

# Northside Meadows

518 Pleasant Street  
Framingham, Massachusetts

PREPARED FOR

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April 2016





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# 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.<sup>1</sup> 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<sup>2</sup>
- 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.

<sup>1</sup> 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.

<sup>2</sup> 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

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## 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.

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### 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

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Signature and Date

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## Checklist

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

- New development
- Redevelopment
- Mix of New Development and Redevelopment



# Checklist for Stormwater Report

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## Checklist (continued)

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

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

### Standard 1: No New Untreated Discharges

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



# Checklist for Stormwater Report

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## 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<sup>1</sup>
- 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.

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<sup>1</sup> 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



# Checklist for Stormwater Report

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## 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

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## Checklist (continued)

### Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
  - The ½" or 1" Water Quality Volume or
  - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does **not** cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

### Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



# Checklist for Stormwater Report

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## Checklist (continued)

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

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
  - Limited Project
  - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
  - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
  - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
  - Bike Path and/or Foot Path
  - Redevelopment Project
  - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
  - Construction Period Operation and Maintenance Plan;
  - Names of Persons or Entity Responsible for Plan Compliance;
  - Construction Period Pollution Prevention Measures;
  - Erosion and Sedimentation Control Plan Drawings;
  - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
  - Vegetation Planning;
  - Site Development Plan;
  - Construction Sequencing Plan;
  - Sequencing of Erosion and Sedimentation Controls;
  - Operation and Maintenance of Erosion and Sedimentation Controls;
  - Inspection Schedule;
  - Maintenance Schedule;
  - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



# Checklist for Stormwater Report

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## 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 Report Narrative

This Stormwater Report has been prepared to demonstrate compliance with the Massachusetts Stormwater Management Standards in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) and Water Quality Certification Regulations (314 CMR 9.00).

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## Project Description

Brendon Properties Northside Meadow, LLC and Benchmark Senior Living (herein after collectively referred to as the Applicant) proposes to construct an active adult residential housing and an assisted living facility, collectively referred to as Northside Meadows (the Project). As proposed, the Project consists of 60 units of active adult housing and 52 units of assisting living, ancillary landscape improvements, parking spaces, and utility improvements to support this use.

The Project will entail the construction of housing units and is not considered a Land Use with Higher Potential Pollutant Loads (LUHPPL).

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## Site Description

The Project Site is a 28.7-acre parcel of land (the Site) located at 518 Pleasant Street in Framingham, Massachusetts (see Figure 1). The Site is bounded by Pleasant Street to the north, the Massachusetts Turnpike (Route 90) to the south, Temple Street to the east, and residential single family houses with frontage on Royal Meadow Lane to the west. See Figure 1, Site Locus Map. The Site lies within the Sudbury-Assabet-Concord surface watershed. Additionally, the Site is located near the Framingham Reservoir No. 3 which is considered an Outstanding Resource Water.

Several wetland resource areas are present on the Site. For detailed information regarding the on-Site wetland resource areas, refer to the Project Notice of Intent prepared by others.

According to the National Resources Conservation Service (NRCS), surface soils on the Site include Freetown muck, Haven silt loam, Narragansett silt loam and Urban land. On-site soils are classified as Hydrologic Soil Groups (HSG) A. Based on the soil evaluation included in Appendix B, portions of the Site are considered to be within



areas of rapid infiltration (soils with a saturated hydraulic conductivity greater than 2.4 inches per hour).

## Existing Drainage Conditions

Under existing conditions, the Site is developed with the Marist House, a religious conference center and retreat, which includes two buildings, out buildings, parking lots, open fields and wetland resources with generally rolling topography. Figure 2 illustrates the existing drainage patterns on the Site. Currently, the Site is divided into seven (7) drainage areas as stormwater runoff flows to four (4) Design Points, which have been identified as:

- DP-1: the off-Site wetland resources southwest of the Site;
- DP-2: the southern property line;
- DP-3: the on-Site southeastern wetland resource; and,
- DP-4: the on-Site northeastern wetland resource.

Table 2 below provides a summary of the existing conditions hydrologic data.

**Table 2**  
**Existing Conditions Hydrologic Data**

<i>Drainage Area</i>	<i>Discharge Location</i>	<i>Design Point</i>	<i>Area (acres)</i>	<i>Curve Number</i>	<i>Time of Concentration (min)</i>
E1a	Culvert under Pleasant St	DP-1	3.0	63	16.6
E1b	Low point on the west of the Site	DP-1	3.6	48	7.7
E1c	Off-site wetlands SW of Site	DP-1	8.1	49	24.5
E2	Southern property line	DP-2	3.1	45	11.5
E3	On-site SE wetland	DP-3	5.2	36	12.1
E4a	Drainage Area E4b	DP-4	5.3	51	14.7
E4b	On-site NE wetland	DP-4	5.4	42	19.0

Total = 33.7

## Proposed Drainage Conditions

Figure 3 illustrates the proposed “post construction” drainage conditions for the Project. As shown, the Site will be divided into ten (10) drainage areas that discharge treated stormwater to the same four (4) Design Points identified in the Existing Conditions. Table 3 below provides a summary of the proposed conditions hydrologic data.



**Table 3  
Proposed Conditions Hydrologic Data**

<i>Drainage Area</i>	<i>Discharge Location</i>	<i>Design Point</i>	<i>Area (acres)</i>	<i>Curve Number</i>	<i>Time of Concentration (min)</i>
E1a	Culvert under Pleasant St	DP-1	3.0	63	16.6
P10a	Low point on the west of the Site	DP-1	1.1	59	11.5
P10b	Off-site wetlands SW of Site	DP-1	1.7	42	15.5
P11	Infiltration Basin P1b	DP-1	1.5	59	13.5
P12	Infiltration Basin P1c	DP-1	7.9	66	23.5
P20	Southern property line	DP-2	0.2	39	5.0
P30	On-site SE wetland	DP-3	4.0	36	8.4
P31	Infiltration Basin P3b	DP-3	3.0	63	15.9
P32	Rain Garden P3a	DP-3	1.8	55	19.7
P40	On-site NE wetland	DP-4	3.9	53	14.0
P41	Infiltration Basin P4	DP-4	5.6	66	13.7

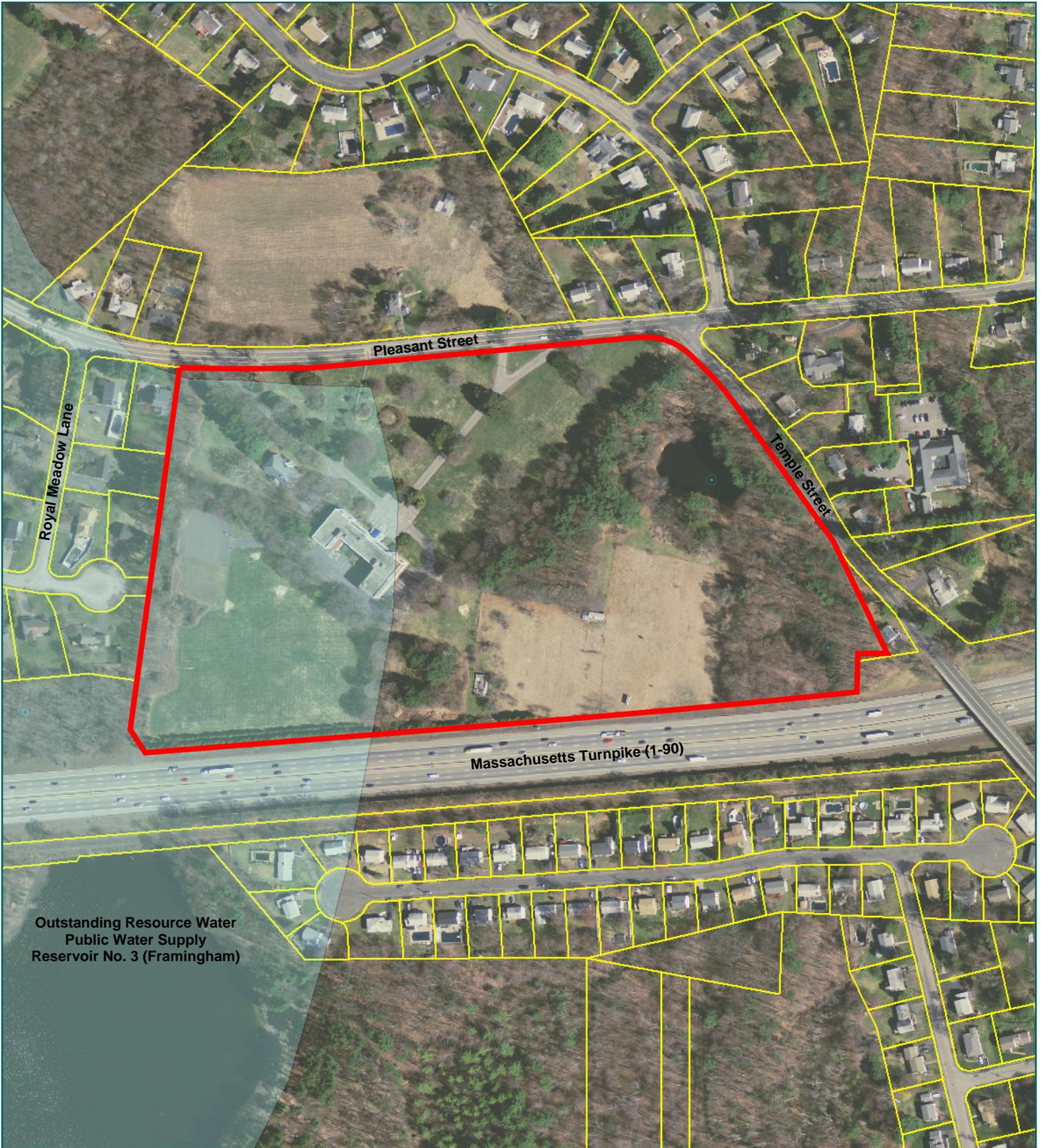
Total = 33.7

Integrated into the site design is a comprehensive stormwater management system that has been developed in accordance with the Massachusetts Stormwater Handbook. Because portions of the Project are located within an area of rapid infiltration and near an Outstanding Resource Water, the proposed stormwater management system has been designed to treat the one inch Water Quality Volume and provide 44% Total Suspended Solids (TSS) pretreatment prior to infiltration, where required.

**Environmentally Sensitive and Low Impact Development (LID) Techniques**

Low Impact Development (LID) techniques and stormwater Best Management Practices (BMPs) implemented into the site design include cluster development and naturalized surface infiltration basins. In general, stormwater from the proposed impervious surfaces is collected in deep-sump, hooded catch basins and discharged to sediment forebays, where necessary, and then infiltrated in surface infiltration basins.





Source: MassGIS



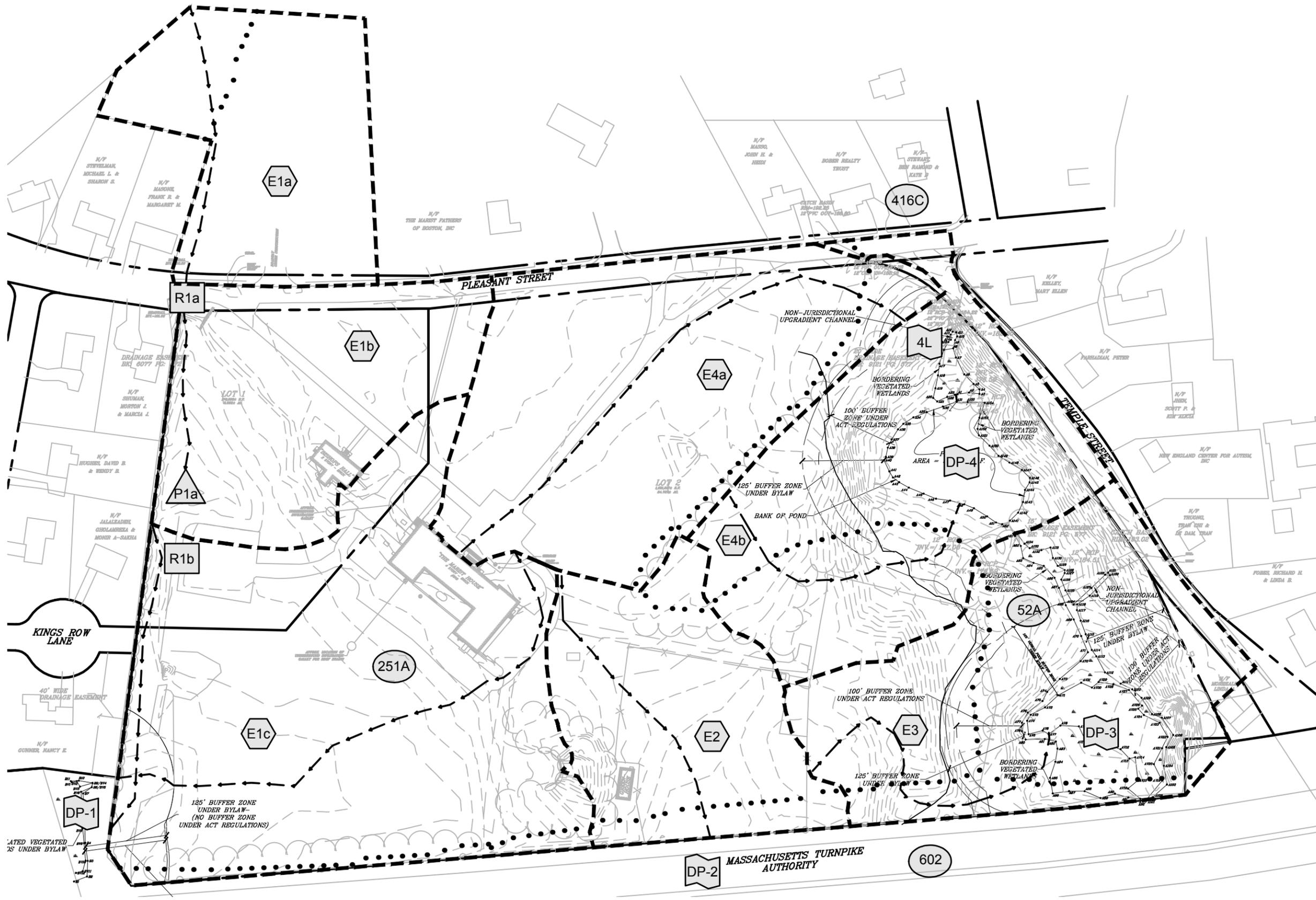
Scale = 1:3,600



Figure 1 – Site Locus Map

Northside Meadows  
Framingham, Massachusetts



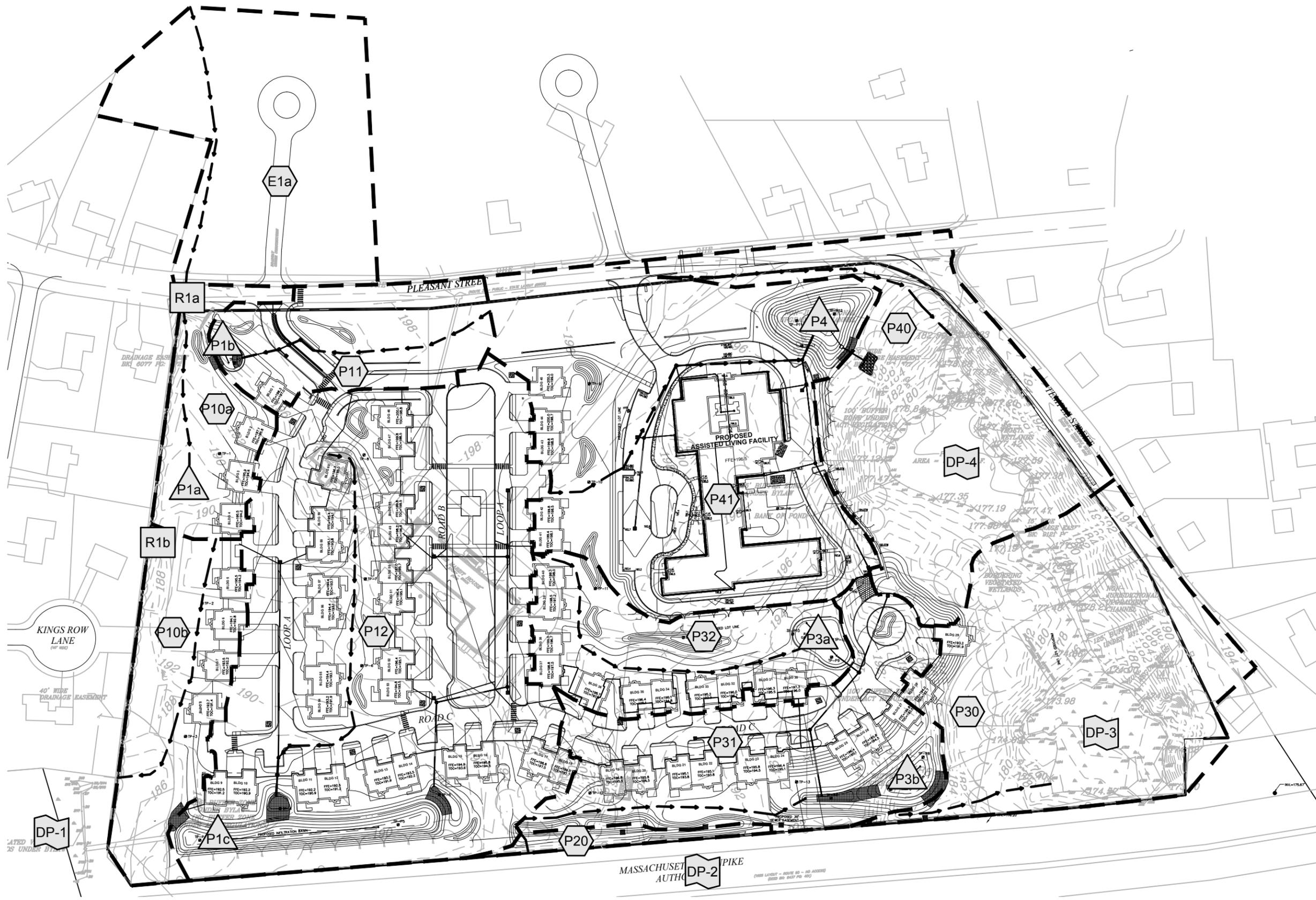


Symbol	Description
#	Drainage Area
---	Drainage Area Boundary
#	Detention Basin/Pond
#	Reach
#	Discharge Point
→	Tc Path
.....	Soil Boundary
SCS Soil Classification	
52A	Freetown Muck HSG - A
251A	Haven Silt Loam HSG - A
416C	Narragansett Silt Loam HSG - A
602	Urban Land HSG - Unknown

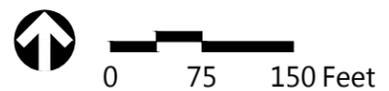


**vhb** Existing Conditions Drainage Area Map **Figure 2**  
 Northside Meadows  
 Pleasant Street  
 Framingham, Massachusetts  
 April 2016





Symbol	Description
	Drainage Area
	Drainage Area Boundary
	Detention Basin/Pond
	Reach
	Discharge Point
	Tc Path







# Regulatory Compliance

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## Massachusetts Department of Environmental Protection (DEP) - Stormwater Management Standards

As demonstrated below, the proposed Project fully complies with the DEP Stormwater Management Standards.

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### Standard 1: No New Untreated Discharges or Erosion to Wetlands

The Project has been designed to comply with Standard 1.

The Best Management Practices (BMPs) included in the proposed stormwater management system have been designed in accordance with the Massachusetts Stormwater Handbook. Supporting information and computations demonstrating that no new untreated discharges will result from the Project are presented through compliance with Standards 4 through 6.

All proposed Project stormwater outlets and conveyances have been designed to not cause erosion or scour to wetlands or receiving waters. Outlets from closed drainage systems have been designed with flared end sections that discharge to locations equipped with turf reinforcement mats to protect down gradient areas from erosion. Overflows from BMP's that impound stormwater have also been designed with turf reinforcement mats to protect down gradient areas from erosion.

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### Standard 2: Peak Rate Attenuation

The Project has been designed to comply with Standard 2.

The rainfall-runoff response of the Site under existing and proposed conditions was analyzed for storm events with recurrence intervals of 2, 10, 25 and 100-years. The results of the analysis, as summarized in Table 3 below, indicate that there is no increase in peak discharge rates between the existing and proposed conditions for the analyzed storm events.

Computations and supporting information regarding the hydrologic modeling are included in Appendix A.



**Table 4  
Peak Discharge Rates (cfs\*)**

<i>Design Point</i>	<i>2-year</i>	<i>10-year</i>	<i>25-year</i>	<i>100-year</i>
<b>Design Point: DP-1</b>				
Existing	0.2	2.6	8.6	23.1
Proposed	0.2	1.7	6.0	18.5
<b>Design Point: DP-2</b>				
Existing	0.0	0.3	1.4	4.6
Proposed	0.0	0.0	0.0	0.2
<b>Design Point: DP-3</b>				
Existing	0.0	0.0	0.2	2.7
Proposed	0.0	0.0	0.2	2.4
<b>Design Point: DP-4</b>				
Existing	0.1	1.8	5.1	15.1
Proposed	0.1	1.8	3.8	14.9

### Standard 3: Stormwater Recharge

The Project has been designed to comply with Standard 3.

In accordance with the Stormwater Handbook, the Required Recharge Volume for the Project is 19,427 cubic feet.

Recharge of stormwater has been provided through the use of surface infiltration basins, which have been sized using the static method. Each infiltration BMP has been designed to drain completely within 72 hours. Table 5 below provides a summary of the proposed infiltration BMPs utilized for the Project.

**Table 5  
Summary of Recharge Calculations**

<i>Infiltration BMP</i>	<i>Provided Recharge Volume (cubic feet)</i>
Infiltration Basin 1Pb	1,012
Infiltration Basin 1Pc	28,326
Infiltration Basin P3b	19,577
Infiltration Basin P4	29,490
<b>Total Provided Recharge</b>	<b>78,404</b>
<b>Total Required Recharge</b>	<b>19,427</b>

Soil evaluation (including Geotechnical Report), computations, and supporting information are included in Appendix B.



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#### **Standard 4: Water Quality**

The Project has been designed to comply with Standard 4.

The proposed stormwater management system implements a treatment train of BMPs that has been designed to provide 80% TSS removal of stormwater runoff from all proposed impervious surfaces, as well as 44% pretreatment prior to infiltration BMPs.

Computations and supporting information, including the Long-Term Pollution Prevention Plan, are included in Appendix C.

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#### **Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs)**

The Project is not considered a LUHPPL.

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#### **Standard 6: Critical Areas**

The Project will discharge treated storm water near a critical area and therefore has been designed with suitable BMPs sized to treat the 1-inch Water Quality Volume and provide the pretreatment requirement of 44% TSS removal prior to infiltration. Proposed source controls and pollution prevention measures have been identified in the Long-Term Pollution Prevention Plan included in Appendix C.

For computations and supporting information regarding the sizing of BMPs suitable for treatment of runoff near or to critical areas, see Appendix C.

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#### **Standard 7: Redevelopments and Other Projects Subject to the Standards only to the Maximum Extent Practicable**

The Project has been designed to comply with all ten of the Stormwater Management Standards.

Refer directly to each Standard for applicable computations and supporting information demonstrating compliance with each.

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#### **Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Controls**

The Project will disturb approximately 25 acres of land and is therefore required to obtain coverage under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Construction General Permit. As required under this permit, a Stormwater Pollution Prevention Plan (SWPPP) will be developed and submitted before land disturbance begins. Recommended construction



period pollution prevention and erosion and sedimentation controls to be finalized in the SWPPP are included in Appendix D.

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### **Standard 9: Operation and Maintenance Plan**

In compliance with Standard 9, a Post Construction Stormwater Operation and Maintenance (O&M) Plan has been developed for the Project. The O&M Plan is included in Appendix C as part of the Long Term Pollution Prevention Plan.

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### **Standard 10: Prohibition of Illicit Discharges**

Sanitary sewer and storm drainage structures which were part of the previous development on this site are to be completely removed during the site redevelopment. The design plans submitted with this report have been designed in full compliance with current standards. The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges.



# Appendix A

## Standard 2 Computations and Supporting Information

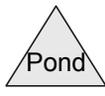
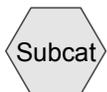
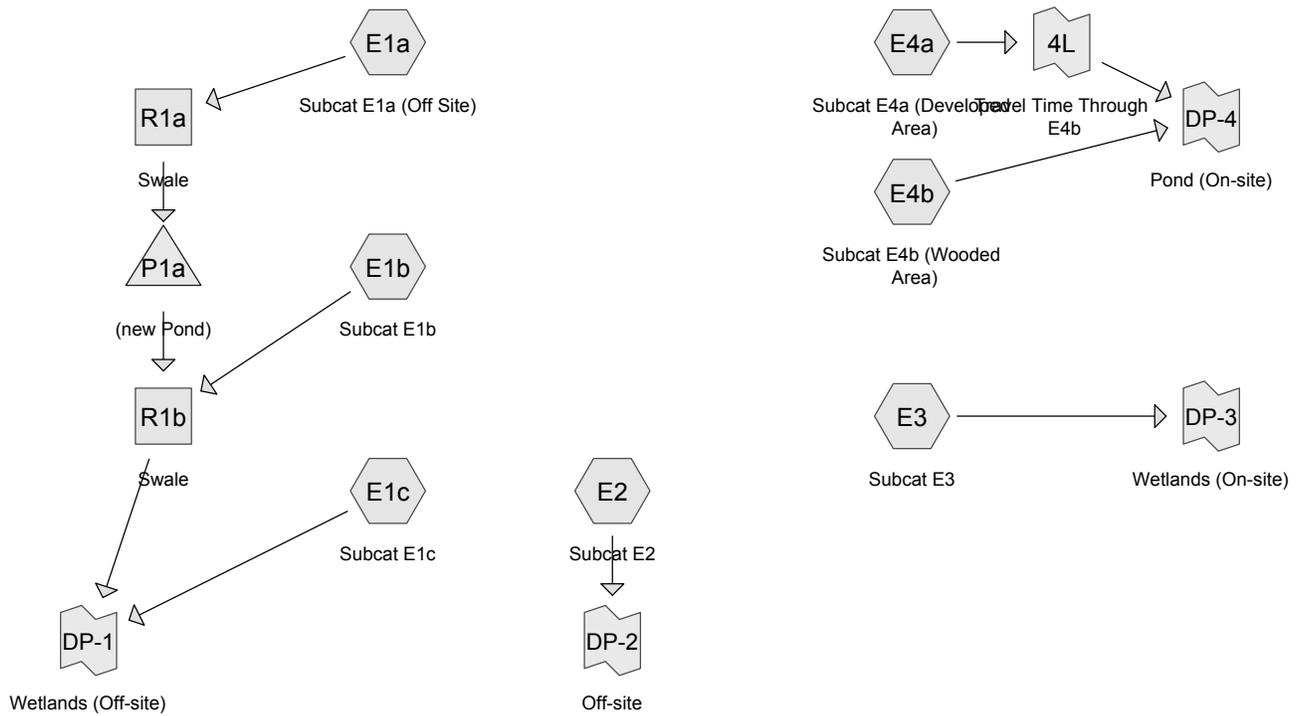
Rainfall volumes used for this analysis were based on the Northeast Regional Climate Center (NRCC) extreme precipitation database distributed by Cornell University, 24-hour storm event for Middlesex County. Runoff coefficients for the existing and proposed conditions, as previously shown in Tables 1 and 2 respectively, were determined using NRCS Technical Release 55 (TR-55) methodology as provided in HydroCAD. The HydroCAD model is based on the NRCS Technical Release 20 (TR-20) Model for Project Formulation Hydrology.





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## HydroCAD Analysis: Existing Conditions





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## 2-Year Storm Event – Existing

**13168.00-EX Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentE1a: Subcat E1a (Off Site)** Runoff Area=3.0 ac 32.0% Impervious Runoff Depth=0.5"  
 Flow Length=414' Slope=0.0310 '/' Tc=16.6 min CN=63 Runoff=0.9 cfs 0.1 af

**SubcatchmentE1b: Subcat E1b** Runoff Area=3.6 ac 16.7% Impervious Runoff Depth=0.1"  
 Flow Length=280' Tc=7.7 min CN=48 Runoff=0.0 cfs 0.0 af

**SubcatchmentE1c: Subcat E1c** Runoff Area=8.1 ac 17.3% Impervious Runoff Depth=0.1"  
 Flow Length=870' Tc=24.5 min CN=49 Runoff=0.1 cfs 0.1 af

**SubcatchmentE2: Subcat E2** Runoff Area=3.1 ac 0.0% Impervious Runoff Depth=0.0"  
 Flow Length=478' Tc=11.5 min CN=45 Runoff=0.0 cfs 0.0 af

**SubcatchmentE3: Subcat E3** Runoff Area=5.2 ac 3.8% Impervious Runoff Depth=0.0"  
 Flow Length=547' Tc=12.1 min CN=36 Runoff=0.0 cfs 0.0 af

**SubcatchmentE4a: Subcat E4a (Developed)** Runoff Area=5.3 ac 20.8% Impervious Runoff Depth=0.1"  
 Flow Length=926' Tc=14.7 min CN=51 Runoff=0.1 cfs 0.1 af

**SubcatchmentE4b: Subcat E4b (Wooded Area)** Runoff Area=5.4 ac 1.9% Impervious Runoff Depth=0.0"  
 Flow Length=476' Tc=19.0 min CN=42 Runoff=0.0 cfs 0.0 af

**Reach R1a: Swale** Avg. Flow Depth=0.1' Max Vel=2.31 fps Inflow=0.9 cfs 0.1 af  
 n=0.012 L=250.0' S=0.0140 '/' Capacity=704.5 cfs Outflow=0.9 cfs 0.1 af

**Reach R1b: Swale** Avg. Flow Depth=0.0' Max Vel=1.01 fps Inflow=0.1 cfs 0.1 af  
 n=0.012 L=475.0' S=0.0095 '/' Capacity=775.3 cfs Outflow=0.1 cfs 0.1 af

**Pond P1a: (new Pond)** Peak Elev=189.02' Storage=3,485 cf Inflow=0.9 cfs 0.1 af  
 Outflow=0.1 cfs 0.0 af

**Link 4L: Travel Time Through E4b** delayed by 1.0 min Inflow=0.1 cfs 0.1 af  
 Primary=0.1 cfs 0.1 af

**Link DP-1: Wetlands (Off-site)** Inflow=0.2 cfs 0.1 af  
 Primary=0.2 cfs 0.1 af

**Link DP-2: Off-site** Inflow=0.0 cfs 0.0 af  
 Primary=0.0 cfs 0.0 af

**Link DP-3: Wetlands (On-site)** Inflow=0.0 cfs 0.0 af  
 Primary=0.0 cfs 0.0 af

**Link DP-4: Pond (On-site)** Inflow=0.1 cfs 0.1 af  
 Primary=0.1 cfs 0.1 af

**Total Runoff Area = 33.7 ac Runoff Volume = 0.3 af Average Runoff Depth = 0.1"**  
**87.1% Pervious = 29.3 ac 12.9% Impervious = 4.4 ac**

**13168.00-EX Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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**Summary for Subcatchment E1a: Subcat E1a (Off Site)**

Runoff = 0.9 cfs @ 12.40 hrs, Volume= 0.1 af, Depth= 0.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.0	39	>75% Grass cover, Good, HSG A
0.2	98	Paved roads w/curbs & sewers, HSG A
1.7	61	1/4 acre lots, 38% imp, HSG A
0.4	30	Woods, Good, HSG A
0.3	83	1/4 acre lots, 38% imp, HSG C
0.4	70	Woods, Good, HSG C
3.0	63	Weighted Average
2.0		68.0% Pervious Area
1.0		32.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0310	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
1.7	124	0.0310	1.23		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	240	0.0310	0.88		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.6	414	Total			

**Summary for Subcatchment E1b: Subcat E1b**

Runoff = 0.0 cfs @ 17.67 hrs, Volume= 0.0 af, Depth= 0.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.1	98	Roofs, HSG A
2.8	39	>75% Grass cover, Good, HSG A
0.5	98	Paved parking, HSG A
0.0	98	Paved roads w/curbs & sewers, HSG A
0.2	30	Woods, Good, HSG A
3.6	48	Weighted Average
3.0		83.3% Pervious Area
0.6		16.7% Impervious Area

**13168.00-EX Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0230	0.16		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.3	186	0.0230	2.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	44	0.0200	0.71		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.7	280	Total			

**Summary for Subcatchment E1c: Subcat E1c**

Runoff = 0.1 cfs @ 13.81 hrs, Volume= 0.1 af, Depth= 0.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.0	30	Meadow, non-grazed, HSG A
1.1	98	Paved parking, HSG A
0.3	98	Roofs, HSG A
0.1	76	Gravel roads, HSG A
0.2	68	<50% Grass cover, Poor, HSG A
5.1	39	>75% Grass cover, Good, HSG A
1.3	30	Woods, Good, HSG A
8.1	49	Weighted Average
6.7		82.7% Pervious Area
1.4		17.3% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0040	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.0	46	0.0130	0.80		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.1	184	0.0190	2.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
10.0	499	0.0140	0.83		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.6	91	0.0350	0.94		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
24.5	870	Total			

