Stormwater Report
Proposed Photovoltaic Solar Project

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Leicester, Massachusetts

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Stormwater Report

- **MassDEP Stormwater Report Summary**
- **MassDEP Checklist**
- **Stormwater Modeling Report and Summary Table**
- **Rainfall Data**
- **Drainage Maps**
- **Stormwater Calculations**
- **NRCS Soil Report**
- **Stormwater O&M Plan and Long-Term Pollution Prevention Plan**

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MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

STORMWATER REPORT

Stormwater Management Summary for
Leicester, MA Solar PV Array

Standard 1: No New Untreated Discharges

The Massachusetts Stormwater Handbook requires that the project demonstrate that there are no new untreated discharges and that new discharges will not cause erosion or scour to downstream wetlands.

The proposed solar array installation work consists of concrete equipment pads and ground screw foundation poles installed on the existing ground surface. A permanent gravel road extension is proposed for access to portions of the site. Discharges from access roads are addressed under Standard 8.

Standard 2: Peak Rate Attenuation

Standard 2 requires that peak rates of flow be attenuated for the proposed development condition.

This Project will create minimal impervious area. The only new impervious area consists of the ground screw foundation poles installed on the existing ground surface to support the racks and concrete equipment pads. The access road will be gravel. All other impacted areas will be restored to vegetated ground cover. This Project does not involve any change to existing grades. Peak flow rates will be attenuated on-site upgradient of the on-site wetlands in two proposed stone infiltration trenches.

Standard 3: Stormwater Recharge

Standard 3 requires that the infiltration into the ground under post-development conditions is at least as much as the infiltration volume under pre-development conditions.

There will be approximately 6.7 acres of tree clearing for the project. Following tree clearing, the existing ground surface will be restored with grass. The existing stumps and root systems will remain for the majority of the Site except where impeding the ground screw installation. The overall hydrologic conditions, including infiltration into existing rocky soils, are anticipated to remain largely unchanged.

Standard 4: Water Quality

Standard 4 requires that all stormwater management systems be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The Massachusetts Stormwater Handbook states that this standard is met when:

a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
b. Structural stormwater best management practices (BMPs) are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and
c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

Although tree clearing is proposed, the majority of existing stumps and root systems will remain and will be restored with grass, which will provide stormwater treatment.

Long term pollution prevention plan

Post-construction stormwater BMPs are proposed which include grass swales and stone infiltration trenches; therefore, a long term pollution prevention plan is included within the O&M Plan in the Stormwater Report.

Water quality treatment volume

The only added impervious area is from the ground screw foundation poles and the concrete equipment pad. These impervious areas will be managed as disconnected impervious area and will not be directed to a single (or series of) BMPs designed to handle the water quality volume.

TSS Removal Computations
Since permanent, post-construction BMPs are not proposed due to the nearly identical runoff rates from pre- to post-development, TSS removal computations have not been performed.

Standard 5: Land Uses with Higher Potential Pollutant Loads
The installation of the solar array is not considered a Land Use with Higher Potential Pollutant Loads (LUHPPL).

Standard 6: Critical Areas
A Critical Areas Map is enclosed, which indicates there are no critical areas on or near the Site. The Project does not discharge stormwater within the Zone A or Interim Wellhead Protection Area of a public water supply, nor does it discharge near or to a Public Water Supply Watershed.

Standard 7: Redevelopments
The Project is a new development. Certain standards are not fully met and an explanation of why these standards are not met is contained in the Stormwater Report.

Standard 8: Construction Period Pollution Prevention and Erosion & Sedimentation Control
Construction period pollution prevention and erosion and sedimentation control measures must be implemented at the site to control construction related impacts during construction and land disturbance activities. An erosion and sedimentation control plan and a Stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to the start of construction. The SWPPP will be prepared following the US EPA's guidelines as this project will require coverage under the NPDES Construction General Permit due to land disturbance greater than one acre. Construction period BMPs will be employed before construction of the access road extensions and before the installation of the arrays to prevent erosion of exposed soils and retain sediment on-site.

Restoration activities are detailed on the construction plans, and include revegetating areas in accordance with the *Massachusetts Guidelines for Erosion and Sedimentation Control for Urban and Suburban Areas, 2003*. Erosion and sedimentation controls will remain in place during restoration activities, and shall not be removed until upgradient areas have been stabilized.

Standard 9: Operation and Maintenance Plan
According to the Massachusetts Stormwater Handbook, the goal of an Operation and Maintenance (O&M) plan is not only to protect resources on-site or nearby, but also to protect resources in the region that may be affected by the post-development activities at the site. The proposed work will create stormwater BMPs which are outlined in the attached Stormwater O&M plan and Stormwater Report. The responsible party in not the owner of the parcel where the BMP is located; however, a lease agreement is currently being executed by the applicant and the property owner and will be provided upon completion. Routine O&M inspections will also occur as part of the solar PV array operation. Part of these routine O&M inspections will include observation of any stormwater issues at the site.

Standard 10: Prohibition of Illicit Discharges
Standard 10 of the Massachusetts Stormwater Handbook prohibits illicit discharges to stormwater management systems. As stated in the handbook, "The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater."

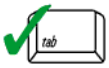
Proponents of projects within wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site, and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system. Illicit discharges are not applicable to this Project and an Illicit Discharge Compliance Statement is not required.

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

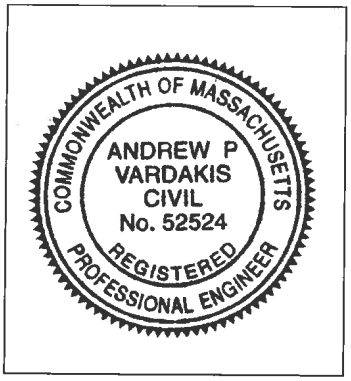
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



A. P. Vardakis 7/12/17

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge (See Stormwater Report)

☐ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality (See Stormwater Report)

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas (See Stormwater Report)

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan (See Stormwater Report)

☒ 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.

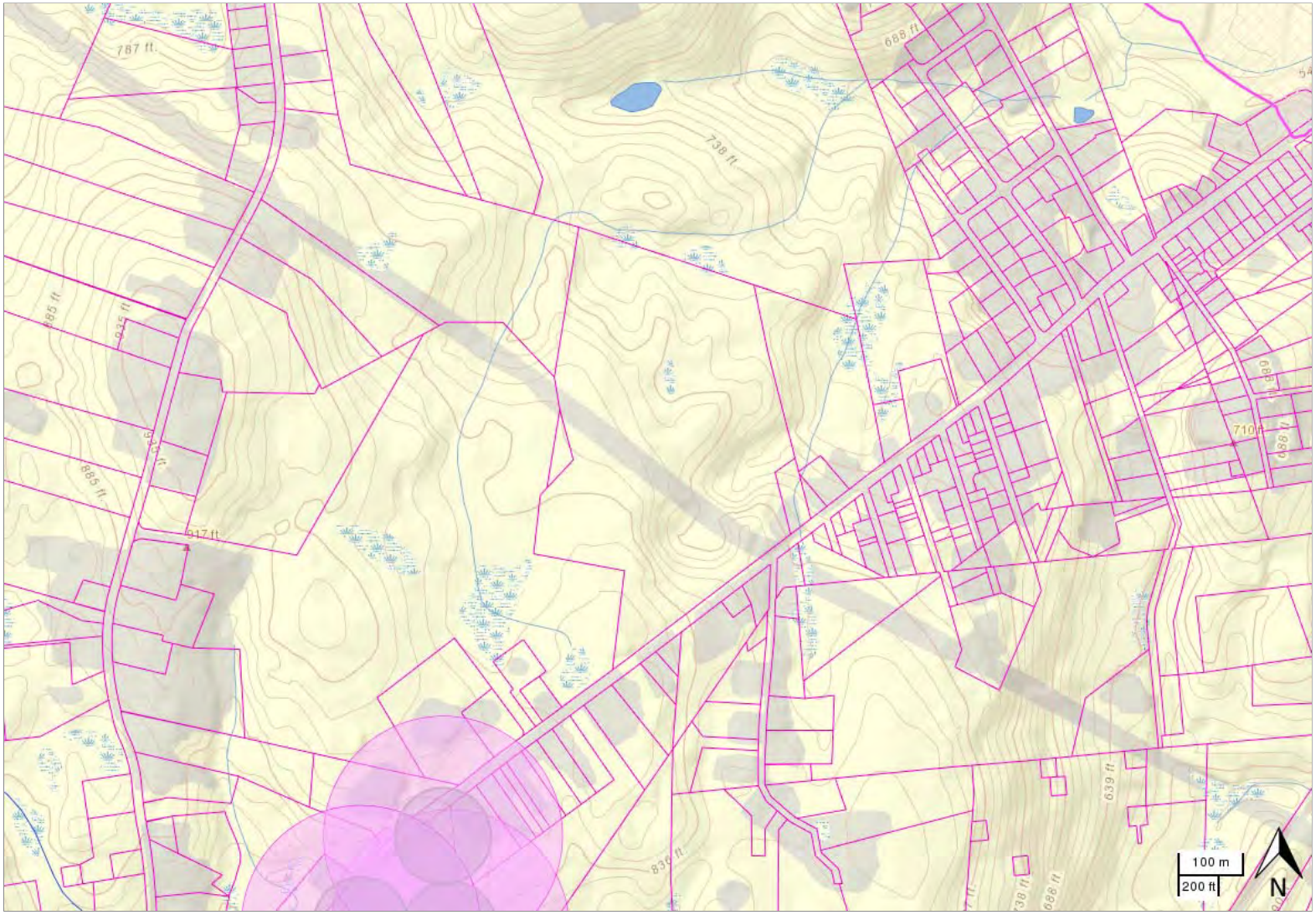
Standard 10: Prohibition of Illicit Discharges (See Stormwater Report)

☐ 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.

Critical Areas Map - National Grid, Stafford Street, Leicester MA



Zone A

DFW Coldwater Fisheries Resources

Shellfish Growing Areas

- APPROVED
- CONDITIONALLY APPROVED
- RESTRICTED
- CONDITIONALLY RESTRICTED
- PROHIBITED

NHESP Certified Vernal Pools

Zone Is

IWPAs

Outstanding Resource Waters

- PUBLIC WATER SUPPLY CONTRIBUTOR
- ORW FOR ACEC
- ORW FOR BOTH WATER SUPPLY AND OTHER

Zone IIs

Areas of Critical Environmental Concern
ACECs

Tax Parcels

MassGIS Statewide Basemap
MassGIS Topographic Features Basemap

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STORMWATER REPORT

Stormwater Modeling

The stormwater runoff pattern for the Leicester site will not be altered for this Project. The site is an existing wooded area where tree clearing and minimal site grading is proposed. Surface drainage from the site is conveyed over the existing wooded areas from west to east to two on-site wetlands to the north and south. The titles of Wetland 5 (north) and Wetland 3 (south) have been retained in this stormwater report to coincide with the existing wetlands delineation.

Runoff calculations were performed for the Soil Conservation Service (SCS) Type III 2- and 10-year, 24-hour storm events. The documented rainfall was estimated from the Northeast Regional Climate Center (NRCC) Extreme Precipitation Tables to be 3.24, 4.86, and 8.76 inches for the 2-, 10-, and 100-year storm events, respectively.

The existing and proposed condition peak-design flows were assessed using the National Resources Conservation Service (NRCS) Technical Release 55 (TR-55) methodology. Autodesk® Storm and Sanitary Analysis 2015 stormwater modeling software was used. The software program is included in the AutoCAD Civil 3D package that utilizes the TR-55 methodology. It is a comprehensive hydrodynamic modeling program which analyzes and designs site hydrology, surface drainage systems, and storm drains. It can manage a variety of flow situations such as overland flow, drainage swales, ponds, and piping systems.

The existing conditions topography is from a field survey performed by AMEC in March 2017. This topography was used to develop the stormwater model. There were two scenarios evaluated: the Existing Condition (pre-PV array development) and the Proposed Condition (post-PV array development). The detailed stormwater model, NRCS Soil Report, and the NRCC precipitation table for Leicester, MA are enclosed.

The primary impact of the solar PV array on the stormwater runoff rate and volume is a result of the ground screw foundation poles of the rack assembly and tree clearing to eliminate shading of the array. There will be a total of 155 panel rack assemblies. Each of these rack assemblies require four ground screw posts to anchor them to the ground (620 total ground screws). The ground screw diameter used for this project is 4 inches.

In addition to the ground screws, there will be concrete equipment pads for the required electrical connection of the solar array. The equipment pad areas used in this stormwater analysis are 162 square feet in Sub-basin A and 438 square feet in Sub-Basin B.

There will be approximately 6.7 acres of tree clearing for the project. Following tree clearing, the existing ground surface will be restored with grass. The existing stumps and root systems will remain for the majority of the Site except where impeding the ground screw installation. A proposed gravel access road will extend from the existing gravel area adjacent to the existing solar site located to the south of the proposed project. The proposed gravel access road is approximately 16 feet wide and 680 feet long which includes two turnaround areas and upgrading the existing gravel area east of the existing solar site. A 6-inch ductile iron culvert is proposed beneath the access road to convey surface water drainage from west to east in Sub-basin B. With the exception of the ground screws, concrete equipment pad, and gravel access road, all disturbed areas will be restored with vegetated ground cover.

The impervious cover associated with the proposed ground screws and equipment pad accounts for approximately 0.1% of the affected drainage sub-basin area (see summary table enclosed). Also

represented in the summary table are the existing and proposed conditions for peak runoff rate and volume for the 2-, 10-, and 100-year 24-hour storm events.

Two proposed stone infiltration trenches are proposed upgradient of each of the wetland discharge areas (Wetland 3 and 5). The infiltration trenches will attenuate the minimal increase in on-site runoff associated with the ground screws and equipment pads. As a result, the model shows that there is no increase in peak runoff to the existing wetland areas and no change in off-site conditions.

Stormwater Erosion Control Plan

A Stormwater Erosion Control Plan will be implemented prior to and during construction. This plan will address all potential avenues and pathways for erosion during construction and operation. This section briefly describes what the erosion control plan will encompass.

The primary construction activities that the plan will address will include: the cutting of trees in the existing wooded areas; the addition of gravel fill material for the proposed gravel road construction; the movement of heavy machinery; and re-vegetation of disturbed areas (if required). Vegetative cover outside of the limit of disturbance is to remain. If the vegetative cover outside the intended work area is damaged or disturbed during construction, it will be repaired to re-establish vegetation. Erosion control measures will be installed at the perimeter of the work to prevent sediment from leaving the site. Material stockpiles, if required, will be maintained in one or more central locations. Perimeter erosion control will placed around all stockpiles and will consist of sediment barriers sufficient enough to contain sediment.

Disturbance of the existing ground surface and access road by equipment is another possible source of erosion during construction. Rutting or exposed soil will require repair and attempts to mitigate future rutting at the same location will be made. Avoiding site work on-site during periods of heavy precipitation or when the cover soils are saturated and soft should mitigate many of the issues related to equipment use on-site.

The lower edge of each panel array, or the “drip edge,” has been identified as a potential source of ongoing erosion. This is not likely to be an issue due to the relatively short drip distance and the proposed vegetative cover. If erosion along the drip edge becomes an issue it will be mitigated as part of ongoing maintenance at the landfill, likely with a gravel splash strip or erosion control blanket.

LEICESTER, MA - SOLAR PV DEVELOPMENT 7/12/2017

Ground Screw Area 0.09 sf

Equipment Pad Area A 162 sf
Equipment Pad Area B 438 sf

Condition	Sub-basin		Ground Screws		Gravel	Woods	Brush	Grass
	Sub-basin	Total Area (acres)	# Screws	Total Ground Screw Area (acre)[1]	Total Gravel Area (acre)	Woods Area (acre)	Brush Area (acre)	Grass Area (acre)
EXISTING	A	5.36			0.00	3.71	1.65	0.00
	B	6.05			0.29	3.03	2.73	0.00
TOTAL		**11.41**			**0.29**	**6.74**	**4.38**	**0.00**
PROPOSED	A	5.36	296	0.004	0.01	0.00	1.65	3.70
	B	6.05	324	0.011	0.56	0.00	2.73	2.75
TOTAL		**11.41**	**620**	**0.015**	**0.57**	**0.00**	**4.38**	**6.44**

620 **Total ground screws**

0.1% **Increase in impervious area due to ground screws and equipment pads.**

1. Ground screw areas include concrete equipment pads.

ON-SITE SUMMARY		FLOW		
Sub-basin / Wetland	24-hour Storm Event	Existing Condition Peak Inflow (cfs)	Proposed Condition Peak Inflow (cfs)	**Difference in Peak Flow (cfs)**
Sub-basin A Wetland 5	2	0.36	0.00	**-0.36**
	10	2.99	2.76	**-0.23**
	100	15.05	14.40	**-0.65**
Sub-basin B Wetland 3	2	0.46	0.00	**-0.46**
	10	3.70	2.93	**-0.77**
	100	17.45	17.33	**-0.12**

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	71.884 degrees West
Latitude	42.212 degrees North
Elevation	0 feet
Date/Time	Mon, 22 May 2017 17:32:53 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.42	0.53	0.69	0.86	1.09	1yr	0.75	1.07	1.27	1.61	2.06	2.64	2.91	1yr	2.34	2.79	3.19	3.87	4.48	1yr
2yr	0.35	0.53	0.66	0.88	1.10	1.39	2yr	0.95	1.27	1.61	2.03	2.56	3.24	3.50	2yr	2.86	3.37	3.87	4.59	5.22	2yr
5yr	0.41	0.63	0.80	1.07	1.36	1.74	5yr	1.18	1.57	2.03	2.56	3.23	4.08	4.46	5yr	3.61	4.29	4.91	5.75	6.47	5yr
10yr	0.46	0.72	0.91	1.24	1.61	2.07	10yr	1.39	1.85	2.42	3.07	3.86	4.86	5.36	10yr	4.30	5.15	5.88	6.82	7.61	10yr
25yr	0.54	0.86	1.09	1.50	1.99	2.59	25yr	1.72	2.29	3.04	3.87	4.89	6.14	6.84	25yr	5.43	6.58	7.46	8.56	9.43	25yr
50yr	0.60	0.97	1.24	1.74	2.35	3.09	50yr	2.03	2.70	3.64	4.64	5.85	7.33	8.24	50yr	6.49	7.92	8.94	10.17	11.11	50yr
100yr	0.69	1.12	1.44	2.03	2.77	3.66	100yr	2.39	3.17	4.33	5.53	6.99	8.76	9.93	100yr	7.75	9.55	10.72	12.08	13.08	100yr
200yr	0.78	1.27	1.65	2.36	3.27	4.35	200yr	2.82	3.74	5.16	6.62	8.36	10.46	11.98	200yr	9.26	11.52	12.85	14.36	15.40	200yr
500yr	0.93	1.53	2.00	2.90	4.07	5.47	500yr	3.51	4.65	6.51	8.37	10.59	13.26	15.38	500yr	11.73	14.79	16.35	18.06	19.13	500yr

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.21	0.32	0.39	0.53	0.65	0.99	1yr	0.56	0.97	1.09	1.46	1.83	2.27	2.50	1yr	2.01	2.40	2.70	3.27	4.13	1yr
2yr	0.34	0.52	0.64	0.87	1.08	1.25	2yr	0.93	1.23	1.44	1.89	2.43	3.14	3.39	2yr	2.78	3.26	3.75	4.44	5.04	2yr
5yr	0.38	0.59	0.74	1.01	1.28	1.49	5yr	1.11	1.46	1.70	2.23	2.85	3.81	4.15	5yr	3.37	3.99	4.56	5.29	5.94	5yr
10yr	0.42	0.65	0.81	1.13	1.45	1.70	10yr	1.26	1.66	1.93	2.51	3.20	4.40	4.84	10yr	3.90	4.65	5.27	6.05	6.70	10yr
25yr	0.48	0.74	0.92	1.31	1.72	2.02	25yr	1.49	1.97	2.28	2.96	3.74	5.35	5.94	25yr	4.74	5.71	6.40	7.25	7.87	25yr
50yr	0.53	0.81	1.01	1.45	1.96	2.29	50yr	1.69	2.24	2.60	3.35	4.21	6.22	6.96	50yr	5.51	6.69	7.43	8.32	8.90	50yr
100yr	0.59	0.89	1.12	1.62	2.22	2.61	100yr	1.92	2.55	2.96	3.79	4.74	7.25	8.18	100yr	6.41	7.87	8.65	9.57	10.06	100yr
200yr	0.65	0.99	1.25	1.81	2.52	2.98	200yr	2.18	2.92	3.37	4.31	5.35	8.45	9.67	200yr	7.48	9.30	10.09	11.00	11.38	200yr
500yr	0.78	1.16	1.49	2.17	3.08	3.56	500yr	2.66	3.48	4.02	5.13	6.29	10.37	12.11	500yr	9.17	11.64	12.41	13.30	13.37	500yr

