundaries of the watersheds were field checked and all runoff flowing off the site is included.
- Stormwater flow from the entire site, including portions of abutting properties that contribute stormwater flow to the subject property, were analyzed to the two design points noted above.
- The summary of the existing peak rates and volumes of runoff for the 2, 10, 25 and 100-year storms to all Design Points are shown on the Summary Tables at the end of this Narrative.

Proposed Conditions Hydrologic Model
The following items are noted:
- Watershed boundaries are shown on the Proposed Conditions Watershed Map (WSD-PR) in Section 4 of this report.
- The total proposed impervious area for this project is 48,259 square feet.
- The intent of the current design is to not increase the peak rates of runoff to any of the Design Points for all storms up to the 100-year event. To achieve this, all stormwater runoff

from the roadway, driveways, roof areas and upgradient areas is collected, treated and directed to recharge (infiltration) systems and detention systems.

- Once the minimum recharge volumes are achieved, flow is directed to a detention system to control the peak rate of runoff before discharge to the various design points.
- Most of the roadway runoff is collected and treated prior to entering a recharge system.
- Based on the observed soil conditions during the on-site soil testing, the intent is to meet the MassDEP Stormwater Regulations for recharge (0.25 inches over the impervious surfaces for HSG - C soils) for the new area of impervious surfaces.
- The recharge BMPs have been designed to provide a water quality volume of 0.5 inches from the contributing impervious surfaces.

Stormwater Management System

This project utilizes a variety of Stormwater Management Best Management Practices (BMPs) to meet the Standards of the Massachusetts Stormwater Management Regulations. This project is classified as new construction. The system as designed meets the full recharge and water quality requirements for new construction with no increase in the peak rates of runoff at any discharge point. The drainage patterns for the proposed project are generally maintained. Complete compliance calculations and information is contained in Section 2 of this report. The following provides explanation of the different components of the proposed stormwater management system:

- Pre-Treatment: Deep Sump Catch Basins fitted with an oil and gas trap hood collect runoff from paved surfaces. The runoff is then directed to a Stormwater Treatment Unit (STU). The proposed treatment units will be a CDS Treatment Unit or approved equal. This unit has been verified by the NJCAT and Certified by the New Jersey DEP to provide at least 50% TSS removal. The units provide the required pre-treatment for the underground recharge systems.

- Recharger #1, #2, #3 (Underground Recharge Chamber Systems):
  These systems consist of HDPE chambers bedded on clean stone and surrounded on all sides with clean stone. The bottom of the stone bed is set two feet above the estimated seasonal high groundwater level. These will recharge a minimum of 0.5 inches of runoff.

- Detention System #1:
  This is a surface basin used to control the volume of runoff prior to discharge to the abutting property from a small portion of the new entry driveway.

- Detention System #2:
  This system consists of HDPE chambers bedded on clean stone and surrounded on all sides with clean stone with an impermeable barrier. This chamber system, in combination with an outlet control structure, controls the volume of runoff prior to discharge to the design point.

Benefits of the Design

- There is no increase in the peak rates of runoff to either of the two (2) Design Points for any storm event (2, 10, 25 and 100-year). See the Summary Tables in Section 2.
- Infiltration volumes meet the MassDEP Stormwater Management Standards for "new construction." See calculations in Section 2.
- The overall system provides greater than 80% TSS removal treatment for stormwater collected from the site.
- The underground recharge systems are considered a Limited Impact Development (LID) Stormwater Management Technique.

Erosion and Sediment Control during Construction

Included with the plans is an Erosion and Sediment Control Plan with performance standards and details that show the practices to be implemented to protect the downstream stormwater system and surrounding areas.

Because the project is subject to the U.S. Environmental Protection Agency NPDES requirements for Construction Activities, a complete Stormwater Pollution Prevention Plan (SWPPP) and a Notice of Intent filing with the EPA is required prior to construction. This will be prepared by the General Contractor as part of the Contract requirements, and it will be subject to review and approval by the project engineer and Town permitting agencies. The Contractor will be responsible to manage the site to protect the downstream drain system and surrounding areas at all times and operate in compliance with the US EPA Construction General Permit.

The Erosion and Sediment Control Plan shows the initial erosion controls, general BMPs and detailed information as to the responsibilities of the Contractor.

The plan presented at this time may be part of the SWPPP but is not to be considered as meeting the full requirements for a SWPPP. All permit conditions set by approving authorities for erosion and sediment controls are also to be incorporated into the Contract Documents and into the SWPPP.

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SECTION 2

COMPLIANCE CALCULATIONS

- MassDEP “Checklist for Stormwater Report”
- Stormwater Standards Compliance Summary
- Illicit Discharge Statement
- Standard 1 – Scour Calculations
- Standard 3 – Recharge Calculations & Drawdown Time Calculations and Standard 4 – Water Quality and TSS Removal Calculations

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

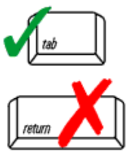
DGT Job No.: F25889

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.

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

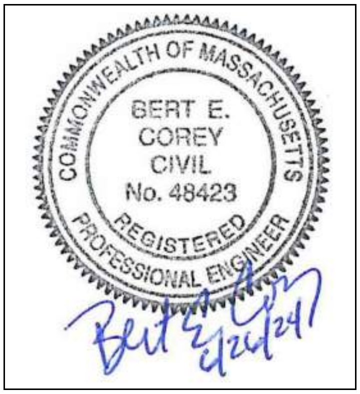
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

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

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

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

☐ Use of “country drainage” versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe): Subsurface infiltration

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 (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 (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 (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 (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

STORMWATER STANDARDS COMPLIANCE SUMMARY

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA

MASSDEP STORMWATER REGULATIONS STANDARDS

Standard 1: (Untreated Discharges)

There are no new stormwater conveyances proposed that discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. Prior to discharge, stormwater runoff is passed through pretreatment and treatment BMPs as required. Scour calculations are provided in this Section to demonstrate the non-erosive velocities at the outfalls.

Standard 2: (Peak rate control and flood protection)

There will be no increase in the peak rate of discharge over existing conditions from any storm event up to and including the 100-year storm from the project site to downgradient locations (Design Point #1 and Design Point #2).

Computations have been made for the 2, 10, 25 and 100-year storms. The computations for the peak rates of runoff, flood levels and volumes are contained in Section 3 and Section 4 of this report. The summary tables for each Design Point are as follows:

Design Point #1 – Northeast corner

Storm Event	24 hr Rainfall	Peak Flow (cfs)		Volume (acre feet)	
		Existing	Proposed	Existing	Proposed
2 Year	3.33 in.	2.52	2.22	0.404	0.382
10 Year	5.21 in.	7.25	6.95	0.905	0.974
25 Year	6.39 in.	10.66	9.89	1.255	1.390
100 Year	8.20 in.	16.27	13.46	1.820	2.061

Design Point #2 – Northwest Corner

Storm Event	24 hr Rainfall	Peak Flow (cfs)		Volume (acre feet)	
		Existing	Proposed	Existing	Proposed
2 Year	3.33 in.	2.72	1.68	0.353	0.249
10 Year	5.21 in.	7.25	5.03	0.854	0.734
25 Year	6.39 in.	10.56	10.19	1.212	1.069
100 Year	8.20 in.	16.05	15.96	1.799	1.609

Standard 3: (Recharge to Groundwater)

To meet the current DEP Stormwater Regulations, Standard 3 requires that a minimum 0.60, 0.35, 0.25 & 0.10 inches of runoff from the impervious surfaces must be recharged to the ground for hydrologic soil groups (HSG) A, B, C, & D respectively. The subject site is within HSG C.

Three (3) Stormwater infiltration BMPs are incorporated into the design, which are underground recharge systems.

This project is classified as new construction. The total proposed impervious area for this project is 48,259 square feet. Therefore, the minimum required adjusted recharge volume is computed to be 1,033 cubic feet. The proposed infiltration BMP results in a total recharge volume of 4,778 cubic feet. The proposed infiltration BMPs drain within 72 hours.

Detailed calculations demonstrating compliance with this standard are included in this section.

Standard 4: (80% TSS Removal)

This project incorporates several stormwater pretreatment and treatment BMP's. Runoff from paved surfaces is routed through pretreatment BMP's (deep sump catch basins, proprietary stormwater treatment unit to a subsurface recharge treatment BMP).

The Water Quality Volume (WQV) used for the stormwater design is 0.5 inches.

Design calculations for each treatment train and TSS Removal Calculation Worksheets are included in this section. Stormwater runoff is collected from the paved surfaces via deep sump catch basins for pretreatment. The runoff is then directed to proprietary treatment units. The proprietary treatment units provide 50% TSS Removal per the NJTARP. The pretreated stormwater is then routed to recharge BMPs. This results in a minimum TSS Removal of 80%.

In compliance with Standard 4, a Long-Term Pollution Prevention Plan is included in Appendix 2 and the Stormwater Operation and Maintenance Plan is included in Appendix 3.

Standard 5: (Land Use with Higher Potential Pollutant Load)

This site is <u>not</u> a use with a land use with higher potential pollutant load.

Standard 6: (Critical Areas)

This site does <u>not</u> discharge runoff to Critical Areas.

Standard 7: (Redevelopment)

This project is <u>not</u> considered a Redevelopment Project.

Standard 8: (Erosion, Sediment Control)

Erosion and sediment control BMPs are included in the Erosion and Sediment Control Plan prepared for the initial project setup and includes detailed information regarding the responsibilities for the Contractor in managing the site in compliance with applicable permits. This project is subject to the NPDES requirements for construction sites. Coverage under the NPDES Construction General Permit is required.

As provided by this Standard, a detailed SWPPP will be prepared by the General Contractor who will be responsible for the management of the construction site and compliance with the NPDES Construction General Permit and will file a Notice of Intent with the EPA for coverage under that permit. The SWPPP will also be provided for review and approval prior to the start of work.

Standard 9: (Operation & Maintenance)

A Long-Term Pollution Prevention Plan (LTPPP) for the general management of the site is included in Appendix 2. A Stormwater BMP Operation & Maintenance Plan for the stormwater system is included in Appendix 3.

Standard 10: (Illicit Discharges)

The proposed design will be in compliance with state and local building codes. There are no illicit discharges designed or proposed. No illicit discharges are known to exist at the site. An Illicit Discharge Statement is included in Section 2.

DGT Associates
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June 26, 2024

F25889

Town of Sherborn
19 Washington Street
Sherborn, MA 01770

RE: Illicit Discharge Compliance Statement

In accordance with Standard 10 of the Massachusetts Stormwater Regulations, the following statements are made regarding the proposed site development for Brush Hill Homes located at 34 Brush Hill Road in Sherborn, MA:

- The proposed site development design will be in compliance with state and local building codes. There are no illicit discharges designed or proposed.

Please feel free to contact me if you have any questions.

Sincerely yours,
DGT Associates

Bert E. Corey, P.E.
Engineering Group Manager

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Stormwater Calculations – Scour & Erosion – Standard 1

Brush Hill Homes
34 Brush Hill Road in Sherborn, MA

The peak rate of discharge at all the existing discharge points are the same or less than existing conditions for all storms up to a 100-year event.

Two (2) new outlets from the proposed stormwater system will discharge to flow overland within the uplands to the wetland resource areas. To control the outflows, riprap lined level spreaders are designed to spread and distribute the flow at non-erosive velocities over the vegetated terrain. Permissible velocity for slopes greater than 10% from the 2-year 24-hour storm is 5.0 ft/sec. The following calculations provide compliance with Standard 1 for the discharges from the pipe outfalls:

Level Spreader #1

Level Spreader Length = 25 feet
Outlet Invert Elevation = 197.0
End of Outfall Elevation = 191.00
Grass Slope Length = 18 feet
Outfall Slope = 0.3333

	2 Year	10 Year	25 Year	100 Year .
Maximum Velocity	2.43 ft/sec	3.81 ft/sec	4.37 ft/sec	4.74 ft/sec

Level Spreader #2

Level Spreader Length = 25 feet
Outlet Invert Elevation = 186.0
End of Outfall Elevation = 181.00
Grass Slope Length = 37 feet
Outfall Slope = 0.1351

	2 Year	10 Year	25 Year	100 Year .
Maximum Velocity	1.33 ft/sec	2.21 ft/sec	2.62 ft/sec	3.13 ft/sec

Table from Volume 3, Chapter 1, Page 3 showing permissible velocities to prevent scour and erosion.

Channel Slope	Lining [1]	Permissible Velocity (feet/second)
0 - 5%	Tall fescue Kentucky bluegrass	5
	Grass-legume mixture	4
	Red fescue Redtop Sericea lespedeza Annual lespedeza Small grains	2.5
5 - 10%	Tall fescue Kentucky bluegrass	4
	Grass-legume mixture	3
Greater Than 10%	Tall fescue Kentucky bluegrass	3

Table 2.3.1: Example of Permissible Velocity Table, Modified from Soil and Water Conservation Engineering, 1992, Schwab et al, John Wiley and Sons

Summary for Reach LS1: Level Spreader #1

Inflow Area = 3.993 ac, 22.17% Impervious, Inflow Depth > 0.89" for 2 Year event
Inflow = 1.90 cfs @ 12.53 hrs, Volume= 0.298 af
Outflow = 1.90 cfs @ 12.53 hrs, Volume= 0.298 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.43 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 0.4 min

Peak Storage= 14 cf @ 12.53 hrs
Average Depth at Peak Storage= 0.03'
Bank-Full Depth= 0.20' Flow Area= 5.0 sf, Capacity= 41.47 cfs

25.00' x 0.20' deep channel, n= 0.035 Earth, dense weeds
Length= 18.0' Slope= 0.3333 '/'
Inlet Invert= 197.00', Outlet Invert= 191.00'

Summary for Reach LS2: Level Spreader #2

Inflow Area = 1.748 ac, 28.21% Impervious, Inflow Depth > 1.04" for 2 Year event
Inflow = 0.83 cfs @ 12.48 hrs, Volume= 0.151 af
Outflow = 0.83 cfs @ 12.49 hrs, Volume= 0.151 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 1.33 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.48 fps, Avg. Travel Time= 1.3 min

Peak Storage= 23 cf @ 12.48 hrs
Average Depth at Peak Storage= 0.02'
Bank-Full Depth= 0.20' Flow Area= 5.0 sf, Capacity= 26.41 cfs

25.00' x 0.20' deep channel, n= 0.035 Earth, dense weeds
Length= 37.0' Slope= 0.1351 '/'
Inlet Invert= 186.00', Outlet Invert= 181.00'

Summary for Reach LS1: Level Spreader #1

Inflow Area = 3.993 ac, 22.17% Impervious, Inflow Depth = 2.34" for 10 Year event
Inflow = 5.85 cfs @ 12.38 hrs, Volume= 0.778 af
Outflow = 5.85 cfs @ 12.38 hrs, Volume= 0.778 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.81 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.98 fps, Avg. Travel Time= 0.3 min

Peak Storage= 28 cf @ 12.38 hrs
Average Depth at Peak Storage= 0.06'
Bank-Full Depth= 0.20' Flow Area= 5.0 sf, Capacity= 41.47 cfs

25.00' x 0.20' deep channel, n= 0.035 Earth, dense weeds
Length= 18.0' Slope= 0.3333 '/'
Inlet Invert= 197.00', Outlet Invert= 191.00'

Summary for Reach LS2: Level Spreader #2

Inflow Area = 1.748 ac, 28.21% Impervious, Inflow Depth > 2.58" for 10 Year event
Inflow = 2.96 cfs @ 12.25 hrs, Volume= 0.376 af
Outflow = 2.96 cfs @ 12.26 hrs, Volume= 0.376 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.21 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 1.0 min

Peak Storage= 50 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.20' Flow Area= 5.0 sf, Capacity= 26.41 cfs

25.00' x 0.20' deep channel, n= 0.035 Earth, dense weeds
Length= 37.0' Slope= 0.1351 '/'
Inlet Invert= 186.00', Outlet Invert= 181.00'

Summary for Reach LS1: Level Spreader #1

Inflow Area = 3.993 ac, 22.17% Impervious, Inflow Depth = 3.35" for 25 Year event
Inflow = 8.30 cfs @ 12.35 hrs, Volume= 1.115 af
Outflow = 8.30 cfs @ 12.35 hrs, Volume= 1.115 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.37 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.10 fps, Avg. Travel Time= 0.3 min

Peak Storage= 34 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.08'
Bank-Full Depth= 0.20' Flow Area= 5.0 sf, Capacity= 41.47 cfs

25.00' x 0.20' deep channel, n= 0.035 Earth, dense weeds
Length= 18.0' Slope= 0.3333 '/'
Inlet Invert= 197.00', Outlet Invert= 191.00'

Summary for Reach LS2: Level Spreader #2

Inflow Area = 1.748 ac, 28.21% Impervious, Inflow Depth > 3.62" for 25 Year event
Inflow = 4.53 cfs @ 12.21 hrs, Volume= 0.528 af
Outflow = 4.53 cfs @ 12.21 hrs, Volume= 0.528 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.62 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 0.9 min

Peak Storage= 64 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.07'
Bank-Full Depth= 0.20' Flow Area= 5.0 sf, Capacity= 26.41 cfs

25.00' x 0.20' deep channel, n= 0.035 Earth, dense weeds
Length= 37.0' Slope= 0.1351 '/'
Inlet Invert= 186.00', Outlet Invert= 181.00'

Summary for Reach LS1: Level Spreader #1

Inflow Area = 3.993 ac, 22.17% Impervious, Inflow Depth = 4.98" for 100 Year event
Inflow = 10.15 cfs @ 12.39 hrs, Volume= 1.656 af
Outflow = 10.15 cfs @ 12.39 hrs, Volume= 1.656 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.74 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.25 fps, Avg. Travel Time= 0.2 min

Peak Storage= 39 cf @ 12.39 hrs
Average Depth at Peak Storage= 0.09'
Bank-Full Depth= 0.20' Flow Area= 5.0 sf, Capacity= 41.47 cfs

25.00' x 0.20' deep channel, n= 0.035 Earth, dense weeds
Length= 18.0' Slope= 0.3333 '/'
Inlet Invert= 197.00', Outlet Invert= 191.00'

Summary for Reach LS2: Level Spreader #2

Inflow Area = 1.748 ac, 28.21% Impervious, Inflow Depth > 5.28" for 100 Year event
Inflow = 7.05 cfs @ 12.18 hrs, Volume= 0.769 af
Outflow = 7.05 cfs @ 12.19 hrs, Volume= 0.769 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.13 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 0.8 min

Peak Storage= 83 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.09'
Bank-Full Depth= 0.20' Flow Area= 5.0 sf, Capacity= 26.41 cfs

25.00' x 0.20' deep channel, n= 0.035 Earth, dense weeds
Length= 37.0' Slope= 0.1351 '/'
Inlet Invert= 186.00', Outlet Invert= 181.00'

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Stormwater Calculations: Standard 3 – Recharge Calculations & Drawdown Time Calculations and Standard 4 – Water Quality Calculations

Brush Hill Homes
34 Brush Hill Road in Sherborn, MA

Proposed Impervious Area	= 48,259 ft^2
Existing Impervious Area	= 0 ft^2
Increase in Impervious Area	= 48,259 ft^2

Soils HSG: B → Recharge = 0.25 inches of runoff

Minimum Required Recharge for New Construction:
(48,259 sf)(0.25 in ÷ 12) = 1,006 ft^3

Note that the proposed impervious area directed to Infiltration Facilities is 47,023 ft^2. The total proposed impervious area for the project is 48,259 ft^2. This is equivalent to 97% of the total impervious area which is greater than 65%.

Using the capture area adjustment (65% Rule), the adjusted recharge volume is:
(48,259 ÷ 47,023) x (1,006) = 1,033 ft^3.

Recharger #1 is designed to capture 3,107 ft^3 (volume in chambers + surrounding stone)
Recharger #2 is designed to capture 1,011 ft^3 (volume in chambers + surrounding stone)
Recharger #3 is designed to capture 660 ft^3 (volume in chambers + surrounding stone)

3,107 ft^3 + 1,011 ft^3 + 660 ft^3 = 4,778 ft^3

4,778 ft^3 > 1,033 ft^3 ← okay

Recharge Required for Water Quality Volume Requirements = 0.5 inches of runoff over post development impervious surface.

Require Recharged = (48,259 sf)(0.5 in ÷ 12) = 2,011 ft^3

4,778 ft^3 > 2,011 ft^3 ← okay

THIS PROJECT MEETS THE REQUIREMENTS OF MASSDEP STANDARD 3 & 4

DGT Associates Surveying & Engineering

Recharge System Sizing Calculations – Static Method

Recharger #1:
Contributing Impervious Area = 19,056 ft^2
Minimum Capture Volume = 19,056 ft^2 x (0.5 in/12) = 794 ft^3

Volume provided below the outlet invert (Elev=212.42) = 3,107 ft^3

3,107 ft^3 > 794 ft^3 ← okay

Recharger #2:
Contributing Impervious Area = 21,484 ft^2
Minimum Capture Volume = 21,484 ft^2 x (0.5 in/12) = 895 ft^3

Volume provided below the outlet invert (Elev=197.80) = 1,011 ft^3

1,011 ft^3 > 895 ft^3 ← okay

Recharger #3:
Contributing Impervious Area = 6,483 ft^2
Minimum Capture Volume = 6,483 ft^2 x (0.5 in/12) = 270 ft^3

Volume provided below the outlet invert (Elev=204.33) = 660 ft^3

660 ft^3 > 270 ft^3 ← okay

Drawdown Calculations

Recharger #1:
Recharger #1 Bottom Area = 3,927 ft^2
Provided Capture Volume = 3,107 ft^3

$Time_{drawdown}$ = Rv ÷ (K)(Bottom Area)
$Time_{drawdown}$ = 3,107 ft^3 ÷ (1.02 in/hr)(3,927 ft^2)(1 ft / 12 in.)
$Time_{drawdown}$ = 9.3 hours

9.3 hours < 72 hours ← okay

Recharger #2:
Recharger #2 Bottom Area = 1,137 ft^2
Provided Capture Volume = 1,011 ft^3

$Time_{drawdown}$ = Rv ÷ (K)(Bottom Area)
$Time_{drawdown}$ = 1,011 ft^3 ÷ (1.02 in/hr)(1,137 ft^2)(1 ft / 12 in.)
$Time_{drawdown}$ = 10.5 hours

10.5 hours < 72 hours ← okay

<u>Recharger #3</u>:
Recharger #3 Bottom Area = 648 ft^2
Provided Capture Volume = 660 ft^3

$Time_{drawdown}$ = Rv ÷ (K)(Bottom Area)
$Time_{drawdown}$ = 660 ft^3 ÷ (1.02 in/hr)(648 ft^2)(1 ft / 12 in.)
$Time_{drawdown}$ = 12.0 hours

12.0 hours < 72 hours ← okay

Project:	**Brush Hill Homes**	
Location:	**Sherborn, MA**	
Prepared For:	**DGT Associates**	

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

Q = (qu) (A) (WQV)

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
STU 1	0.33	0.0005221	6.0	0.100	1.00	774.00	0.40
STU 2	0.36	0.0005617	6.0	0.100	1.00	774.00	0.43

The WQf sizing calculation selects the minimum size CDS/Cascade/StormCeptor model capable of operating at the computed WQf peak flowrate prior to bypassing. It assumes free discharge of the WQf through the unit and ignores the routing effect of any upstream storm drain piping. As with all hydrodynamic separators, there will be some impact to the Hydraulic Gradient of the corresponding drainage system, and evaluation of this impact should be considered in the design.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

BRUSH HILL HOMES SHERBORN, MA

Area	**0.33 ac**	Unit Site Designation	**STU 1**
Weighted C	**0.9**	Rainfall Station #	**68**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.0
0.04	9.5%	18.8%	0.01	0.01	9.1
0.06	8.7%	27.5%	0.02	0.02	8.4
0.08	10.1%	37.6%	0.02	0.02	9.6
0.10	7.2%	44.8%	0.03	0.03	6.8
0.12	6.0%	50.8%	0.04	0.04	5.7
0.14	6.3%	57.1%	0.04	0.04	6.0
0.16	5.6%	62.7%	0.05	0.05	5.3
0.18	4.7%	67.4%	0.05	0.05	4.4
0.20	3.6%	71.0%	0.06	0.06	3.4
0.25	8.2%	79.1%	0.08	0.08	7.5
0.50	14.9%	94.0%	0.15	0.15	13.0
0.75	3.2%	97.3%	0.23	0.23	2.6
1.00	1.2%	98.5%	0.30	0.30	1.0
1.50	0.7%	99.2%	0.45	0.45	0.5
2.00	0.8%	100.0%	0.60	0.60	0.4
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					92.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**86.2%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

BRUSH HILL HOMES
SHERBORN, MA

Area	0.36 ac	Unit Site Designation	STU 2
Weighted C	0.9	Rainfall Station #	68
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.0
0.04	9.5%	18.8%	0.01	0.01	9.1
0.06	8.7%	27.5%	0.02	0.02	8.4
0.08	10.1%	37.6%	0.03	0.03	9.6
0.10	7.2%	44.8%	0.03	0.03	6.8
0.12	6.0%	50.8%	0.04	0.04	5.7
0.14	6.3%	57.1%	0.05	0.05	5.9
0.16	5.6%	62.7%	0.05	0.05	5.2
0.18	4.7%	67.4%	0.06	0.06	4.4
0.20	3.6%	71.0%	0.06	0.06	3.4
0.25	8.2%	79.1%	0.08	0.08	7.5
0.50	14.9%	94.0%	0.16	0.16	12.9
0.75	3.2%	97.3%	0.24	0.24	2.6
1.00	1.2%	98.5%	0.32	0.32	0.9
1.50	0.7%	99.2%	0.49	0.49	0.5
2.00	0.8%	100.0%	0.65	0.65	0.4
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					92.3
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**85.8%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: 34 Brush Hill Road in Sherborn, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Proprietary Treatment Practice	**0.00**	**0.75**	**0.00**	**0.75**
Infiltration Basin	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = 85%

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

Project: **Brush Hill Homes**
Prepared By: **DGT Associates**
Date: **26-Jun-24**

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

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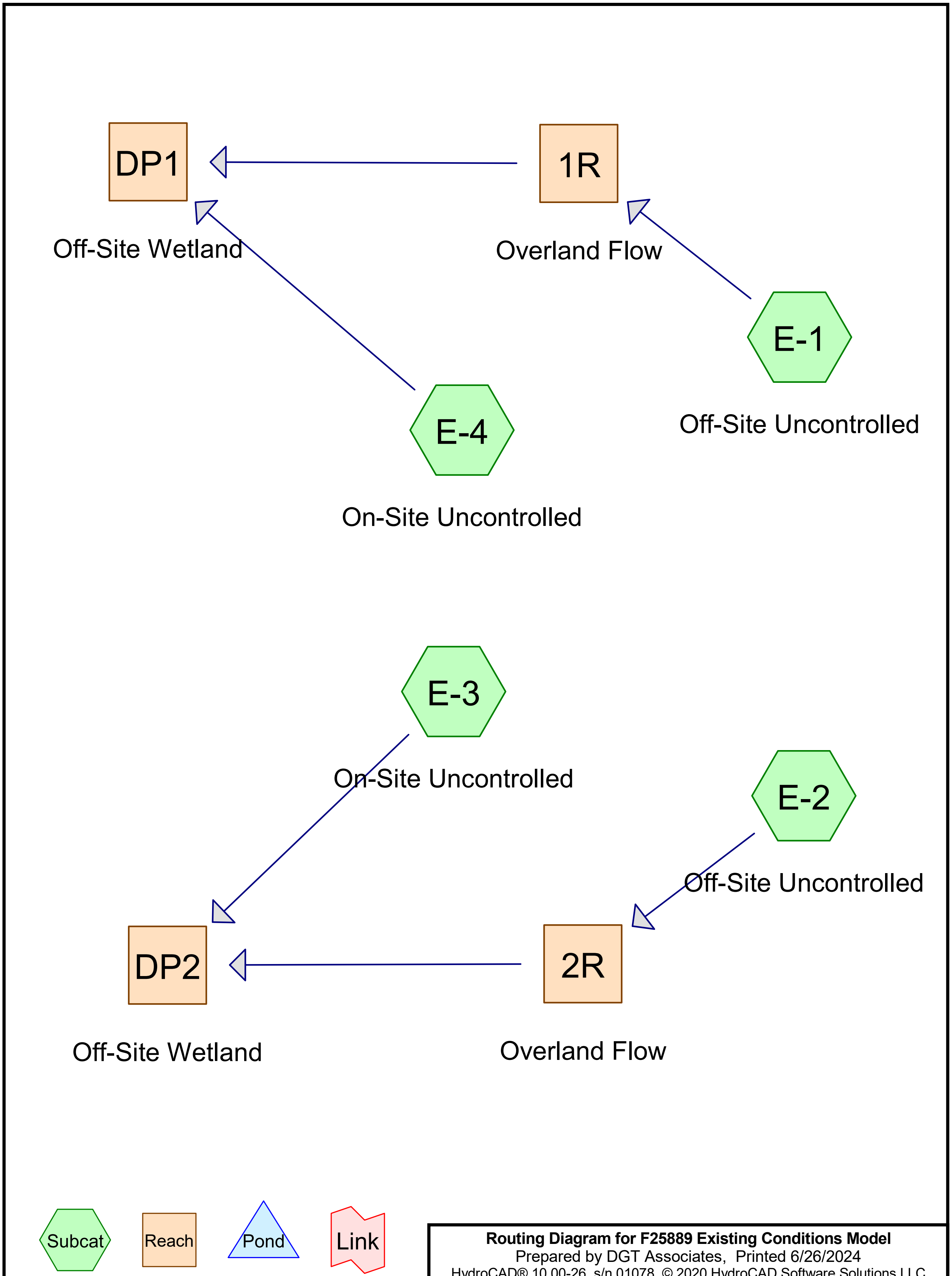
SECTION 3

Existing Conditions Stormwater Model showing Stormwater Flows and Flood Routing Computations using HydroCAD version 10.00

Existing Conditions Watershed Map: WSD-EX

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

DGT Job No.: F25889



Routing Diagram for F25889 Existing Conditions Model
Prepared by DGT Associates, Printed 6/26/2024
HydroCAD® 10.00-26 s/n 01078 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.546	74	>75% Grass cover, Good, HSG C (E-1, E-2, E-4)
0.229	98	Paved parking, HSG C (E-1)
0.127	98	Roofs, HSG C (E-1)
5.997	70	Woods, Good, HSG C (E-1, E-2, E-3, E-4)
8.899	**72**	**TOTAL AREA**

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 E-1: Off-Site Uncontrolled Runoff Area=127,167 sf 12.21% Impervious Runoff Depth=1.24"
Flow Length=532' Tc=9.5 min CN=76 Runoff=3.65 cfs 0.302 af

Subcatchment E-2: Off-Site Uncontrolled Runoff Area=59,516 sf 0.00% Impervious Runoff Depth=0.96"
Flow Length=344' Tc=7.4 min CN=71 Runoff=1.34 cfs 0.109 af

Subcatchment E-3: On-Site Uncontrolled Runoff Area=142,081 sf 0.00% Impervious Runoff Depth=0.90"
Flow Length=451' Tc=10.1 min CN=70 Runoff=2.72 cfs 0.246 af

Subcatchment E-4: On-Site Uncontrolled Runoff Area=58,882 sf 0.00% Impervious Runoff Depth=0.90"
Flow Length=364' Tc=11.5 min CN=70 Runoff=1.08 cfs 0.102 af

Reach 1R: Overland Flow Avg. Flow Depth=0.11' Max Vel=0.28 fps Inflow=3.65 cfs 0.302 af
n=0.400 L=331.0' S=0.1133 '/' Capacity=16.20 cfs Outflow=2.19 cfs 0.302 af

Reach 2R: Overland Flow Avg. Flow Depth=0.04' Max Vel=0.14 fps Inflow=1.34 cfs 0.109 af
n=0.400 L=451.0' S=0.1064 '/' Capacity=15.70 cfs Outflow=0.43 cfs 0.107 af

Reach DP1: Off-Site Wetland Inflow=2.52 cfs 0.404 af
Outflow=2.52 cfs 0.404 af

Reach DP2: Off-Site Wetland Inflow=2.72 cfs 0.353 af
Outflow=2.72 cfs 0.353 af

Total Runoff Area = 8.899 ac Runoff Volume = 0.759 af Average Runoff Depth = 1.02"
96.00% Pervious = 8.543 ac 4.00% Impervious = 0.356 ac

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 E-1: Off-Site Uncontrolled Runoff Area=127,167 sf 12.21% Impervious Runoff Depth=2.71"
Flow Length=532' Tc=9.5 min CN=76 Runoff=8.23 cfs 0.659 af

Subcatchment E-2: Off-Site Uncontrolled Runoff Area=59,516 sf 0.00% Impervious Runoff Depth=2.28"
Flow Length=344' Tc=7.4 min CN=71 Runoff=3.43 cfs 0.259 af

Subcatchment E-3: On-Site Uncontrolled Runoff Area=142,081 sf 0.00% Impervious Runoff Depth=2.19"
Flow Length=451' Tc=10.1 min CN=70 Runoff=7.18 cfs 0.596 af

Subcatchment E-4: On-Site Uncontrolled Runoff Area=58,882 sf 0.00% Impervious Runoff Depth=2.19"
Flow Length=364' Tc=11.5 min CN=70 Runoff=2.85 cfs 0.247 af

Reach 1R: Overland Flow Avg. Flow Depth=0.19' Max Vel=0.41 fps Inflow=8.23 cfs 0.659 af
n=0.400 L=331.0' S=0.1133 '/' Capacity=16.20 cfs Outflow=5.88 cfs 0.658 af

Reach 2R: Overland Flow Avg. Flow Depth=0.09' Max Vel=0.24 fps Inflow=3.43 cfs 0.259 af
n=0.400 L=451.0' S=0.1064 '/' Capacity=15.70 cfs Outflow=1.57 cfs 0.257 af

Reach DP1: Off-Site Wetland Inflow=7.25 cfs 0.905 af
Outflow=7.25 cfs 0.905 af

Reach DP2: Off-Site Wetland Inflow=7.25 cfs 0.854 af
Outflow=7.25 cfs 0.854 af

Total Runoff Area = 8.899 ac Runoff Volume = 1.762 af Average Runoff Depth = 2.38"
96.00% Pervious = 8.543 ac 4.00% Impervious = 0.356 ac

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 E-1: Off-Site Uncontrolled Runoff Area=127,167 sf 12.21% Impervious Runoff Depth=3.72"
Flow Length=532' Tc=9.5 min CN=76 Runoff=11.31 cfs 0.905 af

Subcatchment E-2: Off-Site Uncontrolled Runoff Area=59,516 sf 0.00% Impervious Runoff Depth=3.22"
Flow Length=344' Tc=7.4 min CN=71 Runoff=4.90 cfs 0.366 af

Subcatchment E-3: On-Site Uncontrolled Runoff Area=142,081 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=451' Tc=10.1 min CN=70 Runoff=10.33 cfs 0.847 af

Subcatchment E-4: On-Site Uncontrolled Runoff Area=58,882 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=364' Tc=11.5 min CN=70 Runoff=4.10 cfs 0.351 af

Reach 1R: Overland Flow Avg. Flow Depth=0.24' Max Vel=0.48 fps Inflow=11.31 cfs 0.905 af
n=0.400 L=331.0' S=0.1133 '/' Capacity=16.20 cfs Outflow=8.51 cfs 0.904 af

Reach 2R: Overland Flow Avg. Flow Depth=0.12' Max Vel=0.29 fps Inflow=4.90 cfs 0.366 af
n=0.400 L=451.0' S=0.1064 '/' Capacity=15.70 cfs Outflow=2.49 cfs 0.364 af

Reach DP1: Off-Site Wetland Inflow=10.66 cfs 1.255 af
Outflow=10.66 cfs 1.255 af

Reach DP2: Off-Site Wetland Inflow=10.56 cfs 1.212 af
Outflow=10.56 cfs 1.212 af

Total Runoff Area = 8.899 ac Runoff Volume = 2.470 af Average Runoff Depth = 3.33"
96.00% Pervious = 8.543 ac 4.00% Impervious = 0.356 ac

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 E-1: Off-Site Uncontrolled Runoff Area=127,167 sf 12.21% Impervious Runoff Depth=5.34"
Flow Length=532' Tc=9.5 min CN=76 Runoff=16.15 cfs 1.299 af

Subcatchment E-2: Off-Site Uncontrolled Runoff Area=59,516 sf 0.00% Impervious Runoff Depth=4.75"
Flow Length=344' Tc=7.4 min CN=71 Runoff=7.25 cfs 0.541 af

Subcatchment E-3: On-Site Uncontrolled Runoff Area=142,081 sf 0.00% Impervious Runoff Depth=4.64"
Flow Length=451' Tc=10.1 min CN=70 Runoff=15.44 cfs 1.260 af

Subcatchment E-4: On-Site Uncontrolled Runoff Area=58,882 sf 0.00% Impervious Runoff Depth=4.64"
Flow Length=364' Tc=11.5 min CN=70 Runoff=6.13 cfs 0.522 af

Reach 1R: Overland Flow Avg. Flow Depth=0.30' Max Vel=0.56 fps Inflow=16.15 cfs 1.299 af
n=0.400 L=331.0' S=0.1133 '/' Capacity=16.20 cfs Outflow=12.79 cfs 1.298 af

Reach 2R: Overland Flow Avg. Flow Depth=0.16' Max Vel=0.35 fps Inflow=7.25 cfs 0.541 af
n=0.400 L=451.0' S=0.1064 '/' Capacity=15.70 cfs Outflow=4.11 cfs 0.539 af

Reach DP1: Off-Site Wetland Inflow=16.27 cfs 1.820 af
Outflow=16.27 cfs 1.820 af

Reach DP2: Off-Site Wetland Inflow=16.05 cfs 1.799 af
Outflow=16.05 cfs 1.799 af

Total Runoff Area = 8.899 ac Runoff Volume = 3.623 af Average Runoff Depth = 4.89"
96.00% Pervious = 8.543 ac 4.00% Impervious = 0.356 ac

Summary for Subcatchment E-1: Off-Site Uncontrolled

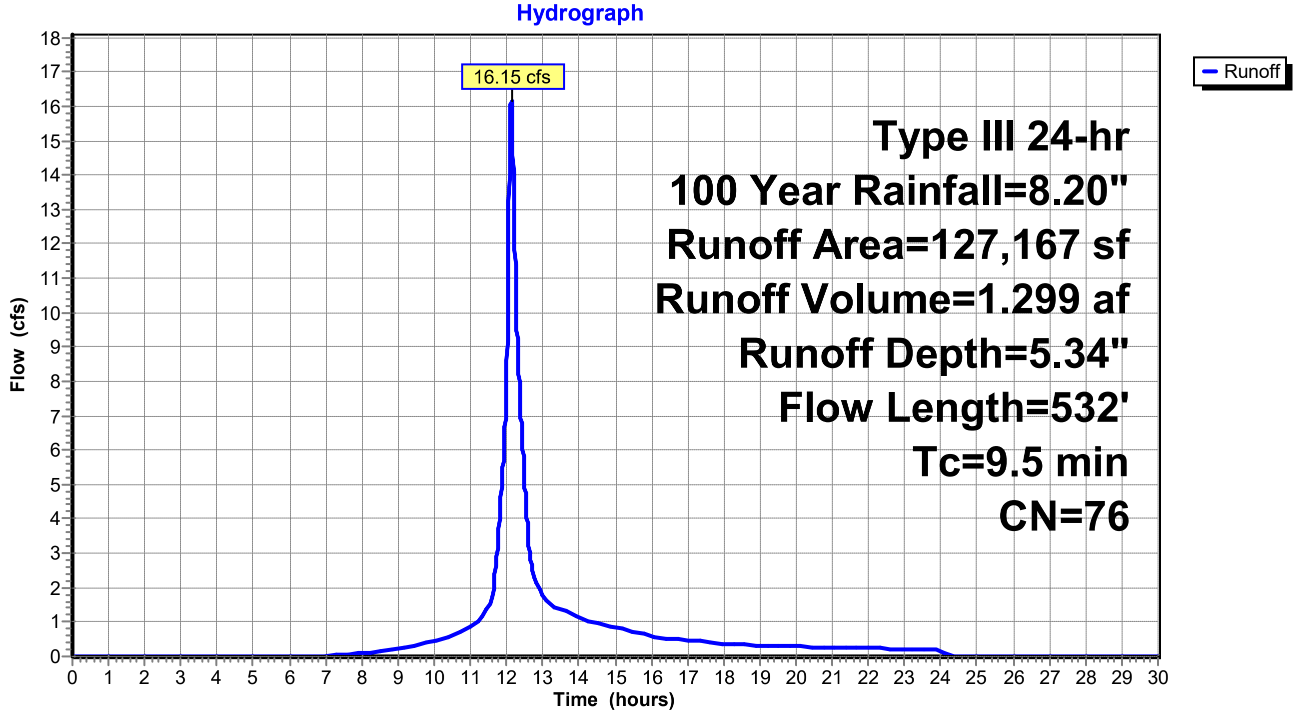
Runoff = 16.15 cfs @ 12.13 hrs, Volume= 1.299 af, Depth= 5.34"