**Summary for Subcatchment E2: Subcat E2**

Runoff = 0.0 cfs @ 23.28 hrs, Volume= 0.0 af, Depth= 0.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

**13168.00-EX Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Area (ac)	CN	Description
0.0	98	Paved parking, HSG A
0.0	98	Roofs, HSG A
0.1	76	Gravel roads, HSG A
1.9	49	50-75% Grass cover, Fair, HSG A
0.7	39	>75% Grass cover, Good, HSG A
0.4	30	Woods, Good, HSG A
3.1	45	Weighted Average
3.1		100.0% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.2	18	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	25	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
3.6	385	0.0120	1.76		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
11.5	478	Total			

**Summary for Subcatchment E3: Subcat E3**

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Depth= 0.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.0	98	Roofs, HSG A
0.0	98	Paved parking, HSG A
0.2	98	Paved roads w/curbs & sewers, HSG A
1.7	39	>75% Grass cover, Good, HSG A
3.3	30	Woods, Good, HSG A
5.2	36	Weighted Average
5.0		96.2% Pervious Area
0.2		3.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0090	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.6	115	0.0380	3.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.2	220	0.0410	3.04		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
2.5	162	0.0480	1.10		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
12.1	547	Total			

**13168.00-EX Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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**Summary for Subcatchment E4a: Subcat E4a (Developed Area)**

Runoff = 0.1 cfs @ 13.61 hrs, Volume= 0.1 af, Depth= 0.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.5	98	Paved parking, HSG A
0.6	98	Paved roads w/curbs & sewers, HSG A
4.2	39	>75% Grass cover, Good, HSG A
5.3	51	Weighted Average
4.2		79.2% Pervious Area
1.1		20.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	10	0.0100	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.9	40	0.0070	0.75		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.2"
1.0	97	0.0070	1.70		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
6.7	328	0.0030	0.82		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
2.7	270	0.0110	1.69		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.6	106	0.0350	3.01		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.7	75	0.1300	1.80		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
14.7	926	Total			

**Summary for Subcatchment E4b: Subcat E4b (Wooded Area)**

Runoff = 0.0 cfs @ 24.02 hrs, Volume= 0.0 af, Depth= 0.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.0	98	Roofs, HSG A
0.1	98	Paved roads w/curbs & sewers, HSG A
1.7	39	>75% Grass cover, Good, HSG A
3.0	30	Woods, Good, HSG A
0.6	98	Water Surface, 0% imp, HSG A
5.4	42	Weighted Average
5.3		98.1% Pervious Area
0.1		1.9% Impervious Area

**13168.00-EX Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	50	0.0134	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
2.3	67	0.0097	0.49		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.7	53	0.0560	1.18		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.4	306	0.0550	3.78		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
19.0	476	Total			

**Summary for Reach R1a: Swale**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 0.5" for 2\_year event  
 Inflow = 0.9 cfs @ 12.40 hrs, Volume= 0.1 af  
 Outflow = 0.9 cfs @ 12.45 hrs, Volume= 0.1 af, Atten= 2%, Lag= 3.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Max. Velocity= 2.31 fps, Min. Travel Time= 1.8 min  
 Avg. Velocity = 1.19 fps, Avg. Travel Time= 3.5 min

Peak Storage= 100 cf @ 12.42 hrs  
 Average Depth at Peak Storage= 0.1'  
 Bank-Full Depth= 2.0' Flow Area= 40.0 sf, Capacity= 704.5 cfs

30.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished  
 Length= 250.0' Slope= 0.0140 '/  
 Inlet Invert= 193.00', Outlet Invert= 189.50'

**Summary for Reach R1b: Swale**

Inflow Area = 6.6 ac, 23.6% Impervious, Inflow Depth = 0.1" for 2\_year event  
 Inflow = 0.1 cfs @ 17.90 hrs, Volume= 0.1 af  
 Outflow = 0.1 cfs @ 18.14 hrs, Volume= 0.1 af, Atten= 0%, Lag= 14.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Max. Velocity= 1.01 fps, Min. Travel Time= 7.8 min  
 Avg. Velocity = 0.83 fps, Avg. Travel Time= 9.6 min

Peak Storage= 55 cf @ 18.01 hrs  
 Average Depth at Peak Storage= 0.0'  
 Bank-Full Depth= 2.0' Flow Area= 53.3 sf, Capacity= 775.3 cfs

**13168.00-EX Drainage**

40.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished  
Length= 475.0' Slope= 0.0095 '/  
Inlet Invert= 189.50', Outlet Invert= 185.00'



**Summary for Pond P1a: (new Pond)**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 0.5" for 2\_year event  
Inflow = 0.9 cfs @ 12.45 hrs, Volume= 0.1 af  
Outflow = 0.1 cfs @ 17.95 hrs, Volume= 0.0 af, Atten= 90%, Lag= 330.1 min  
Primary = 0.1 cfs @ 17.95 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
Peak Elev= 189.02' @ 17.95 hrs Surf.Area= 6,180 sf Storage= 3,485 cf

Plug-Flow detention time= 463.5 min calculated for 0.0 af (38% of inflow)  
Center-of-Mass det. time= 266.4 min ( 1,230.1 - 963.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	12,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	600	0	0
189.00	6,085	3,343	3,343
190.00	12,230	9,158	12,500

Device	Routing	Invert	Outlet Devices
#1	Primary	189.00'	<b>15.0' long x 30.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=0.1 cfs @ 17.95 hrs HW=189.02' (Free Discharge)  
↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.1 cfs @ 0.33 fps)

**Summary for Link 4L: Travel Time Through E4b**

Inflow Area = 5.3 ac, 20.8% Impervious, Inflow Depth = 0.1" for 2\_year event  
Inflow = 0.1 cfs @ 13.61 hrs, Volume= 0.1 af  
Primary = 0.1 cfs @ 13.62 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.9 min

Primary outflow = Inflow delayed by 1.0 min, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-1: Wetlands (Off-site)**

Inflow Area = 14.7 ac, 20.1% Impervious, Inflow Depth = 0.1" for 2\_year event  
Inflow = 0.2 cfs @ 18.05 hrs, Volume= 0.1 af  
Primary = 0.2 cfs @ 18.05 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-2: Off-site**

Inflow Area = 3.1 ac, 0.0% Impervious, Inflow Depth = 0.0" for 2\_year event  
Inflow = 0.0 cfs @ 23.28 hrs, Volume= 0.0 af  
Primary = 0.0 cfs @ 23.28 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-3: Wetlands (On-site)**

Inflow Area = 5.2 ac, 3.8% Impervious, Inflow Depth = 0.0" for 2\_year event  
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af  
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-4: Pond (On-site)**

Inflow Area = 10.7 ac, 11.2% Impervious, Inflow Depth = 0.1" for 2\_year event  
Inflow = 0.1 cfs @ 13.62 hrs, Volume= 0.1 af  
Primary = 0.1 cfs @ 13.62 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs



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## 10-Year Storm Event – Existing

**13168.00-EX Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentE1a: Subcat E1a (Off Site)** Runoff Area=3.0 ac 32.0% Impervious Runoff Depth=1.3"  
 Flow Length=414' Slope=0.0310 '/' Tc=16.6 min CN=63 Runoff=3.0 cfs 0.3 af

**SubcatchmentE1b: Subcat E1b** Runoff Area=3.6 ac 16.7% Impervious Runoff Depth=0.5"  
 Flow Length=280' Tc=7.7 min CN=48 Runoff=0.9 cfs 0.1 af

**SubcatchmentE1c: Subcat E1c** Runoff Area=8.1 ac 17.3% Impervious Runoff Depth=0.5"  
 Flow Length=870' Tc=24.5 min CN=49 Runoff=1.5 cfs 0.4 af

**SubcatchmentE2: Subcat E2** Runoff Area=3.1 ac 0.0% Impervious Runoff Depth=0.4"  
 Flow Length=478' Tc=11.5 min CN=45 Runoff=0.3 cfs 0.1 af

**SubcatchmentE3: Subcat E3** Runoff Area=5.2 ac 3.8% Impervious Runoff Depth=0.1"  
 Flow Length=547' Tc=12.1 min CN=36 Runoff=0.0 cfs 0.0 af

**SubcatchmentE4a: Subcat E4a (Developed)** Runoff Area=5.3 ac 20.8% Impervious Runoff Depth=0.6"  
 Flow Length=926' Tc=14.7 min CN=51 Runoff=1.8 cfs 0.3 af

**SubcatchmentE4b: Subcat E4b (Wooded Area)** Runoff Area=5.4 ac 1.9% Impervious Runoff Depth=0.2"  
 Flow Length=476' Tc=19.0 min CN=42 Runoff=0.2 cfs 0.1 af

**Reach R1a: Swale** Avg. Flow Depth=0.2' Max Vel=3.30 fps Inflow=3.0 cfs 0.3 af  
 n=0.012 L=250.0' S=0.0140 '/' Capacity=704.5 cfs Outflow=3.0 cfs 0.3 af

**Reach R1b: Swale** Avg. Flow Depth=0.1' Max Vel=2.14 fps Inflow=1.5 cfs 0.4 af  
 n=0.012 L=475.0' S=0.0095 '/' Capacity=775.3 cfs Outflow=1.5 cfs 0.4 af

**Pond P1a: (new Pond)** Peak Elev=189.10' Storage=4,215 cf Inflow=3.0 cfs 0.3 af  
 Outflow=1.2 cfs 0.3 af

**Link 4L: Travel Time Through E4b** delayed by 1.0 min Inflow=1.8 cfs 0.3 af  
 Primary=1.8 cfs 0.3 af

**Link DP-1: Wetlands (Off-site)** Inflow=2.6 cfs 0.8 af  
 Primary=2.6 cfs 0.8 af

**Link DP-2: Off-site** Inflow=0.3 cfs 0.1 af  
 Primary=0.3 cfs 0.1 af

**Link DP-3: Wetlands (On-site)** Inflow=0.0 cfs 0.0 af  
 Primary=0.0 cfs 0.0 af

**Link DP-4: Pond (On-site)** Inflow=1.8 cfs 0.4 af  
 Primary=1.8 cfs 0.4 af

**Total Runoff Area = 33.7 ac Runoff Volume = 1.3 af Average Runoff Depth = 0.5"**  
**87.1% Pervious = 29.3 ac 12.9% Impervious = 4.4 ac**

**13168.00-EX Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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**Summary for Subcatchment E1a: Subcat E1a (Off Site)**

Runoff = 3.0 cfs @ 12.37 hrs, Volume= 0.3 af, Depth= 1.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.0	39	>75% Grass cover, Good, HSG A
0.2	98	Paved roads w/curbs & sewers, HSG A
1.7	61	1/4 acre lots, 38% imp, HSG A
0.4	30	Woods, Good, HSG A
0.3	83	1/4 acre lots, 38% imp, HSG C
0.4	70	Woods, Good, HSG C
3.0	63	Weighted Average
2.0		68.0% Pervious Area
1.0		32.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0310	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
1.7	124	0.0310	1.23		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	240	0.0310	0.88		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.6	414	Total			

**Summary for Subcatchment E1b: Subcat E1b**

Runoff = 0.9 cfs @ 12.30 hrs, Volume= 0.1 af, Depth= 0.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.1	98	Roofs, HSG A
2.8	39	>75% Grass cover, Good, HSG A
0.5	98	Paved parking, HSG A
0.0	98	Paved roads w/curbs & sewers, HSG A
0.2	30	Woods, Good, HSG A
3.6	48	Weighted Average
3.0		83.3% Pervious Area
0.6		16.7% Impervious Area

**13168.00-EX Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0230	0.16		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.3	186	0.0230	2.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	44	0.0200	0.71		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.7	280	Total			

**Summary for Subcatchment E1c: Subcat E1c**

Runoff = 1.5 cfs @ 12.56 hrs, Volume= 0.4 af, Depth= 0.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.0	30	Meadow, non-grazed, HSG A
1.1	98	Paved parking, HSG A
0.3	98	Roofs, HSG A
0.1	76	Gravel roads, HSG A
0.2	68	<50% Grass cover, Poor, HSG A
5.1	39	>75% Grass cover, Good, HSG A
1.3	30	Woods, Good, HSG A
8.1	49	Weighted Average
6.7		82.7% Pervious Area
1.4		17.3% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0040	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.0	46	0.0130	0.80		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.1	184	0.0190	2.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
10.0	499	0.0140	0.83		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.6	91	0.0350	0.94		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
24.5	870	Total			

**Summary for Subcatchment E2: Subcat E2**

Runoff = 0.3 cfs @ 12.42 hrs, Volume= 0.1 af, Depth= 0.4"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

**13168.00-EX Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Area (ac)	CN	Description
0.0	98	Paved parking, HSG A
0.0	98	Roofs, HSG A
0.1	76	Gravel roads, HSG A
1.9	49	50-75% Grass cover, Fair, HSG A
0.7	39	>75% Grass cover, Good, HSG A
0.4	30	Woods, Good, HSG A
3.1	45	Weighted Average
3.1		100.0% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.2	18	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	25	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
3.6	385	0.0120	1.76		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
11.5	478	Total			

**Summary for Subcatchment E3: Subcat E3**

Runoff = 0.0 cfs @ 18.11 hrs, Volume= 0.0 af, Depth= 0.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.0	98	Roofs, HSG A
0.0	98	Paved parking, HSG A
0.2	98	Paved roads w/curbs & sewers, HSG A
1.7	39	>75% Grass cover, Good, HSG A
3.3	30	Woods, Good, HSG A
5.2	36	Weighted Average
5.0		96.2% Pervious Area
0.2		3.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0090	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.6	115	0.0380	3.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.2	220	0.0410	3.04		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
2.5	162	0.0480	1.10		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
12.1	547	Total			

**13168.00-EX Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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**Summary for Subcatchment E4a: Subcat E4a (Developed Area)**

Runoff = 1.8 cfs @ 12.38 hrs, Volume= 0.3 af, Depth= 0.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.5	98	Paved parking, HSG A
0.6	98	Paved roads w/curbs & sewers, HSG A
4.2	39	>75% Grass cover, Good, HSG A
5.3	51	Weighted Average
4.2		79.2% Pervious Area
1.1		20.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	10	0.0100	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.9	40	0.0070	0.75		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.2"
1.0	97	0.0070	1.70		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
6.7	328	0.0030	0.82		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
2.7	270	0.0110	1.69		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.6	106	0.0350	3.01		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.7	75	0.1300	1.80		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
14.7	926	Total			

**Summary for Subcatchment E4b: Subcat E4b (Wooded Area)**

Runoff = 0.2 cfs @ 13.29 hrs, Volume= 0.1 af, Depth= 0.2"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.0	98	Roofs, HSG A
0.1	98	Paved roads w/curbs & sewers, HSG A
1.7	39	>75% Grass cover, Good, HSG A
3.0	30	Woods, Good, HSG A
0.6	98	Water Surface, 0% imp, HSG A
5.4	42	Weighted Average
5.3		98.1% Pervious Area
0.1		1.9% Impervious Area

**13168.00-EX Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	50	0.0134	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
2.3	67	0.0097	0.49		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.7	53	0.0560	1.18		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.4	306	0.0550	3.78		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
19.0	476	Total			

**Summary for Reach R1a: Swale**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 1.3" for 10\_year event  
 Inflow = 3.0 cfs @ 12.37 hrs, Volume= 0.3 af  
 Outflow = 3.0 cfs @ 12.41 hrs, Volume= 0.3 af, Atten= 2%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Max. Velocity= 3.30 fps, Min. Travel Time= 1.3 min  
 Avg. Velocity = 1.46 fps, Avg. Travel Time= 2.8 min

Peak Storage= 228 cf @ 12.39 hrs  
 Average Depth at Peak Storage= 0.2'  
 Bank-Full Depth= 2.0' Flow Area= 40.0 sf, Capacity= 704.5 cfs

30.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished  
 Length= 250.0' Slope= 0.0140 '/'  
 Inlet Invert= 193.00', Outlet Invert= 189.50'

**Summary for Reach R1b: Swale**

Inflow Area = 6.6 ac, 23.6% Impervious, Inflow Depth = 0.7" for 10\_year event  
 Inflow = 1.5 cfs @ 12.73 hrs, Volume= 0.4 af  
 Outflow = 1.5 cfs @ 12.86 hrs, Volume= 0.4 af, Atten= 2%, Lag= 7.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Max. Velocity= 2.14 fps, Min. Travel Time= 3.7 min  
 Avg. Velocity = 1.22 fps, Avg. Travel Time= 6.5 min

Peak Storage= 333 cf @ 12.80 hrs  
 Average Depth at Peak Storage= 0.1'  
 Bank-Full Depth= 2.0' Flow Area= 53.3 sf, Capacity= 775.3 cfs

**13168.00-EX Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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40.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished  
Length= 475.0' Slope= 0.0095 '  
Inlet Invert= 189.50', Outlet Invert= 185.00'



**Summary for Pond P1a: (new Pond)**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 1.3" for 10\_year event  
 Inflow = 3.0 cfs @ 12.41 hrs, Volume= 0.3 af  
 Outflow = 1.2 cfs @ 12.76 hrs, Volume= 0.3 af, Atten= 60%, Lag= 21.2 min  
 Primary = 1.2 cfs @ 12.76 hrs, Volume= 0.3 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 189.10' @ 12.76 hrs Surf.Area= 6,671 sf Storage= 4,215 cf

Plug-Flow detention time= 172.9 min calculated for 0.3 af (77% of inflow)  
 Center-of-Mass det. time= 73.2 min ( 989.1 - 915.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	12,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	600	0	0
189.00	6,085	3,343	3,343
190.00	12,230	9,158	12,500

Device	Routing	Invert	Outlet Devices
#1	Primary	189.00'	<b>15.0' long x 30.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=1.2 cfs @ 12.76 hrs HW=189.10' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 1.2 cfs @ 0.83 fps)

**Summary for Link 4L: Travel Time Through E4b**

Inflow Area = 5.3 ac, 20.8% Impervious, Inflow Depth = 0.6" for 10\_year event  
 Inflow = 1.8 cfs @ 12.38 hrs, Volume= 0.3 af  
 Primary = 1.8 cfs @ 12.40 hrs, Volume= 0.3 af, Atten= 1%, Lag= 1.2 min

Primary outflow = Inflow delayed by 1.0 min, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-1: Wetlands (Off-site)**

Inflow Area = 14.7 ac, 20.1% Impervious, Inflow Depth = 0.6" for 10\_year event  
Inflow = 2.6 cfs @ 12.80 hrs, Volume= 0.8 af  
Primary = 2.6 cfs @ 12.80 hrs, Volume= 0.8 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-2: Off-site**

Inflow Area = 3.1 ac, 0.0% Impervious, Inflow Depth = 0.4" for 10\_year event  
Inflow = 0.3 cfs @ 12.42 hrs, Volume= 0.1 af  
Primary = 0.3 cfs @ 12.42 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-3: Wetlands (On-site)**

Inflow Area = 5.2 ac, 3.8% Impervious, Inflow Depth = 0.1" for 10\_year event  
Inflow = 0.0 cfs @ 18.11 hrs, Volume= 0.0 af  
Primary = 0.0 cfs @ 18.11 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-4: Pond (On-site)**

Inflow Area = 10.7 ac, 11.2% Impervious, Inflow Depth = 0.4" for 10\_year event  
Inflow = 1.8 cfs @ 12.41 hrs, Volume= 0.4 af  
Primary = 1.8 cfs @ 12.41 hrs, Volume= 0.4 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs



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## 25-Year Storm Event- Existing

**13168.00-EX Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentE1a: Subcat E1a (Off Site)** Runoff Area=3.0 ac 32.0% Impervious Runoff Depth=2.1"  
 Flow Length=414' Slope=0.0310 '/' Tc=16.6 min CN=63 Runoff=4.9 cfs 0.5 af

**SubcatchmentE1b: Subcat E1b** Runoff Area=3.6 ac 16.7% Impervious Runoff Depth=1.0"  
 Flow Length=280' Tc=7.7 min CN=48 Runoff=2.7 cfs 0.3 af

**SubcatchmentE1c: Subcat E1c** Runoff Area=8.1 ac 17.3% Impervious Runoff Depth=1.0"  
 Flow Length=870' Tc=24.5 min CN=49 Runoff=4.2 cfs 0.7 af

**SubcatchmentE2: Subcat E2** Runoff Area=3.1 ac 0.0% Impervious Runoff Depth=0.8"  
 Flow Length=478' Tc=11.5 min CN=45 Runoff=1.4 cfs 0.2 af

**SubcatchmentE3: Subcat E3** Runoff Area=5.2 ac 3.8% Impervious Runoff Depth=0.3"  
 Flow Length=547' Tc=12.1 min CN=36 Runoff=0.2 cfs 0.1 af

**SubcatchmentE4a: Subcat E4a (Developed)** Runoff Area=5.3 ac 20.8% Impervious Runoff Depth=1.2"  
 Flow Length=926' Tc=14.7 min CN=51 Runoff=4.3 cfs 0.5 af

**SubcatchmentE4b: Subcat E4b (Wooded Area)** Runoff Area=5.4 ac 1.9% Impervious Runoff Depth=0.6"  
 Flow Length=476' Tc=19.0 min CN=42 Runoff=1.1 cfs 0.3 af

**Reach R1a: Swale** Avg. Flow Depth=0.2' Max Vel=3.82 fps Inflow=4.9 cfs 0.5 af  
 n=0.012 L=250.0' S=0.0140 '/' Capacity=704.5 cfs Outflow=4.8 cfs 0.5 af

**Reach R1b: Swale** Avg. Flow Depth=0.2' Max Vel=3.01 fps Inflow=4.7 cfs 0.7 af  
 n=0.012 L=475.0' S=0.0095 '/' Capacity=775.3 cfs Outflow=4.6 cfs 0.7 af

**Pond P1a: (new Pond)** Peak Elev=189.20' Storage=5,171 cf Inflow=4.8 cfs 0.5 af  
 Outflow=3.6 cfs 0.5 af

**Link 4L: Travel Time Through E4b** delayed by 1.0 min Inflow=4.3 cfs 0.5 af  
 Primary=4.2 cfs 0.5 af

**Link DP-1: Wetlands (Off-site)** Inflow=8.6 cfs 1.4 af  
 Primary=8.6 cfs 1.4 af

**Link DP-2: Off-site** Inflow=1.4 cfs 0.2 af  
 Primary=1.4 cfs 0.2 af

**Link DP-3: Wetlands (On-site)** Inflow=0.2 cfs 0.1 af  
 Primary=0.2 cfs 0.1 af

**Link DP-4: Pond (On-site)** Inflow=5.1 cfs 0.8 af  
 Primary=5.1 cfs 0.8 af

**Total Runoff Area = 33.7 ac Runoff Volume = 2.6 af Average Runoff Depth = 0.9"**  
**87.1% Pervious = 29.3 ac 12.9% Impervious = 4.4 ac**

**13168.00-EX Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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**Summary for Subcatchment E1a: Subcat E1a (Off Site)**

Runoff = 4.9 cfs @ 12.37 hrs, Volume= 0.5 af, Depth= 2.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.0	39	>75% Grass cover, Good, HSG A
0.2	98	Paved roads w/curbs & sewers, HSG A
1.7	61	1/4 acre lots, 38% imp, HSG A
0.4	30	Woods, Good, HSG A
0.3	83	1/4 acre lots, 38% imp, HSG C
0.4	70	Woods, Good, HSG C
3.0	63	Weighted Average
2.0		68.0% Pervious Area
1.0		32.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0310	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
1.7	124	0.0310	1.23		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	240	0.0310	0.88		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.6	414	Total			

**Summary for Subcatchment E1b: Subcat E1b**

Runoff = 2.7 cfs @ 12.27 hrs, Volume= 0.3 af, Depth= 1.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.1	98	Roofs, HSG A
2.8	39	>75% Grass cover, Good, HSG A
0.5	98	Paved parking, HSG A
0.0	98	Paved roads w/curbs & sewers, HSG A
0.2	30	Woods, Good, HSG A
3.6	48	Weighted Average
3.0		83.3% Pervious Area
0.6		16.7% Impervious Area

**13168.00-EX Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0230	0.16		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.3	186	0.0230	2.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	44	0.0200	0.71		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.7	280	Total			

**Summary for Subcatchment E1c: Subcat E1c**

Runoff = 4.2 cfs @ 12.51 hrs, Volume= 0.7 af, Depth= 1.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.0	30	Meadow, non-grazed, HSG A
1.1	98	Paved parking, HSG A
0.3	98	Roofs, HSG A
0.1	76	Gravel roads, HSG A
0.2	68	<50% Grass cover, Poor, HSG A
5.1	39	>75% Grass cover, Good, HSG A
1.3	30	Woods, Good, HSG A
8.1	49	Weighted Average
6.7		82.7% Pervious Area
1.4		17.3% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0040	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.0	46	0.0130	0.80		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.1	184	0.0190	2.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
10.0	499	0.0140	0.83		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.6	91	0.0350	0.94		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
24.5	870	Total			

**Summary for Subcatchment E2: Subcat E2**

Runoff = 1.4 cfs @ 12.34 hrs, Volume= 0.2 af, Depth= 0.8"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

**13168.00-EX Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Area (ac)	CN	Description
0.0	98	Paved parking, HSG A
0.0	98	Roofs, HSG A
0.1	76	Gravel roads, HSG A
1.9	49	50-75% Grass cover, Fair, HSG A
0.7	39	>75% Grass cover, Good, HSG A
0.4	30	Woods, Good, HSG A
3.1	45	Weighted Average
3.1		100.0% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.2	18	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	25	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
3.6	385	0.0120	1.76		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
11.5	478	Total			

**Summary for Subcatchment E3: Subcat E3**

Runoff = 0.2 cfs @ 13.21 hrs, Volume= 0.1 af, Depth= 0.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.0	98	Roofs, HSG A
0.0	98	Paved parking, HSG A
0.2	98	Paved roads w/curbs & sewers, HSG A
1.7	39	>75% Grass cover, Good, HSG A
3.3	30	Woods, Good, HSG A
5.2	36	Weighted Average
5.0		96.2% Pervious Area
0.2		3.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0090	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.6	115	0.0380	3.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.2	220	0.0410	3.04		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
2.5	162	0.0480	1.10		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
12.1	547	Total			

**13168.00-EX Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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**Summary for Subcatchment E4a: Subcat E4a (Developed Area)**

Runoff = 4.3 cfs @ 12.36 hrs, Volume= 0.5 af, Depth= 1.2"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.5	98	Paved parking, HSG A
0.6	98	Paved roads w/curbs & sewers, HSG A
4.2	39	>75% Grass cover, Good, HSG A
5.3	51	Weighted Average
4.2		79.2% Pervious Area
1.1		20.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	10	0.0100	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.9	40	0.0070	0.75		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.2"
1.0	97	0.0070	1.70		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
6.7	328	0.0030	0.82		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
2.7	270	0.0110	1.69		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.6	106	0.0350	3.01		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.7	75	0.1300	1.80		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
14.7	926	Total			

**Summary for Subcatchment E4b: Subcat E4b (Wooded Area)**

Runoff = 1.1 cfs @ 12.50 hrs, Volume= 0.3 af, Depth= 0.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.0	98	Roofs, HSG A
0.1	98	Paved roads w/curbs & sewers, HSG A
1.7	39	>75% Grass cover, Good, HSG A
3.0	30	Woods, Good, HSG A
0.6	98	Water Surface, 0% imp, HSG A
5.4	42	Weighted Average
5.3		98.1% Pervious Area
0.1		1.9% Impervious Area

**13168.00-EX Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	50	0.0134	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
2.3	67	0.0097	0.49		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.7	53	0.0560	1.18		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.4	306	0.0550	3.78		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
19.0	476	Total			

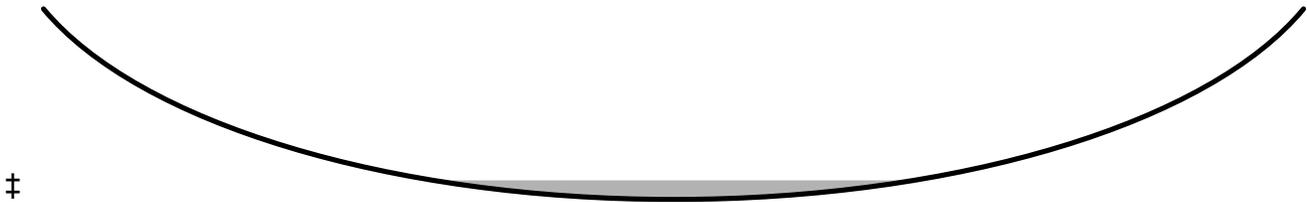
**Summary for Reach R1a: Swale**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 2.1" for 25\_year event  
 Inflow = 4.9 cfs @ 12.37 hrs, Volume= 0.5 af  
 Outflow = 4.8 cfs @ 12.40 hrs, Volume= 0.5 af, Atten= 1%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Max. Velocity= 3.82 fps, Min. Travel Time= 1.1 min  
 Avg. Velocity = 1.62 fps, Avg. Travel Time= 2.6 min

Peak Storage= 318 cf @ 12.38 hrs  
 Average Depth at Peak Storage= 0.2'  
 Bank-Full Depth= 2.0' Flow Area= 40.0 sf, Capacity= 704.5 cfs

30.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished  
 Length= 250.0' Slope= 0.0140 '/'  
 Inlet Invert= 193.00', Outlet Invert= 189.50'

**Summary for Reach R1b: Swale**

Inflow Area = 6.6 ac, 23.6% Impervious, Inflow Depth = 1.4" for 25\_year event  
 Inflow = 4.7 cfs @ 12.52 hrs, Volume= 0.7 af  
 Outflow = 4.6 cfs @ 12.60 hrs, Volume= 0.7 af, Atten= 2%, Lag= 4.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Max. Velocity= 3.01 fps, Min. Travel Time= 2.6 min  
 Avg. Velocity = 1.39 fps, Avg. Travel Time= 5.7 min

Peak Storage= 723 cf @ 12.56 hrs  
 Average Depth at Peak Storage= 0.2'  
 Bank-Full Depth= 2.0' Flow Area= 53.3 sf, Capacity= 775.3 cfs

**13168.00-EX Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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40.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished  
Length= 475.0' Slope= 0.0095 '  
Inlet Invert= 189.50', Outlet Invert= 185.00'



**Summary for Pond P1a: (new Pond)**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 2.1" for 25\_year event  
 Inflow = 4.8 cfs @ 12.40 hrs, Volume= 0.5 af  
 Outflow = 3.6 cfs @ 12.54 hrs, Volume= 0.5 af, Atten= 26%, Lag= 8.4 min  
 Primary = 3.6 cfs @ 12.54 hrs, Volume= 0.5 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 189.20' @ 12.54 hrs Surf.Area= 7,312 sf Storage= 5,171 cf

Plug-Flow detention time= 114.4 min calculated for 0.5 af (85% of inflow)  
 Center-of-Mass det. time= 45.7 min ( 942.2 - 896.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	12,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	600	0	0
189.00	6,085	3,343	3,343
190.00	12,230	9,158	12,500

Device	Routing	Invert	Outlet Devices
#1	Primary	189.00'	<b>15.0' long x 30.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=3.6 cfs @ 12.54 hrs HW=189.20' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 3.6 cfs @ 1.19 fps)

**Summary for Link 4L: Travel Time Through E4b**

Inflow Area = 5.3 ac, 20.8% Impervious, Inflow Depth = 1.2" for 25\_year event  
 Inflow = 4.3 cfs @ 12.36 hrs, Volume= 0.5 af  
 Primary = 4.2 cfs @ 12.38 hrs, Volume= 0.5 af, Atten= 1%, Lag= 1.0 min

Primary outflow = Inflow delayed by 1.0 min, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-1: Wetlands (Off-site)**

Inflow Area = 14.7 ac, 20.1% Impervious, Inflow Depth = 1.2" for 25\_year event  
Inflow = 8.6 cfs @ 12.57 hrs, Volume= 1.4 af  
Primary = 8.6 cfs @ 12.57 hrs, Volume= 1.4 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-2: Off-site**

Inflow Area = 3.1 ac, 0.0% Impervious, Inflow Depth = 0.8" for 25\_year event  
Inflow = 1.4 cfs @ 12.34 hrs, Volume= 0.2 af  
Primary = 1.4 cfs @ 12.34 hrs, Volume= 0.2 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-3: Wetlands (On-site)**

Inflow Area = 5.2 ac, 3.8% Impervious, Inflow Depth = 0.3" for 25\_year event  
Inflow = 0.2 cfs @ 13.21 hrs, Volume= 0.1 af  
Primary = 0.2 cfs @ 13.21 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-4: Pond (On-site)**

Inflow Area = 10.7 ac, 11.2% Impervious, Inflow Depth = 0.9" for 25\_year event  
Inflow = 5.1 cfs @ 12.40 hrs, Volume= 0.8 af  
Primary = 5.1 cfs @ 12.40 hrs, Volume= 0.8 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs



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## 100-Year Storm Event – Existing

**13168.00-EX Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentE1a: Subcat E1a (Off Site)** Runoff Area=3.0 ac 32.0% Impervious Runoff Depth=4.0"  
 Flow Length=414' Slope=0.0310 '/' Tc=16.6 min CN=63 Runoff=9.0 cfs 1.0 af

