

DRAINAGE REPORT ADDENDUM

For



PROPOSED

“UNIFIED Parkway”

***Providence Road @ Boston Road
Sutton, Massachusetts
Worcester County***

Prepared by:

BOHLER ENGINEERING
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900 TEL.



John A. Kucich
Massachusetts P.E. Lic. #41530

BOHLER //

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REDEVELOPMENT OF BOSTON ROAD AT UNIFIED PARKWAY

I. EXECUTIVE SUMMARY

The addendum has been prepared due to proposed changes to Stormwater Management Area #4 (SWM #4) at the intersection of Unified Parkway and Boston Road which discharges to Design Point #1 (DP-1). The design and layout of Unified Parkway at the intersection with Boston Road has been modified at the request of the Town of Sutton Planning Board which impacts the location and design of SWM #4. In addition, the project will provide improvement to Boston Road, including a widening, and a portion of the drainage system from Boston Road will be directed into SWM#4 which will provide additional treatment and recharge. This addendum provides updated design information relative to these two design items and their impacts on SWM#4 only. Refer to the Drainage Report dated December 16, 2021 prepared by our office, for additional calculation and information on the other basins and design points which remain unchanged. For additional information regarding Boston Road Stormwater Management refer to the attached supplemental Memorandum prepared by VHB, dated September 15, 2022 included in the Appendix F to this summary.

Table 1.1 provides the updated pre- and post-development peak rates of runoff to design point #1 (DP1) based upon the proposed design modifications. As shown, post-development rates are at or below pre-development rates similar to what was originally reviewed and approved by the Town. The revised design for SWM#4 is discussed in further detail below.

Table 1.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	0.11	0.01	-0.10	1.32	0.15	-1.17	2.67	0.42	-2.25	7.00	1.80	-5.20

**Flows are represented in cubic feet per second (cfs)*

II. EXISTING SITE CONDITIONS

Existing site information has been updated due to the modified roadway alignment and include the additional off-site area relative the Boston Road improvements. Existing on-site and off-site watersheds discharge to Design Point #1. Design Point #1 (DP1) is a wetland system located adjacent to Boston Road and located east of the subject site. Under existing conditions this design point receives stormwater flows from approximately 14.4± acres of land designated as Watershed “E1” and Watershed “E1a”. Watershed E1 flows overland to DP1 and consists of dirt roads, grass and wooded areas and has a calculated curve number (CN) of 35 and a time of concentration (Tc) of 30.3 minutes. Watershed E1a flow overland to DP1 and consists of paved roadways, single family homes, grass cover and woodlands. Watershed E1a has a calculated curve number (CN) of 51 and a time of concentration (Tc) of 21.9 minutes. Additional hydrologic information and an updated Drainage Area Map are enclosed in the Appendices of this Addendum.

III. PROPOSED SITE CONDITIONS

Proposed Watersheds and Design Point Information

The proposed design has been updated due to the modified roadway alignment and to accommodate a portion of the drainage from the Boston Road improvements. Under proposed conditions, DP1 receives stormwater flows from approximately 14.6± acres of land. The sub-catchments associated with DP1 are described in more detail below in **Table 3.1**.

Table 3.1: DP1 Sub-catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Curve Number (CN)	Time of Concentration (Tc, minutes)	Hydrologic Routing
P1a	2.6±	Paved parking, grass, basin bottom, woods	62	6.0	Basin #4
P1b	8.3±	Dirt roads, grass, woods	33	26.2	DP1
P1c	3.2±	Paved roads, roofs, grass, woods	53	21.3	Basin #4
P1d	0.49±	Paved parking, Grass	47	6.0	DP1

Additional hydrologic information and an updated Drainage Area Map are enclosed in the Appendices of this Addendum. Stormwater Basin#4 has been designed with approximately 10,500 cubic feet of additional storage capacity below the lowest outlet during the 100-yr storm event. The excess capacity has been provided to account for additional impervious area related to a potential future widening of Boston Road. For additional information regarding Boston Road Stormwater Management refer to the attached supplemental Memorandum prepared by VHB, dated September 15, 2022 provided in the Appendix F of this report.

IV. STORMWATER MANAGEMENT STANDARDS

Methodology utilized to design the proposed stormwater management system is consistent with the original approved design including compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook.

Standard #1: No New Untreated Discharges

The project has been designed so that proposed impervious areas shall be collected and passed through the proposed drainage system for treatment prior to discharge.

Standard #2: Peak Rate Attenuation

As outlined in **Table 1.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at all design points.

Standard #3: Recharge

The stormwater runoff from the project will be collected and diverted to one of four (4) proposed surface infiltration basins. The project as proposed will involve the creation of 7.6± acres of new impervious area including the Boston Road improvements that drain to SWM#4 and is required to infiltrate 16,545 cubic feet of stormwater as defined in Stormwater Standard 3. The proposed infiltration basins will provide a total of 33,053 cubic feet of volume below the lowest outlet for groundwater recharge. Updated calculations for total required recharge volume and the recharge volume provided at SWM#4 are provided in the Appendices of this addendum.

The DEP Stormwater Standards require that the infiltration BMP drains completely within 72 hours of the end of the storm event. Calculations showing that SWM#4 will drain within 72 hours are included in the Appendices of this addendum.

A four (4) foot separation is provided to from the bottom of SWM#4 to estimated seasonal high groundwater, therefore a groundwater mounding analysis is not required.

Standard #4: Water Quality

Water quality treatment is provided via deep sump catch basins, forebays, and surface infiltration basins. The project as proposed will involve the creation of 7.6± acres of new impervious area including the Boston Road improvements that drain to SWM#4 and is required to treat 30,520 cubic feet of water quality volume as defined in Stormwater Standard 4. The proposed infiltration basins provide a total of 33,053 cubic feet of water quality volume below the lowest outlet for water quality treatment. Updated calculations for total required water quality volume and the water quality volume provided at SWM#4 are provided in the Appendices of this addendum.

Standard #5: Land Use with Higher Potential Pollutant Loads

Not Applicable for this project; however, the project is designed to provide 44% TSS removal prior to infiltration and treat 1" of WQV.

Standard #6: Critical Areas

A Zone II has been established for the site which covers the central portion of the site. A Zone I Wellhead Protection Area is located in the eastern portion of the Zone II in the central portion of the site. The project has been designed to provide one (1) inch of water quality volume in accordance with Standard #6 and as outlined in Standard #4 above.

The proposed stormwater management system has been designed to provide at least eighty percent (80%) removal of Total Suspended Solids (TSS) through the use of several Best Management Practices (BMPs), including deep-sump hooded catch basins, forebays, and surface infiltration basins. The deep-sump hooded catch basins and forebays will provide a minimum of 44% TSS removal prior to all infiltration basins. Updated TSS calculations for stormwater conveyed to SWM#4 are provided in the Appendices of this addendum

Standard #7: Redevelopment

Not Applicable for this project.

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

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction exit, protection for stormwater inlets, and various other techniques as outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent.

Standard #9: Operation and Maintenance Plan (O&M Plan)

An Operation and Maintenance (O&M) Plan for this site was prepared and included in the Appendices of the approved Drainage Report. There are no changes to the design that require modification to the approved O&M Plan.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement was included in the Appendices of the approved Drainage Report.

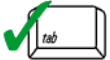
APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST



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 8²
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

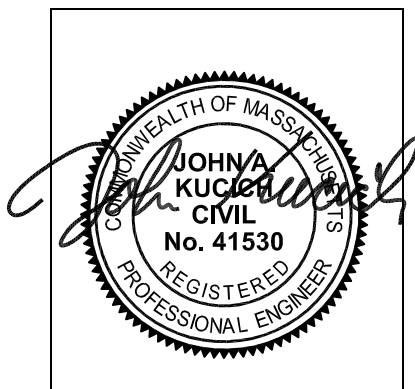
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



09/28/22

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): Surface Infiltration Systems

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- ☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- ☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- ☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- ☒ Soil Analysis provided.
- ☒ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - ☒ Static
 - ☐ Simple Dynamic
 - ☐ Dynamic Field¹
- ☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.
- ☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- ☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
 - ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
 - ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- ☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- ☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- ☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☒ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- ☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - ☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - ☒ is within the Zone II or Interim Wellhead Protection Area
 - ☐ is near or to other critical areas
 - ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - ☐ involves runoff from land uses with higher potential pollutant loads.
 - ☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - ☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

Standard 6: Critical Areas

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



Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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



Checklist for Stormwater Report

Checklist (continued)

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

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☐ The project is **not** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - ☒ Name of the stormwater management system owners;
 - ☒ Party responsible for operation and maintenance;
 - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
 - ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
 - ☐ Description and delineation of public safety features;
 - ☐ Estimated operation and maintenance budget; and
 - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- ☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

APPENDIX B: SOIL INFORMATION

➤ **NCRS CUSTOM SOIL RESOURCE REPORT**



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

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

Custom Soil Resource Report for Worcester County, Massachusetts, Southern Part

Boston Road - Sutton, MA



September 2, 2022

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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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

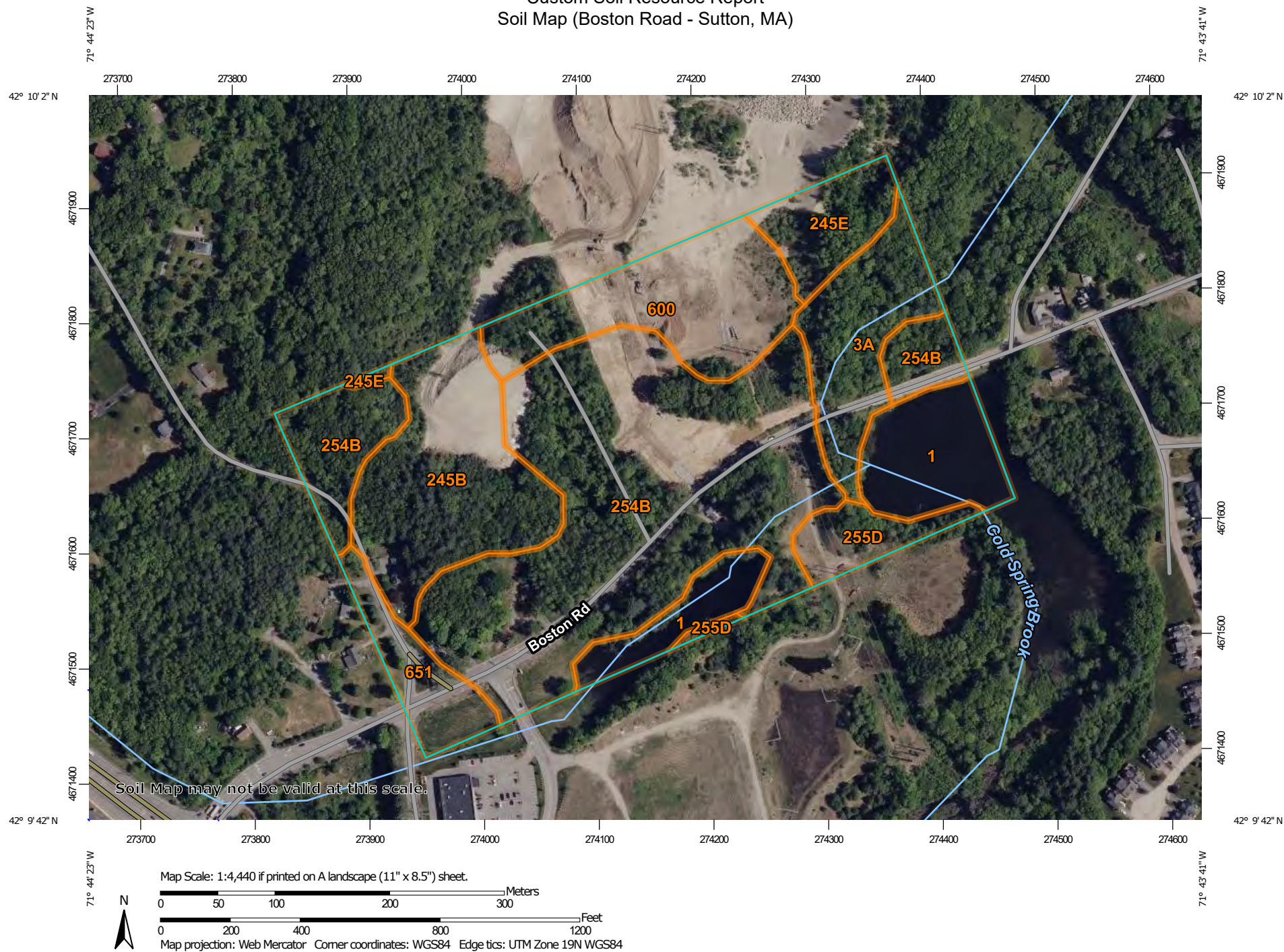
Custom Soil Resource Report

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 (Boston Road - Sutton, MA)




Custom Soil Resource Report


MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines


 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit


 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot


 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water


 Perennial Water

 Rock Outcrop


 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole


 Slide or Slip


 Sodic Spot


 Spoil Area

 Stony Spot


 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals


Transportation

 Rails


 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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, Southern Part
Survey Area Data: Version 14, Sep 3, 2021

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

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

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Boston Road - Sutton, MA)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	4.5	10.0%
3A	Scarboro and Walpole soils, 0 to 3 percent slopes	3.7	8.1%
245B	Hinckley loamy sand, 3 to 8 percent slopes	6.5	14.2%
245E	Hinckley loamy sand, 15 to 35 percent slopes	2.2	4.7%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	20.1	44.2%
255D	Windsor loamy sand, 15 to 25 percent slopes	1.5	3.4%
600	Pits, gravel	5.1	11.2%
651	Udorthents, smoothed	1.9	4.2%
Totals for Area of Interest		45.6	100.0%

Map Unit Descriptions (Boston Road - Sutton, MA)

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, 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

3A—Scarboro and Walpole soils, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svks
Elevation: 160 to 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

Scarboro and similar soils: 45 percent
Walpole and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scarboro

Setting

Landform: Drainageways, depressions, outwash deltas, outwash terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from schist and/or sandy glaciofluvial deposits derived from gneiss and/or sandy glaciofluvial deposits derived from granite

Typical profile

Oe - 0 to 3 inches: mucky peat
A - 3 to 11 inches: mucky fine sandy loam

Custom Soil Resource Report

Cg1 - 11 to 21 inches: sand

Cg2 - 21 to 65 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Very poorly drained

Runoff class: Negligible

*Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(1.42 to 14.17 in/hr)*

Depth to water table: About 0 to 2 inches

Frequency of flooding: None

Frequency of ponding: Frequent

Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 5w

Hydrologic Soil Group: A/D

Ecological site: F144AY031MA - Very Wet Outwash

Hydric soil rating: Yes

Description of Walpole

Setting

Landform: Depressions on outwash plains, drainageways on outwash terraces

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Base slope, tread, dip, talf

Down-slope shape: Concave

Across-slope shape: Concave

*Parent material: Sandy and gravelly glaciofluvial deposits derived from granite
and/or schist and/or gneiss*