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.31	0.48	0.58	0.78	0.96	1.18	1yr	0.83	1.15	1.36	1.77	2.33	2.89	3.15	1yr	2.56	3.03	3.47	4.17	4.81	1yr
2yr	0.36	0.56	0.69	0.94	1.15	1.34	2yr	1.00	1.31	1.53	2.01	2.59	3.34	3.64	2yr	2.96	3.50	4.02	4.77	5.44	2yr
5yr	0.43	0.67	0.83	1.14	1.45	1.72	5yr	1.25	1.69	1.99	2.56	3.23	4.38	4.81	5yr	3.87	4.62	5.28	6.24	7.05	5yr
10yr	0.50	0.77	0.96	1.34	1.73	2.09	10yr	1.49	2.05	2.41	3.09	3.85	5.36	5.93	10yr	4.74	5.70	6.49	7.65	8.56	10yr
25yr	0.62	0.95	1.18	1.68	2.21	2.70	25yr	1.91	2.64	3.12	3.94	4.86	7.01	7.84	25yr	6.20	7.54	8.53	10.00	11.12	25yr
50yr	0.73	1.11	1.38	1.98	2.67	3.28	50yr	2.30	3.21	3.81	4.74	5.78	8.59	9.68	50yr	7.60	9.30	10.49	12.27	13.56	50yr
100yr	0.86	1.30	1.62	2.34	3.22	3.98	100yr	2.77	3.89	4.63	5.72	6.90	10.52	11.94	100yr	9.31	11.49	12.89	15.01	16.53	100yr
200yr	1.01	1.52	1.92	2.78	3.88	4.84	200yr	3.35	4.73	5.64	6.87	8.22	12.90	14.75	200yr	11.41	14.18	15.81	18.38	20.17	200yr
500yr	1.29	1.92	2.48	3.60	5.11	6.26	500yr	4.41	6.12	7.31	8.78	10.36	16.85	19.44	500yr	14.91	18.70	20.71	24.00	26.21	500yr

Powered by ACIS
Northeast Regional Climate Center

LEGEND:

- MAJOR CONTOUR
- MINOR CONTOUR
- PROPERTY LINE
- APPROXIMATE ABUTTERS PROPERTY LINE
- 100' PROPERTY LINE OFFSET
- WETLAND LINE
- WETLAND FLAG WITH IDENTIFIER
- 25' WETLAND LINE BUFFER (NO DISTURB)
- 100' WETLAND LINE BUFFER
- TRAIL
- FENCE
- STONEWALL
- TREE LINE
- OVERHEAD ELECTRIC LINE
- UTILITY POLE
- GUY
- ZONING DISTRICT BOUNDARY LINE
- TRANSMISSION LINE TOWER
- 250' POWER LINE RIGHT-OF-WAY
- DRILL HOLE FOUND
- SURVEY MONUMENT FOUND
- SUB-BASIN BOUNDARY
- SUB-BASIN NAME
- DESIGN MODEL NODE
- TIME OF CONCENTRATION
- FLOW DIRECTION

0' 50' 100' 150'
1" = 100'

ISSUED FOR LOCAL PERMITTING/NOT FOR CONSTRUCTION

amec foster wheeler
AMEC MASSACHUSETTS, INC.
271 MILL ROAD
CHELMSFORD MASSACHUSETTS 01824
TELEPHONE: (978) 692-9090
FAX: (978) 692-6533
WEB: WWW.AMECFW.COM

REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
1	07/12/2017	REVISED PER TOWN COMMENTS	DAA	APV
0	05/23/2017	ISSUED FOR LOCAL PERMITTING/NOT FOR CONSTRUCTION	DAA	APV

PROJECT:
NATIONAL GRID SOLAR PHASE III
1.354 MW SOLAR PV ARRAY
LEICESTER, MASSACHUSETTS

TITLE:
STORMWATER EXISTING CONDITIONS SITE PLAN

CLIENT:
AMERESCO, INC.
111 SPEEN STREET
FRAMINGHAM, MA 01701

AMERESCO
Green • Clean • Sustainable

SEAL:

DESIGNED BY: APV	DRAWN BY: DED
CHECKED BY: DAA	SCALE: AS SHOWN
PROJECT NUMBER: 3652170091.0300.0002	
DRAWING NUMBER: **SW-101**	
SHEET NUMBER: **1 OF 2**	

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LEGEND:

- MAJOR CONTOUR
- MINOR CONTOUR
- PROPERTY LINE
- APPROXIMATE ABUTTERS PROPERTY LINE
- 100' PROPERTY LINE OFFSET
- WETLAND LINE
- WETLAND FLAG
- 25' WETLAND LINE BUFFER (NO DISTURB)
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- TRANSMISSION LINE TOWER
- 250' POWER LINE RIGHT-OF-WAY
- DRILL HOLE FOUND
- SURVEY MONUMENT FOUND
- PROPOSED 5x5 SOLAR PANEL RACK
- PROPOSED 5x4 SOLAR PANEL RACK
- PROPOSED TREE CLEARING LINE
- PROPOSED FENCE
- PROPOSED UNDERGROUND ELECTRIC
- PROPOSED OVERHEAD ELECTRIC
- PROPOSED SEDIMENT BARRIER
- SUB-BASIN BOUNDARY
- SUB-BASIN NAME
- DESIGN MODEL NODE
- TIME OF CONCENTRATION
- FLOW DIRECTION

0' 50' 100' 150'
1" = 100'

ISSUED FOR LOCAL PERMITTING/NOT FOR CONSTRUCTION

amec foster wheeler
AMEC MASSACHUSETTS, INC.
271 MILL ROAD
CHELMSFORD MASSACHUSETTS 01824
TELEPHONE: (978) 692-9090
FAX: (978) 692-6533
WEB: WWW.AMECFW.COM

REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
1	07/12/2017	REVISED PER TOWN COMMENTS	DAA	APV
0	06/23/2017	ISSUED FOR LOCAL PERMITTING/NOT FOR CONSTRUCTION	DAA	APV

PROJECT:
NATIONAL GRID SOLAR PHASE III
1.354 MW SOLAR PV ARRAY
LEICESTER, MASSACHUSETTS

TITLE:
STORMWATER PROPOSED CONDITIONS SITE PLAN

CLIENT:
AMERESCO, INC.
111 SPEEN STREET
FRAMINGHAM, MA 01701

AMERESCO
Green • Clean • Sustainable

SEAL:

DESIGNED BY: APV	DRAWN BY: DED
CHECKED BY: DAA	SCALE: AS SHOWN
PROJECT NUMBER: 3652170091.0300.0002	
DRAWING NUMBER: **SW-102**	
SHEET NUMBER: **2 OF 2**	

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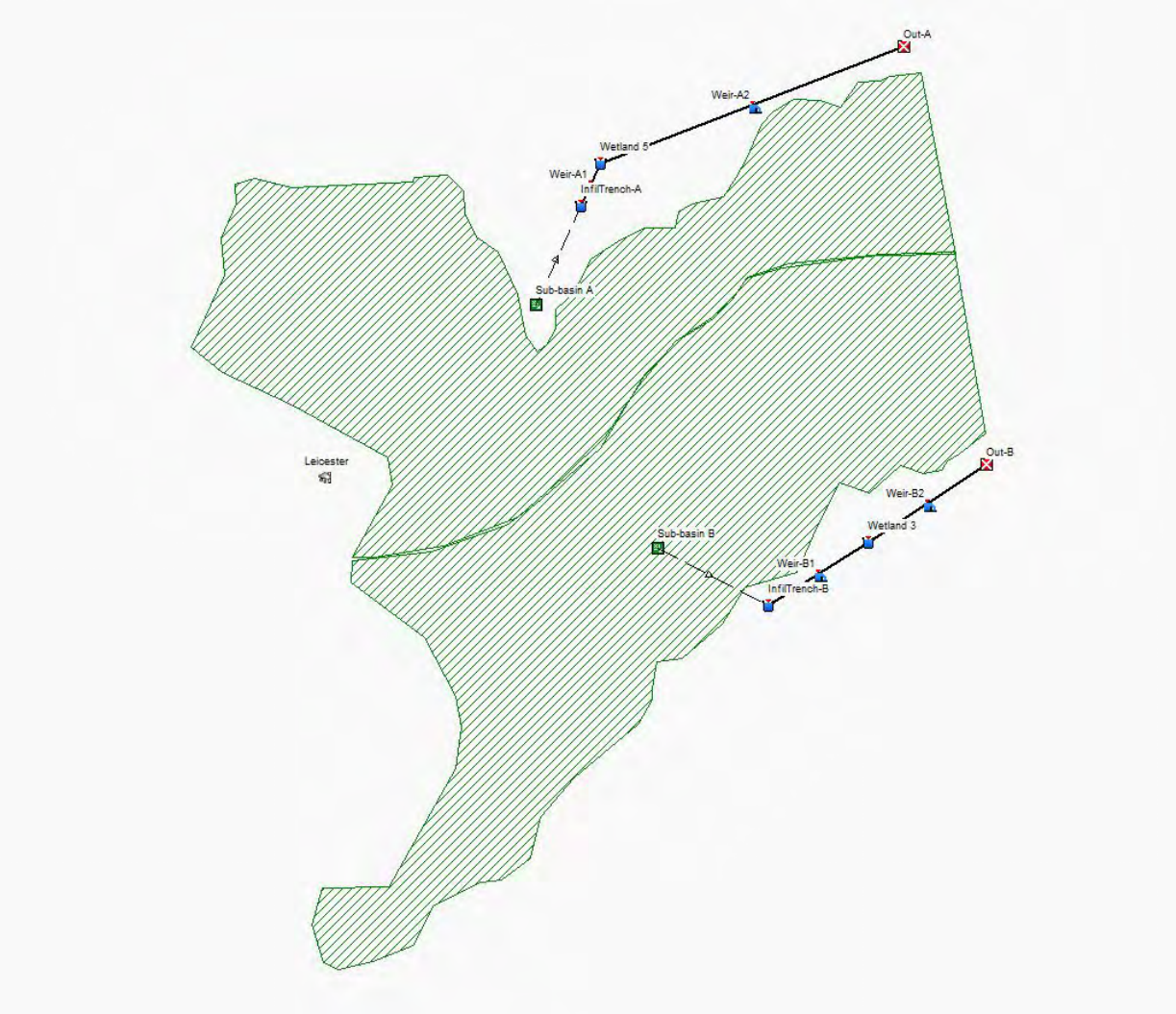

Out-A
Weir-A2
Wetland 5
Weir-A1
InfilTrench-A
Sub-basin A
Leicester
Out-B
Weir-B2
Wetland 3
Sub-basin B
Weir-B1
InfilTrench-B

Project Description

File Name ..... Leicester Stormwater Model-Pre 7-10-17.SPF
Description .....
Leicester, MA Solar

Stormwater Report

Project Options

Flow Units ..... CFS
Elevation Type ..... Elevation
Hydrology Method ..... SCS TR-55
Time of Concentration (TOC) Method ..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Enable Overflow Ponding at Nodes ..... YES
Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On ..... May 22, 2017 00:00:00
End Analysis On ..... May 23, 2017 00:00:00
Start Reporting On ..... May 22, 2017 00:00:00
Antecedent Dry Days ..... 0 days
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss
Reporting Time Step ..... 0 00:05:00 days hh:mm:ss
Routing Time Step ..... 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	2
Nodes	4
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	2
Links	2
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Leicester	Time Series	2-year	Cumulative	inches	Massachusetts	Worcester	2	3.24	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-basin A	5.36	52.85	3.24	0.20	1.09	0.36	0 00:10:34
2	Sub-basin B	6.05	53.28	3.24	0.22	1.30	0.46	0 00:09:22

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-A	Outfall	761.00					0.00	761.00					
2	Out-B	Outfall	741.00					0.00	741.00					
3	Wetland 3	Storage Node	748.00	754.00	748.00		20178.00	0.46	748.23				0.00	0.00
4	Wetland 5	Storage Node	784.00	790.00	784.00		72180.00	0.36	784.05				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Weir-A	Weir	Wetland 5	Out-A		784.00	761.00				0.00							
2	Weir-B	Weir	Wetland 3	Out-B		748.00	741.00				0.00							

Subbasin Hydrology

Subbasin : Sub-basin A

Input Data

Area (ac) 5.36
Weighted Curve Number 52.85
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.00	B	85.00
Woods, Good	3.71	B	55.00
Brush, Good	1.65	B	48.00
Meadow, non-grazed	0.00	B	58.00
Composite Area & Weighted CN	5.36		52.85

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.17	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	228	0.00
Slope (%) :	11	12	0.00
Surface Type :	Woodland	Forest	Unpaved
Velocity (ft/sec) :	1.66	0.87	0.00
Computed Flow Time (min) :	0.60	4.37	0.00

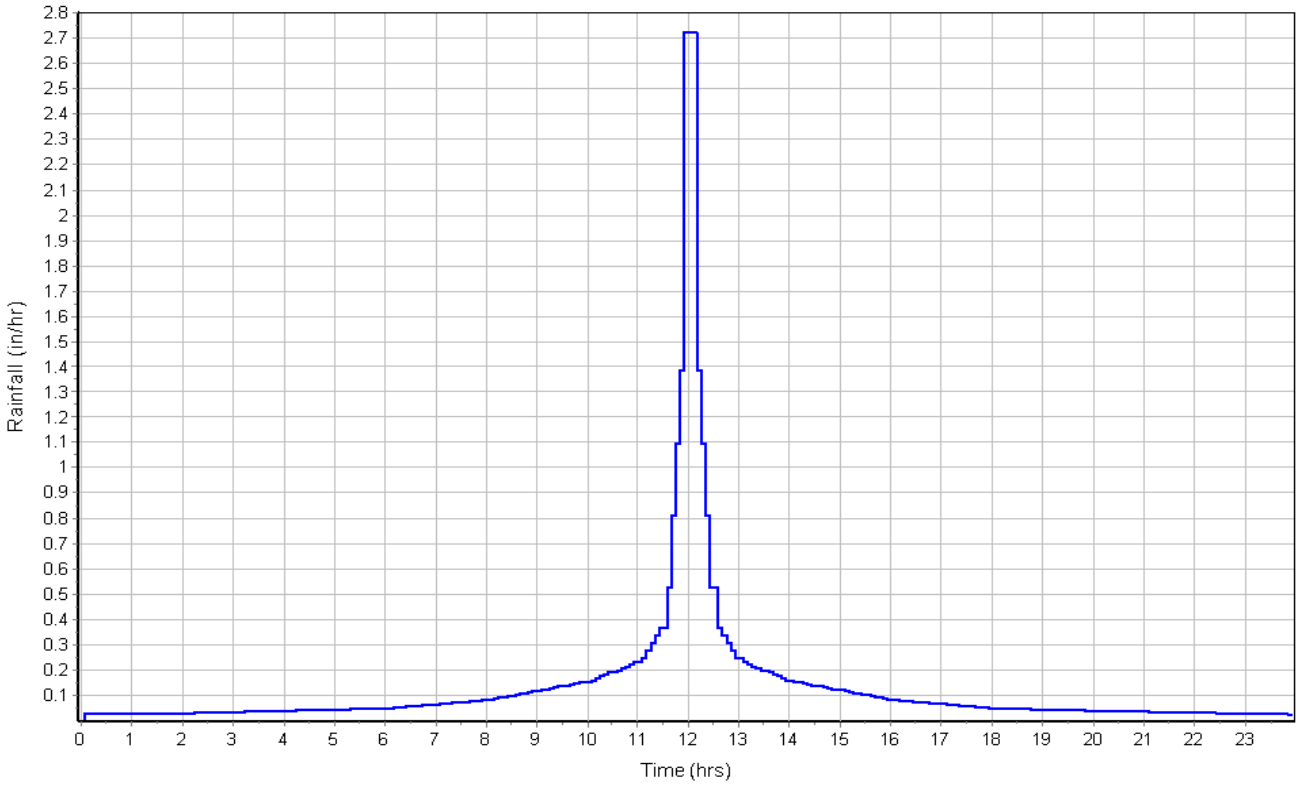
Total TOC (min) 10.57

Subbasin Runoff Results

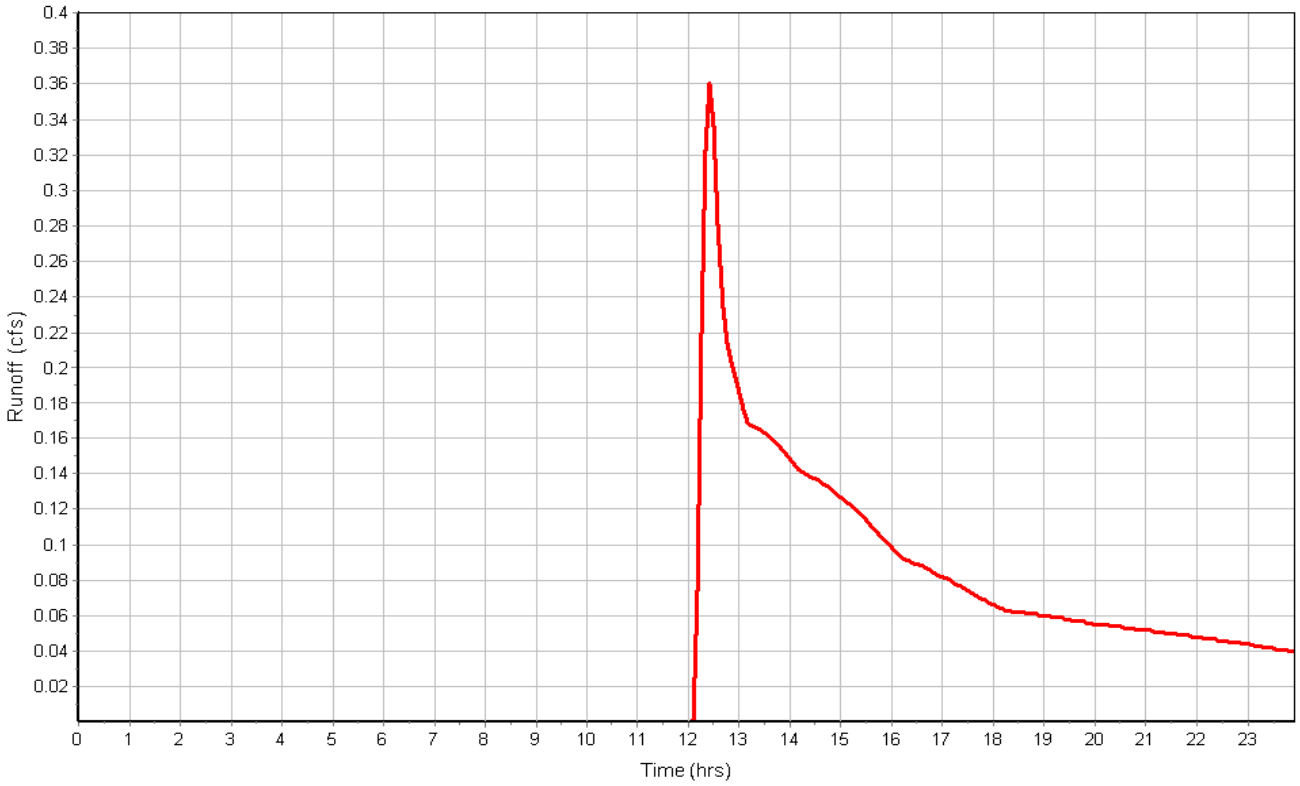
Total Rainfall (in)	3.24
Total Runoff (in)	0.20
Peak Runoff (cfs)	0.36
Weighted Curve Number	52.85
Time of Concentration (days hh:mm:ss)	0 00:10:34