**SubcatchmentE1b: Subcat E1b** Runoff Area=3.6 ac 16.7% Impervious Runoff Depth=2.3"  
 Flow Length=280' Tc=7.7 min CN=48 Runoff=7.3 cfs 0.7 af

**SubcatchmentE1c: Subcat E1c** Runoff Area=8.1 ac 17.3% Impervious Runoff Depth=2.4"  
 Flow Length=870' Tc=24.5 min CN=49 Runoff=11.4 cfs 1.6 af

**SubcatchmentE2: Subcat E2** Runoff Area=3.1 ac 0.0% Impervious Runoff Depth=1.9"  
 Flow Length=478' Tc=11.5 min CN=45 Runoff=4.6 cfs 0.5 af

**SubcatchmentE3: Subcat E3** Runoff Area=5.2 ac 3.8% Impervious Runoff Depth=1.0"  
 Flow Length=547' Tc=12.1 min CN=36 Runoff=2.7 cfs 0.4 af

**SubcatchmentE4a: Subcat E4a (Developed)** Runoff Area=5.3 ac 20.8% Impervious Runoff Depth=2.6"  
 Flow Length=926' Tc=14.7 min CN=51 Runoff=10.3 cfs 1.1 af

**SubcatchmentE4b: Subcat E4b (Wooded Area)** Runoff Area=5.4 ac 1.9% Impervious Runoff Depth=1.6"  
 Flow Length=476' Tc=19.0 min CN=42 Runoff=5.1 cfs 0.7 af

**Reach R1a: Swale** Avg. Flow Depth=0.3' Max Vel=4.62 fps Inflow=9.0 cfs 1.0 af  
 n=0.012 L=250.0' S=0.0140 '/' Capacity=704.5 cfs Outflow=8.9 cfs 1.0 af

**Reach R1b: Swale** Avg. Flow Depth=0.3' Max Vel=4.03 fps Inflow=11.9 cfs 1.6 af  
 n=0.012 L=475.0' S=0.0095 '/' Capacity=775.3 cfs Outflow=11.8 cfs 1.6 af

**Pond P1a: (new Pond)** Peak Elev=189.34' Storage=6,492 cf Inflow=8.9 cfs 1.0 af  
 Outflow=8.2 cfs 0.9 af

**Link 4L: Travel Time Through E4b** delayed by 1.0 min Inflow=10.3 cfs 1.1 af  
 Primary=10.3 cfs 1.1 af

**Link DP-1: Wetlands (Off-site)** Inflow=23.1 cfs 3.2 af  
 Primary=23.1 cfs 3.2 af

**Link DP-2: Off-site** Inflow=4.6 cfs 0.5 af  
 Primary=4.6 cfs 0.5 af

**Link DP-3: Wetlands (On-site)** Inflow=2.7 cfs 0.4 af  
 Primary=2.7 cfs 0.4 af

**Link DP-4: Pond (On-site)** Inflow=15.1 cfs 1.9 af  
 Primary=15.1 cfs 1.9 af

**Total Runoff Area = 33.7 ac Runoff Volume = 6.1 af Average Runoff Depth = 2.2"**  
**87.1% Pervious = 29.3 ac 12.9% Impervious = 4.4 ac**

**13168.00-EX Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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**Summary for Subcatchment E1a: Subcat E1a (Off Site)**

Runoff = 9.0 cfs @ 12.36 hrs, Volume= 1.0 af, Depth= 4.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.0	39	>75% Grass cover, Good, HSG A
0.2	98	Paved roads w/curbs & sewers, HSG A
1.7	61	1/4 acre lots, 38% imp, HSG A
0.4	30	Woods, Good, HSG A
0.3	83	1/4 acre lots, 38% imp, HSG C
0.4	70	Woods, Good, HSG C
3.0	63	Weighted Average
2.0		68.0% Pervious Area
1.0		32.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0310	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
1.7	124	0.0310	1.23		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	240	0.0310	0.88		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.6	414	Total			

**Summary for Subcatchment E1b: Subcat E1b**

Runoff = 7.3 cfs @ 12.26 hrs, Volume= 0.7 af, Depth= 2.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.1	98	Roofs, HSG A
2.8	39	>75% Grass cover, Good, HSG A
0.5	98	Paved parking, HSG A
0.0	98	Paved roads w/curbs & sewers, HSG A
0.2	30	Woods, Good, HSG A
3.6	48	Weighted Average
3.0		83.3% Pervious Area
0.6		16.7% Impervious Area

**13168.00-EX Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0230	0.16		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.3	186	0.0230	2.44		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	44	0.0200	0.71		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.7	280	Total			

**Summary for Subcatchment E1c: Subcat E1c**

Runoff = 11.4 cfs @ 12.48 hrs, Volume= 1.6 af, Depth= 2.4"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.0	30	Meadow, non-grazed, HSG A
1.1	98	Paved parking, HSG A
0.3	98	Roofs, HSG A
0.1	76	Gravel roads, HSG A
0.2	68	<50% Grass cover, Poor, HSG A
5.1	39	>75% Grass cover, Good, HSG A
1.3	30	Woods, Good, HSG A
8.1	49	Weighted Average
6.7		82.7% Pervious Area
1.4		17.3% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0040	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.0	46	0.0130	0.80		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.1	184	0.0190	2.80		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
10.0	499	0.0140	0.83		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.6	91	0.0350	0.94		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
24.5	870	Total			

**Summary for Subcatchment E2: Subcat E2**

Runoff = 4.6 cfs @ 12.31 hrs, Volume= 0.5 af, Depth= 1.9"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

**13168.00-EX Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Area (ac)	CN	Description
0.0	98	Paved parking, HSG A
0.0	98	Roofs, HSG A
0.1	76	Gravel roads, HSG A
1.9	49	50-75% Grass cover, Fair, HSG A
0.7	39	>75% Grass cover, Good, HSG A
0.4	30	Woods, Good, HSG A
3.1	45	Weighted Average
3.1		100.0% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.2	18	0.0100	1.61		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	25	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
3.6	385	0.0120	1.76		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
11.5	478	Total			

**Summary for Subcatchment E3: Subcat E3**

Runoff = 2.7 cfs @ 12.36 hrs, Volume= 0.4 af, Depth= 1.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.0	98	Roofs, HSG A
0.0	98	Paved parking, HSG A
0.2	98	Paved roads w/curbs & sewers, HSG A
1.7	39	>75% Grass cover, Good, HSG A
3.3	30	Woods, Good, HSG A
5.2	36	Weighted Average
5.0		96.2% Pervious Area
0.2		3.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0090	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.6	115	0.0380	3.14		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.2	220	0.0410	3.04		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
2.5	162	0.0480	1.10		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
12.1	547	Total			

**13168.00-EX Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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**Summary for Subcatchment E4a: Subcat E4a (Developed Area)**

Runoff = 10.3 cfs @ 12.35 hrs, Volume= 1.1 af, Depth= 2.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.5	98	Paved parking, HSG A
0.6	98	Paved roads w/curbs & sewers, HSG A
4.2	39	>75% Grass cover, Good, HSG A
5.3	51	Weighted Average
4.2		79.2% Pervious Area
1.1		20.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	10	0.0100	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.9	40	0.0070	0.75		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.2"
1.0	97	0.0070	1.70		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
6.7	328	0.0030	0.82		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
2.7	270	0.0110	1.69		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.6	106	0.0350	3.01		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.7	75	0.1300	1.80		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
14.7	926	Total			

**Summary for Subcatchment E4b: Subcat E4b (Wooded Area)**

Runoff = 5.1 cfs @ 12.42 hrs, Volume= 0.7 af, Depth= 1.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.0	98	Roofs, HSG A
0.1	98	Paved roads w/curbs & sewers, HSG A
1.7	39	>75% Grass cover, Good, HSG A
3.0	30	Woods, Good, HSG A
0.6	98	Water Surface, 0% imp, HSG A
5.4	42	Weighted Average
5.3		98.1% Pervious Area
0.1		1.9% Impervious Area

**13168.00-EX Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	50	0.0134	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
2.3	67	0.0097	0.49		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.7	53	0.0560	1.18		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.4	306	0.0550	3.78		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
19.0	476	Total			

**Summary for Reach R1a: Swale**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 4.0" for 100\_year event  
 Inflow = 9.0 cfs @ 12.36 hrs, Volume= 1.0 af  
 Outflow = 8.9 cfs @ 12.39 hrs, Volume= 1.0 af, Atten= 1%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Max. Velocity= 4.62 fps, Min. Travel Time= 0.9 min  
 Avg. Velocity = 1.85 fps, Avg. Travel Time= 2.3 min

Peak Storage= 485 cf @ 12.37 hrs  
 Average Depth at Peak Storage= 0.3'  
 Bank-Full Depth= 2.0' Flow Area= 40.0 sf, Capacity= 704.5 cfs

30.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished  
 Length= 250.0' Slope= 0.0140 '/'  
 Inlet Invert= 193.00', Outlet Invert= 189.50'



**Summary for Reach R1b: Swale**

Inflow Area = 6.6 ac, 23.6% Impervious, Inflow Depth = 2.9" for 100\_year event  
 Inflow = 11.9 cfs @ 12.32 hrs, Volume= 1.6 af  
 Outflow = 11.8 cfs @ 12.39 hrs, Volume= 1.6 af, Atten= 0%, Lag= 4.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Max. Velocity= 4.03 fps, Min. Travel Time= 2.0 min  
 Avg. Velocity = 1.64 fps, Avg. Travel Time= 4.8 min

Peak Storage= 1,397 cf @ 12.36 hrs  
 Average Depth at Peak Storage= 0.3'  
 Bank-Full Depth= 2.0' Flow Area= 53.3 sf, Capacity= 775.3 cfs

**13168.00-EX Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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40.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished  
 Length= 475.0' Slope= 0.0095 '  
 Inlet Invert= 189.50', Outlet Invert= 185.00'



**Summary for Pond P1a: (new Pond)**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 4.0" for 100\_year event  
 Inflow = 8.9 cfs @ 12.39 hrs, Volume= 1.0 af  
 Outflow = 8.2 cfs @ 12.46 hrs, Volume= 0.9 af, Atten= 8%, Lag= 4.2 min  
 Primary = 8.2 cfs @ 12.46 hrs, Volume= 0.9 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 189.34' @ 12.46 hrs Surf.Area= 8,198 sf Storage= 6,492 cf

Plug-Flow detention time= 69.8 min calculated for 0.9 af (92% of inflow)  
 Center-of-Mass det. time= 29.4 min ( 900.4 - 871.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	12,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	600	0	0
189.00	6,085	3,343	3,343
190.00	12,230	9,158	12,500

Device	Routing	Invert	Outlet Devices
#1	Primary	189.00'	<b>15.0' long x 30.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=8.1 cfs @ 12.46 hrs HW=189.34' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 8.1 cfs @ 1.58 fps)

**Summary for Link 4L: Travel Time Through E4b**

Inflow Area = 5.3 ac, 20.8% Impervious, Inflow Depth = 2.6" for 100\_year event  
 Inflow = 10.3 cfs @ 12.35 hrs, Volume= 1.1 af  
 Primary = 10.3 cfs @ 12.36 hrs, Volume= 1.1 af, Atten= 1%, Lag= 1.1 min

Primary outflow = Inflow delayed by 1.0 min, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-1: Wetlands (Off-site)**

Inflow Area = 14.7 ac, 20.1% Impervious, Inflow Depth = 2.6" for 100\_year event  
Inflow = 23.1 cfs @ 12.47 hrs, Volume= 3.2 af  
Primary = 23.1 cfs @ 12.47 hrs, Volume= 3.2 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-2: Off-site**

Inflow Area = 3.1 ac, 0.0% Impervious, Inflow Depth = 1.9" for 100\_year event  
Inflow = 4.6 cfs @ 12.31 hrs, Volume= 0.5 af  
Primary = 4.6 cfs @ 12.31 hrs, Volume= 0.5 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-3: Wetlands (On-site)**

Inflow Area = 5.2 ac, 3.8% Impervious, Inflow Depth = 1.0" for 100\_year event  
Inflow = 2.7 cfs @ 12.36 hrs, Volume= 0.4 af  
Primary = 2.7 cfs @ 12.36 hrs, Volume= 0.4 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-4: Pond (On-site)**

Inflow Area = 10.7 ac, 11.2% Impervious, Inflow Depth = 2.1" for 100\_year event  
Inflow = 15.1 cfs @ 12.38 hrs, Volume= 1.9 af  
Primary = 15.1 cfs @ 12.38 hrs, Volume= 1.9 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs



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## HydroCAD Analysis: Proposed Conditions





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## 2-Year Storm Event – Proposed

**13168.00-PR Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentE1a: Subcat E1a (Off Site)** Runoff Area=3.0 ac 32.0% Impervious Runoff Depth=0.5"  
 Flow Length=414' Slope=0.0310 '/' Tc=16.6 min CN=63 Runoff=0.9 cfs 0.1 af

**SubcatchmentP10a: Subcat P10a** Runoff Area=1.1 ac 36.4% Impervious Runoff Depth=0.4"  
 Flow Length=336' Tc=11.5 min CN=59 Runoff=0.2 cfs 0.0 af

**SubcatchmentP10b: Subcat P10b** Runoff Area=1.7 ac 11.8% Impervious Runoff Depth=0.0"  
 Flow Length=428' Tc=15.5 min CN=42 Runoff=0.0 cfs 0.0 af

**SubcatchmentP11: Subcat P11** Runoff Area=1.5 ac 33.3% Impervious Runoff Depth=0.4"  
 Flow Length=405' Slope=0.0100 '/' Tc=13.5 min CN=59 Runoff=0.3 cfs 0.0 af

**SubcatchmentP12: Subcat P12** Runoff Area=7.9 ac 46.8% Impervious Runoff Depth=0.6"  
 Flow Length=681' Tc=23.5 min CN=66 Runoff=2.9 cfs 0.4 af

**SubcatchmentP20: Subcat P20** Runoff Area=0.2 ac 0.0% Impervious Runoff Depth=0.0"  
 Flow Length=32' Tc=5.0 min CN=39 Runoff=0.0 cfs 0.0 af

**SubcatchmentP30: Subcat E3 Remaining** Runoff Area=4.0 ac 7.5% Impervious Runoff Depth=0.0"  
 Flow Length=240' Tc=8.4 min CN=36 Runoff=0.0 cfs 0.0 af

**SubcatchmentP31: Subcat P31** Runoff Area=3.0 ac 40.0% Impervious Runoff Depth=0.5"  
 Flow Length=440' Tc=15.9 min CN=63 Runoff=1.0 cfs 0.1 af

**SubcatchmentP32: Subcat P32** Runoff Area=1.8 ac 27.8% Impervious Runoff Depth=0.2"  
 Flow Length=550' Tc=19.7 min CN=55 Runoff=0.1 cfs 0.0 af

**SubcatchmentP40: Subcat E5a&E5b** Runoff Area=3.9 ac 17.9% Impervious Runoff Depth=0.2"  
 Flow Length=450' Tc=14.0 min CN=53 Runoff=0.1 cfs 0.1 af

**SubcatchmentP41: Subcat P41** Runoff Area=5.6 ac 46.4% Impervious Runoff Depth=0.6"  
 Flow Length=525' Tc=13.7 min CN=66 Runoff=2.7 cfs 0.3 af

**Reach R1a: Swale** Avg. Flow Depth=0.1' Max Vel=2.31 fps Inflow=0.9 cfs 0.1 af  
 n=0.012 L=250.0' S=0.0140 '/' Capacity=704.5 cfs Outflow=0.9 cfs 0.1 af

**Reach R1b: Swale** Avg. Flow Depth=0.0' Max Vel=1.08 fps Inflow=0.2 cfs 0.1 af  
 n=0.012 L=475.0' S=0.0095 '/' Capacity=775.3 cfs Outflow=0.2 cfs 0.1 af

**Pond P1a: (new Pond)** Peak Elev=189.02' Storage=3,485 cf Inflow=0.9 cfs 0.1 af  
 Outflow=0.1 cfs 0.0 af

**Pond P1b: Infiltration Basin** Peak Elev=193.15' Storage=222 cf Inflow=0.3 cfs 0.0 af  
 Discarded=0.1 cfs 0.0 af Secondary=0.0 cfs 0.0 af Outflow=0.1 cfs 0.0 af

**Pond P1c: Infiltration Basin (Southwest Corner)** Peak Elev=184.02' Storage=2,741 cf Inflow=2.9 cfs 0.4 af  
 Discarded=1.2 cfs 0.4 af Primary=0.0 cfs 0.0 af Outflow=1.2 cfs 0.4 af

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**Pond P3a: Rain Garden**

Peak Elev=191.01' Storage=40 cf Inflow=0.1 cfs 0.0 af  
Discarded=0.1 cfs 0.0 af Secondary=0.0 cfs 0.0 af Outflow=0.1 cfs 0.0 af

**Pond P3b: Infiltration Basin**

Peak Elev=180.91' Storage=1,611 cf Inflow=1.0 cfs 0.1 af  
Discarded=0.1 cfs 0.1 af Secondary=0.0 cfs 0.0 af Outflow=0.1 cfs 0.1 af

**Pond P4: Infiltration Basin**

Peak Elev=187.45' Storage=4,634 cf Inflow=2.7 cfs 0.3 af  
Discarded=0.2 cfs 0.3 af Primary=0.0 cfs 0.0 af Outflow=0.2 cfs 0.3 af

**Link DP-1: Wetlands (Off-site)**

Inflow=0.2 cfs 0.1 af  
Primary=0.2 cfs 0.1 af

**Link DP-2: Off-site**

Inflow=0.0 cfs 0.0 af  
Primary=0.0 cfs 0.0 af

**Link DP-3: Wetlands (On-site)**

Inflow=0.0 cfs 0.0 af  
Primary=0.0 cfs 0.0 af

**Link DP-4: Pond (On-site)**

Inflow=0.1 cfs 0.1 af  
Primary=0.1 cfs 0.1 af

**Total Runoff Area = 33.7 ac   Runoff Volume = 1.1 af   Average Runoff Depth = 0.4"**  
**67.2% Pervious = 22.6 ac   32.8% Impervious = 11.1 ac**

**13168.00-PR Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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**Summary for Subcatchment E1a: Subcat E1a (Off Site)**

Runoff = 0.9 cfs @ 12.40 hrs, Volume= 0.1 af, Depth= 0.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.0	39	>75% Grass cover, Good, HSG A
* 0.2	98	Off-site Paved Roads, HSG A
1.7	61	1/4 acre lots, 38% imp, HSG A
0.4	30	Woods, Good, HSG A
0.3	83	1/4 acre lots, 38% imp, HSG C
0.4	70	Woods, Good, HSG C
3.0	63	Weighted Average
2.0		68.0% Pervious Area
1.0		32.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0310	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
1.7	124	0.0310	1.23		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	240	0.0310	0.88		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.6	414	Total			

**Summary for Subcatchment P10a: Subcat P10a**

Runoff = 0.2 cfs @ 12.35 hrs, Volume= 0.0 af, Depth= 0.4"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.5	39	>75% Grass cover, Good, HSG A
0.3	98	Off-site Paved Roads, HSG A
0.2	30	Woods, Good, HSG A
* 0.1	98	Roofs
1.1	59	Weighted Average
0.7		63.6% Pervious Area
0.4		36.4% Impervious Area

**13168.00-PR Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0230	0.16		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
2.9	186	0.0230	1.06		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.3	100	0.0100	0.50		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
11.5	336	Total			

**Summary for Subcatchment P10b: Subcat P10b**

Runoff = 0.0 cfs @ 24.02 hrs, Volume= 0.0 af, Depth= 0.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.8	39	>75% Grass cover, Good, HSG A
0.7	30	Woods, Good, HSG A
* 0.2	98	Roofs
1.7	42	Weighted Average
1.5		88.2% Pervious Area
0.2		11.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0080	0.10		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.2	248	0.0130	0.80		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
2.2	130	0.0380	0.97		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
15.5	428	Total			

**Summary for Subcatchment P11: Subcat P11**

Runoff = 0.3 cfs @ 12.38 hrs, Volume= 0.0 af, Depth= 0.4"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.1	98	Roofs, HSG A
1.0	39	>75% Grass cover, Good, HSG A
* 0.2	98	Off-site Paved Roads, HSG A
* 0.2	98	On-site Paved Roads, HSG A
1.5	59	Weighted Average
1.0		66.7% Pervious Area
0.5		33.3% Impervious Area

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.6	235	0.0100	0.70		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.2	25	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.3	95	0.0100	5.36	4.21	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
13.5	405	Total			

**Summary for Subcatchment P12: Subcat P12**

Runoff = 2.9 cfs @ 12.48 hrs, Volume= 0.4 af, Depth= 0.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
1.6	98	Roofs, HSG A
* 2.1	98	On-site Paved Roads, HSG A
0.3	30	Woods, Good, HSG A
3.9	39	>75% Grass cover, Good, HSG A
7.9	66	Weighted Average
4.2		53.2% Pervious Area
3.7		46.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
12.3	400	0.0060	0.54		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.9	110	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.5	121	0.0060	3.81	2.99	<b>Pipe Channel, RCP_Round 12"</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
23.5	681	Total			

**Summary for Subcatchment P20: Subcat P20**

Runoff = 0.0 cfs @ 24.00 hrs, Volume= 0.0 af, Depth= 0.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

**13168.00-PR Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Area (ac)	CN	Description
0.2	39	>75% Grass cover, Good, HSG A
0.2		100.0% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	12	0.0050	0.06		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.1	20	0.2500	3.50		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.2	32	Total, Increased to minimum Tc = 5.0 min			

**Summary for Subcatchment P30: Subcat E3 Remaining Overland**

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Depth= 0.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.2	98	Off-site Paved Roads, HSG A
0.5	39	>75% Grass cover, Good, HSG A
3.2	30	Woods, Good, HSG A
* 0.1	98	Roofs
4.0	36	Weighted Average
3.7		92.5% Pervious Area
0.3		7.5% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.1	80	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.7	110	0.0450	1.06		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
8.4	240	Total			

**Summary for Subcatchment P31: Subcat P31**

Runoff = 1.0 cfs @ 12.39 hrs, Volume= 0.1 af, Depth= 0.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

**13168.00-PR Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Area (ac)	CN	Description
0.4	98	Roofs, HSG A
* 0.8	98	On-site Paved Roads, HSG A
1.8	39	>75% Grass cover, Good, HSG A
3.0	63	Weighted Average
1.8		60.0% Pervious Area
1.2		40.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
8.1	340	0.0100	0.70		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	50	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
15.9	440	Total			

**Summary for Subcatchment P32: Subcat P32**

Runoff = 0.1 cfs @ 12.55 hrs, Volume= 0.0 af, Depth= 0.2"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
1.3	39	>75% Grass cover, Good, HSG A
0.5	98	Roofs, HSG A
1.8	55	Weighted Average
1.3		72.2% Pervious Area
0.5		27.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	50	0.0020	0.06		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.6	500	0.0100	1.50		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
19.7	550	Total			

**Summary for Subcatchment P40: Subcat E5a&E5b Remaining Overland**

Runoff = 0.1 cfs @ 12.57 hrs, Volume= 0.1 af, Depth= 0.2"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

**13168.00-PR Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Area (ac)	CN	Description
0.7	98	Off-site Paved Roads, HSG A
0.2	39	>75% Grass cover, Good, HSG A
2.4	30	Woods, Good, HSG A
0.6	98	Water Surface, 0% imp, HSG A
3.9	53	Weighted Average
3.2		82.1% Pervious Area
0.7		17.9% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0150	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.7	340	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
2.0	60	0.0100	0.50		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
14.0	450	Total			

**Summary for Subcatchment P41: Subcat P41**

Runoff = 2.7 cfs @ 12.34 hrs, Volume= 0.3 af, Depth= 0.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

Area (ac)	CN	Description
0.2	98	Off-site Paved Roads, HSG A
* 1.2	98	On-site Paved Roads, HSG A
3.0	39	>75% Grass cover, Good, HSG A
1.2	98	Roofs, HSG A
5.6	66	Weighted Average
3.0		53.6% Pervious Area
2.6		46.4% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
2.0	60	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.1	15	0.2500	3.50		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.8	400	0.0060	3.81	2.99	<b>Pipe Channel, RCP_Round 12"</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
13.7	525	Total			

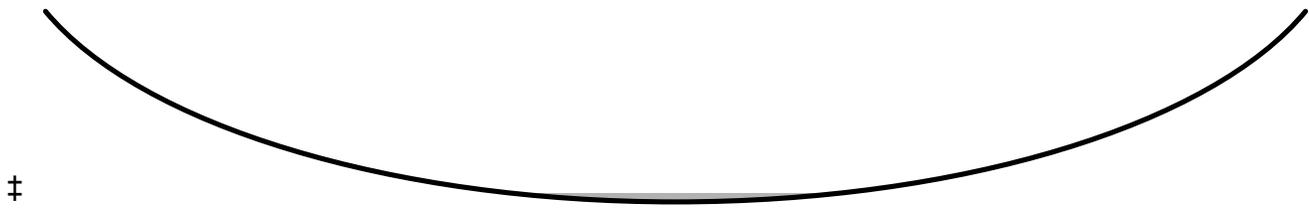
Summary for Reach R1a: Swale

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 0.5" for 2\_year event
Inflow = 0.9 cfs @ 12.40 hrs, Volume= 0.1 af
Outflow = 0.9 cfs @ 12.45 hrs, Volume= 0.1 af, Atten= 2%, Lag= 3.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 2.31 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 3.5 min

Peak Storage= 100 cf @ 12.42 hrs
Average Depth at Peak Storage= 0.1'
Bank-Full Depth= 2.0' Flow Area= 40.0 sf, Capacity= 704.5 cfs

30.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished
Length= 250.0' Slope= 0.0140 '/'
Inlet Invert= 193.00', Outlet Invert= 189.50'



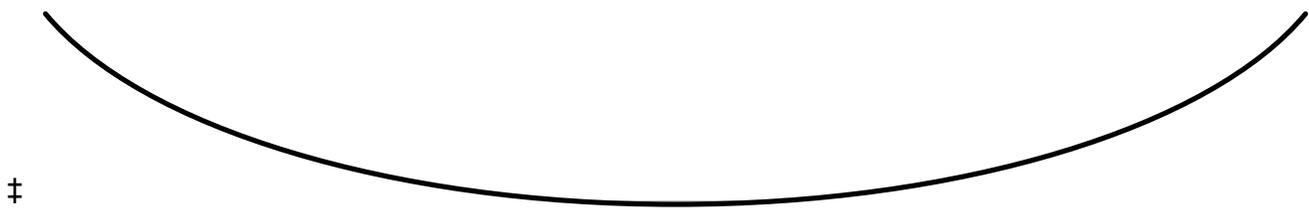
Summary for Reach R1b: Swale

Inflow Area = 4.1 ac, 33.2% Impervious, Inflow Depth = 0.2" for 2\_year event
Inflow = 0.2 cfs @ 12.35 hrs, Volume= 0.1 af
Outflow = 0.2 cfs @ 12.57 hrs, Volume= 0.1 af, Atten= 23%, Lag= 13.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 1.08 fps, Min. Travel Time= 7.3 min
Avg. Velocity = 0.84 fps, Avg. Travel Time= 9.4 min

Peak Storage= 73 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.0'
Bank-Full Depth= 2.0' Flow Area= 53.3 sf, Capacity= 775.3 cfs

40.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished
Length= 475.0' Slope= 0.0095 '/'
Inlet Invert= 189.50', Outlet Invert= 185.00'



**Summary for Pond P1a: (new Pond)**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 0.5" for 2\_year event  
 Inflow = 0.9 cfs @ 12.45 hrs, Volume= 0.1 af  
 Outflow = 0.1 cfs @ 17.95 hrs, Volume= 0.0 af, Atten= 90%, Lag= 330.1 min  
 Primary = 0.1 cfs @ 17.95 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 189.02' @ 17.95 hrs Surf.Area= 6,180 sf Storage= 3,485 cf

Plug-Flow detention time= 463.5 min calculated for 0.0 af (38% of inflow)  
 Center-of-Mass det. time= 266.4 min ( 1,230.1 - 963.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	12,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	600	0	0
189.00	6,085	3,343	3,343
190.00	12,230	9,158	12,500

Device	Routing	Invert	Outlet Devices
#1	Primary	189.00'	<b>15.0' long x 30.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=0.1 cfs @ 17.95 hrs HW=189.02' (Free Discharge)  
 1=**Broad-Crested Rectangular Weir**(Weir Controls 0.1 cfs @ 0.33 fps)

**Summary for Pond P1b: Infiltration Basin**

Inflow Area = 1.5 ac, 33.3% Impervious, Inflow Depth = 0.4" for 2\_year event  
 Inflow = 0.3 cfs @ 12.38 hrs, Volume= 0.0 af  
 Outflow = 0.1 cfs @ 13.08 hrs, Volume= 0.0 af, Atten= 69%, Lag= 42.4 min  
 Discarded = 0.1 cfs @ 13.08 hrs, Volume= 0.0 af  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 193.15' @ 13.08 hrs Surf.Area= 1,514 sf Storage= 222 cf

Plug-Flow detention time= 16.7 min calculated for 0.0 af (100% of inflow)  
 Center-of-Mass det. time= 16.7 min ( 998.9 - 982.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	193.00'	173 cf	<b>Forebay (Prismatic)</b> Listed below (Recalc)
#2	193.00'	1,413 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		1,586 cf	Total Available Storage

**13168.00-PR Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.00	273	0	0
193.50	420	173	173

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.00	1,100	0	0
194.00	1,725	1,413	1,413

Device	Routing	Invert	Outlet Devices
#1	Discarded	193.00'	<b>2.410 in/hr Exfiltration over Surface area</b> Phase-In= 0.01' <b>30.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Secondary	193.80'	

**Discarded OutFlow** Max=0.1 cfs @ 13.08 hrs HW=193.15' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.1 cfs)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=193.00' (Free Discharge)  
 ↑2=Broad-Crested Rectangular Weir( Controls 0.0 cfs)

**Summary for Pond P1c: Infiltration Basin (Southwest Corner)**

Inflow Area = 7.9 ac, 46.8% Impervious, Inflow Depth = 0.6" for 2\_year event  
 Inflow = 2.9 cfs @ 12.48 hrs, Volume= 0.4 af  
 Outflow = 1.2 cfs @ 12.93 hrs, Volume= 0.4 af, Atten= 60%, Lag= 26.9 min  
 Discarded = 1.2 cfs @ 12.93 hrs, Volume= 0.4 af  
 Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 184.02' @ 12.93 hrs Surf.Area= 6,038 sf Storage= 2,741 cf

Plug-Flow detention time= 17.1 min calculated for 0.4 af (100% of inflow)  
 Center-of-Mass det. time= 17.0 min ( 966.1 - 949.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	833 cf	<b>Forebay 1 (Prismatic)</b> Listed below (Recalc)
#2	188.00'	933 cf	<b>Forebay 2 (Prismatic)</b> Listed below (Recalc)
#3	183.40'	54,639 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		56,404 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	615	0	0
187.00	1,050	833	833

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	625	0	0
189.00	1,240	933	933

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
183.40	2,847	0	0
184.00	5,984	2,649	2,649
185.00	9,493	7,739	10,388
186.00	12,771	11,132	21,520
187.00	16,132	14,452	35,971
188.00	21,203	18,668	54,639

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.40'	<b>8.270 in/hr Exfiltration over Surface area</b> Phase-In= 0.02'
#2	Primary	186.70'	<b>30.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

**Discarded OutFlow** Max=1.2 cfs @ 12.93 hrs HW=184.02' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 1.2 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=183.40' (Free Discharge)

↳ **2=Broad-Crested Rectangular Weir** ( Controls 0.0 cfs)

**Summary for Pond P3a: Rain Garden**

Inflow Area = 1.8 ac, 27.8% Impervious, Inflow Depth = 0.2" for 2\_year event  
 Inflow = 0.1 cfs @ 12.55 hrs, Volume= 0.0 af  
 Outflow = 0.1 cfs @ 12.73 hrs, Volume= 0.0 af, Atten= 12%, Lag= 10.5 min  
 Discarded = 0.1 cfs @ 12.73 hrs, Volume= 0.0 af  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs / 2

Peak Elev= 191.01' @ 12.73 hrs Surf.Area= 3,795 sf Storage= 40 cf

Plug-Flow detention time= 7.5 min calculated for 0.0 af (100% of inflow)

Center-of-Mass det. time= 7.5 min ( 1,030.4 - 1,022.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	191.00'	6,871 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
191.00	3,785	0	0
191.50	4,270	2,014	2,014
192.00	4,782	2,263	4,277
192.50	5,596	2,595	6,871

**13168.00-PR Drainage**

NCDC\_Framingham\_2\_year 2\_year Rainfall=3.2"

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Device	Routing	Invert	Outlet Devices
#1	Discarded	191.00'	<b>2.400 in/hr Exfiltration over Surface area</b> Phase-In= 0.01'
#2	Secondary	192.00'	<b>18.0" Vert. Orifice/Grate X 2.00</b> C= 0.600

**Discarded OutFlow** Max=0.2 cfs @ 12.73 hrs HW=191.01' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.2 cfs)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=191.00' (Free Discharge)  
 ↳2=Orifice/Grate ( Controls 0.0 cfs)