Typical profile

O - 0 to 2 inches: muck

A - 2 to 11 inches: fine sandy loam

Bg - 11 to 24 inches: fine sandy loam

Bw - 24 to 28 inches: sandy loam

Cg - 28 to 65 inches: sand

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: 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 12 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: B/D

Custom Soil Resource Report

Ecological site: F144AY028MA - Wet Outwash

Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 10 percent

Landform: Swamps, bogs

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

Hydric soil rating: Yes

Wareham

Percent of map unit: 10 percent

Landform: Depressions

Down-slope shape: Concave

Across-slope shape: Concave

Hydric soil rating: Yes

245B—Hinckley loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svm8

Elevation: 0 to 1,430 feet

Mean annual precipitation: 36 to 53 inches

Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 250 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, kames, kame terraces, moraines, eskers, outwash plains

Landform position (two-dimensional): Summit, shoulder, backslope, footslope

Landform position (three-dimensional): Nose slope, side slope, crest, base slope, riser, tread

Down-slope shape: Concave, convex, linear

Across-slope shape: Convex, linear, concave

Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material

Custom Soil Resource Report

A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: 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
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 8 percent
Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, crest, base slope, riser, tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, moraines, outwash plains, kame terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Head slope, side slope, base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

Agawam

Percent of map unit: 2 percent
Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Concave, convex, linear

Custom Soil Resource Report

Across-slope shape: Convex, linear, concave
Hydric soil rating: No

245E—Hinckley loamy sand, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2svmd
Elevation: 0 to 860 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

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

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: 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
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)

Custom Soil Resource Report

Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A

Ecological site: F144AY022MA - Dry Outwash

Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 10 percent

Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser

Down-slope shape: Concave, convex, linear

Across-slope shape: Convex, linear, concave

Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent

Landform: Kame terraces, outwash plains, outwash terraces, moraines, eskers, kames

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser

Down-slope shape: Concave, convex, linear

Across-slope shape: Convex, linear, concave

Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent

Landform: Outwash deltas, outwash plains, kame terraces, outwash terraces, moraines

Landform position (two-dimensional): Backslope, footslope, toeslope

Landform position (three-dimensional): Base slope, tread

Down-slope shape: Concave, linear

Across-slope shape: Concave, linear

Hydric soil rating: No

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs

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

Custom Soil Resource Report

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, outwash terraces, moraines, eskers, kames

Landform position (two-dimensional): Summit, shoulder, backslope, footslope

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: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

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 content: 2 percent

Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)

Sodium adsorption ratio, maximum: 1.0

Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2s

Hydrologic Soil Group: A

Ecological site: F145XY008MA - Dry Outwash

Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 5 percent

Landform: Deltas, kames, eskers, outwash plains

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise

Down-slope shape: Convex

Across-slope shape: Convex, linear

Custom Soil Resource Report

Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent

Landform: Deltas, terraces, outwash plains

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Tread, dip

Down-slope shape: Concave

Across-slope shape: Linear

Hydric soil rating: No

Windsor

Percent of map unit: 3 percent

Landform: Outwash terraces, dunes, deltas, outwash plains

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Tread, riser

Down-slope shape: Linear, convex

Across-slope shape: Linear, convex

Hydric soil rating: No

Agawam

Percent of map unit: 2 percent

Landform: Outwash plains, outwash terraces, moraines, stream terraces, eskers, kames

Landform position (three-dimensional): Rise

Down-slope shape: Convex

Across-slope shape: Convex

Hydric soil rating: No

255D—Windsor loamy sand, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2svlb

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

Windsor and similar soils: 90 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Outwash terraces, outwash plains, dunes, deltas

Landform position (three-dimensional): Tread, riser

Down-slope shape: Linear, convex

Across-slope shape: Linear, convex

Custom Soil Resource Report

Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: 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
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley

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

Merrimac

Percent of map unit: 5 percent
Landform: Outwash plains, outwash terraces, moraines, stream terraces, eskers, kames
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

600—Pits, gravel

Map Unit Setting

National map unit symbol: 9bf6

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

Pits, gravel: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits, Gravel

Setting

Parent material: Loose sandy and gravelly glaciofluvial deposits

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8s

Hydric soil rating: Unranked

651—Udorthents, smoothed

Map Unit Setting

National map unit symbol: 9bfc

Elevation: 0 to 3,000 feet

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

Udorthents and similar soils: 80 percent

Urban land: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Made land over firm coarse-loamy basal till and/or dense coarse-loamy lodgment till

Typical profile

H1 - 0 to 6 inches: variable

Custom Soil Resource Report

H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 25 percent

Depth to restrictive feature: More than 80 inches

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified

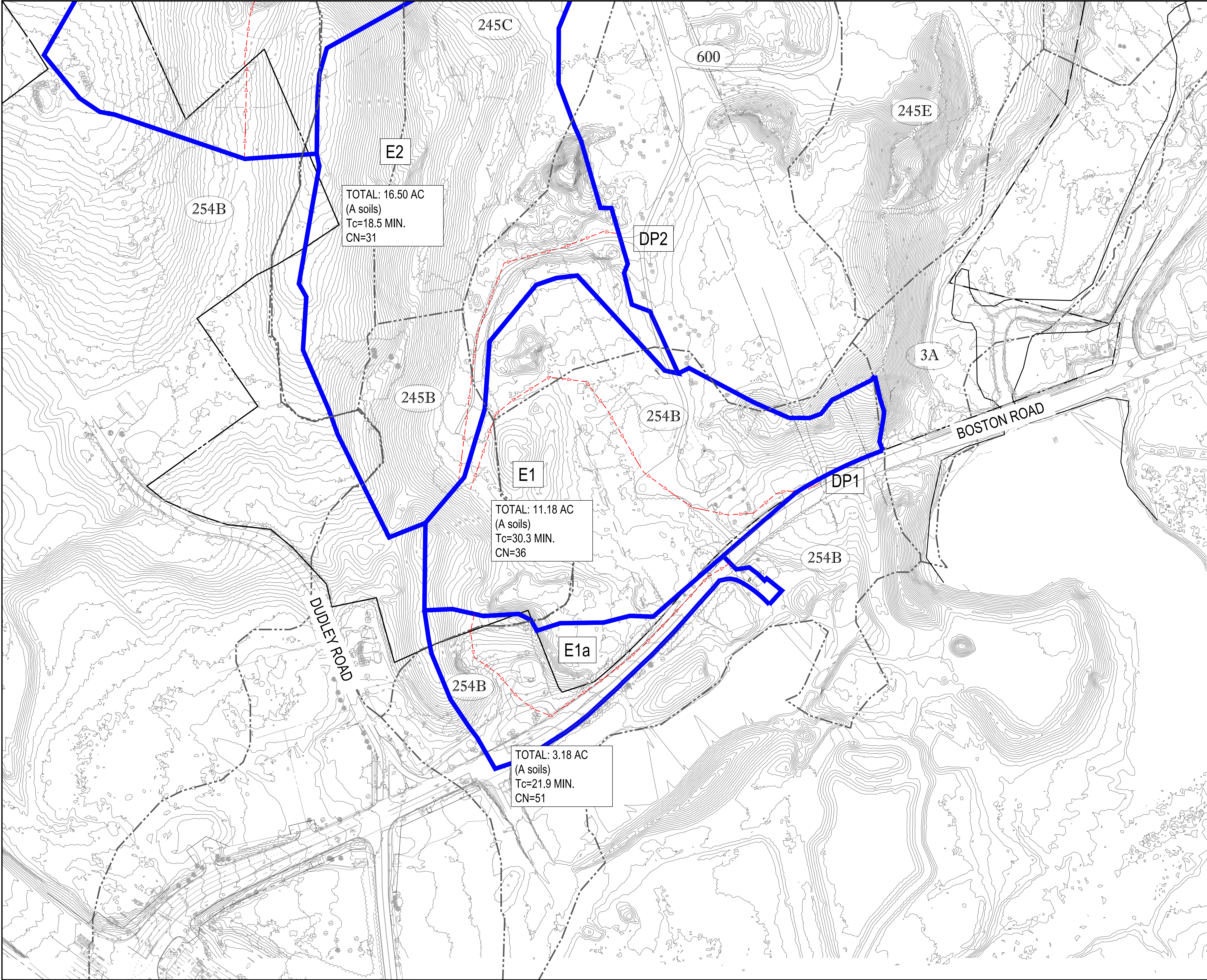
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: A

Hydric soil rating: No

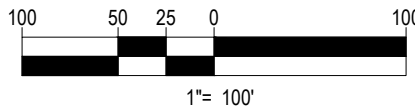
**APPENDIX C: EXISTING CONDITIONS HYDROLOGIC ANALYSIS (Addendum
9/28/2022)**

- EXISTING CONDITIONS DRAINAGE MAP
- EXISTING CONDITIONS HYDROCAD COMPUTATIONS



KEY

- 654 SOIL GROUP
- SOIL BOUNDARY
- - - - - TIME OF CONCENTRATION
- E1 EXISTING WATERSHED
- DP1 DESIGN POINT

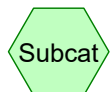
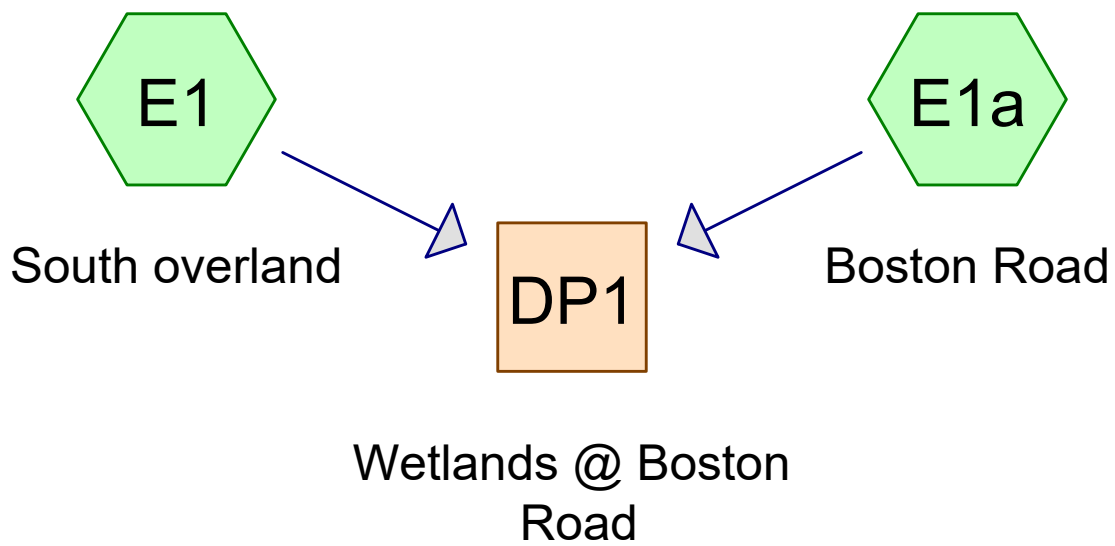


**PRE-DEVELOPMENT
DRAINAGE ANALYSIS
EXHIBIT**
UNIFIED PARKWAY
SUTTON, MA

PREPARED BY

BOHLER //

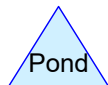
SCALE: 1"=100' DATE: 11/10/2021
ADDENDUM: 09/28/2022



Subcat



Reach



Pond



Link

Routing Diagram for W211141-EX-Rev5

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.593	39	>75% Grass cover, Good, HSG A (E1, E1a)
1.096	72	Dirt roads, HSG A (E1)
0.813	98	Paved roads w/curbs & sewers, HSG A (E1a)
0.062	98	Roofs, HSG A (E1a)
10.801	30	Woods, Good, HSG A (E1, E1a)
14.365	38	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
14.365	HSG A	E1, E1a
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
14.365		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
1.593	0.000	0.000	0.000	0.000	1.593	>75% Grass cover, Good	E1, E1a
1.096	0.000	0.000	0.000	0.000	1.096	Dirt roads	E1
0.813	0.000	0.000	0.000	0.000	0.813	Paved roads w/curbs & sewers	E1a
0.062	0.000	0.000	0.000	0.000	0.062	Roofs	E1a
10.801	0.000	0.000	0.000	0.000	10.801	Woods, Good	E1, E1a
14.365	0.000	0.000	0.000	0.000	14.365	TOTAL AREA	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: South overland

Runoff Area=11.181 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,127' Tc=30.3 min CN=35 Runoff=0.00 cfs 0.000 af

Subcatchment E1a: Boston Road

Runoff Area=3.184 ac 27.48% Impervious Runoff Depth=0.17"
Flow Length=869' Tc=21.9 min CN=51 Runoff=0.11 cfs 0.044 af

Reach DP1: Wetlands @ Boston Road

Inflow=0.11 cfs 0.044 af
Outflow=0.11 cfs 0.044 af

Total Runoff Area = 14.365 ac Runoff Volume = 0.044 af Average Runoff Depth = 0.04"
93.91% Pervious = 13.490 ac 6.09% Impervious = 0.875 ac

Summary for Subcatchment E1: South overland

[45] Hint: Runoff=Zero

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

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.27"

Area (ac)	CN	Description
1.096	72	Dirt roads, HSG A
9.415	30	Woods, Good, HSG A
0.670	39	>75% Grass cover, Good, HSG A
11.181	35	Weighted Average
11.181		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0460	0.09		Sheet Flow, 418-415.7 Woods: Light underbrush n= 0.400 P2= 3.00"
13.7	596	0.0210	0.72		Shallow Concentrated Flow, 415.7 - 403.3 Woodland Kv= 5.0 fps
2.1	109	0.0030	0.88		Shallow Concentrated Flow, 403.3 to 403 Unpaved Kv= 16.1 fps
1.9	76	0.0170	0.65		Shallow Concentrated Flow, 403 to 401.7 Woodland Kv= 5.0 fps
0.7	122	0.0300	2.79		Shallow Concentrated Flow, 401.7 to 398 Unpaved Kv= 16.1 fps
1.9	109	0.0370	0.96		Shallow Concentrated Flow, 398 to 394 Woodland Kv= 5.0 fps
0.9	65	0.0310	1.23		Shallow Concentrated Flow, 394 to 392 Short Grass Pasture Kv= 7.0 fps
30.3	1,127	Total			

Summary for Subcatchment E1a: Boston Road

Runoff = 0.11 cfs @ 12.67 hrs, Volume= 0.044 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.27"

Area (ac)	CN	Description
0.813	98	Paved roads w/curbs & sewers, HSG A
0.062	98	Roofs, HSG A
0.923	39	>75% Grass cover, Good, HSG A
1.386	30	Woods, Good, HSG A
3.184	51	Weighted Average
2.309		72.52% Pervious Area
0.875		27.48% Impervious Area