Subbasin : Sub-basin A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-basin B

Input Data

Area (ac) 6.05
Weighted Curve Number 53.28
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.29	B	85.00
Woods, Good	3.03	B	55.00
Brush, Good	2.73	B	48.00
Meadow, non-grazed	0.00	B	58.00
Composite Area & Weighted CN	6.05		53.28

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.93	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	213	236	0.00
Slope (%) :	14.5	16	0.00
Surface Type :	Woodland	Forest	Unpaved
Velocity (ft/sec) :	1.90	1.00	0.00
Computed Flow Time (min) :	1.87	3.93	0.00

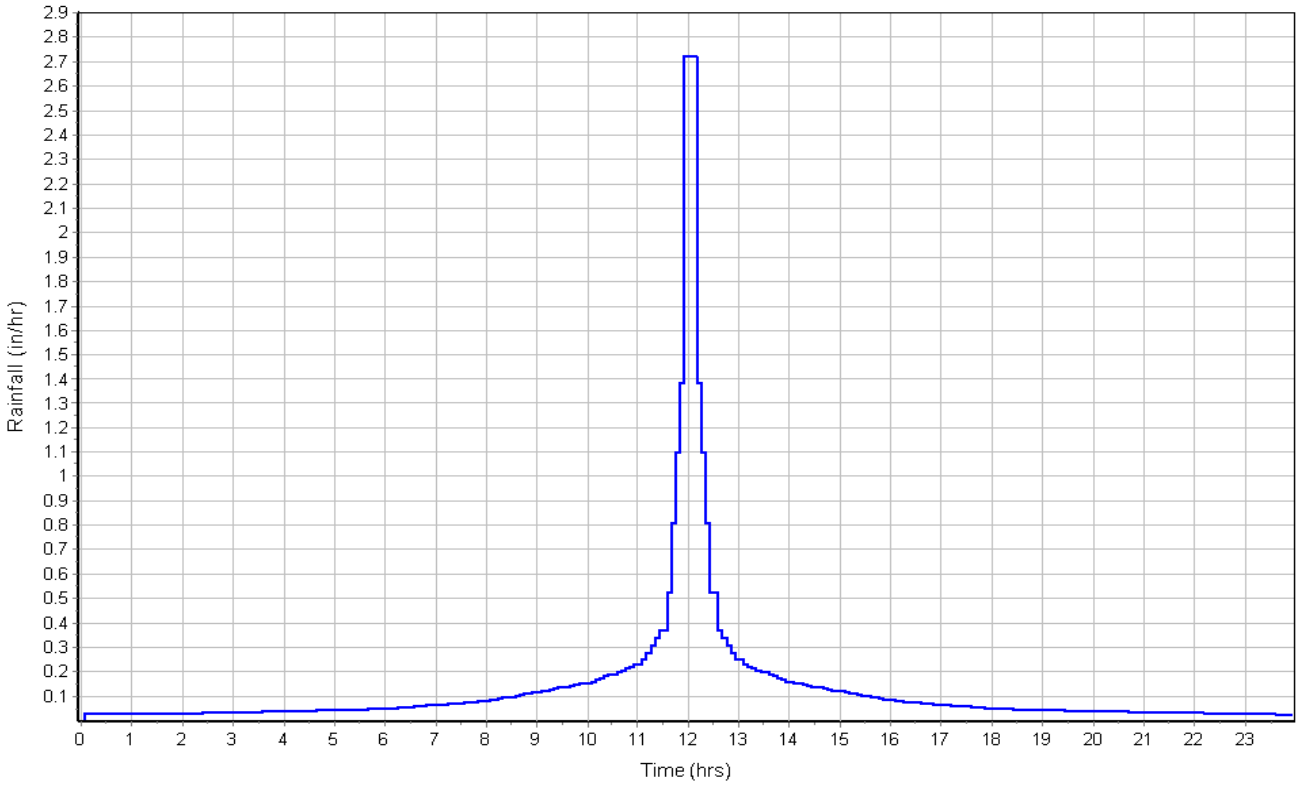
Total TOC (min) 9.37

Subbasin Runoff Results

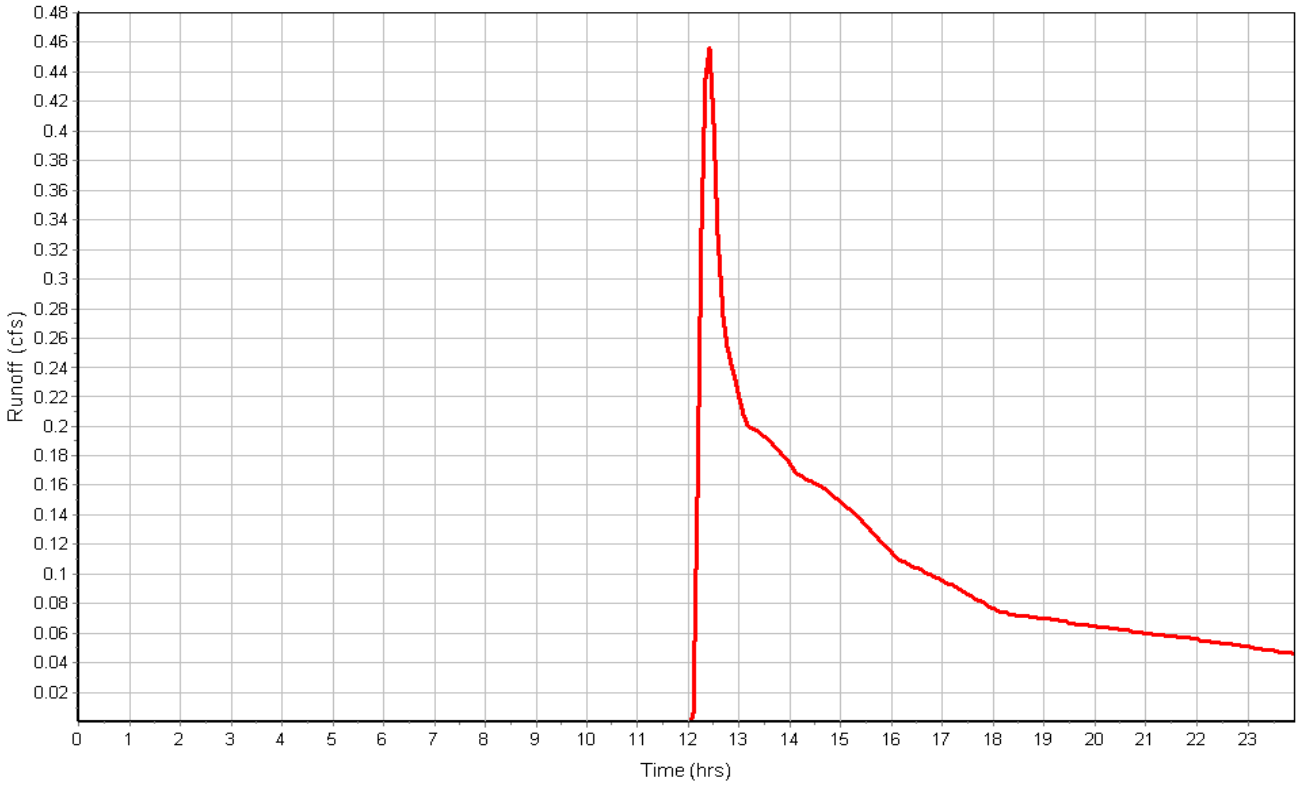
Total Rainfall (in) 3.24
Total Runoff (in) 0.22
Peak Runoff (cfs) 0.46
Weighted Curve Number 53.28
Time of Concentration (days hh:mm:ss) 0 00:09:22

Subbasin : Sub-basin B

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Wetland 3

Input Data

Invert Elevation (ft) 748.00
Max (Rim) Elevation (ft) 754.00
Max (Rim) Offset (ft) 6.00
Initial Water Elevation (ft) 748.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 20178.00
Evaporation Loss 0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B	Rectangular	No	754.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs) 0.46
Peak Lateral Inflow (cfs) 0.46
Peak Outflow (cfs) 0.00
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 748.23
Max HGL Depth Attained (ft) 0.23
Average HGL Elevation Attained (ft) 748.08
Average HGL Depth Attained (ft) 0.08
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Storage Node : Wetland 5

Input Data

Invert Elevation (ft) 784.00
Max (Rim) Elevation (ft) 790.00
Max (Rim) Offset (ft) 6.00
Initial Water Elevation (ft) 784.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 72180.00
Evaporation Loss 0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A	Rectangular	No	790.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs) 0.36
Peak Lateral Inflow (cfs) 0.36
Peak Outflow (cfs) 0.00
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 784.05
Max HGL Depth Attained (ft) 0.05
Average HGL Elevation Attained (ft) 784.02
Average HGL Depth Attained (ft) 0.02
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Project Description

File Name	Leicester Stormwater Model-Pre 7-10-17.SPF
Description	
	Leicester, MA Solar
	Stormwater Report

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	May 22, 2017	00:00:00
End Analysis On	May 23, 2017	00:00:00
Start Reporting On	May 22, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	2
Nodes	4
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	2
Links	2
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Leicester	Time Series	10-year	Cumulative	inches	Massachusetts	Worcester	10	4.86	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-basin A	5.36	52.85	4.86	0.79	4.23	3.01	0 00:10:34
2	Sub-basin B	6.05	53.28	4.86	0.81	4.92	3.70	0 00:09:22

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-A	Outfall	761.00					0.00	761.00					
2	Out-B	Outfall	741.00					0.00	741.00					
3	Wetland 3	Storage Node	748.00	754.00	748.00		20178.00	3.70	748.88				0.00	0.00
4	Wetland 5	Storage Node	784.00	790.00	784.00		72180.00	2.99	784.21				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Weir-A	Weir	Wetland 5	Out-A		784.00	761.00				0.00							
2	Weir-B	Weir	Wetland 3	Out-B		748.00	741.00				0.00							

Subbasin Hydrology

Subbasin : Sub-basin A

Input Data

Area (ac) 5.36
Weighted Curve Number 52.85
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.00	B	85.00
Woods, Good	3.71	B	55.00
Brush, Good	1.65	B	48.00
Meadow, non-grazed	0.00	B	58.00
Composite Area & Weighted CN	5.36		52.85

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.17	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	228	0.00
Slope (%) :	11	12	0.00
Surface Type :	Woodland	Forest	Unpaved
Velocity (ft/sec) :	1.66	0.87	0.00
Computed Flow Time (min) :	0.60	4.37	0.00

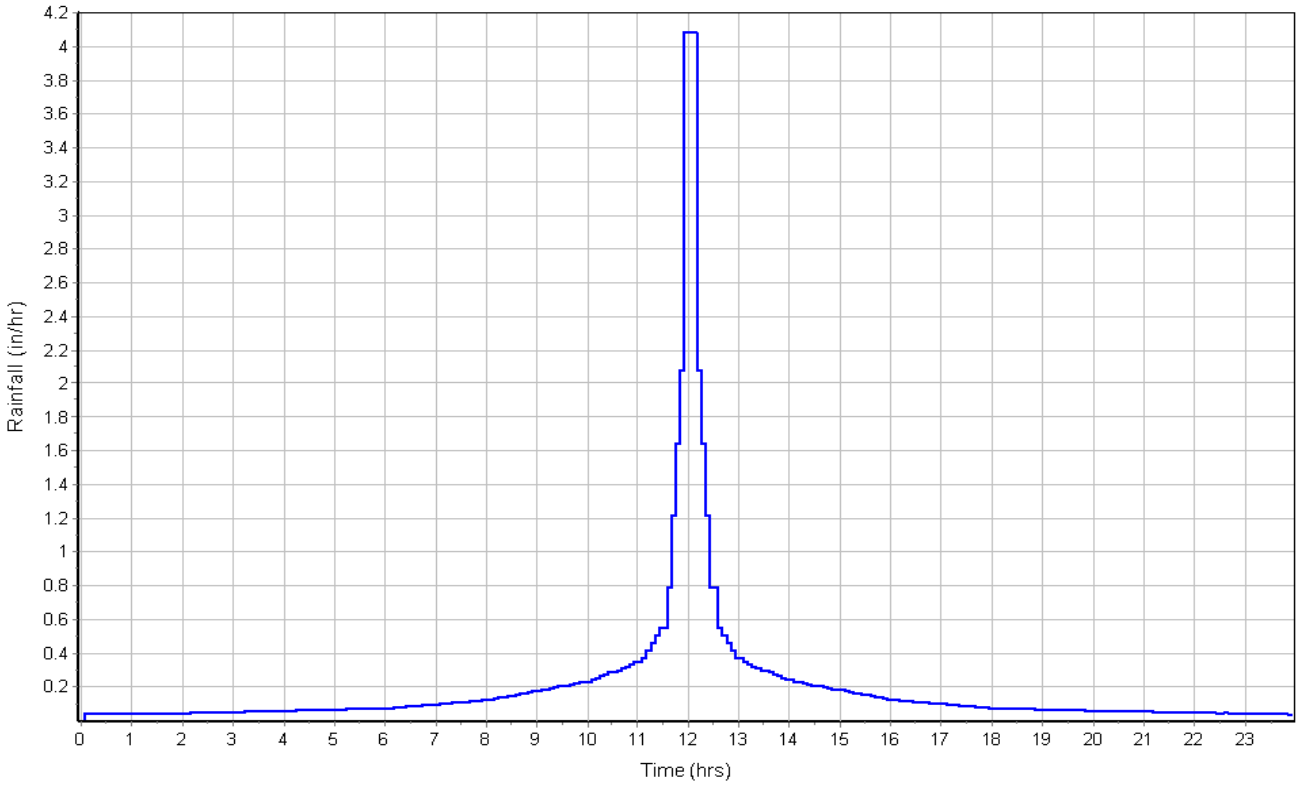
Total TOC (min) 10.57

Subbasin Runoff Results

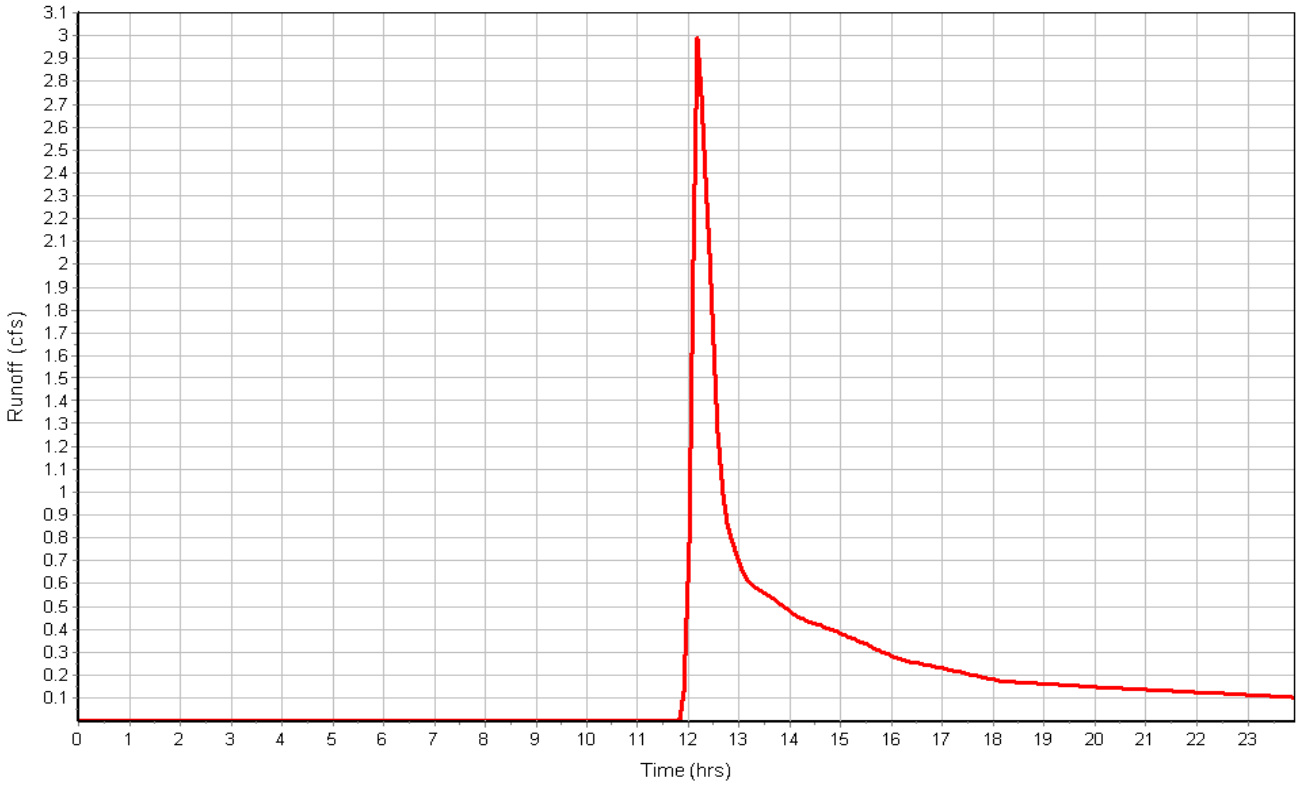
Total Rainfall (in)	4.86
Total Runoff (in)	0.79
Peak Runoff (cfs)	3.01
Weighted Curve Number	52.85
Time of Concentration (days hh:mm:ss)	0 00:10:34

Subbasin : Sub-basin A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-basin B

Input Data

Area (ac) 6.05
Weighted Curve Number 53.28
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.29	B	85.00
Woods, Good	3.03	B	55.00
Brush, Good	2.73	B	48.00
Meadow, non-grazed	0.00	B	58.00
Composite Area & Weighted CN	6.05		53.28

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.93	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	213	236	0.00
Slope (%) :	14.5	16	0.00
Surface Type :	Woodland	Forest	Unpaved
Velocity (ft/sec) :	1.90	1.00	0.00
Computed Flow Time (min) :	1.87	3.93	0.00