**Summary for Pond P3b: Infiltration Basin**

Inflow Area = 3.0 ac, 40.0% Impervious, Inflow Depth = 0.5" for 2\_year event  
 Inflow = 1.0 cfs @ 12.39 hrs, Volume= 0.1 af  
 Outflow = 0.1 cfs @ 14.76 hrs, Volume= 0.1 af, Atten= 86%, Lag= 142.4 min  
 Discarded = 0.1 cfs @ 14.76 hrs, Volume= 0.1 af  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 180.91' @ 14.76 hrs Surf.Area= 2,332 sf Storage= 1,611 cf

Plug-Flow detention time= 155.4 min calculated for 0.1 af (100% of inflow)  
 Center-of-Mass det. time= 155.3 min ( 1,113.5 - 958.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	184.00'	749 cf	<b>Forebay (Prismatic)</b> Listed below (Recalc)
#2	180.00'	24,518 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		25,266 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
184.00	490	0	0
185.00	1,007	749	749

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
180.00	1,211	0	0
181.00	2,443	1,827	1,827
182.00	4,086	3,265	5,092
183.00	5,476	4,781	9,873
184.00	7,048	6,262	16,135
185.00	9,718	8,383	24,518

Device	Routing	Invert	Outlet Devices
#1	Discarded	180.00'	<b>2.400 in/hr Exfiltration over Surface area</b> Phase-In= 0.01'
#2	Secondary	184.80'	<b>40.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

**Discarded OutFlow** Max=0.1 cfs @ 14.76 hrs HW=180.91' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.1 cfs)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=180.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)

**Summary for Pond P4: Infiltration Basin**

Inflow Area = 5.6 ac, 46.4% Impervious, Inflow Depth = 0.6" for 2\_year event  
 Inflow = 2.7 cfs @ 12.34 hrs, Volume= 0.3 af  
 Outflow = 0.2 cfs @ 15.19 hrs, Volume= 0.3 af, Atten= 91%, Lag= 170.5 min  
 Discarded = 0.2 cfs @ 15.19 hrs, Volume= 0.3 af  
 Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 187.45' @ 15.19 hrs Surf.Area= 4,468 sf Storage= 4,634 cf

Plug-Flow detention time= 238.3 min calculated for 0.3 af (100% of inflow)  
 Center-of-Mass det. time= 238.2 min ( 1,178.1 - 940.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	53,073 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	1,597	0	0
187.00	3,887	2,742	2,742
188.00	5,170	4,529	7,271
189.00	6,574	5,872	13,143
190.00	8,144	7,359	20,502
191.00	9,832	8,988	29,490
192.00	11,550	10,691	40,181
193.00	14,235	12,893	53,073

Device	Routing	Invert	Outlet Devices
#1	Discarded	186.00'	<b>2.410 in/hr Exfiltration over Surface area</b> Phase-In= 0.02'
#2	Primary	191.00'	<b>40.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.2 cfs @ 15.19 hrs HW=187.45' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.2 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=186.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)

**Summary for Link DP-1: Wetlands (Off-site)**

Inflow Area = 13.7 ac, 38.4% Impervious, Inflow Depth = 0.1" for 2\_year event  
Inflow = 0.2 cfs @ 12.57 hrs, Volume= 0.1 af  
Primary = 0.2 cfs @ 12.57 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-2: Off-site**

Inflow Area = 0.2 ac, 0.0% Impervious, Inflow Depth = 0.0" for 2\_year event  
Inflow = 0.0 cfs @ 24.00 hrs, Volume= 0.0 af  
Primary = 0.0 cfs @ 24.00 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-3: Wetlands (On-site)**

Inflow Area = 4.0 ac, 7.5% Impervious, Inflow Depth = 0.0" for 2\_year event  
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af  
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-4: Pond (On-site)**

Inflow Area = 9.5 ac, 34.7% Impervious, Inflow Depth = 0.1" for 2\_year event  
Inflow = 0.1 cfs @ 12.57 hrs, Volume= 0.1 af  
Primary = 0.1 cfs @ 12.57 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs



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## 10-Year Storm Event- Proposed

**13168.00-PR Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>SubcatchmentE1a: Subcat E1a (Off Site)</b>	Runoff Area=3.0 ac 32.0% Impervious Runoff Depth=1.3" Flow Length=414' Slope=0.0310 '/' Tc=16.6 min CN=63 Runoff=3.0 cfs 0.3 af
<b>SubcatchmentP10a: Subcat P10a</b>	Runoff Area=1.1 ac 36.4% Impervious Runoff Depth=1.1" Flow Length=336' Tc=11.5 min CN=59 Runoff=1.0 cfs 0.1 af
<b>SubcatchmentP10b: Subcat P10b</b>	Runoff Area=1.7 ac 11.8% Impervious Runoff Depth=0.2" Flow Length=428' Tc=15.5 min CN=42 Runoff=0.1 cfs 0.0 af
<b>SubcatchmentP11: Subcat P11</b>	Runoff Area=1.5 ac 33.3% Impervious Runoff Depth=1.1" Flow Length=405' Slope=0.0100 '/' Tc=13.5 min CN=59 Runoff=1.3 cfs 0.1 af
<b>SubcatchmentP12: Subcat P12</b>	Runoff Area=7.9 ac 46.8% Impervious Runoff Depth=1.5" Flow Length=681' Tc=23.5 min CN=66 Runoff=8.0 cfs 1.0 af
<b>SubcatchmentP20: Subcat P20</b>	Runoff Area=0.2 ac 0.0% Impervious Runoff Depth=0.1" Flow Length=32' Tc=5.0 min CN=39 Runoff=0.0 cfs 0.0 af
<b>SubcatchmentP30: Subcat E3 Remaining</b>	Runoff Area=4.0 ac 7.5% Impervious Runoff Depth=0.1" Flow Length=240' Tc=8.4 min CN=36 Runoff=0.0 cfs 0.0 af
<b>SubcatchmentP31: Subcat P31</b>	Runoff Area=3.0 ac 40.0% Impervious Runoff Depth=1.3" Flow Length=440' Tc=15.9 min CN=63 Runoff=3.1 cfs 0.3 af
<b>SubcatchmentP32: Subcat P32</b>	Runoff Area=1.8 ac 27.8% Impervious Runoff Depth=0.8" Flow Length=550' Tc=19.7 min CN=55 Runoff=0.9 cfs 0.1 af
<b>SubcatchmentP40: Subcat E5a&amp;E5b</b>	Runoff Area=3.9 ac 17.9% Impervious Runoff Depth=0.7" Flow Length=450' Tc=14.0 min CN=53 Runoff=1.8 cfs 0.2 af
<b>SubcatchmentP41: Subcat P41</b>	Runoff Area=5.6 ac 46.4% Impervious Runoff Depth=1.5" Flow Length=525' Tc=13.7 min CN=66 Runoff=7.3 cfs 0.7 af
<b>Reach R1a: Swale</b>	Avg. Flow Depth=0.2' Max Vel=3.30 fps Inflow=3.0 cfs 0.4 af n=0.012 L=250.0' S=0.0140 '/' Capacity=704.5 cfs Outflow=3.0 cfs 0.4 af
<b>Reach R1b: Swale</b>	Avg. Flow Depth=0.1' Max Vel=2.22 fps Inflow=1.7 cfs 0.4 af n=0.012 L=475.0' S=0.0095 '/' Capacity=775.3 cfs Outflow=1.7 cfs 0.4 af
<b>Pond P1a: (new Pond)</b>	Peak Elev=189.11' Storage=4,350 cf Inflow=3.0 cfs 0.4 af Outflow=1.5 cfs 0.3 af
<b>Pond P1b: Infiltration Basin</b>	Peak Elev=193.83' Storage=1,309 cf Inflow=1.3 cfs 0.1 af Discarded=0.1 cfs 0.1 af Secondary=0.5 cfs 0.0 af Outflow=0.6 cfs 0.1 af
<b>Pond P1c: Infiltration Basin (Southwest</b>	Peak Elev=185.17' Storage=12,076 cf Inflow=8.0 cfs 1.0 af Discarded=1.9 cfs 1.0 af Primary=0.0 cfs 0.0 af Outflow=1.9 cfs 1.0 af

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NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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**Pond P3a: Rain Garden**

Peak Elev=191.28' Storage=1,096 cf Inflow=0.9 cfs 0.1 af  
Discarded=0.2 cfs 0.1 af Secondary=0.0 cfs 0.0 af Outflow=0.2 cfs 0.1 af

**Pond P3b: Infiltration Basin**

Peak Elev=182.33' Storage=6,507 cf Inflow=3.1 cfs 0.3 af  
Discarded=0.3 cfs 0.3 af Secondary=0.0 cfs 0.0 af Outflow=0.3 cfs 0.3 af

**Pond P4: Infiltration Basin**

Peak Elev=189.46' Storage=16,356 cf Inflow=7.3 cfs 0.7 af  
Discarded=0.4 cfs 0.7 af Primary=0.0 cfs 0.0 af Outflow=0.4 cfs 0.7 af

**Link DP-1: Wetlands (Off-site)**

Inflow=1.7 cfs 0.4 af  
Primary=1.7 cfs 0.4 af

**Link DP-2: Off-site**

Inflow=0.0 cfs 0.0 af  
Primary=0.0 cfs 0.0 af

**Link DP-3: Wetlands (On-site)**

Inflow=0.0 cfs 0.0 af  
Primary=0.0 cfs 0.0 af

**Link DP-4: Pond (On-site)**

Inflow=1.8 cfs 0.2 af  
Primary=1.8 cfs 0.2 af

**Total Runoff Area = 33.7 ac Runoff Volume = 3.0 af Average Runoff Depth = 1.1"**  
**67.2% Pervious = 22.6 ac 32.8% Impervious = 11.1 ac**

**Summary for Subcatchment E1a: Subcat E1a (Off Site)**

Runoff = 3.0 cfs @ 12.37 hrs, Volume= 0.3 af, Depth= 1.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.0	39	>75% Grass cover, Good, HSG A
* 0.2	98	Off-site Paved Roads, HSG A
1.7	61	1/4 acre lots, 38% imp, HSG A
0.4	30	Woods, Good, HSG A
0.3	83	1/4 acre lots, 38% imp, HSG C
0.4	70	Woods, Good, HSG C
3.0	63	Weighted Average
2.0		68.0% Pervious Area
1.0		32.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0310	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
1.7	124	0.0310	1.23		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	240	0.0310	0.88		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.6	414	Total			

**Summary for Subcatchment P10a: Subcat P10a**

Runoff = 1.0 cfs @ 12.31 hrs, Volume= 0.1 af, Depth= 1.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.5	39	>75% Grass cover, Good, HSG A
0.3	98	Off-site Paved Roads, HSG A
0.2	30	Woods, Good, HSG A
* 0.1	98	Roofs
1.1	59	Weighted Average
0.7		63.6% Pervious Area
0.4		36.4% Impervious Area

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0230	0.16		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
2.9	186	0.0230	1.06		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.3	100	0.0100	0.50		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
11.5	336	Total			

**Summary for Subcatchment P10b: Subcat P10b**

Runoff = 0.1 cfs @ 13.24 hrs, Volume= 0.0 af, Depth= 0.2"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.8	39	>75% Grass cover, Good, HSG A
0.7	30	Woods, Good, HSG A
* 0.2	98	Roofs
1.7	42	Weighted Average
1.5		88.2% Pervious Area
0.2		11.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0080	0.10		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.2	248	0.0130	0.80		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
2.2	130	0.0380	0.97		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
15.5	428	Total			

**Summary for Subcatchment P11: Subcat P11**

Runoff = 1.3 cfs @ 12.34 hrs, Volume= 0.1 af, Depth= 1.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.1	98	Roofs, HSG A
1.0	39	>75% Grass cover, Good, HSG A
* 0.2	98	Off-site Paved Roads, HSG A
* 0.2	98	On-site Paved Roads, HSG A
1.5	59	Weighted Average
1.0		66.7% Pervious Area
0.5		33.3% Impervious Area

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.6	235	0.0100	0.70		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.2	25	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.3	95	0.0100	5.36	4.21	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
13.5	405	Total			

**Summary for Subcatchment P12: Subcat P12**

Runoff = 8.0 cfs @ 12.46 hrs, Volume= 1.0 af, Depth= 1.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
1.6	98	Roofs, HSG A
* 2.1	98	On-site Paved Roads, HSG A
0.3	30	Woods, Good, HSG A
3.9	39	>75% Grass cover, Good, HSG A
7.9	66	Weighted Average
4.2		53.2% Pervious Area
3.7		46.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
12.3	400	0.0060	0.54		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.9	110	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.5	121	0.0060	3.81	2.99	<b>Pipe Channel, RCP_Round 12"</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
23.5	681	Total			

**Summary for Subcatchment P20: Subcat P20**

Runoff = 0.0 cfs @ 13.59 hrs, Volume= 0.0 af, Depth= 0.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

**13168.00-PR Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Area (ac)	CN	Description
0.2	39	>75% Grass cover, Good, HSG A
0.2		100.0% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	12	0.0050	0.06		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.1	20	0.2500	3.50		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.2	32	Total, Increased to minimum Tc = 5.0 min			

**Summary for Subcatchment P30: Subcat E3 Remaining Overland**

Runoff = 0.0 cfs @ 18.07 hrs, Volume= 0.0 af, Depth= 0.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.2	98	Off-site Paved Roads, HSG A
0.5	39	>75% Grass cover, Good, HSG A
3.2	30	Woods, Good, HSG A
* 0.1	98	Roofs
4.0	36	Weighted Average
3.7		92.5% Pervious Area
0.3		7.5% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.1	80	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.7	110	0.0450	1.06		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
8.4	240	Total			

**Summary for Subcatchment P31: Subcat P31**

Runoff = 3.1 cfs @ 12.36 hrs, Volume= 0.3 af, Depth= 1.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

**13168.00-PR Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Area (ac)	CN	Description
0.4	98	Roofs, HSG A
* 0.8	98	On-site Paved Roads, HSG A
1.8	39	>75% Grass cover, Good, HSG A
3.0	63	Weighted Average
1.8		60.0% Pervious Area
1.2		40.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
8.1	340	0.0100	0.70		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	50	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
15.9	440	Total			

**Summary for Subcatchment P32: Subcat P32**

Runoff = 0.9 cfs @ 12.43 hrs, Volume= 0.1 af, Depth= 0.8"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
1.3	39	>75% Grass cover, Good, HSG A
0.5	98	Roofs, HSG A
1.8	55	Weighted Average
1.3		72.2% Pervious Area
0.5		27.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	50	0.0020	0.06		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.6	500	0.0100	1.50		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
19.7	550	Total			

**Summary for Subcatchment P40: Subcat E5a&E5b Remaining Overland**

Runoff = 1.8 cfs @ 12.36 hrs, Volume= 0.2 af, Depth= 0.7"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Area (ac)	CN	Description
0.7	98	Off-site Paved Roads, HSG A
0.2	39	>75% Grass cover, Good, HSG A
2.4	30	Woods, Good, HSG A
0.6	98	Water Surface, 0% imp, HSG A
3.9	53	Weighted Average
3.2		82.1% Pervious Area
0.7		17.9% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0150	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.7	340	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
2.0	60	0.0100	0.50		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
14.0	450	Total			

**Summary for Subcatchment P41: Subcat P41**

Runoff = 7.3 cfs @ 12.33 hrs, Volume= 0.7 af, Depth= 1.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

Area (ac)	CN	Description
0.2	98	Off-site Paved Roads, HSG A
* 1.2	98	On-site Paved Roads, HSG A
3.0	39	>75% Grass cover, Good, HSG A
1.2	98	Roofs, HSG A
5.6	66	Weighted Average
3.0		53.6% Pervious Area
2.6		46.4% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
2.0	60	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.1	15	0.2500	3.50		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.8	400	0.0060	3.81	2.99	<b>Pipe Channel, RCP_Round 12"</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
13.7	525	Total			

Summary for Reach R1a: Swale

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 1.4" for 10\_year event
Inflow = 3.0 cfs @ 12.37 hrs, Volume= 0.4 af
Outflow = 3.0 cfs @ 12.41 hrs, Volume= 0.4 af, Atten= 2%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 3.30 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.48 fps, Avg. Travel Time= 2.8 min

Peak Storage= 228 cf @ 12.39 hrs
Average Depth at Peak Storage= 0.2'
Bank-Full Depth= 2.0' Flow Area= 40.0 sf, Capacity= 704.5 cfs

30.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished
Length= 250.0' Slope= 0.0140 '/'
Inlet Invert= 193.00', Outlet Invert= 189.50'



Summary for Reach R1b: Swale

Inflow Area = 4.1 ac, 33.2% Impervious, Inflow Depth = 1.1" for 10\_year event
Inflow = 1.7 cfs @ 12.76 hrs, Volume= 0.4 af
Outflow = 1.7 cfs @ 12.87 hrs, Volume= 0.4 af, Atten= 2%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 2.22 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 1.17 fps, Avg. Travel Time= 6.8 min

Peak Storage= 363 cf @ 12.81 hrs
Average Depth at Peak Storage= 0.1'
Bank-Full Depth= 2.0' Flow Area= 53.3 sf, Capacity= 775.3 cfs

40.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished
Length= 475.0' Slope= 0.0095 '/'
Inlet Invert= 189.50', Outlet Invert= 185.00'



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**Summary for Pond P1a: (new Pond)**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 1.4" for 10\_year event  
 Inflow = 3.0 cfs @ 12.41 hrs, Volume= 0.4 af  
 Outflow = 1.5 cfs @ 12.77 hrs, Volume= 0.3 af, Atten= 51%, Lag= 21.9 min  
 Primary = 1.5 cfs @ 12.77 hrs, Volume= 0.3 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 189.11' @ 12.77 hrs Surf.Area= 6,761 sf Storage= 4,350 cf

Plug-Flow detention time= 159.6 min calculated for 0.3 af (78% of inflow)  
 Center-of-Mass det. time= 65.9 min ( 974.0 - 908.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	12,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	600	0	0
189.00	6,085	3,343	3,343
190.00	12,230	9,158	12,500

Device	Routing	Invert	Outlet Devices
#1	Primary	189.00'	<b>15.0' long x 30.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=1.5 cfs @ 12.77 hrs HW=189.11' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 1.5 cfs @ 0.89 fps)

**Summary for Pond P1b: Infiltration Basin**

Inflow Area = 1.5 ac, 33.3% Impervious, Inflow Depth = 1.1" for 10\_year event  
 Inflow = 1.3 cfs @ 12.34 hrs, Volume= 0.1 af  
 Outflow = 0.6 cfs @ 12.61 hrs, Volume= 0.1 af, Atten= 54%, Lag= 16.5 min  
 Discarded = 0.1 cfs @ 12.61 hrs, Volume= 0.1 af  
 Secondary = 0.5 cfs @ 12.61 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 193.83' @ 12.61 hrs Surf.Area= 2,042 sf Storage= 1,309 cf

Plug-Flow detention time= 113.8 min calculated for 0.1 af (100% of inflow)  
 Center-of-Mass det. time= 113.8 min ( 1,038.3 - 924.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	193.00'	173 cf	<b>Forebay (Prismatic)</b> Listed below (Recalc)
#2	193.00'	1,413 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		1,586 cf	Total Available Storage

**13168.00-PR Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.00	273	0	0
193.50	420	173	173

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.00	1,100	0	0
194.00	1,725	1,413	1,413

Device	Routing	Invert	Outlet Devices
#1	Discarded	193.00'	<b>2.410 in/hr Exfiltration over Surface area</b> Phase-In= 0.01' <b>30.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Secondary	193.80'	

**Discarded OutFlow** Max=0.1 cfs @ 12.61 hrs HW=193.83' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.1 cfs)

**Secondary OutFlow** Max=0.4 cfs @ 12.61 hrs HW=193.83' (Free Discharge)  
 ↳2=Broad-Crested Rectangular Weir (Weir Controls 0.4 cfs @ 0.44 fps)

**Summary for Pond P1c: Infiltration Basin (Southwest Corner)**

Inflow Area = 7.9 ac, 46.8% Impervious, Inflow Depth = 1.5" for 10\_year event  
 Inflow = 8.0 cfs @ 12.46 hrs, Volume= 1.0 af  
 Outflow = 1.9 cfs @ 13.29 hrs, Volume= 1.0 af, Atten= 76%, Lag= 50.0 min  
 Discarded = 1.9 cfs @ 13.29 hrs, Volume= 1.0 af  
 Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 185.17' @ 13.29 hrs Surf.Area= 10,059 sf Storage= 12,076 cf

Plug-Flow detention time= 57.9 min calculated for 1.0 af (100% of inflow)  
 Center-of-Mass det. time= 57.9 min ( 966.3 - 908.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	833 cf	<b>Forebay 1 (Prismatic)</b> Listed below (Recalc)
#2	188.00'	933 cf	<b>Forebay 2 (Prismatic)</b> Listed below (Recalc)
#3	183.40'	54,639 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		56,404 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	615	0	0
187.00	1,050	833	833

**13168.00-PR Drainage**

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	625	0	0
189.00	1,240	933	933

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
183.40	2,847	0	0
184.00	5,984	2,649	2,649
185.00	9,493	7,739	10,388
186.00	12,771	11,132	21,520
187.00	16,132	14,452	35,971
188.00	21,203	18,668	54,639

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.40'	<b>8.270 in/hr Exfiltration over Surface area</b> Phase-In= 0.02'
#2	Primary	186.70'	<b>30.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

**Discarded OutFlow** Max=1.9 cfs @ 13.29 hrs HW=185.17' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 1.9 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=183.40' (Free Discharge)

↳ **2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

**Summary for Pond P3a: Rain Garden**

Inflow Area = 1.8 ac, 27.8% Impervious, Inflow Depth = 0.8" for 10\_year event  
 Inflow = 0.9 cfs @ 12.43 hrs, Volume= 0.1 af  
 Outflow = 0.2 cfs @ 13.47 hrs, Volume= 0.1 af, Atten= 74%, Lag= 62.4 min  
 Discarded = 0.2 cfs @ 13.47 hrs, Volume= 0.1 af  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 191.28' @ 13.47 hrs Surf.Area= 4,056 sf Storage= 1,096 cf

Plug-Flow detention time= 37.7 min calculated for 0.1 af (100% of inflow)  
 Center-of-Mass det. time= 37.8 min ( 985.7 - 947.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	191.00'	6,871 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
191.00	3,785	0	0
191.50	4,270	2,014	2,014
192.00	4,782	2,263	4,277
192.50	5,596	2,595	6,871

**13168.00-PR Drainage**

NCDC\_Framingham\_10\_year 10\_year Rainfall=4.7"

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Device	Routing	Invert	Outlet Devices
#1	Discarded	191.00'	<b>2.400 in/hr Exfiltration over Surface area</b> Phase-In= 0.01'
#2	Secondary	192.00'	<b>18.0" Vert. Orifice/Grate X 2.00</b> C= 0.600

**Discarded OutFlow** Max=0.2 cfs @ 13.47 hrs HW=191.28' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.2 cfs)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=191.00' (Free Discharge)  
 ↳2=Orifice/Grate ( Controls 0.0 cfs)

**Summary for Pond P3b: Infiltration Basin**

Inflow Area = 3.0 ac, 40.0% Impervious, Inflow Depth = 1.3" for 10\_year event  
 Inflow = 3.1 cfs @ 12.36 hrs, Volume= 0.3 af  
 Outflow = 0.3 cfs @ 15.32 hrs, Volume= 0.3 af, Atten= 92%, Lag= 177.7 min  
 Discarded = 0.3 cfs @ 15.32 hrs, Volume= 0.3 af  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 182.33' @ 15.32 hrs Surf.Area= 4,542 sf Storage= 6,507 cf

Plug-Flow detention time= 338.0 min calculated for 0.3 af (100% of inflow)  
 Center-of-Mass det. time= 338.0 min ( 1,249.6 - 911.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	184.00'	749 cf	<b>Forebay (Prismatic)</b> Listed below (Recalc)
#2	180.00'	24,518 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		25,266 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
184.00	490	0	0
185.00	1,007	749	749

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
180.00	1,211	0	0
181.00	2,443	1,827	1,827
182.00	4,086	3,265	5,092
183.00	5,476	4,781	9,873
184.00	7,048	6,262	16,135
185.00	9,718	8,383	24,518

Device	Routing	Invert	Outlet Devices
#1	Discarded	180.00'	<b>2.400 in/hr Exfiltration over Surface area</b> Phase-In= 0.01'
#2	Secondary	184.80'	<b>40.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

**Discarded OutFlow** Max=0.3 cfs @ 15.32 hrs HW=182.33' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.3 cfs)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=180.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)

**Summary for Pond P4: Infiltration Basin**

Inflow Area = 5.6 ac, 46.4% Impervious, Inflow Depth = 1.5" for 10\_year event  
 Inflow = 7.3 cfs @ 12.33 hrs, Volume= 0.7 af  
 Outflow = 0.4 cfs @ 17.35 hrs, Volume= 0.7 af, Atten= 94%, Lag= 301.0 min  
 Discarded = 0.4 cfs @ 17.35 hrs, Volume= 0.7 af  
 Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 189.46' @ 17.35 hrs Surf.Area= 7,301 sf Storage= 16,356 cf

Plug-Flow detention time= 513.5 min calculated for 0.7 af (100% of inflow)  
 Center-of-Mass det. time= 513.7 min ( 1,413.1 - 899.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	53,073 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	1,597	0	0
187.00	3,887	2,742	2,742
188.00	5,170	4,529	7,271
189.00	6,574	5,872	13,143
190.00	8,144	7,359	20,502
191.00	9,832	8,988	29,490
192.00	11,550	10,691	40,181
193.00	14,235	12,893	53,073

Device	Routing	Invert	Outlet Devices
#1	Discarded	186.00'	<b>2.410 in/hr Exfiltration over Surface area</b> Phase-In= 0.02'
#2	Primary	191.00'	<b>40.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.4 cfs @ 17.35 hrs HW=189.46' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.4 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=186.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)

**Summary for Link DP-1: Wetlands (Off-site)**

Inflow Area = 13.7 ac, 38.4% Impervious, Inflow Depth = 0.4" for 10\_year event  
Inflow = 1.7 cfs @ 12.87 hrs, Volume= 0.4 af  
Primary = 1.7 cfs @ 12.87 hrs, Volume= 0.4 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-2: Off-site**

Inflow Area = 0.2 ac, 0.0% Impervious, Inflow Depth = 0.1" for 10\_year event  
Inflow = 0.0 cfs @ 13.59 hrs, Volume= 0.0 af  
Primary = 0.0 cfs @ 13.59 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-3: Wetlands (On-site)**

Inflow Area = 4.0 ac, 7.5% Impervious, Inflow Depth = 0.1" for 10\_year event  
Inflow = 0.0 cfs @ 18.07 hrs, Volume= 0.0 af  
Primary = 0.0 cfs @ 18.07 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-4: Pond (On-site)**

Inflow Area = 9.5 ac, 34.7% Impervious, Inflow Depth = 0.3" for 10\_year event  
Inflow = 1.8 cfs @ 12.36 hrs, Volume= 0.2 af  
Primary = 1.8 cfs @ 12.36 hrs, Volume= 0.2 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs



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## 25-Year Storm Event- Proposed

**13168.00-PR Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>SubcatchmentE1a: Subcat E1a (Off Site)</b>	Runoff Area=3.0 ac 32.0% Impervious Runoff Depth=2.1" Flow Length=414' Slope=0.0310 '/' Tc=16.6 min CN=63 Runoff=4.9 cfs 0.5 af
<b>SubcatchmentP10a: Subcat P10a</b>	Runoff Area=1.1 ac 36.4% Impervious Runoff Depth=1.8" Flow Length=336' Tc=11.5 min CN=59 Runoff=1.7 cfs 0.2 af
<b>SubcatchmentP10b: Subcat P10b</b>	Runoff Area=1.7 ac 11.8% Impervious Runoff Depth=0.6" Flow Length=428' Tc=15.5 min CN=42 Runoff=0.4 cfs 0.1 af
<b>SubcatchmentP11: Subcat P11</b>	Runoff Area=1.5 ac 33.3% Impervious Runoff Depth=1.8" Flow Length=405' Slope=0.0100 '/' Tc=13.5 min CN=59 Runoff=2.2 cfs 0.2 af
<b>SubcatchmentP12: Subcat P12</b>	Runoff Area=7.9 ac 46.8% Impervious Runoff Depth=2.4" Flow Length=681' Tc=23.5 min CN=66 Runoff=12.5 cfs 1.6 af
<b>SubcatchmentP20: Subcat P20</b>	Runoff Area=0.2 ac 0.0% Impervious Runoff Depth=0.4" Flow Length=32' Tc=5.0 min CN=39 Runoff=0.0 cfs 0.0 af
<b>SubcatchmentP30: Subcat E3 Remaining</b>	Runoff Area=4.0 ac 7.5% Impervious Runoff Depth=0.3" Flow Length=240' Tc=8.4 min CN=36 Runoff=0.2 cfs 0.1 af
<b>SubcatchmentP31: Subcat P31</b>	Runoff Area=3.0 ac 40.0% Impervious Runoff Depth=2.1" Flow Length=440' Tc=15.9 min CN=63 Runoff=5.0 cfs 0.5 af
<b>SubcatchmentP32: Subcat P32</b>	Runoff Area=1.8 ac 27.8% Impervious Runoff Depth=1.5" Flow Length=550' Tc=19.7 min CN=55 Runoff=1.7 cfs 0.2 af
<b>SubcatchmentP40: Subcat E5a&amp;E5b</b>	Runoff Area=3.9 ac 17.9% Impervious Runoff Depth=1.3" Flow Length=450' Tc=14.0 min CN=53 Runoff=3.8 cfs 0.4 af
<b>SubcatchmentP41: Subcat P41</b>	Runoff Area=5.6 ac 46.4% Impervious Runoff Depth=2.4" Flow Length=525' Tc=13.7 min CN=66 Runoff=11.3 cfs 1.1 af
<b>Reach R1a: Swale</b>	Avg. Flow Depth=0.2' Max Vel=4.27 fps Inflow=7.2 cfs 0.6 af n=0.012 L=250.0' S=0.0140 '/' Capacity=704.5 cfs Outflow=6.8 cfs 0.6 af
<b>Reach R1b: Swale</b>	Avg. Flow Depth=0.2' Max Vel=3.21 fps Inflow=5.8 cfs 0.7 af n=0.012 L=475.0' S=0.0095 '/' Capacity=775.3 cfs Outflow=5.7 cfs 0.7 af
<b>Pond P1a: (new Pond)</b>	Peak Elev=189.25' Storage=5,623 cf Inflow=6.8 cfs 0.6 af Outflow=5.0 cfs 0.5 af
<b>Pond P1b: Infiltration Basin</b>	Peak Elev=193.90' Storage=1,418 cf Inflow=2.2 cfs 0.2 af Discarded=0.1 cfs 0.1 af Secondary=2.3 cfs 0.1 af Outflow=2.4 cfs 0.2 af
<b>Pond P1c: Infiltration Basin (Southwest</b>	Peak Elev=186.05' Storage=22,257 cf Inflow=12.5 cfs 1.6 af Discarded=2.6 cfs 1.6 af Primary=0.0 cfs 0.0 af Outflow=2.6 cfs 1.6 af

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*NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"*

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**Pond P3a: Rain Garden**

Peak Elev=191.77' Storage=3,182 cf Inflow=1.7 cfs 0.2 af  
Discarded=0.3 cfs 0.2 af Secondary=0.0 cfs 0.0 af Outflow=0.3 cfs 0.2 af

**Pond P3b: Infiltration Basin**

Peak Elev=183.34' Storage=11,835 cf Inflow=5.0 cfs 0.5 af  
Discarded=0.3 cfs 0.5 af Secondary=0.0 cfs 0.0 af Outflow=0.3 cfs 0.5 af

**Pond P4: Infiltration Basin**

Peak Elev=190.86' Storage=28,136 cf Inflow=11.3 cfs 1.1 af  
Discarded=0.5 cfs 1.1 af Primary=0.0 cfs 0.0 af Outflow=0.5 cfs 1.1 af

**Link DP-1: Wetlands (Off-site)**

Inflow=6.0 cfs 0.8 af  
Primary=6.0 cfs 0.8 af

**Link DP-2: Off-site**

Inflow=0.0 cfs 0.0 af  
Primary=0.0 cfs 0.0 af

**Link DP-3: Wetlands (On-site)**

Inflow=0.2 cfs 0.1 af  
Primary=0.2 cfs 0.1 af

**Link DP-4: Pond (On-site)**

Inflow=3.8 cfs 0.4 af  
Primary=3.8 cfs 0.4 af

**Total Runoff Area = 33.7 ac Runoff Volume = 5.0 af Average Runoff Depth = 1.8"**  
**67.2% Pervious = 22.6 ac 32.8% Impervious = 11.1 ac**

**Summary for Subcatchment E1a: Subcat E1a (Off Site)**

Runoff = 4.9 cfs @ 12.37 hrs, Volume= 0.5 af, Depth= 2.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.0	39	>75% Grass cover, Good, HSG A
* 0.2	98	Off-site Paved Roads, HSG A
1.7	61	1/4 acre lots, 38% imp, HSG A
0.4	30	Woods, Good, HSG A
0.3	83	1/4 acre lots, 38% imp, HSG C
0.4	70	Woods, Good, HSG C
3.0	63	Weighted Average
2.0		68.0% Pervious Area
1.0		32.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0310	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
1.7	124	0.0310	1.23		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	240	0.0310	0.88		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.6	414	Total			