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Type III 24-hr 2-YR Rainfall=3.27"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0100	0.05		Sheet Flow, 438-437.5 Woods: Light underbrush n= 0.400 P2= 3.00"
2.2	268	0.0860	2.05		Shallow Concentrated Flow, 437.5-417.5 Short Grass Pasture Kv= 7.0 fps
2.9	551	0.0250	3.21		Shallow Concentrated Flow, 417.5-404 Paved Kv= 20.3 fps
21.9	869	Total			

Summary for Reach DP1: Wetlands @ Boston Road

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.365 ac, 6.09% Impervious, Inflow Depth = 0.04" for 2-YR event
 Inflow = 0.11 cfs @ 12.67 hrs, Volume= 0.044 af
 Outflow = 0.11 cfs @ 12.67 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: South overland

Runoff Area=11.181 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=1,127' Tc=30.3 min CN=35 Runoff=0.13 cfs 0.086 af

Subcatchment E1a: Boston Road

Runoff Area=3.184 ac 27.48% Impervious Runoff Depth=0.78"
Flow Length=869' Tc=21.9 min CN=51 Runoff=1.32 cfs 0.206 af

Reach DP1: Wetlands @ Boston Road

Inflow=1.32 cfs 0.292 af
Outflow=1.32 cfs 0.292 af

Total Runoff Area = 14.365 ac Runoff Volume = 0.292 af Average Runoff Depth = 0.24"
93.91% Pervious = 13.490 ac 6.09% Impervious = 0.875 ac

Summary for Subcatchment E1: South overland

Runoff = 0.13 cfs @ 15.43 hrs, Volume= 0.086 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.07"

Area (ac)	CN	Description
1.096	72	Dirt roads, HSG A
9.415	30	Woods, Good, HSG A
0.670	39	>75% Grass cover, Good, HSG A
11.181	35	Weighted Average
11.181		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0460	0.09		Sheet Flow, 418-415.7
					Woods: Light underbrush n= 0.400 P2= 3.00"
13.7	596	0.0210	0.72		Shallow Concentrated Flow, 415.7 - 403.3
					Woodland Kv= 5.0 fps
2.1	109	0.0030	0.88		Shallow Concentrated Flow, 403.3 to 403
					Unpaved Kv= 16.1 fps
1.9	76	0.0170	0.65		Shallow Concentrated Flow, 403 to 401.7
					Woodland Kv= 5.0 fps
0.7	122	0.0300	2.79		Shallow Concentrated Flow, 401.7 to 398
					Unpaved Kv= 16.1 fps
1.9	109	0.0370	0.96		Shallow Concentrated Flow, 398 to 394
					Woodland Kv= 5.0 fps
0.9	65	0.0310	1.23		Shallow Concentrated Flow, 394 to 392
					Short Grass Pasture Kv= 7.0 fps
30.3	1,127	Total			

Summary for Subcatchment E1a: Boston Road

Runoff = 1.32 cfs @ 12.41 hrs, Volume= 0.206 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.07"

Area (ac)	CN	Description
0.813	98	Paved roads w/curbs & sewers, HSG A
0.062	98	Roofs, HSG A
0.923	39	>75% Grass cover, Good, HSG A
1.386	30	Woods, Good, HSG A
3.184	51	Weighted Average
2.309		72.52% Pervious Area
0.875		27.48% Impervious Area

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Type III 24-hr 10-YR Rainfall=5.07"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0100	0.05		Sheet Flow, 438-437.5 Woods: Light underbrush n= 0.400 P2= 3.00"
2.2	268	0.0860	2.05		Shallow Concentrated Flow, 437.5-417.5 Short Grass Pasture Kv= 7.0 fps
2.9	551	0.0250	3.21		Shallow Concentrated Flow, 417.5-404 Paved Kv= 20.3 fps
21.9	869	Total			

Summary for Reach DP1: Wetlands @ Boston Road

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.365 ac, 6.09% Impervious, Inflow Depth = 0.24" for 10-YR event
 Inflow = 1.32 cfs @ 12.41 hrs, Volume= 0.292 af
 Outflow = 1.32 cfs @ 12.41 hrs, Volume= 0.292 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: South overland

Runoff Area=11.181 ac 0.00% Impervious Runoff Depth=0.29"
Flow Length=1,127' Tc=30.3 min CN=35 Runoff=0.56 cfs 0.271 af

Subcatchment E1a: Boston Road

Runoff Area=3.184 ac 27.48% Impervious Runoff Depth=1.31"
Flow Length=869' Tc=21.9 min CN=51 Runoff=2.63 cfs 0.348 af

Reach DP1: Wetlands @ Boston Road

Inflow=2.67 cfs 0.620 af
Outflow=2.67 cfs 0.620 af

Total Runoff Area = 14.365 ac Runoff Volume = 0.620 af Average Runoff Depth = 0.52"
93.91% Pervious = 13.490 ac 6.09% Impervious = 0.875 ac

Summary for Subcatchment E1: South overland

Runoff = 0.56 cfs @ 12.90 hrs, Volume= 0.271 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.19"

Area (ac)	CN	Description
1.096	72	Dirt roads, HSG A
9.415	30	Woods, Good, HSG A
0.670	39	>75% Grass cover, Good, HSG A
11.181	35	Weighted Average
11.181		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0460	0.09		Sheet Flow, 418-415.7
					Woods: Light underbrush n= 0.400 P2= 3.00"
13.7	596	0.0210	0.72		Shallow Concentrated Flow, 415.7 - 403.3
					Woodland Kv= 5.0 fps
2.1	109	0.0030	0.88		Shallow Concentrated Flow, 403.3 to 403
					Unpaved Kv= 16.1 fps
1.9	76	0.0170	0.65		Shallow Concentrated Flow, 403 to 401.7
					Woodland Kv= 5.0 fps
0.7	122	0.0300	2.79		Shallow Concentrated Flow, 401.7 to 398
					Unpaved Kv= 16.1 fps
1.9	109	0.0370	0.96		Shallow Concentrated Flow, 398 to 394
					Woodland Kv= 5.0 fps
0.9	65	0.0310	1.23		Shallow Concentrated Flow, 394 to 392
					Short Grass Pasture Kv= 7.0 fps
30.3	1,127	Total			

Summary for Subcatchment E1a: Boston Road

Runoff = 2.63 cfs @ 12.37 hrs, Volume= 0.348 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.19"

Area (ac)	CN	Description
0.813	98	Paved roads w/curbs & sewers, HSG A
0.062	98	Roofs, HSG A
0.923	39	>75% Grass cover, Good, HSG A
1.386	30	Woods, Good, HSG A
3.184	51	Weighted Average
2.309		72.52% Pervious Area
0.875		27.48% Impervious Area

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Type III 24-hr 25-YR Rainfall=6.19"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0100	0.05		Sheet Flow, 438-437.5 Woods: Light underbrush n= 0.400 P2= 3.00"
2.2	268	0.0860	2.05		Shallow Concentrated Flow, 437.5-417.5 Short Grass Pasture Kv= 7.0 fps
2.9	551	0.0250	3.21		Shallow Concentrated Flow, 417.5-404 Paved Kv= 20.3 fps
21.9	869	Total			

Summary for Reach DP1: Wetlands @ Boston Road

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.365 ac, 6.09% Impervious, Inflow Depth = 0.52" for 25-YR event
 Inflow = 2.67 cfs @ 12.38 hrs, Volume= 0.620 af
 Outflow = 2.67 cfs @ 12.38 hrs, Volume= 0.620 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: South overland

Runoff Area=11.181 ac 0.00% Impervious Runoff Depth=0.78"
Flow Length=1,127' Tc=30.3 min CN=35 Runoff=3.10 cfs 0.724 af

Subcatchment E1a: Boston Road

Runoff Area=3.184 ac 27.48% Impervious Runoff Depth=2.31"
Flow Length=869' Tc=21.9 min CN=51 Runoff=5.12 cfs 0.612 af

Reach DP1: Wetlands @ Boston Road

Inflow=7.00 cfs 1.335 af
Outflow=7.00 cfs 1.335 af

Total Runoff Area = 14.365 ac Runoff Volume = 1.335 af Average Runoff Depth = 1.12"
93.91% Pervious = 13.490 ac 6.09% Impervious = 0.875 ac

Summary for Subcatchment E1: South overland

Runoff = 3.10 cfs @ 12.64 hrs, Volume= 0.724 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.92"

Area (ac)	CN	Description
1.096	72	Dirt roads, HSG A
9.415	30	Woods, Good, HSG A
0.670	39	>75% Grass cover, Good, HSG A
11.181	35	Weighted Average
11.181		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0460	0.09		Sheet Flow, 418-415.7
					Woods: Light underbrush n= 0.400 P2= 3.00"
13.7	596	0.0210	0.72		Shallow Concentrated Flow, 415.7 - 403.3
					Woodland Kv= 5.0 fps
2.1	109	0.0030	0.88		Shallow Concentrated Flow, 403.3 to 403
					Unpaved Kv= 16.1 fps
1.9	76	0.0170	0.65		Shallow Concentrated Flow, 403 to 401.7
					Woodland Kv= 5.0 fps
0.7	122	0.0300	2.79		Shallow Concentrated Flow, 401.7 to 398
					Unpaved Kv= 16.1 fps
1.9	109	0.0370	0.96		Shallow Concentrated Flow, 398 to 394
					Woodland Kv= 5.0 fps
0.9	65	0.0310	1.23		Shallow Concentrated Flow, 394 to 392
					Short Grass Pasture Kv= 7.0 fps
30.3	1,127	Total			

Summary for Subcatchment E1a: Boston Road

Runoff = 5.12 cfs @ 12.34 hrs, Volume= 0.612 af, Depth= 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.92"

Area (ac)	CN	Description
0.813	98	Paved roads w/curbs & sewers, HSG A
0.062	98	Roofs, HSG A
0.923	39	>75% Grass cover, Good, HSG A
1.386	30	Woods, Good, HSG A
3.184	51	Weighted Average
2.309		72.52% Pervious Area
0.875		27.48% Impervious Area

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Type III 24-hr 100-YR Rainfall=7.92"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0100	0.05		Sheet Flow, 438-437.5
					Woods: Light underbrush n= 0.400 P2= 3.00"
2.2	268	0.0860	2.05		Shallow Concentrated Flow, 437.5-417.5
					Short Grass Pasture Kv= 7.0 fps
2.9	551	0.0250	3.21		Shallow Concentrated Flow, 417.5-404
					Paved Kv= 20.3 fps
21.9	869	Total			

Summary for Reach DP1: Wetlands @ Boston Road

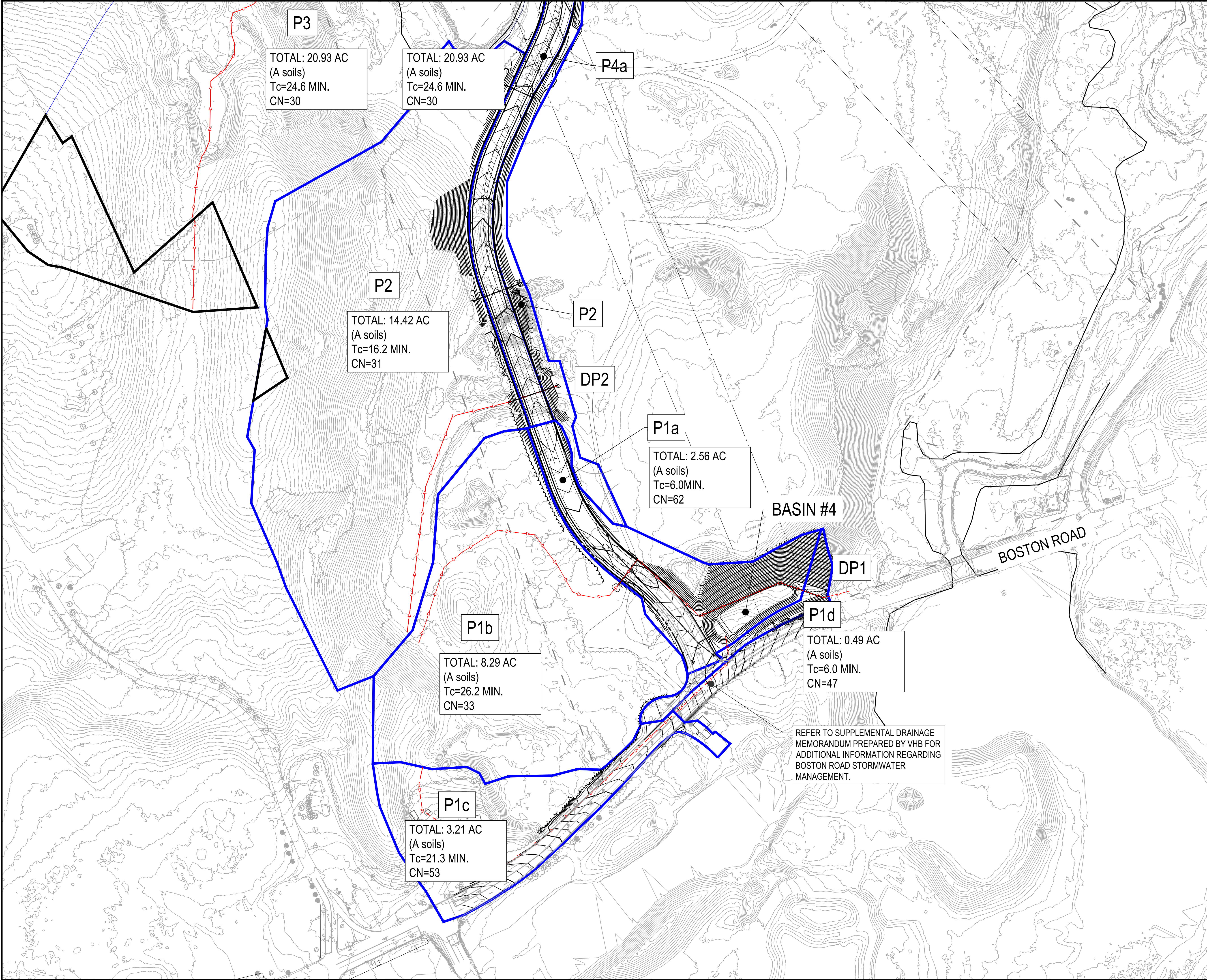
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.365 ac, 6.09% Impervious, Inflow Depth = 1.12" for 100-YR event
 Inflow = 7.00 cfs @ 12.47 hrs, Volume= 1.335 af
 Outflow = 7.00 cfs @ 12.47 hrs, Volume= 1.335 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

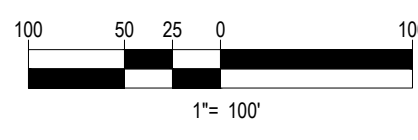
**APPENDIX D: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS (Addendum
9/28/2022)**