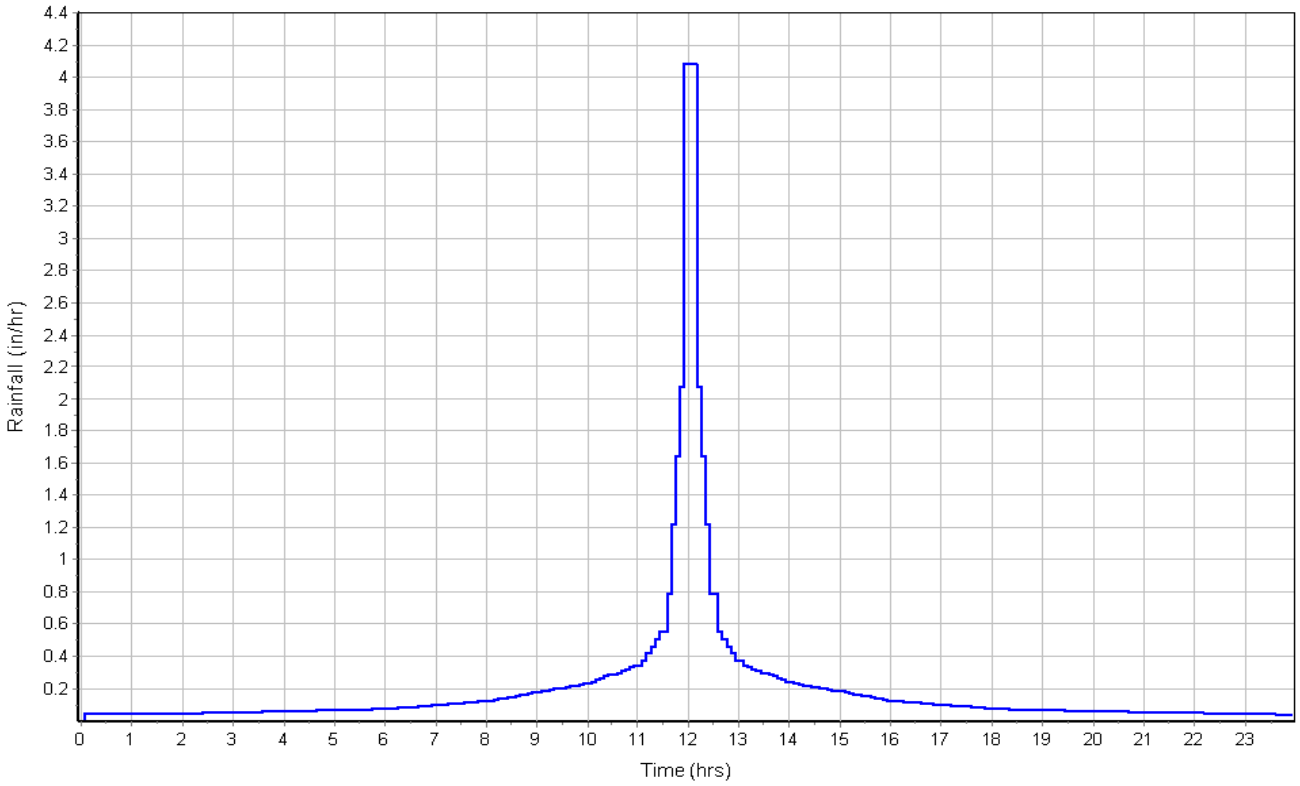
Total TOC (min) 9.37

Subbasin Runoff Results

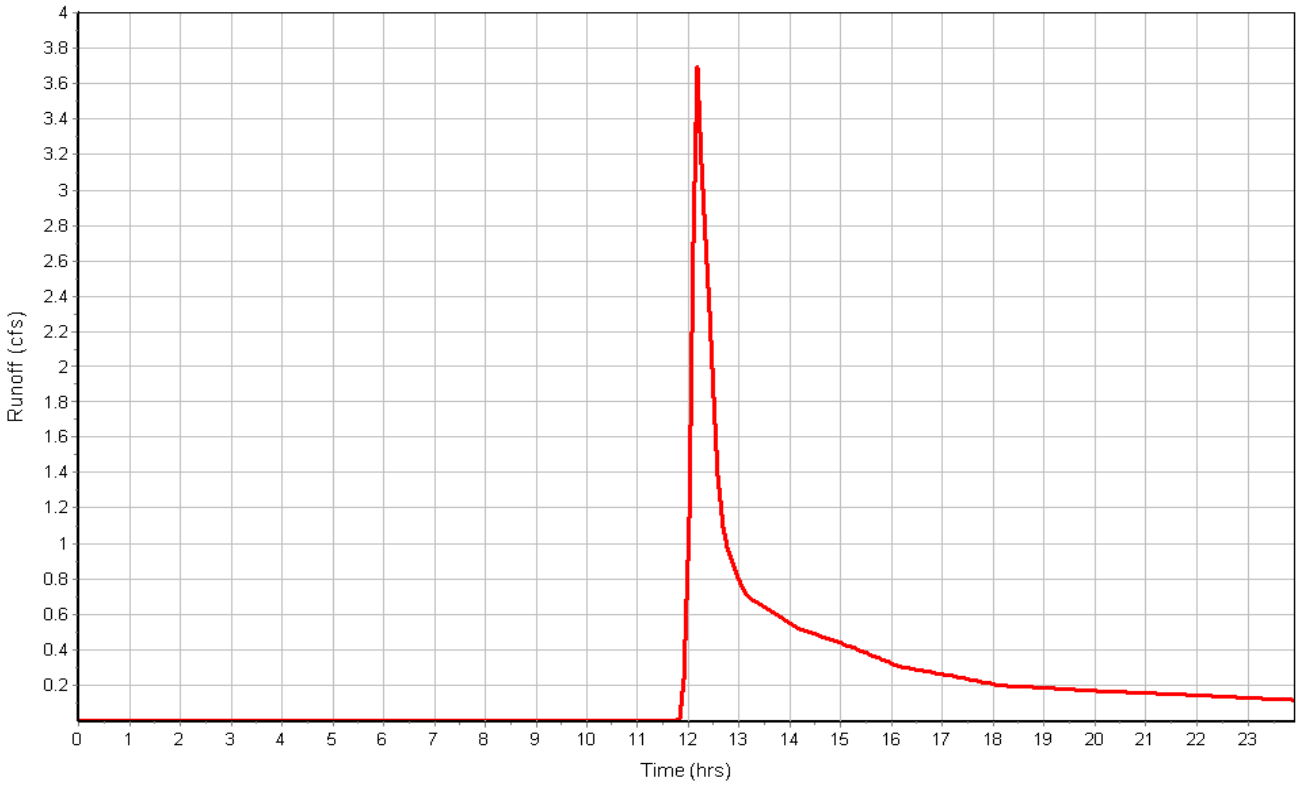
Total Rainfall (in) 4.86
Total Runoff (in) 0.81
Peak Runoff (cfs) 3.70
Weighted Curve Number 53.28
Time of Concentration (days hh:mm:ss) 0 00:09:22

Subbasin : Sub-basin B

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Wetland 3

Input Data

Invert Elevation (ft)	748.00
Max (Rim) Elevation (ft)	754.00
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	748.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	20178.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B	Rectangular	No	754.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	3.70
Peak Lateral Inflow (cfs)	3.70
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	748.88
Max HGL Depth Attained (ft)	0.88
Average HGL Elevation Attained (ft)	748.33
Average HGL Depth Attained (ft)	0.33
Time of Max HGL Occurrence (days hh:mm)	1 00:00
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Wetland 5

Input Data

Invert Elevation (ft)	784.00
Max (Rim) Elevation (ft)	790.00
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	784.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	72180.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A	Rectangular	No	790.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	2.99
Peak Lateral Inflow (cfs)	2.99
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	784.21
Max HGL Depth Attained (ft)	0.21
Average HGL Elevation Attained (ft)	784.08
Average HGL Depth Attained (ft)	0.08
Time of Max HGL Occurrence (days hh:mm)	1 00:00
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name ..... Leicester Stormwater Model-Pre 7-10-17.SPF
Description .....
Leicester, MA Solar

Stormwater Report

Project Options

Flow Units ..... CFS
Elevation Type ..... Elevation
Hydrology Method ..... SCS TR-55
Time of Concentration (TOC) Method ..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Enable Overflow Ponding at Nodes ..... YES
Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On ..... May 22, 2017 00:00:00
End Analysis On ..... May 23, 2017 00:00:00
Start Reporting On ..... May 22, 2017 00:00:00
Antecedent Dry Days ..... 0 days
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss
Reporting Time Step ..... 0 00:05:00 days hh:mm:ss
Routing Time Step ..... 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	2
Nodes	4
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	2
Links	2
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Leicester	Time Series	100-year	Cumulative	inches	Massachusetts	Worcester	100	8.76	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-basin A	5.36	52.85	8.76	3.06	16.41	15.15	0 00:10:34
2	Sub-basin B	6.05	53.28	8.76	3.11	18.83	17.90	0 00:09:22

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-A	Outfall	761.00					0.00	761.00					
2	Out-B	Outfall	741.00					0.00	741.00					
3	Wetland 3	Storage Node	748.00	754.00	748.00		20178.00	17.45	751.37				0.00	0.00
4	Wetland 5	Storage Node	784.00	790.00	784.00		72180.00	15.05	784.82				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Weir-A	Weir	Wetland 5	Out-A		784.00	761.00				0.00							
2	Weir-B	Weir	Wetland 3	Out-B		748.00	741.00				0.00							

Subbasin Hydrology

Subbasin : Sub-basin A

Input Data

Area (ac)	5.36
Weighted Curve Number	52.85
Rain Gage ID	Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.00	B	85.00
Woods, Good	3.71	B	55.00
Brush, Good	1.65	B	48.00
Meadow, non-grazed	0.00	B	58.00
Composite Area & Weighted CN	5.36		52.85

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.17	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	228	0.00
Slope (%) :	11	12	0.00
Surface Type :	Woodland	Forest	Unpaved
Velocity (ft/sec) :	1.66	0.87	0.00
Computed Flow Time (min) :	0.60	4.37	0.00

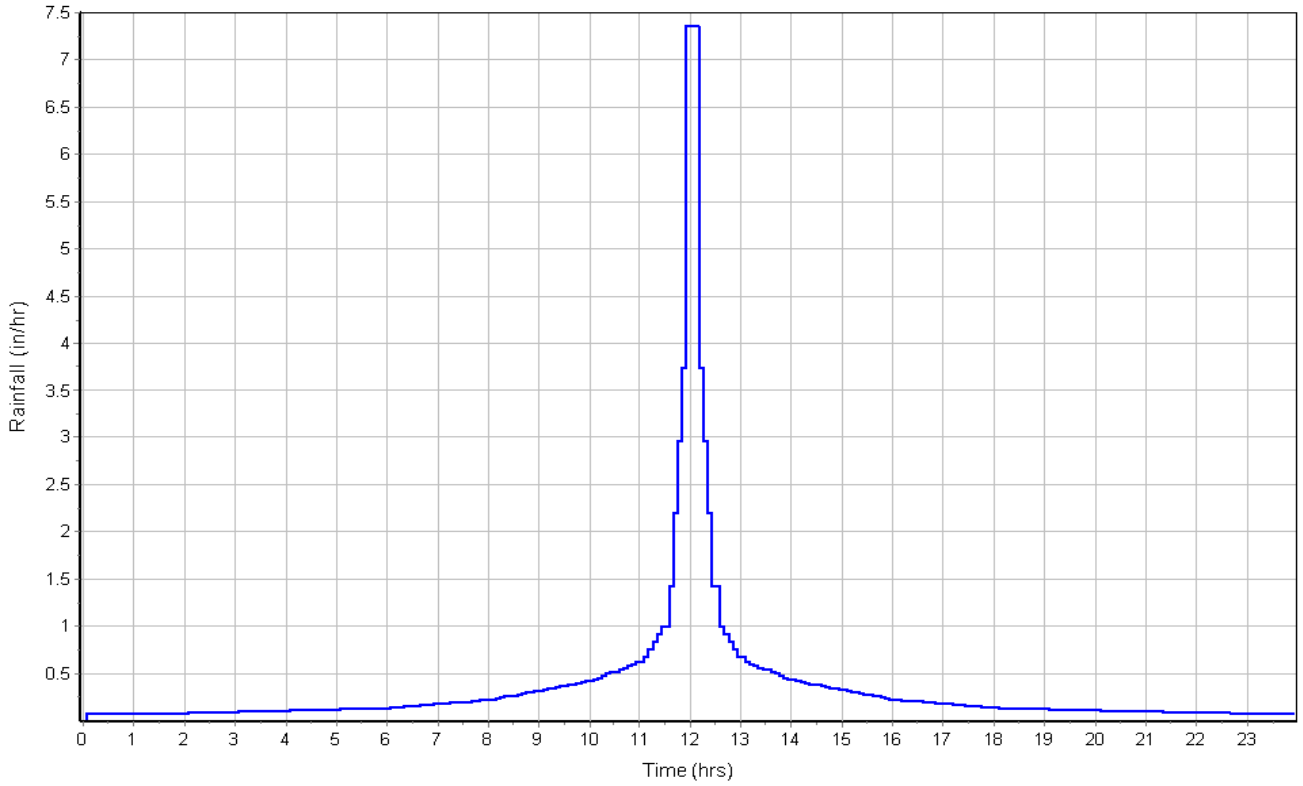
Total TOC (min) 10.57

Subbasin Runoff Results

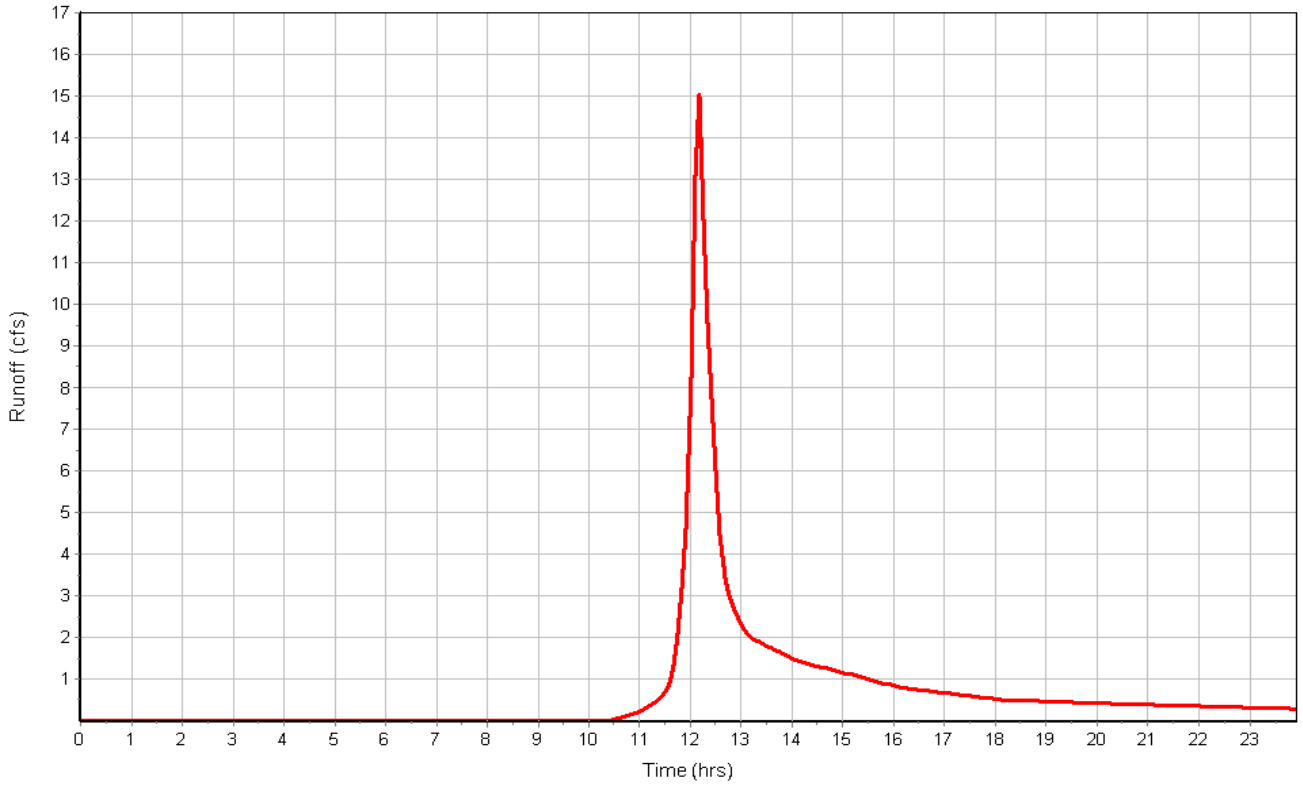
Total Rainfall (in)	8.76
Total Runoff (in)	3.06
Peak Runoff (cfs)	15.15
Weighted Curve Number	52.85
Time of Concentration (days hh:mm:ss)	0 00:10:34

Subbasin : Sub-basin A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-basin B

Input Data

Area (ac) 6.05
Weighted Curve Number 53.28
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.29	B	85.00
Woods, Good	3.03	B	55.00
Brush, Good	2.73	B	48.00
Meadow, non-grazed	0.00	B	58.00
Composite Area & Weighted CN	6.05		53.28

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.93	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	213	236	0.00
Slope (%) :	14.5	16	0.00
Surface Type :	Woodland	Forest	Unpaved
Velocity (ft/sec) :	1.90	1.00	0.00
Computed Flow Time (min) :	1.87	3.93	0.00

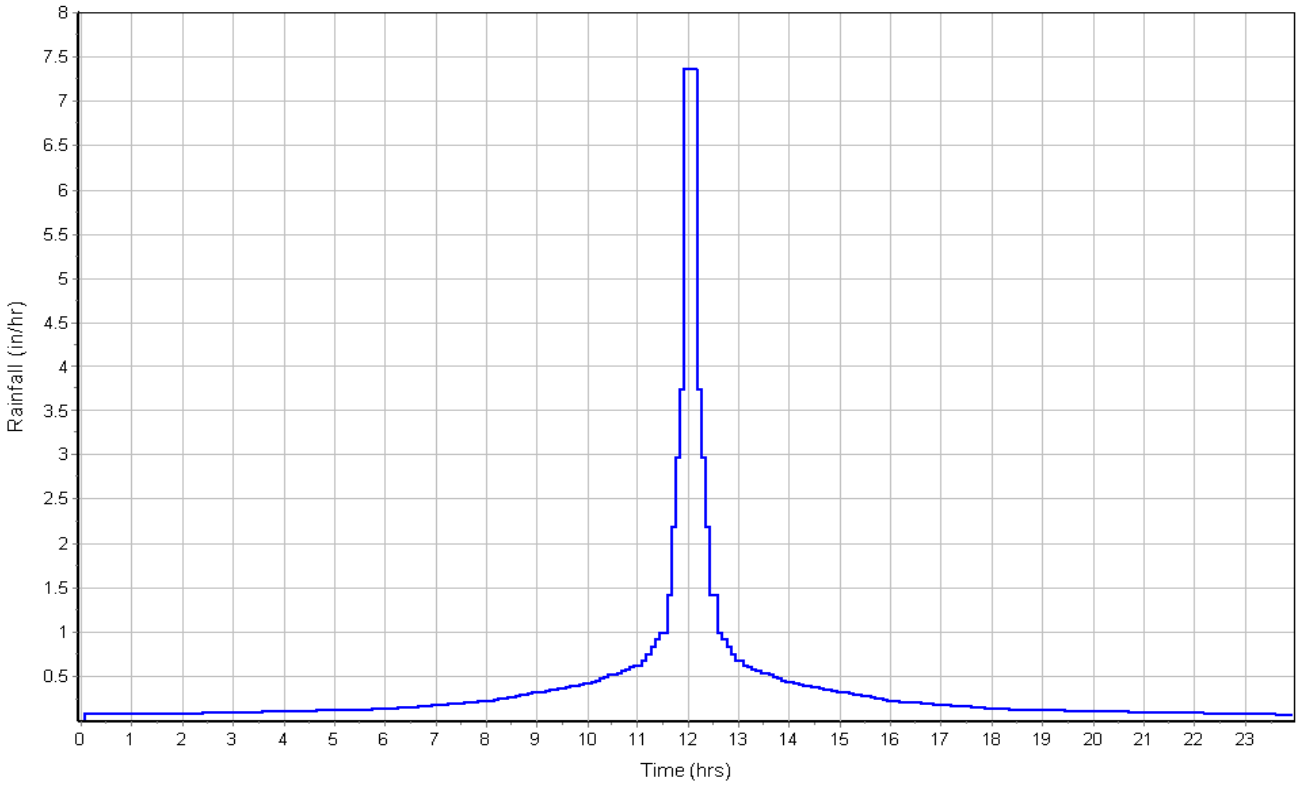
Total TOC (min) 9.37

Subbasin Runoff Results

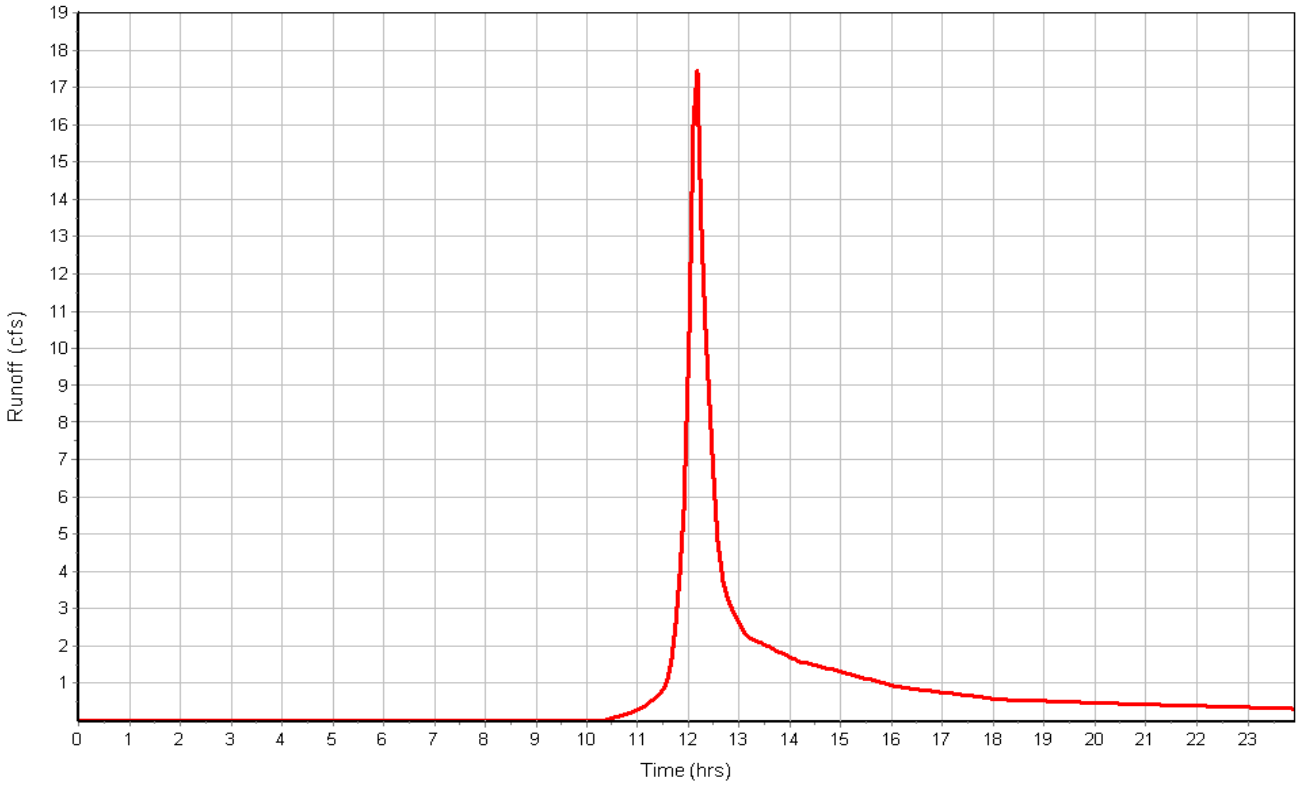
Total Rainfall (in) 8.76
Total Runoff (in) 3.11
Peak Runoff (cfs) 17.90
Weighted Curve Number 53.28
Time of Concentration (days hh:mm:ss) 0 00:09:22