**Summary for Subcatchment P10a: Subcat P10a**

Runoff = 1.7 cfs @ 12.31 hrs, Volume= 0.2 af, Depth= 1.8"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.5	39	>75% Grass cover, Good, HSG A
0.3	98	Off-site Paved Roads, HSG A
0.2	30	Woods, Good, HSG A
* 0.1	98	Roofs
1.1	59	Weighted Average
0.7		63.6% Pervious Area
0.4		36.4% Impervious Area

**13168.00-PR Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0230	0.16		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
2.9	186	0.0230	1.06		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.3	100	0.0100	0.50		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
11.5	336	Total			

**Summary for Subcatchment P10b: Subcat P10b**

Runoff = 0.4 cfs @ 12.44 hrs, Volume= 0.1 af, Depth= 0.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.8	39	>75% Grass cover, Good, HSG A
0.7	30	Woods, Good, HSG A
* 0.2	98	Roofs
1.7	42	Weighted Average
1.5		88.2% Pervious Area
0.2		11.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0080	0.10		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.2	248	0.0130	0.80		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
2.2	130	0.0380	0.97		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
15.5	428	Total			

**Summary for Subcatchment P11: Subcat P11**

Runoff = 2.2 cfs @ 12.33 hrs, Volume= 0.2 af, Depth= 1.8"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.1	98	Roofs, HSG A
1.0	39	>75% Grass cover, Good, HSG A
* 0.2	98	Off-site Paved Roads, HSG A
* 0.2	98	On-site Paved Roads, HSG A
1.5	59	Weighted Average
1.0		66.7% Pervious Area
0.5		33.3% Impervious Area

**13168.00-PR Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.6	235	0.0100	0.70		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.2	25	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.3	95	0.0100	5.36	4.21	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
13.5	405	Total			

**Summary for Subcatchment P12: Subcat P12**

Runoff = 12.5 cfs @ 12.45 hrs, Volume= 1.6 af, Depth= 2.4"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
1.6	98	Roofs, HSG A
* 2.1	98	On-site Paved Roads, HSG A
0.3	30	Woods, Good, HSG A
3.9	39	>75% Grass cover, Good, HSG A
7.9	66	Weighted Average
4.2		53.2% Pervious Area
3.7		46.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
12.3	400	0.0060	0.54		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.9	110	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.5	121	0.0060	3.81	2.99	<b>Pipe Channel, RCP_Round 12"</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
23.5	681	Total			

**Summary for Subcatchment P20: Subcat P20**

Runoff = 0.0 cfs @ 12.31 hrs, Volume= 0.0 af, Depth= 0.4"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Area (ac)	CN	Description
0.2	39	>75% Grass cover, Good, HSG A
0.2		100.0% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	12	0.0050	0.06		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.1	20	0.2500	3.50		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.2	32	Total, Increased to minimum Tc = 5.0 min			

**Summary for Subcatchment P30: Subcat E3 Remaining Overland**

Runoff = 0.2 cfs @ 13.16 hrs, Volume= 0.1 af, Depth= 0.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.2	98	Off-site Paved Roads, HSG A
0.5	39	>75% Grass cover, Good, HSG A
3.2	30	Woods, Good, HSG A
* 0.1	98	Roofs
4.0	36	Weighted Average
3.7		92.5% Pervious Area
0.3		7.5% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.1	80	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.7	110	0.0450	1.06		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
8.4	240	Total			

**Summary for Subcatchment P31: Subcat P31**

Runoff = 5.0 cfs @ 12.36 hrs, Volume= 0.5 af, Depth= 2.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

**13168.00-PR Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Area (ac)	CN	Description
0.4	98	Roofs, HSG A
* 0.8	98	On-site Paved Roads, HSG A
1.8	39	>75% Grass cover, Good, HSG A
3.0	63	Weighted Average
1.8		60.0% Pervious Area
1.2		40.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
8.1	340	0.0100	0.70		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	50	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps

15.9 440 Total

**Summary for Subcatchment P32: Subcat P32**

Runoff = 1.7 cfs @ 12.42 hrs, Volume= 0.2 af, Depth= 1.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
1.3	39	>75% Grass cover, Good, HSG A
0.5	98	Roofs, HSG A
1.8	55	Weighted Average
1.3		72.2% Pervious Area
0.5		27.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	50	0.0020	0.06		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.6	500	0.0100	1.50		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps

19.7 550 Total

**Summary for Subcatchment P40: Subcat E5a&E5b Remaining Overland**

Runoff = 3.8 cfs @ 12.35 hrs, Volume= 0.4 af, Depth= 1.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

**13168.00-PR Drainage**

NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Area (ac)	CN	Description
0.7	98	Off-site Paved Roads, HSG A
0.2	39	>75% Grass cover, Good, HSG A
2.4	30	Woods, Good, HSG A
0.6	98	Water Surface, 0% imp, HSG A
3.9	53	Weighted Average
3.2		82.1% Pervious Area
0.7		17.9% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0150	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.7	340	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
2.0	60	0.0100	0.50		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
14.0	450	Total			

**Summary for Subcatchment P41: Subcat P41**

Runoff = 11.3 cfs @ 12.33 hrs, Volume= 1.1 af, Depth= 2.4"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

Area (ac)	CN	Description
0.2	98	Off-site Paved Roads, HSG A
* 1.2	98	On-site Paved Roads, HSG A
3.0	39	>75% Grass cover, Good, HSG A
1.2	98	Roofs, HSG A
5.6	66	Weighted Average
3.0		53.6% Pervious Area
2.6		46.4% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
2.0	60	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.1	15	0.2500	3.50		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.8	400	0.0060	3.81	2.99	<b>Pipe Channel, RCP_Round 12"</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
13.7	525	Total			

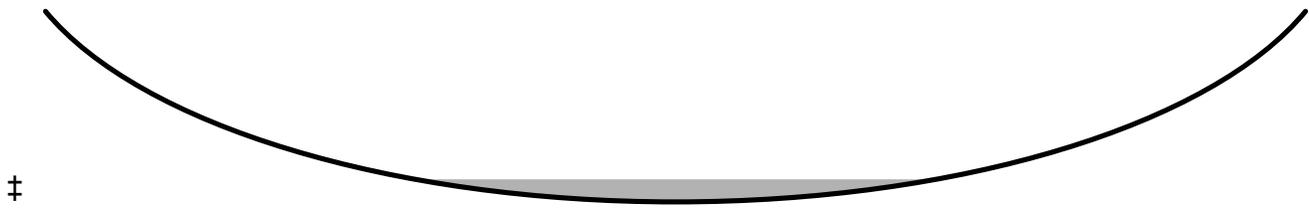
Summary for Reach R1a: Swale

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 2.5" for 25\_year event
Inflow = 7.2 cfs @ 12.37 hrs, Volume= 0.6 af
Outflow = 6.8 cfs @ 12.41 hrs, Volume= 0.6 af, Atten= 5%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 4.27 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 2.5 min

Peak Storage= 407 cf @ 12.39 hrs
Average Depth at Peak Storage= 0.2'
Bank-Full Depth= 2.0' Flow Area= 40.0 sf, Capacity= 704.5 cfs

30.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished
Length= 250.0' Slope= 0.0140 '/'
Inlet Invert= 193.00', Outlet Invert= 189.50'



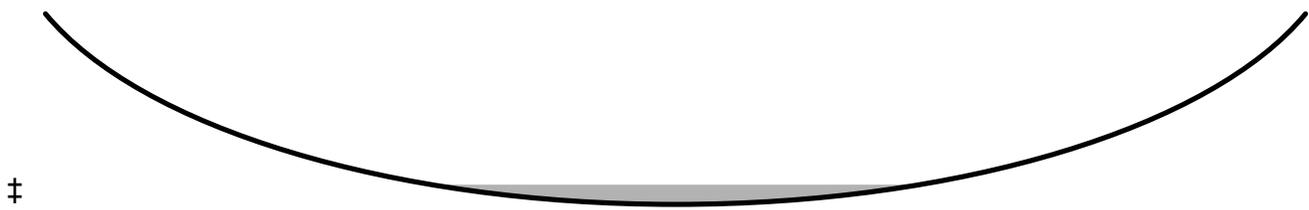
Summary for Reach R1b: Swale

Inflow Area = 4.1 ac, 33.2% Impervious, Inflow Depth = 2.1" for 25\_year event
Inflow = 5.8 cfs @ 12.52 hrs, Volume= 0.7 af
Outflow = 5.7 cfs @ 12.59 hrs, Volume= 0.7 af, Atten= 2%, Lag= 4.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 3.21 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 6.1 min

Peak Storage= 840 cf @ 12.55 hrs
Average Depth at Peak Storage= 0.2'
Bank-Full Depth= 2.0' Flow Area= 53.3 sf, Capacity= 775.3 cfs

40.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished
Length= 475.0' Slope= 0.0095 '/'
Inlet Invert= 189.50', Outlet Invert= 185.00'



**Summary for Pond P1a: (new Pond)**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 2.5" for 25\_year event  
 Inflow = 6.8 cfs @ 12.41 hrs, Volume= 0.6 af  
 Outflow = 5.0 cfs @ 12.53 hrs, Volume= 0.5 af, Atten= 26%, Lag= 7.1 min  
 Primary = 5.0 cfs @ 12.53 hrs, Volume= 0.5 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 189.25' @ 12.53 hrs Surf.Area= 7,615 sf Storage= 5,623 cf

Plug-Flow detention time= 97.2 min calculated for 0.5 af (88% of inflow)  
 Center-of-Mass det. time= 37.5 min ( 919.8 - 882.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	12,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	600	0	0
189.00	6,085	3,343	3,343
190.00	12,230	9,158	12,500

Device	Routing	Invert	Outlet Devices
#1	Primary	189.00'	<b>15.0' long x 30.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=5.0 cfs @ 12.53 hrs HW=189.25' (Free Discharge)  
 1=**Broad-Crested Rectangular Weir**(Weir Controls 5.0 cfs @ 1.34 fps)

**Summary for Pond P1b: Infiltration Basin**

Inflow Area = 1.5 ac, 33.3% Impervious, Inflow Depth = 1.8" for 25\_year event  
 Inflow = 2.2 cfs @ 12.33 hrs, Volume= 0.2 af  
 Outflow = 2.4 cfs @ 12.37 hrs, Volume= 0.2 af, Atten= 0%, Lag= 2.6 min  
 Discarded = 0.1 cfs @ 12.37 hrs, Volume= 0.1 af  
 Secondary = 2.3 cfs @ 12.37 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 193.90' @ 12.37 hrs Surf.Area= 2,083 sf Storage= 1,418 cf

Plug-Flow detention time= 92.4 min calculated for 0.2 af (100% of inflow)  
 Center-of-Mass det. time= 92.4 min ( 995.3 - 902.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	193.00'	173 cf	<b>Forebay (Prismatic)</b> Listed below (Recalc)
#2	193.00'	1,413 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		1,586 cf	Total Available Storage

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.00	273	0	0
193.50	420	173	173

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.00	1,100	0	0
194.00	1,725	1,413	1,413

Device	Routing	Invert	Outlet Devices
#1	Discarded	193.00'	<b>2.410 in/hr Exfiltration over Surface area</b> Phase-In= 0.01' <b>30.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Secondary	193.80'	

**Discarded OutFlow** Max=0.1 cfs @ 12.37 hrs HW=193.89' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.1 cfs)

**Secondary OutFlow** Max=2.1 cfs @ 12.37 hrs HW=193.89' (Free Discharge)  
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 2.1 cfs @ 0.74 fps)

**Summary for Pond P1c: Infiltration Basin (Southwest Corner)**

Inflow Area = 7.9 ac, 46.8% Impervious, Inflow Depth = 2.4" for 25\_year event  
 Inflow = 12.5 cfs @ 12.45 hrs, Volume= 1.6 af  
 Outflow = 2.6 cfs @ 13.46 hrs, Volume= 1.6 af, Atten= 79%, Lag= 60.4 min  
 Discarded = 2.6 cfs @ 13.46 hrs, Volume= 1.6 af  
 Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 186.05' @ 13.46 hrs Surf.Area= 13,593 sf Storage= 22,257 cf

Plug-Flow detention time= 90.6 min calculated for 1.6 af (100% of inflow)  
 Center-of-Mass det. time= 90.5 min ( 981.6 - 891.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	833 cf	<b>Forebay 1 (Prismatic)</b> Listed below (Recalc)
#2	188.00'	933 cf	<b>Forebay 2 (Prismatic)</b> Listed below (Recalc)
#3	183.40'	54,639 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		56,404 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	615	0	0
187.00	1,050	833	833

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	625	0	0
189.00	1,240	933	933

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
183.40	2,847	0	0
184.00	5,984	2,649	2,649
185.00	9,493	7,739	10,388
186.00	12,771	11,132	21,520
187.00	16,132	14,452	35,971
188.00	21,203	18,668	54,639

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.40'	<b>8.270 in/hr Exfiltration over Surface area</b> Phase-In= 0.02'
#2	Primary	186.70'	<b>30.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

**Discarded OutFlow** Max=2.6 cfs @ 13.46 hrs HW=186.05' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 2.6 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=183.40' (Free Discharge)

↳ **2=Broad-Crested Rectangular Weir** ( Controls 0.0 cfs)

**Summary for Pond P3a: Rain Garden**

Inflow Area = 1.8 ac, 27.8% Impervious, Inflow Depth = 1.5" for 25\_year event  
 Inflow = 1.7 cfs @ 12.42 hrs, Volume= 0.2 af  
 Outflow = 0.3 cfs @ 14.17 hrs, Volume= 0.2 af, Atten= 85%, Lag= 105.1 min  
 Discarded = 0.3 cfs @ 14.17 hrs, Volume= 0.2 af  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 191.77' @ 14.17 hrs Surf.Area= 4,541 sf Storage= 3,182 cf

Plug-Flow detention time= 128.0 min calculated for 0.2 af (100% of inflow)  
 Center-of-Mass det. time= 127.9 min ( 1,050.3 - 922.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	191.00'	6,871 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
191.00	3,785	0	0
191.50	4,270	2,014	2,014
192.00	4,782	2,263	4,277
192.50	5,596	2,595	6,871

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NCDC\_Framingham\_25\_year 25\_year Rainfall=5.9"

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Device	Routing	Invert	Outlet Devices
#1	Discarded	191.00'	<b>2.400 in/hr Exfiltration over Surface area</b> Phase-In= 0.01'
#2	Secondary	192.00'	<b>18.0" Vert. Orifice/Grate X 2.00</b> C= 0.600

**Discarded OutFlow** Max=0.3 cfs @ 14.17 hrs HW=191.77' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.3 cfs)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=191.00' (Free Discharge)  
 ↳2=Orifice/Grate ( Controls 0.0 cfs)

**Summary for Pond P3b: Infiltration Basin**

Inflow Area = 3.0 ac, 40.0% Impervious, Inflow Depth = 2.1" for 25\_year event  
 Inflow = 5.0 cfs @ 12.36 hrs, Volume= 0.5 af  
 Outflow = 0.3 cfs @ 15.84 hrs, Volume= 0.5 af, Atten= 93%, Lag= 208.8 min  
 Discarded = 0.3 cfs @ 15.84 hrs, Volume= 0.5 af  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 183.34' @ 15.84 hrs Surf.Area= 6,013 sf Storage= 11,835 cf

Plug-Flow detention time= 460.5 min calculated for 0.5 af (100% of inflow)  
 Center-of-Mass det. time= 460.7 min ( 1,353.5 - 892.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	184.00'	749 cf	<b>Forebay (Prismatic)</b> Listed below (Recalc)
#2	180.00'	24,518 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		25,266 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
184.00	490	0	0
185.00	1,007	749	749

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
180.00	1,211	0	0
181.00	2,443	1,827	1,827
182.00	4,086	3,265	5,092
183.00	5,476	4,781	9,873
184.00	7,048	6,262	16,135
185.00	9,718	8,383	24,518

Device	Routing	Invert	Outlet Devices
#1	Discarded	180.00'	<b>2.400 in/hr Exfiltration over Surface area</b> Phase-In= 0.01'
#2	Secondary	184.80'	<b>40.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

**Discarded OutFlow** Max=0.3 cfs @ 15.84 hrs HW=183.34' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.3 cfs)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=180.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)

**Summary for Pond P4: Infiltration Basin**

Inflow Area = 5.6 ac, 46.4% Impervious, Inflow Depth = 2.4" for 25\_year event  
 Inflow = 11.3 cfs @ 12.33 hrs, Volume= 1.1 af  
 Outflow = 0.5 cfs @ 17.96 hrs, Volume= 1.1 af, Atten= 95%, Lag= 338.1 min  
 Discarded = 0.5 cfs @ 17.96 hrs, Volume= 1.1 af  
 Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 190.86' @ 17.96 hrs Surf.Area= 9,597 sf Storage= 28,136 cf

Plug-Flow detention time= 667.6 min calculated for 1.1 af (100% of inflow)  
 Center-of-Mass det. time= 668.0 min ( 1,550.0 - 882.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	53,073 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	1,597	0	0
187.00	3,887	2,742	2,742
188.00	5,170	4,529	7,271
189.00	6,574	5,872	13,143
190.00	8,144	7,359	20,502
191.00	9,832	8,988	29,490
192.00	11,550	10,691	40,181
193.00	14,235	12,893	53,073

Device	Routing	Invert	Outlet Devices
#1	Discarded	186.00'	<b>2.410 in/hr Exfiltration over Surface area</b> Phase-In= 0.02'
#2	Primary	191.00'	<b>40.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.5 cfs @ 17.96 hrs HW=190.86' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.5 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=186.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)

**Summary for Link DP-1: Wetlands (Off-site)**

Inflow Area = 13.7 ac, 38.4% Impervious, Inflow Depth = 0.7" for 25\_year event  
Inflow = 6.0 cfs @ 12.59 hrs, Volume= 0.8 af  
Primary = 6.0 cfs @ 12.59 hrs, Volume= 0.8 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-2: Off-site**

Inflow Area = 0.2 ac, 0.0% Impervious, Inflow Depth = 0.4" for 25\_year event  
Inflow = 0.0 cfs @ 12.31 hrs, Volume= 0.0 af  
Primary = 0.0 cfs @ 12.31 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-3: Wetlands (On-site)**

Inflow Area = 4.0 ac, 7.5% Impervious, Inflow Depth = 0.3" for 25\_year event  
Inflow = 0.2 cfs @ 13.16 hrs, Volume= 0.1 af  
Primary = 0.2 cfs @ 13.16 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-4: Pond (On-site)**

Inflow Area = 9.5 ac, 34.7% Impervious, Inflow Depth = 0.5" for 25\_year event  
Inflow = 3.8 cfs @ 12.35 hrs, Volume= 0.4 af  
Primary = 3.8 cfs @ 12.35 hrs, Volume= 0.4 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs



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## 100-Year Storm Event – Proposed

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>SubcatchmentE1a: Subcat E1a (Off Site)</b>	Runoff Area=3.0 ac 32.0% Impervious Runoff Depth=4.0" Flow Length=414' Slope=0.0310 '/' Tc=16.6 min CN=63 Runoff=9.0 cfs 1.0 af
<b>SubcatchmentP10a: Subcat P10a</b>	Runoff Area=1.1 ac 36.4% Impervious Runoff Depth=3.5" Flow Length=336' Tc=11.5 min CN=59 Runoff=3.3 cfs 0.3 af
<b>SubcatchmentP10b: Subcat P10b</b>	Runoff Area=1.7 ac 11.8% Impervious Runoff Depth=1.6" Flow Length=428' Tc=15.5 min CN=42 Runoff=1.7 cfs 0.2 af
<b>SubcatchmentP11: Subcat P11</b>	Runoff Area=1.5 ac 33.3% Impervious Runoff Depth=3.5" Flow Length=405' Slope=0.0100 '/' Tc=13.5 min CN=59 Runoff=4.3 cfs 0.4 af
<b>SubcatchmentP12: Subcat P12</b>	Runoff Area=7.9 ac 46.8% Impervious Runoff Depth=4.3" Flow Length=681' Tc=23.5 min CN=66 Runoff=22.3 cfs 2.9 af
<b>SubcatchmentP20: Subcat P20</b>	Runoff Area=0.2 ac 0.0% Impervious Runoff Depth=1.3" Flow Length=32' Tc=5.0 min CN=39 Runoff=0.2 cfs 0.0 af
<b>SubcatchmentP30: Subcat E3 Remaining</b>	Runoff Area=4.0 ac 7.5% Impervious Runoff Depth=1.0" Flow Length=240' Tc=8.4 min CN=36 Runoff=2.4 cfs 0.3 af
<b>SubcatchmentP31: Subcat P31</b>	Runoff Area=3.0 ac 40.0% Impervious Runoff Depth=4.0" Flow Length=440' Tc=15.9 min CN=63 Runoff=9.1 cfs 1.0 af
<b>SubcatchmentP32: Subcat P32</b>	Runoff Area=1.8 ac 27.8% Impervious Runoff Depth=3.1" Flow Length=550' Tc=19.7 min CN=55 Runoff=3.8 cfs 0.5 af
<b>SubcatchmentP40: Subcat E5a&amp;E5b</b>	Runoff Area=3.9 ac 17.9% Impervious Runoff Depth=2.8" Flow Length=450' Tc=14.0 min CN=53 Runoff=8.6 cfs 0.9 af
<b>SubcatchmentP41: Subcat P41</b>	Runoff Area=5.6 ac 46.4% Impervious Runoff Depth=4.3" Flow Length=525' Tc=13.7 min CN=66 Runoff=19.7 cfs 2.0 af
<b>Reach R1a: Swale</b>	Avg. Flow Depth=0.3' Max Vel=5.19 fps Inflow=13.1 cfs 1.3 af n=0.012 L=250.0' S=0.0140 '/' Capacity=704.5 cfs Outflow=12.9 cfs 1.3 af
<b>Reach R1b: Swale</b>	Avg. Flow Depth=0.3' Max Vel=4.25 fps Inflow=14.2 cfs 1.5 af n=0.012 L=475.0' S=0.0095 '/' Capacity=775.3 cfs Outflow=14.0 cfs 1.5 af
<b>Pond P1a: (new Pond)</b>	Peak Elev=189.44' Storage=7,402 cf Inflow=12.9 cfs 1.3 af Outflow=12.0 cfs 1.2 af
<b>Pond P1b: Infiltration Basin</b>	Peak Elev=193.95' Storage=1,496 cf Inflow=4.3 cfs 0.4 af Discarded=0.1 cfs 0.2 af Secondary=4.1 cfs 0.3 af Outflow=4.2 cfs 0.4 af
<b>Pond P1c: Infiltration Basin (Southwest</b>	Peak Elev=186.95' Storage=35,914 cf Inflow=22.3 cfs 2.9 af Discarded=3.3 cfs 2.4 af Primary=9.1 cfs 0.4 af Outflow=12.4 cfs 2.9 af

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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**Pond P3a: Rain Garden**

Peak Elev=192.33' Storage=5,921 cf Inflow=3.8 cfs 0.5 af  
Discarded=0.3 cfs 0.3 af Secondary=1.1 cfs 0.1 af Outflow=1.4 cfs 0.5 af

**Pond P3b: Infiltration Basin**

Peak Elev=184.86' Storage=23,814 cf Inflow=9.1 cfs 1.1 af  
Discarded=0.6 cfs 1.0 af Secondary=1.6 cfs 0.1 af Outflow=2.1 cfs 1.1 af

**Pond P4: Infiltration Basin**

Peak Elev=191.21' Storage=31,596 cf Inflow=19.7 cfs 2.0 af  
Discarded=0.6 cfs 1.3 af Primary=9.7 cfs 0.7 af Outflow=10.3 cfs 2.0 af

**Link DP-1: Wetlands (Off-site)**

Inflow=18.5 cfs 2.2 af  
Primary=18.5 cfs 2.2 af

**Link DP-2: Off-site**

Inflow=0.2 cfs 0.0 af  
Primary=0.2 cfs 0.0 af

**Link DP-3: Wetlands (On-site)**

Inflow=2.4 cfs 0.5 af  
Primary=2.4 cfs 0.5 af

**Link DP-4: Pond (On-site)**

Inflow=14.9 cfs 1.7 af  
Primary=14.9 cfs 1.7 af

**Total Runoff Area = 33.7 ac Runoff Volume = 9.6 af Average Runoff Depth = 3.4"**  
**67.2% Pervious = 22.6 ac 32.8% Impervious = 11.1 ac**

**13168.00-PR Drainage**

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**Summary for Subcatchment E1a: Subcat E1a (Off Site)**

Runoff = 9.0 cfs @ 12.36 hrs, Volume= 1.0 af, Depth= 4.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.0	39	>75% Grass cover, Good, HSG A
* 0.2	98	Off-site Paved Roads, HSG A
1.7	61	1/4 acre lots, 38% imp, HSG A
0.4	30	Woods, Good, HSG A
0.3	83	1/4 acre lots, 38% imp, HSG C
0.4	70	Woods, Good, HSG C
3.0	63	Weighted Average
2.0		68.0% Pervious Area
1.0		32.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0310	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.2"
1.7	124	0.0310	1.23		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	240	0.0310	0.88		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.6	414	Total			

**Summary for Subcatchment P10a: Subcat P10a**

Runoff = 3.3 cfs @ 12.30 hrs, Volume= 0.3 af, Depth= 3.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.5	39	>75% Grass cover, Good, HSG A
0.3	98	Off-site Paved Roads, HSG A
0.2	30	Woods, Good, HSG A
* 0.1	98	Roofs
1.1	59	Weighted Average
0.7		63.6% Pervious Area
0.4		36.4% Impervious Area

**13168.00-PR Drainage**

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0230	0.16		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
2.9	186	0.0230	1.06		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.3	100	0.0100	0.50		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
11.5	336	Total			

**Summary for Subcatchment P10b: Subcat P10b**

Runoff = 1.7 cfs @ 12.37 hrs, Volume= 0.2 af, Depth= 1.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.8	39	>75% Grass cover, Good, HSG A
0.7	30	Woods, Good, HSG A
* 0.2	98	Roofs
1.7	42	Weighted Average
1.5		88.2% Pervious Area
0.2		11.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0080	0.10		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.2	248	0.0130	0.80		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
2.2	130	0.0380	0.97		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
15.5	428	Total			

**Summary for Subcatchment P11: Subcat P11**

Runoff = 4.3 cfs @ 12.32 hrs, Volume= 0.4 af, Depth= 3.5"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.1	98	Roofs, HSG A
1.0	39	>75% Grass cover, Good, HSG A
* 0.2	98	Off-site Paved Roads, HSG A
* 0.2	98	On-site Paved Roads, HSG A
1.5	59	Weighted Average
1.0		66.7% Pervious Area
0.5		33.3% Impervious Area

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.6	235	0.0100	0.70		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.2	25	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.3	95	0.0100	5.36	4.21	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
13.5	405	Total			

**Summary for Subcatchment P12: Subcat P12**

Runoff = 22.3 cfs @ 12.44 hrs, Volume= 2.9 af, Depth= 4.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
1.6	98	Roofs, HSG A
* 2.1	98	On-site Paved Roads, HSG A
0.3	30	Woods, Good, HSG A
3.9	39	>75% Grass cover, Good, HSG A
7.9	66	Weighted Average
4.2		53.2% Pervious Area
3.7		46.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
12.3	400	0.0060	0.54		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.9	110	0.0100	2.03		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.5	121	0.0060	3.81	2.99	<b>Pipe Channel, RCP_Round 12"</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
23.5	681	Total			

**Summary for Subcatchment P20: Subcat P20**

Runoff = 0.2 cfs @ 12.24 hrs, Volume= 0.0 af, Depth= 1.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Area (ac)	CN	Description
0.2	39	>75% Grass cover, Good, HSG A
0.2		100.0% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	12	0.0050	0.06		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
0.1	20	0.2500	3.50		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.2	32	Total, Increased to minimum Tc = 5.0 min			

**Summary for Subcatchment P30: Subcat E3 Remaining Overland**

Runoff = 2.4 cfs @ 12.30 hrs, Volume= 0.3 af, Depth= 1.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.2	98	Off-site Paved Roads, HSG A
0.5	39	>75% Grass cover, Good, HSG A
3.2	30	Woods, Good, HSG A
* 0.1	98	Roofs
4.0	36	Weighted Average
3.7		92.5% Pervious Area
0.3		7.5% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
1.1	80	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.7	110	0.0450	1.06		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
8.4	240	Total			

**Summary for Subcatchment P31: Subcat P31**

Runoff = 9.1 cfs @ 12.35 hrs, Volume= 1.0 af, Depth= 4.0"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Area (ac)	CN	Description
0.4	98	Roofs, HSG A
* 0.8	98	On-site Paved Roads, HSG A
1.8	39	>75% Grass cover, Good, HSG A
3.0	63	Weighted Average
1.8		60.0% Pervious Area
1.2		40.0% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
8.1	340	0.0100	0.70		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	50	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps

15.9 440 Total

**Summary for Subcatchment P32: Subcat P32**

Runoff = 3.8 cfs @ 12.41 hrs, Volume= 0.5 af, Depth= 3.1"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
1.3	39	>75% Grass cover, Good, HSG A
0.5	98	Roofs, HSG A
1.8	55	Weighted Average
1.3		72.2% Pervious Area
0.5		27.8% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	50	0.0020	0.06		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.6	500	0.0100	1.50		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps

19.7 550 Total

**Summary for Subcatchment P40: Subcat E5a&E5b Remaining Overland**

Runoff = 8.6 cfs @ 12.33 hrs, Volume= 0.9 af, Depth= 2.8"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Area (ac)	CN	Description
0.7	98	Off-site Paved Roads, HSG A
0.2	39	>75% Grass cover, Good, HSG A
2.4	30	Woods, Good, HSG A
0.6	98	Water Surface, 0% imp, HSG A
3.9	53	Weighted Average
3.2		82.1% Pervious Area
0.7		17.9% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0150	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
5.7	340	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
2.0	60	0.0100	0.50		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
14.0	450	Total			

**Summary for Subcatchment P41: Subcat P41**

Runoff = 19.7 cfs @ 12.32 hrs, Volume= 2.0 af, Depth= 4.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

Area (ac)	CN	Description
0.2	98	Off-site Paved Roads, HSG A
* 1.2	98	On-site Paved Roads, HSG A
3.0	39	>75% Grass cover, Good, HSG A
1.2	98	Roofs, HSG A
5.6	66	Weighted Average
3.0		53.6% Pervious Area
2.6		46.4% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.2"
2.0	60	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.1	15	0.2500	3.50		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.8	400	0.0060	3.81	2.99	<b>Pipe Channel, RCP_Round 12"</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
13.7	525	Total			

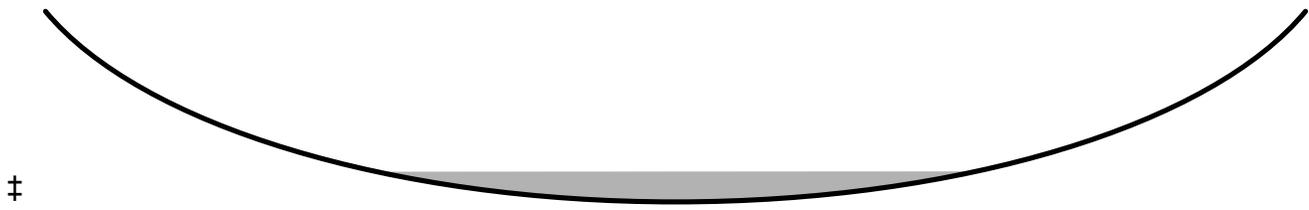
Summary for Reach R1a: Swale

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 5.1" for 100\_year event
Inflow = 13.1 cfs @ 12.35 hrs, Volume= 1.3 af
Outflow = 12.9 cfs @ 12.37 hrs, Volume= 1.3 af, Atten= 1%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 5.19 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.94 fps, Avg. Travel Time= 2.1 min

Peak Storage= 629 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.3'
Bank-Full Depth= 2.0' Flow Area= 40.0 sf, Capacity= 704.5 cfs

30.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished
Length= 250.0' Slope= 0.0140 '/'
Inlet Invert= 193.00', Outlet Invert= 189.50'



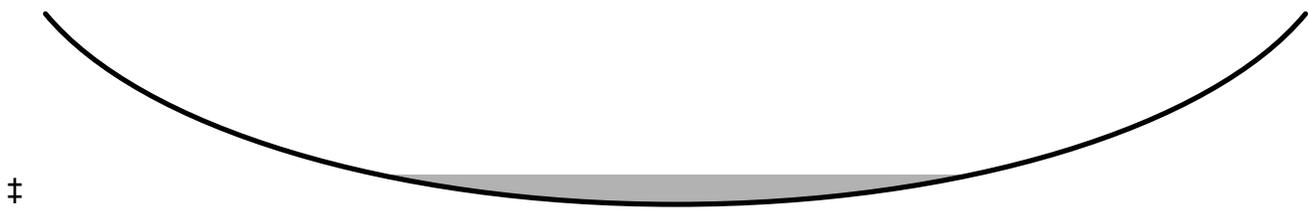
Summary for Reach R1b: Swale

Inflow Area = 4.1 ac, 33.2% Impervious, Inflow Depth = 4.5" for 100\_year event
Inflow = 14.2 cfs @ 12.42 hrs, Volume= 1.5 af
Outflow = 14.0 cfs @ 12.47 hrs, Volume= 1.5 af, Atten= 1%, Lag= 3.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 4.25 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 5.3 min