- *PROPOSED CONDITIONS DRAINAGE MAP*
- *PROPOSED CONDITIONS HYDROCAD CALCULATIONS*



KEY

- SOIL GROUP
- SOIL BOUNDARY
- TIME OF CONCENTRATION
- P1 PROPOSED WATERSHED
- DP1 DESIGN POINT

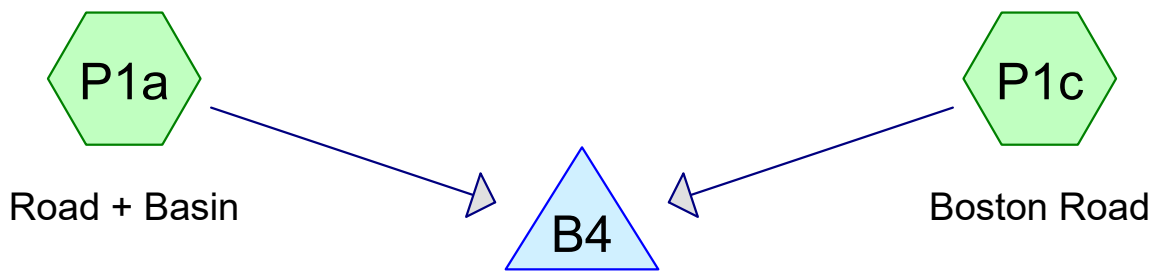


**POST-DEVELOPMENT
DRAINAGE ANALYSIS
EXHIBIT**

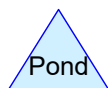
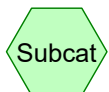
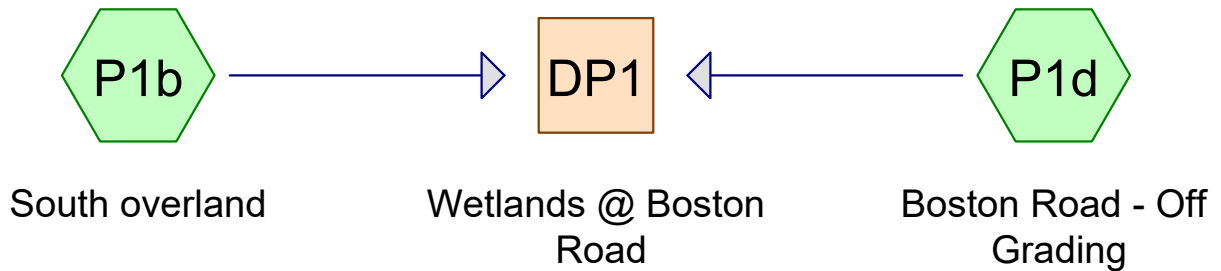
PROVIDENCE ROAD @ BOSTON ROAD
SUTTON, MA

PREPARED BY
BOHLER

SCALE: 1"=100' DATE: 11/10/2021
ADDENDUM: 09/28/2022



Surface Infiltration Basin
#4



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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.993	39	>75% Grass cover, Good, HSG A (P1a, P1b, P1c, P1d)
0.151	98	Bot. Basin, 0% imp, HSG A (P1a)
0.304	72	Dirt roads, HSG A (P1b)
0.927	98	Paved parking, HSG A (P1a, P1d)
0.918	98	Paved roads w/curbs & sewers, HSG A (P1c)
0.054	98	Roofs, HSG A (P1c)
8.199	30	Woods, Good, HSG A (P1a, P1b, P1c)
14.546	43	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
14.546	HSG A	P1a, P1b, P1c, P1d
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
14.546		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
3.993	0.000	0.000	0.000	0.000	3.993	>75% Grass cover, Good	P1a,
							P1b,
							P1c,
							P1d
0.151	0.000	0.000	0.000	0.000	0.151	Bot. Basin, 0% imp	P1a
0.304	0.000	0.000	0.000	0.000	0.304	Dirt roads	P1b
0.927	0.000	0.000	0.000	0.000	0.927	Paved parking	P1a,
							P1d
0.918	0.000	0.000	0.000	0.000	0.918	Paved roads w/curbs & sewers	P1c
0.054	0.000	0.000	0.000	0.000	0.054	Roofs	P1c
8.199	0.000	0.000	0.000	0.000	8.199	Woods, Good	P1a,
							P1b,
							P1c
14.546	0.000	0.000	0.000	0.000	14.546	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	P1b	0.00	0.00	592.0	0.0270	0.013	24.0	0.0	0.0
2	P1c	0.00	0.00	544.0	0.0250	0.012	12.0	0.0	0.0
3	B4	389.00	386.00	138.0	0.0217	0.013	24.0	0.0	0.0

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Type III 24-hr 2-YR Rainfall=3.27"

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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentP1a: Road + Basin

Runoff Area=2.559 ac 33.49% Impervious Runoff Depth=0.51"
Tc=6.0 min CN=62 Runoff=1.05 cfs 0.109 af

SubcatchmentP1b: South overland

Runoff Area=8.292 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,347' Tc=26.2 min CN=33 Runoff=0.00 cfs 0.000 af

SubcatchmentP1c: Boston Road

Runoff Area=3.206 ac 30.32% Impervious Runoff Depth=0.22"
Flow Length=1,098' Tc=21.3 min CN=53 Runoff=0.20 cfs 0.058 af

SubcatchmentP1d: Boston Road - Off

Runoff Area=0.489 ac 14.31% Impervious Runoff Depth=0.08"
Tc=6.0 min CN=47 Runoff=0.01 cfs 0.003 af

Reach DP1: Wetlands @ Boston Road

Inflow=0.01 cfs 0.003 af
Outflow=0.01 cfs 0.003 af

Pond B4: Surface Infiltration Basin #4

Peak Elev=393.03' Storage=225 cf Inflow=1.05 cfs 0.167 af
Discarded=0.87 cfs 0.167 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.87 cfs 0.167 af

Total Runoff Area = 14.546 ac Runoff Volume = 0.170 af Average Runoff Depth = 0.14"
86.94% Pervious = 12.647 ac 13.06% Impervious = 1.899 ac

Summary for Subcatchment P1a: Road + Basin

Runoff = 1.05 cfs @ 12.12 hrs, Volume= 0.109 af, Depth= 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.27"

Area (ac)	CN	Description
0.857	98	Paved parking, HSG A
1.482	39	>75% Grass cover, Good, HSG A
* 0.151	98	Bot. Basin, 0% imp, HSG A
0.069	30	Woods, Good, HSG A
2.559	62	Weighted Average
1.702		66.51% Pervious Area
0.857		33.49% Impervious Area

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

Summary for Subcatchment P1b: South overland

[45] Hint: Runoff=Zero

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

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.27"

Area (ac)	CN	Description
1.148	39	>75% Grass cover, Good, HSG A
0.304	72	Dirt roads, HSG A
6.840	30	Woods, Good, HSG A
8.292	33	Weighted Average
8.292		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0460	0.09		Sheet Flow, 418-415.7 Woods: Light underbrush n= 0.400 P2= 3.00"
14.6	620	0.0200	0.71		Shallow Concentrated Flow, 415.7 to 403.2 Woodland Kv= 5.0 fps
1.7	85	0.0140	0.83		Shallow Concentrated Flow, 403.2 to 402 Short Grass Pasture Kv= 7.0 fps
0.8	592	0.0270	11.83	37.17	Pipe Channel, 402 to 386 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
26.2	1,347	Total			

Summary for Subcatchment P1c: Boston Road

Runoff = 0.20 cfs @ 12.60 hrs, Volume= 0.058 af, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.27"

Area (ac)	CN	Description
0.918	98	Paved roads w/curbs & sewers, HSG A
0.054	98	Roofs, HSG A
0.944	39	>75% Grass cover, Good, HSG A
1.290	30	Woods, Good, HSG A
3.206	53	Weighted Average
2.234		69.68% Pervious Area
0.972		30.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0100	0.05		Sheet Flow, 438-437.5 Woods: Light underbrush n= 0.400 P2= 3.00"
2.2	268	0.0860	2.05		Shallow Concentrated Flow, 437.5-417.5 Short Grass Pasture Kv= 7.0 fps
1.1	236	0.0290	3.46		Shallow Concentrated Flow, 417.5-410.6 Paved Kv= 20.3 fps
1.2	544	0.0250	7.77	6.10	Pipe Channel, 406.3-393 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
21.3	1,098	Total			

Summary for Subcatchment P1d: Boston Road - Off Grading

Runoff = 0.01 cfs @ 14.66 hrs, Volume= 0.003 af, Depth= 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.27"

Area (ac)	CN	Description
0.419	39	>75% Grass cover, Good, HSG A
0.070	98	Paved parking, HSG A
0.489	47	Weighted Average
0.419		85.69% Pervious Area
0.070		14.31% Impervious Area

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

Summary for Reach DP1: Wetlands @ Boston Road

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.546 ac, 13.06% Impervious, Inflow Depth = 0.00" for 2-YR event
 Inflow = 0.01 cfs @ 14.66 hrs, Volume= 0.003 af
 Outflow = 0.01 cfs @ 14.66 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B4: Surface Infiltration Basin #4

Inflow Area = 5.765 ac, 31.73% Impervious, Inflow Depth = 0.35" for 2-YR event
 Inflow = 1.05 cfs @ 12.12 hrs, Volume= 0.167 af
 Outflow = 0.87 cfs @ 12.21 hrs, Volume= 0.167 af, Atten= 18%, Lag= 5.5 min
 Discarded = 0.87 cfs @ 12.21 hrs, Volume= 0.167 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 393.03' @ 12.21 hrs Surf.Area= 6,631 sf Storage= 225 cf

Plug-Flow detention time= 4.3 min calculated for 0.167 af (100% of inflow)
 Center-of-Mass det. time= 4.3 min (937.5 - 933.2)

Volume	Invert	Avail.Storage	Storage Description
#1	393.00'	54,286 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
393.00	6,589	0	0
394.00	7,822	7,206	7,206
394.50	8,460	4,071	11,276
396.00	12,188	15,486	26,762
398.00	15,336	27,524	54,286

Device	Routing	Invert	Outlet Devices
#1	Discarded	393.00'	8.270 in/hr Exfiltration over Surface area
#2	Primary	389.00'	24.0" Round Culvert L= 138.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 389.00' / 386.00' S= 0.0217 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	396.50'	24.0" x 24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	397.00'	20.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=1.27 cfs @ 12.21 hrs HW=393.03' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 1.27 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=393.00' (Free Discharge)

↑**2=Culvert** (Passes 0.00 cfs of 26.20 cfs potential flow)

↑**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=393.00' (Free Discharge)

↑**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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Type III 24-hr 10-YR Rainfall=5.07"

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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentP1a: Road + BasinRunoff Area=2.559 ac 33.49% Impervious Runoff Depth=1.48"
Tc=6.0 min CN=62 Runoff=4.05 cfs 0.316 af**SubcatchmentP1b: South overland**Runoff Area=8.292 ac 0.00% Impervious Runoff Depth=0.05"
Flow Length=1,347' Tc=26.2 min CN=33 Runoff=0.05 cfs 0.033 af**SubcatchmentP1c: Boston Road**Runoff Area=3.206 ac 30.32% Impervious Runoff Depth=0.89"
Flow Length=1,098' Tc=21.3 min CN=53 Runoff=1.67 cfs 0.239 af**SubcatchmentP1d: Boston Road - Off**Runoff Area=0.489 ac 14.31% Impervious Runoff Depth=0.56"
Tc=6.0 min CN=47 Runoff=0.15 cfs 0.023 af**Reach DP1: Wetlands @ Boston Road**Inflow=0.15 cfs 0.056 af
Outflow=0.15 cfs 0.056 af**Pond B4: Surface Infiltration Basin #4**Peak Elev=393.71' Storage=5,000 cf Inflow=4.50 cfs 0.555 af
Discarded=1.43 cfs 0.555 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=1.43 cfs 0.555 af**Total Runoff Area = 14.546 ac Runoff Volume = 0.611 af Average Runoff Depth = 0.50"**
86.94% Pervious = 12.647 ac 13.06% Impervious = 1.899 ac

Summary for Subcatchment P1a: Road + Basin

Runoff = 4.05 cfs @ 12.10 hrs, Volume= 0.316 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.07"

Area (ac)	CN	Description
0.857	98	Paved parking, HSG A
1.482	39	>75% Grass cover, Good, HSG A
* 0.151	98	Bot. Basin, 0% imp, HSG A
0.069	30	Woods, Good, HSG A
2.559	62	Weighted Average
1.702		66.51% Pervious Area
0.857		33.49% Impervious Area

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

Summary for Subcatchment P1b: South overland

Runoff = 0.05 cfs @ 17.03 hrs, Volume= 0.033 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.07"

Area (ac)	CN	Description
1.148	39	>75% Grass cover, Good, HSG A
0.304	72	Dirt roads, HSG A
6.840	30	Woods, Good, HSG A
8.292	33	Weighted Average
8.292		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0460	0.09		Sheet Flow, 418-415.7 Woods: Light underbrush n= 0.400 P2= 3.00"
14.6	620	0.0200	0.71		Shallow Concentrated Flow, 415.7 to 403.2 Woodland Kv= 5.0 fps
1.7	85	0.0140	0.83		Shallow Concentrated Flow, 403.2 to 402 Short Grass Pasture Kv= 7.0 fps
0.8	592	0.0270	11.83	37.17	Pipe Channel, 402 to 386 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
26.2	1,347	Total			

Summary for Subcatchment P1c: Boston Road

Runoff = 1.67 cfs @ 12.38 hrs, Volume= 0.239 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.07"

Area (ac)	CN	Description
0.918	98	Paved roads w/curbs & sewers, HSG A
0.054	98	Roofs, HSG A
0.944	39	>75% Grass cover, Good, HSG A
1.290	30	Woods, Good, HSG A
3.206	53	Weighted Average
2.234		69.68% Pervious Area
0.972		30.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0100	0.05		Sheet Flow, 438-437.5 Woods: Light underbrush n= 0.400 P2= 3.00"
2.2	268	0.0860	2.05		Shallow Concentrated Flow, 437.5-417.5 Short Grass Pasture Kv= 7.0 fps
1.1	236	0.0290	3.46		Shallow Concentrated Flow, 417.5-410.6 Paved Kv= 20.3 fps
1.2	544	0.0250	7.77	6.10	Pipe Channel, 406.3-393 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
21.3	1,098	Total			

Summary for Subcatchment P1d: Boston Road - Off Grading

Runoff = 0.15 cfs @ 12.16 hrs, Volume= 0.023 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.07"

Area (ac)	CN	Description
0.419	39	>75% Grass cover, Good, HSG A
0.070	98	Paved parking, HSG A
0.489	47	Weighted Average
0.419		85.69% Pervious Area
0.070		14.31% Impervious Area

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

Summary for Reach DP1: Wetlands @ Boston Road

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.546 ac, 13.06% Impervious, Inflow Depth = 0.05" for 10-YR event
 Inflow = 0.15 cfs @ 12.16 hrs, Volume= 0.056 af
 Outflow = 0.15 cfs @ 12.16 hrs, Volume= 0.056 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B4: Surface Infiltration Basin #4