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=8.20"

Area (sf)	CN	Description
9,988	98	Paved parking, HSG C
5,537	98	Roofs, HSG C
88,412	74	>75% Grass cover, Good, HSG C
23,230	70	Woods, Good, HSG C
127,167	76	Weighted Average
111,642		87.79% Pervious Area
15,525		12.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.33"
2.6	227	0.0441	1.47		**Shallow Concentrated Flow, Segment 2** Short Grass Pasture Kv= 7.0 fps
1.4	112	0.0759	1.38		**Shallow Concentrated Flow, Segment 3** Woodland Kv= 5.0 fps
1.3	143	0.0699	1.85		**Shallow Concentrated Flow, Segment 4** Short Grass Pasture Kv= 7.0 fps
9.5	532	Total			

Subcatchment E-1: Off-Site Uncontrolled



Summary for Subcatchment E-2: Off-Site Uncontrolled

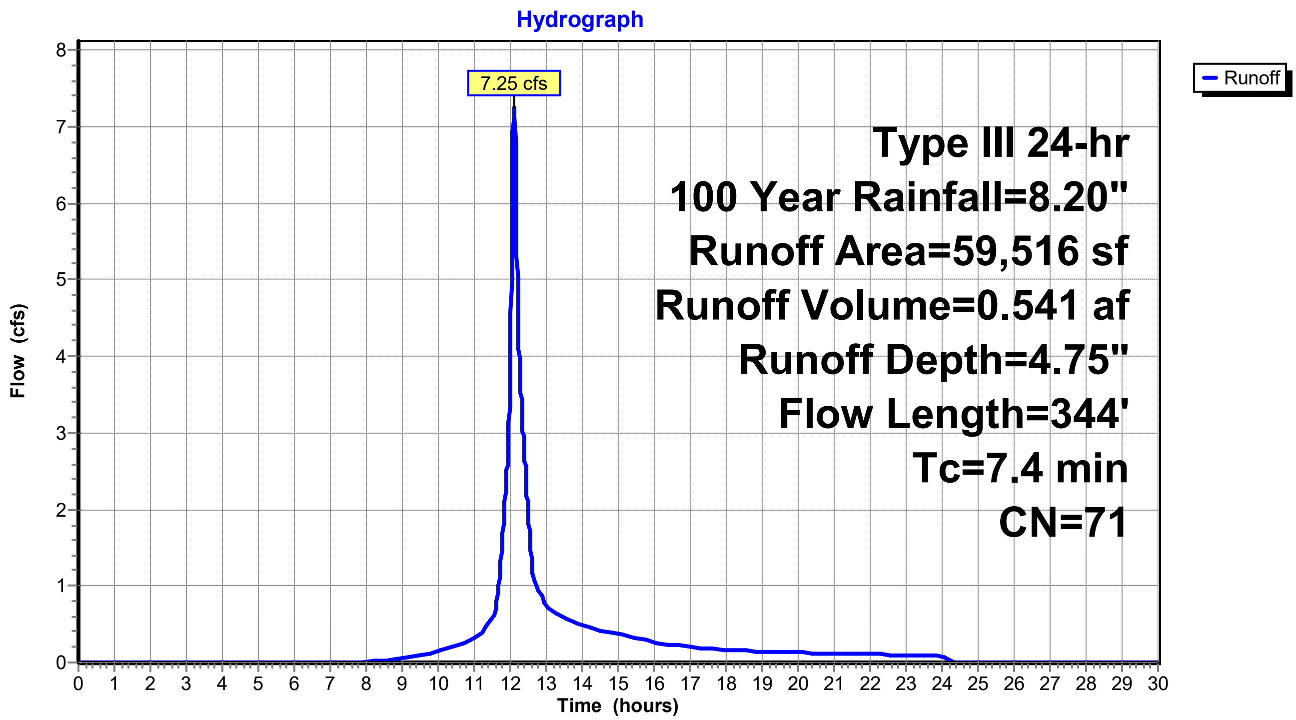
Runoff = 7.25 cfs @ 12.11 hrs, Volume= 0.541 af, Depth= 4.75"

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=8.20"

Area (sf)	CN	Description
17,767	74	>75% Grass cover, Good, HSG C
41,749	70	Woods, Good, HSG C
59,516	71	Weighted Average
59,516		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.33"
1.1	123	0.0650	1.78		**Shallow Concentrated Flow, Segment 2** Short Grass Pasture Kv= 7.0 fps
2.1	171	0.0760	1.38		**Shallow Concentrated Flow, Segment 3** Woodland Kv= 5.0 fps
7.4	344	Total			

Subcatchment E-2: Off-Site Uncontrolled



Summary for Subcatchment E-3: On-Site Uncontrolled

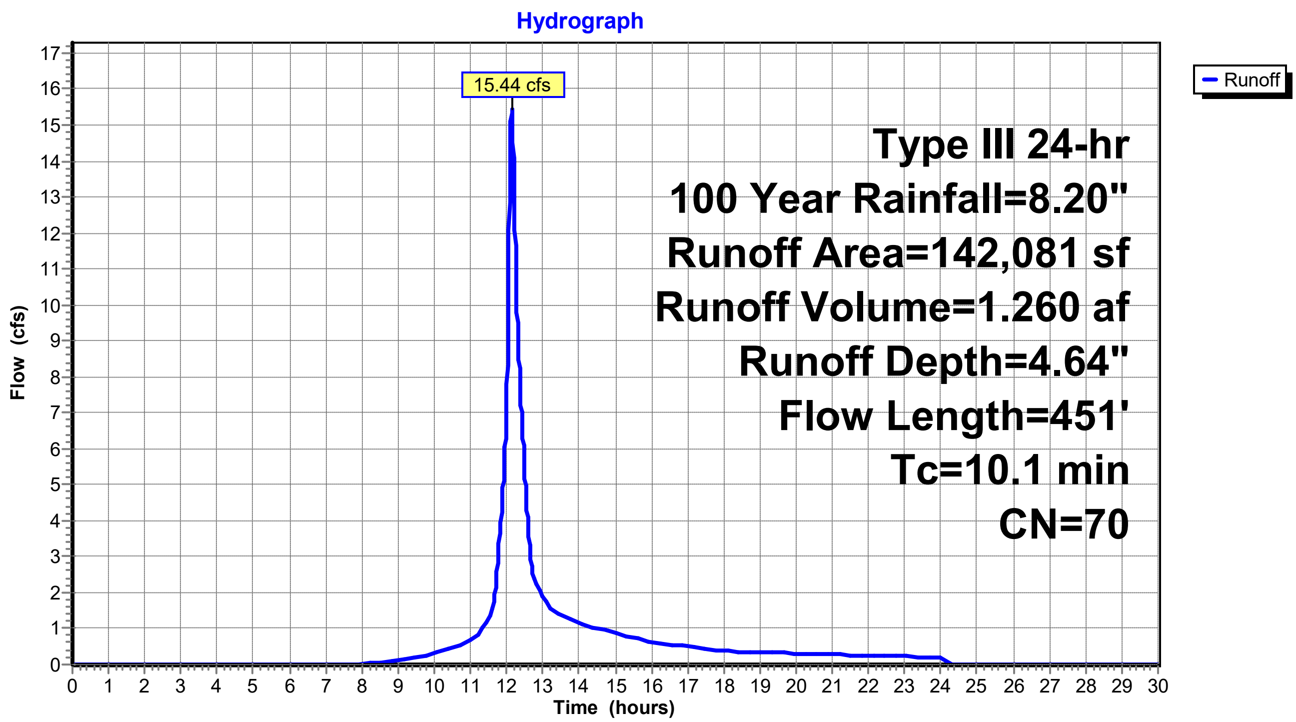
Runoff = 15.44 cfs @ 12.14 hrs, Volume= 1.260 af, Depth= 4.64"

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=8.20"

Area (sf)	CN	Description
142,081	70	Woods, Good, HSG C
142,081		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.1000	0.13		**Sheet Flow, Segment 1** Woods: Light underbrush n= 0.400 P2= 3.33"
3.7	401	0.1322	1.82		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
10.1	451	Total			

Subcatchment E-3: On-Site Uncontrolled



Summary for Subcatchment E-4: On-Site Uncontrolled

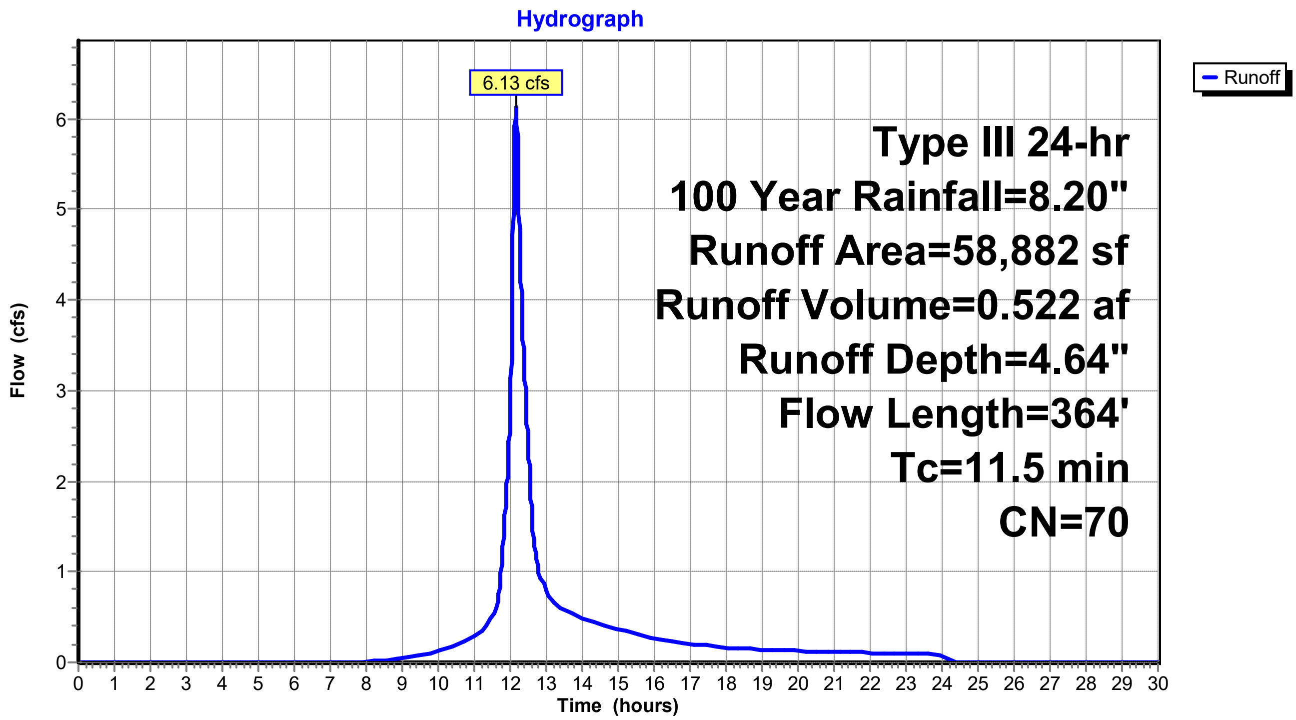
Runoff = 6.13 cfs @ 12.16 hrs, Volume= 0.522 af, Depth= 4.64"

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=8.20"

Area (sf)	CN	Description
4,710	74	>75% Grass cover, Good, HSG C
54,172	70	Woods, Good, HSG C
58,882	70	Weighted Average
58,882		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	50	0.0500	0.10		**Sheet Flow, Segment 1**
					Woods: Light underbrush n= 0.400 P2= 3.33"
3.1	314	0.1115	1.67		**Shallow Concentrated Flow, Segment 2**
					Woodland Kv= 5.0 fps
11.5	364	Total			

Subcatchment E-4: On-Site Uncontrolled



Summary for Reach 1R: Overland Flow

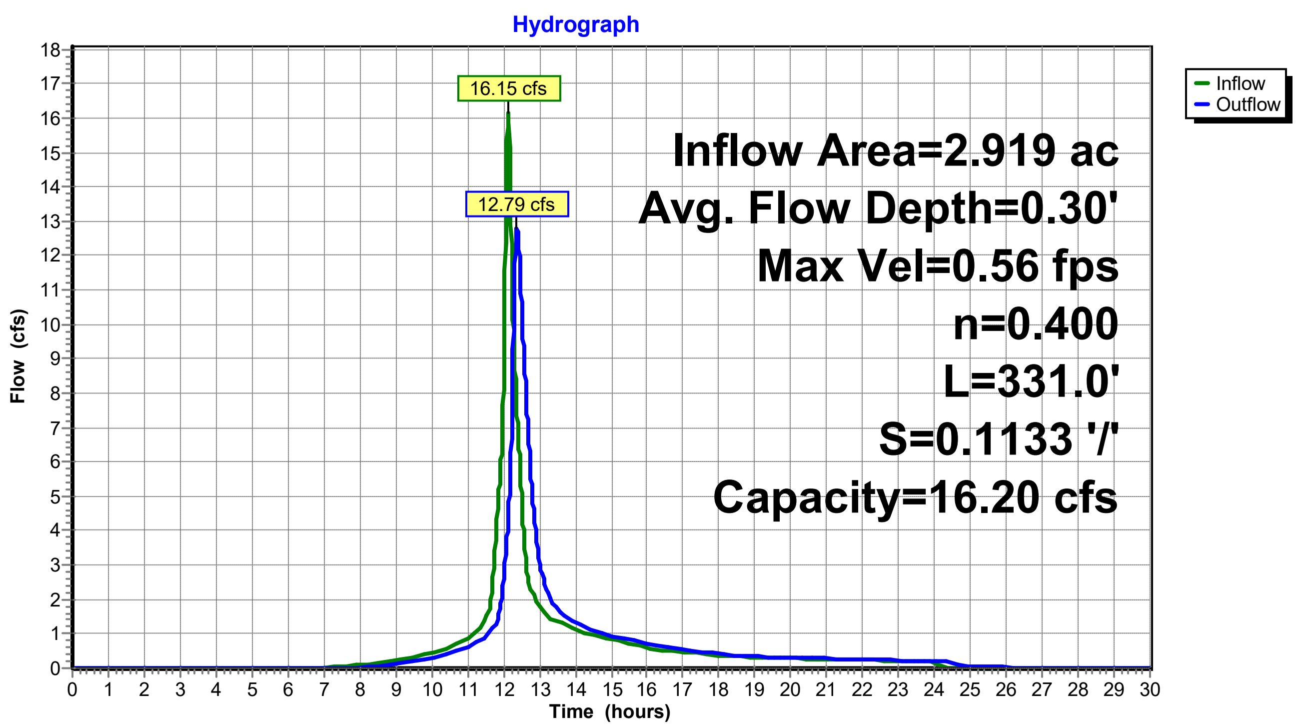
Inflow Area = 2.919 ac, 12.21% Impervious, Inflow Depth = 5.34" for 100 Year event
Inflow = 16.15 cfs @ 12.13 hrs, Volume= 1.299 af
Outflow = 12.79 cfs @ 12.38 hrs, Volume= 1.298 af, Atten= 21%, Lag= 14.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 0.56 fps, Min. Travel Time= 9.8 min
Avg. Velocity = 0.13 fps, Avg. Travel Time= 43.5 min

Peak Storage= 7,539 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 0.35' Flow Area= 26.3 sf, Capacity= 16.20 cfs

75.00' x 0.35' deep channel, n= 0.400 Sheet flow: Woods+light brush
Length= 331.0' Slope= 0.1133 '/'
Inlet Invert= 221.50', Outlet Invert= 184.00'

Reach 1R: Overland Flow



Summary for Reach 2R: Overland Flow

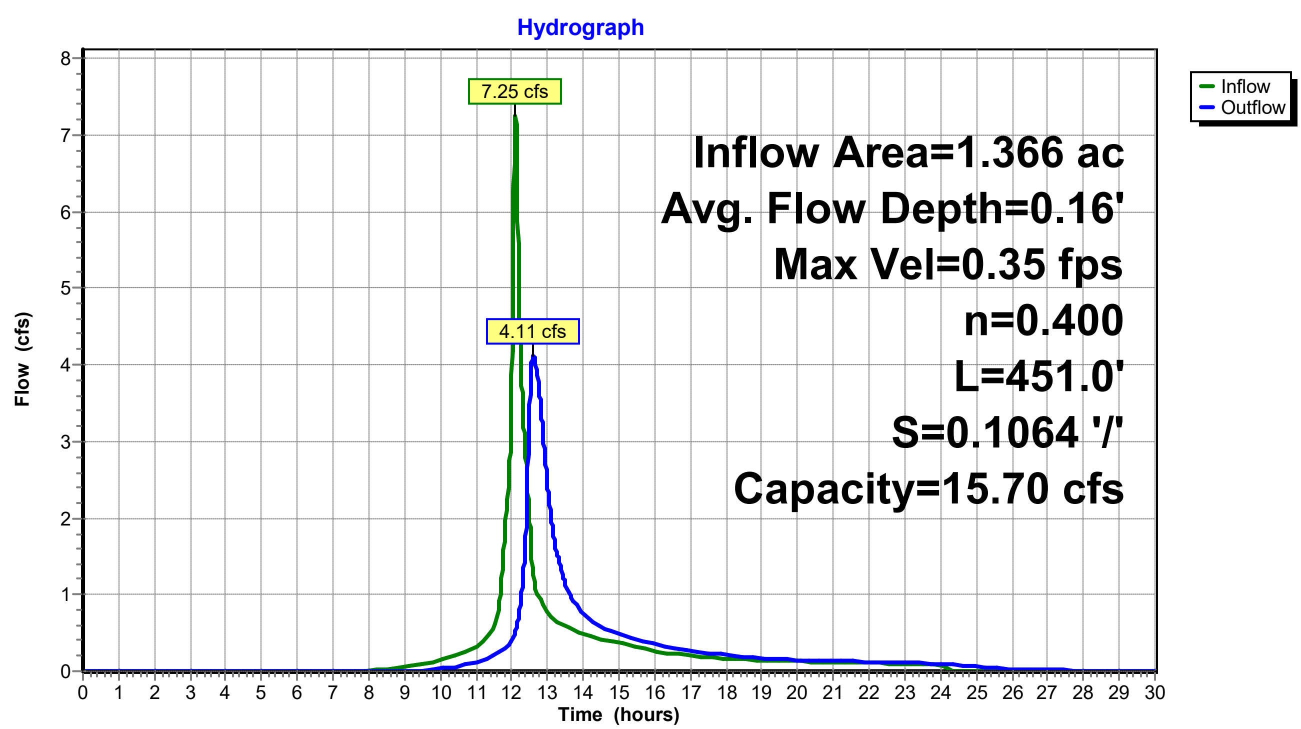
Inflow Area = 1.366 ac, 0.00% Impervious, Inflow Depth = 4.75" for 100 Year event
Inflow = 7.25 cfs @ 12.11 hrs, Volume= 0.541 af
Outflow = 4.11 cfs @ 12.61 hrs, Volume= 0.539 af, Atten= 43%, Lag= 30.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 0.35 fps, Min. Travel Time= 21.4 min
Avg. Velocity = 0.09 fps, Avg. Travel Time= 81.1 min

Peak Storage= 5,290 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 0.35' Flow Area= 26.3 sf, Capacity= 15.70 cfs

75.00' x 0.35' deep channel, n= 0.400 Sheet flow: Woods+light brush
Length= 451.0' Slope= 0.1064 '/'
Inlet Invert= 228.50', Outlet Invert= 180.50'

Reach 2R: Overland Flow

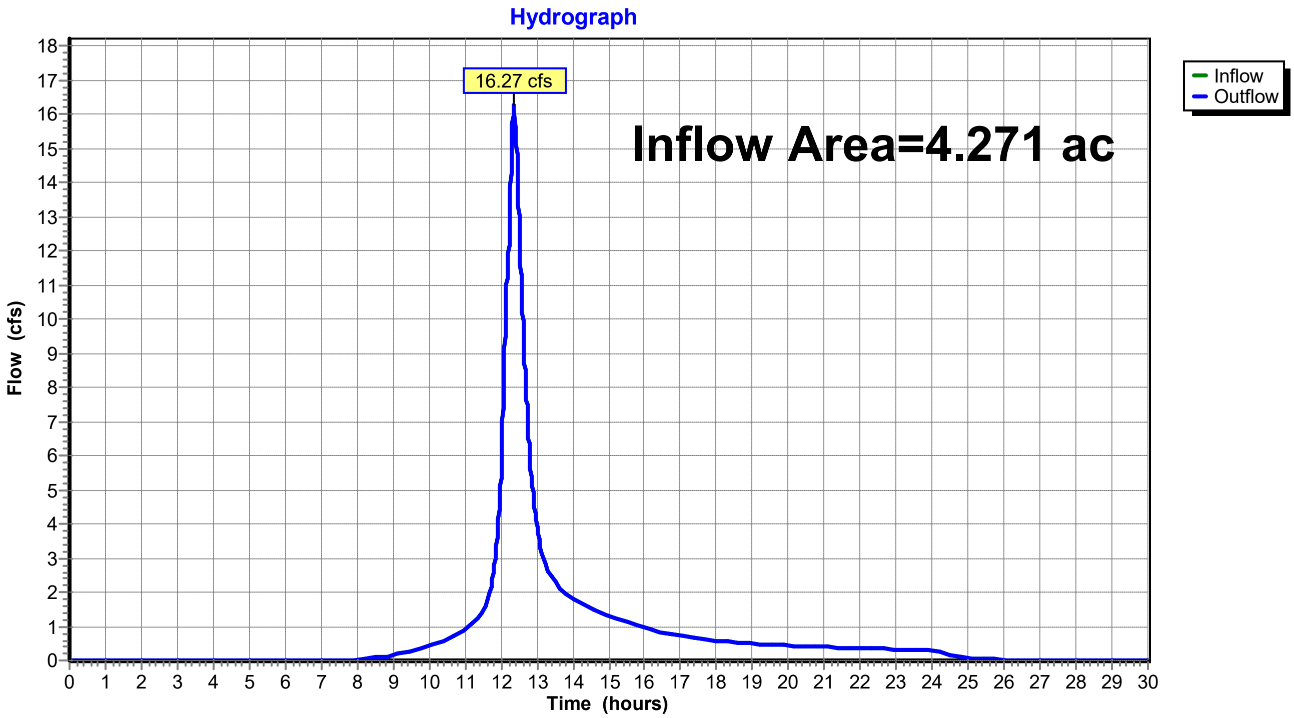


Summary for Reach DP1: Off-Site Wetland

Inflow Area =	4.271 ac,	8.34% Impervious,	Inflow Depth > 5.11"	for 100 Year event	
Inflow =	16.27 cfs @	12.36 hrs,	Volume=	1.820 af	
Outflow =	16.27 cfs @	12.36 hrs,	Volume=	1.820 af,	Atten= 0%, Lag= 0.0 min

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

Reach DP1: Off-Site Wetland

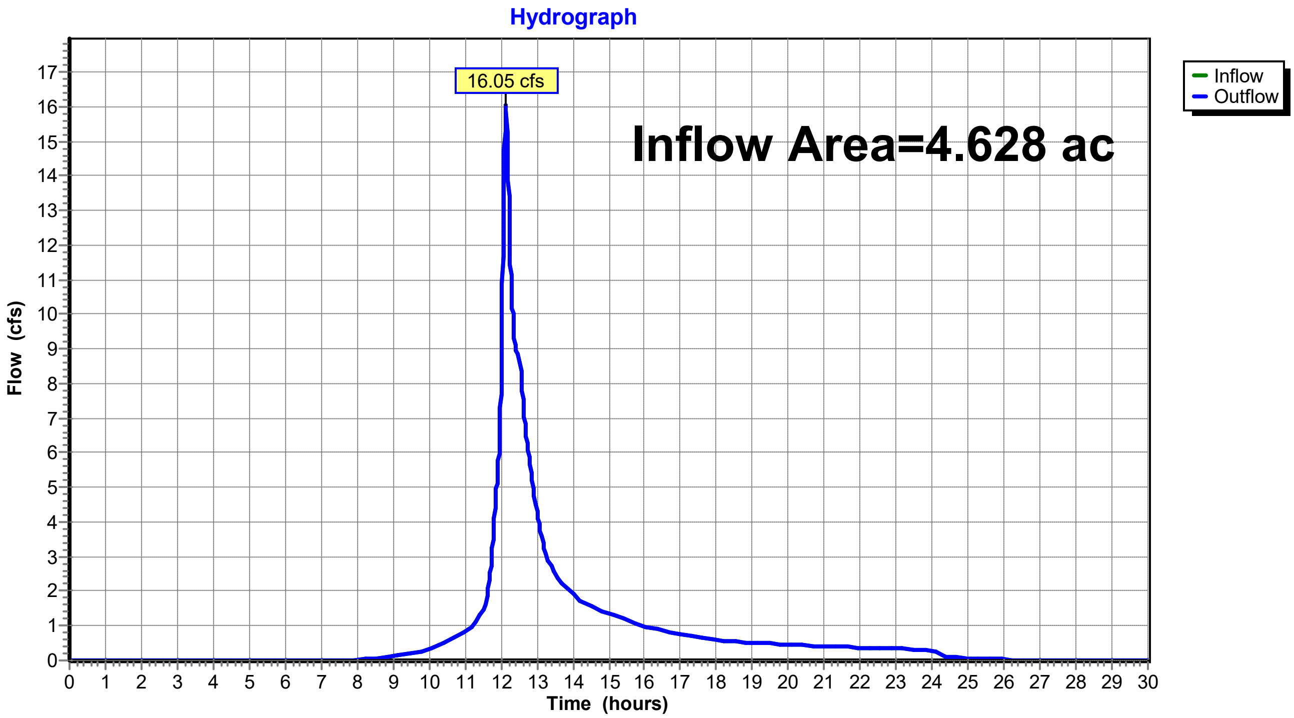


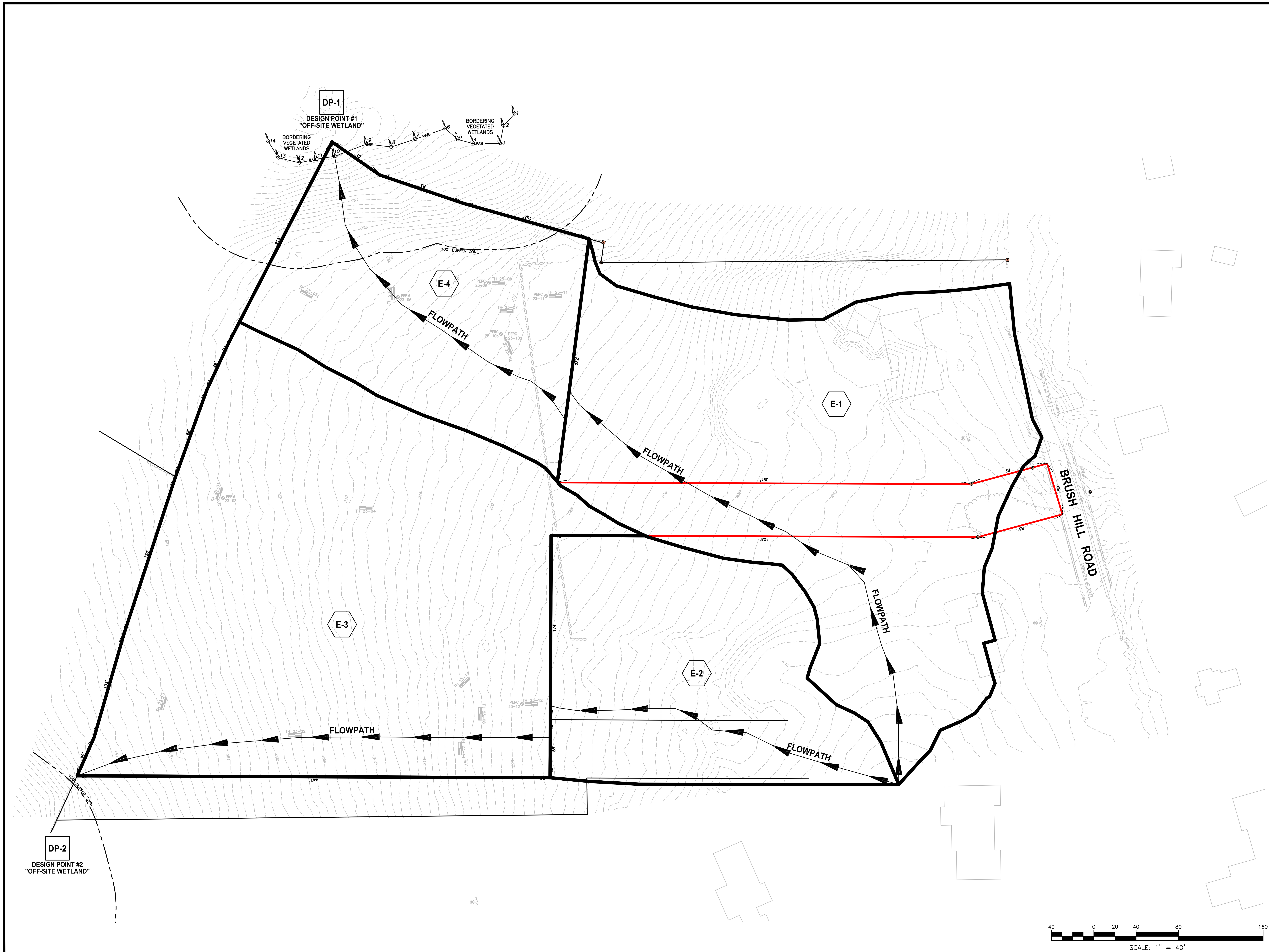
Summary for Reach DP2: Off-Site Wetland

Inflow Area = 4.628 ac, 0.00% Impervious, Inflow Depth > 4.67" for 100 Year event
Inflow = 16.05 cfs @ 12.14 hrs, Volume= 1.799 af
Outflow = 16.05 cfs @ 12.14 hrs, Volume= 1.799 af, Atten= 0%, Lag= 0.0 min

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

Reach DP2: Off-Site Wetland





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ISSUED FOR:

PRELIMINARY DESIGN

NO.	APP	DATE	DESCRIPTION

DATE: **JUNE 26, 2024**

SCALE: **1" = 40'**

DESIGN:	DRAFTED:	CHECKED:
KMR	KMR	BEC

PROJECT TITLE:

BRUSH HILL HOMES

34 BRUSH HILL ROAD
SHERBORN, MA 01770

SHEET TITLE:

EXISTING CONDITIONS WATERSHED MAP

SHEET: 1 OF 1

PROJECT NO.: F-25889

WSD-EX

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Engineering

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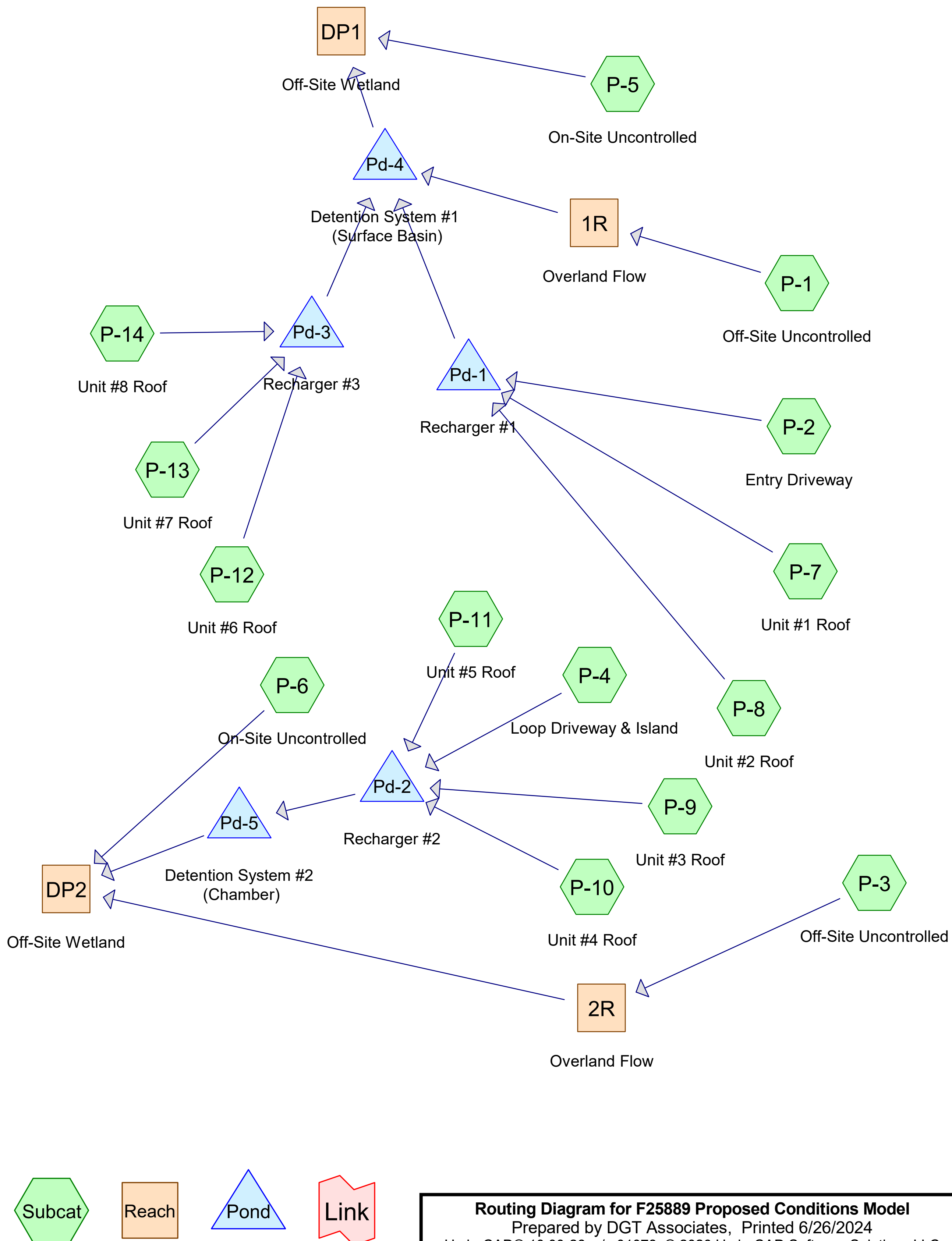
SECTION 4

Proposed Conditions Stormwater Model showing Stormwater Flows and Flood Routing Computations using HydroCAD version 10.00

Proposed Conditions Watershed Map: WSD-PR

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

DGT Job No.: F25889



Routing Diagram for F25889 Proposed Conditions Model
Prepared by DGT Associates, Printed 6/26/2024
HydroCAD® 10.00-26 s/n 01078 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5.780	74	>75% Grass cover, Good, HSG C (P-1, P-2, P-3, P-4, P-5, P-6)
0.894	98	Paved parking, HSG C (P-1, P-2, P-4, P-6)
0.513	98	Roofs, HSG C (P-1, P-10, P-11, P-12, P-13, P-14, P-2, P-7, P-8, P-9)
1.502	70	Woods, Good, HSG C (P-2, P-3, P-5, P-6)
0.329	70	Woods, Good, HSG C - OFF SITE (P-4)
9.018	**77**	**TOTAL AREA**

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 P-1: Off-Site Uncontrolled Runoff Area=82,859 sf 15.71% Impervious Runoff Depth=1.37"
Flow Length=577' Tc=8.7 min CN=78 Runoff=2.73 cfs 0.217 af

Subcatchment P-10: Unit #4 Roof Runoff Area=1,832 sf 100.00% Impervious Runoff Depth=3.10"
Tc=5.0 min CN=98 Runoff=0.14 cfs 0.011 af

Subcatchment P-11: Unit #5 Roof Runoff Area=1,832 sf 100.00% Impervious Runoff Depth=3.10"
Tc=5.0 min CN=98 Runoff=0.14 cfs 0.011 af

Subcatchment P-12: Unit #6 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=3.10"
Tc=5.0 min CN=98 Runoff=0.17 cfs 0.013 af

Subcatchment P-13: Unit #7 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=3.10"
Tc=5.0 min CN=98 Runoff=0.17 cfs 0.013 af

Subcatchment P-14: Unit #8 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=3.10"
Tc=5.0 min CN=98 Runoff=0.17 cfs 0.013 af

Subcatchment P-2: Entry Driveway Runoff Area=80,080 sf 18.18% Impervious Runoff Depth=1.37"
Flow Length=567' Tc=8.6 min CN=78 Runoff=2.65 cfs 0.210 af

Subcatchment P-3: Off-Site Uncontrolled Runoff Area=28,221 sf 0.00% Impervious Runoff Depth=1.01"
Flow Length=344' Tc=7.4 min CN=72 Runoff=0.68 cfs 0.055 af

Subcatchment P-4: Loop Driveway & Island Runoff Area=70,327 sf 22.27% Impervious Runoff Depth=1.44"
Tc=5.0 min CN=79 Runoff=2.78 cfs 0.193 af

Subcatchment P-5: On-Site Uncontrolled Runoff Area=43,391 sf 0.00% Impervious Runoff Depth=1.01"
Flow Length=274' Tc=5.2 min CN=72 Runoff=1.14 cfs 0.084 af

Subcatchment P-6: On-Site Uncontrolled Runoff Area=71,135 sf 1.74% Impervious Runoff Depth=1.07"
Flow Length=471' Tc=9.9 min CN=73 Runoff=1.68 cfs 0.145 af

Subcatchment P-7: Unit #1 Roof Runoff Area=2,339 sf 100.00% Impervious Runoff Depth=3.10"
Tc=5.0 min CN=98 Runoff=0.18 cfs 0.014 af

Subcatchment P-8: Unit #2 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=3.10"
Tc=5.0 min CN=98 Runoff=0.17 cfs 0.013 af

Subcatchment P-9: Unit #3 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=3.10"
Tc=5.0 min CN=98 Runoff=0.17 cfs 0.013 af

Reach 1R: Overland Flow Avg. Flow Depth=0.34' Max Vel=11.47 fps Inflow=2.73 cfs 0.217 af
12.0" Round Pipe n=0.013 L=331.0' S=0.0921 '/' Capacity=10.82 cfs Outflow=2.72 cfs 0.217 af

Reach 2R: Overland Flow Avg. Flow Depth=0.02' Max Vel=0.10 fps Inflow=0.68 cfs 0.055 af
n=0.400 L=451.0' S=0.1064 '/' Capacity=15.70 cfs Outflow=0.17 cfs 0.053 af