Subbasin : Sub-basin B

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Wetland 3

Input Data

Invert Elevation (ft)	748.00
Max (Rim) Elevation (ft)	754.00
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	748.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	20178.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B	Rectangular	No	754.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	17.45
Peak Lateral Inflow (cfs)	17.45
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	751.37
Max HGL Depth Attained (ft)	3.37
Average HGL Elevation Attained (ft)	749.36
Average HGL Depth Attained (ft)	1.36
Time of Max HGL Occurrence (days hh:mm)	1 00:00
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Wetland 5

Input Data

Invert Elevation (ft)	784.00
Max (Rim) Elevation (ft)	790.00
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	784.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	72180.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A	Rectangular	No	790.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	15.05
Peak Lateral Inflow (cfs)	15.05
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	784.82
Max HGL Depth Attained (ft)	0.82
Average HGL Elevation Attained (ft)	784.33
Average HGL Depth Attained (ft)	0.33
Time of Max HGL Occurrence (days hh:mm)	1 00:00
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	Leicester Stormwater Model-Post 7-10-17.SPF
Description	
	Leicester, MA Solar
	Stormwater Report

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	May 22, 2017	00:00:00
End Analysis On	May 23, 2017	00:00:00
Start Reporting On	May 22, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	2
Nodes	6
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	4
Links	4
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	4
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Leicester	Time Series	2-year	Cumulative	inches	Massachusetts	Worcester	2	3.24	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-basin A	5.36	55.01	3.24	0.26	1.41	0.59	0 00:09:01
2	Sub-basin B	6.05	56.06	3.24	0.29	1.78	0.80	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-A	Outfall	761.00					0.00	761.00					
2	Out-B	Outfall	741.00					0.00	741.00					
3	InfilTrench-A	Storage Node	788.00	790.00	788.00		150.00	0.58	788.00				0.00	0.00
4	InfilTrench-B	Storage Node	768.00	770.00	768.00		150.00	0.80	768.00				0.00	0.00
5	Wetland 3	Storage Node	748.00	754.00	748.00		20178.00	0.00	748.00				0.00	0.00
6	Wetland 5	Storage Node	784.00	790.00	784.00		72180.00	0.00	784.00				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Weir-A1	Weir	InfilTrench-A	Wetland 5		788.00	784.00				0.00							
2	Weir-A2	Weir	Wetland 5	Out-A		784.00	761.00				0.00							
3	Weir-B1	Weir	InfilTrench-B	Wetland 3		768.00	748.00				0.00							
4	Weir-B2	Weir	Wetland 3	Out-B		748.00	741.00				0.00							

Subbasin Hydrology

Subbasin : Sub-basin A

Input Data

Area (ac) 5.36
Weighted Curve Number 55.01
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.01	B	85.00
Woods, Good	0.00	B	55.00
Brush, Good	1.65	B	48.00
Meadow, non-grazed	3.70	B	58.00
Ground Screws/Equipment Pads	0.00	B	98.00
Composite Area & Weighted CN	5.36		55.01

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.17	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	190	0.00
Slope (%) :	11	12.5	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.66	2.47	0.00
Computed Flow Time (min) :	0.60	1.28	0.00

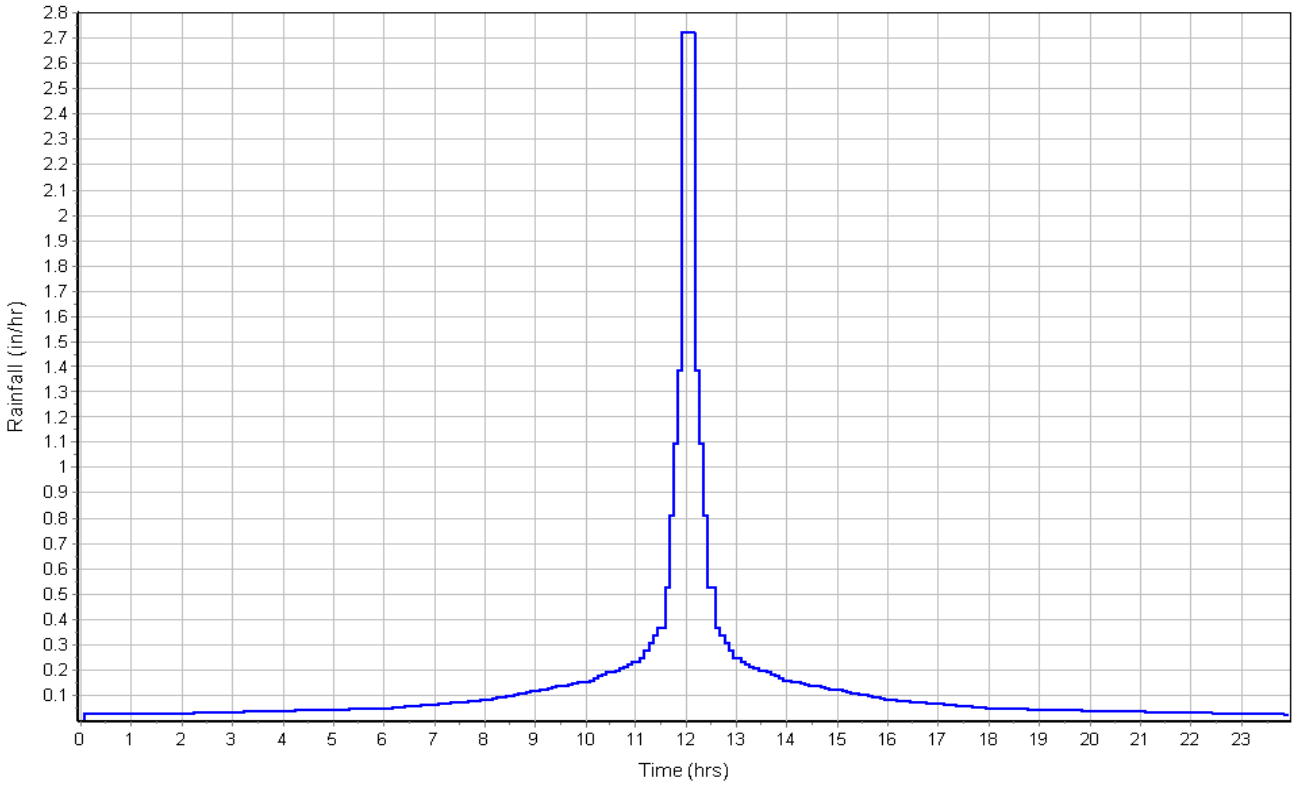
Total TOC (min) 9.03

Subbasin Runoff Results

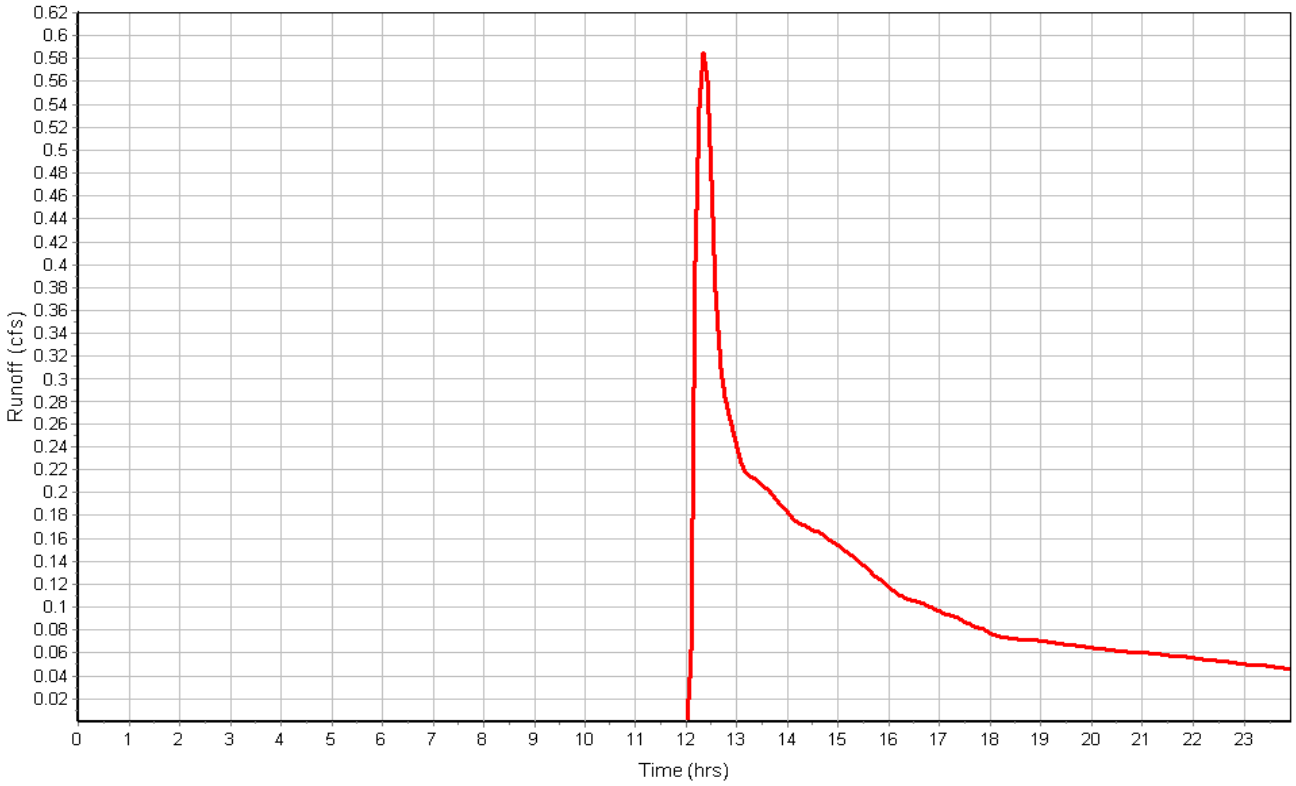
Total Rainfall (in)	3.24
Total Runoff (in)	0.26
Peak Runoff (cfs)	0.59
Weighted Curve Number	55.01
Time of Concentration (days hh:mm:ss)	0 00:09:02

Subbasin : Sub-basin A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-basin B

Input Data

Area (ac) 6.05
Weighted Curve Number 56.06
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.56	B	85.00
Woods, Good	0.00	B	55.00
Brush, Good	2.73	B	48.00
Meadow, non-grazed	2.75	B	58.00
Ground Screws/Equipment Pads	0.01	B	98.00
Composite Area & Weighted CN	6.05		56.06

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.93	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	213	236	0.00
Slope (%) :	14.5	16	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.90	2.80	0.00
Computed Flow Time (min) :	1.87	1.40	0.00

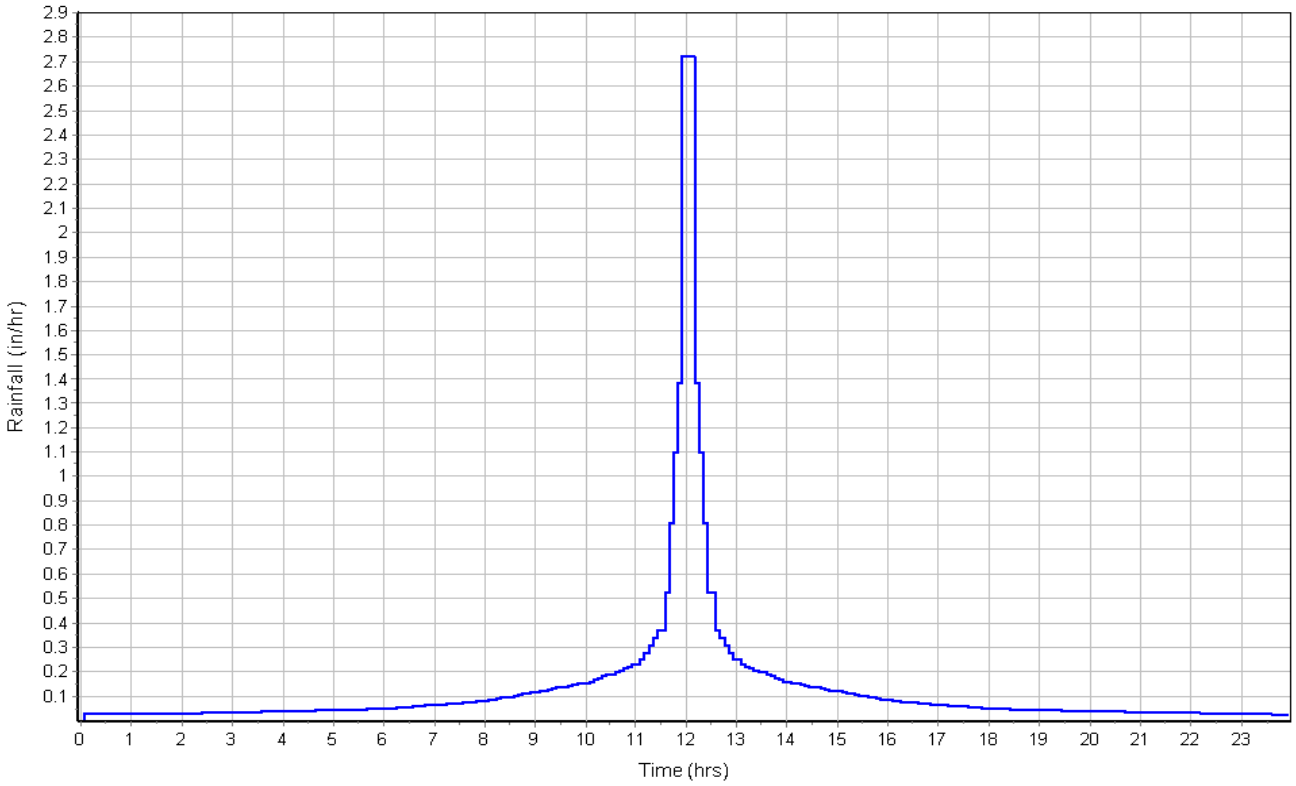
Total TOC (min) 8.10

Subbasin Runoff Results

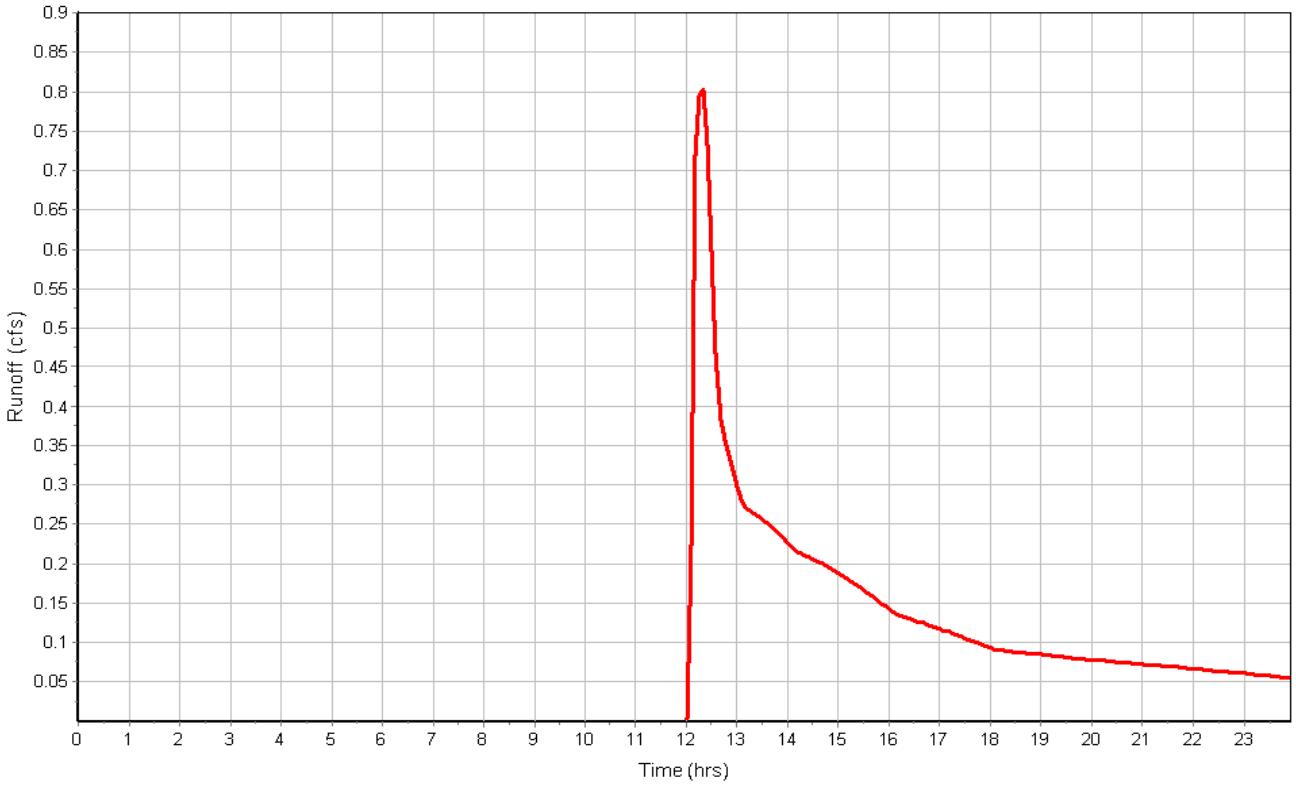
Total Rainfall (in) 3.24
Total Runoff (in) 0.29
Peak Runoff (cfs) 0.80
Weighted Curve Number 56.06
Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Sub-basin B