Peak Storage= 1,574 cf @ 12.44 hrs
Average Depth at Peak Storage= 0.3'
Bank-Full Depth= 2.0' Flow Area= 53.3 sf, Capacity= 775.3 cfs

40.00' x 2.00' deep Parabolic Channel, n= 0.012 Concrete pipe, finished
Length= 475.0' Slope= 0.0095 '/'
Inlet Invert= 189.50', Outlet Invert= 185.00'



**Summary for Pond P1a: (new Pond)**

Inflow Area = 3.0 ac, 32.0% Impervious, Inflow Depth = 5.1" for 100\_year event  
 Inflow = 12.9 cfs @ 12.37 hrs, Volume= 1.3 af  
 Outflow = 12.0 cfs @ 12.44 hrs, Volume= 1.2 af, Atten= 8%, Lag= 3.9 min  
 Primary = 12.0 cfs @ 12.44 hrs, Volume= 1.2 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 189.44' @ 12.44 hrs Surf.Area= 8,809 sf Storage= 7,402 cf

Plug-Flow detention time= 55.5 min calculated for 1.2 af (94% of inflow)  
 Center-of-Mass det. time= 23.3 min ( 883.5 - 860.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	12,500 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	600	0	0
189.00	6,085	3,343	3,343
190.00	12,230	9,158	12,500

Device	Routing	Invert	Outlet Devices
#1	Primary	189.00'	<b>15.0' long x 30.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=12.0 cfs @ 12.44 hrs HW=189.44' (Free Discharge)  
 1=**Broad-Crested Rectangular Weir**(Weir Controls 12.0 cfs @ 1.80 fps)

**Summary for Pond P1b: Infiltration Basin**

Inflow Area = 1.5 ac, 33.3% Impervious, Inflow Depth = 3.5" for 100\_year event  
 Inflow = 4.3 cfs @ 12.32 hrs, Volume= 0.4 af  
 Outflow = 4.2 cfs @ 12.34 hrs, Volume= 0.4 af, Atten= 0%, Lag= 0.7 min  
 Discarded = 0.1 cfs @ 12.34 hrs, Volume= 0.2 af  
 Secondary = 4.1 cfs @ 12.34 hrs, Volume= 0.3 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 193.95' @ 12.34 hrs Surf.Area= 2,112 sf Storage= 1,496 cf

Plug-Flow detention time= 57.2 min calculated for 0.4 af (100% of inflow)  
 Center-of-Mass det. time= 57.3 min ( 932.8 - 875.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	193.00'	173 cf	<b>Forebay (Prismatic)</b> Listed below (Recalc)
#2	193.00'	1,413 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		1,586 cf	Total Available Storage

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.00	273	0	0
193.50	420	173	173

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.00	1,100	0	0
194.00	1,725	1,413	1,413

Device	Routing	Invert	Outlet Devices
#1	Discarded	193.00'	<b>2.410 in/hr Exfiltration over Surface area</b> Phase-In= 0.01' <b>30.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Secondary	193.80'	

**Discarded OutFlow** Max=0.1 cfs @ 12.34 hrs HW=193.95' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.1 cfs)

**Secondary OutFlow** Max=4.1 cfs @ 12.34 hrs HW=193.95' (Free Discharge)  
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 4.1 cfs @ 0.93 fps)

**Summary for Pond P1c: Infiltration Basin (Southwest Corner)**

Inflow Area = 7.9 ac, 46.8% Impervious, Inflow Depth = 4.3" for 100\_year event  
 Inflow = 22.3 cfs @ 12.44 hrs, Volume= 2.9 af  
 Outflow = 12.4 cfs @ 12.76 hrs, Volume= 2.9 af, Atten= 44%, Lag= 18.7 min  
 Discarded = 3.3 cfs @ 12.76 hrs, Volume= 2.4 af  
 Primary = 9.1 cfs @ 12.76 hrs, Volume= 0.4 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 186.95' @ 12.76 hrs Surf.Area= 16,984 sf Storage= 35,914 cf

Plug-Flow detention time= 103.1 min calculated for 2.9 af (100% of inflow)  
 Center-of-Mass det. time= 103.1 min ( 970.6 - 867.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	833 cf	<b>Forebay 1 (Prismatic)</b> Listed below (Recalc)
#2	188.00'	933 cf	<b>Forebay 2 (Prismatic)</b> Listed below (Recalc)
#3	183.40'	54,639 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		56,404 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	615	0	0
187.00	1,050	833	833

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	625	0	0
189.00	1,240	933	933

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
183.40	2,847	0	0
184.00	5,984	2,649	2,649
185.00	9,493	7,739	10,388
186.00	12,771	11,132	21,520
187.00	16,132	14,452	35,971
188.00	21,203	18,668	54,639

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.40'	<b>8.270 in/hr Exfiltration over Surface area</b> Phase-In= 0.02'
#2	Primary	186.70'	<b>30.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

**Discarded OutFlow** Max=3.3 cfs @ 12.76 hrs HW=186.95' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 3.3 cfs)

**Primary OutFlow** Max=9.1 cfs @ 12.76 hrs HW=186.95' (Free Discharge)

↳ **2=Broad-Crested Rectangular Weir** (Weir Controls 9.1 cfs @ 1.22 fps)

**Summary for Pond P3a: Rain Garden**

Inflow Area = 1.8 ac, 27.8% Impervious, Inflow Depth = 3.1" for 100\_year event  
 Inflow = 3.8 cfs @ 12.41 hrs, Volume= 0.5 af  
 Outflow = 1.4 cfs @ 12.87 hrs, Volume= 0.5 af, Atten= 63%, Lag= 28.0 min  
 Discarded = 0.3 cfs @ 12.87 hrs, Volume= 0.3 af  
 Secondary = 1.1 cfs @ 12.87 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 192.33' @ 12.87 hrs Surf.Area= 5,312 sf Storage= 5,921 cf

Plug-Flow detention time= 157.5 min calculated for 0.5 af (100% of inflow)  
 Center-of-Mass det. time= 157.4 min ( 1,049.2 - 891.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	191.00'	6,871 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
191.00	3,785	0	0
191.50	4,270	2,014	2,014
192.00	4,782	2,263	4,277
192.50	5,596	2,595	6,871

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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Device	Routing	Invert	Outlet Devices
#1	Discarded	191.00'	<b>2.400 in/hr Exfiltration over Surface area</b> Phase-In= 0.01'
#2	Secondary	192.00'	<b>18.0" Vert. Orifice/Grate X 2.00</b> C= 0.600

**Discarded OutFlow** Max=0.3 cfs @ 12.87 hrs HW=192.33' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 0.3 cfs)

**Secondary OutFlow** Max=1.1 cfs @ 12.87 hrs HW=192.33' (Free Discharge)

↳ **2=Orifice/Grate** (Orifice Controls 1.1 cfs @ 1.94 fps)

**Summary for Pond P3b: Infiltration Basin**

Inflow Area = 3.0 ac, 40.0% Impervious, Inflow Depth = 4.5" for 100\_year event  
 Inflow = 9.1 cfs @ 12.35 hrs, Volume= 1.1 af  
 Outflow = 2.1 cfs @ 13.50 hrs, Volume= 1.1 af, Atten= 77%, Lag= 68.7 min  
 Discarded = 0.6 cfs @ 13.50 hrs, Volume= 1.0 af  
 Secondary = 1.6 cfs @ 13.50 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 184.86' @ 13.50 hrs Surf.Area= 10,284 sf Storage= 23,814 cf

Plug-Flow detention time= 499.6 min calculated for 1.1 af (100% of inflow)  
 Center-of-Mass det. time= 500.1 min ( 1,362.9 - 862.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	184.00'	749 cf	<b>Forebay (Prismatic)</b> Listed below (Recalc)
#2	180.00'	24,518 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)
		25,266 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
184.00	490	0	0
185.00	1,007	749	749

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
180.00	1,211	0	0
181.00	2,443	1,827	1,827
182.00	4,086	3,265	5,092
183.00	5,476	4,781	9,873
184.00	7,048	6,262	16,135
185.00	9,718	8,383	24,518

Device	Routing	Invert	Outlet Devices
#1	Discarded	180.00'	<b>2.400 in/hr Exfiltration over Surface area</b> Phase-In= 0.01'
#2	Secondary	184.80'	<b>40.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

**13168.00-PR Drainage**

NCDC\_Framingham\_100\_year 100\_year Rainfall=8.4"

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**Discarded OutFlow** Max=0.6 cfs @ 13.50 hrs HW=184.86' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.6 cfs)

**Secondary OutFlow** Max=1.5 cfs @ 13.50 hrs HW=184.86' (Free Discharge)

↑2=Broad-Crested Rectangular Weir (Weir Controls 1.5 cfs @ 0.60 fps)

**Summary for Pond P4: Infiltration Basin**

Inflow Area = 5.6 ac, 46.4% Impervious, Inflow Depth = 4.3" for 100\_year event  
 Inflow = 19.7 cfs @ 12.32 hrs, Volume= 2.0 af  
 Outflow = 10.3 cfs @ 12.54 hrs, Volume= 2.0 af, Atten= 48%, Lag= 13.0 min  
 Discarded = 0.6 cfs @ 12.54 hrs, Volume= 1.3 af  
 Primary = 9.7 cfs @ 12.54 hrs, Volume= 0.7 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs  
 Peak Elev= 191.21' @ 12.54 hrs Surf.Area= 10,193 sf Storage= 31,596 cf

Plug-Flow detention time= 442.3 min calculated for 2.0 af (100% of inflow)  
 Center-of-Mass det. time= 442.9 min ( 1,301.3 - 858.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	53,073 cf	<b>Basin (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	1,597	0	0
187.00	3,887	2,742	2,742
188.00	5,170	4,529	7,271
189.00	6,574	5,872	13,143
190.00	8,144	7,359	20,502
191.00	9,832	8,988	29,490
192.00	11,550	10,691	40,181
193.00	14,235	12,893	53,073

Device	Routing	Invert	Outlet Devices
#1	Discarded	186.00'	<b>2.410 in/hr Exfiltration over Surface area</b> Phase-In= 0.02'
#2	Primary	191.00'	<b>40.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.6 cfs @ 12.54 hrs HW=191.21' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.6 cfs)

**Primary OutFlow** Max=9.5 cfs @ 12.54 hrs HW=191.21' (Free Discharge)

↑2=Broad-Crested Rectangular Weir (Weir Controls 9.5 cfs @ 1.14 fps)

**Summary for Link DP-1: Wetlands (Off-site)**

Inflow Area = 13.7 ac, 38.4% Impervious, Inflow Depth = 1.9" for 100\_year event  
Inflow = 18.5 cfs @ 12.71 hrs, Volume= 2.2 af  
Primary = 18.5 cfs @ 12.71 hrs, Volume= 2.2 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-2: Off-site**

Inflow Area = 0.2 ac, 0.0% Impervious, Inflow Depth = 1.3" for 100\_year event  
Inflow = 0.2 cfs @ 12.24 hrs, Volume= 0.0 af  
Primary = 0.2 cfs @ 12.24 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-3: Wetlands (On-site)**

Inflow Area = 4.0 ac, 7.5% Impervious, Inflow Depth = 1.5" for 100\_year event  
Inflow = 2.4 cfs @ 12.30 hrs, Volume= 0.5 af  
Primary = 2.4 cfs @ 12.30 hrs, Volume= 0.5 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

**Summary for Link DP-4: Pond (On-site)**

Inflow Area = 9.5 ac, 34.7% Impervious, Inflow Depth = 2.1" for 100\_year event  
Inflow = 14.9 cfs @ 12.53 hrs, Volume= 1.7 af  
Primary = 14.9 cfs @ 12.53 hrs, Volume= 1.7 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs



# Appendix B

## Standard 3 Computations and Supporting Information

- Soil Evaluation
- Required/Provided Recharge Volume Calculations & 72 hour drawdown analysis





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## Soil Evaluation and Analysis



Hydrologic Soil Group—Middlesex County, Massachusetts

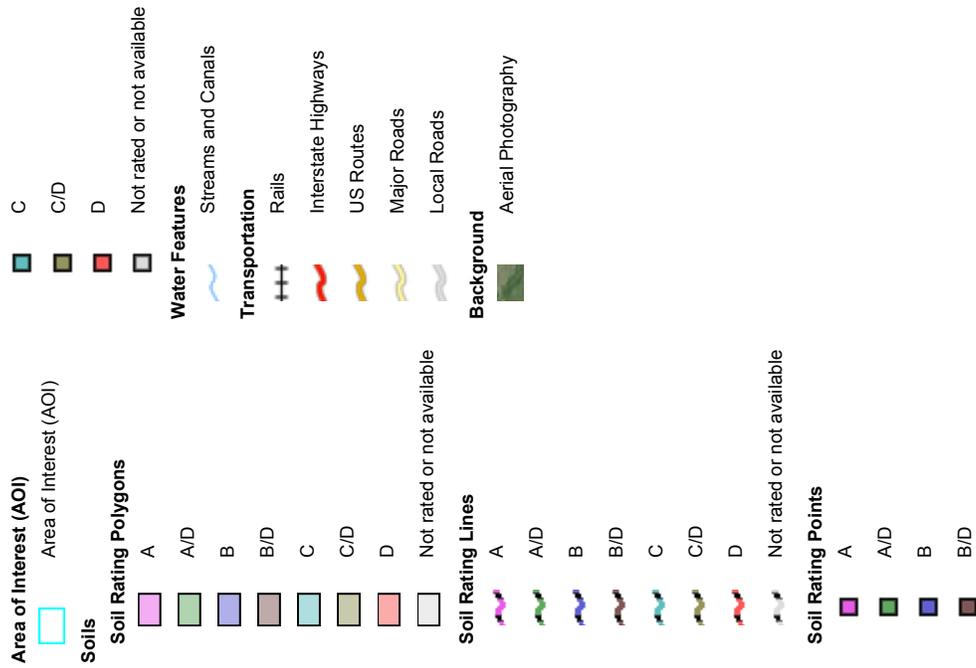


Map Scale: 1:3,530 if printed on A landscape (11" x 8.5") sheet.



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

## MAP LEGEND



## MAP INFORMATION

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

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

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

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 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 14, Sep 19, 2014

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

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

## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts (MA017)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	A/D	7.9	20.8%
251A	Haven silt loam, 0 to 3 percent slopes	A	25.0	65.5%
416C	Narragansett silt loam, 8 to 15 percent slopes, very stony	A	0.3	0.8%
602	Urban land		4.9	12.8%
<b>Totals for Area of Interest</b>			<b>38.1</b>	<b>100.0%</b>

### Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher



GeoInsight®

Environmental Strategy & Engineering  
*Practical in Nature*

December 11, 2015

GeoInsight Project 7869-000

Brendon Properties Northside Meadow, LLC.  
259 Turnpike Road, Suite 110  
Southborough, MA 01772

RE: Preliminary Subsurface Investigation  
518 Pleasant Street  
Framingham, Massachusetts

Dear Sir/Madam:

GeoInsight, Inc. (GeoInsight) prepared this report for Brendon Properties Northside Meadow, LLC. (BPNM) to describe the results of a Preliminary Subsurface Investigation completed at a proposed development site located at 518 Pleasant Street in Framingham, Massachusetts (the Property). The general purpose of the Preliminary Subsurface Investigation was to collect physical soils and bedrock information at the Property, including groundwater occurrence (observed depth to groundwater and estimated seasonal high water table [SHWT]), to assist BPNM and Vanasse Hangen Brustlin, Inc. (VHB) in completing a civil and stormwater management design for the proposed development.

In addition to conducting the Preliminary Subsurface Investigation, GeoInsight also reviewed available aerial photographs, topographic maps and surficial soil maps of the project area. The Property is located on the south side of Pleasant Street, west of Temple Street, and north of the Massachusetts Turnpike (Figure 1). The Property is relatively open (i.e., grassed) with mature tree growth in the southwest and eastern portions of the Property. A pond with surrounding wetland areas are located on the northeast corner of the Property. The Property was formerly used for residential purposes by clergy and consists of (Marist Brothers and Fathers) two brick buildings (still standing, but vacant) and associated paved drives and a parking area on a parcel of land approximately 35-acres in area. We understand the development is in the preliminary planning stages, but may include age-restricted housing units and a separate assisted living facility. The planned location of the proposed buildings is not known to GeoInsight at this time.

### **Background Geology and Soils Information**

Massachusetts surficial geology maps indicated the likely subsurface conditions consist of 'loose' coarse-grained (coarse to fine sand), stratified glacio-fluvial deposits in the western portion of the Property. The Natural Resources Conservation Service (NRCS) soils mapping (Attachment A) indicate the western portion of the Property is predominately mapped as

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Fax (978) 679-1601

**GeoInsight, Inc.**  
200 Court Street, 2<sup>nd</sup> Floor  
Middletown, CT 06457-3341  
Tel (860) 894-1022  
Fax (860) 894-1023



Haven silt loam and the eastern portion of the Property surrounding the pond is mapped as Freetown muck. According to the NRCS, a typical profile for Haven silt loam is as follows:

- 0 to 20 inches, silt loam;
- 20 to 32 inches, very fine sandy loam; and
- 32 to 65 inches, stratified fine to coarse sand.

The NCRS information also indicates: the depth to restrictive features in Haven silt loam (strongly contrasting textural stratification) is between 18 and 36 inches; the soil is well drained; depth to groundwater is greater than 80 inches; the saturated hydraulic conductivity ( $K_{sat}$ ) for the most restrictive layer is 2 to 6 inches per hour; and the soil is part of Hydrologic Soil Group (HSG) A.

### **Preliminary Subsurface Investigation / Test Pitting Observations**

GeoInsight completed a preliminary subsurface investigation using test pits to evaluate subsurface conditions at 17 locations identified by VHB on the site plan (Figure 2). The test pits were completed on October 21 and 22, 2015 under the oversight of a GeoInsight geologist. Sixteen of the seventeen test pits were located in the Haven silt loam soil unit as mapped by the NRCS. Test pit TP-16 was located within the mapped Freetown muck unit (test pit TP-16 field observations indicated that muck soil was not present at this location, as described below).

The 17 test pits were all advanced into soil that was predominately sand and gravel, or gravelly sand, with varying silt, cobble, and boulder content, which was interpreted to be consistent with the geologic and soils mapping indicative of a parent soil derived from glacio-fluvial depositional processes. In addition to obvious soil stratification observed in the field, cobbles and gravel were predominately rounded to sub-angular also indicating deposition in a fluvial environment. Test pits TP-13 through TP-17 all contained an upper unit of soil (ground surface to 6 feet below ground surface [bgs]) that was comprised of silt and fine sand. These five test pits were located on the eastern portion of the Property. A unit of sand and gravel interpreted as fill (ground surface to 5 feet bgs), was encountered at test pit TP-2, which is located adjacent to a paved parking area on the west side of the property. The NRCS maps indicated muck soil in the vicinity of test pit TP-16; however, glacio-fluvial sand, gravel, and cobble soil was encountered at this location. Although the eastern-most portion of the Property was not investigated with test pits by GeoInsight, it is expected that the wetland and pond on that portion of the Property will be underlain by muck/peat/wetland soil.

Groundwater was only encountered in test pits TP-1 through TP-3, located along on the western-most Property boundary at depths of 13 to 16 feet bgs. Mottling indicating evidence of a likely SHWT zone was observed in test pits TP-1 through TP-3 at depths of 11.5 to 13 feet bgs (observations were made from the ground surface since the test pits could not be safely entered to view soil conditions up close at depth). Obvious mottling indicating possible SHWT zones in the remaining test pits was not observed to the maximum depth of the test pit explorations (again, with test pit soil observations made from the ground surface). Stratigraphic layers with orange coloring were observed in several test pit locations at depths

December 11, 2015

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Page 2



generally above 6 feet bgs. GeoInsight interpreted this orange coloring to represent a “rust line<sup>1</sup>” formed from water percolating downward and oxidizing certain strata at textural changes, as opposed to mottling indicating SHWT.

Detailed subsurface investigation findings are summarized on the test pit logs in Attachment B and representative test pit photographs are presented below.



**Test Pit TP-2** (note possible fill from ground surface to 5 feet bgs, thin organic horizon at 6 feet, orange “rust line” at 6 to 7.5 feet bgs, and standing water at 16 feet BGS).



**Test Pit TP-6** (note the cobbles and gravel as logged from 1 to 4.5 feet bgs)

---

<sup>1</sup> A “rust line” is defined by Fletcher, P. and P. Veneman, *Soil Morphology as an Indicator or Seasonal High Water Tables*, University of Massachusetts ([nesoil.com/properties/eshwt.htm](http://nesoil.com/properties/eshwt.htm)) as the process not associated with a high water table, but instead from momentary interruptions of percolating water through the soil column at abrupt stratigraphic textural changes.





**Test Pit 16** (note gray silt and fine sand unit logged from ground surface to 6 feet bgs)

The summary table below provides a listing of observed test pit termination depths, refusal/bedrock depths (if encountered), depth to standing groundwater (if encountered), and an estimate of SHWT (if present and discernible).

**TEST PIT INFORMATION SUMMARY TABLE**

Test Pit Identification	Approximate TP Termination Depth / Refusal-Bedrock Depth (feet bgs)	Observed Depth to Groundwater / SHWT (feet bgs)
TP-1	13.5 / NRE	13 / 11.5
TP-2	17 / NRE	16 / 13
TP-3	16 / NRE	16 / 13
TP-4	17 / NRE	>17 / >17
TP-5	17 / NRE	>17 / >17
TP-6	16 / NRE	>16 / >16
TP-7	9.5 / 9.5	>9.5 / >9.5
TP-8	6 / 6	>6 / >6
TP-9	16 / NRE	>16 / >16
TP-10	10.5 / 10.5	>10.5 / >10.5
TP-11	10.5 / 10.5	>10.5 / >10.5
TP-12	9.5 / 9.5	>9.5 / >9.5
TP-13	17 / 17	>17 / >17
TP-14	10.5 / 10.5	>10.5 / >10.5
TP-15	17 / NRE	>17 / >17
TP-16	12 / 12	>12 / >12
TP-17	17 / NRE	>17 / >17

Notes: TP = test pit; SHWT = seasonal high water table; NRE = No Refusal Encountered

**Grain-Size Testing, Soil Textural Class, and Hydrologic Soil Group**

GeoInsight selected nine representative soil samples from various stratigraphic units and depths within seven test pits for laboratory grain-size/sieve analyses. The sieve reports are included in Attachment C. The summary table below provides a listing of sand and silt content used to determine NRCS textural class, HSG, and estimated  $K_{sat}$  rates.



### **SOIL TEXTURAL CLASS AND HYDROLOGIC SOIL GROUP SUMMARY TABLE**

<b>Test Pit Identification and Sample Depth</b>	<b>% Sand / % Silt from Sieve Report (with gravel content removed)</b>	<b>NRCS Soil Textural Class</b>	<b>NRCS HSG</b>	<b>K<sub>sat</sub> rates (in/hr)</b>
TP-2 at 8 feet	90.7 / 9.3	SAND	A	8.27
TP-4 at 7 feet	91.3 / 8.7	SAND	A	8.27
TP-8 at 5 feet	63.6 / 36.4	SANDY LOAM	B	1.02
TP-9 at 6 feet	96.4 / 3.6	SAND	A	8.27
TP-11 at 7 feet	64.4 / 35.6	SANDY LOAM	B	1.02
TP-13 at 2.5 feet	15.6 / 84.4	SILT	C	0.27
TP-13 at 5 feet	82.2 / 17.8	LOAMY SAND	A	2.41
TP-16 at 4 feet	13.6 / 86.4	SILT	C	0.27
TP-16 at 8 feet	75.4 / 24.6	LOAMY SAND	A	2.41

Notes: K<sub>sat</sub> rates obtained from Table 2.3.3 "1982 Rawls Rates" Volume 3 of the Massachusetts Stormwater Manual.

### **Preliminary Geotechnical Considerations**

GeoInsight provided BPNM with a proposal (as a separate document) to conduct a focused geotechnical investigation at the Property to develop recommendations associated with future building foundation construction and earthwork. A specialized geotechnical investigation is needed because the test pit program may not include exploration locations that overlap with proposed buildings (to be designed), and the soils below the Property may be considered "loose" granular glacial outwash (for which soil boring data are warranted for geotechnical evaluation purposes).

As discussed herein, the findings of the Preliminary Subsurface Investigation (test pits) indicated the Property is underlain with granular soils consistent with glacio-fluvial deposition. The test pits were excavated to depths ranging from 6 to 17 feet bgs. Based upon the presence of the observed glacio-fluvial deposit and the anticipated size of the proposed building structure (expected to consist of a multi-story structure with a plan area of approximately 30,000 square feet, or greater), we recommend performing the above-referenced focused geotechnical investigation program in order to further assess subsurface conditions below the proposed building footprint. The geotechnical test boring program would be performed to collect geotechnical soil data (i.e., soil composition and density via the Standard Penetration Test [SPT; ASTM D-1586]) at depths below the proposed building footprint that are necessary for geotechnical design given the expected size of the proposed structure and the subsurface soil conditions encountered in the test pits. The actual number and locations of the test borings will be selected after reviewing VHB's design plans for the re-development, when provided, and in consultation with VHB and BPNM.



GeoInsight appreciates the opportunity to be of service to BPNM, and we look forward to continuing to work with you to make this project successful. If you have questions about this report or the proposed geotechnical investigation, please contact us at (603) 314-0820.

Sincerely,  
GEOINSIGHT, INC.

Darrin L. Santos, P.G.  
Senior Geologist

Brian T. Nereson, P.E.  
Project Engineer

Michael C. Penney, P.E.  
Senior Engineer/Principal

cc. Vanasse Hangen Brustlin, Inc.

Attachments

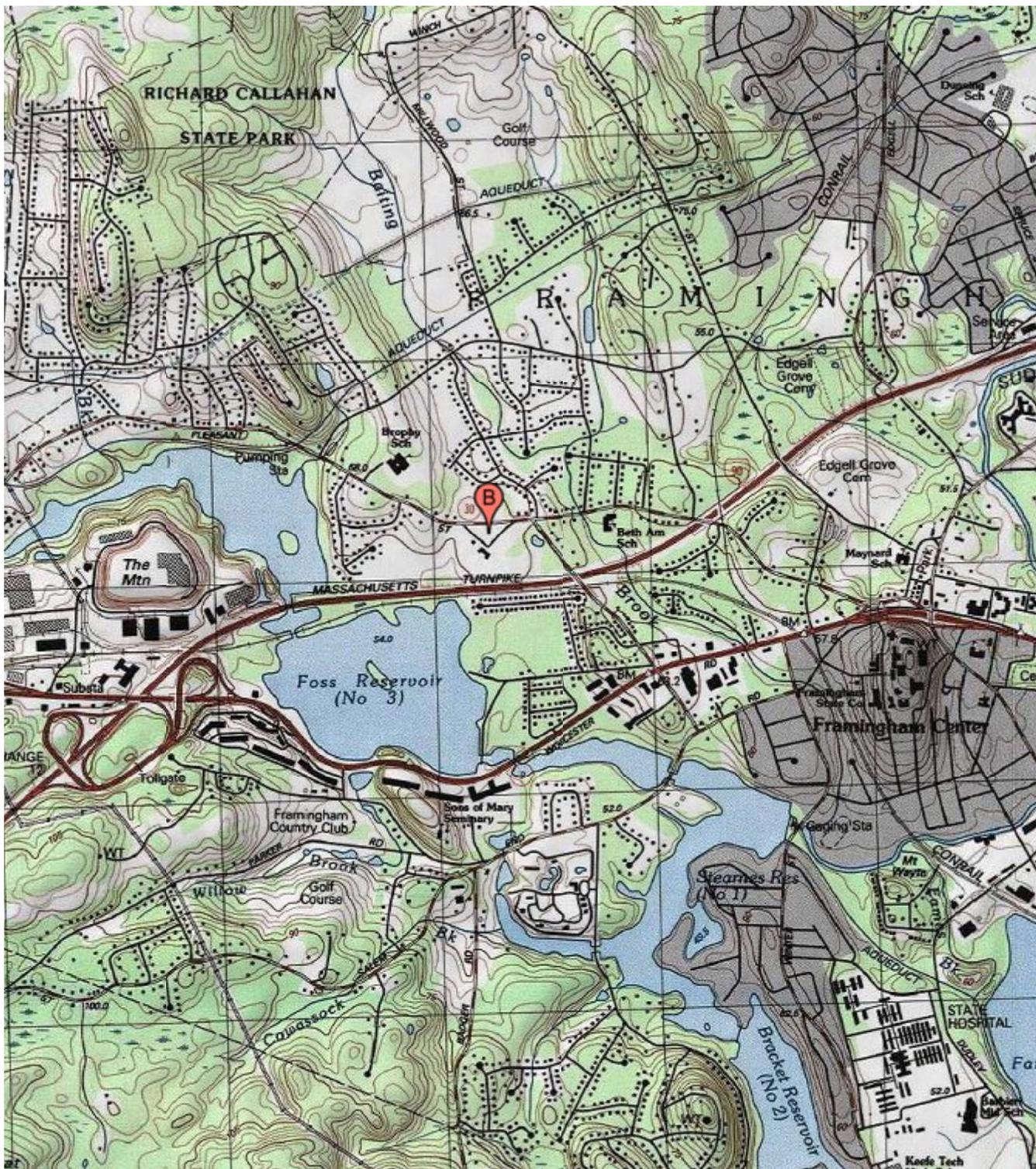
P:\7869 - Brendon Properties-VHB - Framingham, MA\FraminghamSubsurface.docx





## FIGURES





GEOINSIGHT, INC.  
FIGURE 1 - SITE LOCUS





**GEOINSIGHT, INC.**  
**FIGURE 2 -**  
**SITE PLAN / TEST PIT**  
**LOCATIONS**

● Approximate Test Pit Locations



Proposed Test Pit Locations  
 Marist Development  
 518 Pleasant Street  
 Framingham, MA

September 2015



**ATTACHMENT A**  
**NRCS INFORMATION**



Soil Map—Middlesex County, Massachusetts



Map Scale: 1:2,040 if printed on B landscape (17" x 11") sheet.  
0 30 60 120 180 Meters  
0 50 100 200 300 Feet  
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84



Natural Resources  
Conservation Service

Web Soil Survey  
National Cooperative Soil Survey

10/2/2015  
Page 1 of 3

## 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 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 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 14, Sep 19, 2014

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

Date(s) aerial images were photographed: Apr 8, 2011—Sep 28, 2014

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

## Map Unit Legend

Middlesex County, Massachusetts (MA017)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	6.6	19.2%
251A	Haven silt loam, 0 to 3 percent slopes	26.6	77.8%
416C	Narragansett silt loam, 8 to 15 percent slopes, very stony	0.1	0.2%
602	Urban land	1.0	2.8%
<b>Totals for Area of Interest</b>		<b>34.2</b>	<b>100.0%</b>



**ATTACHMENT B**  
**TEST PIT LOGS**





**GeoInsight**  
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**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

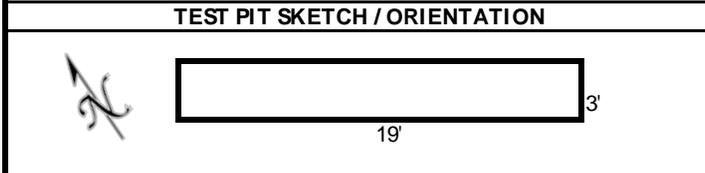
Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

Test Pit No: TP-1  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 07:30 Stop Time: 08:00  
Chkd. By: DLS  
Weather: Rain  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT	0-1': Dark brown fine SAND and SILT, organics (grass roots), dry.				
2	Gravelly SAND & COBBLES	1-2': Orange-brown fine to coarse SAND, some Gravel, some Cobbles up to 12", dry.				
3		2-6': Brown fine to coarse SAND and COBBLES, some Gravel, dry.				
4						
5						
6						
7	SAND & GRAVEL	6-8': Brown fine to coarse SAND and GRAVEL, trace Cobbles, dry.	TP-1 (6')	6		1
8						
9	Cobbly SAND	8-10': Brown fine to coarse SAND, some Cobbles, little Gravel, dry.				
10						
11		10-13': Brown-Gray fine to coarse SAND, some Cobbles, little Gravel, dry.				
12						
13						
14		Test pit terminated at 13.5' bgs. Refusal not encountered.				
15						
16						
17						
18						

**NOTES:**  
1. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**  
Depth: 13 ft BGS  
Stabilization: 10 minutes  
Est. SHWT: 11.5 ft BGS  
Description: Gray coloration



**TEST PIT DETAILS**  
Length: 19 Depth: 13.5  
Width: 3 Stability: Good

**FIELD TESTING PERFORMED**



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**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

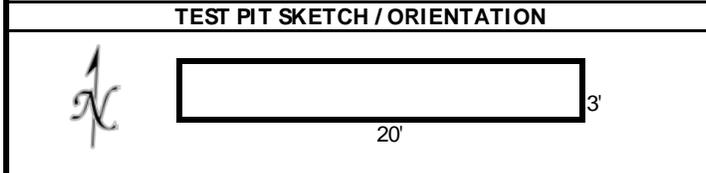
Test Pit No: TP-2  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 08:15 Stop Time: 08:50  
Chkd. By: DLS  
Weather: Light Rain  
Ground Surface Elev.: NA  
Datum: NA

Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT  SAND (Possible FILL)	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry.				
2		0.5-1.25': Brown fine to coarse SAND, little Gravel, dry				
3		1.25-5': Brown fine to medium SAND, some Gravel, trace Cobbles, trace trace boulders, dry.				
4						
5						
6	SAND & SILT	5-6': Dark brown fine SAND and SILT, organics (roots), dry.				
7	Gravelly SAND	6-7.5': Orange-brown fine to coarse SAND, some Gravel, trace Cobbles, dry.				1
8						
9	SAND & GRAVEL & COBBLES	7.5-11': Brown fine to coarse SAND, GRAVEL, and COBBLES, dry.	TP-2 (8)	8		2
10						
11	Gravelly SAND	11-13': Brown fine to coarse SAND, some Gravel, little Cobbles, dry.				
12						
13						
14	SAND	13-16': Gray-brown fine to coarse SAND, dry.				
15						
16						
17		16-17': Gray-brown fine to coarse SAND, wet				
18		Test pit terminated at 17' bgs. Refusal not encountered.				