Inflow Area = 5.765 ac, 31.73% Impervious, Inflow Depth = 1.15" for 10-YR event
 Inflow = 4.50 cfs @ 12.11 hrs, Volume= 0.555 af
 Outflow = 1.43 cfs @ 12.82 hrs, Volume= 0.555 af, Atten= 68%, Lag= 42.4 min
 Discarded = 1.43 cfs @ 12.82 hrs, Volume= 0.555 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 393.71' @ 12.82 hrs Surf.Area= 7,466 sf Storage= 5,000 cf

Plug-Flow detention time= 24.9 min calculated for 0.554 af (100% of inflow)
 Center-of-Mass det. time= 24.9 min (912.7 - 887.8)

Volume	Invert	Avail.Storage	Storage Description
#1	393.00'	54,286 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
393.00	6,589	0	0
394.00	7,822	7,206	7,206
394.50	8,460	4,071	11,276
396.00	12,188	15,486	26,762
398.00	15,336	27,524	54,286

Device	Routing	Invert	Outlet Devices
#1	Discarded	393.00'	8.270 in/hr Exfiltration over Surface area
#2	Primary	389.00'	24.0" Round Culvert L= 138.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 389.00' / 386.00' S= 0.0217 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	396.50'	24.0" x 24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	397.00'	20.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=1.43 cfs @ 12.82 hrs HW=393.71' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 1.43 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=393.00' (Free Discharge)

↑**2=Culvert** (Passes 0.00 cfs of 26.20 cfs potential flow)

↑**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=393.00' (Free Discharge)

↑**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

W211141-PR-REV5

Prepared by Bohler Engineering

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Type III 24-hr 25-YR Rainfall=6.19"

Printed 9/27/2022

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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1a: Road + Basin Runoff Area=2.559 ac 33.49% Impervious Runoff Depth=2.22"
Tc=6.0 min CN=62 Runoff=6.33 cfs 0.474 af

Subcatchment P1b: South overland Runoff Area=8.292 ac 0.00% Impervious Runoff Depth=0.20"
Flow Length=1,347' Tc=26.2 min CN=33 Runoff=0.23 cfs 0.140 af

Subcatchment P1c: Boston Road Runoff Area=3.206 ac 30.32% Impervious Runoff Depth=1.47"
Flow Length=1,098' Tc=21.3 min CN=53 Runoff=3.12 cfs 0.392 af

Subcatchment P1d: Boston Road - Off Runoff Area=0.489 ac 14.31% Impervious Runoff Depth=1.02"
Tc=6.0 min CN=47 Runoff=0.42 cfs 0.041 af

Reach DP1: Wetlands @ Boston Road Inflow=0.42 cfs 0.181 af
Outflow=0.42 cfs 0.181 af

Pond B4: Surface Infiltration Basin #4 Peak Elev=394.48' Storage=11,138 cf Inflow=7.56 cfs 0.866 af
Discarded=1.62 cfs 0.866 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=1.62 cfs 0.866 af

Total Runoff Area = 14.546 ac Runoff Volume = 1.047 af Average Runoff Depth = 0.86"
86.94% Pervious = 12.647 ac 13.06% Impervious = 1.899 ac

Summary for Subcatchment P1a: Road + Basin

Runoff = 6.33 cfs @ 12.10 hrs, Volume= 0.474 af, Depth= 2.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.19"

Area (ac)	CN	Description
0.857	98	Paved parking, HSG A
1.482	39	>75% Grass cover, Good, HSG A
* 0.151	98	Bot. Basin, 0% imp, HSG A
0.069	30	Woods, Good, HSG A
2.559	62	Weighted Average
1.702		66.51% Pervious Area
0.857		33.49% Impervious Area

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

Summary for Subcatchment P1b: South overland

Runoff = 0.23 cfs @ 14.01 hrs, Volume= 0.140 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.19"

Area (ac)	CN	Description
1.148	39	>75% Grass cover, Good, HSG A
0.304	72	Dirt roads, HSG A
6.840	30	Woods, Good, HSG A
8.292	33	Weighted Average
8.292		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0460	0.09		Sheet Flow, 418-415.7 Woods: Light underbrush n= 0.400 P2= 3.00"
14.6	620	0.0200	0.71		Shallow Concentrated Flow, 415.7 to 403.2 Woodland Kv= 5.0 fps
1.7	85	0.0140	0.83		Shallow Concentrated Flow, 403.2 to 402 Short Grass Pasture Kv= 7.0 fps
0.8	592	0.0270	11.83	37.17	Pipe Channel, 402 to 386 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
26.2	1,347	Total			

Summary for Subcatchment P1c: Boston Road

Runoff = 3.12 cfs @ 12.35 hrs, Volume= 0.392 af, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.19"

Area (ac)	CN	Description
0.918	98	Paved roads w/curbs & sewers, HSG A
0.054	98	Roofs, HSG A
0.944	39	>75% Grass cover, Good, HSG A
1.290	30	Woods, Good, HSG A
3.206	53	Weighted Average
2.234		69.68% Pervious Area
0.972		30.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0100	0.05		Sheet Flow, 438-437.5 Woods: Light underbrush n= 0.400 P2= 3.00"
2.2	268	0.0860	2.05		Shallow Concentrated Flow, 437.5-417.5 Short Grass Pasture Kv= 7.0 fps
1.1	236	0.0290	3.46		Shallow Concentrated Flow, 417.5-410.6 Paved Kv= 20.3 fps
1.2	544	0.0250	7.77	6.10	Pipe Channel, 406.3-393 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
21.3	1,098	Total			

Summary for Subcatchment P1d: Boston Road - Off Grading

Runoff = 0.42 cfs @ 12.12 hrs, Volume= 0.041 af, Depth= 1.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.19"

Area (ac)	CN	Description
0.419	39	>75% Grass cover, Good, HSG A
0.070	98	Paved parking, HSG A
0.489	47	Weighted Average
0.419		85.69% Pervious Area
0.070		14.31% Impervious Area

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

Summary for Reach DP1: Wetlands @ Boston Road

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.546 ac, 13.06% Impervious, Inflow Depth = 0.15" for 25-YR event
 Inflow = 0.42 cfs @ 12.12 hrs, Volume= 0.181 af
 Outflow = 0.42 cfs @ 12.12 hrs, Volume= 0.181 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B4: Surface Infiltration Basin #4

Inflow Area = 5.765 ac, 31.73% Impervious, Inflow Depth = 1.80" for 25-YR event
 Inflow = 7.56 cfs @ 12.11 hrs, Volume= 0.866 af
 Outflow = 1.62 cfs @ 13.05 hrs, Volume= 0.866 af, Atten= 79%, Lag= 56.1 min
 Discarded = 1.62 cfs @ 13.05 hrs, Volume= 0.866 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 394.48' @ 13.05 hrs Surf.Area= 8,439 sf Storage= 11,138 cf

Plug-Flow detention time= 60.2 min calculated for 0.865 af (100% of inflow)
 Center-of-Mass det. time= 60.1 min (933.8 - 873.6)

Volume	Invert	Avail.Storage	Storage Description
#1	393.00'	54,286 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
393.00	6,589	0	0
394.00	7,822	7,206	7,206
394.50	8,460	4,071	11,276
396.00	12,188	15,486	26,762
398.00	15,336	27,524	54,286

Device	Routing	Invert	Outlet Devices
#1	Discarded	393.00'	8.270 in/hr Exfiltration over Surface area
#2	Primary	389.00'	24.0" Round Culvert L= 138.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 389.00' / 386.00' S= 0.0217 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	396.50'	24.0" x 24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	397.00'	20.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=1.62 cfs @ 13.05 hrs HW=394.48' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 1.62 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=393.00' (Free Discharge)

↑**2=Culvert** (Passes 0.00 cfs of 26.20 cfs potential flow)

↑**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=393.00' (Free Discharge)

↑**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

W211141-PR-REV5

Prepared by Bohler Engineering

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Type III 24-hr 100-YR Rainfall=7.92"

Printed 9/27/2022

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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1a: Road + BasinRunoff Area=2.559 ac 33.49% Impervious Runoff Depth=3.49"
Tc=6.0 min CN=62 Runoff=10.19 cfs 0.745 af**Subcatchment P1b: South overland**Runoff Area=8.292 ac 0.00% Impervious Runoff Depth=0.62"
Flow Length=1,347' Tc=26.2 min CN=33 Runoff=1.61 cfs 0.426 af**Subcatchment P1c: Boston Road**Runoff Area=3.206 ac 30.32% Impervious Runoff Depth=2.52"
Flow Length=1,098' Tc=21.3 min CN=53 Runoff=5.81 cfs 0.672 af**Subcatchment P1d: Boston Road - Off**Runoff Area=0.489 ac 14.31% Impervious Runoff Depth=1.89"
Tc=6.0 min CN=47 Runoff=0.93 cfs 0.077 af**Reach DP1: Wetlands @ Boston Road**Inflow=1.80 cfs 0.503 af
Outflow=1.80 cfs 0.503 af**Pond B4: Surface Infiltration Basin #4**Peak Elev=395.64' Storage=22,575 cf Inflow=12.95 cfs 1.417 af
Discarded=2.16 cfs 1.417 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=2.16 cfs 1.417 af**Total Runoff Area = 14.546 ac Runoff Volume = 1.921 af Average Runoff Depth = 1.58"**
86.94% Pervious = 12.647 ac 13.06% Impervious = 1.899 ac

Summary for Subcatchment P1a: Road + Basin

Runoff = 10.19 cfs @ 12.10 hrs, Volume= 0.745 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.92"

Area (ac)	CN	Description
0.857	98	Paved parking, HSG A
1.482	39	>75% Grass cover, Good, HSG A
* 0.151	98	Bot. Basin, 0% imp, HSG A
0.069	30	Woods, Good, HSG A
2.559	62	Weighted Average
1.702		66.51% Pervious Area
0.857		33.49% Impervious Area

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

Summary for Subcatchment P1b: South overland

Runoff = 1.61 cfs @ 12.63 hrs, Volume= 0.426 af, Depth= 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.92"

Area (ac)	CN	Description
1.148	39	>75% Grass cover, Good, HSG A
0.304	72	Dirt roads, HSG A
6.840	30	Woods, Good, HSG A
8.292	33	Weighted Average
8.292		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0460	0.09		Sheet Flow, 418-415.7 Woods: Light underbrush n= 0.400 P2= 3.00"
14.6	620	0.0200	0.71		Shallow Concentrated Flow, 415.7 to 403.2 Woodland Kv= 5.0 fps
1.7	85	0.0140	0.83		Shallow Concentrated Flow, 403.2 to 402 Short Grass Pasture Kv= 7.0 fps
0.8	592	0.0270	11.83	37.17	Pipe Channel, 402 to 386 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
26.2	1,347	Total			

Summary for Subcatchment P1c: Boston Road

Runoff = 5.81 cfs @ 12.32 hrs, Volume= 0.672 af, Depth= 2.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.92"

Area (ac)	CN	Description
0.918	98	Paved roads w/curbs & sewers, HSG A
0.054	98	Roofs, HSG A
0.944	39	>75% Grass cover, Good, HSG A
1.290	30	Woods, Good, HSG A
3.206	53	Weighted Average
2.234		69.68% Pervious Area
0.972		30.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	50	0.0100	0.05		Sheet Flow, 438-437.5 Woods: Light underbrush n= 0.400 P2= 3.00"
2.2	268	0.0860	2.05		Shallow Concentrated Flow, 437.5-417.5 Short Grass Pasture Kv= 7.0 fps
1.1	236	0.0290	3.46		Shallow Concentrated Flow, 417.5-410.6 Paved Kv= 20.3 fps
1.2	544	0.0250	7.77	6.10	Pipe Channel, 406.3-393 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
21.3	1,098	Total			

Summary for Subcatchment P1d: Boston Road - Off Grading

Runoff = 0.93 cfs @ 12.11 hrs, Volume= 0.077 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.92"

Area (ac)	CN	Description
0.419	39	>75% Grass cover, Good, HSG A
0.070	98	Paved parking, HSG A
0.489	47	Weighted Average
0.419		85.69% Pervious Area
0.070		14.31% Impervious Area

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

Summary for Reach DP1: Wetlands @ Boston Road

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 14.546 ac, 13.06% Impervious, Inflow Depth = 0.42" for 100-YR event
 Inflow = 1.80 cfs @ 12.61 hrs, Volume= 0.503 af
 Outflow = 1.80 cfs @ 12.61 hrs, Volume= 0.503 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B4: Surface Infiltration Basin #4

Inflow Area = 5.765 ac, 31.73% Impervious, Inflow Depth = 2.95" for 100-YR event
 Inflow = 12.95 cfs @ 12.11 hrs, Volume= 1.417 af
 Outflow = 2.16 cfs @ 13.21 hrs, Volume= 1.417 af, Atten= 83%, Lag= 66.2 min
 Discarded = 2.16 cfs @ 13.21 hrs, Volume= 1.417 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 395.64' @ 13.21 hrs Surf.Area= 11,302 sf Storage= 22,575 cf

Plug-Flow detention time= 108.9 min calculated for 1.416 af (100% of inflow)
 Center-of-Mass det. time= 108.9 min (967.9 - 859.0)

Volume	Invert	Avail.Storage	Storage Description
#1	393.00'	54,286 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
393.00	6,589	0	0
394.00	7,822	7,206	7,206
394.50	8,460	4,071	11,276
396.00	12,188	15,486	26,762
398.00	15,336	27,524	54,286

Device	Routing	Invert	Outlet Devices
#1	Discarded	393.00'	8.270 in/hr Exfiltration over Surface area
#2	Primary	389.00'	24.0" Round Culvert L= 138.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 389.00' / 386.00' S= 0.0217 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	396.50'	24.0" x 24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	397.00'	20.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=2.16 cfs @ 13.21 hrs HW=395.64' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 2.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=393.00' (Free Discharge)

↑**2=Culvert** (Passes 0.00 cfs of 26.20 cfs potential flow)

↑**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=393.00' (Free Discharge)

↑**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

APPENDIX E: STORMWATER CALCULATIONS

- MA STANDARD #3 – RECHARGE AND DRAWDOWN TIME (Addendum 9/02/22)
- MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL (Addendum 9-/02/22)
- OUTLET PROTECTION SIZING (Addendum 9/28/22)

Proposed Subdivision Roadway
UNIFIED Parkway
Sutton, MA
Bohler Job Number: W211141
November 10, 2021
Revised December 16, 2021
Addendum: September 28, 2022

MA DEP Standard 3: Recharge Volume Calculations

Required Recharge Volume - A Soils (0.60 in.)

Existing Site Impervious Area (ac)	0.813
Proposed Site Impervious Area (ac)	8.408
Proposed Increase in Site Impervious Area (ac)	7.595
Recharge Volume Required (cf)	16,542

Required Recharge Volume - B Soils (0.35 in.)

Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	0

Required Recharge Volume - C Soils (0.25 in.)

Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	0

Required Recharge Volume - D Soils (0.10 in.)

Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	0

Total Recharge Volume Required (cf) 16,542

Recharge Volume Adjustment Factor

Impervious Area Directed to Infiltration BMP (ac)	8.408
%Impervious Directed to Infiltration BMP	100%
Adjustment Factor	1.00
Adjusted Total Recharge Volume Required (cf)	16,542

Provided Recharge Volume*

Basin 1	29,948
Basin 2	61,466
Basin 3	63,392
Basin 4	33,053
Total Recharge Volume Provided (cf)	187,859

Provided greater than or Equal to Required

*Volume provided below lowest outlet in cubic feet (cf)

Stage-Area-Storage for Pond B4: Surface Infiltration Basin #4

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
393.00	6,589	0	395.65	11,318	22,648
393.05	6,651	331	395.70	11,442	23,217
393.10	6,712	665	395.75	11,567	23,793
393.15	6,774	1,002	395.80	11,691	24,374
393.20	6,836	1,342	395.85	11,815	24,962
393.25	6,897	1,686	395.90	11,939	25,556
393.30	6,959	2,032	395.95	12,064	26,156
393.35	7,021	2,382	396.00	12,188	26,762
393.40	7,082	2,734	396.05	12,267	27,373
393.45	7,144	3,090	396.10	12,345	27,989
393.50	7,206	3,449	396.15	12,424	28,608
393.55	7,267	3,810	396.20	12,503	29,231
393.60	7,329	4,175	396.25	12,582	29,858
393.65	7,390	4,543	396.30	12,660	30,489
393.70	7,452	4,914	396.35	12,739	31,124
393.75	7,514	5,289	396.40	12,818	31,763
393.80	7,575	5,666	396.45	12,896	32,406
393.85	7,637	6,046	396.50	12,975	33,053
393.90	7,699	6,429	396.55	13,054	33,703
393.95	7,760	6,816	396.60	13,132	34,358
394.00	7,822	7,206	396.65	13,211	35,017
394.05	7,886	7,598	396.70	13,290	35,679
394.10	7,950	7,994	396.75	13,369	36,346
394.15	8,013	8,393	396.80	13,447	37,016
394.20	8,077	8,795	396.85	13,526	37,690
394.25	8,141	9,201	396.90	13,605	38,369
394.30	8,205	9,610	396.95	13,683	39,051
394.35	8,269	10,021	397.00	13,762	39,737
394.40	8,332	10,436	397.05	13,841	40,427
394.45	8,396	10,855	397.10	13,919	41,121
394.50	8,460	11,276	397.15	13,998	41,819
394.55	8,584	11,702	397.20	14,077	42,521
394.60	8,709	12,134	397.25	14,156	43,227
394.65	8,833	12,573	397.30	14,234	43,936
394.70	8,957	13,018	397.35	14,313	44,650
394.75	9,081	13,469	397.40	14,392	45,368
394.80	9,206	13,926	397.45	14,470	46,089
394.85	9,330	14,389	397.50	14,549	46,815
394.90	9,454	14,859	397.55	14,628	47,544
394.95	9,578	15,335	397.60	14,706	48,278
395.00	9,703	15,817	397.65	14,785	49,015
395.05	9,827	16,305	397.70	14,864	49,756
395.10	9,951	16,799	397.75	14,943	50,501
395.15	10,075	17,300	397.80	15,021	51,250
395.20	10,200	17,807	397.85	15,100	52,003
395.25	10,324	18,320	397.90	15,179	52,760
395.30	10,448	18,839	397.95	15,257	53,521
395.35	10,573	19,365	398.00	15,336	54,286
395.40	10,697	19,897			
395.45	10,821	20,435			
395.50	10,945	20,979			
395.55	11,070	21,529			
395.60	11,194	22,086			

Proposed Subdivision Roadway
UNIFIED Parkway
Sutton, MA
Bohler Job Number: W211141
November 10, 2021
Revised December 16, 2021
Addendum: September 28, 2022

MA DEP Standard 3: Drawdown Time Calculations

Drawdown Time - Basin 4

Volume below outlet pipe (Rv) (cf)	33,053
Soil Type	Sand - A
Infiltration rate (K)*	8.27
Bottom Area (sf)	5,795
Drawdown time (Hours)**	8.3

*Infiltration Rates taken from Rawls Table

**Drawdown time = $R_v / (K) \times (\text{bottom area})$

Basins 1-3 excluded as no modifications are proposed to said basins

Proposed Subdivision Roadway
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Revised December 16, 2021
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MA DEP Standard 4: Water Quality Volume Calculations

Water Quality Volume Required

Water Quality Volume runoff (in.)*	1.0
Total Post Development Impervious Area (sf)	366,245
Required Water Quality Volume (cf)	30,520

*Water Quality volume runoff is equal to 1.0 inch of runoff times the total impervious area of the post development project site.

Water Quality Volume Provided*

Basin 1	29,948
Basin 2	61,466
Basin 3	63,392
Basin 4	33,053
Total Provided Water Quality Volume (cf)	187,859

Provided greater than or Equal to Required

*Volume provided below lowest outlet pipe in cubic feet (cf)

TSS Removal Calculation Worksheet

Location: (Pretreatment) CB to Forebay #4

Basins 1-3 excluded as no modifications are proposed to said basins

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded Catch Basins	0.25	1.00	0.25	0.75
Forebay	0.25	0.75	0.19	0.56

Total TSS Removal =

44%

Project: W211141

Prepared By: Bohler Engineering

Date: 9/28/2022

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

TSS Removal Calculation Worksheet

Location: (Treatment) CB to Surface Infiltration Basins #4

Basins 1-3 excluded as no modifications are proposed to said basins

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded Catch Basins	0.25	1.00	0.25	0.75
Surface Infiltration Basin (with forebay pretreatment)	0.80	0.75	0.60	0.15

Total TSS Removal =

85%

Project: W211141

Prepared By: Bohler Engineering

Date: 9/28/2022

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

Proposed Subdivision Roadway
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Forebay Sizing Calculations

Forebay #4	
Total Post Development Impervious Area (acres)	1.98
Forebay Volume Required (cf)	719
Forebay Volume Provided (cf)*	1,295
*Volume provided below lowest outlet of forebay, refer to attached storage tables Forebays 1-3 excluded as no modifications are proposed to said basins	

W211141-Forebay-Rev5

Prepared by Bohler Engineering

HydroCAD® 10.00-21 s/n 08311 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.27"

Printed 9/26/2022

Page 1

Stage-Area-Storage for Pond 4: Forebay 4

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
393.00	601	0	394.06	969	831
393.02	608	12	394.08	977	850
393.04	615	24	394.10	985	870
393.06	622	37	394.12	992	890
393.08	629	49	394.14	1,000	910
393.10	636	62	394.16	1,008	930
393.12	642	75	394.18	1,015	950
393.14	649	88	394.20	1,023	970
393.16	656	101	394.22	1,031	991
393.18	663	114	394.24	1,039	1,012
393.20	670	127	394.26	1,046	1,033
393.22	677	141	394.28	1,054	1,054
393.24	684	154	394.30	1,062	1,075
393.26	691	168	394.32	1,070	1,096
393.28	698	182	394.34	1,077	1,117
393.30	705	196	394.36	1,085	1,139
393.32	711	210	394.38	1,093	1,161
393.34	718	224	394.40	1,100	1,183
393.36	725	239	394.42	1,108	1,205
393.38	732	253	394.44	1,116	1,227
393.40	739	268	394.46	1,124	1,249
393.42	746	283	394.48	1,131	1,272
393.44	753	298	394.50	1,139	1,295
393.46	760	313			
393.48	767	328			
393.50	774	344			
393.52	780	359			
393.54	787	375			
393.56	794	391			
393.58	801	407			
393.60	808	423			
393.62	815	439			
393.64	822	455			
393.66	829	472			
393.68	836	488			
393.70	842	505			
393.72	849	522			
393.74	856	539			
393.76	863	556			
393.78	870	574			
393.80	877	591			
393.82	884	609			
393.84	891	627			
393.86	898	644			
393.88	905	662			
393.90	911	681			
393.92	918	699			
393.94	925	717			
393.96	932	736			
393.98	939	755			
394.00	946	774			
394.02	954	792			
394.04	961	812			

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Sutton, MA
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Addendum: September 28, 2022

Rip Rap Sizing Calculations

Rip Rap Sizing Calculations						
Design Period Storm:			100	Year		
Location	Pipe Size (in)	Pipe Size (ft)	Q (cfs)	TW* (ft)	D ₅₀ (ft)	D ₅₀ ** (in)
FES 400	12	1.0	6.62	0.3	0.52	6
FES 401	12	1.0	7.55	0.3	0.61	7
HW 502	24	2.0	20.43	0.3	0.92	11

Based on Eq. 11.35 of ConnDOT Drainage Manual

* Assume tailwater =0.3

** Q<10 cfs - min. 6" stone size, Q>10 cfs - min. 12" stone size

Outlet Protection Sizing Calculations						
Design Period Storm:			100	Year		
Location	Pipe Size (in)	Pipe Size (ft)	Q (cfs)	W1 (ft)	La (ft)	W2 (ft)
FES 400	12	1.0	6.62	3.00	Use Scour Hole	
FES 401	12	1.0	7.55	3.00	Use Scour Hole	
HW 502	24	2.0	20.43	6.00	Use Scour Hole	

Based ConnDOT Drainage Manual - Type A Riprap Apron

**Proposed Subdivision Roadway
UNIFIED Parkway
Sutton, MA**

Scour Hole Sizing Calculations						
Design Period Storm:		100	Year			
Location	Pipe Size (in)	Pipe Size (ft)	Q (cfs)	F (ft)	C (ft)	B (ft)
FES 400	12	1.0	6.62	0.50	10	10
FES 401	12	1.0	7.55	0.50	10	10
HW 502	24	2.0	20.43	1.00	12	10

Based on ConnDOT Drainage Manual - Type 1 Scour Hole

APPENDIX F: MEMORANDUM PREPARED BY VHB (DATED: 9/15/2022) RE:
REDEVELOPMENT OF BOSTON ROAD AT UNIFIED PARKWAY



Memorandum

To: Bohler
352 Turnpike Road
Southborough, MA 01772

Date: September 15, 2022

Project #: 15047.00 Unified Parkway at Boston Road, Sutton

From: Karen S. Fung, PE
Luke Boucher, PE

Re: Redevelopment of Boston Road at Unified Parkway

This Appendix supplements the Stormwater Management Report for the Definitive Subdivision Project Unified Parkway at Boston Road. This memo describes the stormwater management in association with the redevelopment of Boston Road and is intended to show compliance with the Massachusetts Stormwater Management Standards to the maximum extent practicable, in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00).

Project Description

The Applicant, UGPG RE Sutton, LLC, is proposing to construct a new access, Unified Parkway, onto Boston Road to service the Definitive Subdivision (approved January 12, 2022). The access will intersect Boston Road approximately 800 feet to the east of Galaxy Pass.

In association with the Subdivision, approximately 1,162 ft of main Boston Road will be redeveloped; specifically, a dedicated left turn will be added on the west side approach and a scored concrete median between will be added on the east side approach. Roadway construction consists primarily of mill and overlay with widening of less than a whole lane. A pedestrian walk with varying grass strip is proposed along a portion of Boston Road. Within the redevelopment limits on Boston Road, additional deep-sump catch basins are proposed to supplement the existing municipal drainage system. Under the proposed conditions, runoff from portions of the impervious roadway will be treated and directed to a Best Management Practice (BMP) system as part of the subdivision, thereby reducing the area tributary to the Municipal system, resulting in improved stormwater quality and reduced stormwater quantity.

As shown in Figure A1, portions of the redevelopment area are within the 100-foot buffer zone to Bordering Vegetated Wetlands (BVW) for wetlands near Girard Pond, which are subject to the jurisdiction of the Massachusetts Wetland Protections Act. The redevelopment area is not located within any well protection area (Figure A6.2).

Under the Stormwater Management Standards, the work on Boston Road is considered a redevelopment project because it involves maintenance and improvement of an existing roadway, including widening less than a single lane, and correcting substandard intersections and drainage. The redevelopment has been designed to meet the Stormwater Management Standards to the maximum extent practicable, and to improve upon existing conditions.



Memorandum

Site Description

Watershed

Existing discharge points for roadway runoff within the redevelopment area include Girard Pond and Woodbury Pond. Both ponds are listed on the Massachusetts 2018/2020 Integrated List of Waters. Girard Pond (MA51053) is listed as Category 4c "Impairment not caused by a pollutant – TMDL not required". Woodbury Pond (MA51185) is listed as Category 5, 303(d) List "Waters requiring a TMDL" for Aquatic Plants (Macrophytes). No TMDLs have been prepared at the time of this supplement. A third design point, Cold Spring Brook, is not listed. See Figure A2.

The Project is not located in an area designated as an Outstanding Resource Water (ORW)¹.

Land Use

As the redevelopment area is linear, land use is primarily Impervious for the existing roadway. Abutting the redevelopment area is mostly deciduous forest with a smaller percentage of developed open space near Galaxy Pass toward the southern end of the project. Minor areas of evergreen forest or pasture/hay are also located adjacent to the roadway throughout. See Figure A3.

Utilities

Subsurface utilities along the Project Area include water, sanitary sewer, closed drainage, and gas. Above-ground utilities include utility poles, overhead wires, and hydrants. Lastly, there are traffic signals and a traffic control box at the southern end of the redevelopment area.

Topography

In general, the redevelopment area is located in the river valley formed between Aldrich Pond, Girard Pond, Woodbury Pond and Cold Spring Brook. The valley typically descends with elevations ranging from approximately 420 ft at Galaxy Pass to approximately 375 ft at the northeast end of the redevelopment at Buttonwood Ave. Beyond the project area, the river valley turns north and parallels Buttonwood Ave to junctions at the Blackstone River north of the project area.

In general, the area is neither level nor mountainous but has rolling terrain with slopes ranging from approximately 2% to 5%. The proposed profile follows the existing with positive drainage descending toward the northeast to eventually discharge into the Design Point Offsite at Cold Spring Brook.

Soils

The Natural Resources Conservation Service (NRCS) soil survey² has mapped the surface soils within the redevelopment area as predominantly Merrimac 254B (HSG A) with a small portion near Unified Parkway as Scarboro 3A (HSG B/D). See Figure A4.

¹ Massachusetts DEP, 2013. 314 CMR 4.00 Massachusetts Surface Water Quality Standards.

² Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey.



Memorandum

Floodplain

The redevelopment area lies outside of the FEMA 100-yr flood limits and no filling below the flood elevation is anticipated. See Figure A5.

Existing Drainage Infrastructure and Structural Best Management Practices (BMPs)

The existing drainage infrastructure within the redevelopment area on Boston Road consists of either country drainage off the edge of the pavement or municipal closed-drainage system (catch basins, drop inlets, manholes, pipes). Final discharge points occur at the wetland areas south of the roadway (Girard Pond or Woodbury Pond) or at the wetland area surrounding Cold Spring Brook downstream of Woodbury Pond and at the northeastern end of the redevelopment. None of the existing inlets have deep sumps (4 ft or more). There is no stormwater treatment within the project area under existing conditions.