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : InfilTrench-A

Input Data

Invert Elevation (ft) 788.00
Max (Rim) Elevation (ft) 790.00
Max (Rim) Offset (ft) 2.00
Initial Water Elevation (ft) 788.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 150.00
Evaporation Loss 0.00

Infiltration/Exfiltration

Constant Flow Rate (cfs) 2.0000

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A1	Rectangular	No	790.00	2.00	20.00	0.10	3.33

Output Summary Results

Peak Inflow (cfs) 0.58
Peak Lateral Inflow (cfs) 0.58
Peak Outflow (cfs) 0.00
Peak Exfiltration Flow Rate (cfm) 120.00
Max HGL Elevation Attained (ft) 788.00
Max HGL Depth Attained (ft) 0
Average HGL Elevation Attained (ft) 788.00
Average HGL Depth Attained (ft) 0
Time of Max HGL Occurrence (days hh:mm) 0 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Storage Node : InfilTrench-B

Input Data

Invert Elevation (ft)	768.00
Max (Rim) Elevation (ft)	770.00
Max (Rim) Offset (ft)	2.00
Initial Water Elevation (ft)	768.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	150.00
Evaporation Loss	0.00

Infiltration/Exfiltration

Constant Flow Rate (cfs)	2.0000

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B1	Rectangular	No	770.00	2.00	20.00	0.10	3.33

Output Summary Results

Peak Inflow (cfs)	0.80
Peak Lateral Inflow (cfs)	0.80
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	120.00
Max HGL Elevation Attained (ft)	768.00
Max HGL Depth Attained (ft)	0
Average HGL Elevation Attained (ft)	768.00
Average HGL Depth Attained (ft)	0
Time of Max HGL Occurrence (days hh:mm)	0 00:00
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Wetland 3

Input Data

Invert Elevation (ft)	748.00
Max (Rim) Elevation (ft)	754.00
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	748.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	20178.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B2	Rectangular	No	754.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	0.00
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	748.00
Max HGL Depth Attained (ft)	0
Average HGL Elevation Attained (ft)	748.00
Average HGL Depth Attained (ft)	0
Time of Max HGL Occurrence (days hh:mm)	0 00:00
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Wetland 5

Input Data

Invert Elevation (ft) 784.00
Max (Rim) Elevation (ft) 790.00
Max (Rim) Offset (ft) 6.00
Initial Water Elevation (ft) 784.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 72180.00
Evaporation Loss 0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A2	Rectangular	No	790.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs) 0.00
Peak Lateral Inflow (cfs) 0.00
Peak Outflow (cfs) 0.00
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 784.00
Max HGL Depth Attained (ft) 0
Average HGL Elevation Attained (ft) 784.00
Average HGL Depth Attained (ft) 0
Time of Max HGL Occurrence (days hh:mm) 0 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Project Description

File Name	Leicester Stormwater Model-Post 7-10-17.SPF
Description	
	Leicester, MA Solar
	Stormwater Report

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	May 22, 2017	00:00:00
End Analysis On	May 23, 2017	00:00:00
Start Reporting On	May 22, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	2
Nodes	6
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	4
Links	4
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	4
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Leicester	Time Series	10-year	Cumulative	inches	Massachusetts	Worcester	10	4.86	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-basin A	5.36	55.01	4.86	0.91	4.89	3.95	0 00:09:01
2	Sub-basin B	6.05	56.06	4.86	0.97	5.89	5.04	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-A	Outfall	761.00					0.00	761.00					
2	Out-B	Outfall	741.00					0.00	741.00					
3	InfilTrench-A	Storage Node	788.00	790.00	788.00		150.00	3.93	790.14				0.03	23.00
4	InfilTrench-B	Storage Node	768.00	770.00	768.00		150.00	4.90	770.15				0.04	27.00
5	Wetland 3	Storage Node	748.00	754.00	748.00		20178.00	2.93	748.13				0.00	0.00
6	Wetland 5	Storage Node	784.00	790.00	784.00		72180.00	2.76	784.02				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Weir-A1	Weir	InfilTrench-A	Wetland 5		788.00	784.00				2.76							
2	Weir-A2	Weir	Wetland 5	Out-A		784.00	761.00				0.00							
3	Weir-B1	Weir	InfilTrench-B	Wetland 3		768.00	748.00				2.93							
4	Weir-B2	Weir	Wetland 3	Out-B		748.00	741.00				0.00							

Subbasin Hydrology

Subbasin : Sub-basin A

Input Data

Area (ac) 5.36
Weighted Curve Number 55.01
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.01	B	85.00
Woods, Good	0.00	B	55.00
Brush, Good	1.65	B	48.00
Meadow, non-grazed	3.70	B	58.00
Ground Screws/Equipment Pads	0.00	B	98.00
Composite Area & Weighted CN	5.36		55.01

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.17	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	190	0.00
Slope (%) :	11	12.5	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.66	2.47	0.00
Computed Flow Time (min) :	0.60	1.28	0.00

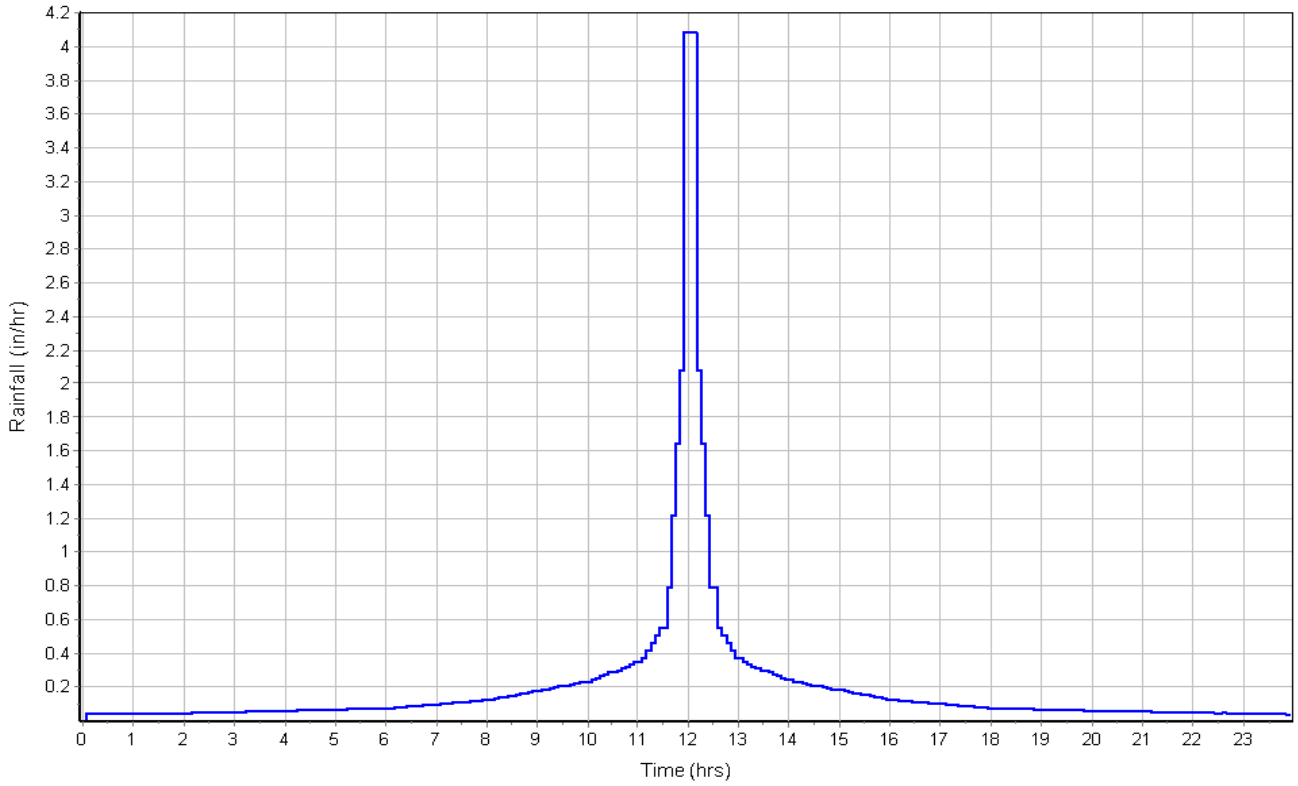
Total TOC (min) 9.03

Subbasin Runoff Results

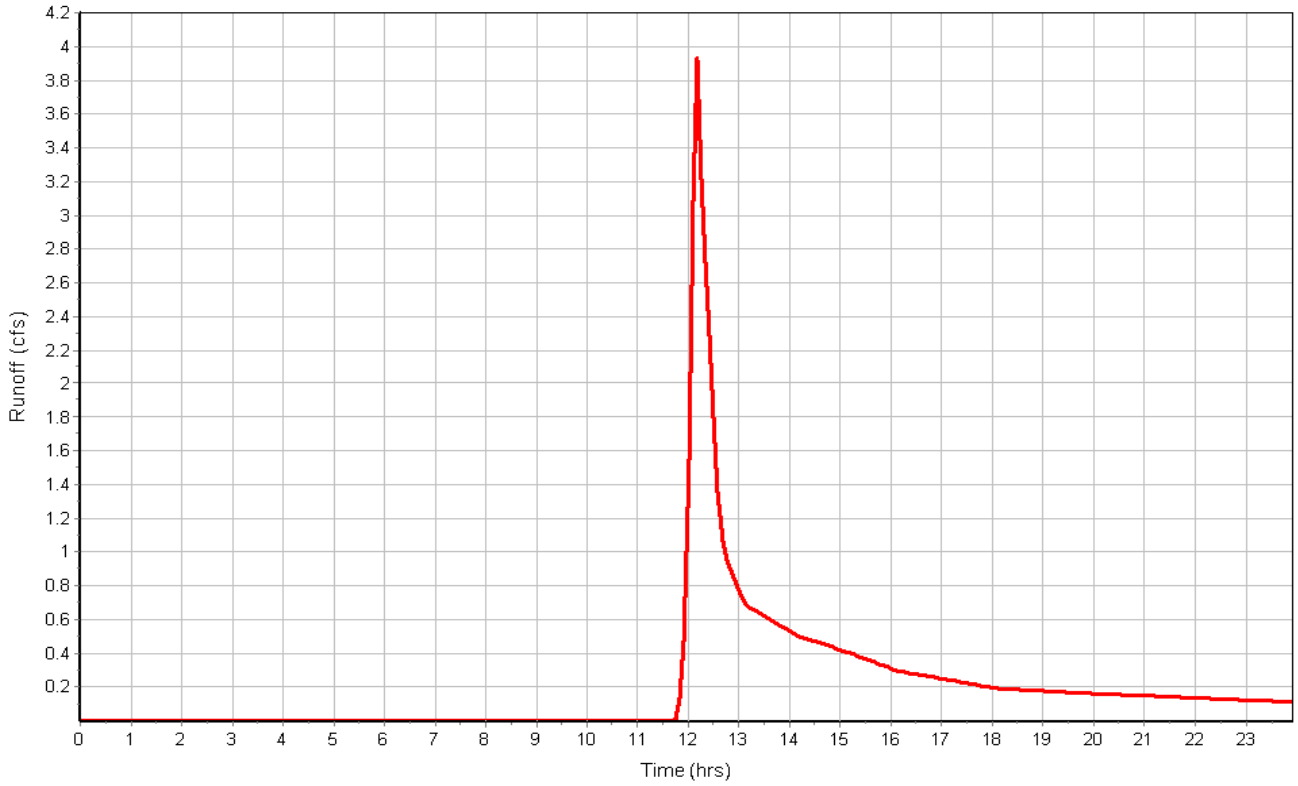
Total Rainfall (in)	4.86
Total Runoff (in)	0.91
Peak Runoff (cfs)	3.95
Weighted Curve Number	55.01
Time of Concentration (days hh:mm:ss)	0 00:09:02

Subbasin : Sub-basin A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-basin B

Input Data

Area (ac) 6.05
Weighted Curve Number 56.06
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.56	B	85.00
Woods, Good	0.00	B	55.00
Brush, Good	2.73	B	48.00
Meadow, non-grazed	2.75	B	58.00
Ground Screws/Equipment Pads	0.01	B	98.00
Composite Area & Weighted CN	6.05		56.06

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.93	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	213	236	0.00
Slope (%) :	14.5	16	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.90	2.80	0.00
Computed Flow Time (min) :	1.87	1.40	0.00

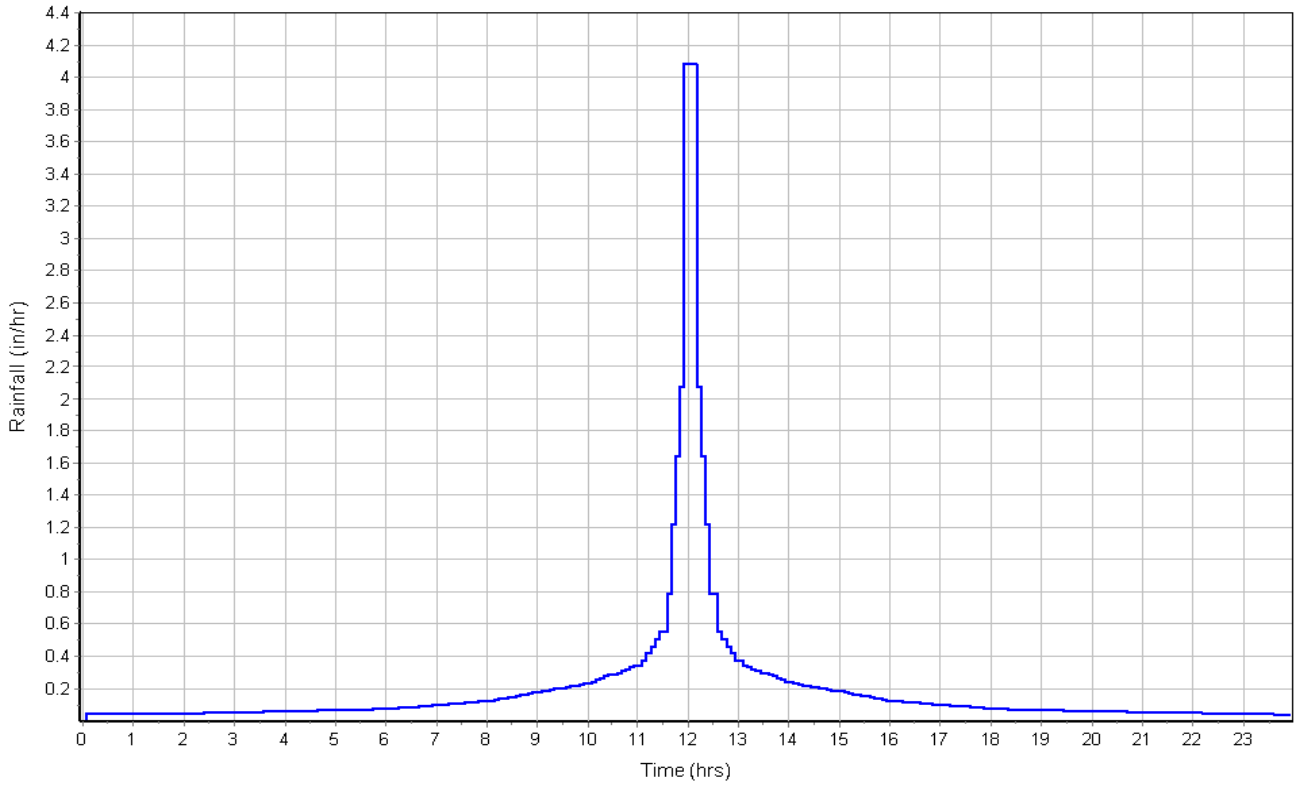
Total TOC (min) 8.10

Subbasin Runoff Results

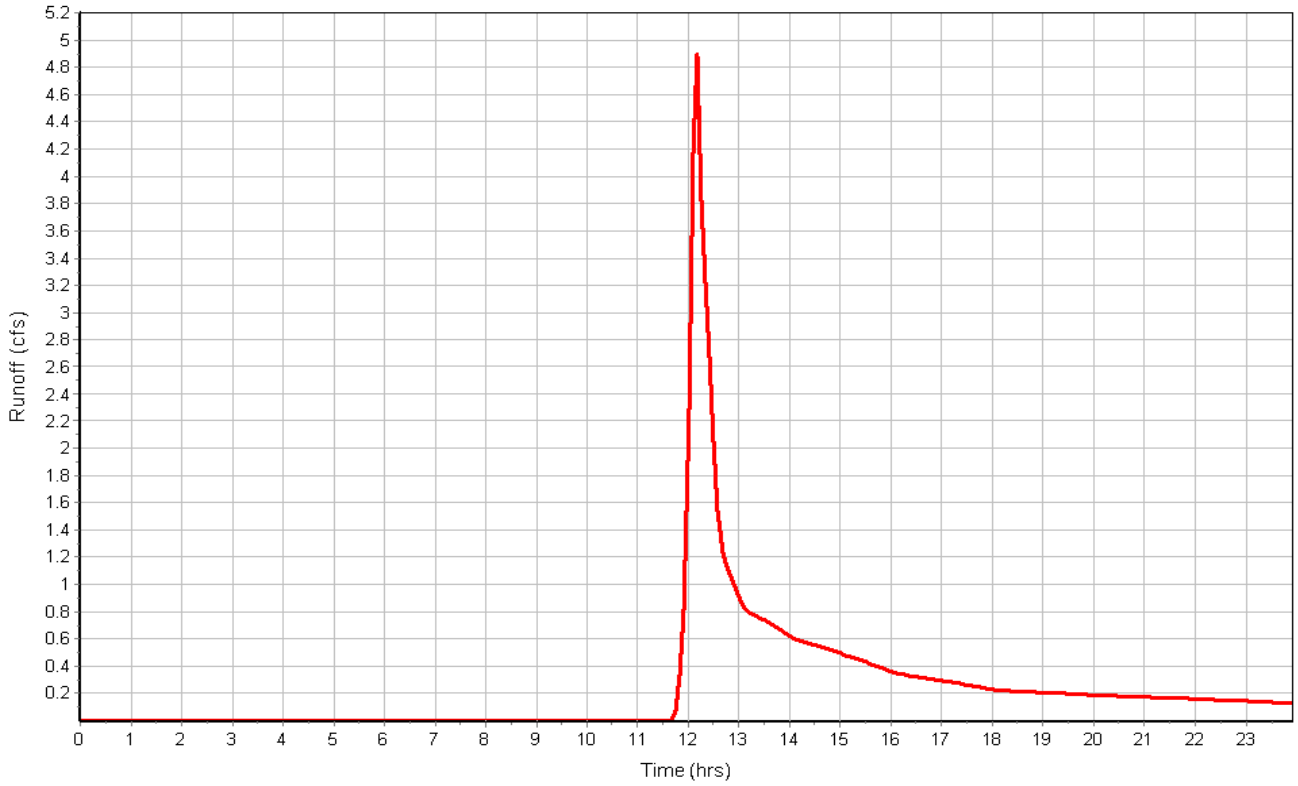
Total Rainfall (in) 4.86
Total Runoff (in) 0.97
Peak Runoff (cfs) 5.04
Weighted Curve Number 56.06
Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Sub-basin B

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : InfilTrench-A

Input Data

Invert Elevation (ft) 788.00
Max (Rim) Elevation (ft) 790.00
Max (Rim) Offset (ft) 2.00
Initial Water Elevation (ft) 788.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 150.00
Evaporation Loss 0.00

Infiltration/Exfiltration

Constant Flow Rate (cfs) 2.0000

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A1	Rectangular	No	790.00	2.00	20.00	0.10	3.33