Reach DP1: Off-Site Wetland Inflow=2.22 cfs 0.382 af
Outflow=2.22 cfs 0.382 af

Reach DP2: Off-Site Wetland Inflow=2.06 cfs 0.349 af
Outflow=2.06 cfs 0.349 af

Pond Pd-1: Recharger #1 Peak Elev=212.62' Storage=3,581 cf Inflow=2.93 cfs 0.236 af
Discarded=0.09 cfs 0.153 af Primary=1.02 cfs 0.074 af Outflow=1.11 cfs 0.227 af

Pond Pd-2: Recharger #2 Peak Elev=198.22' Storage=1,226 cf Inflow=3.23 cfs 0.228 af
Discarded=0.03 cfs 0.049 af Primary=3.17 cfs 0.168 af Outflow=3.20 cfs 0.217 af

Pond Pd-3: Recharger #3 Peak Elev=204.39' Storage=675 cf Inflow=0.50 cfs 0.038 af
Discarded=0.02 cfs 0.030 af Primary=0.15 cfs 0.006 af Outflow=0.17 cfs 0.036 af

Pond Pd-4: Detention System #1 (Surface Peak Elev=201.01' Storage=2,076 cf Inflow=2.72 cfs 0.298 af
Outflow=1.90 cfs 0.298 af

Pond Pd-5: Detention System #2 (Chamber) Peak Elev=192.65' Storage=2,658 cf Inflow=3.17 cfs 0.168 af
Outflow=0.83 cfs 0.151 af

Total Runoff Area = 9.018 ac Runoff Volume = 1.003 af Average Runoff Depth = 1.34"
84.40% Pervious = 7.611 ac 15.60% Impervious = 1.407 ac

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 P-1: Off-Site Uncontrolled Runoff Area=82,859 sf 15.71% Impervious Runoff Depth=2.89"
Flow Length=577' Tc=8.7 min CN=78 Runoff=5.88 cfs 0.458 af

Subcatchment P-10: Unit #4 Roof Runoff Area=1,832 sf 100.00% Impervious Runoff Depth=4.97"
Tc=5.0 min CN=98 Runoff=0.22 cfs 0.017 af

Subcatchment P-11: Unit #5 Roof Runoff Area=1,832 sf 100.00% Impervious Runoff Depth=4.97"
Tc=5.0 min CN=98 Runoff=0.22 cfs 0.017 af

Subcatchment P-12: Unit #6 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=4.97"
Tc=5.0 min CN=98 Runoff=0.26 cfs 0.021 af

Subcatchment P-13: Unit #7 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=4.97"
Tc=5.0 min CN=98 Runoff=0.26 cfs 0.021 af

Subcatchment P-14: Unit #8 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=4.97"
Tc=5.0 min CN=98 Runoff=0.26 cfs 0.021 af

Subcatchment P-2: Entry Driveway Runoff Area=80,080 sf 18.18% Impervious Runoff Depth=2.89"
Flow Length=567' Tc=8.6 min CN=78 Runoff=5.70 cfs 0.443 af

Subcatchment P-3: Off-Site Uncontrolled Runoff Area=28,221 sf 0.00% Impervious Runoff Depth=2.36"
Flow Length=344' Tc=7.4 min CN=72 Runoff=1.69 cfs 0.127 af

Subcatchment P-4: Loop Driveway & Island Runoff Area=70,327 sf 22.27% Impervious Runoff Depth=2.98"
Tc=5.0 min CN=79 Runoff=5.86 cfs 0.401 af

Subcatchment P-5: On-Site Uncontrolled Runoff Area=43,391 sf 0.00% Impervious Runoff Depth=2.36"
Flow Length=274' Tc=5.2 min CN=72 Runoff=2.82 cfs 0.196 af

Subcatchment P-6: On-Site Uncontrolled Runoff Area=71,135 sf 1.74% Impervious Runoff Depth=2.45"
Flow Length=471' Tc=9.9 min CN=73 Runoff=4.08 cfs 0.333 af

Subcatchment P-7: Unit #1 Roof Runoff Area=2,339 sf 100.00% Impervious Runoff Depth=4.97"
Tc=5.0 min CN=98 Runoff=0.28 cfs 0.022 af

Subcatchment P-8: Unit #2 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=4.97"
Tc=5.0 min CN=98 Runoff=0.26 cfs 0.021 af

Subcatchment P-9: Unit #3 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=4.97"
Tc=5.0 min CN=98 Runoff=0.26 cfs 0.021 af

Reach 1R: Overland Flow Avg. Flow Depth=0.52' Max Vel=14.05 fps Inflow=5.88 cfs 0.458 af
12.0" Round Pipe n=0.013 L=331.0' S=0.0921 '/' Capacity=10.82 cfs Outflow=5.86 cfs 0.458 af

Reach 2R: Overland Flow Avg. Flow Depth=0.05' Max Vel=0.17 fps Inflow=1.69 cfs 0.127 af
n=0.400 L=451.0' S=0.1064 '/' Capacity=15.70 cfs Outflow=0.63 cfs 0.126 af

Reach DP1: Off-Site Wetland Inflow=6.95 cfs 0.974 af
Outflow=6.95 cfs 0.974 af

Reach DP2: Off-Site Wetland Inflow=6.76 cfs 0.835 af
Outflow=6.76 cfs 0.835 af

Pond Pd-1: Recharger #1 Peak Elev=213.02' Storage=4,278 cf Inflow=6.15 cfs 0.486 af
Discarded=0.09 cfs 0.165 af Primary=5.70 cfs 0.295 af Outflow=5.79 cfs 0.461 af

Pond Pd-2: Recharger #2 Peak Elev=198.45' Storage=1,330 cf Inflow=6.56 cfs 0.457 af
Discarded=0.03 cfs 0.053 af Primary=6.50 cfs 0.393 af Outflow=6.53 cfs 0.447 af

Pond Pd-3: Recharger #3 Peak Elev=204.50' Storage=704 cf Inflow=0.79 cfs 0.062 af
Discarded=0.02 cfs 0.032 af Primary=0.76 cfs 0.025 af Outflow=0.78 cfs 0.057 af

Pond Pd-4: Detention System #1 (Surface Peak Elev=202.14' Storage=7,209 cf Inflow=12.09 cfs 0.778 af
Outflow=5.85 cfs 0.778 af

Pond Pd-5: Detention System #2 (Chamber) Peak Elev=193.50' Storage=5,121 cf Inflow=6.50 cfs 0.393 af
Outflow=2.96 cfs 0.376 af

Total Runoff Area = 9.018 ac Runoff Volume = 2.119 af Average Runoff Depth = 2.82"
84.40% Pervious = 7.611 ac 15.60% Impervious = 1.407 ac

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 P-1: Off-Site Uncontrolled Runoff Area=82,859 sf 15.71% Impervious Runoff Depth=3.93"
Flow Length=577' Tc=8.7 min CN=78 Runoff=7.96 cfs 0.622 af

Subcatchment P-10: Unit #4 Roof Runoff Area=1,832 sf 100.00% Impervious Runoff Depth=6.15"
Tc=5.0 min CN=98 Runoff=0.27 cfs 0.022 af

Subcatchment P-11: Unit #5 Roof Runoff Area=1,832 sf 100.00% Impervious Runoff Depth=6.15"
Tc=5.0 min CN=98 Runoff=0.27 cfs 0.022 af

Subcatchment P-12: Unit #6 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=6.15"
Tc=5.0 min CN=98 Runoff=0.32 cfs 0.025 af

Subcatchment P-13: Unit #7 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=6.15"
Tc=5.0 min CN=98 Runoff=0.32 cfs 0.025 af

Subcatchment P-14: Unit #8 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=6.15"
Tc=5.0 min CN=98 Runoff=0.32 cfs 0.025 af

Subcatchment P-2: Entry Driveway Runoff Area=80,080 sf 18.18% Impervious Runoff Depth=3.93"
Flow Length=567' Tc=8.6 min CN=78 Runoff=7.72 cfs 0.601 af

Subcatchment P-3: Off-Site Uncontrolled Runoff Area=28,221 sf 0.00% Impervious Runoff Depth=3.32"
Flow Length=344' Tc=7.4 min CN=72 Runoff=2.40 cfs 0.179 af

Subcatchment P-4: Loop Driveway & Island Runoff Area=70,327 sf 22.27% Impervious Runoff Depth=4.03"
Tc=5.0 min CN=79 Runoff=7.88 cfs 0.542 af

Subcatchment P-5: On-Site Uncontrolled Runoff Area=43,391 sf 0.00% Impervious Runoff Depth=3.32"
Flow Length=274' Tc=5.2 min CN=72 Runoff=3.98 cfs 0.275 af

Subcatchment P-6: On-Site Uncontrolled Runoff Area=71,135 sf 1.74% Impervious Runoff Depth=3.41"
Flow Length=471' Tc=9.9 min CN=73 Runoff=5.73 cfs 0.465 af

Subcatchment P-7: Unit #1 Roof Runoff Area=2,339 sf 100.00% Impervious Runoff Depth=6.15"
Tc=5.0 min CN=98 Runoff=0.35 cfs 0.028 af

Subcatchment P-8: Unit #2 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=6.15"
Tc=5.0 min CN=98 Runoff=0.32 cfs 0.025 af

Subcatchment P-9: Unit #3 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=6.15"
Tc=5.0 min CN=98 Runoff=0.32 cfs 0.025 af

Reach 1R: Overland Flow Avg. Flow Depth=0.64' Max Vel=15.05 fps Inflow=7.96 cfs 0.622 af
12.0" Round Pipe n=0.013 L=331.0' S=0.0921 '/' Capacity=10.82 cfs Outflow=7.94 cfs 0.622 af

Reach 2R: Overland Flow Avg. Flow Depth=0.07' Max Vel=0.20 fps Inflow=2.40 cfs 0.179 af
n=0.400 L=451.0' S=0.1064 '/' Capacity=15.70 cfs Outflow=1.02 cfs 0.177 af

Reach DP1: Off-Site Wetland Inflow=9.89 cfs 1.390 af
Outflow=9.89 cfs 1.390 af

Reach DP2: Off-Site Wetland Inflow=10.08 cfs 1.170 af
Outflow=10.08 cfs 1.170 af

Pond Pd-1: Recharger #1 Peak Elev=213.15' Storage=4,478 cf Inflow=8.28 cfs 0.654 af
Discarded=0.09 cfs 0.172 af Primary=7.95 cfs 0.456 af Outflow=8.05 cfs 0.628 af

Pond Pd-2: Recharger #2 Peak Elev=198.56' Storage=1,383 cf Inflow=8.74 cfs 0.611 af
Discarded=0.03 cfs 0.055 af Primary=8.68 cfs 0.545 af Outflow=8.71 cfs 0.600 af

Pond Pd-3: Recharger #3 Peak Elev=204.52' Storage=710 cf Inflow=0.97 cfs 0.076 af
Discarded=0.02 cfs 0.034 af Primary=0.94 cfs 0.037 af Outflow=0.96 cfs 0.071 af

Pond Pd-4: Detention System #1 (Surface Peak Elev=202.70' Storage=10,723 cf Inflow=16.64 cfs 1.115 af
Outflow=8.30 cfs 1.115 af

Pond Pd-5: Detention System #2 (Chamber) Peak Elev=194.00' Storage=6,463 cf Inflow=8.68 cfs 0.545 af
Outflow=4.53 cfs 0.528 af

Total Runoff Area = 9.018 ac Runoff Volume = 2.882 af Average Runoff Depth = 3.84"
84.40% Pervious = 7.611 ac 15.60% Impervious = 1.407 ac

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 P-1: Off-Site Uncontrolled Runoff Area=82,859 sf 15.71% Impervious Runoff Depth=5.58"
Flow Length=577' Tc=8.7 min CN=78 Runoff=11.21 cfs 0.884 af

Subcatchment P-10: Unit #4 Roof Runoff Area=1,832 sf 100.00% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=98 Runoff=0.35 cfs 0.028 af

Subcatchment P-11: Unit #5 Roof Runoff Area=1,832 sf 100.00% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=98 Runoff=0.35 cfs 0.028 af

Subcatchment P-12: Unit #6 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.033 af

Subcatchment P-13: Unit #7 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.033 af

Subcatchment P-14: Unit #8 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.033 af

Subcatchment P-2: Entry Driveway Runoff Area=80,080 sf 18.18% Impervious Runoff Depth=5.58"
Flow Length=567' Tc=8.6 min CN=78 Runoff=10.87 cfs 0.854 af

Subcatchment P-3: Off-Site Uncontrolled Runoff Area=28,221 sf 0.00% Impervious Runoff Depth=4.87"
Flow Length=344' Tc=7.4 min CN=72 Runoff=3.52 cfs 0.263 af

Subcatchment P-4: Loop Driveway & Island Runoff Area=70,327 sf 22.27% Impervious Runoff Depth=5.69"
Tc=5.0 min CN=79 Runoff=11.02 cfs 0.766 af

Subcatchment P-5: On-Site Uncontrolled Runoff Area=43,391 sf 0.00% Impervious Runoff Depth=4.87"
Flow Length=274' Tc=5.2 min CN=72 Runoff=5.85 cfs 0.404 af

Subcatchment P-6: On-Site Uncontrolled Runoff Area=71,135 sf 1.74% Impervious Runoff Depth=4.99"
Flow Length=471' Tc=9.9 min CN=73 Runoff=8.36 cfs 0.679 af

Subcatchment P-7: Unit #1 Roof Runoff Area=2,339 sf 100.00% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=98 Runoff=0.45 cfs 0.036 af

Subcatchment P-8: Unit #2 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.033 af

Subcatchment P-9: Unit #3 Roof Runoff Area=2,161 sf 100.00% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.033 af

Reach 1R: Overland Flow Avg. Flow Depth=0.85' Max Vel=15.70 fps Inflow=11.21 cfs 0.884 af
12.0" Round Pipe n=0.013 L=331.0' S=0.0921 '/' Capacity=10.82 cfs Outflow=11.17 cfs 0.884 af

Reach 2R: Overland Flow Avg. Flow Depth=0.09' Max Vel=0.25 fps Inflow=3.52 cfs 0.263 af
n=0.400 L=451.0' S=0.1064 '/' Capacity=15.70 cfs Outflow=1.69 cfs 0.261 af

Reach DP1: Off-Site Wetland Inflow=13.48 cfs 2.061 af
Outflow=13.48 cfs 2.061 af

Reach DP2: Off-Site Wetland Inflow=15.38 cfs 1.709 af
Outflow=15.38 cfs 1.709 af

Pond Pd-1: Recharger #1 Peak Elev=213.31' Storage=4,744 cf Inflow=11.60 cfs 0.923 af
Discarded=0.09 cfs 0.180 af Primary=11.21 cfs 0.716 af Outflow=11.30 cfs 0.895 af

Pond Pd-2: Recharger #2 Peak Elev=198.74' Storage=1,463 cf Inflow=12.13 cfs 0.855 af
Discarded=0.03 cfs 0.057 af Primary=12.06 cfs 0.787 af Outflow=12.08 cfs 0.844 af

Pond Pd-3: Recharger #3 Peak Elev=204.56' Storage=719 cf Inflow=1.24 cfs 0.099 af
Discarded=0.02 cfs 0.035 af Primary=1.22 cfs 0.057 af Outflow=1.23 cfs 0.092 af

Pond Pd-4: Detention System #1 (Surface Peak Elev=203.58' Storage=17,105 cf Inflow=23.35 cfs 1.657 af
Outflow=10.15 cfs 1.656 af

Pond Pd-5: Detention System #2 (Chamber) Peak Elev=194.68' Storage=8,200 cf Inflow=12.06 cfs 0.787 af
Outflow=7.05 cfs 0.769 af

Total Runoff Area = 9.018 ac Runoff Volume = 4.106 af Average Runoff Depth = 5.46"
84.40% Pervious = 7.611 ac 15.60% Impervious = 1.407 ac

Summary for Subcatchment P-1: Off-Site Uncontrolled

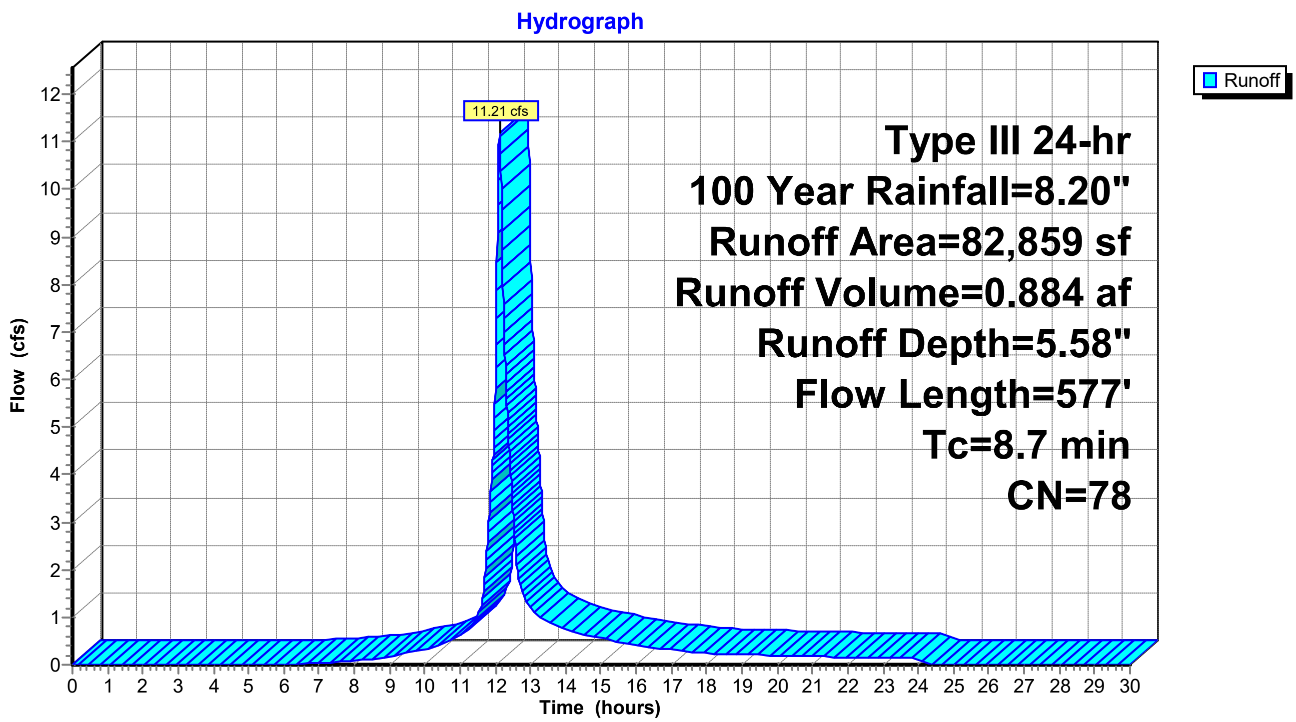
Runoff = 11.21 cfs @ 12.12 hrs, Volume= 0.884 af, Depth= 5.58"

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=8.20"

Area (sf)	CN	Description
8,871	98	Paved parking, HSG C
69,843	74	>75% Grass cover, Good, HSG C
4,145	98	Roofs, HSG C
82,859	78	Weighted Average
69,843		84.29% Pervious Area
13,016		15.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	50	0.0900	0.28		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.33"
2.9	240	0.0396	1.39		**Shallow Concentrated Flow, Segment 2** Short Grass Pasture Kv= 7.0 fps
2.8	287	0.0592	1.70		**Shallow Concentrated Flow, Segment 3** Short Grass Pasture Kv= 7.0 fps
8.7	577	Total			

Subcatchment P-1: Off-Site Uncontrolled



Summary for Subcatchment P-10: Unit #4 Roof

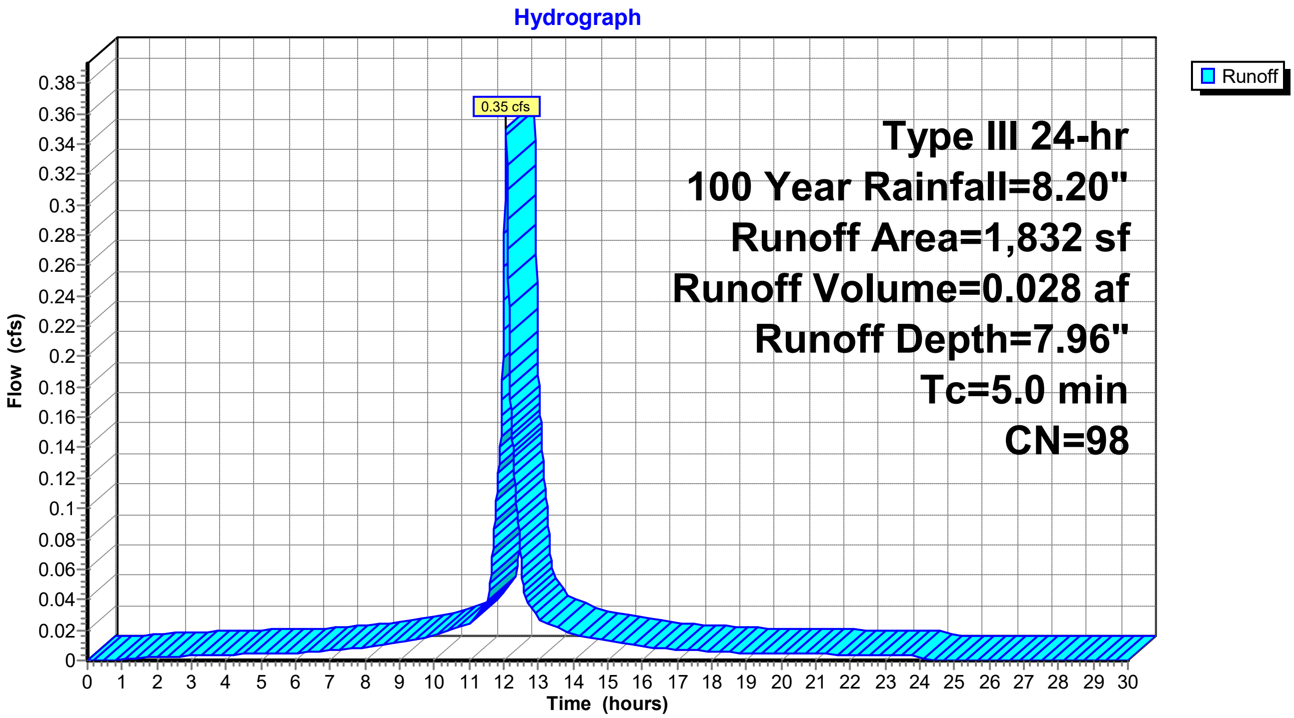
Runoff = 0.35 cfs @ 12.07 hrs, Volume= 0.028 af, Depth= 7.96"

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=8.20"

Area (sf)	CN	Description
1,832	98	Roofs, HSG C
1,832		100.00% Impervious Area

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

Subcatchment P-10: Unit #4 Roof



Summary for Subcatchment P-11: Unit #5 Roof

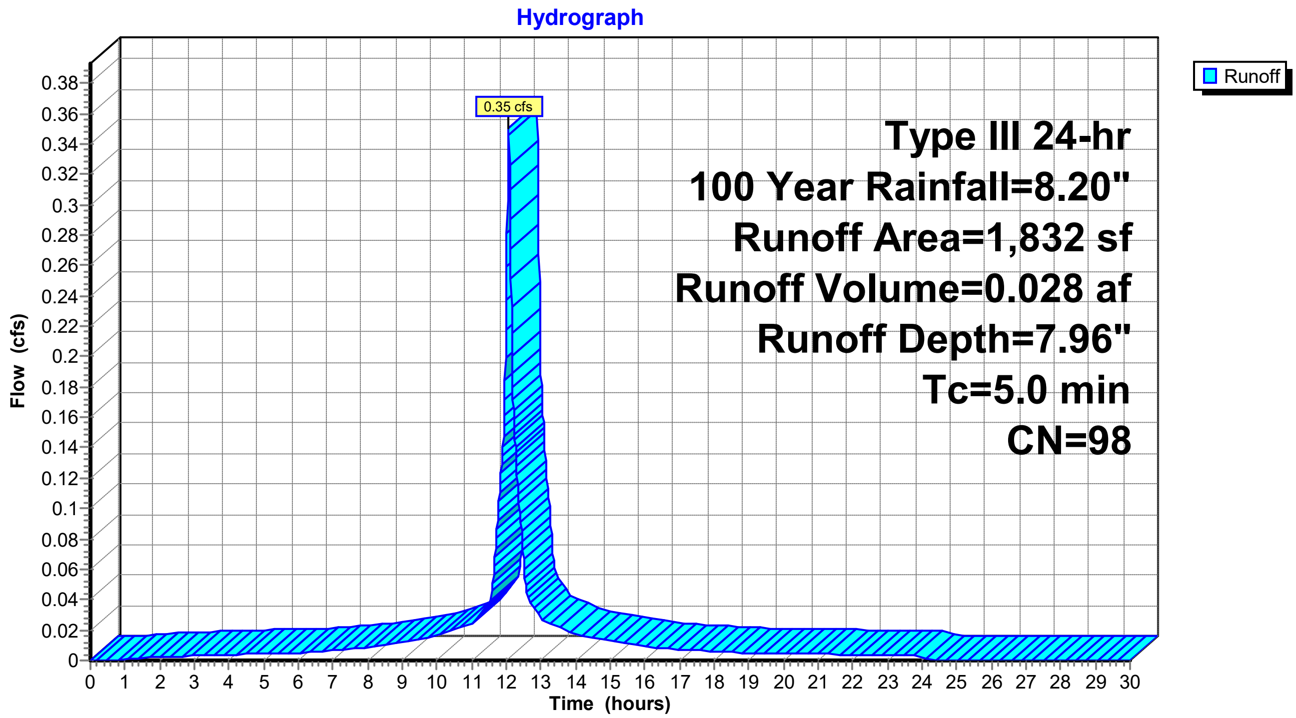
Runoff = 0.35 cfs @ 12.07 hrs, Volume= 0.028 af, Depth= 7.96"

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=8.20"

Area (sf)	CN	Description
1,832	98	Roofs, HSG C
1,832		100.00% Impervious Area

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

Subcatchment P-11: Unit #5 Roof



Summary for Subcatchment P-12: Unit #6 Roof

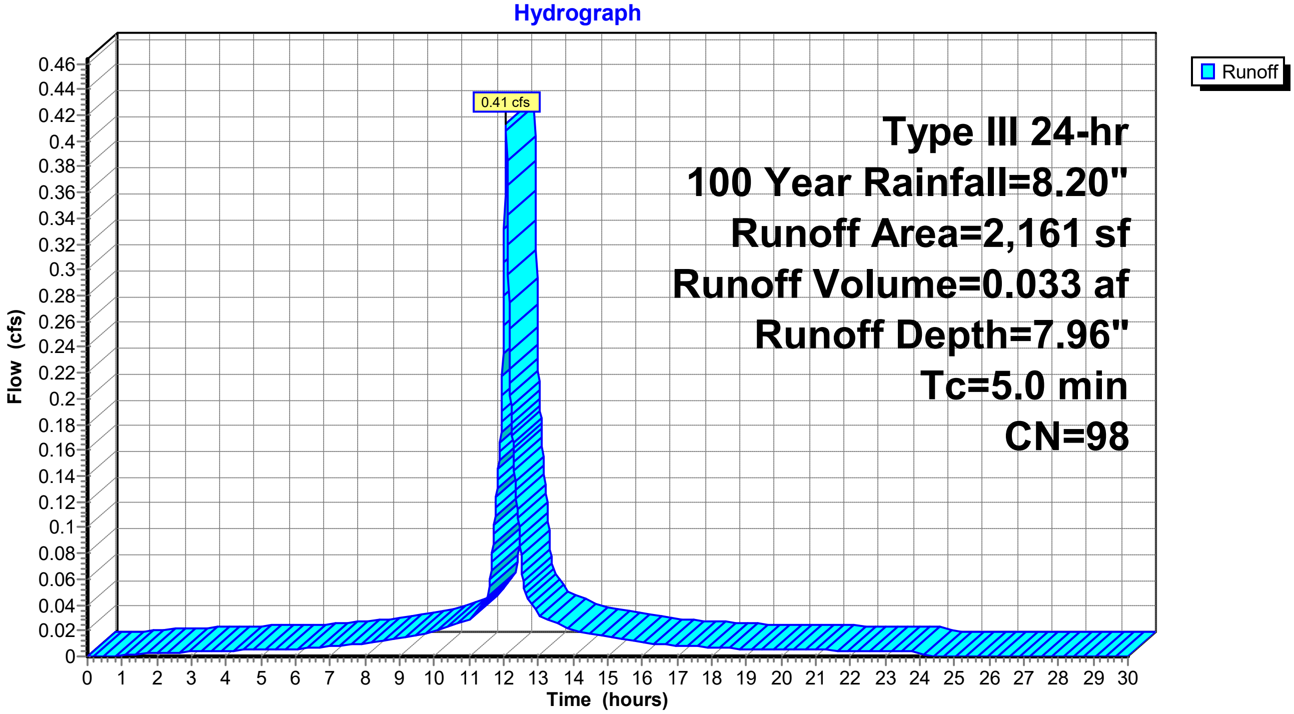
Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.033 af, Depth= 7.96"

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=8.20"

Area (sf)	CN	Description
2,161	98	Roofs, HSG C
2,161		100.00% Impervious Area

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

Subcatchment P-12: Unit #6 Roof



Summary for Subcatchment P-13: Unit #7 Roof

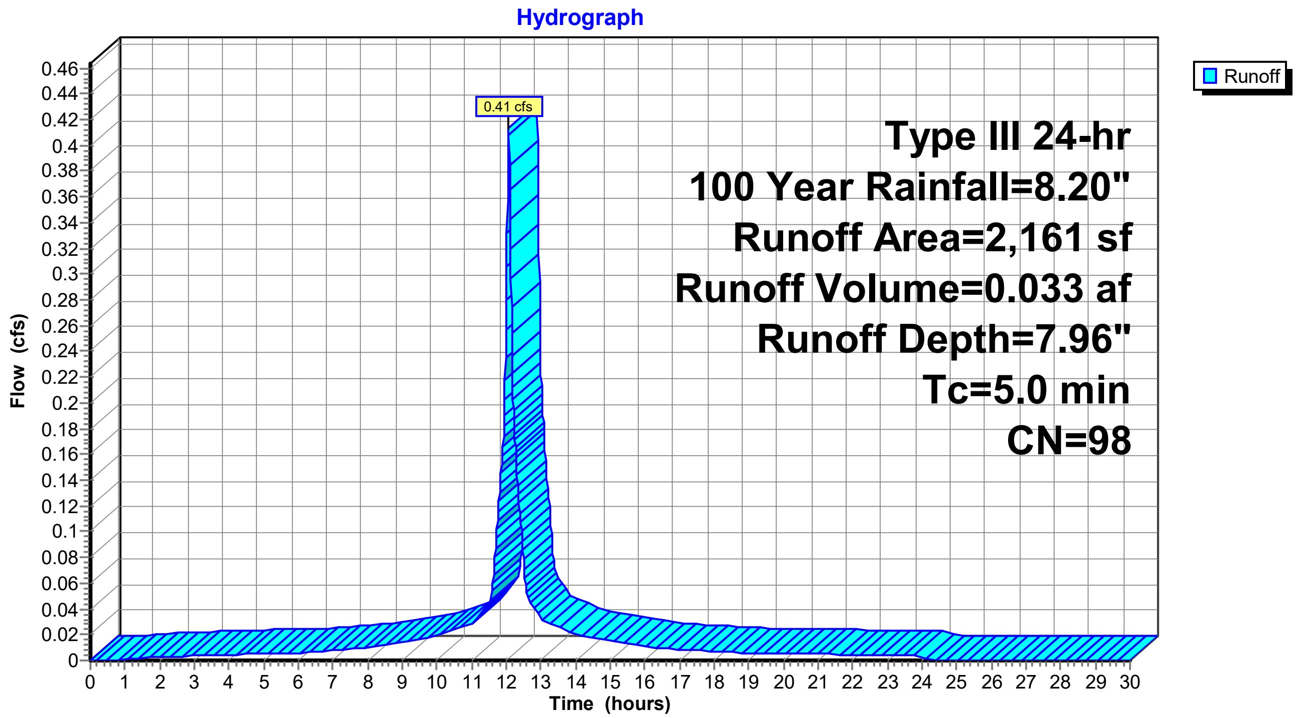
Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.033 af, Depth= 7.96"

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=8.20"

Area (sf)	CN	Description
2,161	98	Roofs, HSG C
2,161		100.00% Impervious Area

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

Subcatchment P-13: Unit #7 Roof



Summary for Subcatchment P-14: Unit #8 Roof

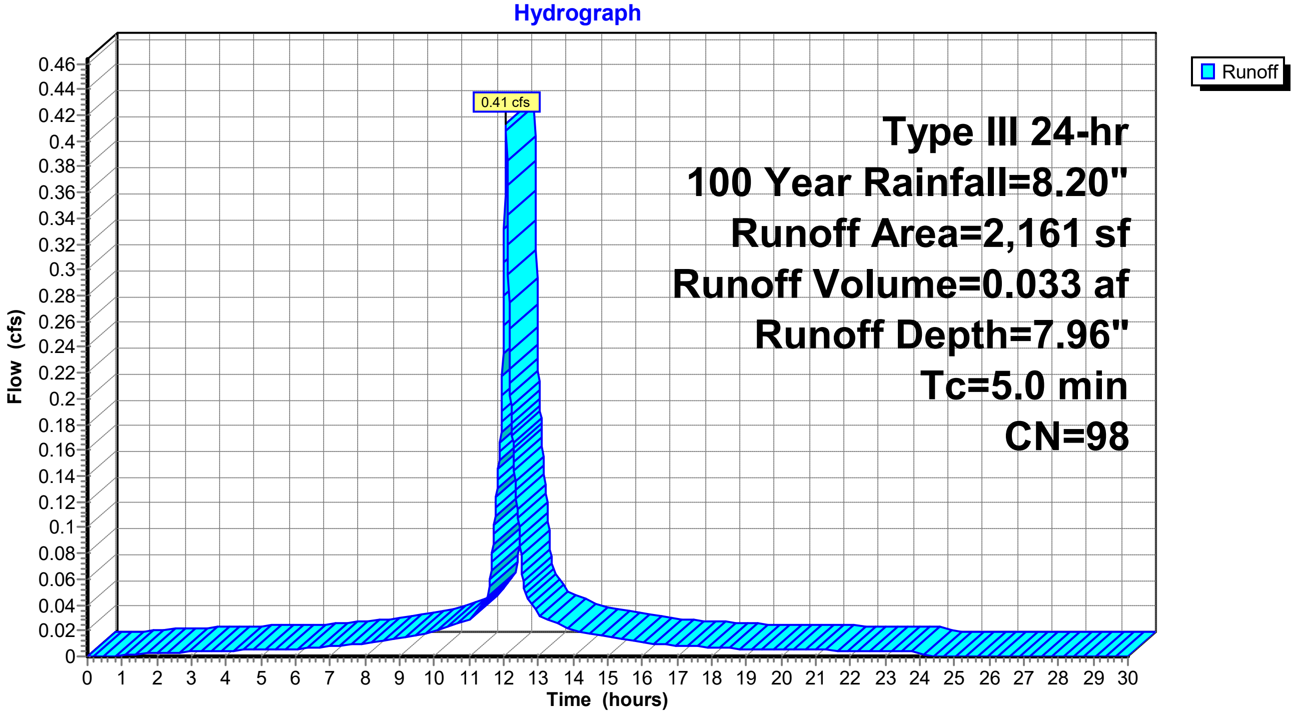
Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.033 af, Depth= 7.96"

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=8.20"

Area (sf)	CN	Description
2,161	98	Roofs, HSG C
2,161		100.00% Impervious Area

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

Subcatchment P-14: Unit #8 Roof



Summary for Subcatchment P-2: Entry Driveway

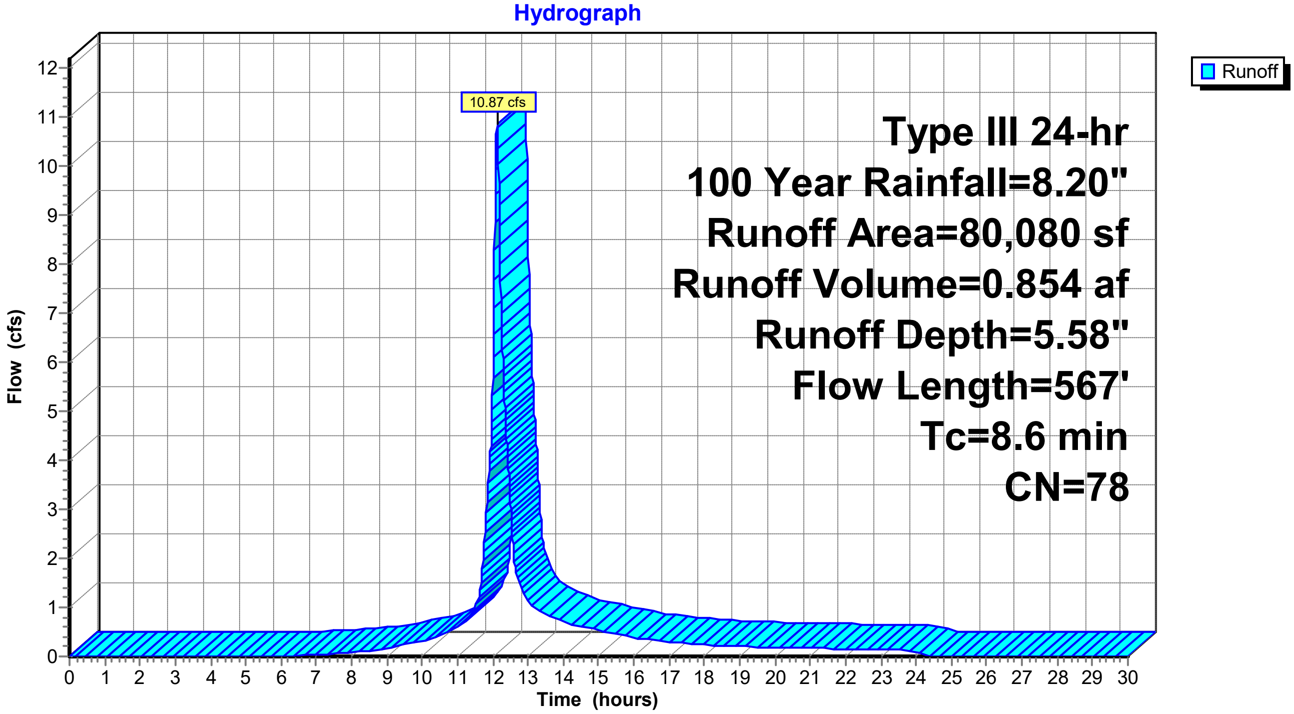
Runoff = 10.87 cfs @ 12.12 hrs, Volume= 0.854 af, Depth= 5.58"

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=8.20"

Area (sf)	CN	Description
13,164	98	Paved parking, HSG C
52,365	74	>75% Grass cover, Good, HSG C
13,159	70	Woods, Good, HSG C
1,392	98	Roofs, HSG C
80,080	78	Weighted Average
65,524		81.82% Pervious Area
14,556		18.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.33"
2.5	229	0.0459	1.50		**Shallow Concentrated Flow, Segment 2** Short Grass Pasture Kv= 7.0 fps
1.3	103	0.0728	1.35		**Shallow Concentrated Flow, Segment 3** Woodland Kv= 5.0 fps
0.1	21	0.1429	2.65		**Shallow Concentrated Flow, Segment 4** Short Grass Pasture Kv= 7.0 fps
0.5	164	0.0640	5.14		**Shallow Concentrated Flow, Segment 5** Paved Kv= 20.3 fps
8.6	567	Total			