**NOTES:**  
1. Orange coloration interpreted as a "rust line" and not SHWT mottling.  
2. Sample retained (no laboratory grain size analysis).

GROUND WATER OBSERVATIONS		
Depth:	<u>16</u>	ft BGS
Stabilization:	<u>20</u>	minutes
Est. SHWT:	<u>13</u>	ft BGS
Description:	<u>Gray coloration</u>	



TEST PIT DETAILS		
Length:	<u>20</u>	Depth: <u>17</u>
Width:	<u>3</u>	Stability: <u>Good</u>
FIELD TESTING PERFORMED		



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**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

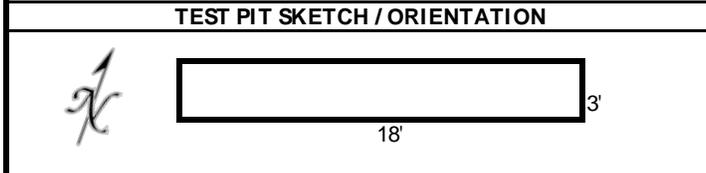
Test Pit No: TP-3  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 09:00 Stop Time: 09:35  
Chkd. By: DLS  
Weather: Light Rain  
Ground Surface Elev.: NA  
Datum: NA

Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE	
			Sample I.D.	Depth (ft)	PID (PPM)		
	SAND & SILT	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry.					
1	SAND	0.5-1.5': Orange-brown fine SAND, trace Silt, dry					
2		1.5-3': Gray fine SAND, dry.					
3							
4		3-6': Orange-brown fine to coarse SAND, some Gravel, dry.				1	
5							
6							
7		6-10': Gray-brown fine to coarse SAND, some Gravel, dry.					
8				TP-3 (7)	7		2
9							
10							
11		10-16': Brown fine to coarse SAND, trace Gravel, dry.					
12							
13							
14		Gray-Brown at 13' bgs.					
15							
16		Wet at 16' bgs.					
17		Test pit terminated at 16' bgs. Refusal not encountered.					
18							

**NOTES:**  
1. Orange coloration interpreted as a "rust line" and not SHWT mottling.  
2. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**  
Depth: 16 ft BGS  
Stabilization: 10 minutes  
Est. SHWT: 13 ft BGS  
Description: Gray coloration



**TEST PIT DETAILS**  
Length: 18 Depth: 16  
Width: 3 Stability: Good

**FIELD TESTING PERFORMED**



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Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

Test Pit No: TP-4  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 09:30 Stop Time: 10:15  
Chkd. By: DLS

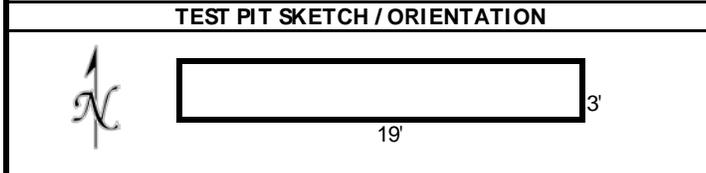
Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

Weather: Light Rain  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT     Gravelly SAND	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry.				
2		0.5-1.5': Orange-brown fine SAND, trace Silt, dry				
3		1.5-2.5': Gray fine SAND, dry.				
4		2.5-4': Orange fine to coarse SAND, some Gravel, dry.				1
5		4-8.5': Gray-brown medium to coarse SAND, some Gravel, trace Cobbles, dry.				
6						
7						
8				TP-4 (7)	7	
9	SAND & GRAVEL	8.5-13': Gray-brown medium to coarse SAND and GRAVEL, little cobbles, dry.				
10						
11						
12						
13	SAND	13-17': Gray-brown medium to coarse SAND, trace Gravel, dry.				
14						
15						
16						
17						
18		Test pit terminated at 17' bgs. Refusal not encountered.				

**NOTES:**  
1. Orange coloration interpreted as a "rust line" and not SHWT mottling.  
2. Sample submitted for laboratory grain size analysis.

**GROUND WATER OBSERVATIONS**  
Depth: > 17 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 19 Depth: 16 17  
Width: 3 Stability: Fair

**FIELD TESTING PERFORMED**



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**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

Test Pit No: TP-5  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 10:20 Stop Time: 10:55  
Chkd. By: DLS

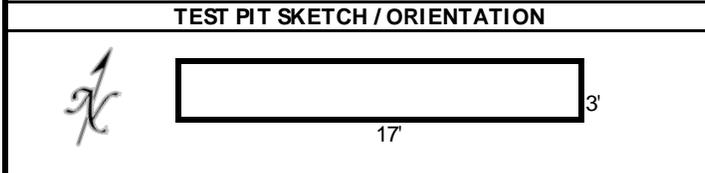
Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

Weather: Light Rain  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE	
			Sample I.D.	Depth (ft)	PID (PPM)		
1	SAND & SILT	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry.					
2	SAND	0.5-1.5': Orange-brown fine SAND, trace Silt, dry					
3		1.5-4': Gray fine SAND, dry.					
4							
5	Gravelly SAND	4-6': Orange fine to coarse SAND, some Gravel, dry.				1	
6							
7		6-12': Light brown fine to coarse SAND, some Gravel, trace Cobbles, trace boulders up to 2.5', dry.					
8							
9				TP-5 (8)	8		2
10							
11							
12							
13		12-17': Light gray-brown fine to coarse SAND, some Gravel, little cobbles, little boulders, dry.					
14							
15							
16							
17							
18		Test pit terminated at 17' bgs. Refusal not encountered.					

**NOTES:**  
1. Orange coloration interpreted as a "rust line" and not SHWT mottling.  
2. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**  
Depth: > 17 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 17 Depth: 17  
Width: 3 Stability: Good

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

Test Pit No: TP-6  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 11:00 Stop Time: 11:25  
Chkd. By: DLS

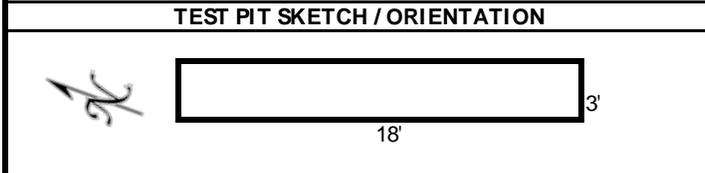
Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

Weather: Light Rain  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE	
			Sample I.D.	Depth (ft)	PID (PPM)		
	SAND & SILT	0-1': Dark brown fine SAND and SILT, organics (grass roots), dry.					
1	SAND	1-2': Orange-brown fine SAND, trace Silt, trace Organics (roots), dry.					
2		2-3.5': Gray fine SAND, dry.					
3							
4		3.5-5': Light brown fine SAND, dry.					
5							
6		5-9': light orange-brown fine to coarse SAND, little Gravel, dry.					
7				TP-6 (6')	6		1
8							
9							
10	Gravelly SAND	9-12': Light gray-brown fine to coarse SAND, some Gravel, trace Boulders up to 2', dry.					
11							
12							
13		12-16': Light gray-brown fine to coarse SAND, some Gravel, little cobbles, little boulders, dry.					
14							
15							
16							
17			Test pit terminated at 16' bgs. Refusal not encountered.				
18							

**NOTES:**  
1. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**  
Depth: > 16 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 18 Depth: 16  
Width: 3 Stability: Good  
**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

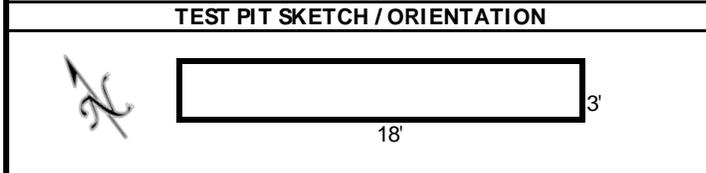
Test Pit No: TP-7  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 11:33 Stop Time: 11:55  
Chkd. By: DLS  
Weather: Rain  
Ground Surface Elev.: NA  
Datum: NA

Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT	0-1.5': Dark brown fine SAND and SILT, organics (grass roots), dry.				
2	SAND	1.5-3.5': Gray fine SAND, dry.				
3						
4	SAND, COBBLES, & BOULDERS	3.5-4.5': Orange-brown fine to coarse SAND, COBBLES and BOULDERS, little Gravel, dry.				1
5		4.5-9.5': Light brown fine to coarse SAND, COBBLES and BOULDERS, little Gravel dry.				
6						
7				TP-7 (6')	6	
8						
9						
10		<i>Test pit terminated at 9.5' bgs. Apparent bedrock refusal.</i>				
11						
12						
13						
14						
15						
16						
17						
18						

**NOTES:**  
1. Orange coloration interpreted as a "rust line" and not SHWT mottling.  
2. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**  
Depth: >9.5 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 18 Depth: 9.5  
Width: 3 Stability: Good

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

Test Pit No: TP-8  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 12:05 Stop Time: 12:20  
Chkd. By: DLS  
Weather: Cloudy  
Ground Surface Elev.: NA  
Datum: NA

Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT SAND	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry. 0.5-1': Brown fine SAND, some Silt, organics (roots), dry.				
2	Gravelly SAND, COBBLES, & BOULDERS	1-6': Light gray-brown fine to coarse SAND and COBBLES, some boulders, little Gravel, little Silt, dry.				
3						
4						
5						
6				TP-8 (5)	5	
7		<i>Test pit terminated at 6' bgs. Apparent bedrock refusal.</i>				
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

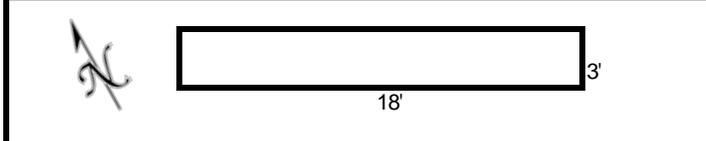
**NOTES:**

1. Sample submitted for laboratory grain size analysis.

**GROUND WATER OBSERVATIONS**

Depth: >6 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered

**TEST PIT SKETCH / ORIENTATION**



**TEST PIT DETAILS**

Length: 18 Depth: 6  
Width: 3 Stability: Good

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

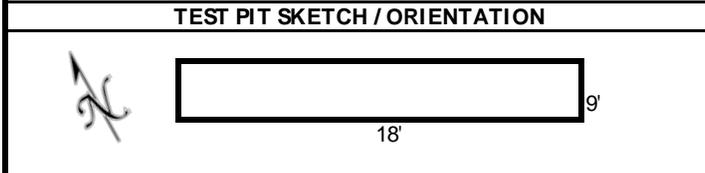
Equip.: CAT 320B      Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard      Contractor: Brendon Properties  
Reach: 17 feet      Operator: Rich

Test Pit No: TP-9  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 12:20      Stop Time: 12:55  
Chkd. By: DLS  
Weather: Cloudy  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE	
			Sample I.D.	Depth (ft)	PID (PPM)		
1	SAND & SILT SAND	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry. 0.5-1': Brown fine SAND, some Silt, organics (roots), dry.					
2	SANDY GRAVEL & COBBLES	1-4.5': Orange-brown fine to coarse COBBLES and GRAVEL, some fine to coarse Sand, dry.					
3							
4				TP-9 (3')	3		1
5	SAND	4.5-16': Brown medium to coarse SAND, some cobbles, some Gravel, dry.					
6							
7				TP-9 (6')	6		2
8							
9							
10							
11							
12							
13							
14							
15							
16							
17		<i>Test pit terminated at 16' bgs. Refusal not encountered.</i>					
18							

**NOTES:**  
1. Sample retained (no laboratory grain size analysis).  
2. Sample submitted for laboratory grain size analysis.

**GROUND WATER OBSERVATIONS**  
Depth: >16 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 18      Depth: 16  
Width: 9      Stability: Poor

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties

Location: 518 Pleasant Street, Framingham, Massachusetts

Equip.: CAT 320B

Capacity: 1/2 yard

Reach: 17 feet

Geolnsight Rep.: J. E. Blackwell

Contractor: Brendon Properties

Operator: Rich

Test Pit No: TP-10

Sheet: 1 Of: 1

Project Number: 7869

Date: 10/21/2015

Start Time: 13:10 Stop Time: 13:25

Chkd. By: DLS

Weather: Cloudy

Ground Surface Elev.: NA

Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT	0-1': Dark brown fine SAND and SILT, organics (grass roots), dry.				
2	SAND	1-3.5': Gray fine SAND, dry.				
3						
4	SAND & GRAVEL	3.5-7': Brown fine to coarse SAND and GRAVEL, some cobbles, dry.				
5						
6			TP-10 (5)	5		1
7						
8	SAND	7-10.5': Light gray-brown fine to coarse SAND, little Gravel, trace cobbles, dry.				
9						
10						
11						
12	Test pit terminated at 10.5' bgs. Apparent bedrock refusal.					
13						
14						
15						
16						
17						
18						

**NOTES:**

1. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**

Depth: >10.5 ft BGS  
 Stabilization: NA minutes  
 Est. SHWT: NA ft BGS  
 Description: Groundwater not encountered

**TEST PIT SKETCH / ORIENTATION**



**TEST PIT DETAILS**

Length: 20 Depth: 10.5  
 Width: 3 Stability: Poor

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

Equip.: CAT 320B      Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard      Contractor: Brendon Properties  
Reach: 17 feet      Operator: Rich

Test Pit No: TP-11  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 13:30 Stop Time: 14:00  
Chkd. By: DLS  
Weather: Cloudy  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT        SAND	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry. 0.5-1.5': Orange-brown fine SAND, organics (roots), dry.				
2		1.5-4': Gray fine SAND, dry.				
3						
4						
5		4-5': Dark orange fine to coarse SAND, some Cobbles, some Gravel, dry.				
6		5-10': Brown fine to coarse SAND, some Cobbles, some Gravel, little Silt, trace boulders, dry				
7						
8		Increase in Gravel content at 7'	TP-11 (7)	7		1
9						
10						
11	Test pit terminated at 10.5' bgs. Apparent bedrock refusal.					
12						
13						
14						
15						
16						
17						
18						

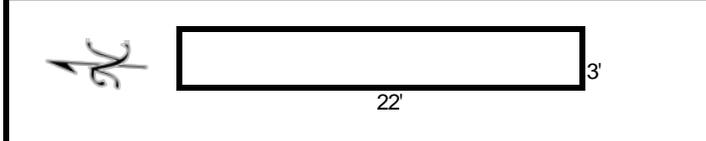
**NOTES:**

1. Sample submitted for laboratory grain size analysis.

**GROUND WATER OBSERVATIONS**

Depth: >10 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered

**TEST PIT SKETCH / ORIENTATION**



**TEST PIT DETAILS**

Length: 22      Depth: 10  
Width: 3      Stability: Good

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

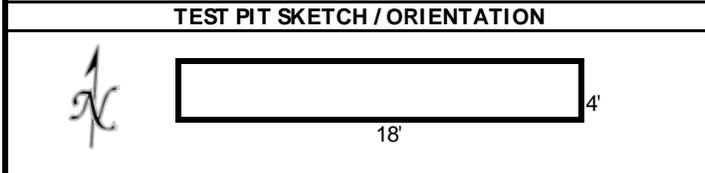
Equip.: CAT 320B Geolinsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Rich

Test Pit No: TP-12  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/21/2015  
Start Time: 14:15 Stop Time: 14:50  
Chkd. By: DLS  
Weather: Cloudy  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE	
			Sample I.D.	Depth (ft)	PID (PPM)		
1	SAND & SILT	0-1': Dark brown fine SAND and SILT, organics (grass roots), dry.					
2	Cobbly SAND	1-3': Light brown fine SAND, little Gravel, organics (roots), dry.					
3							
4		3-9.5': Light brown fine SAND, some Cobbles, little Boulders up to 4', trace med to coarse Sand, dry.					
5							
6							
7				TP-12 (6')	6		1
8							
9							
10		<i>Test pit terminated at 9.5' bgs. Apparent bedrock refusal.</i>					
11							
12							
13							
14							
15							
16							
17							
18							

**NOTES:**  
1. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**  
Depth: >9.5 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 18 Depth: 9.5  
Width: 4 Stability: Poor  
**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

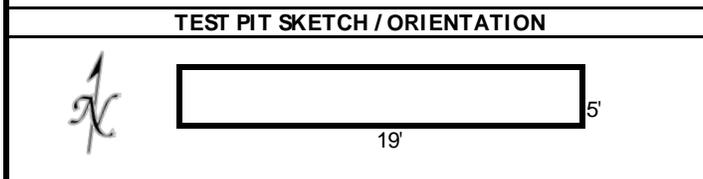
Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts  
Equip.: CAT 320B  
Capacity: 1/2 yard  
Reach: 17 feet  
Geolnsight Rep.: J. E. Blackwell  
Contractor: Brendon Properties  
Operator: Frank

Test Pit No: TP-13  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/22/2015  
Start Time: 07:45 Stop Time: 08:30  
Chkd. By: DLS  
Weather: Cloudy  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT	0-1': Dark brown fine SAND and SILT, organics (grass roots), dry.				
2		1-1.5': Orange-brown fine SAND, some Silt, dry.				
3		1.5-3.5': Gray SILT & fine SAND, dry.				
4	SAND & GRAVEL	3.5-4.5': Orange-brown medium to coarse SAND and GRAVEL, some cobbles, dry				1
5	Gravelly SAND & COBBLES	4.5-14': Brown medium to coarse SAND and COBBLES, some Gravel, dry.	TP-13 (2.5')	2.5		2
6						
7						
8						
9						
10						
11						
12						
13						
14						
15	Gravelly SAND	14-17': Gray-brown fine to coarse SAND, some Gravel, trace Cobbles, dry.	TP-13 (5')	5		1
16						
17						
18		Test pit terminated at 17' bgs. Apparent bedrock refusal.				

**NOTES:**  
1. Sample submitted for laboratory grain size analysis.  
2. Orange coloration interpreted as a "rust line" and not SHWT mottling.

**GROUND WATER OBSERVATIONS**  
Depth: >17 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 19 Depth: 17  
Width: 5 Stability: Poor

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties

Location: 518 Pleasant Street, Framingham, Massachusetts

Equip.: CAT 320B

Capacity: 1/2 yard

Reach: 17 feet

Geolnsight Rep.: J. E. Blackwell

Contractor: Brendon Properties

Operator: Frank

Test Pit No: TP-14

Sheet: 1 Of: 1

Project Number: 7869

Date: 10/22/2015

Start Time: 08:35 Stop Time: 09:05

Chkd. By: DLS

Weather: Cloudy

Ground Surface Elev.: NA

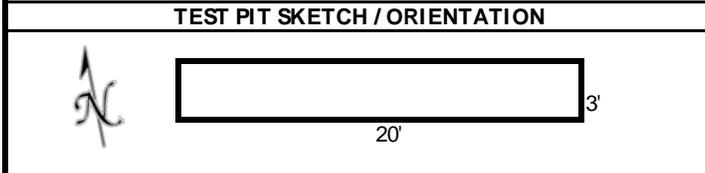
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT	0-1': Dark brown fine SAND and SILT, organics (grass roots), dry.				
2		1-2': Orange-brown fine SAND, some Silt, organics (roots), dry.				
3		2-4.5': Light brown-gray SILT & fine SAND, dry.				
4			TP-14 (3)	3		1
5	SAND & GRAVEL	4.5-5.5': Orange-Brown fine to coarse SAND and GRAVEL, some Cobbles, dry.				2
6	Gravelly SAND	5.5-10.5': Brown fine to coarse SAND, some Gravel, some Cobbles, dry.				
7						
8			TP-14 (7)	7		1
9						
10						
11		Test pit terminated at 10.5' bgs. Apparent bedrock refusal.				
12						
13						
14						
15						
16						
17						
18						

**NOTES:**

- Orange coloration interpreted as a "rust line" and not SHWT mottling.
- Sample retained (no laboratory grain size analysis).

GROUND WATER OBSERVATIONS	
Depth:	>10.5 ft BGS
Stabilization:	NA minutes
Est. SHWT:	NA ft BGS
Description:	Groundwater not encountered



TEST PIT DETAILS	
Length:	20
Width:	3
Depth:	10.5
Stability:	Good
FIELD TESTING PERFORMED	



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

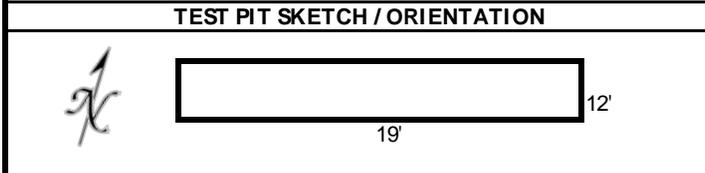
Equip.: CAT 320B      Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard      Contractor: Brendon Properties  
Reach: 17 feet      Operator: Frank

Test Pit No: TP-15  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/22/2015  
Start Time: 09:10      Stop Time: 10:40  
Chkd. By: DLS  
Weather: Cloudy  
Ground Surface Elev.: NA  
Datum: NA

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE	
			Sample I.D.	Depth (ft)	PID (PPM)		
1	SAND & SILT	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry.					
		0.5-1.5': Orange-brown fine SAND, some Silt, organics (roots), dry.					
2		1.5-3.5': Gray fine SILT & SAND, dry.					
3							
4	Gravelly SAND & COBBLES	3.5-13': Brown fine to coarse SAND and COBBLES, some Gravel, dry.					
5							
6				TP-15 (5)	5		1
7							
8							
9							
10							
11			6"-thick lens of light brown fine SAND at 10' bgs.				
12							
13							
14	Gravelly SAND	13-17': Brown medium to coarse SAND, some Gravel, trace Cobbles, trace boulders, dry.					
15							
16							
17							
18		Test pit terminated at 17' bgs. Refusal not encountered.					

**NOTES:**  
1. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**  
Depth: >17 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 19      Depth: 17  
Width: 12      Stability: Poor

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

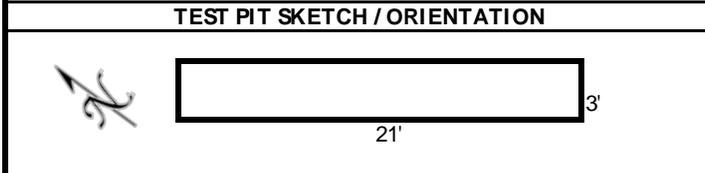
Test Pit No: TP-16  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/22/2015  
Start Time: 10:55 Stop Time: 11:35  
Chkd. By: DLS  
Weather: Cloudy  
Ground Surface Elev.: NA  
Datum: NA

Equip.: CAT 320B Geolnsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Frank

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE	
			Sample I.D.	Depth (ft)	PID (PPM)		
1	SAND & SILT	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry.					
2		0.5-2': Orange-brown fine SAND, some Silt, organics (roots), dry.					
3		2-6': Gray SILT & fine SAND, dry.					
4							
5				TP-16 (4')	4		1
6							
7	SAND & COBBLES	6-7.5': Orange-brown fine to coarse SAND and COBBLES, some Gravel, dry.				2	
8	SAND & GRAVEL	7.5-12': Brown fine to coarse SAND and GRAVEL, some cobbles, little boulders, dry.					
9			TP-16 (8')	8		1	
10		6'-diameter boulder at 9' bgs.					
11							
12							
13		<i>Test pit terminated at 12' bgs. Apparent bedrock refusal.</i>					
14							
15							
16							
17							
18							

**NOTES:**  
1. Sample submitted for laboratory grain size analysis.  
2. Orange coloration interpreted as a "rust line" and not SHWT mottling.

**GROUND WATER OBSERVATIONS**  
Depth: >12 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 21 Depth: 12  
Width: 12 Stability: Fair

**FIELD TESTING PERFORMED**



**GeoInsight**  
Practical in Nature

**TEST PIT LOG**

Project: Brendon Properties  
Location: 518 Pleasant Street, Framingham, Massachusetts

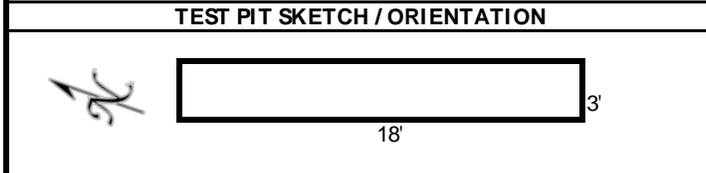
Test Pit No: TP-17  
Sheet: 1 Of: 1  
Project Number: 7869  
Date: 10/22/2015  
Start Time: 11:40 Stop Time: 12:15  
Chkd. By: DLS  
Weather: Cloudy  
Ground Surface Elev.: NA  
Datum: NA

Equip.: CAT 320B Geolinsight Rep.: J. E. Blackwell  
Capacity: 1/2 yard Contractor: Brendon Properties  
Reach: 17 feet Operator: Frank

DEPTH (ft)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	SAMPLE			NOTE
			Sample I.D.	Depth (ft)	PID (PPM)	
1	SAND & SILT	0-0.5': Dark brown fine SAND and SILT, organics (grass roots), dry.				
2		0.5-2.5': Orange-brown fine SAND, little Silt, organics (roots), dry.				
3		2.5-5.5': Gray SILT & fine SAND, dry.				
4	SAND, GRAVEL, & COBBLES	5.5-11.5': Brown fine to coarse SAND, GRAVEL, and COBBLES, trace boulders, dry.				
5						
6						
7						
8						
9	Gravelly SAND	11.5-17': Gray-brown fine to coarse SAND, some Gravel, Dry.				
10						
11						
12						
13						
14						
15						
16						
17						
18		Test pit terminated at 17' bgs. Refusal not encountered.				

**NOTES:**  
1. Sample retained (no laboratory grain size analysis).

**GROUND WATER OBSERVATIONS**  
Depth: >17 ft BGS  
Stabilization: NA minutes  
Est. SHWT: NA ft BGS  
Description: Groundwater not encountered



**TEST PIT DETAILS**  
Length: 18 Depth: 17  
Width: 3 Stability: Good  
**FIELD TESTING PERFORMED**



**ATTACHMENT C**  
**GRAIN-SIZE / SIEVE REPORTS**

























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## Required and Provided Recharge Volumes & 72-hour Drawdown Analysis



## Recharge Calculations

**Project Name:** Northside Meadows      **Proj. No.:** 13168.00  
**Date:** 3/30/2016  
**Project Location:** Framingham, MA      **Calculated by:** BMG

### Proposed Impervious Surface Summary

#### Proposed On-site Impervious Areas by Hydrologic Soil Group (HSG) in acres

Subcatchment	HSG A	HSG B	HSG C	HSG D	Total
P10a	0.1				0.1
P10b	0.2				0.2
P11	0.3				0.3
P12	3.7				3.7
P20	0.0				0.0
P30	0.1				0.1
P31	1.2				1.2
P32	0.5				0.5
P40	0.0				0.0
P41	2.4				2.4
<b>TOTAL</b>	<b>8.5</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>8.5</b>

#### Required Recharge Volume (Cubic Feet)

HSG	Area (acres)	Recharge Depth* (in.)	Volume (c.f.)
<b>A</b>	8.5	0.60	18,513
<b>B</b>	0.0	0.35	0
<b>C</b>	0.0	0.25	0
<b>D</b>	0.0	0.10	0
<b>TOTAL</b>			<b>18,513</b>

Assumptions:

\* Massachusetts DEP Infiltration requirement: HSG A = 0.60 in; HSG B = 0.35 in; HSG C = 0.25 in; HSG D = 0.10 in.

### Capture Area Adjustment

Required Recharge Volume	18,513 c.f.
Total Site Impervious Area	8.5 acres
Total Site Impervious Area Draining to Recharge Facilities*	8.1 acres
Capture Area Adjustment Factor	1.05 -
<b>Adjusted Required Recharge Volume:</b>	<b>19,427 c.f.</b>

## Provided Recharge Volume (Cubic Feet) and Drawdown Times

### SURFACE INFILTRATION BASINS

#### Infiltration Basin P1b (Recharge Volume and Drawdown Time)

Infiltration Volumes Provided in Basin below Outlet Orifice at elevation 193.8

##### **Basin Volume Below Weir**

<b>Elevation</b>	<b>Area (s.f.)</b>	<b>Incremental Volume (c.f.)</b>	<b>Drawdown (hours)</b>
193.00	958	0	
193.80	1,572	1,012	4.0
<b>TOTAL</b>		<b>1,012</b>	<b>4.0</b>

##### **Assumptions:**

Recharge Rate: 2.41 in/hr

**Total Drawdown Time: 4.0 hours**

**Total Recharge Volume: 1,012 c.f.**

#### Infiltration Basin P1c (Recharge Volume and Drawdown Time)

Infiltration Volumes Provided in Basin below orifice at 186.5

##### **Basin Volume Below Weir**

<b>Elevation</b>	<b>Area (s.f.)</b>	<b>Incremental Volume (c.f.)</b>	<b>Drawdown (hours)</b>
183.40	2,847	0	
184.00	5,984	2,649	0.9
185.00	9,493	10,388	1.5
186.00	12,771	21,520	1.5
186.50	14,452	28,326	0.7
<b>TOTAL</b>		<b>28,326</b>	<b>4.5</b>

##### **Assumptions:**

Recharge Rate: 8.27 in/hr

**Drawdown Time: 4.5 hours**

**Total Recharge Volume: 28,326 c.f.**

**Infiltration Basin P3b (Recharge Volume and Drawdown Time)**

Infiltration Volumes Provided in Basin below orifice at 184.45

**Basin Volume Below Orifice**

<b>Elevation</b>	<b>Area (s.f.)</b>	<b>Incremental Volume (c.f.)</b>	<b>Drawdown (hours)</b>
180.00	1,211	0	
181.00	2,443	1,827	5.0
182.00	4,086	5,092	5.0
183.00	5,476	9,873	5.0
184.00	7,048	16,135	5.0
184.45	8,250	19,577	2.2
<b>TOTAL</b>		<b>19,577</b>	<b>22.2</b>

**Assumptions:**

Recharge Rate: 2.41 in/hr

**Drawdown Time:** 22.2 hours

**Total Recharge Volume:** 19,577 c.f.

**Infiltration Basin P4 (Recharge Volume and Drawdown Time)**

Infiltration Volumes Provided in Basin below orifice at 190.0

**Basin Volume Below Orifice**

<b>Elevation</b>	<b>Area (s.f.)</b>	<b>Incremental Volume (c.f.)</b>	<b>Drawdown (hours)</b>
186.00	1,597	0	
187.00	3,887	2,742	5.0
188.00	5,170	7,271	5.0
189.00	6,574	13,143	5.0
190.00	8,144	20,502	5.0
191.00	9,832	29,490	5.0
<b>TOTAL</b>		<b>29,490</b>	<b>24.9</b>

**Assumptions:**

Recharge Rate: 2.41 in/hr

**Drawdown Time:** 24.9 hours

**Total Recharge Volume:** 29,490 c.f.

**Recharge Volume Summary**

<b>Basin</b>	<b>Volume</b>
Infiltration Basin P1b Recharge Provided:	1,012 c.f.
Infiltration Basin P1c Recharge Provided:	28,326 c.f.
Infiltration Basin P3b Recharge Provided:	19,577 c.f.
Infiltration Basin P4 Recharge Provided:	29,490 c.f.
<b>Total Recharge Volume Provided*:</b>	<b>78,404 c.f.</b>

**Adjusted Required Recharge Volume:** **19,427 c.f.**



# Appendix C

## Standard 4 Computations and Supporting Information

- Long-Term Pollution Prevention Plan and Checklist
- TSS Removal Worksheets
- Water Quality Volume Calculations and Flow Rate Conversion
- MASTEP CDS Report



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## Long –Term Pollution Prevention Plan



# Long-Term Pollution Prevention Plan

This Long-Term Pollution Prevention Plan has been developed to establish site management practices that improve the quality of stormwater discharges from the Project.

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## Description of Pollutant Sources

Potential pollutant sources at the site include roadways, driveways, dumpster pads, and loading areas.