Output Summary Results

Peak Inflow (cfs) 3.93
Peak Lateral Inflow (cfs) 3.93
Peak Outflow (cfs) 2.76
Peak Exfiltration Flow Rate (cfm) 120.00
Max HGL Elevation Attained (ft) 790.14
Max HGL Depth Attained (ft) 2.14
Average HGL Elevation Attained (ft) 788.04
Average HGL Depth Attained (ft) 0.04
Time of Max HGL Occurrence (days hh:mm) 0 12:19
Total Exfiltration Volume (1000-ft³) 3.600
Total Flooded Volume (ac-in) 0.03
Total Time Flooded (min) 23
Total Retention Time (sec) 0.00

Storage Node : InfilTrench-B

Input Data

Invert Elevation (ft)	768.00
Max (Rim) Elevation (ft)	770.00
Max (Rim) Offset (ft)	2.00
Initial Water Elevation (ft)	768.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	150.00
Evaporation Loss	0.00

Infiltration/Exfiltration

Constant Flow Rate (cfs)	2.0000

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B1	Rectangular	No	770.00	2.00	20.00	0.10	3.33

Output Summary Results

Peak Inflow (cfs)	4.90
Peak Lateral Inflow (cfs)	4.90
Peak Outflow (cfs)	2.93
Peak Exfiltration Flow Rate (cfm)	120.00
Max HGL Elevation Attained (ft)	770.15
Max HGL Depth Attained (ft)	2.15
Average HGL Elevation Attained (ft)	768.05
Average HGL Depth Attained (ft)	0.05
Time of Max HGL Occurrence (days hh:mm)	0 12:08
Total Exfiltration Volume (1000-ft³)	4.800
Total Flooded Volume (ac-in)	0.04
Total Time Flooded (min)	27
Total Retention Time (sec)	0.00

Storage Node : Wetland 3

Input Data

Invert Elevation (ft)	748.00
Max (Rim) Elevation (ft)	754.00
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	748.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	20178.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B2	Rectangular	No	754.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	2.93
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	748.13
Max HGL Depth Attained (ft)	0.13
Average HGL Elevation Attained (ft)	748.06
Average HGL Depth Attained (ft)	0.06
Time of Max HGL Occurrence (days hh:mm)	0 12:54
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Wetland 5

Input Data

Invert Elevation (ft)	784.00
Max (Rim) Elevation (ft)	790.00
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	784.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	72180.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A2	Rectangular	No	790.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	2.76
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	784.02
Max HGL Depth Attained (ft)	0.02
Average HGL Elevation Attained (ft)	784.01
Average HGL Depth Attained (ft)	0.01
Time of Max HGL Occurrence (days hh:mm)	0 12:52
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	Leicester Stormwater Model-Post 7-10-17.SPF
Description	
	Leicester, MA Solar
	Stormwater Report

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	May 22, 2017	00:00:00
End Analysis On	May 23, 2017	00:00:00
Start Reporting On	May 22, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	2
Nodes	6
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	4
Links	4
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	4
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Leicester	Time Series	100-year	Cumulative	inches	Massachusetts	Worcester	100	8.76	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-basin A	5.36	55.01	8.76	3.32	17.78	17.18	0 00:09:01
2	Sub-basin B	6.05	56.06	8.76	3.44	20.82	20.58	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-A	Outfall	761.00					0.00	761.00					
2	Out-B	Outfall	741.00					0.00	741.00					
3	InfilTrench-A	Storage Node	788.00	790.00	788.00		150.00	16.59	792.39				0.04	93.00
4	InfilTrench-B	Storage Node	768.00	770.00	768.00		150.00	19.42	773.44				0.06	120.00
5	Wetland 3	Storage Node	748.00	754.00	748.00		20178.00	17.33	749.47				0.00	0.00
6	Wetland 5	Storage Node	784.00	790.00	784.00		72180.00	14.40	784.32				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Weir-A1	Weir	InfilTrench-A	Wetland 5		788.00	784.00				14.40							
2	Weir-A2	Weir	Wetland 5	Out-A		784.00	761.00				0.00							
3	Weir-B1	Weir	InfilTrench-B	Wetland 3		768.00	748.00				17.33							
4	Weir-B2	Weir	Wetland 3	Out-B		748.00	741.00				0.00							

Subbasin Hydrology

Subbasin : Sub-basin A

Input Data

Area (ac) 5.36
Weighted Curve Number 55.01
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.01	B	85.00
Woods, Good	0.00	B	55.00
Brush, Good	1.65	B	48.00
Meadow, non-grazed	3.70	B	58.00
Ground Screws/Equipment Pads	0.00	B	98.00
Composite Area & Weighted CN	5.36		55.01

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.17	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	190	0.00
Slope (%) :	11	12.5	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.66	2.47	0.00
Computed Flow Time (min) :	0.60	1.28	0.00

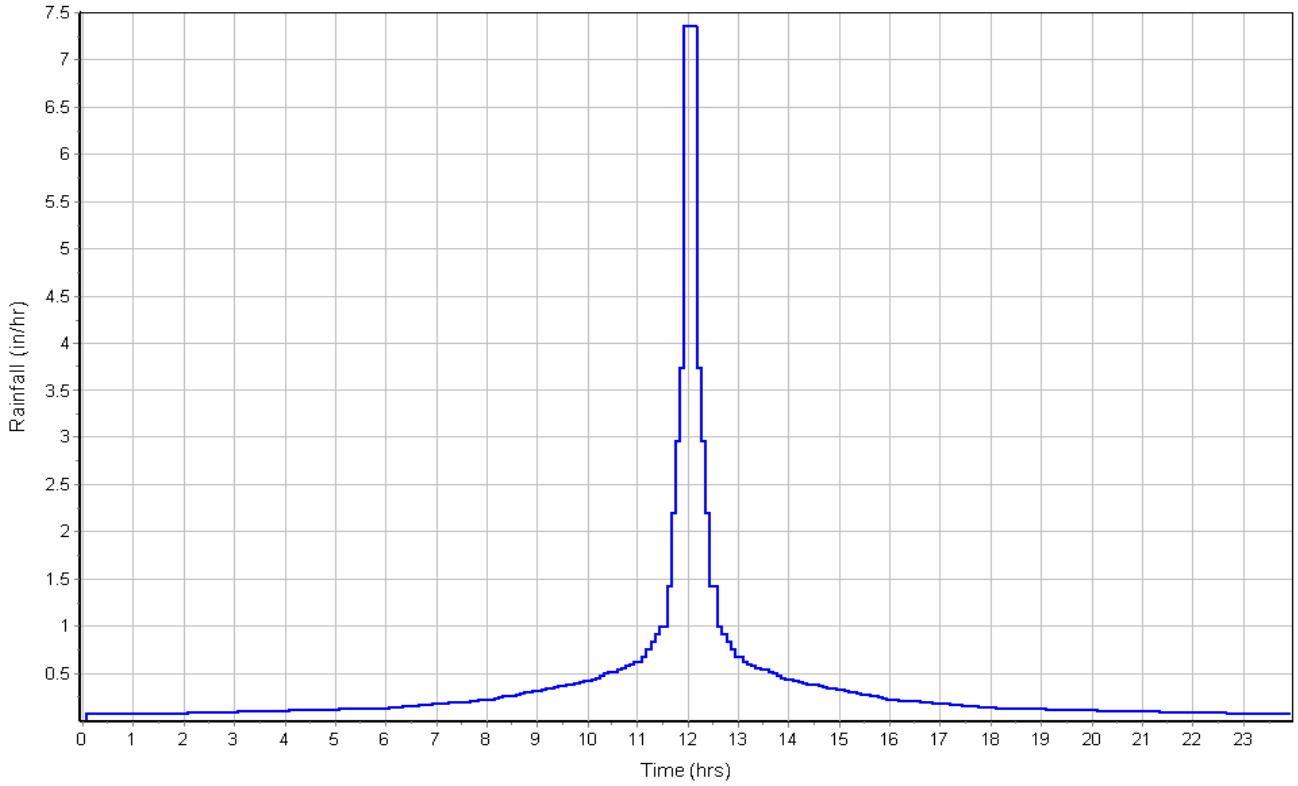
Total TOC (min) 9.03

Subbasin Runoff Results

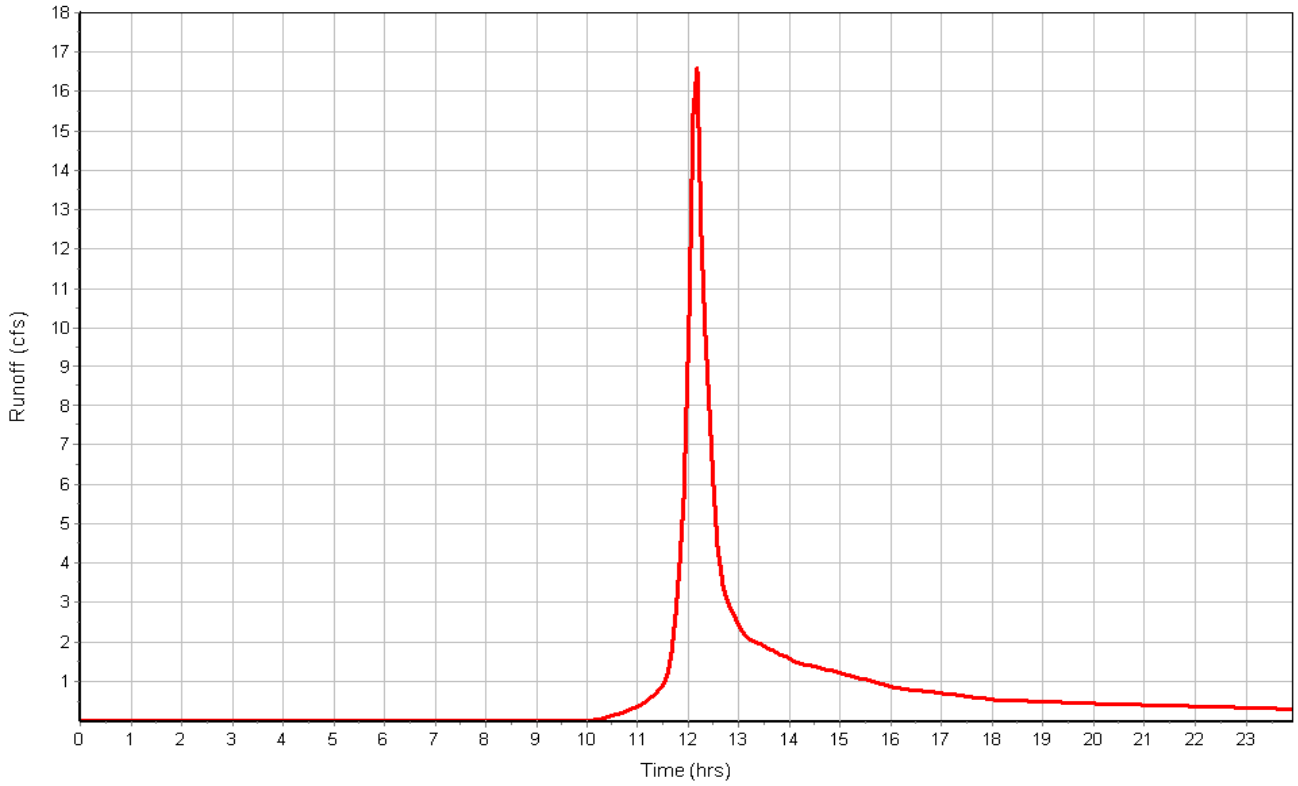
Total Rainfall (in)	8.76
Total Runoff (in)	3.32
Peak Runoff (cfs)	17.18
Weighted Curve Number	55.01
Time of Concentration (days hh:mm:ss)	0 00:09:02

Subbasin : Sub-basin A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-basin B

Input Data

Area (ac) 6.05
Weighted Curve Number 56.06
Rain Gage ID ..... Leicester

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.56	B	85.00
Woods, Good	0.00	B	55.00
Brush, Good	2.73	B	48.00
Meadow, non-grazed	2.75	B	58.00
Ground Screws/Equipment Pads	0.01	B	98.00
Composite Area & Weighted CN	6.05		56.06

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.24	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.93	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	213	236	0.00
Slope (%) :	14.5	16	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.90	2.80	0.00
Computed Flow Time (min) :	1.87	1.40	0.00

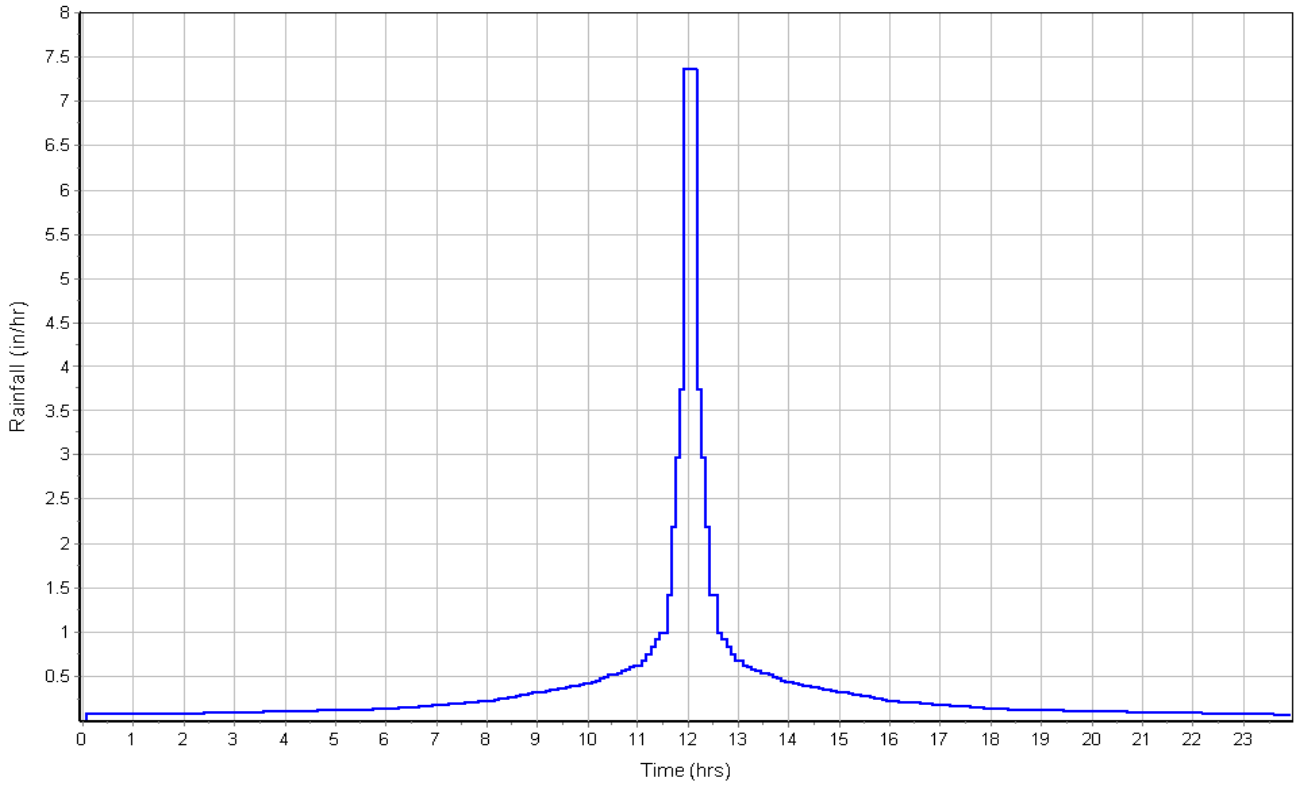
Total TOC (min) 8.10

Subbasin Runoff Results

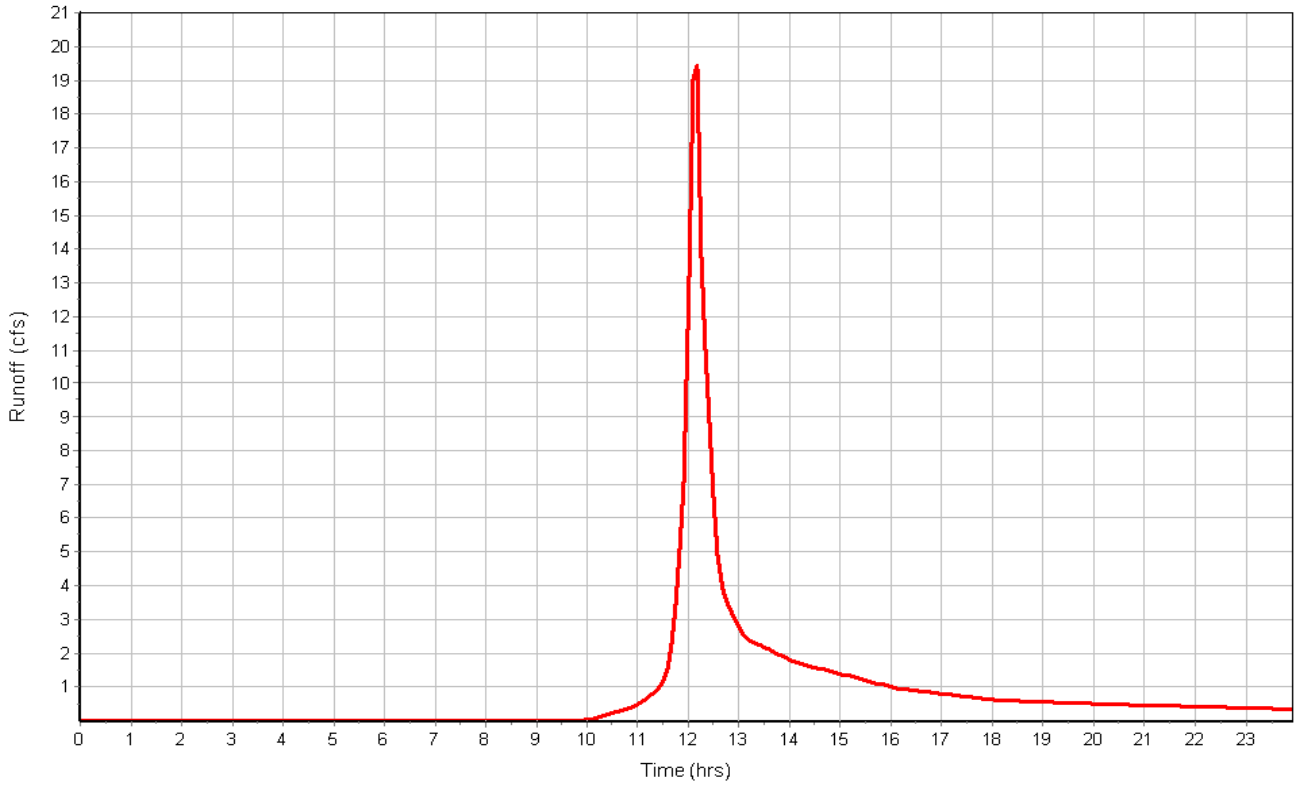
Total Rainfall (in) 8.76
Total Runoff (in) 3.44
Peak Runoff (cfs) 20.58
Weighted Curve Number 56.06
Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Sub-basin B

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : InfilTrench-A

Input Data

Invert Elevation (ft)	788.00
Max (Rim) Elevation (ft)	790.00
Max (Rim) Offset (ft)	2.00
Initial Water Elevation (ft)	788.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	150.00
Evaporation Loss	0.00

Infiltration/Exfiltration

Constant Flow Rate (cfs)	2.0000

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A1	Rectangular	No	790.00	2.00	20.00	0.10	3.33

Output Summary Results

Peak Inflow (cfs)	16.59
Peak Lateral Inflow (cfs)	16.59
Peak Outflow (cfs)	14.40
Peak Exfiltration Flow Rate (cfm)	120.00
Max HGL Elevation Attained (ft)	792.39
Max HGL Depth Attained (ft)	4.39
Average HGL Elevation Attained (ft)	788.18
Average HGL Depth Attained (ft)	0.18
Time of Max HGL Occurrence (days hh:mm)	0 12:15
Total Exfiltration Volume (1000-ft³)	13.800
Total Flooded Volume (ac-in)	0.04
Total Time Flooded (min)	93
Total Retention Time (sec)	0.00