Subcatchment P-2: Entry Driveway



Summary for Subcatchment P-3: Off-Site Uncontrolled

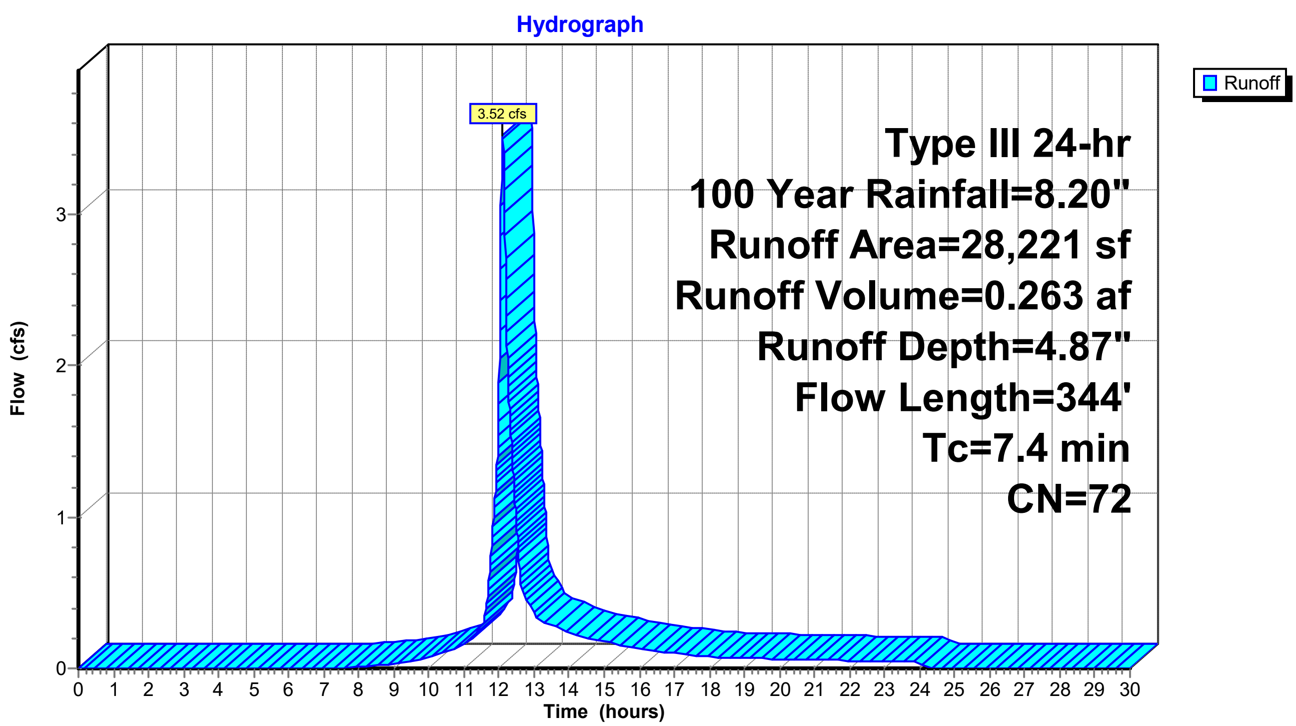
Runoff = 3.52 cfs @ 12.11 hrs, Volume= 0.263 af, Depth= 4.87"

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=8.20"

Area (sf)	CN	Description
12,332	74	>75% Grass cover, Good, HSG C
15,889	70	Woods, Good, HSG C
28,221	72	Weighted Average
28,221		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.33"
1.1	123	0.0650	1.78		**Shallow Concentrated Flow, Segment 2** Short Grass Pasture Kv= 7.0 fps
2.1	171	0.0760	1.38		**Shallow Concentrated Flow, Segment 3** Woodland Kv= 5.0 fps
7.4	344	Total			

Subcatchment P-3: Off-Site Uncontrolled



Summary for Subcatchment P-4: Loop Driveway & Island

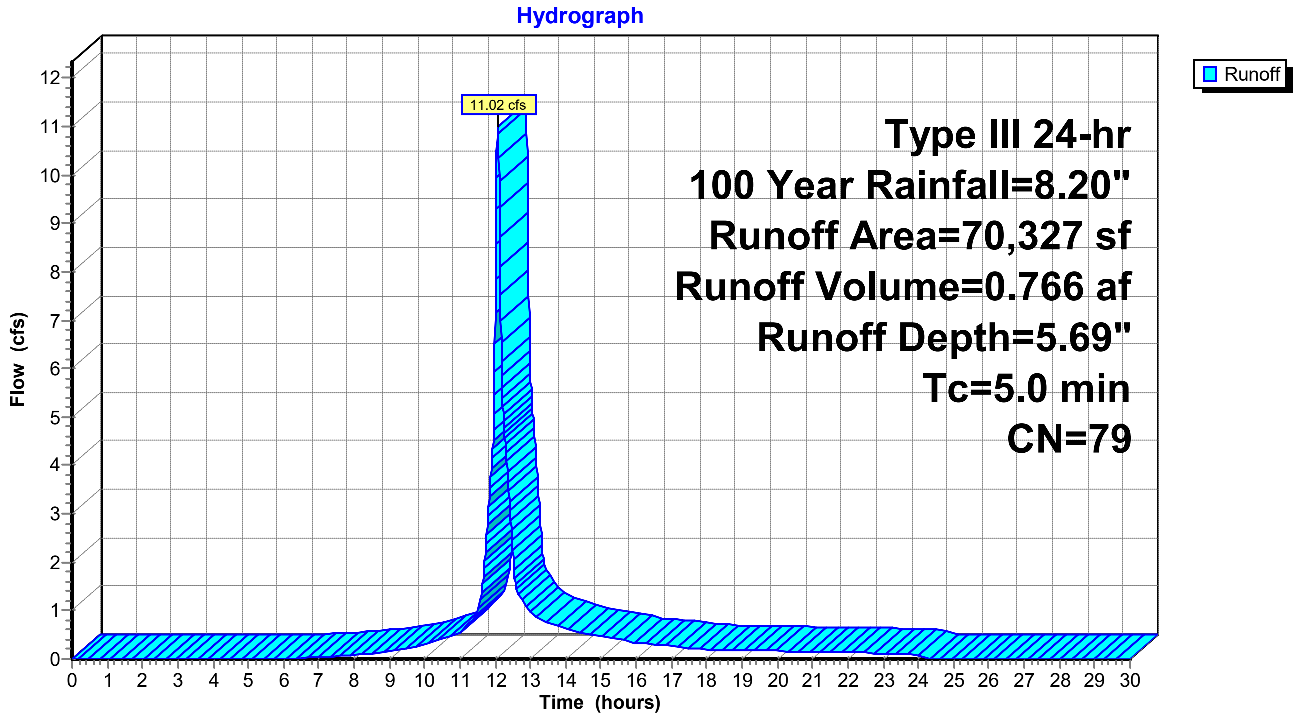
Runoff = 11.02 cfs @ 12.07 hrs, Volume= 0.766 af, Depth= 5.69"

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 100 Year Rainfall=8.20"

	Area (sf)	CN	Description
	15,659	98	Paved parking, HSG C
	40,336	74	>75% Grass cover, Good, HSG C
*	14,332	70	Woods, Good, HSG C - OFF SITE
	70,327	79	Weighted Average
	54,668		77.73% Pervious Area
	15,659		22.27% Impervious Area

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

Subcatchment P-4: Loop Driveway & Island



Summary for Subcatchment P-5: On-Site Uncontrolled

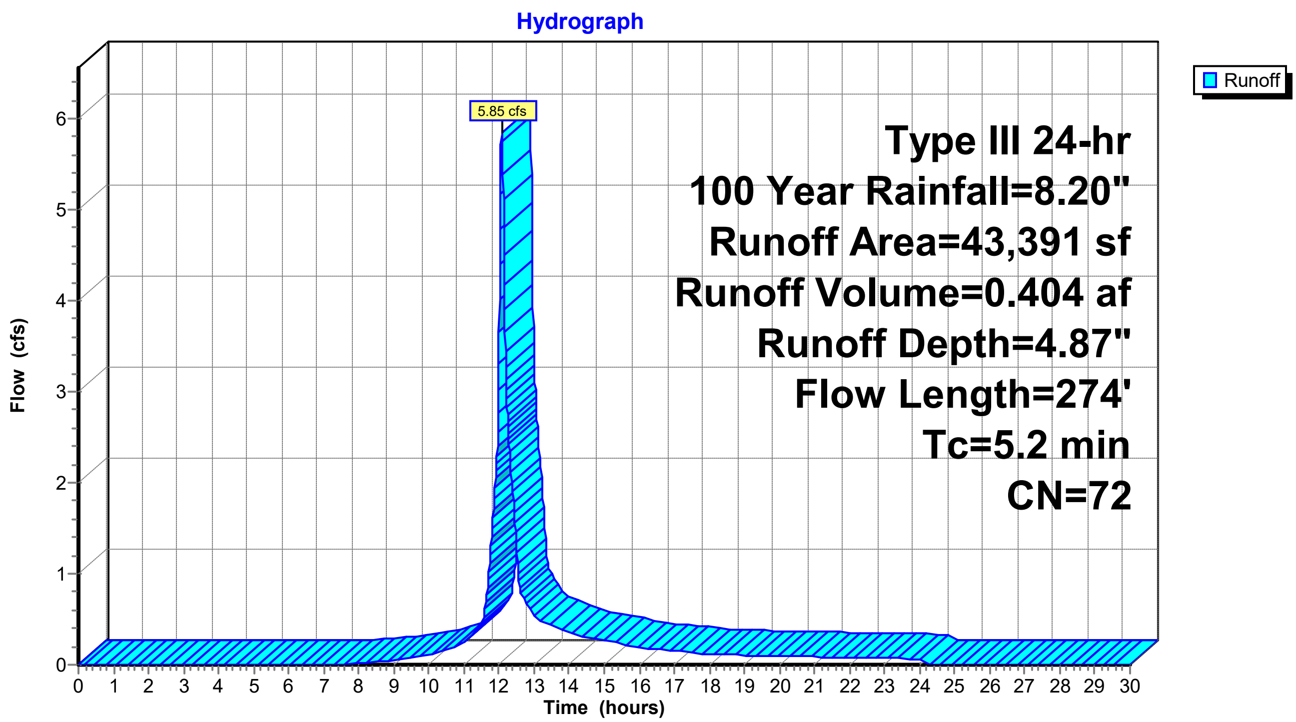
Runoff = 5.85 cfs @ 12.08 hrs, Volume= 0.404 af, Depth= 4.87"

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=8.20"

Area (sf)	CN	Description
26,253	74	>75% Grass cover, Good, HSG C
17,138	70	Woods, Good, HSG C
43,391	72	Weighted Average
43,391		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.33"
0.2	25	0.0800	1.98		**Shallow Concentrated Flow, Segment 2** Short Grass Pasture Kv= 7.0 fps
0.4	72	0.1677	2.87		**Shallow Concentrated Flow, Segment 3** Short Grass Pasture Kv= 7.0 fps
1.0	127	0.1654	2.03		**Shallow Concentrated Flow, Segment 4** Woodland Kv= 5.0 fps
5.2	274	Total			

Subcatchment P-5: On-Site Uncontrolled



Summary for Subcatchment P-6: On-Site Uncontrolled

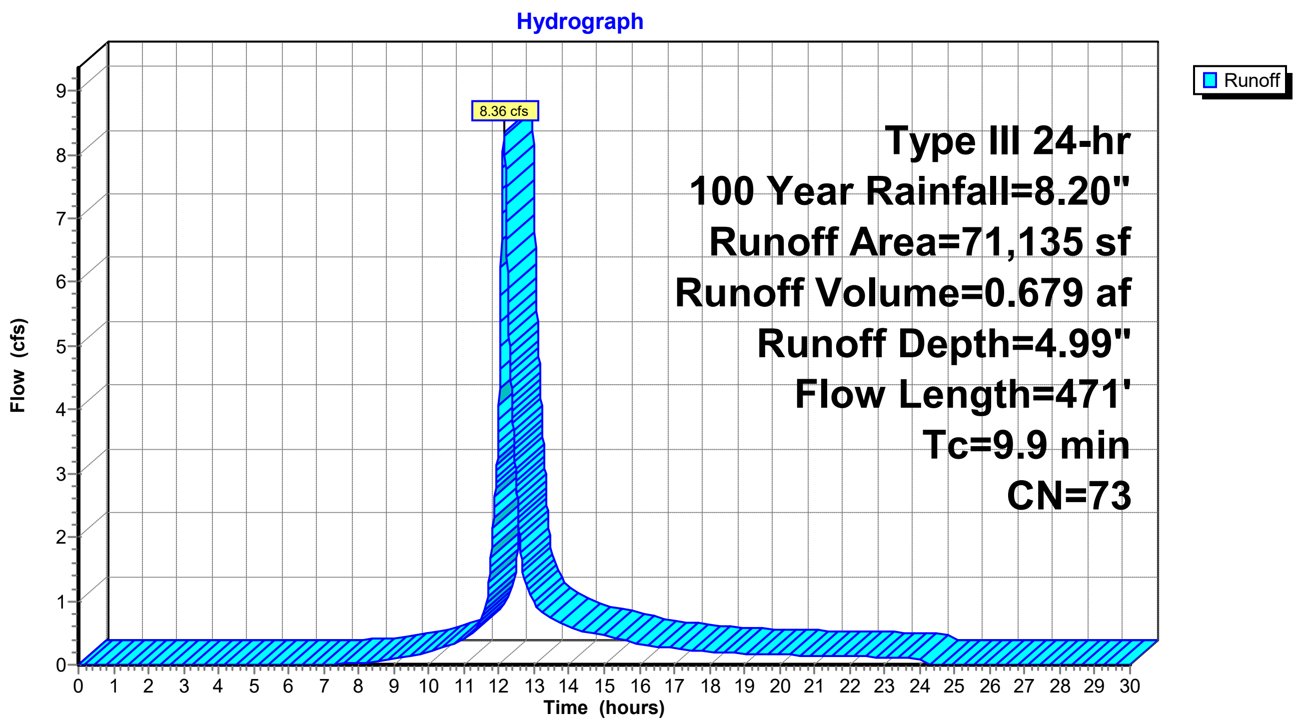
Runoff = 8.36 cfs @ 12.14 hrs, Volume= 0.679 af, Depth= 4.99"

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=8.20"

Area (sf)	CN	Description
1,236	98	Paved parking, HSG C
50,641	74	>75% Grass cover, Good, HSG C
19,258	70	Woods, Good, HSG C
71,135	73	Weighted Average
69,899		98.26% Pervious Area
1,236		1.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.0900	0.13		**Sheet Flow, Segment 1** Woods: Light underbrush n= 0.400 P2= 3.33"
2.7	361	0.1025	2.24		**Shallow Concentrated Flow, Segment 2** Short Grass Pasture Kv= 7.0 fps
0.6	60	0.1000	1.58		**Shallow Concentrated Flow, Segment 3** Woodland Kv= 5.0 fps
9.9	471	Total			

Subcatchment P-6: On-Site Uncontrolled



Summary for Subcatchment P-7: Unit #1 Roof

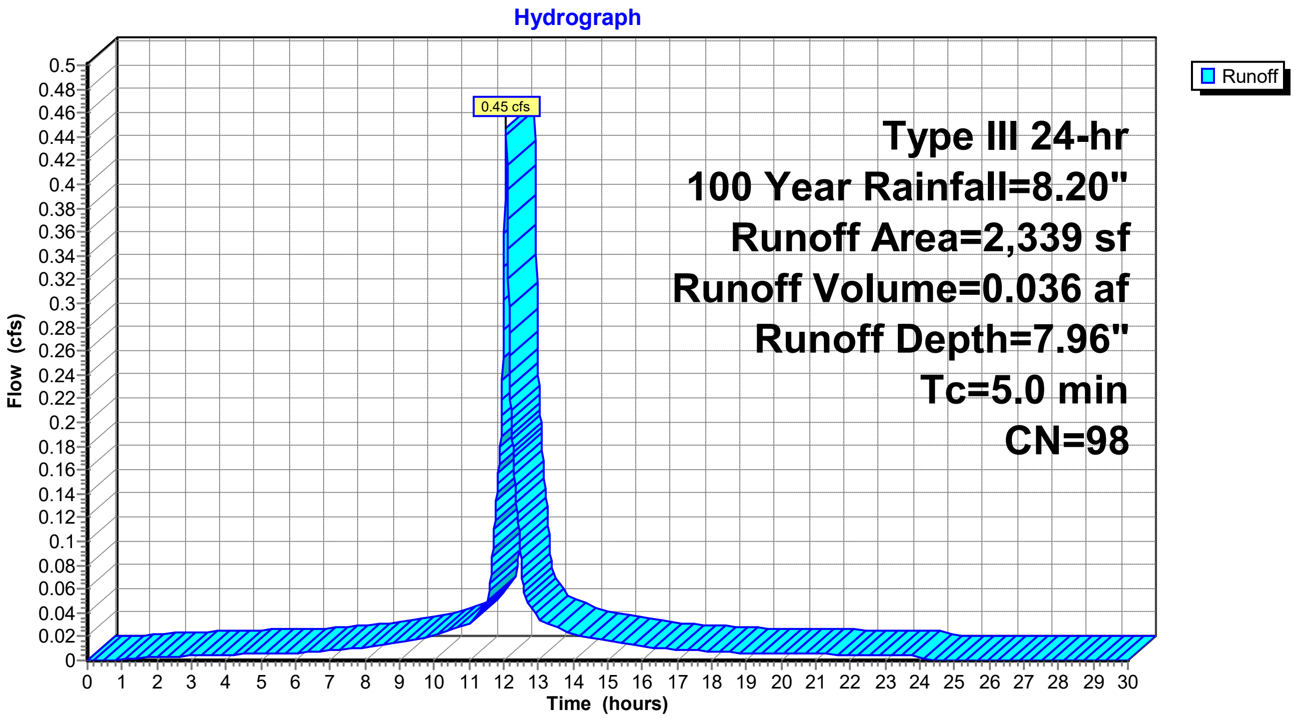
Runoff = 0.45 cfs @ 12.07 hrs, Volume= 0.036 af, Depth= 7.96"

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=8.20"

Area (sf)	CN	Description
2,339	98	Roofs, HSG C
2,339		100.00% Impervious Area

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

Subcatchment P-7: Unit #1 Roof



Summary for Subcatchment P-8: Unit #2 Roof

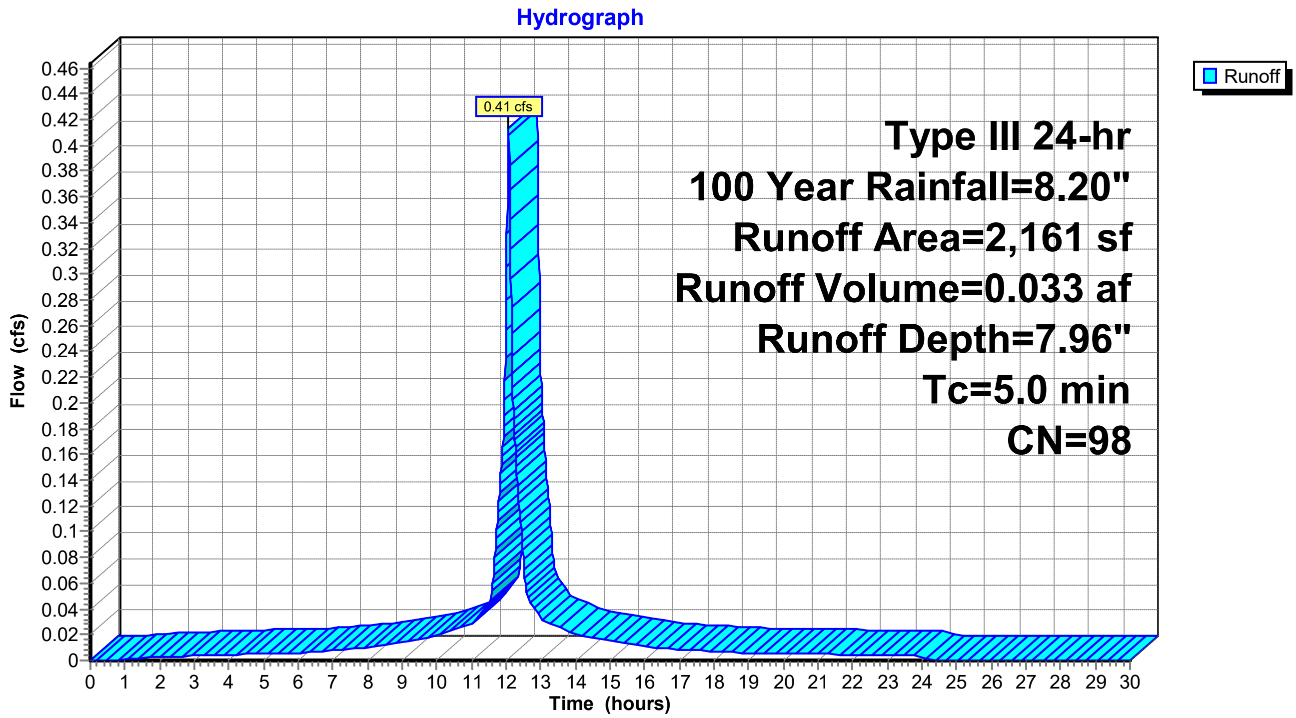
Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.033 af, Depth= 7.96"

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=8.20"

Area (sf)	CN	Description
2,161	98	Roofs, HSG C
2,161		100.00% Impervious Area

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

Subcatchment P-8: Unit #2 Roof



Summary for Subcatchment P-9: Unit #3 Roof

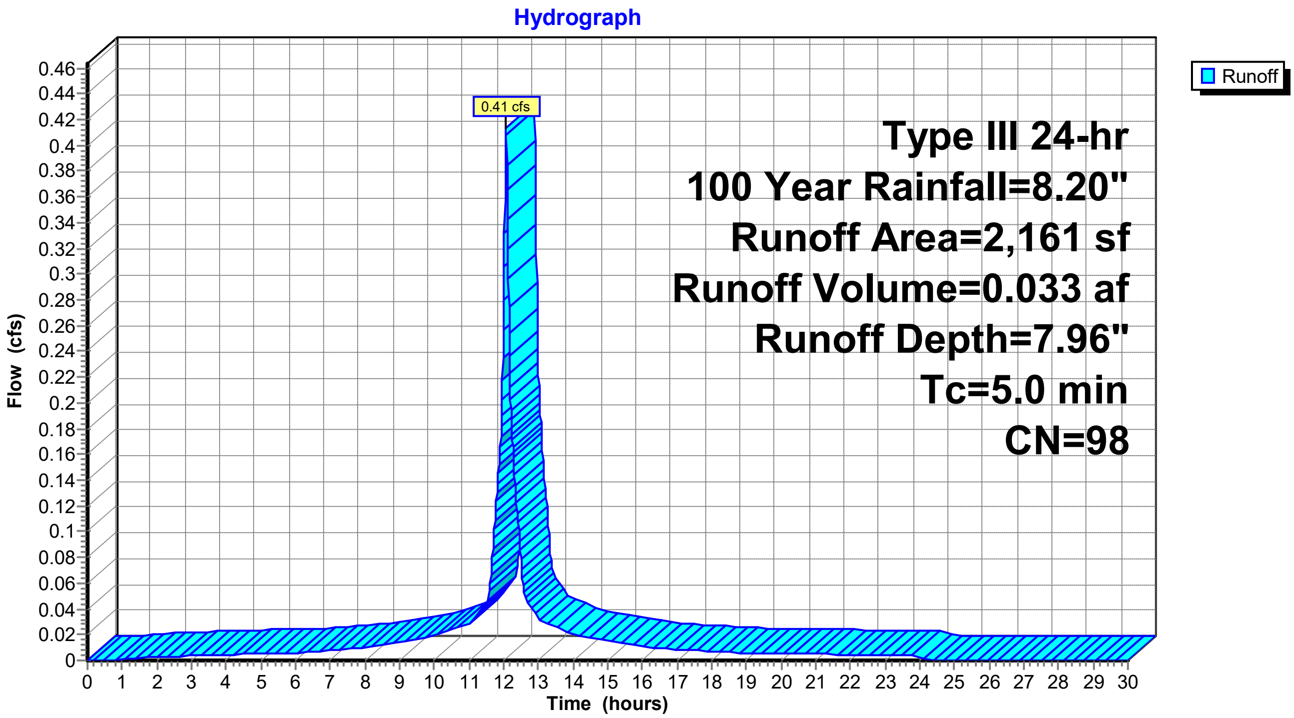
Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.033 af, Depth= 7.96"

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=8.20"

Area (sf)	CN	Description
2,161	98	Roofs, HSG C
2,161		100.00% Impervious Area

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

Subcatchment P-9: Unit #3 Roof



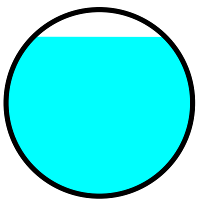
Summary for Reach 1R: Overland Flow

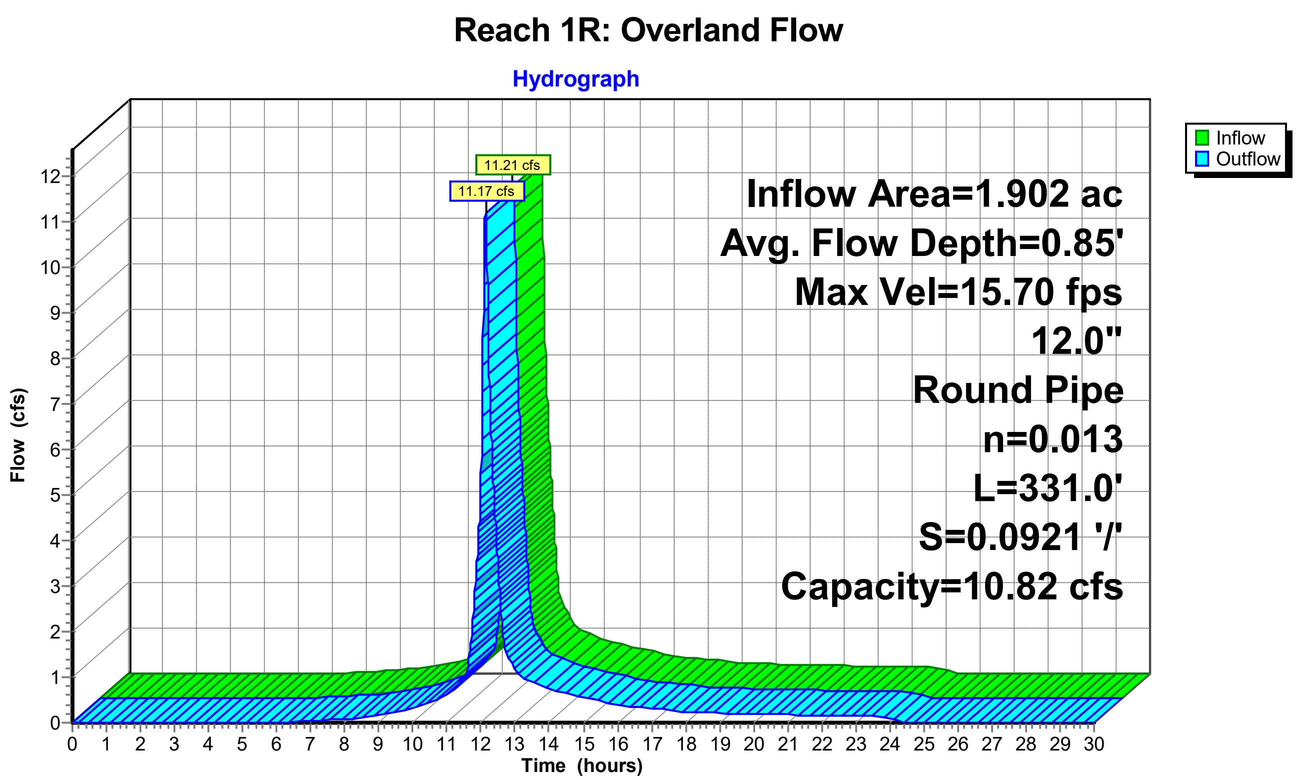
Inflow Area = 1.902 ac, 15.71% Impervious, Inflow Depth = 5.58" for 100 Year event
Inflow = 11.21 cfs @ 12.12 hrs, Volume= 0.884 af
Outflow = 11.17 cfs @ 12.13 hrs, Volume= 0.884 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 15.70 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 5.99 fps, Avg. Travel Time= 0.9 min

Peak Storage= 236 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 10.82 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 331.0' Slope= 0.0921 '/'
Inlet Invert= 221.50', Outlet Invert= 191.00'





Summary for Reach 2R: Overland Flow

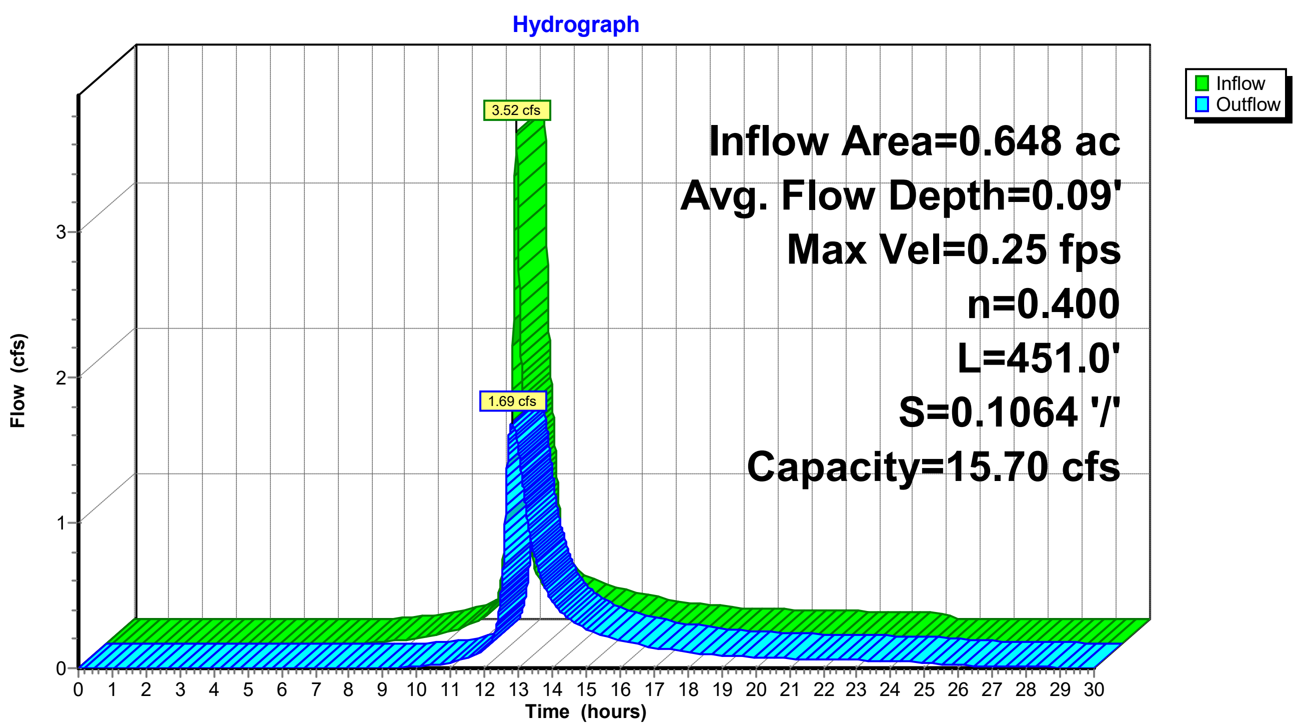
Inflow Area = 0.648 ac, 0.00% Impervious, Inflow Depth = 4.87" for 100 Year event
Inflow = 3.52 cfs @ 12.11 hrs, Volume= 0.263 af
Outflow = 1.69 cfs @ 12.81 hrs, Volume= 0.261 af, Atten= 52%, Lag= 42.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 0.25 fps, Min. Travel Time= 30.6 min
Avg. Velocity = 0.07 fps, Avg. Travel Time= 105.6 min

Peak Storage= 3,097 cf @ 12.30 hrs
Average Depth at Peak Storage= 0.09'
Bank-Full Depth= 0.35' Flow Area= 26.3 sf, Capacity= 15.70 cfs

75.00' x 0.35' deep channel, n= 0.400 Sheet flow: Woods+light brush
Length= 451.0' Slope= 0.1064 '/'
Inlet Invert= 228.50', Outlet Invert= 180.50'

Reach 2R: Overland Flow

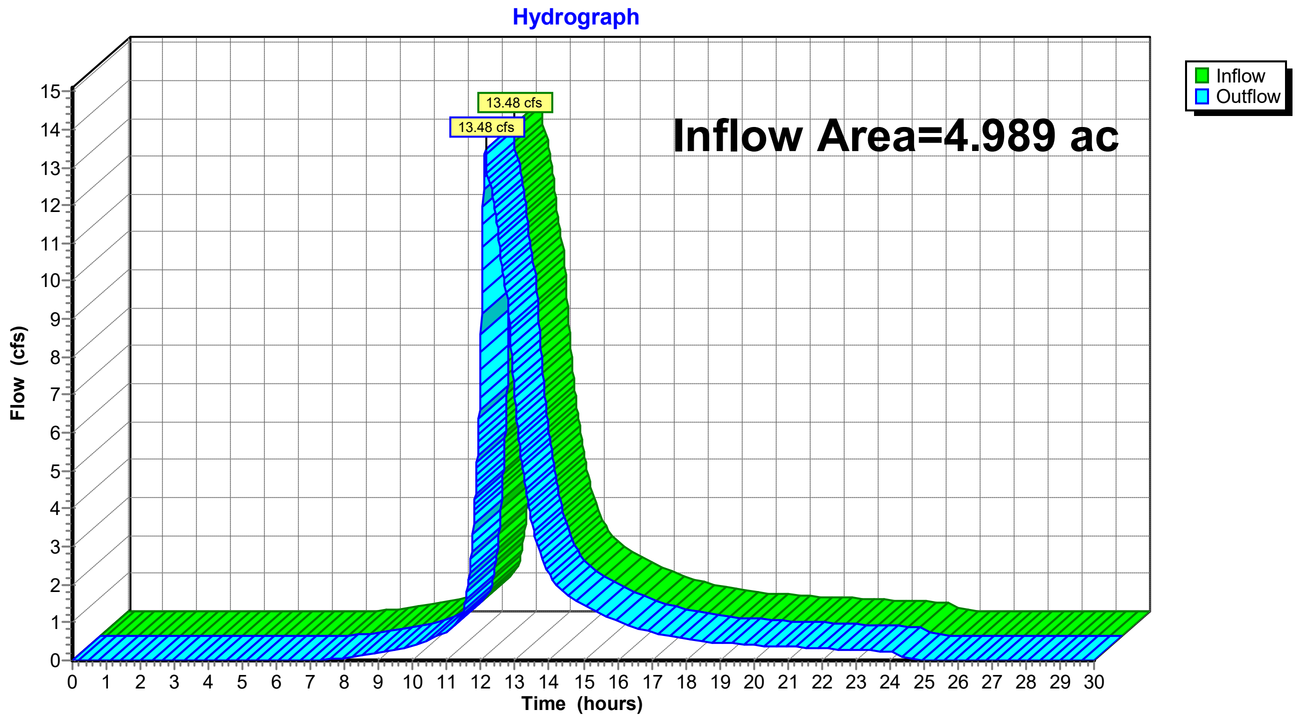


Summary for Reach DP1: Off-Site Wetland

Inflow Area = 4.989 ac, 17.74% Impervious, Inflow Depth = 4.96" for 100 Year event
Inflow = 13.48 cfs @ 12.13 hrs, Volume= 2.061 af
Outflow = 13.48 cfs @ 12.13 hrs, Volume= 2.061 af, Atten= 0%, Lag= 0.0 min

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

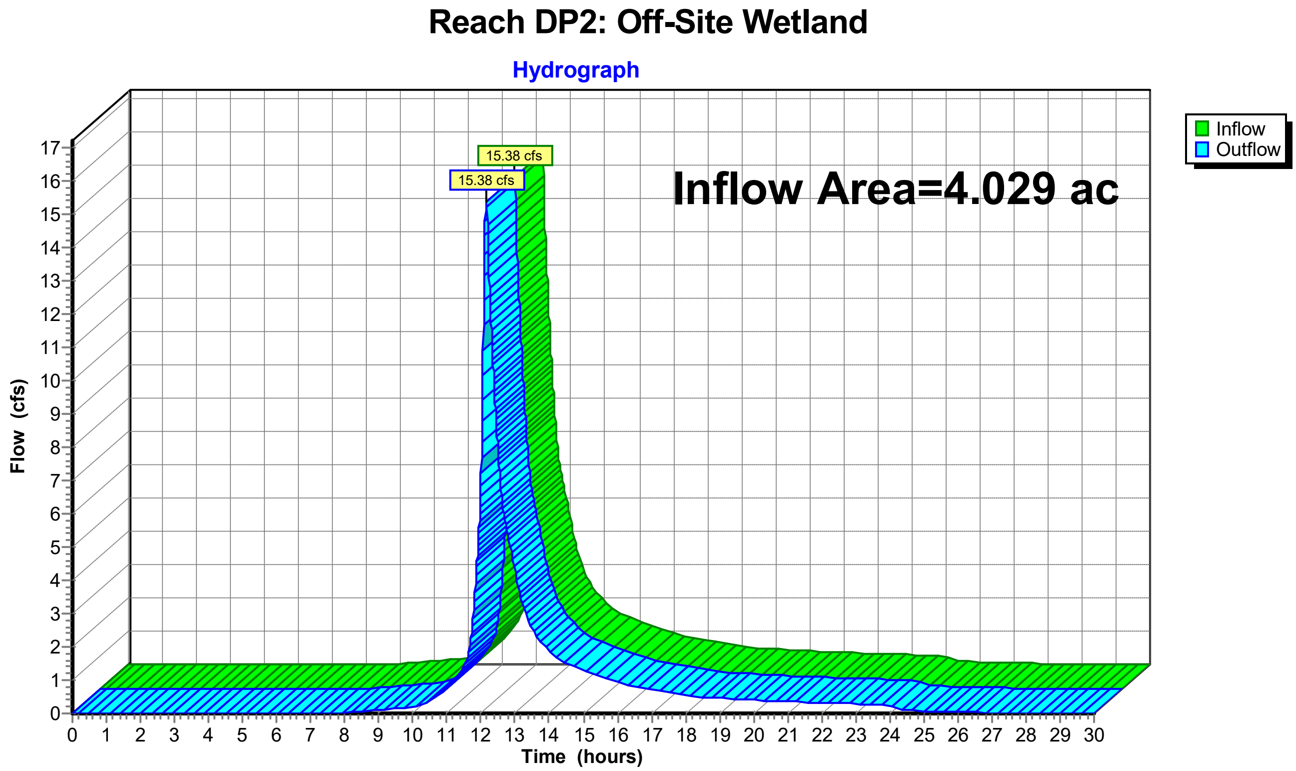
Reach DP1: Off-Site Wetland



Summary for Reach DP2: Off-Site Wetland

Inflow Area = 4.029 ac, 12.95% Impervious, Inflow Depth > 5.09" for 100 Year event
Inflow = 15.38 cfs @ 12.15 hrs, Volume= 1.709 af
Outflow = 15.38 cfs @ 12.15 hrs, Volume= 1.709 af, Atten= 0%, Lag= 0.0 min

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



Summary for Pond Pd-1: Recharger #1

Inflow Area = 1.942 ac, 22.53% Impervious, Inflow Depth = 5.70" for 100 Year event
Inflow = 11.60 cfs @ 12.12 hrs, Volume= 0.923 af
Outflow = 11.30 cfs @ 12.14 hrs, Volume= 0.895 af, Atten= 3%, Lag= 1.4 min
Discarded = 0.09 cfs @ 7.99 hrs, Volume= 0.180 af
Primary = 11.21 cfs @ 12.14 hrs, Volume= 0.716 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 213.31' @ 12.14 hrs Surf.Area= 3,927 sf Storage= 4,744 cf