Figure A1 and Table A1 show the existing impervious areas. The total impervious area producing runoff is approximately 42,216 sf. The majority of runoff, from approximately 34,901 sf of impervious area, enters the municipal system to discharge to Woodbury Pond or downstream into Cold Spring Brook. The balance of runoff enters overland to Girard Pond. None of the runoff from the existing roadway area is treated before entering the wetlands.

Proposed Drainage Conditions

Land Cover

The redevelopment proposes to increase impervious cover by approximately 0.25 acres. Proposed impervious cover will be comprised of asphalt roadway widening of less than a whole lane and a new 5-ft wide walk with grass strip on the left side of the redevelopment.

Structural BMPs

The redevelopment project proposes to supplement the existing closed drainage system with new deep-sump, hooded catch basins which will treat runoff produced from the majority of the existing impervious area as well as portions of the additional proposed impervious areas. Also, much of the runoff will be removed from the municipal system to discharge to a stormwater treatment area (BMP) for the definitive subdivision.

Erosion and Sediment Control

An erosion and sedimentation control program will be implemented to minimize temporary impacts to wetland resource areas prior to and during the construction phase of the Project. The program will incorporate BMPs specified in guidelines developed by the DEP³ and the U.S. Environmental Protection Agency (EPA)⁴.

Non-structural practices to be used during construction include permanent seeding and pavement sweeping. These practices will be initiated as soon as practicable during construction. Structural erosion and sedimentation controls include erosion control barriers and catch basin inlet protection.

³ DEP, 1997. *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers, and Municipal Officials*.

⁴ EPA, 2007. *Interim Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites*. Office of Water. Report EPA 833-R-060-04.



Closed-Drainage System

The proposed drainage system is designed to meet gutter spread, hydraulic grade line, and velocity requirements to the maximum extent practicable.

Figure A1 and Table A1 also show the proposed impervious areas. Under proposed conditions, runoff is treated and/or removed from the municipal system.

Under proposed conditions, the total amount of impervious area within the redevelopment area is approximately 53,309 sf and includes both proposed and existing surfaces. South of the intersection, not only does runoff from the new widened areas and new walk receive BMP treatment, but also runoff from the previously existing impervious areas is removed from the municipal system and is re-routed to the BMP treatment (approximately 33,843 sf area discharging to an on-site BMP); runoff from approximately 19,466 sf remains in the municipal system. Refer to Stormwater Report prepared by Bohler Engineering for discussion regarding the 33,843 sf area discharging to the on-site BMP. Runoff from the remaining 19,466 sf of impervious area enters a new gutter inlet or continues offsite to be captured by the existing municipal system before discharging to the design point at Woodbury Pond or Cold Spring Brook. This 19,466 sf is a 54% reduction from the 42,216 sf of impervious surfaces discharging to the design point under existing conditions.

Massachusetts Department of Environmental Protection (MassDEP) – Stormwater Management Standards

Under the Stormwater Management Standards, the Project is considered a redevelopment project because it involves maintenance and improvement of an existing roadway, including widening less than a single lane, and correcting substandard intersections and drainage. The Project has been designed to meet the Stormwater Management Standards to the maximum extent practicable, and to improve upon existing conditions.

Standard 1: No New Untreated Discharges or Erosion to Wetlands

The redevelopment project has been designed to comply with Standard 1.

The project proposes no new untreated discharges to wetlands or receiving waters. All discharges will be treated through deep-sump, hooded catch basins and no new discharges are proposed.

Standard 2: Peak Rate Attenuation

As the roadway portion of the project results in a 54% reduction in impervious area tributary to the design point, the project will not result in an increase in peak rates at the design point. As a result, this portion of the project has been designed to comply with Standard 2.



Standard 3: Stormwater Recharge

As a redevelopment, the design complies with Standard 3 to the maximum extent practicable.

Due to limited space within the right-of-way in the project corridor, infiltration BMPs are not able to be incorporated into the design for the roadway portion of the work discharging to the municipal system.

Standard 4: Water Quality

As a redevelopment, the design complies with Standard 4 to the maximum extent practicable.

Under existing conditions, stormwater BMPs on the roadway are limited to only catch basins, many of which do not have deep sumps.

Runoff from the project area will be collected by deep-sump, hooded catch basins and then discharged to a flared end section. These catch basins have been designed to provide a total of 25% TSS removal. As the project will result in an increase in the number of deep-sump, hooded catch basins, the provided treatment will result in improved water quality at the discharge location.

The redevelopment area, located within the Blackstone River Watershed, is covered by a Draft TMDL for pathogens. The Draft TMDL does not require mitigation beyond the six minimum control measures (MCMs) as covered under the Town and MassDOT MS4 stormwater management programs.

Under existing conditions, the majority of runoff from the redevelopment area is collected by existing catch basins on the roadway, which will be either retained or replaced or by country drainage. Additional deep-sump catch basins are proposed along the project corridor to supplement the existing catch basins, resulting in a greater capacity for treatment. It should be noted that the new catch basins will be routed to a BMP storm water management area which also treats runoff from the Definitive Subdivision.

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

There are no known land uses with higher potential pollutant loads (LUHPPLs) in or with drainage areas directly tributary to the Project Area. As a result, the redevelopment complies fully with Standard 5.



Standard 6: Critical Areas

Although Cold Spring Brook is listed as a Coldwater Fishery Resource, redevelopment work is outside of the 200 ft riverfront boundary. See Figure A6.1.

The redevelopment project is also located outside of any other Area of Critical Environmental Concern (including wellhead protection areas, Zone A Surface Water Protection areas, bathing beaches, and shellfish growing areas). See Figure A6.2.

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

The Boston Road project is considered as redevelopment and has been designed to comply with the Stormwater Management Standards to the maximum extent practicable. The project fully complies with Standards 1, 2, 5, 6, 8, 9, and 10. Due to site constraints, the project complies with the pretreatment and structural best management practice requirements of Standards 3 and 4 to the maximum extent practicable.

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

The overall project will disturb over 1 acre of land and is therefore required to obtain coverage under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Construction General Permit. As required under this permit, a Stormwater Pollution Prevention Plan (SWPPP) will be developed and submitted before land disturbance begins.

Standard 9: Operation and Maintenance Plan

Operation and maintenance of the revised municipal system is covered under Town guidelines.

Operation and maintenance of the BMP stormwater management area is covered under the Definitive Subdivision Long Term Pollution Prevention Plan.



Standard 10: Prohibition of Illicit Discharges

The redevelopment area does not have any known illicit connections. Any illicit connections to sanitary sewer or storm drainage structures found in the project limit of work will be removed or incorporated into the project.

See also the Long-Term Pollution Prevention Plan for the Definitive Subdivision for measures to prevent illicit discharges.

Tables:

Table A1 – Existing and Proposed Impervious Areas

Figures:

Figure A1 – Existing and Proposed Impervious Areas
Figure A2 – Final Massachusetts Integrated List of Waters 2018/2020
Figure A3 – Land Use, MassMapper Screenshot Sept. 2022
Figure A4 – USGS Soils, MassMapper Screenshot Sept. 2022
Figure A5 – FEMA Limits, MassMapper Screenshot Sept. 2022
Figure A6.1 – Coldwater Fishery Resource, MassMapper Screenshot Sept. 2022
Figure A6.2 – Wellhead Protection Areas, MassMapper Screenshot Sept. 2022

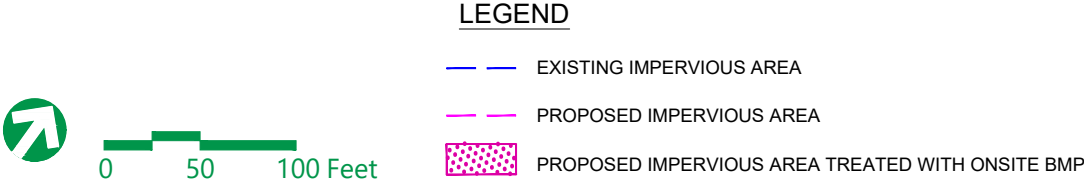
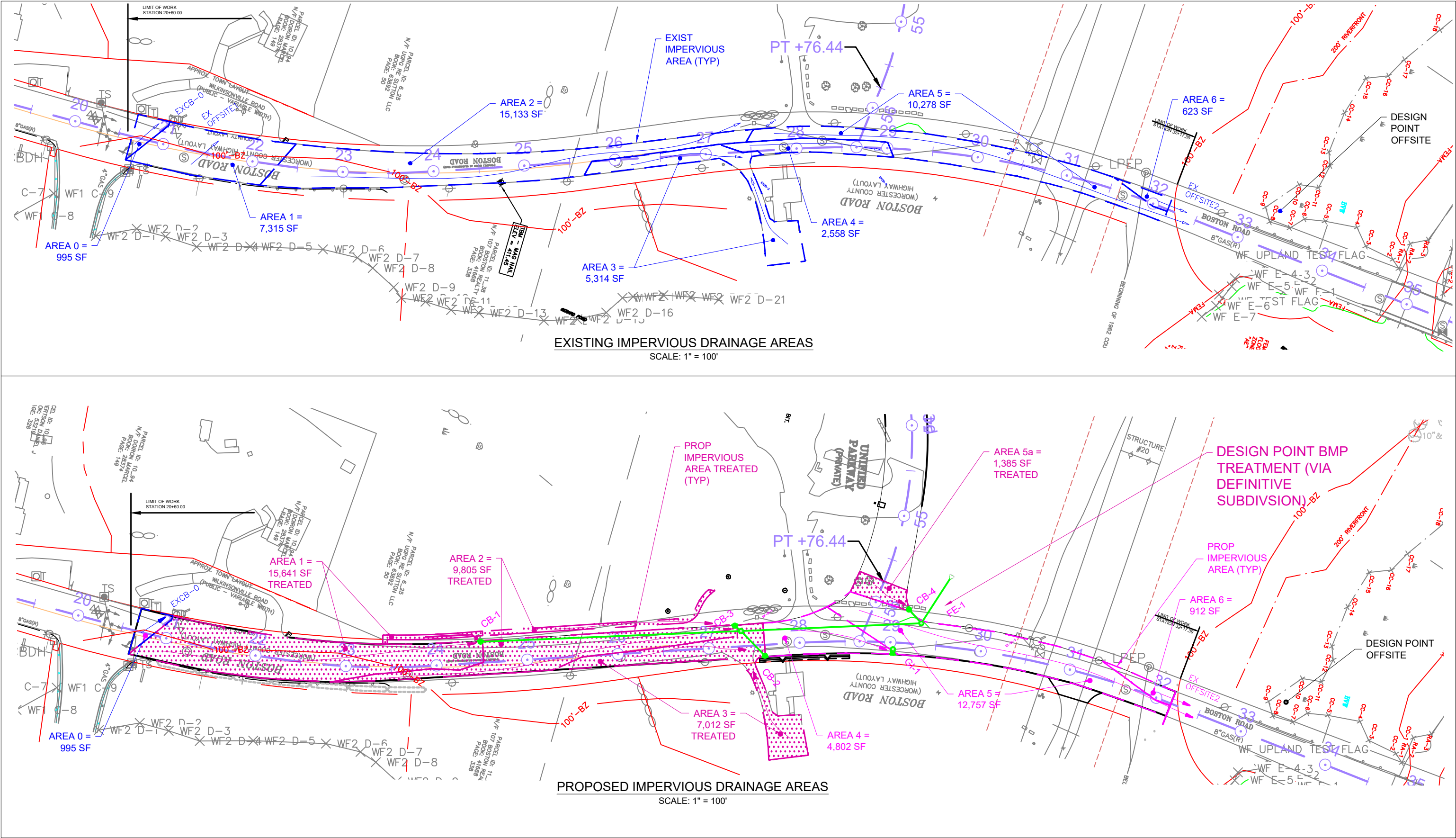


TABLE A1 - Existing and Impervious Areas

Impervious Drainage Areas

Project: 15047
Unified Drive, Sutton, MA
Revised 9/14/2022

Drainage Area	Existing Impervious (SF)	Existing Inlet	Proposed Impervious (SF)	Proposed Inlet
Area 0	995	Exist CB-0, Sta 20+98 LT	995	Exist CB-0, Sta 20+98 LT
Area 1	7,315	Offsite 1	15,641	Prop BMP system - Deep Sump CB-1
Area 2	15,133	Existing DI-1	9,805	Prop BMP system - Deep Sump CB-3
Area 3	5,314	Existing CB-2	7,012	Prop BMP system - Deep Sump CB-4
Area 4	2,558	Existing CB-5	4,802	GI-1
Area 5	10,278	Offsite to DESIGN POINT	12,757	to DESIGN POINT OFFSITE
Area 5a (Prop Design Only)	--	--	1,385	Prop BMP system - Deep Sump CB-2
Area 6	623	Offsite to DESIGN POINT	912	to DESIGN POINT OFFSITE
TOTAL IMPERVIOUS AREA	42,216	SF	53,309	SF
		Proposed amount treated & removed from municipal system	33,843	SF
		Proposed amount remaining in system, untreated	19,466	SF