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## Pollutant Control Approach

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### Maintenance of Pavement Systems

#### Standard Asphalt Pavement

Regular maintenance of pavement surfaces will prevent pollutants such as oil and grease, trash, and sediments from entering the stormwater management system. The following practices should be performed:

- Sweep or vacuum asphalt pavement areas semi-annually with a commercial cleaning unit and dispose of removed material.
- Check loading docks and dumpster areas frequently for spillage and/or pavement staining and clean as necessary
- Routinely pick up and remove litter from the parking areas, islands, and perimeter landscaping.

---

### Maintenance of Vegetated Areas

Proper maintenance of vegetated areas can prevent the pollution of stormwater runoff by controlling the source of pollutants such as suspended sediments, excess nutrients, and chemicals from landscape care products. Practices that should be followed under the regular maintenance of the vegetated landscape include:

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.



- Immediately clean any soil deposited on pavement.
- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.
- The grass vegetation should be cut to a height between three and four inches.
- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas, but should not be applied on a regular basis unless necessary.

---

## Management of Snow and Ice

### Storage and Disposal

Snow shall be stockpiled on standard pavement surfaces so sand and salt may be swept in the spring or removed as snow melts and drains through the stormwater management system. Key practices for the safe storage and disposal of snow include:

- Under no circumstances shall snow be disposed or stored in wetland resource areas.
- Under no circumstances shall snow be disposed or stored in stormwater basins, ponds, rain gardens, swales, channels, or trenches.

### Salt and Deicing Chemicals

The amount of salt and deicing chemicals to be used on the site shall be reduced to the minimum amount needed to provide safe pedestrian and vehicle travel. The following practices should be followed to control the amount of salt and deicing materials that come into contact with stormwater runoff:

- Devices used for spreading salt and deicing chemicals should be capable of varying the rate of application based on the site specific conditions.
- Sand and salt should be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming in contact with the deicing materials



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## Spill Prevention and Response Plan

Spill prevention equipment and training will be provided by the property management company.

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### Initial Notification

In the event of a spill the facility and/or construction manager or supervisor will be notified immediately.

Facility Manager (name): \_\_\_\_\_

Facility Manager (phone): \_\_\_\_\_

Construction Manager (name) : \_\_\_\_\_

Construction Manager (phone): \_\_\_\_\_

The supervisor will first contact the Fire Department and then notify the Police Department, the Public Health Commission and the Conservation Commission. The Fire Department is ultimately responsible for matters of public health and safety and should be notified immediately.

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### Further Notification

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. The attached list of emergency phone numbers shall be posted in the main construction/facility office and readily accessible to all employees. A hazardous waste spill report shall be completed as necessary using the attached form.



## Emergency Notification Phone Numbers

1.	FACILITY MANAGER NAME: _____  ALTERNATE CONTACT: NAME: _____	PHONE: _____ BEEPER/CELL: _____/_____ HOME PHONE: _____  PHONE: _____ BEEPER/CELL: _____/_____ HOME PHONE: _____
2.	FIRE & POLICE DEPARTMENT	EMERGENCY: <b>911</b>
3.	CLEANUP CONTRACTOR: _____ ADDRESS: _____ _____	PHONE: _____
4.	MA DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP)	EMERGENCY PHONE: <b>(888) 304-1133</b>
5.	NATIONAL RESPONSE CENTER  ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY	PHONE: (800) 424-8802  EMERGENCY: (800) 424-8802 BUSINESS: (202) 564-8600
6.	FRAMINGHAM HEALTH DEPARTMENT	PHONE: (508) 532-5470
	FRAMINGHAM CONSERVATION COMMISSION	PHONE: (508) 532-5460



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## Hazardous Waste / Oil Spill Report

Date: \_\_\_/\_\_\_/\_\_\_ Time: \_\_\_ AM / PM

Exact location \_\_\_\_\_

Type of equipment: \_\_\_\_\_ Make: \_\_\_\_\_ Size: \_\_\_\_\_

License or S/N: \_\_\_\_\_ Weather Conditions: \_\_\_\_\_

On or near water  Yes If yes, name of body of water: \_\_\_\_\_

No

Type of chemical / oil spilled: \_\_\_\_\_

Amount of chemical / oil spilled: \_\_\_\_\_

Cause of spill: \_\_\_\_\_

\_\_\_\_\_

Measures taken to contain or clean up spill: \_\_\_\_\_

\_\_\_\_\_

Amount of chemical / oil recovered: \_\_\_\_\_ Method: \_\_\_\_\_

Material collected as a result of clean up

\_\_\_\_\_ drums containing: \_\_\_\_\_

\_\_\_\_\_ drums containing: \_\_\_\_\_

\_\_\_\_\_ drums containing: \_\_\_\_\_

Location and method of debris disposal: \_\_\_\_\_

Name and address of any person, firm, or corporation suffering damages: \_\_\_\_\_

\_\_\_\_\_

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring: : \_\_\_\_\_

\_\_\_\_\_

Spill reported to General Office by: \_\_\_\_\_ Time: \_\_\_\_\_ AM / PM

Spill reported to DEP / National Response Center by: \_\_\_\_\_

DEP Date: \_\_\_/\_\_\_/\_\_\_ Time: \_\_\_\_\_ AM / PM Inspector: \_\_\_\_\_

NRC Date: \_\_\_/\_\_\_/\_\_\_ Time: \_\_\_\_\_ AM / PM Inspector: \_\_\_\_\_

Additional comments: \_\_\_\_\_

\_\_\_\_\_



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## Assessment - Initial Containment

The supervisor or manager will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. A list of recommended spill equipment to be kept on site is included on the following page.

<b>Fire / Police Department:</b>	<b>911</b>
<b>Framingham Health Department</b>	<b>(508) 532-5470</b>
<b>Framingham Conservation Commission:</b>	<b>(508) 532-5460</b>



## Emergency Response Equipment

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

<b>Supplies</b>		<b>Recommended Suppliers</b>
➤ SORBENT PILLOWS/"PIGS"	2	<a href="http://www.newpig.com">http://www.newpig.com</a>
➤ SORBENT BOOM/SOCK	25 FEET	Item # KIT276 – mobile container with two pigs,
➤ SORBENT PADS	50	26 feet of sock, 50 pads, and five pounds of
➤ LITE-DRI® ABSORBENT	5	absorbent (or equivalent)
<b>POUNDS</b>		<a href="http://www.forestry-suppliers.com">http://www.forestry-suppliers.com</a>
➤ SHOVEL	1	Item # 43210 – Manhole cover pick (or equivalent)
➤ PRY BAR	1	Item # 33934 – Shovel (or equivalent)
➤ GOGGLES	1 PAIR	Item # 90926 – Gloves (or equivalent)
➤ GLOVES - HEAVY	1 PAIR	Item # 23334 – Goggles (or equivalent)



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## Stormwater Operation and Maintenance Plan

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### Project Information

#### Site

Northside Meadows  
518 Pleasant Street  
Framingham, Massachusetts

#### Owner

Brendon Properties Northside Meadows, LLC  
259 Turnpike Road Suite 110  
Southborough, Massachusetts 01772

#### Site Supervisor

Site Manager Name - TBD  
Site Manager Address - TBD  
Site Manager City, State Zip - TBD  
Site Manager Phone Number - TBD

Name: \_\_\_\_\_

Telephone: \_\_\_\_\_

Cell phone: \_\_\_\_\_

Email: \_\_\_\_\_



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## Description of Stormwater Maintenance Measures

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

### Catch Basins

- All catch basins shall be inspected and cleaned a minimum of 4 times per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

### Structural Water Quality Devices

- Inspect devices monthly for the first three months after construction.
- After initial three month period, all water quality units are to be inspected at least four times per year and cleaned a minimum of at least once per year or when sediment reaches 8" in depth.
- Follow manufacturer instructions for inspection and cleaning and contact manufacturer if system is malfunctioning.

### Stormwater Outfalls

- Inspect outfall locations monthly for the first three months after construction to ensure proper functioning and correct any areas that have settled or experienced washouts.
- Inspect outfalls annually after initial three month period.
- Outfalls shall be inspected at least 4 times per year and after large storms, when washouts may occur.
- Maintain vegetation around outfalls to prevent blockages at the outfall.
- Maintain rip rap pad below each outfall and replace any washouts.
- Remove and dispose of any trash or debris at the outfall.



## **Roof Drain Leaders**

- Perform routine roof inspections 4 times per year.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.

## **Vegetated Surface Basins**

### **Initial Post-Construction Inspection**

- Surface basins should be inspected after every major storm for the first few months to ensure proper stabilization and function.

### **Long-Term Maintenance**

- The grass on the sideslopes and in the buffer areas should be mowed, and grass clippings, organic matter, and accumulated trash and debris removed, at least twice during the growing season.
- Eroded or barren spots should be reseeded immediately after inspection to prevent additional erosion and accumulation of sediment.
- Deep tilling can be used to break up a clogged surface area.
- Sediment should be removed from the basin as necessary. Removal procedures should not take place until the floor of the basin is thoroughly dry.

### **Inspections and Cleaning**

- Vegetated basins should be inspected at least twice a year to ensure proper stabilization and function.
- Light equipment, which will not compact the underlying soil, should be used to remove the top layer.





Inspection Date:     /     /     Inspection Performed By: \_\_\_\_\_

**Water Quality Units – Inspect 4 times per year, clean at least once per year or when sediment reaches a depth of 8 inches**

Outfall	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	
WQU				/ /	

**Vegetated Surface Basins – Inspect twice per year, remove sediment if more than 6 inches has accumulated in sediment forebay**

Basin	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Sediment, Damage)
SB				/ /	
SB				/ /	
SB				/ /	
SB				/ /	
SB				/ /	
SB				/ /	
SB				/ /	
SB				/ /	
SB				/ /	
SB				/ /	
SB				/ /	





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## TSS Removal Worksheets





101 Walnut Street  
 Post Office Box 9151  
 Watertown, MA 02471  
 P 617.924.1770

## TSS Removal Calculation Worksheet

Project Name: **Northside Meadows**  
 Project Number: **13168.00**  
 Location: **Framingham, MA**  
 Discharge Point: **DP-1**  
 Drainage Area(s): **P11**

Sheet: **1 of 4**  
 Date: **30-Mar-2016**  
 Computed by: **BMG**  
 Checked by: **KSS**

### 1. Pre-Treatment prior to Infiltration

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	25%	100%	25%	75%
Sediment Forebay	25%	75%	19%	56%
	0%	56%	0%	56%
			<b>Pre-Treatment TSS Removal =</b>	
			<b>44%</b>	

### 2. Total TSS Removal including Pretreatment 1.

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Infiltration Basin	80%	100%	80%	20%
	0%	20%	0%	20%
	0%	20%	0%	20%
	0%	20%	0%	20%
			<b>Treatment Train TSS Removal =</b>	
			<b>80%</b>	

\* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.  
 \*\* Equals remaining load from previous BMP (E)



101 Walnut Street  
 Post Office Box 9151  
 Watertown, MA 02471  
 P 617.924.1770

## TSS Removal Calculation Worksheet

Project Name: **Northside Meadows**  
 Project Number: **13168.00**  
 Location: **Framingham, MA**  
 Discharge Point: **DP-1**  
 Drainage Area(s): **P12**

Sheet: **2 of 4**  
 Date: **30-Mar-2016**  
 Computed by: **BMG**  
 Checked by: **KSS**

### 1. Pre-Treatment prior to Infiltration

BMP*	
Deep Sump and Hooded Catch Basin	
Sediment Forebay	

TSS Removal Rate*	<b>25%</b>
	<b>25%</b>
	<b>0%</b>

Starting TSS Load**	<b>100%</b>
	<b>75%</b>
	<b>56%</b>

Amount Removed (C*D)	<b>25%</b>
	<b>19%</b>
	<b>0%</b>

Remaining Load (D-E)	<b>75%</b>
	<b>56%</b>
	<b>56%</b>
	<b>44%</b>

**Pre-Treatment TSS Removal =**

### 2. Total TSS Removal including Pretreatment 1.

BMP*	
Infiltration Basin	

TSS Removal Rate*	<b>80%</b>
	<b>0%</b>
	<b>0%</b>
	<b>0%</b>

Starting TSS Load**	<b>100%</b>
	<b>20%</b>
	<b>20%</b>
	<b>20%</b>

Amount Removed (C*D)	<b>80%</b>
	<b>0%</b>
	<b>0%</b>
	<b>0%</b>

Remaining Load (D-E)	<b>20%</b>
	<b>20%</b>
	<b>20%</b>
	<b>20%</b>

\* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.  
 \*\* Equals remaining load from previous BMP (E)

**Treatment Train  
 TSS Removal =**

<b>80%</b>
------------



101 Walnut Street  
 Post Office Box 9151  
 Watertown, MA 02471  
 P 617.924.1770

## TSS Removal Calculation Worksheet

Project Name:  
 Project Number:  
 Location:  
 Discharge Point:  
 Drainage Area(s):

Northside Meadows  
 13168.00  
 Framingham, MA  
 DP-3  
 P31

Sheet:  
 Date:  
 Computed by:  
 Checked by:

3 of 4  
 30-Mar-2016  
 BMG  
 KSS

### 1. Pre-Treatment prior to Infiltration

BMP*
Deep Sump and Hooded Catch Basin
Sediment Forebay

TSS Removal Rate*	25%
	25%
	0%

Starting TSS Load**	100%
	75%
	56%

Amount Removed (C*D)	25%
	19%
	0%

Remaining Load (D-E)	75%
	56%
	56%
	44%

**Pre-Treatment TSS Removal =**

### 2. Total TSS Removal including Pretreatment 1.

BMP*
Infiltration Basin

TSS Removal Rate*	80%
	0%
	0%
	0%

Starting TSS Load**	100%
	20%
	20%
	20%

Amount Removed (C*D)	80%
	0%
	0%
	0%

Remaining Load (D-E)	20%
	20%
	20%
	20%

\* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.  
 \*\* Equals remaining load from previous BMP (E)

**Treatment Train  
 TSS Removal =**

<b>80%</b>
------------



101 Walnut Street  
 Post Office Box 9151  
 Watertown, MA 02471  
 P 617.924.1770

## TSS Removal Calculation Worksheet

Project Name:  
 Project Number:  
 Location:  
 Discharge Point:  
 Drainage Area(s):

Northside Meadows  
 13168.00  
 Framingham, MA  
 DP-4  
 P41

Sheet:  
 Date:  
 Computed by:  
 Checked by:

4 of 4  
 30-Mar-2016  
 BMG  
 KSS

### 1. Pre-Treatment prior to Infiltration

BMP*
Deep Sump and Hooded Catch Basin
CDS

TSS Removal Rate*
25%
74%
0%

Starting TSS Load**
100%
75%
20%

Amount Removed (C*D)
25%
55%
0%

Remaining Load (D-E)
75%
20%
20%
80%

**Pre-Treatment TSS Removal =**

### 2. Total TSS Removal including Pretreatment 1.

BMP*
Infiltration Basin

TSS Removal Rate*
80%
0%
0%
0%

Starting TSS Load**
100%
20%
20%
20%

Amount Removed (C*D)
80%
0%
0%
0%

Remaining Load (D-E)
20%
20%
20%
20%

\* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.  
 \*\* Equals remaining load from previous BMP (E)

**Treatment Train  
 TSS Removal =**

80%
-----



---

## Water Quality Volume Calculations



## Water Quality Volume Calculations

**Project Name:** Northside Meadows      **Proj. No.:** 13168.00  
**Project Location:** Framingham, MA      **Date:** 4/4/2016  
**Calculated by:** BMG

**Surface Infiltration Basin (1Pb)**  
(runoff from Area P11)

Total Impervious Area =      **0.3**      Acres

Basin

Required:

	Runoff Depth to be Treated (in.)	Required Volume (c.f.)
Water Quality Volume	1	<b>1,053</b>

Provided:

Elevation	Area (s.f.)	Volume (c.f.)
193.0	1,100	0
193.8	1,580	<b>1,072</b>

Forebay

Required:

	Runoff Depth to be Treated (in.)	Required Volume (c.f.)
Forebay Water Quality Volume	0.1	<b>105</b>

Provided:

Elevation	Area (s.f.)	Volume (c.f.)
193.0	273	0
193.5	420	<b>173</b>

---



## Water Quality Volume Calculations

**Project Name:** Northside Meadows      **Proj. No.:** 13168.00  
**Project Location:** Framingham, MA      **Date:** 4/4/2016  
**Calculated by:** BMG

**Surface Infiltration Basin (1Pc)**  
(runoff from Area P12)

Total Impervious Area =      **3.7**      Acres

Basin

Required:

	Runoff Depth to be Treated (in.)	Required Volume (c.f.)
Water Quality Volume	1	<b>13,431</b>

Provided:

	Elevation	Area (s.f.)	Cumulative Volume (c.f.)
	183.4	2847	0
	184.0	5984	2,649
	185.0	9493	10,388
	186.0	12771	21,520
	186.5	14,452	<b>28,326</b>

Forebay

Required:

	Runoff Depth to be Treated (in.)	Required Volume (c.f.)
Forebay Water Quality Volume	0.1	<b>1,343</b>

Provided:

	Elevation	Area (s.f.)	Cumulative Volume (c.f.)
	186.0	615	0
	187.0	1,050	833
	187.5	1,300	<b>1,420</b>

Provided:

	Elevation	Area (s.f.)	Cumulative Volume (c.f.)
	188.0	626	0
	189.0	1,240	933
	189.5	1,600	<b>1,643</b>

---



## Water Quality Volume Calculations

**Project Name:** Northside Meadows      **Proj. No.:** 13168.00  
**Project Location:** Framingham, MA      **Date:** 4/4/2016  
**Calculated by:** BMG

**Surface Infiltration Basin (P3b)**  
(runoff from Area P31)

Basin      Total Impervious Area =      **1.2**      Acres

Required:

	Runoff Depth to be Treated (in.)	Required Volume (c.f.)
Water Quality Volume	1	<b>4,356</b>

Provided:

	Elevation	Area (s.f.)	Cumulative Volume (c.f.)
	180.0	1,211	0
	181.0	2,443	1,827
	182.0	4,086	5,092
	183.0	5,476	9,873
	184.0	7,048	16,135
	184.45	8,250	<b>19,577</b>

Forebay

Required:

	Runoff Depth to be Treated (in.)	Required Volume (c.f.)
Water Quality Volume	0.1	<b>436</b>

Provided:

	Elevation	Area (s.f.)	Cumulative Volume (c.f.)
	184.0	490	0
	185.0	1,007	<b>749</b>

**Surface Infiltration Basin (P4)**  
(runoff from Area P41)

Basin      Total Impervious Area =      **2.4**      Acres

Required:

	Runoff Depth to be Treated (in.)	Required Volume (c.f.)
Water Quality Volume	1	<b>8,712</b>

Provided:

	Elevation	Area (s.f.)	Cumulative Volume (c.f.)
	186.0	1,597	0
	187.0	3,887	2,742
	188.0	5,170	7,271
	189.0	6,574	13,143
	190.0	8,144	20,502
	191.0	9,832	<b>29,490</b>



---

## MASTEP CDS Report

Current User:  
MASTEP GUEST



## Stormwater Technologies Clearinghouse

<a href="#">Project Information</a>	<a href="#">Stormwater Library</a>	<a href="#">The Database</a>	<a href="#">External Links</a>	<a href="#">Contact</a>
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**CDS Inline Unit :: A product from [CONTECH STORMWATER SOLUTIONS, INC.](#) ::**

**General Information:**

This report describes a laboratory study that evaluated the performance of a CDS model PMSU20\_20\_6 with a special configuration, involving an enlarged pipe diameter and a sediment weir. This is an inverted oil baffle that extends several inches above the outlet invert. This reconfigured unit is sold in NJ and NY. Anyone considering this unit with expectations of sediment removal performance comparable to this study should ensure that a unit with the sediment weir, and with a 2400 micron screen is obtained. A 4700 screen is also available – solids removal would be adversely affected with the larger mesh screen. A particularly fine sediment mix (Sil-Col-Sil 106, pre-washed to remove all particles > 100 microns), which created rigorous testing conditions for sediment removal. It tested a rather narrow range of influent sediment concentration (164 – 203 mg/l, average 184), but this is within the NJDEP-recommended 100-300 mg/l range. For the most part, the study tested NJ-recommended operating rates; except that no tests at 125% operating rate were conducted. 0% credit for sediment removal at this rate was given when calculating the overall performance of 73.7% removal. The report states that this figure may be conservative because of the 0% credit at 125% operating rate. However, this assertion cannot be substantiated, because no scour tests were conducted. No discussion of quality control. MASTEP Rating 3: This study has some scientific merit. Significant caveats exist regarding use of the study information.

Report title	Author	Agency conducting study	Funding source for study
NJCAT Technology Verification Addendum Report High Efficiency Continuous Deflective Separators	-	Portland State U, for NJCAT	-

Report date	Date system installed	Study start date	Study end date
12/01/2004	-	-	-

Name, location of test site	Watershed where test site exists	% impervious surface in test watershed	Size of BMP drainage area (acres)
-	-	-	-

**Performance claims statement used for this study:**

A 500 GPM unit (Model PMSU20\_20\_5) with a 2400 micron screen opening and a reconfigured outlet for best sediment control, operating with an average influent TSS concentration of 184 mg/L and zero initial sediment loading, has been shown to have a total mass TSS removal efficiency of 73.7% (per NJDEP treatment efficiency calculation methodology) for silica sand particles < 100 microns (d50 particle size of 63 microns) in laboratory studies using simulated stormwater.

**Rating /Verification given by agency conducting study:**

Based on the evaluation of the results from the Portland State University sub-100 micron particle testing studies, sufficient data is available to support the CDS Technologies Claim: A 500 GPM unit (Model PMSU20\_20\_5) with a 2400 micron screen opening and a reconfigured outlet for best sediment control, operating with an average influent TSS concentration of 184mg/l and zero initial sediment loading, has been shown to have a total mass TSS removal efficiency of 73.7% (per NJDEP treatment efficiency calculation methodology) for silica sand particles <100 microns (d50 particle size of 63 microns) in laboratory studies using simulated stormwater.

Average annual number of storms in test watershed	Average annual rainfall at test site (inches)	Average monthly rainfall during test period (inches)
-	-	-

% of total annual rainfall monitored during study	Number of storms that occurred during study period	Number of storm events that were monitored during the study
-	-	-

-		-		-	
<b>Dates, precipitation amounts of storm events occurring during study</b>			<b>Dates of storm events that were monitored during study</b>		
-		-		-	
<b>Qualifying event minimum storm depth (inches)</b>	<b>Maximum event <u>recurrence interval</u> (years)</b>	<b>Was bypass monitored?</b>			
-	-	No			
<b>Type of samples collected</b>	<b>Parameters measured</b>	<b>Analytical methods used</b>	<b>Statistical methods used</b>	<b>Pollution removal efficiency calculation methods</b>	
-	-	-	-	9	

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STORMWATER TECHNOLOGIES CLEARINGHOUSE © 2004

This project has been financed with Federal Funds from the Environmental Protection Agency (EPA) to the Massachusetts Department of Environmental Protection (the Department) under an s. 319 competitive grant. The contents do not necessarily reflect the views and policies of EPA or of the Department, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.







# Appendix D

## Standard 8 Supporting Information

- Recommended construction period pollution prevention and erosion and sedimentation checklist



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## **Recommended Construction Period Pollution Prevention and Erosion and Sedimentation Checklist**

Inspection Date: \_\_\_/\_\_\_/\_\_\_ Inspection Performed By: \_\_\_\_\_

Construction Practices Maintenance/ Evaluation Checklist

Best Management Practice	Inspection Frequency	Date Inspected	Inspector Initials	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed <input type="checkbox"/> Yes <input type="checkbox"/> No (List Items)	Date of Cleaning/Repair	Performed by:
Linear Erosion Control Barriers	Weekly and after any rainfall	/ /		<ul style="list-style-type: none"> <li>Sediment build up</li> <li>Broken bales or stakes</li> </ul>	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Gravel Construction Entrance	Weekly and after any rainfall	/ /		<ul style="list-style-type: none"> <li>Filled voids</li> <li>Runoff/sediments into street</li> </ul>	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Catch Basin Protection	Weekly and after any rainfall	/ /		<ul style="list-style-type: none"> <li>Clogged or sediment build-up at surface or in basin</li> </ul>	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Diversion Channels	Weekly and after any rainfall	/ /		<ul style="list-style-type: none"> <li>Maintained</li> <li>Moved as necessary to correct locations</li> <li>Check for erosion or breakout</li> </ul>	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Temporary Sedimentation Basins	Weekly and after any rainfall	/ /		<ul style="list-style-type: none"> <li>Cracking</li> <li>Erosion</li> <li>Breakout</li> <li>Sediment buildup</li> <li>Contaminants</li> </ul>	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Vegetated Slope Stabilization	Weekly and after any rainfall	/ /			<input type="checkbox"/> Yes <input type="checkbox"/> No		

Stormwater Control Manager \_\_\_\_\_





# Appendix E

## Hydraulic Pipe Sizing

- 25-year Hydraulic Drainage Pipe Sizing



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## 25-year Hydraulic Drainage Pipe Sizing

Project:	<u>Northside Meadows</u>	Project #:	<u>13168.00</u>
Location:	<u>Framingham, MA</u>	Sheet:	<u>1 of 1</u>
Calculated By:	<u>BMG</u>	Date:	<u>4/18/2016</u>
Title:	<u>25-Year Storm Drain Calculations per Stormcad Model</u>		

Start Node	Stop Node	Upstream Invert (ft)	Downstream Invert (ft)	Slope (ft/ft)	Manning's n	Diameter (in)	Length (ft)	System Intensity (in/hr)	Upstream Inlet Area (sf)	Upstream Inlet C (acres)	Flow (cfs)	Capacity (cfs)	Average Velocity (ft/s)	Elevation Ground Start (ft)	Cover Start (ft)	Elevation Ground Stop (ft)	Cover Stop (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
SHAL CB 100	DMH 102	193.7	193.5	0.006	0.012	12	35.2	6.0	0.18	0.90	1.0	2.9	3.3	196.2	1.5	196.3	1.8	194.11	193.97
SHAL CB 101	DMH 102	193.7	193.5	0.013	0.012	12	14.8	6.0	0.13	0.31	0.3	4.5	3.1	196.2	1.5	196.3	1.8	193.95	193.97
DMH 102	FES 103	193.4	193.1	0.006	0.012	12	53.9	6.0	(N/A)	(N/A)	1.2	2.9	3.5	196.3	1.9	195.1	1.0	193.86	193.83
CB-200	DMH 202	189.2	186.4	0.009	0.012	12	299.0	6.0	0.57	0.53	1.8	3.7	4.7	192.2	2.0	189.4	2.0	189.78	187.70
SHAL CB 201	DMH 202	186.6	186.4	0.008	0.012	15	25.1	6.0	2.34	0.43	6.1	6.3	5.0	189.5	1.7	189.4	1.8	187.89	187.70
DMH 202	FES 203	186.3	186.0	0.005	0.012	18	57.2	5.8	(N/A)	(N/A)	7.6	8.3	5.3	189.4	1.6	188.0	0.5	187.44	187.07
CB 300	DMH 302	193.5	190.8	0.027	0.013	12	101.5	6.0	0.38	0.66	1.5	5.8	6.2	196.5	2.0	197.2	5.4	194.02	191.62
CB 305	DMH 306	189.1	189.0	0.012	0.013	12	7.7	6.0	1.10	0.33	2.2	4.0	2.8	192.1	2.0	192.1	2.1	190.27	190.24
DMH 306	FES 307	188.9	188.2	0.005	0.012	18	127.9	5.6	(N/A)	(N/A)	5.9	8.4	5.2	192.1	1.7	190.2	0.5	189.84	189.13
CB 400	DMH 405	189.6	188.3	0.007	0.013	12	176.2	6.0	0.64	0.55	2.1	3.1	4.2	192.6	2.0	194.8	5.5	190.22	188.91
CB 401	DMH 404	186.7	186.0	0.006	0.013	12	125.5	6.0	0.63	0.64	2.5	2.7	3.9	189.7	2.0	192.5	5.5	187.46	186.76
LD 403	DMH 404	188.5	187.5	0.023	0.013	12	42.9	6.0	(N/A)	(N/A)	0.4	5.4	4.0	192.0	2.5	192.5	4.0	188.76	187.68
DMH 404	DMH 405	185.9	185.2	0.006	0.013	15	115.2	5.9	(N/A)	(N/A)	2.8	5.0	4.2	192.5	5.4	194.8	8.4	186.57	186.36
DMH 405	FES 406	185.1	184.5	0.006	0.013	15	101.9	5.8	(N/A)	(N/A)	4.8	5.0	4.6	194.8	8.5	186.5	0.8	186.10	185.39
SHAL CB-500	DMH-502	190.0	189.2	0.006	0.012	15	137.7	6.0	1.01	0.52	3.2	5.3	2.6	192.5	1.3	193.2	2.8	191.51	191.23
CB-501	DMH-502	190.0	189.8	0.022	0.012	12	9.5	6.0	2.02	0.38	4.7	5.8	5.9	193.0	2.0	193.2	2.4	191.36	191.23
CB 504	DMH-505	189.3	188.4	0.005	0.012	15	176.1	6.0	0.68	0.68	2.8	5.0	2.3	191.8	1.3	195.3	5.7	191.71	191.43
CB-506	DMH-507	191.0	190.8	0.022	0.012	12	9.3	6.0	0.36	0.73	1.6	5.8	6.3	194.0	2.0	194.2	2.4	191.54	191.21
CB 301	DMH 302	191.4	190.8	0.005	0.013	12	112.6	6.0	0.34	0.65	1.3	2.6	3.3	194.9	2.5	197.2	5.4	191.91	191.62
DMH 302	DMH 304	190.7	189.7	0.005	0.013	15	198.8	5.9	(N/A)	(N/A)	2.8	4.6	3.9	197.2	5.3	194.6	3.7	191.41	190.54
CB 303	DMH 304	191.5	191.4	0.011	0.013	12	8.9	6.0	0.33	0.60	1.2	3.8	4.2	194.5	2.0	194.6	2.2	191.96	191.80
DMH 304	DMH 306	189.6	189.0	0.005	0.013	15	111.1	5.7	(N/A)	(N/A)	3.9	4.8	4.3	194.6	3.8	192.1	1.9	190.54	190.24
DMH-502	DMH 503	189.1	188.4	0.006	0.012	24	120.9	5.8	(N/A)	(N/A)	9.0	18.6	2.9	193.2	2.1	194.7	4.3	191.23	191.06
DMH 503	WQU-508	188.3	187.3	0.005	0.012	24	193.3	5.7	(N/A)	(N/A)	10.1	17.6	3.2	194.7	4.4	195.1	5.8	190.97	190.64
DMH-505	DMH-507	188.3	187.6	0.006	0.012	15	121.1	5.7	(N/A)	(N/A)	4.6	5.3	3.8	195.3	5.8	194.2	5.4	191.43	190.91
DMH-507	WQU-508	187.5	187.3	0.005	0.012	18	38.5	5.6	(N/A)	(N/A)	6.4	8.2	3.6	194.2	5.2	195.1	6.3	190.77	190.64
ROOF-1	DMH-502	189.0	188.5	0.011	0.012	12	46.9	6.0	0.27	0.90	1.5	4.0	1.9	195.0	5.0	193.2	3.7	191.30	191.23
ROOF-2	DMH 503	189.0	188.8	0.010	0.013	12	20.3	6.0	0.24	0.90	1.3	3.6	1.7	195.5	5.5	194.7	4.9	191.09	191.06
ROOF-3	DMH-507	188.0	187.6	0.010	0.013	12	39.7	6.0	0.06	0.90	0.3	3.6	0.4	195.5	6.5	194.2	5.6	190.91	190.91
ROOF-4	DMH-505	189.0	188.4	0.007	0.012	12	82.9	6.0	0.37	0.90	2.0	3.3	2.6	196.5	6.5	195.3	5.9	191.66	191.43
WQU-508	FES-509	187.2	187.0	0.005	0.012	24	40.1	5.5	(N/A)	(N/A)	15.9	17.3	5.1	195.1	5.9	195.0	6.0	190.33	190.16





# Appendix F

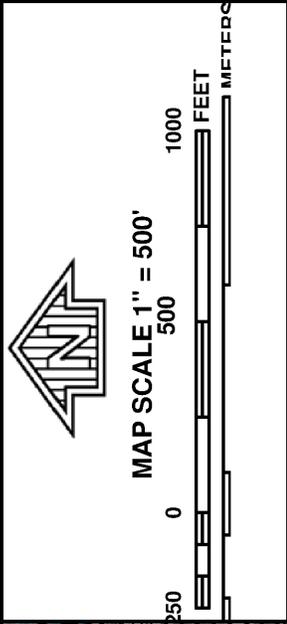
## FEMA Flood Insurance Rate Map

- ▶ FEMA Flood Insurance Rate Map



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## FEMA Flood Insurance Rate Map



**NFP** NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0512F

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
**MIDDLESEX COUNTY,**  
**MASSACHUSETTS**  
**(ALL JURISDICTIONS)**

**PANEL 512 OF 656**  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ASHLAND, TOWN OF	250179	0512	F
FRAMINGHAM, TOWN OF	250193	0512	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



**MAP NUMBER**  
**25017C0512F**  
**MAP REVISED**  
**JULY 7, 2014**

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