Plug-Flow detention time= 77.6 min calculated for 0.895 af (97% of inflow)
Center-of-Mass det. time= 60.2 min (864.0 - 803.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	211.10'	2,822 cf	**40.17'W x 97.76'L x 2.33'H Field A** 9,162 cf Overall - 2,108 cf Embedded = 7,054 cf x 40.0% Voids
#2A	211.60'	2,108 cf	**ADS_StormTech SC-310 +Cap** x 143 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 143 Chambers in 11 Rows
		4,930 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	211.10'	**1.020 in/hr Exfiltration over Horizontal area**
#2	Primary	212.42'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.09 cfs @ 7.99 hrs HW=211.12' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=11.20 cfs @ 12.14 hrs HW=213.31' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 11.20 cfs @ 3.13 fps)

Pond Pd-1: Recharger #1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-310 +Cap (ADS StormTech® SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

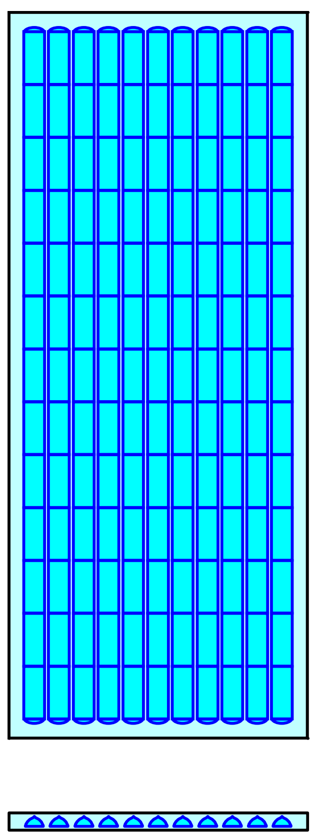
13 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 93.76' Row Length +24.0" End Stone x 2 = 97.76' Base Length
11 Rows x 34.0" Wide + 6.0" Spacing x 10 + 24.0" Side Stone x 2 = 40.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

143 Chambers x 14.7 cf = 2,108.1 cf Chamber Storage

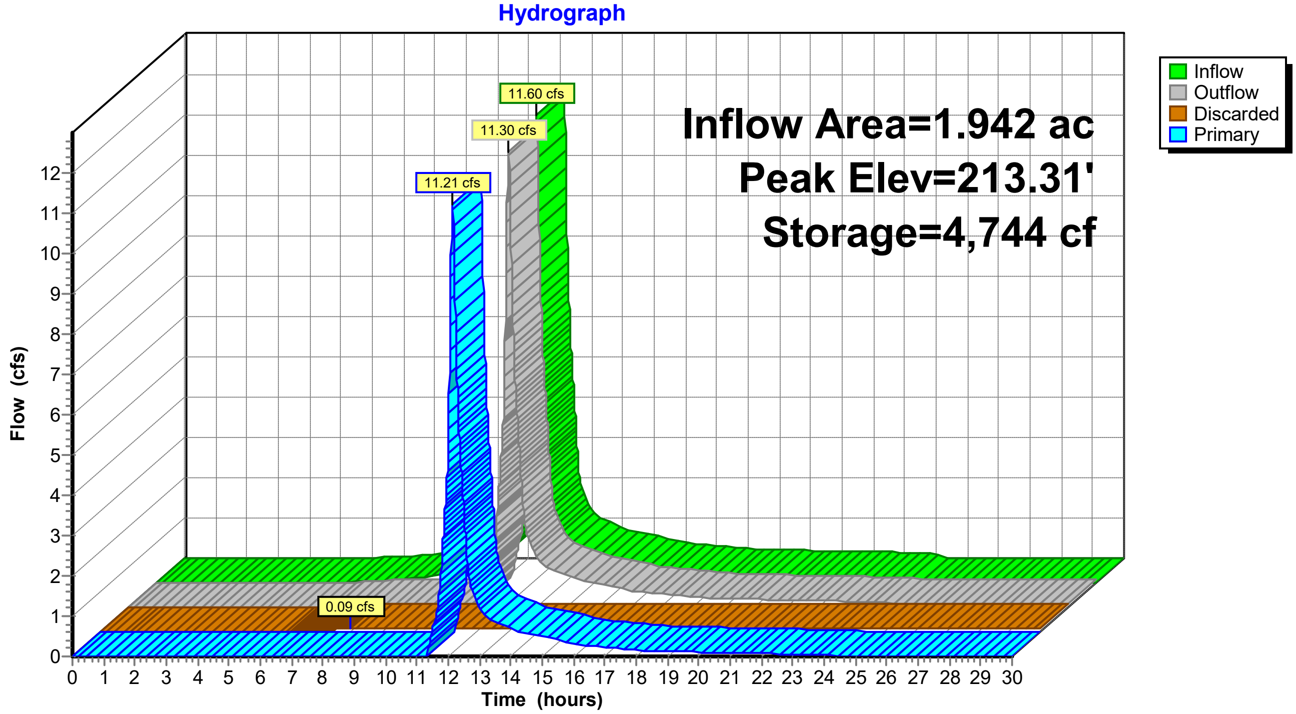
9,162.3 cf Field - 2,108.1 cf Chambers = 7,054.2 cf Stone x 40.0% Voids = 2,821.7 cf Stone Storage

Chamber Storage + Stone Storage = 4,929.8 cf = 0.113 af
Overall Storage Efficiency = 53.8%
Overall System Size = 97.76' x 40.17' x 2.33'

143 Chambers
339.3 cy Field
261.3 cy Stone



Pond Pd-1: Recharger #1



Summary for Pond Pd-2: Recharger #2

Inflow Area = 1.748 ac, 28.21% Impervious, Inflow Depth = 5.87" for 100 Year event
Inflow = 12.13 cfs @ 12.07 hrs, Volume= 0.855 af
Outflow = 12.08 cfs @ 12.08 hrs, Volume= 0.844 af, Atten= 0%, Lag= 0.4 min
Discarded = 0.03 cfs @ 6.25 hrs, Volume= 0.057 af
Primary = 12.06 cfs @ 12.08 hrs, Volume= 0.787 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 198.74' @ 12.08 hrs Surf.Area= 1,137 sf Storage= 1,463 cf

Plug-Flow detention time= 29.9 min calculated for 0.844 af (99% of inflow)
Center-of-Mass det. time= 22.3 min (819.1 - 796.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	196.30'	1,053 cf	**15.08'W x 75.40'L x 2.83'H Field A** 3,222 cf Overall - 590 cf Embedded = 2,633 cf x 40.0% Voids
#2A	196.80'	590 cf	**ADS_StormTech RC-310 +Cap** x 40 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 40 Chambers in 4 Rows
		1,643 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	196.30'	**1.020 in/hr Exfiltration over Horizontal area**
#2	Primary	197.80'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.03 cfs @ 6.25 hrs HW=196.33' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=12.05 cfs @ 12.08 hrs HW=198.74' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 12.05 cfs @ 3.21 fps)

Pond Pd-2: Recharger #2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech RC-310 +Cap (ADS StormTech® RC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 3.0" Spacing = 37.0" C-C Row Spacing

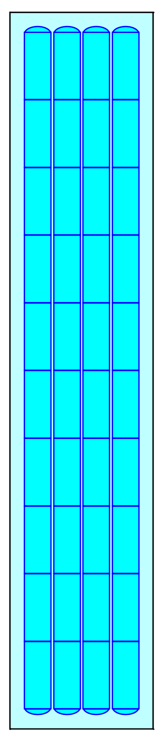
10 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 72.40' Row Length +18.0" End Stone x 2 = 75.40' Base Length
4 Rows x 34.0" Wide + 3.0" Spacing x 3 + 18.0" Side Stone x 2 = 15.08' Base Width
6.0" Base + 16.0" Chamber Height + 12.0" Cover = 2.83' Field Height

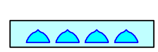
40 Chambers x 14.7 cf = 589.7 cf Chamber Storage

3,222.3 cf Field - 589.7 cf Chambers = 2,632.6 cf Stone x 40.0% Voids = 1,053.0 cf Stone Storage

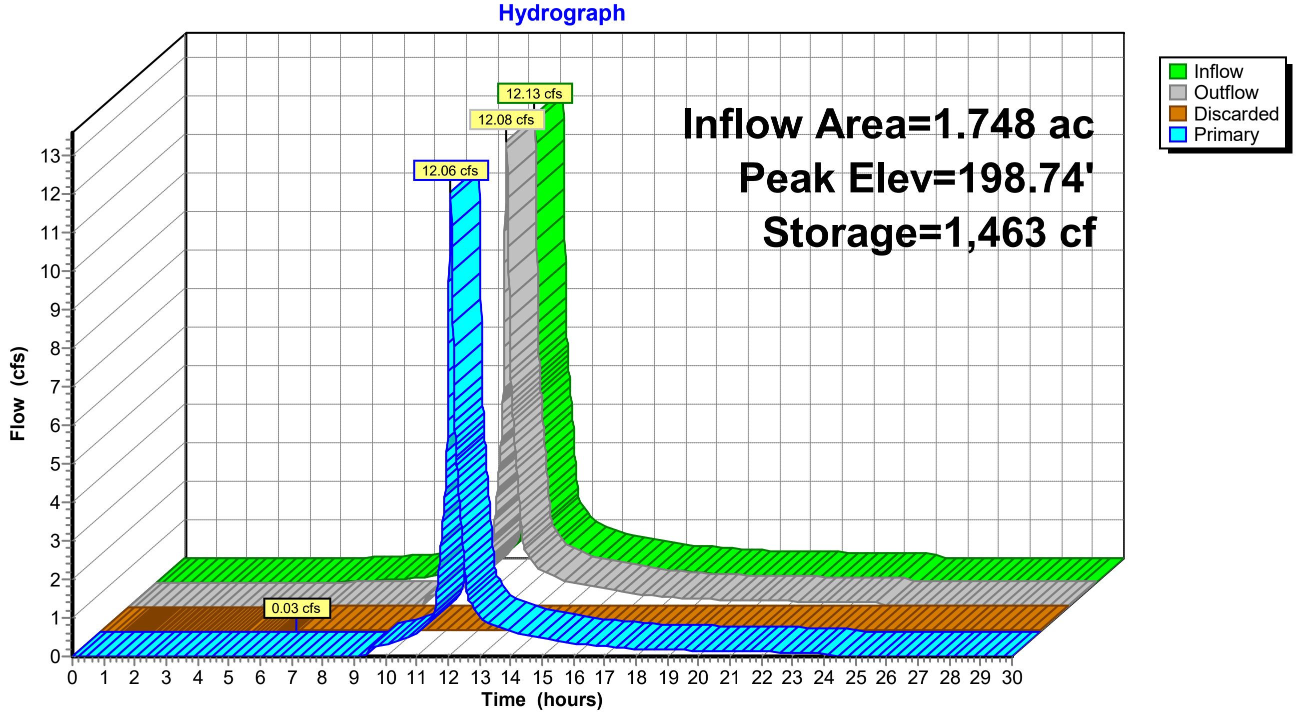
Chamber Storage + Stone Storage = 1,642.7 cf = 0.038 af
Overall Storage Efficiency = 51.0%
Overall System Size = 75.40' x 15.08' x 2.83'

40 Chambers
119.3 cy Field
97.5 cy Stone





Pond Pd-2: Recharger #2



Summary for Pond Pd-3: Recharger #3

Inflow Area = 0.149 ac,100.00% Impervious, Inflow Depth = 7.96" for 100 Year event
Inflow = 1.24 cfs @ 12.07 hrs, Volume= 0.099 af
Outflow = 1.23 cfs @ 12.08 hrs, Volume= 0.092 af, Atten= 1%, Lag= 0.5 min
Discarded = 0.02 cfs @ 4.94 hrs, Volume= 0.035 af
Primary = 1.22 cfs @ 12.08 hrs, Volume= 0.057 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 204.56' @ 12.08 hrs Surf.Area= 648 sf Storage= 719 cf

Plug-Flow detention time= 141.5 min calculated for 0.092 af (93% of inflow)
Center-of-Mass det. time= 102.5 min (842.5 - 740.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	202.50'	611 cf	**12.00'W x 54.04'L x 2.83'H Field A** 1,837 cf Overall - 310 cf Embedded = 1,528 cf x 40.0% Voids
#2A	203.00'	310 cf	**ADS_StormTech RC-310 +Cap** x 21 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 21 Chambers in 3 Rows
		921 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.50'	**1.020 in/hr Exfiltration over Horizontal area**
#2	Primary	204.33'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.02 cfs @ 4.94 hrs HW=202.53' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.21 cfs @ 12.08 hrs HW=204.56' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 1.21 cfs @ 1.34 fps)

Pond Pd-3: Recharger #3 - Chamber Wizard Field A

Chamber Model = ADS_StormTech RC-310 +Cap (ADS StormTech® RC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 3.0" Spacing = 37.0" C-C Row Spacing

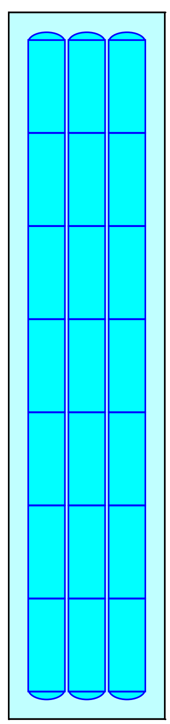
7 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 51.04' Row Length +18.0" End Stone x 2 = 54.04' Base Length
3 Rows x 34.0" Wide + 3.0" Spacing x 2 + 18.0" Side Stone x 2 = 12.00' Base Width
6.0" Base + 16.0" Chamber Height + 12.0" Cover = 2.83' Field Height

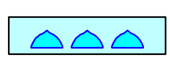
21 Chambers x 14.7 cf = 309.6 cf Chamber Storage

1,837.4 cf Field - 309.6 cf Chambers = 1,527.8 cf Stone x 40.0% Voids = 611.1 cf Stone Storage

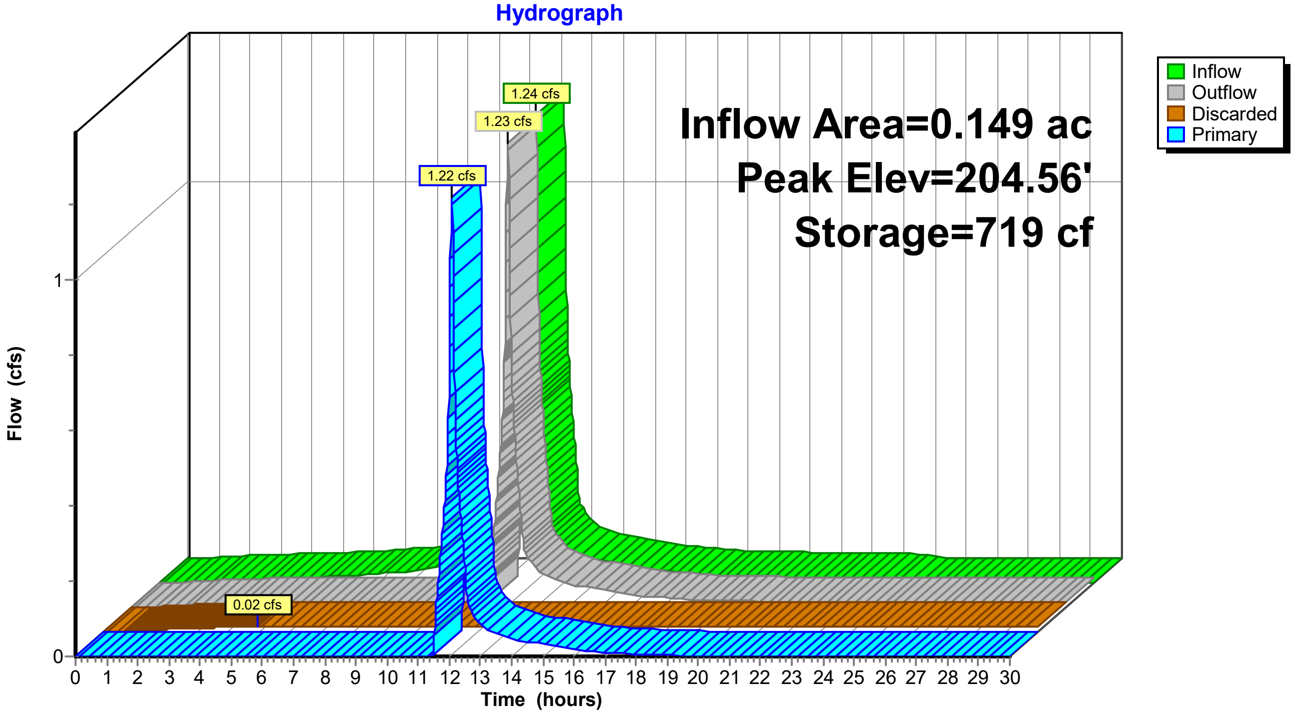
Chamber Storage + Stone Storage = 920.7 cf = 0.021 af
Overall Storage Efficiency = 50.1%
Overall System Size = 54.04' x 12.00' x 2.83'

21 Chambers
68.1 cy Field
56.6 cy Stone





Pond Pd-3: Recharger #3



Summary for Pond Pd-4: Detention System #1 (Surface Basin)

Inflow Area = 3.993 ac, 22.17% Impervious, Inflow Depth = 4.98" for 100 Year event
Inflow = 23.35 cfs @ 12.13 hrs, Volume= 1.657 af
Outflow = 10.15 cfs @ 12.39 hrs, Volume= 1.656 af, Atten= 57%, Lag= 15.3 min
Primary = 10.15 cfs @ 12.39 hrs, Volume= 1.656 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 203.58' @ 12.39 hrs Surf.Area= 7,855 sf Storage= 17,105 cf

Plug-Flow detention time= 22.2 min calculated for 1.656 af (100% of inflow)
Center-of-Mass det. time= 22.1 min (829.0 - 806.9)

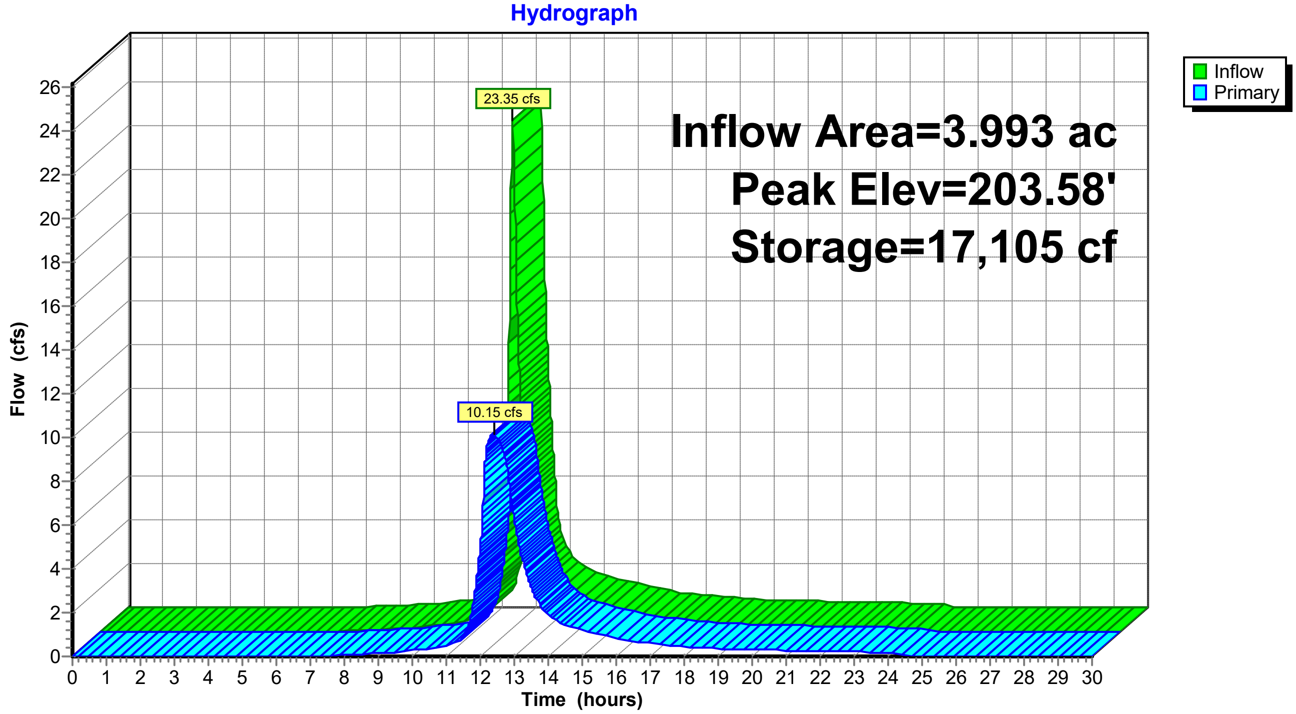
Volume	Invert	Avail.Storage	Storage Description
#1	200.00'	20,545 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) x 1.25

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
200.00	914	150.0	0	0	914
201.00	2,486	309.0	1,636	1,636	6,726
202.00	4,595	342.0	3,487	5,123	8,466
203.00	5,650	361.0	5,113	10,236	9,586
203.50	6,198	371.0	2,961	13,197	10,197
204.00	6,761	380.0	3,239	16,436	10,766

Device	Routing	Invert	Outlet Devices
#1	Primary	200.00'	**15.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.00' / 199.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	200.00'	**7.0" W x 42.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	203.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=10.15 cfs @ 12.39 hrs HW=203.58' (Free Discharge)
└─**1=Culvert** (Inlet Controls 10.15 cfs @ 8.27 fps)
  ├─**2=Orifice/Grate** (Passes < 12.63 cfs potential flow)
  └─**3=Broad-Crested Rectangular Weir** (Passes < 0.24 cfs potential flow)

Pond Pd-4: Detention System #1 (Surface Basin)



Summary for Pond Pd-5: Detention System #2 (Chamber)

Inflow Area = 1.748 ac, 28.21% Impervious, Inflow Depth = 5.40" for 100 Year event
Inflow = 12.06 cfs @ 12.08 hrs, Volume= 0.787 af
Outflow = 7.05 cfs @ 12.18 hrs, Volume= 0.769 af, Atten= 41%, Lag= 6.1 min
Primary = 7.05 cfs @ 12.18 hrs, Volume= 0.769 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 194.68' @ 12.18 hrs Surf.Area= 3,678 sf Storage= 8,200 cf

Plug-Flow detention time= 52.3 min calculated for 0.769 af (98% of inflow)
Center-of-Mass det. time= 39.1 min (843.6 - 804.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	191.50'	4,302 cf	**31.92'W x 115.25'L x 4.75'H Field A** 17,472 cf Overall - 6,716 cf Embedded = 10,756 cf x 40.0% Voids
#2A	192.00'	6,716 cf	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 60 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		11,019 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	187.00'	**15.0" Round Culvert** L= 44.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 187.00' / 186.50' S= 0.0114 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	192.00'	**6.0" W x 39.0" H Vert. Orifice** C= 0.600
#3	Device 1	195.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=7.05 cfs @ 12.18 hrs HW=194.68' (Free Discharge)
└─**1=Culvert** (Passes 7.05 cfs of 15.70 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 7.05 cfs @ 5.26 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond Pd-5: Detention System #2 (Chamber) - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf

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

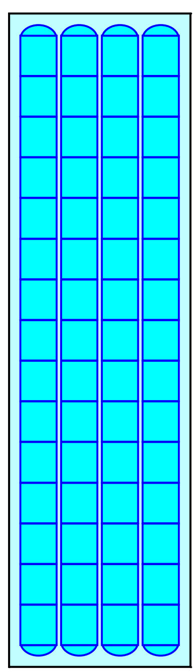
15 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 111.25' Row Length +24.0" End Stone x 2 = 115.25' Base Length
4 Rows x 77.0" Wide + 9.0" Spacing x 3 + 24.0" Side Stone x 2 = 31.92' Base Width
6.0" Base + 45.0" Chamber Height + 6.0" Cover = 4.75' Field Height

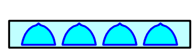
60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 4 Rows = 6,716.3 cf Chamber Storage

17,472.4 cf Field - 6,716.3 cf Chambers = 10,756.1 cf Stone x 40.0% Voids = 4,302.4 cf Stone Storage

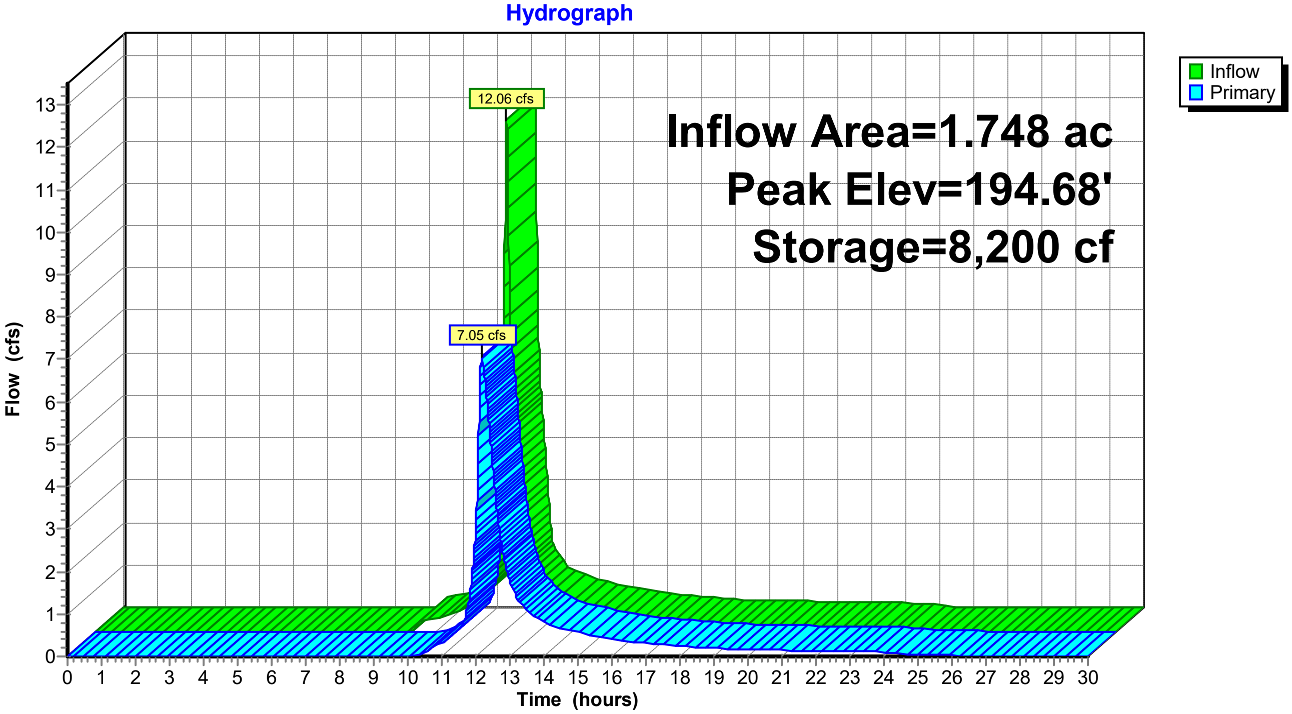
Chamber Storage + Stone Storage = 11,018.7 cf = 0.253 af
Overall Storage Efficiency = 63.1%
Overall System Size = 115.25' x 31.92' x 4.75'

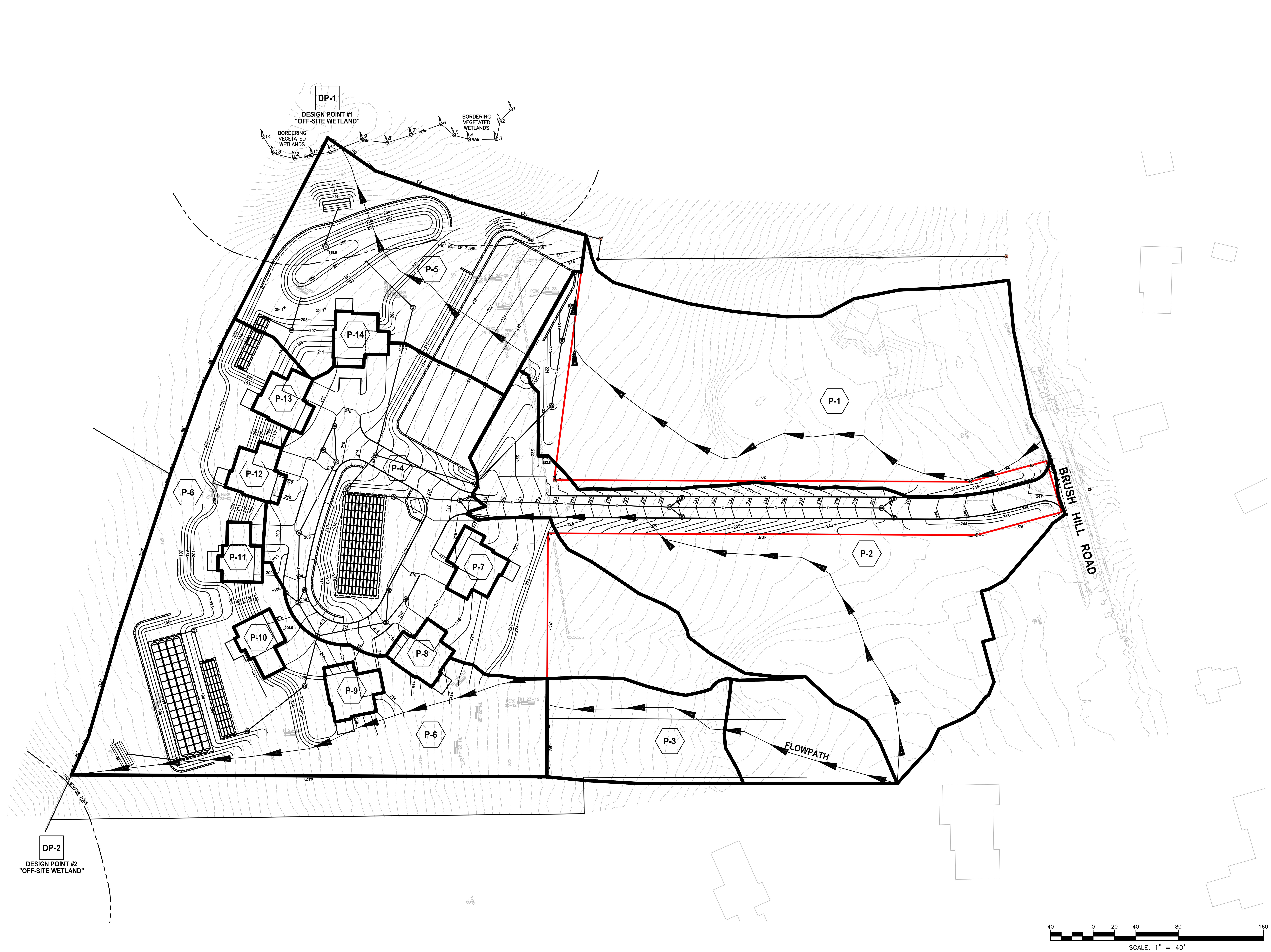
60 Chambers
647.1 cy Field
398.4 cy Stone





Pond Pd-5: Detention System #2 (Chamber)





DGT Associates
Surveying & Engineering

Framingham
Boston ● Worcester ● Preston, CT

1071 Worcester Road
Framingham, MA 01701
508-879-0030

www.DGTassociates.com

ISSUED FOR:

PRELIMINARY DESIGN

NO.	APP	DATE	DESCRIPTION

DATE: JUNE 26, 2024

SCALE: 1" = 40'

DESIGN:	DRAFTED:	CHECKED:
KMR	KMR	BEC

PROJECT TITLE:

BRUSH HILL HOMES

34 BRUSH HILL ROAD
SHERBORN, MA 01770

SHEET TITLE:

PROPOSED CONDITIONS WATERSHED MAP

SHEET: 1 OF 1

PROJECT NO.: F-25889

WSD-PR

F:\F-25800\F-25889 Fenix 34 Brush Hill Rd Sherborn MA\F-25889_Master\Dwg\F-25889 Eng Wp.dwg

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Surveying &
Engineering

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APPENDIX 1

Soils Data

Soil Test Data Report by
DGT Associates
(Testing performed on October 25th & 26th, 2023)
with NRCS Soils Information
for Middlesex County

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

DGT Job No.: F25889

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November 27, 2023

Job: 25889

Mr. Mark Oram
19 Washington Street
Sherborn, MA 01770

RE: 34 Brush Hill Road – Soil Testing

Dear Mr. Oram:

This report contains the results of the on-site soil testing conducted by DGT Associates on October 25th and 26th, 2023, at the subject property in Sherborn, Massachusetts. The testing consisted of fourteen (14) deep hole test pits, five (5) percolation test holes, and two (2) permeability test holes.

The purpose of the testing was to assess the suitability of the soils for the design of a new soil absorption system (SAS) and for stormwater purposes at the subject property. Testing was performed by Massachusetts Licensed Soil Evaluator (Frederick J. Schobel, E.I.T.) of DGT and on 10/26/23 was witnessed by Mark Oram for the Town of Sherborn Board of Health. The testing was also observed by Kevin Riopelle of DGT. Backhoe excavation services were provided by Cambell C. Jones Construction.

According to the Natural Resources Conservation Service (NRCS) Soils Mapping, the soil in the area of testing is Paxton fine sandy loam. The testing generally confirmed the NRCS data. The NRCS soils map and soil information is contained in Attachment #3.

DGT began testing on the first day (10/25/23) on the downhill portion of the lot (Northwest) with test pits TH 23-01 through 23-06. The purpose of those test pits was for stormwater management and therefore unwitnessed by the Board of Health Agent. Two additional unwitnessed test pits, TH 23-07 and 23-08, were completed in the area of the planned soil absorption system for exploratory purposes to confirm soil consistency and groundwater conditions in preparation for the scheduled witnessed testing on 10/26/23.

The second day of testing (10/26/23) testing was conducted on the uphill portion of the lot for the design of the soil absorption system. This comprised of test pits TH 23-09 through TH 23-14.

The Test Holes on both days of testing generally revealed a fine sandy loam topsoil over a firm sandy loam substratum. The soil test logs and Soil Test Hole Location Plan are contained in Attachment #1 and Attachment #2 respectively.

The Estimated Seasonal High Groundwater Table (ESHGWT) was determined by the observation of redoximorphic features within each of the test holes. The redoximorphic features were observed between 29 - 38” below grade. Weeping and standing groundwater were also observed in most of these test holes. The weeping elevation of groundwater varied across the site with it generally being shallower in the test holes on the downhill (Northwest) portion of the lot and deeper in the test holes uphill (Southeast). The weeping groundwater was observed between 32 – 111” below grade. In the test pits that had standing groundwater, it was observed between 108 – 111” below grade.

No refusal was observed in any of the test pits conducted on the site.

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Percolation tests were performed within the substratum layers adjacent to test pits TH 23-09, 23-10, 23-11, and 23-12. A percolation test was performed in each of the substratum soil types observed to determine the most restrictive percolation rate to be used for design purposes. The percolation rates observed for TH 23-09, 23-10b, and 23-11 were 20, 47 and 14 minutes per inch respectively. The percolation tests for TH 23-10a and 23-12 were canceled in the field by the soil evaluator due to groundwater intrusion. The percolation test logs are contained in Attachment #1.

Please contact me if you have any questions regarding this report.