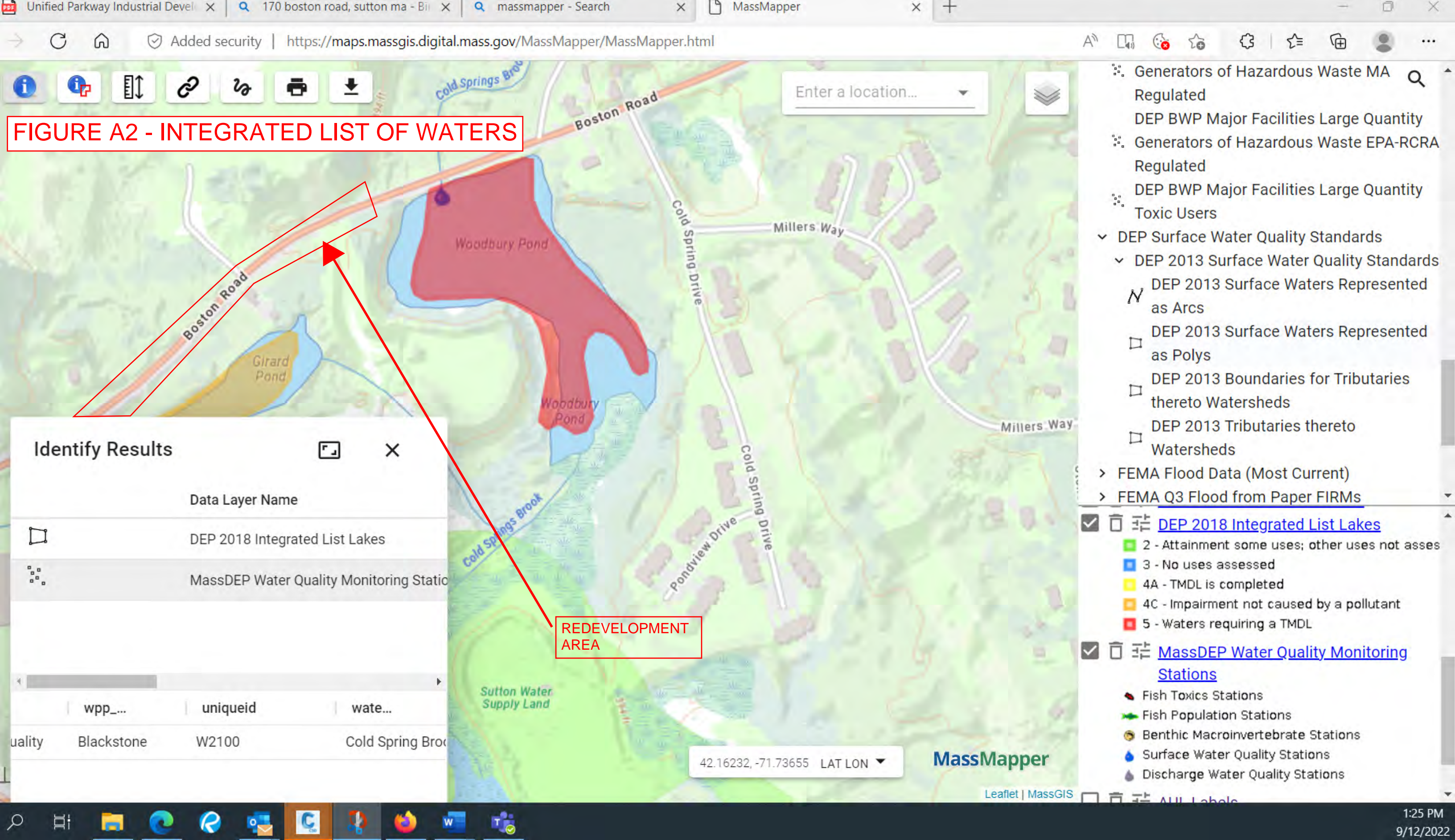
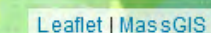
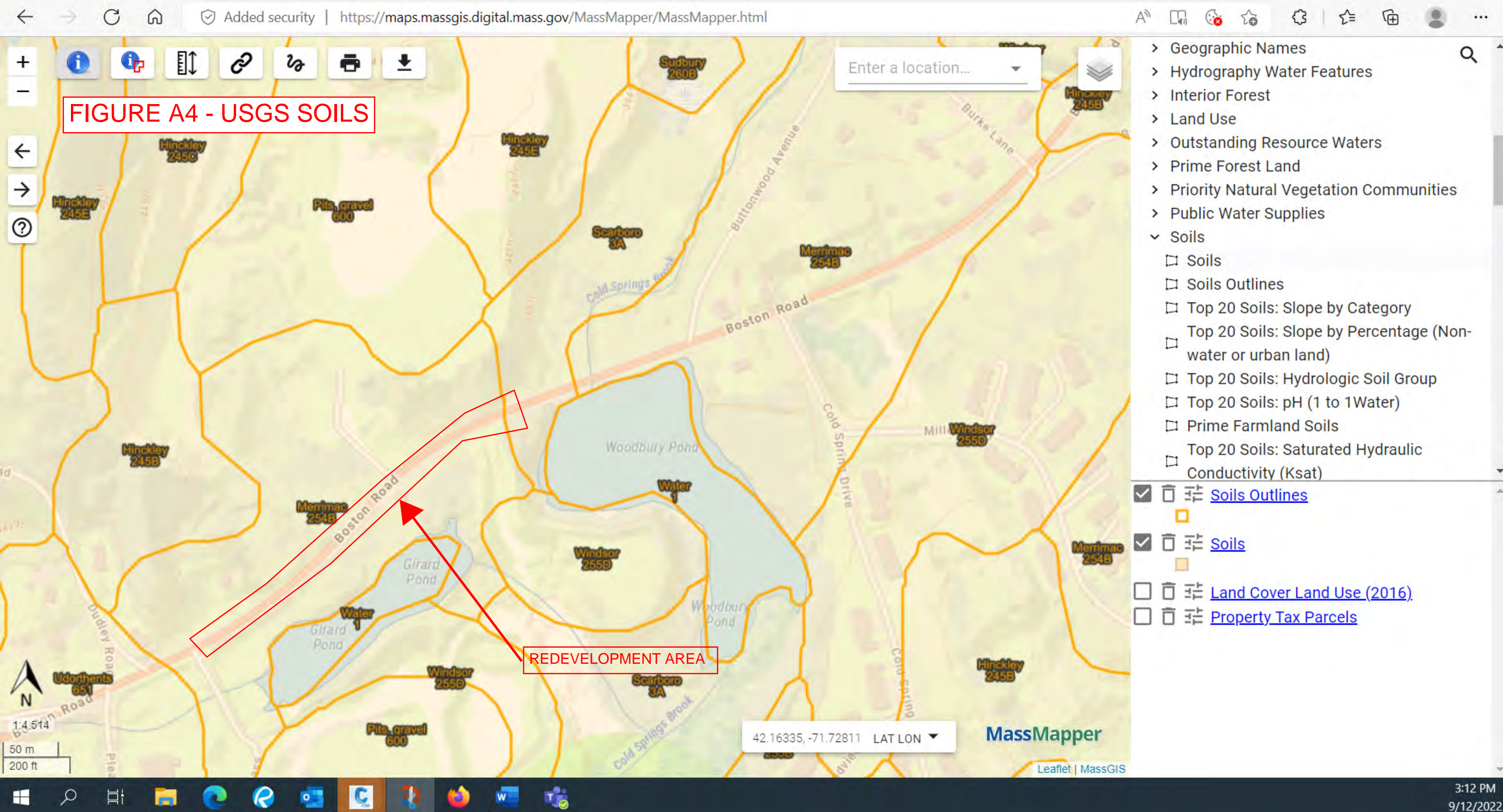


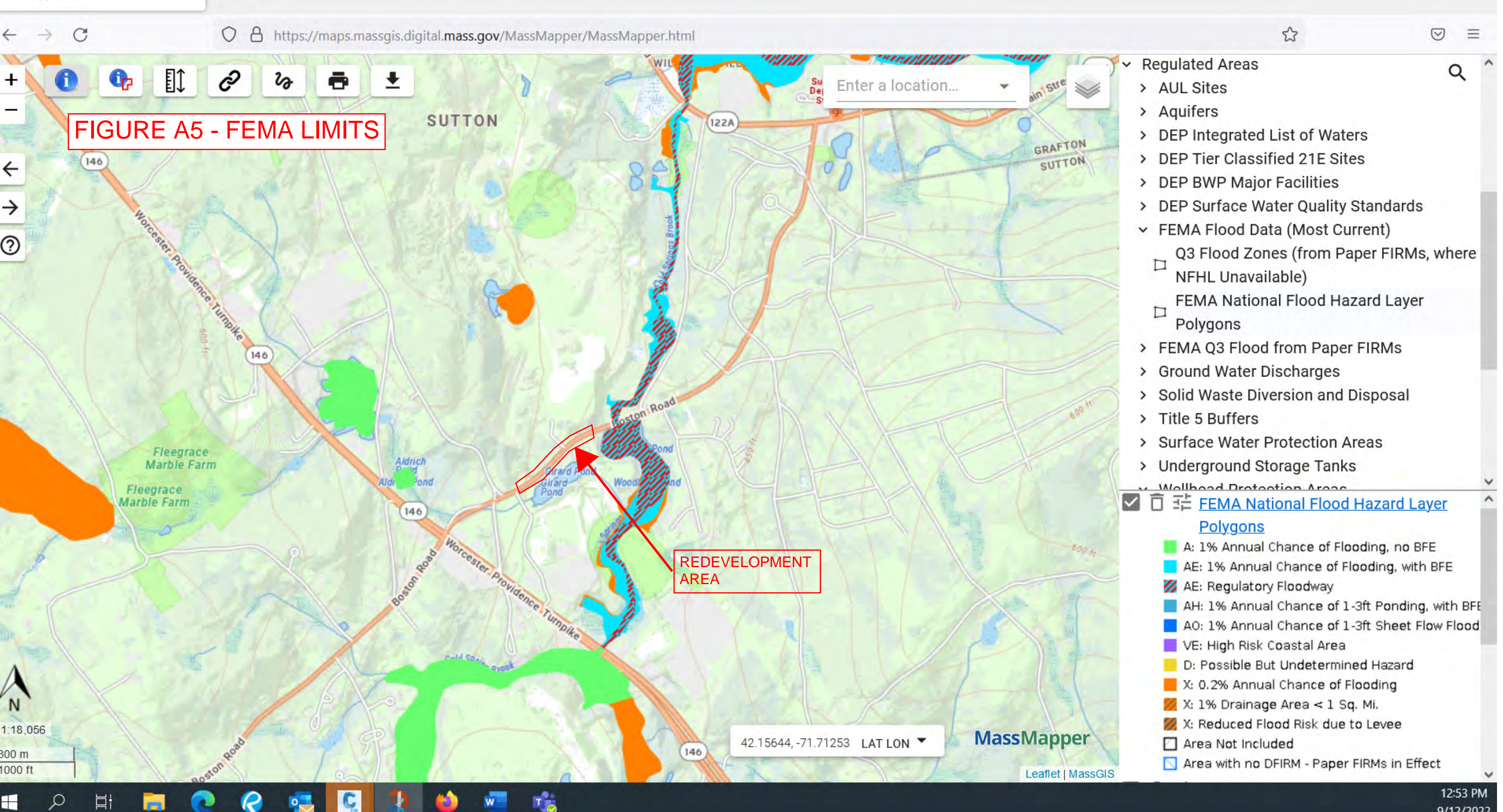


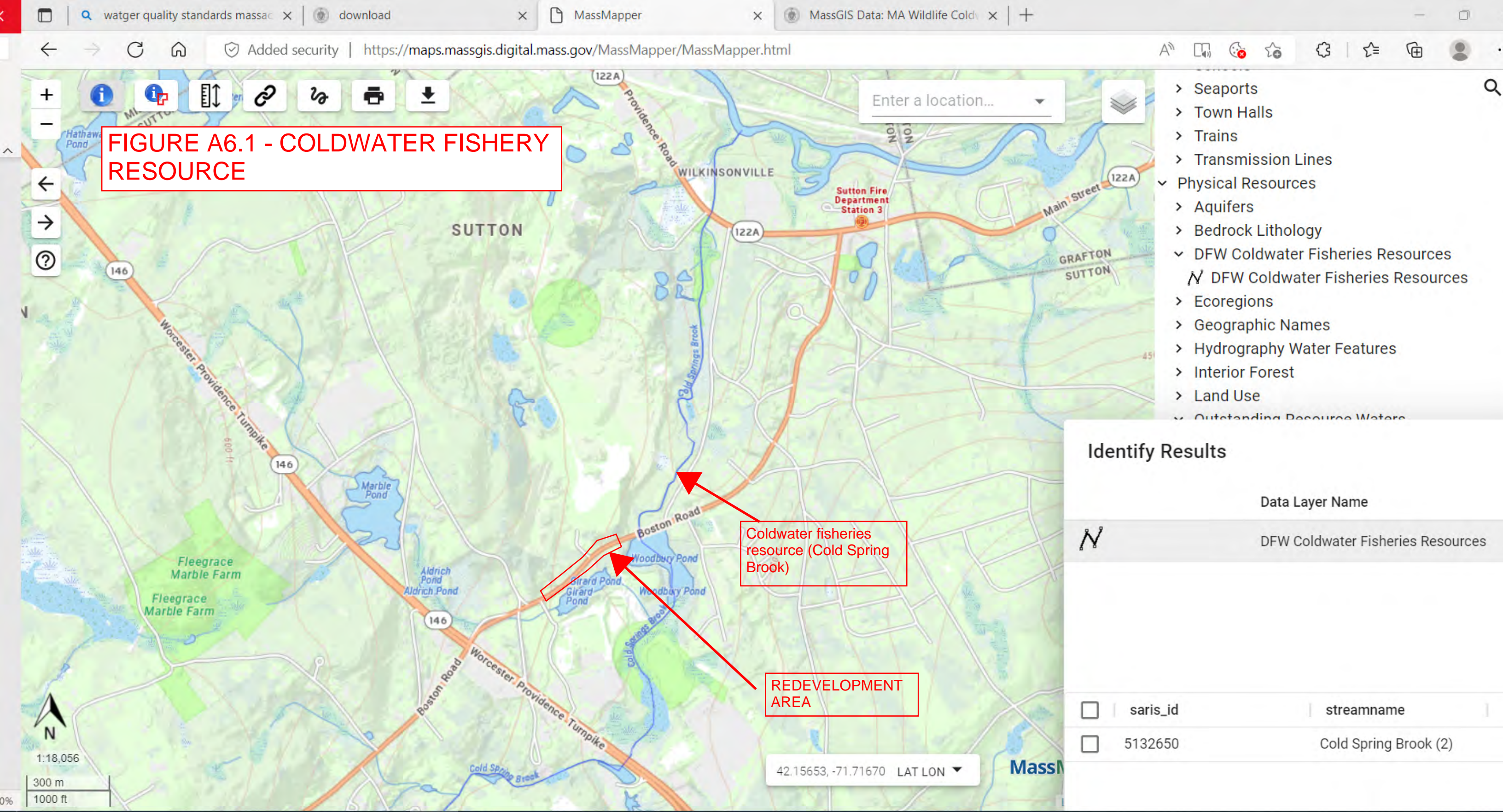
FIGURE A3 - LAND USE



-  Residential - Single Family
-  Residential - Multi Family
-  Residential - Other
-  Commercial
-  Industrial
-  Mixed Use - Primarily Residential
-  Mixed Use - Primarily Commercial
-  Mixed Use - Other
-  Other Impervious
-  Right-of-way
-  Cultivated
-  Pasture or Hay
-  Developed Open Space
-  Deciduous Forest
-  Evergreen Forest









REDEVELOPMENT
AREA

- Regulated Areas
 - > AUL Sites
 - > Aquifers
 - > DEP Integrated List of Waters
 - > DEP Tier Classified 21E Sites
 - > DEP BWP Major Facilities
 - > DEP Surface Water Quality Standards
 - FEMA Flood Data (Most Current)
 - Q3 Flood Zones (from Paper FIRMs, where NFHL Unavailable)
 - FEMA National Flood Hazard Layer Polygons
 - FEMA Q3 Flood from Paper FIRMs
 - Ground Water Discharges
 - Solid Waste Diversion and Disposal
 - Title 5 Buffers
 - Surface Water Protection Areas
 - Underground Storage Tanks
 - Wellhead Protection Areas

 - ☒ ☐ ☐ [IWPAs Dissolved](#)
 - ☒ ☐ ☐ [IWPAs](#)
 - ☒ ☐ ☐ [Zone IIs Dissolved](#)
 - ☒ ☐ ☐ [Zone IIs](#)
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