Storage Node : InfilTrench-B

Input Data

Invert Elevation (ft)	768.00
Max (Rim) Elevation (ft)	770.00
Max (Rim) Offset (ft)	2.00
Initial Water Elevation (ft)	768.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	150.00
Evaporation Loss	0.00

Infiltration/Exfiltration

Constant Flow Rate (cfs)	2.0000

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B1	Rectangular	No	770.00	2.00	20.00	0.10	3.33

Output Summary Results

Peak Inflow (cfs)	19.42
Peak Lateral Inflow (cfs)	19.42
Peak Outflow (cfs)	17.33
Peak Exfiltration Flow Rate (cfm)	120.00
Max HGL Elevation Attained (ft)	773.44
Max HGL Depth Attained (ft)	5.44
Average HGL Elevation Attained (ft)	768.23
Average HGL Depth Attained (ft)	0.23
Time of Max HGL Occurrence (days hh:mm)	0 12:15
Total Exfiltration Volume (1000-ft³)	16.800
Total Flooded Volume (ac-in)	0.06
Total Time Flooded (min)	120
Total Retention Time (sec)	0.00

Storage Node : Wetland 3

Input Data

Invert Elevation (ft)	748.00
Max (Rim) Elevation (ft)	754.00
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	748.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	20178.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-B2	Rectangular	No	754.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	17.33
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	0.00
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	749.47
Max HGL Depth Attained (ft)	1.47
Average HGL Elevation Attained (ft)	748.72
Average HGL Depth Attained (ft)	0.72
Time of Max HGL Occurrence (days hh:mm)	0 14:05
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Storage Node : Wetland 5

Input Data

Invert Elevation (ft) 784.00
Max (Rim) Elevation (ft) 790.00
Max (Rim) Offset (ft) 6.00
Initial Water Elevation (ft) 784.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 72180.00
Evaporation Loss 0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-A2	Rectangular	No	790.00	6.00	100.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs) 14.40
Peak Lateral Inflow (cfs) 0.00
Peak Outflow (cfs) 0.00
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 784.32
Max HGL Depth Attained (ft) 0.32
Average HGL Elevation Attained (ft) 784.16
Average HGL Depth Attained (ft) 0.16
Time of Max HGL Occurrence (days hh:mm) 0 13:40
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Worcester County, Massachusetts, Northeastern Part; and Worcester County, Massachusetts, Southern Part

Stafford St, Leicester, MA

May 22, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:9,680 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 450 900 1800 2700

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 11, Sep 14, 2016

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 9, Sep 15, 2016

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil

MAP LEGEND

MAP INFORMATION

properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Worcester County, Massachusetts, Northeastern Part (MA613)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	4.0	0.9%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	0.2	0.0%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	0.1	0.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	0.9	0.2%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	2.2	0.5%
422D	Canton fine sandy loam, 15 to 35 percent slopes, extremely stony	4.2	0.9%
Subtotals for Soil Survey Area		**11.5**	**2.6%**
Totals for Area of Interest		**445.5**	**100.0%**

Worcester County, Massachusetts, Southern Part (MA615)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1	Water	0.5	0.1%
51A	Swansea muck, 0 to 1 percent slopes	1.0	0.2%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	5.6	1.3%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	15.0	3.4%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	22.9	5.1%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	9.7	2.2%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	34.9	7.8%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	22.7	5.1%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	3.3	0.7%

Worcester County, Massachusetts, Southern Part (MA615)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
307E	Paxton fine sandy loam, 15 to 35 percent slopes, extremely stony	24.6	5.5%
420B	Canton fine sandy loam, 3 to 8 percent slopes	100.3	22.5%
420C	Canton fine sandy loam, 8 to 15 percent slopes	20.6	4.6%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	131.7	29.6%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	39.6	8.9%
422E	Canton fine sandy loam, 15 to 35 percent slopes, extremely stony	1.5	0.3%
Subtotals for Soil Survey Area		**434.0**	**97.4%**
Totals for Area of Interest		**445.5**	**100.0%**

Map Unit Descriptions

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

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

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

mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

Worcester County, Massachusetts, Northeastern Part

71A—Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69b
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ridgebury, Extremely Stony

Setting

Landform: Depressions, ground moraines, drumlins, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony
Percent of map unit: 7 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Crest, base slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony
Percent of map unit: 7 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony
Percent of map unit: 1 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

102C—Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2w69g
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Chatfield, extremely stony, and similar soils: 39 percent
Hollis, extremely stony, and similar soils: 26 percent
Rock outcrop: 17 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope

Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Nose slope, crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 12 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Sutton, extremely stony

Percent of map unit: 3 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Leicester, extremely stony

Percent of map unit: 1 percent
Landform: Depressions, ground moraines, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

254A—Merrimac fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tyqr
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Merrimac

Setting

Landform: Outwash plains, kames, eskers, outwash terraces, moraines
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Sudbury
Percent of map unit: 5 percent
Landform: Deltas, outwash plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley
Percent of map unit: 5 percent
Landform: Deltas, outwash plains, kames, eskers
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Agawam
Percent of map unit: 3 percent
Landform: Kames, eskers, outwash terraces, moraines, outwash plains, stream terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor
Percent of map unit: 2 percent
Landform: Deltas, dunes, outwash plains, outwash terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

420B—Canton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w81b
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Canton

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 10 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk

Percent of map unit: 5 percent
Landform: Ground moraines, drumlins, hills, moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton

Percent of map unit: 4 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent
Landform: Depressions, bogs, marshes, kettles, swamps
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

422C—Canton fine sandy loam, 8 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w815
Elevation: 0 to 1,310 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Canton, Extremely Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Scituate, extremely stony

Percent of map unit: 6 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 5 percent
Landform: Ground moraines, drumlins, recessionial moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope

Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 5 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Hollis, extremely stony

Percent of map unit: 4 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

422D—Canton fine sandy loam, 15 to 35 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w81j
Elevation: 0 to 1,340 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Canton, Extremely Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam

Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Montauk, extremely stony

Percent of map unit: 6 percent
Landform: Ground moraines, drumlins, recessionial moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 6 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Hollis, extremely stony

Percent of map unit: 4 percent
Landform: Ridges, hills
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 4 percent

Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Worcester County, Massachusetts, Southern Part

1—Water

Map Unit Setting

National map unit symbol: 9bgp
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Landform: Lakes

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Swansea

Setting

Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

71A—Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69b

Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ridgebury, Extremely Stony

Setting

Landform: Depressions, drumlins, ground moraines, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony

Percent of map unit: 7 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Crest, base slope

Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 7 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 1 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Crest
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ridgebury, Extremely Stony

Setting

Landform: Depressions, drumlins, ground moraines, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam

Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Footslope, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 8 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

73A—Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w695
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Whitman, extremely stony, and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Whitman, Extremely Stony

Setting

Landform: Depressions, drumlins, ground moraines, drainageways, hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 1 inches: peat
A - 1 to 10 inches: fine sandy loam
Bg - 10 to 17 inches: gravelly fine sandy loam
Cdg - 17 to 61 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 7 to 38 inches to densic material
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Ridgebury, extremely stony
Percent of map unit: 10 percent
Landform: Depressions, drumlins, ground moraines, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro
Percent of map unit: 5 percent
Landform: Depressions, outwash terraces, drainageways, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea
Percent of map unit: 3 percent
Landform: Bogs, marshes, swamps
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Woodbridge, extremely stony
Percent of map unit: 1 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

102C—Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2w69g
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Chatfield, extremely stony, and similar soils: 39 percent
Hollis, extremely stony, and similar soils: 26 percent

Rock outcrop: 17 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Nose slope, crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam

2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 12 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Sutton, extremely stony

Percent of map unit: 3 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Leicester, extremely stony

Percent of map unit: 1 percent
Landform: Depressions, ground moraines, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

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

Map Unit Setting

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

Map Unit Composition

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

Description of Paxton

Setting

Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam

Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Woodbridge

Percent of map unit: 9 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

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

Charlton

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

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

Map Unit Setting

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

Map Unit Composition

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

Description of Paxton

Setting

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

Typical profile

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

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

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

Hydric soil rating: No

Minor Components

Charlton

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

Woodbridge

Percent of map unit: 6 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 2 percent
Landform: Depressions, drumlins, ground moraines, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

307C—Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w676
Elevation: 0 to 1,490 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Paxton, Extremely Stony

Setting

Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge, extremely stony

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

Ridgebury, extremely stony

Percent of map unit: 1 percent
Landform: Depressions, drumlins, ground moraines, drainageways, hills

Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

307E—Paxton fine sandy loam, 15 to 35 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w67m
Elevation: 310 to 1,130 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, extremely stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Extremely Stony

Setting

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

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Charlton, extremely stony
Percent of map unit: 20 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge, extremely stony
Percent of map unit: 4 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury, extremely stony
Percent of map unit: 1 percent
Landform: Depressions, drumlins, ground moraines, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

420B—Canton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting
National map unit symbol: 2w81b
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Canton and similar soils: 80 percent

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

Description of Canton

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 10 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk

Percent of map unit: 5 percent
Landform: Drumlins, ground moraines, hills, moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex

Hydric soil rating: No

Charlton

Percent of map unit: 4 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent
Landform: Bogs, depressions, kettles, marshes, swamps
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

420C—Canton fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w817
Elevation: 0 to 1,330 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Canton

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Montauk

Percent of map unit: 6 percent
Landform: Drumlins, ground moraines, hills, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Scituate

Percent of map unit: 6 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Newfields

Percent of map unit: 4 percent
Landform: Ground moraines, hills, moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Charlton

Percent of map unit: 4 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

422B—Canton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w818
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Canton, Extremely Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Scituate, extremely stony

Percent of map unit: 6 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 6 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 4 percent
Landform: Drumlins, ground moraines, recessionial moraines, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 4 percent
Landform: Bogs, depressions, kettles, marshes, swamps
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

422C—Canton fine sandy loam, 8 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w815
Elevation: 0 to 1,310 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Canton, Extremely Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Scituate, extremely stony

Percent of map unit: 6 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 5 percent
Landform: Drumlins, ground moraines, recessionial moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 5 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Hollis, extremely stony

Percent of map unit: 4 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

422E—Canton fine sandy loam, 15 to 35 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w81j
Elevation: 0 to 1,340 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Canton, Extremely Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex

Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Montauk, extremely stony

Percent of map unit: 6 percent
Landform: Drumlins, ground moraines, recessionial moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 6 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Hollis, extremely stony

Percent of map unit: 4 percent
Landform: Ridges, hills
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope, nose slope

Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 4 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

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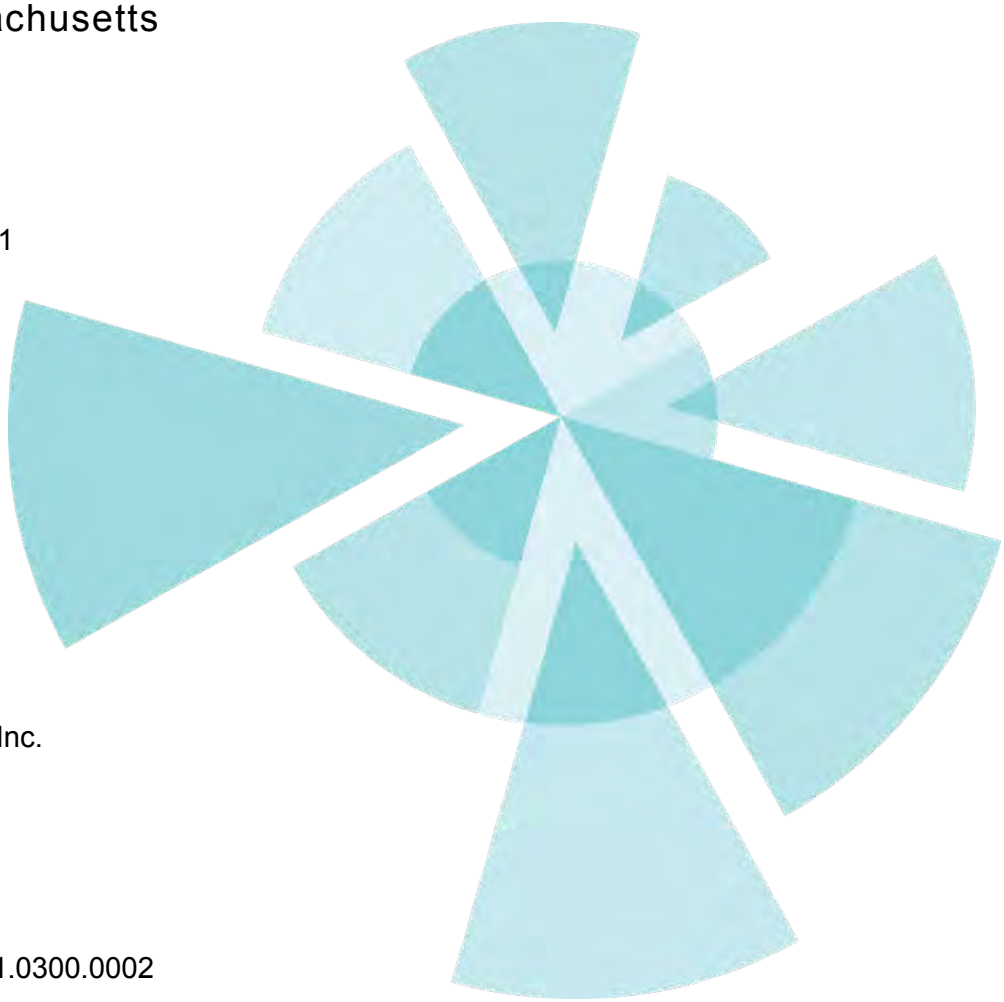
OPERATION AND MAINTENANCE PLAN
and
LONG-TERM POLLUTION PREVENTION PLAN

Solar Photovoltaic Project
Stafford Street
Leicester, Massachusetts

Prepared for:

Ameresco, Inc.
111 Speen Street
Framingham, MA 01701



Prepared by:

AMEC Massachusetts, Inc.
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July 12, 2017

Project No. 3652170091.0300.0002

TABLE OF CONTENTS

1.0 INTRODUCTION

AMEC Massachusetts, Inc. (AMEC) has prepared this Operations and Maintenance Plan and Long-Term Pollution Prevention Plan as a combined document to ensure that the stormwater best management practices (BMPs) designed and constructed as part of the 1.354 megawatt (MW) ground-mounted solar photovoltaic (PV) project (the Project) located off of Stafford Street in Leicester (the Site) continue to function as designed. The elements of this plan were developed in accordance with the Standards 4 and 9 of the Massachusetts Stormwater Standards and the requirements of the Massachusetts Stormwater Handbook.

2.0 OPERATIONS AND MAINTENANCE PLAN

The BMPs designed and constructed as part of the Project shall be operated and maintained in accordance with the requirements identified on the drawings submitted with the Notice of Intent and this Operations and Maintenance Plan.

2.1 Stormwater Management System Owners and Responsible Party

The owner of the stormwater management system at the Site and the party responsible for operation and maintenance of the stormwater BMPs is:

Ameresco, Inc.
111 Speen Street
Framingham, MA 01701

2.2 Maintenance Tasks

2.2.1 General O&M Requirements

The BMPs specified for this Project are designed to attenuate runoff from the Project in areas located upgradient of the existing surrounding wetlands. These BMPs will be most effective if properly maintained. This section describes the general maintenance concepts that must be implemented in order to extend the lifespan of the BMPs and maximize their ability to minimize accelerated erosion and sediment pollution.

In general, maintenance of BMPs requiring earth disturbance should occur in late spring or summer, after spring rains have diminished, drier weather has set in, and when vegetation can re-establish itself through the growing season. Other times may be suitable if weather permits or if the potential for sediment transport is low. Any maintenance should occur with the intent to limit earth disturbance during times of high erosion potential.

If earth disturbance occurs as part of maintenance activities, appropriate erosion and sediment controls shall be implemented. Fertilizer should never be applied, as this will result in an export of nitrogen and phosphorus from the BMP; with an exception for initial vegetation establishment.

Removed sediment shall always be managed in such a manner that it will not erode and wash into the stormwater conveyance system or a local water body.

2.2.2 Stone Infiltration Trench

Inspect at least twice per year to monitor for proper function. Inspections should also occur after major storms to determine if the trench is meeting the expected infiltration rate. The trench should be inspected for subsidence, erosion, and sediment accumulation.

- Remove accumulated sediment from the trench on an annual basis or sooner if noticeable clogging of the stone is present.

2.2.3 Grass Swale

Inspect monthly the first few months after construction to make sure that there is no slumping, and that the vegetation is installed and maintained adequately. Thereafter, inspect the channel twice per year for slope integrity, soil stability, soil compaction, soil erosion, ponding, and sediment accumulation.

- Mow banks at least once per year (preferably mid-June or early July) to avoid growth of woody vegetation. Do not cut the grass shorter than four inches.
- Remove sediment and debris manually at least once per year during the summer months.
- Take care to protect drainage channels from snow removal procedures.
- If mechanical means are necessary to remove excessive sediment, the channel must be returned to its original dimensions.

2.2.4 Culvert Aprons

Sediment accumulation in the stone reduces its ability to dissipate flow velocity thereby increasing the likelihood of downgradient erosion. Inspect the stone aprons at the inlet and outlet of all culverts twice per year and after large storm events. During inspection, remove large debris, trash, and leaves. Replace the stone when sediment has filled the void space within the stone.

2.3 Scaled Plans

Plans drawn to scale that depict the location of the stormwater features, their discharge points, and elements of the overall stormwater management system are included with the Notice of Intent.

2.4 Public Safety Features

The Project will be surrounded by a chain link fence. The gate will be locked at all times, and will need to be opened to conduct routing maintenance activities.

2.5 Operations and Maintenance Budget

The budget for operations and maintenance activities is approximately $5,000 per year.

3.0 LONG TERM POLLUTION PREVENTION PLAN

In accordance with EPA Standards, the development and implementation of suitable practices for source control and pollution prevention shall be incorporated in a Long Term Pollution Prevention Plan (LTPPP). The primary focus of the LTPPP is to establish procedures and controls for limiting the potential sources of pollutants, including nutrients that may contribute to excessive contaminant levels in the site's stormwater runoff. To this end the following sources controls and procedures will be in place at the site:

- **Good House Keeping** – The site shall be kept clean at all times. Refuse disposal and pickup shall occur on a regular basis and all material shall be disposed of in designated locations.

- **Storing Material and waste products inside or under cover** – No material storage is to take place outside at the site on either paved or lawn areas. All materials stored on-site will be in conformance with all storage requirements of local, state, and federal agencies.

- **Spill Prevention and Response** – A spill recovery kit shall be readily accessible at the facility at all times. Contact information for an emergency cleanup vendor shall be visible and apparent at the facility. All employees shall be briefed on clean-up response and procedures.

- **Maintenance of lawns and other landscaped areas** – All landscaping and maintenance shall be performed so as not to disturb stabilized surfaces.

- **Storage and use of fertilizers, herbicides and pesticides** – Application of herbicides or pesticides (if required) will not be applied during construction. Fertilizers shall be applied to promote initial seed growth and placed in accordance with manufacturer's recommendations.

- **Nutrient management plan** – The goal of the nutrient management plan is to minimize the potential sources of excess nutrients on the site and the release of nutrients in the stormwater from the site. This minimization relates both to infiltrated water and runoff. In general, the nature of the site use will tend to reduce nutrients in the stormwater. Further, procedures indicated above or in the O&M Plan will act to reduce the levels of nutrients in the stormwater and the nutrients entering the groundwater.

Solar PV Project
Stafford Street, Leicester, MA
BMP MAINTENANCE LOG

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BMP STRUCTURE	FREQUENCY	WORK PERFORMED	DATE PERFORMED	COMMENTS
Vegetation Trimming/Mowing	Annual mowing & removal of woody vegetation			
Vegetated Channels	Annual mowing & sediment removal			
Stone infiltration trenches	Inspect annually, clean/repair as needed			
Vegetated ground cover	Inspect annually, repair as needed			
Other				
Additional Comments:				

Inspector Name: _____ Date: _____