Sincerely,
DGT Associates

Fred Schobel

Frederick J Schobel, EIT (SE 14561)
Staff Engineer

Attachments:

1. Deep Test Hole, Percolation, and Permeability Test Logs
2. Soil Test Hole Location Plan
3. NRCS and USGS Soil Maps and Information

Attachment 1

Deep Hole, Percolation, and Permeability Test Logs

Commonwealth of Massachusetts
City/Town of Sherborn

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

A. Facility Information

Fenix Partners Brush Hill LLC
Owner Name

34 Brush Hill Road
Street Address

1/18
Map/Lot #

Sherborn
City

MA
State

01770
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade

2. Soil Survey
   NRCS — Source
   305B/305C — Soil Map Unit
   Paxton Fine Sandy Loam — Soil Series
   Ground Moraines, Drumlins, Hills — Landform
   Shallow depth to groundwater — Soil Limitations
   Coarse-loamy lodgement till derived from gneiss, granite, and/or schist — Soil Parent material

3. Surficial Geological Report
   2018 Stone et. al. — Year Published/Source
   Thick Till — Map Unit
   Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered gravel clasts and few large boulders — Description of Geologic Map Unit:

4. Flood Rate Insurance Map — Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No — If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): 10/23/2023 MA-DVW 10R (Month/Day/ Year) — Range: ☒ Above Normal ☐ Normal ☐ Below Normal

8. Other references reviewed: N/A
   (Zone II, IWPA, Zone A, EEA Data Portal, etc.)

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-01 (Hole #) | 10/25/2023 (Date) | A.M. (Time) | 60 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 48" Depth to Weeping in Hole N/A Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 6"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
6 - 16"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
16 - 33"	C_1	SL	10 YR 5/4		Cnc : Dpl:				Massive	Friable	
33 - 128"	C_2	SL	2.5 Y 5/4	33"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:
Unwitnessed test pit for Stormwater purposes

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-02 (Hole #) | 10/25/2023 (Date) | A.M. (Time) | 60 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet

   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 32" Depth to Weeping in Hole 108" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 12"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
12 - 30"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
30 - 110"	C	SL	2.5 Y 5/4	30"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:
Unwitnessed test pit for Stormwater purposes

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-03 (Hole #) 10/25/2023 (Date) A.M. (Time) 60 Sunny (Weather) 42.2570 (Latitude) -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) Wooded (Vegetation) None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist — Ground Moraines, Drumlins (Landform) — BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet; Drainage Way >100 feet; Wetlands >100 feet; Property Line >10 feet; Drinking Water Well >100 feet; Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 45" Depth to Weeping in Hole N/A Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 6"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
6 - 20"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
20 - 30"	C_1	SL	10 YR 5/4		Cnc : Dpl:				Massive	Friable	
30 - 108"	C_2	SL	2.5 Y 5/4	30"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes: Unwitnessed test pit for Stormwater purposes

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-04 (Hole #) | 10/25/2023 (Date) | A.M. (Time) | 60 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet

   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 47" Depth to Weeping in Hole | N/A Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 8"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
8 - 20"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
20 - 30"	C_1	SL	10 YR 5/4		Cnc : Dpl:				Massive	Friable	
30 - 120"	C_2	SL	2.5 Y 5/4	29"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes: Unwitnessed test pit for Stormwater purposes

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-05 (Hole #) | 10/25/2023 (Date) | A.M. (Time) | 60 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 44" Depth to Weeping in Hole N/A Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 6"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
6 - 20"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
20 - 33"	C_1	SL	10 YR 5/4		Cnc : Dpl:				Massive	Friable	
33 - 126"	C_2	SL	2.5 Y 5/4	30"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:
Unwitnessed test pit for Stormwater purposes

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-06 (Hole #) | 10/25/2023 (Date) | A.M. (Time) | 60 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 72" Depth to Weeping in Hole N/A Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 6"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
6 - 25"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
25 - 36"	C_1	SL	10 YR 5/4		Cnc : Dpl:				Massive	Friable	
36 - 114"	C_2	SL	2.5 Y 5/4	30"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:
Unwitnessed test pit for Stormwater purposes

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-07 (Hole #) | 10/25/2023 (Date) | P.M. (Time) | 60 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet

   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No   If yes: N/A Depth to Weeping in Hole   N/A Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 9"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
9 - 32"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
32 - 40"	C_1	SL	10 YR 5/4		Cnc : Dpl:				Massive	Friable	
40 - 126"	C_2	SL	2.5 Y 5/4	32"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes: Unwitnessed test pit for exploratory purposes

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-08 (Hole #) | 10/25/2023 (Date) | P.M. (Time) | 60 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line >10 feet | Drinking Water Well >100 feet | Other ____ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 57" Depth to Weeping in Hole N/A Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 10"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
10 - 28"	B_W	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
28 - 34"	C_1	SL	10 YR 5/4		Cnc : Dpl:				Massive	Friable	
34 - 100"	C_2	SL	2.5 Y 5/4	31"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes: Unwitnessed test pit for exploratory purposes

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-09 (Hole #) | 10/26/2023 (Date) | A.M. (Time) | 70 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet

   Property Line >10 feet | Drinking Water Well >100 feet | Other ____ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 96" Depth to Weeping in Hole N/A Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 15"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
15 - 31"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
31 - 37"	C_1	SL	10 YR 4/4		Cnc : Dpl:				Massive	Friable	
37 - 120"	C_2	SL	2.5 Y 4/3	38"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5	Some	Some	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-10 (Hole #) | 10/26/2023 (Date) | A.M. (Time) | 70 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 54" Depth to Weeping in Hole 108" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 10"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
10 - 34"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
34 - 40"	C_1	SL	10 YR 4/4		Cnc : Dpl:				Massive	Friable	
40 - 120"	C_2	SL	2.5 Y 4/3	36"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-11 (Hole #) | 10/26/2023 (Date) | A.M. (Time) | 70 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Grass Lawn (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 111" Depth to Weeping in Hole 117" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 16"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
16 - 27"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
27 - 40"	C_1	SL	10 YR 4/4	37"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Friable	
40 - 72"	C_2	SL	2.5 Y 5/4		Cnc : Dpl:				Massive	Friable	Firm in place Stratified layers of LS
72 - 132"	C_3	SL	2.5 Y 4/3		Cnc : Dpl:				Massive	Firm	
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-12 (Hole #) | 10/26/2023 (Date) | P.M. (Time) | 70 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet

   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 86" Depth to Weeping in Hole 130" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 12"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
12 - 20"	B_W	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
20 - 42"	C_1	SL	10 YR 4/4	36"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Friable	
42 - 60"	C_2	SL	2.5 Y 5/4		Cnc : Dpl:				Massive	Friable	Firm in place
60 - 136"	C_3	SL	2.5 Y 4/3		Cnc : Dpl:				Massive	Firm	
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-13 (Hole #) | 10/26/2023 (Date) | P.M. (Time) | 70 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet

   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 75" Depth to Weeping in Hole 130" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 11"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
11 - 24"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
24 - 31"	C_1	SL	10 YR 4/4		Cnc : Dpl:				Massive	Friable	
31 - 46"	C_2	SL	2.5 Y 5/4	31"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Friable	Firm in place
46 - 146"	C_3	SL	2.5 Y 4/3		Cnc : Dpl:		Some		Massive	Firm	
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sherborn

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

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

Deep Observation Hole Number: 23-14 (Hole #) | 10/26/2023 (Date) | P.M. (Time) | 70 Sunny (Weather) | 42.2570 (Latitude) | -71.4009 (Longitude)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location: See Test Hole Location Plan

2. Soil Parent Material: Coarse-loamy lodgement till derived from gneiss, granite, and/or schist | Ground Moraines, Drumlins (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >50 feet | Drainage Way >100 feet | Wetlands >100 feet

   Property Line >10 feet | Drinking Water Well >100 feet | Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 51" Depth to Weeping in Hole 108" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0 - 8"	A	FSL	10 YR 3/2		Cnc : Dpl:				Massive	Friable	
8 - 22"	B_w	FSL	10 YR 4/6		Cnc : Dpl:				Massive	Friable	
22 - 32"	C_1	SL	10 YR 4/4		Cnc : Dpl:				Massive	Friable	
32 - 120"	C_2	SL	2.5 Y 4/3	36"	Cnc : 7.5 YR 6/8 Dpl: 5 Y 6/1	>5			Massive	Firm	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sherborn

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

D. Determination of High Groundwater Elevation

1. Method Used (Choose one): Obs. Hole # 23-01 Obs. Hole # 23-02

	Obs. Hole # 23-01	Obs. Hole # 23-02
☒ Depth to soil redoximorphic features	33 inches	30 inches
☐ Depth to observed standing water in observation hole	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_______________ Index Well Number   _______________ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☒ Yes ☐ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: 16 inches Lower boundary: 128 inches

   c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Sherborn

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

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # 23-03	Obs. Hole # 23-04
☒ Depth to soil redoximorphic features	30 inches	29 inches
☐ Depth to observed standing water in observation hole	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_______________ Index Well Number

_______________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: 20 inches Lower boundary: 120 inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

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

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # 23-05	Obs. Hole # 23-06
☒ Depth to soil redoximorphic features	30 inches	30 inches
☐ Depth to observed standing water in observation hole	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____________________ Index Well Number

_____________________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☒ Yes ☐ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: 20 inches Lower boundary: 126 inches

   c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Sherborn

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

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # 23-07	Obs. Hole # 23-08
☒ Depth to soil redoximorphic features	32 inches	31 inches
☐ Depth to observed standing water in observation hole	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_______________ Index Well Number   _______________ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: 28 inches Lower boundary: 126 inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

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

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # 23-09	Obs. Hole # 23-10
☒ Depth to soil redoximorphic features	38 inches	36 inches
☐ Depth to observed standing water in observation hole	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_______________ Index Well Number

_______________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: 31 inches Lower boundary: 120 inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

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

D. Determination of High Groundwater Elevation

1. Method Used (Choose one): Obs. Hole # 23-11 Obs. Hole # 23-12

	Obs. Hole # 23-11	Obs. Hole # 23-12
☒ Depth to soil redoximorphic features	37 inches	36 inches
☐ Depth to observed standing water in observation hole	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_______________ Index Well Number _______________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☒ Yes ☐ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: 20 inches Lower boundary: 136 inches

   c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Sherborn

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

D. Determination of High Groundwater Elevation

1. Method Used (Choose one): Obs. Hole # 23-13 Obs. Hole # 23-14

	Obs. Hole # 23-13	Obs. Hole # 23-14
☒ Depth to soil redoximorphic features	31 inches	36 inches
☐ Depth to observed standing water in observation hole	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

______________________ Index Well Number ______________________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: 24 inches Lower boundary: 146 inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Fred Schobel	11/27/23
Signature of Soil Evaluator	Date
Frederick Schobel, EIT, SE 14561	10/1/2024
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
Mark Oram, RS, CHO	Sherborn
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Sherborn
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

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

tab

return

A. Site Information

Fenix Partners Brush Hill LLC
Owner Name

34 Brush Hill Road
Street Address or Lot #

Sherborn — City/Town
MA — State
01770 — Zip Code

Contact Person (if different from Owner)
617-308-1961 — Telephone Number

B. Test Results

Date / Time	10/26/23 9:44 A.M.	10/26/23 10:20 A.M.
Observation Hole #	23-09	23-11
Depth of Perc	54 - 66"	52 - 64"
Start Pre-Soak	9:44 A.M.	10:20 A.M.
End Pre-Soak	9:59 A.M.	10:35 A.M.
Time at 12”	10:06 A.M.	10:35 A.M.
Time at 9”	10:47 A.M.	12:35 P.M.
Time at 6”	11:47 A.M.	2:56 P.M.
Time (9”-6”)	60 Minutes	141 Minutes
Rate (Min./Inch)	20 Min./Inch	47 Min./Inch
	Test Passed: ☒ Test Failed: ☐	Test Passed: ☒ Test Failed: ☐

Frederick Schobel, EIT, SE 14561
Test Performed By:

Mark Oram, RS, CHO
Board of Health Witness

Comments:

Commonwealth of Massachusetts
City/Town of Sherborn

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

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

A. Site Information

Fenix Partners Brush Hill LLC
Owner Name

34 Brush Hill Road
Street Address or Lot #

Sherborn	MA	01770
City/Town	State	Zip Code
	617-308-1961	
Contact Person (if different from Owner)	Telephone Number	

B. Test Results

	10/26/23	9:38 A.M.	10/26/23	11:20 A.M.
	Date	Time	Date	Time
Observation Hole #	23-10a		23-10b	
Depth of Perc	53 - 65"		30 - 42"	
Start Pre-Soak	9:38 A.M.		11:20 A.M.	
End Pre-Soak	9:53 A.M.		11:35 A.M.	
Time at 12”	9:53 A.M.		11:35 A.M.	
Time at 9”	Test canceled due to		11:58 A.M.	
Time at 6”	Groundwater Intrusion		12:40 P.M.	
Time (9”-6”)			42 Minutes	
Rate (Min./Inch)			14 Min./Inch	
	Test Passed: ☐		Test Passed: ☒	
	Test Failed: ☐		Test Failed: ☐	

Frederick Schobel, EIT, SE 14561
Test Performed By:

Mark Oram, RS, CHO
Board of Health Witness

Comments:

Commonwealth of Massachusetts
City/Town of Sherborn
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

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

A. Site Information

Fenix Partners Brush Hill LLC
Owner Name

34 Brush Hill Road
Street Address or Lot #

Sherborn	MA	01770
City/Town	State	Zip Code

	617-308-1961
Contact Person (if different from Owner)	Telephone Number

B. Test Results

	Date	Time	Date	Time
	10/26/23	12:53 P.M.		
Observation Hole #	23-12			
Depth of Perc	39 - 51"			
Start Pre-Soak	12:53 P.M.			
End Pre-Soak	1:08 P.M.			
Time at 12"	1:08 P.M.			
Time at 9"	3:40 P.M.			
Time at 6"				
Time (9"-6")	Test canceled due to			
Rate (Min./Inch)	Groundwater Intrusion			

	Column 1	Column 2
Test Passed:	☐	☐
Test Failed:	☐	☐

Frederick Schobel, EIT, SE 14561
Test Performed By:

Mark Oram, RS, CHO
Board of Health Witness

Comments:

Permeability Test Pit 23-03

Date Performed:	25-Oct-23
Soil Horizon of Perm Test:	C_2
Depth to water level =	19"
Depth to bottom of tube =	30"
Start Soak:	9:50 a.m.
Start Test:	10:05 a.m.

	Time Interval (Minutes)	Incremental Volume(L)
Test 1:	5	0.750
Test 2:	5	0.750
Test 3:	5	0.750
Test 4:	5	0.750
Test 5:	5	0.750
Test 6:	5	0.750
Test 7:	5	0.750
Test 8:	5	0.750
Test 9:	5	0.750
Test 10:	5	0.750
Cumulative Time/Volume	**50**	**7.500**

Q=Cumulative Volume cm^3 / Total time in seconds

Q= 2.500 cm^3/sec

Computation of Permeability(k)

k=Q / 5.5 r Hw=

k=coefficient of permeability (cm/sec)
r=inside radius of pipe in centimeters= 7.6 (6" DIA.)
Hw=applied head in centimeters= 28 cm (11 inches)
Q=Computed flow rate in CC/sec= 2.500 cm^3/sec

k=Q / 5.5 r Hw= 0.00214 cm/sec 3.027 IN/HR

Permeability Test Pit 23-06

Date Performed:	25-Oct-23
Soil Horizon of Perm Test:	C_1
Depth to water level =	22"
Depth to bottom of tube =	33"
Start Soak:	11:34 a.m.
Start Test:	11:49 a.m.

	Time Interval (Minutes)	Incremental Volume(L)
Test 1:	5	0.500
Test 2:	5	0.500
Test 3:	5	0.500
Test 4:	5	0.500
Test 5:	5	0.500
Test 6:	5	0.500
Test 7:	5	0.500
Test 8:	5	0.500
Cumulative Time/Volume	**40**	**4.000**

Q=Cumulative Volume cm^3 / Total time in seconds

Q= 1.667 cm^3/sec

Computation of Permeability(k)

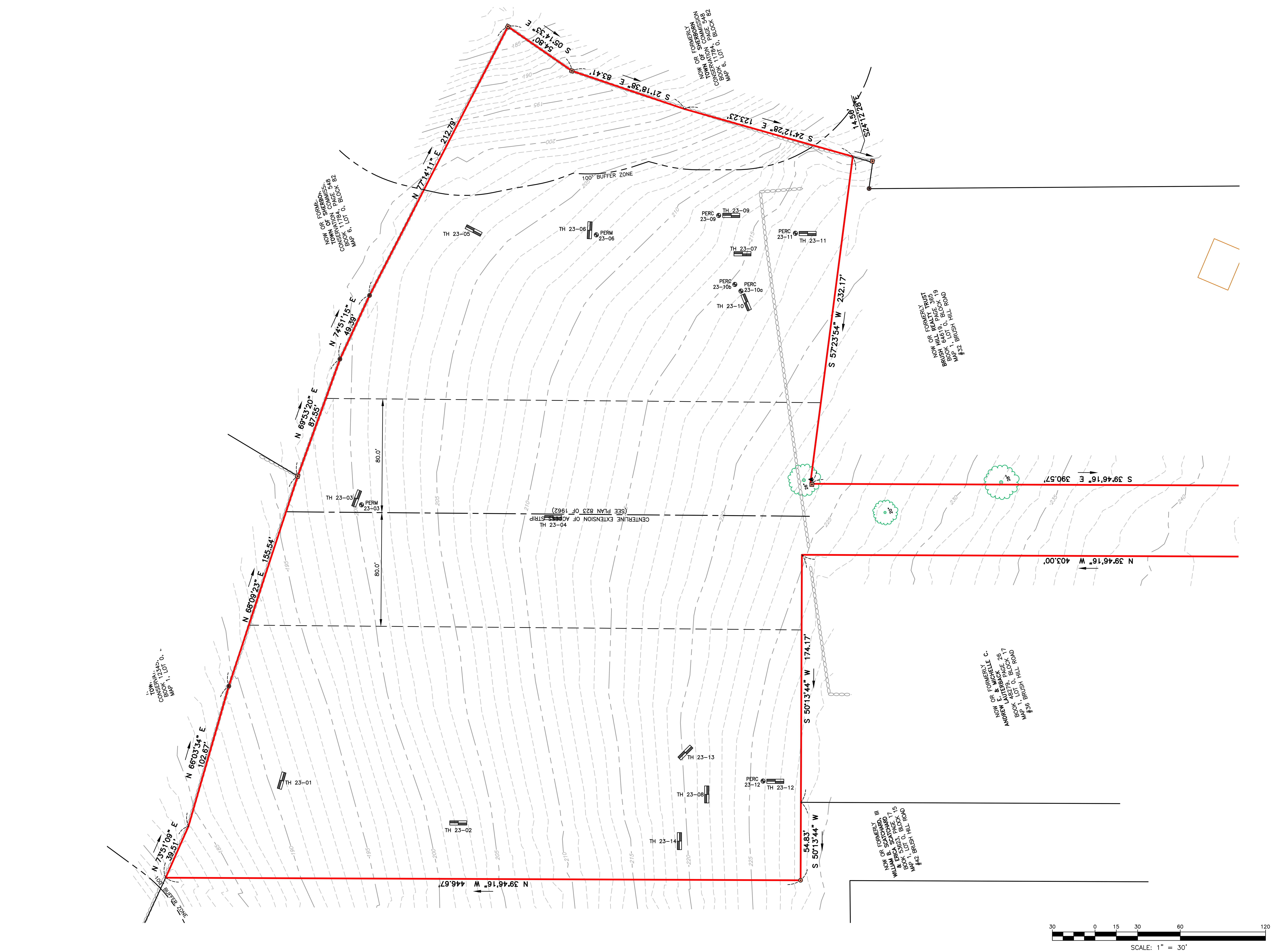
k=Q / 5.5 r Hw=

k=coefficient of permeability (cm/sec)
r=inside radius of pipe in centimeters= 7.6 (6" DIA.)
Hw=applied head in centimeters= 28 cm (11 inches)
Q=Computed flow rate in CC/sec= 1.667 cm^3/sec

k=Q / 5.5 r Hw= 0.00142 cm/sec 2.018 IN/HR

Attachment 2

Soil Test Hole Location Plan



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Framingham, MA 01701
508-879-0030

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NO.	APP	DATE	DESCRIPTION

DATE: **NOVEMBER 20, 2023**

SCALE: **1" = 30'**

DESIGN:	DRAFTED: FJS	CHECKED: KMR

PROJECT TITLE:

SHERBORN COTTAGE COURT

34 BRUSH HILL ROAD
SHERBORN, MA 01770

SHEET TITLE:

SOIL TEST HOLE LOCATION PLAN

SHEET: 1 OF 1

PROJECT NO.: F25889

ST-1

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Attachment 3

National Resources Conservation Service (NRCS)
Soils Map and Information

United States Geological Survey (USGS)
Surficial Materials Map and Information

Soil Map—Middlesex County, Massachusetts
(34 Brush Hill Road, Sherborn)

Map Scale: 1:3,110 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

N

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 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 23, Sep 12, 2023

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	0.0	0.1%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	3.5	9.9%
73B	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	0.6	1.8%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	1.5	4.2%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	0.7	1.9%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 25 percent slopes	1.1	3.1%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	9.3	26.3%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	16.4	46.5%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	2.2	6.3%
Totals for Area of Interest		**35.2**	**100.0%**

Middlesex County, Massachusetts

305B—Paxton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2qp
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Paxton

Setting

Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

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

Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge

Percent of map unit: 9 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 6 percent
Landform: Depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Charlton

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 23, Sep 12, 2023

Middlesex County, Massachusetts

305C—Paxton fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w66y
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Paxton

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C

Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 7 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 6 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 2 percent
Landform: Drumlins, drainageways, depressions, ground moraines, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

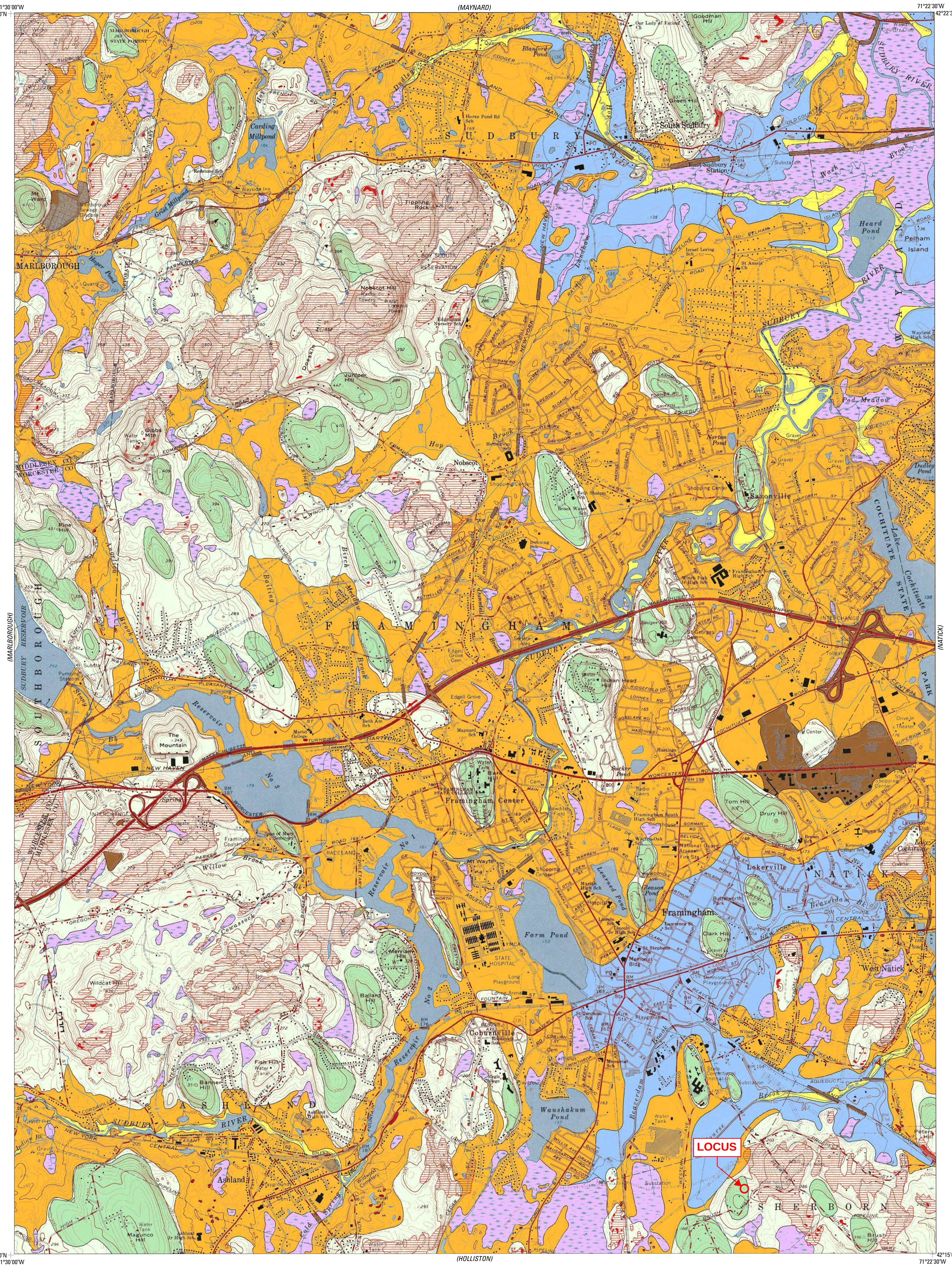
Data Source Information

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 23, Sep 12, 2023

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
Commonwealth of Massachusetts
Massachusetts Geological Survey
and Executive Office for Administration and Finance

Scientific Investigations Map 3402
Quadrangle 98—Framingham
Discussion of surficial materials and description of map units available at https://doi.org/10.3133/sim3402



Base from U.S. Geological Survey, 1965

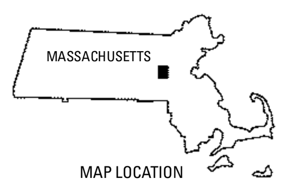
Map was scanned, processed, georeferenced, rectified, and cropped by the Massachusetts Geological Survey

Lambert Conformal Conic projection. North American Datum of 1983

Massachusetts state plane coordinate system, mainland zone

14½°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2018

SCALE 1:24 000
1 0.5 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0.5 0 1 KILOMETER
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



MAP LOCATION

Map units were reproduced from Nelson (1974b). Some units were mapped or revised from analysis of topographic (lidar) data and 2005 orthophoto images.

Surficial Materials Map of the Framingham Quadrangle, Massachusetts

Compiled by
Janet R. Stone and Byron D. Stone
2018

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For sale by U.S. Geological Survey, Box 25286, Denver Federal Center, Denver, CO 80225; https://store.usgs.gov; 1–888–ASK–USGS (1–888–275–8747)

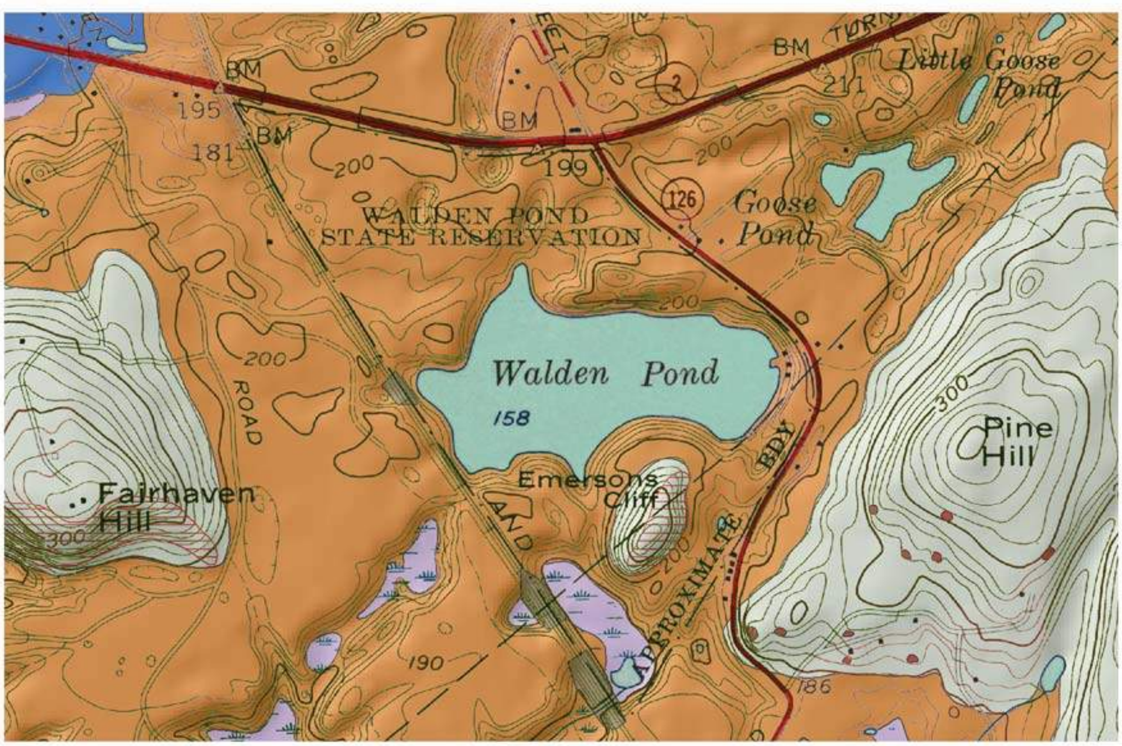
Suggested citation: Stone, J.R., and Stone, B.D., comps., 2018, Surficial materials map of the Framingham quadrangle, Massachusetts, quadrangle 98 *in* Stone, J.R., Stone, B.D., DiGiacomo-Cohen, M.L., and Mabee, S.B., comps., Surficial materials of Massachusetts—A 1:24,000-scale geologic map database: U.S. Geological Survey Scientific Investigations Map 3402, 1 sheet, scale 1:24,000, https://doi.org/10.3133/sim3402.

ISSN 2329-132X (online)
https://doi.org/10.3133/sim3402

Prepared in cooperation with the Commonwealth of Massachusetts
Office of the State Geologist and Executive Office of Environmental Affairs

Surficial Geologic Map of the Clinton-Concord-Grafton-Medfield 12-quadrangle area in East Central Massachusetts

Compiled by Janet R. Stone and Byron D. Stone



Open-File Report 2006-1260A

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
Dirk Kempthorne, Secretary

U.S. Geological Survey
Mark D. Myers, Director

U.S. Geological Survey, Reston, Virginia 2006

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Suggested citation:
Stone, J.R., and Stone, B.D., 2006, Surficial Geologic Map of the Clinton-Concord-Grafton-Medfield 12-quadrangle area in East Central Massachusetts: U.S. Geological Survey Open-File Report 2006-1260A.

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Cover figure. A portion of the surficial geologic map of the Concord quadrangle, shown with semi-transparent shaded relief on a scanned topographic base map.

Contents

Figures

Surficial Geologic Map of the Clinton-Concord-Grafton-Medfield 12-quadrangle area in East Central Massachusetts

Compiled by Janet R. Stone, and Byron D. Stone

Introduction

The surficial geologic map shows the distribution of nonlithified earth materials at land surface in an area of twelve 7.5-minute quadrangles (total 660 mi^2) in east-central Massachusetts (fig. 1). Across Massachusetts, these materials range from a few feet to more than 500 ft in thickness. They overlie bedrock, which crops out in upland hills and in resistant ledges in valley areas. The geologic map differentiates surficial materials of Quaternary age on the basis of their lithologic characteristics (grain size, sedimentary structures, mineral and rock-particle composition), constructional geomorphic features, stratigraphic relationships, and age. Surficial materials also are known in engineering classifications as unconsolidated soils, which include coarse-grained soils, fine-grained soils, or organic fine-grained soils. Surficial materials underlie and are the parent materials of modern pedogenic soils, which have developed in them at the land surface. Surficial earth materials significantly affect human use of the land, and an accurate description of their distribution is particularly important for water resources, construction aggregate resources, earth-surface hazards assessments, and land-use decisions.

The mapped distribution of surficial materials that lie between the land surface and the bedrock surface is based on detailed geologic mapping of 7.5-minute topographic quadrangles, as part of a cooperative state-wide mapping program between the U.S. Geological Survey and the Massachusetts Department of Public Works (now Massachusetts Highway Department) (Page, 1967; Stone, 1982), and the Office of the Massachusetts State Geologist. Each published geologic map presents a detailed description of local geologic map units, the genesis of the deposits, and age correlations among units. Regional summaries of these maps and unpublished maps discuss the ages of multiple glaciations, the nature of glaciofluvial, glaciolacustrine, and glaciomarine deposits, and the processes of ice advance and retreat across Massachusetts (Warren and Stone, 1986; Koteff and Pessl, 1981; papers in Larson and Stone, 1982; Oldale and Barlow, 1986; Stone and Borns, 1986).

This compilation of surficial geologic materials is an interim product that defines the areas of exposed bedrock, and the boundaries between glacial till, glacial stratified deposits, and overlying postglacial deposits. This work is part of a comprehensive study to produce a statewide digital map of the surficial geology at a 1:24,000-scale level of accuracy. This map of 12 quadrangles revises previous digital surficial geologic maps (Stone and Beinikis, 1993; MassGIS, 1999) that were compiled on base maps at regional scales of 1:250,000 and 1:125,000. The purpose of this study is to provide fundamental geologic data for the evaluation of natural resources, hazards, and land information within the Commonwealth of Massachusetts.

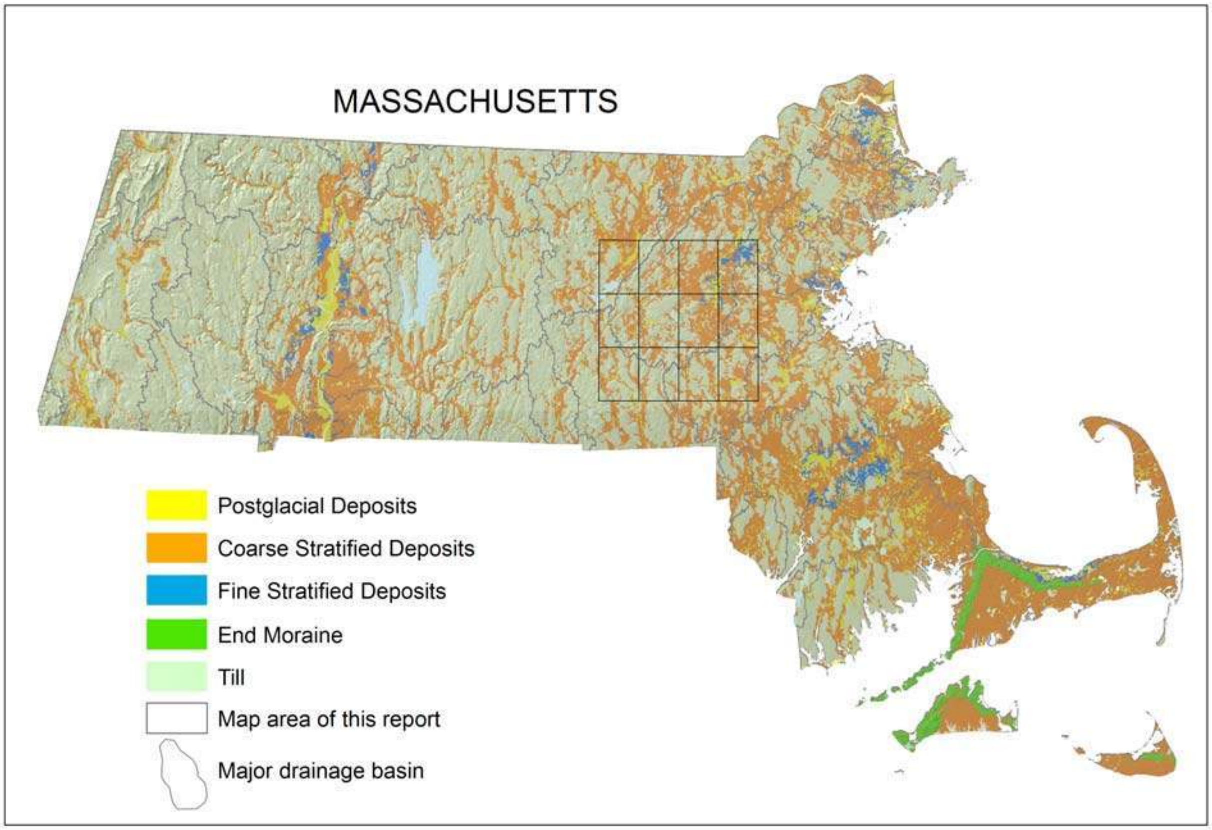


Figure 1. General distribution of glacial and postglacial deposits in Massachusetts (Stone and Beinikis, 1993, MassGIS, 1999) and map area covered by this report.

Surficial Materials in Massachusetts

Most of the surficial materials in Massachusetts are deposits of the last two continental ice sheets that covered all of New England in the latter part of the Pleistocene ice age (Schafer and Hartshorn, 1965; Stone and Borns, 1986; Oldale and others, 1982). The glacial deposits are divided into two broad categories, ***glacial till*** and ***glacial stratified deposits***. Till, the most widespread glacial deposit, was laid down directly by glacier ice. Glacial stratified deposits are concentrated in valleys and lowland areas and were laid down by glacial meltwater in streams, lakes, and the sea in front of the retreating ice margin during the last deglaciation. Postglacial sediments, primarily floodplain alluvium and swamp deposits, make up a lesser proportion of the unconsolidated materials.

Glacial till deposits consist of nonsorted, generally nonstratified mixtures of mineral and rock particles ranging in grain size from clay to large boulders. The matrix of most tills is composed dominantly of fine sand and silt. Boulders within and on the surface of tills range from sparse to abundant. Some tills contain lenses of sorted sand and gravel and less commonly, masses of laminated fine-grained sediments. The color and lithologic characteristics of till deposits vary across Massachusetts, but generally reflect the composition of the local underlying and northerly adjacent bedrock from which the till was derived. Till blankets the bedrock surface in variable thickness, ranging from a few inches to more than 200 ft, and commonly underlies stratified meltwater deposits. Tills deposited during the last two glaciations occur in superposition within Massachusetts (Koteff, 1966; Newton, 1978; Weddle and others, 1989). The upper till was deposited during the last (late Wisconsinan) glaciation; it is the most extensive till and commonly is observed in surface exposures, especially in areas where till thickness is less than 15 ft (thin till unit on the map). The lower till ("old" till) was deposited during an earlier glaciation (probably Illinoian). The lower till has a more limited distribution; it is principally a subsurface deposit that constitutes the bulk of material in drumlins and other hills where till thickness is greater than 15 ft. The distribution of lower till is shown primarily by the thick till unit on the map. The lower till generally is overlain by thin upper till deposits in these areas. In all exposures showing the superposed two tills, the base of the upper till truncates the weathered surface of the old till. The lower part of the upper till commonly displays a zone of shearing, dislocation, and brecciation in which clasts of lower till were mixed and incorporated into the upper till during the last glaciation.

End moraine deposits are composed predominantly of bouldery ablation till, but may also locally include sorted sediments. These deposits were laid down by glacial-melting processes along active ice margins during retreat of the last (late-Wisconsinan) ice sheet. Extensive end moraines on Nantucket and Martha's Vineyard (fig. 1) are related to the terminal position of the late-Wisconsinan ice sheet, and the end moraines on Cape Cod are associated with recessional positions of the last ice sheet. Less extensive end moraines occur locally elsewhere in southeastern Massachusetts, in the Boston area and in the Gloucester-Rockport area of northeastern Massachusetts.

Glacial stratified deposits consist of layers of well-sorted to poorly sorted gravel, sand, silt, and clay laid down by flowing meltwater in glacial streams, lakes, and marine embayments that occupied the valleys and lowlands of Massachusetts during retreat of the last ice sheet. Textural variations within the meltwater deposits occur both areally and vertically because meltwater-flow regimes were different in glaciofluvial (stream), glaciodeltaic (where a stream entered a lake or the sea), glaciolacustrine (lake bottom), and glaciomarine (marine bottom) depositional environments. Grain-size variations also resulted from meltwater deposition in positions either proximal to or distal from the retreating glacier margin, which was the principal sediment source. A common depositional setting contained a proximal, ice-marginal meltwater stream in which horizontally bedded glaciofluvial gravel and/or sand and gravel were laid down; farther down valley, the stream entered a glacial lake where glaciodeltaic sediments were deposited, consisting of horizontally layered sand and gravel delta-topset beds overlying inclined layers of sand in delta-foreset beds. Farther out in the glacial lake, very fine sand, silt, and clay settled out on the lake bottom in flat-lying, thinly bedded glaciolacustrine layers. Thick sequences having these textural variations commonly are present in the vertical section of meltwater deposits across the State (Stone and others, 1992). Detailed geologic maps permit precise mapping of meltwater sedimentary units within each glacial lake or valley outwash system (Jahns, 1941; 1953; Koteff, 1966). These units, known as *morphosequences* (Koteff, 1974; Koteff and Pessl, 1981), are the smallest mappable stratigraphic units on detailed geologic maps. *Morphosequences* are bodies of stratified meltwater sediments that are contained in a continuum of landforms, grading from ice-contact forms (eskers, kames) to non-ice-contact forms (flat valley terrace, delta plains) that were deposited simultaneously at and beyond the margin of the ice sheet, graded to a specific base level. Each morphosequence consists of a proximal part (head) deposited within or near the ice margin, and a distal part deposited farther away from the ice margin. Both grain size and ice-melt collapse deformation of beds decrease from the proximal to the distal part of each morphosequence. The head of each morphosequence is either ice marginal (ice contact) or near ice marginal. The surface altitude of fluvial sediments in each morphosequence was controlled by a specific base level, either a glacial-lake or marine water plane or a valley knickpoint. Few morphosequences extend distally more than 10 km, and most are less than 2 km in length. In any one basin, individual morphosequences were deposited sequentially as the ice margin retreated systematically northward. Consequently, in many places the distal, finer grained facies of a younger morphosequence stratigraphically overlies the proximal, coarse-grained facies of a preceding morphosequence. Figure 2 shows the variability of sediment types in the subsurface of glacial stratified deposits. The figure schematically shows the relationship between coarse-grained deltaic deposits and extensive fine-grained lake (or marine) deposits in the subsurface. Such coarse- and fine-grained units are common in most of the valleys and lowlands of Massachusetts (Langer, 1979, Stone and others, 1979; Stone and others, 1992; Stone and others, 2005). On this interim map, coarse-grained and fine-grained textural variations within glacial stratified deposits are shown only where they occur at land surface. Subsurface textural variations are not shown.

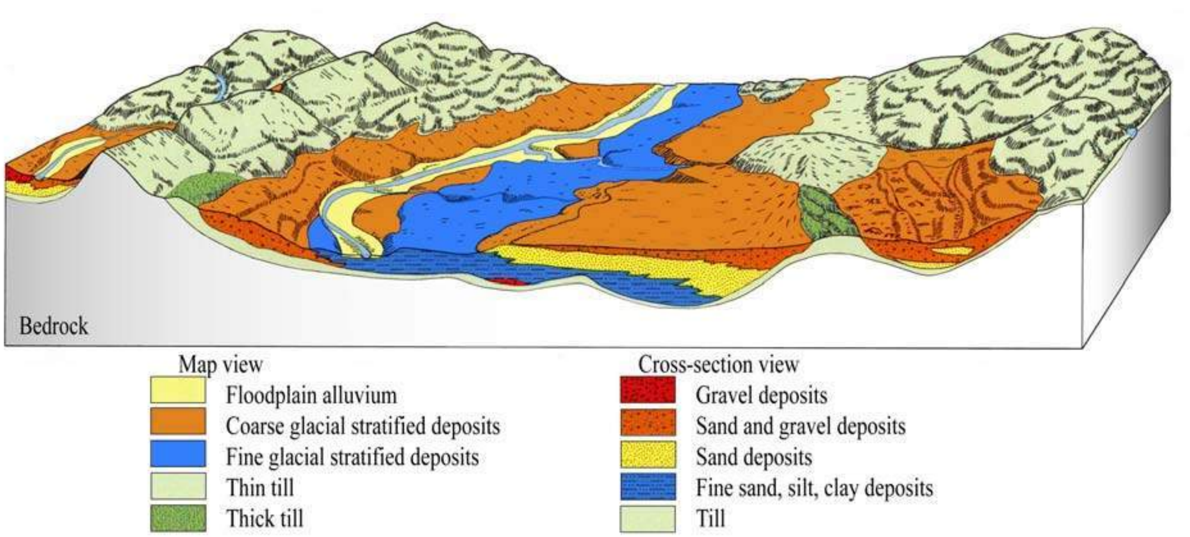


Figure 2. Block diagram illustrating the typical areal and vertical distribution of glacial and postglacial deposits overlying bedrock (modified from Stone and others, 1992).

The areal distribution of till and stratified deposits across Massachusetts is related regional physiography (fig. 1). The thickness of these materials varies considerably because of such factors as the high relief of the bedrock surface, changing environments of deposition during deglaciation, and various effects of postglacial erosion and removal of glacial sediments. In highland areas, notably in the western and central parts of the State, till is the major surficial material and is present as a discontinuous mantle of variable thickness over the bedrock surface. Till is thickest in drumlins (reportedly as much as 230 ft thick) and on the northwest slopes of most bedrock hills. Glacial meltwater deposits that average 50 feet in thickness (Stone and Beinikis, 1993) overlie the till in small upland valleys and north-sloping basins between bedrock hills. Glacial stratified deposits are the predominant surficial materials in the Connecticut River valley, the northeastern and southeastern lowlands, and on Cape Cod and the islands. These deposits generally overlie till; however, well logs indicate that in some places till is not present and the stratified deposits lie directly on bedrock. On Cape Cod and the islands, in the southeastern lowland, and in parts of the Connecticut River valley these deposits completely cover the till-draped bedrock surface.

Postglacial deposits locally overlie the glacial deposits throughout the State. Alluvium underlies the floodplains of most streams and rivers. Swamps occur in low-lying, poorly drained areas in upland and lowland settings, but swamp deposits are shown only where they are estimated to be at least 3 ft thick. Salt-marsh and estuarine deposits are present mainly along the tidal portions of streams and rivers entering the offshore areas. Beach deposits occur along the shoreline.

Description of Map Units

Postglacial Deposits

Artificial fill—Earth materials and manmade materials that have been artificially emplaced, primarily in highway and railroad embankments, and in dams; may also include landfills, urban development areas, and filled coastal wetlands.

Floodplain alluvium—Sand, gravel, silt, and some organic material, stratified and well sorted to poorly sorted, beneath the floodplains of modern streams. The texture of alluvium commonly varies over short distances both laterally and vertically, and generally is similar to the texture of adjacent glacial deposits. Along smaller streams, alluvium is commonly less than 5 ft thick. The most extensive deposit of alluvium on the map is along the Charles, Assabet, and Concord Rivers where the texture is predominantly sand, fine gravel, and silt, and total thickness is as much as 25 ft. Alluvium typically overlies thicker glacial stratified deposits.

Swamp deposits—Organic muck and peat that contain minor amounts of sand, silt, and clay, stratified and poorly sorted, in kettle depressions or poorly drained areas. Most swamp deposits are less than about 10 ft thick. Swamp deposits overlie glacial deposits or bedrock. They locally overlie glacial till even where they occur within thin glacial meltwater deposits.

Glacial Stratified Deposits

Sorted and stratified sediments composed of gravel, sand, silt, and clay (as defined in particle size diagram, fig. 3) deposited in layers by glacial meltwater. These sediments occur as four basic textural units—gravel deposits, sand and gravel deposits, sand deposits, and fine deposits. On this interim map, gravel, sand and gravel, and sand deposits are not differentiated and are shown as *Coarse Deposits* where they occur at land surface. *Fine Deposits* also are shown where they occur at land surface. **Textural changes occur both areally and vertically (fig. 2), however subsurface textural variations are not shown on this interim map.**

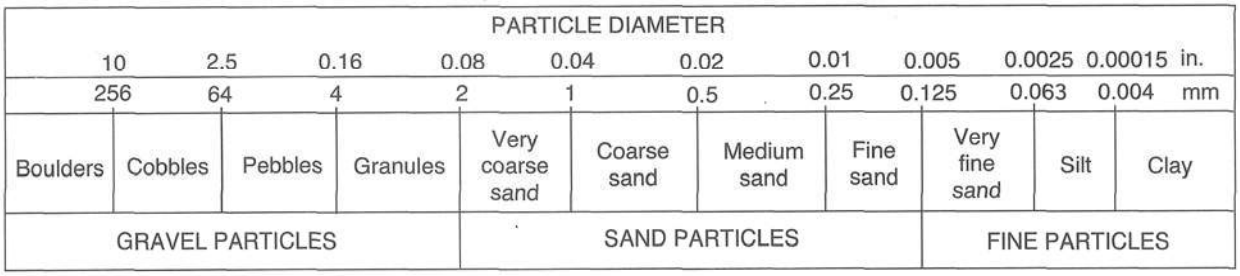


Figure 3. Grain-size classification used in this report, modified from Wentworth (1922).

Coarse deposits include: *Gravel deposits* composed mainly of gravel-sized clasts; cobbles and boulders predominate; minor amounts of sand within gravel beds, and sand comprises few separate layers. Gravel layers generally are poorly sorted and bedding commonly is distorted and faulted due to postdepositional collapse related to melting of ice. *Sand and gravel deposits* composed of mixtures of gravel and sand within individual layers and as alternating layers. Sand and gravel layers generally range from 25 to 50 percent gravel particles and from 50 to 75 percent sand particles. Layers are well to poorly sorted; bedding may be distorted and faulted due to postdepositional collapse. *Sand deposits* composed mainly of very coarse to fine sand, commonly in well-sorted layers. Coarser layers may contain up to 25 percent gravel particles, generally granules and pebbles; finer layers may contain some very fine sand, silt, and clay.

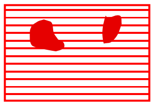
Fine deposits include very fine sand, silt, and clay that occurs as well-sorted, thin layers of alternating silt and clay, or thicker layers of very fine sand and silt. Very fine sand commonly occurs at the surface and grades downward into rhythmically bedded silt and clay varves. Locally, this map unit may include areas underlain by fine sand.

Glacial Till Deposits

Thin till—Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered gravel clasts and few large boulders; in areas where till is generally less than 10-15 ft thick and including areas of bedrock outcrop where till is absent. Predominantly upper till of the last glaciation; loose to moderately compact, generally sandy, commonly stony. Two facies are present in some places; a looser, coarser-grained ablation facies, melted out from supraglacial position; and an underlying more compact, finer-grained lodgement facies deposited subglacially. In general, both ablation and lodgement facies of upper till derived from fine-grained bedrock are finer grained, more compact, less stony and have fewer surface boulders than upper till derived from coarser grained crystalline rocks. Fine-grained bedrock sources include the red Mesozoic sedimentary rocks of the Connecticut River lowland, marble in the western river valleys, and fine-grained schists in upland areas.

Thick till—Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered gravel clasts and few large boulders at the surface; in the shallow subsurface, compact, nonsorted matrix of silt, very fine sand, and some clay containing scattered small gravel clasts in areas where till is greater than 10-15 ft thick, chiefly in drumlin landforms in which till thickness commonly exceeds 100 ft (maximum recorded thickness is 230 ft). Although upper till is the surface deposit, the lower till constitutes the bulk of the material in these areas. Lower till is moderately to very compact, and is commonly finer grained and less stony than upper till. An oxidized zone, the lower part of a soil profile formed during a period of interglacial weathering, is generally present in the upper part of the lower till. This zone commonly shows closely spaced joints that are stained with iron and manganese oxides.

Bedrock Areas



Bedrock outcrops and areas of abundant outcrop or shallow bedrock— Solid color shows extent of individual bedrock outcrops; line pattern indicates areas of shallow bedrock or areas where small outcrops are too numerous to map individually; in areas of shallow bedrock, surficial materials are less than 5-10 ft thick.

Map Compilation

This compilation is the first in a series of interim products showing surficial geology in twelve 7.5-minute quadrangles in east-central Massachusetts: Clinton, Hudson, Maynard, Concord, Shrewsbury, Marlborough, Framingham, Natick, Grafton, Milford, Holliston, and Medfield (fig. 4, fig 5 area A). Figure 5 shows all of the compilation areas for surficial geology in Massachusetts. These maps will be produced sequentially by letter designation.

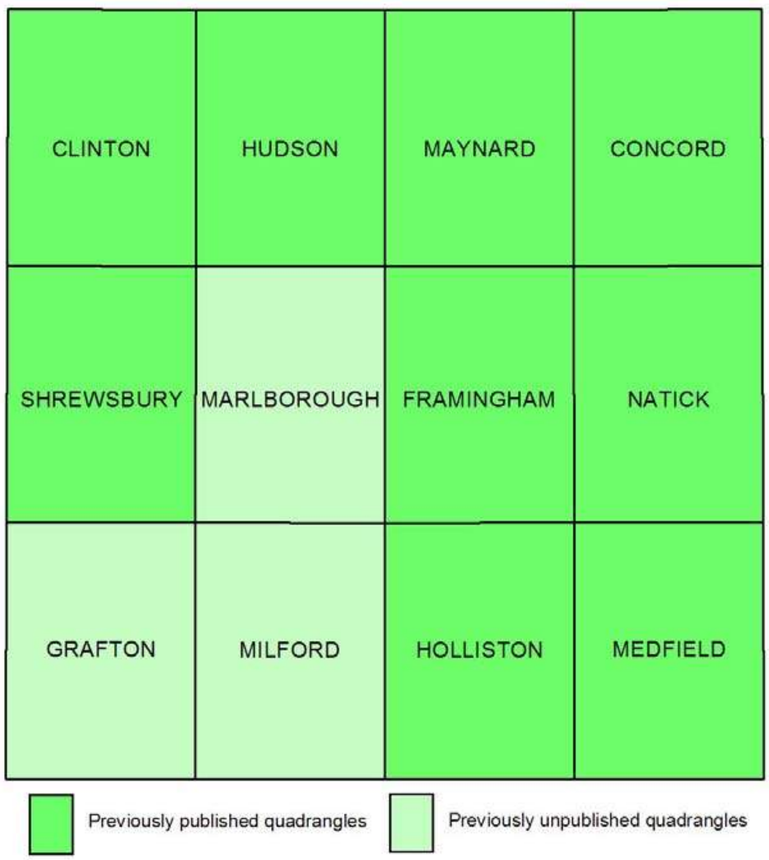


Figure 4. 7.5-minute quadrangles in this compilation.

This map was compiled in several steps: 1) Paper copies of the published surficial geologic maps for nine quadrangles were scanned and georeferenced by MASSGIS. 2) The Office of the Massachusetts State Geologist vectorized the georeferenced images in order to digitally retain the original line work of the published maps (Mabee and others, 2004). 3) Digital geologic map units were compiled and grouped into nine basic units in four broader categories: *Postglacial deposits* including artificial fill, swamp deposits, and floodplain alluvium; *glacial stratified deposits* including coarse-grained and fine-grained deposits; *glacial till* including thin till and thick till (drumlins); and *bedrock areas* including outcrops and areas of shallow bedrock). The distribution of glacial stratified deposits beneath adjacent overlying postglacial deposits and water bodies was inferred by the compilers. 4) The same basic units for three unpublished quadrangles were compiled and digitized from scanned field maps by U.S. Geological Survey personnel. 5) The 12 individual quadrangles were joined and edge-matched in order to form a seamless geologic map. Discrepancies along quadrangle boundaries were resolved, and thick till areas were added by the compilers in quadrangles where this unit was not previously mapped.

All geologic mapping was completed at 1:24,000-scale; however the browse graphic is presented at 1:50,000 scale with shaded relief base. The 1:24,000-scale, 10-ft contour interval topographic base maps used for this mapping effort are included as part of the digital data package in the TOPOS folder. The GEOLOGY folder included with this report contains 3 ARCGIS shapefiles which are geologic units that cover the entire map area, and are intended for use at quadrangle scale; the shapefiles can be clipped by quadrangle or town boundaries. Unlike conventional geologic maps, the digital mapping is arranged in layers according to superposition. The till-bedrock shapefile should be placed on the bottom, and overlain by the stratified deposits shapefile; these materials are shown everywhere that they occur including beneath postglacial deposits, such as swamp deposits, floodplain alluvium, and water bodies. The postglacial shapefile should be placed on top because these materials overlie the other two layers. Instructions for using the digital files are included in the README file and metadata.

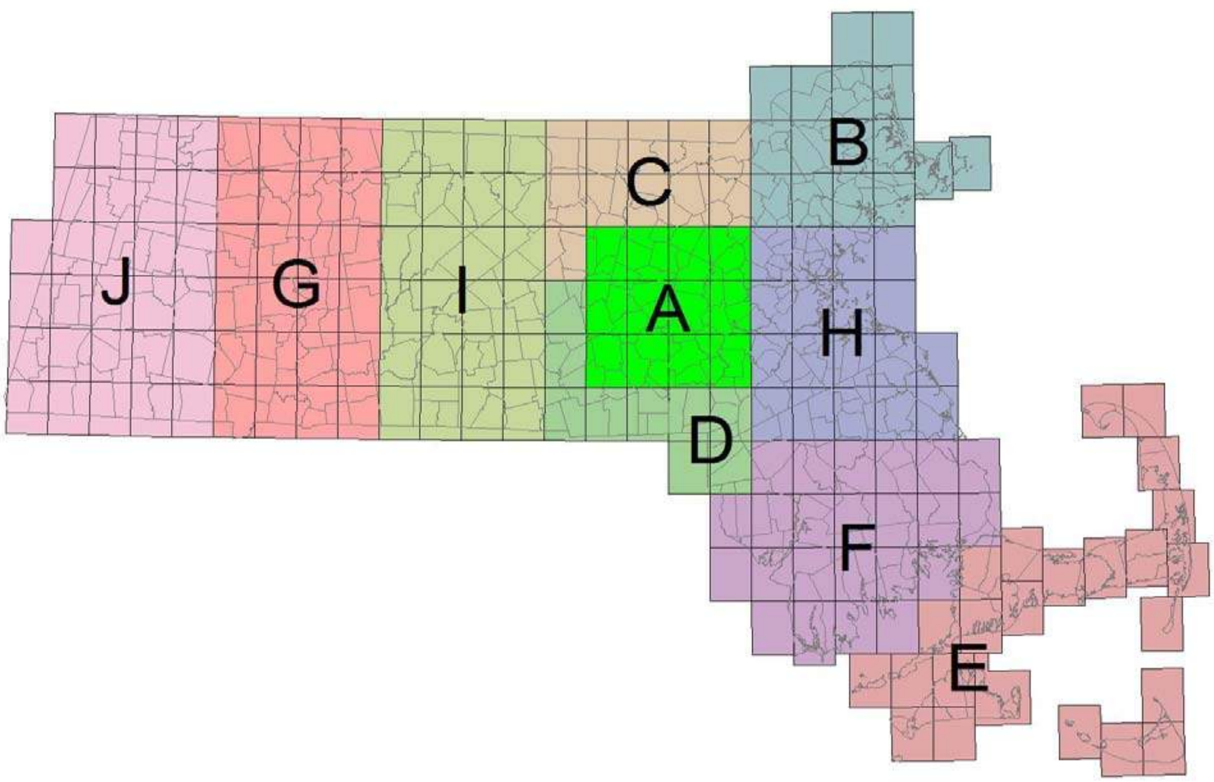


Figure 5. Compilation areas in Massachusetts.

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Appendix

Sources of Data by 7.5-Minute Quadrangle

Clinton Quadrangle

Map units were reproduced from Koteff (1966). Glacial Stratified Deposits in this quadrangle include deposits of glacial Lakes Nashua, Assabet, and Leominster, and other smaller valley deposits. Fine-grained glacial stratified deposits at land surface include glacial Lake Nashua lake-bottom deposits (unit Qnbb of Koteff, 1966). Areas of thick till shown on this map were inferred from photographic image and topographic analysis and drumlin symbols shown by Koteff (1966).

Hudson and Maynard Quadrangles

Map units were reproduced from Hansen (1956). Glacial Stratified Deposits in this quadrangle include various glacial lake and stream deposits. Fine-grained glacial stratified deposits at land surface include lake-bottom deposits of glacial Lake Sudbury (parts of unit Qsg of Hansen, 1956); this unit has been extended beneath adjacent water bodies and postglacial deposits on this map. Drumlin till unit was reproduced from the published map; other areas of thick till were inferred from photographic image and topographic analysis.

Concord Quadrangle

Map units were reproduced from Koteff (1964). Glacial Stratified Deposits in this quadrangle include deposits of glacial lakes Sudbury and Concord, and other smaller valley deposits. Fine-grained glacial stratified deposits at land surface include lake-bottom deposits of glacial Lakes Sudbury and Concord (unit Qlsb and Qlcb of Koteff, 1964); these units have been extended beneath adjacent water bodies and postglacial deposits on this map. Thick till areas shown on this map were inferred from photographic image and topographic analysis and drumlin symbols shown by Koteff (1964).

Shrewsbury Quadrangle

Map units were reproduced from Shaw (1969). Glacial Stratified Deposits in this quadrangle include deposits of glacial Lakes Assabet and Nashua, and other smaller valley deposits. Thick till areas shown on this map were inferred from photographic image and topographic analysis and drumlin symbols shown by Shaw (1969).

Marlborough Quadrangle

Stone, B.D., 1982, Unpublished field maps

Hildreth, C.T., and Stone, B.D., 2004, Surficial geologic map of the Marlborough Quadrangle, unpublished data.

Framingham Quadrangle

Map units were reproduced from Nelson (1974). Glacial Stratified Deposits in this quadrangle include deposits of glacial Lakes Charles and Sudbury, and other smaller valley deposits. Fine-grained glacial stratified deposits at land surface include lake-bottom deposits of glacial Lakes Sudbury and Charles (unit Qlsb and Qlcb of Nelson, 1974); these units have been extended beneath adjacent water bodies and postglacial deposits on this map. Some contacts between till and glacial stratified deposits have been modified from Nelson (1974). Thick till areas shown on this map were inferred from photographic image and topographic analysis and drumlin symbols shown by Nelson (1974).

Natick Quadrangle

Map units were reproduced from Nelson (1974). Glacial Stratified Deposits in this quadrangle include deposits of glacial Lakes Charles and Sudbury, and other smaller valley deposits. Fine-grained glacial stratified deposits at land surface include lake-bottom deposits of glacial lake Sudbury (unit Qlsb of Nelson, 1974); this unit has been extended beneath adjacent water bodies and postglacial deposits on this map. Thick till areas shown on this map were inferred from photographic image and topographic analysis and drumlin symbols shown by Nelson (1974).

Grafton Quadrangle

Haselton, G.M., and Fontaine, E., 1982, Unpublished field maps

Distribution of bedrock outcrops from Walsh, G.W., 2005, Bedrock Geologic Map of the Grafton quadrangle, unpublished data.

Milford Quadrangle

Haselton, G.M., and Fontaine, E., 1982, Unpublished field map.

Holliston Quadrangle

Map units were reproduced from Volckman (1975). Glacial Stratified Deposits in this quadrangle include deposits of glacial Lake Medfield, and other smaller valley deposits. Fine-grained glacial stratified deposits at land surface include lake-bottom deposits of glacial Lake Medfield (unit Qm2 of Volckman, 1975); this unit has been extended beneath adjacent water bodies and postglacial deposits on this map. Thick till areas shown on this map were inferred from photographic image and topographic analysis and drumlin symbols shown by Volckman (1975).

Medfield Quadrangle

Map units were reproduced from Volckman (1975). Glacial Stratified Deposits in this quadrangle include deposits of glacial Lake Medfield, and other smaller valley deposits. Thick till areas shown on this map were inferred from photographic image and topographic analysis and drumlin symbols shown by Volckman (1975).

DGT Associates
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Engineering

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508.879.0030
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APPENDIX 2

Long-Term Pollution Prevention Plan
with Attachments

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

DGT Job No.: F25889

DGT Associates
Surveying &
Engineering

1071 Worcester Rd.
Framingham, MA 01701
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Long-Term Pollution Prevention Plan

Attachment 1
MassDEP Snow Disposal Guidance

Attachment 2
Snow Disposal Exhibit Plan

Brush Hill Homes

34 Brush Hill Road
Sherborn, MA 01770

DGT Job No.: F25889

INTRODUCTION

This Long-Term Pollution Prevention Plan (LTPPP) prepared by DGT Associates is for the anticipated property management at Brush Hill Homes in Sherborn, Massachusetts. The document provides detailed information on practices for pollution prevention and source control to be implemented at the property following construction.

This document has been prepared in accordance with the requirements of the Stormwater Regulations issued by the Massachusetts Department of Environmental Protection (MassDEP), effective January 2, 2008. It is intended to comply with Standards 4 and 9.

The property owner will implement this Long-Term Pollution Prevention Plan and proactively conduct operations at the site in an environmentally responsible manner.

Compliance with this Long-Term Pollution Prevention Plan does not in any way dismiss the owner from compliance with other applicable Federal, State or local laws.

LONG-TERM POLLUTION PREVENTION PLAN - IMPLEMENTATION

The owner is responsible for the implementation of the Long-Term Pollution Prevention Plan and will reevaluate and amend this Long-Term Pollution Prevention Plan whenever an improvement or modification to operations can be implemented.

AVAILABILITY OF PLAN DOCUMENTS

The owner shall maintain a copy of the Long-Term Pollution Prevention Plan and related inspection reports, amendments, etc. at their offices. Copies will be made available for review to authorized personnel of the Sherborn DPW, and other authorized public officials upon request.

1.0 LONG-TERM POLLUTION PREVENTION PLAN RESPONSIBILITIES

1.01 RESPONSIBLE PARTY AND CONTACT INFORMATION

At the completion of the project, the site will be the responsibility of the owner/applicant.

Presently, the responsible party for the implementation of the Long-Term Pollution Prevention Plan is:

Brush Hill Homes, LLC
Attn.: Bob Murchison
177 Lake Street
Sherborn, MA 01770
Bob.murchison@me.com

1.02 RESPONSIBILTIES FOR IMPLEMENTATION

The following responsibilities for the implementation of the Long-Term Pollution Prevention Plan are as follows:

- Oversee property management activities on the site.
- Oversee inspection, monitoring, and reporting compliance. Ensure property management contracts includes both this Long-Term Pollution Prevention Plan as well as the Stormwater Operations and Maintenance Plan, and any other requirements issued by the Town of Sherborn to ensure compliance with this Long-Term Pollution Prevent Plan and the Operations and Maintenance Plan.
- Provide training, if necessary, to those responsible for the inspection, monitoring, and maintenance of the site.
- Identify other potential pollutant sources or deficiencies in the BMP’s (Best Management Practices) and amend the Long-Term Pollution Prevention Plan as appropriate to address those issues.

2.0 PROJECT DESCRIPTION

2.01 EXISTING SITE DESCRIPTION

Currently the site is comprised of an undeveloped wooded parcel of land. The grades generally slope down from the front to the rear of the site. There are nearby wetland resource areas that are located to the northeast and northwest of the site. Stormwater runoff from the subject site flows overland to the wetland areas.

2.02 PROPOSED PROJECT

The proposed project includes construction of eight (8) single-family houses. Site improvements include a paved roadway and associated site landscaping. Other proposed improvements include an on-site sewage disposal system and on-site water supply wells as well as a stormwater management system to meet the current MassDEP Stormwater Management Regulations.

The new stormwater management system is designed to ensure that the runoff peak flows after development will be the same or less than the existing conditions and will meet the water quality treatment and groundwater recharge requirements per the Massachusetts Stormwater Regulations. This is to ensure that there will be no impact to the downstream wetland resource areas or surrounding areas at the site. Maintenance of the stormwater management features is included in the Stormwater Operations and Maintenance Plan (Appendix 3).

3.0 PRACTICES FOR SOURCE CONTROL AND POLLUTION PREVENTION

3.01 Good Housekeeping:
Good housekeeping procedures to reduce the possibility of accidental releases and to reduce safety hazards include, but not be limited to the following:

- Proper handling and storage of solid wastes,
- Proper handling, storage and inventory of household chemicals, and
- Prompt cleanup and removal of de minimus releases.
- The owner of the facility will contract for solid waste disposal and recycling.

3.02 Storage and Proper Disposal of Hazardous Chemicals:
The owner should be aware of not only the potential hazards of various chemicals to the human body but also to the environment. Personnel need to be instructed on the proper disposal of hazardous waste and should use the Town programs such as Hazardous Waste Days for the disposal of various chemicals, including automobile fluids, paints, solvents, cleaners, etc.

3.03 Vehicle Washing:
The washing of personal vehicles on the property is not allowed. The owner should communicate the impacts of outdoor washing of vehicles on the stormwater drainage system. High loads of nutrients, metals, and hydrocarbons can enter the stormwater drainage system and have negative impacts on downstream environments. The use of commercial car wash facilities equipped for the washing of vehicles and equipment should be encouraged.

3.04 Routine Inspections and Maintenance of Stormwater BMP’s:
Detailed information regarding stormwater BMPs, including descriptions and maintenance requirements is contained in the Stormwater Operations and Maintenance Plan (Appendix 3).

3.05 Spill Prevention and Response:
The owner will implement release response procedures for releases of significant materials such as fuels, oils, or chemical materials onto the ground or other areas that could reasonably be expected to discharge to surface or groundwater.

Reportable quantities will immediately be reported to the applicable Federal, State and local agencies as required by law.

Applicable containment and cleanup procedures will be performed immediately. Impacted material collected during the response must be removed promptly and disposed of in accordance with Federal, State and local requirements. A licensed emergency response contractor may be required to assist in cleanup of releases depending on the size and location of the release, and the ability of the Contractor to perform the required response.

Reportable quantities are established under the following:

1. 40 CFR Part 110 addressing the discharge of oil in such quantities as may be harmful pursuant to Section 311 (b) (4) of the Clean Water Act.
2. 40 CFR Part 117 addresses the determination of such quantities of hazardous substances that may be harmful pursuant to Section 311 (b) (3) of the Clean Water Act.
3. 40 CFR Part 302 addresses the designation, reportable quantities, and notification requirements for the release of substances designated under section 311 (b) (2) (A) of the Clean Water Act.

3.06 Maintenance of Lawns, Fields and other Landscaped Areas:
The site includes lawn areas that require turf management to maintain them in good condition for their intended purposes. Application of fertilizers, herbicides and pesticides should be minimized.

3.07 Storage of Fertilizers, Herbicides, and Pesticides:
These chemicals should be stored inside or under cover with adequate containment.

3.08 Pet Waste Management:
The owner should require and implement “pooper-scooper” requirements for pets on the property to maintain the property free of pet waste.

3.09 Operation and Maintenance of Sanitary Sewer System
Sewage is discharged to the on-site sanitary sewer system. The system is designed for a sewage flow of gallons per day and consists of one septic tank, pump chamber (storage tank and duplex pumping system) and a gravity-fed subsurface soil absorption system (aka leaching area). The septic system, inclusive of all of its different components, must be maintained and operated in conformance with Massachusetts Title 5 Regulations. Many common chemicals can be a threat to the environment if disposed improperly. Hazardous chemicals must NOT be “poured down the drain.”

The following are the recommended maintenance and inspection procedures:

a. All components should be inspected by the owner quarterly for proper operation. This includes:
    1. Septic Tanks (Sludge thickness, scum thickness, sanitary tees and general structural integrity.
    2. Pump System: Check the control box, record the event counter, check the float switches, alarms and pump alteration, check sump for sludge buildup, manually test pumps, check for tank integrity.
    3. Soil Absorption System: Measure ponding depth in the trench observation tubes for signs of abnormal ponding depth.
b. Additional inspection requirements on an annual basis:
    1. Check the system vents for proper air venting.
    2. Check and calibrate the pump chamber dose.

The following are Routine Maintenance Tasks:

a. The septic tank is to be pumped to remove sludge when the accumulated sludge exceeds 1 foot in thickness or at least every 2 years.
b. The floating scum is to be removed when it exceeds 6 inches in thickness or at least every 2 years.
c. Any sludge in the pump storage tank and pump chamber must be removed if it exceeds 4 inches.
d. Perform any repairs or maintenance as indicated by the results of the inspections immediately as required.
e. The leaching area lines must be cleaned annually.

Note that the pumping of the tankage need only remove sufficient liquid to remove the accumulated sludge and scum. It is not necessary to remove all liquid content.

3.10 Solid Waste Management:

All waste materials are to be stored in securely lidded dumpster(s) or other secure containers as applicable to the material. Said dumpsters and containers will be monitored by the owner and emptied by a licensed waste disposal contractor on a regular basis.

3.11 Snow Disposal and Use of Deicing Chemicals:

The proposed project will require a snow management plan to be fully developed by the Owner. This plan should include the information contained within this Section 3.11 when developing the site-specific plan.

Maintenance personnel and any contractors selected for snow plowing and deicing shall be made fully aware of the requirements of this section. During typical snow plowing operations, snow shall be pushed to the shoulders of the roads. In circumstances where excess snow is impacting public safety or parking capacity, and requires snow stockpiling, the stockpiles shall be created only at designated areas. If severe conditions result in the designated areas being full, low use areas may be used for snow stockpiling on an emergency basis or snow may be removed off site. The snow shall be removed from the site and properly disposed of in accordance with the MassDEP Snow Disposal Guidance. (See Attachment 1)

Care must be taken to avoid damage of structures and landscaping.

Alternatives to sodium chloride (commonly used salt) such as sand or calcium chloride, and reduced applications, should be considered and implemented if public safety is not jeopardized.

Before winter begins, the owner and the contractor should review snow plowing, deicing, and stockpiling procedures. Areas designated for stockpiling should be cleaned of any debris. After winter but no later than May 15, the debris must be removed from the stockpiling areas and any damage to the turf, vegetation, fences, etc., should be repaired.

3.12 Street Sweeping

A roadway sweeping program should be developed in order to limit the amount of debris and pollutants that could have a negative effect on the components of the Stormwater Management System. Sweeping a minimum of twice (2) per year is recommended. Frequency should be based on the time of year as well as the weather. The first sweeping should be during the month of March before the spring rains wash off residual sand from winter applications. This will allow for the highest removal of street dirt and pollutants before they are washed into the other BMP's of the Stormwater Management System. The second sweeping should take place during the month of November to allow for the removal of leaves, twigs, and other debris caused by the late year storms, leaf fall and before the snow arrives. Any other sweeping should be determined by the owner on an as needed basis. If possible, additional sweeping should take place if the roadway becomes cluttered with dirt and debris that may have a negative effect of the other components of the Stormwater Management System.

Once removed from paved surfaces, the sweepings must be handled and disposed of properly. Pavement sweepings are solid waste subject to the Massachusetts solid waste regulations.

3.13 Stormwater System:

All routine maintenance of the new Stormwater System shall be in accordance with the Stormwater Operations and Maintenance Plan contained within Appendix 3.

4.0 INSPECTIONS AND REPORT PREPARATION

The owner shall maintain inspection and maintenance logs of the maintenance and repair of the site for items as contained in this Long-Term Pollution Prevention Plan and Stormwater Operation and Maintenance Plan. Generally, forms need to be completed when inspections, maintenance and repairs are performed. In conjunction with the Long-Term Pollution Prevention Plan, the requirements of the Stormwater Operations and Maintenance Plan shall be implemented, and the owner will oversee the inspections and preparation of the required inspection reports for compliance with that document. Forms for this purpose are contained in Appendix 3.

5.0 COORDINATION WITH OTHER PERMITS AND REQUIREMENTS

This project will be subject to a permit issued by the Town of Sherborn and other agencies as applicable. Certain conditions of those approvals affecting the long-term management of the property shall be considered part of this Long-Term Pollution Prevention Plan. The owner shall become familiar with those documents and perform their work in compliance thereto.

ATTACHMENTS

1. MassDEP Snow Disposal Guidance
2. Snow Disposal Exhibit Plan

Attachment 1

MassDEP SNOW DISPOSAL GUIDANCE

Snow Disposal Guidance

Effective Date: March 8, 2001

Guideline No. BRPG01-01

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

Supersedes: BRP Snow Disposal Guideline BRPG97-1 issued 12/19/97, and all previous snow disposal guidance

Approved by: Glenn Haas, Assistant Commissioner for Resource Protection

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are acceptable to the Department of Environmental Protection, Bureau of Resource Protection.

APPLICABILITY: These Guidelines are issued by the Bureau of Resource Protection on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to public agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

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

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

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

The purpose of these guidelines is to help municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter.

RECOMMENDED GUIDELINES

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

1. SITE SELECTION

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

- Avoid dumping of snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Do not dump snow within a Zone II or Interim Wellhead Protection Area (IWPA) of a public water supply well or within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater (see the next page for information on ordering maps from MassGIS showing the locations of aquifers, Zone II's, and IWPAs in your community).
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.
- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Site Selection Procedures

a. It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:
b. Estimate how much snow disposal capacity is needed for the season so that an adequate number of disposal sites can be selected and prepared.

c. Identify sites that could potentially be used for snow disposal such as municipal open space (e.g., parking lots or parks).
d. Sites located in upland locations that are not likely to impact sensitive environmental resources should be selected first.
e. If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

MassGIS Maps of Open Space and Water Resources

If local maps do not show the information you need to select appropriate snow disposal sites, you may order maps from MassGIS (Massachusetts Geographic Information System) which show publicly owned open spaces and approximate locations of sensitive environmental resources (locations should be field-verified where possible). Different coverages or map themes depicting sensitive environmental resources are available from MassGIS on the map you order. At a minimum, you should order the Priority Resources Map. The Priority Resources Map includes aquifers, public water supplies, MassDEP-approved Zone II's, Interim Wellhead Protection Areas, Wetlands, Open Space, Areas of Critical Environmental Concern, NHESP Wetlands Habitats, MassDEP Permitted Solid Waste facilities, Surface Water Protection areas (Zone A's) and base map features. The cost of this map is $25.00. Other coverages or map themes you may consider, depending on the location of your city or town, include Outstanding Resource Waters and MassDEP Eelgrass Resources. These are available at $25.00 each, with each map theme being depicted on a separate map. Maps should be ordered from MassGIS . Maps may also be ordered by fax at 617-626-1249 (order form available from the MassGIS web site) or mail. For further information, contact MassGIS at 617-626-1189.

2. SITE PREPARATION AND MAINTENANCE

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

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- To filter pollutants out of the meltwater, a 50-foot vegetative buffer strip should be maintained during the growth season between the disposal site and adjacent waterbodies.
- Debris should be cleared from the site prior to using the site for snow disposal.
- Debris should be cleared from the site and properly disposed of at the end of the snow season and no later than May 15.

3. EMERGENCY SNOW DISPOSAL

As mentioned earlier, it is important to estimate the amount of snow disposal capacity you will need so that an adequate number of upland disposal sites can be selected and prepared.

If despite your planning, upland disposal sites have been exhausted, snow may be disposed of near waterbodies. A vegetated buffer of at least 50 feet should still be maintained between the site and the waterbody in these situations. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, disposal of snow that is not obviously contaminated with road salt, sand, and other pollutants may be allowed in certain waterbodies under certain conditions. In these dire situations, notify your Conservation Commission and the appropriate MassDEP Regional Service Center before disposing of snow in a waterbody.

Use the following guidelines in these emergency situations:

- Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
- Do not dispose of snow in saltmarshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
- Do not dispose of snow where trucks may cause shoreline damage or erosion.
- Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.

FOR MORE INFORMATION

If you need more information, contact one of MassDEP's Regional Service Centers:

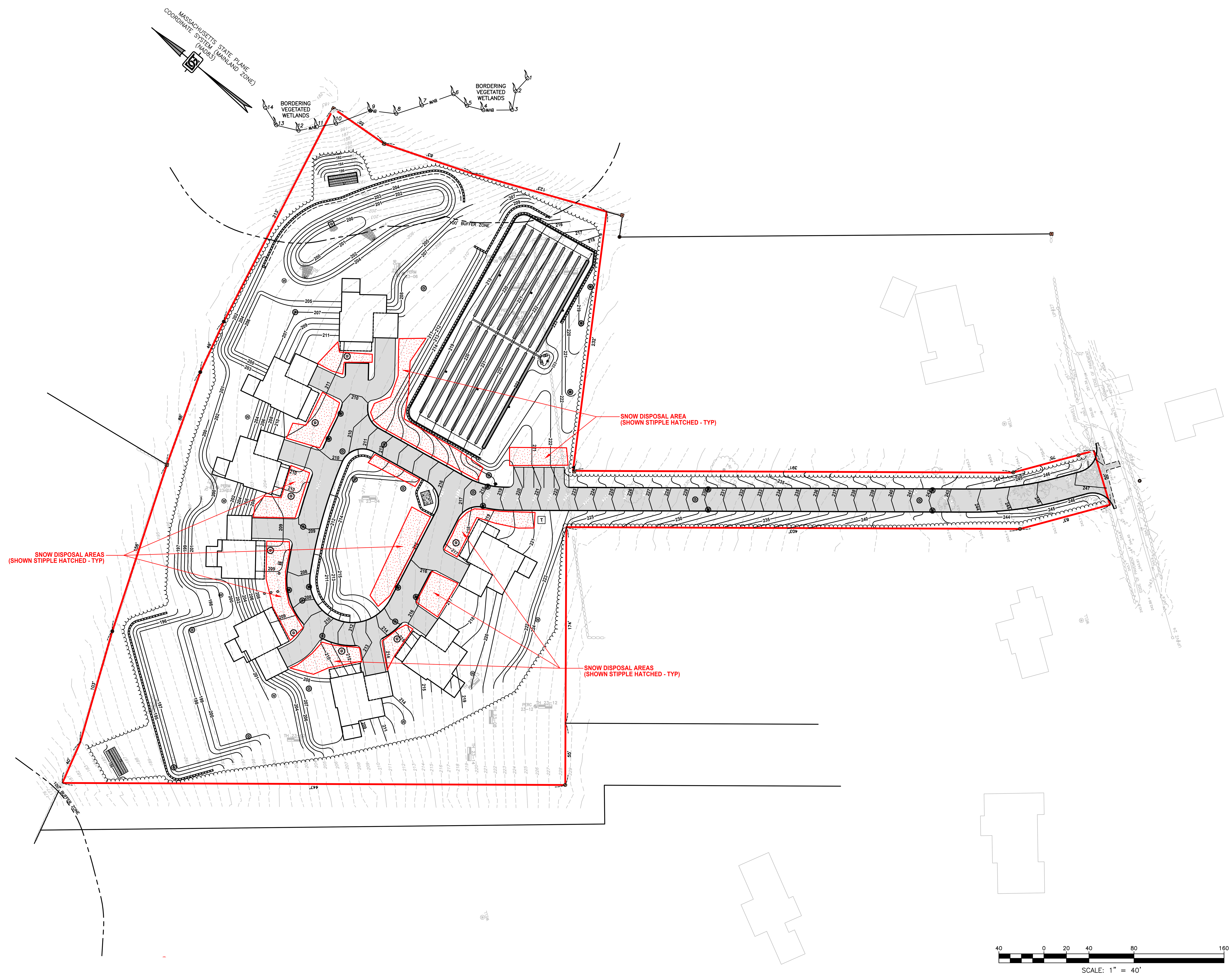
Northeast Regional Office, Wilmington, 978-694-3200
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7683
Western Regional Office, Springfield, 413-755-2214

or

Call Thomas Maguire of DEP's Bureau of Resource Protection in Boston at 617-292-5602.

Attachment 2

SNOW DISPOSAL EXHIBIT PLAN



DGT Associates Surveying & Engineering

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APPLICANT:
FENIX PARTNERS BRUSH HILL, LLC
177 LAKE STREET
SHERBORN, MA 01770

OWNER:
FENIX PARTNERS BRUSH HILL, LLC
ref.
MIDDLESEX REGISTRY OF DEEDS
BOOK: 81892 PAGE: 265

PARCEL ID:
MAP 1, LOT 0, BLOCK 18

ISSUED FOR:
COMPREHENSIVE PERMIT APPLICATION

NO.	APP	DATE	DESCRIPTION

DATE: **JUNE 26, 2024**

SCALE: **1" = 40'**

DESIGN:	DRAFTED:	CHECKED:
KMR	KMR	BEC

PROJECT TITLE:

BRUSH HILL HOMES

34 BRUSH HILL ROAD
SHERBORN, MA 01770

SHEET TITLE:

SNOW DISPOSAL EXHIBIT PLAN

SHEET: **1 OF 1**

PROJECT NO.: **F-25889**

SNOW

F:\F-25800\F-25889 Fenix 34 Brush Hill Rd Sherborn MA\F-25889_Master\Dwg\F-25889 Eng Wp.dwg

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Surveying &
Engineering

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Framingham, MA 01701
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APPENDIX 3

Stormwater BMP Operation & Maintenance Plan

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

DGT Job No.: F25889

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Stormwater BMP Operation and Maintenance Plan

Operation and Maintenance Manual
Inspection Forms
Stormwater System Maintenance Record
Proprietary Systems Operation and Maintenance Guides

Brush Hill Homes
34 Brush Hill Road
Sherborn, MA 01770

DGT Job No.: F25889

STORMWATER MANAGEMENT SYSTEM

OPERATION AND MAINTENANCE PLAN

Brush Hill Homes
34 Brush Hill Road in Sherborn, MA

In order for the stormwater management system to function properly as designed, the system must be inspected on a regular basis and maintained. The responsibility for the maintenance and operation of the system will be as follows:

Brush Hill Homes
Attn.: Bob Murchison
177 Lake Street
Sherborn, MA 01770
Bob.murchison@me.com

Routine inspections and some of the routine maintenance tasks will be performed by the owner's maintenance personnel. Hired outside contractors will be utilized for some items such as the removal of trapped oils, hydrocarbons and sediment from the stormwater treatment units and for non-routine repairs.

The stormwater management system contains the following Stormwater Best Management Practices (BMPs):

- Deep Sump Catch Basins
- Stormwater Treatment Units
- Subsurface Recharger (Infiltration) Systems
- Subsurface Detention Systems
- Surface Detention Basin
- Pipe Outfalls
- Outlet Control Structures
- Level Spreader Outlets

OPERATION AND MAINTENANCE MANUAL

Upon completion of the project, a complete Stormwater Management System, Operation and Maintenance Plan (O&M) shall be prepared containing detailed plans of the as-built system components, a description of the purpose and function of each component, inspection and maintenance tasks and schedules, check lists, and report forms.

INSPECTIONS AND MAINTENANCE

The following pages describe the inspection, routine maintenance and non-routine maintenance which are required for each BMP. These are described in a general manner at this time. The final O&M Plan will contain detailed information and actual schedules. The inspection and maintenance requirements are based on the recommendations from the MassDEP Stormwater Management Standards Handbook, February 2008. Maintenance requirements for the Stormwater Treatment Unit will be per the manufacturer's specifications. We have included the recommended maintenance requirements from the CDS Technologies design manual for the specified treatment unit. If other systems are selected, maintenance shall be in accordance with the manufacturer's recommendations.

The recommended procedures below should be followed strictly for at least the first two years of the system operation. During that period, the observations and experience gained from the monitoring and maintenance will provide the information necessary so that adjustments can be made for the most efficient operation and maintenance of the system.

NON-STORMWATER DISCHARGES

This is to provide notice to the owner and operator(s) of the subject property that the discharge of any non-stormwater to the stormwater management system is prohibited. Also, there shall be no modifications to the stormwater system for the purpose of discharging non-stormwater to the system. Non-stormwater discharges are any liquid or materials that are not the result of natural rainfall runoff or runoff from snow and ice melt. Non-stormwater discharges include, but are not limited to, detergents, soaps and sanitary sewage. The purpose of this is to protect groundwater and surface water quality, and the downstream wetlands resource areas, as well as to ensure compliance with applicable laws.

CONFINED SPACE ENTRY

Note that any inspections or maintenance activity of underground piping, chambers, deep manholes, etc that requires entry into the system must be in accordance with OSHA confined space regulations.

DEEP SUMP CATCH BASINS

DESCRIPTION AND FUNCTION

These structures collect stormwater from small drainage areas with added features to enhance the capture of gas, oils, grease, trash, floating debris, and sediment. The inlet to each deep sump catch basin is a cast iron grate over a precast concrete structure. The sump is over-sized to a minimum depth of 4 feet below the outlet pipe invert to enhance trapping of sediment. The outlet pipe includes a hooded cover to keep floating hydrocarbons and other floating debris in the catch basin.

The deep sump catch basins are effective as a pretreatment device for other stormwater BMP's.

INSPECTIONS

The deep sump catch basins should be inspected at least four times per year including at the end of the foliage and snow removal seasons. For a full inspection, remove the grate and inspect the general condition of the unit including the amount of floating debris and the presence of hydrocarbons if any. If the inspection finds a large presence of hydrocarbons, such as a layer of floating oil or a strong odor of gas, it should be removed immediately. Measure the amount of sediment that has been collected. Pipe outlets should be clear of debris. To be effective, the 4-foot deep sump must be water tight to maintain a permanent pool to the outlet pipe invert. If the water level is significantly below the outlet pipe, closer inspection for possible leaks is warranted. Note that a water level somewhat below the outlet pipe is normal during extended periods with no precipitation due to evaporation and minor expected seepage.

ROUTINE MAINTENANCE

Initially, the deep sump catch basins should be cleaned a minimum of two times a year and additionally, if necessary, based on the results of the quarterly inspection. Cleaning consists of the removal of floating hydrocarbons and accumulated sediment and clearing the inlet grate and outlet pipe. Sediment should be removed from the deep sump catch basin if the measurement of the sediment is over one foot in depth. A hazardous waste disposal contractor must perform the removal of hydrocarbons.

NON-ROUTINE MAINTENANCE

These are structural repairs and replacement of system components. Typical items for this BMP may include:

- Repairing the outlet hood and/or pipe
- Filling cracks in the concrete
- Patching mortar and brick.
- Resetting inlet grates

MAINTENANCE EQUIPMENT

- Hand tools for opening grates
- Measuring stick
- Vacuum pumping truck (haz-mat contractor for hydrocarbon removal)
- Vacuum pumping truck or clamshell (for sediment removal)

STORMWATER TREATMENT UNITS

DESCRIPTION AND FUNCTION

The Stormwater Treatment Units (STUs) are non-mechanical self-operating systems that function any time there is flow into the storm drainage system. The STU technology features a patented non-blocking, indirect screening technique to capture and retain a wide range of organic and inorganic solids and pollutants including suspended solids, fine sands, larger particles, and trash. The units are equipped with conventional oil baffles to capture and retain oil and grease. Pollutants are retained in the units' separation chamber and sump even when the design capacity is exceeded.

INSPECTIONS

The unit(s) should be inspected on a bi-monthly basis and after major storm events for the first year. Remove the cover and inspect the general condition of the unit including the amount of floating debris and the presence of hydrocarbons if any. If the inspection finds a large presence of hydrocarbons, such as a layer of floating oil or a strong odor of gasoline, it should be removed immediately. Measure the amount of sediment that has collected using a measuring stick or "Sludge Judge" measuring tube. Pipe inlets and outlets should be clear of debris. After the first year, the number of inspections may be reduced based on the experience during the first-year monitoring but not less than 2 times per year. Two of the inspections must include one at the end of the foliage season and one at the end of the snow season.

ROUTINE MAINTENANCE

The units should be cleaned a minimum of two times during the first year or when the sediment level reaches 75% of the capacity of the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated, per the manufacturer's maintenance specifications. A copy of the CDS Technologies Inspection and Maintenance Guide is provided attached to the end of this section. Cleaning consists of the removal of floating hydrocarbons and accumulated sediment and clearing the inlet pipes. The removal of hydrocarbons must be performed by a hazardous waste disposal contractor. Removal of the sediment is by a standard vacuum truck.

NON-ROUTINE MAINTENANCE
These are structural repairs and replacement of system components. Typical items for this BMP may include:

Repairing the inlet or outlet pipes.
Filling cracks in the concrete
Resetting covers.

MAINTENANCE EQUIPMENT
Hand tools for opening covers
Measuring stick or "Sludge Judge".
Vacuum pumping truck (haz-mat contractor for hydrocarbon removal)
Contracted vacuum pumping truck (for sediment removal)

SUBSURFACE RECHARGE (INFILTRATION) SYSTEMS

DESCRIPTION AND FUNCTION
Recharger #1, #2, and #3 are subsurface (underground) infiltration systems made of high-density polyethylene (HDPE) underground chamber systems arranged in parallel rows surrounded by washed stone. The chambers create arch-shaped voids within the stone to provide stormwater infiltration and detention. The chambers are constructed in a permeable soil suitable for infiltrating. An emergency overflow is provided for the system once the storage volume is exceeded. Manholes/observation ports are to finished grade and will be used for access.

The purpose of the infiltration systems is to meet the recharge requirements and to treat runoff from the paved areas of the site per the MassDEP Stormwater Management Standards.

INSPECTIONS
The infiltration systems should be inspected after every major storm for the first few months. After this time period it may be inspected once each year and should preferably be inspected two to three days after a significant storm event. The inspection should examine whether the systems are draining properly following storms. The underground infiltration systems should drain within a maximum of 72 hours following a storm event. Pipe inlets and outlets should be clear of debris and there should be no significant accumulation of sediment in the chambers. The annual inspection of the infiltration systems should include removal of the key manhole covers/observation ports to view the interior of the chamber. If significant accumulation of sediment occurs, most will be near the inlet pipe(s) to the underground chambers and can be removed by hand or vacuum pumper. A significant accumulation of sediment may indicate a problem with soil migrating into the system from the surrounding soil indicating a failure of the filter fabric protection or a pipe problem in the pipe leading into the system. Also, the outlet control structure for each subsurface recharge system shall be inspected. Refer to the inspection section for the outlet control structures for the proper procedures.

ROUTINE MAINTENANCE
The stormwater system includes significant pretreatment BMPs that protect the infiltration systems so sediment removal should rarely be required. Routine maintenance generally includes clearing debris from the inlet and outlet pipes if found during an inspection.

NON-ROUTINE MAINTENANCE
These are structural repairs and replacement of system components. Typical items for this BMP may include:

- Repairing the inlet pipes
- Filling cracks in the concrete
- Resetting covers
- Removal of significant accumulation of sediment from the chambers that affects the infiltration capacity.

MAINTENANCE EQUIPMENT
Hand tools for opening covers, flashlight.
Equipment as may be necessary to comply with OSHA confined space requirements.

SUBSURFACE DETENTION SYSTEMS

DESCRIPTION AND FUNCTION
The purpose of the detention systems is to temporarily store runoff and release the water at a controlled rate to the downstream wetland resource areas. This is to meet the peak flow requirements of the MassDEP Stormwater Management Standards.

Detention System #2 is a subsurface (underground) detention systems and is made of high-density polyethylene (HDPE) underground chamber systems arranged in parallel rows surrounded by washed stone, and filter fabric/impermeable barrier. Outlet control manholes are included to control the peak rate of runoff to downstream drainage systems.

INSPECTIONS
The detention systems should be inspected after every major storm for the first few months. After this time period they may be inspected once each year and should preferably be inspected two to three days after a significant storm event. The inspection should examine whether the chamber is draining properly following storms. Pipe inlets and outlets should be clear of debris and there should be no significant accumulation of sediment in the chambers. The annual inspection of the detention systems should include removal of the key manhole covers to view the interior of the chamber. If significant accumulation of sediment occurs, most will be near the inlet pipe(s) to the underground chamber and can be removed by hand or vacuum pumper. A significant accumulation of sediment may indicate a problem with soil migrating into the system from the surrounding soil indicating a failure of the filter fabric protection or a pipe problem in the pipe leading into the system. Also, the outlet control structure for each subsurface detention system shall be inspected. Refer to the inspection section for the Outlet Control Structures for the proper procedures.

ROUTINE MAINTENANCE
The stormwater system includes significant pretreatment BMPs that protect the detention systems so sediment removal should rarely be required. Routine maintenance generally includes clearing debris from the inlet and outlet pipes if found during an inspection.

NON-ROUTINE MAINTENANCE
These are structural repairs and replacement of system components. Typical items for this BMP may include:

- Repairing the inlet pipes

- Filling cracks in the concrete
- Resetting covers
- Removal of significant accumulation of sediment from the chambers. Removal of sediment typically requires jetting the system.

MAINTENANCE EQUIPMENT

Hand tools for opening covers, flash light.
Equipment as may be necessary to comply with OSHA confined space requirements.

SURFACE DETENTION BASIN

DESCRIPTION AND FUNCTION

Detention Basin #1 is an open, vegetated depression that temporarily detains stormwater runoff from the site and regulates the outflow. The outflow is controlled by a broad crested vegetated weir.

INSPECTIONS

The basin should be inspected semi-annually with additional inspections during the first few months after completion of the re-grading to ensure that the vegetation becomes adequately established. The basin should be inspected for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding and sedimentation. Significant ponding should be present for only a few hours following a rain event.

ROUTINE MAINTENANCE

Repairs and reseeding may be needed during the first few months until the vegetation becomes secure. The basin should be mowed once or twice per year to prevent the establishment of trees and shrubs, except those specifically planted as part of the landscape plan. The mowing must be in the mid-summer when the basin is as dry as possible, and the grass clippings should be removed. The grass should not be cut shorter than four inches. Sediment and debris should be removed at least once a year in late spring. Other tasks include fertilizing of the side slope vegetation, liming, watering, pruning, and weed and pest control. Additional mowing to 4-inch height to maintain a more “landscaped” or “manicured” appearance is allowable.

Debris cannot be allowed to accumulate on the overflow weir.

NON-ROUTINE MAINTENANCE

These are structural repairs and replacement of system components. Typical items for this BMP may include:

Major repairs of slopes
Removal of accumulated sediment should be performed at least every 10 years or when warranted based on the inspection.

MAINTENANCE EQUIPMENT

Grounds equipment
(mower, rakes, etc.)
Tractor Mower for basin bottom.

PIPE OUTFALLS

INSPECTIONS

The pipe outfalls should be inspected monthly and after a significant rain event for the first few months of operation and twice per year minimum following that. Inspect the general condition of the area including the amount of debris, the presence of hydrocarbons if any, the amount of sediment, the condition of the vegetation within and adjacent to the pipe outlets, the condition of the outfall stone and the area downstream. If the inspection finds a large presence of sediment, it should be removed. Measure the amount of sediment that has collected. Pipe inlets should be clear of debris with special attention paid to make sure no rilling or erosion has taken place around the lip of the spreader.

ROUTINE MAINTENANCE

The pipe outfalls should be cleaned a minimum of two times per year and additionally, if necessary, based on the results of the inspections. Cleaning consists of the removal of accumulated sediment and debris and clearing the inlet pipe. Vegetation around the pipe outlet should be mowed or trimmed throughout the year with the clippings removed and disposed of outside the area around the outfall. If the lip has eroded, it should be fixed immediately to prevent erosion. Observe the pipe outfalls for signs that the pipe is not draining properly. This is best observed during a significant storm event. A hazardous waste disposal contractor must perform the removal of hydrocarbons if any.

NON-ROUTINE MAINTENANCE

These are structural repairs and replacement of system components. Typical items for this BMP may include:

Re-vegetation of surrounding areas
Replacement of riprap stone lining

MAINTENANCE EQUIPMENT

Hand tools for cleaning trash and sediment

OUTLET CONTROL STRUCTURES

DESCRIPTION AND FUNCTION

These structures are precast concrete structures that regulate captured stormwater volume and the flow within subsurface rechargers and detention basins. The outlet control structures are underground manhole structures with various inlet and outlet pipes and a weir wall with orifices to control flow.

INSPECTIONS

The outlet control structures should be inspected at least four times per year including at the end of the foliage and snow removal seasons. For a full inspection, remove the cover/grate and inspect the general condition of the units including the condition of the interior weir wall and inlet/outlet pipes and orifices as applicable.

ROUTINE MAINTENANCE

Initially, the outlet control structures should be cleaned a minimum of two times a year and additionally, if necessary, based on the results of the quarterly inspection. Cleaning consists of the removal of floating debris, if any, from the interior of the structure and clearing the inlet grate, outlet pipes, weirs and control orifices as applicable for each unit.

NON-ROUTINE MAINTENANCE

These are structural repairs and replacement of system components. Typical items for this BMP may include:

- Repairing the inlet/outlet pipes
- Filling cracks in the concrete
- Patching mortar and brick.
- Resetting inlet grates

MAINTENANCE EQUIPMENT

Hand tools for opening grates & measuring stick.

LEVEL SPREADER OUTLETS

INSPECTIONS

The level spreaders should be inspected monthly and after a significant rain event for the first few months of operation and twice per year minimum following that. Inspect the general condition of the unit including the amount of debris, the presence of hydrocarbons if any, the amount of sediment, the condition of the vegetation within and adjacent to the spreader, the condition of the outfall and the area downstream. If the inspection finds a large presence of sediment, it should be removed. Measure the amount of sediment that has collected. Pipe inlets should be clear of debris with special attention paid to make sure no rilling or erosion has taken place around the lip of the spreader. Check to make sure the basin and outlet area is not becoming overgrown (choked) with vegetation.

ROUTINE MAINTENANCE

The level spreaders should be cleaned a minimum of two times per year and additionally if necessary based on the results of the inspections. Cleaning consists of the removal of accumulated sediment and debris, and clearing the inlet pipe. Vegetation around the spreader should be mowed or trimmed throughout the year with the clippings removed and disposed of outside the area around the spreader. If the lip has eroded or the curb is no longer level, it should be fixed immediately to prevent erosion. The level spreader contains a perforated pipe below the stone. Observe the pipe at the cleanout tube for signs that the pipe is not draining properly. This is best observed during a significant storm event. <u>A hazardous waste disposal contractor must perform the removal of hydrocarbons if any.</u>

NON-ROUTINE MAINTENANCE

These are structural repairs and replacement of system components. Typical items for this BMP may include:

- Repairing the inlet pipes
- Repair of erosion from outlet of lip of the spreader
- Re-vegetation of surrounding areas
- Replacement of riprap stone lining
- Adjustment leveling of outfall curb

MAINTENANCE EQUIPMENT

Hand tools for cleaning trash and sediment

Removing the outlet control manhole cover
Measuring stick for sediment depth
Vacuum pumping truck (haz-mat contractor for hydrocarbon removal)

STORMWATER SYSTEM MAINTENANCE BUDGET (PRELIMINARY)

The following is a preliminary budget for the first two years after the completion of the project. The cost assumes contracting for the services to provide routine maintenance.

Stormwater System structures to be inspected and maintained:

Item #1	Deep Sump Catch Basins (15 total)
Item #2	Stormwater Treatment Units (2 total)
Item #3	Subsurface Recharge (Infiltration) System (3 total)
Item #4	Subsurface Detention System (1 total)
Item #5	Surface Detention Basin (1 total)
Item #6	Pipe Outfalls (2 total)
Item #7	Outlet Control Structures (5 total)
Item #8	Level Spreader Outlets (2 total)

ROUTINE MAINTENANCE:
Item #1 will require a pump truck to be hired and the structure will need to be pumped to clean all of the sediment and debris out of it. This is to be done a minimum of 2 times per year.

1 Pump Truck x 2 Times/Year x $1,500 = $ 3,000/year for pumping service

Item #2 will require a vactor truck to be hired and the structure will need to be pumped to clean all of the sediment and debris out of the units. This is to be done a minimum of 2 times per year.

1 Pump Truck x 2 Times/Year x $800 = $ 1,600/year for pumping services

Item #3 routine maintenance will require removing accumulated sediment as necessary, and at least once per year near the inlet and outlet pipes if found during an inspection and the cleaning of the outlet control structure.

Est. cost = $ 300 per unit per year = $900/year

Item #4 routine maintenance will require removing accumulated sediment as necessary, and at least once per year near the inlet and outlet pipes if found during an inspection and the cleaning of the outlet control structure.

Est. cost = $ 300 per unit per year = $300/year

Item #5 will require removing accumulated sediment and debris in the basin if found during an annual inspection and the cleaning of the outlet structure. The sediment and debris should be removed with the use of hand tools (or pump truck if significant accumulation of sediment occurs).

Est. Cost = $ 600 per unit per year = $600/year

Item #6 routine maintenance will require the moving/replacing of stone and removing debris at least 2 times per year.

Est. cost = $ 500 per unit per year = $1,000/year

Item #7 routine maintenance will require removing accumulated sediment and debris out of the structures as necessary, and at least 2 times per year.

Est. cost = $ 300 per unit per year = $1,500/year

Item #8 routine maintenance will require the moving/replacing of stone and removing debris and vegetation at least 2 times per year.

Est. cost = $ 500 per unit per year = $1,000/year

Total Estimated Yearly Budget (First Year) = $9,900/year for Routine Maintenance

ROUTINE INSPECTIONS:

The routine inspections shall be performed by the on-site maintenance personnel on a monthly basis and after every major rainfall event (assumed 1 major rainfall event per month). A two (2) man crew will perform the inspections to the stormwater BMP's. The following is the budget for the routine inspections:

Deep Sump Catch Basins = 10 minutes/structure per inspection
Stormwater Treatment Units = 15 minutes/structure per inspection
Subsurface Infiltration Systems = 30 minutes/structure per inspection
Subsurface Detention Systems = 30 minutes/structure per inspection
Surface Detention Basins = 30 minutes/structure per inspection
Pipe Outfalls = 10 minutes/structure per inspection
Outlet Control Structures = 15 minutes/structure per inspection
Level Spreader Outlets = 10 minutes/structure per inspection

STORMWATER MANAGEMENT SYSTEM

INSPECTION AND MAINTENANCE FORMS

CONTENTS:

STORMWATER BMP	INSPECTION SCHEDULE	MAINTENANCE SCHEDULE
DEEP SUMP CATCH BASINS	4x per year	2x per year
STORMWATER TREATMENT UNITS	2x per year	2x per year
INFILTRATION SYSTEMS	1x per year	1x per year
SUBSURFACE DETENTION BASINS	1x per year	1x per year
SURFACE DETENTION BASIN	2x per year	2x per year
PIPE OUTFALLS	2x per year	2x per year
OUTLET CONTROL STRUCTURES	2x per year	2x per year
LEVEL SPREADER OUTLETS	2x per year	2x per year

DEEP SUMP CATCH BASINS, AREA DRAINS, & TRENCH DRAINS

Routine Inspection Checklist - Inspected quarterly Date ____________

	Inlet Grate	Sediment Depth	Hydrocarbons*	Structural Integrity	Pipes Clear	Recommended Maintenance
CB #1						
CB #2						
CB #3						
CB #4						
CB #5						
CB #6						
CB #7						
CB #8						
CB #9						
CB #10						
CB #11						
CB #12						
CB #13						
CB #14						
CB #15						

* Presence of hydrocarbons is a clearly visible layer of oil, gasoline, grease, hydraulic fluid, etc., floating on the surface or a strong odor of gas or oil

STORMWATER TREATMENT UNITS

Routine Inspection Checklist - Inspected 2 x per year Date ____________

	Structural Integrity	Sediment Depth	Hydrocarbons*	Inlet/Outlet Pipe	Floating Debris	Recommended Maintenance
STU #1						
STU #2						

* Presence of hydrocarbons is a clearly visible layer of oil, gasoline, grease, hydraulic fluid, etc., floating on the surface or a strong odor of gas or oil

RECHARGERS & DETENTION SYSTEMS

Date ____________

Routine Inspection Checklist - Inspected annually two to three days after a rainfall.

	Draining Properly	Sediment	Structural Integrity	Pipe Inlet/Outlet	Debris	Recommended Maintenance
Recharger #1						
Recharger #2						
Recharger #3						
Detention #2						

	Ponding	Sediment Depth	Outlet Structure	Floating Debris	Vegetation	Recommended Maintenance
Detention #1						

* Presence of hydrocarbons is a clearly visible layer of oil, gasoline, grease, hydraulic fluid, etc., floating on the surface or a strong odor of gas or oil

PIPE OUTFALLS

Routine Inspection Checklist - Inspected semi-annually.

Date ____________

	Draining Properly	Sediment	Structural Integrity	Pipe Inlet/Outlet	Debris	Outlet Erosion
Pipe Outfall #1	______	______	______	______	______	______
Pipe Outfall #2	______	______	______	______	______	______

OUTLET CONTROL STRUCTURES

Routine Inspection Checklist - Inspected semi-annually. Date ____________

	Inlet Grate	Sediment Depth	Hydrocarbons*	Structural Integrity	Pipes Clear	Recommended Maintenance
OCS #1	________	________	________	________	________	________
OCS #2	________	________	________	________	________	________
OCS #3	________	________	________	________	________	________
OCS #4	________	________	________	________	________	________
OCS #5	________	________	________	________	________	________

LEVEL SPREADER OUTLETS

Routine Inspection Checklist - Inspected semi-annually. Date ___________

	Draining Properly	Sediment	Structural Integrity	Pipe Inlet/Outlet	Debris	Comments
Level Spreader #1	________	________	________	________	________	________
Level Spreader #2	________	________	________	________	________	________

BRUSH HILL HOMES
STORMWATER SYSTEM MAINTENANCE RECORD

Date of Maintenance: ________________ Performed By:________________________

Maintenance / repair tasks were performed on the following on-site BMP structures:

Stormwater Structure Work Performed.________________________________

Other Comments:

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CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

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

Inspection

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

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

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

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

Cleaning

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

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

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

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y³	m³
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

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

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Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

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CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

StormTech®

MC-3500 & MC-4500 Design Manual

StormTech® Chamber Systems for Stormwater Management

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

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***For SC-160LP, SC-310, SC-740 & DC-780 designs, please refer to the SC-160LP/SC-310/SC-740/DC-780 Design Manual.**

StormTech Engineering Services assists design professionals in specifying StormTech stormwater systems. This assistance includes the layout of chambers to meet the engineer's volume requirements and the connections to and from the chambers. They can also assist converting and cost engineering projects currently specified with ponds, pipe, concrete vaults and other manufactured stormwater detention/retention products. Please note that it is the responsibility of the site design engineer to ensure that the chamber bed layout meets all design requirements and is in compliance with applicable laws and regulations governing a project.

PROPOSED LAYOUT

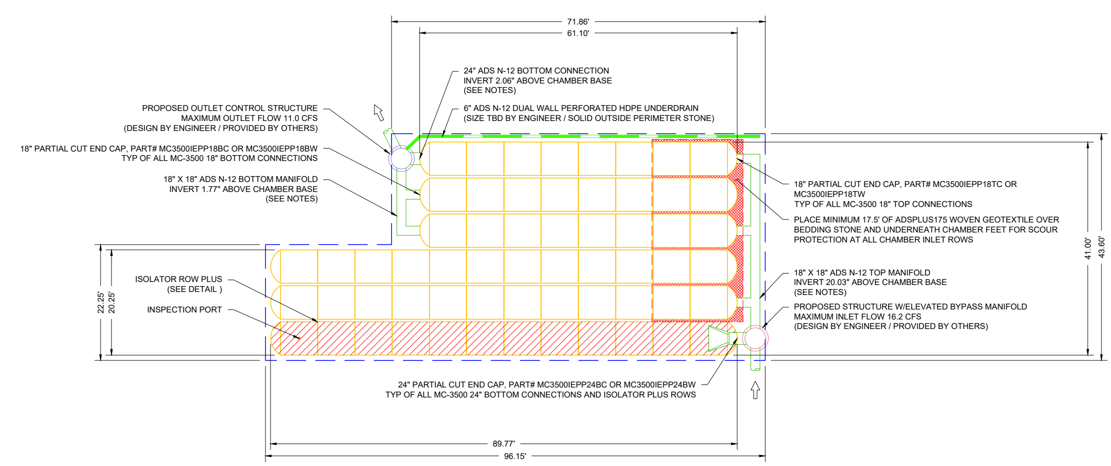
60	STORMTECH MC-3500 CHAMBERS
12	STORMTECH MC-3500 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	% STONE VOID
12,149	**INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED)**
3,674	SYSTEM AREA (ft²)
280	SYSTEM PERIMETER (ft)

PROPOSED ELEVATIONS

979.50	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
973.50	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)
973.00	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC)
973.00	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)
973.00	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT)
972.50	TOP OF STONE
971.50	TOP OF MC-3500 CHAMBER
969.42	18" TOP MANIFOLD INVERT
967.92	24" BOTTOM CONNECTION INVERT
967.92	24" ISOLATOR ROW PLUS CONNECTION INVERT
967.90	18" BOTTOM MANIFOLD INVERT
967.75	BOTTOM OF MC-3500 CHAMBER
967.00	UNDERDRAIN INVERT
967.00	BOTTOM OF STONE

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECHNICAL NOTE 6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.



EXAMPLE LAYOUT
MC-3500 CHAMBER
DATE: 08/27/20 DRAWN: ALI
PROJECT #: 123456 CHECKED: ALI

DATE | DRWN | CHKD | DESCRIPTION

StormTech

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

0 15' 30'

SHEET 2 OF 5

This manual is exclusively intended to assist engineers in the design of subsurface stormwater systems using StormTech chambers.

9.1 ISOLATOR ROW PLUS PLUS INSPECTION

Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row PLUS. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3” (76 mm), cleanout is required.

A StormTech Isolator Row PLUS should initially be inspected immediately after completion of the site’s construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site’s owner. Once in normal service, a StormTech Isolator Row PLUS should be inspected bi-annually until an understanding of the sites characteristics is developed. The site’s maintenance manager can then revise the inspection schedule based on experience or local requirements.

9.2 ISOLATOR ROW PLUS MAINTENANCE

JetVac maintenance is recommended if sediment has been collected to an average depth of 3” (76 mm) inside the Isolator Row PLUS. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row PLUS. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row PLUS while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combi- nation vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” (1143 mm) are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. The JetVac process shall only be performed on StormTech Rows that have ADS PLUS fabric over the foundation stone.

A FLAMP (flared end ramp) is attached to the inlet pipe on the inside of the chamber end cap to provide a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance over time by distributing sediment and debris that would otherwise collect at the inlet. It also serves to improve the fluid and solid flow back into the inlet pipe during maintenance and cleaning, and to guide cleaning and inspection equipment back into the inlet pipe when complete.

FLAMP (Flared End Ramp)

A typical JetVac truck (This is not a StormTech product.)

Examples of culvert cleaning nozzles appropriate for Isolator Row PLUS maintenance. (These are not StormTech products).

SC-160LP, SC-310, SC-740, DC-780 & SC-800
Design Manual

StormTech® Chamber Systems for Stormwater Management

ADS StormTech™

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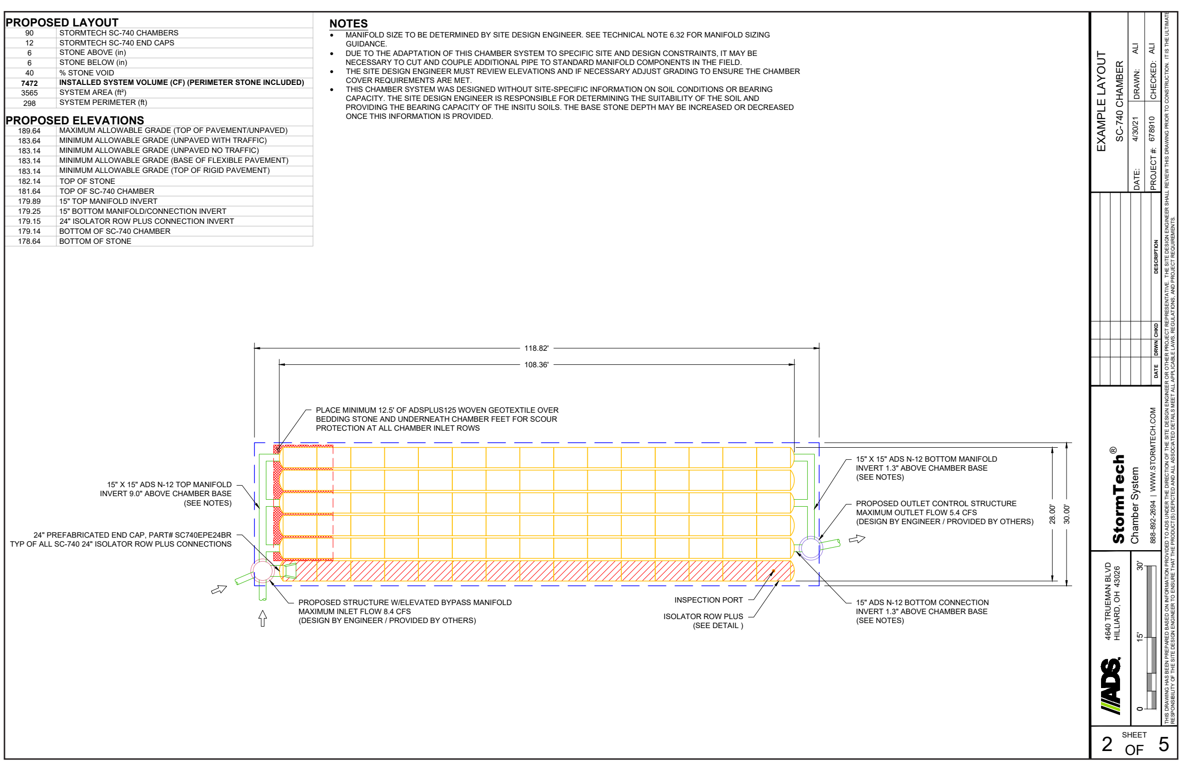
* For MC-3500 and MC-7200 designs, please refer to the MC-3500/MC-7200 Design Manual.

The StormTech Technical Services Department assists design professionals in specifying StormTech storm water systems. This assistance includes the layout of chambers to meet the engineer's volume requirements and the connections to and from the chambers. The Technical Department can also assist converting and cost engineering projects currently specified with ponds, pipe, concrete and other manufactured storm water detention/retention products. Please note that it is the responsibility of the design engineer to ensure that the chamber bed layout meets all design requirements and is in compliance with applicable laws and regulations governing this project.



This manual is exclusively intended to assist engineers in the design of subsurface stormwater systems using StormTech chambers.

12.0 Inspection and Maintenance

12.1 Isolator Row Plus Inspection

Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row PLUS. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3” (75 mm), cleanout is required.

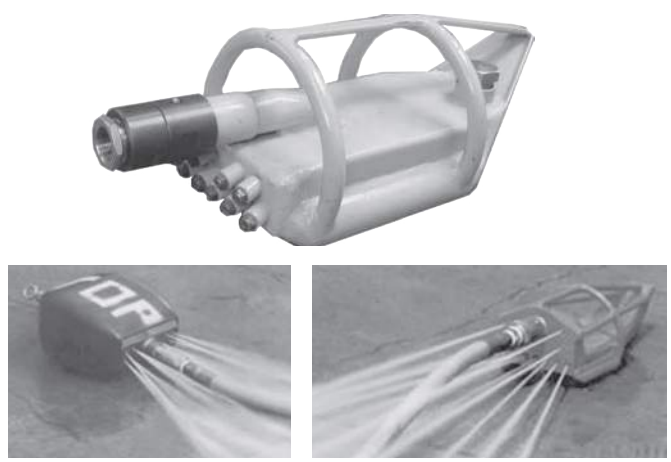
A StormTech Isolator Row PLUS should initially be inspected immediately after completion of the site’s construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site’s owner. Once in normal service, a StormTech Isolator Row PLUS should be inspected bi-annually until an understanding of the sites characteristics is developed. The site’s maintenance manager can then revise the inspection schedule based on experience or local requirements.

12.2 Isolator Row Plus Maintenance

JetVac maintenance is recommended if sediment has been collected to an average depth of 3” (75 mm) inside the Isolator Row PLUS. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row PLUS. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row PLUS while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” (1125 mm) are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. The JetVac process shall only be performed on StormTech Rows that have ADS PLUS fabric over the foundation stone.

Looking down the Isolator Row PLUS

A typical JetVac truck (This is not a StormTech product.)



Examples of culvert cleaning nozzles appropriate for Isolator Row PLUS maintenance. (These are not StormTech products).

12.0 Inspection & Maintenance

StormTech Isolator Row Plus - Step-by-Step Maintenance Procedures

Step 1: Inspect Isolator Row PLUS for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment

iv. If sediment is at, or above, 3” (76 mm) depth proceed to Step 2. If not proceed to Step 3.

B) All Isolator Plus Rows

i. Remove cover from manhole at upstream end of Isolator Row PLUS

ii. Using a flashlight, inspect down Isolator Row PLUS through outlet pipe

1. Follow OSHA regulations for confined space entry if entering manhole
2. Mirrors on poles or cameras may be used to avoid a confined space entry

iii. If sediment is at or above the lower row of sidewall holes [approximately 3” (76 mm)]proceed to Step 2. If not proceed to Step 3.

Step 2: Clean out Isolator Row PLUS using the JetVac process

A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45” (1125 mm) or more is preferable

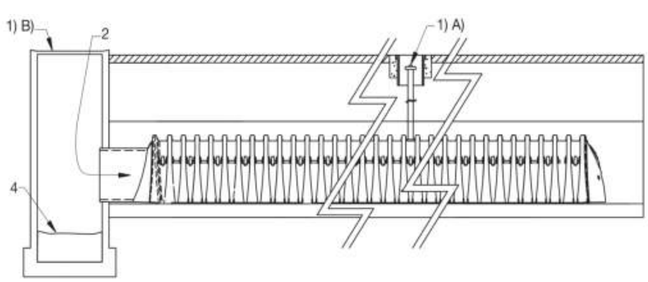
B) Apply multiple passes of JetVac until backflush water is clean

C) Vacuum manhole sump as required during jetting

Step 3: Replace all caps, lids and covers

Step 4: Inspect and clean catch basins and manholes upstream of the StormTech system following local guidelines.

Figure 18 – StormTech Isolator Row Plus (not to scale)



12.3 Eccentric Pipe Header Inspection

Theses guidelines do not supercede a pipe manufacturer’s recommended I&M procedures. Consult with the manufacturer of the pipe header system for specific I&M procedures. Inspection of the header system should be carried out quarterly. On sites which generate higher levels of sediment more frequent inspections may be necessary. Headers may be accessed through risers, access ports or manholes. Measurement of sediment may be taken with a stadia rod or similar device. Cleanout of sediment should occur when the sediment volume has reduced the storage area by 25% or the depth of sediment has reached approximately 25% of the diameter of the structure.

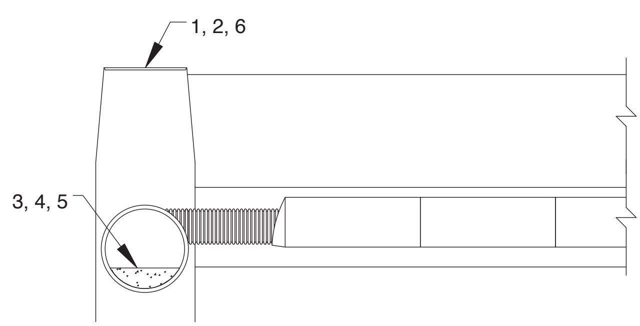
12.4 Eccentric Pipe Manifold Maintenance

Cleanout of accumulated material should be accomplished by vacuum pumping the material from the header. Cleanout should be accomplished during dry weather. Care should be taken to avoid flushing sediments out through the outlet pipes and into the chamber rows.

Eccentric Header Step-by-Step Maintenance Procedures

1. Locate manholes connected to the manifold system
2. Remove grates or covers
3. Using a stadia rod, measure the depth of sediment
4. If sediment is at a depth of about 25% pipe volume or 25% pipe diameter proceed to step 5. If not proceed to step 6.
5. Vacuum pump the sediment. Do not flush sediment out inlet pipes.
6. Replace grates and covers
7. Record depth and date and schedule next inspection

Figure 19 – Eccentric Manifold Maintenance



Please contact StormTech’s Technical Services Department at 888-892-2894 for a spreadsheet to estimate cleaning intervals.